2008 ENGINE

2.3L - Ranger

SPECIFICATIONS

MATERIAL SPECIFICATIONS

MATERIAL SPECIFICATIONS

Item	Specification	Fill Capacity
High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A	WSS-M1C267-A1	-
Motorcraft Metal Surface Prep ZC-31	-	-
Motorcraft Premium Gold Engine Coolant with Bittering Agent (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	3.8L (4 qt) with filter change
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B	-
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

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Item	Specification
Displacement	2.3L
No. of cylinders	4

Bore/stroke	87.5/94.0
Firing order	1-3-4-2
Oil pressure (hot @ 2,000 RPM)	29-39 psi 200-268 kPa
Engine weight (without accessory drive components)	133 Kg (293 lb)
Cylinder Block	
Cylinder bore diameter	87.5-87.53 mm (3.444-3.445 in)
Out of round	0.008 mm (0.0003 in)
Main bearing bore diameter	57.020-57.038 mm (2.244-2.245 in)
Head face flatness	0.1 mm/general 0.05 mm/200 x 200 (0.0003 in/general) (0.0019 in/7.87 x 7.87)
Piston	
Diameter (1)	87.5-87.51 mm (3.444-3.445 in)
Diameter (2)	87.51-87.52 mm (3.4452-3.4456 in)
Diameter (3)	87.52-87.53 mm (3.444-3.446 in)
Piston to bore clearance	0.025-0.045 mm (0.0009-0.0017 in)
Ring groove width - top	1.203-1.205 mm (0.0473-0.0474 in)
Ring groove width - 2nd	1.17-1.19 mm (0.0.460-0.0468 in)
Ring groove width - oil	2.501-2.503 mm (0.0984-0.0985 in)
Piston skirt coating thickness	0.008-0.020 mm (0.0003-0.0007 in)
Piston Pin	
Diameter	20.995-21.0 mm (0.8266-0.8268 in)
Length	59.6-60.4 mm (2.346-2.377 in)
Piston to pin clearance	0.008-0.016 mm (0.0003-0.0006 in)
Pin to rod clearance	Press fit
Cylinder Head	
Exhaust valve lift (in @ zero lash)	7.4 mm (0.2913 in)

Intake valve lift (in @ zero lash)	7.9 mm (0.3110 in)
Valve guide diameter	5.509-5.539 mm (0.216-0.218 in)
Valve seat width - intake/exhaust	0.99-1.84 mm (0.038-0.072 in)
Valve seat angle	45 degrees
Valve seat runout	0.075 mm (0.0029 in)
Valve lash adjustor bore diameter	31.00-31.03 mm (1.220-1.221 in)
Cam bore diameter	25.015-25.040 mm (0.984-0.985 in)
Valve	
Valve head diameter - intake	34.85-35.15 mm (1.372-1.383 in)
Valve head diameter - exhaust	29.85-30.15 mm (1.175-1.187 in)
Valve stem diameter - intake	5.470-5.485 mm (0.2153-0.2159 in)
Valve stem diameter - exhaust	5.465-5.480 mm (0.2151-0.2157 in)
Valve stem to guide clearance - intake	0.0027 mm (0.0009 in)
Valve stem to guide clearance - exhaust	0.0029 mm (0.0011 in)
Valve face runout	0.05 mm (0.001 in)
Valve face angle	45 degrees
Valve Spring - Compression Pressure	
Intake and exhaust (installed)	38.667 lb
Intake (valve open) 8.9 mm (0.35 in) of lift	97.032 lb
Exhaust (valve open) 7.4 mm of lift	93.338 lb
Free length	44.92 mm (1.768 in)
Assembled height	37.9 mm (1.492 in)
Crankshaft	
Main bearing journal diameter	51.980-52.000 mm (2.046-2.047 in)
Production repair	51.730-51.750 mm (2.036-2.037 in)
Main bearing clearance	0.019-0.035 mm (0.0007-0.0013 in)
Connecting rod journal diameter	49.980-50.000 mm (1.967-1.968 in)
Production repair	49.730-49.750 mm (1.957-1.958 in)
End play	0.22-0.43 mm (0.008-0.016 in)

Rings	
Width - top	1.17-1.185 mm (0.0460-0.0466 in)
Width - 2nd	1.197-1.199 mm (0.0471-0.0472 in)
Width - oil	2.38-2.45 mm (0.093-0.096 in)
Ring gap (in bore) - top	0.16-0.31 mm (0.006-0.012 in)
Ring gap (in bore) - 2nd	0.33-0.48 mm (0.012-0.018 in)
Ring gap (in bore) - oil	0.2-0.7 mm (0.007-0.027 in)
Valve Tappet	
Diameter	30.97-30.98 mm (1.2192-1.2196 in)
Tappet to valve clearance - intake	0.22- 0.28 mm (0.008-0.011 in)
Tappet to valve clearance - exhaust	0.27-0.33 mm (0.010-0.013 in)
Tappet to bore clearance	0.02-0.06 mm (0.0007-0.0023 in)
Camshaft	
Lobe lift - intake	8.24999 mm (0.324 in)
Lobe lift - exhaust	7.80007 mm (0.307 in)
Runout (1)[a]	0.03 mm (0.001 in)
Thrust clearance	0.09-0.24 mm (0.003-0.009 in)
Journal diameter	24.96-24.98 mm (0.982-0.983 in)
Journal to bore clearance	0.035-0.080 mm (0.001-0.003 in)
Connecting Rod	
Bearing clearance	0.027-0.052 mm (0.001-0.002 in)
Bearing thickness	1.496-1.520 mm (0.058-0.059 in)
Crank bore diameter	53.025-53.045 mm (2.087-2.088 in)
Pin bore diameter	20.965-20.985 mm (0.825-0.826 in)
Length (center to center)	154.8 mm (6.094 in)
Side clearance	1.95-3.05 mm (0.076-0.120 in)
Axial clearance	0.14-0.36 mm

	(0.005-0.014 in)
All dimensions are in mm unless noted.	

[a] No. 3 Journal - Supported by No. 1 and No. 5 Journals.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner bolt	50	37	-
A/C compressor bolts	25	18	-
A/C manifold tube bolt	20	15	-
Battery cable nuts	12	9	-
Camshaft bearing caps[a]	-	-	-
Camshaft position (CMP) sensor bolts	7	-	62
Camshaft sprocket bolt	72	53	-
Clutch pressure plate bolts	32	24	-
Coolant outlet (front) connector bolts	25	18	-
Coolant outlet pipe bolts	10	-	89
Coolant pump bolts	10	-	89
Coolant pump pulley bolts	20	15	-
Coolant thermostat bolts	10	-	89
Coolant tube nuts	20	15	-
Crankcase vent oil separator	10	-	89
Crankshaft oil seal retainer[a]	-	-	-
Crankshaft position (CKP) sensor	7	-	62
Crankshaft pulley bolt[a]	-	-	-
Cylinder block coolant drain plug	55	41	-
Cylinder head bolts[a]	-	-	-
Cylinder head temperature (CHT) sensor	12	9	-
Engine front cover bolts[a]	-	-	-
Engine ground cable-to-cylinder head stud bolt	10	-	89
Engine lifting eye bolts	45	33	-
Engine support insulator-to-crossmember nuts	103	76	-
Engine support insulator-to-engine bracket nuts	102	75	-
Engine-to-transmission bolts	48	35	-
Engine wire harness connector bracket bolt	10	-	89
EGR tube bracket bolt	10	-	89
EGR outlet tube-to-cylinder head fitting	55	41	-
EGR outlet tube-to-intake manifold flange bolts	18	13	-
EGR valve bolts	20	15	-

Exhaust manifold-to-cylinder head nuts	54	40	-
Exhaust manifold-to-cylinder head studs	17	13	-
Exhaust manifold-to-exhaust downpipe flange nuts	40	30	-
Flywheel or flexplate bolt[a]	-	-	-
Fuel rail bolts	25	18	-
Generator battery cable nut	8	-	71
Generator/A/C compressor support bracket bolts[a]	-	-	-
Ground strap bolt	10	-	89
Ignition coil bolts	6	-	53
Intake manifold bolts	18	13	-
Knock sensor (KS) bolt	20	15	-
Motor mount bolts	49	36	-
Oil drain plug	28	21	-
Oil filter adapter bolts	25	18	-
Oil level indicator tube bolt	10	-	89
Oil pan bolts[a]	-	-	-
Oil pressure sensor	15	11	-
Oil pump assembly bolts[a]	-	-	-
Oil pump chain tensioner bolts	10	-	89
Oil pump pickup tube and screen bolts	10	-	89
Oil pump sprocket bolt	25	18	-
PCM harness ground cable stud bolt	10	-	89
PCM harness retainer nut	4	-	35
Power steering pressure (PSP) tube nut	20	15	-
Power steering pump bolts	25	18	-
Solenoid control wire and nut	6	-	53
Spark plugs	15	11	-
Starter motor bolts	25	18	-
Timing chain guide bolts	10	-	89
Timing chain tensioner bolts	10	-	89
Timing peg plug	20	15	-
Torque converter-to-flywheel nuts	35	26	-
Tranmission-to-cylinder block bolts	48	35	-
Transmission-to-oil pan bolts	48	35	-
Transmission bracket-to-transmission bolts	90	66	-
Transmission dust shield bolts	10	-	89
Transmission lines bracket bolt	28	21	-
Valve cover bolts[a]	-	-	-
Wiring harness bracket-to-transmission nut	10	-	89

[a] Refer to the appropriate procedures in this article.

DESCRIPTION AND OPERATION

ENGINE

The 2.3L (140 CID) 4-cylinder engine has the following features:

- Dual overhead camshaft
- Four valves per cylinder
- Sequential multiport fuel injection (SFI)
- Aluminum cylinder head
- Aluminum cylinder block
- Electronic ignition system with 2 coil packs

The 2.3L engine is a 4 valve-per-cylinder, dual overhead camshaft engine. The engine uses a distributorless ignition system. The cylinder block is made of aluminum and the bearing caps are integrated into the ladder assembly. An aluminum oil pan bolts to the bottom of the lower cylinder block and to the transmission to provide greater strength. The camshafts are mounted in the cylinder heads and act against valve tappets to open and close the valves. The camshafts are driven off the front of the cylinder head by one timing chain. The chain is driven by a sprocket that is located on the crankshaft. The piston assembly is an aluminum piston with a cast iron connecting rod. The oil pump is driven by the crankshaft via a dedicated chain that is driven by the same sprocket that drives the timing chain.

Identification - Always refer to these labels when installation of new parts is necessary or when checking engine calibrations. The engine parts often differ within a CID family. Verification of the identification codes will make sure that the correct parts are obtained. These codes contain all the pertinent information relating to the dates, optional equipment and revisions. The Ford Master Parts Catalog contains a complete listing of the codes and their application

Code Information - The engine code information label, located on the side of the valve cover and the front side of the valve cover, contains the:

- engine build date.
- engine plant code.
- engine code.

Exhaust Emission Control System - Operation and necessary maintenance of the exhaust emission control devices used on this engine are covered in the **Introduction - Gasoline Engines** article.

Induction System - The sequential multiport fuel injection (SFI) provides the fuel/air mixture needed for combustion in the cylinders. The 4 solenoid-operated fuel injectors:

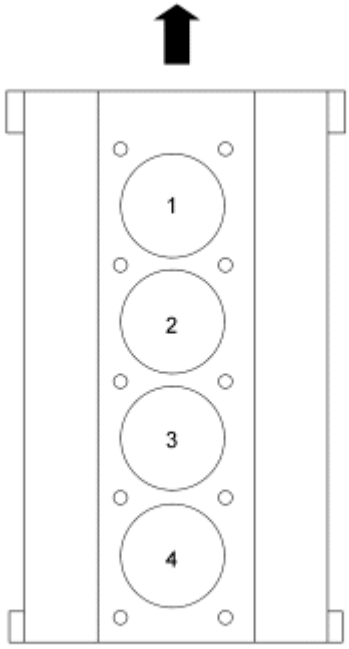
- are mounted in the cylinder head.
- meter fuel to the air intake stream in accordance with engine demand.

- are positioned so their tips direct fuel just ahead of the engine intake valves.

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

Lubrication System - The engine lubrication system operates as follows:

- Oil is drawn into the oil pump through the oil pump screen cover and tube in the sump of the oil pan.
- Oil is pumped through the oil filter on the left front side of the cylinder block.
- Oil enters the main gallery where it is distributed to the crankshaft main journals and to the cylinder head.
- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston ring assembly.



N0070002

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.

GENERAL PROCEDURES

VALVE CLEARANCE CHECK

1. Remove the valve cover. For additional information, refer to **Valve Cover**.

CAUTION: Turn the engine clockwise only and use the crankshaft bolt only or the engine may be damaged.

NOTE: Measure each valve's clearance at base circle with the lobe pointed away from the tappet, before removing the camshafts. Failure to measure all clearances prior to removing the camshafts will necessitate repeated removal and installation and wasted labor time.

2. Use a feeler gauge to measure each valve's clearance and record its location.

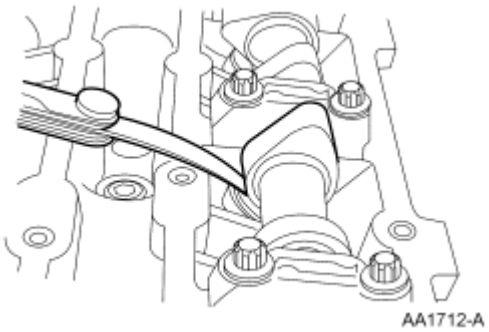


Fig. 2: Measuring Each Valve's Clearance Using A Feeler Gauge
Courtesy of FORD MOTOR CO.

NOTE: The number on the valve tappet only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

NOTE: The nominal desired mid-range clearance is:

- **Intake: 0.25 mm (0.0095 in)**
- **Exhaust: 0.30 mm (0.0115 in)**

Select tappets using this formula: tappet thickness = measured clearance + the base tappet thickness - most desirable thickness.

NOTE: The acceptable clearances after being fully installed are:

- **Intake: 0.22-0.28 mm (0.008-0.011 in)**
- **Exhaust: 0.27-0.33 mm (0.010-0.013 in)**

3. Select the closest tappet size available and mark the installation location.
4. If any tappets do not measure within specifications, install new tappets in those locations. For additional information, refer to **Valve Tappets**.

IN-VEHICLE SERVICING

INTAKE MANIFOLD

Material

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

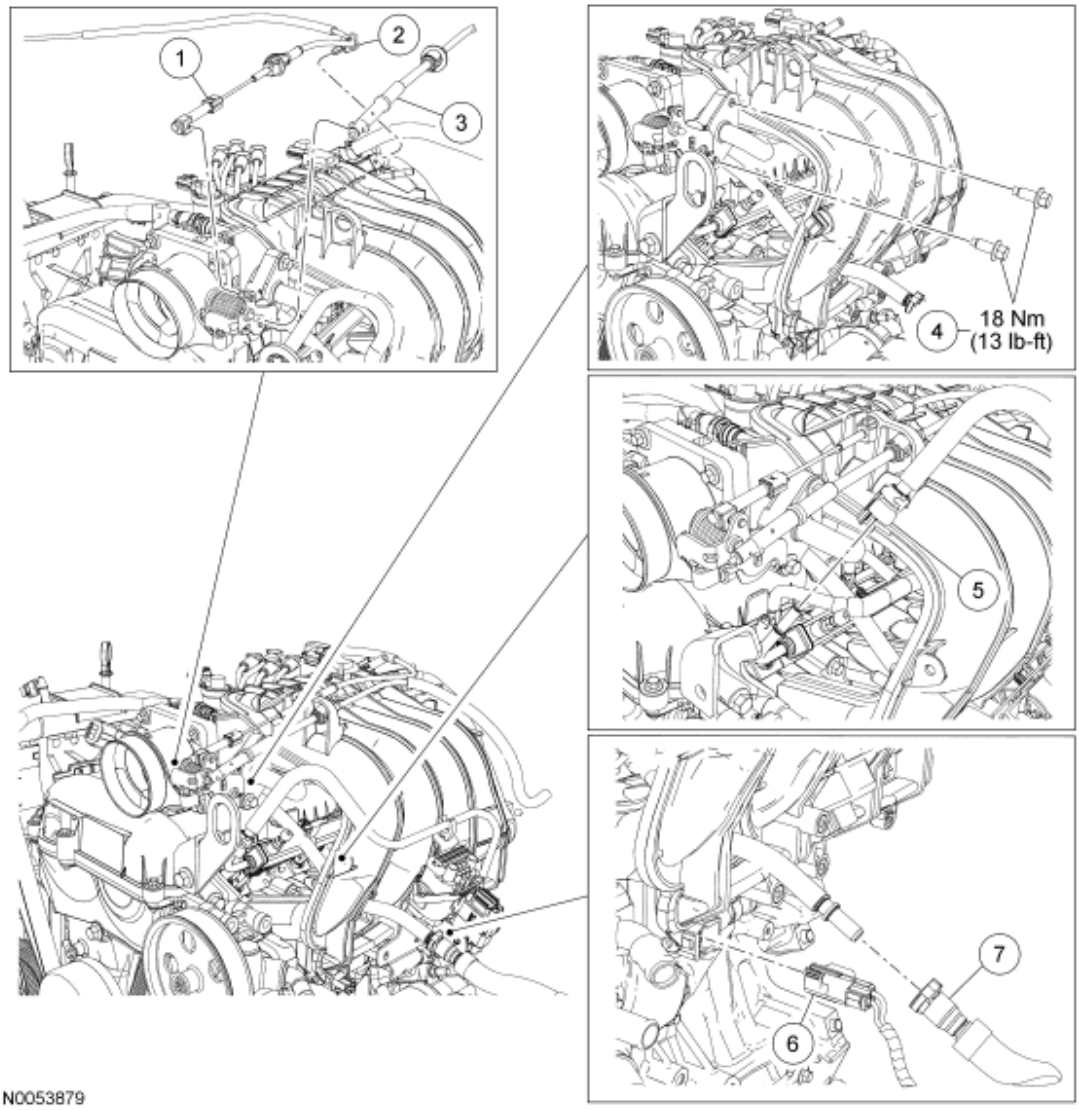


Fig. 3: Intake Manifold - Cables and LH Connections With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	9A825	Speed control cable
2	N802768	Speed control cable position retainer clip
3	9A758	Accelerator control cable
4	W500222	EGR tube bolts (2 required)
5	9J280	Fuel supply tube
6	-	Knock sensor (KS) electrical connector (part of 14A290)
7	9Y476	Evaporative emissions (EVAP) vent tube quick connect coupling

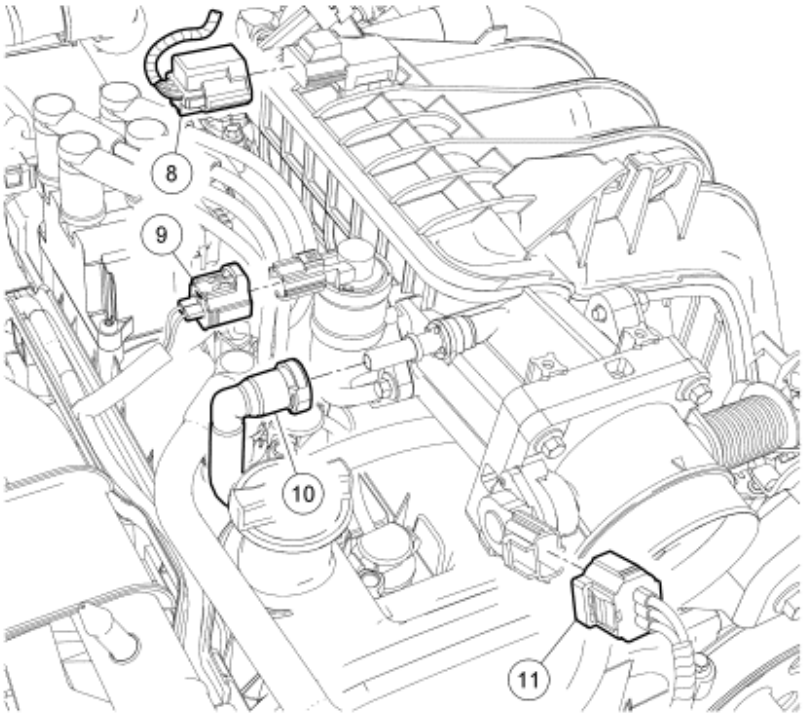


Fig. 4: Intake Manifold - RH Connections
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
8	-	Manifold absolute pressure (MAP) sensor electrical connector (part of 12B637)
9	-	Idle air control (IAC) valve electrical connector (part of 12B637)
10	9G297	Vacuum tube quick connect coupling
		Throttle position (TP) sensor electrical

11	-	connector (part of 12B637)

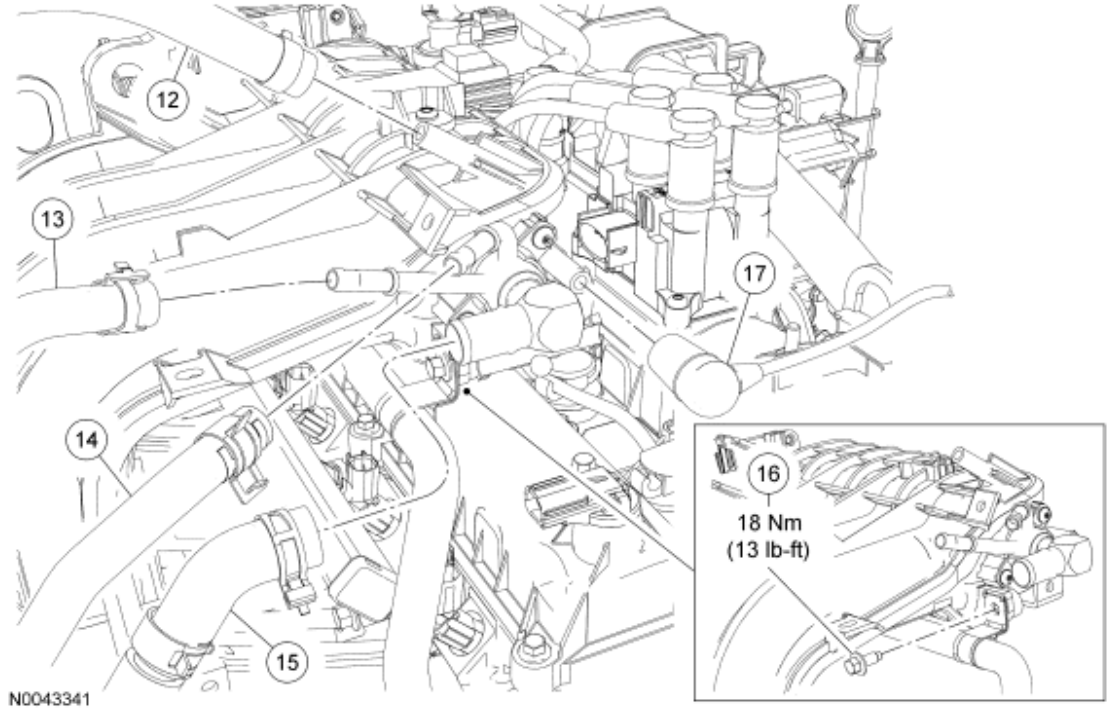


Fig. 5: Intake Manifold - Rear Connections With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
12	381298	Brake booster vacuum hose
13	8C633	Coolant hose
14	9Y439	Coolant hose
15	6758	Crankcase breather hose
16	W500211	EGR tube support retainer bolt
17	9E498	Vacuum hose

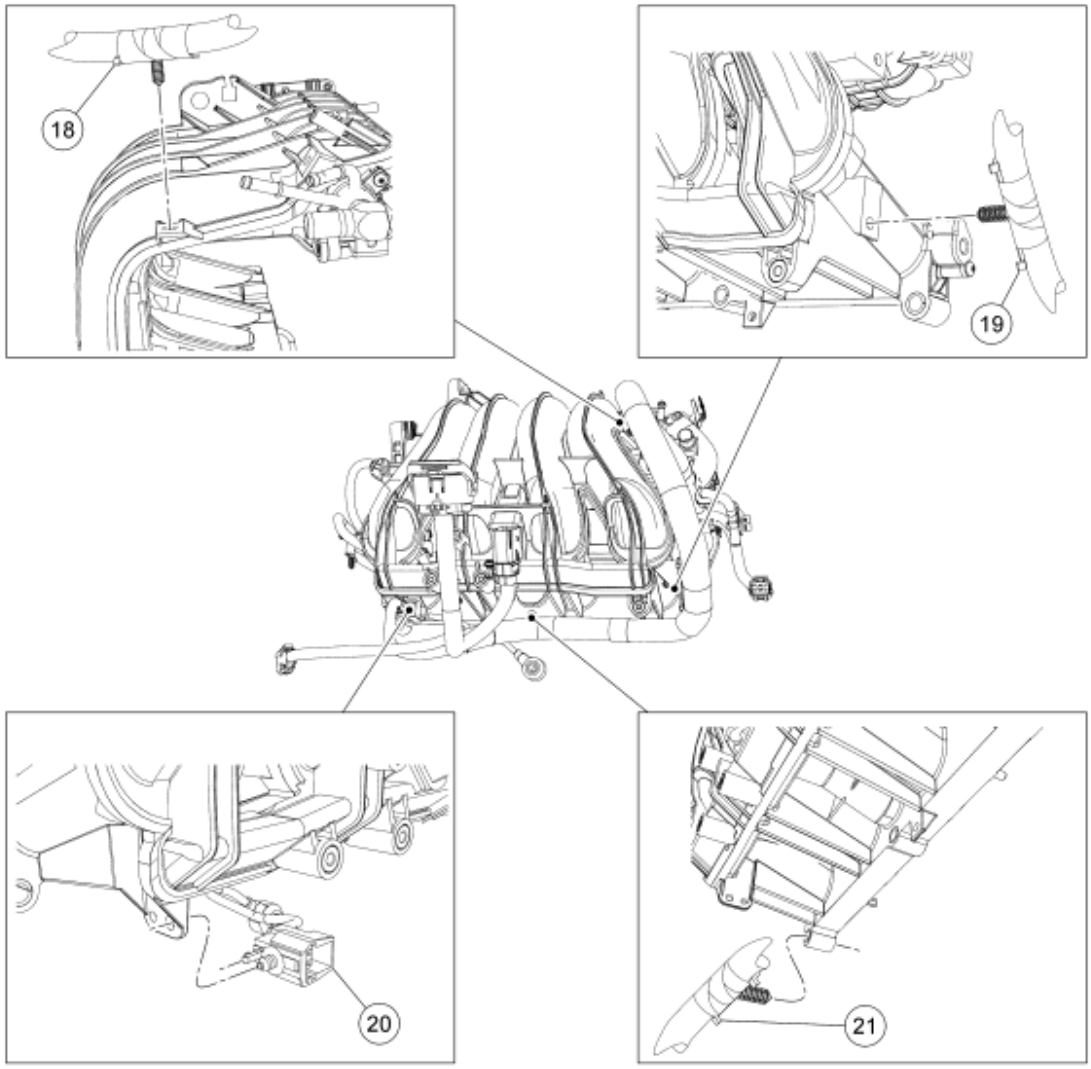


Fig. 6: Intake Manifold - Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
18	13A506	Wiring harness retainer (part of 12B637)
19	13A506	Wiring harness retainer (part of 12B637)
20	-	KS electrical connector retainer (part of 12A699)
21	13A506	Wiring harness retainer (part of 12B637)

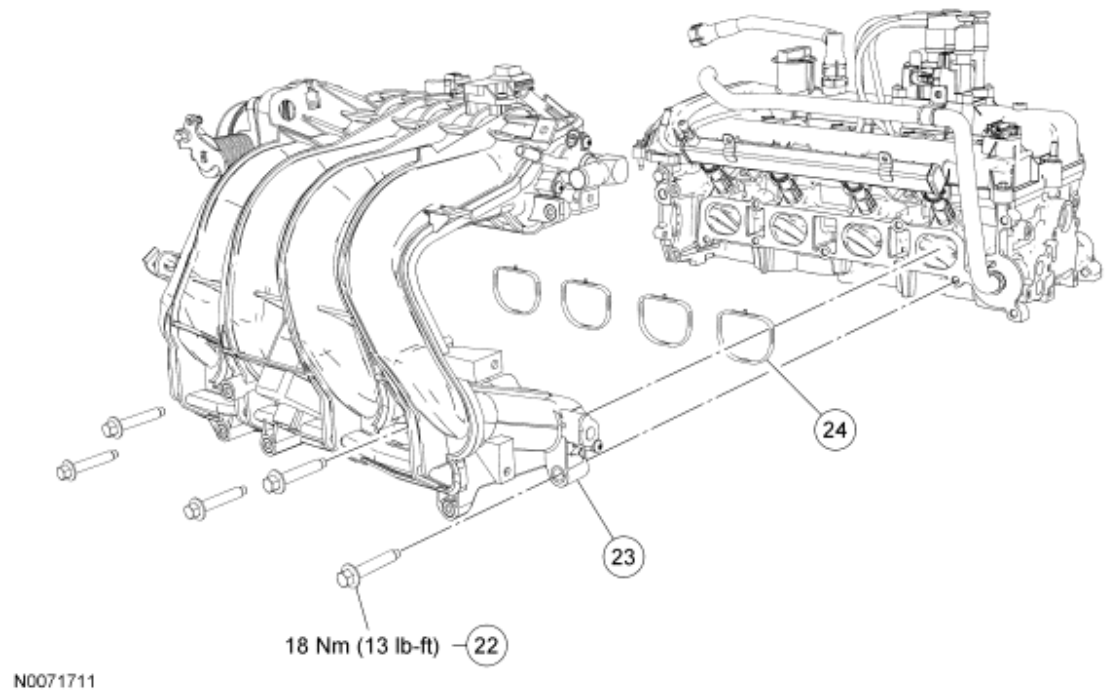


Fig. 7: Exploded View Of Intake Manifold With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
22	W500311	Intake manifold bolt (5 required)
23	9424	Intake manifold
24	9441	Intake manifold gasket (4 required)

REMOVAL

1. Drain the engine cooling system. For additional information, refer to **ENGINE COOLING** article.
2. Remove the air cleaner outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** article.
3. Disconnect the acceleration control cable from the intake manifold and throttle body (TB).
4. If equipped, disconnect the speed control cable from the intake manifold and TB.
5. Disconnect the throttle position (TP) sensor electrical connector.
6. Disconnect the manifold absolute pressure (MAP) sensor electrical connector.
7. Disconnect the idle air control (IAC) valve electrical connector.
8. Disconnect the vapor purge tube quick connect coupling. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
9. Disconnect the engine vacuum harness, brake booster hose, the crankcase breather hose and the coolant hoses.
10. Disconnect 2 engine wiring harness pin-type retainers from the intake manifold.
11. Disconnect the pin-type retainer from the rear of the intake manifold.

12. Remove the EGR tube support bracket bolt.
13. Remove the 2 bolts from the EGR tube flange.
14. Detach the fuel supply tube and the electrical connectors from the bracket and disconnect the evaporative emissions (EVAP) tube quick connect coupling. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
15. Disconnect the knock sensor (KS) electrical connector and disconnect the connector retainer from the intake manifold.
16. Remove the wiring harness pushpin from the bottom of the intake manifold.
17. Disconnect fuel supply tube spring lock coupling. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.

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

18. Remove the 5 bolts and the intake manifold.
    - Clean the sealing surface of the cylinder head with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.
19. Remove and discard the intake manifold gaskets.

INSTALLATION

1. Install new intake manifold gaskets.
2. Position the intake manifold and install the 5 bolts.
    - Tighten to 18 Nm (13 lb-ft).
3. Connect the wiring pushpin to the bottom of the intake manifold.
4. Connect the KS connector retainer to the intake manifold and connect the electrical connector.
5. Attach the electrical connectors and the fuel supply tube to the bracket and connect the EVAP tube quick connect coupling. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
6. Install the 2 EGR flange mounting bolts.
    - Tighten to 18 Nm (13 lb-ft).
7. Install the EGR tube support bracket bolt.
    - Tighten to 10 Nm (89 lb-in).
8. Position the engine wiring harness and connect the pin-type retainers.
9. Connect the engine vacuum harness, brake booster hose, the crankcase breather hose and coolant hoses.
10. Connect the IAC valve electrical connector and the fuel supply tube spring lock coupling. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
11. Connect the MAP sensor electrical connector.
12. Connect the TP sensor electrical connector.

13. Connect the acceleration control cable to the intake manifold and the TB.
14. If equipped, connect the speed control cable to the intake manifold and the TB.
15. Install the air cleaner outlet tube. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** article.
16. Fill and bleed the engine cooling system. For additional information, refer to **ENGINE COOLING** article.

VALVE COVER

Material

Item	Specification
Motorcraft Metal Surface Prep ZC-31	-
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	-

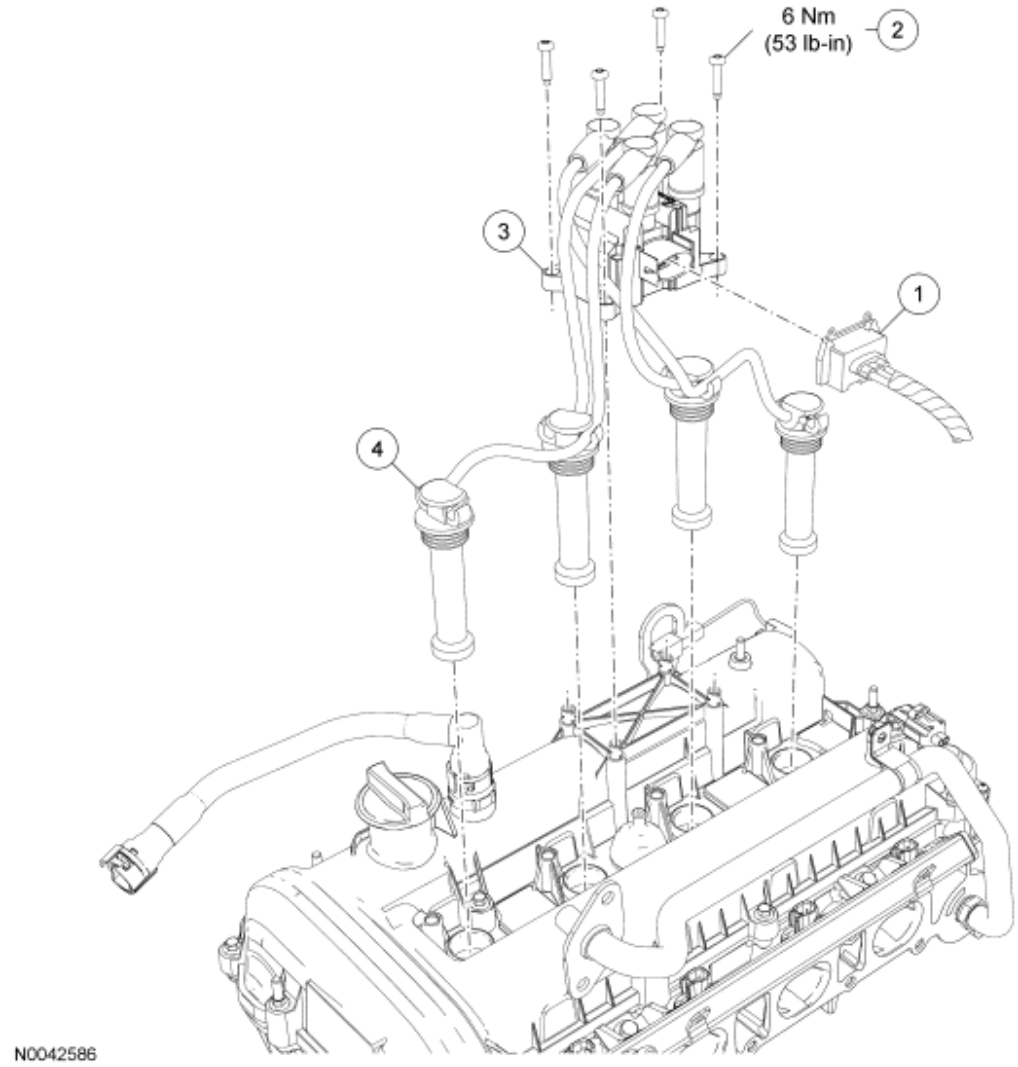


Fig. 8: Exploded View Of Valve Cover - Ignition Coil and Wires With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Ignition coil electrical connector (part of 12B637)
2	W505575	Ignition coil bolt (4 required)
3	12029	Ignition coil
4	-	Spark plug wire (4 required)

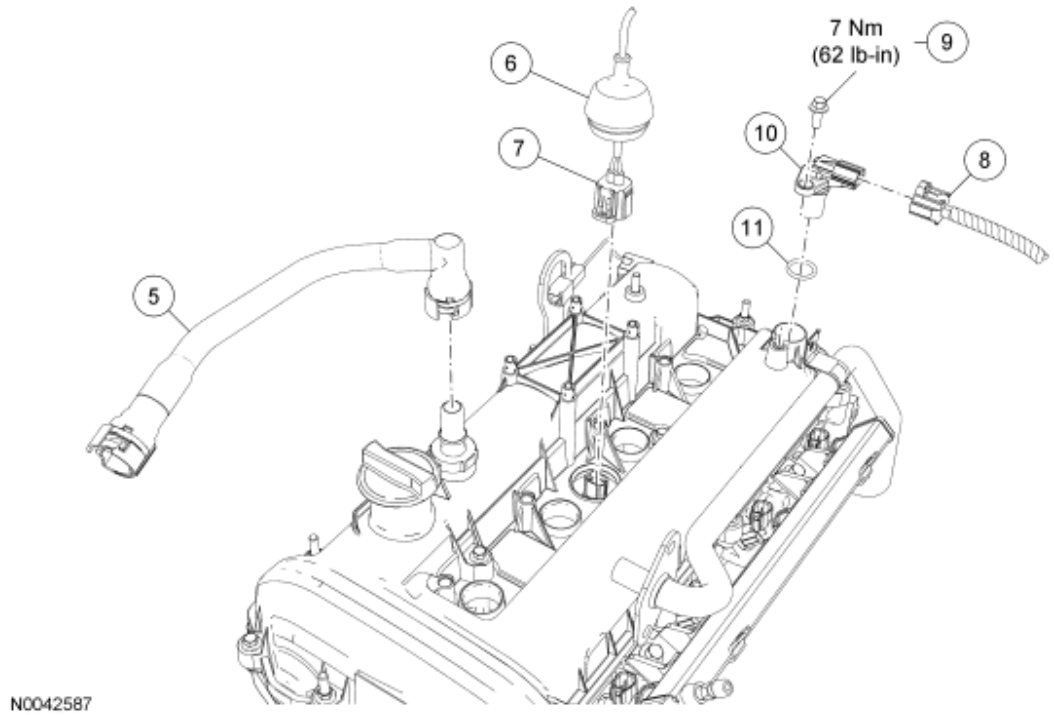


Fig. 9: Exploded View Of Valve Cover - Connections With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
5	6758	Crankcase breather tube
6	-	Cylinder head temperature (CHT) sensor cover (part of 12B637)
7	-	CHT sensor electrical connector (part of 12B637)
8	-	Camshaft position (CMP) sensor electrical connector (part of 12B637)
9	W701219	CMP sensor bolt
10	12K073	CMP sensor
11	-	CMP sensor O-ring seal

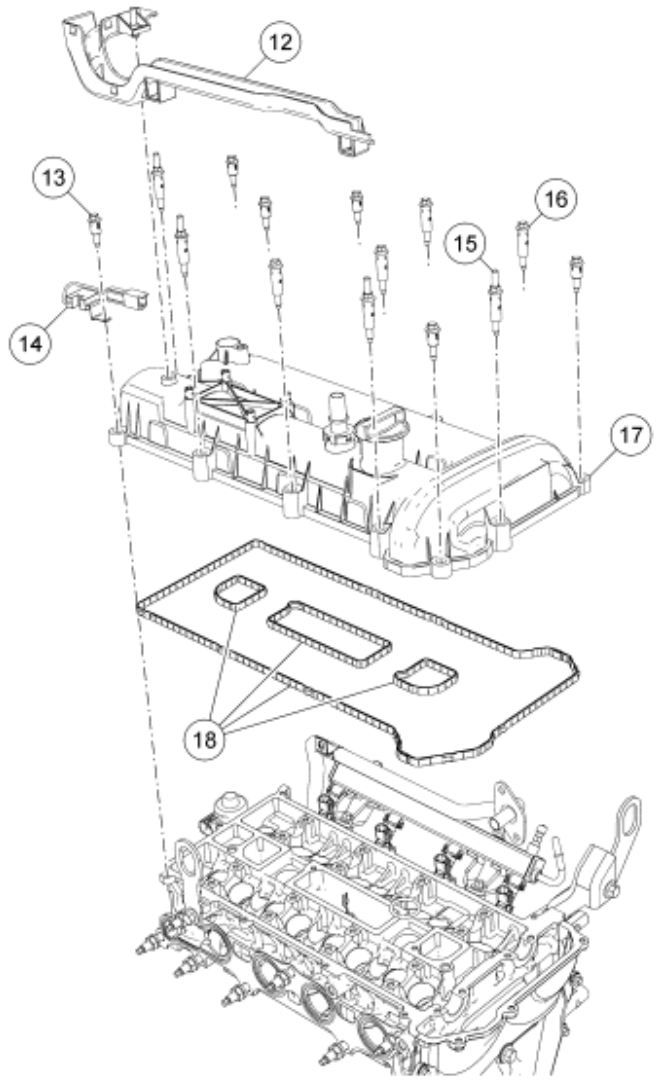


Fig. 10: Exploded View Of Valve Cover
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
12	14A099	Wiring harness shield/support bracket
13	6C295	Valve cover bolt (short shoulder) (6 required)
14	18801	Radio ignition interference capacitor
15	-	Valve cover stud bolt (4 required)
16	-	Valve cover bolt (medium shoulder) (4 required)
17	6K272	Valve cover
18	6K620	Valve cover seals (4 required)

REMOVAL

1. Disconnect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING & CABLES** article.
2. Remove the intake manifold assembly. For additional information, refer to **Intake Manifold**.
3. Position aside the cylinder head temperature (CHT) sensor cover.
4. Disconnect the CHT sensor electrical connector.
5. Disconnect the engine wiring harness support bracket retainers from the valve cover studs.
6. Disconnect the spark plug wires from the spark plugs. For additional information, refer to **ENGINE IGNITION - 2.3L** article.
7. Disconnect the ignition coil electrical connector.
8. Remove the 4 bolts and the ignition coil and spark plug wires as an assembly.
9. Disconnect the camshaft position (CMP) sensor electrical connector.
10. Remove the bolt and the CMP sensor.
11. Disconnect the crankcase ventilation tube quick connect coupling. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
12. Remove the bolts and the valve cover.

CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.

13. Clean and inspect the cylinder head sealing surfaces with metal surface prep and silicone gasket remover. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.
14. Remove and discard the valve cover gaskets.

INSTALLATION

1. Install new valve cover gaskets.
2. Position the valve cover and install the bolts in the sequence shown in illustration.
   - Tighten to 10 Nm (89 lb-in).

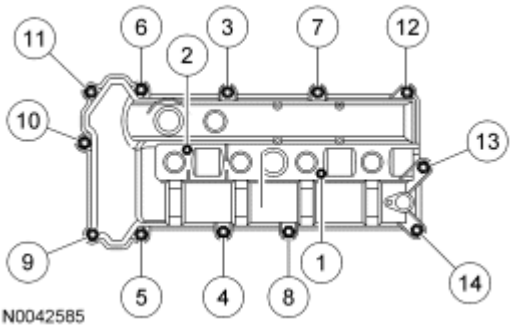


Fig. 11: Identifying Tightening Sequence Of Valve Cover Bolts
Courtesy of FORD MOTOR CO.

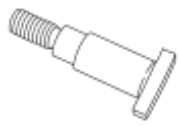
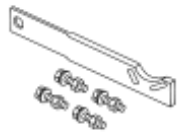
3. Connect the crankcase ventilation tube quick connect coupling. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.

NOTE: Apply clean engine oil to the O-ring seal prior to installation.

4. Install the CMP sensor and the bolt.
   - Tighten to 7 Nm (62 lb-in).
5. Connect the CMP sensor electrical connector.
6. Position the ignition coil and install the 4 bolts.
   - Tighten to 6 Nm (53 lb-in).
7. Connect the ignition coil electrical connector.
8. Connect the spark plug wires to the spark plugs. For additional information, refer to **ENGINE IGNITION - 2.3L** article.
9. Install the engine wiring harness support bracket retainers onto the valve cover studs.
10. Connect the CHT sensor electrical connector.
11. Position back the CHT sensor boot.
12. Install the intake manifold. For additional information, refer to **Intake Manifold**.
13. Connect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING & CABLES** article.

CRANKSHAFT PULLEY

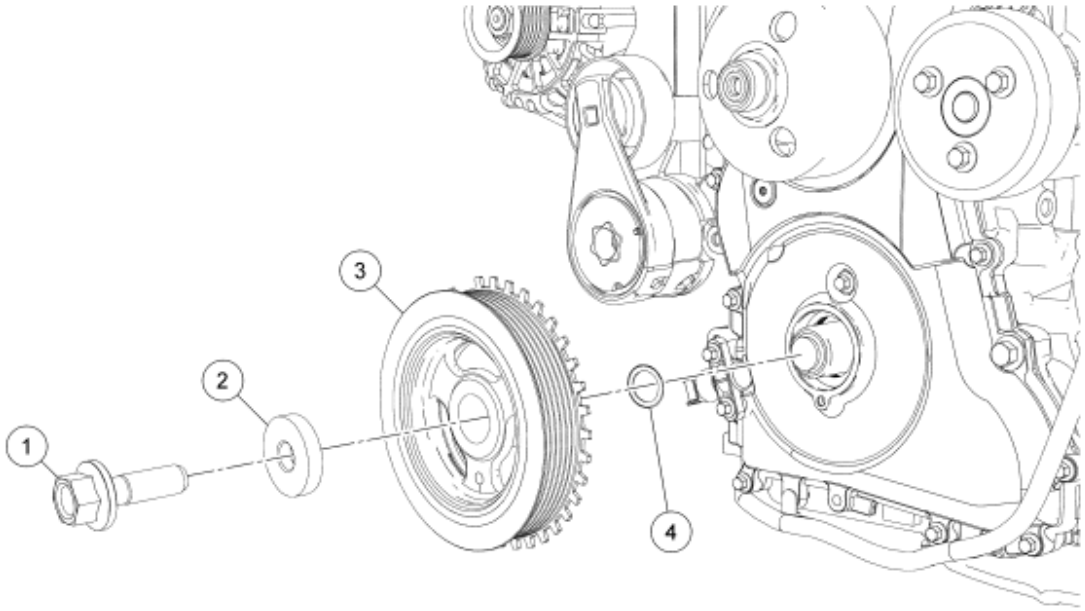
Special Tools

Illustration	Tool Name	Tool Number
 ST2639-A	Adapter for 205-126	205-072-02
 ST2645-A	Alignment Plate, Camshaft	303-465 (T94P-6256-CH)
 ST2647-A	Holding Fixture, Drive Pinion Flange	205-126 (T78P-4851-A)

 ST2638-A	Timing Peg, Crankshaft	303-507

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



N0078846

Fig. 12: Exploded View Of Crankshaft Pulley
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6K340	Crankshaft pulley bolt
2	-	Crankshaft pulley bolt washer
3	6316	Crankshaft pulley
4	6378	Diamond washer

REMOVAL

CAUTION: Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if you loosen the pulley bolt. Before any repair required loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special tools, otherwise severe engine damage can occur.

CAUTION: 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 & LIFTING** article.
2. Remove the fan and shroud. For additional information, refer to **ENGINE COOLING** article.
3. Remove the accessory drive belt. For additional information, refer to **ACCESSORY DRIVE** article.
4. Remove the valve cover. For additional information, refer to **Valve Cover**.

CAUTION: Failure to position the No. 1 piston at top dead center (TDC) can result in damage to the engine. Turn the crankshaft in the normal direction of rotation only.

5. Using the crankshaft pulley bolt, turn the crankshaft clockwise to position the No. 1 piston at top dead center (TDC).
   - The hole in the crankshaft pulley should be in the 6 o'clock position.

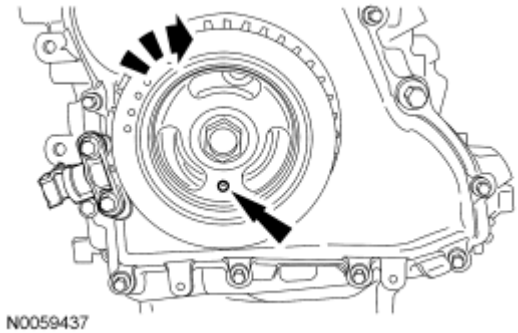


Fig. 13: Turning Crankshaft Clockwise
Courtesy of FORD MOTOR CO.

CAUTION: The special tool 303-465 is for camshaft alignment only. Using this tool to prevent engine rotation can result in engine damage.

NOTE: The camshaft timing slots are offset. If the special tool cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

6. Install the special tool in the slots on the rear of both camshafts.

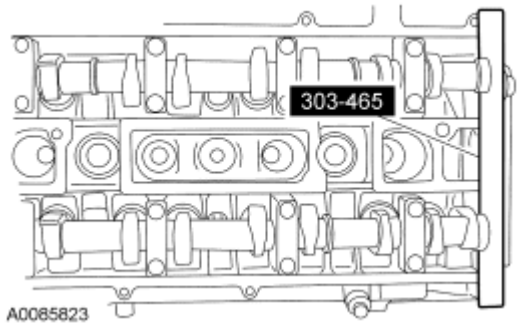


Fig. 14: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

7. Remove the engine plug bolt.

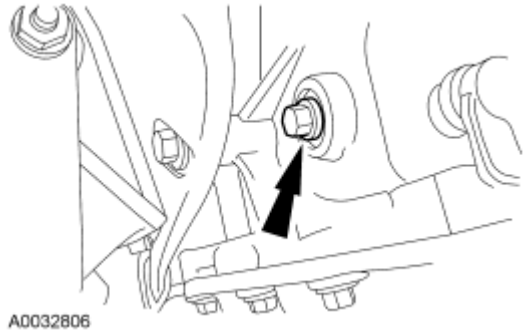


Fig. 15: Locating Engine Plug Bolt
Courtesy of FORD MOTOR CO.

NOTE: The special tool will contact the crankshaft and prevent it from turning past TDC. However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain at the TDC position during the crankshaft pulley removal and installation.

8. Install the special tool.

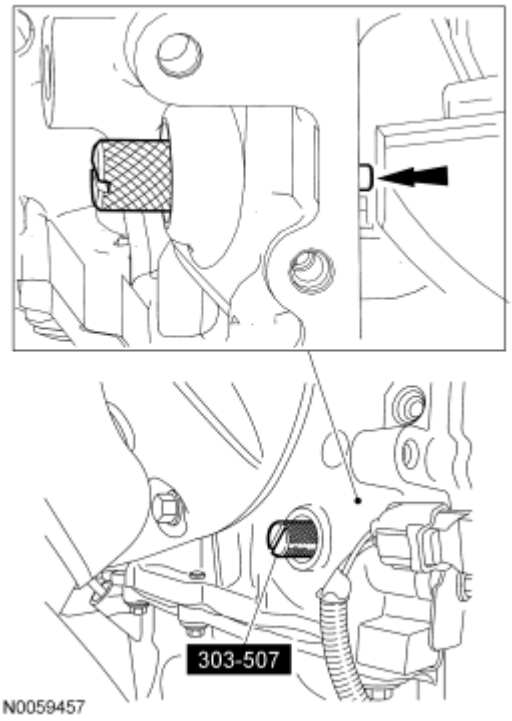


Fig. 16: Identifying Special Tool (303-507)
Courtesy of FORD MOTOR CO.

9. Assemble the special tools using 4 hardened washers in the locations shown in illustration.

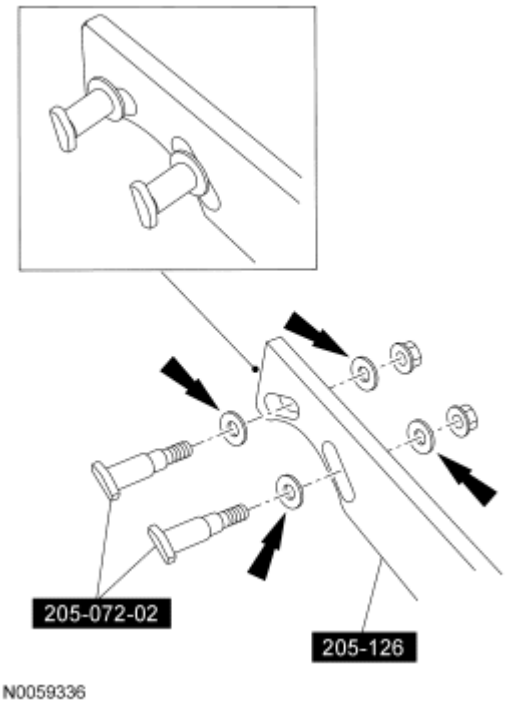


Fig. 17: Assembling Special Tools (205-126 And 205-072-02)

Courtesy of FORD MOTOR CO.

CAUTION: The crankshaft must remain in the top dead center (TDC) position during removal of the pulley bolt or damage to the engine can occur. Therefore, the crankshaft pulley must be held in place with the special tool and the bolt should be removed using an air impact wrench (1/2-in drive minimum).

CAUTION: The crankshaft sprocket diamond washer may come off with the crankshaft pulley. The diamond washer must be replaced; remove and discard the diamond washer. If the diamond washer is not installed, engine damage may occur.

10. Using the special tools and an air impact wrench, remove the crankshaft pulley.
    - Remove and discard the crankshaft pulley bolt and washer.
    - Remove the crankshaft pulley.
    - Remove the diamond washer and discard.

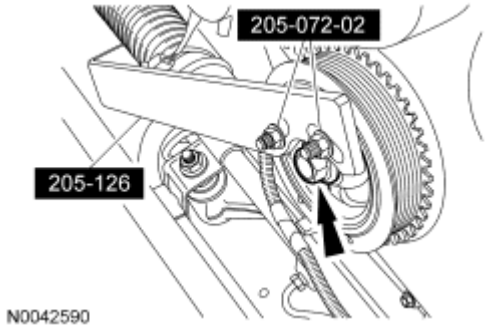


Fig. 18: Identifying Special Tools (205-072-02, 205-126) And Crankshaft Pulley Bolt
Courtesy of FORD MOTOR CO.

INSTALLATION

1. Install a new diamond washer.

NOTE: Do not install the crankshaft pulley bolt at this time.

NOTE: Apply clean engine oil on the crankshaft front seal area before installing.

2. Install the crankshaft pulley onto the crankshaft with the hole in the pulley at the 6 o'clock position.

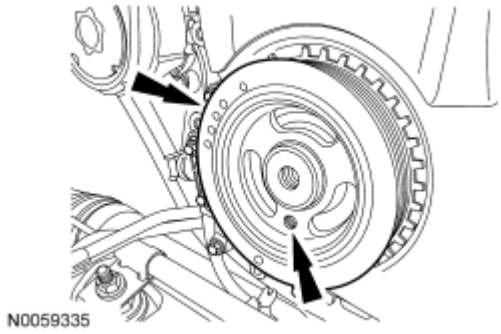


Fig. 19: Locating Crankshaft Pulley & Hole
Courtesy of FORD MOTOR CO.

CAUTION: Only hand-tighten the 6 mm (0.23 in) bolt or damage to the front cover can occur.

NOTE: This step will correctly align the crankshaft pulley to the crankshaft.

3. Install a standard 6 mm (0.23 in) x 18 mm (0.7 in) bolt through the crankshaft pulley and thread it into the front cover.

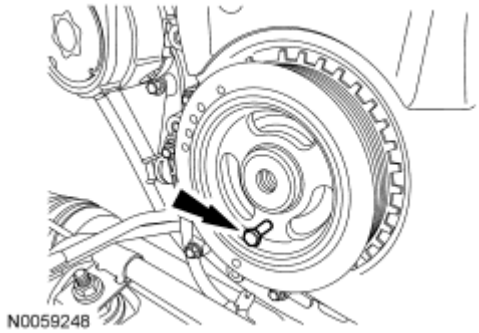


Fig. 20: Locating Crankshaft Pulley Bolt
Courtesy of FORD MOTOR CO.

CAUTION: The crankshaft must remain in the top dead center (TDC) position during installation of the pulley bolt or damage to the engine can occur. Therefore, the crankshaft pulley must be held in place with the special tool and the bolt should be installed using hand tools only.

NOTE: Do not reuse the crankshaft pulley bolt.

4. Install a new crankshaft pulley bolt. Using the special tools to hold the crankshaft pulley in place, tighten the crankshaft pulley bolt in 2 stages:
   - Stage 1: Tighten to 100 Nm (74 lb-ft).
   - Stage 2: Rotate an additional 90 degrees.

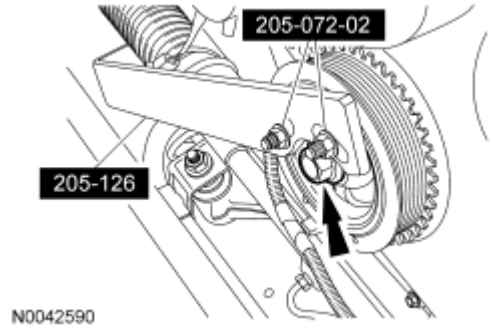


Fig. 21: Identifying Special Tools (205-072-02, 205-126) And Crankshaft Pulley Bolt
Courtesy of FORD MOTOR CO.

5. Remove the 6 mm (0.23 in) x 18 mm (0.7 in) bolt.

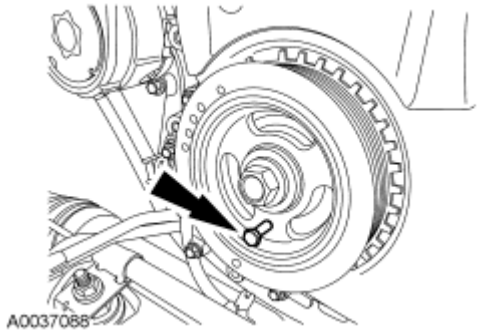


Fig. 22: Installing Bolt Through Crankshaft Pulley And Thread It Into Front Cover
Courtesy of FORD MOTOR CO.

6. Remove the special tool.

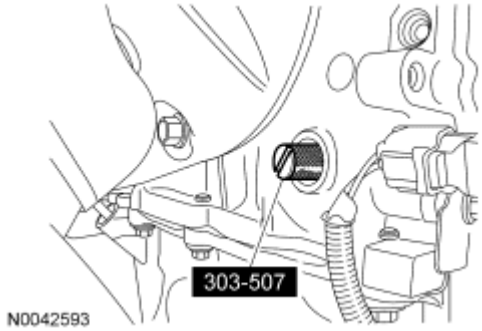


Fig. 23: Identifying Special Tool (303-507)
Courtesy of FORD MOTOR CO.

7. Remove the special tool.

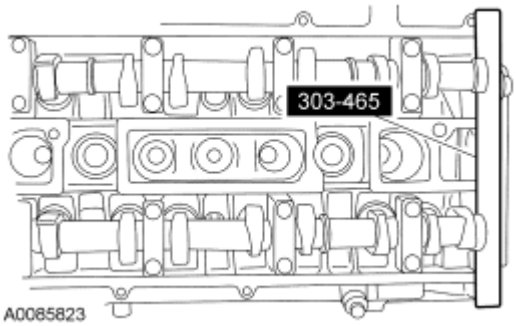


Fig. 24: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

NOTE: Only turn the crankshaft in the normal direction of rotation.

8. Turn the crankshaft clockwise 1 and 3/4 turns.
9. Install the special tool.

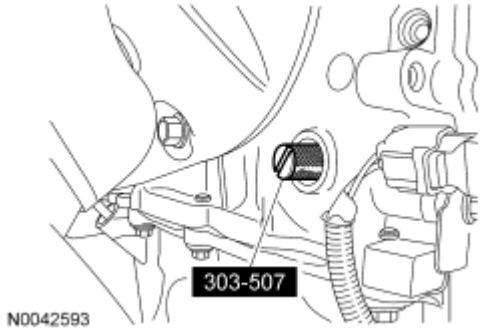


Fig. 25: Identifying Special Tool (303-507)
Courtesy of FORD MOTOR CO.

NOTE: Only turn the crankshaft in the normal direction of rotation.

10. Turn the crankshaft clockwise until the crankshaft contacts the special tool.

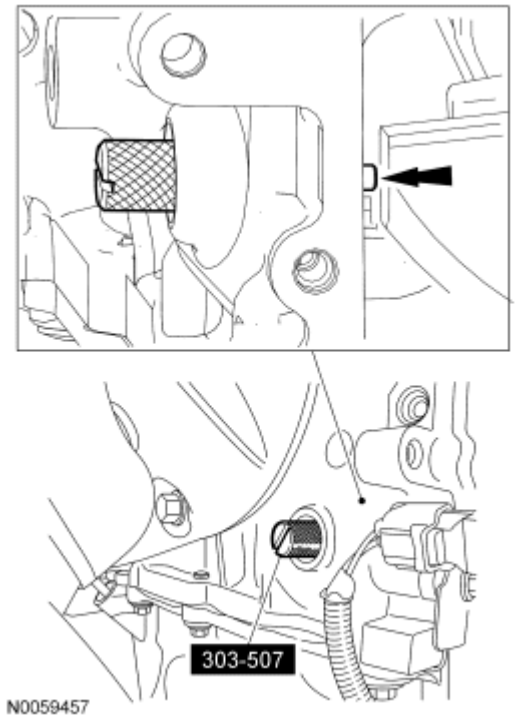


Fig. 26: Identifying Special Tool (303-507)
Courtesy of FORD MOTOR CO.

CAUTION: Only hand-tighten the bolt or damage to the front cover can occur.

11. Using the 6 mm (0.23 in) x 18 mm (0.7 in) bolt, check the position of the crankshaft pulley.
    - If it is not possible to install the bolt, the engine valve timing must be corrected by repeating this procedure.

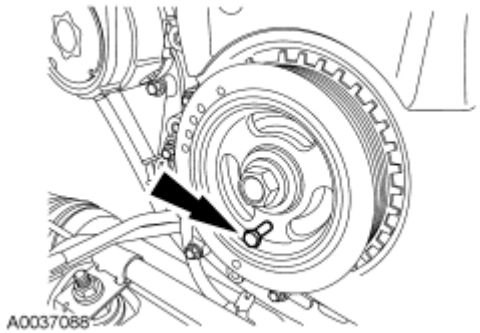


Fig. 27: Installing Bolt Through Crankshaft Pulley And Thread It Into Front Cover
Courtesy of FORD MOTOR CO.

12. Install the special tool to check the position of the camshafts.
    - If it is not possible to install the special tool, the engine valve timing must be corrected by repeating this procedure.

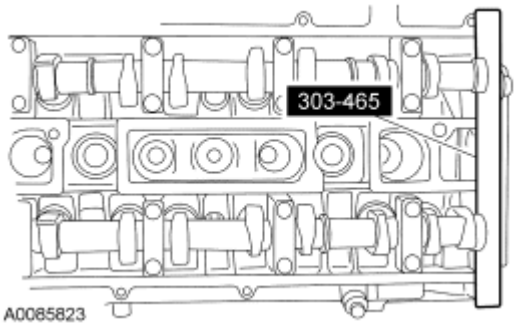


Fig. 28: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

13. Remove the special tool.

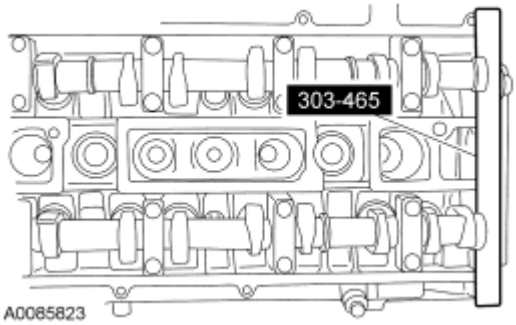


Fig. 29: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

14. Remove the 6 mm (0.23 in) x 18 mm (0.7 in) bolt.

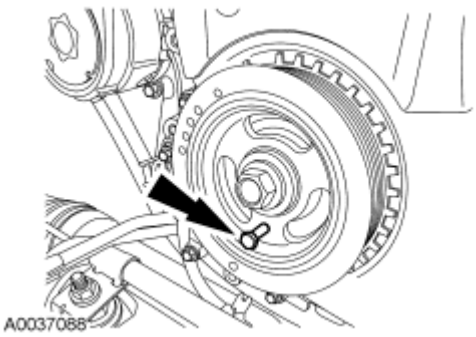


Fig. 30: Installing Bolt Through Crankshaft Pulley And Thread It Into Front Cover
Courtesy of FORD MOTOR CO.

15. Remove the special tool.

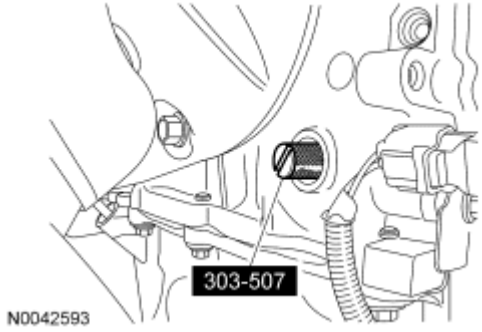


Fig. 31: Identifying Special Tool (303-507)
Courtesy of FORD MOTOR CO.

16. Install the timing peg plug.
    - Tighten to 20 Nm (15 lb-ft).

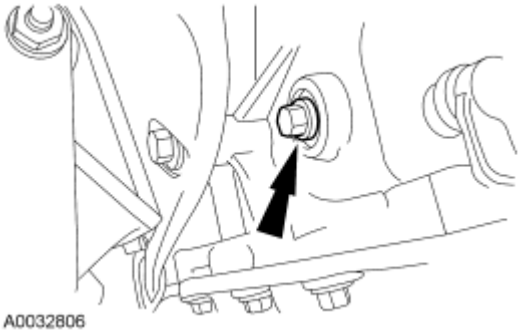
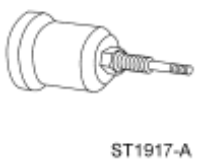


Fig. 32: Locating Engine Plug Bolt
Courtesy of FORD MOTOR CO.

17. Install the valve cover. For additional information, refer to **Valve Cover**.
18. Install the accessory drive belt. For additional information, refer to **ACCESSORY DRIVE** article.
19. Install the fan and shroud. For additional information, refer to **ENGINE COOLING** article.

CRANKSHAFT FRONT SEAL

Special Tools

Illustration	Tool Name	Tool Number
 ST1917-A	Installer, Camshaft Front Oil Seal	303-096 (T74P-6150-A)
	Remover, Seal	303-409 (T92C-6700-CH)

 ST1385-A		

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

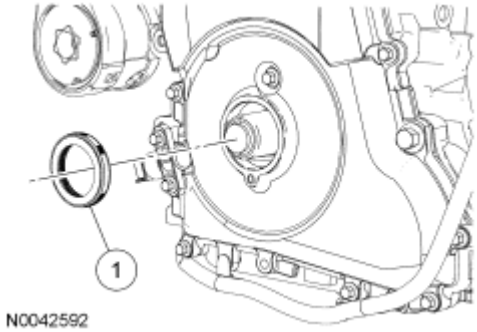


Fig. 33: Identifying Crankshaft Front Oil Seal
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6700	Crankshaft pulley seal

REMOVAL

CAUTION: Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in the crankshaft pulley procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if you loosen the pulley bolt. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special tools, otherwise severe engine damage can occur.

1. Remove the crankshaft pulley. For additional information, refer to **Crankshaft Pulley**.

CAUTION: Use care not to damage the engine front cover or the crankshaft when removing the seal, or oil leakage may occur.

2. Using the special tool, remove the crankshaft front seal.

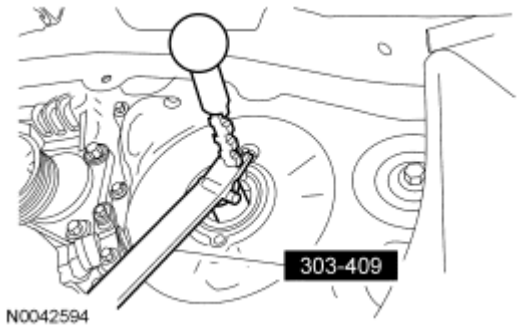


Fig. 34: Identifying Special Tool (303-409)
Courtesy of FORD MOTOR CO.

INSTALLATION

NOTE: Lubricate the new crankshaft front seal with clean engine oil prior to installation.

1. Using the special tool, install the crankshaft front seal.

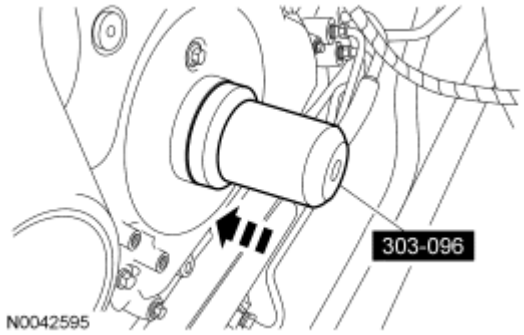


Fig. 35: Installing Crankshaft Front Seal Using Special Tool (303-096)
Courtesy of FORD MOTOR CO.

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

ENGINE FRONT COVER

Material

Item	Specification
Motorcraft Metal Surface Prep ZC-31	-

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

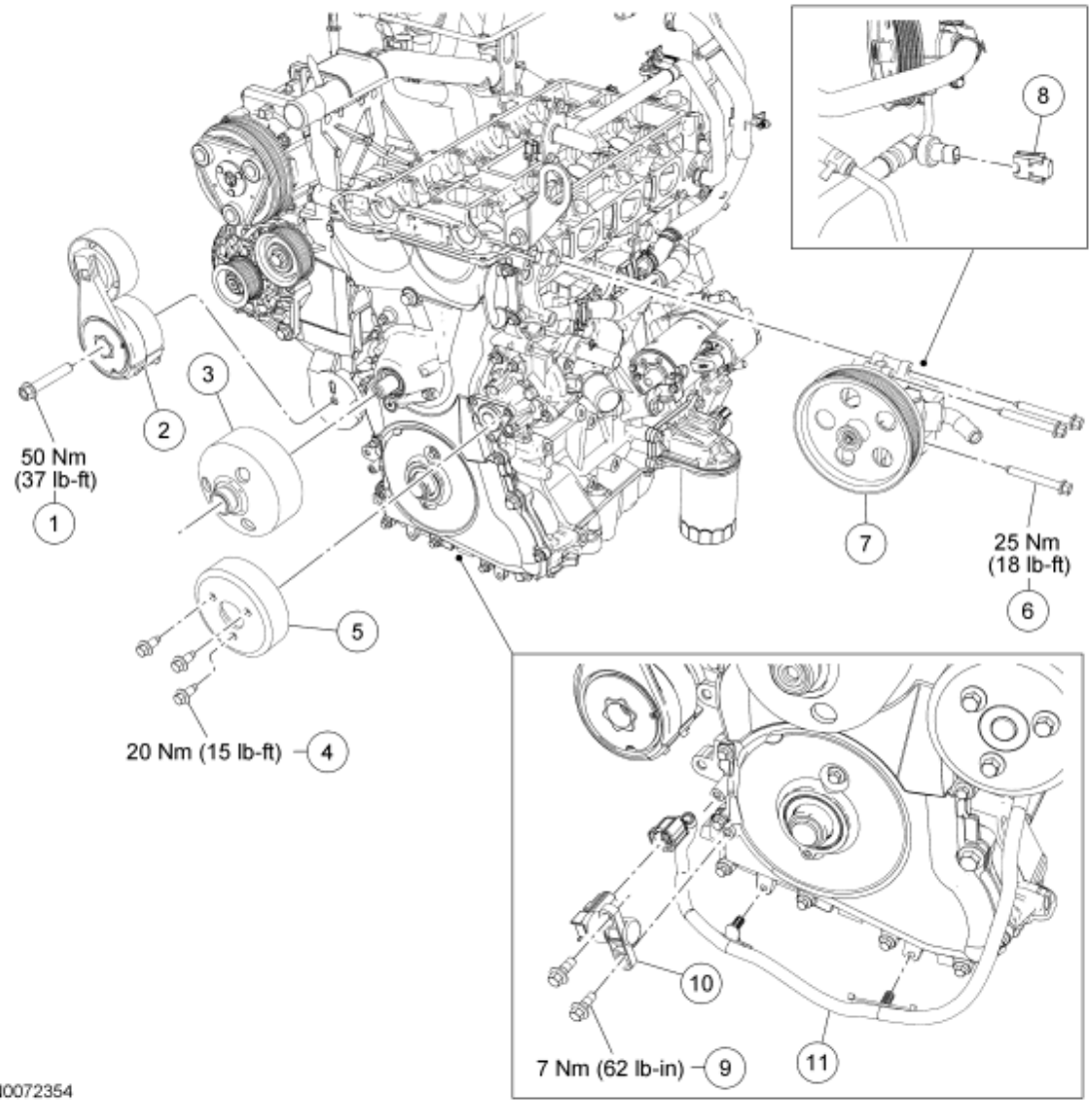


Fig. 36: Exploded View Of Engine Front Cover - Accessories With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Accessory drive belt tensioner bolt
2	-	Accessory drive belt tensioner
3	-	Cooling fan drive pulley
4	W500221	Coolant pump pulley bolt (3 required)
5	8509	Coolant pump pulley

6	W500315	Power steering pump bolt (3 required)
7	3D639	Power steering pump
8	14A464	Power steering pressure switch electrical connector (part of 12B637)
9	W701219	Crankshaft position (CKP) sensor bolt (2 required)
10	6C315	CKP sensor
11	-	CKP sensor wiring harness (part of 12B637)

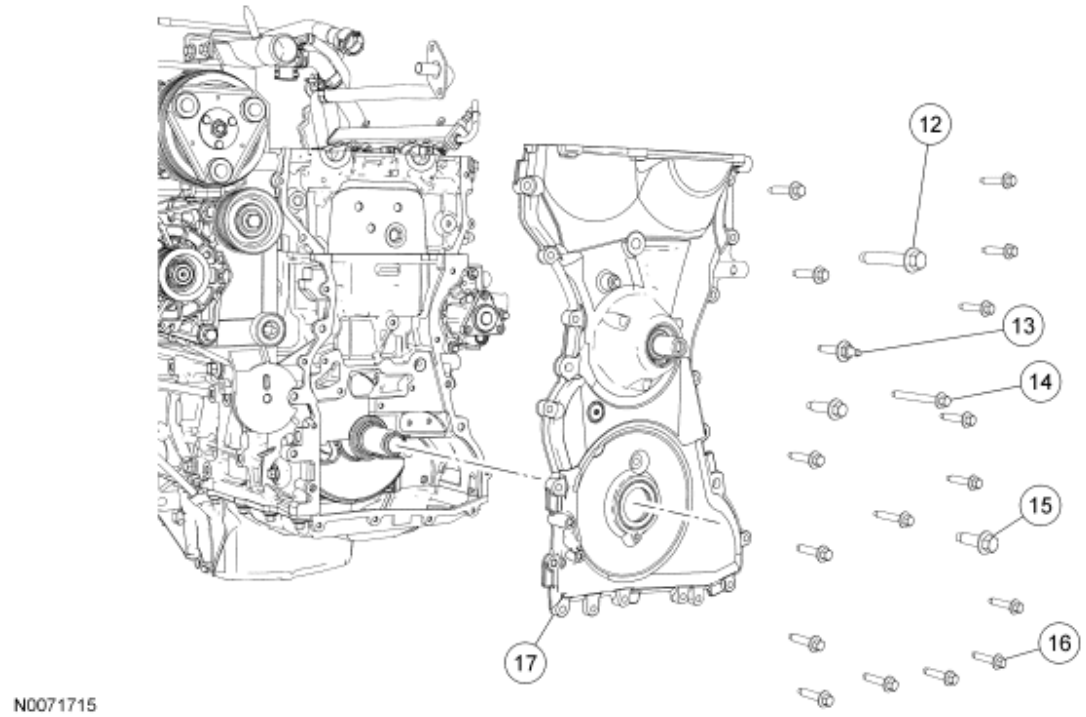


Fig. 37: Exploded View Of Engine Front Cover
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
12	W500320	Engine front cover bolt
13	W705310	Engine front cover stud bolt
14	W500315	Engine front cover bolt
15	W500011	Engine front cover bolt
16	W500215	Engine front cover bolt (15 required)
17	6019	Engine front cover

REMOVAL

CAUTION: Do not loosen or remove the crankshaft pulley bolt without first

installing the special tools as instructed in the crankshaft pulley procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if you loosen the pulley bolt. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special tools, otherwise severe engine damage can occur.

1. Remove the crankshaft pulley. For additional information, refer to **Crankshaft Pulley**.
2. Disconnect the crankshaft position (CKP) sensor electrical connector and the wiring harness pin-type retainers.

NOTE: A new CKP sensor must be installed whenever the old sensor is removed.

3. Remove and discard the CKP sensor.
4. Remove the bolt and the accessory drive belt tensioner.
5. Remove the 3 bolts and the water pump pulley.
6. Disconnect the power steering pressure (PSP) switch electrical connector.
7. Remove the 3 bolts and position the power steering pump aside.

NOTE: This step is needed only if a new front cover is being installed.

8. Using a 3-jaw puller, remove the fan drive pulley.

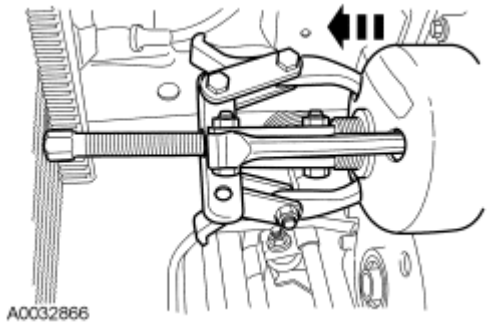


Fig. 38: Removing Fan Drive Pulley Using A Three-Jaw Puller
Courtesy of FORD MOTOR CO.

NOTE: There is one bolt behind the cooling fan drive pulley. This bolt can be accessed by lining up one of the holes in the pulley with the bolt.

9. Remove the bolts and the engine front cover.

CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or

other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

10. Clean the sealing surface with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.

INSTALLATION

NOTE: This step is needed only if a new front cover is being installed.

1. Install the fan drive pulley, using a nut and bolt with flat washers.

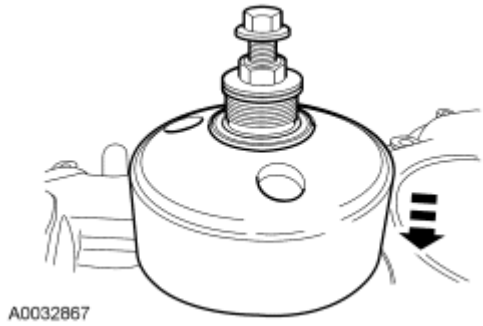


Fig. 39: Installing Fan Drive Pulley Using Nut And Bolt With Flat Washers
Courtesy of FORD MOTOR CO.

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

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

2. Apply a 2.5 mm (0.1 in) bead of silicone gasket and sealant to the cylinder head and oil pan joint areas. Apply a 2.5 mm (0.1 in) bead of silicone gasket and sealant to the front cover.

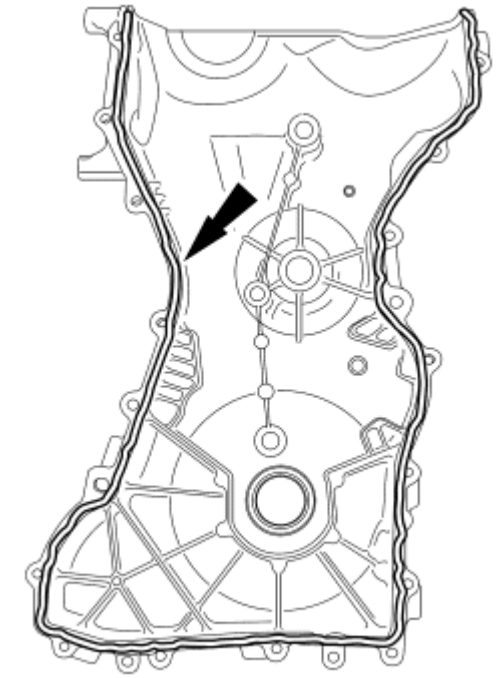


Fig. 40: Locating Silicone Gasket
Courtesy of FORD MOTOR CO.

3. Install the front cover and tighten the bolts in the sequence shown in illustration, to the following specifications:
    - Tighten the 8 mm bolts to 10 Nm (89 lb-in).
    - Tighten the 10 mm bolts to 25 Nm (18 lb-ft).
    - Tighten the 13 mm bolts to 48 Nm (35 lb-ft).

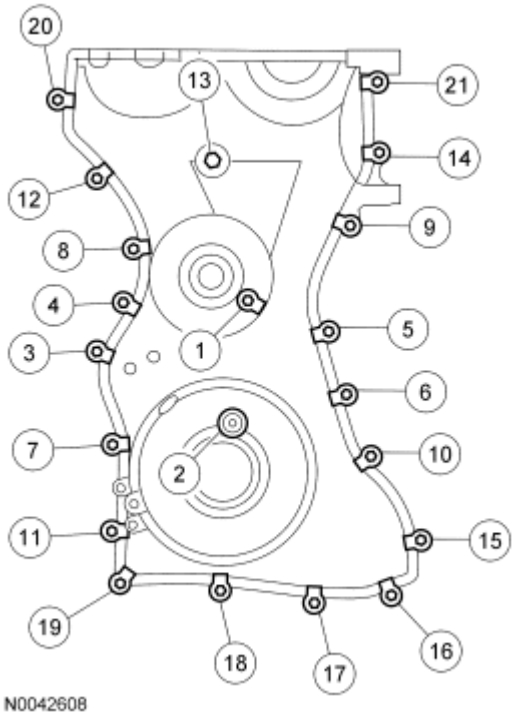


Fig. 41: Identifying Tightening Sequence Of Front Cover Bolts
Courtesy of FORD MOTOR CO.

4. Position the power steering pump and install the bolts.
    - Tighten to 25 Nm (18 lb-ft).
5. Connect the power steering pressure (PSP) switch electrical connector.
6. Position the water pump pulley and install the 3 bolts.
    - Tighten to 20 Nm (15 lb-ft).
7. Install the accessory drive belt tensioner and the bolt.
    - Tighten to 50 Nm (37 lb-ft).
8. Install the crankshaft pulley. For additional information, refer to **Crankshaft Pulley**.
9. Install a 6 mm (0.23 in) x 18 mm (0.7 in) bolt through the crankshaft pulley and thread it into the front cover.

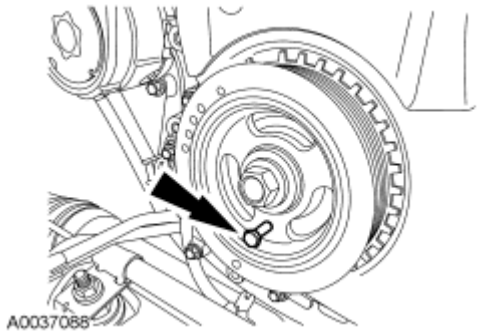


Fig. 42: Installing Bolt Through Crankshaft Pulley And Thread It Into Front Cover

Courtesy of FORD MOTOR CO.

10. Position a new CKP sensor and loosely install the 2 bolts.

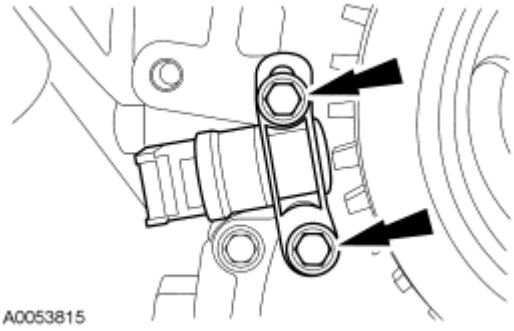


Fig. 43: Locating Crankshaft Position (CKP) Sensor Bolts
Courtesy of FORD MOTOR CO.

NOTE: The CKP sensor alignment tool is supplied with the new sensor and is not available separately.

11. Adjust the CKP with the alignment tool, the tool must engage a tooth of the vibration damper, and tighten the 2 mounting bolts.
    - Tighten to 7 Nm (62 lb-in).

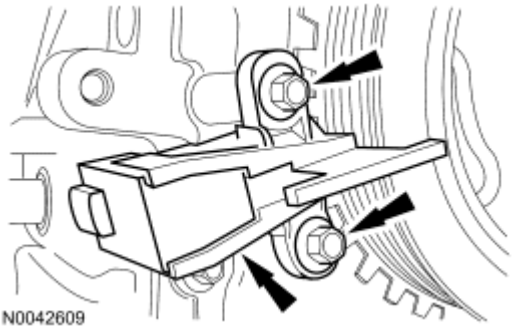


Fig. 44: Locating CKP Sensor Bolts
Courtesy of FORD MOTOR CO.

12. Remove the 6 mm (0.23 in) x 18 mm (0.7 in) bolt.

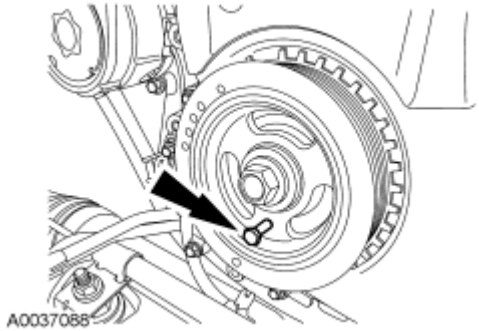


Fig. 45: Installing Bolt Through Crankshaft Pulley And Thread It Into Front Cover
Courtesy of FORD MOTOR CO.

13. Connect the CKP sensor electrical connector and the wiring harness pin-type retainers.

TIMING DRIVE COMPONENTS

Special Tools

Illustration	Tool Name	Tool Number
 ST2645-A	Alignment Plate, Camshaft	303-465 (T94P-6256-CH)

REMOVAL

CAUTION: Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in the crankshaft pulley procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if you loosen the pulley bolt. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special tools, otherwise severe engine damage may occur.

1. Remove the engine front cover. For additional information, refer to **Engine Front Cover**.
2. Compress the timing chain tensioner, and insert a paper clip into the hole. Remove the 2 bolts and the timing chain tensioner.

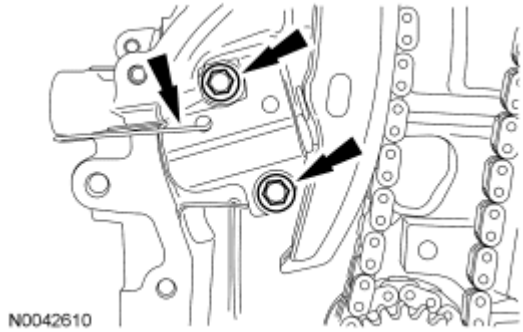


Fig. 46: Locating Timing Chain Tensioner & Bolts
Courtesy of FORD MOTOR CO.

3. Remove the RH timing chain guide.

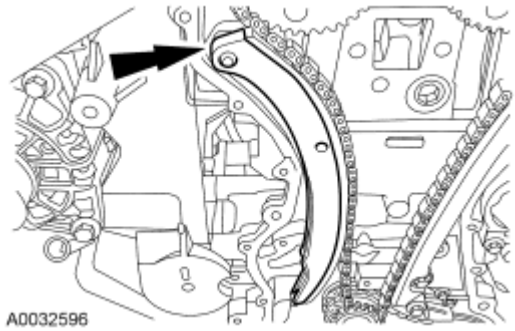


Fig. 47: Locating RH Timing Chain Guide
Courtesy of FORD MOTOR CO.

4. Remove the timing chain.

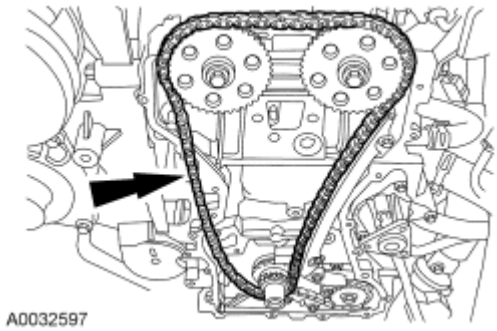


Fig. 48: View Of Timing Chain
Courtesy of FORD MOTOR CO.

5. Remove the 2 bolts and the LH timing chain guide.

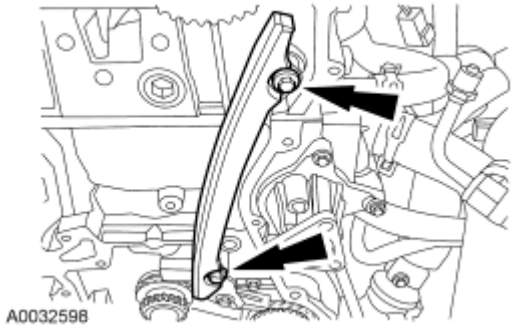


Fig. 49: Identifying Bolts And LH Timing Chain Guide
Courtesy of FORD MOTOR CO.

CAUTION: Do not rely on the Camshaft Alignment Plate to prevent camshaft rotation. The tool or the camshaft may be damaged.

6. If necessary, remove the bolts and the camshaft sprockets.
   - Use the flats on the camshaft to prevent camshaft rotation.

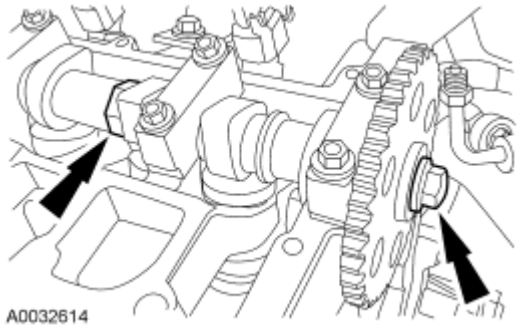


Fig. 50: Locating Cam Holding Area And Sprocket Bolt
Courtesy of FORD MOTOR CO.

INSTALLATION

1. Remove the special tool.

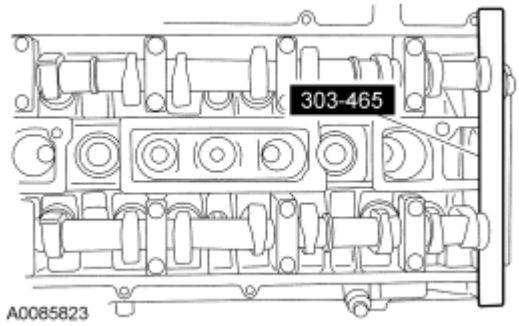


Fig. 51: Identifying Special Camshaft Tool (303-465)

Courtesy of FORD MOTOR CO.

CAUTION: Do not rotate the camshafts. The valves and pistons may be damaged.

2. If the camshaft sprockets were not removed, use the flats on the camshafts to prevent camshaft rotation and loosen the sprocket bolts.

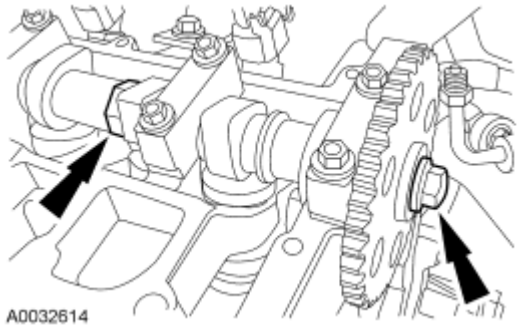


Fig. 52: Locating Cam Holding Area And Sprocket Bolt
Courtesy of FORD MOTOR CO.

3. If removed, install the camshaft sprockets and the bolts. Do not tighten the bolts at this time.

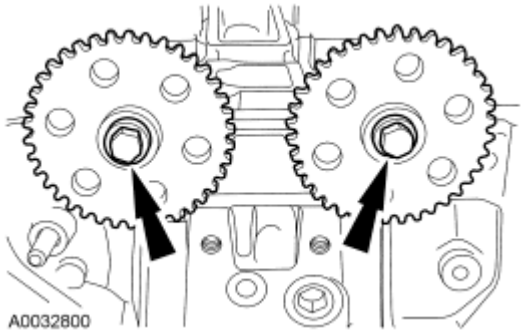


Fig. 53: Locating Camshaft Sprocket Bolts
Courtesy of FORD MOTOR CO.

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

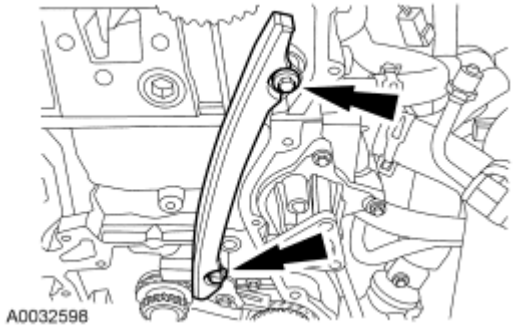


Fig. 54: Identifying Bolts And LH Timing Chain Guide
Courtesy of FORD MOTOR CO.

5. Install the timing chain.

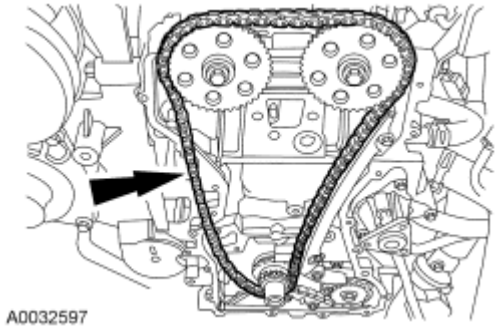


Fig. 55: View Of Timing Chain
Courtesy of FORD MOTOR CO.

6. Install the RH timing chain guide.

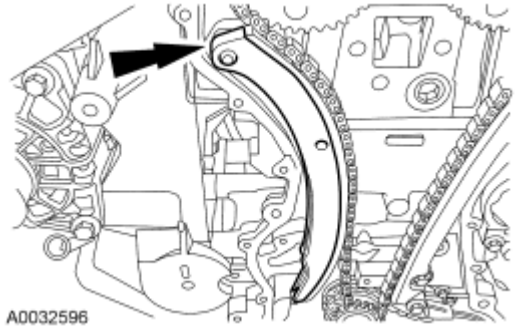


Fig. 56: Locating RH Timing Chain Guide
Courtesy of FORD MOTOR CO.

7. Position the timing chain tensioner and install the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).
   - Remove the paper clip to release the piston.

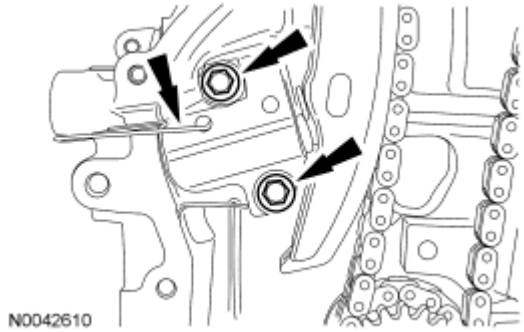


Fig. 57: Locating Timing Chain Tensioner & Bolts
Courtesy of FORD MOTOR CO.

8. Install the special tool.

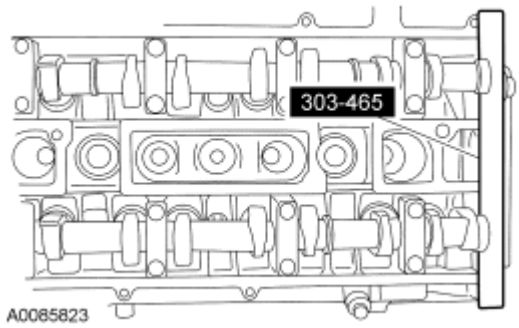


Fig. 58: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

CAUTION: Do not rely on the Camshaft Alignment Plate to prevent camshaft rotation. The tool or the camshafts may be damaged.

9. Using the flats on the camshafts to prevent camshaft rotation, tighten the bolts.
   - Tighten to 72 Nm (53 lb-ft).

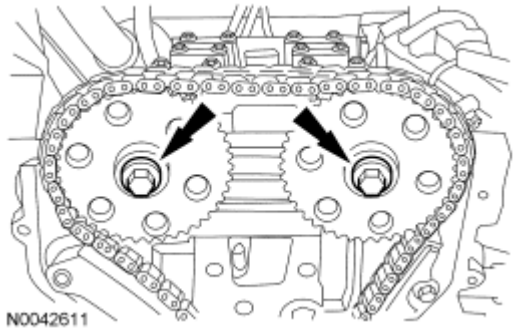


Fig. 59: Locating Camshaft Sprocket Bolts
Courtesy of FORD MOTOR CO.

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

VALVE TRAIN COMPONENTS - EXPLODED VIEW

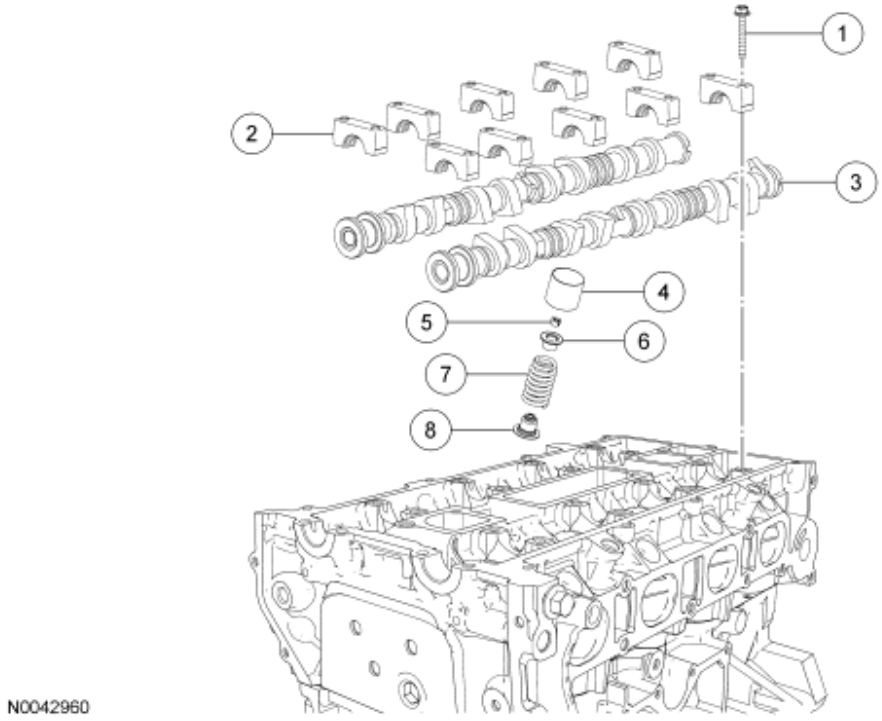


Fig. 60: Exploded View Of Valve Train Components
Courtesy of FORD MOTOR CO.

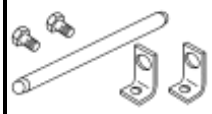
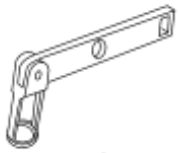
Item	Part Number	Description
1	W706283	Camshaft bearing cap bolt (20 required)
2	6A284	Camshaft bearing cap (10 required)
3	6A267	Camshaft (2 required)
4	6500	Valve tappet (16 required)
5	6518	Valve spring retainer key (16 required)
6	6514	Valve spring retainer (16 required)
7	6513	Valve spring (16 required)
8	6517	Valve seal (16 required)

1. For additional information, refer to the appropriate procedures.

VALVE SPRINGS

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)
 ST1902-A	Compressor, Valve Spring	303-472 (T94P-6565-AH)

REMOVAL

CAUTION: Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in the crankshaft pulley procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if you loosen the pulley bolt. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special tools, otherwise severe engine damage can occur.

1. Remove the valve tappets. For additional information, refer to **Valve Tappets**.

WARNING: Always wear eye protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.

CAUTION: Use compressed air at 7 to 10 bars (100-150 psi). Do not disconnect the compressed air from the cylinder until the valve spring, valve spring retainer and valve spring retainer keys are installed, or the valve can fall into the cylinder.

NOTE: Place all parts in order to one side.

2. Using the special tools, apply compressed air to the cylinder.
   - Using the special tools, compress the valve springs and remove the valve spring retainer keys using

some grease and a small screwdriver.

- Remove the valve spring retainers and the valve springs.

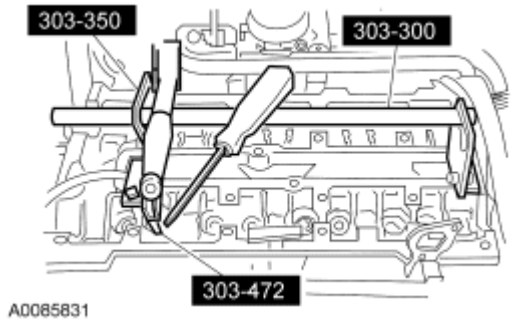


Fig. 61: Identifying Special Tools (303-300, 303-350, 303-472)
Courtesy of FORD MOTOR CO.

INSTALLATION

NOTE: Check that there is no dirt or particles within the valve stem grooves. Check the seating of the valve collets.

1. Using the special tools, install the valve springs.
   - Insert the valve springs and the valve spring retainers.
   - Compress the valve springs and install the valve spring retainers keys.
   - Disconnect and remove the air supply.

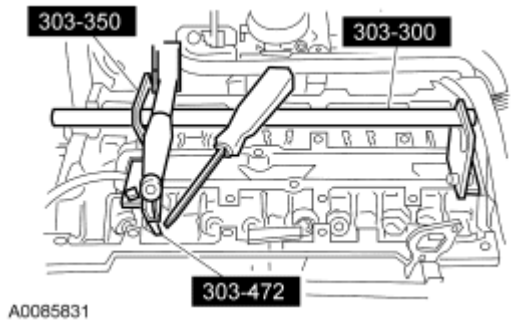


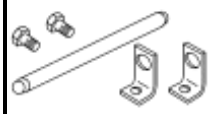
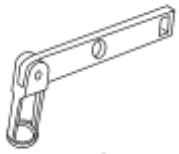
Fig. 62: Identifying Special Tools (303-300, 303-350, 303-472)
Courtesy of FORD MOTOR CO.

2. Install the valve tappets. For additional information, refer to **Valve Tappets**.

VALVE SEALS

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)
 ST1902-A	Compressor, Valve Spring	303-472 (T94P-6565-AH)
 ST1906-A	Installer, Valve Stem Oil Seal	303-470 (T94P-6510-CH)
 ST1904-A	Remover, Valve Stem Oil Seal	303-468 (T94P-6510-AH)
 ST1187-A	Slide Hammer	307-005 (T59L-100-B)

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
Multi-Purpose Grease XG-4 and/or XL-5	ESB-M1C93-B

REMOVAL

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

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** article.
2. Remove the camshafts. For additional information, refer to **Camshafts**.

CAUTION: If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions or the engine can be damaged.

NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

3. Remove and inspect the valve tappets. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article.

WARNING: Always wear eye protection when servicing a vehicle. Failure to follow this instruction may result in serious personal injury.

CAUTION: Use compressed air at 7 to 10 bars (100-150 psi). Do not disconnect the compressed air from the cylinder until the valve spring, valve spring retainer and valve spring retainer keys are installed, or the valve can fall into the cylinder.

4. Remove the spark plug on the cylinder being serviced and connect the compressed air supply.

NOTE: Place all parts in order to one side.

5. Apply compressed air to the cylinder and remove the valve spring.
   - Using the special tools, compress the valve spring and remove the valve spring retainer keys, using some grease and a small screwdriver.
   - Remove the valve spring retainer and the valve spring.

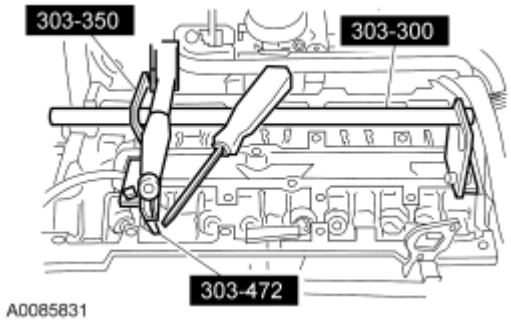


Fig. 63: Identifying Special Tools (303-300, 303-350, 303-472)
Courtesy of FORD MOTOR CO.

6. Using the special tools, remove and discard the valve seal.

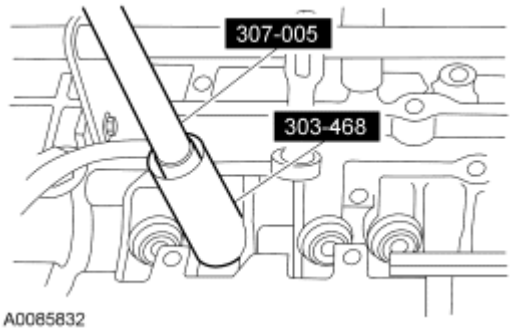


Fig. 64: Removing Valve Seal Using Special Tools (307-005, 303-468)
Courtesy of FORD MOTOR CO.

INSTALLATION

1. Install the valve stem seal installation sleeve.

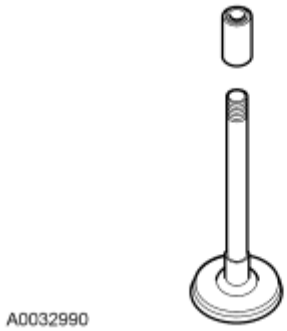


Fig. 65: Identifying Valve Stem Seal Installation Sleeve
Courtesy of FORD MOTOR CO.

2. Using the special tool, install a new valve seal.

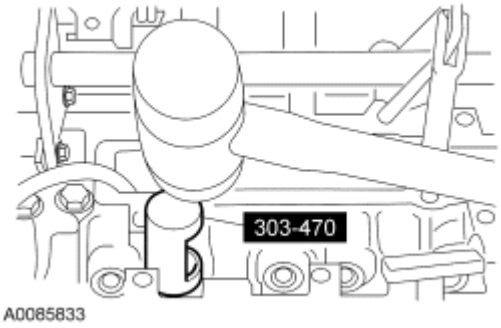


Fig. 66: Installing Valve Seal Using Special Tool (303-470)
Courtesy of FORD MOTOR CO.

NOTE: Check the seating of the valve spring retainer keys.

3. Using the special tools, install the valve spring.
   - Insert the valve spring and the valve spring retainer.
   - Compress the valve spring and install the valve spring retainer keys using some grease and a small screwdriver.

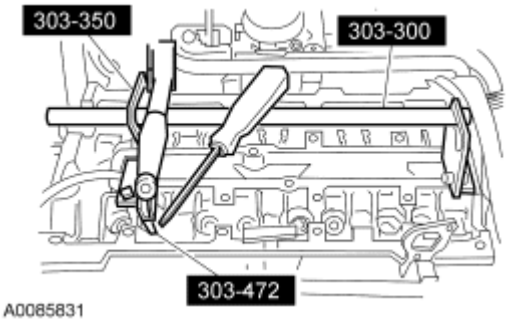


Fig. 67: Identifying Special Tools (303-300, 303-350, 303-472)
Courtesy of FORD MOTOR CO.

4. Disconnect the compressed air supply and install the spark plug.
   - Tighten to 15 Nm (11 lb-ft).
5. Repeat the appropriate removal and installation steps for each of the cylinders being serviced.
6. Coat the valve tappets with clean engine oil and install them in their original positions.
7. Install the camshafts. For additional information, refer to **Camshafts**.

VALVE TAPPETS

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

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

NOTE: Valve tappets are select fit and the valve clearance must be checked before removing the tappets. For additional information, refer to Valve Clearance Check. If the valve clearance has already been checked, proceed with removal.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** article.
2. Remove the camshafts. For additional information, refer to **Camshafts**.

CAUTION: If the camshafts and valve tappets are to be reused, mark the location of the valve tappets to make sure they are assembled in their original positions, or the engine may be damaged.

NOTE: The number on the valve tappets only reflects the digits that follow the decimal. For example, a tappet with the number 0.650 has the thickness of 3.650 mm.

3. Remove and inspect the valve tappets. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article.
4. To install, reverse the removal procedure.
   - Coat the valve tappets with clean engine oil prior to installation.

CAMSHAFTS

Special Tools

Illustration	Tool Name	Tool Number
 ST2645-A	Alignment Plate, Camshaft	303-465 (T94P-6256-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

CAUTION: Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in the crankshaft pulley procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if you loosen the pulley bolt. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special tools, otherwise severe engine damage may occur.

1. Remove the timing chain and sprockets. For additional information, refer to **Timing Drive Components**.
2. Remove the special tool.

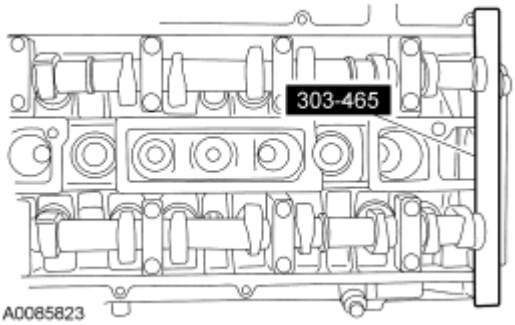


Fig. 68: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

CAUTION: Failure to follow the camshaft loosening procedure may result in damage to the camshafts.

NOTE: Mark the location and orientation of each camshaft bearing cap.

NOTE: Note the position of the lobes on the No. 1 cylinder before removing the camshafts for assembly reference.

3. Remove the camshafts from the engine.
   - Loosen the camshaft bearing cap bolts, in sequence, one turn at a time.

- Repeat the first step until all tension is released from the camshaft bearing caps.
- Remove the camshaft bearing caps.
- Remove the camshafts.

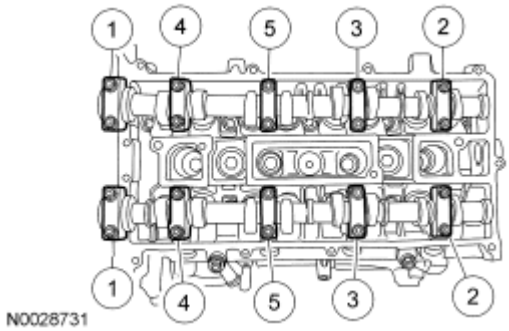


Fig. 69: Identifying Loosening/Tightening Sequence Of Camshaft Bearing Bolts
Courtesy of FORD MOTOR CO.

INSTALLATION

CAUTION: Install the camshafts with the alignment slots in the camshafts lined up so the camshaft alignment plate can be installed without rotating the camshafts. Make sure the lobes on the No. 1 cylinder are in the same position as noted in the removal procedure. Rotating the camshafts when the timing chain is removed, or installing the camshafts 180 degrees out of position, may cause severe damage to the valves and pistons.

NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil prior to installation.

1. Install the camshafts and bearing caps in their original location and orientation. Tighten the bearing caps in the sequence shown in illustration in 3 stages:
   - Stage 1: Tighten the camshaft bearing bolt caps one turn at a time until tight.
   - Stage 2: Tighten the bolts to 7 Nm (62 lb-in).
   - Stage 3: Tighten the bolts to 16 Nm (12 lb-ft).

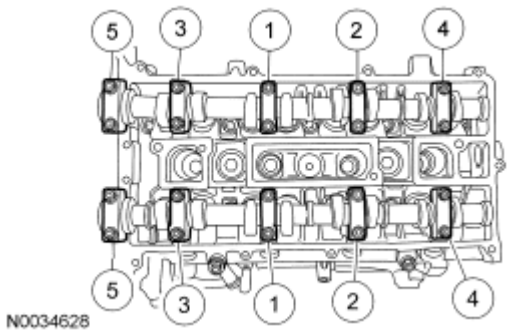


Fig. 70: Identifying Camshaft Bearing Cap Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

2. Install the timing chain and sprockets. For additional information, refer to **Timing Drive Components**.

EXHAUST MANIFOLD

Material

Item	Specification
Motorcraft Metal Surface Prep ZC-31	-
Motorcraft Premium Gold Engine Coolant with Bittering Agent (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

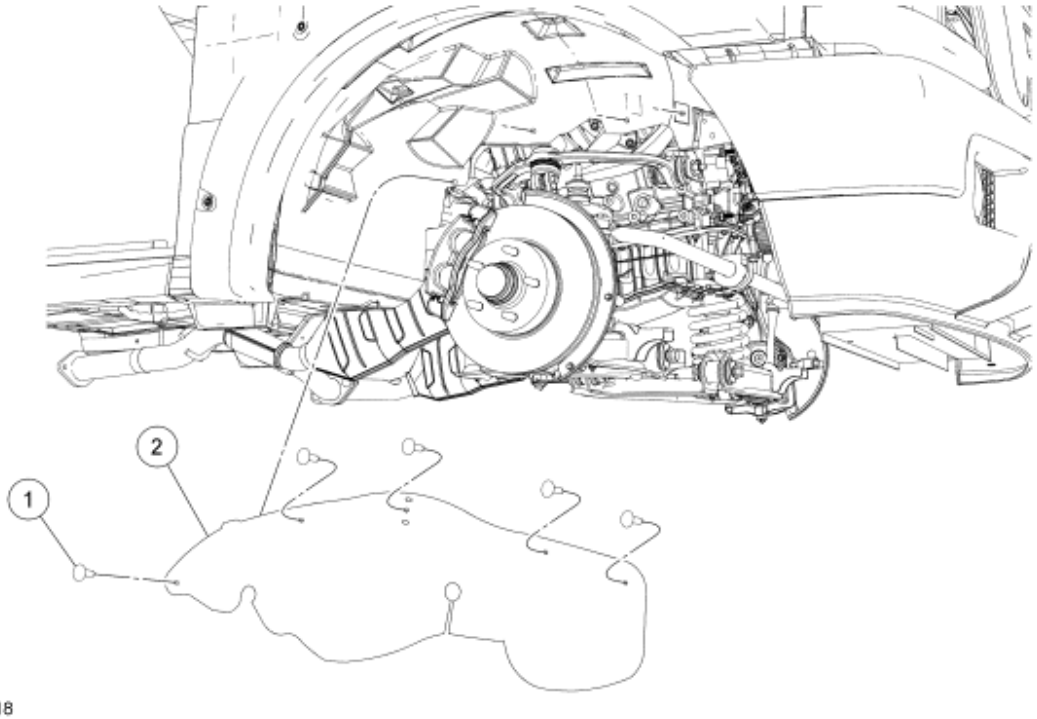


Fig. 71: RH Splash Shield
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	RH splash shield pushpin (5 required)

2	16034	RH splash shield

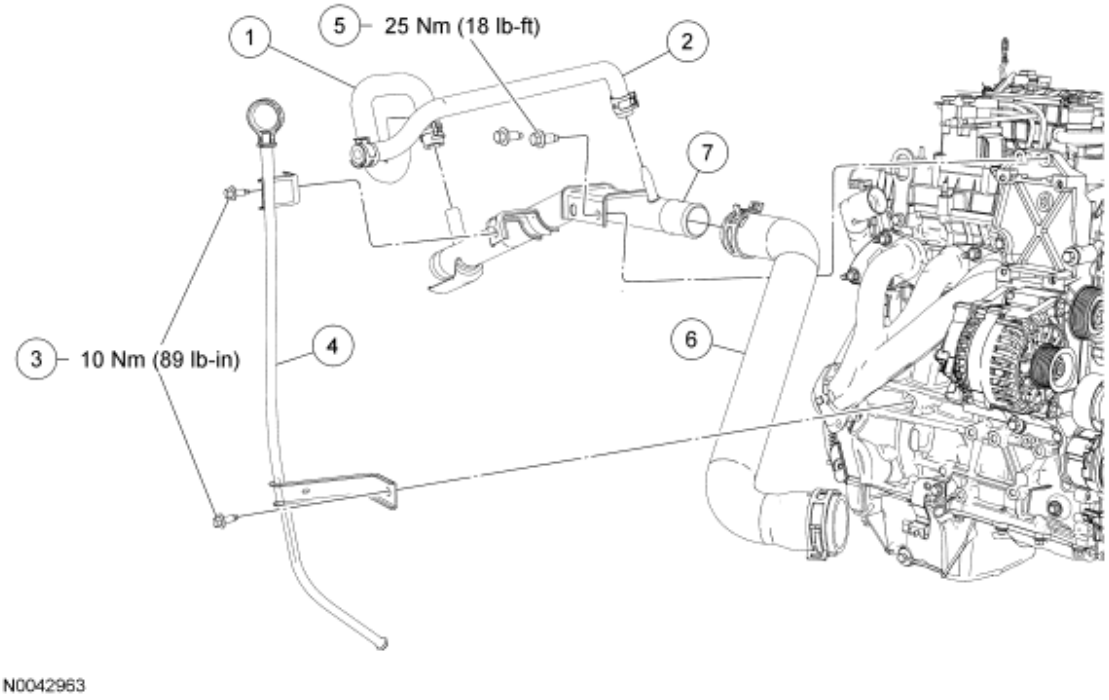


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Fig. 72: Exploded View Of Coolant Hoses and Oil Level Indicator and TubeExploded View
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	18C266	Heater coolant hose
2	8W005	Degas bottle coolant hose
3	W500211	Oil level indicator tube bolts (2 required)
4	-	Oil level indicator and tube assembly
5	W500222	Front coolant outlet pipe bolt (2 required)
6	8B274	Upper radiator coolant hose
7	8594	Front coolant outlet pipe

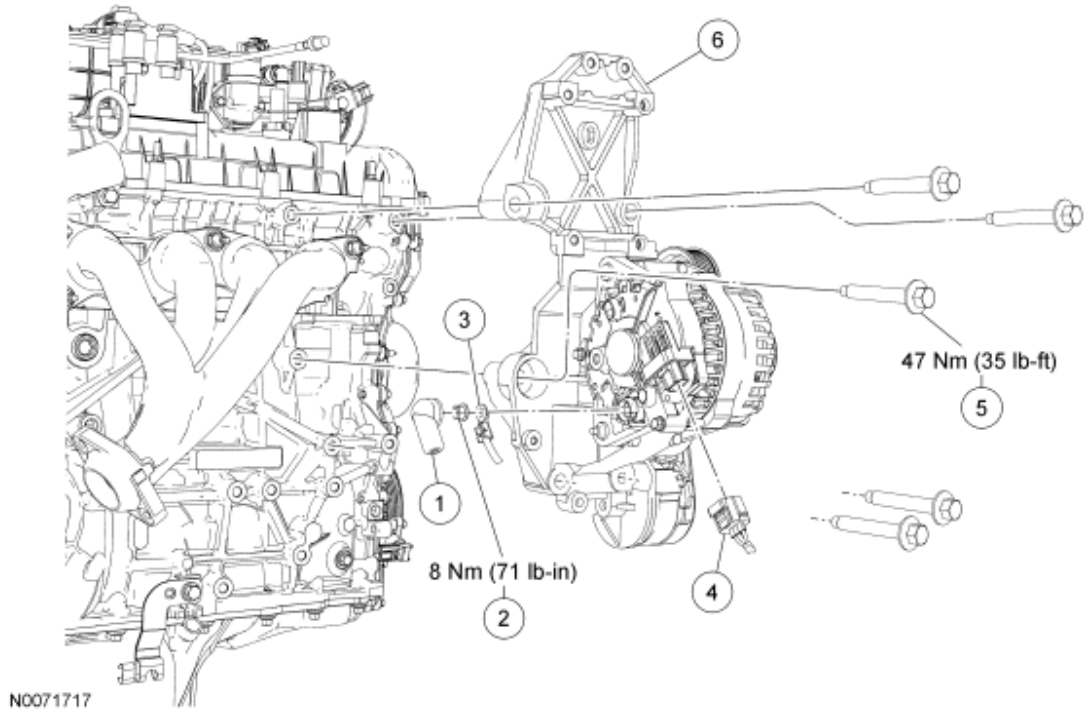

Fig. 73: Exploded View Of Generator and Bracket With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Generator battery cable boot (part of 14A280)
2	W705790	Generator battery cable nut
3	-	Generator battery cable (part of 14A280)
4	-	Generator electrical connector (part of 14A280)
5	W704432	Generator and support bracket assembly bolt (5 required)
6	10C377	Generator and support bracket assembly

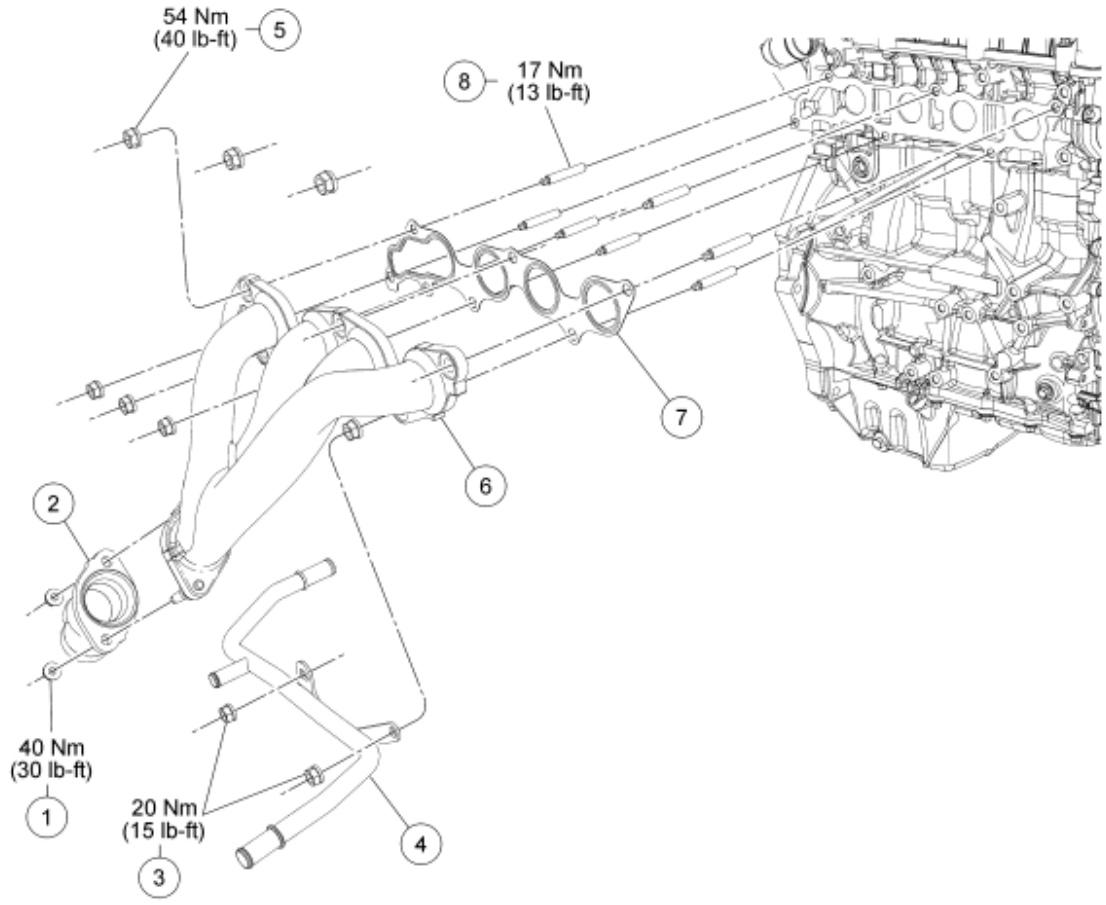

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Fig. 74: Exploded View Of Exhaust Manifold With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W705443	Exhaust downpipe flange nut (2 required)
2	5E212	Exhaust downpipe
3	W708176	Coolant tube nuts (2 required)
4	8C633	Coolant tube
5	W708176	Exhaust manifold nut (7 required)
6	9430	Exhaust manifold
7	9448	Exhaust manifold gasket
8	W704474	Exhaust manifold stud (7 required)

REMOVAL

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** article.
2. Disconnect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING & CABLES** article.
3. Remove the accessory drive belt. For additional information, refer to **ACCESSORY DRIVE** article.
4. Drain the engine cooling system. For additional information, refer to **ENGINE COOLING** article.
5. Remove the 2 exhaust downpipe flange nuts.
6. Disconnect the upper radiator hose and the degas bottle coolant hose from the front coolant outlet pipe.
7. If equipped, remove the A/C compressor. For additional information, refer to **CLIMATE CONTROL** article.
8. Disconnect the heater coolant hose from the front coolant outlet pipe.
9. Remove the oil level indicator, the 2 bolts and the oil level indicator tube.
   - Discard the O-ring seal.
10. Remove the 2 bolts and the front coolant outlet pipe.
    - Discard the O-ring seal.

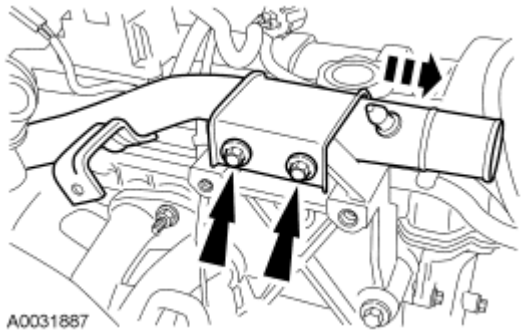


Fig. 75: Locating Bolts & Front Coolant Outlet Pipe
Courtesy of FORD MOTOR CO.

11. Remove the pushpins and position the right inner fender splash shield aside.
12. Disconnect the generator electrical connections.
13. Remove the 5 bolts and the generator and support bracket assembly.
14. Remove the 2 nuts and position the coolant tube aside.
15. Remove the 7 nuts, the exhaust manifold, the gasket and the studs.
    - Discard the exhaust manifold nuts and the gasket.
16. Remove and discard the exhaust manifold-to-cylinder head studs.
17. Clean and inspect the exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article.

CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths.

18. Clean and inspect the sealing surfaces with metal surface prep. Follow the directions on the packaging. Observe all warnings and cautions and follow all application directions contained on the packaging of the metal surface prep.

INSTALLATION

1. Install new exhaust manifold-to-cylinder head studs.
    - Tighten to 17 Nm (13 lb-ft).
2. Install a new exhaust manifold gasket.
3. Position the exhaust manifold and install 7 new nuts.
    - Tighten to 54 Nm (40 lb-ft).
4. Position the coolant tube and install the 2 nuts.
    - Tighten to 20 Nm (15 lb-ft).
5. Position the generator and support bracket assembly and install the 5 bolts in the sequence shown in illustration, in 2 stages.
    - Stage 1: Install finger tight.
    - Stage 2: Tighten to 47 Nm (35 lb-ft).

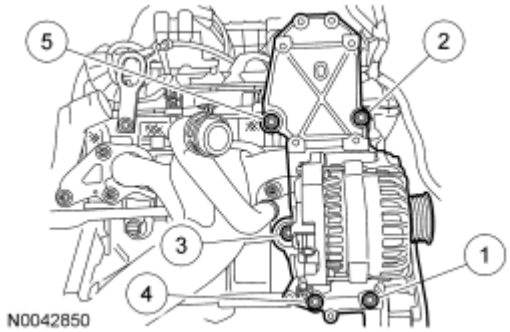


Fig. 76: Identifying Generator & Support Bracket Assembly
Courtesy of FORD MOTOR CO.

6. Connect the generator electrical connections.
    - Tighten the battery cable nut to 8 Nm (71 lb-in).
7. Position the right inner splash shield and install the pushpins.

NOTE: Lubricate the new O-ring seal with clean engine coolant prior to installation.

8. Using a new O-ring seal, position the front coolant outlet pipe and install the 2 bolts.
    - Tighten to 25 Nm (18 lb-ft).

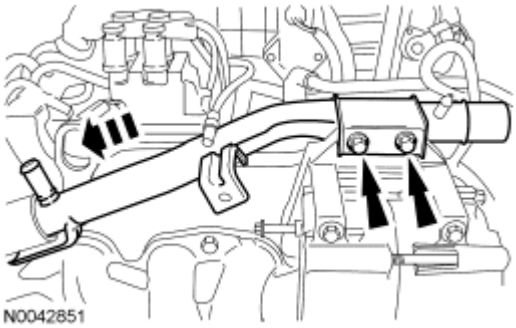


Fig. 77: Positioning Front Coolant Outlet Pipe & Bolts
Courtesy of FORD MOTOR CO.

NOTE: Lubricate the new O-ring seal with clean engine oil prior to installation.

9. Using a new O-ring seal, position the oil level indicator tube assembly and install the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).
10. Install the oil level indicator.
11. Connect the heater coolant hose to the front coolant outlet pipe.
12. If equipped, install the A/C compressor. For additional information, refer to **CLIMATE CONTROL** article.
13. Connect the upper radiator hose and the degas bottle coolant hose to the front coolant outlet pipe.
14. Install the exhaust downpipe flange nuts.
    - Tighten to 40 Nm (30 lb-ft).
15. Install the accessory drive belt. For additional information, refer to **ACCESSORY DRIVE** article.
16. Connect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING & CABLES** article.
17. Fill and bleed the engine cooling system. For additional information, refer to **ENGINE COOLING** article.

CYLINDER HEAD

Material

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

ZC-30	-

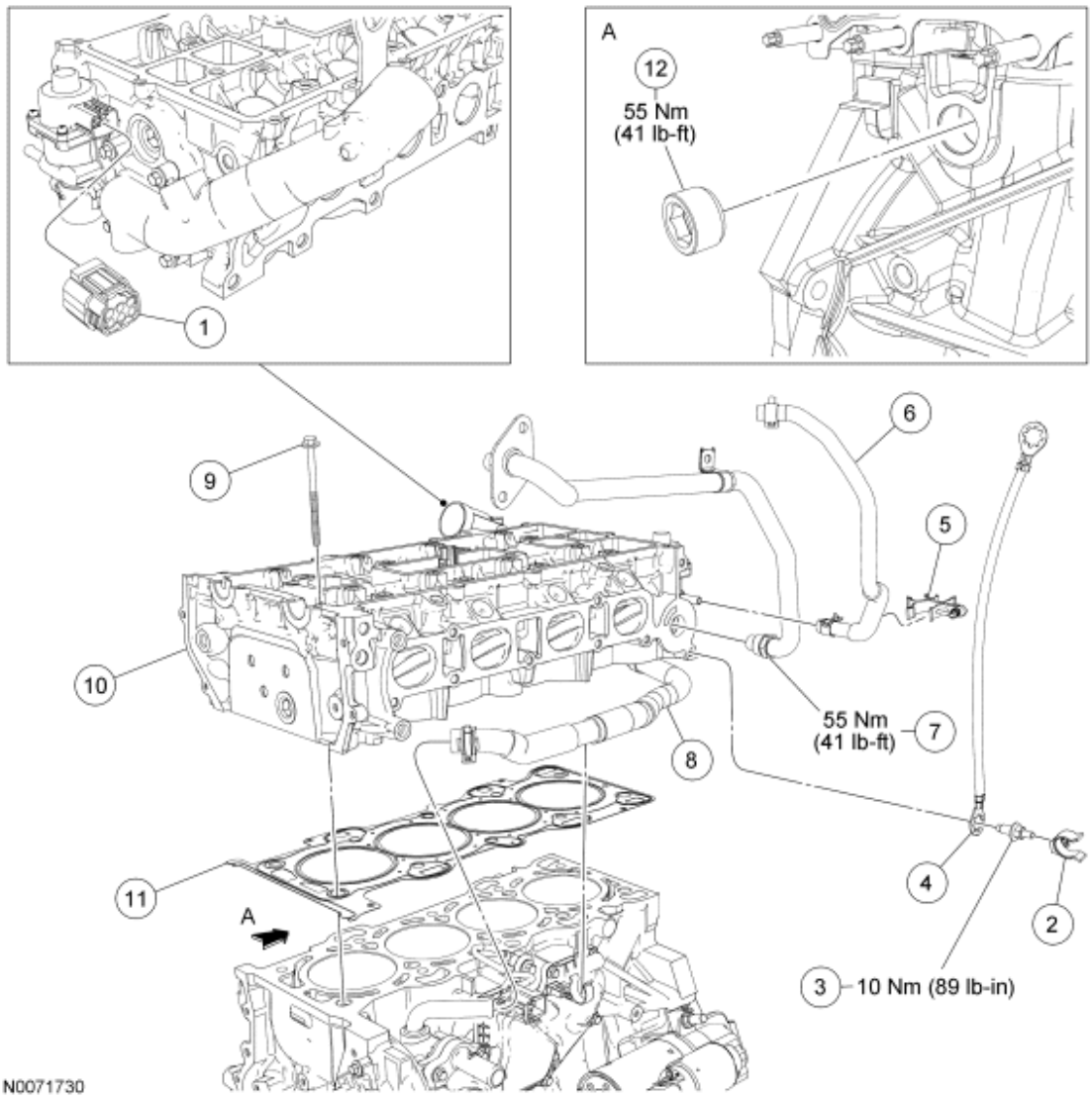


Fig. 78: Exploded View Of Cylinder Head With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	14A464	EGR valve electrical connector (part of 12B637)
2	6758	Hose position retainer clip
3	6758	Ground cable stud bolt
4	14303	Ground cable
5	6758	EGR coolant hose position retainer clip
6	9Y439	EGR coolant hose
7	9E740	EGR tube

8	8548	Coolant bypass hose
9	-	Cylinder head bolt (10 required)
10	6090	Cylinder head
11	6051	Cylinder head gasket
12	W701548	Cylinder block drain plug

REMOVAL

CAUTION: Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in the crankshaft pulley procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if you loosen the pulley bolt. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special tools, otherwise severe engine damage can occur.

1. Disconnect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING & CABLES** article.
2. Remove the camshafts. For additional information, refer to **Camshafts**.
3. Remove the exhaust manifold. For additional information, refer to **Exhaust Manifold**.
4. Remove the fuel rail. For additional information, refer to **FUEL CHARGING & CONTROLS - 2.3L** article.
5. Remove the coolant hose retainer clip, the stud bolt and the ground cable.
6. Remove the EGR tube from the cylinder head.
7. Disconnect the EGR valve electrical connector.
8. Disconnect the EGR coolant hose and remove it from the hose bracket.
9. Disconnect the coolant bypass hose.
10. Remove the cylinder block coolant drain plug.
11. Remove the 10 bolts and the cylinder head.
    - Discard the bolts.
12. Remove and discard the head gasket.
13. Inspect the cylinder head mating surfaces. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article.

INSTALLATION

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

NOTE: Clean the sealing surface with silicone gasket remover and metal surface prep. Observe all warnings or cautions and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

1. Clean the cylinder head-to-cylinder block mating surfaces 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 remaining traces of oil or coolant, and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
2. Clean the cylinder head bolt holes in the cylinder block. Make sure all coolant, oil or other foreign material is removed.

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

NOTE: Clean the sealing surface with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

3. Apply silicone gasket and sealant to the locations shown in illustration.

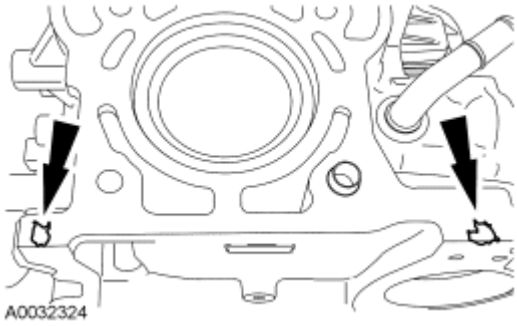


Fig. 79: Identifying Silicone Gasket And Sealant Location
Courtesy of FORD MOTOR CO.

4. Install a new cylinder head gasket.

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

NOTE: The cylinder head bolts are torque-to-yield and must not be reused. New cylinder head bolts must be installed.

NOTE: Lubricate the cylinder head bolts with clean engine oil.

5. Install the cylinder head and the 10 new bolts. Tighten the bolts in the sequence shown in illustration, in 5 stages.
   - Stage 1: Tighten to 5 Nm (44 lb-in).
   - Stage 2: Tighten to 15 Nm (11 lb-ft).
   - Stage 3: Tighten to 45 Nm (33 lb-ft).
   - Stage 4: Tighten an additional 90 degrees.
   - Stage 5: Tighten an additional 90 degrees.

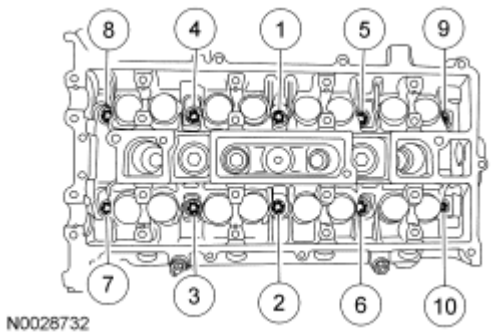


Fig. 80: Identifying Tightening Sequence Of Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

6. Install the cylinder block coolant drain plug.
   - Tighten to 55 Nm (41 lb-ft).
7. Connect the coolant bypass hose.
8. Connect the EGR coolant hose.
9. Connect the EGR valve electrical connector.
10. Connect the EGR tube to the cylinder head.
    - Tighten to 55 Nm (41 lb-ft).
11. Position the ground strap and install the stud bolt to the cylinder head.
    - Tighten to 10 Nm (89 lb-in).
12. Install the PCV hose clips.
13. Install the fuel rail. For additional information, refer to **FUEL CHARGING & CONTROLS - 2.3L** article.
14. Install the exhaust manifold. For additional information, refer to **Exhaust Manifold**.
15. Install the camshafts. For additional information, refer to **Camshafts**.
16. Connect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING & CABLES** article.

OIL FILTER ADAPTER

Material

Item	Specification
Motorcraft Metal Surface Prep ZC-31	-
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	-
Thread Sealant with PTFE TA-24	WSK-M2G350-A2

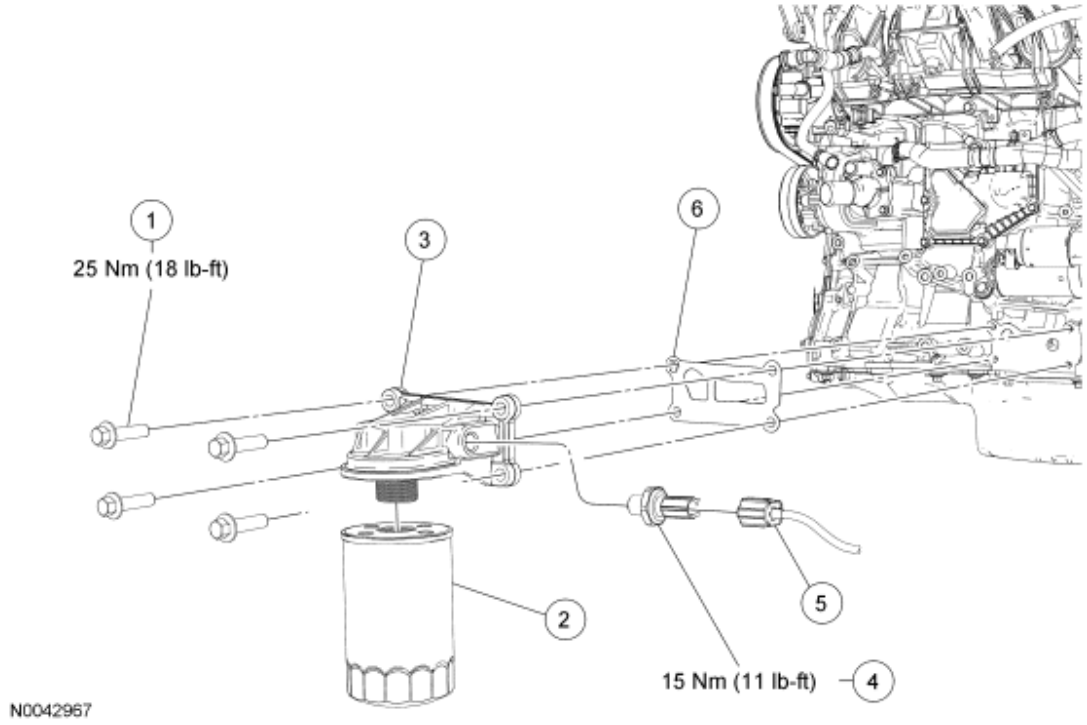


Fig. 81: Exploded View Of Identifying Oil Filter Adapter With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W500025	Oil filter adapter bolt (4 required)
2	6714	Oil filter
3	6884	Oil filter adapter
4	9278	Engine oil pressure (EOP) switch
5	-	EOP switch electrical connector (part of 14A280)
6	6A636	Oil filter adapter gasket

REMOVAL

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** article.
2. Disconnect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING & CABLES** article.
3. Drain the engine oil.
4. Disconnect the engine oil pressure (EOP) switch electrical connector.
5. Remove the EOP switch.
6. Remove and discard the oil filter.
7. Remove the 4 bolts, the oil filter adapter and discard the gasket.

INSTALLATION

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

1. Clean and inspect the engine block and the adapter gasket mounting surfaces with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.
2. Using a new gasket, install the oil filter adapter and the 4 bolts.
   - Tighten to 25 Nm (18 lb-ft).
3. Install a new oil filter.

NOTE: Apply thread sealant with PTFE to the oil pressure sender threads.

4. Install the EOP switch.
   - Tighten to 15 Nm (11 lb-ft).
5. Connect the EOP switch electrical connector.
6. Fill the engine with clean engine oil.
7. Run the engine and check for leaks.

ENGINE OIL PRESSURE (EOP) SWITCH

Material

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

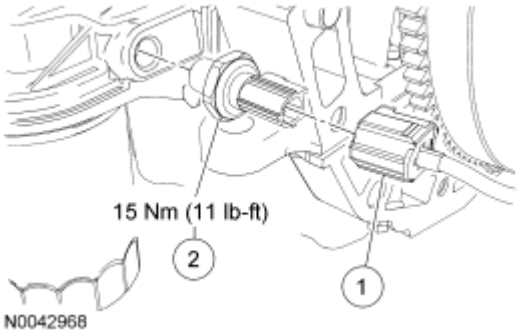


Fig. 82: Identifying Engine Oil Pressure (EOP) Switch With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Engine oil pressure (EOP) switch

		electrical connector (part of 14A280)
2	9278	EOP switch

REMOVAL AND INSTALLATION

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** article.
2. Disconnect the engine oil pressure (EOP) switch electrical connector.
3. Remove the EOP switch.
   - To install, tighten to 15 Nm (11 lb-ft).

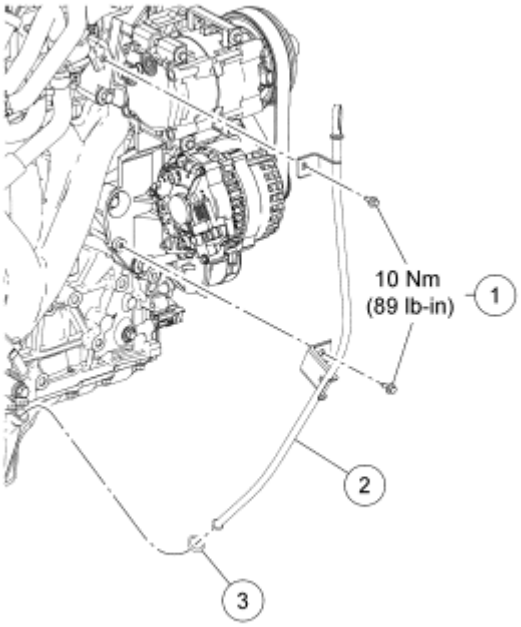
NOTE: Apply thread sealant with PTFE to the sender threads.

4. To install, reverse the removal procedure.

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



N0043358

Fig. 83: Exploded View Of Identifying Oil Level Indicator And Tube With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W500122	Oil level indicator tube bolts (2 required)
2	6750	Oil level indicator tube
3	-	Oil level indicator tube O-ring seal

REMOVAL AND INSTALLATION

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** article.
2. Remove the oil level indicator and the 2 bolts.
   - Tighten to 10 Nm (89 lb-in).
3. Remove the oil level indicator tube and discard the O-ring seal.

NOTE: Apply clean engine oil to the O-ring prior to installation of the indicator tube.

4. To install, reverse the removal procedure.
   - Install a new O-ring seal.

ENGINE LUBRICATION COMPONENTS - EXPLODED VIEW

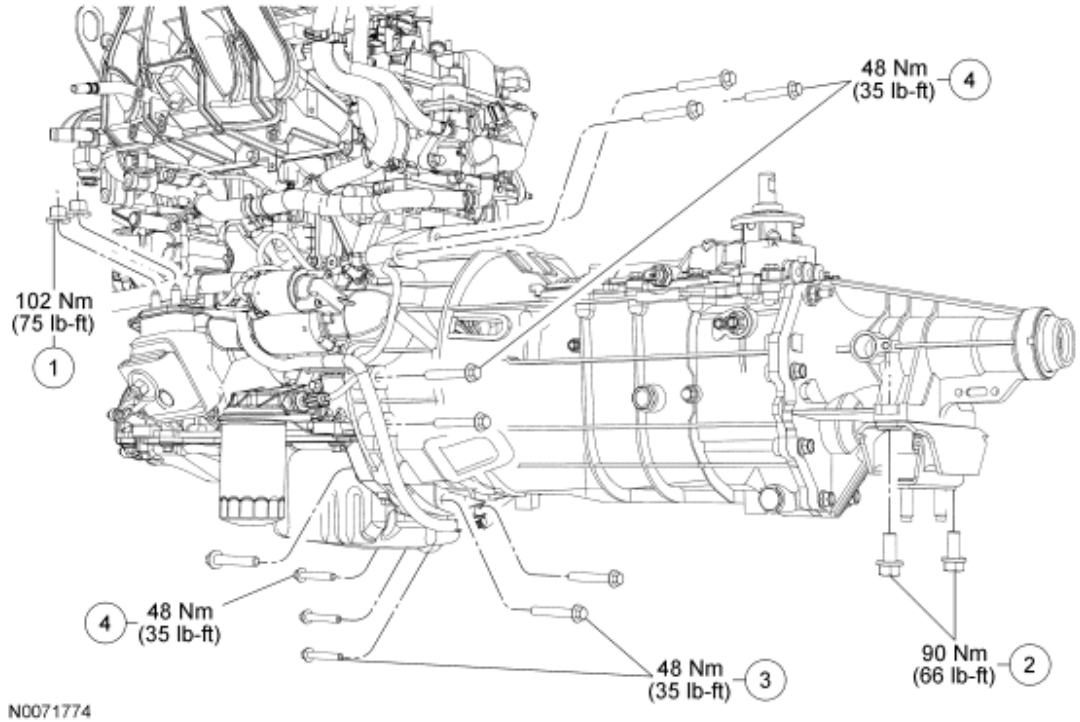


Fig. 84: Exploded View Of Engine and Transmission Mounts and Fasteners With Torque Specifications

Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	N621945	LH engine support insulator nut (2 required)
2	390066	Transmission mount bolts (2 required)
3	W500125	Transmission-to-oil pan bolts (4 required)
4	W500125	Transmission-to-cylinder block bolts (7 required)

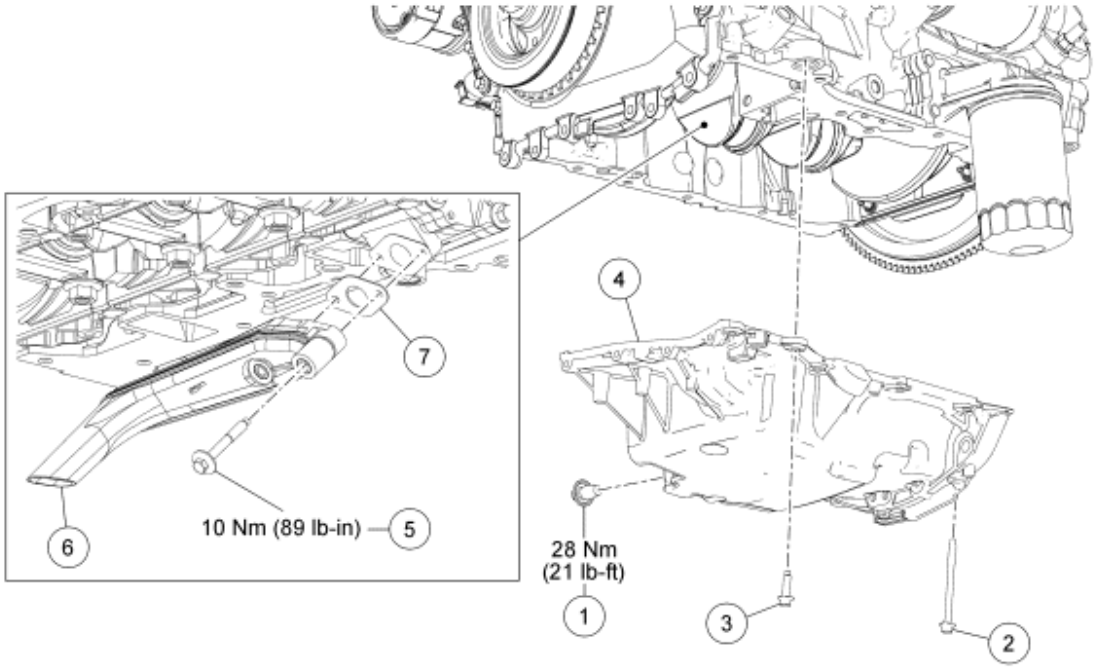


Fig. 85: Exploded View Of Oil Pan, Oil Pump Screen and Pickup Tube With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6730	Oil pan drain plug
2	W706284	Oil pan bolt (2 required)
3	W500224	Oil pan bolt (11 required)
4	6675	Oil pan
5	W706282	Oil pump screen and pickup tube bolt (2 required)
6	6622	Oil pump screen and pickup tube
7	6625	Oil pump screen and pickup tube gasket

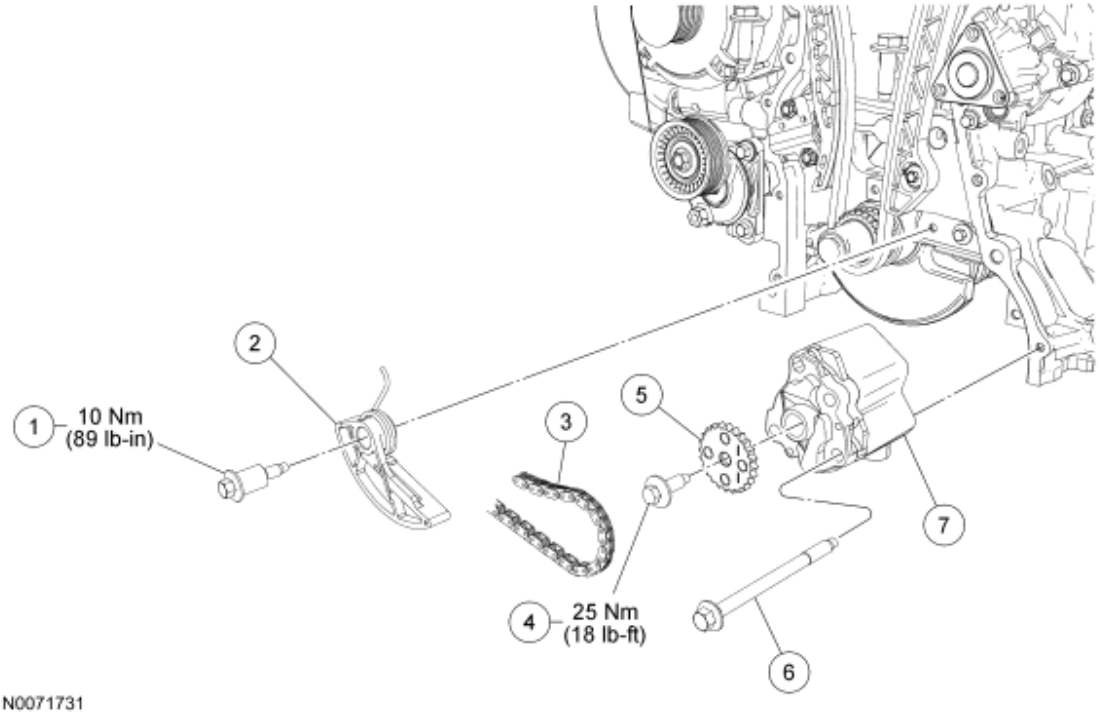


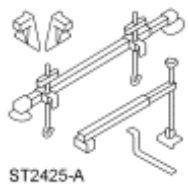
Fig. 86: Exploded View Of Oil Pump With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W703651	Oil pump drive chain tensioner bolt
2	6C271	Oil pump drive chain tensioner
3	6A895	Oil pump drive chain
4	W704397	Oil pump sprocket bolt
5	6652	Oil pump sprocket
6	W703647	Oil pump bolt (4 required)
7	6600	Oil pump

1. For additional information, refer to the appropriate procedures.

OIL PAN

Special Tools

Illustration	Tool Name	Tool Number
 ST2425-A	3-Bar Engine Support Kit	303-F072

 ST1831-A	Lifting Eyes	303-D030 (D81L-6001-D) or equivalent

Material

Item	Specification
Motorcraft Metal Surface Prep ZC-31	-
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 or equivalent	WSE-M4G323-A4
Silicone Gasket Remover ZC-30	-

REMOVAL

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** article.
2. Remove the engine cooling fan. For additional information, refer to **ENGINE COOLING** article.
3. Remove the oil level indicator and tube. For additional information, refer to **Oil Level Indicator and Tube**.

NOTE: Only the LH side of the engine will be raised.

4. Remove the LH engine support insulator-to-engine bracket nuts.
5. Install the special tool.

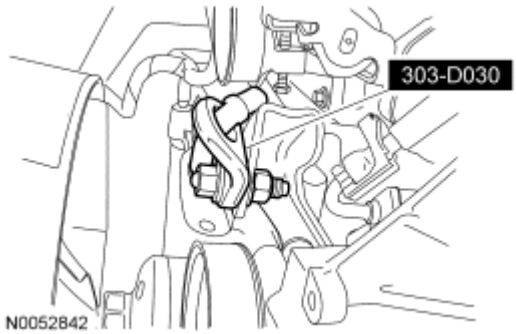


Fig. 87: Identifying Special Tools (303-D030)
Courtesy of FORD MOTOR CO.

6. Install the special tool and raise the LH side of the engine approximately 25 mm (1 in).

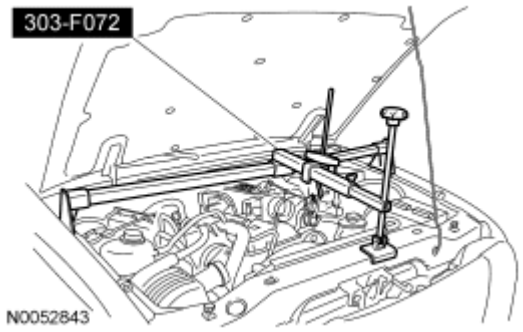


Fig. 88: Identifying Special Tools (303-F072)
Courtesy of FORD MOTOR CO.

7. Remove the drain plug and drain the engine oil. Install the drain plug when finished.
   - Tighten to 28 Nm (21 lb-ft).
8. Detach the wiring harness retainers from the engine front cover.
9. Remove the 4 engine front cover-to-oil pan bolts.
10. Remove the transmission bracket-to-transmission bolts.
11. Remove the 4 transmission-to-oil pan bolts.

CAUTION: To prevent damage to the transmission, do not loosen the transmission-to-engine bolts more than 5 mm (0.19 in).

12. Loosen the 7 transmission-to-cylinder block bolts 5 mm (0.19 in).
13. Slide the transmission rearward 5 mm (0.19 in).

NOTE: If necessary, lift the rear of the transmission to remove the oil pan.

14. Remove the 13 oil pan bolts and the oil pan.

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

15. Clean the sealing surface with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.

INSTALLATION

CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or

other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of sealant.

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

NOTE: If necessary, lift the rear of the transmission to install the oil pan.

1. Apply a 2.5 mm (0.1 in) bead of silicone gasket and sealant to the oil pan. Position the oil pan and install the bolts finger tight.
2. Install the engine front cover-to-oil pan bolts.
   - Tighten to 10 Nm (89 lb-in).
3. Tighten the oil pan bolts in the sequence shown in illustration.
   - Tighten to 25 Nm (18 lb-ft).

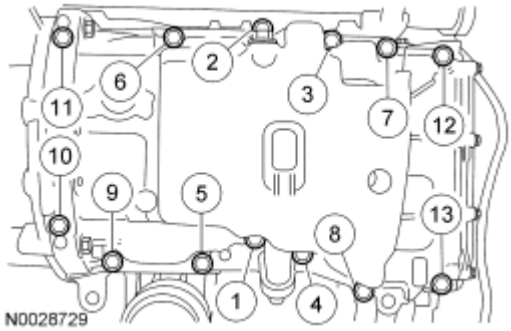


Fig. 89: Identifying Tightening Sequence Of Oil Pan Bolts
Courtesy of FORD MOTOR CO.

4. Attach the wiring harness retainers to the engine front cover.
5. Slide the transmission forward and tighten the 7 transmission-to-cylinder block bolts.
   - Tighten to 48 Nm (35 lb-ft).
6. Install the 4 transmission-to-oil pan bolts.
   - Tighten to 48 Nm (35 lb-ft).
7. Install the transmission bracket-to-transmission bolts.
   - Tighten to 90 Nm (66 lb-ft).
8. Lower the engine and remove the special tools.
9. Install the engine support insulator nuts.

- Tighten to 102 Nm (75 lb-ft).

10. Install the oil level indicator and tube. For additional information, refer to **Oil Level Indicator and Tube**.
11. Install the engine cooling fan. For additional information, refer to **ENGINE COOLING** article.
12. Install a new oil filter.
13. Fill the engine with clean engine oil.

OIL PUMP SCREEN AND PICKUP TUBE

Material

Item	Specification
Motorcraft Metal Surface Prep ZC-31	-

REMOVAL

1. Remove the oil pan. For additional information, refer to **Oil Pan**.
2. Remove the 4 bolts and the oil pump screen and pickup tube.
   - Discard the gasket.

INSTALLATION

NOTE: Clean the sealing surface with metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the metal surface prep.

1. Position a new oil pump pickup tube gasket and the pickup tube, and tighten the 4 bolts in the sequence shown in illustration.
   - Tighten to 10 Nm (89 lb-in).

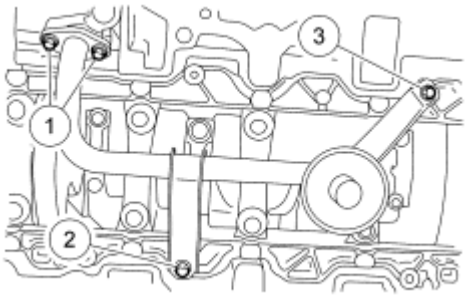


Fig. 90: Identifying Tightening Sequence Of Oil Pump Pickup Tube
Courtesy of FORD MOTOR CO.

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

OIL PUMP

Material

Item	Specification
Motorcraft Metal Surface Prep ZC-31	-

REMOVAL

CAUTION: Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in the crankshaft pulley procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if you loosen the pulley bolt. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special tools, otherwise severe engine damage may occur.

1. Remove the engine front cover. For additional information, refer to **Engine Front Cover**.
2. Remove the oil pump screen and pickup tube. For additional information, refer to **Oil Pump Screen and Pickup Tube**.
3. Remove the oil pump chain tensioner.
   - Release the tension on the tensioner spring.
   - Remove the bolt and the tensioner.

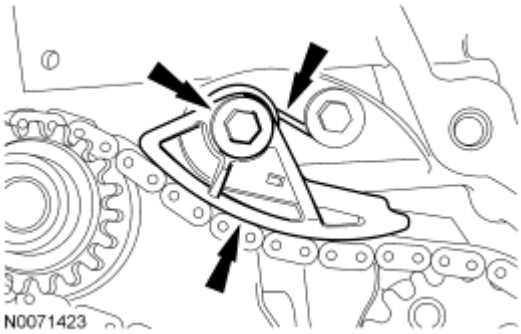


Fig. 91: Locating Tensioner Spring Around Shoulder Bolt
Courtesy of FORD MOTOR CO.

4. Remove the chain from the oil pump sprocket.
5. Remove the bolt and oil pump sprocket.
6. Remove the 4 bolts and the oil pump.

INSTALLATION

NOTE: Clean the oil pump and cylinder block mating surfaces with metal surface

prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure may cause future oil leakage.

1. Install the oil pump assembly. Tighten the 4 bolts in the sequence shown in illustration in 2 stages:
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten to 20 Nm (15 lb-ft).

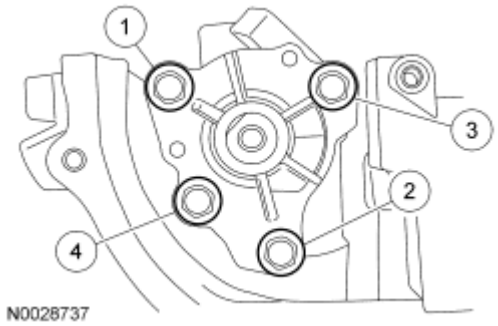


Fig. 92: Identifying Tightening Sequence Of Oil Pump Assembly Bolts
Courtesy of FORD MOTOR CO.

2. Install the oil pump sprocket and bolt.
   - Tighten to 25 Nm (18 lb-ft).
3. Install the chain onto the oil pump sprocket.
4. Install the oil pump chain tensioner and bolt.
   - Hook the tensioner spring around the shoulder bolt.
   - Tighten to 10 Nm (89 lb-in).

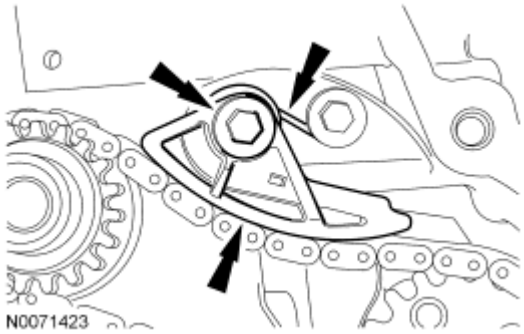


Fig. 93: Locating Tensioner Spring Around Shoulder Bolt
Courtesy of FORD MOTOR CO.

5. Install the oil pump screen and pickup tube. For additional information, refer to **Oil Pump Screen and Pickup Tube**.
6. Install the engine front cover. For additional information, refer to **Engine Front Cover**.

FLEXPLATE OR FLYWHEEL AND CRANKSHAFT REAR SEAL - EXPLODED VIEW

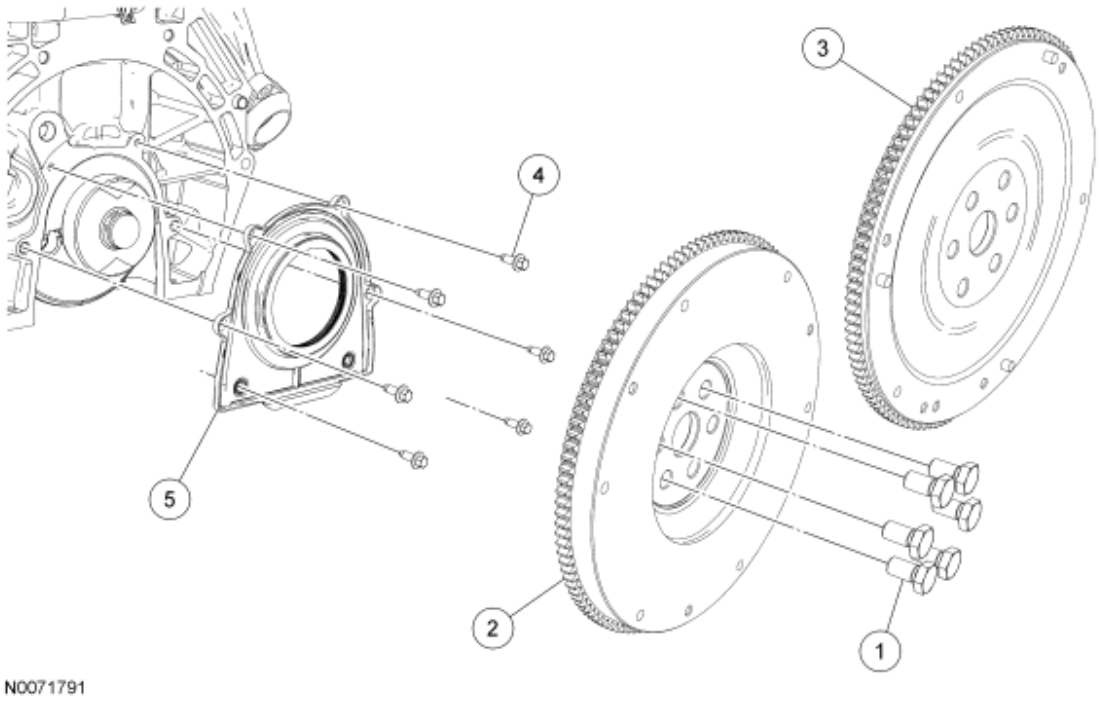


Fig. 94: Exploded View Of Flexplate Or Flywheel & Crankshaft Rear Seal
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6379	Flywheel/flexplate bolt (6 required)
2	6375	Flywheel
3	6375	Flexplate
4	W500212	Crankshaft rear seal and retainer plate bolt (6 required)
5	6K318	Crankshaft rear seal and retainer plate

1. For additional information, refer to the appropriate procedures.

FLYWHEEL

Special Tools

Illustration	Tool Name	Tool Number
 ST2768-A	Locking Tool, Flywheel	303-103 (T74P-8375-A)

REMOVAL

1. Remove the clutch disc and pressure plate. For additional information, refer to **CLUTCH** article.
2. Using the special tool, remove the bolts and the flywheel.

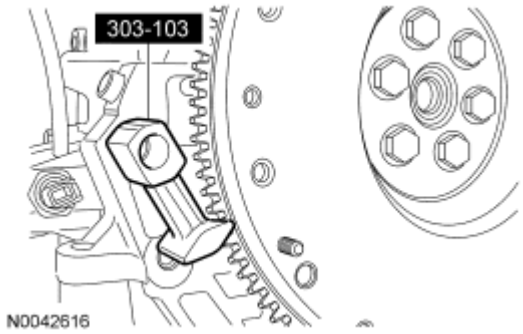


Fig. 95: Identifying Special Tool (303-103)
Courtesy of FORD MOTOR CO.

INSTALLATION

NOTE: Engine balancing is not required. Balance weights should not be installed on the new flywheel.

NOTE: Special bolts are used for installation. Do not use standard bolts.

1. Inspect the pilot bearing. Install a new pilot bearing as necessary.
2. Position the flywheel.
3. Using the special tool, install the bolts in the sequence shown in illustration, in 3 stages.
   - Stage 1: Tighten to 50 Nm (37 lb-ft).
   - Stage 2: Tighten to 80 Nm (59 lb-ft).
   - Stage 3: Tighten to 112 Nm (83 lb-ft).

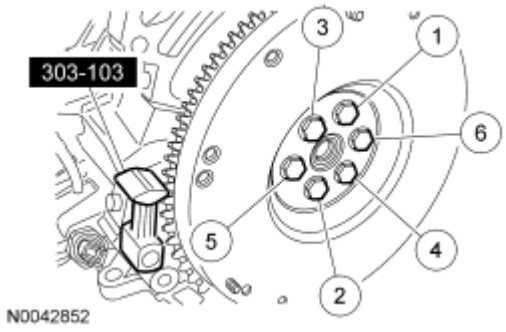


Fig. 96: Identifying Special Tool (303-103)
Courtesy of FORD MOTOR CO.

4. Install the clutch disc and the pressure plate. For additional information, refer to **CLUTCH** article.

FLEXPLATE

Special Tools

Illustration	Tool Name	Tool Number
 ST2768-A	Locking Tool, Flexplate	303-103 (T74P-8375-A)

REMOVAL

1. Remove the transmission. For additional information, refer to **AUTOMATIC TRANSMISSION - 5R44E & 5R55E** article.
2. Using the special tool, remove the bolts and the flexplate.

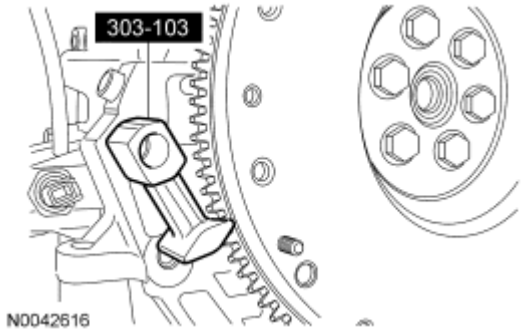


Fig. 97: Identifying Special Tool (303-103)
Courtesy of FORD MOTOR CO.

INSTALLATION

NOTE: Engine balancing is not required. Balance weights should not be installed on the new flexplate.

NOTE: Special bolts are used for installation. Do not use standard bolts.

1. Position the flexplate.
2. Using the special tool, install the bolts in the sequence shown in illustration, in 3 stages.
   - Stage 1: Tighten to 50 Nm (37 lb-ft).
   - Stage 2: Tighten to 80 Nm (59 lb-ft).
   - Stage 3: Tighten to 112 Nm (83 lb-ft).

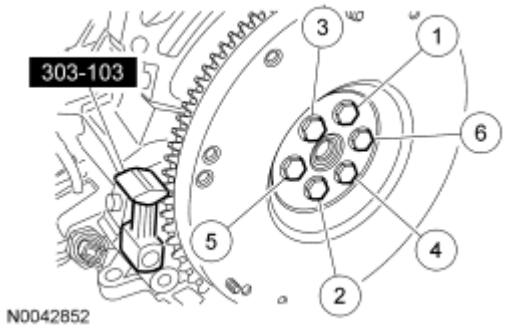


Fig. 98: Identifying Special Tool (303-103)
Courtesy of FORD MOTOR CO.

3. Install the transmission. For additional information, refer to **AUTOMATIC TRANSMISSION - 5R44E & 5R55E** article.

CRANKSHAFT REAR SEAL WITH RETAINER PLATE

Special Tools

Illustration	Tool Name	Tool Number
 ST1506-A	Installer, Crankshaft Rear Seal	303-328 (T88P-6701-B1)

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

1. Remove the flywheel or flexplate. For additional information, refer to **Flexplate** or **Flywheel**.
2. Remove the oil pan. For additional information, refer to **Oil Pan**.
3. Remove the bolts and the crankshaft rear seal and retainer plate as an assembly.

INSTALLATION

1. Using the special tool, position the crankshaft rear oil seal with retainer plate onto the crankshaft.

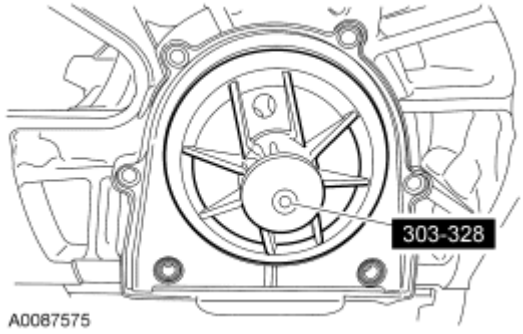


Fig. 99: Positioning Crankshaft Rear Oil Seal Using Special Tool (303-328)
Courtesy of FORD MOTOR CO.

2. Install the 6 crankshaft rear seal with retainer plate bolts.
   - Tighten in the sequence shown in illustration to 10 Nm (89 lb-in).

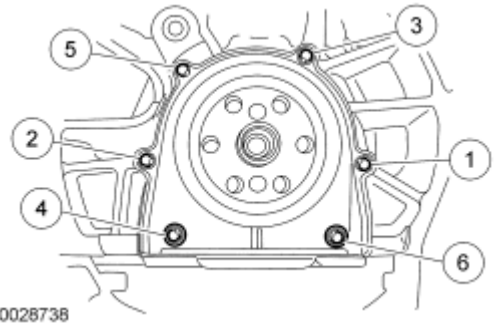
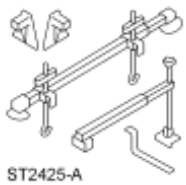


Fig. 100: Identifying Tightening Sequence Of Crankshaft Rear Oil Seal Bolts
Courtesy of FORD MOTOR CO.

3. Install the oil pan. For additional information, refer to **Oil Pan**.
4. Install the flywheel or flexplate. For additional information, refer to **Flexplate** or **Flywheel**.

ENGINE SUPPORT INSULATORS

Special Tools

Illustration	Tool Name	Tool Number
 ST2425-A	3-Bar Engine Support Kit	303-F072
	Lifting Eyes	303-D030 (D81L-6001-D) or equivalent

 ST1631-A		

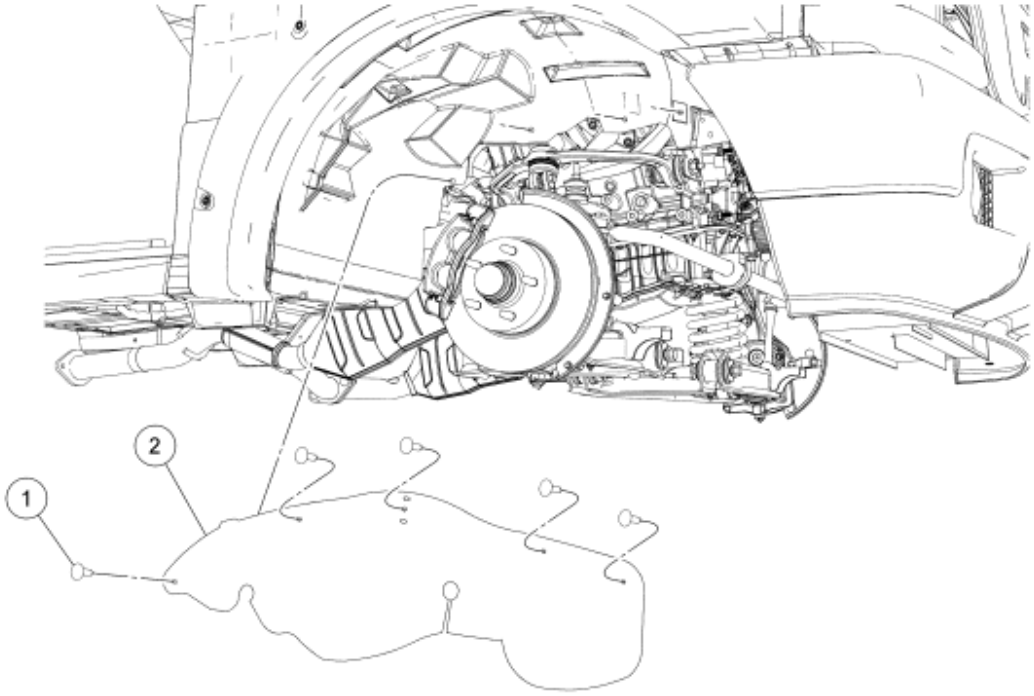


Fig. 101: RH Splash Shield
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	RH splash shield pushpin (5 required
2	-	RH splash shield

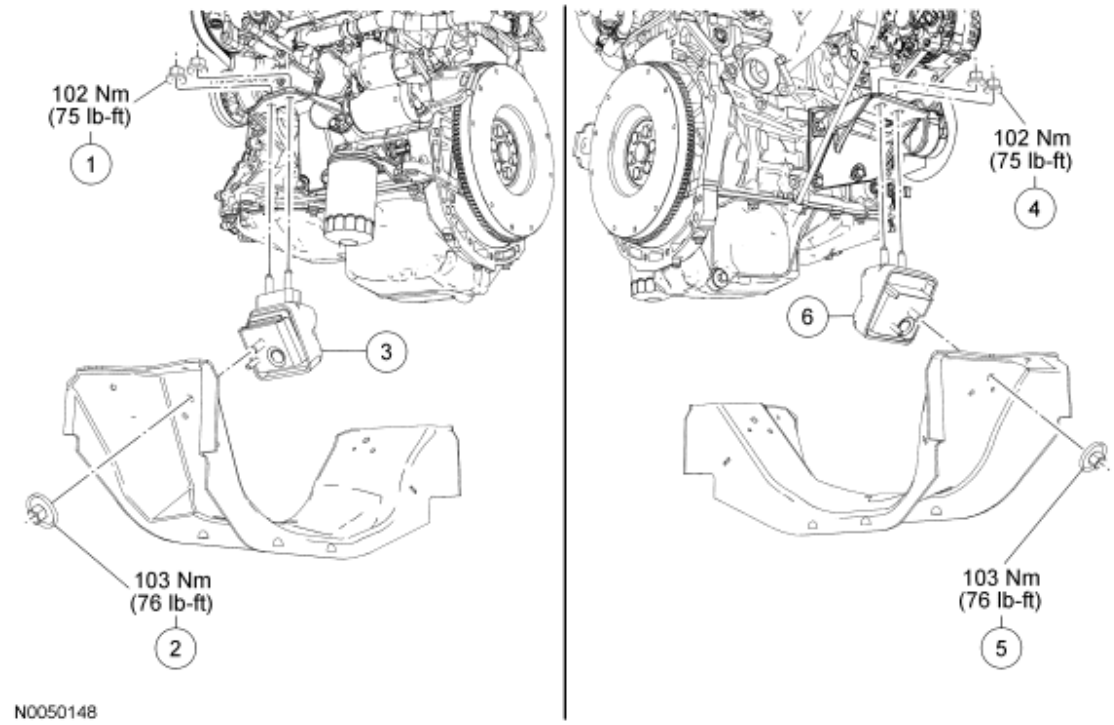


Fig. 102: Exploded View Of Engine Support Insulators With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	N621945	LH engine support insulator-to-engine bracket nut
2	W710657	LH engine support insulator-to-crossmember nut
3	6B032	LH engine support insulator
4	N621945	RH engine support insulator-to-engine bracket nut
5	W710657	RH engine support insulator-to-crossmember nut
6	6B038	RH engine support insulator

REMOVAL

RH and LH engine support insulators

1. Remove the front springs. For additional information, refer to **FRONT SUSPENSION - REAR WHEEL DRIVE (RWD)** article for rear wheel drive (RWD) vehicles or **FRONT SUSPENSION - FOUR WHEEL DRIVE (4WD)** article for four wheel drive (4WD) vehicles.
2. Remove the cooling fan. For additional information, refer to **ENGINE COOLING** article.

RH engine support insulator

3. Remove the 3 rear pushpins and position the right inner fender splash shield aside.

RH and LH engine support insulators

4. Remove the 4 RH and LH engine support insulator upper nuts.
5. Install the Lifting Eyes.
6. Raise the engine with the 3-Bar Engine Support Kit.
7. Remove the lower nut and the engine support insulator.

INSTALLATION

RH and LH engine support insulators

1. Install the engine support insulator and the engine support insulator-to-crossmember nut.
   - Tighten to 103 Nm (76 lb-ft).
2. Lower the engine and remove the 3-Bar Engine Support Kit.
3. Remove the Lifting Eyes.
4. Install the 4 LH and RH engine support insulator-to-engine support bracket nuts.
   - Tighten to 102 Nm (75 lb-ft).

RH engine support insulator

5. Position the right inner fender splash shield and install the pushpins.

RH and LH engine support insulators

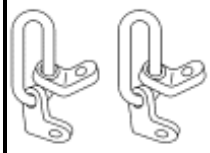
6. Install the cooling fan. For additional information, refer to **ENGINE COOLING** article.
7. Install the front springs. For additional information, refer to **FRONT SUSPENSION - REAR WHEEL DRIVE (RWD)** article for RWD vehicles or **FRONT SUSPENSION - FOUR WHEEL DRIVE (4WD)** article for 4WD vehicles.

REMOVAL

ENGINE

Special Tools

Illustration	Tool Name	Tool Number
 ST1341-A	Heavy Duty Floor Crane	014-00071 or equivalent

 ST1595-A	Lifting Bracket, Engine	303-050 (T70P-6000)
 ST1602-A	Spreader Bar	303-D089 (D93P-6001-A3) or equivalent

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING & LIFTING** article.
2. Relieve the fuel pressure. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
3. Disconnect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING & CABLES** article.
4. Recover the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION & DIAGNOSTICS** article.
5. Drain the engine cooling system. For additional information, refer to **ENGINE COOLING** article.
6. Drain the engine oil.
7. Remove the hood.
8. Remove the air cleaner outlet tube. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** article.
9. Remove the upper radiator hose.

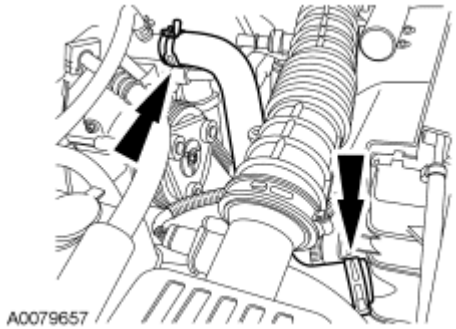


Fig. 103: Locating Upper Radiator Hose
Courtesy of FORD MOTOR CO.

10. Remove the lower radiator hose.

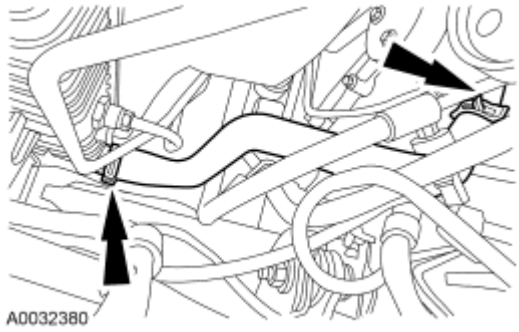


Fig. 104: Locating Lower Radiator Hose
Courtesy of FORD MOTOR CO.

11. Remove the fan and shroud. For additional information, refer to **ENGINE COOLING** article.
12. Disconnect the 3 PCM electrical connectors. Remove the retaining nut on the harness clamp. Position the harness on the engine.

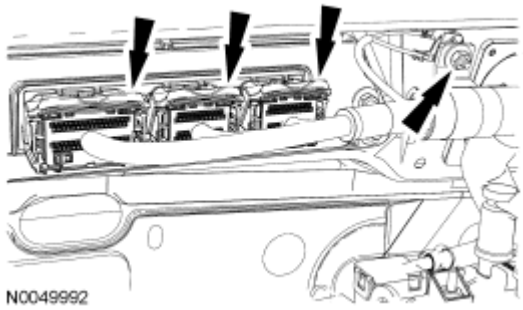


Fig. 105: Powertrain Control Module (PCM) Connectors
Courtesy of FORD MOTOR CO.

13. Remove the stud bolt and the ground cable.

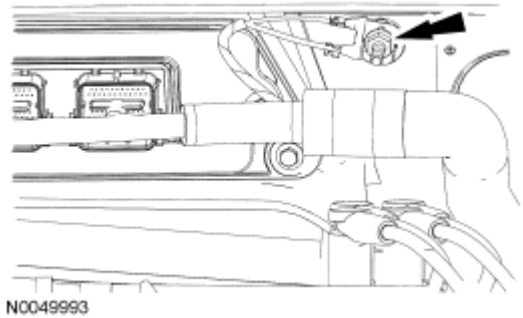


Fig. 106: Locating Ground Strap & Stud Bolt
Courtesy of FORD MOTOR CO.

14. Remove the heater hose assembly.
    1. Disconnect the heater hoses at the bulkhead.

2. Disconnect the vacuum hose.
3. Disconnect the heater hoses at the engine and remove the assembly.

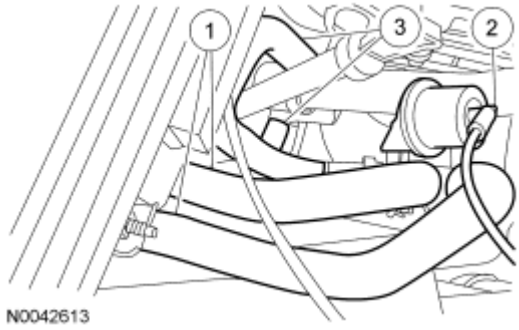


Fig. 107: Identifying Heater Hose Assembly
Courtesy of FORD MOTOR CO.

15. Disconnect the vacuum reservoir tube connection.

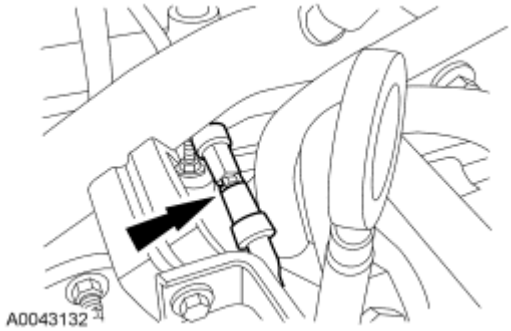


Fig. 108: Locating Vacuum Reservoir Tube Connection
Courtesy of FORD MOTOR CO.

16. Disconnect the engine-to-degas bottle coolant bypass hose.

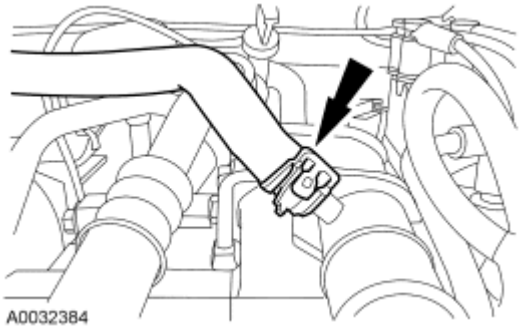


Fig. 109: Locating Engine-To-Coolant Reservoir Bypass Hose
Courtesy of FORD MOTOR CO.

17. Disconnect the degas bottle-to-engine coolant supply hose.

Fig. 110: Locating Coolant Reservoir-To-Engine Supply Hose
Courtesy of FORD MOTOR CO.

18. Disconnect the A/C compressor electrical connector.

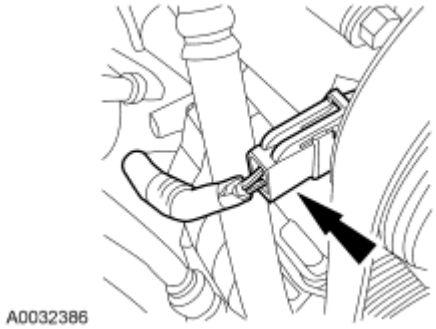


Fig. 111: Locating A/C Compressor Electrical Connector
Courtesy of FORD MOTOR CO.

19. Disconnect the mass air flow sensor (MAF) electrical connector.

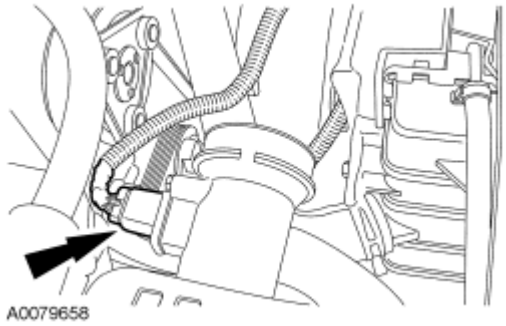


Fig. 112: Locating Mass Airflow Sensor (MAF) Electrical Connector
Courtesy of FORD MOTOR CO.

20. Disconnect the A/C compressor manifold. Plug the lines and the compressor ports.

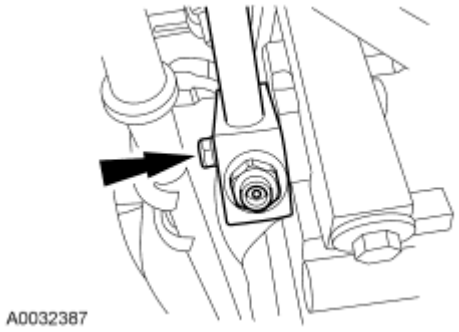


Fig. 113: Locating A/C Compressor Manifold Bolt
Courtesy of FORD MOTOR CO.

21. Disconnect the accelerator cable and, if equipped, the speed control cable from the throttle body (TB) and the cable mounting bracket and position aside.

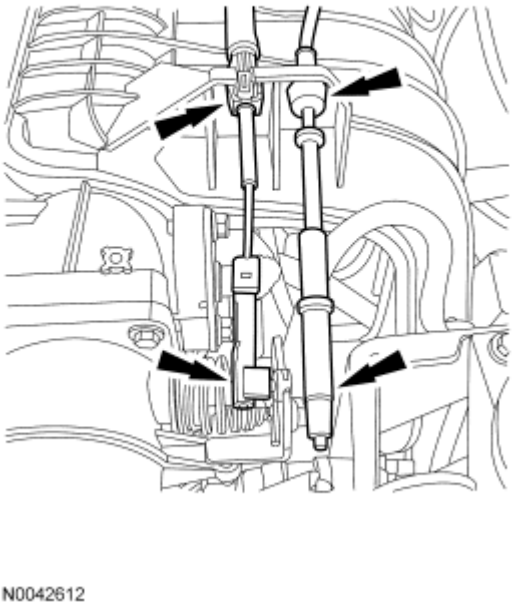


Fig. 114: Locating Accelerator Cable
Courtesy of FORD MOTOR CO.

22. Disconnect and position aside the power steering pressure (PSP) switch electrical connector and the high-pressure power steering tube.

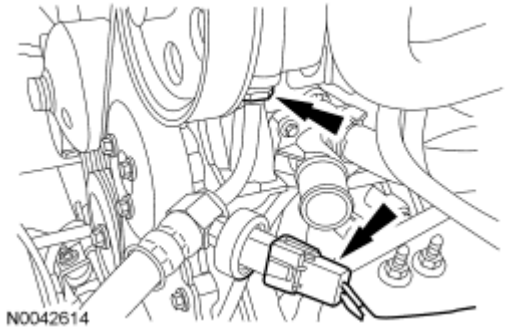


Fig. 115: Locating Power Steering Pressure (PSP) Switch Electrical Connector
Courtesy of FORD MOTOR CO.

23. Disconnect the fuel supply tube spring lock coupling. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.
24. Detach the fuel supply tube, disconnect the electrical connectors and disconnect the evaporative purge tube quick connect coupling. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.

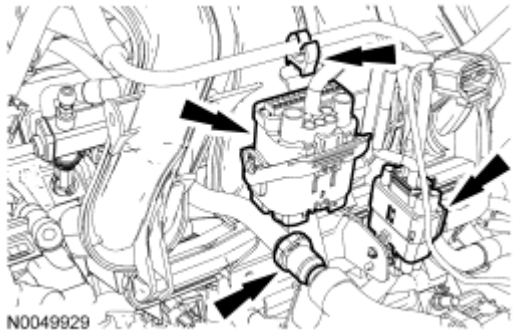


Fig. 116: Locating Fuel Supply Tube Spring Lock Coupling
Courtesy of FORD MOTOR CO.

25. Disconnect the brake booster vacuum hose and the engine ground strap.

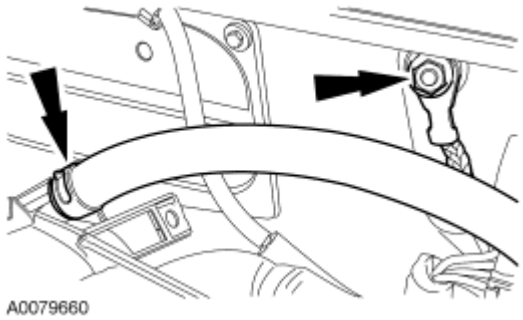


Fig. 117: Locating Brake Booster Vacuum Hose & Engine Ground Strap
Courtesy of FORD MOTOR CO.

26. Disconnect the positive battery cable, the negative battery cable and the solenoid control wire at the

starter.

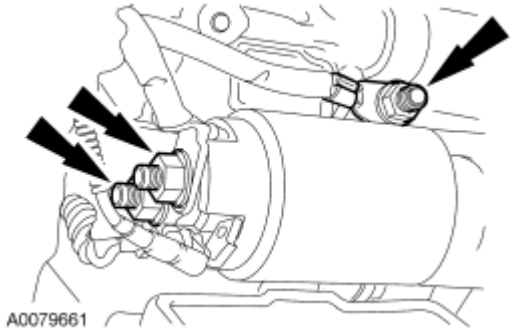


Fig. 118: Locating Solenoid Control Wire & Nut
Courtesy of FORD MOTOR CO.

27. Remove the starter wiring harness support bracket bolt and position the wiring harness aside.

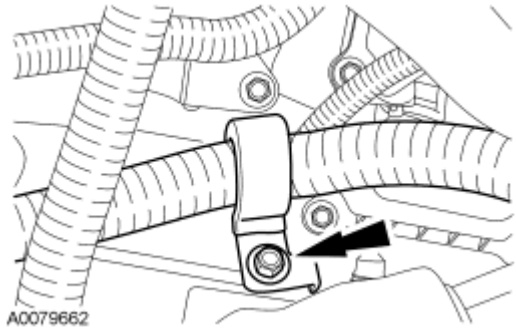


Fig. 119: Locating Starter Wiring Harness Clamp Bolt
Courtesy of FORD MOTOR CO.

28. Position the RH splash shield aside.

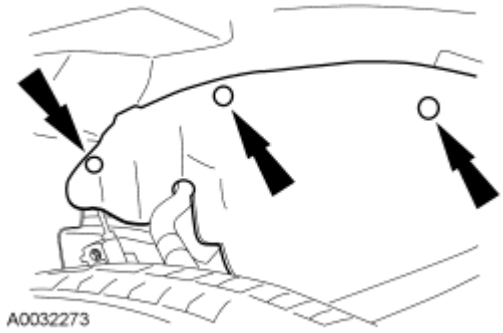


Fig. 120: Locating Splash Shield Pushpins
Courtesy of FORD MOTOR CO.

29. Disconnect the generator electrical connections.

Fig. 121: Locating Generator Electrical Connections
Courtesy of FORD MOTOR CO.

30. Detach generator wiring pin-type retainer.

Fig. 122: Locating Generator Wiring Pin-Type Retainer
Courtesy of FORD MOTOR CO.

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

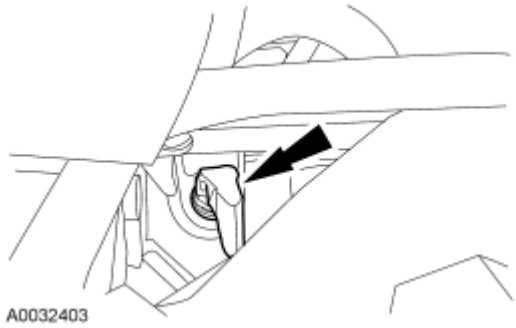


Fig. 123: Locating Block Heater Electrical Connector
Courtesy of FORD MOTOR CO.

32. Disconnect the front heated oxygen sensor (HO2S) electrical connector at the transmission bell housing.

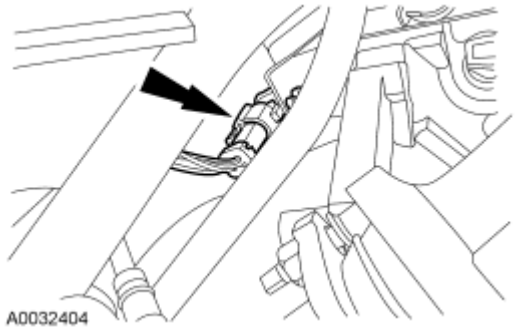


Fig. 124: Locating Front Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

Vehicles with automatic transmission

33. Remove the bolt and the transmission cooling tubes retaining bracket.

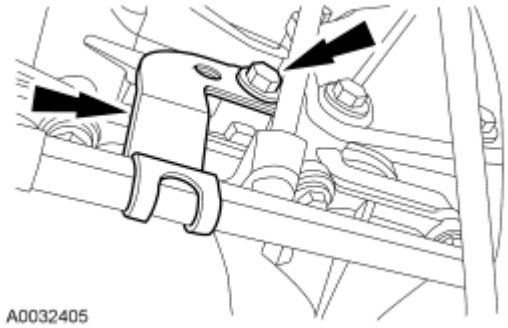


Fig. 125: Locating Transmission Cooling Tubes Retaining Bracket Bolts
Courtesy of FORD MOTOR CO.

All vehicles

34. Remove the bolt and the transmission dust shield.

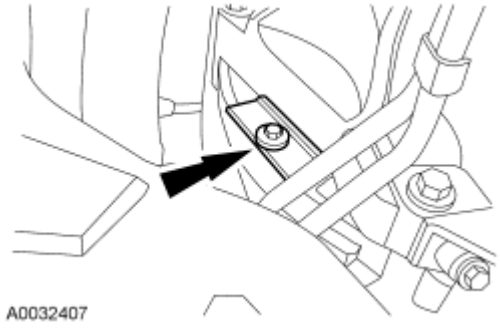


Fig. 126: Locating Transmission Dust Shield Bolts
Courtesy of FORD MOTOR CO.

35. Remove the 2 exhaust manifold-to-front pipe nuts.

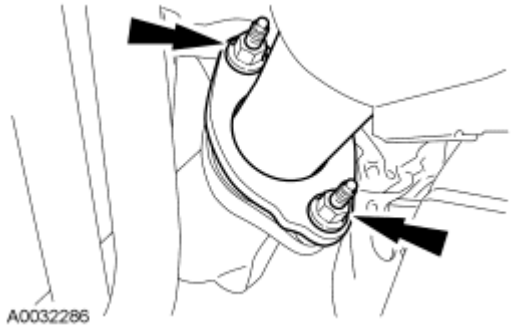


Fig. 127: Locating Exhaust Manifold-To-Front Pipe Nuts
Courtesy of FORD MOTOR CO.

36. Disconnect the engine wiring harness anchor and the pin-type retainer and position the wiring harness aside.

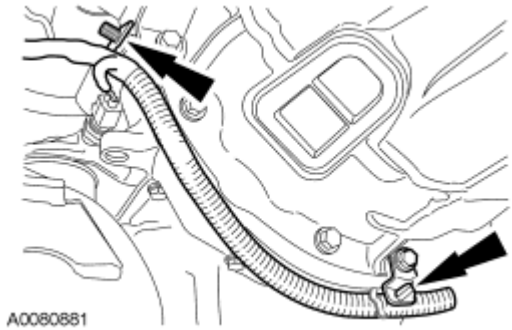


Fig. 128: Locating Anchor & Pin-Type Retainer
Courtesy of FORD MOTOR CO.

37. Disconnect the engine oil pressure (EOP) sensor electrical connector.

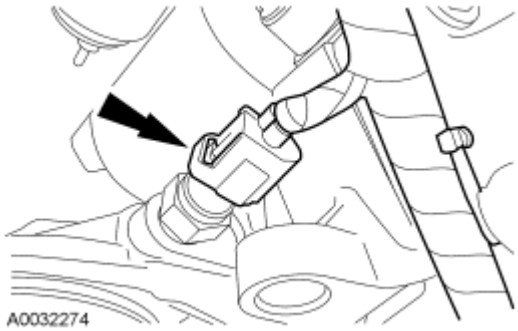


Fig. 129: Locating Engine Oil Pressure (EOP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

38. Remove and discard the engine oil filter.

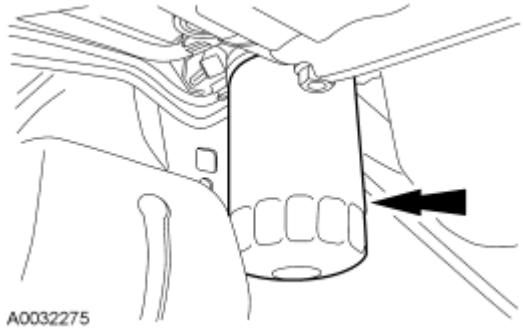


Fig. 130: Locating Oil Filter
Courtesy of FORD MOTOR CO.

39. Detach the wiring harness from the crossmember and disconnect the electrical connector. Route the wiring harness to the transmission.

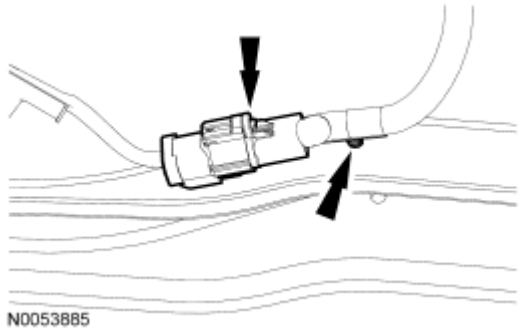


Fig. 131: Locating Electrical Connector & Wiring Harness Retainer To Crossmember
Courtesy of FORD MOTOR CO.

Vehicles with automatic transmission

40. Disconnect the HO2S electrical connector.

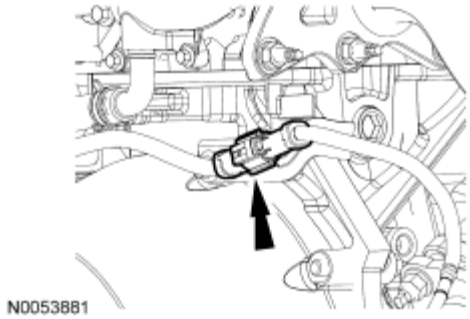


Fig. 132: Locating Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

41. Disconnect the catalyst monitor sensor electrical connector. Remove the nut and route the wiring harness over the transmission.

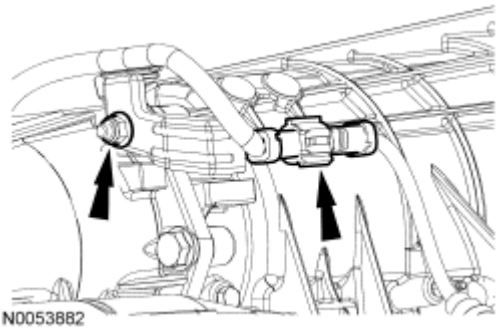


Fig. 133: Locating Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

42. Disconnect the transmission electrical connectors and detach the wiring harness retainers.

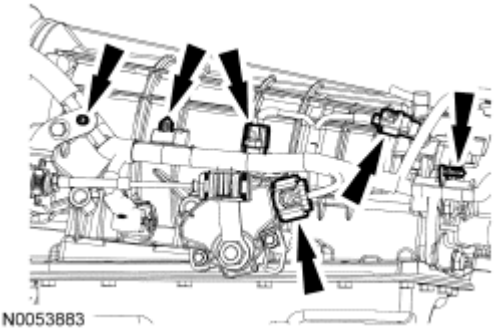


Fig. 134: Locating Transmission Electrical Connectors
Courtesy of FORD MOTOR CO.

43. Detach the wiring harness retainers.

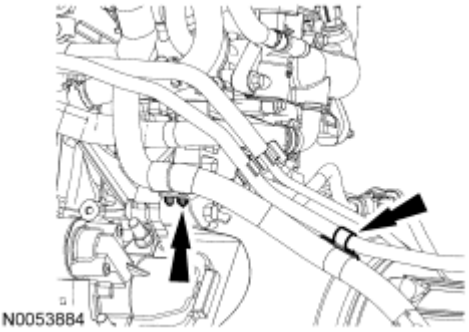


Fig. 135: Locating Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

Vehicles with manual transmission

44. Disconnect the HO2S electrical connector.

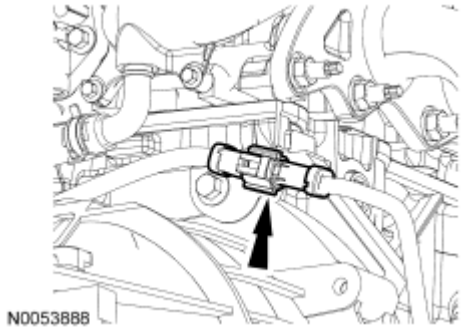


Fig. 136: Locating HO2S Electrical Connector
Courtesy of FORD MOTOR CO.

45. Disconnect the catalyst monitor sensor electrical connector. Remove the nut and route the wiring harness over the transmission.

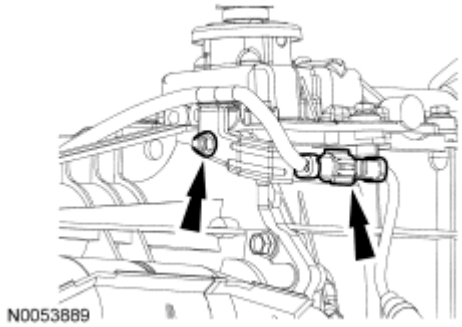


Fig. 137: Locating Catalyst Monitor Sensor Electrical Connector & Nut
Courtesy of FORD MOTOR CO.

46. Disconnect the transmission electrical connectors and detach the wiring harness retainers.

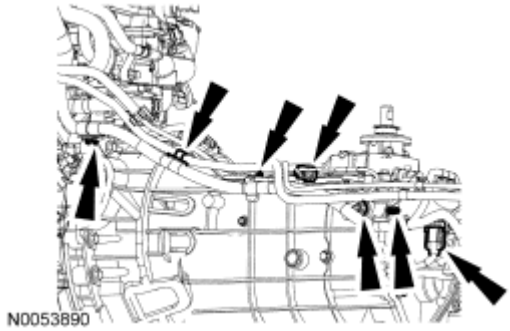


Fig. 138: Locating Wiring Harness Retainers & Connecting Transmission Electrical Connectors
Courtesy of FORD MOTOR CO.

All vehicles

47. Route the transmission portion of the wiring harness to the engine.
48. Remove the 4 bolts and the oil filter adapter.

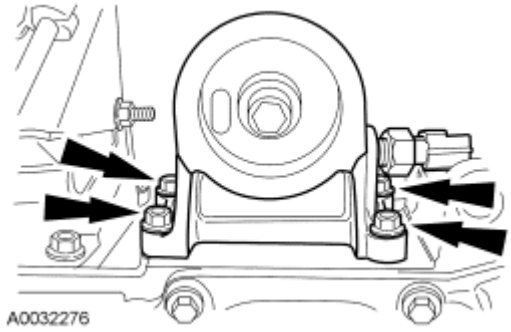


Fig. 139: Locating Oil Filter Adapter Bolts
Courtesy of FORD MOTOR CO.

49. Remove the bolt, the 2 stud bolts and the starter.

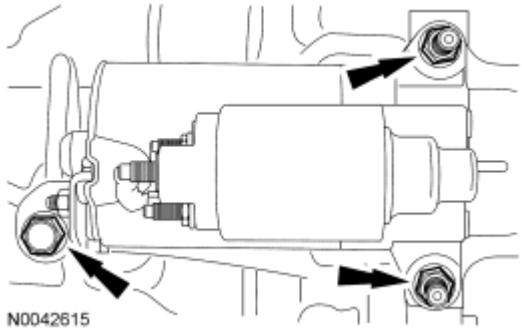


Fig. 140: Locating Starter, Bolt & 2 Stud Bolts
Courtesy of FORD MOTOR CO.

50. Remove the starter dust shield.

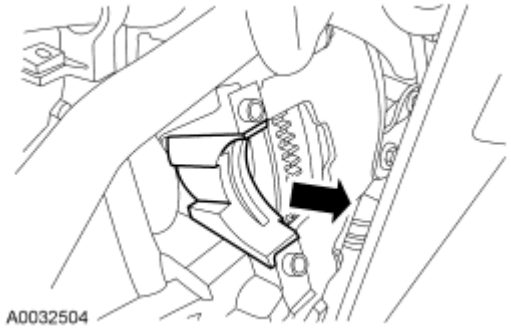


Fig. 141: Locating Starter Dust Shield
Courtesy of FORD MOTOR CO.

Vehicles with automatic transmission

NOTE: Mark one stud and the flexplate for assembly reference.

51. Remove the 4 torque converter nuts.

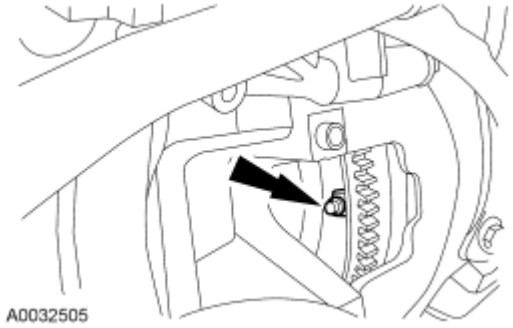


Fig. 142: Locating Torque Converter Nut
Courtesy of FORD MOTOR CO.

All vehicles

NOTE: Leave the 2 side bolts in until the engine is ready to be removed.

52. Remove 9 of the transmission-to-engine bolts.

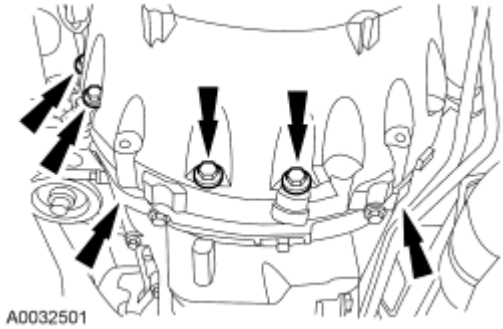


Fig. 143: Locating Transmission-To-Engine Bolts
Courtesy of FORD MOTOR CO.

Vehicles with automatic transmission

53. Remove the transmission fluid indicator and tube assembly.

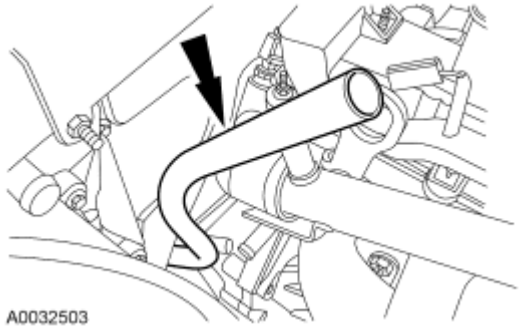


Fig. 144: Locating Transmission Fluid Indicator & Tube Assembly
Courtesy of FORD MOTOR CO.

All vehicles

54. Install the engine lifting bracket.

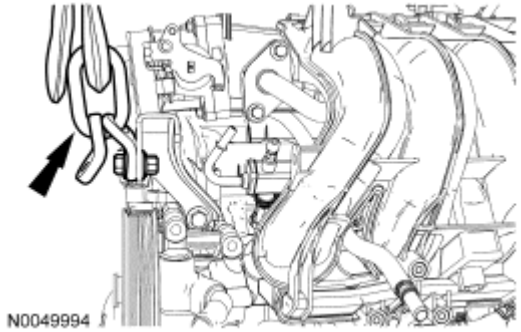


Fig. 145: Locating Engine Lifting Bracket
Courtesy of FORD MOTOR CO.

55. Support the transmission with a floor jack.
56. Support the engine with the Floor Crane, using the Spreader Bar.

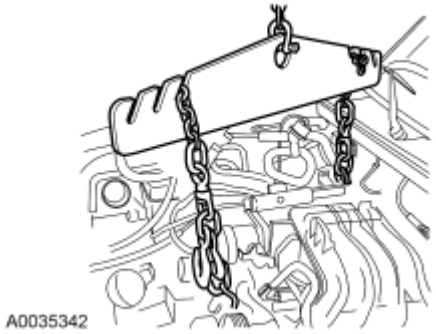


Fig. 146: Supporting Engine With Floor Crane Using Spreader Bar
Courtesy of FORD MOTOR CO.

57. Remove the 2 side transmission-to-engine bolts.

NOTE: Left side shown in illustration, right side similar.

58. Remove the 4 engine support insulator nuts.

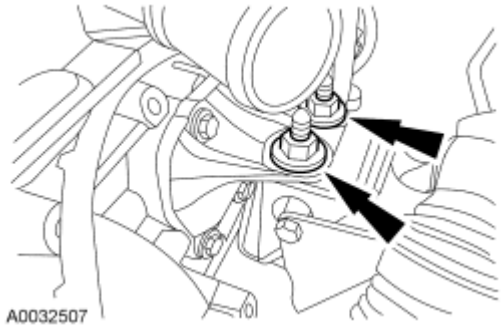


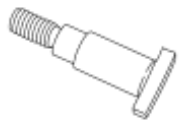
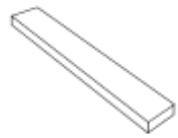
Fig. 147: Locating Engine Support Insulator Nuts
Courtesy of FORD MOTOR CO.

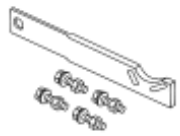
59. Remove the engine from the vehicle.

DISASSEMBLY

ENGINE

Special Tools

Illustration	Tool Name	Tool Number
 ST2639-A	Adapter for 205-126	205-072-02
 ST2599-A	Alignment Plate, Camshaft	303-465 (T94P-6256-CH)
 ST1910-A	Engine Stand	014-00232 or equivalent
	Holding Fixture, Drive Pinion Flange	205-126 (T78P-4851-A)

 ST2647-A		
 ST2768-A	Locking Tool, Flywheel	303-103 (T74P-8375-A)

CAUTION: Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if you loosen the pulley bolt. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special tools, otherwise severe engine damage may occur.

CAUTION: During engine repair procedures, cleanliness is extremely important. Foreign material, including any material created while cleaning gasket surfaces, may enter the cylinders, oil passages, coolant passages or the oil pan, and cause engine failure.

NOTE: Due to the precision fit and timing of the balancer shaft assembly, it cannot be removed from the engine block.

NOTE: For additional information, refer to the exploded views under the engine assembly procedure in this article.

Vehicles with manual transmission

CAUTION: If the clutch disc and pressure plate are to be reinstalled, bolts must be removed evenly or permanent damage to the diaphragm spring will occur, resulting in complete clutch release.

NOTE: If the parts are to be reused, index-mark the clutch pressure plate to the flywheel.

1. Remove the bolts, the clutch pressure plate and the clutch disc.

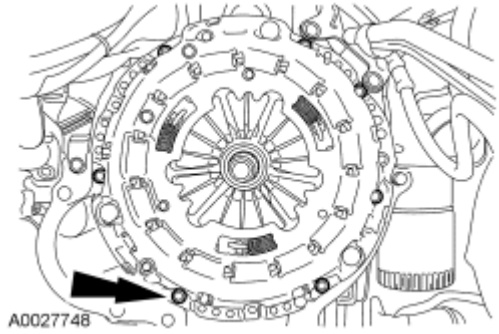


Fig. 148: Locating Clutch Pressure Plate Bolts
Courtesy of FORD MOTOR CO.

All vehicles

2. Using the special tool, remove the bolts and the flexplate.

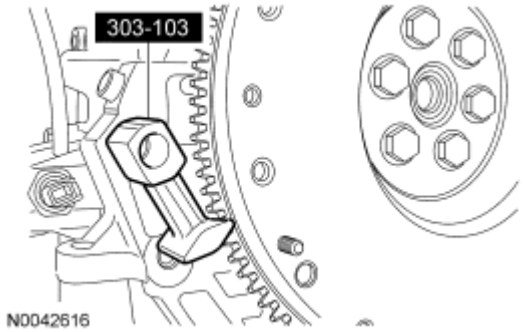


Fig. 149: Identifying Special Tool (303-103)
Courtesy of FORD MOTOR CO.

3. Mount the engine on a suitable engine stand.
4. Remove the drive belt.

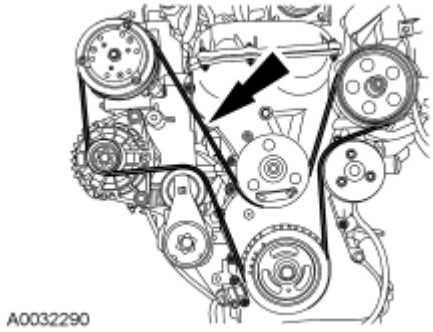


Fig. 150: Locating Drive Belt
Courtesy of FORD MOTOR CO.

5. Remove the engine oil level indicator, 2 bolts and the engine oil level indicator tube.

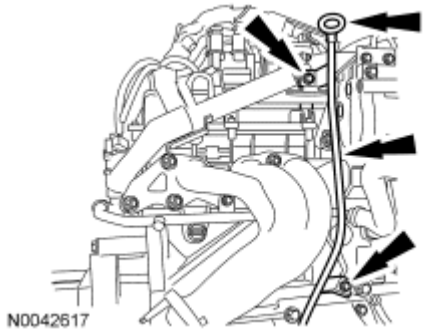


Fig. 151: Locating Engine Oil Level Indicator Tube & Bolt
Courtesy of FORD MOTOR CO.

6. Remove the 2 bolts and the front coolant outlet pipe.

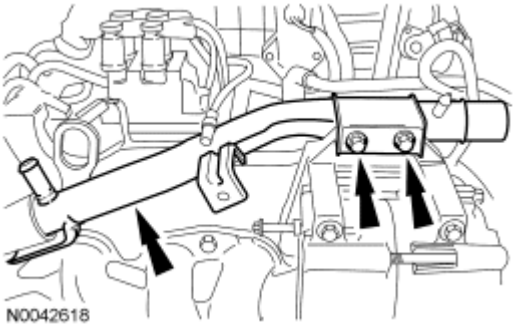


Fig. 152: Locating Bolts & Front Coolant Outlet Pipe
Courtesy of FORD MOTOR CO.

7. Remove the 4 bolts and the A/C compressor.

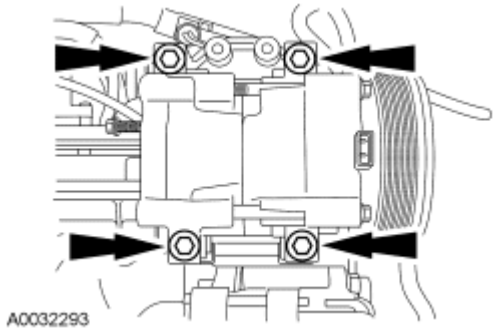


Fig. 153: Locating A/C Compressor Bolts
Courtesy of FORD MOTOR CO.

NOTE: The generator will be removed with the accessory bracket.

8. Remove the bolts and the accessory bracket and generator as an assembly.

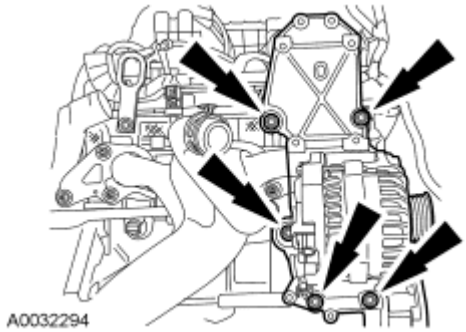


Fig. 154: Locating Accessory Bracket Bolts
Courtesy of FORD MOTOR CO.

9. Remove the 4 bolts and the RH engine mount bracket.

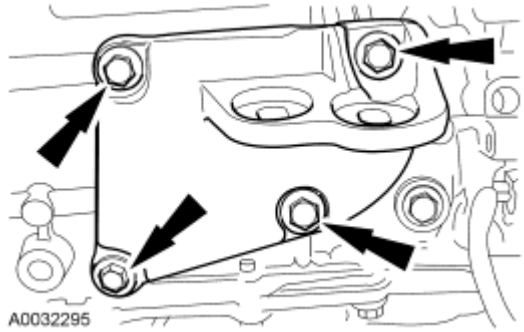


Fig. 155: Locating Bolts & RH Engine Mount Bracket
Courtesy of FORD MOTOR CO.

10. Disconnect the coolant hose assembly from the thermostat housing and the PCV fitting on the intake manifold.

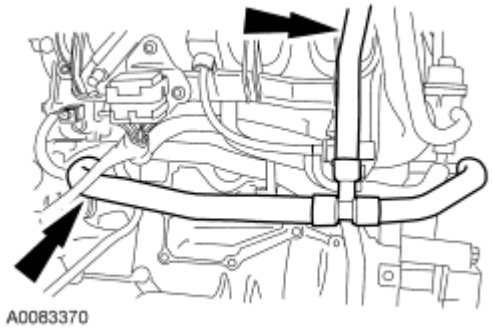


Fig. 156: Locating Positive Crankcase Ventilation (PCV) Fitting On Intake Manifold
Courtesy of FORD MOTOR CO.

11. Remove the 2 nuts and the coolant tube assembly.

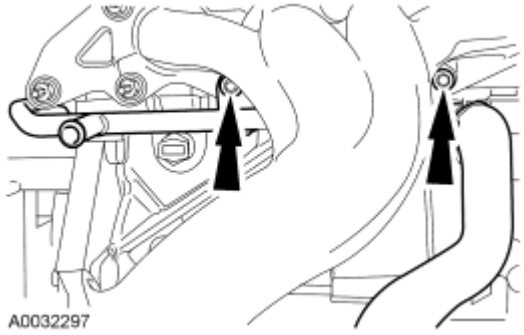


Fig. 157: Locating Coolant Tube Assembly & Nuts
Courtesy of FORD MOTOR CO.

12. Remove the 7 nuts, the exhaust manifold and gasket.
    - Discard the 7 nuts and the exhaust manifold gasket.

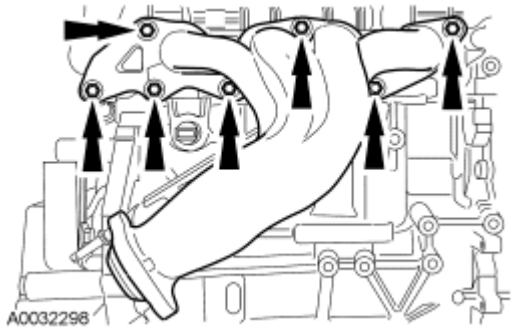


Fig. 158: Locating Exhaust Manifold Nuts & Gasket
Courtesy of FORD MOTOR CO.

13. Remove and discard the exhaust manifold-to-cylinder head studs.
14. Clean and inspect the exhaust manifold. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article.
15. If equipped, remove the block heater.

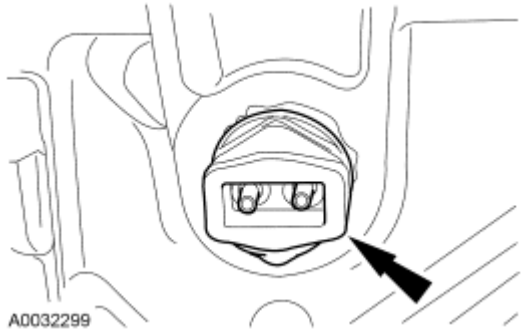


Fig. 159: Locating Block Heater
Courtesy of FORD MOTOR CO.

16. Remove the rear coolant outlet pipe.
    1. Disconnect the coolant hose.
    2. Remove the 4 bolts, the rear coolant outlet pipe and discard the gasket.

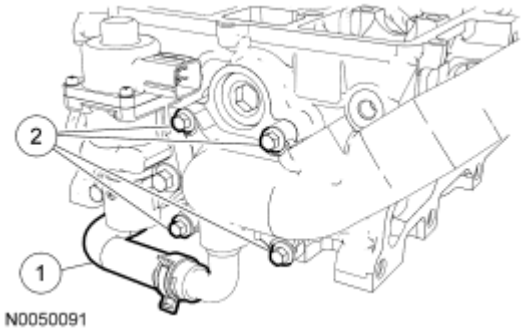


Fig. 160: Locating Bolts & Rear Coolant Outlet Pipe
Courtesy of FORD MOTOR CO.

17. Remove the EGR valve.
    1. Disconnect the electrical connector.
    2. Disconnect the coolant hose.
    3. Remove the 2 bolts, the EGR valve and discard the gasket.

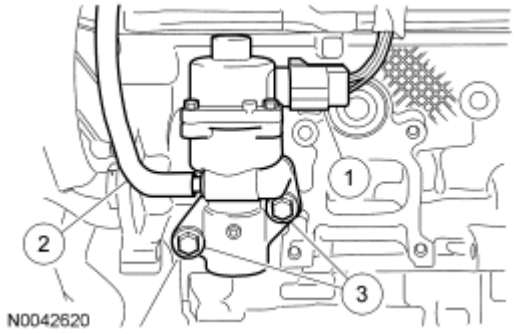


Fig. 161: Identifying Coolant Hose & Bolts
Courtesy of FORD MOTOR CO.

18. Remove the 4 bolts and the power steering pump.

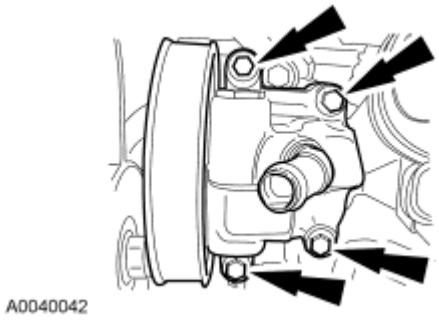


Fig. 162: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

19. Disconnect the idle air control (IAC) valve, the throttle position (TP) sensor and the manifold absolute pressure (MAP) sensor electrical connectors.

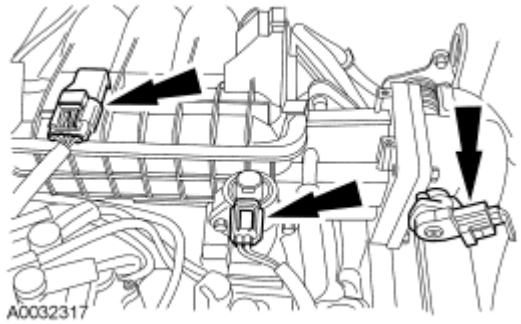


Fig. 163: Disconnecting Electrical Connectors (IAC, TP And MAP)
Courtesy of FORD MOTOR CO.

20. Disconnect the crankshaft position (CKP) sensor and the wiring harness pin-type retainers.

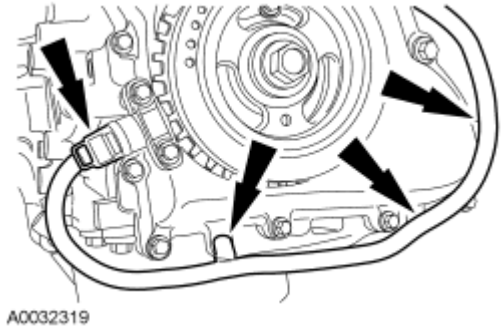


Fig. 164: Locating CKP Sensor Electrical Connection
Courtesy of FORD MOTOR CO.

21. Disconnect the knock sensor (KS) electrical connector, remove the 3 bolts and position the engine wiring harness and bracket aside.

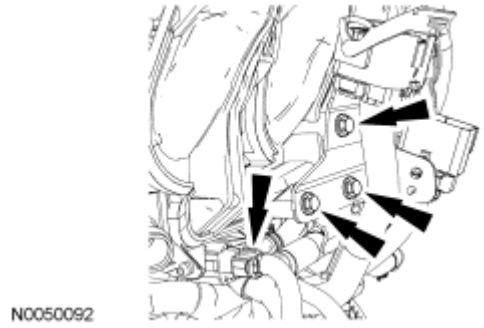


Fig. 165: Locating Bolts & Engine Wiring Harness
Courtesy of FORD MOTOR CO.

22. Disconnect the camshaft position (CMP) sensor electrical connector and the PCV hose.

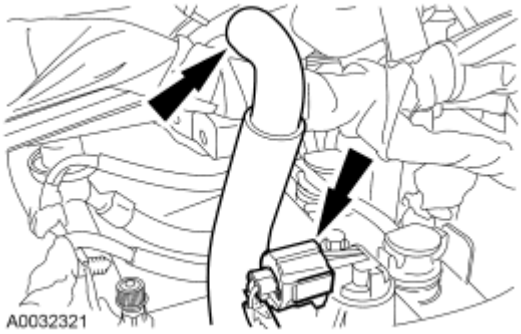


Fig. 166: Locating CMP Sensor Electrical Connector & PCV Hose
Courtesy of FORD MOTOR CO.

23. Disconnect the engine wiring harness pin-type retainers from the intake manifold.
24. Remove the 2 bolts and the EGR tube from the intake manifold.

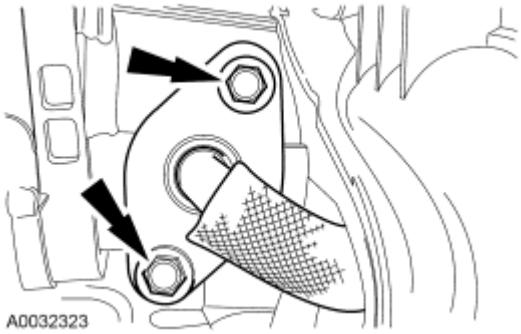


Fig. 167: Locating Intake Manifold EGR Tube Bolt
Courtesy of FORD MOTOR CO.

25. Remove the EGR tube.
    - Remove the EGR tube bracket from the intake manifold.
    - Disconnect the EGR tube from the cylinder head.

- Remove the EGR tube.

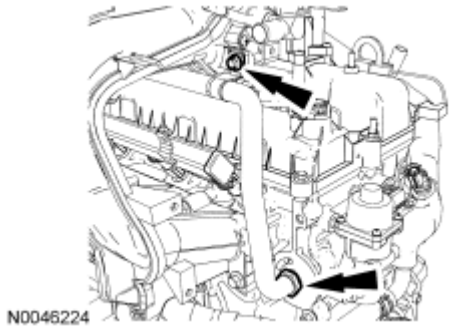


Fig. 168: Locating EGR Tube To Cylinder Head
Courtesy of FORD MOTOR CO.

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

26. Remove the 5 bolts and the intake manifold.
    - Clean and inspect the sealing surfaces with metal surface prep and silicone gasket remover. Follow the directions on the packaging.

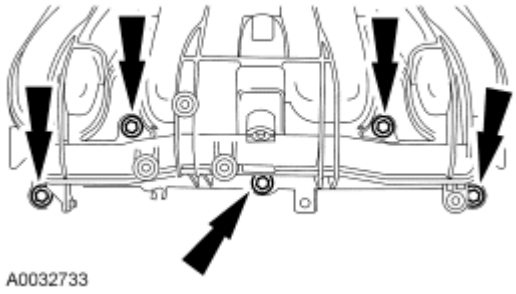


Fig. 169: Locating Intake Manifold Assembly Bolts
Courtesy of FORD MOTOR CO.

27. Disconnect the 4 fuel injector electrical connectors and the 2 wiring harness pin-type retainers.

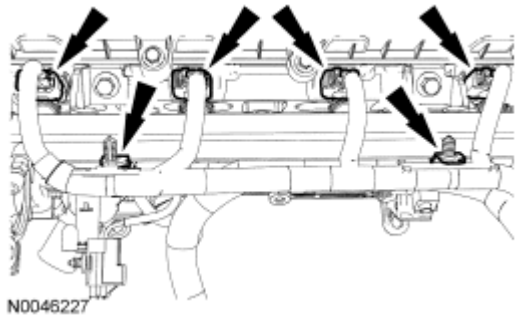


Fig. 170: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

28. Disconnect the ignition coil and the cylinder head temperature (CHT) sensor electrical connectors.

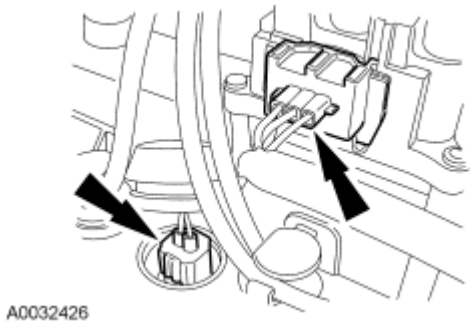


Fig. 171: Locating Ignition Coil & Cylinder Head Temperature (CHT) Sensor Electrical Connectors
Courtesy of FORD MOTOR CO.

29. Detach the engine wiring harness anchors from the valve cover studs. Remove the engine wiring harness.

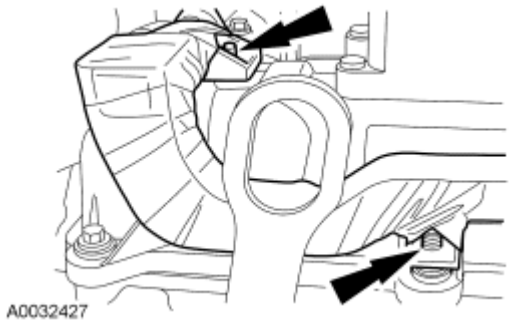


Fig. 172: Detaching Engine Wiring Harness Anchors From Valve Cover Studs
Courtesy of FORD MOTOR CO.

CAUTION: Spark plug wires must be connected correctly. Mark the spark plug wires before removing them. Failure to follow this instruction may result in poor engine performance.

CAUTION: It is important to twist the spark plug wire boots while pulling upward to avoid possible damage to the spark plug wires.

30. With a twisting motion, disconnect the spark plug wires from the spark plugs.
31. Remove the 4 bolts and the ignition coil.

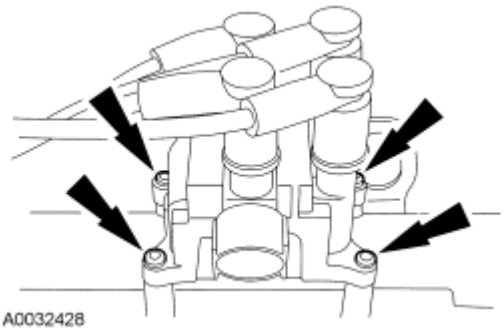


Fig. 173: Locating Ignition Coil Bolts
Courtesy of FORD MOTOR CO.

32. Remove the 3 bolts and the thermostat housing.

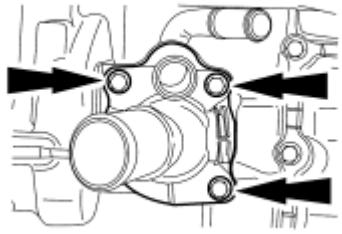


Fig. 174: Locating Thermostat Housing Bolts
Courtesy of FORD MOTOR CO.

33. Remove the bolts, the KS and the engine vent cover.

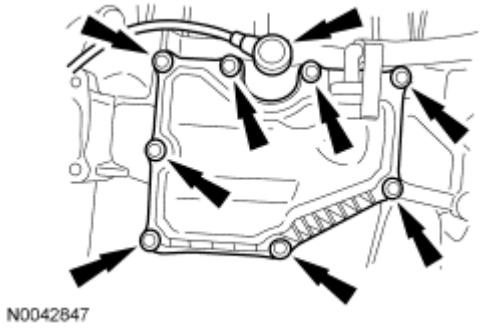


Fig. 175: Locating Engine Vent Cover & KS Bolts

Courtesy of FORD MOTOR CO.

34. Remove the 4 bolts and the LH engine mount bracket.

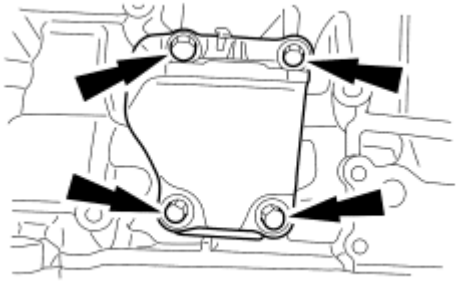


Fig. 176: Locating LH Engine Mount Bracket Bolts
Courtesy of FORD MOTOR CO.

35. Remove the bolts, fuel rail with the injectors and the ground strap.
    - Discard the fuel injector O-ring seals.

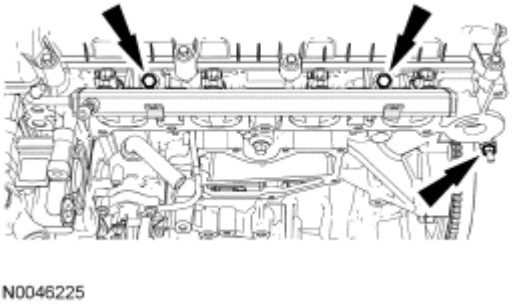


Fig. 177: Locating Fuel Rail Bolts
Courtesy of FORD MOTOR CO.

36. Remove the 3 bolts and the water pump pulley.

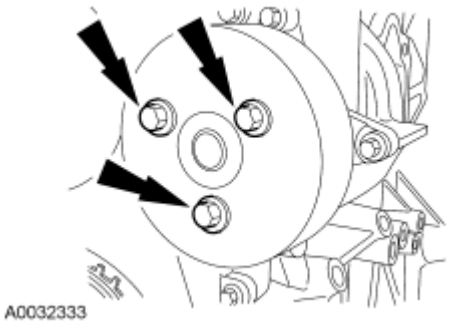


Fig. 178: Locating Coolant Pump Pulley Bolts
Courtesy of FORD MOTOR CO.

37. Remove the 3 bolts and the water pump.
    - Discard the O-ring seal.

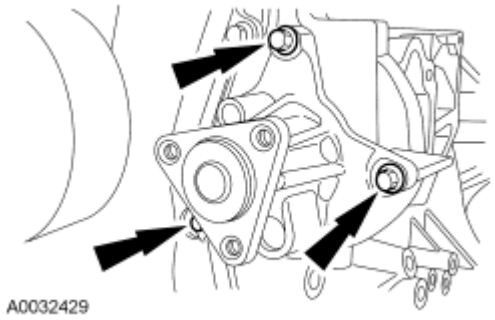


Fig. 179: Locating Coolant Pump Bolts
Courtesy of FORD MOTOR CO.

38. Remove the CMP sensor, CHT sensor and the spark plugs.

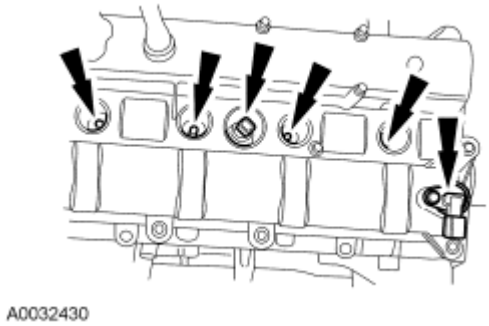


Fig. 180: Locating CMP Sensor, CHT Sensor & Spark Plugs
Courtesy of FORD MOTOR CO.

39. Remove the fasteners and the valve cover.

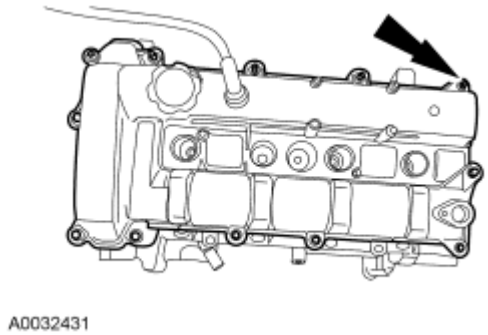


Fig. 181: Locating Valve Cover Fasteners
Courtesy of FORD MOTOR CO.

40. Remove the 2 bolts and discard the CKP sensor.

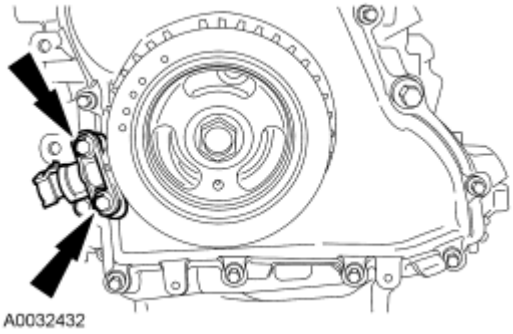


Fig. 182: Locating CKP Sensor Bolts
Courtesy of FORD MOTOR CO.

CAUTION: Do not loosen or remove the crankshaft pulley bolt without first installing the special tools as instructed in this procedure. The crankshaft pulley and the crankshaft timing sprocket are not keyed to the crankshaft. The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if you loosen the pulley bolt. Before any repair requiring loosening or removal of the crankshaft pulley bolt, the crankshaft and camshafts must be locked in place by the special tools, otherwise severe engine damage may occur.

CAUTION: Failure to position the No. 1 piston at top dead center (TDC) may result in damage to the engine.

CAUTION: Turn the crankshaft in the normal direction of rotation only, or the engine may be damaged.

41. Using the crankshaft pulley bolt, turn the crankshaft clockwise to position the No. 1 piston at top dead center (TDC).

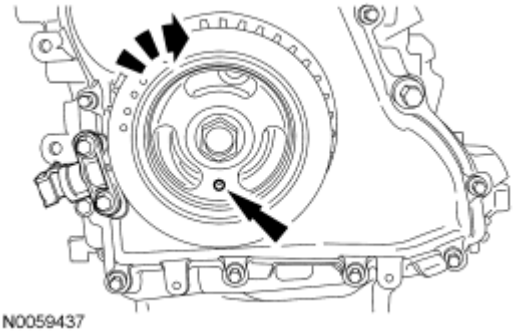


Fig. 183: Turning Crankshaft Clockwise
Courtesy of FORD MOTOR CO.

CAUTION: The special tool 303-465 is for camshaft alignment only. Using this tool to prevent engine rotation may result in engine damage.

NOTE: The camshaft timing slots are offset. If the special tool cannot be installed, rotate the crankshaft one complete revolution clockwise to correctly position the camshafts.

42. Install the special tool in the slots on the rear of both camshafts.

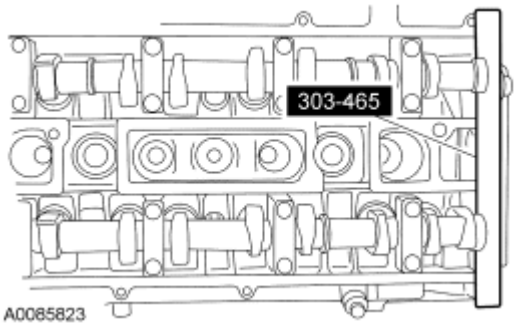


Fig. 184: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

43. Assemble the special tools using 4 hardened washers in the locations shown in illustration.

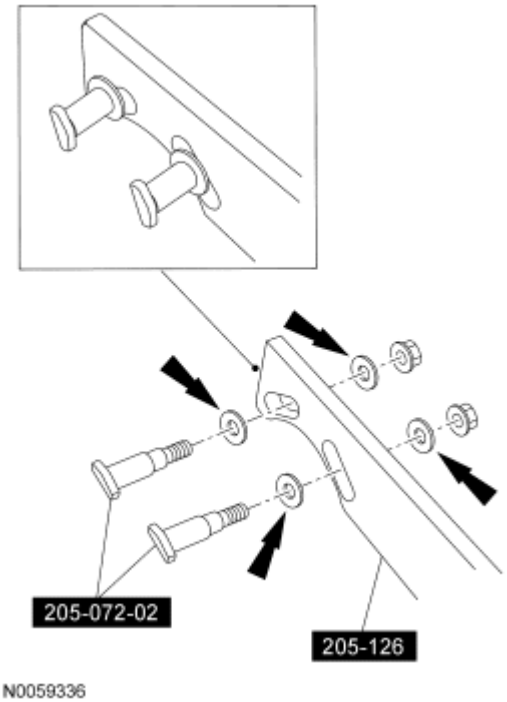


Fig. 185: Assembling Special Tools (205-126 And 205-072-02)
Courtesy of FORD MOTOR CO.

CAUTION: The crankshaft must remain in the top dead center (TDC) position during removal of the pulley bolt or damage to the engine may occur. Therefore, the crankshaft pulley must be held in place with the special tool and the bolt should be removed using an air impact wrench (1/2-in drive minimum).

CAUTION: The crankshaft sprocket diamond washer may come off with the crankshaft pulley. The diamond washer must be replaced; remove and discard the diamond washer. If the diamond washer is not installed, engine damage may occur.

44. Using the special tools and an air impact wrench, remove the crankshaft pulley.
    - Remove and discard the crankshaft pulley bolt and washer.
    - Remove the crankshaft pulley.
    - Remove the diamond washer and discard.

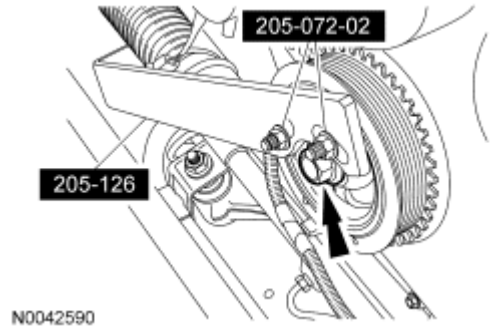


Fig. 186: Identifying Special Tools (205-072-02, 205-126) And Crankshaft Pulley Bolt
Courtesy of FORD MOTOR CO.

NOTE: There is one front cover bolt behind the cooling fan drive pulley. To remove this bolt, align one of the cooling fan drive pulley access holes with the bolt head.

45. Remove the front cover.

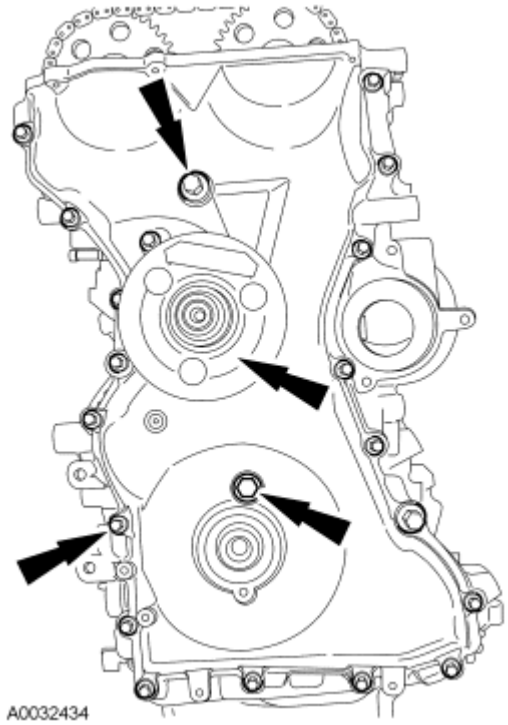


Fig. 187: Locating Front Cover Bolts
Courtesy of FORD MOTOR CO.

46. Compress the timing chain tensioner, and insert a paper clip into the hole. Remove the 2 bolts and the timing chain tensioner.

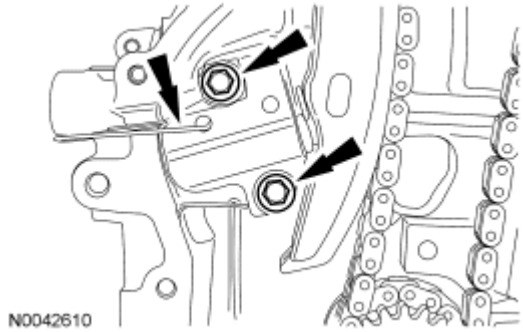


Fig. 188: Locating Timing Chain Tensioner & Bolts
Courtesy of FORD MOTOR CO.

47. Remove the RH timing chain guide.

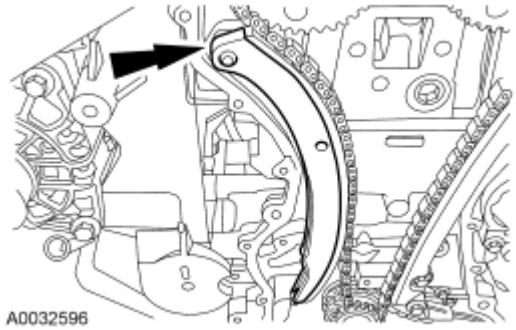


Fig. 189: Locating RH Timing Chain Guide
Courtesy of FORD MOTOR CO.

48. Remove the timing chain.

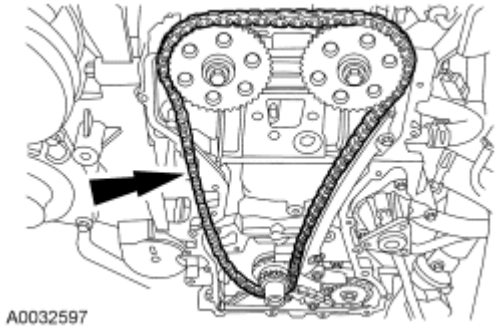


Fig. 190: View Of Timing Chain
Courtesy of FORD MOTOR CO.

49. Remove the 2 bolts and the LH timing chain guide.

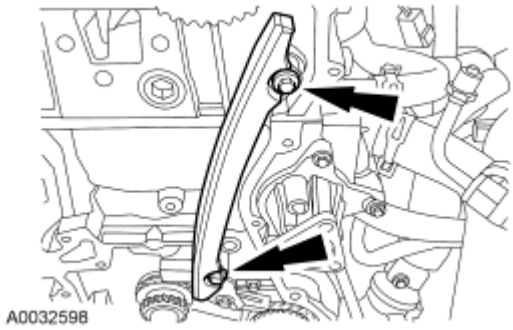


Fig. 191: Identifying Bolts And LH Timing Chain Guide
Courtesy of FORD MOTOR CO.

CAUTION: Do not rely on the Camshaft Alignment Plate to prevent camshaft rotation. Damage to the tool or the camshaft may occur.

NOTE: Use a wrench on the flats between cylinders No. 1 and No. 2 to hold the

camshaft in place.

50. Remove the bolts, washers and camshaft drive sprockets.

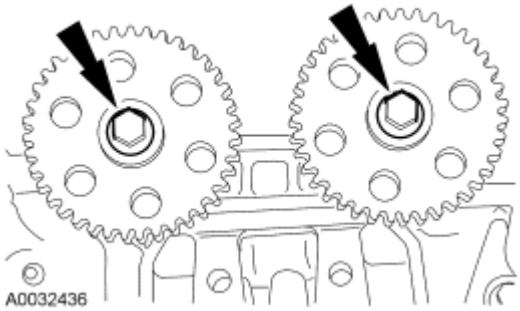


Fig. 192: Locating Camshaft Sprockets & Bolts
Courtesy of FORD MOTOR CO.

51. Remove the oil pump chain drive tensioner.
    1. Release the tension on the tensioner spring.
    2. Remove the 2 shoulder bolts and the tensioner.

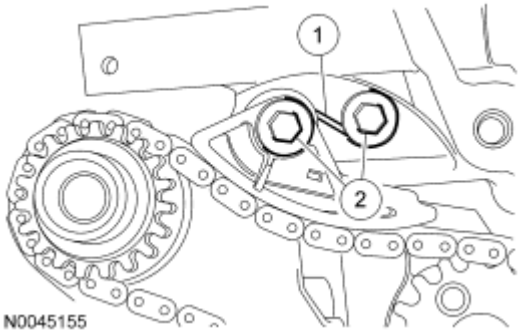


Fig. 193: Locating Shoulder Bolts & Tensioner
Courtesy of FORD MOTOR CO.

NOTE: Remove and discard the crankshaft sprocket diamond washer located behind the crankshaft sprocket.

NOTE: The oil pump chain sprocket must be held in place.

52. Remove the bolt, the chain, sprockets and diamond washers.

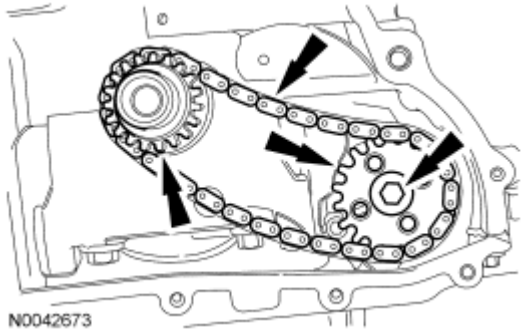


Fig. 194: Locating Bolt, Chain, Sprockets & Diamond Washers
Courtesy of FORD MOTOR CO.

53. Remove the special tool.

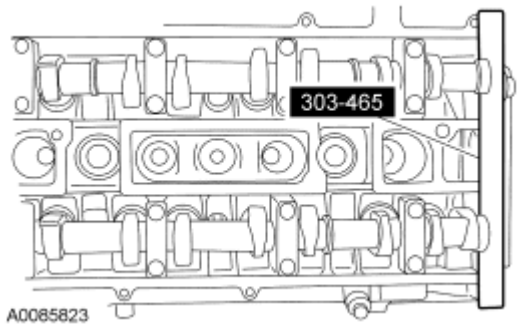


Fig. 195: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

CAUTION: Failure to follow the camshaft loosening procedure may result in damage to the camshafts.

NOTE: Mark the location and orientation of each camshaft bearing cap.

NOTE: Note the position of the lobes on the No. 1 cylinder before removing the camshafts for assembly reference.

54. Remove the camshaft bearing caps.
    - Loosen the camshaft bearing cap bolts in sequence shown in illustration, one turn at a time.
    - Repeat the first step until all tension is released from the camshaft bearing caps.
    - Remove the camshaft bearing caps.

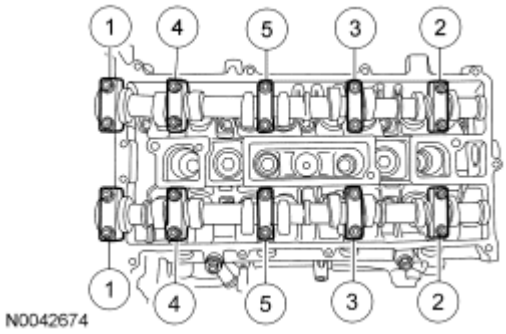


Fig. 196: Identifying Sequence Of Camshaft Bearing Caps
Courtesy of FORD MOTOR CO.

55. Remove the camshafts.

CAUTION: The cylinder head must be cool before removing it from the engine. Cylinder head warpage may result if a warm or hot cylinder head is removed.

CAUTION: Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Foreign material, including any material created while cleaning gasket surfaces, may enter the cylinders, oil passages, coolant passages or the oil pan, and cause engine failure.

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

CAUTION: Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface, or the cylinder head may be damaged.

NOTE: The cylinder head bolts must be discarded and new bolts must be installed. They are tighten-to-yield designed and cannot be reused.

56. Remove the bolts and the cylinder head.
    - Discard the cylinder head bolts.

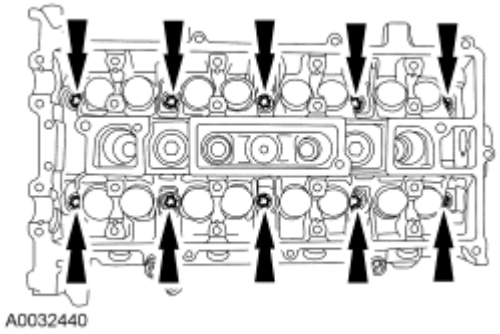


Fig. 197: Locating Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

57. Remove and discard the cylinder head gasket.
58. Remove the cylinder head alignment dowels.

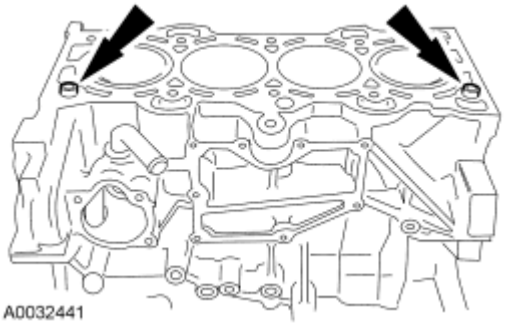


Fig. 198: Identifying Cylinder Head Alignment Dowels
Courtesy of FORD MOTOR CO.

59. Remove the bolts and the oil pan.

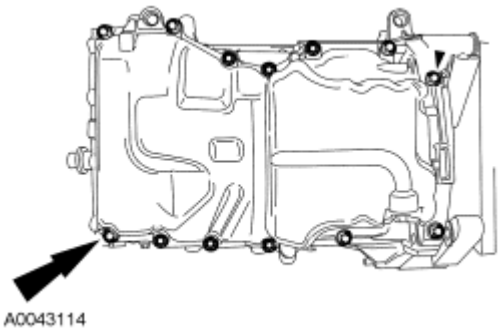


Fig. 199: Locating Oil Pan Bolts
Courtesy of FORD MOTOR CO.

60. Remove the bolts and the rear crankshaft seal and retainer plate.
    - Discard the crankshaft rear seal and retainer plate assembly.

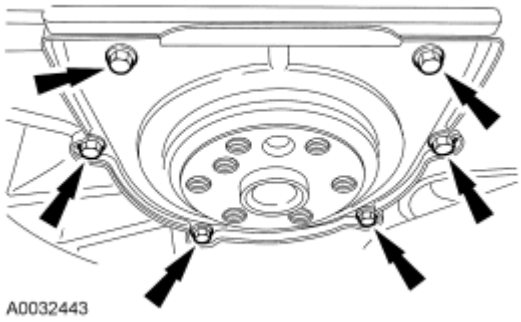


Fig. 200: Locating Rear Crankshaft Seal Bolts
Courtesy of FORD MOTOR CO.

61. Remove the bolts, the oil pump pickup tube and discard the gasket.

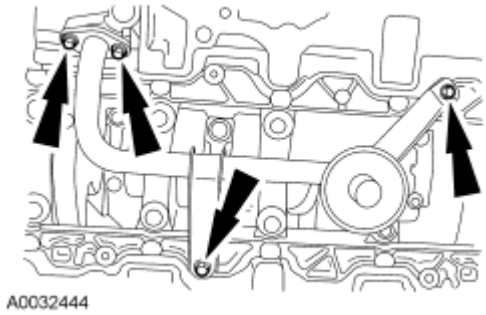


Fig. 201: Locating Oil Pump Screen & Pickup Tube Bolts
Courtesy of FORD MOTOR CO.

62. Remove the 4 bolts and the oil pump assembly.
    - Discard the gasket.

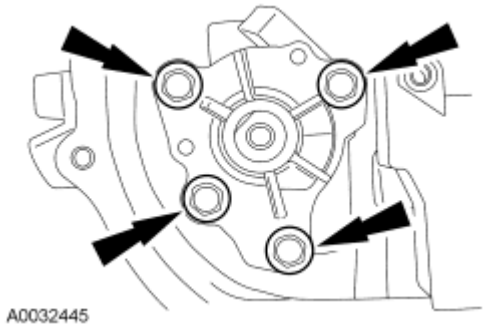
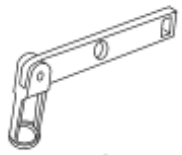
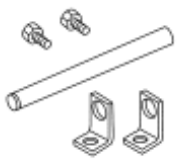


Fig. 202: Locating Oil Pump Assembly & Bolts
Courtesy of FORD MOTOR CO.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

CYLINDER HEAD

Special Tools

Illustration	Tool Name	Tool Number
 ST1902-A	Compressor, Valve Spring	303-472 (T94P-6565-AH)
 ST1187-A	Impact Hammer	307-005 (T59L-100-B)
 ST1907-A	Valve Spring Compressor	303-350 (T89P-6565-A)
 ST1909-A	Valve Spring Compressor Set	303-300 (T87C-6565-A)
 ST1904-A	Valve Stem Seal Remover	303-468 (T94P-6510-AH)
 ST1906-A	Valve Stem Seal Replacer	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

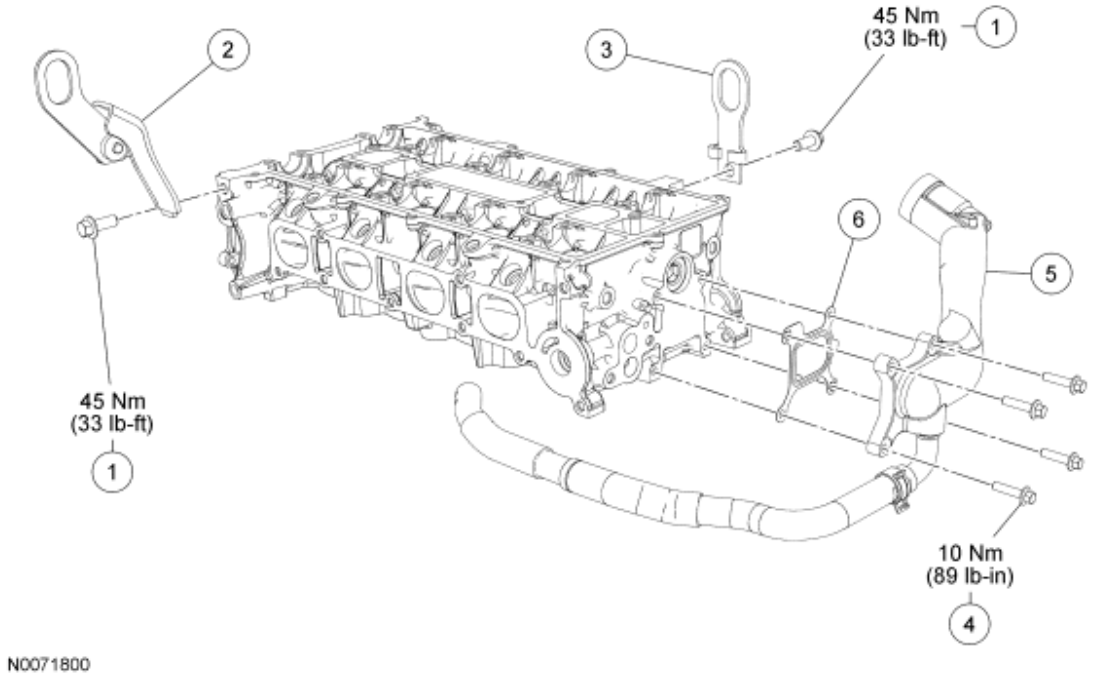


Fig. 203: Exploded View Of Cylinder Head - Coolant Connection and Lifting Eyes With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	W500033	Engine lifting eye bolts (2 required)
2	17K077	Front engine lifting eye
3	17K004	Rear engine lifting eye
4	W500015	Coolant outlet pipe bolt (4 required)
5	9B321	Coolant outlet pipe
6	8255	Coolant outlet pipe gasket

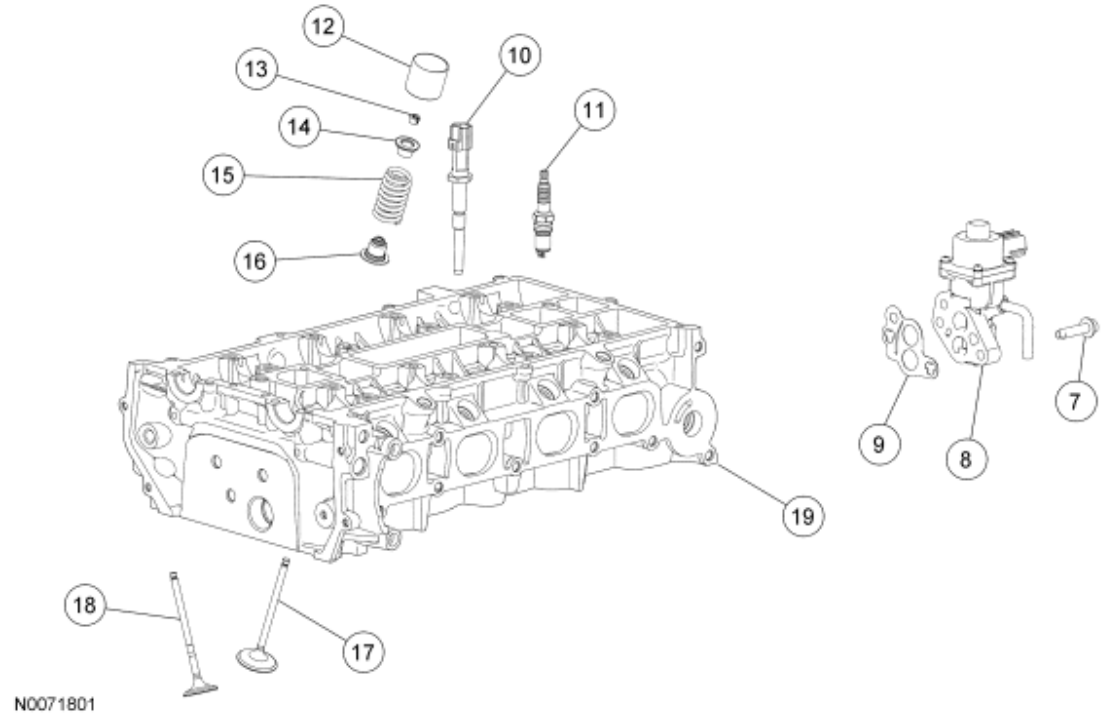


Fig. 204: Exploded View Of Cylinder Head - EGR Valve, Spark Plugs, Cylinder Head Temperature (CHT) Sensor and Valves
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
7	W500225	EGR valve bolt (2 required)
8	9D475	EGR valve
9	9D476	EGR valve gasket
10	6G004	Cylinder head temperature (CHT) sensor
11	12405	Spark plug (4 required)
12	6500	Valve tappet (16 required)
13	6518	Valve spring retainer key (16 required)
14	6514	Valve spring retainer (16 required)
15	6513	Valve spring (16 required)
16	6517	Valve seal (16 required)
17	6505	Intake valve (8 required)
18	6507	Exhaust valve (8 required)
19	6049	Cylinder head

DISASSEMBLY

1. Remove the bolts and the engine lifting eyes.
2. Remove the cylinder head temperature (CHT) sensor.
3. Remove the 4 bolts and the coolant outlet pipe.

- Discard the gasket.

4. Remove the 2 bolts and the EGR valve.
   - Discard the EGR valve gasket.
5. Remove and discard the 4 spark plugs.

NOTE: Note location of the tappets prior to removal.

6. Remove the 16 valve tappets.
7. Using the special tools, compress the valve spring and remove the valve spring retainer keys, the valve spring retainers and the valve springs.
   - Remove the special tools.

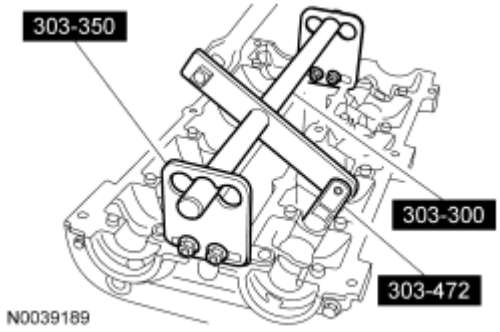


Fig. 205: Compressing Valve Spring Using Special Tools (303-300, 303-350, 303-472)
Courtesy of FORD MOTOR CO.

8. Inspect the valve spring, valve spring retainer and valve spring retainer key. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article. Install new parts as necessary.

NOTE: Note the location of the valves if they are to be reused.

NOTE: Mark each valve if the original valves are to be used.

9. Remove the valves.
10. Using the special tools, remove and discard the valve stem seals.

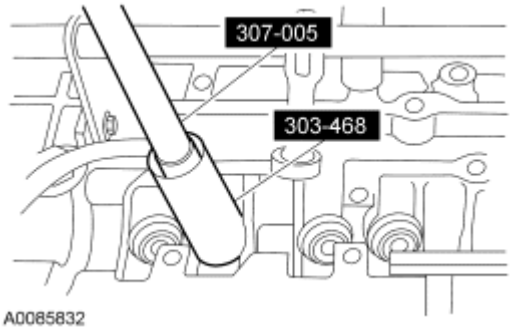


Fig. 206: Removing Valve Seal Using Special Tools (307-005, 303-468)
Courtesy of FORD MOTOR CO.

11. Inspect the valves. For additional information, refer to **ENGINE SYSTEM - GENERAL INFORMATION** article. Install new parts as necessary.

ASSEMBLY

NOTE: If installing the original valves, make sure the valves are installed in the same position from which they were removed. Coat the valve stems with clean engine oil prior to installation.

1. Install the valves.

NOTE: Use the protector provided with the replacement kit to prevent damage to the valve seals.

2. Lubricate the valve stems and guides with clean engine oil and, using the special tool, install the valve seals onto the cylinder head valve guides.

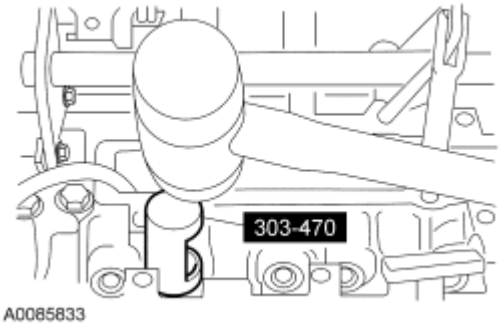


Fig. 207: Installing Valve Seal Using Special Tool (303-470)
Courtesy of FORD MOTOR CO.

3. Place the valve spring in position over the valve and install the valve spring retainer.
4. Using the special tools, compress the valve spring and install the valve spring retainer keys.

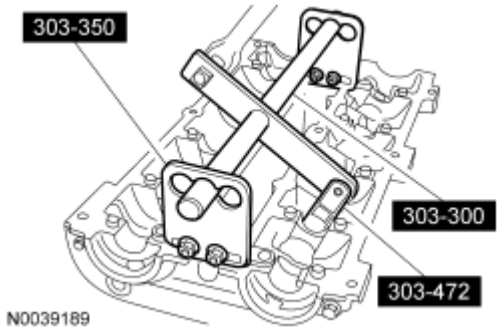


Fig. 208: Compressing Valve Spring Using Special Tools (303-300, 303-350, 303-472)

Courtesy of FORD MOTOR CO.

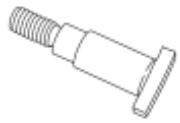
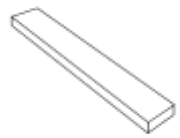
NOTE: Be sure to install the tappets in the same location as they were removed from.

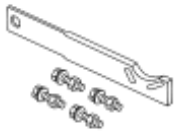
5. Install the 16 valve tappets.
6. Install the CHT sensor.
   - Tighten to 12 Nm (9 lb-ft).
7. Install 4 new spark plugs.
   - Tighten to 15 Nm (11 lb-ft).
8. Using a new gasket, install the EGR valve and the 2 bolts.
   - Tighten to 20 Nm (15 lb-ft).
9. Using a new gasket, install the coolant outlet pipe and the 4 bolts.
   - Tighten to 10 Nm (89 lb-in).
10. Install the engine lifting eyes and the bolts.
    - Tighten to 45 Nm (33 lb-ft).

ASSEMBLY

ENGINE

Special Tools

Illustration	Tool Name	Tool Number
 ST2639-A	Adapter for 205-126	(205-072-02)
 ST1751-A	Aligner, Clutch Disc	308-006 (T71P-7137-H)
 ST2599-A	Alignment Plate, Camshaft	303-465 (T94P-6256-CH)
	Engine Stand	014-0232 or equivalent

 ST1910-A		
 ST1341-A	Heavy-Duty Floor Crane	014-00071 or equivalent
 ST2647-A	Holding Fixture, Drive Pinion Flange	205-126 (T78P-4851-A)
 ST1506-A	Installer, Crankshaft Rear Main Oil Seal	303-328 (T88P-6701-B1)
 ST2768-A	Locking Tool, Flywheel	303-103 (T74P-8375-A
 ST1602-A	Spreader Bar	303-D089 (D93P-6001-A3) or equivalent
 ST2638-A	Timing Peg, Crankshaft	303-507

Material

Item	Specification
High Temperature 4x4 Front Axle and Wheel Bearing Grease E8TZ-19590-A	ESA-M1C198-A
Motorcraft Metal Surface Prep	

ZC-31	-
Motorcraft Premium Gold Engine Coolant with Bittering Agent (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 or equivalent	WSE-M4G323-A4
Silicone Gasket Remover ZC-30	-

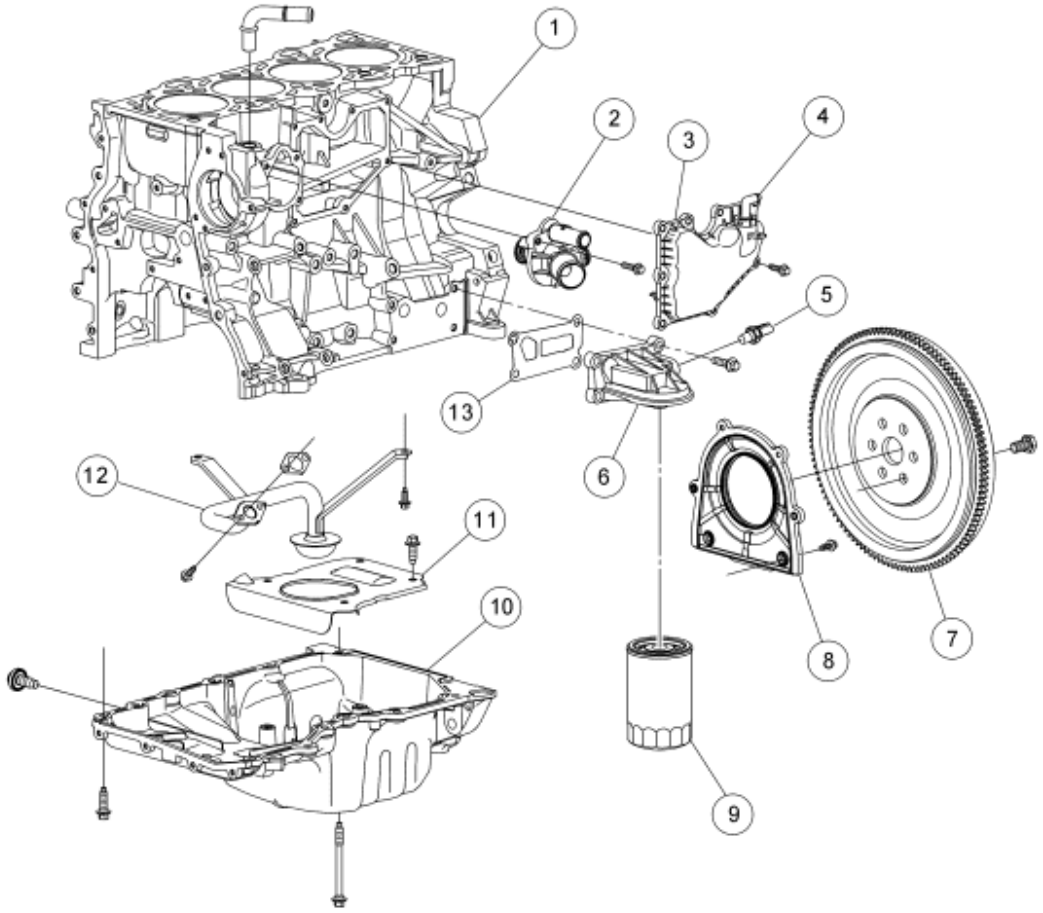


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Fig. 209: Exploded View Of Engine - Lower Engine Block
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6010	Cylinder block
2	8575	Water thermostat assembly
3	6A785	Crankcase vent oil separator
4	6A666	PCV valve
5	9278	Oil pressure sensor
6	6881	Oil filter adapter
7	6375	Flywheel
8	6K301	Crankshaft rear oil seal and retainer
9	6731	Oil filter
10	6675	Oil pan

11	6687	Oil pan baffle
12	6622	Oil pump screen and pickup tube
13	6840	Oil filter adapter gasket

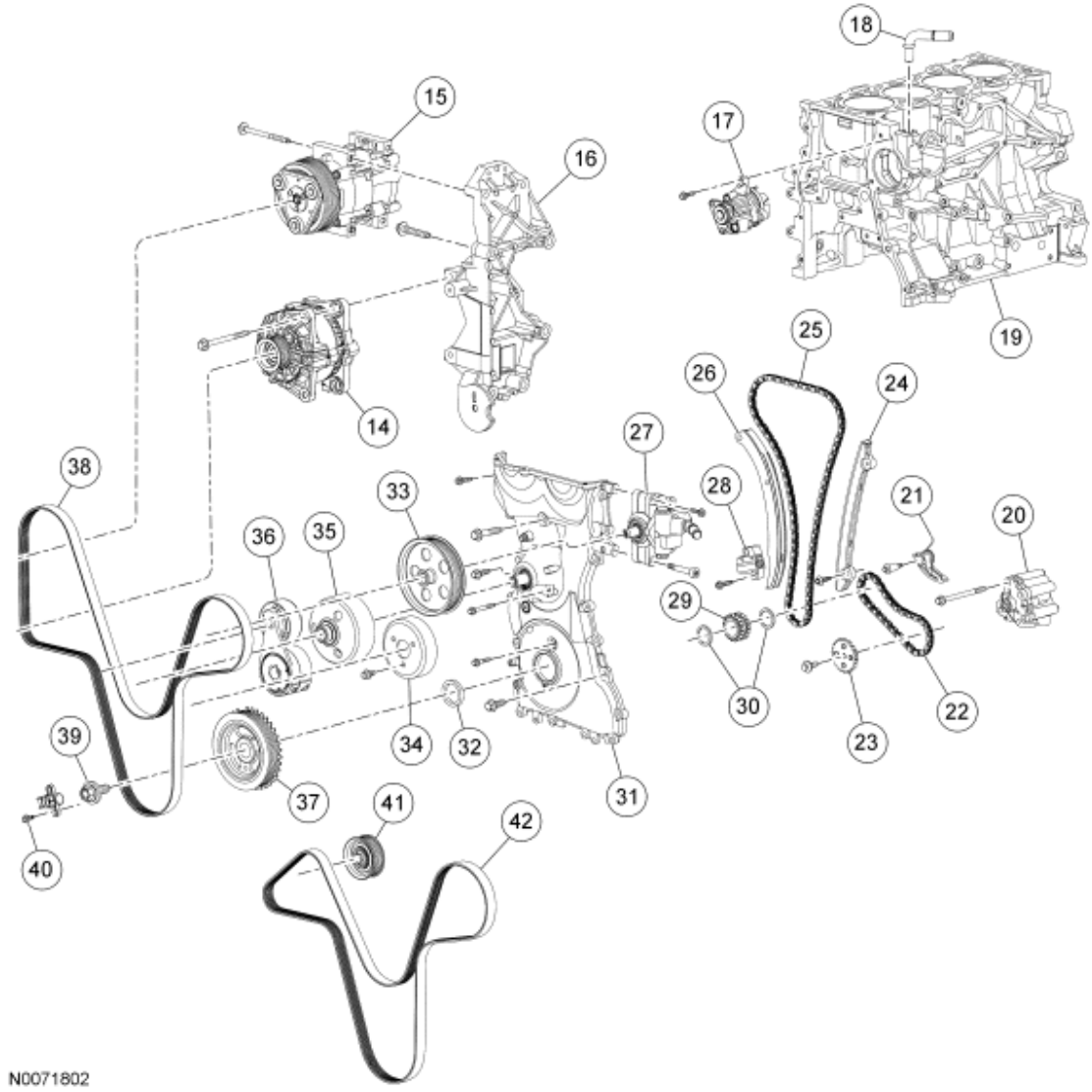

Fig. 210: Exploded View Of Engine - Front Engine Block
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
14	10300	Generator
15	19D629	A/C compressor
16	19E708	Front end accessory drive (FEAD) mounting bracket
17	8501	Water pump
18	8597	Water bypass tube

19	6010	Cylinder block
20	6600	Oil pump
21	6C271	Oil pump chain tensioner
22	6A895	Oil pump chain
23	6652	Oil pump drive gear
24	6K297	Timing chain guide
25	6268	Timing chain
26	-	Timing chain tensioner arm
27	3A674	Power steering pump
28	6K254	Timing chain tensioner
29	6306	Crankshaft sprocket
30	6378	Diamond washers (2 required)
31	6019	Engine front cover
32	6700	Crankshaft front oil seal
33	3A733	Power steering pump pulley
34	8509	Water pump pulley
35	8610	Fan drive pulley
36	6B209	Drive belt tensioner
37	6316	Crankshaft damper
38	8620	Accessory drive belt (with A/C)
39	6A340	Crankshaft pulley bolt
40	6C315	Crankshaft position sensor
41	6C348	Drive belt pulley idler (without A/C)
42	8620	Accessory drive belt (without A/C)

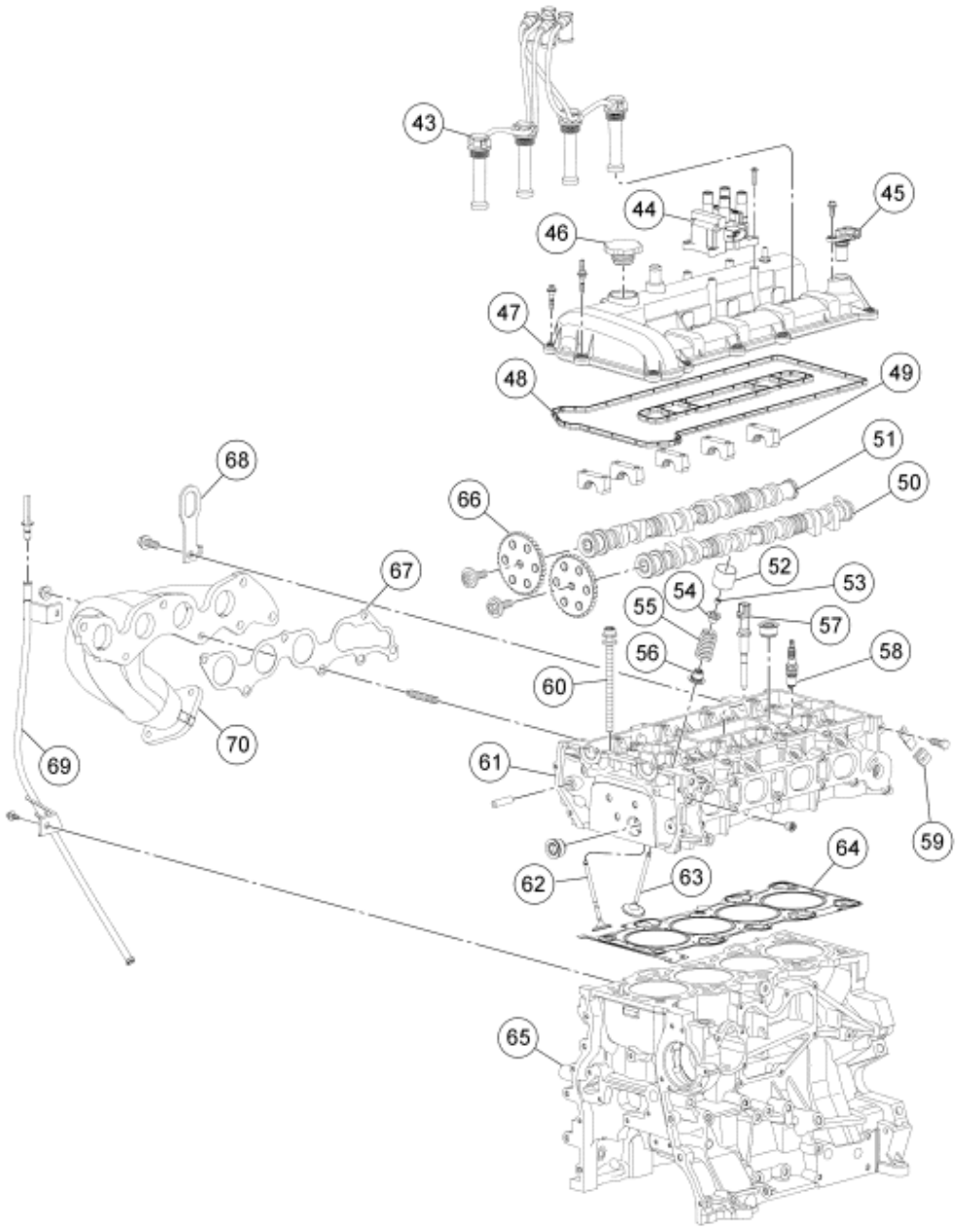

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Fig. 211: Exploded View Of Engine - Cylinder Head
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
43	12281	Spark plug wire set
44	12029	Ignition coil
45	6B288	Camshaft position sensor

46	6766	Oil filler cap
47	6582	Valve cover
48	-	Valve cover gasket
48	-	Camshaft bearing cap
50	6250	Camshaft (intake)
51	6250	Camshaft (exhaust)
52	6500	Valve tappet (16 required)
53	6518	Valve spring retainer key (16 required)
54	6514	Valve spring retainer (16 required)
55	6513	Valve spring (16 required)
56	6571	Valve stem seal (16 required)
57	-	Cylinder head temperature (CHT) sensor
58	12405	Spark plug (4 required)
59	18801	Radio noise suppressor
60	6065	Cylinder head bolt (10 required)
61	6049	Cylinder head
62	6505	Exhaust valve (8 required)
63	6507	Intake valve (8 required)
64	6051	Head gasket
65	6010	Cylinder block
66	6256	Camshaft sprocket (2 required)
67	9448	Exhaust manifold gasket
68	17K004	Engine lifting eye
69	6754	Oil level indicator tube assembly
70	9430	Exhaust manifold

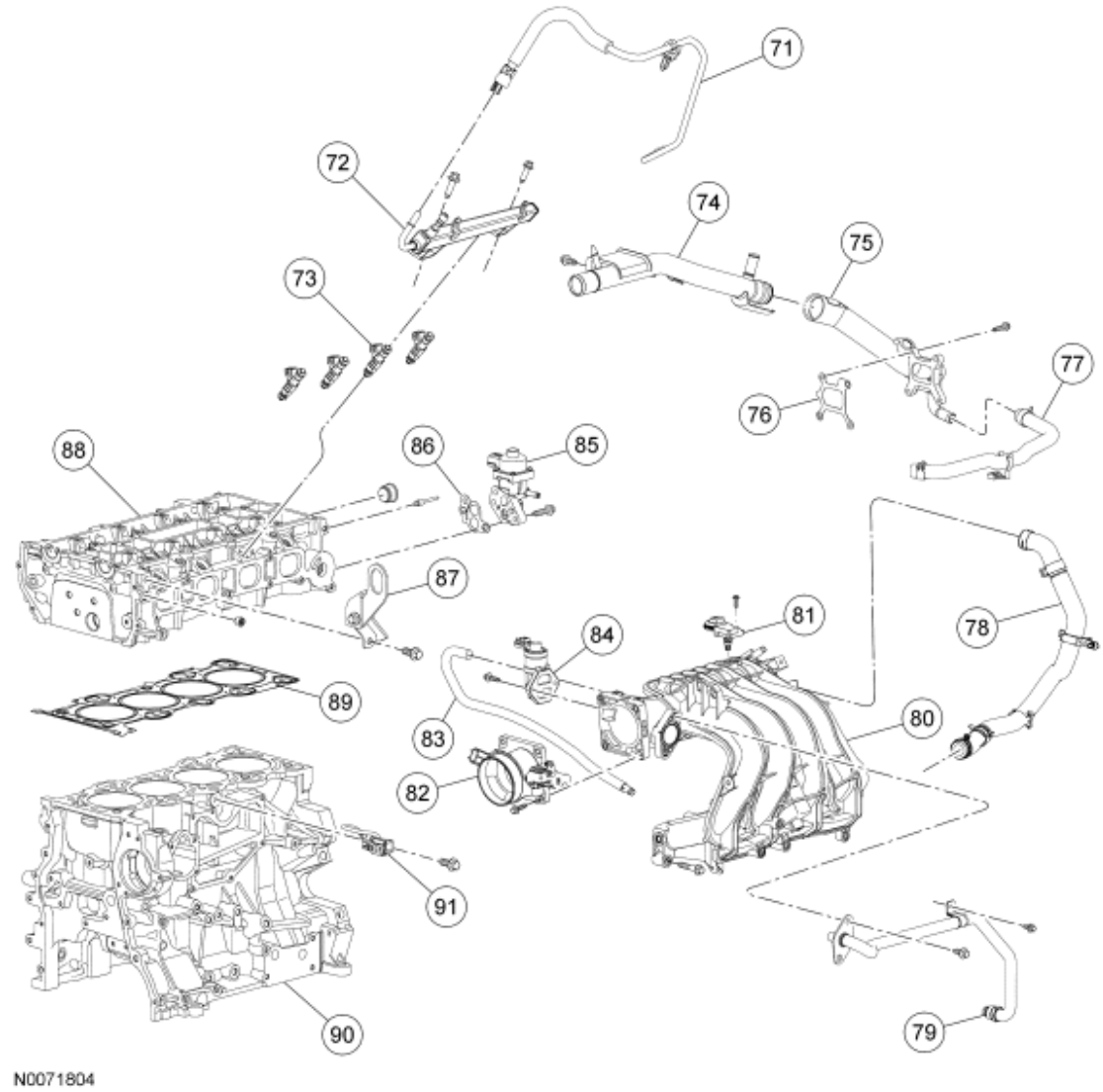


Fig. 212: Exploded View Of Engine - Intake Manifold
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
71	-	High pressure fuel line (supply)
72	9D280	Fuel rail
73	9F593	Fuel injector (4 required)
74	-	Water outlet adapter assembly (front)
75	-	Water outlet adapter assembly (rear)
76	8255	Water outlet connector gasket
77	8A852	Water bypass hose and clamp assembly
78	6758	Crankcase ventilation tube
79	9E470	EGR valve-to-exhaust manifold tube
80	9424	Intake manifold

81	9F479	Manifold absolute pressure (MAP) sensor
82	9E926	Throttle body assembly
83	9G297	Evaporative emission hose
84	9F715	Idle air control valve assembly
85	9D475	EGR valve
86	9D476	EGR valve mounting gasket
87	17K004	Engine lifting eye
88	6049	Cylinder head
89	6051	Cylinder head gasket
90	6010	Cylinder block
91	12A699	Knock sensor

CAUTION: During engine repair procedures, cleanliness is extremely important. Foreign material, including any material created while cleaning gasket surfaces may enter the cylinders, oil passages, coolant passages or the oil pan, and cause engine failure.

CAUTION: The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, using diamond washers between the flange faces on each part. For that reason, the crankshaft sprocket is also unfastened if you loosen the pulley. Therefore, the engine must be retimed each time the damper is removed. Otherwise severe engine damage may occur.

All vehicles

CAUTION: Failure to position the No. 1 piston at top dead center (TDC) may result in damage to the engine.

CAUTION: Turn the crankshaft in the normal direction of rotation only, or the engine may be damaged

1. Using the crankshaft pulley bolt, turn the crankshaft clockwise to position the No. 1 piston at top dead center (TDC).
2. Remove the plug bolt.

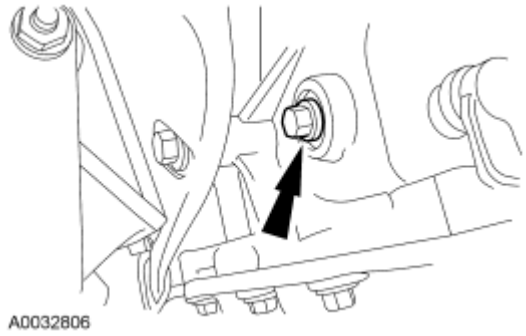


Fig. 213: Locating Engine Plug Bolt
Courtesy of FORD MOTOR CO.

NOTE: The special tool will contact the crankshaft and prevent it from turning past TDC. However, the crankshaft can still be rotated in the counterclockwise direction. The crankshaft must remain in the TDC position during the crankshaft pulley removal and installation.

3. Install the special tool.

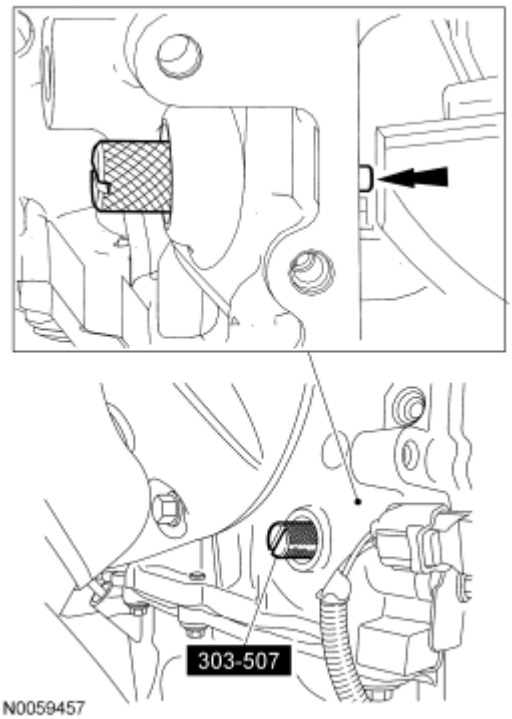


Fig. 214: Identifying Special Tool (303-507)
Courtesy of FORD MOTOR CO.

NOTE: Clean the sealing surface with metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the metal surface prep.

4. Position the oil pump assembly and tighten the bolts in the sequence shown in illustration, in 2 stages.
   - Stage 1: Tighten to 10 Nm (89 lb-in).
   - Stage 2: Tighten to 20 Nm (15 lb-ft).

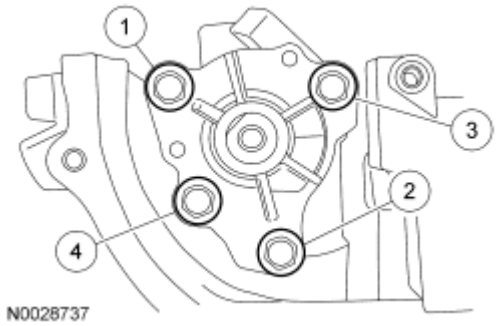


Fig. 215: Identifying Tightening Sequence Of Oil Pump Assembly Bolts
Courtesy of FORD MOTOR CO.

NOTE: Clean the sealing surface with metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the metal surface prep.

5. Position a new oil pump pickup tube gasket and the pickup tube, and tighten the 4 bolts in the sequence shown in illustration.
   - Tighten to 10 Nm (89 lb-in).

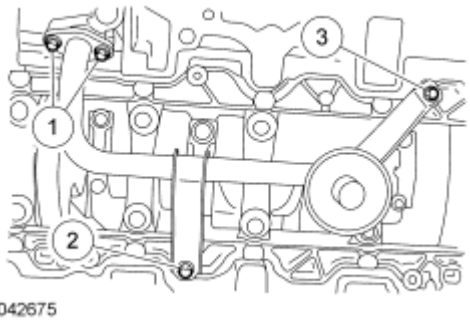


Fig. 216: Identifying Tightening Sequence Of Oil Pump Pickup Tube
Courtesy of FORD MOTOR CO.

6. Using the special tool, install the a new crankshaft rear seal and retainer plate assembly.

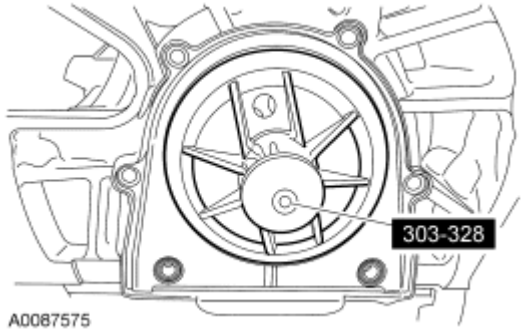


Fig. 217: Positioning Crankshaft Rear Oil Seal Using Special Tool (303-328)
Courtesy of FORD MOTOR CO.

7. Tighten the crankshaft rear seal and retainer plate assembly bolts in the sequence shown in illustration.
   - Tighten to 10 Nm (89 lb-in).

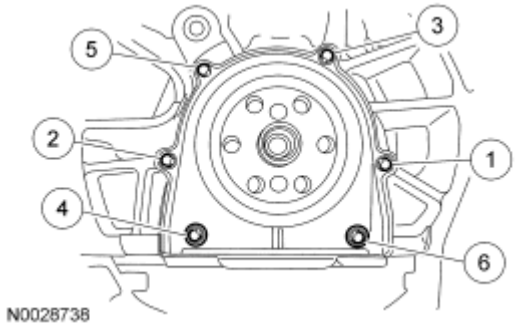


Fig. 218: Identifying Tightening Sequence Of Crankshaft Rear Oil Seal Bolts
Courtesy of FORD MOTOR CO.

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

NOTE: Clean the sealing surface with metal surface prep and silicone gasket remover. Observe all warnings and cautions and follow all application directions contained on the packaging of the metal surface prep and the silicone gasket remover.

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

8. Apply a 2.5 mm (0.1 in) bead of silicone gasket and sealant to the oil pan. Install the oil pan. Tighten the oil pan bolts in the sequence shown in illustration.
   - Tighten to 25 Nm (18 lb-ft).

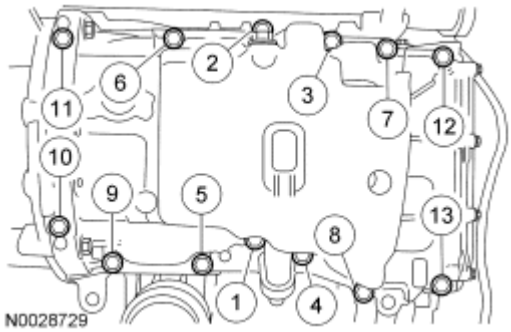


Fig. 219: Identifying Tightening Sequence Of Oil Pan Bolts
Courtesy of FORD MOTOR CO.

CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges 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.

9. Clean the cylinder head-to-cylinder block mating surfaces 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 remaining traces of oil or coolant, and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
10. Install the cylinder head alignment dowels. Dowels must be fully seated in the cylinder block.

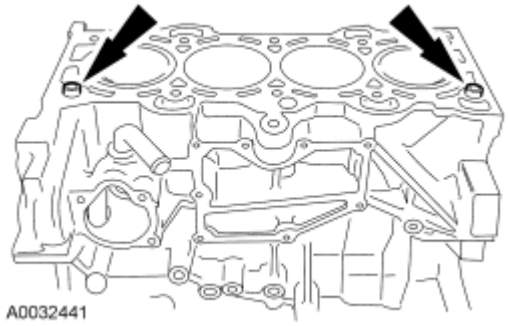


Fig. 220: Identifying Cylinder Head Alignment Dowels
Courtesy of FORD MOTOR CO.

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

NOTE: Clean the sealing surface with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

11. Apply silicone gasket and sealant to the locations shown in illustration.

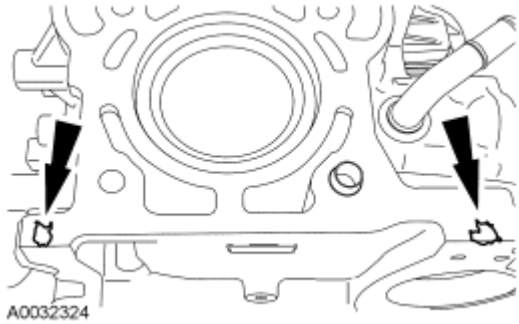


Fig. 221: Identifying Silicone Gasket And Sealant Location
Courtesy of FORD MOTOR CO.

12. Install a new cylinder head gasket.

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

NOTE: The cylinder head bolts are torque-to-yield and must not be reused. New cylinder head bolts must be installed.

NOTE: Lubricate the cylinder head bolts with clean engine oil.

13. Install the cylinder head and the new bolts. Tighten the bolts in the sequence shown in illustration, in 5 stages.
    - Stage 1: Tighten to 5 Nm (44 lb-in).
    - Stage 2: Tighten to 15 Nm (11 lb-ft).
    - Stage 3: Tighten to 45 Nm (33 lb-ft).
    - Stage 4: Tighten an additional 90 degrees (1/4 turn).
    - Stage 5: Tighten an additional 90 degrees (1/4 turn).

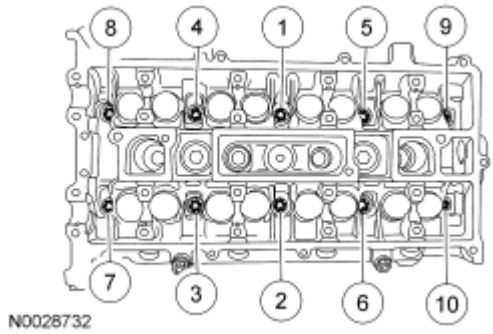


Fig. 222: Identifying Tightening Sequence Of Cylinder Head Bolts
Courtesy of FORD MOTOR CO.

CAUTION: Install the camshafts with the alignment slots in the camshaft lined up so the camshaft alignment plate can be installed without rotating the camshafts. Make sure the lobes on the No. 1 cylinder are in the same position as noted in the disassembly procedure. Rotating the camshafts, or installing the camshafts 180 degrees out of position may cause severe damage to the valves and pistons.

NOTE: Lubricate the camshaft journals and bearing caps with clean engine oil.

14. Install the camshafts and bearing caps in their original location and orientation. Tighten the bearing caps in the sequence shown in illustration in 3 stages:

- Stage 1: Tighten the camshaft bearing caps one turn at a time until tight.
- Stage 2: Tighten the bolts to 7 Nm (62 lb-in).
- Stage 3: Tighten the bolts to 16 Nm (12 lb-ft).

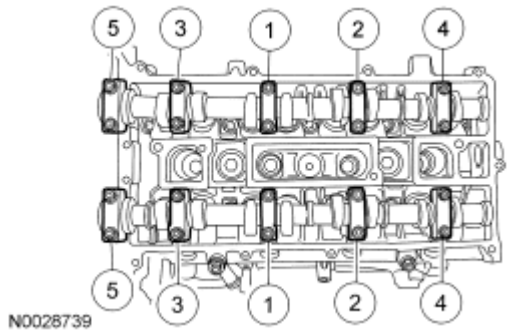


Fig. 223: Identifying Camshaft Bearing Caps Bolts Tightening Sequence
Courtesy of FORD MOTOR CO.

CAUTION: The crankshaft, the crankshaft sprocket and the pulley are fitted together by friction, with diamond washers between the flange faces on each part. The new diamond washers must be installed correctly, or severe engine damage may result.

15. Install the new diamond washers and the oil pump chain and sprockets.
    - The crankshaft sprocket flange must be facing away from the engine block.

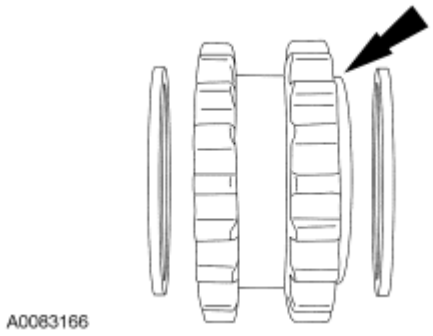


Fig. 224: Locating Washers, Oil Pump Chain & Sprockets
Courtesy of FORD MOTOR CO.

NOTE: The oil pump chain sprocket must be held in place.

16. Tighten the oil pump sprocket bolt.
    - Tighten to 25 Nm (18 lb-ft).

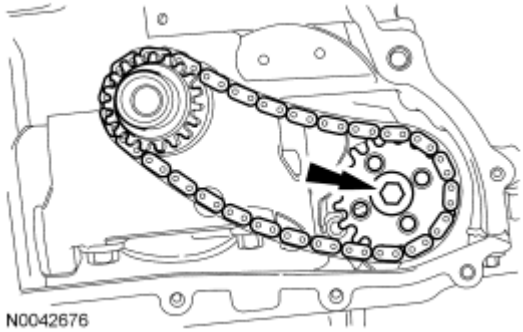


Fig. 225: Locating Oil Pump Sprocket Bolt
Courtesy of FORD MOTOR CO.

17. Install the oil pump chain drive tensioner shoulder bolt.
    - Tighten to 10 Nm (89 lb-in).

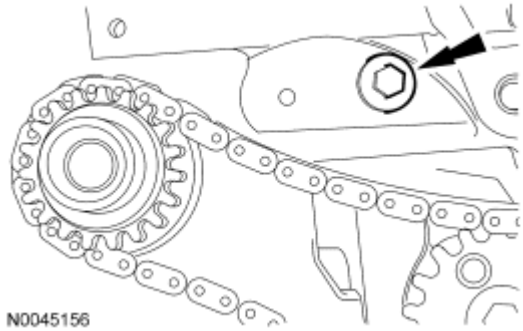


Fig. 226: Locating Oil Pump Chain Drive Tensioner Shoulder Bolt
Courtesy of FORD MOTOR CO.

18. Install the oil pump chain tensioner. Hook the tensioner spring around the shoulder bolt and tighten the tensioner bolt.
    - Tighten to 10 Nm (89 lb-in).

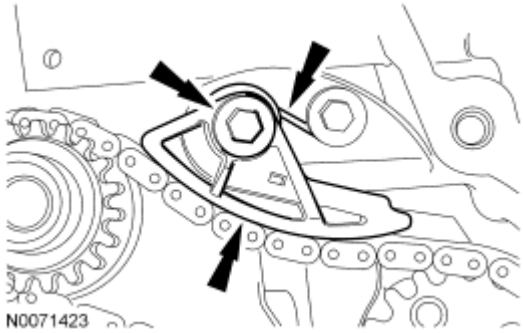


Fig. 227: Locating Tensioner Spring Around Shoulder Bolt
Courtesy of FORD MOTOR CO.

NOTE: Sprockets must turn freely on the camshafts.

19. Position the camshaft sprockets and loosely install the bolts. Do not tighten the sprocket bolts at this time.

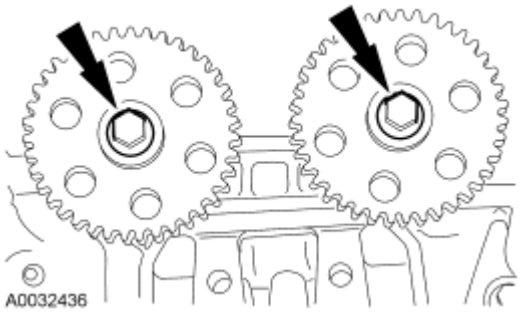


Fig. 228: Locating Camshaft Sprockets & Bolts
Courtesy of FORD MOTOR CO.

CAUTION: Do not compress the ratchet assembly. This will damage the ratchet assembly.

20. Using the edge of a vise, compress the timing chain tensioner plunger.

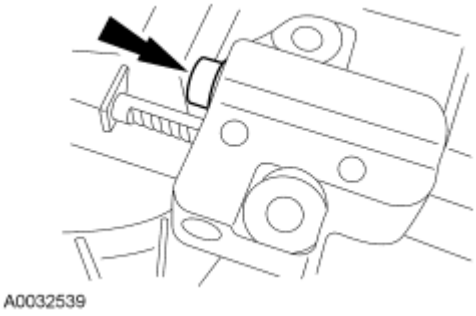


Fig. 229: Locating Timing Chain Tensioner Plunger
Courtesy of FORD MOTOR CO.

21. Using a small pick, push back and hold the ratchet mechanism.

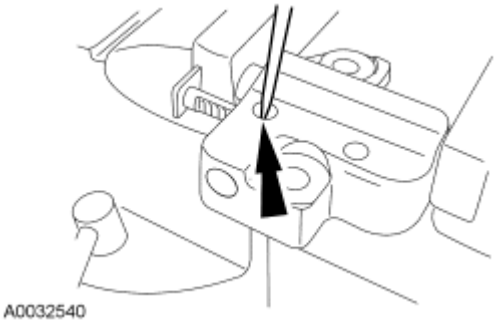


Fig. 230: Using A Small Pick To Push Back And Hold Ratchet Mechanism
Courtesy of FORD MOTOR CO.

22. While holding the ratchet mechanism, push the ratchet arm back into the tensioner housing.

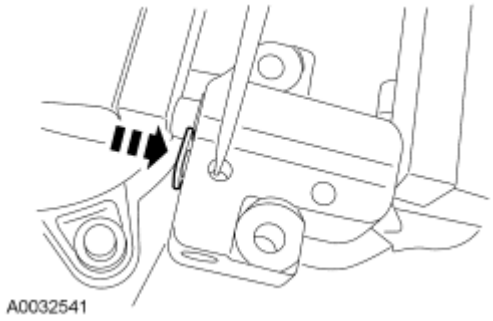


Fig. 231: Pushing Ratchet Arm Back Into Tensioner Housing
Courtesy of FORD MOTOR CO.

23. Install a paper clip into the hole in the tensioner housing to hold the ratchet assembly and the plunger in during installation.

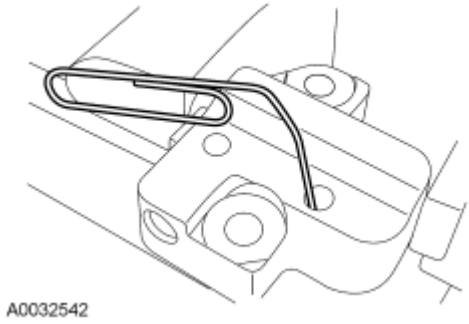


Fig. 232: Installing Paper Clip Into Hole In Tensioner Housing To Hold Ratchet Assembly And Plunger
Courtesy of FORD MOTOR CO.

24. Install the timing chain.

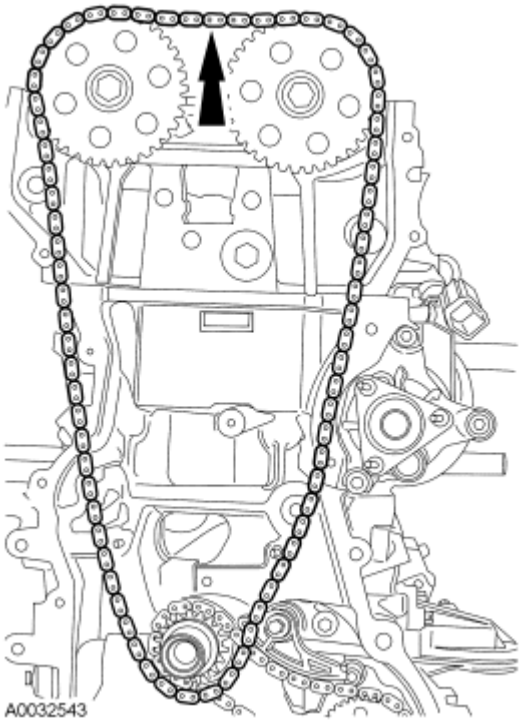


Fig. 233: Locating Timing Chain
Courtesy of FORD MOTOR CO.

25. Position the timing chain guides and install the 2 LH guide bolts.
    - Tighten to 10 Nm (89 lb-in).

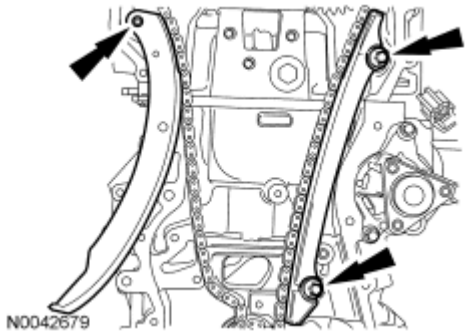


Fig. 234: Locating Timing Chain Guides & Guide Bolts
Courtesy of FORD MOTOR CO.

26. Install the timing chain tensioner and the 2 bolts. Remove the paper clip to apply tension to the timing chain.
    - Tighten to 10 Nm (89 lb-in).

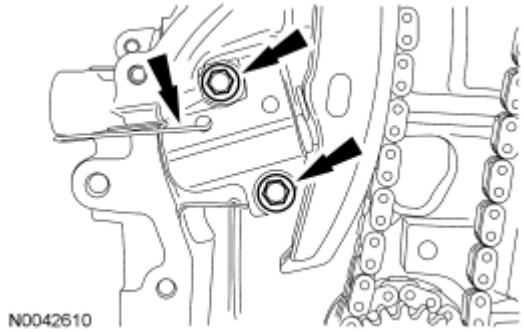


Fig. 235: Locating Timing Chain Tensioner & Bolts
Courtesy of FORD MOTOR CO.

CAUTION: The special tool 303-465 is for camshaft alignment only. Using this tool to prevent engine rotation may result in engine damage.

27. Install the special tool in the timing slots on rear of both camshafts. Timing slots are offset from the centerline of the camshaft.

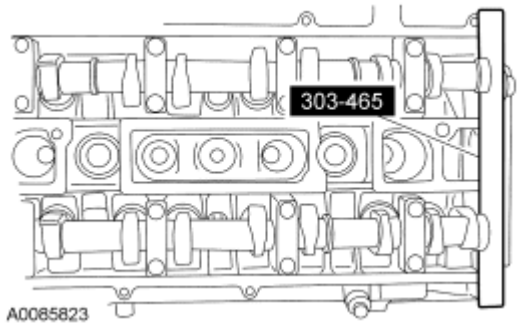


Fig. 236: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

NOTE: Use a wrench on the flats between cylinders No. 1 and No. 2 to hold the camshafts in place.

28. Tighten the camshaft sprocket bolts.
    - Tighten to 72 Nm (53 lb-ft).

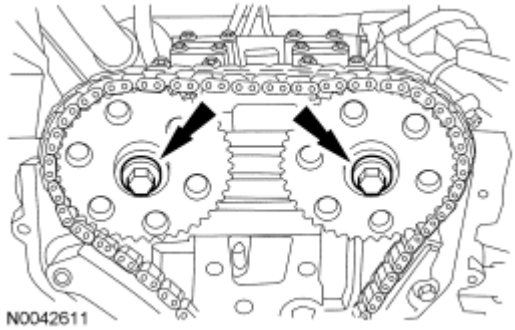


Fig. 237: Locating Camshaft Sprocket Bolts
Courtesy of FORD MOTOR CO.

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

NOTE: Clean the sealing surface with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.

29. Clean the engine front cover gasket surface with silicone gasket remover and metal surface prep.

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

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

30. Apply a 2.5 mm (0.1 in) bead of silicone gasket and sealant to the front cover.

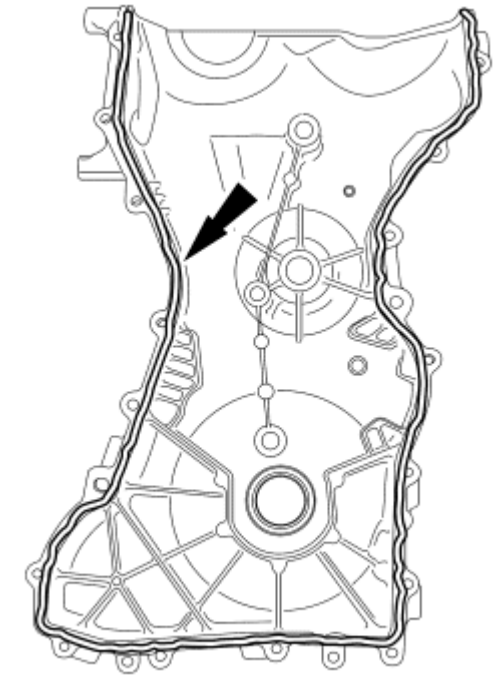


Fig. 238: Locating Silicone Gasket
Courtesy of FORD MOTOR CO.

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

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

31. Apply silicone gasket and sealant to the locations shown in illustration.

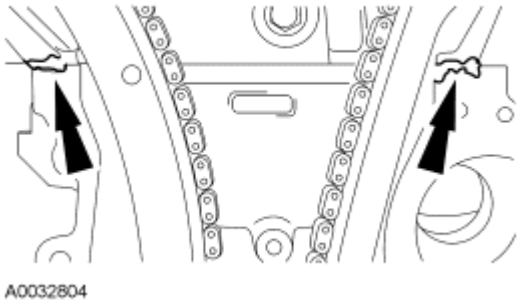


Fig. 239: Applying Silicone Gasket & Sealant To Locations
Courtesy of FORD MOTOR CO.

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

32. Install the front cover. Tighten the bolts in the sequence shown in illustration in 3 stages.
    - Stage 1: Tighten the 8-mm bolts to 10 Nm (89 lb-in).
    - Stage 2: Tighten the 10-mm bolts to 25 Nm (18 lb-ft).
    - Stage 3: Tighten the 13-mm bolts to 48 Nm (35 lb-ft).

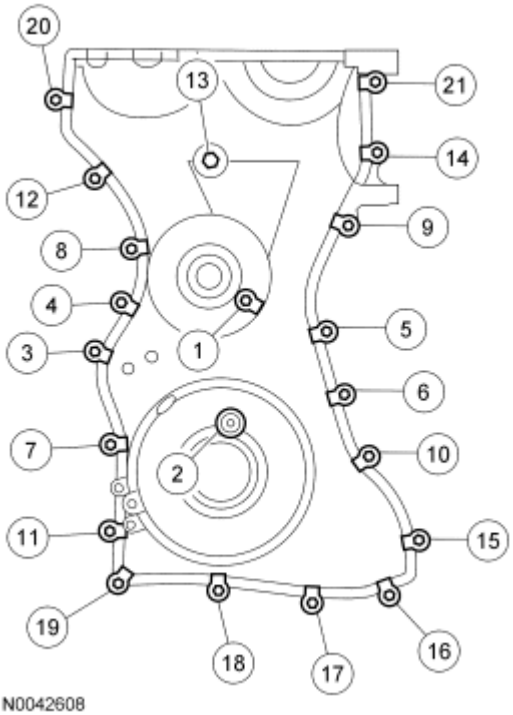


Fig. 240: Identifying Tightening Sequence Of Front Cover Bolts
Courtesy of FORD MOTOR CO.

NOTE: Do not install the crankshaft pulley bolt at this time.

NOTE: Apply clean engine oil to the seal area prior to installing.

33. Position the crankshaft pulley onto the crankshaft with the hole in the pulley at the 6 o'clock position.

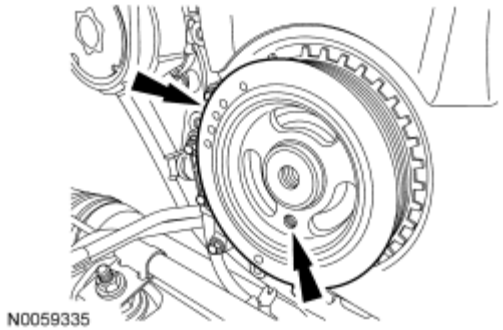


Fig. 241: Locating Crankshaft Pulley & Hole
Courtesy of FORD MOTOR CO.

CAUTION: Only hand-tighten the 6 mm (0.23 in) bolt or damage to the front cover may occur.

NOTE: This step will correctly align the crankshaft pulley to the crankshaft.

34. Install a standard 6 mm (0.23 in) x 18 mm (0.7 in) bolt through the crankshaft pulley and thread it into the front cover.

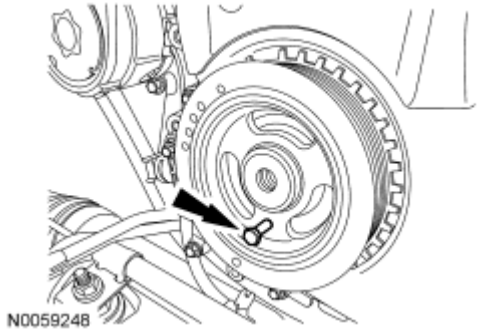


Fig. 242: Locating Crankshaft Pulley Bolt
Courtesy of FORD MOTOR CO.

CAUTION: The crankshaft must remain in the top dead center (TDC) position during installation of the pulley bolt or damage to the engine may occur. Therefore, the crankshaft pulley must be held in place with the

special tool and the bolt should be installed using hand tools only.

NOTE: Do not reuse the crankshaft pulley bolt.

35. Install a new crankshaft pulley bolt. Using the special tool to hold the crankshaft pulley in place, tighten the crankshaft pulley bolt in 2 stages:
    - Stage 1: Tighten to 100 Nm (74 lb-ft).
    - Stage 2: Rotate an additional 90 degrees.

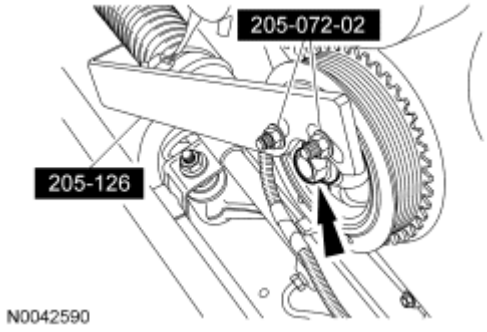


Fig. 243: Identifying Special Tools (205-072-02, 205-126) And Crankshaft Pulley Bolt
Courtesy of FORD MOTOR CO.

36. Remove the 6 mm (0.23 in) x 18 mm (0.7 in) bolt.

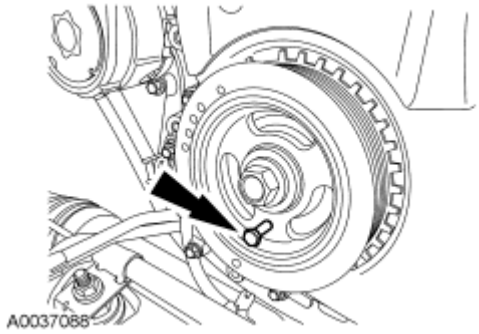


Fig. 244: Installing Bolt Through Crankshaft Pulley And Thread It Into Front Cover
Courtesy of FORD MOTOR CO.

37. Remove the special tool.

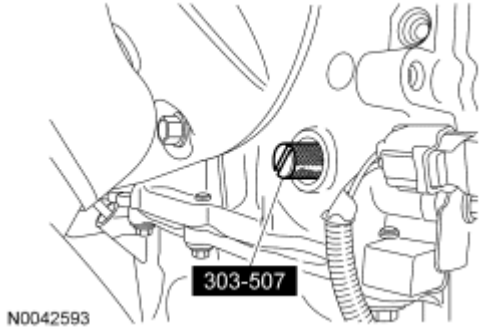


Fig. 245: Identifying Special Tool (303-507)
Courtesy of FORD MOTOR CO.

38. Remove the special tool.

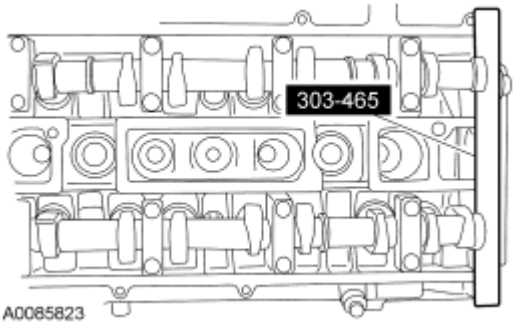


Fig. 246: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

NOTE: Only turn the crankshaft in the normal direction of rotation.

39. Turn the crankshaft clockwise 1 and 3/4 turn.
40. Install the special tool.

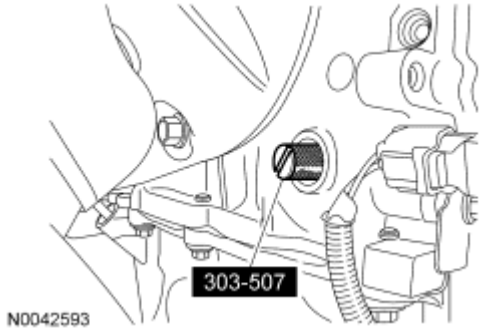


Fig. 247: Identifying Special Tool (303-507)
Courtesy of FORD MOTOR CO.

NOTE: Only turn the crankshaft in the normal direction of rotation.

41. Turn the crankshaft clockwise until the crankshaft contacts the special tool.

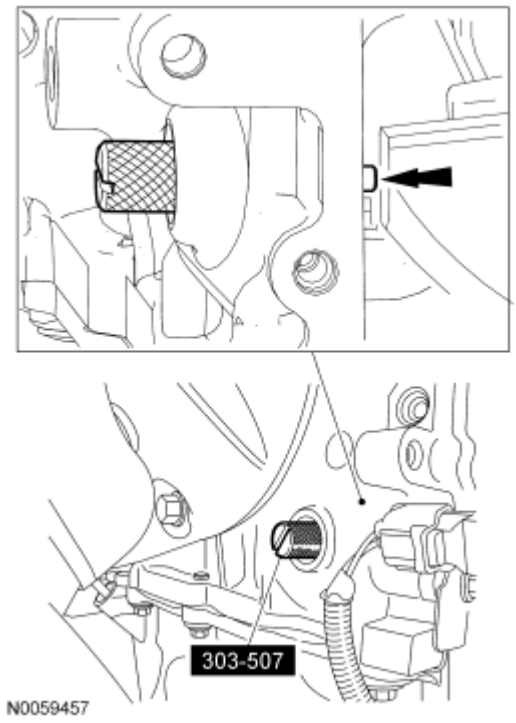


Fig. 248: Identifying Special Tool (303-507)
Courtesy of FORD MOTOR CO.

CAUTION: Only hand-tighten the bolt or damage to the front cover may occur.

42. Using the 6 mm (0.23 in) x 18 mm (0.7 in) bolt, check the position of the crankshaft pulley.
    - If it is not possible to install the bolt, correct the engine timing.

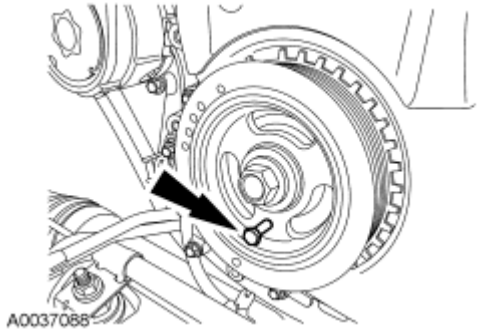


Fig. 249: Installing Bolt Through Crankshaft Pulley And Thread It Into Front Cover
Courtesy of FORD MOTOR CO.

43. Install the special tool to check the position of the camshafts.

- If it is not possible to install the special tool, correct the engine timing.

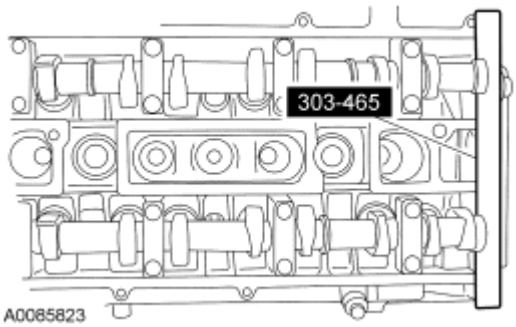


Fig. 250: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

44. Remove the special tool.

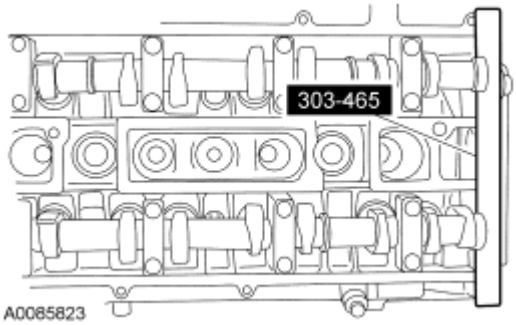


Fig. 251: Identifying Special Camshaft Tool (303-465)
Courtesy of FORD MOTOR CO.

45. Position a new crankshaft position (CKP) sensor and loosely install the 2 bolts.

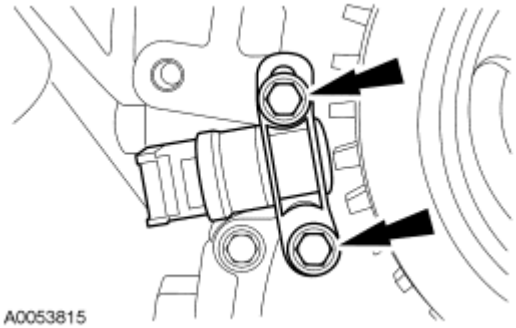


Fig. 252: Locating Crankshaft Position (CKP) Sensor Bolts
Courtesy of FORD MOTOR CO.

NOTE: The CKP sensor alignment tool is supplied with the new sensor and is not available separately.

46. Adjust the CKP with the alignment tool, the tool must engage a tooth of the vibration damper, and tighten the 2 mounting bolts.
    - Tighten to 7 Nm (62 lb-in).

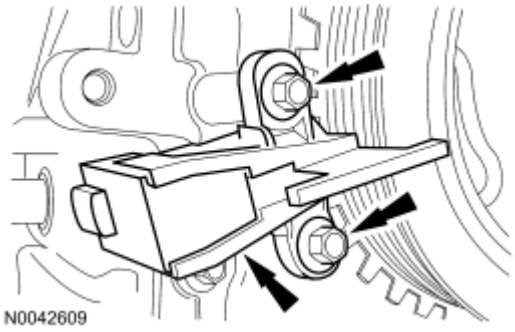


Fig. 253: Locating CKP Sensor Bolts
Courtesy of FORD MOTOR CO.

47. Remove the 6 mm (0.23 in) x 18 mm (0.7 in) bolt.

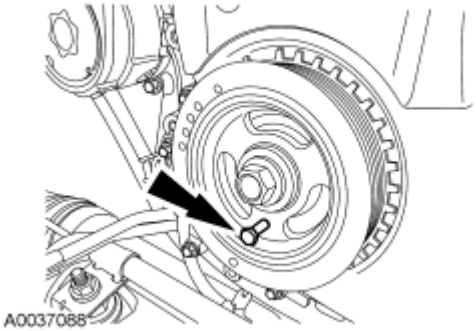


Fig. 254: Installing Bolt Through Crankshaft Pulley And Thread It Into Front Cover
Courtesy of FORD MOTOR CO.

48. Remove the special tool.

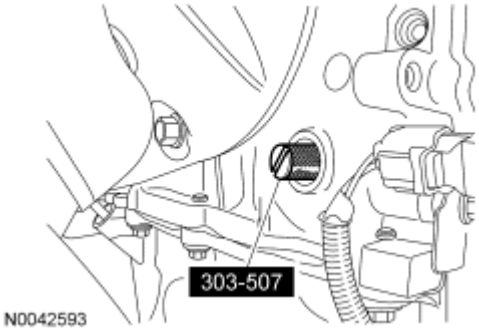


Fig. 255: Identifying Special Tool (303-507)
Courtesy of FORD MOTOR CO.

49. Install the timing peg plug.
    - Tighten to 20 Nm (15 lb-ft).

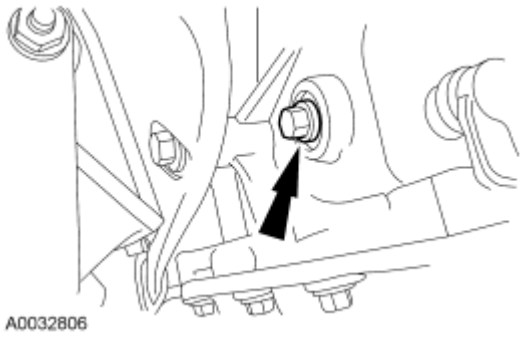


Fig. 256: Locating Engine Plug Bolt
Courtesy of FORD MOTOR CO.

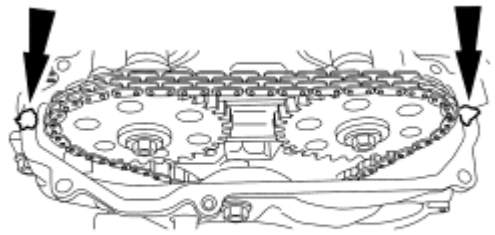
CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

50. Clean the valve cover gasket sealing surface with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.

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

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

51. Apply silicone gasket and sealant to the locations shown in illustration.

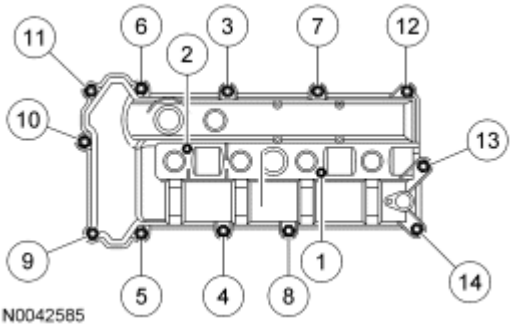


A0032732

Fig. 257: Applying Silicone Gasket And Sealant
Courtesy of FORD MOTOR CO.

NOTE: If not secured within 4 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep. Allow to dry until there is no sign of wetness, or 4 minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

52. Install the valve cover and the fasteners.
    - Tighten to 10 Nm (89 lb-in).



N0042585

Fig. 258: Identifying Tightening Sequence Of Valve Cover Bolts
Courtesy of FORD MOTOR CO.

53. Install the following:
    1. Camshaft position (CMP) sensor and the bolt.
        - Tighten to 7 Nm (62 lb-in).
    2. Cylinder head temperature (CHT) sensor.
        - Tighten to 12 Nm (9 lb-ft).
    3. Spark plugs.
        - Tighten to 15 Nm (11 lb-ft).

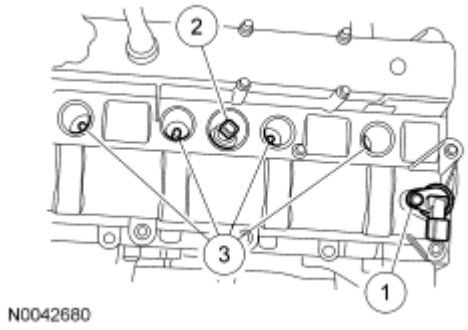


Fig. 259: Identifying Camshaft Position (CMP) Sensor & Bolt
Courtesy of FORD MOTOR CO.

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

NOTE: Clean the sealing surface with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.

NOTE: Lubricate the coolant pump O-ring seal with clean engine coolant prior to assembly.

54. Using a new O-ring seal, install the coolant pump and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

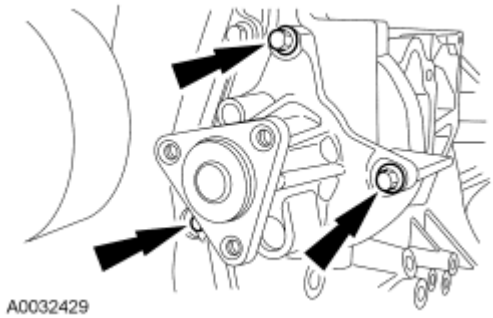


Fig. 260: Locating Coolant Pump Bolts
Courtesy of FORD MOTOR CO.

55. Install the coolant pump pulley and the 3 bolts.
    - Tighten to 20 Nm (15 lb-ft).

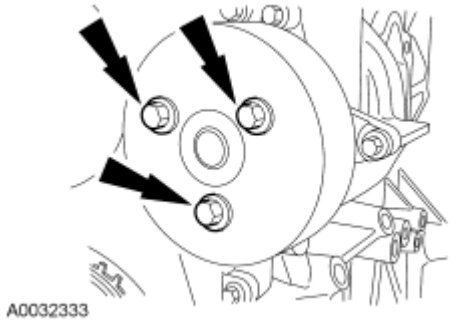


Fig. 261: Locating Coolant Pump Pulley Bolts
Courtesy of FORD MOTOR CO.

NOTE: Lubricate the fuel injector O-ring seals with clean engine oil prior to installation.

56. Using new O-ring seals, install the fuel rail and fuel injectors as an assembly, the ground strap and the bolt.
    - Tighten the 2 fuel rail bolts to 25 Nm (18 lb-ft).
    - Tighten ground strap bolt to 10 Nm (89 lb-in).

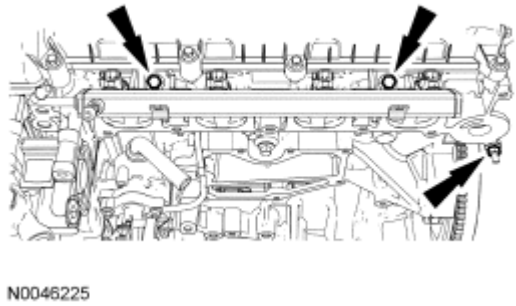


Fig. 262: Locating Fuel Rail Bolts
Courtesy of FORD MOTOR CO.

57. Install the left motor mount and the 4 bolts.
    - Tighten to 49 Nm (36 lb-ft).

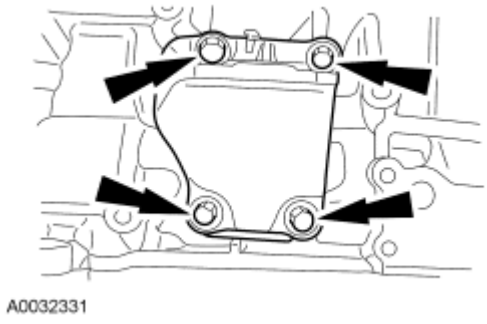


Fig. 263: Locating LH Engine Mount Bracket Bolts
Courtesy of FORD MOTOR CO.

NOTE: The knock sensor (KS) must not touch the crankcase vent oil separator.

58. Install the crankcase vent oil separator and the KS.
    - Tighten the KS bolt to 20 Nm (15 lb-ft).
    - Tighten the crankcase vent oil separator bolts to 10 Nm (89 lb-in).

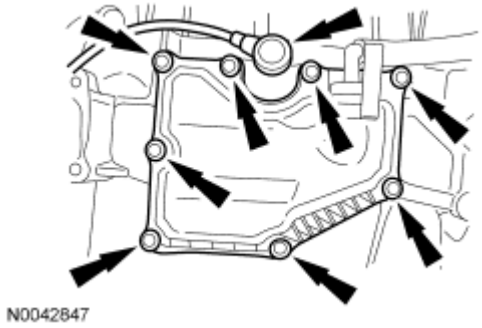


Fig. 264: Locating Engine Vent Cover & KS Bolts
Courtesy of FORD MOTOR CO.

NOTE: Clean the sealing surface with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.

59. Using a new gasket, install the thermostat housing and the 3 bolts.
    - Tighten to 10 Nm (89 lb-in).

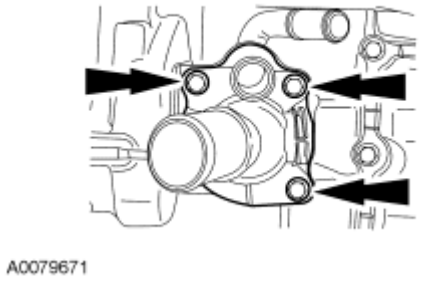


Fig. 265: Locating Thermostat Housing Bolts
Courtesy of FORD MOTOR CO.

60. Install the ignition coil and the 4 bolts.
    - Tighten to 6 Nm (53 lb-in).

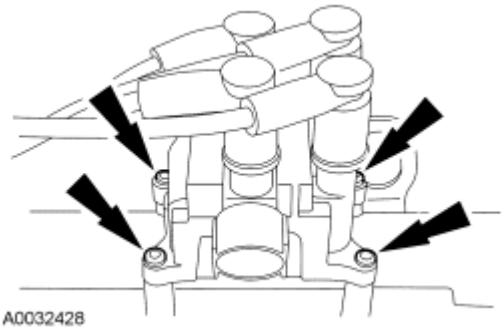


Fig. 266: Locating Ignition Coil Bolts
Courtesy of FORD MOTOR CO.

NOTE: Apply silicone brake caliper grease and dielectric compound to the inside of the spark plug boots prior to installation.

61. Connect the spark plug wires to the spark plugs.
62. Position the fuel charging wiring harness. Attach the fuel charging wiring harness to the valve cover studs.

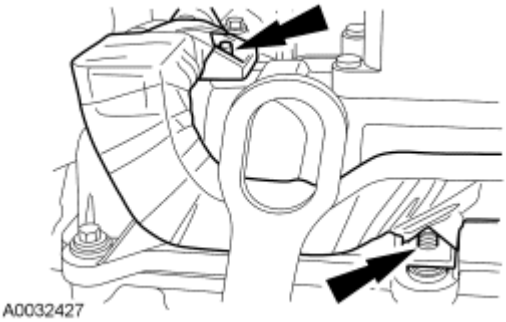


Fig. 267: Detaching Engine Wiring Harness Anchors From Valve Cover Studs
Courtesy of FORD MOTOR CO.

63. Connect the ignition coil and the CHT sensor electrical connectors. Position back the CHT sensor cover.

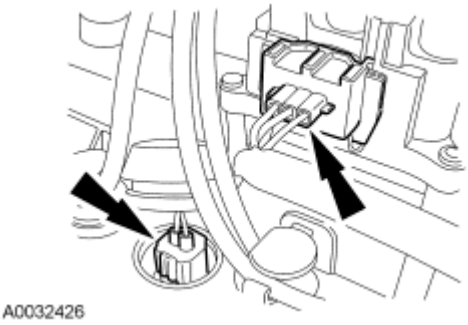


Fig. 268: Locating Ignition Coil & Cylinder Head Temperature (CHT) Sensor Electrical Connectors

Courtesy of FORD MOTOR CO.

64. Connect the fuel injector electrical connectors and attach the wiring harness pin-type retainers.

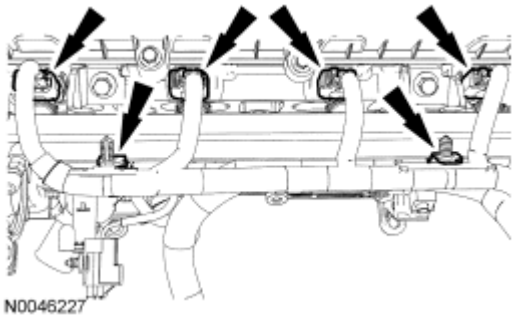


Fig. 269: Locating Fuel Injector Electrical Connectors
Courtesy of FORD MOTOR CO.

65. Inspect and install new intake manifold gaskets, if necessary.

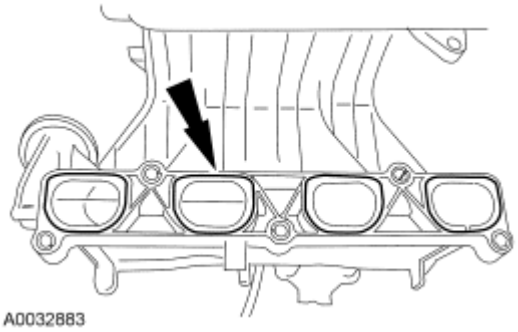


Fig. 270: Locating Intake Manifold Gaskets
Courtesy of FORD MOTOR CO.

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

NOTE: Clean the sealing surface with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.

66. Install the intake manifold and the bolts.
    - Tighten to 18 Nm (13 lb-ft).

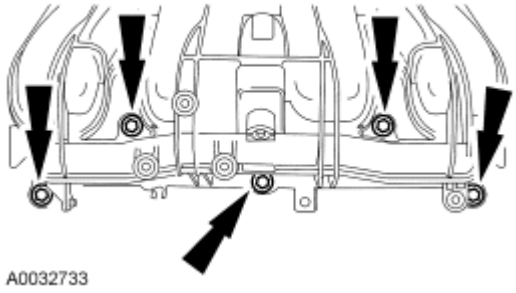


Fig. 271: Locating Intake Manifold Assembly Bolts
Courtesy of FORD MOTOR CO.

67. Install the EGR tube.
    - Install the EGR tube bracket to the intake manifold.
        - Tighten to 10 Nm (89 lb-in).
    - Connect the EGR tube to the cylinder head.
        - Tighten to 55 Nm (41 lb-ft).

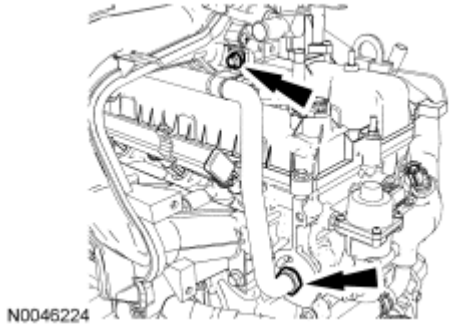


Fig. 272: Locating EGR Tube To Cylinder Head
Courtesy of FORD MOTOR CO.

68. Connect the EGR tube to the intake manifold.
    - Tighten to 18 Nm (13 lb-ft).

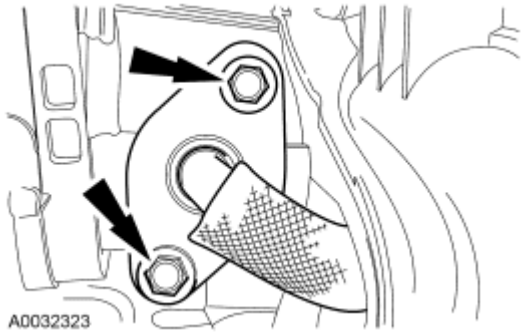


Fig. 273: Locating Intake Manifold EGR Tube Bolt
Courtesy of FORD MOTOR CO.

69. Attach the engine wiring harness pin-type retainers to the intake manifold.
70. Connect the CMP sensor electrical connector and the PCV hose.

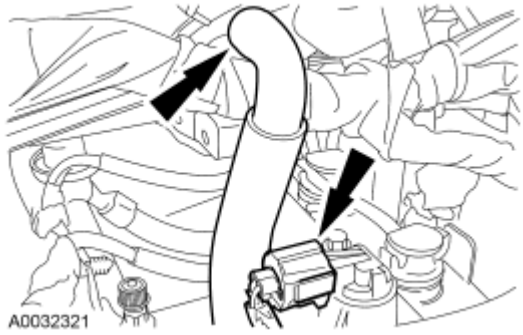


Fig. 274: Locating CMP Sensor Electrical Connector & PCV Hose
Courtesy of FORD MOTOR CO.

71. Install the engine wiring harness connector bracket, the 3 bolts and connect the KS electrical connector.
    - Tighten to 10 Nm (89 lb-in).

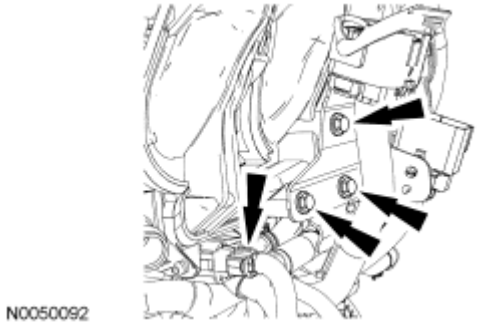


Fig. 275: Locating Bolts & Engine Wiring Harness
Courtesy of FORD MOTOR CO.

72. Connect the CKP sensor electrical connection and attach the wiring pin-type retainers.

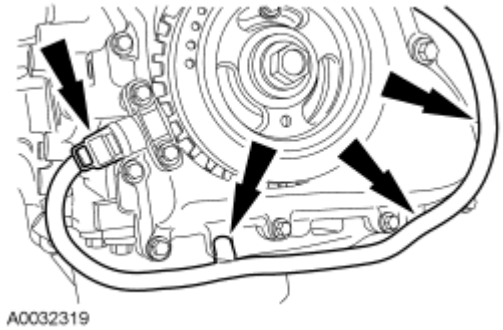


Fig. 276: Locating CKP Sensor Electrical Connection
Courtesy of FORD MOTOR CO.

73. Connect the following electrical connectors:
    - Manifold absolute pressure (MAP) sensor
    - Throttle position (TP) sensor
    - Idle air control (IAC) valve

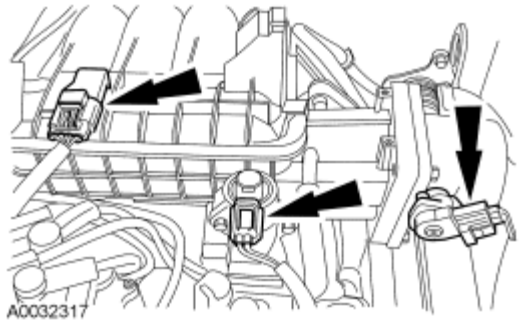


Fig. 277: Disconnecting Electrical Connectors (IAC, TP And MAP)
Courtesy of FORD MOTOR CO.

74. Install the power steering pump assembly and the 4 bolts.
    - Tighten to 25 Nm (18 lb-ft).

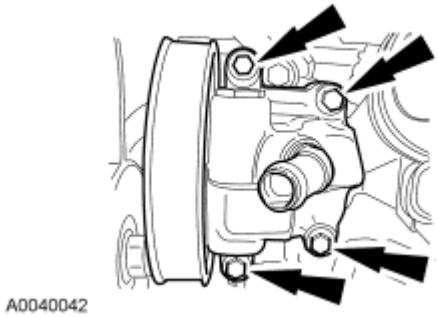


Fig. 278: Locating Power Steering Pump Bolts
Courtesy of FORD MOTOR CO.

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

NOTE: Clean the sealing surface with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.

75. Install the EGR valve.

1. Using a new gasket, position the EGR valve and install the 2 bolts.
    - Tighten to 20 Nm (15 lb-ft).
2. Connect the coolant hose.
3. Connect the electrical connector.

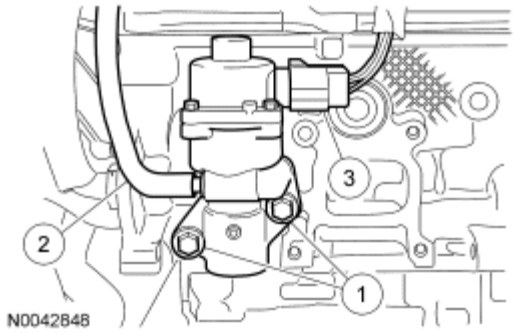


Fig. 279: Identifying EGR Valve & Bolts
Courtesy of FORD MOTOR CO.

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

NOTE: Clean the sealing surface with silicone gasket remover and metal surface prep. Observe all warnings and cautions and follow all application directions contained on the packaging of the silicone gasket remover and metal surface prep.

76. Install the rear coolant outlet pipe.
    1. Using a new gasket, install the rear coolant outlet pipe and the 4 bolts.
        - Tighten to 10 Nm (89 lb-in).
    2. Connect the coolant hose.

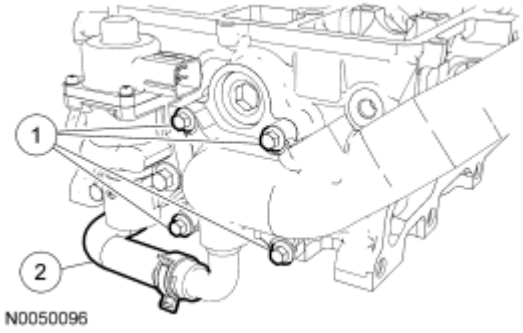


Fig. 280: Locating Rear Coolant Outlet Pipe & Bolts
Courtesy of FORD MOTOR CO.

77. If equipped, install the block heater.

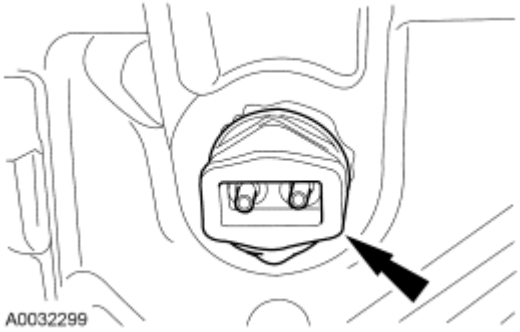


Fig. 281: Locating Block Heater
Courtesy of FORD MOTOR CO.

78. Install 7 new exhaust manifold-to-cylinder head studs.
    - Tighten to 17 Nm (13 lb-ft).
79. Position a new gasket and install the exhaust manifold and 7 new nuts.
    - Tighten to 54 Nm (40 lb-ft).

Fig. 282: Locating Exhaust Manifold Nuts & Gasket
Courtesy of FORD MOTOR CO.

80. Position the coolant tube assembly and install the 2 nuts.
    - Tighten to 20 Nm (15 lb-ft).

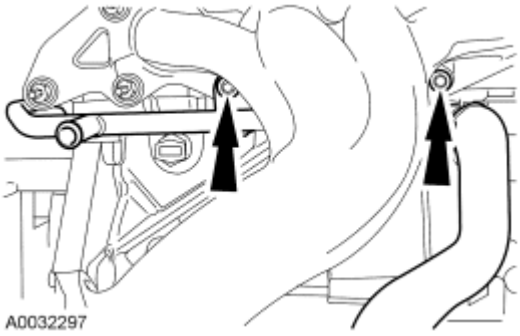


Fig. 283: Locating Coolant Tube Assembly & Nuts
Courtesy of FORD MOTOR CO.

81. Connect the coolant hose to the thermostat and the PCV fitting on the intake manifold.

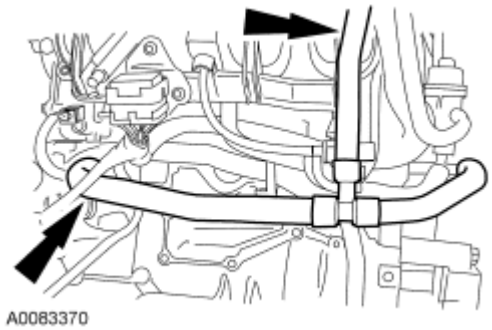


Fig. 284: Locating Positive Crankcase Ventilation (PCV) Fitting On Intake Manifold
Courtesy of FORD MOTOR CO.

82. Position the right motor mount and install the 4 bolts.
    - Tighten to 49 Nm (36 lb-ft).

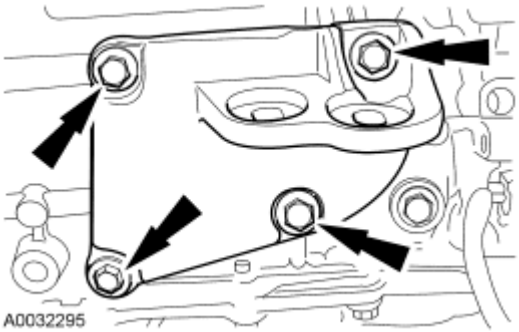


Fig. 285: Locating Bolts & RH Engine Mount Bracket
Courtesy of FORD MOTOR CO.

83. Position the generator and support bracket assembly and install the 5 bolts in the sequence shown in illustration, in 2 stages.
    - Stage 1: Install finger tight.
    - Stage 2: Tighten to 47 Nm (35 lb-ft).

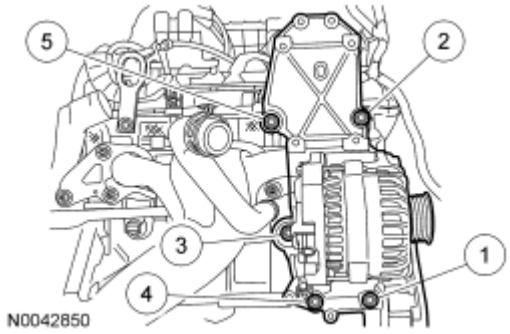


Fig. 286: Identifying Generator & Support Bracket Assembly
Courtesy of FORD MOTOR CO.

84. Position the A/C compressor and install the 4 bolts.
    - Tighten to 25 Nm (18 lb-ft).

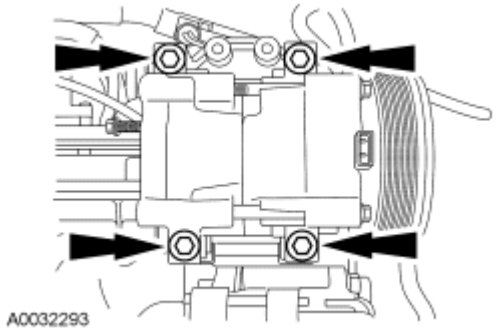


Fig. 287: Locating A/C Compressor Bolts
Courtesy of FORD MOTOR CO.

NOTE: Lubricate the new O-ring seal with clean engine coolant prior to installation.

85. Position the front coolant outlet pipe and install the 2 bolts.
    - Tighten to 10 Nm (89 lb-in).

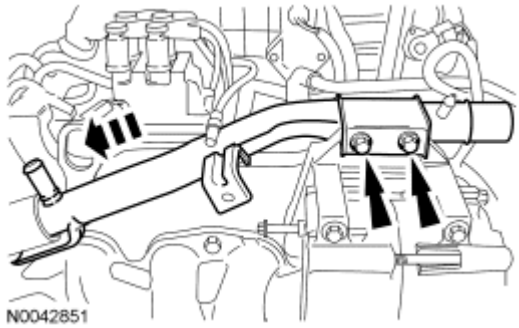


Fig. 288: Positioning Front Coolant Outlet Pipe & Bolts
Courtesy of FORD MOTOR CO.

NOTE: Lubricate the new O-ring seal with clean engine oil prior to installation.

86. Install the engine oil level indicator tube and the bolt.
    - Tighten to 10 Nm (89 lb-in).

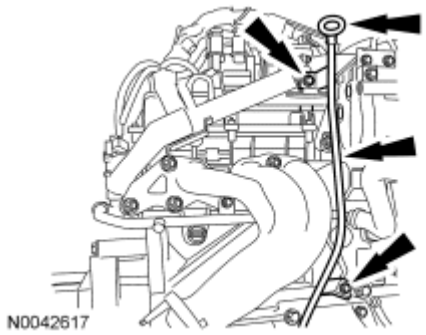


Fig. 289: Locating Engine Oil Level Indicator Tube & Bolt
Courtesy of FORD MOTOR CO.

87. Install the accessory drive belt.

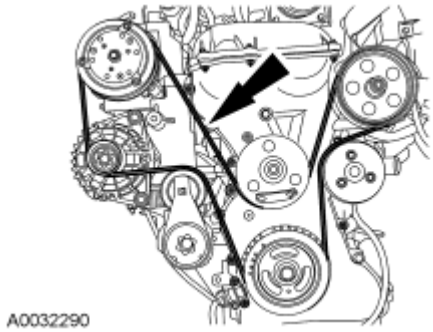


Fig. 290: Locating Drive Belt
Courtesy of FORD MOTOR CO.

88. Using the Spreader Bar and the Floor Crane, remove the engine from the Engine Stand.
89. Position the flywheel or the flexplate and loosely install the bolts.
90. Using the special tool, tighten the bolts in the sequence shown in illustration, in 3 stages.
    - Stage 1: Tighten to 50 Nm (37 lb-ft).
    - Stage 2: Tighten to 80 Nm (59 lb-ft).
    - Stage 3: Tighten to 112 Nm (83 lb-ft).

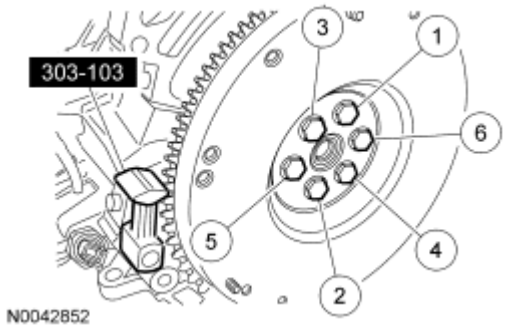


Fig. 291: Identifying Special Tool (303-103)
Courtesy of FORD MOTOR CO.

Vehicles with manual transmission

91. Lubricate the transmission input shaft pilot bearing with front axle grease.

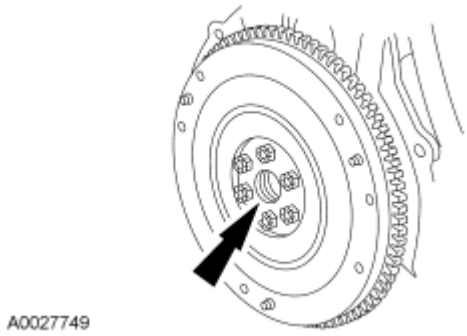


Fig. 292: Locating Transmission Input Shaft Pilot Bearing
Courtesy of FORD MOTOR CO.

92. Adjust the clutch pressure plate.
    1. Using a suitable press, press downward on the fingers until the adjusting ring moves freely.
    2. Rotate the adjusting ring counterclockwise to compress the tension springs. Hold the adjusting ring in this position.
    3. Release the pressure on the fingers. The adjusting ring will stay in the reset position.

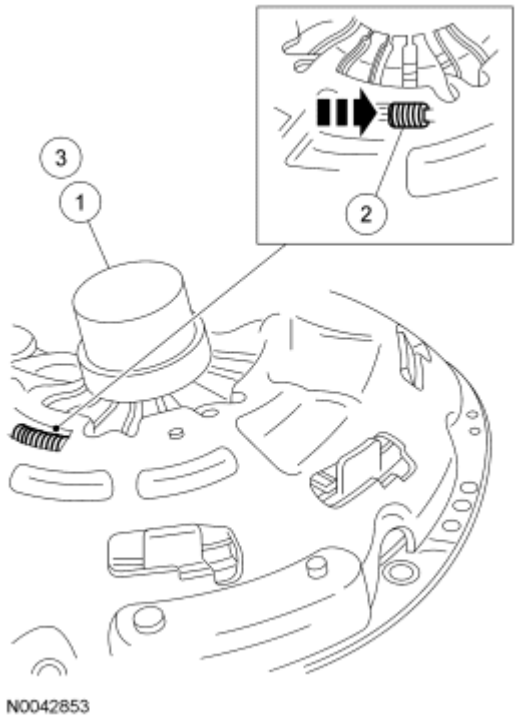


Fig. 293: Adjusting Clutch Pressure Plate
Courtesy of FORD MOTOR CO.

93. Using the special tool, position the clutch disc on the flywheel.

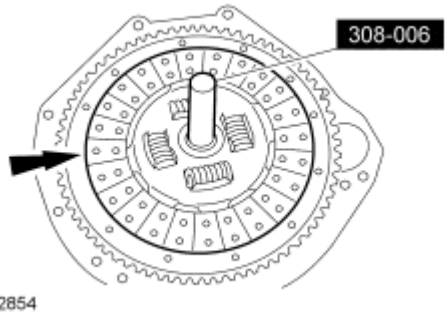


Fig. 294: Identifying Special Tool (308-006)
Courtesy of FORD MOTOR CO.

NOTE: If reusing the clutch pressure plate and flywheel, align the marks made during removal.

94. Position the clutch pressure plate and install the bolts. Tighten the bolts in a star pattern sequence.
    - Tighten to 32 Nm (24 lb-ft).

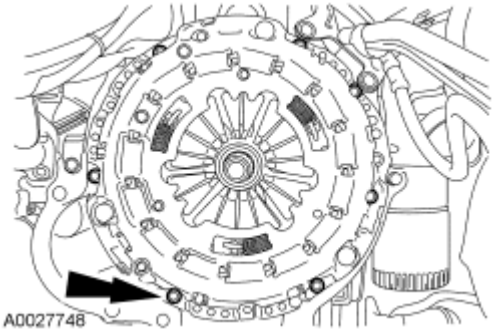


Fig. 295: Locating Clutch Pressure Plate Bolts
Courtesy of FORD MOTOR CO.

INSTALLATION

ENGINE

Special Tools

Illustration	Tool Name	Tool Number
 ST1341-A	Heavy Duty Floor Crane	014-00071 or equivalent
 ST1602-A	Spreader Bar	303-D089 (D93P-6001-A3) or equivalent

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

All vehicles

1. Using the Spreader Bar and the Floor Crane, remove the engine from the stand.
2. Position the engine in the vehicle. Make sure the index marks on the torque converter stud and flexplate made during removal are lined up.
3. Install the 2 side transmission-to-engine bolts.

NOTE: Left side shown in illustration, right side similar.

4. Install the 4 engine support insulator nuts.
   - Tighten to 102 Nm (75 lb-ft).

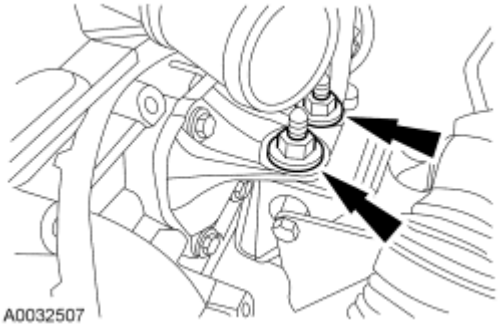


Fig. 296: Locating Engine Support Insulator Nuts
Courtesy of FORD MOTOR CO.

5. Remove the floor jack from the transmission.
6. Remove the floor crane and the spreader bar.

Vehicles with automatic transmission

7. Install the 4 torque converter nuts.
   - Tighten to 35 Nm (26 lb-ft).

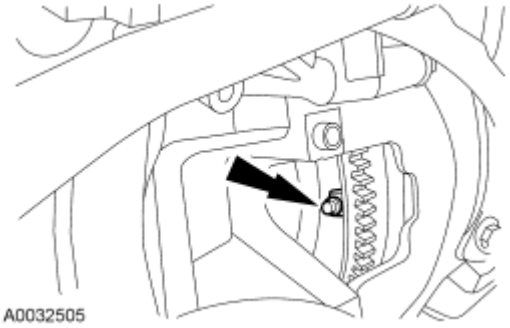


Fig. 297: Locating Torque Converter Nut
Courtesy of FORD MOTOR CO.

8. Install the transmission fluid indicator and tube assembly.

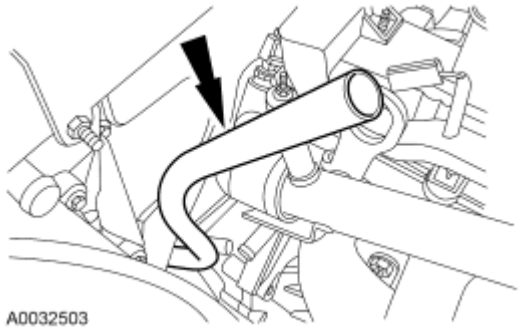


Fig. 298: Locating Transmission Fluid Indicator & Tube Assembly
Courtesy of FORD MOTOR CO.

All vehicles

9. Install the remaining 9 transmission-to-engine bolts.
    - Tighten to 48 Nm (35 lb-ft).

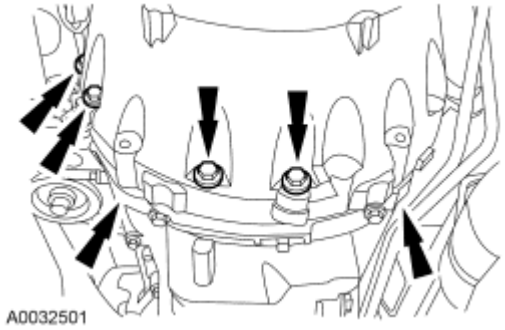


Fig. 299: Locating Transmission-To-Engine Bolts
Courtesy of FORD MOTOR CO.

10. Position the oil filter adapter and install the 4 bolts.
    - Tighten to 25 Nm (18 lb-ft).

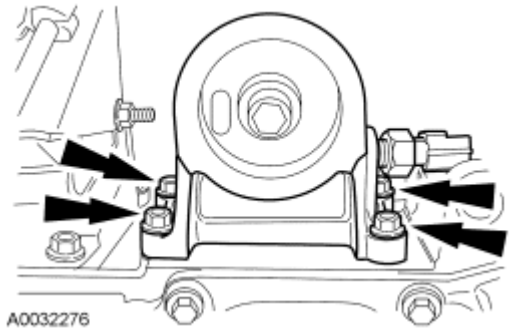


Fig. 300: Locating Oil Filter Adapter Bolts
Courtesy of FORD MOTOR CO.

11. Install the starter dust shield.

Fig. 301: Locating Starter Dust Shield
Courtesy of FORD MOTOR CO.

12. Install the starter, the bolt and the 2 stud bolts.
    - Tighten to 25 Nm (18 lb-ft).

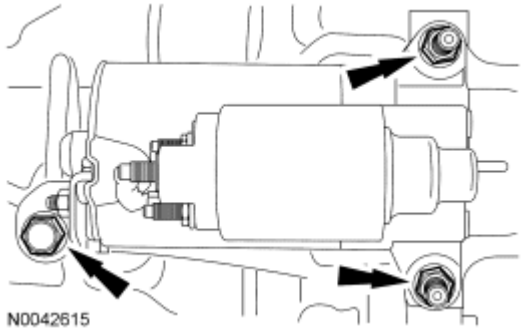


Fig. 302: Locating Starter, Bolt & 2 Stud Bolts
Courtesy of FORD MOTOR CO.

13. Install a new oil filter.

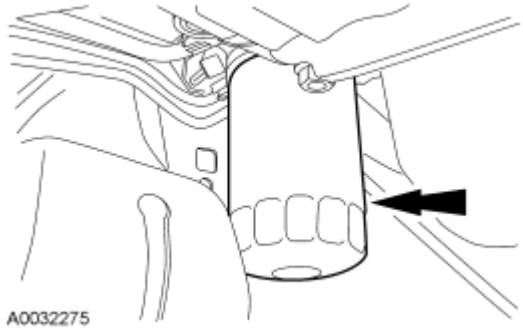


Fig. 303: Locating Oil Filter
Courtesy of FORD MOTOR CO.

14. Connect the engine oil pressure (EOP) sensor electrical connector.

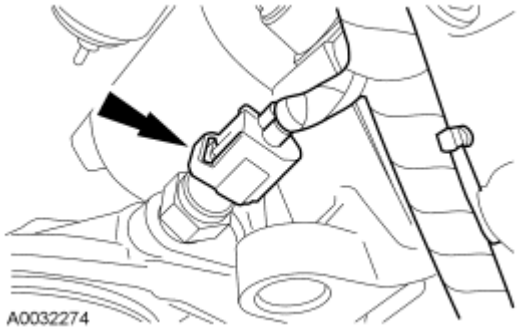


Fig. 304: Locating Engine Oil Pressure (EOP) Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

Vehicles with automatic transmission

15. Attach the wiring harness retainers.

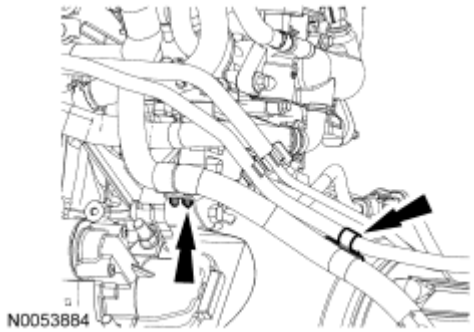


Fig. 305: Locating Wiring Harness Retainers
Courtesy of FORD MOTOR CO.

16. Attach the wiring harness retainers and connect the transmission electrical connectors.

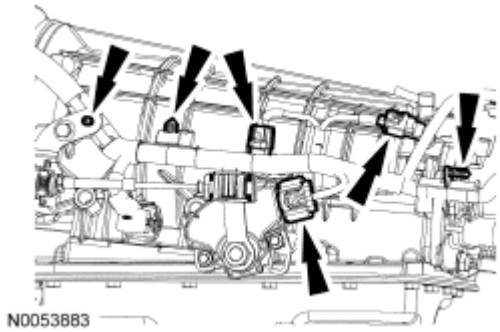


Fig. 306: Locating Transmission Electrical Connectors
Courtesy of FORD MOTOR CO.

17. Route the wiring harness over the transmission, position the bracket and install the nut. Connect the catalyst monitor sensor electrical connector.
    - Tighten to 10 Nm (89 lb-in).

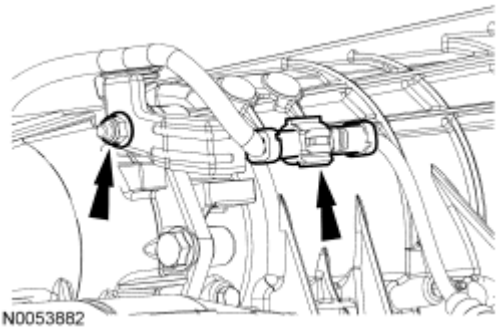


Fig. 307: Locating Catalyst Monitor Sensor Electrical Connector
Courtesy of FORD MOTOR CO.

18. Connect the heated oxygen sensor (HO2S) electrical connector.

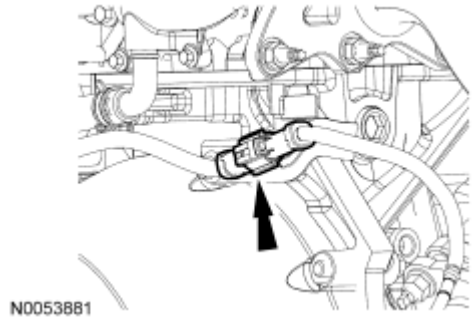


Fig. 308: Locating Heated Oxygen Sensor (HO2S) Electrical Connector
Courtesy of FORD MOTOR CO.

Vehicles with manual transmission

19. Attach the wiring harness retainers and connect the transmission electrical connectors.

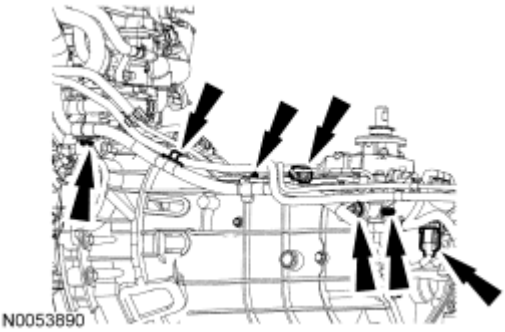


Fig. 309: Locating Wiring Harness Retainers & Connecting Transmission Electrical Connectors
Courtesy of FORD MOTOR CO.

20. Route the wiring harness over the transmission, position the bracket and install the nut. Connect the catalyst monitor sensor electrical connector.
    - Tighten to 10 Nm (89 lb-in).

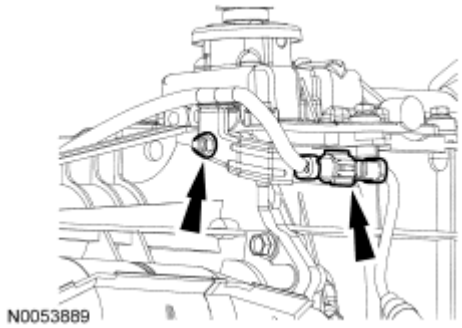


Fig. 310: Locating Catalyst Monitor Sensor Electrical Connector & Nut
Courtesy of FORD MOTOR CO.

21. Connect the HO2S electrical connector.

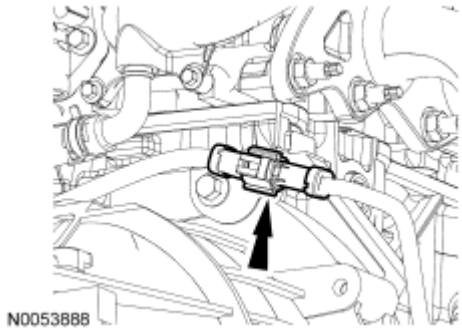


Fig. 311: Locating HO2S Electrical Connector
Courtesy of FORD MOTOR CO.

All vehicles

22. Connect the electrical connector and attach the wiring harness retainer to the crossmember.

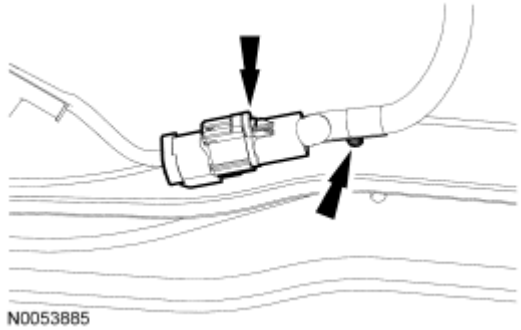


Fig. 312: Locating Electrical Connector & Wiring Harness Retainer To Crossmember
Courtesy of FORD MOTOR CO.

23. Position the exhaust front pipe and install the 2 nuts.
    - Tighten to 40 Nm (30 lb-ft).

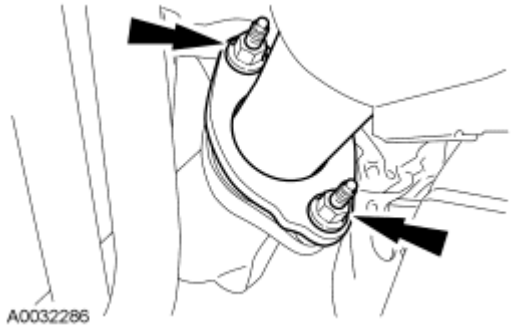


Fig. 313: Locating Exhaust Manifold-To-Front Pipe Nuts
Courtesy of FORD MOTOR CO.

24. Position the transmission dust shield and install the bolt.
    - Tighten to 10 Nm (89 lb-in).

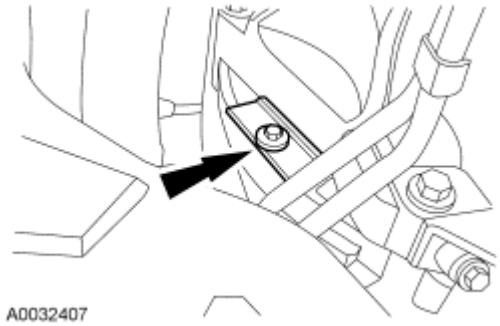


Fig. 314: Locating Transmission Dust Shield Bolts
Courtesy of FORD MOTOR CO.

Vehicles with automatic transmission

25. Install the transmission cooling tubes retaining bracket and the bolt.
    - Tighten to 28 Nm (21 lb-ft).

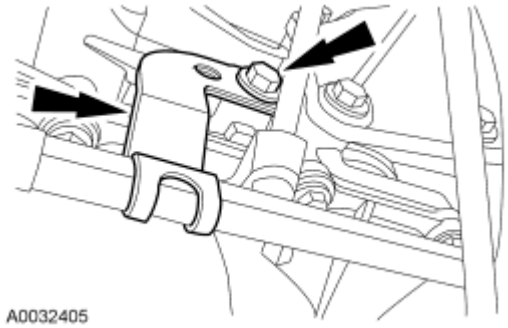


Fig. 315: Locating Transmission Cooling Tubes Retaining Bracket Bolts
Courtesy of FORD MOTOR CO.

All vehicles

26. Position the engine wiring harness and install the anchor and the pin-type retainer.

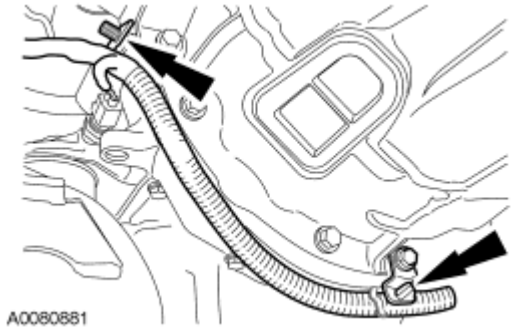


Fig. 316: Locating Anchor & Pin-Type Retainer
Courtesy of FORD MOTOR CO.

27. If equipped, connect the block heater electrical connector.

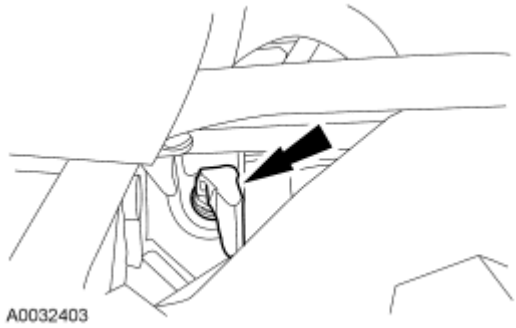


Fig. 317: Locating Block Heater Electrical Connector
Courtesy of FORD MOTOR CO.

28. Attach the generator wiring pin-type retainer.

Fig. 318: Locating Generator Wiring Pin-Type Retainer
Courtesy of FORD MOTOR CO.

29. Connect the generator electrical connections.

- Tighten to 8 Nm (71 lb-in).

Fig. 319: Locating Generator Electrical Connections
Courtesy of FORD MOTOR CO.

30. Position the splash shield and install the pushpins.

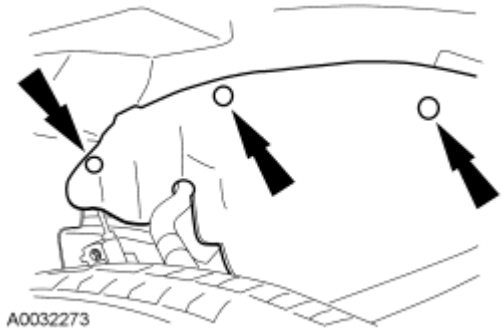


Fig. 320: Locating Splash Shield Pushpins
Courtesy of FORD MOTOR CO.

31. Position the starter wiring harness and install the support bracket and the bolt.
    - Tighten to 24 Nm (18 lb-ft).

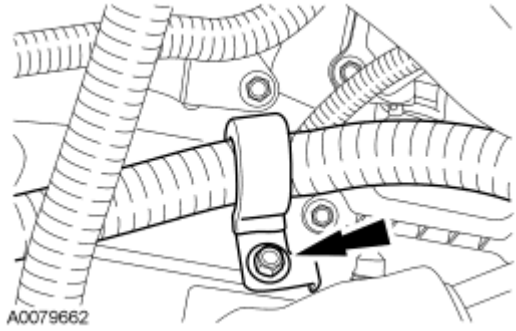


Fig. 321: Locating Starter Wiring Harness Clamp Bolt
Courtesy of FORD MOTOR CO.

32. Connect the following starter motor electrical connections.

- Install the solenoid control wire and nut.
  - Tighten to 6 Nm (53 lb-in).
- Install the negative battery cable and nut.
  - Tighten to 12 Nm (9 lb-ft).
- Install the positive battery cable at the starter and the nut.
  - Tighten to 12 Nm (9 lb-ft).

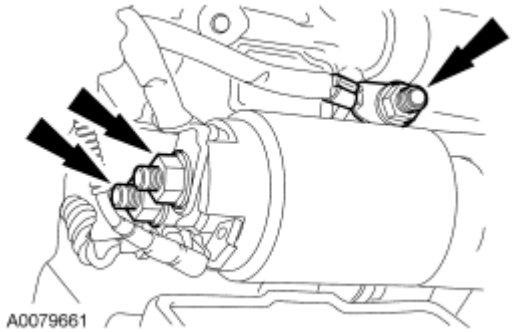


Fig. 322: Locating Solenoid Control Wire & Nut
Courtesy of FORD MOTOR CO.

33. Connect the brake booster vacuum hose and the engine ground strap.
    - Tighten to 10 Nm (89 lb-in).

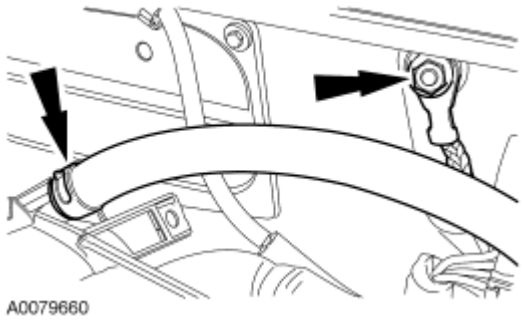


Fig. 323: Locating Brake Booster Vacuum Hose & Engine Ground Strap
Courtesy of FORD MOTOR CO.

34. Connect the electrical connectors, the fuel supply tube and the evaporative purge tube quick connect coupling. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.

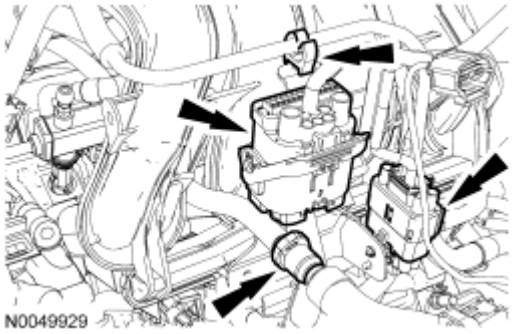


Fig. 324: Locating Fuel Supply Tube Spring Lock Coupling
Courtesy of FORD MOTOR CO.

35. Connect the fuel supply tube spring lock coupling. For additional information, refer to **FUEL SYSTEM - GENERAL INFORMATION** article.

NOTE: Install a new nylon O-ring seal.

36. Connect the power steering high-pressure tube and the power steering pressure (PSP) switch electrical connector.
    - Tighten to 20 Nm (15 lb-ft).

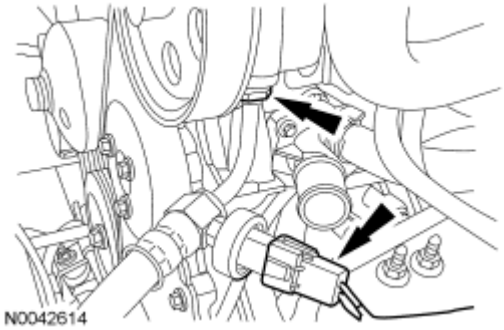


Fig. 325: Locating Power Steering Pressure (PSP) Switch Electrical Connector
Courtesy of FORD MOTOR CO.

37. Connect the accelerator cable and, if equipped, the speed control cable to the throttle body (TB) and the cable mounting bracket.

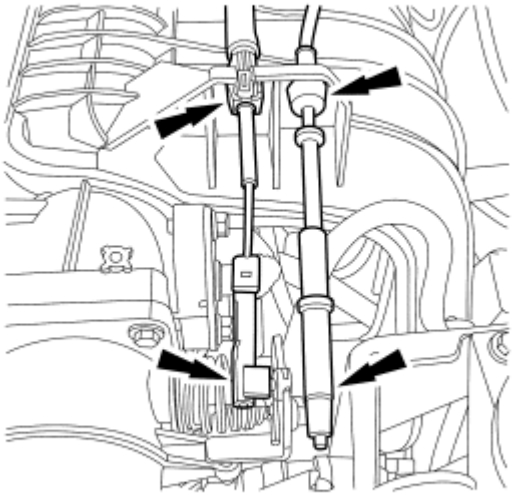


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Fig. 326: Locating Accelerator Cable
Courtesy of FORD MOTOR CO.

38. Remove the plugs and connect the A/C compressor manifold.
    - Tighten to 20 Nm (15 lb-ft).

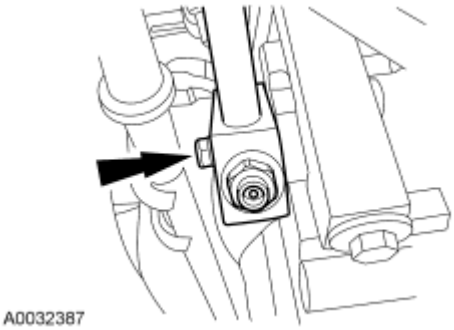

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Fig. 327: Locating A/C Compressor Manifold Bolt
Courtesy of FORD MOTOR CO.

39. Connect the mass air flow (MAF) sensor electrical connector.

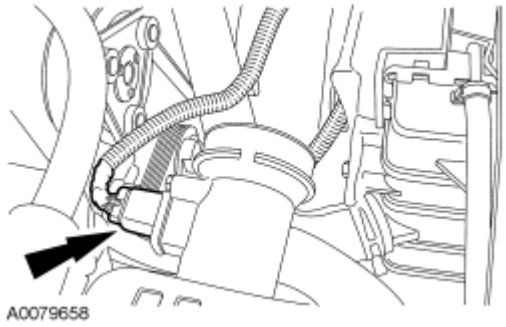

Fig. 328: Locating Mass Airflow Sensor (MAF) Electrical Connector
Courtesy of FORD MOTOR CO.

40. Connect the A/C compressor electrical connector.

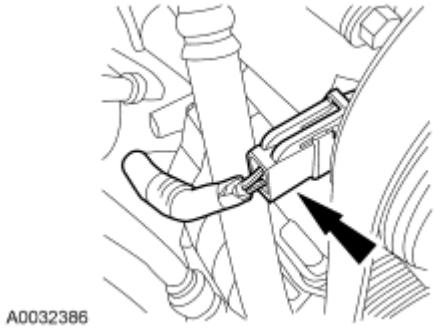

Fig. 329: Locating A/C Compressor Electrical Connector
Courtesy of FORD MOTOR CO.

41. Connect the coolant reservoir-to-engine supply hose.

Fig. 330: Locating Coolant Reservoir-To-Engine Supply Hose
Courtesy of FORD MOTOR CO.

42. Connect the engine-to-coolant reservoir bypass hose.

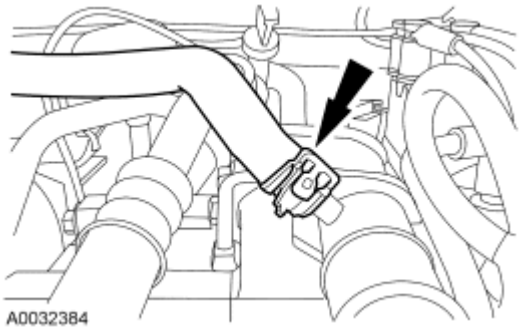

Fig. 331: Locating Engine-To-Coolant Reservoir Bypass Hose
Courtesy of FORD MOTOR CO.

43. Connect the vacuum reservoir tube.

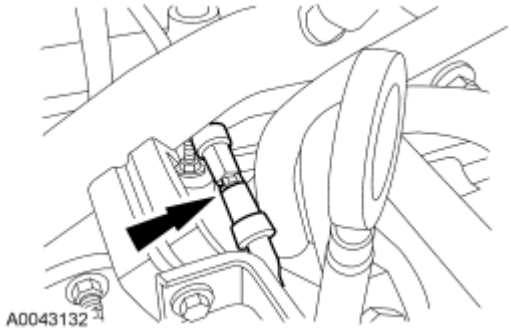

Fig. 332: Locating Vacuum Reservoir Tube Connection
Courtesy of FORD MOTOR CO.

44. Install the heater hose assembly.
    1. Connect the heater hoses to the heater core.
    2. Connect the vacuum hose.
    3. Connect the heater hoses to the engine.

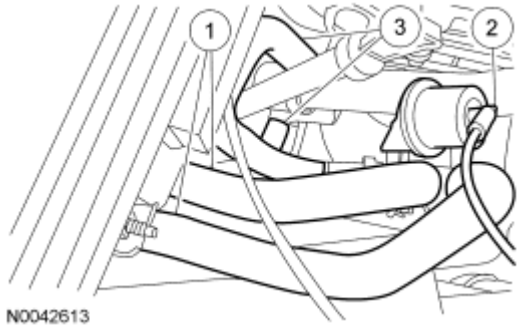

Fig. 333: Identifying Heater Hose Assembly
Courtesy of FORD MOTOR CO.

45. Install the ground strap and stud bolt.

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

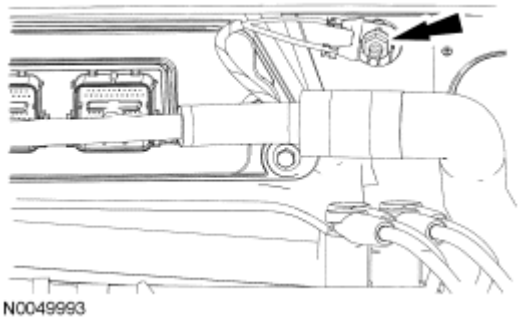

Fig. 334: Locating Ground Strap & Stud Bolt
Courtesy of FORD MOTOR CO.

46. Position the PCM harness, install the harness retaining nut and connect the 3 PCM electrical connectors.
    - Tighten the harness retainer nut to 4 Nm (35 lb-in).

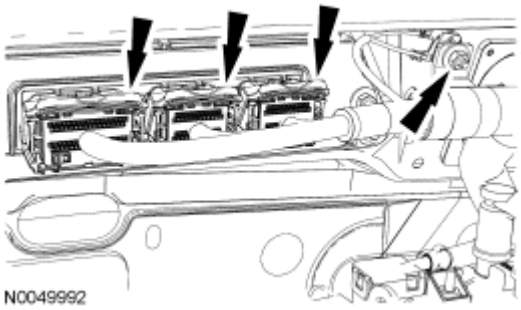

Fig. 335: Powertrain Control Module (PCM) Connectors
Courtesy of FORD MOTOR CO.

47. Install the lower radiator hose.

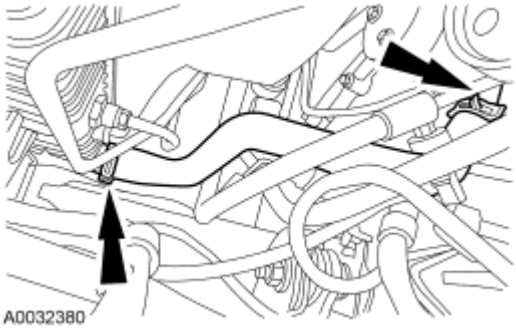

Fig. 336: Locating Lower Radiator Hose
Courtesy of FORD MOTOR CO.

48. Install the fan shroud. For additional information, refer to **ENGINE COOLING** article.

49. Install the upper radiator hose.

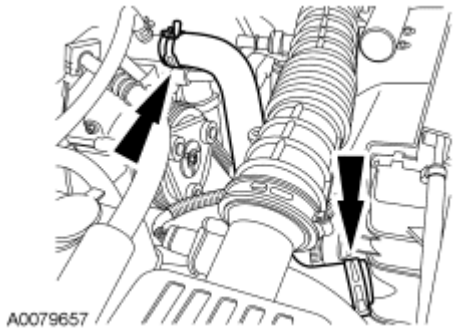

Fig. 337: Locating Upper Radiator Hose
Courtesy of FORD MOTOR CO.

50. Install the air cleaner outlet pipe. For additional information, refer to **INTAKE AIR DISTRIBUTION & FILTERING** article.
51. Install the hood.
52. Fill the engine with clean engine oil.
53. Connect the battery ground cable. For additional information, refer to **BATTERY, MOUNTING & CABLES** article.
54. Fill and bleed the engine cooling system. For additional information, refer to **ENGINE COOLING** article.
55. Fill and bleed the power steering system. For additional information, refer to **STEERING SYSTEM - GENERAL INFORMATION** article.
56. Evacuate and charge the A/C system. For additional information, refer to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION & DIAGNOSTICS** article.

