

**2010 Ford Edge Limited**

2010 ENGINE Engine - 3.5L - Edge &amp; MKX

**2010 ENGINE****Engine - 3.5L - Edge & MKX****SPECIFICATIONS****MATERIAL SPECIFICATION****MATERIAL SPECIFICATION**

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 XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20- LSP12 (Canada); or equivalent	WSS-M2C930-A	5.2L (5.5 qt) includes filter change
Motorcraft® Specialty Green Engine Coolant VC-10-A (US); CVC-10-A (Canada)	WSS-M97B55-A	-
Silicone Gasket Remover ZC-30	-	-
Thread Sealant with PTFE TA-24	WSK-M2G350-A2	-

**GENERAL SPECIFICATION****GENERAL SPECIFICATION**

Item	Specification
<b>Engine</b>	
Displacement	3.5L (4V) (214 CID)
No. cylinders	6
Bore/stroke	92.5/86.7 mm (3.641/3.413 in)
Fire order	1-4-2-5-3-6
Oil pressure	Minimum 30 psi @ 1,500 rpm with engine at normal operating temperature
Spark plug	AYSF-22FM Gap = 1.29-1.45 mm (0.051-0.057 in)
Compression ratio	10.3:1
Engine weight (without accessory drive components)	161 kg (355 lb)
Engine and transaxle weight (without accessory drive components)	260.8 kg (575 lb)
<b>Cylinder Head and Valve Train</b>	
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

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	mm (0.002 in)
Combustion chamber volume	55.84 cc (3.41 CI)
Valve tappet clearance - intake	0.15-0.25 mm (0.006-0.01 in)
Valve tappet clearance - exhaust	0.360-0.460 mm (0.0142-0.0181 in) Engine must be at room temperature before measuring
Valve guide bore inner diameter	5.519-5.549 mm (0.217-0.218 in)
Valve stem diameter - intake	5.479-5.497 mm (0.2157-0.2164 in)
Valve stem diameter - exhaust	5.466-5.484 mm (0.2151-0.2159 in)
Valve stem-to-guide clearance - intake	0.022-0.070 mm (0.0008-0.0027 in)
Valve stem-to-guide clearance - exhaust	0.035-0.083 mm (0.0013-0.032 in)
Valve head diameter - intake	36.82-37.18 mm (1.44-1.46 in)
Valve head diameter - exhaust	30.82-31.18 mm (1.21-1.22 in)
Valve face runout	0.05 mm (0.0001 in)
Valve face angle	44.5-45.5°
Valve seat width - intake	1.3-1.5 mm (0.051-0.059 in)
Valve seat width - exhaust	1.4-1.6 mm (0.055-0.062 in)
Valve seat runout	0.04 mm (0.0001 in) MAX
Valve seat angle	44.5-45.5°
Valve spring free length (approx.)	48.4 mm (1.90 in)
Valve spring compression pressure (N @ spec. length)	510 N @ 27.32 mm (115 lb @ 1.08 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 lbs @ 1.45 in)
Valve spring installed pressure - service limit	10% force loss @ specified height
<b>Camshaft</b>	
Theoretical valve lift @ 0 lash	9.6798 mm (0.38 in)
Lobe lift - intake	9.6798 mm (0.38 in)
Lobe lift - exhaust	9.6798 mm (0.38 in)
Allowable lobe lift loss	0.062 mm (0.0024 in)

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Camshaft journal bore inside diameter - 1st journal	31.0375-31.0625 mm (1.221-1.222 in)
Camshaft journal bore inside diameter - intermediate journals	25.9875-26.0125 mm (1.023-1.024 in)
Camshaft bearing outside diameter - 1st journal	30.993-31.013 mm (1.2202-1.2209 in)
Camshaft bearing outside diameter - intermediate journals	25.937-25.963 mm (1.021-1.022 in)
Camshaft journal-to-bearing clearance, 1st journal - service limit	0.070 mm (0.0027 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
<b>Cylinder Block</b>	
Cylinder bore diameter - grade 1	92.500-92.520 mm (3.641-3.642 in)
Main bearing bore inside diameter	72.400-72.424 mm (2.8503-2.8513 in)
Head gasket surface flatness	Flat within 0.051 mm (0.0002 in) per one foot of tool length
Head gasket surface finish	-
<b>Crankshaft</b>	
Main bearing journal diameter	67.5 mm (2.657 in)
Main bearing journal maximum taper	0.004 mm (0.00015 in)
Main bearing journal maximum out-of-round	0.006 mm (0.00023 in)
Main bearing journal-to-cylinder block clearance	0.026-0.041 mm (0.0010-0.0016 in)
Connecting rod journal diameter	55.983-56.003 mm (2.204-2.205 in)
Connecting rod journal maximum taper	0.004 mm (0.00015 in)
Connecting rod journal maximum out-of-round	0.006 mm (0.00023 in)
Crankshaft maximum end play	0.101-0.291 mm (0.0039-0.0114 in)
<b>Piston and Connecting Rod</b>	
Piston diameter - single grade	92.476-92.490 mm (3.6407-3.6413 in)
Piston-to-cylinder bore clearance	0.010 to 0.044 mm (0.0003-0.0017 in)
Piston ring end gap - compression (top, gauge diameter)	0.15-0.25 mm (0.0059-0.0098 in)
Piston ring end gap - compression	0.30-0.55 mm

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(bottom, gauge diameter)	(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 - compression (bottom)	1.530-1.55 mm (0.0602-0.0610 in)
Piston ring groove width - oil ring	2.53-2.55 mm (0.0996-0.1003 in)
Piston ring width - upper comp ring	1.17-1.19 mm (0.0460-0.0468 in)
Piston ring width - lower comp ring	1.47-1.49 mm (0.0578-0.0586 in)
Piston ring-to-groove clearance (upper and lower compression rings)	0.040-0.080 mm (0.0015-0.0031 in)
Piston pin bore diameter	23.002-23.006 mm (0.9055-0.9057 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	0.002 to 0.009 mm (0.00007-0.0003 in)
Piston-to-connecting rod clearance	2.7 mm (0.1 in)
Connecting rod-to-pin clearance - standard	0.007-0.022 mm (0.0002-0.0009 in)
Connecting rod pin bore diameter	23.007-23.019 mm (0.905-0.906 in)
Connecting rod length (center-to-center)	152.68 mm (6.01 in)
Connecting rod maximum allowed bend	0.038 mm (0.0014 in)
Connecting rod maximum allowed twist	0.050 mm (0.0019 in)
Connecting rod bearing bore diameter - grade 1	59.866-59.872 mm (2.3569-2.3571 in)
Connecting rod bearing bore diameter - grade 2	59.873-59.879 mm (2.3572-2.3574 in)
Connecting rod bearing bore diameter - grade 3	59.880-59.886 mm (2.3574-2.3577 in)
Connecting rod bearing-to-crankshaft clearance	0.020-0.054 mm (0.0007-0.0021 in)
Connecting rod side clearance (assembled to crank) - standard	0.175-0.425 mm (0.0068-0.0167 in)
Connecting rod side clearance	0.175-0.425 mm



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(assembled to crank) - service limit

(0.0068-0.0167 in)

**TORQUE SPECIFICATION****TORQUE SPECIFICATION**

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
A/C tube bracket bolt	8	-	71
Accessory drive belt tensioner bolts	11	-	97
Battery cable power feed cable nut	8	-	71
Block drain plug - LH <sup>(1)</sup>	-	-	-
Block drain plug - RH	40	30	-
Block heater	40	30	-
Camshaft bearing cap bolts <sup>(2)</sup>	-	-	-
Camshaft Position (CMP) sensor bolts	10	-	89
Camshaft sprocket bolts <sup>(2)</sup>	-	-	-
Catalytic converter bracket nut	40	30	-
Catalytic converter bracket bolts	20	-	177
Catalytic converter bracket-to-engine block bolts	48	35	-
Catalytic converter nuts	40	30	-
Connecting rod cap bolts <sup>(2)</sup>	-	-	-
Coolant pump bolts <sup>(2)</sup>	-	-	-
Crankshaft rear seal retainer plate bolts <sup>(2)</sup>	-	-	-
Crankshaft Position (CKP) sensor bolt	10	-	89
CKP sensor heat shield nuts	10	-	89
Crankshaft pulley bolt <sup>(2)</sup>	-	-	-
Cylinder head bolts <sup>(2)</sup>	-	-	-
Cylinder Head Temperature (CHT) sensor	10	-	89
Degas bottle bolts	9	-	80
Engine front cover bolts <sup>(2)</sup>	-	-	-
Engine lifting eye bolts	24	18	-
Engine mount brace bolt and nut	20	-	177
Engine mount bracket bolts	30	22	-
Engine mount studs	20	-	177
Engine mount-to-engine nuts	63	46	-
Engine mount-to-frame bolts	90	66	-
Engine oil filter <sup>(3)</sup>	-	-	-
Engine Oil Pressure (EOP) switch	18	-	159

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Engine roll restrictor bolts	90	66	-
Engine roll-restrictor heat shield nut	11	-	97
Engine roll restrictor-to-subframe through bolt	103	76	-
Exhaust manifold heat shield bolts	10	-	89
Exhaust manifold nuts <sup>(2)</sup>	-	-	-
Exhaust manifold studs	12	-	106
Exhaust pipe clamp	40	30	-
Exhaust Y-pipe nuts	40	30	-
Flexplate bolts	80	59	-
Fuel rail bolts	10	-	89
Generator bolt and nut	47	35	-
Generator B+ terminal nut	17	-	150
Ground wire-to-body bolt	10	-	89
Ground wire-to-engine bolt	10	-	89
Ground wire-to-RH cylinder head bolt	10	-	89
Heat shield nut and 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 <sup>(2)</sup>	-	-	-
Main bearing bolts <sup>(2)</sup>	-	-	-
Main bearing cap support brace bolts <sup>(2)</sup>	-	-	-
Oil filter adapter	10	-	89
Oil pan bolts <sup>(2)</sup>	-	-	-
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	24	18	-
Power steering reservoir nuts	8	-	71
Power Transfer Unit (PTU)	90	66	-
PTU support bracket bolts	70	52	-
Radio interference capacitor-to-cowl nut	10	-	89
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	-

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Starter B+ terminal nut	12	-	106
Starter S-terminal nut	5	-	44
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 bracket bolts	90	66	-
Transaxle bracket plate bolts	90	66	-
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	-
Upper engine mount bracket bolts <sup>(2)</sup>	-	-	-
Upper intake manifold bolts <sup>(2)</sup>	-	-	-
Upper intake manifold bracket-to-engine bolt	10	-	89
Upper intake manifold-to-bracket bolt	10	-	89
Valve cover bolts and stud bolts <sup>(2)</sup>	-	-	-
Variable Camshaft Timing (VCT) assembly bolts <sup>(2)</sup>	-	-	-
VCT housing bolts <sup>(2)</sup>	-	-	-
VCT solenoid bolts	10	-	89
Wiring harness retainer bolt and stud bolt	10	-	89
(1) Tighten to 20 Nm (177 lb-in) plus an additional 180 degrees.			
(2) Refer to the appropriate procedure(s).			
(3) Tighten to 5 Nm (44 lb-in) plus an additional 180 degrees.			

**DESCRIPTION AND OPERATION****ENGINE**

**NOTE:** Early build engines have 11 fastener valve covers, late build engines have 9 fastener valve covers. Do not attempt to install bolts in the 2 empty late build valve cover holes or damage to the valve cover will occur.

**NOTE:** On early build engines, the timing chain rides on the inner side of the RH timing chain guide. Late build engines are equipped with a different design RH timing chain guide that requires the timing chain to ride on the outer side of the RH timing chain guide. For service, all replacement RH timing chain guides will be

### the late build design.

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

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

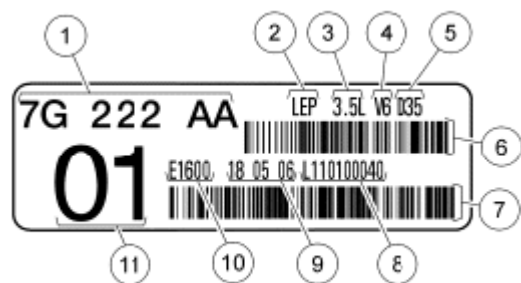
### Engine Identification

For quick identification, refer to the safety certification decal.

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

### Engine Code Information Label

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



N0096929

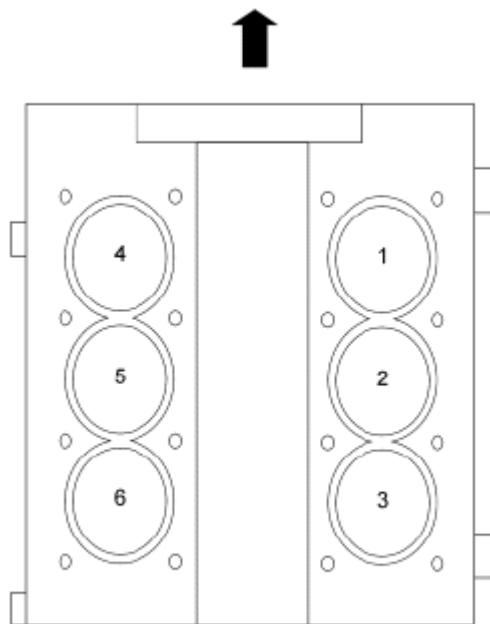
**Fig. 1: Identifying Engine Code Information Label**  
Courtesy of FORD MOTOR CO.

### DESCRIPTION CHART

Item	Description
1	Engine part number
2	Engine plant (Lima)
3	Engine displacement
4	Engine configuration
5	Duratech 3.5L

6	Bar code
7	Bar code
8	Running number
9	Engine build date (DDMMYY)
10	Plant shift line
11	Derivative code

### Engine Cylinder Identification



N0069904

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

### Exhaust Emission Control System

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

### Induction System

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

- are mounted between the fuel rail and the intake manifold.
- meter fuel into the air intake stream in accordance with engine demand.
- are positioned so that their tips direct fuel just ahead of the engine intake valves.

**Valve Train**

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

**Variable Camshaft Timing (VCT) System**

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

**PCV System**

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

**Lubrication System**

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

**Oil Pump**

The lubrication system is designed to provide optimum oil flow to critical components of the engine through its entire operating range.

The heart of the system is a positive displacement internal gear oil pump.

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

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

**Cooling System**

The engine cooling system includes the following:

- Radiator
- Timing chain driven coolant pump

- Electric fan assembly(ies)
- 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 INTRODUCTION - GASOLINE MODELS .

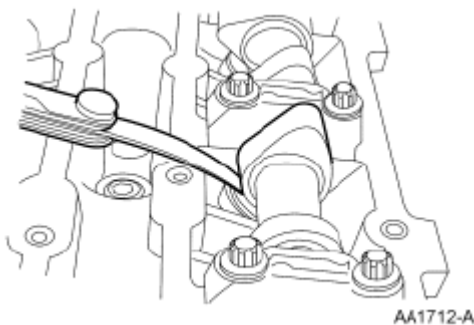
## GENERAL PROCEDURES

### VALVE CLEARANCE CHECK

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

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

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



**Fig. 3: Measuring Clearance Of Valve**  
Courtesy of FORD MOTOR CO.

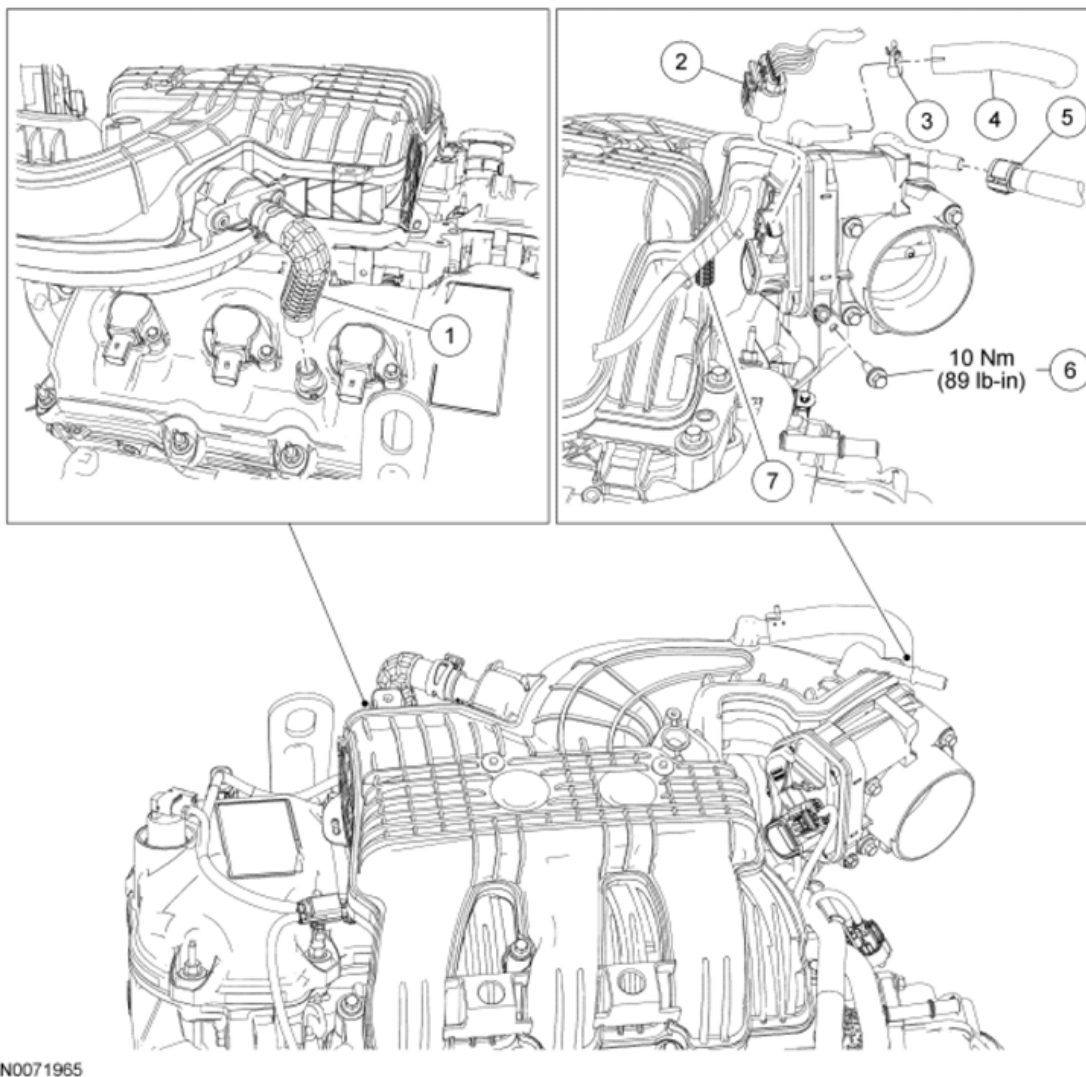
**NOTE:** The number on the valve tappet reflects the thickness of the valve tappet. For example, a tappet with the number 3.310 has the thickness of 3.31 mm (0.13 in).

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

### UPPER INTAKE MANIFOLD

#### Upper Intake Manifold (View 1 of 2)



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

### DESCRIPTION CHART

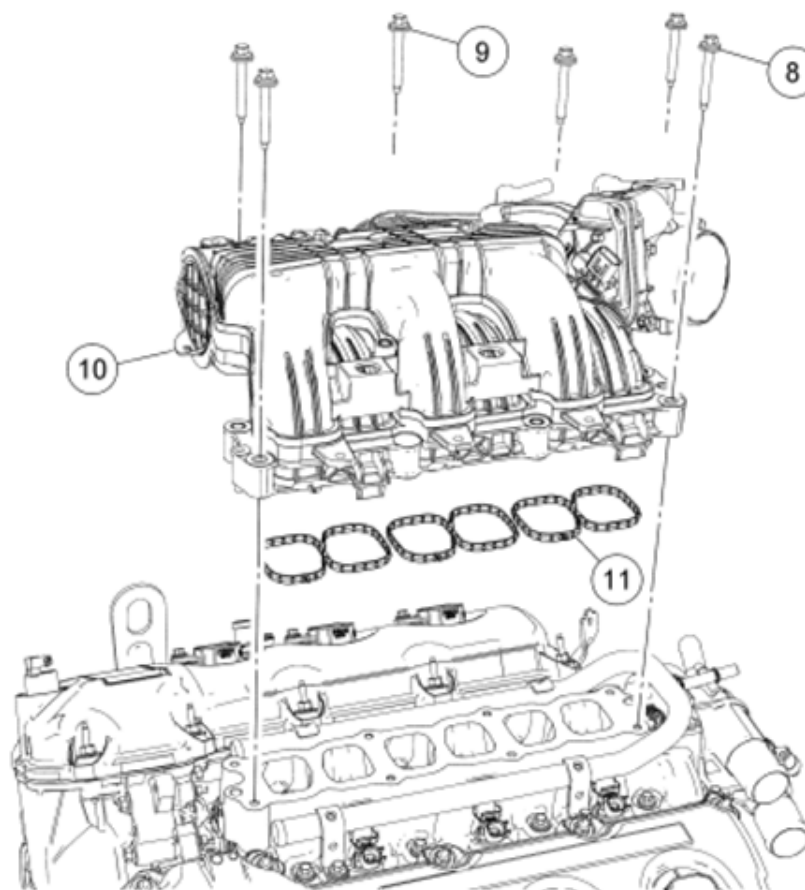


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Item	Part Number	Description
1	6K817	PCV hose
2	14A464	Throttle Body (TB) electrical connector (part of 12C508)
3	CS16140	Brake booster-to-intake manifold vacuum hose clamp
4	6K817	Brake booster-to-intake manifold vacuum hose
5	9D661	Evaporative Emission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

### Upper Intake Manifold (View 2 of 2)



**Fig. 5: Identifying Upper Intake Manifold (2 Of 2)**

Courtesy of FORD MOTOR CO.

### DESCRIPTION CHART

Item	Part Number	Description
8	W503282	Upper intake manifold bolt (5 required)
9	W707083	Upper intake manifold bolt
10	9S455	Upper intake manifold
11	9H486	Upper intake manifold gasket (3 required)

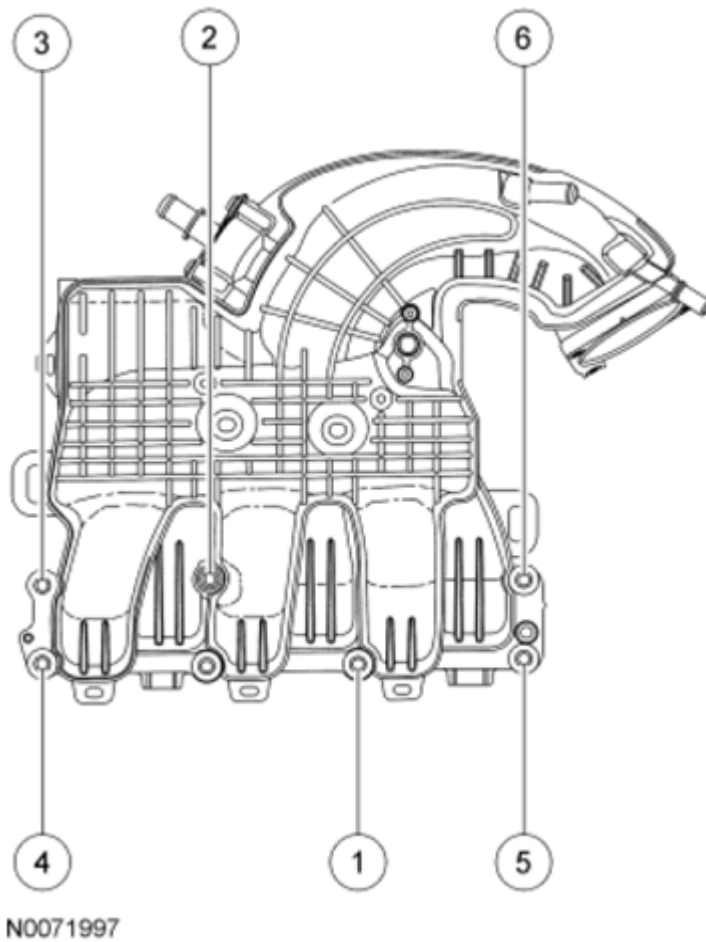
**Removal**

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING**.
2. Disconnect the Throttle Body (TB) electrical connector.
3. Disconnect the Evaporative Emission (EVAP) tube from the intake manifold.
4. Disconnect the brake booster vacuum hose from the intake manifold.
5. Disconnect the PCV tube from the PCV valve.
6. Detach the wiring harness retainers from the upper intake manifold.
7. Remove the upper intake manifold support bracket bolt.
8. Remove the 6 bolts and remove the upper intake manifold.
  - Remove and discard the gaskets.
  - Clean and inspect all of the sealing surfaces of the upper and lower intake manifold.

**Installation**

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

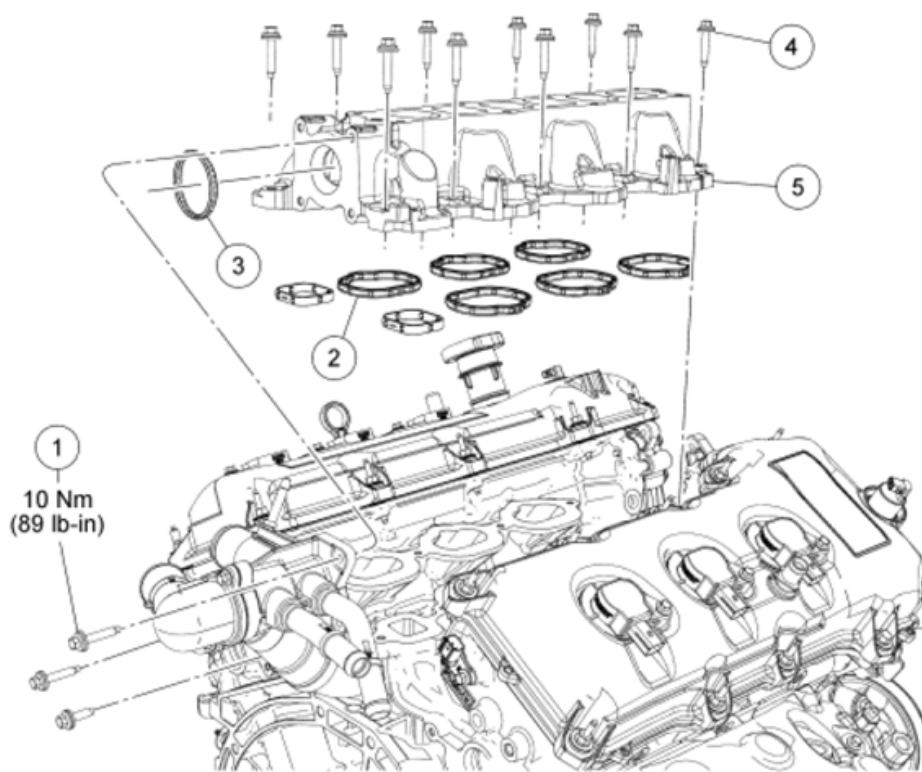
1. Using new gaskets, install the upper intake manifold and the 6 bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 6: Identifying Upper 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. Attach the wiring harness retainers to the upper intake manifold.
4. Connect the PCV tube to the PCV valve.
5. Connect the brake booster vacuum hose to the intake manifold.
6. Connect the **EVAP** tube to the intake manifold.
7. Connect the **TB** electrical connector.
8. Install the **ACL** outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING**.

## LOWER INTAKE MANIFOLD



**Fig. 7: Identifying Lower Intake Manifold Components With Torque Specifications**  
Courtesy of FORD MOTOR CO.

#### DESCRIPTION CHART

Item	Part Number	Description
1	W503279	Thermostat housing-to-lower intake manifold bolt (3 required)
2	9439	Lower intake manifold gasket (8 required)
3	8A571	Thermostat housing gasket
4	W503279	Lower intake manifold bolt (10 required)
5	9K461	Lower intake manifold

#### 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.

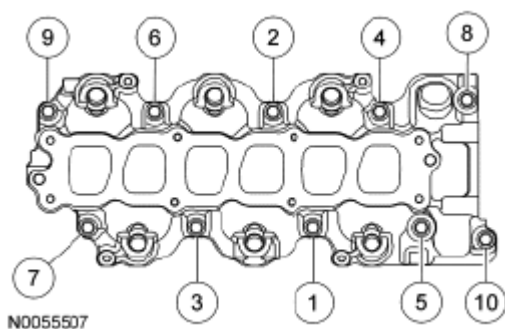
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING**.
2. Drain the cooling system. For additional information, refer to **ENGINE COOLING**.
3. Remove the fuel rail. For additional information, refer to **FUEL CHARGING AND CONTROLS - 3.5L**.

4. Remove the Air Cleaner (ACL) assembly. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING**.
5. Remove the 3 thermostat housing-to-lower intake manifold bolts.
6. Remove the 10 bolts and the lower intake manifold.
  - Remove and discard the intake manifold and thermostat housing gaskets.
  - Clean and inspect all sealing surfaces.

#### Installation

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

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



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

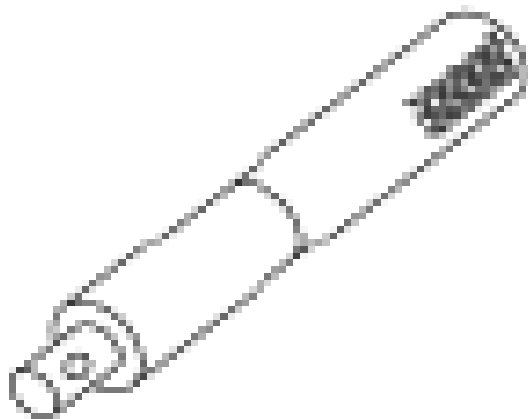
2. Install the 3 thermostat housing-to-lower intake manifold bolts.
  - Tighten to 10 Nm (89 lb-in).
3. Install the ACL assembly. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING**.
4. Install the fuel rail. For additional information, refer to **FUEL CHARGING AND CONTROLS - 3.5L**.
5. Fill and bleed the cooling system. For additional information, refer to **ENGINE COOLING**.

#### VALVE COVER - LH

##### Special Tool(s)

##### SPECIAL TOOL SPECIFICATION

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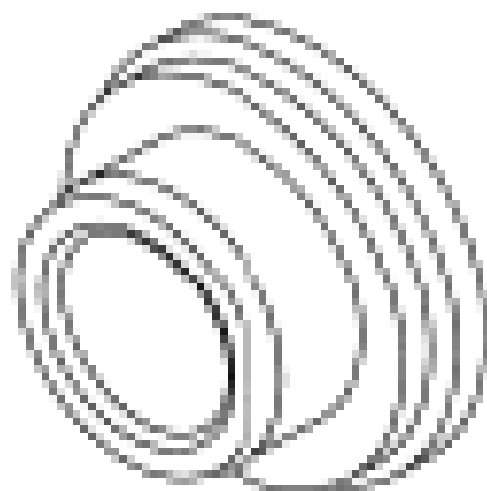
**ST1326-A**

Handle  
205-153 (T80T-4000-W)



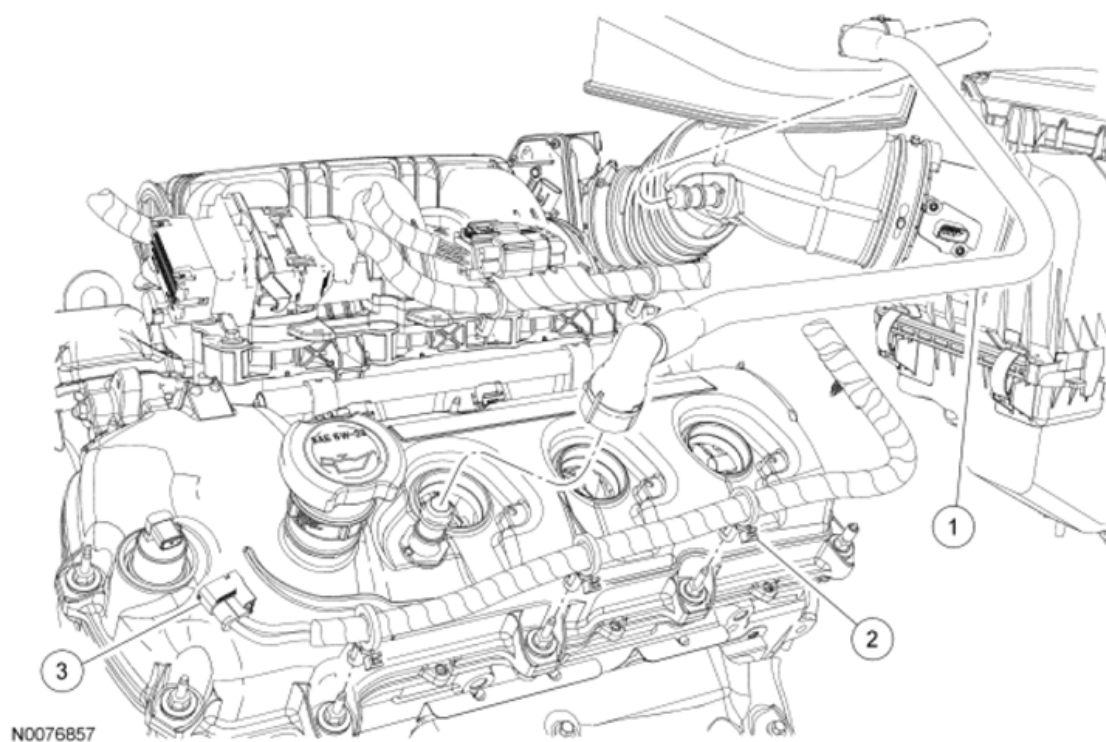
**ST2983-A**

Installer, VCT Spark Plug Tube Seal  
303-1247/2

**ST2982-A**Remover, VCT Spark Plug Tube Seal  
303-1247/1**Material****MATERIAL SPECIFICATION**

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

**Valve Cover - LH (View 1 of 2)**



**Fig. 9: Identifying Valve Cover Components - LH (1 Of 2)**

Courtesy of FORD MOTOR CO.

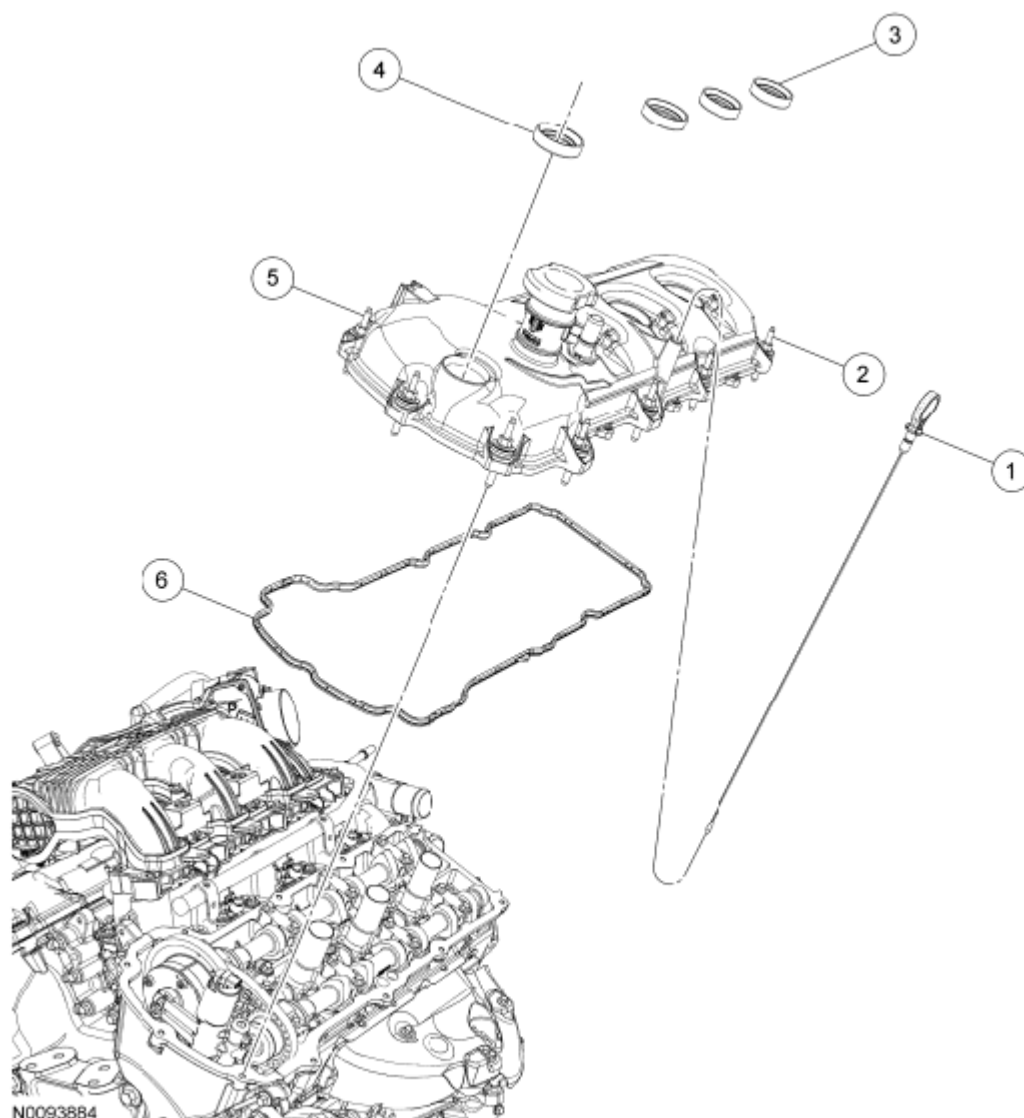
#### DESCRIPTION CHART

Item	Part Number	Description
1	6853	Crankcase vent tube
2	W700497	Engine control wiring harness retainer (part of 12C508)
3	14A464	LH Variable Camshaft Timing (VCT) electrical connector (part of 12C508)

Valve Cover - LH (View 2 of 2)

**NOTE:** Early build shown in illustration, late build similar.





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

#### DESCRIPTION CHART

Item	Part Number	Description
1	6750	Oil level indicator
2	6C519	Valve cover stud bolt (11 required)
3	6C535	Spark plug tube seal (3 required)
4	6C535	Variable Camshaft Timing (VCT) seal
5	6A505	LH valve cover
6	6A559	LH 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:** Early build engines have 11 fastener valve covers, late build engines have 9 fastener valve covers. Do not attempt to install bolts in the 2 empty late build valve cover holes or damage to the valve cover will occur.

#### **All vehicles**

1. Remove the crankcase vent tube.
2. Remove the LH ignition coils. For additional information, refer to **ENGINE IGNITION - 3.5L**.
3. Remove the oil level indicator.
4. Disconnect the LH Variable Camshaft Timing (VCT) solenoid electrical connector.
5. Detach all of the wiring harness retainers from the valve cover and the stud bolts.

#### **Early build vehicles**

6. Loosen the 11 stud bolts and remove the LH valve cover.
  - Discard the gasket.

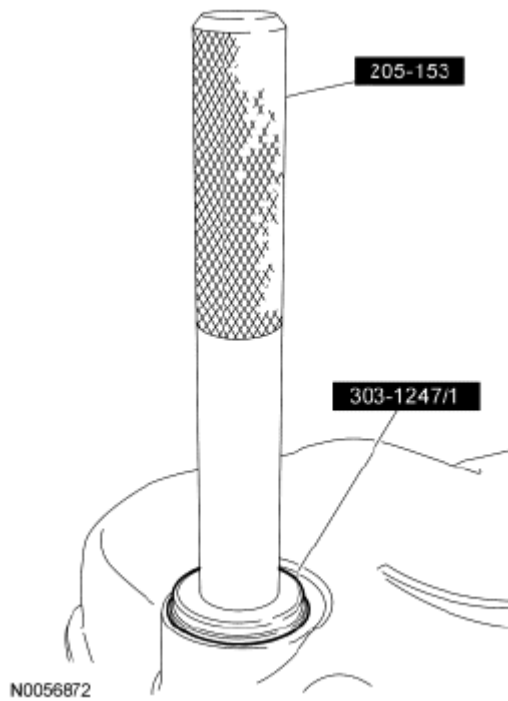
#### **Late build vehicles**

7. Loosen the 9 stud bolts and remove the LH valve cover.
  - Discard the gasket.

#### **All vehicles**

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

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



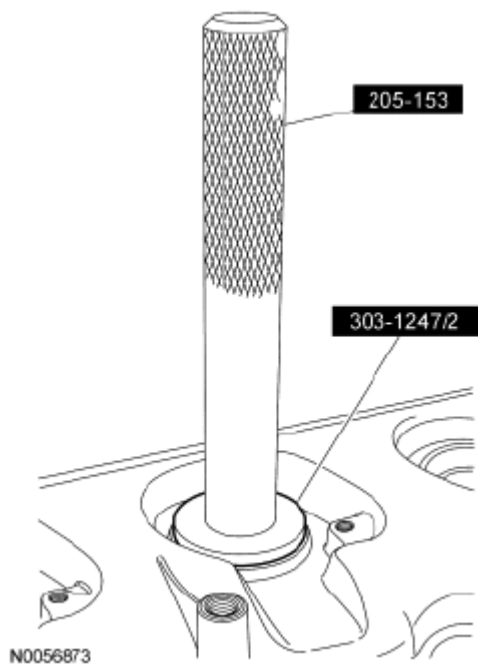
**Fig. 11: Identifying VCT Spark Plug Tube Seal Remover And Handle**  
Courtesy of FORD MOTOR CO.

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

#### Installation

#### All vehicles

- NOTE:** Installation of new seals is only required if damaged seals were removed during disassembly of the engine.
- NOTE:** Spark plug tube seal installation shown in illustration, VCT solenoid seal installation similar.

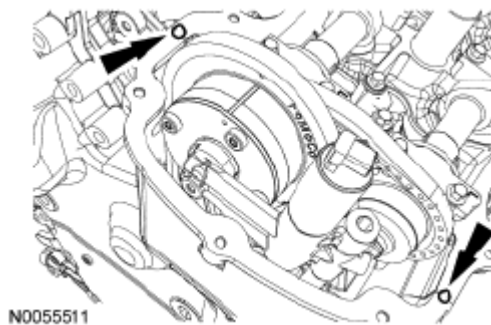


**Fig. 12: Identifying VCT Spark Plug Tube Seal Installer And Handle**  
Courtesy of FORD MOTOR CO.

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

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

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

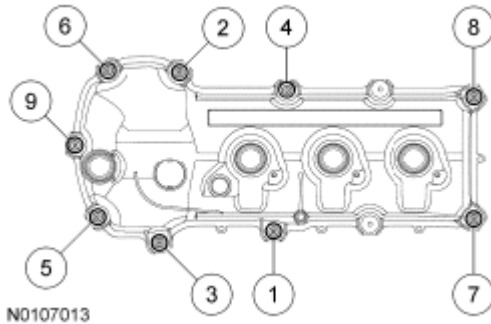


**Fig. 13: Applying RTV Silicone To Engine Front Cover**  
Courtesy of FORD MOTOR CO.

2. Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.

#### Late build vehicles

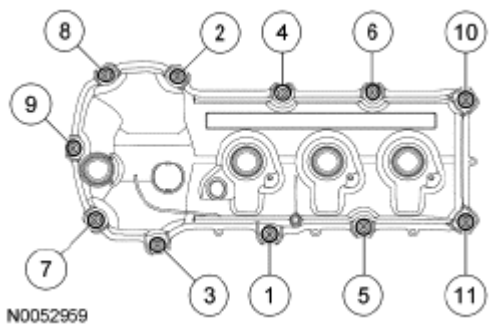
3. Using a new gasket, install the LH valve cover and tighten the 9 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



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

#### Early build vehicles

4. Using a new gasket, install the LH valve cover and tighten the 11 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 15: Identifying LH Valve Cover Stud Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

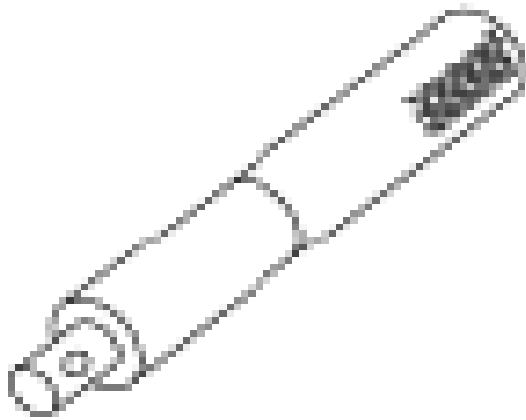
#### All vehicles

5. Attach all of the wiring harness retainers to the valve cover and the stud bolts.
6. Connect the LH VCT solenoid electrical connector.
7. Install the oil level indicator.
8. Install the LH ignition coils. For additional information, refer to **ENGINE IGNITION - 3.5L**.
9. Install the crankcase vent tube.

# VALVE COVER - RH

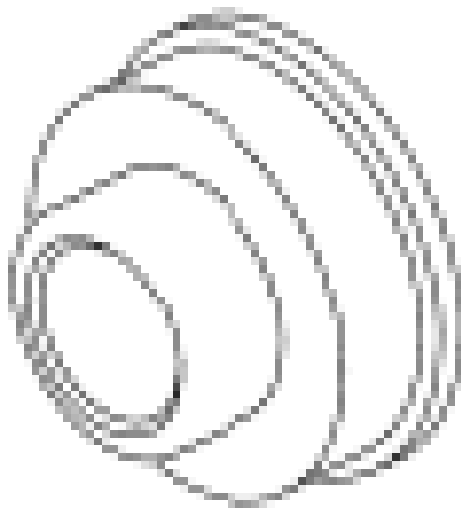
## Special Tool(s)

### SPECIAL TOOL SPECIFICATION



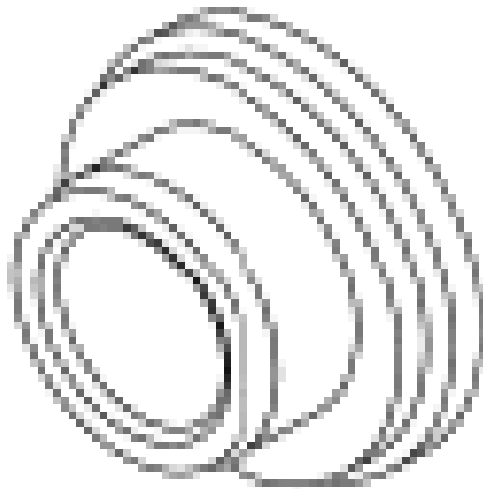
**ST1326-A**

Handle  
205-153 (T80T-4000-W)



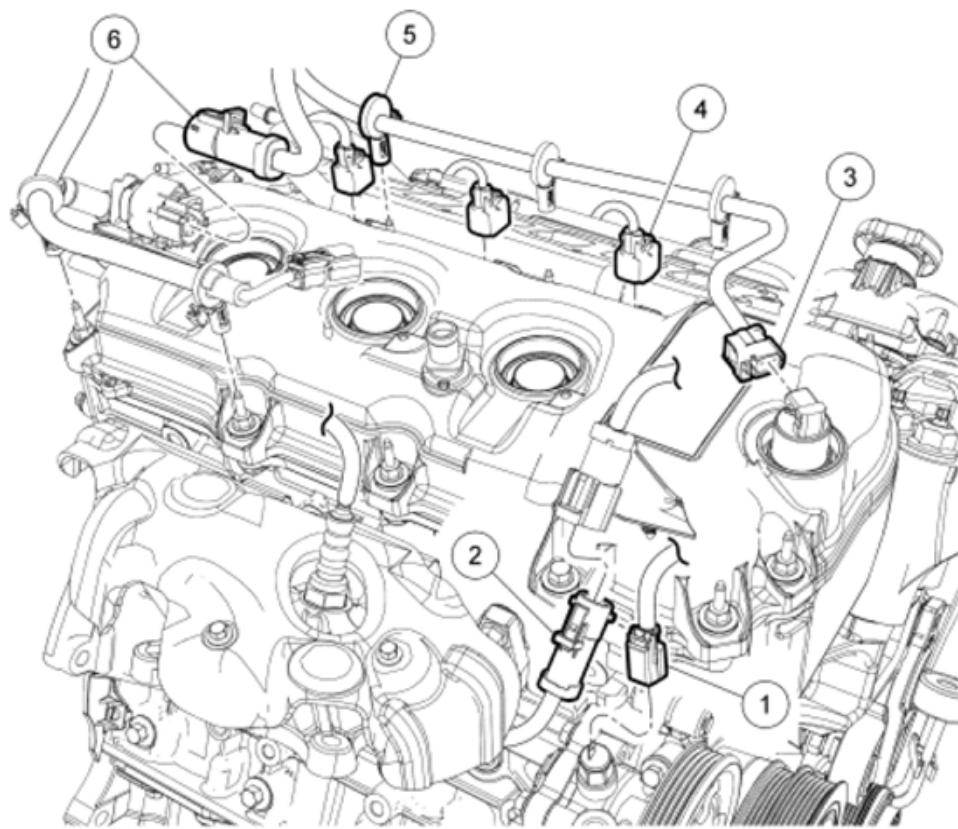
**ST2983-A**

Installer, VCT Spark Plug Tube Seal  
303-1247/2

**ST2982-A**Remover, VCT Spark Plug Tube Seal  
303-1247/1**Material****MATERIAL SPECIFICATION**

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

**Valve Cover - RH (View 1 of 2)**



N0091285

**Fig. 16: Identifying Valve Cover Components - RH (1 Of 2)**  
 Courtesy of FORD MOTOR CO.

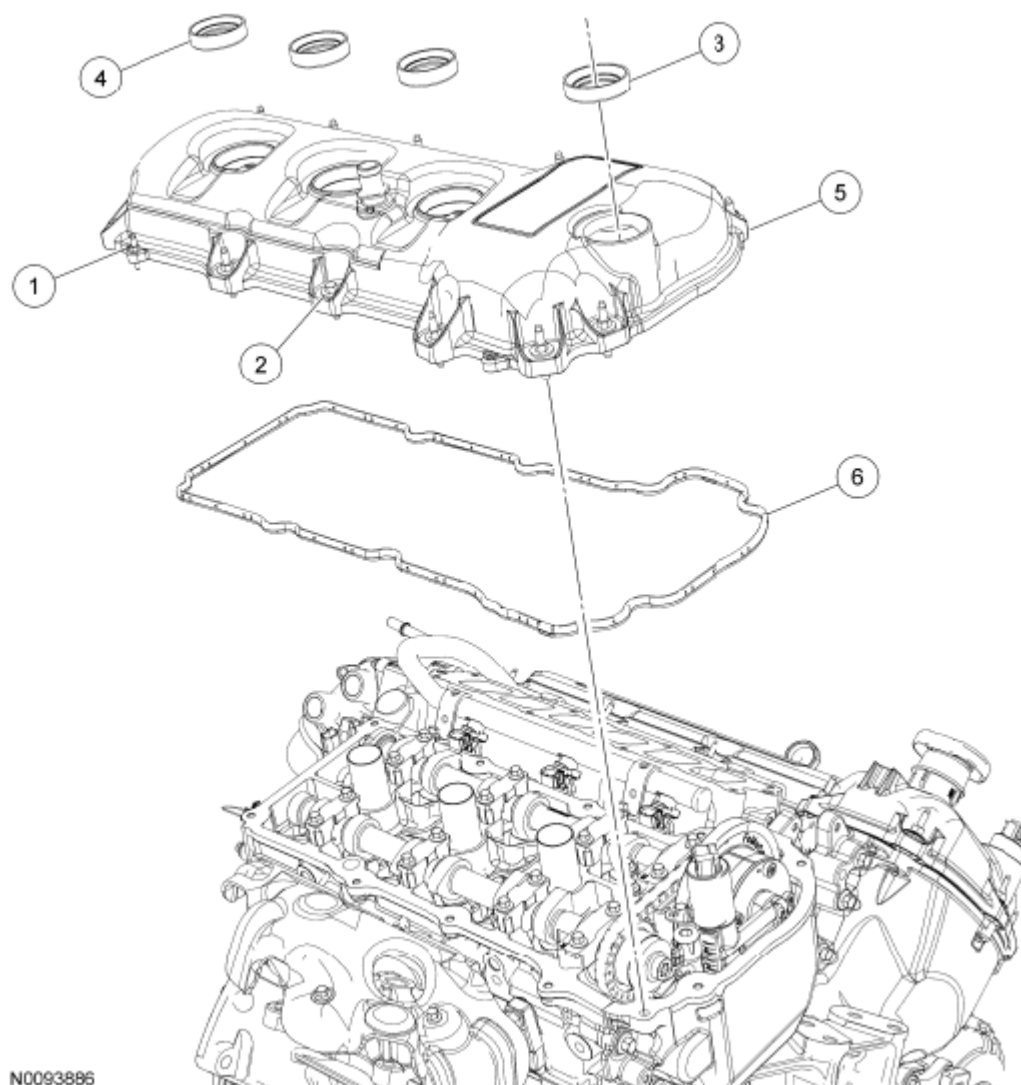
#### DESCRIPTION CHART

Item	Part Number	Description
1	14A464	Power Steering Pressure (PSP) switch electrical connector (part of 12C508)
2	14A464	RH Catalyst Monitor Sensor (CMS) electrical connector (part of 12C508)
3	14A464	RH Variable Camshaft Timing (VCT) electrical connector (part of 12C508)
4	14A464	RH fuel injector electrical connector (part of 12C508) (3 required)
5	W700497	Engine control wiring harness retainer (part of 12C508)
6	14A464	RH Heated Oxygen Sensor (HO2S) electrical connector (part of 12C508)

Valve Cover - RH (View 2 of 2)

**NOTE:** Early build shown in illustration, late build similar.





**Fig. 17: Identifying Valve Cover Components - RH (2 Of 2)**  
 Courtesy of FORD MOTOR CO.

#### DESCRIPTION CHART

Item	Part Number	Description
1	6C519	Valve cover stud bolt (10 required)
2	6C520	Valve cover bolt
3	6C535	Variable Camshaft Timing (VCT) seal
4	6C535	Spark plug tube seal (3 required)
5	6582	RH valve cover
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:** Early build engines have 11 fastener valve covers, late build engines have 9 fastener valve covers. Do not attempt to install bolts in the 2 empty late build valve cover holes or damage to the valve cover will occur.

#### **All vehicles**

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

#### **Early build vehicles**

8. Loosen the bolt, the 10 stud bolts and remove the RH valve cover.
  - Discard the gasket.

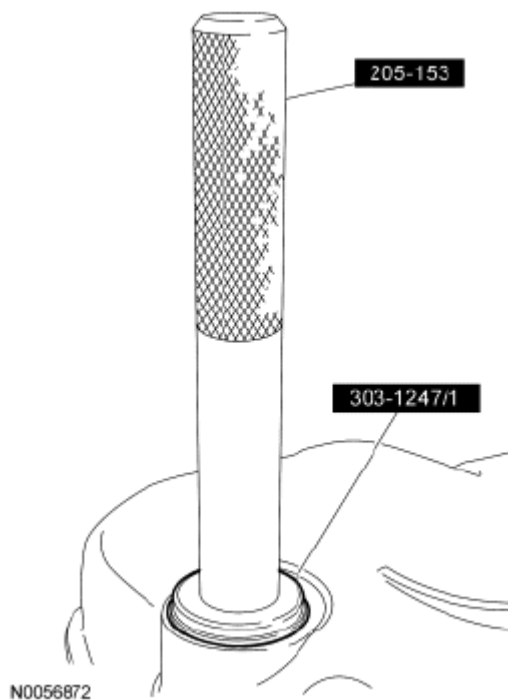
#### **Late build vehicles**

9. Loosen the 9 stud bolts and remove the RH valve cover.
  - Discard the gasket.

#### **All vehicles**

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

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



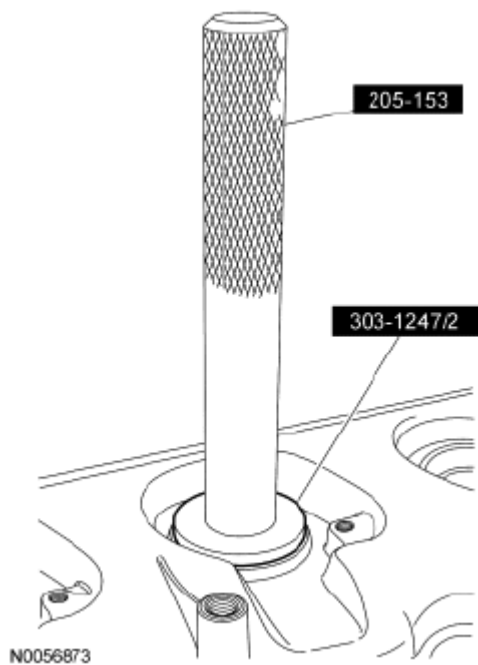
**Fig. 18: Identifying VCT Spark Plug Tube Seal Remover And Handle**  
Courtesy of FORD MOTOR CO.

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

#### Installation

#### All vehicles

- NOTE:** Installation of new seals is only required if damaged seals were removed during disassembly of the engine.
- NOTE:** Spark plug tube seal installation shown in illustration, VCT solenoid seal installation similar.

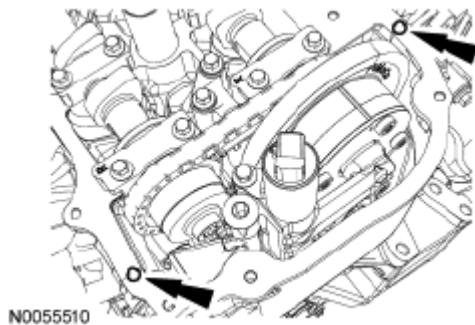


**Fig. 19: Identifying VCT Spark Plug Tube Seal Installer And Handle**  
Courtesy of FORD MOTOR CO.

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

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

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

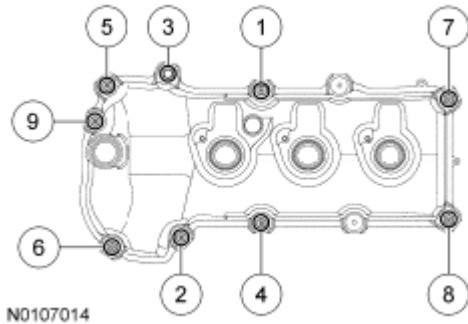


**Fig. 20: Applying RTV Silicone To Engine Front Cover-To-RH Cylinder Head Joints**  
Courtesy of FORD MOTOR CO.

2. Apply an 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.

#### Late build vehicles

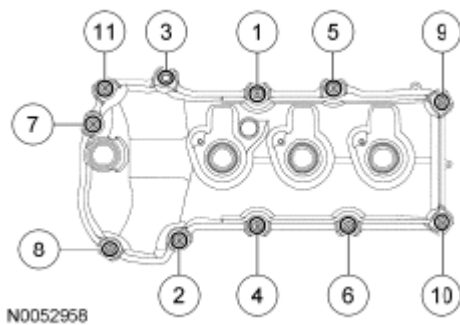
3. Using a new gasket, install the RH valve cover and tighten the 9 stud bolts.
  - Tighten the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 21: Identifying RH Valve Cover Stud Bolts Tightening Sequence (Late Build Vehicles)**  
Courtesy of FORD MOTOR CO.

#### Early build vehicles

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



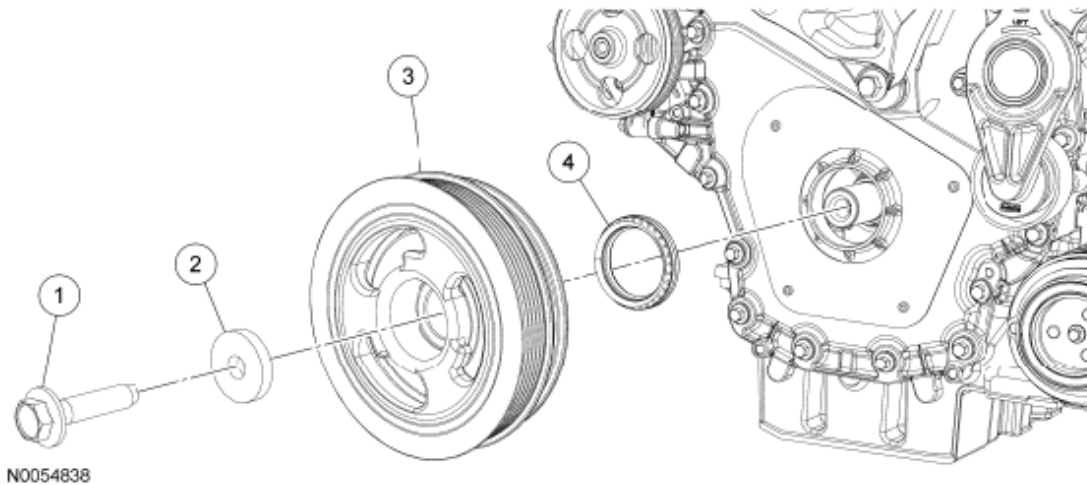
**Fig. 22: Identifying RH Valve Cover Stud Bolts Tightening Sequence (Early Build Vehicles)**  
Courtesy of FORD MOTOR CO.

#### All vehicles

5. Attach all of the wiring harness retainers to the valve cover and the stud bolts.
6. Connect the 3 RH fuel injector electrical connectors.
7. Connect the RH VCT solenoid electrical connector.
8. Connect the RH HO2S electrical connector.
9. Connect the RH CMS electrical connector and pin-type retainer.

10. Connect the **PSP** switch electrical connector.
11. Install the RH ignition coils. For additional information, refer to **ENGINE IGNITION - 3.5L** .

## LOWER END COMPONENTS - EXPLODED VIEW, CRANKSHAFT PULLEY AND CRANKSHAFT FRONT SEAL



**Fig. 23: Identifying Crankshaft Pulley And Crankshaft Front Seal Components**  
Courtesy of FORD MOTOR CO.

### DESCRIPTION CHART

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

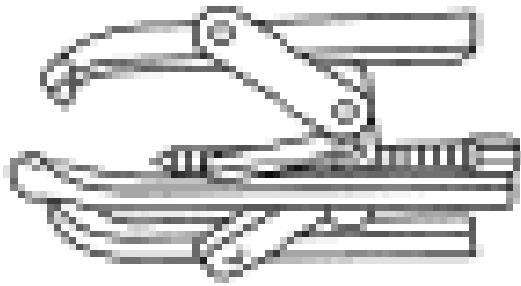
1. For additional information, refer to the appropriate procedure(s).

### CRANKSHAFT PULLEY

#### Special Tool(s)

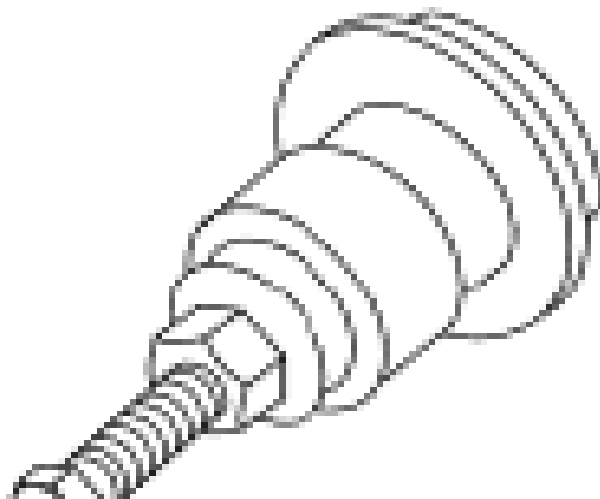
#### SPECIAL TOOL SPECIFICATION

3 Jaw Puller



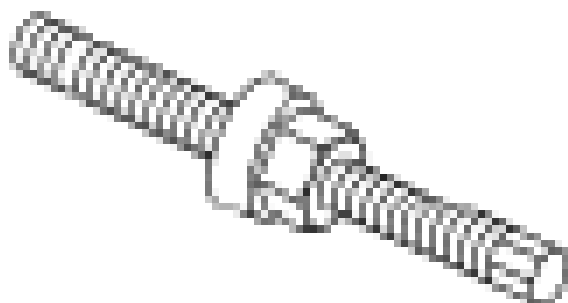
**ST1184-A**

303-D121 or equivalent

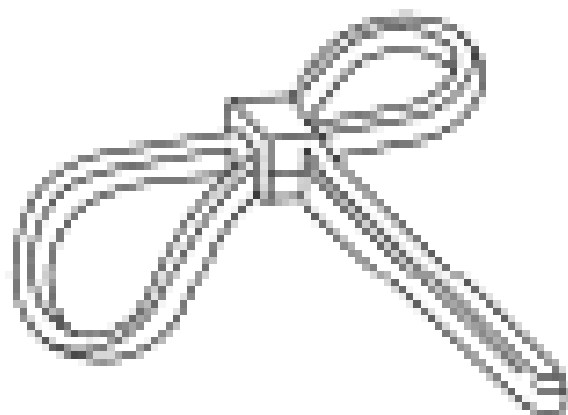


Installer, Front Cover Oil Seal  
303-335

Replacer, Crankshaft Vibration Damper  
303-102 (T74P-6316-B)



**ST1287-A**



**ST1438-A**

Strap Wrench  
303-D055 (D85L-6000-A) or equivalent

## Material

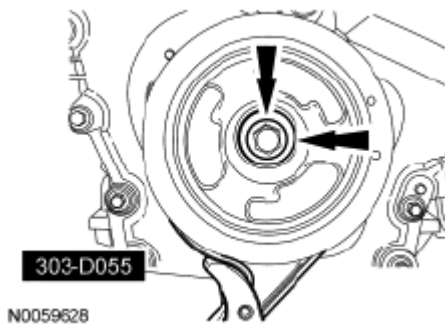
### MATERIAL SPECIFICATION

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



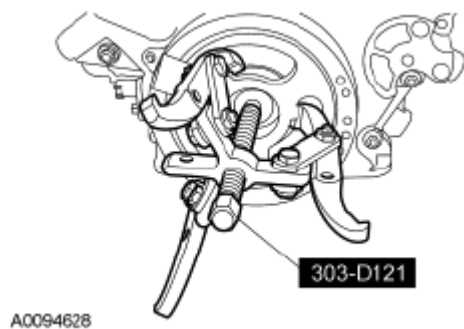
**Removal**

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.



**Fig. 24: Locating Crankshaft Bolt And Washer**  
Courtesy of FORD MOTOR CO.

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

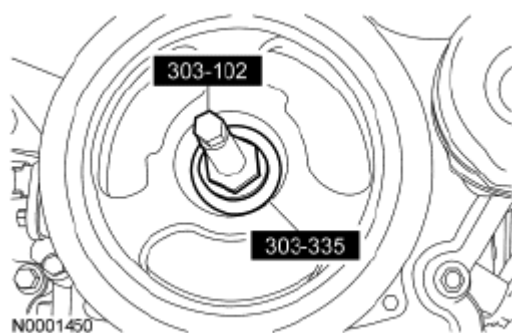


**Fig. 25: Removing Crankshaft Pulley**  
Courtesy of FORD MOTOR CO.

**Installation**

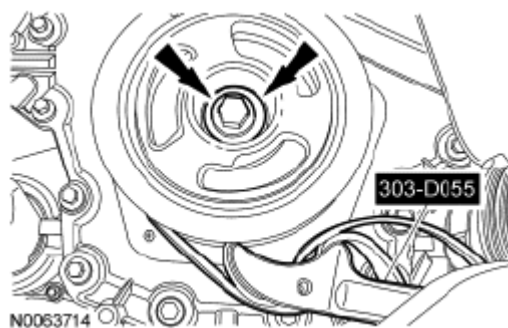
1. Lubricate the crankshaft front seal inner lip with clean engine oil.

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



**Fig. 26: Identifying Crankshaft Vibration Damper Installer And Front Cover Oil Seal Installer**  
Courtesy of FORD MOTOR CO.

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



**Fig. 27: Locating Crankshaft Pulley Washer And Bolt**  
Courtesy of FORD MOTOR CO.

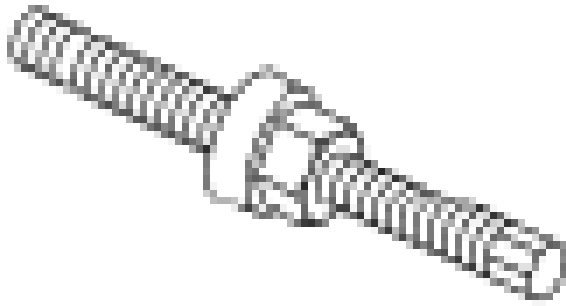
4. Install the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE**.

## CRANKSHAFT FRONT SEAL

### Special Tool(s)

### SPECIAL TOOL SPECIFICATION

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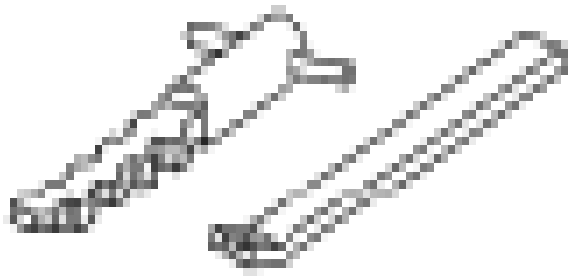
Installer, Crankshaft Vibration Damper  
303-102 (T74P-6316-B)

**ST1287-A**



Installer, Front Crankshaft Seal  
303-1251

**ST2681-A**



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

ST1385-A

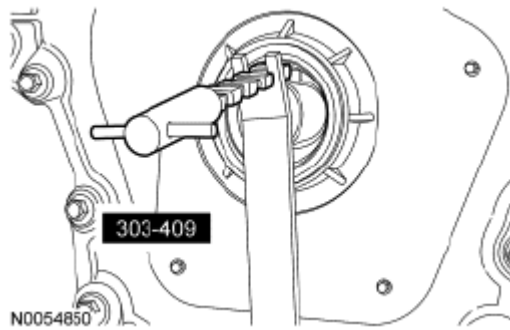
## Material

### MATERIAL SPECIFICATION

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20- LSP12 (Canada); or equivalent	WSS-M2C930- A

## Removal

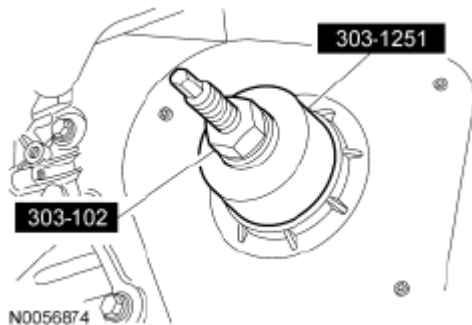
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING**.
2. Remove the crankshaft pulley. For additional information, refer to **CRANKSHAFT PULLEY**.
3. Using the Oil Seal Remover, remove and discard the crankshaft front seal.
  - Clean all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



**Fig. 28: Removing Crankshaft Front Seal**  
Courtesy of FORD MOTOR CO.

#### Installation

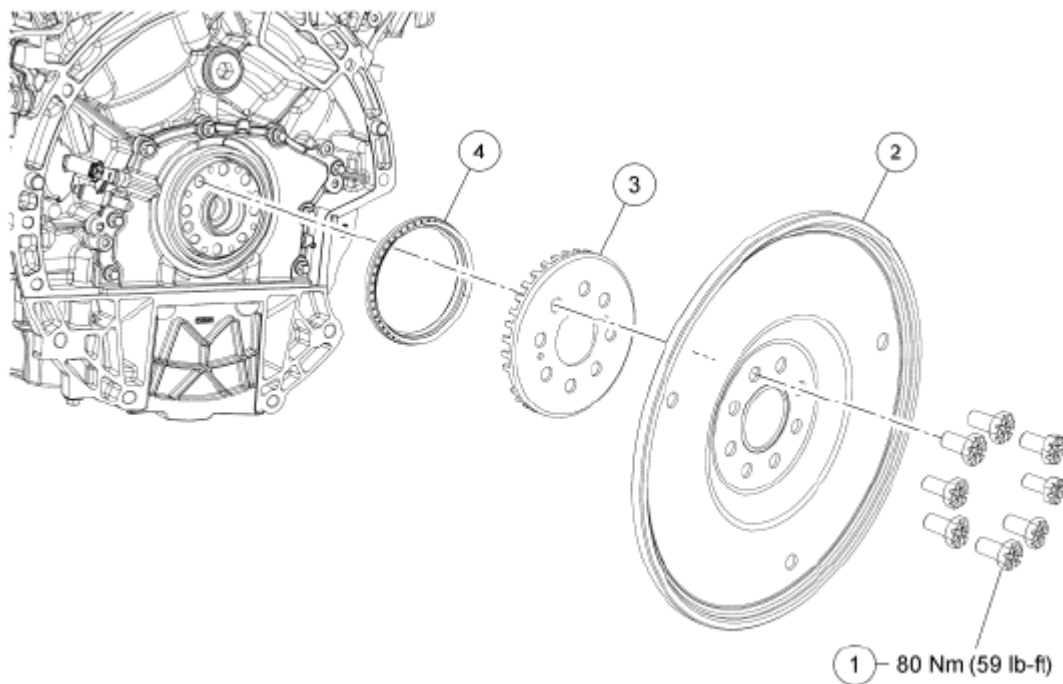
**NOTE:** Apply clean engine oil to the crankshaft front seal bore in the engine front cover.



**Fig. 29: Identifying Crankshaft Vibration Damper Installer And Front Crankshaft Installer**  
Courtesy of FORD MOTOR CO.

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

#### **LOWER END COMPONENTS - EXPLODED VIEW, FLEXPLATE AND CRANKSHAFT REAR SEAL**



**Fig. 30: Identifying Flexplate And Crankshaft Rear Seal Components With Torque Specifications**  
Courtesy of FORD MOTOR CO.

#### DESCRIPTION CHART

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

1. For additional information, refer to the appropriate procedure(s).

#### FLEXPLATE

##### Removal and Installation

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**.

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

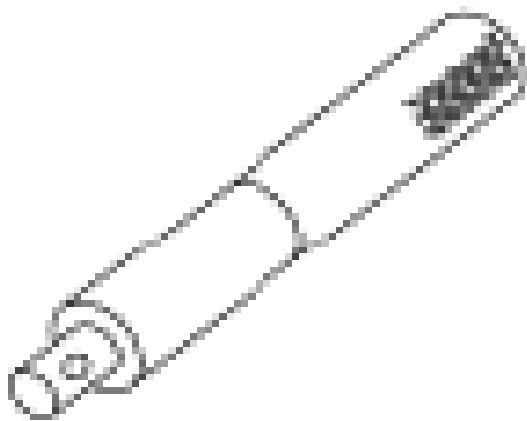
3. Remove the bolts and the flexplate.

- To install, tighten to 80 Nm (59 lb-ft).
4. To install, reverse the removal procedure.

## CRANKSHAFT REAR SEAL

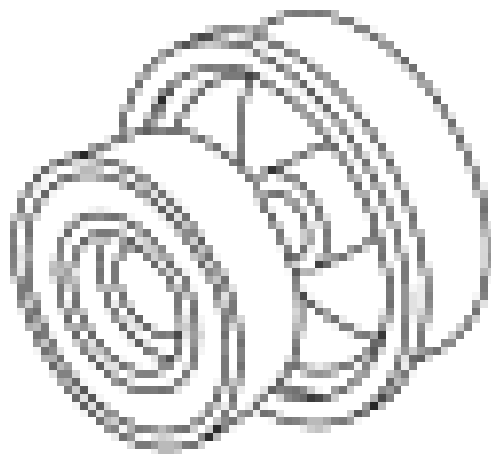
### Special Tool(s)

### SPECIAL TOOL SPECIFICATION



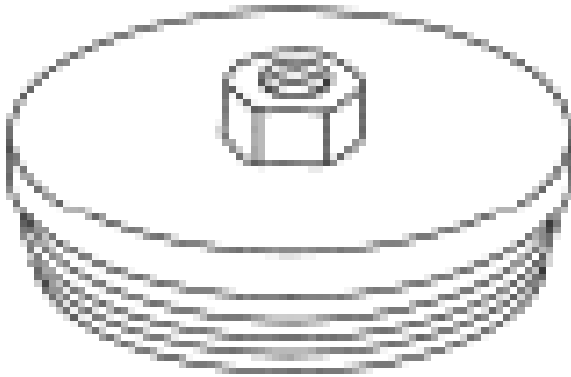
**ST1326-A**

Handle  
205-153 (T80T-4000-W)



**ST2980-A**

Installer, Rear Main Seal  
303-1250



ST1382-A

Remover, Crankshaft Rear Oil Seal  
303-519 (T95P-6701-EH)



ST1187-A

Slide Hammer  
307-005 (T59L-100-B)

## Material

### MATERIAL SPECIFICATION

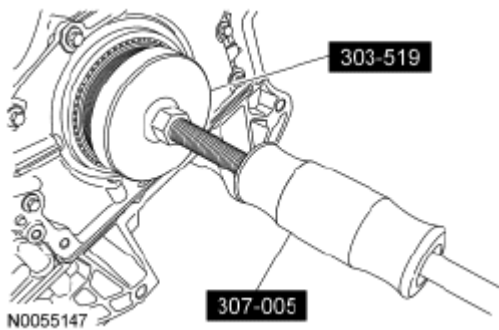
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20- LSP12 (Canada); or equivalent	WSS-M2C930- A

## Removal

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



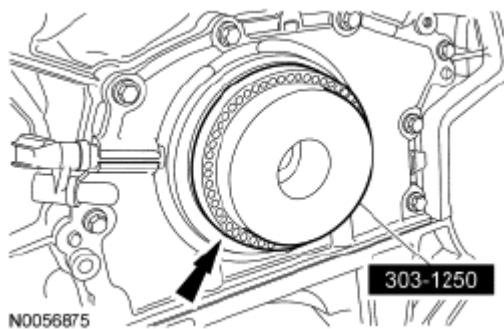
2. Remove the flexplate. For additional information, refer to **FLEXPLATE**.
3. Remove the crankshaft sensor ring.
4. Using the Crankshaft Rear Oil Seal Remover and Slide Hammer, remove and discard the crankshaft rear seal.
  - Clean all sealing surfaces with metal surface prep.



**Fig. 31: Identifying Crankshaft Rear Oil Seal Remover And Slide Hammer**  
Courtesy of FORD MOTOR CO.

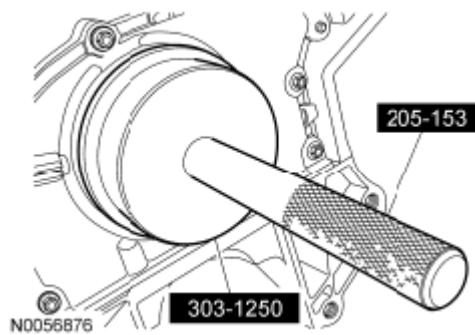
#### Installation

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



**Fig. 32: Identifying Rear Main Seal Installer On Crankshaft**  
Courtesy of FORD MOTOR CO.

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

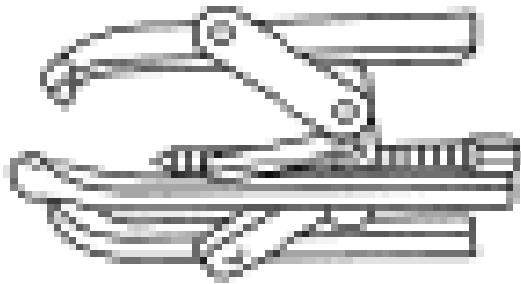


**Fig. 33: Identifying Rear Main Seal Installer And Handle**  
Courtesy of FORD MOTOR CO.

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

## ENGINE FRONT COVER

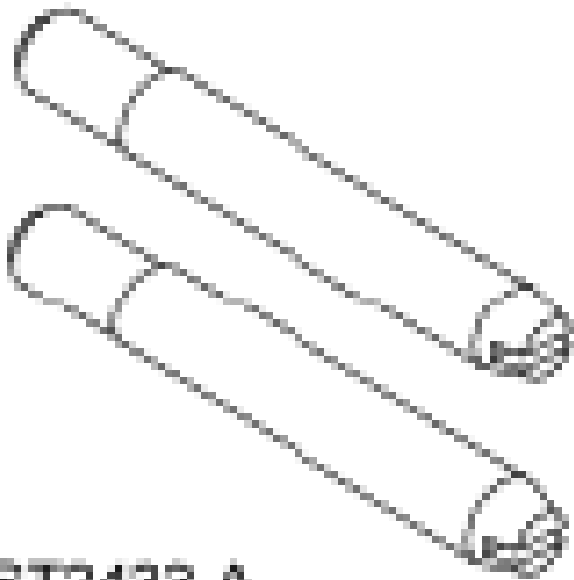
### SPECIAL TOOL SPECIFICATION



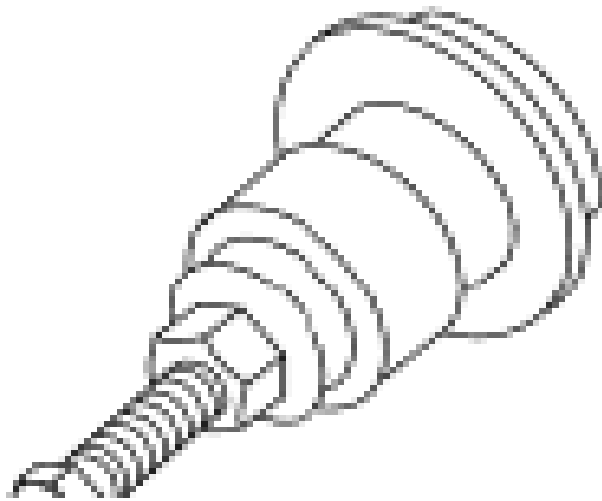
**ST1184-A**

3 Jaw Puller  
303-D121 or equivalent

Alignment Pins  
307-399



ST2433-A

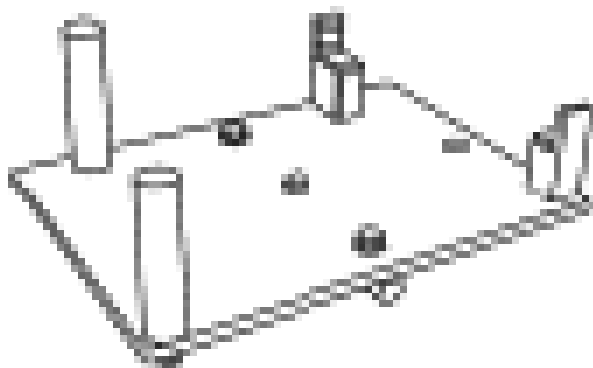


Installer, Front Cover Oil Seal  
303-335 (T88T-6701-A)



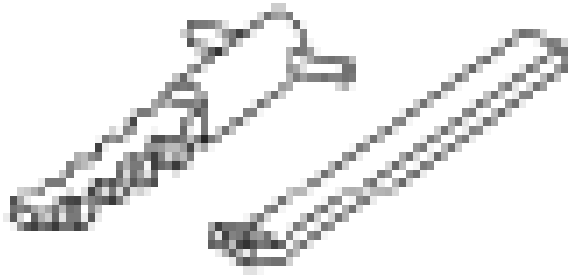
Installer, Front Crankshaft Seal  
303-1251

ST2981-A



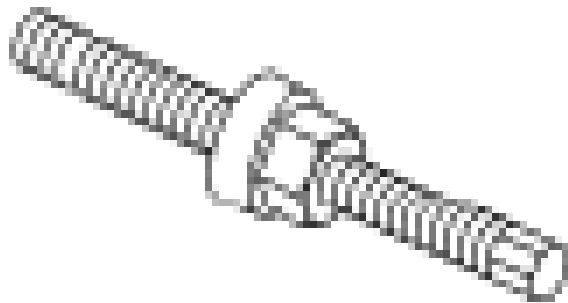
Oil Pan Holding Fixture  
303-1295

ST3034-A



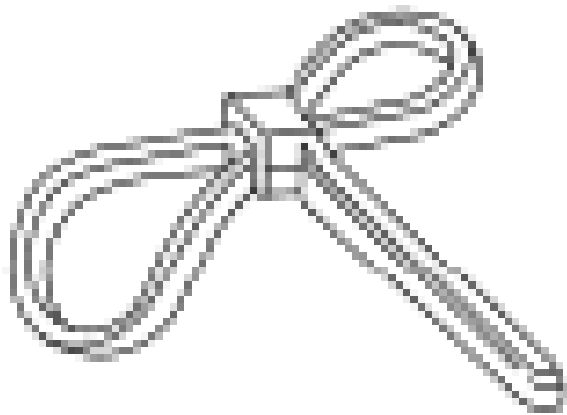
Remover, Oil Seal  
303-409 (T92C-6700CH)

ST1385-A



Replacer, Crankshaft Vibration Damper  
303-102 (T74P-6312-B)

ST1287-A



ST1438-A

Strap Wrench  
303-D055 (D85L-6000-A) or equivalent

## Material

### MATERIAL SPECIFICATION

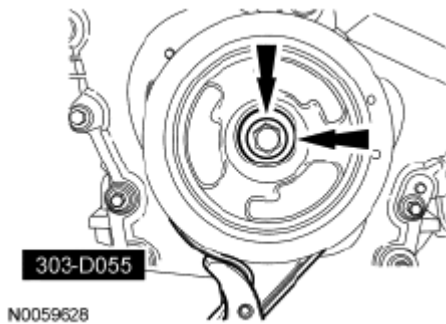
Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WS-EM4G323-A6
Motorcraft® Metal Surface Prep ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A
Silicone Gasket Remover ZC-30	-
Threadlock and Sealer TA-25	WSK-M2G351-A5

## Removal

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

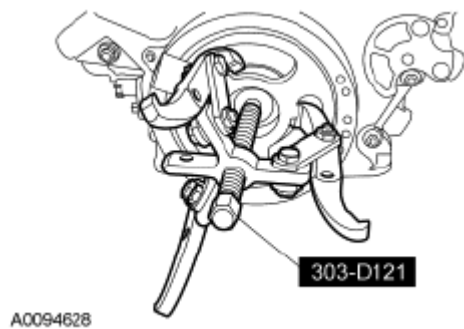
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING**.

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**.
4. Remove the accessory drive belt, tensioner and the power steering belt. For additional information, refer to **ACCESSORY DRIVE**.
5. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
  - Discard the bolt.



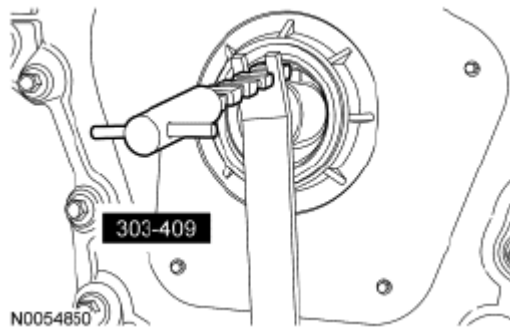
**Fig. 34: Locating Crankshaft Bolt And Washer**  
Courtesy of FORD MOTOR CO.

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



**Fig. 35: Removing Crankshaft Pulley**  
Courtesy of FORD MOTOR CO.

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



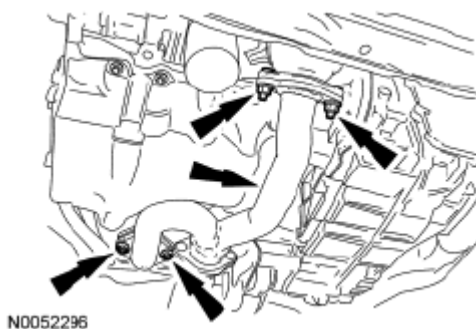
**Fig. 36: Removing Crankshaft Front Seal**  
Courtesy of FORD MOTOR CO.

8. Loosen the exhaust flexible pipe clamp and disconnect the 2 exhaust hangers.



**Fig. 37: Locating Exhaust Flexible Pipe Clamp**  
Courtesy of FORD MOTOR CO.

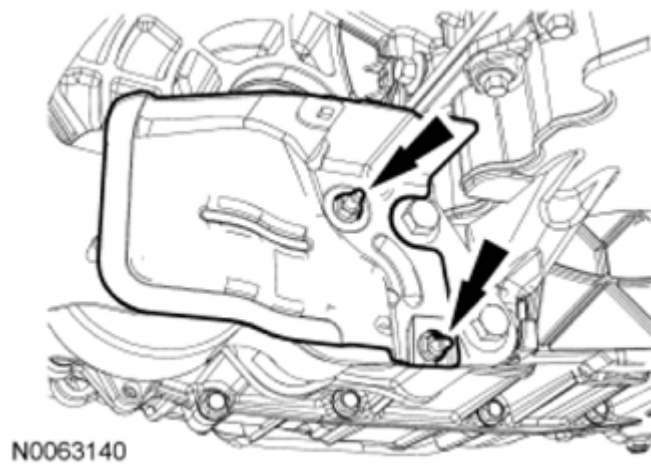
9. Remove the 4 nuts, the exhaust flexible pipe and the Y-pipe as an assembly.
  - Discard the nuts and the gasket.



**Fig. 38: Locating Exhaust Flexible Pipe Nuts**  
Courtesy of FORD MOTOR CO.

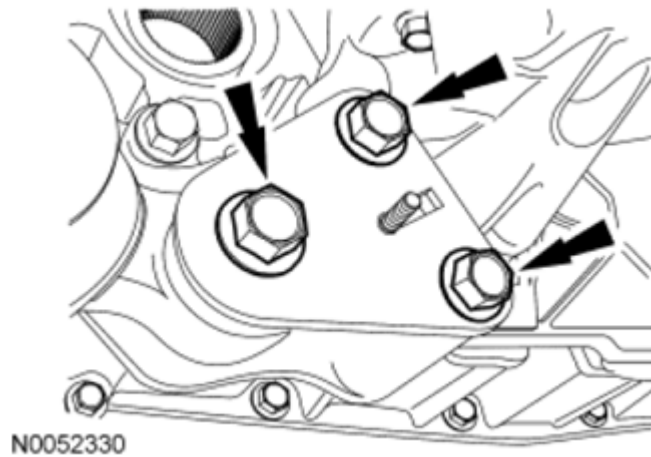


10. Remove the 2 nuts and the roll restrictor heat shield.



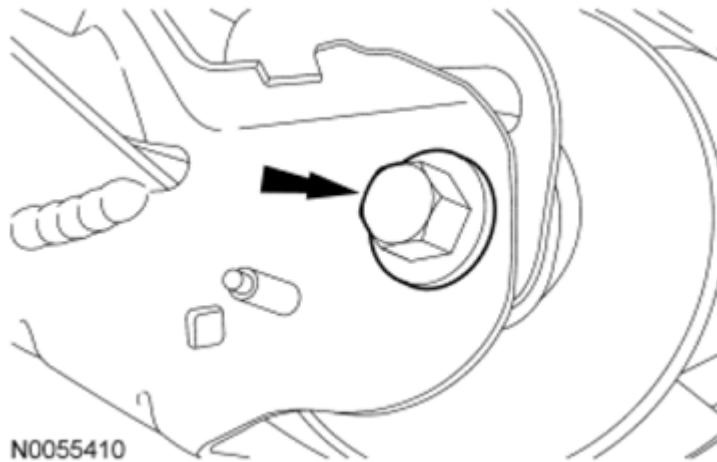
**Fig. 39: Locating Roll Restrictor Heat Shield Nuts**  
Courtesy of FORD MOTOR CO.

11. Remove the roll restrictor through bolt and the 2 roll restrictor-to-transaxle bracket plate bolts.



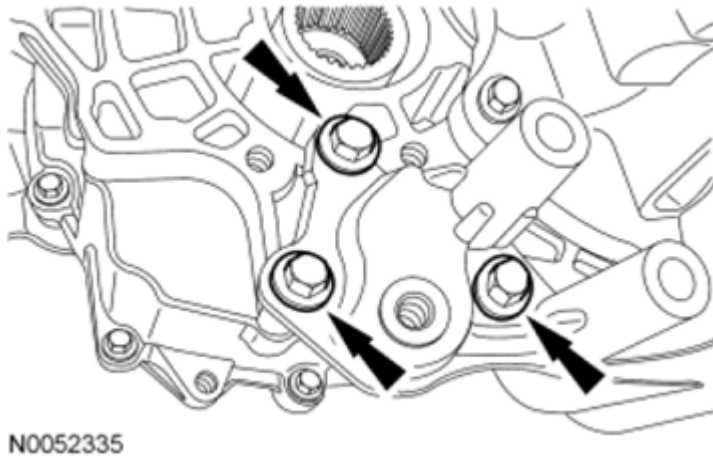
**Fig. 40: Locating Transaxle Bracket Bolts**  
Courtesy of FORD MOTOR CO.

12. Loosen the roll restrictor-to-subframe through bolt.
- Position the roll restrictor and transaxle bracket plate aside.



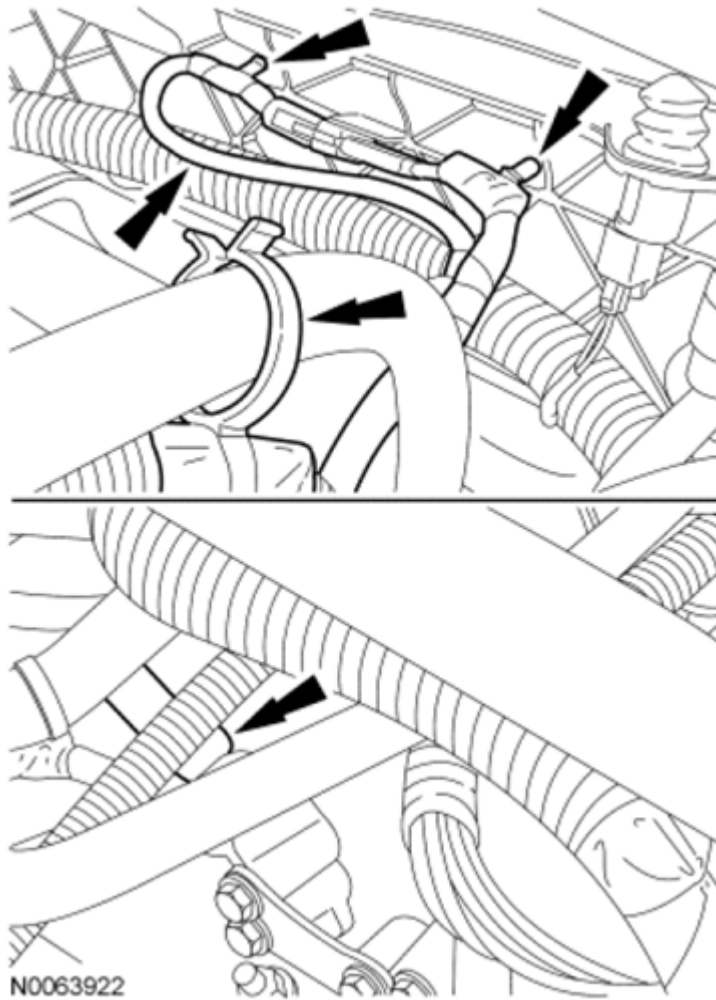
**Fig. 41: Locating Engine Roll Restrictor-To-Subframe Through Bolt**  
Courtesy of FORD MOTOR CO.

13. Remove the 3 bolts and the transaxle bracket.



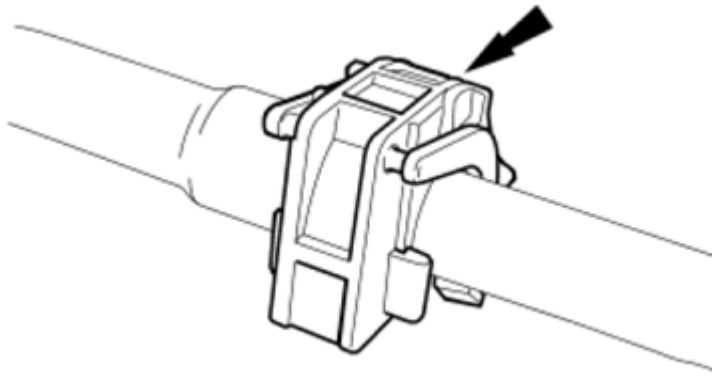
**Fig. 42: Locating Transaxle Bracket Bolts**  
Courtesy of FORD MOTOR CO.

14. Remove the RH front halfshaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS**.
15. Remove the drain plug and drain the engine oil.
  - Install the drain plug and tighten to 27 Nm (20 lb-ft).
16. If equipped, detach the engine block heater harness from the radiator support, the A/C suction tube and the engine wiring harness.



**Fig. 43: Locating Engine Block Heater Harness And A/C Suction Tube**  
Courtesy of FORD MOTOR CO.

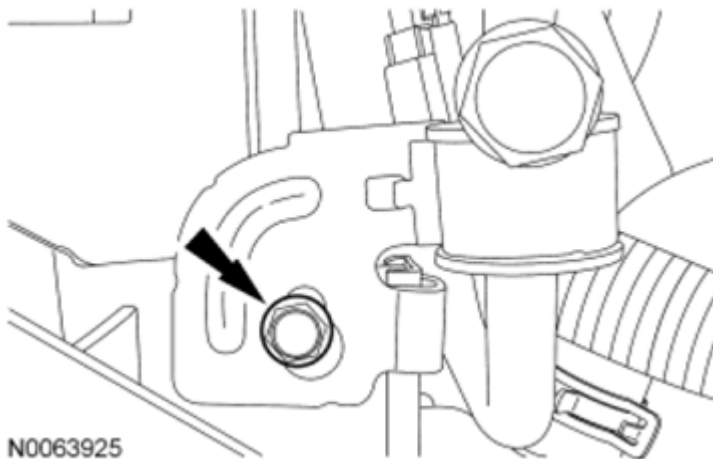
17. Remove the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING**.
18. Remove the LH and RH valve covers. For additional information, refer to **VALVE COVER - LH** and **VALVE COVER - RH**.
19. Remove the safety clip from the A/C suction tube fitting.
  - Disconnect the A/C suction tube fitting and position the tube aside.



N0055420

**Fig. 44: Locating A/C Suction Tube Safety Clip**  
Courtesy of FORD MOTOR CO.

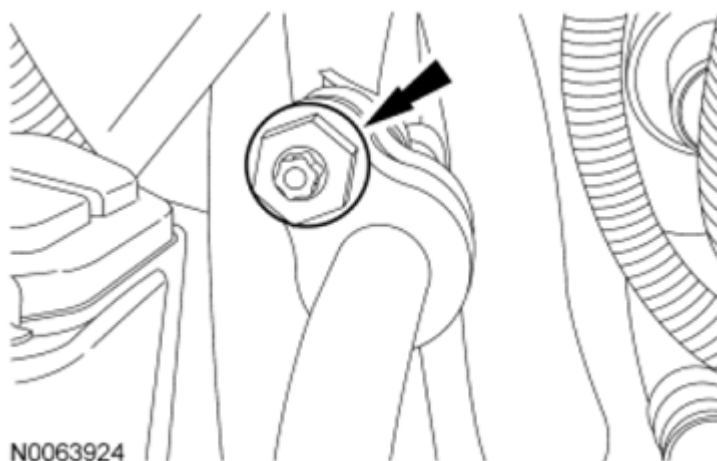
20. Remove the A/C pressure tube bracket bolt.



N0063925

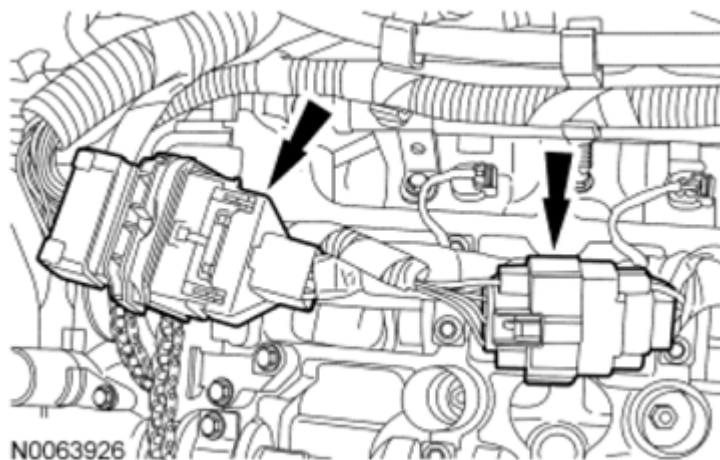
**Fig. 45: Locating A/C Pressure Tube Bracket Bolt**  
Courtesy of FORD MOTOR CO.

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



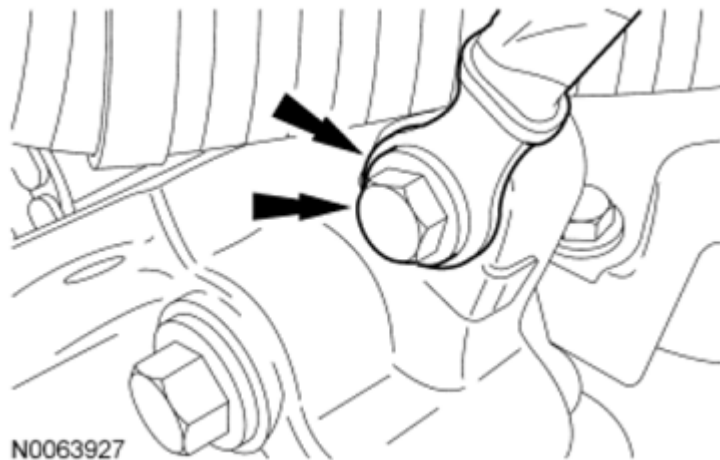
**Fig. 46: Locating A/C Pressure Tube Fitting Nut**  
Courtesy of FORD MOTOR CO.

22. Disconnect the 2 engine wiring harness connectors.



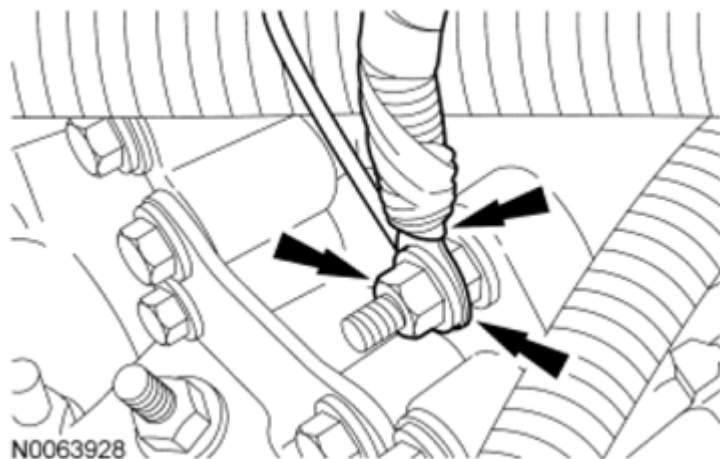
**Fig. 47: Locating Engine Wiring Harness Connectors**  
Courtesy of FORD MOTOR CO.

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



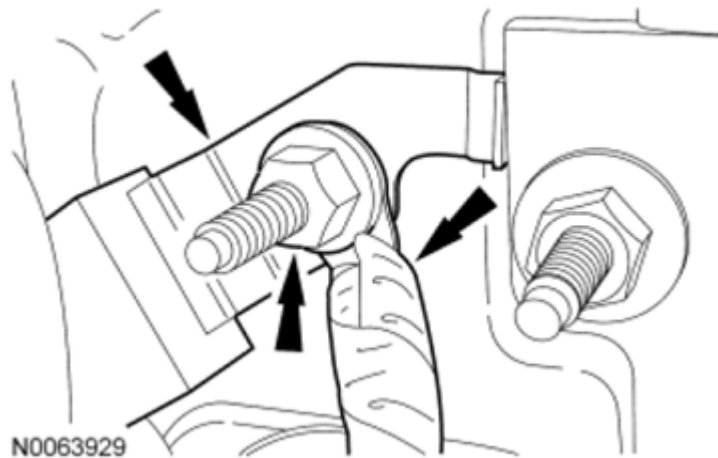
**Fig. 48: Locating Ground Wire Bolt**  
Courtesy of FORD MOTOR CO.

24. Remove the nut, the ground wire and the radio interference capacitor wire from the engine front cover stud.



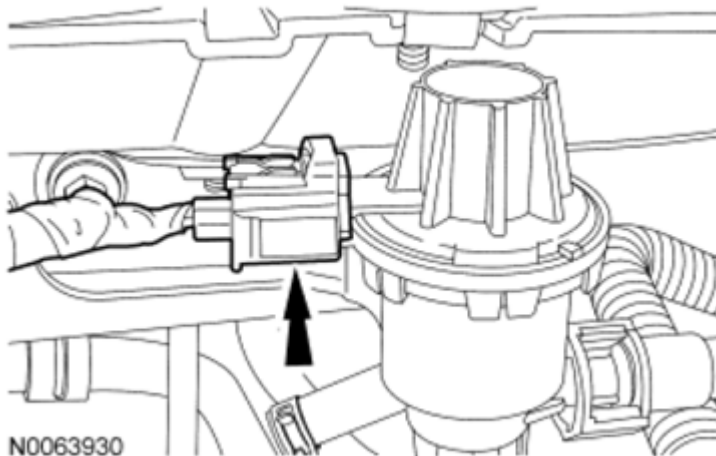
**Fig. 49: Locating Ground Wire Nut**  
Courtesy of FORD MOTOR CO.

25. Remove the nut, the ground wire and the radio interference capacitor from the cowl stud.



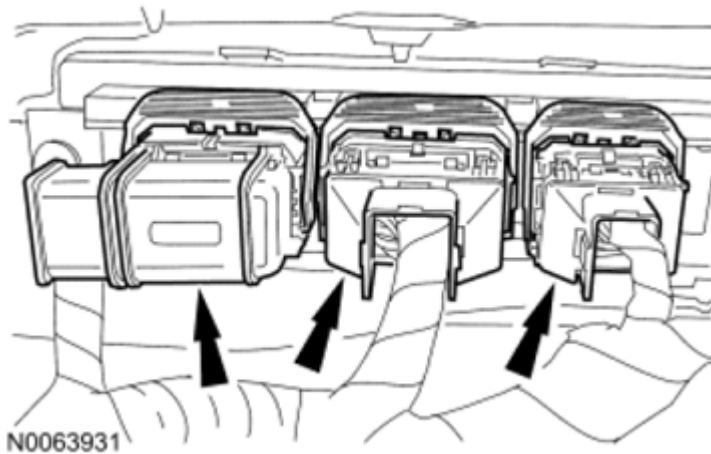
**Fig. 50: Locating Ground Wire Nut**  
Courtesy of FORD MOTOR CO.

26. Disconnect the purge valve electrical connector.



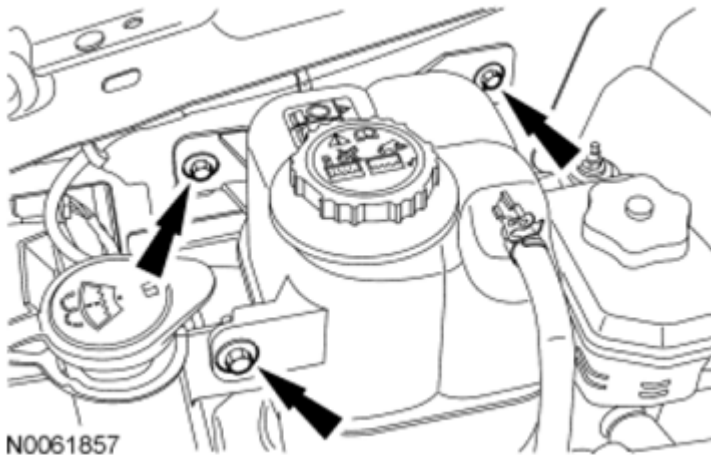
**Fig. 51: Locating Purge Valve Electrical Connector**  
Courtesy of FORD MOTOR CO.

27. Disconnect the 3 PCM electrical connectors and position the wiring harness aside.



**Fig. 52: Locating PCM Electrical Connectors**  
Courtesy of FORD MOTOR CO.

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

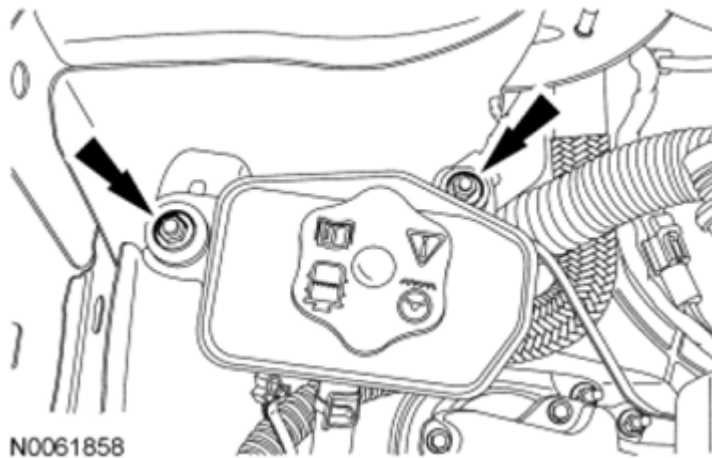


**Fig. 53: Locating Degas Bottle Bolts**  
Courtesy of FORD MOTOR CO.

**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.

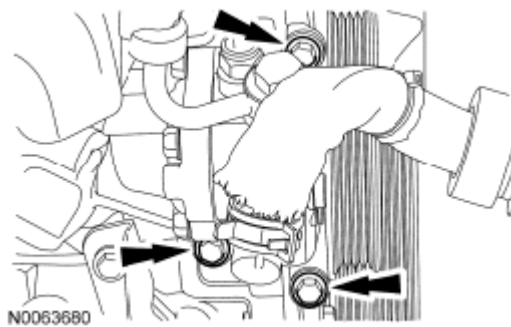
29. Remove the 2 power steering reservoir nuts.
- Support the power steering reservoir and hose away from the front of the engine with a length of mechanic's wire.





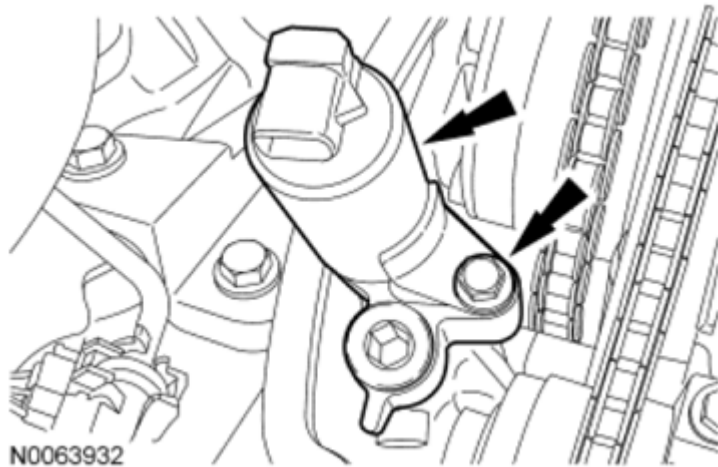
**Fig. 54: Locating Power Steering Reservoir Nuts**  
Courtesy of FORD MOTOR CO.

30. Remove the 3 power steering pump bolts.
- Support the power steering pump and hose away from the front of the engine with a length of mechanic's wire.



**Fig. 55: Locating Power Steering Pump Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** LH shown in illustration, RH similar.

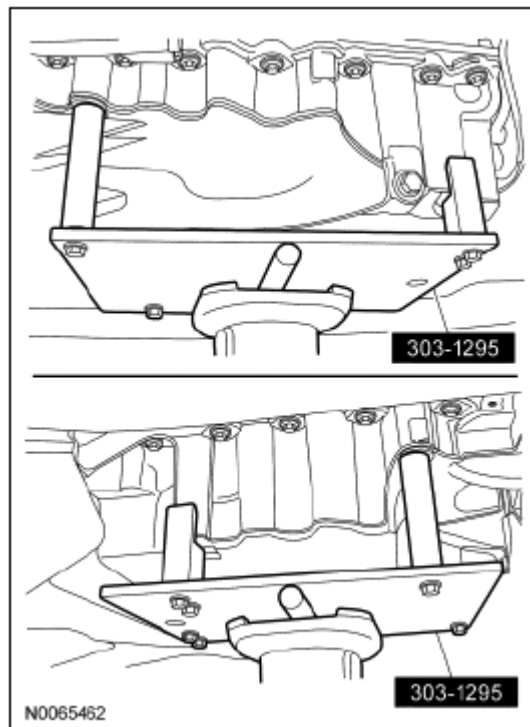


**Fig. 56: Locating Variable Camshaft Timing Solenoids Bolts**  
Courtesy of FORD MOTOR CO.

31. Remove the bolts, the LH and the RH Variable Camshaft Timing (VCT) solenoids.

**NOTE:** The Oil Pan Holding Fixture must be carefully aligned to the mounting bosses on the oil pan. Failure to follow these instructions may result in damage to the oil pan.

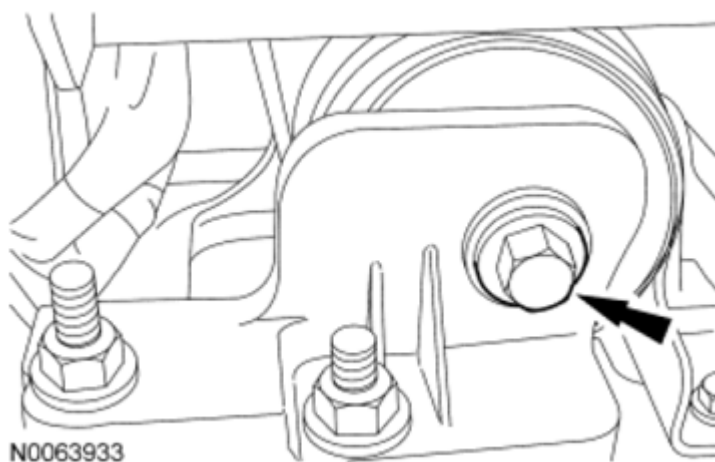
**NOTE:** The Oil Pan Holding Fixture and floor jack are used to raise and lower the engine to access the engine front cover and engine mount bracket fasteners.



**Fig. 57: Positioning Floor Jack And Oil Pan Holding Fixture Under Oil Pan**  
Courtesy of FORD MOTOR CO.

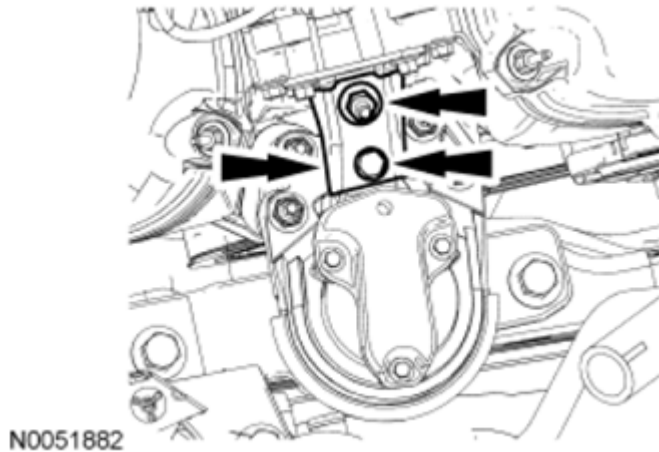
32. Position a floor jack and the Oil Pan Holding Fixture under the oil pan.

**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.



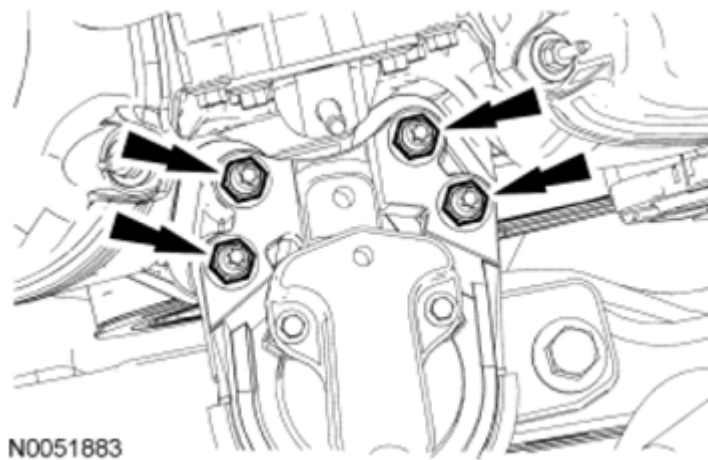
**Fig. 58: Locating Transaxle Mount Through Bolt**  
Courtesy of FORD MOTOR CO.

33. Loosen the transaxle mount through bolt.
34. Remove the nut, bolt and engine mount brace.



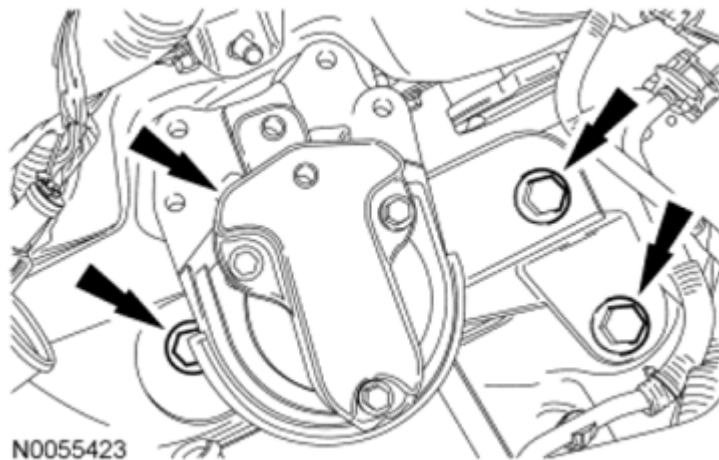
**Fig. 59: Locating Engine Mount Brace Nut And Bolt**  
Courtesy of FORD MOTOR CO.

35. Remove the 4 engine mount nuts.



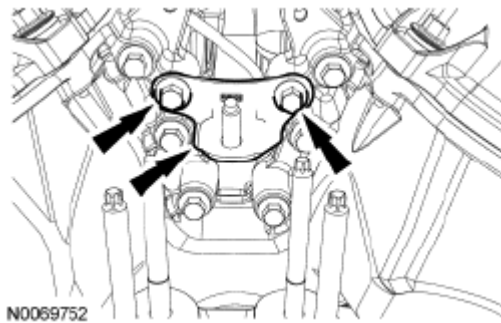
**Fig. 60: Locating Engine Mount Nuts**  
Courtesy of FORD MOTOR CO.

36. Remove the 3 bolts and the engine mount.



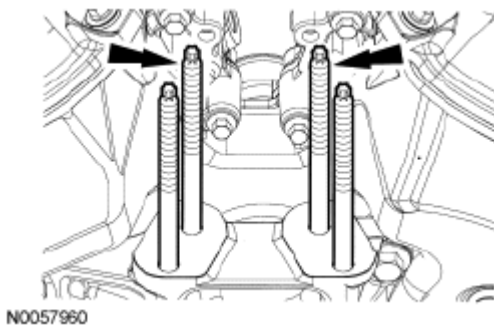
**Fig. 61: Locating Engine Mount Bolts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 62: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

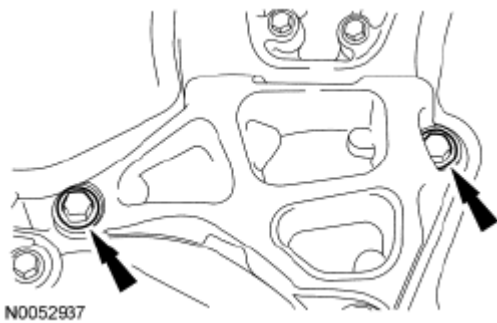
**NOTE:** Only use hand tools to remove the studs.



**Fig. 63: Locating Engine Mount Studs**  
Courtesy of FORD MOTOR CO.

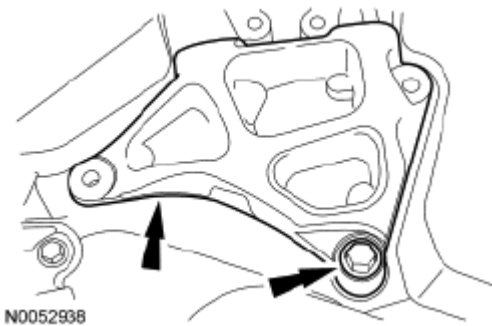
38. Remove the 2 engine mount studs.

39. Remove the 2 upper engine mount bracket bolts.



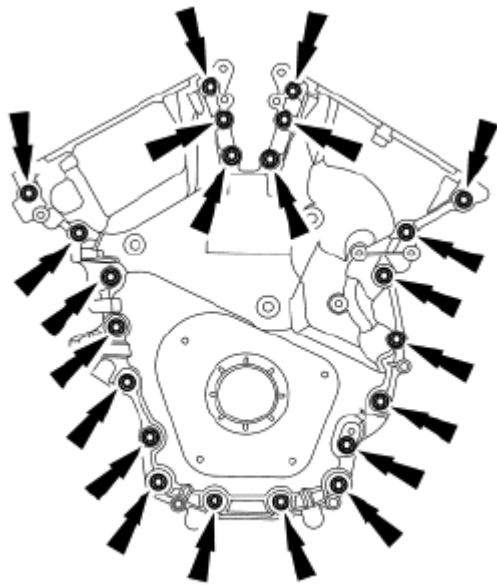
**Fig. 64: Locating Upper Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

40. Lower the engine to access the lower engine mount bracket bolt.
41. Loosen the lower engine mount bracket bolt and remove the engine mount bracket and bolt as an assembly.



**Fig. 65: Locating Lower Engine Mount Bracket Bolt**  
Courtesy of FORD MOTOR CO.

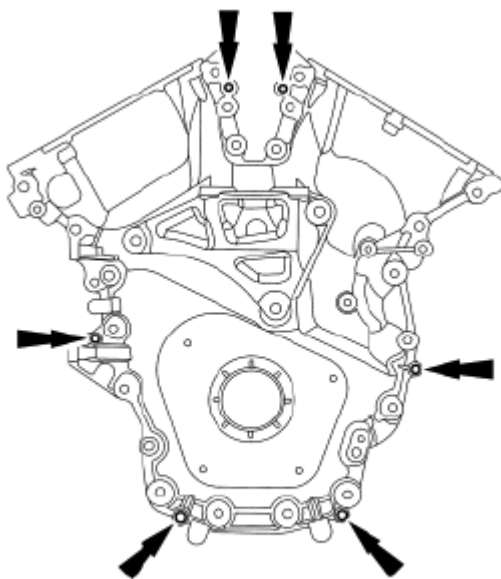
42. Remove the 22 engine front cover bolts.



N0054851

**Fig. 66: Locating Engine Front Cover Bolts**  
Courtesy of FORD MOTOR CO.

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



N0082530

**Fig. 67: Locating Engine Front Cover Bolts**

**Courtesy of FORD MOTOR CO.****Installation**

1. Raise the engine to the installed position.

**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.

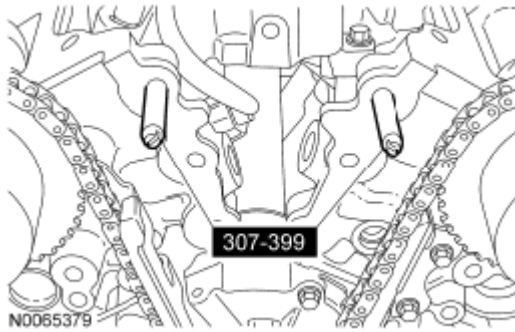
2. Clean the engine front cover using a 3M™ Roloc® Bristle Disk (2-in white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.
  - Thoroughly wash the engine front cover to remove any foreign material, including any abrasive particles created during the cleaning process.

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

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

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

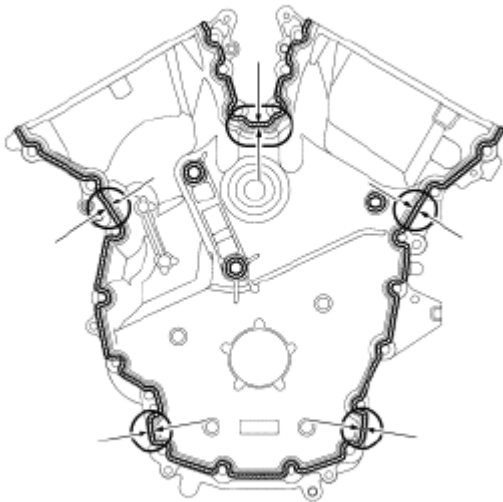




**Fig. 68: Identifying Alignment Pins**  
Courtesy of FORD MOTOR CO.

- NOTE:** Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.
- NOTE:** The engine front cover and bolts 17, 18, 19 and 20 must be installed within 4 minutes of the initial sealant application. The remainder of the engine front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.
5. Apply a 3.0 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover sealing surfaces including the 3 engine mount bracket bosses.
- Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the oil pan-to-cylinder block joint and the cylinder head-to-cylinder block joint areas of the engine front cover in 5 places as indicated.

5.5 mm  
(0.21 in)

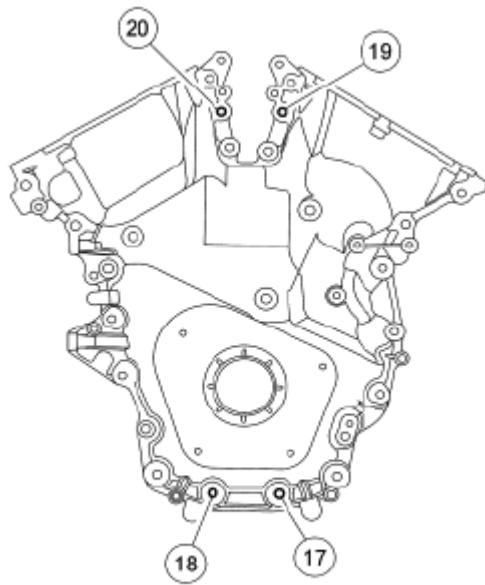


N0068293

**Fig. 69: Identifying RTV Silicone Applying Area**  
Courtesy of FORD MOTOR CO.

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

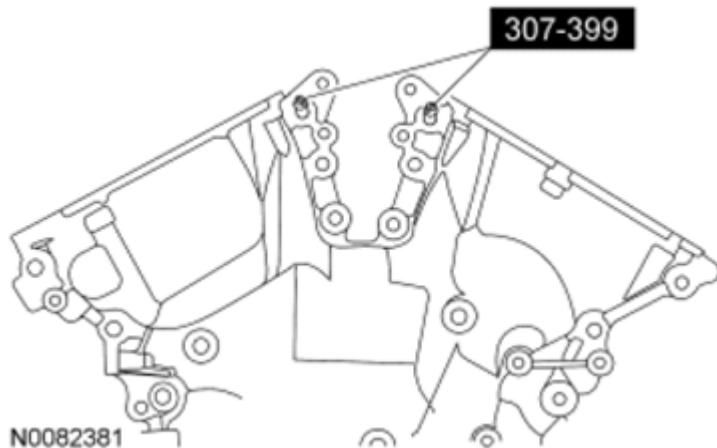
6. Install the engine front cover and bolts 17, 18, 19 and 20.
  - Tighten in sequence to 3 Nm (27 lb-in).



N0068108

**Fig. 70: Identifying Engine Front Cover Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

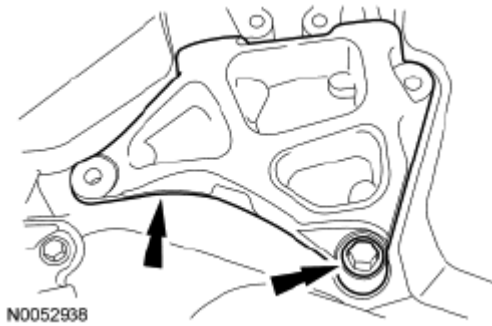
7. Remove the Alignment Pins.



**Fig. 71: Identifying Alignment Pins**  
Courtesy of FORD MOTOR CO.

**NOTE:** Do not tighten the bolt at this time.

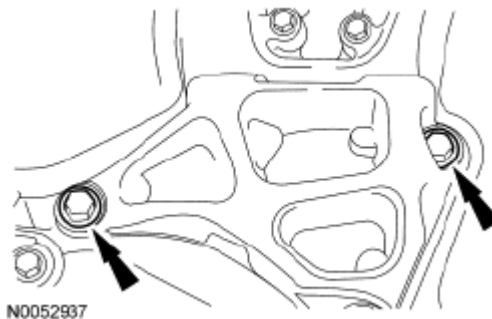
8. Lower the engine to allow installation of the engine mount bracket and lower bolt.
  - Install the engine mount bracket and lower bolt as an assembly.



**Fig. 72: Locating Lower Engine Mount Bracket Bolt**  
Courtesy of FORD MOTOR CO.

**NOTE:** Do not tighten the bolts at this time.

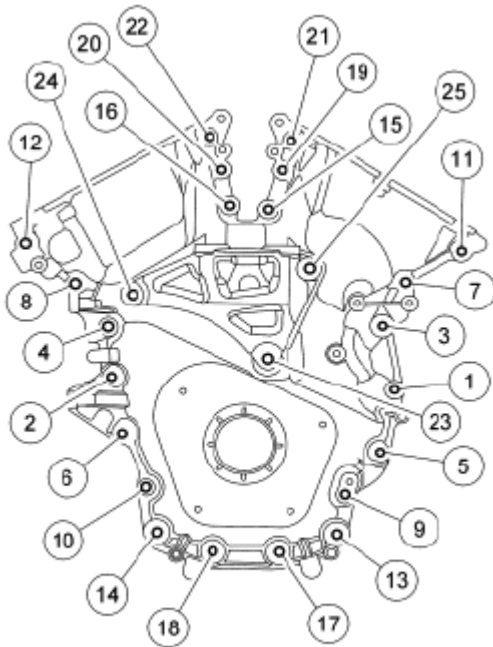
9. Raise the engine to the installed position.
  - Install the 2 upper engine mount bracket bolts.



**Fig. 73: Locating Upper Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

**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.

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 illustration in 2 stages:
  - Stage 1: Tighten bolts 1 thru 22 to 10 Nm (89 lb-in) and bolts 23, 24 and 25 to 15 Nm (133 lb-in).
  - Stage 2: Tighten bolts 1 thru 22 to 24 Nm (18 lb-ft) and bolts 23, 24 and 25 to 75 Nm (55 lb-ft).

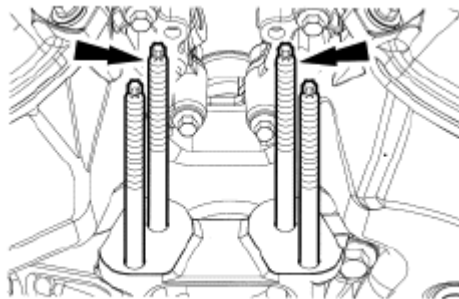


N0068109

**Fig. 74: Identifying Engine Front Cover Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

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

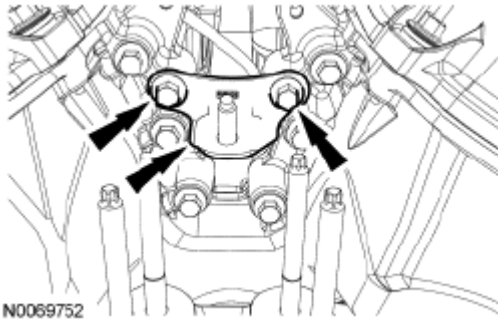
11. Install the engine mount studs in the following sequence.
  1. Clean the front cover engine mount stud holes with pressurized air to remove any foreign material.
  2. Clean all the thread sealer from the engine mount studs (old and new studs).
  3. Apply new Threadlock and Sealer to the engine mount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



N0057960

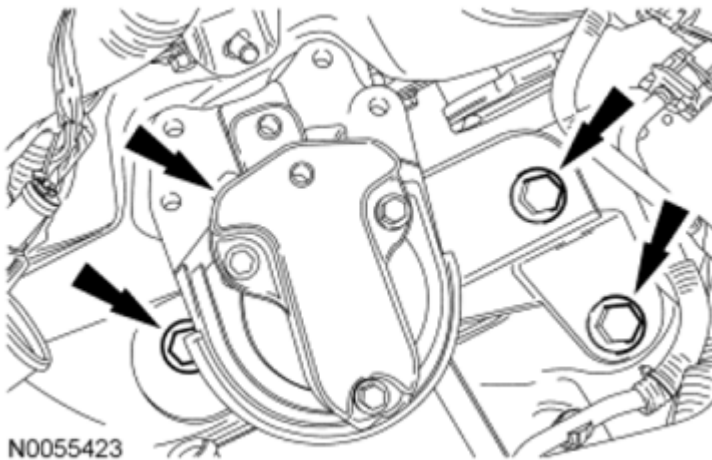
**Fig. 75: Locating Engine Mount Studs**  
Courtesy of FORD MOTOR CO.

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



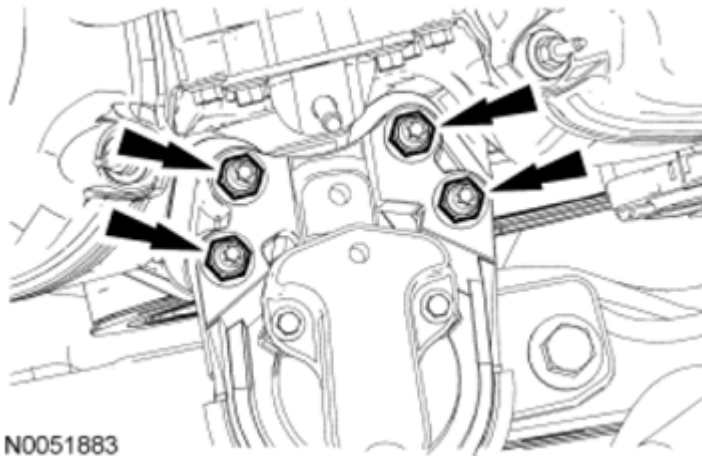
**Fig. 76: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

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



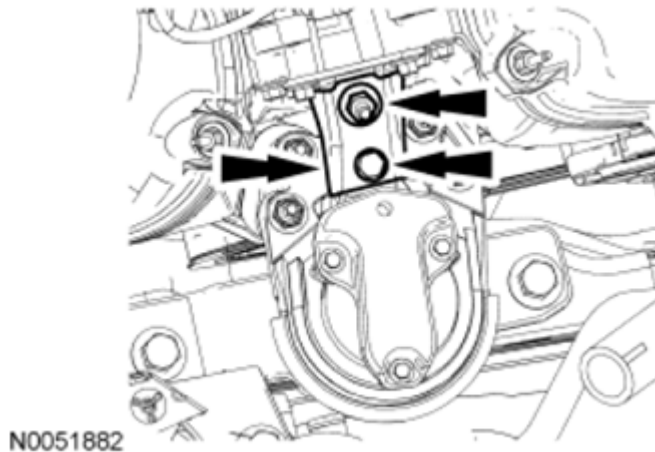
**Fig. 77: Locating Engine Mount Bolts**  
Courtesy of FORD MOTOR CO.

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



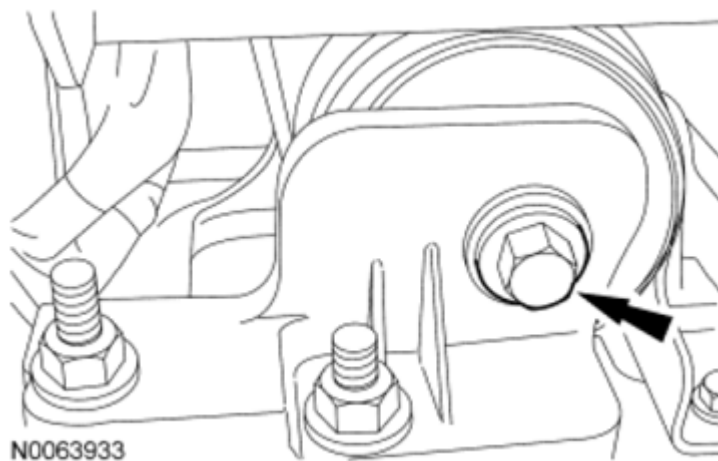
**Fig. 78: Locating Engine Mount Nuts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 79: Locating Engine Mount Brace Nut And Bolt**  
Courtesy of FORD MOTOR CO.

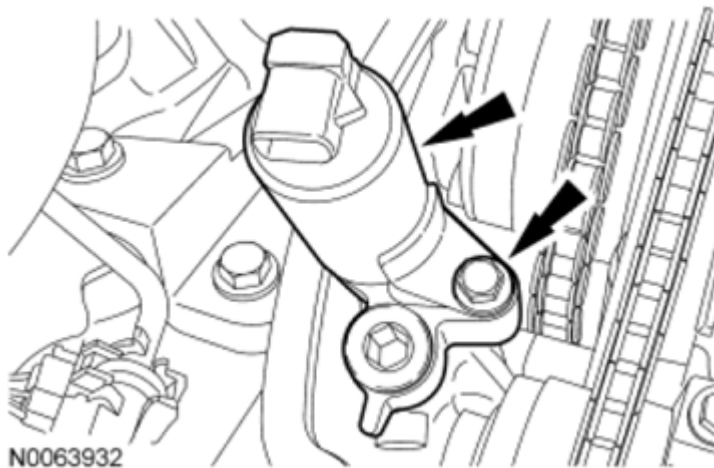
16. Tighten the transaxle mount through bolt to 175 Nm (129 lb-ft).



**Fig. 80: Locating Transaxle Mount Through Bolt**  
Courtesy of FORD MOTOR CO.

**NOTE:** LH shown in illustration, RH similar.

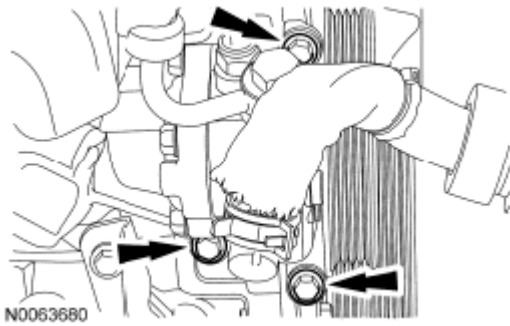
17. Install the LH and RH VCT solenoids and bolts.
  - Tighten to 10 Nm (89 lb-in).



**Fig. 81: Locating Variable Camshaft Timing Solenoids Bolts**  
Courtesy of FORD MOTOR CO.

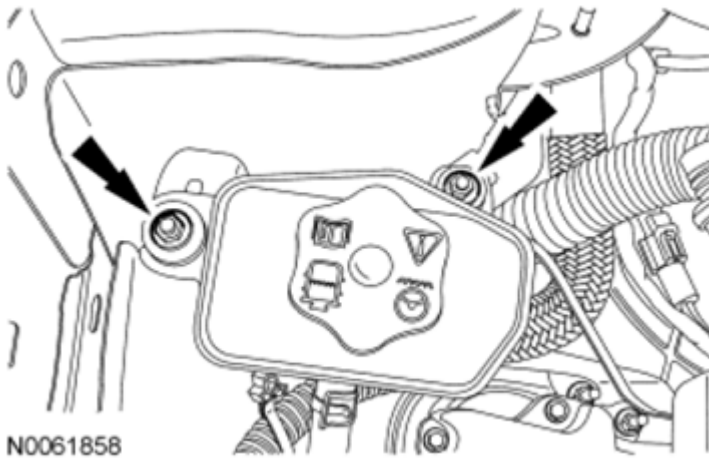
18. Install the power steering pump and the 3 bolts.
  - Tighten to 24 Nm (18 lb-ft).





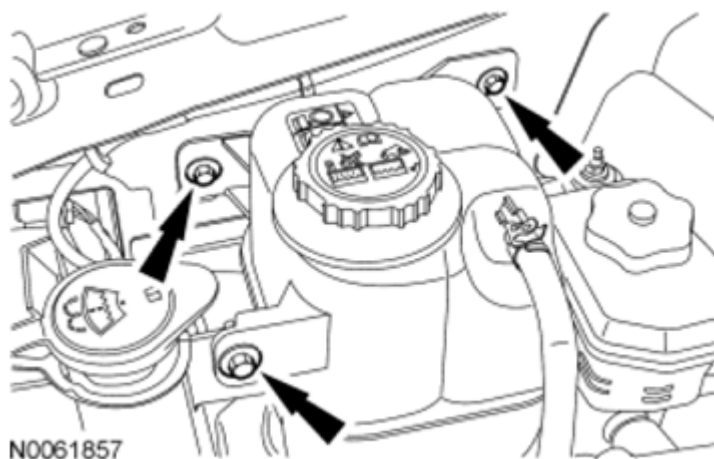
**Fig. 82: Locating Power Steering Pump Bolts**  
Courtesy of FORD MOTOR CO.

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



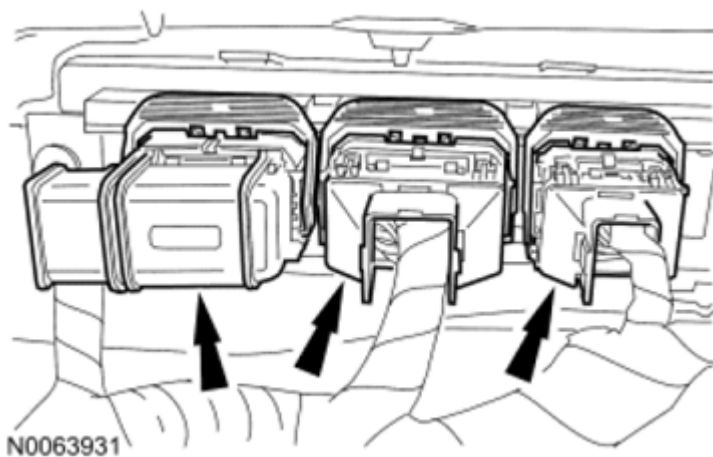
**Fig. 83: Locating Power Steering Reservoir Nuts**  
Courtesy of FORD MOTOR CO.

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



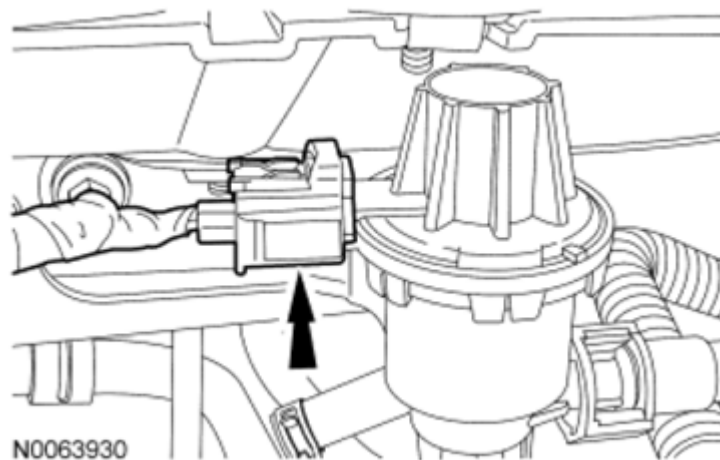
**Fig. 84: Locating Degas Bottle Bolts**  
Courtesy of FORD MOTOR CO.

21. Connect the 3 PCM electrical connectors.



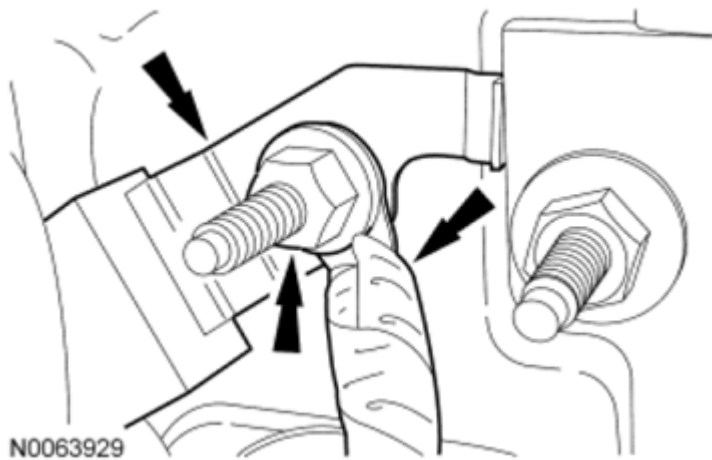
**Fig. 85: Locating PCM Electrical Connectors**  
Courtesy of FORD MOTOR CO.

22. Connect the purge valve electrical connector.



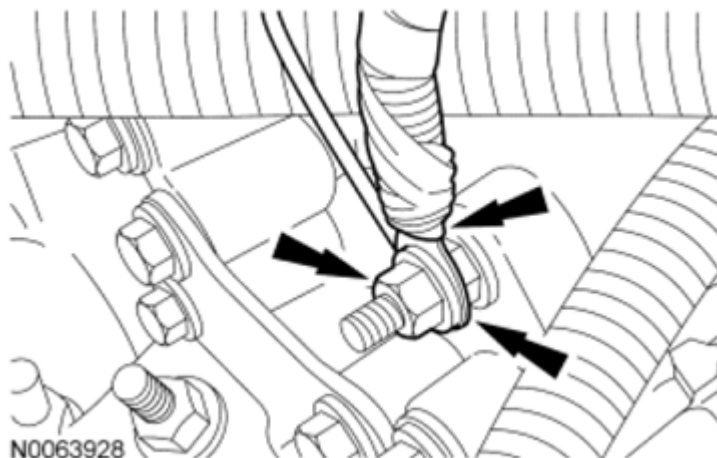
**Fig. 86: Locating Purge Valve Electrical Connector**  
Courtesy of FORD MOTOR CO.

23. Install the radio interference capacitor, the ground wire and the nut to the cowl stud.
- Tighten to 10 Nm (89 lb-in).



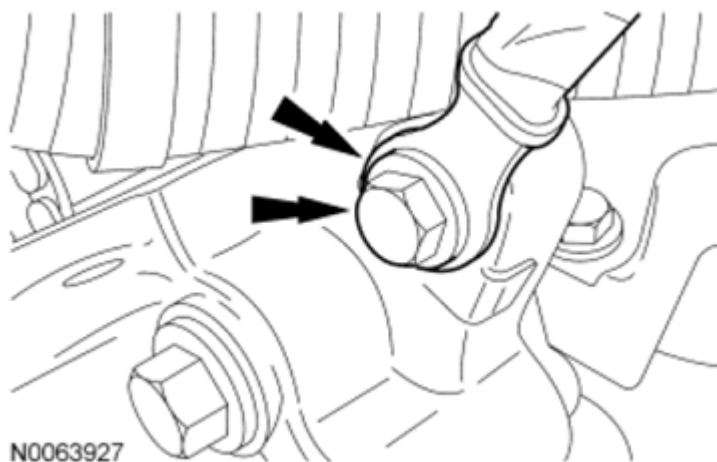
**Fig. 87: Locating Ground Wire Nut**  
Courtesy of FORD MOTOR CO.

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



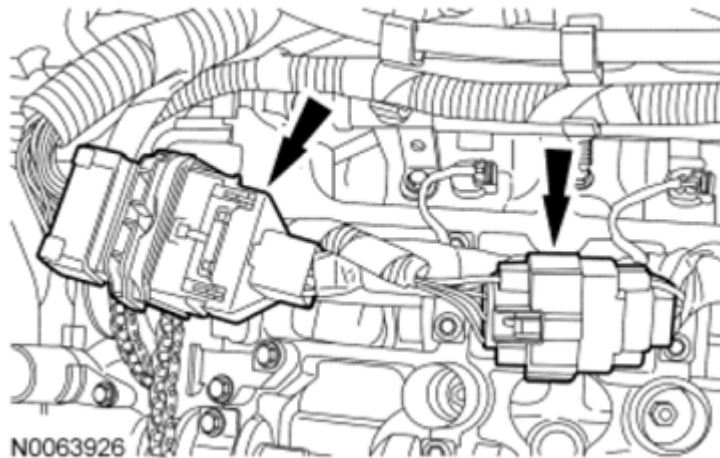
**Fig. 88: Locating Ground Wire Nut**  
Courtesy of FORD MOTOR CO.

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



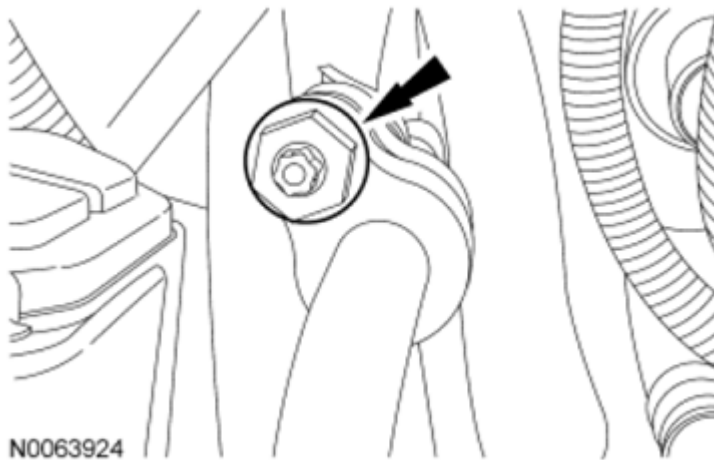
**Fig. 89: Locating Ground Wire Bolt**  
Courtesy of FORD MOTOR CO.

26. Connect the 2 engine wiring harness connectors.



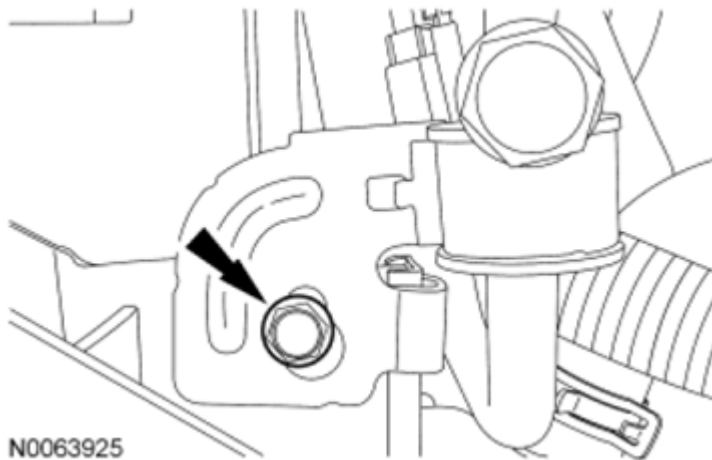
**Fig. 90: Locating Engine Wiring Harness Connectors**  
Courtesy of FORD MOTOR CO.

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



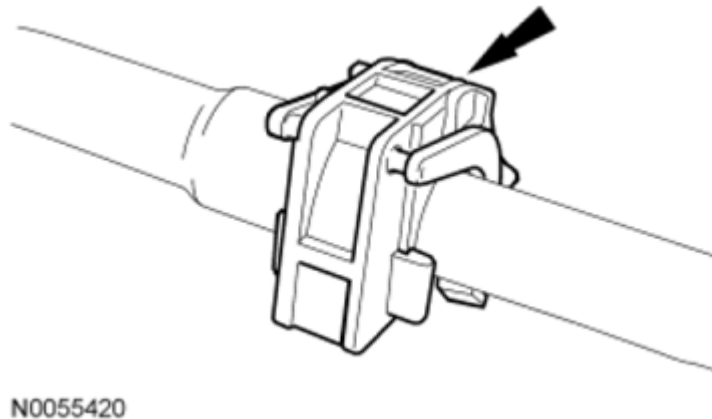
**Fig. 91: Locating A/C Pressure Tube Fitting Nut**  
Courtesy of FORD MOTOR CO.

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



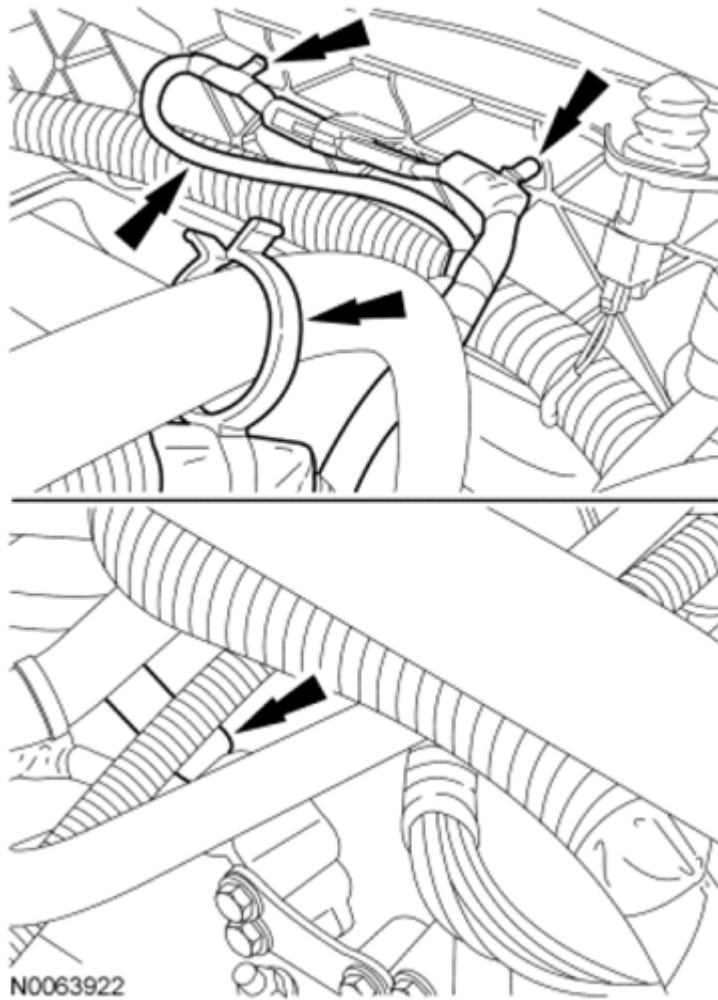
**Fig. 92: Locating A/C Pressure Tube Bracket Bolt**  
Courtesy of FORD MOTOR CO.

29. Connect the A/C suction tube fitting.
  - Install the safety clip onto the fitting.



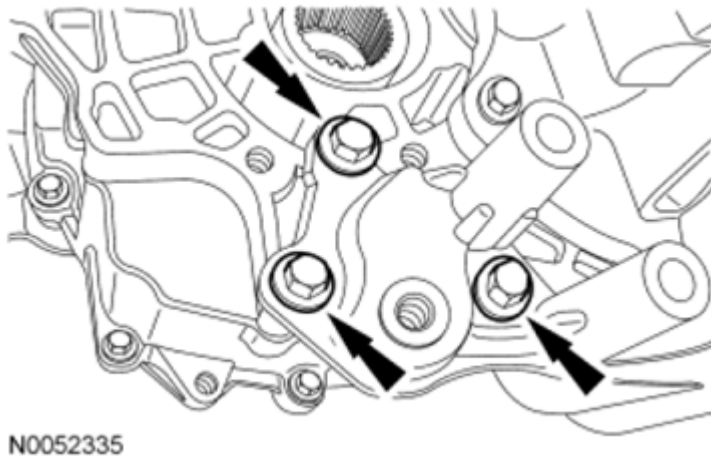
**Fig. 93: Locating A/C Suction Tube Safety Clip**  
Courtesy of FORD MOTOR CO.

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



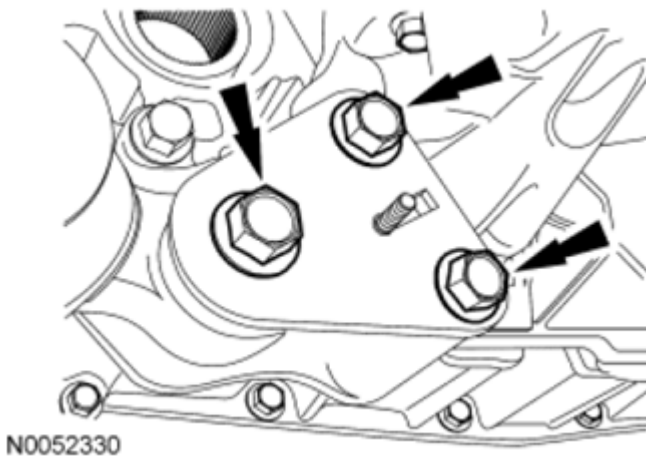
**Fig. 94: Locating Engine Block Heater Harness And A/C Suction Tube**  
Courtesy of FORD MOTOR CO.

33. Install the RH front halfshaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS** .
34. Install and the transaxle bracket and the 3 bolts.
  - Tighten to 90 Nm (66 lb-ft).



**Fig. 95: Locating Transaxle Bracket Bolts**  
Courtesy of FORD MOTOR CO.

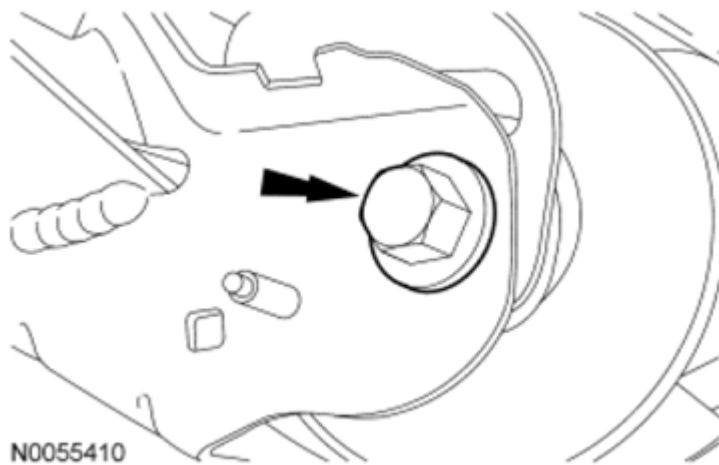
35. Install the engine roll restrictor, transaxle bracket and the 3 bolts.
- Tighten to 90 Nm (66 lb-ft).



**Fig. 96: Locating Transaxle Bracket Bolts**  
Courtesy of FORD MOTOR CO.

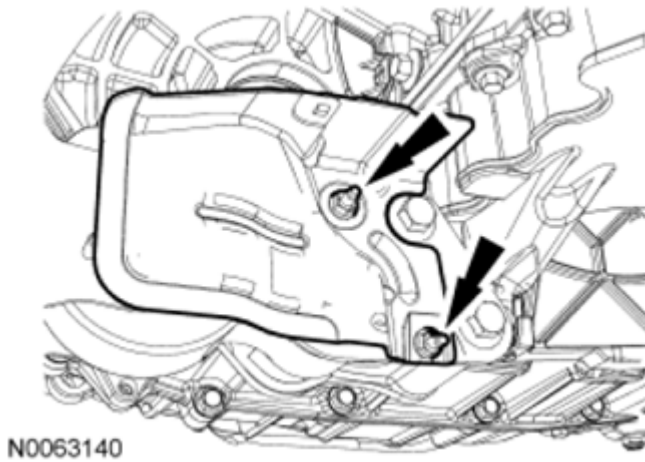
36. Tighten the engine roll restrictor-to-subframe through bolt to 103 Nm (76 lb-ft).





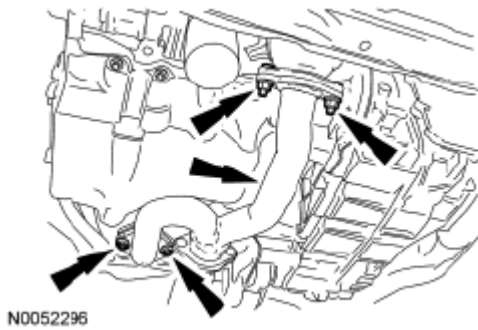
**Fig. 97: Locating Engine Roll Restrictor-To-Subframe Through Bolt**  
Courtesy of FORD MOTOR CO.

37. Install the roll restrictor heat shield and the 2 nuts.
  - Tighten to 11 Nm (97 lb-in).



**Fig. 98: Locating Roll Restrictor Heat Shield Nuts**  
Courtesy of FORD MOTOR CO.

38. Position the Y-pipe assembly in place and install the 4 nuts.
  - Tighten to 40 Nm (30 lb-ft).



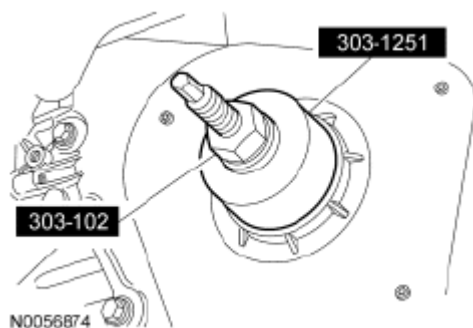
**Fig. 99: Locating Exhaust Flexible Pipe Nuts**  
Courtesy of FORD MOTOR CO.

39. Install the 2 exhaust hangers and tighten the exhaust clamp.
- Tighten to 40 Nm (30 lb-ft).



**Fig. 100: Locating Exhaust Flexible Pipe Clamp**  
Courtesy of FORD MOTOR CO.

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

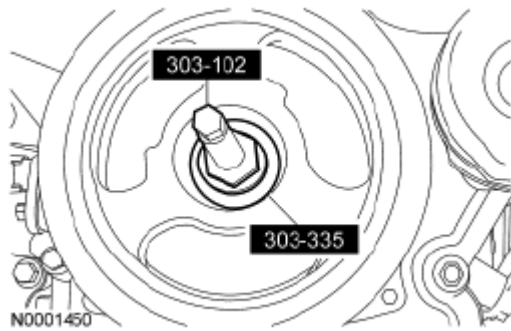


**Fig. 101: Identifying Crankshaft Vibration Damper Installer And Front Crankshaft Installer**

Courtesy of FORD MOTOR CO.

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

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



**Fig. 102: Identifying Crankshaft Vibration Damper Installer And Front Cover Oil Seal Installer**  
Courtesy of FORD MOTOR CO.

41. Using the Crankshaft Vibration Damper Replacer and Front Cover Oil Seal Installer, install the crankshaft pulley.
42. 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. 103: Locating Crankshaft Pulley Washer And Bolt**  
Courtesy of FORD MOTOR CO.

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

**NOTE:** Do not expose the Motorcraft® High Performance Engine RTV Silicone to

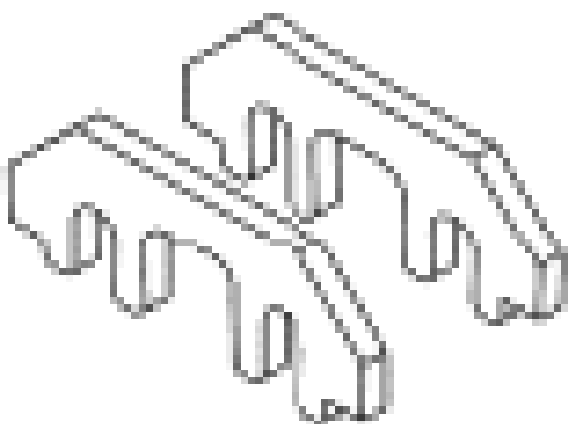
engine oil for at least 90 minutes after installing the engine front cover.  
Failure to follow this instruction may cause oil leakage.

44. Fill the engine with clean engine oil.
45. Connect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING AND CABLES**.
46. Evacuate and recharge the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS**.

## TIMING DRIVE COMPONENTS

### Special Tool(s)

### SPECIAL TOOL SPECIFICATION

 <b>ST2879-A</b>	Tool, Camshaft Holding 303-1248
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### Removal

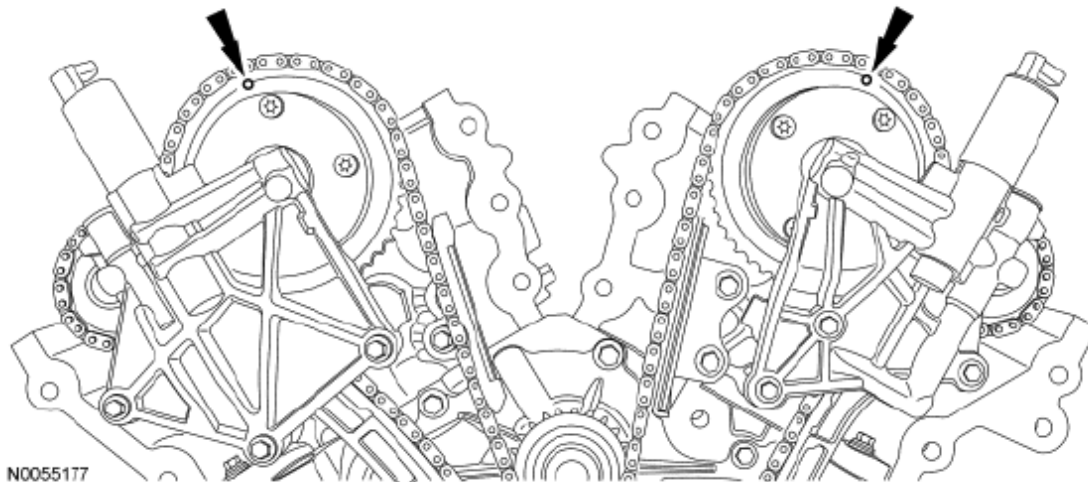
- NOTE:** During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.
- NOTE:** On early build engines, the timing chain rides on the inner side of the RH timing chain guide. Late build engines are equipped with a different design RH timing chain guide that requires the timing chain to ride on the outer side of the RH timing chain guide. For service, all replacement RH timing chain guides will be the late build design.

**All vehicles**

1. Remove the engine front cover. For additional information, refer to **ENGINE FRONT COVER**.

**Engines equipped with early build RH timing chain guides**

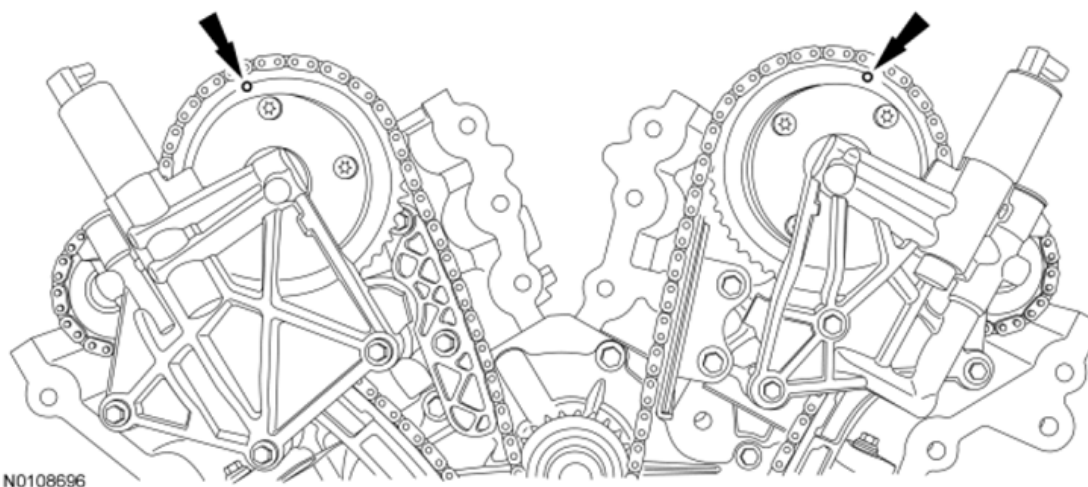
2. Rotate the crankshaft clockwise and align the timing marks on the Variable Camshaft Timing (VCT) assemblies as shown in illustration.



**Fig. 104: Identifying Timing Marks Location**  
Courtesy of FORD MOTOR CO.

**Engines equipped with late build/replacement RH timing chain guides**

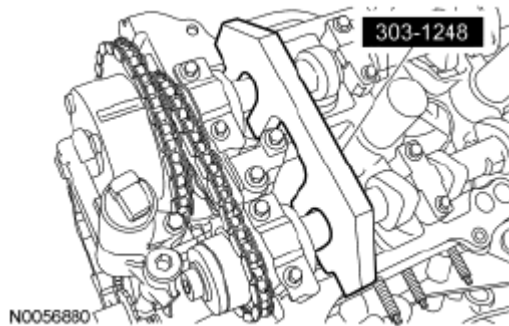
3. Rotate the crankshaft clockwise and align the timing marks on the VCT assemblies as shown in illustration.



**Fig. 105: Identifying Timing Marks Location**  
Courtesy of FORD MOTOR CO.

**All vehicles**

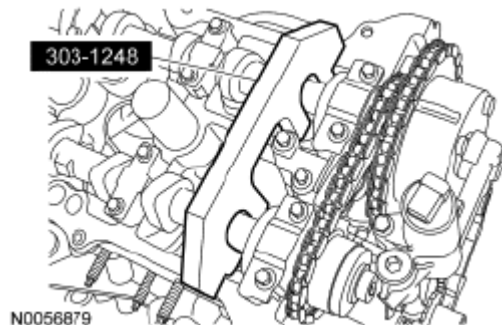
**NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.



**Fig. 106: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

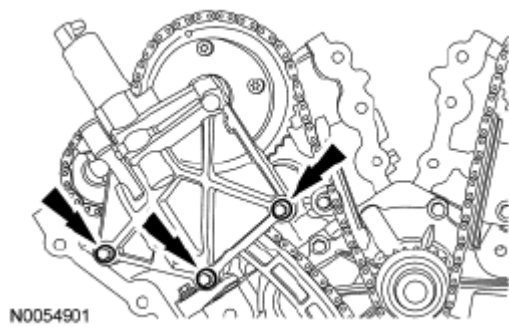
4. Install the Camshaft Holding Tool onto the flats of the LH camshafts.

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



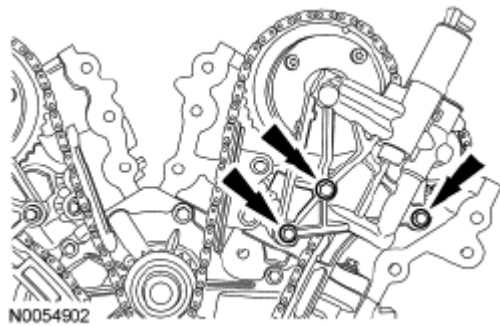
**Fig. 107: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

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



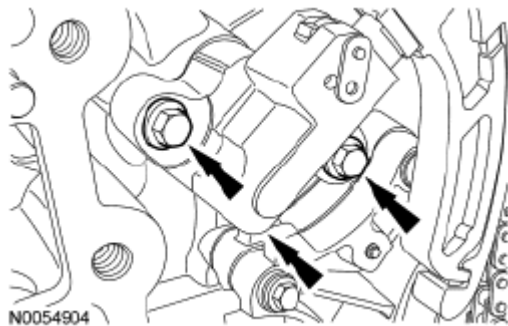
**Fig. 108: Locating RH VCT Housing Bolts**  
Courtesy of FORD MOTOR CO.

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



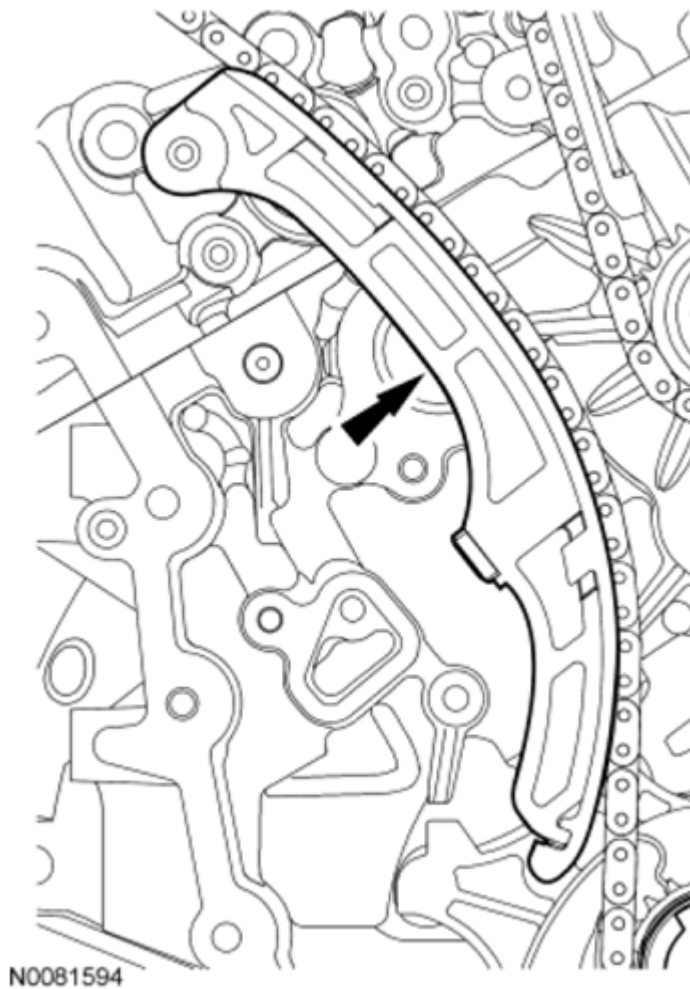
**Fig. 109: Locating LH VCT Housing Bolts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 110: Locating Primary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

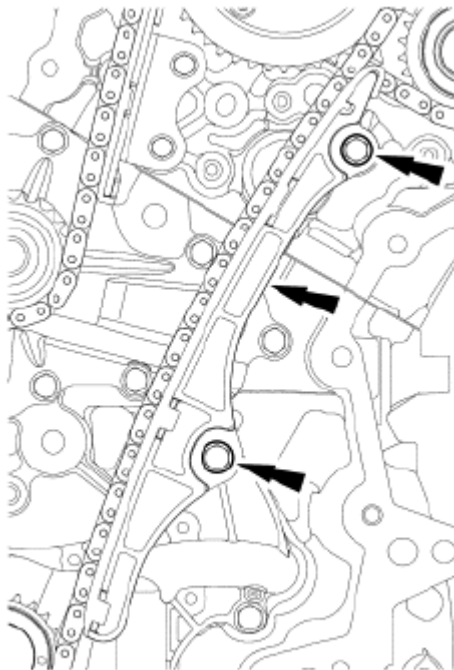
9. Remove the primary timing chain tensioner arm.



**Fig. 111: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

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

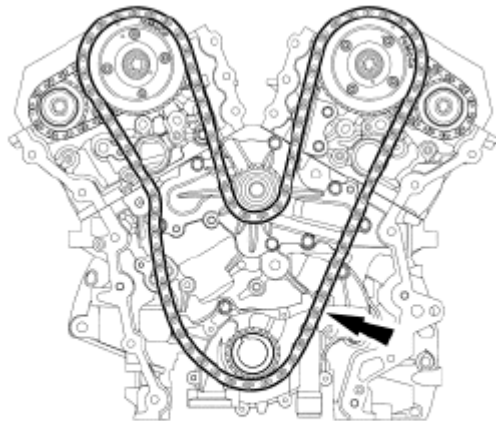




N0054906

**Fig. 112: Locating Lower LH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

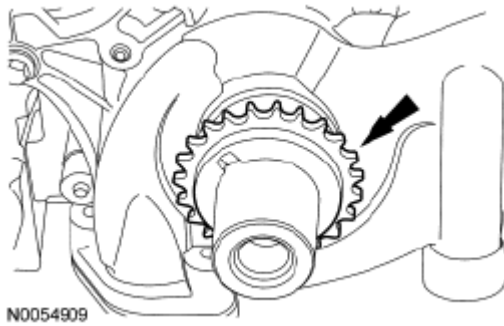
11. Remove the primary timing chain.



N0054908

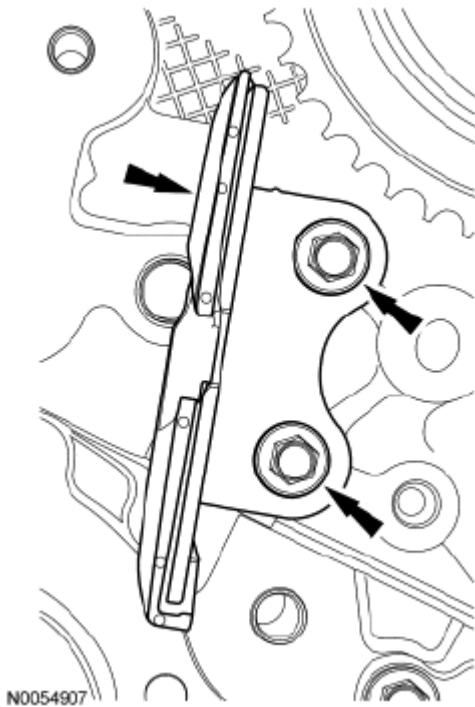
**Fig. 113: Locating Primary Timing Chain**  
Courtesy of FORD MOTOR CO.

12. Remove the crankshaft timing chain sprocket.



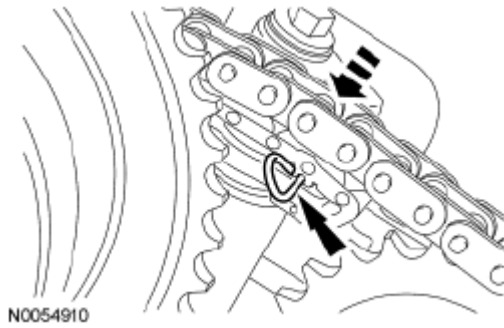
**Fig. 114: Locating Crankshaft Timing Chain Sprocket**  
Courtesy of FORD MOTOR CO.

13. Remove the 2 bolts and the upper LH primary timing chain guide.



**Fig. 115: Locating Upper LH Primary Timing Chain Guide With Bolts**  
Courtesy of FORD MOTOR CO.

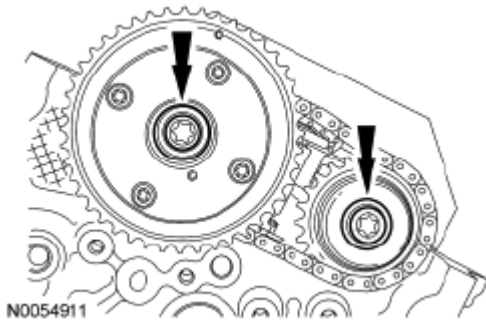
14. Compress the LH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



**Fig. 116: Compressing LH Secondary Timing Chain Tensioner**  
Courtesy of FORD MOTOR CO.

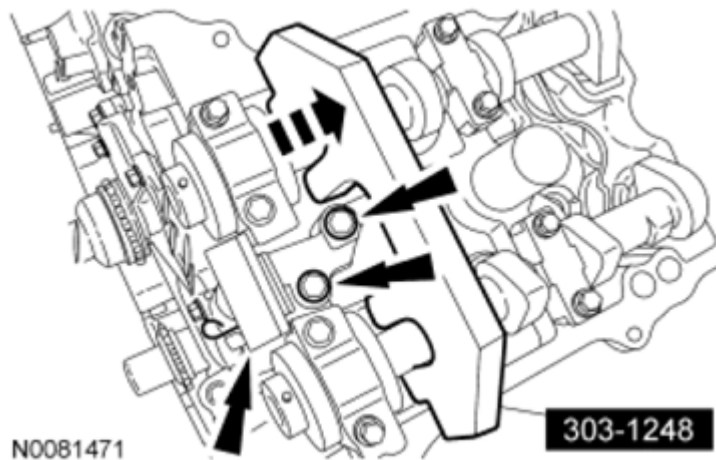
**NOTE:** The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

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



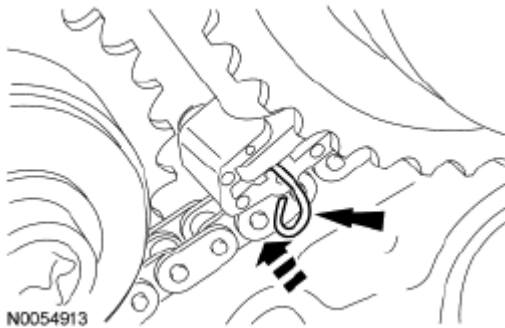
**Fig. 117: Locating Secondary Timing Chain And LH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

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



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

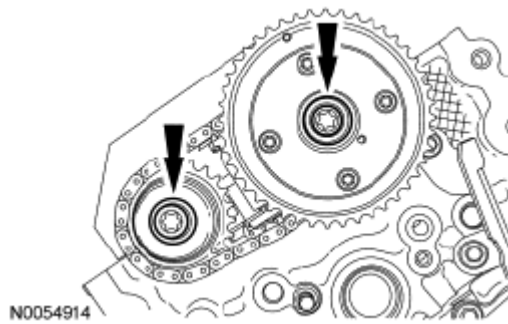
16. Remove the 2 bolts and the LH secondary timing chain tensioner.
17. Compress the RH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



**Fig. 119: Compressing RH Secondary Timing Chain Tensioner**  
Courtesy of FORD MOTOR CO.

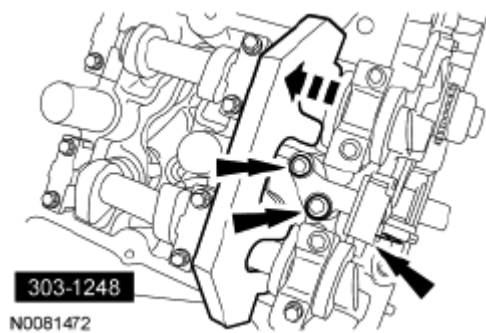
**NOTE:** The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

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



**Fig. 120: Locating Secondary Timing Chain And RH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

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

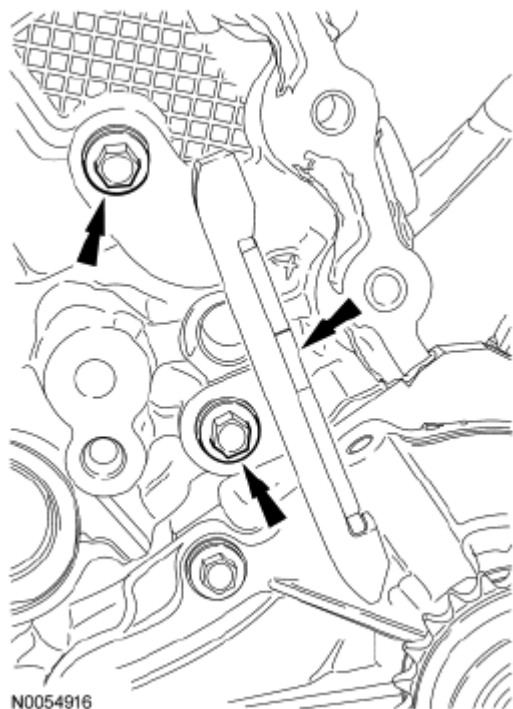


**Fig. 121: Locating RH Secondary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

19. Remove the 2 bolts and the RH secondary timing chain tensioner.

**Engines equipped with early build RH timing chain guides**

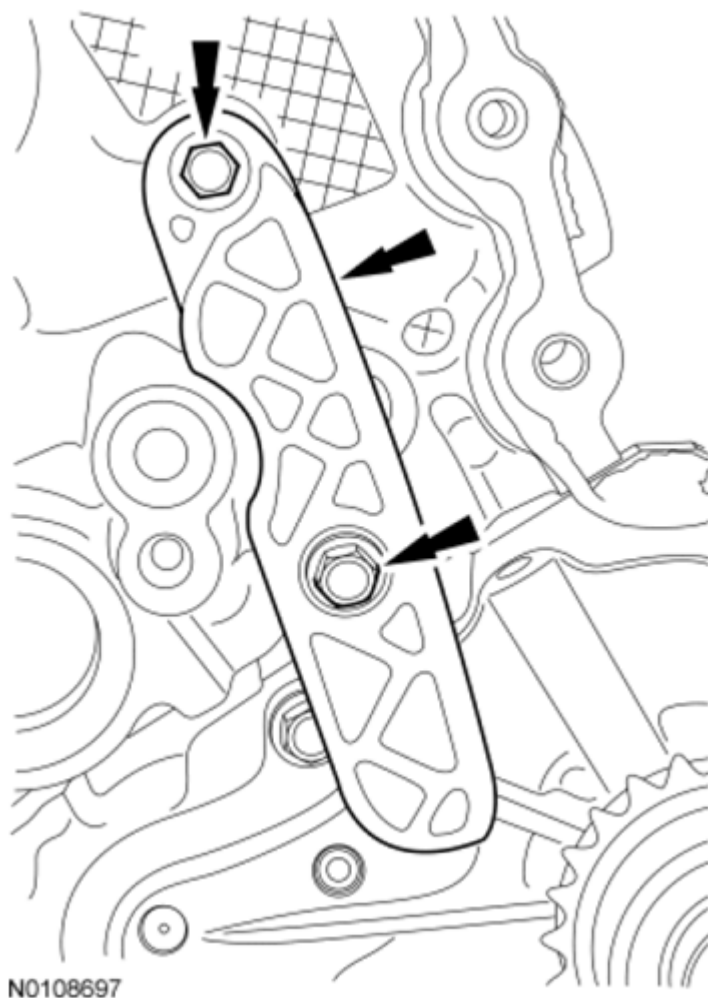
20. Remove the 2 bolts and the RH primary timing chain guide.



**Fig. 122: Locating RH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

**Engines equipped with late build/replacement RH timing chain guides**

21. Remove the 2 bolts and the RH primary timing chain guide.

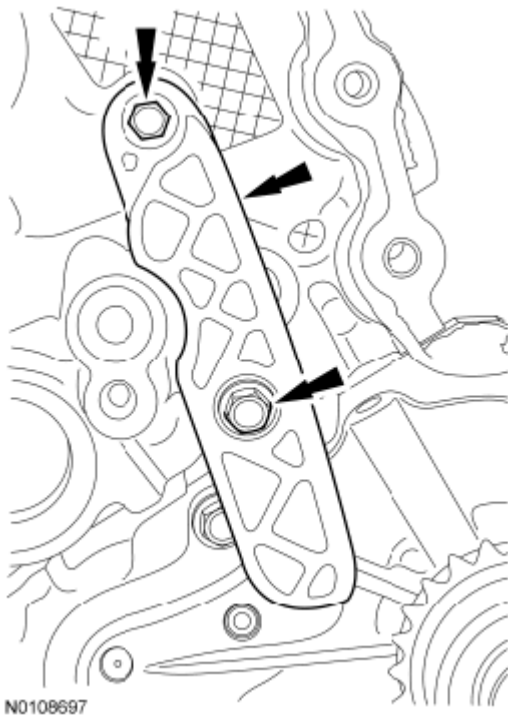


**Fig. 123: Locating RH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

### Installation

#### Engines equipped with late build/replacement RH timing chain guides

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

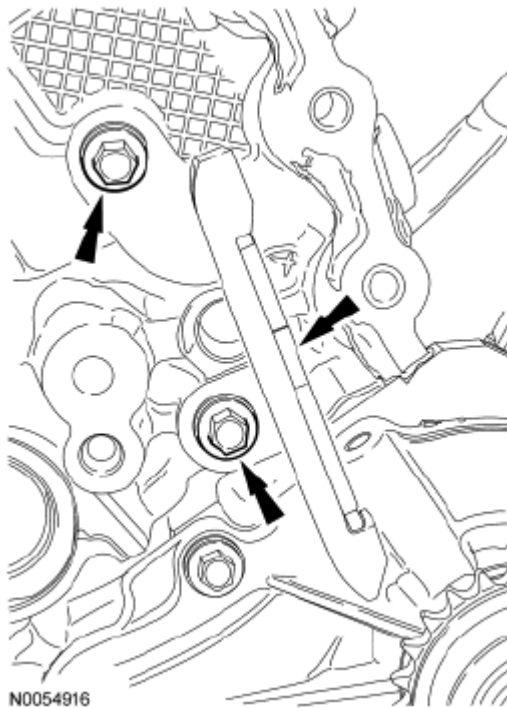


**Fig. 124: Locating RH Primary Timing Chain Guide And Bolts**  
Courtesy of FORD MOTOR CO.

**Engines equipped with early build RH timing chain guides**

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



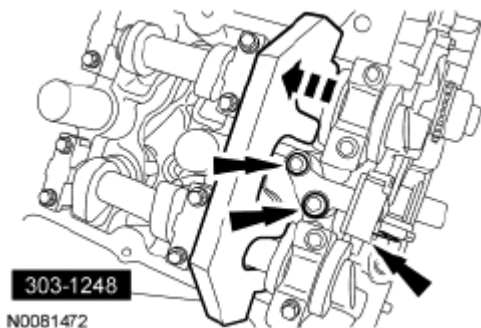


**Fig. 125: Locating RH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

**All vehicles**

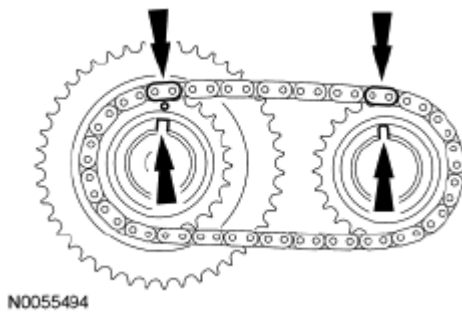
**NOTE:** It is necessary to tilt the Camshaft Holding Tool toward the rear of the engine to access the rearmost secondary timing chain tensioner bolt.

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



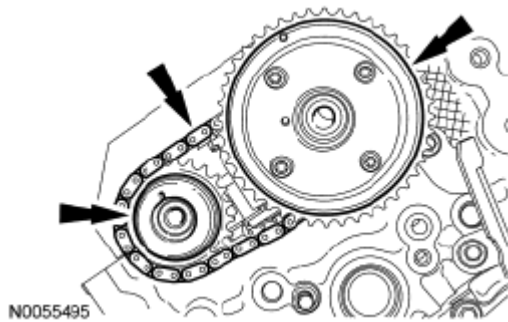
**Fig. 126: Locating RH Secondary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

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



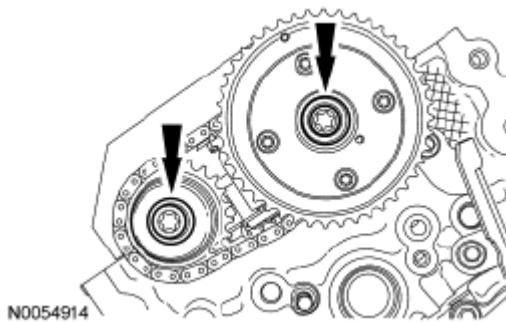
**Fig. 127: Aligning Colored Links With Timing Marks**  
Courtesy of FORD MOTOR CO.

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



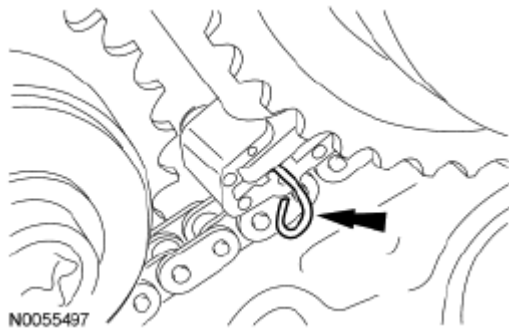
**Fig. 128: Positioning RH Secondary Timing Assembly Onto Camshafts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 129: Locating Secondary Timing Chain And RH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

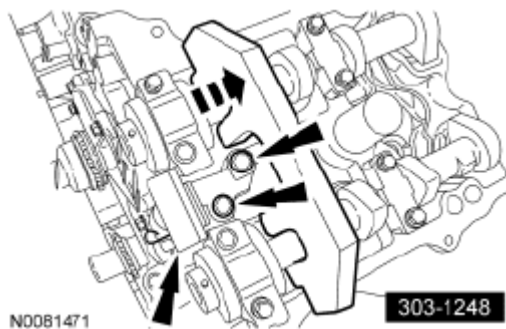
7. Remove the lockpin from the RH secondary timing chain tensioner.



**Fig. 130: Locating Lockpin**  
Courtesy of FORD MOTOR CO.

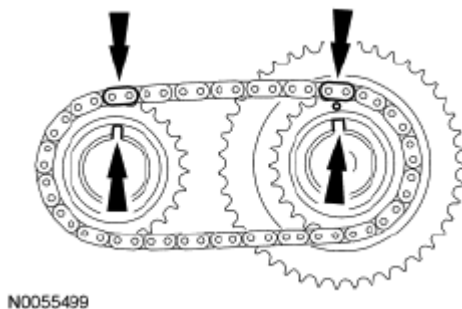
**NOTE:** It is necessary to tilt the Camshaft Holding Tool toward the rear of the engine to access the rearmost secondary timing chain tensioner bolt.

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



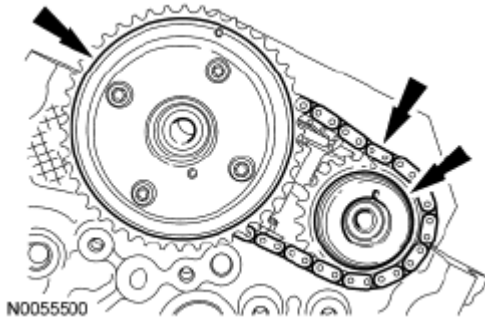
**Fig. 131: Locating LH Secondary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

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



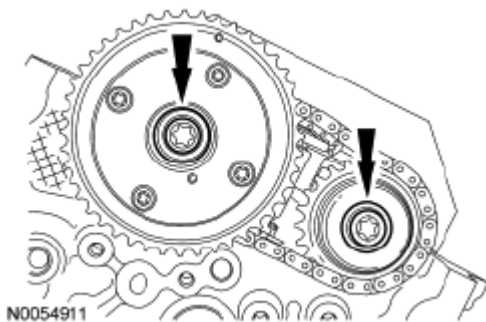
**Fig. 132: Aligning Colored Links With Timing Marks**  
Courtesy of FORD MOTOR CO.

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



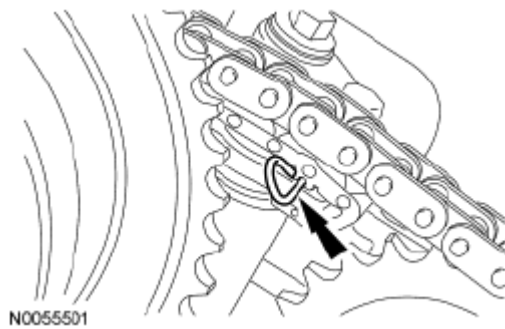
**Fig. 133: Locating LH Secondary Timing Assembly**  
Courtesy of FORD MOTOR CO.

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



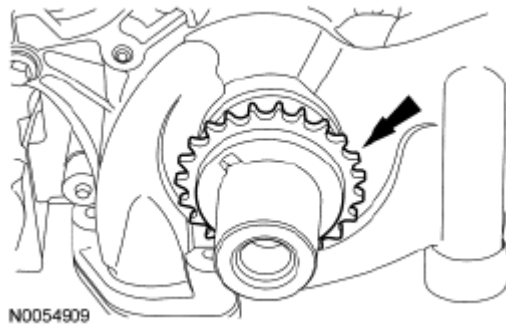
**Fig. 134: Locating Secondary Timing Chain And LH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

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



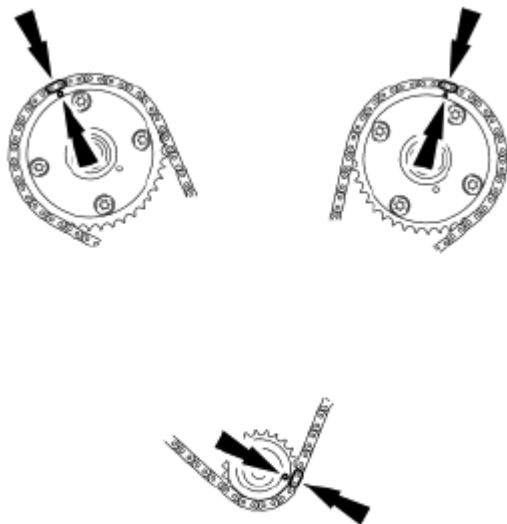
**Fig. 135: Locating Lockpin**  
Courtesy of FORD MOTOR CO.

13. Install the crankshaft timing chain sprocket.



**Fig. 136: Locating Crankshaft Timing Chain Sprocket**  
Courtesy of FORD MOTOR CO.

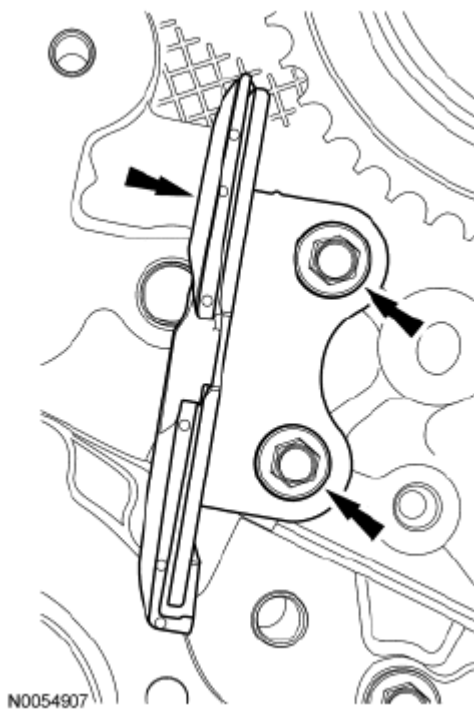
14. Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.



N0055503

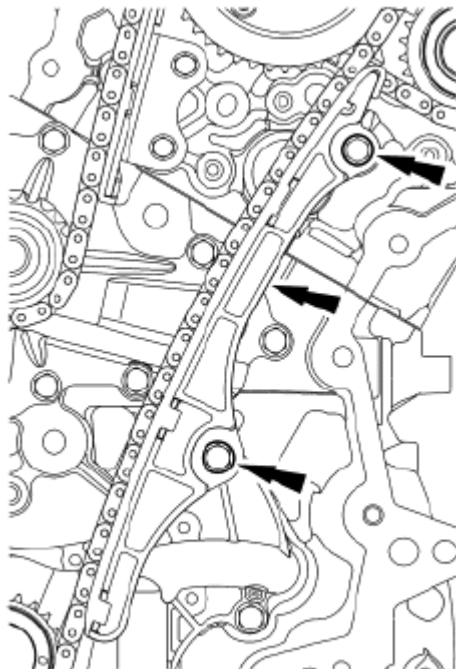
**Fig. 137: Aligning Timing Marks On VCT Assemblies And Crankshaft Sprocket**  
Courtesy of FORD MOTOR CO.

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



**Fig. 138: Locating Upper LH Primary Timing Chain Guide With Bolts**  
Courtesy of FORD MOTOR CO.

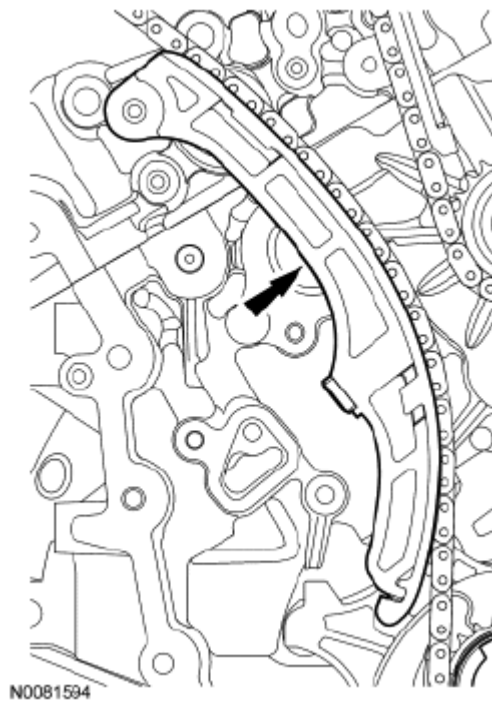
16. Install the lower LH primary timing chain guide and the 2 bolts.
  - Tighten to 10 Nm (89 lb-in).



N0081593

**Fig. 139: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

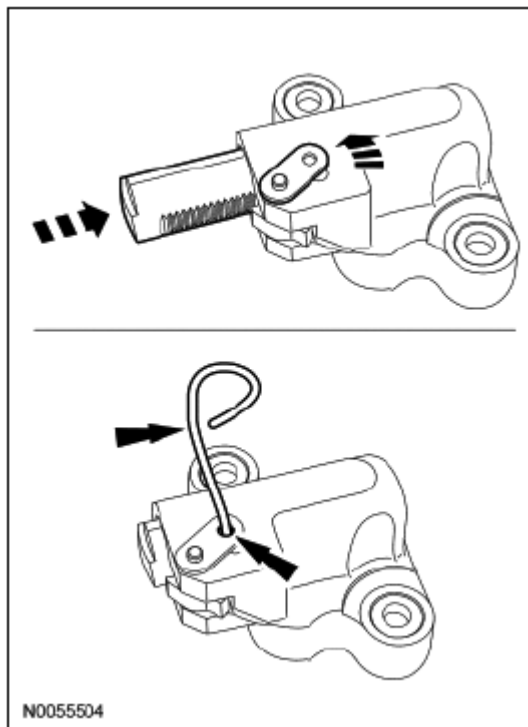
17. Install the primary timing chain tensioner arm.



**Fig. 140: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

18. Reset the primary timing chain tensioner.
  - Rotate the lever counterclockwise.
  - Using a soft-jawed vise, compress the plunger.
  - Align the hole in the lever with the hole in the tensioner housing.
  - Install a suitable lockpin.

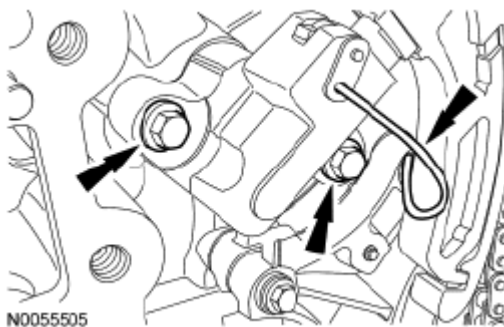




**Fig. 141: Aligning Hole In Lever With Hole In Tensioner Housing**  
Courtesy of FORD MOTOR CO.

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

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



**Fig. 142: Locating Primary Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

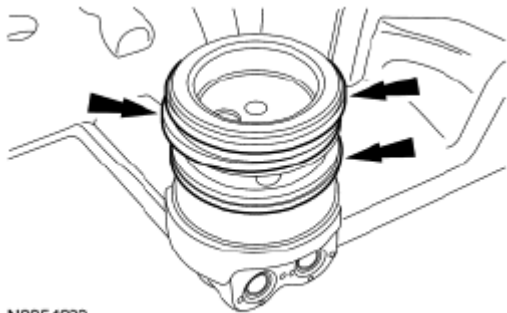
20. As a post-check, verify correct alignment of all timing marks.



N0055496

**Fig. 143: Identifying Timing Marks Location**  
Courtesy of FORD MOTOR CO.

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

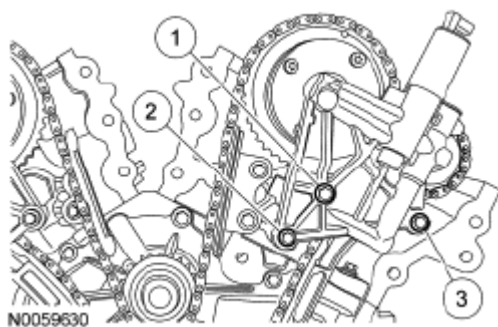


N0054903

**Fig. 144: Locating VCT Housing Seals**  
Courtesy of FORD MOTOR CO.

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

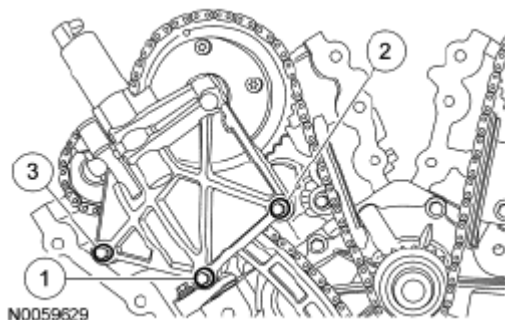
22. Install the LH VCT housing and the 3 bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 145: Identifying LH VCT Housing Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

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

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



**Fig. 146: Identifying RH VCT Housing Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

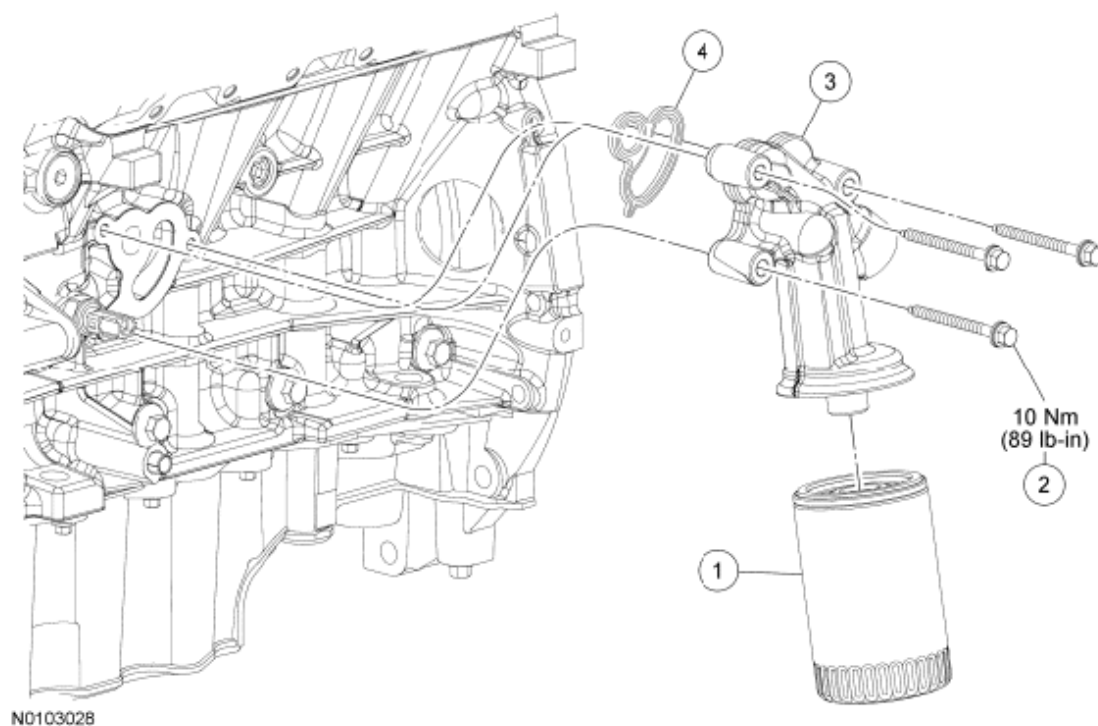
24. Install the engine front cover. For additional information, refer to **ENGINE FRONT COVER**.

## OIL FILTER ADAPTER

### Material

### MATERIAL SPECIFICATION

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



**Fig. 147: Identifying Oil Filter Adapter Components With Torque Specifications**  
 Courtesy of FORD MOTOR CO.

#### 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 and Installation

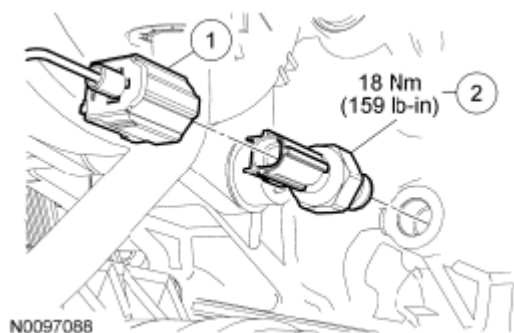
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING**.

**NOTE:** Lubricate the engine oil filter gasket with clean engine oil prior to installing the oil filter.

2. Remove and discard the engine oil filter.
  - To install, tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.
3. Remove the 3 bolts and the oil filter adapter.
  - Discard the gasket.
  - Clean and inspect all sealing surfaces.
  - To install, tighten to 10 Nm (89 lb-in).

**ENGINE OIL PRESSURE (EOP) SWITCH****Material****MATERIAL SPECIFICATION**

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



**Fig. 148: Identifying Engine Oil Pressure Switch With Torque Specifications**  
 Courtesy of FORD MOTOR CO.

**DESCRIPTION CHART**

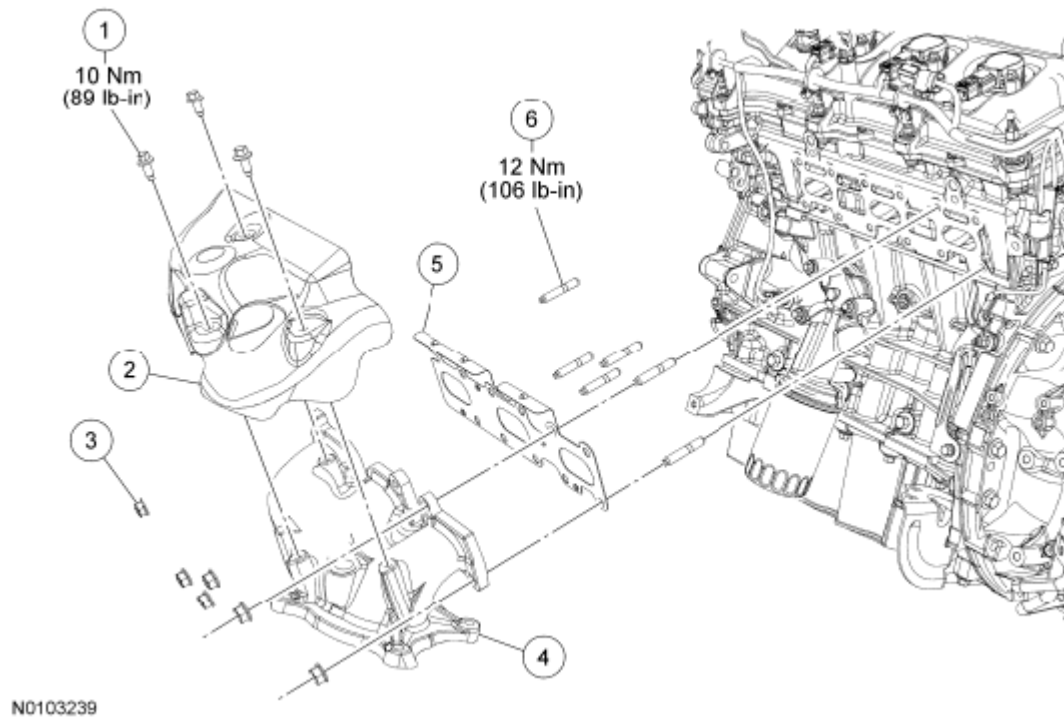
Item	Part Number	Description
1	14A464	Engine Oil Pressure (EOP) switch electrical connector (part of 12C508)
2	9278	<b>EOP switch</b>

**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 18 Nm (159 lb-in).
4. To install, reverse the removal procedure.
  - Apply thread sealant with PTFE to the **EOP** switch threads prior to installation.

**EXHAUST MANIFOLD - LH****Material****MATERIAL SPECIFICATION**

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



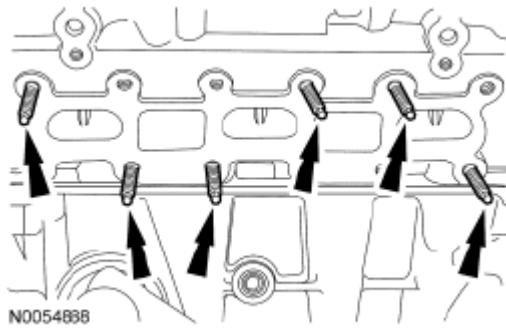
**Fig. 149: Identifying Exhaust Manifold LH Components With Torque Specifications**  
 Courtesy of FORD MOTOR CO.

#### DESCRIPTION CHART

Item	Part Number	Description
1	W713299	LH exhaust manifold heat shield bolt (3 required)
2	9Y427	LH exhaust manifold heat shield
3	W701706	LH exhaust manifold nut (6 required)
4	9431	LH exhaust manifold
5	9448	LH exhaust manifold gasket
6	W701732	LH exhaust manifold stud (6 required)

#### Removal

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



**Fig. 150: Locating LH Exhaust Manifold Studs**  
Courtesy of FORD MOTOR CO.

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

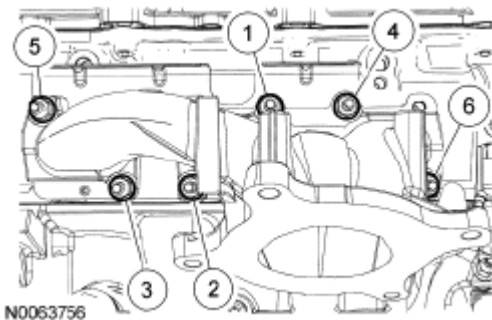
7. Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

#### Installation

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

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

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



**Fig. 151: Identifying LH Exhaust Manifold Nuts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

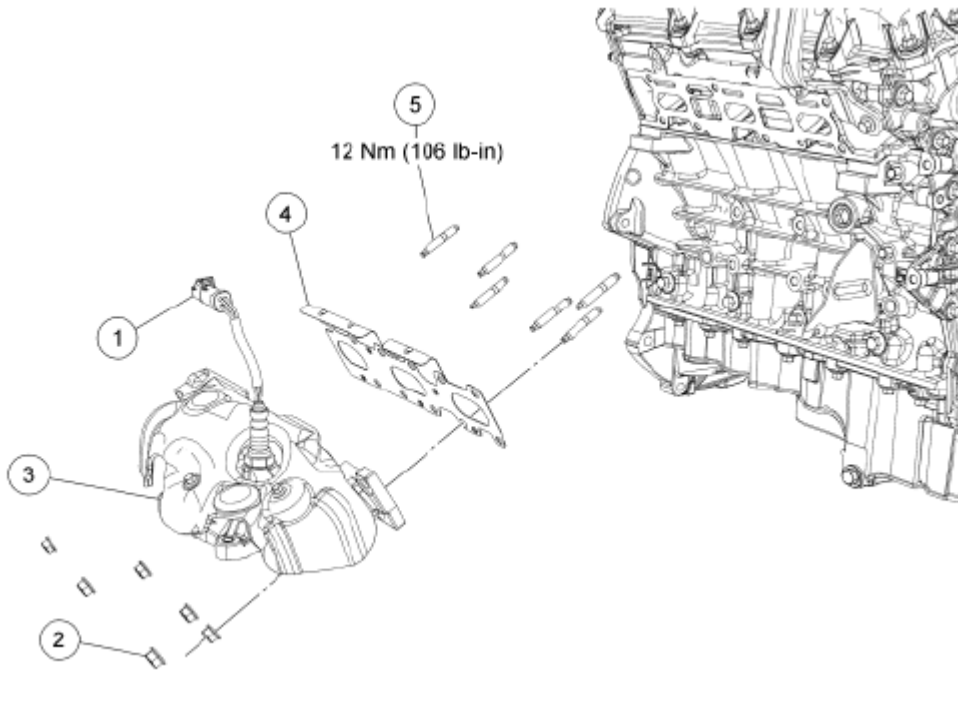
3. Install the LH exhaust manifold heat shield and the 3 bolts.
  - Tighten to 10 Nm (89 lb-in).
4. Install the LH **HO2S** . For additional information, refer to **ELECTRONIC ENGINE CONTROLS** .
5. Install the LH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** .

## EXHAUST MANIFOLD - RH

### Material

### MATERIAL SPECIFICATION

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



**Fig. 152: Identifying Exhaust Manifold RH Components With Torque Specifications**  
Courtesy of FORD MOTOR CO.

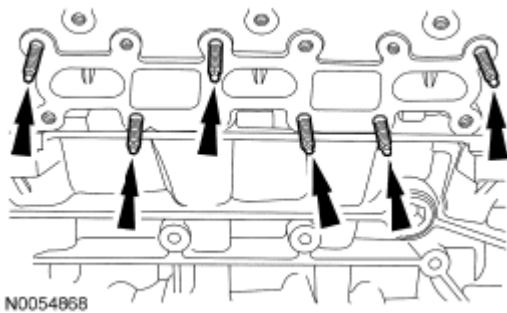
### DESCRIPTION CHART

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



## Removal

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



**Fig. 153: Locating RH Exhaust Manifold Studs**  
Courtesy of FORD MOTOR CO.

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

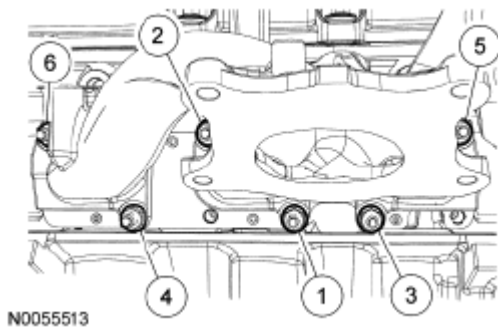
6. Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

## Installation

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

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

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



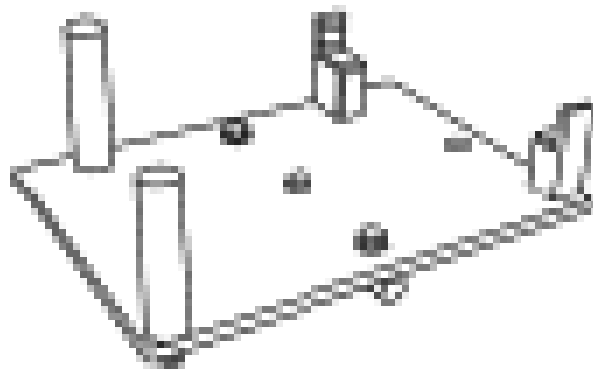
**Fig. 154: Identifying RH Exhaust Manifold Nuts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

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

## ENGINE MOUNT

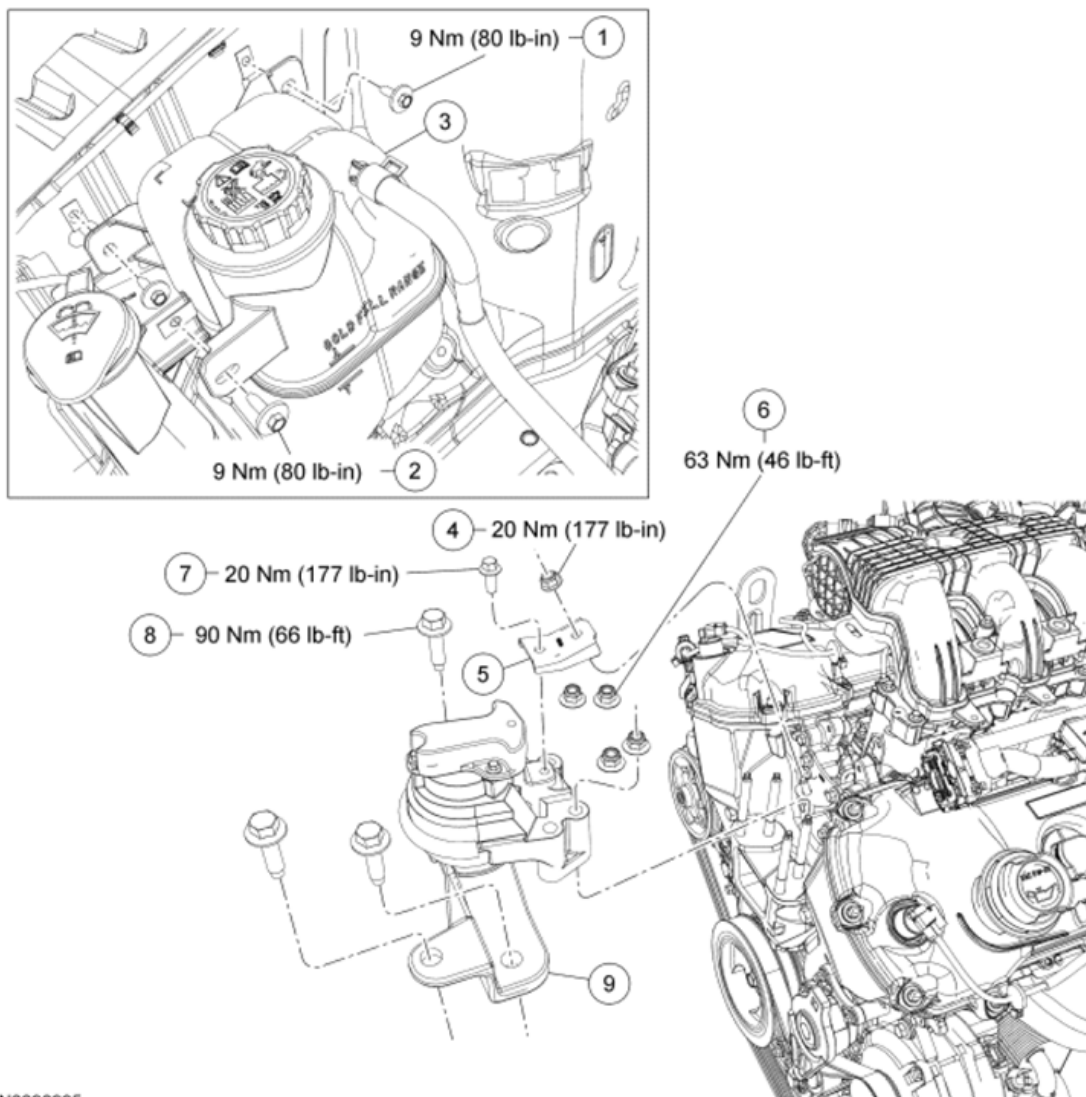
### Special Tool(s)

### SPECIAL TOOL SPECIFICATION



Oil Pan Holding Fixture  
303-1295

ST3034-A



N0090995

**Fig. 155: Identifying Engine Mount Components With Torque Specifications**  
Courtesy of FORD MOTOR CO.

#### 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

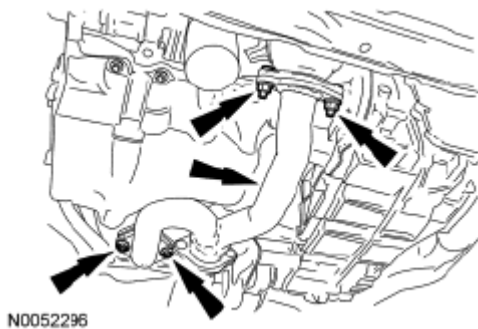
**Removal**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING**.
2. Loosen the exhaust flexible pipe clamp and disconnect the 2 exhaust hangers.



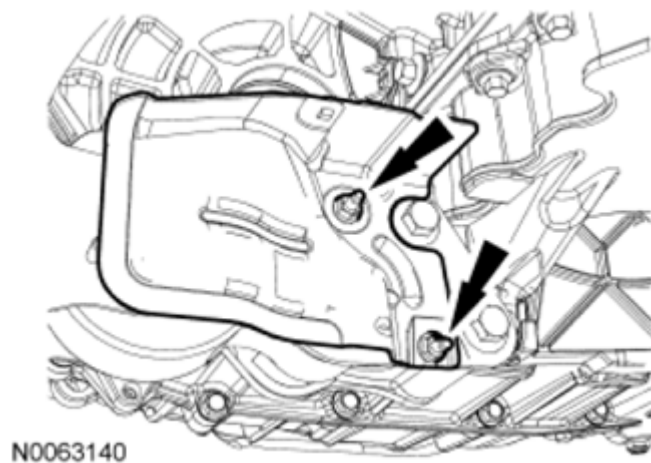
**Fig. 156: Locating Exhaust Flexible Pipe Clamp**  
Courtesy of FORD MOTOR CO.

3. Remove the 4 nuts, the exhaust flexible pipe and the Y-pipe as an assembly.
  - Discard the nuts and the gasket.



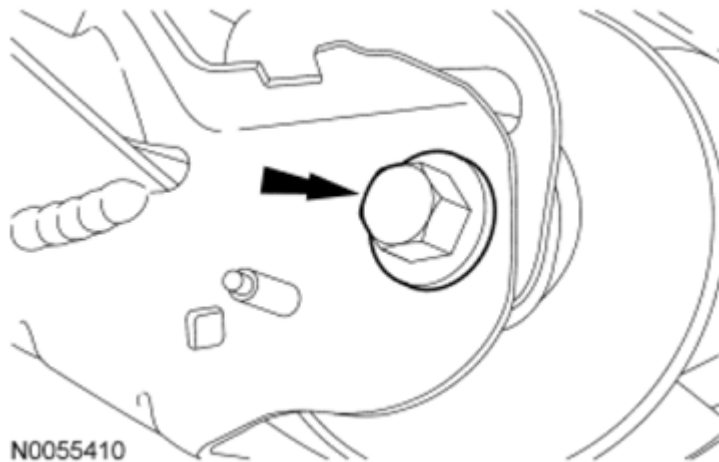
**Fig. 157: Locating Exhaust Flexible Pipe Nuts**  
Courtesy of FORD MOTOR CO.

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



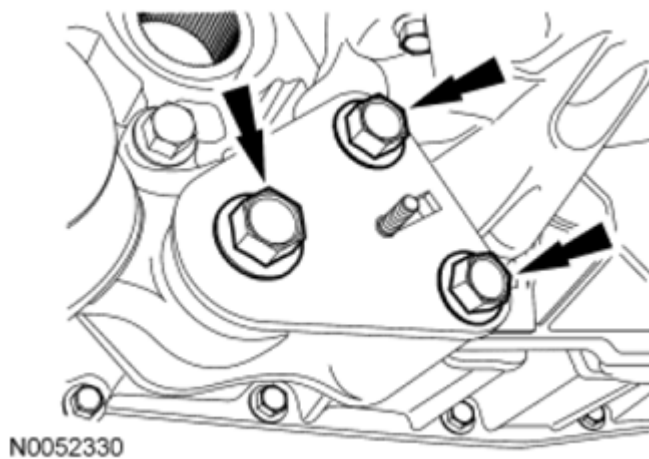
**Fig. 158: Locating Roll Restrictor Heat Shield Nuts**  
Courtesy of FORD MOTOR CO.

5. Loosen the roll restrictor-to-subframe through bolt.



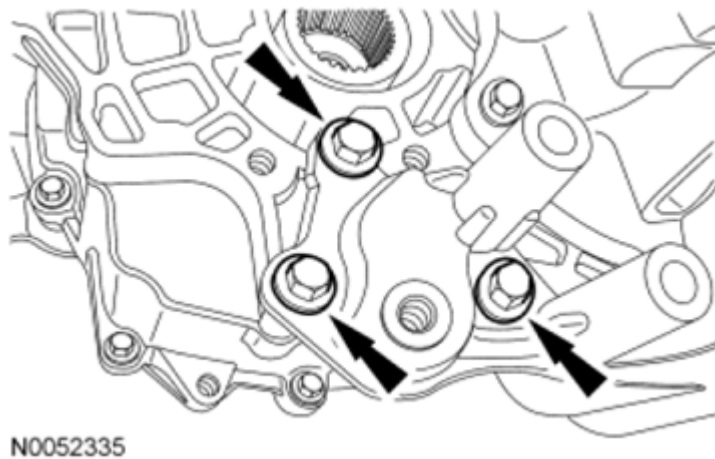
**Fig. 159: Locating Engine Roll Restrictor-To-Subframe Through Bolt**  
Courtesy of FORD MOTOR CO.

6. Remove the roll restrictor through bolt and the 2 roll restrictor-to-transaxle bracket plate bolts.



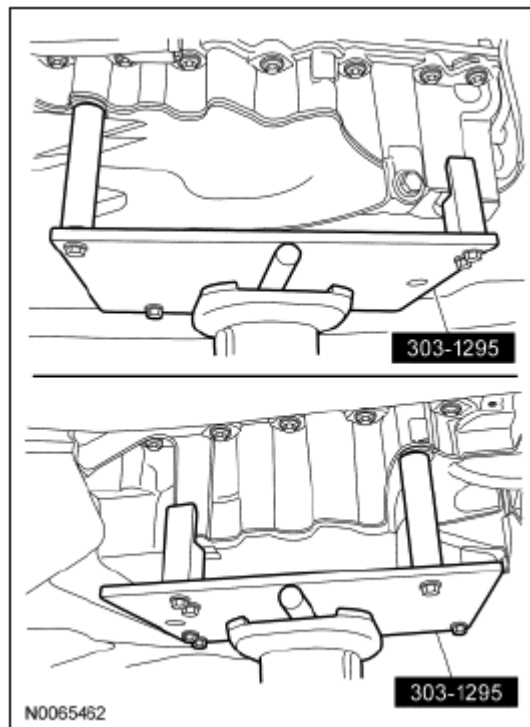
**Fig. 160: Locating Transaxle Bracket Bolts**  
Courtesy of FORD MOTOR CO.

7. Remove the 3 bolts and the transaxle bracket.



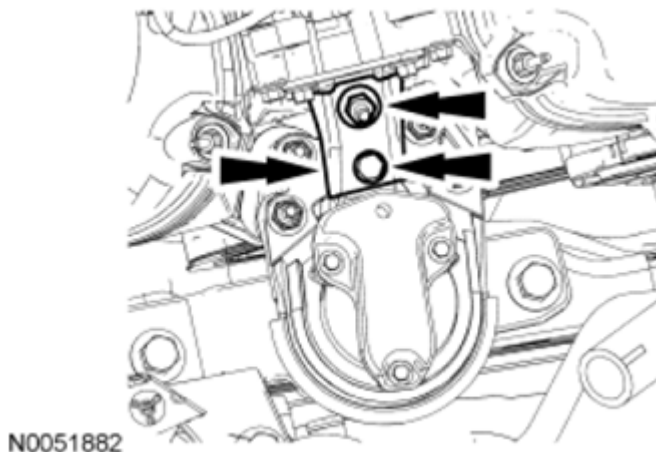
**Fig. 161: Identifying Transaxle Bracket Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** The Oil Pan Holding Fixture must be carefully aligned to the mounting bosses on the oil pan. Failure to follow these instructions may result in damage to the oil pan.



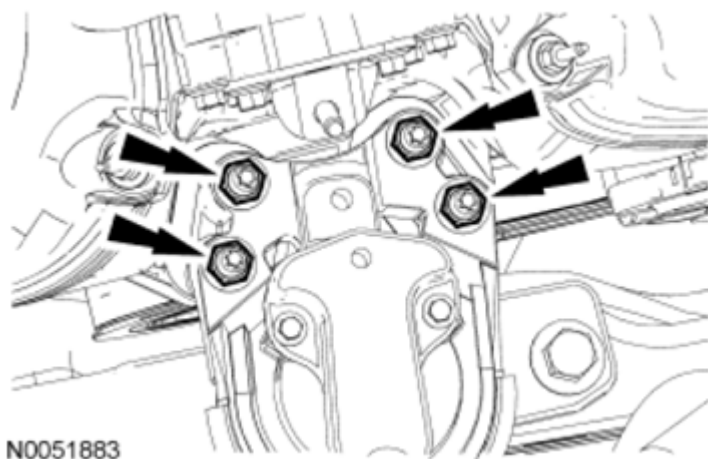
**Fig. 162: Positioning Floor Jack And Oil Pan Holding Fixture Under Oil Pan**  
Courtesy of FORD MOTOR CO.

8. Position a floor jack and the Oil Pan Holding Fixture under the oil pan.
9. Remove the 3 bolts and position the engine coolant degas bottle aside.
10. Remove the nut, bolt and engine mount brace.



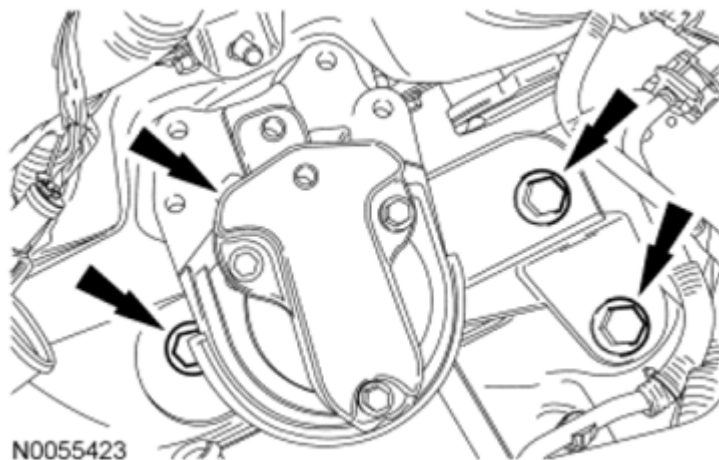
**Fig. 163: Locating Engine Mount Brace Nut And Bolt**  
Courtesy of FORD MOTOR CO.

11. Remove the 4 engine mount nuts.



**Fig. 164: Locating Engine Mount Nuts**  
Courtesy of FORD MOTOR CO.

12. Remove the 3 bolts and the engine mount.

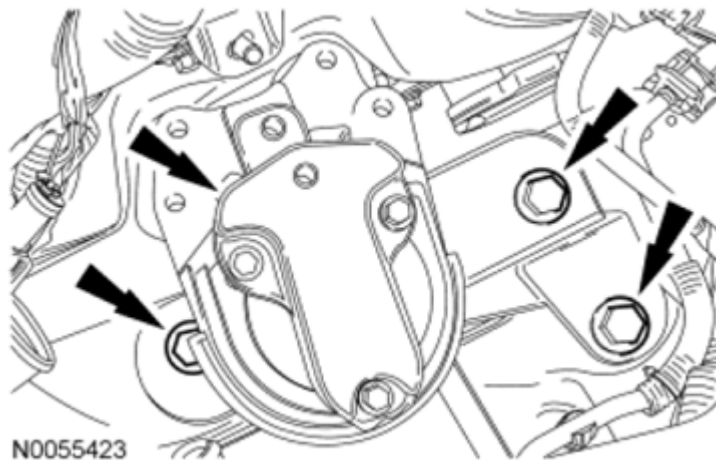


**Fig. 165: Locating Engine Mount Bolts**  
Courtesy of FORD MOTOR CO.

#### Installation

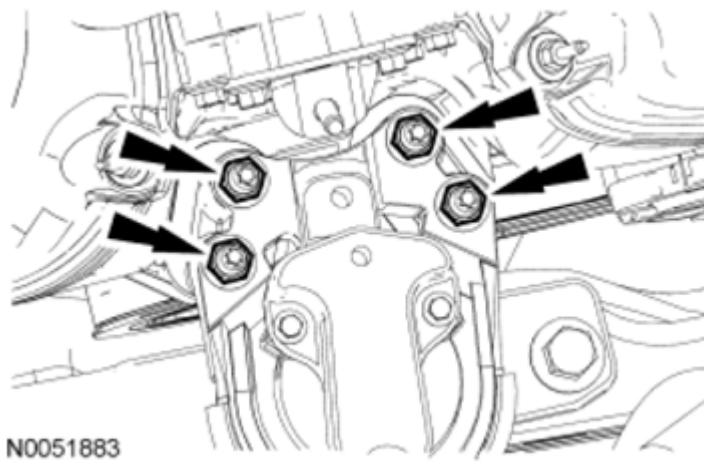
1. Install the engine mount and the 3 bolts.
  - Tighten to 90 Nm (66 lb-ft).





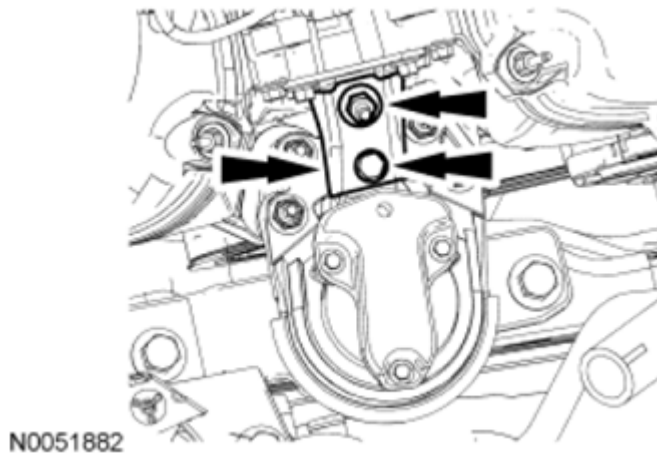
**Fig. 166: Locating Engine Mount Bolts**  
Courtesy of FORD MOTOR CO.

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



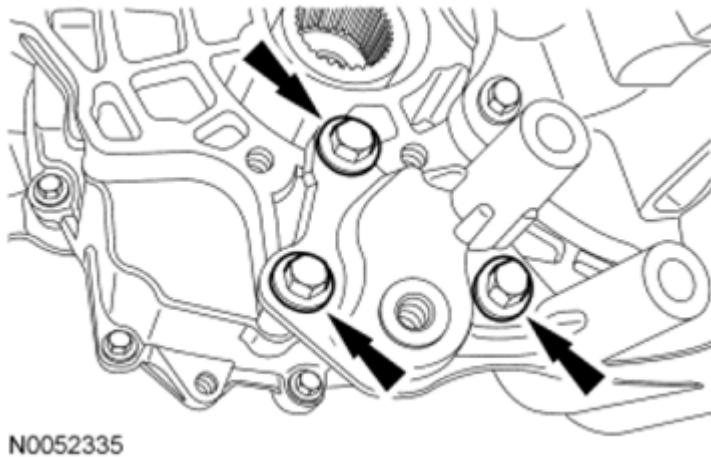
**Fig. 167: Locating Engine Mount Nuts**  
Courtesy of FORD MOTOR CO.

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



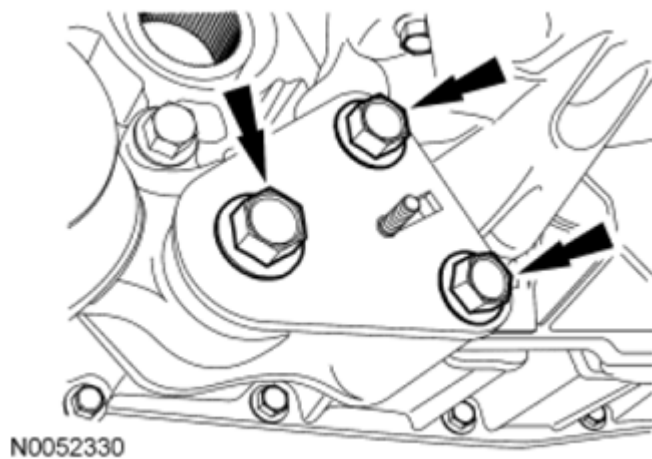
**Fig. 168: Locating Engine Mount Brace Nut And Bolt**  
Courtesy of FORD MOTOR CO.

4. Position the engine coolant degas bottle and install the 3 bolts.
  - Tighten to 9 Nm (80 lb-in).
5. Install the transaxle bracket and the 3 bolts.
  - Tighten to 90 Nm (66 lb-ft).



**Fig. 169: Identifying Transaxle Bracket Bolts**  
Courtesy of FORD MOTOR CO.

6. Install the engine roll restrictor, transaxle bracket and the 3 bolts.
  - Tighten to 90 Nm (66 lb-ft).



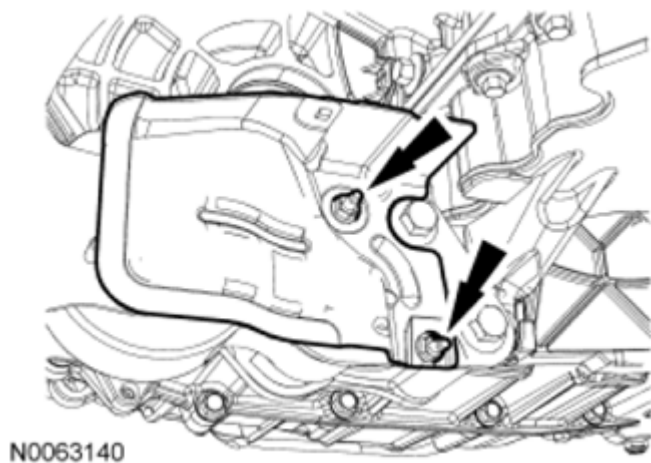
**Fig. 170: Locating Transaxle Bracket Bolts**  
Courtesy of FORD MOTOR CO.

7. Tighten the roll restrictor-to-subframe through bolt.
  - Tighten to 103 Nm (76 lb-ft).



**Fig. 171: Locating Engine Roll Restrictor-To-Subframe Through Bolt**  
Courtesy of FORD MOTOR CO.

8. Install the roll restrictor heat shield and the 2 nuts.
  - Tighten to 11 Nm (97 lb-in).



**Fig. 172: Locating Roll Restrictor Heat Shield Nuts**  
Courtesy of FORD MOTOR CO.

9. Install the new gasket and position the Y-pipe assembly in place and install the 4 new nuts.
  - Tighten to 40 Nm (30 lb-ft).



**Fig. 173: Locating Exhaust Flexible Pipe Nuts**  
Courtesy of FORD MOTOR CO.

10. Install the 2 exhaust hangers and tighten the exhaust clamp.
  - Tighten to 40 Nm (30 lb-ft).

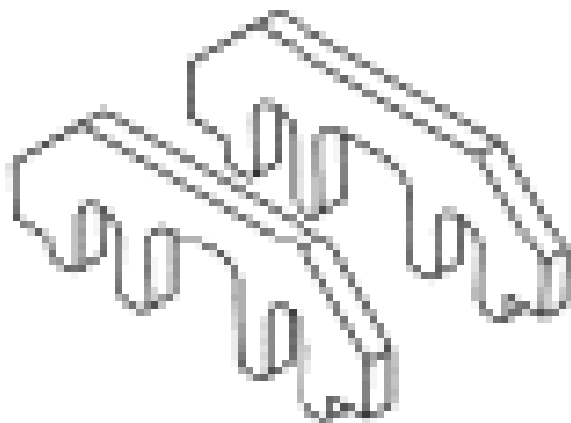


**Fig. 174: Locating Exhaust Flexible Pipe Clamp**  
Courtesy of FORD MOTOR CO.

## OIL PUMP

### Special Tool(s)

### SPECIAL TOOL SPECIFICATION



Tool, Camshaft Holding  
303-1248

### Removal

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

failure.

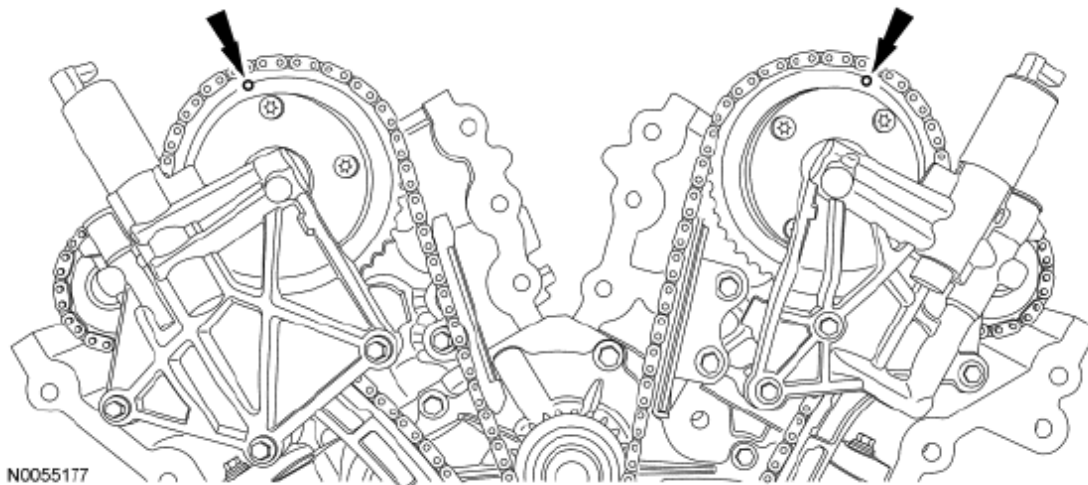
**NOTE:** On early build engines, the timing chain rides on the inner side of the RH timing chain guide. Late build engines are equipped with a different design RH timing chain guide that requires the timing chain to ride on the outer side of the RH timing chain guide. For service, all replacement RH timing chain guides will be the late build design.

#### All vehicles

1. Remove the engine front cover. For additional information, refer to **ENGINE FRONT COVER**.

#### Engines equipped with early build RH timing chain guides

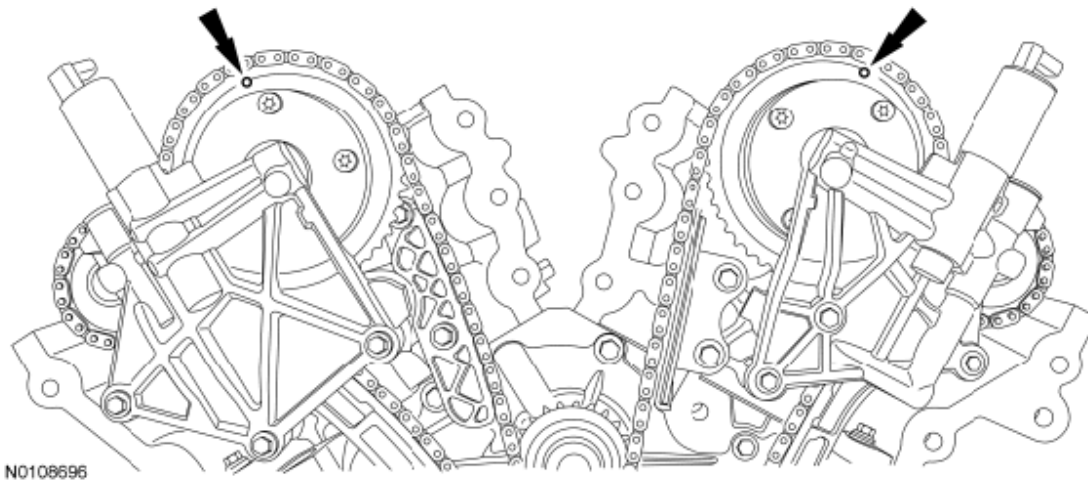
2. Rotate the crankshaft clockwise and align the timing marks on the Variable Camshaft Timing (VCT) assemblies as shown in illustration.



**Fig. 175: Identifying Timing Marks Location**  
Courtesy of FORD MOTOR CO.

#### Engines equipped with late build/replacement RH timing chain guides

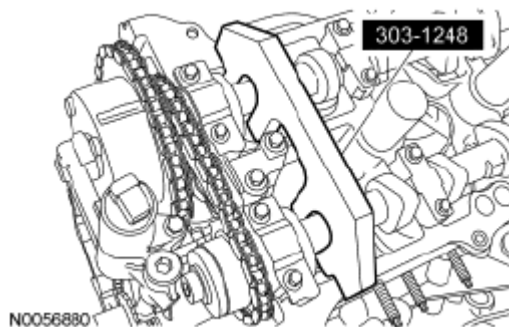
3. Rotate the crankshaft clockwise and align the timing marks on the VCT assemblies as shown in illustration.



**Fig. 176: Aligning Timing Marks On VCT Assemblies**  
Courtesy of FORD MOTOR CO.

All vehicles

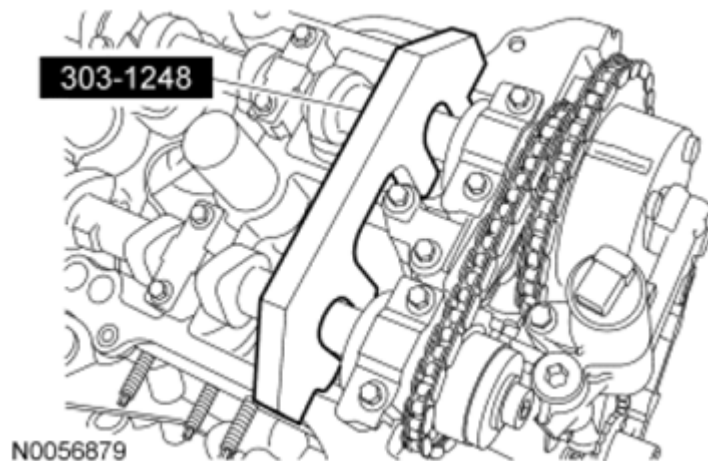
**NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.



**Fig. 177: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

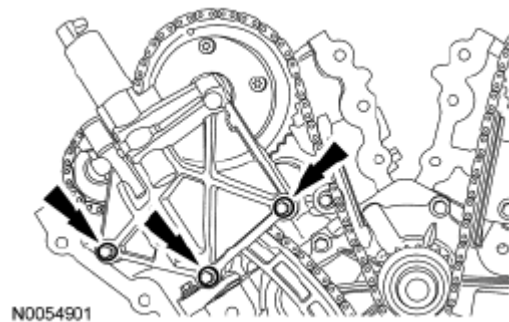
4. Install the Camshaft Holding Tool onto the flats of the LH camshafts.

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



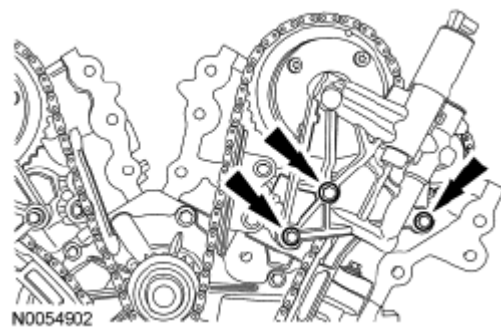
**Fig. 178: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

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



**Fig. 179: Locating RH VCT Housing Bolts**  
Courtesy of FORD MOTOR CO.

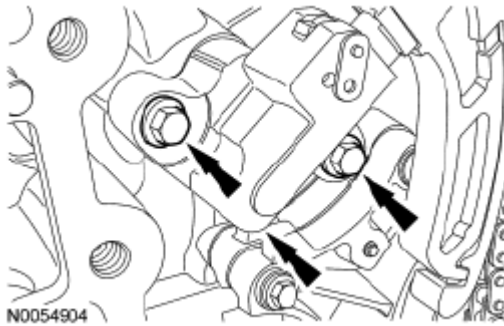
7. Remove the 3 bolts and the LH VCT housing.



**Fig. 180: Locating LH VCT Housing Bolts**  
Courtesy of FORD MOTOR CO.

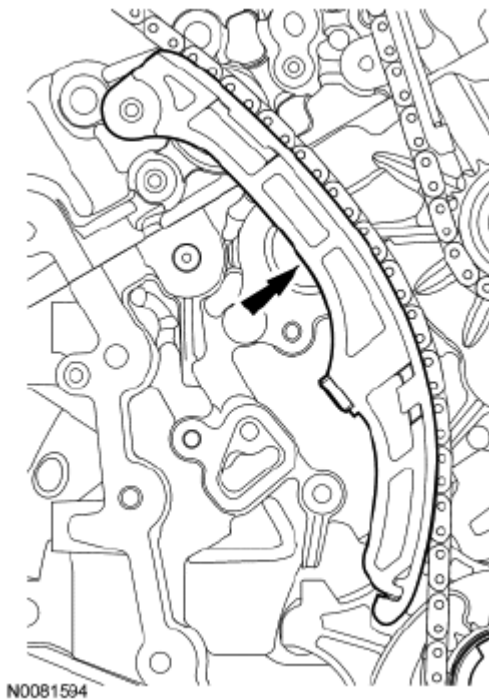


8. Remove the 2 bolts and the primary timing chain tensioner.



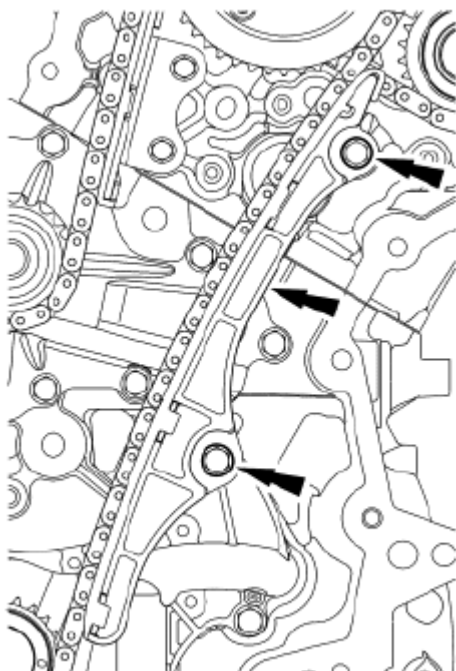
**Fig. 181: Locating Primary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

9. Remove the primary timing chain tensioner arm.



**Fig. 182: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

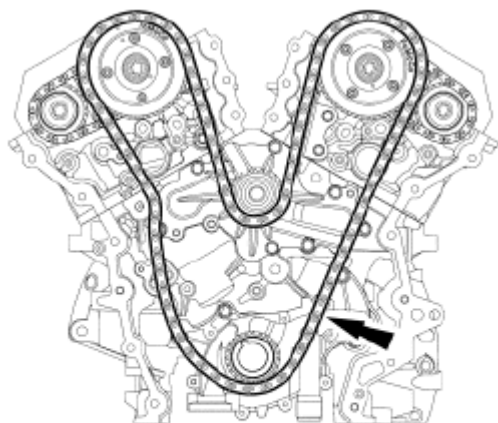
10. Remove the 2 bolts and the lower LH primary timing chain guide.



N0081593

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

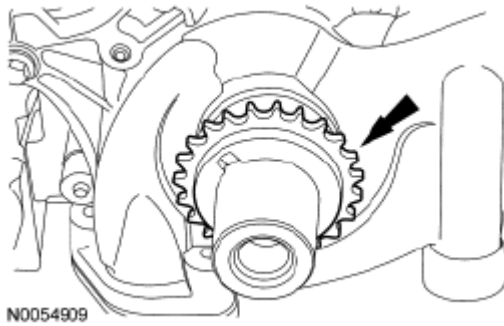
11. Remove the primary timing chain.



N0054908

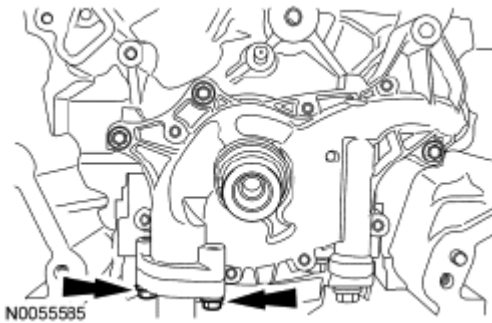
**Fig. 184: Locating Primary Timing Chain**  
Courtesy of FORD MOTOR CO.

12. Remove the crankshaft timing chain sprocket.



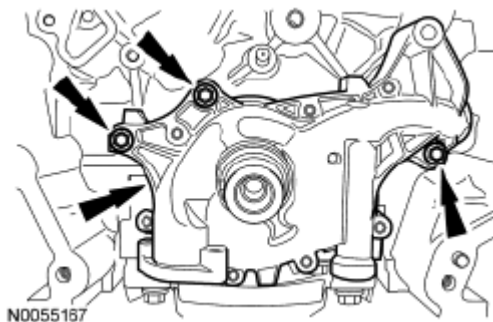
**Fig. 185: Locating Crankshaft Timing Chain Sprocket**  
Courtesy of FORD MOTOR CO.

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



**Fig. 186: Locating Oil Pump Screen And Pickup Tube Bolts**  
Courtesy of FORD MOTOR CO.

14. Remove the 3 bolts and the oil pump.

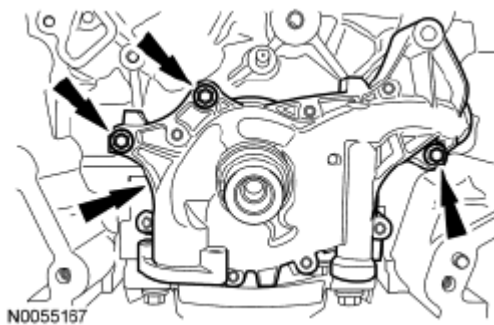


**Fig. 187: Locating Oil Pump Bolts**  
Courtesy of FORD MOTOR CO.

#### Installation

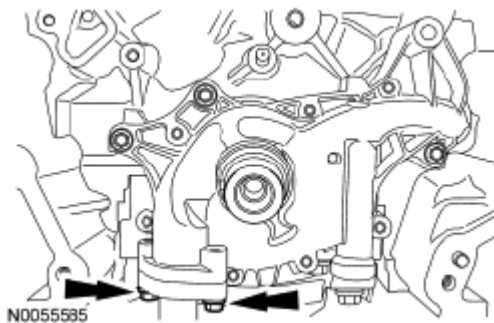
1. Install the oil pump and the 3 bolts.

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



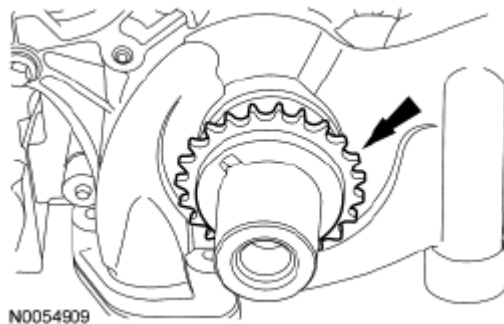
**Fig. 188: Locating Oil Pump Bolts**  
Courtesy of FORD MOTOR CO.

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).



**Fig. 189: Locating Oil Pump Screen And Pickup Tube Bolts**  
Courtesy of FORD MOTOR CO.

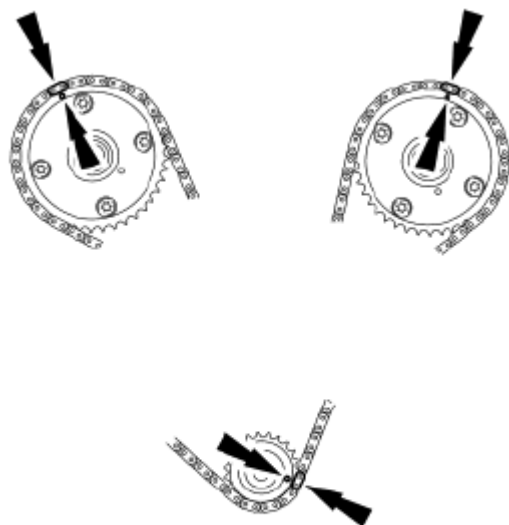
3. Install the crankshaft timing chain sprocket.



**Fig. 190: Locating Crankshaft Timing Chain Sprocket**  
Courtesy of FORD MOTOR CO.

4. Install the primary timing chain with the colored links aligned with the timing marks on the VCT

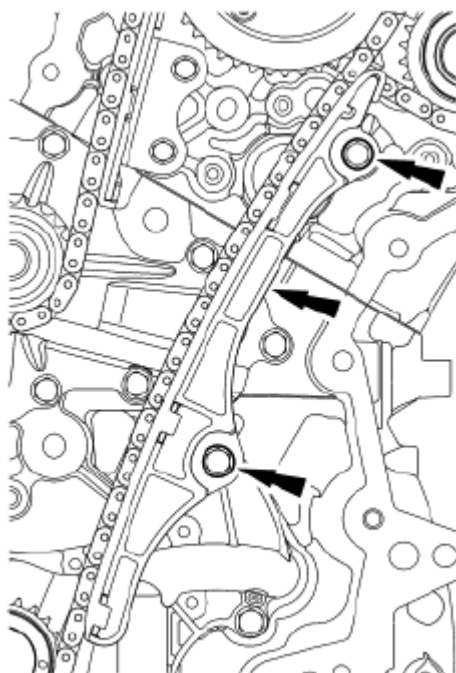
assemblies and the crankshaft sprocket.



N0055503

**Fig. 191: Aligning Timing Marks On VCT Assemblies And Crankshaft Sprocket**  
Courtesy of FORD MOTOR CO.

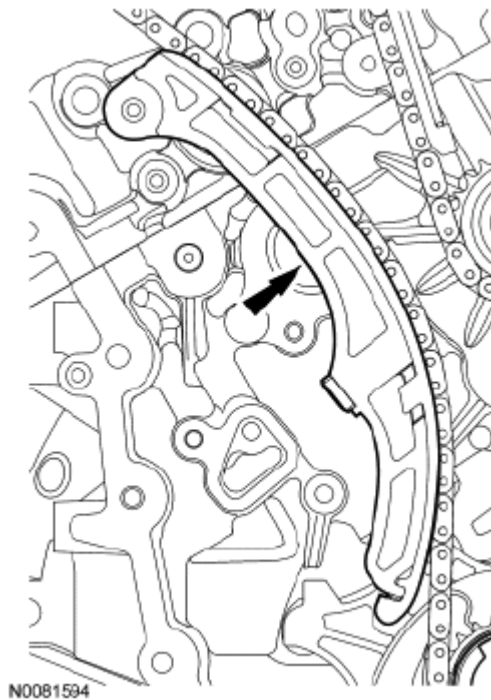
5. Install the LH primary timing chain guide and the 2 bolts.
  - Tighten to 10 Nm (89 lb-in).



N0081593

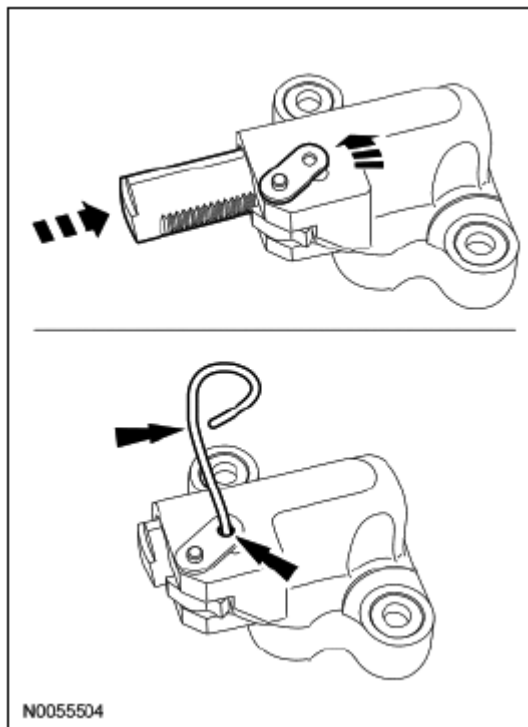
**Fig. 192: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

6. Install the primary timing chain tensioner arm.



**Fig. 193: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

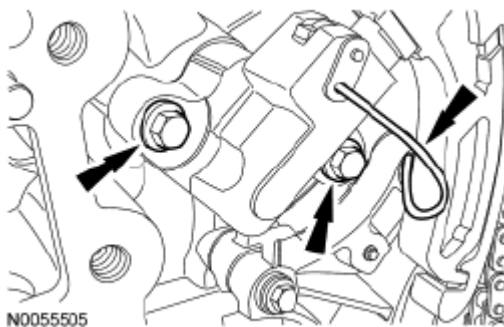
7. Reset the primary timing chain tensioner.
  - Rotate the lever counterclockwise.
  - Using a soft-jawed vise, compress the plunger.
  - Align the hole in the lever with the hole in the tensioner housing.
  - Install a suitable lockpin.



**Fig. 194: Aligning Hole In Lever With Hole In Tensioner Housing**  
Courtesy of FORD MOTOR CO.

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

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



**Fig. 195: Locating Primary Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

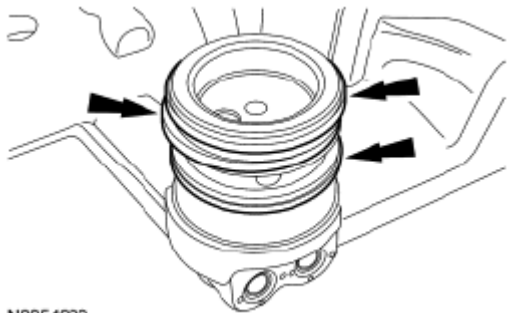
9. As a post-check, verify correct alignment of all timing marks.



N0055496

**Fig. 196: Identifying Timing Marks Location**  
Courtesy of FORD MOTOR CO.

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



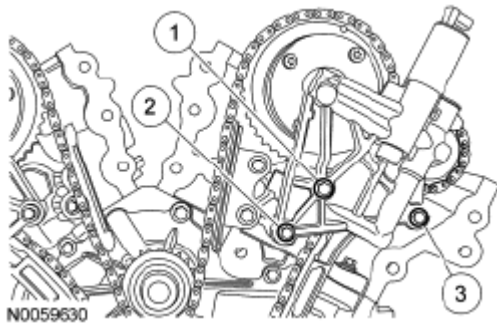
N0054903

**Fig. 197: Locating VCT Housing Seals**  
Courtesy of FORD MOTOR CO.

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

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

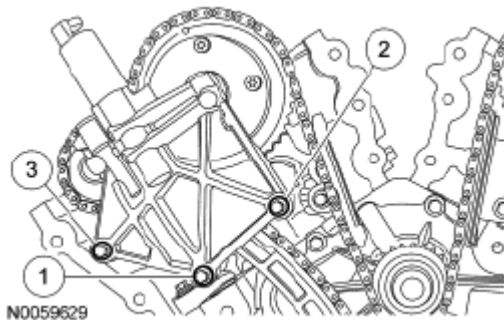




**Fig. 198: Identifying LH VCT Housing Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

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

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



**Fig. 199: Identifying RH VCT Housing Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

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

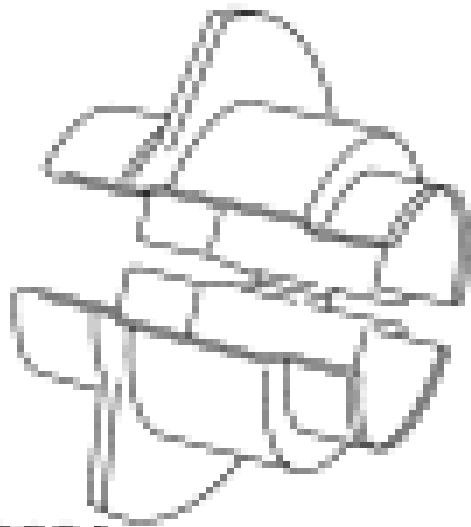
## REMOVAL

### ENGINE

#### Special Tool(s)

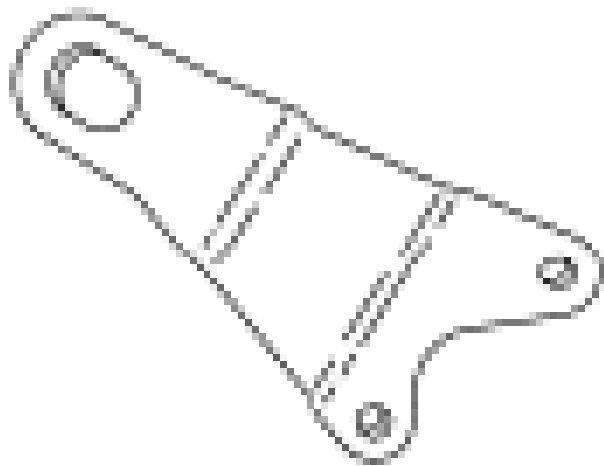
#### SPECIAL TOOL SPECIFICATION

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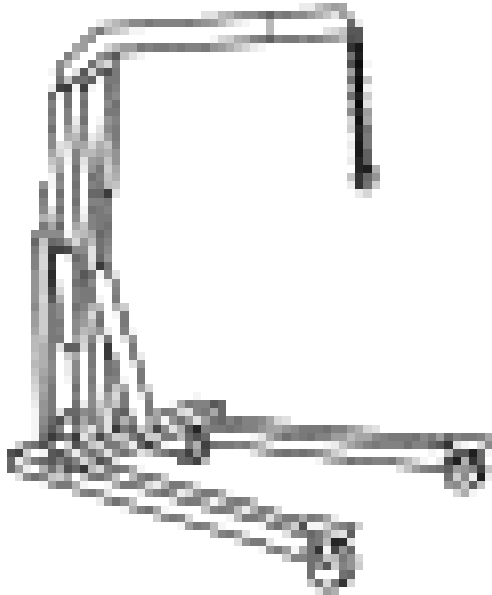
ST2935A

Disconnect Tool, Transmission Cooler Tube  
307-569



ST2976A

Eye, Engine Lift  
303-1245



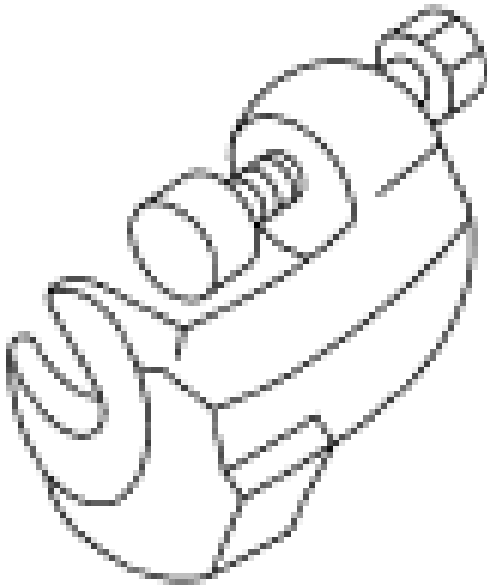
**ST1341-A**

Heavy Duty Floor Crane  
014-00071 or equivalent



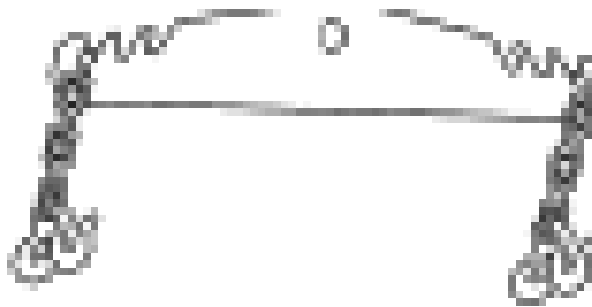
**ST1293-A**

Powertrain Lift  
014-00765 or equivalent



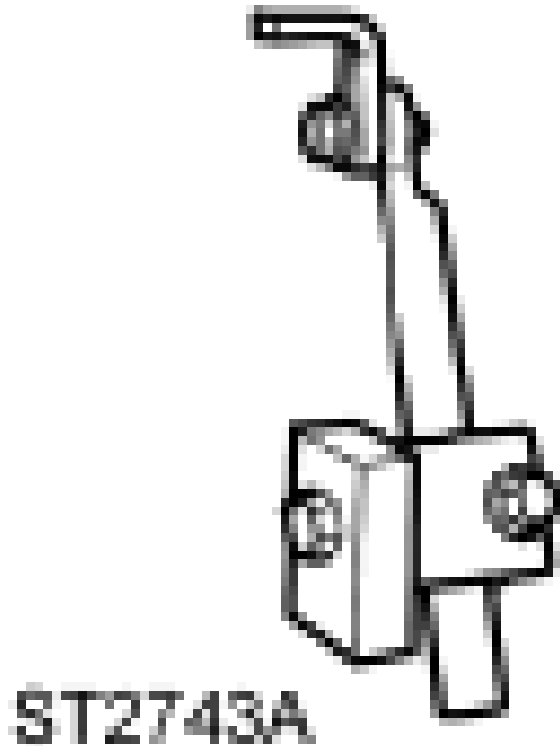
Remover, Tie-Rod End  
211-105

ST1408-A



Spreader Bar  
303-D089 (D93P-6001-A3) or equivalent

ST1408-A

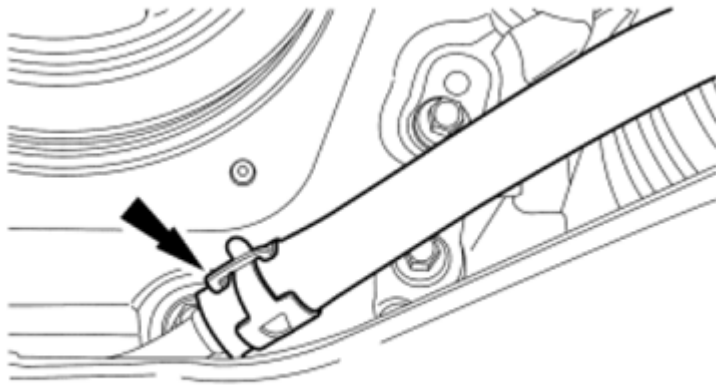


Universal Adapter Brackets  
014-00001 or equivalent

**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. Recover the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS**.
3. Release the fuel system pressure. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION**.
4. Drain the engine cooling system. For additional information, refer to **ENGINE COOLING**.
5. Remove the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE**.
6. Remove the LH halfshaft and intermediate shaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS**.
7. Disconnect the power steering cooler hose and drain the power steering fluid into a suitable drain pan.



N0055404

**Fig. 200: Locating Power Steering Cooler Hose**  
Courtesy of FORD MOTOR CO.

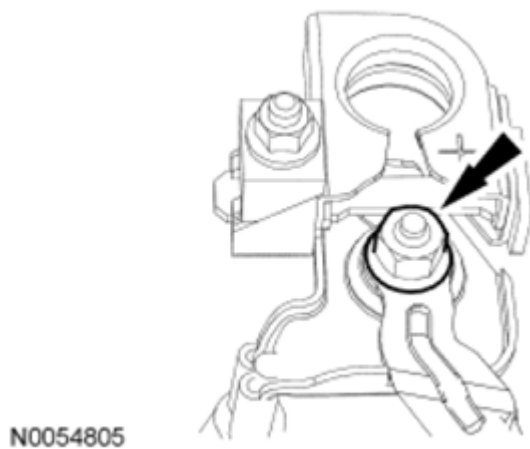
8. Remove the degas bottle. For additional information, refer to **ENGINE COOLING**.
9. Remove the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING**.
10. Remove the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES**.
11. Disconnect the battery harness electrical connector.



N0055413

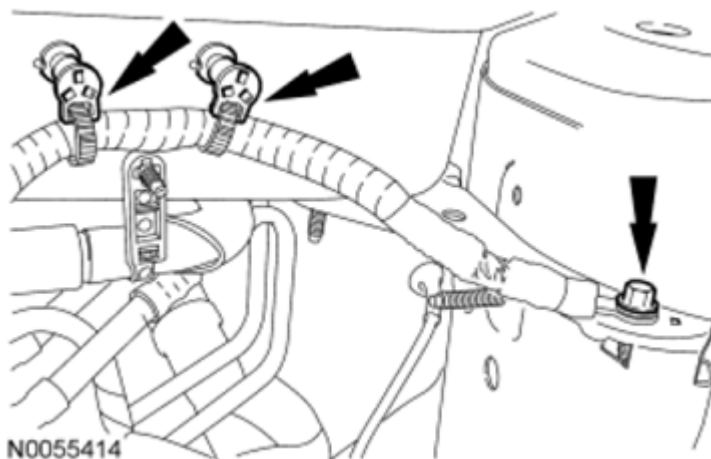
**Fig. 201: Locating Battery Harness Electrical Connector**  
Courtesy of FORD MOTOR CO.

12. Remove the nut and disconnect the power feed from the battery terminal.



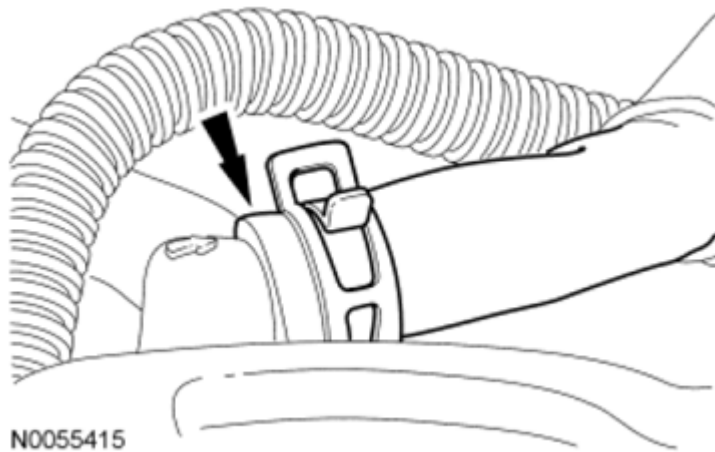
**Fig. 202: Locating Battery Terminal Nut**  
Courtesy of FORD MOTOR CO.

13. Remove the bolt and the ground wire.
  - Detach the 2 wiring harness retainers from the cowl.



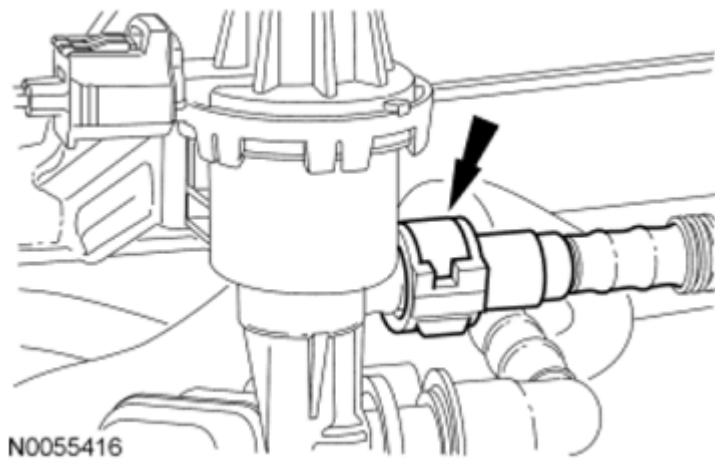
**Fig. 203: Locating Wiring Harness Retainers**  
Courtesy of FORD MOTOR CO.

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



**Fig. 204: Locating Vacuum Hose**  
Courtesy of FORD MOTOR CO.

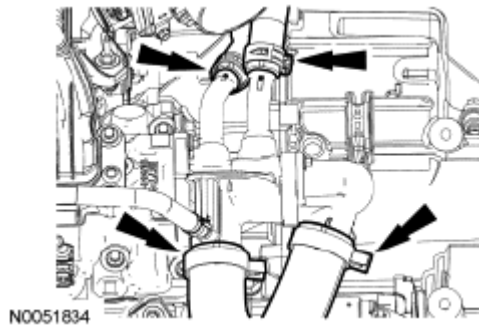
15. Disconnect the upper Evaporative Emission (EVAP) tube quick connect coupling from the purge valve. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION**.



**Fig. 205: Locating Upper Evaporative Emission Tube**  
Courtesy of FORD MOTOR CO.

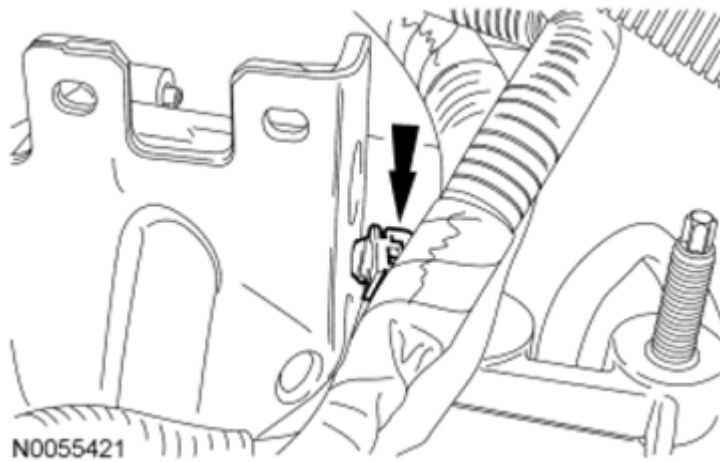
16. Disconnect the upper radiator hose, lower radiator hose and 2 heater hoses from the thermostat housing.





**Fig. 206: Locating Upper And Lower Radiator Hose**  
Courtesy of FORD MOTOR CO.

17. Detach the wiring harness retainer from the transaxle control cable bracket.



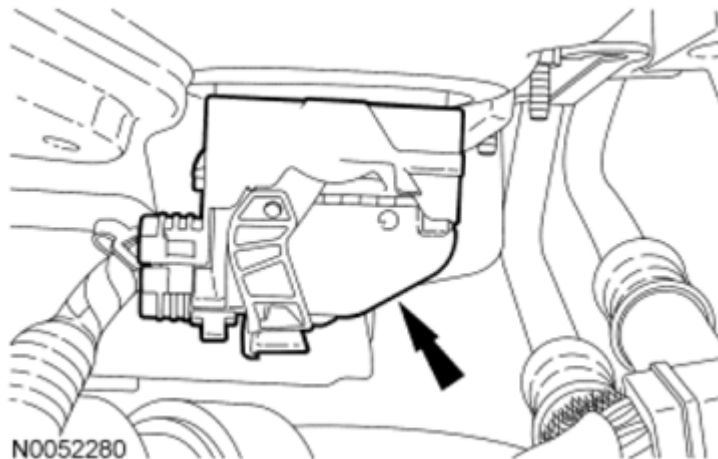
**Fig. 207: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

18. Disconnect the transaxle control cable from the control lever.
  - Detach the control cable from the bracket.



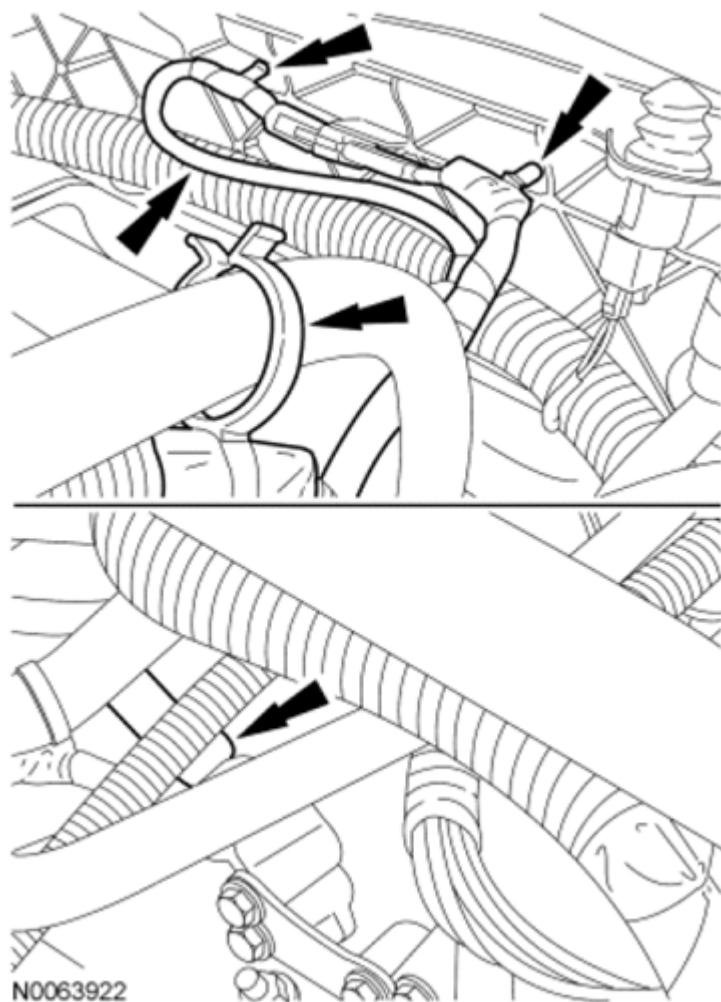
**Fig. 208: Locating Transaxle Control Cable**  
Courtesy of FORD MOTOR CO.

19. Disconnect the transaxle control electrical connector.



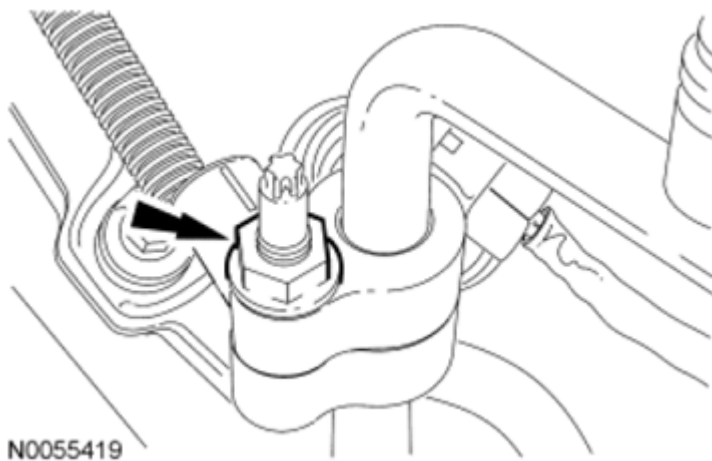
**Fig. 209: Locating Transaxle Control Electrical Connector**  
Courtesy of FORD MOTOR CO.

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



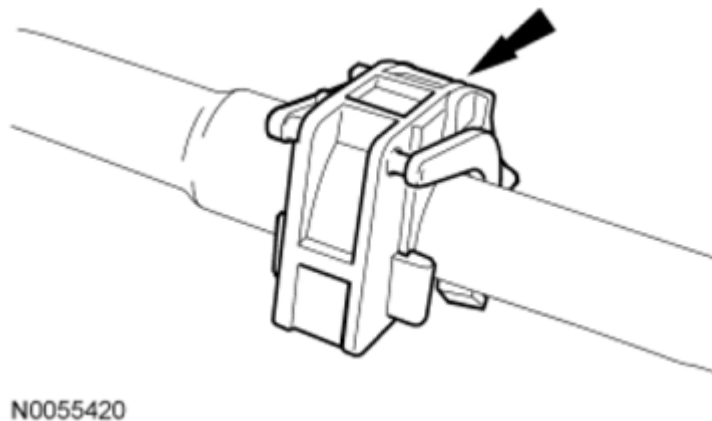
**Fig. 210: Locating Engine Block Heater Harness And A/C Suction Tube**  
Courtesy of FORD MOTOR CO.

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



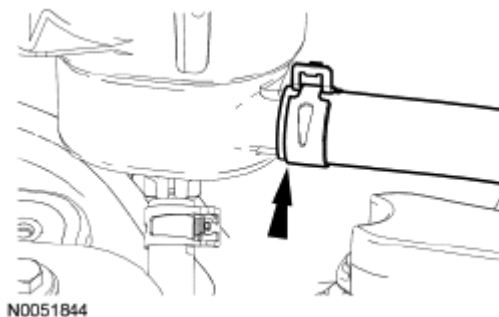
**Fig. 211: Locating A/C Pressure Tube Fitting And Nut**  
Courtesy of FORD MOTOR CO.

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



**Fig. 212: Locating A/C Suction Tube Safety Clip**  
Courtesy of FORD MOTOR CO.

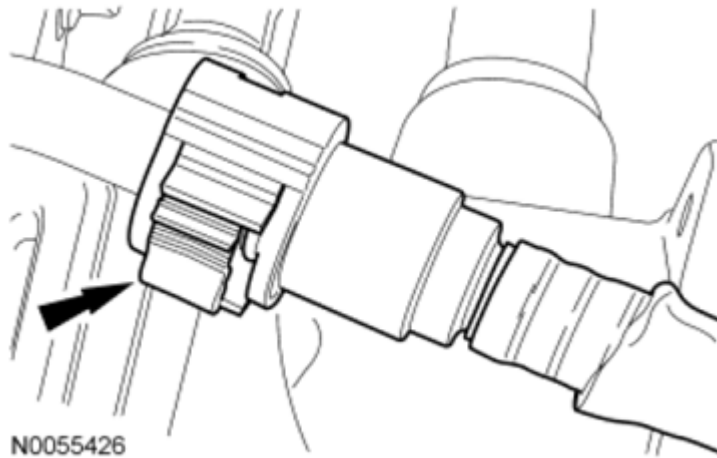
23. Disconnect the hose from the power steering reservoir.



**Fig. 213: Locating Hose**

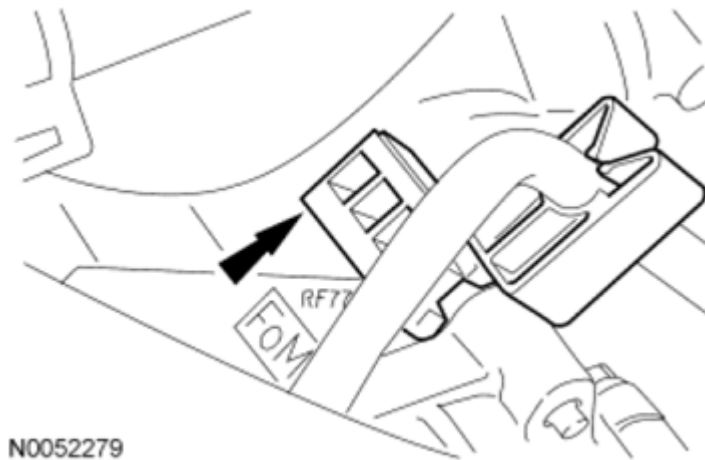
Courtesy of FORD MOTOR CO.

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

**Fig. 214: Locating Fuel Supply Tube**

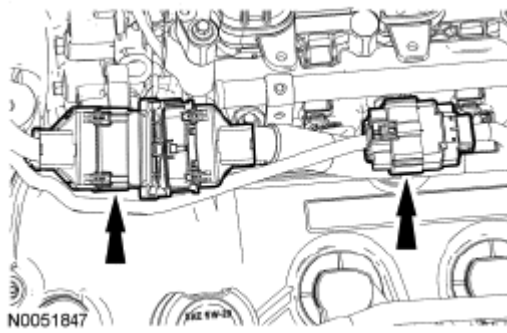
Courtesy of FORD MOTOR CO.

25. Disconnect the fuel hose routing clip from the transaxle stud and position the fuel hose aside.

**Fig. 215: Locating Fuel Hose Routing Clip**

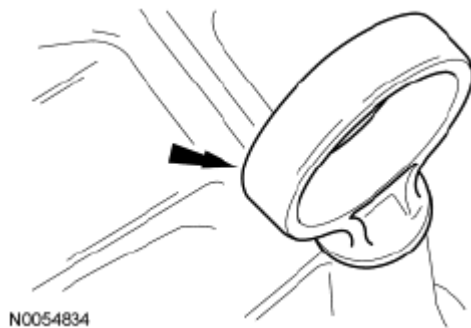
Courtesy of FORD MOTOR CO.

26. Disconnect the 2 engine wiring harness electrical connectors.
- Detach the electrical connector from the LH valve cover.



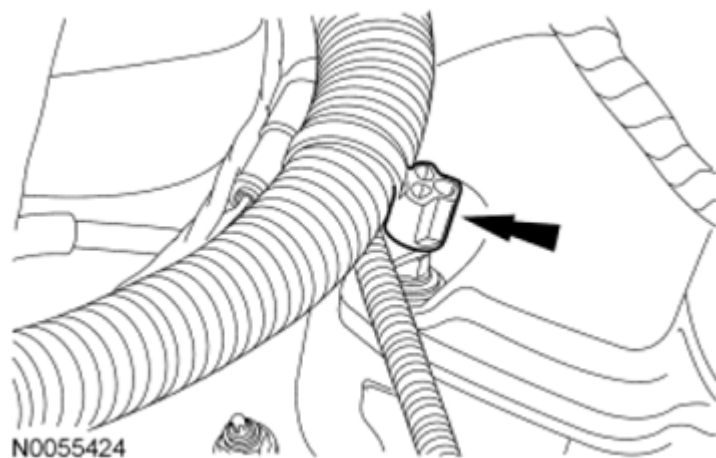
**Fig. 216: Locating Engine Wiring Harness Electrical Connectors**  
Courtesy of FORD MOTOR CO.

27. Remove the oil level indicator.



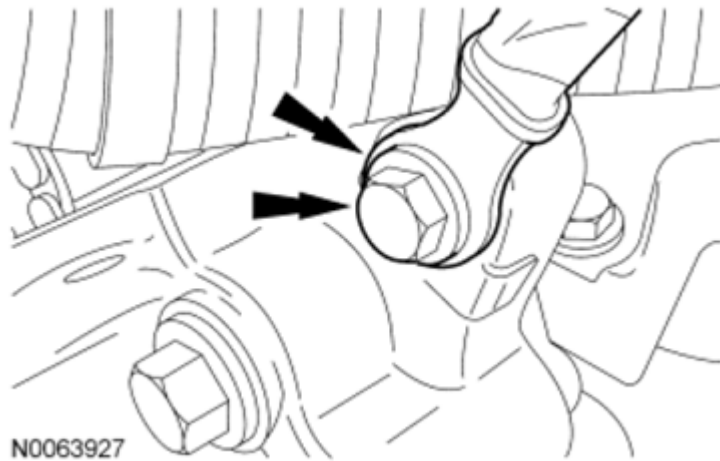
**Fig. 217: Locating Oil Level Indicator**  
Courtesy of FORD MOTOR CO.

28. Detach the wiring harness retainer from the RH valve cover stud bolt.



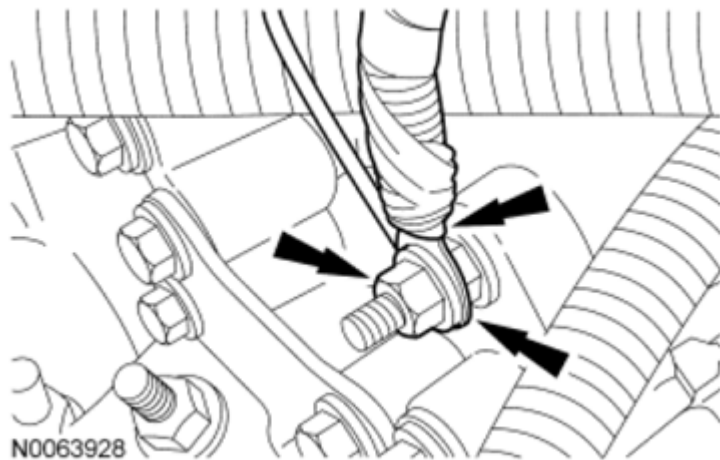
**Fig. 218: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

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



**Fig. 219: Locating Ground Wire Bolt**  
Courtesy of FORD MOTOR CO.

30. Remove the nut, the ground wire and the radio interference capacitor wire from the engine front cover stud.



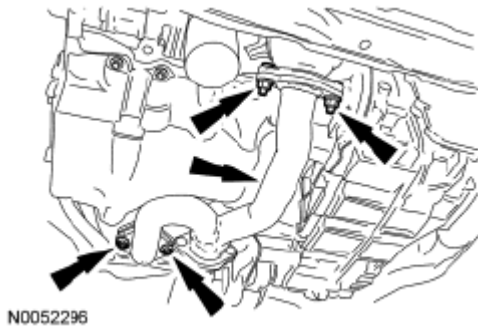
**Fig. 220: Locating Ground Wire Nut**  
Courtesy of FORD MOTOR CO.

31. Loosen the exhaust flexible pipe clamp and disconnect the 2 exhaust hangers.



**Fig. 221: Locating Exhaust Flexible Pipe Clamp**  
Courtesy of FORD MOTOR CO.

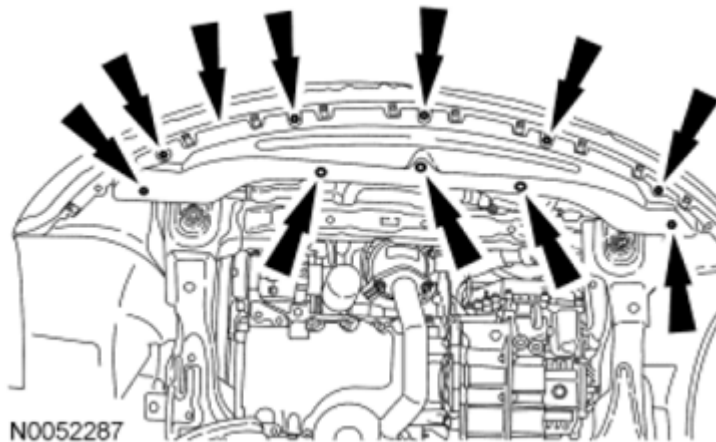
32. Remove the 4 nuts and the exhaust flexible pipe and Y-pipe as an assembly.
  - Discard the nuts and the gasket.



**Fig. 222: Locating Exhaust Flexible Pipe Nuts**  
Courtesy of FORD MOTOR CO.

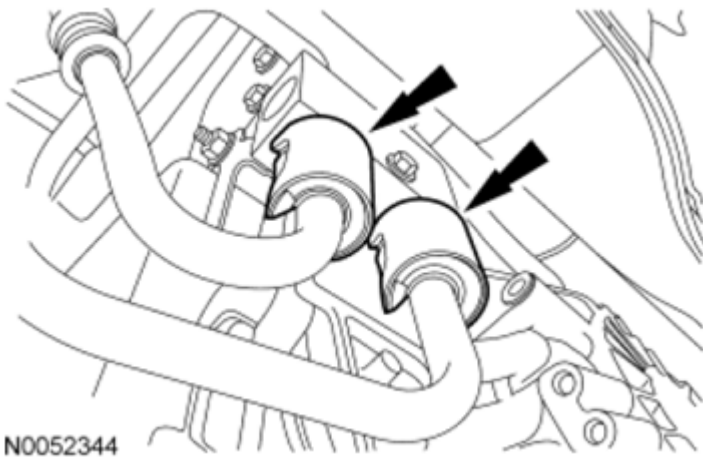
33. Remove the 3 pin-type retainers, the 7 screws and the radiator splash shield.





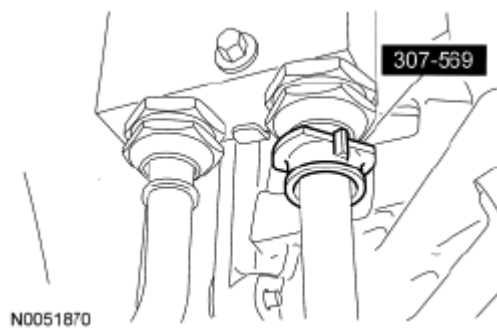
**Fig. 223: Locating Pin-Type Retainers**  
Courtesy of FORD MOTOR CO.

34. Remove the LH inner splash shield. For additional information, refer to **FRONT END BODY PANELS**.
35. Remove the 2 secondary latches from the transmission fluid cooler tubes.



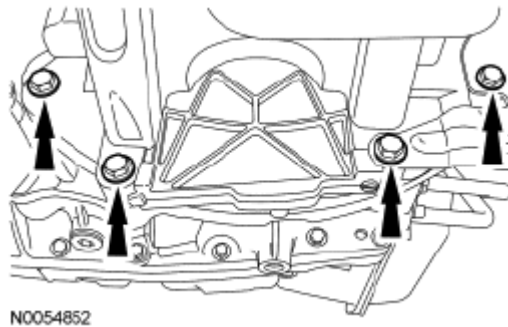
**Fig. 224: Locating Secondary Latches**  
Courtesy of FORD MOTOR CO.

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



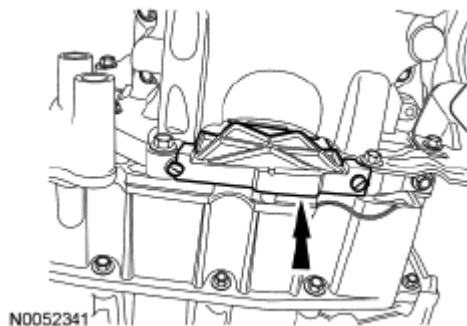
**Fig. 225: Disconnecting Transmission Cooling Tubes**  
Courtesy of FORD MOTOR CO.

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



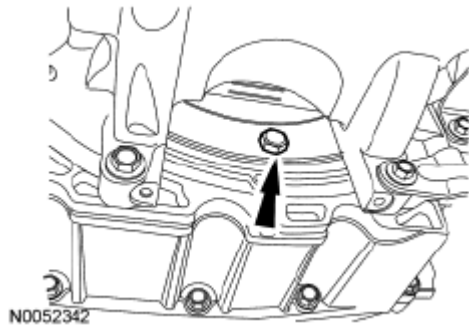
**Fig. 226: Locating Oil Pan-To-Transaxle Bolts**  
Courtesy of FORD MOTOR CO.

38. Remove the 2 fasteners and the inspection cover.



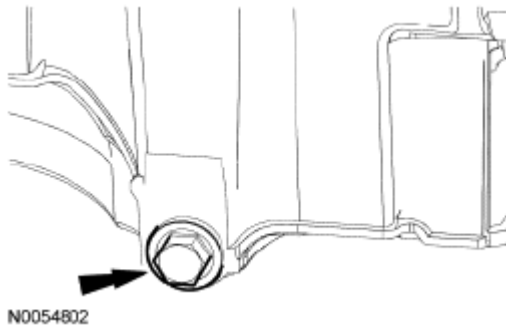
**Fig. 227: Locating Inspection Cover Fasteners**  
Courtesy of FORD MOTOR CO.

39. Remove and discard the 3 torque converter bolts.



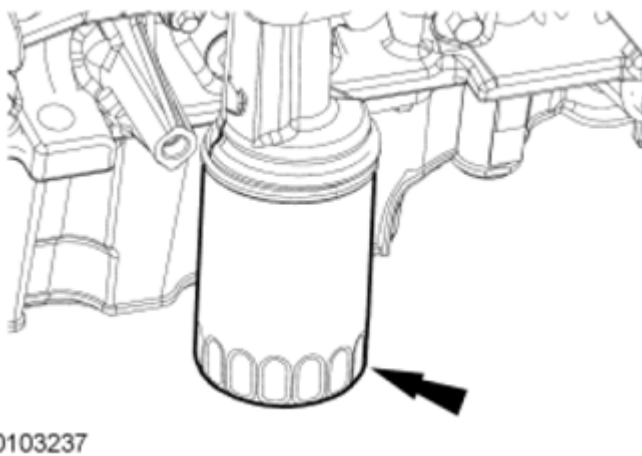
**Fig. 228: Locating Torque Converter Bolts**  
Courtesy of FORD MOTOR CO.

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



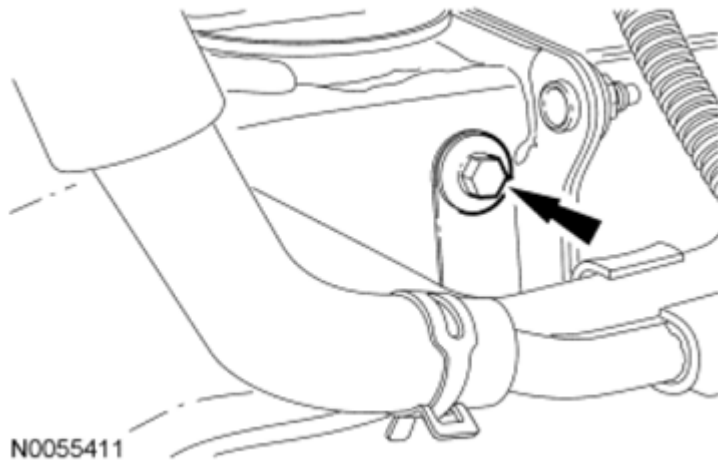
**Fig. 229: Locating Drain Plug**  
Courtesy of FORD MOTOR CO.

41. Remove and discard the engine oil filter.



**Fig. 230: Locating Engine Oil Filter**  
Courtesy of FORD MOTOR CO.

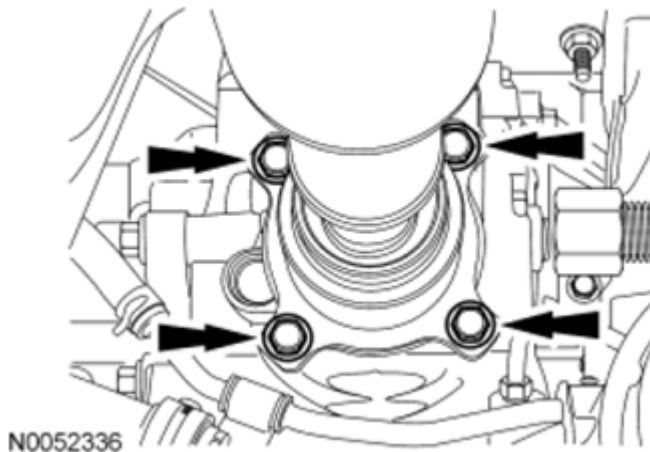
42. Remove the power steering cooler bracket bolt from the RH side of the subframe.



**Fig. 231: Locating Power Steering Cooler Bracket Bolt**  
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

**NOTE:** Index-mark the driveshaft for installation.

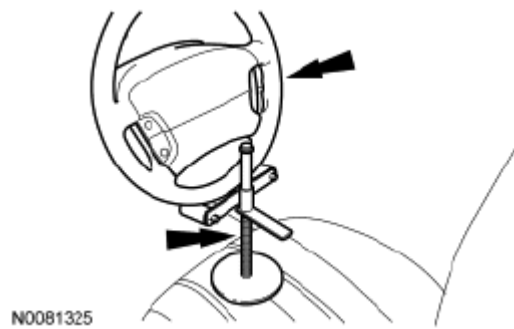


**Fig. 232: Locating Driveshaft Bolts**  
Courtesy of FORD MOTOR CO.

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

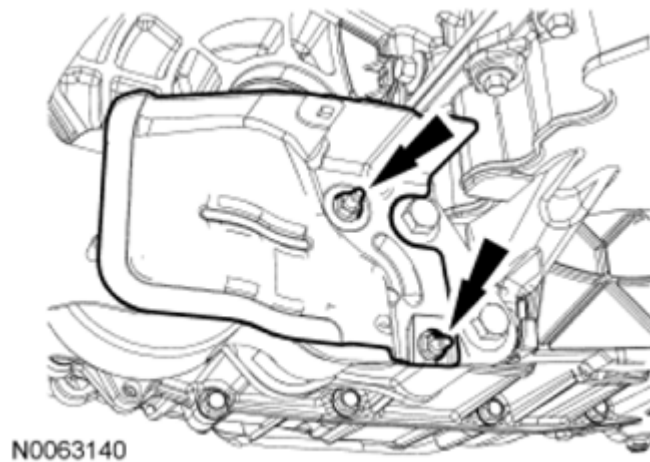
All vehicles

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



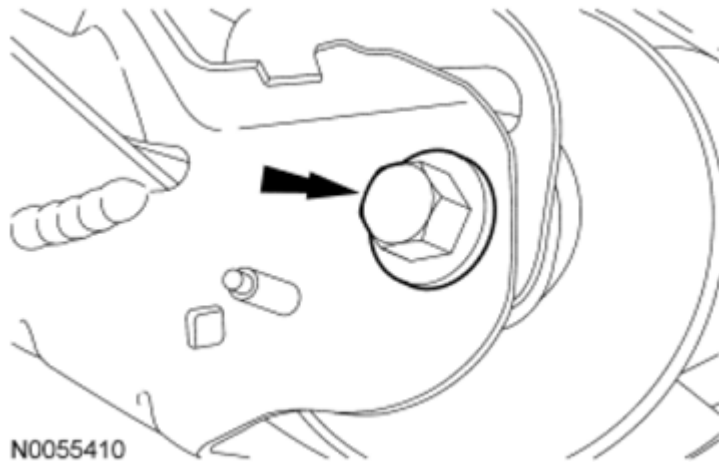
**Fig. 233: Identifying Steering Wheel Holding Device**  
Courtesy of FORD MOTOR CO.

44. Using a suitable holding device, hold the steering wheel in the straight-ahead position.
45. Remove the 2 nuts and the roll restrictor heat shield.



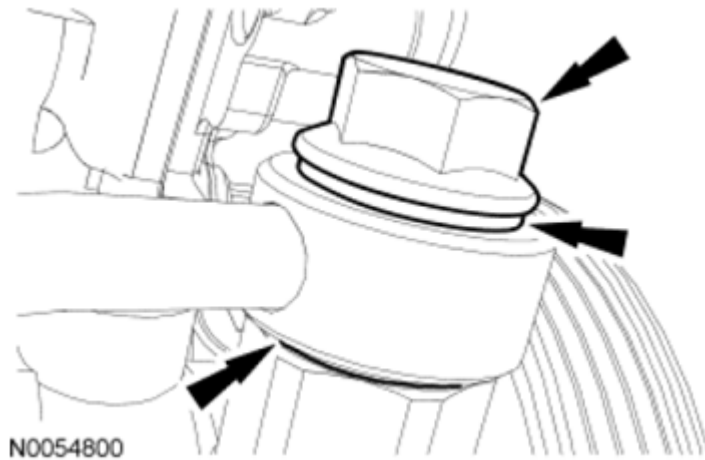
**Fig. 234: Locating Roll Restrictor Heat Shield Nuts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 235: Locating Engine Roll Restrictor-To-Subframe Through Bolt**  
Courtesy of FORD MOTOR CO.

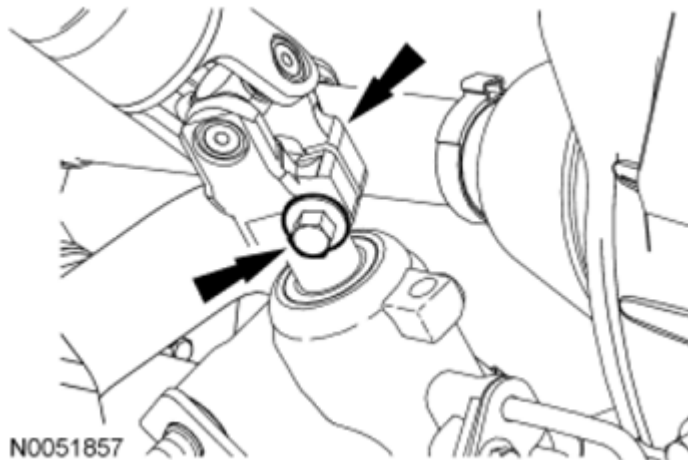
47. Remove and discard the Power Steering Pressure (PSP) tube-to-pump banjo bolt and the 2 seals.



**Fig. 236: Locating Power Steering Pressure Tube-To-Pump Banjo Bolt**  
Courtesy of FORD MOTOR CO.

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

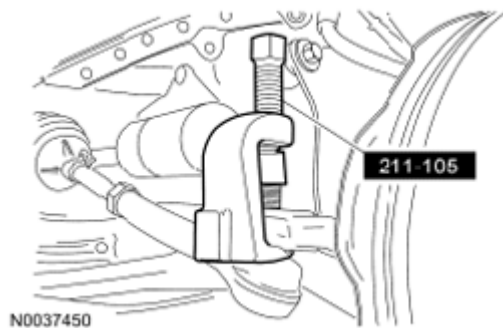
48. Remove and discard the steering intermediate shaft bolt.
- Separate the steering intermediate shaft from the steering gear.



**Fig. 237: Locating Steering Intermediate Shaft Bolt**  
Courtesy of FORD MOTOR CO.

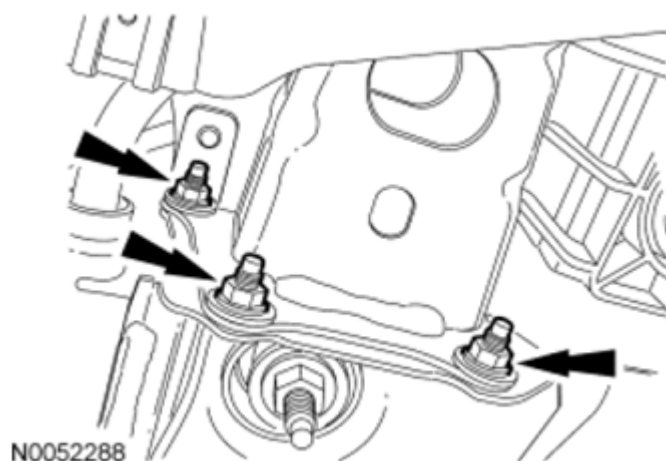
**NOTE:** RH shown in illustration, LH similar.

49. Remove and discard the cotter pins and tie-rod end nuts.
  - Using the Tie-Rod End Remover, separate the tie-rod ends from the wheel knuckles.



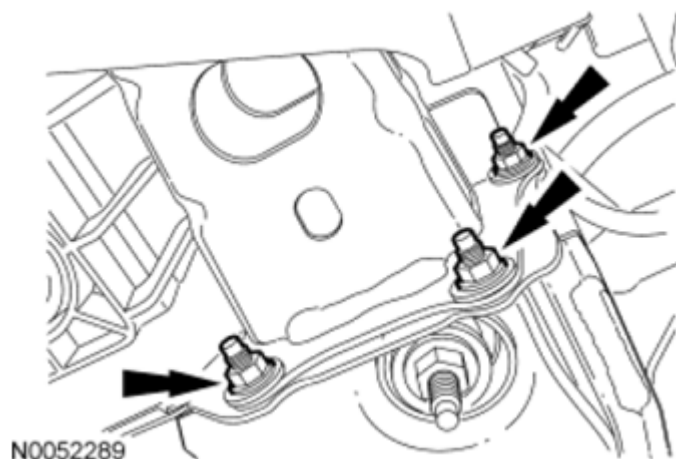
**Fig. 238: Identifying Tie-Rod End Remover**  
Courtesy of FORD MOTOR CO.

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



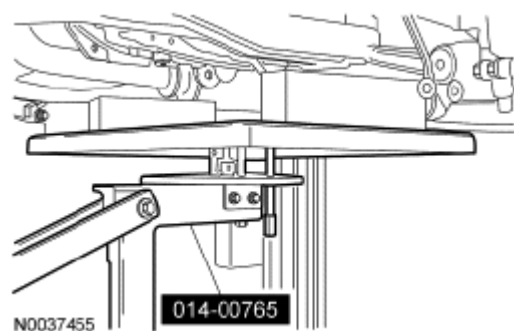
**Fig. 239: Locating RH Subframe-To-Lower Bumper Nuts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 240: Locating LH Subframe-To-Lower Bumper Nuts**  
Courtesy of FORD MOTOR CO.

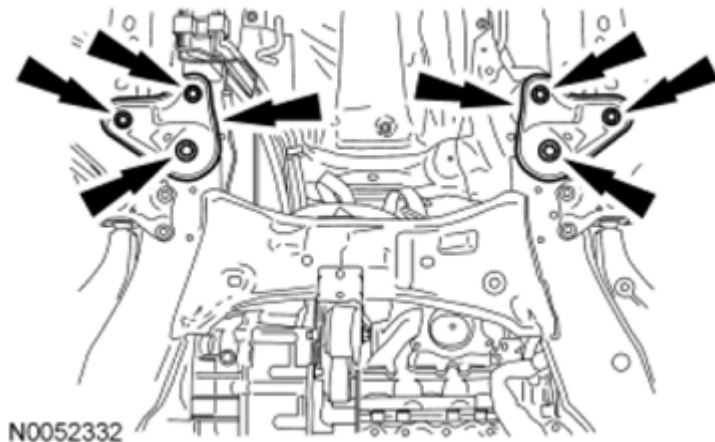
52. Position the Powertrain Lift under the subframe assembly.





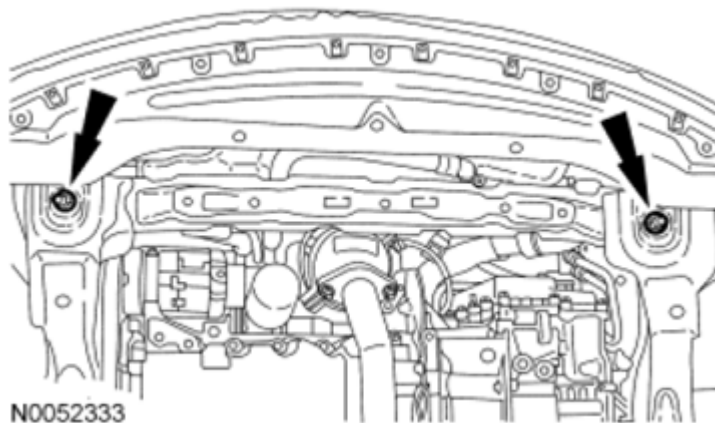
**Fig. 241: Positioning Powertrain Lift Under Subframe Assembly**  
Courtesy of FORD MOTOR CO.

53. Remove the 2 nuts, 4 bolts and the subframe support brackets.



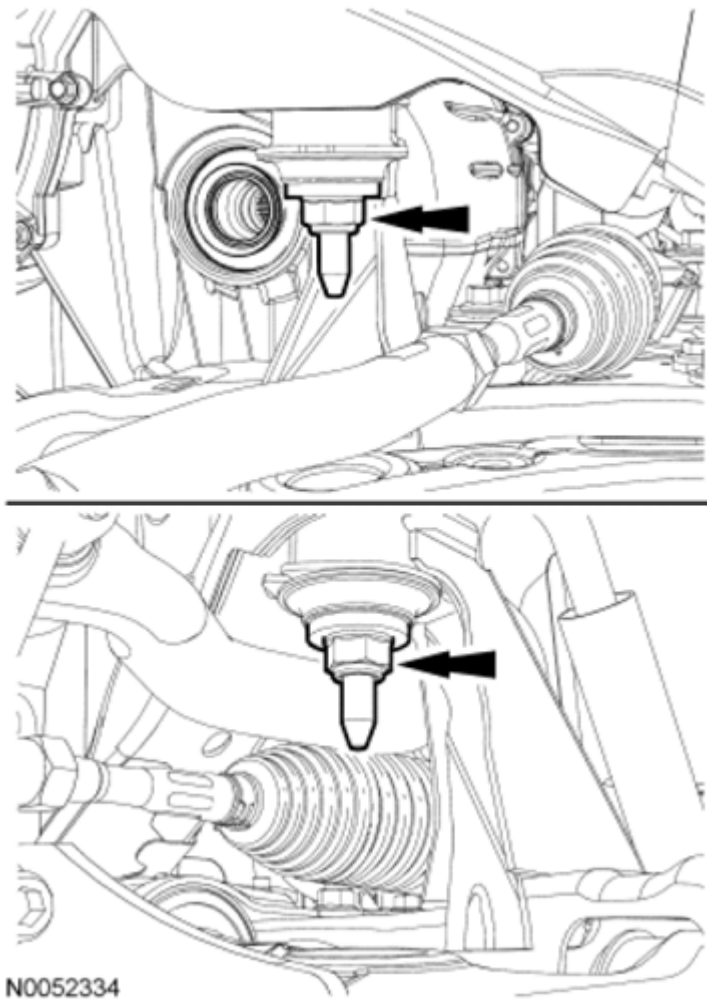
**Fig. 242: Locating Subframe Support Brackets Nuts And Bolts**  
Courtesy of FORD MOTOR CO.

54. Remove the 2 front subframe nuts.



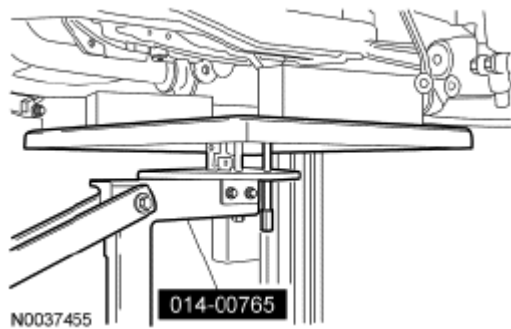
**Fig. 243: Locating Front Subframe Nuts**  
Courtesy of FORD MOTOR CO.

55. Remove the 2 middle subframe nuts.



**Fig. 244: Locating Middle Subframe Nuts**  
Courtesy of FORD MOTOR CO.

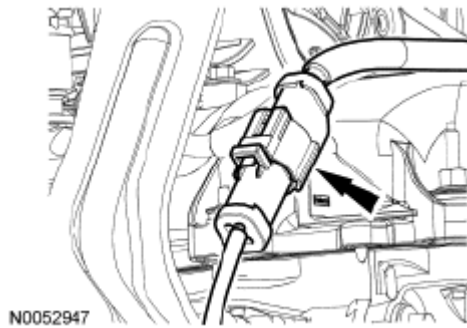
56. Using the Powertrain Lift, lower the subframe assembly from the vehicle.



**Fig. 245: Positioning Powertrain Lift Under Subframe Assembly**  
Courtesy of FORD MOTOR CO.

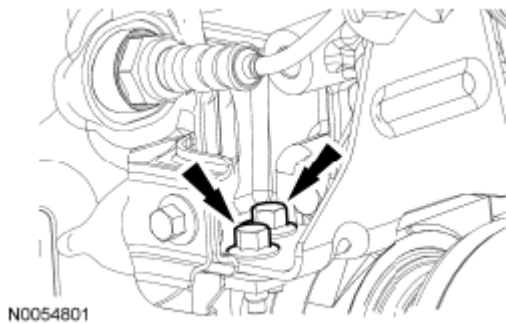
**AWD vehicles**

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



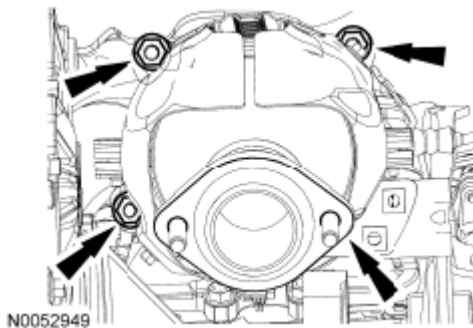
**Fig. 246: Locating RH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

58. Remove the 2 RH catalytic converter support bracket bolts.



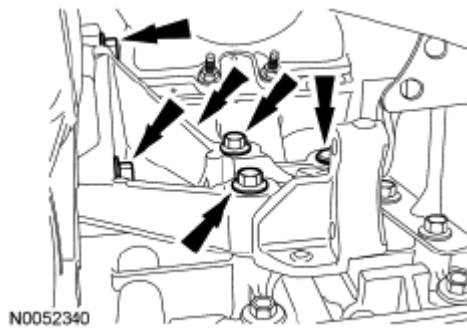
**Fig. 247: Locating RH Catalytic Converter Support Bracket Bolts**  
Courtesy of FORD MOTOR CO.

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



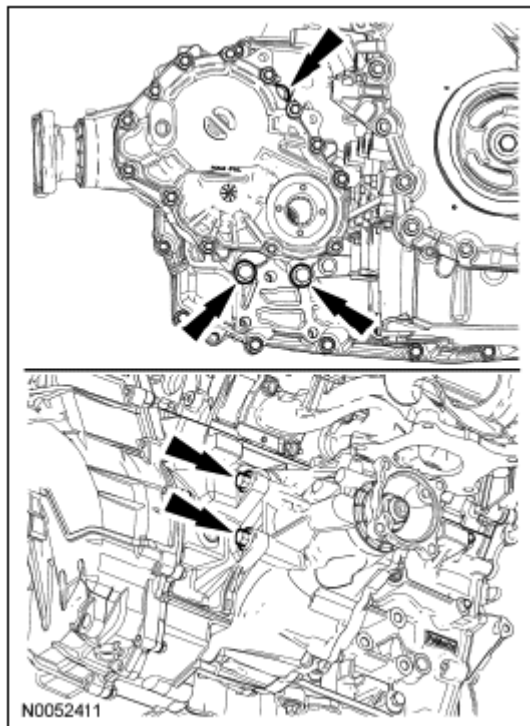
**Fig. 248: Locating RH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 249: Locating Power Transfer Unit Support Bracket Bolts**  
Courtesy of FORD MOTOR CO.

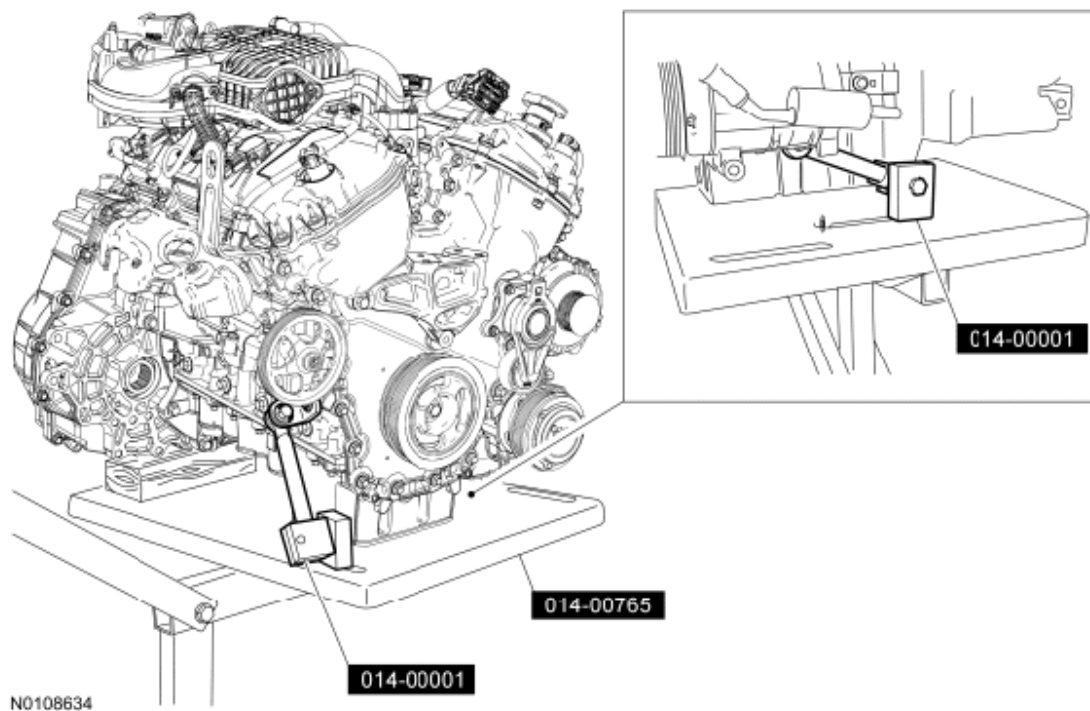
61. Remove the 5 bolts and the PTU .



**Fig. 250: Locating PTU Bolts**  
Courtesy of FORD MOTOR CO.

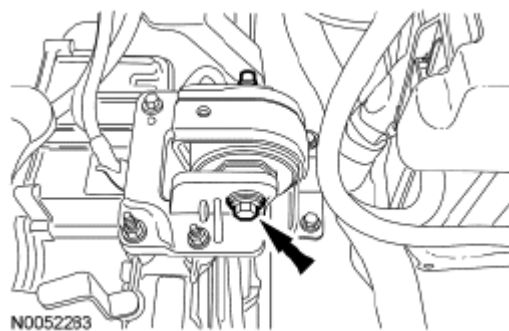
All vehicles

**NOTE:** Position a block of wood under the transaxle.



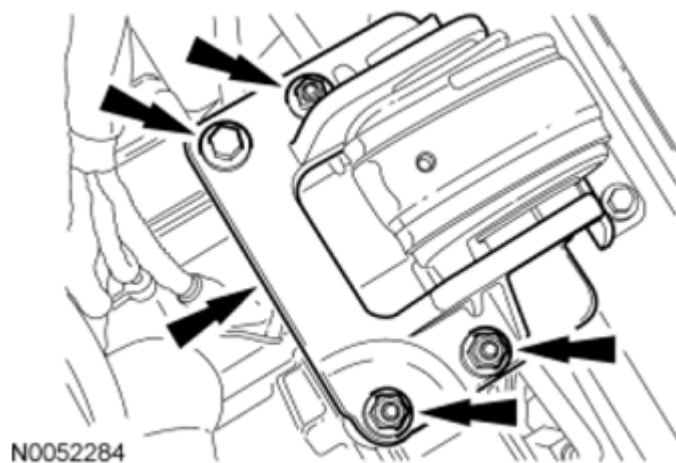
**Fig. 251: Identifying Powertrain Lift And Universal Adapter Brackets**  
 Courtesy of FORD MOTOR CO.

62. Install the Powertrain Lift and Universal Adapter Brackets.
63. Remove the transaxle support insulator through bolt and nut.



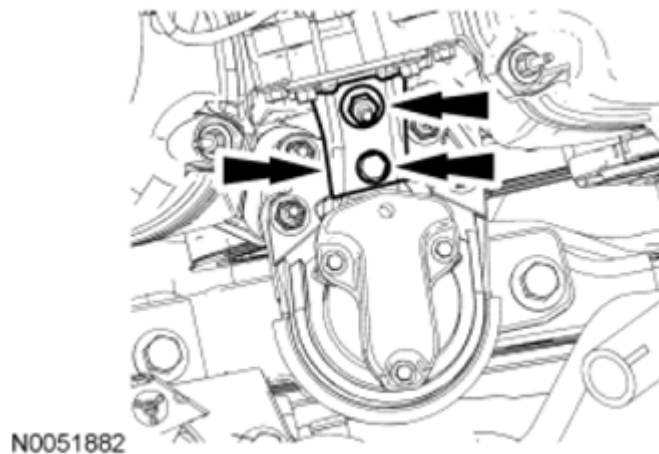
**Fig. 252: Locating Transaxle Support Insulator Through Bolt And Nut**  
 Courtesy of FORD MOTOR CO.

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



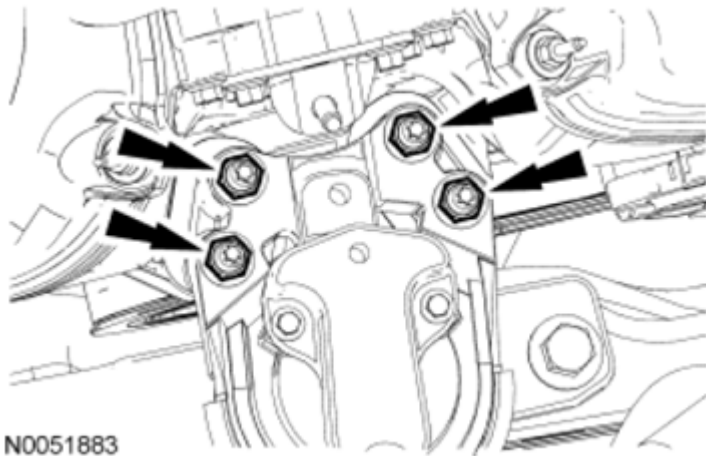
**Fig. 253: Locating Transaxle Support Insulator Bracket Nuts And Bolt**  
Courtesy of FORD MOTOR CO.

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



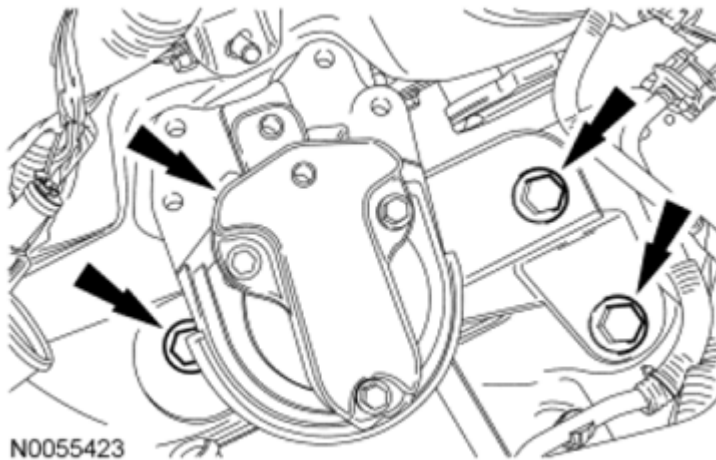
**Fig. 254: Locating Engine Mount Brace Nut And Bolt**  
Courtesy of FORD MOTOR CO.

66. Remove the 4 engine mount nuts.



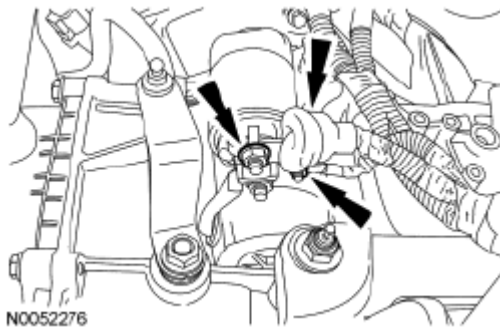
**Fig. 255: Locating Engine Mount Nuts**  
Courtesy of FORD MOTOR CO.

67. Remove the 3 bolts and the engine mount.



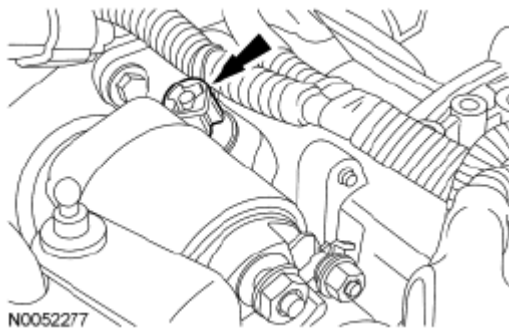
**Fig. 256: Locating Engine Mount Bolts**  
Courtesy of FORD MOTOR CO.

68. Lower the engine and transaxle assembly from the vehicle.
69. Position the starter cable boot back and remove the 2 nuts.
- Detach the 2 wire terminals from the starter.



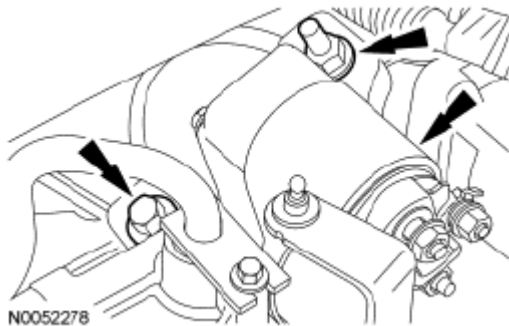
**Fig. 257: Locating Starter Cable Boot**  
Courtesy of FORD MOTOR CO.

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



**Fig. 258: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

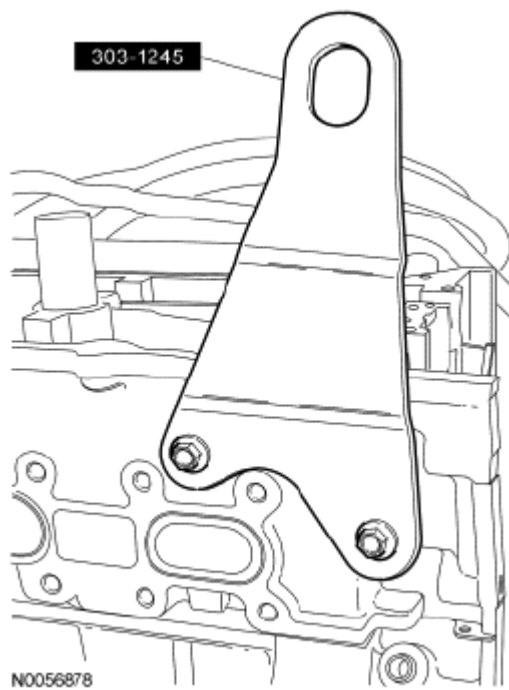
71. Remove the bolt, stud bolt and the starter.



**Fig. 259: Locating Stud Bolt And Starter**  
Courtesy of FORD MOTOR CO.

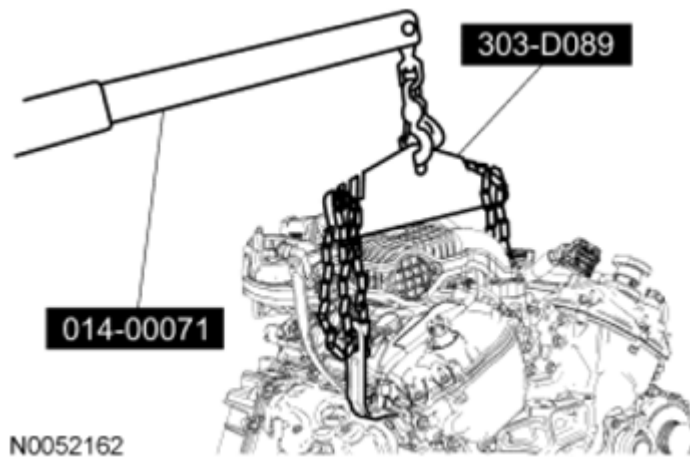
72. Install the Engine Lift Eye on the LH cylinder head.





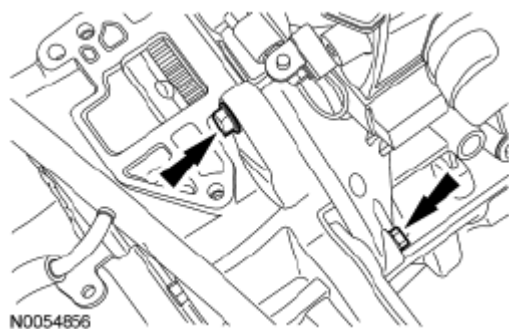
**Fig. 260: Identifying Engine Lift Eye**  
Courtesy of FORD MOTOR CO.

73. Using the Heavy Duty Floor Crane and Spreader Bar and a suitable engine crane, remove the engine and transaxle from the lift table.



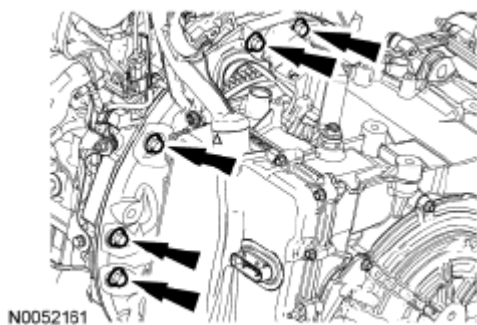
**Fig. 261: Identifying Heavy Duty Floor Crane And Spreader Bar**  
Courtesy of FORD MOTOR CO.

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



**Fig. 262: Locating Engine-To-Transaxle Bolts**  
Courtesy of FORD MOTOR CO.

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



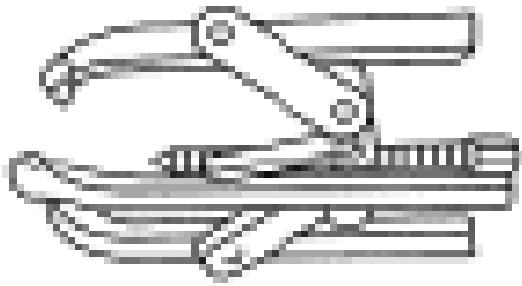
**Fig. 263: Locating Transaxle-To-Engine Bolts**  
Courtesy of FORD MOTOR CO.

## CAMSHAFT

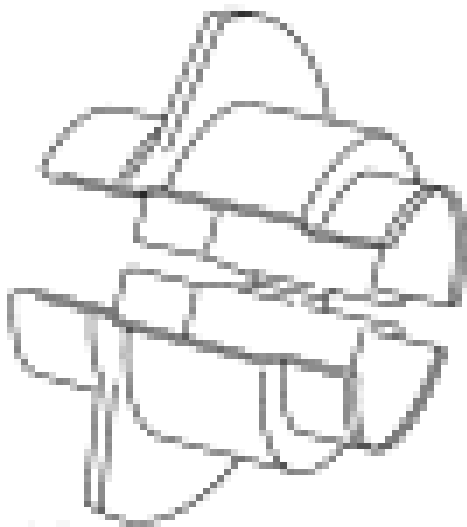
### Special Tool(s)

### SPECIAL TOOL SPECIFICATION

3 Jaw Puller  
303-D121 or equivalent



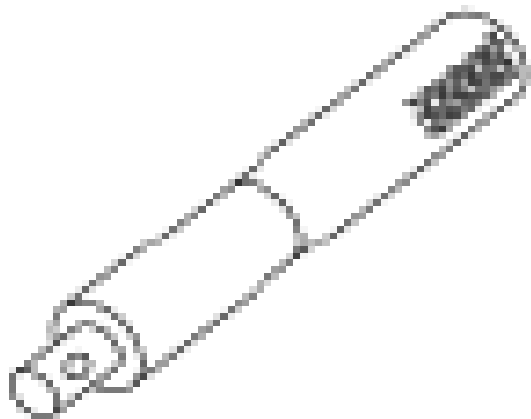
**ST1184-A**



**ST2935A**

Disconnect Tool, Transmission Cooler Line  
307-569

Handle  
205-153 (T80T-4000-W)

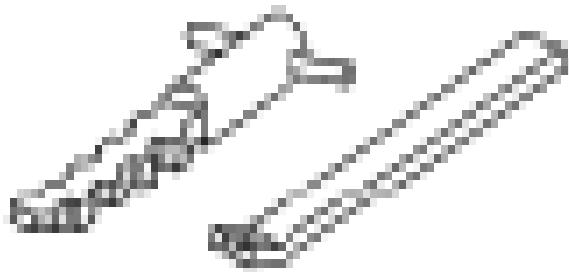


**ST1326-A**



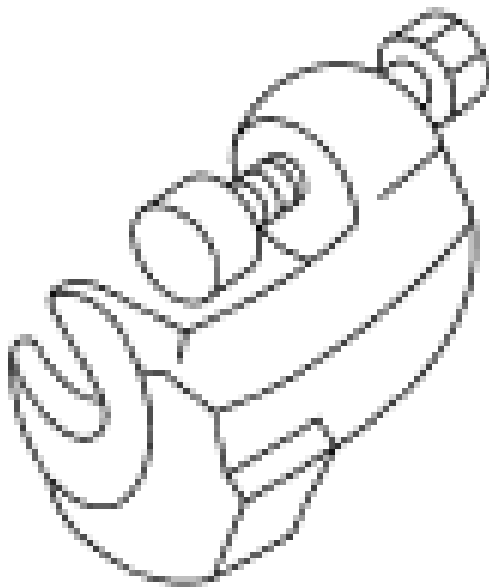
**ST1293-A**

Powertrain Lift  
014-00765 or equivalent



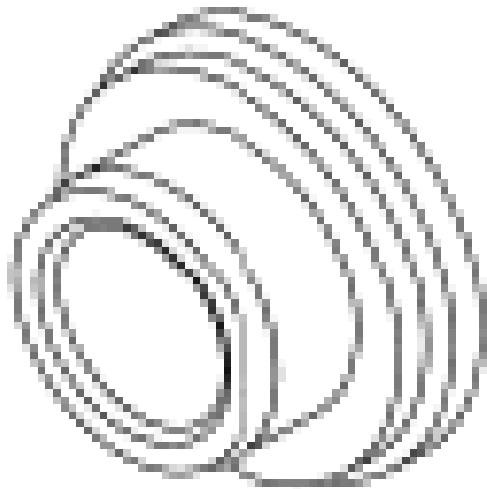
Remover, Oil Seal  
303-409 (T92C-6700CH)

ST1385-A



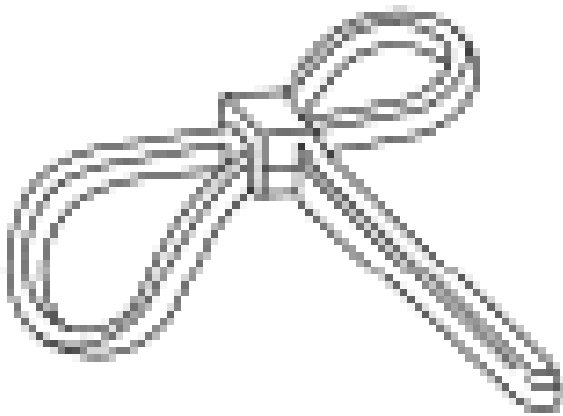
Remover, Tie-Rod End  
211-105

ST1408-A



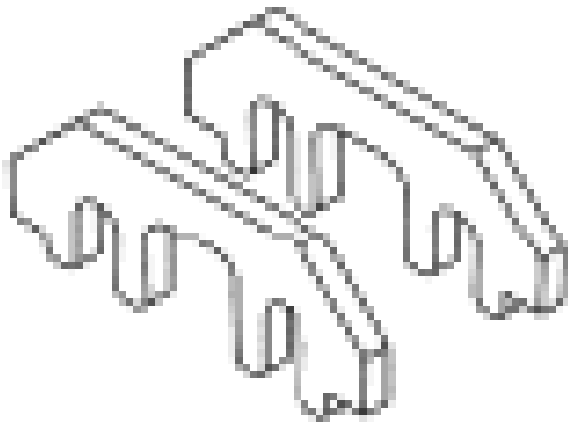
**ST2082-A**

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



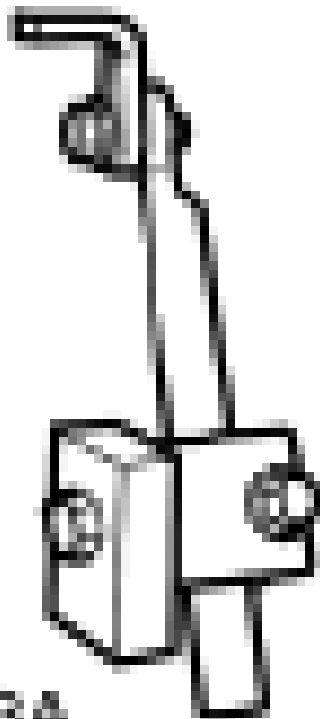
**ST1438-A**

Strap Wrench  
303-D055 (D85L-6000-A) or equivalent



Tool, Camshaft Holding  
303-1248

ST2979-A



Universal Adapter Brackets  
014-00001 or equivalent

ST2743A

**Material**

**MATERIAL SPECIFICATION**

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

**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, can cause engine failure.

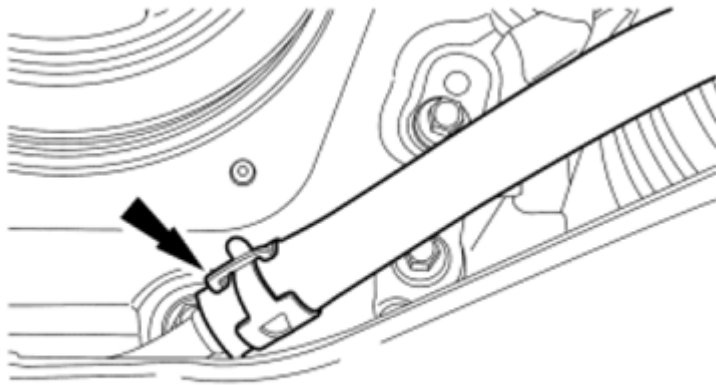
**NOTE:** Early build engines have 11 fastener valve covers, late build engines have 9 fastener valve covers. Do not attempt to install bolts in the 2 empty late build valve cover holes or damage to the valve cover will occur.

**NOTE:** On early build engines, the timing chain rides on the inner side of the RH timing chain guide. Late build engines are equipped with a different design RH timing chain guide that requires the timing chain to ride on the outer side of the RH timing chain guide. For service, all replacement RH timing chain guides will be the late build design.

**All vehicles**

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. Release the fuel system pressure. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION**.
4. Drain the engine cooling system. For additional information, refer to **ENGINE COOLING**.
5. Remove the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE**.
6. Remove the LH halfshaft and intermediate shaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS**.
7. Disconnect the power steering cooler hose and drain the power steering fluid into a suitable drain pan.





N0055404

**Fig. 264: Locating Power Steering Cooler Hose**  
Courtesy of FORD MOTOR CO.

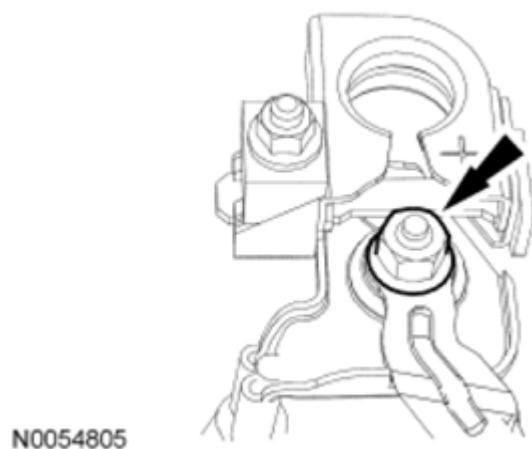
8. Remove the degas bottle. For additional information, refer to **ENGINE COOLING**.
9. Remove the engine Air Cleaner (ACL) and ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING**.
10. Remove the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES**.
11. Disconnect the battery harness electrical connector.



N0055413

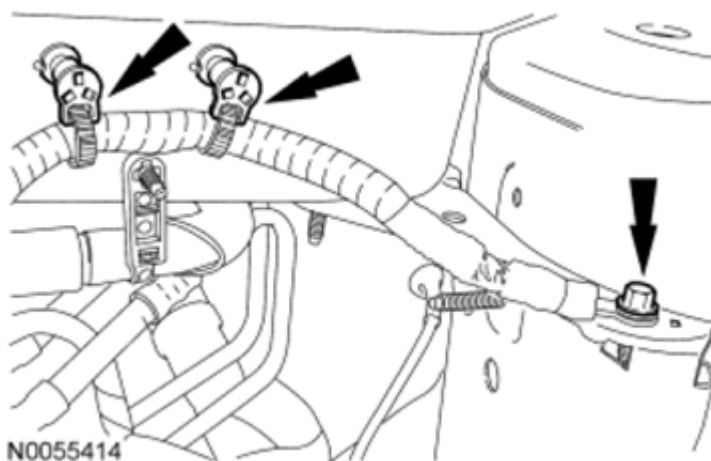
**Fig. 265: Locating Battery Harness Electrical Connector**  
Courtesy of FORD MOTOR CO.

12. Remove the nut and disconnect the power feed from the battery terminal.



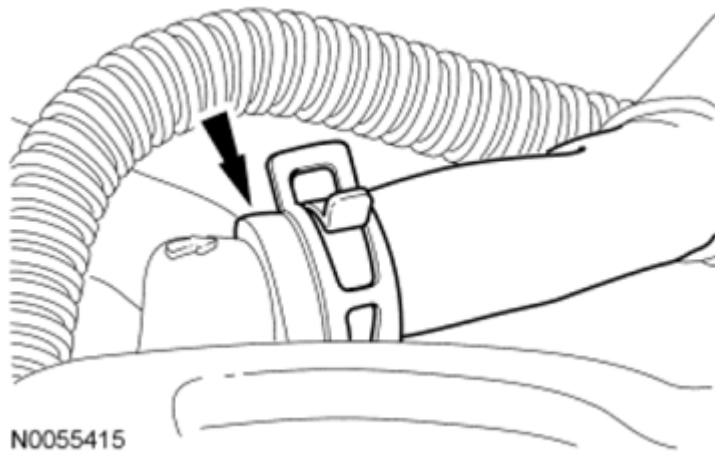
**Fig. 266: Locating Battery Terminal Nut**  
Courtesy of FORD MOTOR CO.

13. Remove the bolt and the ground wire.
  - Detach the 2 wiring harness retainers from the cowl.



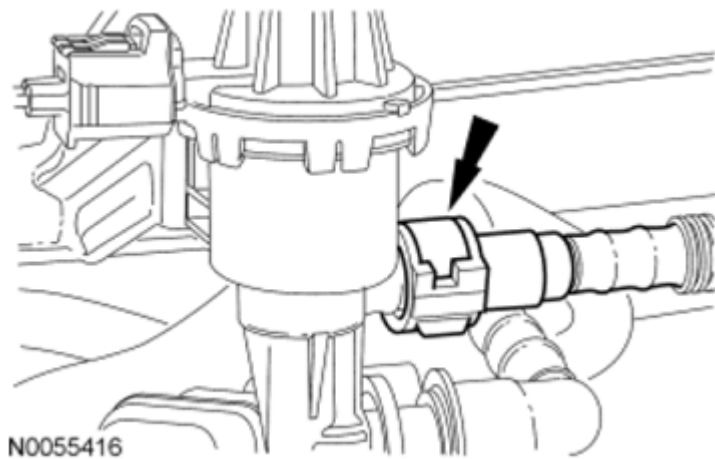
**Fig. 267: Locating Wiring Harness Retainers**  
Courtesy of FORD MOTOR CO.

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



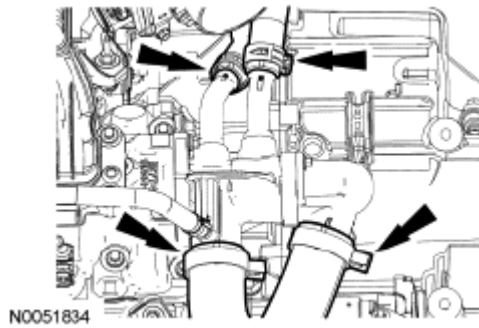
**Fig. 268: Locating Vacuum Hose**  
Courtesy of FORD MOTOR CO.

15. Disconnect the Evaporative Emission (EVAP) tube quick connect coupling from the purge valve. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .



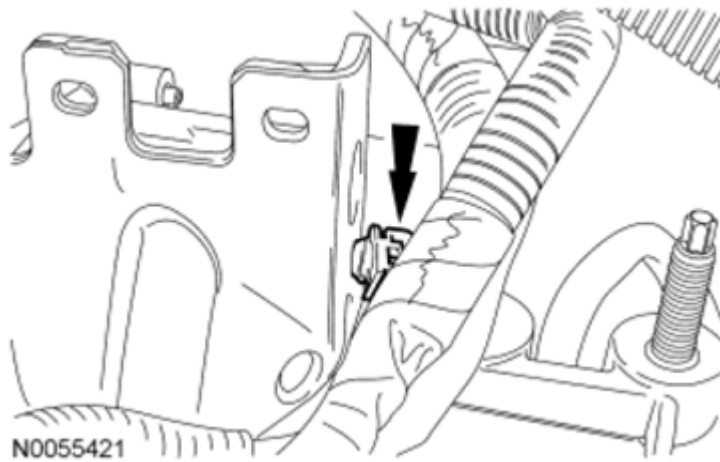
**Fig. 269: Locating Upper Evaporative Emission Tube**  
Courtesy of FORD MOTOR CO.

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



**Fig. 270: Locating Upper And Lower Radiator Hose**  
Courtesy of FORD MOTOR CO.

17. Detach the wiring harness retainer from the transaxle control cable bracket.



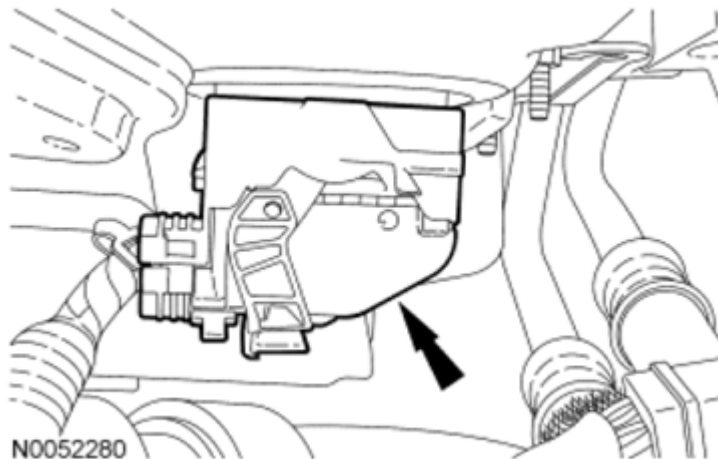
**Fig. 271: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

18. Disconnect the transaxle control cable from the control lever.
  - Detach the control cable from the bracket.



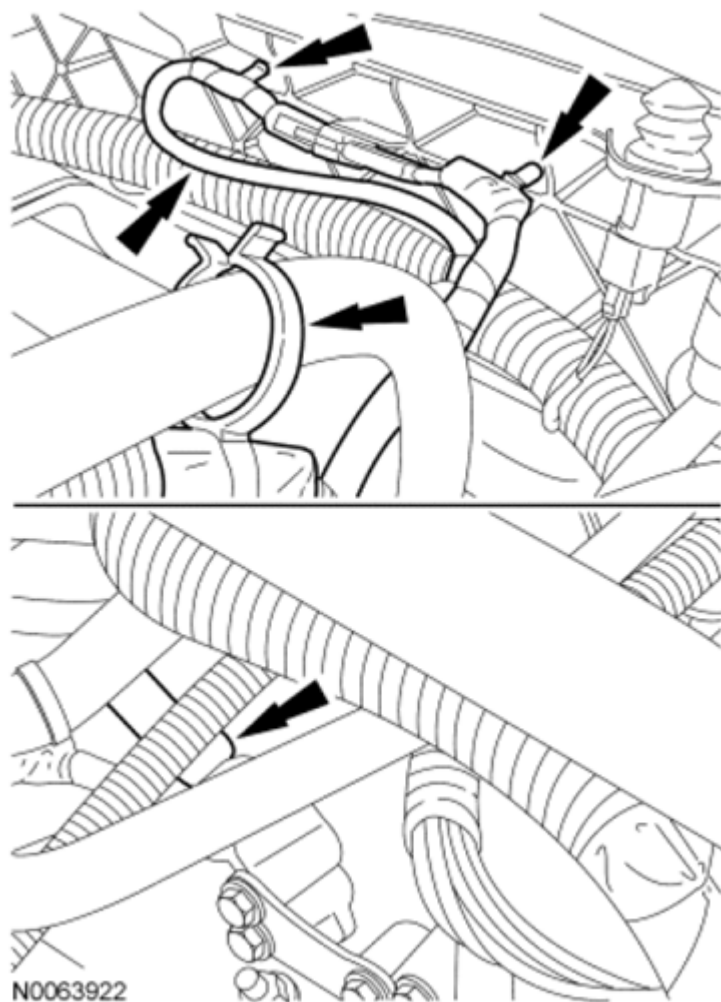
**Fig. 272: Locating Transaxle Control Cable**  
Courtesy of FORD MOTOR CO.

19. Disconnect the transaxle control electrical connector.



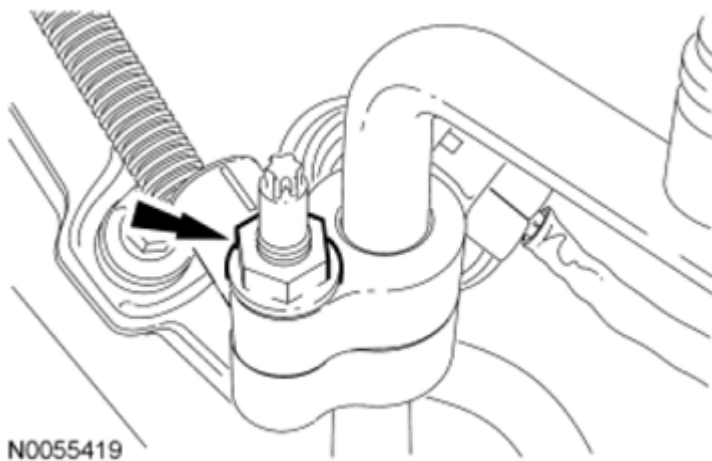
**Fig. 273: Locating Transaxle Control Electrical Connector**  
Courtesy of FORD MOTOR CO.

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



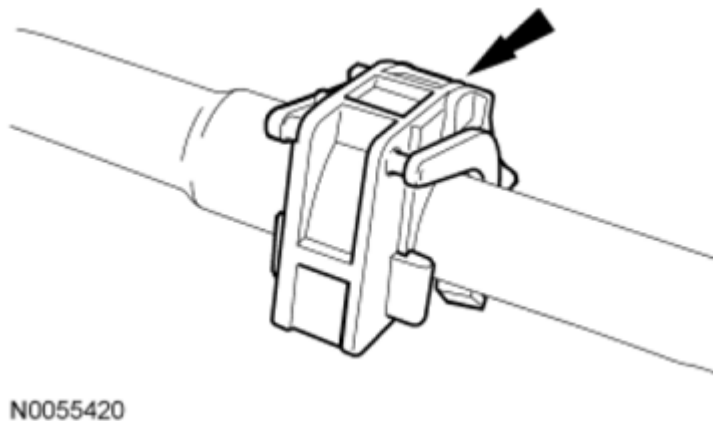
**Fig. 274: Locating Engine Block Heater Harness And A/C Suction Tube**  
Courtesy of FORD MOTOR CO.

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



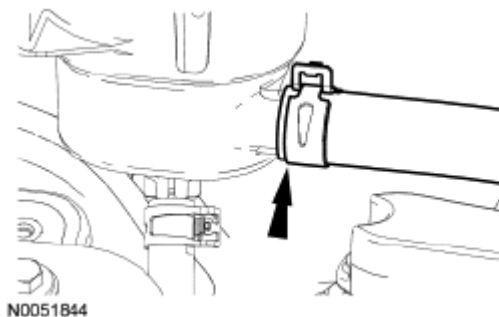
**Fig. 275: Locating A/C Pressure Tube Fitting And Nut**  
Courtesy of FORD MOTOR CO.

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



**Fig. 276: Locating A/C Suction Tube Safety Clip**  
Courtesy of FORD MOTOR CO.

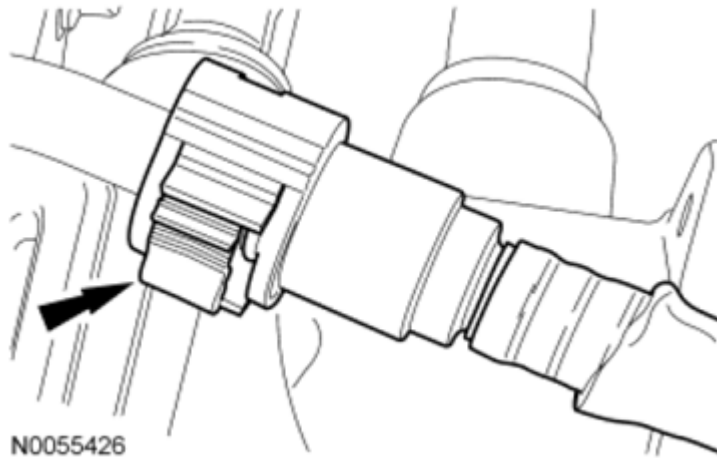
23. Disconnect the hose from the power steering reservoir.



**Fig. 277: Locating Hose**

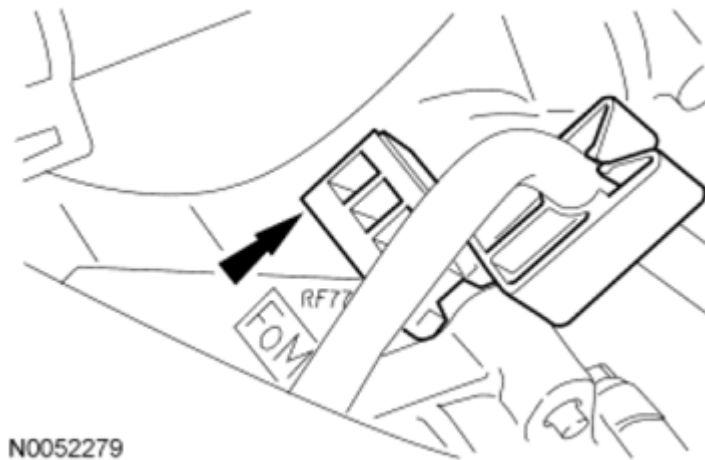
Courtesy of FORD MOTOR CO.

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

**Fig. 278: Locating Fuel Supply Tube**

Courtesy of FORD MOTOR CO.

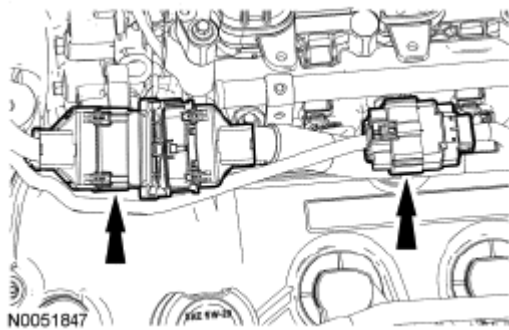
25. Disconnect the fuel hose routing clip from the transaxle stud and position the fuel hose aside.

**Fig. 279: Locating Fuel Hose Routing Clip**

Courtesy of FORD MOTOR CO.

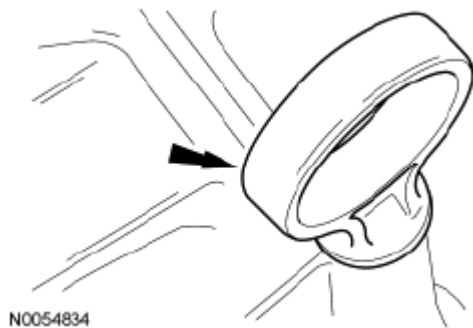
26. Disconnect the 2 engine wiring harness electrical connectors.
- Detach the electrical connector from the LH valve cover.





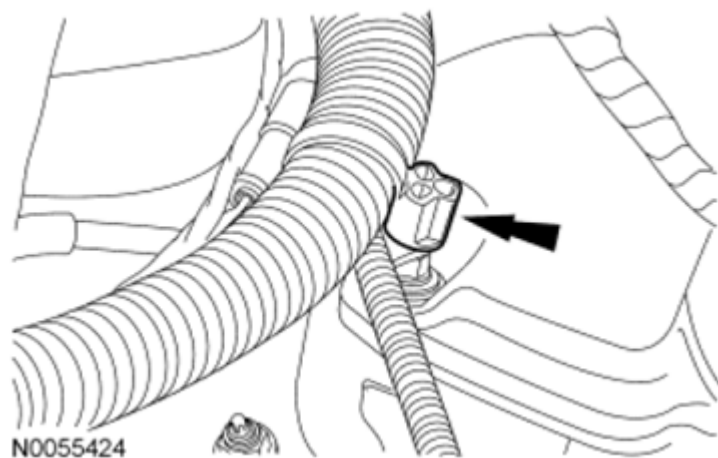
**Fig. 280: Locating Engine Wiring Harness Electrical Connectors**  
Courtesy of FORD MOTOR CO.

27. Remove the oil level indicator.



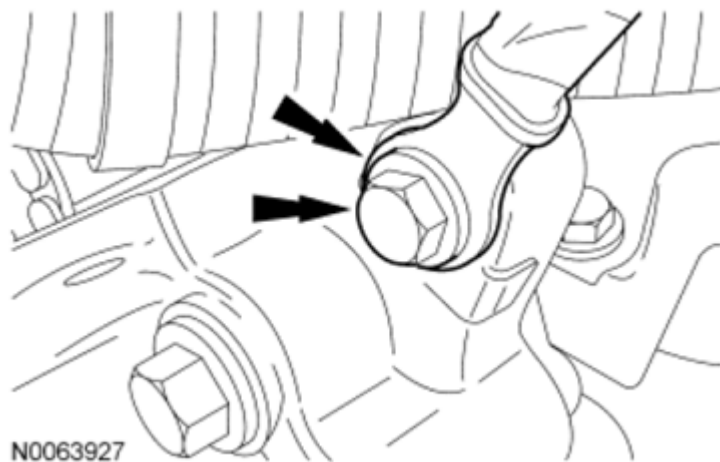
**Fig. 281: Locating Oil Level Indicator**  
Courtesy of FORD MOTOR CO.

28. Detach the wiring harness retainer from the RH valve cover stud bolt.



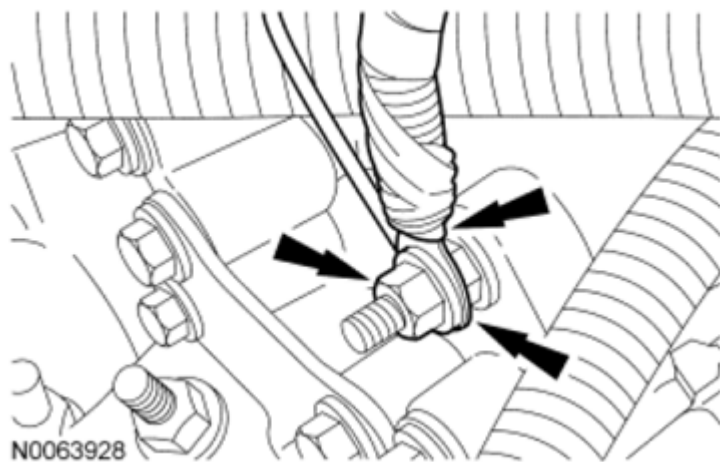
**Fig. 282: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

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



**Fig. 283: Locating Ground Wire Bolt**  
Courtesy of FORD MOTOR CO.

30. Remove the nut, the ground wire and the radio interference capacitor wire from the engine front cover stud.



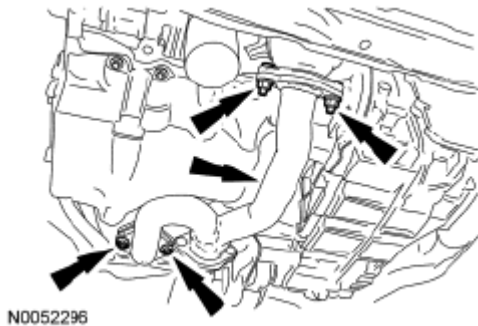
**Fig. 284: Locating Ground Wire Nut**  
Courtesy of FORD MOTOR CO.

31. Loosen the exhaust flexible pipe clamp and disconnect the 2 exhaust hangers.



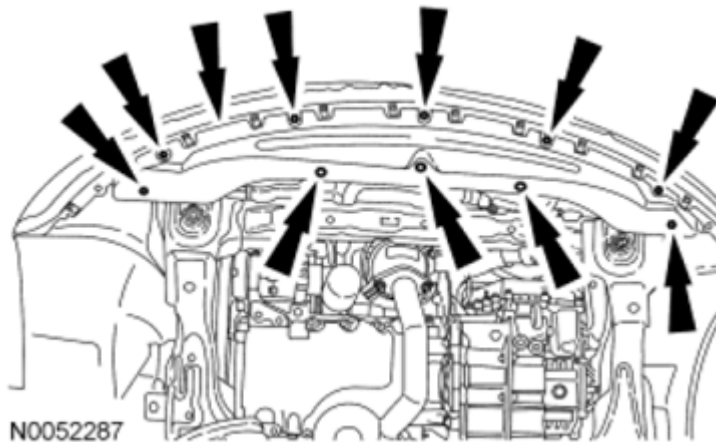
**Fig. 285: Locating Exhaust Flexible Pipe Clamp**  
Courtesy of FORD MOTOR CO.

32. Remove the 4 nuts and the exhaust flexible pipe and Y-pipe as an assembly.
  - Discard the nuts and the gasket.



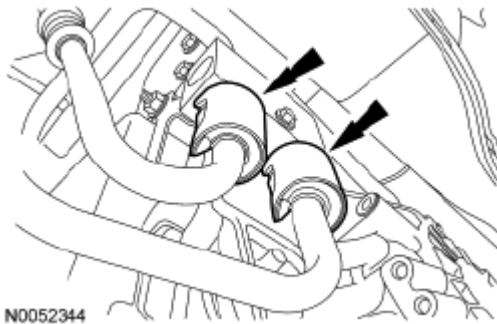
**Fig. 286: Locating Exhaust Flexible Pipe Nuts**  
Courtesy of FORD MOTOR CO.

33. Remove the 3 pin-type retainers, the 7 screws and the radiator splash shield.



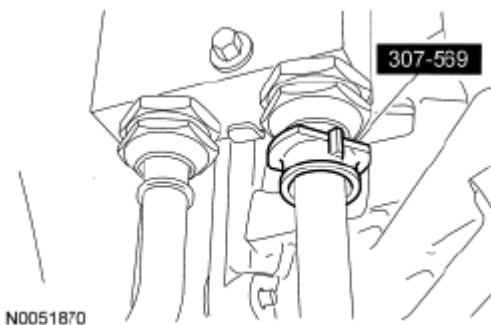
**Fig. 287: Locating Pin-Type Retainers**  
Courtesy of FORD MOTOR CO.

34. Remove the LH inner splash shield. For additional information, refer to **FRONT END BODY PANELS**.
35. Remove the 2 secondary latches from the transmission fluid cooler tubes.



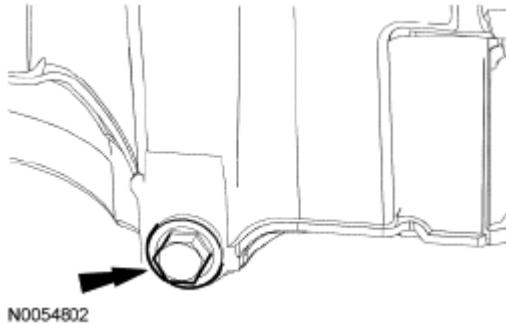
**Fig. 288: Locating Secondary Latches**  
Courtesy of FORD MOTOR CO.

36. Using the Transmission Cooler Line Disconnect Tool, disconnect the transmission cooling tubes.



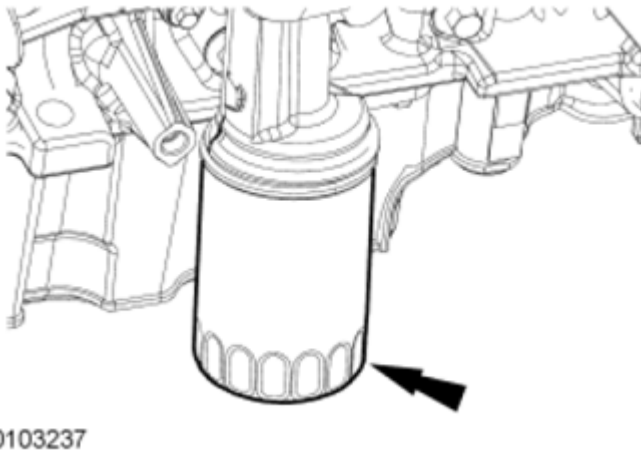
**Fig. 289: Disconnecting Transmission Cooling Tubes**  
Courtesy of FORD MOTOR CO.

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



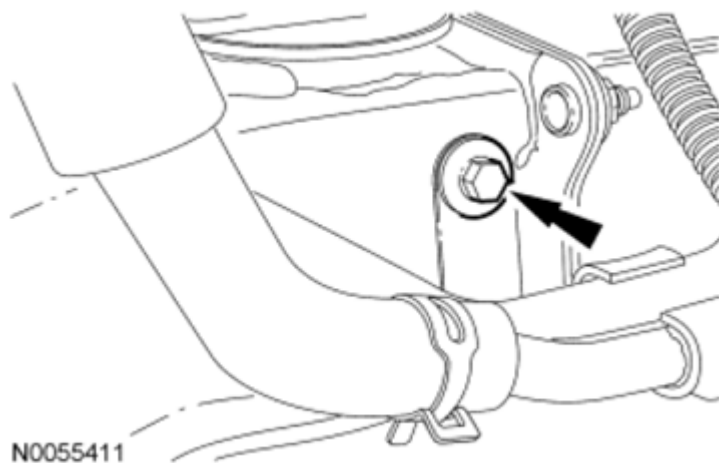
**Fig. 290: Locating Drain Plug**  
Courtesy of FORD MOTOR CO.

38. Remove and discard the engine oil filter.



**Fig. 291: Locating Engine Oil Filter**  
Courtesy of FORD MOTOR CO.

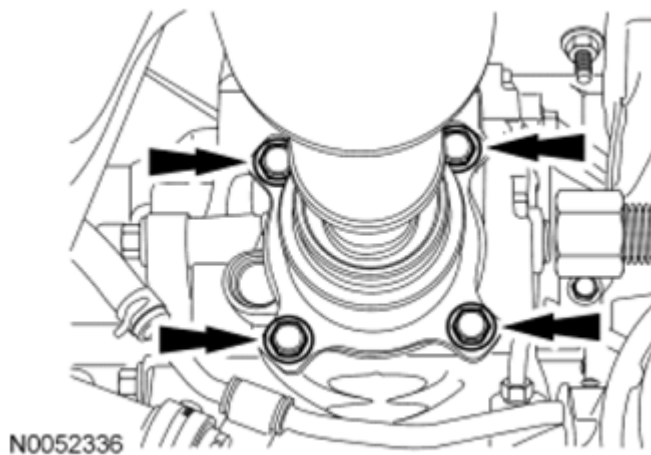
39. Remove the power steering cooler bracket bolt from the RH side of the subframe.



**Fig. 292: Locating Power Steering Cooler Bracket Bolt**  
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

**NOTE:** Index-mark the driveshaft for installation.

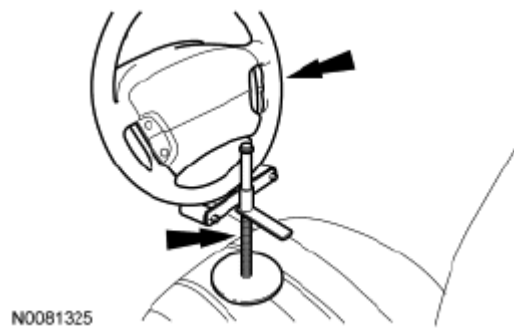


**Fig. 293: Locating Driveshaft Bolts**  
Courtesy of FORD MOTOR CO.

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

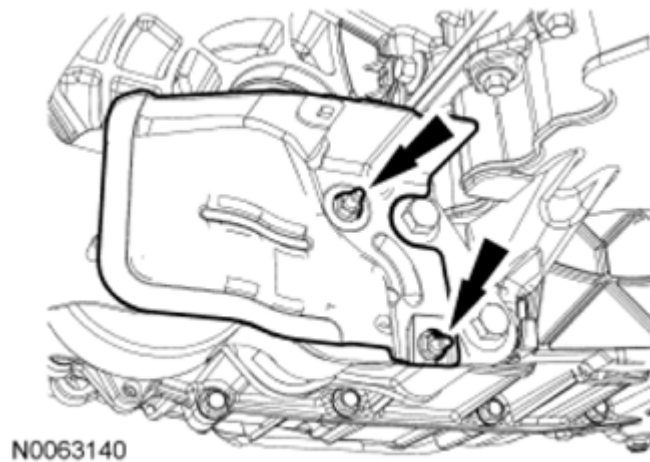
All vehicles

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



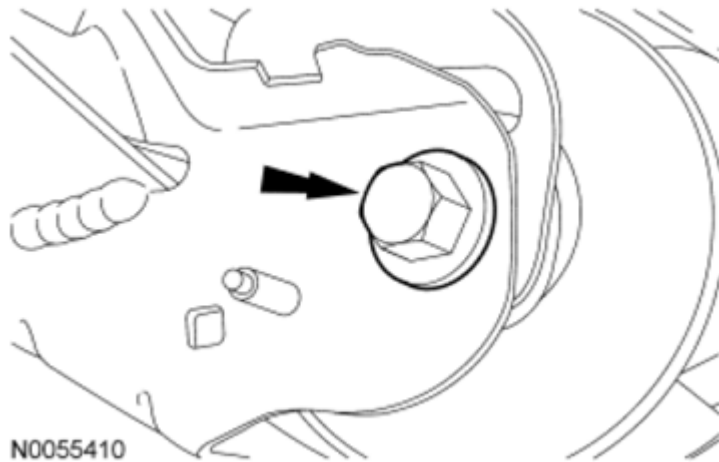
**Fig. 294: Identifying Steering Wheel Holding Device**  
Courtesy of FORD MOTOR CO.

41. Using a suitable holding device, hold the steering wheel in the straight-ahead position.
42. Remove the 2 nuts and the roll restrictor heat shield.



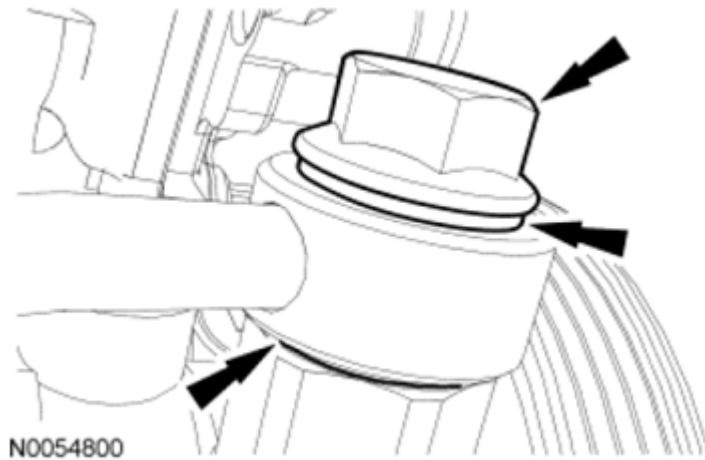
**Fig. 295: Locating Roll Restrictor Heat Shield Nuts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 296: Locating Engine Roll Restrictor-To-Subframe Through Bolt**  
Courtesy of FORD MOTOR CO.

44. Remove and discard the Power Steering Pressure (PSP) tube-to-pump banjo bolt and the 2 seals.

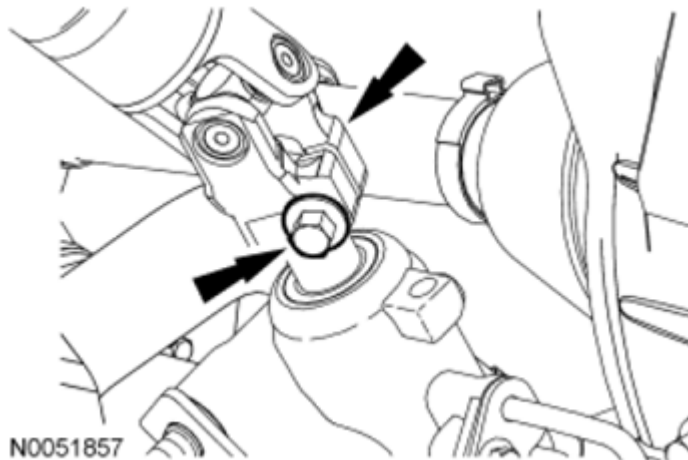


**Fig. 297: Locating Power Steering Pressure Tube-To-Pump Banjo Bolt**  
Courtesy of FORD MOTOR CO.

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

45. Remove and discard the steering intermediate shaft bolt.
- Separate the steering intermediate shaft from the steering gear.

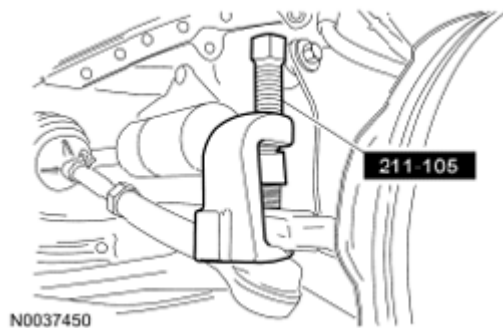




**Fig. 298: Locating Steering Intermediate Shaft Bolt**  
Courtesy of FORD MOTOR CO.

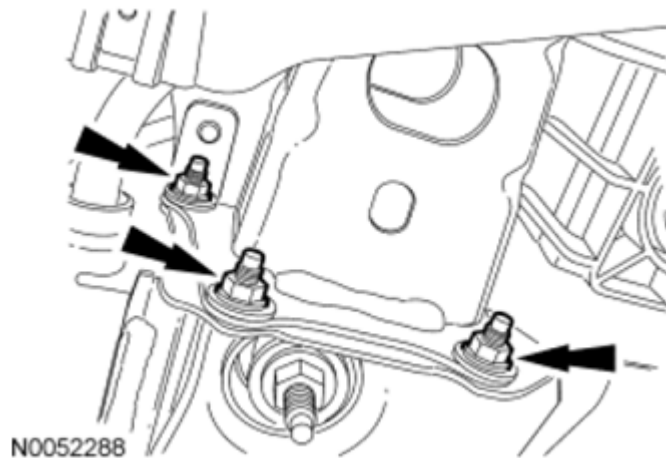
**NOTE:** RH shown in illustration, LH similar.

46. Remove and discard the cotter pins and tie-rod end nuts.
  - Using the Tie-Rod End Remover, separate the tie-rod ends from the wheel knuckles.



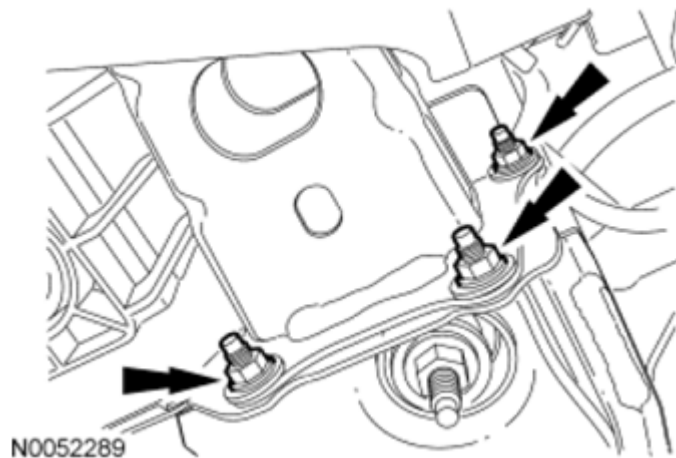
**Fig. 299: Identifying Tie-Rod End Remover**  
Courtesy of FORD MOTOR CO.

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



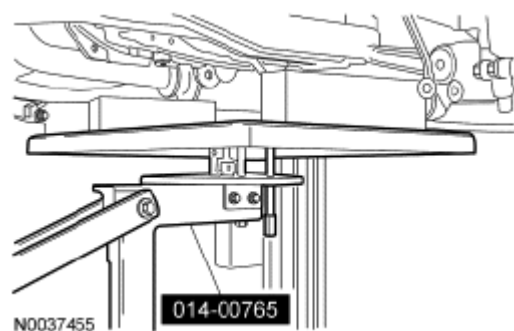
**Fig. 300: Locating RH Subframe-To-Lower Bumper Nuts**  
Courtesy of FORD MOTOR CO.

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



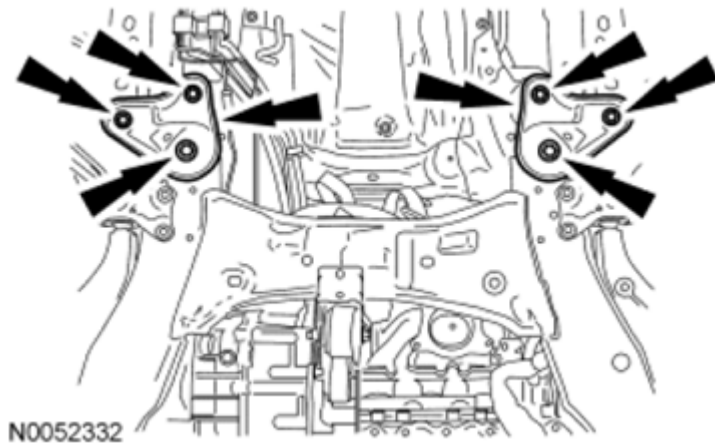
**Fig. 301: Locating LH Subframe-To-Lower Bumper Nuts**  
Courtesy of FORD MOTOR CO.

49. Position the Powertrain Lift under the subframe assembly.



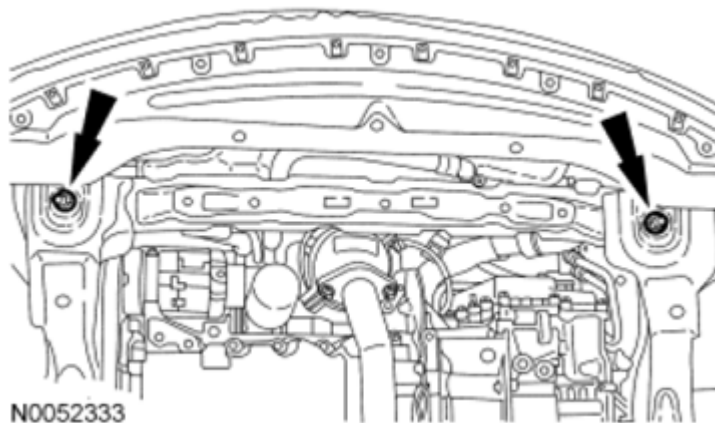
**Fig. 302: Positioning Powertrain Lift Under Subframe Assembly**  
Courtesy of FORD MOTOR CO.

50. Remove the 2 nuts, 4 bolts and the subframe support brackets.



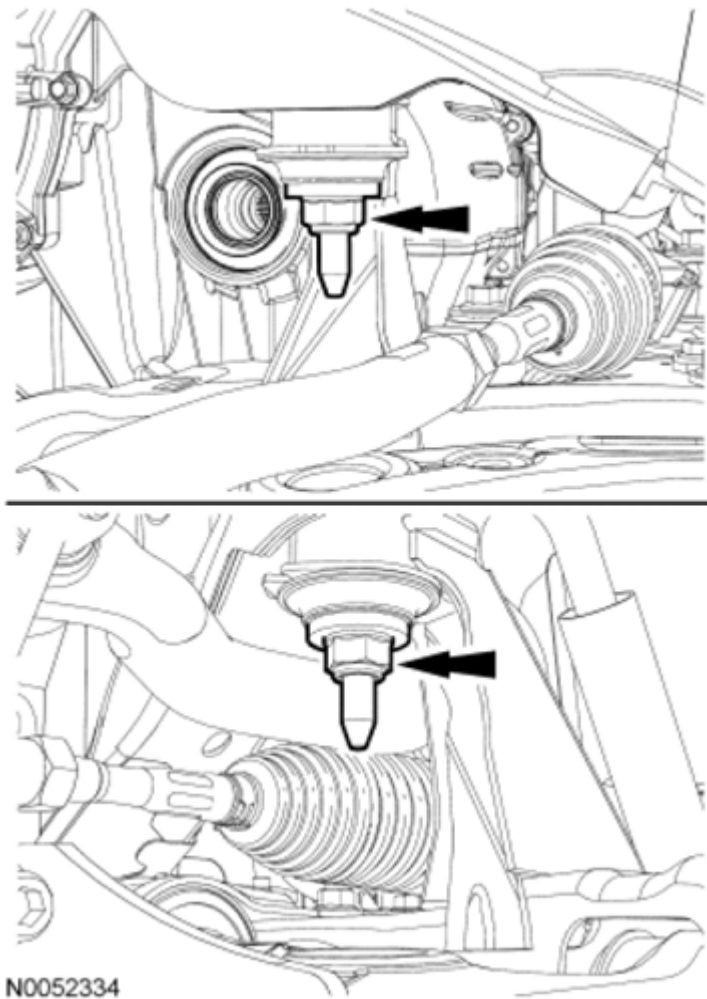
**Fig. 303: Locating Subframe Support Brackets Bolts And Nuts**  
Courtesy of FORD MOTOR CO.

51. Remove the 2 front subframe nuts.



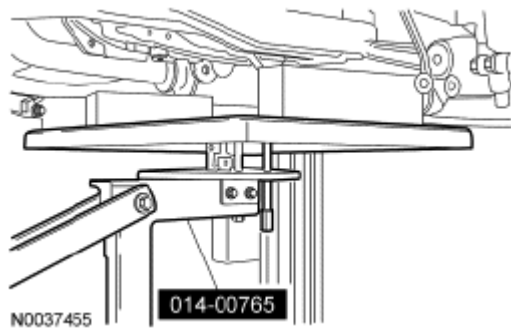
**Fig. 304: Locating Front Subframe Nuts**  
Courtesy of FORD MOTOR CO.

52. Remove the 2 middle subframe nuts.



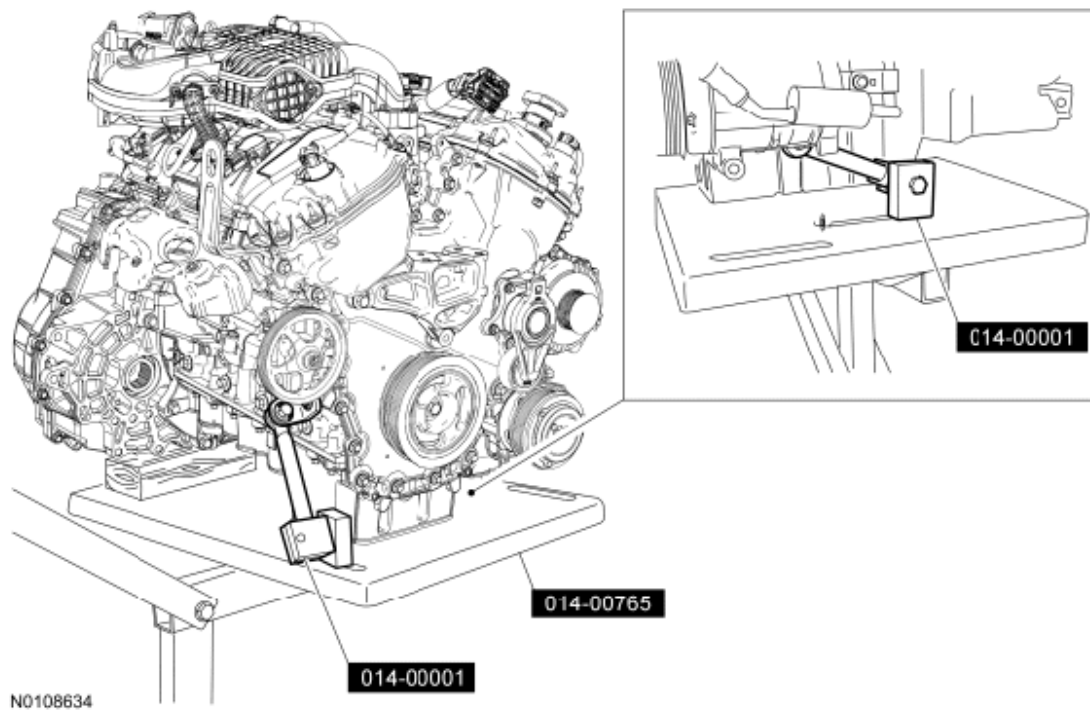
**Fig. 305: Locating Middle Subframe Nuts**  
Courtesy of FORD MOTOR CO.

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



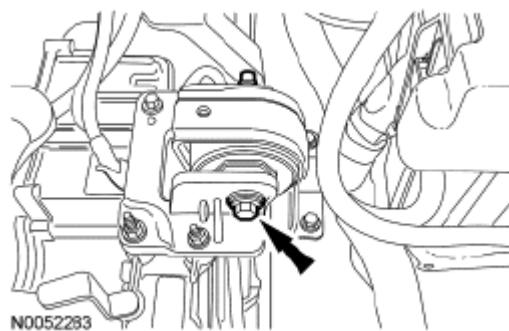
**Fig. 306: Positioning Powertrain Lift Under Subframe Assembly**  
Courtesy of FORD MOTOR CO.

**NOTE:** Position a block of wood under the transaxle.



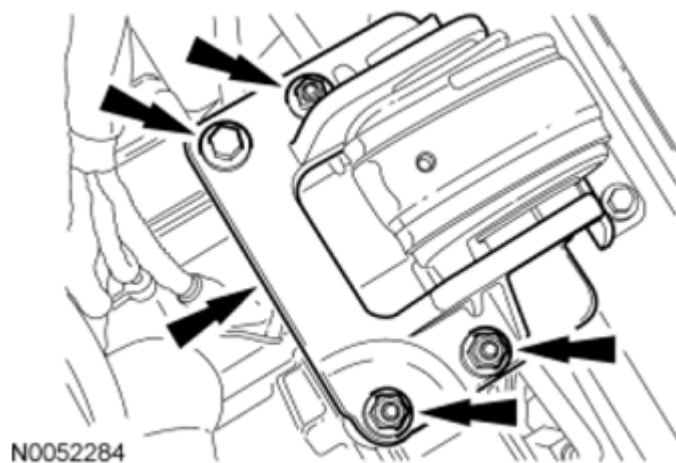
**Fig. 307: Identifying Powertrain Lift And Universal Adapter Brackets**  
Courtesy of FORD MOTOR CO.

54. Install the Powertrain Lift and Universal Adapter Brackets.
55. Remove the transaxle support insulator through bolt and nut.



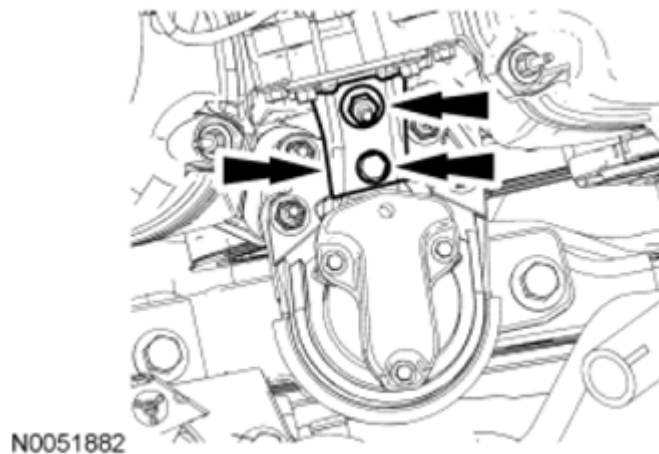
**Fig. 308: Locating Transaxle Support Insulator Through Bolt And Nut**  
Courtesy of FORD MOTOR CO.

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



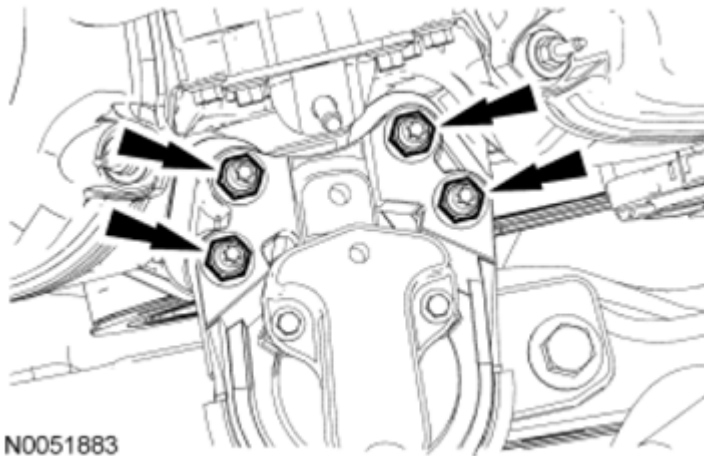
**Fig. 309: Locating Transaxle Support Insulator Bracket Nuts And Bolt**  
Courtesy of FORD MOTOR CO.

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



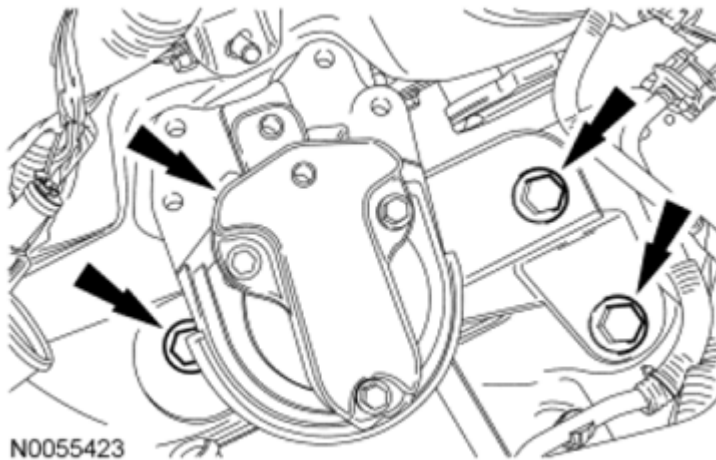
**Fig. 310: Locating Engine Mount Brace Nut And Bolt**  
Courtesy of FORD MOTOR CO.

58. Remove the 4 engine mount nuts.



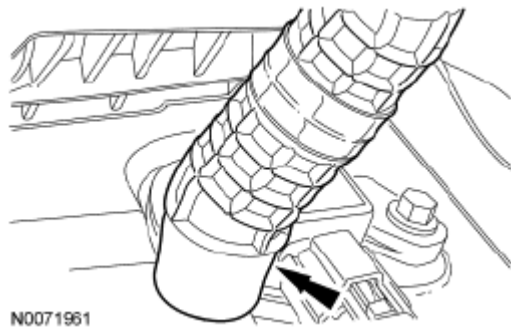
**Fig. 311: Locating Engine Mount Nuts**  
Courtesy of FORD MOTOR CO.

59. Remove the 3 bolts and the engine mount.



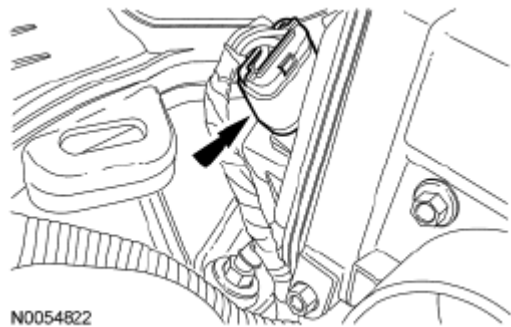
**Fig. 312: Locating Engine Mount Bolts**  
Courtesy of FORD MOTOR CO.

60. Lower the engine and transaxle assembly from the vehicle.  
61. If equipped, detach the engine block heater wiring harness retainers and position the harness aside.  
62. Disconnect the PCV hose from the PCV valve.



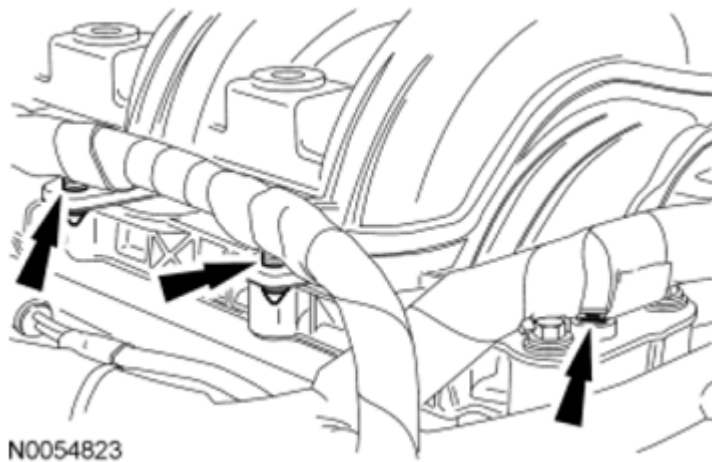
**Fig. 313: Locating PCV Hose**  
Courtesy of FORD MOTOR CO.

63. Disconnect the Throttle Body (TB) electrical connector.



**Fig. 314: Locating Throttle Body Electrical Connector**  
Courtesy of FORD MOTOR CO.

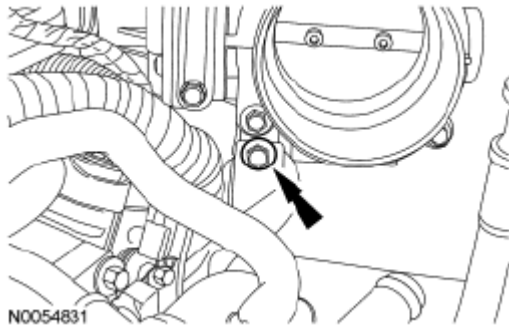
64. Detach the wiring harness retainers from the upper intake manifold.



**Fig. 315: Locating Wiring Harness Retainers**  
Courtesy of FORD MOTOR CO.

65. Remove the upper intake manifold support bracket bolt.

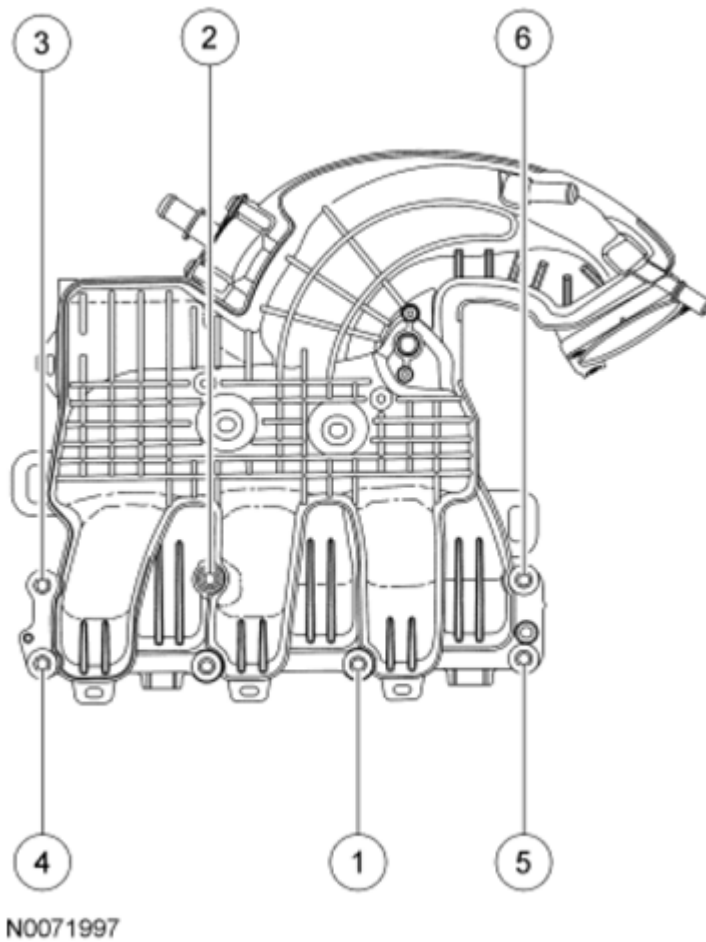




**Fig. 316: Locating Upper Intake Manifold Support Bracket Bolt**  
Courtesy of FORD MOTOR CO.

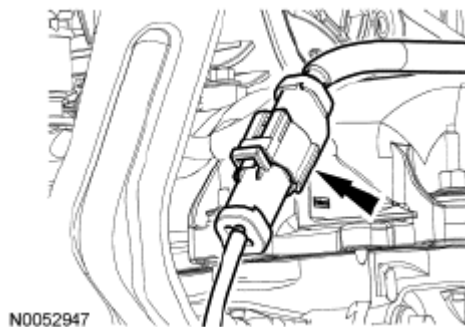
**NOTE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

66. Remove the 6 bolts and the upper intake manifold in the following sequence.
- Discard the gaskets.



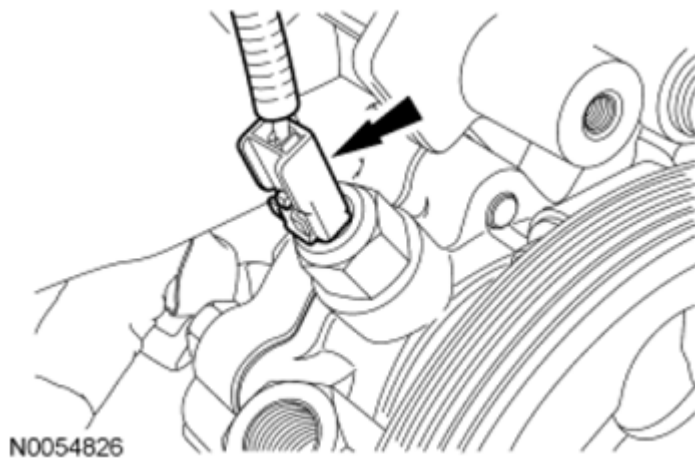
**Fig. 317: Identifying Upper Intake Manifold Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

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



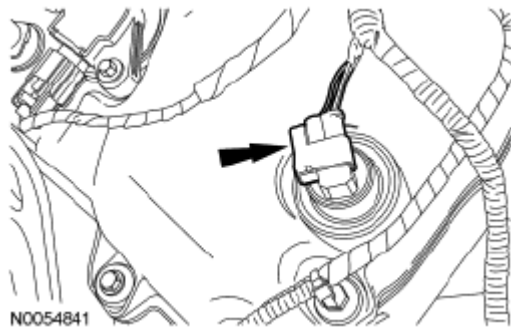
**Fig. 318: Locating RH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

68. Disconnect the **PSP** switch electrical connector.



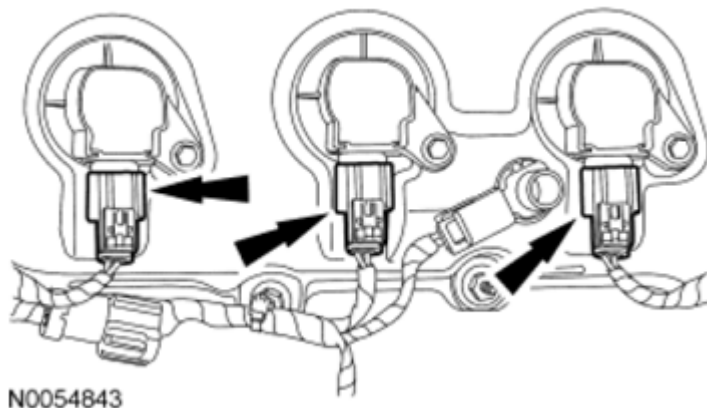
**Fig. 319: Locating PSP Switch Electrical Connector**  
Courtesy of FORD MOTOR CO.

69. Disconnect the RH Variable Camshaft Timing (VCT) solenoid electrical connector.



**Fig. 320: Locating RH Variable Camshaft Timing Solenoid Electrical Connector**  
Courtesy of FORD MOTOR CO.

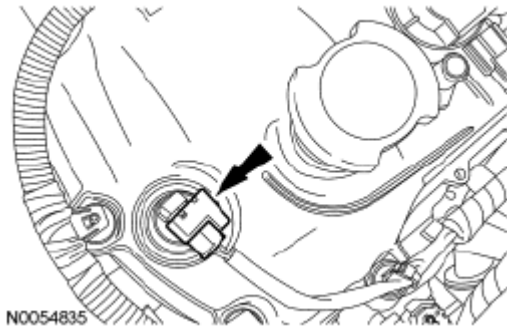
70. Disconnect the 3 RH coil-on-plug electrical connectors.



**Fig. 321: Locating RH Coil-On-Plug Electrical Connectors**

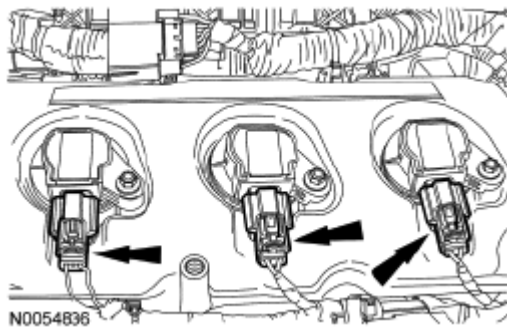
Courtesy of FORD MOTOR CO.

71. Detach all of the wiring harness retainers from the RH valve cover and stud bolts.
72. Disconnect the LH VCT solenoid electrical connector.



**Fig. 322: Locating LH VCT Solenoid Electrical Connector**  
Courtesy of FORD MOTOR CO.

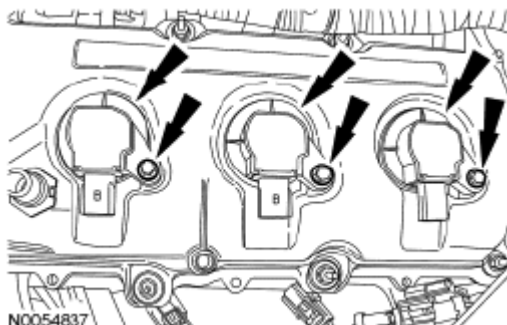
73. Disconnect the 3 LH coil-on-plug electrical connectors.



**Fig. 323: Locating LH Coil-On-Plug Electrical Connectors**  
Courtesy of FORD MOTOR CO.

74. Detach all of the wiring harness retainers from the LH valve cover and stud bolts.

**NOTE:** LH shown in illustration, RH similar.

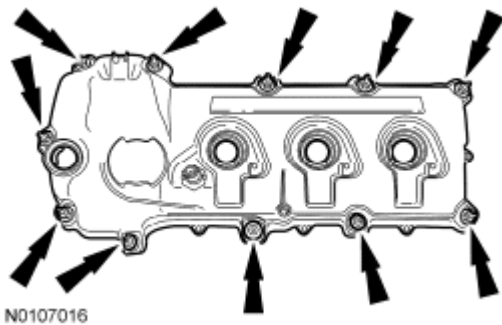


**Fig. 324: Locating Coil-On-Plugs Bolts**  
Courtesy of FORD MOTOR CO.

75. Remove the 6 bolts and the 6 coil-on-plugs.

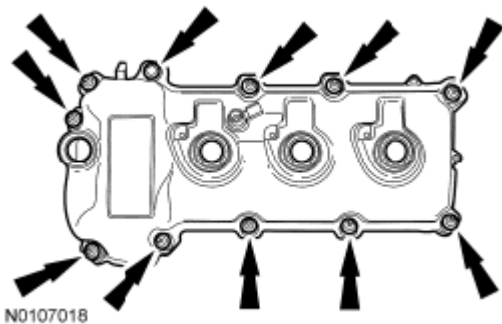
**Early build vehicles**

76. Loosen the 11 stud bolts and remove the LH valve cover.
- Discard the gasket.



**Fig. 325: Locating LH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

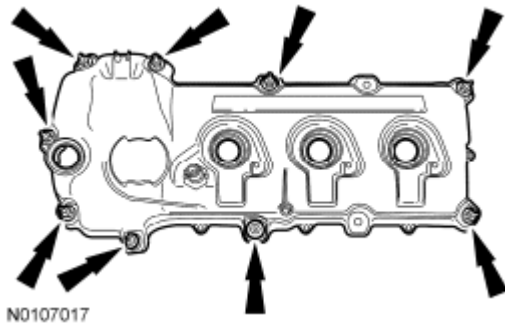
77. Loosen the bolt, the 10 stud bolts and remove the RH valve cover.
- Discard the gasket.



**Fig. 326: Locating RH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

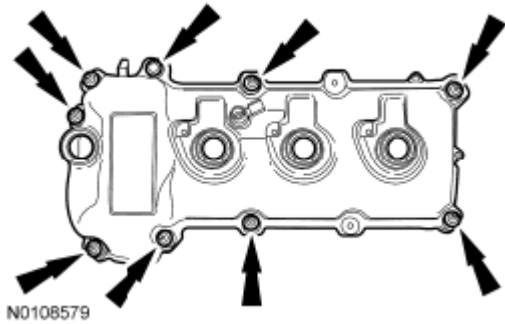
**Late build vehicles**

78. Loosen the 9 stud bolts and remove the LH valve cover.
- Discard the gasket.



**Fig. 327: Locating LH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

79. Loosen the 9 stud bolts and remove the RH valve cover.
  - Discard the gasket.

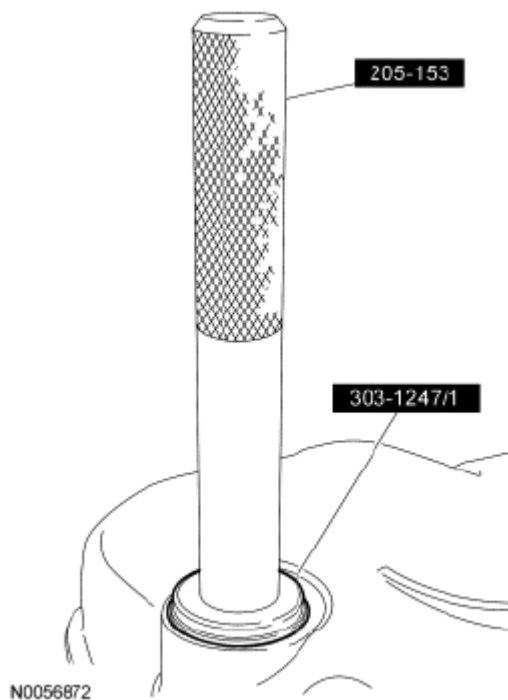


**Fig. 328: Locating RH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

#### All vehicles

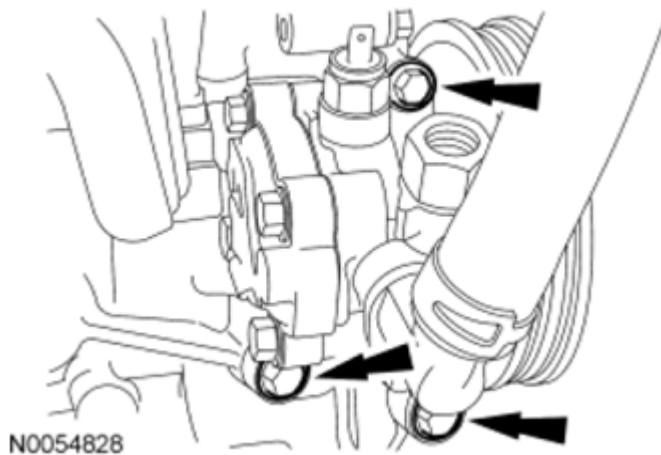
**NOTE:** VCT solenoid seal removal shown in illustration, spark plug tube seal removal similar.

80. Inspect the VCT solenoid seals and the spark plug tube seals. Install new seals if damaged.
  - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



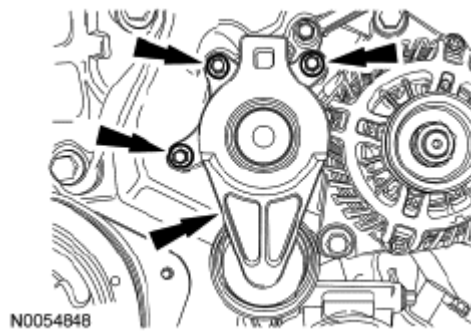
**Fig. 329: Identifying VCT Spark Plug Tube Seal Remover And Handle**  
Courtesy of FORD MOTOR CO.

81. Remove the 3 bolts and the power steering pump.



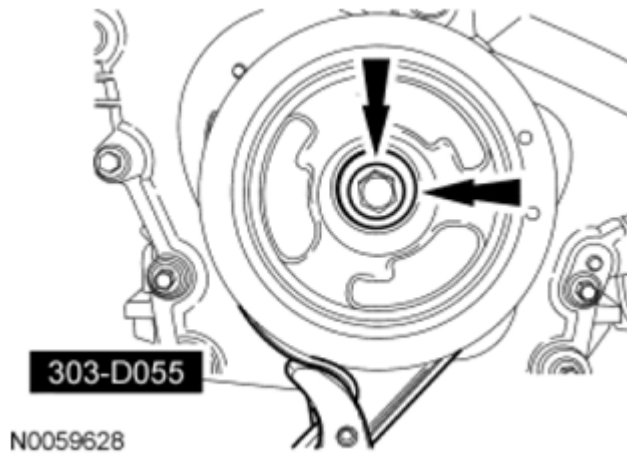
**Fig. 330: Locating Power Steering Pump Bolts**  
Courtesy of FORD MOTOR CO.

82. Remove the 3 bolts and the accessory drive belt tensioner.



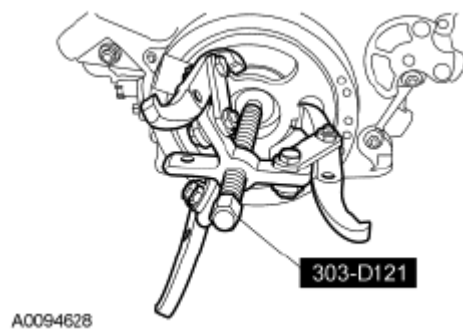
**Fig. 331: Locating Accessory Drive Belt Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

83. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
- Discard the bolt.



**Fig. 332: Locating Crankshaft Pulley Bolt And Washer**  
Courtesy of FORD MOTOR CO.

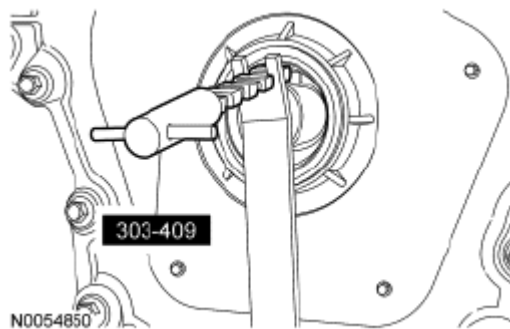
84. Using the 3 Jaw Puller, remove the crankshaft pulley.



**Fig. 333: Removing Crankshaft Pulley**  
Courtesy of FORD MOTOR CO.

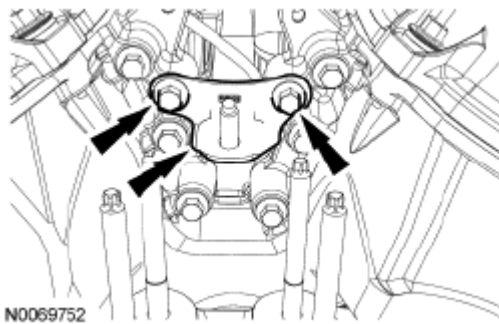


85. Using the Oil Seal Remover, remove and discard the crankshaft front seal.



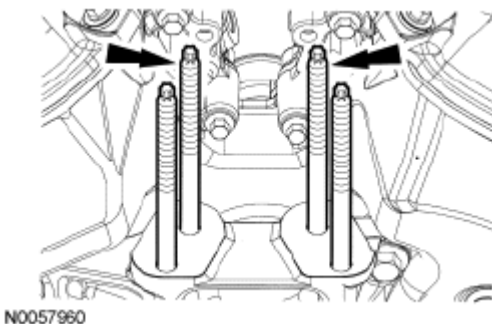
**Fig. 334: Removing Crankshaft Front Seal**  
Courtesy of FORD MOTOR CO.

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



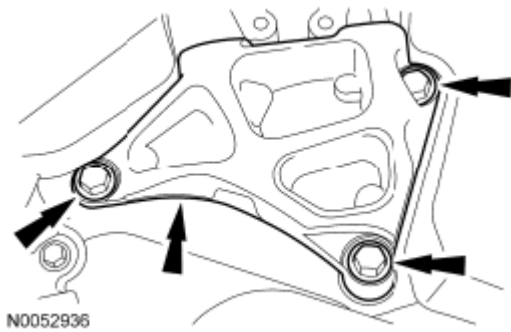
**Fig. 335: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** Only use hand tools to remove the studs.



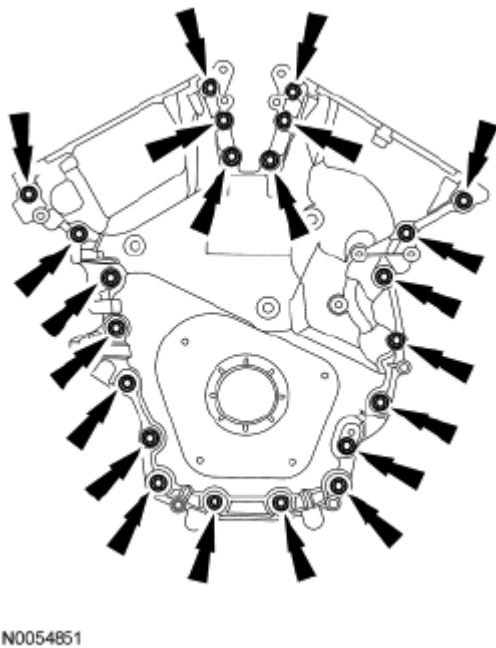
**Fig. 336: Locating Engine Mount Studs**  
Courtesy of FORD MOTOR CO.

87. Remove the 2 engine mount studs.  
88. Remove the 3 bolts and the engine mount bracket.



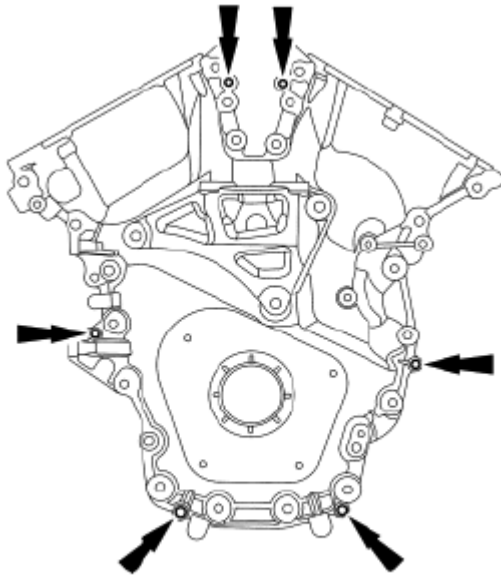
**Fig. 337: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

89. Remove the 22 engine front cover bolts.



**Fig. 338: Locating Engine Front Cover Bolts**  
Courtesy of FORD MOTOR CO.

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



N0082530

**Fig. 339: Locating Engine Front Cover Bolts**  
Courtesy of FORD MOTOR CO.

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

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

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

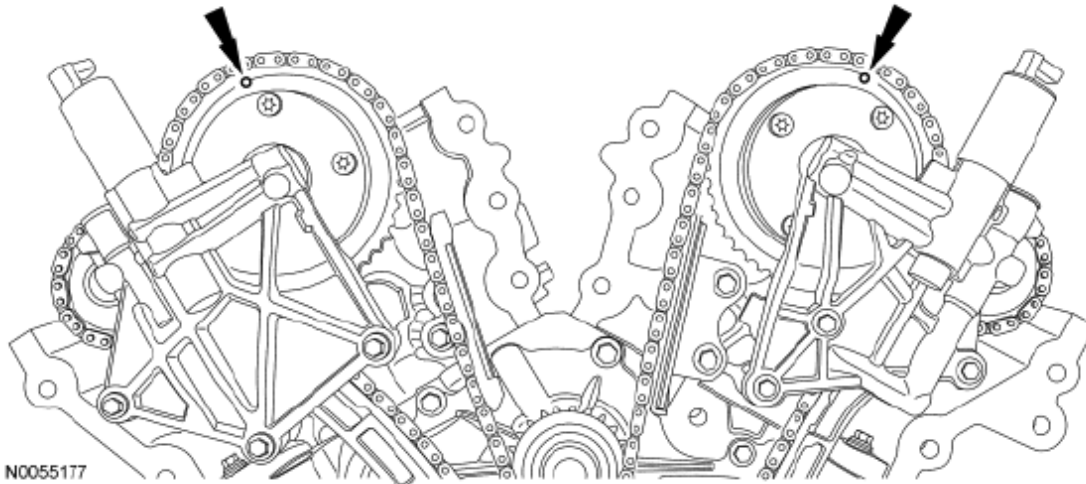
**NOTE:** Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that will cause premature engine failure. Remove all traces of the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

92. Clean the sealing surfaces of the cylinder block in the following sequence.
  1. Remove any large deposits of silicone or gasket material.

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

**Engines equipped with early build RH timing chain guides**

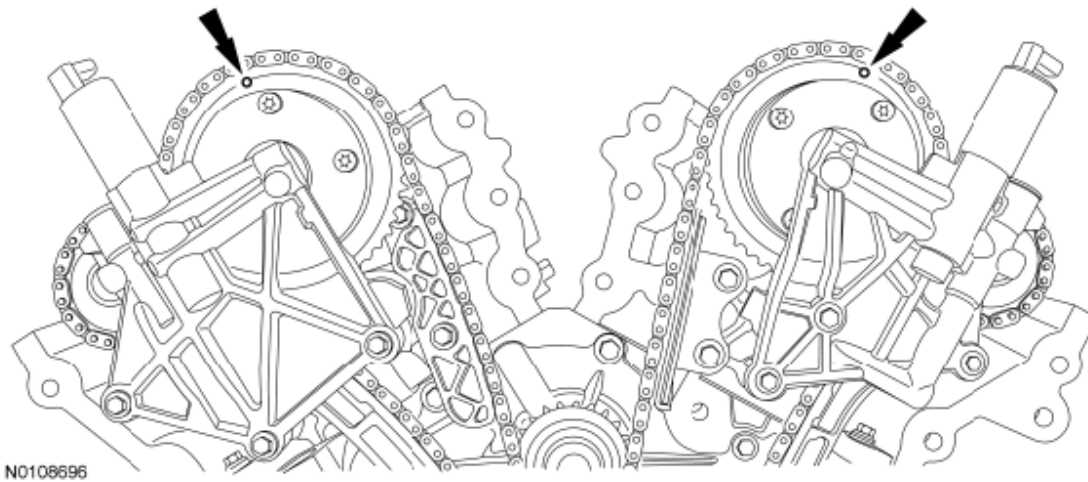
93. Rotate the crankshaft clockwise and align the timing marks on the Variable Camshaft Timing (VCT) assemblies as shown in illustration.



**Fig. 340: Identifying Timing Marks Location**  
Courtesy of FORD MOTOR CO.

**Engines equipped with late build/replacement RH timing chain guides**

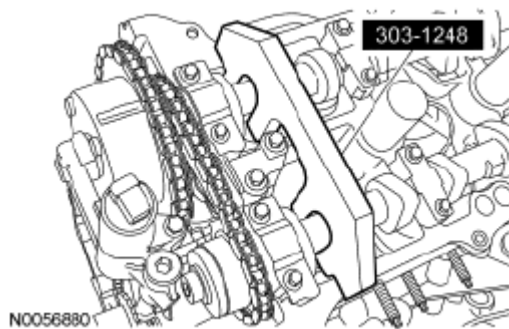
94. Rotate the crankshaft clockwise and align the timing marks on the VCT assemblies as shown in illustration.



**Fig. 341: Aligning Timing Marks On VCT Assemblies**  
Courtesy of FORD MOTOR CO.

All vehicles

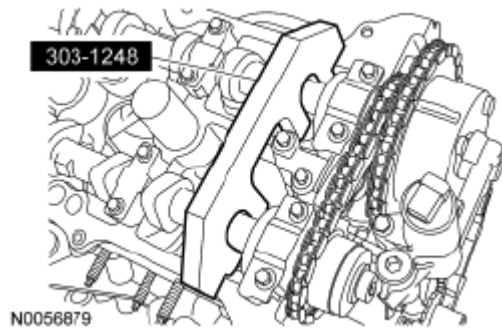
**NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.



**Fig. 342: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

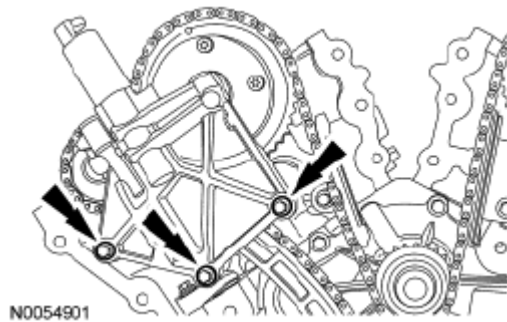
95. Install the Camshaft Holding Tool onto the flats of the LH camshafts.

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



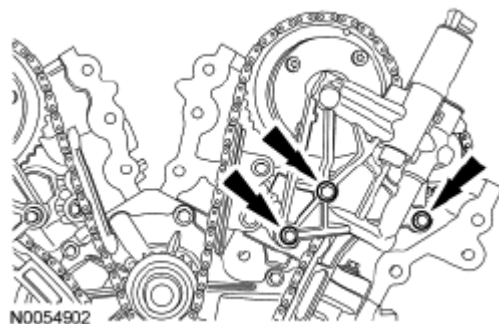
**Fig. 343: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

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



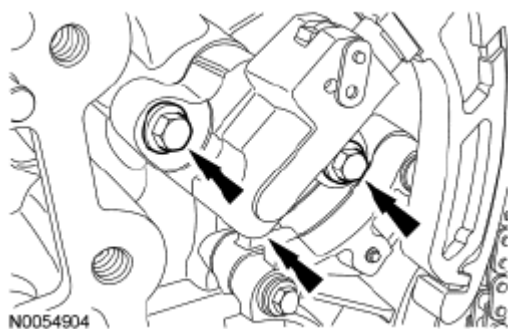
**Fig. 344: Locating RH VCT Housing Bolts**  
Courtesy of FORD MOTOR CO.

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



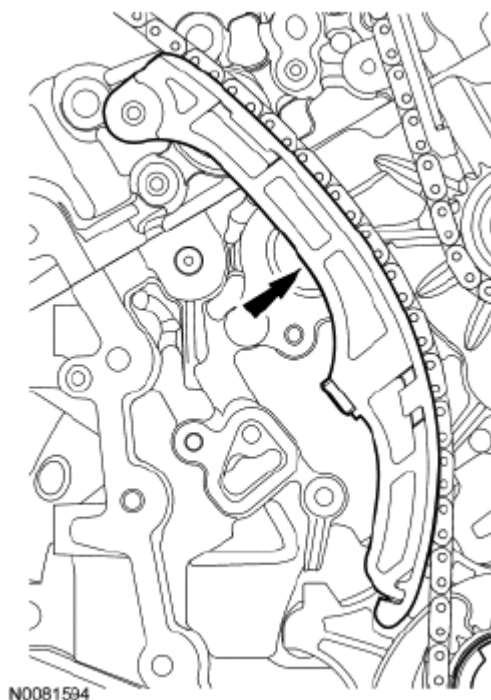
**Fig. 345: Locating LH VCT Housing Bolts**  
Courtesy of FORD MOTOR CO.

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



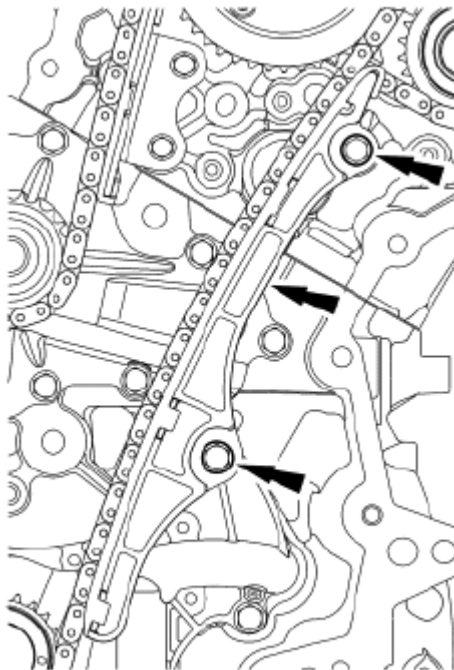
**Fig. 346: Locating Primary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

100. Remove the primary timing chain tensioner arm.



**Fig. 347: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

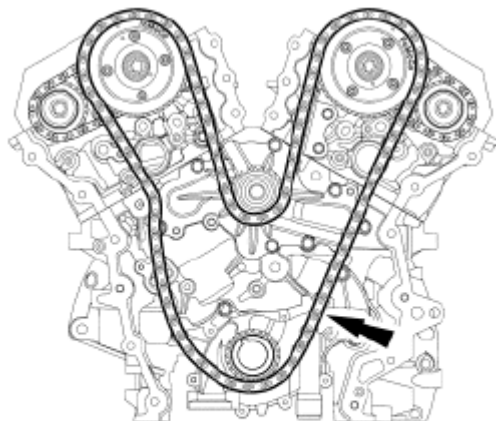
101. Remove the 2 bolts and the lower LH primary timing chain guide.



N0081593

**Fig. 348: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

102. Remove the primary timing chain.



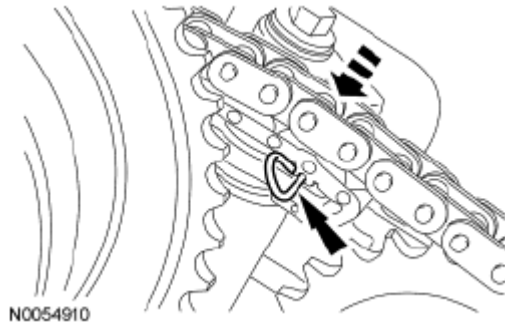
N0054908

**Fig. 349: Locating Primary Timing Chain**  
Courtesy of FORD MOTOR CO.

**LH camshafts**



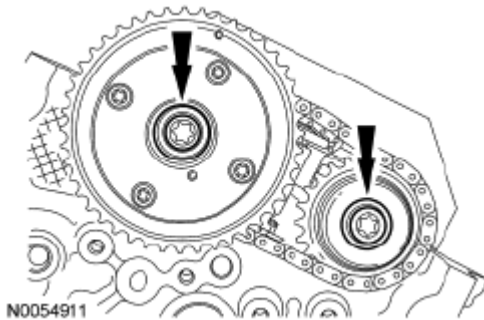
103. Compress the LH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



**Fig. 350: Compressing LH Secondary Timing Chain Tensioner**  
Courtesy of FORD MOTOR CO.

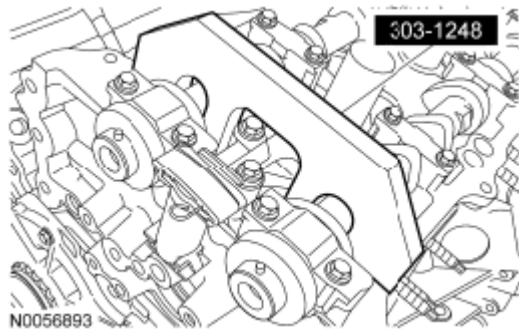
**NOTE:** The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

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



**Fig. 351: Locating Secondary Timing Chain And LH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

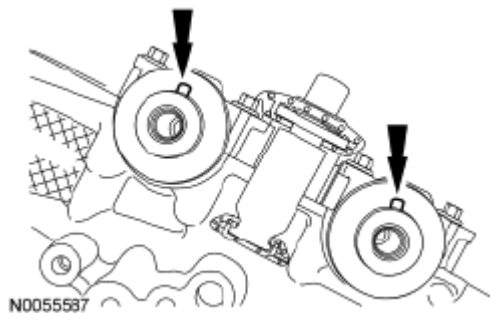
**NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure will rotate the LH camshafts approximately 3 degrees to a neutral position.



**Fig. 352: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

105. Remove the Camshaft Holding Tool from the LH camshafts.

**NOTE:** The camshafts must remain in the neutral position during removal or engine damage may occur.

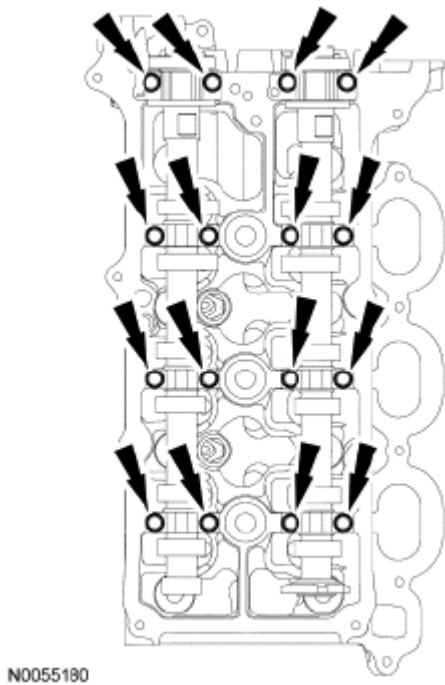


**Fig. 353: Identifying LH Camshafts Neutral Position**  
Courtesy of FORD MOTOR CO.

106. Verify the LH camshafts are in the neutral position.

**NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

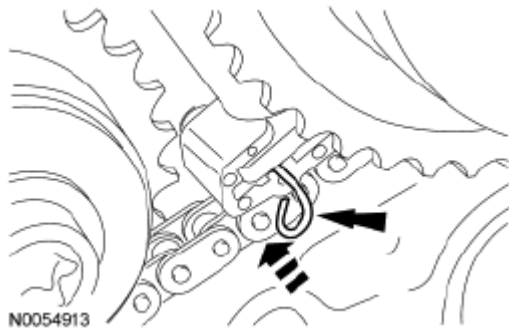
107. Remove the bolts and the LH camshaft bearing caps.
- Remove the LH camshafts.



**Fig. 354: Locating LH Camshaft Bearing Caps Bolts**  
Courtesy of FORD MOTOR CO.

### RH camshafts

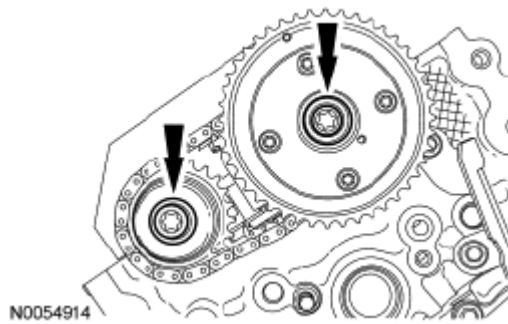
108. Compress the RH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



**Fig. 355: Compressing RH Secondary Timing Chain Tensioner**  
Courtesy of FORD MOTOR CO.

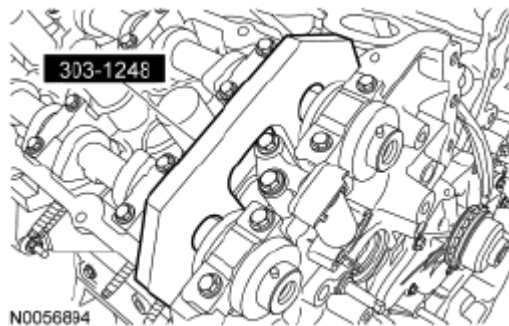
**NOTE:** The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

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



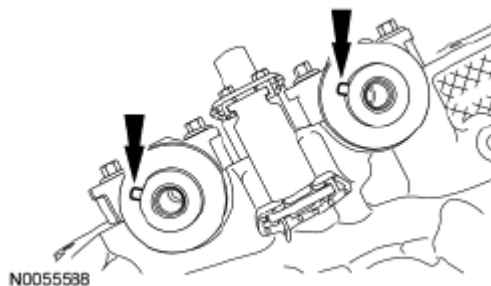
**Fig. 356: Locating Secondary Timing Chain And RH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

110. Remove the Camshaft Holding Tool from the RH camshafts.



**Fig. 357: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

**NOTE:** The camshafts must remain in the neutral position during removal or engine damage may occur.



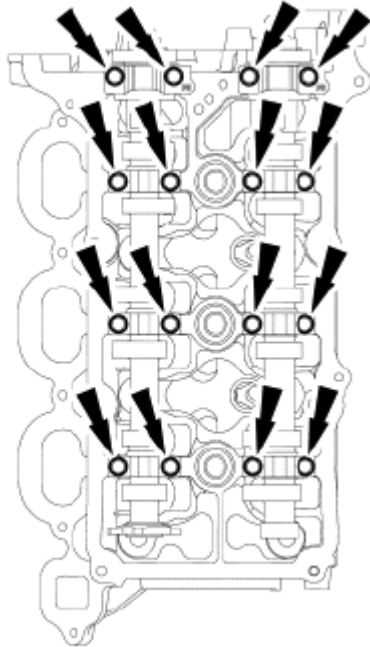
**Fig. 358: Identifying RH Camshafts Neutral Position**  
Courtesy of FORD MOTOR CO.

111. Rotate the RH camshafts counterclockwise to the neutral position.

**NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

112. Remove the bolts and the RH camshaft bearing caps.

- Remove the RH camshafts.



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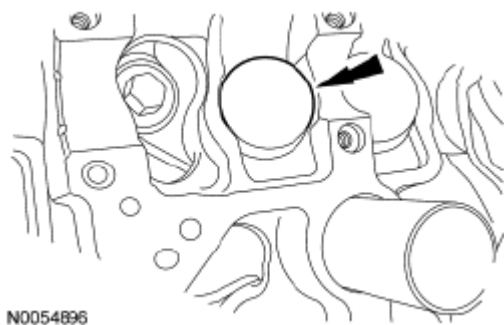
**Fig. 359: Locating RH Camshaft Bearing Caps Bolts**  
Courtesy of FORD MOTOR CO.

## VALVE TAPPETS

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

1. Depending on the valve tappets being serviced, remove the LH and/or the RH camshafts. For additional information, refer to **CAMSHAFT**.

**NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.



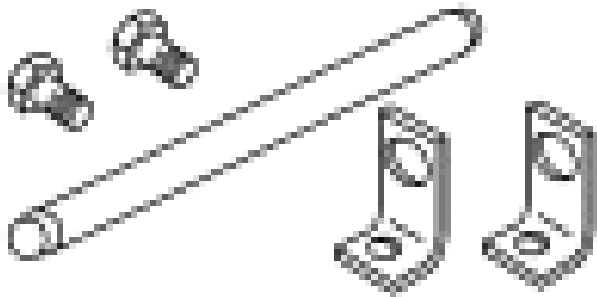
**Fig. 360: Locating Valve Tappets**  
Courtesy of FORD MOTOR CO.

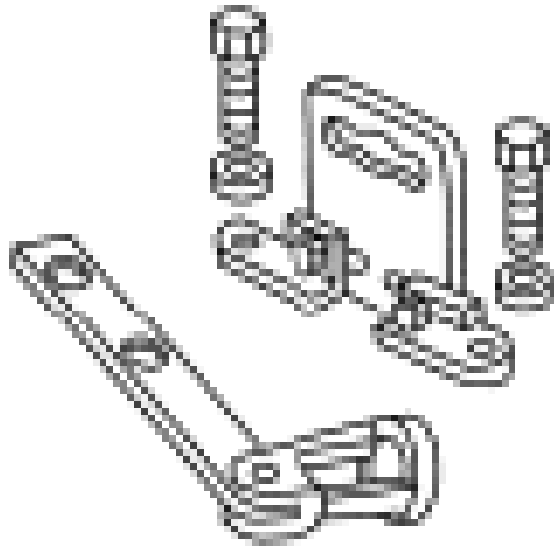
2. Remove the valve tappets from the cylinder head.

### VALVE SPRING, RETAINER AND SEAL

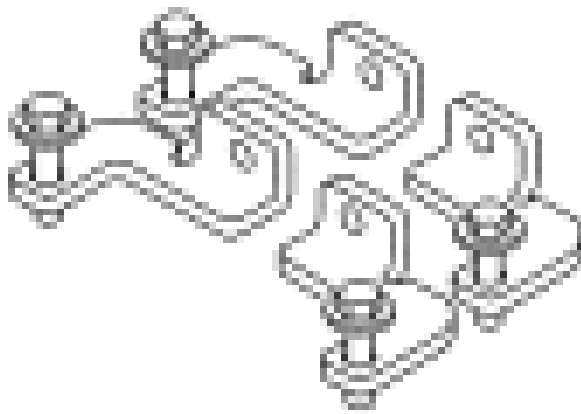
#### Special Tool(s)

#### SPECIAL TOOL SPECIFICATION

 <p>ST1981-A</p>	Compressor, Valve Spring 303-300 (T87C-6565-A)
	Compressor, Valve Spring 303-350 (T89P-6565-A)



ST1907-A



ST302B-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**.

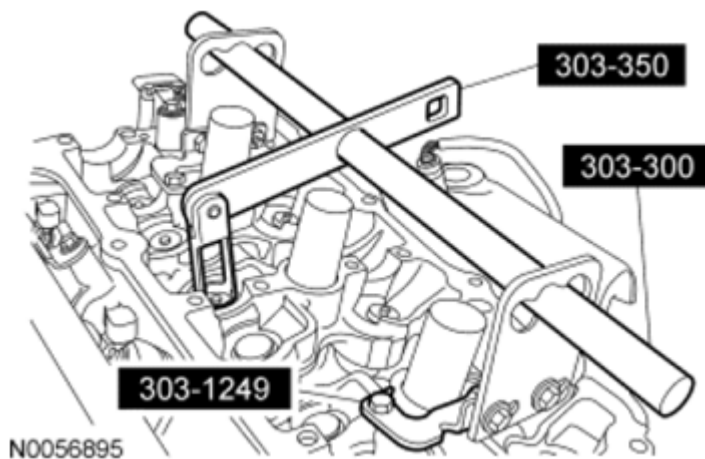
2. Rotate the crankshaft until the piston for the valve being serviced is at the top of its stroke.

**NOTE:** If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed, support the valve prior to removal or engine damage may occur.

**NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

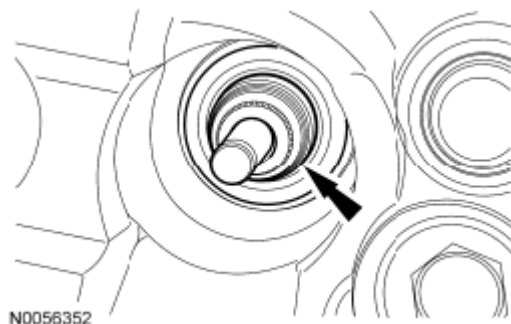
**NOTE:** If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to CYLINDER HEAD - RH or CYLINDER HEAD - LH.

3. Pressurize the cylinder using compressed air.
4. Using the Valve Spring Compressors, remove the keys, retainer and spring.



**Fig. 361: Identifying Valve Spring Compressors**  
Courtesy of FORD MOTOR CO.

5. Remove and discard the valve stem seal.





**Fig. 362: Locating Valve Stem Seal**  
Courtesy of FORD MOTOR CO.

## CYLINDER HEAD - RH

### Material

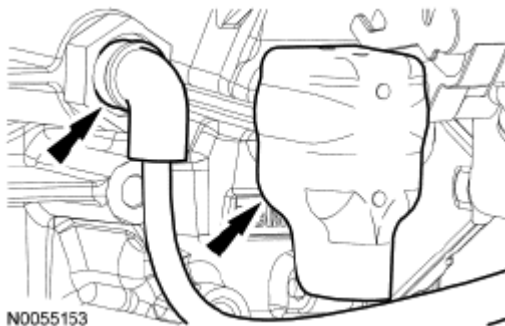
### MATERIAL SPECIFICATION

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

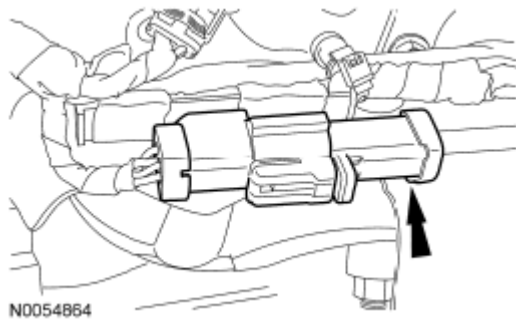
### All vehicles

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.



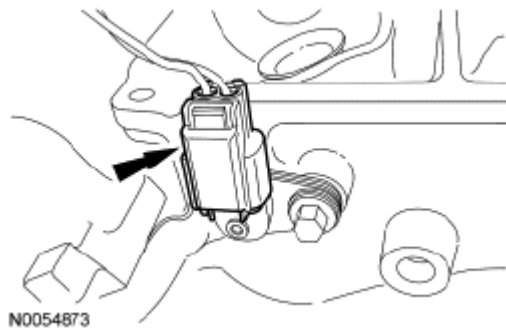
**Fig. 363: Locating Heat Shield**  
Courtesy of FORD MOTOR CO.

3. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.



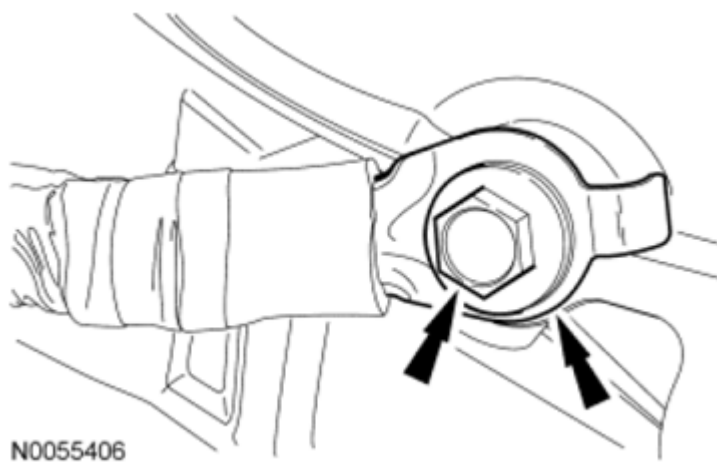
**Fig. 364: Locating RH Heated Oxygen Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

4. Disconnect the RH Camshaft Position (CMP) sensor electrical connector.



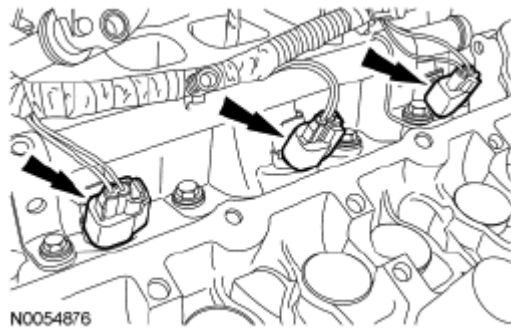
**Fig. 365: Locating RH Camshaft Position (CMP) Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

5. Remove the bolt and the ground cable from the RH cylinder.



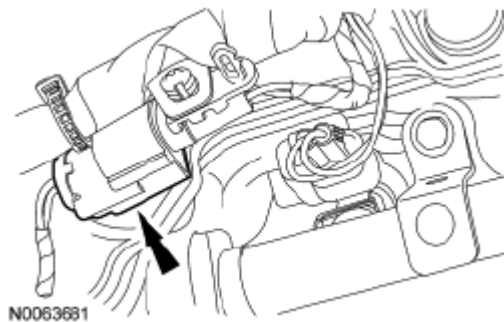
**Fig. 366: Locating Ground Cable Bolts**  
Courtesy of FORD MOTOR CO.

6. Disconnect the 6 fuel injector electrical connectors (3 shown in illustration).



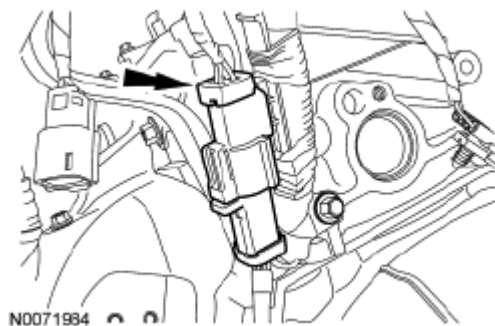
**Fig. 367: Locating Fuel Injector Electrical Connectors**  
Courtesy of FORD MOTOR CO.

7. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.



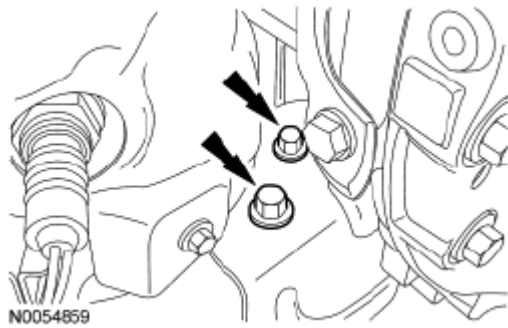
**Fig. 368: Locating Cylinder Head Temperature Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

8. Disconnect the LH Catalyst Monitor Sensor (CMS) electrical connector.



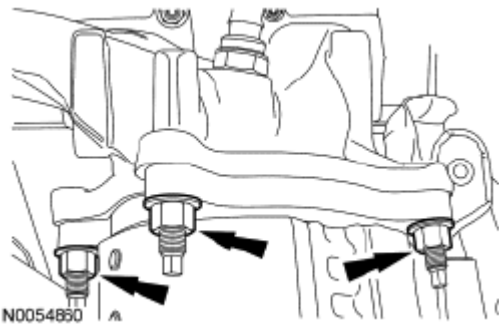
**Fig. 369: Locating LH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

9. Remove the 2 LH catalytic converter bracket bolts.



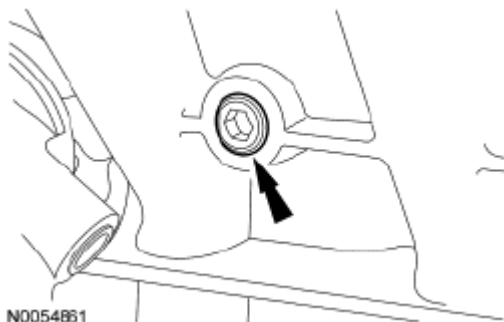
**Fig. 370: Locating LH Catalytic Converter Bracket Bolts**  
Courtesy of FORD MOTOR CO.

10. Remove the 4 nuts (3 shown in illustration) and the LH catalytic converter.
  - Discard the nuts and the gasket.



**Fig. 371: Locating LH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

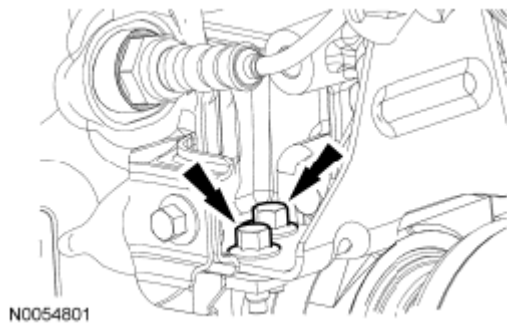
11. Remove the LH cylinder block drain plug.
  - Allow coolant to drain from the cylinder block.



**Fig. 372: Locating LH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

**All-Wheel Drive (AWD) vehicles**

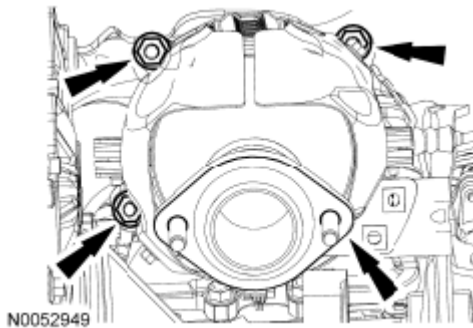
12. Remove the 2 RH catalytic converter bracket bolts.



**Fig. 373: Locating RH Catalytic Converter Support Bracket Bolts**  
Courtesy of FORD MOTOR CO.

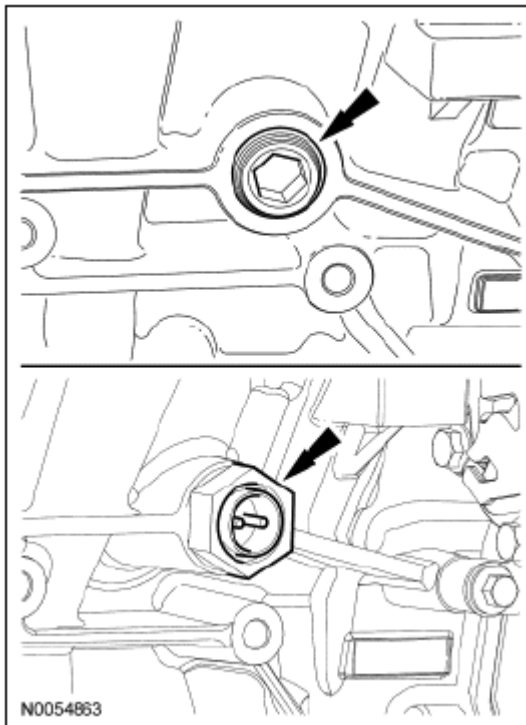
**All vehicles**

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



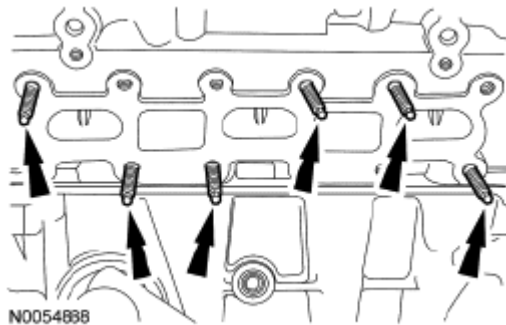
**Fig. 374: Locating RH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

14. Remove the RH cylinder block drain plug or, if equipped, the block heater.
  - Allow coolant to drain from the cylinder block.



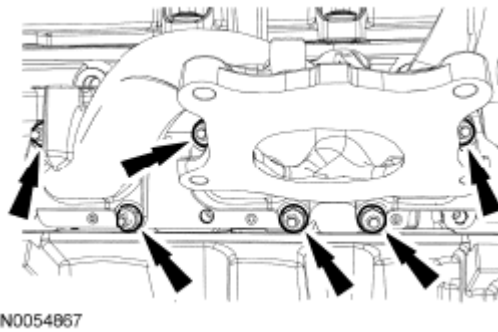
**Fig. 375: Locating RH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

15. Remove the 3 bolts and the RH exhaust manifold heat shield.



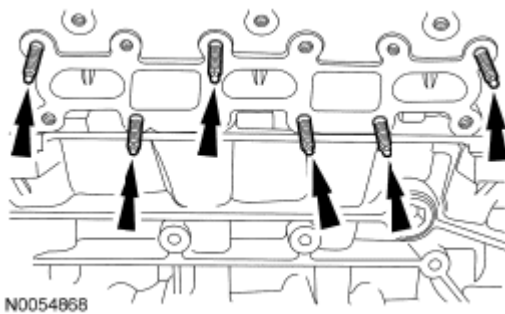
**Fig. 376: Locating RH Exhaust Manifold Heat Shield Bolts**  
Courtesy of FORD MOTOR CO.

16. Remove the 6 nuts and the RH exhaust manifold.
  - Discard the nuts and exhaust manifold gaskets.



**Fig. 377: Locating RH Exhaust Manifold Nuts**  
Courtesy of FORD MOTOR CO.

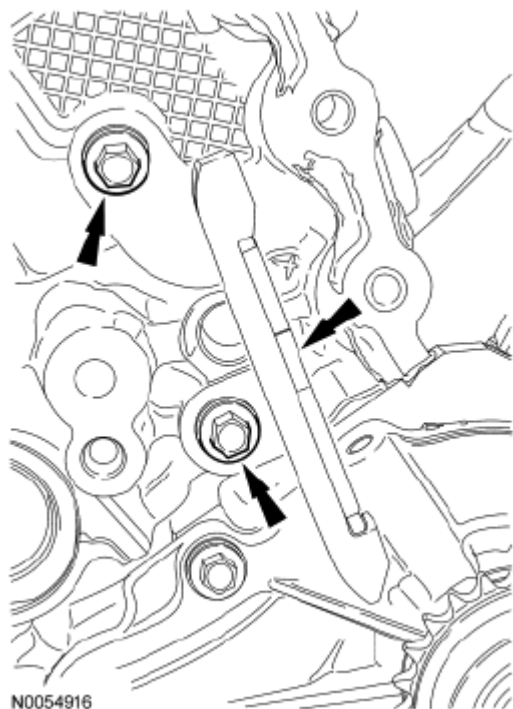
17. Clean and inspect the RH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION**.
18. Remove and discard the 6 RH exhaust manifold studs.



**Fig. 378: Locating RH Exhaust Manifold Studs**  
Courtesy of FORD MOTOR CO.

**Engines equipped with early build RH timing chain guides**

19. Remove the 2 bolts and the RH primary timing chain guide.

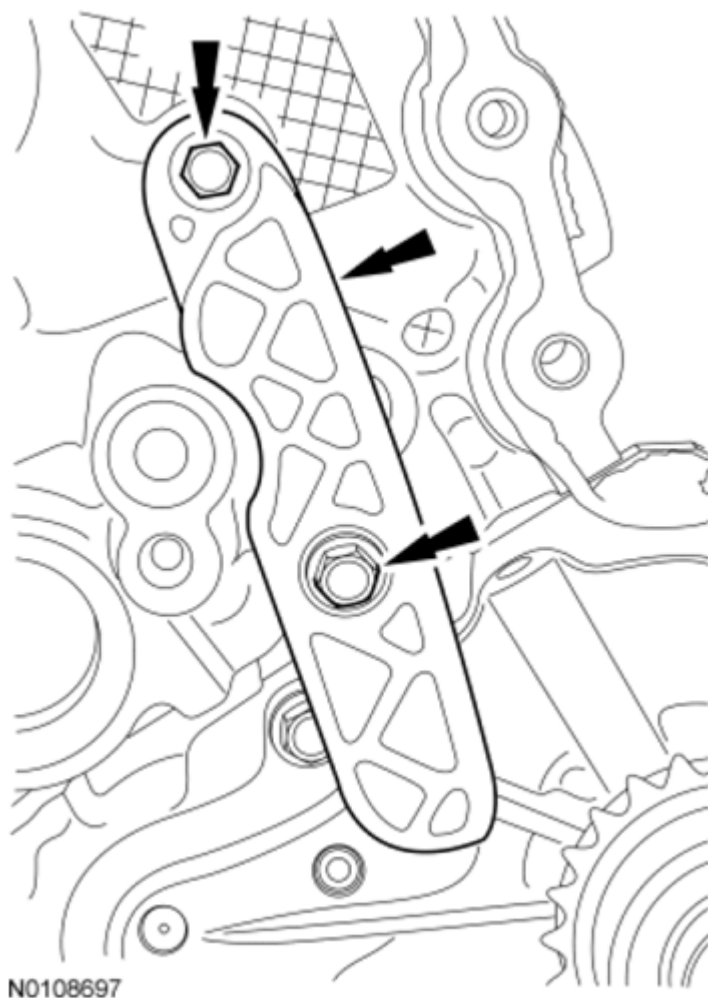


**Fig. 379: Locating RH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

**Engines equipped with late build/replacement RH timing chain guides**

20. Remove the 2 bolts and the RH primary timing chain guide.

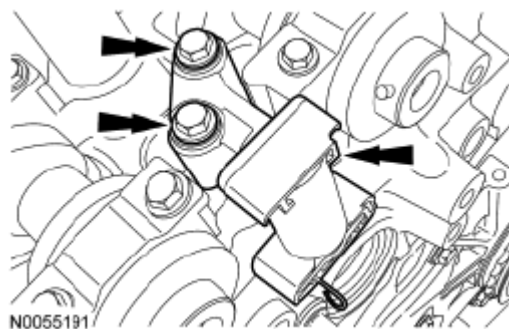




**Fig. 380: Locating RH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

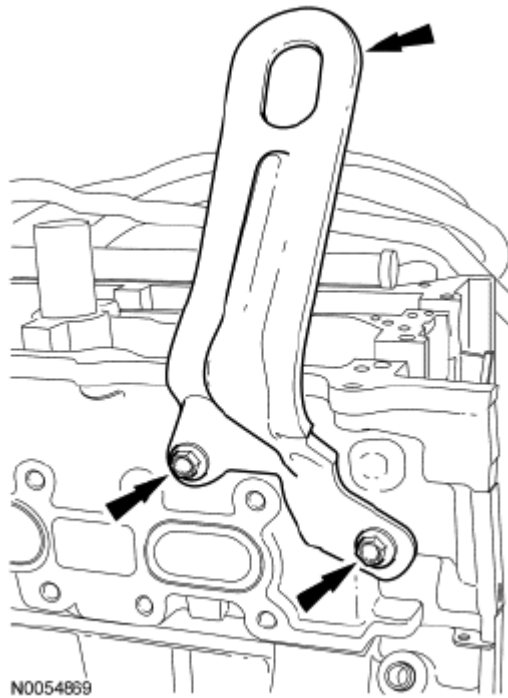
**All vehicles**

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



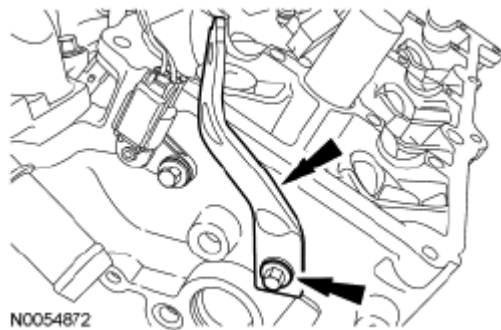
**Fig. 381: Locating RH Secondary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

22. Remove the 2 bolts and the engine lifting eye.



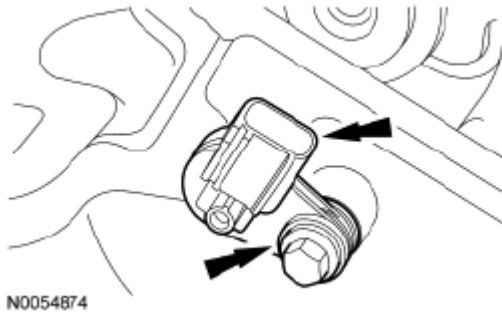
**Fig. 382: Locating Engine Lifting Eye With Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** Index-mark the location of the bracket on the cylinder head for installation.



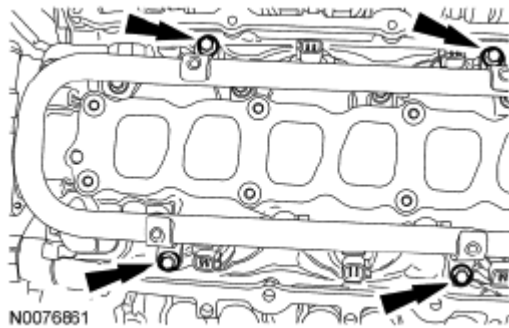
**Fig. 383: Locating Upper Intake Manifold Bracket Bolt**  
Courtesy of FORD MOTOR CO.

23. Remove the bolt and the upper intake manifold bracket.  
24. Remove the bolt and the RH CMP sensor.



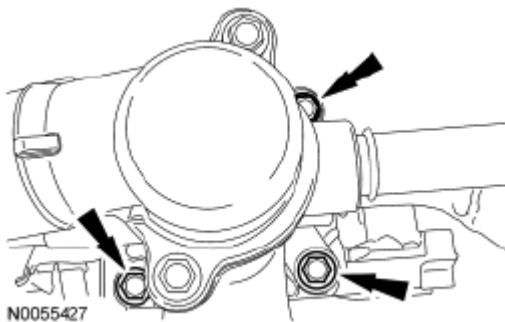
**Fig. 384: Locating RH CMP Sensor Bolt**  
Courtesy of FORD MOTOR CO.

25. Remove the 4 bolts and the fuel rail and injectors as an assembly.



**Fig. 385: Locating Fuel Rail Bolts**  
Courtesy of FORD MOTOR CO.

26. Remove the 3 thermostat housing-to-lower intake manifold bolts.
  - Remove the thermostat housing and discard the gasket and O-ring seal.

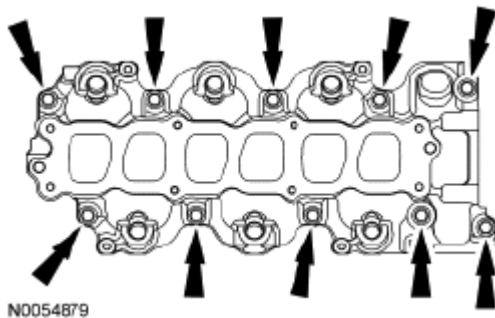


**Fig. 386: Locating Thermostat Housing-To-Lower Intake Manifold Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure

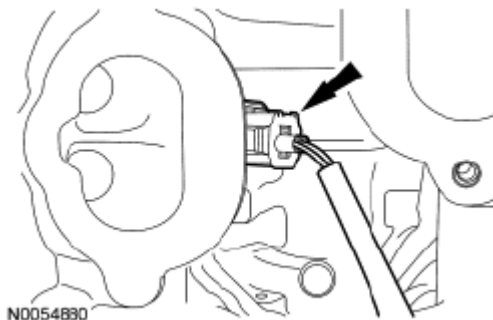
to follow these instructions can result in engine damage.

27. Remove the 10 bolts and the lower intake manifold.
- Discard the gaskets.



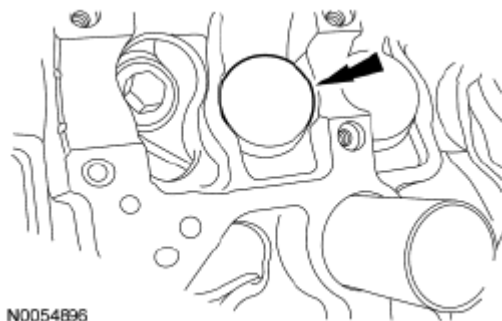
**Fig. 387: Locating Lower Intake Manifold Bolts**  
Courtesy of FORD MOTOR CO.

28. Disconnect and remove the CHT sensor jumper harness.



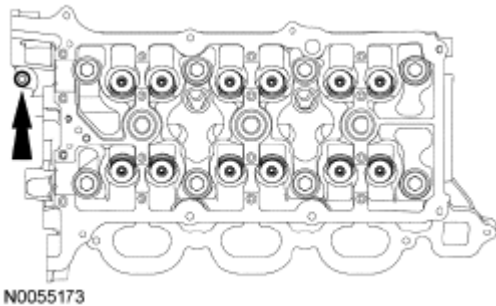
**Fig. 388: Locating CHT Sensor Jumper Harness**  
Courtesy of FORD MOTOR CO.

**NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.



**Fig. 389: Locating Valve Tappets**  
Courtesy of FORD MOTOR CO.

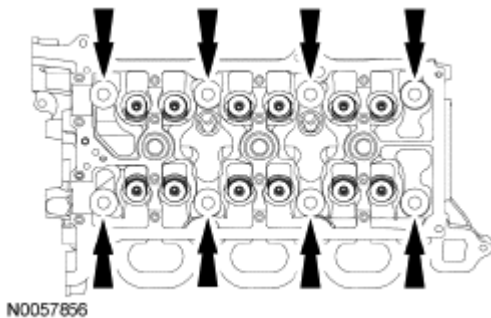
29. Remove the valve tappets from the cylinder head.
30. Remove and discard the M6 bolt.



**Fig. 390: Locating M6 Bolt**  
Courtesy of FORD MOTOR CO.

- 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.

31. Remove and discard the 8 bolts from the cylinder head.
  - Remove the cylinder head.
  - Discard the cylinder head gasket.



**Fig. 391: Locating Cylinder Head Bolts**  
Courtesy of FORD MOTOR CO.

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

**NOTE:** Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

**NOTE:** If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

32. Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.
  1. Remove any large deposits of silicone or gasket material with a plastic scraper.
  2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
  3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
  4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
33. 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 SPECIFICATION

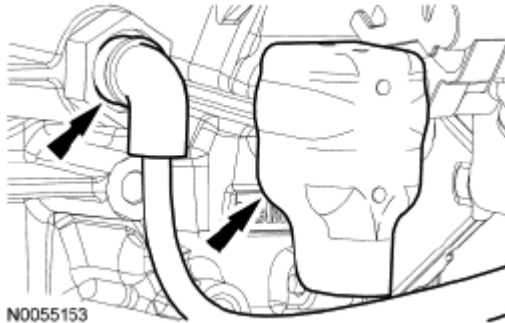
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Silicone Gasket Remover ZC-30	-

**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.

### All vehicles

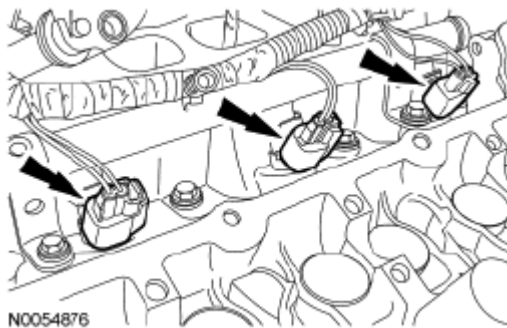
1. Remove the LH camshafts. For additional information, refer to **CAMSHAFT**.

2. If equipped, remove the heat shield and disconnect the block heater electrical connector.
  - Remove the block heater wiring harness from the engine.



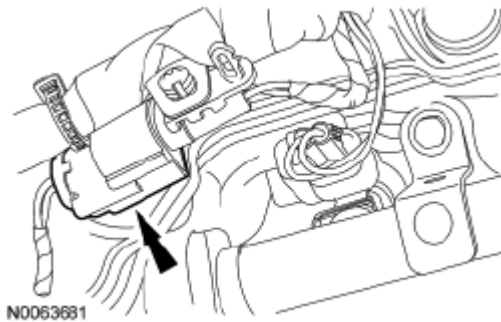
**Fig. 392: Locating Heat Shield**  
Courtesy of FORD MOTOR CO.

3. Disconnect the 6 fuel injector electrical connectors (3 shown in illustration).



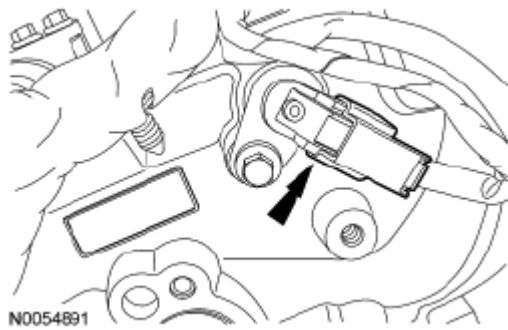
**Fig. 393: Locating Fuel Injector Electrical Connectors**  
Courtesy of FORD MOTOR CO.

4. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.



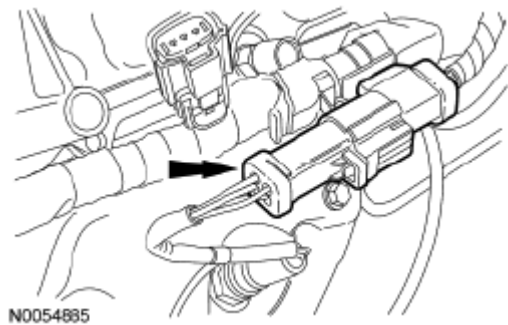
**Fig. 394: Locating Cylinder Head Temperature Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

5. Disconnect the LH Camshaft Position (CMP) sensor electrical connector.



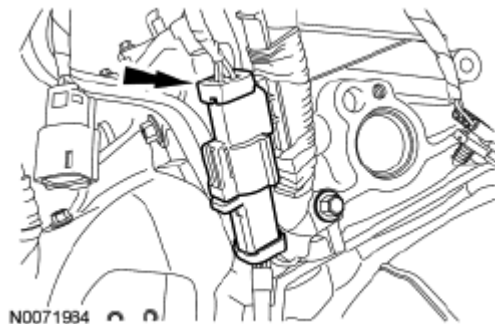
**Fig. 395: Locating LH Camshaft Position Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

6. Disconnect the LH Heated Oxygen Sensor (HO2S) electrical connector.



**Fig. 396: Locating LH Heated Oxygen Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

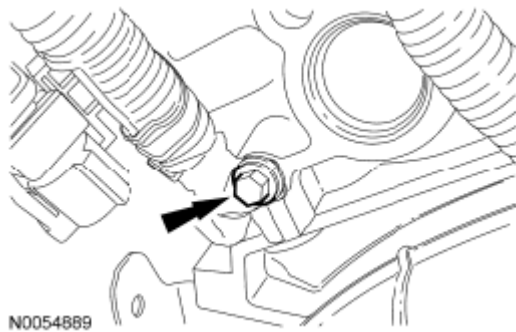
7. Disconnect the LH Catalyst Monitor Sensor (CMS) electrical connector.



**Fig. 397: Locating LH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

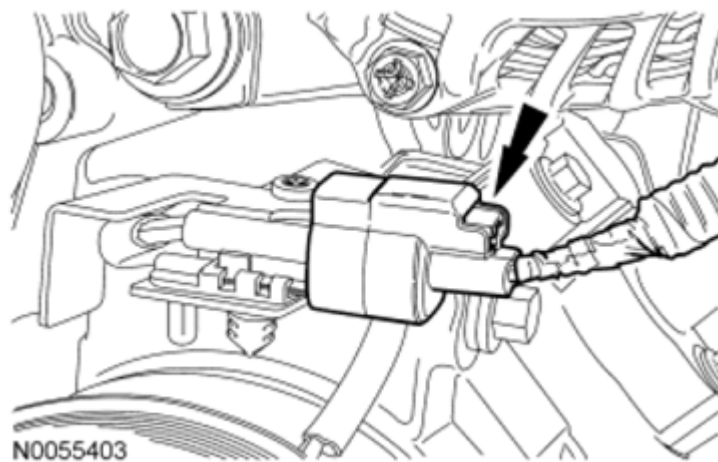
8. Remove the wiring harness retainer bolt from the rear of the LH cylinder head.





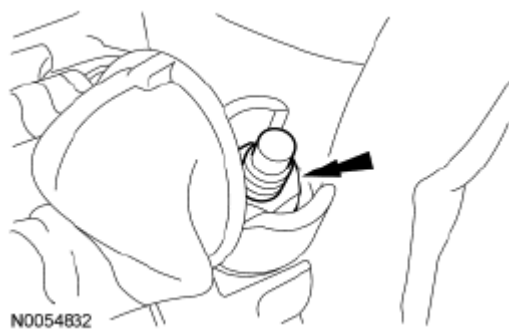
**Fig. 398: Locating Wiring Harness Retainer Bolt**  
Courtesy of FORD MOTOR CO.

9. Disconnect the A/C compressor electrical connector.



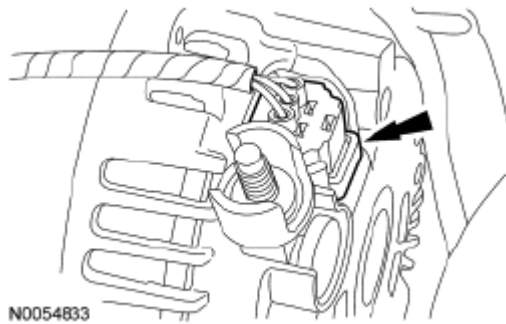
**Fig. 399: Locating A/C Compressor Electrical Connector**  
Courtesy of FORD MOTOR CO.

10. Remove the nut and disconnect the generator B+ cable.



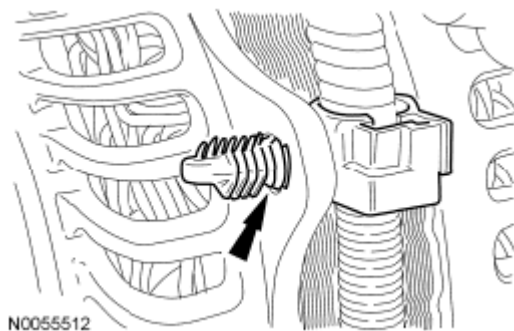
**Fig. 400: Locating Generator B+ Cable**  
Courtesy of FORD MOTOR CO.

11. Disconnect the generator electrical connector.



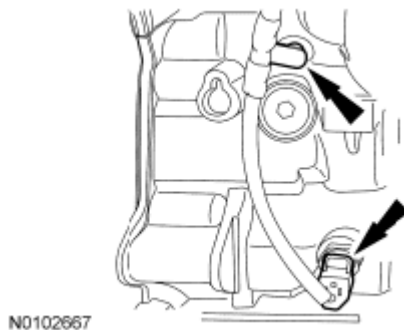
**Fig. 401: Locating Generator Electrical Connector**  
Courtesy of FORD MOTOR CO.

12. Detach the wiring harness retainer from the generator.



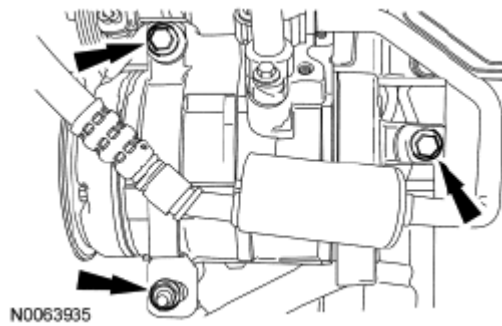
**Fig. 402: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

13. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and the wiring harness pin-type retainer.



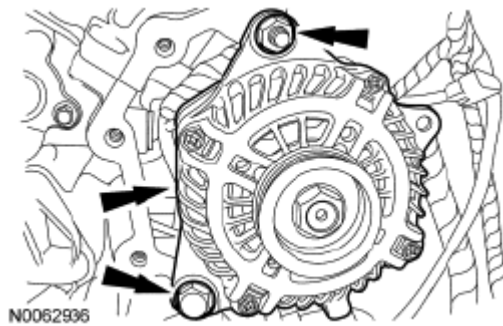
**Fig. 403: Locating Engine Oil Pressure Switch Electrical Connector**  
Courtesy of FORD MOTOR CO.

14. Remove the nut, 2 bolts and the A/C compressor.



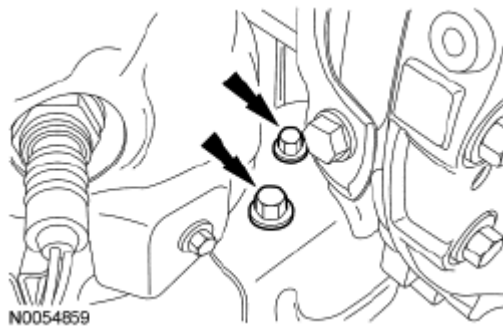
**Fig. 404: Locating A/C Compressor Bolts And Nut**  
Courtesy of FORD MOTOR CO.

15. Remove the nut, bolt and the generator.



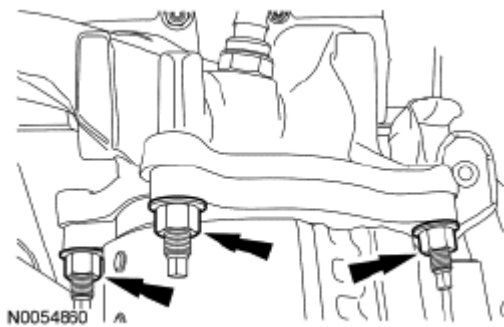
**Fig. 405: Locating Generator Nut And Bolt**  
Courtesy of FORD MOTOR CO.

16. Remove the 2 LH catalytic converter bracket bolts.



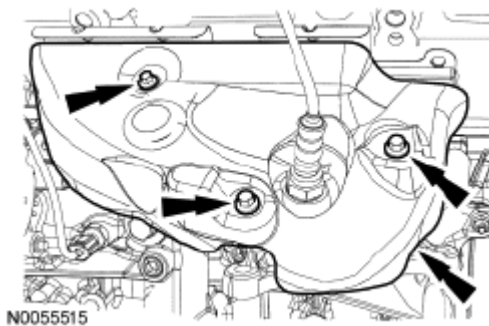
**Fig. 406: Locating LH Catalytic Converter Bracket Bolts**  
Courtesy of FORD MOTOR CO.

17. Remove the 4 nuts (3 shown in illustration) and the LH catalytic converter.
  - Discard the nuts and the gasket.



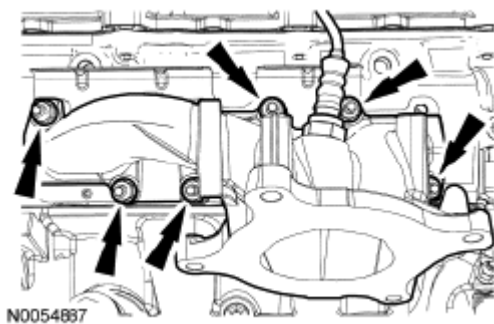
**Fig. 407: Locating LH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

18. Remove the 3 bolts and the LH exhaust manifold heat shield.



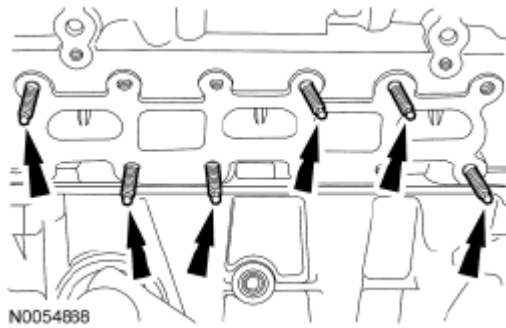
**Fig. 408: Locating LH Exhaust Manifold Heat Shield Bolts**  
Courtesy of FORD MOTOR CO.

19. Remove the 6 nuts and the LH exhaust manifold.
  - Discard the nuts and the exhaust manifold gasket.



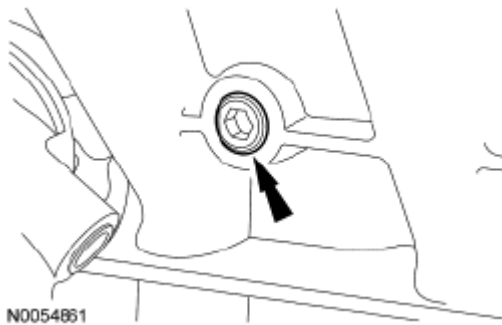
**Fig. 409: Locating LH Exhaust Manifold Nuts**  
Courtesy of FORD MOTOR CO.

20. Clean and inspect the LH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION**.
21. Remove and discard the 6 LH exhaust manifold studs.



**Fig. 410: Locating LH Exhaust Manifold Studs**  
Courtesy of FORD MOTOR CO.

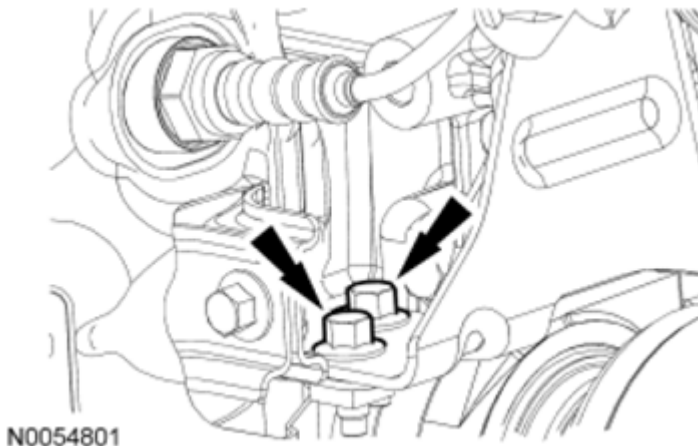
22. Remove the LH cylinder block drain plug.
  - Allow coolant to drain from the cylinder block.



**Fig. 411: Locating LH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

#### All-Wheel Drive (AWD) vehicles

23. Remove the 2 RH catalytic converter bracket bolts.

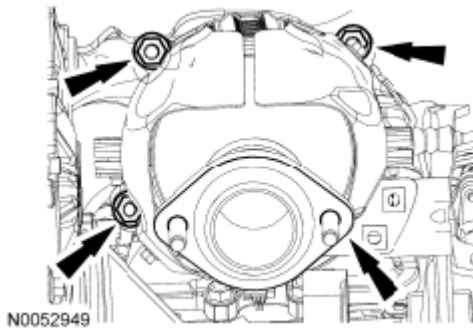


**Fig. 412: Locating RH Catalytic Converter Bracket Bolts**

Courtesy of FORD MOTOR CO.

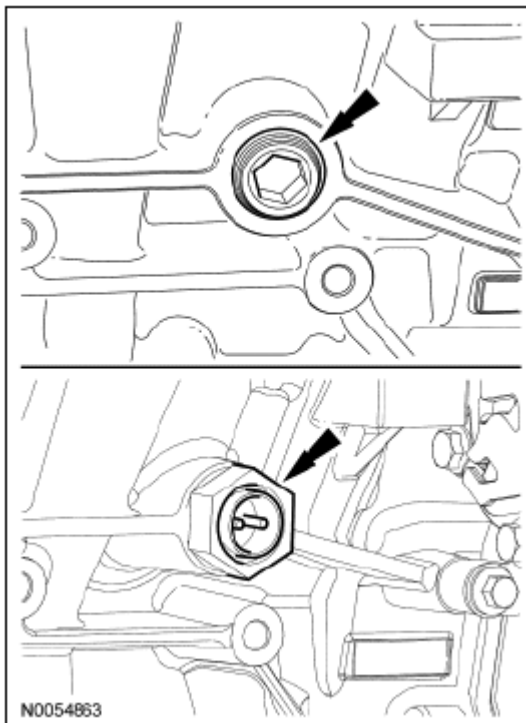
### All vehicles

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



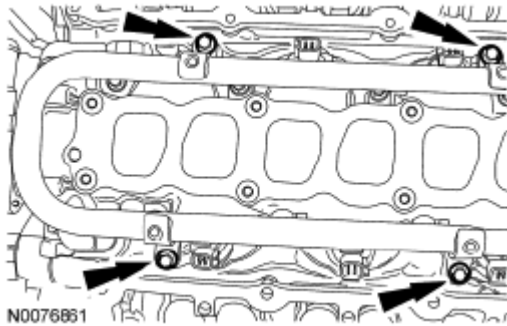
**Fig. 413: Locating RH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

25. Remove the RH cylinder block drain plug or, if equipped, the block heater.
  - Allow coolant to drain from the cylinder block.



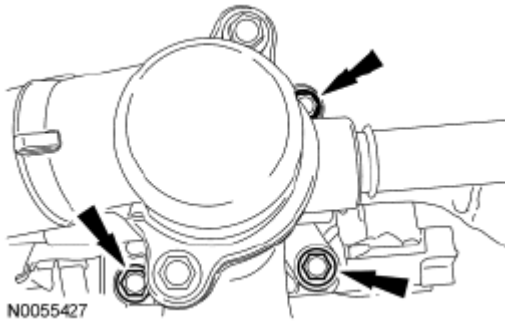
**Fig. 414: Locating RH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

26. Remove the 4 bolts and the fuel rail and injectors as an assembly.



**Fig. 415: Locating Fuel Rail Bolts**  
Courtesy of FORD MOTOR CO.

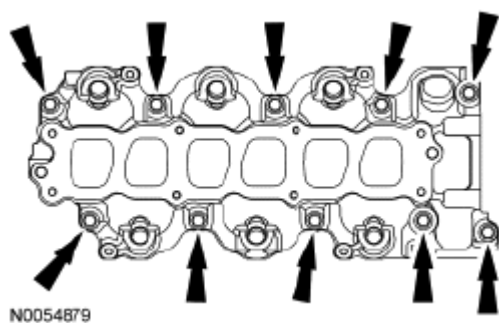
27. Remove the 3 thermostat housing-to-lower intake manifold bolts.
- Remove the thermostat housing and discard the gasket and O-ring seal.



**Fig. 416: Locating Thermostat Housing-To-Lower Intake Manifold Bolts**  
Courtesy of FORD MOTOR CO.

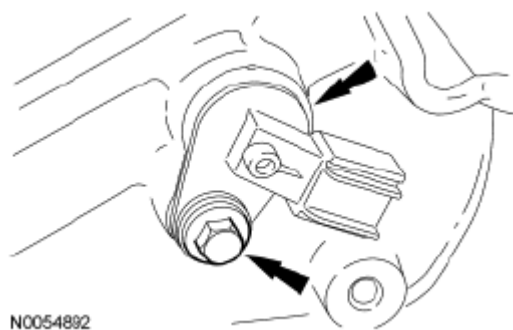
**NOTE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

28. Remove the 10 bolts and the lower intake manifold.
- Discard the gaskets.



**Fig. 417: Locating Lower Intake Manifold Bolts**  
Courtesy of FORD MOTOR CO.

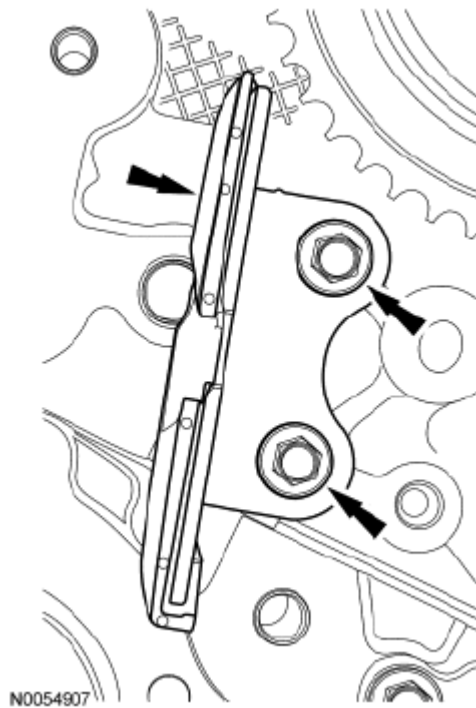
29. Remove the bolt and the LH CMP sensor.



**Fig. 418: Locating LH CMP Sensor**  
Courtesy of FORD MOTOR CO.

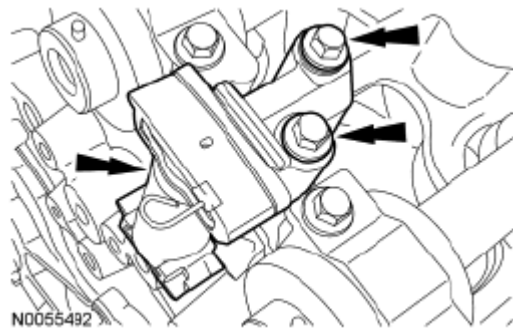
30. Remove the 2 bolts and the upper LH primary timing chain guide.





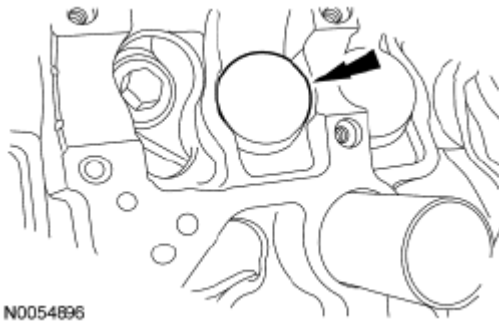
**Fig. 419: Locating Upper LH Primary Timing Chain Guide With Bolts**  
Courtesy of FORD MOTOR CO.

31. Remove the 2 bolts and the LH secondary timing chain tensioner.



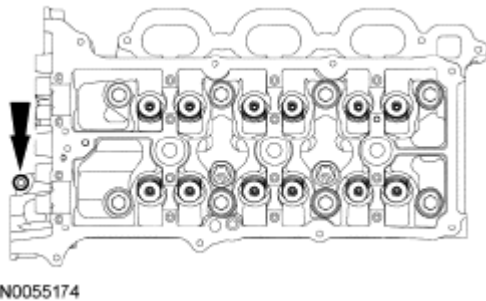
**Fig. 420: Locating LH Secondary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.



**Fig. 421: Locating Valve Tappets**  
Courtesy of FORD MOTOR CO.

32. Remove the valve tappets from the cylinder head.
33. Remove and discard the M6 bolt.



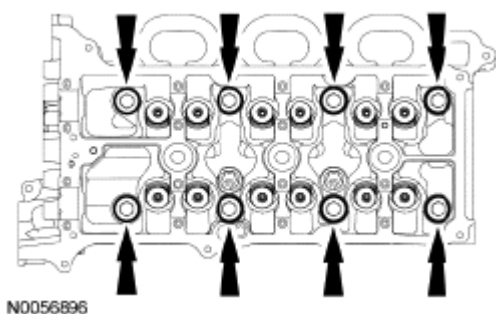
**Fig. 422: Locating M6 Bolt**  
Courtesy of FORD MOTOR CO.

**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.

34. Remove and discard the 8 bolts from the cylinder head.
  - Remove the cylinder head.
  - Discard the cylinder head gasket.



**Fig. 423: Locating Cylinder Head Bolts**  
Courtesy of FORD MOTOR CO.

- NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.
- NOTE:** Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.
- NOTE:** If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

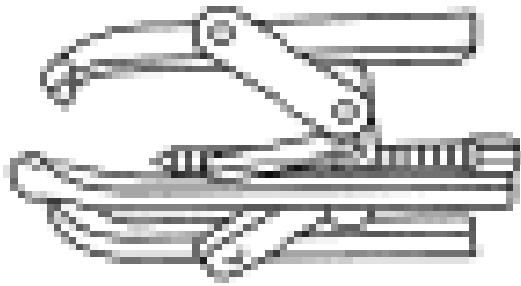
35. Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.
  1. Remove any large deposits of silicone or gasket material with a plastic scraper.
  2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
  3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
  4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
36. 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**.

## OIL PAN

### Special Tool(s)

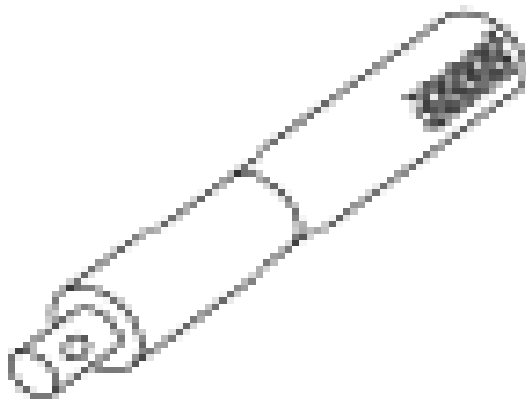
### SPECIAL TOOL SPECIFICATION

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3 Jaw Puller  
303-D121 or equivalent

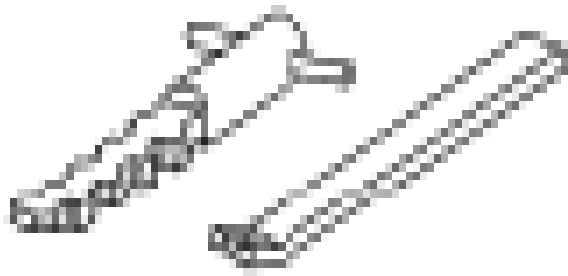
**ST1184-A**



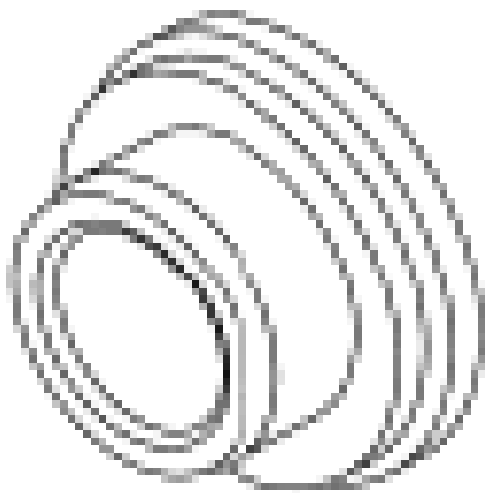
Handle  
205-153 (T80T-4000-W)

**ST1326-A**

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

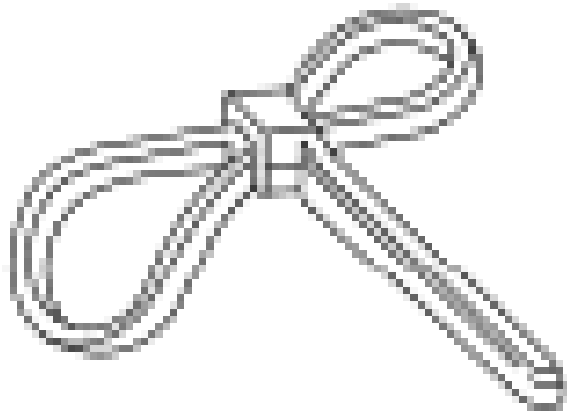


ST1385-A



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

ST2982-A



ST1438-A

Strap Wrench  
303-D055 (D85L-6000-A) or equivalent

**Material****MATERIAL SPECIFICATION**

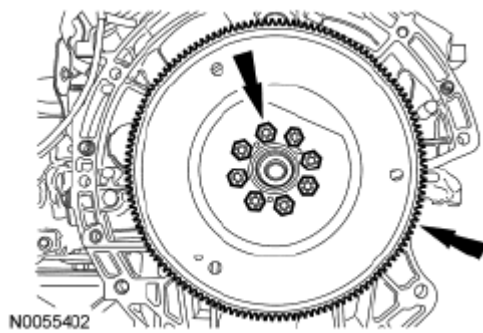
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Silicone Gasket Remover ZC-30	-

**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:** Early build engines have 11 fastener valve covers, late build engines have 9 fastener valve covers. Do not attempt to install bolts in the 2 empty late build valve cover holes or damage to the valve cover will occur.

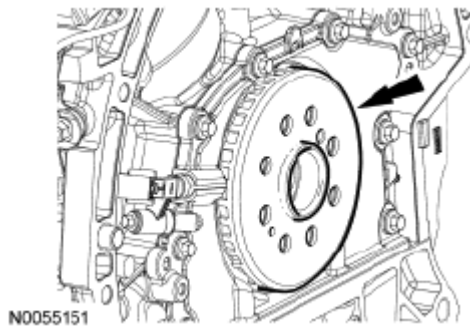
**All vehicles**

1. Remove the engine from the vehicle. For additional information, refer to **ENGINE**.
2. Remove the 8 bolts and the flexplate.



**Fig. 424: Locating Flexplate Bolts**  
Courtesy of FORD MOTOR CO.

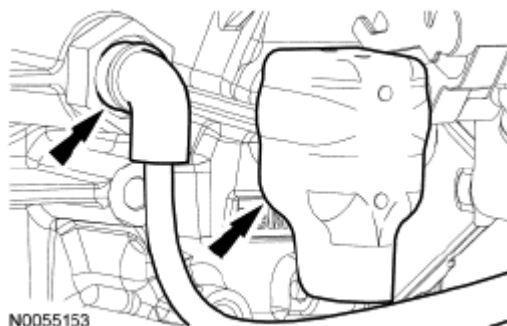
3. Remove the crankshaft sensor ring.



**Fig. 425: Locating Crankshaft Sensor Ring**  
Courtesy of FORD MOTOR CO.

**NOTE:** Install the engine stand bolts into the cylinder block only. Do not install the bolts into the oil pan.

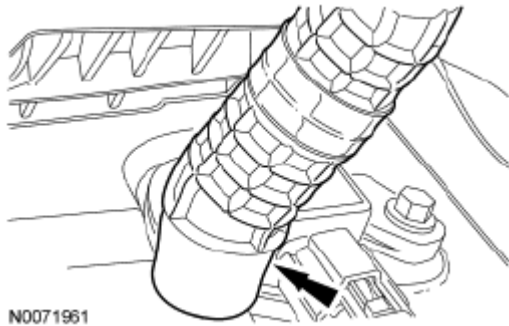
4. Mount the engine on a suitable engine stand.
5. If equipped, remove the heat shield and disconnect the block heater electrical connector.
  - Detach all of the engine block heater harness retainers and remove the harness.



**Fig. 426: Locating Heat Shield**

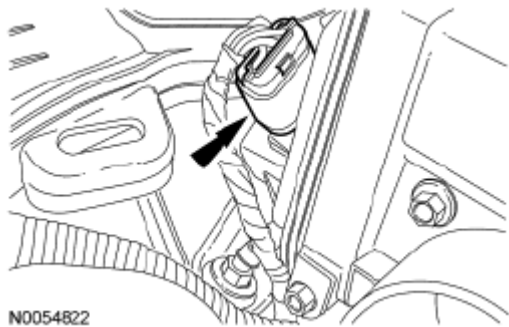
**Courtesy of FORD MOTOR CO.**

6. Disconnect the PCV hose from the PCV valve.



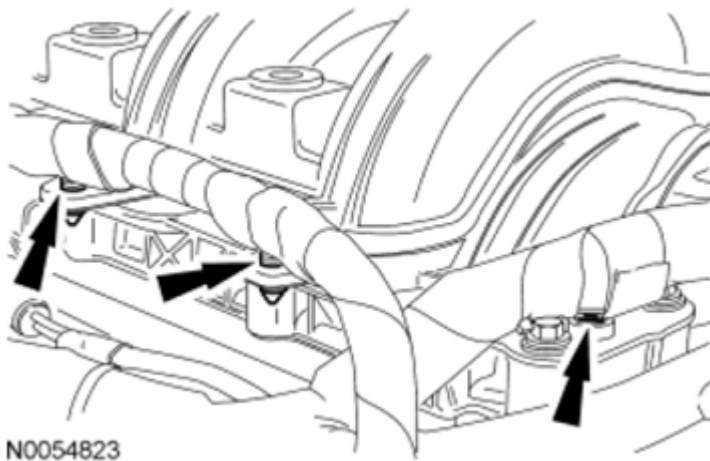
**Fig. 427: Locating PCV Hose**  
Courtesy of FORD MOTOR CO.

7. Disconnect the Throttle Body (TB) electrical connector.



**Fig. 428: Locating Throttle Body Electrical Connector**  
Courtesy of FORD MOTOR CO.

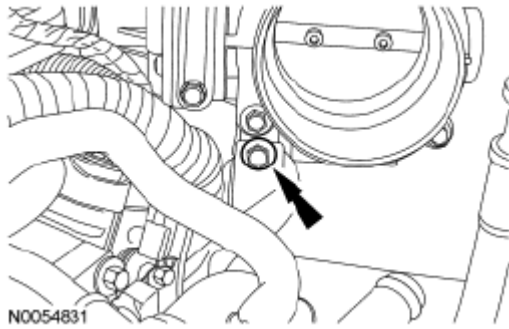
8. Detach the wiring harness retainers from the upper intake manifold.





**Fig. 429: Locating Wiring Harness Retainers**  
Courtesy of FORD MOTOR CO.

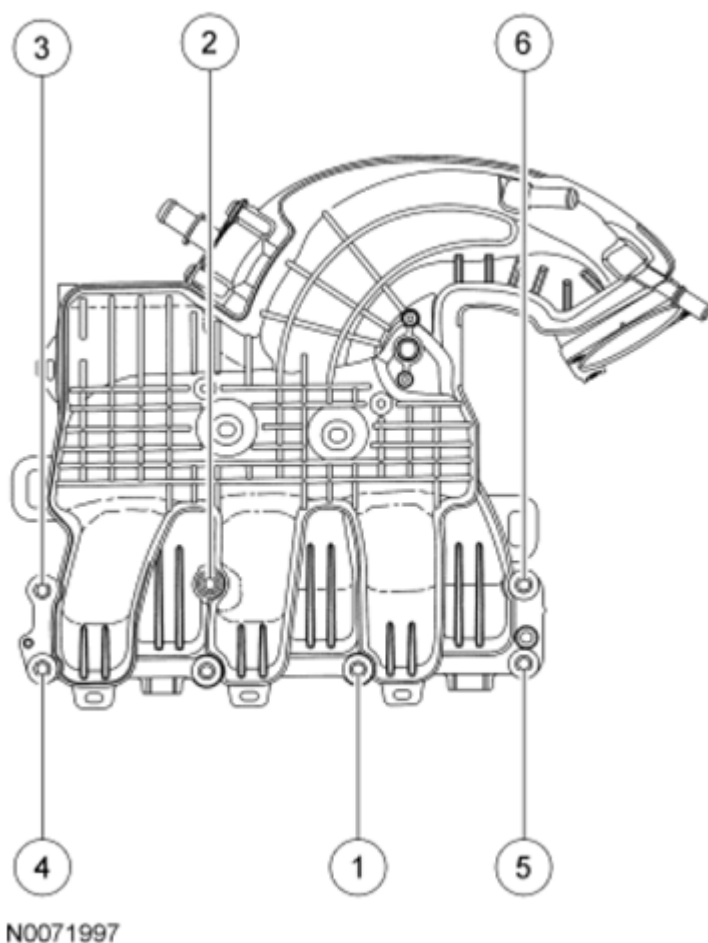
9. Remove the upper intake manifold support bracket bolt.



**Fig. 430: Locating Upper Intake Manifold Support Bracket Bolt**  
Courtesy of FORD MOTOR CO.

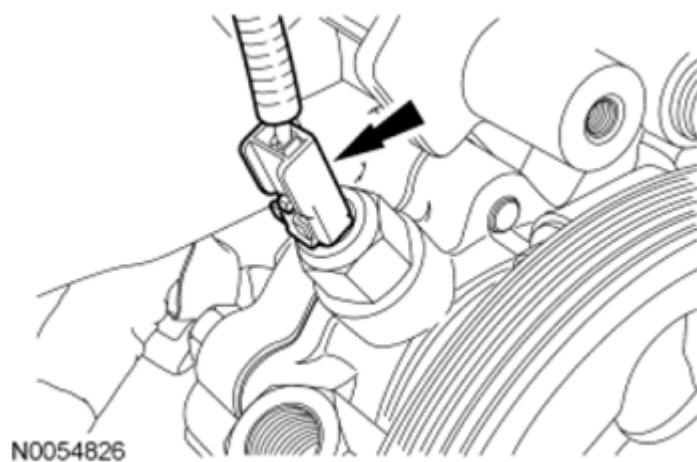
**NOTE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

10. Remove the 6 bolts and the upper intake manifold in the following sequence.
  - Discard the gaskets.



**Fig. 431: Identifying Upper Intake Manifold Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

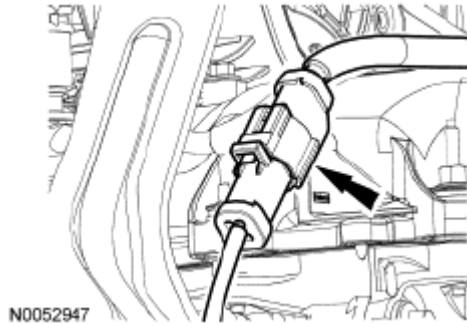
11. Disconnect the Power Steering Pressure (PSP) switch electrical connector.



**Fig. 432: Locating PSP Switch Electrical Connector**  
Courtesy of FORD MOTOR CO.

**Front Wheel Drive (FWD) vehicles**

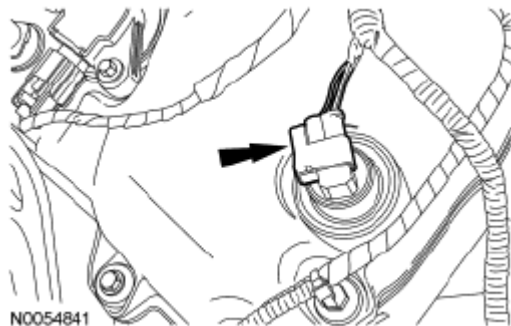
12. Disconnect the RH Catalyst Monitor Sensor (CMS) electrical connector.



**Fig. 433: Locating RH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

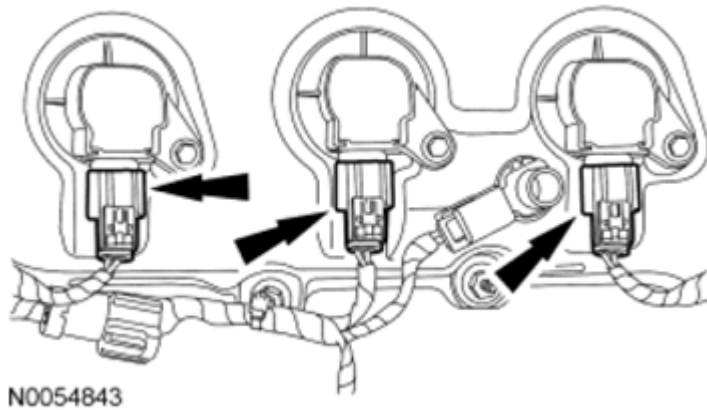
**All vehicles**

13. Disconnect the RH Variable Camshaft Timing (VCT) solenoid electrical connector.



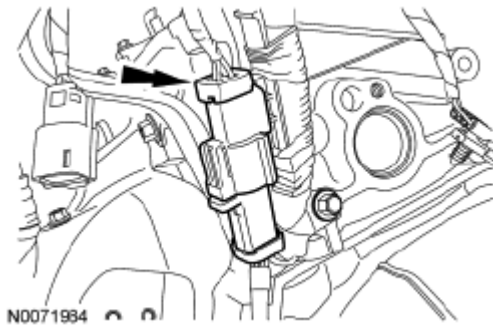
**Fig. 434: Locating RH Variable Camshaft Timing Solenoid Electrical Connector**  
Courtesy of FORD MOTOR CO.

14. Disconnect the 3 RH coil-on-plug electrical connectors.



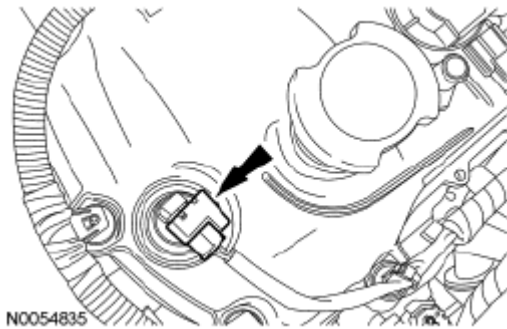
**Fig. 435: Locating RH Coil-On-Plug Electrical Connectors**  
Courtesy of FORD MOTOR CO.

15. Detach all of the wiring harness retainers from the RH valve cover and stud bolts.
16. Disconnect the LH CMS electrical connector.



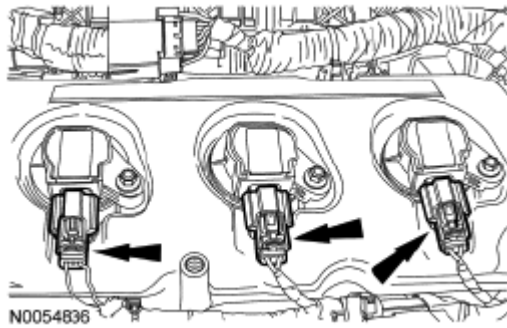
**Fig. 436: Locating LH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

17. Disconnect the LH VCT solenoid electrical connector.



**Fig. 437: Locating LH VCT Solenoid Electrical Connector**  
Courtesy of FORD MOTOR CO.

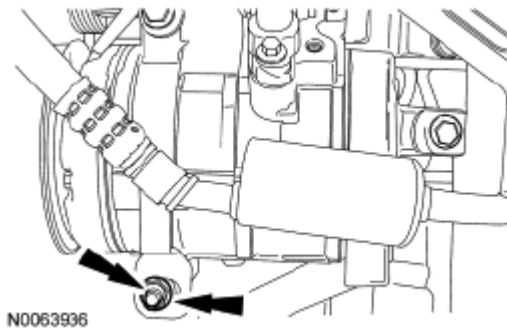
18. Disconnect the 3 LH coil-on-plug electrical connectors.



**Fig. 438: Locating LH Coil-On-Plug Electrical Connectors**  
Courtesy of FORD MOTOR CO.

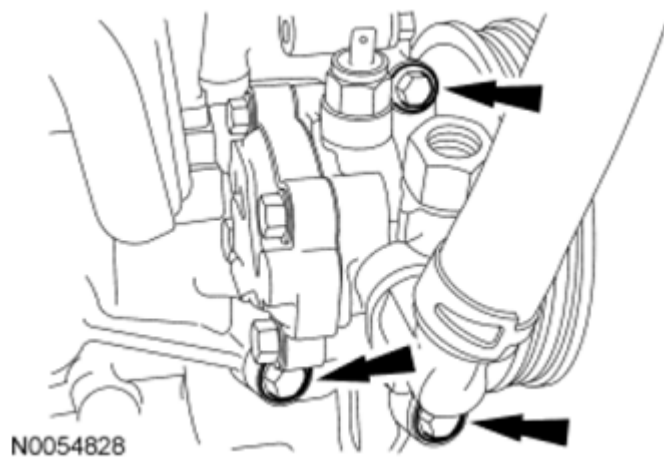
19. Detach all of the wiring harness retainers from the LH valve cover and stud bolts.

**NOTE:** The A/C compressor must remain bolted to the engine block prior to installing the oil pan.



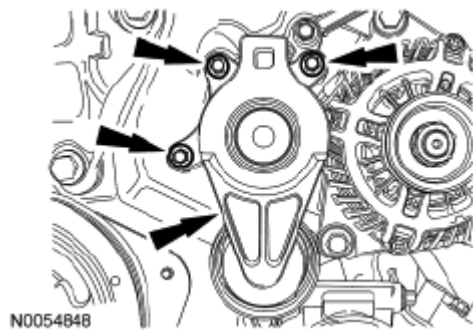
**Fig. 439: Locating A/C Compressor Nut And Stud**  
Courtesy of FORD MOTOR CO.

20. Remove the A/C compressor nut and stud.
21. Remove the 3 bolts and the power steering pump.



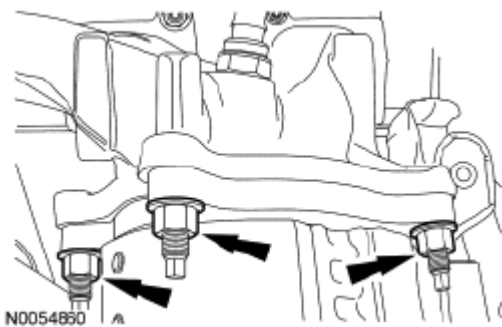
**Fig. 440: Locating Power Steering Pump Bolts**  
Courtesy of FORD MOTOR CO.

22. Remove the 3 bolts and the accessory drive belt tensioner.



**Fig. 441: Locating Accessory Drive Belt Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

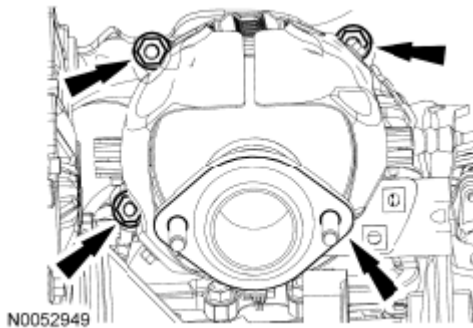
23. Remove the 4 nuts (3 shown in illustration) and the LH catalytic converter.
- Discard the nuts and the gasket.



**Fig. 442: Locating LH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

**FWD vehicles**

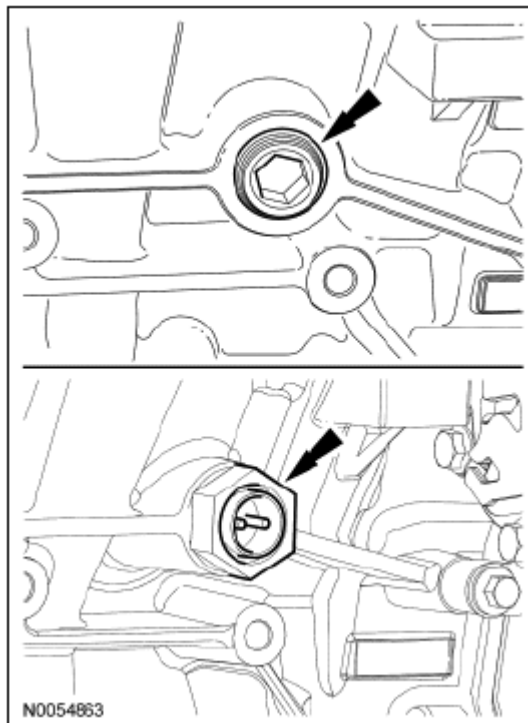
24. Remove the 4 nuts and the RH catalytic converter.
- Discard the nuts and the gasket.



**Fig. 443: Locating RH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

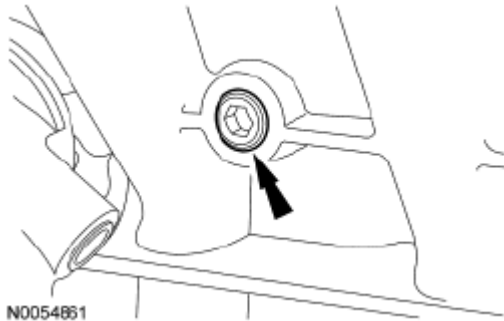
**All vehicles**

25. Remove the RH cylinder block drain plug or, if equipped, the block heater.
- Allow coolant to drain from the cylinder block.



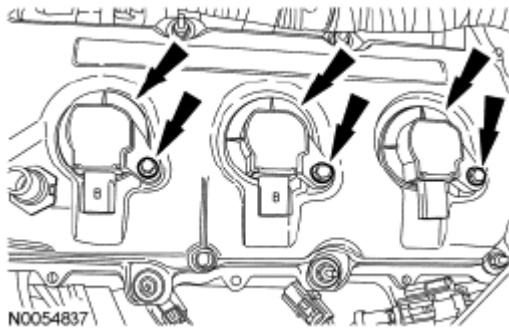
**Fig. 444: Locating RH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

26. Remove the LH cylinder block drain plug.
- Allow coolant to drain from the cylinder block.



**Fig. 445: Locating LH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

**NOTE:** LH shown in illustration, RH similar.



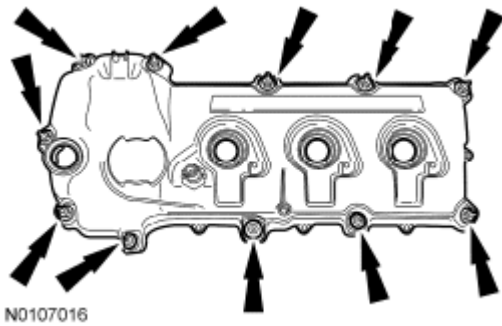
**Fig. 446: Locating Coil-On-Plugs Bolts**  
Courtesy of FORD MOTOR CO.

27. Remove the 6 bolts and the 6 coil-on-plugs.

**Early build vehicles**

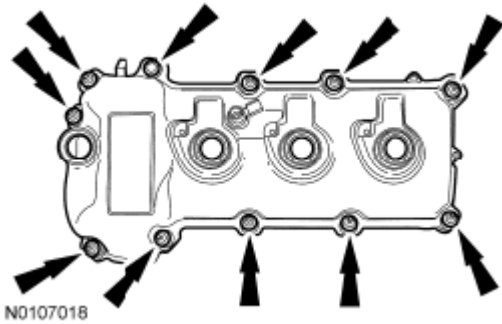
28. Loosen the 11 stud bolts and remove the LH valve cover.
- Discard the gasket.





**Fig. 447: Locating LH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

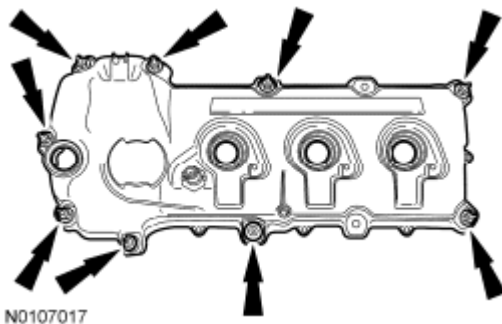
29. Loosen the bolt, the 10 stud bolts and remove the RH valve cover.
- Discard the gasket.



**Fig. 448: Locating RH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

#### Late build vehicles

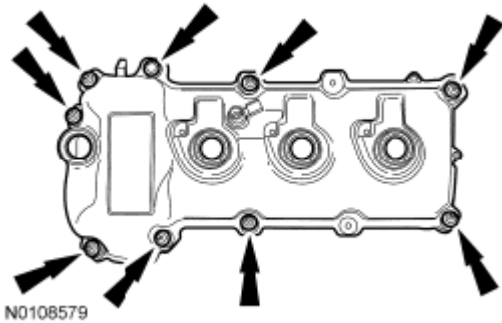
30. Loosen the 9 stud bolts and remove the LH valve cover.
- Discard the gasket.



**Fig. 449: Locating LH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

31. Loosen the 9 stud bolts and remove the RH valve cover.

- Discard the gasket.



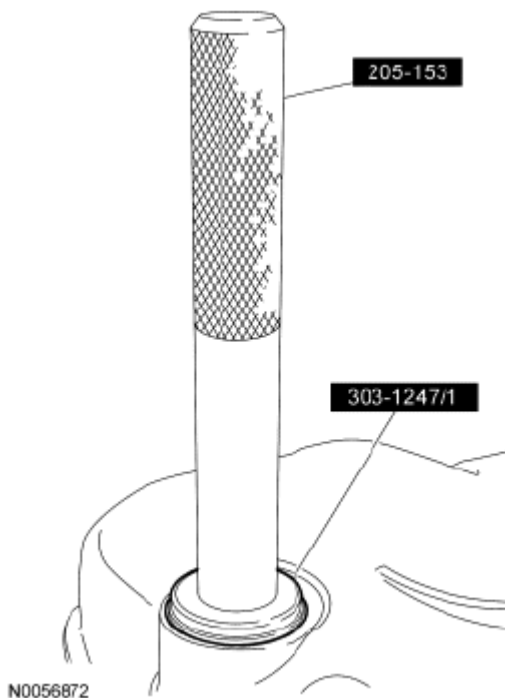
**Fig. 450: Locating RH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

#### All vehicles

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

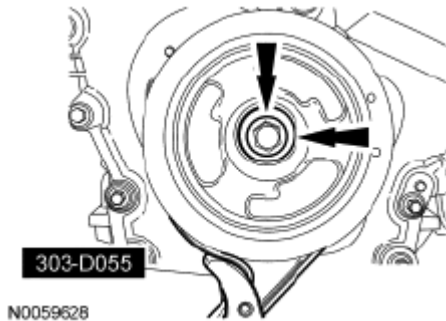
32. Inspect the VCT solenoid seals and the spark plug tube seals. Remove any damaged seals.

- Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



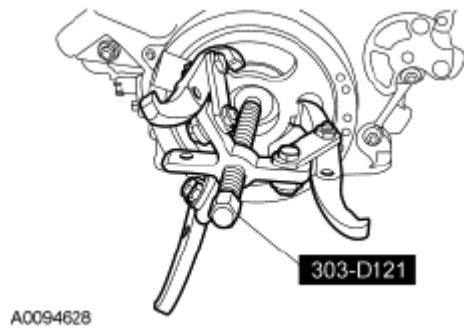
**Fig. 451: Identifying VCT Spark Plug Tube Seal Remover And Handle**  
Courtesy of FORD MOTOR CO.

33. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
- Discard the bolt.



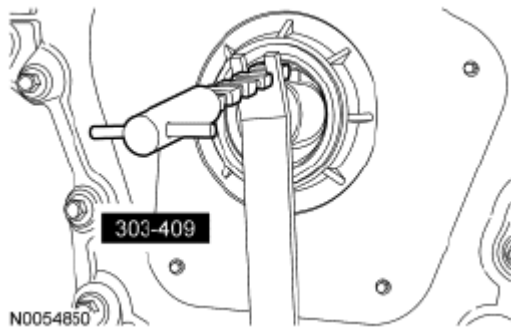
**Fig. 452: Locating Crankshaft Bolt And Washer**  
Courtesy of FORD MOTOR CO.

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



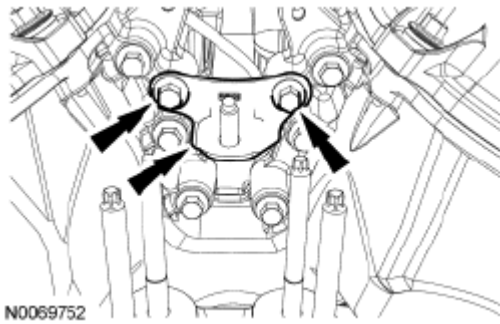
**Fig. 453: Removing Crankshaft Pulley**  
Courtesy of FORD MOTOR CO.

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



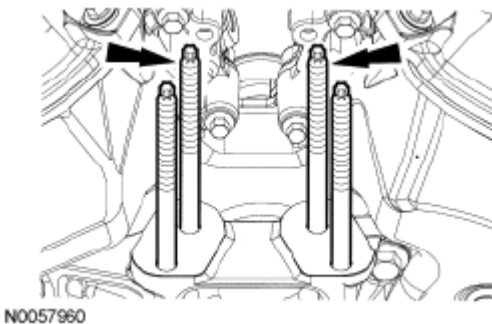
**Fig. 454: Removing Crankshaft Front Seal**  
Courtesy of FORD MOTOR CO.

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



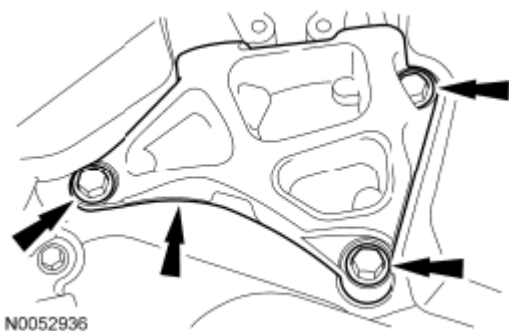
**Fig. 455: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** Only use hand tools to remove the studs.



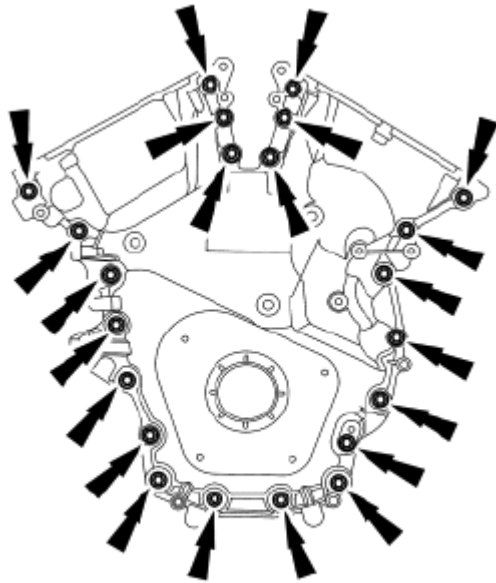
**Fig. 456: Locating Engine Mount Studs**  
Courtesy of FORD MOTOR CO.

37. Remove the 2 engine mount studs.
38. Remove the 3 bolts and the engine mount bracket.



**Fig. 457: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

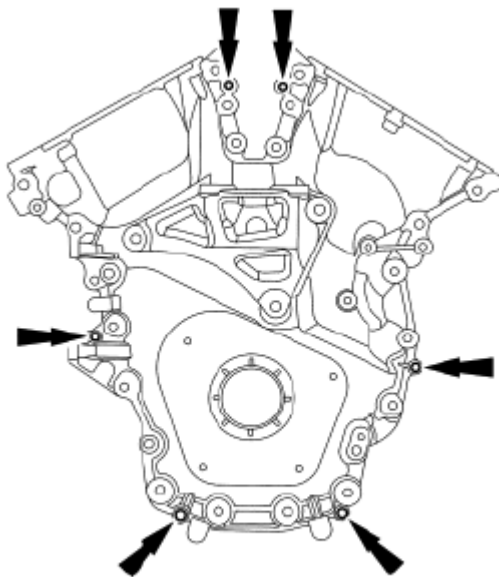
39. Remove the 22 engine front cover bolts.



N0054851

**Fig. 458: Locating Engine Front Cover Bolts**  
Courtesy of FORD MOTOR CO.

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

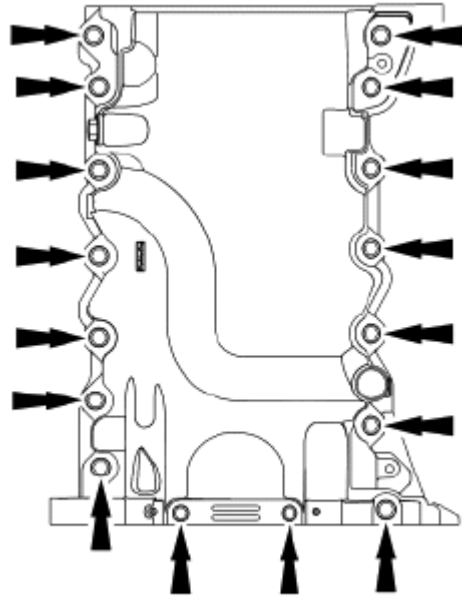


N0082530

**Fig. 459: Locating Engine Front Cover Bolts**

Courtesy of FORD MOTOR CO.

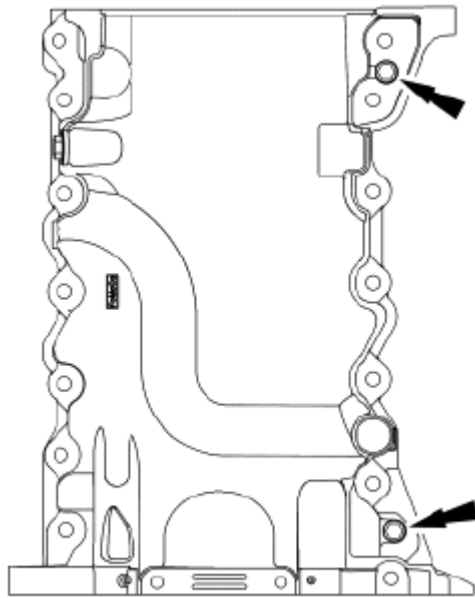
41. Remove the 16 oil pan bolts.



N0055163

**Fig. 460: Locating Oil Pan Bolts**  
Courtesy of FORD MOTOR CO.

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



N0055164

**Fig. 461: Locating Oil Pan Bolts**  
Courtesy of FORD MOTOR CO.

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

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

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

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

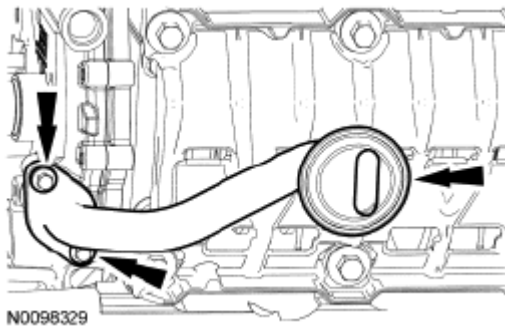
44. Clean the sealing surfaces of the cylinder block in the following sequence.
  1. Remove any large deposits of silicone or gasket material.

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

## OIL PUMP SCREEN AND PICKUP TUBE

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

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



**Fig. 462: Locating Oil Pump Screen And Pickup Tube**  
Courtesy of FORD MOTOR CO.

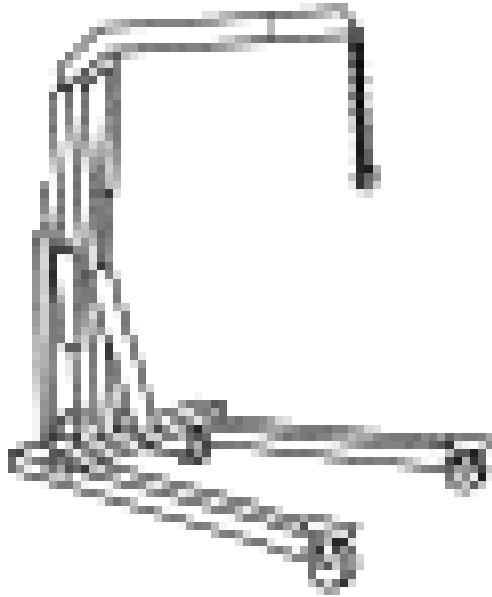
## CRANKSHAFT REAR SEAL WITH RETAINER PLATE

Special Tool(s)

### SPECIAL TOOL SPECIFICATION

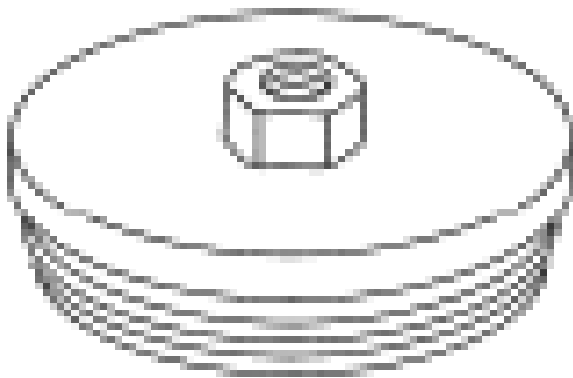
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Heavy Duty Floor Crane  
014-00071 or equivalent

**ST1341-A**



Remover, Crankshaft Rear Oil Seal  
303-519 (T95P-6701-EH)

**ST1382-A**

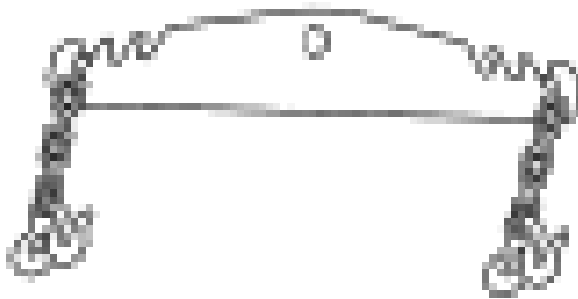
## 2010 Ford Edge Limited

2010 ENGINE Engine - 3.5L - Edge & MKX



Slide Hammer  
307-005 (T59L-100-B)

ST1187-A



Spreader Bar  
303-D089 (D93P-6001-A3) or equivalent

ST1602-A

### Material

### MATERIAL SPECIFICATION

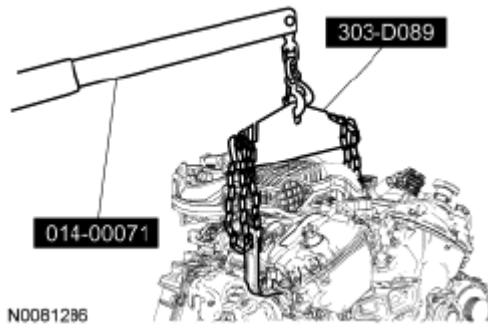
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	-
Silicone Gasket Remover ZC-30	-

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

failure.

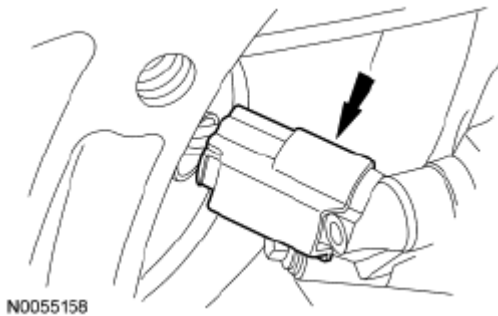
**NOTE:** This procedure is for removal of the crankshaft rear seal and retainer plate and requires removal of the oil pan. If only removing the crankshaft rear seal, refer to CRANKSHAFT REAR SEAL.

1. Remove the oil pan. For additional information, refer to OIL PAN.
2. Using the Heavy Duty Floor Crane and Spreader Bar, remove the engine from the stand.



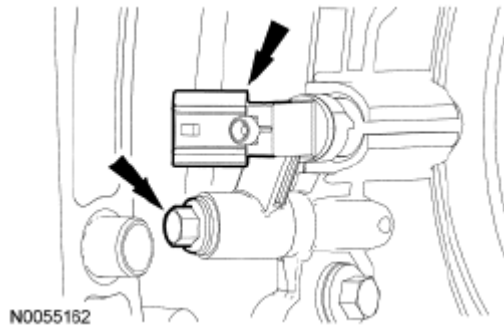
**Fig. 463: Identifying Heavy Duty Floor Crane And Spreader Bar**  
Courtesy of FORD MOTOR CO.

3. Disconnect the Crankshaft Position (CKP) sensor electrical connector.



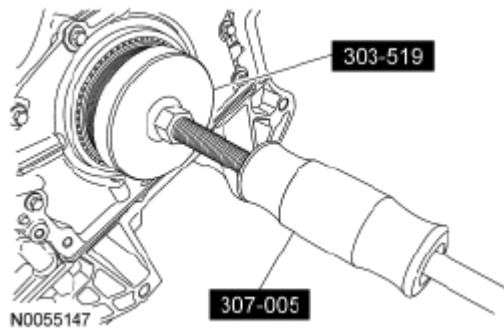
**Fig. 464: Locating Crankshaft Position Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

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



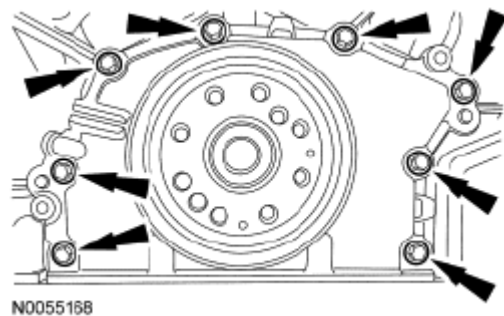
**Fig. 465: Locating CKP Sensor**  
Courtesy of FORD MOTOR CO.

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



**Fig. 466: Identifying Crankshaft Rear Oil Seal Remover And Slide Hammer**  
Courtesy of FORD MOTOR CO.

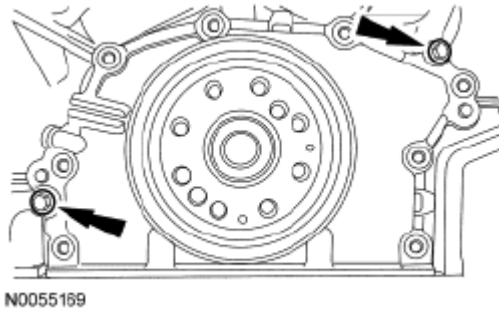
6. Remove the 8 crankshaft rear seal retainer bolts.



**Fig. 467: Locating Crankshaft Rear Seal Retainer Bolts**  
Courtesy of FORD MOTOR CO.

7. 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.



**Fig. 468: Locating M6 Oil Pan Bolts**  
Courtesy of FORD MOTOR CO.

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

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

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

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

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

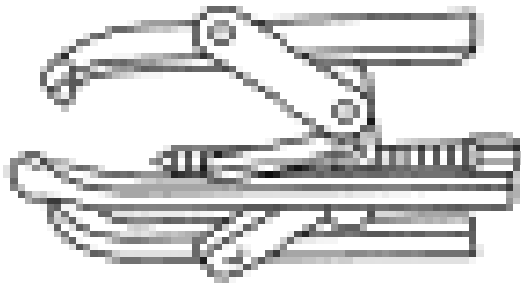
normal.

## DISASSEMBLY

### ENGINE

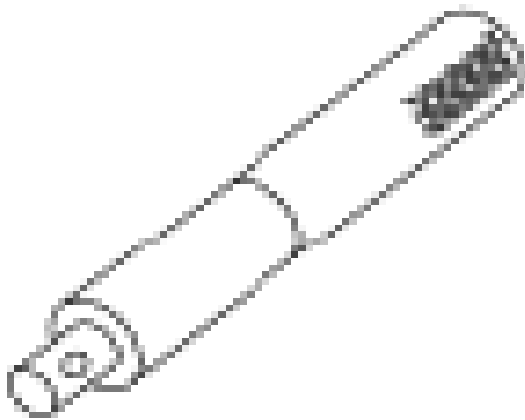
#### Special Tool(s)

#### SPECIAL TOOL SPECIFICATION



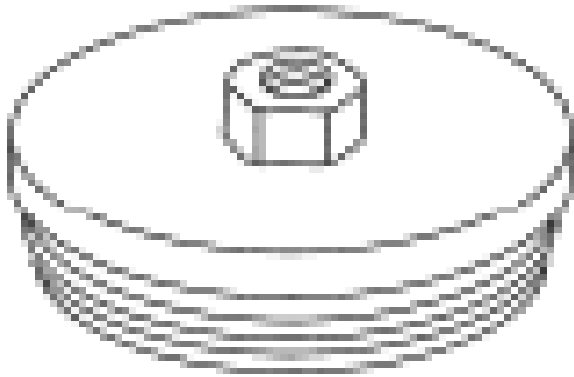
**ST1184-A**

3 Jaw Puller  
303-D121 or equivalent



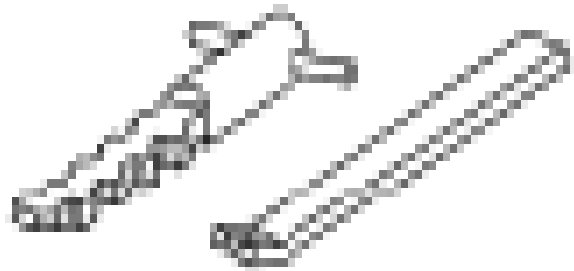
**ST1326-A**

Handle  
205-153 (T80T-4000-W)



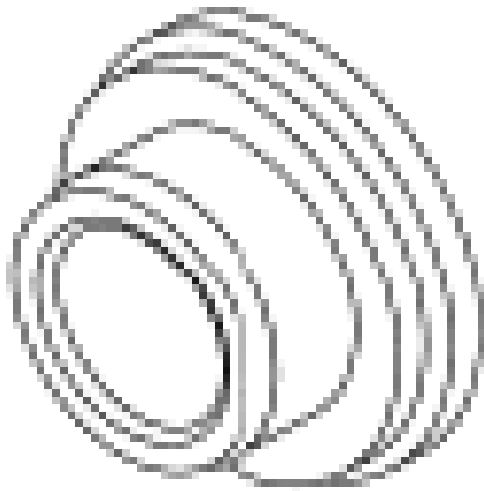
**ST1382-A**

Remover, Crankshaft Rear Oil Seal  
303-519 (T95P-6701-EH)



**ST1385-A**

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



ST2982-A

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

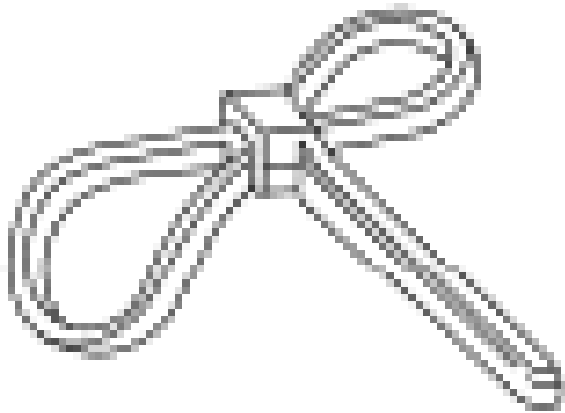


ST1187-A

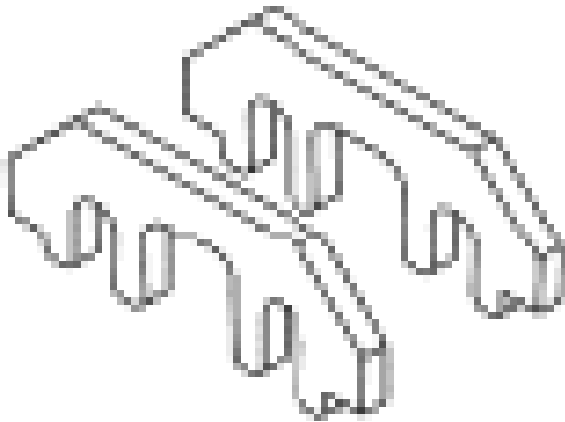
Slide Hammer  
307-005 (T59L-100-B)

Strap Wrench  
303-D055 (D85L-6000-A) or equivalent





**ST1438-A**



**ST2979-A**

Tool, Camshaft Holding  
303-1248

## Material

### MATERIAL SPECIFICATION

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

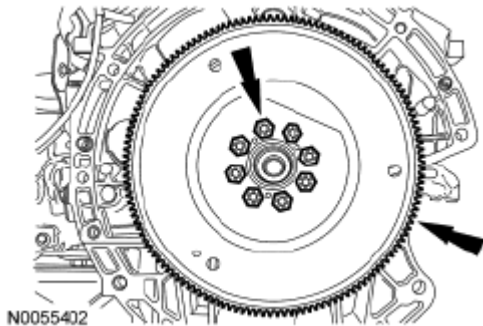
ZC-30

-

- 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:** Early build engines have 11 fastener valve covers, late build engines have 9 fastener valve covers. Do not attempt to install bolts in the 2 empty late build valve cover holes or damage to the valve cover will occur.
- NOTE:** On early build engines, the timing chain rides on the inner side of the RH timing chain guide. Late build engines are equipped with a different design RH timing chain guide that requires the timing chain to ride on the outer side of the RH timing chain guide. For service, all replacement RH timing chain guides will be the late build design.
- NOTE:** For additional information, refer to the exploded view under the ASSEMBLY procedure.

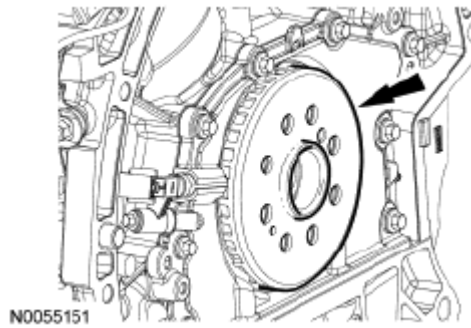
#### All vehicles

1. Remove the 8 bolts and the flexplate.



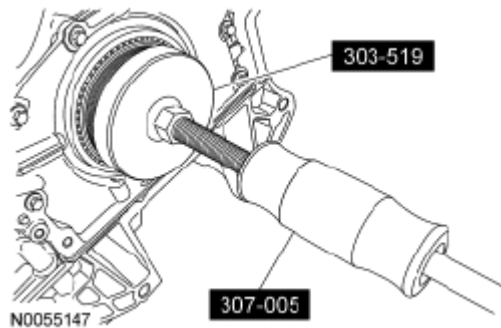
**Fig. 469: Locating Flexplate Bolts**  
Courtesy of FORD MOTOR CO.

2. Remove the crankshaft sensor ring.



**Fig. 470: Locating Crankshaft Sensor Ring**  
Courtesy of FORD MOTOR CO.

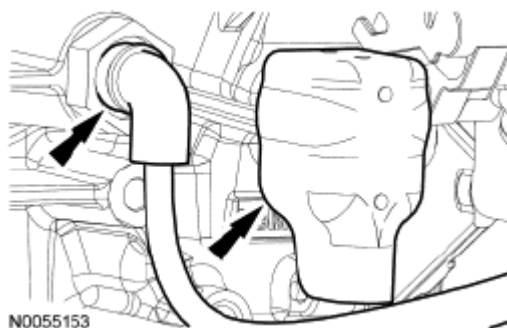
3. Using the Crankshaft Rear Oil Seal Remover and Slide Hammer, remove and discard the rear crankshaft seal.



**Fig. 471: Identifying Crankshaft Rear Oil Seal Remover And Slide Hammer**  
Courtesy of FORD MOTOR CO.

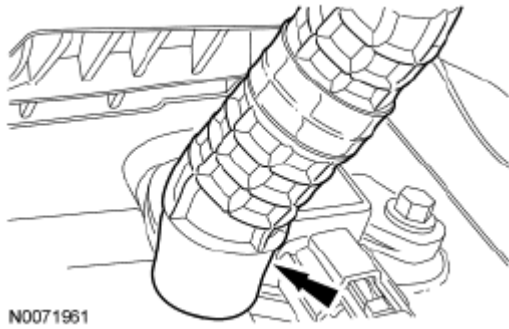
**NOTE:** Install the engine stand bolts into the cylinder block only. Do not install the bolts into the oil pan.

4. Mount the engine on a suitable engine stand.
5. If equipped, remove the heat shield and disconnect the block heater electrical connector.
  - Detach all of the engine block heater harness retainers and remove the harness.



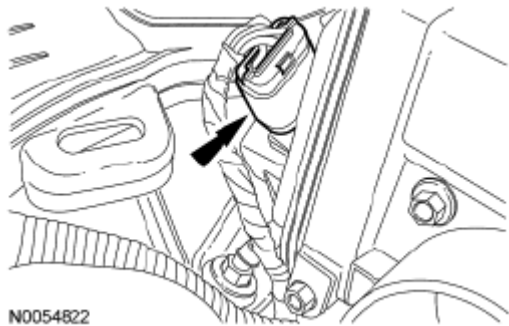
**Fig. 472: Locating Heat Shield**  
Courtesy of FORD MOTOR CO.

6. Disconnect the PCV hose from the PCV valve.



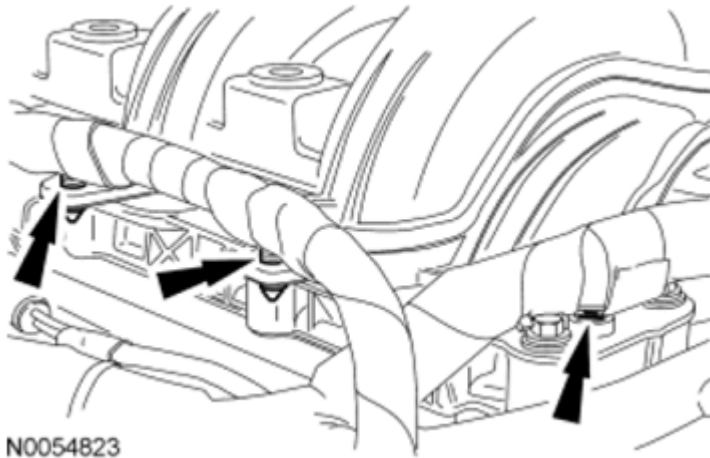
**Fig. 473: Locating PCV Hose**  
Courtesy of FORD MOTOR CO.

7. Disconnect the Throttle Body (TB) electrical connector.



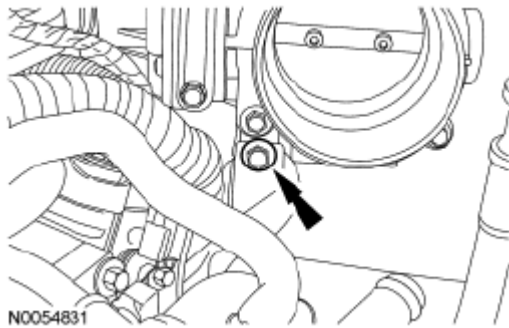
**Fig. 474: Locating Throttle Body Electrical Connector**  
Courtesy of FORD MOTOR CO.

8. Detach the wiring harness retainers from the upper intake manifold.



**Fig. 475: Locating Wiring Harness Retainers**  
Courtesy of FORD MOTOR CO.

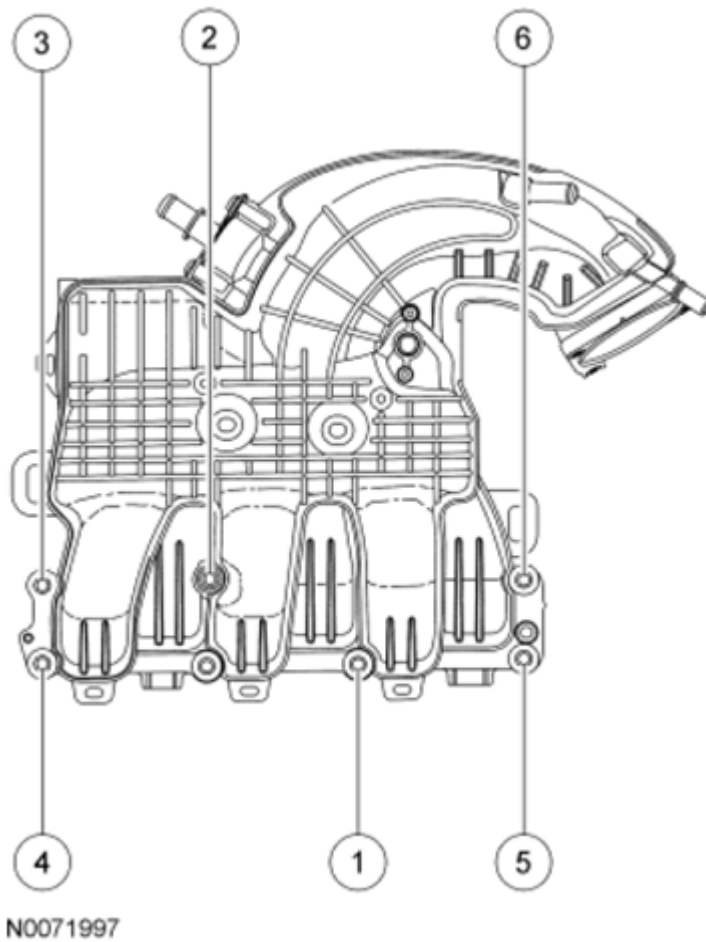
9. Remove the upper intake manifold support bracket bolt.



**Fig. 476: Locating Upper Intake Manifold Support Bracket Bolt**  
Courtesy of FORD MOTOR CO.

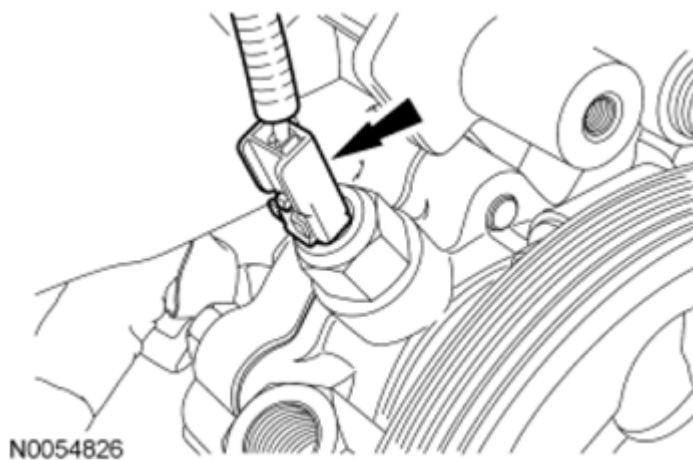
**NOTE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

10. Remove the 6 bolts and the upper intake manifold in the following sequence.
  - Discard the gaskets.



**Fig. 477: Identifying Upper Intake Manifold Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

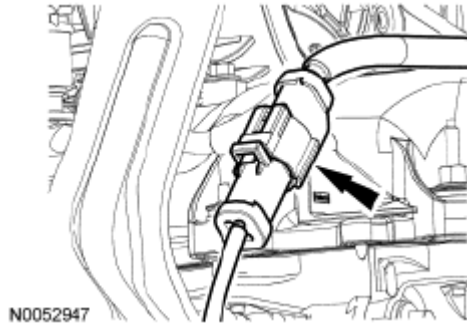
11. Disconnect the Power Steering Pressure (PSP) switch electrical connector.



**Fig. 478: Locating PSP Switch Electrical Connector**  
Courtesy of FORD MOTOR CO.

**Front Wheel Drive (FWD) vehicles**

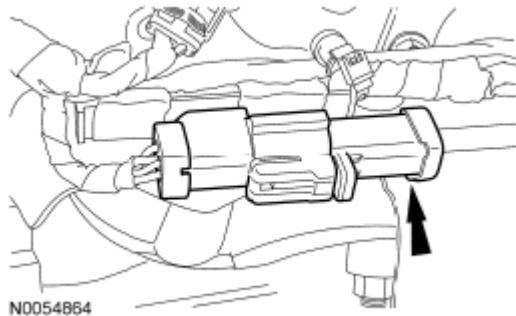
12. Disconnect the RH Catalyst Monitor Sensor (CMS) electrical connector.



**Fig. 479: Locating RH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

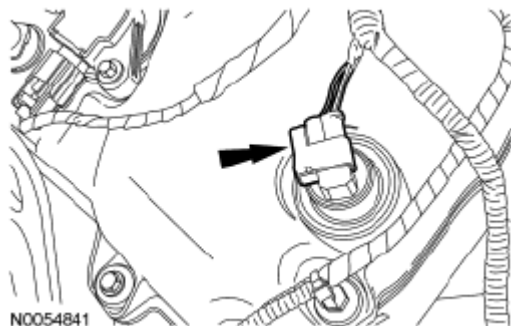
**All vehicles**

13. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.



**Fig. 480: Locating RH Heated Oxygen Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

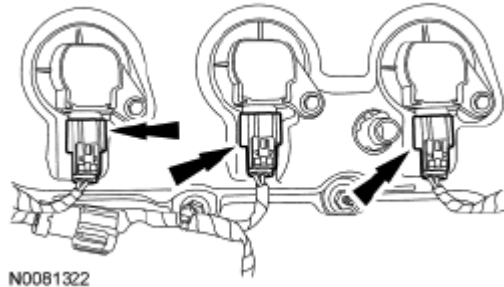
14. Disconnect the RH Variable Camshaft Timing (VCT) solenoid electrical connector.



**Fig. 481: Locating RH Variable Camshaft Timing Solenoid Electrical Connector**

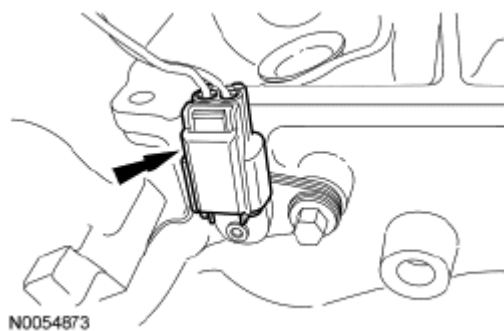
Courtesy of FORD MOTOR CO.

15. Disconnect the 3 RH coil-on-plug electrical connectors.



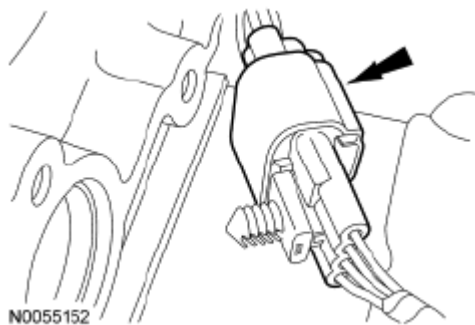
**Fig. 482: Locating RH Coil-On-Plug Electrical Connectors**  
Courtesy of FORD MOTOR CO.

16. Detach all of the wiring harness retainers from the RH valve cover and stud bolts.
17. Disconnect the RH Camshaft Position (CMP) sensor electrical connector.



**Fig. 483: Locating RH Camshaft Position (CMP) Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

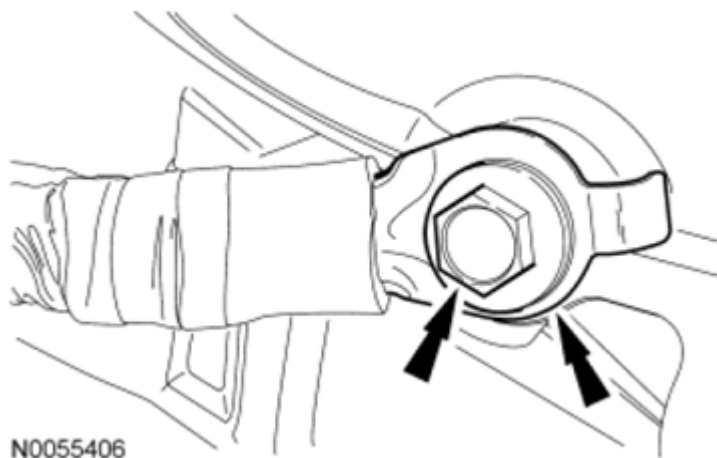
18. Disconnect the Knock Sensor (KS) electrical connector.



**Fig. 484: Locating Knock Sensor (KS) Electrical Connector**  
Courtesy of FORD MOTOR CO.

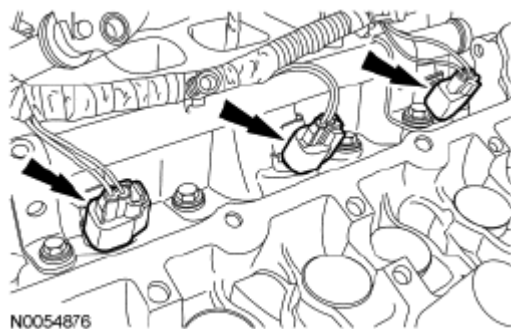


19. Remove the bolt and the ground cable from the RH cylinder.



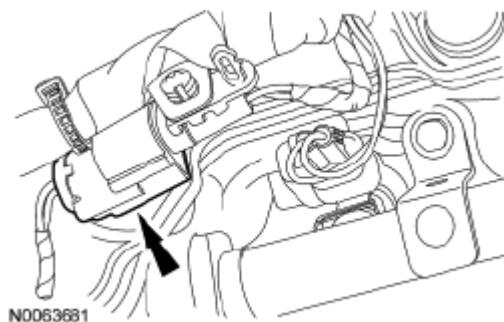
**Fig. 485: Locating Ground Cable Bolts**  
Courtesy of FORD MOTOR CO.

20. Disconnect the 6 fuel injector electrical connectors (3 shown in illustration).



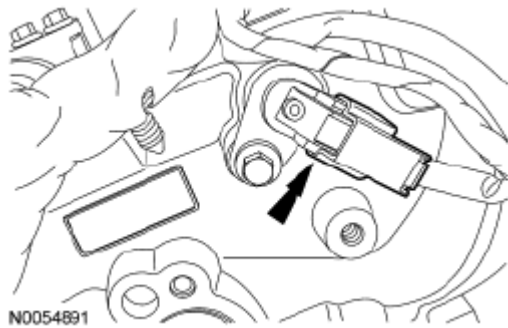
**Fig. 486: Locating Fuel Injector Electrical Connectors**  
Courtesy of FORD MOTOR CO.

21. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.



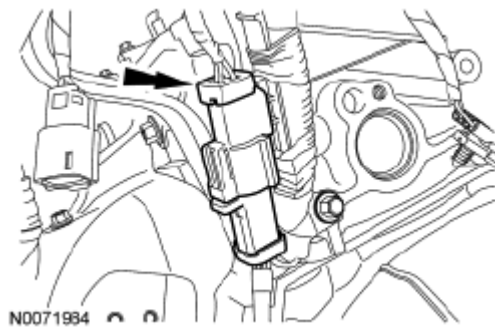
**Fig. 487: Locating Cylinder Head Temperature Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

22. Disconnect the LH **CMP** sensor electrical connector.



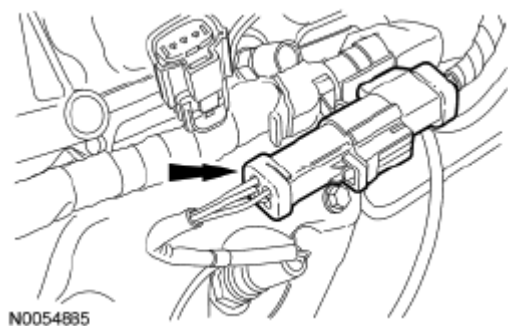
**Fig. 488: Locating LH Camshaft Position Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

23. Disconnect the LH **CMS** electrical connector.



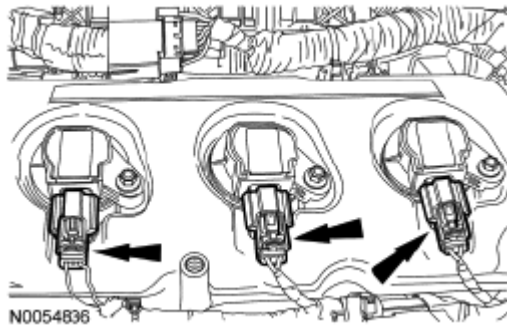
**Fig. 489: Locating LH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

24. Disconnect the LH **HO2S** electrical connector.



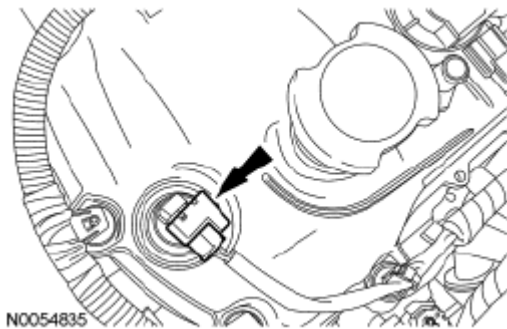
**Fig. 490: Locating LH Heated Oxygen Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

25. Disconnect the 3 LH coil-on-plug electrical connectors.



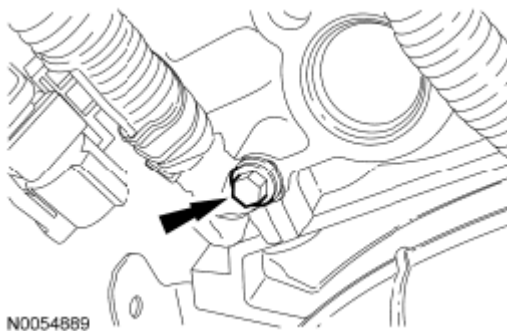
**Fig. 491: Locating LH Coil-On-Plug Electrical Connectors**  
Courtesy of FORD MOTOR CO.

26. Disconnect the LH VCT solenoid electrical connector.



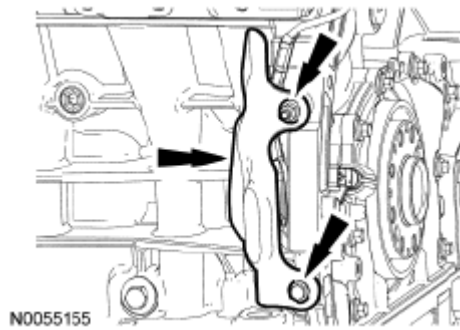
**Fig. 492: Locating LH VCT Solenoid Electrical Connector**  
Courtesy of FORD MOTOR CO.

27. Detach all of the wiring harness retainers from the LH valve cover and stud bolts.  
28. Remove the wiring harness retainer bolt from the rear of the LH cylinder head.



**Fig. 493: Locating Wiring Harness Retainer Bolt**  
Courtesy of FORD MOTOR CO.

29. Remove the nut, the bolt and the heat shield.



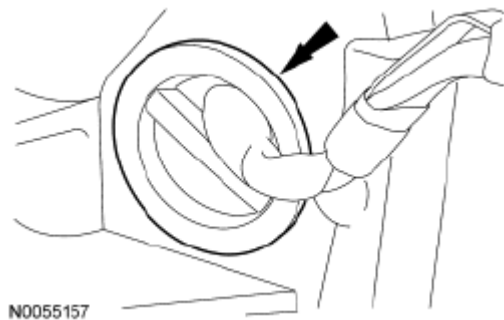
**Fig. 494: Locating Heat Shield Nut And Bolt**  
Courtesy of FORD MOTOR CO.

30. Remove the wiring harness retainer stud bolt.



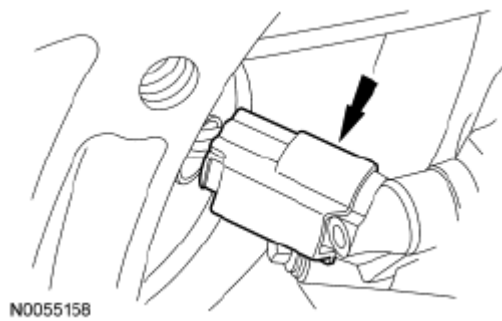
**Fig. 495: Locating Wiring Harness Retainer Stud Bolt**  
Courtesy of FORD MOTOR CO.

31. Remove the wiring harness grommet.



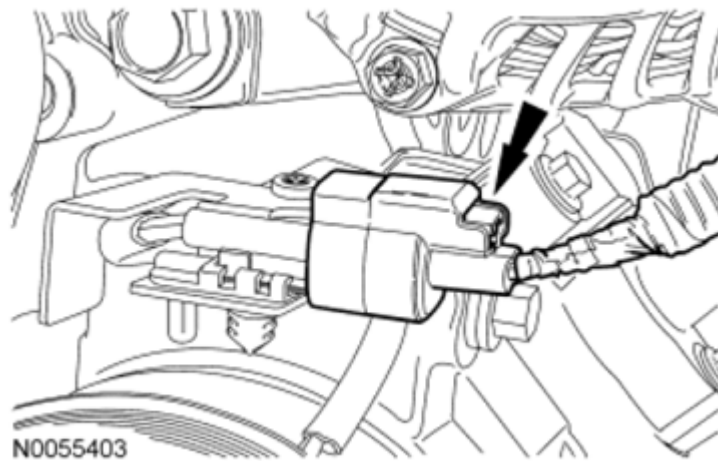
**Fig. 496: Locating Wiring Harness Grommet**  
Courtesy of FORD MOTOR CO.

32. Disconnect the Crankshaft Position (CKP) sensor electrical connector.



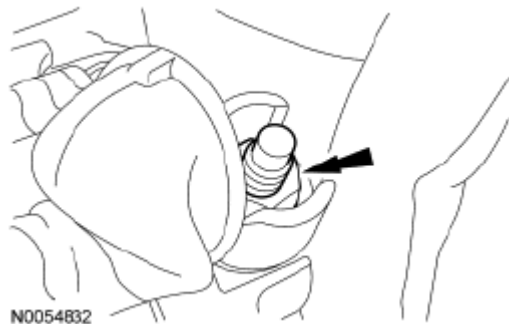
**Fig. 497: Locating Crankshaft Position Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

33. Disconnect the A/C compressor electrical connector.



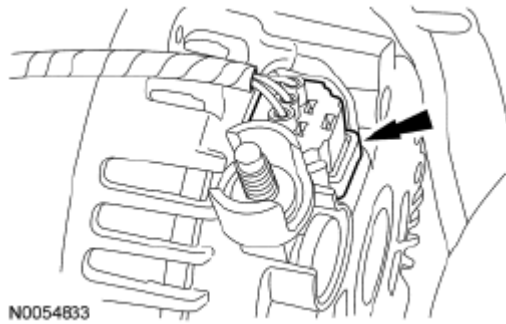
**Fig. 498: Locating A/C Compressor Electrical Connector**  
Courtesy of FORD MOTOR CO.

34. Remove the nut and disconnect the generator B+ cable.



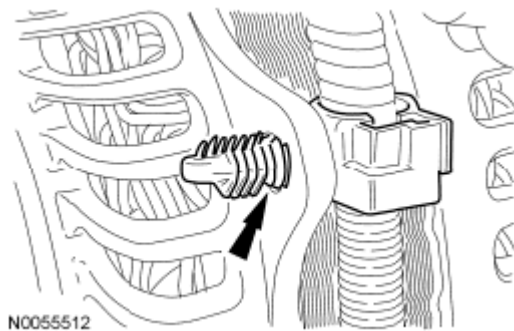
**Fig. 499: Locating Generator B+ Cable**  
Courtesy of FORD MOTOR CO.

35. Disconnect the generator electrical connector.



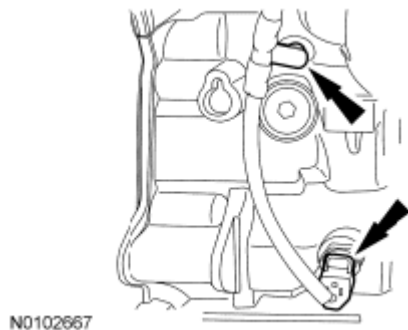
**Fig. 500: Locating Generator Electrical Connector**  
Courtesy of FORD MOTOR CO.

36. Detach the wiring harness retainer from the generator.



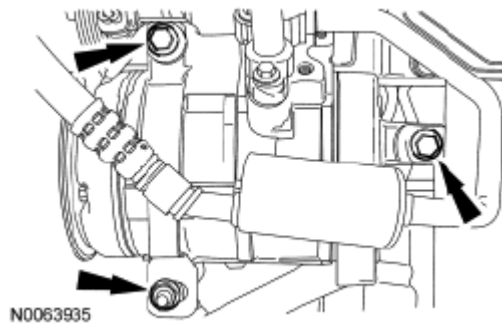
**Fig. 501: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

37. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and the wiring harness pin-type retainer.
  - Remove the wiring harness from the engine.



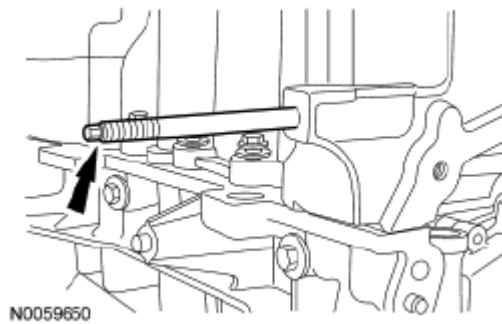
**Fig. 502: Locating Engine Oil Pressure Switch Electrical Connector**  
Courtesy of FORD MOTOR CO.

38. Remove the nut, 2 bolts and the A/C compressor.



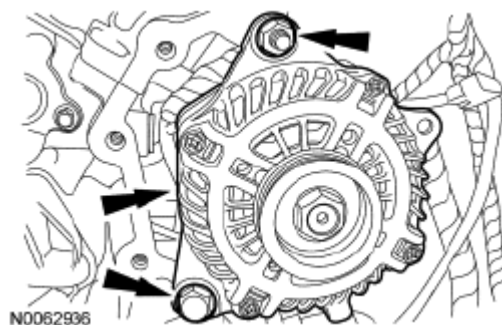
**Fig. 503: Locating A/C Compressor Bolts And Nut**  
Courtesy of FORD MOTOR CO.

39. Remove the A/C compressor mounting stud from the oil pan.



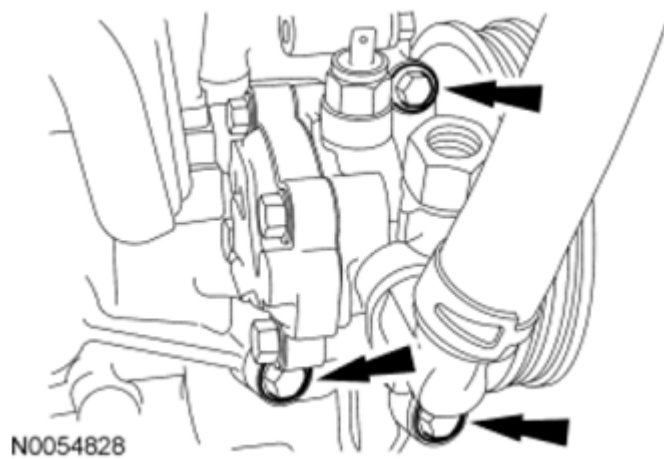
**Fig. 504: Locating A/C Compressor Mounting Stud**  
Courtesy of FORD MOTOR CO.

40. Remove the nut, bolt and the generator.



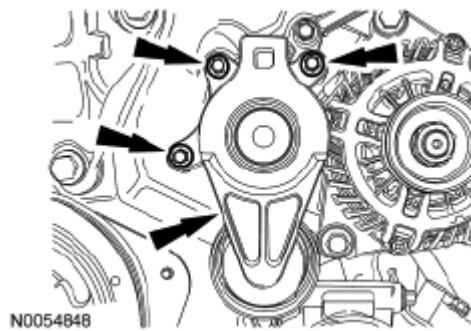
**Fig. 505: Locating Generator Bolt And Nut**  
Courtesy of FORD MOTOR CO.

41. Remove the 3 bolts and the power steering pump.



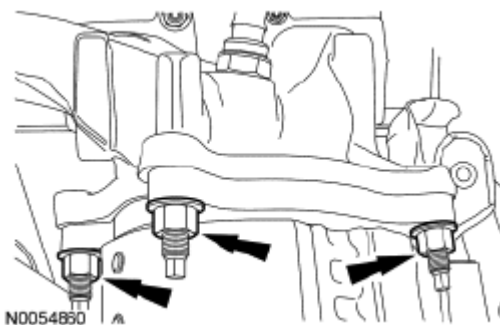
**Fig. 506: Locating Power Steering Pump Bolts**  
Courtesy of FORD MOTOR CO.

42. Remove the 3 bolts and the accessory drive belt tensioner.



**Fig. 507: Locating Accessory Drive Belt Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

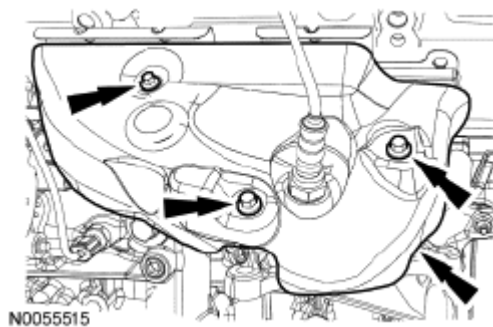
43. Remove the 4 nuts (3 shown in illustration) and the LH catalytic converter.
  - Discard the nuts and the gasket.



**Fig. 508: Locating LH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

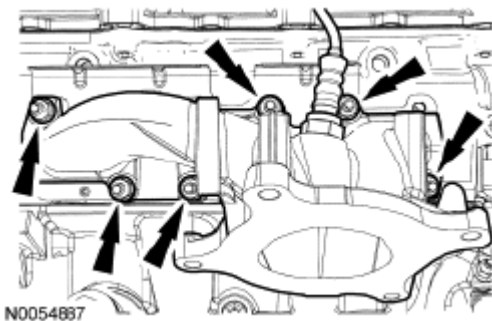


44. Remove the 3 bolts and the LH exhaust manifold heat shield.



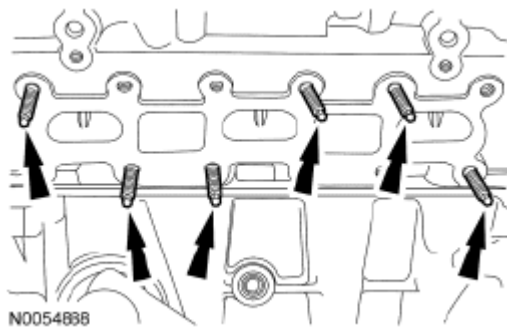
**Fig. 509: Locating LH Exhaust Manifold Heat Shield Bolts**  
Courtesy of FORD MOTOR CO.

45. Remove the 6 nuts and the LH exhaust manifold.
- Discard the nuts and exhaust manifold gaskets.



**Fig. 510: Locating LH Exhaust Manifold Nuts**  
Courtesy of FORD MOTOR CO.

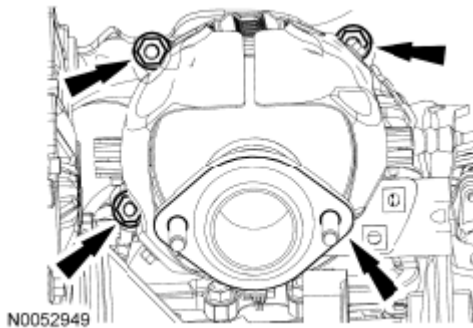
46. Clean and inspect the LH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION**.
47. Remove and discard the 6 LH exhaust manifold studs.



**Fig. 511: Locating LH Exhaust Manifold Studs**  
Courtesy of FORD MOTOR CO.

**FWD vehicles**

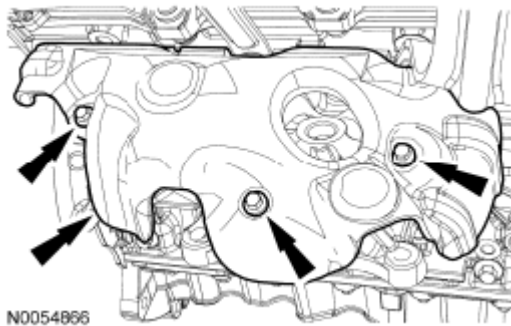
48. Remove the 4 nuts and the RH catalytic converter.
- Discard the nuts and the gasket.



**Fig. 512: Locating RH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

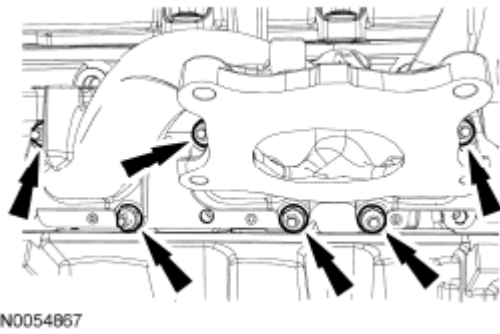
**All vehicles**

49. Remove the 3 bolts and the RH exhaust manifold heat shield.



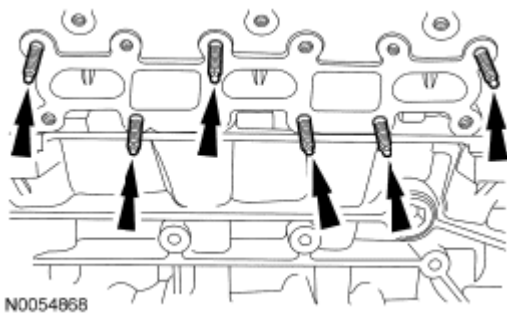
**Fig. 513: Locating RH Exhaust Manifold Heat Shield Bolts**  
Courtesy of FORD MOTOR CO.

50. Remove the 6 nuts and the RH exhaust manifold.
- Discard the nuts and exhaust manifold gaskets.



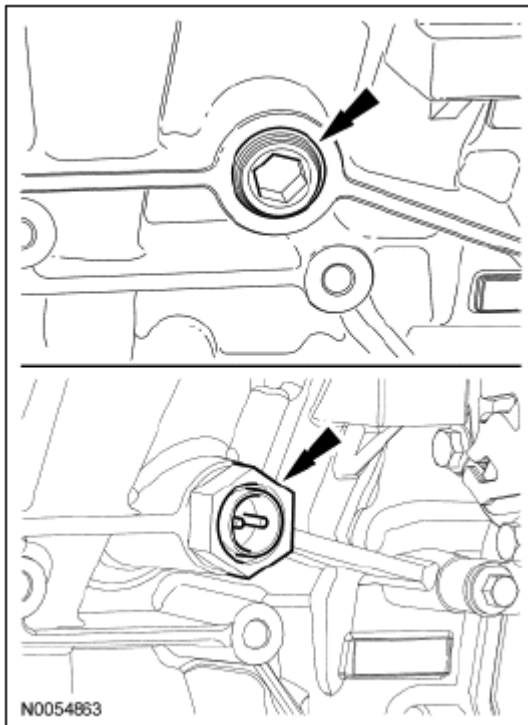
**Fig. 514: Locating RH Exhaust Manifold Nuts**  
Courtesy of FORD MOTOR CO.

51. Clean and inspect the RH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION**.
52. Remove and discard the 6 RH exhaust manifold studs.



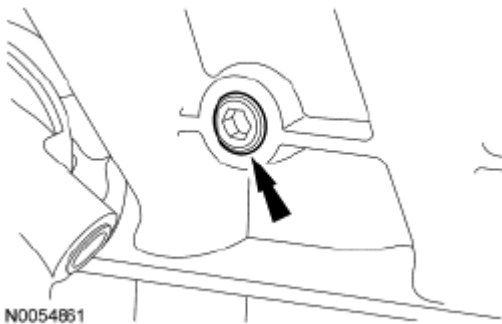
**Fig. 515: Locating RH Exhaust Manifold Studs**  
Courtesy of FORD MOTOR CO.

53. Remove the RH cylinder block drain plug or, if equipped, the block heater.
  - Allow coolant to drain from the cylinder block.



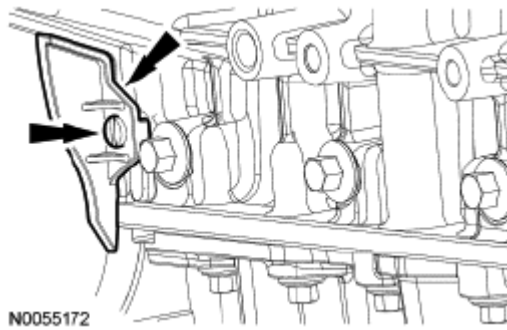
**Fig. 516: Locating RH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

54. Remove the LH cylinder block drain plug.
- Allow coolant to drain from the cylinder block.



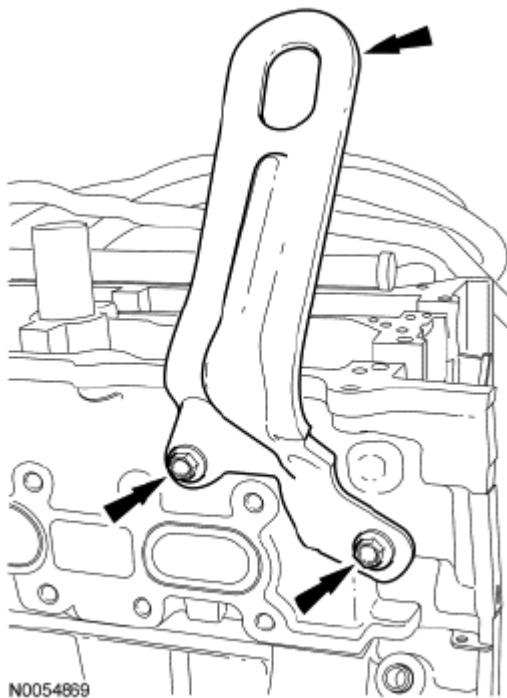
**Fig. 517: Locating LH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

55. Remove the pin-type retainer and the cover.



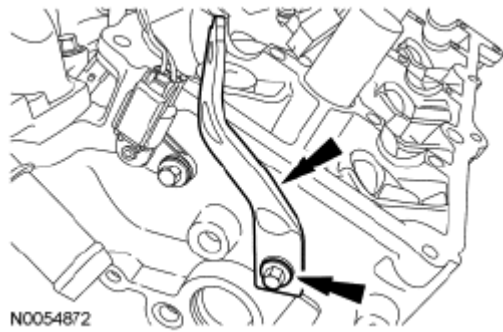
**Fig. 518: Locating Pin-Type Retainer**  
Courtesy of FORD MOTOR CO.

56. Remove the 2 bolts and the engine lifting eye.



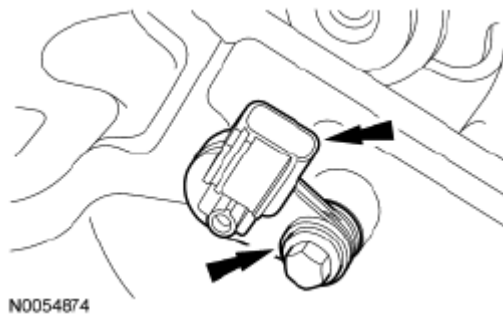
**Fig. 519: Locating Engine Lifting Eye With Bolts**  
Courtesy of FORD MOTOR CO.

57. Remove the bolt and the upper intake manifold bracket.



**Fig. 520: Locating Upper Intake Manifold Bracket Bolt**  
Courtesy of FORD MOTOR CO.

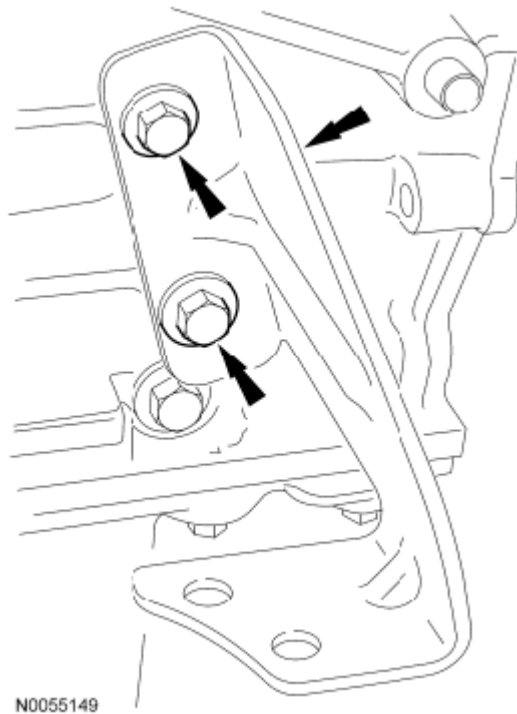
58. Remove the bolt and the RH CMP sensor.



**Fig. 521: Locating RH CMP Sensor Bolt**  
Courtesy of FORD MOTOR CO.

**All-Wheel Drive (AWD) vehicles**

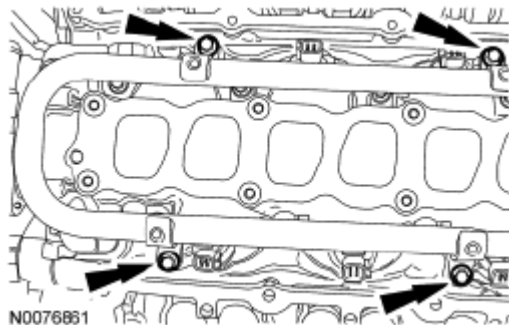
59. Remove the 2 bolts and the catalytic converter bracket.



**Fig. 522: Locating Catalytic Converter Bracket Bolts**  
Courtesy of FORD MOTOR CO.

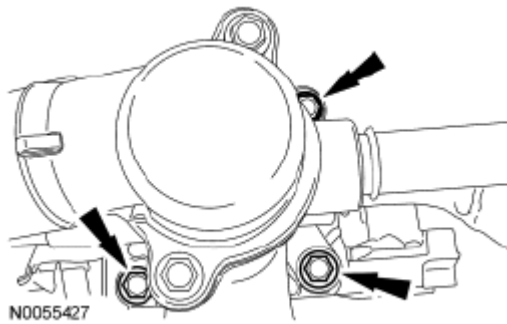
**All vehicles**

60. Remove the 4 bolts and the fuel rail and injectors as an assembly.



**Fig. 523: Locating Fuel Rail Bolts**  
Courtesy of FORD MOTOR CO.

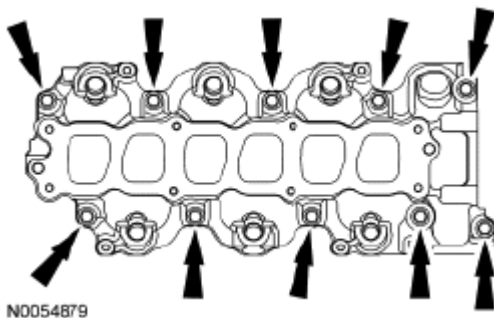
61. Remove the 3 thermostat housing-to-lower intake manifold bolts.
  - Remove the thermostat housing and discard the gasket.



**Fig. 524: Locating Thermostat Housing-To-Lower Intake Manifold Bolts**  
Courtesy of FORD MOTOR CO.

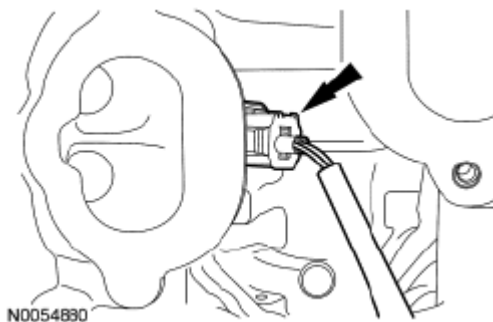
**NOTE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

62. Remove the 10 bolts and the lower intake manifold.
- Discard the gaskets.



**Fig. 525: Locating Lower Intake Manifold Bolts**  
Courtesy of FORD MOTOR CO.

63. Disconnect and remove the CHT sensor jumper harness.

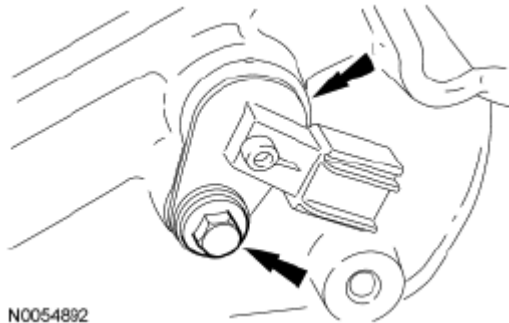


**Fig. 526: Locating CHT Sensor Jumper Harness**



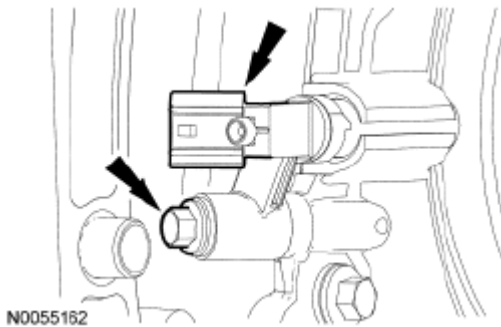
Courtesy of FORD MOTOR CO.

64. Remove the bolt and the LH CMP sensor.



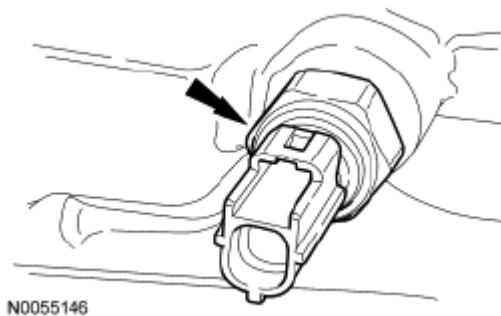
**Fig. 527: Locating LH CMP Sensor**  
Courtesy of FORD MOTOR CO.

65. Remove the bolt and the CKP sensor.



**Fig. 528: Locating CKP Sensor**  
Courtesy of FORD MOTOR CO.

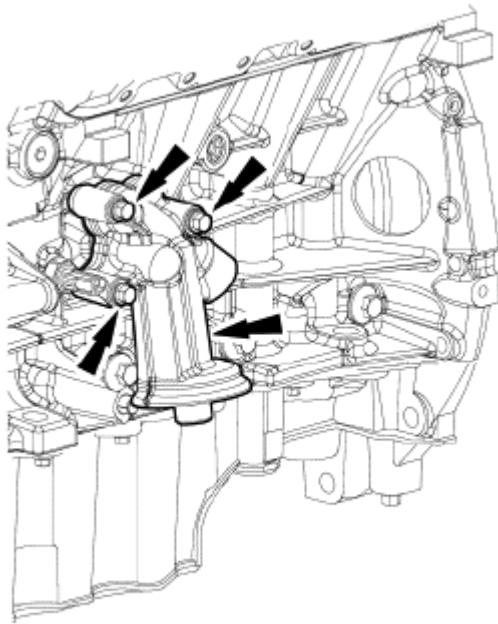
66. Remove the EOP switch.



**Fig. 529: Locating EOP Switch**  
Courtesy of FORD MOTOR CO.

67. Remove the 3 bolts and the oil filter adapter.

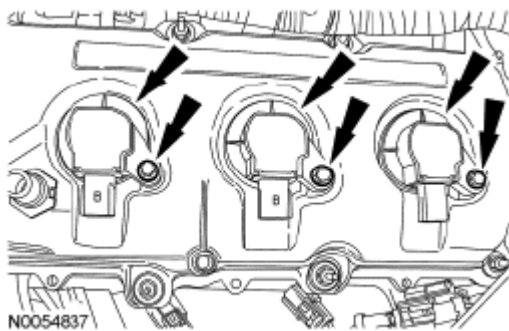
- Discard the gasket.



N0097838

**Fig. 530: Locating Oil Filter Adapter Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** LH shown in illustration, RH similar.



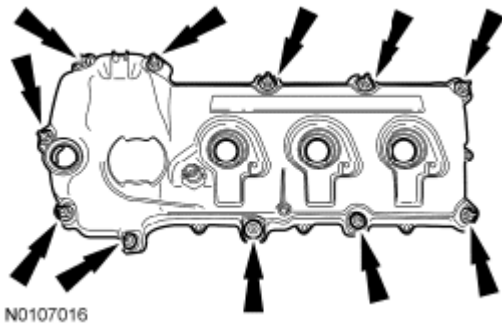
N0054837

**Fig. 531: Locating Coil-On-Plugs Bolts**  
Courtesy of FORD MOTOR CO.

68. Remove the 6 bolts and the 6 coil-on-plugs.

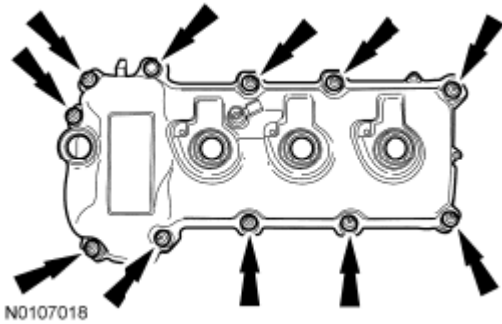
#### **Early build vehicles**

69. Loosen the 11 stud bolts and remove the LH valve cover.
  - Discard the gasket.



**Fig. 532: Locating LH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

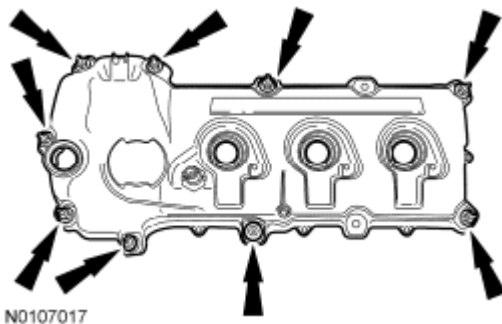
70. Loosen the bolt, the 10 stud bolts and remove the RH valve cover.
- Discard the gasket.



**Fig. 533: Locating RH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

#### Late build vehicles

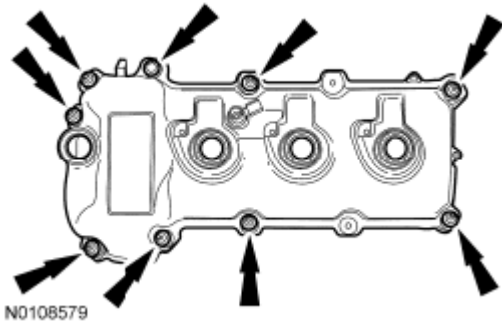
71. Loosen the 9 stud bolts and remove the LH valve cover.
- Discard the gasket.



**Fig. 534: Locating LH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

72. Loosen the 9 stud bolts and remove the RH valve cover.

- Discard the gasket.



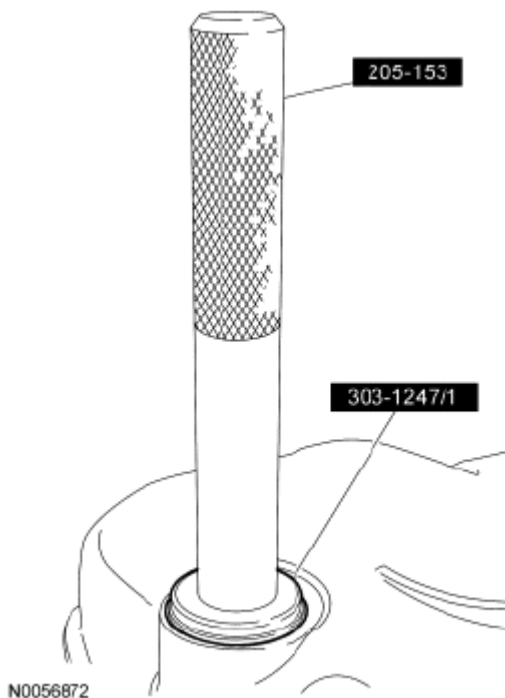
**Fig. 535: Locating RH Valve Cover Stud Bolts**  
Courtesy of FORD MOTOR CO.

#### All vehicles

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

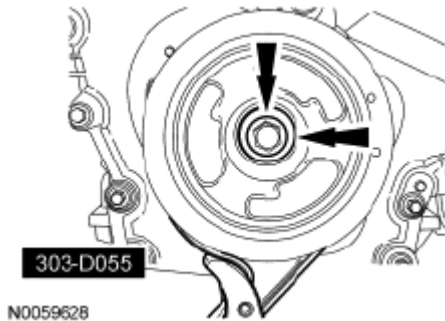
73. Inspect the VCT solenoid seals and the spark plug tube seals. Remove any damaged seals.

- Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



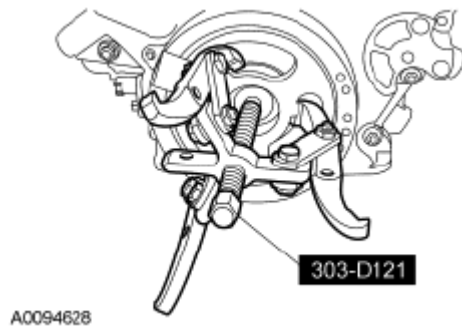
**Fig. 536: Identifying VCT Spark Plug Tube Seal Remover And Handle**  
Courtesy of FORD MOTOR CO.

74. Using the Strap Wrench, remove the crankshaft pulley bolt and washer.
- Discard the bolt.



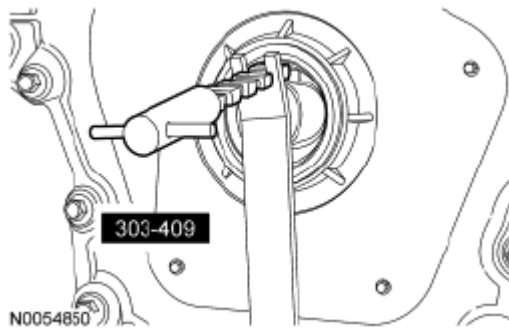
**Fig. 537: Locating Crankshaft Bolt And Washer**  
Courtesy of FORD MOTOR CO.

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



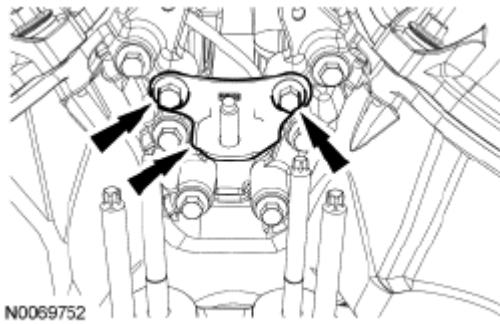
**Fig. 538: Removing Crankshaft Pulley**  
Courtesy of FORD MOTOR CO.

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



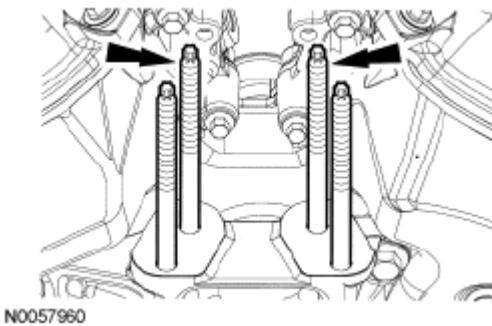
**Fig. 539: Removing Crankshaft Front Seal**  
Courtesy of FORD MOTOR CO.

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



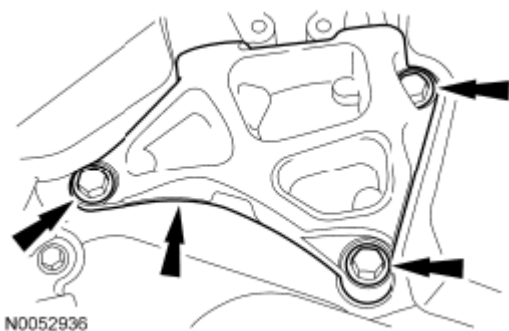
**Fig. 540: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** Only use hand tools to remove the studs.



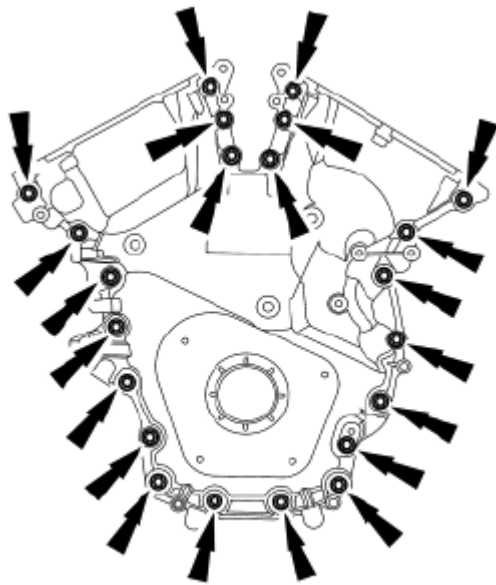
**Fig. 541: Locating Engine Mount Studs**  
Courtesy of FORD MOTOR CO.

78. Remove the 2 engine mount studs.
79. Remove the 3 bolts and the engine mount bracket.



**Fig. 542: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

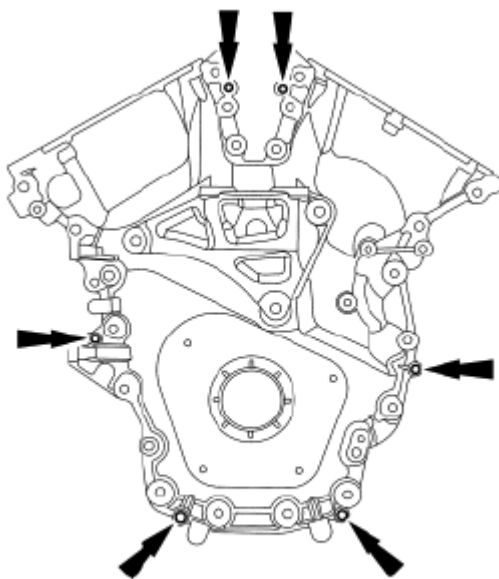
80. Remove the 22 engine front cover bolts.



N0054851

**Fig. 543: Locating Engine Front Cover Bolts**  
Courtesy of FORD MOTOR CO.

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



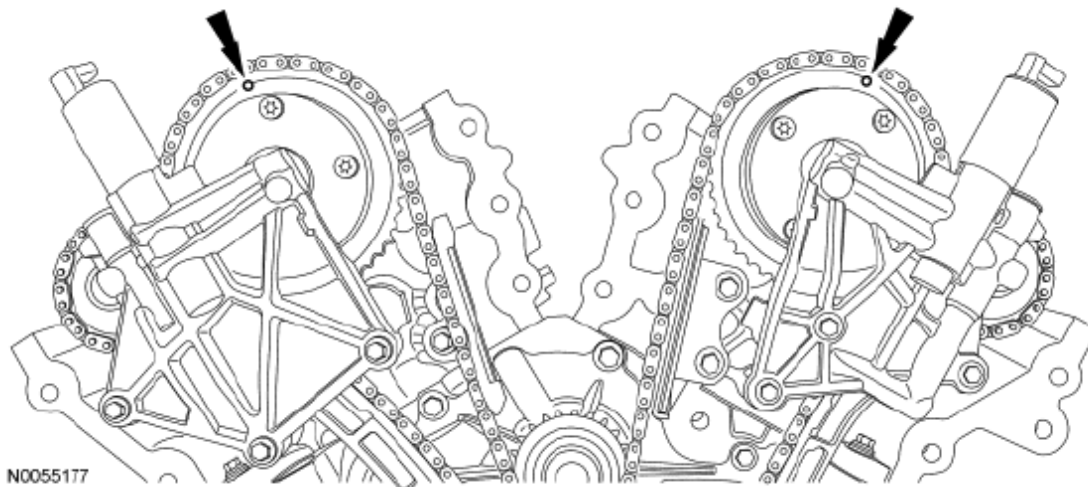
N0082530

**Fig. 544: Locating Engine Front Cover Bolts**

Courtesy of FORD MOTOR CO.

**Engines equipped with early build RH timing chain guides**

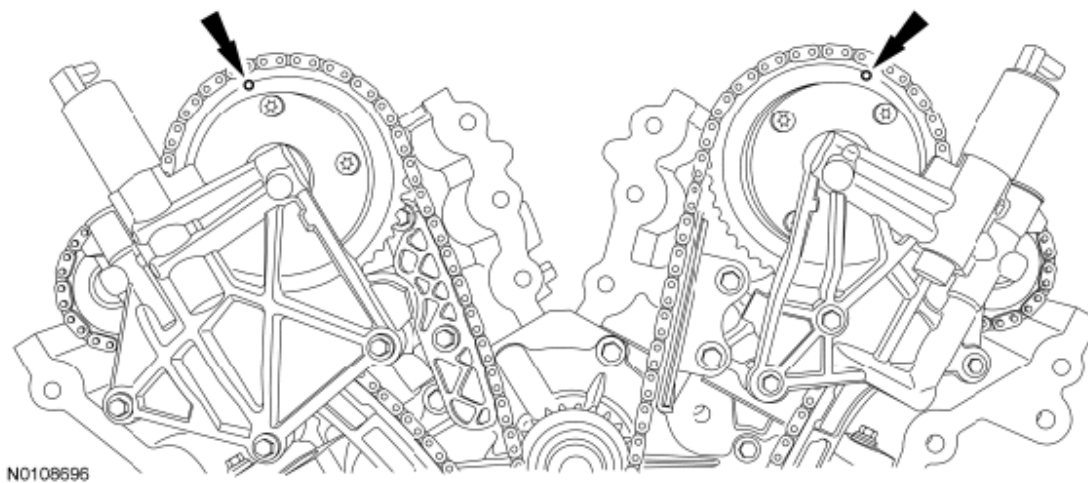
82. Rotate the crankshaft clockwise and align the timing marks on the VCT assemblies as shown in illustration.



**Fig. 545: Identifying Timing Marks Location**  
Courtesy of FORD MOTOR CO.

**Engines equipped with late build/replacement RH timing chain guides**

83. Rotate the crankshaft clockwise and align the timing marks on the VCT assemblies as shown in illustration.

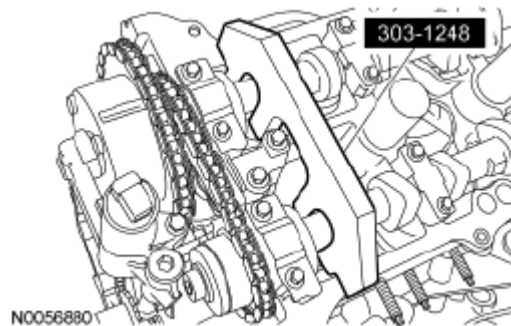


**Fig. 546: Aligning Timing Marks On VCT Assemblies**  
Courtesy of FORD MOTOR CO.

**All vehicles**



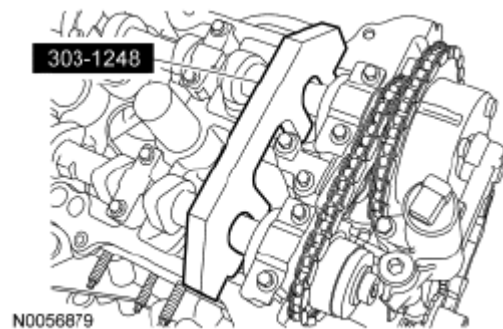
**NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.



**Fig. 547: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

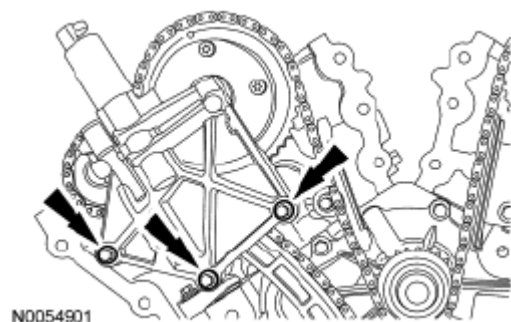
84. Install the Camshaft Holding Tool onto the flats of the LH camshafts.

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



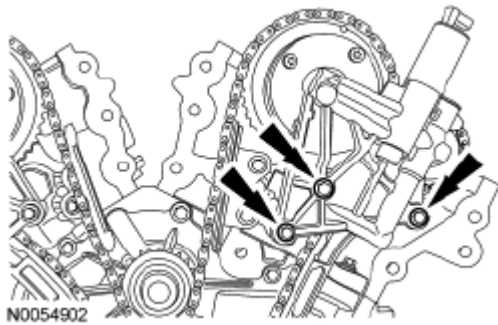
**Fig. 548: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

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



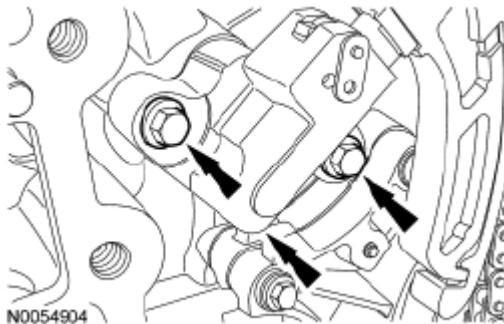
**Fig. 549: Locating RH VCT Housing Bolts**  
Courtesy of FORD MOTOR CO.

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



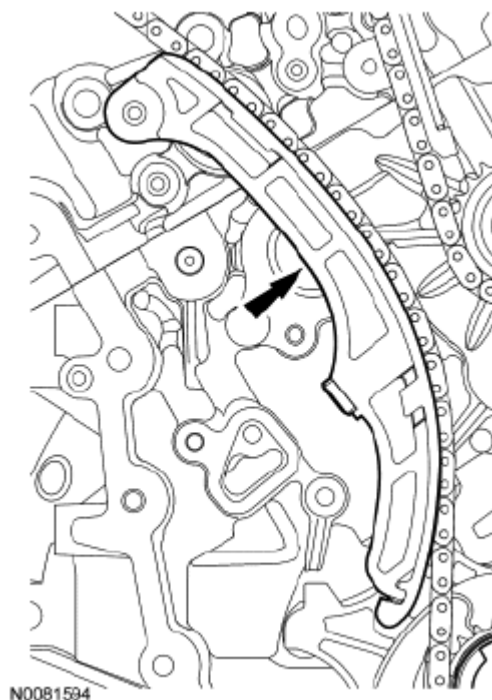
**Fig. 550: Locating LH VCT Housing Bolts**  
Courtesy of FORD MOTOR CO.

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



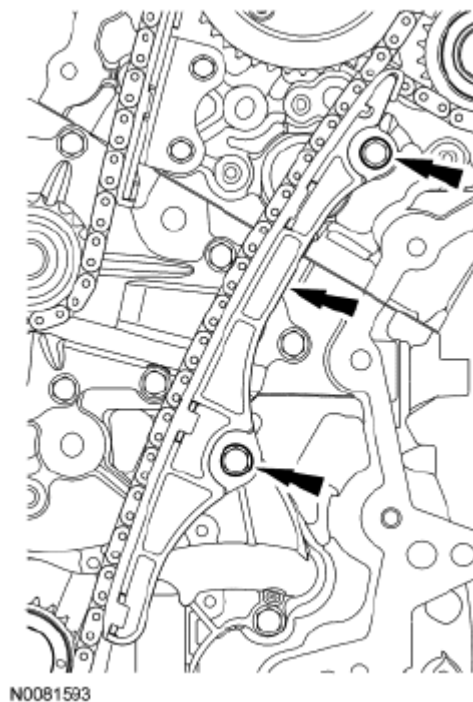
**Fig. 551: Locating Primary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

89. Remove the primary timing chain tensioner arm.



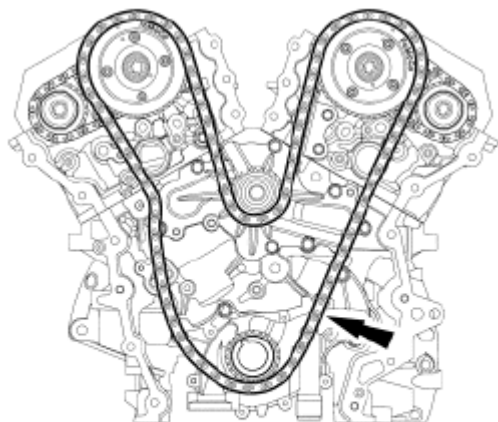
**Fig. 552: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

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



**Fig. 553: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

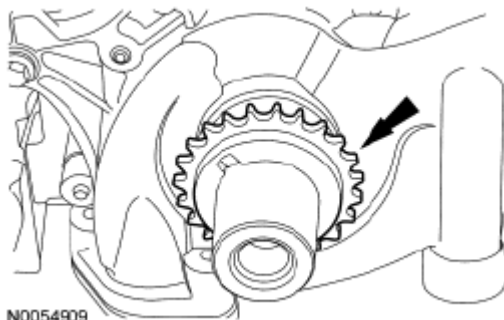
91. Remove the primary timing chain.



N0054908

**Fig. 554: Locating Primary Timing Chain**  
Courtesy of FORD MOTOR CO.

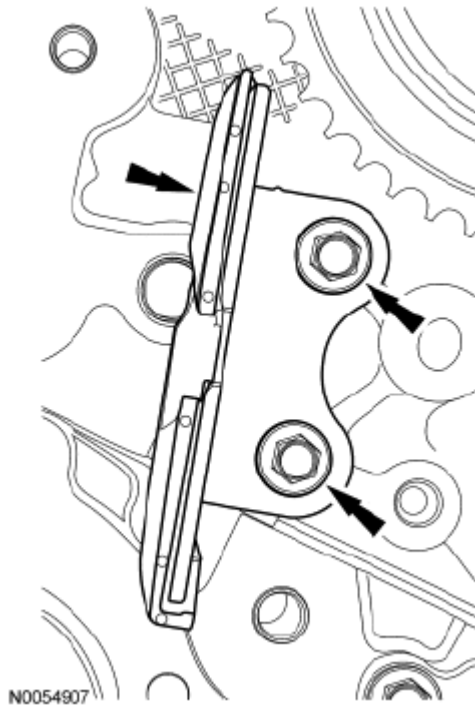
92. Remove the crankshaft timing chain sprocket.



N0054909

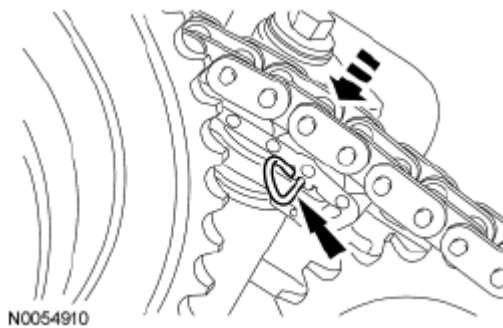
**Fig. 555: Locating Crankshaft Timing Chain Sprocket**  
Courtesy of FORD MOTOR CO.

93. Remove the 2 bolts and the upper LH primary timing chain guide.



**Fig. 556: Locating Upper LH Primary Timing Chain Guide With Bolts**  
Courtesy of FORD MOTOR CO.

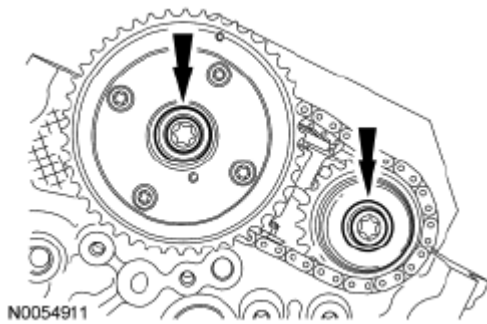
94. Compress the LH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



**Fig. 557: Compressing LH Secondary Timing Chain Tensioner**  
Courtesy of FORD MOTOR CO.

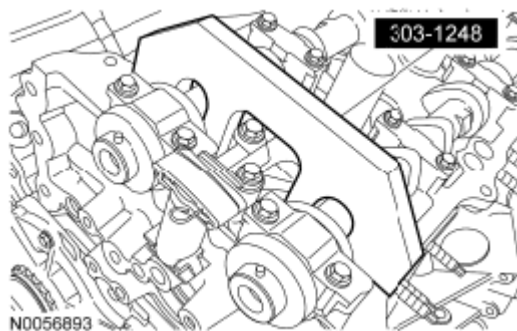
**NOTE:** The VCT bolt and the exhaust camshaft bolt must be discarded and new ones installed. However, the exhaust camshaft washer is reusable.

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



**Fig. 558: Locating Secondary Timing Chain And LH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

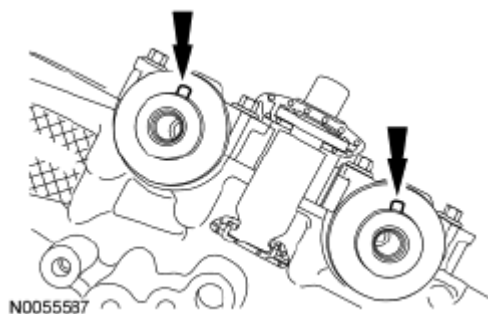
**NOTE:** When the Camshaft Holding Tool is removed, valve spring pressure will rotate the LH camshafts approximately 3 degrees to a neutral position.



**Fig. 559: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

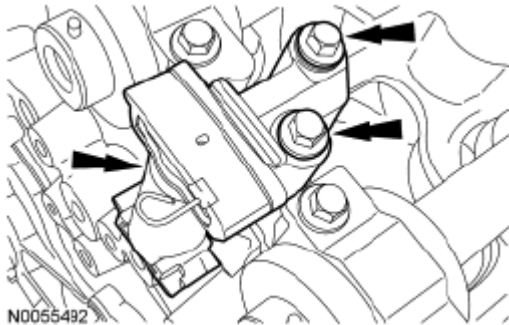
96. Remove the Camshaft Holding Tool from the LH camshafts.

**NOTE:** The camshafts must remain in the neutral position during removal or engine damage may occur.



**Fig. 560: Identifying LH Camshafts Neutral Position**  
Courtesy of FORD MOTOR CO.

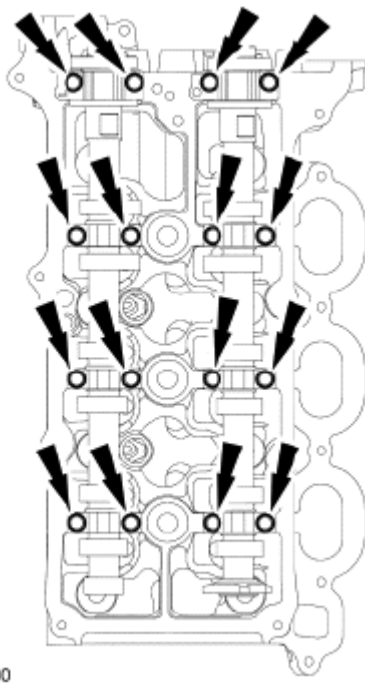
97. Verify the LH camshafts are in the neutral position.
98. Remove the 2 bolts and the LH secondary timing chain tensioner.



**Fig. 561: Locating LH Secondary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

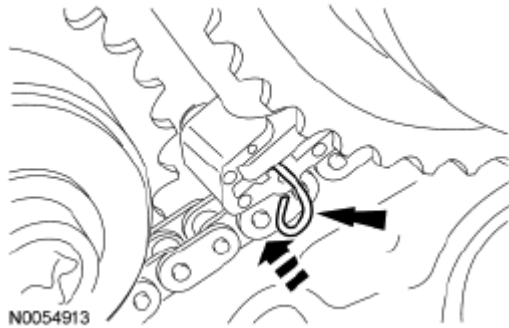
**NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions. If not reassembled in their original position, severe engine damage may occur.

99. Remove the bolts and the LH camshaft bearing caps.
  - Remove the LH camshafts.



**Fig. 562: Locating LH Camshaft Bearing Caps Bolts**  
Courtesy of FORD MOTOR CO.

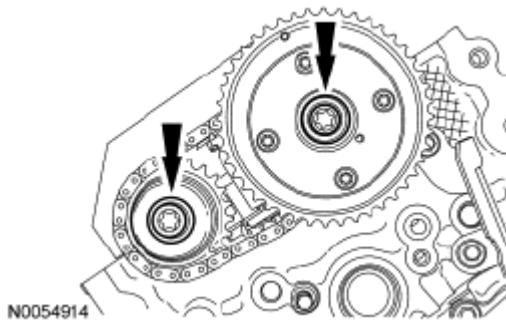
100. Compress the RH secondary timing chain tensioner and install a suitable lockpin to retain the tensioner in the collapsed position.



**Fig. 563: Compressing RH Secondary Timing Chain Tensioner**  
Courtesy of FORD MOTOR CO.

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

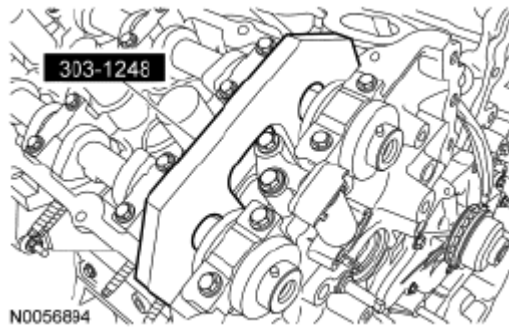
101. Remove and discard the RH VCT assembly bolt and the RH exhaust camshaft sprocket bolt.
- Remove the RH VCT assembly, secondary timing chain and the RH exhaust camshaft sprocket as an assembly.



**Fig. 564: Locating Secondary Timing Chain And RH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

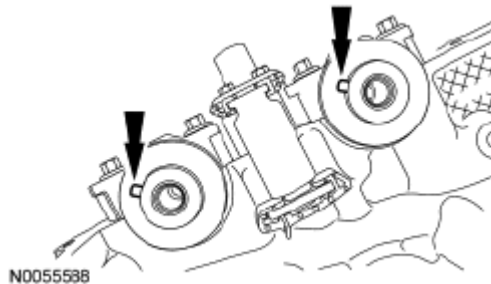
102. Remove the Camshaft Holding Tool from the RH camshafts.





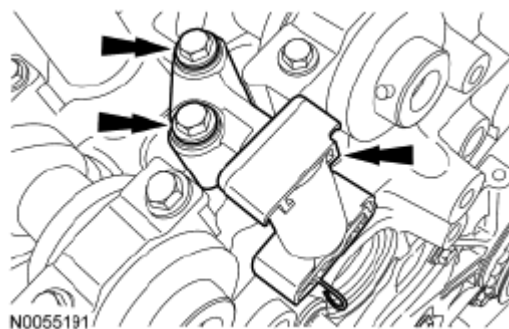
**Fig. 565: Identifying Camshaft Holding Tool**  
Courtesy of FORD MOTOR CO.

**NOTE:** The camshafts must remain in the neutral position during removal or engine damage may occur.



**Fig. 566: Identifying RH Camshafts Neutral Position**  
Courtesy of FORD MOTOR CO.

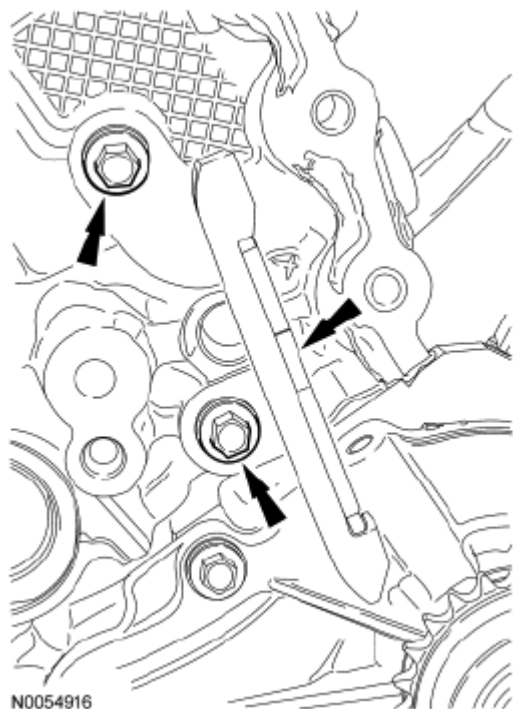
103. Rotate the RH camshafts counterclockwise to the neutral position.
104. Remove the 2 bolts and the RH secondary timing chain tensioner.



**Fig. 567: Locating RH Secondary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

**Engines equipped with early build RH timing chain guides**

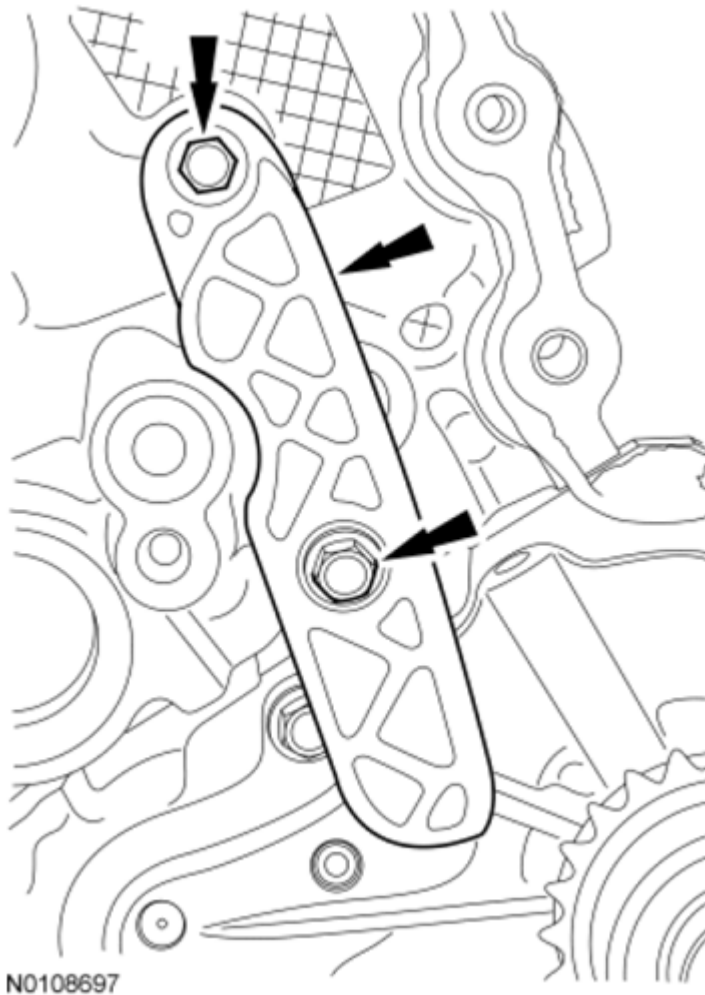
105. Remove the 2 bolts and the RH primary timing chain guide.



**Fig. 568: Locating RH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

**Engines equipped with late build/replacement RH timing chain guides**

106. Remove the 2 bolts and the RH primary timing chain guide.

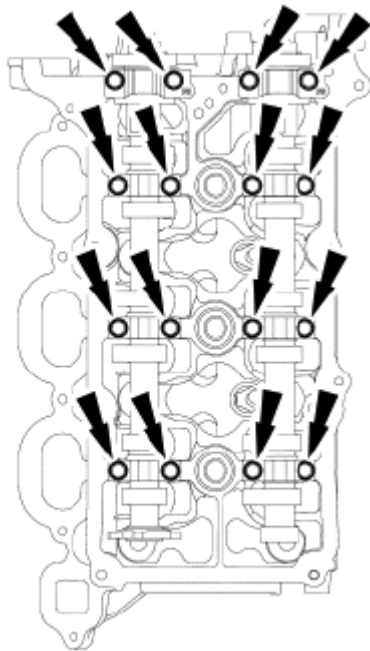


**Fig. 569: Locating RH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

**All vehicles**

**NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions. If not reassembled in their original position, severe engine damage may occur.

107. Remove the bolts and the RH camshaft bearing caps.
  - Remove the RH camshafts.

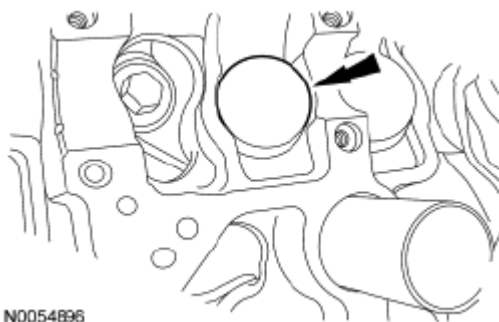


N0055183

**Fig. 570: Locating RH Camshaft Bearing Caps Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

**NOTE:** LH shown in illustration, RH similar.

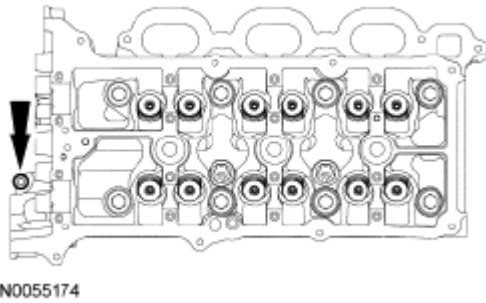


N0054896

**Fig. 571: Locating Valve Tappets**  
Courtesy of FORD MOTOR CO.

108. Remove the valve tappets from the cylinder heads.

**NOTE:** LH shown in illustration, RH similar.



**Fig. 572: Locating M6 Bolt**  
Courtesy of FORD MOTOR CO.

109. Remove and discard the M6 bolt from each cylinder head.

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

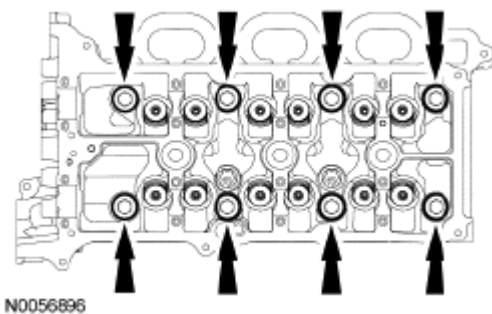
**NOTE:** Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

**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.

110. Remove and discard the 8 bolts from each cylinder head.

- Remove the cylinder heads.
- Discard the cylinder head gaskets.



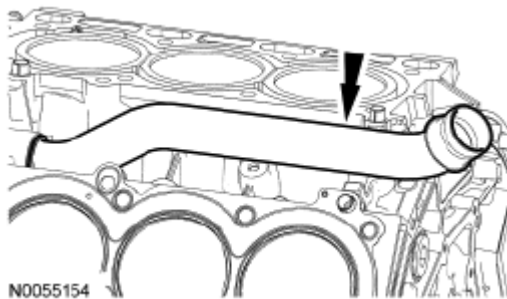
**Fig. 573: Locating Cylinder Head Bolts**  
Courtesy of FORD MOTOR CO.

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

**NOTE:** Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

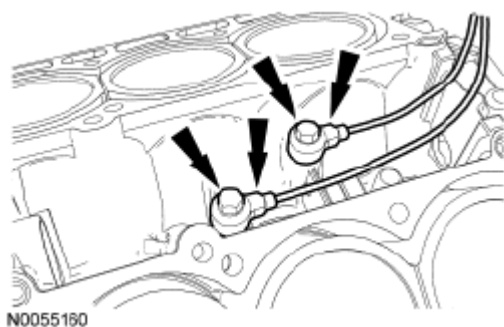
**NOTE:** If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

111. Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder heads and the cylinder block in the following sequence.
  1. Remove any large deposits of silicone or gasket material with a plastic scraper.
  2. Apply silicone gasket remover, following package directions, and allow to set for several minutes.
  3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
  4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
  5. Make sure the 2 locating dowel pins are seated correctly in the cylinder block.
112. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION**.
113. Remove the coolant inlet tube.
  - Remove and discard the O-ring seals.



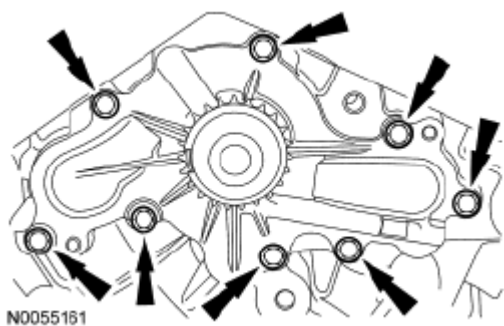
**Fig. 574: Locating Coolant Inlet Tube**  
Courtesy of FORD MOTOR CO.

114. Remove the 2 bolts and the KS .



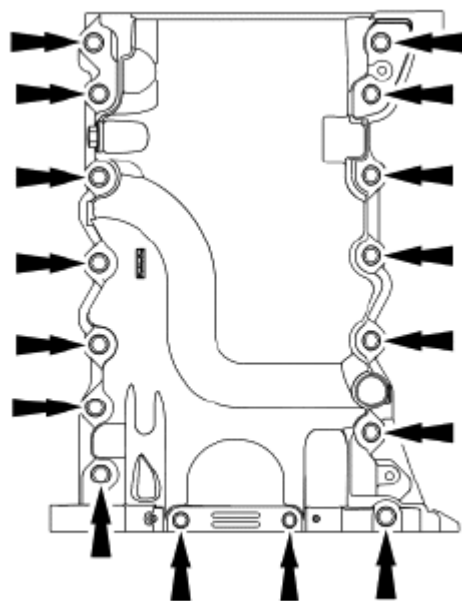
**Fig. 575: Locating KS Bolt**  
Courtesy of FORD MOTOR CO.

115. Remove the 8 bolts and the coolant pump.



**Fig. 576: Locating Coolant Pump Bolts**  
Courtesy of FORD MOTOR CO.

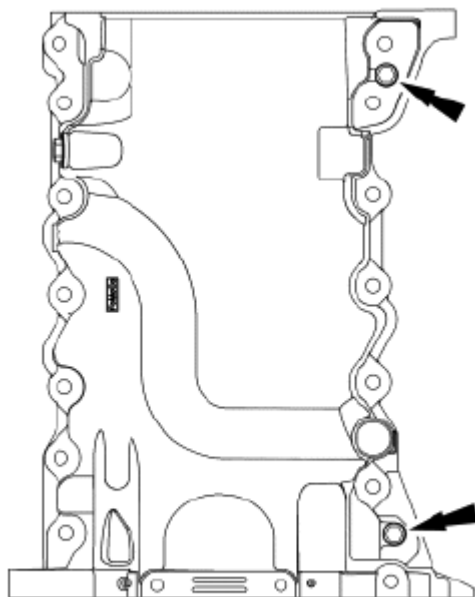
116. Remove the 16 oil pan bolts.



N0055163

**Fig. 577: Locating Oil Pan Bolts**  
Courtesy of FORD MOTOR CO.

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

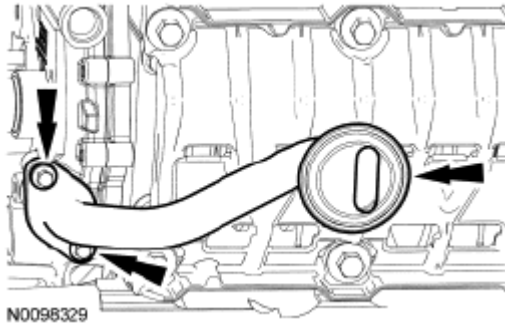


N0055164

**Fig. 578: Locating Oil Pan Bolts**  
Courtesy of FORD MOTOR CO.

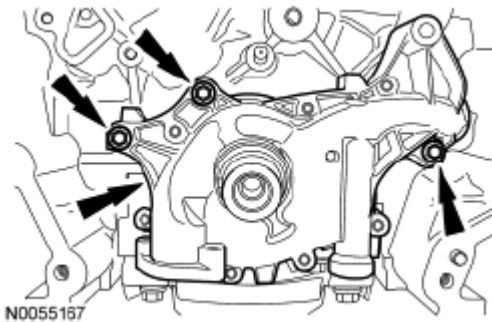


118. Remove the 2 bolts and the oil pump screen and pickup tube.
- Discard the O-ring seal.



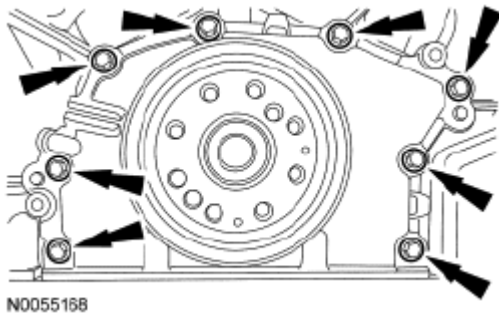
**Fig. 579: Locating Oil Pump Screen And Pickup Tube**  
Courtesy of FORD MOTOR CO.

119. Remove the 3 bolts and the oil pump.



**Fig. 580: Locating Oil Pump Bolts**  
Courtesy of FORD MOTOR CO.

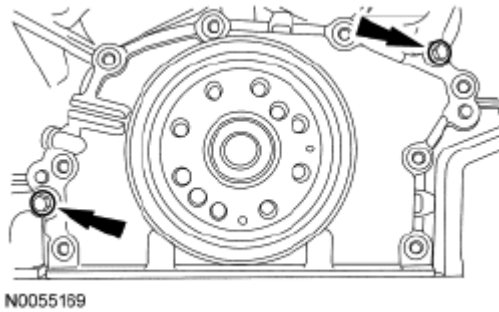
120. Remove the 8 crankshaft rear seal retainer bolts.



**Fig. 581: 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.



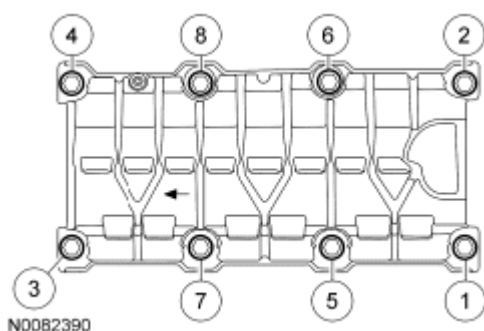
**Fig. 582: Locating M6 Oil Pan Bolts**  
Courtesy of FORD MOTOR CO.

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

122. Clean the engine front cover, oil pan and crankshaft rear seal retainer plate using a 3M™ Roloc® Bristle Disk (2 inch, white, part number 07528) in a suitable tool turning at the recommended speed of 15,000 rpm.
  - Thoroughly wash the engine front cover, oil pan and crankshaft rear seal retainer plate to remove any foreign material, including any abrasive particles created during the cleaning process.
123. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following manufacturer's instructions.

**NOTE:** The main bearing cap support brace bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

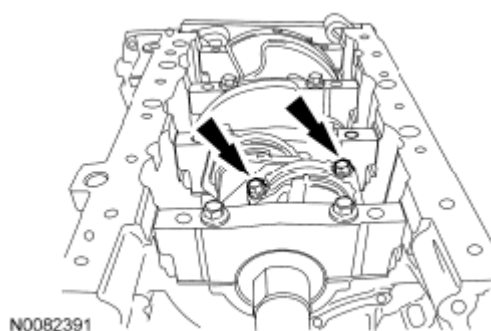
124. Remove the bolts in the sequence shown in illustration.
  - Remove the main bearing cap support brace.
  - Discard the bolts.



**Fig. 583: Identifying Main Bearing Cap Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** The connecting rod cap bolts are a torque-to-yield design. The original connecting rod cap bolts will be used when measuring the connecting rod large end bore during assembly. The connecting rod cap bolts will be discarded after measurement.

**NOTE:** Clearly mark the position and orientation of the connecting rods, connecting rod caps and connecting rod bearings for reassembly.



**Fig. 584: Locating Connecting Rod Cap Bolts**  
Courtesy of FORD MOTOR CO.

125. Remove the connecting rod cap bolts and cap.

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



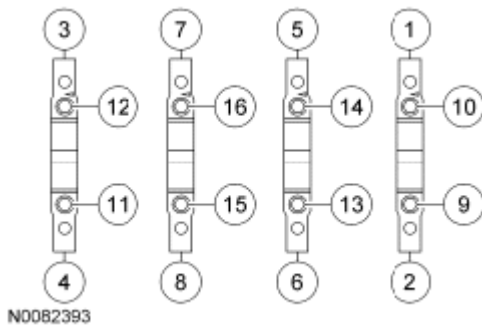
**Fig. 585: Removing Piston/Rod Assembly From Engine Block**  
Courtesy of FORD MOTOR CO.

126. Remove the piston/rod assembly from the engine block.
127. Repeat the previous 2 steps until all the piston/rod assemblies are removed from the engine block.

**NOTE:** The 8 main bearing cap side bolts and the 8 main bearing cap bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

**NOTE:** Clearly mark the position and orientation of the main bearing caps for reassembly.

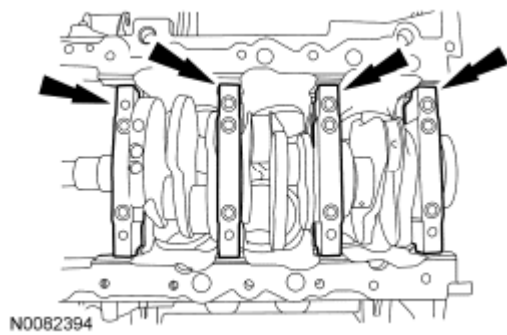
128. Remove the 8 main bearing cap side bolts and the 8 main bearing cap bolts in the sequence shown in illustration.
  - Discard the bolts.



**Fig. 586: Identifying Main Bearing Cap Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

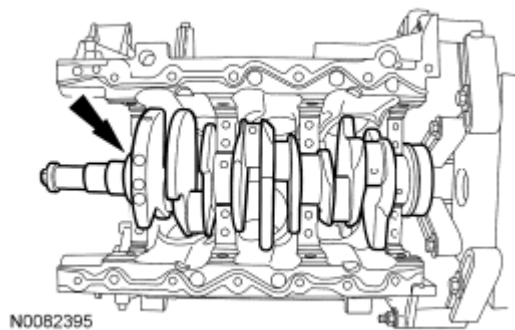
**NOTE:** Note the position of the thrust washer on the outside of the No. 4 rear main bearing cap.



**Fig. 587: Locating Main Bearing Caps**  
Courtesy of FORD MOTOR CO.

129. Remove the 4 main bearing caps.

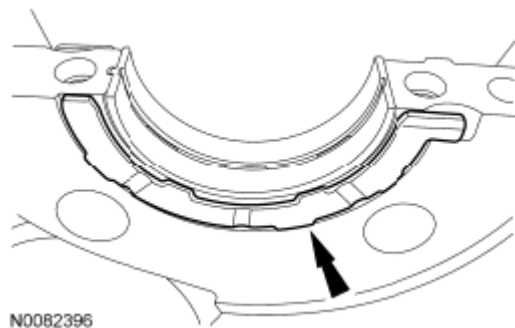
**NOTE:** Note the position of the 2 thrust washers on the inside and outside of the rear main bearing bulkhead.



**Fig. 588: Locating Crankshaft**  
Courtesy of FORD MOTOR CO.

130. Remove the crankshaft.

**NOTE:** Inside shown in illustration, outside similar.

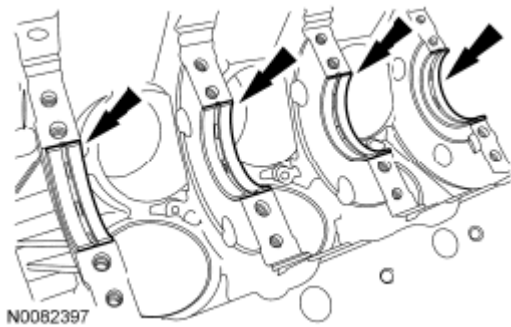


**Fig. 589: Locating Crankshaft Thrust Bearings**

Courtesy of FORD MOTOR CO.

131. Remove the 2 crankshaft thrust bearings from the rear main bearing bulkhead.

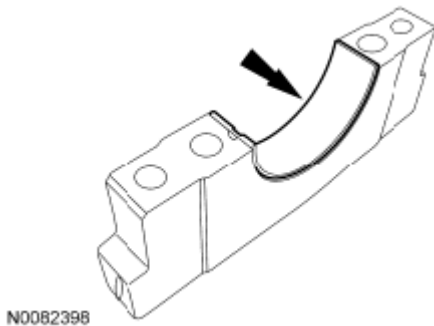
**NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.



**Fig. 590: Locating Crankshaft Main Bearings**  
Courtesy of FORD MOTOR CO.

132. Remove the 4 crankshaft main bearings from the cylinder block.

**NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.



**Fig. 591: Locating Crankshaft Main Bearings**  
Courtesy of FORD MOTOR CO.

133. Remove the 4 crankshaft main bearings from the main bearing caps.
134. Inspect the cylinder block, bearing cap support brace, pistons and connecting rods. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION**.

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

failure.

**NOTE:** Do not use wire brushes, power abrasive discs or 3M™ Roloc® Bristle Disk (2-in white part number 07528) to clean the sealing surfaces. These 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.

135. Clean the sealing surfaces of the cylinder block in the following sequence.

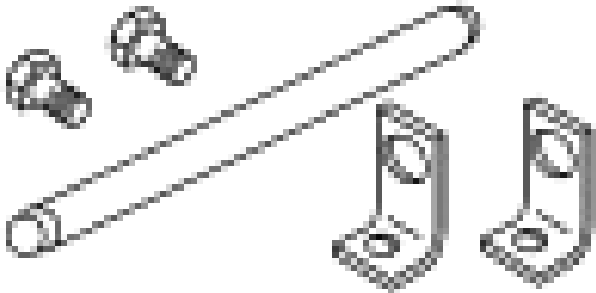
1. Remove any large deposits of silicone or gasket material.
2. Apply silicone gasket remover and allow to set for several minutes.
3. Remove the silicone gasket remover. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
4. Apply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

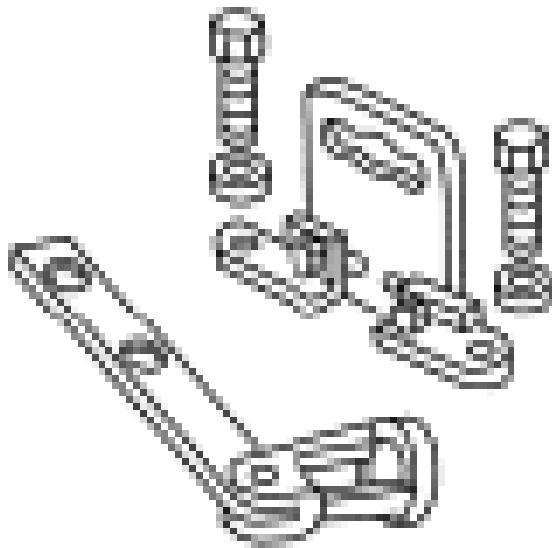
## DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

### CYLINDER HEAD

#### Special Tool(s)

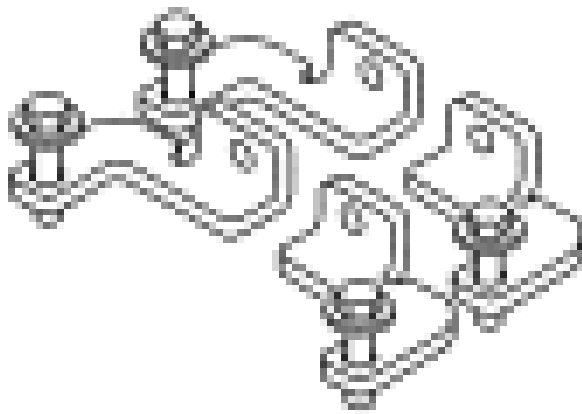
#### SPECIAL TOOL SPECIFICATION

 <p style="text-align: center;"><b>ST1981-A</b></p>	<p>Compressor, Valve Spring 303-300 (T87C-6565-A)</p>



**ST1907-A**

Compressor, Valve Spring  
303-350 (T89P-6565-A)



**ST302B-A**

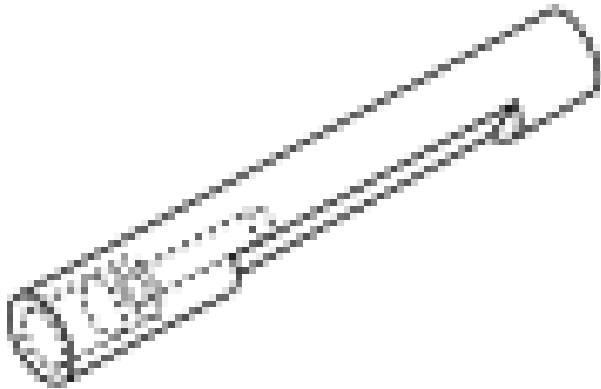
Compressor, Valve Spring  
303-1249

Installer, Valve Stem Oil Seal



## 2010 Ford Edge Limited

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ST1908-A

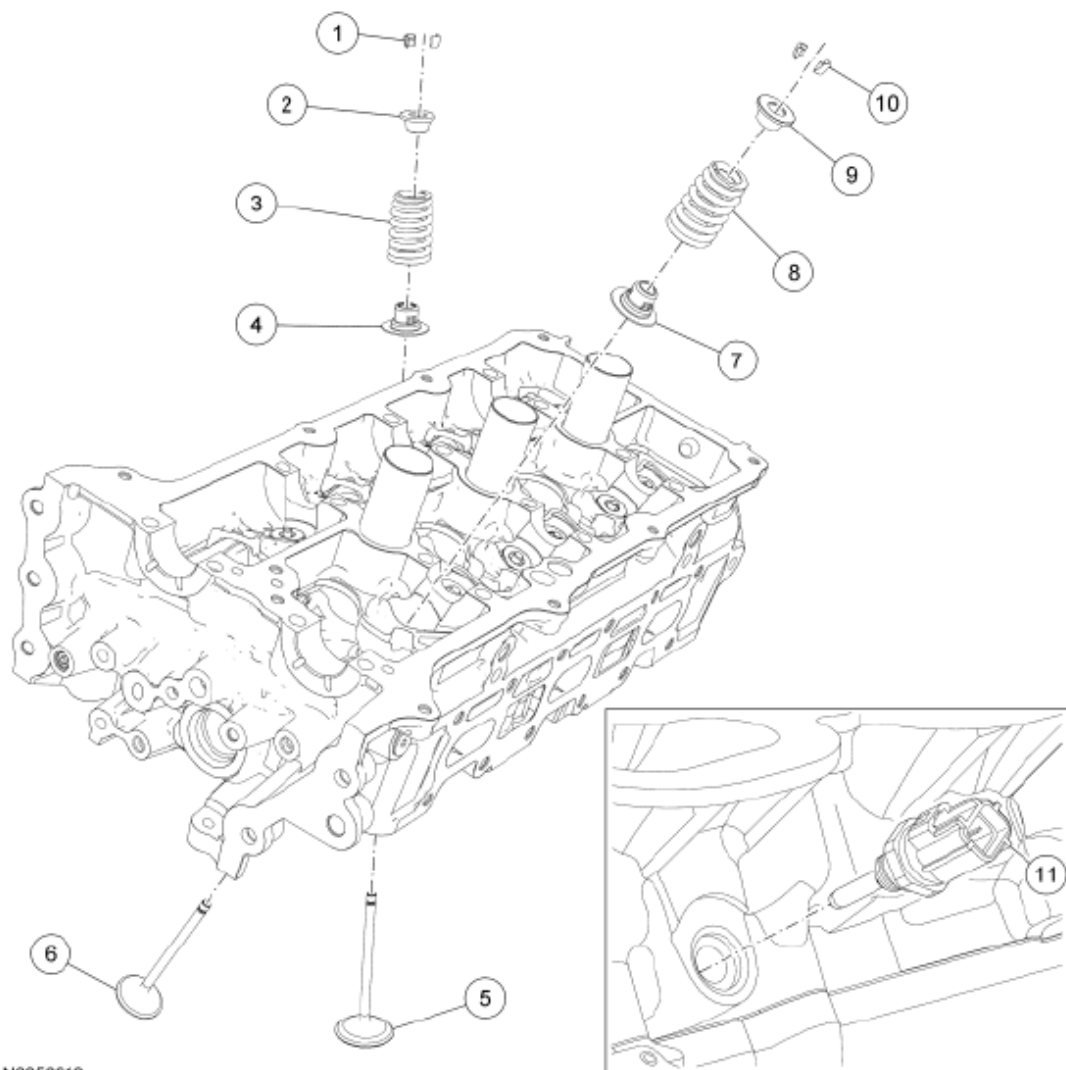
303-470 (T94P-6510-CH)

### Material

#### MATERIAL SPECIFICATION

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

### Cylinder Head



N0056912

**Fig. 592: Identifying Cylinder Head Components**  
 Courtesy of FORD MOTOR CO.

#### 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	6A517	Intake valve stem seal (6 required)
5	6505	Intake valve (6 required)
6	6507	Exhaust valve (6 required)
7	6A517	Exhaust valve stem seal (6 required)
8	6513	Exhaust valve spring (6 required)
9	6514	Exhaust valve spring retainer (6 required)
10	6518	Exhaust valve spring retainer key (12 required)

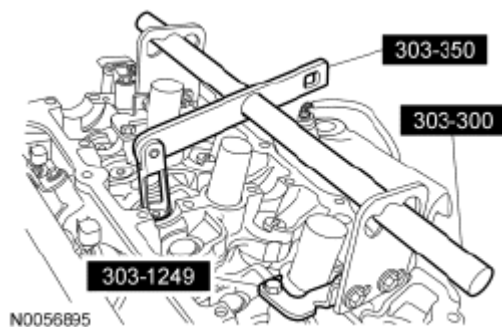
11	6G004	Cylinder Head Temperature (CHT) sensor
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## Disassembly

### 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.

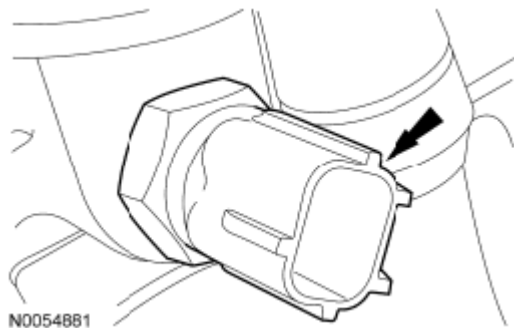


**Fig. 593: Identifying Valve Spring Compressors**  
Courtesy of FORD MOTOR CO.

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.

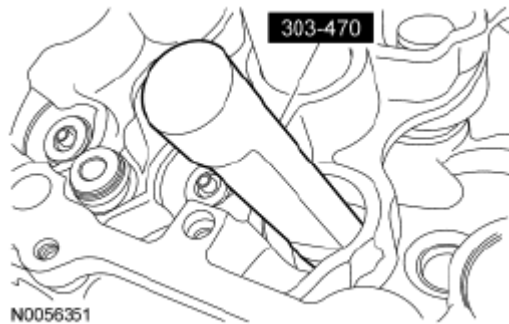


**Fig. 594: Locating Cylinder Head Temperature Sensor**  
Courtesy of FORD MOTOR CO.

## Assembly

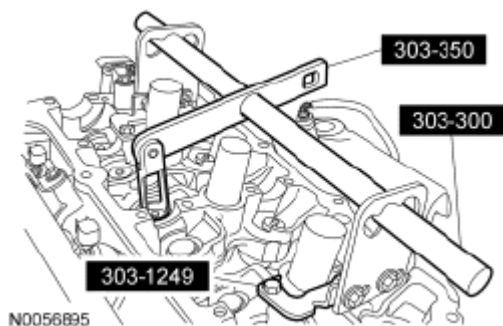
**All cylinder heads**

**NOTE:** Lubricate the valve stem seal with clean engine oil prior to installation.



**Fig. 595: Identifying Valve Stem Oil Seal Installer**  
Courtesy of FORD MOTOR CO.

1. Using the Valve Stem Oil Seal Installer, install a new valve stem seal.
2. Install the valve.
3. Using the Valve Spring Compressors, install the valve spring, retainer and key.



**Fig. 596: Identifying 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 SPECIFICATION**

## 2010 Ford Edge Limited

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Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A



N0010114

**Fig. 597: Identifying Piston Components**  
Courtesy of FORD MOTOR CO.

### DESCRIPTION CHART

Item	Part Number	Description
1	6150	Piston compression upper ring
2	6152	Piston compression lower ring
3	6159	Piston oil control upper segment ring
4	6161	Piston oil control spacer
5	6159	Piston oil control lower segment ring
6	6140	Piston pin retainer clip
7	6140	Piston pin retainer clip
8	6135	Piston pin
9	6200	Connecting rod
10	6110	Piston

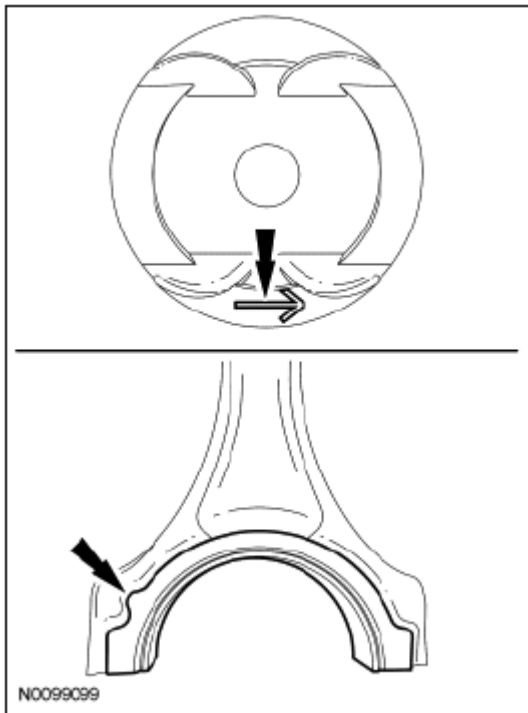
### Disassembly

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.

**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. 598: Identifying Piston And Connecting Rod Installation Position**  
Courtesy of FORD MOTOR CO.

3. Separate the piston from the connecting rod.
4. Clean and inspect the piston and connecting rod. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** .

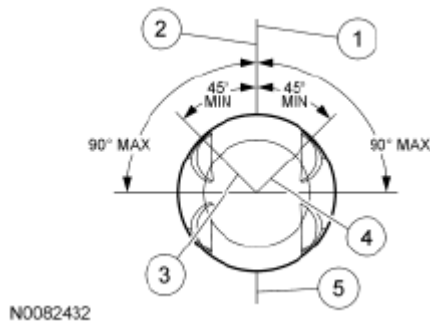
#### Assembly

1. Align the piston-to-connecting rod orientation marks and position the connecting rod in the piston.
2. Lubricate the piston pin and pin bore with clean engine oil.
3. Install the piston pin in the piston and connecting rod assembly.
4. Install the new piston pin retaining clips in the piston.
  - The piston pin retaining clip gap orientation must be toward the top or dome of piston.

5. Lubricate the piston and the new piston rings with clean engine oil.

**NOTE:** The piston compression upper and lower ring should be installed with the "O" mark on the ring face pointing up toward the top of the piston.

6. Install the piston rings onto the piston as shown in illustration.
1. Center line of the piston parallel to the wrist pin bore
  2. Upper compression ring gap location
  3. Upper oil control segment ring gap location
  4. Lower oil control segment ring gap location
  5. Expander ring and lower compression ring gap location



**Fig. 599: Identifying Piston Rings Installation Position**  
Courtesy of FORD MOTOR CO.

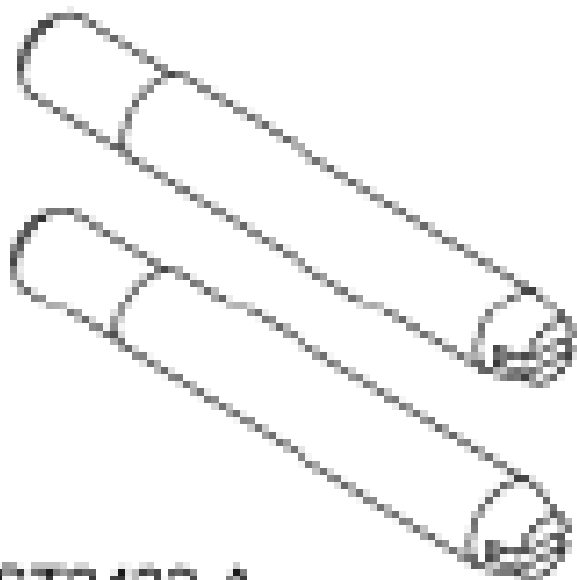
## ASSEMBLY

### ENGINE

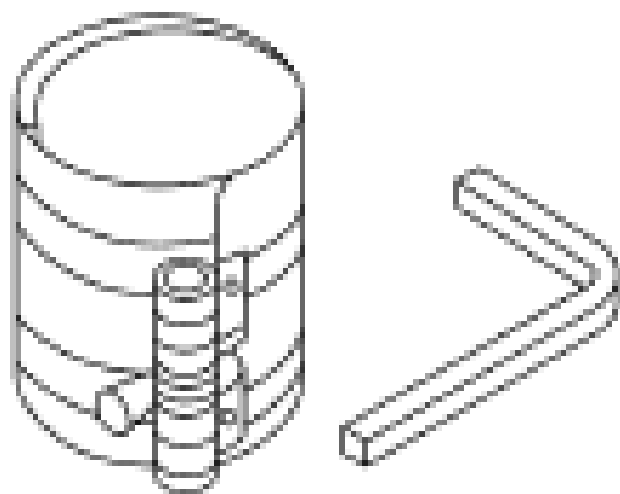
#### Special Tool(s)

#### SPECIAL TOOL SPECIFICATION

Alignment Pins  
307-399



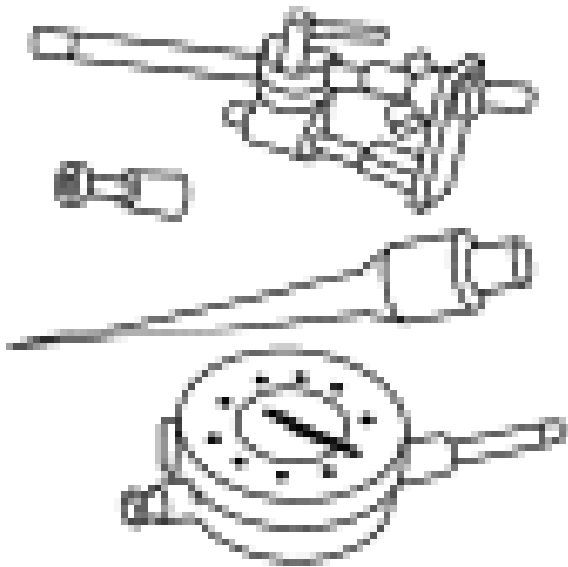
ST2433-A



ST1376-A

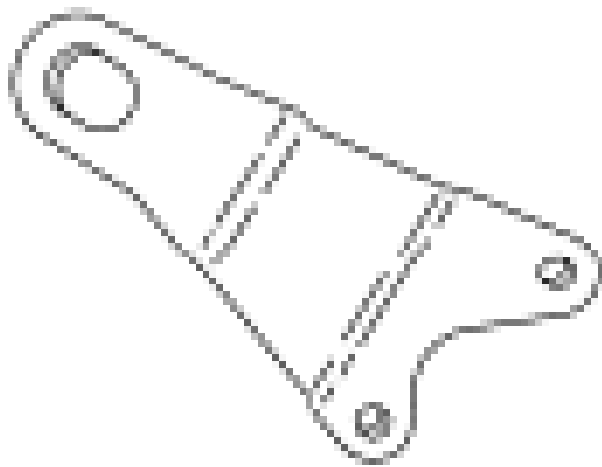
Compressor, Piston Ring  
303-D032 (D81L-6002-C)





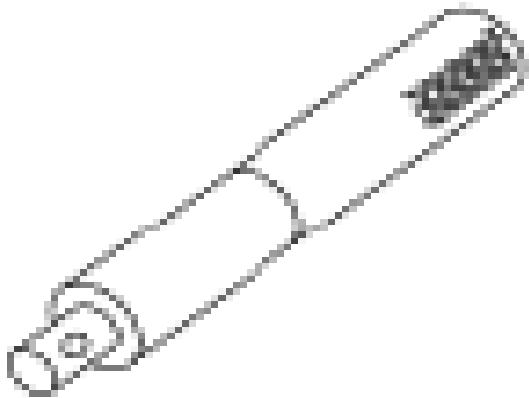
**ST1214-A**

Dial Indicator Gauge with Holding Fixture  
100-002 (TOOL-4201-C)



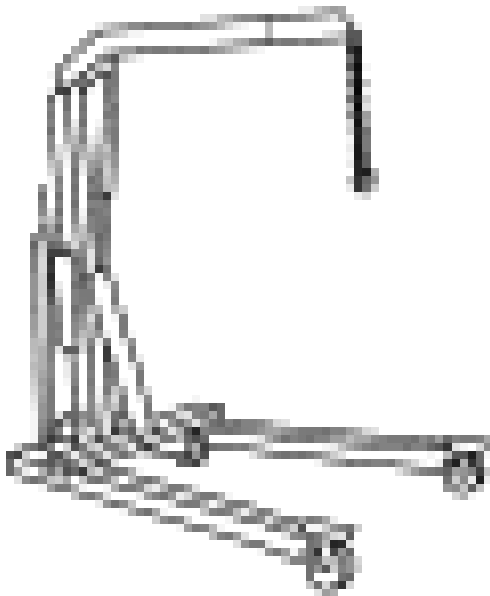
**ST2976A**

Eye, Engine Lift  
303-1245



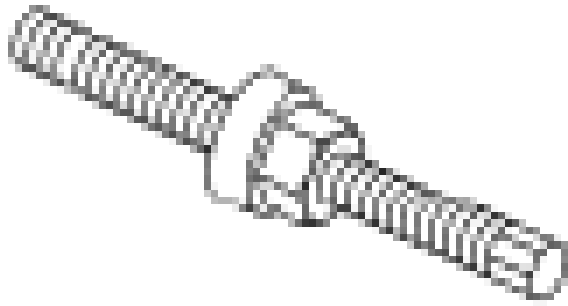
**ST1326-A**

Handle  
205-153 (T80T-4000-W)



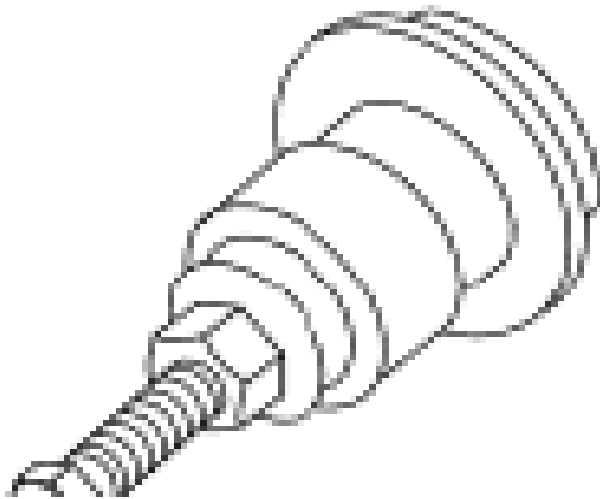
**ST1341-A**

Heavy Duty Floor Crane  
014-00071 or equivalent



ST1287-A

Installer, Crankshaft Vibration Damper  
303-102 (T74P-6316-B)



Installer, Front Cover Oil Seal  
303-335

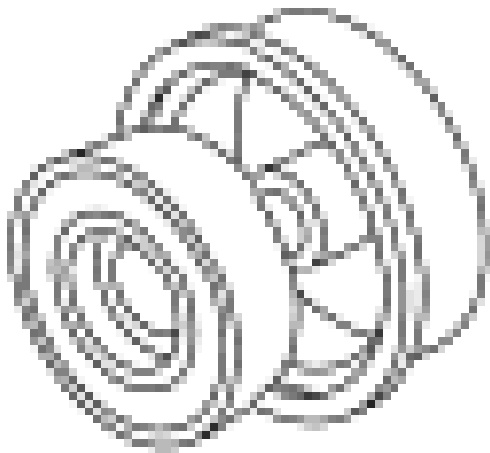
Installer, Front Crankshaft Seal

303-1251

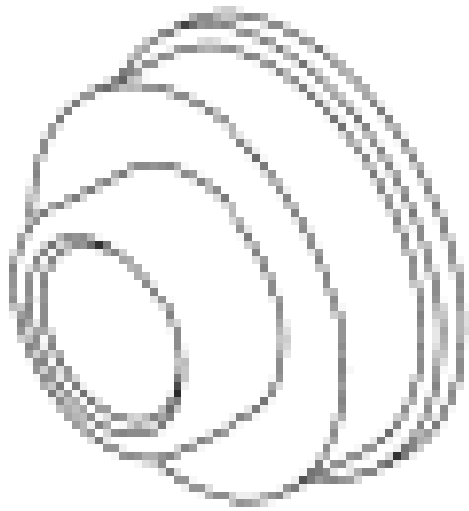


**ST2981-A**

Installer, Rear Main Seal  
303-1250



**ST2980-A**



Installer, VCT Spark Plug Tube Seal  
303-1247/2

ST2983-A

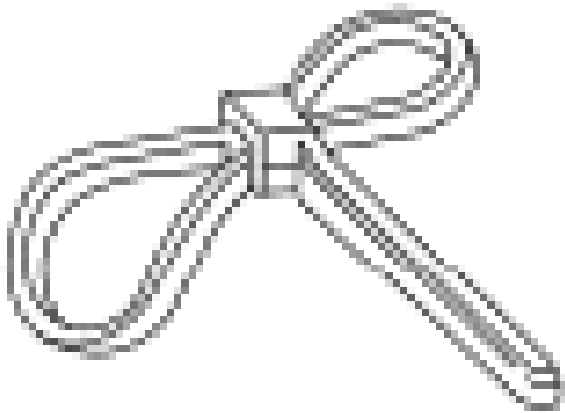


Spreader Bar  
303-D089 (D93P-6001-A3) or equivalent

3T1602-A

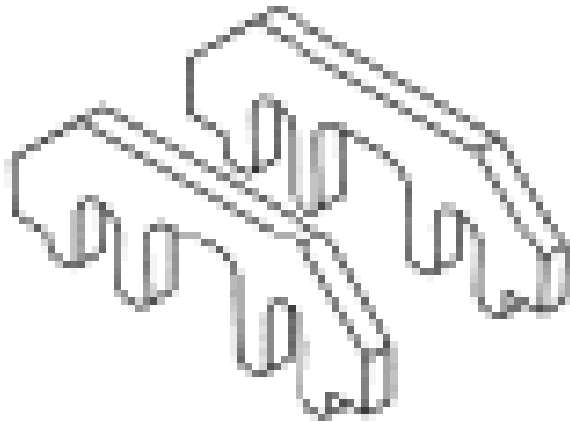
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Strap Wrench  
303-D055 (D85L-6000-A) or equivalent

**ST143B-A**



Tool, Camshaft Holding  
303-1248

**ST297B-A**

### Material

### MATERIAL SPECIFICATION

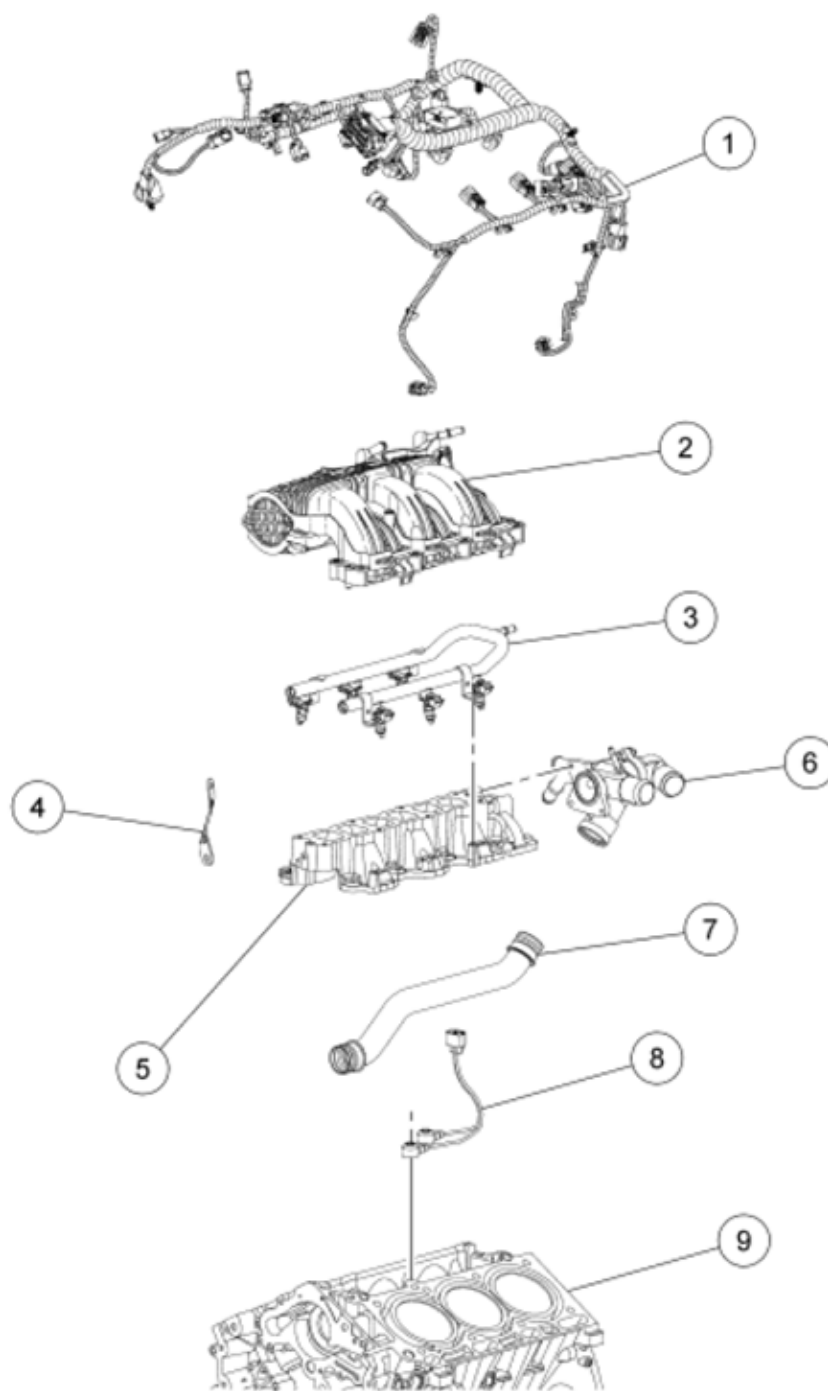
Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® Metal Surface Prep	

**2010 Ford Edge Limited**

2010 ENGINE Engine - 3.5L - Edge &amp; MKX

ZC-31-A	-
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO- 5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A
Motorcraft® Specialty Green Engine Coolant VC-10-A (US); CVC-10-A (Canada)	WSS-M97B55-A
Silicone Gasket Remover ZC-30	-
Threadlock and Sealer TA-25	WSK-M2G351-A5
Thread Sealant with PTFE TA-24	WSK-M2G350-A2

**Engine Upper**



N0076860

**Fig. 600: Identifying Cylinder Block Components - Upper Side**  
Courtesy of FORD MOTOR CO.

#### DESCRIPTION CHART

Item	Part Number	Description
1	12C508	Engine control harness
2	9S455	Upper intake manifold

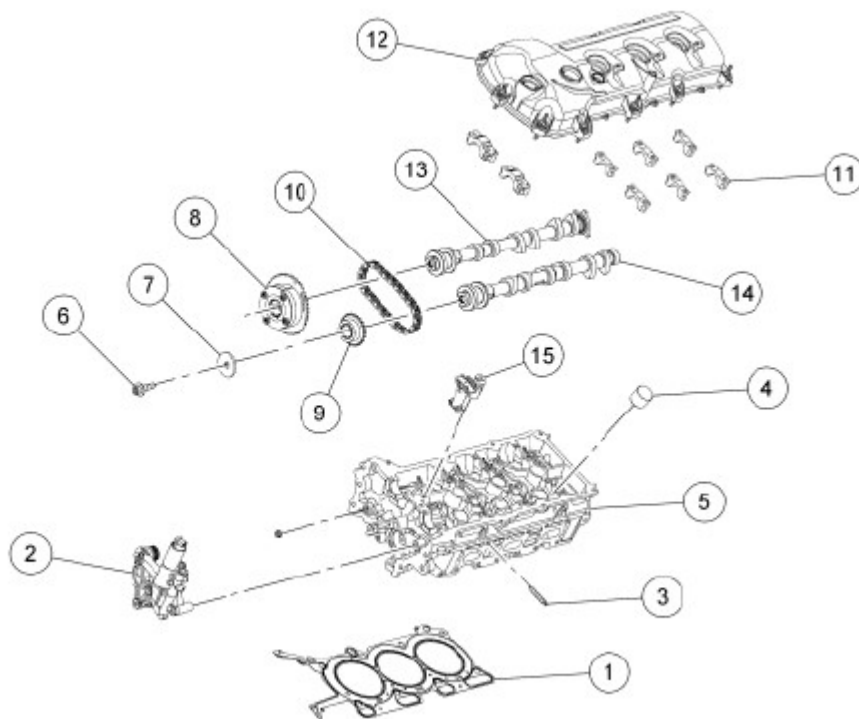


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3	9F797	Fuel rail
4	9J444	Upper intake manifold bracket
5	9K461	Lower intake manifold
6	8A856	Thermostat housing
7	9N271	Coolant tube
8	9N271	Knock Sensor (KS)
9	6010	Cylinder block

### Engine Upper - LH Cylinder Head



**Fig. 601: Identifying LH Cylinder Head Components - Upper Side**  
Courtesy of FORD MOTOR CO.

### DESCRIPTION CHART

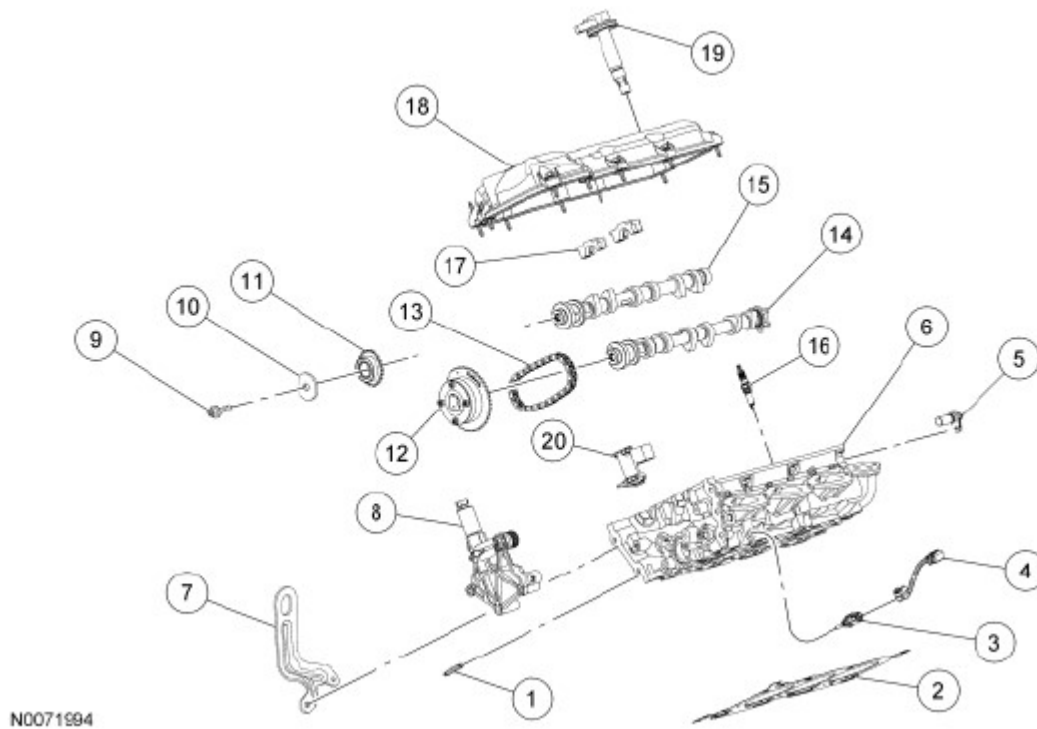
Item	Part Number	Description
1	6083	LH cylinder head gasket
2	6C261	LH Variable Camshaft Timing (VCT) housing
3	W12244	LH exhaust manifold stud (6 required)
4	6500	Valve tappet (32 required)
5	6050	LH cylinder head
6	6279	LH camshaft bolt (2 required)
7	W710738	LH exhaust camshaft sprocket washer
8	6C524	LH VCT assembly
9	6256	LH exhaust camshaft sprocket

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10	6C256	LH secondary timing chain
11	6A258	LH camshaft cap (8 required)
12	6A505	LH valve cover
13	6A267	LH intake camshaft
14	6A269	LH exhaust camshaft
15	6C271	LH secondary timing chain tensioner

### Engine Upper - RH Cylinder Head



**Fig. 602: Identifying RH Cylinder Head Components - Upper Side**  
Courtesy of FORD MOTOR CO.

### DESCRIPTION CHART

Item	Part Number	Description
1	W712244	RH exhaust manifold stud (6 required)
2	6051	RH cylinder head gasket
3	6G004	Cylinder Head Temperature (CHT) sensor
4	14B485	<b>CHT</b> sensor jumper harness
5	6B288	Camshaft Position (CMP) sensor (2 required)
6	6049	RH cylinder head
7	17A084	Engine lift eye
8	6C260	RH Variable Camshaft Timing (VCT) housing
9	6279	RH camshaft bolt (2 required)
10	W710738	RH exhaust camshaft sprocket washer

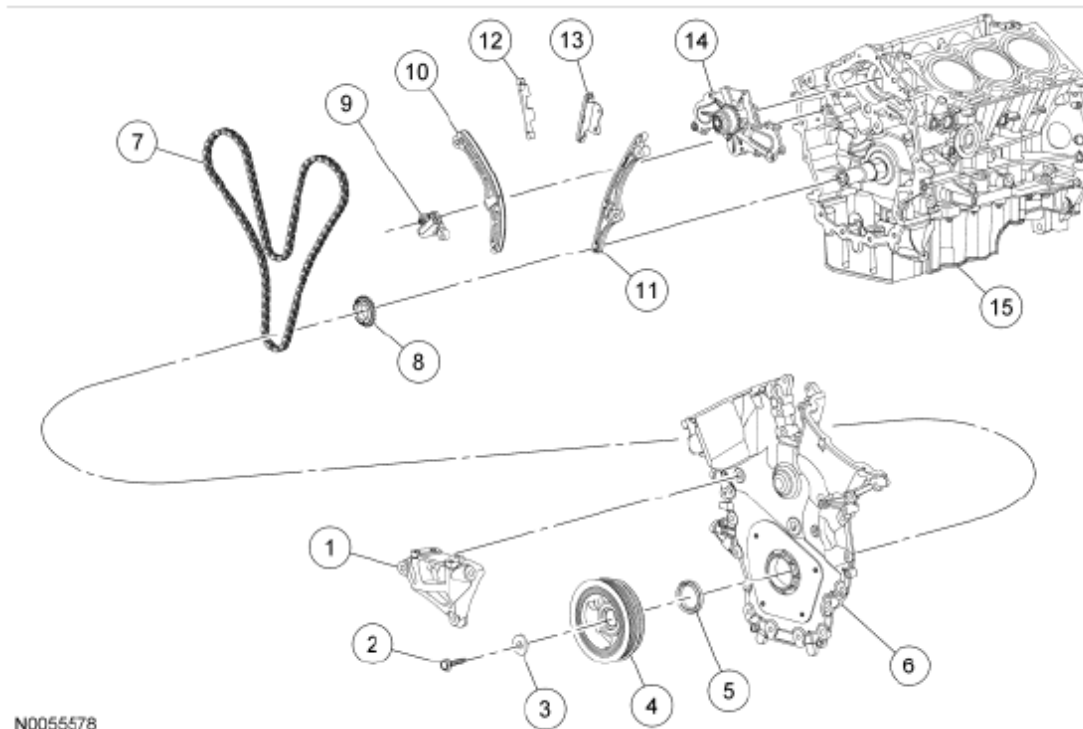
## 2010 Ford Edge Limited

2010 ENGINE Engine - 3.5L - Edge & MKX

11	6256	RH exhaust camshaft sprocket
12	6C524	RH VCT assembly
13	6C256	RH secondary timing chain
14	6A266	RH intake camshaft
15	6A268	RH exhaust camshaft
16	12405	Spark plug (6 required)
17	6A258	RH camshaft cap (8 required)
18	6582	RH valve cover
19	12A375	Coil-on-plug (6 required)
20	6C270	RH secondary timing chain tensioner

### Engine Front

**NOTE:** Early build shown in illustration, late build similar.



N0055578

**Fig. 603: Identifying Cylinder Block Components - Front Side**  
Courtesy of FORD MOTOR CO.

### DESCRIPTION CHART

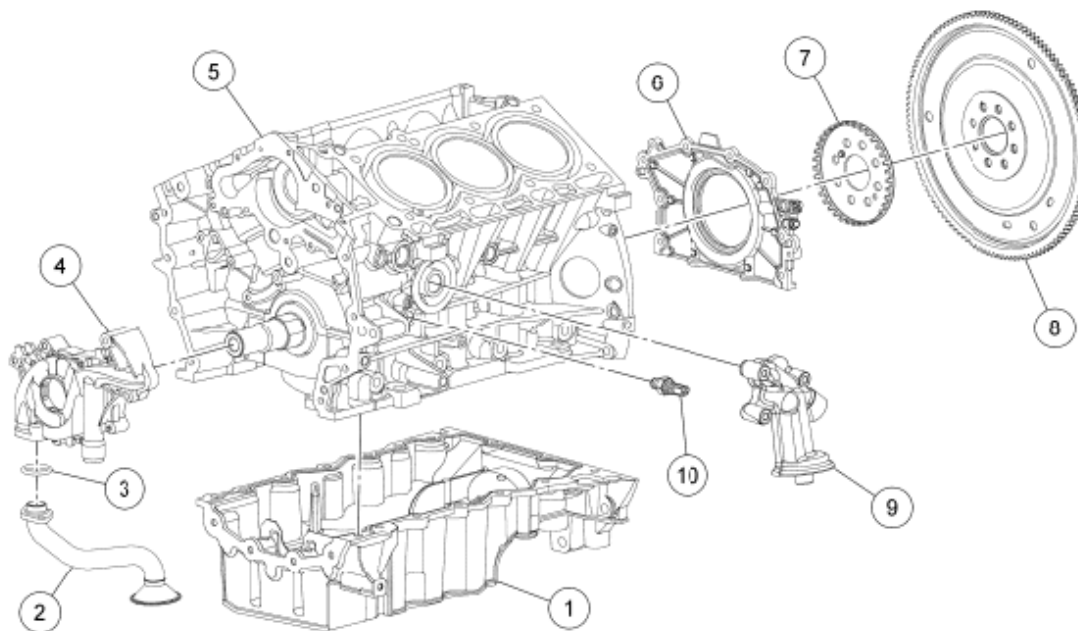
Item	Part Number	Description
1	6A0003	Engine mount bracket
2	W701512	Crankshaft pulley bolt
3	N806165	Crankshaft pulley washer

## 2010 Ford Edge Limited

2010 ENGINE Engine - 3.5L - Edge & MKX

4	6316	Crankshaft pulley
5	6700	Crankshaft front seal
6	6C086	Engine front cover
7	6268	Timing chain
8	6306	Crankshaft timing sprocket
9	6K254	Primary timing chain tensioner
10	6K255	Primary timing chain tensioner arm
11	6B274	LH lower primary timing chain guide
12	6M256	RH primary timing chain guide (early build)
13	6K297	LH upper primary timing chain guide
14	8501	Coolant pump
15	6010	Cylinder block

### Lower Engine Block (View 1)



N0106036

**Fig. 604: Identifying Cylinder Block Components - Lower Side 1**  
Courtesy of FORD MOTOR CO.

### DESCRIPTION CHART

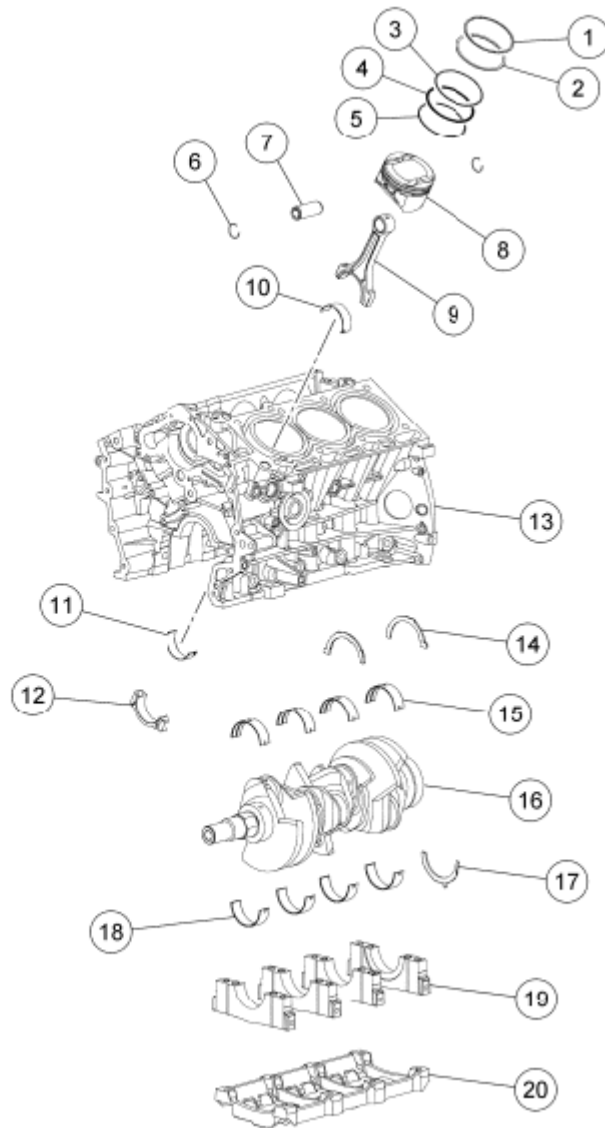
Item	Part Number	Description
1	6675	Oil pan
2	6622	Oil pump screen and pickup tube
3	6625	Oil pump screen and pickup tube O-ring seal
4	6621	Oil pump
5	6010	Cylinder block

## 2010 Ford Edge Limited

2010 ENGINE Engine - 3.5L - Edge & MKX

6	6D327	Crankshaft rear seal retainer
7	12A227	Crankshaft sensor ring
8	6375	Flexplate
9	6881	Oil filter adapter
10	9278	Engine Oil Pressure (EOP) switch

### Lower Engine Block (View 2)



N0105730

**Fig. 605: Identifying Cylinder Block Components - Lower Side 2**  
Courtesy of FORD MOTOR CO.

### DESCRIPTION CHART

Item	Part Number	Description
1	6150	Piston compression upper ring (6 required)

**2010 Ford Edge Limited**

2010 ENGINE Engine - 3.5L - Edge &amp; MKX

2	6152	Piston compression lower ring (6 required)
3	6159	Piston oil control upper segment ring (6 required)
4	6161	Piston oil control spacer (6 required)
5	6159	Piston oil control lower segment ring (6 required)
6	6140	Piston pin retainer (12 required)
7	6135	Piston pin (6 required)
8	6110	Piston (6 required)
9	6200	Connecting rod (6 required)
10	6211	Connecting rod upper bearing (6 required)
11	6211	Connecting rod lower bearing (6 required)
12	6210	Connecting rod cap (6 required)
13	6010	Cylinder block
14	6A341	Crankshaft upper thrust washer (2 required)
15	6333	Cylinder block crankshaft main bearing (4 required)
16	6303	Crankshaft
17	6K302	Crankshaft lower thrust washer
18	6333	Lower crankshaft main bearings (4 required)
19	6325	Lower crankshaft main bearing caps (4 required)
20	6C364	Main bearing cap support brace

**NOTE:** During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can 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:** Early build vehicle (built before January 19, 2009) cooling systems are filled with Motorcraft® Premium Gold Engine Coolant. Late build vehicle (built on or after January 19, 2009) cooling systems are filled with Motorcraft® Specialty Green Engine Coolant. Mixing coolant types degrades the corrosion protection of the coolant. Do not mix coolant types. Failure to follow these instructions may result in engine or cooling system damage.

**NOTE:** Early build engines have 11 fastener valve covers, late build engines have 9 fastener valve covers. Do not attempt to install bolts in the 2 empty late build valve cover holes or damage to the valve cover will occur.

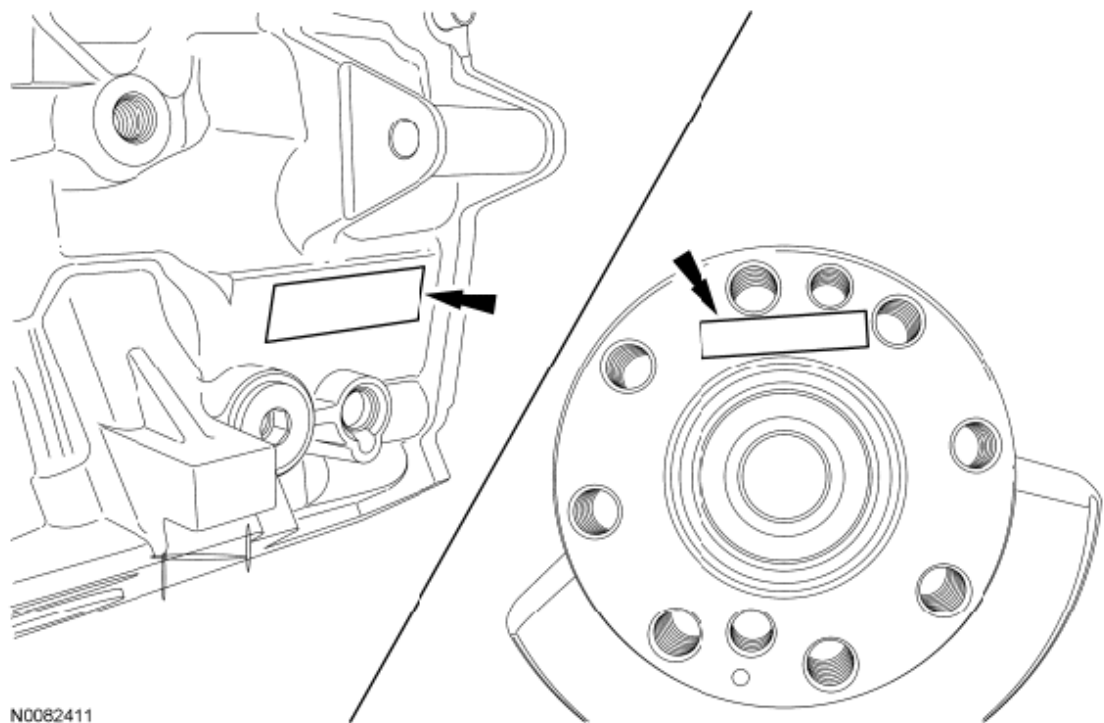
**NOTE:** On early build engines, the timing chain rides on the inner side of the RH timing

chain guide. Late build engines are equipped with a different design RH timing chain guide that requires the timing chain to ride on the outer side of the RH timing chain guide. For service, all replacement RH timing chain guides will be the late build design.

#### All vehicles

**NOTE:** This procedure is for selecting bearings using a new crankshaft.

1. Select the crankshaft main bearings for each crankshaft journal.
  - Read the code on the crankshaft flange.
  - Read the code on the cylinder block face.
    - The first letter after the first asterisk makes up the code for main No. 1 and the next letter for main No. 2. The first letter after the second asterisk makes up the code for main No. 3 and the last letter for main No. 4.



**Fig. 606: Locating Crankshaft Flange Code**  
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.

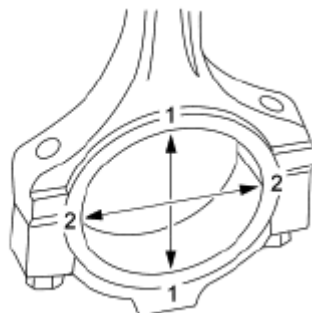
		BLOCK CODE																									
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	
CRANKSHAFT CODE	U	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2
	T	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2
	S	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
	R	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2
	Q	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
	P	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	O	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	N	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	M	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	L	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3
	K	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3
	J	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3
	I	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
	H	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3
	G	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	F	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3
E	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	
D	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	
C	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	
B	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	
A	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	

N0082412

**Fig. 607: Block And Crankshaft Codes Chart**  
Courtesy of FORD MOTOR CO.

**NOTE:** The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.

3. Using the original connecting rod cap bolts, install the connecting rod caps and bolts.
  - Tighten the bolts in 3 stages.
  - Stage 1: Tighten to 23 Nm (17 lb-ft).
  - Stage 2: Tighten to 43 Nm (32 lb-ft).
  - Stage 3: Tighten an additional 90 degrees.
4. Measure the connecting rod large end bore in 2 directions.
  - Remove the bolts and the rod cap.
  - Discard the connecting rod cap bolts.

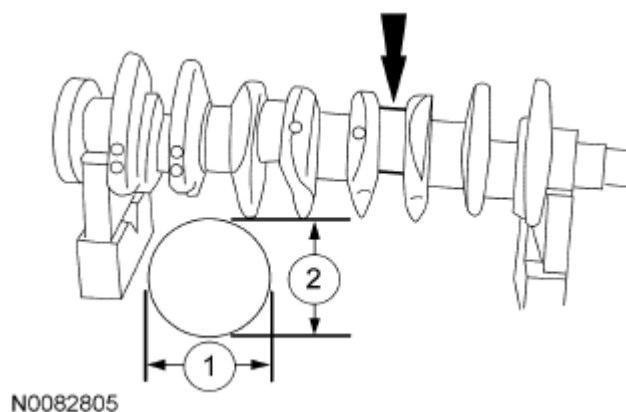


A0026938



**Fig. 608: Measuring Connecting Rod Large End Bore**  
Courtesy of FORD MOTOR CO.

5. Measure each of the crankshaft connecting rod bearing journal diameters in at least 2 directions.



**Fig. 609: Measuring Crankshaft Connecting Rod Bearing Journal**  
Courtesy of FORD MOTOR CO.

6. Using the chart, select the correct connecting rod bearings for each crankshaft connecting rod journal.

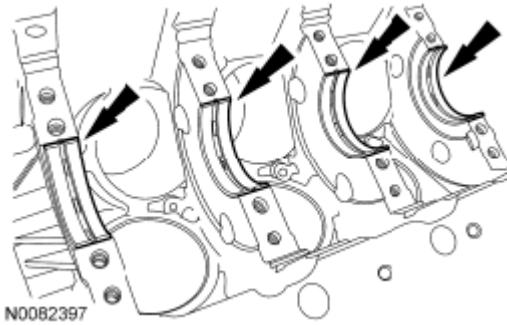
		CONNECTING ROD LARGE END BORE (59.XXX)																				
		1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
		.866	.867	.868	.869	.870	.871	.872	.873	.874	.875	.876	.877	.878	.879	.880	.881	.882	.883	.884	.885	.886
CRANK JOURNAL	56.003	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3	3	3	3
	56.002	1	1	1	1	1	1	1	2	2	2	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. 610: Connecting Rod Bearings Chart**  
Courtesy of FORD MOTOR CO.

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

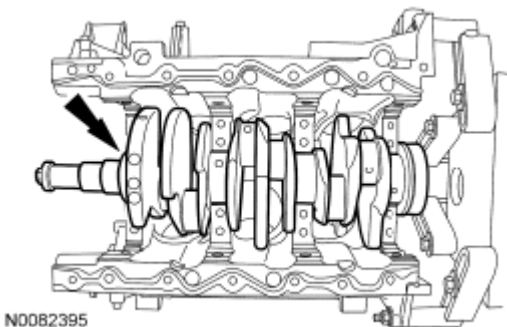


**Fig. 611: Locating Crankshaft Main Bearings**  
Courtesy of FORD MOTOR CO.

7. Lubricate the upper crankshaft main bearings with clean engine oil and install the 4 crankshaft main bearings in the cylinder block.

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

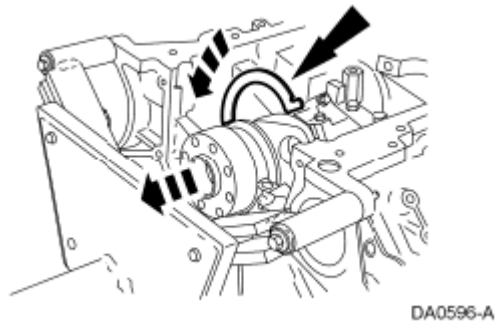
**NOTE:** Lubricate the thrust surfaces of the crankshaft with clean engine oil.



**Fig. 612: Locating Crankshaft**  
Courtesy of FORD MOTOR CO.

8. Install the crankshaft onto the upper main bearings.

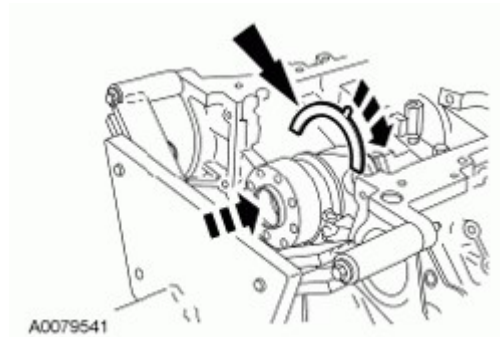
**NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.



**Fig. 613: Installing Rear Crankshaft Upper Thrust Washer**  
Courtesy of FORD MOTOR CO.

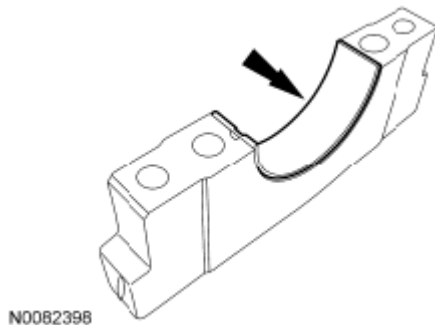
9. Push the crankshaft rearward and install the rear crankshaft upper thrust washer at the back of the No. 4 rear bulkhead.

**NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.



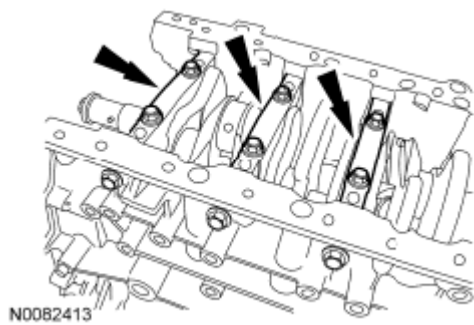
**Fig. 614: Installing Front Crankshaft Upper Thrust Washer**  
Courtesy of FORD MOTOR CO.

10. Push the crankshaft forward and install the front crankshaft upper thrust washer at the front of the No. 4 rear bulkhead.
11. Lubricate the crankshaft lower main bearings with clean engine oil and install them into the main bearing caps. Visually check seating and squareness of the bearings to make sure of proper seating in caps.



**Fig. 615: Locating Crankshaft Main Bearings**  
Courtesy of FORD MOTOR CO.

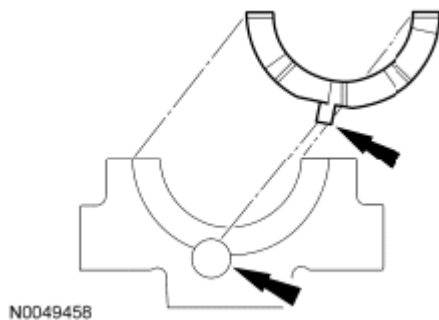
12. Position the No. 1, No. 2 and No. 3 main bearing caps on the cylinder block and, keeping the caps as square as possible, alternately draw the caps down evenly using the new bolts until the main bearing caps are seated.



**Fig. 616: Locating Main Bearing Caps**  
Courtesy of FORD MOTOR CO.

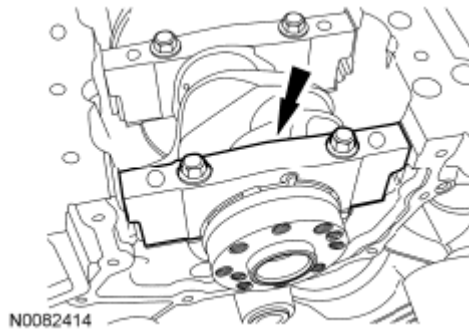
**NOTE:** Make sure the side of the thrust washer, with the wide oil grooves, faces the crankshaft thrust surface.

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



**Fig. 617: Identifying Lower Crankshaft Thrust Washer Installation Position**  
Courtesy of FORD MOTOR CO.

13. Install the lower crankshaft thrust washer to the back side of the No. 4 rear main bearing cap, with the tab aligned with the cutout in the main bearing cap.
14. Position main bearing cap No. 4 on the cylinder block and keeping the cap as square as possible, alternately draw the cap down evenly using the new bolts until the main bearing cap is seated.



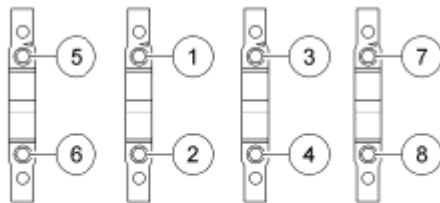
**Fig. 618: Locating Main Bearing Cap**  
Courtesy of FORD MOTOR CO.

15. Loosen the No. 4 main bearing cap bolts.

**NOTE:** While tightening the main bearing vertical bolts, push the crankshaft forward and the No. 4 main bearing cap rearward to seat the crankshaft thrust washers.

16. Tighten the main bearing bolts in the sequence shown in illustration in 2 stages.

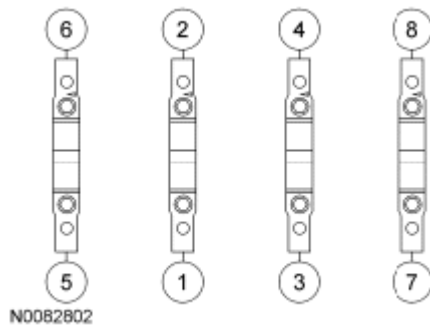
- Stage 1: Tighten fasteners 1 through 8 to 60 Nm (44 lb-ft).
- Stage 2: Tighten fasteners 1 through 8 an additional 90 degrees.



**Fig. 619: Identifying Main Bearing Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

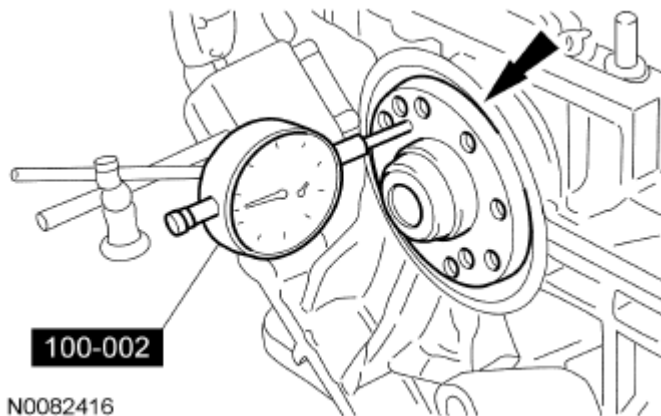
17. Install the new 8 main bearing cap side bolts. Tighten in the sequence shown in illustration in 2 stages.

- Stage 1: Tighten fasteners 1 through 8 to 45 Nm (33 lb-ft).
- Stage 2: Tighten fasteners 1 through 8 an additional 90 degrees.



**Fig. 620: Identifying Main Bearing Cap Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

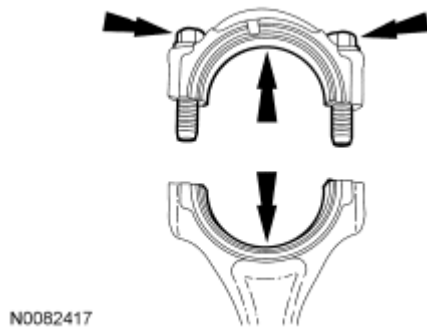
18. Using the Dial Indicator Gauge with Holding Fixture, measure crankshaft end play.
- Position the crankshaft to the rear of the cylinder block.
  - Zero the Dial Indicator Gauge.
  - Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.



**Fig. 621: Measuring Crankshaft End Play**  
Courtesy of FORD MOTOR CO.

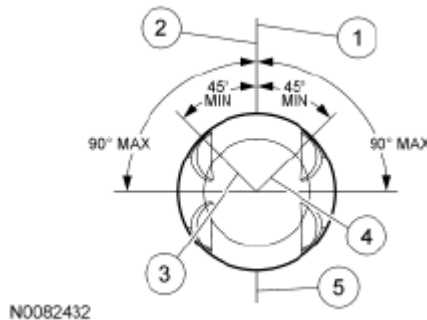
**NOTE:** The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.

19. Prepare the connecting rod and cap.
- Insert the new bolts in the rod cap.
  - Insert the upper and lower rod bearings into the rod and cap.



**Fig. 622: Inserting Upper And Lower Rod Bearings Into Rod And Cap**  
Courtesy of FORD MOTOR CO.

20. Before installing the pistons into the cylinder block, verify proper ring gap location.
1. Center line of the piston parallel to the wrist pin bore
  2. Upper compression ring gap location
  3. Upper oil control segment ring gap location
  4. Lower oil control segment ring gap location
  5. Expander ring and lower compression ring gap location

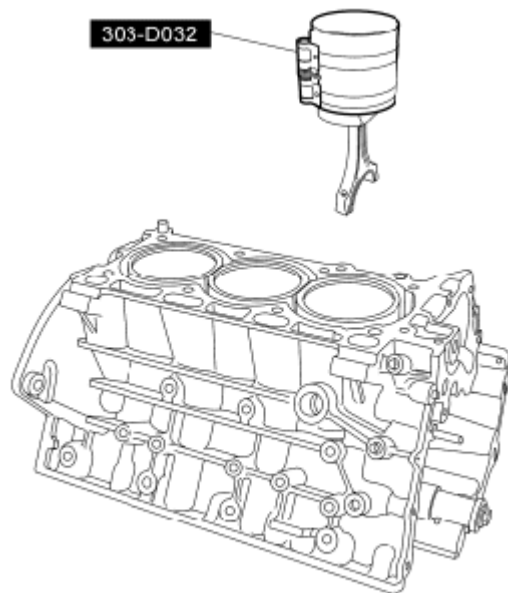


**Fig. 623: Identifying Piston Rings Installation Position**  
Courtesy of FORD MOTOR CO.

- NOTE:** Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Push the piston down until the connecting rod bearing seats on the crankshaft journal.
- NOTE:** The next 3 steps are for all 6 connecting rods, rod caps and pistons. Only 1 connecting rod, rod cap and piston is shown in illustration.
- NOTE:** Lubricate the pistons, piston rings, connecting rod bearings and the entire cylinder bores with clean engine oil.
- 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.



N0082418

**Fig. 624: Installing Piston And Connecting Rod Assemblies**  
Courtesy of FORD MOTOR CO.

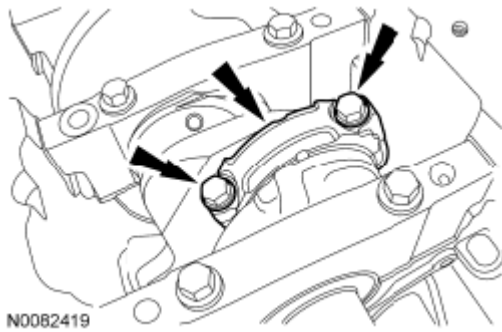
21. Using the Piston Ring Compressor, install the piston and connecting rod assemblies.
22. Seat the connecting rod on the crankshaft journal.

**NOTE:** The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.

**NOTE:** After installation of each piston, connecting rod, rod cap and bolts, rotate the crankshaft to verify smooth operation.

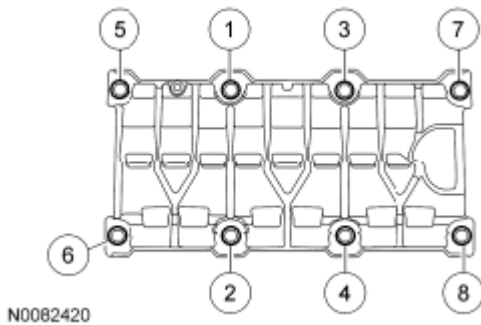
23. Install the connecting rod cap and bolts.
  - Tighten the bolts in 3 stages.
  - Stage 1: Tighten to 23 Nm (17 lb-ft).
  - Stage 2: Tighten to 43 Nm (32 lb-ft).
  - Stage 3: Tighten an additional 90 degrees.





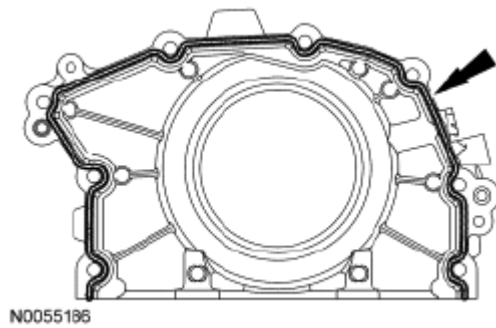
**Fig. 625: Locating Connecting Rod Cap Bolts**  
Courtesy of FORD MOTOR CO.

24. Repeat the previous 3 steps until all 6 piston, connecting rod and connecting rod cap assemblies are installed.
25. Install the main bearing cap support brace and the new bolts. Tighten in the sequence shown in illustration in 2 steps.
  - Stage 1: Tighten fasteners to 20 Nm (177 lb-in).
  - Stage 2: Tighten fasteners an additional 180 degrees.



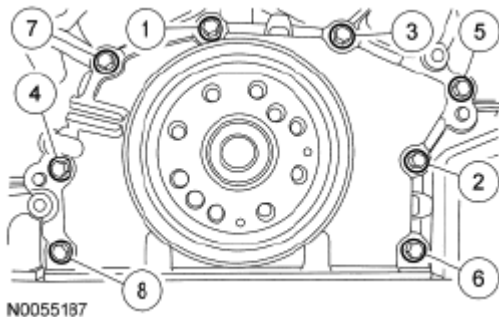
**Fig. 626: Identifying Main Bearing Cap Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

- NOTE:** Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.
- NOTE:** The crankshaft rear seal retainer must be installed and the bolts tightened within 4 minutes of sealant application.



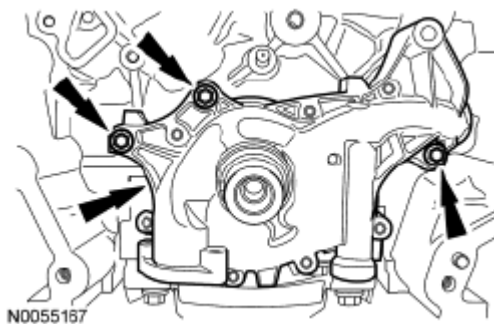
**Fig. 627: Identifying RTV Silicone Applying Area**  
Courtesy of FORD MOTOR CO.

26. Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the crankshaft rear seal retainer.
27. Install the crankshaft rear seal retainer and the 8 bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



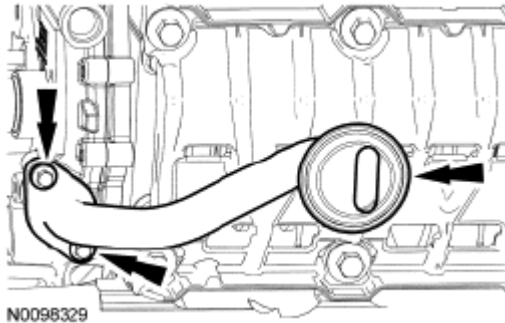
**Fig. 628: Identifying Crankshaft Rear Seal Retainer And Bolts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 629: Locating Oil Pump Bolts**  
Courtesy of FORD MOTOR CO.

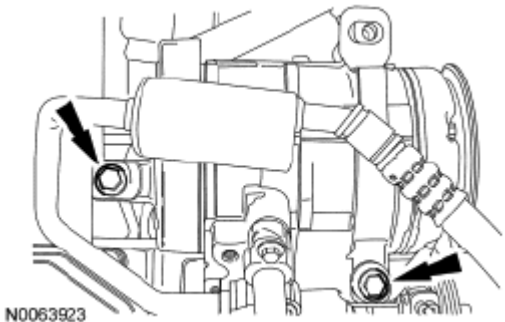
29. Using a new O-ring seal, install the oil pump screen and pickup tube and the 2 bolts.
  - Tighten to 10 Nm (89 lb-in).



**Fig. 630: Locating Oil Pump Screen And Pickup Tube**  
Courtesy of FORD MOTOR CO.

**NOTE:** The A/C compressor must be installed on the cylinder block and the 2 bolts tightened prior to installing the oil pan.

30. Install the A/C compressor and the 2 bolts.
  - Tighten to 25 Nm (18 lb-ft).



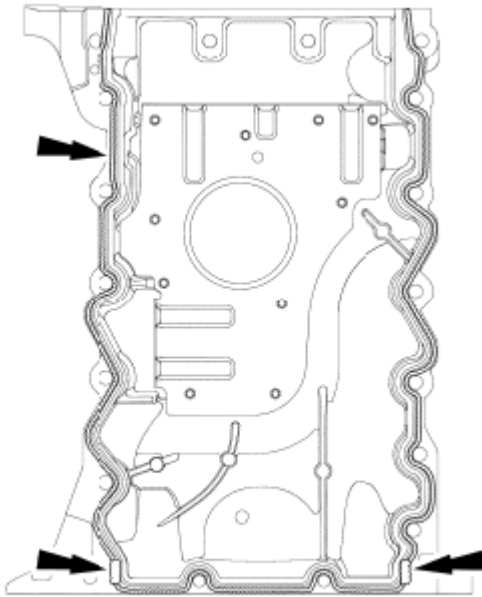
**Fig. 631: Locating A/C Compressor Bolts**  
Courtesy of FORD MOTOR CO.

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

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

31. Apply a 3 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the sealing surface of the oil pan.

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

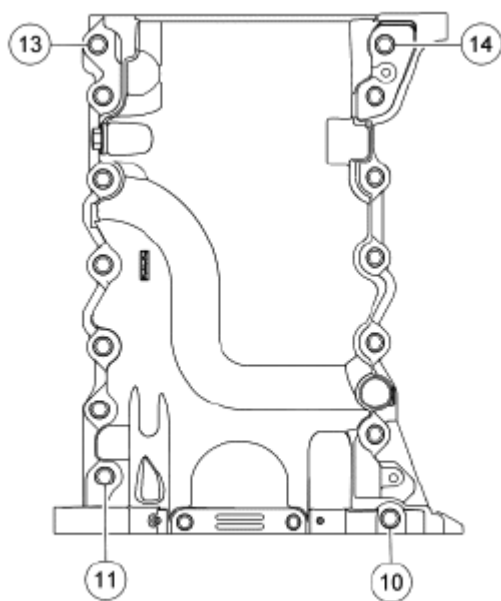


N0055188

**Fig. 632: Identifying RTV Silicone Applying Area**  
Courtesy of FORD MOTOR CO.

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

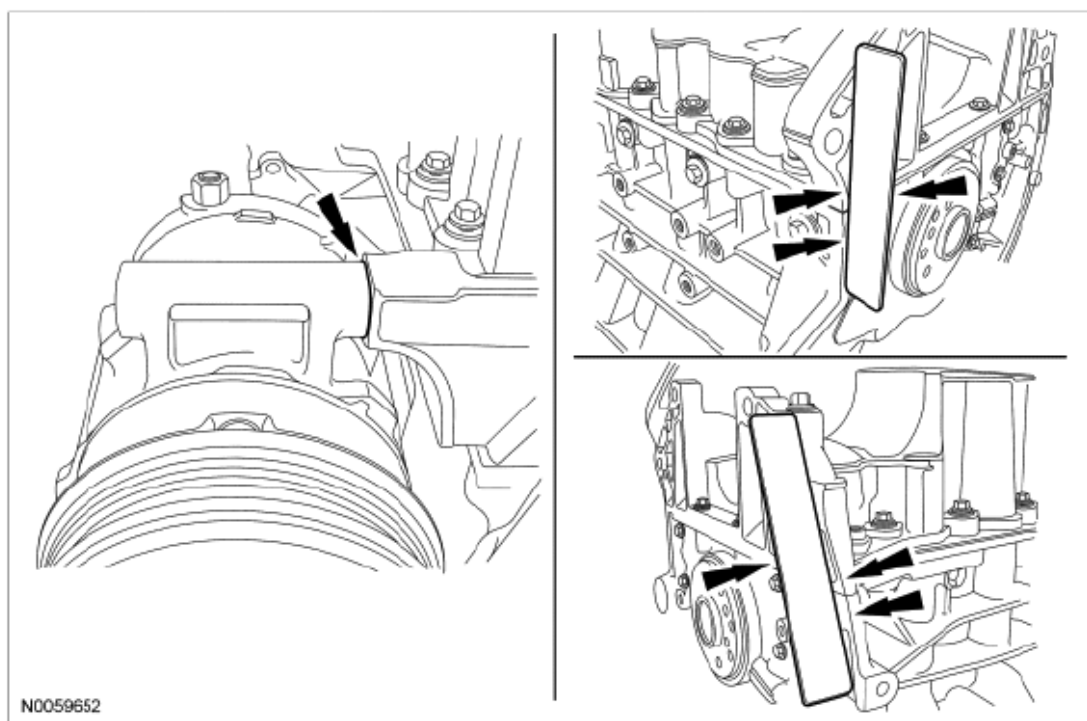
32. Install the oil pan and bolts 10, 11, 13 and 14.
- Tighten the bolts in the sequence shown in illustration to 3 Nm (27 lb-in).
  - Loosen the bolts 180 degrees.



N0069773

**Fig. 633: Identifying Oil Pan And 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.

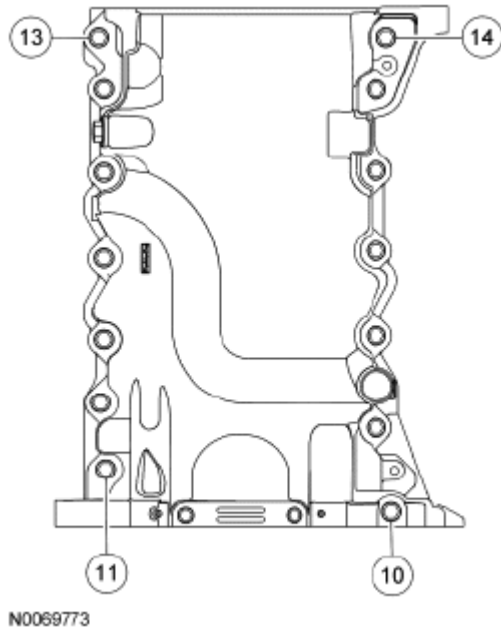


N0059652

**Fig. 634: Aligning Oil Pan Flush With Rear Of Cylinder Block Areas**

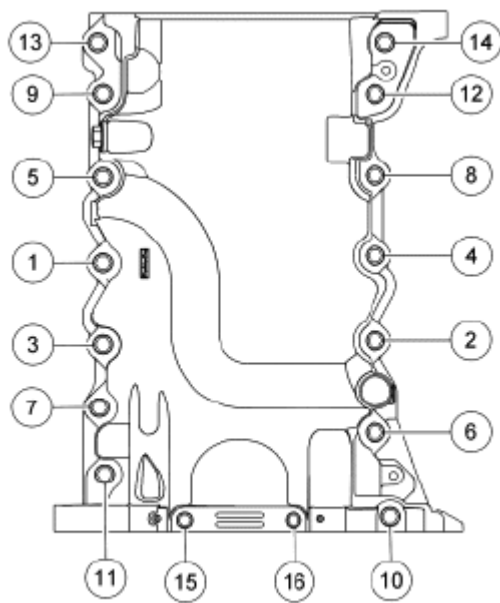
Courtesy of FORD MOTOR CO.

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



**Fig. 635: Identifying Oil Pan And Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

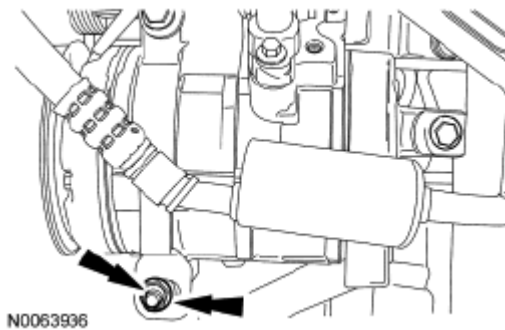
35. Install the remaining oil pan bolts. Tighten all the oil pan bolts in the sequence shown in illustration.
- Tighten the large bolts (1-14) to 24 Nm (18 lb-ft).
  - Tighten the small bolts (15 and 16) to 10 Nm (89 lb-in).



N0055165

**Fig. 636: Identifying Oil Pan And Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

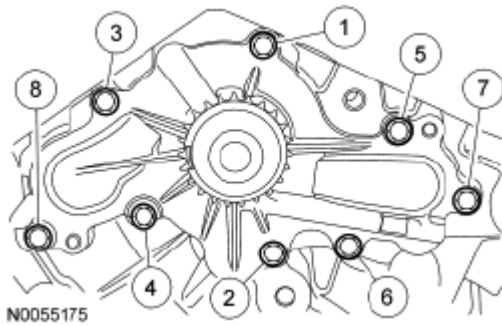
36. Install the A/C compressor mounting stud and nut.
- Tighten the stud to 9 Nm (80 lb-in) and the nut to 25 Nm (18 lb-ft).



N0063936

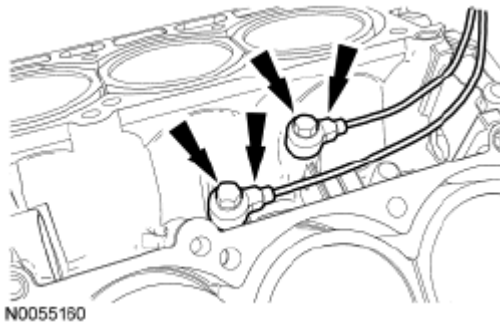
**Fig. 637: Locating A/C Compressor Nut And Stud**  
Courtesy of FORD MOTOR CO.

37. Install the coolant pump and the 8 bolts.
- Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



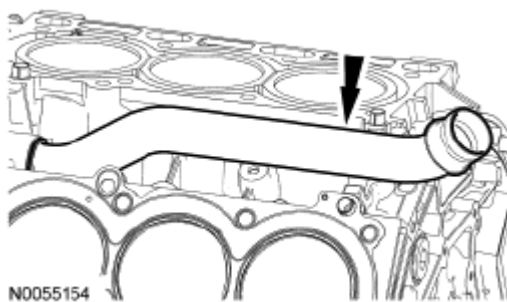
**Fig. 638: Identifying Coolant Pump Bolts**  
Courtesy of FORD MOTOR CO.

38. Install the Knock Sensor (KS) and the 2 bolts.
  - Tighten to 20 Nm (177 lb-in).



**Fig. 639: Locating Knock Sensor With Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** Apply clean engine coolant to the O-ring seals prior to installation.

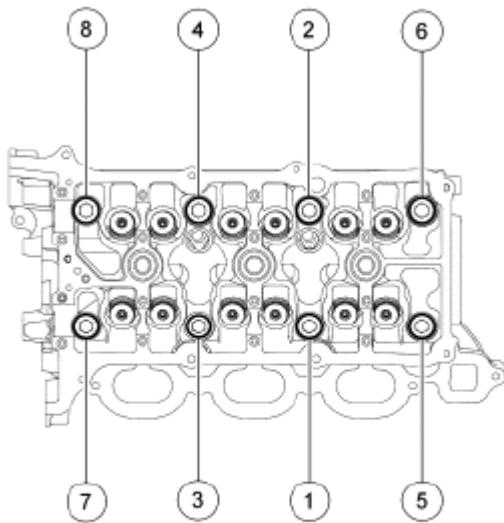


**Fig. 640: Locating Coolant Inlet Tube**  
Courtesy of FORD MOTOR CO.

39. Using new O-ring seals, install the coolant inlet tube.
40. Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in the sequence shown in illustration in 5 stages:



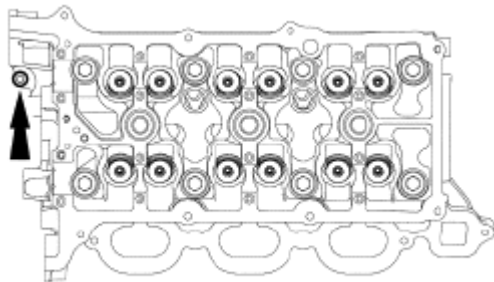
- Stage 1: Tighten to 20 Nm (177 lb-in).
- Stage 2: Tighten to 35 Nm (26 lb-ft).
- Stage 3: Tighten 90 degrees.
- Stage 4: Tighten 90 degrees.
- Stage 5: Tighten 90 degrees.



N0054884

**Fig. 641: Identifying RH Cylinder Head Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

41. Install the bolt.
  - Tighten to 10 Nm (89 lb-in).

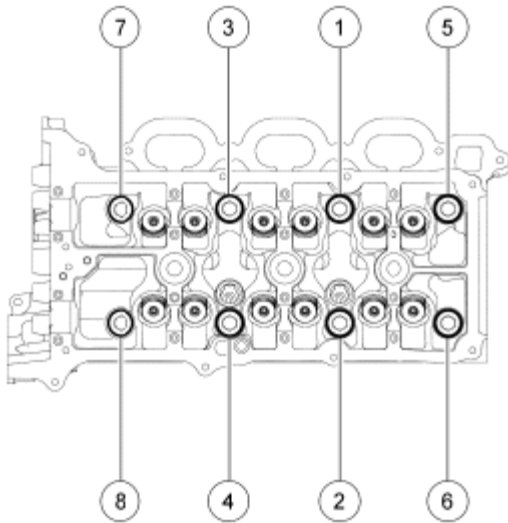


N0055173

**Fig. 642: Identifying RH Cylinder Head Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

42. Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in the sequence shown in illustration in 5 stages:
  - Stage 1: Tighten to 20 Nm (177 lb-in).

- Stage 2: Tighten to 35 Nm (26 lb-ft).
- Stage 3: Tighten 90 degrees.
- Stage 4: Tighten 90 degrees.
- Stage 5: Tighten 90 degrees.

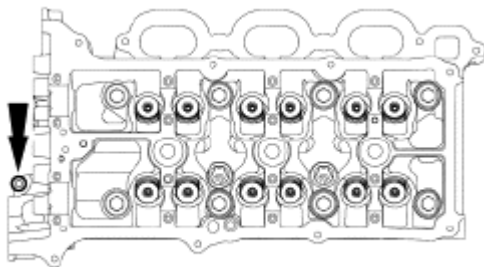


N0054898

**Fig. 643: Identifying LH Cylinder Head Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

43. Install the bolt.

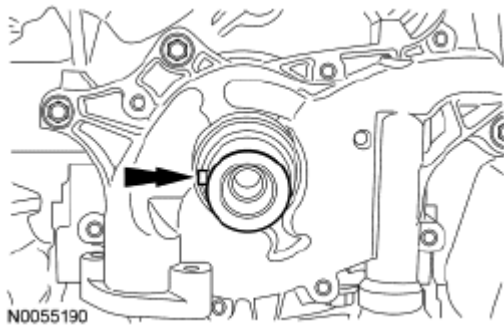
- Tighten to 10 Nm (89 lb-in).



N0055174

**Fig. 644: Locating M6 Bolt**  
Courtesy of FORD MOTOR CO.

**NOTE:** The crankshaft must remain in the freewheeling position (crankshaft dowel pin at 9 o'clock) until after the camshafts are installed and the valve clearance is checked/adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.



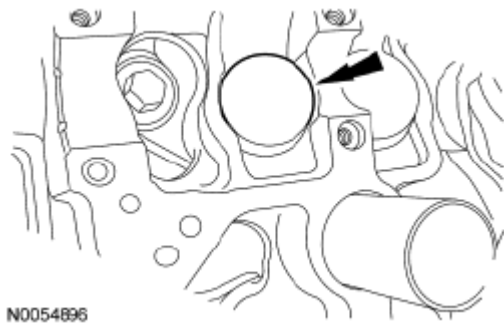
**Fig. 645: Locating Crankshaft Dowel Pin**  
Courtesy of FORD MOTOR CO.

44. Position the crankshaft dowel pin in the 9 o'clock position.

**NOTE:** The valve tappets must be installed in their original positions.

**NOTE:** Coat the valve tappets with clean engine oil prior to installation.

**NOTE:** LH shown in illustration, RH similar.

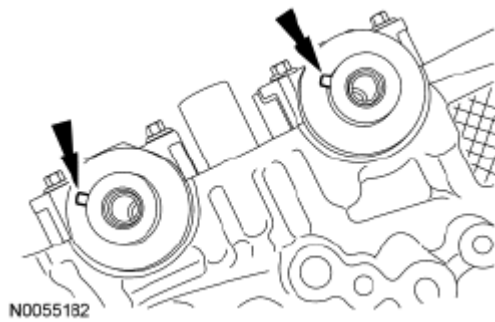


**Fig. 646: Locating Valve Tappets**  
Courtesy of FORD MOTOR CO.

45. Install the valve tappets.

**NOTE:** The camshafts must remain in the neutral position during installation or engine damage may occur.

**NOTE:** Coat the camshafts with clean engine oil prior to installation.

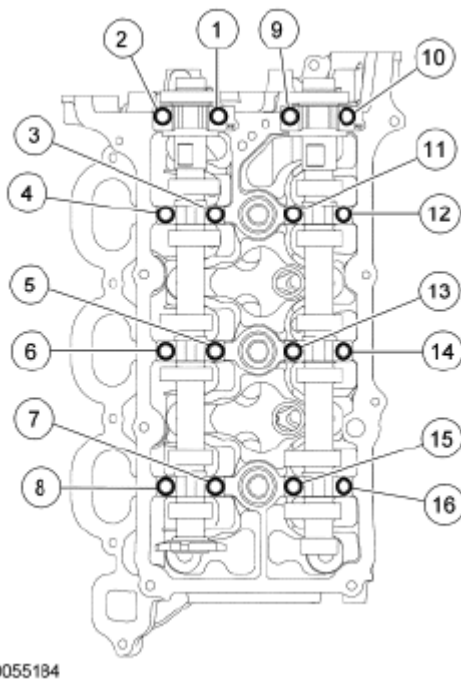


**Fig. 647: Identifying Camshafts Neutral Position**  
Courtesy of FORD MOTOR CO.

46. Position the camshafts onto the RH cylinder head in the neutral position as shown in illustration.

**NOTE:**      **Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

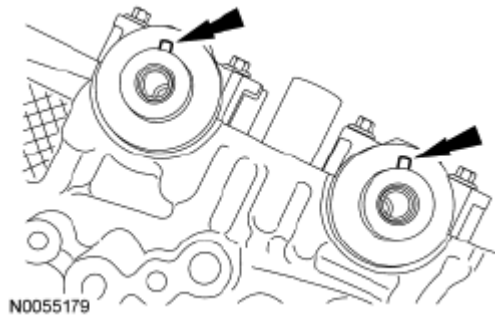
47. Install the 8 camshaft caps and the 16 bolts.
- Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 648: Identifying Camshaft Caps Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

**NOTE:**      **The camshafts must remain in the neutral position during installation or engine damage may occur.**

**NOTE:** Coat the camshafts with clean engine oil prior to installation.

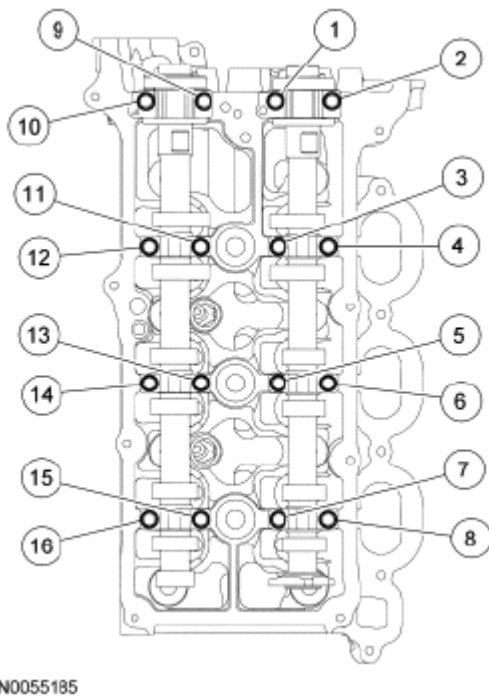


**Fig. 649: Identifying Camshafts Neutral Position**  
Courtesy of FORD MOTOR CO.

48. Position the camshafts onto the LH cylinder head in the neutral position as shown in illustration.

**NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions. If not reassembled in their original positions, severe engine damage may occur.

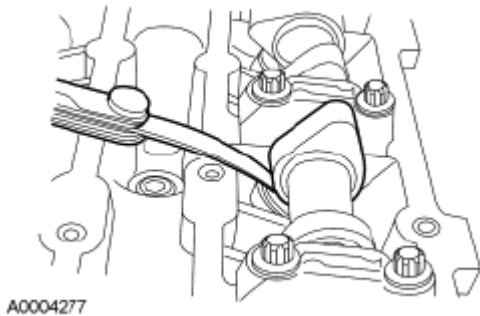
49. Install the 8 camshaft caps and the 16 bolts.
- Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 650: Identifying Camshaft Caps Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

**NOTE:** If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.

**NOTE:** Use a camshaft sprocket bolt to turn the camshafts.

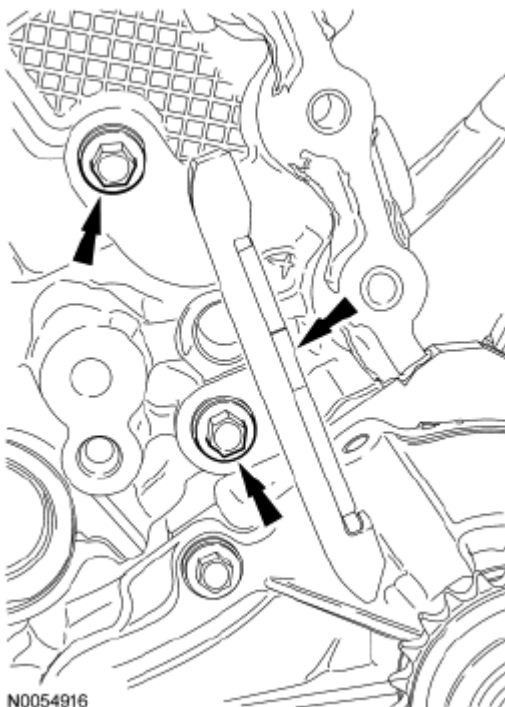


**Fig. 651: Checking Valve Tappet Clearances**  
Courtesy of FORD MOTOR CO.

50. Using a feeler gauge, confirm that the valve tappet clearances are within specification. For additional information, refer to **VALVE CLEARANCE CHECK**.

**Engines equipped with early build RH timing chain guides**

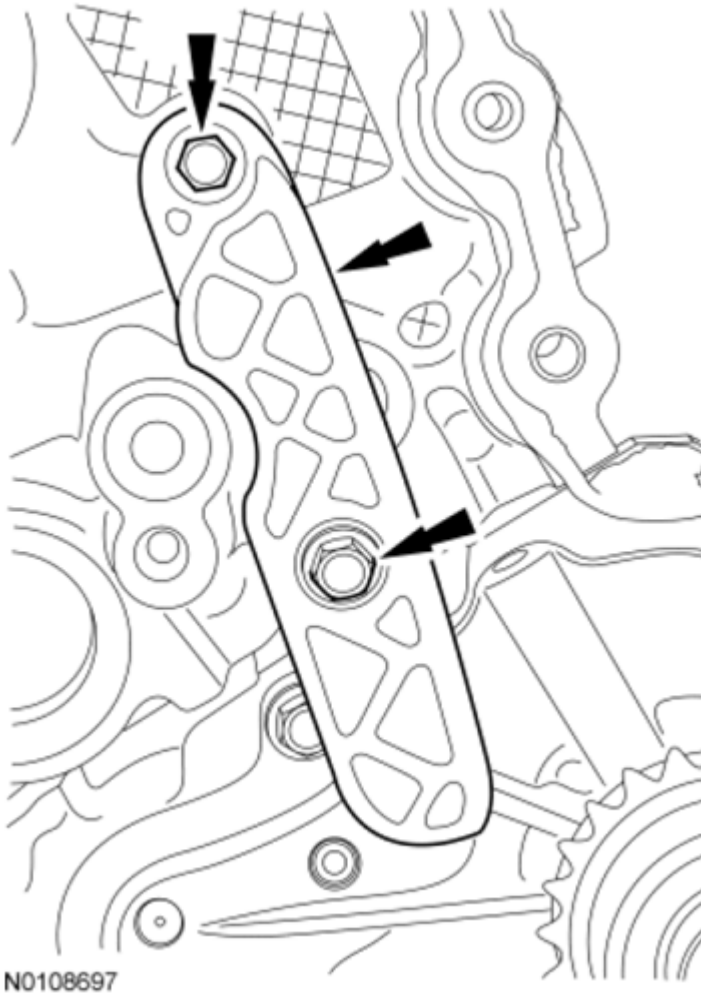
51. Install the RH primary timing chain guide and the 2 bolts.
- Tighten to 10 Nm (89 lb-in).



**Fig. 652: Locating RH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

**Engines equipped with late build/replacement RH timing chain guides**

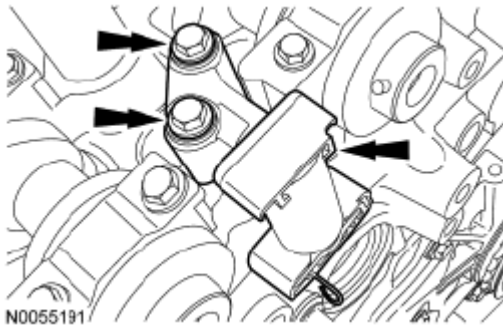
52. Install the RH primary timing chain guide and the 2 bolts.
- Tighten to 10 Nm (89 lb-in).



**Fig. 653: Locating RH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

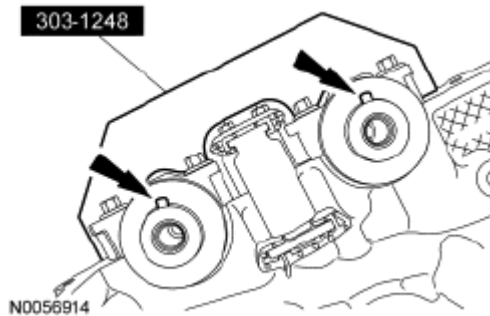
**All vehicles**

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



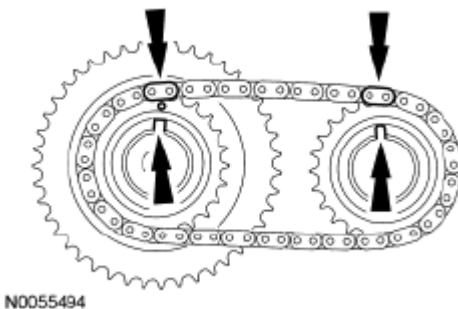
**Fig. 654: Locating RH Secondary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** Use a camshaft sprocket bolt to turn the camshafts.



**Fig. 655: Installing Camshaft Holding Tool On Flats Of Camshafts**  
Courtesy of FORD MOTOR CO.

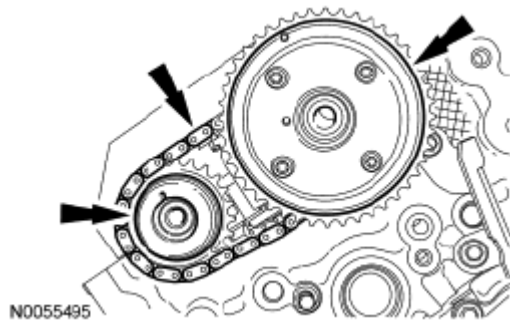
54. Rotate the RH camshafts to the top dead center position and install the Camshaft Holding Tool on the flats of the camshafts.
55. Assemble the RH Variable Camshaft Timing (VCT) assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
  - Align the colored links with the timing marks.



**Fig. 656: Aligning Colored Links With Timing Marks**  
Courtesy of FORD MOTOR CO.



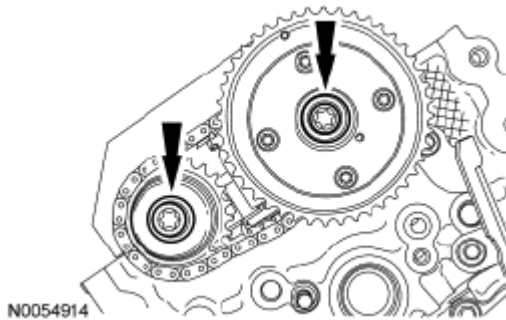
56. Position the RH secondary timing assembly onto the camshafts.



**Fig. 657: Positioning RH Secondary Timing Assembly Onto Camshafts**  
Courtesy of FORD MOTOR CO.

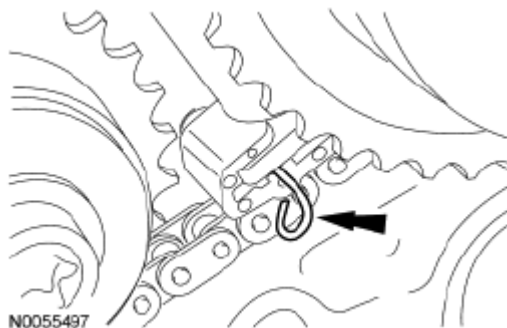
57. Install 2 new bolts and the original washer. Tighten in 4 stages.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Loosen one full turn.
- Stage 3: Tighten to 10 Nm (89 lb-in).
- Stage 4: Tighten 90 degrees.



**Fig. 658: Locating Secondary Timing Chain And RH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

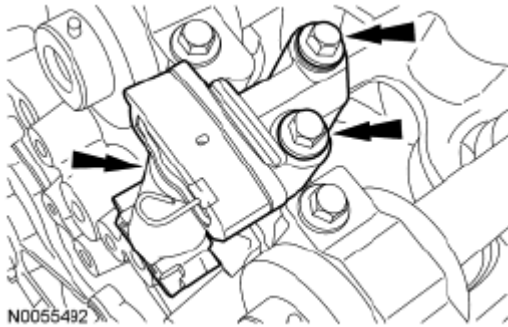
58. Remove the lockpin from the RH secondary timing chain tensioner.



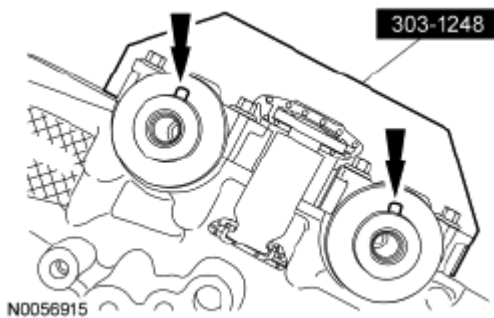
**Fig. 659: Locating Lockpin**

Courtesy of FORD MOTOR CO.

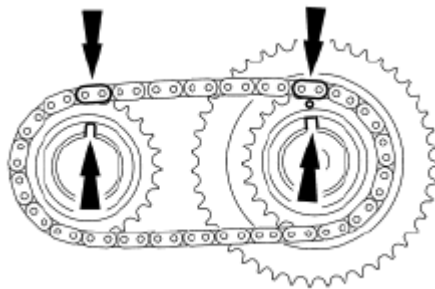
59. Install the LH secondary timing chain tensioner and the 2 bolts.
- Tighten to 10 Nm (89 lb-in).

**Fig. 660: Locating LH Secondary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** Use a camshaft sprocket bolt to turn the camshafts.

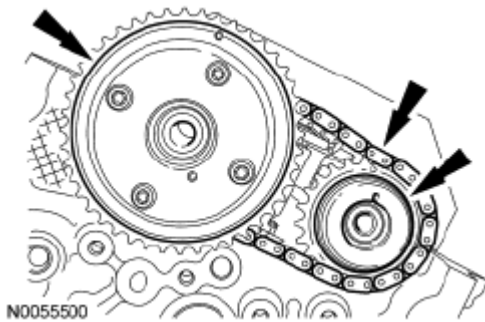
**Fig. 661: Installing Camshaft Holding Tool On Flats Of Camshafts**  
Courtesy of FORD MOTOR CO.

60. Rotate the LH camshafts to the Top Dead Center (TDC) position and install the Camshaft Holding Tool on the flats of the camshafts.
61. Assemble the LH Variable Camshaft Timing (VCT) assembly, the LH exhaust camshaft sprocket and the LH secondary timing chain.
- Align the colored links with the timing marks.



**Fig. 662: Aligning Colored Links With Timing Marks**  
Courtesy of FORD MOTOR CO.

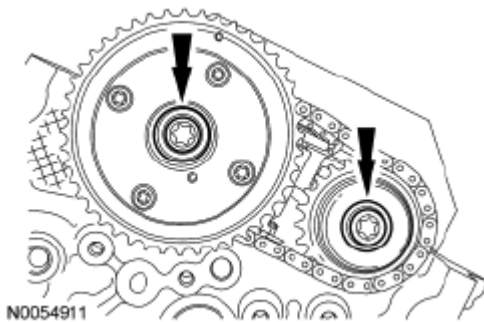
62. Position the LH secondary timing assembly onto the camshafts.



**Fig. 663: Locating LH Secondary Timing Assembly**  
Courtesy of FORD MOTOR CO.

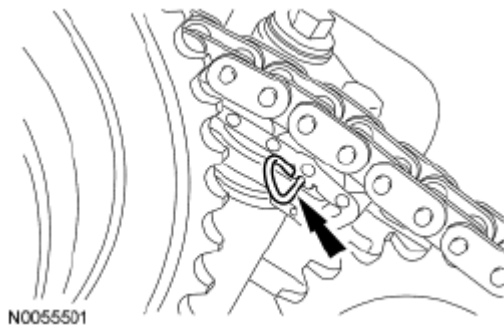
63. Install 2 new bolts and the original washer. Tighten in 4 stages.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Loosen one full turn.
- Stage 3: Tighten to 10 Nm (89 lb-in).
- Stage 4: Tighten 90 degrees.



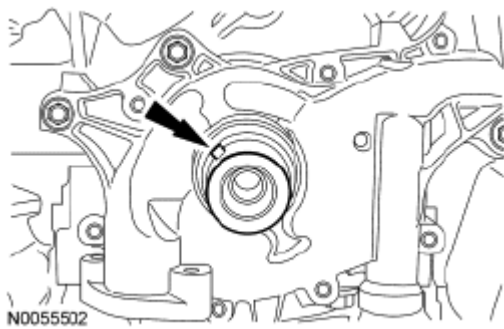
**Fig. 664: Locating Secondary Timing Chain And LH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

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



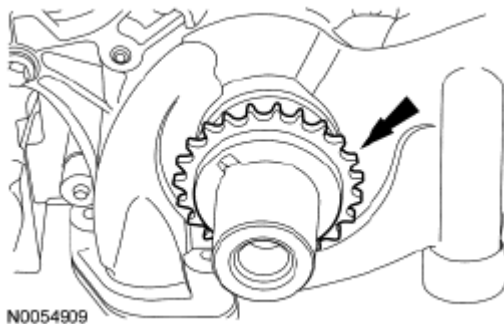
**Fig. 665: Locating Lockpin**  
Courtesy of FORD MOTOR CO.

65. Rotate the crankshaft clockwise 60 degrees to the **TDC** position (crankshaft dowel pin at 11 o'clock).



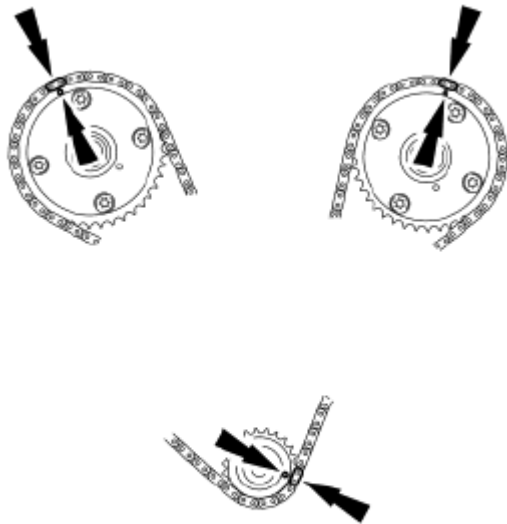
**Fig. 666: Identifying Crankshaft Position**  
Courtesy of FORD MOTOR CO.

66. Install the crankshaft timing chain sprocket.



**Fig. 667: Locating Crankshaft Timing Chain Sprocket**  
Courtesy of FORD MOTOR CO.

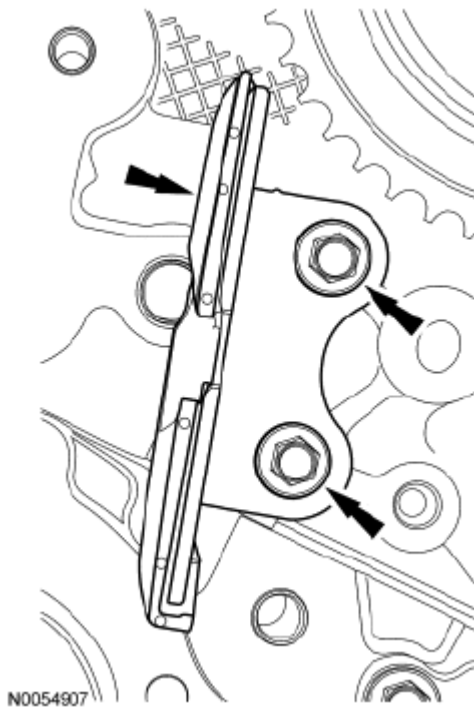
67. Install the primary timing chain with the colored links aligned with the timing marks on the **VCT** assemblies and the crankshaft sprocket.



N0055503

**Fig. 668: Aligning Timing Marks On VCT Assemblies And Crankshaft Sprocket**  
Courtesy of FORD MOTOR CO.

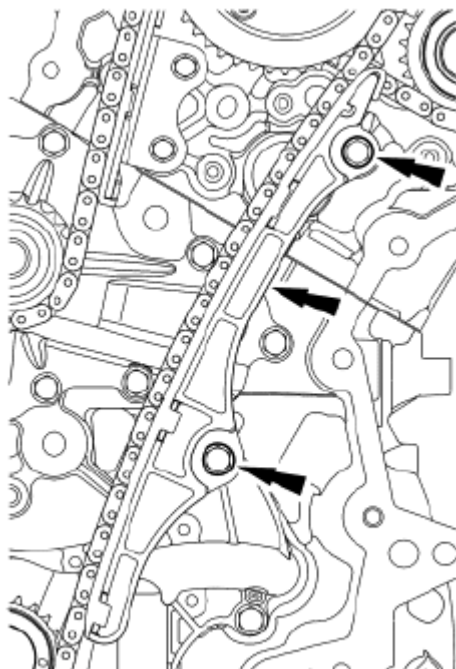
68. Install the upper LH primary timing chain guide and the 2 bolts.
  - Tighten to 10 Nm (89 lb-in).



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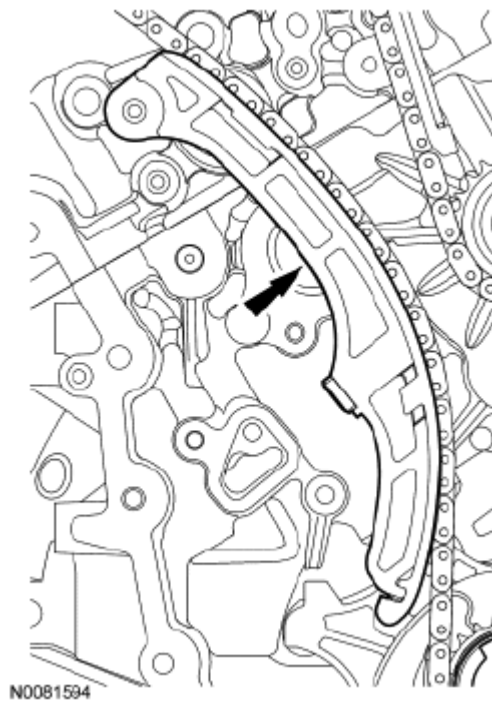
**Fig. 669: Locating Upper LH Primary Timing Chain Guide With Bolts**  
Courtesy of FORD MOTOR CO.

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



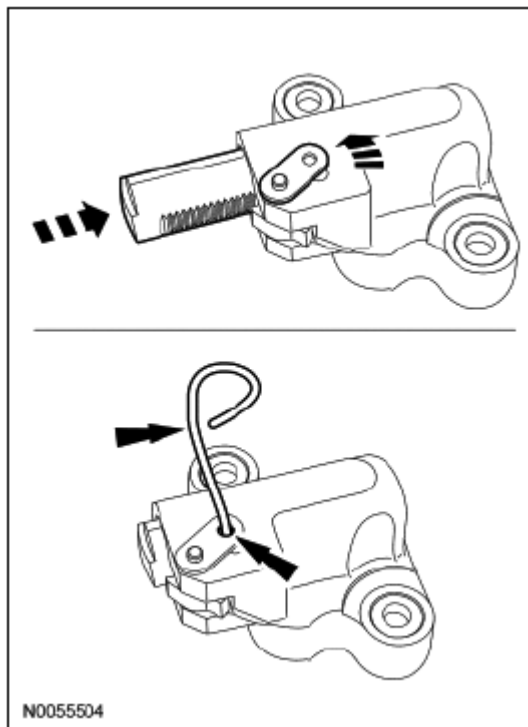
**Fig. 670: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

70. Install the primary timing chain tensioner arm.



**Fig. 671: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

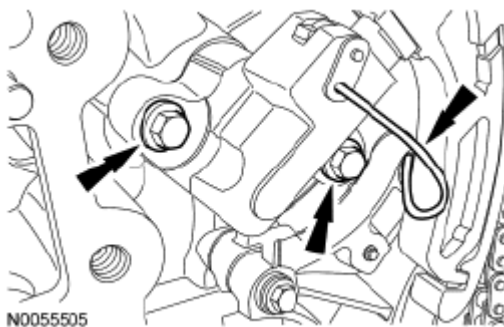
71. Reset the primary timing chain tensioner.
- Rotate the lever counterclockwise.
  - Using a soft-jawed vise, compress the plunger.
  - Align the hole in the lever with the hole in the tensioner housing.
  - Install a suitable lockpin.



**Fig. 672: Aligning Hole In Lever With Hole In Tensioner Housing**  
Courtesy of FORD MOTOR CO.

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

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



**Fig. 673: Locating Primary Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

73. As a post-check, verify correct alignment of all timing marks.

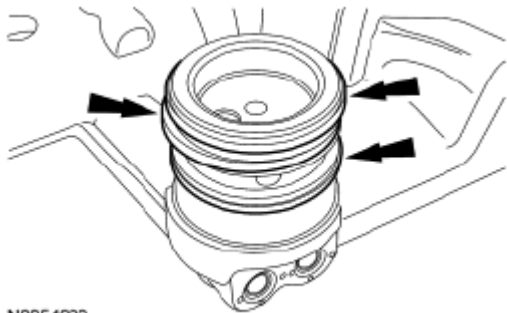




N0055496

**Fig. 674: Identifying Timing Marks Location**  
Courtesy of FORD MOTOR CO.

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

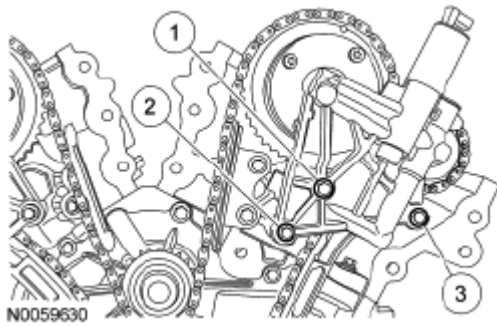


N0054903

**Fig. 675: Locating VCT Housing Seals**  
Courtesy of FORD MOTOR CO.

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

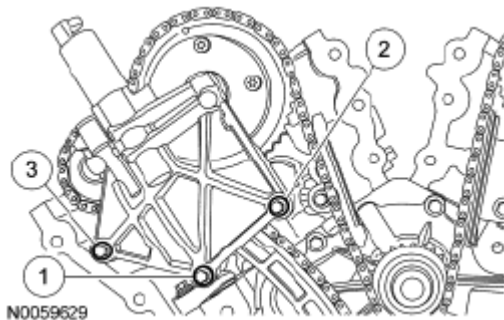
75. Install the LH VCT housing and the 3 bolts.
- Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 676: Identifying LH VCT Housing Bolts**  
Courtesy of FORD MOTOR CO.

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

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



**Fig. 677: Identifying RH VCT Housing Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

77. Install the Alignment Pins.

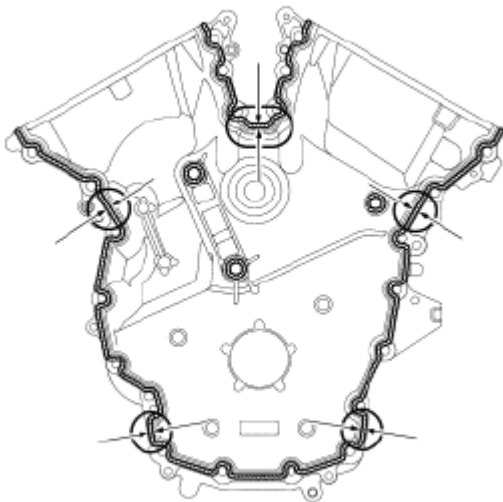


**Fig. 678: Identifying Alignment Pins**  
Courtesy of FORD MOTOR CO.

- NOTE:** Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.
- NOTE:** The engine front cover and bolts 17, 18, 19 and 20 must be installed within 4 minutes of the initial sealant application. The remainder of the engine front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

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

5.5 mm  
(0.21 in)



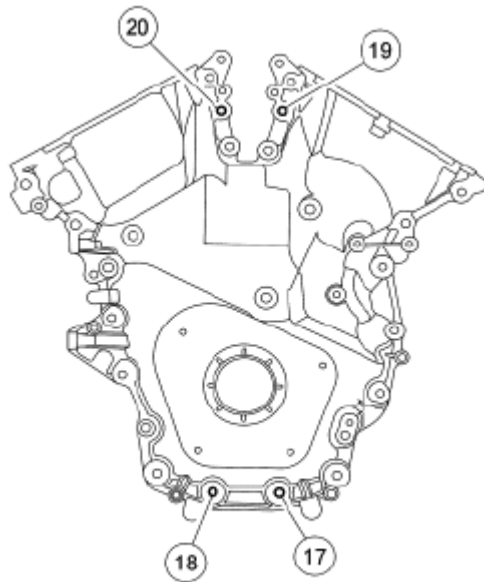
N0068283

**Fig. 679: Identifying RTV Silicone Applying Area**  
Courtesy of FORD MOTOR CO.

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

79. Install the engine front cover and bolts 17, 18, 19 and 20.

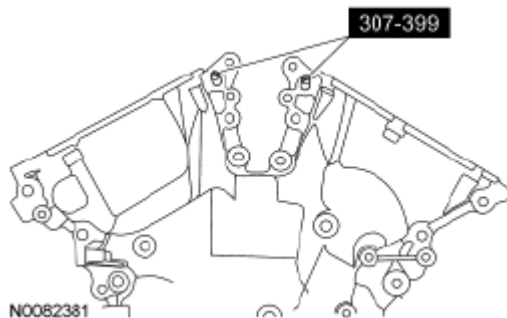
- Tighten in sequence to 3 Nm (27 lb-in).



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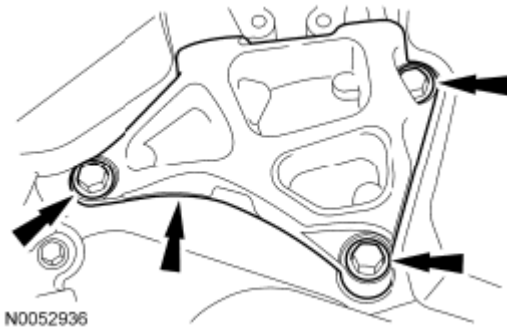
**Fig. 680: Identifying Engine Front Cover Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

80. Remove the Alignment Pins.



**Fig. 681: Identifying Alignment Pins**  
Courtesy of FORD MOTOR CO.

**NOTE:** Do not tighten the bolts at this time.

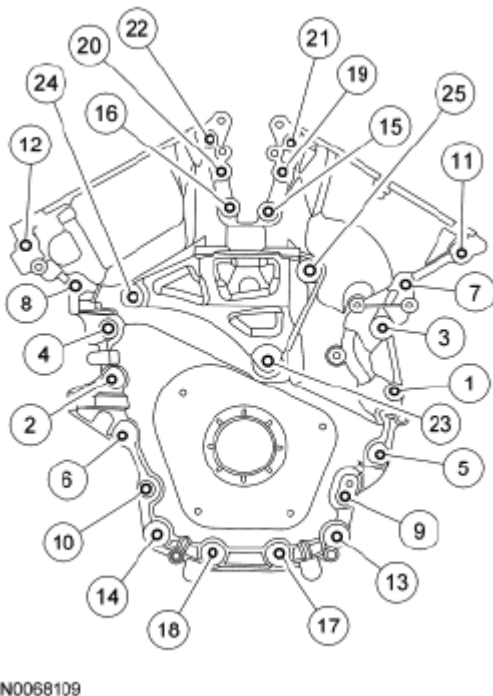


**Fig. 682: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

81. Install the engine mount bracket and the 3 bolts.

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

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

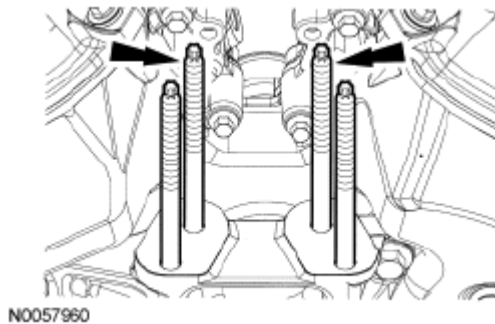


**Fig. 683: Identifying Engine Front Cover Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

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

83. Install the engine mount studs in the following sequence.

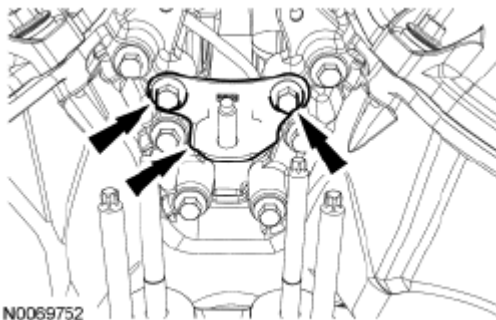
1. Clean the front cover engine mount stud holes with pressurized air to remove any foreign material.
2. Clean all the thread sealer from the engine mount studs (old and new studs).
3. Apply new Threadlock and Sealer to the engine mount stud threads.
4. Install the 2 engine mount studs.
  - Tighten to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



**Fig. 684: Locating Engine Mount Studs**  
Courtesy of FORD MOTOR CO.

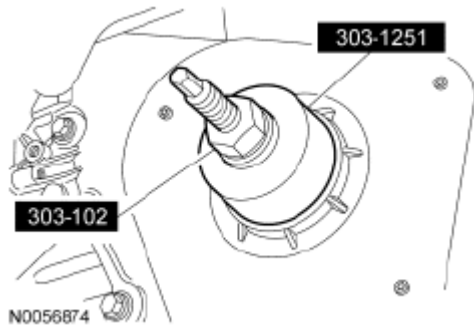
84. Install the engine mount bracket and the 2 bolts.

- Tighten to 30 Nm (22 lb-ft).



**Fig. 685: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

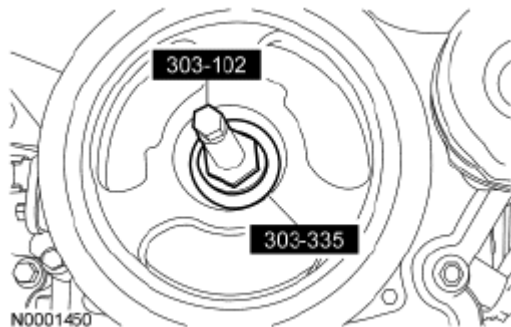
**NOTE:** Apply clean engine oil to the crankshaft front seal bore in the engine front cover.



**Fig. 686: Identifying Crankshaft Vibration Damper Installer And Front Crankshaft Installer**  
Courtesy of FORD MOTOR CO.

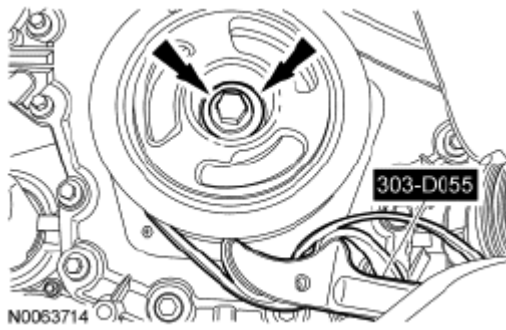
85. Using the Crankshaft Vibration Damper Installer and Front Crankshaft Seal Installer, install a new crankshaft front seal.

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



**Fig. 687: Identifying Crankshaft Vibration Damper Installer And Front Cover Oil Seal Installer**  
Courtesy of FORD MOTOR CO.

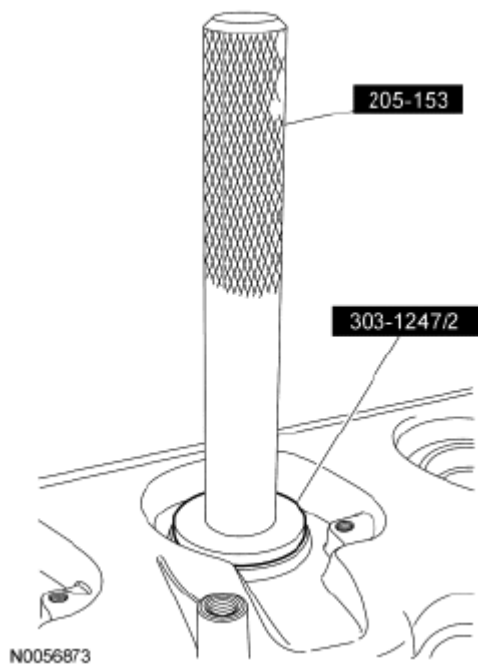
86. Using the Crankshaft Vibration Damper Installer and Front Cover Oil Seal Installer, install the crankshaft pulley.
87. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
- Stage 1: Tighten to 120 Nm (89 lb-ft).
  - Stage 2: Loosen one full turn.
  -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



**Fig. 688: Locating Crankshaft Pulley Washer And Bolt**  
Courtesy of FORD MOTOR CO.

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

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



**Fig. 689: Identifying VCT Spark Plug Tube Seal Installer And Handle**  
Courtesy of FORD MOTOR CO.

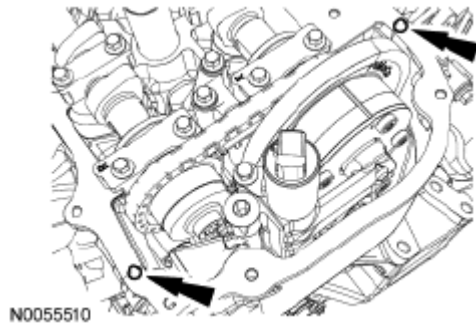
88. Using the VCT Spark Plug Tube Seal Installer and Handle, install new VCT solenoid and/or spark plug tube seals.

**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. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

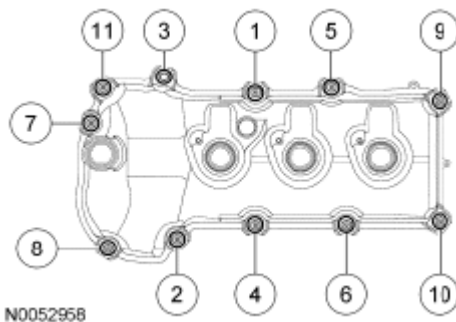


**Fig. 690: Applying RTV Silicone To Engine Front Cover-To-RH Cylinder Head Joints**  
Courtesy of FORD MOTOR CO.

89. Apply a 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.

#### Early build vehicles

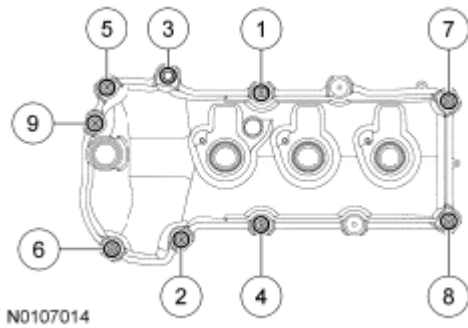
90. Using a new gasket, install the RH valve cover and tighten the bolt and the 10 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 691: Identifying RH Valve Cover Stud Bolts Tightening Sequence (Early Build Vehicles)**  
Courtesy of FORD MOTOR CO.

#### Late build vehicles

91. Using a new gasket, install the RH valve cover and tighten the 9 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

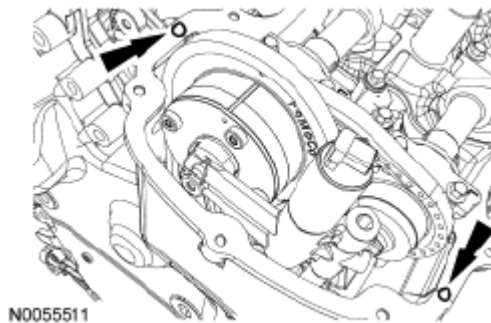


**Fig. 692: Identifying RH Valve Cover Stud Bolts Tightening Sequence (Late Build Vehicles)**  
Courtesy of FORD MOTOR CO.

#### All vehicles

**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. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

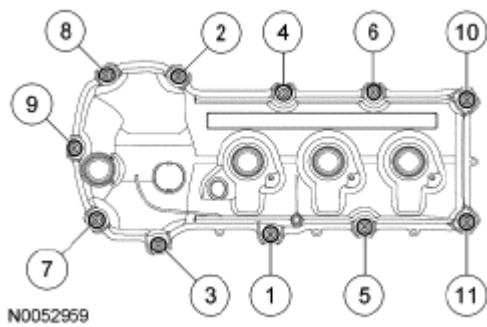


**Fig. 693: Applying RTV Silicone To Engine Front Cover**  
Courtesy of FORD MOTOR CO.

92. Apply a 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.

#### Early build vehicles

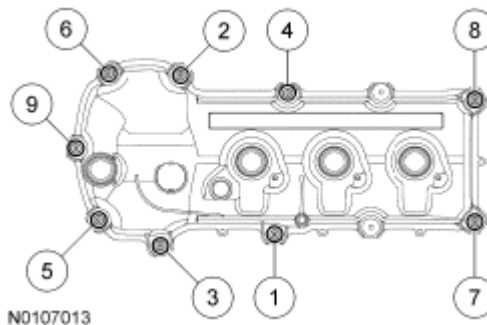
93. Using a new gasket, install the LH valve cover and tighten the 11 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 694: Identifying LH Valve Cover Stud Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

### Late build vehicles

94. Using a new gasket, install the LH valve cover and tighten the 9 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

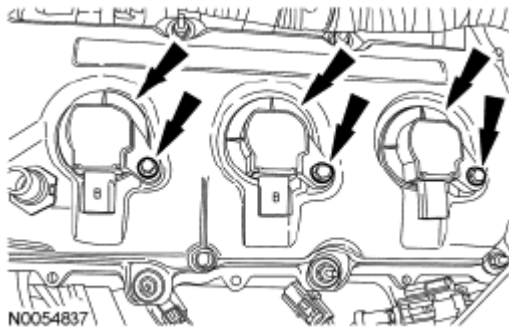


**Fig. 695: Identifying LH Valve Cover Stud Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

### All vehicles

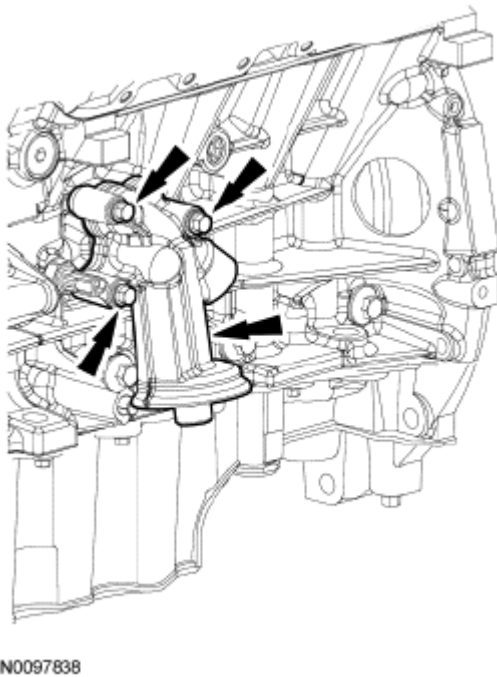
**NOTE:** LH shown in illustration, RH similar.

95. Install the 6 coil-on-plug assemblies and the 6 bolts.
  - Tighten to 7 Nm (62 lb-in).



**Fig. 696: Locating Coil-On-Plugs Bolts**  
Courtesy of FORD MOTOR CO.

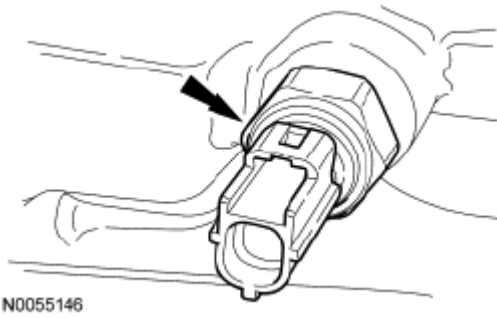
96. Using a new gasket, install the oil filter adapter and the 3 bolts.
- Tighten to 10 Nm (89 lb-in).



**Fig. 697: Locating Oil Filter Adapter Bolts**  
Courtesy of FORD MOTOR CO.

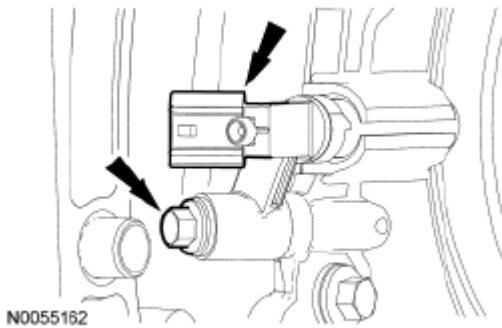
**NOTE:** Apply thread sealant with PTFE to the Engine Oil Pressure (EOP) switch threads.

97. Install the **EOP** switch.
- Tighten to 18 Nm (159 lb-in).



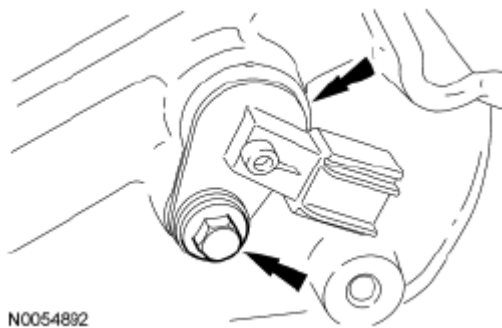
**Fig. 698: Locating EOP Switch**  
Courtesy of FORD MOTOR CO.

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



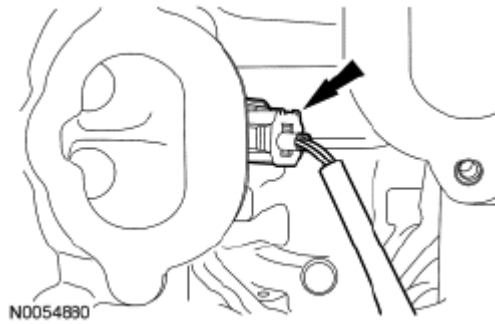
**Fig. 699: Locating CKP Sensor**  
Courtesy of FORD MOTOR CO.

99. Install LH Camshaft Position (CMP) sensor and the bolt.
- Tighten to 10 Nm (89 lb-in).



**Fig. 700: Locating LH CMP Sensor**  
Courtesy of FORD MOTOR CO.

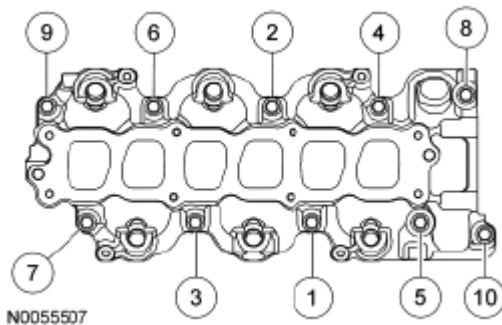
100. Install and connect the Cylinder Head Temperature (CHT) sensor jumper harness.



**Fig. 701: Locating CHT Sensor Jumper Harness**  
Courtesy of FORD MOTOR CO.

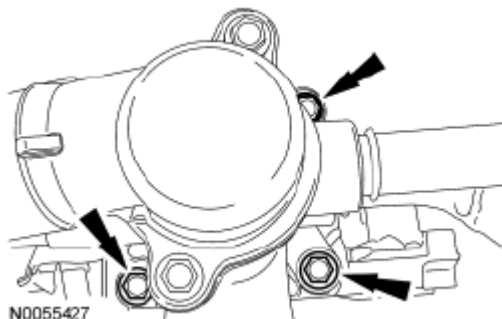
**NOTE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

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



**Fig. 702: Identifying Intake Manifold Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

102. Using a new gasket, install the thermostat housing and the 3 bolts.
- Tighten to 10 Nm (89 lb-in).



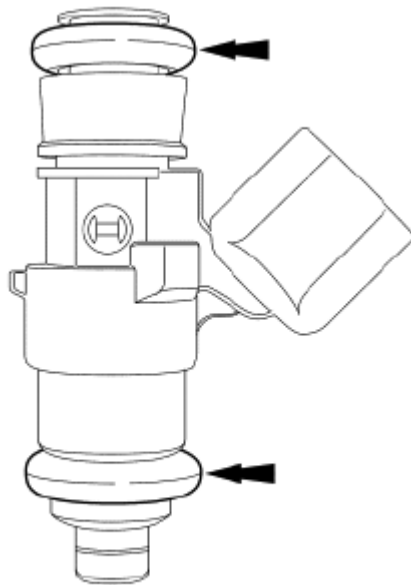
**Fig. 703: Locating Thermostat Housing-To-Lower Intake Manifold Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-rings can cause the fuel system to leak. Do not reuse the O-ring seals.

**NOTE:** The upper and lower O-ring seals are not interchangeable.

103. Install new fuel injector O-ring seals.

- Remove the retaining clips and separate the fuel injectors from the fuel rail.
- Remove and discard the O-ring seals.
- Install new O-ring seals and lubricate with clean engine oil.
- Install the fuel injectors and the retaining clips onto the fuel rail.

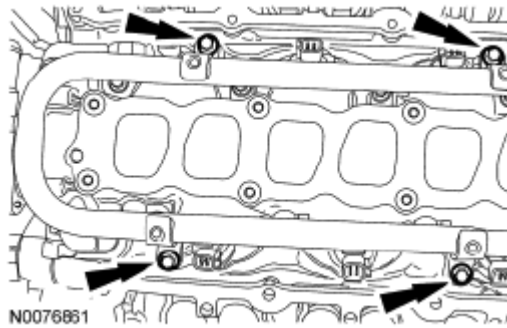


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**Fig. 704: Locating Fuel Injector O-Ring Seals**  
Courtesy of FORD MOTOR CO.

104. Install the fuel rail and injectors as an assembly and install the 4 bolts.

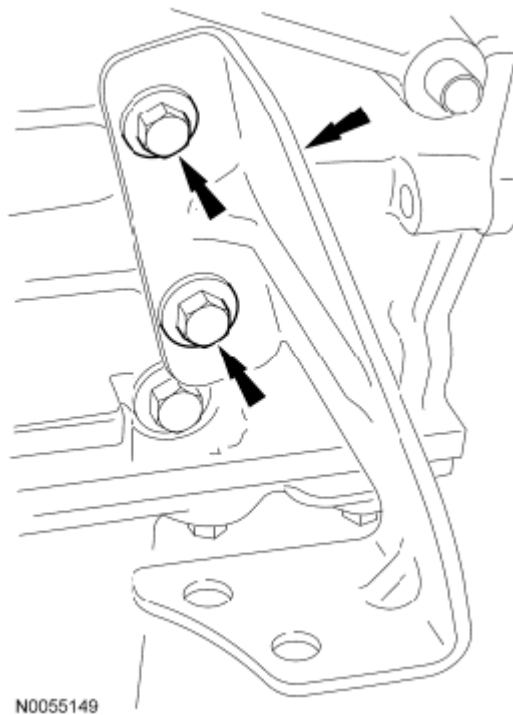
- Tighten to 10 Nm (89 lb-in).



**Fig. 705: Locating Fuel Rail Bolts**  
Courtesy of FORD MOTOR CO.

**All-Wheel Drive (AWD) vehicles**

105. Install the catalytic converter bracket and the 2 bolts.
- Tighten to 48 Nm (35 lb-ft).

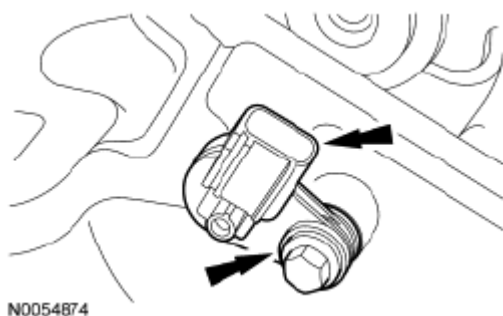


**Fig. 706: Locating Catalytic Converter Bracket Bolts**  
Courtesy of FORD MOTOR CO.

**All vehicles**

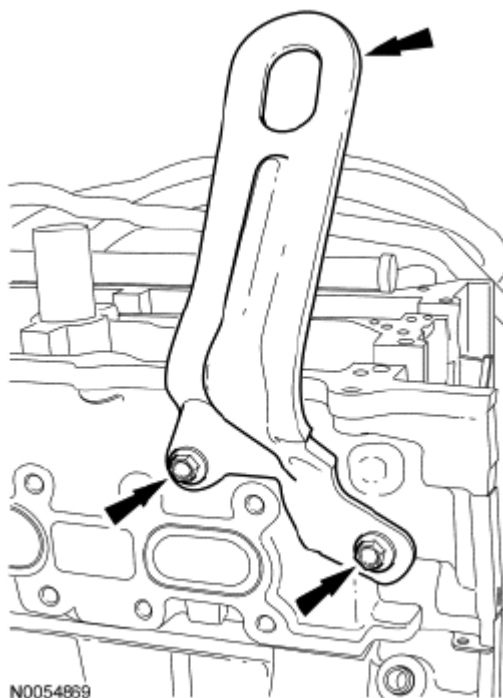
106. Install the RH **CMP** sensor and the bolt.
- Tighten to 10 Nm (89 lb-in).





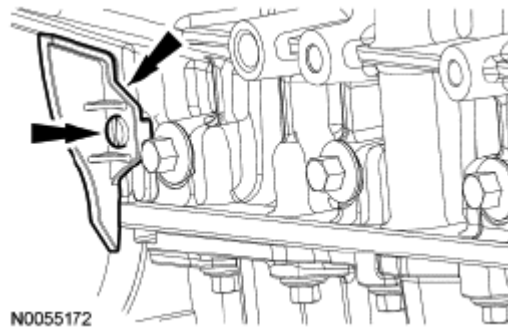
**Fig. 707: Locating RH CMP Sensor Bolt**  
Courtesy of FORD MOTOR CO.

107. Install the engine lifting eye and the 2 bolts.
- Tighten to 24 Nm (18 lb-ft).



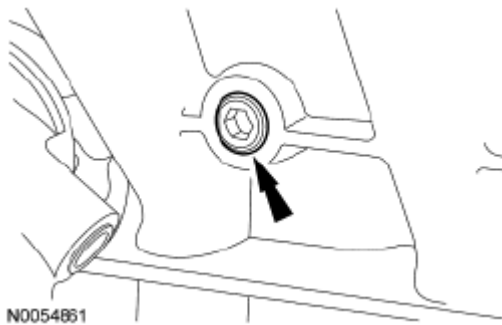
**Fig. 708: Locating Engine Lifting Eye With Bolts**  
Courtesy of FORD MOTOR CO.

108. Install the cover and the pin-type retainer.



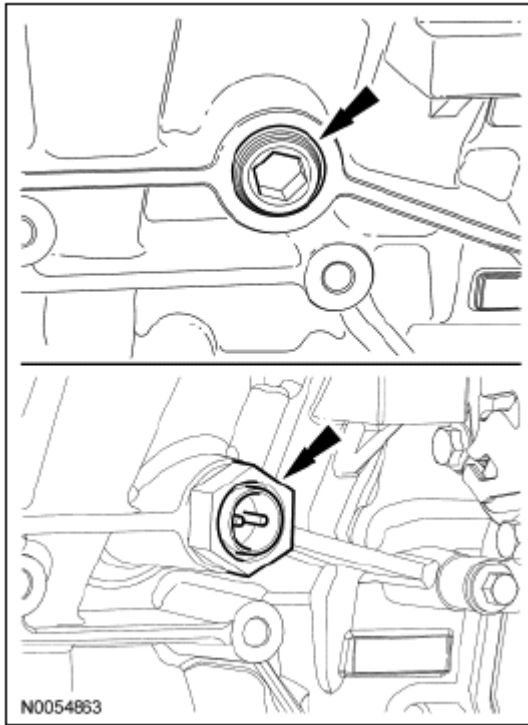
**Fig. 709: Locating Pin-Type Retainer**  
Courtesy of FORD MOTOR CO.

109. Install the LH cylinder block drain plug.
  - Tighten to 20 Nm (177 lb-in) plus an additional 180 degrees.



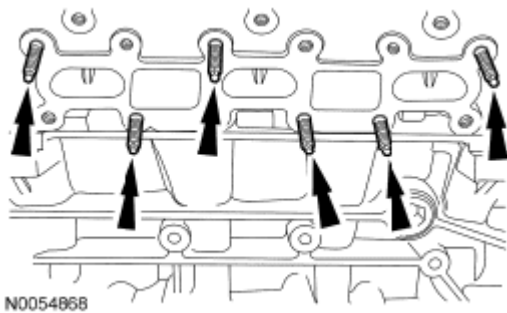
**Fig. 710: Locating LH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

110. Install the RH cylinder block drain plug or, if equipped, the block heater.
  - Tighten to 40 Nm (30 lb-ft).



**Fig. 711: Locating RH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

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

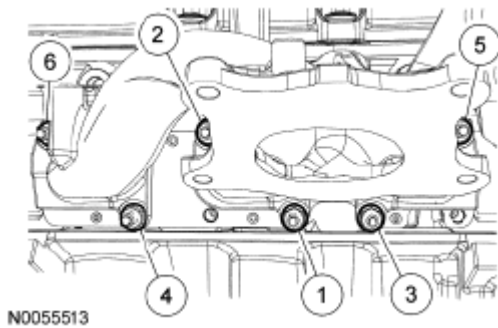


**Fig. 712: Locating RH Exhaust Manifold Studs**  
Courtesy of FORD MOTOR CO.

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

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

- Stage 2: Tighten to 25 Nm (18 lb-ft).

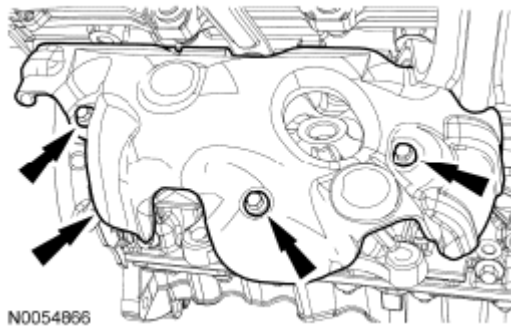


**Fig. 713: Identifying RH Exhaust Manifold Nuts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

### Front Wheel Drive (FWD) vehicles

113. Install the RH exhaust manifold heat shield and the 3 bolts.

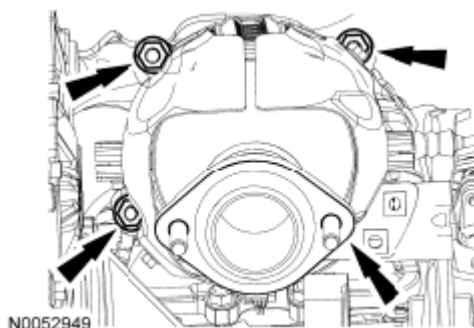
- Tighten to 10 Nm (89 lb-in).



**Fig. 714: Locating RH Exhaust Manifold Heat Shield Bolts**  
Courtesy of FORD MOTOR CO.

114. Using a new gasket, install the RH catalytic converter and the 4 new nuts.

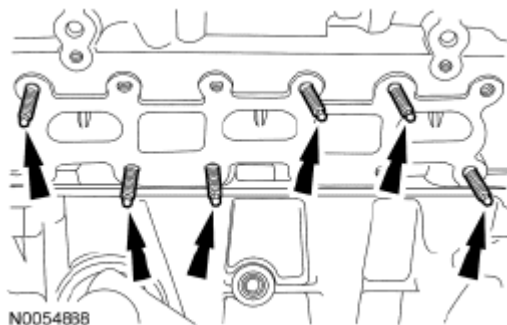
- Tighten to 40 Nm (30 lb-ft).



**Fig. 715: Locating RH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

**All vehicles**

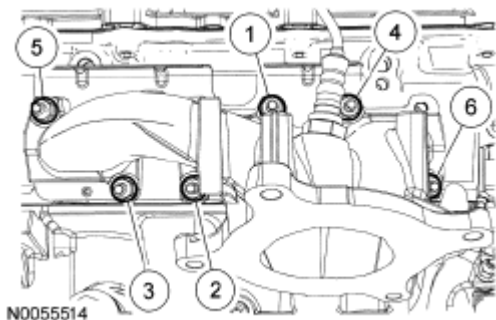
115. Install 6 new LH exhaust manifold studs.
- Tighten to 12 Nm (106 lb-in).



**Fig. 716: Locating LH Exhaust Manifold Studs**  
Courtesy of FORD MOTOR CO.

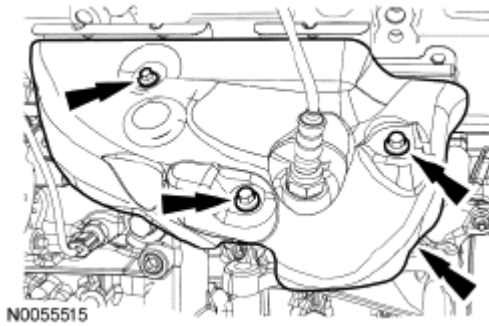
**NOTE:** Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.

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



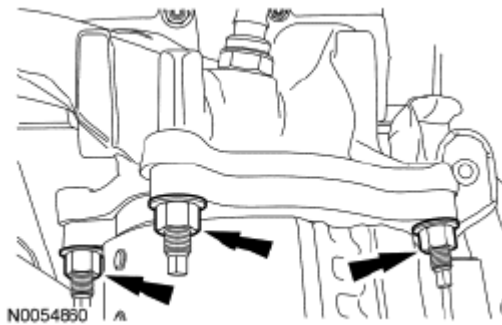
**Fig. 717: Identifying LH Exhaust Manifold Nuts**  
Courtesy of FORD MOTOR CO.

117. Install the LH exhaust manifold heat shield and the 3 bolts.
- Tighten to 10 Nm (89 lb-in).



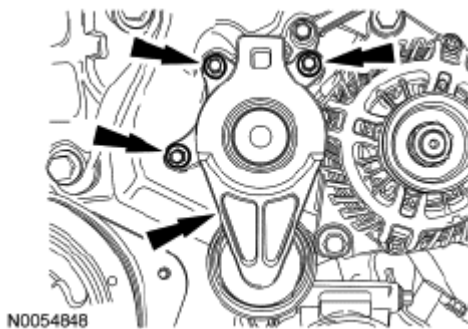
**Fig. 718: Locating LH Exhaust Manifold Heat Shield Bolts**  
Courtesy of FORD MOTOR CO.

118. Using a new gasket, install the LH catalytic converter and 4 new nuts (3 shown in illustration).
- Tighten to 40 Nm (30 lb-ft).



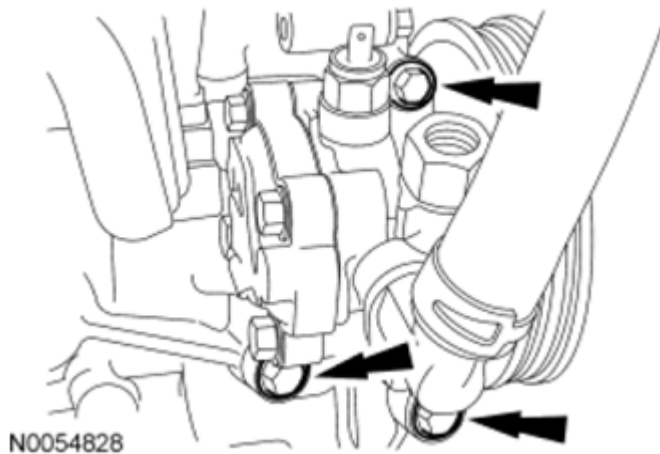
**Fig. 719: Locating LH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

119. Install the accessory drive belt tensioner and the 3 bolts.
- Tighten to 11 Nm (97 lb-in).



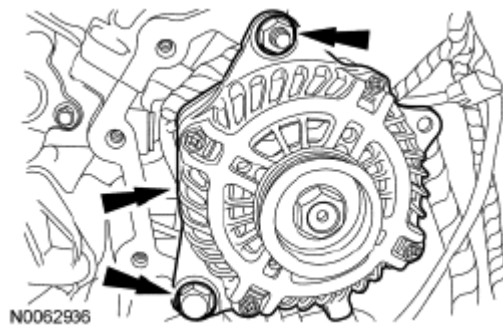
**Fig. 720: Locating Accessory Drive Belt Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

120. Install the power steering pump and the 3 bolts.
- Tighten to 24 Nm (18 lb-ft).



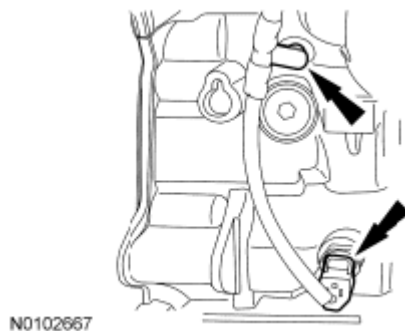
**Fig. 721: Locating Power Steering Pump Bolts**  
Courtesy of FORD MOTOR CO.

121. Install the generator, the bolt and the nut.
  - Tighten to 47 Nm (35 lb-ft).



**Fig. 722: Locating Generator Bolt And Nut**  
Courtesy of FORD MOTOR CO.

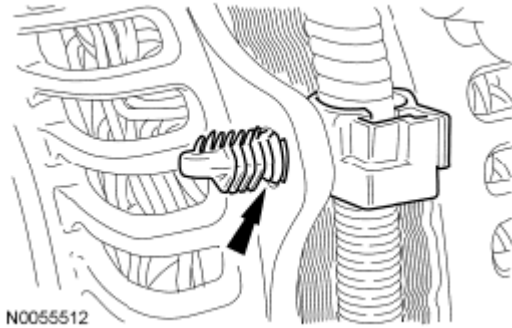
122. Position the wiring harness onto the engine.
123. Connect the **EOP** switch electrical connector and the wiring harness pin-type retainer.



**Fig. 723: Locating Engine Oil Pressure Switch Electrical Connector**

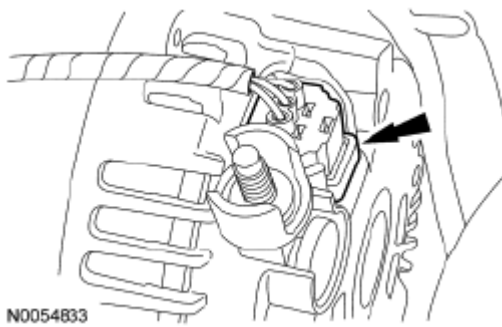
Courtesy of FORD MOTOR CO.

124. Attach the wiring harness retainer to the generator.



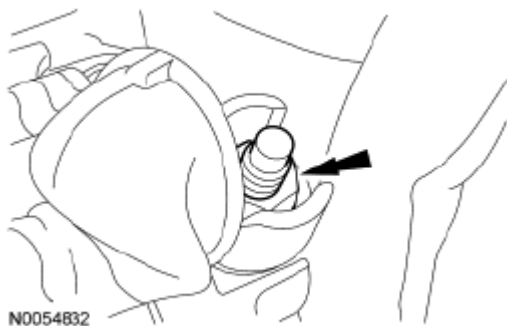
**Fig. 724: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

125. Connect the generator electrical connector.



**Fig. 725: Locating Generator Electrical Connector**  
Courtesy of FORD MOTOR CO.

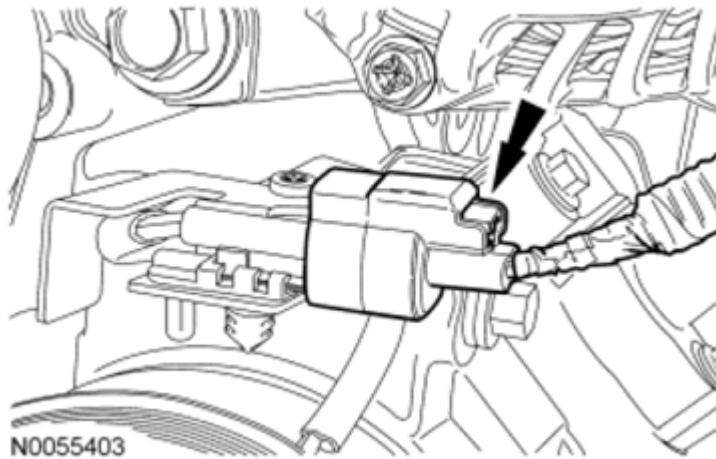
126. Connect the generator B+ cable and install the nut.
- Tighten to 17 Nm (150 lb-in).



**Fig. 726: Locating Generator B+ Cable**  
Courtesy of FORD MOTOR CO.

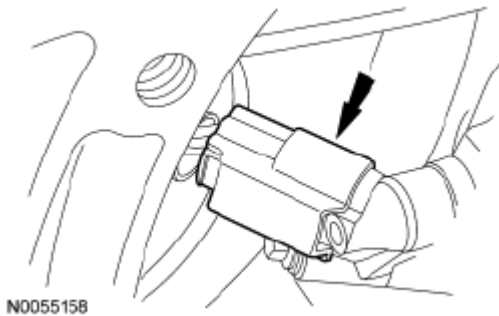


127. Connect the A/C compressor electrical connector.



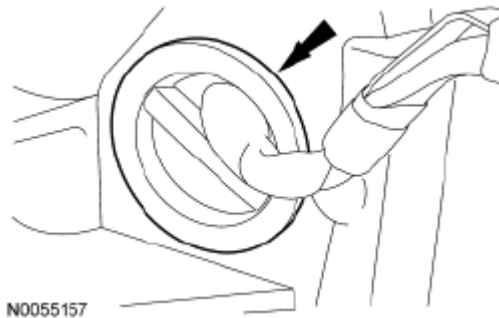
**Fig. 727: Locating A/C Compressor Electrical Connector**  
Courtesy of FORD MOTOR CO.

128. Connect the CKP sensor electrical connector.



**Fig. 728: Locating Crankshaft Position Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

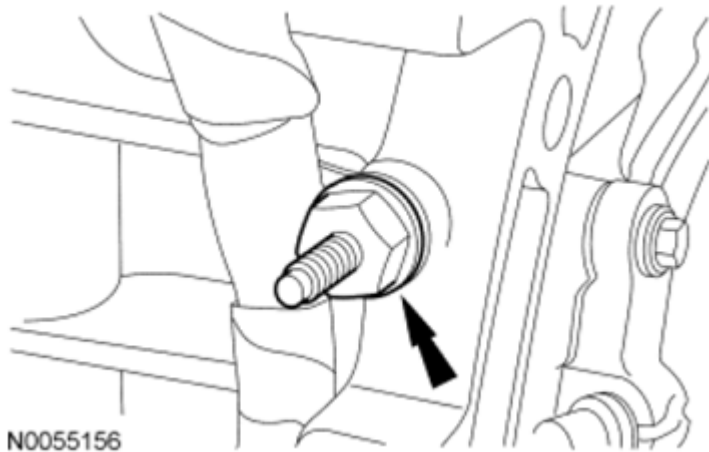
129. Install the wiring harness grommet.



**Fig. 729: Locating Wiring Harness Grommet**  
Courtesy of FORD MOTOR CO.

130. Install the wiring harness retainer stud bolt.

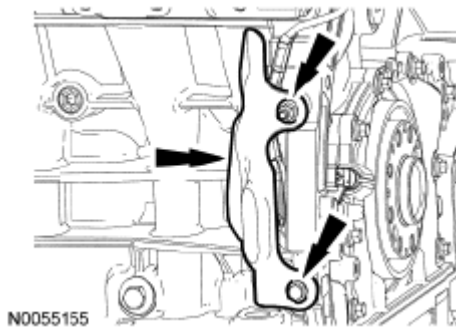
- Tighten to 10 Nm (89 lb-in).



**Fig. 730: Locating Wiring Harness Retainer Stud Bolt**  
Courtesy of FORD MOTOR CO.

131. Install the heat shield, the nut and the bolt.

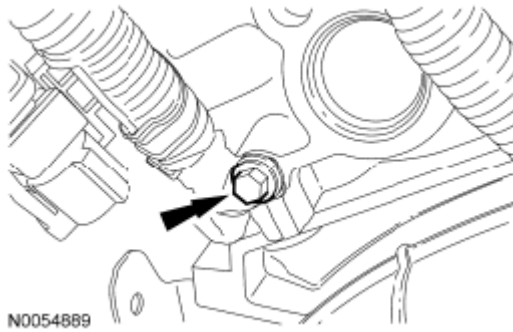
- Tighten to 10 Nm (89 lb-in).



**Fig. 731: Locating Heat Shield Nut And Bolt**  
Courtesy of FORD MOTOR CO.

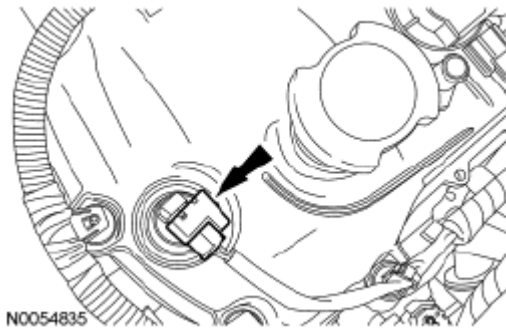
132. Install the wiring harness retainer bolt on the rear of the LH cylinder head.

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



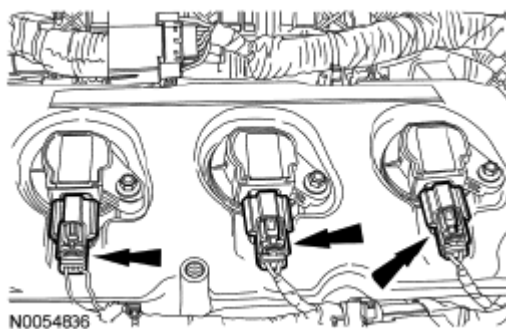
**Fig. 732: Locating Wiring Harness Retainer Bolt**  
Courtesy of FORD MOTOR CO.

133. Attach all of the wiring harness retainers to the LH valve cover and stud bolts.
134. Connect the LH camshaft VCT solenoid electrical connector.



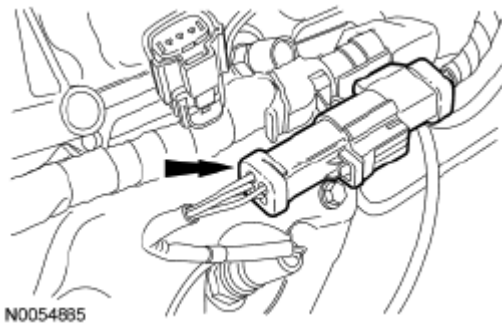
**Fig. 733: Locating LH VCT Solenoid Electrical Connector**  
Courtesy of FORD MOTOR CO.

135. Connect the 3 LH coil-on-plug electrical connectors.



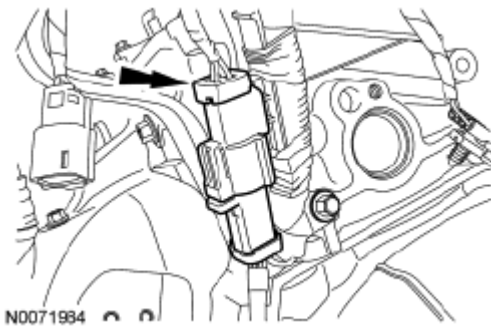
**Fig. 734: Locating LH Coil-On-Plug Electrical Connectors**  
Courtesy of FORD MOTOR CO.

136. Connect the LH Heated Oxygen Sensor (HO2S) electrical connector.



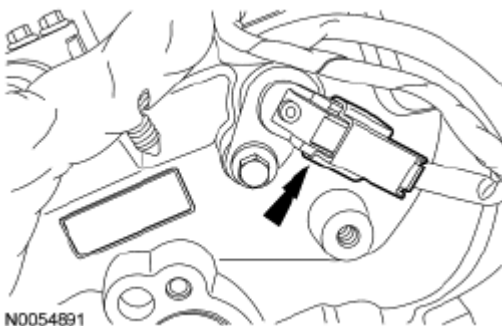
**Fig. 735: Locating LH Heated Oxygen Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

137. Connect the LH Catalyst Monitor Sensor (CMS) electrical connector.



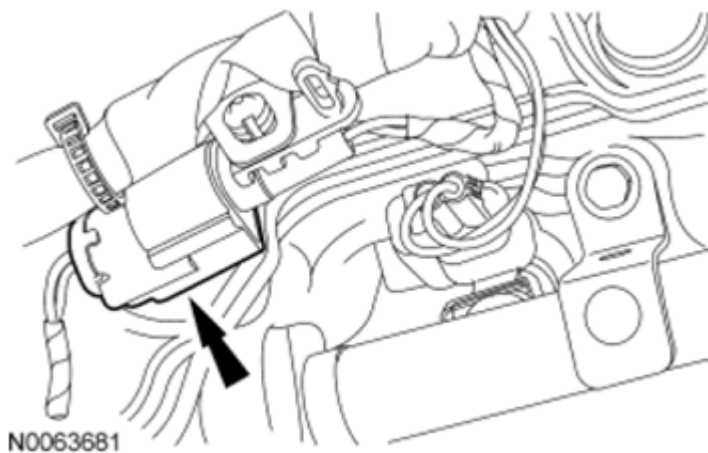
**Fig. 736: Locating LH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

138. Connect the LH **CMP** sensor electrical connector.



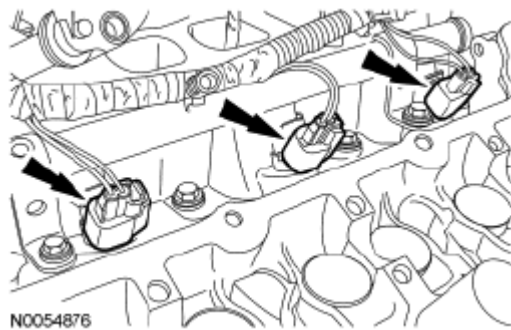
**Fig. 737: Locating LH Camshaft Position Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

139. Connect the **CHT** sensor electrical connector.



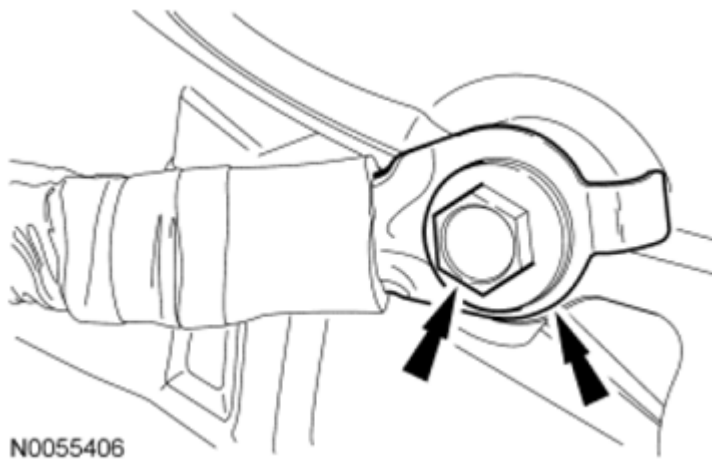
**Fig. 738: Locating CHT Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

140. Connect the 6 fuel injector electrical connectors (3 shown in illustration).



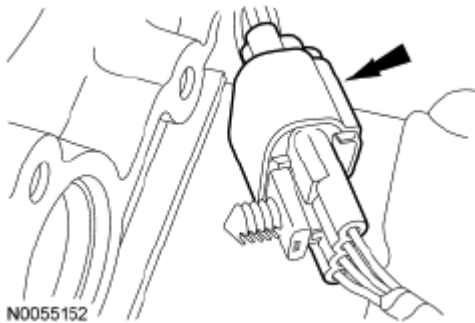
**Fig. 739: Locating Fuel Injector Electrical Connectors**  
Courtesy of FORD MOTOR CO.

141. Install the ground cable and the bolt.
- Tighten to 10 Nm (89 lb-in).



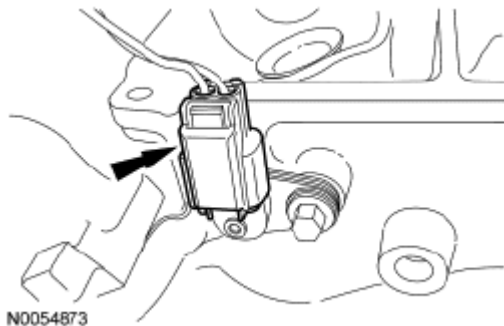
**Fig. 740: Locating Ground Cable Bolts**  
Courtesy of FORD MOTOR CO.

142. Connect the **KS** electrical connector.



**Fig. 741: Locating Knock Sensor (KS) Electrical Connector**  
Courtesy of FORD MOTOR CO.

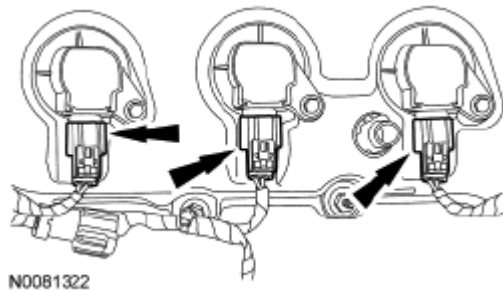
143. Connect the RH **CMP** sensor electrical connector.



**Fig. 742: Locating RH Camshaft Position (CMP) Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

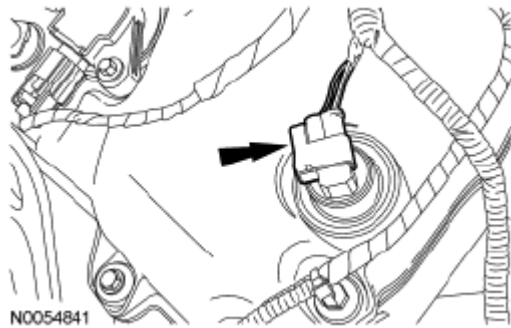
144. Attach all of the wiring harness retainers to the RH valve cover and stud bolts.

145. Connect the 3 RH coil-on-plug electrical connectors.



**Fig. 743: Locating RH Coil-On-Plug Electrical Connectors**  
Courtesy of FORD MOTOR CO.

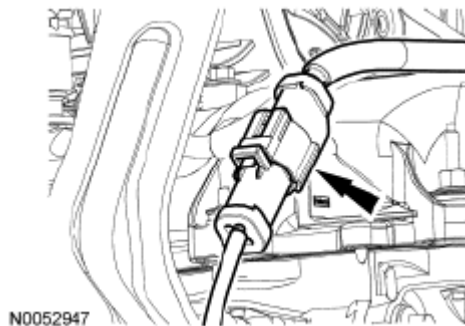
146. Connect the RH VCT solenoid electrical connector.



**Fig. 744: Locating RH Variable Camshaft Timing Solenoid Electrical Connector**  
Courtesy of FORD MOTOR CO.

#### **FWD vehicles**

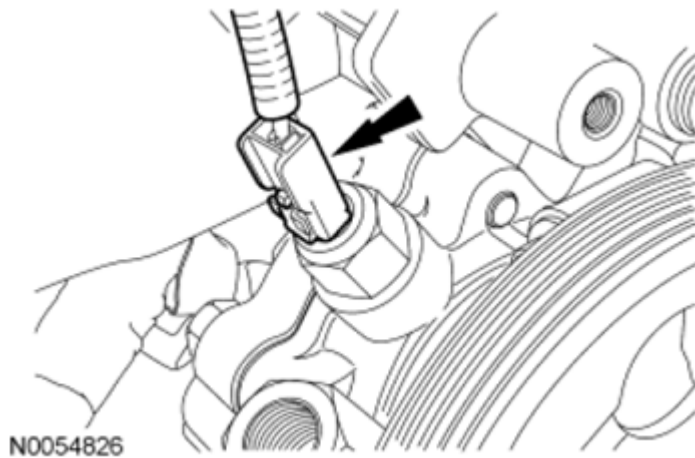
147. Connect the RH CMS electrical connector.



**Fig. 745: Locating RH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

#### **All vehicles**

148. Connect the Power Steering Pressure (PSP) switch electrical connector.

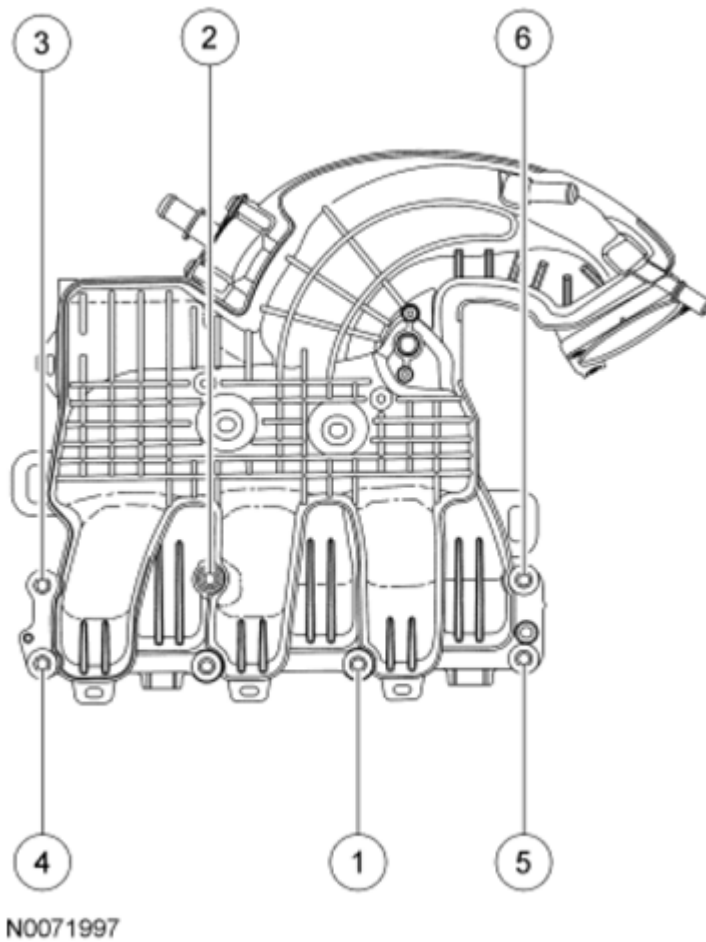


**Fig. 746: Locating Power Steering Pressure Switch Electrical Connector**  
Courtesy of FORD MOTOR CO.

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

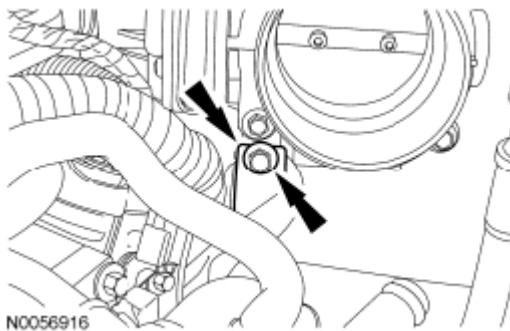
149. Using a new gasket, install the upper intake manifold and the 6 bolts.
- Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).





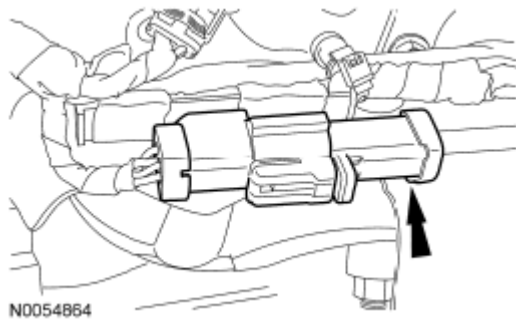
**Fig. 747: Identifying Upper Intake Manifold Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

150. Install the upper intake manifold support bracket and the 2 bolts (1 shown in illustration).
  - Tighten to 10 Nm (89 lb-in).



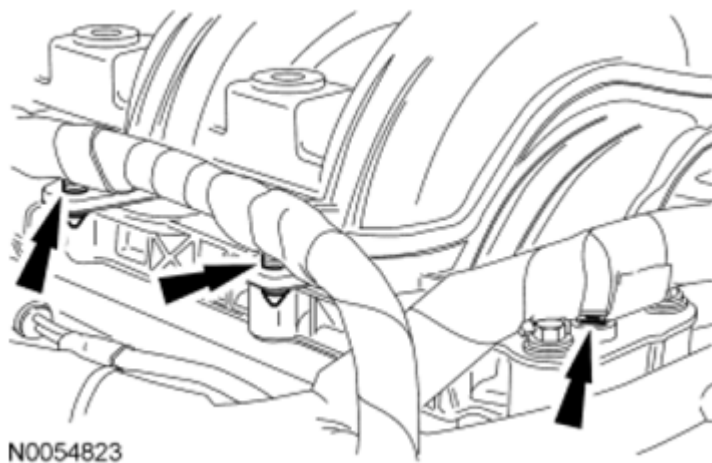
**Fig. 748: Identifying Upper Intake Manifold Support Bracket With Bolts**  
Courtesy of FORD MOTOR CO.

151. Connect the RH **HO2S** electrical connector.



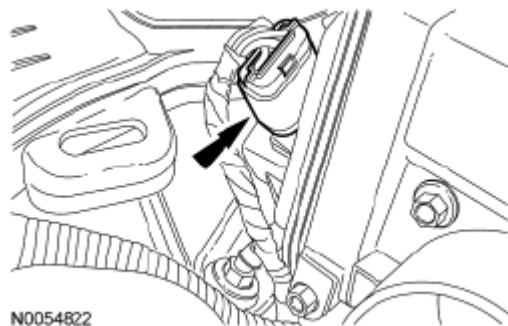
**Fig. 749: Locating RH Heated Oxygen Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

152. Attach the wiring harness retainers to the upper intake manifold.



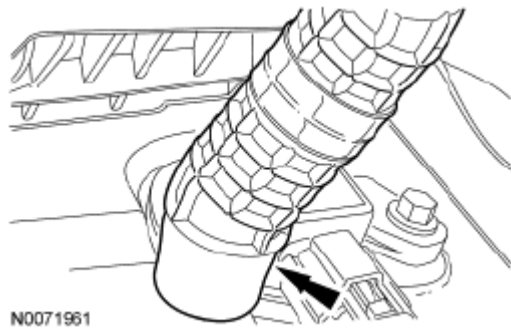
**Fig. 750: Locating Wiring Harness Retainers**  
Courtesy of FORD MOTOR CO.

153. Connect the Throttle Body (TB) electrical connector.



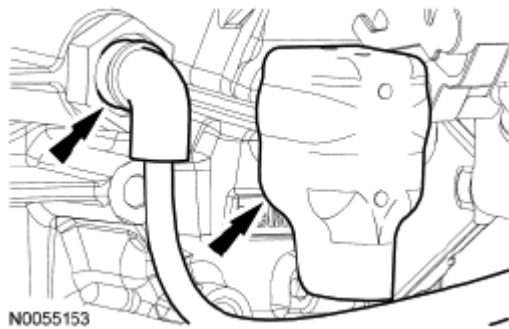
**Fig. 751: Locating Throttle Body Electrical Connector**  
Courtesy of FORD MOTOR CO.

154. Connect the PCV hose to the PCV valve.



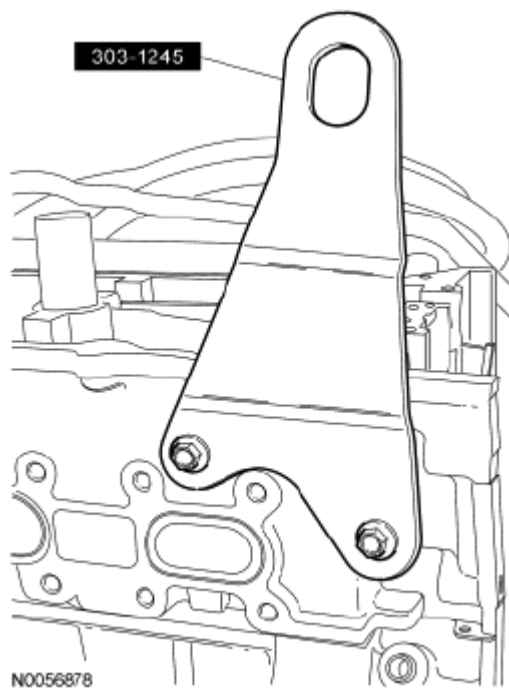
**Fig. 752: Locating PCV Hose**  
Courtesy of FORD MOTOR CO.

155. If equipped, position the block heater wiring harness onto the engine and attach all of the harness retainers.
156. If equipped, connect the block heater electrical connector and install the heat shield.



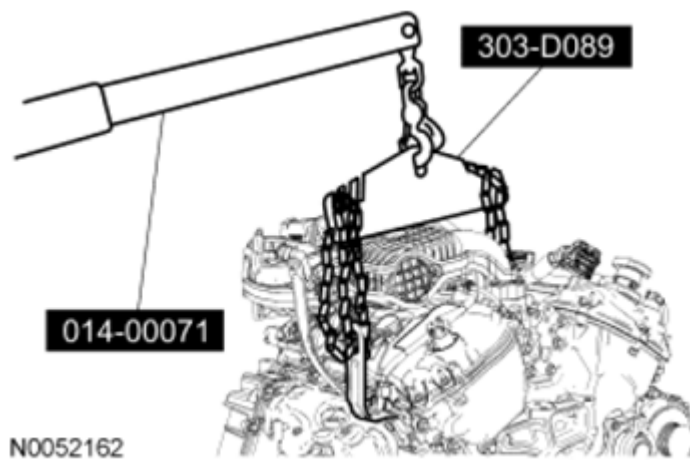
**Fig. 753: Locating Heat Shield**  
Courtesy of FORD MOTOR CO.

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



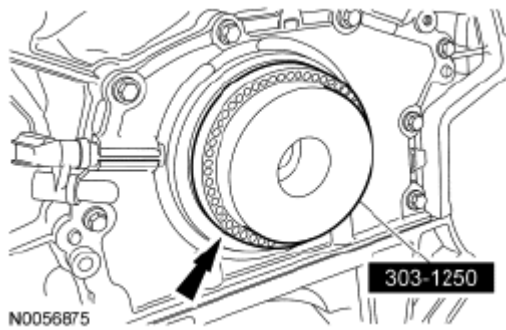
**Fig. 754: Identifying Engine Lift Eye**  
Courtesy of FORD MOTOR CO.

158. Using the Heavy Duty Floor Crane and Spreader Bar, remove the engine from the stand.



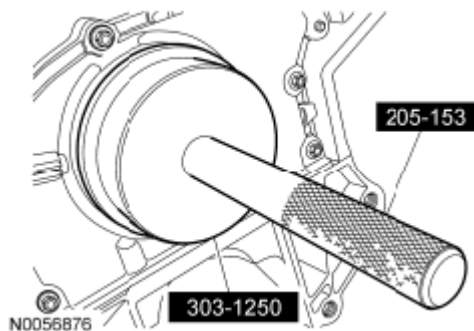
**Fig. 755: Identifying Heavy Duty Floor Crane And Spreader Bar**  
Courtesy of FORD MOTOR CO.

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



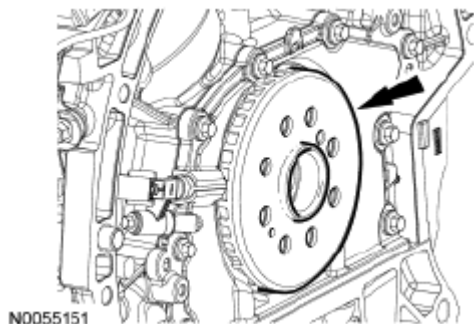
**Fig. 756: Identifying Rear Main Seal Installer On Crankshaft**  
Courtesy of FORD MOTOR CO.

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



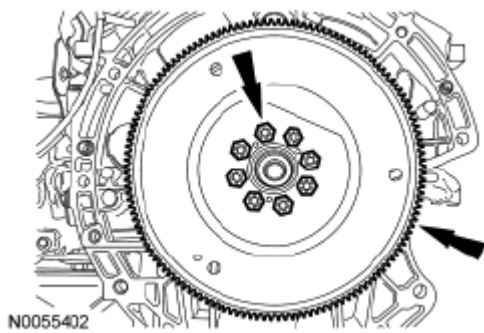
**Fig. 757: Identifying Rear Main Seal Installer And Handle**  
Courtesy of FORD MOTOR CO.

161. Install the crankshaft sensor ring.



**Fig. 758: Locating Crankshaft Sensor Ring**  
Courtesy of FORD MOTOR CO.

162. Install the flexplate and the 8 bolts.
  - Tighten to 80 Nm (59 lb-ft).



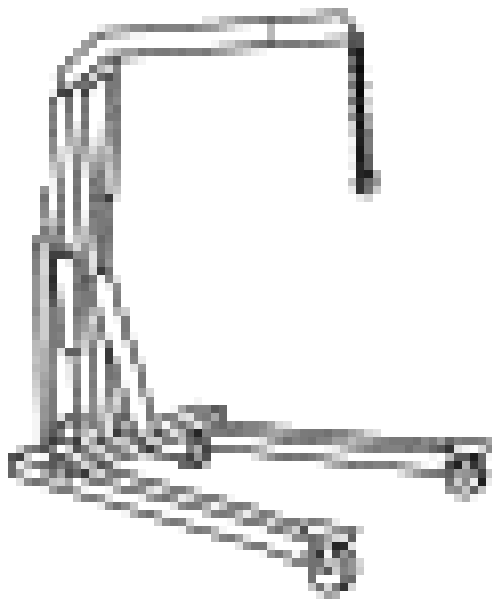
**Fig. 759: Locating Flexplate Bolts**  
Courtesy of FORD MOTOR CO.

## INSTALLATION

### ENGINE

#### Special Tool(s)

#### SPECIAL TOOL SPECIFICATION

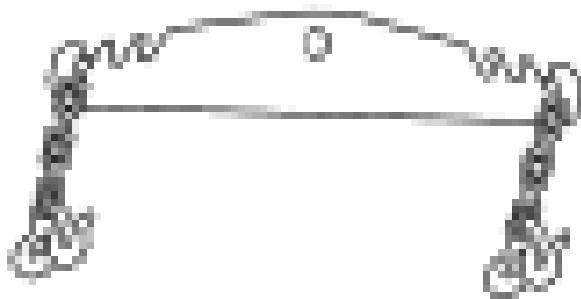


**ST1341-A**

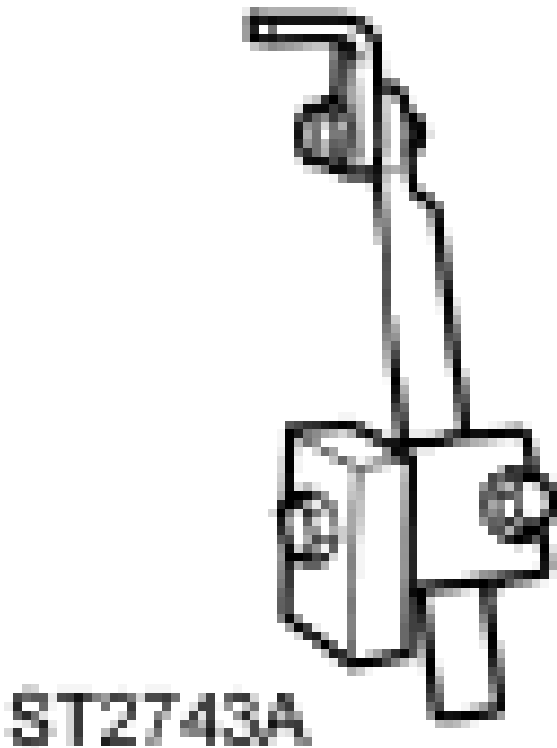
Heavy Duty Floor Crane  
014-00071 or equivalent



Powertrain Lift  
014-00765 or equivalent



Spreader Bar  
303-D089 (D93P-6001-A3) or equivalent



Universal Adapter Brackets  
014-00001 or equivalent

#### Material

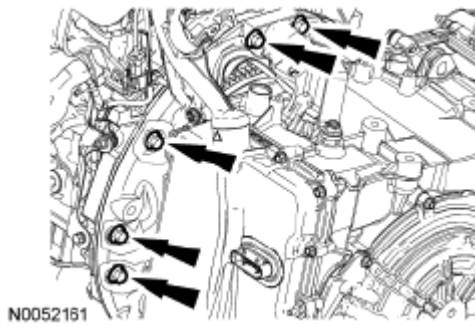
#### MATERIAL SPECIFICATION

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

#### All vehicles

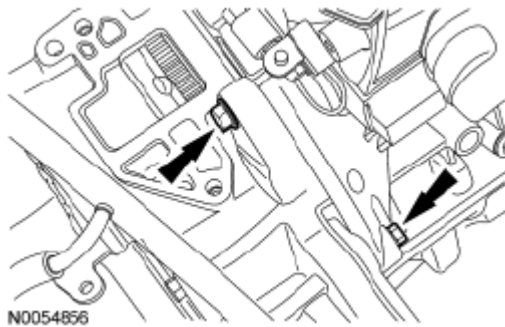
1. Align the transaxle to the engine.
2. Install the 5 transaxle-to-engine bolts.
  - Tighten to 48 Nm (35 lb-ft).





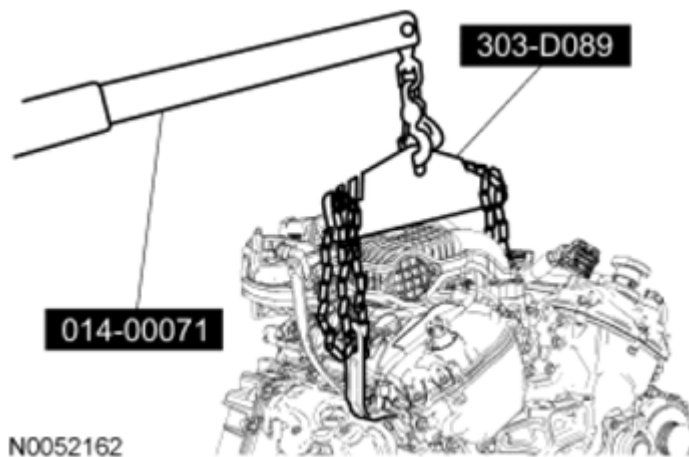
**Fig. 760: Locating Transaxle-To-Engine Bolts**  
Courtesy of FORD MOTOR CO.

3. Install the 2 engine-to-transaxle bolts.
  - Tighten to 48 Nm (35 lb-ft).



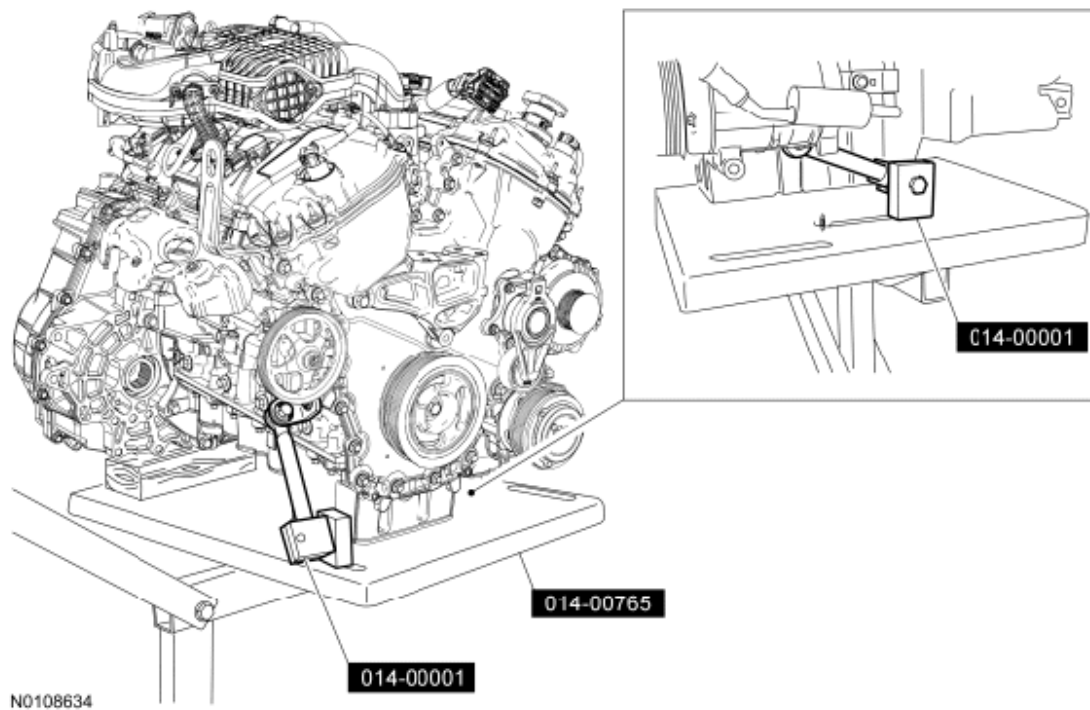
**Fig. 761: Locating Engine-To-Transaxle Bolts**  
Courtesy of FORD MOTOR CO.

4. Using the Heavy Duty Floor Crane and Spreader Bar, position the engine and transaxle onto the lift table.



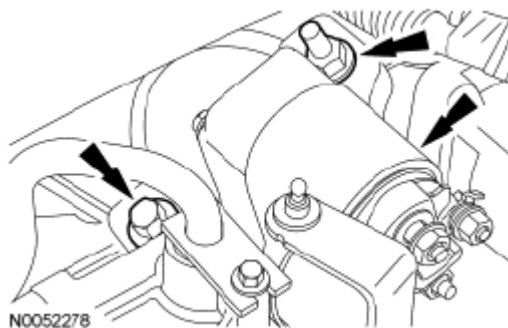
**Fig. 762: Identifying Heavy Duty Floor Crane And Spreader Bar**  
Courtesy of FORD MOTOR CO.

**NOTE:** Position a block of wood under the transaxle.



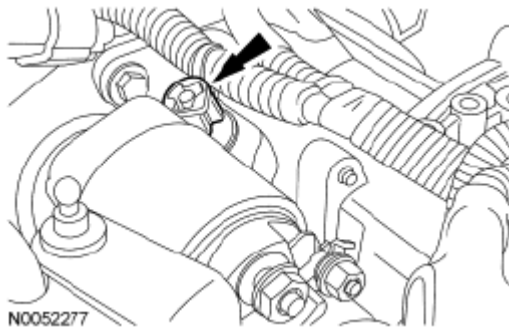
**Fig. 763: Identifying Powertrain Lift And Universal Adapter Brackets**  
Courtesy of FORD MOTOR CO.

5. Install the Powertrain Lift and Universal Adapter Brackets.
6. Install the starter, the bolt and the stud bolt.
  - Tighten to 27 Nm (20 lb-ft).



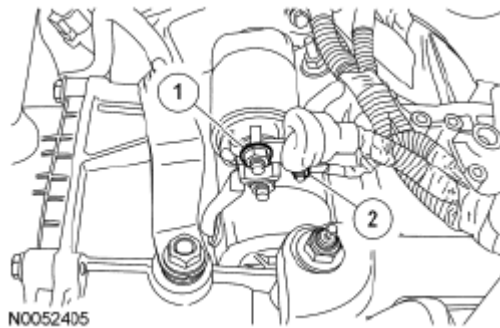
**Fig. 764: Locating Stud Bolt And Starter**  
Courtesy of FORD MOTOR CO.

7. Connect the wiring harness retainer to the starter stud bolt.



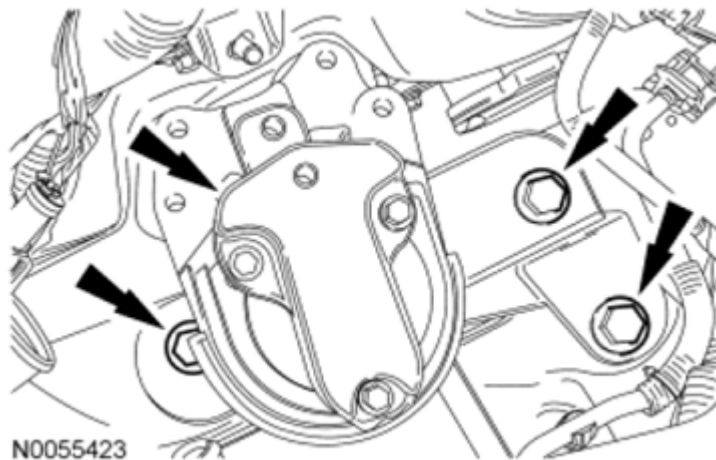
**Fig. 765: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

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.



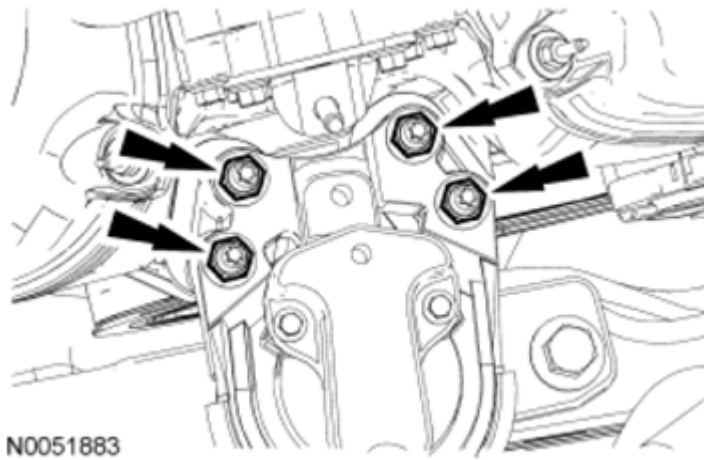
**Fig. 766: Identifying Starter Motor Wire Terminals**  
Courtesy of FORD MOTOR CO.

9. Raise the engine and transaxle assembly into the vehicle.
10. Install the engine mount and the 3 bolts.
  - Tighten to 90 Nm (66 lb-ft).



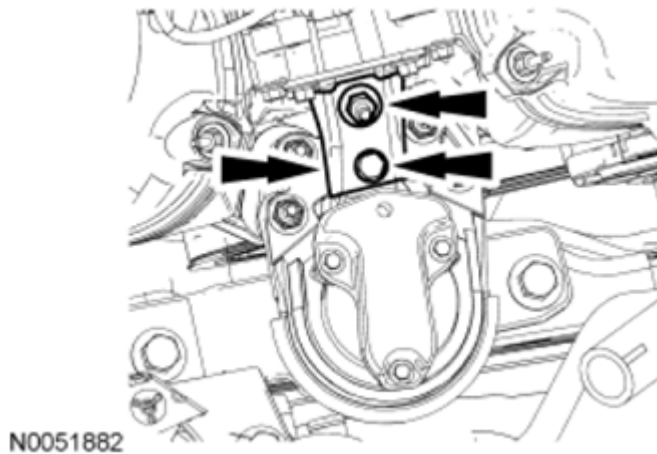
**Fig. 767: Locating Engine Mount Bolts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 768: Locating Engine Mount Nuts**  
Courtesy of FORD MOTOR CO.

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



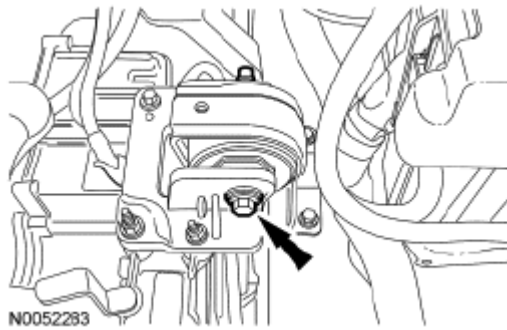
**Fig. 769: Locating Engine Mount Brace Nut And Bolt**  
Courtesy of FORD MOTOR CO.

13. Install the transaxle support insulator bracket, the 3 nuts and the bolt.
  - Tighten the 3 nuts to 63 Nm (46 lb-ft).
  - Tighten the bolt to 80 Nm (59 lb-ft).



**Fig. 770: Identifying Transaxle Support Insulator Bracket Nuts**  
Courtesy of FORD MOTOR CO.

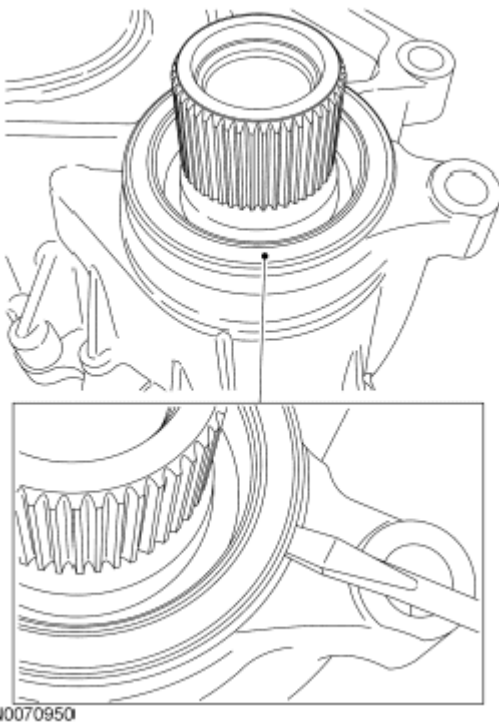
14. Install the transaxle support insulator through bolt and nut.
  - Tighten to 175 Nm (129 lb-ft).



**Fig. 771: Locating Transaxle Support Insulator Through Bolt And Nut**  
Courtesy of FORD MOTOR CO.

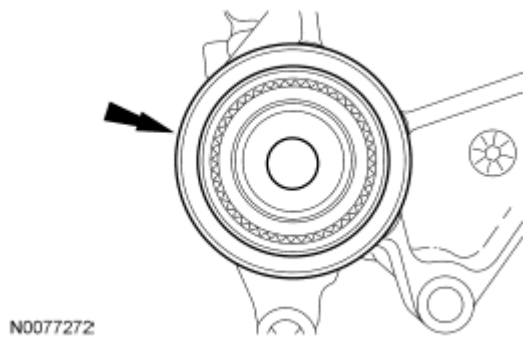
All-Wheel Drive (AWD) vehicles

**NOTE:** A new compression seal must be installed whenever the Power Transfer Unit (PTU) is removed from the vehicle.



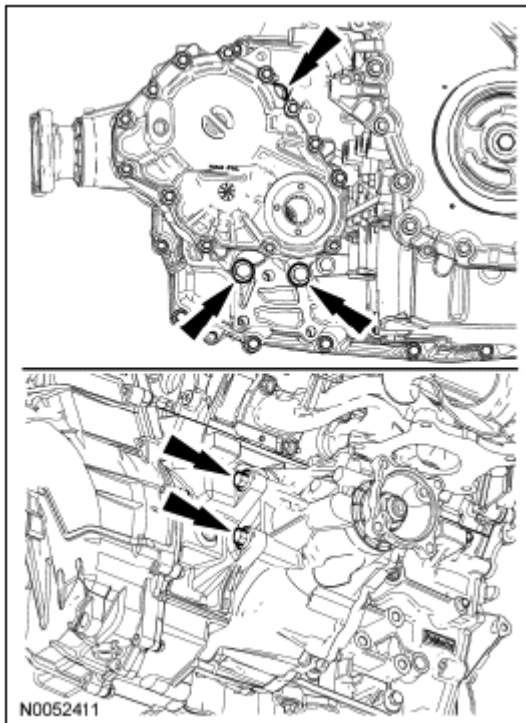
**Fig. 772: Removing Compression Seal**  
Courtesy of FORD MOTOR CO.

15. Using a small screwdriver, remove the compression seal and discard.
16. Using a soft-face hammer, install the new compression seal.



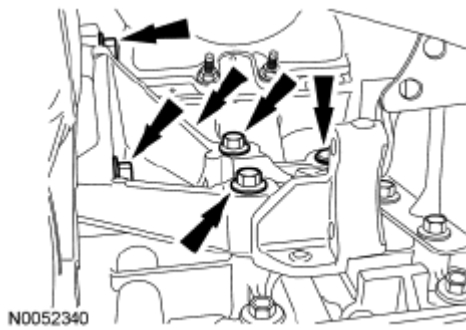
**Fig. 773: Locating Compression Seal**  
Courtesy of FORD MOTOR CO.

17. Position the **PTU** in place and install the 5 bolts.
  - Tighten to 90 Nm (66 lb-ft).



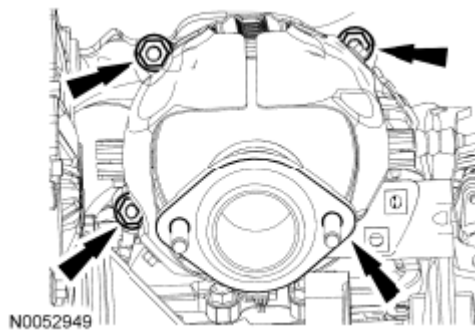
**Fig. 774: Locating PTU Bolts**  
Courtesy of FORD MOTOR CO.

18. Position the **PTU** support bracket in place and install the 5 bolts.
  - Tighten to 70 Nm (52 lb-ft).



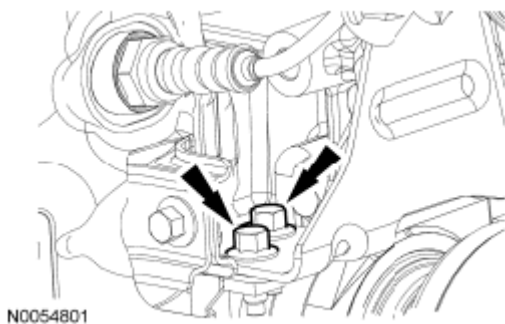
**Fig. 775: Locating Power Transfer Unit Support Bracket Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** Do not tighten the 4 catalytic converter nuts at this time.



**Fig. 776: Locating RH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

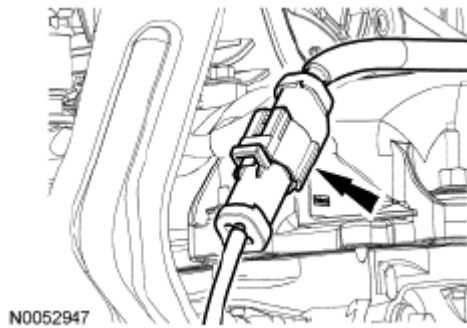
19. Using a new gasket, install the RH catalytic converter and 4 new nuts.
20. Install the 2 catalytic converter-to-bracket bolts.
  - Tighten the 4 catalytic converter nuts to 40 Nm (30 lb-ft).
  - Tighten the 2 catalytic converter-to-bracket bolts to 20 Nm (177 lb-in).



**Fig. 777: Locating RH Catalytic Converter Support Bracket Bolts**  
Courtesy of FORD MOTOR CO.



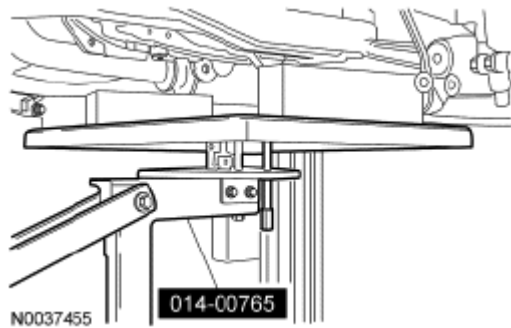
21. Connect the RH Catalyst Monitor Sensor (CMS) electrical connector.



**Fig. 778: Locating RH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

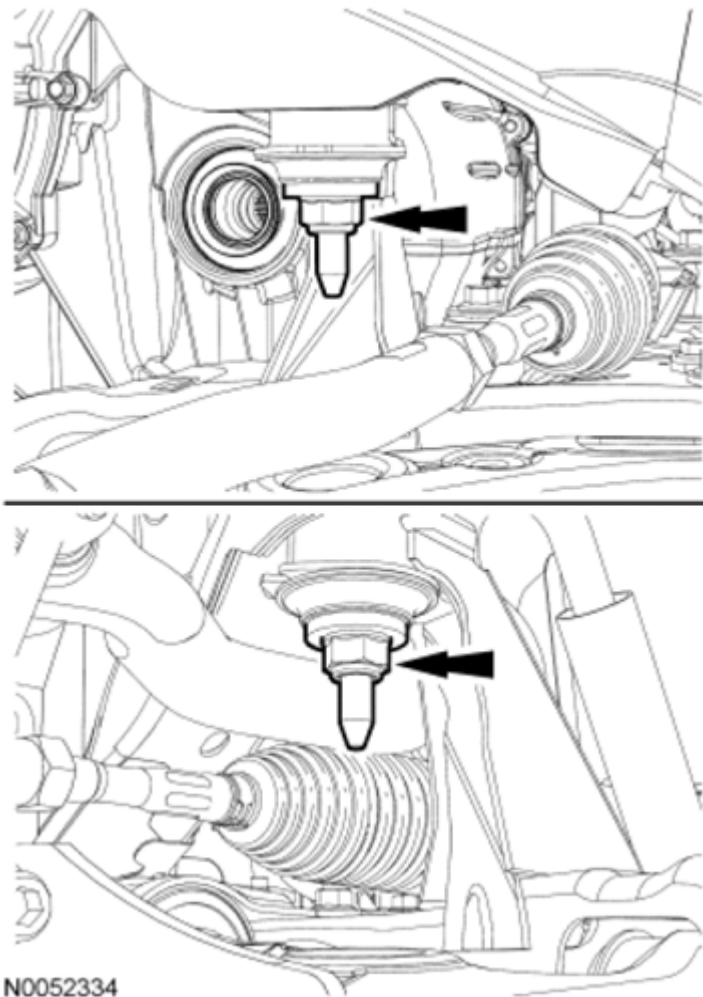
**All vehicles**

22. Using the Powertrain Lift, raise the subframe into the installed position.



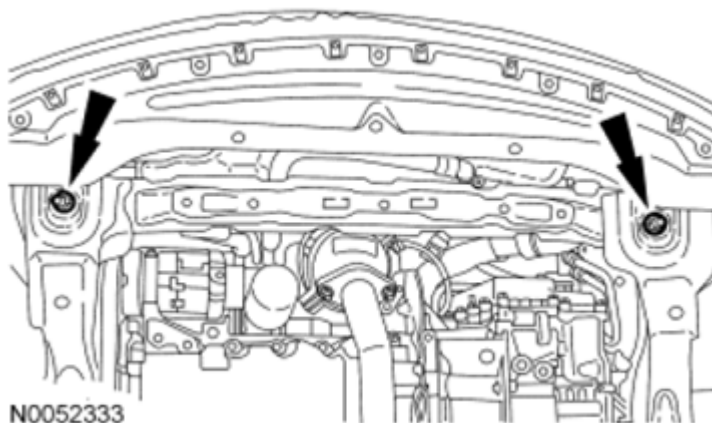
**Fig. 779: Positioning Powertrain Lift Under Subframe Assembly**  
Courtesy of FORD MOTOR CO.

23. Install the 2 middle subframe nuts.
- Tighten to 133 Nm (98 lb-ft).



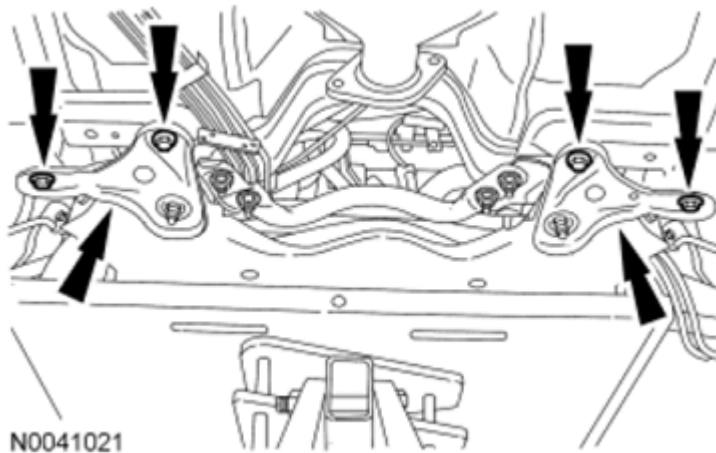
**Fig. 780: Locating Middle Subframe Nuts**  
Courtesy of FORD MOTOR CO.

24. Install the 2 front subframe nuts.
- Tighten to 133 Nm (98 lb-ft).



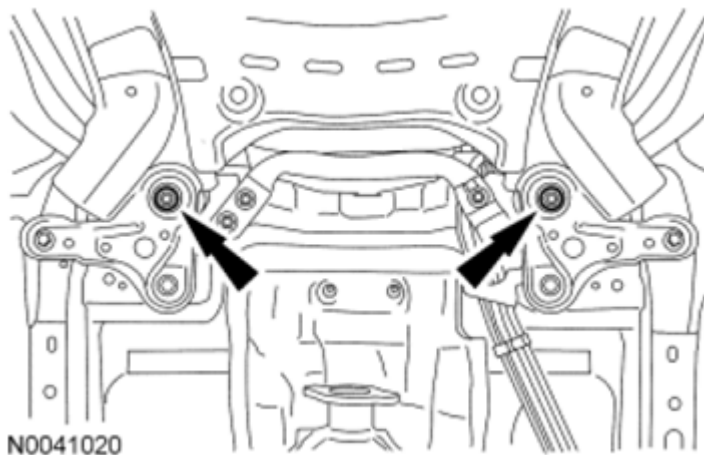
**Fig. 781: Locating Front Subframe Nuts**  
Courtesy of FORD MOTOR CO.

25. Position the subframe support brackets in place and loosely install the 4 bolts.



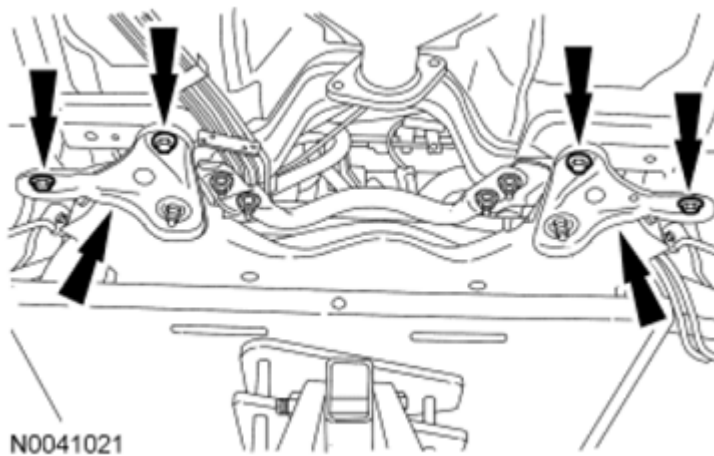
**Fig. 782: Locating Subframe Support Brackets Bolts**  
Courtesy of FORD MOTOR CO.

26. Install the 2 rear subframe bracket nuts.
- Tighten to 133 Nm (98 lb-ft).



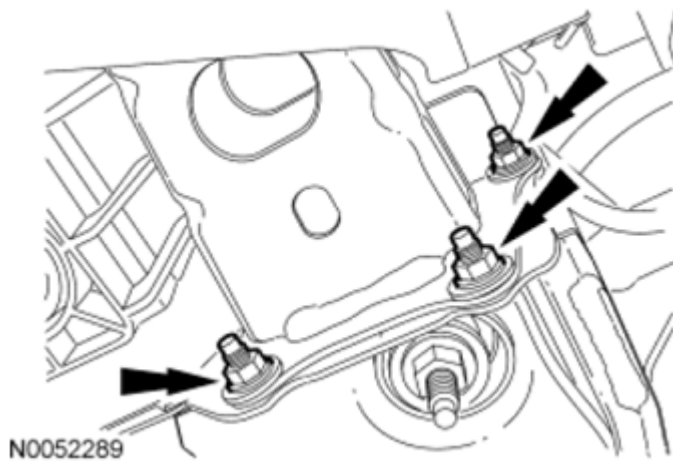
**Fig. 783: Locating Rear Subframe Bracket Nuts**  
Courtesy of FORD MOTOR CO.

27. Tighten the 4 subframe support bracket bolts.
- Tighten to 90 Nm (66 lb-ft).



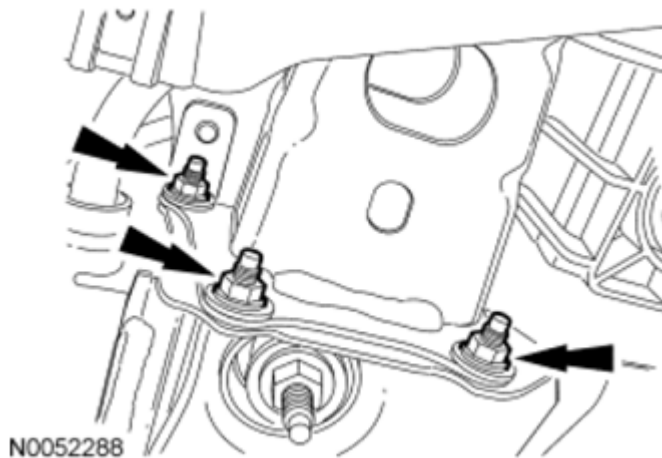
**Fig. 784: Locating Subframe Support Bracket Bolts**  
Courtesy of FORD MOTOR CO.

28. Position the lower bumper on the subframe and install the 3 LH nuts.
- Tighten to 9 Nm (80 lb-in).



**Fig. 785: Locating LH Subframe-To-Lower Bumper Nuts**  
Courtesy of FORD MOTOR CO.

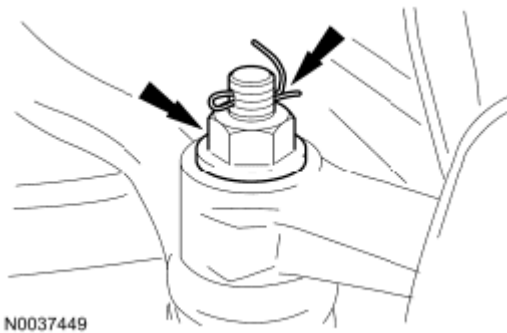
29. Install the 3 RH lower bumper-to-subframe nuts.
- Tighten to 9 Nm (80 lb-in).



**Fig. 786: Locating RH Subframe-To-Lower Bumper Nuts**  
Courtesy of FORD MOTOR CO.

**NOTE:** RH shown in illustration, LH similar.

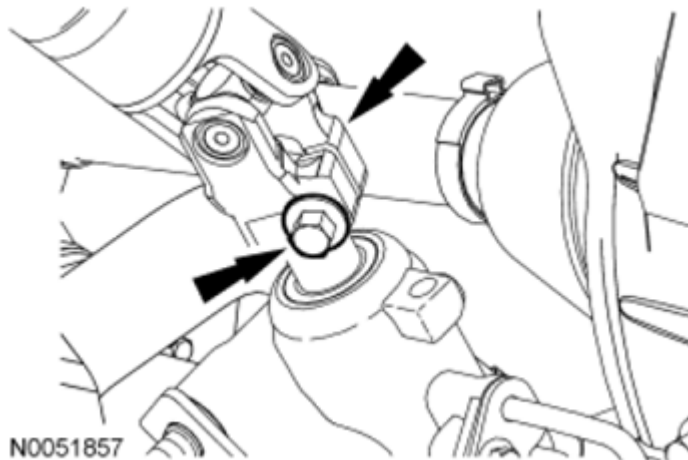
30. Install the tie-rod ends and nuts.
  - Tighten to 48 Nm (35 lb-ft).
  - Install new cotter pins.



**Fig. 787: Locating Tie-Rod Ends And Nuts**  
Courtesy of FORD MOTOR CO.

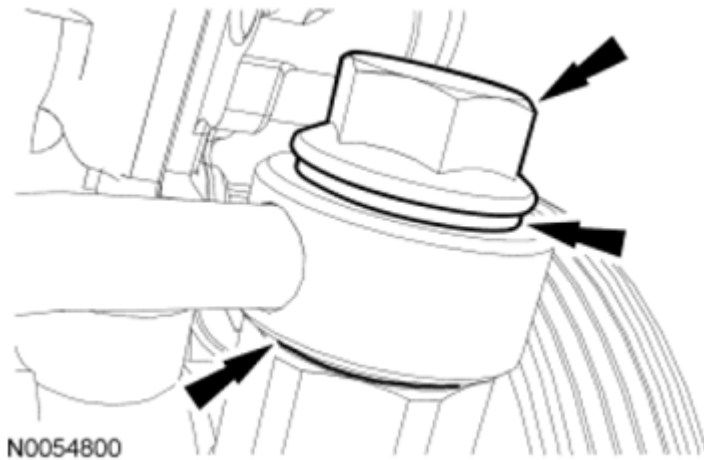
**NOTE:** Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to SUPPLEMENTAL RESTRAINT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

31. Install the intermediate shaft onto the steering gear and install a new bolt.
  - Tighten to 23 Nm (17 lb-ft).



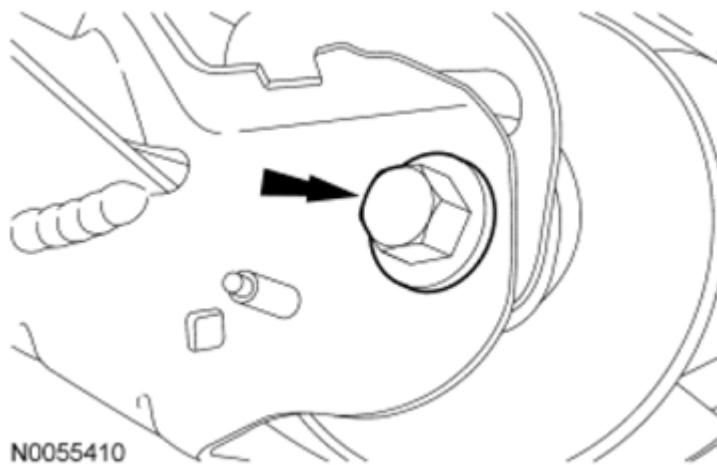
**Fig. 788: Locating Steering Intermediate Shaft Bolt**  
 Courtesy of FORD MOTOR CO.

32. Using a new banjo bolt and 2 new seals, install the Power Steering Pressure (PSP) tube.
  - Tighten to 48 Nm (35 lb-ft).



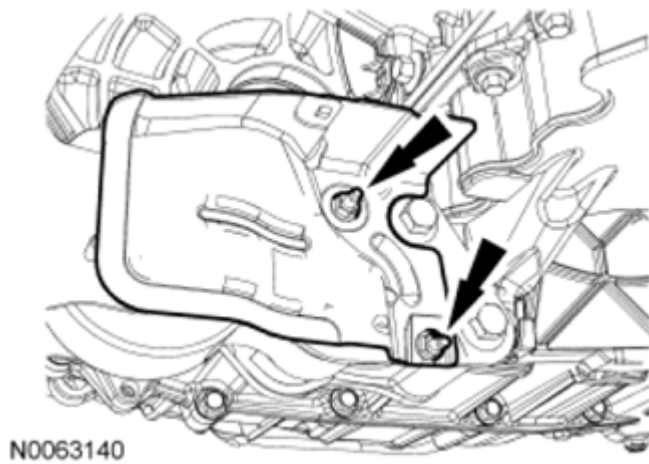
**Fig. 789: Locating Power Steering Pressure Tube-To-Pump Banjo Bolt**  
 Courtesy of FORD MOTOR CO.

33. Install the engine roll restrictor-to-subframe through bolt.
  - Tighten to 103 Nm (76 lb-ft).



**Fig. 790: Locating Engine Roll Restrictor-To-Subframe Through Bolt**  
Courtesy of FORD MOTOR CO.

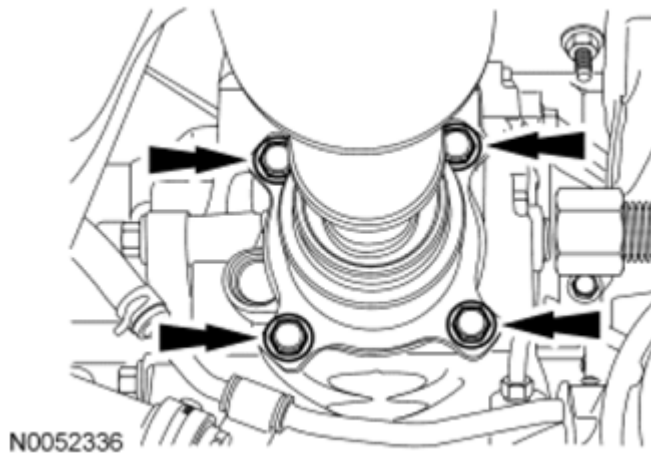
34. Install the roll restrictor heat shield and the 2 nuts.
  - Tighten to 11 Nm (97 lb-in).



**Fig. 791: Locating Roll Restrictor Heat Shield Nuts**  
Courtesy of FORD MOTOR CO.

#### **AWD vehicles**

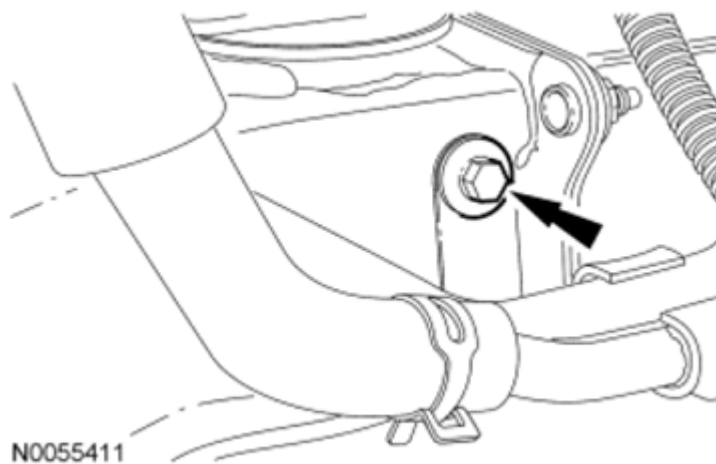
35. Line up the index marks on the rear driveshaft to the index marks on the **PTU** flange made during removal and install the 4 bolts.
  - Tighten to 70 Nm (52 lb-ft).



**Fig. 792: Locating Driveshaft Bolts**  
Courtesy of FORD MOTOR CO.

**All vehicles**

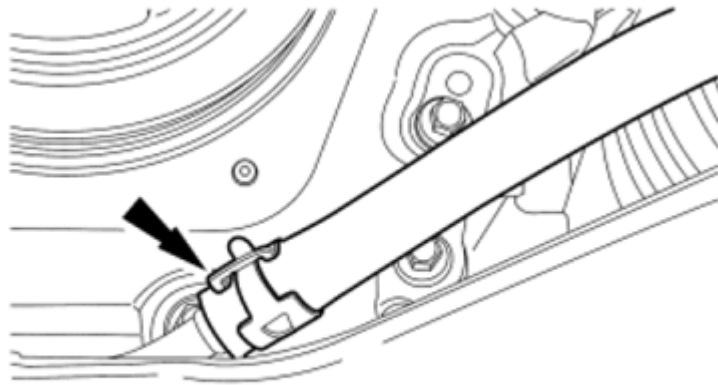
36. Install the power steering cooler bracket bolt to the RH side of the subframe.
  - Tighten to 9 Nm (80 lb-in).



**Fig. 793: Locating Power Steering Cooler Bracket Bolt**  
Courtesy of FORD MOTOR CO.

37. Connect the power steering cooler hose.



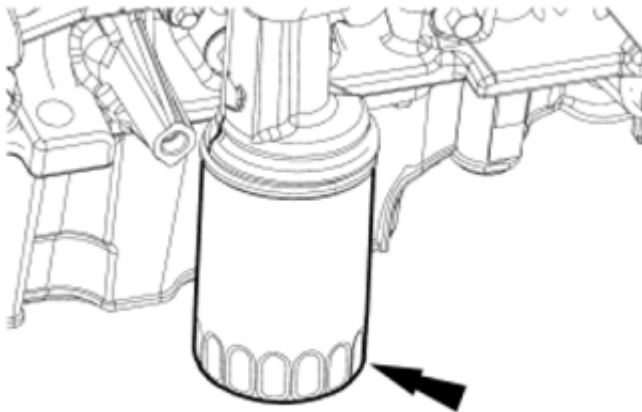


N0055404

**Fig. 794: Locating Power Steering Cooler Hose**  
Courtesy of FORD MOTOR CO.

**NOTE:** Lubricate the engine oil filter gasket with clean engine oil prior to installing the oil filter.

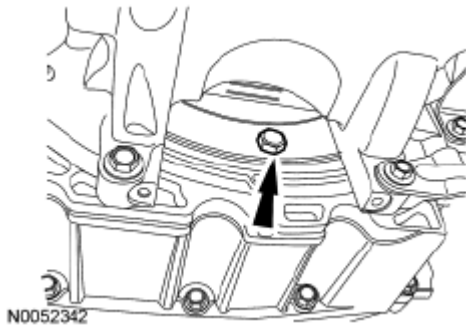
38. Install a new engine oil filter.
- Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.



N0103237

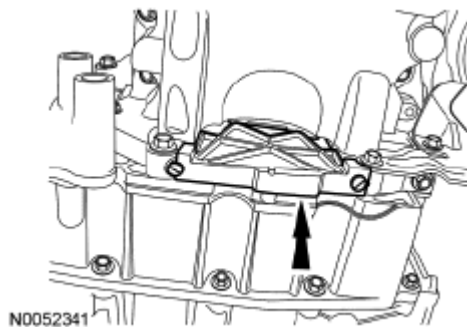
**Fig. 795: Locating Engine Oil Filter**  
Courtesy of FORD MOTOR CO.

39. Install the 3 new torque converter bolts.
- Tighten to 55 Nm (41 lb-ft).



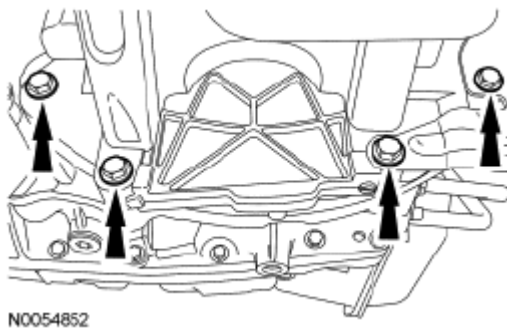
**Fig. 796: Locating Torque Converter Bolts**  
Courtesy of FORD MOTOR CO.

40. Install the inspection cover and the 2 fasteners.



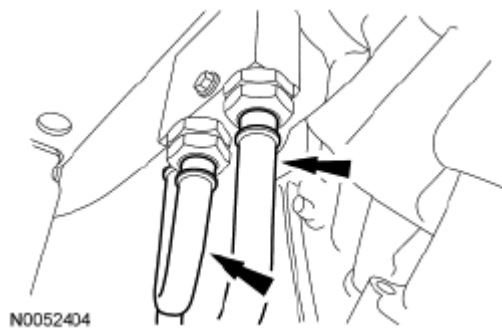
**Fig. 797: Locating Inspection Cover Fasteners**  
Courtesy of FORD MOTOR CO.

41. Install the 4 oil pan-to-transaxle bolts.
- Tighten to 48 Nm (35 lb-ft).



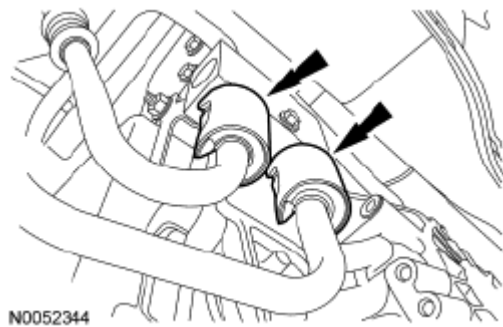
**Fig. 798: Locating Oil Pan-To-Transaxle Bolts**  
Courtesy of FORD MOTOR CO.

42. Connect the 2 transmission fluid cooler tubes.



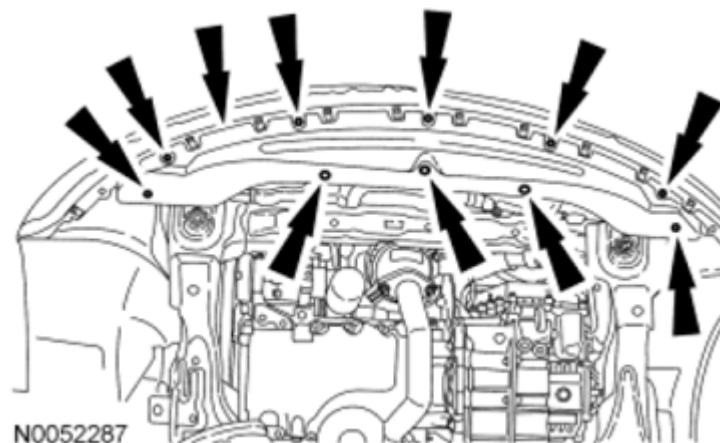
**Fig. 799: Locating Transmission Fluid Cooler Tubes**  
Courtesy of FORD MOTOR CO.

43. Install the 2 secondary latches onto the transmission fluid cooler tubes.



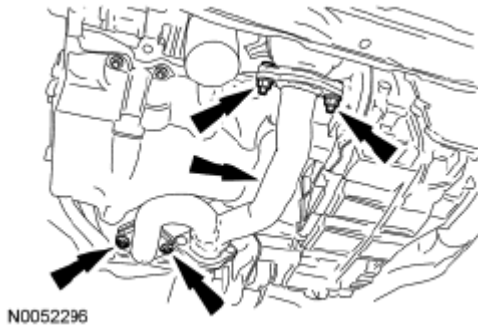
**Fig. 800: Locating Secondary Latches**  
Courtesy of FORD MOTOR CO.

44. Install the LH inner splash shield. For additional information, refer to **FRONT END BODY PANELS** .  
45. Install the radiator splash shield, the 3 pin-type retainers and the 7 screws.



**Fig. 801: Locating Pin-Type Retainers**  
Courtesy of FORD MOTOR CO.

46. Using a new gasket, install the Y-pipe and exhaust flexible pipe assembly and 4 new nuts.
- Tighten to 40 Nm (30 lb-ft).



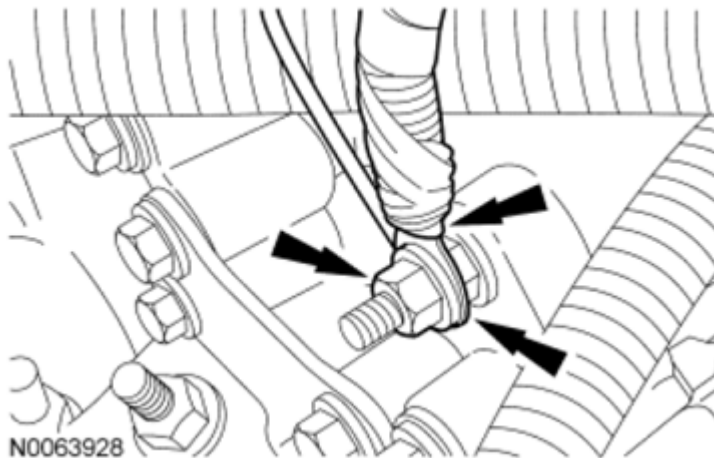
**Fig. 802: Locating Exhaust Flexible Pipe Nuts**  
Courtesy of FORD MOTOR CO.

47. Install the 2 exhaust hangers and tighten the exhaust clamp.
- Tighten to 40 Nm (30 lb-ft).



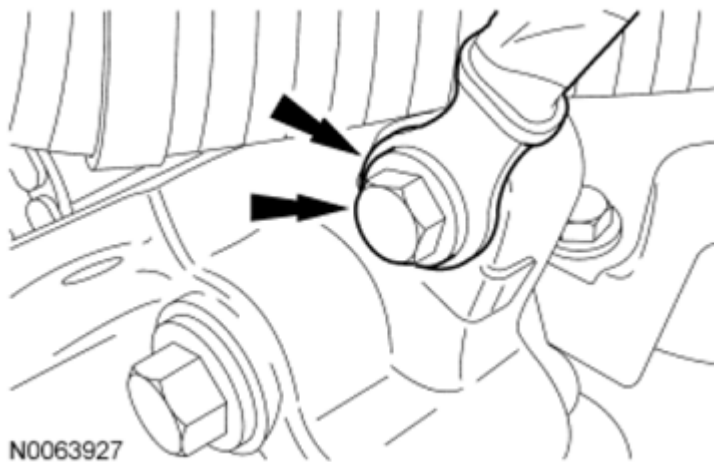
**Fig. 803: Locating Exhaust Flexible Pipe Clamp**  
Courtesy of FORD MOTOR CO.

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



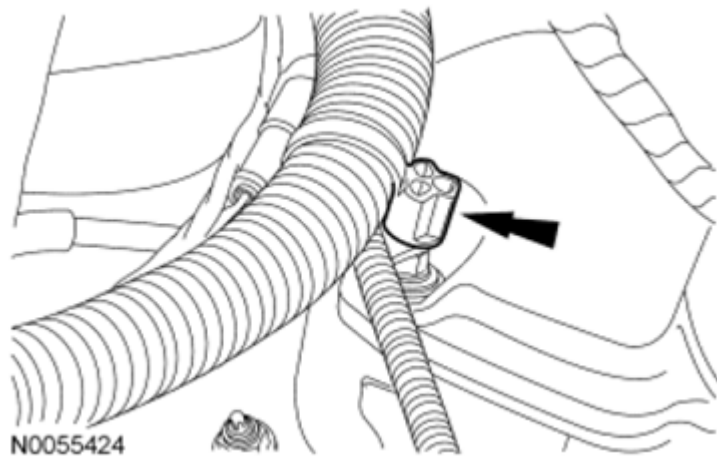
**Fig. 804: Locating Ground Wire Nut**  
Courtesy of FORD MOTOR CO.

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



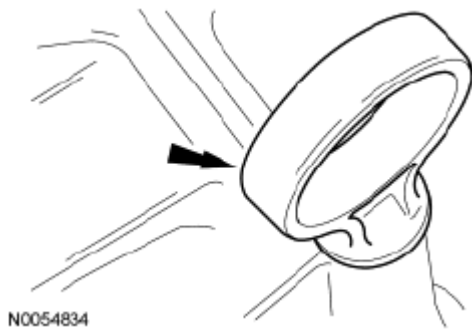
**Fig. 805: Locating Ground Wire Bolt**  
Courtesy of FORD MOTOR CO.

50. Attach the wiring harness retainer to the RH valve cover stud bolt.



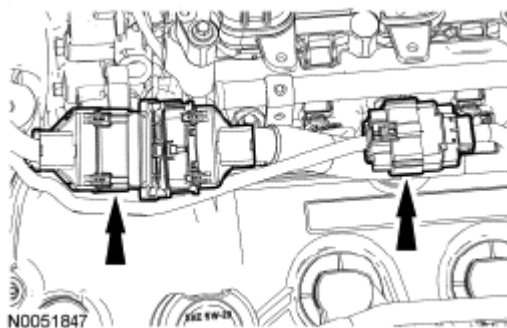
**Fig. 806: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

51. Install the oil level indicator.



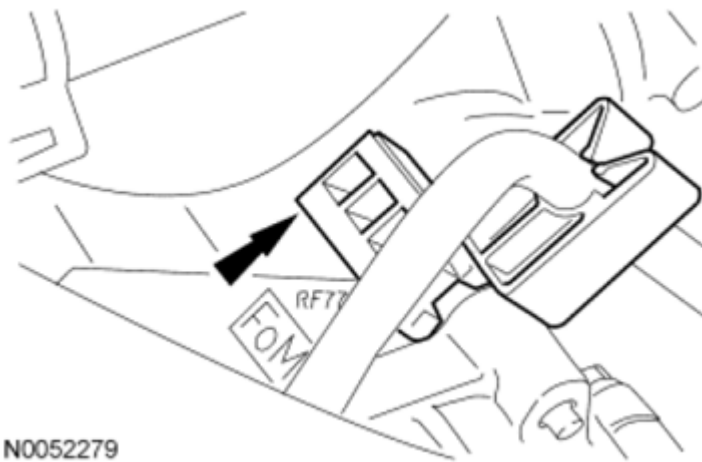
**Fig. 807: Locating Oil Level Indicator**  
Courtesy of FORD MOTOR CO.

52. Connect the 2 engine wiring harness electrical connectors.
- Attach the electrical connector to the LH valve cover.



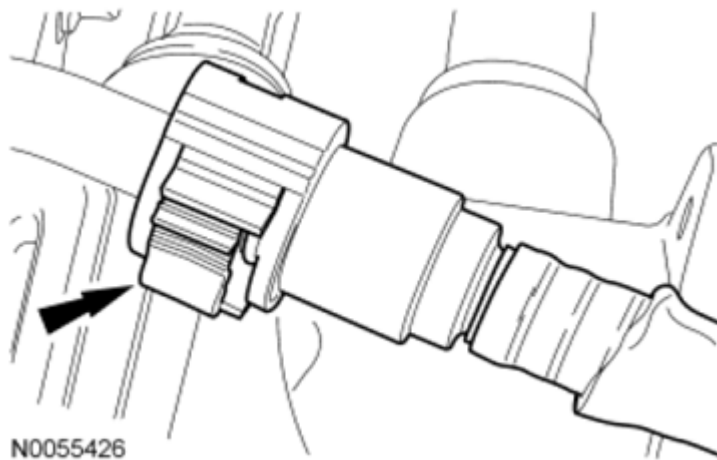
**Fig. 808: Locating Engine Wiring Harness Electrical Connectors**  
Courtesy of FORD MOTOR CO.

53. Connect the fuel hose routing clip to the transaxle stud.



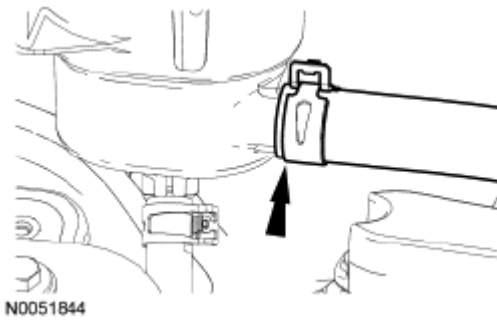
**Fig. 809: Locating Fuel Hose Routing Clip**  
Courtesy of FORD MOTOR CO.

54. Connect the fuel supply tube. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION**.



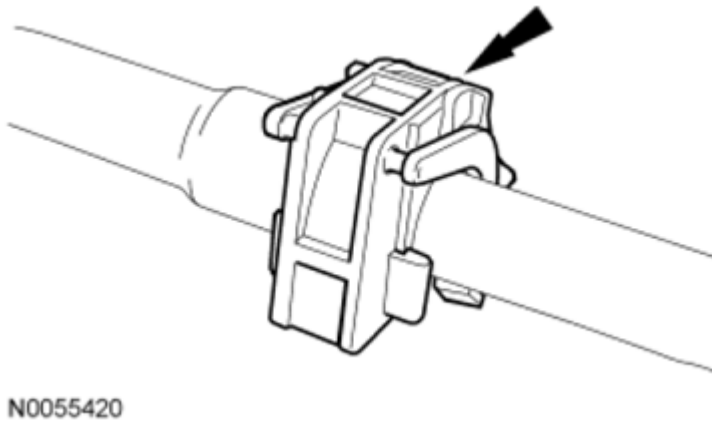
**Fig. 810: Locating Fuel Supply Tube**  
Courtesy of FORD MOTOR CO.

55. Connect the hose to the power steering reservoir.



**Fig. 811: Locating Hose**  
Courtesy of FORD MOTOR CO.

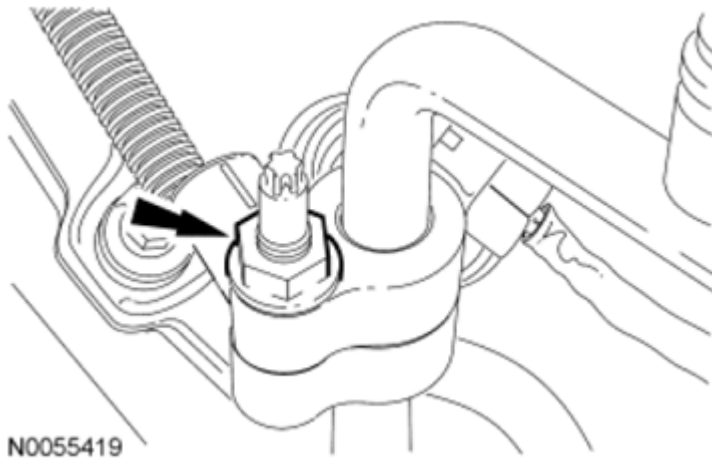
56. Connect the A/C suction tube fitting.
  - Install the safety clip onto the A/C fitting.



**Fig. 812: Locating A/C Suction Tube Safety Clip**  
Courtesy of FORD MOTOR CO.

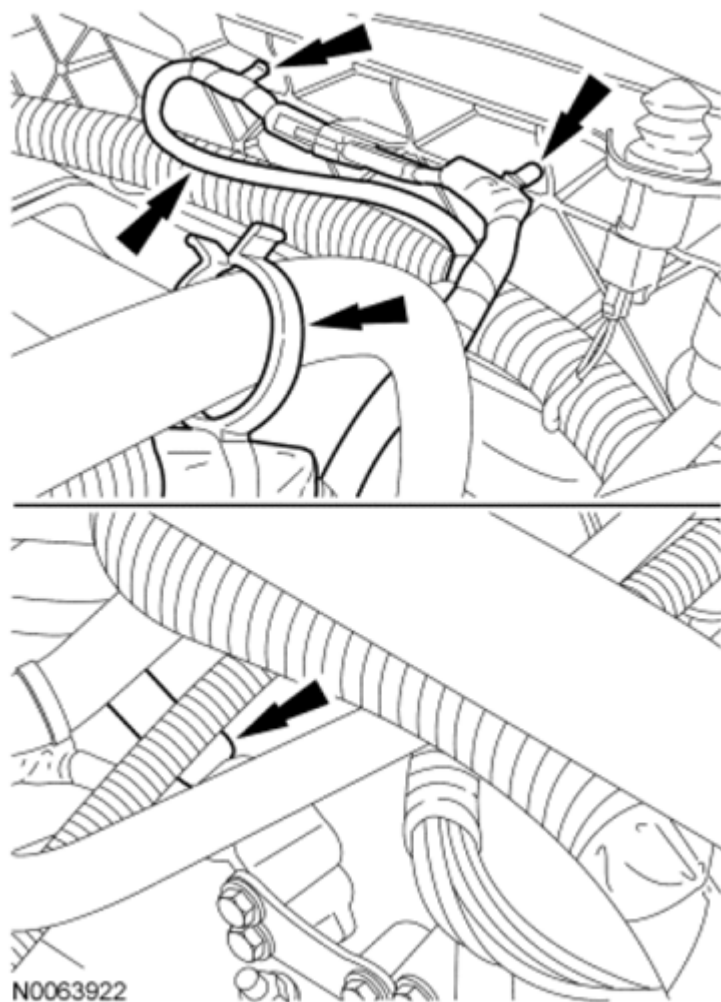
57. Using a new O-ring seal, connect the A/C tube fitting and install the nut.
  - Tighten to 8 Nm (71 lb-in).





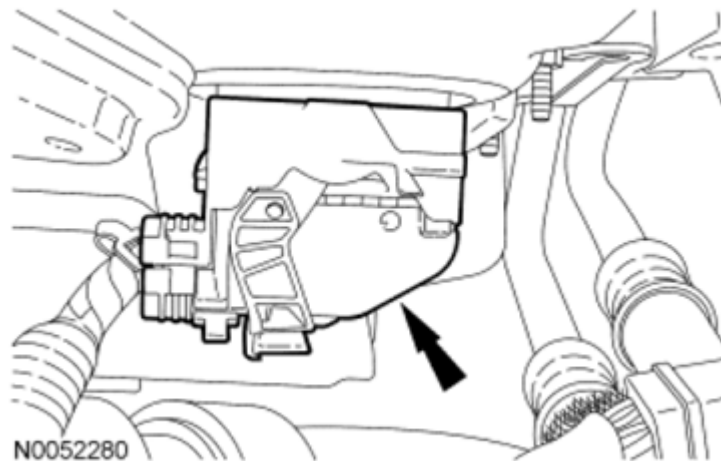
**Fig. 813: Locating A/C Pressure Tube Fitting And Nut**  
Courtesy of FORD MOTOR CO.

58. If equipped, attach the engine block heater harness retainers to the radiator support and the A/C suction tube.



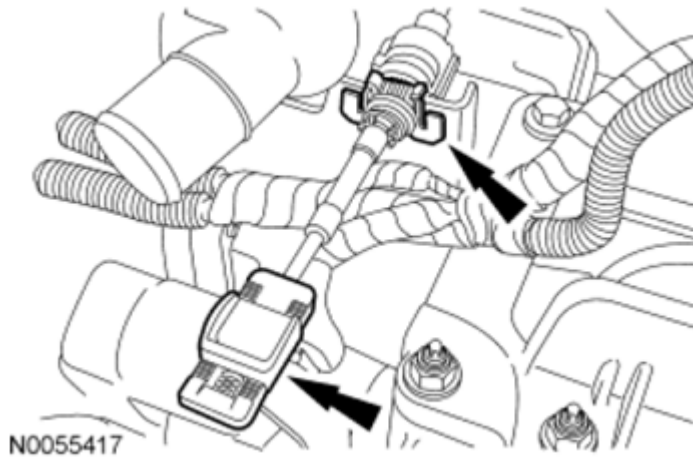
**Fig. 814: Locating Engine Block Heater Harness And A/C Suction Tube**  
Courtesy of FORD MOTOR CO.

59. Connect the transaxle control electrical connector.



**Fig. 815: Locating Transaxle Control Electrical Connector**  
Courtesy of FORD MOTOR CO.

60. Attach the control cable to the bracket.
- Connect the transaxle control cable to the control lever.



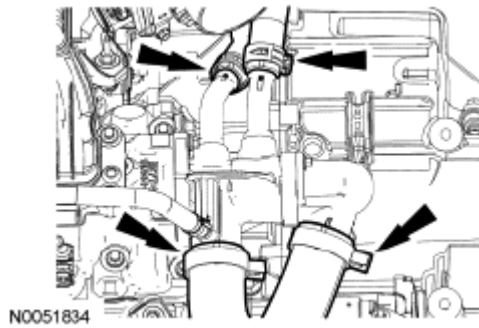
**Fig. 816: Locating Transaxle Control Cable**  
Courtesy of FORD MOTOR CO.

61. Attach the wiring harness retainer to the transaxle control cable bracket.



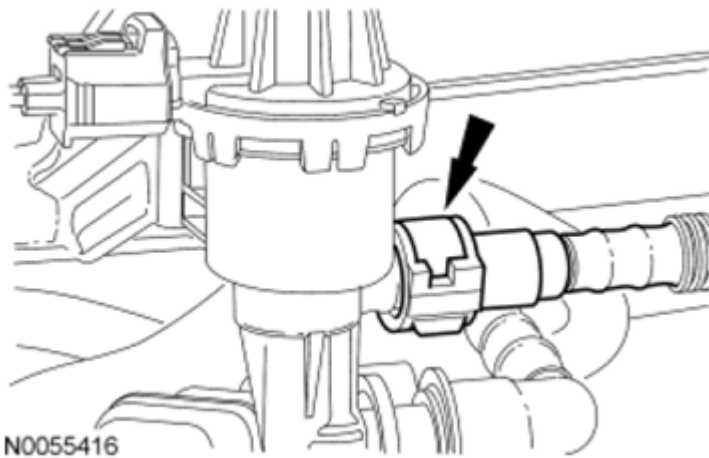
**Fig. 817: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

62. Connect the upper radiator hose, lower radiator hose and 2 heater hoses to the thermostat housing.



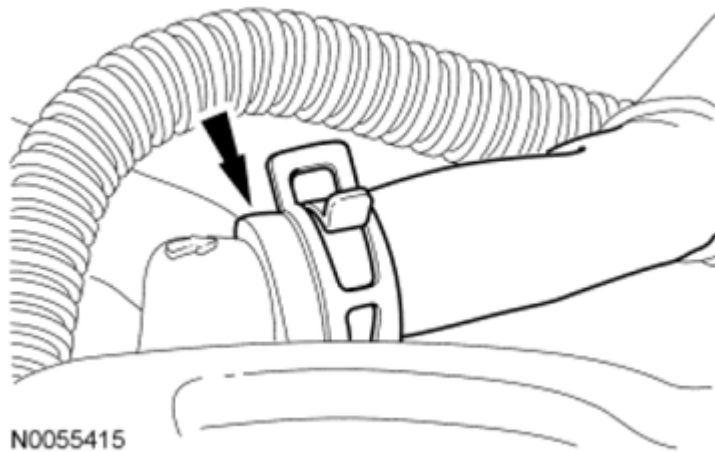
**Fig. 818: Locating Upper And Lower Radiator Hose**  
Courtesy of FORD MOTOR CO.

63. Connect the upper Evaporative Emission (EVAP) tube quick connect coupling to the purge valve. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .



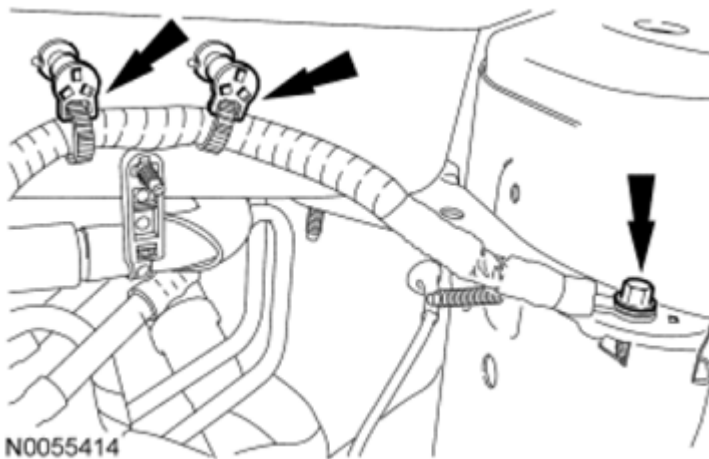
**Fig. 819: Locating Upper Evaporative Emission Tube**  
Courtesy of FORD MOTOR CO.

64. Connect the vacuum hose to the upper intake manifold.



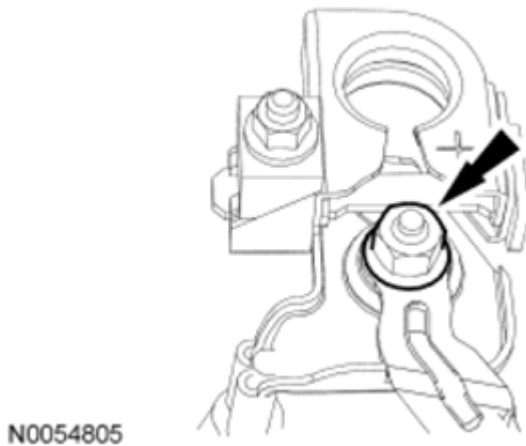
**Fig. 820: Locating Vacuum Hose**  
Courtesy of FORD MOTOR CO.

65. Install the ground wire and the bolt.
- Tighten to 10 Nm (89 lb-in).
  - Attach the 2 wiring harness retainers to the cowl.



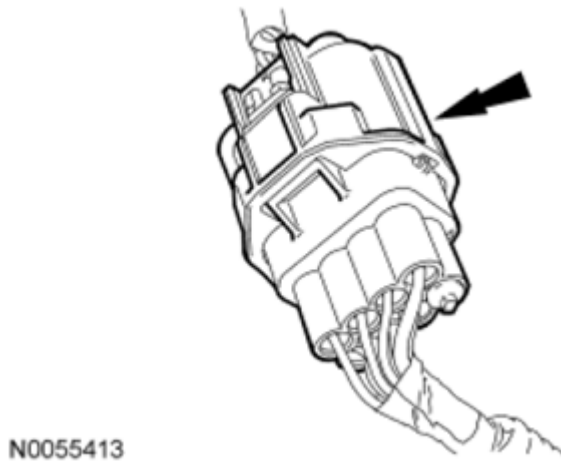
**Fig. 821: Locating Wiring Harness Retainers**  
Courtesy of FORD MOTOR CO.

66. Connect the power feed to the battery terminal and install the nut.
- Tighten to 8 Nm (71 lb-in).



**Fig. 822: Locating Battery Terminal Nut**  
Courtesy of FORD MOTOR CO.

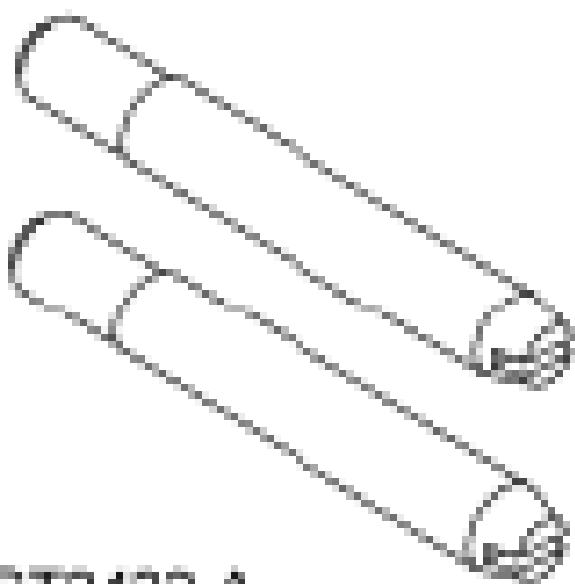
67. Connect the battery harness electrical connector.



**Fig. 823: Locating Battery Harness Electrical Connector**  
Courtesy of FORD MOTOR CO.

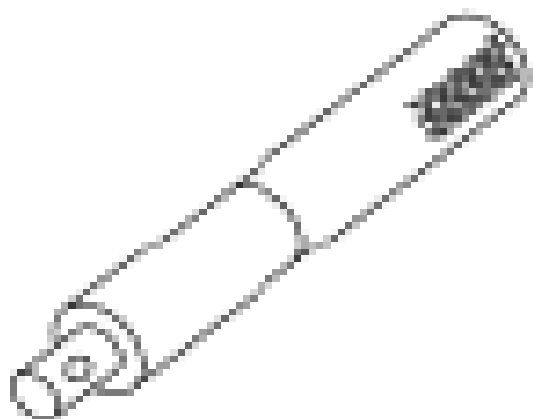
68. Install the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
69. Install the engine Air Cleaner (ACL) and the ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
70. Install the degas bottle. For additional information, refer to **ENGINE COOLING** .
71. Install the LH halfshaft and intermediate shaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS** .
72. Install the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .
73. Fill the engine with clean engine oil.
74. Fill and bleed the cooling system. For additional information, refer to **ENGINE COOLING** .
75. Fill the power steering system. For additional information, refer to **STEERING SYSTEM** .

76. Recharge the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS**.

**CAMSHAFT****Special Tool(s)****SPECIAL TOOL SPECIFICATION**

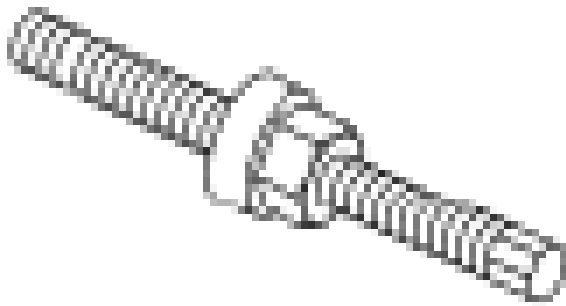
Alignment Pins  
307-399

**ST2433-A**



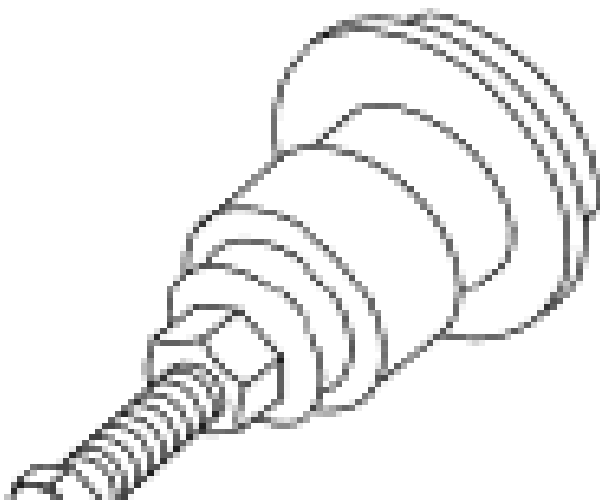
Handle  
205-153 (T80T-4000-W)

**ST1326-A**



Installer, Crankshaft Vibration Damper  
303-102 (T74P-6316-B)

ST1287-A



Installer, Front Cover Oil Seal  
303-335

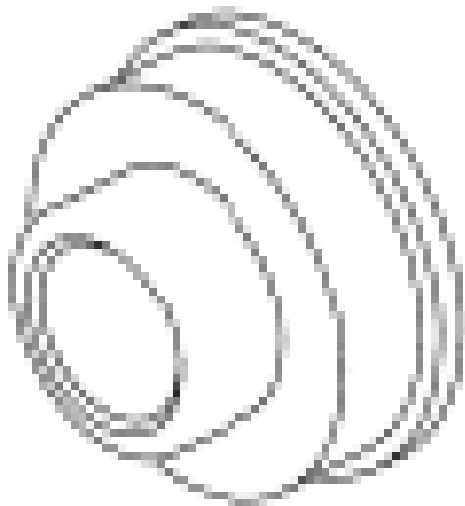
Installer, Front Crankshaft Seal





**ST2881-A**

303-1251



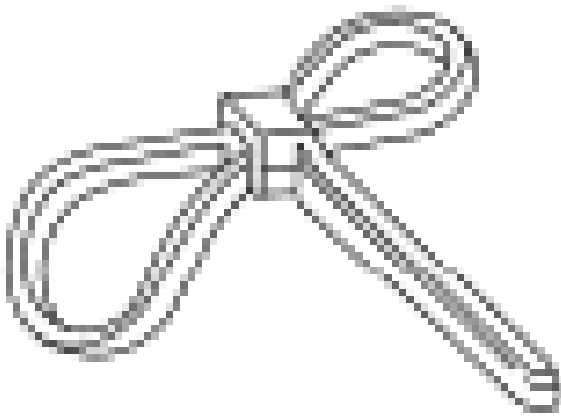
**ST2883-A**

Installer, **VCT Spark Plug Tube Seal**  
303-1247/2



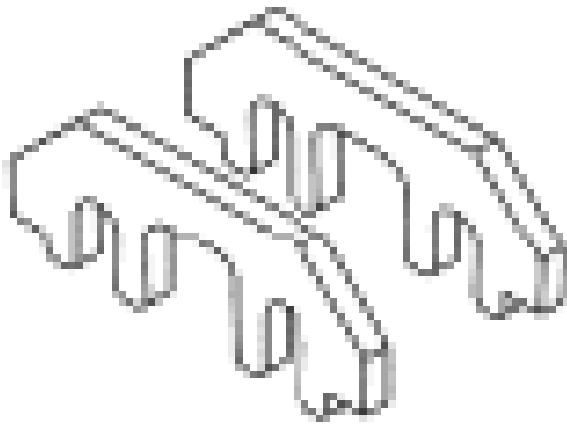
**ST1293-A**

Powertrain Lift  
014-00765 or equivalent



**ST1438-A**

Strap Wrench  
303-D055 (D85L-6000-A) or equivalent



ST2979-A

Tool, Camshaft Holding  
303-1248

## Material

### MATERIAL SPECIFICATION

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 XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO- 5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A
Silicone Gasket Remover ZC-30	-
Threadlock and Sealer TA-25	WSK-M2G351-A5

**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.

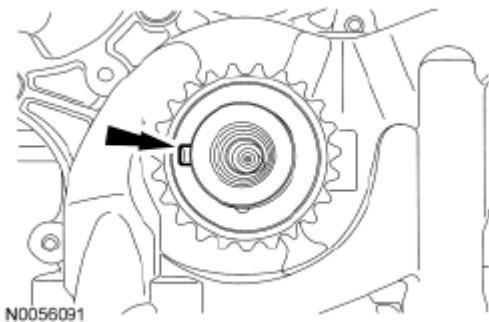
**NOTE:** During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

**NOTE:** Early build engines have 11 fastener valve covers, late build engines have 9 fastener valve covers. Do not attempt to install bolts in the 2 empty late build valve cover holes or damage to the valve cover will occur.

**NOTE:** On early build engines, the timing chain rides on the inner side of the RH timing chain guide. Late build engines are equipped with a different design RH timing chain guide that requires the timing chain to ride on the outer side of the RH timing chain guide. For service, all replacement RH timing chain guides will be the late build design.

### All camshafts

**NOTE:** The crankshaft must remain in the freewheeling position (crankshaft dowel pin at 9 o'clock) until after the camshafts are installed and the valve clearance is checked/adjusted. Do not turn the crankshaft until instructed to do so. Failure to follow this process will result in severe engine damage.



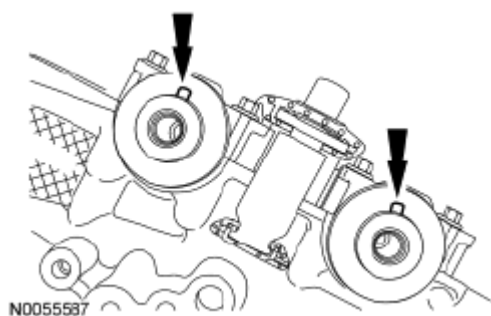
**Fig. 824: Locating Crankshaft Dowel Pin**  
Courtesy of FORD MOTOR CO.

1. Rotate the crankshaft counterclockwise until the crankshaft dowel pin is in the 9 o'clock position.

### LH camshafts

**NOTE:** The camshafts must remain in the neutral position during installation or engine damage may occur.

**NOTE:** Coat the camshafts with clean engine oil prior to installation.

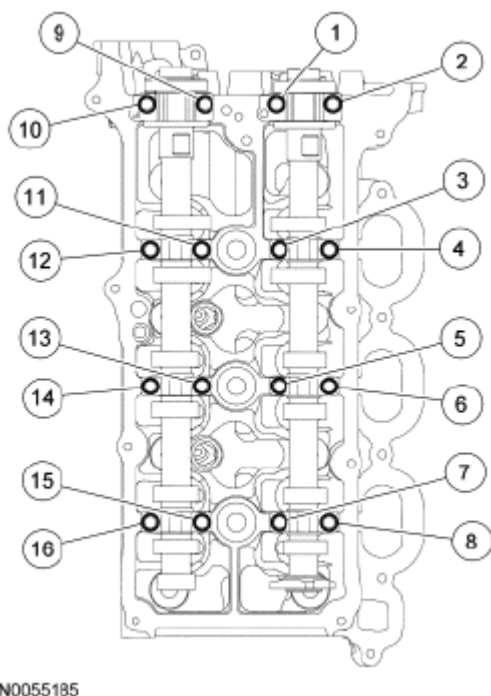


**Fig. 825: Identifying LH Camshafts Neutral Position**  
 Courtesy of FORD MOTOR CO.

2. Position the camshafts onto the LH cylinder head in the neutral position as shown in illustration.

**NOTE:**      **Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions. If not reassembled in their original positions, severe engine damage may occur.**

3. Install the 8 camshaft caps and the 16 bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

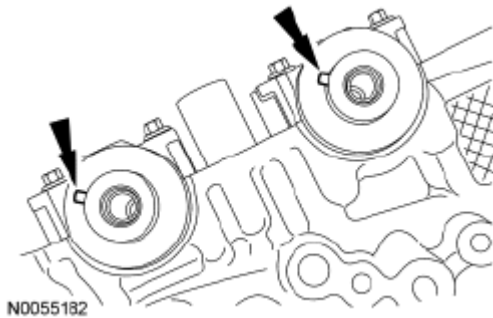


**Fig. 826: Identifying Camshaft Caps Bolts Tightening Sequence**  
 Courtesy of FORD MOTOR CO.

#### RH camshafts

**NOTE:** The camshafts must remain in the neutral position during installation or engine damage may occur.

**NOTE:** Coat the camshafts with clean engine oil prior to installation.

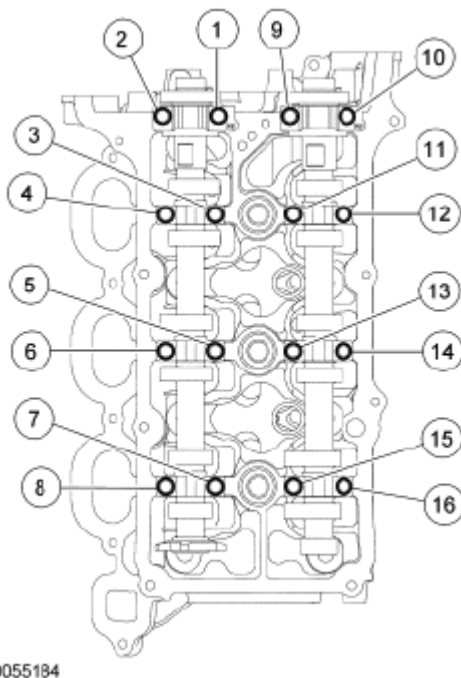


**Fig. 827: Identifying Camshafts Neutral Position**  
Courtesy of FORD MOTOR CO.

4. Position the camshafts onto the RH cylinder head in the neutral position as shown in illustration.

**NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions. If not reassembled in their original positions, severe engine damage may occur.

5. Install the 8 camshaft caps and the 16 bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

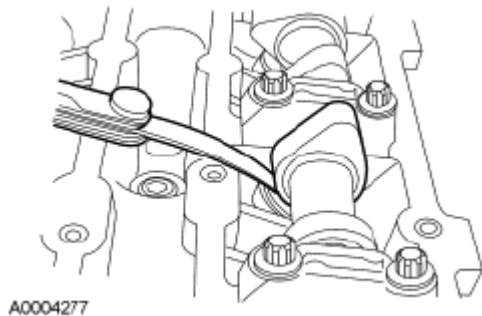


**Fig. 828: Identifying Camshaft Caps Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

**All camshafts**

**NOTE:** If any components are installed new, the engine valve clearance must be checked/adjusted or engine damage may occur.

**NOTE:** Use a camshaft sprocket bolt to turn the camshafts.

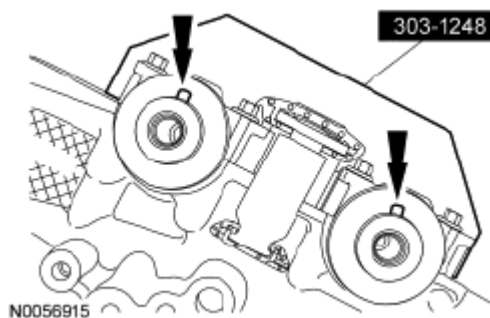


**Fig. 829: Checking Valve Tappet Clearances**  
Courtesy of FORD MOTOR CO.

- Using a feeler gauge, confirm that the valve tappet clearances are within specification. If valve tappet clearances are not within specification, the clearance must be adjusted by installing new valve tappet (s) of the correct size. For additional information, refer to **VALVE CLEARANCE CHECK**.

**LH camshafts**

**NOTE:** Use a camshaft sprocket bolt to turn the camshafts.

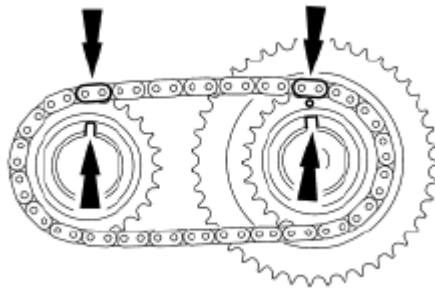


**Fig. 830: Installing Camshaft Holding Tool On Flats Of Camshafts**  
Courtesy of FORD MOTOR CO.

- Rotate the LH camshafts to the Top Dead Center (TDC) position and install the Camshaft Holding Tool on the flats of the camshafts.
- Assemble the LH Variable Camshaft Timing (VCT) assembly, the LH exhaust camshaft sprocket and the

LH secondary timing chain.

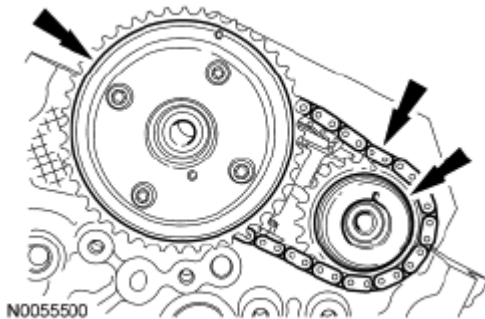
- Align the colored links with the timing marks.



N0055499

**Fig. 831: Aligning Colored Links With Timing Marks**  
Courtesy of FORD MOTOR CO.

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

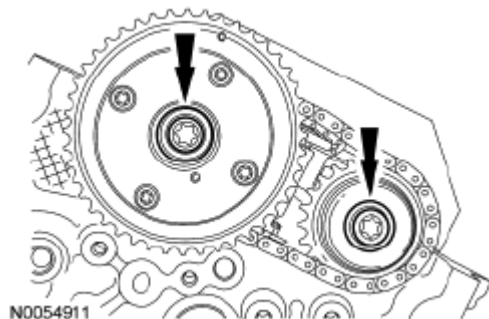


N0055500

**Fig. 832: Locating LH Secondary Timing Assembly**  
Courtesy of FORD MOTOR CO.

10. Install 2 new bolts and the original washer. Tighten in 4 stages.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Loosen one full turn.
- Stage 3: Tighten to 10 Nm (89 lb-in).
- Stage 4: Tighten 90 degrees.

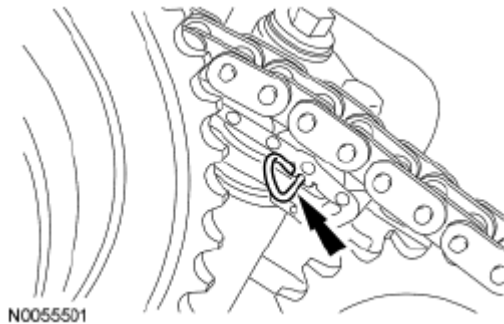


N0054911



**Fig. 833: Locating Secondary Timing Chain And LH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

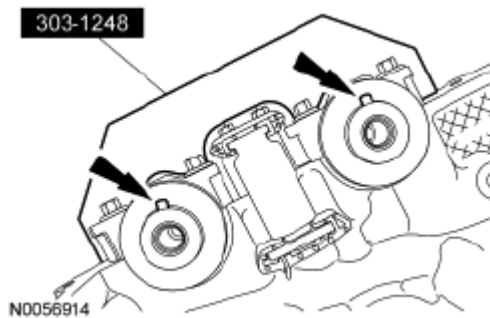
11. Remove the lockpin from the LH secondary timing chain tensioner.



**Fig. 834: Locating Lockpin**  
Courtesy of FORD MOTOR CO.

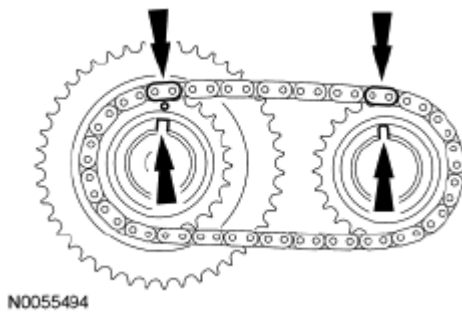
#### RH camshafts

**NOTE:** Use a camshaft sprocket bolt to turn the camshafts.



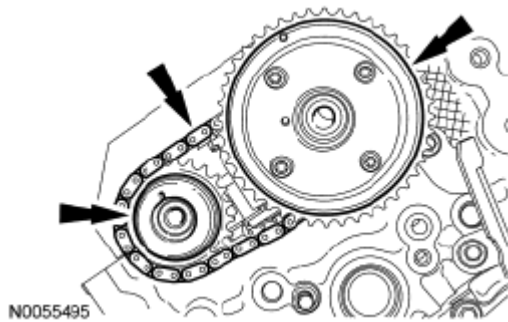
**Fig. 835: Installing Camshaft Holding Tool On Flats Of Camshafts**  
Courtesy of FORD MOTOR CO.

12. Rotate the RH camshafts to the **TDC** position and install the Camshaft Holding Tool on the flats of the camshafts.
13. Assemble the RH **VCT** assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
  - Align the colored links with the timing marks.



**Fig. 836: Aligning Colored Links With Timing Marks**  
Courtesy of FORD MOTOR CO.

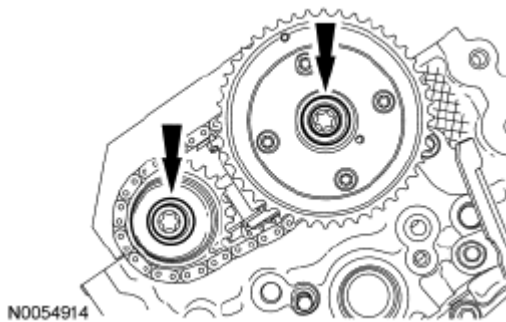
14. Position the RH secondary timing assembly onto the camshafts.



**Fig. 837: Positioning RH Secondary Timing Assembly Onto Camshafts**  
Courtesy of FORD MOTOR CO.

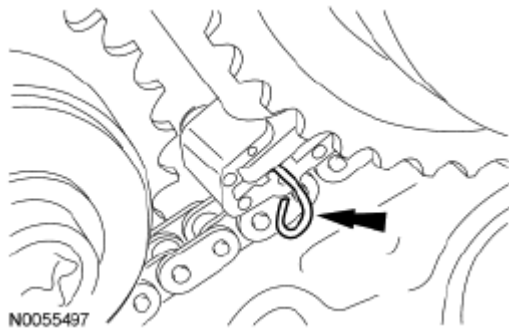
15. Install 2 new bolts and the original washer. Tighten in 4 stages.

- Stage 1: Tighten to 40 Nm (30 lb-ft).
- Stage 2: Loosen one full turn.
- Stage 3: Tighten to 10 Nm (89 lb-in).
- Stage 4: Tighten 90 degrees.



**Fig. 838: Locating Secondary Timing Chain And RH Exhaust Camshaft Sprocket**  
Courtesy of FORD MOTOR CO.

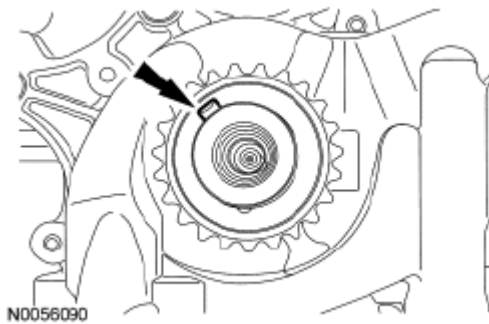
16. Remove the lockpin from the RH secondary timing chain tensioner.



**Fig. 839: Locating Lockpin**  
Courtesy of FORD MOTOR CO.

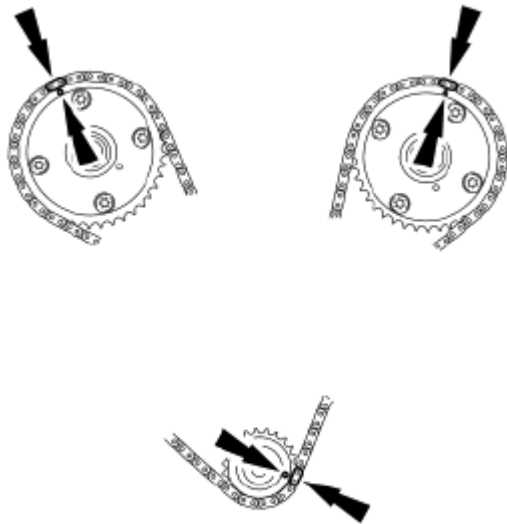
**All camshafts**

17. Rotate the crankshaft clockwise 60 degrees to the **TDC** position (crankshaft dowel pin at 11 o'clock).



**Fig. 840: Locating Crankshaft Position**  
Courtesy of FORD MOTOR CO.

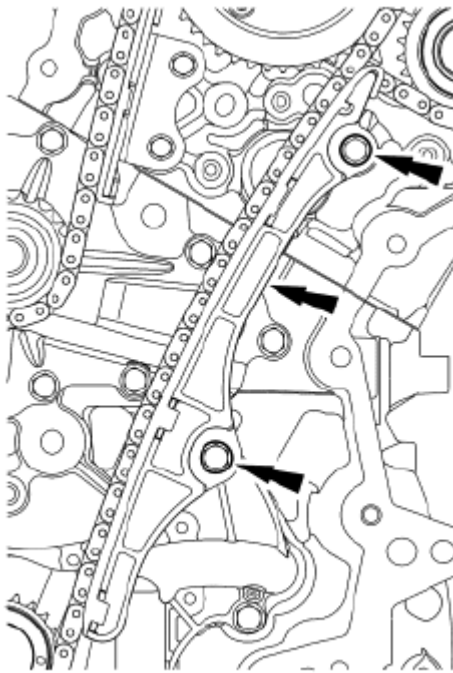
18. Install the primary timing chain with the colored links aligned with the timing marks on the **VCT** assemblies and the crankshaft sprocket.



N0055503

**Fig. 841: Aligning Timing Marks On VCT Assemblies And Crankshaft Sprocket**  
Courtesy of FORD MOTOR CO.

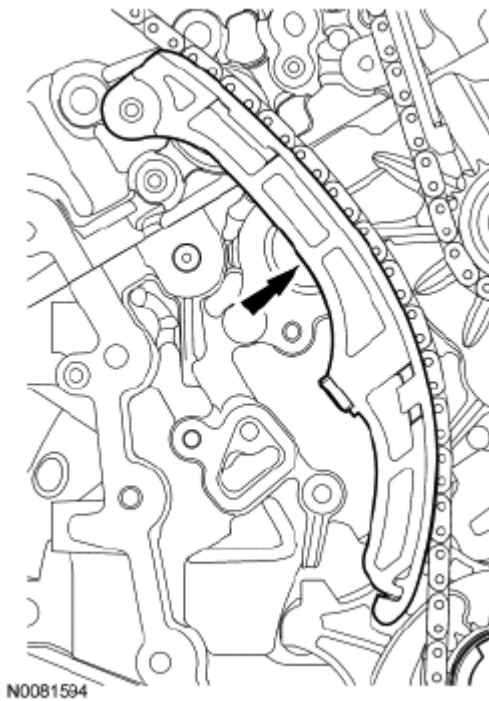
19. Install the lower LH primary timing chain guide and the 2 bolts.
  - Tighten to 10 Nm (89 lb-in).



N0081593

**Fig. 842: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

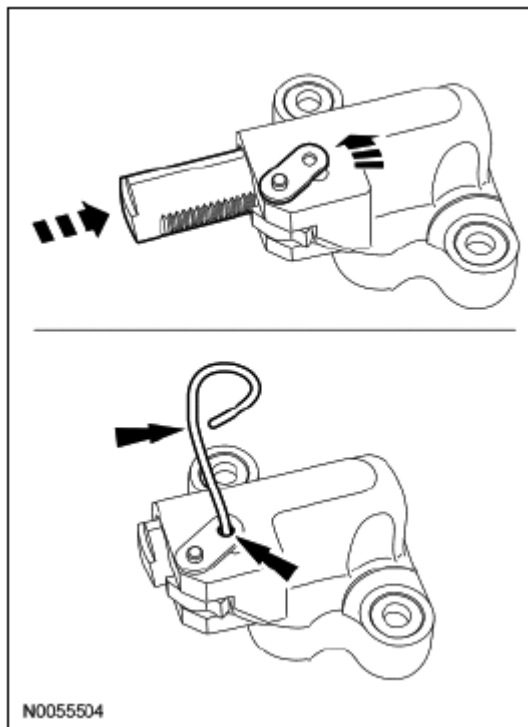
20. Install the primary timing chain tensioner arm.



**Fig. 843: Locating Primary Timing Chain Tensioner Arm**  
Courtesy of FORD MOTOR CO.

21. Reset the primary timing chain tensioner.

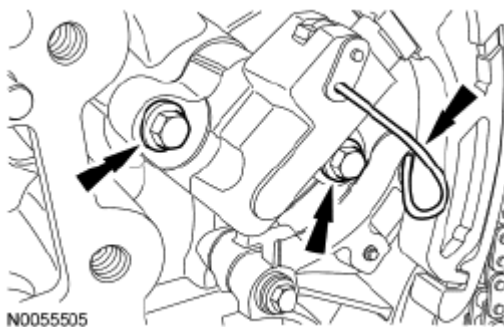
- Rotate the lever counterclockwise.
- Using a soft-jawed vise, compress the plunger.
- Align the hole in the lever with the hole in the tensioner housing.
- Install a suitable lockpin.



**Fig. 844: Aligning Hole In Lever With Hole In Tensioner Housing**  
Courtesy of FORD MOTOR CO.

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

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



**Fig. 845: Locating Primary Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

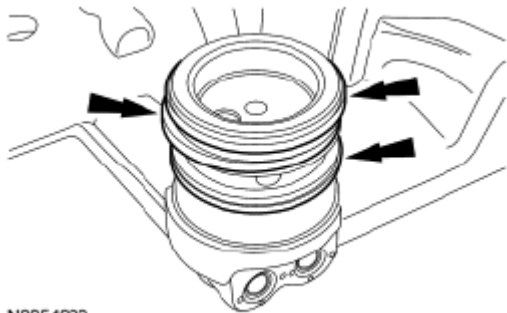
23. As a post-check, verify correct alignment of all timing marks.



N0055496

**Fig. 846: Identifying Timing Marks Location**  
Courtesy of FORD MOTOR CO.

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

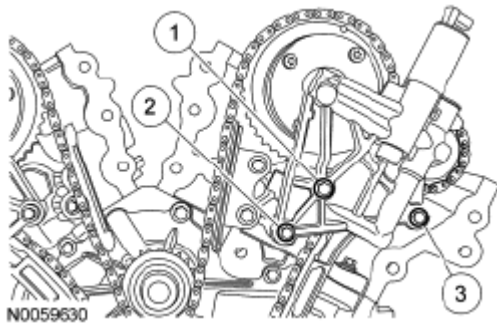


N0054903

**Fig. 847: Locating VCT Housing Seals**  
Courtesy of FORD MOTOR CO.

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

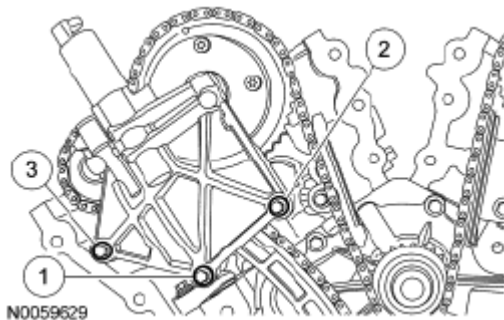
25. Install the LH VCT housing and the 3 bolts.
- Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 848: Identifying LH VCT Housing Bolts**  
Courtesy of FORD MOTOR CO.

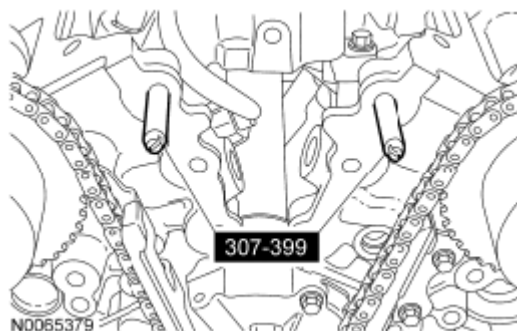
**NOTE:** Make sure the dowels on the Variable Camshaft Timing (VCT) housing are fully engaged in the cylinder head prior to tightening the bolts. Failure to follow this process will result in severe engine damage.

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



**Fig. 849: Identifying RH VCT Housing Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

27. Install the Alignment Pins.



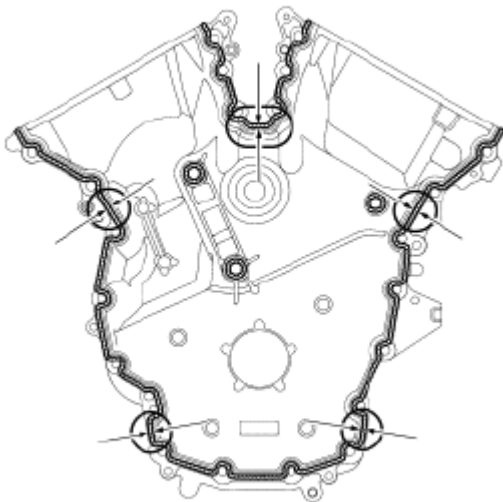
**Fig. 850: Identifying Alignment Pins**  
Courtesy of FORD MOTOR CO.



- NOTE:** Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.
- NOTE:** The engine front cover and bolts 17, 18, 19 and 20 must be installed within 4 minutes of the initial sealant application. The remainder of the engine front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

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

5.5 mm  
(0.21 in)



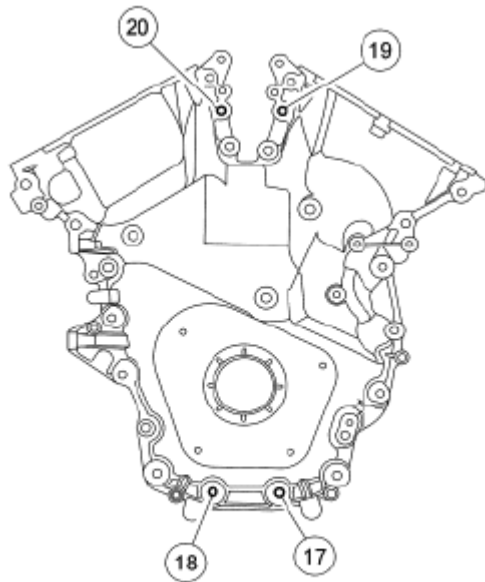
N0068283

**Fig. 851: Identifying RTV Silicone Applying Area**  
Courtesy of FORD MOTOR CO.

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

29. Install the engine front cover and bolts 17, 18, 19 and 20.

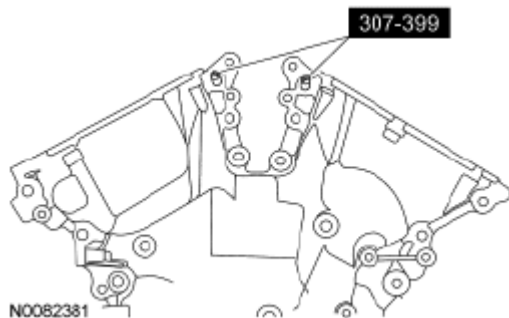
- Tighten in sequence to 3 Nm (27 lb-in).



N0068108

**Fig. 852: Identifying Engine Front Cover Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

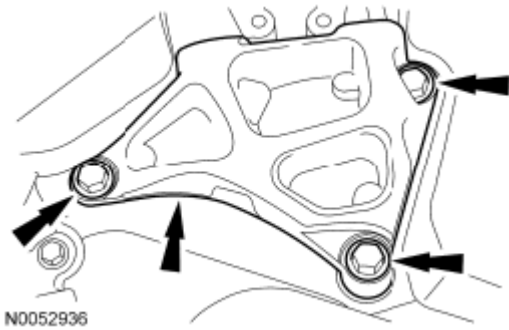
30. Remove the Alignment Pins.



N0082381

**Fig. 853: Identifying Alignment Pins**  
Courtesy of FORD MOTOR CO.

**NOTE:** Do not tighten the bolts at this time.

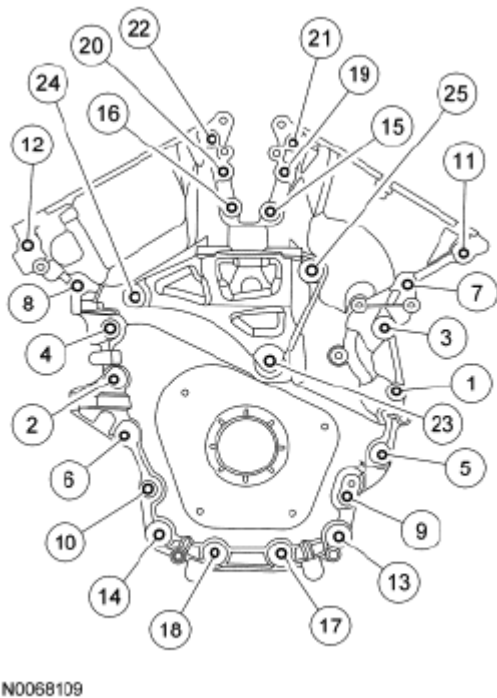


**Fig. 854: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

31. Install the engine mount bracket and the 3 bolts.

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

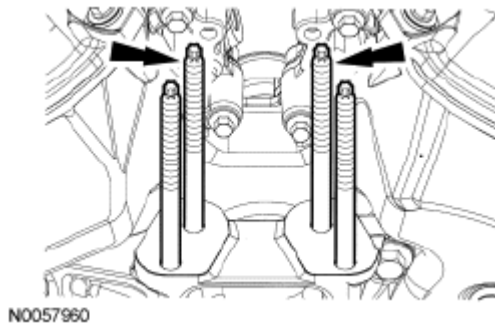
32. Install the remaining engine front cover bolts. Tighten all of the engine front cover bolts and engine mount bracket bolts in the sequence shown in illustration in 2 stages:
- Stage 1: Tighten bolts 1 thru 22 to 10 Nm (89 lb-in) and bolts 23, 24 and 25 to 15 Nm (133 lb-in).
  - Stage 2: Tighten bolts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



**Fig. 855: Identifying Engine Front Cover Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

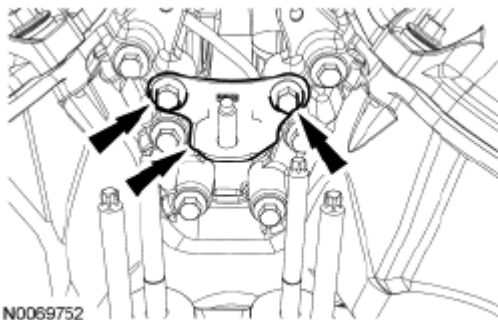
**NOTE:** The thread sealer on the engine mount studs (including new engine mount studs if applicable) must be cleaned off with a wire brush and new Threadlock and Sealer applied prior to installing the engine mount studs. Failure to follow this procedure may result in damage to the engine mount studs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

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



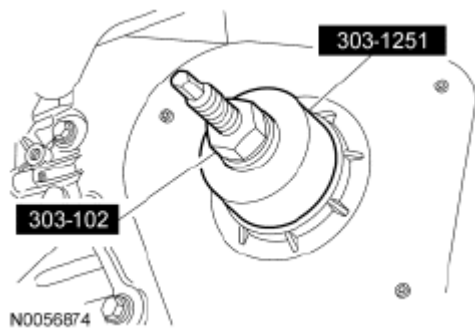
**Fig. 856: Locating Engine Mount Studs**  
Courtesy of FORD MOTOR CO.

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



**Fig. 857: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

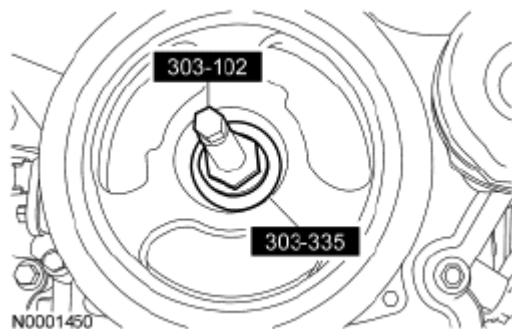
**NOTE:** Apply clean engine oil to the crankshaft front seal bore in the engine front cover.



**Fig. 858: Identifying Crankshaft Vibration Damper Installer And Front Crankshaft Installer**  
Courtesy of FORD MOTOR CO.

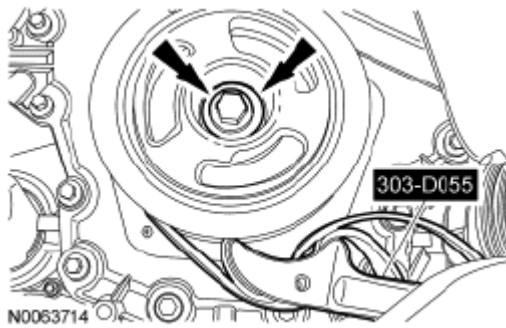
35. Using the Crankshaft Vibration Damper Installer and Front Crankshaft Seal Installer, install a new crankshaft front seal.

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



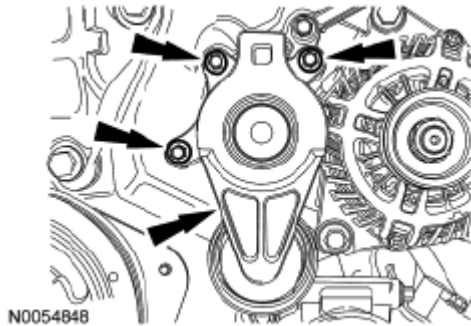
**Fig. 859: Identifying Crankshaft Vibration Damper Installer And Front Cover Oil Seal Installer**  
Courtesy of FORD MOTOR CO.

36. Using the Crankshaft Vibration Damper Installer and Front Cover Oil Seal Installer, install the crankshaft pulley.
37. 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.



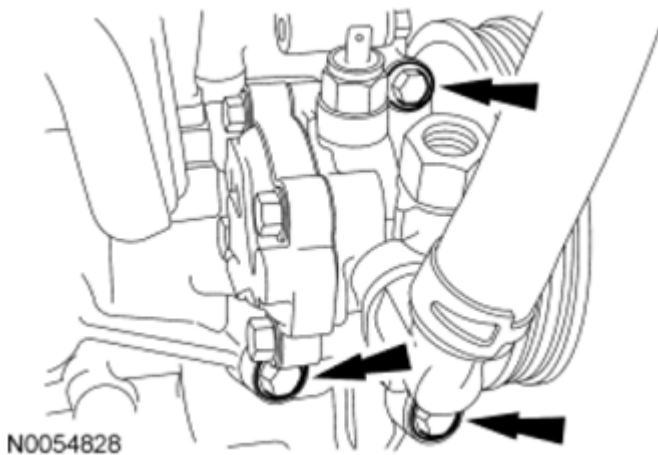
**Fig. 860: Locating Crankshaft Pulley Washer And Bolt**  
Courtesy of FORD MOTOR CO.

38. Install the accessory drive belt tensioner and the 3 bolts.
- Tighten to 11 Nm (97 lb-in).



**Fig. 861: Locating Accessory Drive Belt Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

39. Install the power steering pump and the 3 bolts.
- Tighten to 24 Nm (18 lb-ft).

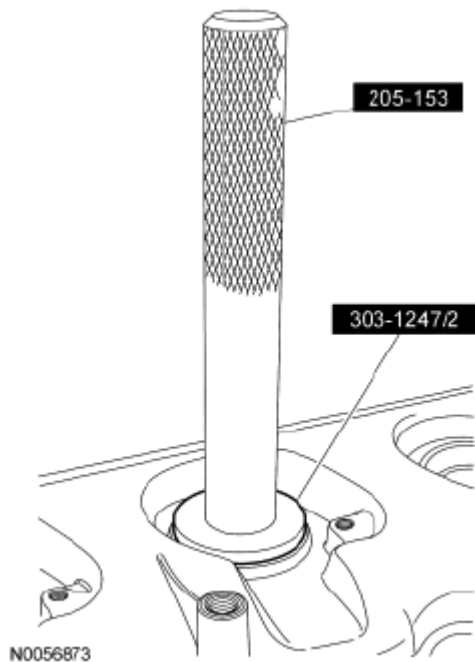


**Fig. 862: Locating Power Steering Pump And Bolts**

Courtesy of FORD MOTOR CO.

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

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

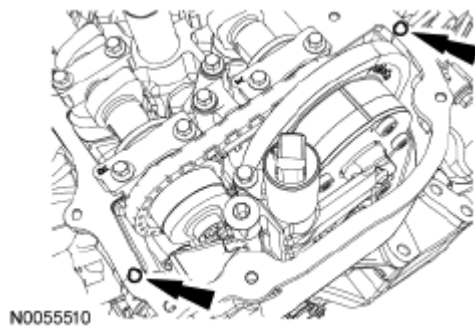


**Fig. 863: Identifying VCT Spark Plug Tube Seal Installer And Handle**  
Courtesy of FORD MOTOR CO.

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

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

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

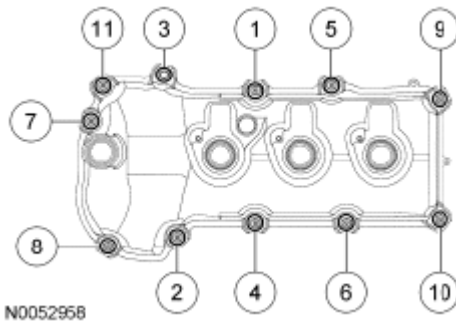


**Fig. 864: Applying RTV Silicone To Engine Front Cover-To-RH Cylinder Head Joints**  
Courtesy of FORD MOTOR CO.

41. Apply a 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.

#### Early build vehicles

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

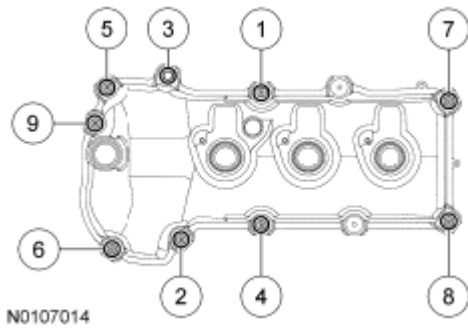


**Fig. 865: Identifying RH Valve Cover Stud Bolts Tightening Sequence (Early Build Vehicles)**  
Courtesy of FORD MOTOR CO.

#### Late build vehicles

43. Using a new gasket, install the RH valve cover and tighten the 9 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



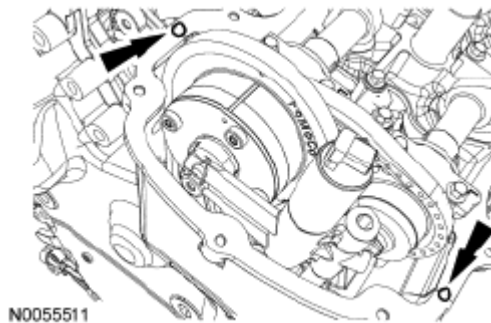


**Fig. 866: Identifying RH Valve Cover Stud Bolts Tightening Sequence (Late Build Vehicles)**  
Courtesy of FORD MOTOR CO.

#### All vehicles

**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. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

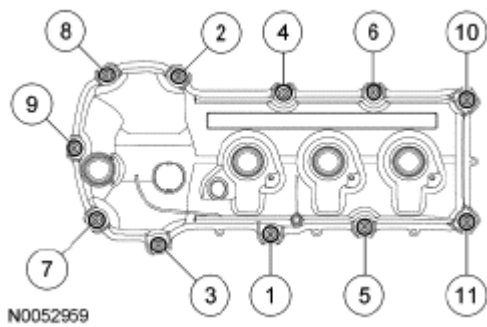


**Fig. 867: Applying RTV Silicone To Engine Front Cover**  
Courtesy of FORD MOTOR CO.

44. Apply a 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.

#### Early build vehicles

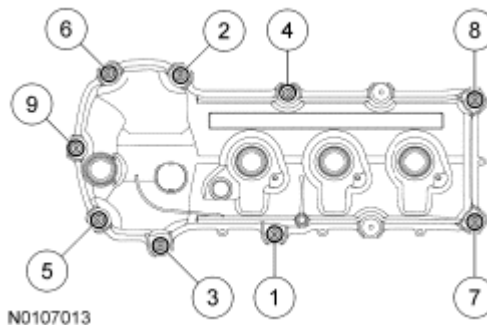
45. Using a new gasket, install the LH valve cover and tighten the 11 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 868: Identifying LH Valve Cover Stud Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

### Late build vehicles

46. Using a new gasket, install the LH valve cover and tighten the 9 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

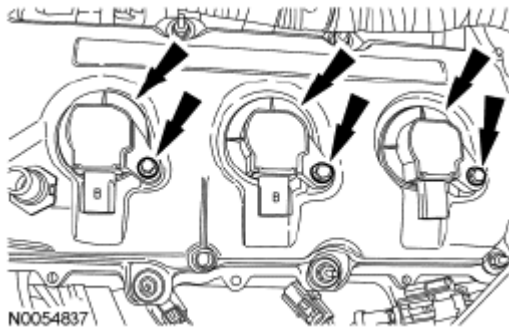


**Fig. 869: Identifying LH Valve Cover Stud Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

### All vehicles

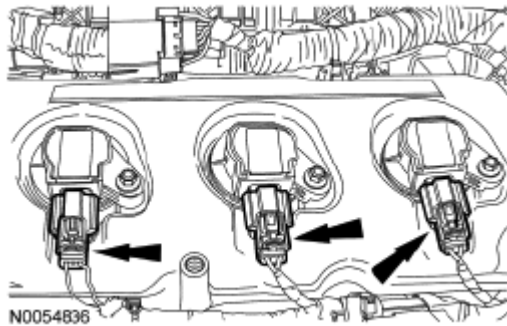
**NOTE:** LH shown in illustration, RH similar.

47. Install the 6 coil-on-plug assemblies and the 6 bolts.
  - Tighten to 7 Nm (62 lb-in).



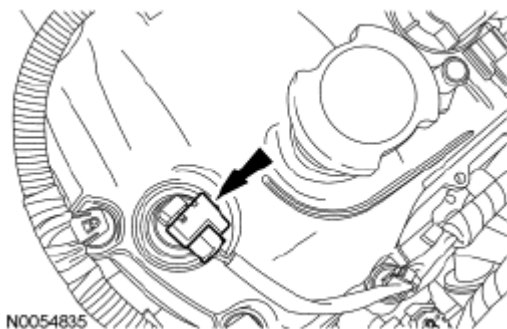
**Fig. 870: Locating Coil-On-Plugs Bolts**  
Courtesy of FORD MOTOR CO.

48. Attach all of the wiring harness retainers to the LH valve cover and stud bolts.
49. Connect the 3 LH coil-on-plug electrical connectors.



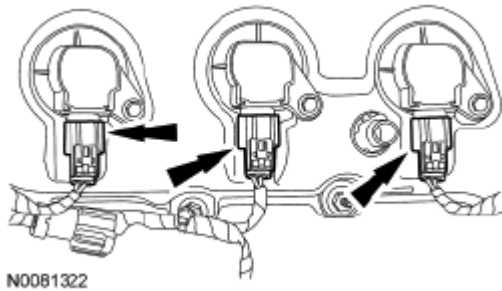
**Fig. 871: Locating LH Coil-On-Plug Electrical Connectors**  
Courtesy of FORD MOTOR CO.

50. Connect the LH camshaft VCT solenoid electrical connector.



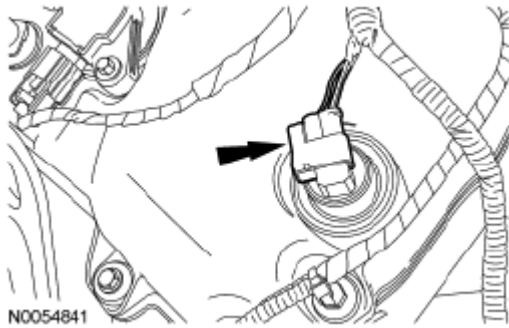
**Fig. 872: Locating LH VCT Solenoid Electrical Connector**  
Courtesy of FORD MOTOR CO.

51. Attach all of the wiring harness retainers to the RH valve cover and stud bolts.
52. Connect the 3 RH coil-on-plug electrical connectors.



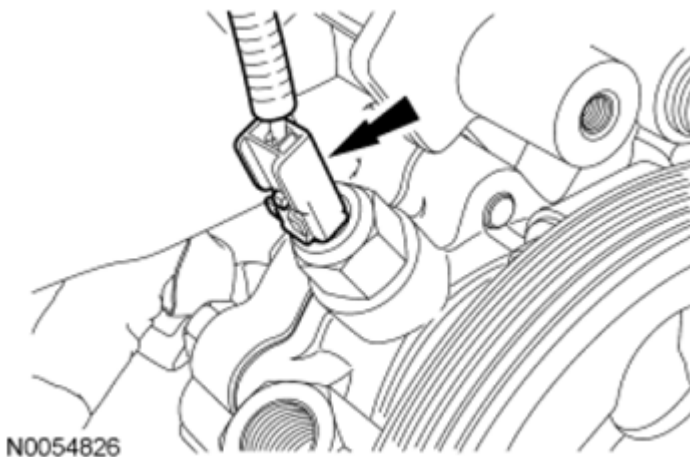
**Fig. 873: Locating RH Coil-On-Plug Electrical Connectors**  
Courtesy of FORD MOTOR CO.

53. Connect the RH VCT solenoid electrical connector.



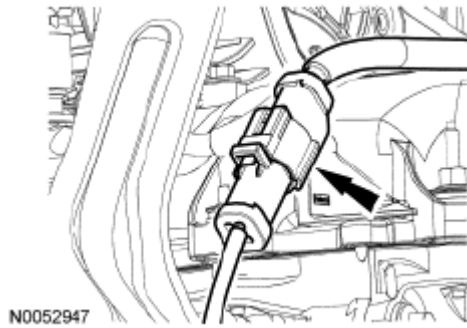
**Fig. 874: Locating RH Variable Camshaft Timing Solenoid Electrical Connector**  
Courtesy of FORD MOTOR CO.

54. Connect the Power Steering Pressure (PSP) switch electrical connector.



**Fig. 875: Locating PSP Switch Electrical Connector**  
Courtesy of FORD MOTOR CO.

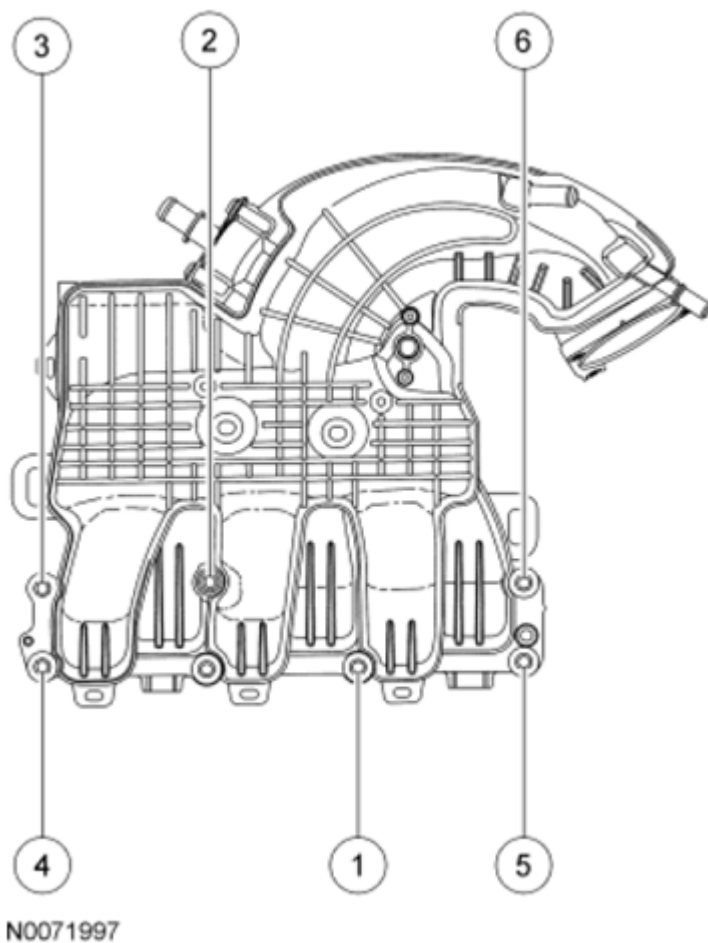
55. Connect the RH Catalyst Monitor Sensor (CMS) sensor electrical connector.



**Fig. 876: Locating RH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

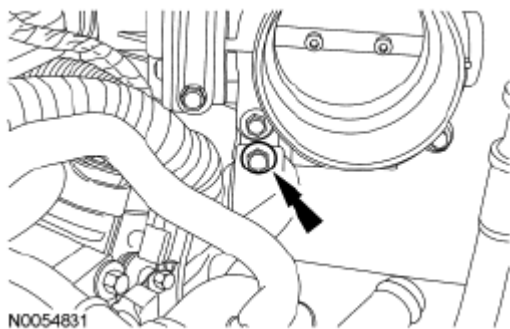
**NOTE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

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



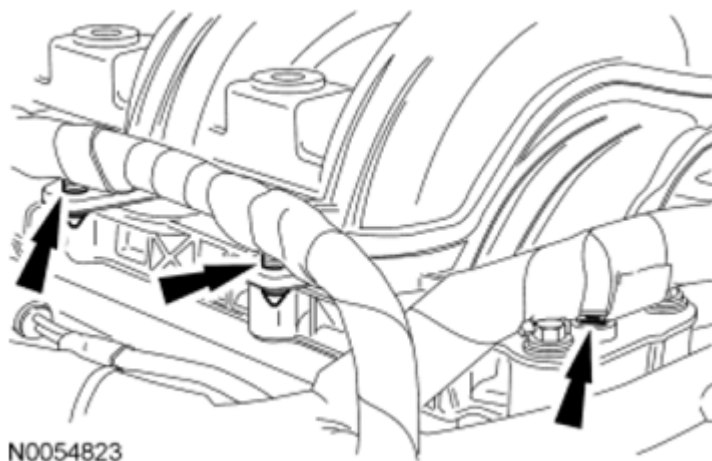
**Fig. 877: Identifying Upper Intake Manifold Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

57. Install the upper intake manifold support bracket bolt.
  - Tighten to 10 Nm (89 lb-in).



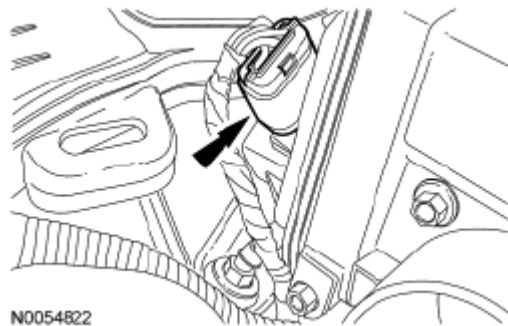
**Fig. 878: Locating Upper Intake Manifold Support Bracket Bolt**  
Courtesy of FORD MOTOR CO.

58. Attach the wiring harness retainers to the upper intake manifold.



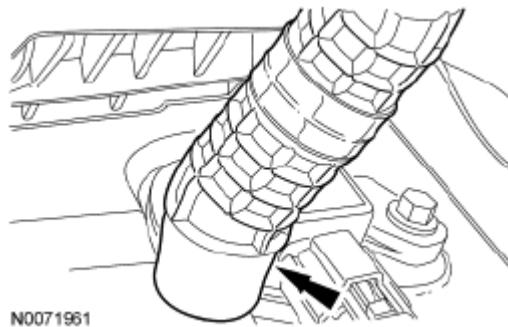
**Fig. 879: Locating Wiring Harness Retainers**  
Courtesy of FORD MOTOR CO.

59. Connect the Throttle Body (TB) electrical connector.



**Fig. 880: Locating Throttle Body Electrical Connector**  
Courtesy of FORD MOTOR CO.

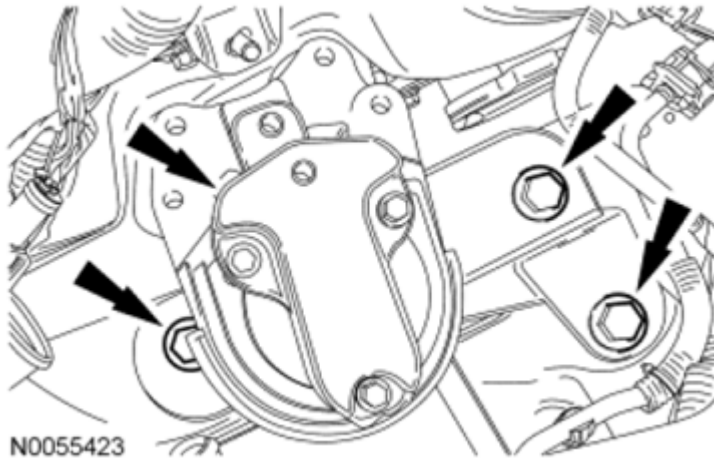
60. Connect the PCV hose to the PCV valve.



**Fig. 881: Locating PCV Hose**  
Courtesy of FORD MOTOR CO.

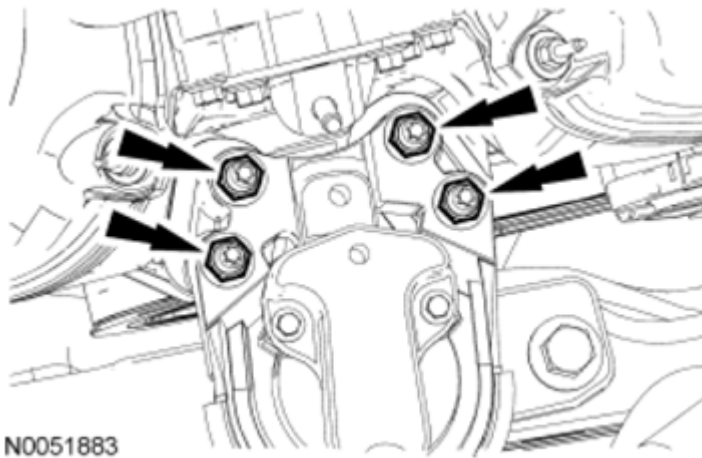
61. If equipped, attach the engine block heater wiring harness retainers.

62. Raise the engine and transaxle assembly into the vehicle.
63. Install the engine mount and the 3 bolts.
  - Tighten to 90 Nm (66 lb-ft).



**Fig. 882: Locating Engine Mount Bolts**  
Courtesy of FORD MOTOR CO.

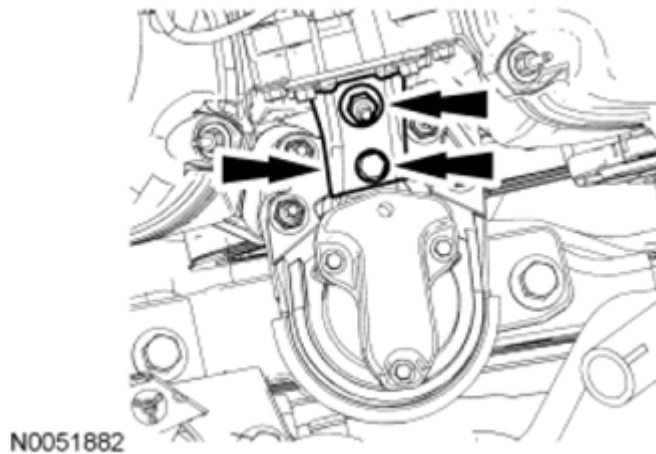
64. Install the 4 engine mount nuts.
  - Tighten to 63 Nm (46 lb-ft).



**Fig. 883: Locating Engine Mount Nuts**  
Courtesy of FORD MOTOR CO.

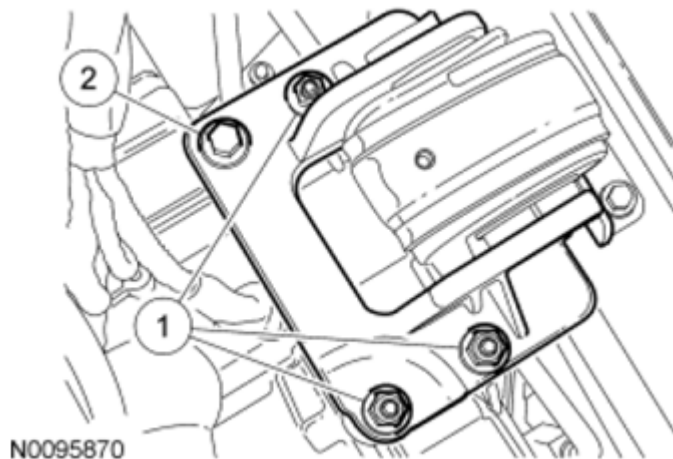
65. Install the engine mount brace, the nut and the bolt.
  - Tighten to 20 Nm (177 lb-in).





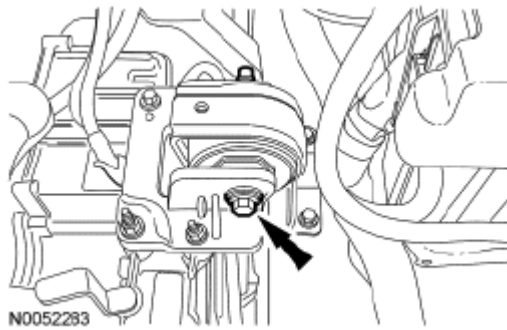
**Fig. 884: Locating Engine Mount Brace Nut And Bolt**  
Courtesy of FORD MOTOR CO.

66. Install the transaxle support insulator bracket, the 3 nuts and the bolt.
  - Tighten the 3 nuts to 63 Nm (46 lb-ft).
  - Tighten the bolt to 80 Nm (59 lb-ft).



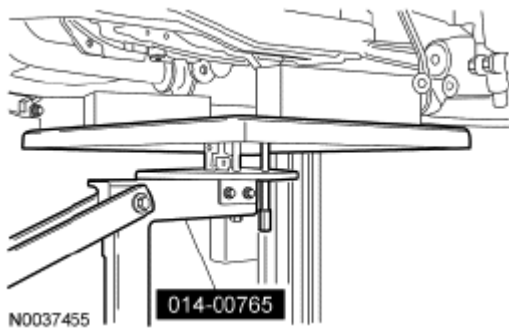
**Fig. 885: Identifying Transaxle Support Insulator Bracket Nuts**  
Courtesy of FORD MOTOR CO.

67. Install the transaxle support insulator through bolt and nut.
  - Tighten to 175 Nm (129 lb-ft).



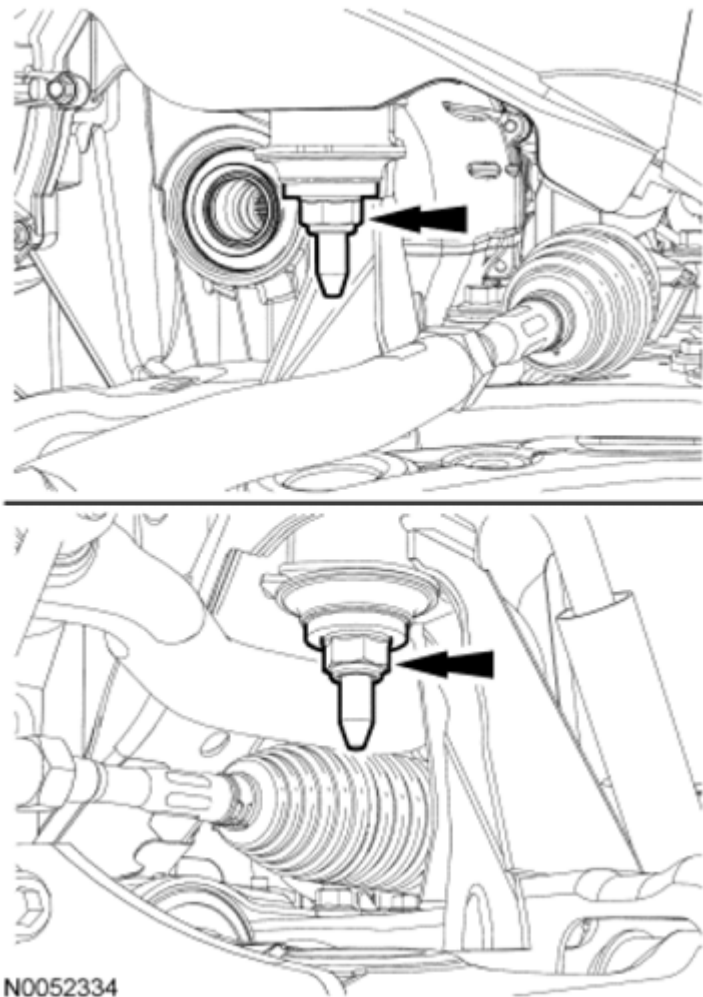
**Fig. 886: Locating Transaxle Support Insulator Through Bolt And Nut**  
Courtesy of FORD MOTOR CO.

68. Using the Powertrain Lift, raise the subframe into the installed position.



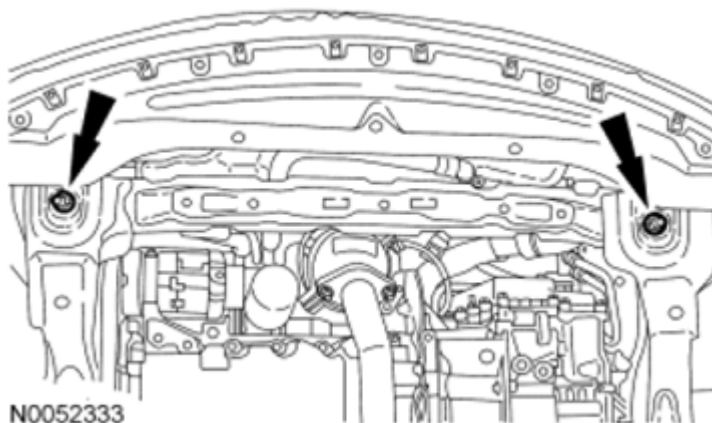
**Fig. 887: Positioning Powertrain Lift Under Subframe Assembly**  
Courtesy of FORD MOTOR CO.

69. Install the 2 middle subframe nuts.
- Tighten to 133 Nm (98 lb-ft).



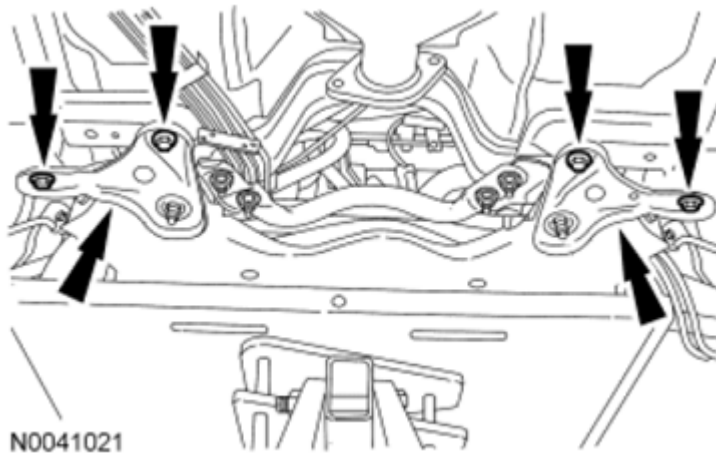
**Fig. 888: Locating Middle Subframe Nuts**  
Courtesy of FORD MOTOR CO.

70. Install the 2 front subframe nuts.
- Tighten to 133 Nm (98 lb-ft).



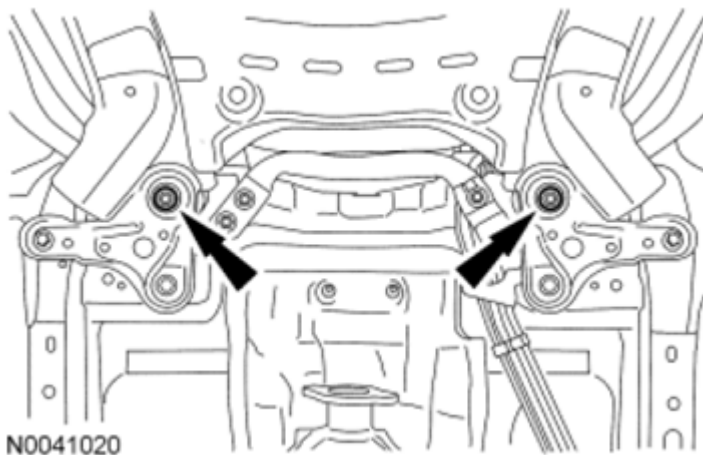
**Fig. 889: Locating Front Subframe Nuts**  
Courtesy of FORD MOTOR CO.

71. Position the subframe support brackets in place and loosely install the 4 bolts.



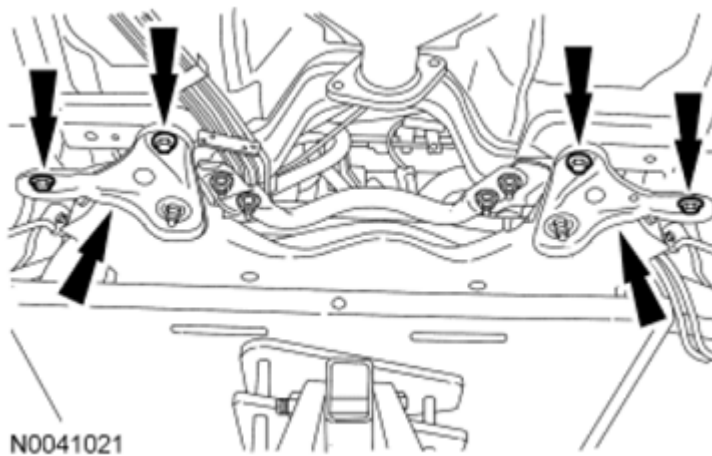
**Fig. 890: Locating Subframe Support Bracket Bolts**  
Courtesy of FORD MOTOR CO.

72. Install the 2 rear subframe bracket nuts.
- Tighten to 133 Nm (98 lb-ft).



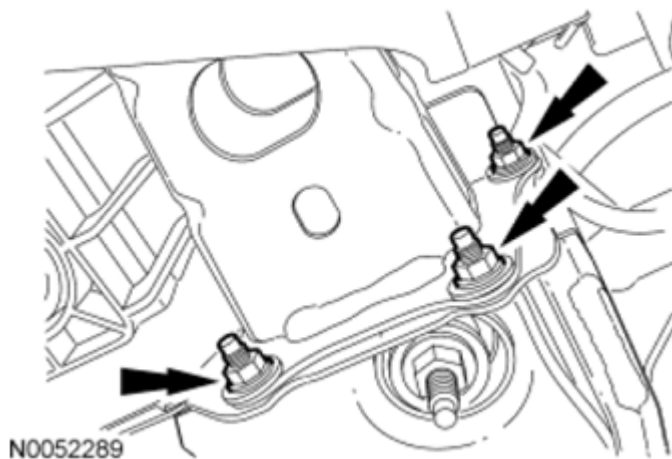
**Fig. 891: Locating Rear Subframe Bracket Nuts**  
Courtesy of FORD MOTOR CO.

73. Tighten the 4 subframe support bracket bolts.
- Tighten to 90 Nm (66 lb-ft).



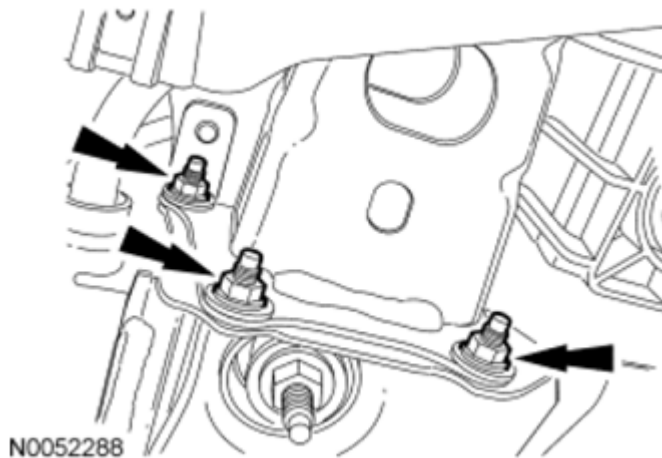
**Fig. 892: Locating Subframe Support Bracket Bolts**  
Courtesy of FORD MOTOR CO.

74. Position the lower bumper on the subframe and install the 3 LH nuts.
- Tighten to 9 Nm (80 lb-in).



**Fig. 893: Locating LH Subframe-To-Lower Bumper Nuts**  
Courtesy of FORD MOTOR CO.

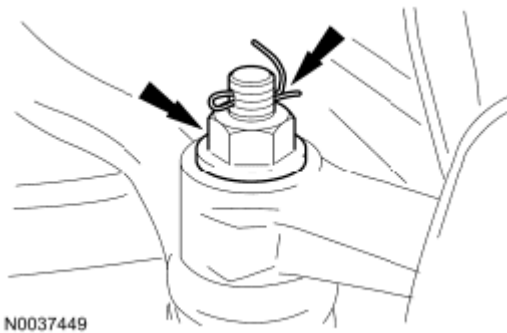
75. Install the 3 RH lower bumper-to-subframe nuts.
- Tighten to 9 Nm (80 lb-in).



**Fig. 894: Locating RH Subframe-To-Lower Bumper Nuts**  
Courtesy of FORD MOTOR CO.

**NOTE:** RH shown in illustration, LH similar.

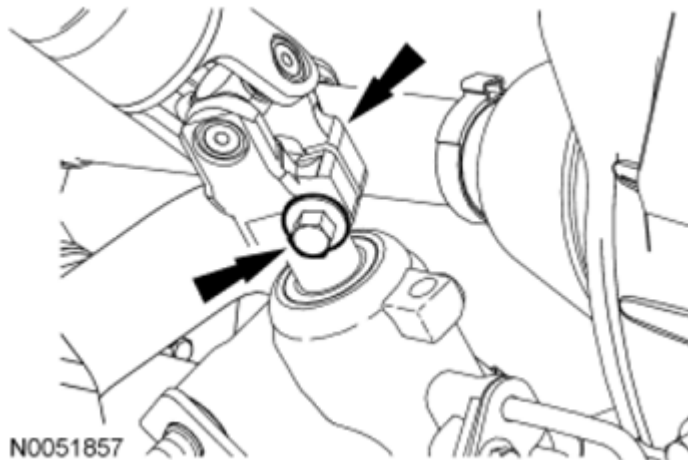
76. Install the tie-rod ends and nuts.
- Tighten to 48 Nm (35 lb-ft).
  - Install new cotter pins.



**Fig. 895: Locating Tie-Rod Ends And Nuts**  
Courtesy of FORD MOTOR CO.

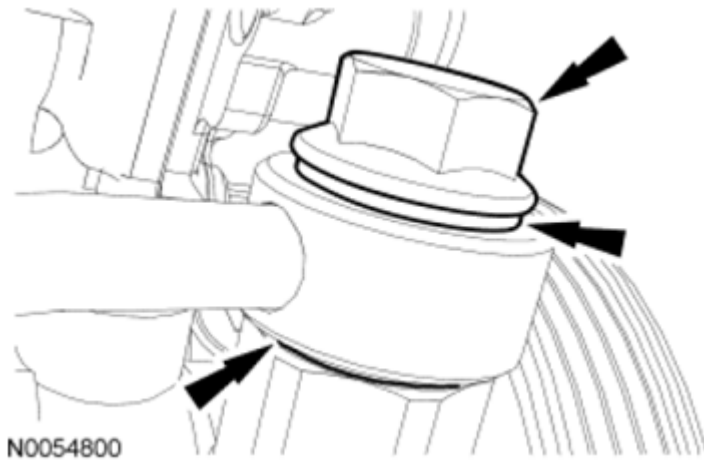
**NOTE:** Do not allow the intermediate shaft to rotate while it is disconnected from the gear or damage to the clockspring can occur. If there is evidence that the intermediate shaft has rotated, the clockspring must be removed and recentered. For additional information, refer to SUPPLEMENTAL RESTRAINT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

77. Install the intermediate shaft onto the steering gear and install a new bolt.
- Tighten to 23 Nm (17 lb-ft).



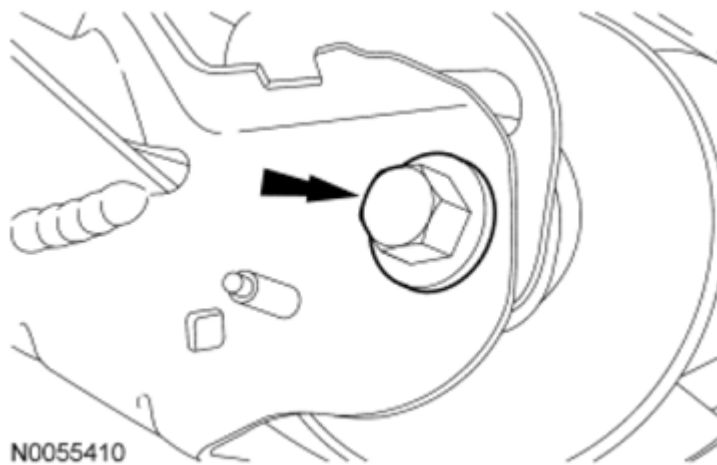
**Fig. 896: Locating Steering Intermediate Shaft Bolt**  
Courtesy of FORD MOTOR CO.

78. Using a new banjo bolt and 2 new seals, install the **PSP** tube.
- Tighten to 48 Nm (35 lb-ft).



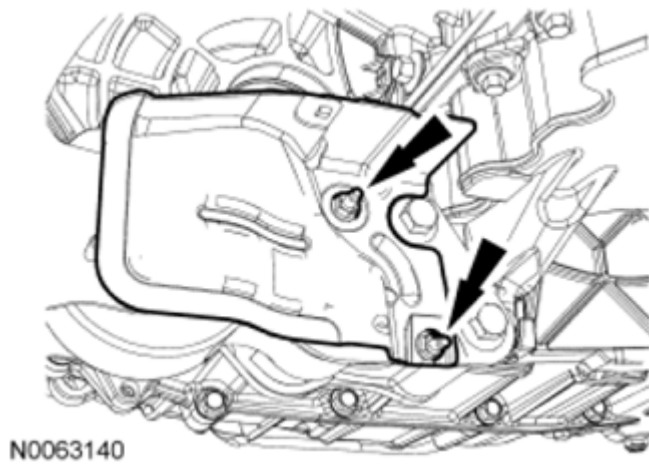
**Fig. 897: Locating Power Steering Pressure Tube-To-Pump Banjo Bolt**  
Courtesy of FORD MOTOR CO.

79. Install the engine roll restrictor-to-subframe through bolt.
- Tighten to 103 Nm (76 lb-ft).



**Fig. 898: Locating Engine Roll Restrictor-To-Subframe Through Bolt**  
Courtesy of FORD MOTOR CO.

80. Install the roll restrictor heat shield and the 2 nuts.
- Tighten to 11 Nm (97 lb-in).

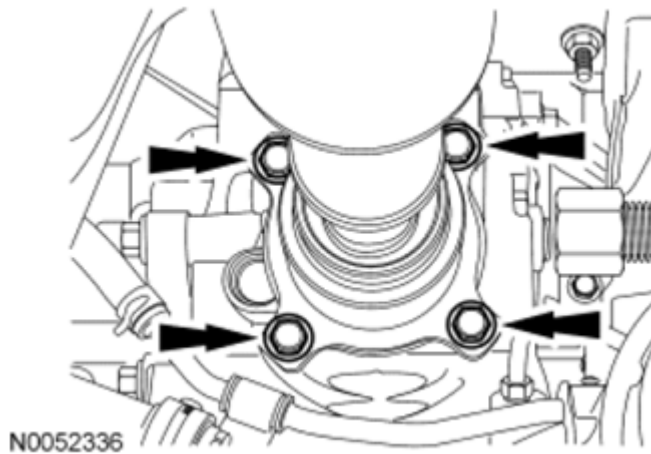


**Fig. 899: Locating Roll Restrictor Heat Shield Nuts**  
Courtesy of FORD MOTOR CO.

#### **AWD vehicles**

81. 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).

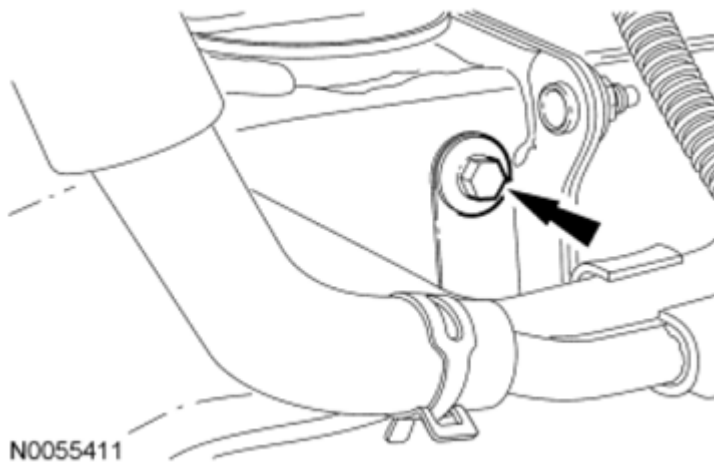




**Fig. 900: Locating Driveshaft Bolts**  
Courtesy of FORD MOTOR CO.

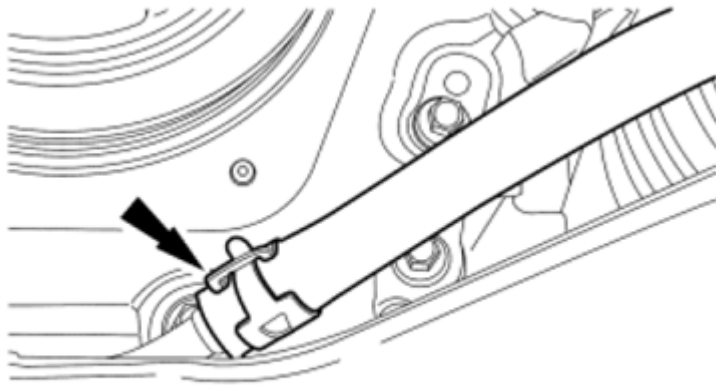
**All vehicles**

82. Install the power steering cooler bracket bolt to the RH side of the subframe.
  - Tighten to 9 Nm (80 lb-in).



**Fig. 901: Locating Power Steering Cooler Bracket Bolt**  
Courtesy of FORD MOTOR CO.

83. Connect the power steering cooler hose.

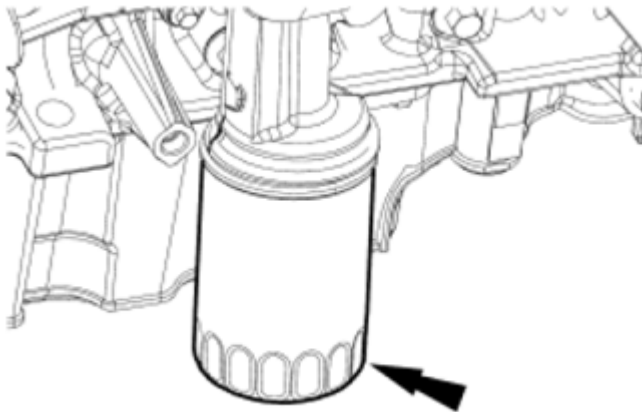


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**Fig. 902: Locating Power Steering Cooler Hose**  
Courtesy of FORD MOTOR CO.

**NOTE:** Lubricate the engine oil filter gasket with clean engine oil prior to installing the oil filter.

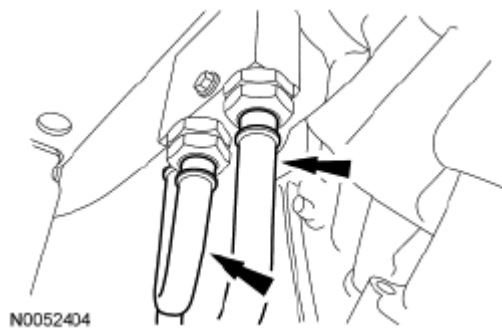
84. Install a new engine oil filter.
- Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.



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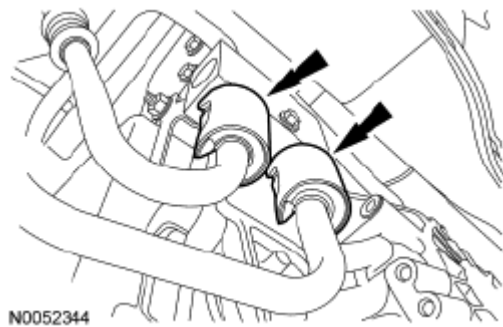
**Fig. 903: Locating Engine Oil Filter**  
Courtesy of FORD MOTOR CO.

85. Connect the 2 transmission fluid cooler tubes.



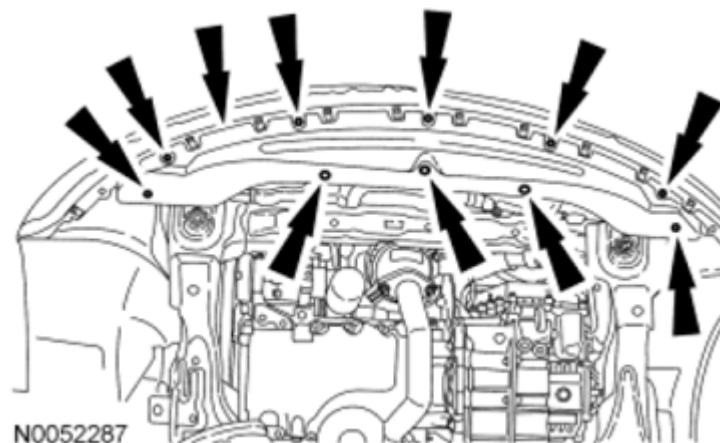
**Fig. 904: Locating Transmission Fluid Cooler Tubes**  
Courtesy of FORD MOTOR CO.

86. Install the 2 secondary latches onto the transmission fluid cooler tubes.



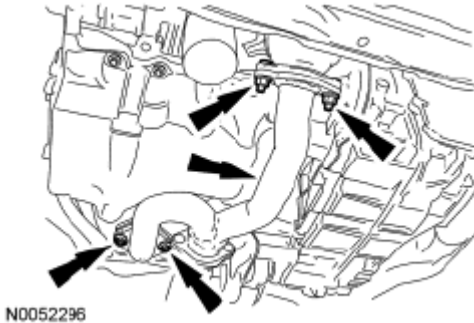
**Fig. 905: Locating Secondary Latches**  
Courtesy of FORD MOTOR CO.

87. Install the LH inner splash shield. For additional information, refer to **FRONT END BODY PANELS** .  
88. Install the radiator splash shield, the 3 pin-type retainers and the 7 screws.



**Fig. 906: Locating Pin-Type Retainers**  
Courtesy of FORD MOTOR CO.

89. Using a new gasket, install the Y-pipe and exhaust flexible pipe assembly and 4 new nuts.
- Tighten to 40 Nm (30 lb-ft).



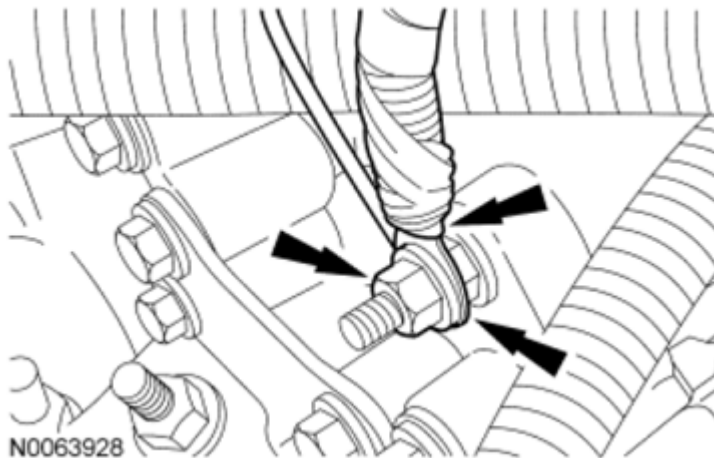
**Fig. 907: Locating Exhaust Flexible Pipe Nuts**  
Courtesy of FORD MOTOR CO.

90. Install the 2 exhaust hangers and tighten the exhaust clamp.
- Tighten to 40 Nm (30 lb-ft).



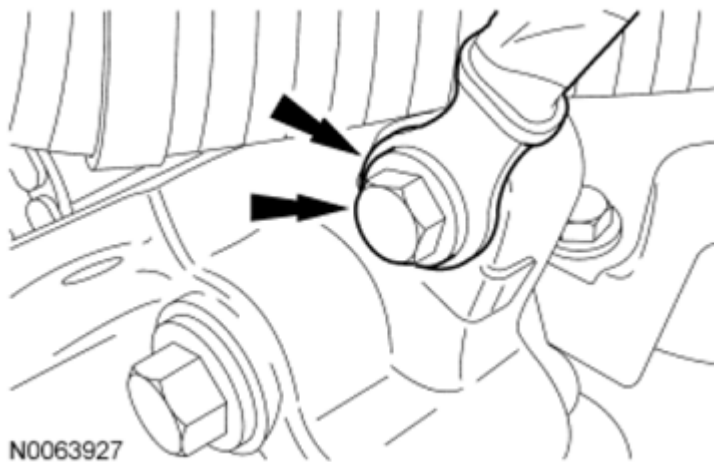
**Fig. 908: Locating Exhaust Flexible Pipe Clamp**  
Courtesy of FORD MOTOR CO.

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



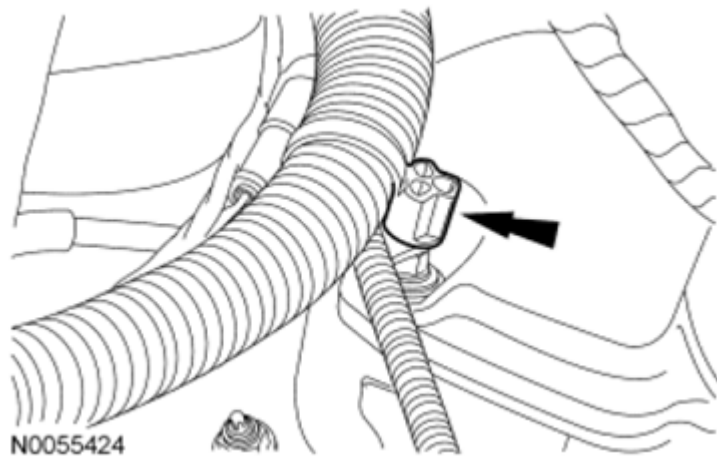
**Fig. 909: Locating Ground Wire Nut**  
Courtesy of FORD MOTOR CO.

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



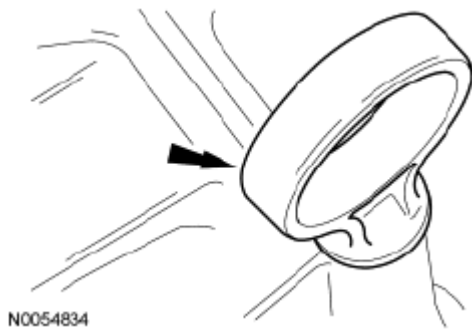
**Fig. 910: Locating Ground Wire Bolt**  
Courtesy of FORD MOTOR CO.

93. Attach the wiring harness retainer to the RH valve cover stud bolt.



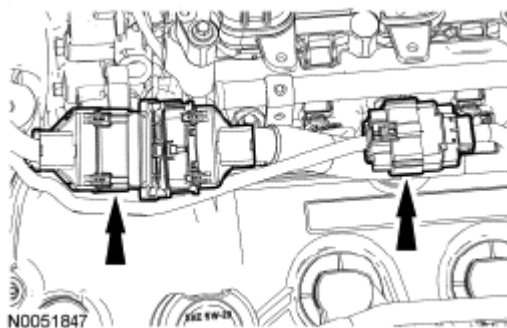
**Fig. 911: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

94. Install the oil level indicator.



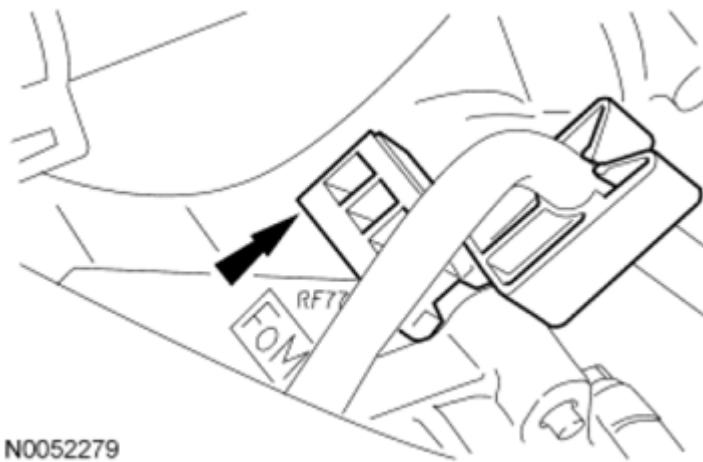
**Fig. 912: Locating Oil Level Indicator**  
Courtesy of FORD MOTOR CO.

95. Connect the 2 engine wiring harness electrical connectors.
- Attach the electrical connector to the LH valve cover.



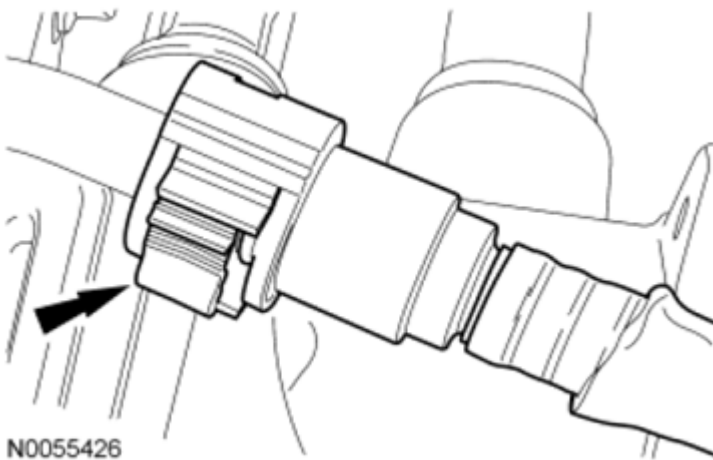
**Fig. 913: Locating Engine Wiring Harness Electrical Connectors**  
Courtesy of FORD MOTOR CO.

96. Connect the fuel hose routing clip to the transaxle stud.



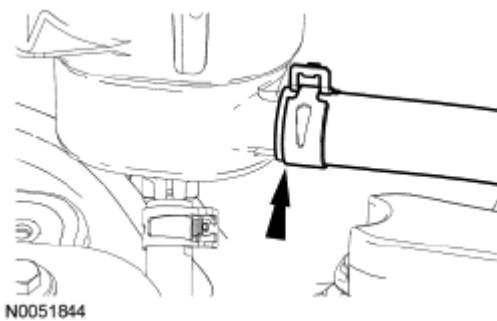
**Fig. 914: Locating Fuel Hose Routing Clip**  
Courtesy of FORD MOTOR CO.

97. Connect the fuel supply tube. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION**.



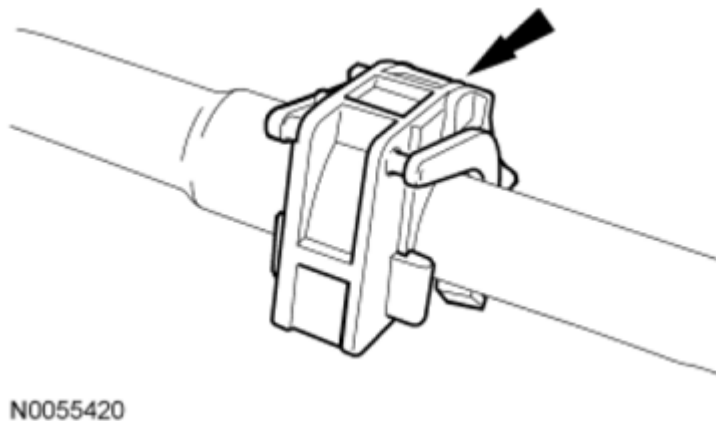
**Fig. 915: Locating Fuel Supply Tube**  
Courtesy of FORD MOTOR CO.

98. Connect the hose to the power steering reservoir.



**Fig. 916: Locating Hose**  
Courtesy of FORD MOTOR CO.

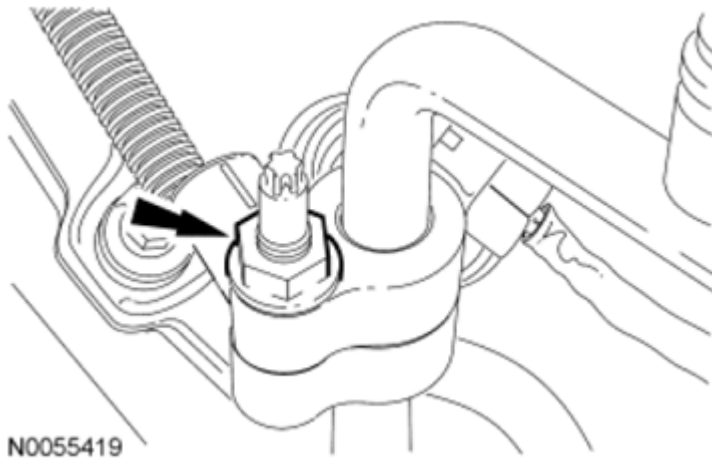
99. Connect the A/C suction tube fitting.
  - Install the safety clip onto the A/C fitting.



**Fig. 917: Locating A/C Suction Tube Safety Clip**  
Courtesy of FORD MOTOR CO.

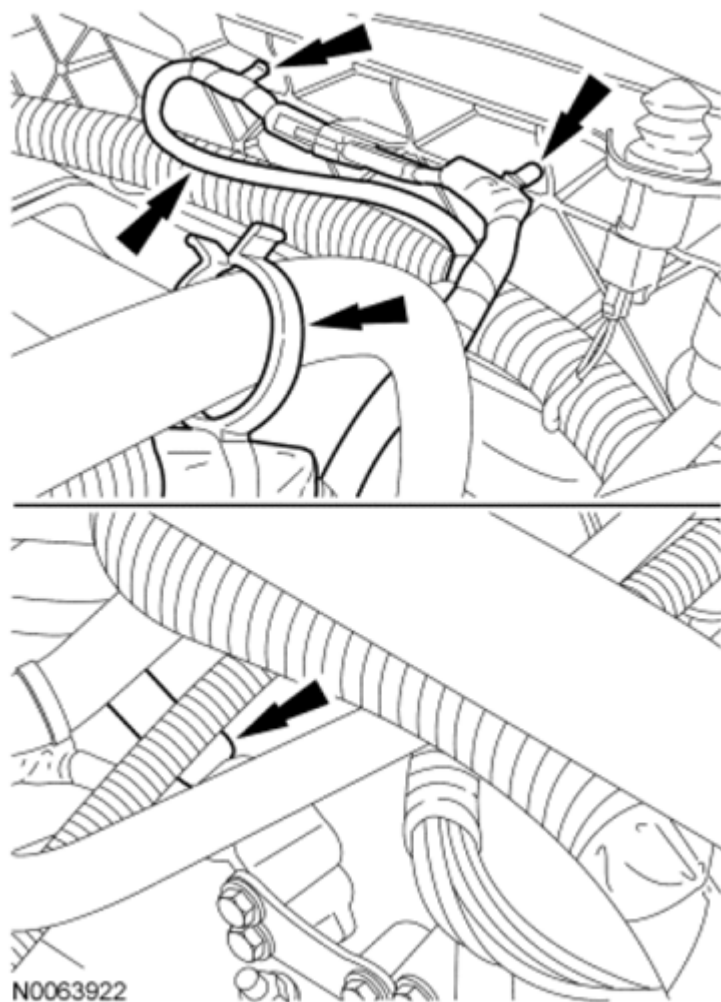
100. Using a new O-ring seal, connect the A/C pressure tube fitting and install the nut.
  - Tighten to 8 Nm (71 lb-in).





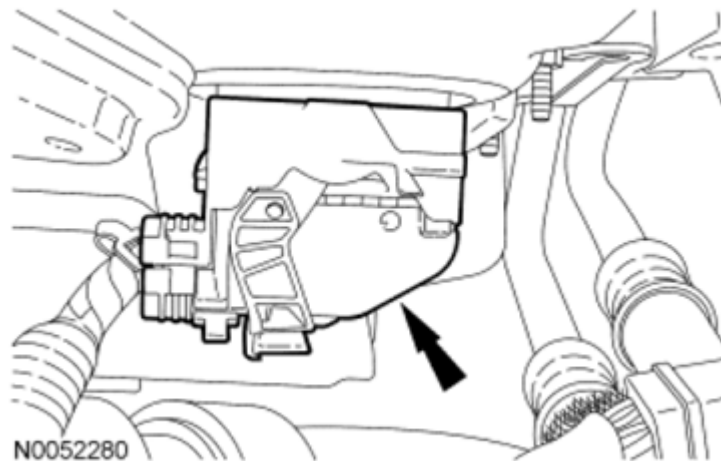
**Fig. 918: Locating A/C Pressure Tube Fitting And Nut**  
Courtesy of FORD MOTOR CO.

101. If equipped, attach the engine block heater harness retainers from to the radiator support and the A/C suction tube.



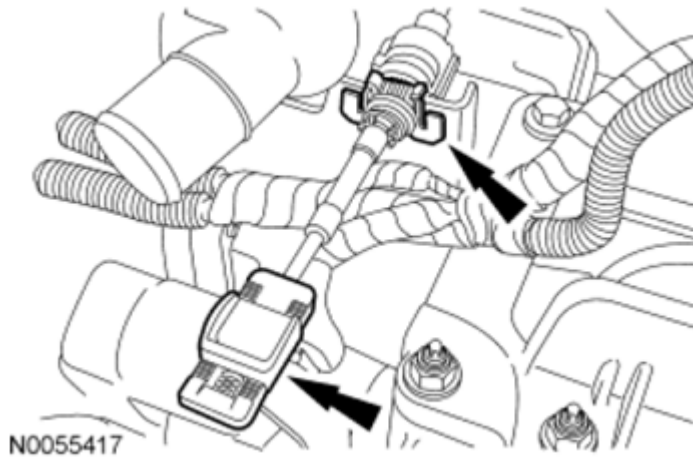
**Fig. 919: Locating Engine Block Heater Harness And A/C Suction Tube**  
Courtesy of FORD MOTOR CO.

102. Connect the transaxle control electrical connector.



**Fig. 920: Locating Transaxle Control Electrical Connector**  
Courtesy of FORD MOTOR CO.

103. Attach the control cable to the bracket.
- Connect the transaxle control cable to the control lever.



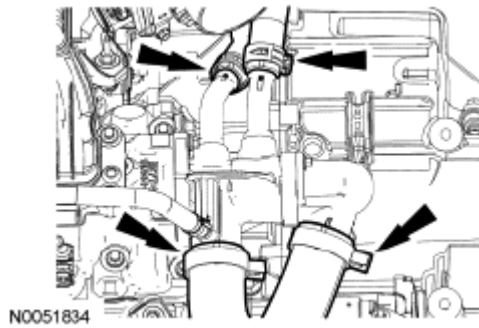
**Fig. 921: Locating Transaxle Control Cable**  
Courtesy of FORD MOTOR CO.

104. Attach the wiring harness retainer to the transaxle control cable bracket.



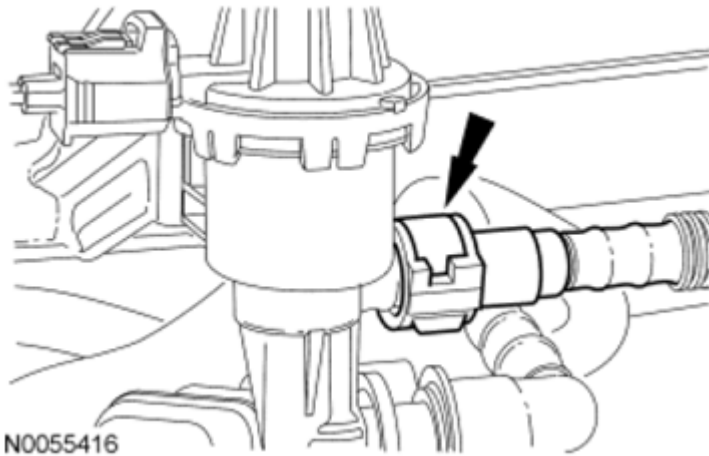
**Fig. 922: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

105. Connect the upper radiator hose, lower radiator hose and 2 heater hoses to the thermostat housing.



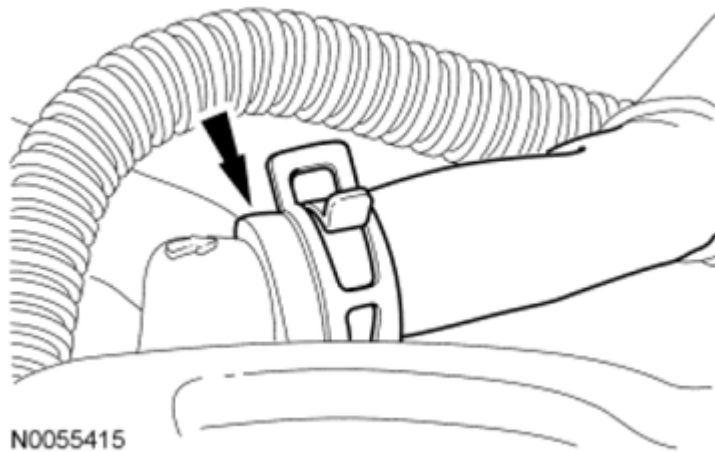
**Fig. 923: Locating Upper And Lower Radiator Hose**  
Courtesy of FORD MOTOR CO.

106. Connect the upper Evaporative Emission (EVAP) tube quick connect coupling to the purge valve. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** .



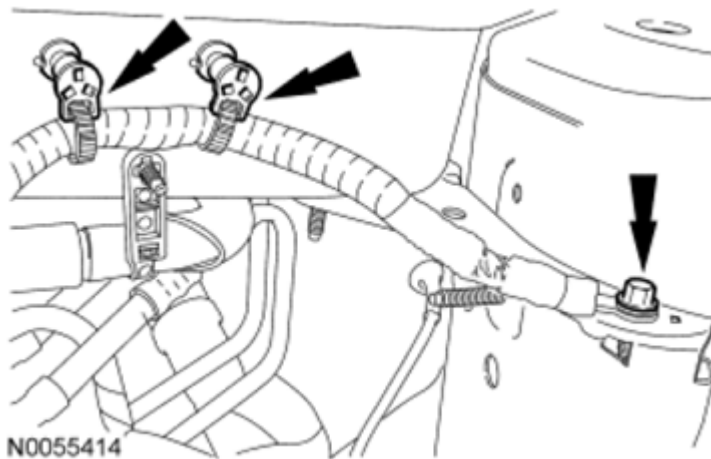
**Fig. 924: Locating Upper Evaporative Emission Tube**  
Courtesy of FORD MOTOR CO.

107. Connect the vacuum hose to the upper intake manifold.



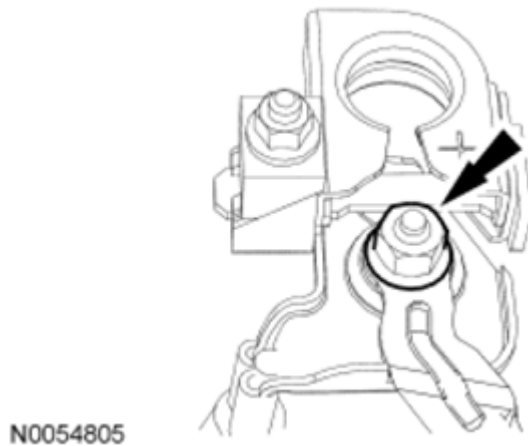
**Fig. 925: Locating Vacuum Hose**  
Courtesy of FORD MOTOR CO.

108. Install the ground wire and the bolt.
- Tighten to 10 Nm (89 lb-in).
  - Attach the 2 wiring harness retainers to the cowl.



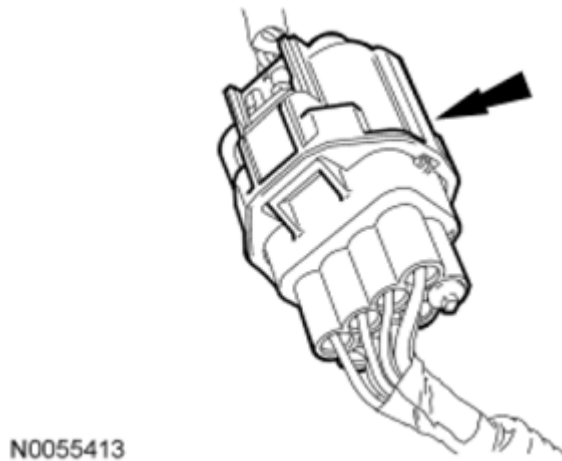
**Fig. 926: Locating Wiring Harness Retainers**  
Courtesy of FORD MOTOR CO.

109. Connect the power feed to the battery terminal and install the nut.
- Tighten to 8 Nm (71 lb-in).



**Fig. 927: Locating Battery Terminal Nut**  
Courtesy of FORD MOTOR CO.

110. Connect the battery harness electrical connector.



**Fig. 928: Locating Battery Harness Electrical Connector**  
Courtesy of FORD MOTOR CO.

111. Install the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** .
112. Install the engine Air Cleaner (ACL) and the ACL outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING** .
113. Install the degas bottle. For additional information, refer to **ENGINE COOLING** .
114. Install the LH halfshaft and intermediate shaft. For additional information, refer to **FRONT DRIVE HALFSHAFTS** .
115. Install the accessory drive belt and the power steering belt. For additional information, refer to **ACCESSORY DRIVE** .

**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.**

116. Fill the engine with clean engine oil.
117. Fill and bleed the cooling system. For additional information, refer to **ENGINE COOLING**.
118. Fill the power steering system. For additional information, refer to **STEERING SYSTEM**.
119. Recharge the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS**.

## VALVE TAPPETS

### Material

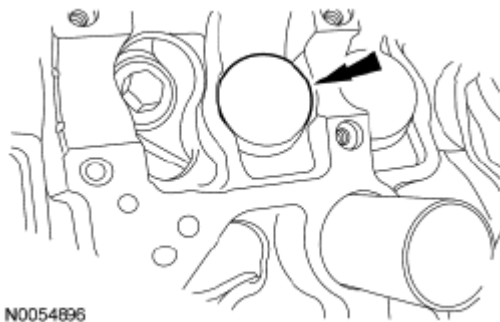
### MATERIAL SPECIFICATION

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

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

**NOTE:** The valve tappets must be installed in their original positions.

**NOTE:** Coat the valve tappets with clean engine oil prior to installation.



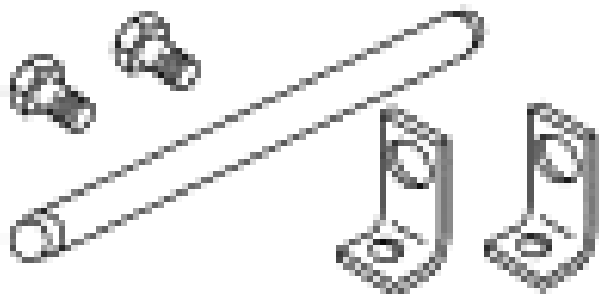
**Fig. 929: Locating Valve Tappets**  
Courtesy of FORD MOTOR CO.

1. Install the valve tappets.
2. Depending on the valve tappets being serviced, install the LH and/or the RH camshafts. For additional information, refer to **CAMSHAFT**.

## VALVE SPRING, RETAINER AND SEAL

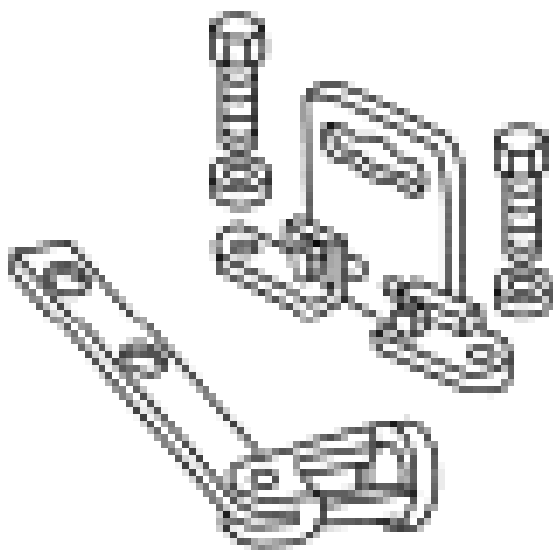
## Special Tool(s)

## SPECIAL TOOL SPECIFICATION



ST1981-A

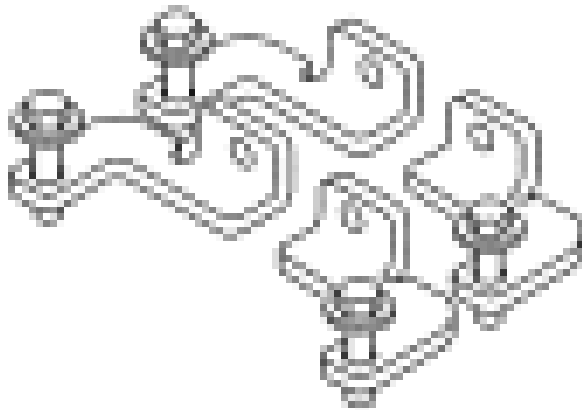
Compressor, Valve Spring  
303-300 (T87C-6565-A)



ST1907-A

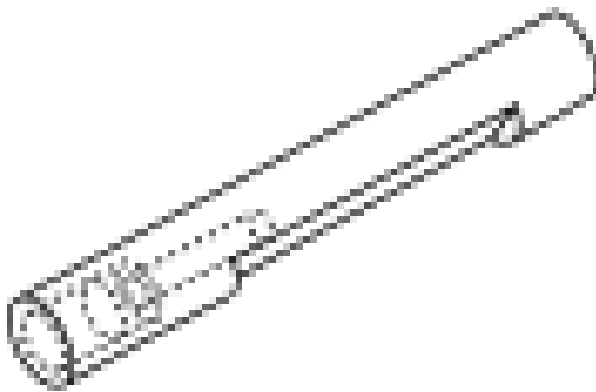
Compressor, Valve Spring  
303-350 (T89P-6565-A)





ST302B-A

Compressor, Valve Spring  
303-1249



ST190B-A

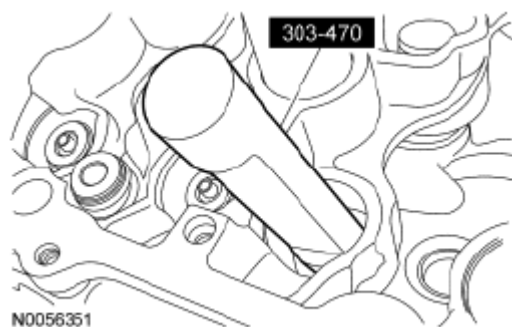
Installer, Valve Stem Oil Seal  
303-470 (T94P-6510-CH)

## Material

### MATERIAL SPECIFICATION

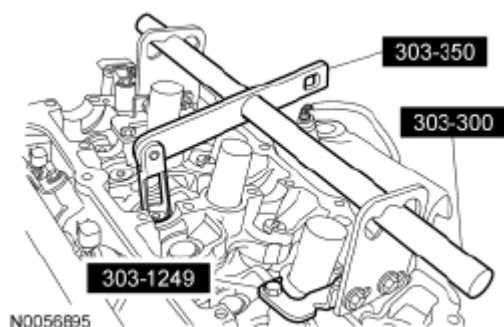
Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

**NOTE:** Lubricate the valve stem seal with clean engine oil prior to installation.



**Fig. 930: Identifying Valve Stem Oil Seal Installer**  
Courtesy of FORD MOTOR CO.

1. Using the Valve Stem Oil Seal Installer, install a new valve stem seal.
2. Using the Valve Spring Compressors, install the valve spring, retainer and key.



**Fig. 931: Identifying 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 SPECIFICATION

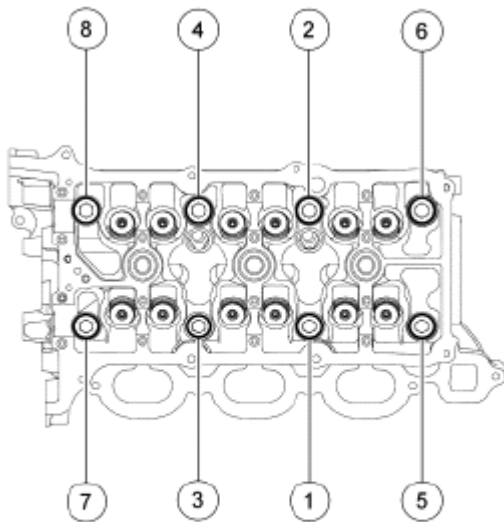
Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

**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:** On early build engines, the timing chain rides on the inner side of the RH timing chain guide. Late build engines are equipped with a different design RH timing chain guide that requires the timing chain to ride on the outer side of the RH timing chain guide. For service, all replacement RH timing chain guides will be the late build design.

#### All vehicles

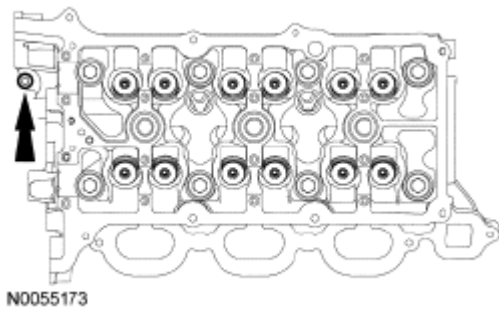
1. Install a new gasket, the RH cylinder head and 8 new bolts. Tighten in the sequence shown in illustration in 5 stages:
  - Stage 1: Tighten to 20 Nm (177 lb-in).
  - Stage 2: Tighten to 35 Nm (26 lb-ft).
  - Stage 3: Tighten 90 degrees.
  - Stage 4: Tighten 90 degrees.
  - Stage 5: Tighten 90 degrees.



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**Fig. 932: Identifying RH Cylinder Head Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

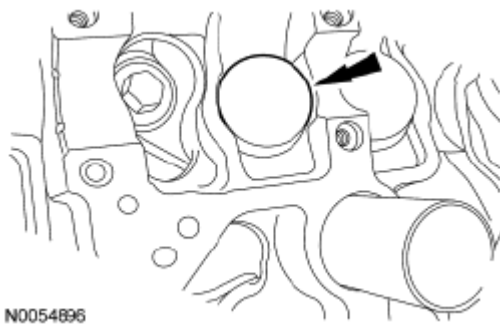
2. Install the bolt.
  - Tighten to 10 Nm (89 lb-in).



**Fig. 933: Identifying RH Cylinder Head Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

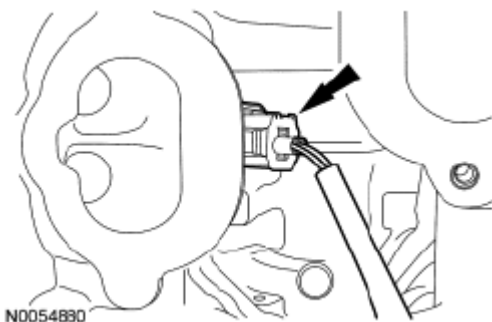
**NOTE:** The valve tappets must be installed in their original positions.

**NOTE:** Coat the valve tappets with clean engine oil prior to installation.



**Fig. 934: Locating Valve Tappets**  
Courtesy of FORD MOTOR CO.

3. Install the valve tappets.
4. Install and connect the Cylinder Head Temperature (CHT) sensor jumper harness.

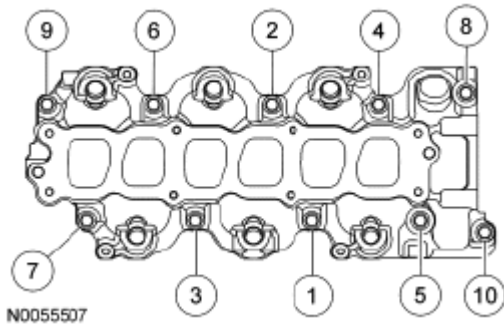


**Fig. 935: Locating CHT Sensor Jumper Harness**  
Courtesy of FORD MOTOR CO.

**NOTE:** If the engine is repaired or replaced because of upper engine failure,

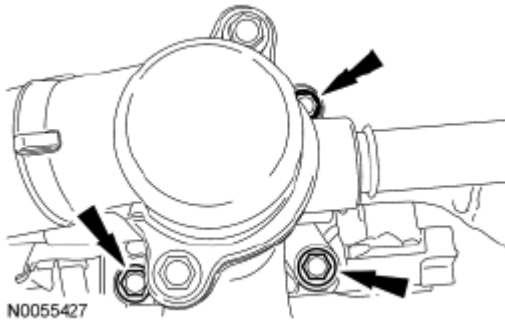
typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

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



**Fig. 936: Identifying Intake Manifold Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

6. Using a new gasket and O-ring seal, install the thermostat housing and the 3 bolts.
  - Tighten to 10 Nm (89 lb-in).



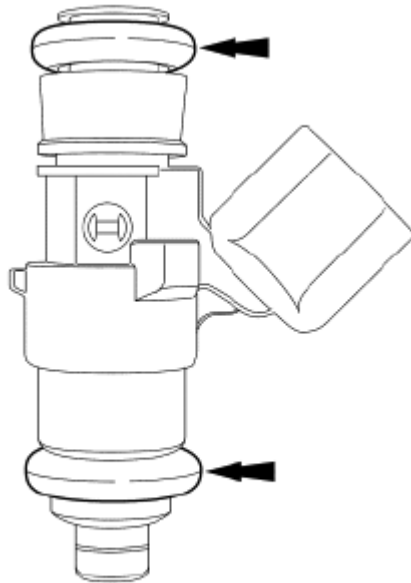
**Fig. 937: Locating Thermostat Housing-To-Lower Intake Manifold Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-rings can cause the fuel system to leak. Do not reuse the O-ring seals.

**NOTE:** The upper and lower O-ring seals are not interchangeable.

7. Install new fuel injector O-ring seals.
  - Remove the retaining clips and separate the fuel injectors from the fuel rail.
  - Remove and discard the O-ring seals.

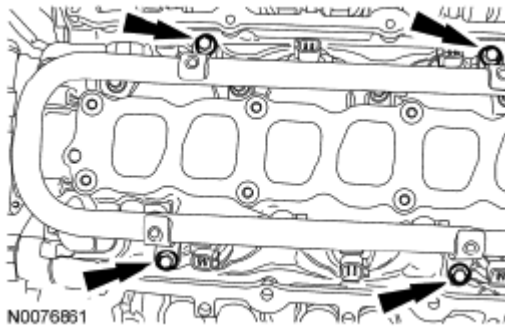
- Install new O-ring seals and lubricate with clean engine oil.
- Install the fuel injectors and the retaining clips onto the fuel rail.



N0055508

**Fig. 938: Locating Fuel Injector O-Ring Seals**  
Courtesy of FORD MOTOR CO.

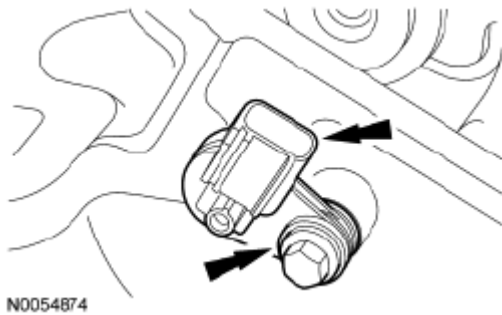
8. Install the fuel rail and injectors as an assembly and install the 4 bolts.
- Tighten to 10 Nm (89 lb-in).



N0076861

**Fig. 939: Locating Fuel Rail Bolts**  
Courtesy of FORD MOTOR CO.

9. Install the RH Camshaft Position (CMP) sensor and the bolt.
- Tighten to 10 Nm (89 lb-in).

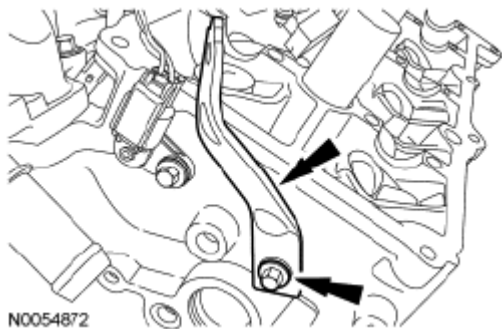


**Fig. 940: Locating RH CMP Sensor Bolt**  
Courtesy of FORD MOTOR CO.

**NOTE:** Align the bracket with the index mark made during removal.

10. Install the upper intake manifold bracket and the bolt.

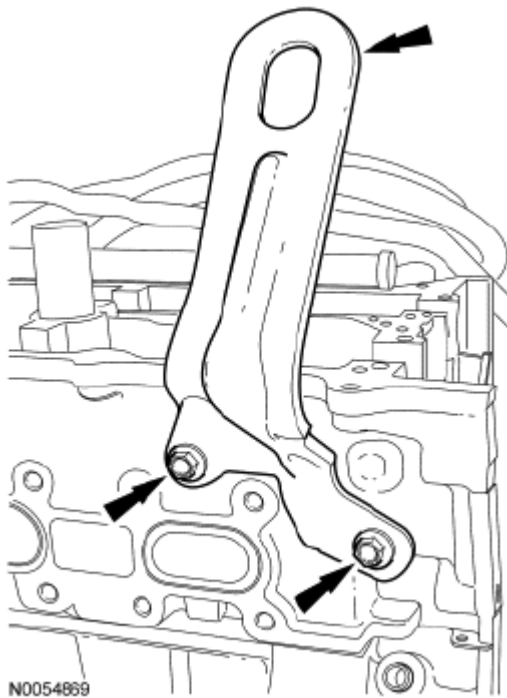
- Tighten to 10 Nm (89 lb-in).



**Fig. 941: Locating Upper Intake Manifold Bracket Bolt**  
Courtesy of FORD MOTOR CO.

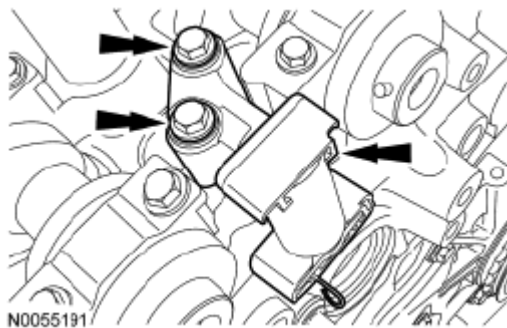
11. Install the engine lifting eye and the 2 bolts.

- Tighten to 24 Nm (18 lb-ft).



**Fig. 942: Locating Engine Lifting Eye With Bolts**  
Courtesy of FORD MOTOR CO.

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

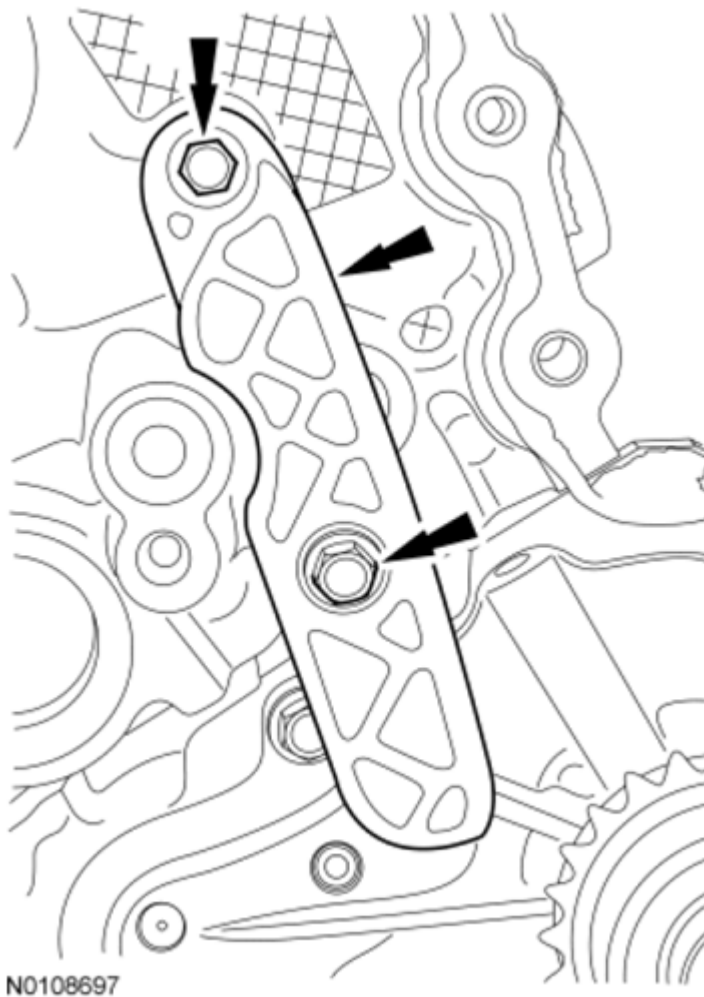


**Fig. 943: Locating RH Secondary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

**Engines equipped with late build/replacement RH timing chain guides**

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

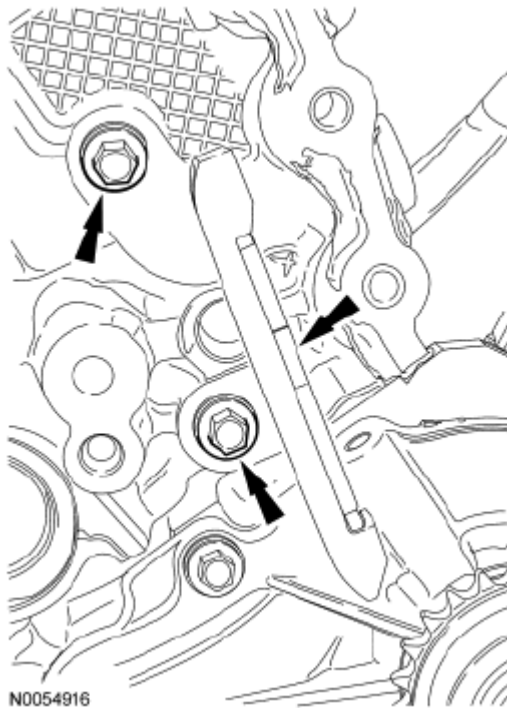




**Fig. 944: Locating RH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

**Engines equipped with early build RH timing chain guides**

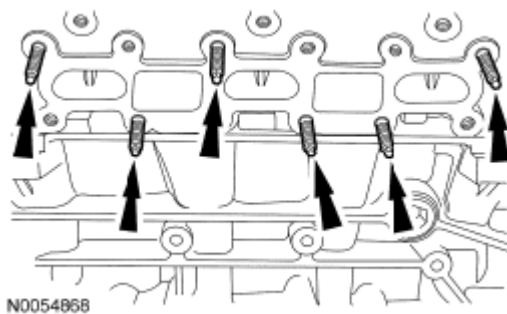
14. Install the RH primary timing chain guide and the 2 bolts.
  - Tighten to 10 Nm (89 lb-in).



**Fig. 945: Locating RH Primary Timing Chain Guide Bolts**  
Courtesy of FORD MOTOR CO.

**All vehicles**

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

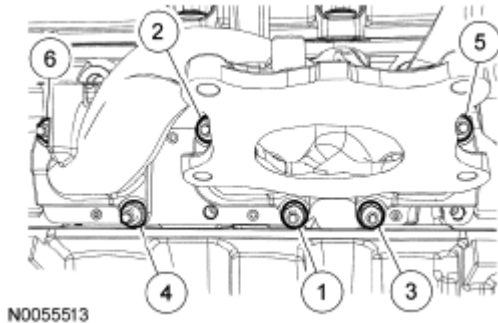


**Fig. 946: Locating RH Exhaust Manifold Studs**  
Courtesy of FORD MOTOR CO.

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

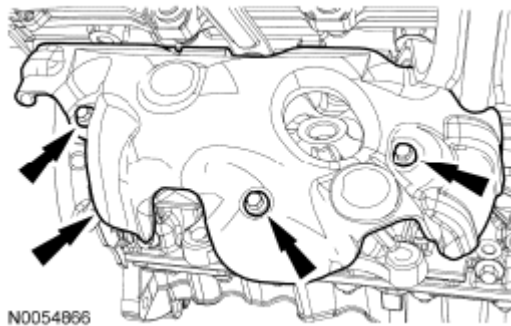
16. Using a new gasket, install the RH exhaust manifold and 6 new nuts. Tighten in 2 stages in the sequence shown in illustration:

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



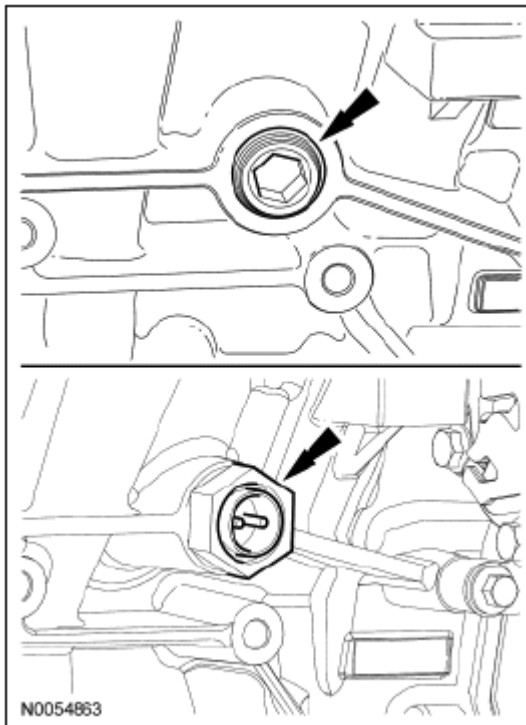
**Fig. 947: Identifying RH Exhaust Manifold Nuts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

17. Install the RH exhaust manifold heat shield and the 3 bolts.
  - Tighten to 10 Nm (89 lb-in).



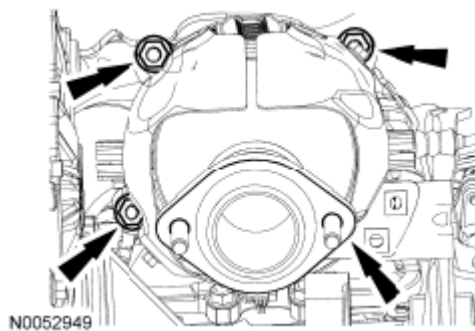
**Fig. 948: Locating RH Exhaust Manifold Heat Shield Bolts**  
Courtesy of FORD MOTOR CO.

18. Install the RH cylinder block drain plug or, if equipped, the block heater.
  - Tighten to 40 Nm (30 lb-ft).



**Fig. 949: Locating RH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

**NOTE:** Do not tighten the 4 catalytic converter nuts at this time.

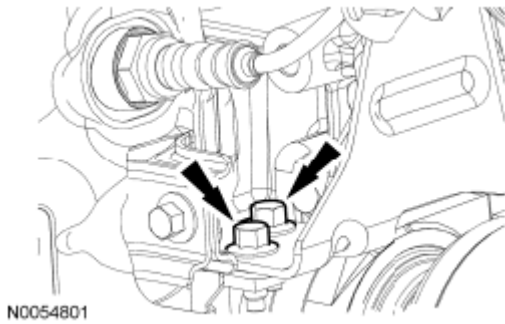


**Fig. 950: Locating RH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

19. Using a new gasket, install the RH catalytic converter and 4 new nuts.

**All-Wheel Drive (AWD) vehicles**

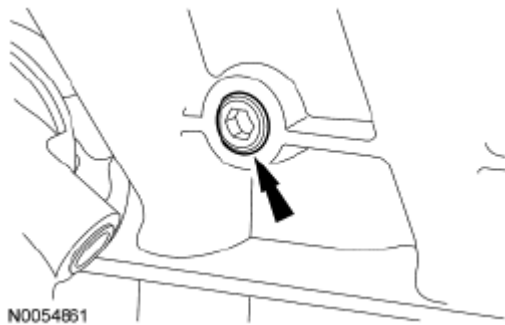
20. Install the 2 RH catalytic converter bracket bolts.
  - Tighten the 4 catalytic converter nuts to 40 Nm (30 lb-ft).
  - Tighten the 2 catalytic converter bracket bolts to 20 Nm (177 lb-in).



**Fig. 951: Locating RH Catalytic Converter Support Bracket Bolts**  
Courtesy of FORD MOTOR CO.

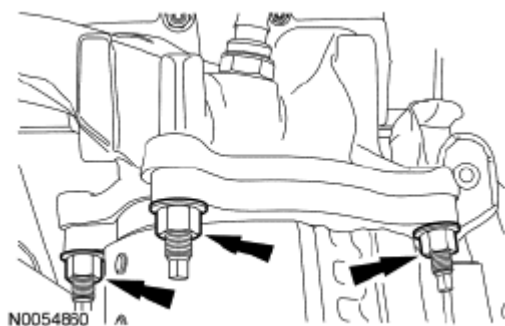
**All vehicles**

21. Install the LH cylinder block drain plug.
  - Tighten to 20 Nm (177 lb-in) plus an additional 180 degrees.



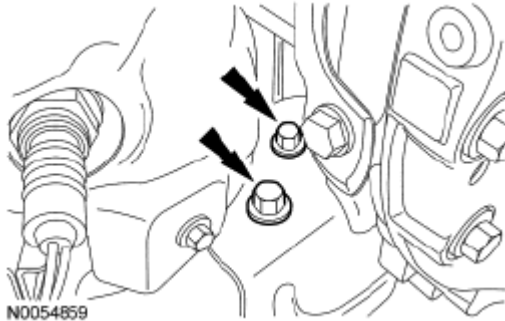
**Fig. 952: Locating LH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

22. Using a new gasket, install the LH catalytic converter and 4 new nuts (3 shown in illustration).
  - Tighten to 40 Nm (30 lb-ft).



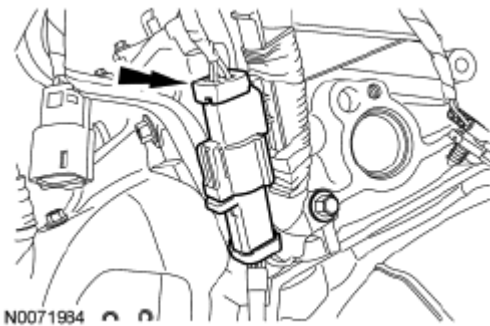
**Fig. 953: Locating LH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

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



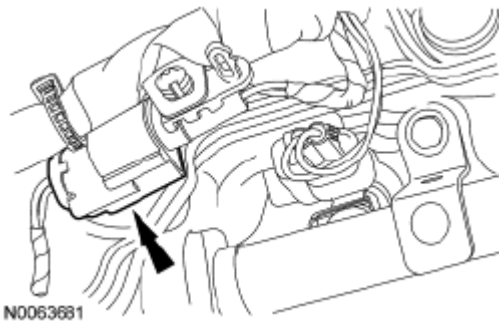
**Fig. 954: Locating LH Catalytic Converter Bracket Bolts**  
Courtesy of FORD MOTOR CO.

24. Connect the LH Catalyst Monitor Sensor (CMS) electrical connector.



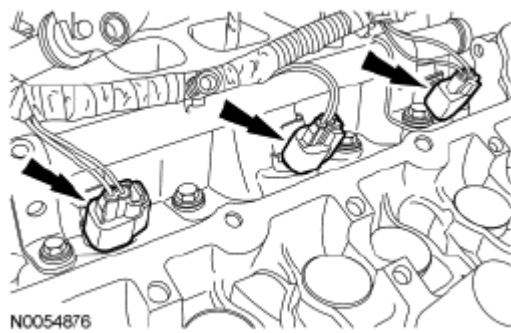
**Fig. 955: Locating LH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

25. Connect the CHT sensor electrical connector.



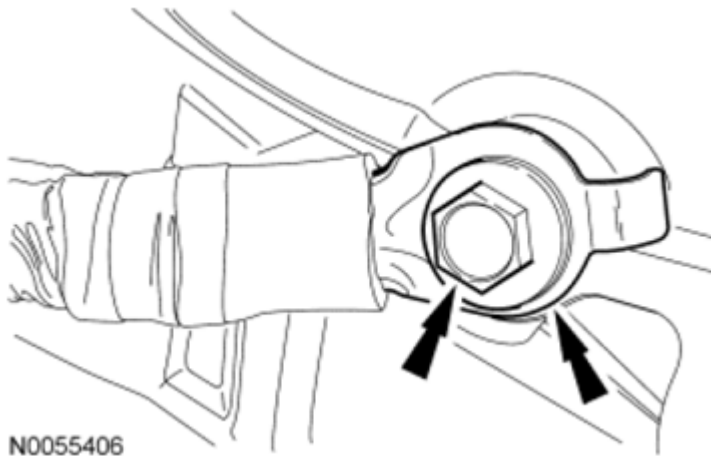
**Fig. 956: Locating Cylinder Head Temperature Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

26. Connect the 6 fuel injector electrical connectors (3 shown in illustration).



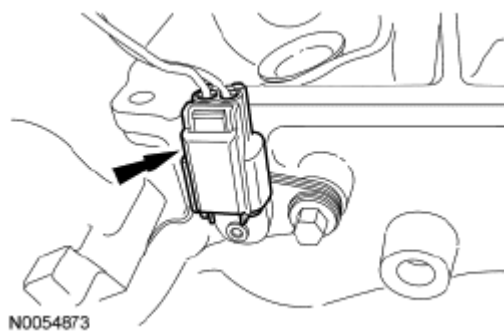
**Fig. 957: Locating Fuel Injector Electrical Connectors**  
Courtesy of FORD MOTOR CO.

27. Install the ground cable and the bolt.
  - Tighten to 10 Nm (89 lb-in).



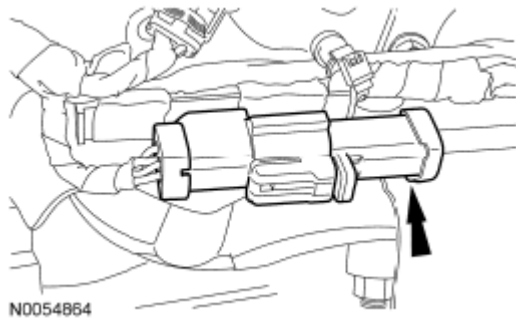
**Fig. 958: Locating Ground Cable Bolts**  
Courtesy of FORD MOTOR CO.

28. Connect the RH CMP sensor electrical connector.



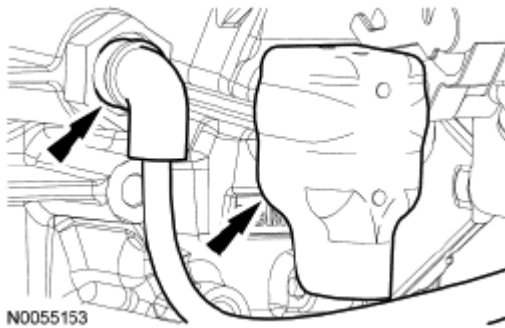
**Fig. 959: Locating RH Camshaft Position (CMP) Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

29. Connect the RH Heated Oxygen Sensor (HO2S) electrical connector.



**Fig. 960: Locating RH Heated Oxygen Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

30. If equipped, install the block heater wiring harness onto the engine.
- Connect the block heater electrical connector and install the heat shield.



**Fig. 961: Locating Heat Shield**  
Courtesy of FORD MOTOR CO.

31. Install the RH camshafts. For additional information, refer to **CAMSHAFT**.

## CYLINDER HEAD - LH

### Material

### MATERIAL SPECIFICATION

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A

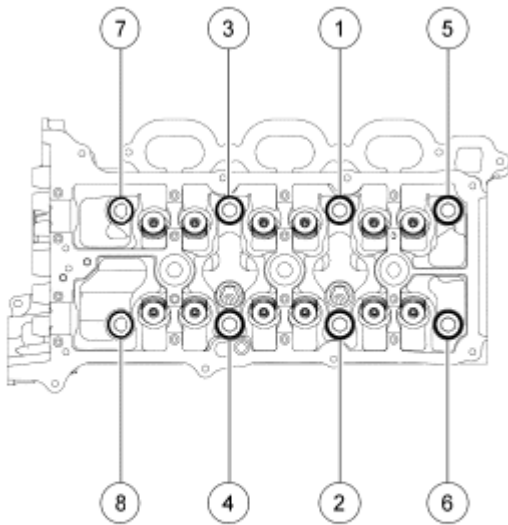
**NOTE:** During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine



failure.

### All vehicles

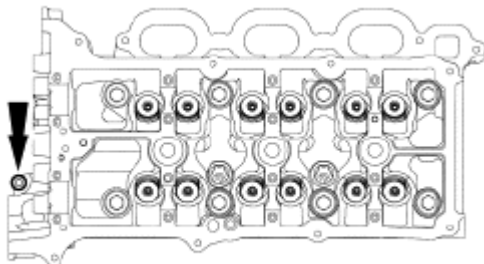
1. Install a new gasket, the LH cylinder head and 8 new bolts. Tighten in the sequence shown in illustration in 5 stages:
  - Stage 1: Tighten to 20 Nm (177 lb-in).
  - Stage 2: Tighten to 35 Nm (26 lb-ft).
  - Stage 3: Tighten 90 degrees.
  - Stage 4: Tighten 90 degrees.
  - Stage 5: Tighten 90 degrees.



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**Fig. 962: Identifying LH Cylinder Head Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

2. Install the bolt.
  - Tighten to 10 Nm (89 lb-in).

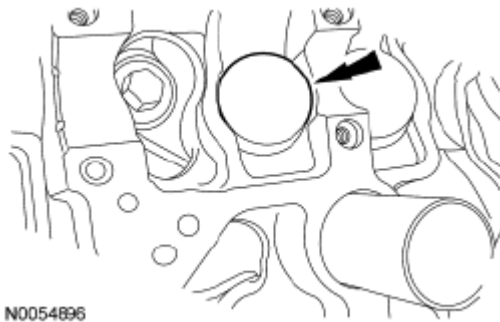


N0055174

**Fig. 963: Locating M6 Bolt**  
Courtesy of FORD MOTOR CO.

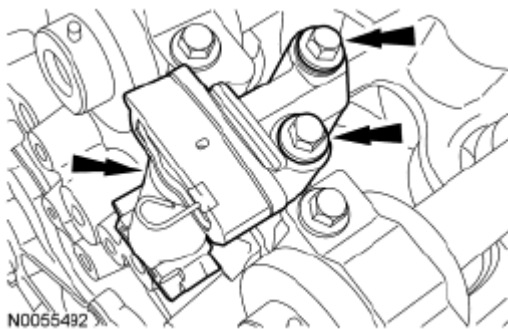
**NOTE:** The valve tappets must be installed in their original positions.

**NOTE:** Coat the valve tappets with clean engine oil prior to installation.



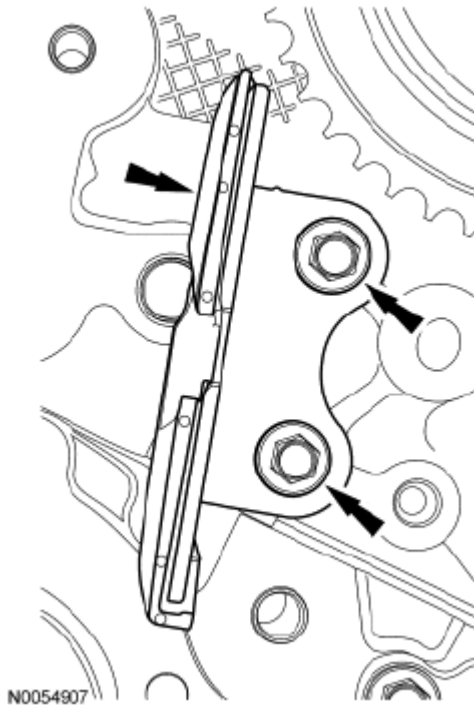
**Fig. 964: Locating Valve Tappets**  
Courtesy of FORD MOTOR CO.

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



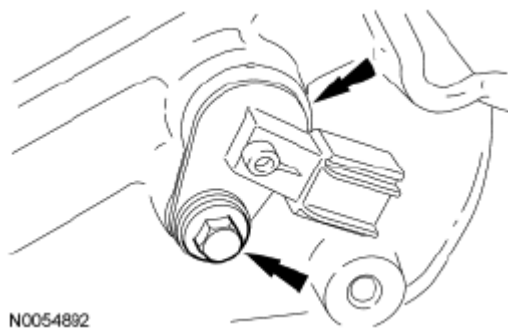
**Fig. 965: Locating LH Secondary Timing Chain Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

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



**Fig. 966: Locating Upper LH Primary Timing Chain Guide With Bolts**  
Courtesy of FORD MOTOR CO.

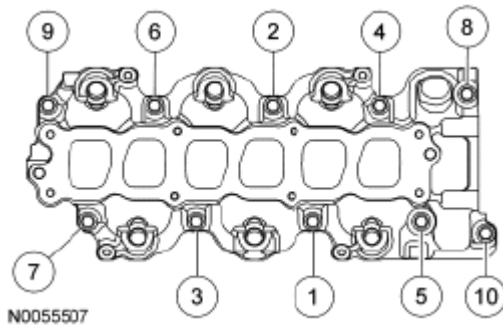
6. Install LH Camshaft Position (CMP) sensor and the bolt.
  - Tighten to 10 Nm (89 lb-in).



**Fig. 967: Locating LH CMP Sensor**  
Courtesy of FORD MOTOR CO.

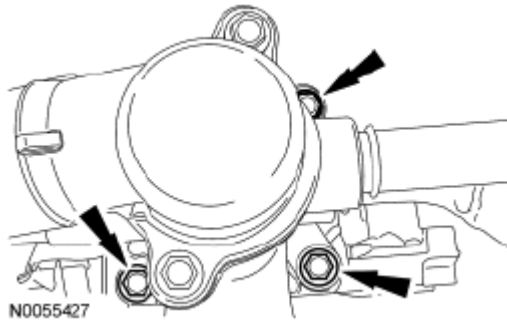
**NOTE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

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



**Fig. 968: Identifying Intake Manifold Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

8. Using a new gasket and O-ring seal, install the thermostat housing and the 3 bolts.
  - Tighten to 10 Nm (89 lb-in).

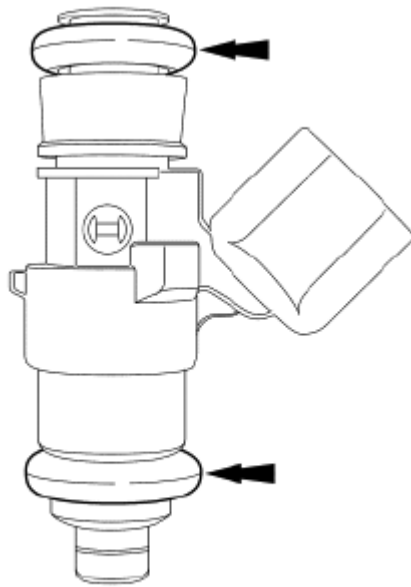


**Fig. 969: Locating Thermostat Housing-To-Lower Intake Manifold Bolts**  
Courtesy of FORD MOTOR CO.

**NOTE:** Use O-ring seals that are made of special fuel-resistant material. The use of ordinary O-rings can cause the fuel system to leak. Do not reuse the O-ring seals.

**NOTE:** The upper and lower O-ring seals are not interchangeable.

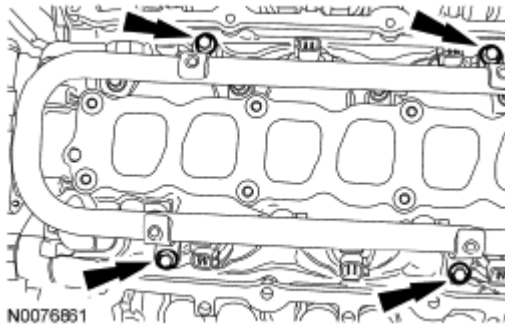
9. Install new fuel injector O-ring seals.
  - Remove the retaining clips and separate the fuel injectors from the fuel rail.
  - Remove and discard the O-ring seals.
  - Install new O-ring seals and lubricate with clean engine oil.
  - Install the fuel injectors and the retaining clips onto the fuel rail.



N0055508

**Fig. 970: Locating Fuel Injector O-Ring Seals**  
Courtesy of FORD MOTOR CO.

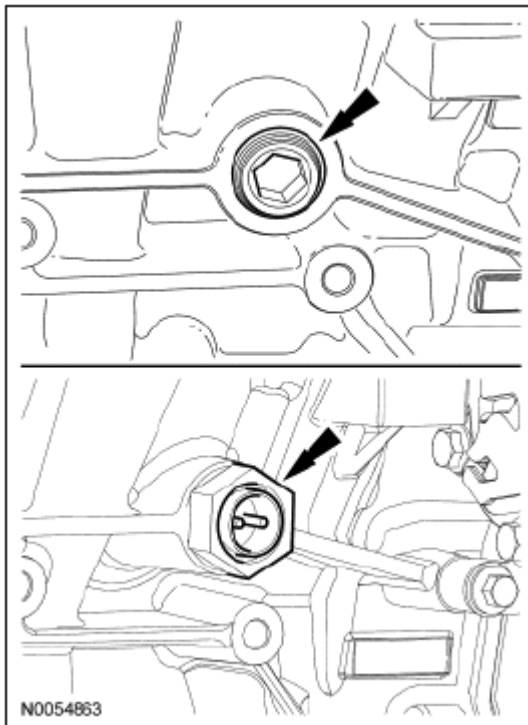
10. Install the fuel rail and injectors as an assembly and install the 4 bolts.
  - Tighten to 10 Nm (89 lb-in).



N0076861

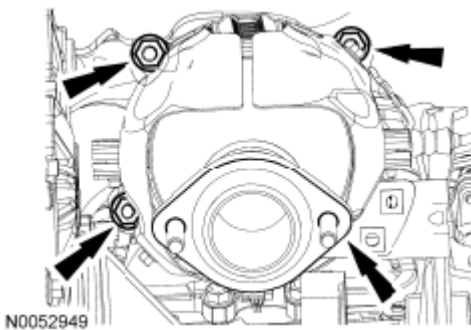
**Fig. 971: Locating Fuel Rail Bolts**  
Courtesy of FORD MOTOR CO.

11. Install the RH cylinder block drain plug or, if equipped, the block heater.
  - Tighten to 40 Nm (30 lb-ft).



**Fig. 972: Locating RH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

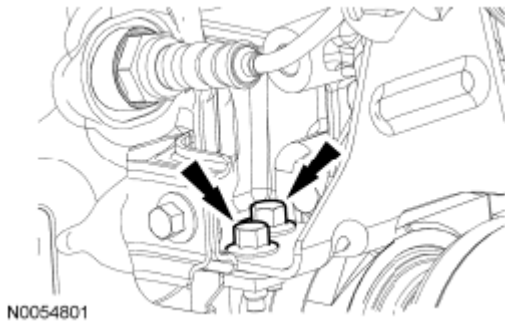
12. Using a new gasket, install the RH catalytic converter and 4 new nuts.
  - Tighten to 40 Nm (30 lb-ft).



**Fig. 973: Locating RH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

#### All-Wheel Drive (AWD) vehicles

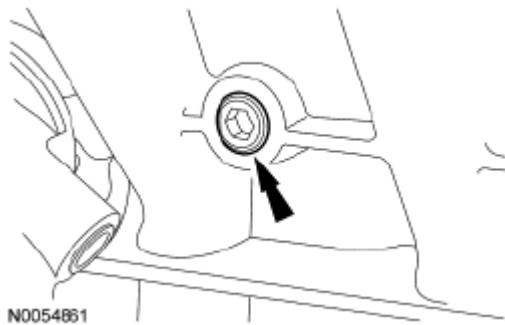
13. Install the 2 RH catalytic converter bracket bolts.
  - Tighten the 4 catalytic converter nuts to 40 Nm (30 lb-ft).
  - Tighten the 2 catalytic converter brackets to 20 Nm (177 lb-in).



**Fig. 974: Locating RH Catalytic Converter Support Bracket Bolts**  
Courtesy of FORD MOTOR CO.

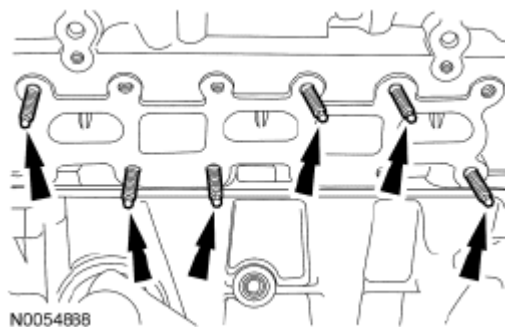
**All vehicles**

14. Install the LH cylinder block drain plug.
  - Tighten to 20 Nm (177 lb-in) plus an additional 180 degrees.



**Fig. 975: Locating LH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

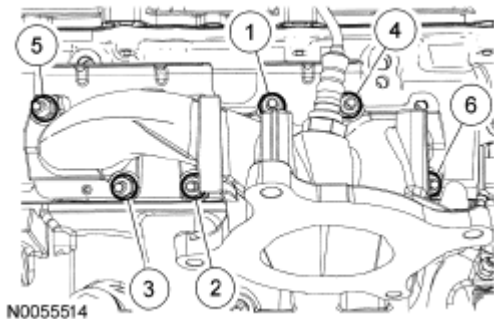
15. Install 6 new LH exhaust manifold studs.
  - Tighten to 12 Nm (106 lb-in).



**Fig. 976: Locating LH Exhaust Manifold Studs**  
Courtesy of FORD MOTOR CO.

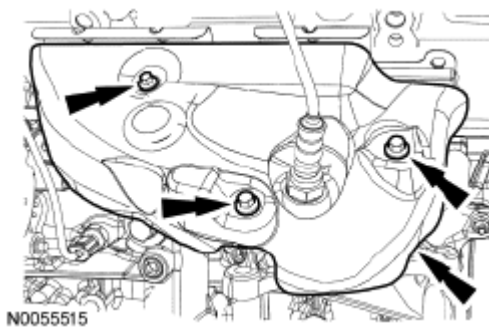
**NOTE:** Failure to tighten the exhaust manifold nuts to specification a second time will cause the exhaust manifold to develop an exhaust leak.

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



**Fig. 977: Identifying LH Exhaust Manifold Nuts**  
Courtesy of FORD MOTOR CO.

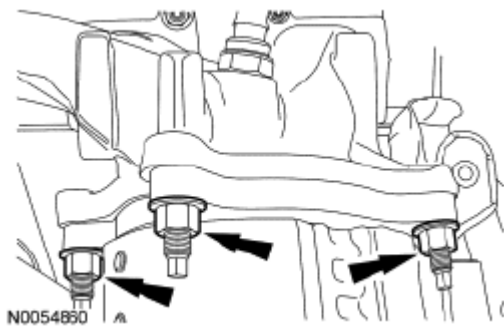
17. Install the LH exhaust manifold heat shield and the 3 bolts.
- Tighten to 10 Nm (89 lb-in).



**Fig. 978: Locating LH Exhaust Manifold Heat Shield Bolts**  
Courtesy of FORD MOTOR CO.

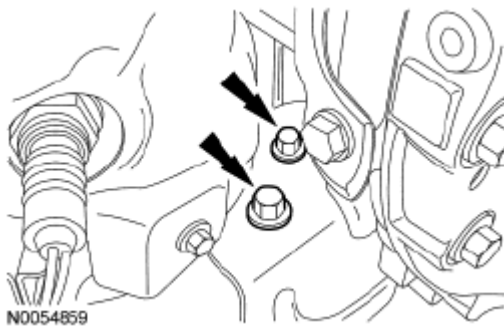
18. Using a new gasket, install the LH catalytic converter and 4 new nuts (3 shown in illustration).
- Tighten to 40 Nm (30 lb-ft).





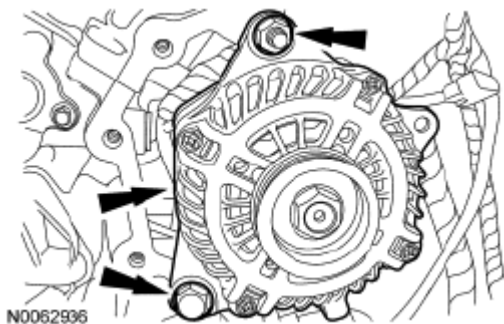
**Fig. 979: Locating LH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

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



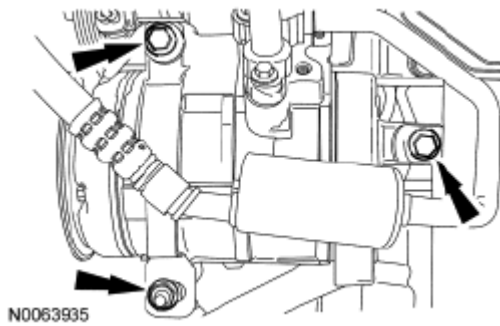
**Fig. 980: Locating LH Catalytic Converter Bracket Bolts**  
Courtesy of FORD MOTOR CO.

20. Install the generator, the bolt and the nut.
  - Tighten to 47 Nm (35 lb-ft).



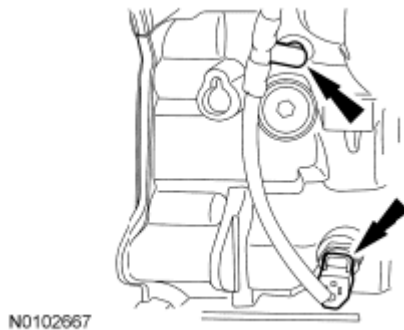
**Fig. 981: Locating Generator Bolt And Nut**  
Courtesy of FORD MOTOR CO.

21. Install the A/C compressor, the nut and the 2 bolts.
  - Tighten to 25 Nm (18 lb-ft).



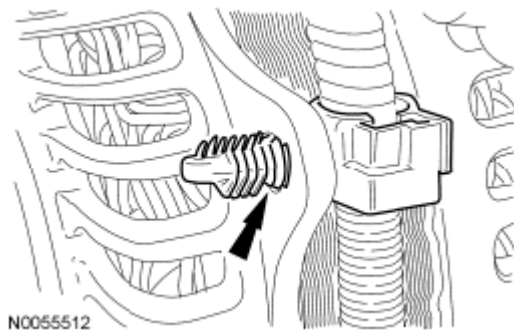
**Fig. 982: Locating A/C Compressor Bolts And Nut**  
Courtesy of FORD MOTOR CO.

22. Connect the Engine Oil Pressure (EOP) switch electrical connector and the wiring harness pin-type retainer.



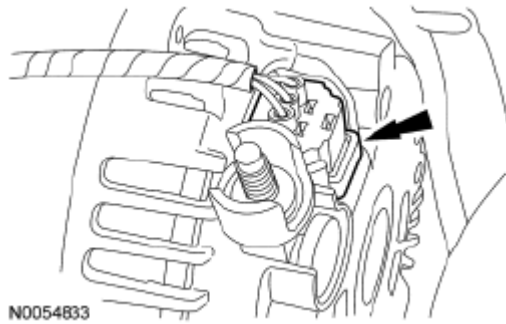
**Fig. 983: Locating Engine Oil Pressure Switch Electrical Connector**  
Courtesy of FORD MOTOR CO.

23. Attach the wiring harness retainer to the generator.



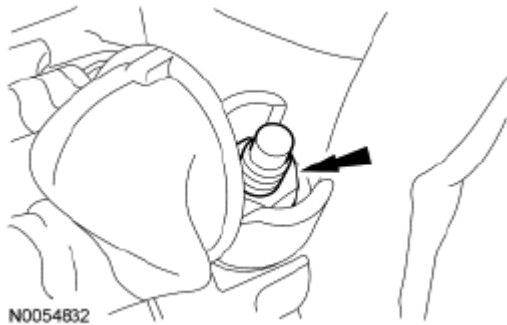
**Fig. 984: Locating Wiring Harness Retainer**  
Courtesy of FORD MOTOR CO.

24. Connect the generator electrical connector.



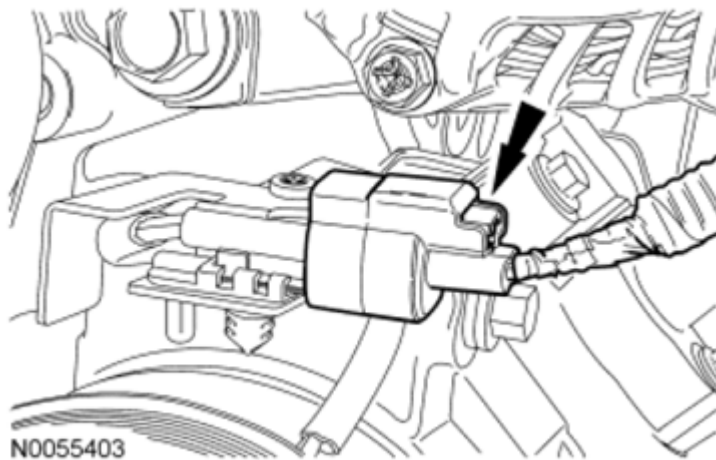
**Fig. 985: Locating Generator Electrical Connector**  
Courtesy of FORD MOTOR CO.

25. Connect the generator B+ cable and install the nut.
  - Tighten to 17 Nm (150 lb-in).



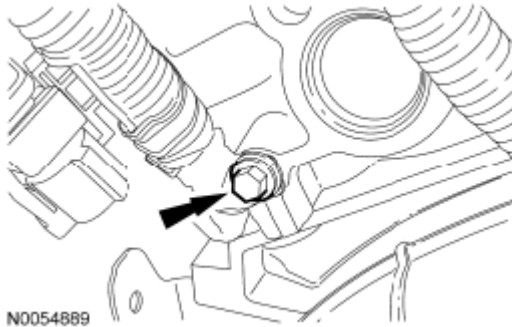
**Fig. 986: Locating Generator B+ Cable**  
Courtesy of FORD MOTOR CO.

26. Connect the A/C compressor electrical connector.



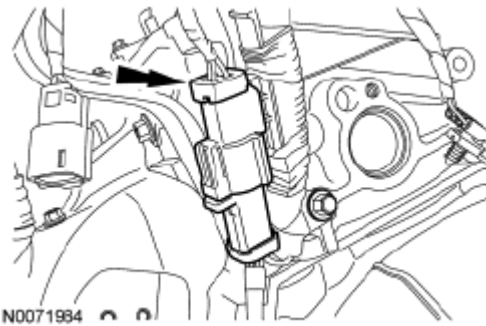
**Fig. 987: Locating A/C Compressor Electrical Connector**  
Courtesy of FORD MOTOR CO.

27. Install the wiring harness retainer bolt on the rear of the LH cylinder head.
- Tighten to 10 Nm (89 lb-in).



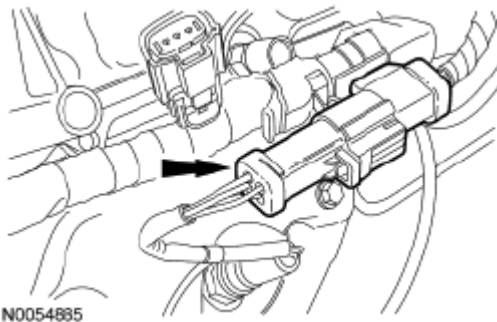
**Fig. 988: Locating Wiring Harness Retainer Bolt**  
Courtesy of FORD MOTOR CO.

28. Connect the LH Catalyst Monitor Sensor (CMS) electrical connector.



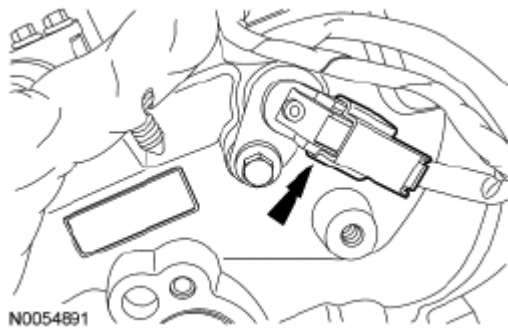
**Fig. 989: Locating LH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

29. Connect the LH Heated Oxygen Sensor (HO2S) electrical connector.



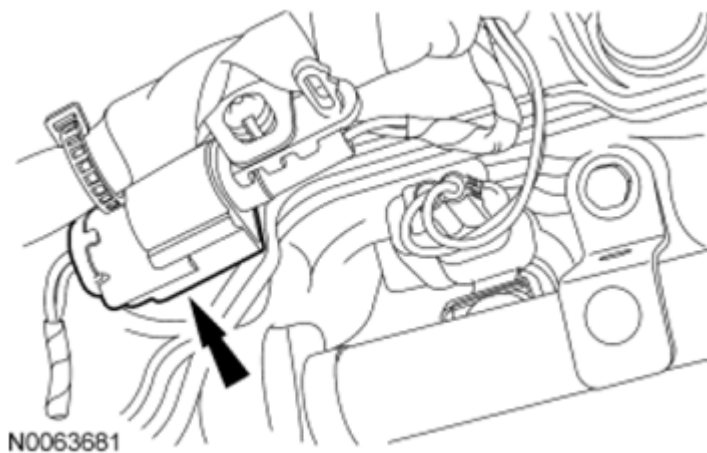
**Fig. 990: Locating LH Heated Oxygen Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

30. Connect the LH **CMP** sensor electrical connector.



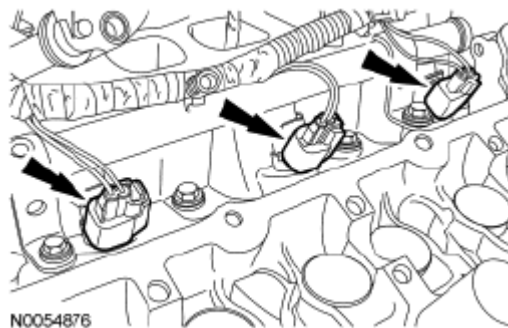
**Fig. 991: Locating LH Camshaft Position Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

31. Connect the Cylinder Head Temperature (CHT) sensor electrical connector.



**Fig. 992: Locating CHT Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

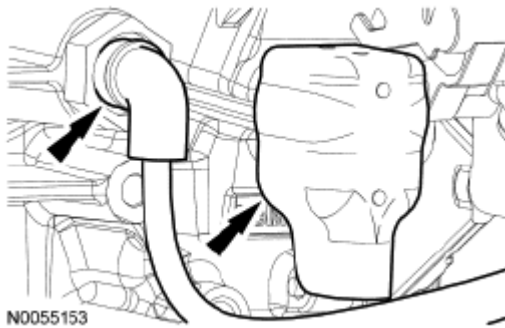
32. Connect the 6 fuel injector electrical connectors (3 shown in illustration).



**Fig. 993: Locating Fuel Injector Electrical Connectors**  
Courtesy of FORD MOTOR CO.

33. If equipped, install the block heater wiring harness onto the engine.

- Connect the block heater electrical connector and install the heat shield.



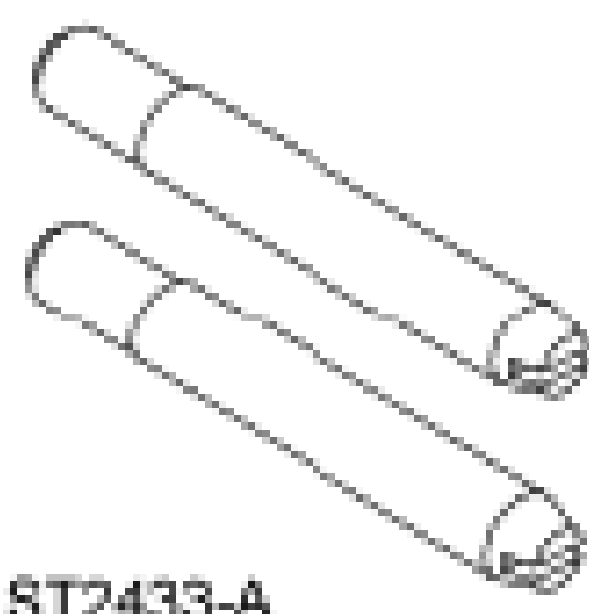
**Fig. 994: Locating Heat Shield**  
Courtesy of FORD MOTOR CO.

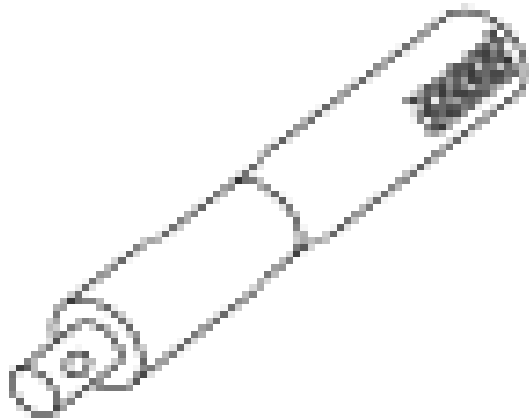
34. Install the LH camshafts. For additional information, refer to **CAMSHAFT**.

## OIL PAN

### Special Tool(s)

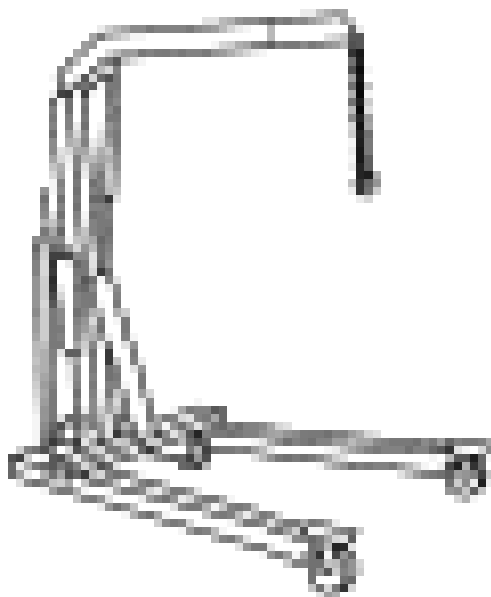
### SPECIAL TOOL SPECIFICATION

 <p>ST2433-A</p>	<p>Alignment Pins 307-399</p>



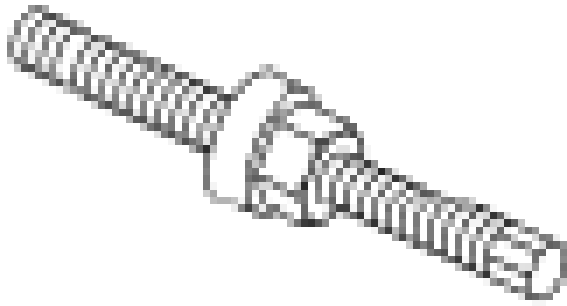
**ST1326-A**

Handle  
205-153 (T80T-4000-W)



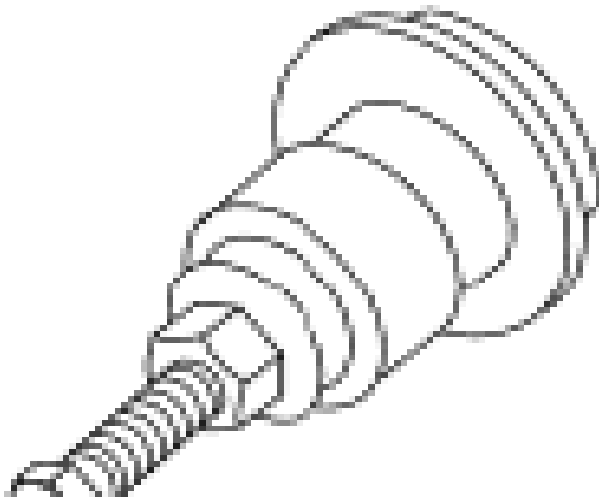
**ST1341-A**

Heavy Duty Floor Crane  
014-00071 or equivalent



**ST1287-A**

Installer, Crankshaft Vibration Damper  
303-102 (T74P-6316-B)



Installer, Front Cover Oil Seal  
303-335

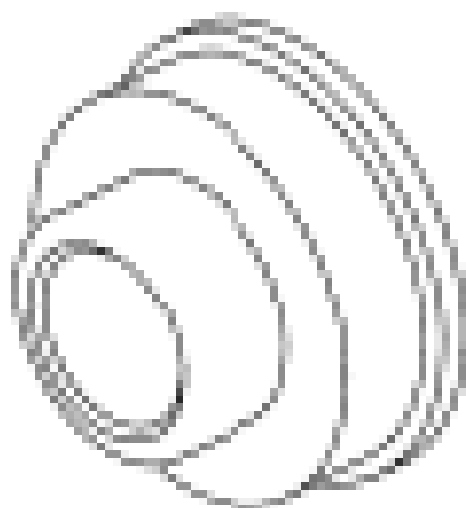
Installer, Front Crankshaft Seal





**ST2981-A**

303-1251

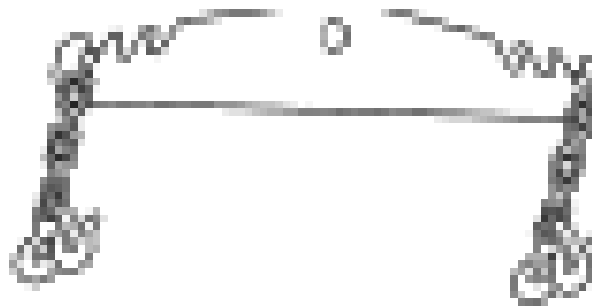


**ST2983-A**

Installer, VCT Spark Plug Tube Seal  
303-1247/2

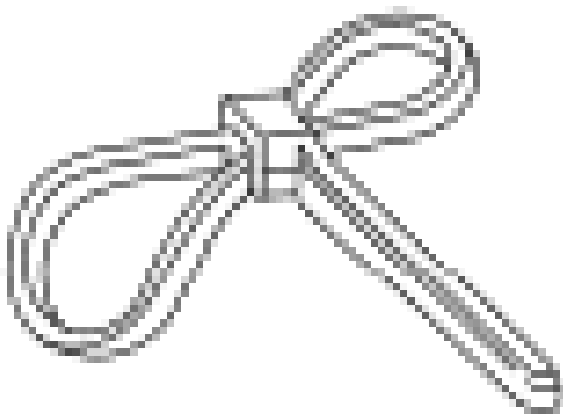
## 2010 Ford Edge Limited

2010 ENGINE Engine - 3.5L - Edge & MKX



ST1402-A

Spreader Bar  
303-D089 (D93P-6001-A3) or equivalent



ST1438-A

Strap Wrench  
303-D055 (D85L-6000-A) or equivalent

### Material

#### MATERIAL SPECIFICATION

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

**2010 Ford Edge Limited**

2010 ENGINE Engine - 3.5L - Edge &amp; MKX

Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO- 5W20-LSP12 (Canada); or equivalent	WSS-M2C930-A
Silicone Gasket Remover ZC-30	-
Threadlock and Sealer TA-25	WSK-M2G351-A5

**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.

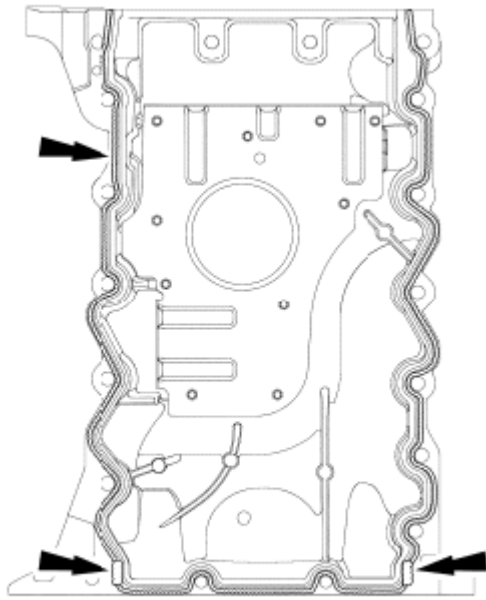
**NOTE:** Early build engines have 11 fastener valve covers, late build engines have 9 fastener valve covers. Do not attempt to install bolts in the 2 empty late build valve cover holes or damage to the valve cover will occur.

**All vehicles**

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

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

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

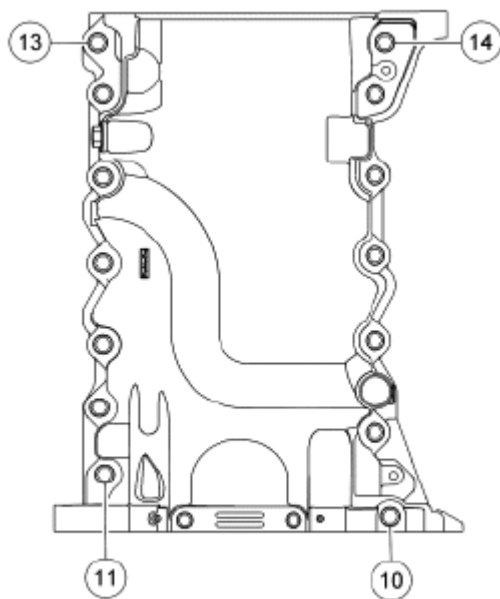


N0055188

**Fig. 995: Identifying RTV Silicone Applying Area**  
Courtesy of FORD MOTOR CO.

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

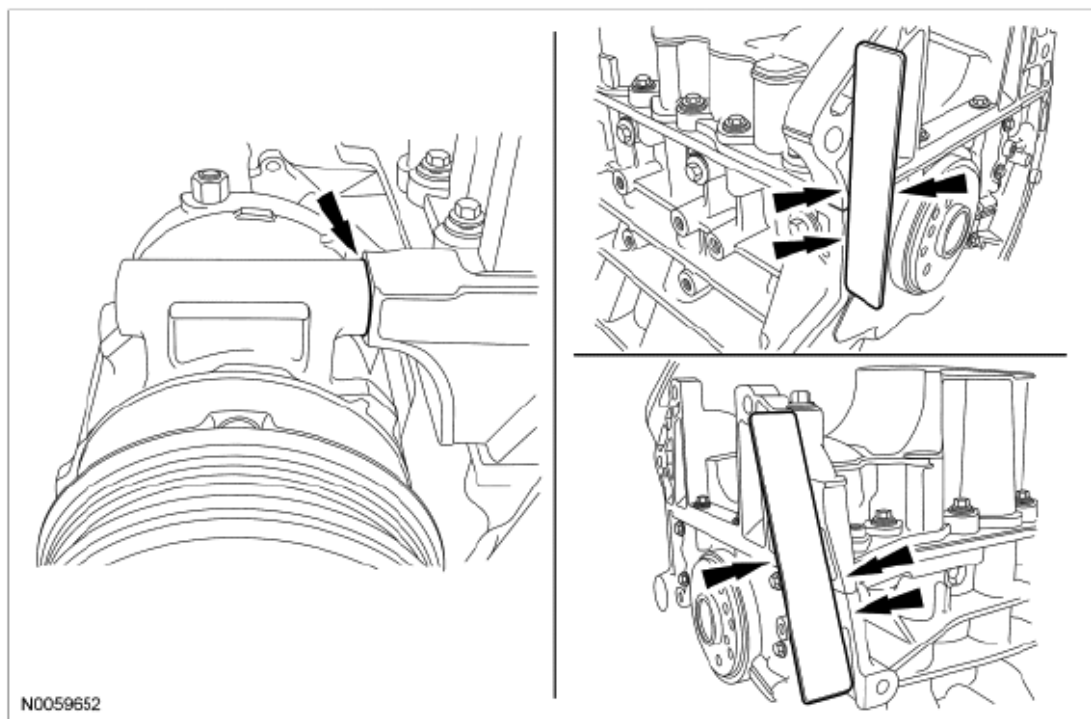
2. Install the oil pan and bolts 10, 11, 13 and 14.
  - Tighten the bolts in the sequence shown in illustration to 3 Nm (27 lb-in).
  - Loosen the bolts 180 degrees.



N0069773

**Fig. 996: Identifying Oil Pan And Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

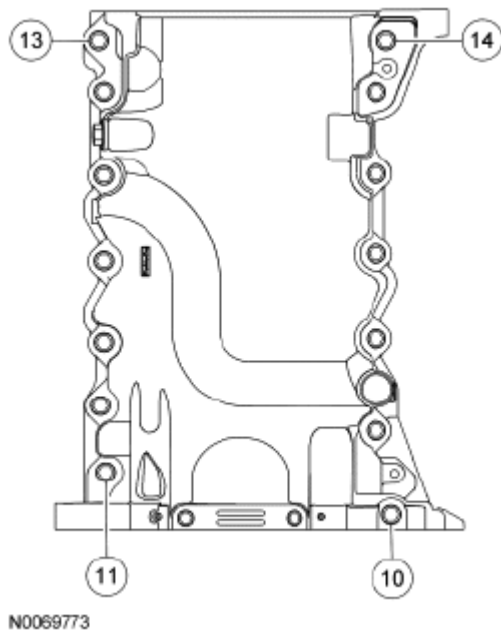
3. Align the oil pan to the cylinder block and the A/C compressor.
  - Position the oil pan so the mounting boss is against the A/C compressor and using a straightedge, align the oil pan flush with the rear of the cylinder block at the 2 areas shown in illustration.



**Fig. 997: Aligning Oil Pan Flush With Rear Of Cylinder Block Areas**

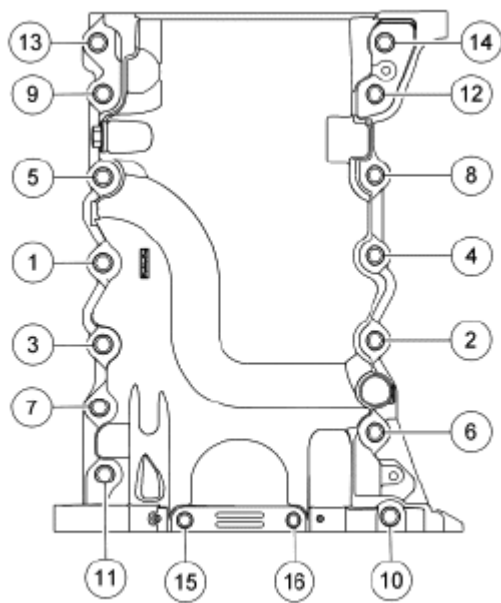
Courtesy of FORD MOTOR CO.

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



**Fig. 998: Identifying Oil Pan And Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

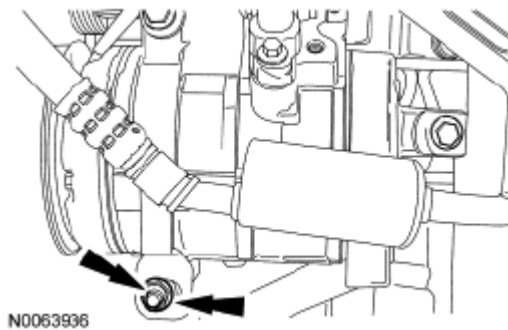
5. Install the remaining oil pan bolts. Tighten all the oil pan bolts in the sequence shown in illustration.
- Tighten the large bolts (1-14) to 24 Nm (18 lb-ft).
  - Tighten the small bolts (15 and 16) to 10 Nm (89 lb-in).



N0055165

**Fig. 999: Identifying Oil Pan And Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

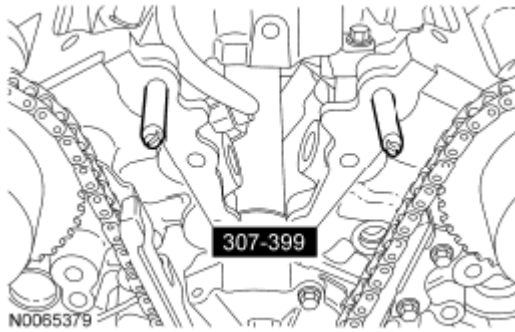
6. Install the A/C compressor mounting stud and nut.
  - Tighten the stud to 9 Nm (80 lb-in) and the nut to 25 Nm (18 lb-ft).



N0063936

**Fig. 1000: Locating A/C Compressor Nut And Stud**  
Courtesy of FORD MOTOR CO.

7. Install the Alignment Pins.

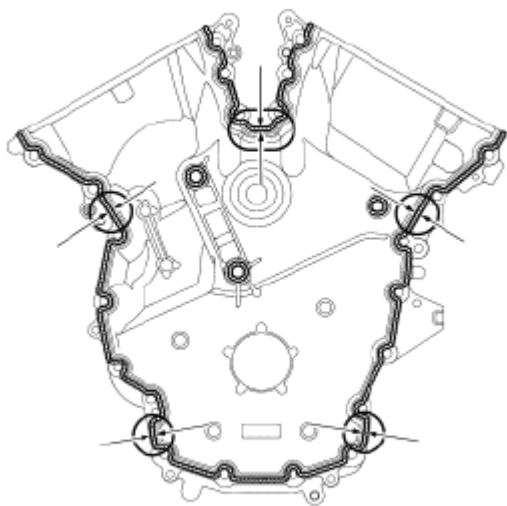


**Fig. 1001: Identifying Alignment Pins**  
Courtesy of FORD MOTOR CO.

- NOTE:** Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.
- NOTE:** The engine front cover and bolts 17, 18, 19 and 20 must be installed within 4 minutes of the initial sealant application. The remainder of the engine front cover bolts and the engine mount bracket bolts must be installed and tightened within 35 minutes of the initial sealant application. If the time limits are exceeded, the sealant must be removed, the sealing area cleaned and sealant reapplied. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.
8. Apply a 3.0 mm (0.11 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover sealing surfaces including the 3 engine mount bracket bosses.
- Apply a 5.5 mm (0.21 in) bead of Motorcraft® High Performance Engine RTV Silicone to the oil pan-to-cylinder block joint and the cylinder head-to-cylinder block joint areas of the engine front cover in 5 places as indicated.



5.5 mm  
(0.21 in)

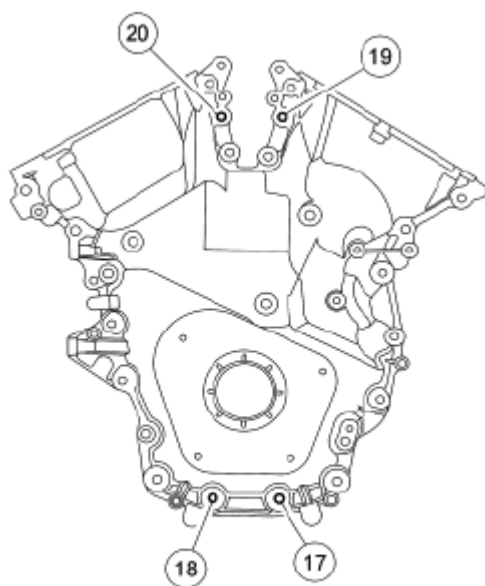


N0068293

**Fig. 1002: Identifying RTV Silicone Applying Area**  
Courtesy of FORD MOTOR CO.

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

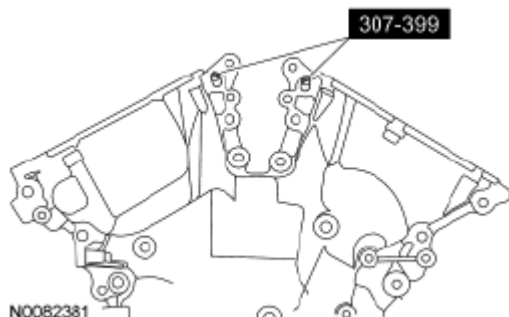
9. Install the engine front cover and bolts 17, 18, 19 and 20.
  - Tighten in sequence to 3 Nm (27 lb-in).



N0068108

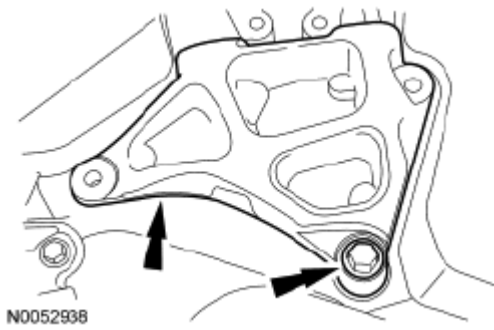
**Fig. 1003: Identifying Engine Front Cover Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

10. Remove the Alignment Pins.



**Fig. 1004: Identifying Alignment Pins**  
Courtesy of FORD MOTOR CO.

**NOTE:** Do not tighten the bolt at this time.

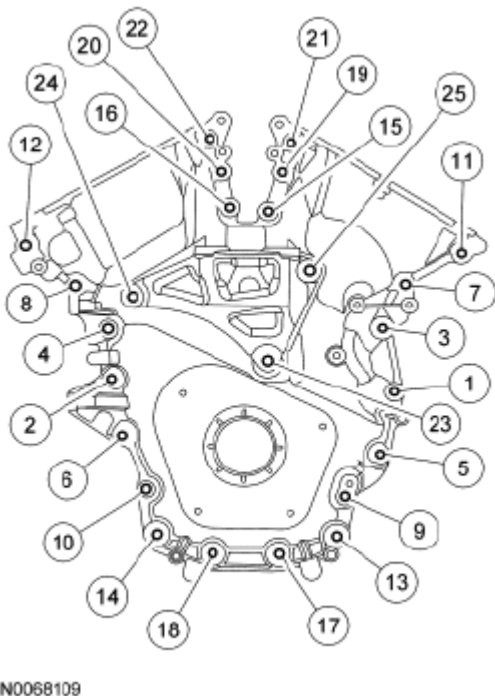


**Fig. 1005: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

11. Install the engine mount bracket and the 3 bolts.

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

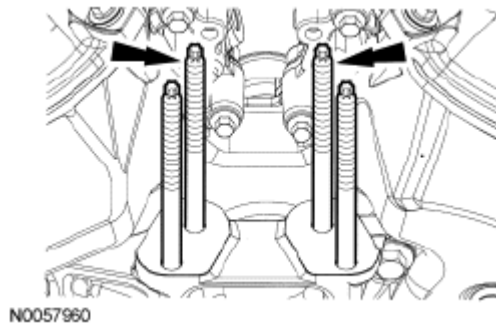
12. Install the remaining engine front cover bolts. Tighten all of the engine front cover bolts and engine mount bracket bolts in the sequence shown in illustration in 2 stages:
  - Stage 1: Tighten bolts 1 thru 22 to 10 Nm (89 lb-in) and bolts 23, 24 and 25 to 15 Nm (133 lb-in).
  - Stage 2: Tighten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



**Fig. 1006: Identifying Engine Front Cover Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

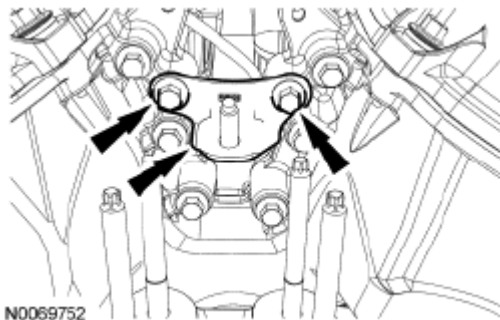
**NOTE:** The thread sealer on the engine mount studs (including new engine mount studs if applicable) must be cleaned off with a wire brush and new Threadlock and Sealer applied prior to installing the engine mount studs. Failure to follow this procedure may result in damage to the engine mount studs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

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



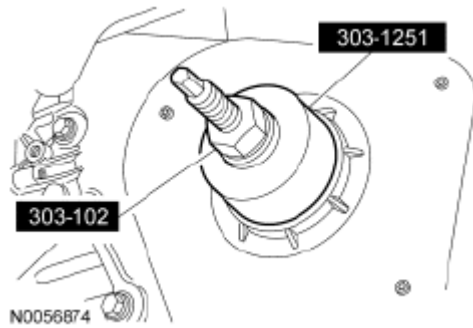
**Fig. 1007: Locating Engine Mount Studs**  
Courtesy of FORD MOTOR CO.

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



**Fig. 1008: Locating Engine Mount Bracket Bolts**  
Courtesy of FORD MOTOR CO.

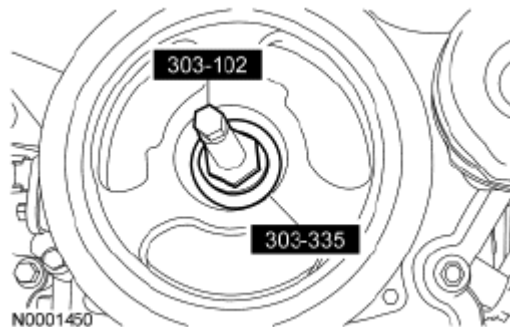
**NOTE:** Apply clean engine oil to the crankshaft front seal bore in the engine front cover.



**Fig. 1009: Identifying Crankshaft Vibration Damper Installer And Front Crankshaft Installer**  
Courtesy of FORD MOTOR CO.

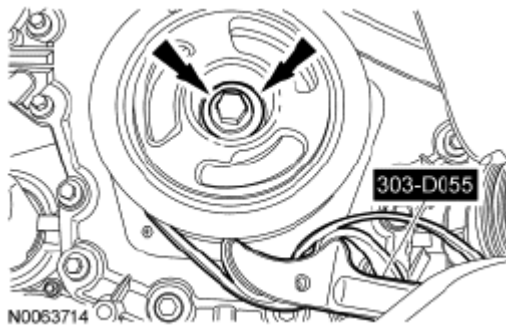
15. Using the Crankshaft Vibration Damper Installer and Front Crankshaft Seal Installer, install a new crankshaft front seal.

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



**Fig. 1010: Identifying Crankshaft Vibration Damper Installer And Front Cover Oil Seal Installer**  
Courtesy of FORD MOTOR CO.

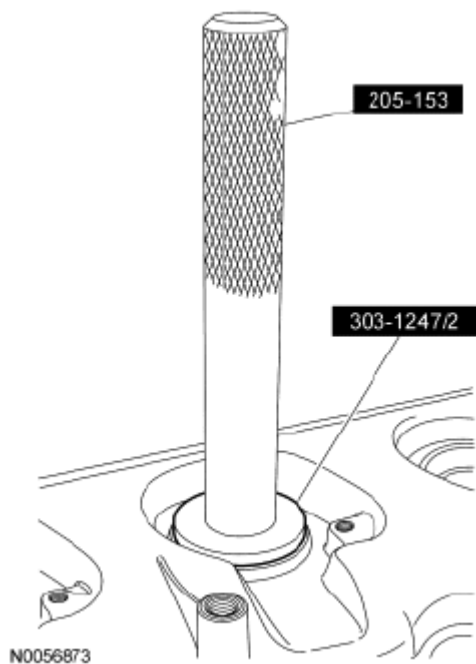
16. Using the Crankshaft Vibration Damper Installer and Front Cover Oil Seal Installer, install the crankshaft pulley.
17. Using the Strap Wrench, install the crankshaft pulley washer and new bolt and tighten in 4 stages.
  - Stage 1: Tighten to 120 Nm (89 lb-ft).
  - Stage 2: Loosen one full turn.
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



**Fig. 1011: Locating Crankshaft Pulley Washer And Bolt**  
Courtesy of FORD MOTOR CO.

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

**NOTE:** Spark plug tube seal installation shown in illustration, Variable Camshaft Timing (VCT) seal installation similar.



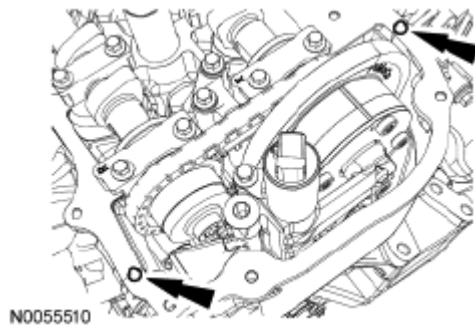
**Fig. 1012: Identifying VCT Spark Plug Tube Seal Installer And Handle**  
Courtesy of FORD MOTOR CO.

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

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

damage.

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

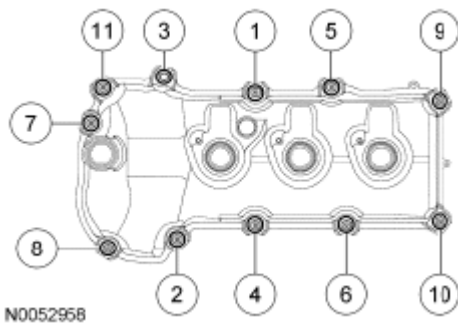


**Fig. 1013: Applying RTV Silicone To Engine Front Cover-To-RH Cylinder Head Joints**  
Courtesy of FORD MOTOR CO.

19. Apply a 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-RH cylinder head joints.

#### Early build vehicles

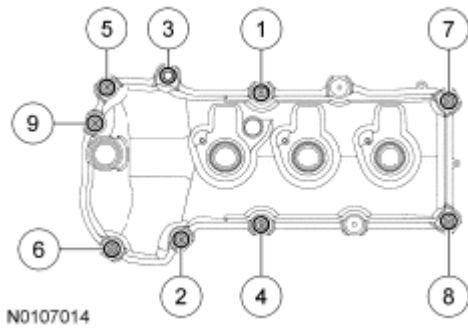
20. Using a new gasket, install the RH valve cover and tighten the bolt and 10 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



**Fig. 1014: Identifying RH Valve Cover Stud Bolts Tightening Sequence (Early Build Vehicles)**  
Courtesy of FORD MOTOR CO.

#### Late build vehicles

21. Using a new gasket, install the RH valve cover and tighten the 9 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

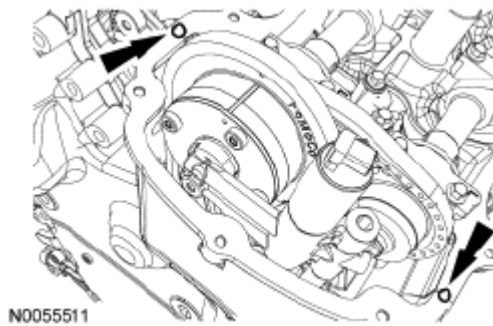


**Fig. 1015: Identifying RH Valve Cover Stud Bolts Tightening Sequence (Late Build Vehicles)**  
Courtesy of FORD MOTOR CO.

#### All vehicles

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

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



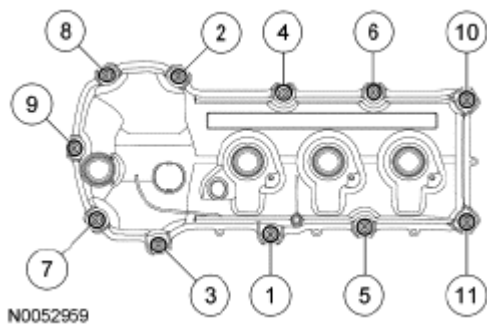
**Fig. 1016: Applying RTV Silicone To Engine Front Cover**  
Courtesy of FORD MOTOR CO.

22. Apply a 8 mm (0.31 in) bead of Motorcraft® High Performance Engine RTV Silicone to the engine front cover-to-LH cylinder head joints.

#### Early build vehicles

23. Using a new gasket, install the LH valve cover and tighten the 11 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

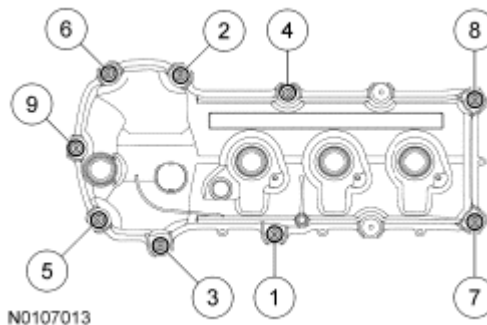




**Fig. 1017: Identifying LH Valve Cover Stud Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

### Late build vehicles

24. Using a new gasket, install the LH valve cover and tighten the 9 stud bolts.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

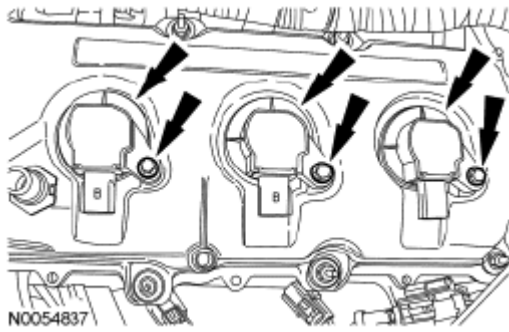


**Fig. 1018: Identifying LH Valve Cover Stud Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

### All vehicles

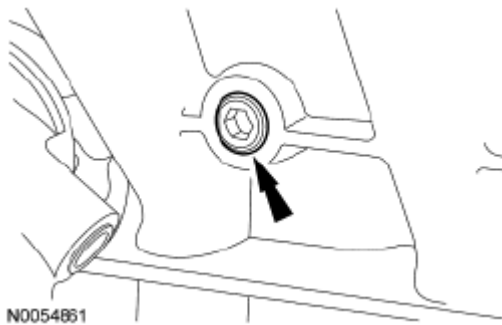
**NOTE:** LH shown in illustration, RH similar.

25. Install the 6 coil-on-plug assemblies and the 6 bolts.
  - Tighten to 7 Nm (62 lb-in).



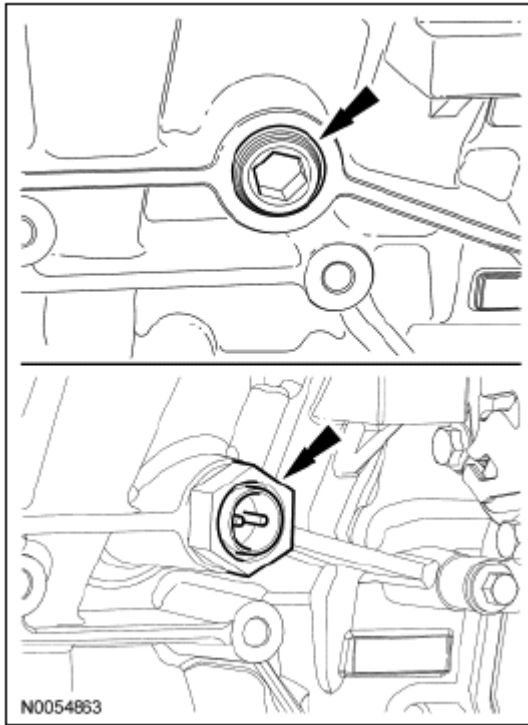
**Fig. 1019: Locating Coil-On-Plugs Bolts**  
Courtesy of FORD MOTOR CO.

26. Install the LH cylinder block drain plug.
- Tighten to 20 Nm (177 lb-in) plus an additional 180 degrees.



**Fig. 1020: Locating LH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

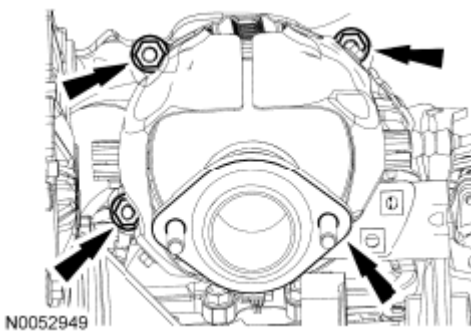
27. Install the RH cylinder block drain plug or, if equipped, the block heater.
- Tighten to 40 Nm (30 lb-ft).



**Fig. 1021: Locating RH Cylinder Block Drain Plug**  
Courtesy of FORD MOTOR CO.

#### **Front Wheel Drive (FWD) vehicles**

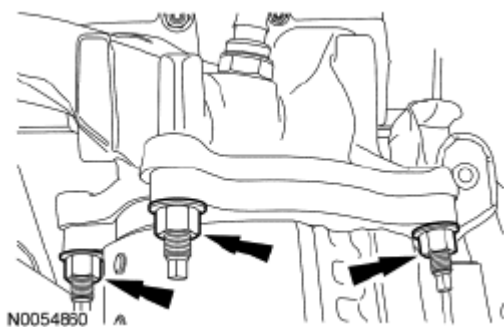
28. Using a new gasket, install the RH catalytic converter and 4 new nuts.
- Tighten to 40 Nm (30 lb-ft).



**Fig. 1022: Locating RH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

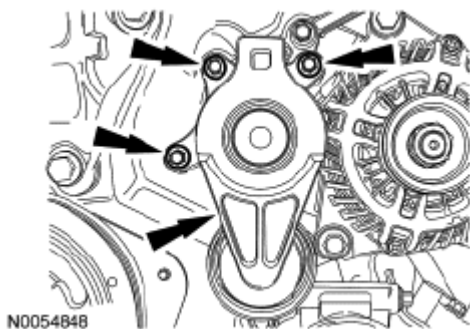
#### **All vehicles**

29. Using a new gasket, install the LH catalytic converter and 4 new nuts (3 shown in illustration).
- Tighten to 40 Nm (30 lb-ft).



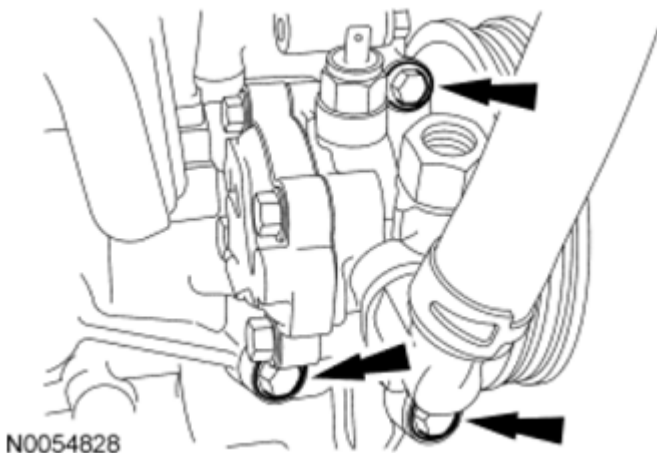
**Fig. 1023: Locating LH Catalytic Converter Nuts**  
Courtesy of FORD MOTOR CO.

30. Install the accessory drive belt tensioner and the 3 bolts.
  - Tighten to 11 Nm (97 lb-in).



**Fig. 1024: Locating Accessory Drive Belt Tensioner Bolts**  
Courtesy of FORD MOTOR CO.

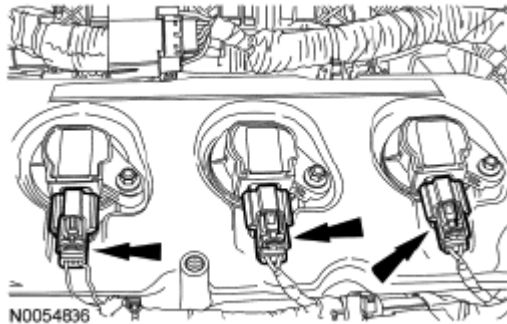
31. Install the power steering pump and the 3 bolts.
  - Tighten to 24 Nm (18 lb-ft).



**Fig. 1025: Locating Power Steering Pump And Bolts**

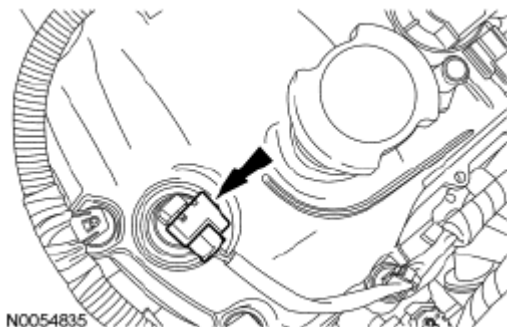
**Courtesy of FORD MOTOR CO.**

32. Attach all of the wiring harness retainers to the LH valve cover and stud bolts.
33. Connect the 3 LH coil-on-plug electrical connectors.



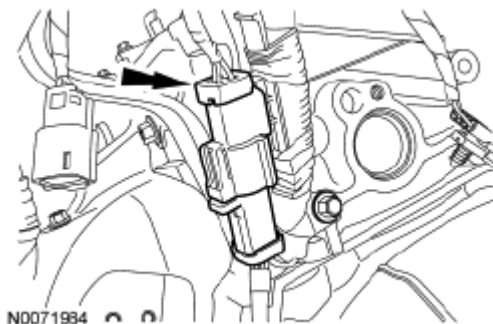
**Fig. 1026: Locating LH Coil-On-Plug Electrical Connectors**  
Courtesy of FORD MOTOR CO.

34. Connect the LH camshaft VCT solenoid electrical connector.



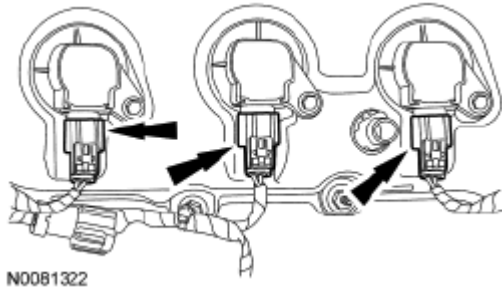
**Fig. 1027: Locating LH VCT Solenoid Electrical Connector**  
Courtesy of FORD MOTOR CO.

35. Connect the LH Catalyst Monitor Sensor (CMS) electrical connector.



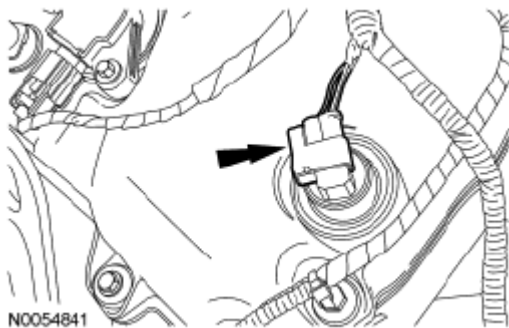
**Fig. 1028: Locating LH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

36. Attach all of the wiring harness retainers to the RH valve cover and stud bolts.
37. Connect the 3 RH coil-on-plug electrical connectors.



**Fig. 1029: Locating RH Coil-On-Plug Electrical Connectors**  
Courtesy of FORD MOTOR CO.

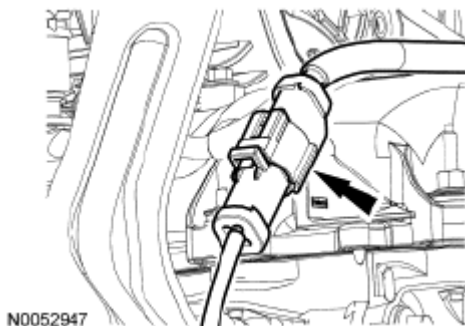
38. Connect the RH VCT solenoid electrical connector.



**Fig. 1030: Locating RH Variable Camshaft Timing Solenoid Electrical Connector**  
Courtesy of FORD MOTOR CO.

#### **FWD vehicles**

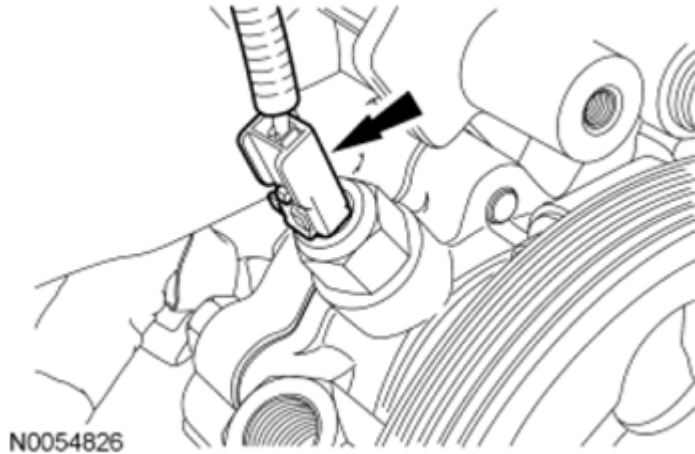
39. Connect the RH CMS electrical connector.



**Fig. 1031: Locating RH Catalyst Monitor Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

**All vehicles**

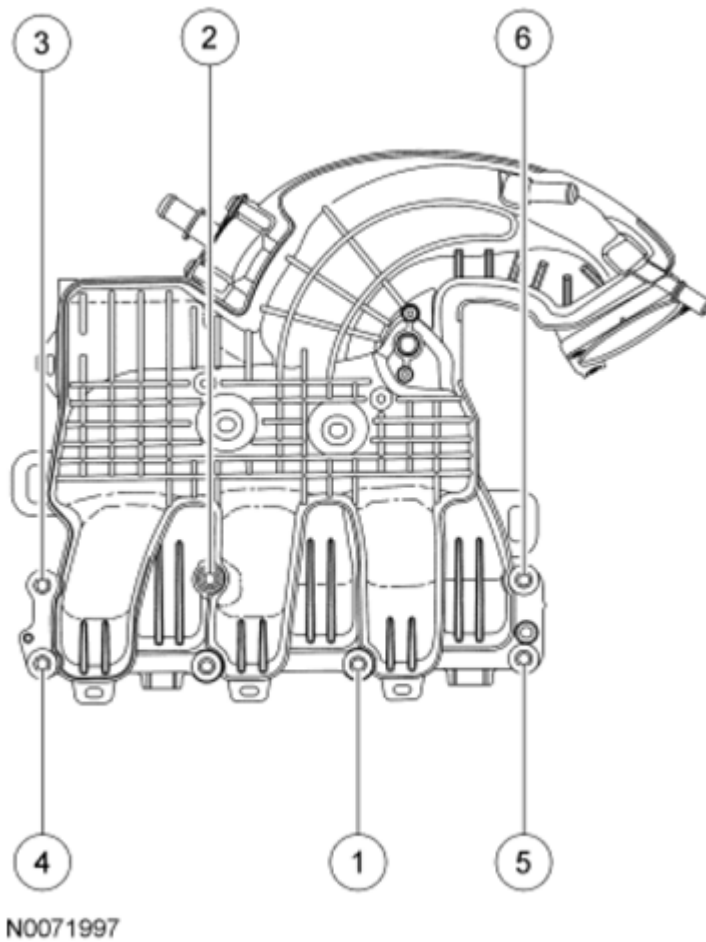
40. Connect the Power Steering Pressure (PSP) switch electrical connector.



**Fig. 1032: Locating PSP Switch Electrical Connector**  
Courtesy of FORD MOTOR CO.

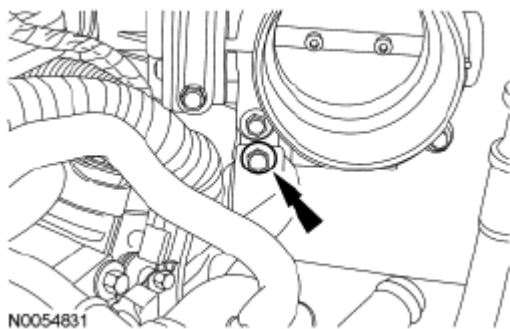
**NOTE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

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



**Fig. 1033: Identifying Upper Intake Manifold Bolts Tightening Sequence**  
Courtesy of FORD MOTOR CO.

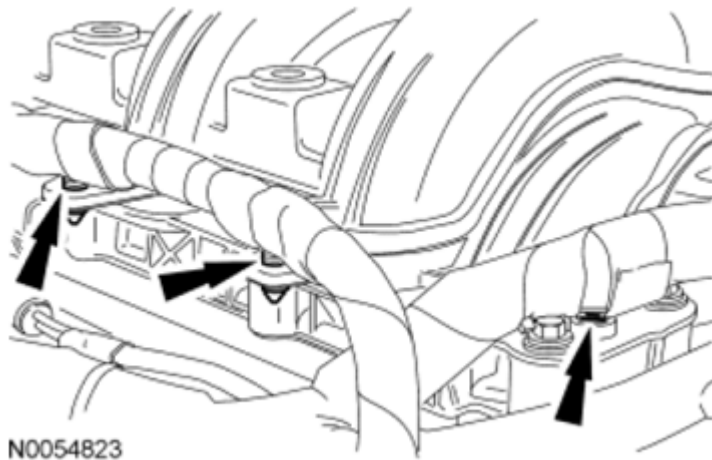
42. Install the upper intake manifold support bracket bolt.
  - Tighten to 10 Nm (89 lb-in).



**Fig. 1034: Locating Upper Intake Manifold Support Bracket Bolt**  
Courtesy of FORD MOTOR CO.

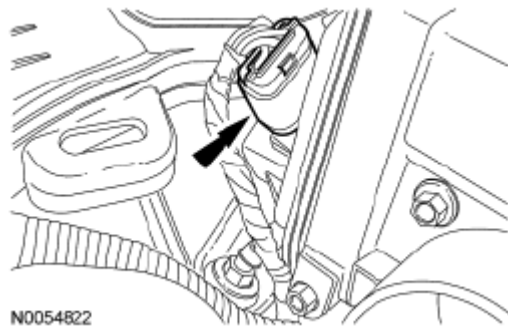
43. Attach the wiring harness retainers to the upper intake manifold.





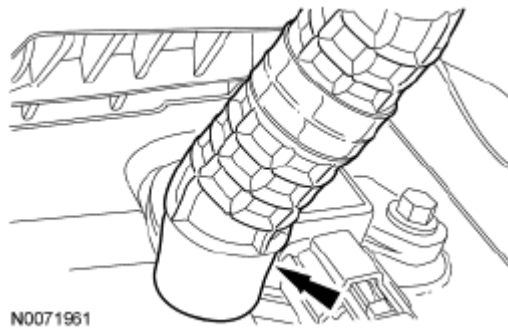
**Fig. 1035: Locating Wiring Harness Retainers**  
Courtesy of FORD MOTOR CO.

44. Connect the Throttle Body (TB) electrical connector.



**Fig. 1036: Locating Throttle Body Electrical Connector**  
Courtesy of FORD MOTOR CO.

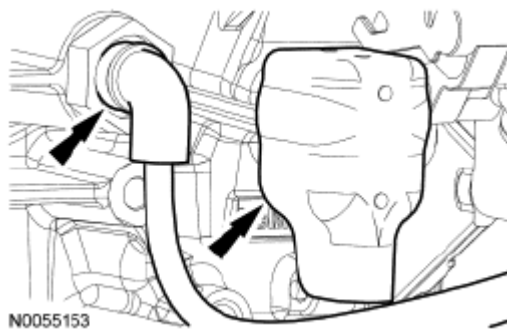
45. Connect the PCV hose to the PCV valve.



**Fig. 1037: Locating PCV Hose**  
Courtesy of FORD MOTOR CO.

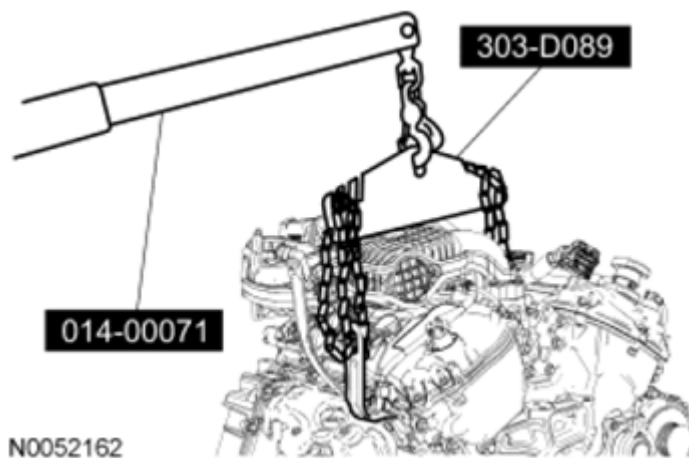
46. If equipped, position the engine block heater harness on the engine and attach all of the harness retainers.

- Connect the engine block heater electrical connector and install the heat shield.



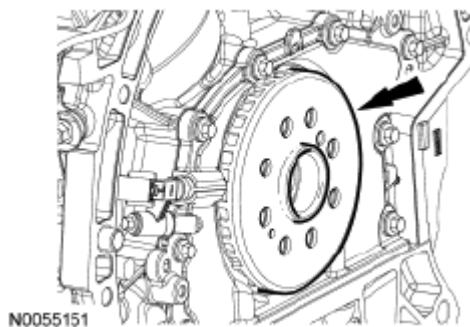
**Fig. 1038: Locating Heat Shield**  
Courtesy of FORD MOTOR CO.

47. Using the Heavy Duty Floor Crane and Spreader Bar, remove the engine from the stand.



**Fig. 1039: Identifying Heavy Duty Floor Crane And Spreader Bar**  
Courtesy of FORD MOTOR CO.

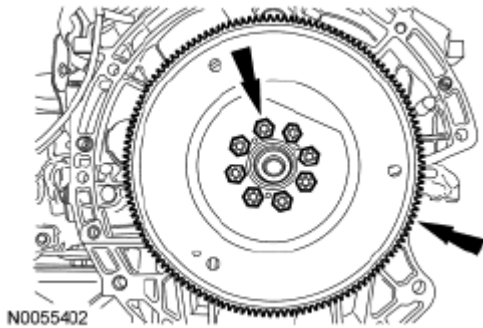
48. Install the crankshaft sensor ring.



**Fig. 1040: Locating Crankshaft Sensor Ring**

Courtesy of FORD MOTOR CO.

49. Install the flexplate and the 8 bolts.
  - Tighten to 80 Nm (59 lb-ft).



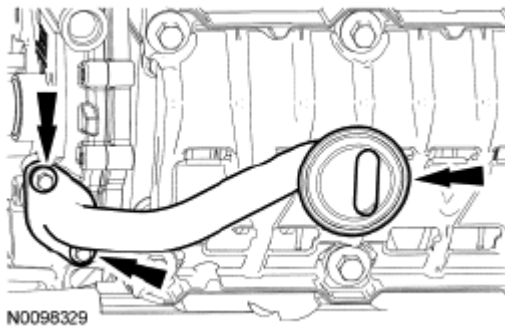
**Fig. 1041: Locating Flexplate Bolts**  
Courtesy of FORD MOTOR CO.

50. Install the engine in the vehicle. For additional information, refer to ENGINE.

#### OIL PUMP SCREEN AND PICKUP TUBE

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

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).



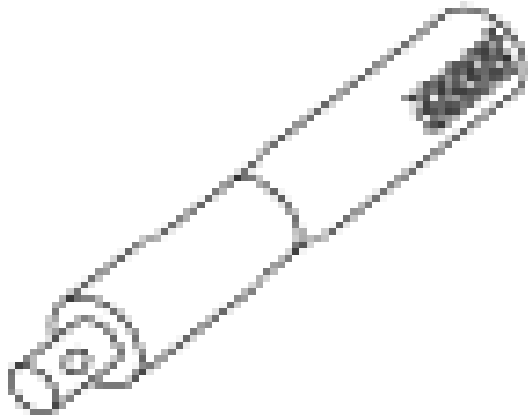
**Fig. 1042: Locating Oil Pump Screen And Pickup Tube**  
Courtesy of FORD MOTOR CO.

2. Install the oil pan. For additional information, refer to OIL PAN.

#### CRANKSHAFT REAR SEAL WITH RETAINER PLATE

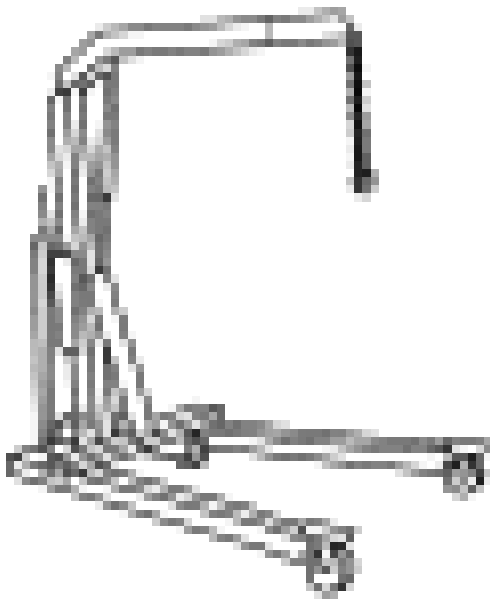
Special Tool(s)

SPECIAL TOOL SPECIFICATION



ST1326-A

Handle  
205-153 (T80T-4000-W)

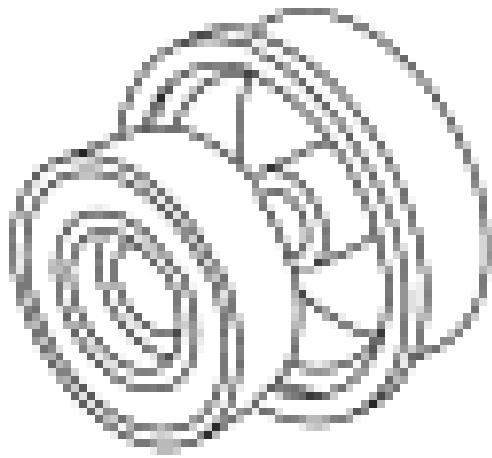


ST1341-A

Heavy Duty Floor Crane  
014-00071 or equivalent

## 2010 Ford Edge Limited

2010 ENGINE Engine - 3.5L - Edge & MKX



**ST2980-A**

Installer, Rear Main Seal  
303-1250



**3T1A02-A**

Spreader Bar  
303-D089 (D93P-6001-A3) or equivalent

### Material

#### MATERIAL SPECIFICATION

Item	Specification
Motorcraft® High Performance Engine RTV Silicone TA-357	WSE-M4G323-A6
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil	

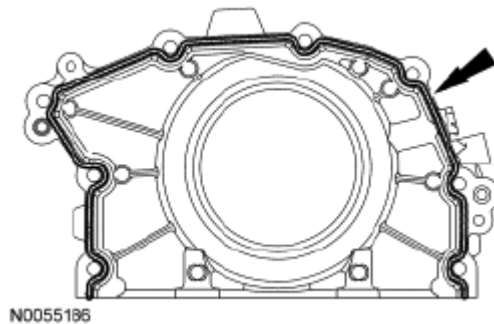
XO-5W20-QSP (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil CXO-5W20-LSP12 (Canada); or equivalent

WSS-M2C930-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.

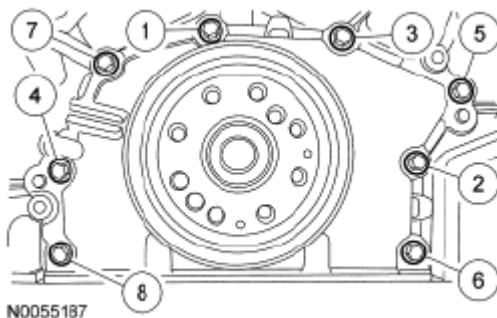
**NOTE:** Failure to use Motorcraft® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

**NOTE:** The crankshaft rear seal retainer must be installed and the bolts tightened within 4 minutes of sealant application.



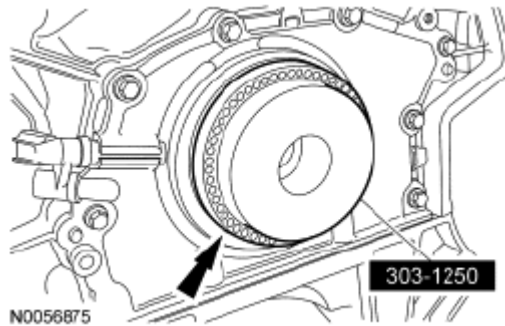
**Fig. 1043: Identifying RTV Silicone Applying Area**  
Courtesy of FORD MOTOR CO.

1. 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.
2. Install the rear seal retainer and the 8 bolts in the sequence shown in illustration.
  - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).



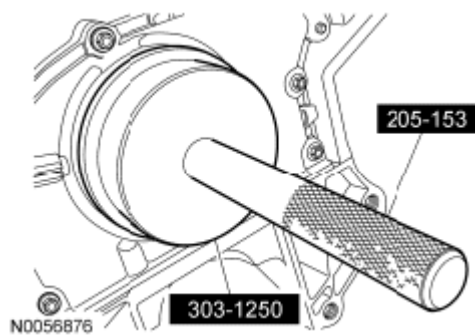
**Fig. 1044: Identifying Crankshaft Rear Seal Retainer And Bolts**  
Courtesy of FORD MOTOR CO.

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



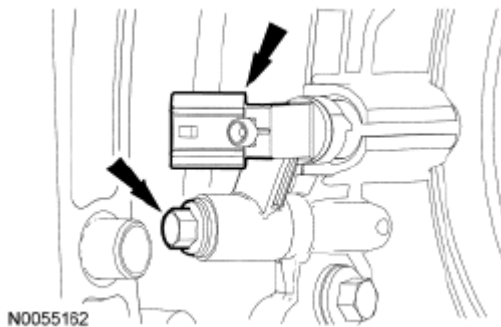
**Fig. 1045: Identifying Rear Main Seal Installer On Crankshaft**  
Courtesy of FORD MOTOR CO.

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



**Fig. 1046: Identifying Rear Main Seal Installer And Handle**  
Courtesy of FORD MOTOR CO.

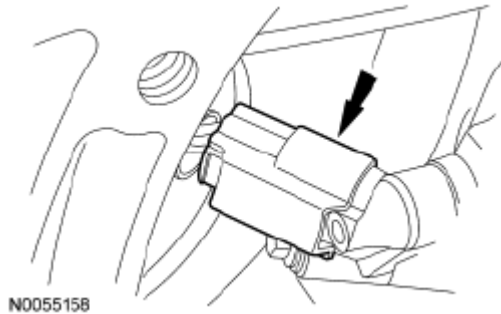
5. Install the Crankshaft Position (CKP) sensor and install the bolt.
  - Tighten to 10 Nm (89 lb-in).



**Fig. 1047: Locating CKP Sensor**

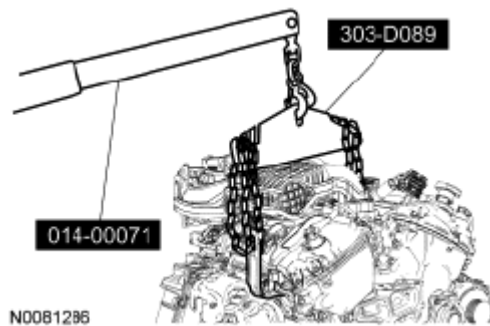
Courtesy of FORD MOTOR CO.

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



**Fig. 1048: Locating Crankshaft Position Sensor Electrical Connector**  
Courtesy of FORD MOTOR CO.

7. Using the Heavy Duty Floor Crane and Spreader Bar, install the engine onto the stand.



**Fig. 1049: Identifying Heavy Duty Floor Crane And Spreader Bar**  
Courtesy of FORD MOTOR CO.

8. Install the oil pan. For additional information, refer to **OIL PAN**.