2008 ENGINE

Engine - 3.0L (4V) - Fusion, Milan & MKZ

SPECIFICATIONS

MATERIAL

Material

Item	Specification	Fill Capacity
Motorcraft Metal Surface Prep ZC-31-A	-	-
Motorcraft Premium Gold Engine Coolant with Bittering Agent (bittered in US only) VC-7-B (US); CVC-7-A (Canada); or equivalent (yellow color)	WSS-M97B51-A1	-
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	5.7L (6.0 qt) includes filter change
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	-
Silicone Gasket Remover ZC-30	-	-
Thread Sealant with PTFE TA-24	WSK-M2G350-A2	-

GENERAL SPECIFICATIONS

GENERAL SPECIFICATIONS

Item	Specification
Engine	
Displacement	3.0L (4V) (182 CID)
No. cylinders	6
Bore/stroke	89.0 x 79.5 mm (3.5 x 3.13 in)
Fire order	1-4-2-5-3-6
Oil pressure (Minimum at 1,500 RPM with engine warmed up after 10 minutes of idling)	138 kPa (20 psi)
Compression Ratio	10.0:1
Engine and transaxle assembly weight (without accessory drive components)	234 kg (516 lb)
Engine weight (without accessory drive components	146 kg (322 lb)

and flexplate)	
Spark plug	AGSF-32M Gap = 1.30-1.40 mm (0.052-0.056 inch)
Cylinder Head and Valve Train	
Cylinder head gasket surface flatness	-
Combustion chamber volume	52 cc (3.17 CI)
Valve arrangement (front to rear)	LH intake I-I-I-I-I-I LH exhaust E-E-E-E-E-E RH intake I-I-I-I-I-I RH exhaust E-E-E-E-E-E
Valve guide bore inner diameter	6.015-6.044 mm (0.236-0.237 in)
Valve stem diameter - intake	5.975-5.995 mm (0.2350-0.2358 in)
Valve stem diameter - exhaust	5.950-5.970 mm (0.2343-0.2350 in)
Valve stem-to-guide clearance - intake	0.019-0.069 mm (0.0007-0.0027 in)
Valve stem-to-guide clearance - exhaust	0.045-0.094 mm (0.0017-0.037 in)
Valve head diameter - intake	35 mm (1.38 in)
Valve head diameter - exhaust	30 mm (1.18 in)
Valve head diameter (intake) - gauge diameter	33.5 mm (1.3189 in)
Valve head diameter (exhaust) - gauge diameter	28.0 mm (1.10236 in)
Valve face runout	0.05 mm (0.001 in)
Valve face angle	45.5 degrees
Valve seat width - intake	1.1-1.4 mm (0.043-0.055 in)
Valve seat width - exhaust	1.4-1.7 mm (0.055-0.066 in)
Valve seat runout	0.04 mm (0.001 in)
Valve seat angle	44.75 degrees
Valve spring free length (approx.)	46.6 mm (1.84 in)
Valve spring squareness	2.5%
Valve spring compression pressure (N @ spec. length)	693 N @ 30.09 mm (156 lb @ 1.18 in)
Valve spring installed height	39.89 mm (1.57 in)
Valve spring installed pressure (N @ spec. length)	240 N @ 39.89 mm (53.95 lbs @ 1.57 in)
Valve spring installed pressure - service limit	10% force loss @ specified height
Roller follower ratio @ max. lift	2.0:1
Hydraulic Lash Adjuster	
Diameter (standard)	16-15.988 mm (0.6290-0.6294 in)
Clearance to bore	0.018-0.069 mm (0.0007-0.0027 in)
Hydraulic leakdown rate	5-25 seconds
Collapsed lash adjuster gap	0.50-1.11 mm (0.019-0.043 in)
Camshaft	
Theoretical valve lift @ 0 lash	9.80 mm (0.388 in)

Lobe lift	4.80 mm (0.189 in)
Allowable lobe lift loss	0.76 mm (0.03 in)
Journal diameter (all)	26.962-26.936 mm (1.061-1.060 in)
Camshaft journal bore inside diameter	27.012-26.987 mm (1.063-1.062 in)
Camshaft journal-to-bearing clearance - standard	0.025-0.076 mm (0.001-0.0029 in)
Camshaft journal-to-bearing clearance - service limit	0.121 mm (0.0047 in)
Runout	-
End play - service limit	0.190 mm (0.00748 in)
Cylinder Block	
Cylinder bore diameter - grade 1	89.000-89.010 mm (3.50393-3.504323 in)
Cylinder bore diameter - grade 2	89.010-89.020 mm (3.504323-3.504717 in)
Cylinder bore diameter - grade 3	89.020-82.030 mm (3.504717-3.50511 in)
Cylinder bore maximum taper	0.020 mm (0.0008 in)
Cylinder bore maximum out-of-round	0.015 mm (0.0005 in)
Cylinder bore maximum out-of-round - service limit	0.020 mm (0.0007 in)
Main bearing bore inside diameter	67.998-68.022 mm (2.677-2.6780 in)
Head gasket surface flatness	0.15 mm (0.0059 in) allowed 150 x 150 mm (0.5 x 0.5 in)
Crankshaft	
Main bearing journal diameter	62.968-62.992 mm (2.467-2.479 in)
Main bearing journal maximum taper	0.008 mm (0.0003 in)
Main bearing journal maximum out-of-round	0.006 mm (0.0002 in)
Main bearing journal-to-cylinder block clearance	0.024-0.072 mm (0.0009-0.003 in)
Connecting rod journal diameter	49.969-49.991 mm (1.967-1.968 in)
Connecting rod journal maximum taper	0.008 mm (0.0003 in)
Connecting rod journal maximum out-of-round	0.006 mm (0.0002 in)
Crankshaft maximum end play	0.135-0.255 mm (0.005-0.010 in)
Piston and Connecting Rod	
Piston diameter - coated, grade 1	88.990-89.010 mm (3.5035-3.5043 in)
Piston diameter - coated, grade 2	88.998-89.022 mm (3.5039-3.5048 in)
Piston diameter - coated, grade 3	89.010-89.030 mm (3.5043-3.5051 in)
Piston diameter - uncoated, grade 1	88.970-88.980 mm (3.50275-3.50314 in)
Piston diameter - uncoated, grade 2	88.978-88.992 mm (3.50306-3.50362 in)
Piston diameter - uncoated, grade 3	89.010-89.030 mm (3.50432-3.50511 in)
Piston-to-cylinder bore clearance	0.012 to 0.022 mm (0.0005-0.0009 in)
Piston ring end gap - compression (top, gauge diameter)[a]	0.100-0.250 mm (0.0039-0.0098 in)
Piston ring end gap - compression (bottom, gauge diameter)	0.27-0.42 mm (0.0106-0.0165 in)
Piston ring end gap - oil ring (steel rail, gauge diameter)	0.15-0.65 mm (0.0059-0.0255 in)

Piston ring end gap - compression (top, service limit)	0.50 mm (0.0196 in) max
Piston ring end gap - compression (bottom, service limit)	0.65 mm (0.0255 in) max
Piston ring end gap - oil ring (steel rail, service limit)	0.90 mm (0.0354 in) max
Piston ring groove width - compression (top)	1.230-1.245 mm (0.0484-0.0490 in)
Piston ring groove width - compression (bottom)	1.530-1.545 mm (0.0602-0.0608 in)
Piston ring groove width - oil ring	3.030-3.055 mm (0.1192-0.0120 in)
Piston ring width	-
Piston ring-to-groove clearance	-
Piston pin bore diameter	21.008-21.012 mm (0.8270-0.8272 in)
Piston pin diameter	21.011-21.013 mm (0.8271-0.8273 in)
Piston pin length	60.51-60.08 mm (2.382-2.365 in)
Piston pin-to-piston fit	0.002 to 0.009 mm (0.00007-0.0003 in)
Piston-to-connecting rod clearance	-
Connecting rod-to-pin clearance - standard	0.004-0.02 mm (0.0001-0.0007 in)
Connecting rod-to-pin clearance - service limit	0.035 mm (0.0013 in)
Connecting rod pin bore diameter	21.017-21.031 mm (0.827-0.828 in)
Connecting rod length (center-to-center)	138.06-138.14 mm (5.435-5.38 in)
Connecting rod maximum allowed bend	0.038 per 25 mm (0.0014 per 0.984 in)
Connecting rod maximum allowed twist	0.050 per 25 mm (0.0019 per 0.984 in)
Connecting rod bearing bore diameter	53.015-53.035 mm (2.0872-2.0879 in)
Connecting rod bearing-to-crankshaft clearance	0.028-0.066 mm (0.001-0.0025 in)
Connecting rod side clearance	0.100-0.30 mm (0.0039-0.0118 in)

[a] Specification 82.4 mm (3.2441 in) diameter gauge

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	Nm	lb-ft	lb-in
A/C compressor bolts	25	18	-
A/C compressor bracket bolts	25	18	-
A/C manifold bolt	15	-	133
A/C tube bracket bolts	10	-	89
A/C tube connection bolts	8	-	71
A/C tube retaining bolts	8	-	71
Accessory drive belt idler (grooved) pulley bolt	25	18	-
Accessory drive belt idler (non-grooved) pulley bolt	48	35	-

Accessory drive belt tensioner bolt	45	33	-
Block heater	40	30	-
Camshaft bearing cap bolts[a]	-	-	-
Camshaft oil seal retainer bolts	10	-	89
Camshaft thrust bearing cap bolts[a]	-	-	-
Catalyst monitor sensor	48	35	-
Catalyst monitor sensor bracket bolt	12	-	106
Catalytic converter bracket-to-converter bolts	20	-	177
Catalytic converter heat shield bolts	11	-	97
Catalytic converter nuts	48	35	-
Catalytic converter nuts - LH and RH Front Wheel Drive (FWD)	20	-	177
Catalytic converter nuts - RH All-Wheel Drive (AWD)	20	-	177
Catalytic converter studs	12	-	106
Catalytic converter-to-engine bracket bolts	35	26	-
Coolant bypass tube nuts and body	20	-	177
Coolant pump bolts[a]	-	-	-
Crankcase cover bolts	10	-	89
Crankshaft pulley bolt[a]	-	-	-
Cylinder head bolts[a]	-	-	-
EGR tube nuts	40	30	-
EGR valve bolts	25	18	-
Engine cover ball studs	4	-	35
Engine front cover bolts[a]	-	-	-
Engine mount bracket bolt	115	85	-
Engine mount bracket nuts	63	46	-
Engine mount damper bolt	23	17	-
Engine mount nut and bolts	55	41	-
Engine oil filter[a]	-	-	-
Engine Oil Pressure (EOP) switch	14	-	124
Engine roll-restrictor bolts	90	66	-
Exhaust heat shield - RH	11	-	97
Exhaust heat shield bracket bolts (inboard half)	40	30	-
Exhaust heat shield bracket nuts (outboard half)	20	-	177
Exhaust manifold nuts[a]	-	-	-
Exhaust manifold studs	12	-	106
Flexplate bolts	80	59	-
Generator B+ terminal nut	6	-	53
Generator bolts and stud bolt	48	35	-
Ground wire-to-engine mount bracket bolt	10	-	89
Ground wire-to-transaxle bolt	12	-	106

Halfshaft carrier bearing bracket bolts - AWD	23	17	-
Halfshaft carrier bearing bracket bolts - FWD	55	41	-
Heated Oxygen Sensor (HO2S)	48	35	-
Ignition coil-on-plug bolts	7	-	62
Intermediate steering shaft bolt	23	17	-
Knock Sensor (KS) bolt	20	-	177
Lower ball joint nuts	200	148	-
Lower control arm-to-strut through bolt	103	76	-
Lower intake manifold bolts[a]	-	-	-
Oil level indicator tube stud bolt	9	-	80
Oil pan baffle nuts[a]	-	-	-
Oil pan bolts and stud bolts[a]	-	-	-
Oil pan drain plug	26	19	-
Oil pan-to-engine front cover bolts	25	18	-
Oil pan-to-transaxle bolts	48	35	-
Oil pump bolts[a]	-	-	-
Oil pump screen and pickup tube bolts	10	-	89
Oil separator cover bolts	10	-	89
Power Steering Pressure (PSP) tube banjo bolts	35	26	-
PSP tube bracket-to-cylinder head bolt	9	-	80
PSP tube bracket-to-reservoir bolt	9	-	80
PSP tube bracket-to-steering gear bolt	15	-	133
Power steering pump bolts	25	18	-
Power steering rack heat shield bolts	15	-	133
Power steering reservoir nuts	9	-	80
Power Transfer Unit (PTU) bracket bolts	70	52	-
PTU-to-transaxle bolts	90	66	-
Radio frequency interference capacitor nut	6	-	53
Rear driveshaft-to-PTU flange bolts	70	52	-
Spark plugs	15	-	133
Stabilizer bar link nuts	40	30	-
Starter B+ terminal nut	12	-	106
Starter motor bolts	27	20	-
Starter S terminal nut	5	-	44
Subframe bracket bolts	103	76	-
Subframe nuts	150	111	-
Throttle Body (TB) bolts	10	-	89
Tie-rod end nuts	48	35	-
Timing chain tensioner bolts	25	18	-
Torque converter-to-flexplate nuts	36	27	-

Transaxle control cable bracket	8	-	71
Transaxle mount bolts	90	66	-
Transaxle-to-engine bolts	48	35	-
Upper intake manifold bolts[a]	-	-	-
Vacuum tube bracket	10	-	89
Valve cover bolts and stud bolts[a]	-	-	-
Variable Camshaft Timing (VCT) actuator bolts[a]	-	-	-
VCT assembly bolts	25	18	-
Windshield washer bottle and A/C tube retaining bolt	7	-	62
Wiring harness retainer bolt	10	-	89

[a] Refer to the procedure.

DESCRIPTION AND OPERATION

ENGINE

The 3.0L (4V) is a V-6 engine with the following features:

- Dual overhead camshafts
- Four valves per cylinder
- Sequential Multi-Port Fuel Injection (SFI)
- A composite lower intake manifold and a composite upper intake manifold
- Aluminum cylinder heads
- Two-piece design aluminum cylinder block
- Electronic ignition system with 6 ignition coils

Identification

For quick identification refer to the safety certification decal.

- The decal is located on the LH front door lock face panel.
- An engine identification label is also attached to the engine.
- The symbol code on the identification tag identifies each engine for determining parts usage; for instance, engine displacement in liters or cubic inch displacement and model year.

Exhaust Emission Control System

Operation and required maintenance of the exhaust emission control devices used on this engine are covered in the **Introduction - Gasoline Engines** article.

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 camshafts are mounted in the cylinder heads and act against a roller follower to open and close the valves. A hydraulic lash adjuster is located on one side of the roller follower and the valve tip on the opposite end. The camshafts are driven off the front of each cylinder head by 2 chains (one each side). Both of the chains are driven by sprockets that are located on the crankshaft, just in front of the oil pump.

Positive Crankcase Ventilation System

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

Lubrication System

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

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:

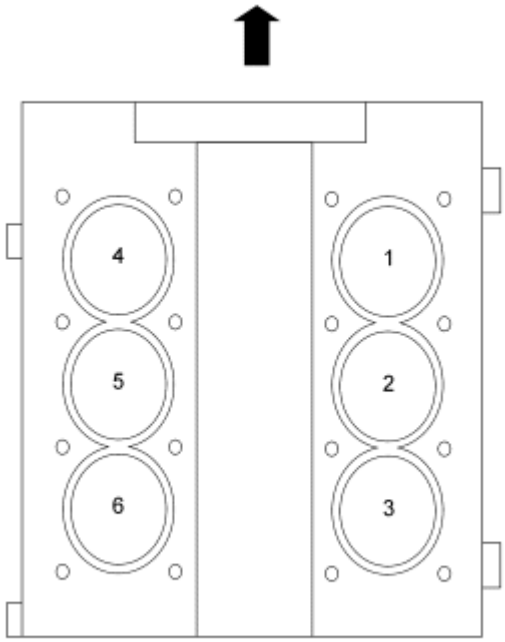
- The oil pump is mounted on the front face of the cylinder block.
- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.
- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the 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 components:

- Radiator
- Electric cooling fan motor
- Degas bottle (aids in maintaining the correct volume of engine coolant)
- Coolant thermostat
- Coolant hoses

Engine Cylinder Identification



N0069904

Fig. 1: Engine Cylinder Identification
Courtesy of FORD MOTOR CO.

DIAGNOSTIC TESTS

ENGINE

For basic engine mechanical concerns, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article.
For driveability concerns, refer to the **Introduction - Gasoline Engines** article.

IN-VEHICLE SERVICING

UPPER INTAKE MANIFOLD

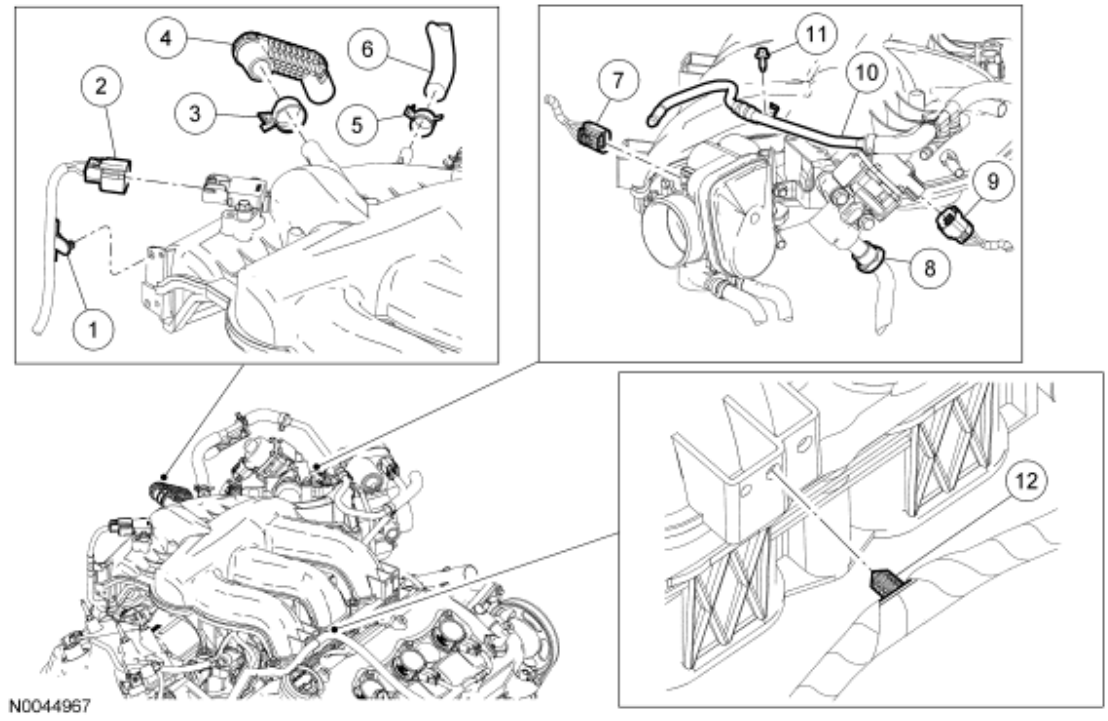


Fig. 2: Exploded View Of Upper Intake Manifold (1 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Wiring harness retainer (part of 12B637)
2	14A464	Manifold Absolute Pressure (MAP) sensor electrical connector (part of 12B637)
3	-	PCV hose clamp (part of 6K817)
4	6K817	PCV hose
5	392984	Brake booster vacuum hose clamp
6	2C053	Brake booster vacuum hose
7	2C053	Throttle Body (TB) electrical connector (part of 12B637)
8	-	EGR tube nut (part of 9D477)
9	14A464	EGR valve electrical connector (part of 12B637)
10	-	Vacuum tube
11	-	Vacuum tube retainer bolt
12	-	Wiring harness retainer (part of 12B637)

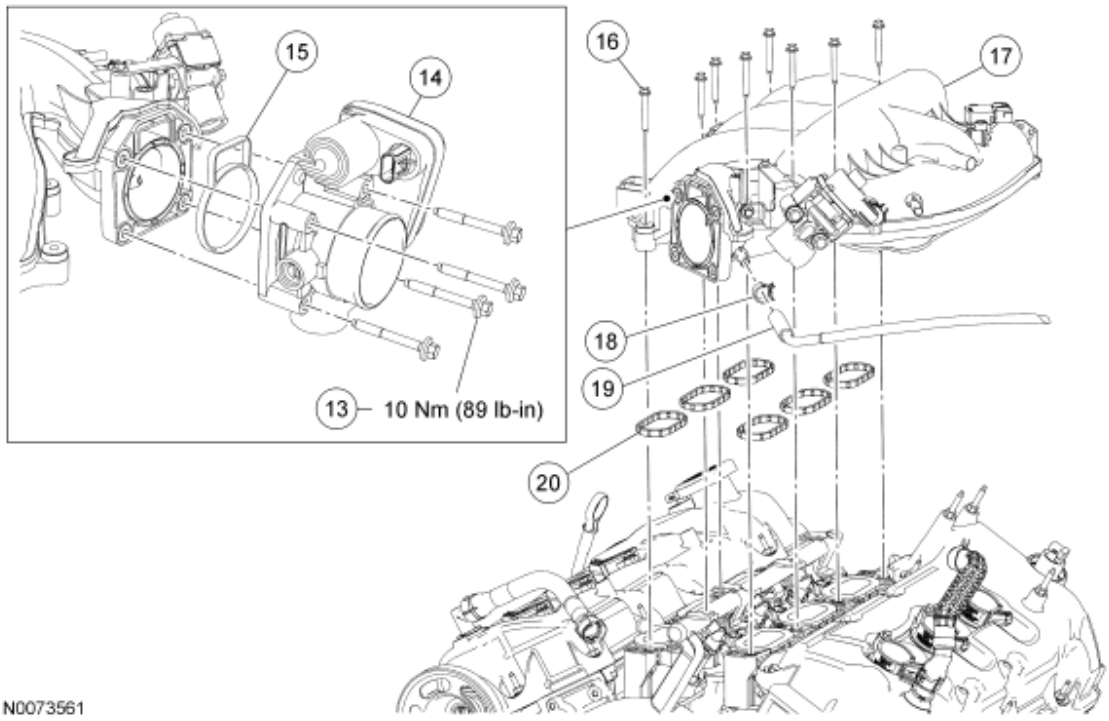


Fig. 3: Exploded View Of Upper Intake Manifold With Torque Specifications (2 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
13	W709168	TB bolt (4 required)
14	9F991	TB
15	9E936	TB gasket
16	9Y450	Upper intake manifold bolt (8 required)
17	9424	Upper intake manifold
18	-	Clamp (part of 9D661)
19	9D661	Evaporative Emission (EVAP) tube
20	9H486	Upper intake manifold gasket (6 required)

REMOVAL

1. Remove the air cleaner outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING - 3.0L (4V)** article.
2. Disconnect the Throttle Body (TB) electrical connector.
3. Remove the 4 bolts and position the TB aside.
   - Discard the gasket.
4. Disconnect the Evaporative Emission (EVAP) tube from the intake manifold.
5. Remove the vacuum tube clamp bolt.
6. Disconnect the vacuum tube from the intake manifold.

7. Disconnect the PCV tube from the intake manifold.
8. Disconnect the EGR valve electrical connector.
9. Loosen the EGR tube-to-EGR valve nut.
10. Disconnect the Manifold Absolute Pressure (MAP) sensor electrical connector and the pin-type retainer.
11. Detach the wiring harness retainer from the front of the upper intake manifold.
12. Remove the 8 bolts and remove the upper intake manifold.
    - Remove and discard the gaskets.

INSTALLATION

1. Clean and inspect all of the sealing surfaces of the upper intake manifold.

NOTE: Install new upper intake manifold gaskets.

2. Install the upper intake manifold, gaskets and the 8 bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

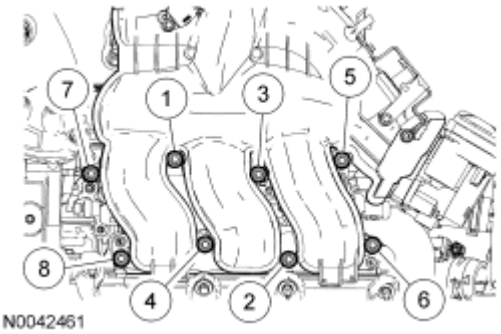


Fig. 4: Identifying Tightening Sequence Of Upper Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

3. Attach the wiring harness retainer to the front of the upper intake manifold.
4. Connect the MAP sensor electrical connector and the pin-type retainer.
5. Install the EGR tube-to-EGR valve nut.
    - Tighten to 40 Nm (30 lb-ft).
6. Connect the EGR valve electrical connector.
7. Connect the PCV tube to the intake manifold.
8. Connect the vacuum tube to the intake manifold.
9. Install the vacuum tube clamp bolt.
    - Tighten to 10 Nm (89 lb-in).
10. Connect the EVAP tube to the intake manifold.

NOTE: Install a new TB gasket.

11. Install the gasket, TB and 4 bolts.
    - Tighten to 10 Nm (89 lb-in).
12. Connect the TB electrical connector.
13. Install the air cleaner outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING - 3.0L (4V)** article.

LOWER INTAKE MANIFOLD

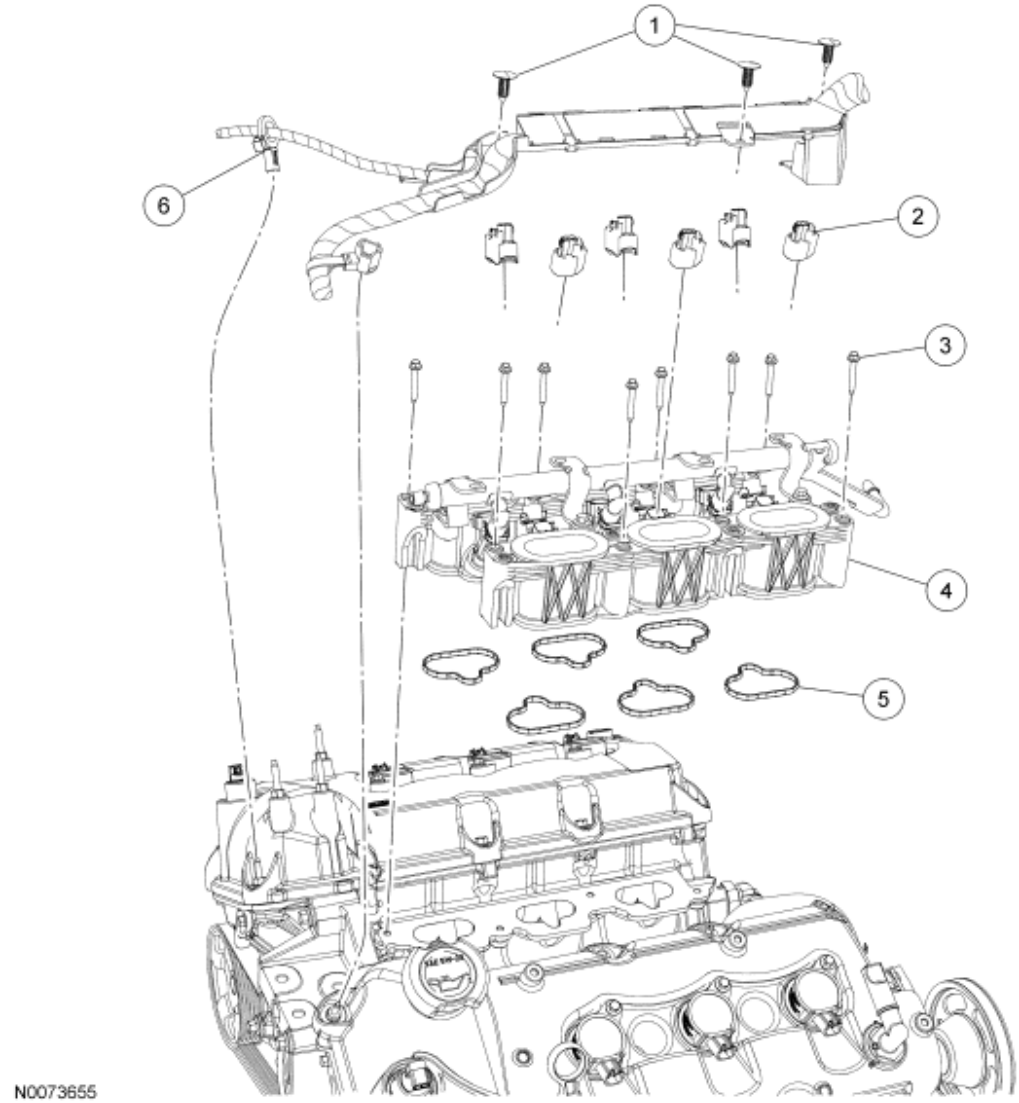


Fig. 5: Exploded View Of Lower Intake Manifold
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Wiring harness retainers (3 required) (part of 12B637)
2	14A464	Fuel injector electrical connector (6 required) (part of 12B637)

3	W708187	Lower intake manifold bolt (8 required)
4	9K461	Lower intake manifold
5	9439	Lower intake manifold gasket (6 required)
6	-	RH and LH valve cover stud bolt wiring harness retainers (2 required) (part of 12B637)

REMOVAL

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.

WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result in serious personal injury.

1. Release the fuel system pressure. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
2. Disconnect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING AND CABLES** article.
3. Remove the upper intake manifold. For additional information, refer to **Upper Intake Manifold**.
4. Disconnect the fuel supply tube quick connect coupling from the fuel rail. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
5. Detach the 2 wiring harness retainers from the RH and LH valve cover stud bolts.
6. Detach the 3 pin-type retainers from the fuel rail.
7. Disconnect the 6 fuel injector electrical connectors.
8. Remove the 8 lower intake manifold bolts and the lower intake manifold.
   - Remove and discard the gaskets.

INSTALLATION

NOTE: Clean and inspect all sealing surfaces.

1. Using new gaskets, install the lower intake manifold and the 8 bolts.
   - Tighten in the sequence shown to 10 Nm (89 lb-in).

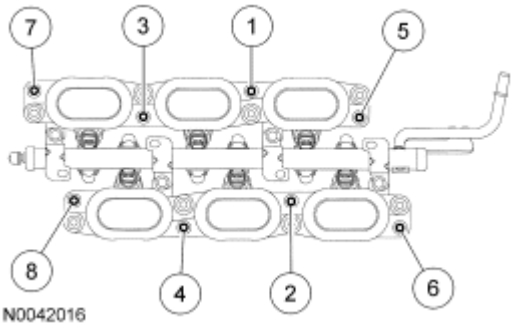


Fig. 6: Identifying Tightening Sequence Of Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

2. Connect the 6 fuel injector electrical connectors.
3. Attach the 3 pin-type retainers to the fuel rail.
4. Attach the 2 wiring harness retainers to the RH and LH valve cover stud bolts.
5. Connect the fuel supply tube quick connect coupling at the fuel rail. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
6. Install the upper intake manifold. For additional information, refer to **Upper Intake Manifold**.
7. Connect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING AND CABLES** article.

VALVE COVER - LH

Material

Item	Specification
Motorcraft Metal Surface Prep ZC-31-A	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

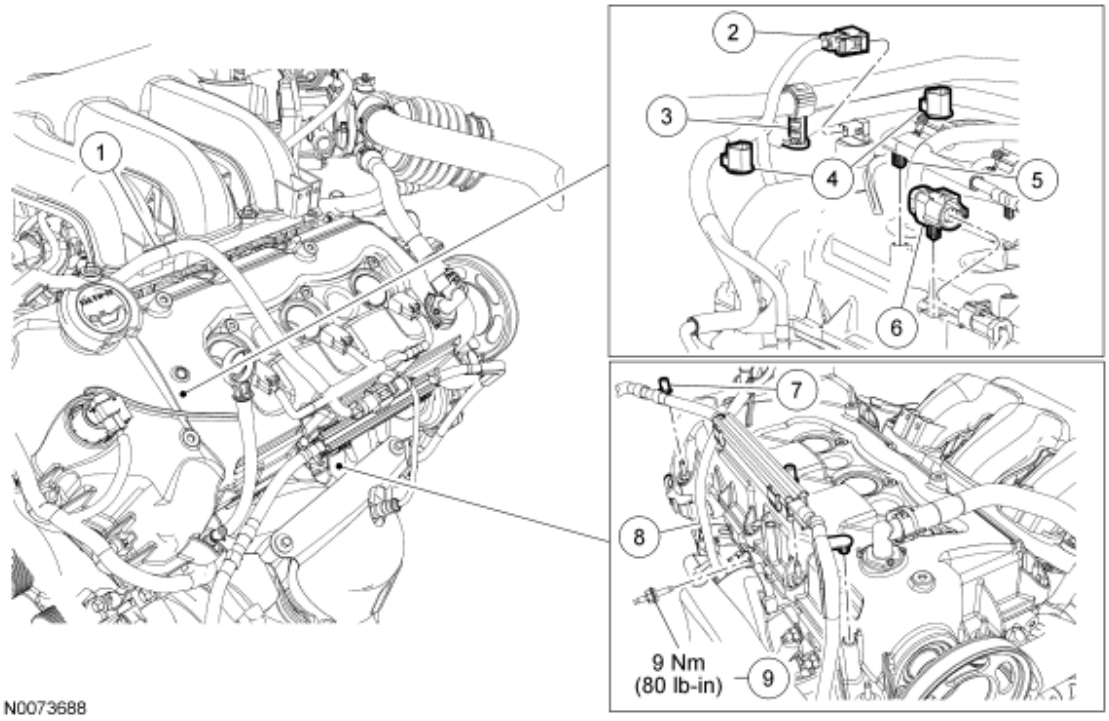


Fig. 7: Exploded View Of LH Valve Cover With Torque Specification (1 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Upper intake manifold wiring harness retainer (part of 12B637)
2	14A464	Variable Camshaft Timing (VCT) solenoid electrical connector (part of 12B637)
3	-	Power steering hose retainer clip
4	-	Wiring harness retainers (2 required) (part of 12B637)
5	13A506	Wiring harness retainer (2 required) (part of 12B637)
6	14A464	LH Heated Oxygen Sensor (HO2S) electrical connector (part of 12B637)
7	-	Wiring harness retainer (3 required) (part of 12B637)
8	6754	Oil level indicator tube
9	W701822	Oil level indicator tube stud bolt

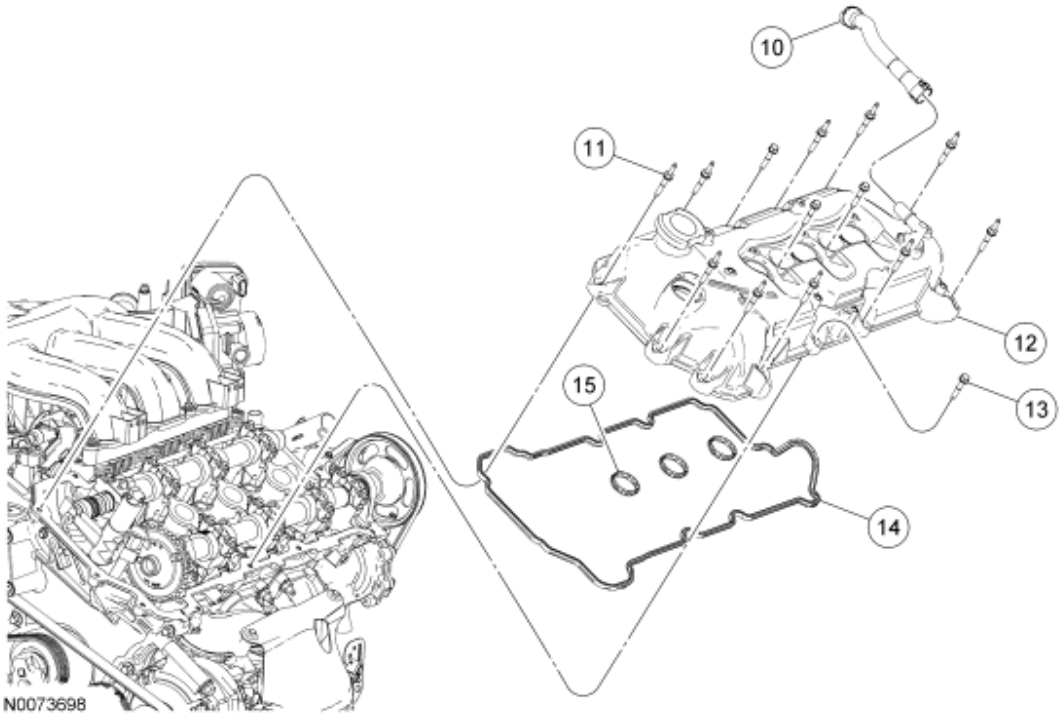


Fig. 8: Exploded View Of LH Valve Cover (2 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
10	6758	Crankcase ventilation tube
11	6C519	Valve cover stud bolt (10 required)
12	6A505	Valve cover
13	6C519	Valve cover bolt (4 required)
14	6A559	Valve cover gasket
15	6C527	Spark plug cavity gasket (3 required)

REMOVAL

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

1. Remove the LH ignition coil-on-plugs. For additional information, refer to **ENGINE IGNITION - 3.0L (4V)** article.
2. Remove the crankcase ventilation tube.
3. Disconnect the Variable Camshaft Timing (VCT) solenoid electrical connector.
4. Disconnect the LH Heated Oxygen Sensor (HO2S) electrical connector and pin-type retainer.
5. Detach the power steering hose retainer from the valve cover stud bolt.

6. Remove the oil level indicator.
7. Remove the stud bolt and position the oil level indicator tube aside.
8. Detach the wiring harness retainer from the upper intake manifold.
9. Detach the 2 wiring harness retainers from the valve cover stud bolts.
10. Detach the 2 pin-type retainers from the valve cover and position the wiring harness aside.
11. Remove the 4 bolts, 10 stud bolts and the valve cover.
    - Discard the gaskets.

INSTALLATION

1. Clean the valve cover, cylinder head and front cover sealing surfaces with metal surface prep and install new valve cover and spark plug cavity gaskets.

NOTE: The valve cover must be installed and the bolts and stud bolts tightened within 4 minutes of sealant application.

2. Apply an 8 mm (0.31 in) dot of silicone gasket sealant to the front cover-to-cylinder head joints and the camshaft seal retainer-to-cylinder head joints.

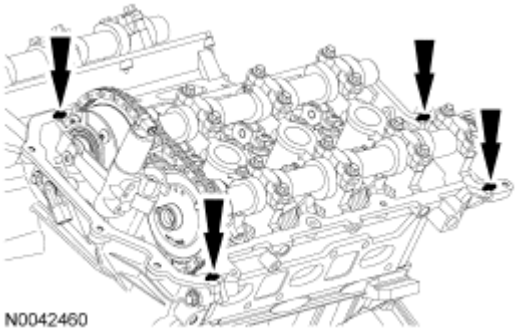


Fig. 9: Locating Silicone Gasket Sealant
Courtesy of FORD MOTOR CO.

3. Position the valve cover and install the bolts and stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

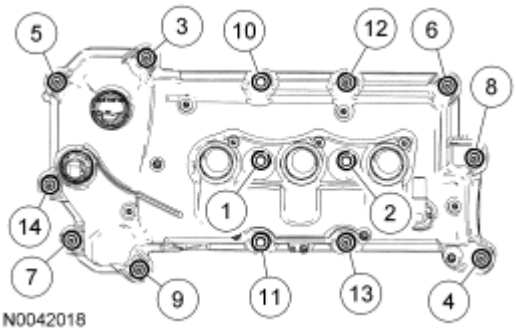


Fig. 10: Identifying Tightening Sequence Of Valve Cover Bolts
Courtesy of FORD MOTOR CO.

4. Position the wiring harness and attach the 2 pin-type retainers to the valve cover.
5. Attach the 2 wiring harness retainers to the valve cover stud bolts.
6. Attach the wiring harness retainer to the upper intake manifold.
7. Position the oil level indicator tube and install the stud bolt.
    - Tighten to 9 Nm (80 lb-in).
8. Install the oil level indicator.
9. Attach the power steering tube retainer to the valve cover stud bolt.
10. Connect the LH HO2S electrical connector and pin-type retainer.
11. Connect the VCT solenoid electrical connector.
12. Install the crankcase ventilation tube.
13. Install the LH ignition coil-on-plugs. For additional information, refer to **ENGINE IGNITION - 3.0L (4V)** article.

VALVE COVER - RH

Material

Item	Specification
Motorcraft Metal Surface Prep ZC-31-A	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

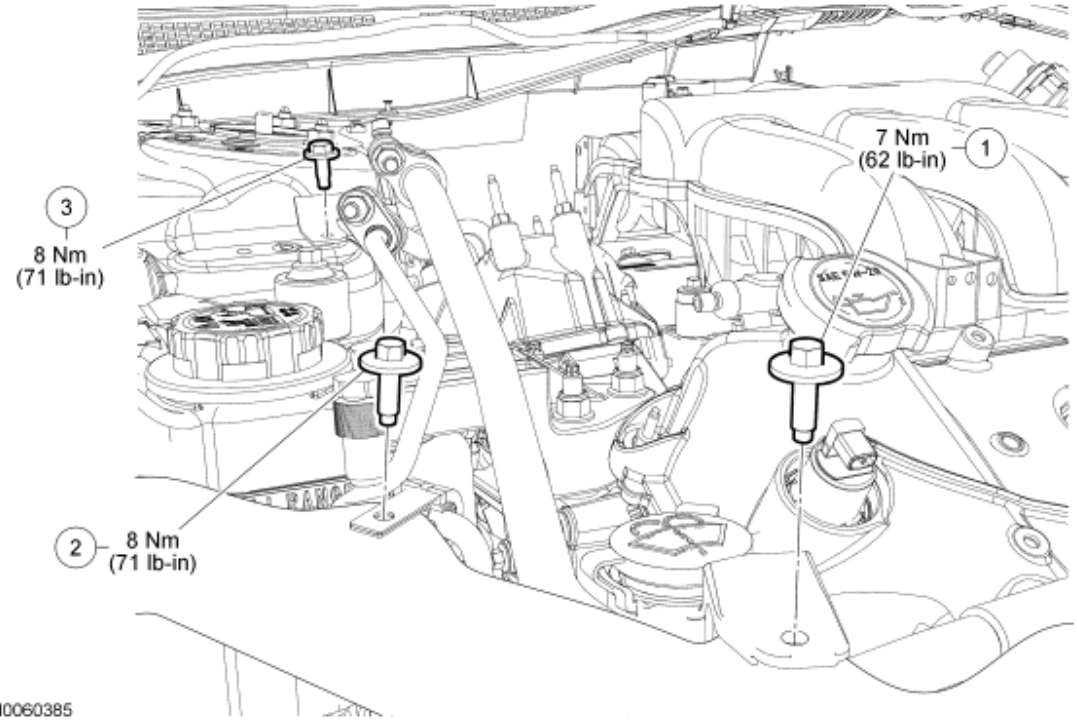


Fig. 11: Exploded View Of RH Valve Cover With Torque Specifications (1 Of 4)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W503924	Windshield washer bottle and A/C tube retaining clamp bolt
2	W503924	A/C tube retaining clamp bolt
3	W505422	A/C tube retaining clamp bolt

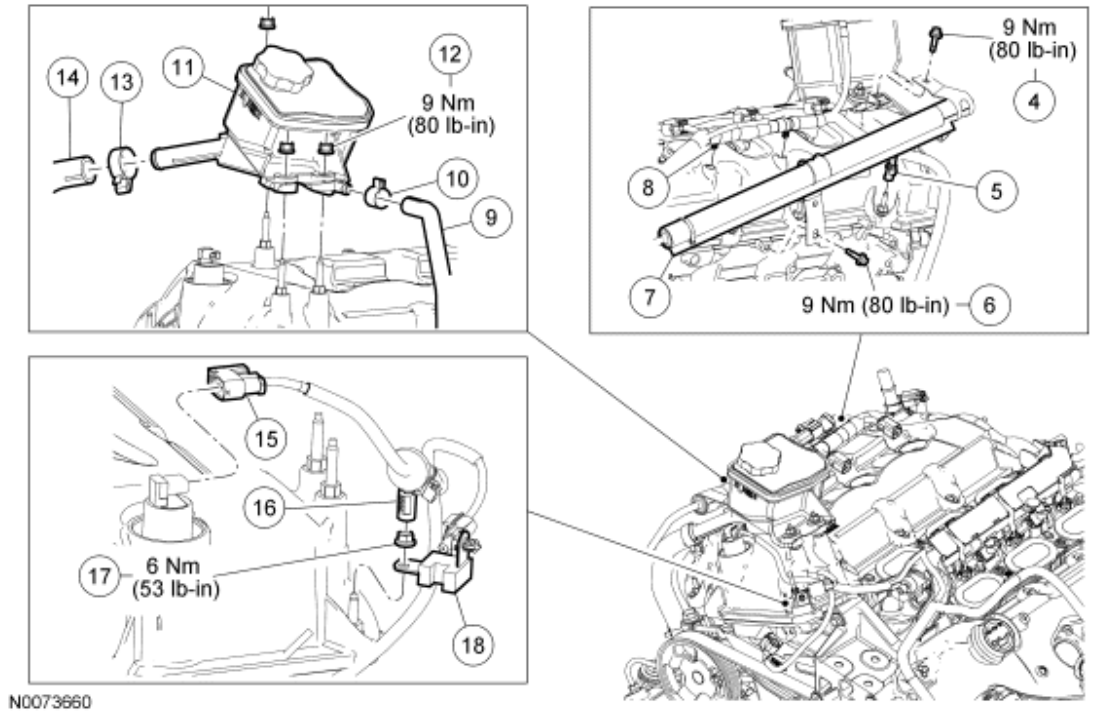


Fig. 12: Exploded View Of RH Valve Cover With Torque Specifications (2 Of 4)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
4	W506413	Power Steering Pressure (PSP) tube bracket-to-reservoir bolt
5	-	Wiring harness retainer (part of 12B637)
6	W506413	PSP tube bracket-to-cylinder head bolt
7	3A719	PSP tube
8	-	Wiring harness retainer (2 required) (part of 12B637)
9	3493	Power steering hose
10	-	Power steering hose clamp (part of 3493)
11	3R700	Power steering reservoir
12	W520111	Power steering reservoir nut (3 required)
13	-	Power steering hose clamp
14	3681	Power steering hose
15	-	Variable Camshaft Timing (VCT) solenoid electrical connector (part of 12B637)
16	-	Wiring harness retainer (part of 12B637)
17	W520411	Radio frequency interference capacitor nut
18	18801	Radio frequency interference capacitor

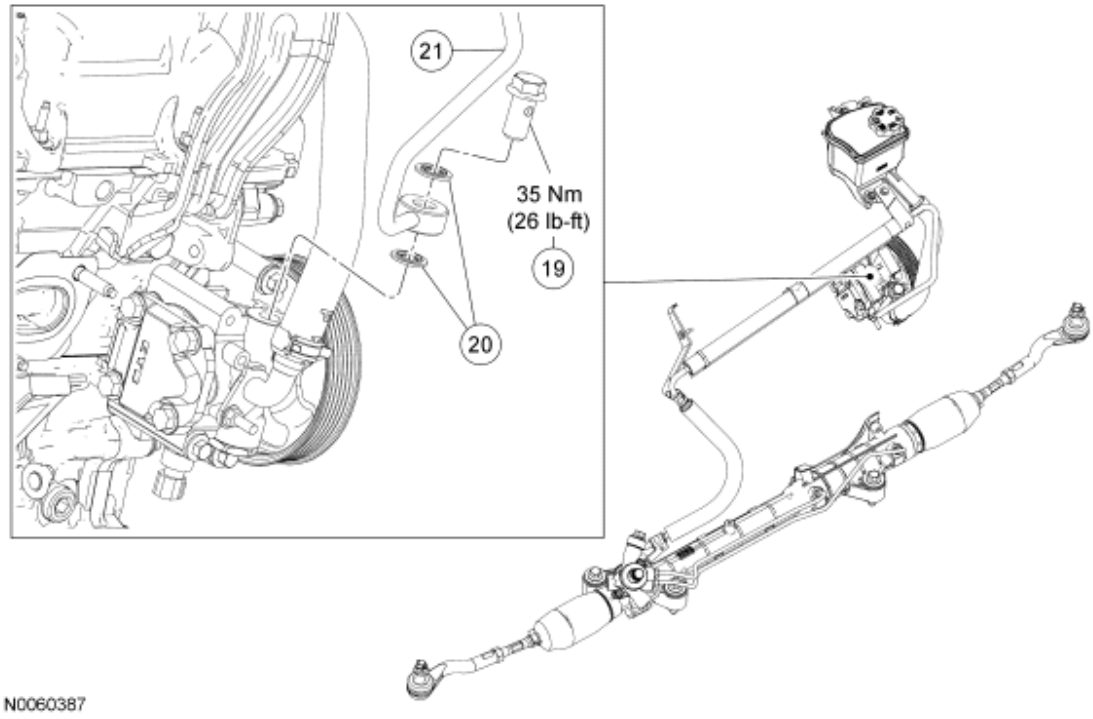


Fig. 13: Exploded View Of RH Valve Cover With Torque Specification (3 Of 4)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
19	506413	PSP tube-to-power steering pump banjo bolt
20	-	PSP tube seals
21	3A719	PSP tube

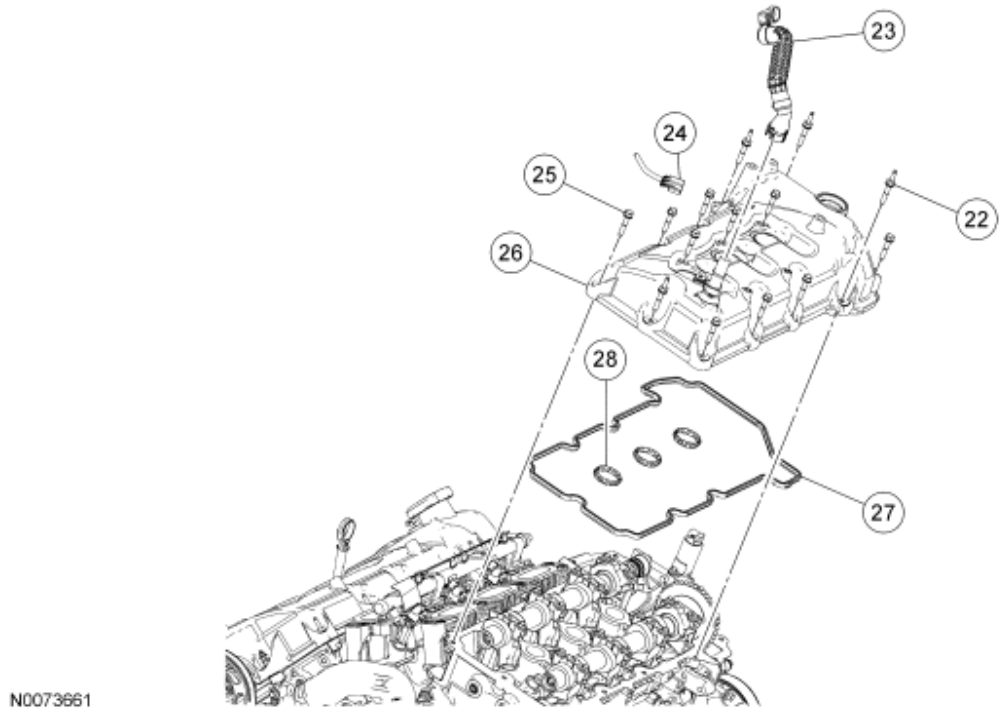


Fig. 14: Exploded View Of RH Valve Cover (4 Of 4)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
22	6C519	Valve cover stud bolt (4 required)
23	6K817	PCV hose
24	14A464	PCV valve electrical connector (part of 12B637)
25	6C519	Valve cover bolt (10 required)
26	6582	Valve cover
27	6584	Valve cover gasket
28	6C527	Spark plug cavity gasket (3 required)

REMOVAL

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

1. Remove the lower cowl panel. For additional information, refer to the cowl panel grille procedure in **FRONT END BODY PANELS** article.
2. Remove the RH ignition coil-on-plugs. For additional information, refer to **ENGINE IGNITION - 3.0L (4V)** article.
3. Remove the retaining bolt from the windshield washer bottle and A/C tube.

4. Remove the 2 A/C tube retaining bolts and position the A/C tubes aside.
5. Remove the PCV tube.
6. Disconnect the PCV valve electrical connector.
7. Disconnect the power steering hose from the reservoir.
8. Remove the 3 power steering reservoir nuts.
9. Remove the Power Steering Pressure (PSP) tube bracket-to-reservoir bolt.
10. Remove the PSP tube bracket-to-cylinder head bolt.
11. Reposition the power steering reservoir and disconnect the reservoir-to-pump hose.
    - Remove the power steering reservoir.
12. Remove the PSP tube-to-power steering pump banjo bolt and position the PSP tube aside.
    - Discard the bolt and seals.
13. Disconnect the Variable Camshaft Timing (VCT) solenoid electrical connector.
14. Detach the wiring harness retainer from the valve cover stud bolt.
15. Remove the nut and the radio frequency interference capacitor from the valve cover stud bolt.
16. Detach the 2 pin-type retainers from the valve cover and position the wiring harness aside.
17. Remove the 10 bolts, 4 stud bolts and the valve cover.
    - Discard the gaskets.

INSTALLATION

1. Clean the valve cover, cylinder head and front cover sealing surfaces with metal surface prep and install a new valve cover and spark plug cavity gaskets.

NOTE: The valve cover must be installed and the bolts and stud bolts tightened within 4 minutes of sealant application.

2. Apply an 8 mm (0.31 in) dot of silicone gasket sealant to the front cover-to-cylinder head joints.

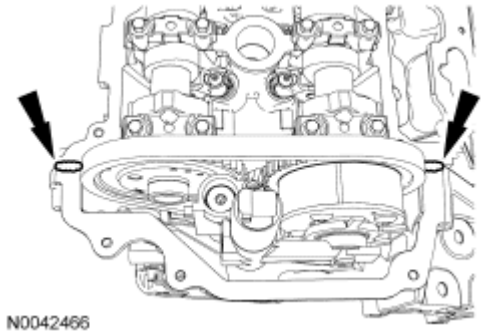


Fig. 15: Locating Silicone Gasket Sealant
Courtesy of FORD MOTOR CO.

3. Position the valve cover and install the bolts and stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

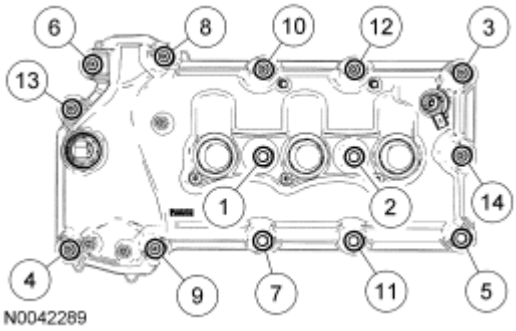


Fig. 16: Identifying Tightening Sequence Of Valve Cover Bolts
Courtesy of FORD MOTOR CO.

4. Position the wiring harness and attach the 2 pin-type retainers to the valve cover.
5. Install the radio frequency interference capacitor and the nut.
   - Tighten to 6 Nm (53 lb-in).
6. Attach the wiring harness retainer to the stud bolt.
7. Connect the VCT solenoid electrical connector.

NOTE: A new bolt and new seals must be installed any time the Power Steering Pressure (PSP) tube is disconnected from the power steering pump.

8. Position the PSP tube-to-power steering pump and install the new seals and banjo bolt.
   - Tighten to 35 Nm (26 lb-ft).
9. Position the power steering reservoir and connect the reservoir-to-pump hose.
10. Install the PSP tube bracket-to-cylinder head bolt.
    - Tighten to 9 Nm (80 lb-in).
11. Install the PSP tube bracket-to-reservoir bolt.
    - Tighten to 9 Nm (80 lb-in).
12. Install the 3 power steering reservoir nuts.
    - Tighten to 9 Nm (80 lb-in).
13. Connect the power steering hose to the reservoir.
14. Connect the PCV valve electrical connector.
15. Install the PCV tube.
16. Position the A/C tubes and install the 2 A/C tube retaining bolts.
    - Tighten to 8 Nm (71 lb-in).
17. Install the A/C tube and windshield washer bottle retaining bolt.
    - Tighten to 7 Nm (62 lb-in).
18. Install the RH ignition coil-on-plugs. For additional information, refer to **ENGINE IGNITION - 3.0L (4V)** article.
19. Install the lower cowl panel. For additional information, refer to the cowl panel grille procedure in **FRONT END BODY PANELS** article.

20. Fill the power steering system. For additional information, refer to **STEERING SYSTEM - GENERAL INFORMATION** article.

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

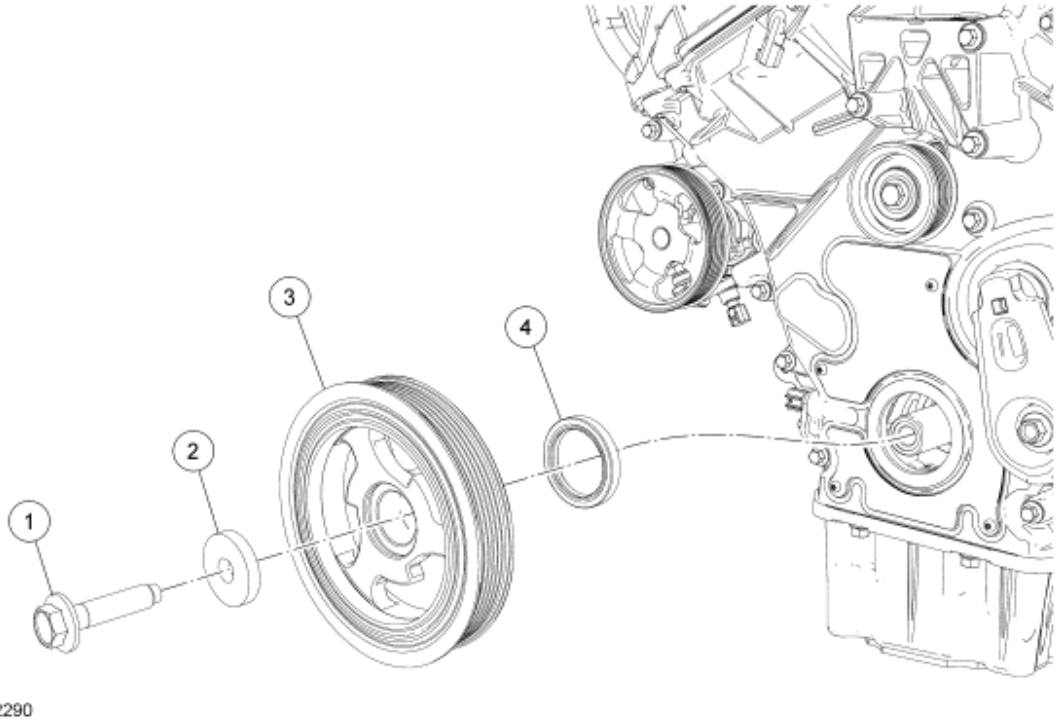


Fig. 17: Exploded View Of Crankshaft Pulley & Crankshaft Front Seal
Courtesy of FORD MOTOR CO.

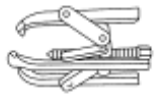
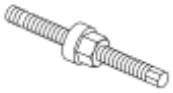
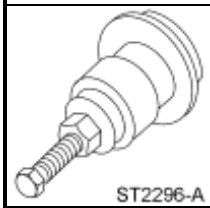
Item	Part Number	Description
1	W701512	Crankshaft pulley bolt
2	N806165	Washer
3	6316	Crankshaft pulley
4	6700	Crankshaft front seal

1. For additional information, refer to the procedures.

CRANKSHAFT PULLEY

Special Tools

Illustration	Tool Name	Tool Number
	3-Jaw Puller	303-D121

 ST1184-A		
 ST1287-A	Installer, Crankshaft Vibration Damper	303-102 (T74P-6316-B)
 ST2296-A	Installer, Front Cover Oil Seal	303-335 (T88T-6701-A)
 ST1438-A	Strap Wrench	303-D055 (D85L-6000-A)

Material

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
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

REMOVAL

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING** article.
2. Remove the accessory drive belt. For additional information, refer to **ACCESSORY DRIVE - 3.0L (4V)** article.
3. Use the Strap Wrench to hold the crankshaft pulley and remove the crankshaft pulley bolt and washer.

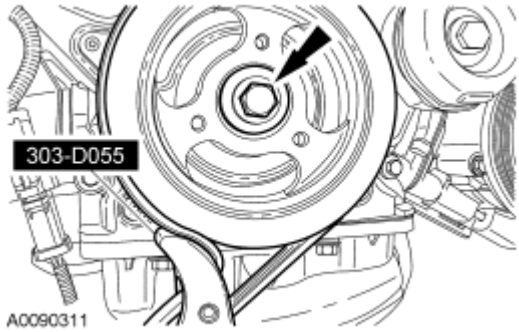


Fig. 18: Identifying Special Tool (303-D055) And Crankshaft Pulley Bolts
Courtesy of FORD MOTOR CO.

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

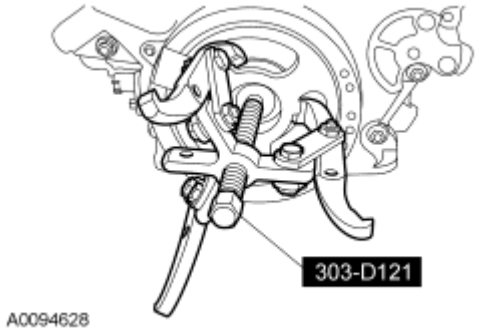


Fig. 19: Identifying Special Tools (303-D121) And Crankshaft Pulley
Courtesy of FORD MOTOR CO.

INSTALLATION

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

NOTE: Clean the keyway and slot using metal surface prep before applying silicone gasket and sealer.

NOTE: The crankshaft pulley must be installed and the bolt tightened within 4 minutes of applying the silicone gasket and sealer.

2. Apply silicone gasket and sealant to the end of the keyway slot.

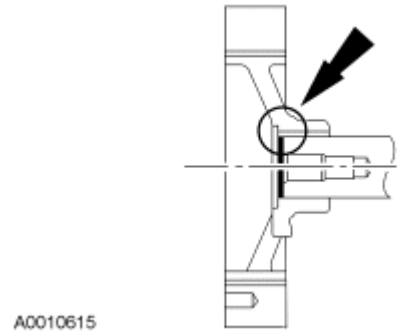


Fig. 20: Applying Silicone Gasket And Sealant
Courtesy of FORD MOTOR CO.

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

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

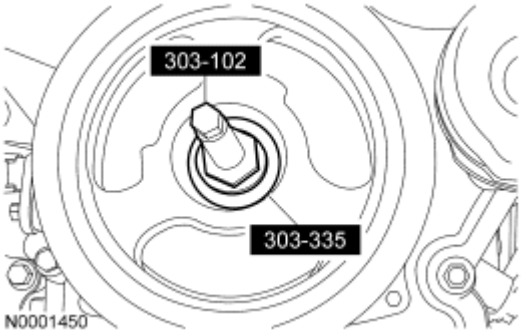


Fig. 21: Installing Crankshaft Pulley
Courtesy of FORD MOTOR CO.

4. Install the bolt and washer. Using the Strap Wrench to hold the crankshaft pulley, tighten the bolt 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.

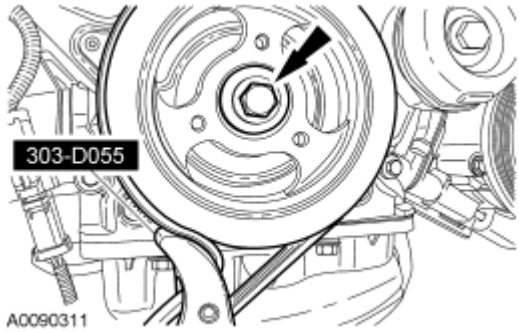
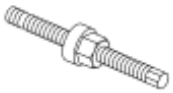
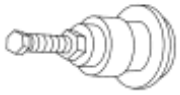


Fig. 22: Identifying Special Tool (303-D055) And Crankshaft Pulley Bolts
Courtesy of FORD MOTOR CO.

5. Install the accessory drive belt. For additional information, refer to **ACCESSORY DRIVE - 3.0L (4V)** article.

CRANKSHAFT FRONT SEAL

Special Tools

Illustration	Tool Name	Tool Number
 ST1287-A	Installer, Crankshaft Vibration Damper	303-102 (T74P-6316-B)
 ST1328-A	Installer, Front Cover Oil Seal	303-335 (T88T-6701-A)
 ST1385-A	Remover, Oil Seal	303-409 (T92C-6700CH)

Material

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** article.
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.

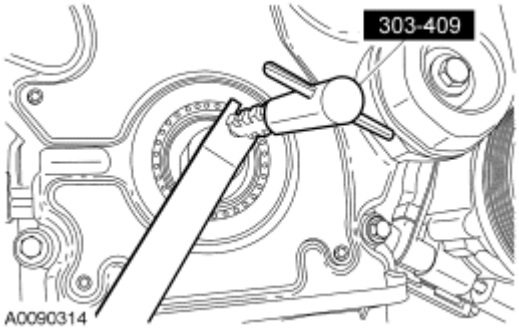


Fig. 23: Removing Crankshaft Front Seal Using Special Tool (303-409)
Courtesy of FORD MOTOR CO.

INSTALLATION

NOTE: Clean all sealing surfaces with metal surface prep.

1. Apply clean engine oil to the seal lip and seal bore before installing the seal.
2. Using the Crankshaft Vibration Damper Installer and the Front Cover Oil Seal Installer, install a new crankshaft front seal.

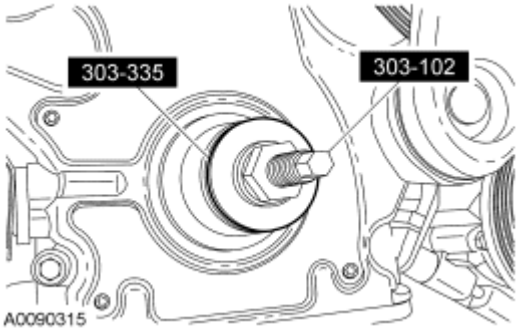


Fig. 24: Installing Crankshaft Seal Using Special Tools (303-335 And 303-102)
Courtesy of FORD MOTOR CO.

3. Install the crankshaft pulley. For additional information, refer to **Crankshaft Pulley**.

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

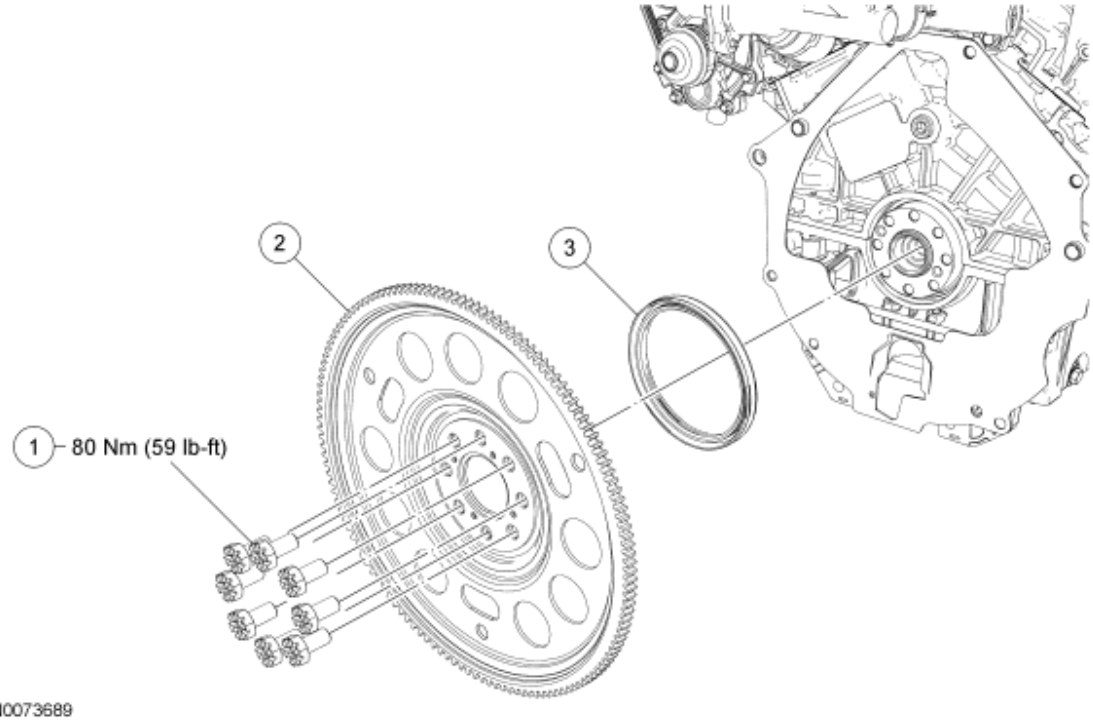


Fig. 25: Exploded View Of Flexplate & Crankshaft Rear Seal With Torque Specification
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W701559-S	Flexplate bolt (8 required)
2	6375	Flexplate
3	6701	Crankshaft rear seal

1. For additional information, refer to the procedures.

FLEXPLATE

REMOVAL AND INSTALLATION

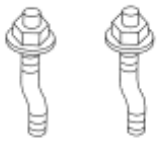
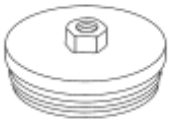
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING** article.
2. Remove the transaxle. For additional information, refer to **AUTOMATIC TRANSAXLE/TRANSMISSION EXTERNAL CONTROLS** .

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 Tools

Illustration	Tool Name	Tool Number
 ST1333-A	Installer Bolts, Crankshaft Rear Main Oil Seal	303-384 (T91P-6701-A)
 ST1327-A	Installer, Crankshaft Rear Main Oil Seal	303-178 (T82L-6701-A)
 ST1382-A	Remover, Crankshaft Rear Seal	303-519 (T95P-6701-DH)
 ST1187-A	Slide Hammer	307-005 (T59L-100-B)

Material

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** article.
2. Remove the flexplate. For additional information, refer to **Flexplate**.
3. Using the Slide Hammer and the Crankshaft Rear Seal Remover, remove and discard the crankshaft rear oil seal.

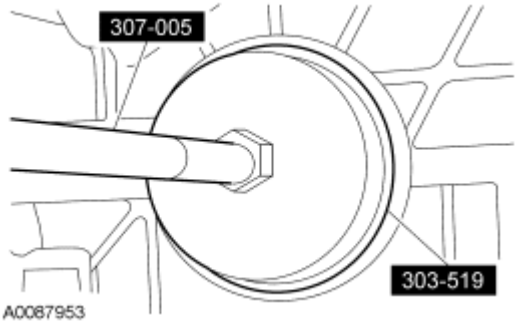


Fig. 26: Identifying Special Tools (307-005 And 303-519)
Courtesy of FORD MOTOR CO.

INSTALLATION

NOTE: Clean all sealing surfaces with metal surface cleaner.

NOTE: Apply clean engine oil to the seal lip and seal bore before installing the seal.

1. Using the Crankshaft Rear Main Oil Seal Installer and the Crankshaft Rear Main Oil Seal Installer Bolts, install the crankshaft rear oil seal.

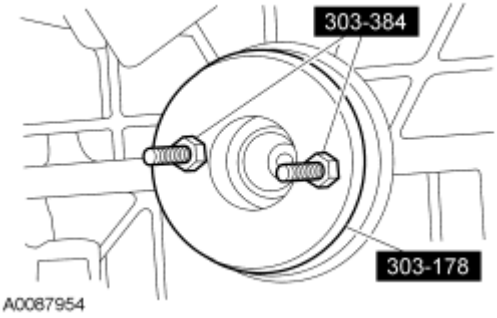


Fig. 27: Identifying Special Tools (303-384 And 303-178)
Courtesy of FORD MOTOR CO.

2. Install the flexplate. For additional information, refer to **Flexplate**.

ENGINE FRONT COVER

Material

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
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

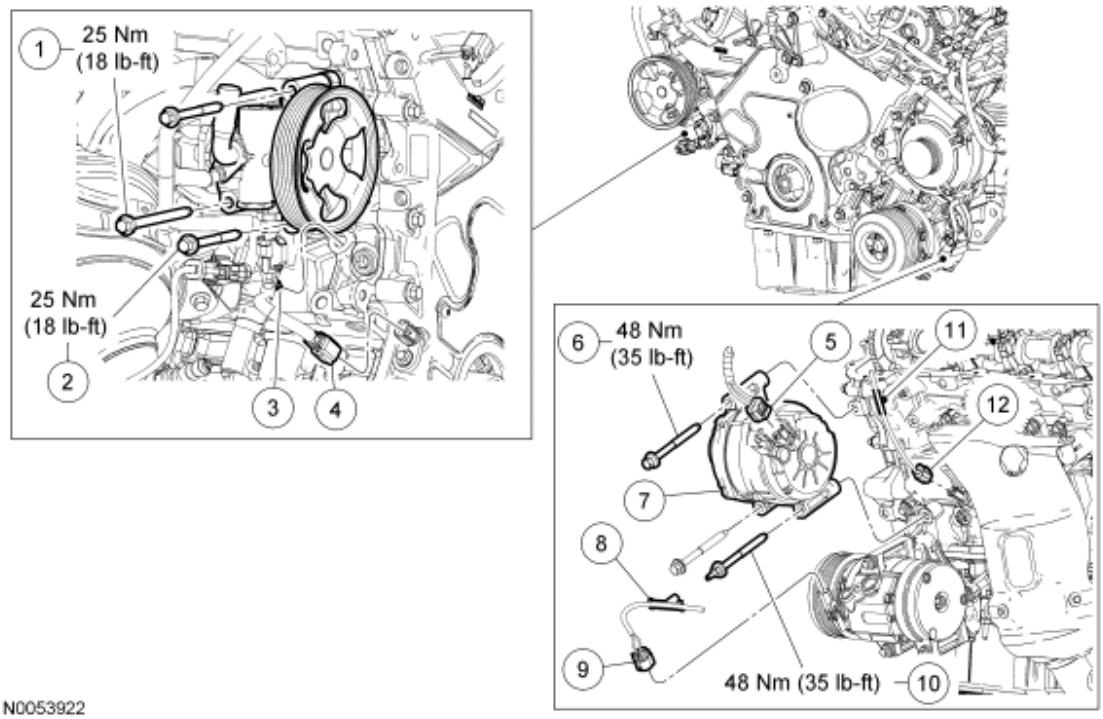


Fig. 28: Exploded View Of Engine Front Cover With Torque Specifications (1 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W701234	Power steering pump bolt
2	W701526	Power steering pump bolt (2 required)
3	-	Wiring harness retainer (part of 12B637)
4	14A464	Crankshaft Position (CKP) sensor electrical connector (part of 12B637)
5	14A464	Generator electrical connector (part of 12B637)
6	W704747	Generator bolt
7	10300	Generator
8	-	Wiring harness retainer (part of 12B637)
9	14A464	A/C compressor electrical connector (part of 12B637)
10	W707669	Generator stud bolt
11	-	Wiring harness retainer (part of 12B637)
12	14A464	Engine Oil Pressure (EOP) switch electrical connector (part of 12B637)

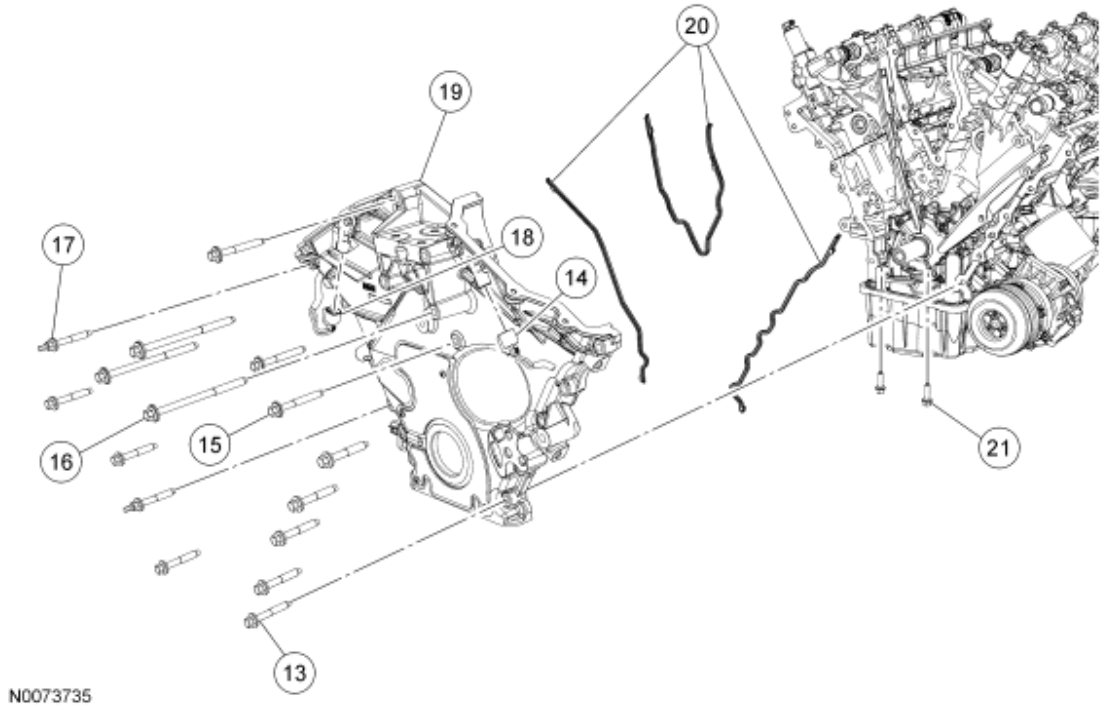


Fig. 29: Exploded View Of Engine Front Cover (2 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
13	W701525	Engine front cover bolt (8 required)
14	14A464	LH Camshaft Position (CMP) sensor electrical connector (part of 12B637)
15	W708222	Engine front cover bolt (3 required)
16	W708221	Engine front cover bolt (3 required)
17	W710030	Engine front cover stud bolt (2 required)
18	14A464	RH CMP sensor electrical connector (part of 12B637)
19	6019	Engine front cover
20	-	Engine front cover gaskets (3 required)
21	W709678	Oil pan-to-front cover bolt (2 required)

REMOVAL

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

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

INFORMATION article.

3. Disconnect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING AND CABLES** article.
4. Remove the crankshaft front seal. For additional information, refer to **Lower End Components - Exploded View, Crankshaft Pulley and Crankshaft Front Seal** and **Crankshaft Front Seal**.
5. Disconnect the Crankshaft Position (CKP) sensor and pin-type retainer.
6. Remove the accessory drive belt tensioner and 2 idler pulleys. For additional information, refer to **ACCESSORY DRIVE - 3.0L (4V)** article.
7. Remove the LH and RH valve covers. For additional information, refer to **Valve Cover - LH** and **Valve Cover - RH**.
8. Remove the 3 bolts and position the power steering pump aside.
9. Remove the engine mount and bracket. For additional information, refer to **Engine Mount**.
10. Remove the LH and RH Camshaft Position (CMP) sensors. For additional information, refer to **ELECTRONIC ENGINE CONTROLS - 3.0L (4V)** article.
11. Disconnect the A/C compressor electrical connector and wiring harness retainer.
12. Disconnect the generator electrical connector.
13. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and position the wiring harness aside.
14. Remove the stud bolt, the 2 bolts and position the generator aside.
15. Remove the 2 oil pan-to-front cover bolts.
16. Remove the 14 bolts, 2 stud bolts and the engine front cover.
    - Remove and discard the gaskets.

INSTALLATION

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 which make leak paths.

NOTE: Do not damage the oil pan gasket while cleaning the sealant from the lower cylinder block-to-oil pan joint.

1. Use a plastic scraping tool to remove all traces of sealant.
    - Clean all sealing surfaces with metal surface prep and install new gaskets.

NOTE: The engine front cover must be installed and the bolts tightened within 4 minutes of applying sealant.

2. Apply a 6 mm (0.23 in) diameter dot of silicone gasket and sealer to the cylinder block, lower cylinder block, cylinder head and oil pan mating surfaces.

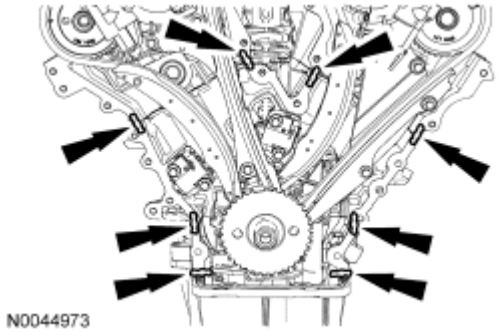


Fig. 30: Locating Silicone Gasket & Sealer To Cylinder Block, Lower Cylinder Block, Cylinder Head & Oil Pan Mating Surfaces
Courtesy of FORD MOTOR CO.

NOTE: Fasteners 1 and 13 are stud bolts.

3. Position the engine front cover and install the 14 bolts and the 2 stud bolts.
   - Tighten in the sequence shown to 25 Nm (18 lb-ft).

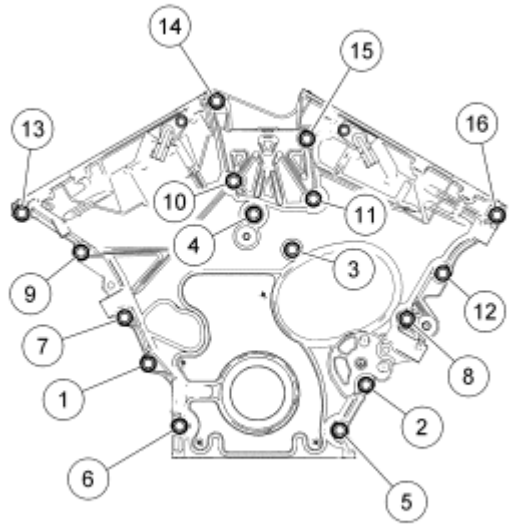


Fig. 31: Locating Tighten Sequence Of Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

4. Install the 2 oil pan-to-front cover bolts.
   - Tighten to 25 Nm (18 lb-ft).
5. Remove the oil pan plug and drain the engine oil.

- Install the plug and tighten to 26 Nm (19 lb-ft).

6. Install the generator, 2 bolts and the stud bolt.
   - Tighten to 48 Nm (35 lb-ft).
7. Connect the Engine Oil Pressure (EOP) switch electrical connector.
8. Connect the generator electrical connector.
9. Connect the A/C compressor electrical connector and wiring harness retainer.
10. Install the LH and RH CMP sensors. For additional information, refer to **ELECTRONIC ENGINE CONTROLS - 3.0L (4V)** article.
11. Install the engine mount and bracket. For additional information, refer to **Engine Mount**.
12. Install the power steering pump and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).
13. Install the LH and RH valve covers. For additional information, refer to **Valve Cover - LH** and **Valve Cover - RH**.
14. Install the accessory drive belt tensioner and 2 idler pulleys. For additional information, refer to **ACCESSORY DRIVE - 3.0L (4V)** article.
15. Connect the CKP sensor electrical connector and pin-type retainer.
16. Install the crankshaft front seal. For additional information, refer to **Lower End Components - Exploded View, Crankshaft Pulley and Crankshaft Front Seal** and **Crankshaft Front Seal**.
17. Fill the engine with clean engine oil.
18. Connect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING AND CABLES** article.
19. Fill the power steering system. For additional information, refer to **STEERING SYSTEM - GENERAL INFORMATION** article.

TIMING DRIVE COMPONENTS

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: Failure to verify correct timing drive component alignment will result in severe engine damage.

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

   NOTE: This pulse wheel is used in several different engines. Install the pulse wheel with the keyway in the slot stamped 30RFF (orange in color).

2. Remove the ignition pulse wheel.

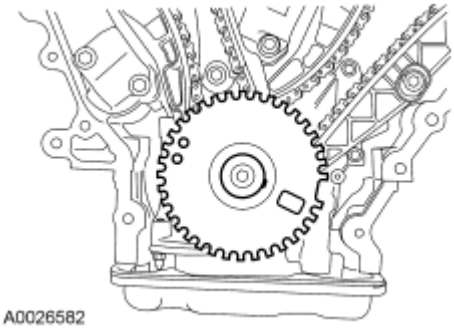


Fig. 32: Identifying Ignition Pulse Wheel
Courtesy of FORD MOTOR CO.

3. Install the crankshaft pulley bolt and washer.

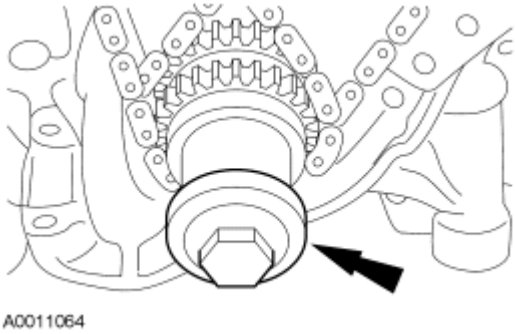


Fig. 33: Identifying Damper Bolt
Courtesy of FORD MOTOR CO.

NOTE: Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.

NOTE: Use compressed air to remove any foreign material in the spark plug well before removing the spark plugs.

4. Remove the 6 spark plugs (1 shown).

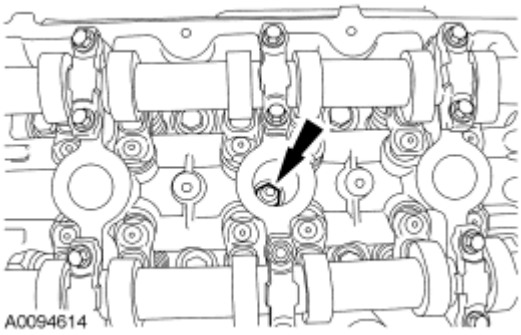


Fig. 34: Locating Spark Plugs

Courtesy of FORD MOTOR CO.

5. Rotate the crankshaft clockwise to position the crankshaft keyway in the 11 o'clock position and position the camshafts in the correct position. This will position the No. 1 cylinder at Top Dead Center (TDC).
   - Verify that the camshafts are correctly located. If not, rotate the crankshaft one additional turn and recheck.

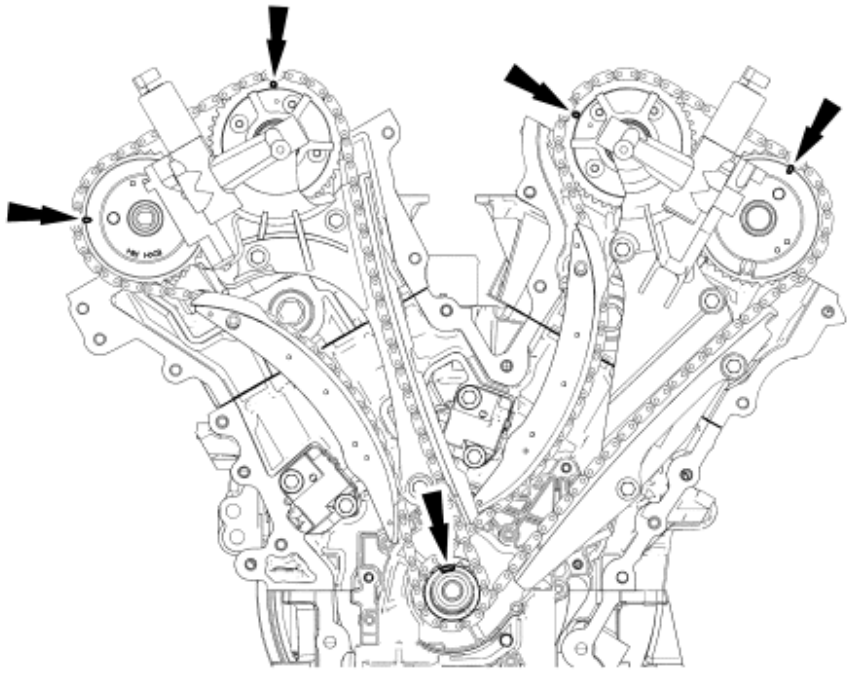


Fig. 35: Locating Crankshaft Keyway Position
Courtesy of FORD MOTOR CO.

6. Rotate the crankshaft clockwise 120 degrees to the 3 o'clock position to position the RH camshafts in the neutral position.

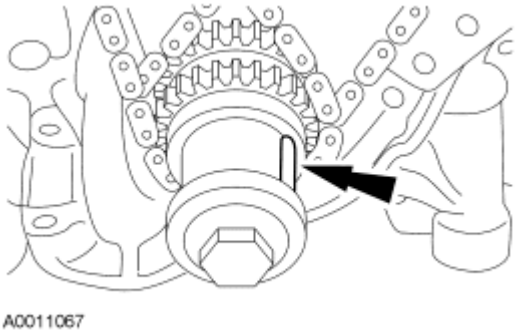


Fig. 36: Identifying Crankshaft Keyway
Courtesy of FORD MOTOR CO.

7. Verify that the RH camshafts are in the neutral position.

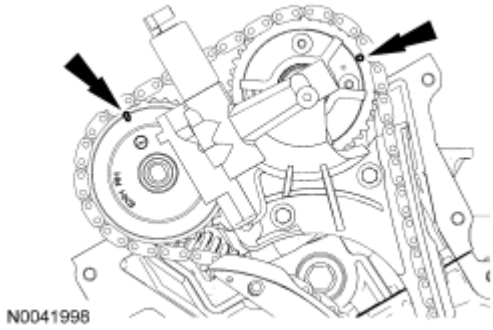


Fig. 37: Locating RH Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

8. Remove the RH timing chain tensioner arm.
    1. Remove the 2 bolts.
    2. Remove the tensioner.
    3. Remove the tensioner arm.

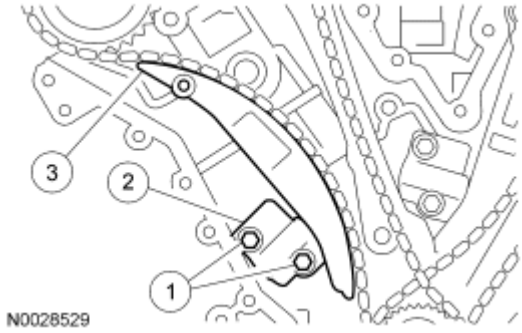


Fig. 38: Identifying RH Timing Chain Tensioner Arm & Bolts
Courtesy of FORD MOTOR CO.

9. Remove the RH timing chain.

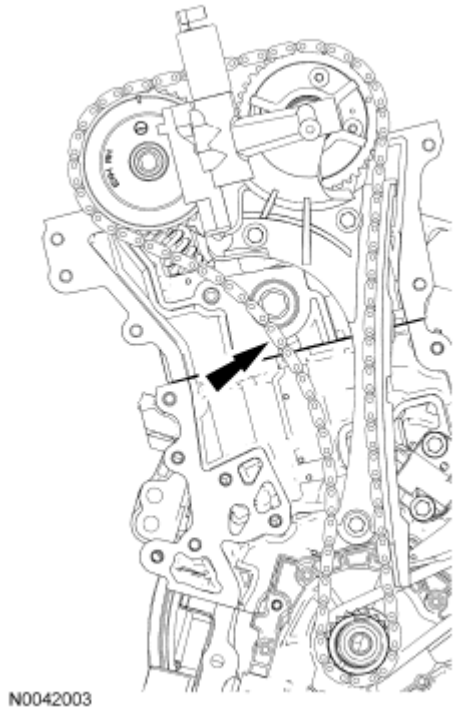


Fig. 39: Locating RH Timing Chain
Courtesy of FORD MOTOR CO.

10. Remove the 3 bolts and the RH Variable Camshaft Timing (VCT) assembly.

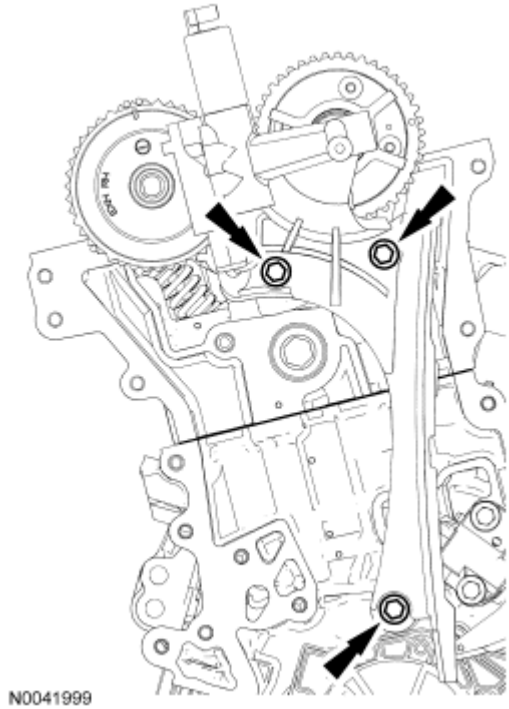


Fig. 40: Locating RH VCT Assembly Bolts

Courtesy of FORD MOTOR CO.

11. Rotate the crankshaft clockwise 600 degrees (1-2/3 turns) to position the crankshaft keyway in the 11 o'clock position. This will position the LH camshafts in the neutral position.

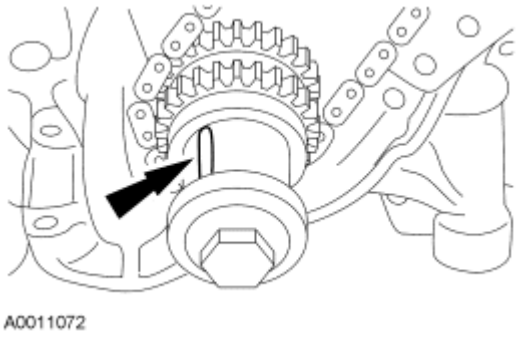


Fig. 41: Positioning Crankcase Key Way In 11 O'Clock Position
Courtesy of FORD MOTOR CO.

12. Verify the LH camshafts are in the neutral position.

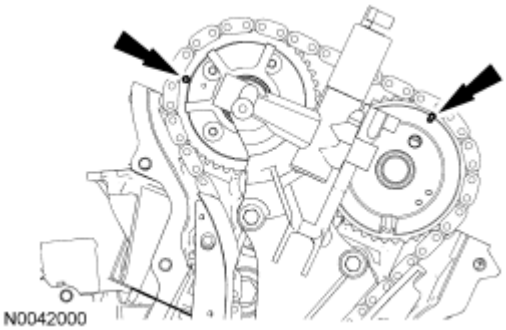


Fig. 42: Locating LH Camshafts Position In NEUTRAL Position
Courtesy of FORD MOTOR CO.

13. Remove the LH timing chain tensioner and tensioner arm.
    1. Remove the 2 bolts.
    2. Remove the tensioner.
    3. Remove the tensioner arm.

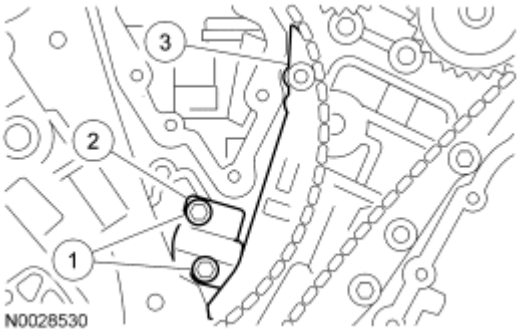


Fig. 43: Locating LH Timing Chain & Tensioner Arm
Courtesy of FORD MOTOR CO.

14. Remove the LH timing chain.

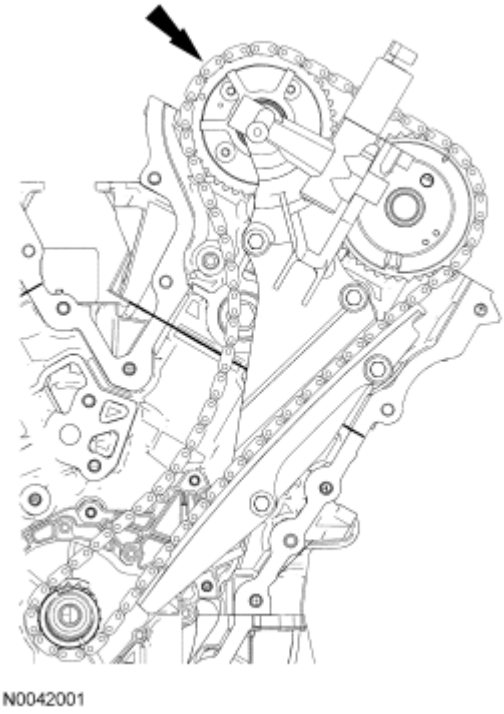


Fig. 44: Locating LH Timing Chain
Courtesy of FORD MOTOR CO.

15. Remove the 4 bolts and the LH VCT assembly.

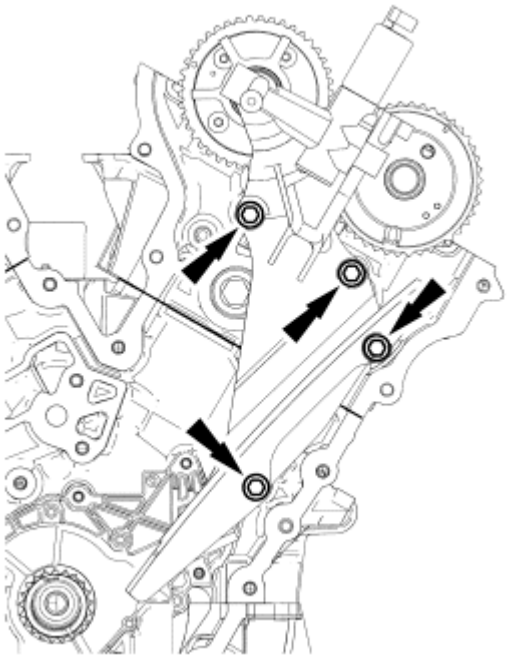


Fig. 45: Identifying LH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

16. Remove the pulley bolt, washer and the crankshaft sprocket.

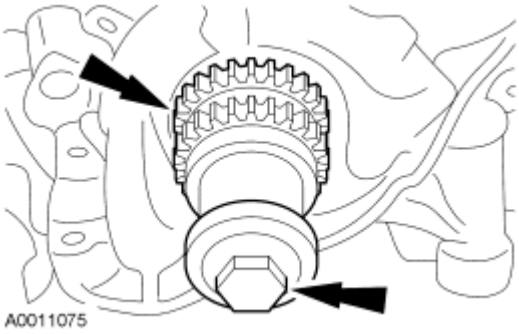


Fig. 46: Locating Damper Bolt & Crankshaft Sprockets
Courtesy of FORD MOTOR CO.

INSTALLATION

1. Install the crankshaft sprockets with the timing marks out.

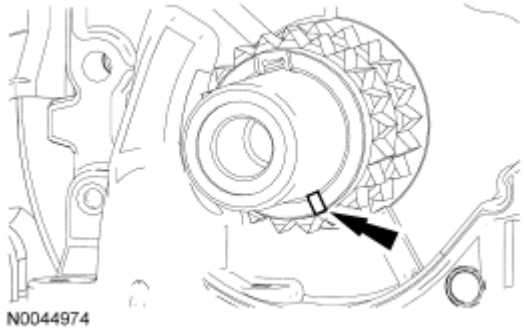


Fig. 47: Locating Timing Marks On Crankshaft Sprockets
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

2. Position the chain tensioner in a soft-jawed vise.

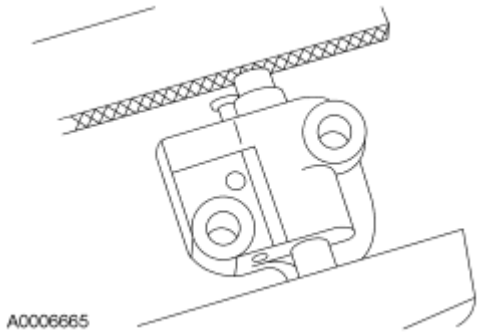


Fig. 48: Identifying Chain Tensioner In Soft-Jawed Vise
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

3. Hold the chain tensioner ratchet lock mechanism away from the ratchet stem with a small pick.

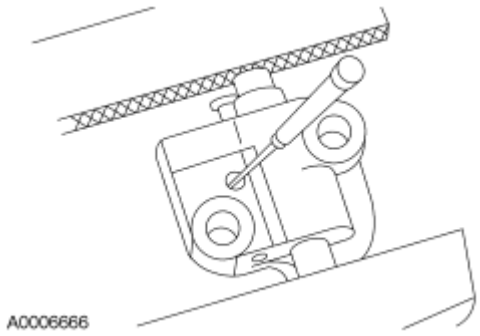


Fig. 49: Holding Chain Tensioner Ratchet Lock Mechanism Away From Ratchet Stem
Courtesy of FORD MOTOR CO.

NOTE: During tensioner compression, do not release the ratchet stem until the tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.

4. Slowly compress the timing chain tensioner.
5. Retain the tensioner piston with a 1.5 mm (0.05 in) wire or paper clip.

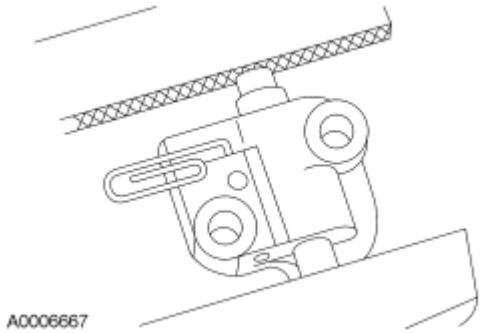


Fig. 50: Retaining Tensioner Piston With 1.5-mm (0.06-in) Wire Or Paper Clip
Courtesy of FORD MOTOR CO.

6. If timing marks in the timing chains are not evident, use a permanent-type marker to mark the crankshaft and camshaft timing marks on the LH and RH timing chains.
    1. Mark any link to use as the crankshaft timing mark.
    2. Starting with the crankshaft timing mark, count counterclockwise 29 links and mark the link.
    3. Continue counting counterclockwise to link 42 and mark the link.

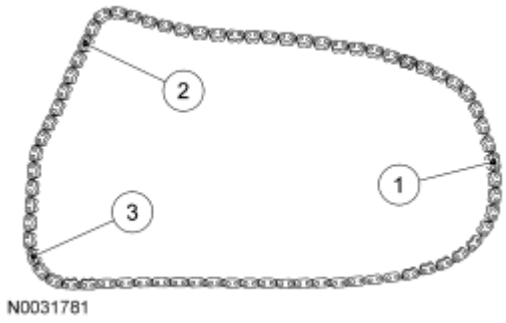


Fig. 51: Locating Crankshaft & Camshaft Timing Marks On LH & RH Timing Chains
Courtesy of FORD MOTOR CO.

7. Verify that the LH camshafts are correctly positioned.

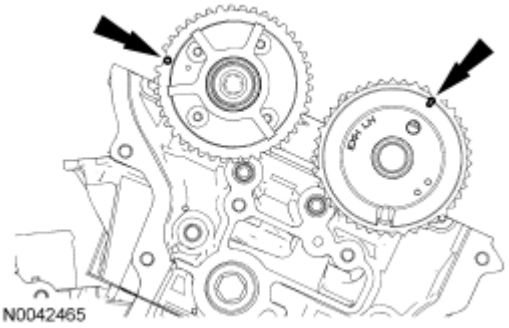


Fig. 52: Locating Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

8. Install the VCT assembly and the 4 bolts.
    - Tighten to 25 Nm (18 lb-ft).

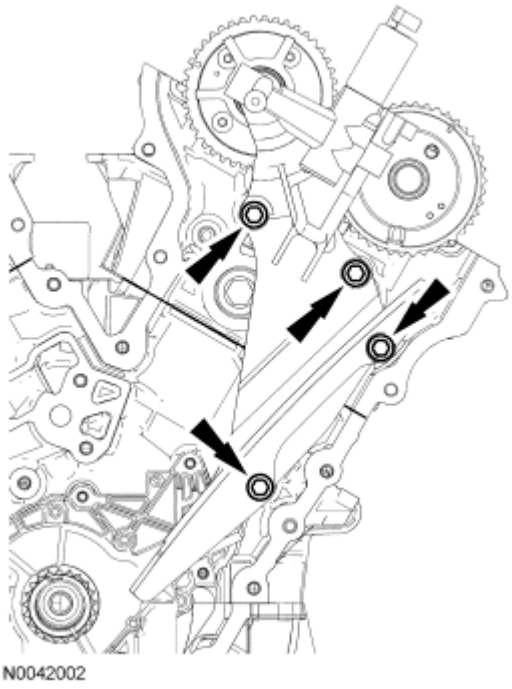


Fig. 53: Identifying LH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

9. Install the LH timing chain.
    - Align the marks on the timing chain with the marks on the camshaft and crankshaft sprockets.

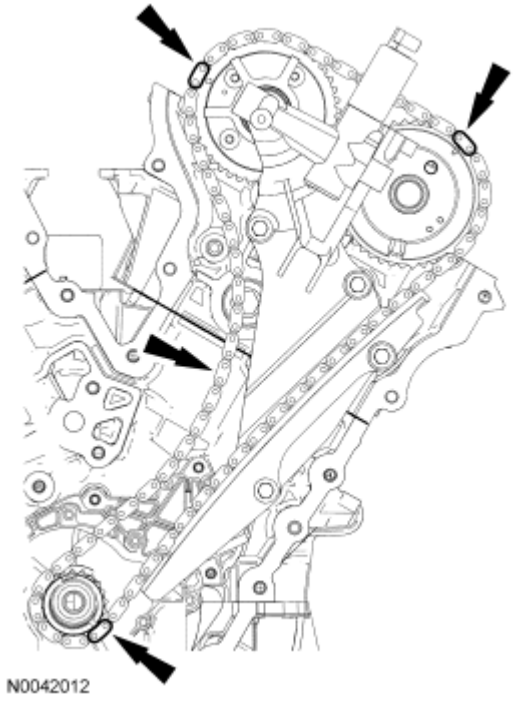


Fig. 54: Aligning Marks On Timing Chain With Marks On Camshaft And Crankshaft Sprockets
Courtesy of FORD MOTOR CO.

10. Install the LH timing chain tensioner arm and the LH timing chain tensioner.
    1. Install the tensioner arm.
    2. Position the tensioner.
    3. Install the 2 bolts.
    4. Tighten to 25 Nm (18 lb-ft).

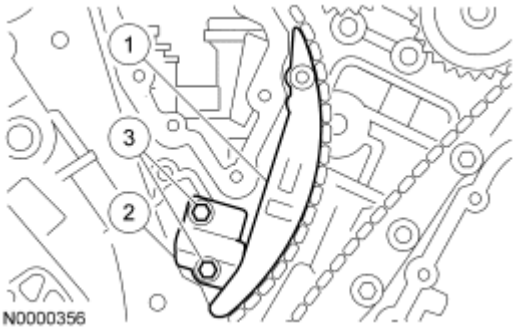


Fig. 55: Identifying Timing Chain Tensioner Arm & Bolts
Courtesy of FORD MOTOR CO.

11. Install the crankshaft pulley bolt and washer and rotate the crankshaft clockwise 120 degrees until the crankshaft keyway is in the 3 o'clock position.

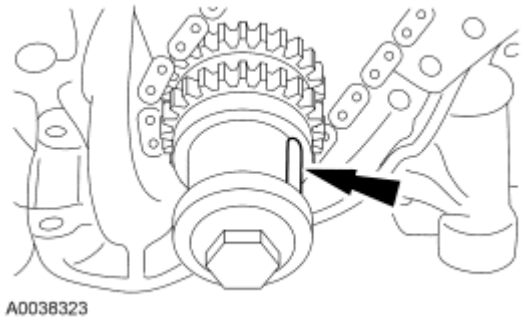


Fig. 56: Locating Crankshaft Keyway
Courtesy of FORD MOTOR CO.

12. Verify that the RH camshafts are correctly positioned.

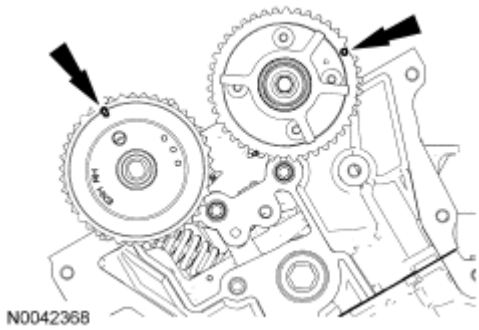


Fig. 57: Locating RH Camshafts Position
Courtesy of FORD MOTOR CO.

13. Install the RH VCT assembly and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

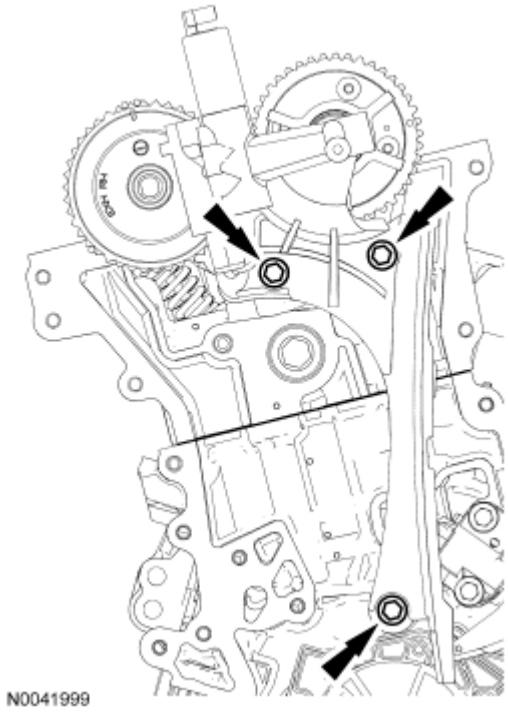


Fig. 58: Locating RH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

14. Install the RH timing chain.
    - Align the marks on the timing chain with the marks on the camshaft and crankshaft sprockets.

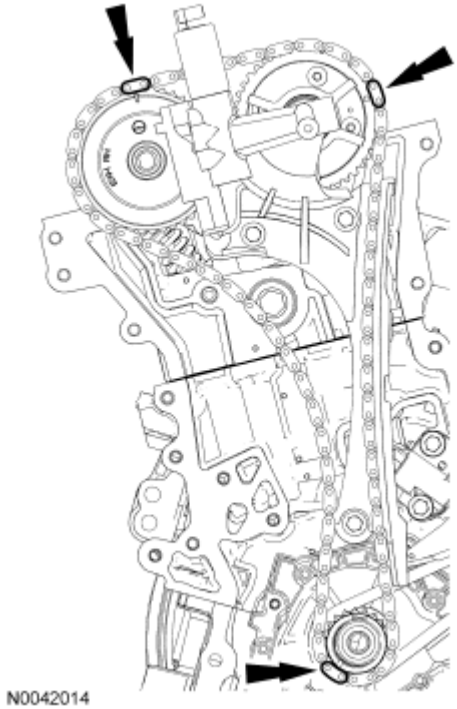


Fig. 59: Aligning Marks On Timing Chain With Marks On Camshaft And Crankshaft Sprockets
Courtesy of FORD MOTOR CO.

15. Install the RH timing chain tensioner and tensioner arm.
    1. Install the tensioner arm.
    2. Position the tensioner.
    3. Install the 2 bolts.
    4. Tighten to 25 Nm (18 lb-ft).

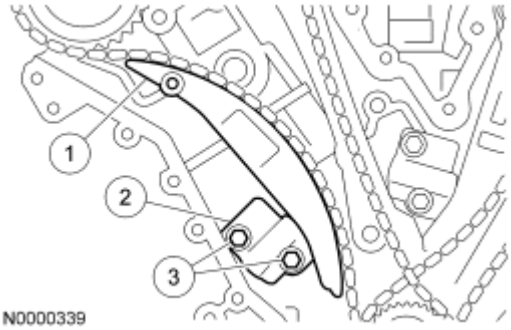


Fig. 60: Identifying Tensioner Arm, Tensioner And Bolts
Courtesy of FORD MOTOR CO.

16. Remove the LH and RH timing chain tensioner piston retaining wires.
17. Rotate the crankshaft counterclockwise 120 degrees to TDC.

NOTE: Failure to verify correct timing drive component alignment will result in severe engine damage.

18. Verify the timing with the following steps.
    1. There should be 12 chain links between the camshaft timing marks.
    2. There should be 27 chain links between the camshaft and the crankshaft timing marks.
    3. There should be 30 chain links between the camshaft and the crankshaft timing marks.

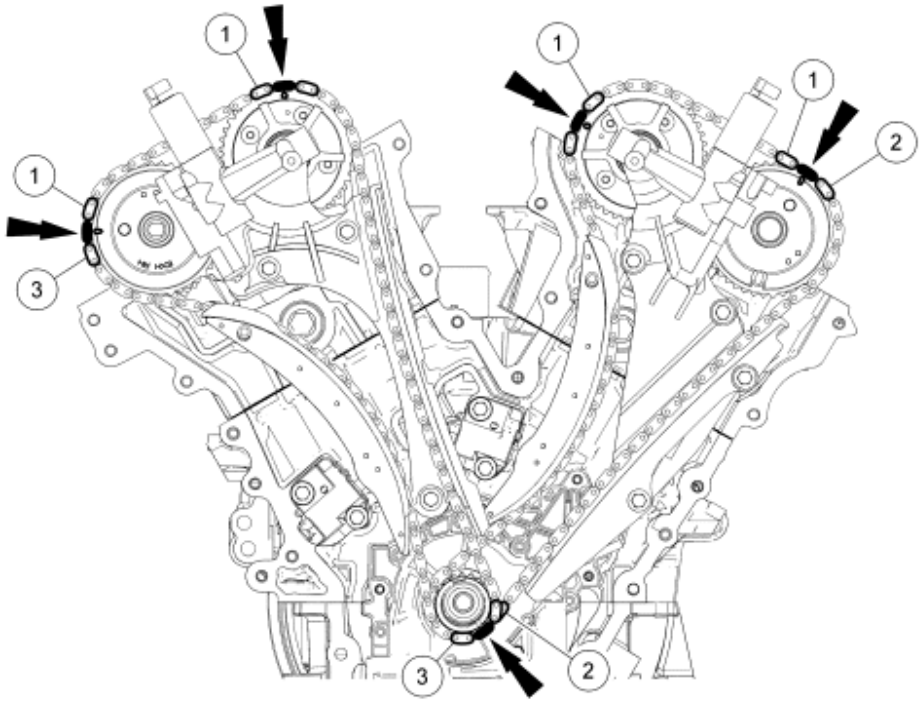


Fig. 61: Locating Align Marks On Chain
Courtesy of FORD MOTOR CO.

19. Remove the crankshaft pulley bolt and washer.

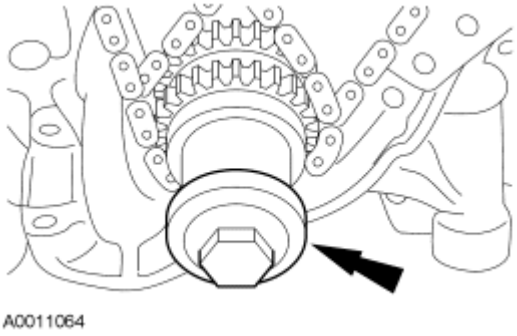


Fig. 62: Identifying Damper Bolt
Courtesy of FORD MOTOR CO.

NOTE: This pulse wheel is used in several different engines. Install the pulse wheel with the keyway in the slot stamped 30RFF (orange in color).

20. Install the ignition pulse wheel.

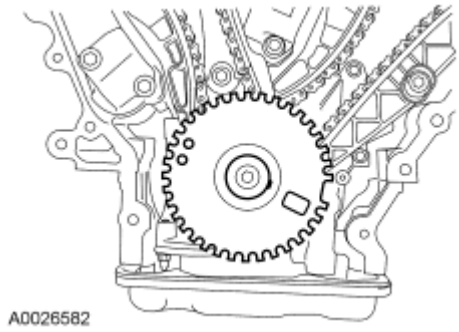


Fig. 63: Identifying Ignition Pulse Wheel
Courtesy of FORD MOTOR CO.

NOTE: Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.

21. Install the 6 spark plugs (1 shown).
    - Tighten to 15 Nm (133 lb-in).

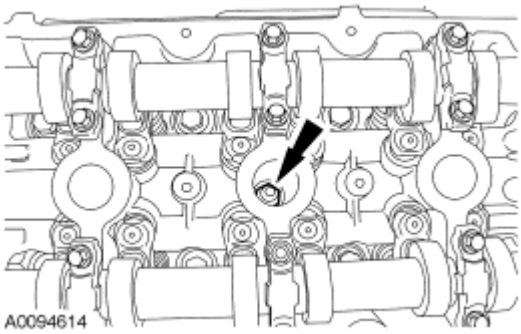


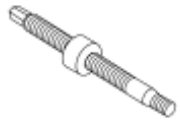
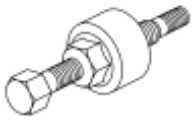
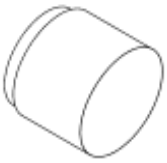
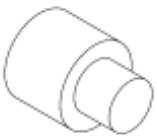
Fig. 64: Locating Spark Plugs
Courtesy of FORD MOTOR CO.

22. Install the engine front cover. For additional information, refer to **Engine Front Cover**.

CAMSHAFTS - LH

Special Tools

Illustration	Tool Name	Tool Number
	Installer, Camshaft Oil Seal	303-464 (T94P-6256-BH)
	Installer, Camshaft Pulley	303-458 (T94P-6312-AH3), part

 ST3042-A		of 303-S455
 ST1586-A	Installer, Power Steering Pump Pulley	211-185 (T91P-3A733-A)
 ST3044-A	Plate, Water Pump Pulley	303-456 (T94P-6312-AH1), part of 303-S455
 ST2060-A	Protector, Camshaft Oil Seal	303-463 (T94P-6256-AH)
 ST3045-A	Protector, Water Pump Shaft	303-457 (T94P-6312-AH2), part of 303-S455
 ST1286-A	Remover, Crankshaft Vibration Damper	303-009 (T58P-6316-D)
 ST1385-A	Remover, Oil Seal	303-409 (T92C-6700-CH)
 ST3043-A	Spacer, Water Pump Pulley	303-459 (T94P-6312-AH4), part of 303-S455

Material

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

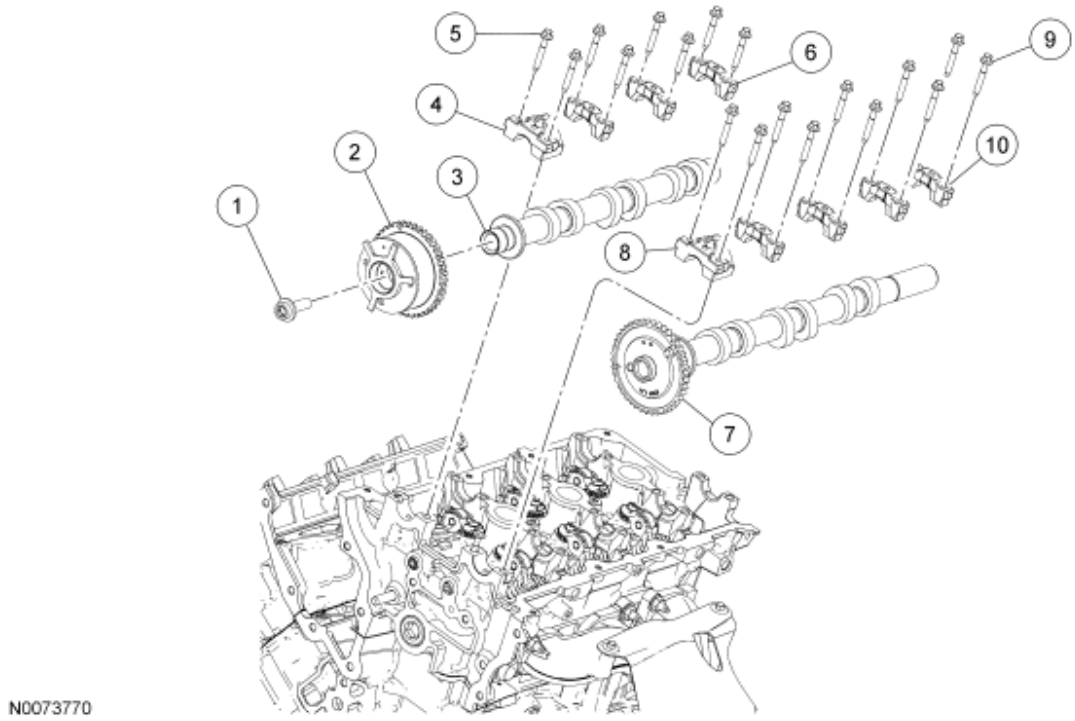


Fig. 65: Exploded View Of LH Camshaft (1 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6279	Variable Camshaft Timing (VCT) actuator bolt
2	6C524	VCT actuator
3	6A267	LH intake camshaft
4	6B280	Intake camshaft thrust bearing cap
5	W710702	Intake camshaft bearing cap bolt (8 required)
6	6B280	Intake camshaft bearing cap (3 required)
7	6A269	LH exhaust camshaft
8	6B280	Exhaust camshaft thrust bearing cap
9	W710702	Exhaust camshaft bearing cap bolt (10 required)

10	6B280	Exhaust camshaft bearing cap (4 required)

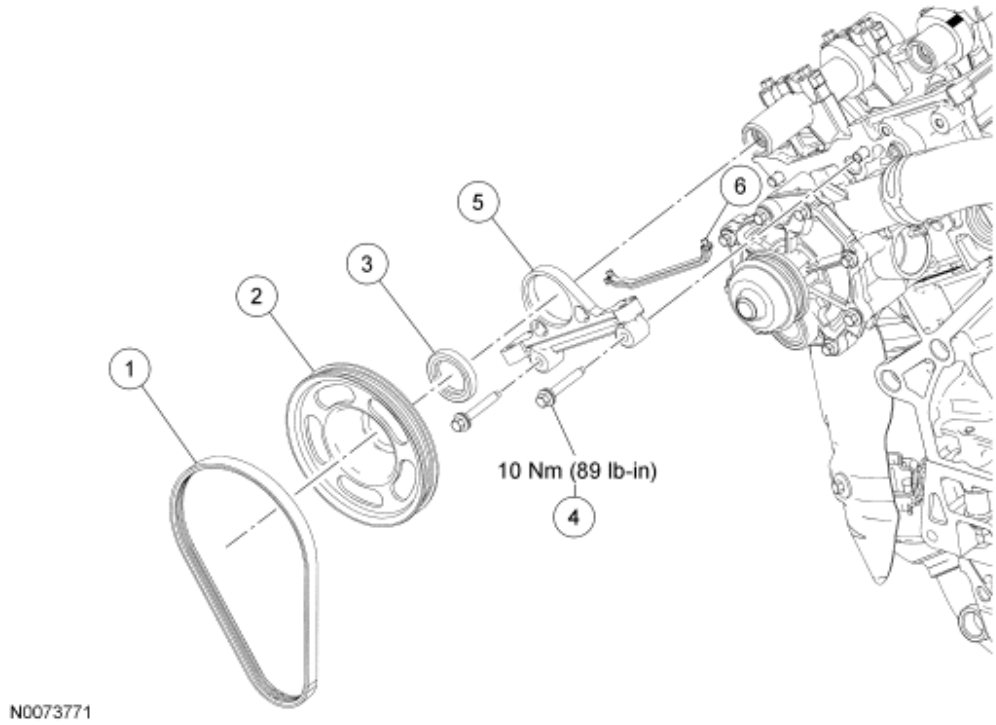


Fig. 66: Exploded View Of LH Camshaft With Torque Specification (2 Of 2)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	8K543	Coolant pump drive belt
2	6A359	Coolant pump drive pulley
3	-	Camshaft oil seal
4	W701242	Camshaft oil seal retainer bolt
5	6B293	Camshaft oil seal retainer
6	6B295	Camshaft oil seal retainer gasket

REMOVAL

1. Remove the timing drive components. For additional information, refer to **Timing Drive Components**.
2. Cut and discard the coolant pump belt.

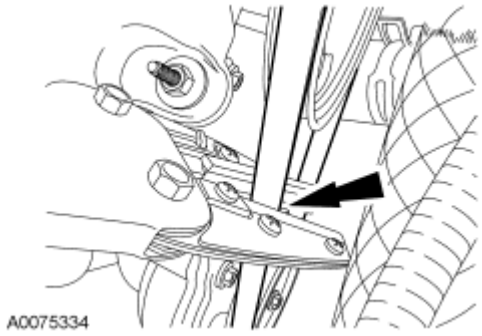


Fig. 67: Locating Coolant Pump Belt
Courtesy of FORD MOTOR CO.

NOTE: Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.

3. Using the Water Pump Pulley Plate, Water Pump Shaft Protector and the Crankshaft Vibration Damper Remover, remove the coolant pump pulley.

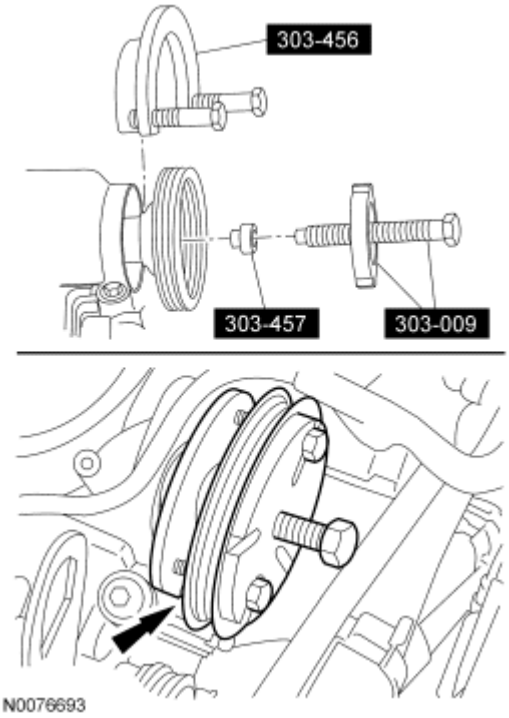


Fig. 68: Removing Coolant Pump Pulley Using Special Tools (303-009, 303-456, 303-457)
Courtesy of FORD MOTOR CO.

NOTE: To make sure of correct sealing, do not scratch the camshaft.

4. Using the Oil Seal Remover, remove and discard the camshaft oil seal.

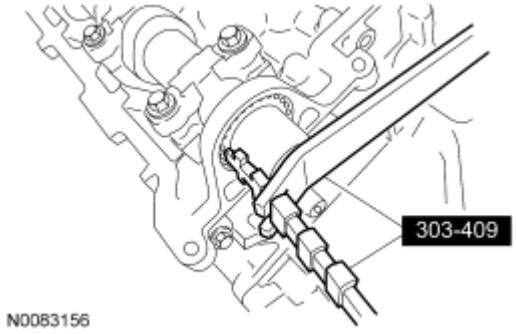


Fig. 69: Removing Camshaft Oil Seal Using Oil Seal Remover
Courtesy of FORD MOTOR CO.

5. Remove the 2 bolts and the camshaft oil seal retainer.
   - Discard the press-in-place gasket.

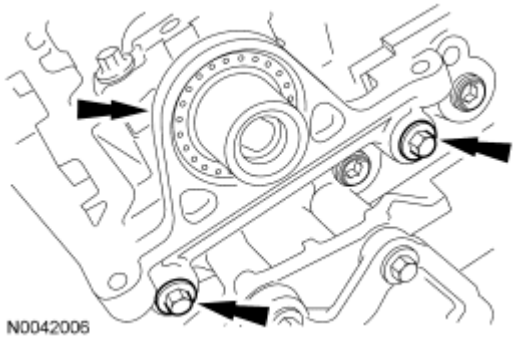


Fig. 70: Locating Camshaft Oil Seal Retainer And Bolts
Courtesy of FORD MOTOR CO.

NOTE: The camshafts must be in the neutral position before removing the bearing caps or damage to the engine may occur.

6. Verify the camshafts are in the neutral position.

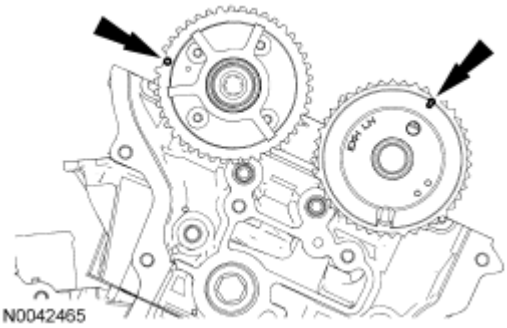


Fig. 71: Locating Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

NOTE: Do not allow the camshaft to rotate from the neutral position while removing the Variable Camshaft Timing (VCT) actuator or damage to the engine may occur.

NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for removal of the VCT actuator bolt.

7. Remove the bolt and the VCT actuator.

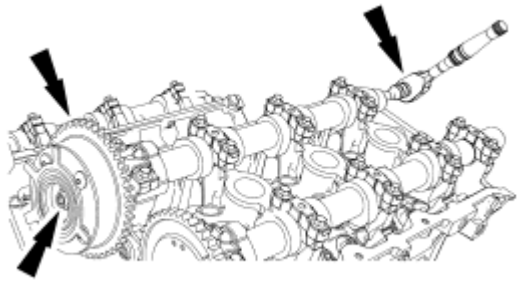


Fig. 72: Locating VCT Actuator And Bolt
Courtesy of FORD MOTOR CO.

NOTE: Cylinder head camshaft bearing caps must be assembled in their original positions. Some engines have factory markings on the camshaft bearing caps (as shown in illustration). Engines that do not have the factory markings must be marked for correct position and orientation prior to removal. Failure to install the camshaft bearing caps in their original position may result in severe engine damage.

8. If necessary, mark the camshaft bearing cap position and orientation as shown in the illustration.

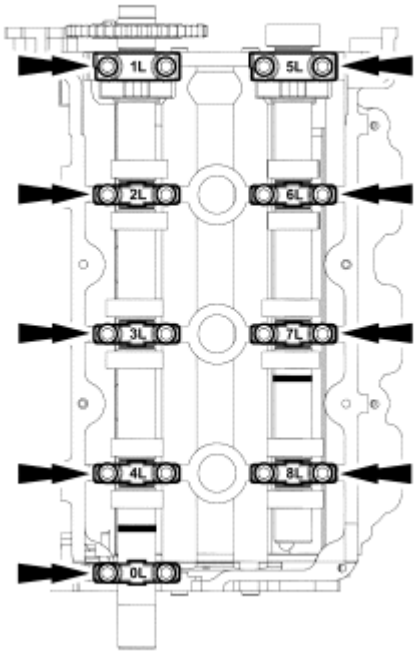


Fig. 73: Marking Camshaft Bearing Cap Position & Orientation
Courtesy of FORD MOTOR CO.

NOTE: After loosening all of the camshaft bearing cap bolts, remove the camshaft bearing thrust caps (1L and 6L) first or damage to the thrust caps may occur.

NOTE: Make sure the camshaft bearing caps are marked as instructed in the previous step.

9. Loosen the bolts evenly in the sequence shown.
    1. Remove the camshaft bearing thrust caps (1L and 6L).
    2. Remove the remaining camshaft bearing caps.
    3. Remove the camshafts from the cylinder head.

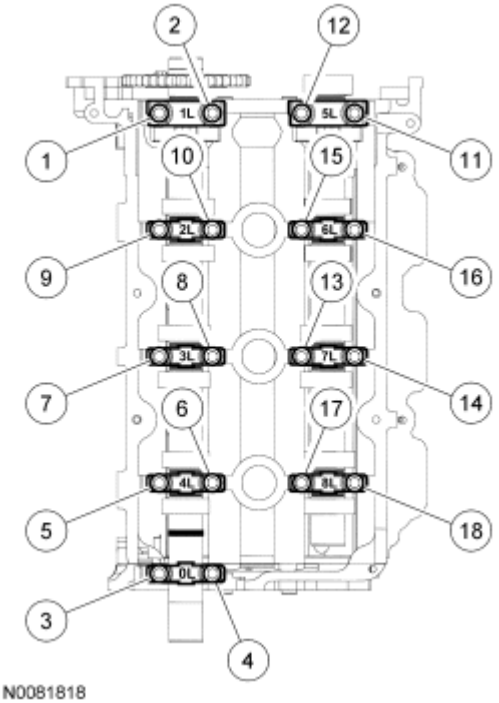


Fig. 74: Loosening Bolts Evenly In Sequence
Courtesy of FORD MOTOR CO.

INSTALLATION

1. Position the VCT actuator onto the intake camshaft.
   - Install the bolt finger-tight.

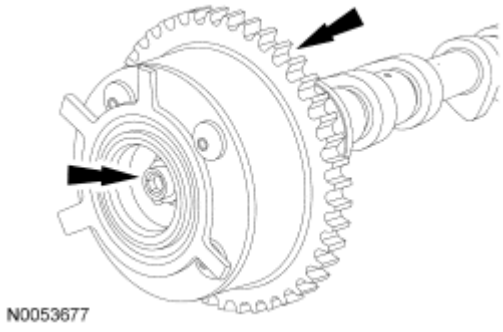


Fig. 75: Locating VCT Actuator Onto Intake Camshaft
Courtesy of FORD MOTOR CO.

NOTE: The camshafts must be installed in the neutral position or damage to the engine may occur.

2. Lubricate the camshafts with clean engine oil and carefully position the camshafts into the cylinder head.
   - Align the camshafts in the neutral position as shown.

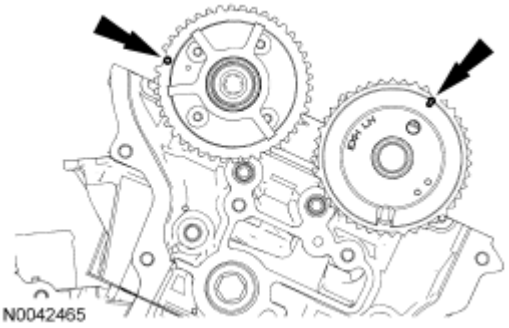


Fig. 76: Locating Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

NOTE: The camshaft caps must be installed in their original positions or damage to the engine may occur.

NOTE: Do not install the camshaft bearing thrust caps until all of the camshaft bearing caps have been installed or damage to the thrust caps may occur.

NOTE: Lubricate the bearing surfaces of the camshaft bearing caps with clean engine oil.

3. Install the camshaft bearing caps.
   - Loosely install the bolts.

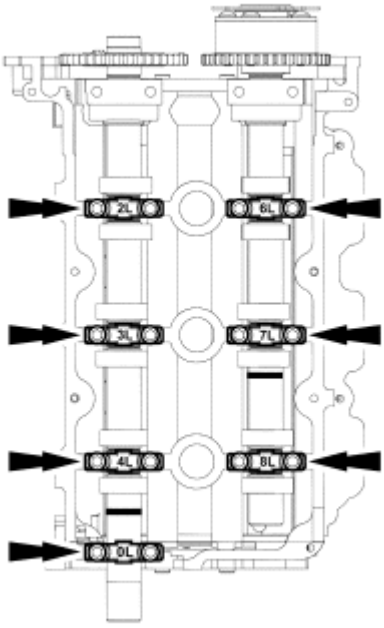


Fig. 77: Loosely Installing Bolts

Courtesy of FORD MOTOR CO.

NOTE: Lubricate the bearing surfaces of the camshaft bearing thrust caps with clean engine oil.

4. Install the camshaft bearing thrust caps.
   - Loosely install the bolts.

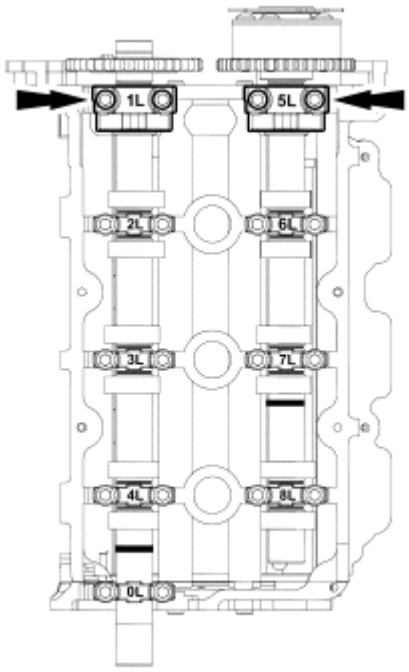


Fig. 78: Loosely Installing Bolts
Courtesy of FORD MOTOR CO.

5. Tighten the camshaft bearing cap bolts in the sequence shown to 10 Nm (89 lb-in).

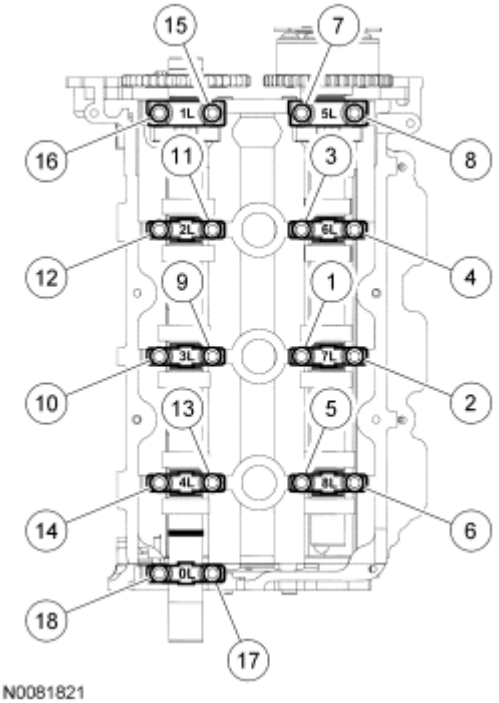


Fig. 79: Tightening Camshaft Bearing Cap Bolts In Sequence
Courtesy of FORD MOTOR CO.

NOTE: Do not allow the camshaft to rotate from the neutral position while tightening the Variable Camshaft Timing (VCT) actuator bolt or damage to the engine may occur.

NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for tightening of the VCT actuator bolt.

6. Tighten the VCT actuator bolt to 40 Nm (30 lb-ft) plus an additional 90 degrees.

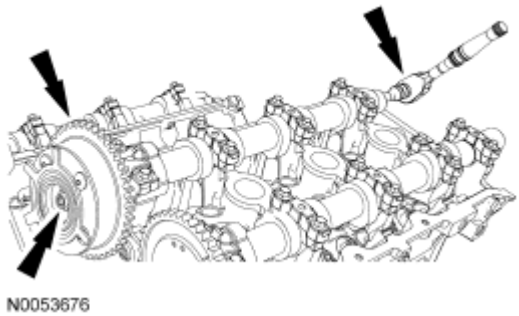


Fig. 80: Locating VCT Actuator And Bolt
Courtesy of FORD MOTOR CO.

NOTE: Clean the sealing surface with metal surface prep before installing a new press-in-place gasket.

7. Install the camshaft oil seal retainer and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).

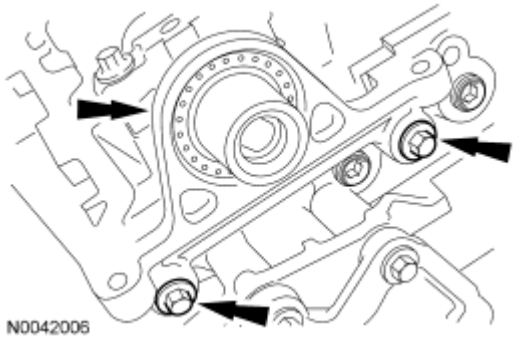


Fig. 81: Locating Camshaft Oil Seal Retainer And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Apply clean engine oil to the seal lip and seal bore before installing the seal.

8. Using the Power Steering Pump Pulley Installer, Camshaft Oil Seal Protector and the Camshaft Oil Seal Installer, install a new camshaft oil seal.

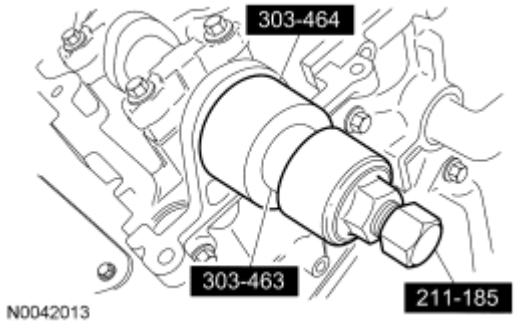


Fig. 82: Identifying Special Tools (303-463, 303-464 And 211-185)
Courtesy of FORD MOTOR CO.

NOTE: Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.

9. Install the Camshaft Pulley Installer in the camshaft as shown in the illustration.
   - Adjust the collar on the special tool screw to get the best thread engagement in the rear of the camshaft.

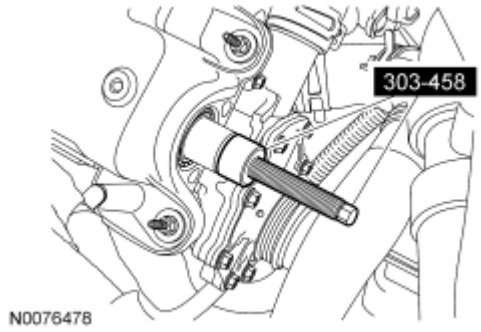


Fig. 83: Installing Special Tool On Camshaft
Courtesy of FORD MOTOR CO.

NOTE: Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.

NOTE: Only the roller collared nut from the Power Steering Pump Pulley Installer (211-185) is used on Camshaft Pulley Installer (303-458).

10. Position the coolant pump pulley over the previously installed Camshaft Pulley Installer and on the end of the camshaft. Install the Camshaft Pulley Installer, Power Steering Pump Pulley Installer and the Water Pump Pulley Spacer as shown in the illustration.
    - Using the Camshaft Pulley Installer, Power Steering Pump Pulley Installer and the Water Pump Pulley Spacer, install a new service coolant pump pulley flush with the end of the camshaft.

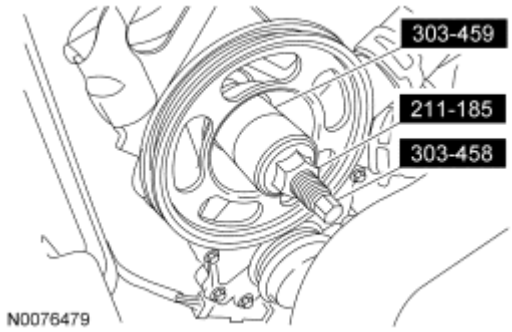


Fig. 84: Installing Coolant Pump Pulley Using Special Tools (211-185, 303-458, 303-459)
Courtesy of FORD MOTOR CO.

11. Install the timing drive components. For additional information, refer to **Timing Drive Components**.
12. Install the coolant pump belt. For additional information, refer to **ACCESSORY DRIVE - 3.0L (4V)** article.

CAMSHAFTS - RH

Material

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

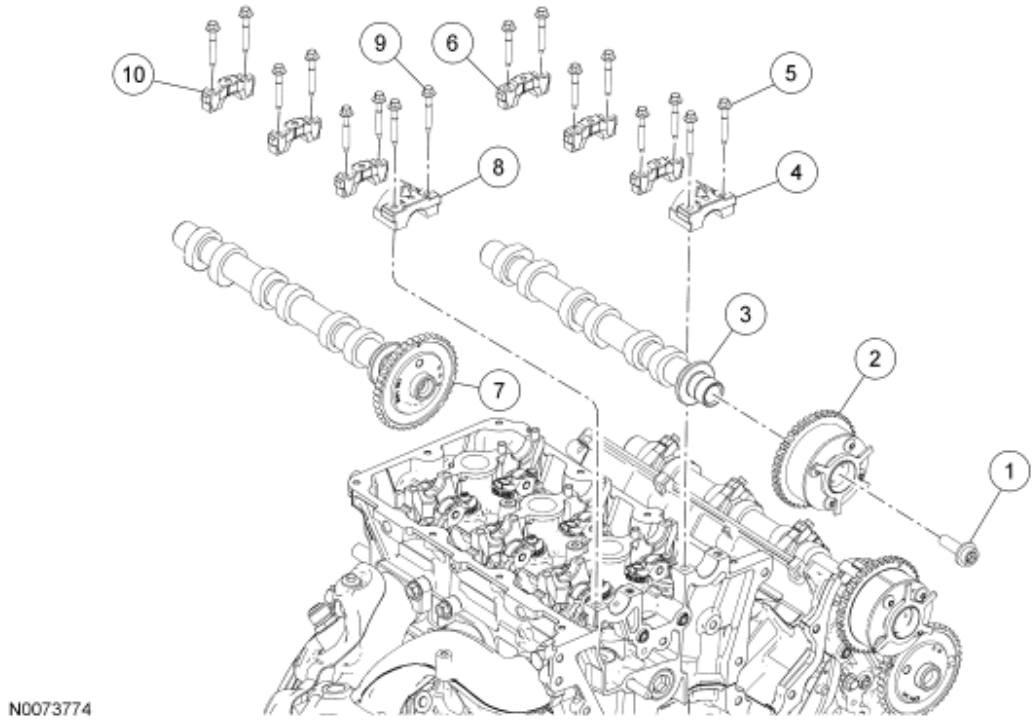


Fig. 85: Exploded View Of Camshafts - RH
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6279	Variable Camshaft Timing (VCT) actuator bolt
2	6C524	VCT actuator
3	6A266	RH intake camshaft
4	6B280	Intake camshaft thrust bearing cap
5	W710702	Intake camshaft bearing cap bolt (8 required)
6	6B280	Intake camshaft bearing cap (3 required)
7	6A268	RH exhaust camshaft
8	6B280	Exhaust camshaft thrust bearing cap
9	W710702	Exhaust camshaft bearing cap bolt (8 required)
10	6B280	Exhaust camshaft bearing cap (3 required)

REMOVAL

1. Remove the timing drive components. For additional information, refer to **Timing Drive Components**.

NOTE: The camshafts must be in the neutral position before removing the bearing caps or damage to the engine may occur.

2. Verify the camshafts are in the neutral position.

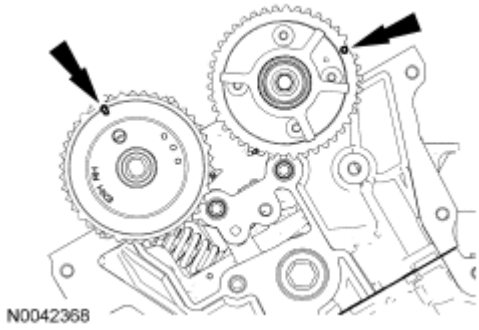


Fig. 86: Locating RH Camshafts Position
Courtesy of FORD MOTOR CO.

NOTE: Do not allow the camshaft to rotate from the neutral position while removing the Variable Camshaft Timing (VCT) actuator or damage to the engine may occur.

NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for removal of the VCT actuator bolt.

3. Remove the bolt and the VCT actuator.

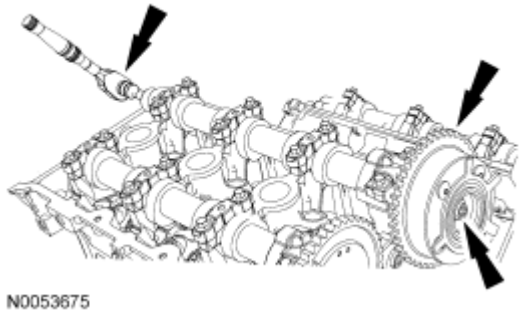
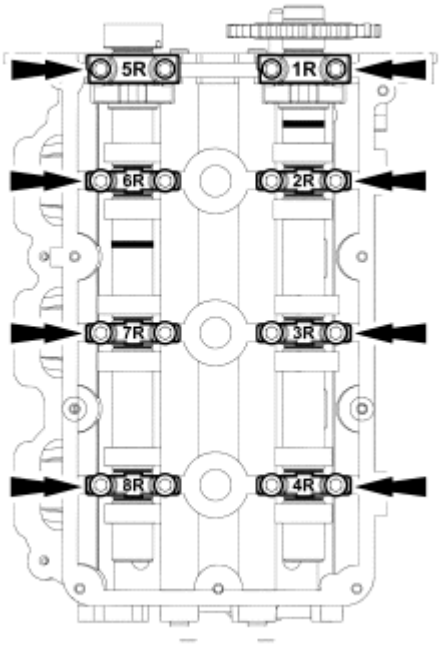


Fig. 87: Locating VCT Actuator And Bolt
Courtesy of FORD MOTOR CO.

NOTE: Cylinder head camshaft bearing caps must be assembled in their original

positions. Some engines have factory markings on the camshaft bearing caps (as shown in illustration). Engines that do not have the factory markings must be marked for correct position and orientation prior to removal. Failure to install the camshaft bearing caps in their original positions may result in severe engine damage.

4. If necessary, mark the camshaft bearing cap position and orientation as shown in the illustration.



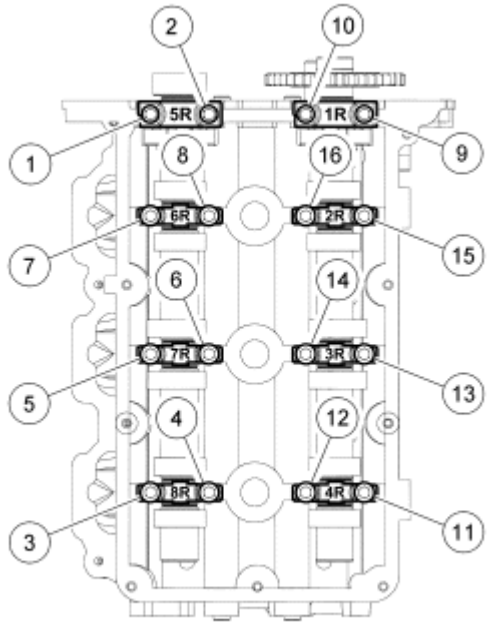
N0071867

Fig. 88: Marking Camshaft Bearing Cap Position & Orientation
Courtesy of FORD MOTOR CO.

NOTE: After loosening all of the camshaft bearing cap bolts, remove the camshaft bearing thrust caps (5R and 1R) first or damage to the thrust caps may occur.

NOTE: Make sure the camshaft bearing caps are marked as instructed in the previous step.

5. Loosen the bolts evenly in the sequence shown.
    1. Remove the camshaft bearing thrust caps (5R and 1R).
    2. Remove the remaining camshaft bearing caps.
    3. Remove the camshafts from the cylinder head.

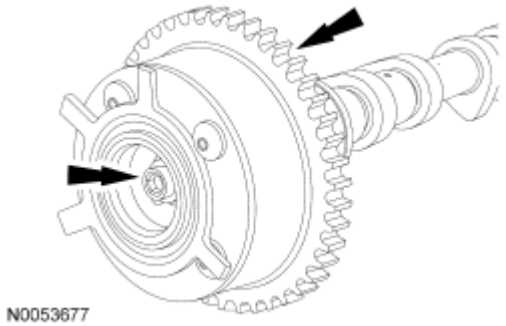


N0053678

Fig. 89: Identifying Loosening Sequence Of Camshaft Bearing Bolts
Courtesy of FORD MOTOR CO.

INSTALLATION

1. Position the VCT actuator onto the intake camshaft.
   - Install the bolt finger-tight.



N0053677

Fig. 90: Locating VCT Actuator Onto Intake Camshaft
Courtesy of FORD MOTOR CO.

NOTE: The camshafts must be installed in the neutral position or damage to the engine may occur.

2. Lubricate the camshafts with clean engine oil and carefully position the camshafts onto the cylinder head.
   - Align the camshafts in the neutral position as shown.

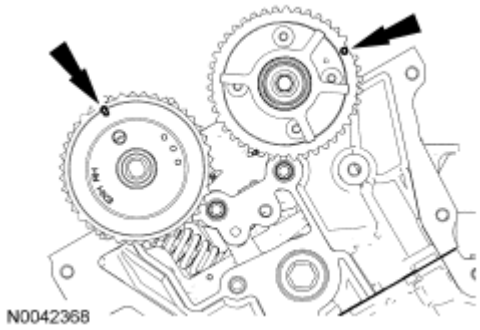


Fig. 91: Locating RH Camshafts Position
Courtesy of FORD MOTOR CO.

NOTE: The camshaft caps must be installed in their original positions or damage to the engine may occur.

NOTE: Do not install the camshaft bearing thrust caps until all of the camshaft bearing caps have been installed or damage to the thrust caps may occur.

NOTE: Lubricate the bearing surfaces of the camshaft bearing caps with clean engine oil.

3. Install the camshaft bearing caps.
   - Loosely install the bolts.

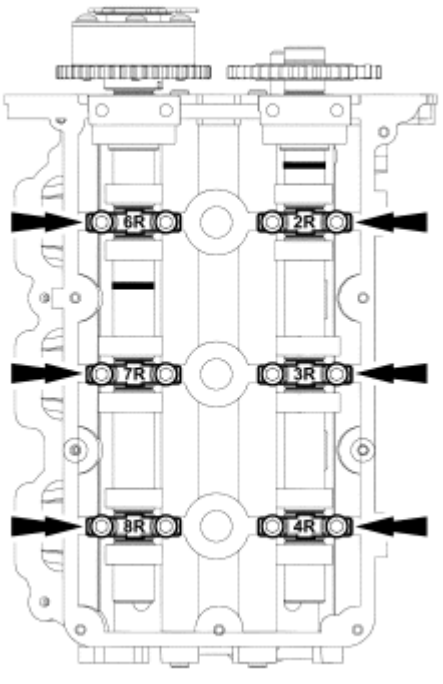


Fig. 92: Locating Camshaft Bearing Caps

Courtesy of FORD MOTOR CO.

NOTE: Lubricate the bearing surfaces of the camshaft bearing thrust caps with clean engine oil.

4. Install the camshaft bearing thrust caps.
   - Loosely install the bolts.

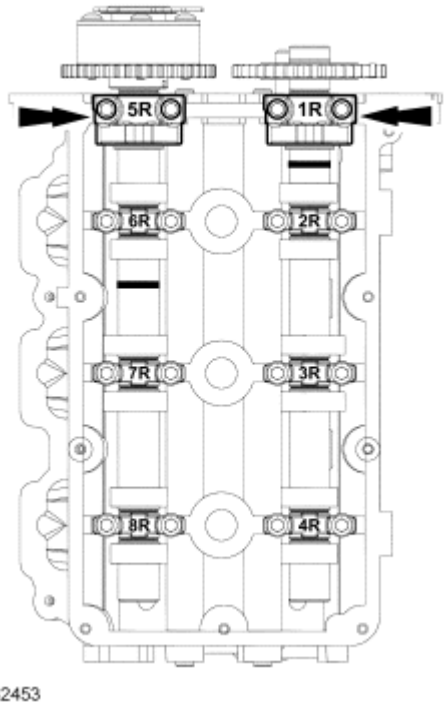
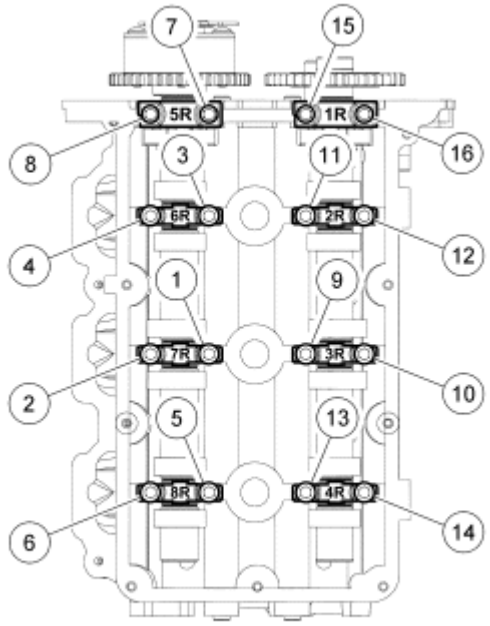


Fig. 93: Locating Camshaft Bearing Thrust Caps
Courtesy of FORD MOTOR CO.

5. Tighten the camshaft bearing cap bolts in the sequence shown to 10 Nm (89 lb-in).



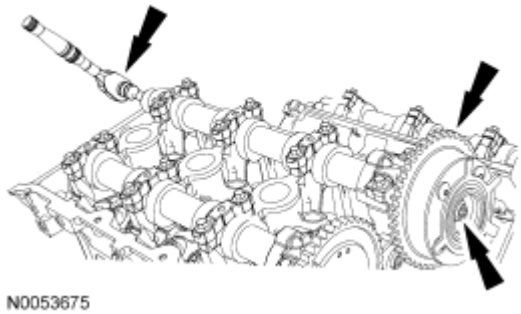
N0081822

Fig. 94: Tightening Camshaft Bearing Cap Bolts In Sequence
Courtesy of FORD MOTOR CO.

NOTE: Do not allow the camshaft to rotate from the neutral position while tightening the Variable Camshaft Timing (VCT) actuator bolt or damage to the engine may occur.

NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for tightening of the VCT actuator bolt.

6. Tighten the VCT actuator bolt to 40 Nm (30 lb-ft) plus an additional 90 degrees.



N0053675

Fig. 95: Locating VCT Actuator And Bolt
Courtesy of FORD MOTOR CO.

7. Install the timing drive components. For additional information, refer to **Timing Drive Components**.

VALVE TRAIN COMPONENTS - EXPLODED VIEW

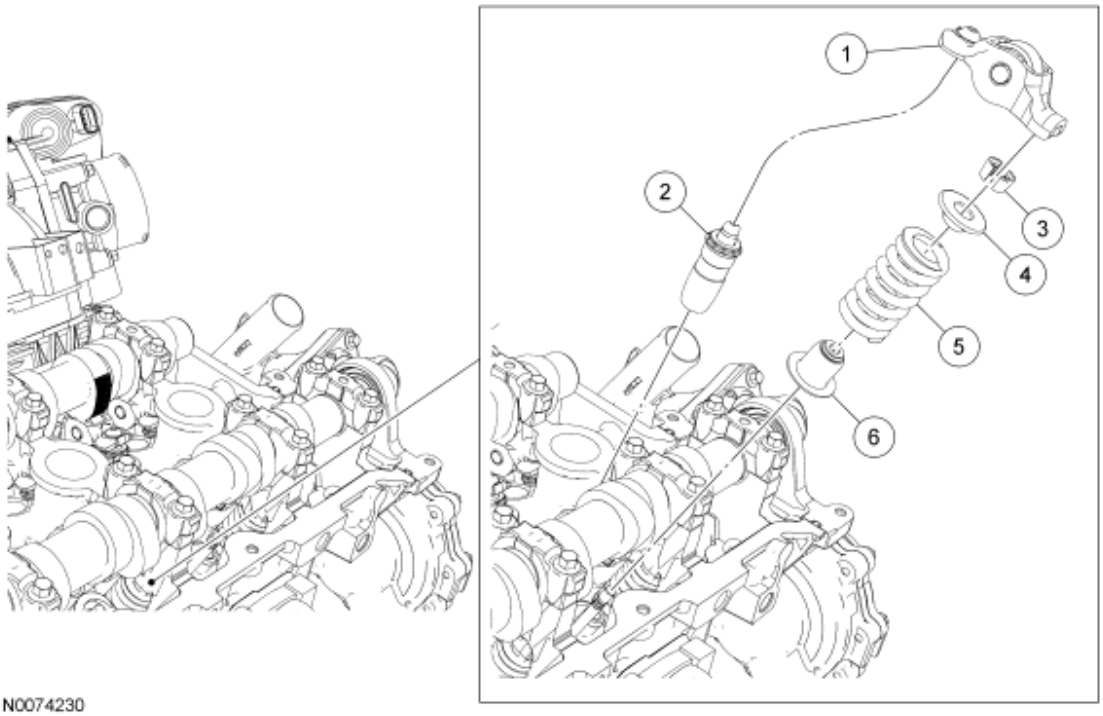


Fig. 96: Exploded View Of Valve Train Components - LH Side
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6529	Roller follower (24 required)
2	6C501	Hydraulic lash adjuster (24 required)
3	6518	Valve spring retainer key (48 required)
4	6514	Valve spring retainer (24 required)
5	6513	Valve spring (24 required)
6	6A517	Valve stem seal (24 required)

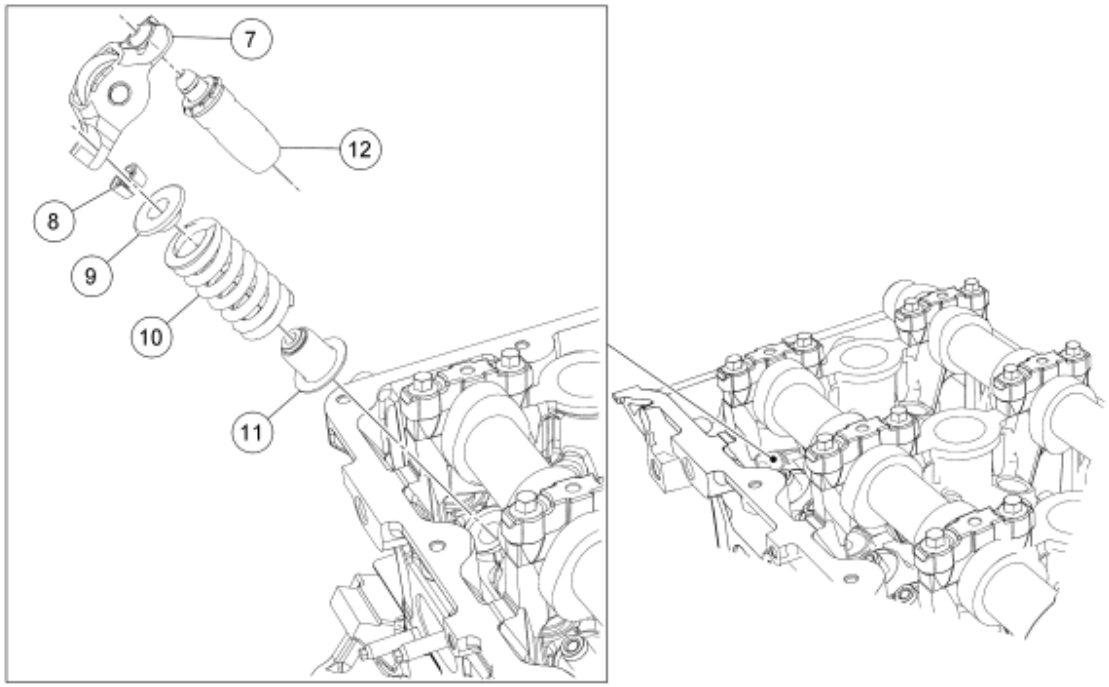


Fig. 97: Exploded View Of Valve Train Components - RH Side
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
7	6529	Roller follower (24 required)
8	6518	Valve spring retainer key (48 required)
9	6514	Valve spring retainer (24 required)
10	6513	Valve spring (24 required)
11	6A517	Valve stem seal (24 required)
12	6C501	Hydraulic lash adjuster (24 required)

1. For additional information, refer to the procedures.

CAMSHAFT ROLLER FOLLOWER

Special Tools

Illustration	Tool Name	Tool Number
 ST1975-A	Compressor, Valve Spring	303-473 (T94P-6565-BH)

Material

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 AND INSTALLATION

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** article.
2. Remove the LH and RH valve covers. For additional information, refer to **Valve Cover - LH** and **Valve Cover - RH**.

NOTE: Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.

3. Remove the 6 spark plugs.
   - To install, tighten to 15 Nm (133 lb-in).
4. Remove the 4 screws and position the RH fender splash shield aside.

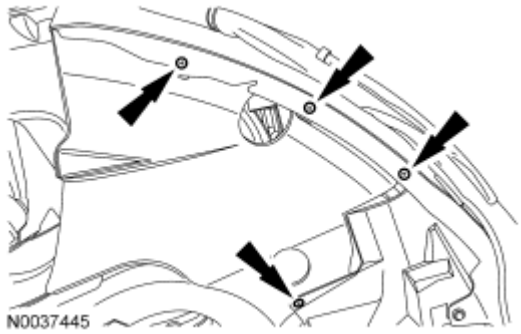


Fig. 98: Locating RH Fender Splash Shield Screws
Courtesy of FORD MOTOR CO.

5. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.

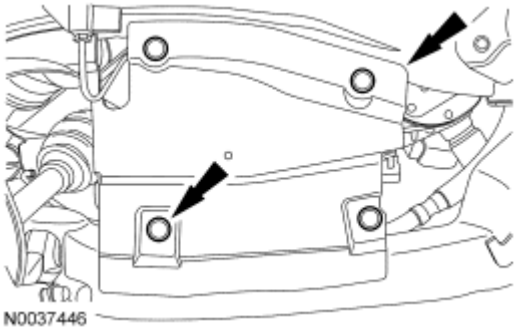


Fig. 99: Locating Splash Shield Pin-Type Retainers
Courtesy of FORD MOTOR CO.

6. Rotate the crankshaft until the camshaft lobe is pointing directly away from the roller follower.

NOTE: Mark the positions of the roller followers to make sure they are assembled in their original positions.

7. Using the Valve Spring Compressor, remove the roller followers.

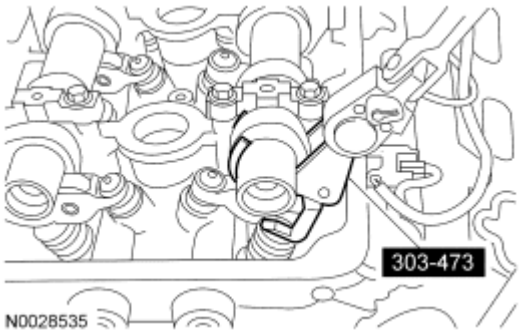


Fig. 100: Removing Roller Using Special Tool (303-473)
Courtesy of FORD MOTOR CO.

NOTE: Lubricate the roller followers with clean engine oil.

8. To install, reverse the removal procedure.

HYDRAULIC LASH ADJUSTER

Material

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 AND INSTALLATION

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

1. Remove the camshaft roller followers. For additional information, refer to **Camshaft Roller Follower**.

   NOTE: Mark the positions of the hydraulic lash adjusters to make sure they are assembled in their original positions.

2. Remove the hydraulic lash adjusters.

   NOTE: Inspect the hydraulic lash adjusters for scoring marks and uneven wear in the bore. Install new lash adjusters if necessary.

3. To install, reverse the removal procedure.
   - Lubricate the hydraulic lash adjusters with clean engine oil.

VALVE SPRING, RETAINER, AND SEAL

Special Tools

Illustration	Tool Name	Tool Number
 ST1975-A	Compressor, Valve Spring	303-473 (T94P-6565-BH)
 ST1977-A	Installer, Valve Stem Oil Seal	303-470 (T94P-6510-CH)

Material

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

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

1. Remove the camshaft roller followers. For additional information, refer to **Camshaft Roller Follower**.

   NOTE: If the components are to be reinstalled, they must be installed in their original positions or damage to the engine may occur. Mark the components for installation into their original locations.

   NOTE: If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this from happening.

   NOTE: If a valve drops into the cylinder, remove the cylinder head. For additional information, refer Cylinder Head - RH or Cylinder Head - LH.

2. Pressurize the cylinder using compressed air.
3. Using the Valve Spring Compressor, remove the key, retainer and the valve spring.

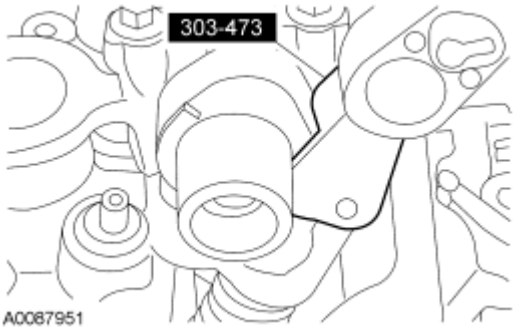


Fig. 101: Identifying Special Tool (303-473)
Courtesy of FORD MOTOR CO.

   NOTE: Camshaft removed for clarity.

4. Remove and discard the valve seal.

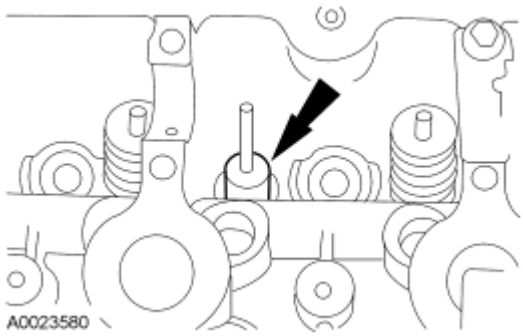


Fig. 102: Locating Valve Seal
Courtesy of FORD MOTOR CO.

INSTALLATION

NOTE: Lubricate the valve guide with clean engine oil.

1. Using the Valve Stem Oil Seal Installer, install the new valve seal.

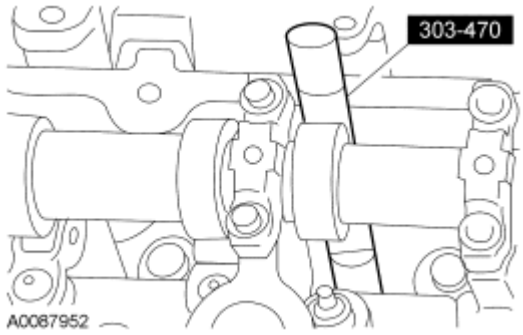


Fig. 103: Installing Valve Seal
Courtesy of FORD MOTOR CO.

NOTE: If the components are to be reinstalled, they must be installed in their original positions or damage to the engine may occur.

2. Using the Valve Spring Compressor, install the valve spring, retainer and key.

Fig. 104: Identifying Special Tool (303-473)
Courtesy of FORD MOTOR CO.

3. Install the camshaft roller followers. For additional information, refer to **Camshaft Roller Follower**.

CYLINDER HEAD - RH

Material

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
Silicone Gasket Remover ZC-30	-

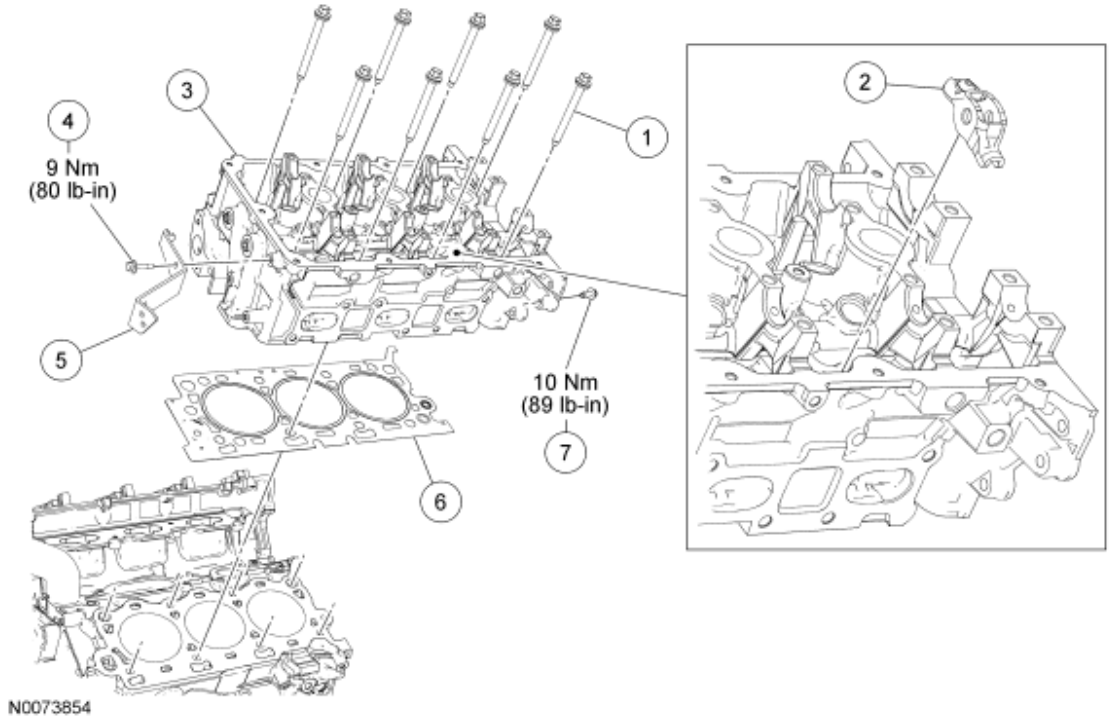


Fig. 105: Exploded View Of Cylinder Head With Torque Specifications - RH
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6065	Cylinder head bolt (8 required)
2	6529	Camshaft roller follower (12 required)

3	6049	Cylinder head
4	506413	Power Steering Pressure (PSP) tube bracket-to-cylinder head bolt
5	3A719	PSP tube bracket
6	6051	Cylinder head gasket
7	-	Wiring harness retainer bolt

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** article.
2. Remove the RH camshafts. For additional information, refer to **Camshafts - RH**.
3. Remove the coolant bypass tube. For additional information, refer to **ENGINE COOLING** article.
4. Remove the bolt and detach the Power Steering Pressure (PSP) tube bracket from the back of the cylinder head.
5. Remove the RH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** article.

NOTE: The camshaft roller followers must be installed in their original positions or damage to the engine may occur.

NOTE: Mark the location of the roller followers using a permanent-type marker.

6. Remove the camshaft roller followers.
7. Loosen the 8 bolts in the sequence shown and remove the cylinder head.
   - Discard the bolts and the gasket.

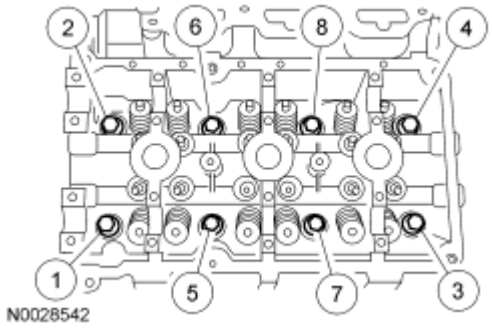


Fig. 106: Identifying Loosening Sequence Of Cylinder Heads Bolts
Courtesy of FORD MOTOR CO.

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.

8. Clean the cylinder head-to-cylinder block mating surface of both the cylinder head and the cylinder block.
    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 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.
9. Support the cylinder head on a bench with the head gasket side up.

NOTE: The straightedge used must be flat within 0.0051 mm (0.0002 in) per foot of tool length.

10. Inspect all areas of the deck face with a straightedge and feeler gauge. The cylinder head must not have depressions deeper than 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area, or scratches more than 0.0254 mm (0.001 in).

INSTALLATION

1. Clean the cylinder head bolt holes in the cylinder block. Make sure all coolant, oil or other foreign material is removed.
2. Position a new gasket and the cylinder head on the engine.

NOTE: New cylinder head bolts must be installed. They are a torque-to-yield design and cannot be reused.

3. Install the 8 bolts and tighten in 6 stages in the sequence shown.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Tighten 90 degrees.
    - Stage 3: Loosen one full turn.
    - Stage 4: Tighten to 40 Nm (30 lb-ft).

- Stage 5: Tighten 90 degrees.
- Stage 6: Tighten 90 degrees.

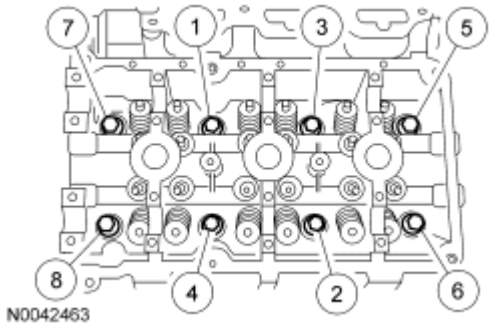


Fig. 107: Identifying Tightening Sequence Of Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

NOTE: The camshaft roller followers must be installed in their original positions or damage to the engine may occur.

NOTE: Lubricate the camshaft roller followers with clean engine oil.

4. Install the camshaft roller followers.
5. Install the RH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** article.
6. Position the PSP tube bracket onto the rear of the cylinder head and install the bolt.
   - Tighten to 9 Nm (80 lb-in).
7. Install the coolant bypass tube. For additional information, refer to **ENGINE COOLING** article.
8. Install the RH camshafts. For additional information, refer to **Camshafts - RH**.

CYLINDER HEAD - LH

Material

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
Silicone Gasket Remover ZC-30	-

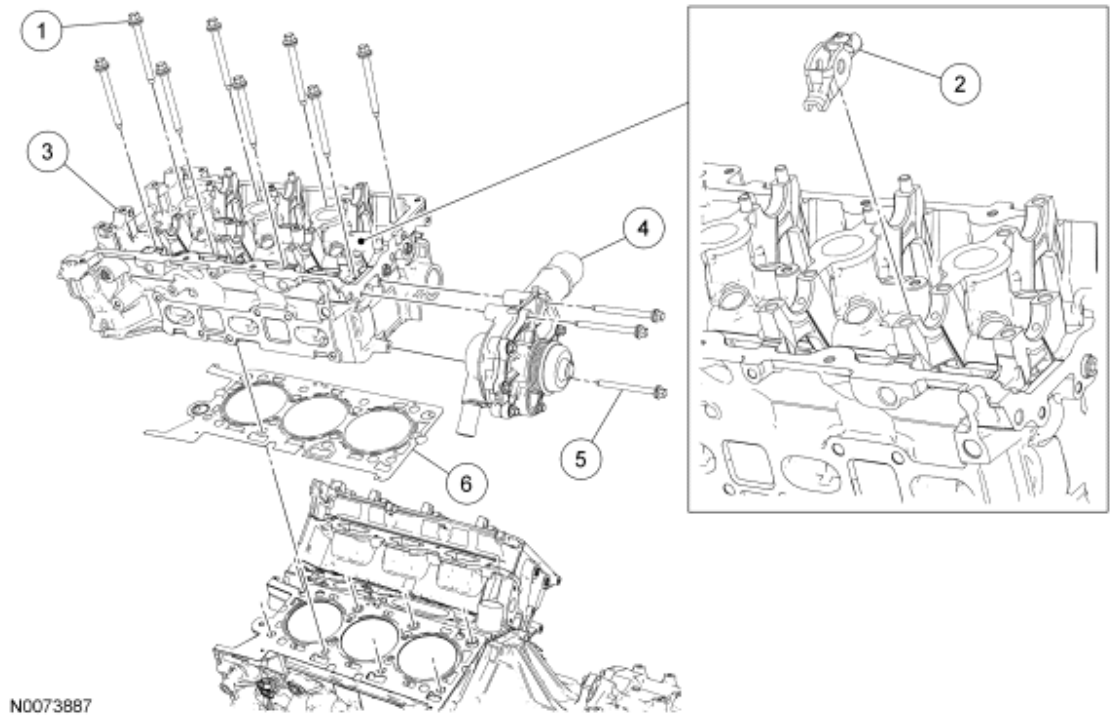


Fig. 108: Exploded View Of Cylinder Head - LH
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6065	Cylinder head bolt (8 required)
2	6529	Camshaft roller follower (12 required)
3	6050	Cylinder head
4	8501	Coolant pump
5	701544	Coolant pump bolt
6	6083	Cylinder head 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.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING** article.
2. Remove the LH camshafts. For additional information, refer to **Camshafts - LH**.
3. Remove the coolant bypass tube. For additional information, refer to **ENGINE COOLING** article.
4. Remove the 3 bolts and position the coolant pump aside.

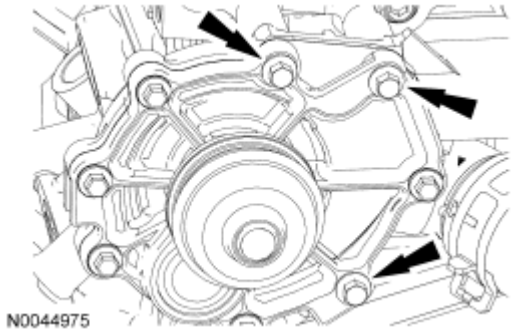


Fig. 109: Locating Coolant Pump And Bolts
Courtesy of FORD MOTOR CO.

5. Remove the LH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** article.

NOTE: The camshaft roller followers must be installed in their original positions or damage to the engine may occur.

NOTE: Mark the location of the roller followers using a permanent-type marker.

6. Remove the camshaft roller followers.
7. Loosen the 8 bolts in the sequence shown and remove the cylinder head.
   - Discard the bolts and the gasket.

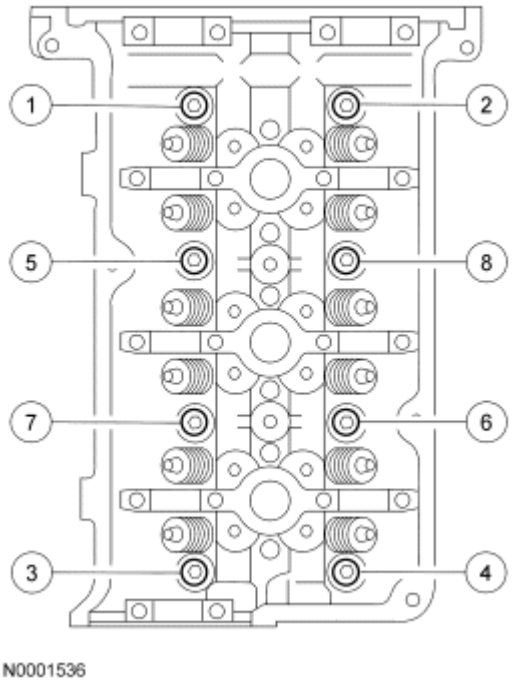


Fig. 110: Identifying Loosening Sequence Of Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

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.

8. Clean the cylinder head-to-cylinder block mating surface of both the cylinder head and the cylinder block.
    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 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.
9. Support the cylinder head on a bench with the head gasket side up.

NOTE: The straightedge used must be flat within 0.0051 mm (0.0002 in) per foot of tool length.

10. Inspect all areas of the deck face with a straightedge and feeler gauge. The cylinder head must not have depressions deeper than 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area, or scratches more than 0.0254 mm (0.001 in).

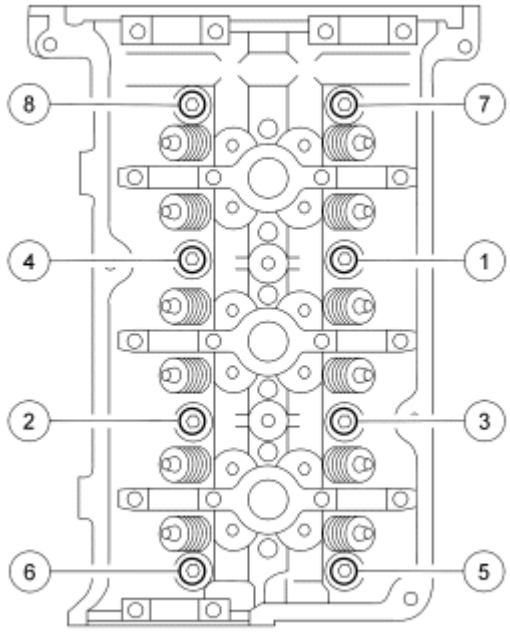
INSTALLATION

1. Clean the cylinder head bolt holes in the cylinder block. Make sure all coolant, oil or other foreign material is removed.
2. Position a new gasket and the cylinder head on the engine.

NOTE: New cylinder head bolts must be installed. They are a torque-to-yield design and cannot be reused.

3. Install the 8 bolts and tighten in 6 stages in the sequence shown.
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Tighten 90 degrees.
    - Stage 3: Loosen one full turn.
    - Stage 4: Tighten to 40 Nm (30 lb-ft).

- Stage 5: Tighten 90 degrees.
- Stage 6: Tighten 90 degrees.



N0001535

Fig. 111: Identifying Tightening Sequence Of Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

NOTE: The camshaft roller followers must be installed in their original positions or damage to the engine may occur.

NOTE: Lubricate the camshaft roller followers with clean engine oil.

4. Install the camshaft roller followers.
5. Install the LH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** article.
6. Position the coolant pump and install the bolts.
   - Tighten to 10 Nm (89 lb-in) then rotate 90 degrees.
7. Install the coolant bypass tube. For additional information, refer to **ENGINE COOLING** article.
8. Install the LH camshafts. For additional information, refer to **Camshafts - LH**.

ENGINE LUBRICATION COMPONENTS - EXPLODED VIEW

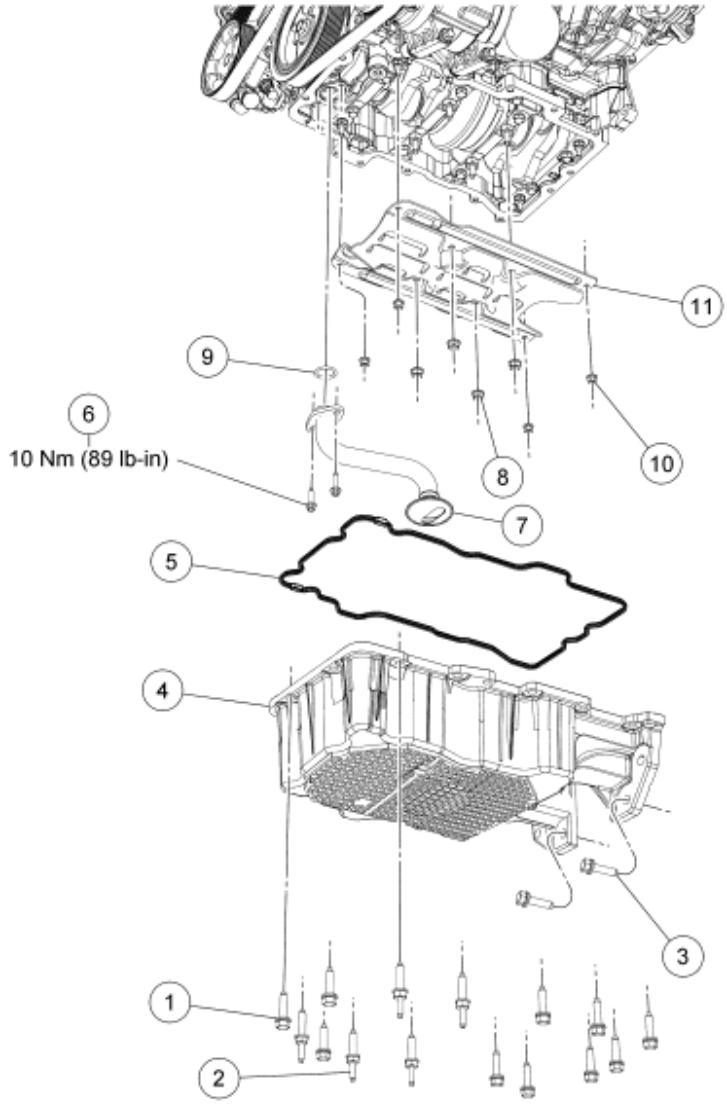


Fig. 112: Exploded View Of Oil Pan, Oil Pump Screen And Pickup Tube & Oil Pan Baffle With Torque Specification
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W709678	Oil pan bolt (10 required)
2	W701606	Oil pan stud bolt (5 required)
3	W500120	Oil pan-to-transaxle bolt (2 required)
4	6675	Oil pan
5	6710	Oil pan gasket
6	W700005	Oil pump screen and pickup tube bolt (2 required)
7	6622	Oil pump screen and pickup tube
8	W701582	Oil pan baffle nut (4 required)

9	6625	Oil pump screen and pickup tube O-ring seal
10	W701542	Oil pan baffle nut (4 required)
11	6687	Oil pan baffle

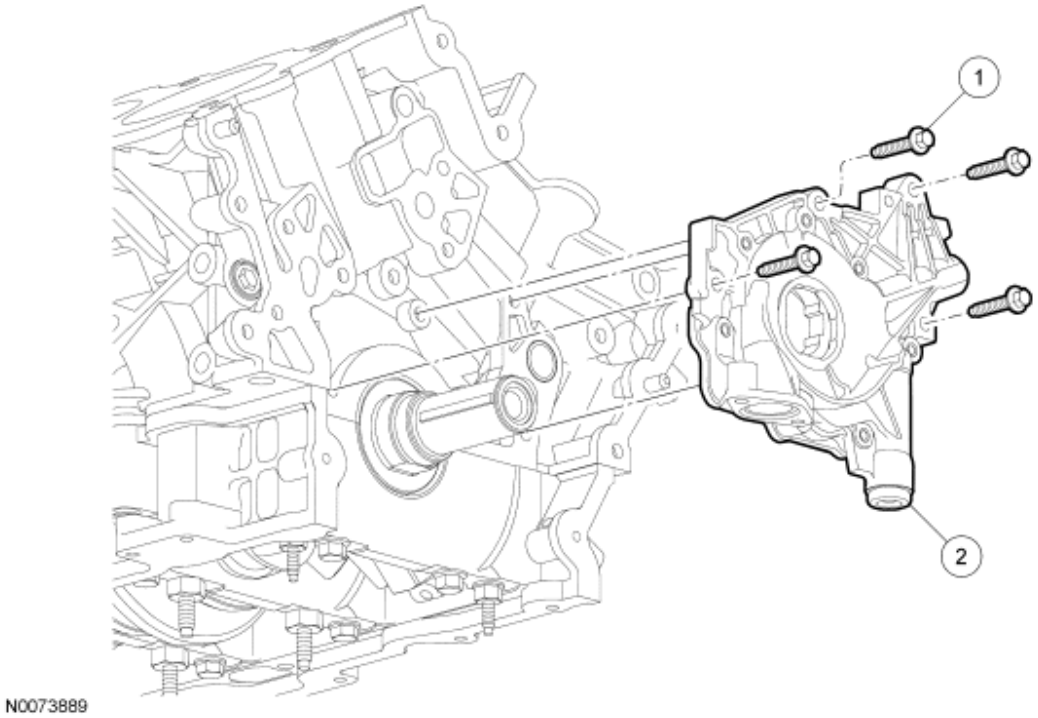


Fig. 113: Exploded View Of Oil Pump
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W500300	Oil pump bolt (4 required)
2	6621	Oil pump

1. For additional information, refer to the procedures.

OIL PAN

Material

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

Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

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** article.
2. Remove the LH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** article.
3. Drain the engine oil and install the drain plug.
   - Tighten to 26 Nm (19 lb-ft).
4. Remove the 2 oil pan-to-transaxle bolts.

NOTE: For reference during installation, mark the location of the stud bolts.

5. Remove the 10 bolts, 5 stud bolts and the oil pan.
   - Discard the gasket.

INSTALLATION

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 which make leak paths.

NOTE: Use a plastic scraping tool to remove all traces of the oil pan gasket.

1. Clean all sealing surfaces with metal surface prep and install a new oil pan gasket.

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

2. Apply a 10 mm (0.39 in) diameter dot of silicone sealant to the areas indicated.

Fig. 114: Locating Silicone Sealant Areas
Courtesy of FORD MOTOR CO.

3. Position the oil pan and install the 10 bolts and 5 stud bolts finger tight.
4. Install the 2 oil pan-to-transaxle bolts.
   - Tighten to 48 Nm (35 lb-ft).
5. Tighten the oil pan-to-engine bolts and stud bolts in the sequence shown to 25 Nm (18 lb-ft).

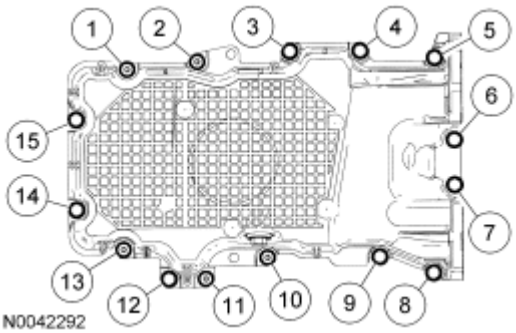


Fig. 115: Identifying Tightening Sequence Of Oil Pan-To-Engine Bolts
Courtesy of FORD MOTOR CO.

6. Install the LH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** article.
7. Fill the engine with clean engine oil.

OIL PUMP SCREEN AND PICKUP TUBE

Material

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

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** article.
2. Remove the oil pan. For additional information, refer to **Oil Pan**.
3. Remove the 2 bolts and the oil pump screen and pickup tube.
   - Remove and discard the O-ring seal.

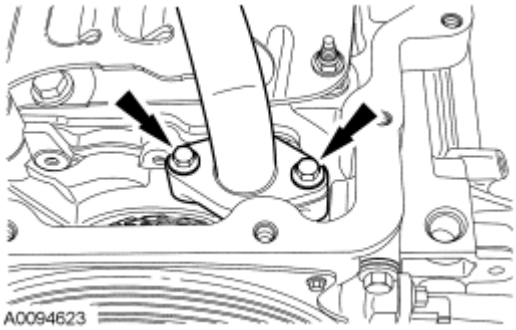


Fig. 116: Locating Oil Pump Screen & Pickup Tube Bolts
Courtesy of FORD MOTOR CO.

INSTALLATION

NOTE: Lubricate the O-ring seal with clean engine oil.

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

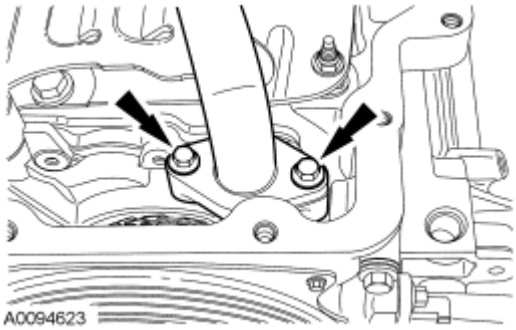


Fig. 117: Locating Oil Pump Screen & Pickup Tube Bolts
Courtesy of FORD MOTOR CO.

3. Install the oil pan. For additional information, refer to **Oil Pan**.

OIL PAN BAFFLE

REMOVAL AND INSTALLATION

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** article.
2. Remove the oil pump screen and pickup tube. For additional information, refer to **Oil Pump Screen and Pickup Tube**.
3. Remove the 8 nuts and the oil pan baffle.
    - To install tighten the oil pan baffle nuts in 2 stages.
        - Stage 1: Tighten the 4 smaller nuts to 5 Nm (44 lb-in) and the larger nuts to 15 Nm (133 lb-in).
        - Stage 2: Tighten all 8 nuts an additional 45 degrees.
4. To install, reverse the removal procedure.

OIL PUMP

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** article.
2. Remove the timing drive components. For additional information, refer to **Timing Drive Components**.
3. Remove the oil pump screen and pickup tube. For additional information, refer to **Oil Pump Screen and Pickup Tube**.
4. Remove the 4 bolts in the sequence shown.

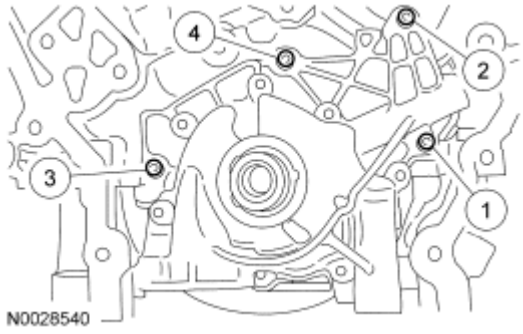


Fig. 118: Identifying Removing Sequence Of Oil Pump Bolts
Courtesy of FORD MOTOR CO.

INSTALLATION

1. Position the oil pump and install the 4 bolts.
   - Tighten in the sequence shown to 10 Nm (89 lb-in).

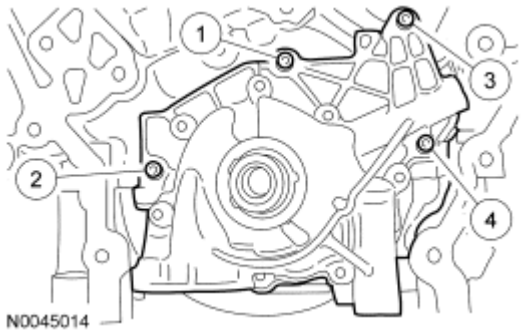


Fig. 119: Identifying Tightening Sequence Of Oil Pump Bolts
Courtesy of FORD MOTOR CO.

2. Install the oil pump screen and pickup tube. For additional information, refer to **Oil Pump Screen and Pickup Tube**.
3. Install the timing drive components. For additional information, refer to **Timing Drive Components**.

OIL LEVEL INDICATOR AND TUBE

Material

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

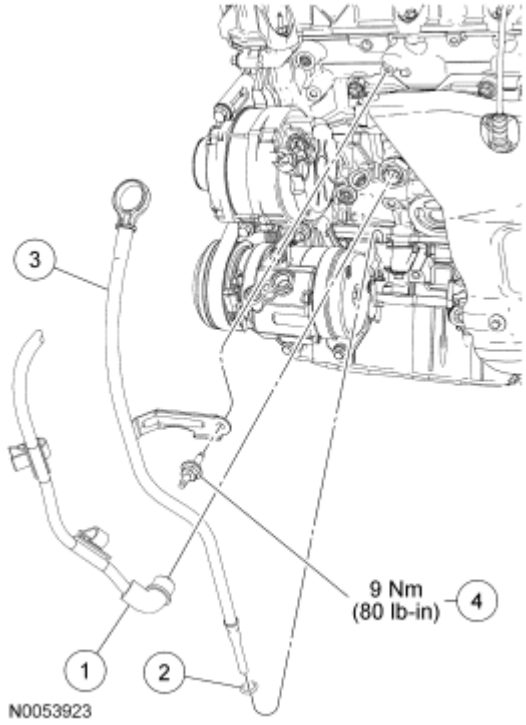


Fig. 120: Exploded View Of Oil Level Indicator & Tube With Torque Specification
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Block heater wiring harness (if equipped)
2	110282	Oil level indicator O-ring seal
3	6754	Oil level indicator tube
4	W701822	Oil level indicator tube stud bolt

REMOVAL AND INSTALLATION

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING** article.
2. Remove the oil level indicator.
3. Remove the oil pressure sender. For additional information, refer to **Engine Oil Pressure (EOP) Switch**.
4. If equipped, disconnect the block heater electrical connector and wiring harness retainers.
5. Remove the stud bolt and the oil level indicator tube.
   - Discard the O-ring seal.
   - To install, tighten to 9 Nm (80 lb-in).

   NOTE: Install a new O-ring seal and lubricate with clean engine oil.

6. To install, reverse the removal procedure.

ENGINE OIL PRESSURE (EOP) SWITCH

Material

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

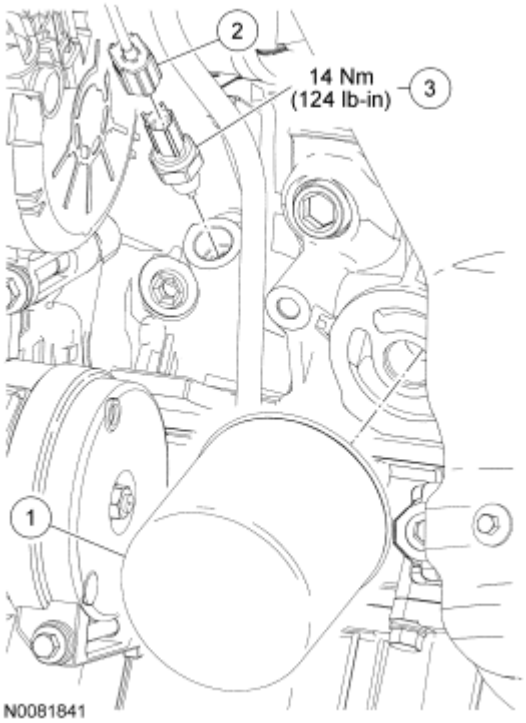


Fig. 121: Exploded View Of Engine Oil Pressure (EOP) Switch With Torque Specification
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6714	Engine oil filter
2	14A464	Engine Oil Pressure (EOP) switch electrical connector (part of 12B637)
3	9278	EOP

REMOVAL AND INSTALLATION

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

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

2. Remove the engine oil filter.

- To install, tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

3. Disconnect the Engine Oil Pressure (EOP) switch electrical connector.
4. Remove the EOP switch.
    - To install, tighten to 14 Nm (124 lb-in).
5. To install, reverse the removal procedure.
    - Apply thread sealant with PTFE to the EOP switch threads.

EXHAUST MANIFOLD - RH, ALL WHEEL DRIVE (AWD)

Material

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

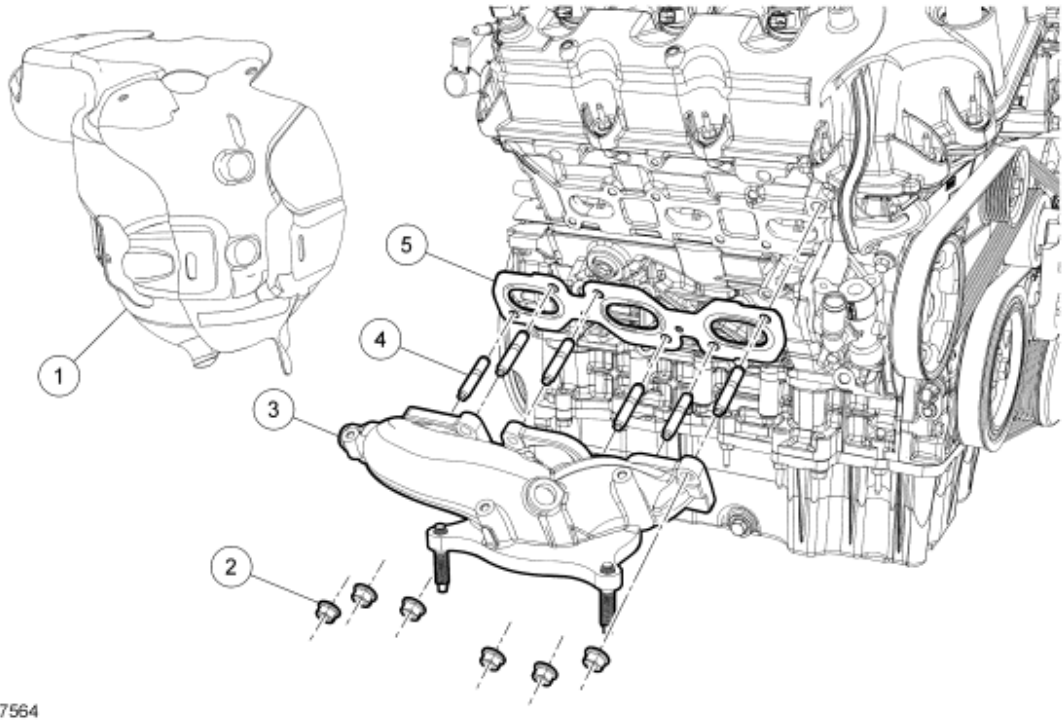


Fig. 122: Exploded View Of Exhaust Manifold - RH, All Wheel Drive (AWD)
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	5K291	RH catalytic converter heat shield
2	W701706	RH exhaust manifold nut (6 required)
3	9430	RH exhaust manifold
4	W701732	RH exhaust manifold stud (6 required)
5	9448	RH exhaust manifold gasket

REMOVAL

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING** article.
2. Remove the EGR tube. For additional information, refer to **ENGINE EMISSION CONTROL - 3.0L (4V)** article.
3. Remove the RH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** article.

NOTE: The heat shield that was unbolted from the exhaust manifold during removal of the RH catalytic converter cannot be removed from the vehicle until the power steering rack heat shield is removed.

4. Remove the 2 bolts and the power steering rack heat shield.
   - Remove the catalytic converter heat shield from the vehicle.

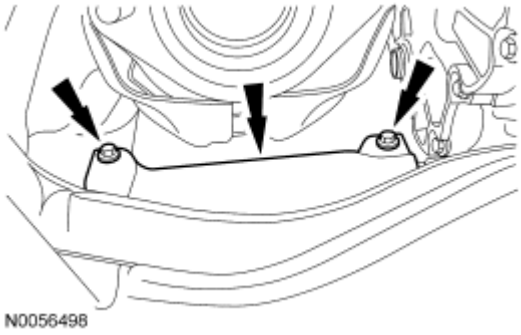


Fig. 123: Identifying Power Steering Rack Shield & Bolts
Courtesy of FORD MOTOR CO.

5. Remove the 6 nuts and the RH exhaust manifold.
   - Discard the gasket and nuts.

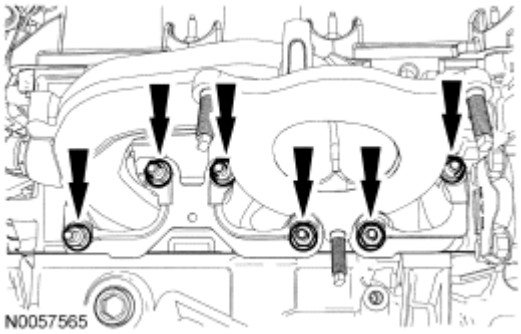


Fig. 124: Identifying RH Exhaust Manifold Nuts
Courtesy of FORD MOTOR CO.

6. Clean and inspect the RH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article.

7. Remove and discard the 6 RH exhaust manifold studs.

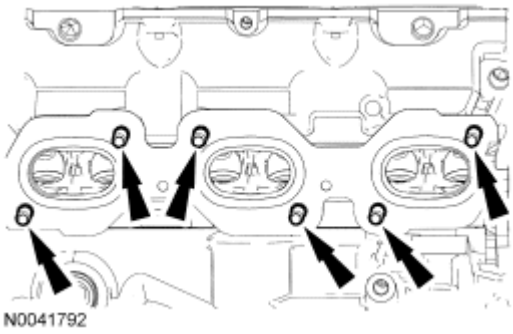


Fig. 125: Locating Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

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.

8. 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).

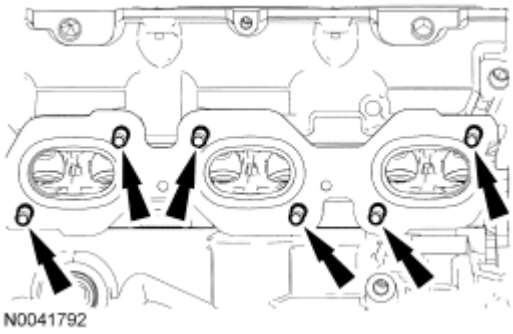


Fig. 126: Locating Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

NOTE: The catalytic converter heat shield must be positioned up into the engine compartment prior to installing the power steering rack heat shield.

2. Position the catalytic converter heat shield into the engine compartment.
3. Install the power steering rack heat shield and the 2 bolts.

- Tighten to 15 Nm (133 lb-in).

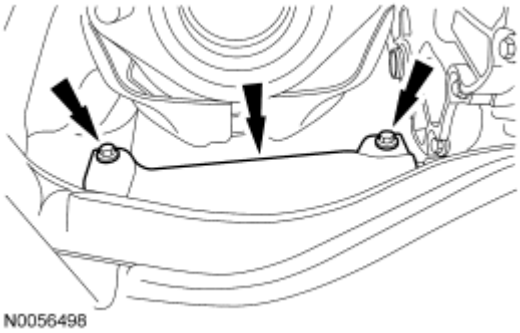


Fig. 127: Identifying Power Steering Rack Shield & Bolts
Courtesy of FORD MOTOR CO.

4. Install a new gasket, the RH exhaust manifold and 6 new nuts.
   - Tighten to 20 Nm (177 lb-in) in the sequence shown.

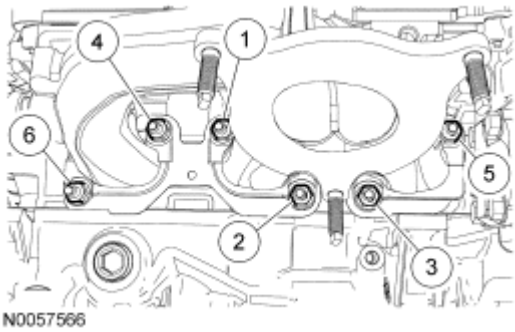
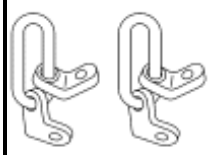


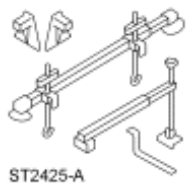
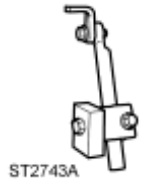
Fig. 128: Identifying Tightening Sequence Of RH Exhaust Manifold Nuts
Courtesy of FORD MOTOR CO.

5. Install the RH catalytic converter. For additional information, refer to **EXHAUST SYSTEM** article.
6. Install the EGR tube. For additional information, refer to **ENGINE EMISSION CONTROL - 3.0L (4V)** article.

ENGINE MOUNT

Special Tools

Illustration	Tool Name	Tool Number
 ST1595-A	Lifting Brackets, Engine	303-050 (T70P-6000)

 ST2425-A	Support Bar, Engine	303-F072
 ST2743A	Universal Adapter Brackets	014-0001

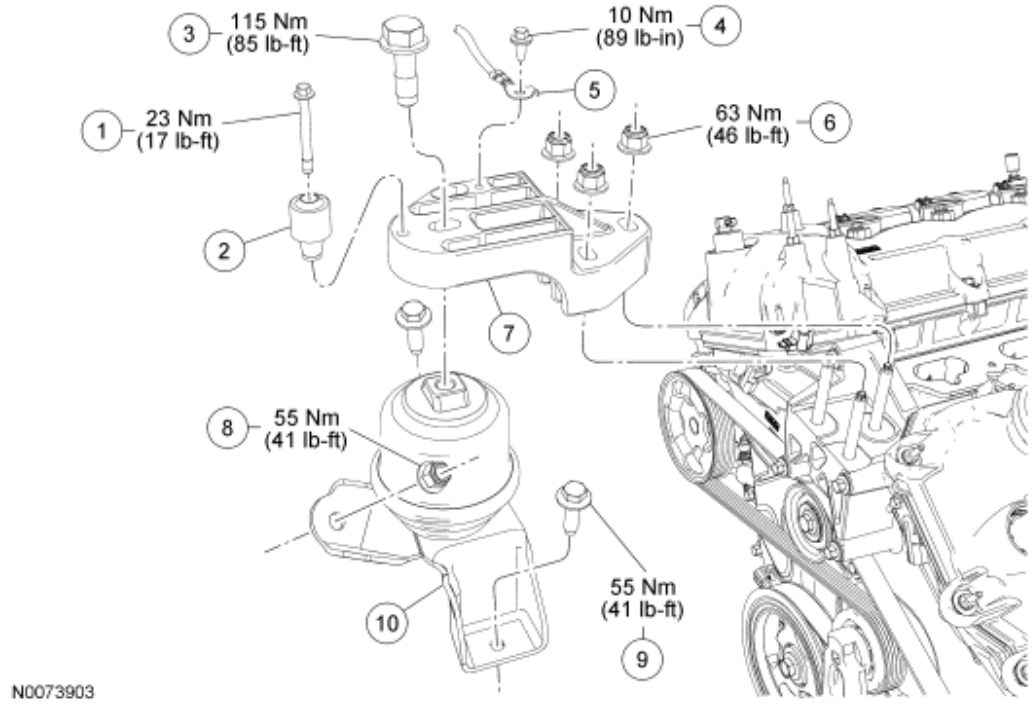


Fig. 129: Exploded View Of Engine Mount With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W711879	Damper bolt
2	7458	Damper
3	W711684	Engine mount bracket bolt
4	W705936	Ground wire bolt
5	19A095	Ground wire
6	W520213	Engine support insulator bracket nut (3 required)
7	6A094	Engine mount bracket
8	W711578	Engine mount nut

9	W706496	Engine mount bolt (2 required)
10	6F012	Engine mount

REMOVAL AND INSTALLATION

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING** article.
2. Release the fuel system pressure. For additional information refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
3. Remove the engine coolant degas bottle. For additional information, refer to **ENGINE COOLING** article.
4. Remove the lower intake manifold. For additional information, refer to **Lower Intake Manifold**.
5. Remove the bolt and position aside the ground wire.
   - To install, tighten to 10 Nm (89 lb-in).
6. Remove the bolt and damper.
   - To install, tighten to 23 Nm (17 lb-ft).
7. Remove the engine mount bracket bolt.
   - To install, tighten to 115 Nm (85 lb-ft).
8. Install the Universal Adapter Brackets and the Engine Lifting Brackets.
   1. Position the 2 Universal Adapter Brackets on top of the cylinder block.
   2. Install 2 M8 x 1.25 x 36 mm (1.41 in) bolts and tighten to 10 Nm (89 lb-in).
   3. Position the Engine Lifting Bracket onto the 2 Universal Adapter Brackets.
   4. Fasten the Engine Lifting Bracket to the 2 Universal Adapter Brackets with a suitable nut and bolt.

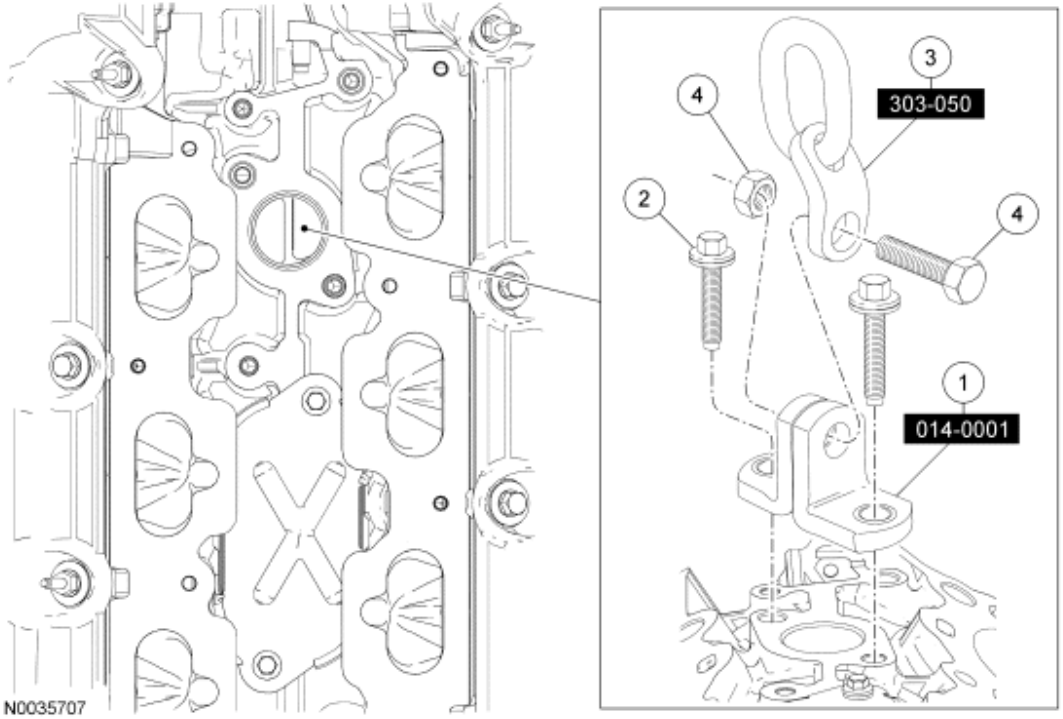


Fig. 130: Identifying Special Tools (303-050 And 014-0001)
Courtesy of FORD MOTOR CO.

9. Install the Engine Support Bar and raise the engine 25 mm (0.98 in).

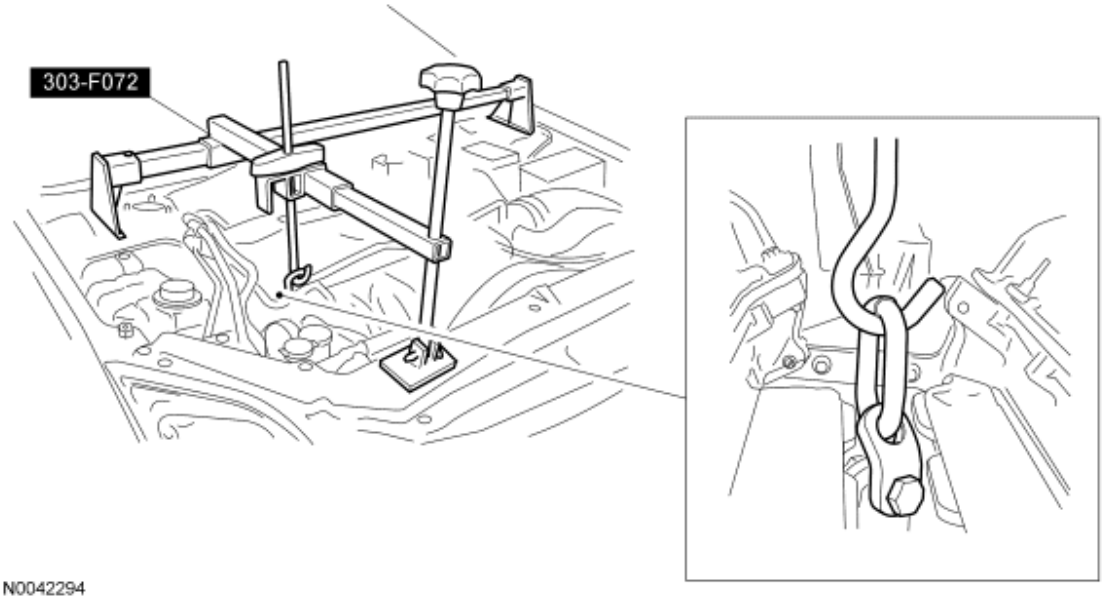


Fig. 131: Identifying Special Tools (303-F072)

Courtesy of FORD MOTOR CO.

10. Remove the 3 engine mount bracket nuts.
    - To install, tighten to 63 Nm (46 lb-ft).
11. Remove the nut, 2 bolts and the engine mount.
    - To install, tighten to 55 Nm (41 lb-ft).

NOTE: If the engine mount bracket is to be removed, the engine must be lowered to avoid contact between the A/C tubes and the engine mount bracket.

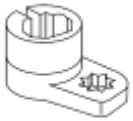
12. Use the Engine Support Bar to lower the engine 25 mm (0.98 in).
    - Remove the engine mount bracket.
13. To install, reverse the removal procedure.

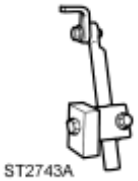
REMOVAL

ENGINE

Special Tools

Illustration	Tool Name	Tool Number
 ST2646-A	Adapter for 204-592	204-592/1
 ST2673-A	Engine Lifting Bracket Set	303-1140
 ST1341-A	Heavy Duty Floor Crane	014-00071 or equivalent
 ST2793-A	Lifting Bracket, Engine	303-050 (T70P-6000)

 ST2463-A	Lifting Brackets, Engine	134-00243 or equivalent
 ST1293-A	Powertrain Lift	014-00765
 ST2939-A	Remover, Halfshaft	205-243
 ST2934-A	Remover, Halfshaft	205-832
 ST2945-A	Separator, Ball Joint	204-592
 ST1185-A	Slide Hammer	100-001
 ST1447-A	Socket, Exhaust Gas Oxygen Sensor	303-476 (T94P-9472-A)
 ST1602-A	Spreader Bar	303-D089 (D93P-6001-A3) or equivalent

 ST1408-A	Tie-Rod End Remover	211-105 (T85M-3395-A)
 ST2743A	Universal Adapter Brackets	014-0001

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** article.
2. Release the fuel system pressure. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
3. Disconnect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING AND CABLES** article.
4. Recover the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** article.
5. Place the steering wheel in the straight-ahead position and the ignition key in the OFF position.

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

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

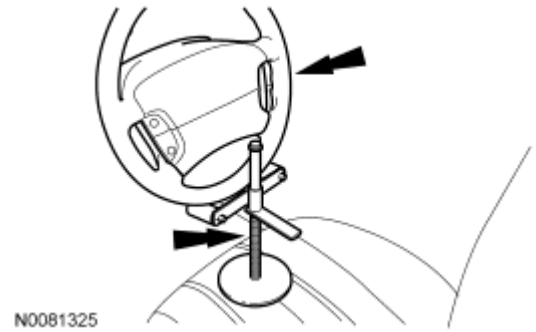


Fig. 132: Holding Steering Wheel In Straight-Ahead Position Using A Suitable Holding Device

Courtesy of FORD MOTOR CO.

7. Remove the 2 nuts and the steering joint cover.

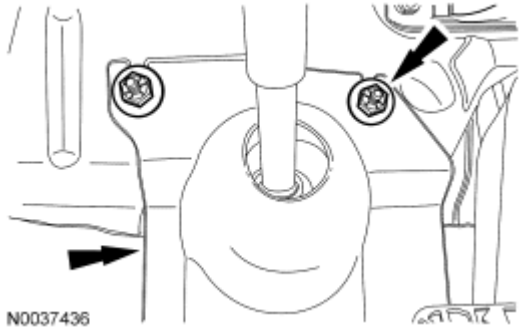


Fig. 133: Locating Steering Joint Cover And Nuts
Courtesy of FORD MOTOR CO.

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 article.

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

8. Remove the bolt and disconnect the steering column shaft from the steering gear.

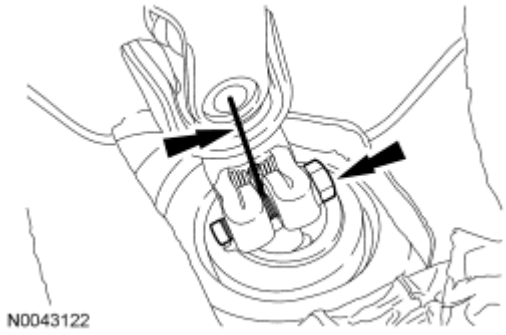


Fig. 134: Locating Steering Column Shaft Index Mark And Bolt
Courtesy of FORD MOTOR CO.

9. Drain the cooling system. For additional information, refer to **ENGINE COOLING** article.
10. Remove the 4 screws and position the RH fender splash shield aside.

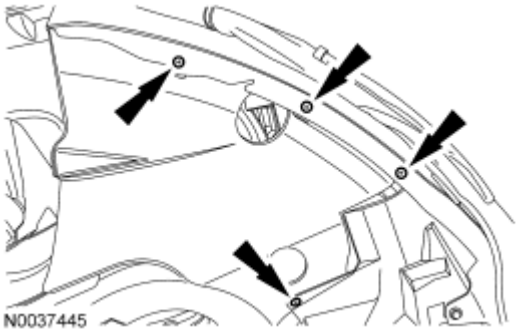


Fig. 135: Locating RH Fender Splash Shield Screws
Courtesy of FORD MOTOR CO.

11. Remove the 6 pin-type retainers (4 shown) and the RH splash shield.

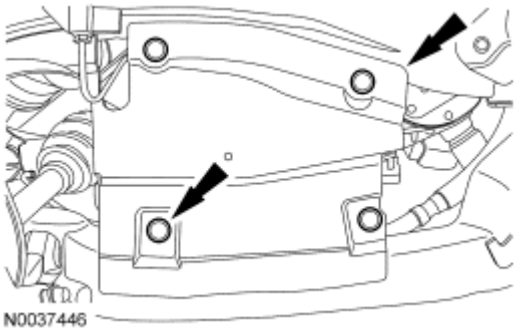


Fig. 136: Locating Splash Shield Pin-Type Retainers
Courtesy of FORD MOTOR CO.

12. Remove the 4 screws and position the LH fender splash shield aside.

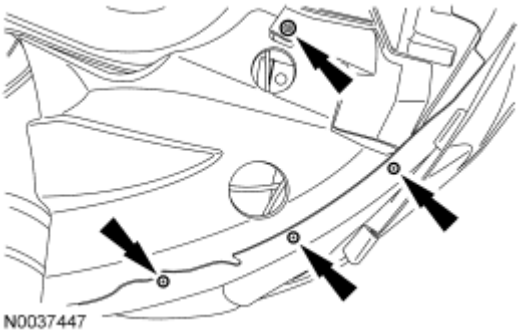


Fig. 137: Locating LH Fender Splash Shield Screws
Courtesy of FORD MOTOR CO.

13. Remove the 6 pin-type retainers (4 shown) and the LH splash shield.

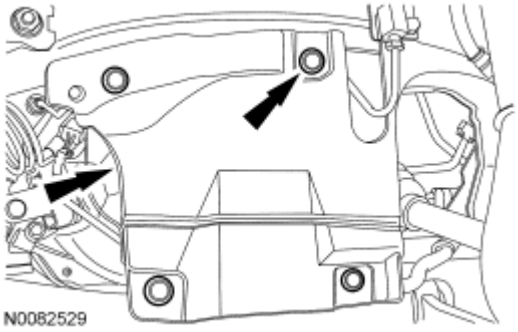


Fig. 138: Locating Pin-Type Retainers & LH Splash Shield
Courtesy of FORD MOTOR CO.

14. Disconnect the power steering hose and drain the power steering fluid into a suitable drain pan.

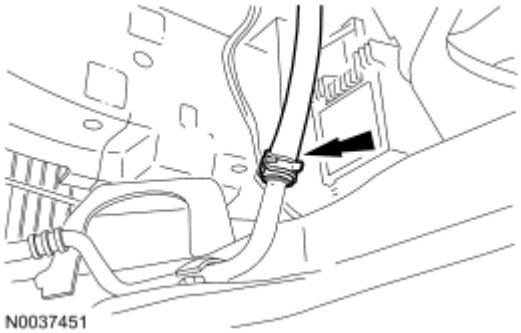


Fig. 139: Locating Power Steering Cooler Tube
Courtesy of FORD MOTOR CO.

15. Remove the exhaust flexible pipe. For additional information, refer to **EXHAUST SYSTEM** article.

All-Wheel Drive (AWD) vehicles

NOTE: Index-mark the driveshaft for installation.

16. Remove the 4 bolts (3 shown) and support the driveshaft with a length of mechanic's wire.

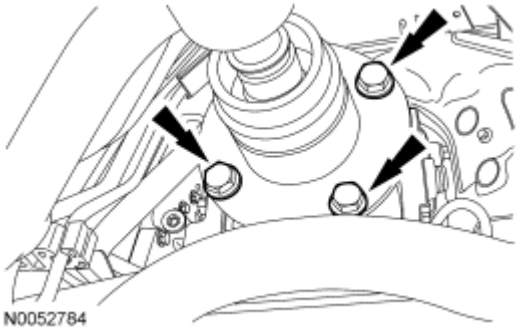


Fig. 140: Identifying Drive Shaft Bolts

Courtesy of FORD MOTOR CO.

All vehicles

NOTE: The steering gear-to-dash seal must be removed or it will be damaged when lowering the subframe.

17. Release the 4 clips (1 shown) and slide the steering gear-to-dash seal off of the steering gear and into the passenger compartment.

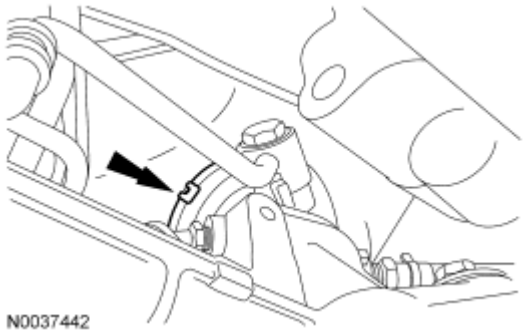


Fig. 141: Locating Steering Gear-To-Dash Seal Clips
Courtesy of FORD MOTOR CO.

18. Remove the Power Steering Pressure (PSP) hose bracket bolt.

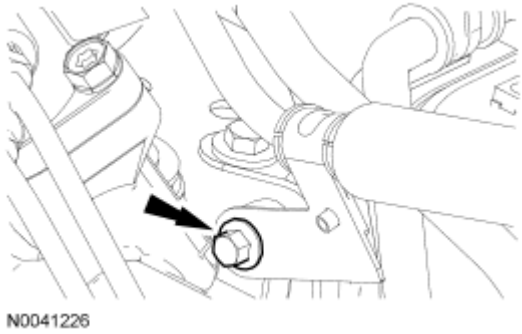


Fig. 142: Locating Power Steering Pressure (PSP) Hose Bracket Bolt
Courtesy of FORD MOTOR CO.

19. Remove and discard the PSP hose banjo bolt and the 2 seals from the steering gear.

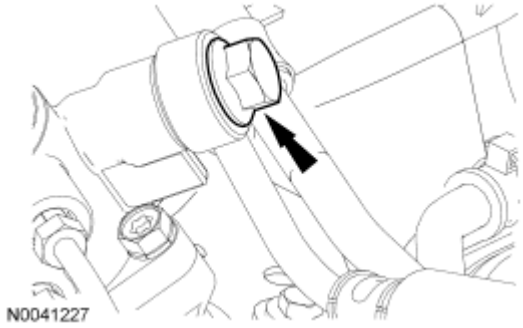


Fig. 143: Locating PSP Hose Banjo Bolt
Courtesy of FORD MOTOR CO.

20. If equipped, remove the 2 bolts and the heat shield.

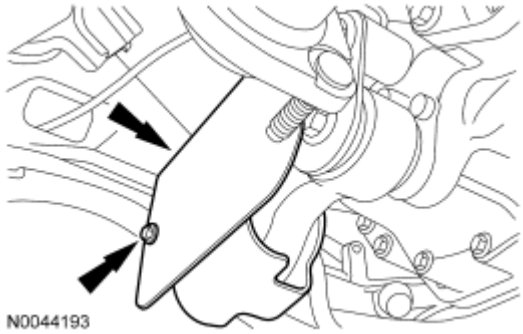


Fig. 144: Locating Heat Shield And Bolts
Courtesy of FORD MOTOR CO.

21. Remove the 2 bolts and the engine roll restrictor.

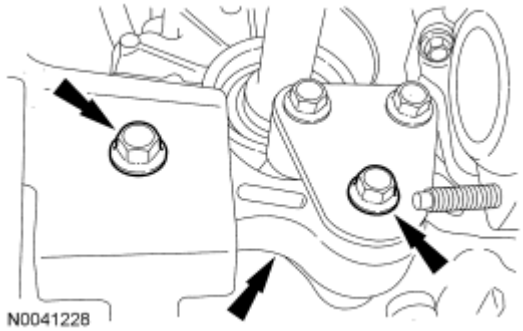


Fig. 145: Identifying Engine Roll Restrictor And Bolts
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

22. Remove the cotter pins and nuts from the tie-rod ends.

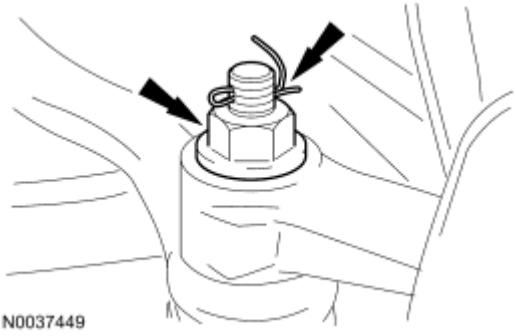


Fig. 146: Locating Tie-Rod Ends Nuts And Cotter Pin
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

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

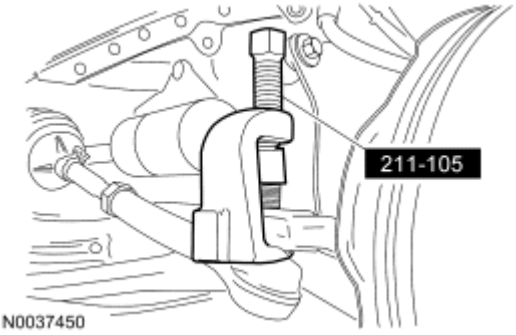


Fig. 147: Separating Tie-Rod Ends From Wheel Knuckles Using Special Tool (211-105)
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

24. Remove the nuts and separate the stabilizer bar links from the struts.

Fig. 148: Locating Stabilizer Bar Links Nut
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

25. Remove the lower ball joint nuts.

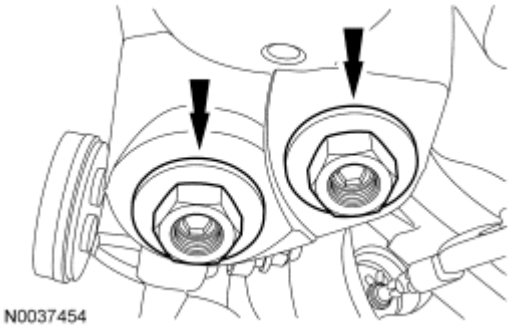


Fig. 149: Locating Lower Ball Joint Nuts
Courtesy of FORD MOTOR CO.

NOTE: When the lower ball joint is separated from the wheel knuckle, the lower arm may strike the outer constant velocity (CV) joint boot with enough force to damage the boot clamp. This will result in a loss of grease from the outer CV joint. Place a block of wood, or similar item, between the lower arm and the outer CV joint to prevent the lower arm from striking the outer CV joint.

NOTE: Once pressure is applied to the ball joint with the Ball Joint Separator and the Adapter, it may be necessary to tap the wheel knuckle at the ball joint area to separate the ball joint from the wheel knuckle.

NOTE: LH shown, RH similar.

26. Using the Ball Joint Separator and the Adapter, separate the lower ball joints from the lower control arms.

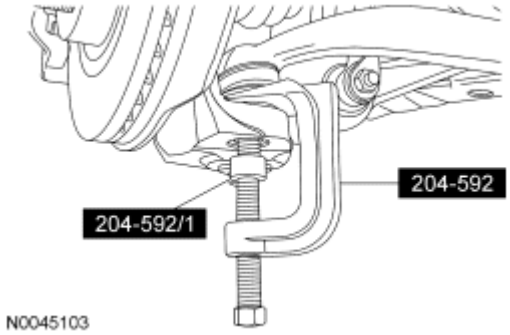


Fig. 150: Identifying Special Tools (204-592/1, 204-592)
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

27. Remove the through bolts from the lower control arms.

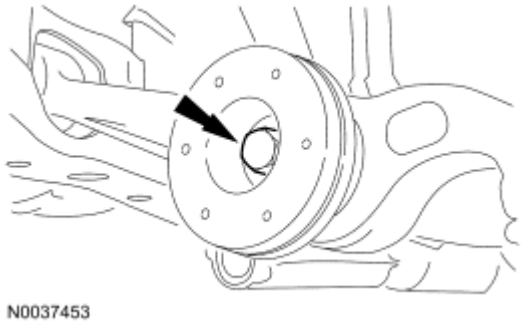


Fig. 151: Locating Lower Control Arms Through Bolt
Courtesy of FORD MOTOR CO.

28. Position the Powertrain Lift under the subframe assembly.

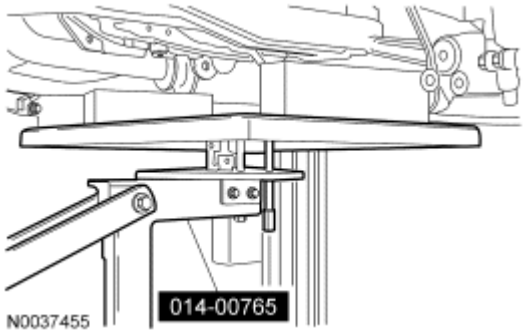


Fig. 152: Positioning Special Tool (014-00765) Under Subframe Assembly
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

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

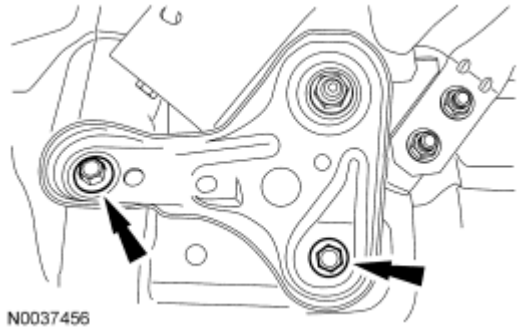


Fig. 153: Locating Subframe Bracket-To-Body Bolts
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

30. Remove the subframe nuts and the subframe brackets.

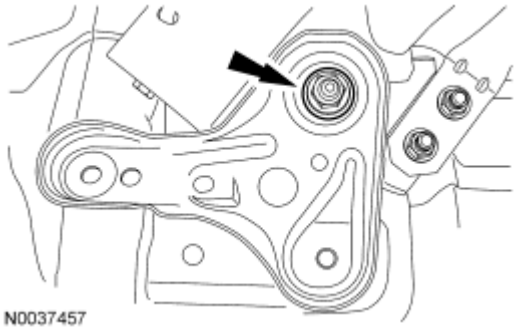


Fig. 154: Locating Subframe Nuts
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

31. Remove the front subframe nuts.

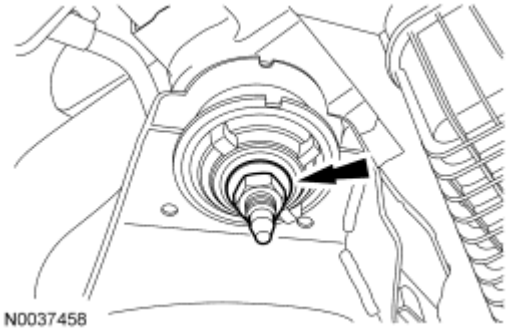


Fig. 155: Locating Front Subframe Nuts
Courtesy of FORD MOTOR CO.

32. Lower the subframe assembly from the vehicle.
33. Disconnect the transaxle cooler hoses.

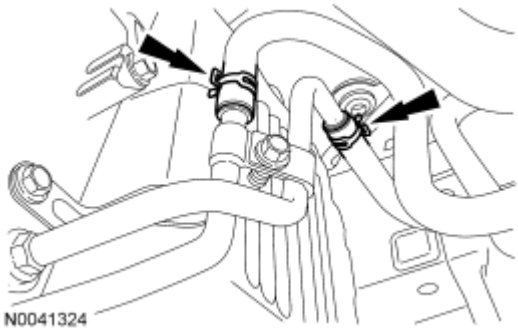


Fig. 156: Locating Transmission Fluid Cooler Hoses
Courtesy of FORD MOTOR CO.

34. Remove the drain plug and drain the engine oil.
    - Install the drain plug and tighten to 26 Nm (19 lb-ft).

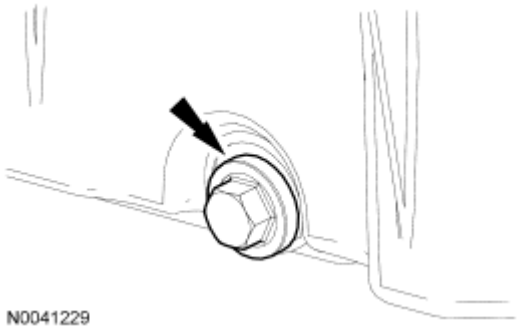


Fig. 157: Locating Drain Plug Bolts
Courtesy of FORD MOTOR CO.

35. Remove and discard the engine oil filter.

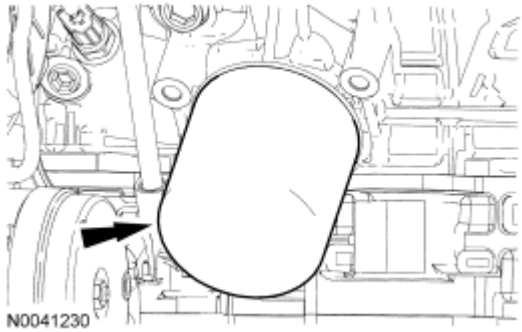


Fig. 158: Locating Engine Oil Filter
Courtesy of FORD MOTOR CO.

36. Remove the engine air cleaner and air cleaner outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING - 3.0L (4V)** article.
37. Remove the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** article.
38. Remove the nut and disconnect the power feed wire from the battery terminal.

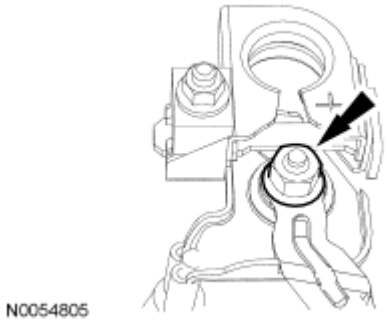


Fig. 159: Locating Power Feed To Battery Terminal And Nut
Courtesy of FORD MOTOR CO.

39. Disconnect the 2 engine wiring harness electrical connectors.

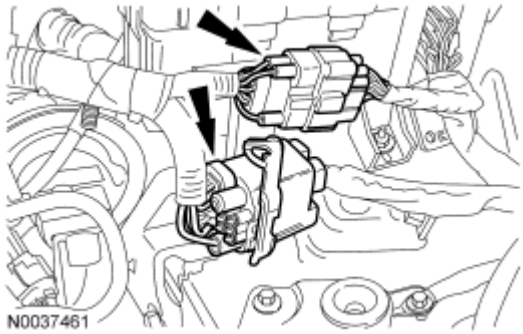


Fig. 160: Locating Engine Wiring Harness Electrical Connectors
Courtesy of FORD MOTOR CO.

40. Remove the bolt and position aside the ground wire.

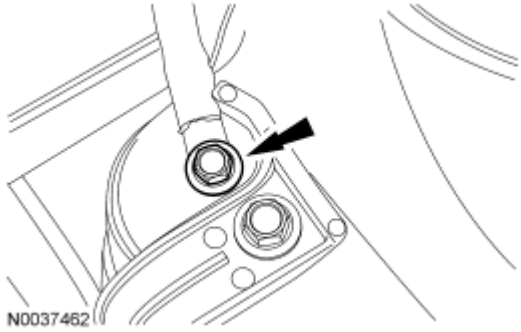


Fig. 161: Locating Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

41. Disconnect the PCM electrical connector and the pin-type retainer.

Fig. 162: Locating Powertrain Control Module (PCM) Electrical Connector And Pin-Type Retainer
Courtesy of FORD MOTOR CO.

42. Disconnect the fuel supply tube from the fuel rail. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
43. Disconnect the heater hose from the thermostat housing.

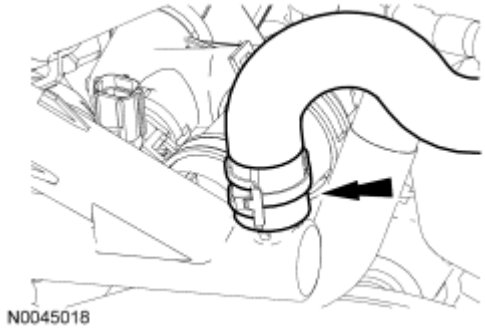


Fig. 163: Locating Heater Hose From Thermostat Housing
Courtesy of FORD MOTOR CO.

44. Disconnect the heater hose inline connection.

Fig. 164: Locating Heater Hose Inline Connection
Courtesy of FORD MOTOR CO.

45. Disconnect the Throttle Body (TB) coolant hose.

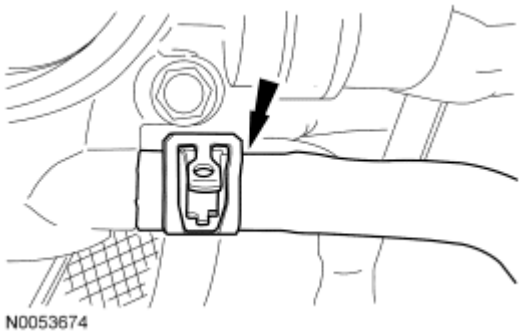


Fig. 165: Locating Throttle Body Coolant Hose
Courtesy of FORD MOTOR CO.

46. Disconnect the Evaporative Emission (EVAP) hose.

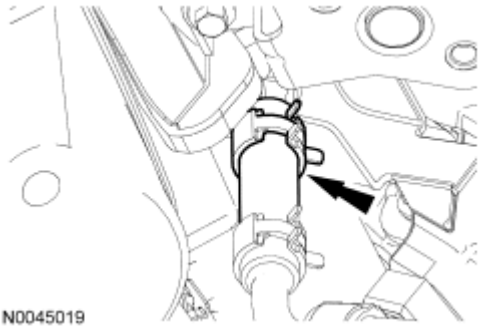


Fig. 166: Locating Evaporative Emissions (EVAP) Hose
Courtesy of FORD MOTOR CO.

47. Disconnect the upper and lower radiator hoses from the thermostat housing.

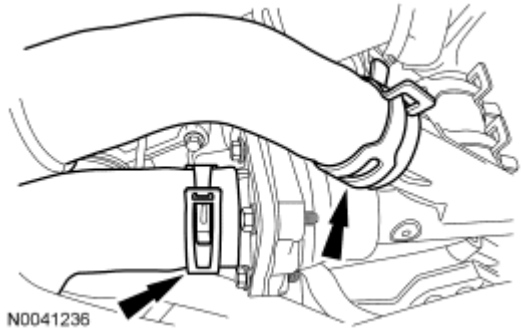


Fig. 167: Locating Upper And Lower Radiator Hoses From Thermostat Housing
Courtesy of FORD MOTOR CO.

48. Disconnect the transaxle control cable from the transaxle selector lever.

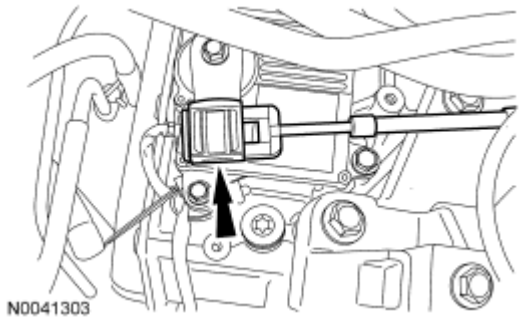


Fig. 168: Locating Selector Lever Cable End
Courtesy of FORD MOTOR CO.

49. Remove the 3 transaxle control cable bracket bolts and position the cable aside.

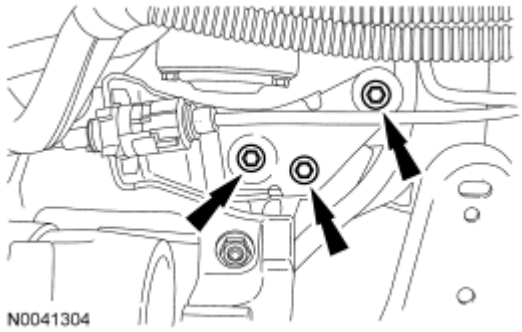


Fig. 169: Locating Transaxle Control Cable Bracket Bolts
Courtesy of FORD MOTOR CO.

50. Remove the bolt and position the ground wire aside.

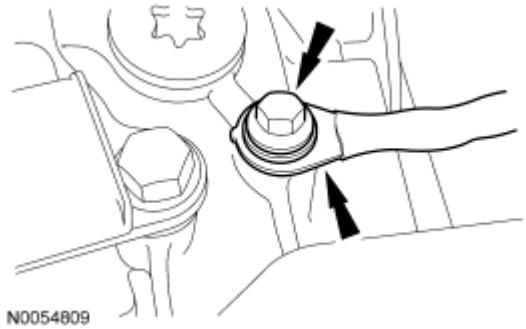


Fig. 170: Locating Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

51. Remove the vacuum tube bracket bolt.

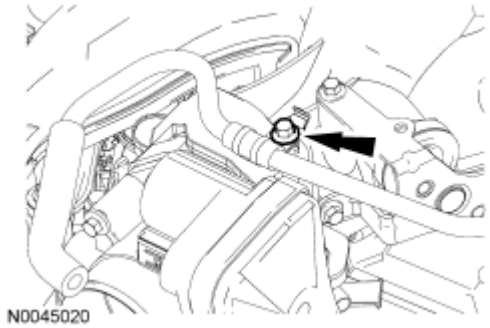


Fig. 171: Locating Vacuum Tube Bracket Bolt
Courtesy of FORD MOTOR CO.

52. Disconnect the vacuum hose from the intake manifold.

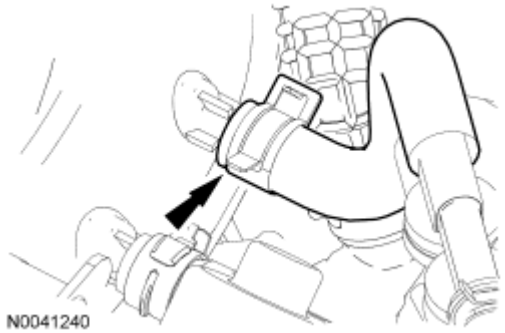


Fig. 172: Locating Vacuum Hose From Intake Manifold
Courtesy of FORD MOTOR CO.

53. If equipped, detach the block heater cable retaining clips from the cooling fan shroud.

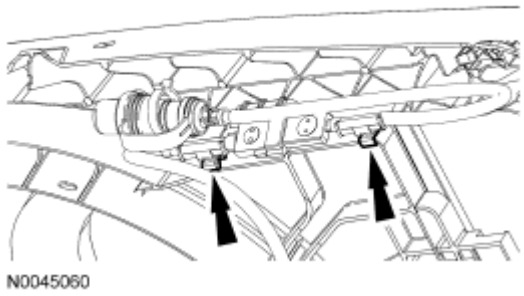


Fig. 173: Locating Block Heater Cable Retaining Clips
Courtesy of FORD MOTOR CO.

54. Disconnect the power steering hose from the power steering reservoir.

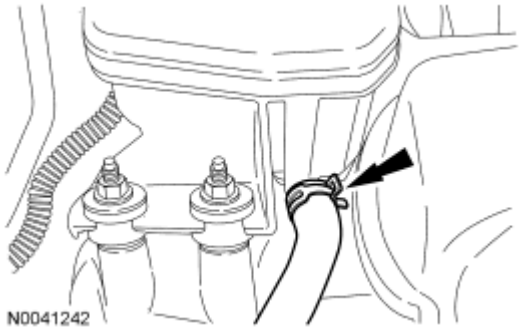


Fig. 174: Locating Power Steering Hose From Power Steering Reservoir
Courtesy of FORD MOTOR CO.

55. Detach the power steering hose retaining clip from the LH valve cover stud bolt and the engine wiring harness.

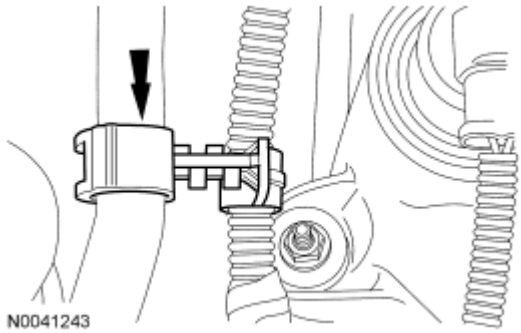


Fig. 175: Locating Power Steering Hose Retaining Clip
Courtesy of FORD MOTOR CO.

56. Disconnect the coolant hose from the degas bottle.

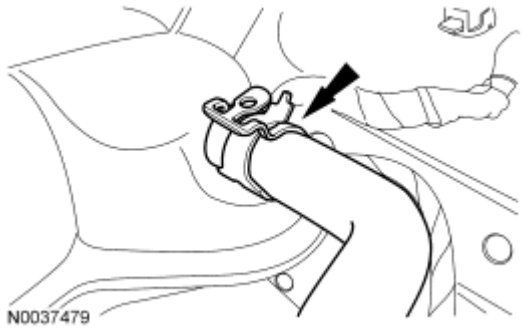


Fig. 176: Locating Coolant Hose To Degas Bottle
Courtesy of FORD MOTOR CO.

57. Detach the coolant hose retaining clip and position the coolant hose aside.

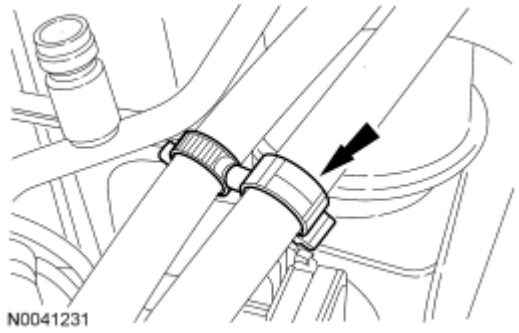


Fig. 177: Locating Coolant Hose Retaining Clip
Courtesy of FORD MOTOR CO.

58. Remove the 2 A/C tube bracket bolts.

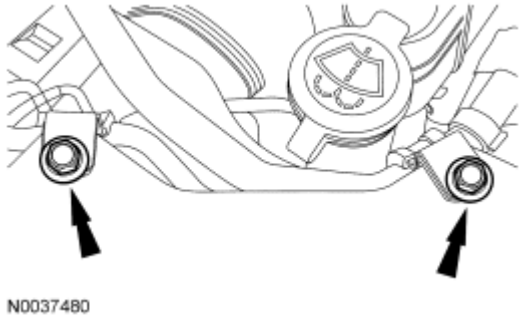


Fig. 178: Locating A/C Tube Bracket Bolts
Courtesy of FORD MOTOR CO.

59. Remove the 2 nuts and disconnect the A/C tubes.

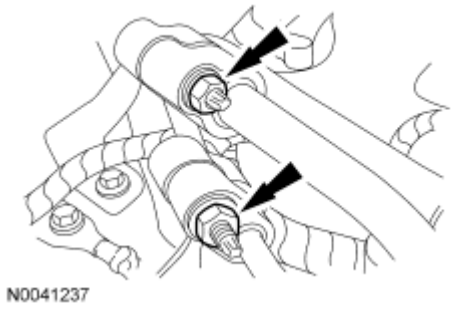


Fig. 179: Locating A/C Tubes And Nuts
Courtesy of FORD MOTOR CO.

60. Remove the bolt and the ground wire from the engine mount bracket.

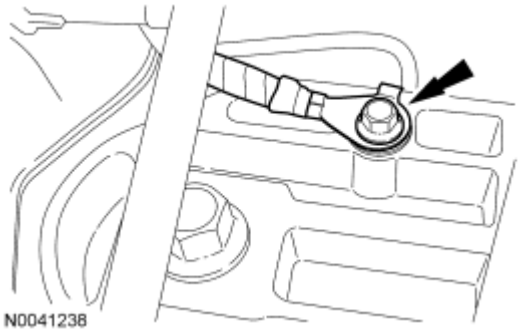


Fig. 180: Locating Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

61. Remove the bolt and separate the A/C manifold from the A/C compressor.

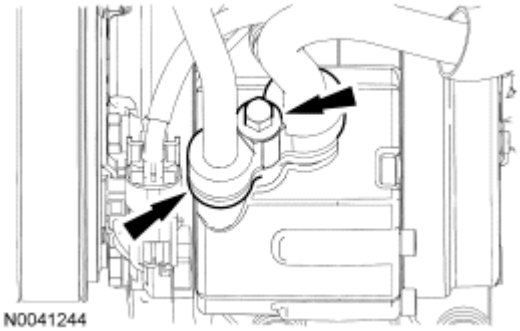


Fig. 181: Locating A/C Manifold And Bolt
Courtesy of FORD MOTOR CO.

62. Using the Slide Hammer and the 2 Halfshaft Removers, separate the LH halfshaft from the transaxle and support the halfshaft with a length of mechanic's wire.

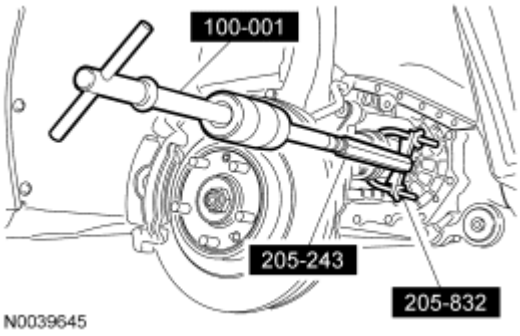


Fig. 182: Identifying Special Tools (100-001, 205-243 And 205-832)
Courtesy of FORD MOTOR CO.

Front Wheel Drive (FWD) vehicles

63. Remove the 2 RH halfshaft carrier bearing bracket bolts.
    - Separate the RH halfshaft from the transaxle and support the halfshaft with a length of mechanic's

wire.

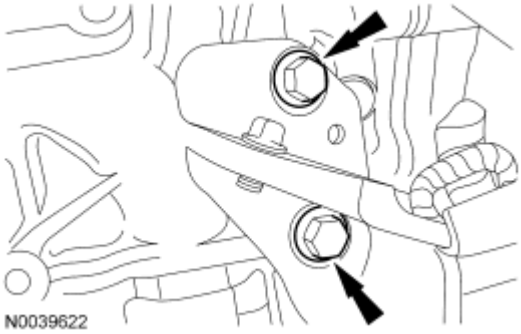


Fig. 183: Locating RH Halfshaft Carrier Bearing Bracket Bolts
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

64. Disconnect the RH catalyst monitor sensor electrical connector and detach the wiring retainer.

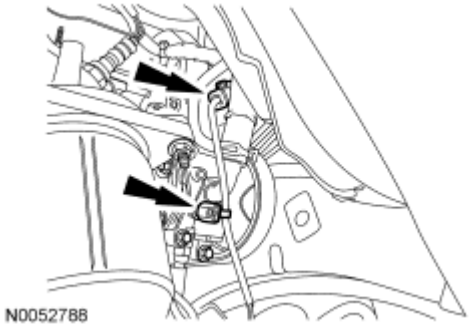


Fig. 184: Locating RH Catalyst Monitor Sensor Electrical Connector & Wiring Retainer
Courtesy of FORD MOTOR CO.

65. Using the Exhaust Gas Oxygen Sensor Socket, remove the RH catalyst monitor sensor.

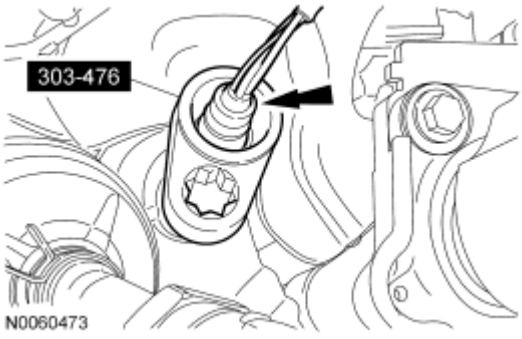


Fig. 185: Identifying RH Catalyst Monitor Sensor & Special Tool (303-476)
Courtesy of FORD MOTOR CO.

66. Disconnect the RH Heated Oxygen Sensor (HO2S) electrical connector.

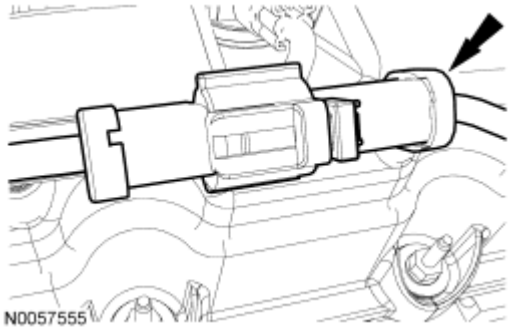


Fig. 186: Identifying RH HO2S Electrical Connector
Courtesy of FORD MOTOR CO.

67. Using the Exhaust Gas Oxygen Sensor Socket, remove the RH HO2S.

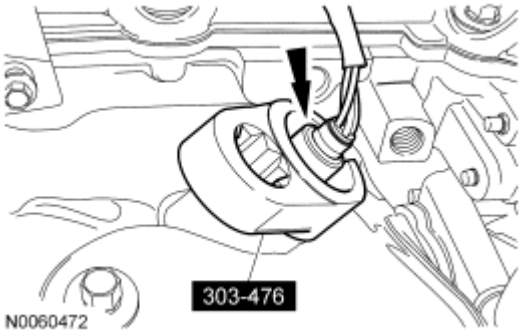


Fig. 187: Identifying RH HO2S & Special Tool (303-476)
Courtesy of FORD MOTOR CO.

68. Remove the 6 bolts and the RH exhaust heat shield.

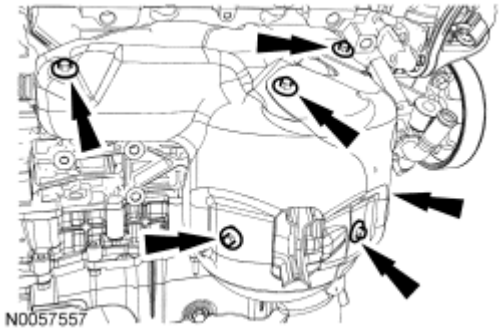


Fig. 188: Locating RH Exhaust Heat Shield Bolts
Courtesy of FORD MOTOR CO.

69. Remove the 3 nuts and the RH exhaust heat shield bracket (outboard half).

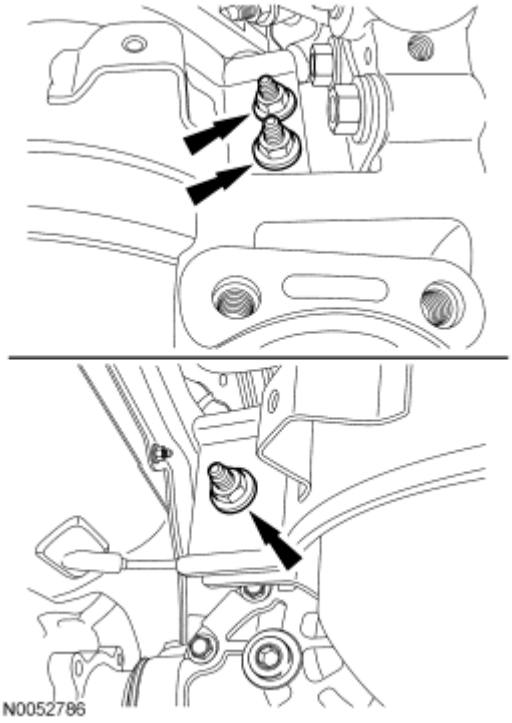


Fig. 189: Locating RH Exhaust Heat Shield Bracket Nuts - Inboard Half
Courtesy of FORD MOTOR CO.

70. Remove the 2 bolts and the RH exhaust heat shield bracket (inboard half).

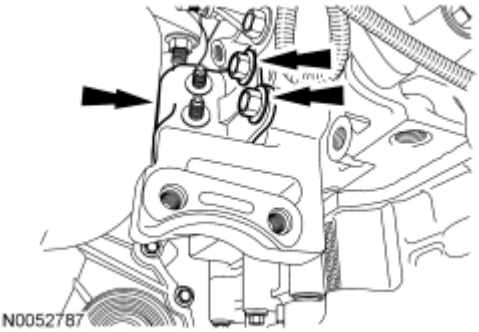


Fig. 190: Locating Catalytic Converter Band Clamp LH Half Nuts
Courtesy of FORD MOTOR CO.

71. Remove the 3 nuts (2 shown) and the RH catalytic converter.
    - Discard the nuts and gasket.

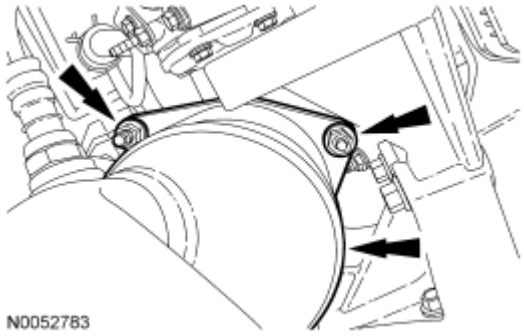


Fig. 191: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

72. Remove the 2 halfshaft carrier bearing bolts.
    - Separate the RH halfshaft from the Power Transfer Unit (PTU) and support the halfshaft with a length of mechanic's wire.

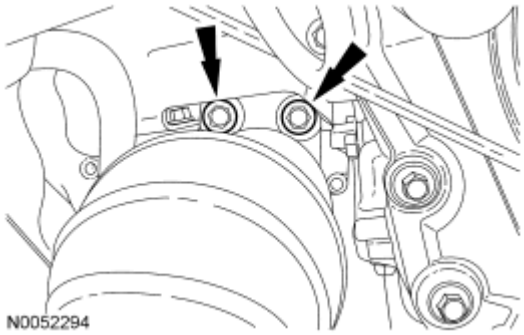


Fig. 192: Locating RH Halfshaft Bearing Support Bracket Bolts
Courtesy of FORD MOTOR CO.

73. Remove the 5 bolts and the PTU support bracket.

Fig. 193: Identifying PTU Support Bracket Bolts
Courtesy of FORD MOTOR CO.

74. Remove the 5 bolts and the PTU.

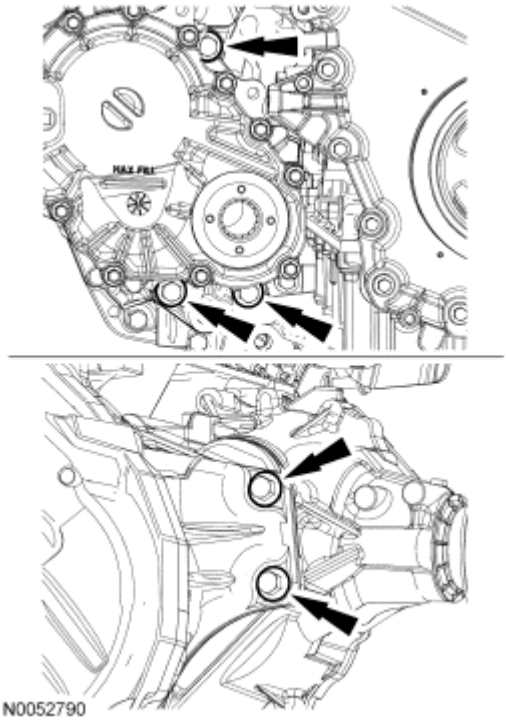


Fig. 194: Locating PTU Bolts
Courtesy of FORD MOTOR CO.

All vehicles

75. Remove the torque converter nut access plug.

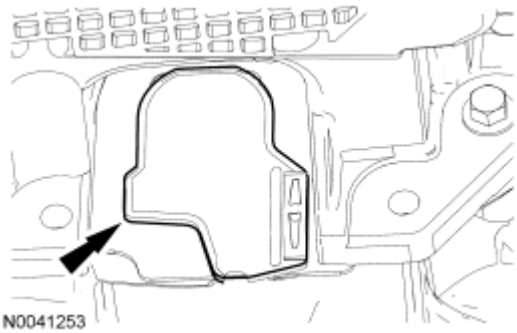


Fig. 195: Locating Torque Converter Nut Access Plug
Courtesy of FORD MOTOR CO.

76. Remove the 3 torque converter nuts.

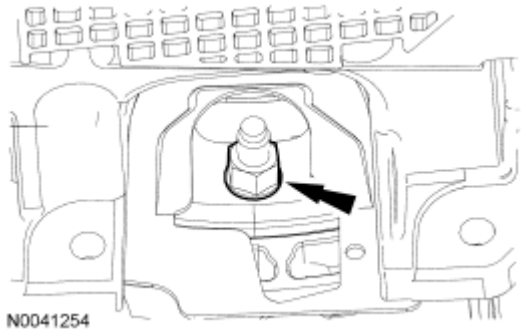


Fig. 196: Locating Torque Converter Nuts
Courtesy of FORD MOTOR CO.

77. Remove the 2 oil pan-to-transaxle bolts.

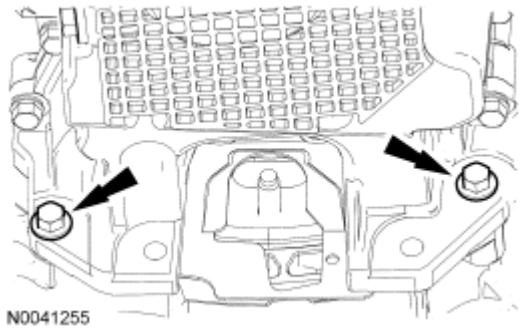


Fig. 197: Locating Oil Pan-To-Transaxle Bolts
Courtesy of FORD MOTOR CO.

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

78. Install the Powertrain Lift and the Universal Adapter Brackets onto the engine.
    - Raise the engine and transaxle 25.4 mm (1 in) to neutralize the engine and transaxle mounts.

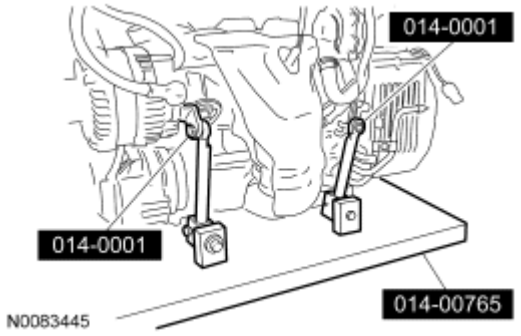


Fig. 198: Installing Powertrain Lift & Universal Adapter Brackets Onto Engine
Courtesy of FORD MOTOR CO.

79. Remove the 2 transaxle mount bolts.

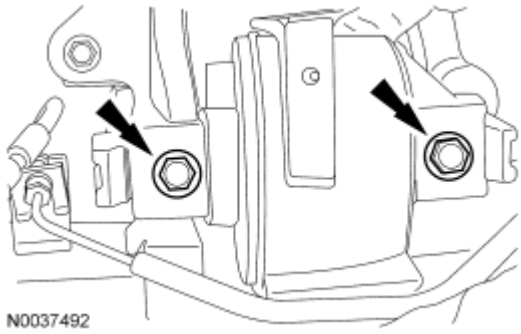


Fig. 199: Locating Transaxle Mount Bolts
Courtesy of FORD MOTOR CO.

80. Remove the bolt and damper.

Fig. 200: Locating Damper And Bolt
Courtesy of FORD MOTOR CO.

81. Remove the bolt, 3 nuts and the engine mount bracket.

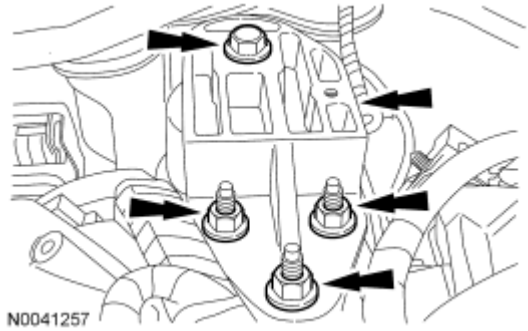


Fig. 201: Locating Engine Mount Bracket, Bolt And Nuts
Courtesy of FORD MOTOR CO.

82. Lower the engine and transaxle from the vehicle.
83. Install the Universal Adapter Bracket and the Engine Lifting Bracket.

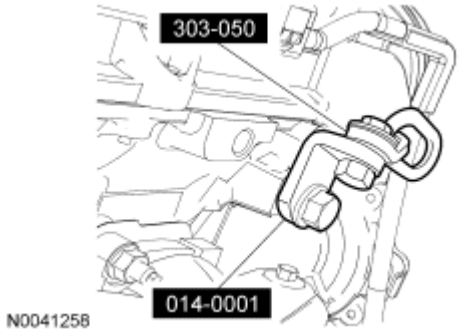


Fig. 202: Identifying Special Tools (303-050 And 014-0001)
Courtesy of FORD MOTOR CO.

84. Detach the wiring harness retainer from the PSP hose bracket.

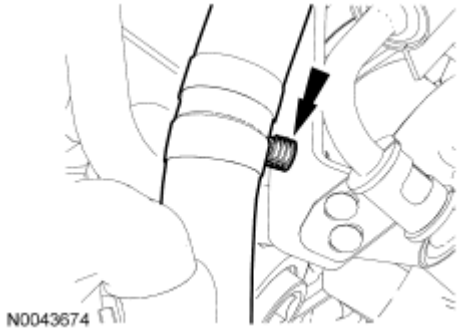


Fig. 203: Locating PSP Hose Bracket Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

85. Remove the bolt and detach the PSP hose bracket from the cylinder head.

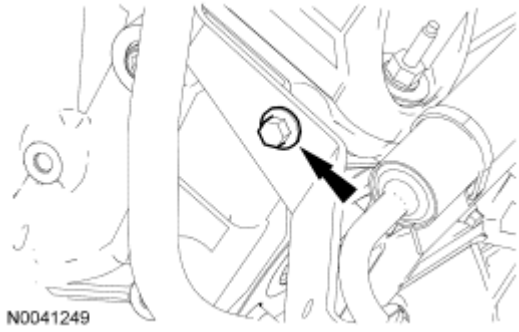


Fig. 204: Locating PSP Hose Bracket To Cylinder Head Bolt
Courtesy of FORD MOTOR CO.

86. Remove the bolt and detach the PSP hose bracket from the cylinder head.

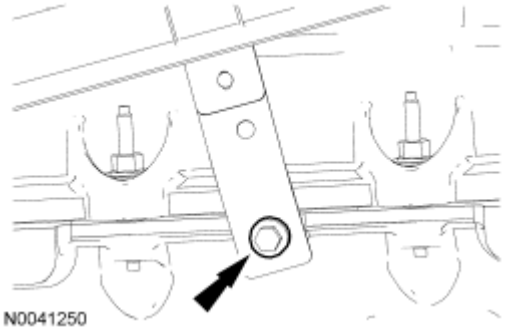


Fig. 205: Locating PSP Hose Bracket To Cylinder Head Bolt
Courtesy of FORD MOTOR CO.

87. Remove the bolt and detach the PSP hose bracket from the power steering reservoir.

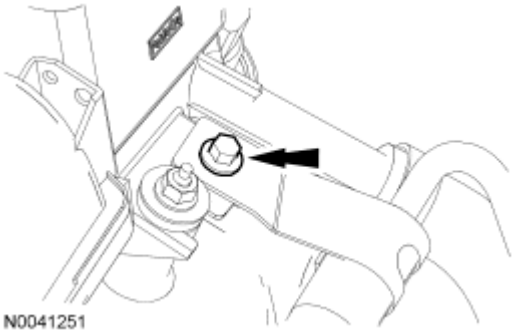


Fig. 206: Locating Power Steering Pressure Hose Bracket-To-Power Steering Reservoir Bolt
Courtesy of FORD MOTOR CO.

88. Remove the banjo bolt and the PSP hose.
    - Discard the banjo bolt and 2 seals.

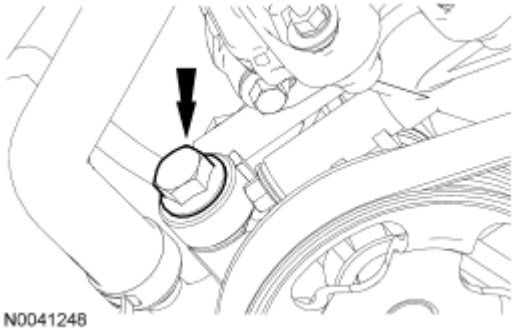


Fig. 207: Locating Banjo Bolt
Courtesy of FORD MOTOR CO.

89. Install the Engine Lifting Bracket.

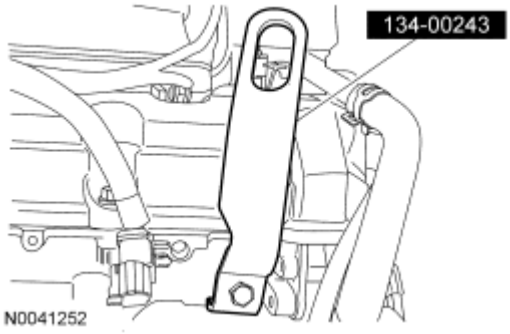


Fig. 208: Identifying Special Tools (134-00243)
Courtesy of FORD MOTOR CO.

90. Disconnect the EGR valve electrical connector.

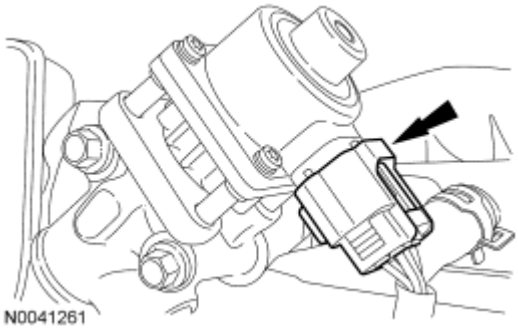


Fig. 209: Locating Exhaust Gas Recirculation Valve Electrical Connector
Courtesy of FORD MOTOR CO.

91. Loosen the EGR tube-to-EGR valve nut.

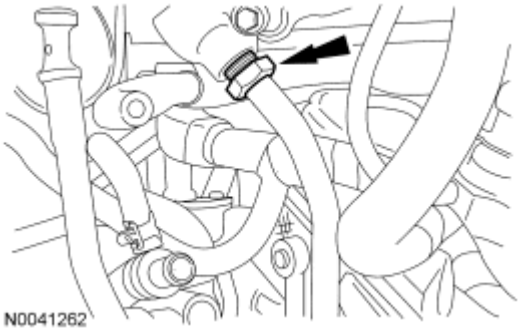


Fig. 210: Locating EGR Tube-To-EGR Valve Nut
Courtesy of FORD MOTOR CO.

92. Remove the 2 bolts and the EGR valve.
    - Discard the gasket.

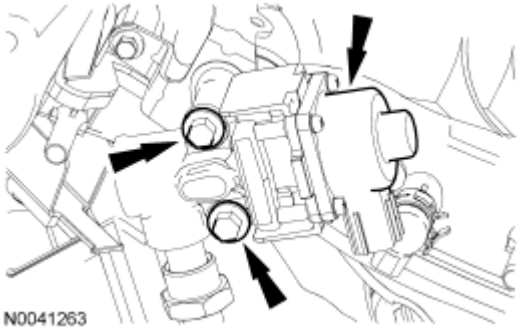


Fig. 211: Locating EGR Valve And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.

93. Loosen the EGR tube-to-catalytic converter nut and remove the EGR tube.

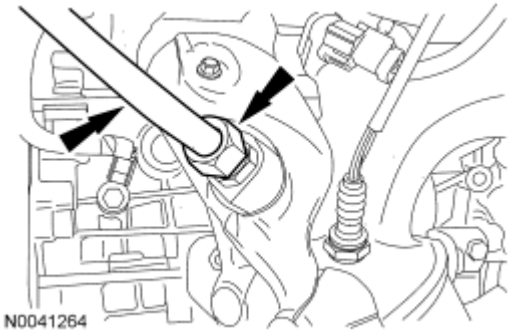


Fig. 212: Locating EGR Tube-To-Catalytic Converter Nut And EGR Tube
Courtesy of FORD MOTOR CO.

FWD vehicles

94. Remove the 2 bolts and the heat shield.

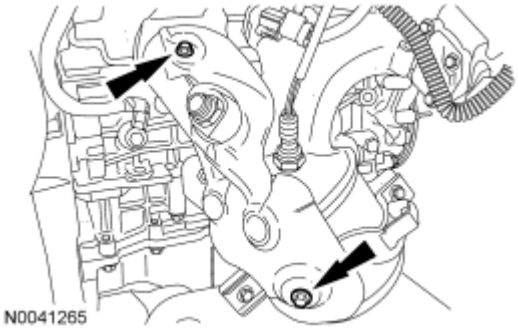


Fig. 213: Locating Heat Shield Bolts
Courtesy of FORD MOTOR CO.

95. Remove the 2 bolts and the catalytic converter bracket.

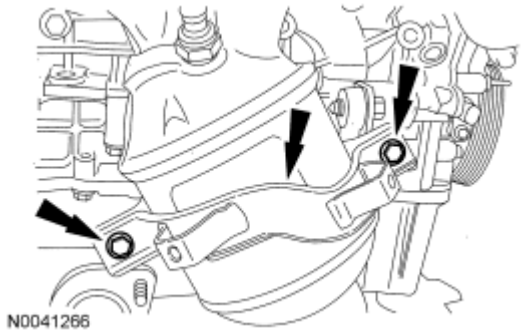


Fig. 214: Locating Catalytic Converter Bracket And Bolts
Courtesy of FORD MOTOR CO.

96. Remove the 2 bolts and the catalytic converter bracket assembly.

Fig. 215: Locating Catalytic Converter Bracket Assembly Bolts
Courtesy of FORD MOTOR CO.

All vehicles

NOTE: When installing the lower half of the lifting bracket it will be easier to loosely install the upper bolt first then install the lower bolt.

97. Install the lower half of the Engine Lifting Bracket Set.

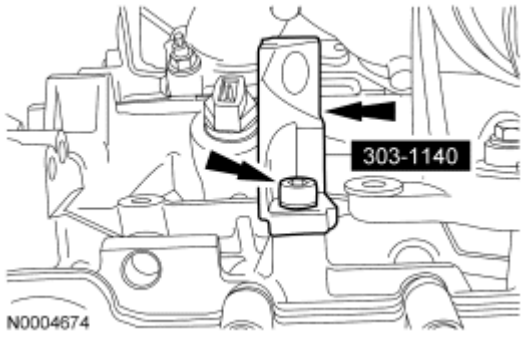


Fig. 216: Identifying Lower Half Of Lifting Hook
Courtesy of FORD MOTOR CO.

98. Install the upper half of the Engine Lifting Bracket Set.

Fig. 217: Identifying Upper Half Of Lifting Hook
Courtesy of FORD MOTOR CO.

99. Using the Spreader Bar, Engine Lifting Bracket, Engine Lifting Bracket Set and a suitable engine crane, remove the engine and transaxle from the lift table.

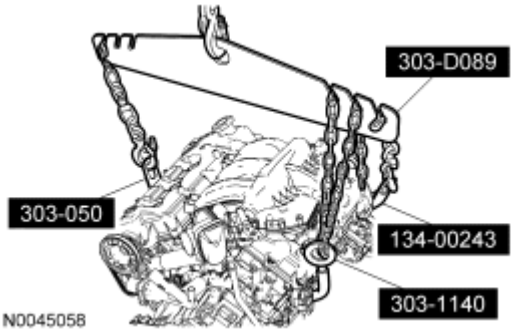


Fig. 218: Identifying Special Tools (134-00243, 303-050, 303-1140, 303-D089)
Courtesy of FORD MOTOR CO.

100. Remove the bolt and ground wire.

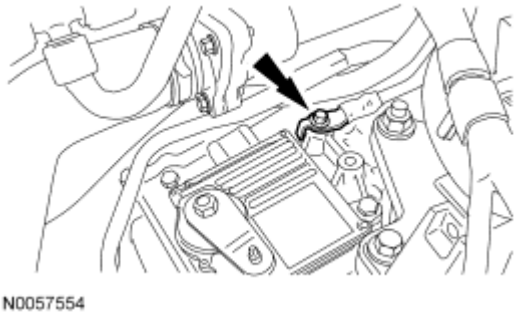


Fig. 219: Identifying Ground Wire Bolt
Courtesy of FORD MOTOR CO.

101. Remove the bolt and the catalyst monitor sensor electrical connector bracket.

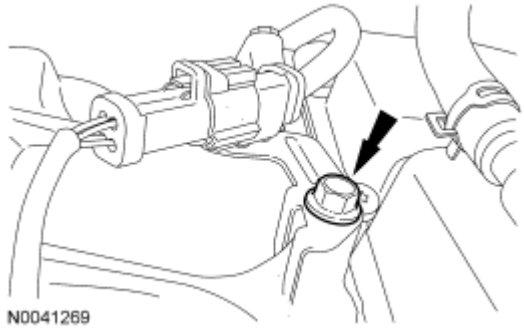


Fig. 220: Locating Catalyst Monitor Sensor (CMS) Electrical Connector Bracket Bolt
Courtesy of FORD MOTOR CO.

102. Disconnect the Transmission Control Module (TCM) electrical connector.

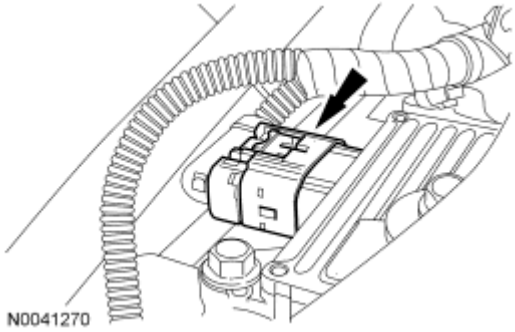


Fig. 221: Locating Transmission Control Module (TCM) Electrical Connector
Courtesy of FORD MOTOR CO.

103. Remove the 2 nuts and the starter motor wiring.

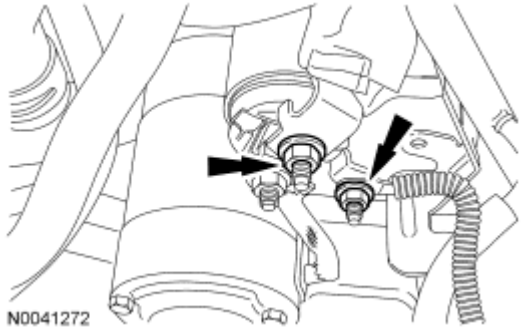


Fig. 222: Locating Starter Motor Wiring Nuts
Courtesy of FORD MOTOR CO.

104. Remove the 2 bolts and the starter motor.

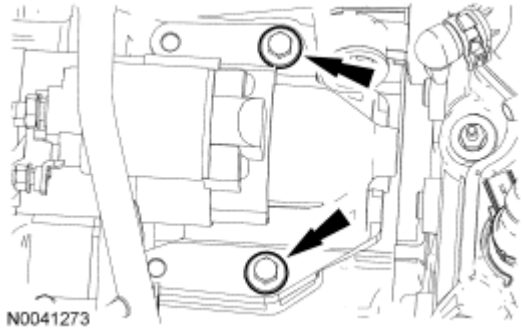


Fig. 223: Locating Starter Motor Bolts
Courtesy of FORD MOTOR CO.

105. Remove the engine-to-transaxle bolt.

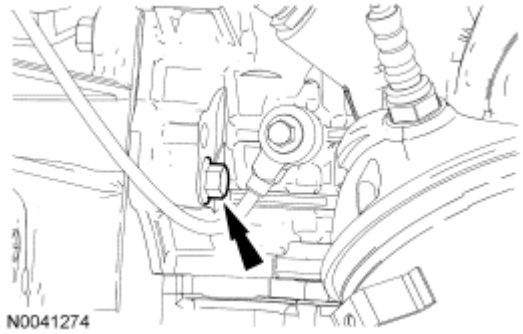


Fig. 224: Locating Engine-To-Transaxle Bolt
Courtesy of FORD MOTOR CO.

106. Remove the 3 transaxle-to-engine bolts.

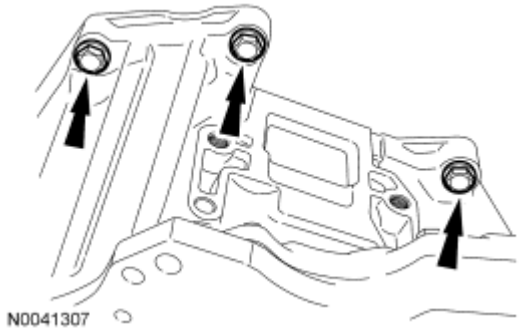


Fig. 225: Locating Upper Torque Converter Housing Bolts
Courtesy of FORD MOTOR CO.

107. Detach the wiring harness retainer from the stud bolt.

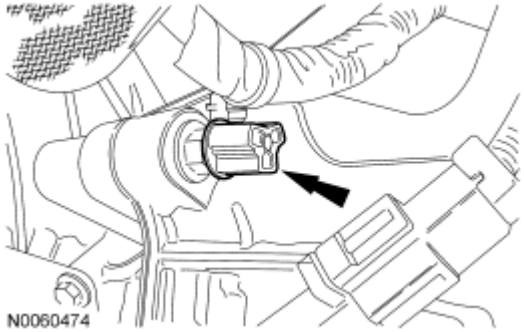


Fig. 226: Locating Wiring Harness Retainer From Stud Bolt
Courtesy of FORD MOTOR CO.

108. Remove the transaxle-to-engine stud bolt, bolt and nut.

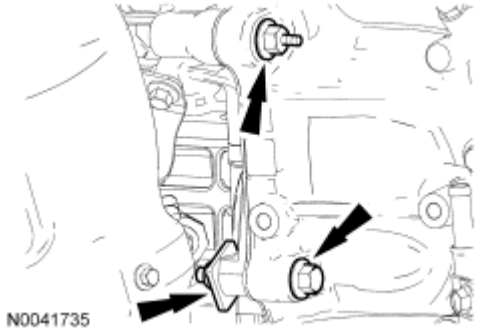


Fig. 227: Locating Transaxle-To-Engine Stud Bolt, Bolt And Nut
Courtesy of FORD MOTOR CO.

109. Using the Spreader Bar, Engine Lifting Brackets, Engine Lifting Bracket Set and the Heavy Duty Floor Crane, separate the engine and transaxle.

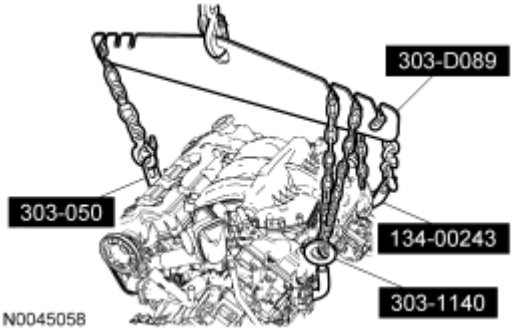
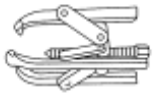
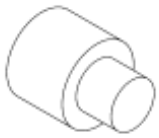
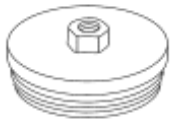


Fig. 228: Identifying Special Tools (134-00243, 303-050, 303-1140, 303-D089)
Courtesy of FORD MOTOR CO.

DISASSEMBLY

ENGINE

Special Tools

Illustration	Tool Name	Tool Number
 ST1184-A	3-Jaw Puller	303-D121
 ST3044-A	Plate, Water Pump Pulley	303-456 (T94P-6312-AH1), part of 303-S455
 ST3045-A	Protector, Water Pump Shaft	303-457 (T94P-6312-AH2), part of 303-S455
 ST1382-A	Remover, Crankshaft Rear Oil Seal	303-519 (T95P-6701-EH)
 ST1286-A	Remover, Crankshaft Vibration Damper	303-009 (T58P-6316-D)
 ST1385-A	Remover, Oil Seal	303-409 (T92C-6700CH)
 ST1187-A	Slide Hammer	307-005 (T59L-100-B)
	Strap Wrench	303-D055 (D85L-6000-A)

 ST1438-A		

Material

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: For additional information, refer to the exploded view under the ASSEMBLY.

All engines

1. Remove the 8 bolts and the flexplate.

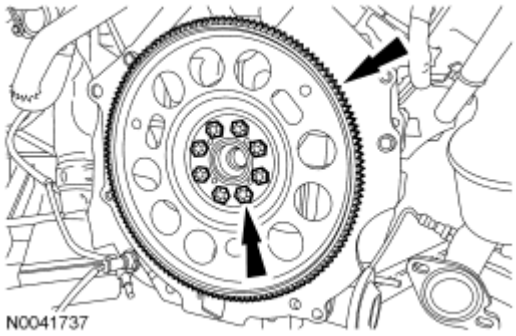

N0041737

Fig. 229: Locating Flexplate And Bolts
Courtesy of FORD MOTOR CO.

2. Remove the engine-to-transaxle separator plate.

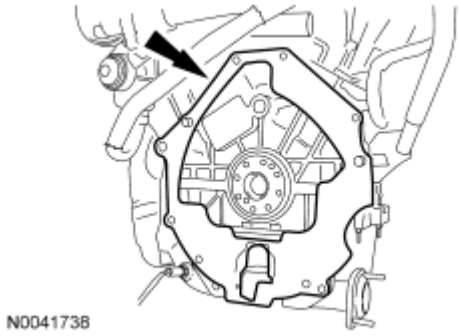


Fig. 230: Locating Engine-To-Transaxle Separator Plate
Courtesy of FORD MOTOR CO.

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

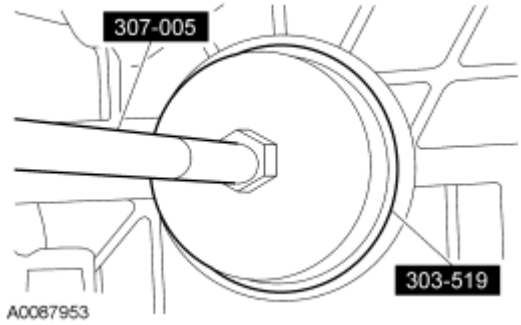


Fig. 231: Identifying Special Tools (307-005 And 303-519)
Courtesy of FORD MOTOR CO.

4. Mount the engine on a suitable stand.
5. Disconnect the Manifold Absolute Pressure (MAP) sensor electrical connector and the pin-type retainer.

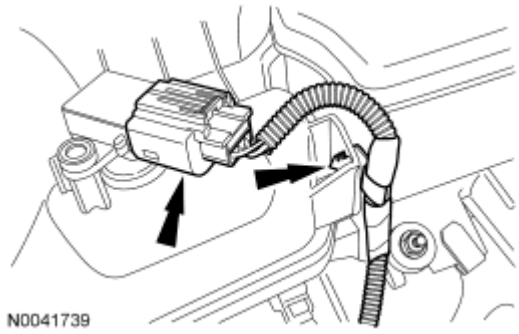


Fig. 232: Locating Manifold Actual Pressure Sensor Electrical Connector And Pin-Type Retainer
Courtesy of FORD MOTOR CO.

6. Detach the wiring harness pin-type retainer from the upper intake manifold.

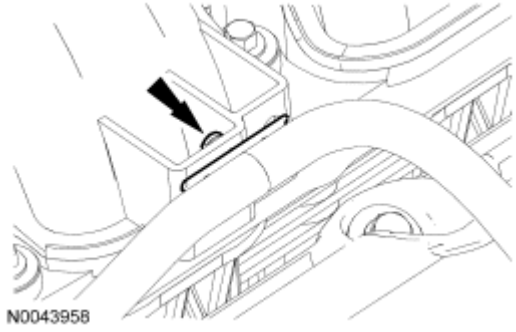


Fig. 233: Locating Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

7. Disconnect the crankcase vent hose from the upper intake manifold.

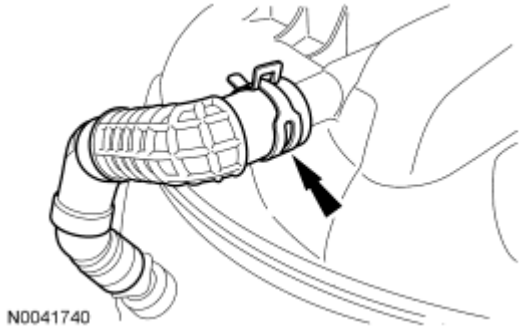


Fig. 234: Locating Crankcase Vent Hose From Upper Intake Manifold
Courtesy of FORD MOTOR CO.

8. Disconnect the electronic Throttle Body (TB) electrical connector.

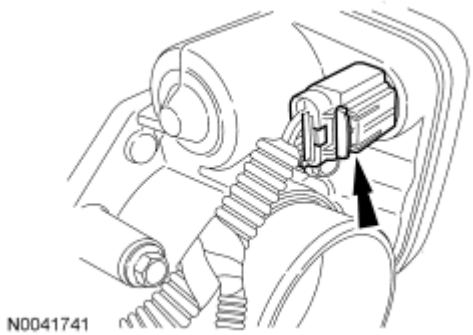


Fig. 235: Locating Electronic Throttle Body Electrical Connector
Courtesy of FORD MOTOR CO.

9. Disconnect the TB coolant hose.

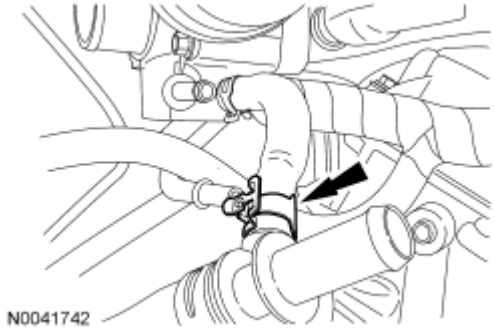


Fig. 236: Locating Throttle Body Coolant Hose
Courtesy of FORD MOTOR CO.

10. Remove the 8 bolts and the upper intake manifold.
    - Discard the gaskets.

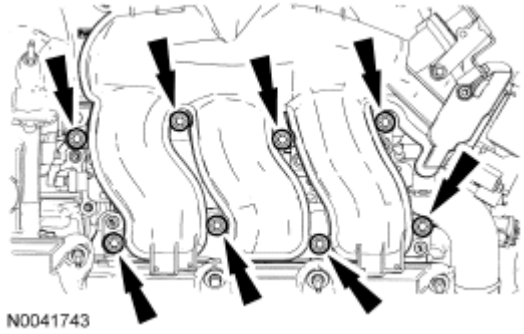


Fig. 237: Locating Upper Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

11. Disconnect the A/C compressor electrical connector and the wiring harness retainer.

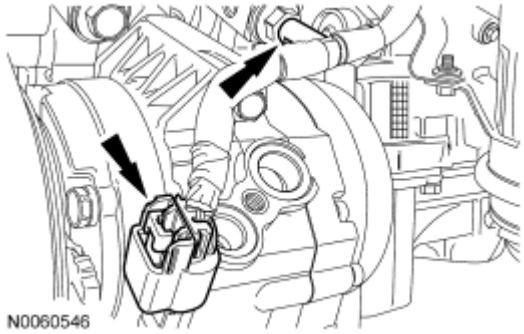


Fig. 238: Identifying A/C Compressor Electrical Connector & Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

12. If equipped, disconnect the block heater electrical connector.

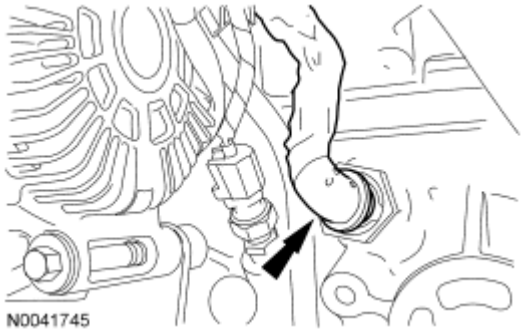


Fig. 239: Locating Block Heater Electrical Connector
Courtesy of FORD MOTOR CO.

13. If equipped, detach the block heater wiring harness retainers from the oil level indicator tube and remove the harness.

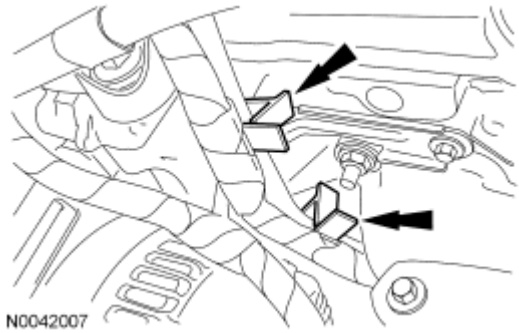


Fig. 240: Locating Block Heater Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

14. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and the wiring harness retainer.

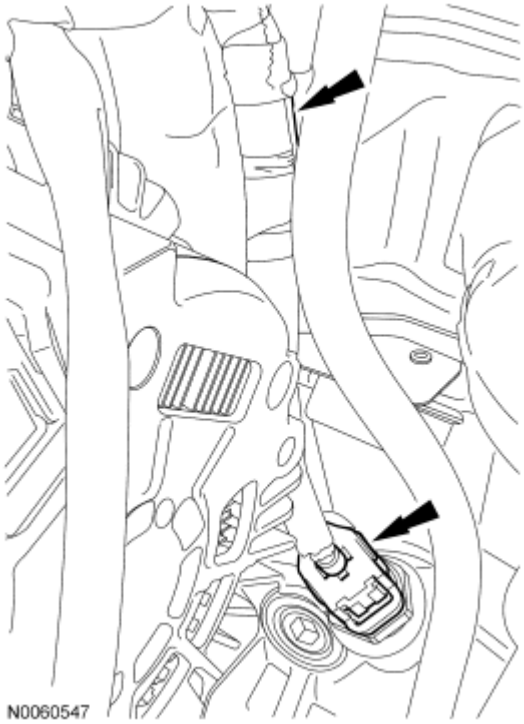


Fig. 241: Identifying Engine Oil Pressure (EOP) Switch Electrical Connector & Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

15. Remove the nut and disconnect the generator B+ cable and electrical connector.

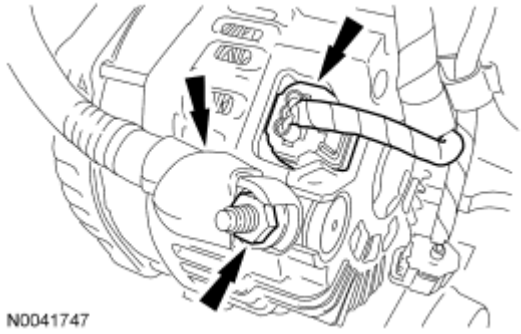


Fig. 242: Locating Generator B+ Cable, Electrical Connector And Nut
Courtesy of FORD MOTOR CO.

16. Disconnect the LH Variable Camshaft Timing (VCT) solenoid and LH Camshaft Position (CMP) sensor electrical connectors.
    - Detach the 2 wiring harness retainers from the valve cover stud bolts.

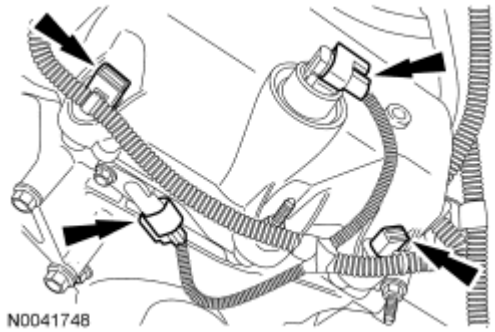


Fig. 243: Locating LH Variable Camshaft Timing Solenoid And LH Camshaft Position Sensor Electrical Connectors
Courtesy of FORD MOTOR CO.

17. Disconnect the LH Heated Oxygen Sensor (HO2S) electrical connector and pin-type retainer.

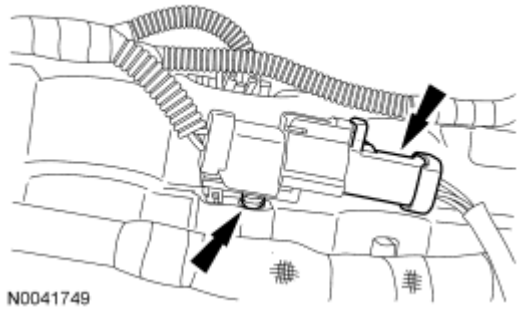


Fig. 244: Locating LH Heated Oxygen Sensor Electrical Connector And Pin-Type Retainer
Courtesy of FORD MOTOR CO.

18. Detach the 3 wiring harness retainers from the valve cover stud bolts.

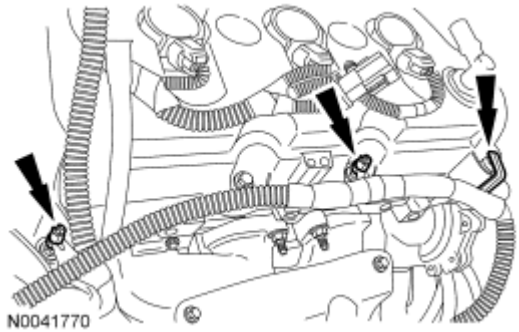


Fig. 245: Locating Wiring Harness Retainers From Valve Cover Stud Bolts
Courtesy of FORD MOTOR CO.

19. Disconnect the 3 LH coil-on-plug electrical connectors.
    - Detach the 2 wiring harness pin-type retainers from the valve cover.

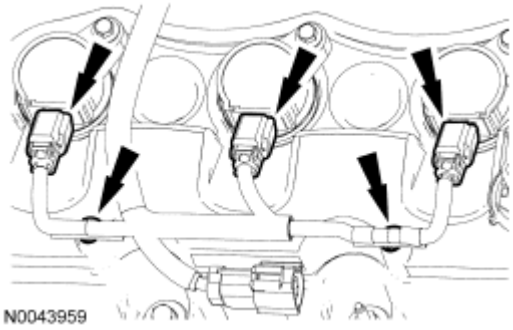


Fig. 246: Locating LH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

20. If equipped, detach the wiring harness retainer from the LH valve cover stud bolt.

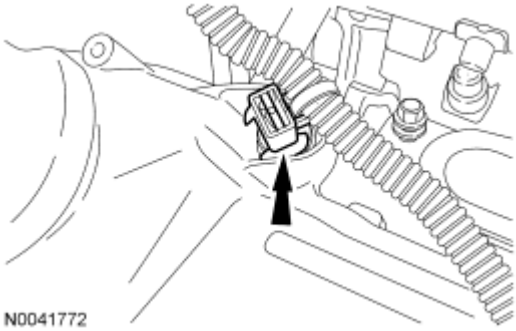


Fig. 247: Locating Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

21. Disconnect the 6 fuel injector electrical connectors (3 shown).

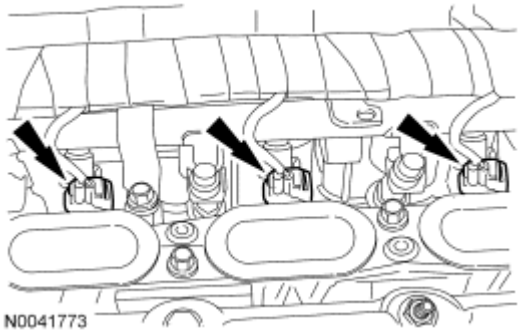


Fig. 248: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

NOTE: One wiring harness retainer shown, other wiring harness retainers similar.

22. Detach the 3 wiring harness retainers from the fuel rail.

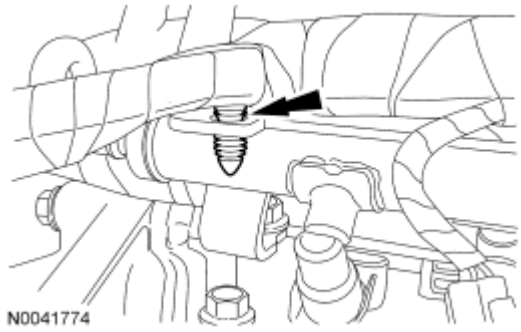


Fig. 249: Locating Fuel Rail Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

23. Disconnect the 3 RH coil-on-plug electrical connectors.
    - Detach the 2 wiring harness pin-type retainers from the valve cover.

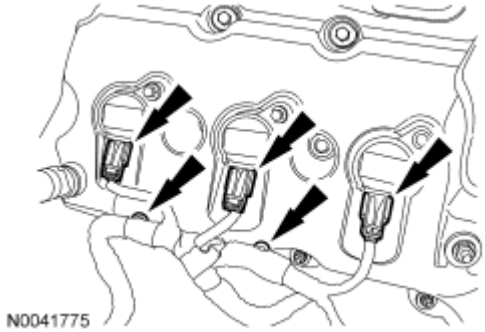


Fig. 250: Locating RH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

24. Disconnect the RH VCT solenoid and LH CMP sensor electrical connectors.
    - If equipped, detach the 2 wiring harness retainers from the valve cover stud bolts.

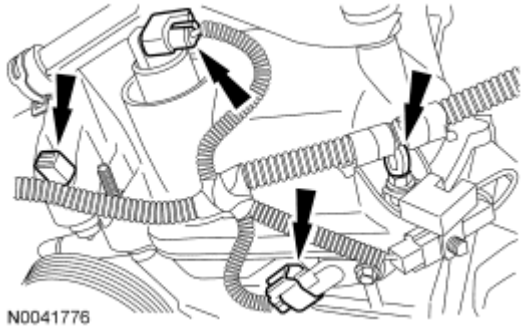


Fig. 251: Locating RH VCT Solenoid And LH Camshaft Position Sensor Electrical Connectors
Courtesy of FORD MOTOR CO.

25. Remove the nut and the radio frequency interference capacitor.

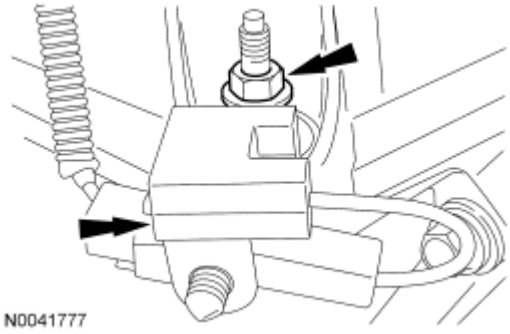


Fig. 252: Locating Radio Frequency Interference Capacitor And Nut
Courtesy of FORD MOTOR CO.

26. Detach the 2 wiring harness retainers.

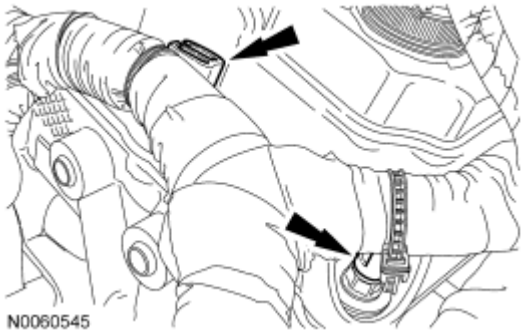


Fig. 253: Identifying Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

27. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

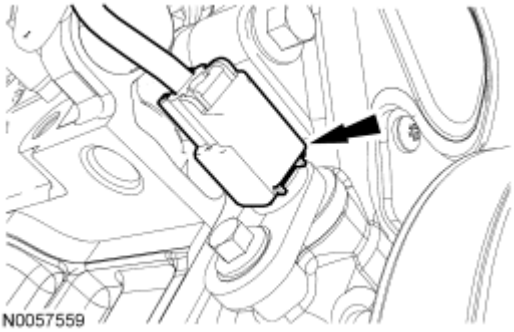


Fig. 254: Identifying Crankshaft Position (CKP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

28. Disconnect the PSP switch electrical connector.

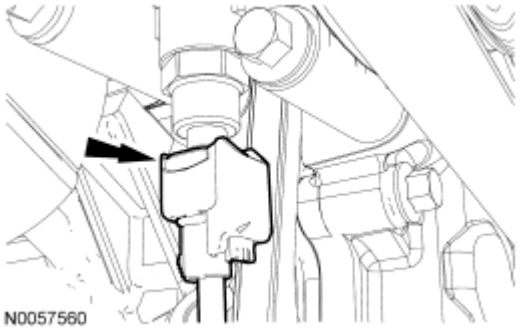


Fig. 255: Identifying Power Steering Pressure (PSP) Switch Electrical Connector
Courtesy of FORD MOTOR CO.

Front Wheel Drive (FWD) engines

29. Disconnect the RH catalyst monitor sensor electrical connector.

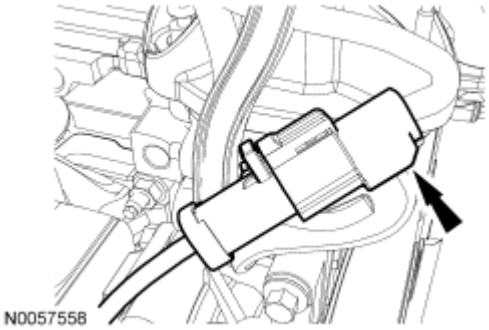


Fig. 256: Identifying RH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

30. Detach the wiring harness retainer from the power steering stud bolt.

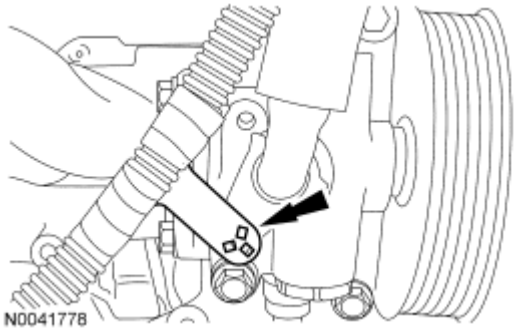


Fig. 257: Locating Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

31. Disconnect the RH HO2S electrical connector.

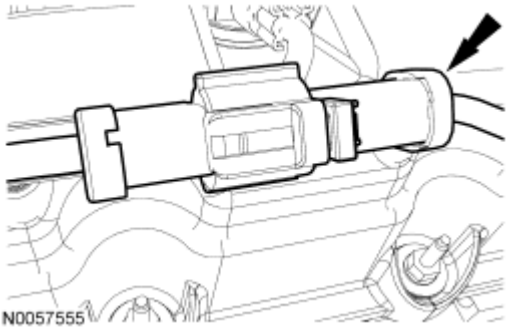


Fig. 258: Identifying RH HO2S Electrical Connector
Courtesy of FORD MOTOR CO.

All engines

32. Disconnect the PCV valve electrical connector.

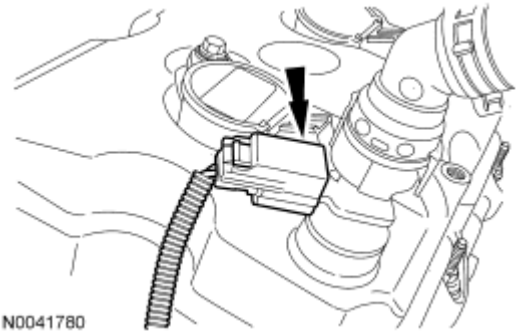


Fig. 259: Locating Positive Crankcase Ventilation Valve Electrical Connector
Courtesy of FORD MOTOR CO.

33. Disconnect the Knock Sensor (KS) electrical connector.

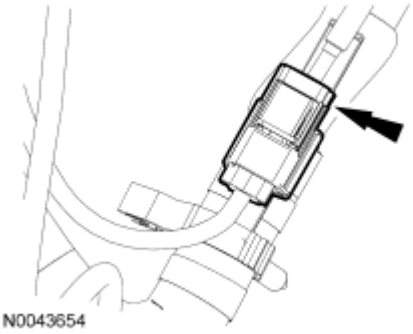


Fig. 260: Locating Knock Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

34. Disconnect the Engine Coolant Temperature (ECT) sensor electrical connector.

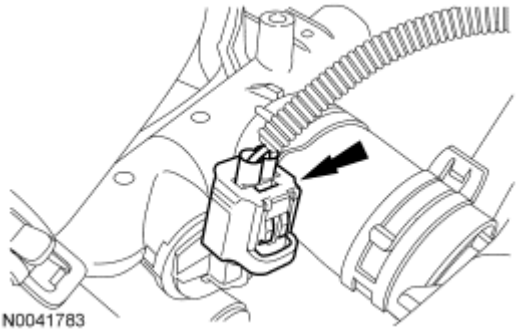


Fig. 261: Locating Electronic Coolant Temperature Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

35. Detach the wiring harness retainer from the coolant bypass stud bolt.

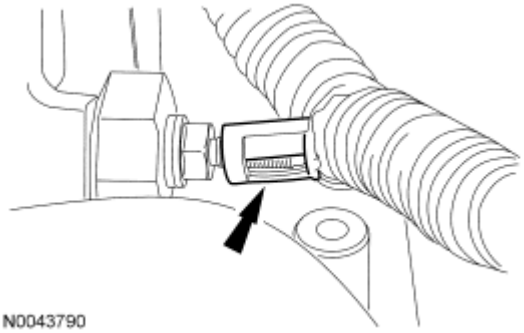


Fig. 262: Locating Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

36. Disconnect the LH catalyst monitor sensor electrical connector.

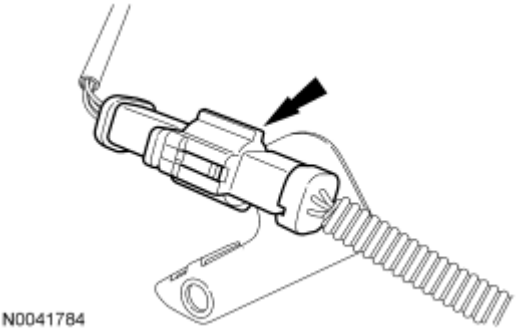


Fig. 263: Locating LH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

37. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt.

Fig. 264: Rotating Accessory Drive Belt Tensioner Counterclockwise
Courtesy of FORD MOTOR CO.

38. Remove the 3 power steering reservoir nuts.

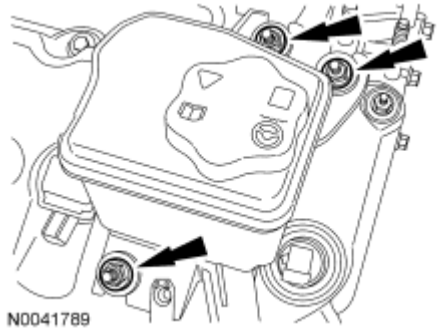


Fig. 265: Locating Power Steering Reservoir Nuts
Courtesy of FORD MOTOR CO.

39. Remove the 3 bolts and the power steering pump and reservoir assembly.

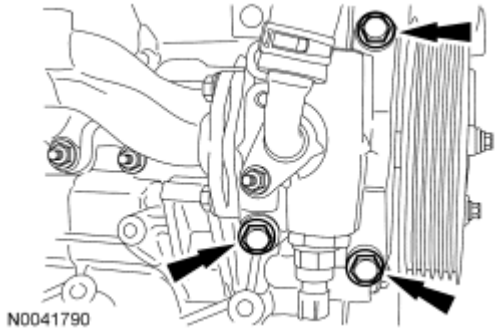


Fig. 266: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

40. Remove the wiring harness retainer bolt.

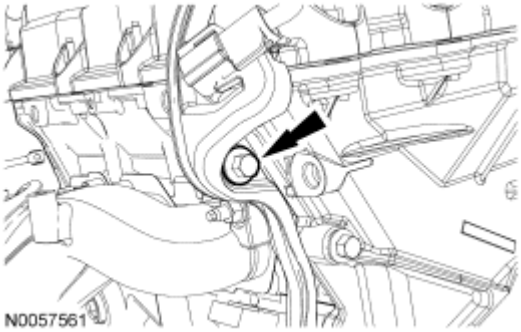


Fig. 267: Identifying Wiring Harness Retainer Bolt
Courtesy of FORD MOTOR CO.

41. Detach the wiring harness from the cylinder block.

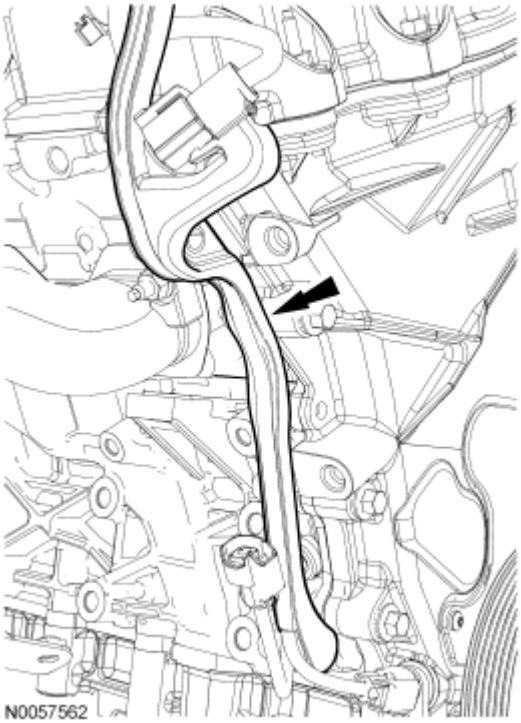


Fig. 268: Locating Wiring Harness From Cylinder Block
Courtesy of FORD MOTOR CO.

42. Remove the wiring harness from the engine.
43. Remove the 3 bolts and the generator.

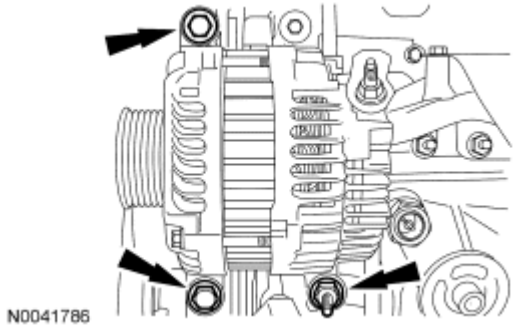


Fig. 269: Locating Generator Bolts
Courtesy of FORD MOTOR CO.

44. Remove the 3 bolts and the A/C compressor.

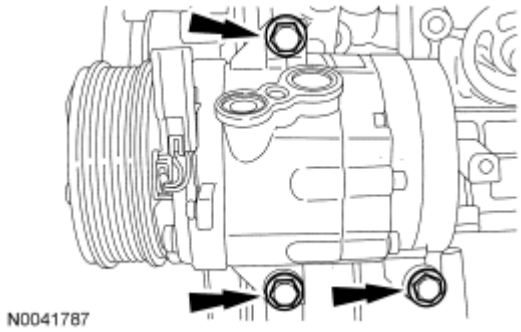


Fig. 270: Locating A/C Compressor Bolts
Courtesy of FORD MOTOR CO.

45. Remove the 3 bolts and the A/C compressor bracket.

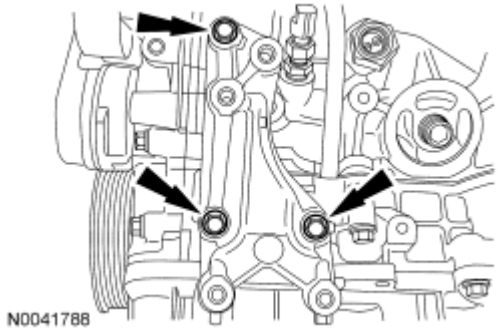


Fig. 271: Locating A/C Compressor Bracket Bolts
Courtesy of FORD MOTOR CO.

FWD engines

46. Remove the 6 nuts and the RH catalytic converter manifold.
    - Discard the gasket and nuts.

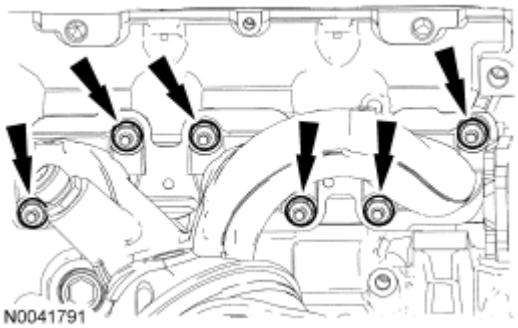


Fig. 272: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

47. Clean and inspect the RH catalytic converter manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article.

All-Wheel Drive (AWD) engines

48. Remove the 6 nuts and the RH exhaust manifold.
    - Discard the gasket and nuts.

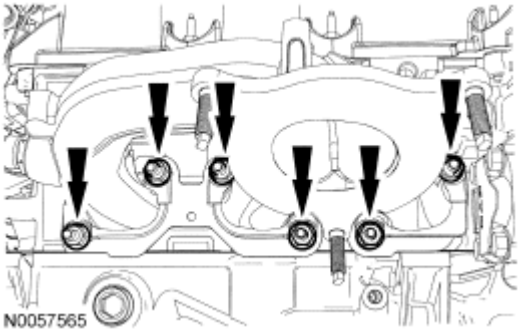


Fig. 273: Identifying RH Exhaust Manifold Nuts
Courtesy of FORD MOTOR CO.

49. Clean and inspect the RH exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article.

All engines

50. Remove and discard the 6 RH catalytic converter manifold studs.

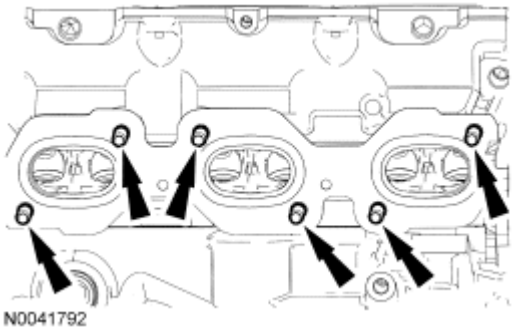


Fig. 274: Locating Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

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.

51. Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.
52. Remove the 4 bolts and the LH heat shield.

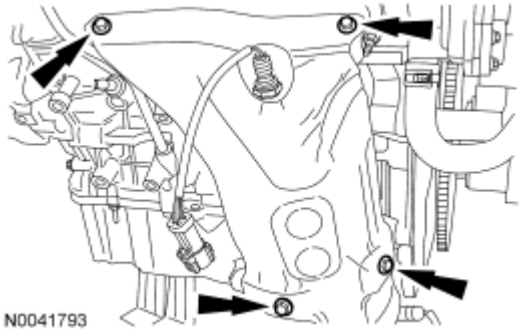


Fig. 275: Locating Heat Shield Bolts
Courtesy of FORD MOTOR CO.

53. Remove the 2 bolts from the LH catalytic converter bracket.

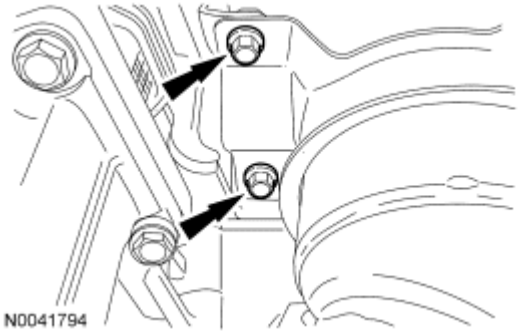


Fig. 276: Locating LH Catalytic Converter Bracket Bolts
Courtesy of FORD MOTOR CO.

54. Remove the 6 nuts and the LH catalytic converter manifold.
    - Discard the gasket and nuts.

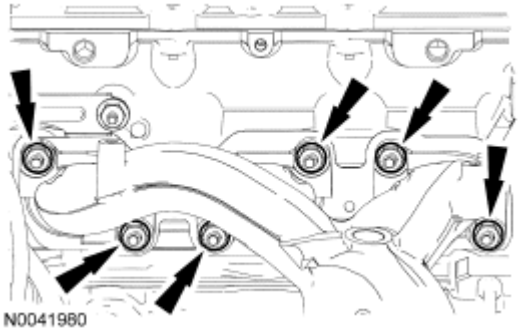


Fig. 277: Locating LH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

55. Clean and inspect the LH catalytic converter manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article.
56. Remove and discard the 6 LH catalytic converter manifold studs.

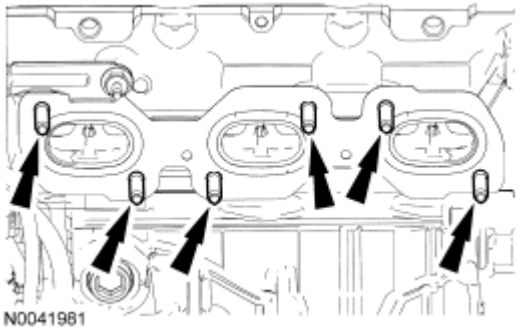


Fig. 278: Locating LH Catalytic Converter Studs
Courtesy of FORD MOTOR CO.

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.

57. Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.
58. Remove the 2 bolts and the LH catalytic converter bracket.

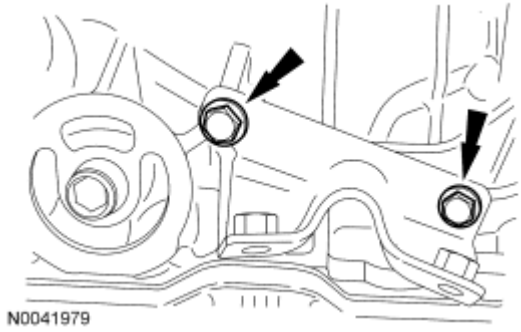


Fig. 279: Locating LH Catalytic Converter Bracket Bolts
Courtesy of FORD MOTOR CO.

59. Remove the bolt and the oil level indicator tube.
    - Remove and discard the O-ring seal.

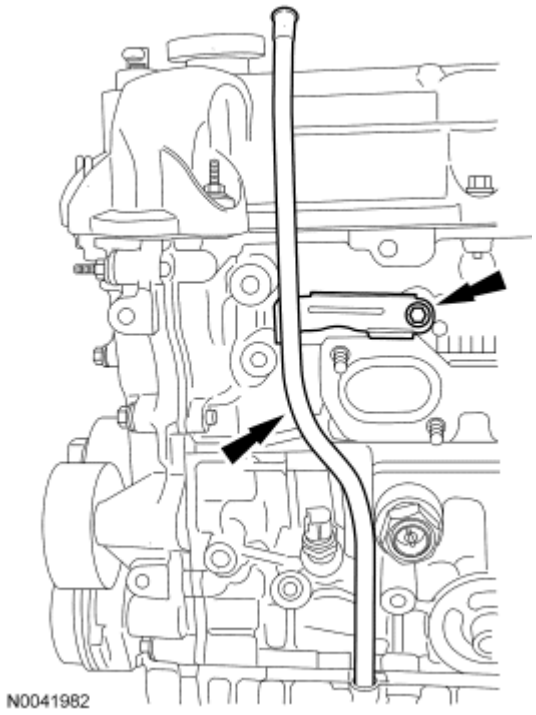


Fig. 280: Locating Oil Level Indicator Tube And Bolt
Courtesy of FORD MOTOR CO.

60. Remove the 8 bolts and the lower intake manifold.
    - Discard the gaskets.

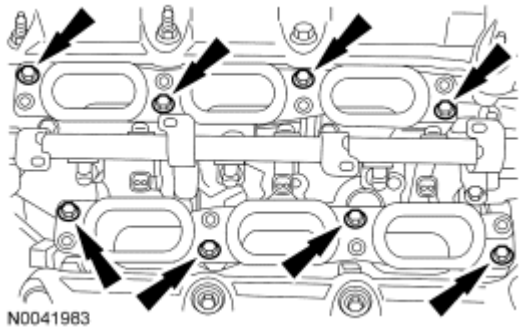


Fig. 281: Locating Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

61. Cut and discard the coolant pump belt.

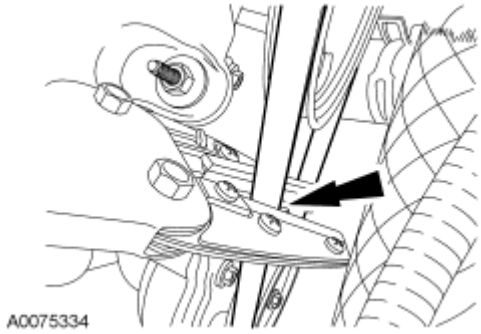


Fig. 282: Locating Coolant Pump Belt
Courtesy of FORD MOTOR CO.

62. Release the 2 clamps and remove the thermostat housing.

Fig. 283: Locating Clamps And Thermostat Housing
Courtesy of FORD MOTOR CO.

63. Remove the bolt, stud bolt and the coolant bypass.
    - Remove and discard the O-ring seals.

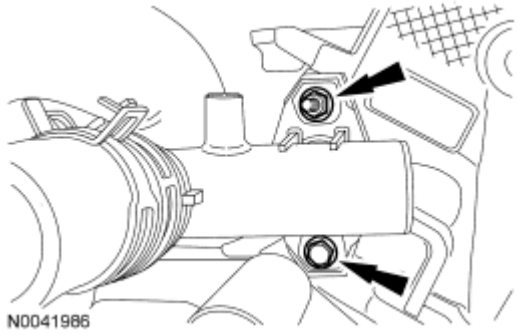


Fig. 284: Locating Bolt, Stud Bolt And Coolant Bypass
Courtesy of FORD MOTOR CO.

64. Disconnect the coolant pump hose from the cylinder block outlet.

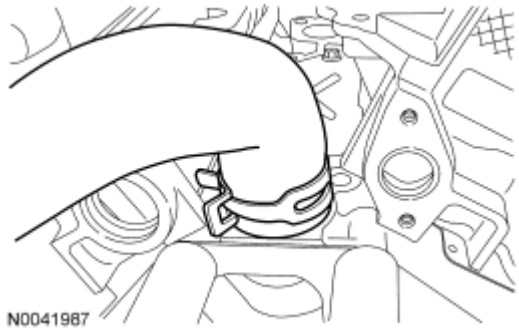


Fig. 285: Locating Coolant Pump Hose From Cylinder Block Outlet
Courtesy of FORD MOTOR CO.

NOTE: Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.

65. Using the Water Pump Pulley Plate, Water Pump Shaft Protector and the Crankshaft Vibration Damper Remover, remove the coolant pump pulley.

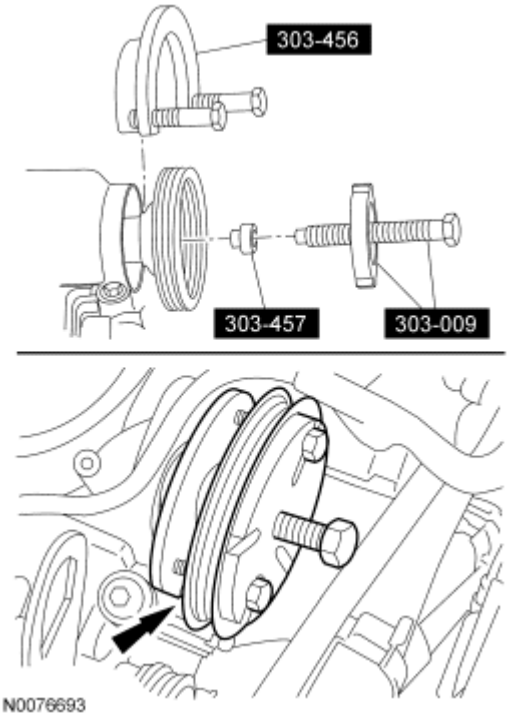


Fig. 286: Removing Coolant Pump Pulley Using Special Tools (303-009, 303-456, 303-457)
Courtesy of FORD MOTOR CO.

66. Remove the 3 bolts and the coolant pump.

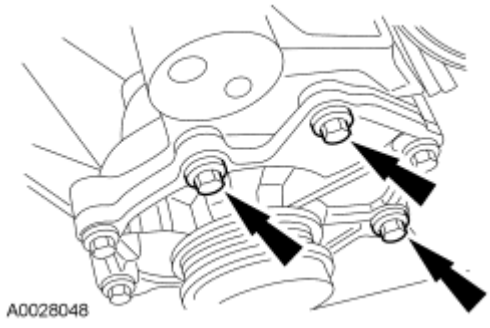


Fig. 287: Identifying Coolant Pump Assembly Bolts
Courtesy of FORD MOTOR CO.

67. Remove the bolt and the KS.

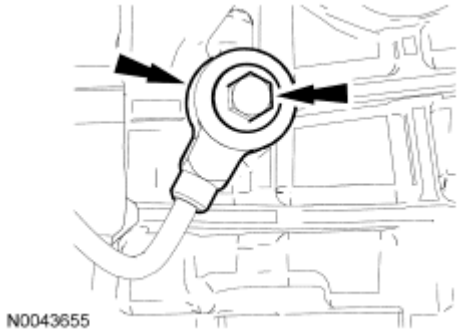


Fig. 288: Locating Knock Sensor (KS) And Bolt
Courtesy of FORD MOTOR CO.

68. Remove the EOP switch.

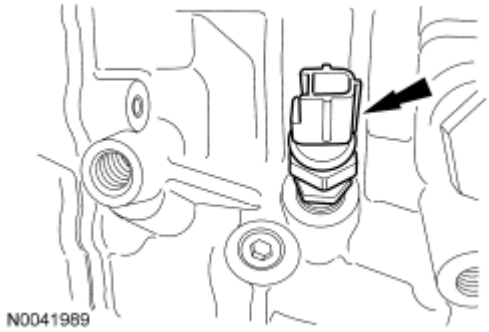


Fig. 289: Locating EOP Switch
Courtesy of FORD MOTOR CO.

69. If equipped, remove the block heater.

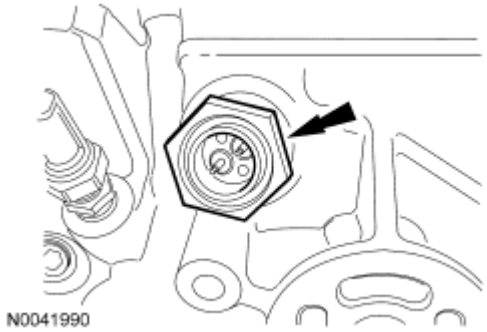


Fig. 290: Locating Block Heater
Courtesy of FORD MOTOR CO.

NOTE: When removing the coil-on-plug assemblies, a slight twisting motion will break the seal and ease removal.

70. Remove the 3 bolts and the 3 LH coil-on-plug assemblies.

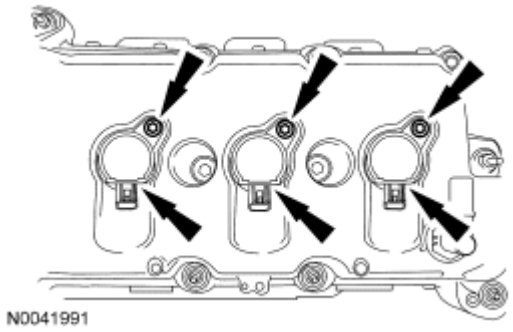


Fig. 291: Locating LH Coil-On-Plug Assemblies And Bolts
Courtesy of FORD MOTOR CO.

71. Remove the bolts, stud bolts and the LH valve cover.
    - Discard the gaskets.

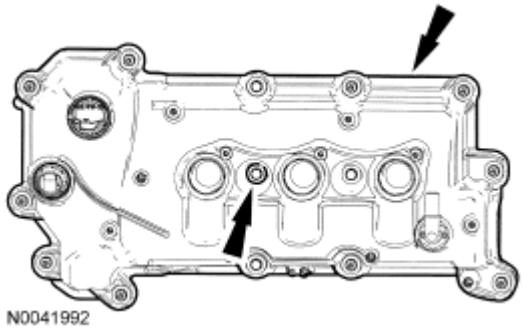


Fig. 292: Locating LH Valve Cover And Bolts
Courtesy of FORD MOTOR CO.

NOTE: When removing the coil-on-plug assemblies, a slight twisting motion will break the seal and ease removal.

72. Remove the 3 bolts and the 3 RH coil-on-plug assemblies.

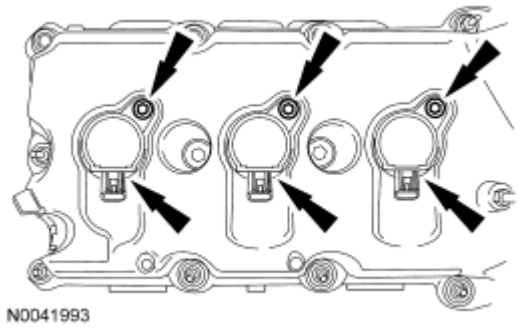


Fig. 293: Locating RH Coil-On-Plug Assemblies And Bolts
Courtesy of FORD MOTOR CO.

73. Remove the bolts, stud bolts and the RH valve cover.
    - Discard the gaskets.

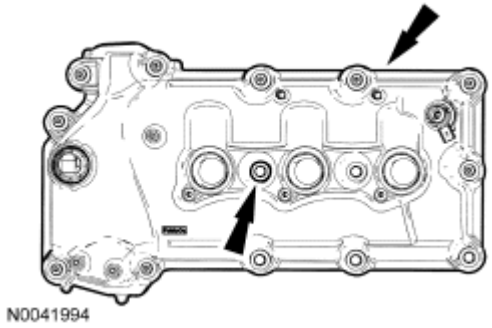


Fig. 294: Locating RH Valve Cover And Bolts
Courtesy of FORD MOTOR CO.

74. Remove the 10 bolts, 5 stud bolts and the oil pan.
    - Discard the gasket.

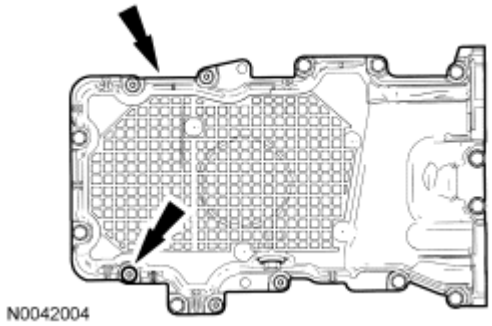


Fig. 295: Locating Oil Pan And Bolts
Courtesy of FORD MOTOR CO.

75. Remove the 2 bolts and the oil pump screen and pickup tube.
    - Remove and discard the O-ring seal.

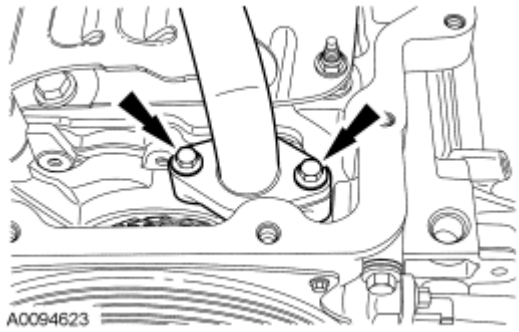


Fig. 296: Locating Oil Pump Screen & Pickup Tube Bolts
Courtesy of FORD MOTOR CO.

76. Remove the 8 nuts and the oil pan baffle.

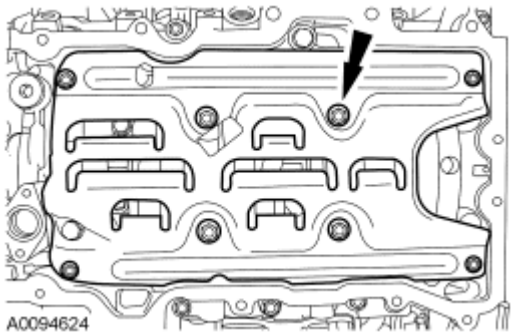


Fig. 297: Locating Oil Pan Baffle Nuts
Courtesy of FORD MOTOR CO.

77. Remove the accessory drive belt tensioner and the 2 idler pulleys.

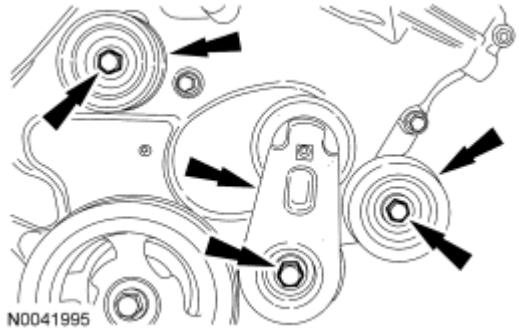


Fig. 298: Locating Accessory Drive Belt Tensioner And Idler Pulleys
Courtesy of FORD MOTOR CO.

78. Using the Strap Wrench, remove the crankshaft pulley bolt.

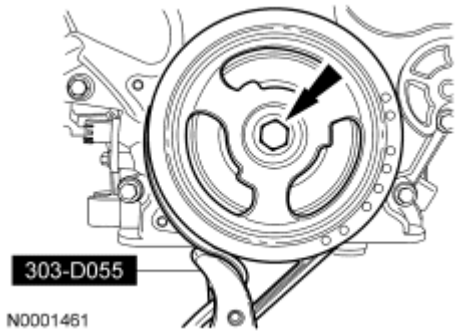


Fig. 299: Identifying Crankshaft Pulley Bolt & Special Tools
Courtesy of FORD MOTOR CO.

79. Using the 3-Jaw Puller, remove the crankshaft pulley.

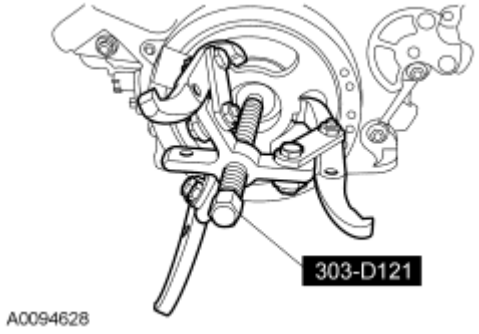


Fig. 300: Identifying Special Tools (303-D121) And Crankshaft Pulley
Courtesy of FORD MOTOR CO.

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

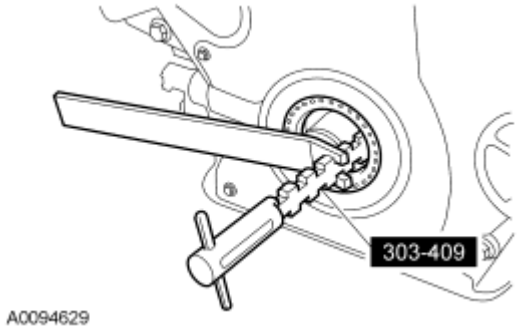
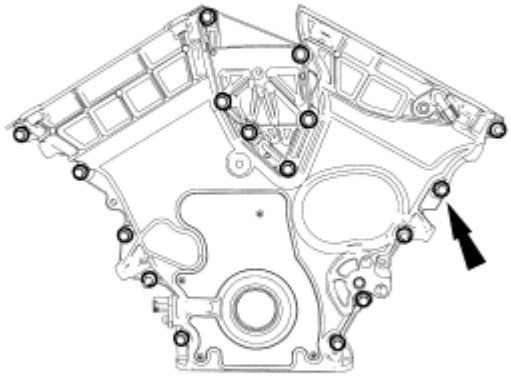


Fig. 301: Identifying Special Tools (303-409) And Crankshaft Front Seal
Courtesy of FORD MOTOR CO.

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

81. Remove the 16 bolts and the engine front cover.
    - Discard the gaskets.

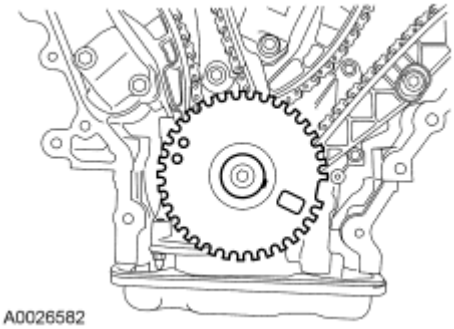


A0090759

Fig. 302: Locating Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

NOTE: This pulse wheel is used in several different engines. Install the pulse wheel with the keyway in the slot stamped 30 or 30RFF (orange in color).

82. Remove the ignition pulse wheel.



A0026582

Fig. 303: Identifying Ignition Pulse Wheel
Courtesy of FORD MOTOR CO.

83. Install the crankshaft pulley bolt and washer.

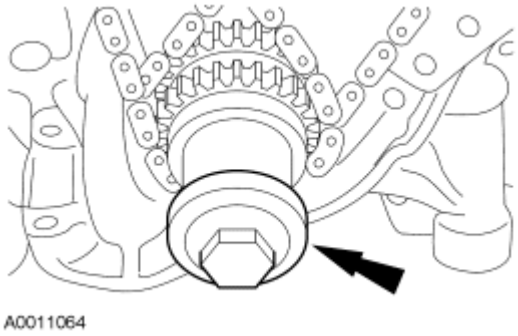


Fig. 304: Identifying Damper Bolt
Courtesy of FORD MOTOR CO.

NOTE: Only use hand tools when removing or installing the spark plugs, damage can occur to the cylinder head or spark plug.

84. Remove the 6 spark plugs

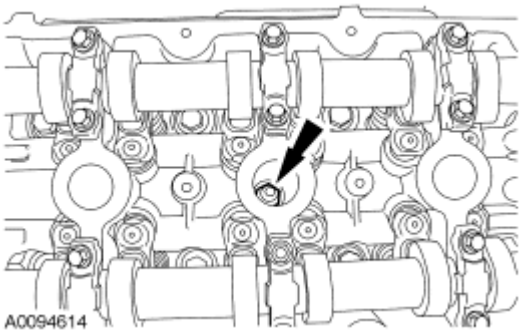


Fig. 305: Locating Spark Plugs
Courtesy of FORD MOTOR CO.

85. Rotate the crankshaft clockwise to position the crankshaft keyway in the 11 o'clock position and position the camshafts in the correct position. This will position the No. 1 cylinder at Top Dead Center (TDC).
    - Verify that the camshafts are correctly located. If not, rotate the crankshaft one additional turn and recheck.

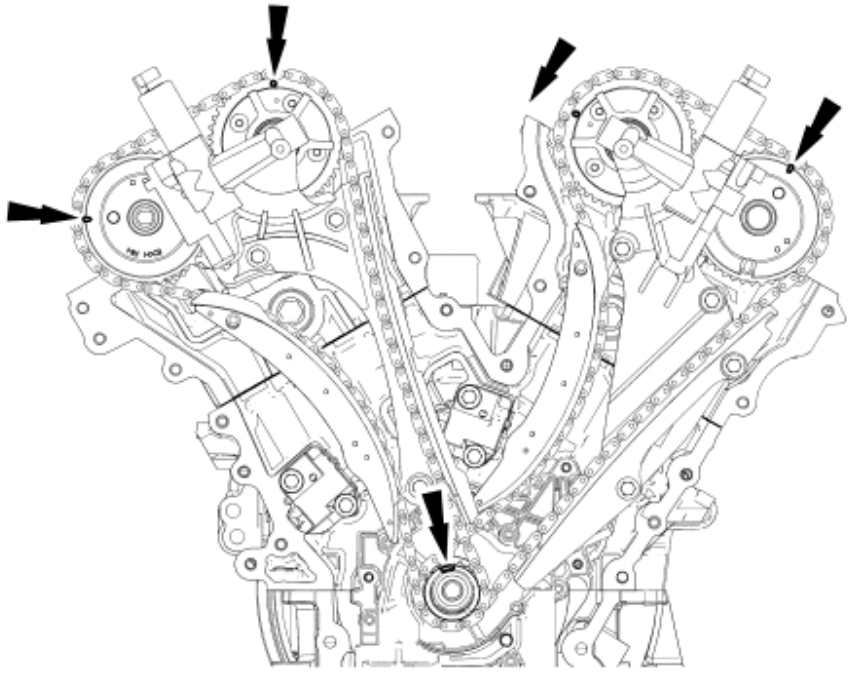


Fig. 306: Locating Keyways Position
Courtesy of FORD MOTOR CO.

86. Rotate the crankshaft clockwise 120 degrees to the 3 o'clock position to position the RH camshafts in the neutral position.

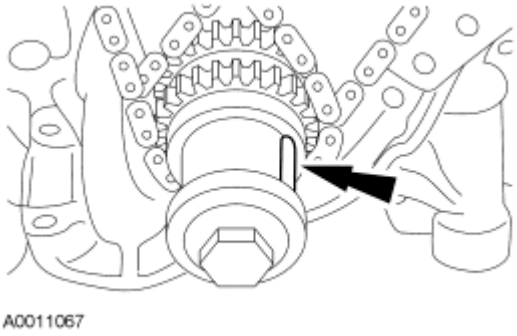


Fig. 307: Identifying Crankshaft Keyway
Courtesy of FORD MOTOR CO.

87. Verify that the RH camshafts are in the neutral position.

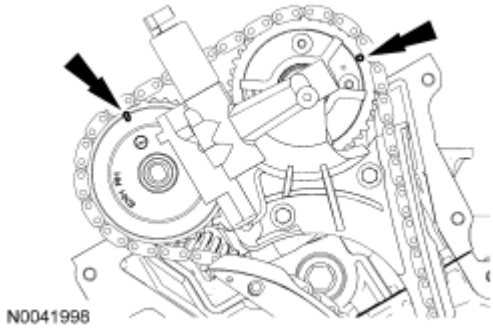


Fig. 308: Locating RH Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

88. Remove the RH timing chain tensioner arm.
    1. Remove the bolts.
    2. Remove the tensioner.
    3. Remove the tensioner arm.

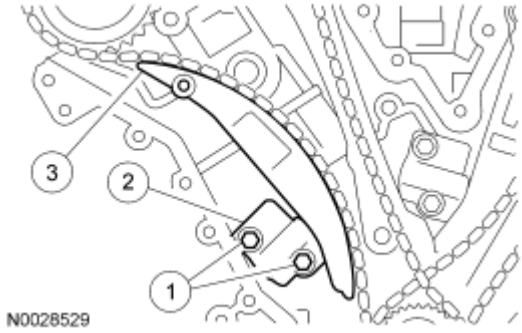


Fig. 309: Identifying RH Timing Chain Tensioner Arm & Bolts
Courtesy of FORD MOTOR CO.

89. Remove the RH timing chain.

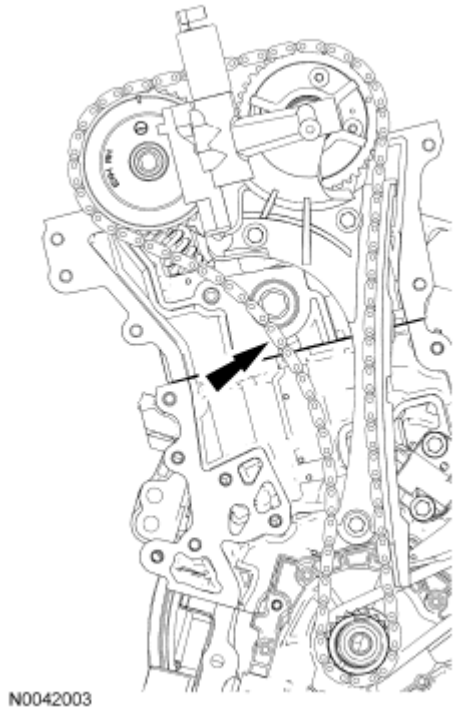


Fig. 310: Locating RH Timing Chain
Courtesy of FORD MOTOR CO.

90. Remove the 3 bolts and the RH VCT assembly.

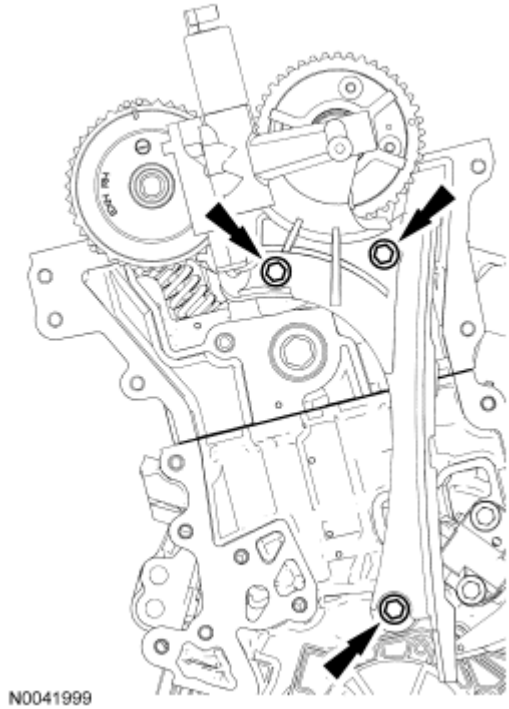


Fig. 311: Locating RH VCT Assembly Bolts

Courtesy of FORD MOTOR CO.

91. Rotate the crankcase clockwise 600 degrees (1-2/3 turns) to position the crankcase keyway in the 11 o'clock position. This will position the LH camshafts in the neutral position.

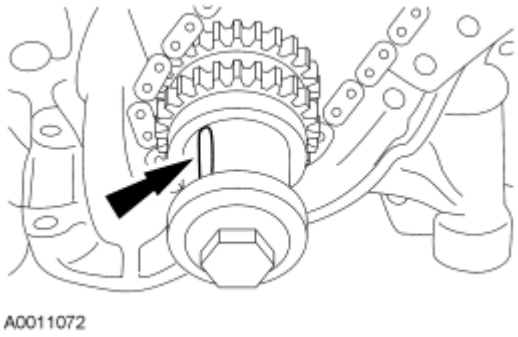


Fig. 312: Positioning Crankcase Key Way In 11 O'Clock Position
Courtesy of FORD MOTOR CO.

92. Verify the LH camshafts are in the neutral position.

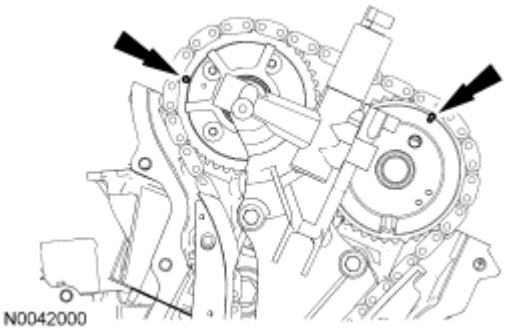


Fig. 313: Locating LH Camshafts Position In NEUTRAL Position
Courtesy of FORD MOTOR CO.

93. Remove the LH timing chain tensioner and tensioner arm.
    1. Remove the bolts.
    2. Remove the tensioner.
    3. Remove the tensioner arm.

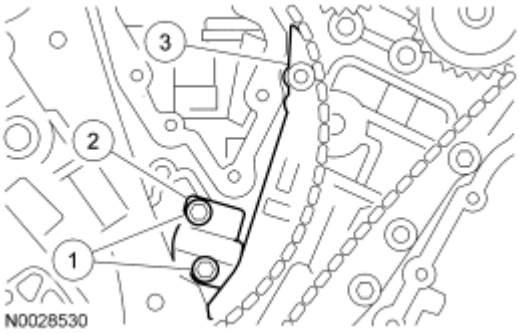


Fig. 314: Locating LH Timing Chain & Tensioner Arm
Courtesy of FORD MOTOR CO.

94. Remove the LH timing chain.

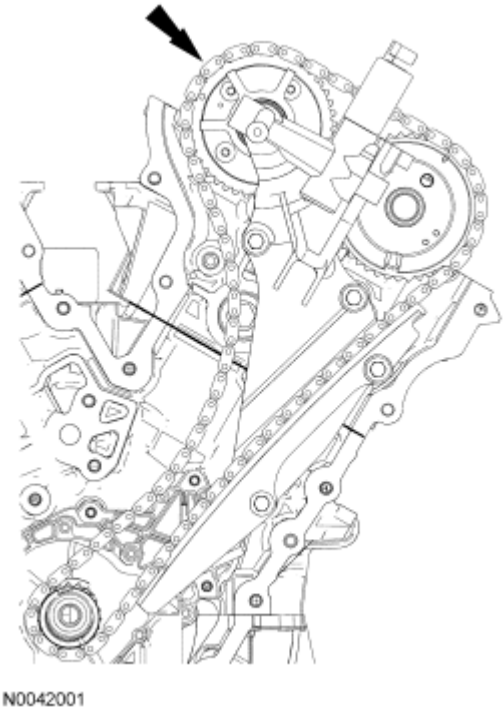


Fig. 315: Locating LH Timing Chain
Courtesy of FORD MOTOR CO.

95. Remove the 4 bolts and the LH VCT assembly.

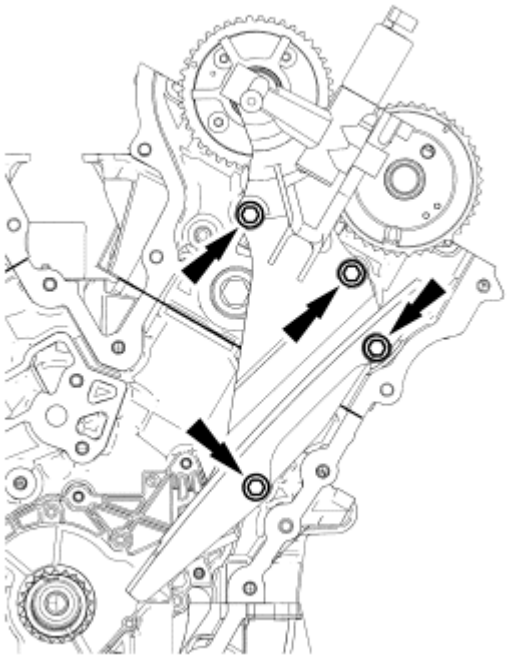


Fig. 316: Identifying LH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

96. Remove the pulley bolt, washer and the crankshaft sprocket.

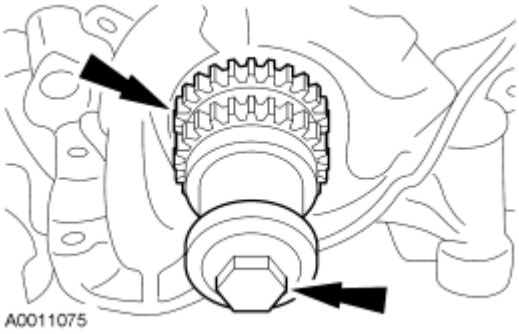


Fig. 317: Locating Damper Bolt & Crankshaft Sprockets
Courtesy of FORD MOTOR CO.

97. Remove the 4 bolts in the sequence shown.
    - Remove the oil pump.

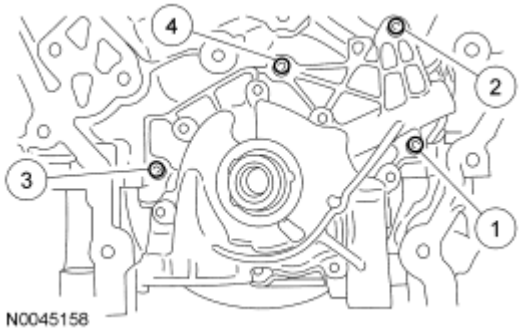


Fig. 318: Identifying Removal Sequence Of Oil Pump Bolts
Courtesy of FORD MOTOR CO.

98. Remove the crankshaft key.

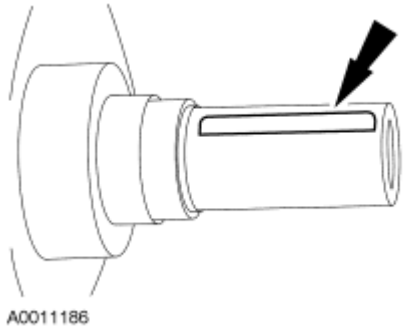


Fig. 319: Locating Crankshaft Key
Courtesy of FORD MOTOR CO.

NOTE: To make sure of correct sealing, do not scratch the camshaft.

99. Using the special tools, remove the camshaft oil seal and discard.

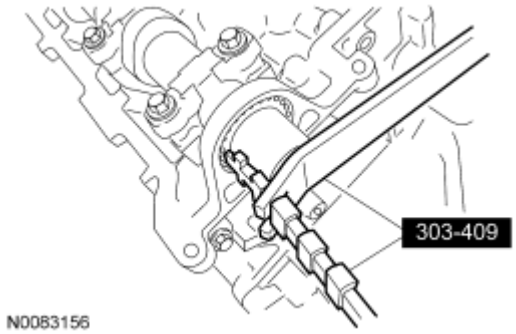


Fig. 320: Removing Camshaft Oil Seal Using Special Tool (303-409)
Courtesy of FORD MOTOR CO.

100. Remove the 2 bolts and the camshaft oil seal retainer.
    - Discard the press-in-place gasket.

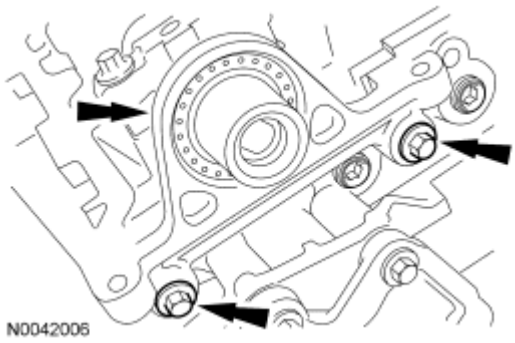


Fig. 321: Locating Camshaft Oil Seal Retainer And Bolts
Courtesy of FORD MOTOR CO.

NOTE: The camshafts must be in the neutral position before removing the bearing caps or damage to the engine may occur.

101. Verify the camshafts are in the neutral position.

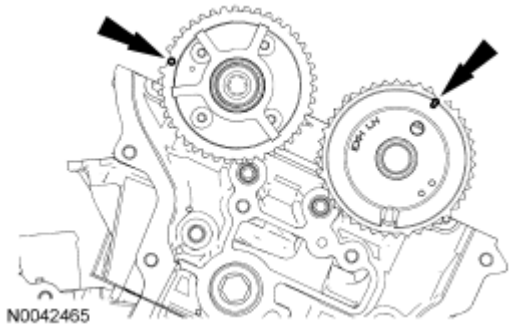


Fig. 322: Locating Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

NOTE: Do not allow the camshaft to rotate from the neutral position while removing the Variable Camshaft Timing (VCT) actuator or damage to the engine may occur.

NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for removal of the VCT actuator bolt.

102. Remove the bolt and the VCT actuator.

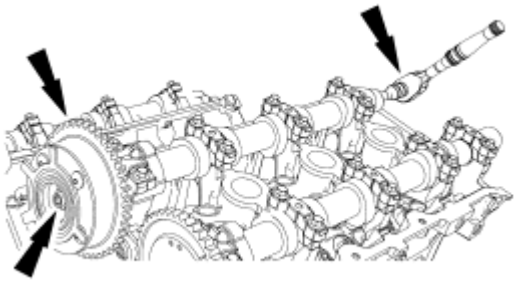


Fig. 323: Locating VCT Actuator And Bolt
Courtesy of FORD MOTOR CO.

NOTE: Cylinder head camshaft bearing caps must be assembled in their original positions. Some engines have factory markings on the camshaft bearing caps (as shown in illustration). Engines that do not have the factory markings must be marked for correct position and orientation prior to removal. Failure to install the camshaft bearing caps in their original positions may result in severe engine damage.

103. If necessary, mark the camshaft bearing cap position and orientation as shown in the illustration.

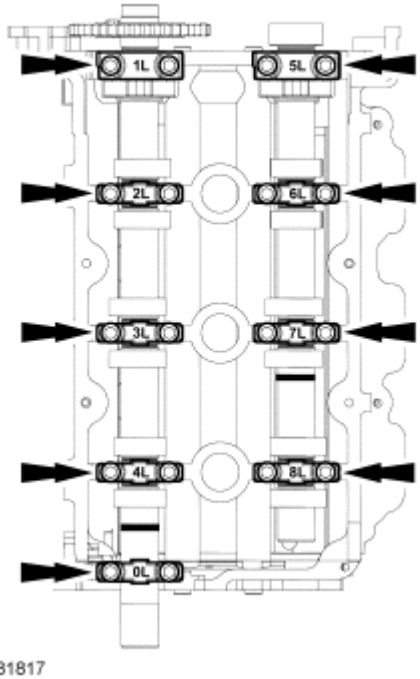


Fig. 324: Marking Camshaft Bearing Cap Position & Orientation
Courtesy of FORD MOTOR CO.

NOTE: After loosening all of the camshaft bearing cap bolts, remove the camshaft

bearing thrust caps (1L and 6L) first or damage to the thrust caps may occur.

NOTE: Make sure the camshaft bearing caps are marked as instructed in the previous step.

104. Loosen the bolts evenly in the sequence shown.
    1. Remove the camshaft bearing thrust caps (1L and 6L).
    2. Remove the remaining camshaft bearing caps.
    3. Remove the camshafts from the cylinder head.

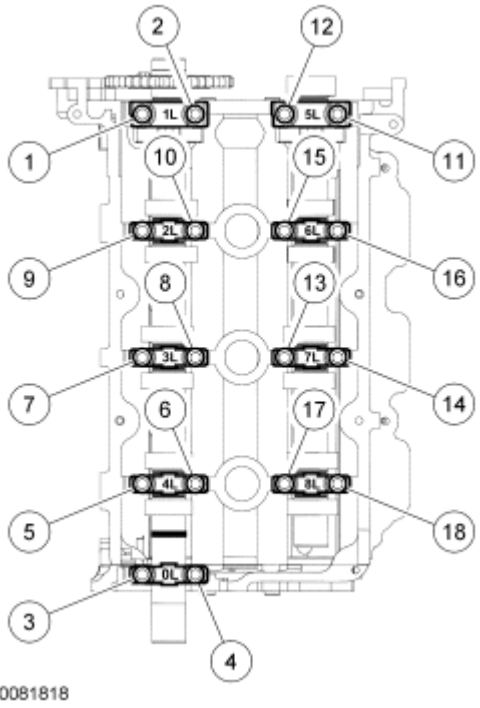


Fig. 325: Loosening Bolts Evenly In Sequence
Courtesy of FORD MOTOR CO.

NOTE: The camshafts must be in the neutral position before removing the bearing caps or damage to the engine may occur.

105. Verify the camshafts are in the neutral position.

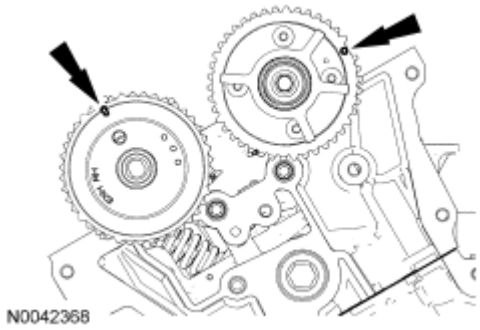


Fig. 326: Locating RH Camshafts Position
Courtesy of FORD MOTOR CO.

NOTE: Do not allow the camshaft to rotate from the neutral position while removing the Variable Camshaft Timing (VCT) actuator or damage to the engine may occur.

NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for removal of the VCT actuator bolt.

106. Remove the bolt and the VCT actuator.

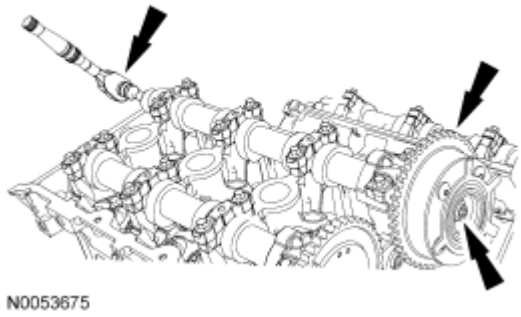


Fig. 327: Locating VCT Actuator And Bolt
Courtesy of FORD MOTOR CO.

NOTE: Cylinder head camshaft bearing caps must be assembled in their original positions. Some engines have factory markings on the camshaft bearing caps (as shown in illustration). Engines that do not have the factory markings must be marked for correct position and orientation prior to removal. Failure to install the camshaft bearing caps in their original positions may result in severe engine damage.

107. If necessary, mark the camshaft bearing cap position and orientation as shown in the illustration.

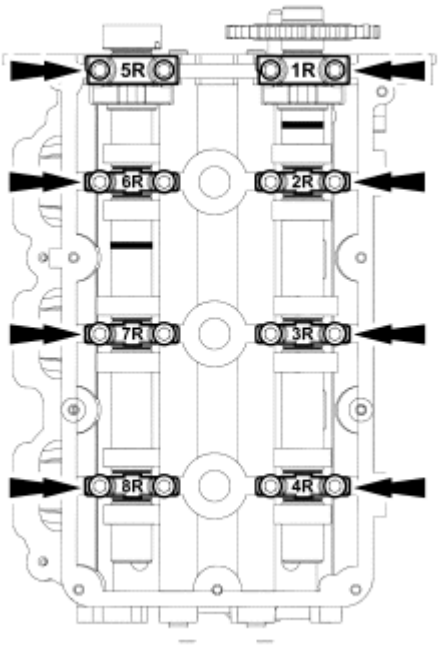
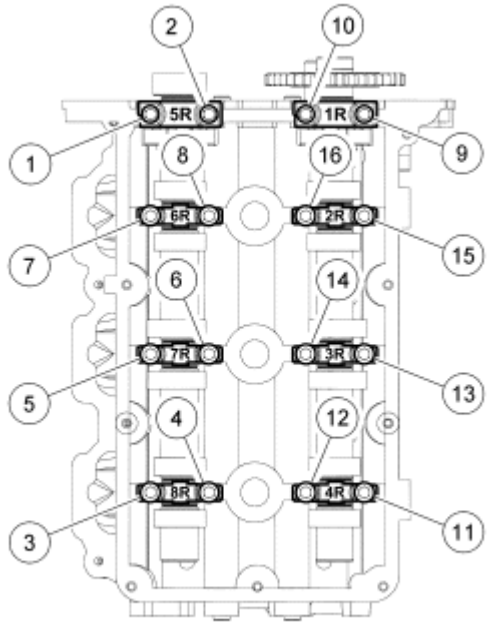


Fig. 328: Marking Camshaft Bearing Cap Position & Orientation
Courtesy of FORD MOTOR CO.

NOTE: After loosening all of the camshaft bearing cap bolts, remove the camshaft bearing thrust caps (5R and 1R) first or damage to the thrust caps may occur.

NOTE: Make sure the camshaft bearing caps are marked as instructed in the previous step.

108. Loosen the bolts evenly in the sequence shown.
    1. Remove the camshaft bearing thrust caps (5R and 1R).
    2. Remove the remaining camshaft bearing caps.
    3. Remove the camshafts from the cylinder head.



N0053678

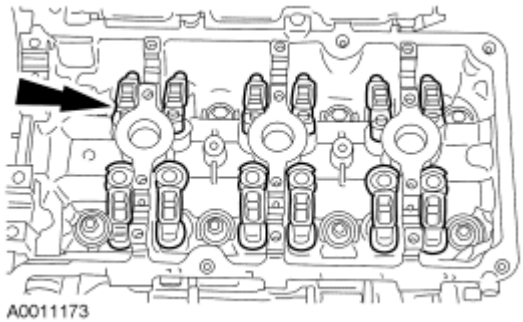
Fig. 329: Identifying Loosening Sequence Of Camshaft Bearing Bolts
Courtesy of FORD MOTOR CO.

NOTE: The camshaft roller followers must be installed in their original positions or damage to the engine may occur.

NOTE: RH shown, LH similar.

NOTE: Mark the location of the roller followers, using a permanent-type marker.

109. Remove the LH and RH camshaft roller followers.



A0011173

Fig. 330: Locating Camshaft Roller Followers
Courtesy of FORD MOTOR CO.

NOTE: RH shown, LH similar.

110. Loosen the 8 bolts in the indicated sequence and remove the LH and RH cylinder heads.
    - Discard the bolts and the gaskets.

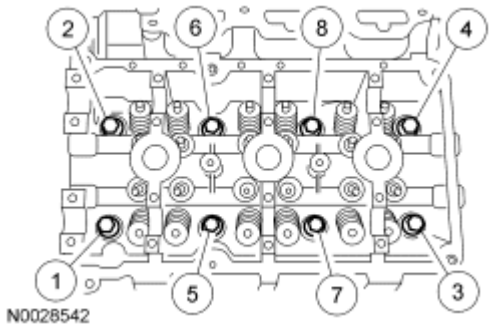


Fig. 331: Identifying Loosening Sequence Of Cylinder Heads Bolts
Courtesy of FORD MOTOR CO.

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 surface of both the cylinder head and the cylinder block.
    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 traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
112. Support the cylinder head on a bench with the head gasket side up.

NOTE: The straightedge used must be flat within 0.0051 mm (0.0002 in) per foot of tool length.

113. Inspect all areas of the deck face with a straightedge and feeler gauge. The cylinder head must not have

depressions deeper than 0.0254 mm (0.001 in) across a 38.1 mm (1.5 in) square area, or scratches more than 0.0254 mm (0.001 in).

114. Remove the bolts and the oil separator cover.
    - Discard the gasket.

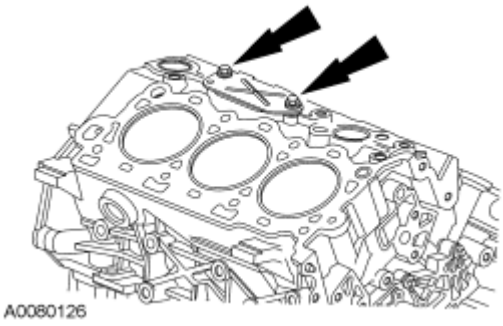
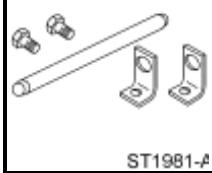


Fig. 332: Locating Oil Separator Cover Bolts
Courtesy of FORD MOTOR CO.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

CYLINDER HEAD

Special Tools

Illustration	Tool Name	Tool Number
 ST1981-A	Compressor, Valve Spring	303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring	303-350 (T89P-6565-A)
 ST1906-A	Installer, Valve Stem Oil Seal	303-470 (T94P-6510-CH)

Material

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

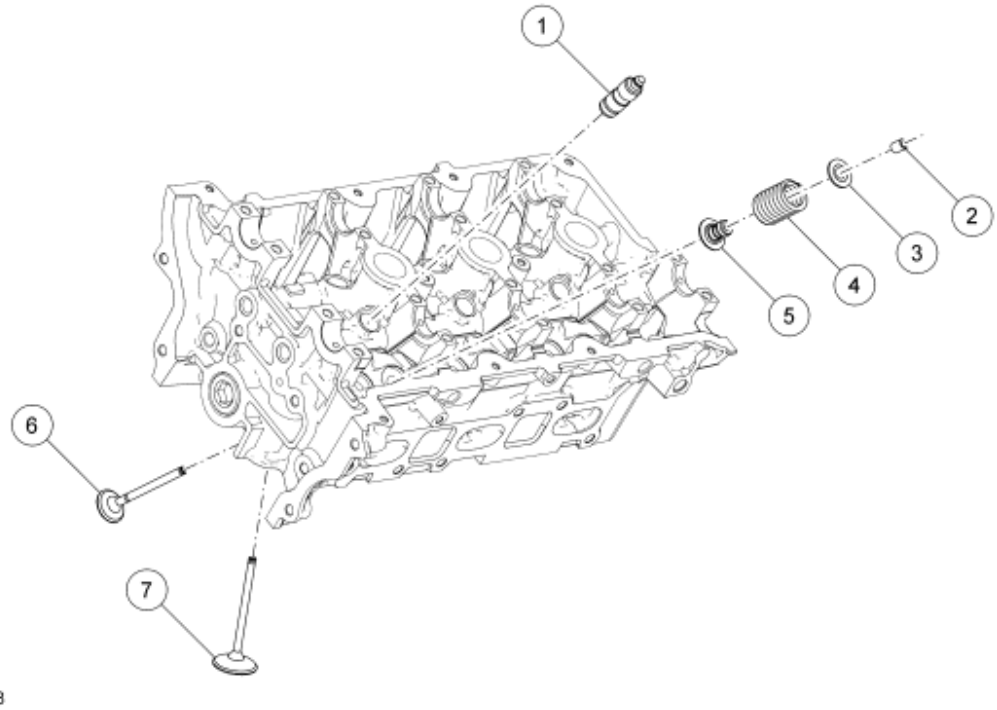


Fig. 333: Exploded View Of Cylinder Head
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6C501	Hydraulic lash adjuster (12 required)
2	6518	Valve spring retainer key (24 required)
3	6514	Valve spring retainer (12 required)
4	6513	Valve spring (12 required)
5	6A517	Valve stem seal (12 required)
6	6507	Exhaust valve (6 required)
7	6505	Intake valve (6 required)

DISASSEMBLY

NOTE: If the components are to be reinstalled, they must be installed in the same positions. Mark the components removed for locations. If not reassembled in their original positions, severe engine damage may occur.

1. Remove the hydraulic lash adjusters.
2. Using the Valve Spring Compressors, remove the keys, retainer and spring.

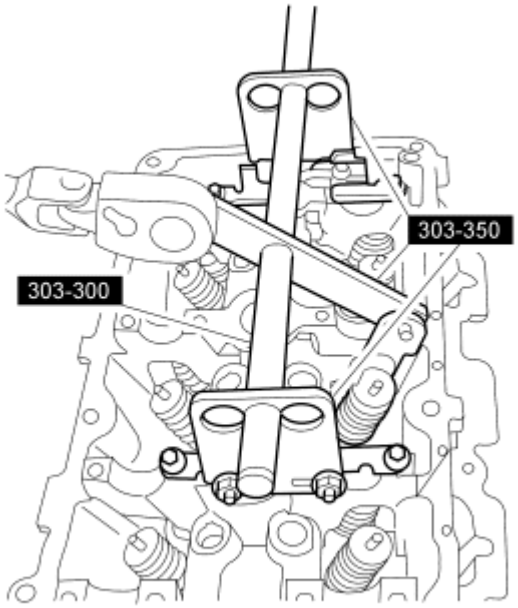


Fig. 334: Identifying Special Tools (303-300 And 303-350)
Courtesy of FORD MOTOR CO.

3. Remove the valve from the cylinder head.
4. Remove the valve stem seal.

ASSEMBLY

1. Using the Valve Stem Oil Seal Installer, install the valve stem seal.

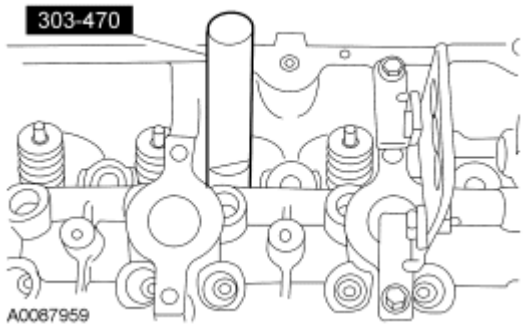


Fig. 335: Installing Valve Stem Seal
Courtesy of FORD MOTOR CO.

2. Install the valve.
3. Using the Valve Spring Compressors, install the valve spring, retainer and key.

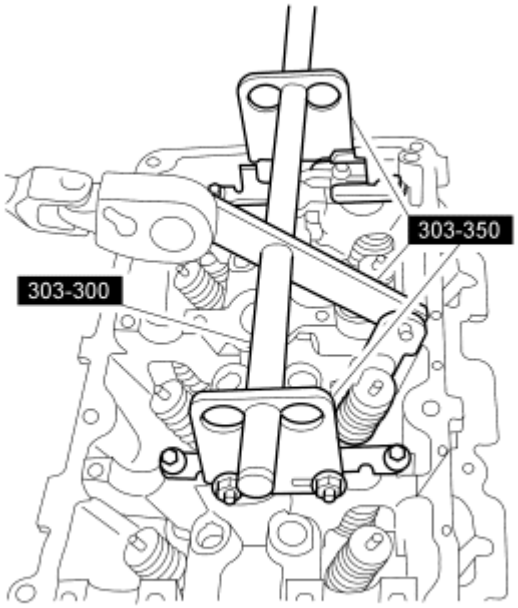


Fig. 336: Identifying Special Tools (303-300 And 303-350)
Courtesy of FORD MOTOR CO.

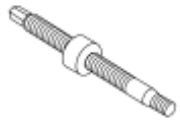
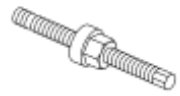
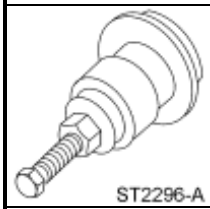
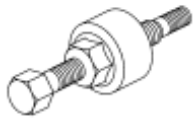
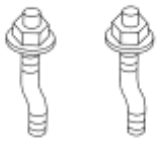
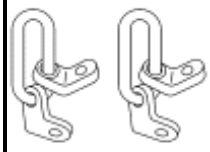
4. Install the hydraulic lash adjusters.
    - Lubricate the hydraulic lash adjusters with clean engine oil.

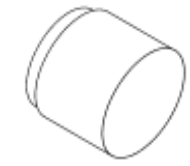
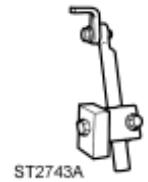
ASSEMBLY

ENGINE

Special Tools

Illustration	Tool Name	Tool Number
 ST2673-A	Engine Lifting Bracket Set	303-1140
 ST1979-A	Installer, Camshaft Oil Seal	303-464 (T94P-6256-BH)
		303-458 (T94P-6312-AH3), part

 ST3042-A	Installer, Camshaft Pulley	of 303-S455
 ST1327-A	Installer, Crankshaft Rear Main Oil Seal	303-178 (T82L-6701-A)
 ST1287-A	Installer, Crankshaft Vibration Damper	303-102 (T74P-6316-B)
 ST2296-A	Installer, Front Cover Oil Seal	303-335 (T88T-6701-A)
 ST1586-A	Installer, Power Steering Pump Pulley	211-185 (T91P-3A733-A)
 ST1333-A	Installer Bolts, Crankshaft Rear Main Oil Seal	303-384 (T91P-6701-A)
 ST2463-A	Lifting Brackets, Engine	134-00243 or equivalent
 ST1595-A	Lifting Brackets, Engine	303-050 (T70P-6000)

 ST2060-A	Protector, Camshaft Oil Seal	303-463 (T91P-6256-AH)
 ST3043-A	Spacer, Water Pump Pulley	303-459 (T94P-6312-AH4), part of 303-S455
 ST1602-A	Spreader Bar	303-D089 (D93P-6001-A3) or equivalent
 ST1438-A	Strap Wrench	303-D055 (D85L-6000-A)
 ST2743A	Universal Adapter Brackets	014-0001

Material

Item	Specification
Motorcraft Metal Surface Prep ZC-31-A	-
Motorcraft Premium Gold Engine Coolant with Bittering Agent (bittered in US only) VC-7-B (US); CVC-7-A (Canada); or equivalent (yellow color)	WSS-M97B51-A1
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 Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A
Silicone Gasket and Sealant	

TA-30	WSE-M4G323-A4
Thread Sealant with PTFE TA-24	WSK-M2G350-A2

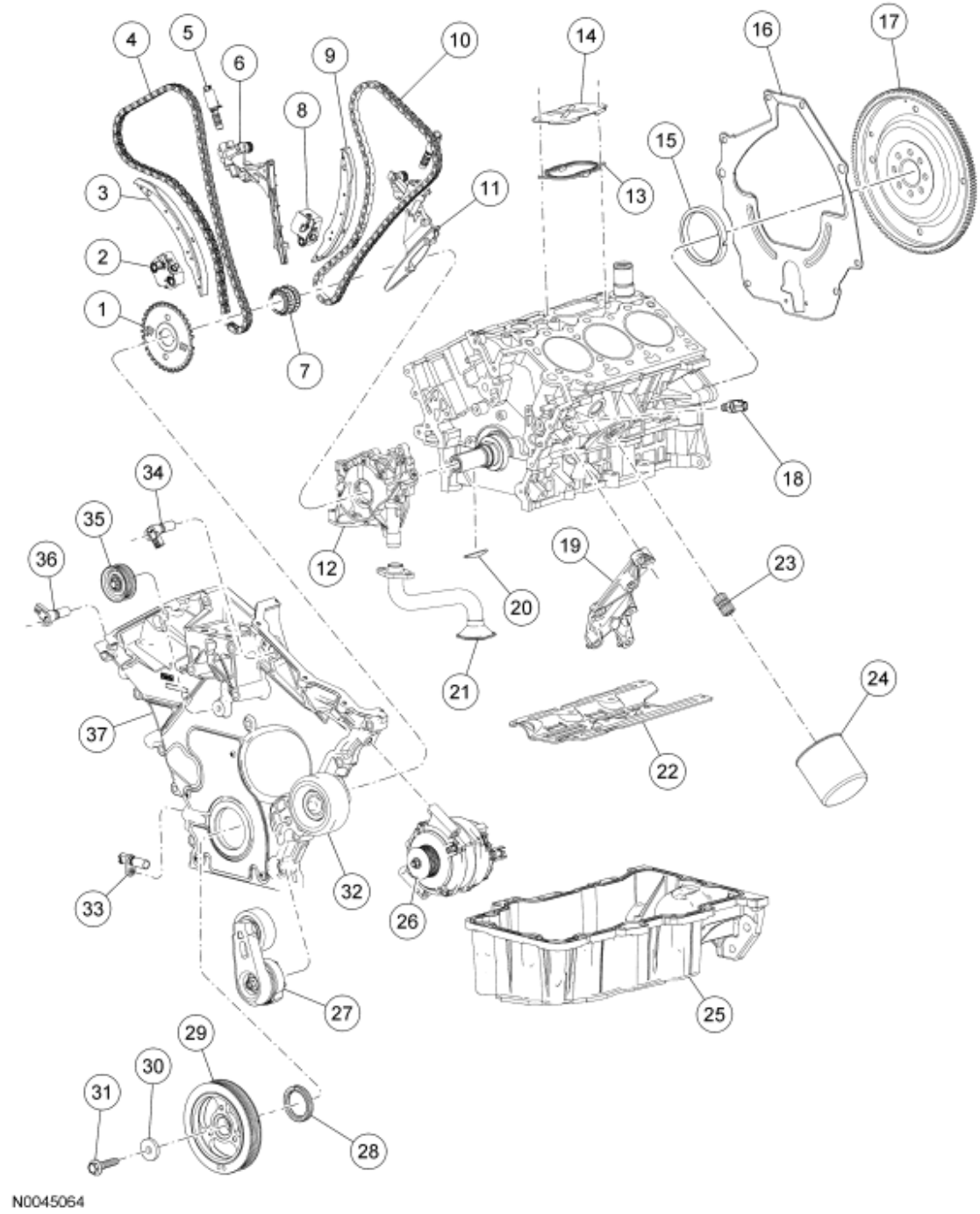


Fig. 337: Exploded View Of Lower Engine Components
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	12A227	Ignition pulse wheel
2	6L266	RH timing chain tensioner
3	6K255	RH timing chain tensioner arm
4	6268	RH timing chain
5	6M280	Oil control valve
6	6C260	RH Variable Camshaft Timing (VCT) assembly
7	6306	Crankshaft sprocket
8	6L266	LH timing chain tensioner
9	6K255	LH timing chain tensioner arm
10	6268	LH timing chain
11	6C261	LH VCT assembly
12	6621	Oil pump
13	6B752	Oil separator gasket
14	6869	Cover
15	6701	Crankshaft rear oil seal
16	6A373	Spacer plate
17	6K375	Flexplate
18	9278	Oil pressure switch
19	19N586	A/C compressor bracket
20	W705934	Woodruff key
21	6622	Oil pickup tube and screen
22	6687	Oil pan baffle
23	6890	Oil filter adapter
24	6714	Oil filter
25	6675	Oil pan
26	10300	Generator
27	6B209	Accessory drive belt tensioner
28	6700	Crankshaft front seal
29	6316	Crankshaft pulley
30	N806165	Crankshaft pulley washer
31	W701512	Crankshaft pulley bolt
32	19A216	Accessory drive belt idler (non-grooved)
33	6C315	Crankshaft Position (CKP) sensor
34	6B288	Camshaft Position (CMP) sensor
35	19A216	Accessory drive belt idler pulley (grooved)
36	6B288	CMP sensor
37	6019	Front cover

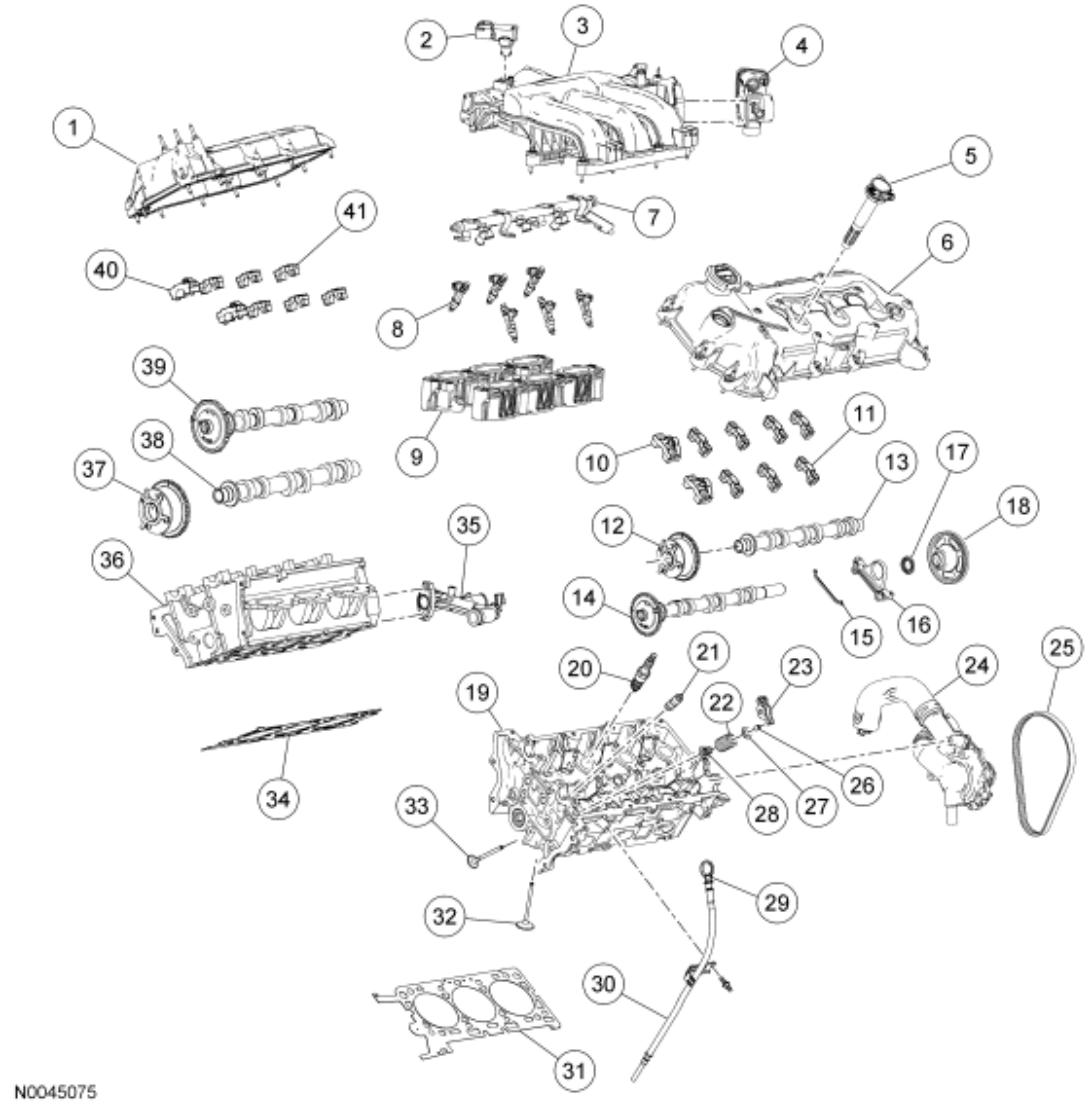


Fig. 338: Exploded View Of Upper Engine Components
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6582	RH valve cover
2	9F479	Mass Air Flow (MAF) sensor
3	9424	Upper intake manifold
4	9F991	Throttle Body (TB)
5	12A375	Coil-on-plug (6 required)
6	6A505	LH valve cover
7	9F792	Fuel rail
8	9F543	Fuel injector (6 required)
9	9K461	Lower intake manifold
10	6B280	Camshaft thrust bearing cap

11	6B280	Camshaft bearing cap
12	6C524	Variable Camshaft Timing (VCT) actuator
13	6A267	LH intake camshaft
14	6A269	LH exhaust camshaft
15	6B295	Camshaft oil seal retainer gasket
16	6B293	Camshaft oil seal retainer
17	-	Camshaft oil seal
18	6A359	Coolant pump drive pulley
19	6050	LH cylinder head
20	12405	Spark plug
21	6C501	Hydraulic lash adjuster
22	6513	Valve spring
23	6529	Camshaft roller follower
24	8501	Coolant pump
25	8K543	Coolant pump belt
26	6518	Valve spring retainer key
27	6514	Valve spring retainer
28	6A517	Valve stem seal
29	-	Oil level indicator
30	6754	Oil level indicator tube
31	6083	LH cylinder head gasket
32	6507	Intake valve
33	6505	Exhaust valve
34	6051	RH cylinder head gasket
35	8548	Coolant bypass tube
36	6050	RH cylinder head
37	6C254	VCT actuator
38	6A266	RH intake camshaft
39	6A268	RH exhaust camshaft
40	6B280	Camshaft thrust bearing cap
41	6A258	Camshaft bearing cap

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

NOTE: If the oil pan was removed during engine disassembly, it must be installed after the engine and transaxle are assembled and the transaxle-to-engine bolts are installed. Failure to follow this assembly sequence can result in engine oil leaks.

All engines

1. Install the oil separator cover, a new gasket and the bolts.
   - Tighten to 10 Nm (89 lb-in).

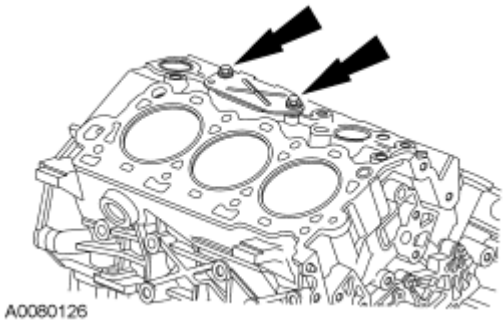


Fig. 339: Locating Oil Separator Cover Bolts
Courtesy of FORD MOTOR CO.

NOTE: RH shown, LH similar.

2. Position the new gaskets and the LH and RH cylinder heads. Install new bolts and tighten in the sequence shown in 6 stages:
   - Stage 1: Tighten to 40 Nm (30 lb-ft).
   - Stage 2: Tighten to 90 Nm (66 lb-ft).
   - Stage 3: Loosen one full turn.
   - Stage 4: Tighten to 40 Nm (30 lb-ft).
   - Stage 5: Tighten 90 degrees.
   - Stage 6: Tighten 90 degrees.

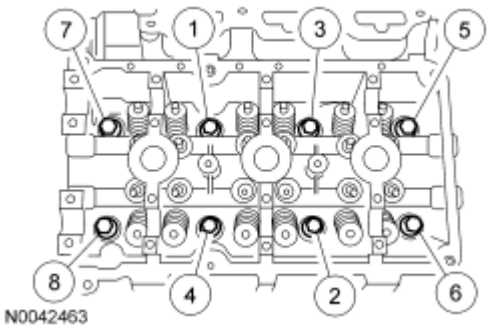


Fig. 340: Identifying Tightening Sequence Of Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

3. Position the oil pump and install the 4 bolts.
   - Tighten in the sequence shown to 10 Nm (89 lb-in).

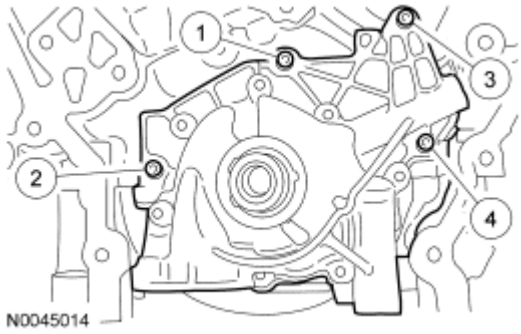


Fig. 341: Identifying Tightening Sequence Of Oil Pump Bolts
Courtesy of FORD MOTOR CO.

4. If removed, install the crankshaft key into the keyway on the crankshaft.

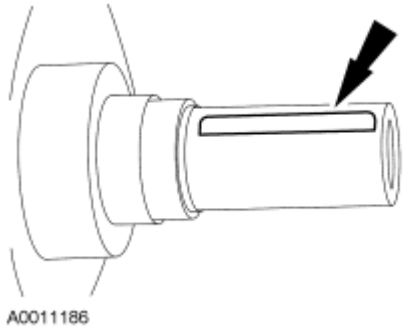


Fig. 342: Locating Crankshaft Key
Courtesy of FORD MOTOR CO.

5. Install the crankshaft pulley bolt and washer and rotate the crankshaft keyway to the 11 o'clock position to locate Top Dead Center (TDC).

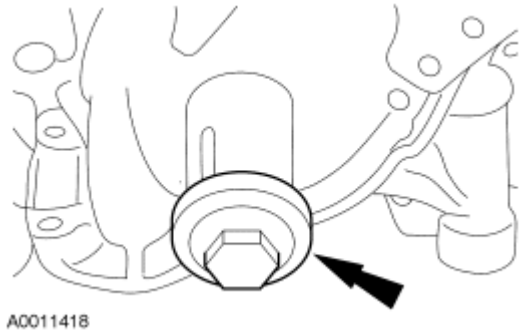


Fig. 343: Locating Crankshaft Damper Bolt
Courtesy of FORD MOTOR CO.

6. Apply clean engine oil to the LH and RH camshaft roller followers.

NOTE: The camshaft roller followers must be installed in their original positions

or damage to the engine may occur.

NOTE: RH shown, LH similar.

7. Install the LH and RH camshaft roller followers.

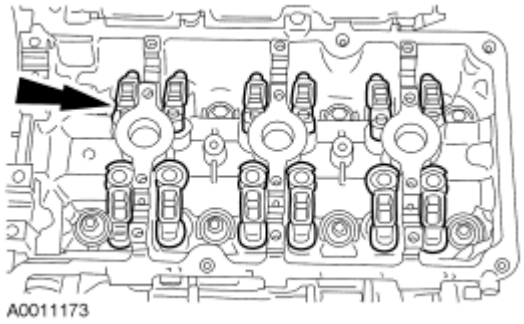


Fig. 344: Locating Camshaft Roller Followers
Courtesy of FORD MOTOR CO.

8. Position the Variable Camshaft Timing (VCT) actuators onto the intake camshafts.
   - Install the bolts finger-tight.

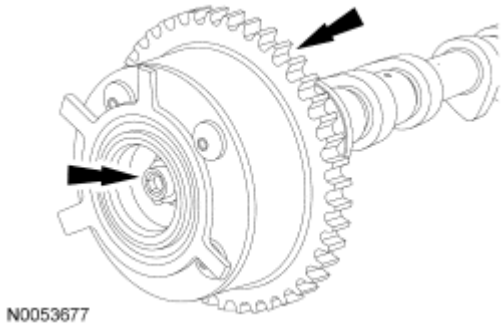


Fig. 345: Locating VCT Actuator Onto Intake Camshaft
Courtesy of FORD MOTOR CO.

9. Lubricate the RH camshafts with clean engine oil and carefully position the camshafts onto the cylinder head.
   - Align the RH camshafts as shown.

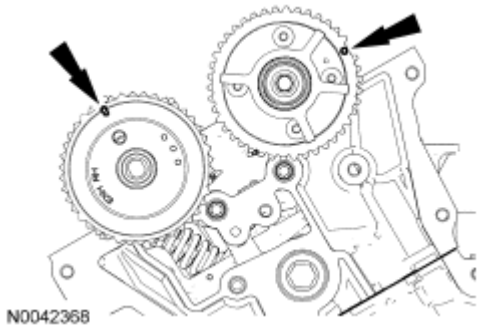


Fig. 346: Locating RH Camshafts Position
Courtesy of FORD MOTOR CO.

NOTE: The camshaft caps must be installed in their original positions or damage to the engine may occur.

NOTE: Do not install the camshaft bearing thrust caps until all of the camshaft bearing caps have been installed or damage to the thrust caps may occur.

NOTE: Lubricate the bearing surfaces of the camshaft bearing caps with clean engine oil.

10. Install the RH camshaft bearing caps.
    - Loosely install the bolts.

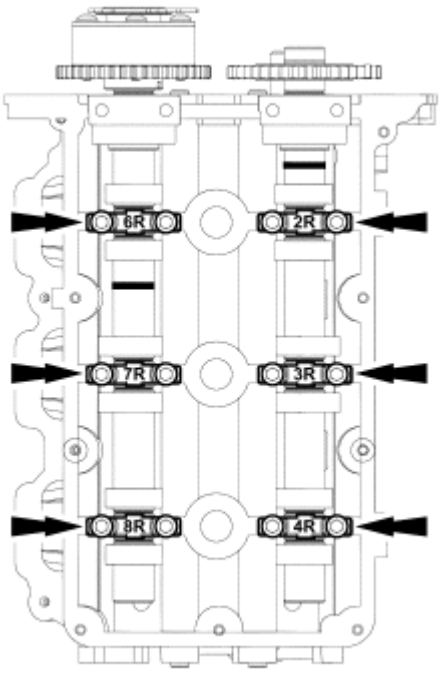


Fig. 347: Locating Camshaft Bearing Caps

Courtesy of FORD MOTOR CO.

NOTE: Lubricate the bearing surfaces of the camshaft bearing thrust caps with clean engine oil.

11. Install the RH camshaft bearing thrust caps.
    - Loosely install the bolts.

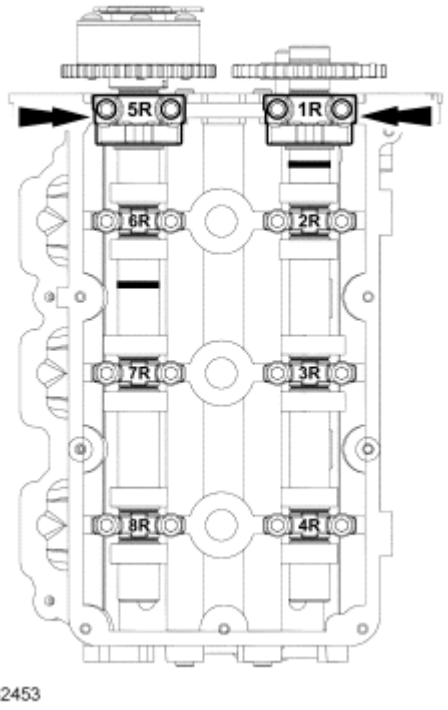
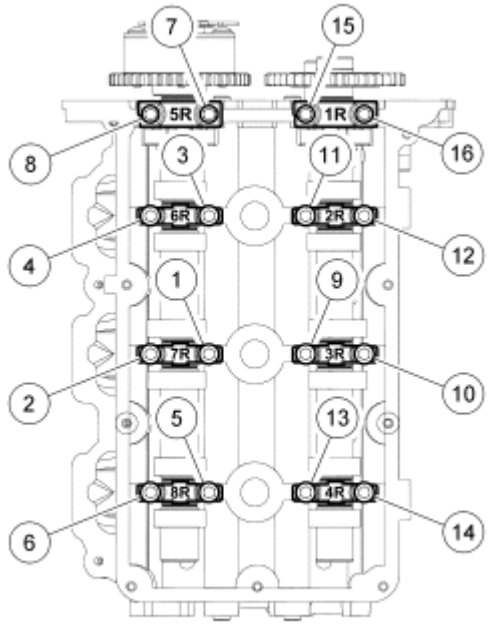


Fig. 348: Locating Camshaft Bearing Thrust Caps
Courtesy of FORD MOTOR CO.

12. Tighten the RH camshaft bearing cap bolts in the sequence shown to 10 Nm (89 lb-in).



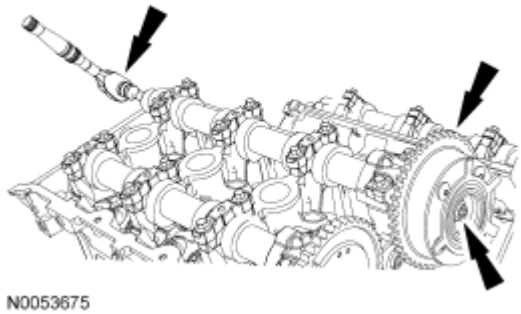
N0081822

Fig. 349: Tightening RH Camshaft Bearing Cap Bolts In Sequence
Courtesy of FORD MOTOR CO.

NOTE: Do not allow the camshaft to rotate from the neutral position while removing the Variable Camshaft Timing (VCT) actuator or damage to the engine may occur.

NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for tightening of the VCT actuator bolt.

13. Tighten the RH VCT actuator bolt to 40 Nm (30 lb-ft) plus an additional 90 degrees.



N0053675

Fig. 350: Locating VCT Actuator And Bolt
Courtesy of FORD MOTOR CO.

14. Lubricate the LH camshafts with clean engine oil and carefully position the camshafts into the cylinder head.
    - Align the LH camshafts as shown.

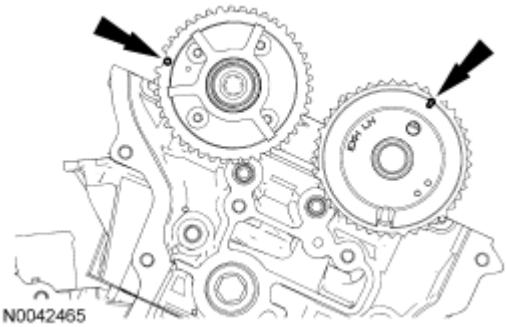


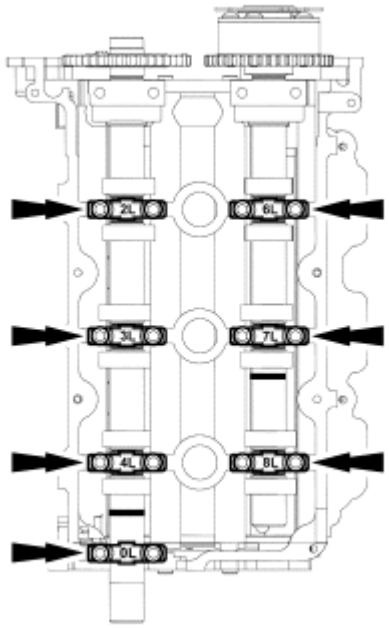
Fig. 351: Locating Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

NOTE: The camshaft caps must be installed in their original positions or damage to the engine may occur.

NOTE: Do not install the camshaft bearing thrust caps until all of the camshaft bearing caps have been installed or damage to the thrust caps may occur.

NOTE: Lubricate the bearing surfaces of the camshaft bearing caps with clean engine oil.

15. Install the LH camshaft bearing caps.
    - Loosely install the bolts.



N0081819

Fig. 352: Loosely Installing Bolts
Courtesy of FORD MOTOR CO.

NOTE: Lubricate the bearing surfaces of the camshaft bearing thrust caps with clean engine oil.

16. Install the LH camshaft bearing thrust caps.
    - Loosely install the bolts.

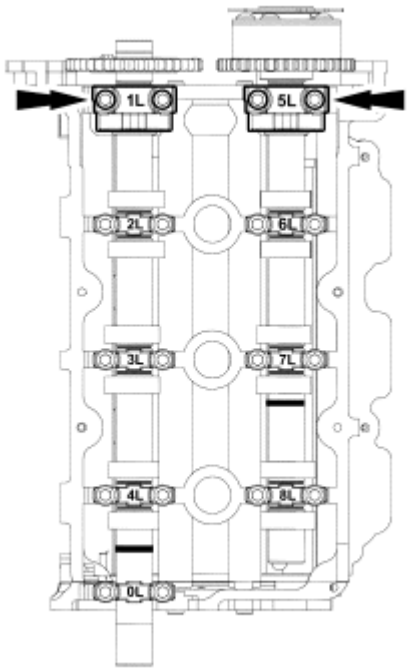


Fig. 353: Loosely Installing Bolts
Courtesy of FORD MOTOR CO.

17. Tighten the LH camshaft bearing cap bolts in the sequence shown to 10 Nm (89 lb-in).

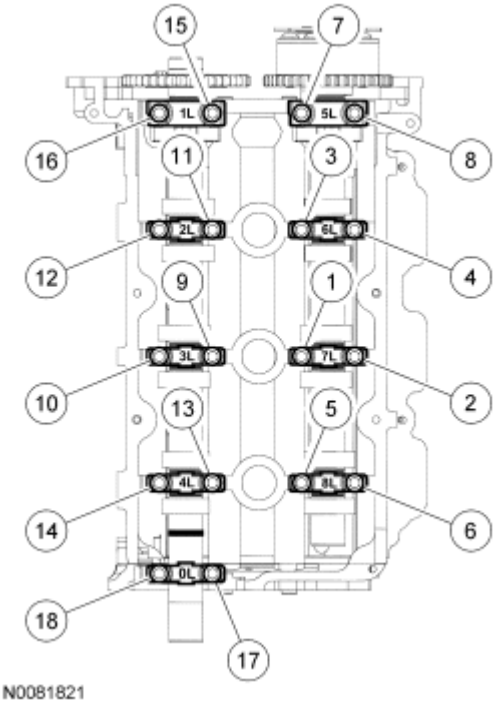


Fig. 354: Tightening LH Camshaft Bearing Cap Bolts In Sequence

Courtesy of FORD MOTOR CO.

NOTE: Do not allow the camshaft to rotate from the neutral position while tightening the Variable Camshaft Timing (VCT) actuator bolt or damage to the engine may occur.

NOTE: Install a 3/8-in ratchet and extension into the D-slot on the rear of the intake camshaft to hold the camshaft in place for tightening of the VCT actuator bolt.

18. Tighten the LH VCT actuator bolt to 40 Nm (30 lb-ft) plus an additional 90 degrees.

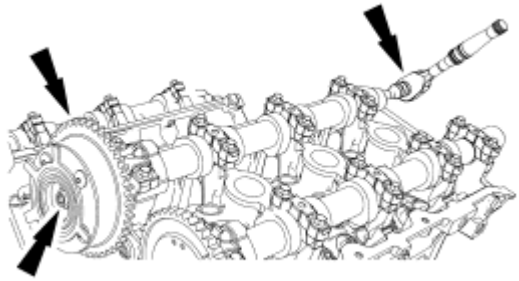


Fig. 355: Locating VCT Actuator And Bolt
Courtesy of FORD MOTOR CO.

NOTE: Clean the sealing surface with metal surface prep before installing a new press-in-place gasket.

19. Install the camshaft oil seal retainer and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

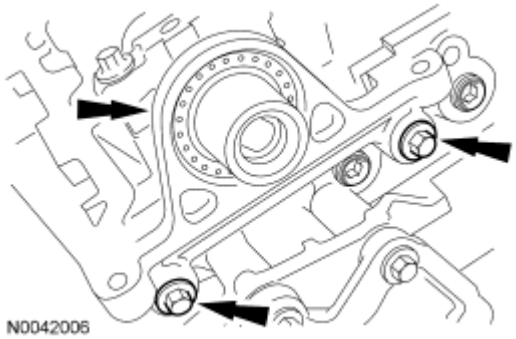


Fig. 356: Locating Camshaft Oil Seal Retainer And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Apply clean engine oil to the seal lip and seal bore before installing the seal.

20. Using the Camshaft Oil Seal Protector, Camshaft Oil Seal Installer and the Power Steering Pump Pulley Installer, install a new camshaft oil seal.

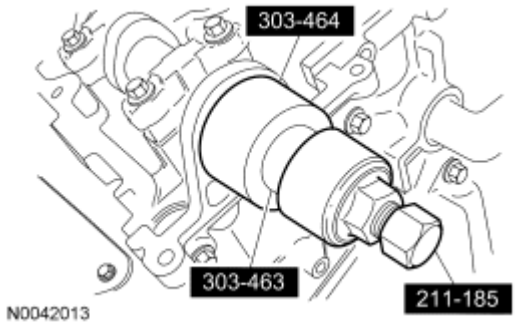


Fig. 357: Identifying Special Tools (303-463, 303-464 And 211-185)
Courtesy of FORD MOTOR CO.

21. Remove the crankshaft pulley bolt and washer.

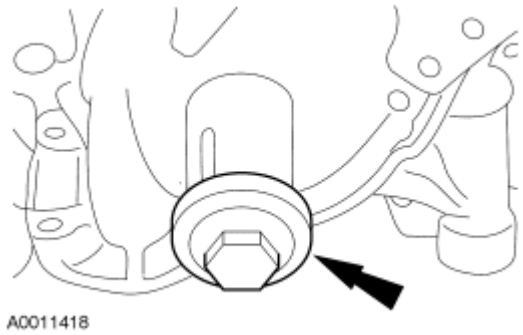


Fig. 358: Locating Crankshaft Damper Bolt
Courtesy of FORD MOTOR CO.

22. Install the crankshaft sprockets with the timing marks out.

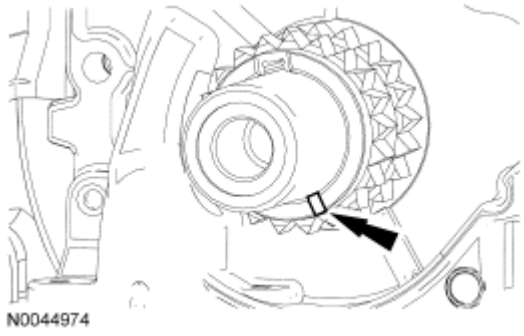


Fig. 359: Locating Timing Marks On Crankshaft Sprockets
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

23. Position the chain tensioner in a soft-jawed vise.

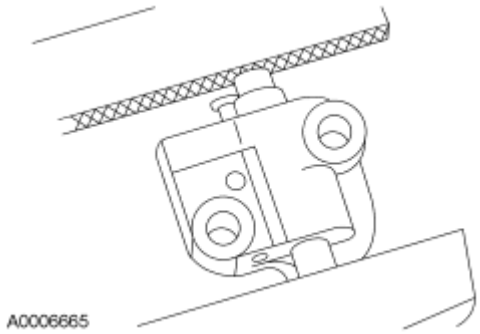


Fig. 360: Identifying Chain Tensioner In Soft-Jawed Vise
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

24. Hold the chain tensioner ratchet lock mechanism away from the ratchet stem with a small pick.

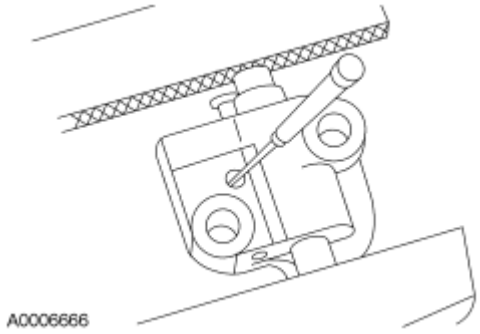


Fig. 361: Holding Chain Tensioner Ratchet Lock Mechanism Away From Ratchet Stem
Courtesy of FORD MOTOR CO.

NOTE: During tensioner compression, do not release the ratchet stem until the tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.

25. Slowly compress the timing chain tensioner.
26. Retain the tensioner piston with a 1.5 mm (0.05 in) wire or paper clip.

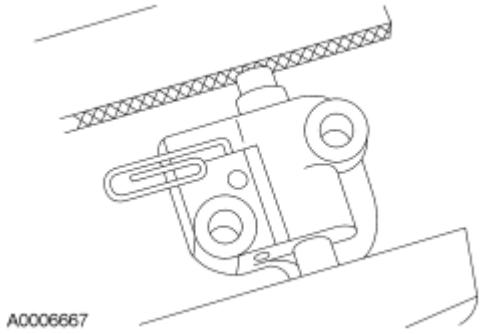


Fig. 362: Retaining Tensioner Piston With 1.5-mm (0.06-in) Wire Or Paper Clip
Courtesy of FORD MOTOR CO.

27. If timing marks in the timing chains are not evident, use a permanent-type marker to mark the crankshaft and camshaft timing marks on the LH and RH timing chains.
    1. Mark any link to use as the crankshaft timing mark.
    2. Starting with the crankshaft timing mark, count counterclockwise 29 links and mark the link.
    3. Continue counting counterclockwise to link 42 and mark the link.

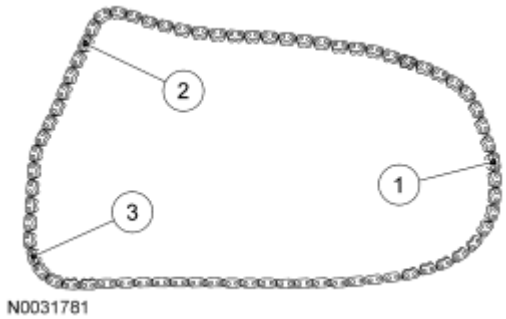


Fig. 363: Locating Crankshaft & Camshaft Timing Marks On LH & RH Timing Chains
Courtesy of FORD MOTOR CO.

28. Verify that the LH camshafts are correctly positioned.

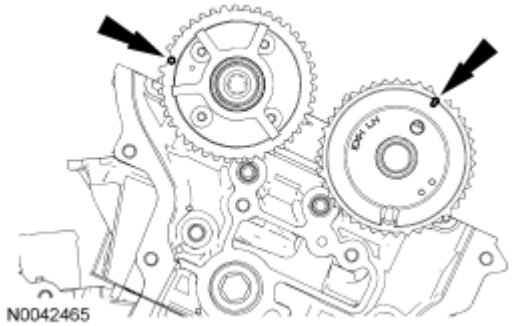


Fig. 364: Locating Camshafts In Neutral Position
Courtesy of FORD MOTOR CO.

29. Install the VCT assembly and the 4 bolts.
    - Tighten to 25 Nm (18 lb-ft).

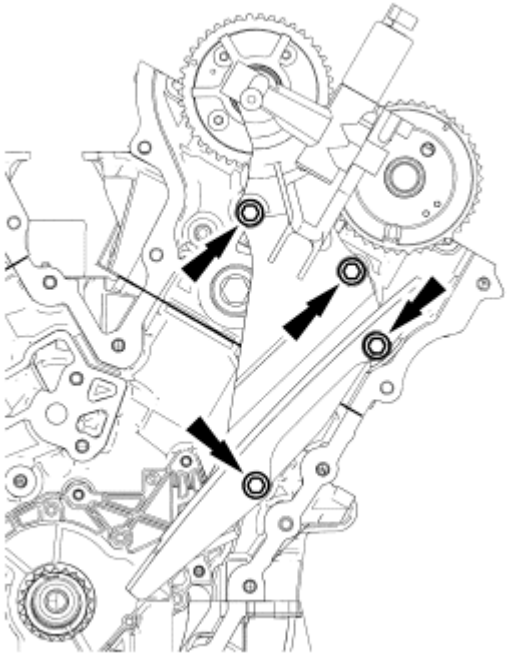


Fig. 365: Identifying LH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

30. Install the LH timing chain.
    - Align the marks on the timing chain with the marks on the camshaft and crankshaft sprockets.

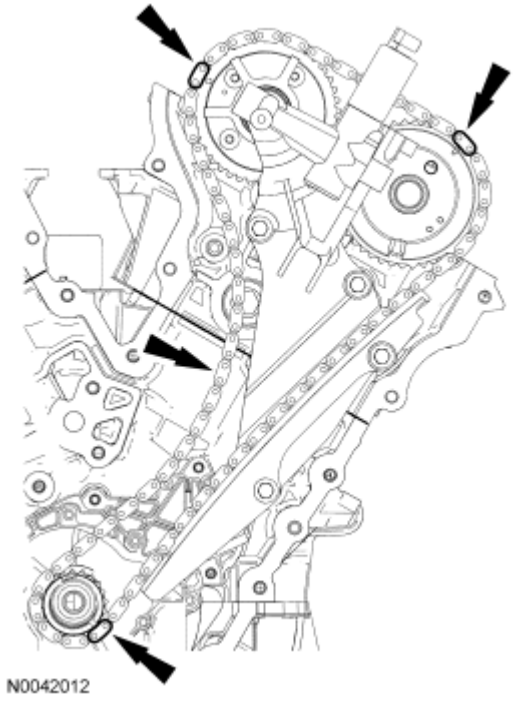


Fig. 366: Aligning Marks On Timing Chain With Marks On Camshaft And Crankshaft Sprockets
Courtesy of FORD MOTOR CO.

31. Install the LH timing chain tensioner arm and the LH timing chain tensioner.
    1. Install the tensioner arm.
    2. Position the tensioner.
    3. Install the 2 bolts.
    4. Tighten to 25 Nm (18 lb-ft).

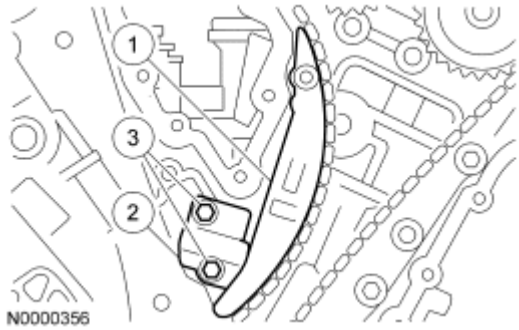


Fig. 367: Identifying Timing Chain Tensioner Arm & Bolts
Courtesy of FORD MOTOR CO.

32. Install the crankshaft pulley bolt and washer and rotate the crankshaft clockwise 120 degrees until the crankshaft keyway is in the 3 o'clock position.

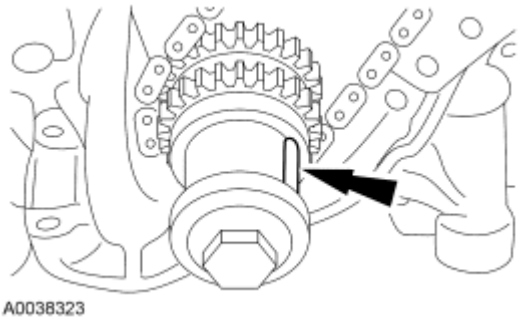


Fig. 368: Locating Crankshaft Keyway
Courtesy of FORD MOTOR CO.

33. Verify that the RH camshafts are correctly positioned.

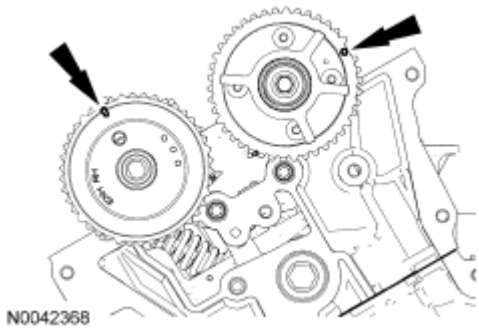


Fig. 369: Locating RH Camshafts Position
Courtesy of FORD MOTOR CO.

34. Install the RH VCT assembly and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

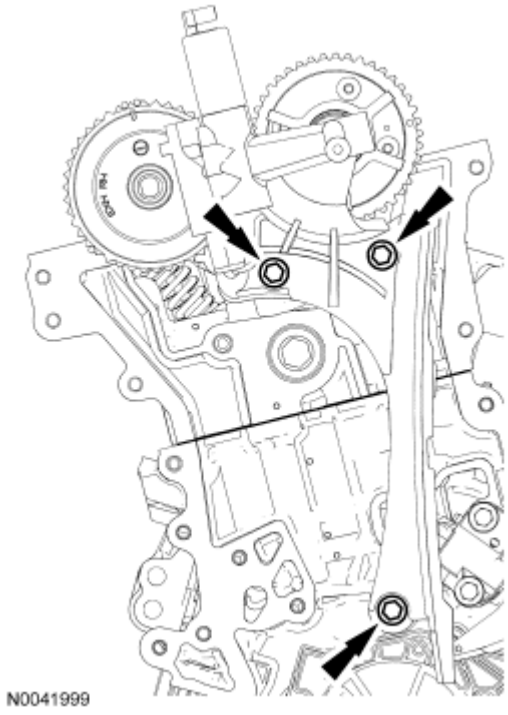


Fig. 370: Locating RH VCT Assembly Bolts
Courtesy of FORD MOTOR CO.

35. Install the RH timing chain.
    - Align the marks on the timing chain with the marks on the camshaft and crankshaft sprockets.

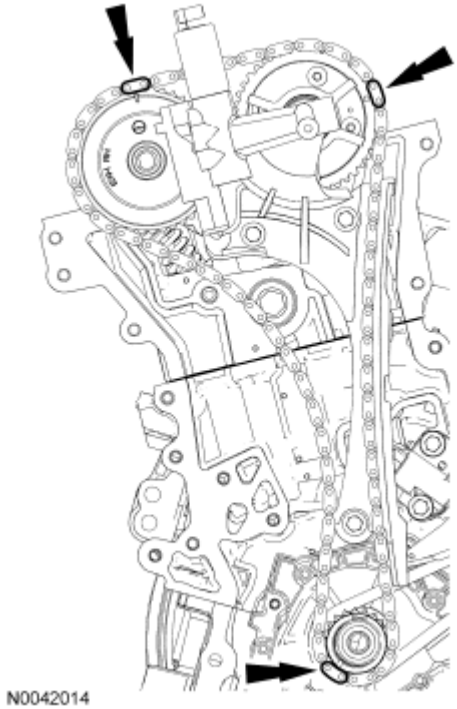


Fig. 371: Aligning Marks On Timing Chain With Marks On Camshaft And Crankshaft Sprockets
Courtesy of FORD MOTOR CO.

36. Install the RH timing chain tensioner and tensioner arm.
    1. Install the tensioner arm.
    2. Position the tensioner.
    3. Install the 2 bolts.
    4. Tighten to 25 Nm (18 lb-ft).

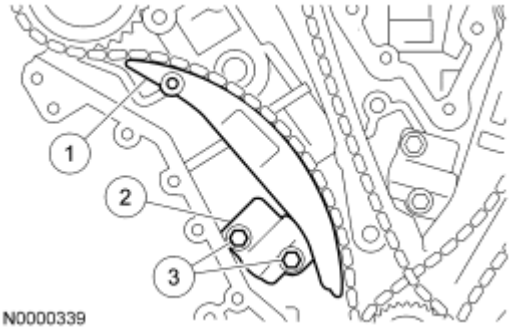


Fig. 372: Identifying Tensioner Arm, Tensioner And Bolts
Courtesy of FORD MOTOR CO.

37. Remove the LH and RH timing chain tensioner piston retaining wires.
38. Rotate the crankshaft counterclockwise 120 degrees to TDC.

NOTE: Failure to verify correct timing drive component alignment will result in severe engine damage.

39. Verify the timing with the following steps.
    1. There should be 12 chain links between the camshaft timing marks.
    2. There should be 27 chain links between the camshaft and the crankshaft timing marks.
    3. There should be 30 chain links between the camshaft and the crankshaft timing marks.

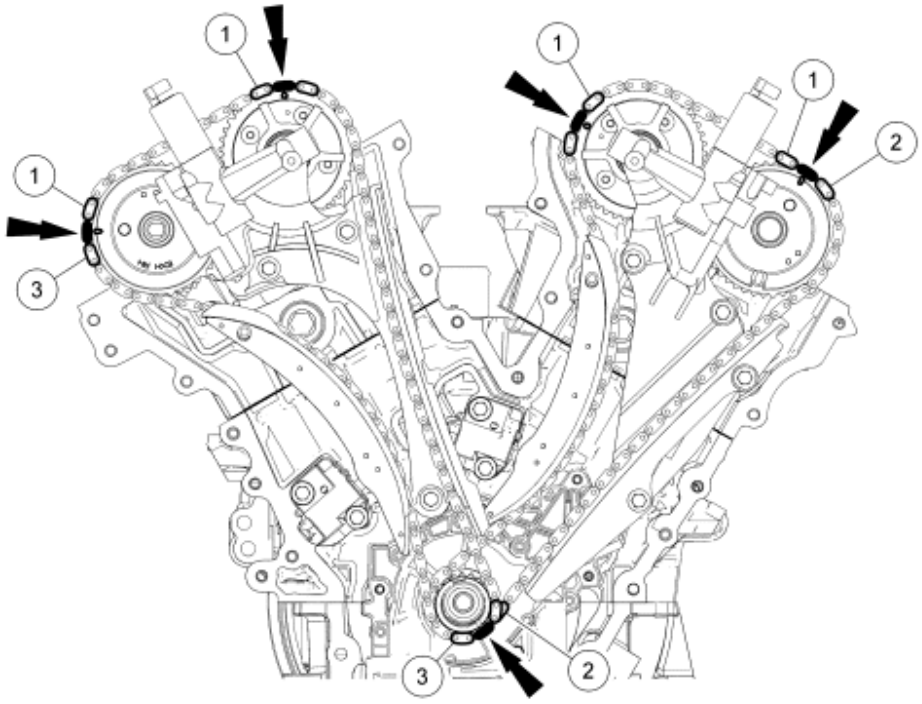


Fig. 373: Locating Align Marks On Chain
Courtesy of FORD MOTOR CO.

40. Remove the crankshaft pulley bolt and washer.

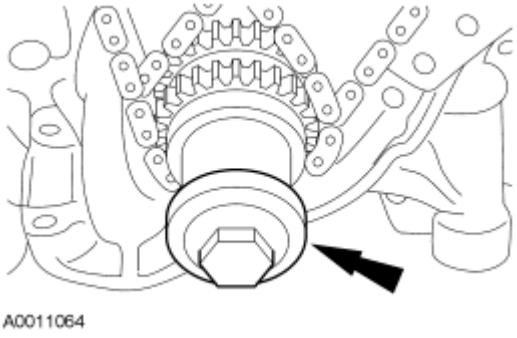


Fig. 374: Identifying Damper Bolt
Courtesy of FORD MOTOR CO.

NOTE: This pulse wheel is used in several different engines. Install the pulse wheel with the keyway in the slot stamped 30RFF only (orange in color).

41. Install the ignition pulse wheel.

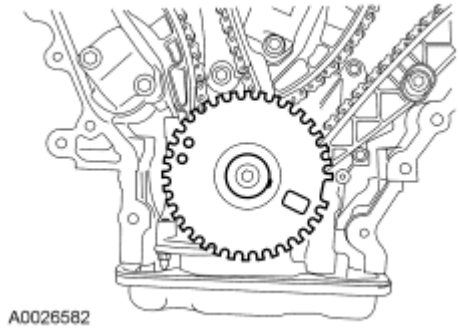


Fig. 375: Identifying Ignition Pulse Wheel
Courtesy of FORD MOTOR CO.

42. Install 3 new gaskets in the front cover.

NOTE: Clean the sealing surfaces with metal surface prep before applying gasket and sealant.

NOTE: The front cover must be installed and the bolts tightened within 4 minutes of sealant application.

43. Apply a 6 mm (0.23 in) dot of silicone gasket and sealant to the cylinder block to lower cylinder block and cylinder head mating surfaces.

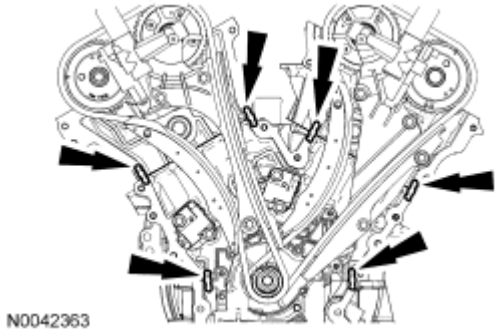
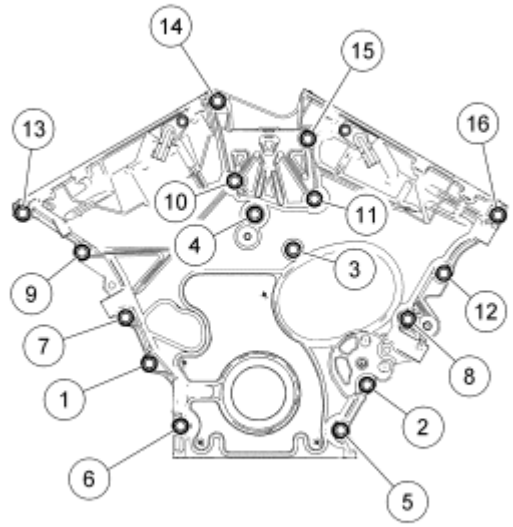


Fig. 376: Locating Silicone Gasket And Sealant On Cylinder Block
Courtesy of FORD MOTOR CO.

NOTE: Fasteners 1 and 13 are stud bolts.

44. Position the engine front cover and install the 14 bolts and 2 stud bolts.
    - Tighten in the sequence shown to 25 Nm (18 lb-ft).



N0042364

Fig. 377: Locating Tighten Sequence Of Engine Front Cover Bolts
Courtesy of FORD MOTOR CO.

45. Apply clean engine oil to the seal lip and seal bore before installing the seal.
46. Using the Front Cover Oil Seal Installer and the Crankshaft Vibration Damper Installer, install a new crankshaft front seal.

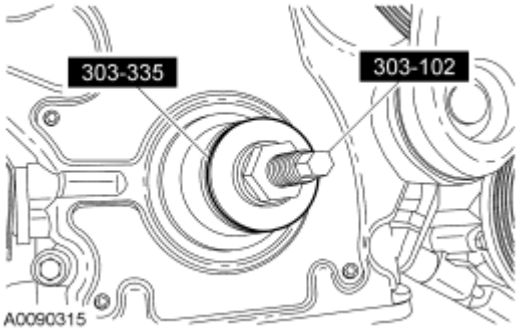


Fig. 378: Installing Crankshaft Seal Using Special Tools (303-335 And 303-102)
Courtesy of FORD MOTOR CO.

NOTE: Clean the keyway and slot using metal surface prep before applying silicone gasket and sealant.

NOTE: The crankshaft pulley must be installed and the bolt tightened within 4 minutes of applying the silicone gasket and sealer.

47. Apply silicone gasket and sealant to the end of the keyway slot.

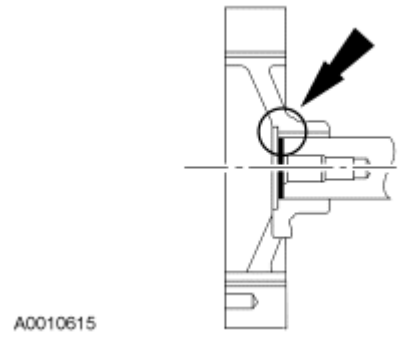


Fig. 379: Applying Silicone Gasket And Sealant
Courtesy of FORD MOTOR CO.

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

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

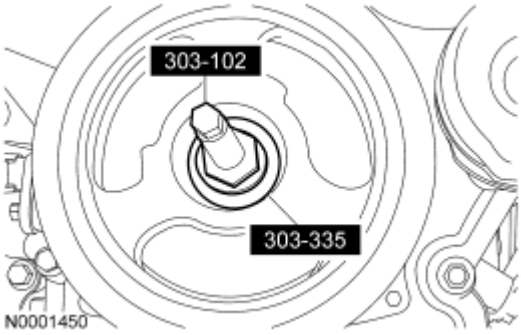


Fig. 380: Installing Crankshaft Pulley
Courtesy of FORD MOTOR CO.

49. Install the bolt and washer. Using the Strap Wrench to hold the crankshaft pulley, tighten the bolt 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.

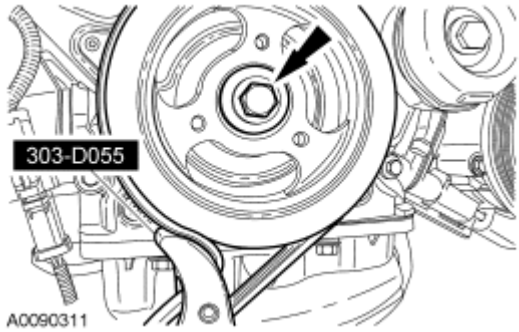


Fig. 381: Identifying Special Tool (303-D055) And Crankshaft Pulley Bolts
Courtesy of FORD MOTOR CO.

50. Install the accessory drive belt tensioner and the 2 idler pulleys.
    - Tighten the tensioner bolt to 45 Nm (33 lb-ft).
    - Tighten the idler pulley bolts to 25 Nm (18 lb-ft).

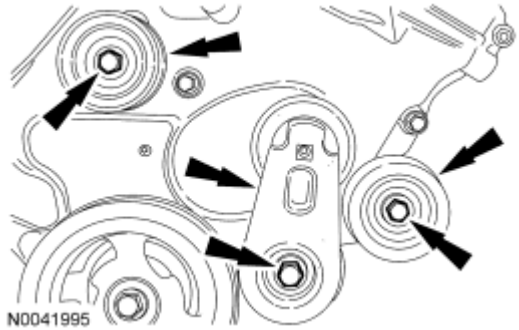


Fig. 382: Locating Accessory Drive Belt Tensioner And Idler Pulleys
Courtesy of FORD MOTOR CO.

51. Install the oil pan baffle and the 8 nuts.
    - Tighten the oil pan baffle nuts in 2 stages.
        - Stage 1: Tighten the 4 smaller nuts to 5 Nm (44 lb-in) and the larger nuts to 15 Nm (133 lb-in).
        - Stage 2: Tighten all 8 nuts an additional 45 degrees.

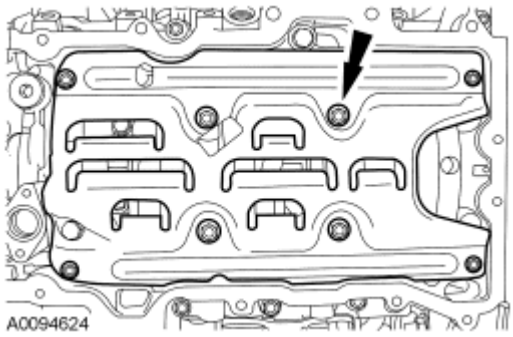


Fig. 383: Locating Oil Pan Baffle Nuts

Courtesy of FORD MOTOR CO.

52. Install a new O-ring seal on the oil pump screen and pickup tube.
    - Lubricate with clean engine oil.

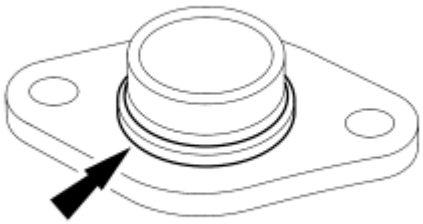


Fig. 384: Locating O-Ring Seal
Courtesy of FORD MOTOR CO.

53. Install the oil pump screen and pickup tube and the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

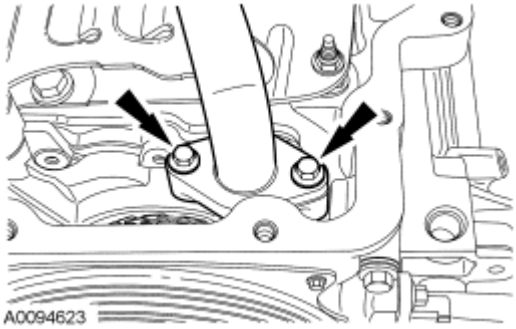


Fig. 385: Locating Oil Pump Screen & Pickup Tube Bolts
Courtesy of FORD MOTOR CO.

NOTE: Only use hand tools when removing or installing the spark plugs or damage can occur to the cylinder head or spark plug.

54. Install the LH and RH spark plugs.
    - Tighten to 15 Nm (133 lb-in).

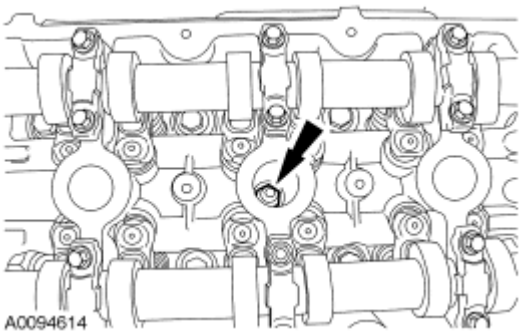


Fig. 386: Locating Spark Plugs
Courtesy of FORD MOTOR CO.

NOTE: The valve cover must be installed and the bolts and stud bolts tightened within 4 minutes of sealant application.

55. Apply a an 8 mm (0.31 in) dot of silicone gasket sealant to the front cover-to-cylinder head joints and the cam seal retainer-to-cylinder head joints.

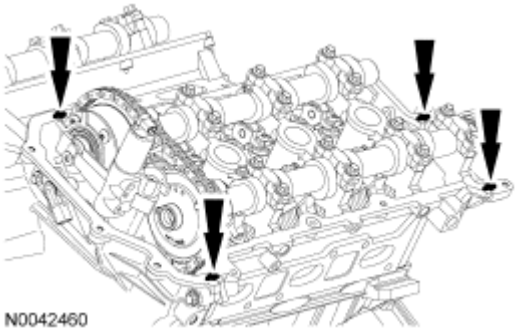


Fig. 387: Locating Silicone Gasket Sealant
Courtesy of FORD MOTOR CO.

56. Position the LH valve cover and install the bolts and stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

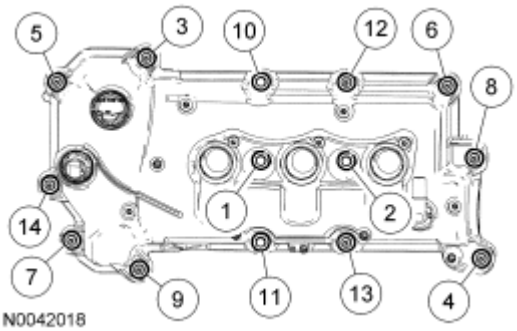


Fig. 388: Identifying Tightening Sequence Of Valve Cover Bolts
Courtesy of FORD MOTOR CO.

NOTE: Apply a light film of silicone brake caliper grease and dielectric compound to the interior of the spark plug boot prior to installation.

57. Install the 3 LH coil-on-plug assemblies and the 3 bolts.
    - Tighten to 7 Nm (62 lb-in).

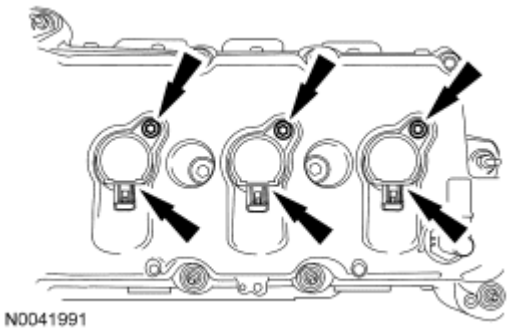


Fig. 389: Locating LH Coil-On-Plug Assemblies And Bolts
Courtesy of FORD MOTOR CO.

NOTE: The valve cover must be installed and the bolts and stud bolts tightened within 4 minutes of sealant application.

58. Apply an 8 mm (0.31 in) dot of silicone gasket sealant to the front cover-to-cylinder head joints.

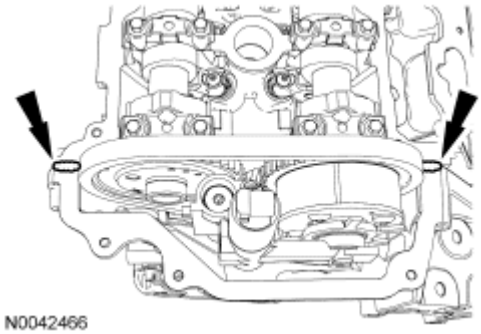


Fig. 390: Locating Silicone Gasket Sealant
Courtesy of FORD MOTOR CO.

59. Position the RH valve cover and install the bolts and stud bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

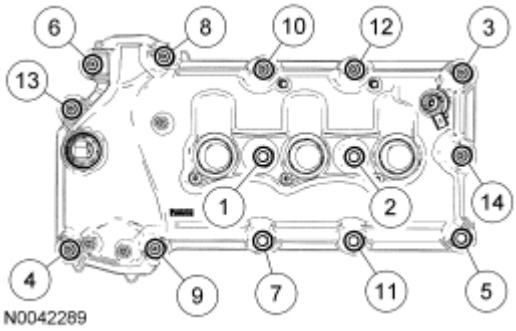


Fig. 391: Identifying Tightening Sequence Of Valve Cover Bolts
Courtesy of FORD MOTOR CO.

NOTE: Apply a light film of silicone brake caliper grease and dielectric compound to the interior of the spark plug boot prior to installation.

60. Install the 3 RH coil-on-plug assemblies and the 3 bolts.
    - Tighten to 7 Nm (62 lb-in).

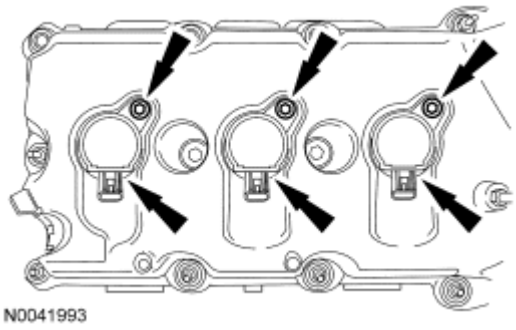


Fig. 392: Locating RH Coil-On-Plug Assemblies And Bolts
Courtesy of FORD MOTOR CO.

61. If equipped, install the block heater.
    - Tighten to 40 Nm (30 lb-ft).

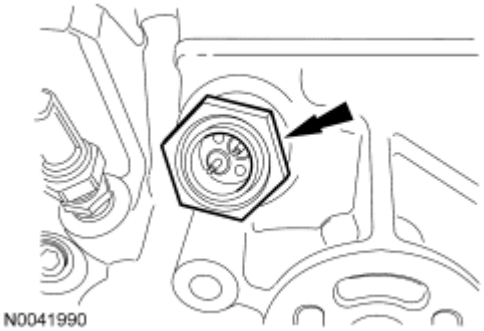


Fig. 393: Locating Block Heater
Courtesy of FORD MOTOR CO.

NOTE: Apply thread sealant with PTFE to the Engine Oil Pressure (EOP) switch threads.

62. Install the EOP switch.
    - Tighten to 14 Nm (124 lb-in).

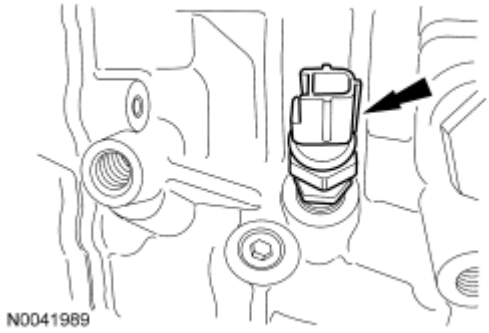


Fig. 394: Locating EOP Switch
Courtesy of FORD MOTOR CO.

63. Install the KS and the bolt.
    - Tighten to 20 Nm (177 lb-in).

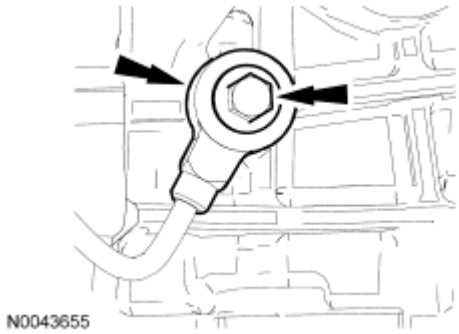


Fig. 395: Locating Knock Sensor (KS) And Bolt
Courtesy of FORD MOTOR CO.

64. Install the coolant pump and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in) then rotate 90 degrees.

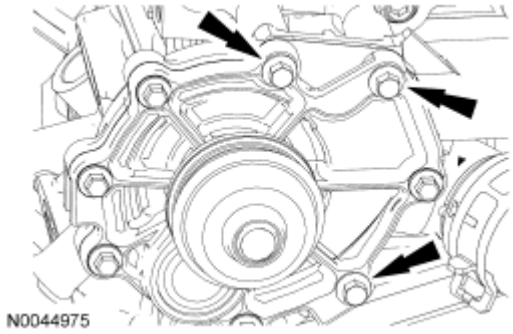


Fig. 396: Locating Coolant Pump And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.

65. Install the Camshaft Pulley Installer on the camshaft as shown in the illustration.
    - Adjust the collar on the Camshaft Pulley Installer screw to get the best thread engagement in the rear of the camshaft.

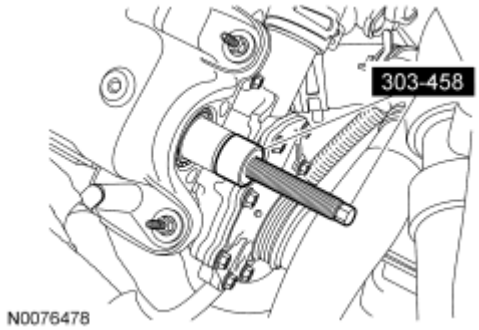


Fig. 397: Installing Special Tool On Camshaft
Courtesy of FORD MOTOR CO.

NOTE: Failure to use the correct special tools, assembled as shown in the illustration, will result in damage to the coolant pump pulley and/or special tools.

NOTE: Only the roller collared nut from the Power Steering Pump Pulley Installer (211-185) is used on the Camshaft Pulley Installer (303-458).

66. Position the coolant pump pulley over the previously installed Camshaft Pulley Installer, Water Pump Pulley Spacer and the Power Steering Pump Pulley Installer, and on the end of the camshaft. Install the Camshaft Pulley Installer, Water Pump Pulley Spacer and the Power Steering Pump Pulley Installer, as shown in the illustration.
    - Using the Camshaft Pulley Installer, Water Pump Pulley Spacer and the Power Steering Pump

Pulley Installer, install the coolant pump pulley flush with the end of the camshaft.

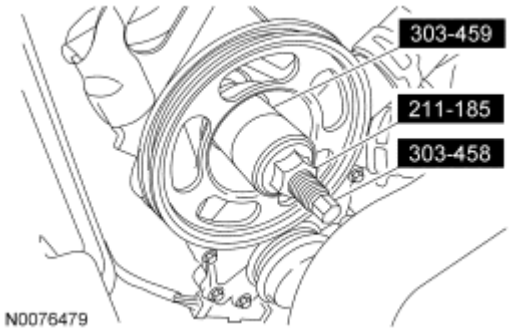


Fig. 398: Installing Coolant Pump Pulley Using Special Tools (211-185, 303-458, 303-459)
Courtesy of FORD MOTOR CO.

67. Install the coolant pump belt on the coolant pump pulley and position it on the coolant pump drive pulley.

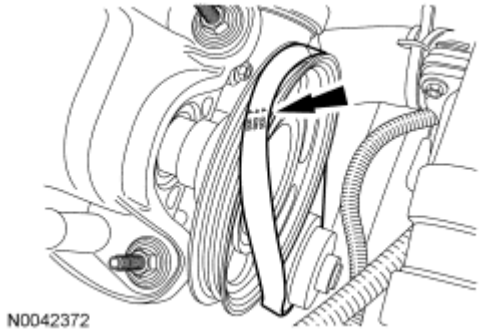


Fig. 399: Locating Coolant Pump Belt On Coolant Pump Pulley
Courtesy of FORD MOTOR CO.

NOTE: Do not use any screwdrivers, pliers or other metal objects that could cause damage to the belt or pulley while installing the belt.

68. Rotate the crankshaft clockwise to seat the coolant pump belt on the coolant pump drive belt pulley.
69. Connect the coolant pump hose to the cylinder block outlet.

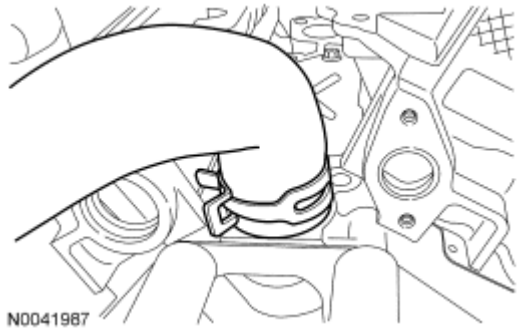


Fig. 400: Locating Coolant Pump Hose From Cylinder Block Outlet

Courtesy of FORD MOTOR CO.

NOTE: Lubricate the new O-ring seals with clean engine coolant.

70. Install new O-ring seals, the coolant bypass tube, bolt and stud bolt.
    - Tighten to 10 Nm (89 lb-in).

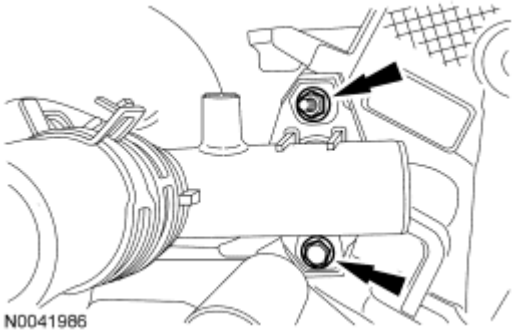


Fig. 401: Locating Bolt, Stud Bolt And Coolant Bypass
Courtesy of FORD MOTOR CO.

71. Install the thermostat housing.

Fig. 402: Locating Clamps And Thermostat Housing
Courtesy of FORD MOTOR CO.

NOTE: Clean and inspect all sealing surfaces. Install new gaskets.

72. Position the lower intake manifold and install the 8 bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

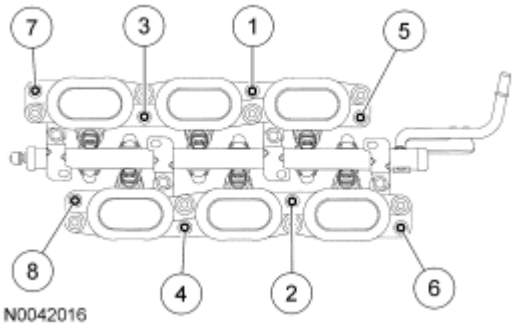


Fig. 403: Identifying Tightening Sequence Of Lower Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

73. Install a new O-ring on the oil level indicator tube. Apply clean engine oil to the O-ring.

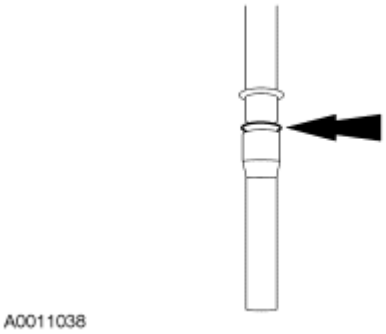


Fig. 404: Locating O-Ring On Oil Level Indicator Tube
Courtesy of FORD MOTOR CO.

74. Position the oil level indicator and tube and install the stud bolt.
    - Tighten to 9 Nm (80 lb-in).

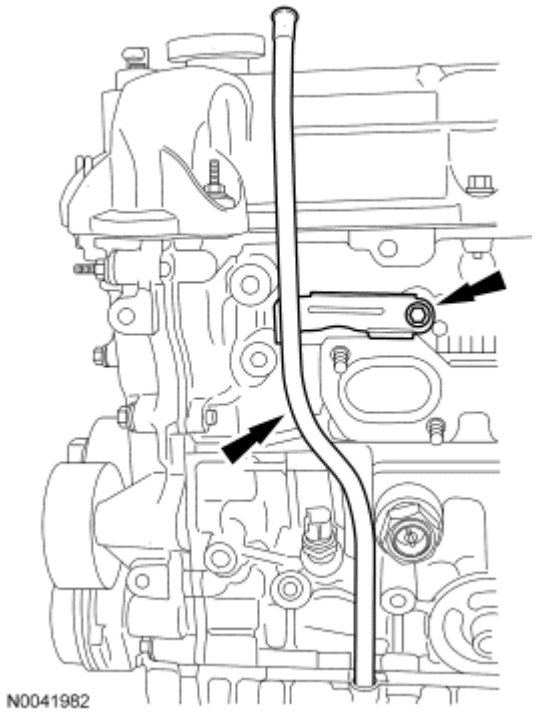


Fig. 405: Locating Oil Level Indicator Tube And Bolt
Courtesy of FORD MOTOR CO.

75. Install the LH catalytic converter bracket and the 2 bolts.
    - Tighten to 35 Nm (26 lb-ft).

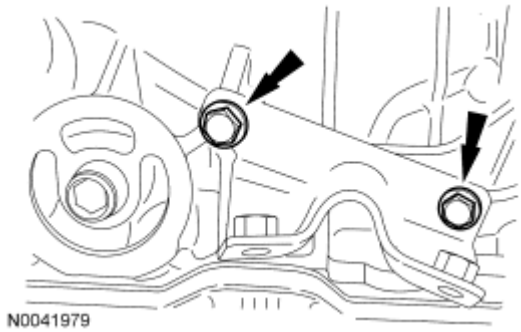


Fig. 406: Locating LH Catalytic Converter Bracket Bolts
Courtesy of FORD MOTOR CO.

76. Install 6 new RH catalytic converter studs.
    - Tighten to 12 Nm (106 lb-in).

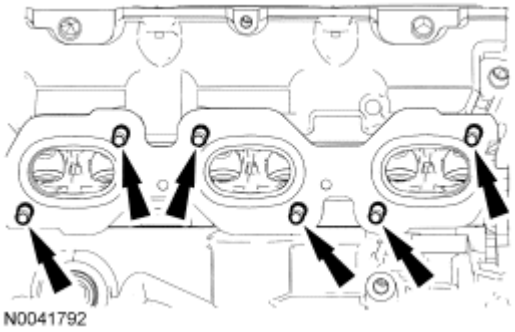


Fig. 407: Locating Exhaust Manifold Studs
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) engines

77. Install a new gasket, the RH exhaust manifold and 6 new nuts.
    - Tighten to 20 Nm (177 lb-in) in the sequence shown.

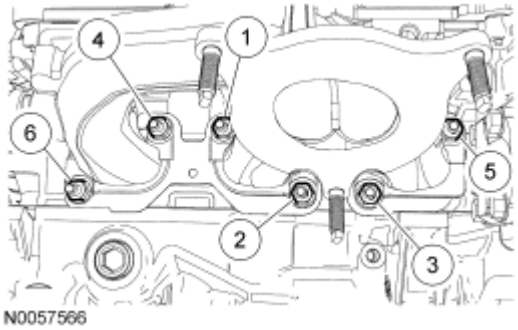


Fig. 408: Identifying Tightening Sequence Of RH Exhaust Manifold Nuts
Courtesy of FORD MOTOR CO.

Front Wheel Drive (FWD) engines

78. Install a new gasket, the RH catalytic converter and 6 new nuts.
    - Tighten to 20 Nm (177 lb-in) in the sequence shown.

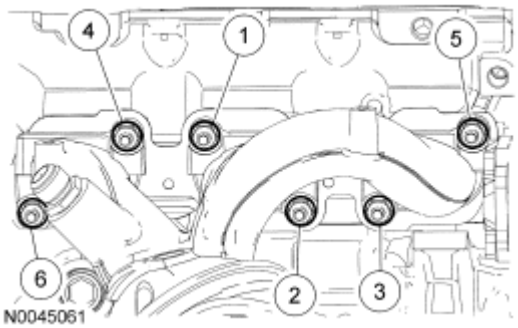


Fig. 409: Identifying Tightening Sequence Of RH Catalytic Converter Nuts

Courtesy of FORD MOTOR CO.

All engines

79. Install the A/C compressor bracket and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

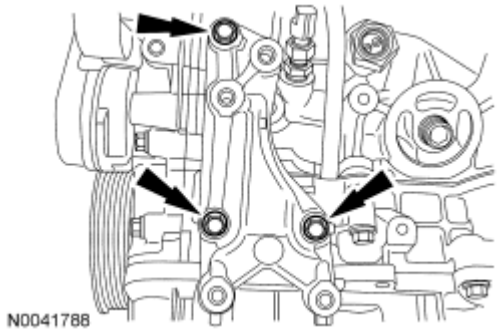


Fig. 410: Locating A/C Compressor Bracket Bolts
Courtesy of FORD MOTOR CO.

80. Install the A/C compressor and the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

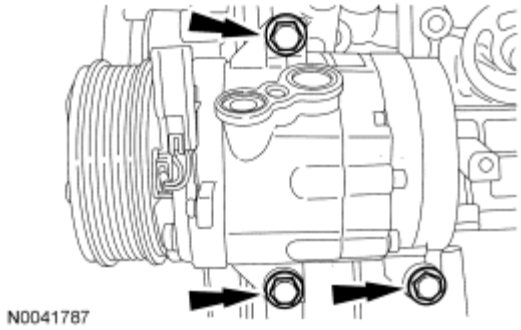


Fig. 411: Locating A/C Compressor Bolts
Courtesy of FORD MOTOR CO.

81. Install the generator and the 3 bolts.
    - Tighten to 48 Nm (35 lb-ft).

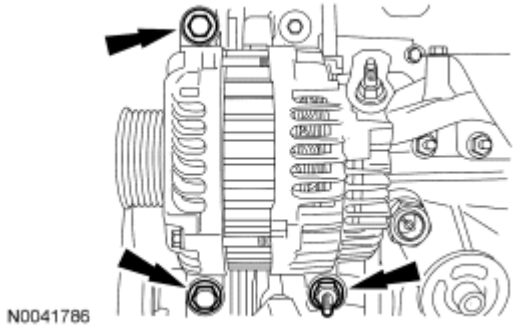


Fig. 412: Locating Generator Bolts
Courtesy of FORD MOTOR CO.

82. Position the wiring harness onto the engine.
83. Attach the wiring harness to the cylinder block.

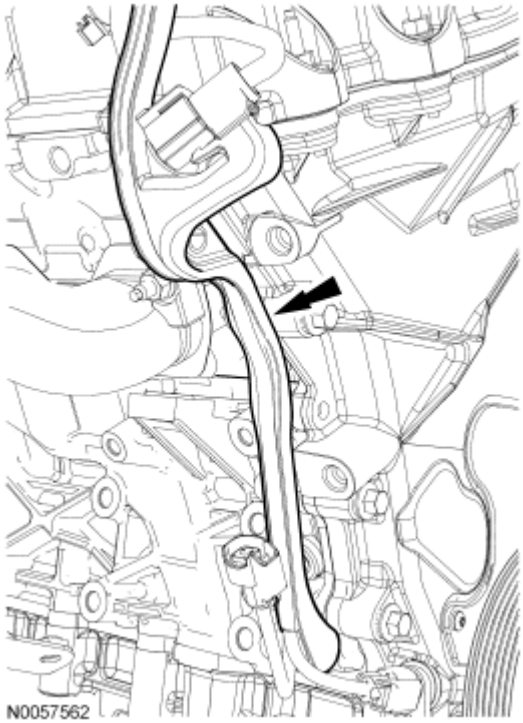


Fig. 413: Locating Wiring Harness From Cylinder Block
Courtesy of FORD MOTOR CO.

84. Install the wiring harness retainer bolt.
    - Tighten to 10 Nm (89 lb-in).

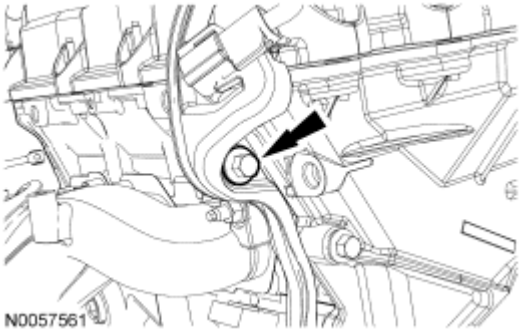


Fig. 414: Identifying Wiring Harness Retainer Bolt
Courtesy of FORD MOTOR CO.

85. Position the power steering pump and reservoir assembly onto the engine and install the 3 bolts.
    - Tighten to 25 Nm (18 lb-ft).

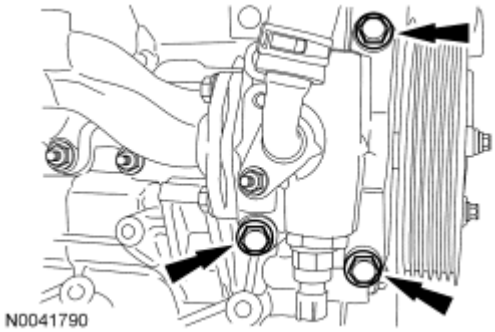


Fig. 415: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

86. Install the 3 power steering reservoir nuts.
    - Tighten to 9 Nm (80 lb-in).

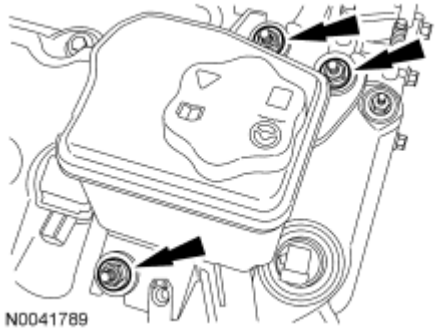


Fig. 416: Locating Power Steering Reservoir Nuts
Courtesy of FORD MOTOR CO.

87. Rotate the accessory drive belt tensioner counterclockwise and install the accessory drive belt.

Fig. 417: Rotating Accessory Drive Belt Tensioner Counterclockwise
Courtesy of FORD MOTOR CO.

88. Attach the wiring harness retainer to the coolant bypass stud bolt.

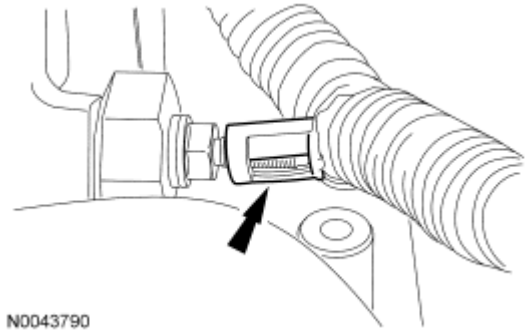


Fig. 418: Locating Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

89. Position the wiring harness onto the engine and connect the ECT sensor electrical connector.

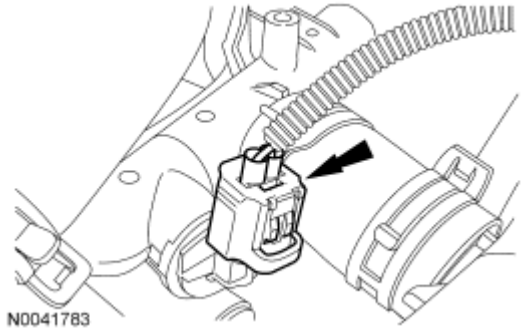


Fig. 419: Locating Electronic Coolant Temperature Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

90. Connect the KS electrical connector.

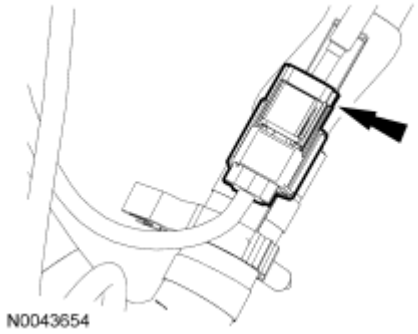


Fig. 420: Locating Knock Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

91. Connect the PCV valve electrical connector.

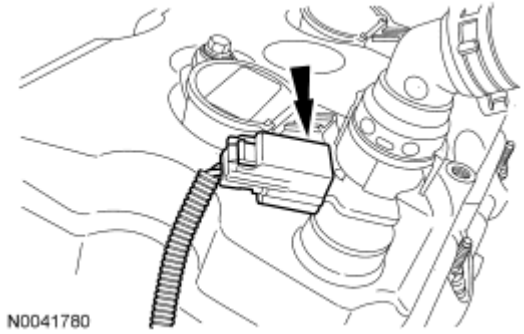


Fig. 421: Locating Positive Crankcase Ventilation Valve Electrical Connector
Courtesy of FORD MOTOR CO.

92. Connect the Power Steering Pressure (PSP) switch electrical connector.

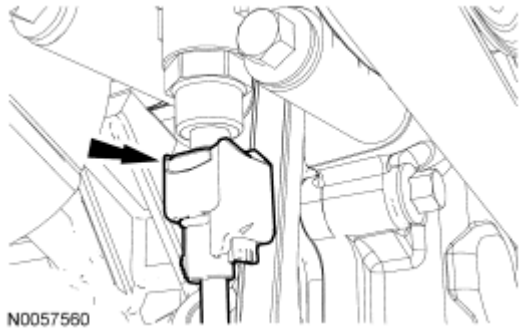


Fig. 422: Identifying Power Steering Pressure (PSP) Switch Electrical Connector
Courtesy of FORD MOTOR CO.

93. Connect the Crankshaft Position (CKP) sensor electrical connector.

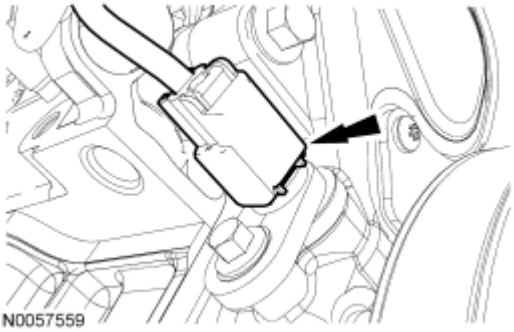


Fig. 423: Identifying Crankshaft Position (CKP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

94. Attach the 2 wiring harness retainers.

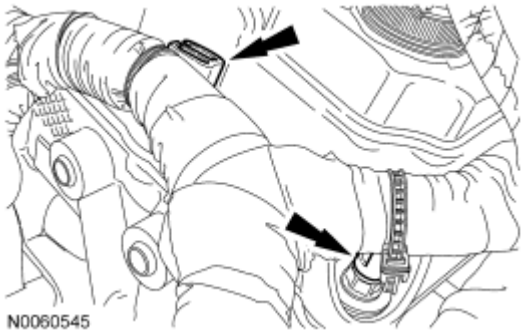


Fig. 424: Identifying Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

FWD engines

95. Connect the RH Heated Oxygen Sensor (HO2S) electrical connector.

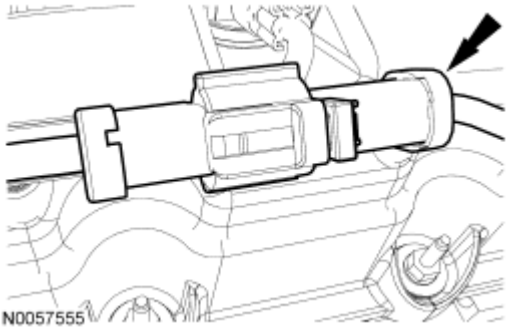


Fig. 425: Identifying RH HO2S Electrical Connector
Courtesy of FORD MOTOR CO.

96. Attach the wiring harness retainer to the power steering stud bolt.

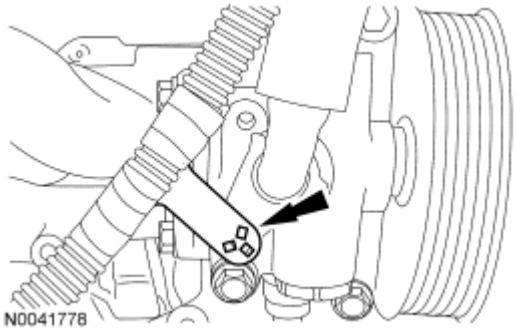


Fig. 426: Locating Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

97. Connect the RH catalyst monitor sensor electrical connector.

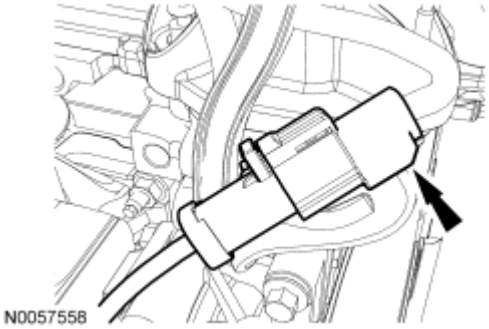


Fig. 427: Identifying RH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

All engines

98. Install the radio frequency interference capacitor and the nut.
    - Tighten to 6 Nm (53 lb-in).

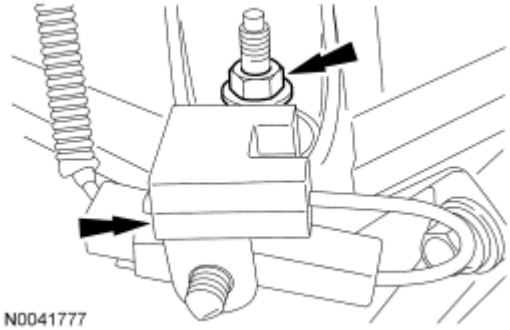


Fig. 428: Locating Radio Frequency Interference Capacitor And Nut
Courtesy of FORD MOTOR CO.

99. Connect the RH VCT solenoid and LH Camshaft Position (CMP) sensor electrical connectors.

- If equipped, attach the 2 wiring harness retainers to the valve cover stud bolts.

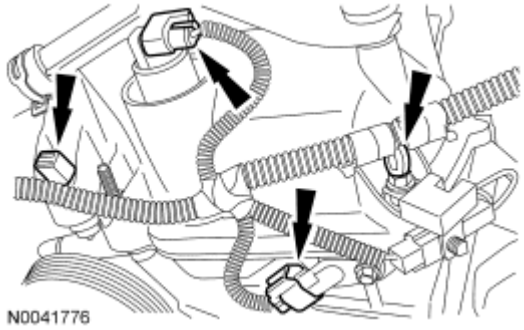


Fig. 429: Locating RH VCT Solenoid And LH Camshaft Position Sensor Electrical Connectors
Courtesy of FORD MOTOR CO.

100. Connect the 3 RH coil-on-plug electrical connectors.
    - Attach the 2 wiring harness pin-type retainers to the valve cover.

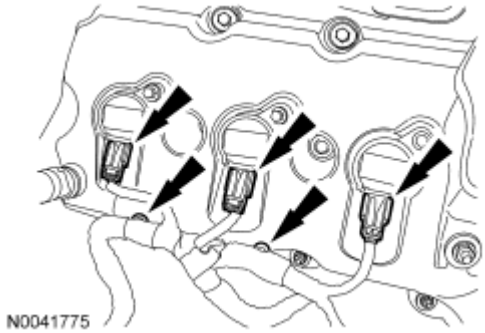


Fig. 430: Locating RH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

NOTE: Only one wiring harness retainer shown, other wiring harness retainer similar.

101. Attach the 2 wiring harness retainers to the fuel rail.

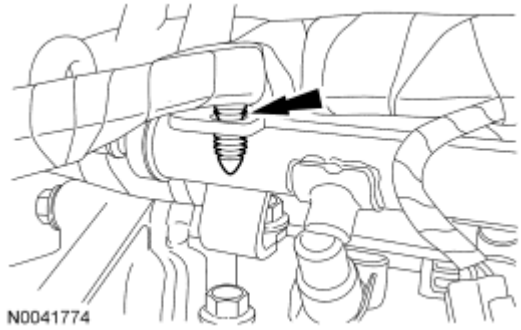


Fig. 431: Locating Fuel Rail Wiring Harness Retainer

Courtesy of FORD MOTOR CO.

102. Connect the 6 fuel injector electrical connectors (3 shown).

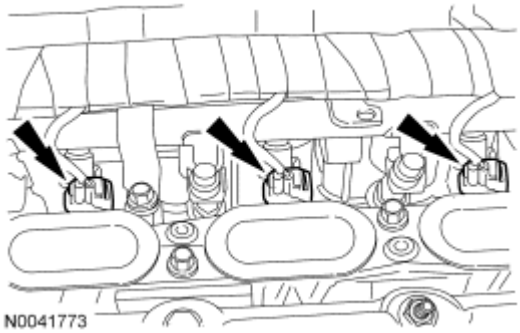


Fig. 432: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

103. If equipped, attach the wiring harness retainer to the LH valve cover stud bolt.

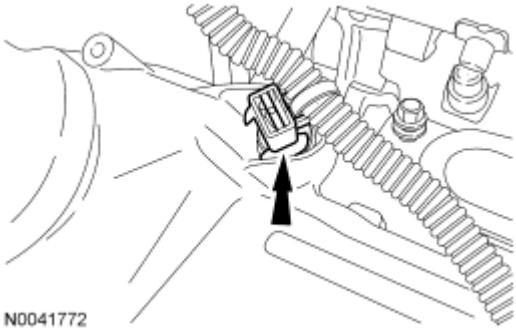


Fig. 433: Locating Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

104. Connect the 3 LH coil-on-plug electrical connectors.
    - Attach the 2 wiring harness pin-type retainers to the valve cover.

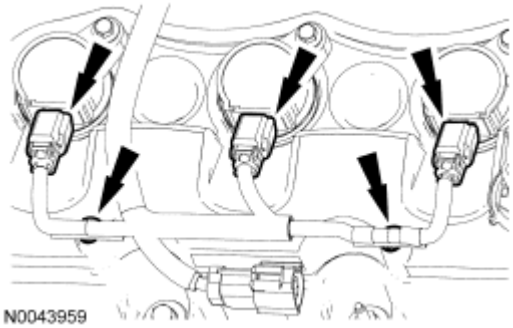


Fig. 434: Locating LH Coil-On-Plug Electrical Connectors
Courtesy of FORD MOTOR CO.

105. Attach the 3 wiring harness retainers to the valve cover stud bolts.

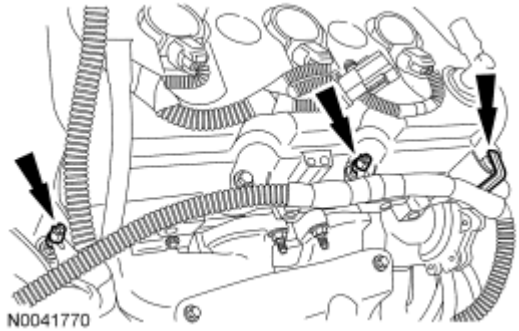


Fig. 435: Locating Wiring Harness Retainers From Valve Cover Stud Bolts
Courtesy of FORD MOTOR CO.

106. Connect the LH VCT solenoid and LH CMP sensor electrical connectors.
    - Attach the 2 wiring harness retainers to the valve cover stud bolts.

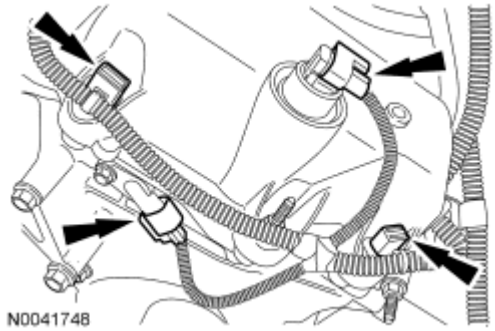


Fig. 436: Locating LH Variable Camshaft Timing Solenoid And LH Camshaft Position Sensor Electrical Connectors
Courtesy of FORD MOTOR CO.

107. Connect the generator B+ cable and electrical connector and install the nut.
    - Tighten to 6 Nm (53 lb-in).

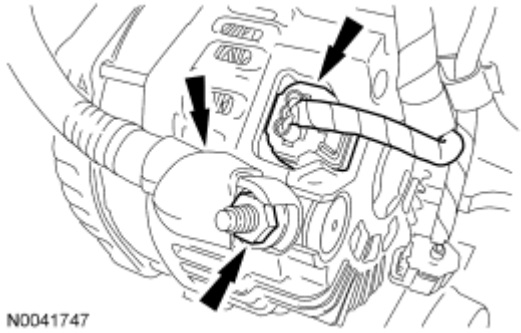


Fig. 437: Locating Generator B+ Cable, Electrical Connector And Nut
Courtesy of FORD MOTOR CO.

108. Connect the EOP switch electrical connector and wiring harness retainer.

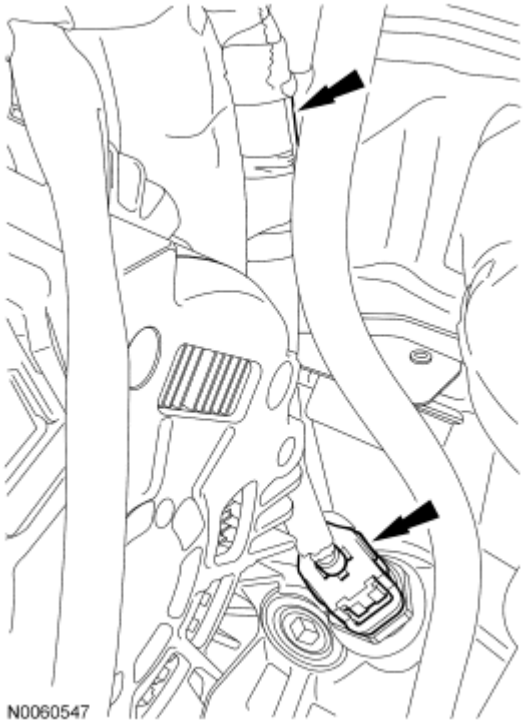


Fig. 438: Identifying Engine Oil Pressure (EOP) Switch Electrical Connector & Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

109. If equipped, attach the block heater wiring harness retainers to the oil level indicator tube and remove the harness.

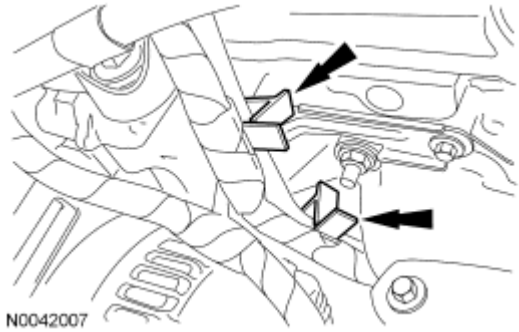


Fig. 439: Locating Block Heater Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

110. If equipped, connect the block heater electrical connector.

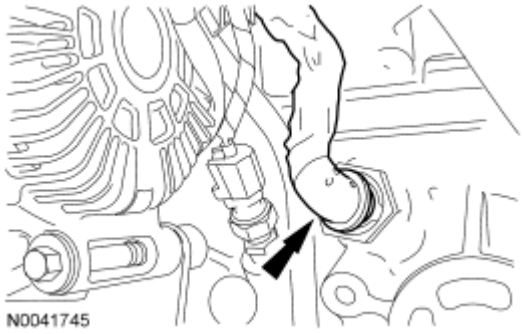


Fig. 440: Locating Block Heater Electrical Connector
Courtesy of FORD MOTOR CO.

111. Connect the A/C compressor electrical connector and the wiring harness retainer.

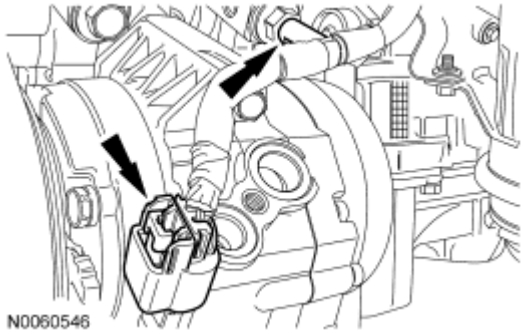


Fig. 441: Identifying A/C Compressor Electrical Connector & Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

NOTE: Clean and inspect all sealing surfaces. Install new gaskets.

112. Position the upper intake manifold and install the 8 bolts.
    - Tighten in the sequence shown to 10 Nm (89 lb-in).

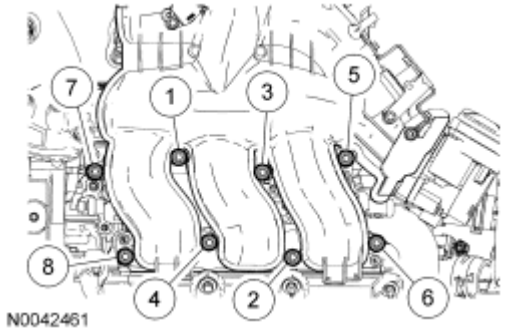


Fig. 442: Identifying Tightening Sequence Of Upper Intake Manifold Bolts
Courtesy of FORD MOTOR CO.

113. Connect the Throttle Body (TB) coolant hose.

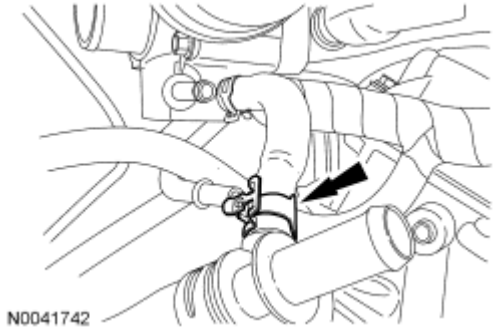


Fig. 443: Locating Throttle Body Coolant Hose
Courtesy of FORD MOTOR CO.

114. Connect the electronic TB electrical connector.

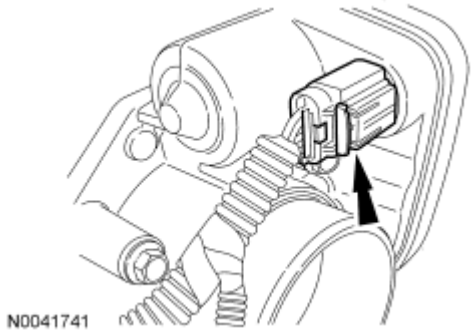


Fig. 444: Locating Electronic Throttle Body Electrical Connector
Courtesy of FORD MOTOR CO.

115. Connect the crankcase vent hose to the upper intake manifold.

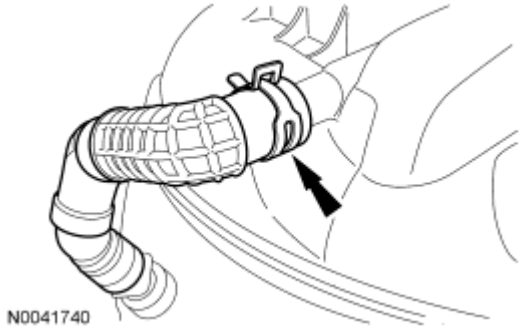


Fig. 445: Locating Crankcase Vent Hose From Upper Intake Manifold
Courtesy of FORD MOTOR CO.

116. Attach the wiring harness pin-type retainer to the upper intake manifold.

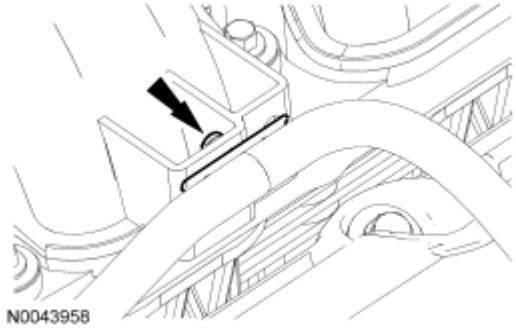


Fig. 446: Locating Wiring Harness Pin-Type Retainer
Courtesy of FORD MOTOR CO.

117. Connect the Manifold Absolute Pressure (MAP) sensor electrical connector and the pin-type retainer.

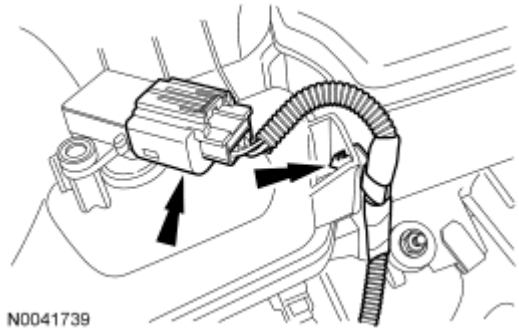


Fig. 447: Locating Manifold Actual Pressure Sensor Electrical Connector And Pin-Type Retainer
Courtesy of FORD MOTOR CO.

NOTE: When installing the lower half of the lifting bracket it will be easier to loosely install the upper bolt first then install the lower bolt.

118. Install the lower half of the Engine Lifting Bracket Set.

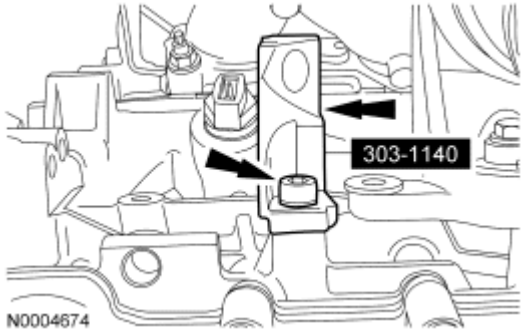


Fig. 448: Identifying Lower Half Of Lifting Hook
Courtesy of FORD MOTOR CO.

119. Install the upper half of the Engine Lifting Bracket Set.

Fig. 449: Identifying Upper Half Of Lifting Hook
Courtesy of FORD MOTOR CO.

120. Install the Engine Lifting Bracket.

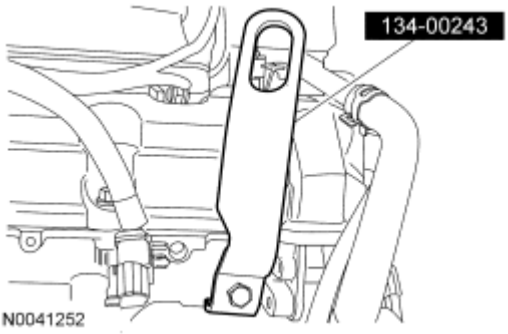


Fig. 450: Identifying Special Tools (134-00243)
Courtesy of FORD MOTOR CO.

121. Install the Engine Lifting Bracket and the Universal Adapter Bracket.

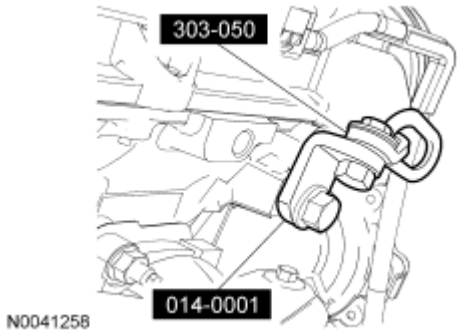


Fig. 451: Identifying Special Tools (303-050 And 014-0001)
Courtesy of FORD MOTOR CO.

122. Using the Spreader Bar, Engine Lifting Brackets, Engine Lifting Bracket Set and a suitable engine crane, remove the engine from the engine stand.

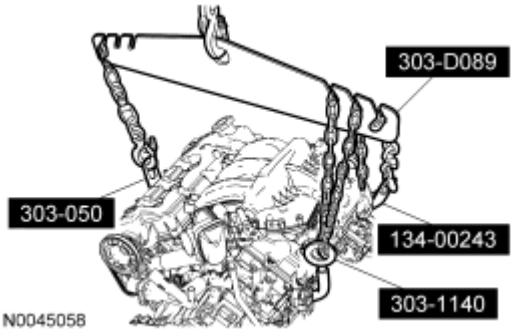


Fig. 452: Identifying Special Tools (134-00243, 303-050, 303-1140, 303-D089)
Courtesy of FORD MOTOR CO.

NOTE: Lubricate the seal lips and seal bore with clean engine oil before installing.

123. Using the Crankshaft Rear Main Oil Seal Installer and the Crankshaft Rear Main Oil Seal Installer Bolts, install the crankshaft rear seal.

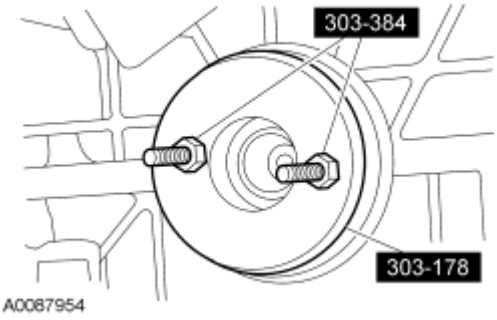


Fig. 453: Identifying Special Tools (303-384 And 303-178)
Courtesy of FORD MOTOR CO.

124. Install the engine-to-transaxle separator plate.

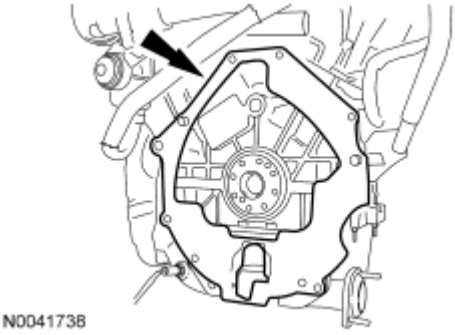


Fig. 454: Locating Engine-To-Transaxle Separator Plate
Courtesy of FORD MOTOR CO.

125. Position the flexplate and install the 8 bolts.

- Tighten to 80 Nm (59 lb-ft).

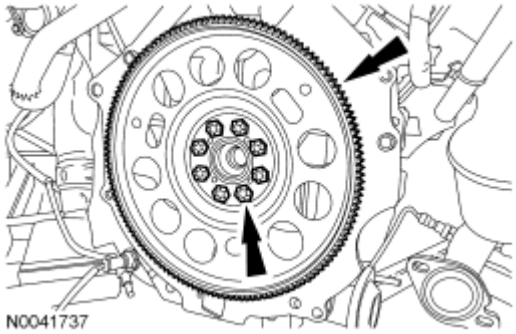
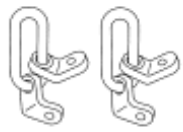


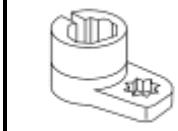
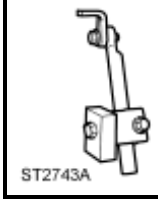
Fig. 455: Locating Flexplate And Bolts
Courtesy of FORD MOTOR CO.

INSTALLATION

ENGINE

Special Tools

Illustration	Tool Name	Tool Number
 ST2673-A	Engine Lifting Bracket Set	303-1140
 ST1341-A	Heavy Duty Floor Crane	014-00071 or equivalent
 ST2793-A	Lifting Bracket, Engine	303-050 (T70P-6000)
 ST2463-A	Lifting Brackets, Engine	134-00243 or equivalent

 ST1293-A	Powertrain Lift	014-00765
 ST1447-A	Socket, Exhaust Gas Oxygen Sensor	303-476
 ST1602-A	Spreader Bar	303-D089 (D93P-6001-A3) or equivalent
 ST2743A	Universal Adapter Brackets	014-0001

Material

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
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

INSTALLATION

NOTE: If the oil pan was removed during engine disassembly, it must be installed after engine and transaxle are assembled and the transaxle-to-engine bolts are installed. Failure to follow this assembly sequence can result in engine oil leaks.

All vehicles

1. Using the Spreader Bar, Engine Lifting Brackets, Engine Lifting Bracket Set and a suitable engine crane, align the transaxle to the engine.

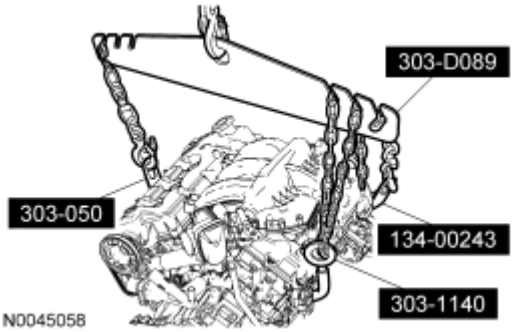


Fig. 456: Identifying Special Tools (134-00243, 303-050, 303-1140, 303-D089)
Courtesy of FORD MOTOR CO.

2. Install the transaxle-to-engine stud bolt, bolt and nut.
   - Tighten to 48 Nm (35 lb-ft).

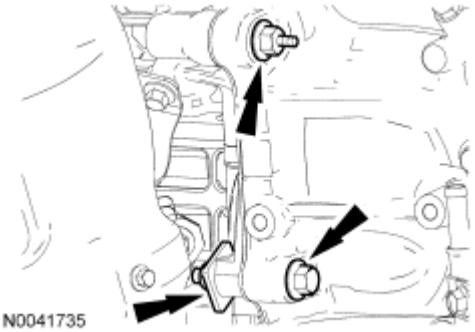


Fig. 457: Locating Transaxle-To-Engine Stud Bolt, Bolt And Nut
Courtesy of FORD MOTOR CO.

3. Attach the wiring harness retainer to the stud bolt.

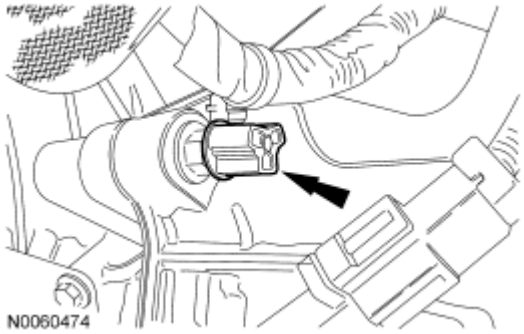


Fig. 458: Locating Wiring Harness Retainer From Stud Bolt
Courtesy of FORD MOTOR CO.

4. Install the 3 transaxle-to-engine bolts.
   - Tighten to 48 Nm (35 lb-ft).

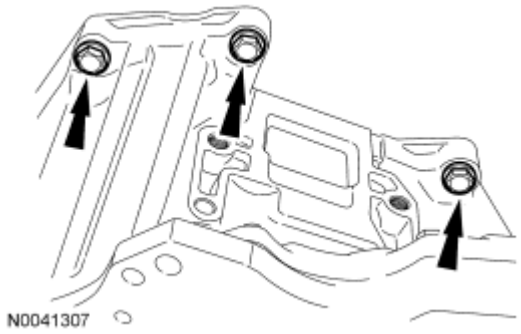


Fig. 459: Locating Upper Torque Converter Housing Bolts
Courtesy of FORD MOTOR CO.

5. Install the engine-to-transaxle bolt.
   - Tighten to 48 Nm (35 lb-ft).

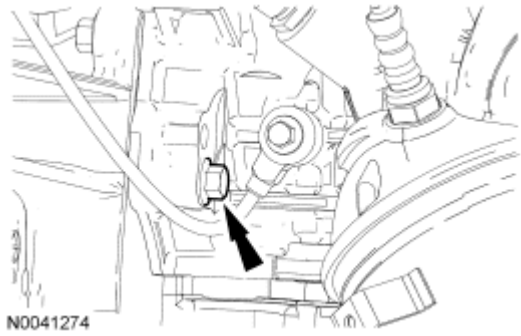


Fig. 460: Locating Engine-To-Transaxle Bolt
Courtesy of FORD MOTOR CO.

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 which make leak paths.

6. Use a plastic scraping tool to remove all traces of the oil pan gasket.
   - Clean all sealing surfaces with metal surface prep and install a new oil pan gasket.

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

7. Apply a 10 mm (0.39 in) diameter dot of silicone sealant to the areas indicated.

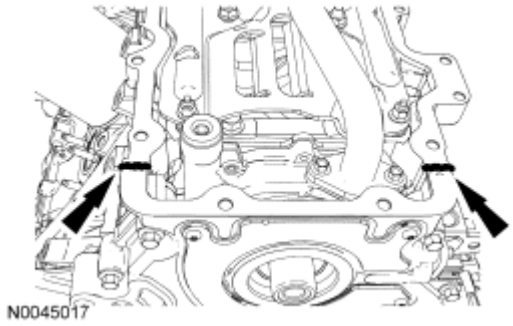


Fig. 461: Locating Silicone Sealant Areas
Courtesy of FORD MOTOR CO.

8. Position the oil pan and install the 10 bolts and 5 stud bolts finger tight.
9. Install the 2 oil pan-to-transaxle bolts.
    - Tighten to 48 Nm (35 lb-ft).

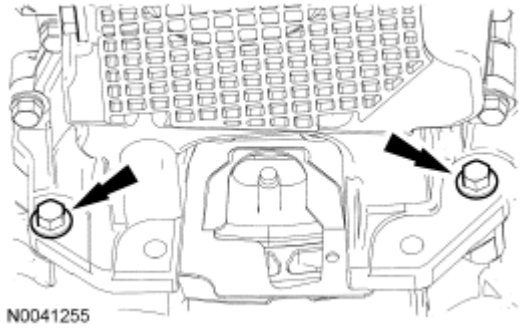


Fig. 462: Locating Oil Pan-To-Transaxle Bolts
Courtesy of FORD MOTOR CO.

10. Tighten the 15 oil pan-to-engine bolts and stud bolts in the sequence shown to 25 Nm (18 lb-ft).

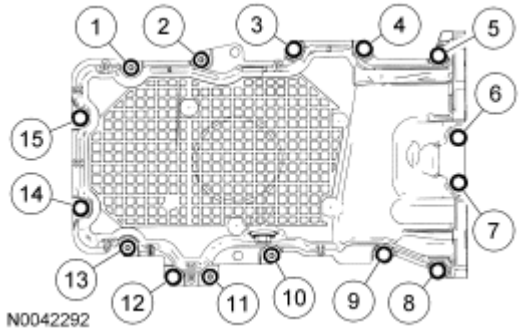


Fig. 463: Identifying Tightening Sequence Of Oil Pan-To-Engine Bolts
Courtesy of FORD MOTOR CO.

11. Install 6 new LH catalytic converter studs.
    - Tighten to 12 Nm (106 lb-in).

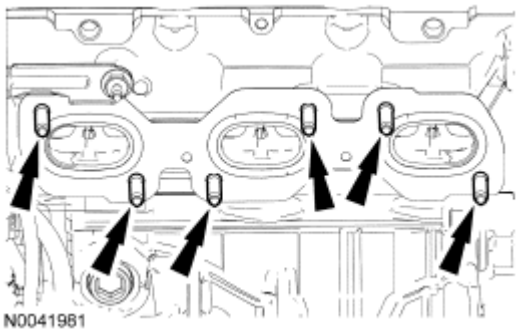


Fig. 464: Locating LH Catalytic Converter Studs
Courtesy of FORD MOTOR CO.

12. Install a new gasket, the LH catalytic converter and 6 new nuts.
    - Tighten to 20 Nm (177 lb-in) in the sequence shown.

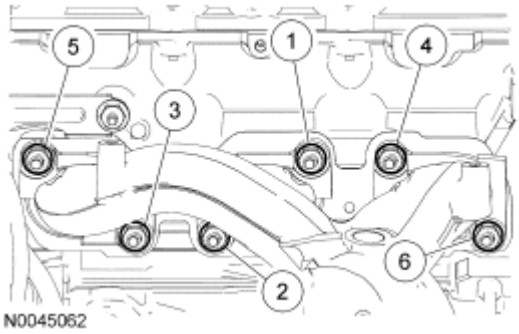


Fig. 465: Identifying Tightening Sequence Of LH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

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

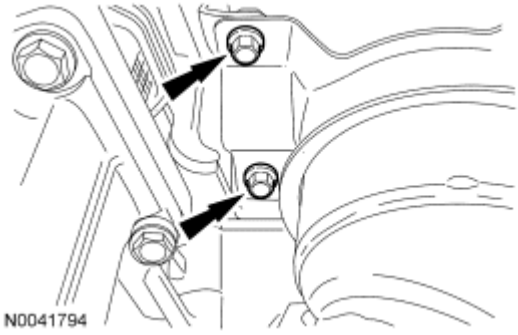


Fig. 466: Locating LH Catalytic Converter Bracket Bolts
Courtesy of FORD MOTOR CO.

14. Install the heat shield and the 4 bolts.
    - Tighten to 11 Nm (97 lb-in).

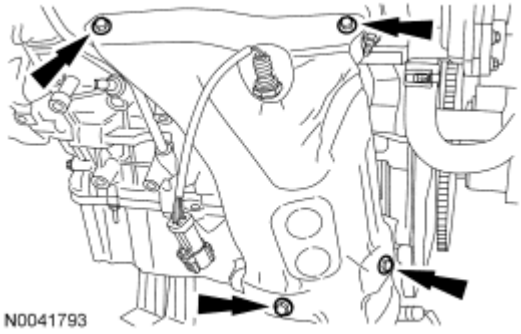


Fig. 467: Locating Heat Shield Bolts
Courtesy of FORD MOTOR CO.

15. Connect the LH Heated Oxygen Sensor (HO2S) electrical connector and pin-type retainer.

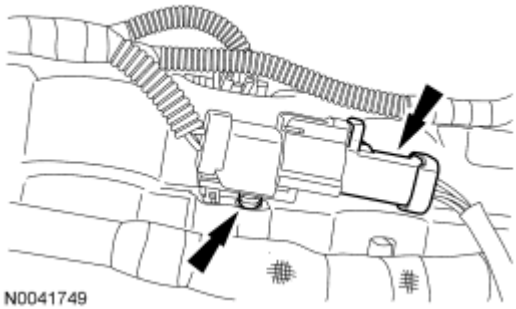


Fig. 468: Locating LH Heated Oxygen Sensor Electrical Connector And Pin-Type Retainer
Courtesy of FORD MOTOR CO.

16. Connect the LH catalyst monitor sensor electrical connector.

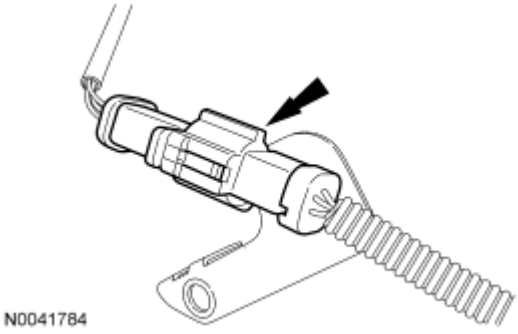


Fig. 469: Locating LH Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

17. Install the starter motor and the 2 bolts.
    - Tighten to 27 Nm (20 lb-ft).

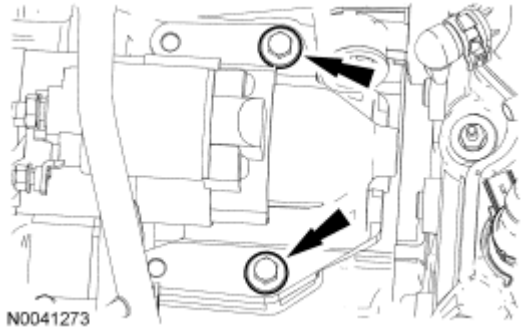


Fig. 470: Locating Starter Motor Bolts
Courtesy of FORD MOTOR CO.

18. Connect the starter motor wiring and install the 2 nuts.
    - Tighten the large nut to 12 Nm (106 lb-in).
    - Tighten the small nut to 5 Nm (44 lb-in).

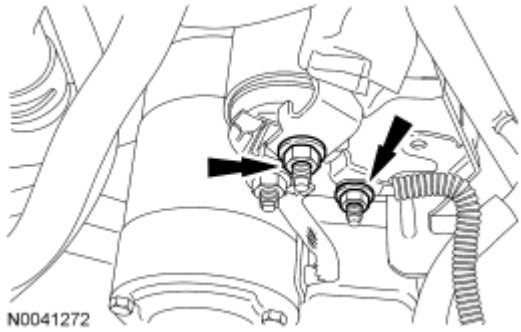


Fig. 471: Locating Starter Motor Wiring Nuts
Courtesy of FORD MOTOR CO.

19. Connect the Transmission Control Module (TCM) electrical connector.

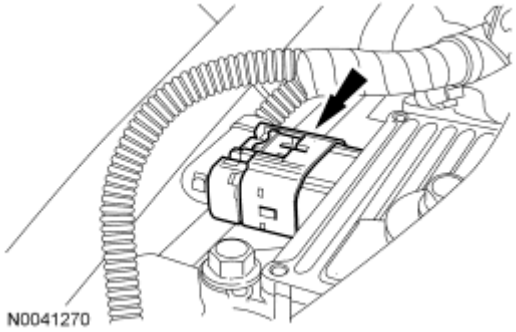


Fig. 472: Locating Transmission Control Module (TCM) Electrical Connector
Courtesy of FORD MOTOR CO.

20. Install the catalyst monitor sensor bracket and the bolt.
    - Tighten to 12 Nm (106 lb-in).

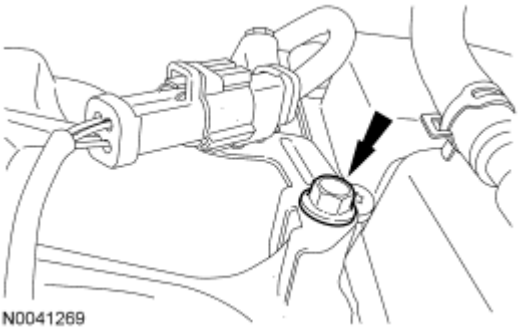


Fig. 473: Locating Catalyst Monitor Sensor (CMS) Electrical Connector Bracket Bolt
Courtesy of FORD MOTOR CO.

21. Install the ground wire and the bolt.
    - Tighten to 12 Nm (106 lb-in).

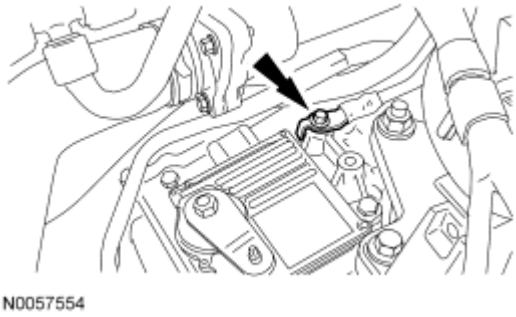


Fig. 474: Identifying Ground Wire Bolt
Courtesy of FORD MOTOR CO.

22. Using the Spreader Bar, Engine Lifting Brackets, Engine Lifting Bracket Set and a suitable engine crane, position the engine and transaxle onto the lift table.

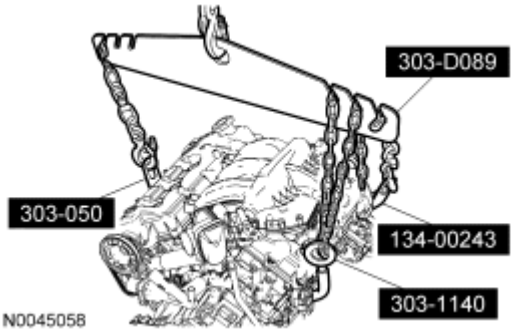


Fig. 475: Identifying Special Tools (134-00243, 303-050, 303-1140, 303-D089)
Courtesy of FORD MOTOR CO.

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

23. Install the Engine Lifting Bracket Set and the Powertrain Lift to the engine.

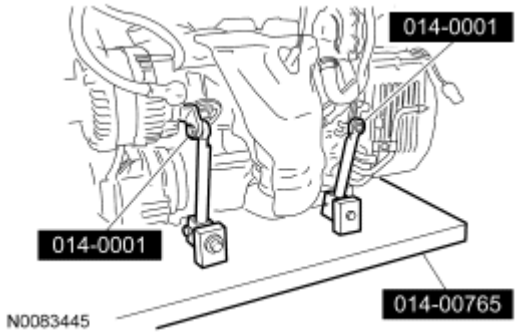


Fig. 476: Installing Engine Lifting Bracket Set & Powertrain Lift To Engine
Courtesy of FORD MOTOR CO.

Front Wheel Drive (FWD) vehicles

24. Install the catalytic converter bracket assembly and the 2 bolts.
    - Tighten to 35 Nm (26 lb-ft).

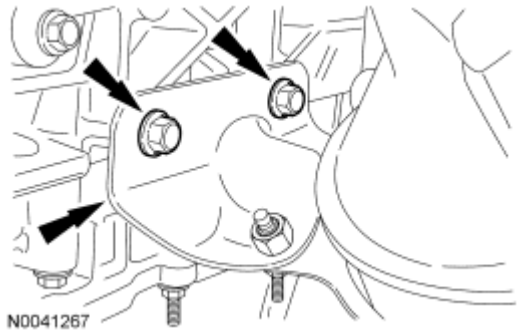


Fig. 477: Locating Catalytic Converter Bracket Assembly Bolts
Courtesy of FORD MOTOR CO.

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

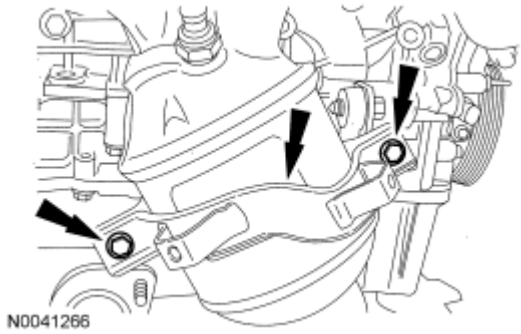


Fig. 478: Locating Catalytic Converter Bracket And Bolts

Courtesy of FORD MOTOR CO.

26. Install the heat shield and the 2 bolts.
    - Tighten to 11 Nm (97 lb-in).

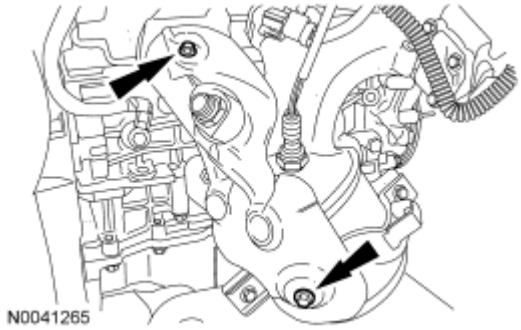


Fig. 479: Locating Heat Shield Bolts
Courtesy of FORD MOTOR CO.

All vehicles

27. Using a new gasket, install the EGR valve and the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).

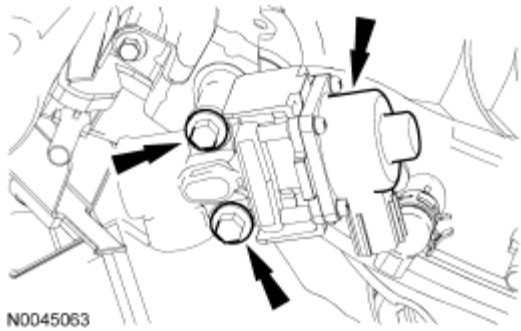


Fig. 480: Locating EGR Valve And Bolts
Courtesy of FORD MOTOR CO.

NOTE: Front Wheel Drive (FWD) shown, All-Wheel Drive (AWD) similar.

28. Install the EGR tube.
    - Tighten both EGR tube nuts to 40 Nm (30 lb-ft).

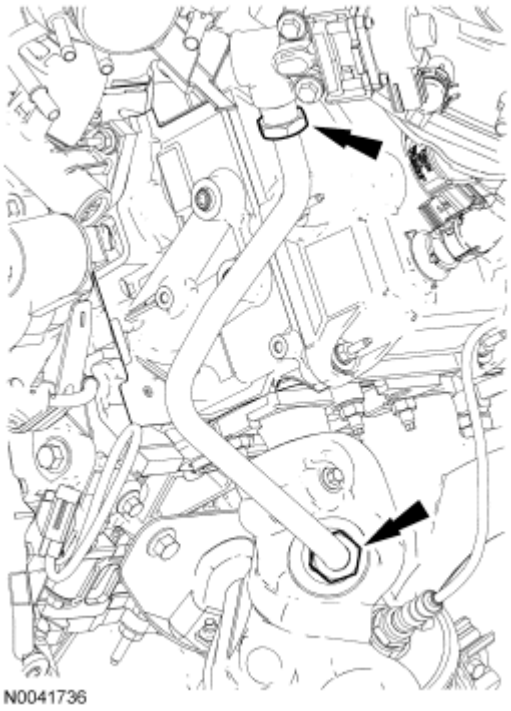


Fig. 481: Locating EGR Tube And Nuts
Courtesy of FORD MOTOR CO.

29. Connect the EGR valve electrical connector.

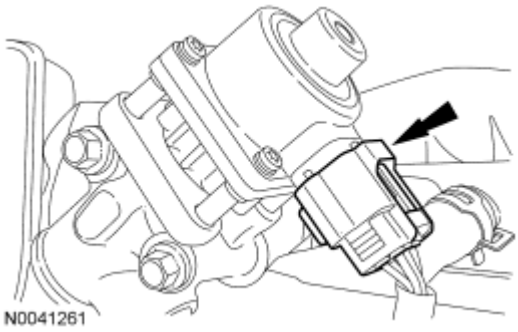


Fig. 482: Locating Exhaust Gas Recirculation Valve Electrical Connector
Courtesy of FORD MOTOR CO.

30. Position the Power Steering Pressure (PSP) hose on the engine and install the PSP hose bracket-to-power steering reservoir bolt.
    - Tighten to 9 Nm (80 lb-in).

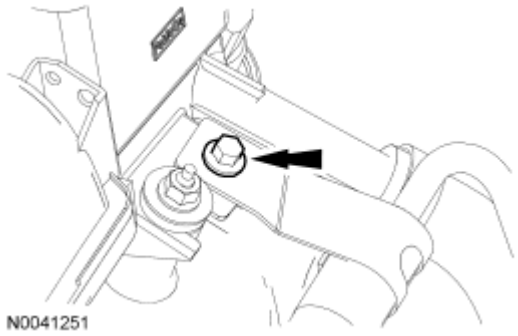


Fig. 483: Locating Power Steering Pressure Hose Bracket-To-Power Steering Reservoir Bolt
Courtesy of FORD MOTOR CO.

31. Using a new banjo bolt and 2 seals, connect the PSP hose to the power steering pump.
    - Tighten to 35 Nm (26 lb-ft).

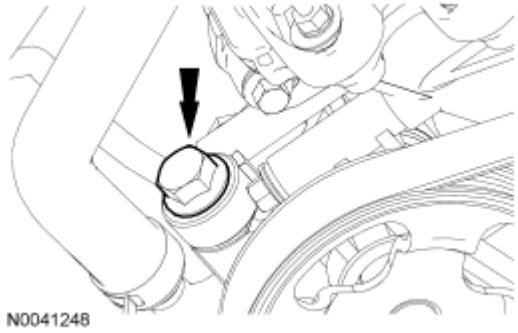


Fig. 484: Locating Banjo Bolt
Courtesy of FORD MOTOR CO.

32. Attach the PSP hose bracket to the cylinder head and install the bolt.
    - Tighten to 9 Nm (80 lb-in).

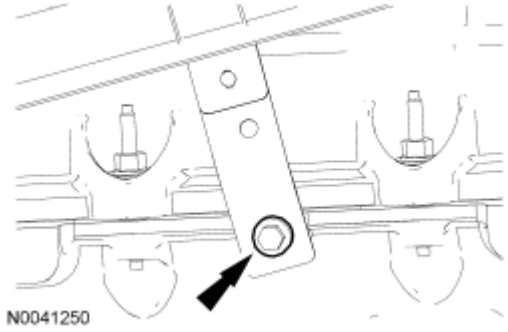


Fig. 485: Locating PSP Hose Bracket To Cylinder Head Bolt
Courtesy of FORD MOTOR CO.

33. Attach the PSP hose bracket to the cylinder head and install the bolt.
    - Tighten to 9 Nm (80 lb-in).

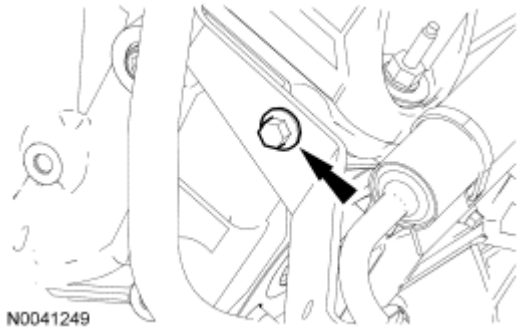


Fig. 486: Locating PSP Hose Bracket To Cylinder Head Bolt
Courtesy of FORD MOTOR CO.

34. Attach the wiring harness retainer to the PSP hose bracket.

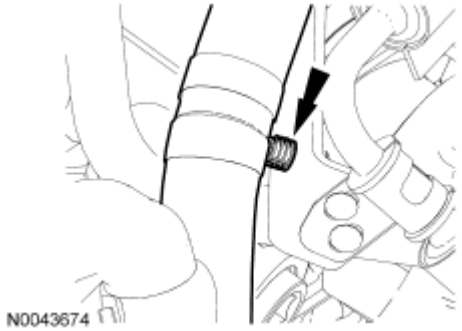


Fig. 487: Locating PSP Hose Bracket Wiring Harness Retainer
Courtesy of FORD MOTOR CO.

35. Raise the engine and transaxle up into the vehicle.
36. Install the engine mount bracket, 3 nuts and the bolt.
    - Tighten the nuts to 63 Nm (46 lb-ft).
    - Tighten the bolt to 115 Nm (85 lb-ft).

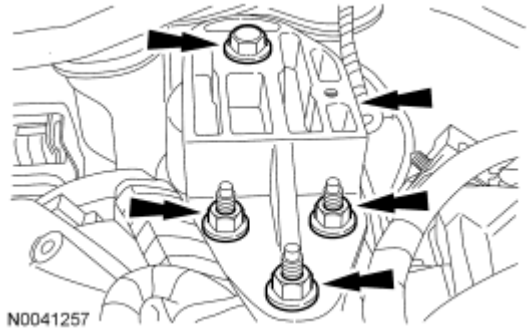


Fig. 488: Locating Engine Mount Bracket, Bolt And Nuts
Courtesy of FORD MOTOR CO.

37. Install the damper and bolt.

- Tighten to 23 Nm (17 lb-ft).

Fig. 489: Locating Damper And Bolt
Courtesy of FORD MOTOR CO.

38. Install the 2 transaxle mount bolts.
    - Tighten to 90 Nm (66 lb-ft).

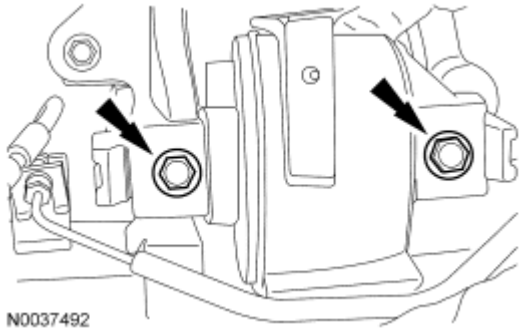


Fig. 490: Locating Transaxle Mount Bolts
Courtesy of FORD MOTOR CO.

39. Install the 3 torque converter nuts.
    - Tighten to 36 Nm (27 lb-ft).

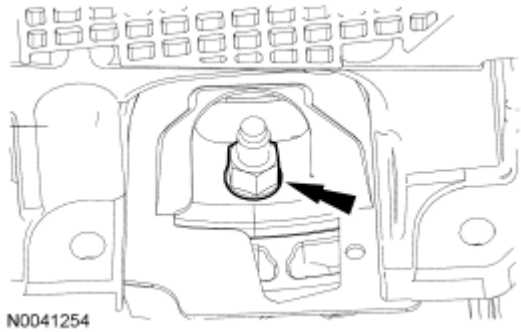


Fig. 491: Locating Torque Converter Nuts
Courtesy of FORD MOTOR CO.

40. Install the torque converter nut access plug.

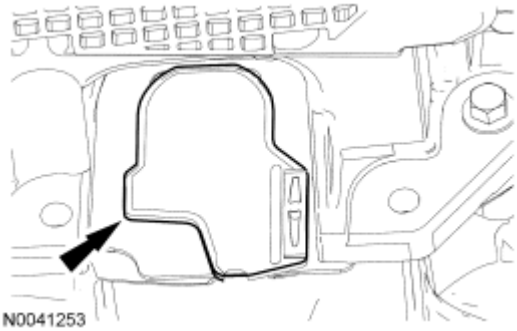


Fig. 492: Locating Torque Converter Nut Access Plug
Courtesy of FORD MOTOR CO.

All-Wheel Drive (AWD) vehicles

41. Install the Power Transfer Unit (PTU) and the 5 bolts.
    - Tighten to 90 Nm (66 lb-ft).

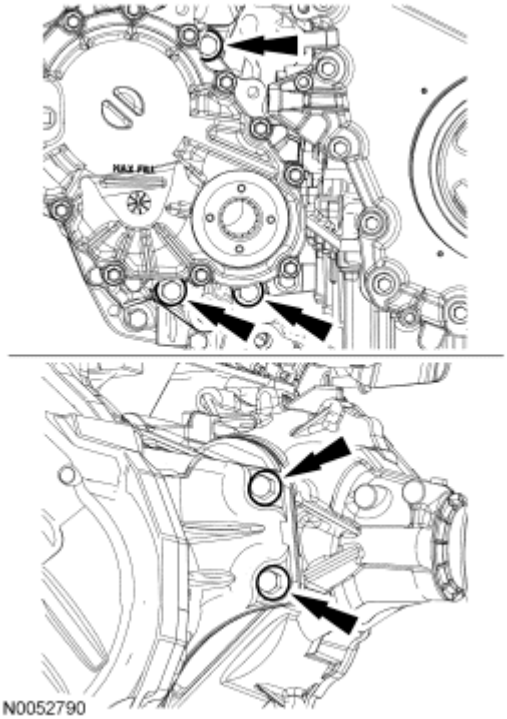


Fig. 493: Locating PTU Bolts
Courtesy of FORD MOTOR CO.

42. Install the PTU support bracket and the 5 bolts.
    - Tighten to 70 Nm (52 lb-ft).

Fig. 494: Identifying PTU Support Bracket Bolts
Courtesy of FORD MOTOR CO.

NOTE: A new Power Transfer Unit (PTU) seal must be installed whenever the intermediate shaft is removed.

43. Install a new PTU seal. For additional information, refer to **TRANSFER CASE - POWER TRANSFER UNIT (PTU)** article.

NOTE: Prior to installation of the halfshaft, inspect the halfshaft sealing surface for wear or damage and install new, if necessary.

44. Position the RH driveshaft in place and install the 2 bolts.
    - Tighten to 23 Nm (17 lb-ft).

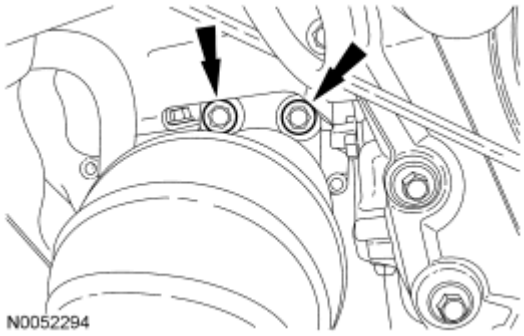


Fig. 495: Locating RH Halfshaft Bearing Support Bracket Bolts
Courtesy of FORD MOTOR CO.

45. Using a new gasket, install the RH catalytic converter and 3 new nuts.
    - Tighten to 48 Nm (35 lb-ft).

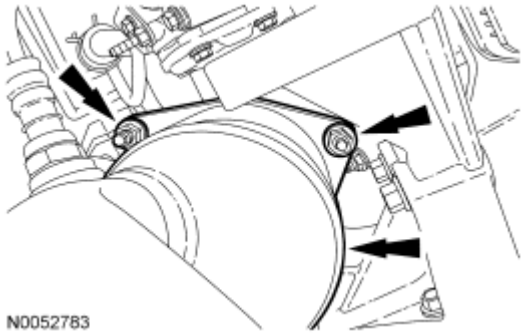


Fig. 496: Locating RH Catalytic Converter Nuts
Courtesy of FORD MOTOR CO.

46. Install the RH exhaust heat shield bracket (inboard half) and the 2 bolts.
    - Tighten to 40 Nm (30 lb-ft).

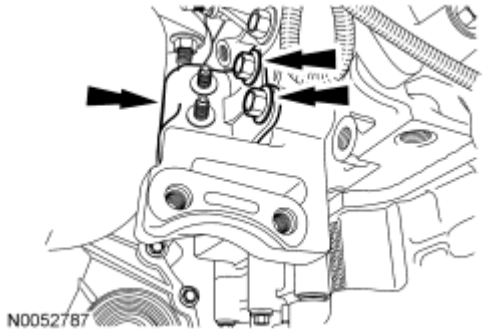


Fig. 497: Locating Catalytic Converter Band Clamp LH Half Nuts
Courtesy of FORD MOTOR CO.

47. Install the RH exhaust heat shield bracket (outboard half) and the 3 nuts.
    - Tighten to 20 Nm (177 lb-in).

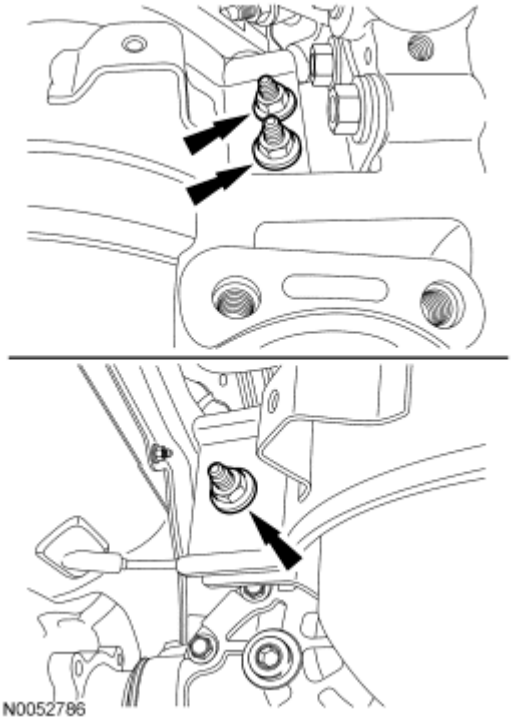


Fig. 498: Locating RH Exhaust Heat Shield Bracket Nuts - Inboard Half
Courtesy of FORD MOTOR CO.

48. Install the RH exhaust heat shield and the 6 bolts.
    - Tighten to 11 Nm (97 lb-in).

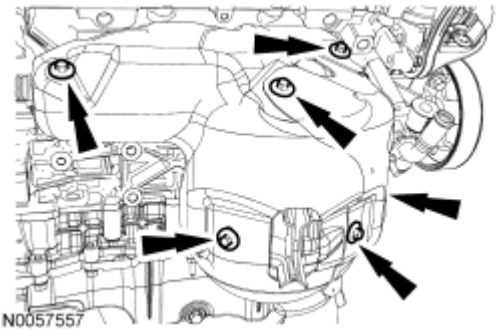


Fig. 499: Locating RH Exhaust Heat Shield Bolts
Courtesy of FORD MOTOR CO.

49. Using the Exhaust Gas Oxygen Sensor Socket, install the RH HO2S.
    - Tighten to 48 Nm (35 lb-ft).

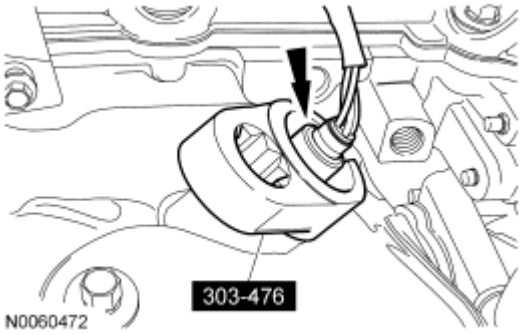


Fig. 500: Identifying RH HO2S & Special Tool (303-476)
Courtesy of FORD MOTOR CO.

50. Connect the RH HO2S electrical connector.

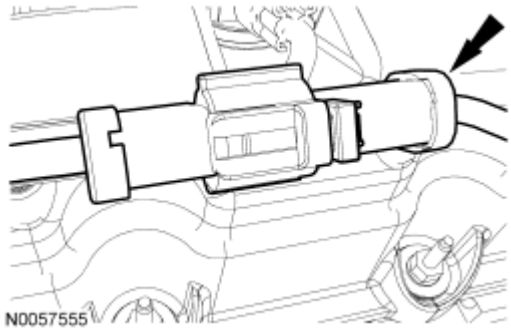


Fig. 501: Identifying RH HO2S Electrical Connector
Courtesy of FORD MOTOR CO.

51. Using the Exhaust Gas Oxygen Sensor Socket, install the RH catalyst monitor sensor.
    - Tighten to 48 Nm (35 lb-ft).

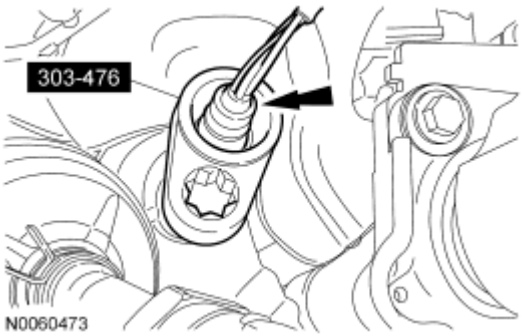


Fig. 502: Identifying RH Catalyst Monitor Sensor & Special Tool (303-476)
Courtesy of FORD MOTOR CO.

52. Connect the RH catalyst monitor sensor electrical connector and attach the wiring harness retainer.

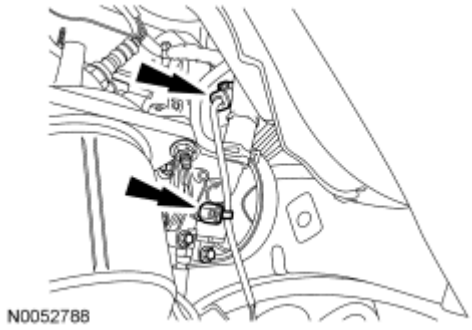


Fig. 503: Locating RH Catalyst Monitor Sensor Electrical Connector & Wiring Retainer
Courtesy of FORD MOTOR CO.

FWD vehicles

53. Install the RH halfshaft into the transaxle.

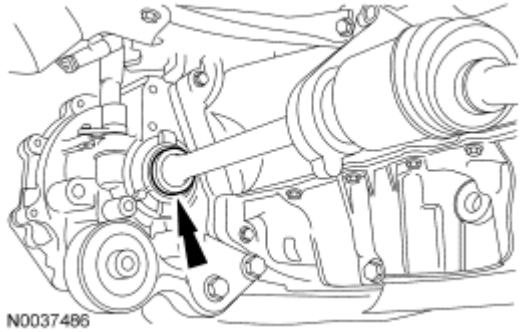


Fig. 504: Locating RH Halfshaft
Courtesy of FORD MOTOR CO.

54. Install the 2 RH halfshaft carrier bearing bracket bolts.
    - Tighten to 55 Nm (41 lb-ft).

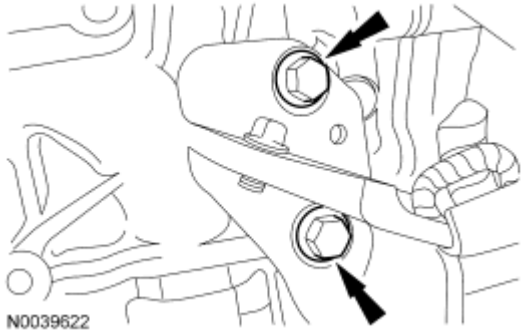


Fig. 505: Locating RH Halfshaft Carrier Bearing Bracket Bolts
Courtesy of FORD MOTOR CO.

All vehicles

NOTE: Prior to installation of the halfshaft, inspect the halfshaft sealing surface for wear or damage and install new, if necessary.

NOTE: Start one end of the circlip in the groove and work the circlip over the halfshaft and into the groove to prevent the circlip from overexpanding.

55. Install a new circlip in the groove on the LH halfshaft.

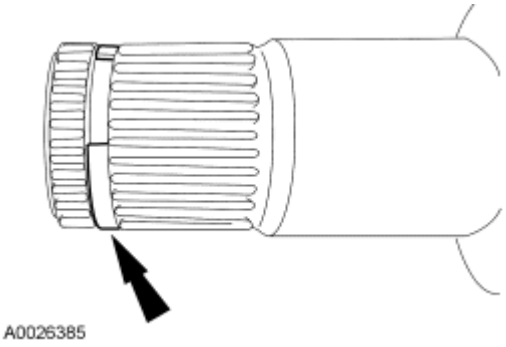


Fig. 506: Locating Halfshaft Circlip
Courtesy of FORD MOTOR CO.

56. Install the LH halfshaft into the transaxle.

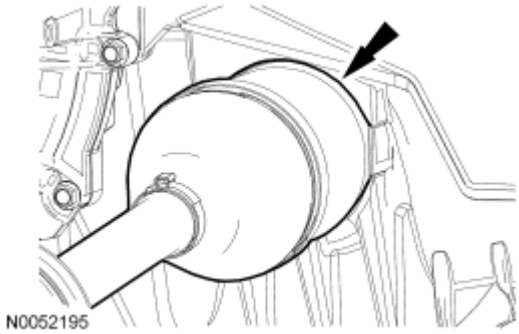


Fig. 507: Identifying LH Halfshaft
Courtesy of FORD MOTOR CO.

57. Position the A/C manifold onto the A/C compressor and install the bolt.
    - Tighten to 15 Nm (133 lb-in).

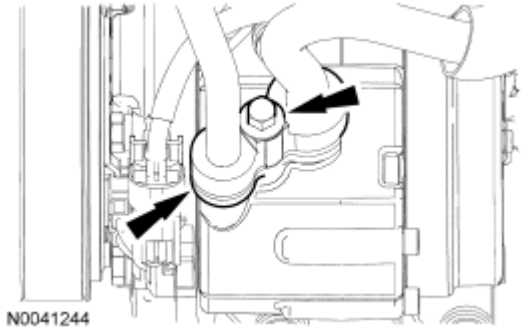


Fig. 508: Locating A/C Manifold And Bolt
Courtesy of FORD MOTOR CO.

58. Install the ground wire and bolt to the engine mount bracket.
    - Tighten to 10 Nm (89 lb-in).

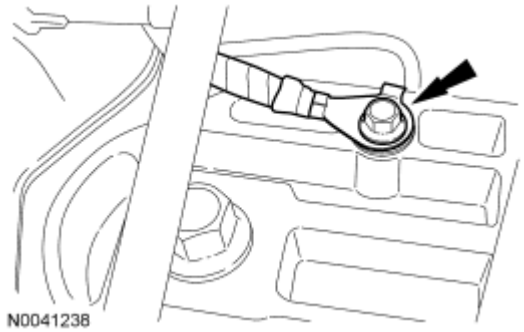


Fig. 509: Locating Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

59. Connect the A/C tubes and install the 2 nuts.
    - Tighten to 8 Nm (71 lb-in).

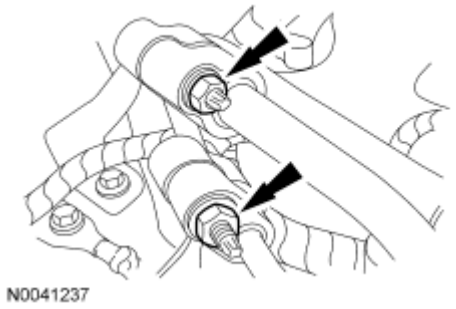


Fig. 510: Locating A/C Tubes And Nuts
Courtesy of FORD MOTOR CO.

60. Install the 2 A/C tube bracket bolts.
    - Tighten to 10 Nm (89 lb-in).

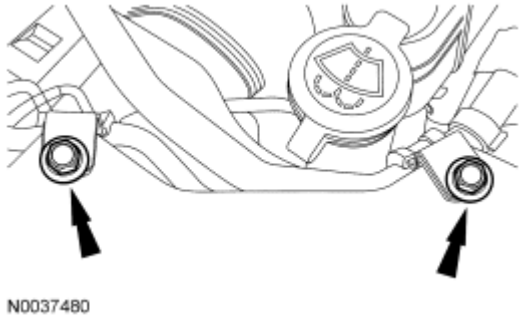


Fig. 511: Locating A/C Tube Bracket Bolts
Courtesy of FORD MOTOR CO.

61. Attach the coolant hose retaining clip.

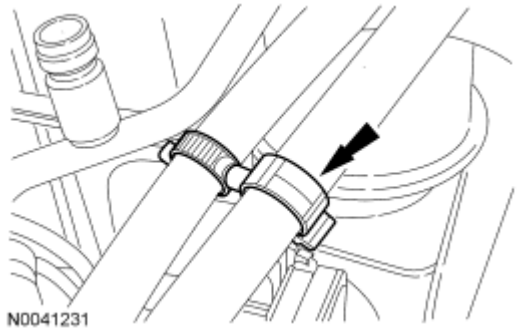


Fig. 512: Locating Coolant Hose Retaining Clip
Courtesy of FORD MOTOR CO.

62. Connect the coolant hose to the degas bottle.

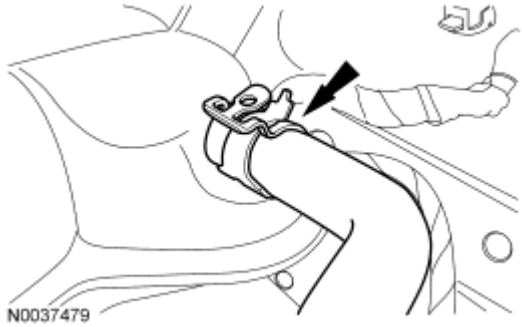


Fig. 513: Locating Coolant Hose To Degas Bottle
Courtesy of FORD MOTOR CO.

63. Attach the power steering hose retaining clip to the engine wiring harness and the LH valve cover stud bolt.

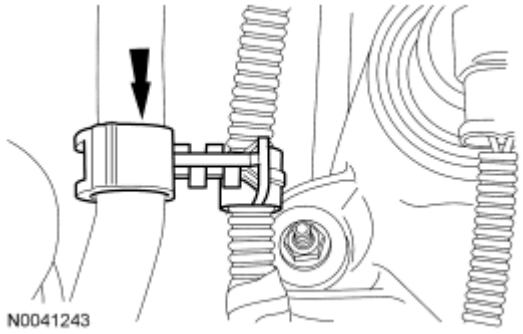


Fig. 514: Locating Power Steering Hose Retaining Clip
Courtesy of FORD MOTOR CO.

64. Connect the power steering hose to the power steering reservoir.

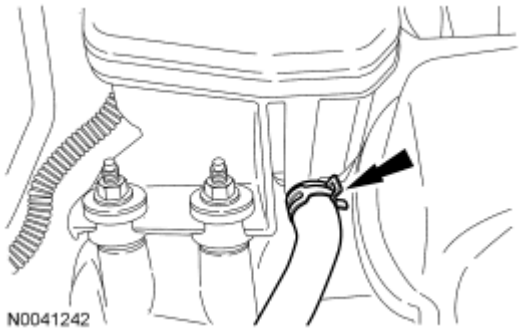


Fig. 515: Locating Power Steering Hose From Power Steering Reservoir
Courtesy of FORD MOTOR CO.

65. If equipped, attach the block heater cable retaining clips to the cooling fan shroud.

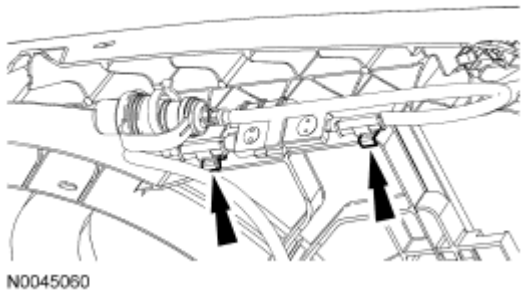


Fig. 516: Locating Block Heater Cable Retaining Clips
Courtesy of FORD MOTOR CO.

66. Connect the vacuum hose to the intake manifold.

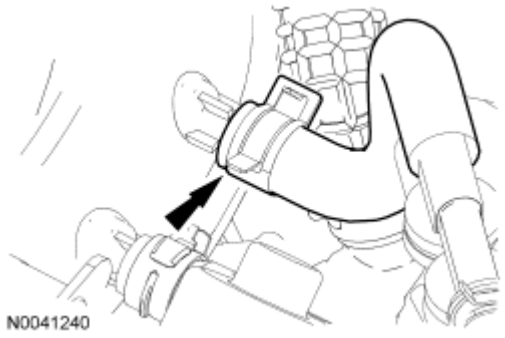


Fig. 517: Locating Vacuum Hose From Intake Manifold
Courtesy of FORD MOTOR CO.

67. Install the vacuum tube bracket bolt.
    - Tighten to 10 Nm (89 lb-in).

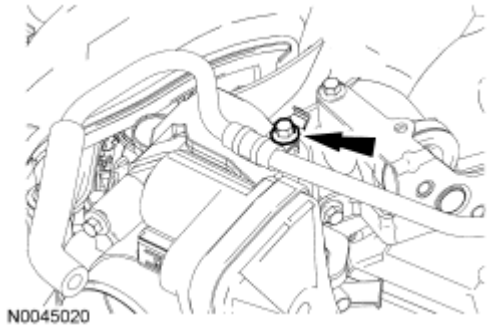


Fig. 518: Locating Vacuum Tube Bracket Bolt
Courtesy of FORD MOTOR CO.

68. Install the ground wire and the bolt.
    - Tighten to 12 Nm (106 lb-in).

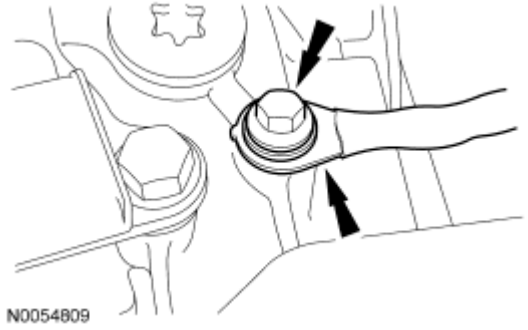


Fig. 519: Locating Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

69. Install the transaxle control cable bracket and the 3 bolts.
    - Tighten to 8 Nm (71 lb-in).

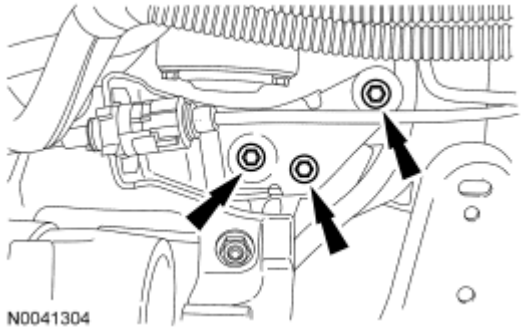


Fig. 520: Locating Transaxle Control Cable Bracket Bolts
Courtesy of FORD MOTOR CO.

70. Connect the transaxle control cable to the transaxle selector lever.

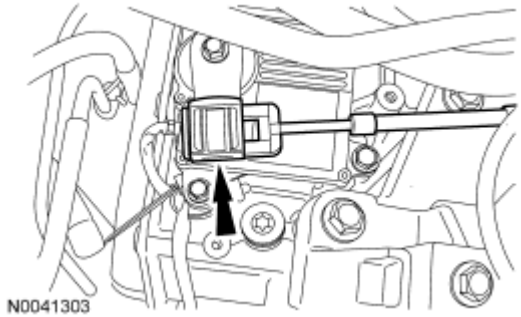


Fig. 521: Locating Selector Lever Cable End
Courtesy of FORD MOTOR CO.

71. Connect the upper and lower radiator hoses to the thermostat housing.

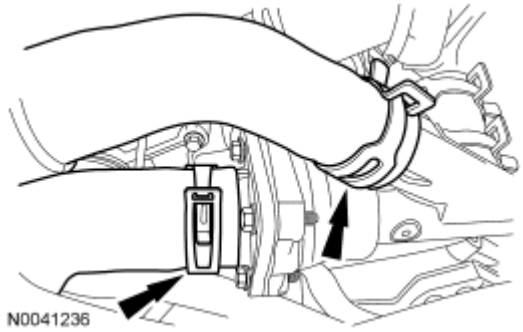


Fig. 522: Locating Upper And Lower Radiator Hoses From Thermostat Housing
Courtesy of FORD MOTOR CO.

72. Connect the Evaporative Emission (EVAP) hose.

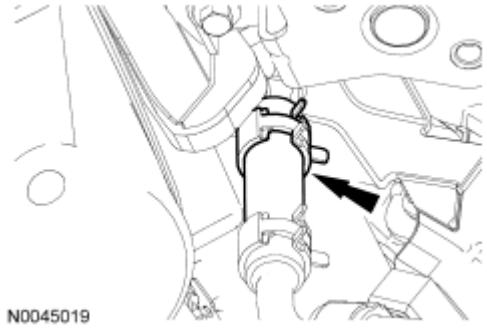


Fig. 523: Locating Evaporative Emissions (EVAP) Hose
Courtesy of FORD MOTOR CO.

73. Connect the Throttle Body (TB) coolant hose.

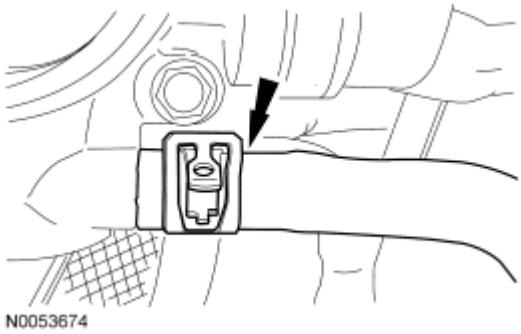


Fig. 524: Locating Throttle Body Coolant Hose
Courtesy of FORD MOTOR CO.

74. Connect the heater hose inline connection.

Fig. 525: Locating Heater Hose Inline Connection
Courtesy of FORD MOTOR CO.

75. Connect the heater hose to the thermostat housing.

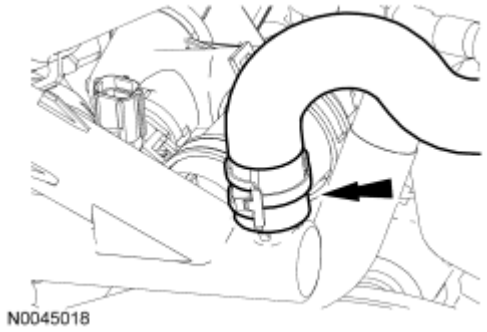


Fig. 526: Locating Heater Hose From Thermostat Housing
Courtesy of FORD MOTOR CO.

76. Connect the fuel supply tube to the fuel rail. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
77. Connect the PCM electrical connector and the pin-type retainer.

Fig. 527: Locating Powertrain Control Module (PCM) Electrical Connector And Pin-Type Retainer
Courtesy of FORD MOTOR CO.

78. Install the ground wire and bolt.
    - Tighten to 10 Nm (89 lb-in).

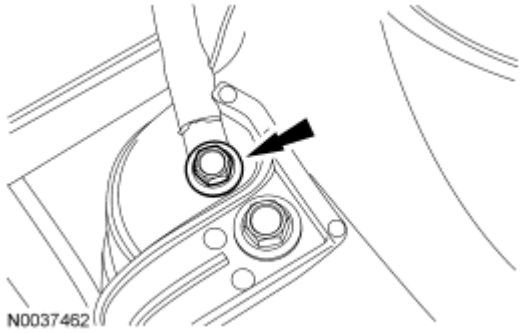


Fig. 528: Locating Ground Wire And Bolt
Courtesy of FORD MOTOR CO.

79. Connect the 2 engine wiring harness electrical connectors.

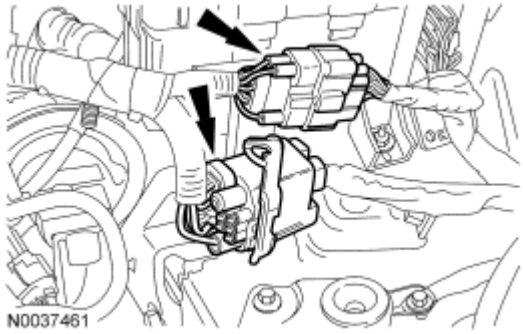


Fig. 529: Locating Engine Wiring Harness Electrical Connectors
Courtesy of FORD MOTOR CO.

80. Connect the power feed to the battery terminal and install the nut.
    - Tighten to 6 Nm (53 lb-in).

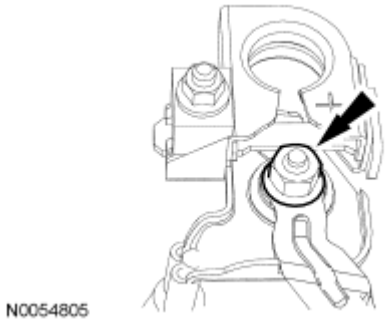


Fig. 530: Locating Power Feed To Battery Terminal And Nut
Courtesy of FORD MOTOR CO.

81. Install the battery tray. For additional information, refer to **BATTERY, MOUNTING AND CABLES** article.
82. Install the engine air cleaner and air cleaner outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION AND FILTERING - 3.0L (4V)** article.

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

83. Install a new engine oil filter.
    - Tighten to 5 Nm (44 lb-in) and then rotate an additional 180 degrees.

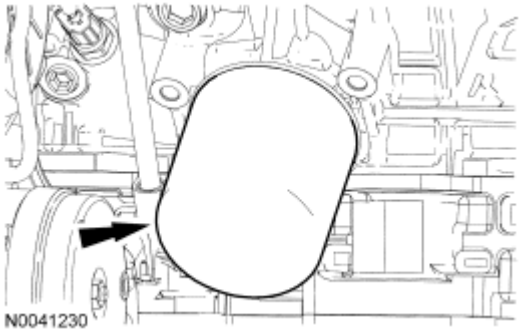


Fig. 531: Locating Engine Oil Filter
Courtesy of FORD MOTOR CO.

84. Connect the transaxle cooler hoses.

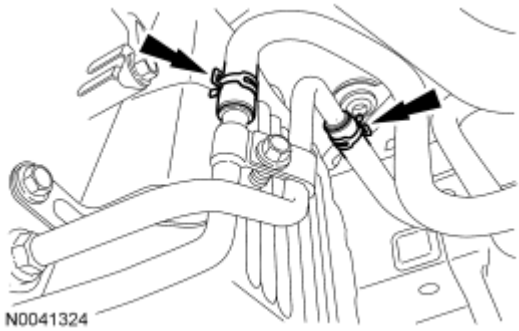


Fig. 532: Locating Transmission Fluid Cooler Hoses
Courtesy of FORD MOTOR CO.

85. Place the subframe assembly on the Powertrain Lift and raise the subframe into the installed position.

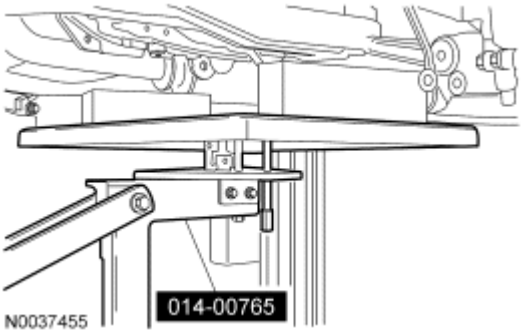


Fig. 533: Positioning Special Tool (014-00765) Under Subframe Assembly
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

86. Install the front subframe nuts.
    - Tighten to 150 Nm (111 lb-ft).

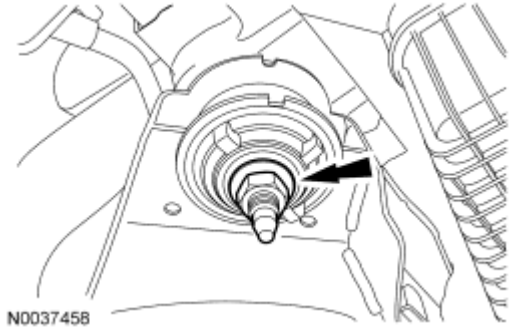


Fig. 534: Locating Front Subframe Nuts
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

87. Position the subframe brackets and install the bolts finger-tight.

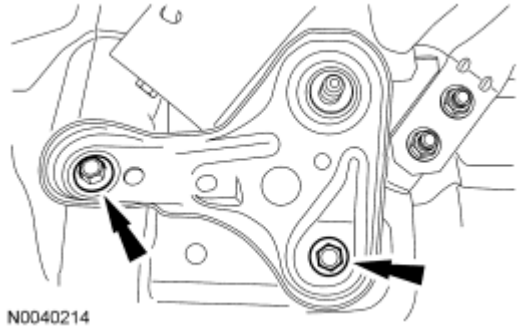


Fig. 535: Locating Subframe Brackets And Bolts Finger-Tight
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

88. Install the subframe nuts.
    - Tighten to 150 Nm (111 lb-ft).

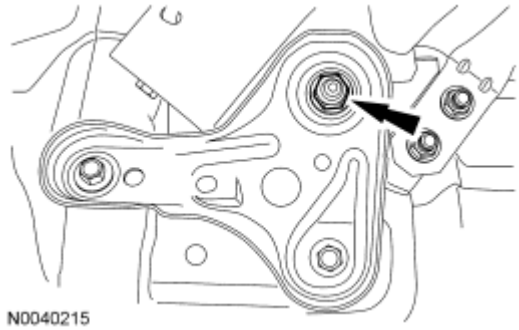


Fig. 536: Locating Subframe Nuts
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

89. Tighten the subframe bracket-to-body bolts to 103 Nm (76 lb-ft).

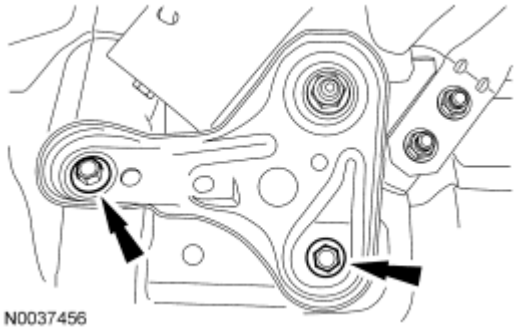


Fig. 537: Locating Subframe Bracket-To-Body Bolts
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

90. Install the through bolts into the lower control arms.
    - Tighten to 103 Nm (76 lb-ft).

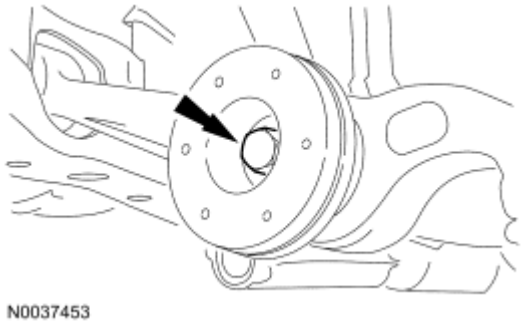


Fig. 538: Locating Lower Control Arms Through Bolt
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

91. Install the lower ball joint nuts.
    - Tighten to 200 Nm (148 lb-ft).

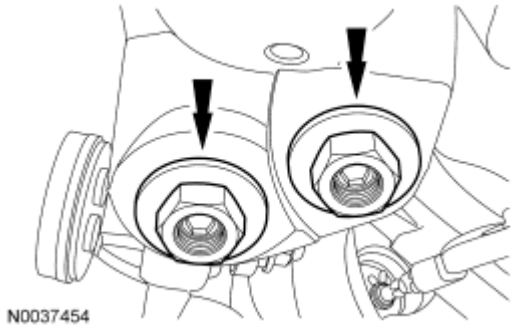


Fig. 539: Locating Lower Ball Joint Nuts
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

92. Install the sway bar links and nuts to the struts.
    - Tighten to 40 Nm (30 lb-ft).

Fig. 540: Locating Stabilizer Bar Links Nut
Courtesy of FORD MOTOR CO.

93. Connect the power steering cooler hose.

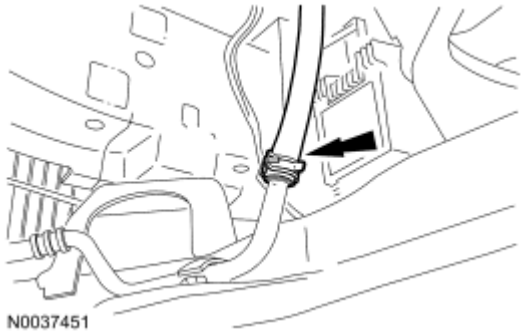


Fig. 541: Locating Power Steering Cooler Tube
Courtesy of FORD MOTOR CO.

NOTE: LH shown, RH similar.

94. Install the tie-rod ends and nuts.
    - Tighten to 48 Nm (35 lb-ft).
    - Install the cotter pin.

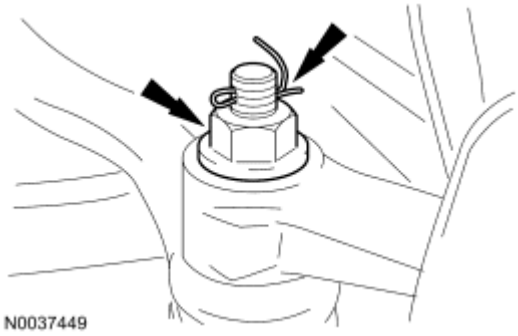


Fig. 542: Locating Tie-Rod Ends Nuts And Cotter Pin
Courtesy of FORD MOTOR CO.

95. Install the LH splash shield and the 6 pin-type retainers (4 shown).

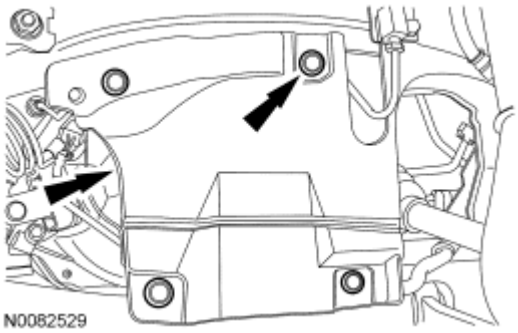


Fig. 543: Locating LH Splash Shield & Pin-Type Retainers
Courtesy of FORD MOTOR CO.

96. Position the LH fender splash shield and install the 4 screws.

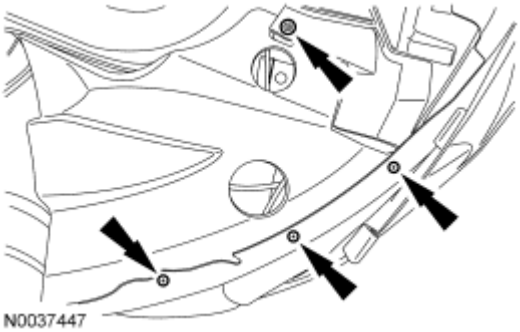


Fig. 544: Locating LH Fender Splash Shield Screws
Courtesy of FORD MOTOR CO.

97. Install the RH splash shield and the 6 pin-type retainers (4 shown).

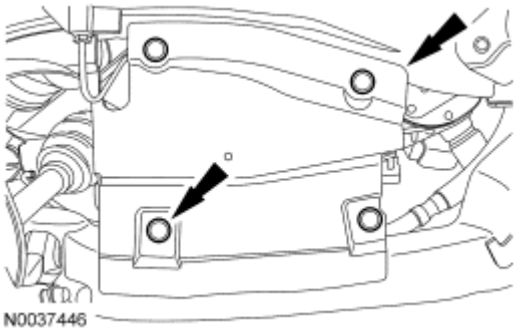


Fig. 545: Locating Splash Shield Pin-Type Retainers
Courtesy of FORD MOTOR CO.

98. Position the RH fender splash shield and install the 4 screws.

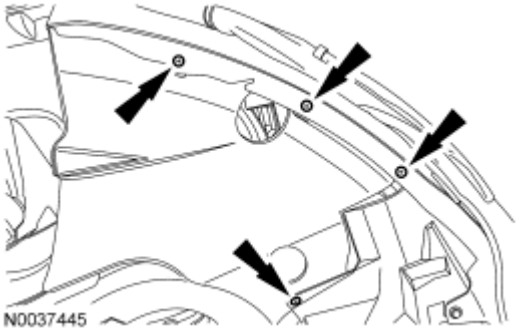


Fig. 546: Locating RH Fender Splash Shield Screws
Courtesy of FORD MOTOR CO.

99. Install the engine roll restrictor and the 2 bolts.
    - Tighten to 90 Nm (66 lb-ft).

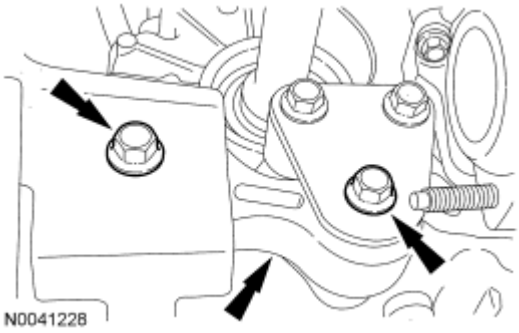


Fig. 547: Identifying Engine Roll Restrictor And Bolts
Courtesy of FORD MOTOR CO.

100. If equipped, install the heat shield and the 2 bolts.

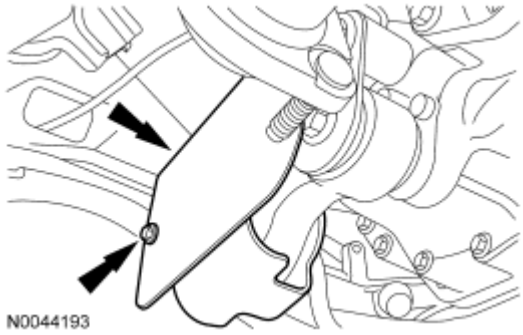


Fig. 548: Locating Heat Shield And Bolts
Courtesy of FORD MOTOR CO.

101. Using a new banjo bolt and 2 seals, connect the PSP hose to the power steering gear.
    - Tighten to 35 Nm (26 lb-ft).

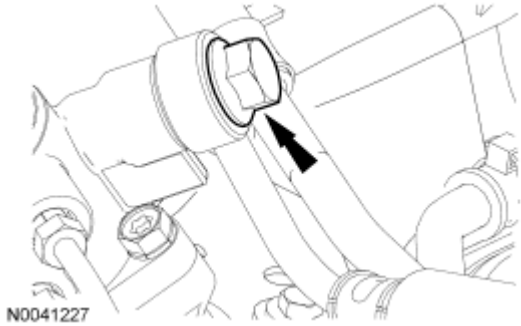


Fig. 549: Locating PSP Hose Banjo Bolt
Courtesy of FORD MOTOR CO.

102. Position the PSP hose onto the steering gear and install the PSP hose bracket bolt.
    - Tighten to 15 Nm (133 lb-in).

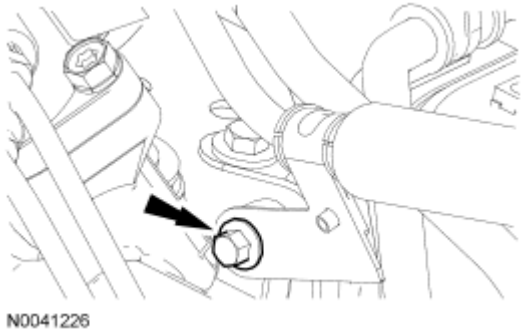


Fig. 550: Locating Power Steering Pressure (PSP) Hose Bracket Bolt
Courtesy of FORD MOTOR CO.

103. Slide the steering gear-to-dash seal onto the steering gear and engage the 4 retaining clips (1 shown) into the body.

- From under the vehicle, verify that the seal is properly installed on the steering gear and the retaining clips are fully engaged into the body.

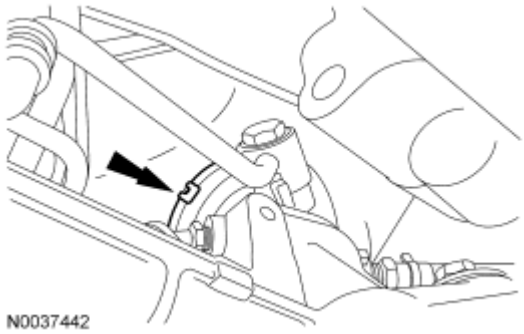


Fig. 551: Locating Steering Gear-To-Dash Seal Clips
Courtesy of FORD MOTOR CO.

AWD vehicles

104. Line up the index marks on the rear driveshaft to the index marks on the PTU flange made during removal and install the 4 bolts (3 shown).
    - Tighten to 70 Nm (52 lb-ft).

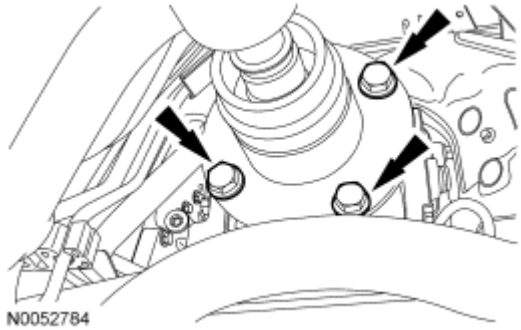


Fig. 552: Identifying Drive Shaft Bolts
Courtesy of FORD MOTOR CO.

All vehicles

105. Install the exhaust flexible pipe. For additional information, refer to **EXHAUST SYSTEM** article.

NOTE: Align the index marks made during removal.

106. Install the steering intermediate shaft onto the steering gear and install the bolt.
    - Tighten to 23 Nm (17 lb-ft).

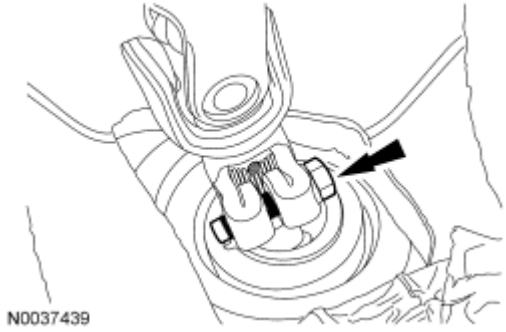


Fig. 553: Locating Steering Intermediate Shaft Bolt
Courtesy of FORD MOTOR CO.

107. Install the steering joint cover and the 2 nuts.

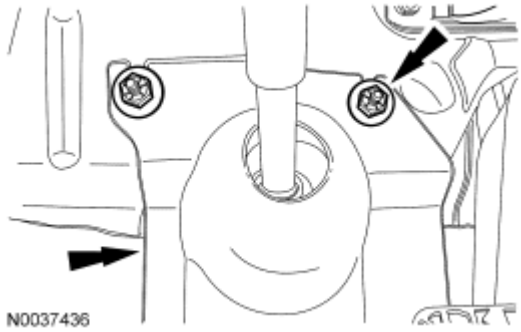


Fig. 554: Locating Steering Joint Cover And Nuts
Courtesy of FORD MOTOR CO.

108. Fill the engine with clean engine oil.
109. Connect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING AND CABLES** article.
110. Fill and bleed the cooling system. For additional information, refer to **ENGINE COOLING** article.
111. Fill the power steering system. For additional information, refer to **STEERING SYSTEM - GENERAL INFORMATION** article.
112. Check the transaxle fluid and add fluid if necessary. For additional information, refer to the transmission fluid drain and refill procedure in **AUTOMATIC TRANSAXLE/TRANSMISSION - AISIN AW21** article.
113. Recharge the air conditioning system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** article.

