

SECTION 303-04C: Fuel Charging and Controls — 5.0L (4V)
SPECIFICATIONS

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Material

Item	Specification	Fill Capacity
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	—

Torque Specifications

Description	Nm	lb-in
Fuel pump control module nuts	8	71
Fuel rail bolts ^a	—	—
Throttle Body (TB) bolts ^a	—	—

^a Refer to the procedure.

Fuel Charging and Controls

Sequential Multi-Port Fuel Injection (SFI)

The fuel charging and controls system consists of the:

- electronic Throttle Body (TB).
- fuel injectors.
- fuel rail.
- fuel pump control module.

The fuel charging and controls system is:

- a Sequential Multi-Port Fuel Injection (SFI) system.
- Pulse Width Modulated (PWM).
- Mass Air Flow (MAF) controlled.

Fuel is metered into each intake port in a sequential firing order. Fuel injectors pulse to follow engine firing order, in accordance with engine demand, on a tuned intake manifold.

The basic fuel requirement of the engine is determined from the data supplied to the PCM by the MAF sensor, which measures the amount of air being drawn into the engine.

The various sensors detect any changes in the operating conditions and send signals to the PCM. This permits the PCM to control the opening duration (pulse width) of the fuel injectors and maintain optimum exhaust emission control and engine performance for all operating conditions.

Throttle Body (TB)

The TB:

- controls air supply to the intake manifold by electronically positioning the throttle plate.
- is not adjustable.

Fuel Rail

The fuel rail:

- receives fuel from the fuel supply tube.
- delivers fuel to the fuel injectors.

Fuel Injectors

The fuel injectors:

- are electronically operated by the PCM.
- atomize the fuel as the fuel is delivered.
- each have an internal solenoid which opens a needle valve to inject fuel into the intake manifold.
- are deposit-resistant.

Fuel Pump Control Module

The fuel pump control module:

- controls the voltage to the Fuel Pump (FP) based on the duty cycle request from the PCM.
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REMOVAL AND INSTALLATION

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Fuel Injectors

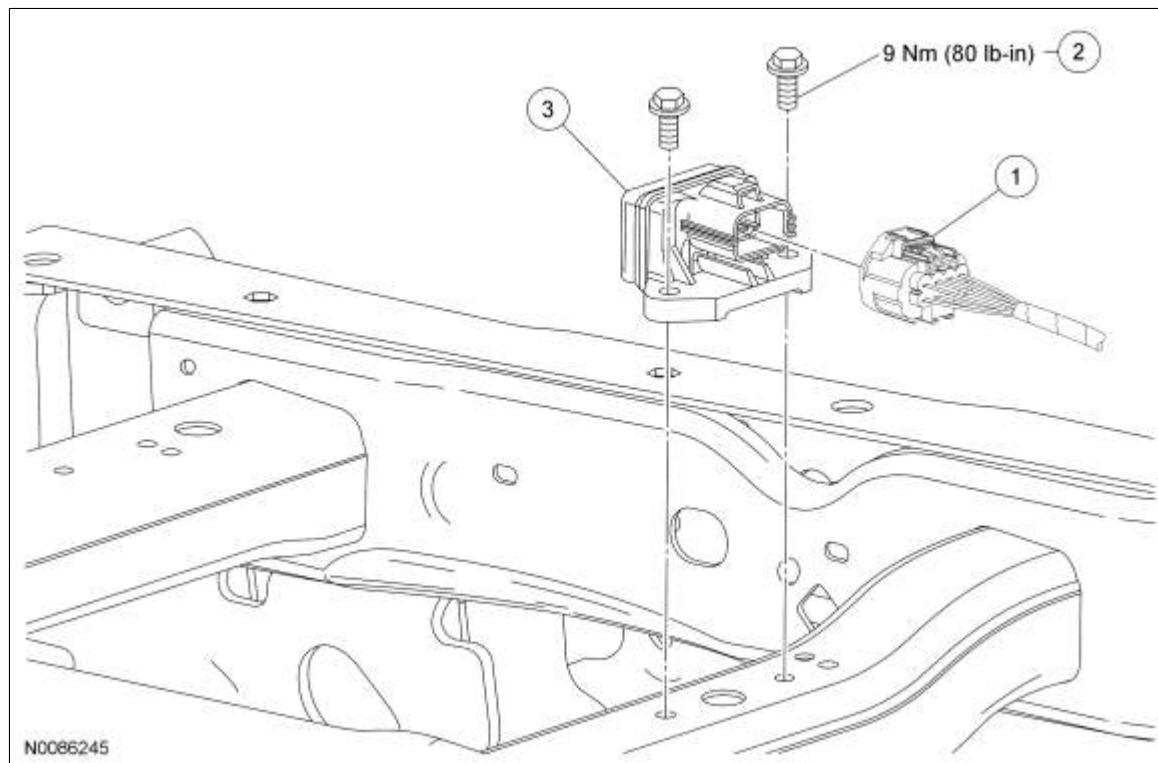
Removal and Installation

1. The fuel injectors are serviced with the fuel rail. For additional information, refer to [Fuel Rail and Fuel Injector — Exploded View](#) and [Fuel Rail](#) in this section.
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Fuel Pump Control Module



Item	Part Number	Description
1	14A464	Fuel Pump (FP) control module electrical connector (part of 14404)
2	W705549	FP control module bolt (2 required)
3	9D412	FP control module

Removal and Installation

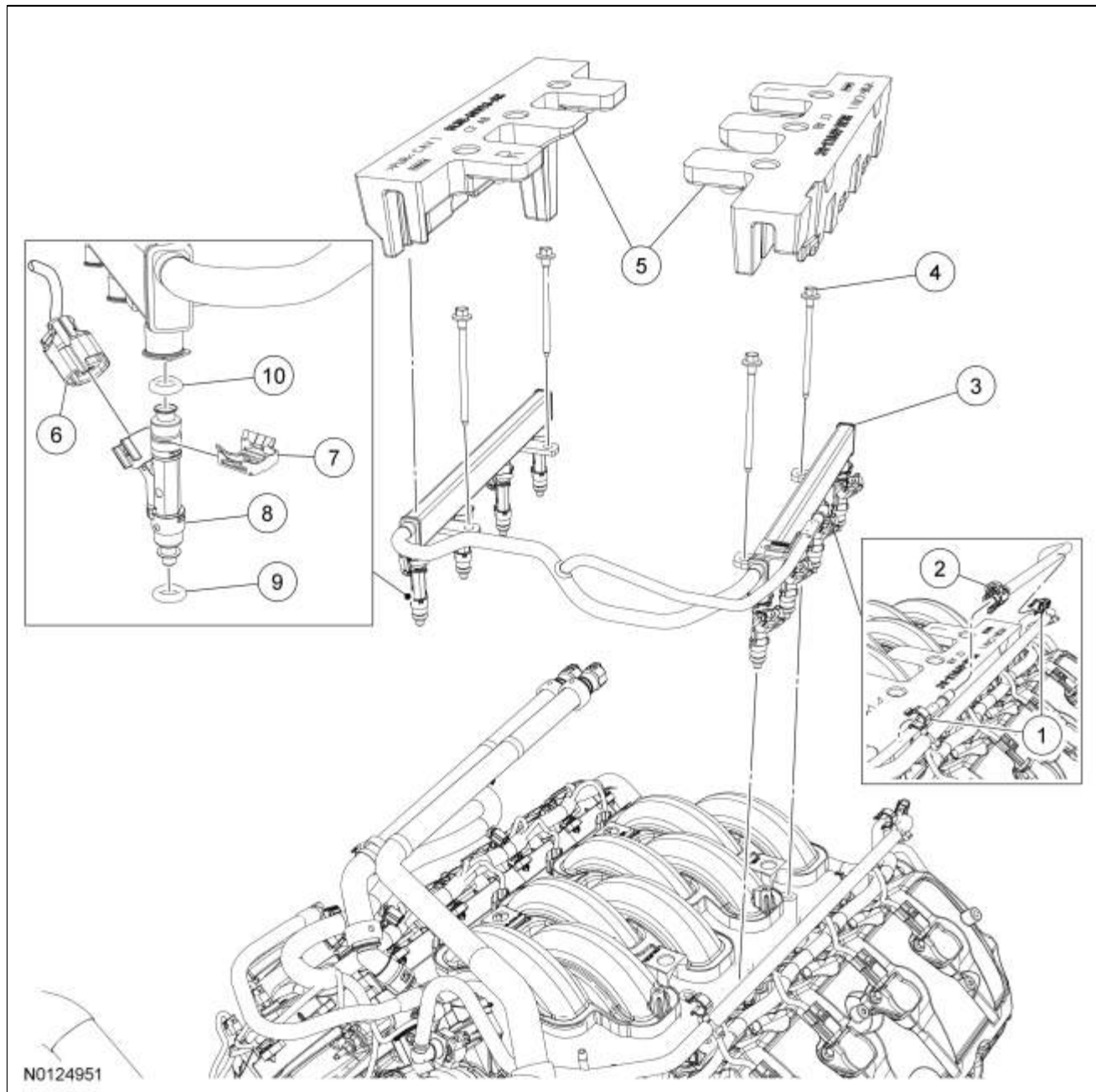
1. Disconnect the Fuel Pump (FP) control module electrical connector.
2. Remove the 2 bolts and the FP control module.
 - To install, tighten to 9 Nm (80 lb-in).
3. To install, reverse the removal procedure.

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Fuel Rail and Fuel Injector — Exploded View

Fuel Rail Insulators, Fuel Rail and Fuel Injectors



Item	Part Number	Description
1	—	Evaporative Emission (EVAP) tube retaining clips

		(part of 9J280)
2	9J280	Fuel supply tube
3	9F792	Fuel rail
4	W714864	Fuel rail bolt (4 required)
5	6P013	Fuel rail insulators
6	—	Fuel injector electrical connector (part of 12A581) (8 required)
7	9C995	Fuel injector clip (8 required)
8	9F593	Fuel injector (8 required)
9	9229	Lower fuel injector O-ring seal (8 required)
10	9229	Upper fuel injector O-ring seal (8 required)

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

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



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



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



WARNING: Do not carry personal electronic devices such as cell phones, pagers or audio equipment of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.



WARNING: Clean all fuel residue from the engine compartment. If not removed, fuel residue may ignite when the engine is returned to operation. Failure to follow this instruction may result in serious personal injury.



WARNING: Always disconnect the battery ground cable at the battery when working on an evaporative emission (EVAP) system or fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

1. Release the fuel system pressure. For additional information refer to [Section 310-00](#).
2. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
3. Disconnect the 2 Evaporative Emission (EVAP) tube retaining clips from the fuel rail.
4. Remove the LH and RH fuel rail insulators.
5. Disconnect the 8 fuel injector electrical connectors.

6. Disconnect the fuel supply tube. For additional information, refer to the quick connect procedure in [Section 310-00](#).
7. Remove the 4 fuel rail bolts.
8. Remove the fuel rail and fuel injectors as an assembly from the intake manifold.
9. Remove the retaining clips and fuel injectors from the fuel rail.
10. **NOTICE: Do not reuse the O-ring seals. Failure to follow this direction may cause the fuel system to leak.**

Remove and discard the fuel injector O-ring seals.

Installation

1. **NOTICE: Use O-ring seals that are made of special fuel-resistant material. Use of ordinary O-ring seals may cause the fuel system to leak.**

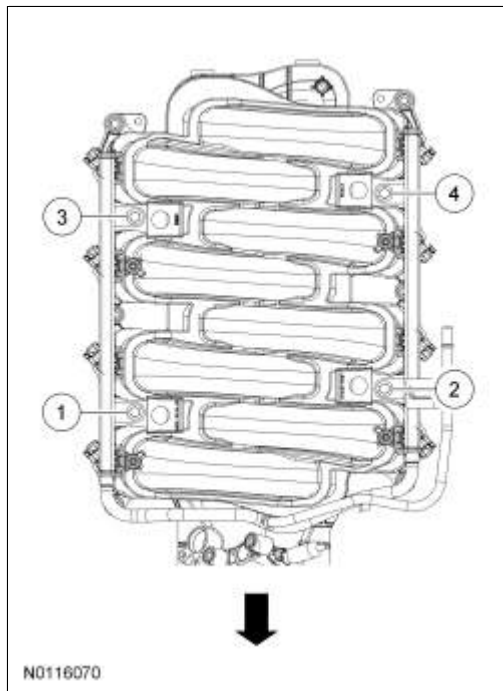
Install new O-ring seals on the fuel injectors.

2. **NOTE:** The fuel injector clip can be reused if it is not damaged during removal. If the clip is reused, the 2 sides of the clip should be squeezed back into shape by placing it between index finger and thumb.

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

Install the fuel injectors and retaining clips onto the fuel rail.

3. Install the fuel rail and fuel injectors as an assembly onto the intake manifold.
4. Install the 4 bolts and tighten in the sequence shown in 3 stages.
 - Stage 1: Hand tighten.
 - Stage 2: Tighten to 10 Nm (89 lb-in).
 - Stage 3: Tighten an additional 90 degrees.

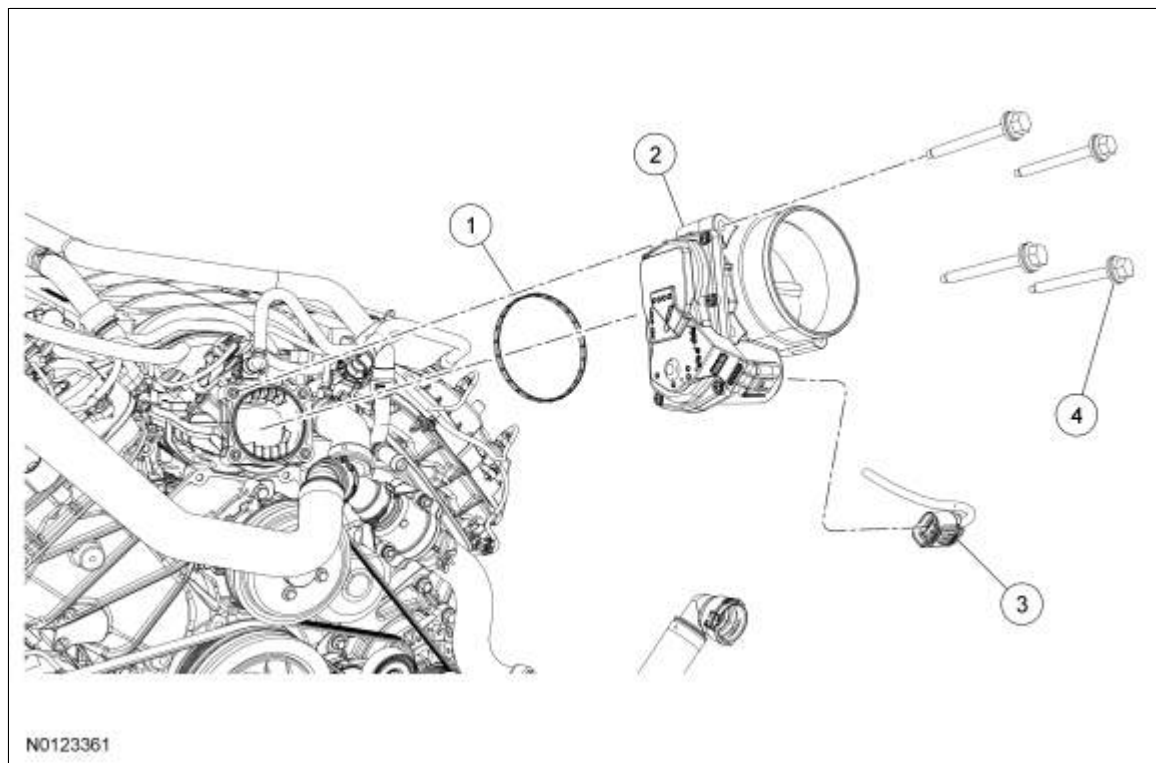


5. Connect the fuel supply tube. For additional information, refer to the quick connect procedure in [Section 310-00](#).
 6. Connect the 8 fuel injector electrical connectors.
 7. Install the LH and RH fuel rail insulators.
 8. Connect the 2 EVAP tube retaining clips to the fuel rail.
 9. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
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Throttle Body



Item	Part Number	Description
1	9E936	Throttle Body (TB) gasket
2	9E926	<u>TB</u>
3	—	Electronic throttle control electrical connector (part of 12A581)
4	W714866	<u>TB</u> bolt (4 required)

Removal

1. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to [Section 303-12](#).
2. Disconnect the Electronic Throttle Control (ETC) electrical connector.
3. Remove the 4 bolts and the Throttle Body (TB)
 - Discard the gasket.

Installation

1. Using a new gasket, position the TB and install the 4 bolts loosely.
2. While holding the TB in the most upward position tighten the 4 bolts in 2 stages.

- Stage 1: Tighten to 10 Nm (89 lb-in).
 - Stage 2: Tighten an additional 45 degrees.
3. Connect the ETC electrical connector.
 4. Install the ACL outlet pipe. For additional information, refer to [Section 303-12](#).
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SECTION 303-07C: Engine Ignition — 5.0L (4V)
SPECIFICATIONS

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Material

Item	Specification	Fill Capacity
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	—

General Specifications

Item	Specification
Firing order	1-5-4-8-6-3-7-2
Spark plug gap	1.25 - 1.35 mm (0.049 - 0.053 in)
Spark plug type	12405

Torque Specifications

Description	Nm	lb-in
Ignition coil-on-plug bolts	6	53
Spark plugs	14	124

SECTION 303-07C: Engine Ignition — 5.0L (4V)
DESCRIPTION AND OPERATION

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Engine Ignition

The Electronic Ignition (EI) system is a coil-on-plug ignition system. The coil-on-plug ignition system consists of the:

- eight ignition coil-on-plugs.
- eight spark plugs.

The 8 separate ignition coil-on-plugs:

- change low voltage signals from the PCM to high voltage pulses.
- produce the high voltage pulses to the spark plugs.
- are connected directly to the spark plug.
- have replaceable ignition coil-on-plug seals.

The 8 spark plugs:

- change high voltage pulses into a spark which ignites the fuel and air mixture.
 - originally equipped on the vehicle have a iridium-enhanced fine wire electrode for long life.
-

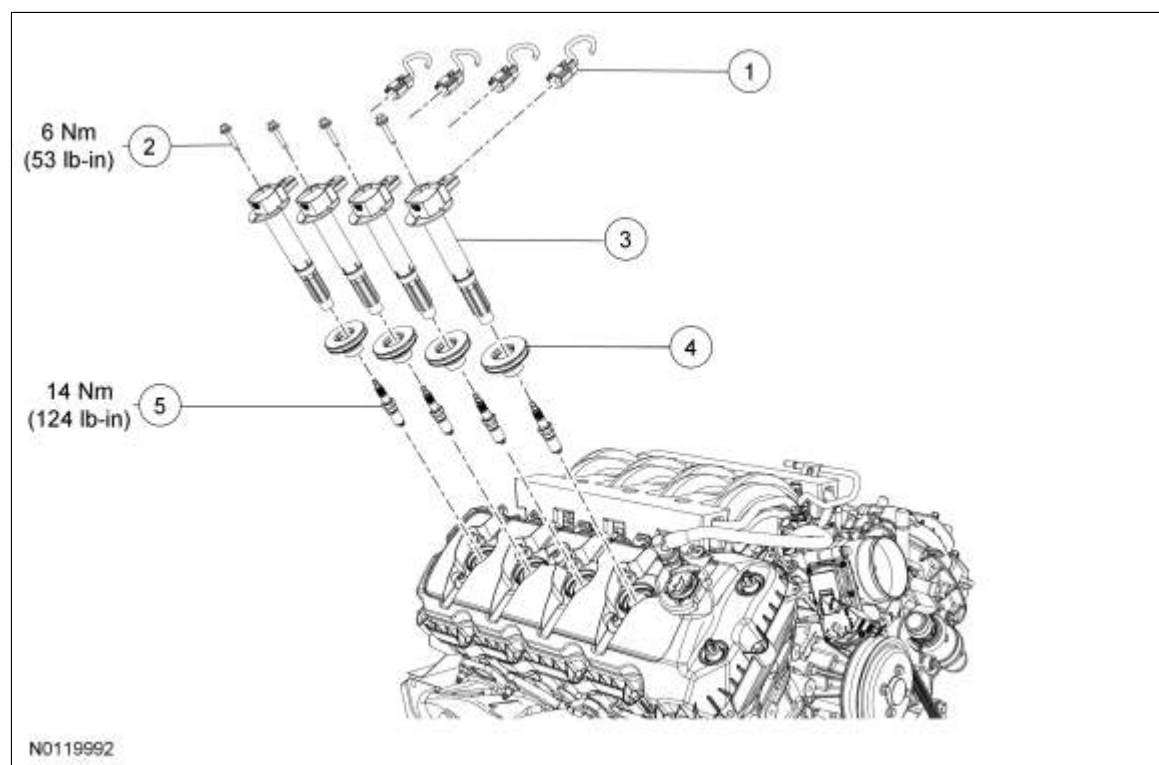
SECTION 303-07C: Engine Ignition — 5.0L (4V)
REMOVAL AND INSTALLATION

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Engine Ignition Components — Exploded View

LH Ignition Components

NOTE: RH side shown, LH side similar



Item	Part Number	Description
1	—	Ignition coil-on-plug electrical connector (part of 9D930) (4 required)
2	W714507	Ignition coil-on-plug bolt (4 required)
3	12029	Ignition coil-on-plug (4 required)
4	12025	Ignition coil-on-plug seal (part of 12029) (4 required)
5	12405	Spark plug (4 required)

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

SECTION 303-07C: Engine Ignition — 5.0L (4V)
REMOVAL AND INSTALLATION

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Ignition Coil-On-Plug

Material

Item	Specification
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A

Removal and Installation

1. **NOTE:** Use compressed air to remove any foreign material from the ignition coil-on-plugs and surrounding area before removing the ignition coil-on-plugs.

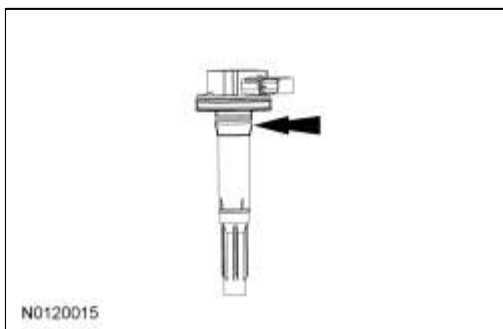
Disconnect the 8 ignition coil-on-plug electrical connectors.

2. **NOTE:** When removing the ignition coil-on-plugs, a slight twisting motion will break the seal and ease removal.

Remove the 8 bolts and the 8 ignition coil-on-plugs.

- To install, tighten to 6 Nm (53 lb-in).

3. Inspect the ignition coil-on-plug seals for rips, nicks or tears. Remove and discard any damaged ignition coil-on-plug seals.
 - To install, slide the new ignition coil-on-plug seal onto the ignition coil-on-plug until it is fully seated at the top of the ignition coil-on-plug .



4. **NOTE:** Verify that the ignition coil-on-plug spring is correctly located inside the ignition coil-on-plug boot and that there is no damage to the tip of the boot.

To install, reverse the removal procedure.

- Apply a small amount of dielectric grease to the inside of the ignition coil-on-plug boots before attaching to the spark plugs.

SECTION 303-07C: Engine Ignition — 5.0L (4V)
REMOVAL AND INSTALLATION

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Spark Plugs

Removal and Installation

1. Remove the ignition coil-on-plugs. For additional information, refer to [Ignition Coil-On-Plug](#) in this section.
2. **NOTICE:** Only use hand tools when removing or installing the spark plugs, or damage may occur to the cylinder head or spark plug.

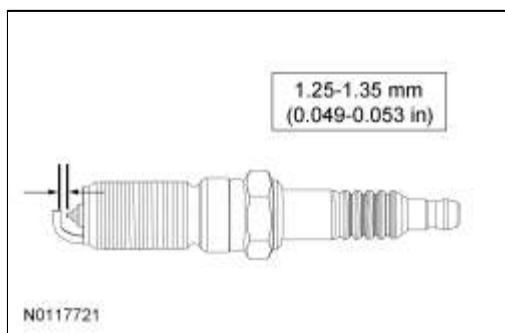
NOTE: Use compressed air to remove any foreign material from the spark plug well before removing the spark plugs.

NOTE: If an original spark plug is used, make sure it is installed in the same cylinder from which it was taken. New spark plugs can be used in any cylinder.

Remove the 8 spark plugs.

- To install, tighten to 14 Nm (124 lb-in).

3. Inspect the spark plugs. Install new spark plugs as necessary. For additional information, refer to [Section 303-00](#).
4. Adjust the spark plug gap as necessary.



5. To install, reverse the removal procedure.
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SECTION 303-01C: Engine — 5.0L (4V)
SPECIFICATIONS

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Material

Item	Specification	Fill Capacity
Motorcraft® Multi-Purpose Grease XL-5	ESB-M1C93-B	—
Motorcraft® Metal Surface Prep ZC-31-A	—	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A	7.33 L (7.75 qt)
Motorcraft® Silicone Gasket Remover ZC-30	—	—
Motorcraft® Orange Antifreeze/Coolant Concentrated VC-3-B (US); CVC-3-B2 (Canada)	WSS-M97B44-D	—
Motorcraft® Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A	—
Motorcraft® Silicone Gasket and Sealant TA-30	WSE-M4G323-A4	—
Motorcraft® Threadlock 262 TA-26	WSK-M2G351-A6	—

General Specifications

Item	Specification
Engine	
Displacement	4.957 L (302 CID)
Number of cylinders	8
Bore	92.2 mm (3.629 in)
Stroke	92.7 mm (3.649 in)
Firing order	1-5-4-8-6-3-7-2
Spark plug	12405
Spark plug gap	1.25-1.35 mm (0.049-0.053 in)
Minimum oil pressure at idle (engine at normal operating temperature, transmission in park)	103 kPa (15 psi)
Compression ratio	10.5:1

Engine weight	197.3 kg (435 lb)
Cylinder Head and Valve Train	
Combustion chamber volume	54.5-57.5 cc (3.33-3.51 cu in)
Valve stem diameter — intake	5.975-5.995 mm (0.2352-0.2360 in)
Valve stem diameter — exhaust	5.950-5.970 mm (0.2342-0.2350 in)
Valve stem-to-guide clearance — intake	0.020-0.069 mm (0.0008-0.0027 in)
Valve stem-to-guide clearance — exhaust	0.045-0.094 mm (0.0018-0.0037 in)
Valve head diameter — intake	37 mm (1.45 in)
Valve head diameter — exhaust	31 mm (1.22 in)
Valve face runout	0.05 mm (0.0019 in)
Valve face angle	45 degrees
Valve seat width — intake	1.3-1.5 mm (0.051-0.059 in)
Valve seat width — exhaust	1.4-1.6 mm (0.059-0.063 in)
Valve seat runout	0.04 mm (0.0016 in)
Valve seat angle	120/90/60 degrees
Valve spring free length — intake	51.32 mm (2.02 in)
Valve spring free length — exhaust	51.32 mm (2.02 in)
Valve spring perpendicularity — intake	3 mm (0.118 in)
Valve spring perpendicularity — exhaust	3 mm (0.118 in)
Valve spring compression force — intake	650 N
Valve spring compression force — exhaust	650 N
Valve spring installed height — intake	40 mm (1.5748 in)
Valve spring installed height — exhaust	40 mm (1.5748 in)
Valve spring installed force — intake	265 N
Valve spring installed force — exhaust	265 N
Roller follower ratio	2:1
Head gasket surface flatness	0.025 mm (0.001 in) in any 25 mm (1 in) x 25 mm (1 in) area; 0.050 mm (0.002 in) in any 150 mm (6 in) x 150 mm (6 in) area; 0.1 mm (0.004 in) overall
Hydraulic Lash Adjuster	
Diameter — intake	11.89-12.00 mm (0.4681-0.472 in)
Diameter — exhaust	11.89-12.00 mm (0.4681-0.472 in)
Clearance-to-bore	0.018-0.050 mm (0.0007-0.0019 in)
Hydraulic leakdown rate — intake	0.45-3 seconds ^a
Hydraulic leakdown rate — exhaust	0.45-3 seconds ^a
Collapsed lash adjuster gap	0.35-0.85 mm (0.0137-0.0334 in)
Camshaft	

Lobe lift — intake	5.258 mm (0.2070 in)
Lobe lift — exhaust	5.488 mm (0.2160 in)
Journal diameter	28.607-28.633 mm (1.1262-1.1272 in)
Journal bore inside diameter	28.682-28.657 mm (1.1292-1.1282 in)
Journal-to-bearing clearance	0.025-0.075 mm (0.001-0.002 in)
Runout	0.04 mm (0.0016 in) (4 places)
End play	0.15 mm (0.0059 in)
Cylinder Block	
Cylinder bore diameter	92.200-92.220 mm (3.6299-3.6307 in)
Cylinder bore maximum taper	0.013 mm (0.0005 in)
Cylinder bore maximum out-of-round	0.010 mm (0.0004 in)
Main bearing bore inside diameter	72.400-72.424 mm (2.850-2.851 in)
Head gasket surface flatness	0.0254 mm (0.001 in) across any 38.1 mm (1.5 in) square
Crankshaft	
Main bearing journal diameter	67.481-67.505 mm (2.657-2.658 in)
Main bearing journal maximum taper	0.004 mm (0.0002 in)
Main bearing journal maximum out-of-round	0.008 mm (0.0003 in) between cross sections
Main bearing journal-to-main bearing clearance	0.025-0.045 mm (0.0009-0.0018 in)
Connecting rod journal diameter	52.983-53.003 mm (2.086-2.087 in)
Connecting rod journal maximum taper	0.004 mm (0.0002 in)
Crankshaft maximum end play	0.28 mm (0.011 in)
Piston and Connecting Rod	
Piston diameter	92.161-92.175 mm (3.6283-3.6289 in)
Piston-to-cylinder bore clearance (at grade size) ^b	0.025-0.059 mm (0.0009-0.0023 in)
Piston ring end gap — top	0.15-0.25 mm (0.0059-0.0098 in)
Piston ring end gap — intermediate	0.30-0.55 mm (0.0118-0.0216 in)
Piston ring gap — oil control	0.15-0.45 mm (0.0059-0.0177 in)
Piston ring groove width — top	1.220-1.250 mm (0.0480-0.0492 in)
Piston ring groove width — intermediate	1.220-1.240 mm (0.0480-0.0488 in)
Piston ring groove width — oil control	2.530-2.550 mm (0.0996-0.1003 in)
Piston ring width — top	1.17-1.19 mm (0.0460-0.0468 in)
Piston ring width — intermediate	1.17-1.19 mm (0.0460-0.0468 in)
Piston ring-to-groove clearance — top	0.030-0.080 mm (0.0019-0.0031 in)
Piston ring-to-groove clearance — intermediate	0.030-0.070 mm (0.0019-0.0028 in)
Piston pin bore diameter	22.004-22.010 mm (0.8663-0.8665 in)
Piston pin diameter	21.997-22.000 mm (0.8649-0.8661 in)
Piston pin length	60.7-61.0 mm (2.3897-2.4015 in)
Piston pin-to-piston fit (clearance)	0.004-0.013 mm (0.0002-0.0005 in)

Connecting rod-to-pin clearance	0.003-0.018 mm (0.0001-0.0007 in)
Connecting rod pin bore diameter	22.003-22.015 mm (0.8663-0.8667 in)
Connecting rod length (centerline bore-to-bore)	150.7 mm (5.933 in)
Connecting rod maximum allowed bend	0.038 mm (0.0015 in)
Connecting rod maximum allowed twist	0.050 mm (0.0019 in)
Connecting rod bearing-to-crankshaft clearance	0.028-0.069 mm (0.0011-0.0027 in)
Connecting rod side clearance (as assembled to crank) — standard play	0.325 mm (0.0128 in)
Connecting rod side clearance (as assembled to crank) — max. play	0.500 mm (0.0197 in)

^a Time required for the plunger to leak down 1.6 mm of travel with 222 N force and leakdown fluid in the lash adjuster.

^b Before Grafal coating.

Torque Specifications

Description	Nm	lb-ft	lb-in
Accessory drive belt tensioner bolt	48	35	—
A/C compressor stud bolts	25	18	—
Camshaft bearing cap bolts ^a	—	—	—
Camshaft bearing mega cap bolts ^a	—	—	—
Camshaft Position (CMP) sensor bolt	10	—	89
Catalytic convertor-to-exhaust manifold nuts	40	30	—
Connecting rod cap bolts ^a	—	—	—
Coolant outlet bolts	10	—	89
Coolant outlet pipe bolt	10	—	89
Coolant pump bolts	20	—	177
Coolant pump pulley bolts	20	—	177
Crankshaft main bearing cap bolts ^a	—	—	—
Crankshaft Position (CKP) sensor bolt	10	—	89
Crankshaft pulley bolt ^a	—	—	—
Crankshaft rear seal retainer plate bolts ^a	—	—	—
Cylinder head bolts ^a	—	—	—
Cylinder Head Temperature (CHT) sensor	11	—	97
Engine front cover bolts ^a	—	—	—
Engine front cover-to-oil filter adapter jackscrew ^a	—	—	—
Engine oil filter ^b	—	—	—
Engine Oil Pressure (EOP) ^c	—	—	—
Engine support insulator bracket bolts	63	46	—

Engine support insulator through bolts	350	258	—
Engine support insulator bolts ^a	—	—	—
Engine support insulator nuts	175	129	—
Engine support insulator studs	15	—	133
Engine-to-transmission bolts and stud bolts	48	35	—
Exhaust H-pipe clamp nuts	48	35	—
Exhaust manifold nuts ^a	—	—	—
Exhaust manifold studs	25	18	—
Flexplate ^a	—	—	—
Flexplate inspection cover bolts	35	26	—
Fuel rail bolts ^a	—	—	—
Generator B+ wire terminal nut	17	—	150
Generator bolt and nut	48	35	—
Ground strap-to-cowl bolt	10	—	89
Ground strap-to-frame bolt	12	—	106
Hood bolts	12	—	106
Ignition coil-on-plug bolt	6	—	53
Intake manifold assembly bolts ^a	—	—	—
Knock Sensor (KS)	20	—	177
Oil filter adapter bolts ^a	—	—	—
Oil pan bolts ^a	—	—	—
Oil pan drain plug	26	19	—
Oil pan stud bolts ^a	—	—	—
Oil pump bolts and stud bolts ^a	—	—	—
Oil pump screen and pickup tube bolts ^a	—	—	—
Oil pump screen and pickup tube spacer	25	18	—
Piston cooling jet bolts ^a	—	—	—
Primary timing chain tensioner bolts	10	—	89
Skid plate	48	35	—
Spark plugs	15	—	133
Thermostat housing bolts	10	—	89
Timing chain guide bolts	10	—	89
Torque converter nuts	40	30	—
Transmission fluid cooler tube bracket-to-flexplate inspection cover stud bolt nut	13	—	115
Transmission fluid cooler tube bracket-to-RH engine support insulator bracket stud bolt nut	48	35	—
Transmission mount-to-crossmember nut	25	18	—
Valve cover bolts ^a	—	—	—

VCT assembly bolts ^a	—	—	—
Wiring harness-to-frame bracket bolt	20	—	177

^a Refer to the procedure in this section.

^b Do not lubricate O-ring seal, tighten to 16 Nm (142 lb-in).

^c Tighten to 14 Nm (124 lb-in) plus an additional 180 degrees.

SECTION 303-01C: Engine — 5.0L (4V)
DESCRIPTION AND OPERATION

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 Procedure revision date: 10/25/2013

Engine

The 5.0L (302 CID) is a V-8 engine with the following features:

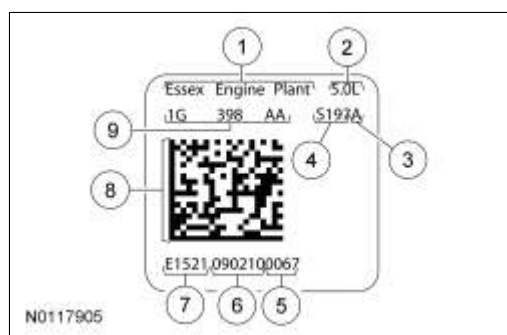
- Dual overhead camshafts
- Four valves per cylinder
- Sequential Multi-Port Fuel Injection (SFI)
- Aluminum cylinder heads
- Aluminum, 90-degree V-cylinder block
- Individually chain-driven camshafts with a hydraulic timing chain tensioner on each timing chain
- Electronic ignition system with 8 ignition coils
- Engine oil cooler

Engine 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 applications.

Engine Code Information Label

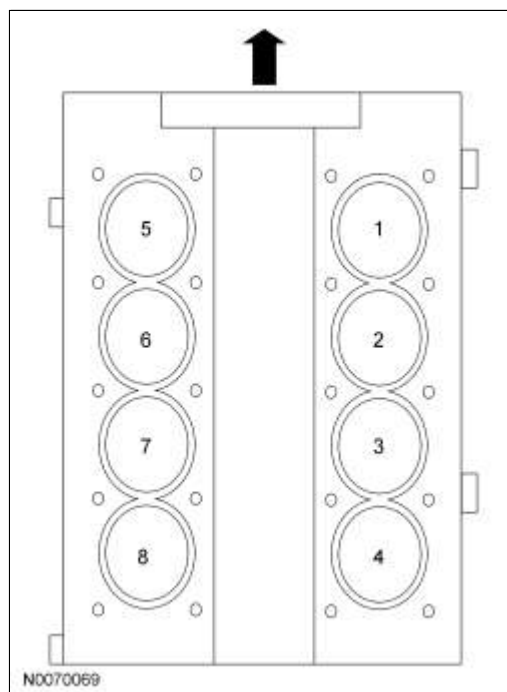
The engine code information label, located on the valve cover, contains the following:



Item	Description
1	Essex engine plant
2	Engine displacement
3	Transmission
4	Vehicle line
5	Sequential number

6	Engine build date (DDMMYY)
7	Essex engine plant
8	Bar code
9	Engine part number

Engine Cylinder Identification



Induction System

The SFI provides the fuel/air mixture needed for combustion in the cylinders. The 8 solenoid-operated fuel injectors:

- are mounted in the fuel injection supply manifold and the intake manifold above the cylinder heads.
- meter fuel into the air intake stream in accordance with engine demand.
- are positioned so that their tips direct fuel just ahead of the engine intake valves.
- supply fuel from the fuel tank by a fuel pump mounted in the fuel tank.

Crankshaft

The crankshaft is supported on the bottom of the cylinder block by 5 crankshaft main bearings.

Camshafts

The camshafts:

- are arranged in pairs, one each (intake and exhaust) on each cylinder head.
- are synchronized through a secondary timing chain.
- depress the roller followers to actuate the valves.

Valve Train

The valves are actuated by a hydraulic lash adjuster and roller follower. The hydraulic lash adjusters and roller followers:

- provide hydraulic lash adjustment.
- ride on the camshaft lobes.

Twin Independent Variable Camshaft Timing (VCT) System

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

PCV System

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

Engine Lubrication System

The engine lubrication system is of the force-feed type in which oil is supplied under full pressure to the:

- crankshaft main bearings.
- crankshaft thrust main bearing.
- connecting rod bearings.
- oil galleries.
- piston cooling jets.

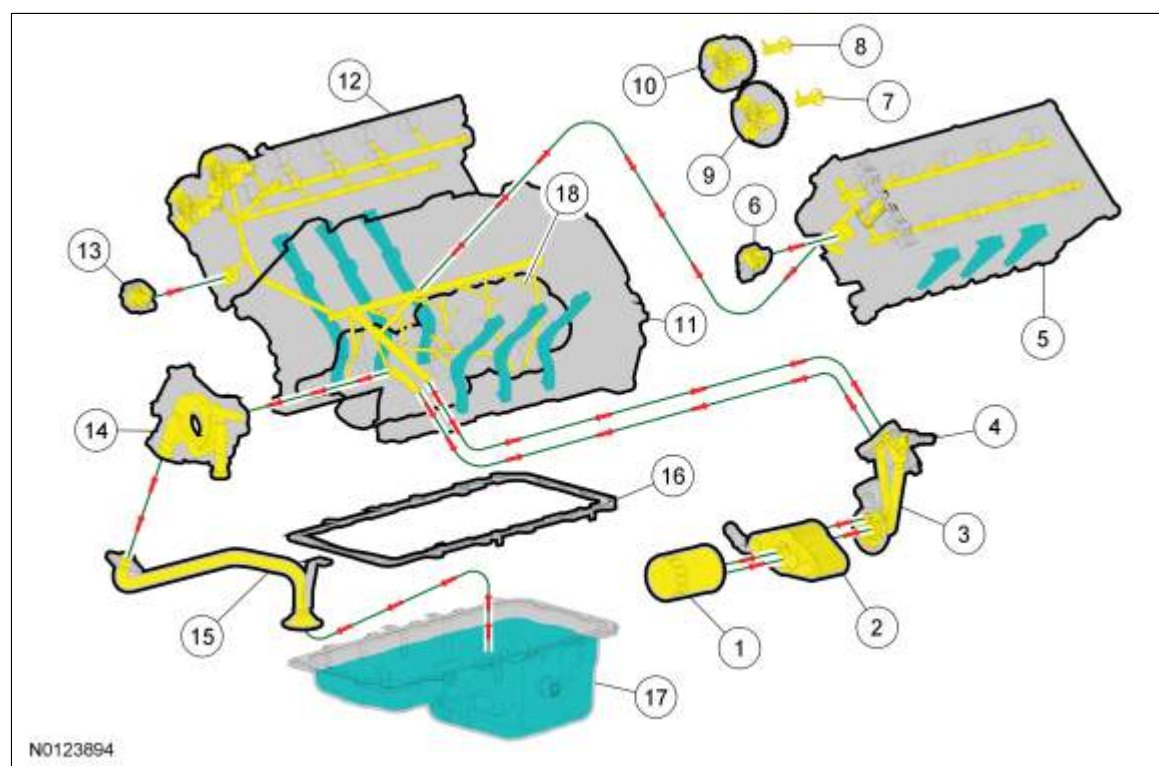
All other parts are lubricated by splash of the oil.

Oil Pump

The lubrication system of the 5.0L (4V) engine is designed to provide optimum oil flow to critical components of the engine through its entire operating range. The heart of the system is a positive displacement internal gear oil pump using top seal rotors.

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

Engine Assembly



Item	Part Number	Description
1	6714	Oil filter
2	6A642	Oil filter cooler
3	6881	Oil filter adapter
4	9278	Engine Oil Pressure (EOP) switch
5	6049	Cylinder head — LH

6	6L266	Timing chain tensioner — LH
7	6250	Exhaust camshaft
8	6250	Intake camshaft
9	6256	Exhaust camshaft Variable Camshaft Timing (VCT)
10	6256	Intake camshaft <u>VCT</u>
11	6010	Cylinder block
12	6049	Cylinder head — RH
13	6L266	Timing chain tensioner — RH
14	6600	Oil pump
15	6622	Oil pump screen and pickup tube
16	6710	Oil pan gasket
17	6675	Oil pan
18	6K868	Piston cooling jet (4 required)

SECTION 303-01C: Engine — 5.0L (4V)
DIAGNOSIS AND TESTING

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Engine

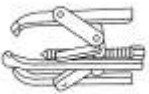

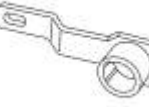
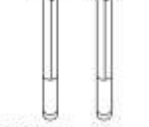


For basic engine mechanical concerns, refer to [Section 303-00](#). For driveability concerns, refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual.



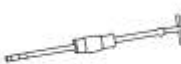
SECTION 303-01C: Engine — 5.0L (4V)
DISASSEMBLY

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Engine

Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
	Remover, Oil Seal 303-409 (T92C-6700-CH)

 ST1385-A	
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

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

NOTICE: 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.

NOTICE: Remove the cylinder heads before removing the crankshaft. Failure to do so can result in engine damage.

NOTE: If the components are to be reinstalled, they must be installed in their original location. Mark the components for installation into their original location.

NOTE: For additional information, refer to the exploded view under the Assembly procedure in this section.

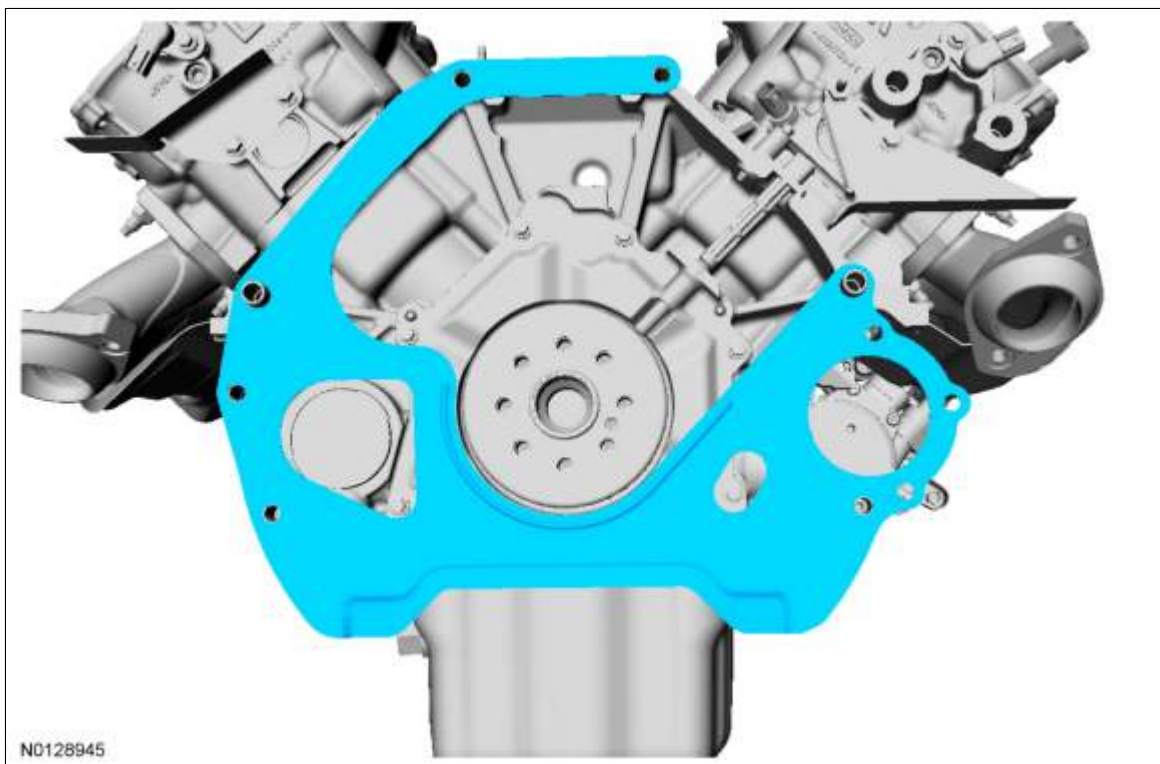
1. Remove the engine. For additional information, refer to [Engine](#) in this section.
2. **NOTE:** The flexplate bolts are torque-to-yield design and are not reusable.

Remove the 8 bolts and the flexplate.

- Discard the bolts.



3. Remove the engine separator plate.

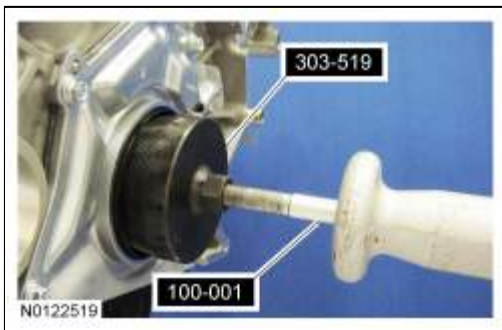


4. **NOTE:** Inspect the crankshaft sensor ring for damage. If the crankshaft sensor ring has been dropped or has any visual damage, it must be discarded.

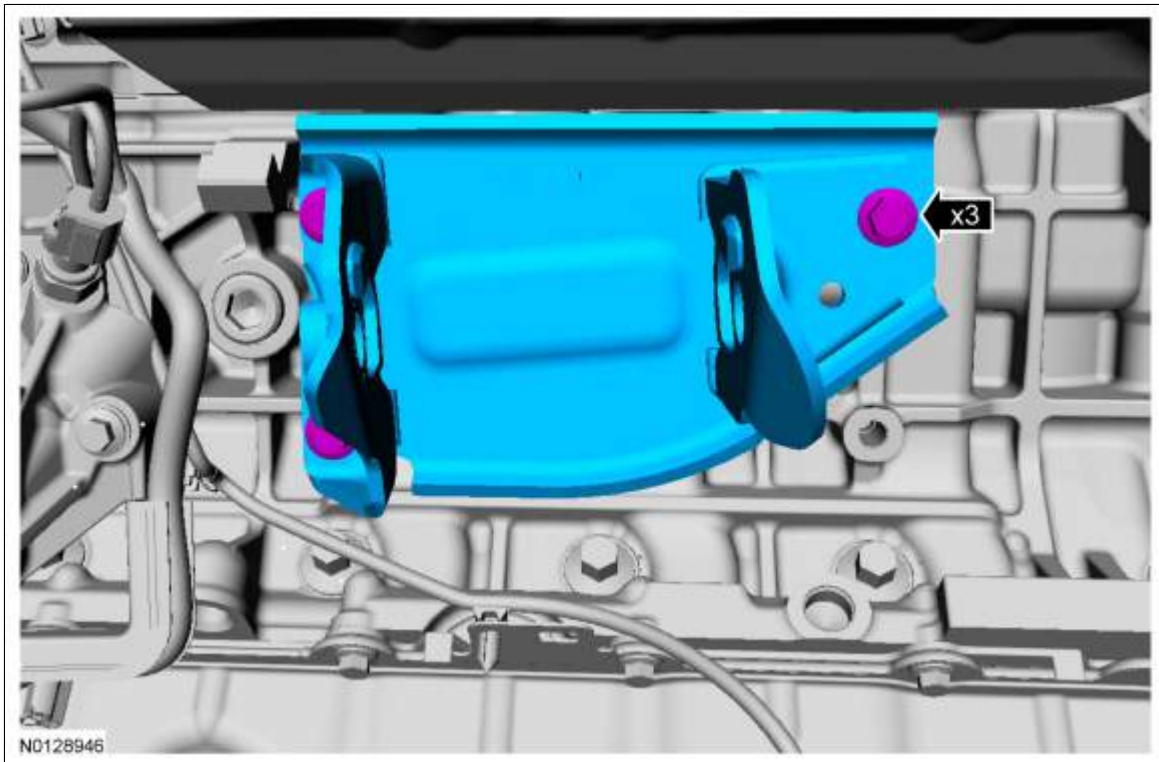
Remove the crankshaft sensor ring.



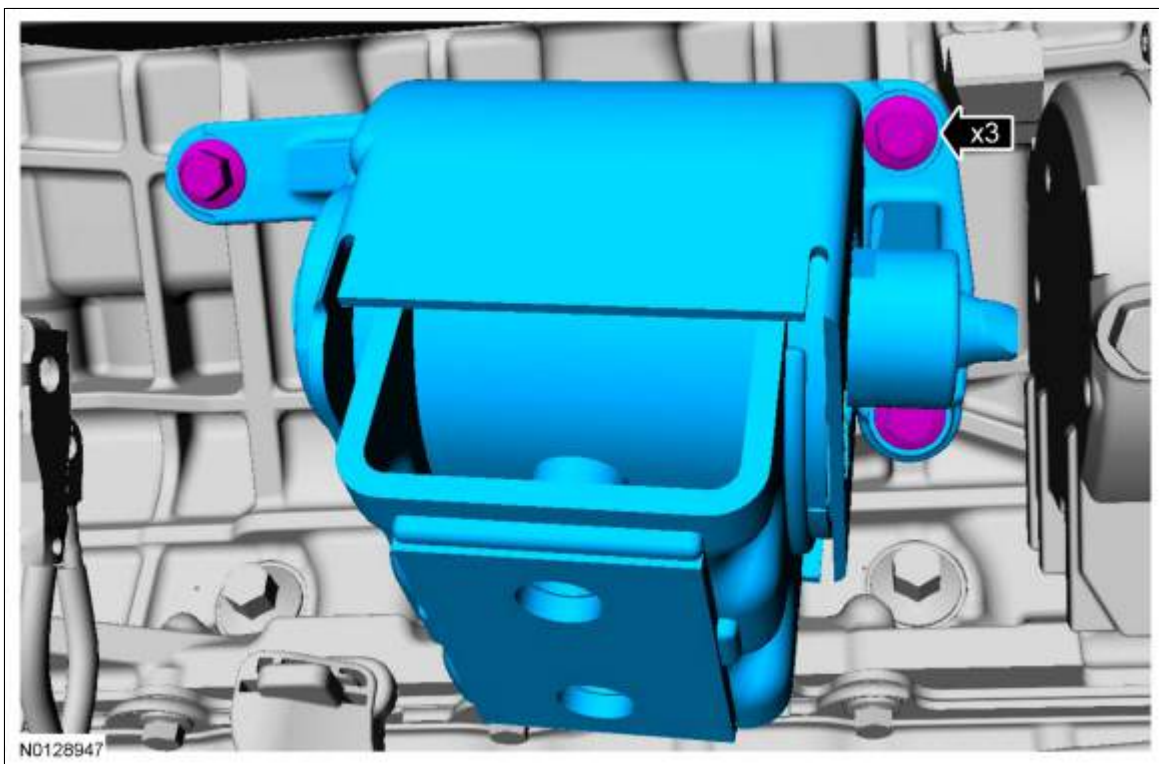
5. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove and discard the crankshaft rear seal.



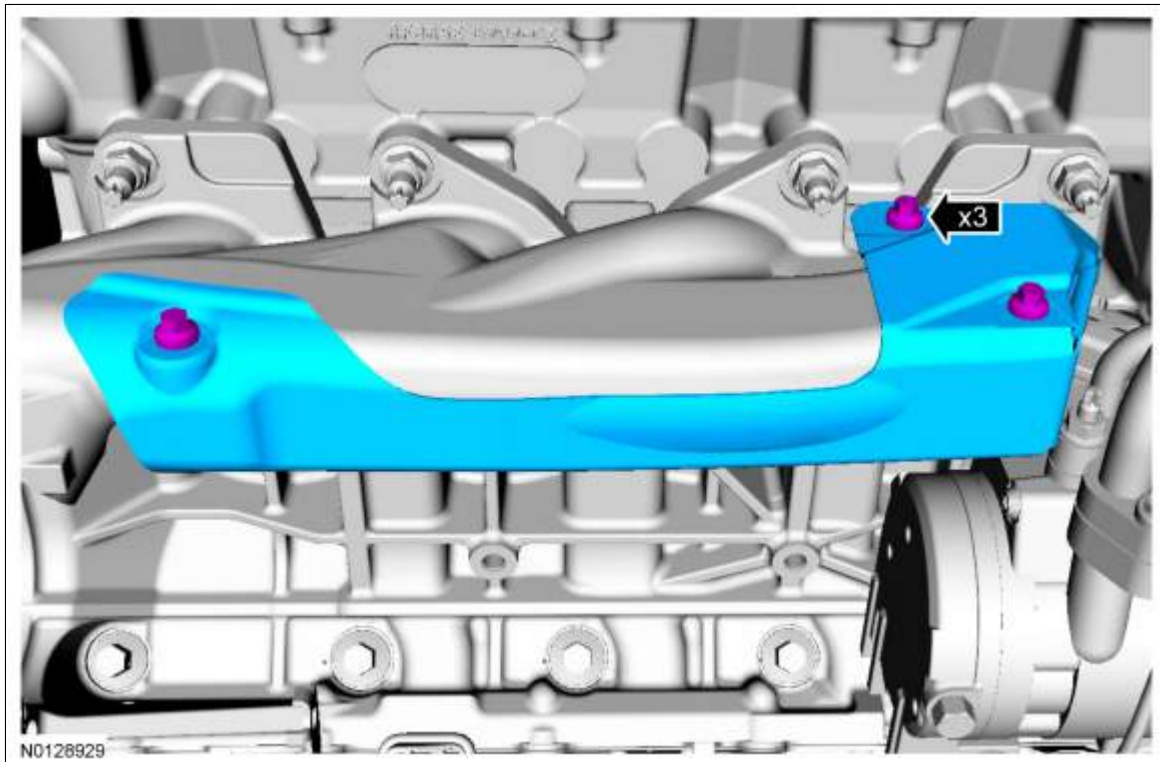
6. Mount the engine on a work stand.
7. Remove the 3 bolts and the LH engine support insulator bracket.



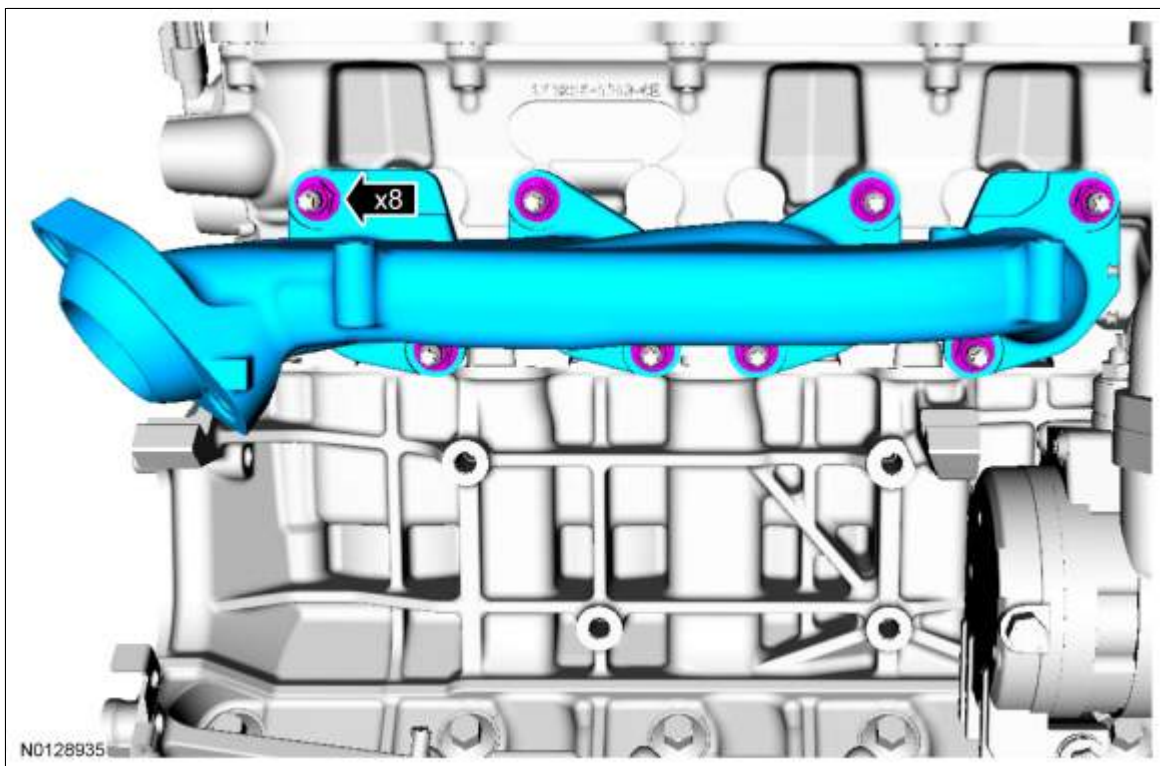
8. Remove the 3 bolts and the RH engine support insulator.



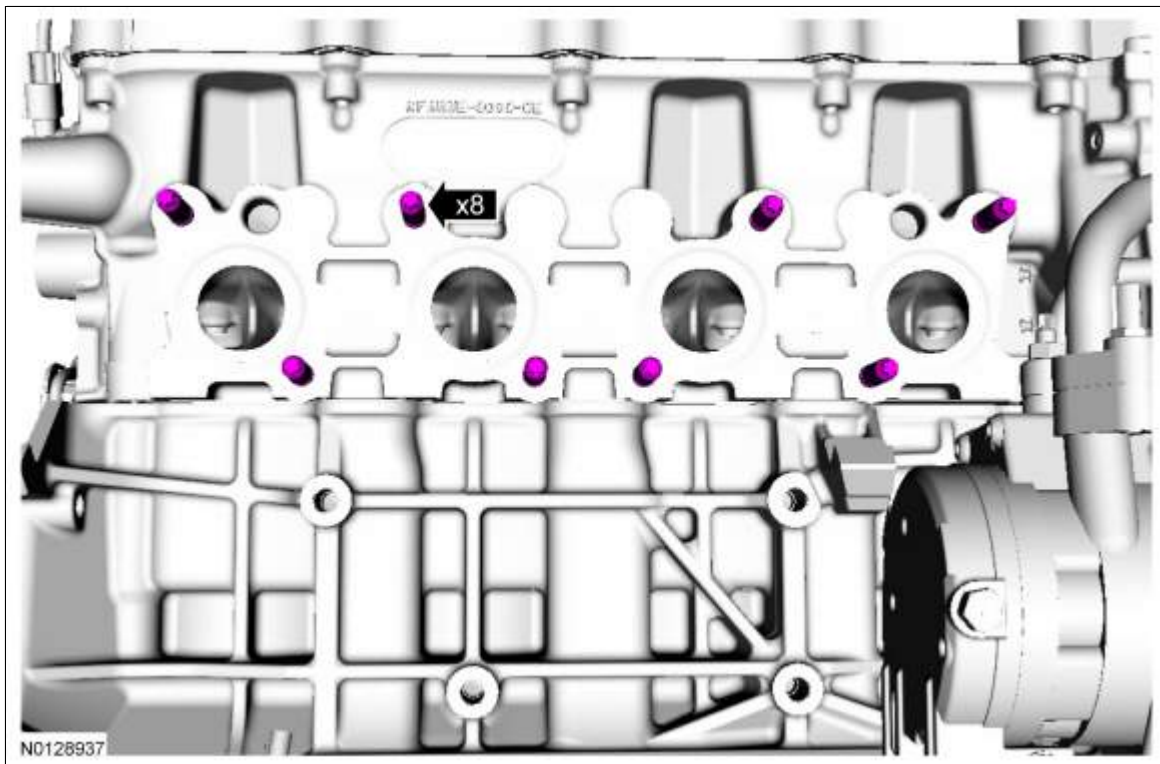
9. Remove the 3 bolts and the RH exhaust manifold heat shield.



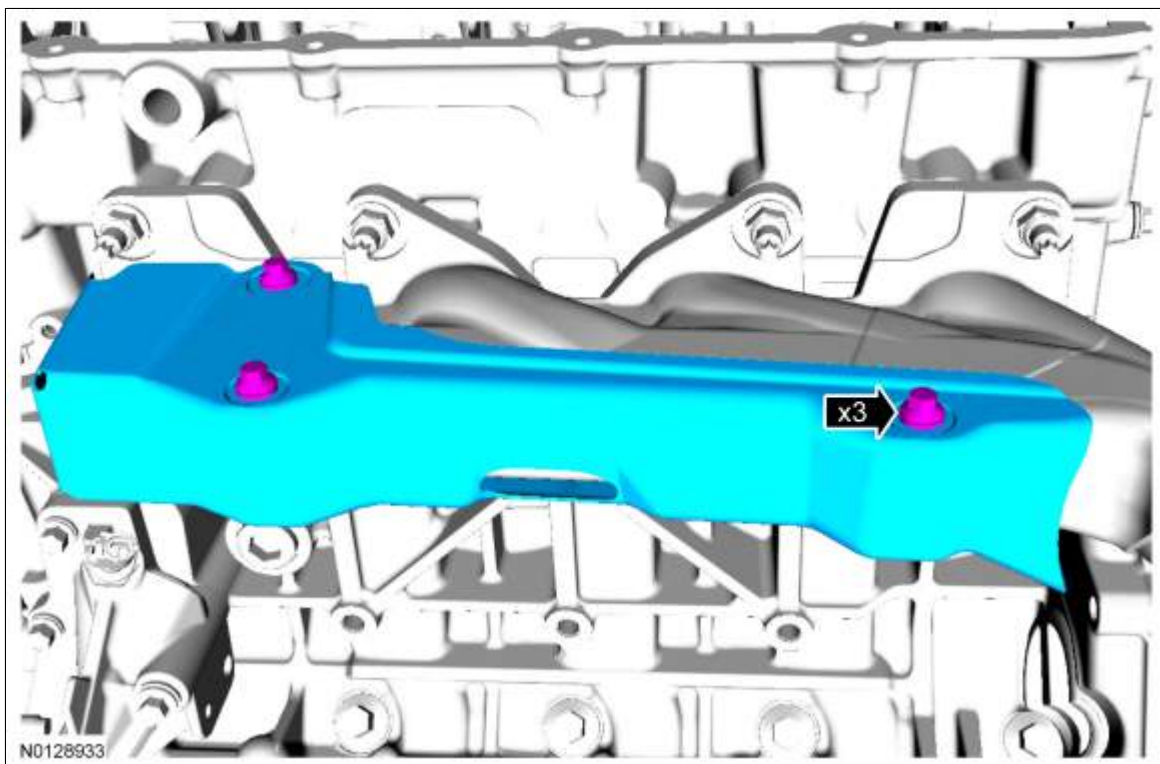
10. Remove the 8 nuts and the RH exhaust manifold.
- Discard the gasket.



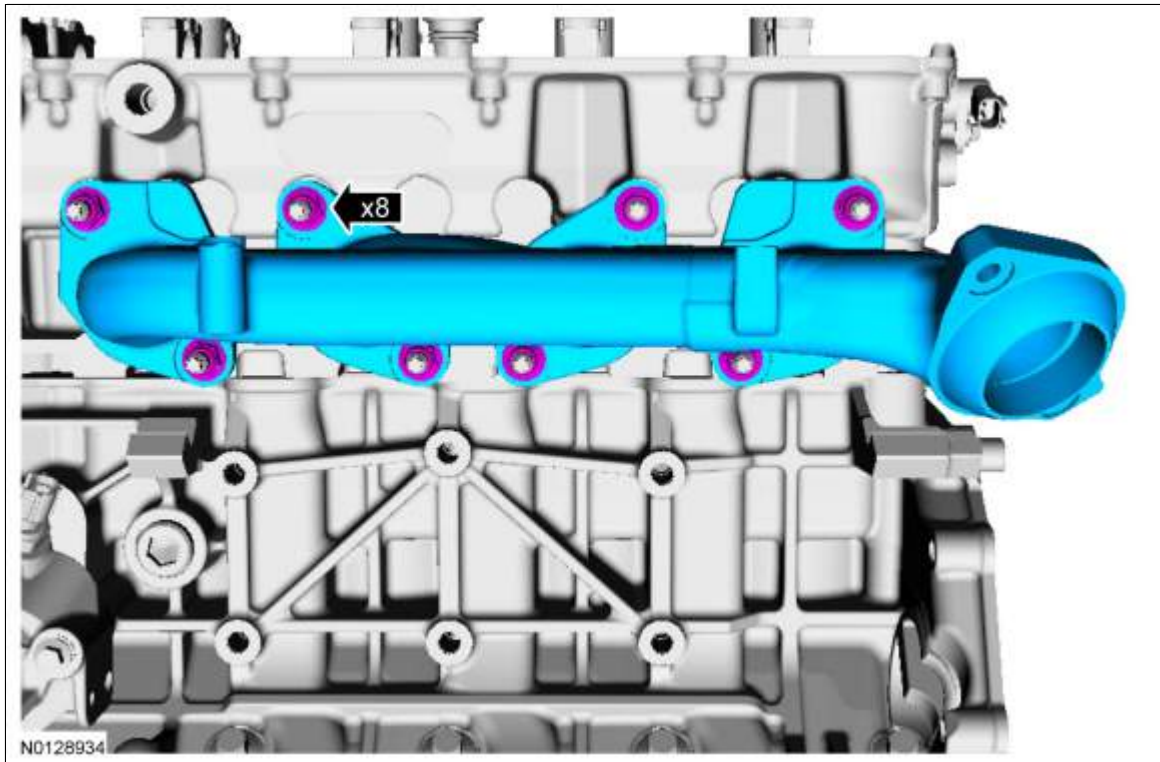
11. Remove and discard the 8 RH exhaust manifold studs.



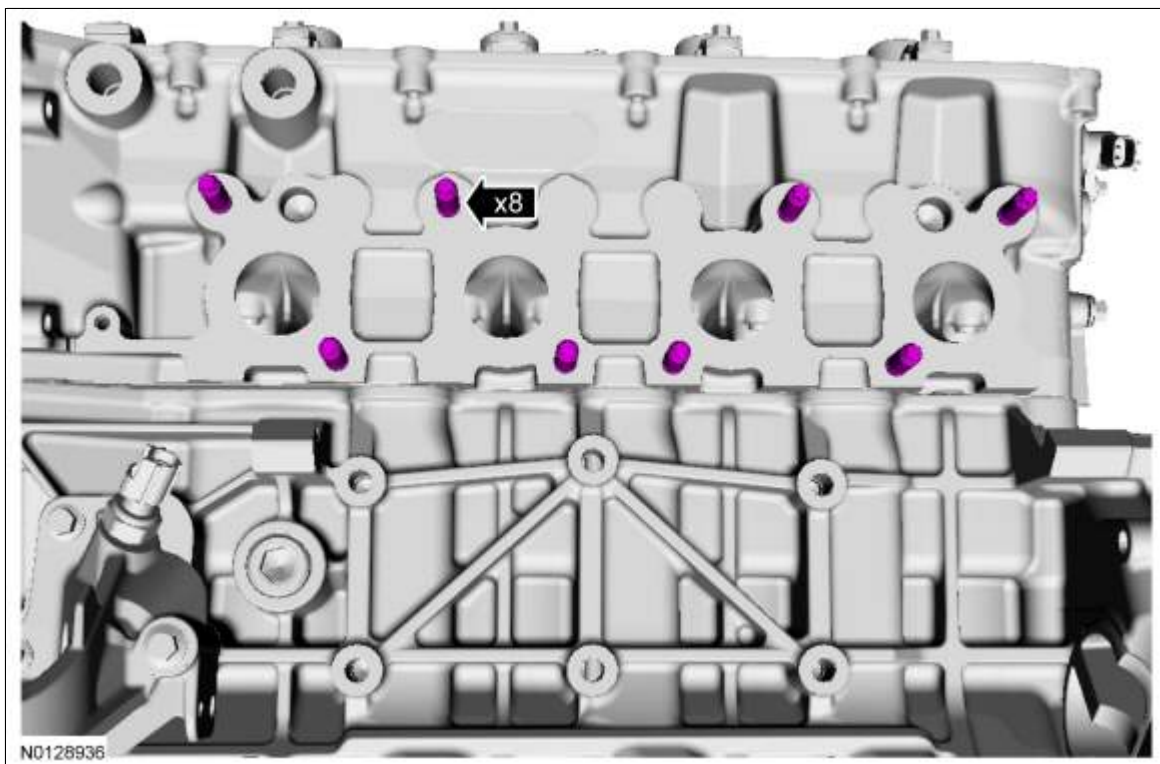
12. Remove the 3 bolts and the LH exhaust manifold heat shield.



13. Remove the 8 nuts and the LH exhaust manifold.
- Discard the gasket.



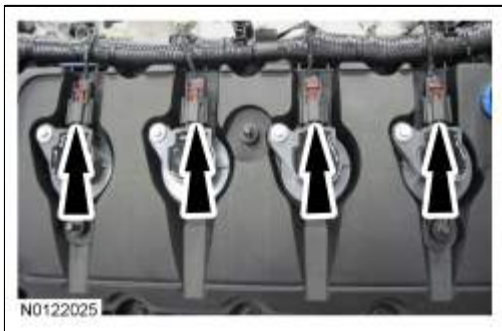
14. Remove and discard the 8 LH exhaust manifold studs.



15. Clean and inspect the RH and LH exhaust manifolds. For additional information, refer to [Section 303-00](#).

16. **NOTE:** RH shown, LH similar.

Disconnect the 8 ignition coil electrical connectors.



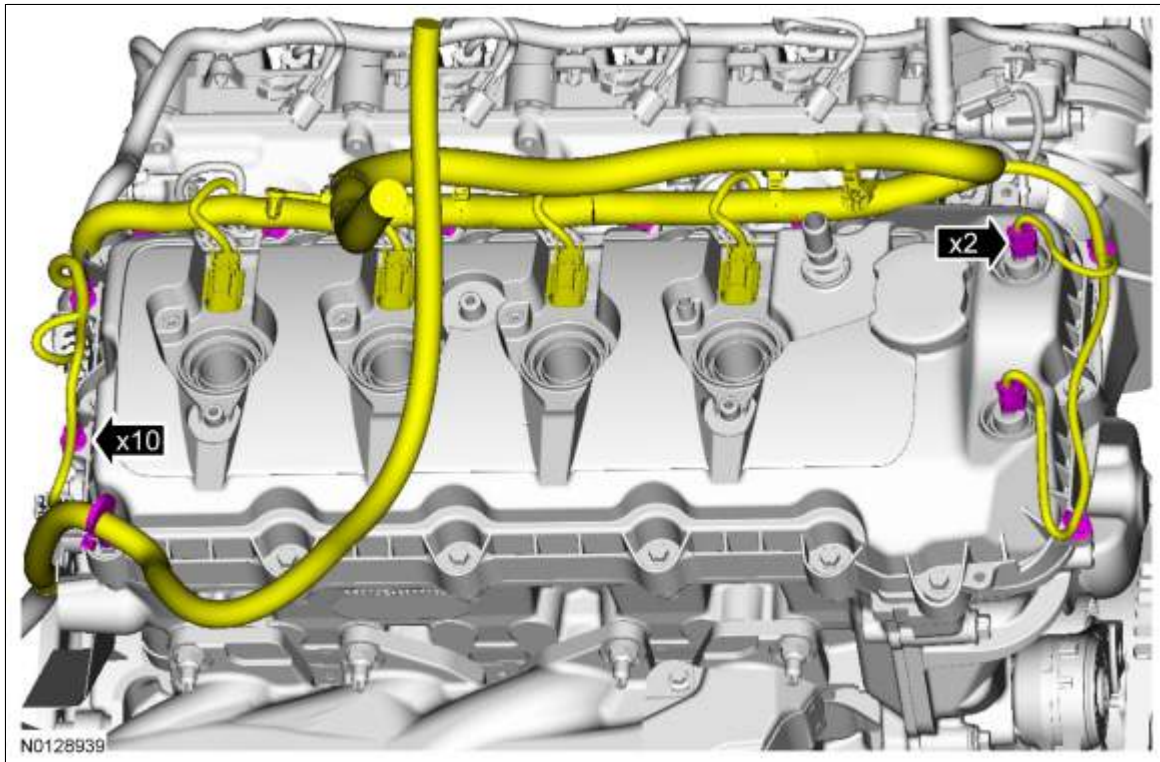
17. **NOTE:** RH shown, LH similar.

NOTE: When removing the ignition coils, a slight twisting motion will break the seal and ease removal. RH shown, LH similar.

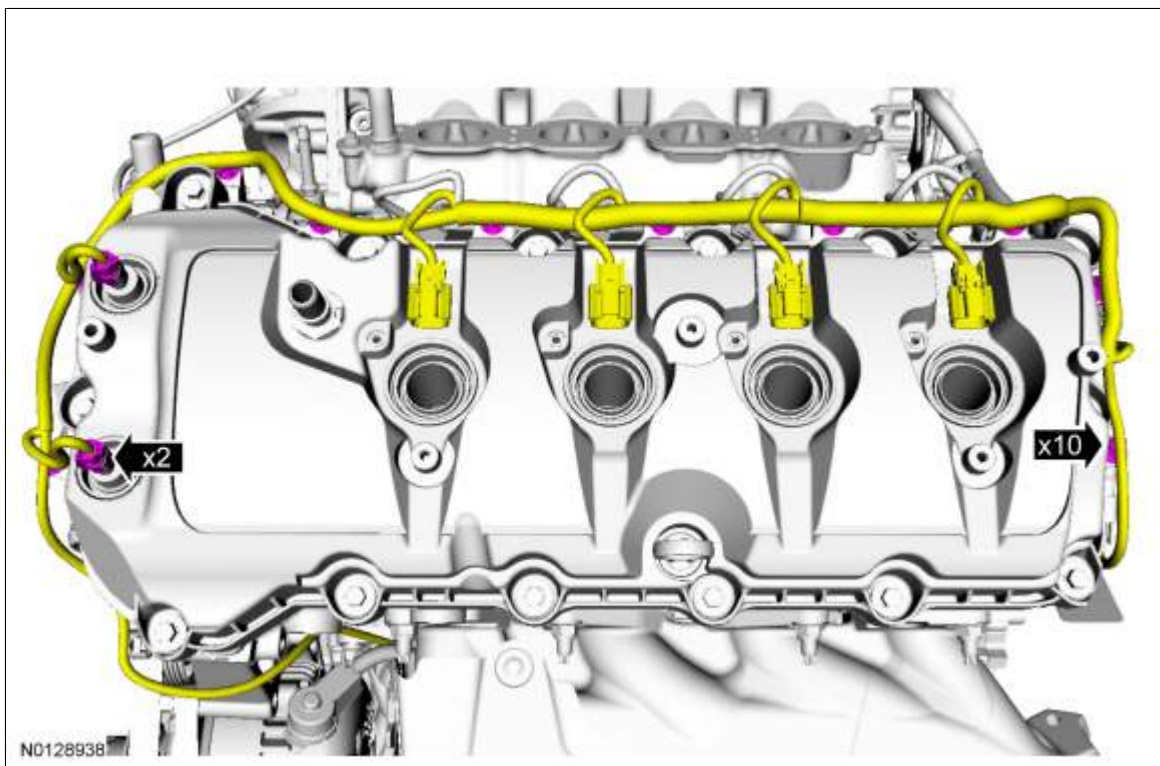
Remove the 8 bolts and the 8 ignition coils.



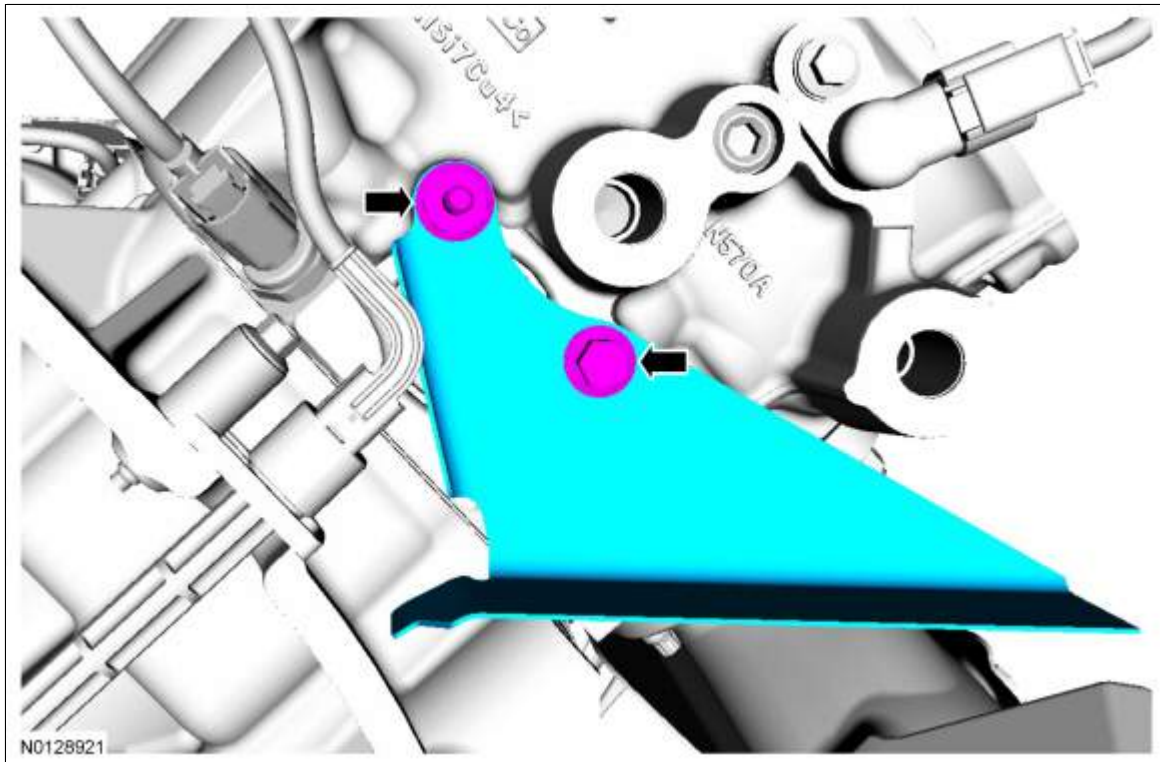
18. Disconnect the 2 Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.
- Detach the 10 wiring harness retainers from the RH valve cover.



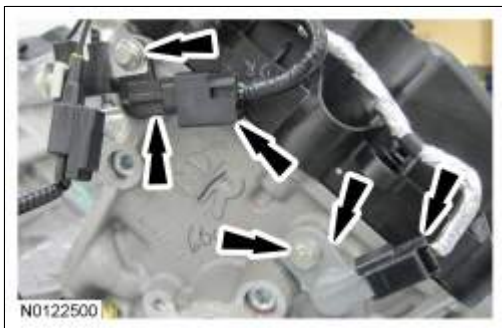
19. Disconnect the 2 VCT variable force solenoid electrical connectors.
- Detach the 10 wiring harness retainers from the LH valve cover.



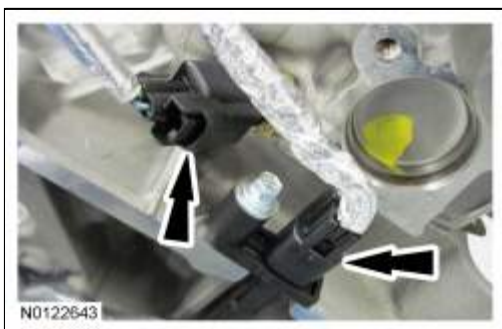
20. Remove the bolt, stud bolt and heat shield from the RH cylinder head.



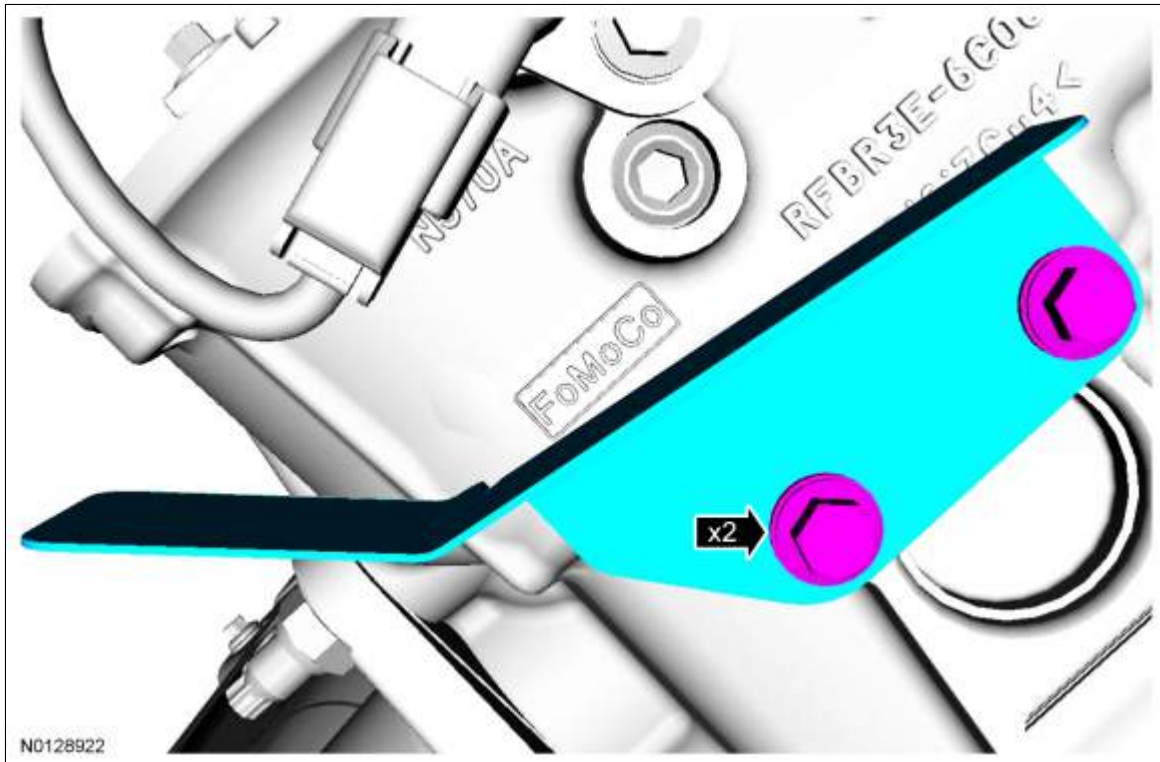
21. Disconnect the RH intake and exhaust Camshaft Position (CMP) sensor electrical connectors.
- Remove the 2 bolts and the RH intake and exhaust CMP sensors.



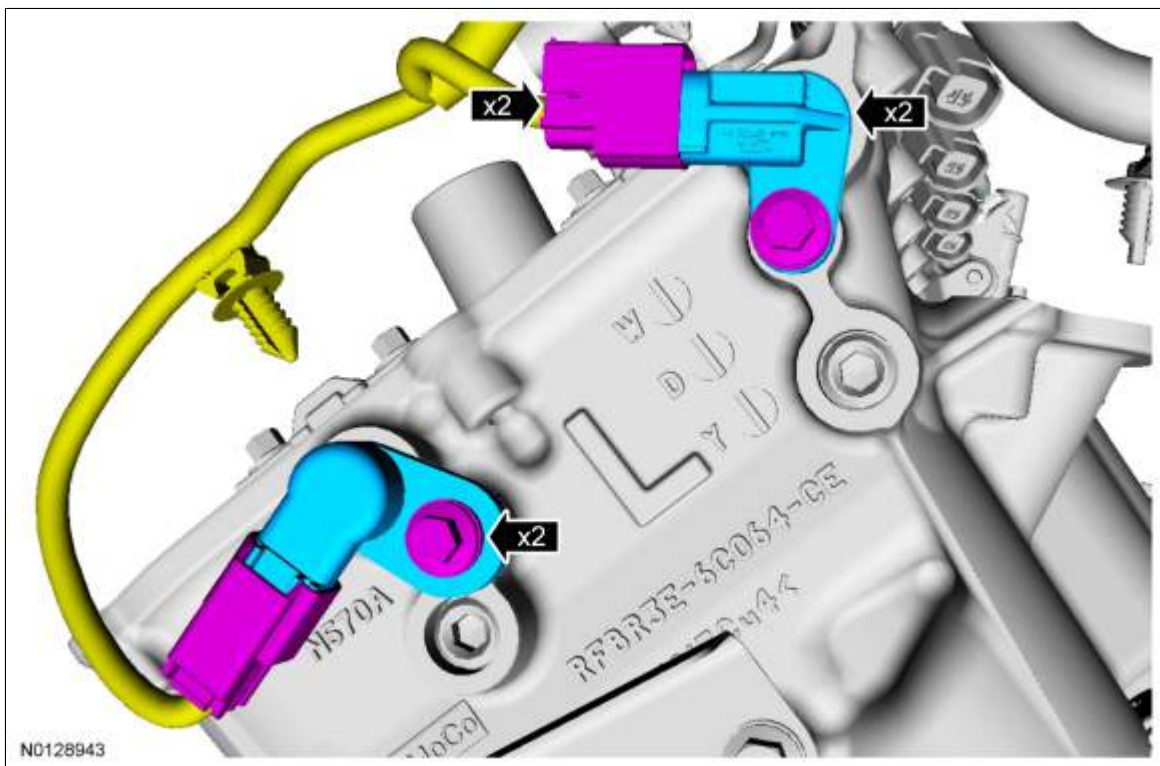
22. Disconnect the Cylinder Head Temperature (CHT) sensor and the Crankshaft Position (CKP) sensor electrical connectors.



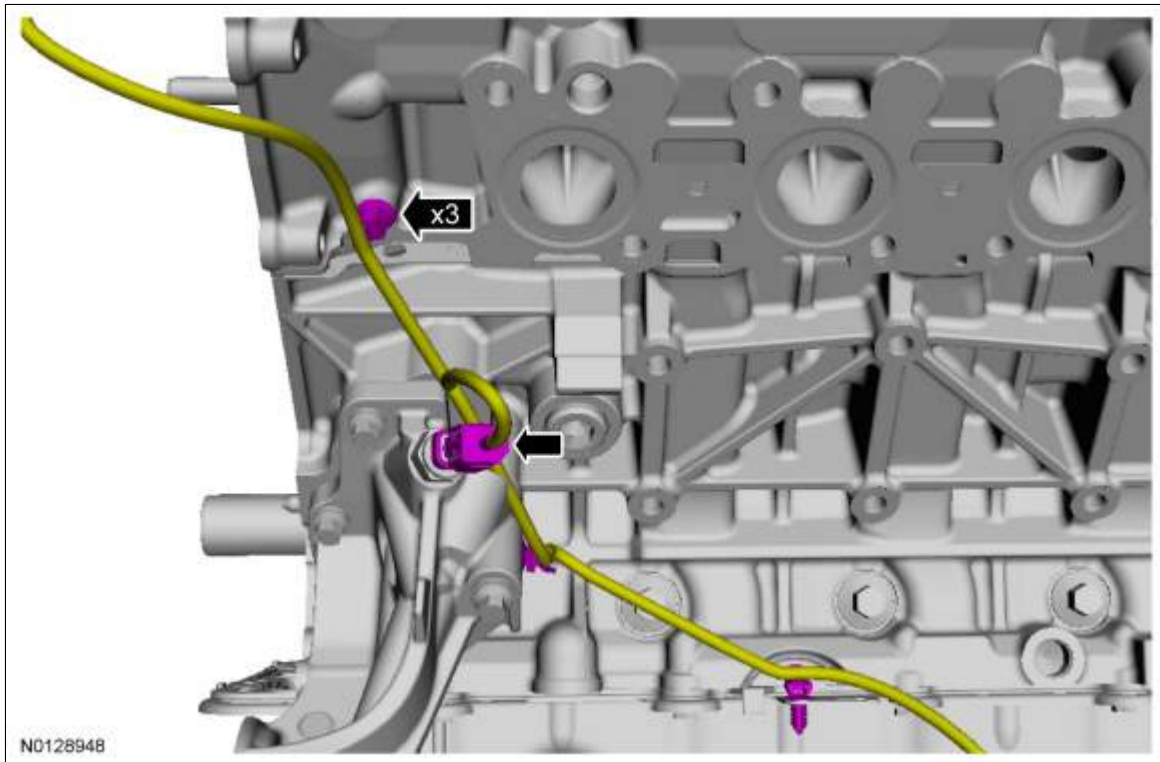
23. Remove the 2 bolts and the heat shield from the LH cylinder head.



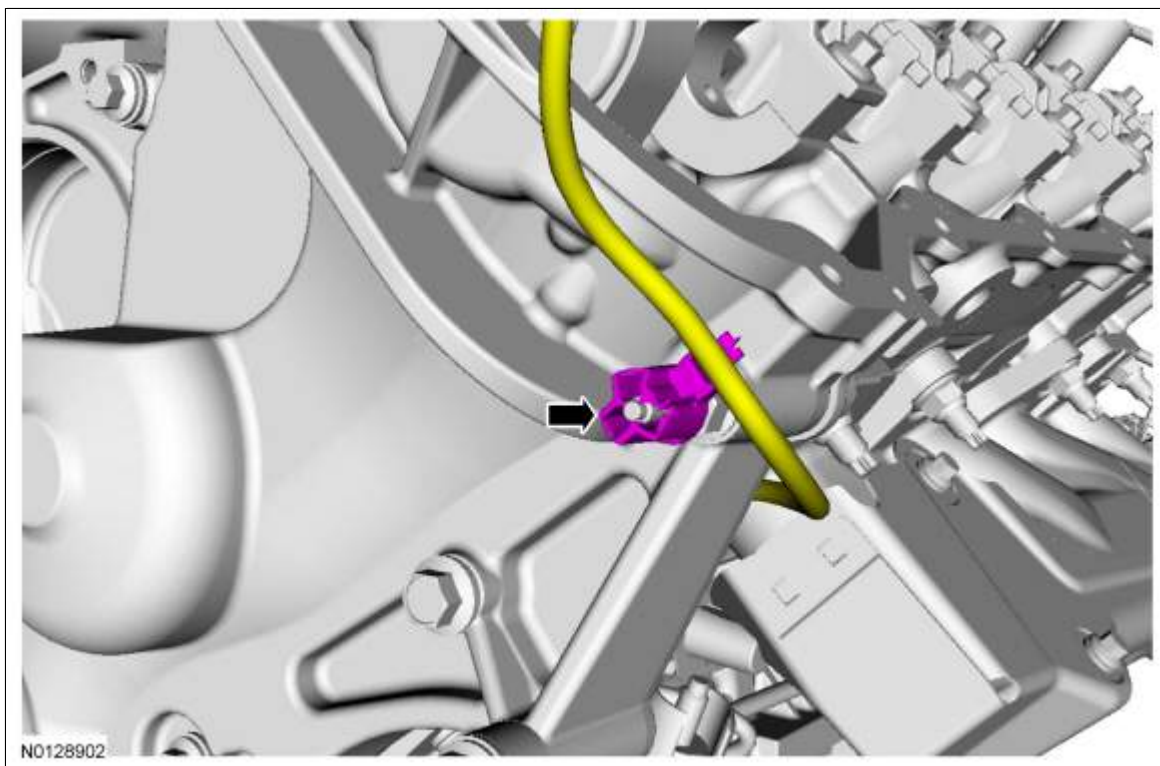
24. Disconnect the LH intake and exhaust Camshaft Position (CMP) sensor electrical connectors.
- Remove the 2 bolts and the LH intake and exhaust CMP sensors.



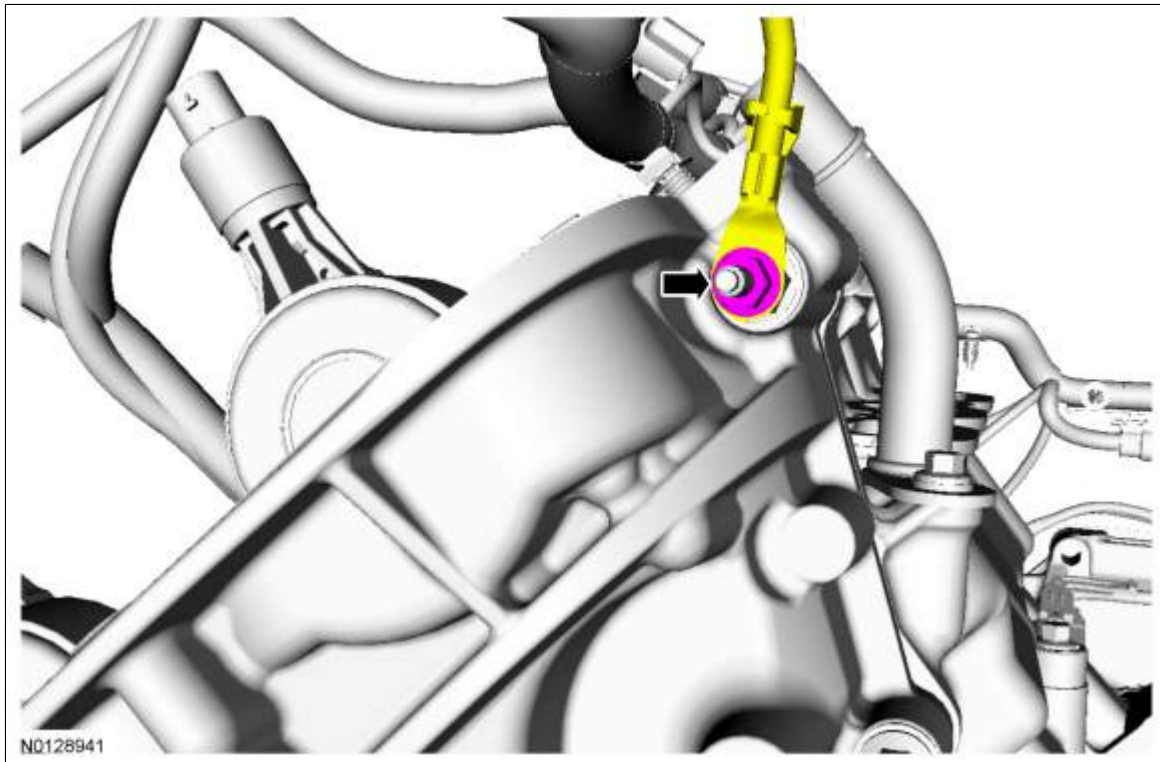
25. Disconnect the Engine Oil Pressure (EOP) switch electrical connector and the 3 wiring harness retainers.



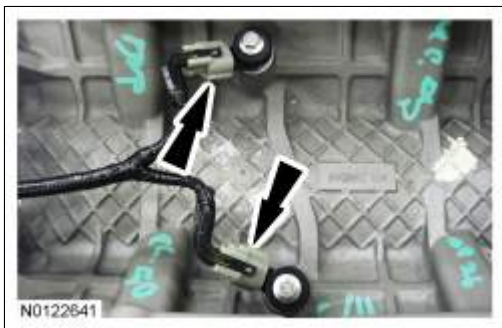
26. Detach the wiring harness retainer from the engine front cover stud bolt.



27. Remove the nut and the ground wire from the engine front cover stud bolt.



28. Disconnect the 2 Knock Sensor (KS) electrical connectors.
- Remove the wiring harness from the engine.



29. **NOTICE:** 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.

Loosen the 14 fasteners and remove the RH valve cover and gasket.

- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.

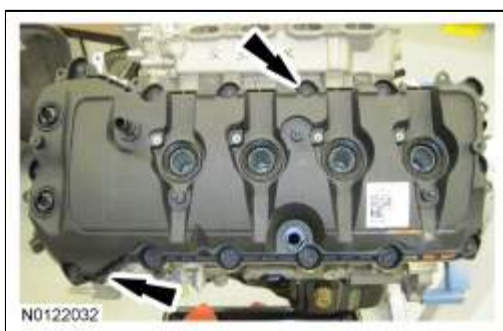


30. Remove the oil level indicator.

31. **NOTICE:** 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.

Loosen the 14 fasteners and remove the LH valve cover and gasket.

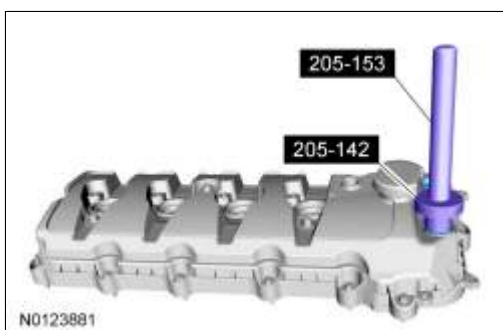
- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



32. **NOTE:** RH shown, LH similar.

Inspect the 2 VCT variable force solenoid seals. Remove any damaged seals.

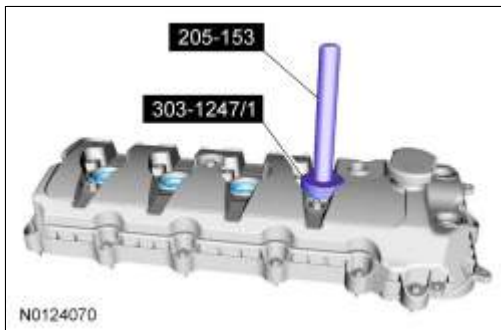
- Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



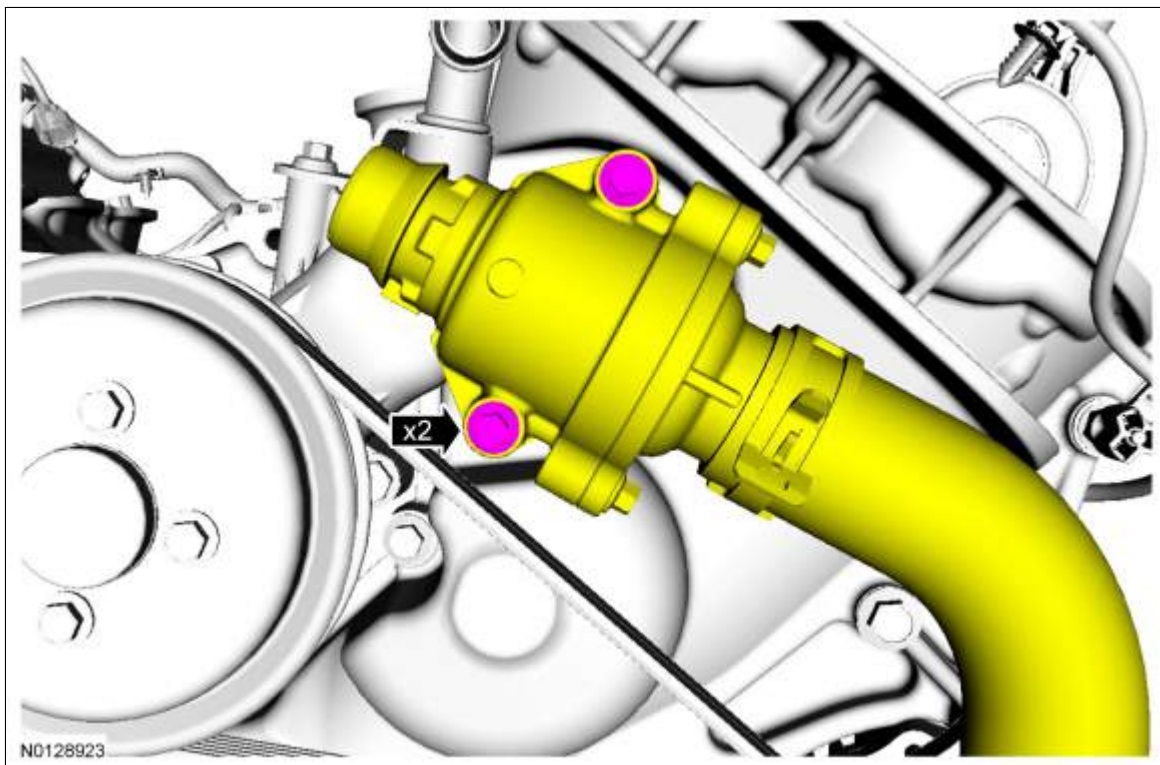
33. **NOTE:** RH shown, LH similar.

Inspect the spark plug tube seals. Remove any damaged seals.

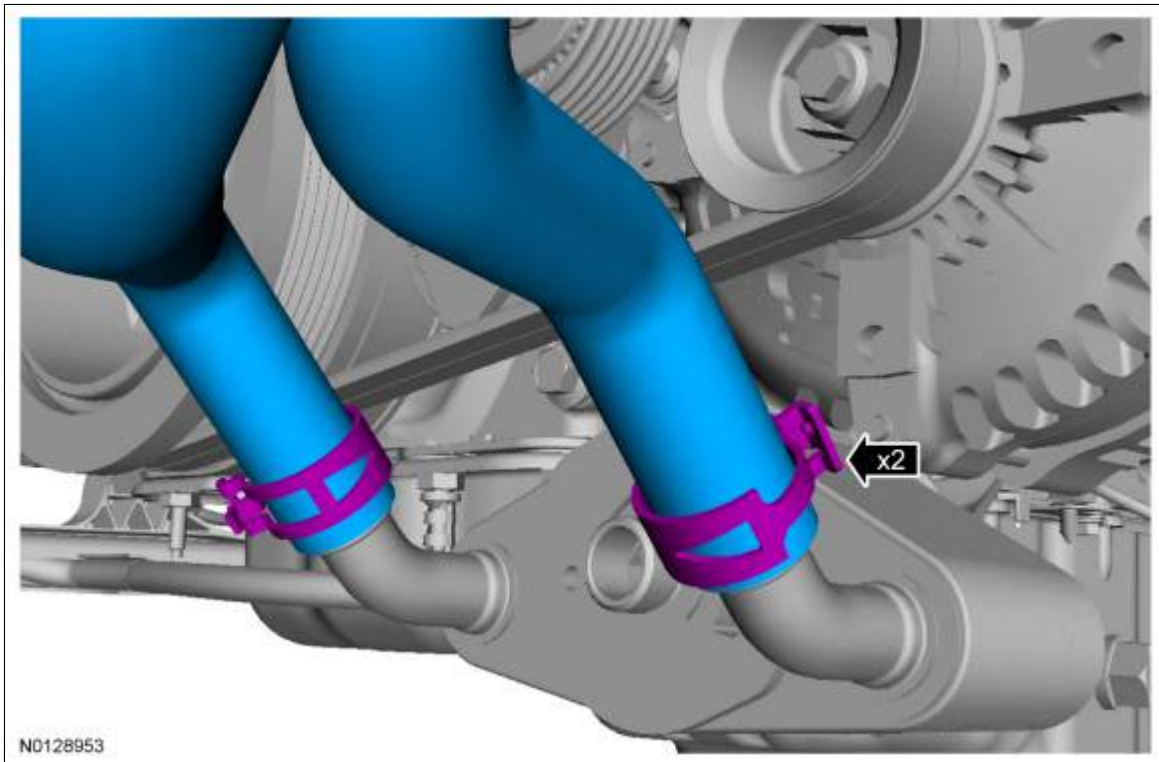
- Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



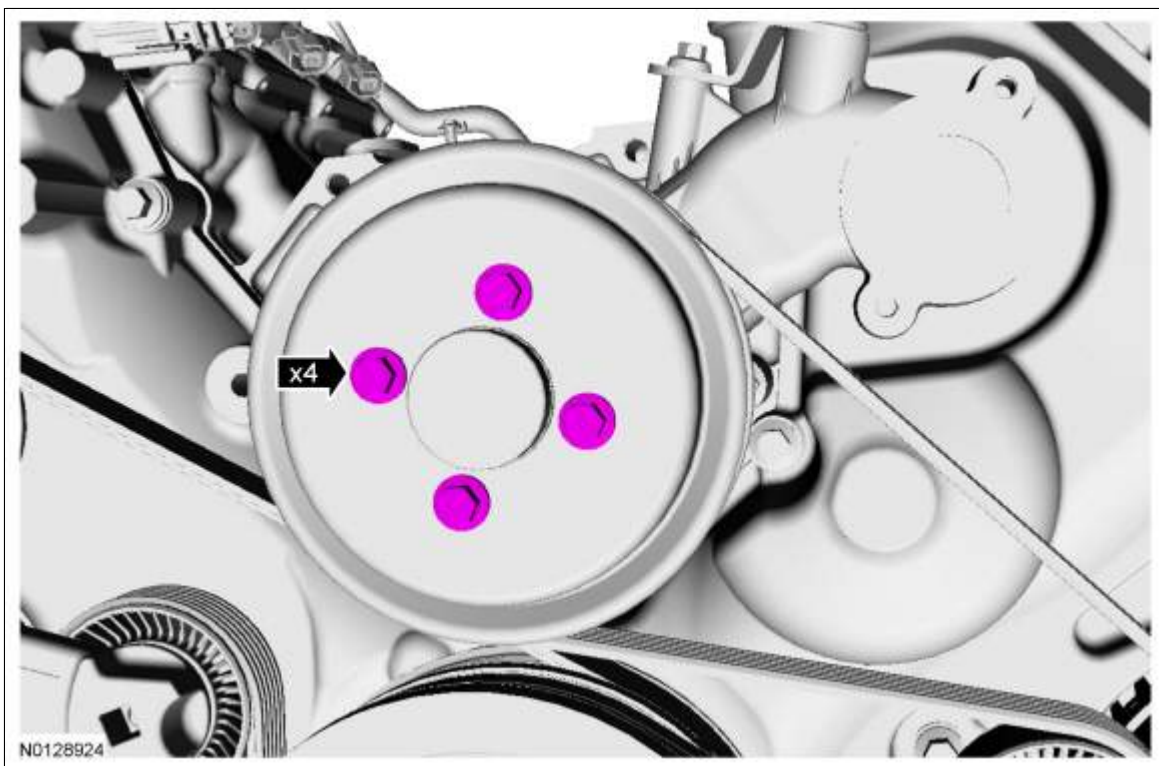
34. Remove the 2 bolts and position the thermostat housing and lower radiator hose aside.
- Remove and discard the thermostat housing O-ring seal.



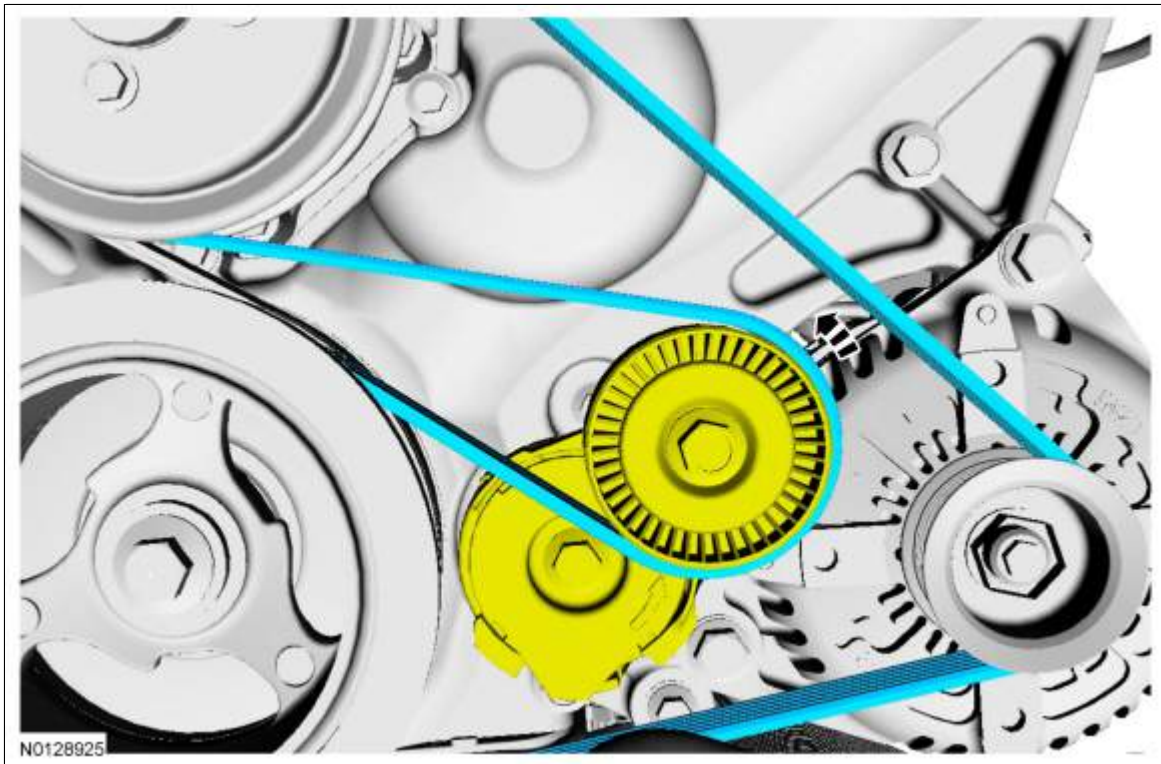
35. Release the 2 clamps and disconnect the coolant hoses from the oil cooler.



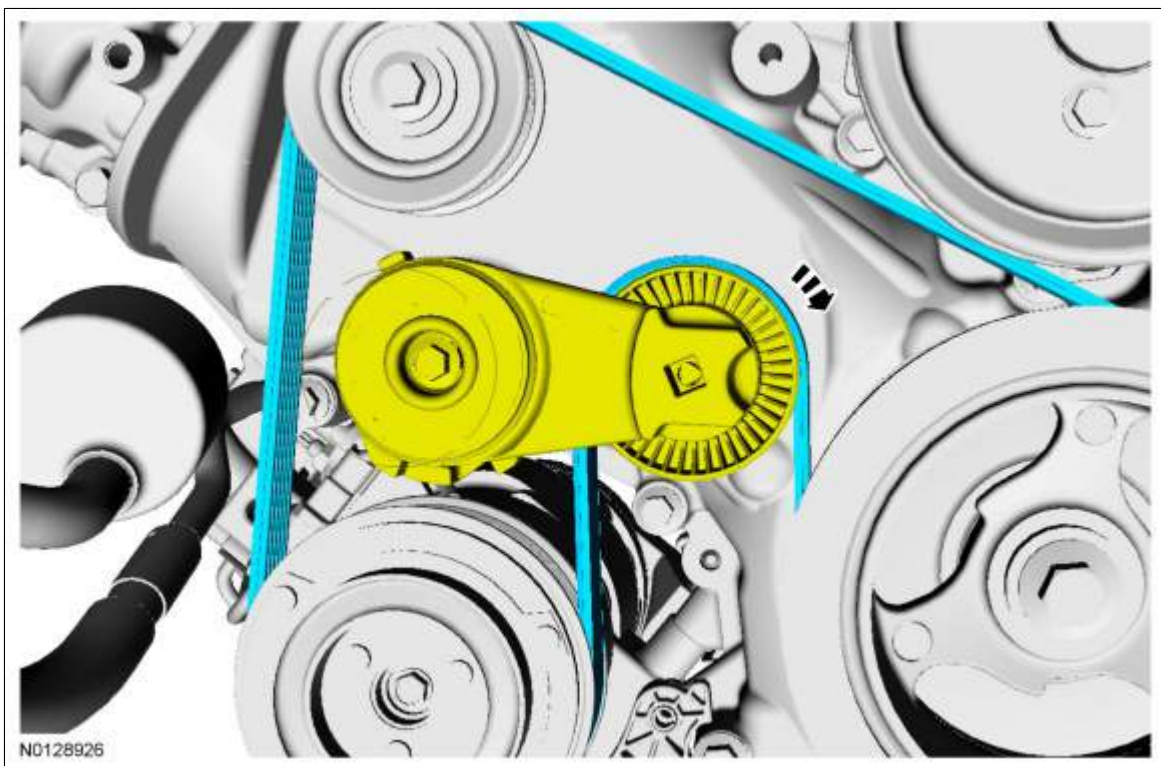
36. Loosen the 4 coolant pump pulley bolts.



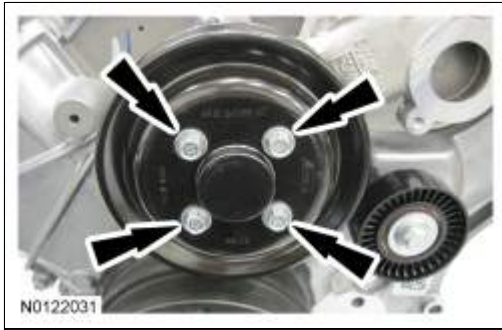
37. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt.



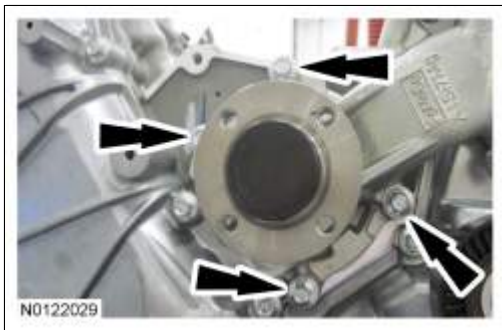
38. Rotate the A/C compressor belt tensioner clockwise and remove the A/C compressor belt.



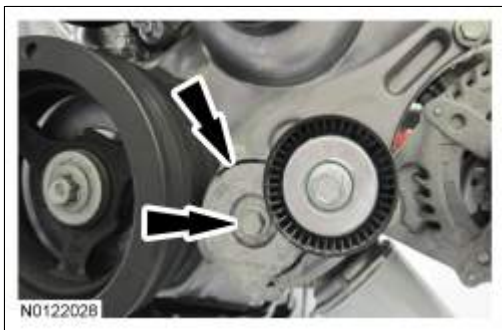
39. Remove the 4 bolts and the coolant pump pulley.



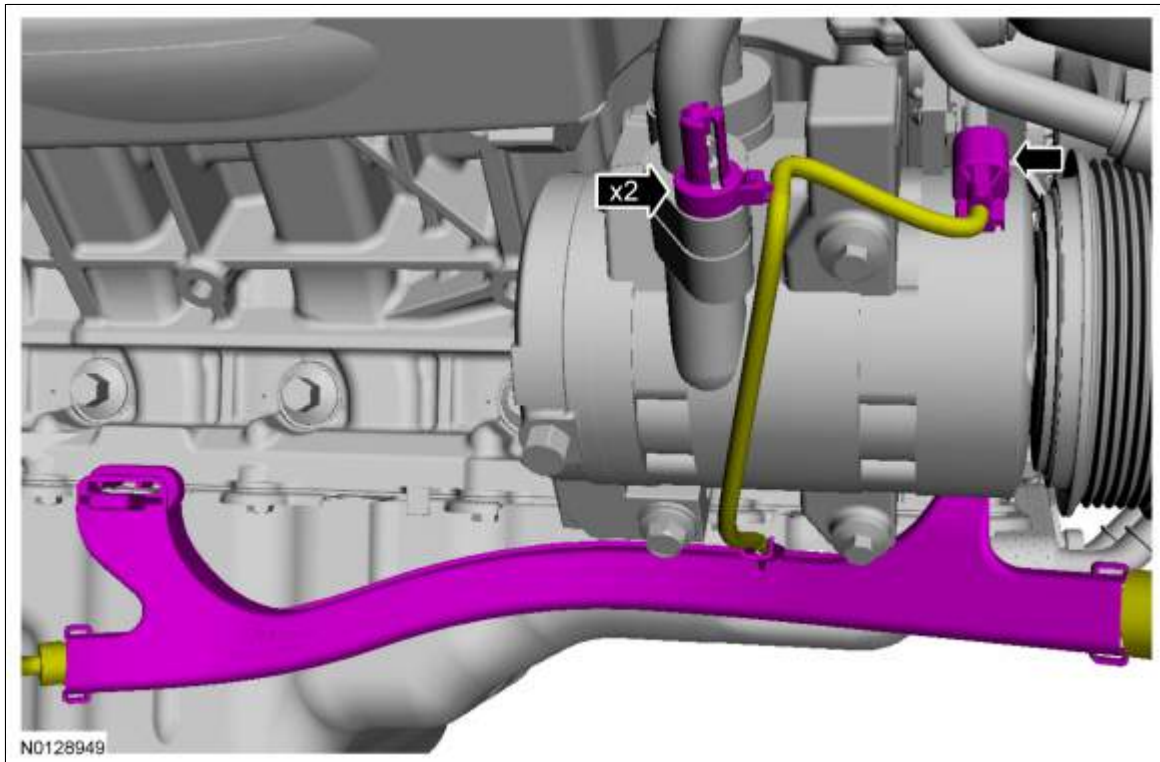
40. Remove the 4 bolts and the coolant pump.
- Remove and discard the O-ring seal.



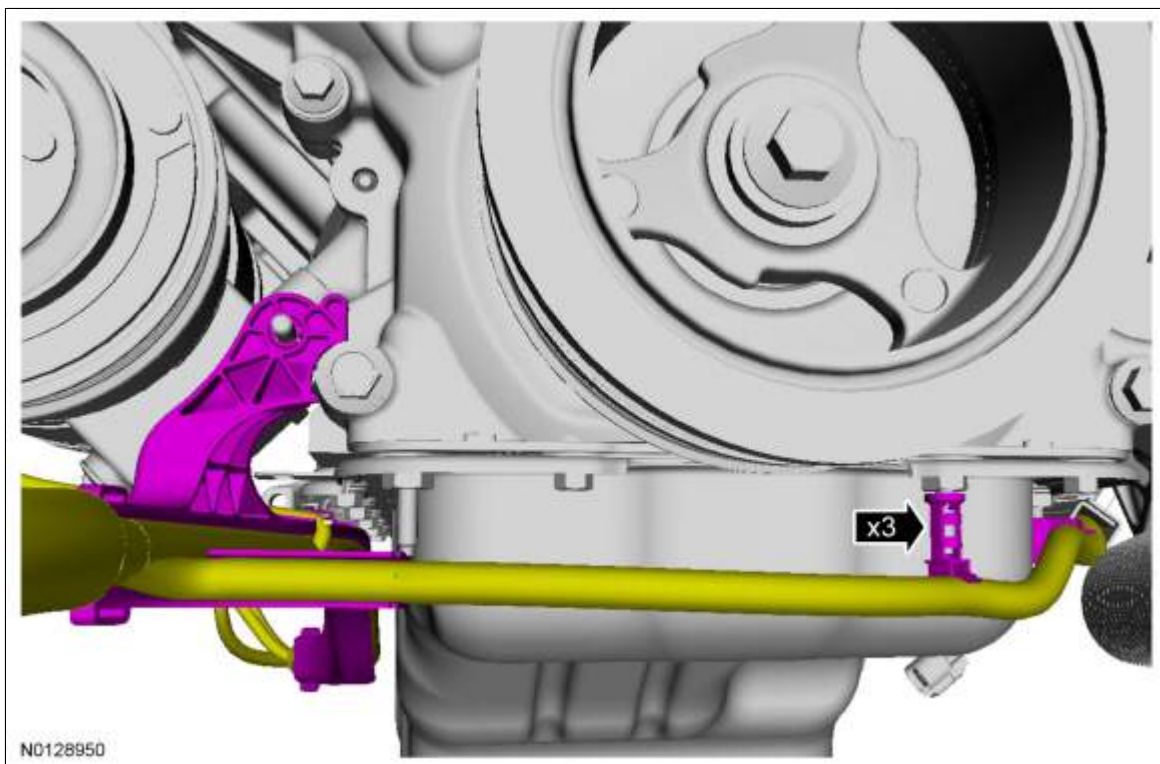
41. Remove the bolt and the accessory drive belt tensioner.



42. Disconnect the A/C compressor electrical connector and the 2 wiring harness retainers.



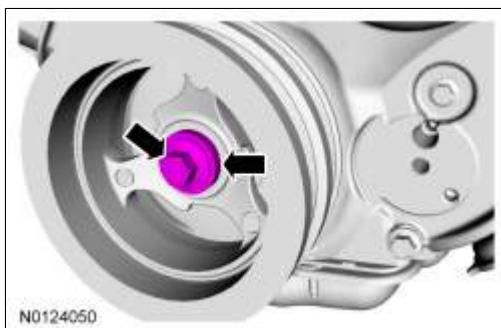
43. Detach the 3 wiring harness retainers.



44. Remove the 2 bolts and the generator.



45. Remove the crankshaft pulley bolt and washer.



46. Using the 3 Jaw Puller and the crankshaft pulley bolt, remove the crankshaft pulley.
- Discard the crankshaft pulley bolt.

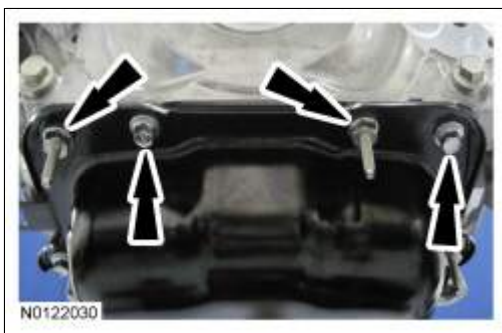


47. **NOTICE:** Use care not to damage the engine front cover or the crankshaft when removing the seal.

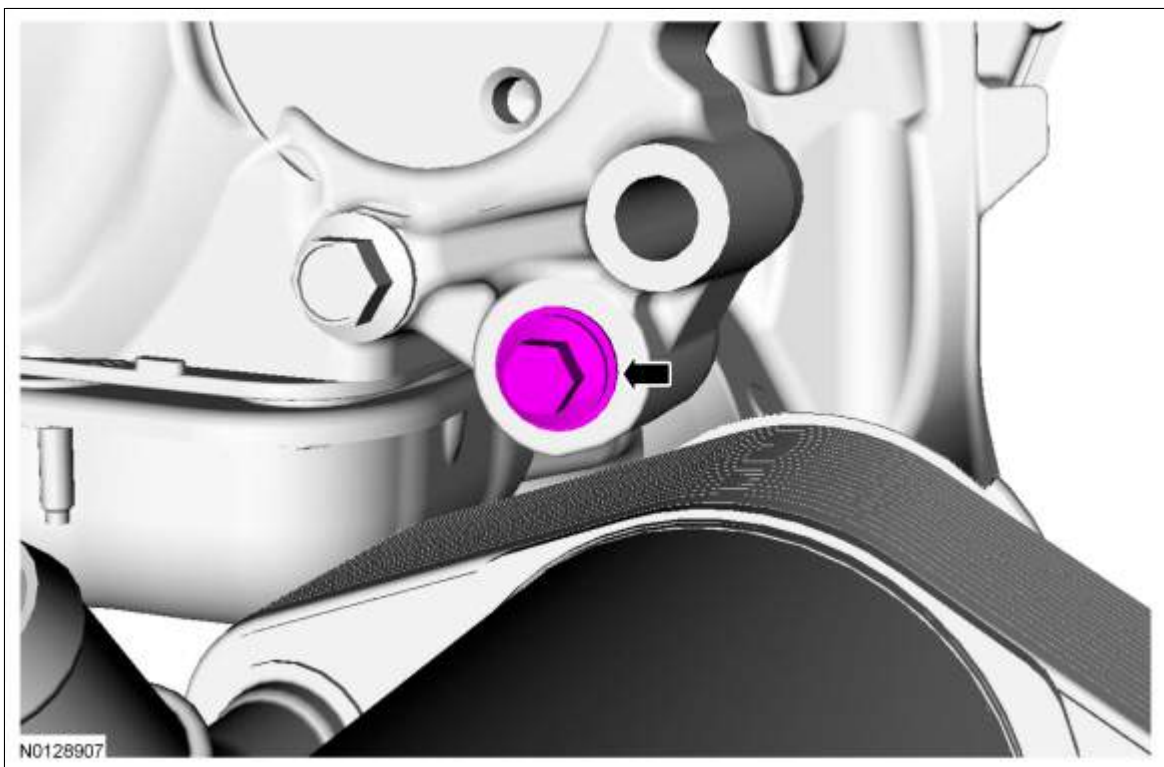
Using the Oil Seal Remover, remove the crankshaft front oil seal.



48. Remove the 2 front oil pan stud bolts and 2 front oil pan bolts.



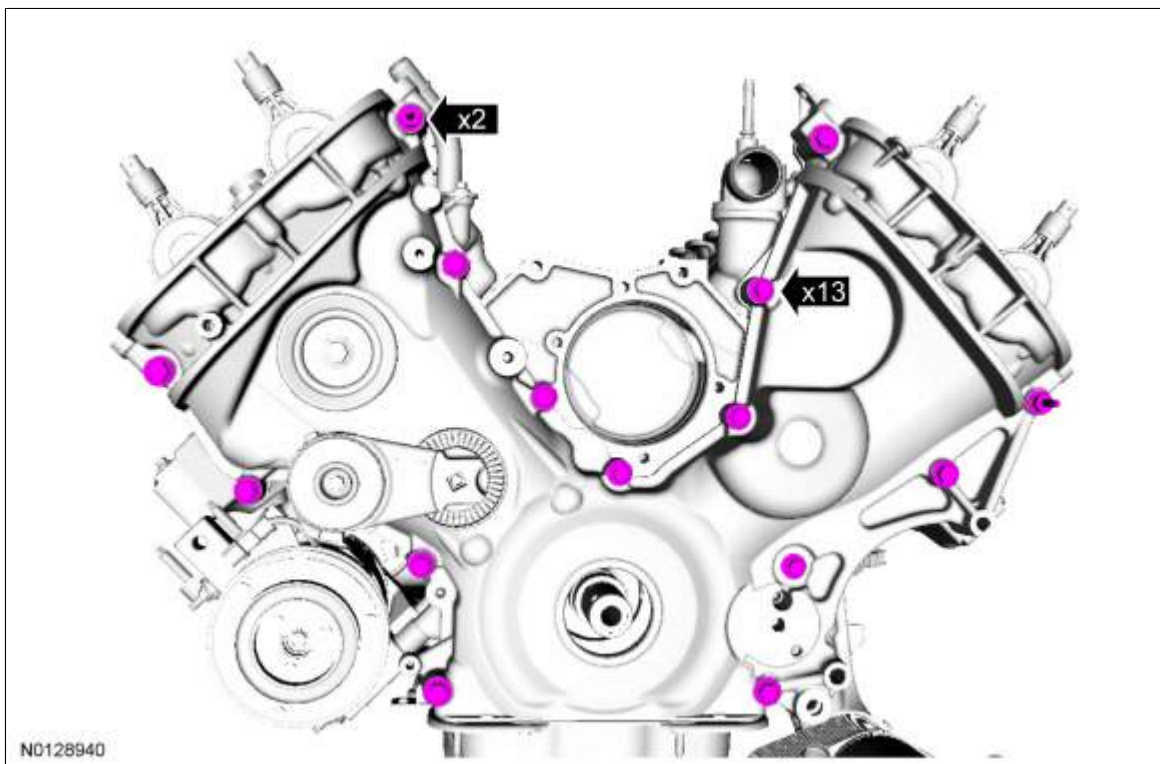
49. Remove the engine front cover-to-oil filter adapter bolt.



50. Using a 10 mm (0.393 in) Hex Bit loosen the engine front cover-to-oil filter adapter jack screw.



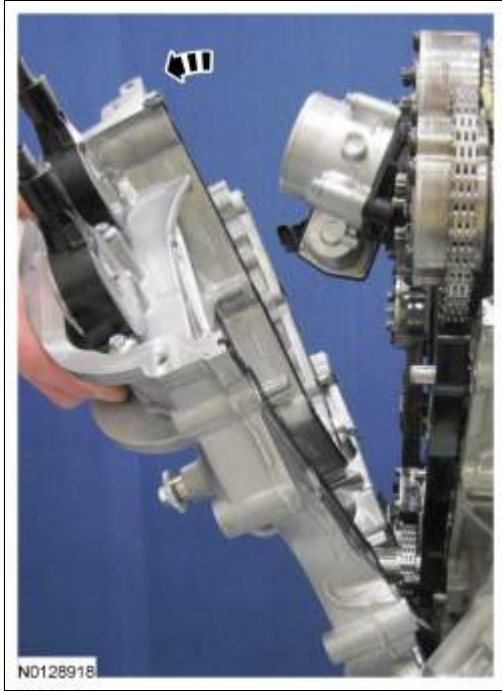
51. Remove the 13 engine front cover bolts and the 2 stud bolts.



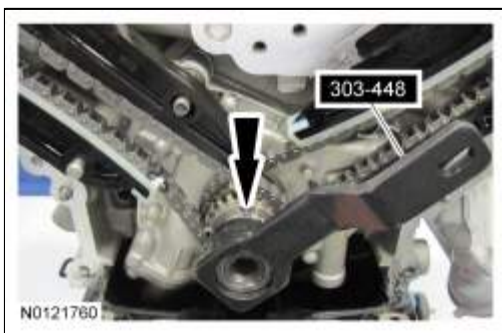
52. **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Remove the engine front cover.

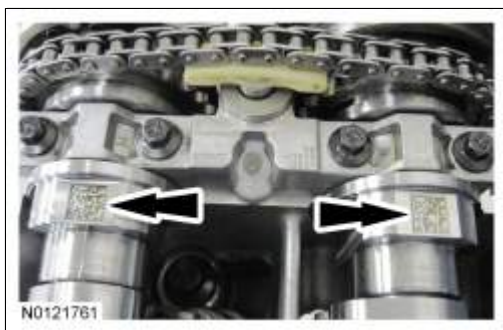
- Remove and discard the engine front cover gaskets.
- Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the mating surfaces.



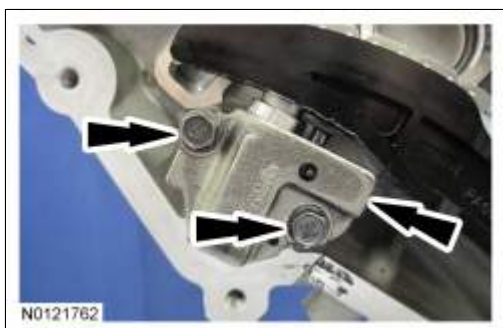
53. Using the crankshaft holding tool, rotate the crankshaft clockwise until the keyway is at the 12 o'clock position.



54. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.



55. Remove the 2 bolts and the RH primary timing chain tensioner.



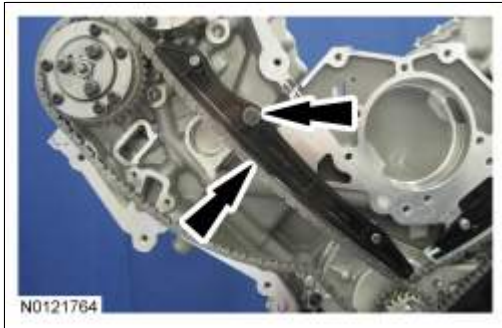
56. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

Remove the RH timing chain tensioner arm.



57. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

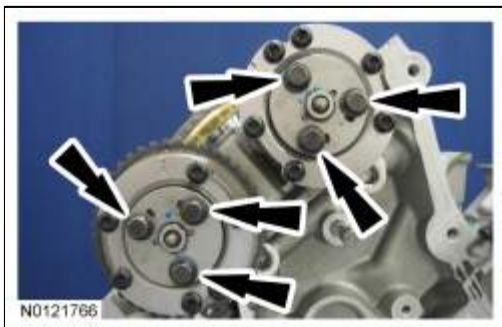
Remove the bolt and the RH timing chain guide.



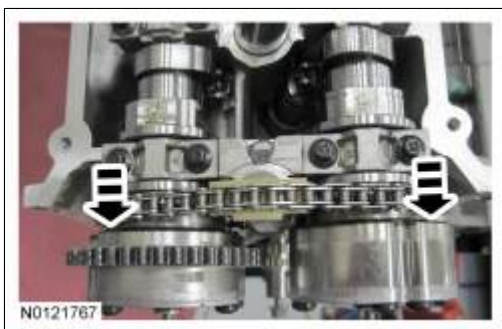
58. Remove the RH primary timing chain.



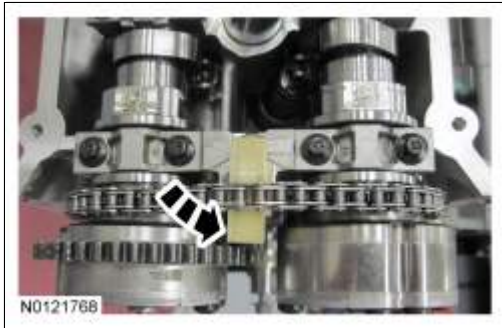
59. Remove the 3 RH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 RH exhaust VCT assembly bolts.



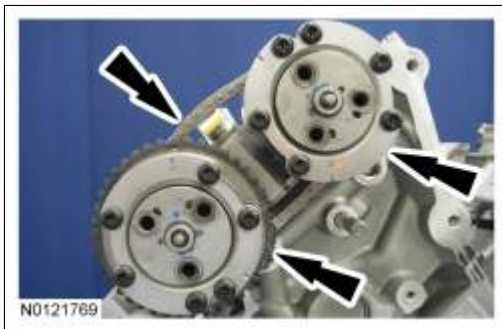
60. Slide the RH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



61. Depress the RH secondary timing chain tensioner and turn the tensioner 90 degrees.

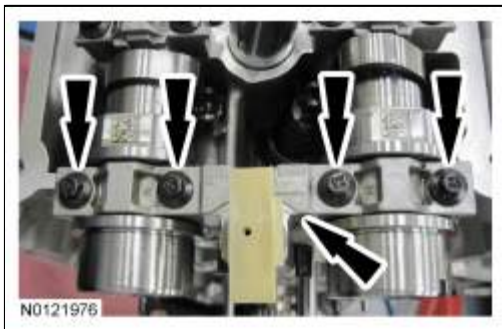


62. Remove the RH VCT assemblies and the RH secondary timing chain.

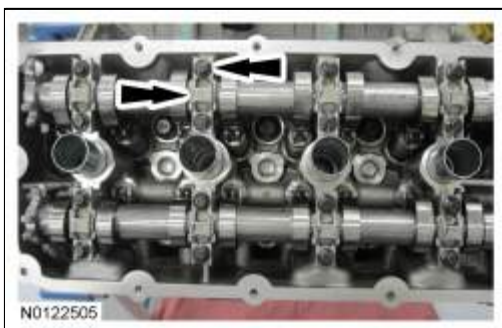


63. **NOTICE:** The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.

Remove the 4 bolts and the RH front camshaft bearing mega cap.



64. Remove the 16 bolts and the 8 camshaft bearing caps.

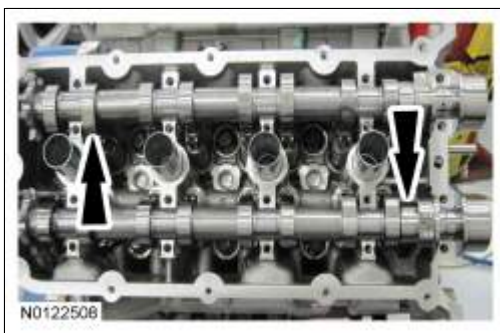


65. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

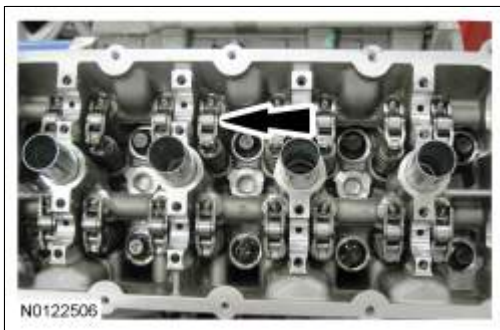
Remove the VCT system oil filter from the intake and exhaust camshafts.



66. Remove the RH intake and exhaust camshafts.



67. Remove the 16 camshaft roller follower and hydraulic lash adjuster assemblies.



68. Remove the bolt and the coolant outlet pipe from the RH cylinder head.

- Remove and discard the O-ring seal.



69. Remove the CHT sensor.



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

NOTICE: Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.

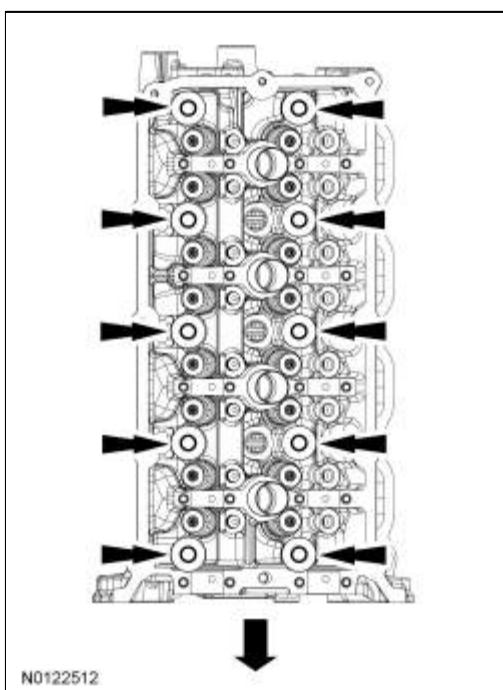
NOTICE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

NOTICE: 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.

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

Remove the 10 bolts and the RH cylinder head.

- Discard the bolts and the cylinder head gasket.



71. **NOTICE:** 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 notices and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

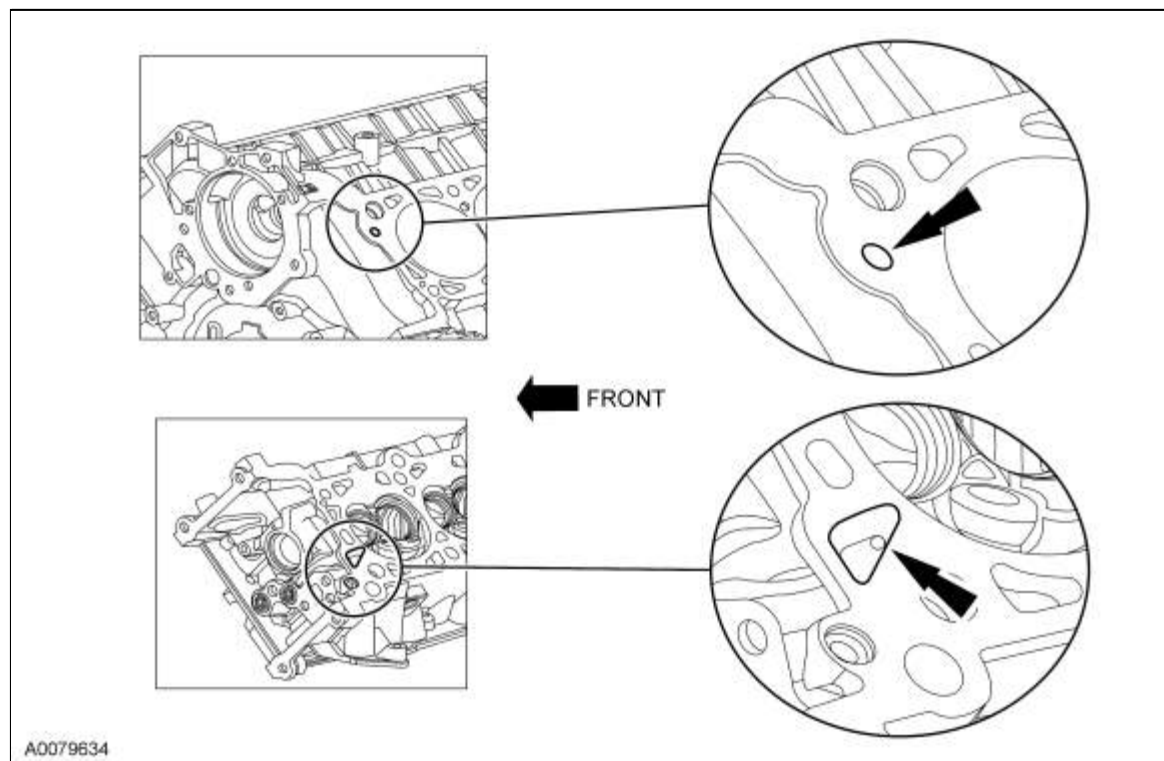
NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder head and the cylinder block in the following sequence.

1. Remove any large deposits of silicone or gasket material with a plastic scraper.
 2. Apply silicone gasket remover, following package directions and allow to set for several minutes.
 3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
 4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
72. **NOTE:** Make sure all cylinder head surfaces are clear of any gasket material, RTV, oil and coolant. The cylinder head surface must be clean and dry before running a flatness check.

NOTE: Use a straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot length. For example, if the straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

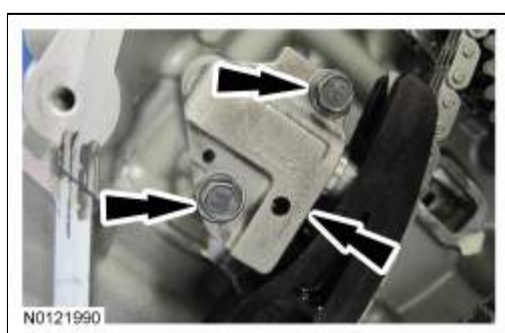
Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion, paying particular attention to the oil pressure feed area. For additional information, refer to [Section 303-00](#).



73. Using the crankshaft holding tool, rotate the crankshaft counterclockwise until the crankshaft keyway is at the 9 o'clock position.



74. Remove the 2 bolts and the LH primary timing chain tensioner.



75. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain tensioner arm.

Remove the LH timing chain tensioner arm.



76. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain guide.

Remove the bolt and the LH timing chain guide.



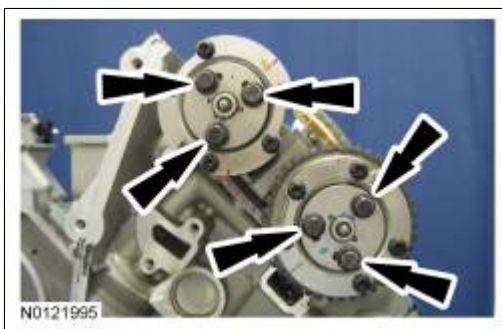
77. Remove the LH primary timing chain.



78. Remove the crankshaft sprocket.



79. Remove the 3 LH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 LH exhaust VCT assembly bolts.



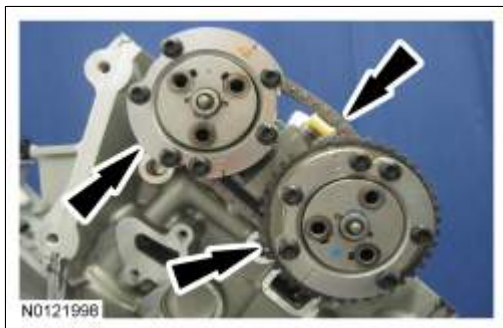
80. Slide the LH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



81. Depress the LH secondary timing chain tensioner and turn the tensioner 90 degrees.

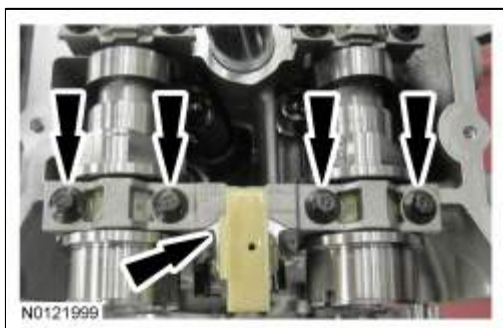


82. Remove the LH VCT assemblies and the LH secondary timing chain.

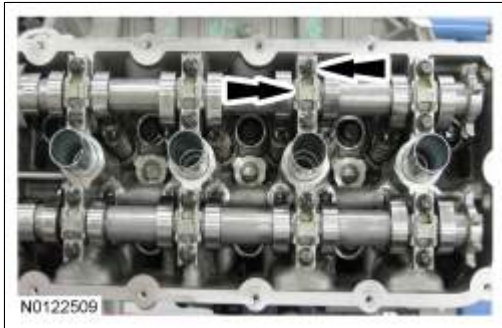


83. **NOTICE:** The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.

Remove the 4 bolts and the LH front camshaft bearing mega cap.



84. Remove the 16 bolts and the 8 camshaft bearing caps.

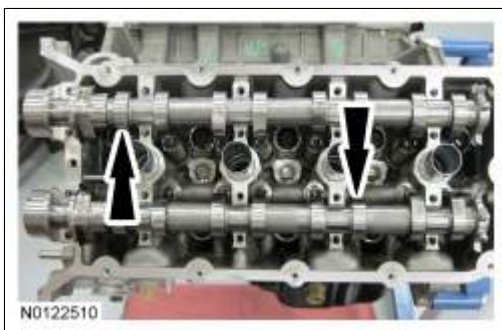


85. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

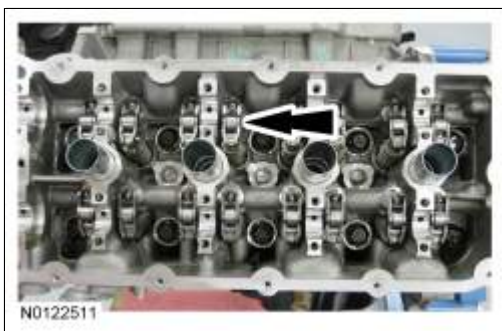
Remove the VCT system oil filter from the intake and exhaust camshafts.



86. Remove the LH intake and exhaust camshafts.



87. Remove the 16 camshaft roller follower and hydraulic lash adjuster assemblies.



88. Remove the 2 bolts and the coolant outlet from the LH cylinder head.

- Remove and discard the gasket.



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

NOTICE: Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.

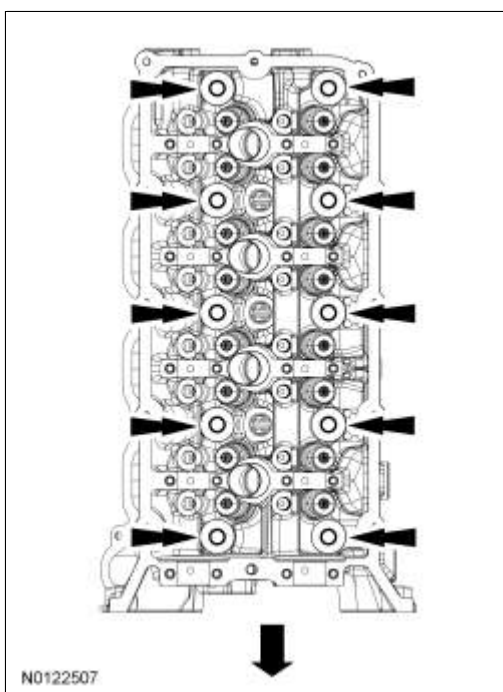
NOTICE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

NOTICE: 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.

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

Remove the 10 bolts and the LH cylinder head.

- Discard the bolts and the cylinder head gasket.



90. **NOTICE:** 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 notices and follow all application directions contained on the packaging of the silicone gasket remover and the metal surface prep.

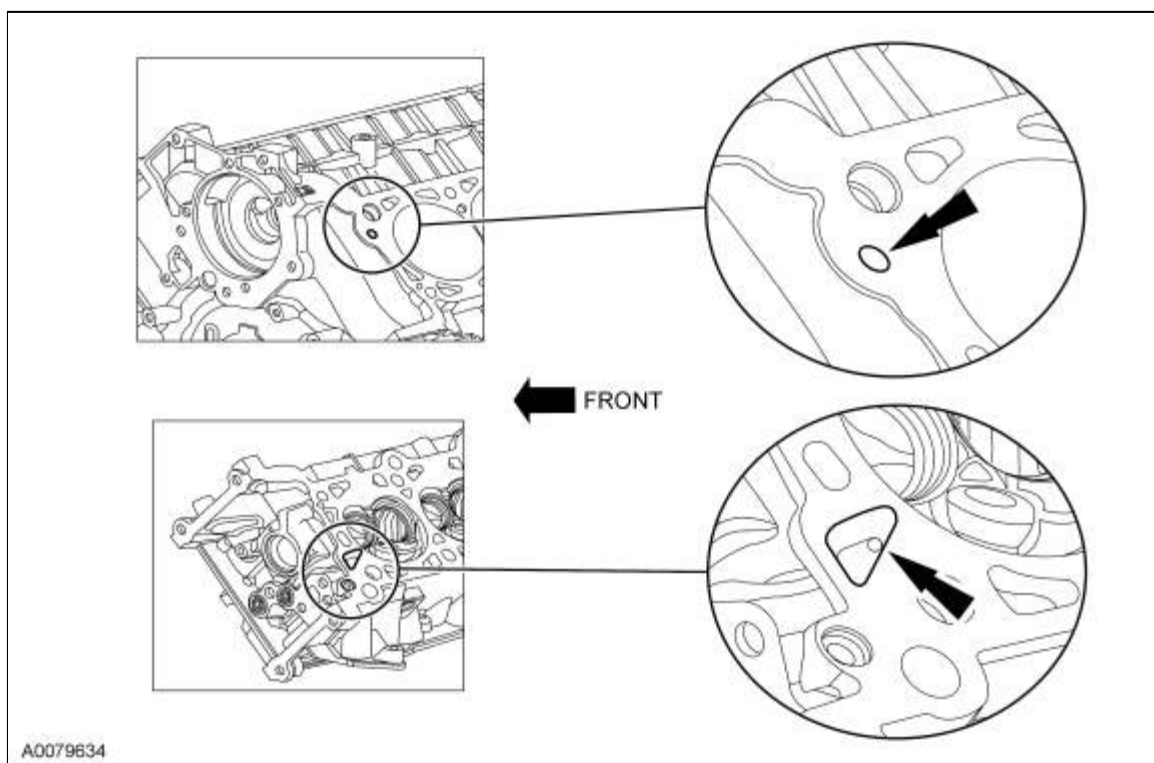
NOTE: If there is no residual gasket material present, metal surface prep can be used to clean and prepare the surfaces.

Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder head and the cylinder block in the following sequence.

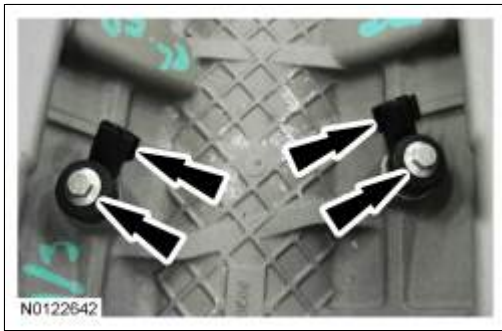
1. Remove any large deposits of silicone or gasket material with a plastic scraper.
 2. Apply silicone gasket remover, following package directions and allow to set for several minutes.
 3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
 4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.
91. **NOTE:** Make sure all cylinder head surfaces are clear of any gasket material, RTV, oil and coolant. The cylinder head surface must be clean and dry before running a flatness check.

NOTE: Use a straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot length. For example, if the straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion, paying particular attention to the oil pressure feed area. For additional information, refer to [Section 303-00](#).



92. Remove the 2 bolts and the 2 KS.



93. Remove the bolt and the Crankshaft Position (CKP) sensor.



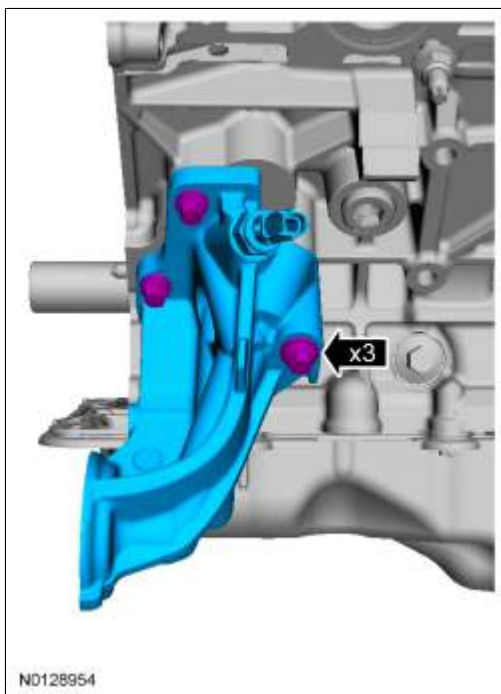
94. **NOTICE:** A new oil cooler must be installed or severe damage to the engine can occur.

Remove the oil cooler threaded insert and the oil cooler.

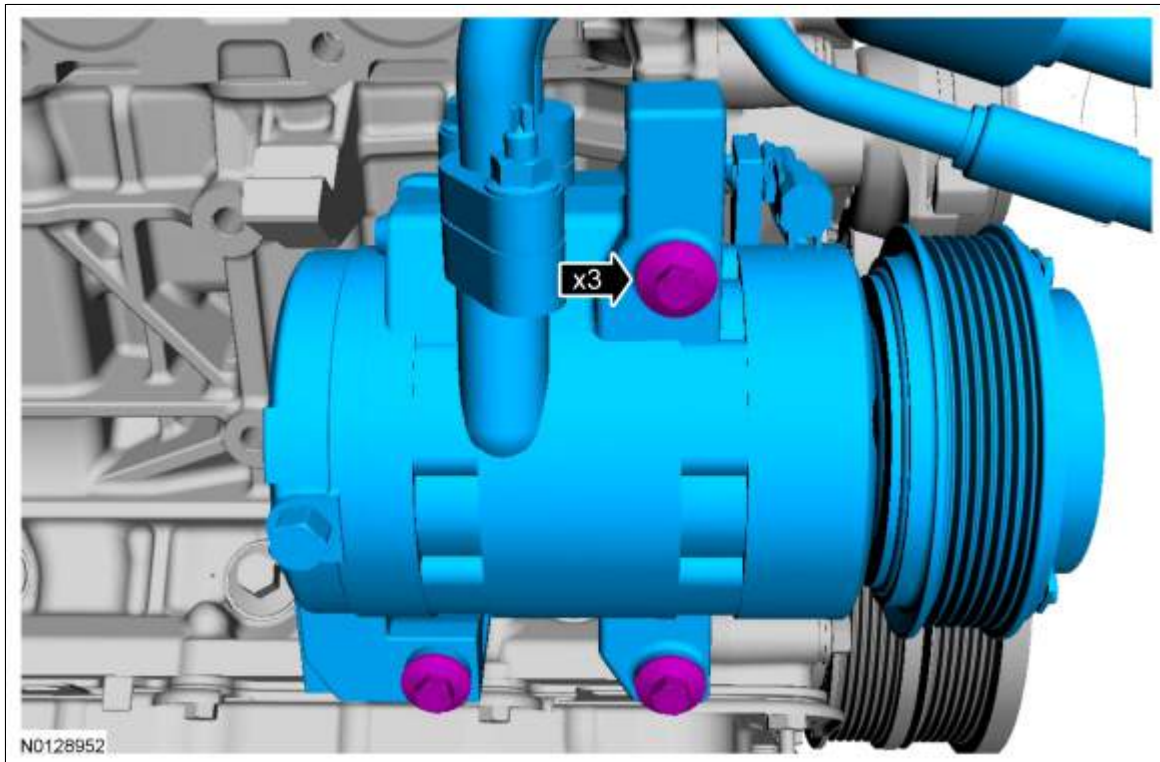
- Discard the oil cooler.



95. Remove the 3 bolts and the oil filter adapter.
- Discard the gasket.



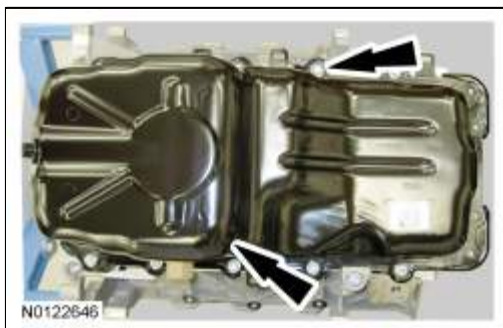
96. Remove the 3 bolts and the A/C compressor.



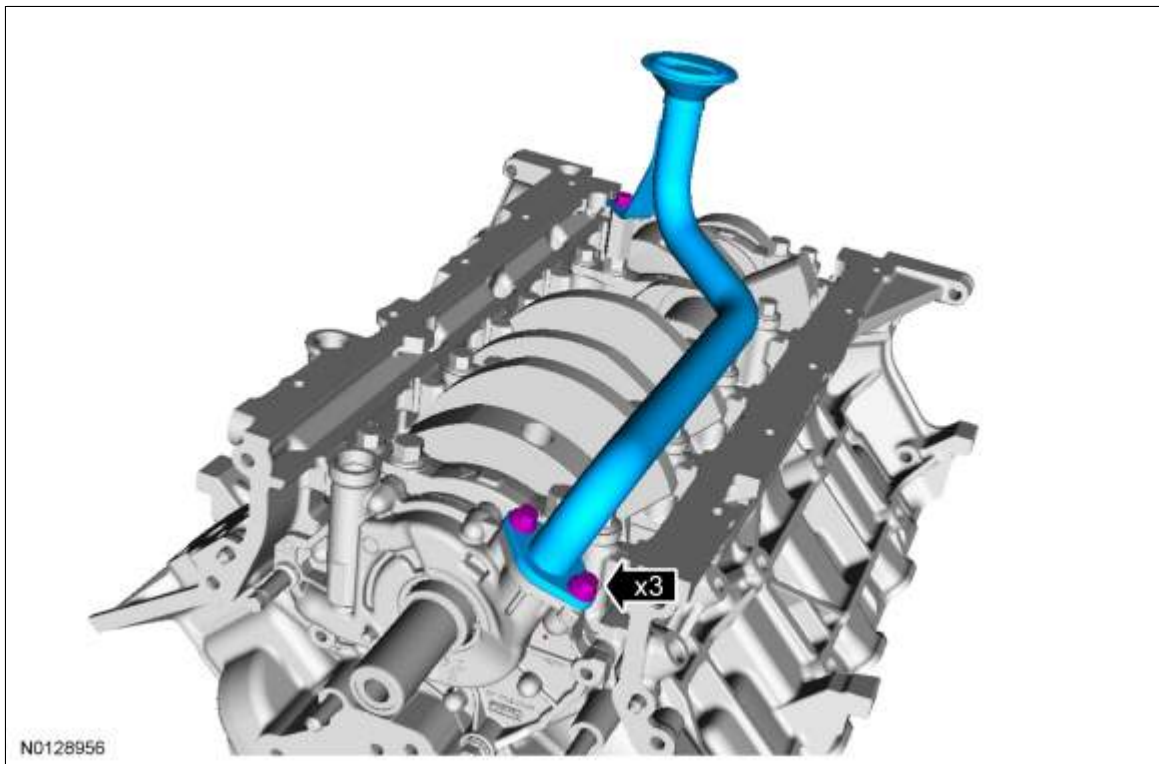
97. **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Remove the bolts and the oil pan.

- Discard the gasket.
- Clean and inspect the sealing surface.



98. Remove the 3 bolts and the oil pump screen and pickup tube.
- Discard the O-ring seal.



99. Remove the oil pump screen and pickup tube spacer.

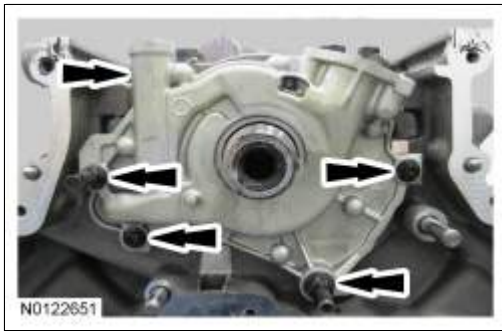


100. Remove the 6 bolts and the crankshaft rear seal retainer plate.
- **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Clean and inspect the sealing surfaces.

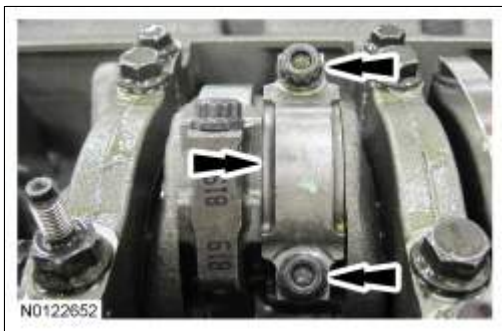


101. Remove the 2 bolts, the 2 stud bolts and the oil pump.



102. Before removing the pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using an abrasive pad or equivalent, following the manufacturer's instructions.
103. **NOTICE:** Verify that the connecting rod and rod cap have orientation numbers cast into them. If not, number the connecting rod and rod cap for correct orientation. Failure to do so can result in engine damage.

Remove the bolts and the connecting rod cap. Discard the bolts.



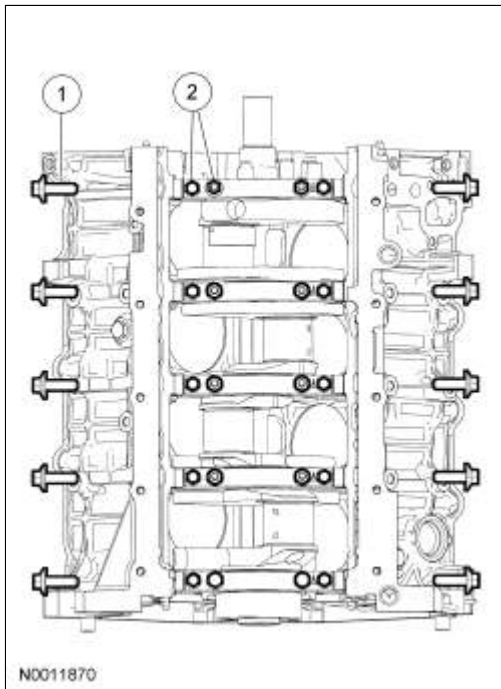
104. **NOTICE:** Do not scratch the cylinder walls or crankshaft journals with the connecting rod or engine damage may occur.

Use the Connecting Rod Installer to push the piston through the top of the cylinder block.

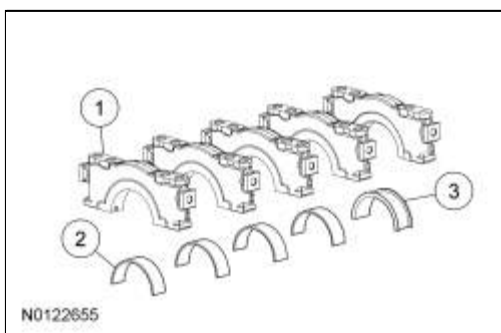


105. Repeat the previous 2 steps for each of the remaining pistons.
106. Disassemble the 8 pistons. For additional information, refer to [Piston](#) in this section.

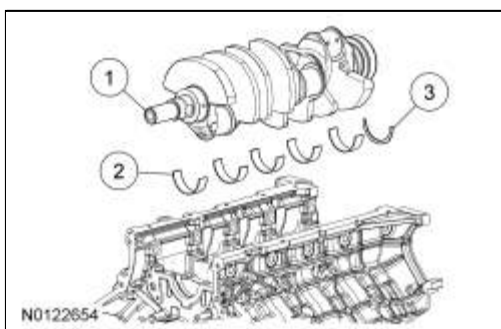
107. Remove the main bearing cap fasteners.
1. Remove and discard the cross-mounted main cap bolts.
 2. Remove and discard the main bearing cap bolts and stud bolt.



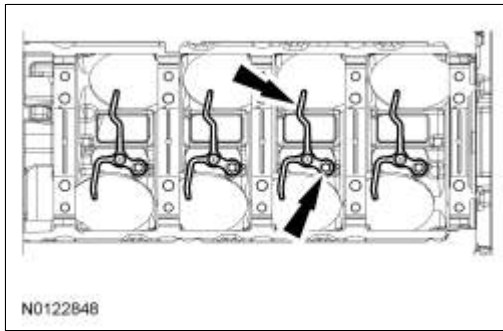
108. Remove the main bearing caps (1), the lower crankshaft main bearings (2) and the lower thrust bearing (3).



109. Remove the crankshaft (1), the upper crankshaft main bearings (2) and the upper thrust washer (3) from the cylinder block.



110. Remove the 4 bolts and 4 piston cooling jets from the cylinder block.





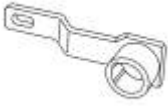




SECTION 303-01C: Engine — 5.0L (4V)
ASSEMBLY

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST2806-A	Alignment Pins, Cylinder Head 303-1040 (SR-015486)
 ST1376-A	Compressor, Piston Ring 303-D032 (D81L-6002-C) or equivalent
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1337-A	Installer, Connecting Rod 303-442 (T93P-6136-A)
	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)

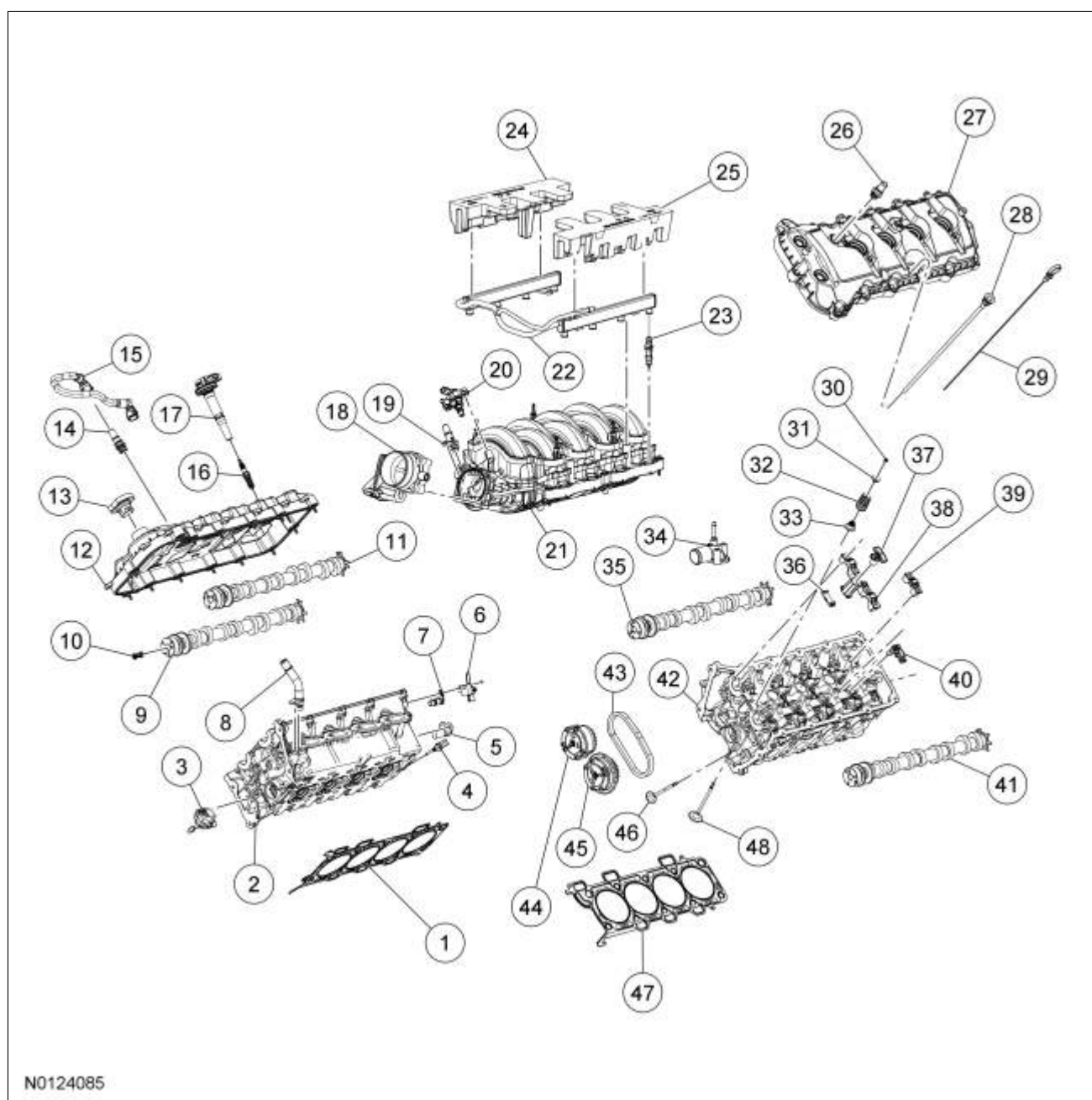
 <p>ST2212-A</p>	
 <p>ST1328-A</p>	<p>Installer, Front Cover Oil Seal 303-335 (T88T-6701-A2 plate only)</p>
 <p>ST3249-A</p>	<p>Installer, Front Crank Seal and Damper 303-1531</p>
 <p>ST2980-A</p>	<p>Installer, Rear Main Seal 303-1250</p>
 <p>ST2983-A</p>	<p>Installer, Spark Plug Tube Seal 303-1247/2</p>
 <p>ST1377-A</p>	<p>Lifting Bracket, Engine 303-F047 (014-00073) or equivalent</p>
 <p>ST1438-A</p>	<p>Strap Wrench 303-D055 (D85L-6000-A) or equivalent</p>

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US);	WSS-M2C945-A

Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	
Motorcraft® SAE 5W-50 Full Synthetic Motor Oil XO-5W50-QGT or equivalent	WSS- M2C931-B
Motorcraft® Silicone Gasket Remover ZC-30	—
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS- M97B44-D
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171-A
Silicone Gasket and Sealant TA-30	WSE- M4G323-A4

Engine — Upper End

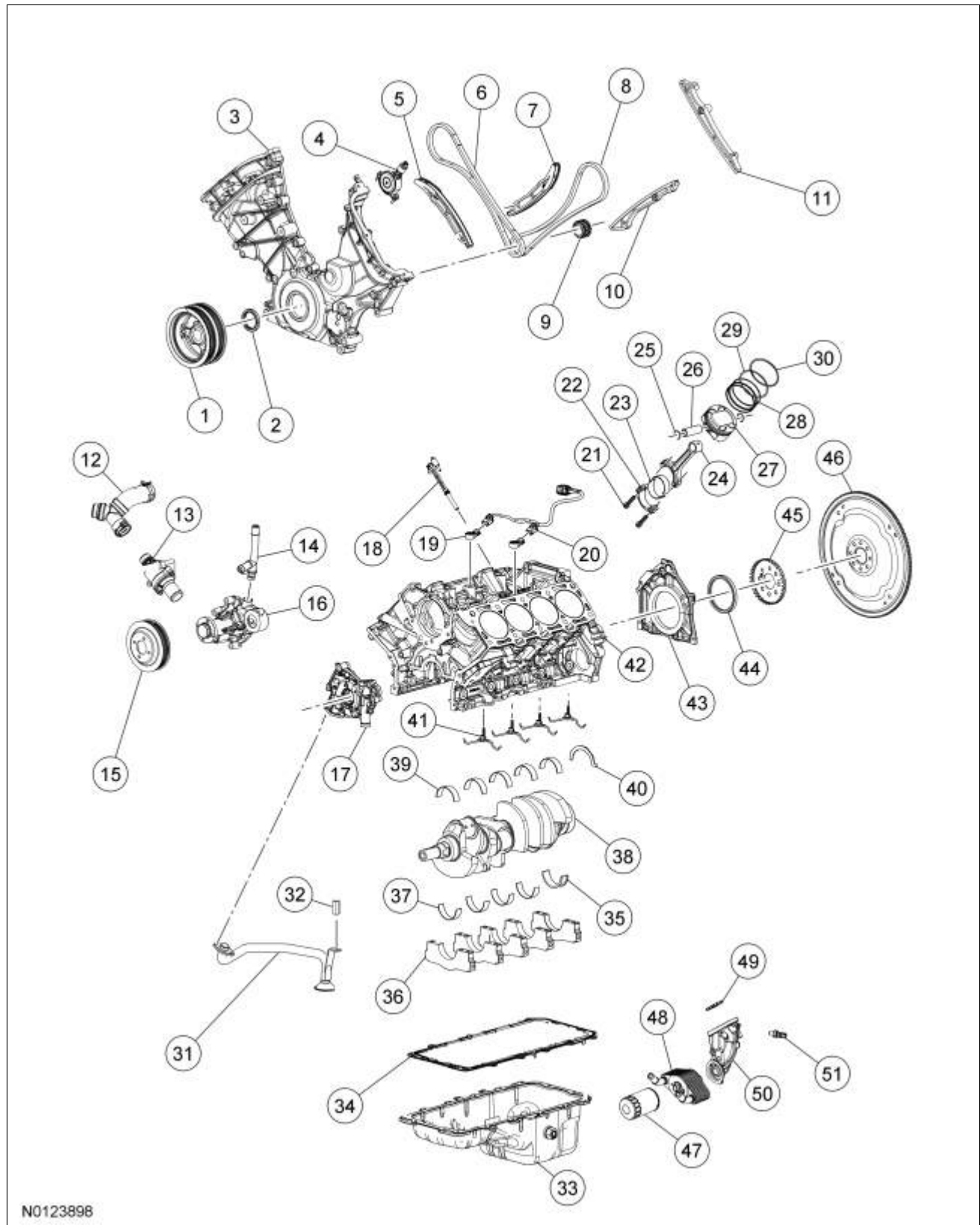


Item	Part Number	Description
1	6051	RH cylinder head gasket
2	6049	RH cylinder head
3	6L266	Primary timing chain tensioner (2 required)
4	6G004	Cylinder Head Temperature (CHT) sensor
5	6B288	Intake Camshaft Position (CMP) sensor (2 required)
6	18801	Radio capacitor (2 required)
7	12K073	Exhaust <u>CMP</u> sensor (2 required)
8	18696	Heater supply tube

9	6250	RH exhaust camshaft
10	6C683	Camshaft engine oil filter (4 required)
11	6250	RH intake camshaft
12	6582	RH valve cover
13	6766	Oil filler cap
14	6A666	PCV valve
15	6578	Crankcase vent hose
16	12405	Spark plug (8 required)
17	12029	Ignition coil on plug (8 required)
18	9F991	Throttle Body (TB)
19	9F624	Heat control inlet tube
20	9C915	Fuel vapor purge valve
21	9424	Intake manifold
22	9F792	Fuel rail
23	9F593	Fuel injector (8 required)
24	6P013	RH fuel injector insulator shield
25	6P013	LH fuel injector insulator shield
26	6762	Crankcase vent valve
27	6582	LH valve cover
28	6754	Oil indicator tube
29	6750	Oil indicator
30	6518	Valve spring retainer key (64 required)
31	6514	Valve spring retainer (32 required)
32	6513	Valve spring (32 required)
33	6571	Valve stem seal (32 required)
34	8594	Coolant outlet connector
35	6250	LH intake camshaft
36	6K297	Secondary tensioner shoe (2 required)
37	6K254	Secondary tensioner (2 required)
38	—	Camshaft bearing cap (part of 6049) (2 required)
39	—	Camshaft bearing cap (part of 6049) (16 required)
40	6500/6564	Hydraulic lash adjuster/camshaft roller follower (32 required)
41	6250	LH exhaust camshaft
42	6049	LH cylinder head
43	6268	Secondary timing chain (2 required)
44	6256	Intake camshaft Variable Camshaft Timing (VCT) (2 required)
45	6256	Exhaust camshaft <u>VCT</u> (2 required)

46	6505	Exhaust valve (16 required)
47	6051	LH cylinder head gasket
48	6507	Intake valve (16 required)

Engine — Lower End



Item	Part Number	Description
1	6316	Crankshaft pulley

2	6700	Crankshaft front oil seal
3	6019	Engine front cover
4	6B297	Variable Camshaft Timing (VCT)variable force solenoid (4 required)
5	6K255	RH timing chain tensioner arm
6	6268	RH primary timing chain
7	6K255	LH timing chain tensioner arm
8	6268	LH primary timing chain
9	6306	Crankshaft sprocket
10	6B274	LH timing chain guide
11	6M256	RH timing chain guide
12	8566	Coolant bypass tee
13	8A586	Thermostat housing
14	18663	Heater outlet tube
15	8509	Coolant pump pulley
16	8501	Coolant pump
17	6600	Oil pump
18	6C315	Crankshaft Position (CKP) sensor
19	12A699	<u>KS</u> (2 required)
20	14A411	<u>KS</u> wiring harness
21	6214	Connecting rod cap bolt (16 required)
22	—	Connecting rod cap (part of 6200) (8 required)
23	6211	Connecting rod bearing (16 required)
24	6200	Connecting rod (8 required)
25	6140	Piston pin retainer (16 required)
26	6135	Piston pin (8 required)
27	6110	Piston (8 required)
28	—	Outer oil control ring (part of 6148) (16 required)
29	—	Lower compression ring (part of 6148) (8 required)
30	—	Upper compression ring (part of 6148) (8 required)
31	6622	Oil pump screen and pickup tube
32	N806180	Oil pump screen and pickup tube spacer
33	6675	Oil pan
34	6710	Oil pan gasket
35	—	Crankshaft main bearing cap (part of 6010) (5 required)
36	6D309	Crankshaft lower main bearing
37	6D309	Crankshaft lower main bearing (4 required)
38	6303	Crankshaft

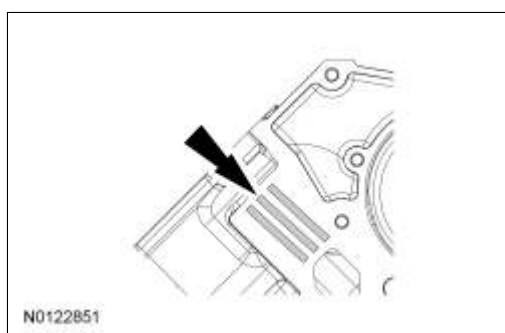
39	6D309	Crankshaft upper main bearing (5 required)
40	6A341	Thrust washer
41	6K868	Piston cooling jets (4 required)
42	6010	Engine block
43	6K318	Crankshaft rear seal retainer plate
44	6701	Crankshaft rear seal
45	12A227	Crankshaft sensor ring
46	6375	Flexplate
47	6731	Oil filter
48	6A642	Oil cooler
49	6840	Oil filter adapter gasket
50	6881	Oil filter adapter
51	9278	Engine Oil Pressure (EOP) switch

NOTICE: 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.

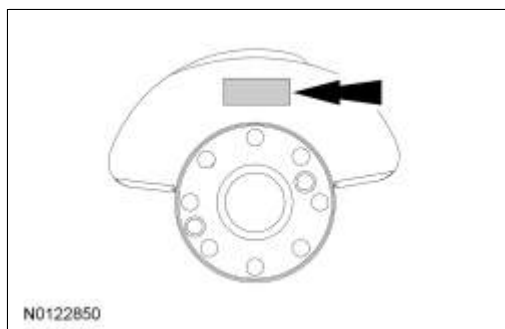
NOTICE: During engine assembly do not allow the piston connecting rods to come in contact with the piston cooling jets or engine damage may occur.

NOTE: During engine assembly it may become necessary to check bearing clearances and end play. For additional information, refer to [Section 303-00](#).

1. Record the main bearing code found on the front of the engine block.



2. Record the main bearing code found on the rear of the crankshaft.

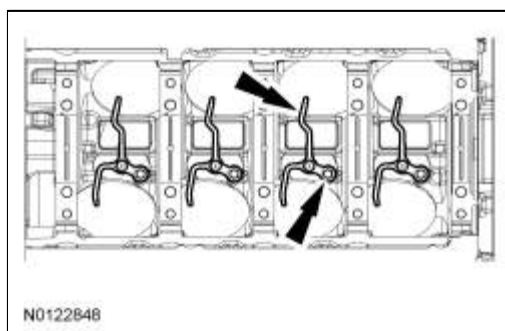


MAINS 2, 3 & 4		MINIMUM BLOCK DIA																									
UPPER/LOWER		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X		
		72.400	.401	.402	.403	.404	.405	.406	.407	.408	.409	.410	.411	.412	.413	.414	.415	.416	.417	.418	.419	.420	.421	.422	.423	.424	
MAXIMUM CRANKSHAFT DIA	X	67.505	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	
	W	67.504	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	
	V	67.503	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	
	U	67.502	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	
	T	67.501	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	
	S	67.500	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/2	
	R	67.499	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	Q	67.498	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	P	67.497	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	O	67.496	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	N	67.495	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	M	67.494	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	L	67.493	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	K	67.492	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	J	67.491	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	I	67.490	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	H	67.489	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	G	67.488	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	F	67.487	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	E	67.486	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	D	67.485	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	C	67.484	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	B	67.483	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
	A	67.482	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	
		67.481	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/2	1/2	1/2	1/2	1/2	1/2	1/2	2/2	2/2	2/2	2/2	2/3	

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NOTE: Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

5. Install the 4 piston cooling jets and 4 bolts. Tighten in 2 stages.
 - Stage 1: Tighten to 10 Nm (89 lb-in).
 - Stage 2: Tighten an additional 45 degrees.



6. Install the crankshaft main bearings.
 - Install the crankshaft upper main bearings into the cylinder block.
 - Install the crankshaft lower main bearings and thrust bearing into the bearing caps.
 - Make sure all oil passages are aligned.
 - Lubricate all main bearings with clean engine oil.

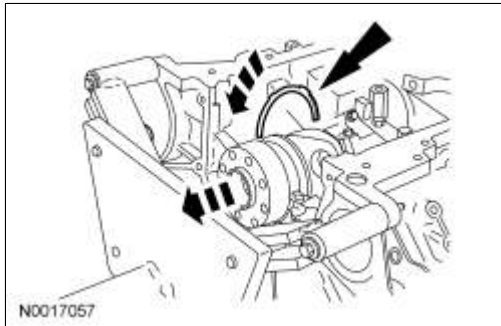
7. **NOTE:** Lubricate the crankshaft bearing journals with clean engine oil.

Install the crankshaft into the cylinder block.

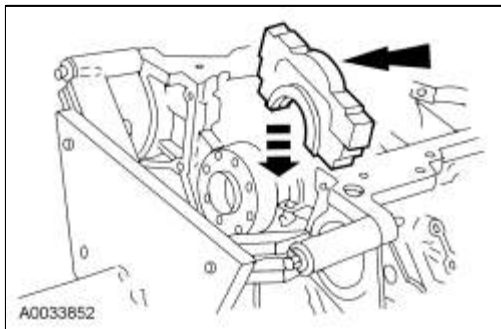
8. **NOTE:** The oil groove on the thrust washer must face toward the rear of the engine (against the

crankshaft thrust surface).

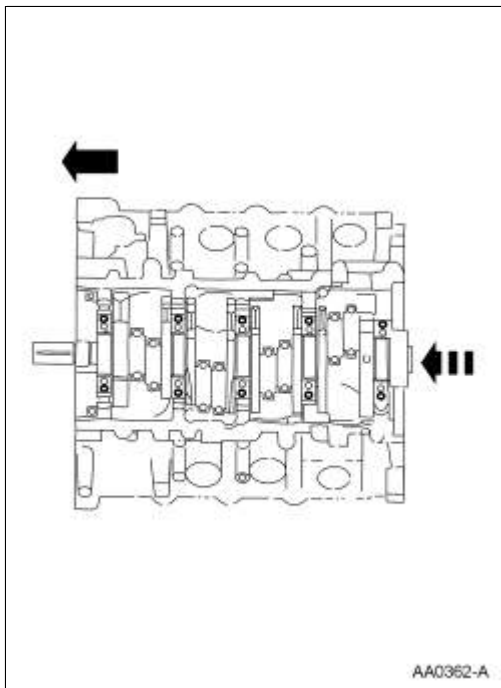
Push the crankshaft rearward and install the rear crankshaft upper thrust washer at the back of the No. 5 main boss.



9. Install the main bearing caps and fasteners on the cylinder block and, keeping the caps as square as possible, alternately draw the caps down evenly using the cap fasteners.

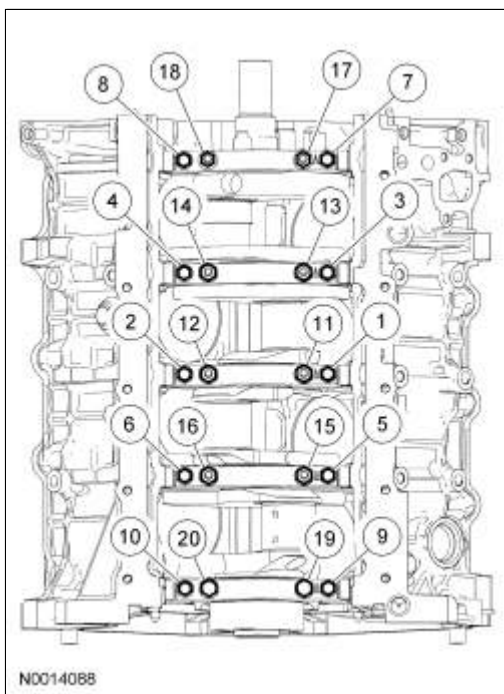


10. Push the crankshaft forward to seat the crankshaft thrust washer. Hold the crankshaft in the forward position.



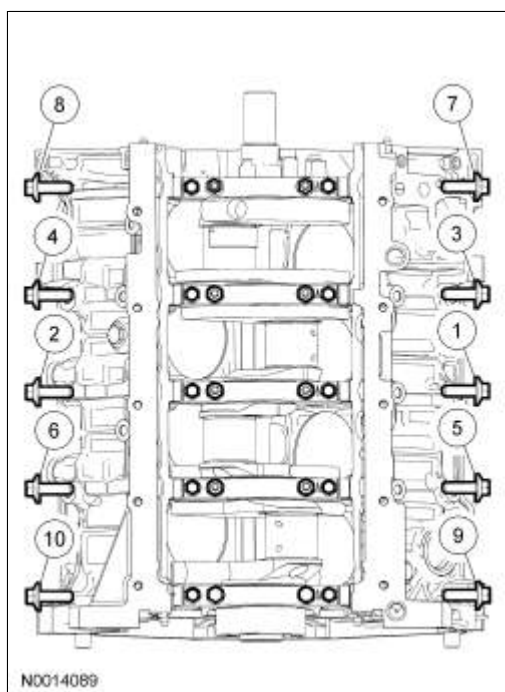
11. Tighten the vertical main bearing cap fasteners in the sequence shown, in 4 stages.

- Stage 1: Tighten fasteners 1 through 20 to 20 Nm (177 lb-in).
- Stage 2: Tighten fasteners 1 through 10 to 40 Nm (30 lb-ft).
- Stage 3: Tighten fasteners 11 through 20 to 65 Nm (48 lb-ft).
- Stage 4: Tighten fasteners 1 through 20 an additional 90 degrees.

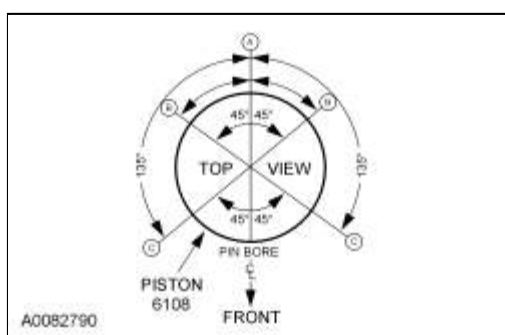


12. Install the cross-mounted main bearing cap fasteners and tighten in the sequence shown, in 3 stages.

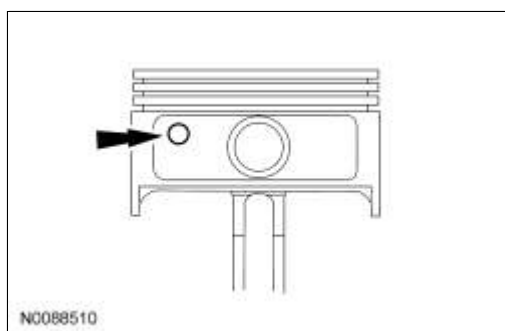
- Stage 1: Tighten to 10 Nm (89 lb-in).
- Stage 2: Tighten to 30 Nm (22 lb-ft).
- Stage 3: Tighten an additional 60 degrees.



13. Check the crankshaft end play. For additional information, refer to [Section 303-00](#).
14. Check that crankshaft torque-to-turn does not exceed 6 Nm (53 lb-in).
15. Check the piston-to-cylinder block and piston ring clearances. For additional information, refer to [Section 303-00](#).
16. Assemble the pistons. For additional information, refer to [Piston](#) in this section.
17. Make sure the ring gaps (oil spacer-A, oil ring-B, compression ring-C) are correctly spaced around the circumference of the piston.



18. Make sure the dimple in the piston faces the front of the engine.

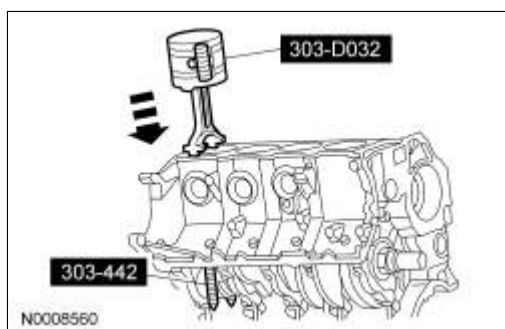


19. **NOTICE:** Do not scratch the cylinder walls or crankshaft journals with the connecting rod or engine damage may occur.

NOTICE: Do not allow the piston connecting rods to come in contact with the piston cooling jets or engine damage may occur.

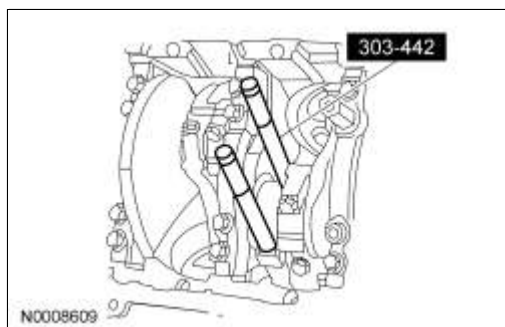
Use the Piston Ring Compressor and the Connecting Rod Installers to install the connecting rod with the upper connecting rod bearing in place.

- Lubricate the piston and ring with clean engine oil.
- Lubricate the rod bearings with clean engine oil.



20. **NOTICE:** Do not scratch the cylinder walls or crankshaft journals with the connecting rod or engine damage may occur.

Once the connecting rod is seated on the crankshaft journal, remove the Connecting Rod Installers.



21. **NOTICE:** The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.

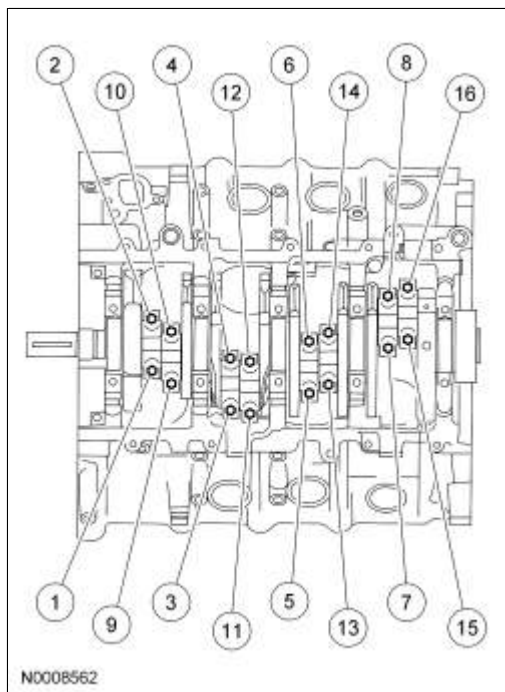
NOTE: The connecting rod caps are of the "cracked" design and must mate with the connecting rod ends. Excessive bearing clearance will result if not mated correctly.

Position the lower bearing and connecting rod and install the new bolts loosely.

22. Repeat the previous 5 steps for each of the remaining pistons.
23. **NOTE:** Main bearing caps are removed for clarity.

Tighten the bolts in the sequence shown in 3 stages.

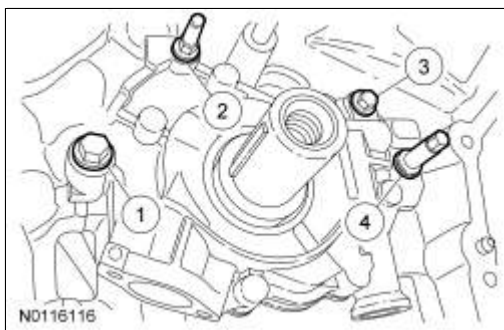
- Stage 1: Tighten to 20 Nm (177 lb-in).
- Stage 2: Tighten to 38 Nm (28 lb-ft).
- Stage 3: Tighten an additional 105 degrees.



24. Rotate the inner rotor of the oil pump assembly to align the flats on the crankshaft and slip the oil pump over the crankshaft until seated against the block.
 - Rotate the oil pump until the bolt holes are aligned to the block and install the fasteners.
25. **NOTE:** Oil pump must be held against the cylinder block until all bolts are tightened.

Tighten the fasteners in the sequence shown in 3 stages:

- Stage 1: Hand tighten.
- Stage 2: Tighten the bolt (1) to 10 Nm (89 lb-in), the stud bolt (2) to 25 Nm (18 lb-ft), the bolt (3) to 10 Nm (89 lb-in) and the stud bolt (4) to 20 Nm (177 lb-in).
- Stage 3: Tighten the bolt (1) an additional 45 degrees, the stud bolt (2) an additional 75 degrees, the bolt (3) an additional 45 degrees and the stud bolt (4) an additional 60 degrees.



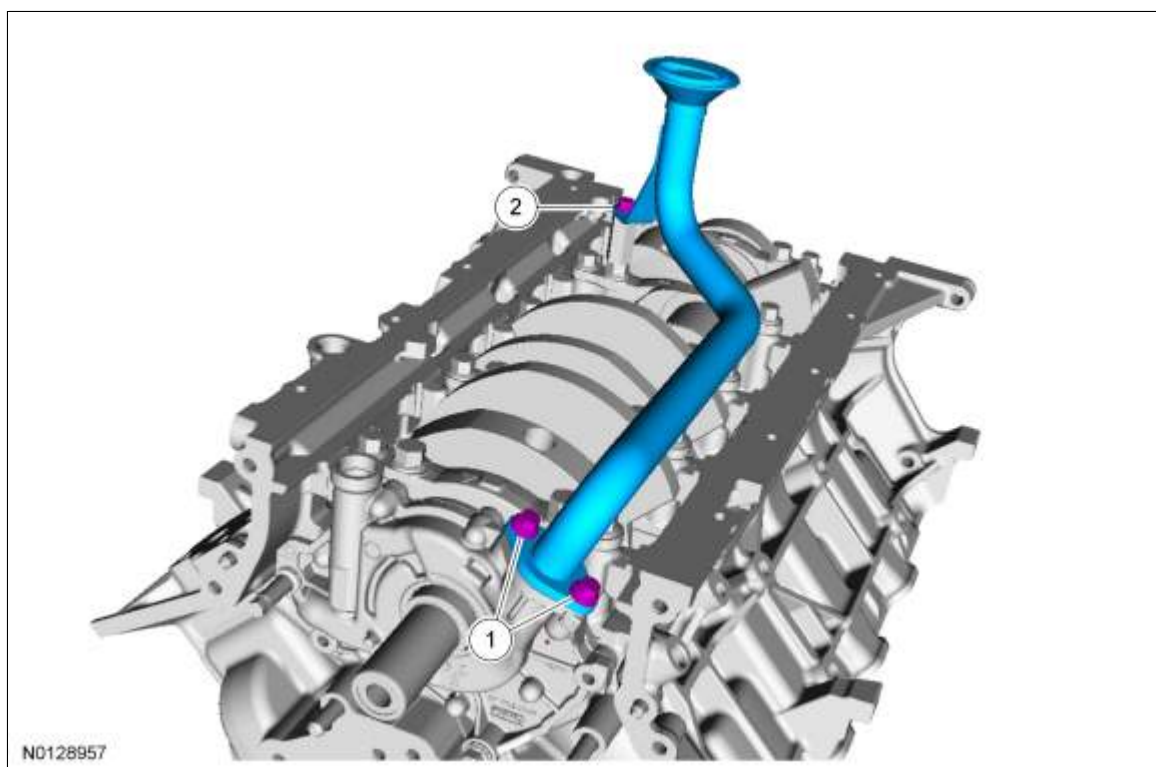
26. Install the oil pump screen and pickup tube spacer.
- Tighten to 25 Nm (18 lb-ft).



27. **NOTE:** The 2 oil pump screen and pickup tube-to-oil pump bolts must be tightened prior to tightening the oil pump screen and pickup tube-to-spacer bolt.

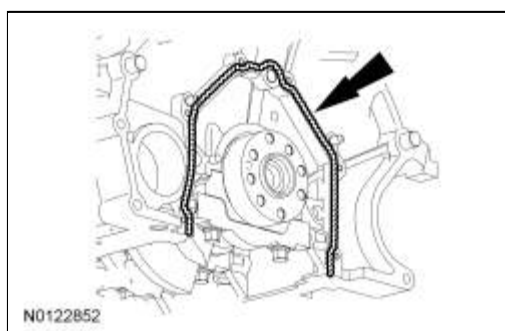
Using a new O-ring seal, install the oil pump screen and pickup tube and the 3 bolts.

1. Tighten the 2 oil pump screen and pickup tube-to-oil pump bolts in 2 stages.
 - Stage 1: Tighten to 10 Nm (89 lb-in).
 - Stage 2: Tighten an additional 45 degrees.
2. Tighten the oil pump screen and pickup tube-to-spacer bolt to 25 Nm (18 lb-ft).

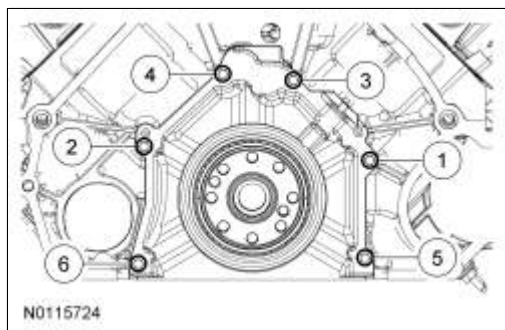


28. **NOTE:** If the rear crankshaft seal retaining plate is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Follow the directions on the packaging. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Failure to follow this procedure may cause future oil leaks.

Apply a 3.75 mm (0.147 in) bead of silicone gasket and sealant to the rear crankshaft seal retainer mating surface on the engine block.



29. Install the crankshaft rear seal retainer plate and the 6 bolts, tighten in the sequence shown in 2 stages.
- Stage 1: Tighten to 10 Nm (89 lb-in).
 - Stage 2: Tighten an additional 45 degrees.

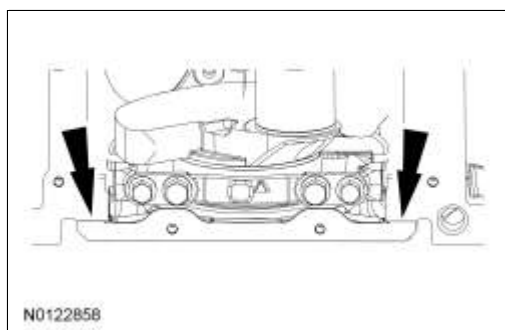


30. **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Inspect the oil pan and engine sealing surfaces. Clean the mating surfaces of the engine and oil pan with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

31. **NOTE:** If the oil pan is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage. If this timing cannot be met, tighten fasteners 7, 8, 9 and 10 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer and final torque all of the fasteners within 1 hour of applying the sealer.

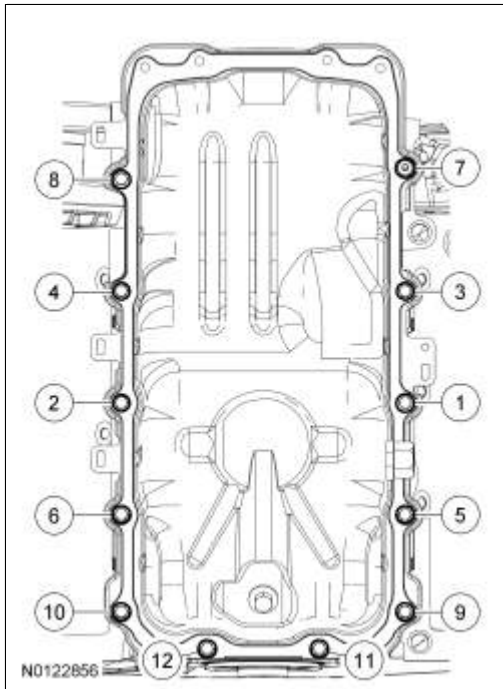
Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the crankshaft rear seal retainer plate-to-cylinder block sealing surfaces and the engine front cover-to-cylinder block sealing surfaces.



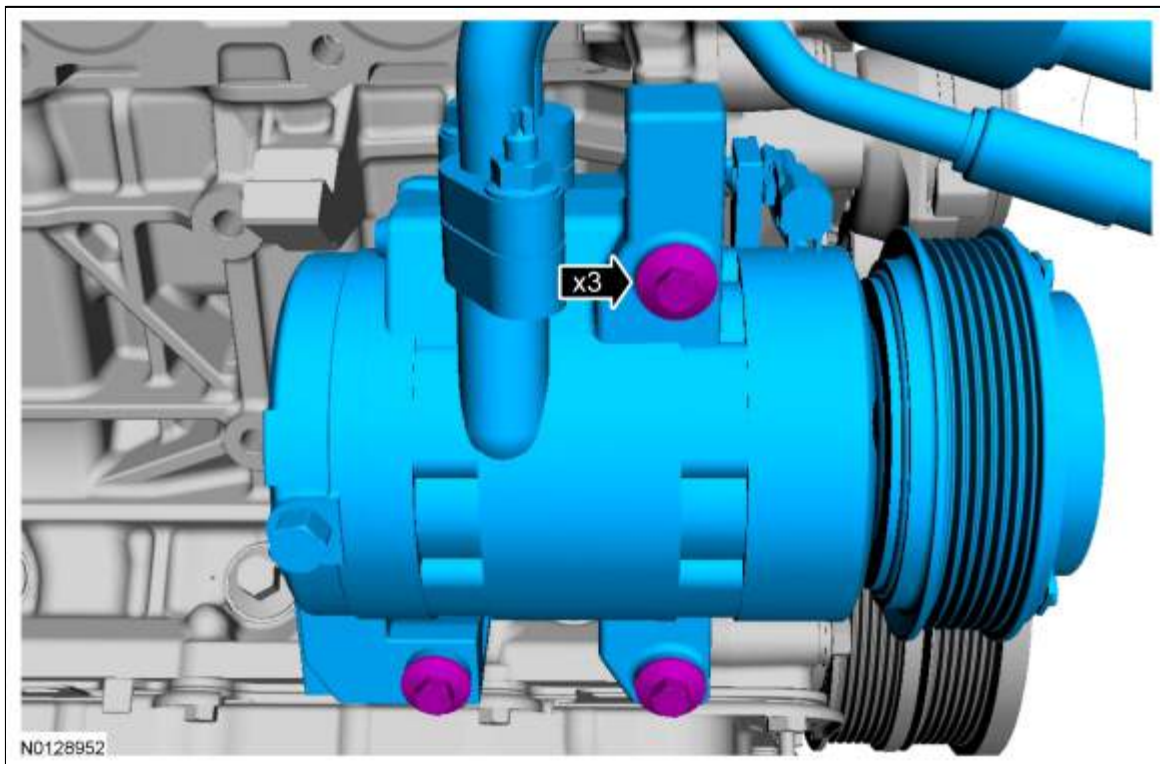
32. **NOTE:** Fastener location 7 is a stud bolt.

Using a new gasket, install the oil pan and tighten the fasteners in sequence in 3 stages.

- Stage 1: Tighten to 2 Nm (18 lb-in)
- Stage 2: Tighten to 10 Nm (89 lb-in).
- Stage 3: Tighten an additional 45 degrees.



33. Install the A/C compressor and the 3 bolts.
- Tighten to 25 Nm (18 lb-ft).

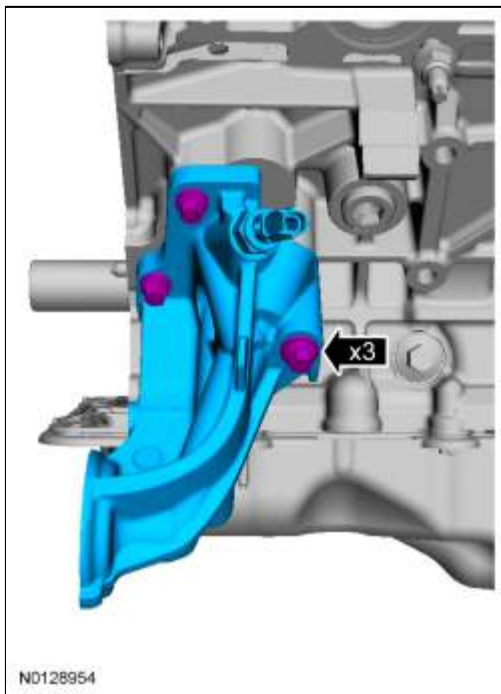


34. **NOTE:** Install a new oil filter adapter gasket.

Using a new gasket, install the oil filter adapter and the 3 bolts. Tighten the bolts in 2 stages.

- Stage 1: Tighten the bolts to 20 Nm (177 lb-in).

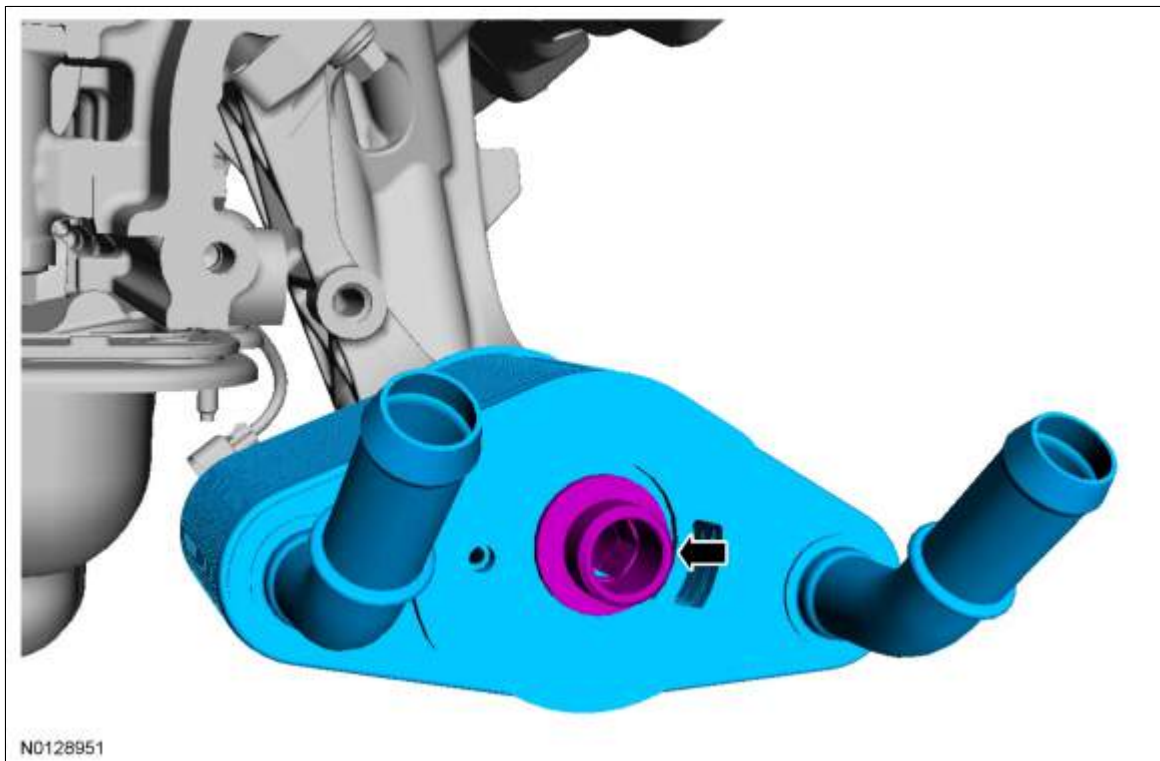
- Stage 2: Tighten an additional 60 degrees.



35. **NOTICE:** A new oil cooler must be installed or severe damage to the engine can occur.

Install a new oil cooler and the threaded fitting.

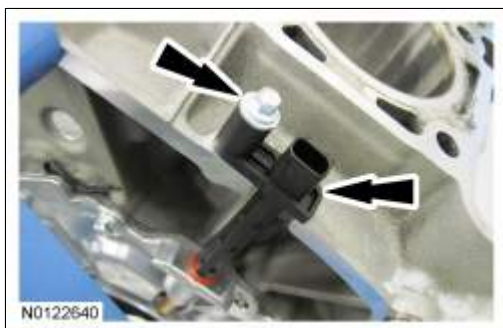
- Tighten to 57 Nm (42 lb-ft).



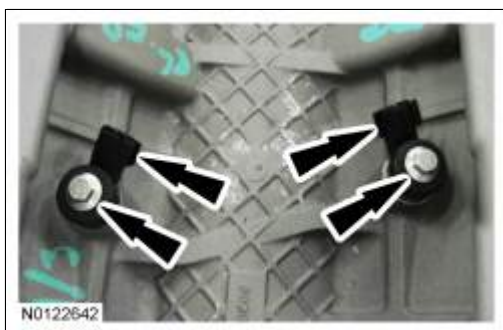
36. **NOTICE:** The Crankshaft Position (CKP) sensor must be positioned into the fitting on the crankshaft rear seal retainer plate and be flush against the boss on the engine block before the bolt is installed. If the CKP sensor is installed incorrectly, the CKP sensor can be damaged.

Position the CKP sensor and install the bolt.

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



37. Install the 2 Knock Sensor (KS) and 2 bolts.
- Tighten to 20 Nm (177 lb-in).



38. Verify the crankshaft keyway is in the 9 o'clock position and install the crankshaft sprocket with the flange facing forward.



39. **NOTICE:** Make sure all coolant residue and foreign material are cleaned from the block surface and cylinder bore. Failure to follow these instructions may result in engine damage.

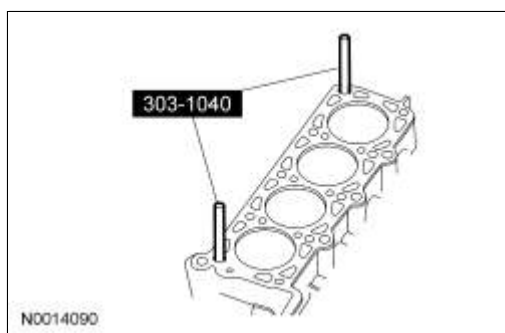
NOTICE: The use of sealing aids (aviation cement, copper spray and glue) is not permitted. The gasket must be installed dry. Failure to follow these instructions may result in future oil leakage.

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

NOTE: Do not turn the crankshaft until instructed to do so.

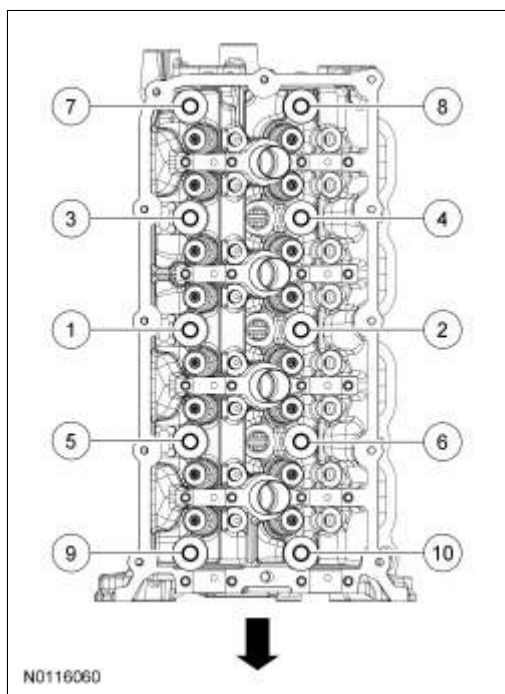
NOTE: LH shown, RH similar.

Using the Cylinder Head Alignment Pins, position the cylinder head gaskets and cylinder heads over the dowels and install the cylinder head bolts loosely.



40. Tighten the new RH cylinder head bolts in 4 stages in the sequence shown.

- Stage 1: Tighten to 25 Nm (18 lb-ft).
- Stage 2: Tighten to 40 Nm (30 lb-ft).
- Stage 3: Tighten an additional 90 degrees.
- Stage 4: Tighten an additional 90 degrees.



41. **NOTICE:** 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 scraper to clean the sealing surfaces.

Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the

directions on the packaging.

42. Install the Cylinder Head Temperature (CHT) sensor.
 - Tighten to 11 Nm (97 lb-in).



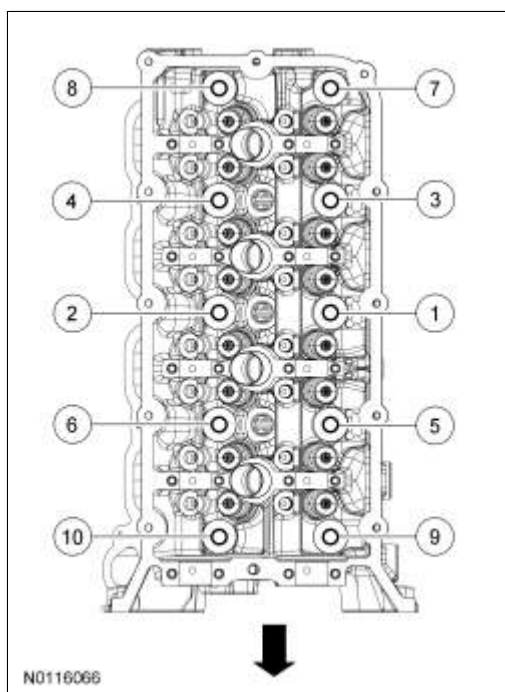
43. **NOTICE:** Lubricate the O-ring seal with clean engine coolant prior to installing.

Using a new O-ring seal, install the coolant outlet pipe.

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



44. Tighten the new LH cylinder head bolts in 4 stages in the sequence shown.
 - Stage 1: Tighten to 25 Nm (18 lb-ft).
 - Stage 2: Tighten to 40 Nm (30 lb-ft).
 - Stage 3: Tighten an additional 90 degrees.
 - Stage 4: Tighten an additional 90 degrees.



45. **NOTICE:** 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 scraper to clean the sealing surfaces.

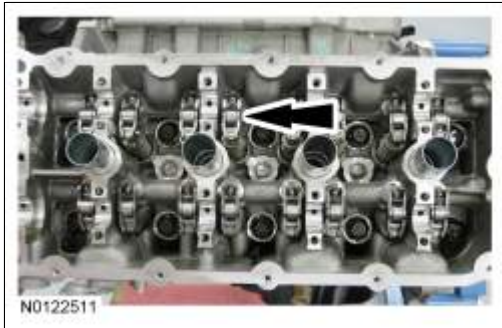
Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

46. Using a new gasket, install the coolant outlet and 2 bolts.
- Tighten to 10 Nm (89 lb-in).



47. **NOTE:** Lubricate the camshaft roller follower and hydraulic lash adjuster assemblies with clean engine oil prior to installation.

Install the 16 camshaft roller follower and hydraulic lash adjuster assemblies.

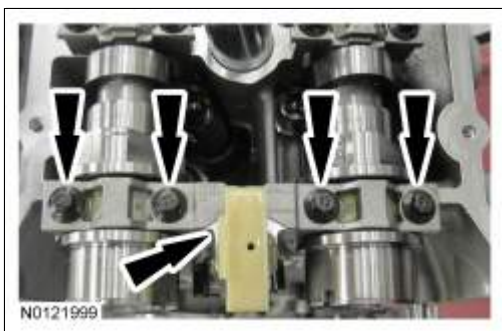


48. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

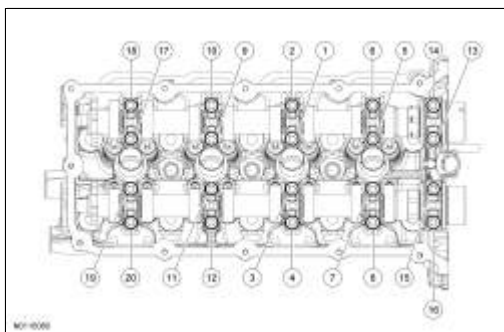
Install the LH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.



49. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.
50. Install the LH front camshaft bearing mega cap and the 4 bolts. Do not tighten the bolts at this time



51. Tighten the bolts in the sequence shown in 2 stages.
- Stage 1: Tighten to 6 Nm (53 lb-in).
 - Stage 2: Tighten an additional 45 degrees.

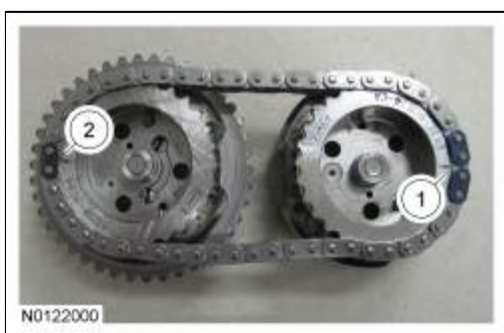


52. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

Install the Variable Camshaft Timing (VCT) system oil filter in the intake and exhaust camshafts.



53. Install the secondary timing chain onto the LH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
 2. The timing mark on the exhaust VCT assembly should align with the single colored link.



54. Install the LH VCT assemblies and the secondary timing chain onto the LH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 11 o'clock position.



55. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.

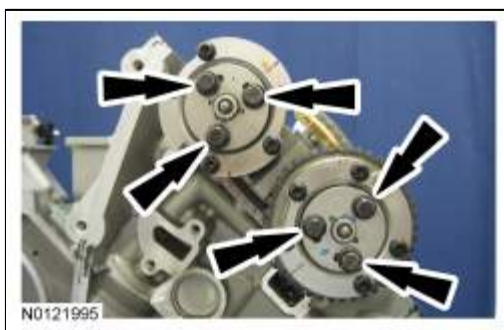
- If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



56. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

Install the 3 LH intake VCT assembly bolts and the 3 LH exhaust VCT assembly bolts.

- Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.



57. Install the LH primary timing chain.
- Align the colored link on the timing chain with the timing mark on the LH VCT assembly.



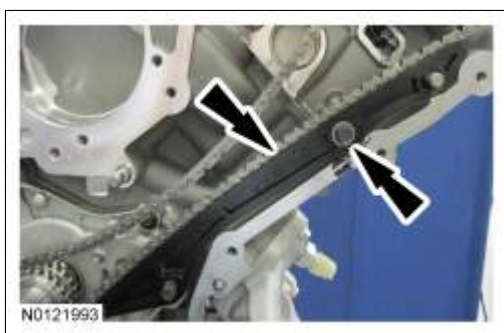
58. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



59. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain guide.

Install the LH timing chain guide and bolt.

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



60. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain tensioner arm.

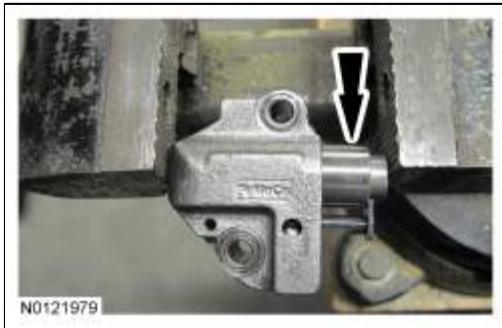
Install the LH timing chain tensioner arm.



NOTE: Complete the following 3 steps on both the LH and RH primary timing chain tensioners.

61. **NOTICE:** Do not compress the ratchet assembly or damage to the tensioner will occur.

Compress the primary timing chain tensioner plunger, using an edge of a vise.



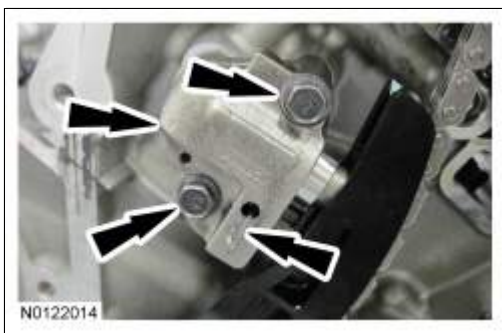
62. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.



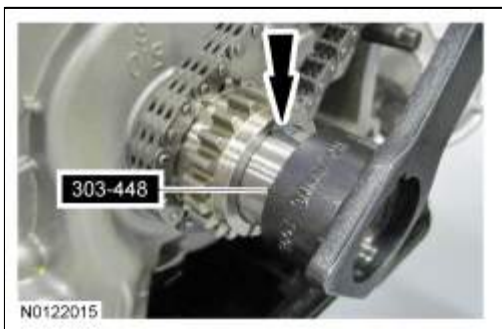
63. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.



64. Install the LH primary timing chain tensioner and 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Remove the holding pin from the tensioner.



65. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.



66. **NOTE:** Lubricate the camshaft roller follower and hydraulic lash adjuster assemblies with clean engine oil prior to installation.

Install the 16 camshaft roller follower and hydraulic lash adjuster assemblies.

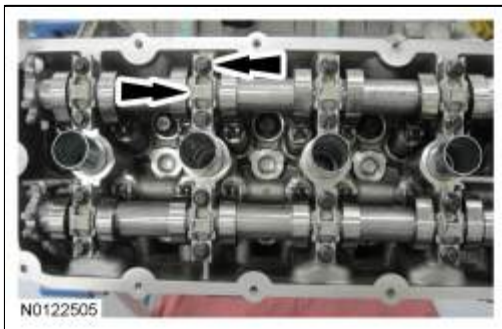


67. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

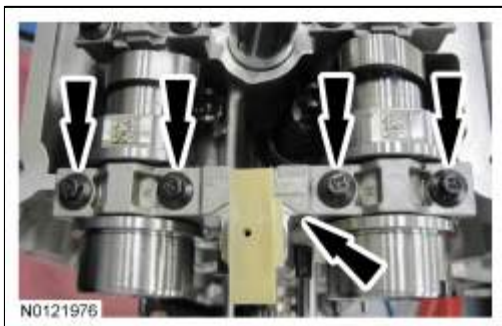
Install the RH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.



68. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.

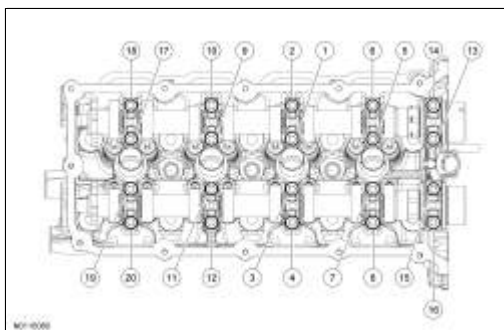


69. Install the RH front camshaft bearing mega cap and the 4 bolts. Do not tighten at this time



70. Tighten the bolts in the sequence shown in 2 stages.

- Stage 1: Tighten to 6 Nm (53 lb-in).
- Stage 2: Tighten an additional 45 degrees.

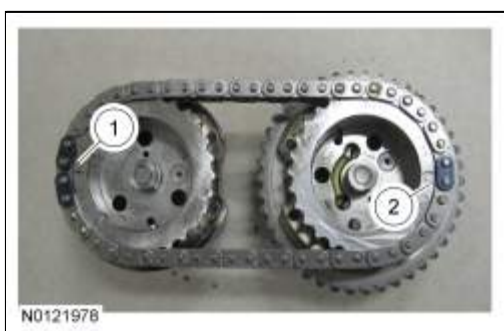


71. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

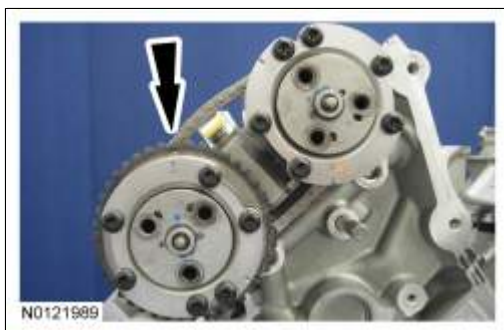
Install the VCT system oil filter in the intake and exhaust camshafts.



72. Install the secondary timing chain onto the RH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
 2. The timing mark on the exhaust VCT assembly should align with the single colored link.



73. Install the RH VCT assemblies and the secondary timing chain onto the RH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 1 o'clock position.



74. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.

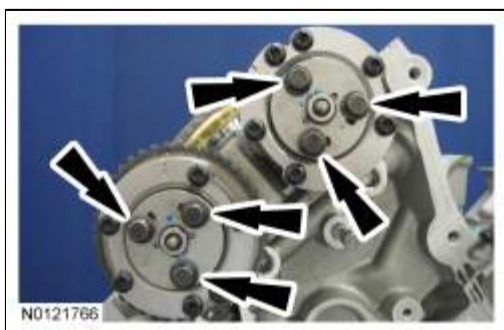
- If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



75. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

Install the 3 RH intake VCT assembly bolts and the 3 RH exhaust VCT assembly bolts.

- Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.



76. Install the RH primary timing chain.
- Align the colored link on the timing chain with the timing mark on the RH VCT assembly.



77. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



78. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

Install the RH timing chain guide and bolt.

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



79. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

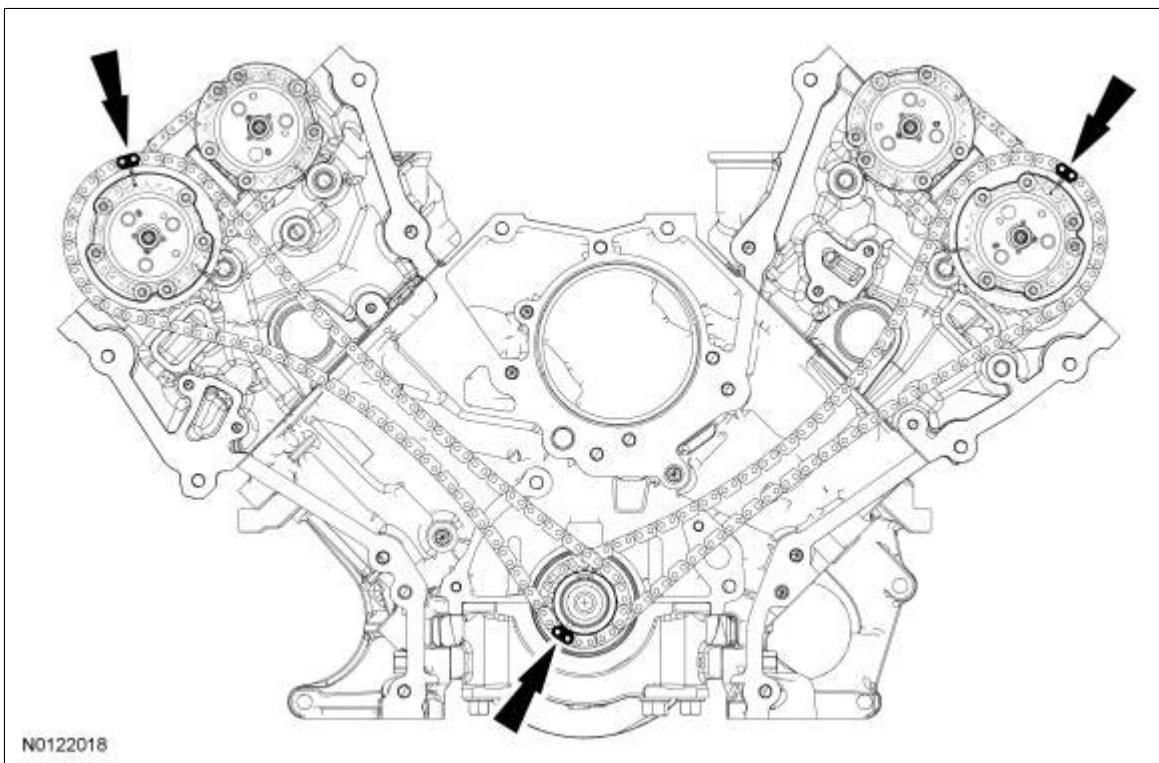
Install the RH timing chain tensioner arm.



80. Install the RH primary timing chain tensioner and 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Remove the holding pin from the tensioner.



81. With the crankshaft keyway still at the 12 o'clock position, verify the timing mark alignment is correct.



82. **NOTICE:** The Variable Camshaft Timing (VCT) variable force solenoid pins must be fully

depressed to avoid interference with the VCT valve tips when installing the engine front cover. Failure to follow these instructions can result in damage to the engine.

NOTE: LH shown, RH similar.

Fully depress the VCT variable force solenoid pins.



83. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

Apply a bead of silicone gasket and sealant to the cylinder head-to-cylinder block joints and the oil pan-to-cylinder block joints as illustrated.

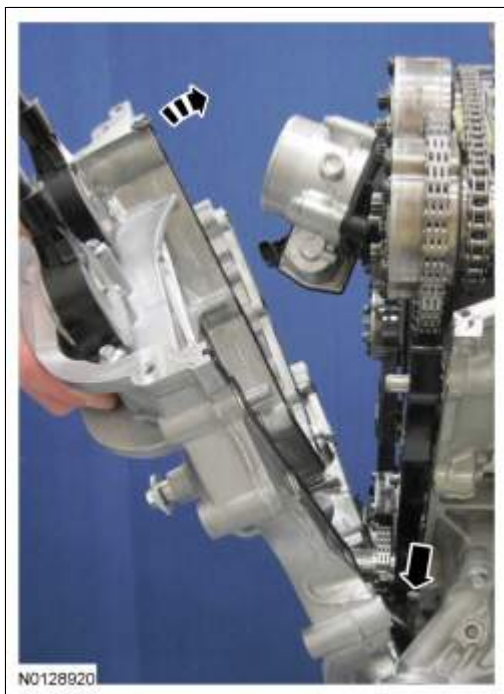


84. **NOTE:** Make sure that the engine front cover gasket is in place on the engine front cover before

installation.

Using new gaskets, position the engine front cover onto the dowels.

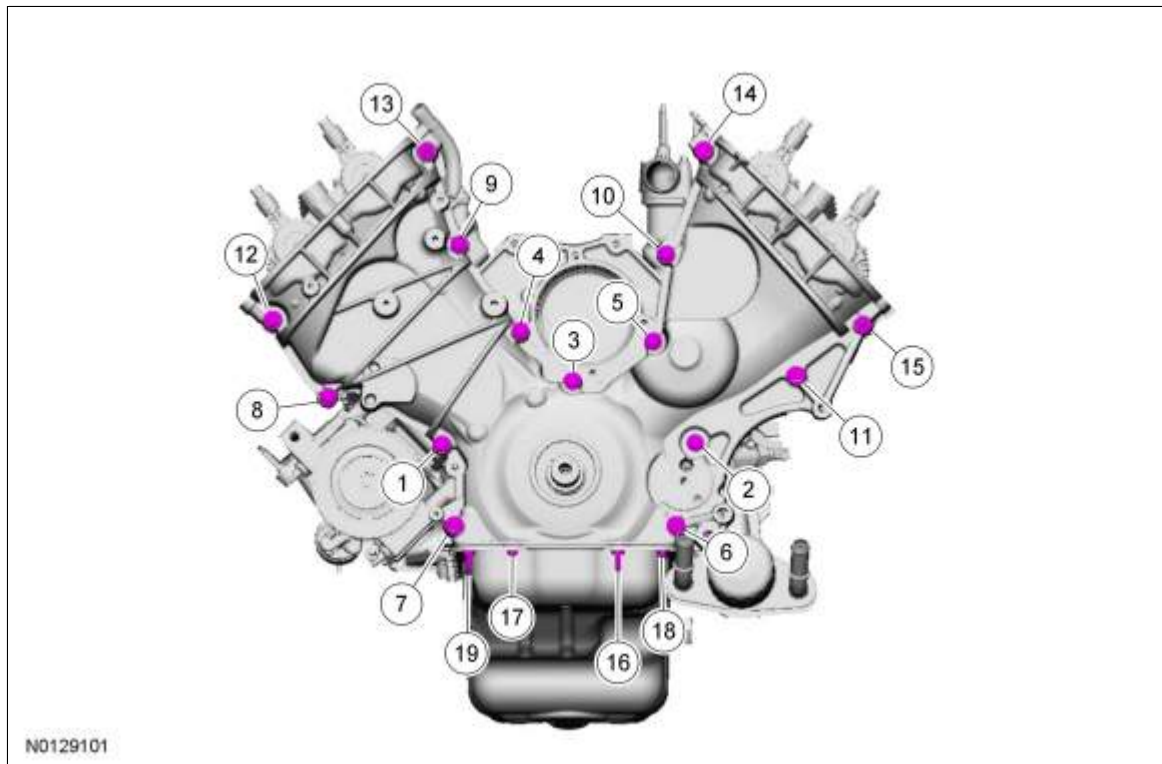
- Install the 13 engine front cover bolts, 2 stud bolts, 2 oil pan-to-engine front cover bolts and 2 oil pan-to-engine front cover stud bolts finger-tight.



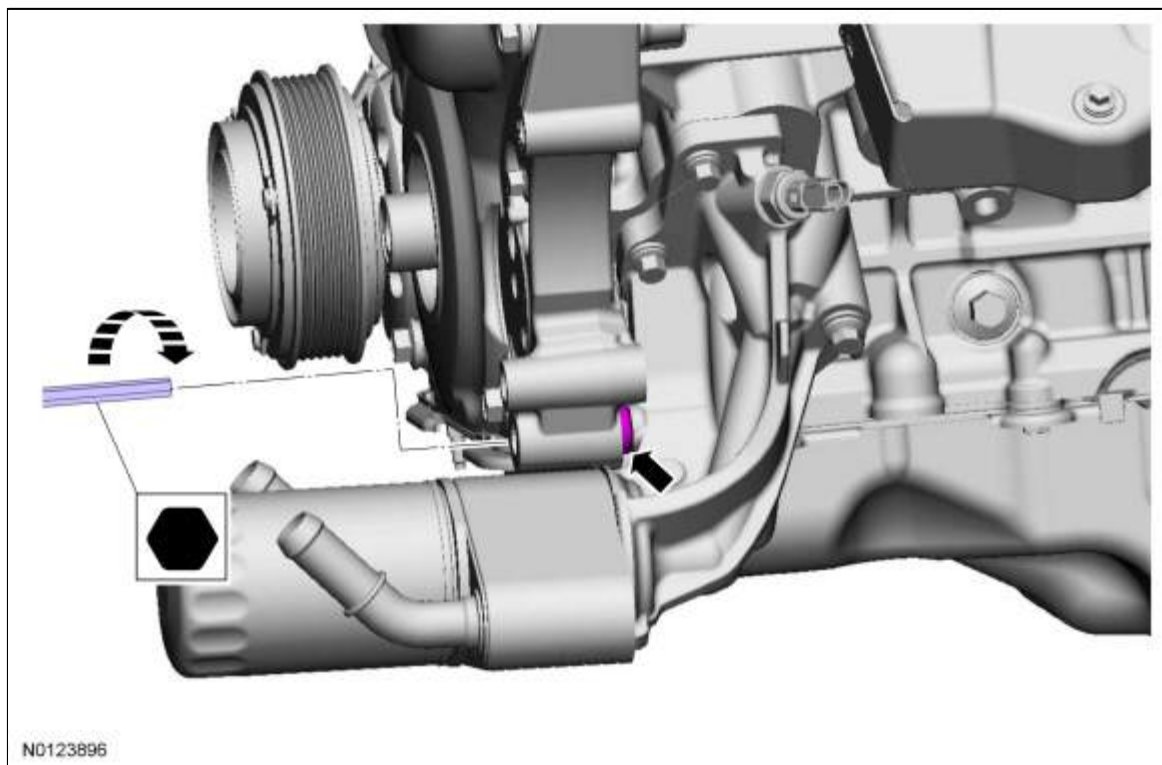
85. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

Tighten the bolts in the sequence shown in 2 stages.

- Stage 1: Tighten bolts 1-15 to 25 Nm (18 lb-ft) and bolts 16-19 to 10 Nm (89 lb-in).
- Stage 2: Tighten bolts 1-15 an additional 60 degrees and bolts 16-19 an additional 45 degrees.



86. Using a 10 mm Hex Bit, rotate the engine front cover jackscrew into contact with the oil filter adapter to 5 Nm (44 lb-in).

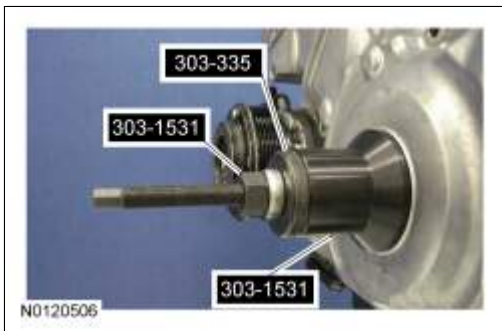


87. Install the engine front cover-to-oil filter adapter bolt and tighten to 25 Nm (18 lb-ft) plus an additional 60 degrees.



88. **NOTE:** Lubricate the engine front cover bore and the crankshaft front oil seal inner lip with clean engine oil.

Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft front oil seal.



89. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

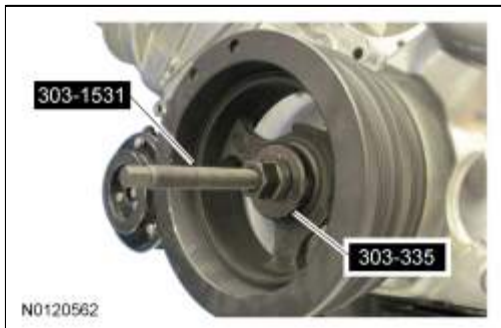
Apply silicone gasket and sealant to the Woodruff key slot in the crankshaft pulley.



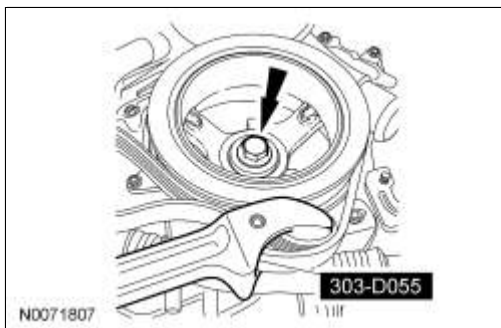
90. Lubricate the crankshaft pulley sealing surface with clean engine oil prior to installation.



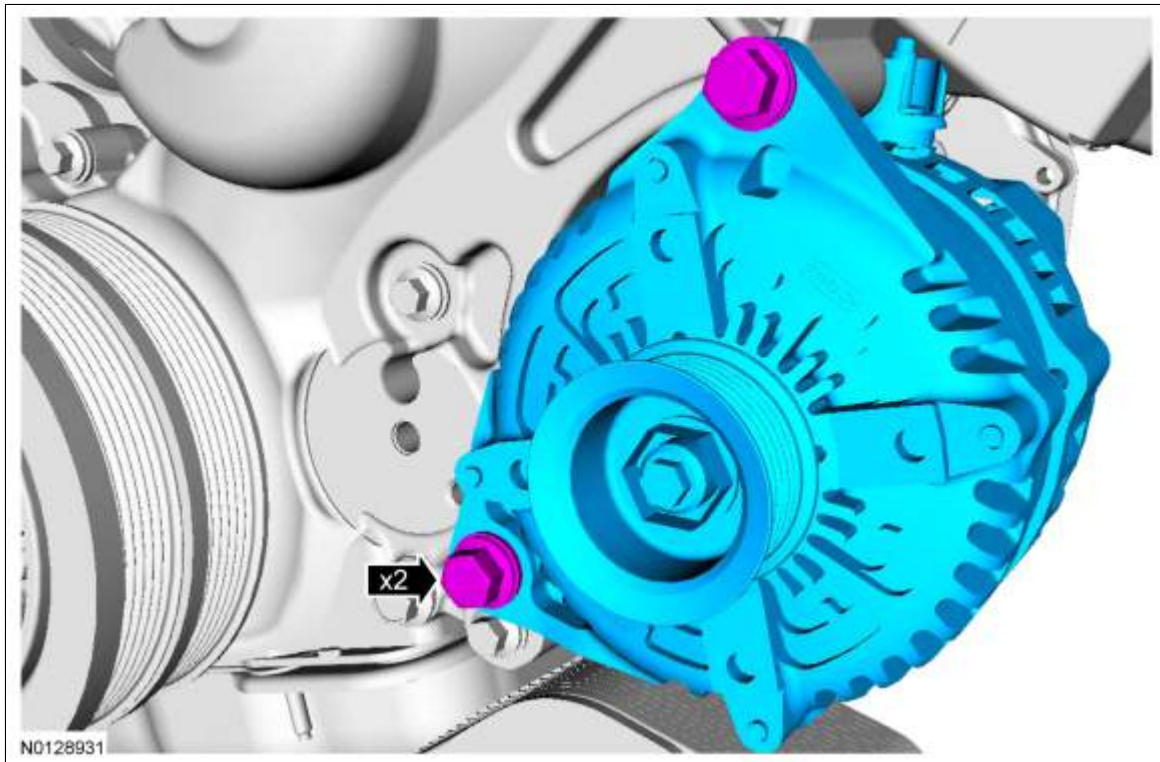
91. Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft pulley.



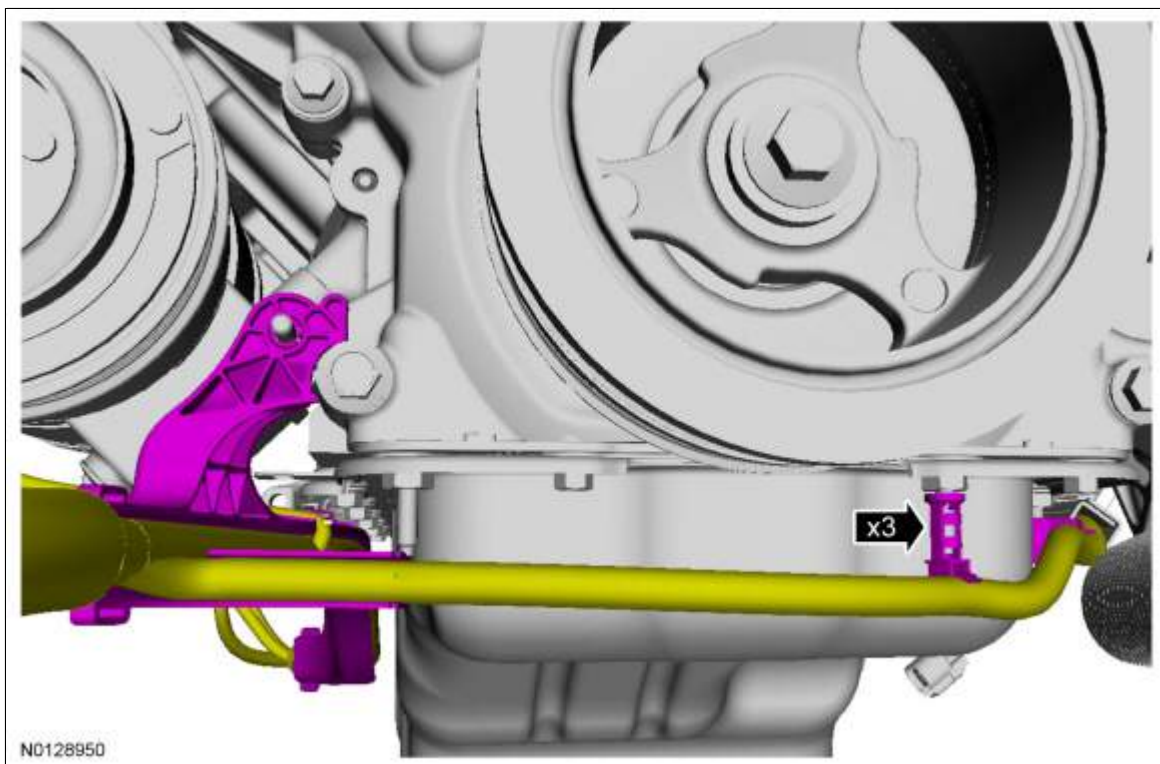
92. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 4 stages:
- Stage 1: Tighten to 140 Nm (103 lb-ft).
 - Stage 2: Loosen 360 degrees.
 - Stage 3: Tighten to 100 Nm (74 lb-ft).
 - Stage 4: Tighten an additional 90 degrees.



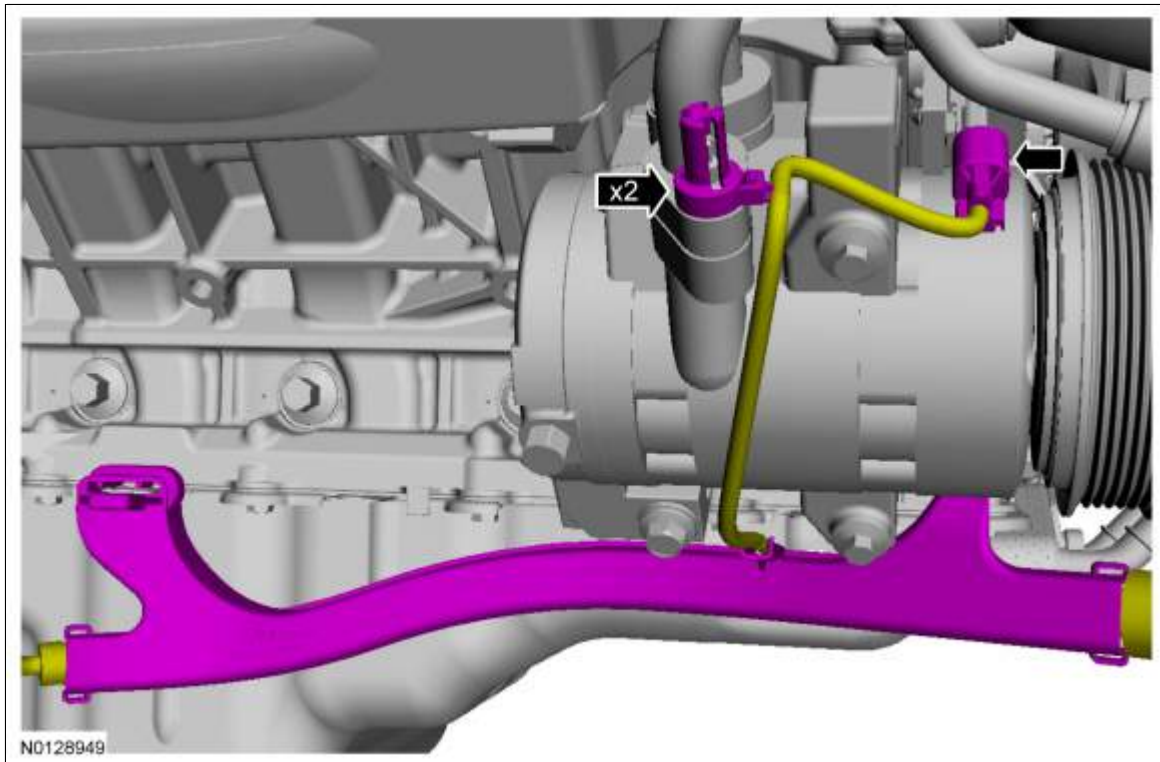
93. Install the generator and the 2 bolts.
- Tighten to 48 Nm (35 lb-ft).



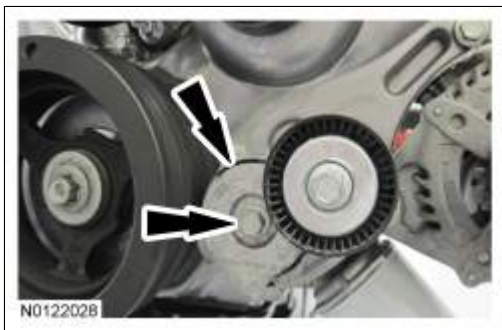
94. Attach the 3 wiring harness retainers.



95. Connect the A/C compressor electrical connector and the 2 wiring harness retainers.



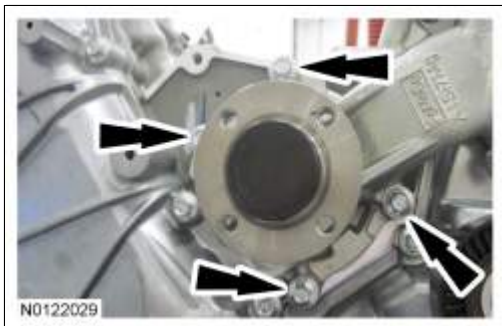
96. Install the accessory drive belt tensioner and the bolt.
- Tighten to 48 Nm (35 lb-ft).



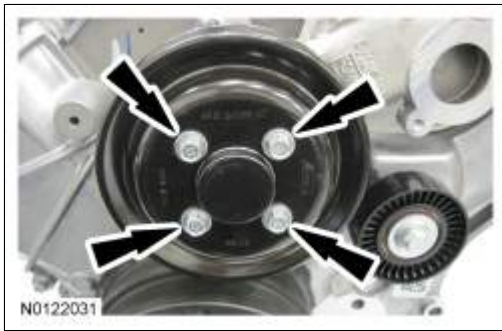
97. **NOTE:** Lubricate the new coolant pump O-ring seal with clean engine coolant.

Using a new O-ring seal, install the coolant pump and the 4 bolts.

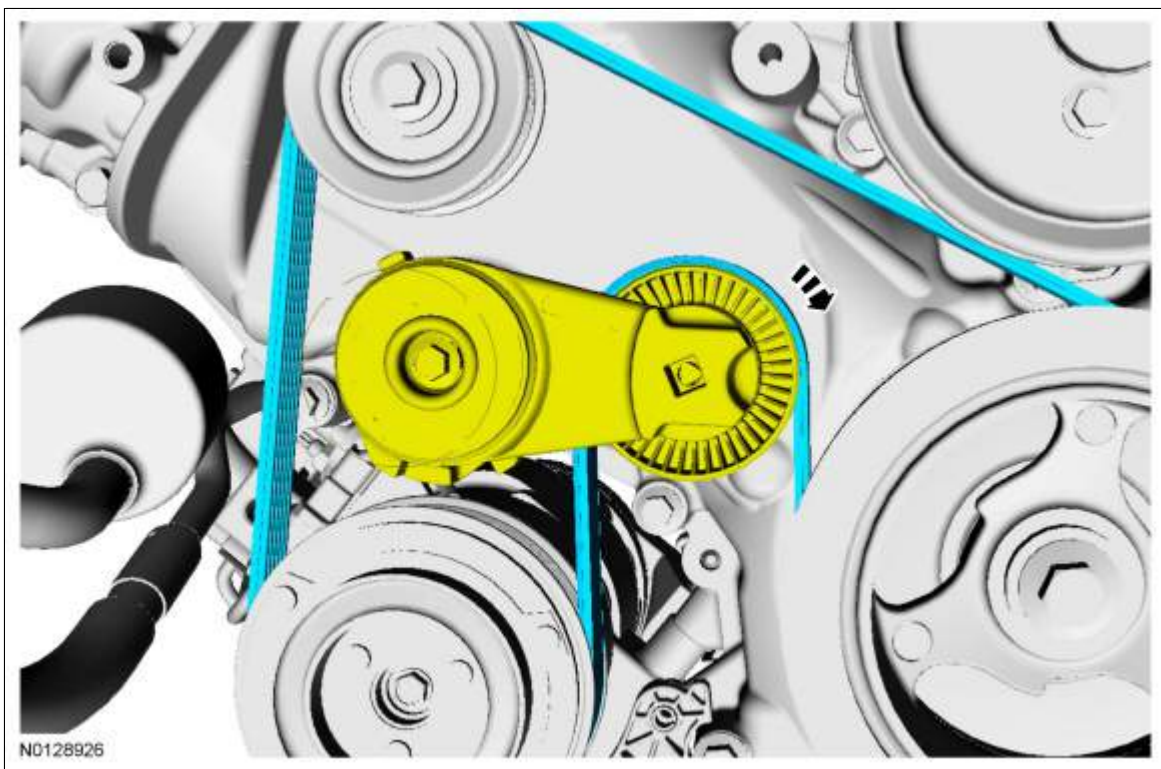
- Tighten to 20 Nm (177 lb-in) plus an additional 60 degrees.



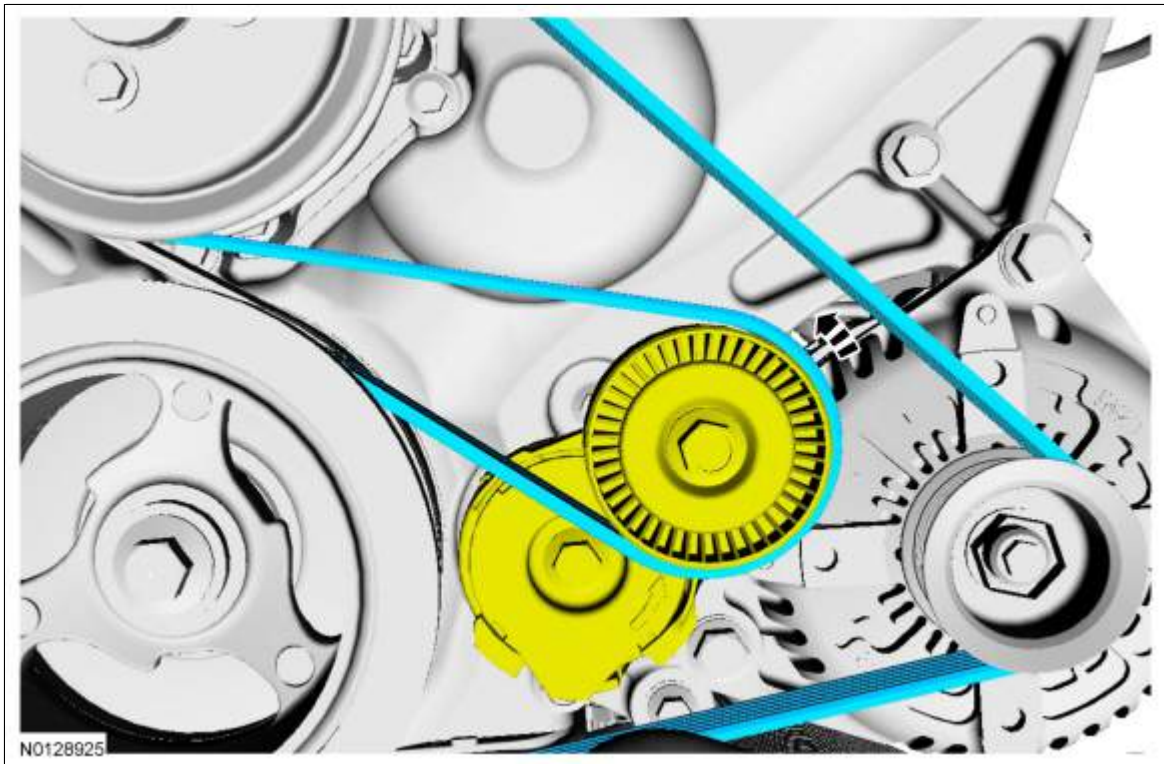
98. Install the coolant pump pulley and the 4 bolts.



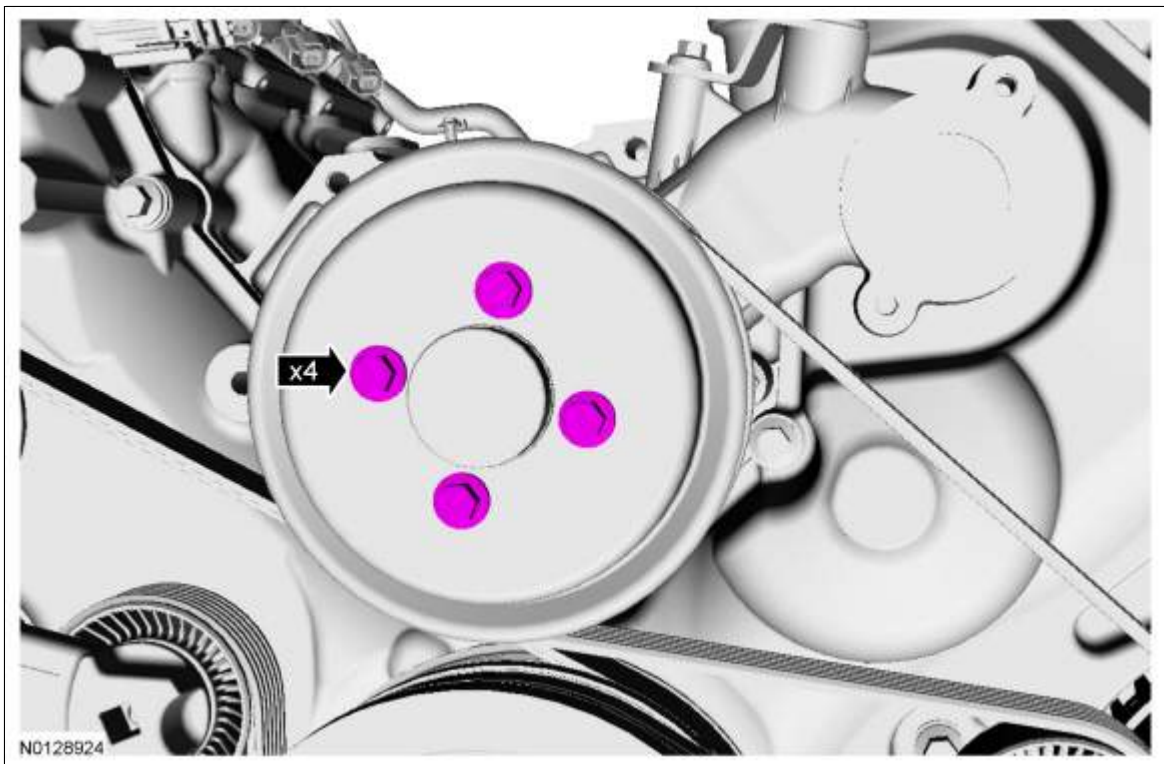
99. Rotate the A/C compressor belt tensioner clockwise and install the A/C compressor belt.



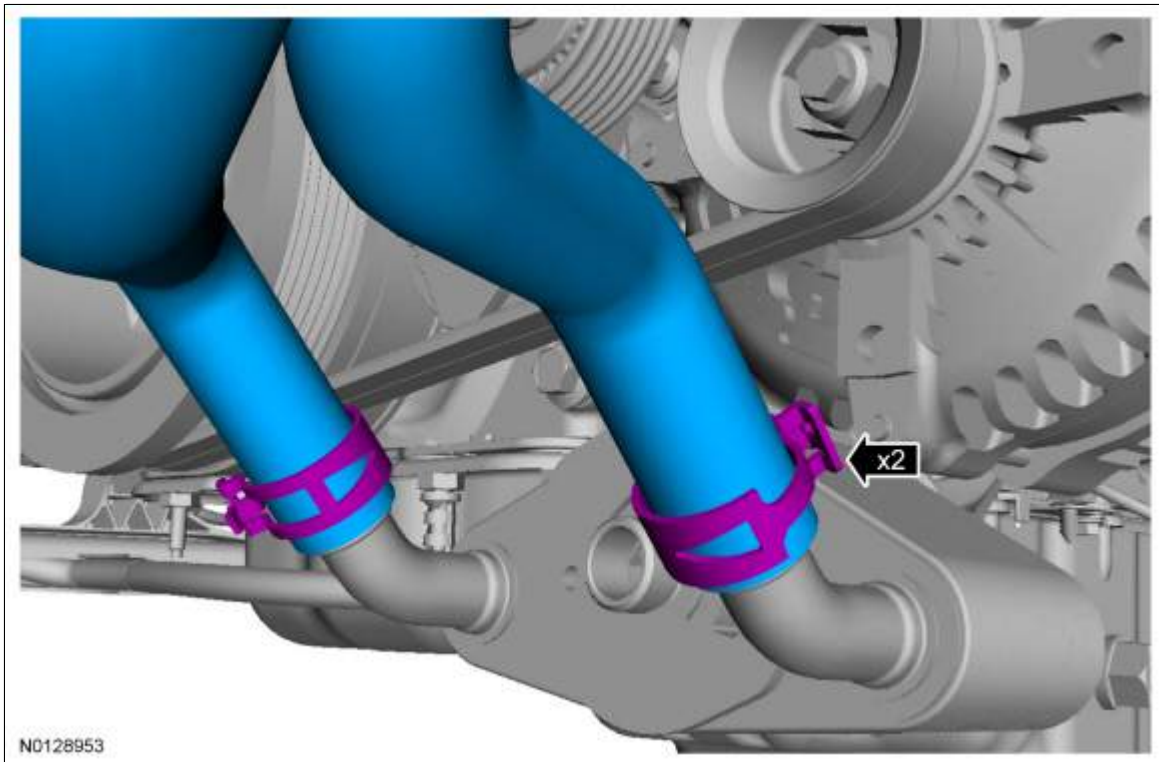
100. Rotate the accessory drive belt tensioner counterclockwise and install the accessory drive belt.



101. Tighten the 4 coolant pump pulley bolts to 25 Nm (18 lb-ft).



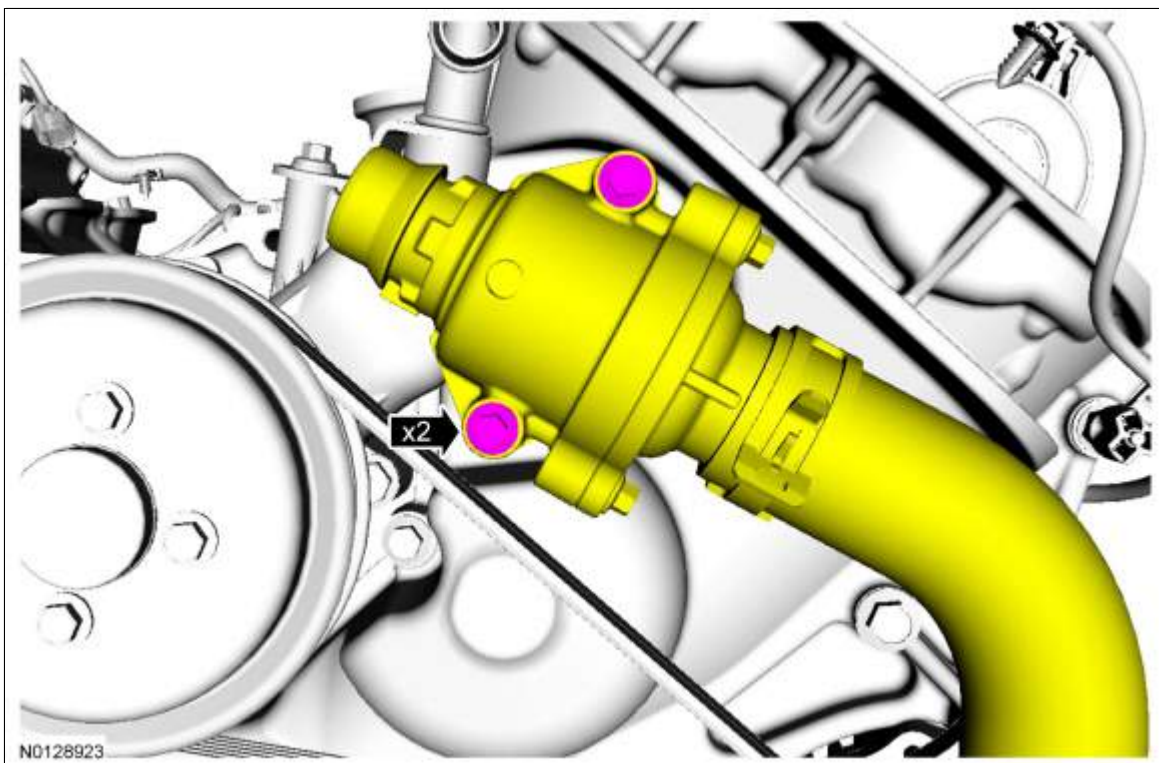
102. Connect the 2 coolant hoses to the oil cooler.



103. **NOTE:** Lubricate the new thermostat housing O-ring seal with clean engine coolant.

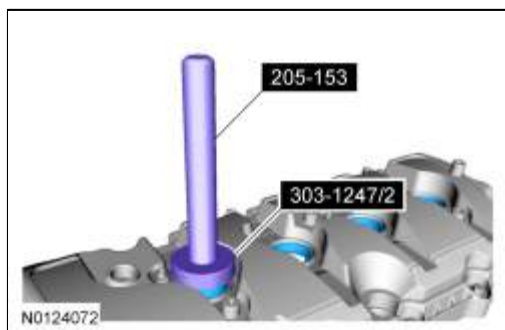
Using a new thermostat housing O-ring seal, install the thermostat housing and the 2 bolts.

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



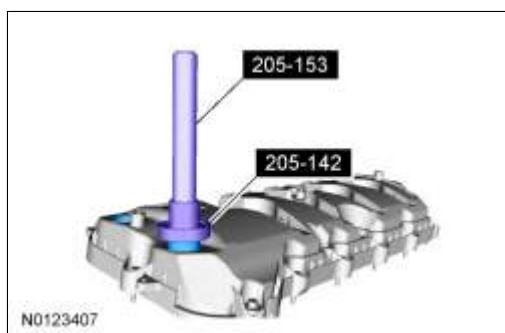
104. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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



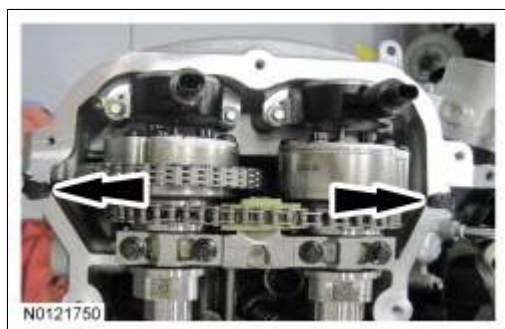
105. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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

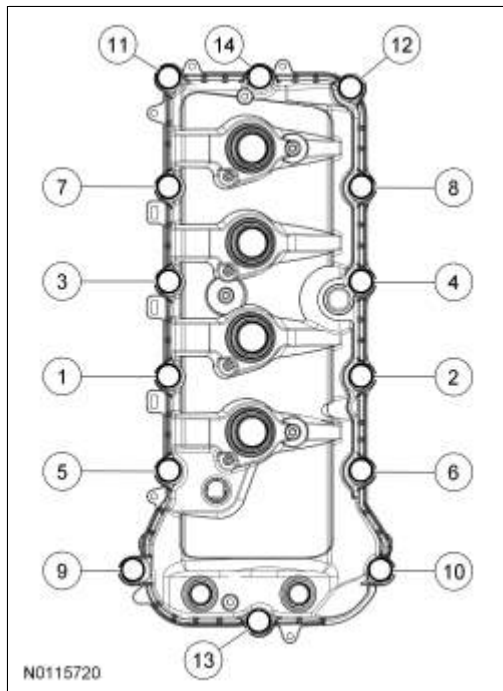


106. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-LH cylinder head joints.



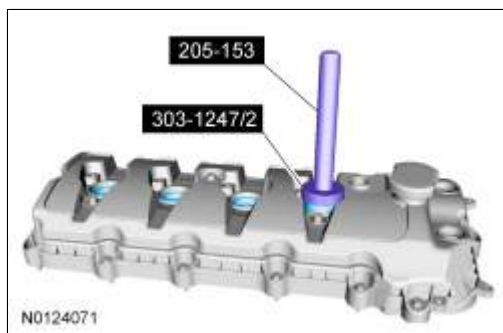
107. Position the LH valve cover and new gasket on the cylinder head.
- Tighten the bolts in the sequence shown to 10 Nm (89 lb-in).



108. Install the oil level indicator.

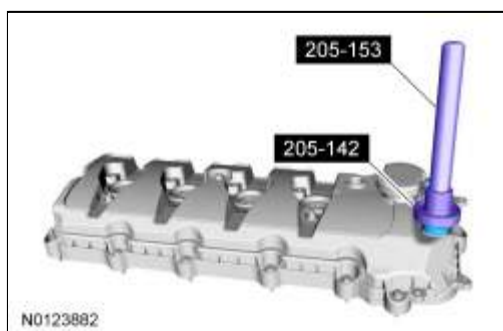
109. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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



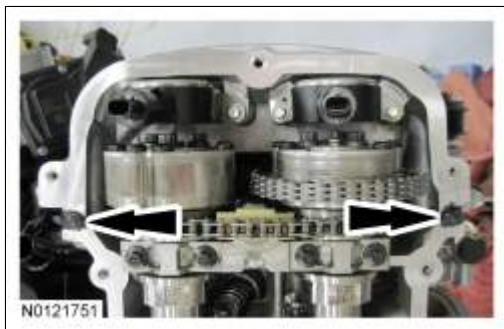
110. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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

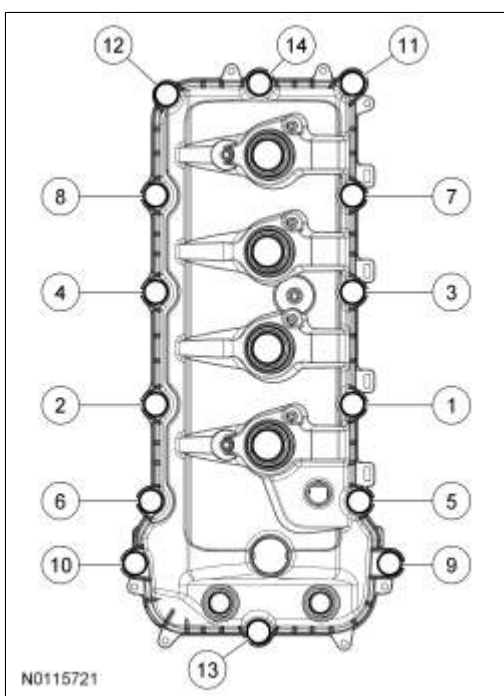


111. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-RH cylinder head joints.



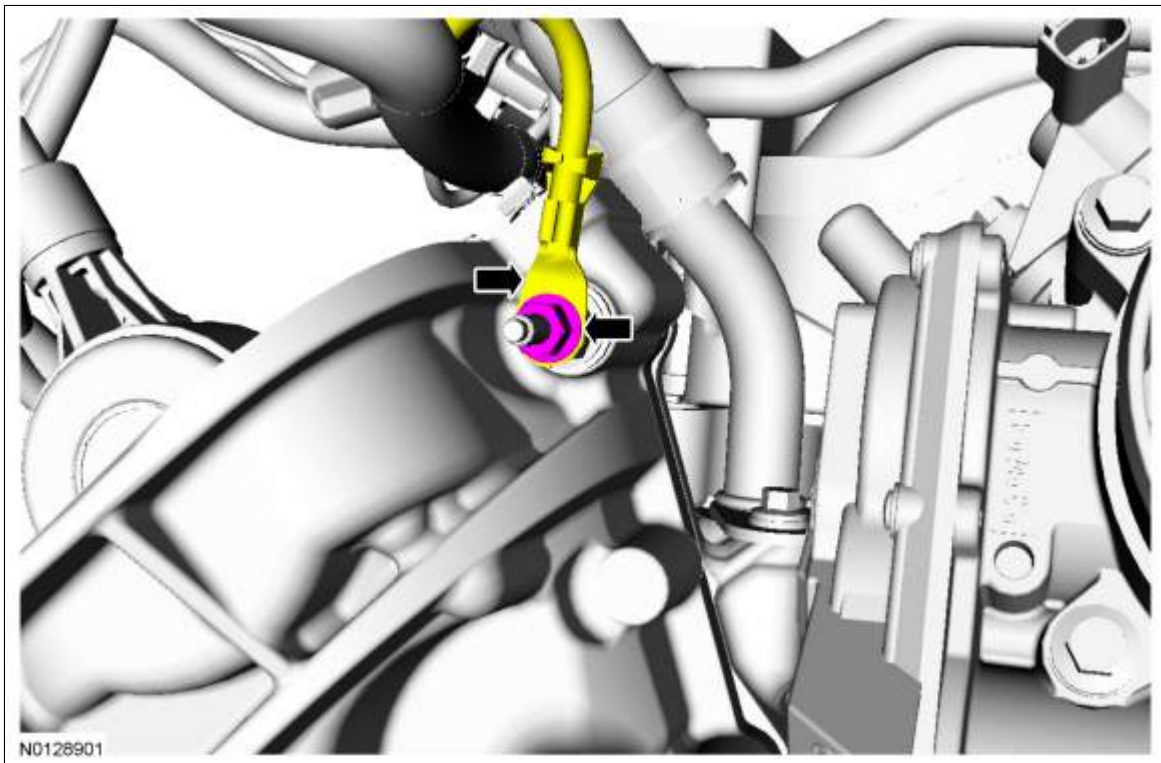
112. Position the RH valve cover and new gasket on the cylinder head.
- Tighten the bolts in the sequence shown to 10 Nm (89 lb-in).



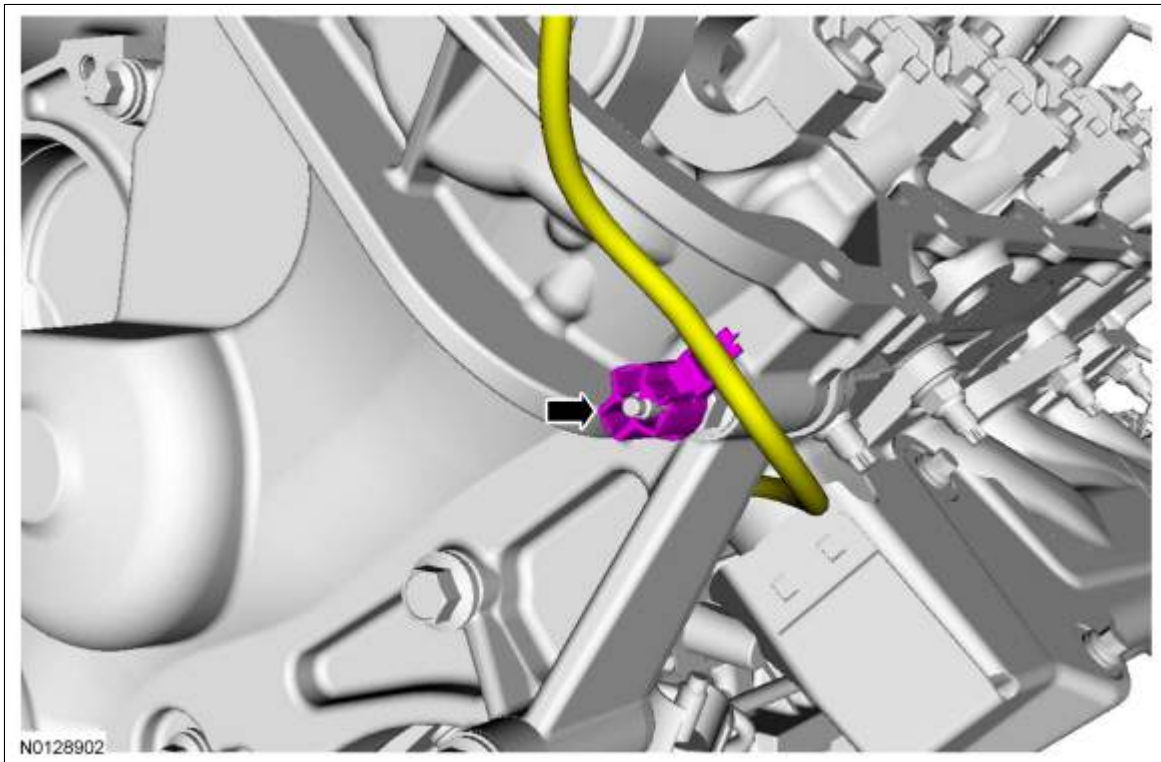
113. Position the wiring harness on the engine.
- Connect the 2 KS electrical connectors.



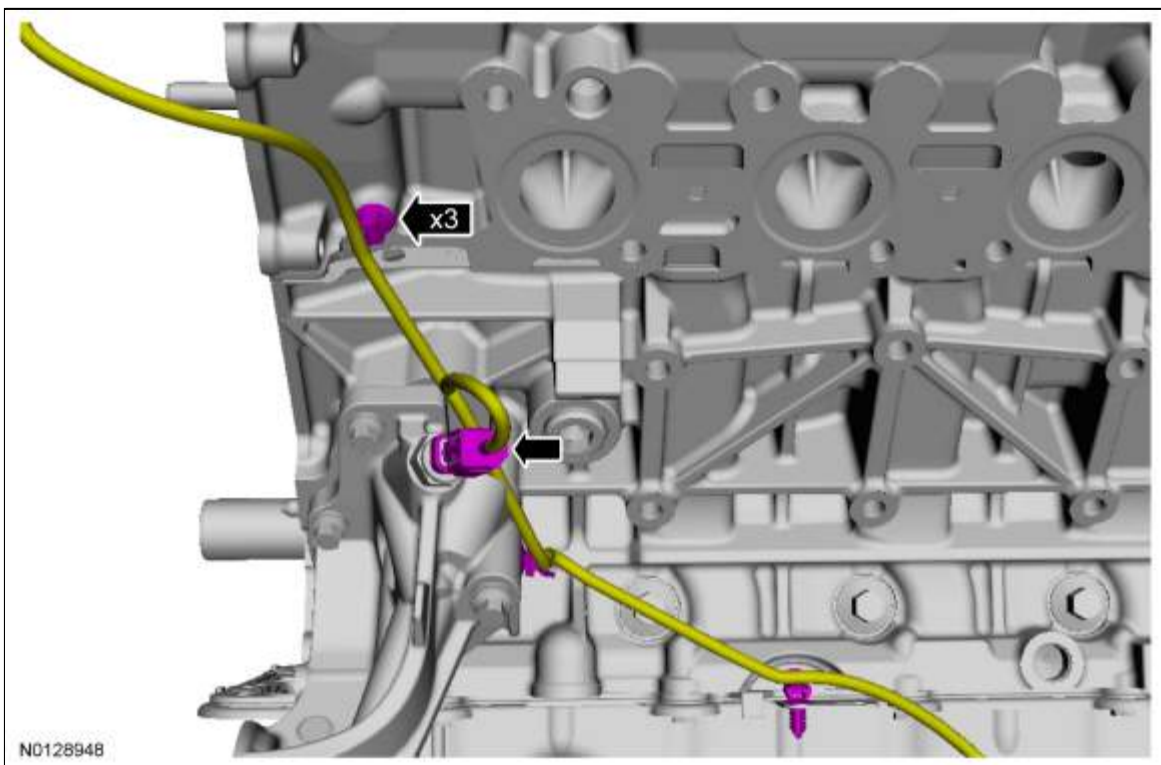
114. Install the ground wire and nut to the engine front cover stud bolt.
- Tighten to 10 Nm (89 lb-in).



115. Attach the wiring harness retainer to the engine front cover stud bolt.

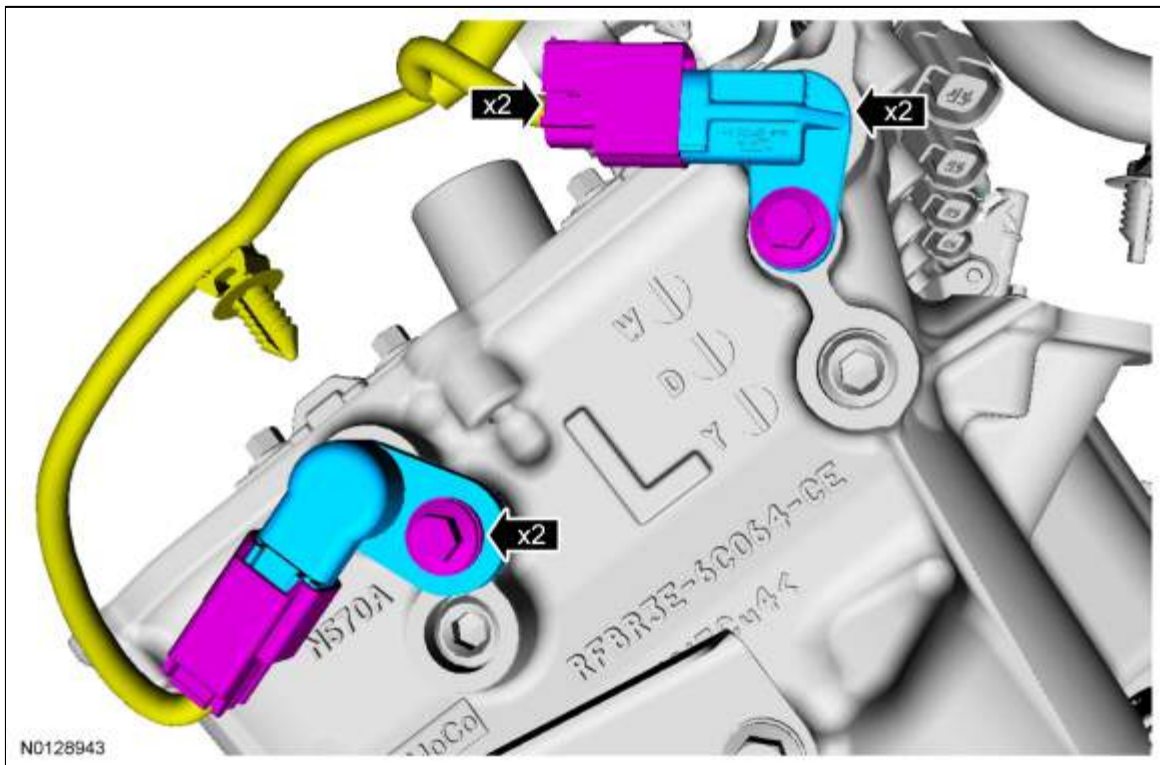


116. Connect the Engine Oil Pressure (EOP) switch electrical connector and the 3 wiring harness retainers.

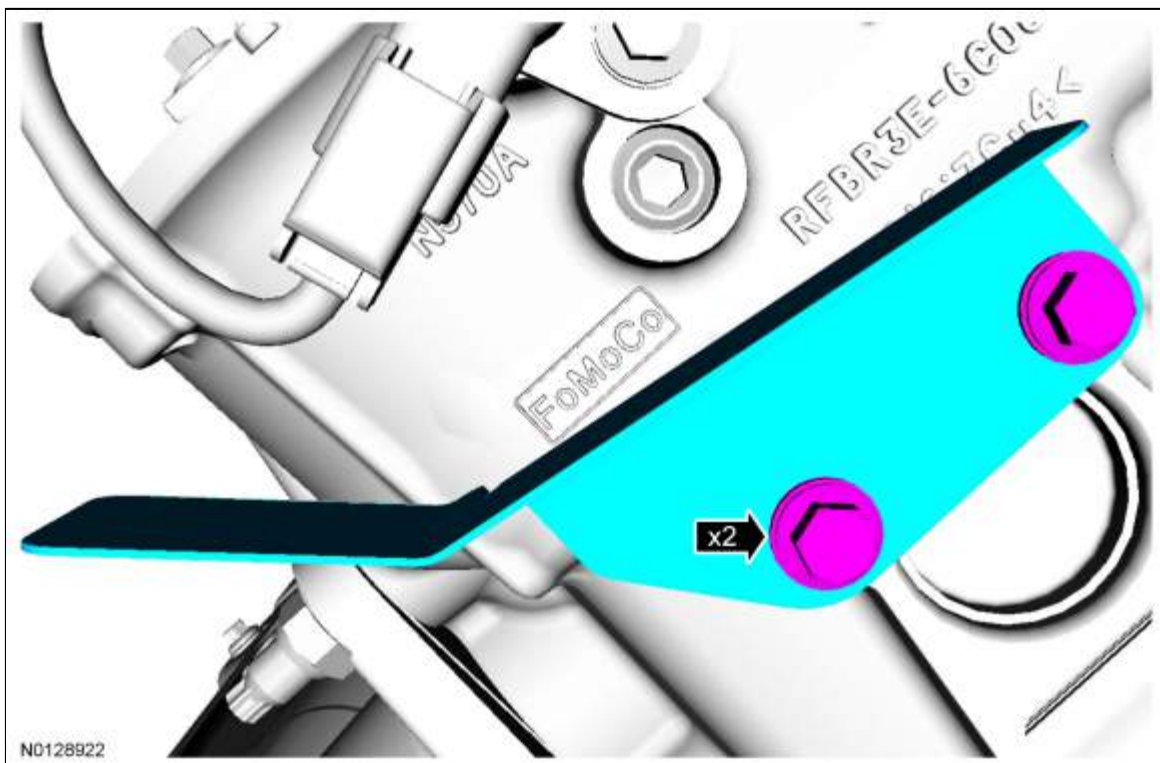


117. If removed, install the LH intake and exhaust Camshaft Position (CMP) sensors and the 2 bolts.
- Tighten to 10 Nm (89 lb-in).

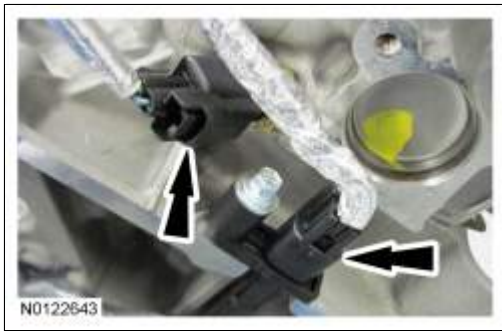
- Connect the LH intake and exhaust CMP sensor electrical connectors.



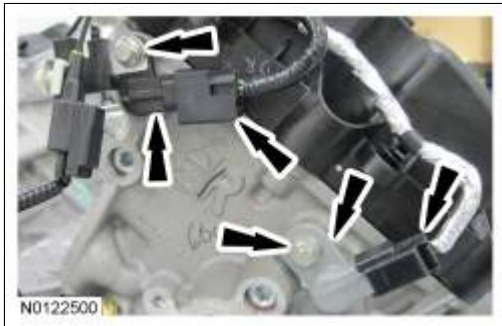
118. Install the heat shield and the 2 bolts to the LH cylinder head.
- Tighten to 10 Nm (89 lb-in).



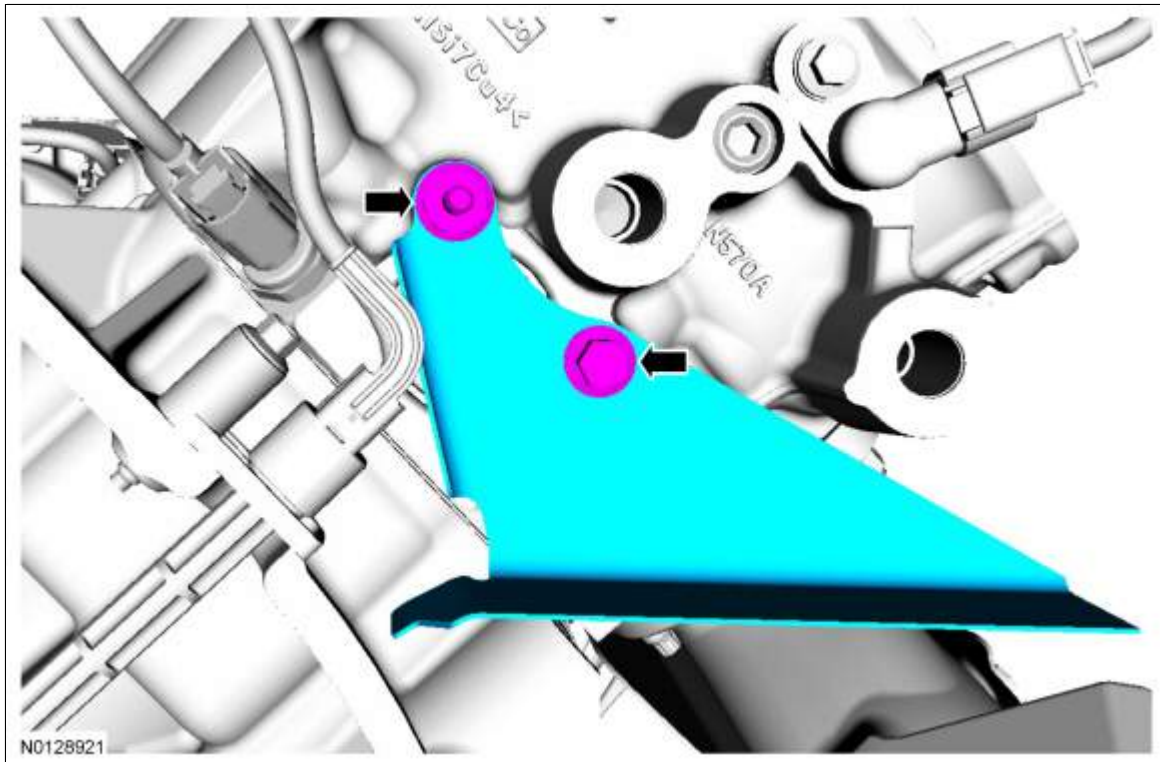
119. Connect the CHT sensor and the CKP sensor electrical connectors.



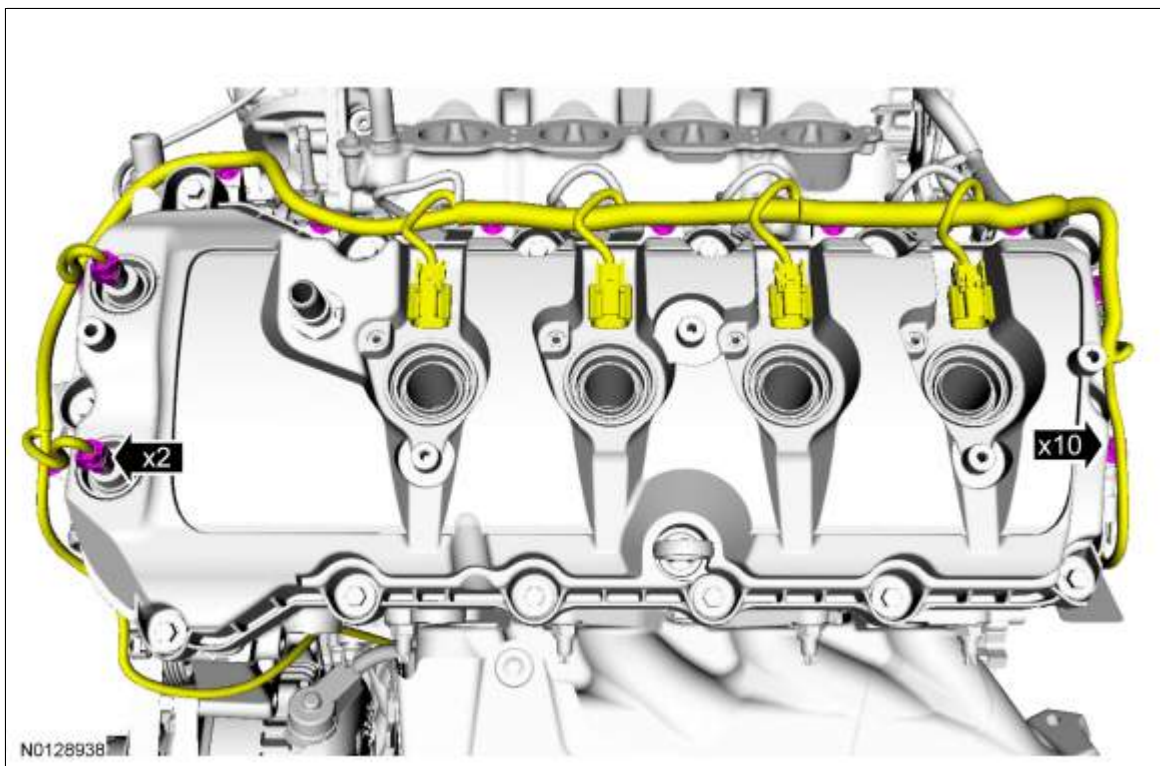
120. Install the RH intake and exhaust CMP sensors and the 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Connect the RH intake and exhaust CMP sensor electrical connectors.



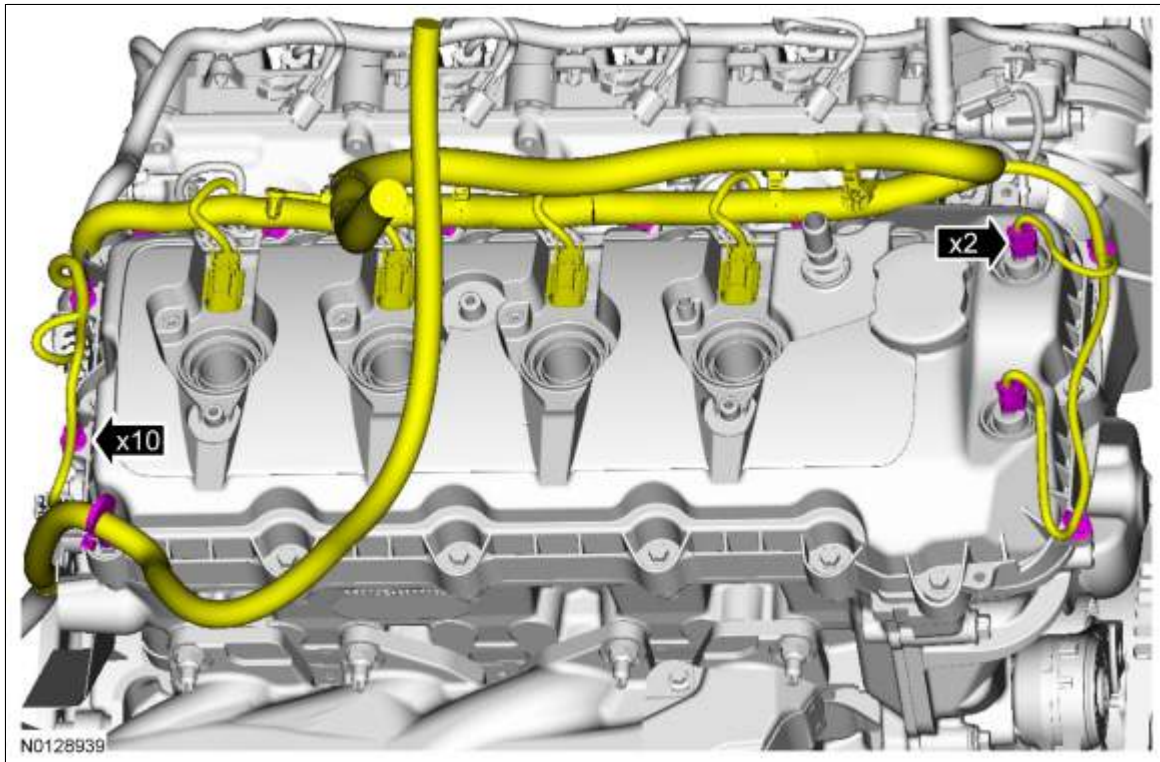
121. Install the heat shield, the bolt and the stud bolt on the RH cylinder head.
- Tighten to 10 Nm (89 lb-in).



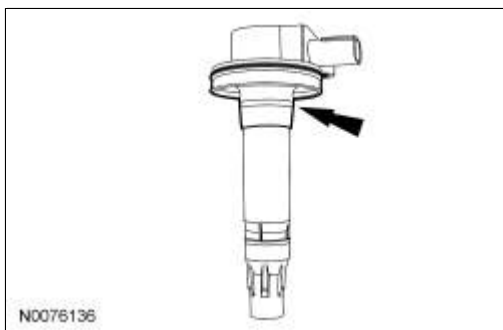
122. Connect the 2 VCT variable force solenoid electrical connectors.
- Attach the 10 wiring harness retainers to the LH valve cover.



123. Connect the 2 Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.
- Attach the 10 wiring harness retainers to the RH valve cover.



124. Inspect the coil seals for rips, nicks or tears. Remove and discard any damaged coil seals.
- To install, slide the new coil seal onto the coil until it is fully seated at the top of the coil.



125. **NOTE:** Apply a small amount of dielectric grease to the inside of the ignition coil-on-plug boots before attaching to the spark plugs. RH shown, LH similar.

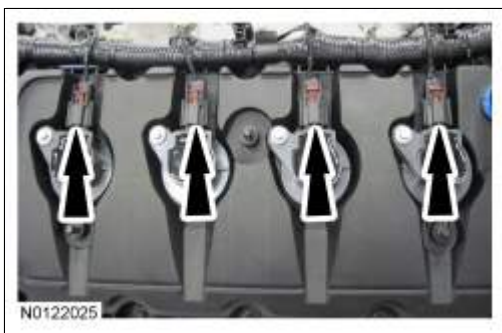
Install the 8 ignition coils and 8 bolts.

- Tighten to 6 Nm (53 lb-in).



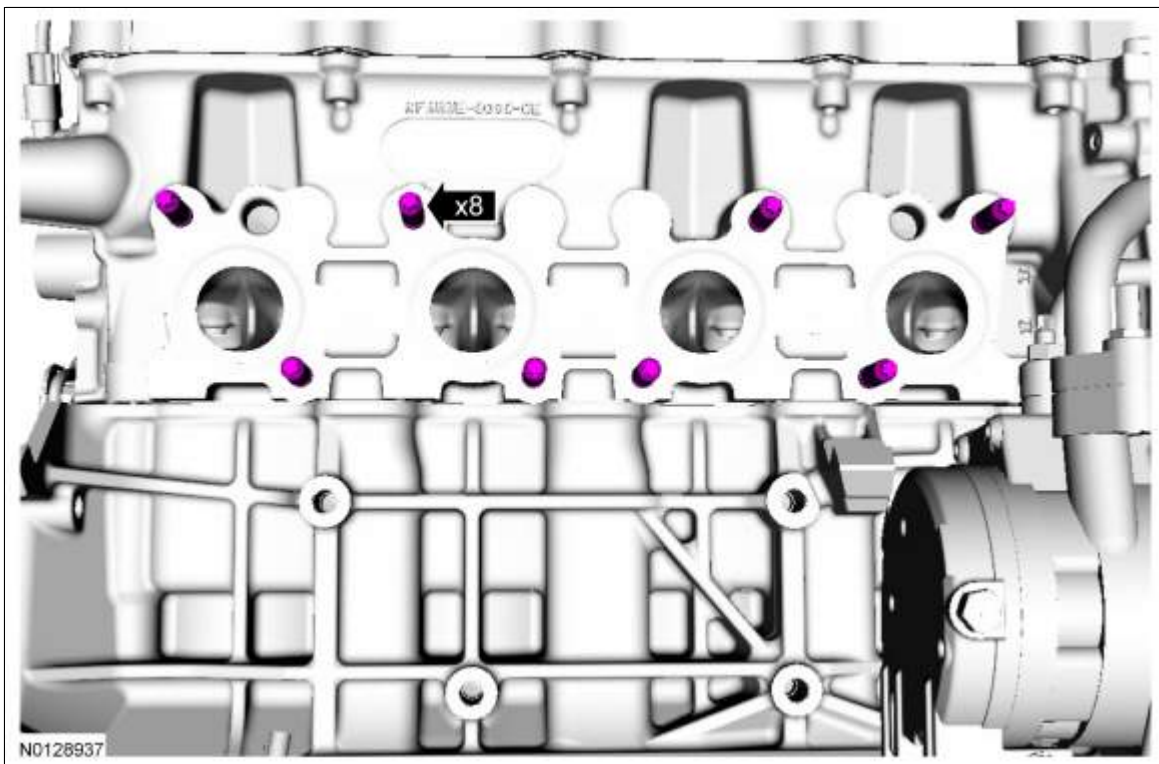
126. **NOTE:** RH shown, LH similar.

Connect the 8 ignition coil electrical connectors.

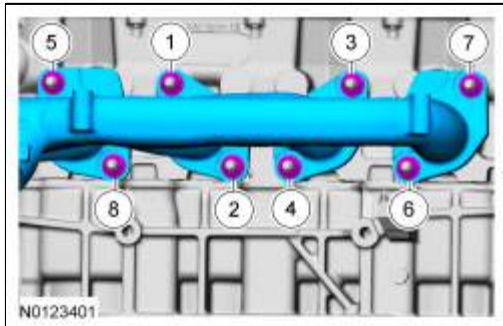


127. Install 8 new RH exhaust manifold studs.

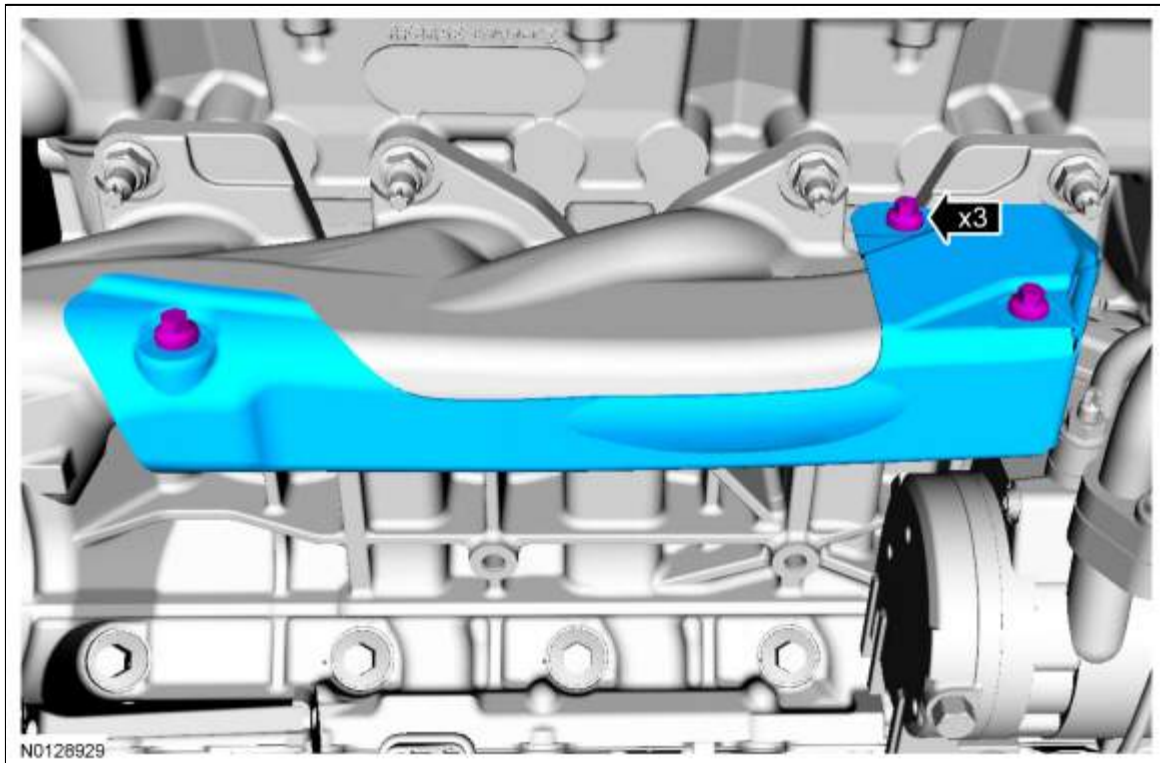
- Tighten to 25 Nm (18 lb-ft).



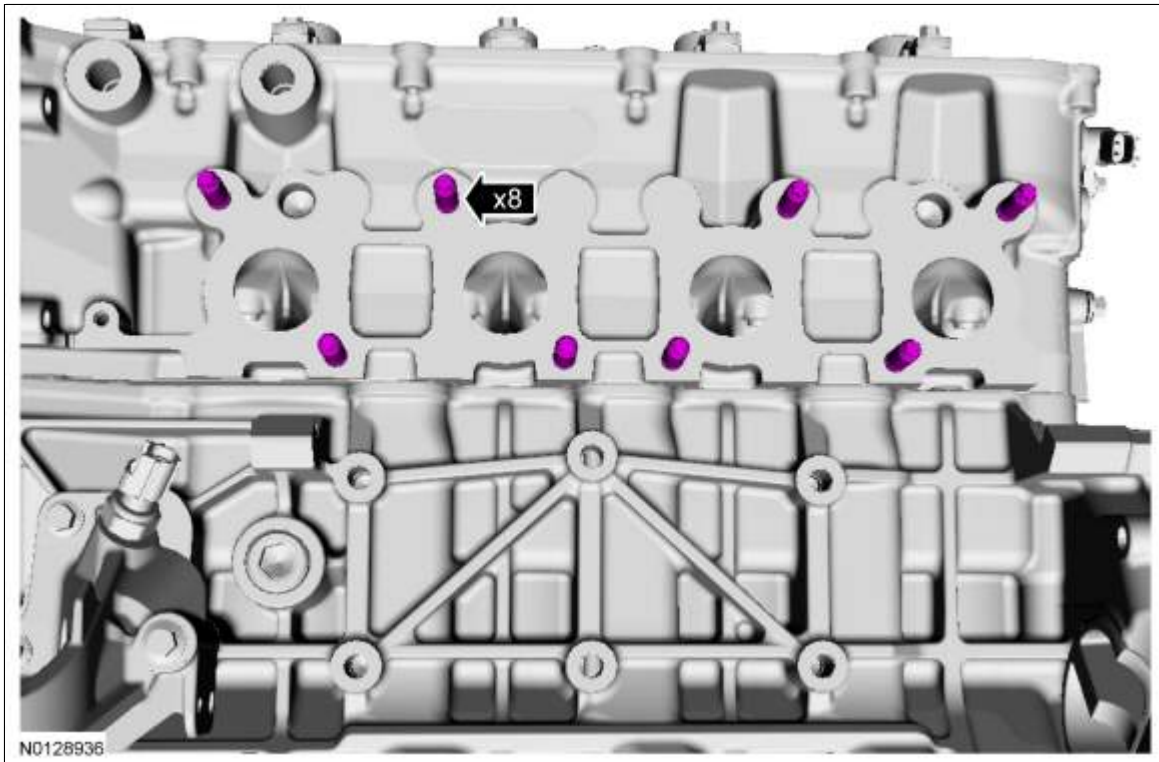
128. Install a new gasket, the RH exhaust manifold and 8 new nuts.
- Tighten the nuts in the sequence shown in 2 stages.
 - Stage 1: Tighten to 24 Nm (18 lb-ft).
 - Stage 2: Tighten to 32 Nm (24 lb-ft).



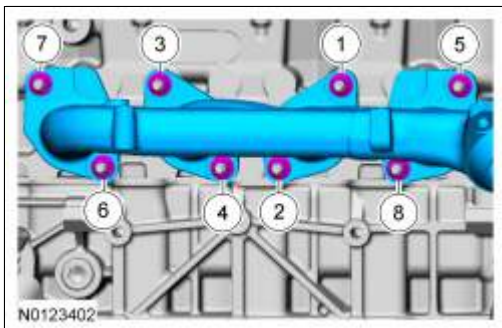
129. Install the RH exhaust manifold heat shield and the 3 bolts.
- Tighten to 12 Nm (106 lb-in).



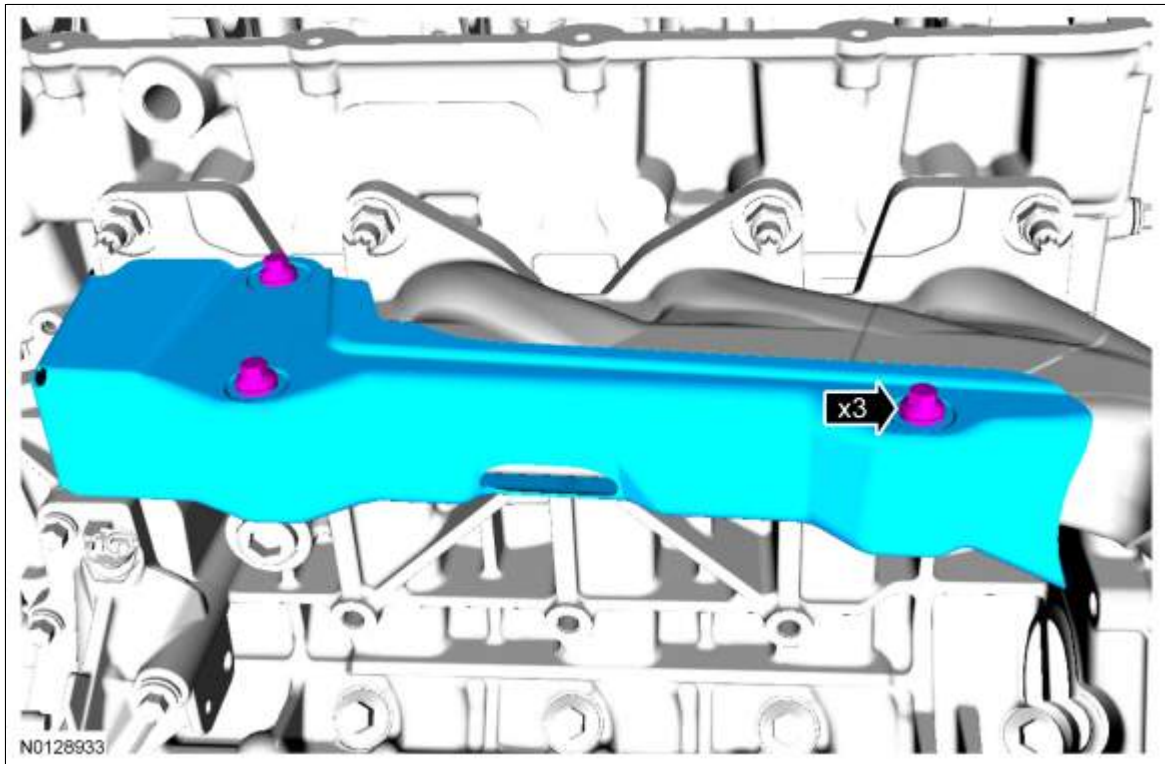
130. Install 8 new LH exhaust manifold studs.
- Tighten to 25 Nm (18 lb-ft).



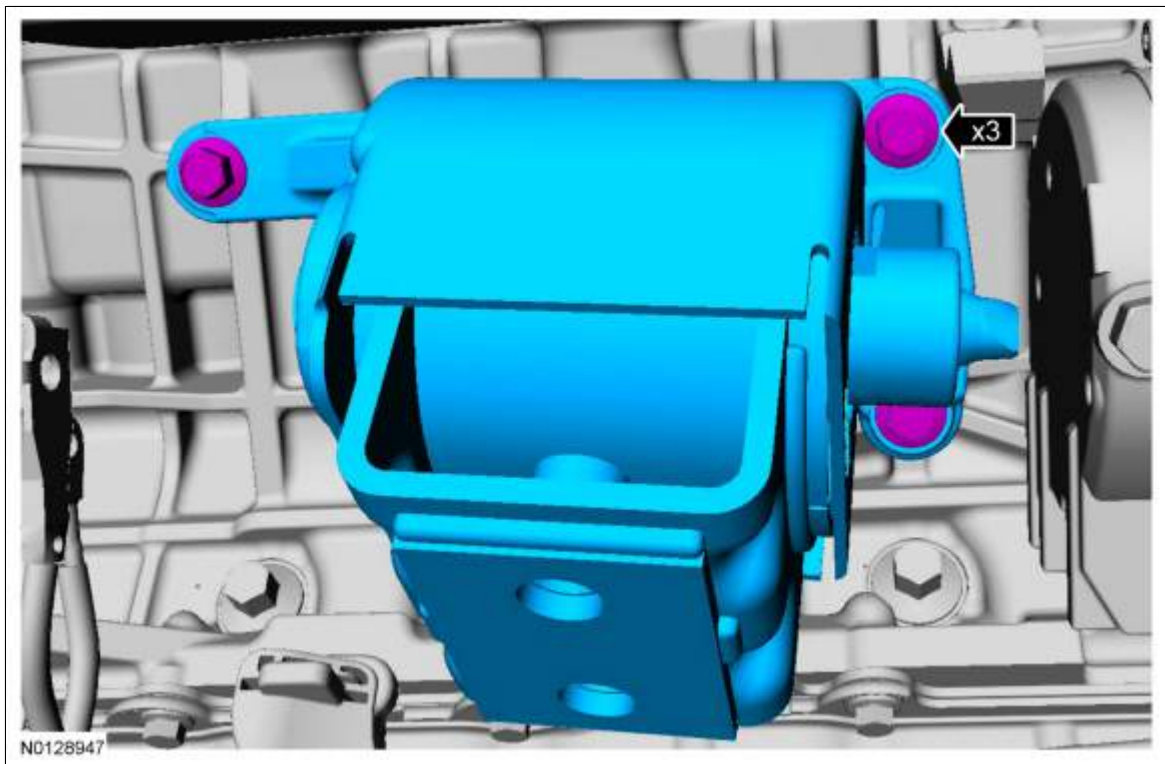
131. Install a new gasket, the LH exhaust manifold and 8 new nuts.
- Tighten in the sequence shown in 2 stages.
 - Stage 1: Tighten to 24 Nm (18 lb-ft).
 - Stage 2: Tighten to 32 Nm (24 lb-ft).



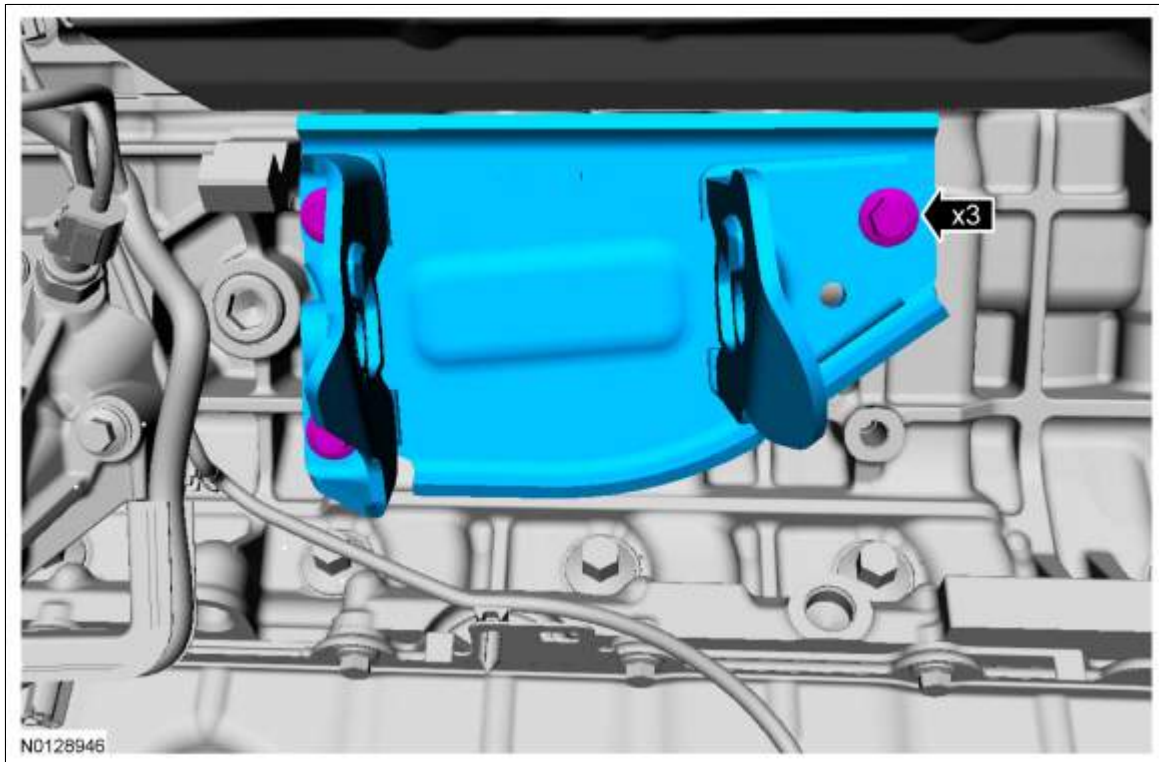
132. Install the LH exhaust manifold heat shield and the 3 bolts.
- Tighten to 12 Nm (106 lb-in).



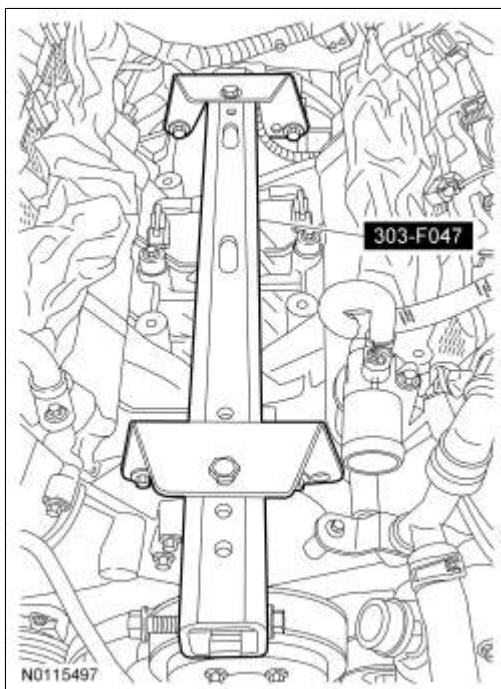
133. Install the RH engine support insulator and the 3 bolts.
- Tighten to 63 Nm (46 lb-ft).



134. Install the LH engine support insulator bracket and the 3 bolts.
- Tighten to 63 Nm (46 lb-ft).



135. Install the Engine Lifting Bracket



136. Using the Floor Crane, remove the engine from the work stand.
137. **NOTE:** Lubricate the seal lips and bore with clean engine oil prior to installation.

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



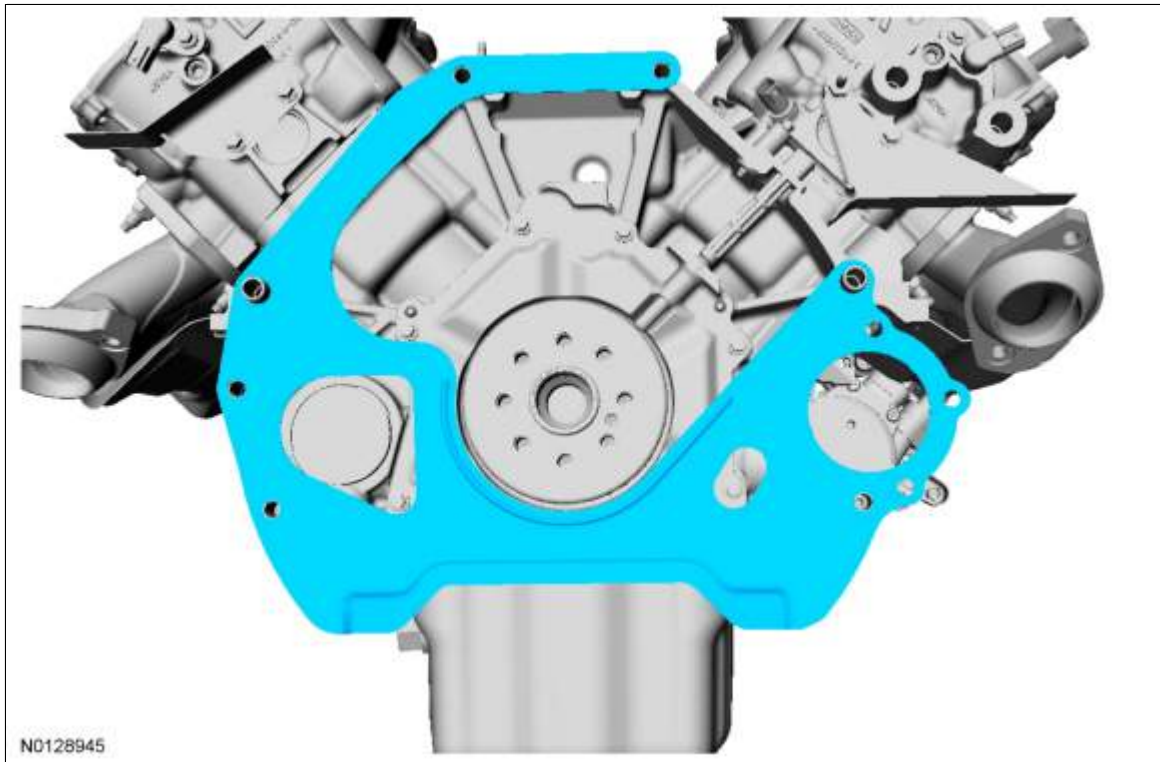
138. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.



139. Install the crankshaft sensor ring.



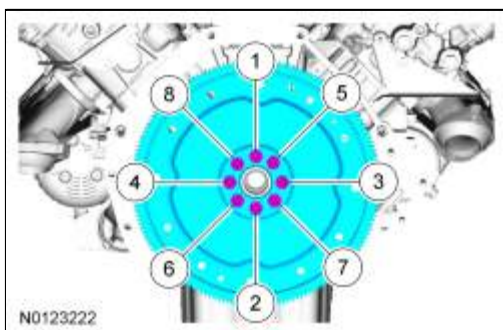
140. Install the engine separator plate.



141. **NOTE:** The flexplate bolts are torque-to-yield design and are not reusable.

Install the engine separator plate, the flexplate and 8 new bolts.

- Tighten in the sequence shown in 2 stages.
 - Stage 1: Tighten to 20 Nm (177 lb-in).
 - Stage 2: Tighten an additional 60 degrees.


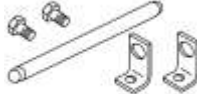




SECTION 303-01C: Engine — 5.0L (4V)
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

2014 F-150 Workshop Manual
 Procedure revision date: 10/25/2013

Cylinder Head

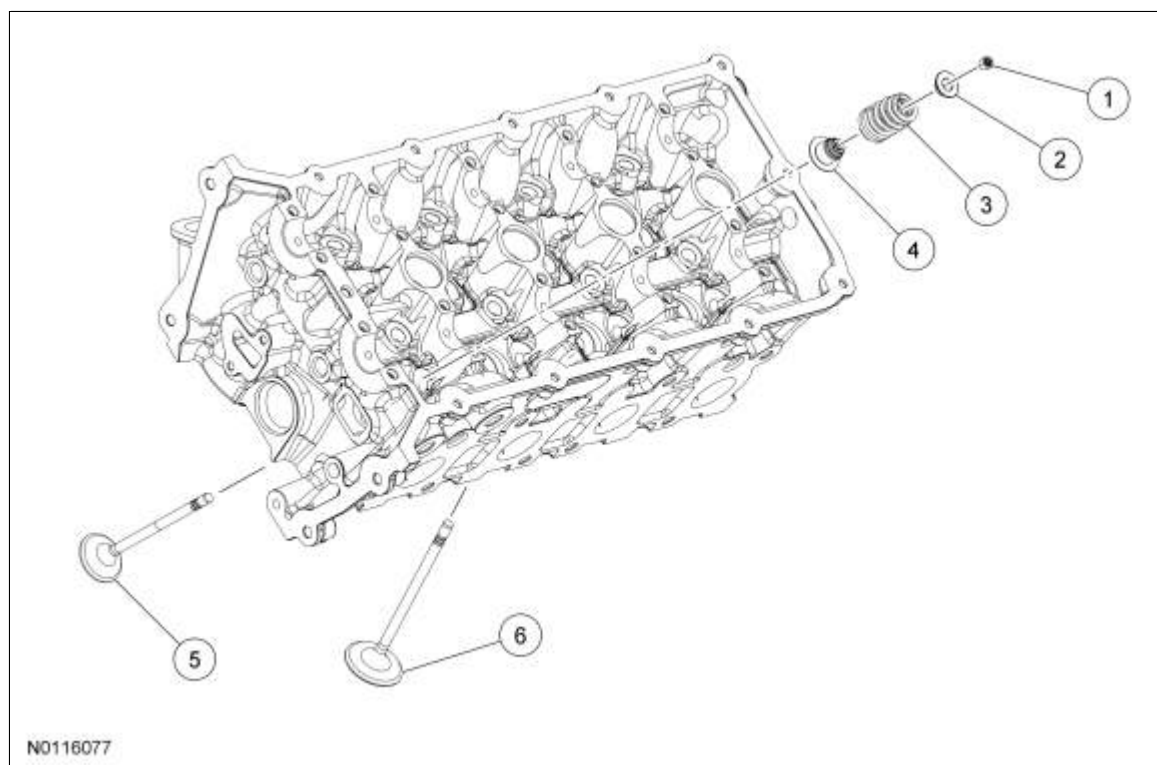
Special Tool(s)

 ST1902-A	Compressor, Valve Spring 303-1418
 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249

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

NOTE: LH cylinder head shown, RH cylinder head similar.



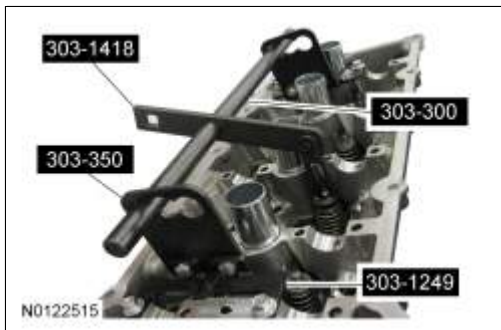
Item	Part Number	Description
1	6518	Valve spring retainer key (32 required)
2	6514	Valve spring retainer (16 required)
3	6513	Valve spring (16 required)
4	6571	Valve seal (16 required)
5	6507	Intake valve (8 required)
6	6505	Exhaust valve (8 required)

Disassembly

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

NOTE: If the components are to be reinstalled, they must be installed in their original locations. Mark the components for installation into their original locations.

1. Using the Valve Spring Compressors, remove the keys, retainer and spring.



2. Remove and discard the valve seal.



3. Remove the valve from the cylinder head.
4. Repeat the previous steps for each of the remaining valves.

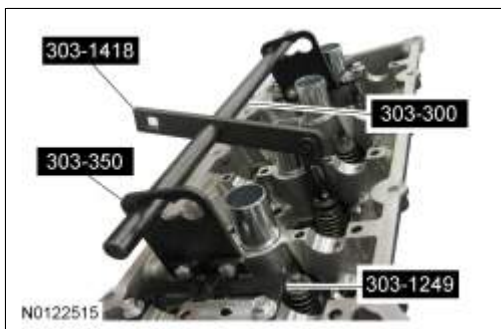
Assembly

NOTE: Apply clean engine oil to the valve seals and the inside diameter of the valve guides prior to assembling the cylinder head components.

1. **NOTE:** The valve seal must be bottomed out on the cylinder head spring seat.

Install the valve seal.

2. Install the valve into the cylinder head.
3. Using the Valve Spring Compressors, install the spring, retainer and keys.



4. Repeat the previous steps for each of the remaining valves.



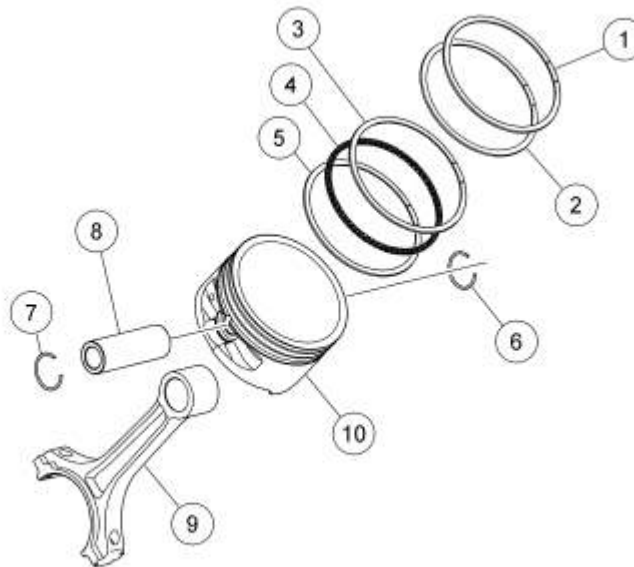
SECTION 303-01C: Engine — 5.0L (4V)
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Piston

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



N0010114

Item	Part Number	Description
1	—	Piston compression upper ring (part of 6148)
2	—	Piston compression lower ring (part of 6148)
3	—	Piston oil control upper segment ring (part of 6148)
4	—	Piston oil control spacer (part of 6148)
5	—	Piston oil control lower segment ring (part of 6148)
6	6140	Piston pin retainer
7	6140	Piston pin retainer
8	6135	Piston pin

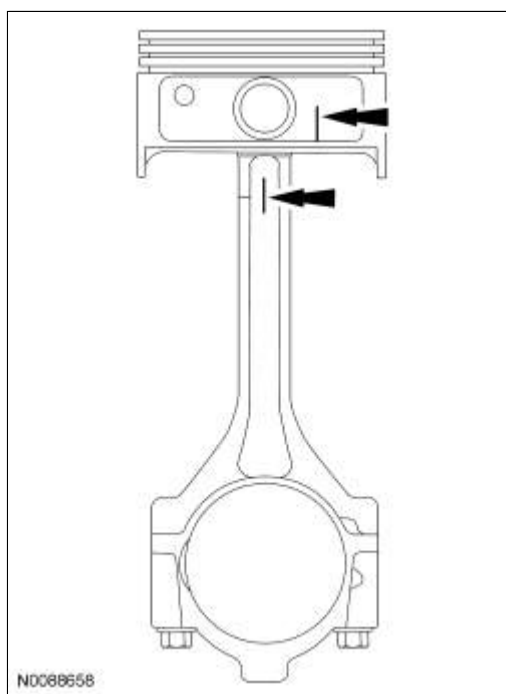
9	6200	Connecting rod
10	6110	Piston

Disassembly



WARNING: Since the retainer ring has a tendency to spring out, cover the end of the pin bore with a hand or shop rag when removing the ring. Wear eye protection. Failure to follow these instructions may result in serious personal injury.

1. Remove the piston rings from the piston.
 - Discard the piston rings.
2. Mark the piston and the connecting rod on the same side for assembly reference.

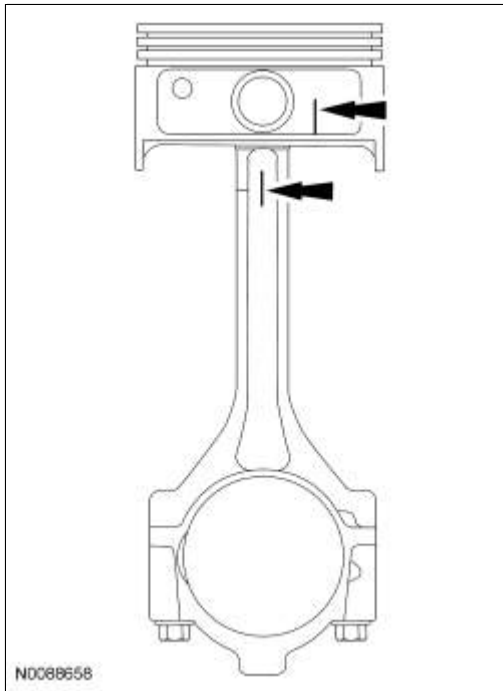


3. Remove the piston pin retainers and the piston pin.
4. Separate the piston from the connecting rod.
5. Clean and inspect the piston and connecting rod. For additional information, refer to [Section 303-00](#).

Assembly

1. **NOTE:** The connecting rod must be installed into the piston with the marks made during disassembly on the same side. If a new piston or connecting rod is being installed, it can be installed in either direction.

Position the connecting rod in the piston.



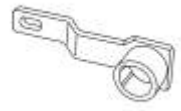
2. Lubricate the piston pin and pin bore with clean engine oil.
 3. Install the piston pin in the piston and connecting rod assembly.
 4. Install the piston pin retaining clips in the piston.
 5. Lubricate the piston and the new piston rings with clean engine oil.
 6. Install the piston rings onto the piston.
-

SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Camshaft — LH

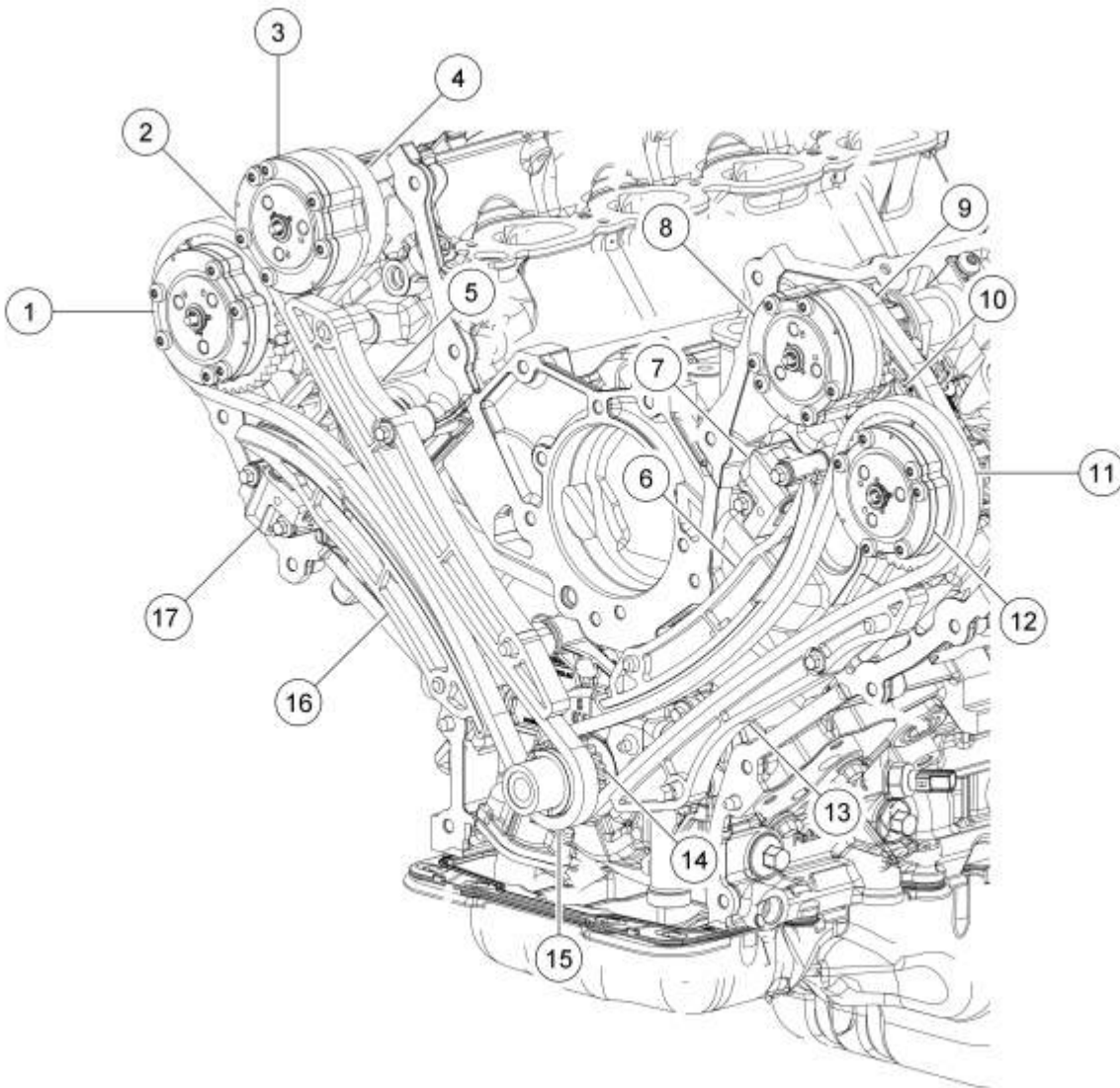
Special Tool(s)

 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
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Material

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

Timing Drive Components

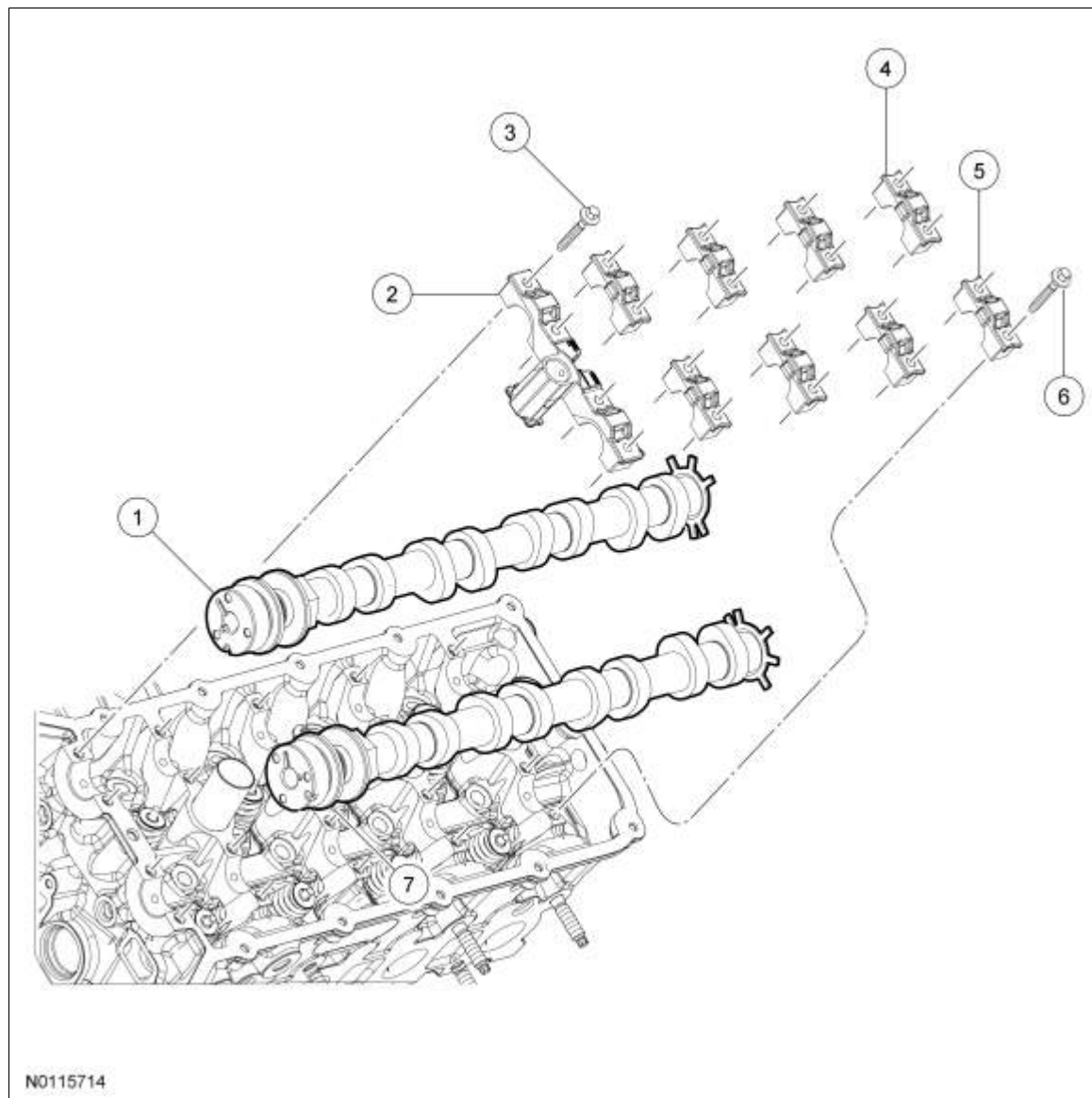


N0115713

Item	Part Number	Description
1	6256	RH exhaust Variable Camshaft Timing (VCT) assembly
2	6K254	RH secondary timing chain tensioner
3	6256	RH intake <u>VCT</u> assembly
4	6268	RH secondary timing chain
5	6M256	RH timing chain guide
6	6K255	LH timing chain tensioner arm
7	6L266	LH primary timing chain tensioner
8	6256	LH intake <u>VCT</u> assembly

9	6268	LH secondary timing chain
10	6K254	LH secondary timing chain tensioner
11	6268	LH primary timing chain
12	6256	LH exhaust VCT_assembly
13	6B274	LH timing chain guide
14	6306	Crankshaft sprocket
15	6268	RH primary timing chain
16	6K255	RH timing chain tensioner arm
17	6L266	RH primary timing chain tensioner

Camshafts



	Part	
--	-------------	--

Item	Number	Description
1	6250	LH intake camshaft
2	—	Front camshaft bearing mega cap (part of 6049)
3	N806183	Front camshaft bearing mega cap bolt (4 required)
4	—	Intake camshaft bearing cap (part of 6049) (4 required)
5	—	Exhaust camshaft bearing cap (part of 6049) (4 required)
6	N806183	Intake/exhaust camshaft bearing cap bolt (16 required)
7	6250	LH exhaust camshaft

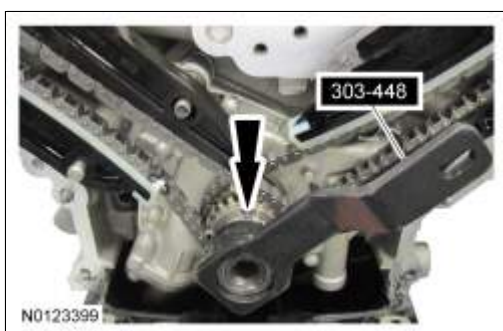
Removal

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

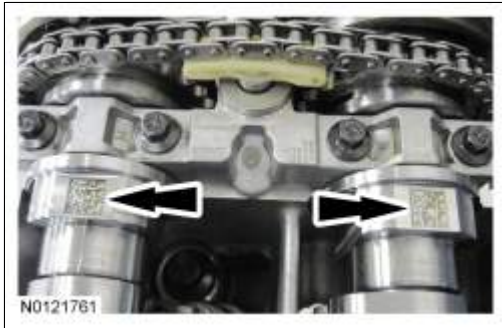
NOTE: If the RH camshafts are being serviced at the same time as the LH camshafts, remove the RH camshafts first. For additional information, refer to [Camshaft — RH](#) in this section.

NOTE: If the components are to be reinstalled, they must be installed in their original location. Mark the components for installation into their original location.

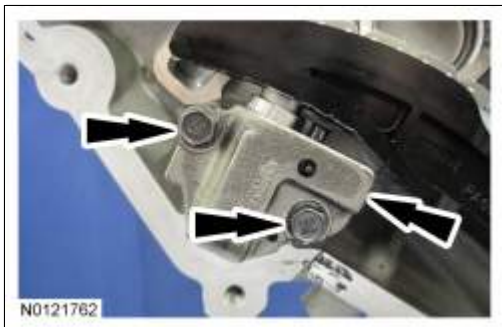
1. Remove the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.
2. Using the crankshaft holding tool, rotate the crankshaft clockwise until the keyway is at the 12 o'clock position.



3. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.



4. Remove the 2 bolts and the RH primary timing chain tensioner.



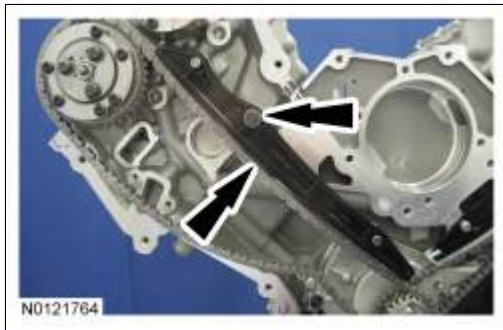
5. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

Remove the RH timing chain tensioner arm.



6. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

Remove the bolt and the RH timing chain guide.



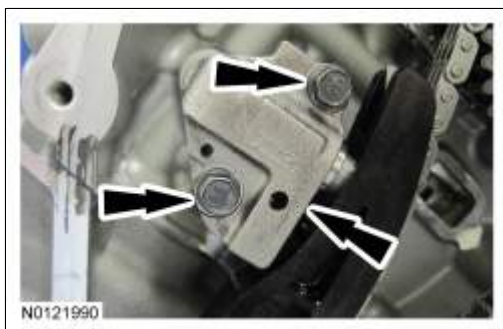
7. Remove the RH primary timing chain.



8. Using the crankshaft holding tool, rotate the crankshaft counterclockwise until the crankshaft keyway is at the 9 o'clock position.



9. Remove the 2 bolts and the LH primary timing chain tensioner.



10. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain tensioner arm.

Remove the LH timing chain tensioner arm.



11. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain guide.

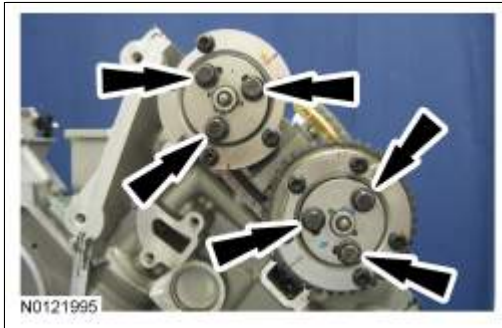
Remove the bolt and the LH timing chain guide.



12. Remove the LH primary timing chain.



13. Remove the 3 LH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 LH exhaust VCT assembly bolts.



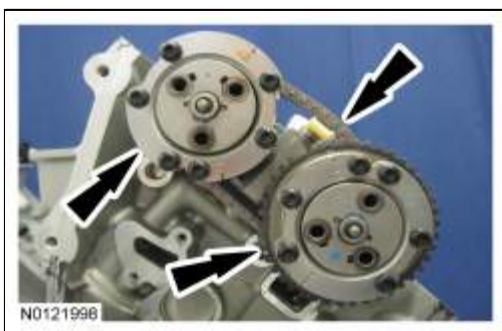
14. Slide the LH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



15. Depress the LH secondary timing chain tensioner and turn the tensioner 90 degrees.



16. Remove the LH VCT assemblies and the LH secondary timing chain.



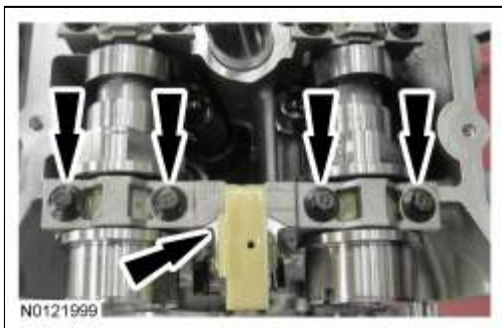
17. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

Remove the VCT system oil filter from the intake and exhaust camshafts.



18. **NOTICE:** The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.

Remove the 4 bolts and the LH front camshaft bearing mega cap.



19. Remove the 16 bolts and the 8 camshaft bearing caps.
20. Remove the LH intake and exhaust camshafts.

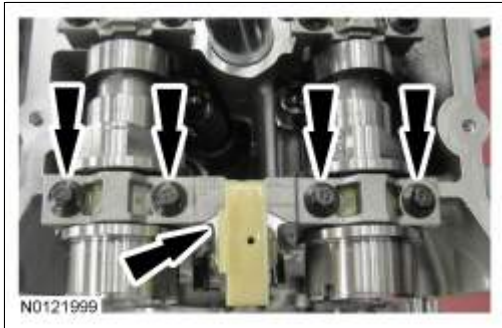
Installation

1. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

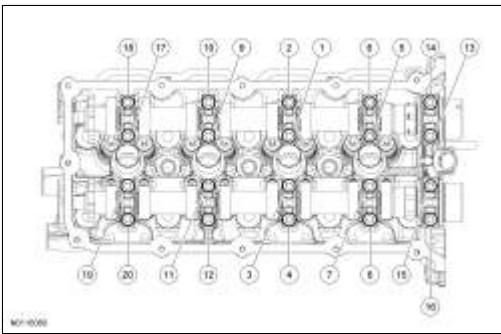
Install the LH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.



2. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.
3. Install the LH front camshaft bearing mega cap and the 4 bolts. Do not tighten the bolts at this time.



4. Tighten the bolts in the sequence shown in 2 stages.
 - Stage 1: Tighten to 6 Nm (53 lb-in).
 - Stage 2: Tighten an additional 45 degrees.

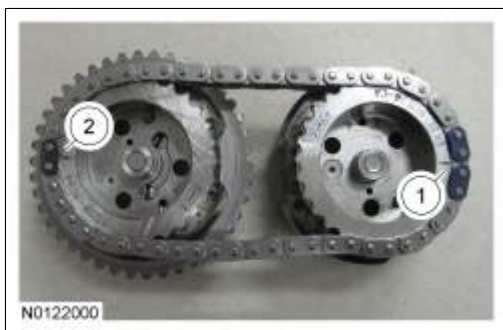


5. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

Install the VCT system oil filter in the intake and exhaust camshafts.



6. Install the secondary timing chain onto the LH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
 1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
 2. The timing mark on the exhaust VCT assembly should align with the single colored link.



7. Install the LH VCT assemblies and the secondary timing chain onto the LH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 11 o'clock position.



8. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.

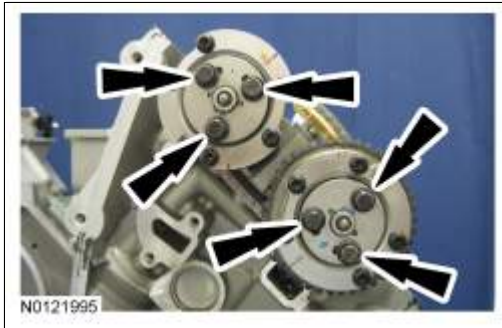
- If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



9. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

Install the 3 LH intake VCT assembly bolts and the 3 LH exhaust VCT assembly bolts.

- Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.



10. Install the LH primary timing chain.
 - Align the colored link on the timing chain with the timing mark on the LH VCT assembly.



11. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



12. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain guide.

Install the LH timing chain guide and bolt.

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



13. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain tensioner arm.

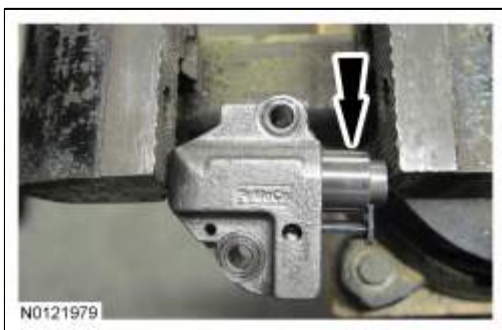
Install the LH timing chain tensioner arm.



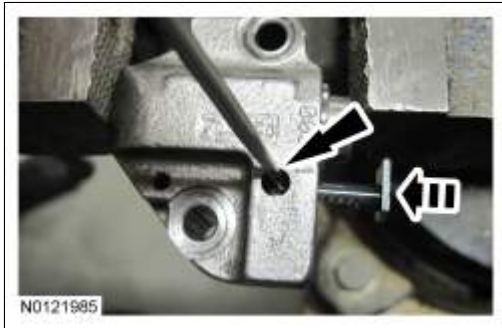
NOTE: Complete the following 3 steps on both the LH and RH primary timing chain tensioners.

14. **NOTICE:** Do not compress the ratchet assembly or damage to the tensioner will occur.

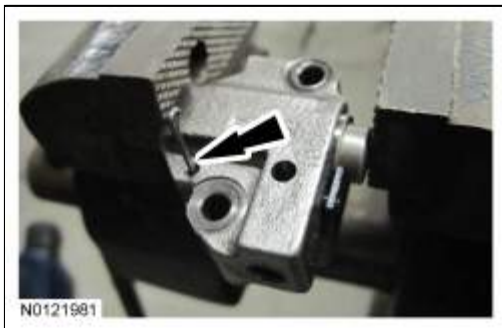
Compress the primary timing chain tensioner plunger, using an edge of a vise.



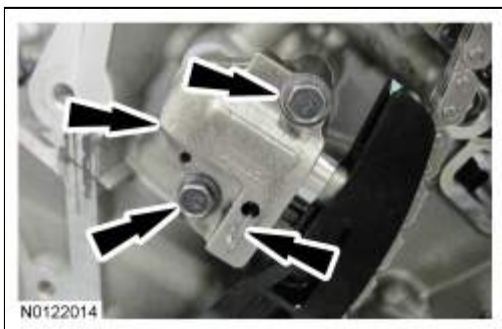
15. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.



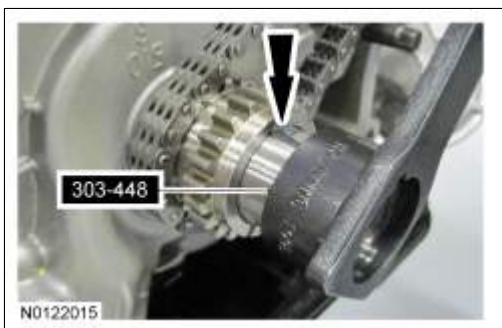
16. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.



17. Install the LH primary timing chain tensioner and 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Remove the holding pin from the tensioner.



18. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.



19. Install the RH primary timing chain.
- Align the colored link on the timing chain with the timing mark on the RH VCT assembly.



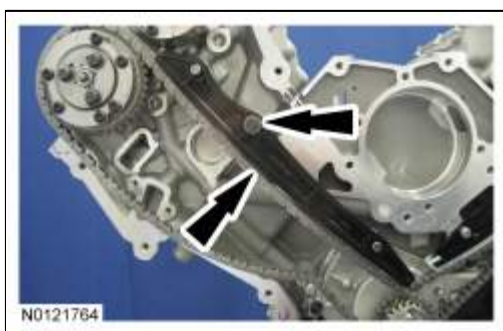
20. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



21. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

Install the RH timing chain guide and bolt.

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



22. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

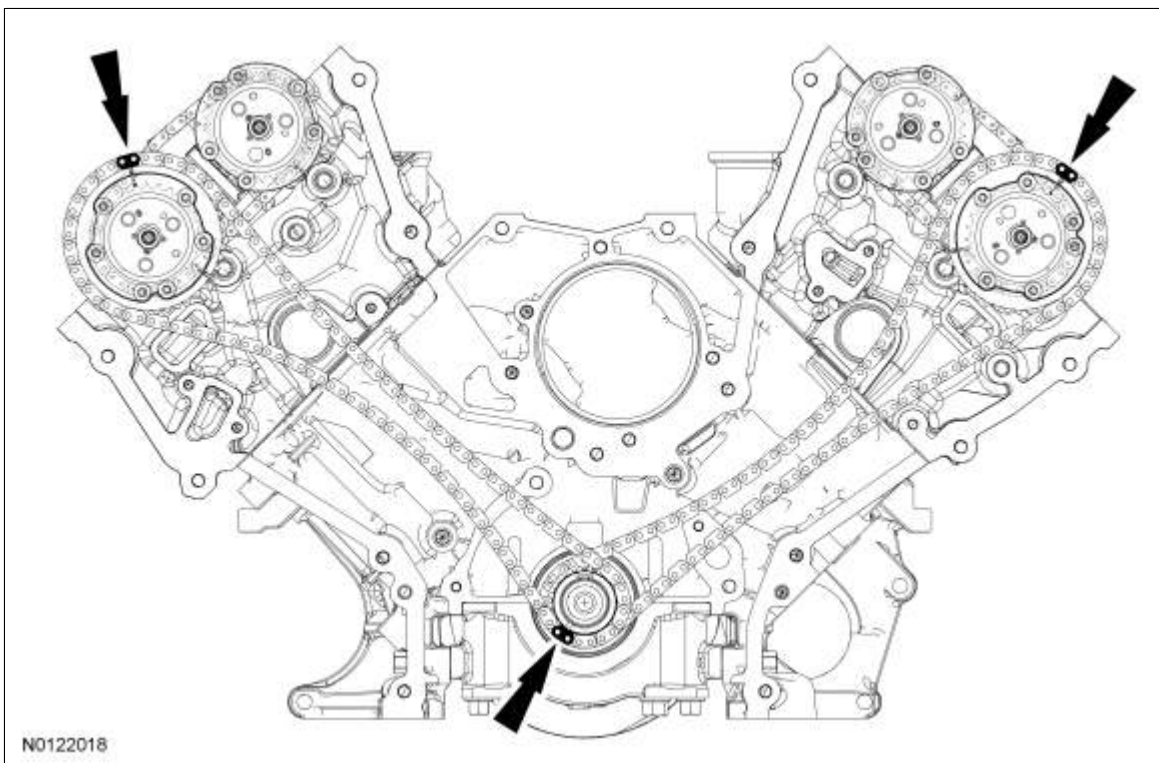
Install the RH timing chain tensioner arm.



23. Install the RH primary timing chain tensioner and 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Remove the holding pin from the tensioner.



24. With the crankshaft keyway still at the 12 o'clock position, verify the timing mark alignment is correct.



25. Install the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.

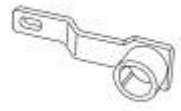


SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Camshaft — RH

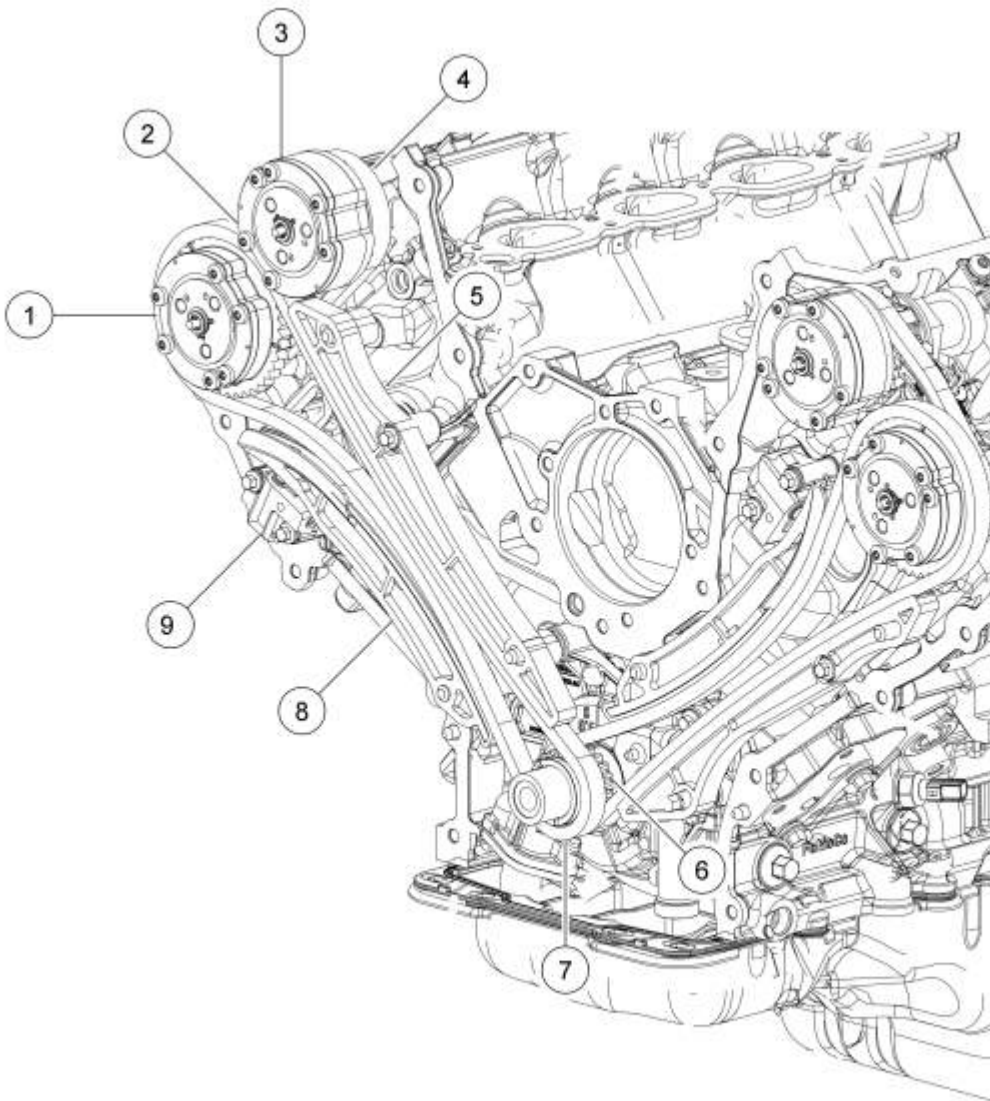
Special Tool(s)

 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
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Material

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

Timing Drive Components

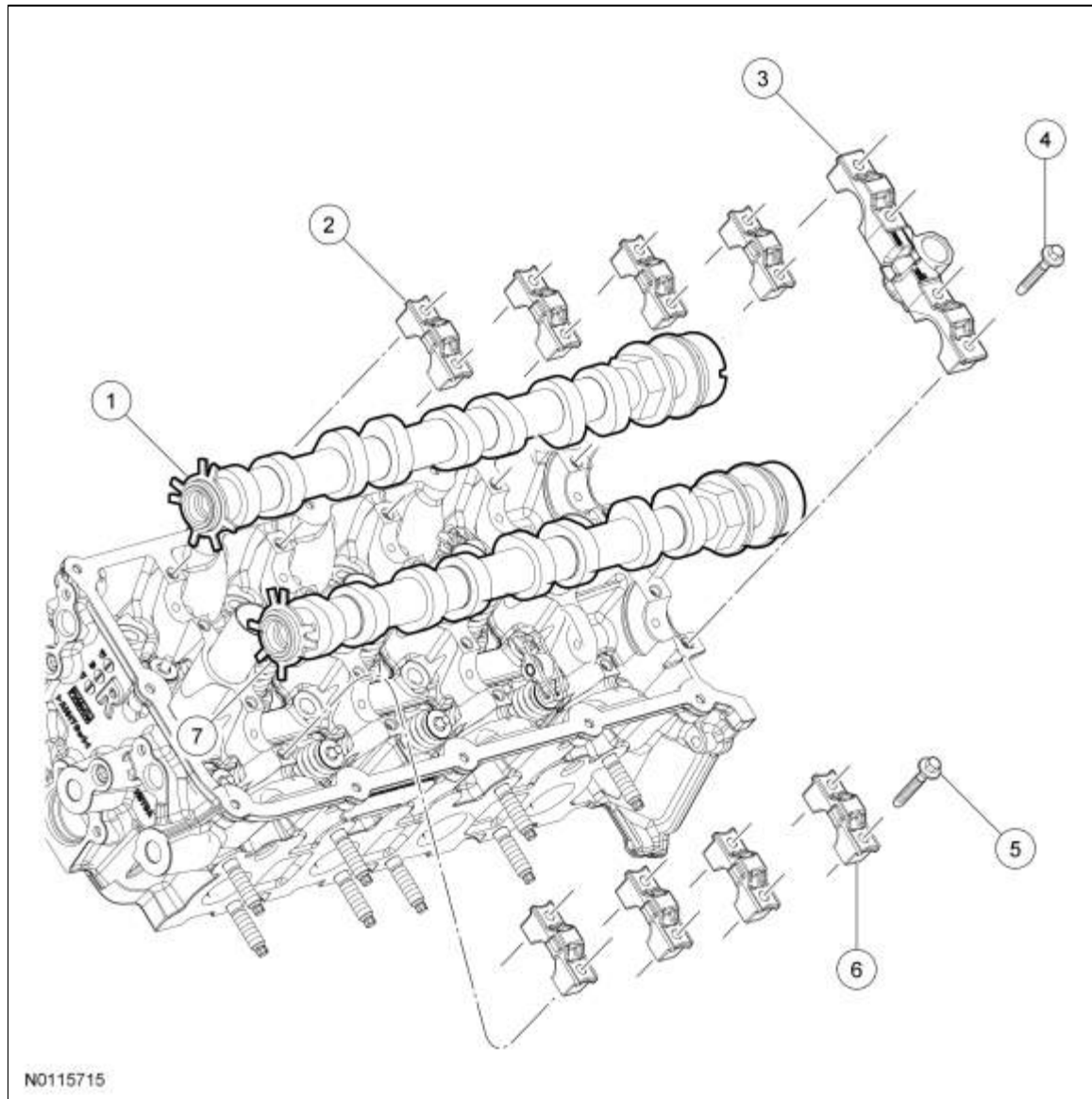


N0121986

Item	Part Number	Description
1	6256	RH exhaust Variable Camshaft Timing (VCT) assembly
2	6K254	RH secondary timing chain tensioner
3	6256	RH intake <u>VCT</u> assembly
4	6268	RH secondary timing chain
5	6M256	RH timing chain guide
6	6306	Crankshaft sprocket
7	6268	RH primary timing chain
8	6K255	RH timing chain tensioner arm

9	6L266	RH primary timing chain tensioner
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Camshafts



Item	Part Number	Description
1	6250	RH intake camshaft
2	—	Intake camshaft bearing cap (part of 6049) (4 required)
3	—	Front camshaft bearing mega cap (part of 6049)
4	N806183	Front camshaft bearing mega cap bolt (4 required)
5	N806183	Intake/exhaust camshaft bearing cap bolt (16 required)
6	—	Exhaust camshaft bearing cap (part of 6049) (4

		required)
7	6250	RH exhaust camshaft

Removal

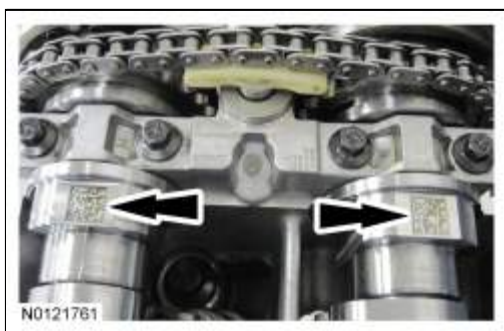
NOTICE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

NOTE: If the components are to be reinstalled, they must be installed in their original location. Mark the components for installation into their original location.

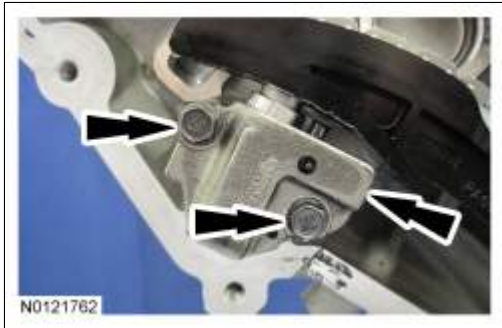
1. Remove the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.
2. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.



3. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.

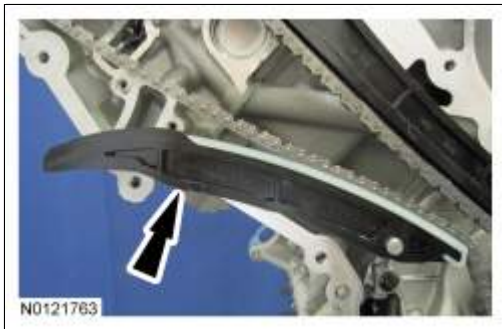


4. Remove the 2 bolts and the RH primary timing chain tensioner.



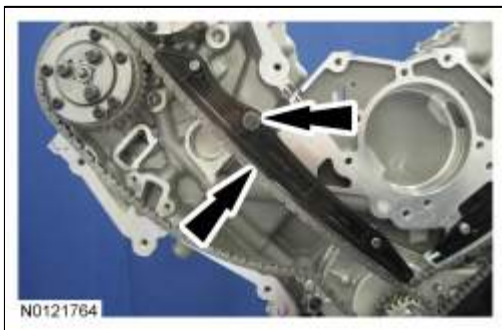
5. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

Remove the RH timing chain tensioner arm.



6. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

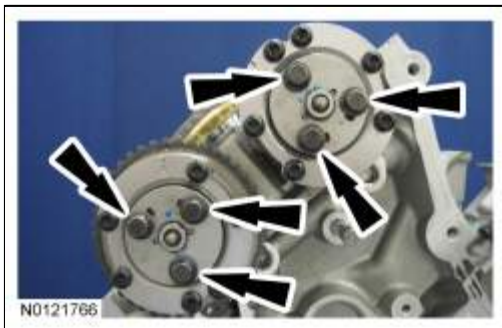
Remove the bolt and the RH timing chain guide.



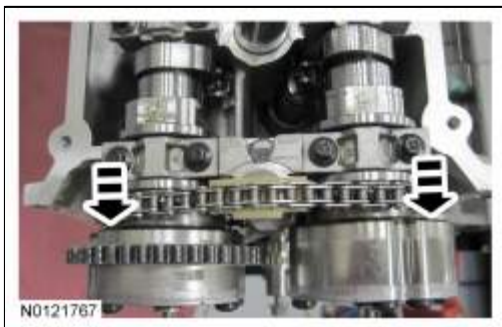
7. Remove the RH primary timing chain.



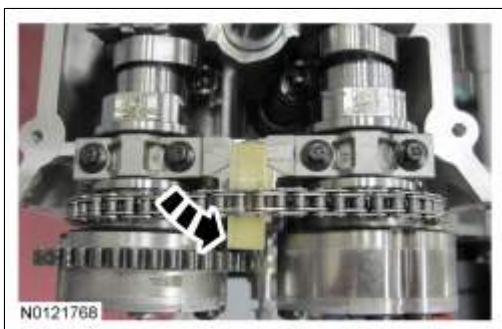
8. Remove the 3 RH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 RH exhaust VCT assembly bolts.



9. Slide the RH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



10. Depress the RH secondary timing chain tensioner and turn the tensioner 90 degrees.



11. Remove the RH VCT assemblies and the RH secondary timing chain.



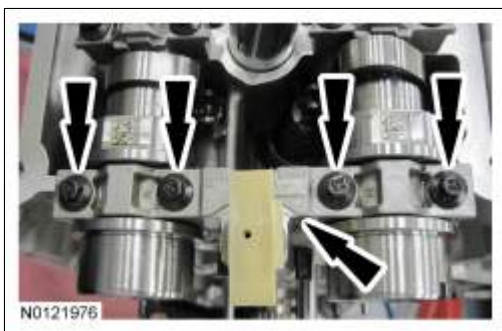
12. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

Remove the VCT system oil filter from the intake and exhaust camshafts.



13. **NOTICE:** The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.

Remove the 4 bolts and the RH front camshaft bearing mega cap.



14. Remove the 16 bolts and the 8 camshaft bearing caps.
15. Remove the RH intake and exhaust camshafts.

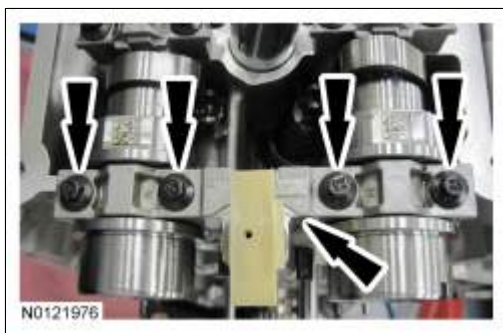
Installation

1. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

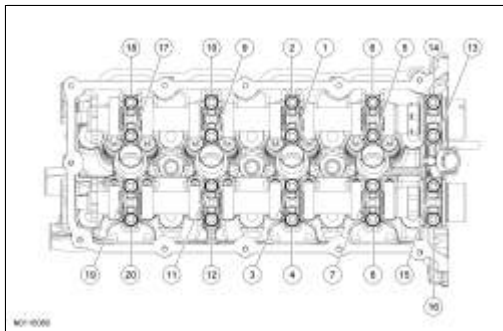
Install the RH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.



2. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.
3. Install the RH front camshaft bearing mega cap and the 4 bolts. Do not tighten at this time



4. Tighten the bolts in the sequence shown in 2 stages.
 - Stage 1: Tighten to 6 Nm (53 lb-in).
 - Stage 2: Tighten an additional 45 degrees.



5. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

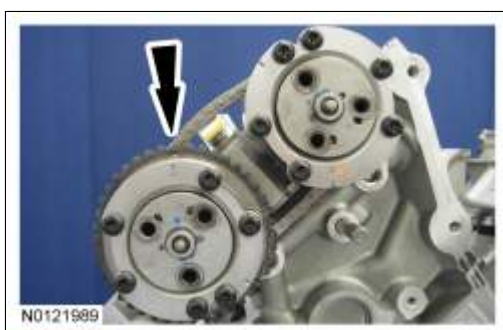
Install the VCT system oil filter in the intake and exhaust camshafts.



6. Install the secondary timing chain onto the RH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
 1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
 2. The timing mark on the exhaust VCT assembly should align with the single colored link.



7. Install the RH VCT assemblies and the secondary timing chain onto the RH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 1 o'clock position.



8. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.

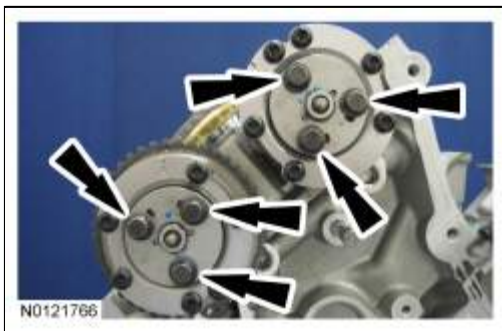
- If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



9. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

Install the 3 RH intake VCT assembly bolts and the 3 RH exhaust VCT assembly bolts.

- Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.



10. Install the RH primary timing chain.
- Align the colored link on the timing chain with the timing mark on the RH VCT assembly.



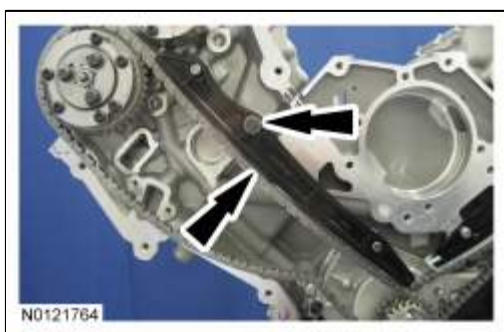
11. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



12. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

Install the RH timing chain guide and bolt.

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



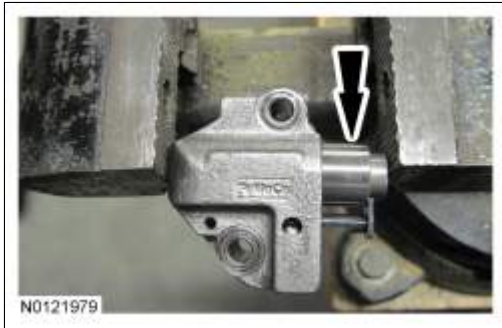
13. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

Install the RH timing chain tensioner arm.



14. **NOTICE:** Do not compress the ratchet assembly or damage to the tensioner will occur.

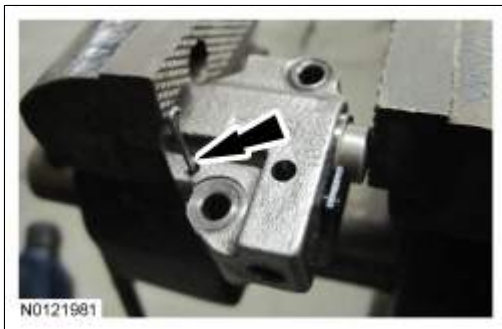
Compress the primary timing chain tensioner plunger, using an edge of a vise.



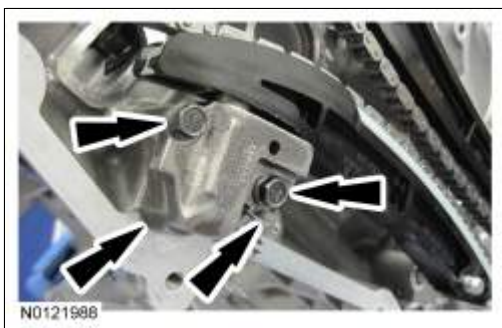
15. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.



16. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.



17. Install the RH primary timing chain tensioner and 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Remove the holding pin from the tensioner.



18. Install the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.
-

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Camshaft Roller Follower

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

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

NOTE: If the components are to be reinstalled, they must be installed in their original locations. Mark the components for installation into their original locations.

1. Remove the camshaft for the camshaft roller follower being serviced. For additional information, refer to [Camshaft — RH](#) and/or [Camshaft — LH](#) in this section.
 2. Remove the camshaft roller follower and hydraulic lash adjuster as an assembly.
 3. Separate the hydraulic lash adjuster from the spring clip on the camshaft roller follower.
 4. To install, reverse the removal procedure.
 - Lubricate the camshaft roller follower and hydraulic lash adjuster assembly with clean engine oil prior to installation.
-

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Crankshaft Front Seal

Special Tool(s)

 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A2 plate only)
 ST3249-A	Installer, Front Crank Seal and Damper 303-1531
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-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

NOTICE: 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 [Section 100-02](#).
2. Remove the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.
3. **NOTICE:** Use care not to damage the engine front cover or the crankshaft when removing the seal.

Using the Oil Seal Remover, remove the crankshaft front oil seal.



Installation

1. **NOTE:** Lubricate the engine front cover bore and the crankshaft front oil seal inner lip with clean engine oil.

Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft front oil seal.

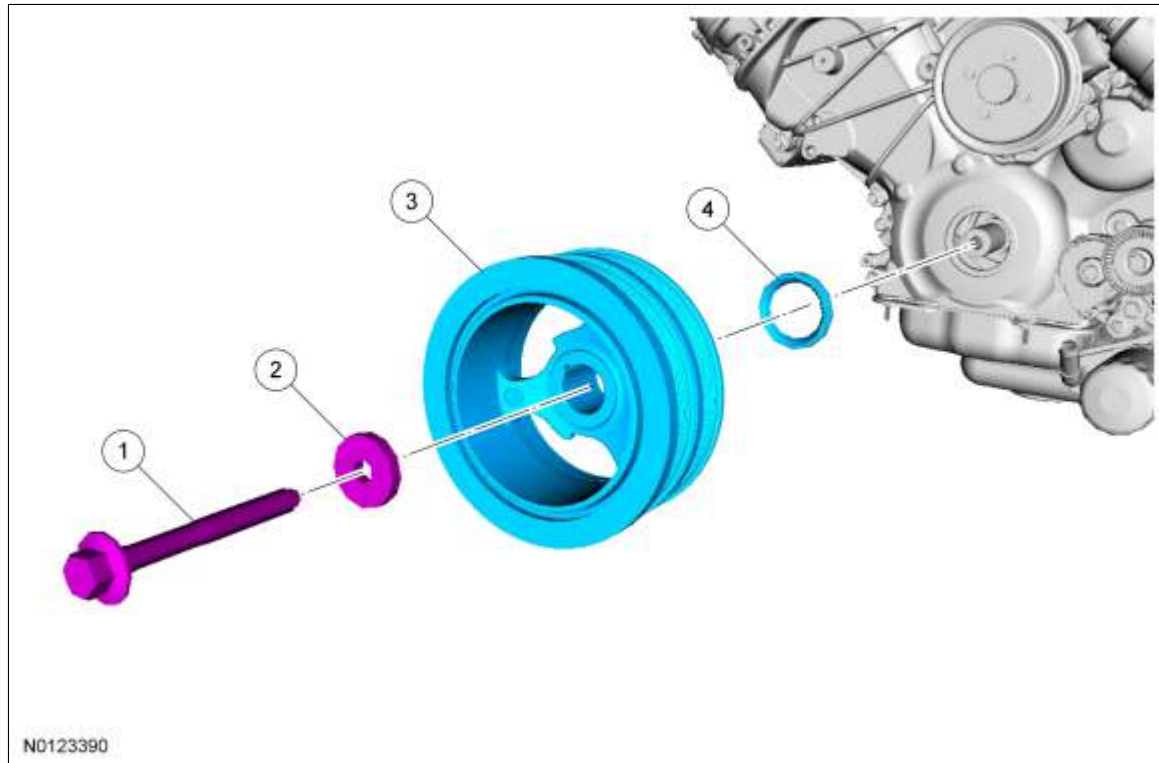


2. Install the crankshaft pulley. For additional information, refer to [Crankshaft Pulley](#) in this section.

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Crankshaft Pulley and Crankshaft Front Seal — Exploded View



Item	Part Number	Description
1	6A340	Crankshaft pulley bolt
2	N807033	Crankshaft pulley washer
3	6316	Crankshaft pulley
4	6700	Crankshaft front seal

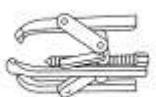
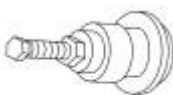



1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.

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Crankshaft Pulley

Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A2 plate only)
 ST3249-A	Installer, Front Crank Seal and Damper 303-1531
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

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

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

Removal

NOTICE: 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 [Section 100-02](#).
2. Remove the accessory drive and A/C compressor belts. For additional information, refer to [Section 303-05](#).
3. Remove the crankshaft pulley bolt and washer.
4. Using the 3 Jaw Puller and the crankshaft pulley bolt, remove the crankshaft pulley.
 - Discard the crankshaft pulley bolt.



Installation

1. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

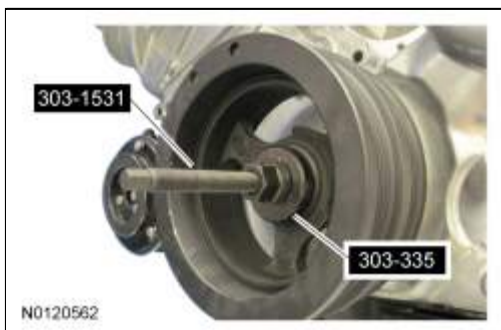
Apply silicone sealer to the Woodruff key slot in the crankshaft pulley.



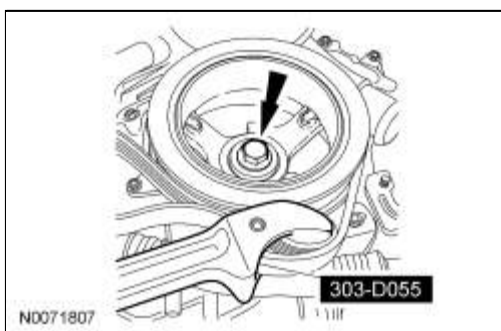
2. Lubricate the crankshaft pulley sealing surface with clean engine oil prior to installation.



3. Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft pulley.



4. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 4 stages:
 - Stage 1: Tighten to 140 Nm (103 lb-ft).
 - Stage 2: Loosen 360 degrees.
 - Stage 3: Tighten to 100 Nm (74 lb-ft).
 - Stage 4: Tighten an additional 90 degrees.



5. Install the accessory drive and A/C compressor belts. For additional information, refer to [Section 303-05](#).
6. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

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Crankshaft Rear Seal with Retainer Plate

Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2980-A	Installer, Rear Main Seal 303-1250
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada); or equivalent	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	—
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

1. Remove the flexplate. For additional information, refer to [Flexplate or Flywheel and Crankshaft Rear Seal — Exploded View](#) and [Flexplate](#).
2. Remove the engine separator plate.
3. **NOTE:** Inspect the crankshaft sensor ring for damage. If the crankshaft sensor ring has been dropped or has any visual damage, it must be discarded.

Remove the crankshaft sensor ring.

4. Remove the oil pan. For additional information, refer to [Engine Lubrication Components — Exploded View](#) and [Oil Pan](#) in this section.
5. Disconnect the Crankshaft Position (CKP) sensor electrical connector.
6. Remove the bolt and the CKP sensor.
7. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove and discard the crankshaft rear seal.



8. Remove the 6 bolts and the crankshaft rear seal retainer plate.

Installation

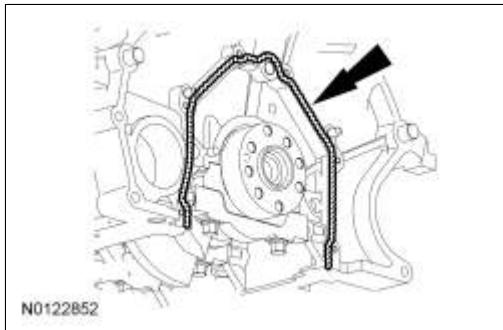
1. **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

NOTE: Clean the sealing surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

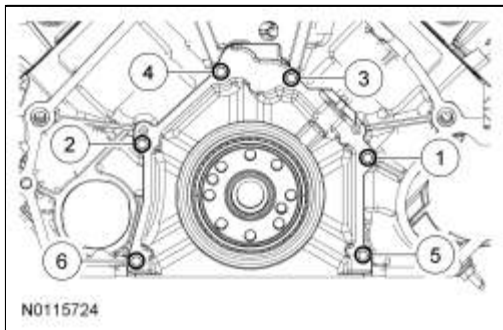
Clean and inspect the mating surface.

2. **NOTE:** If the rear crankshaft seal retaining plate is not secured within 4 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Follow the directions on the packaging. Allow to dry until there is no sign of wetness, or 5 minutes, whichever is longer. Failure to follow this procedure may cause future oil leaks.

Apply a 3.75 mm (0.147 in) bead of silicone sealant to the rear crankshaft seal retainer mating surface on the engine block.



3. Install the crankshaft rear seal retainer plate and the 6 bolts, tighten in the sequence shown in 2 stages.
 - Stage 1: Tighten to 10 Nm (89 lb-in).
 - Stage 2: Tighten an additional 45 degrees.



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

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



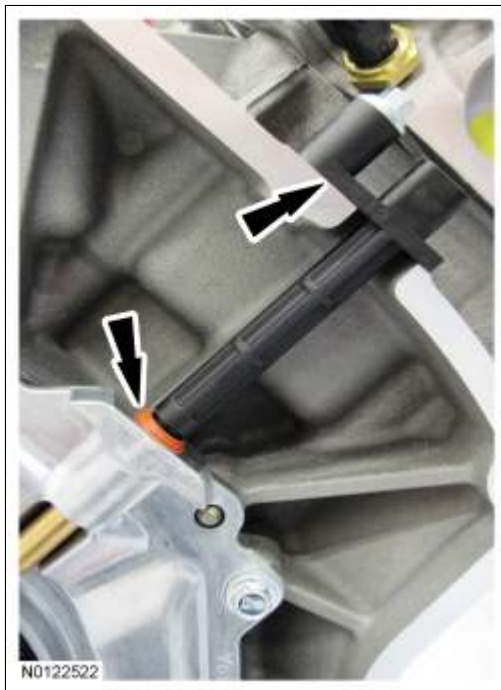
5. Using the Rear Main Seal Installer and Handle, install the new crankshaft rear seal.



6. **NOTICE:** The Crankshaft Position (CKP) sensor must be positioned into the fitting on the crankshaft rear seal retainer plate and be flush against the boss on the engine block before the bolt is installed. If the CKP sensor is installed incorrectly, the CKP sensor can be damaged.

Position the CKP sensor and install the bolt.

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



7. Connect the CKP sensor electrical connector.
8. Install the oil pan. For additional information, refer to [Engine Lubrication Components — Exploded View](#) and [Oil Pan](#) in this section.
9. Install the crankshaft sensor ring.
10. Install the engine separator plate.
11. Install the flexplate. For additional information, refer to [Flexplate or Flywheel and Crankshaft Rear Seal — Exploded View](#) and [Flexplate](#).




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Crankshaft Rear Seal

Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2980-A	Installer, Rear Main Seal 303-1250
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1185-A	Slide Hammer 100-001 (T50T-100-A)

Material

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

Removal

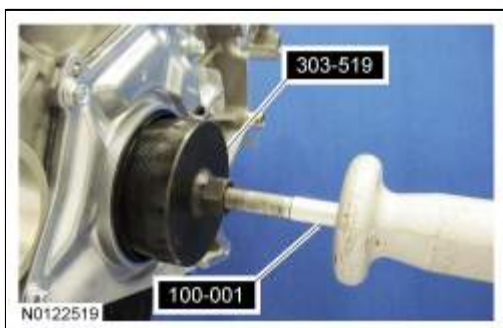
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the flexplate. For additional information, refer to [Flexplate or Flywheel and Crankshaft Rear](#)

[Seal — Exploded View](#) and [Flexplate](#) in this section.

3. Remove the engine separator plate.
4. **NOTE:** Inspect the crankshaft sensor ring for damage. If the crankshaft sensor ring has been dropped or has any visual damage, it must be discarded.

Remove the crankshaft sensor ring.

5. Using the Slide Hammer and the Crankshaft Rear Oil Seal Remover, remove and discard the crankshaft rear seal.
 - Clean all sealing surfaces with metal surface prep.



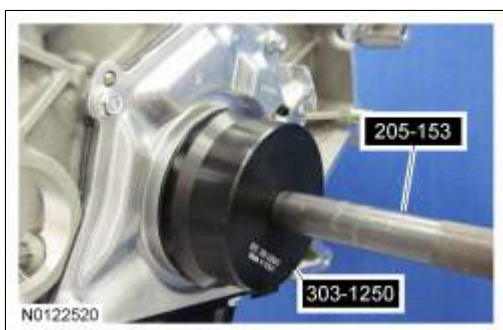
Installation

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

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



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



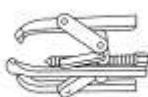
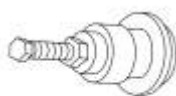




3. Install the crankshaft sensor ring.
 4. Install the engine separator plate.
 5. Install the flexplate. For additional information, refer to [Flexplate or Flywheel and Crankshaft Rear Seal — Exploded View](#) and [Flexplate](#) in this section.
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Engine Front Cover

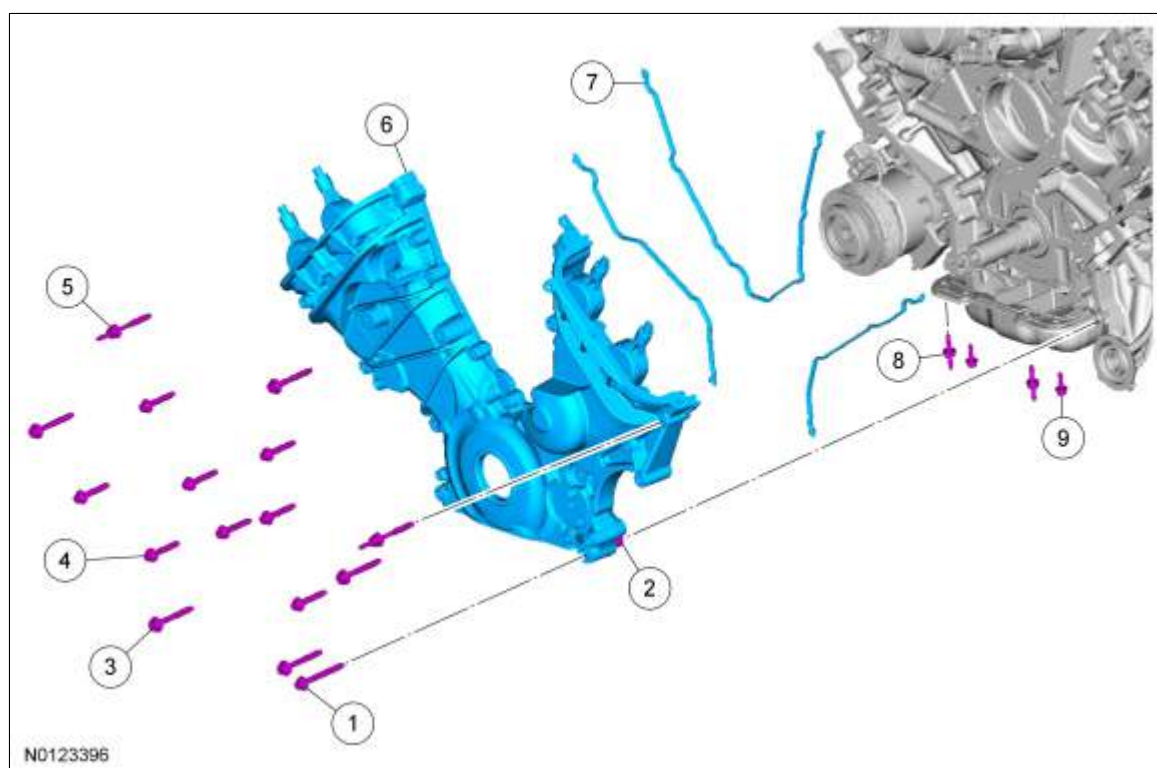
Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A2 plate only)
 ST3249-A	Installer, Front Crank Seal and Damper 303-1531
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

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

Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Motorcraft® Silicone Gasket Remover ZC-30	—
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS-M97B44-D
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

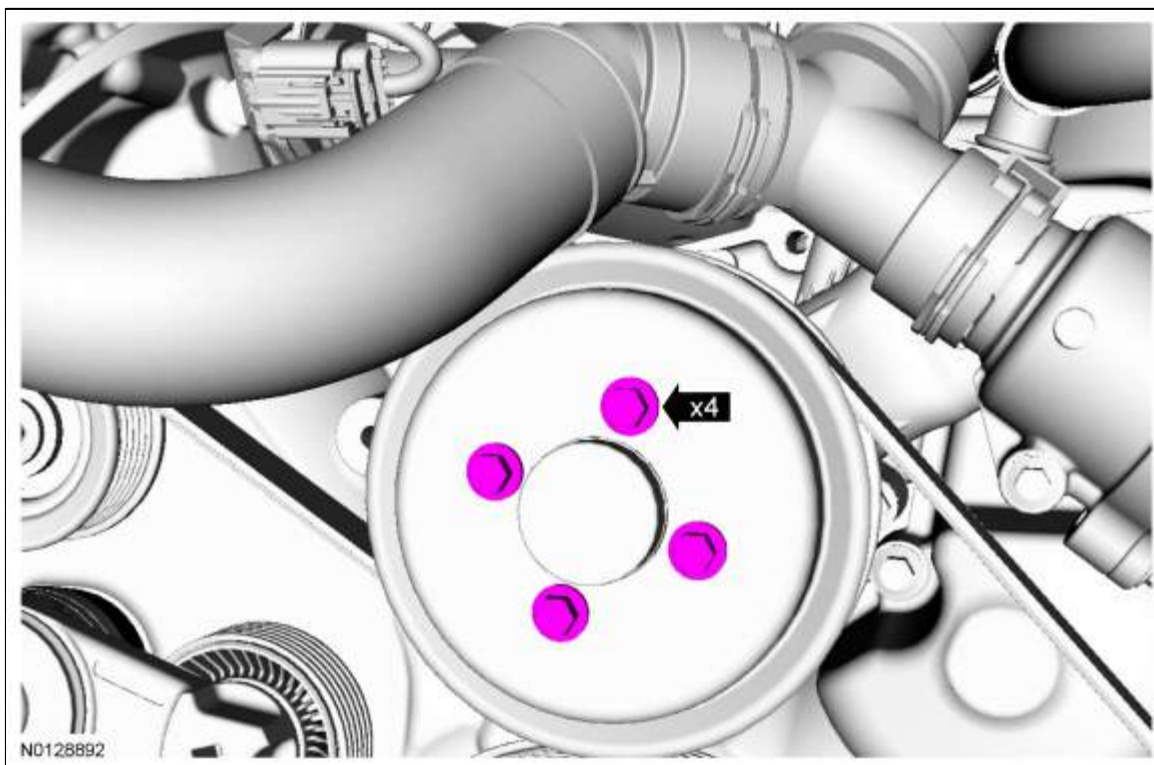


Item	Part Number	Description
1	W503304	Engine front cover-to-oil filter adapter bolt
2	W715209	Engine front cover-to-oil filter adapter jackscrew (part of 6019)
3	W704920	Engine front cover bolt (5 required)
4	W714925	Engine front cover bolt (8 required)
5	W704919	Engine front cover stud bolt (2 required)
6	6019	Engine front cover
7	6020	Engine front cover gasket (3 required)
8	W714963	Oil pan stud bolt (2 required)

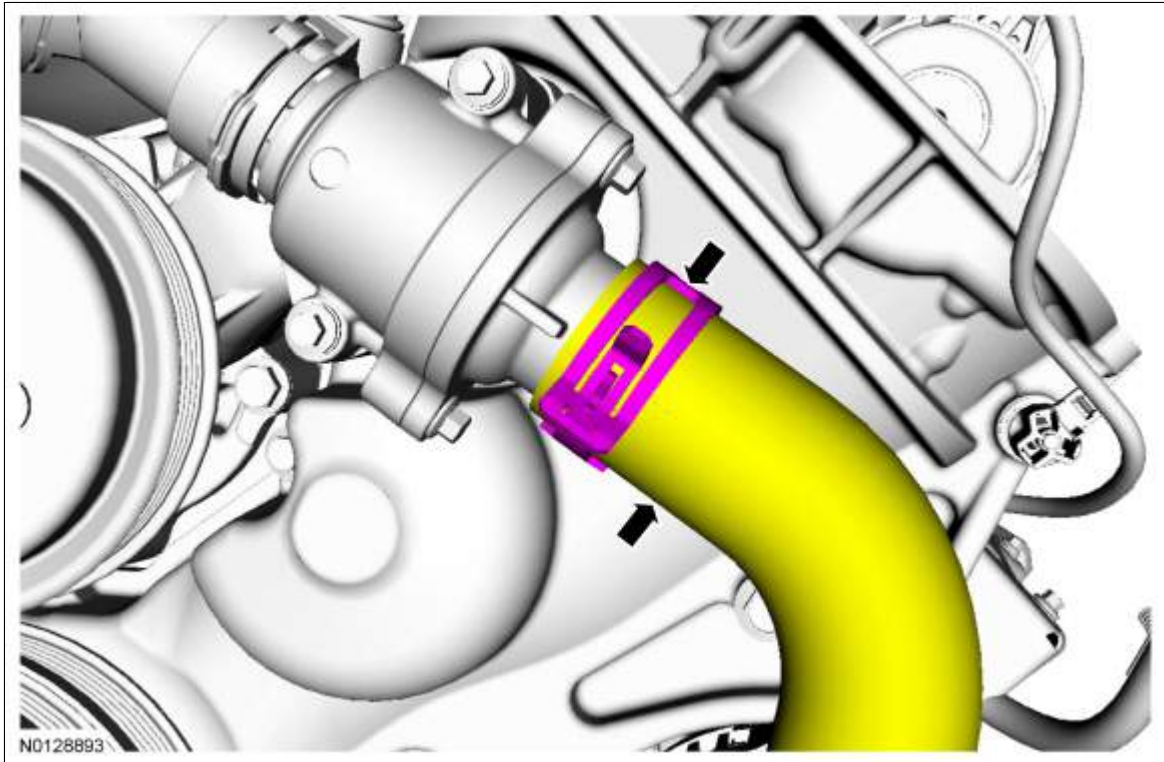
9	W714962	Oil pan bolt (2 required)
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Removal

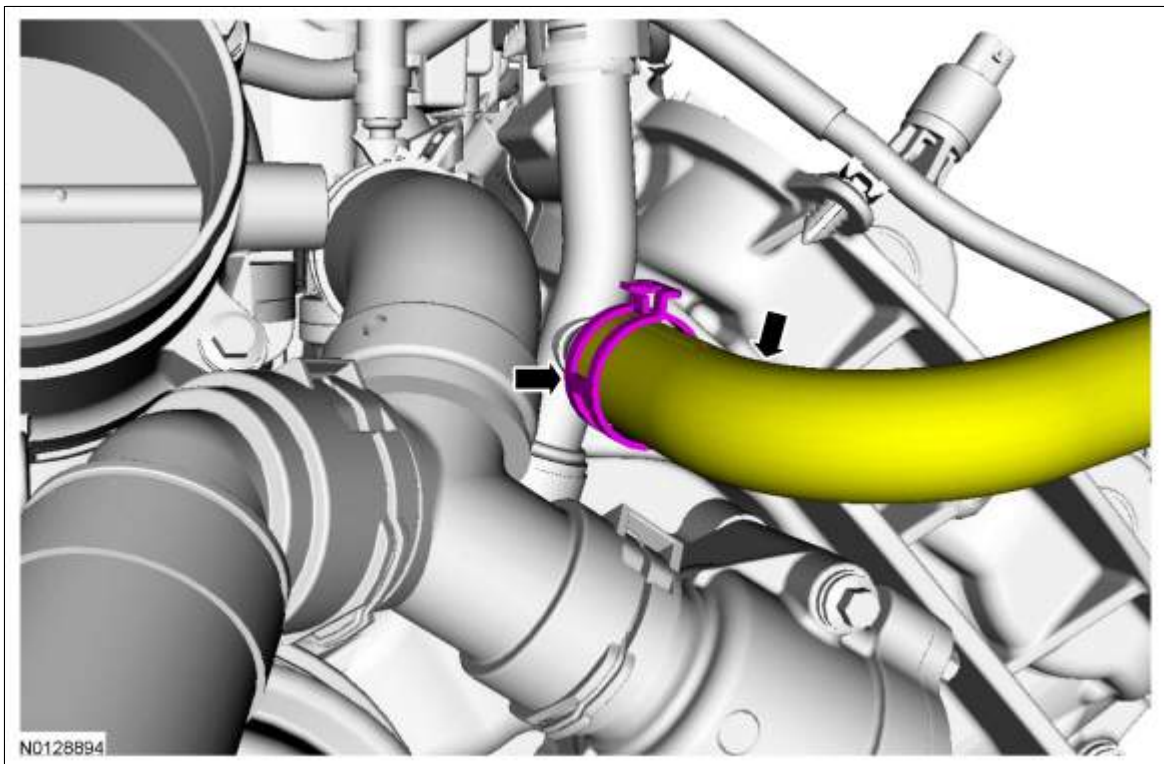
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
3. Drain the engine cooling system. For additional information, refer to [Section 303-03](#).
4. Remove the RH and LH valve covers. For additional information, refer to [Valve Cover — RH](#) and [Valve Cover — LH](#) in this section.
5. Loosen the 4 coolant pump pulley bolts.



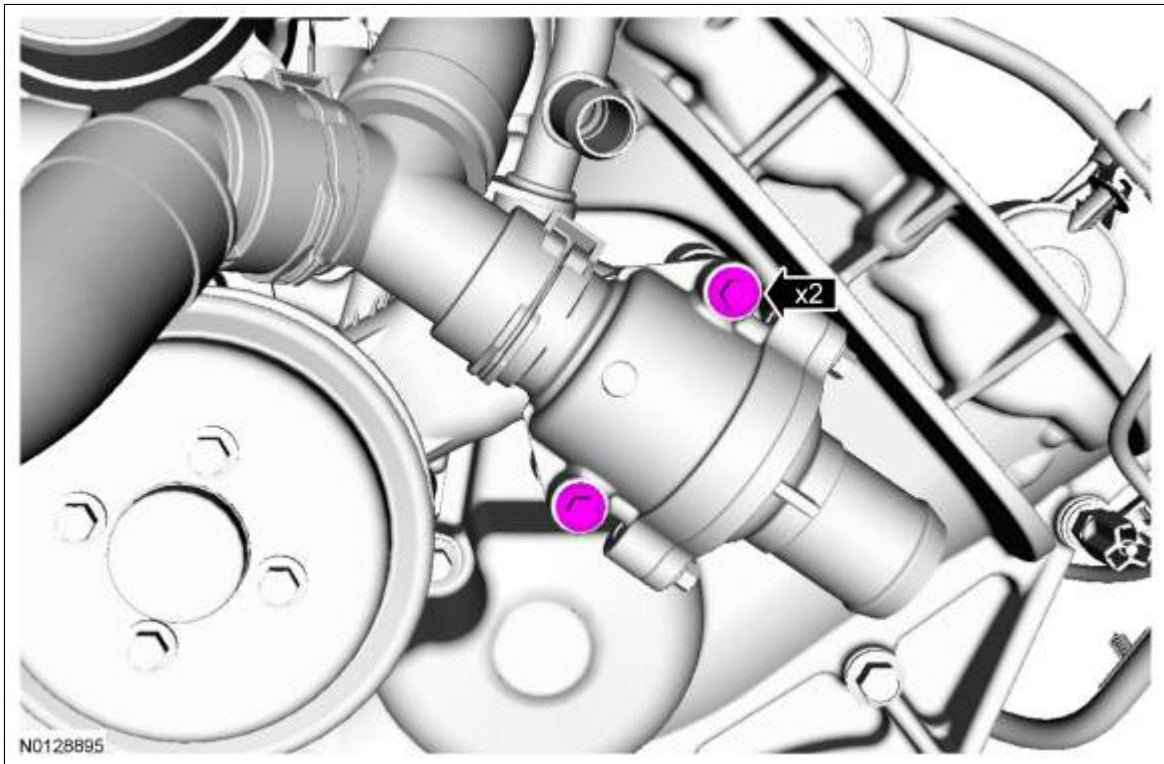
6. Remove the accessory drive and A/C compressor belts. For additional information, refer to [Section 303-05](#).
7. Release the clamp and disconnect the lower radiator hose from the thermostat housing assembly.



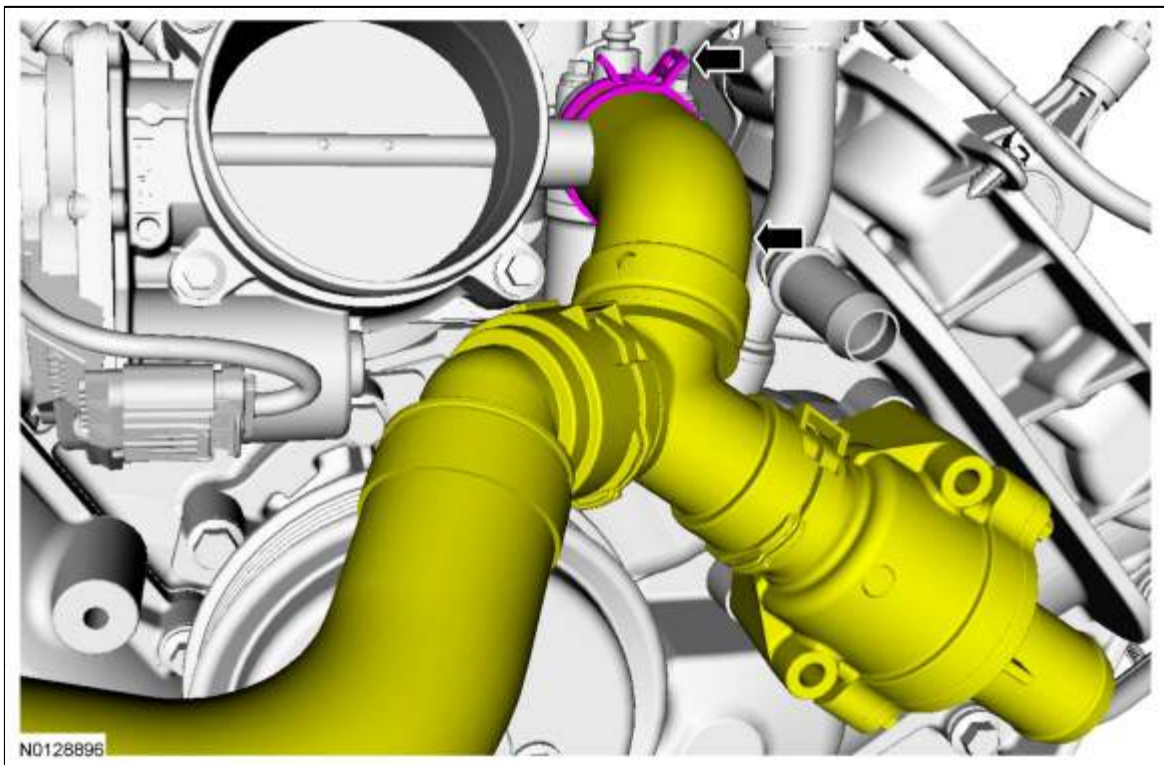
8. Release the clamp and disconnect the degas coolant hose.



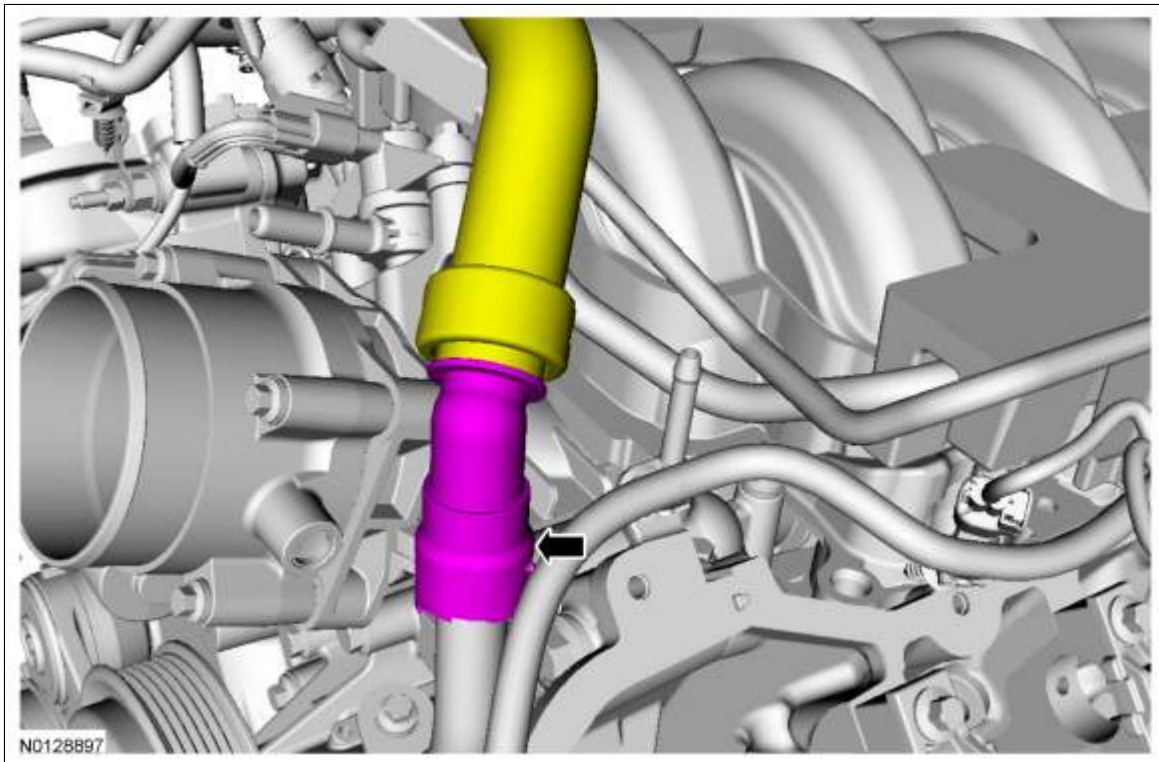
9. Remove the 2 thermostat housing bolts.



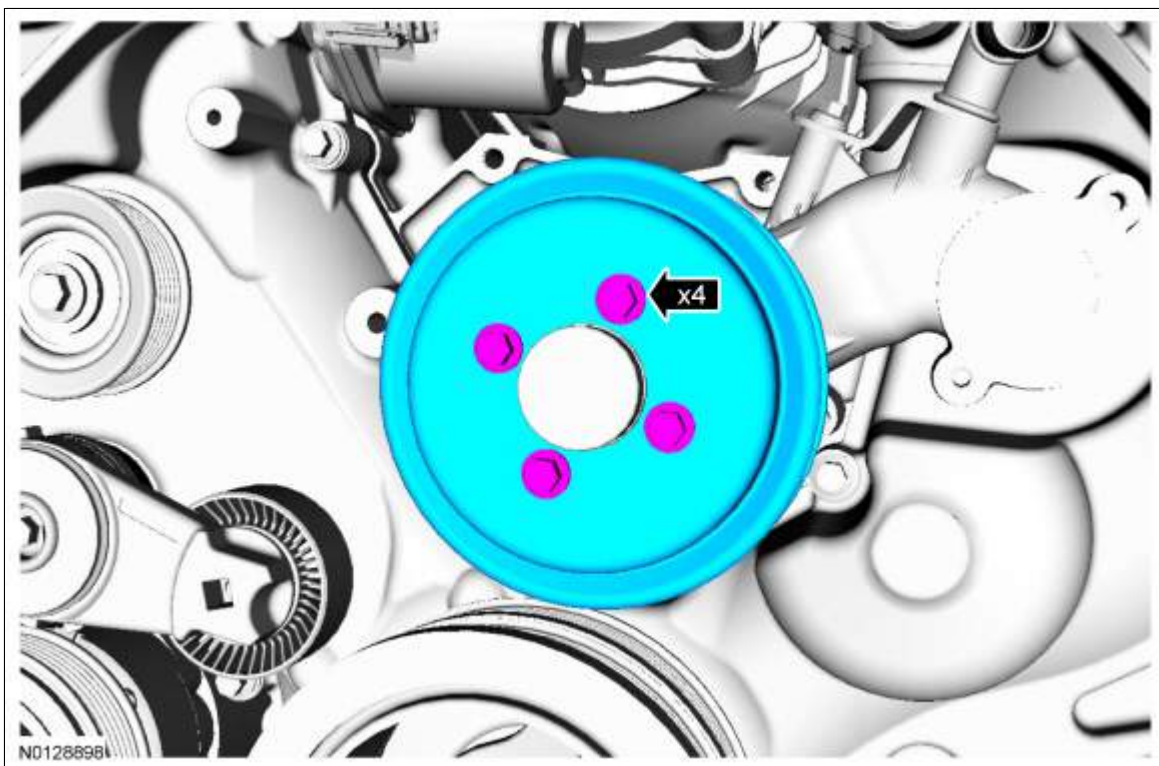
10. Release the clamp and position the upper radiator hose T-connector/thermostat housing assembly aside.
 - Remove and discard the thermostat housing O-ring seal.



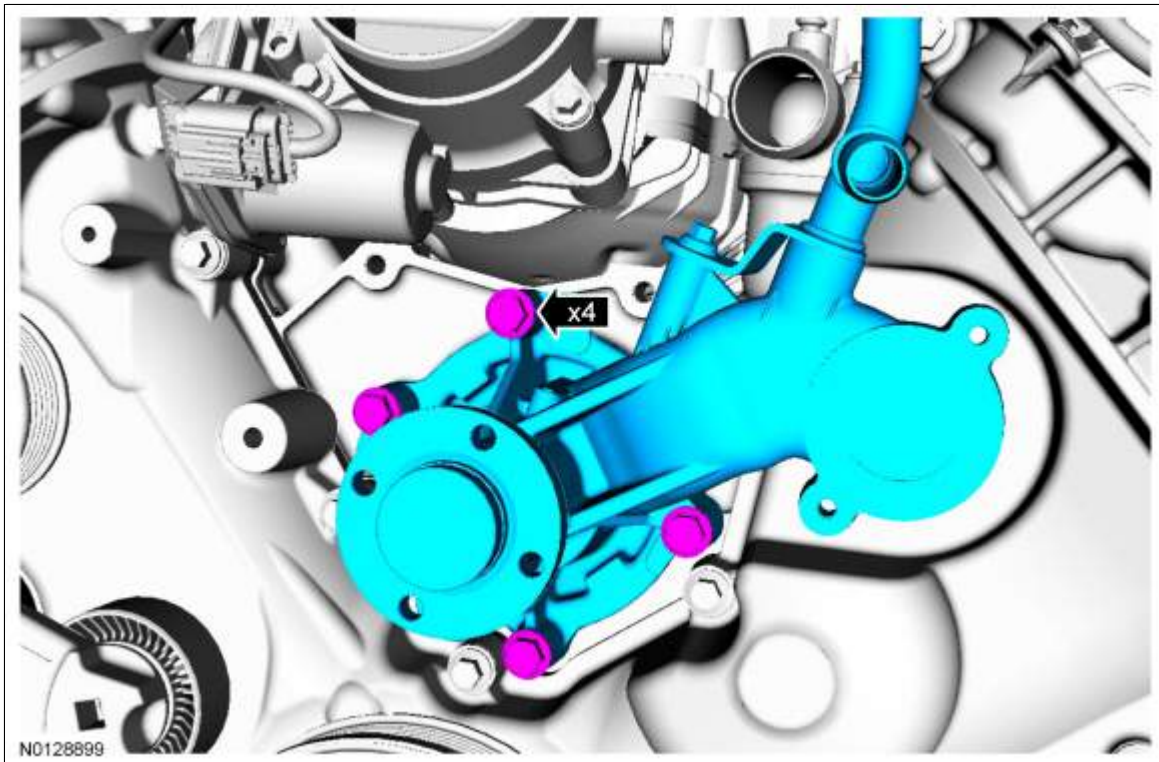
11. Disconnect the heater hose.



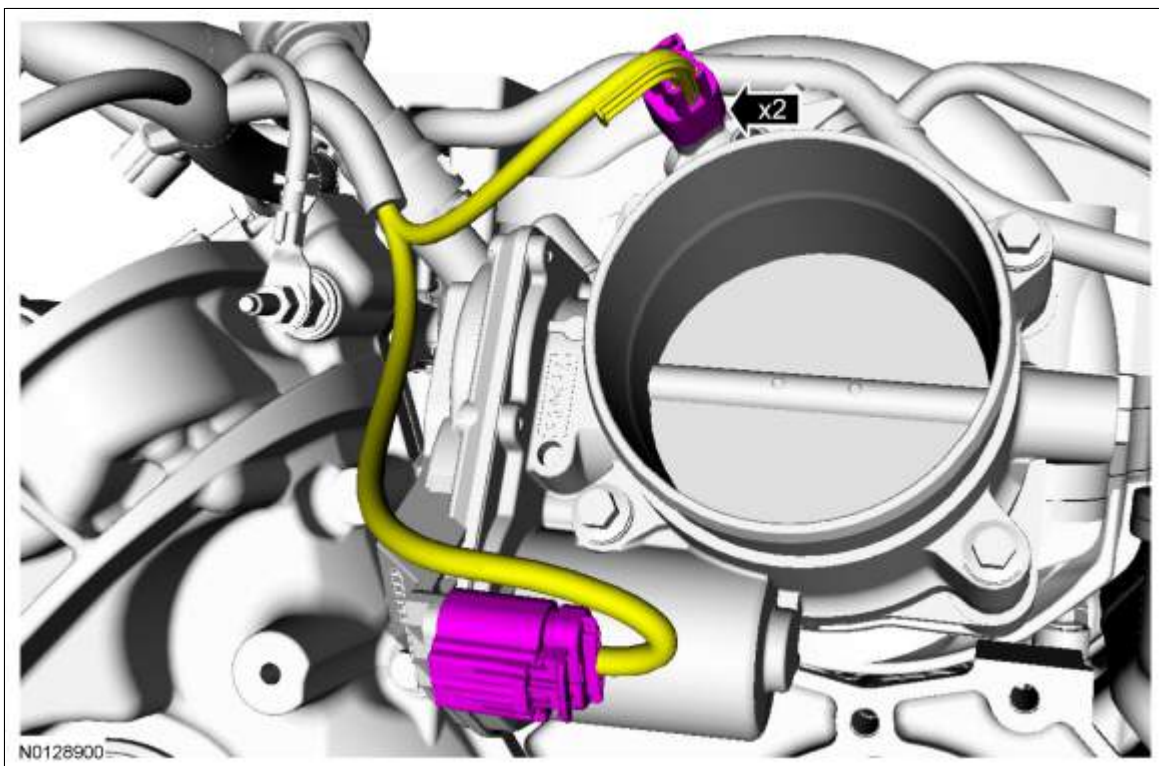
12. Remove the 4 bolts and the coolant pump pulley.



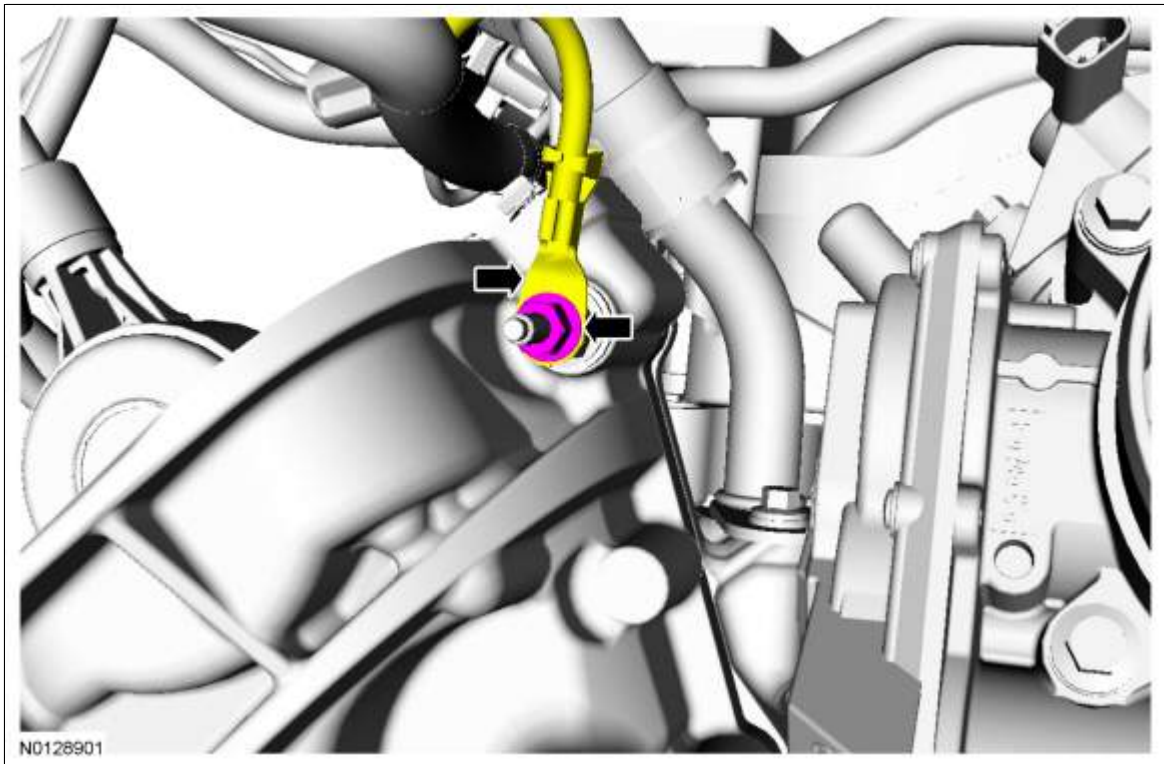
13. Remove the 4 bolts and the coolant pump.
- Remove and discard the O-ring seal.



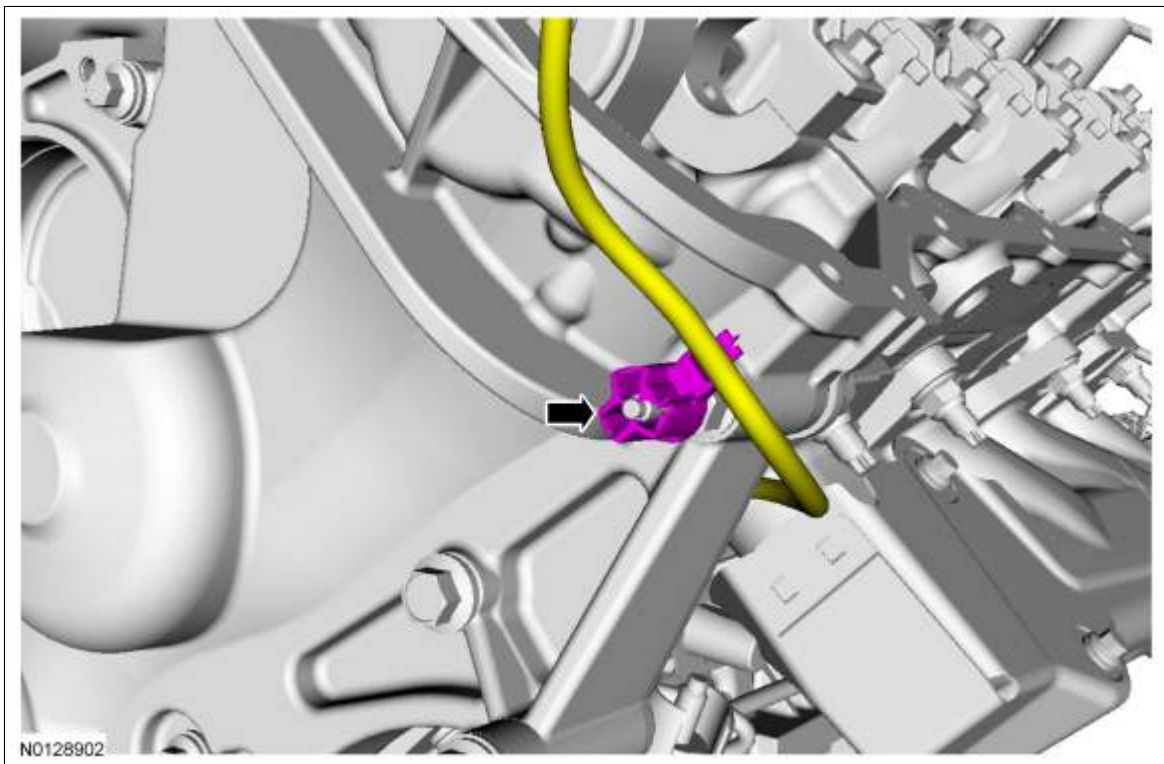
14. Disconnect the throttle body and Evaporative Emission (EVAP) purge valve electrical connectors.



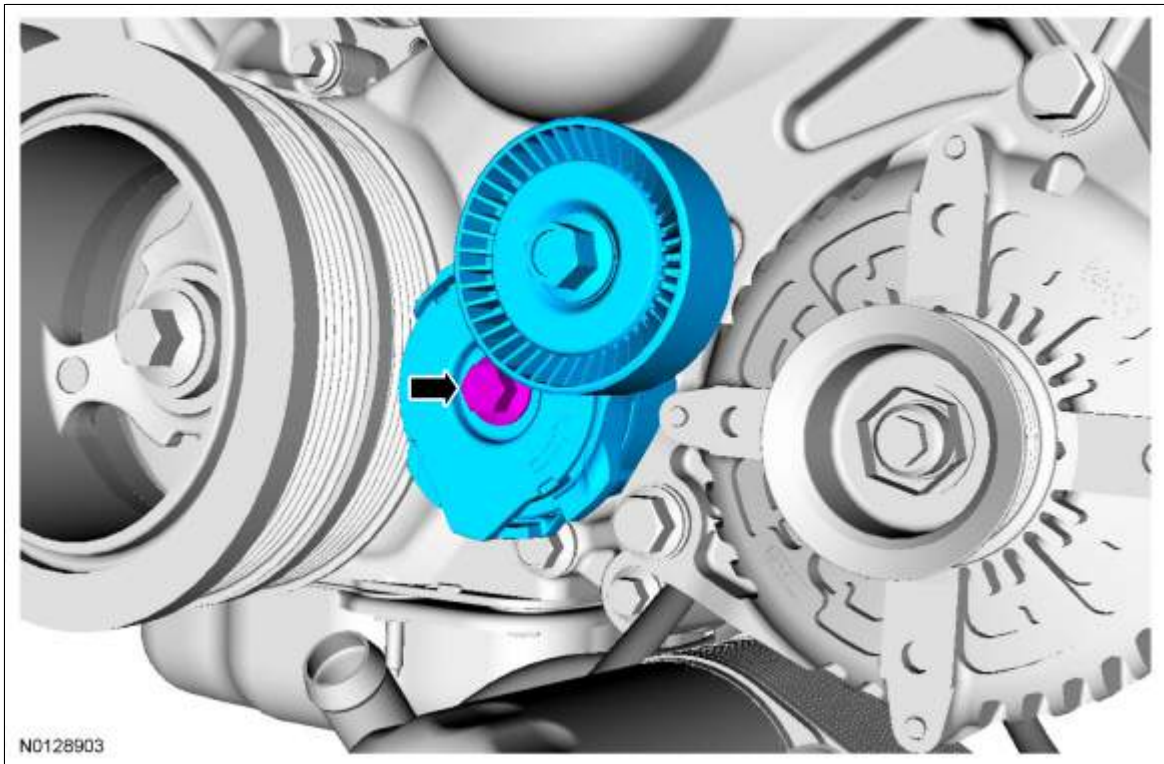
15. Remove the nut and the ground wire from the engine front cover stud bolt.



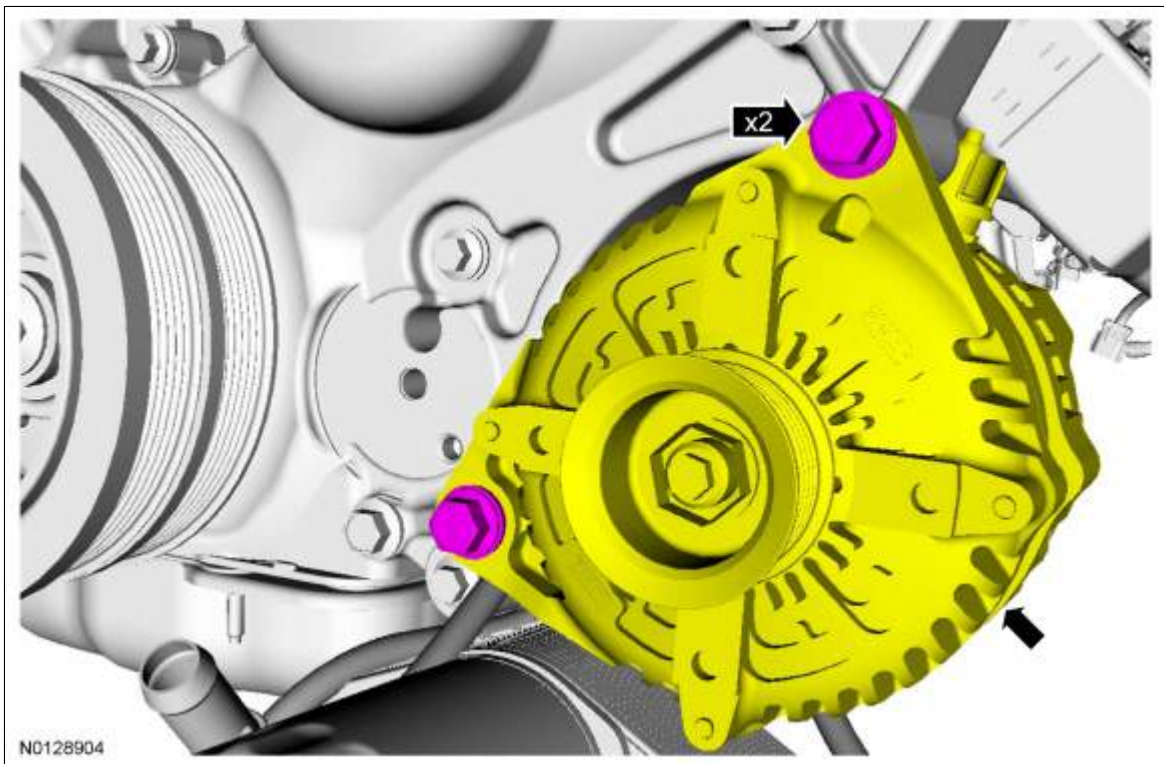
16. Detach the wiring harness retainer from the engine front cover stud bolt.



17. Remove the bolt and the accessory drive belt tensioner.



18. Remove the 2 bolts and position the generator aside.



19. Remove the crankshaft pulley bolt and washer.



20. Using the 3 Jaw Puller and the crankshaft pulley bolt, remove the crankshaft pulley.
- Discard the crankshaft pulley bolt.

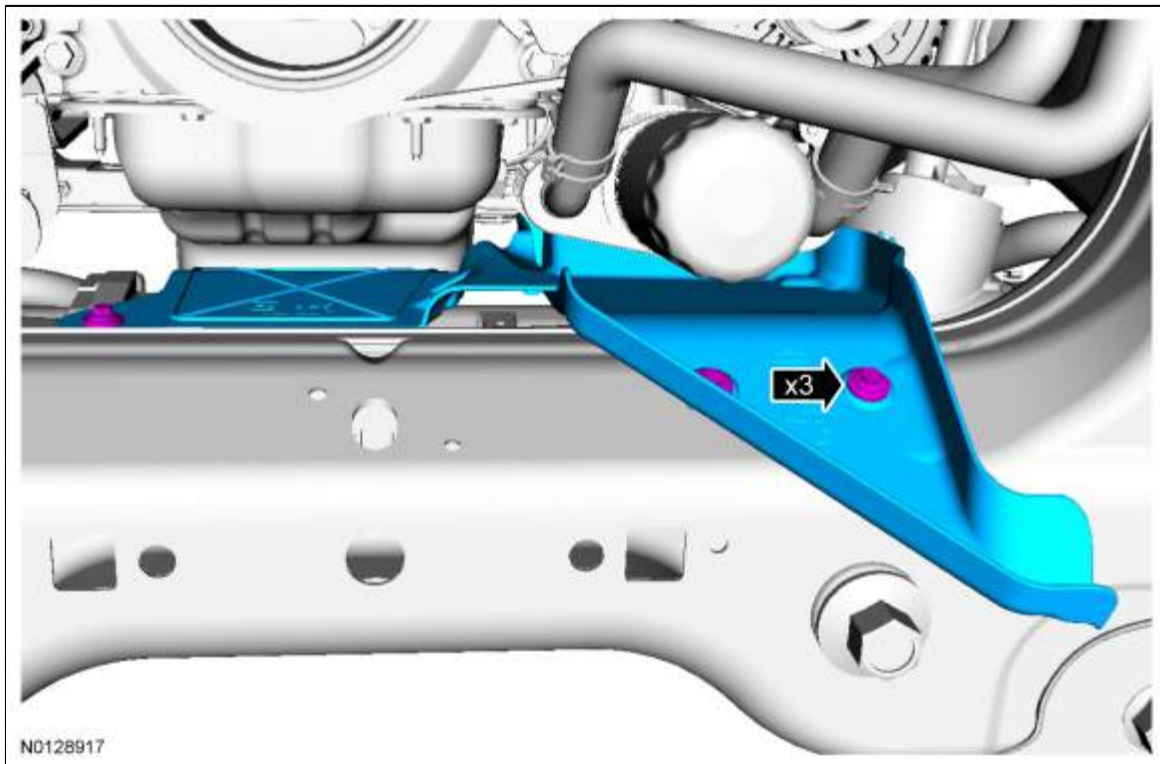


21. **NOTICE:** Use care not to damage the engine front cover or the crankshaft when removing the seal.

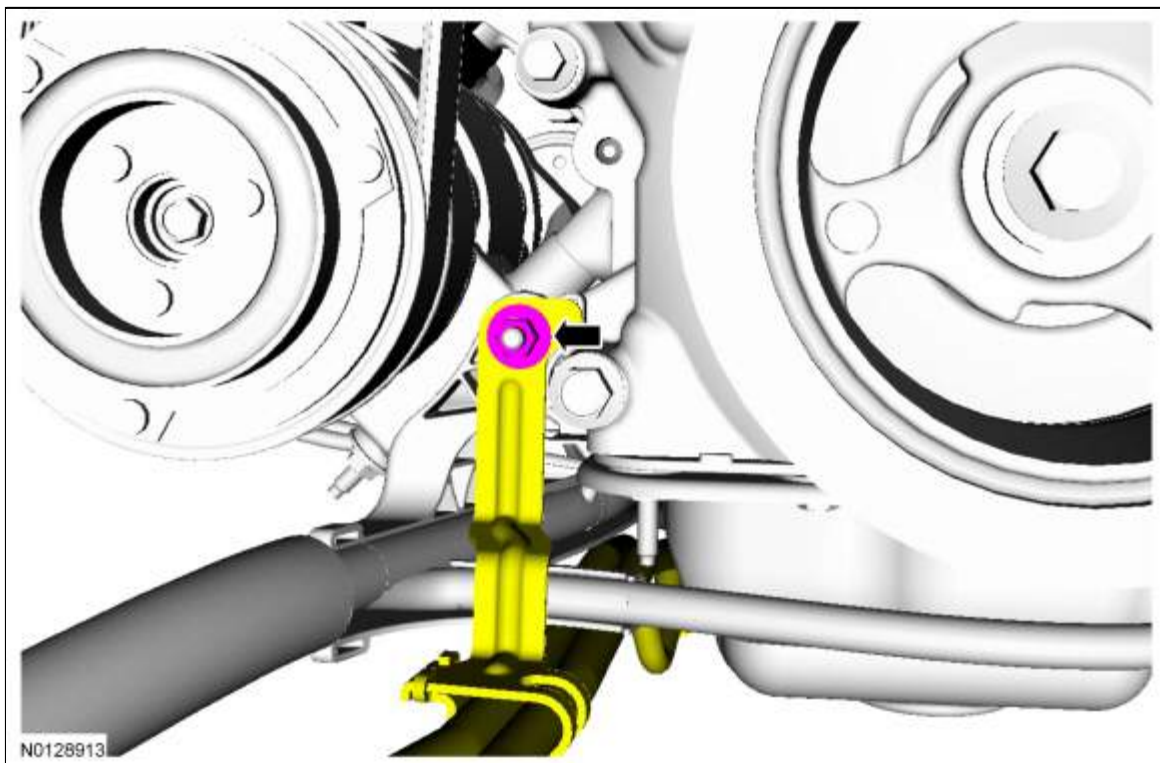
Using the Oil Seal Remover, remove the crankshaft front oil seal.



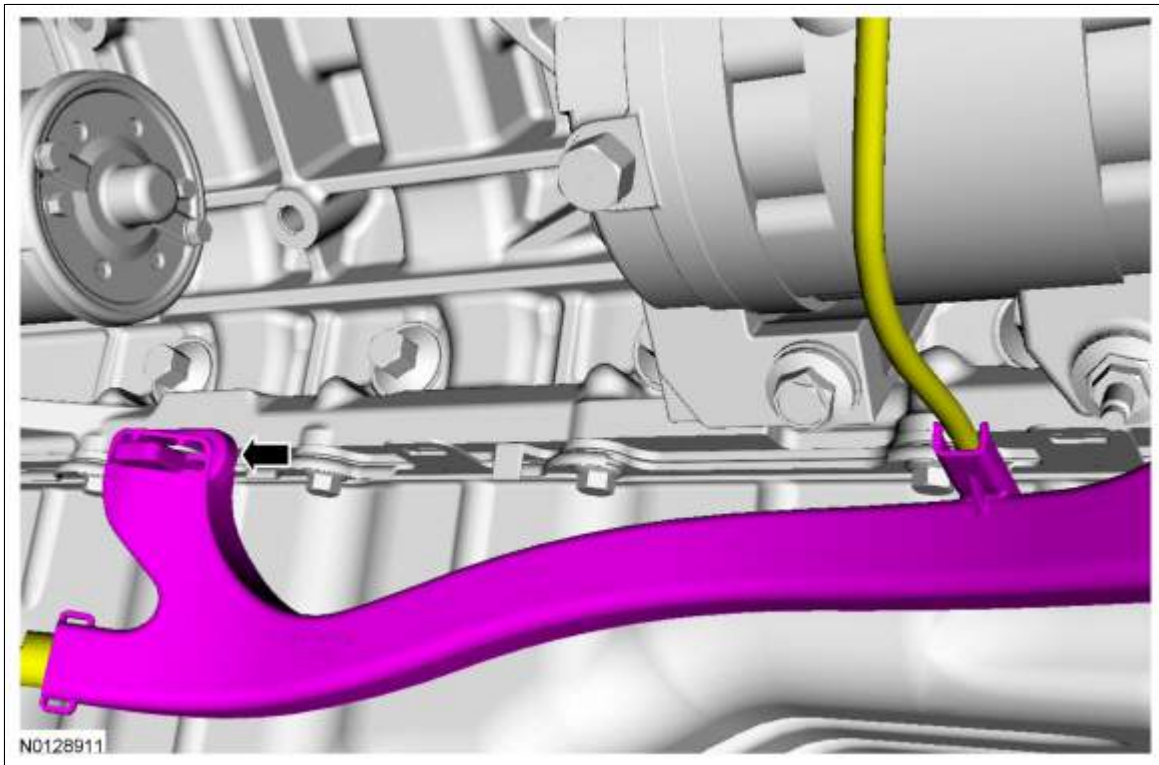
22. Remove the 4 bolts and the skid plate.
23. Remove the 3 bolts and the oil drain gutter.



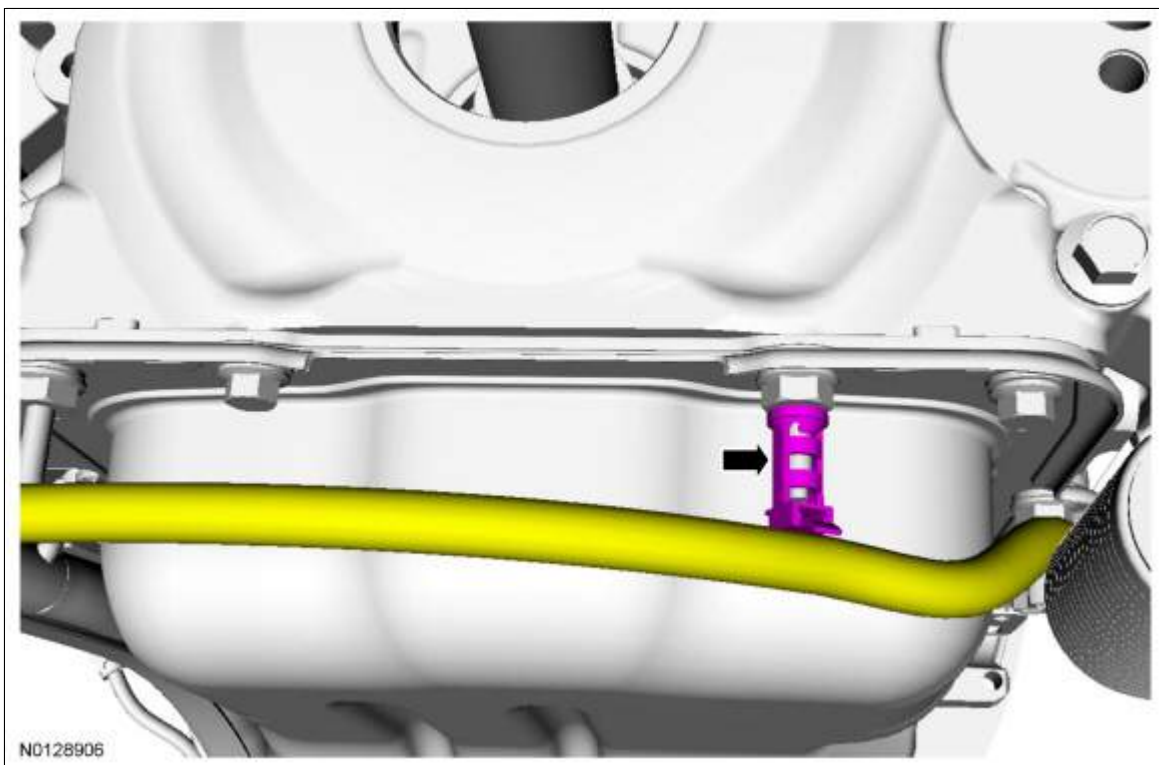
24. Remove the nut and the transmission cooler tube bracket from the engine front cover stud bolt.



25. Detach the starter motor wiring harness retainer from the oil pan.

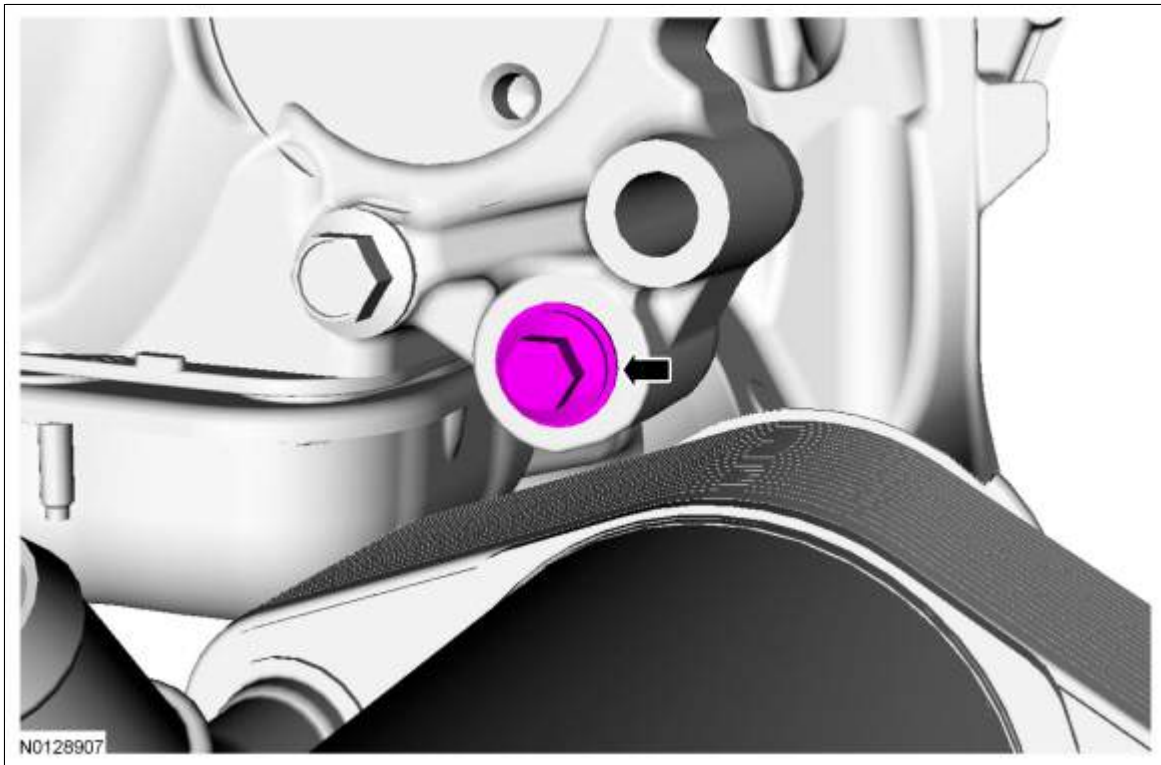


26. Detach the wiring harness retainer from the oil pan stud bolt.



27. Remove the 2 front oil pan stud bolts and 2 front oil pan bolts.

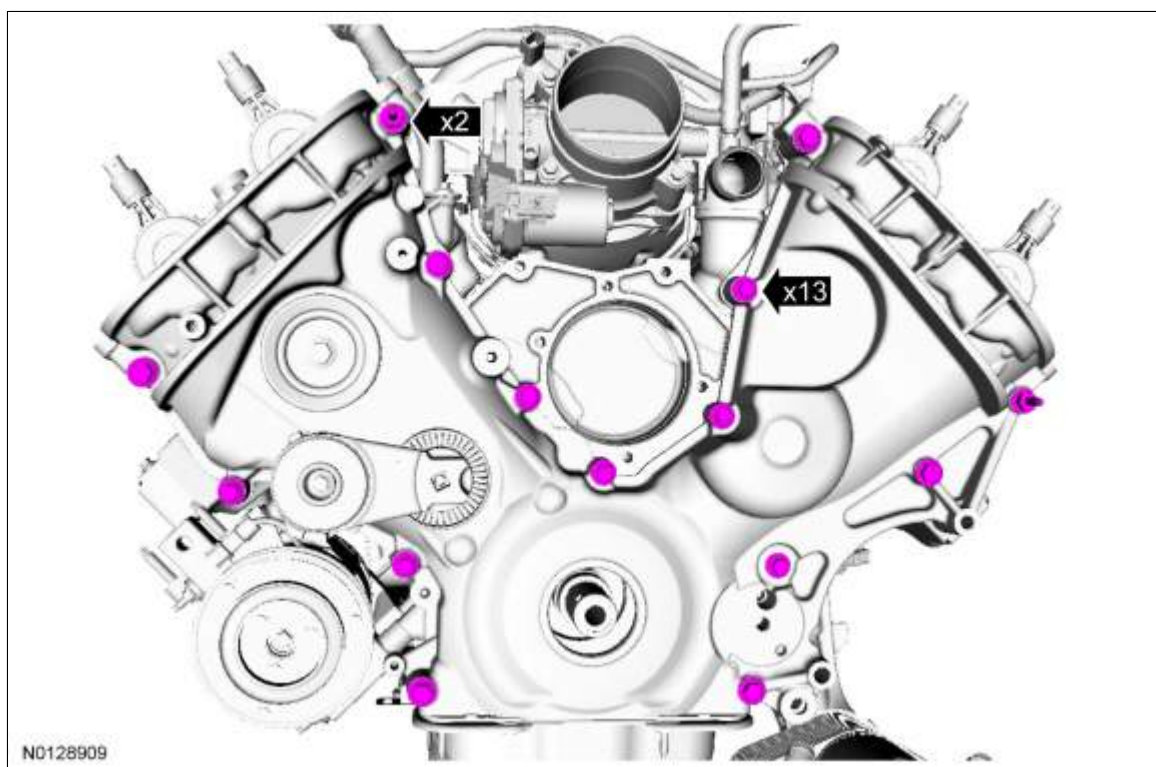
28. Remove the engine front cover-to-oil filter adapter bolt.



29. Using a 10 mm (0.393 in) Hex Bit loosen the engine front cover-to-oil filter adapter jack screw.



30. Remove the 13 engine front cover bolts and the 2 stud bolts.



31. **NOTICE:** 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.

Remove the engine front cover.

- Remove and discard the engine front cover gaskets.
- Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the mating surfaces.



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

Installation

1. **NOTICE:** The Variable Camshaft Timing (VCT) variable force solenoid pins must be fully depressed to avoid interference with the VCT valve tips when installing the engine front cover. Failure to follow these instructions can result in damage to the engine.

NOTE: LH shown, RH similar.

Fully depress the VCT variable force solenoid pins.



2. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

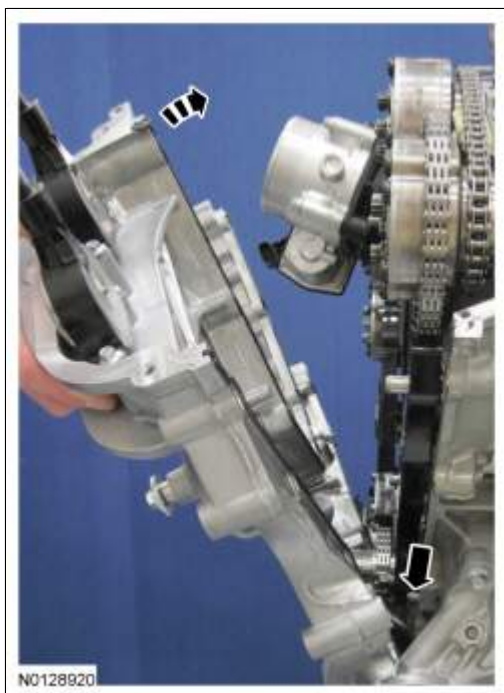
Apply a bead of silicone gasket and sealant to the cylinder head-to-cylinder block joints and the oil pan-to-cylinder block joints as illustrated.



3. **NOTE:** Make sure that the engine front cover gaskets are in place on the engine front cover before installation.

Using new gaskets, position the engine front cover onto the dowels.

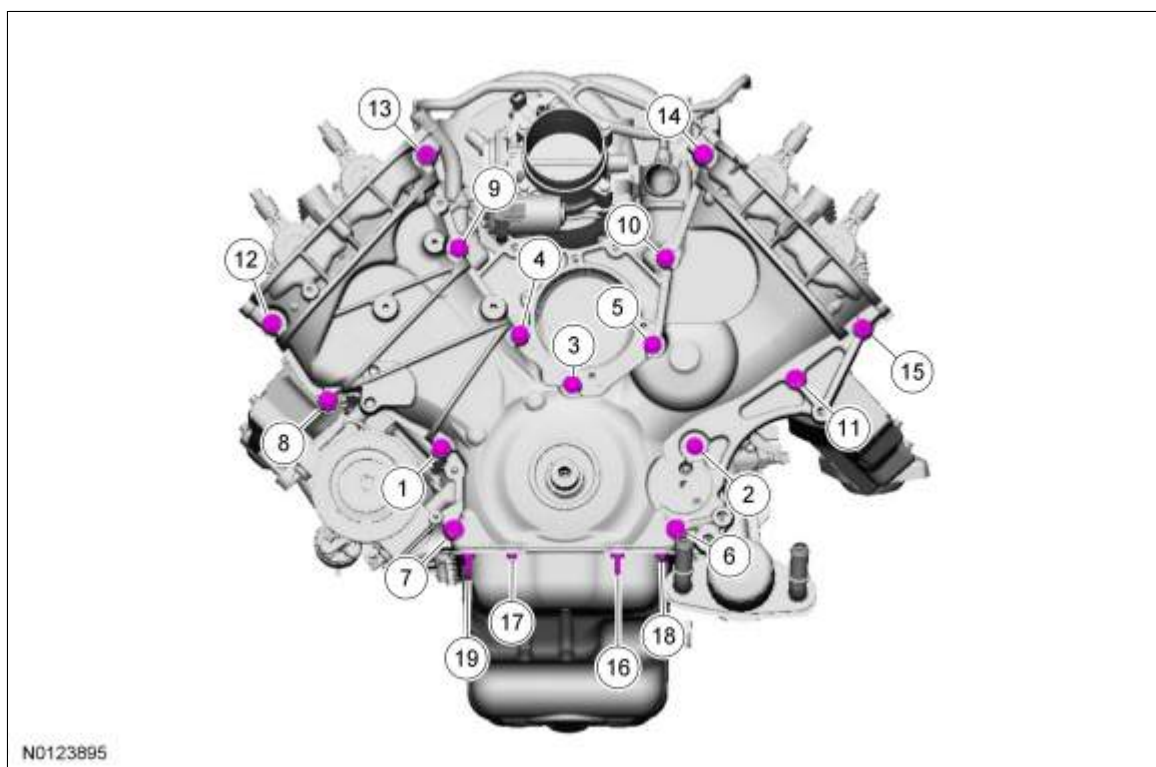
- Install the 13 engine front cover bolts, 2 stud bolts, the 2 oil pan-to-engine front cover bolts and the 2 oil pan-to-engine front cover stud bolts finger-tight.



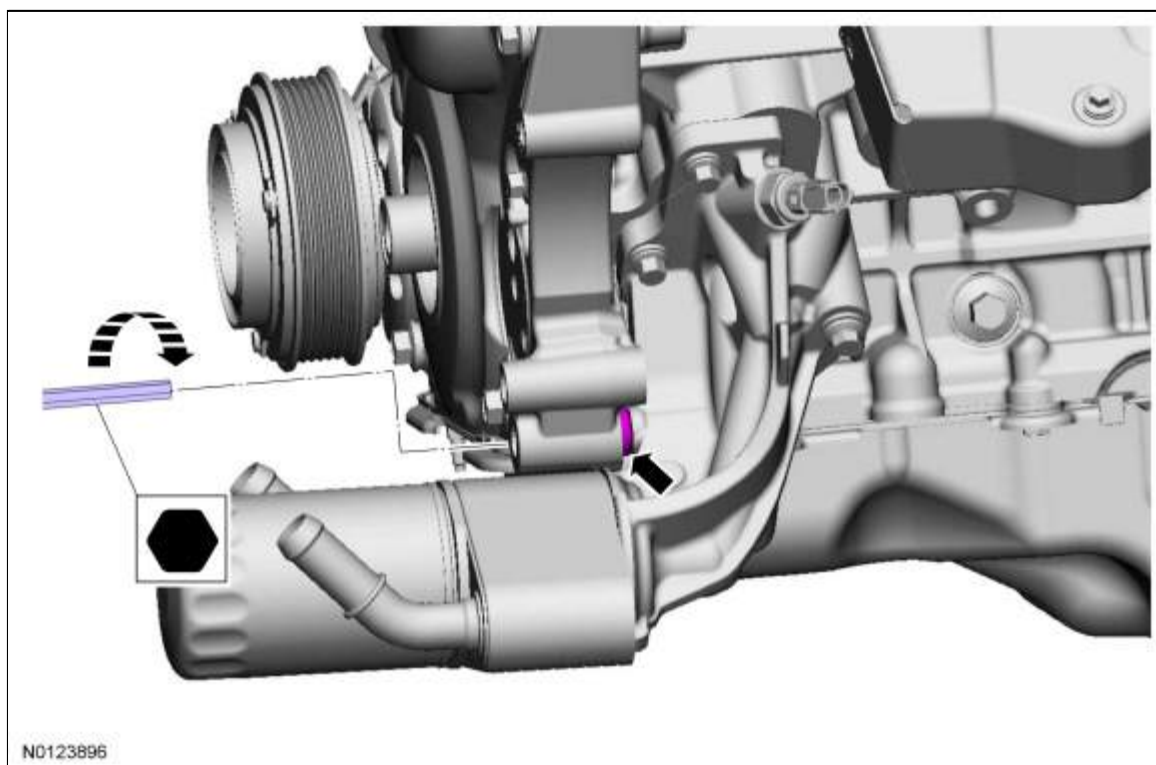
4. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

Tighten the bolts in the sequence shown in 2 stages.

- Stage 1: Tighten bolts 1-15 to 25 Nm (18 lb-ft) and bolts 16-19 to 10 Nm (89 lb-in).
- Stage 2: Tighten bolts 1-15 an additional 60 degrees and bolts 16-19 an additional 45 degrees.



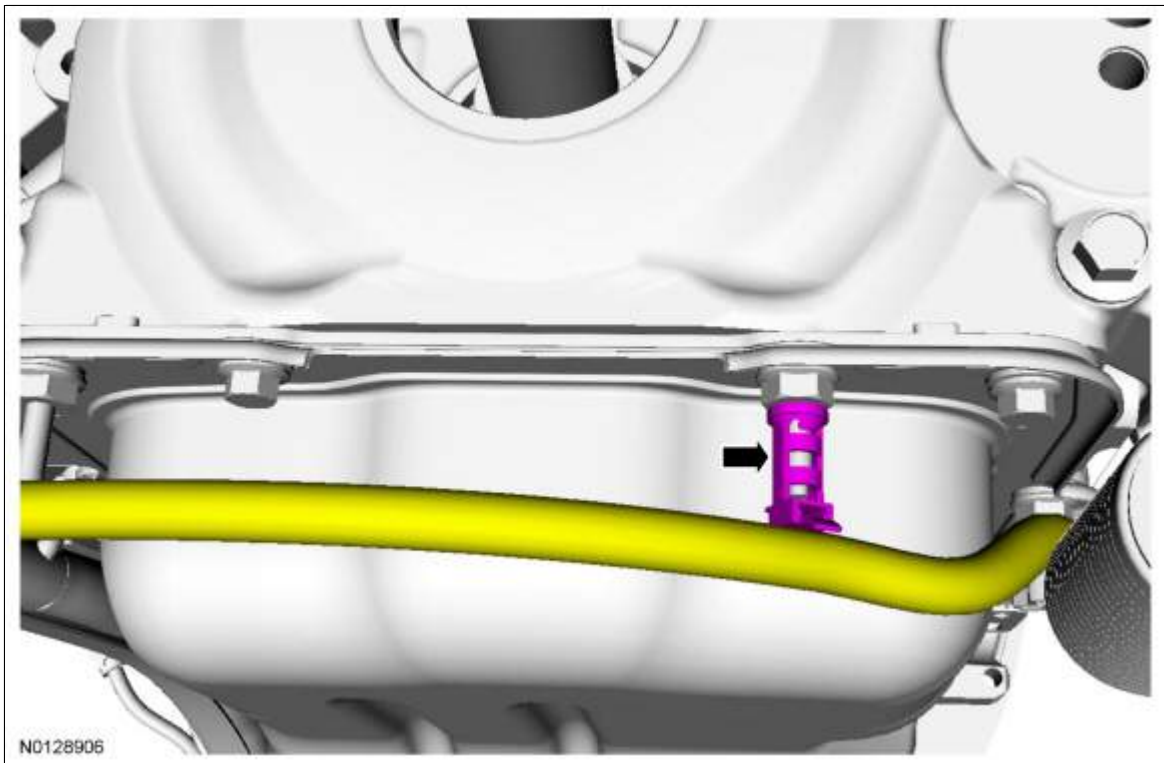
5. Using a 10 mm Hex Bit, rotate the engine front cover jackscrew into contact with the oil filter adapter to 5 Nm (44 lb-in).



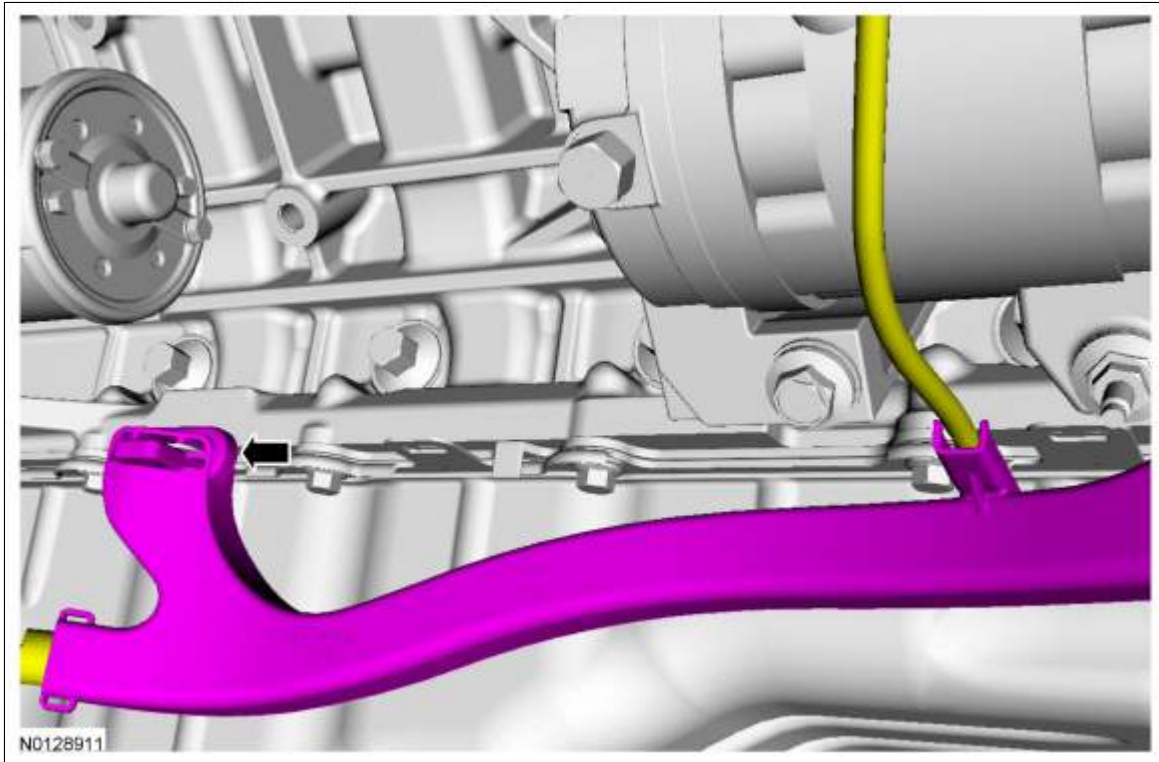
6. Install the engine front cover-to-oil filter adapter bolt and tighten to 25 Nm (18 lb-ft) plus an additional 60 degrees.



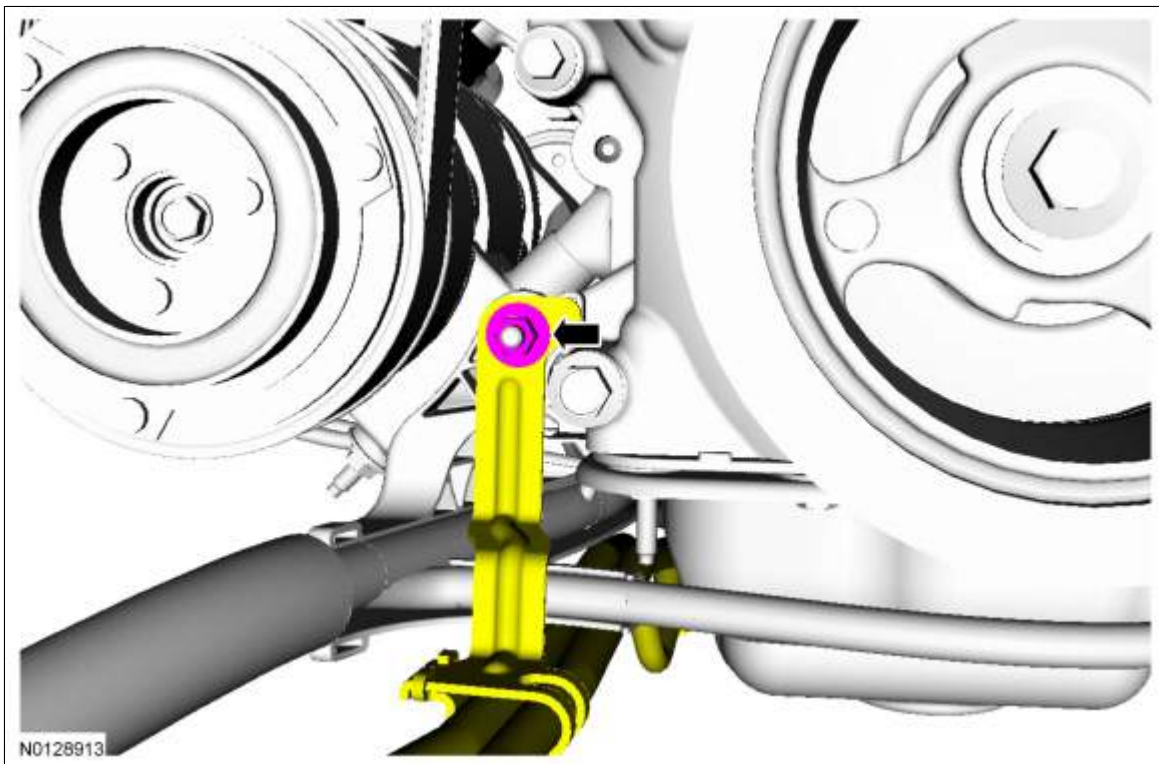
7. Position the wiring harness and install the wiring harness retainer to the oil pan stud bolt.



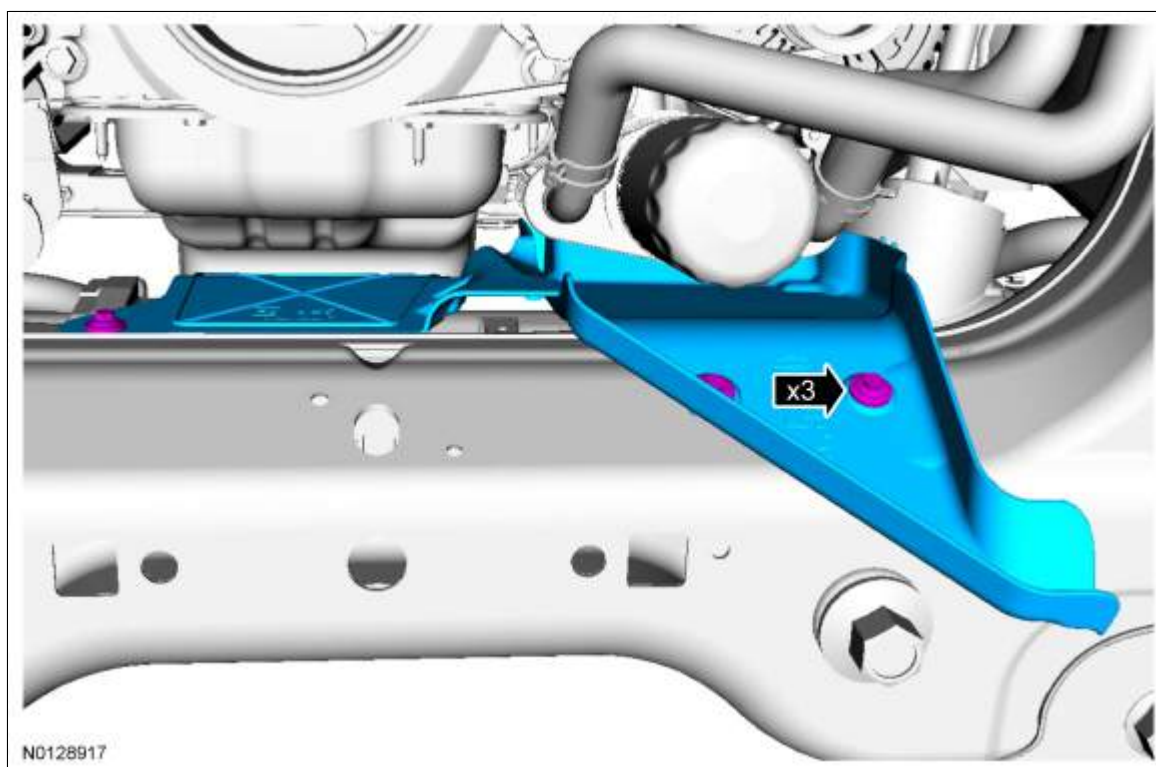
8. Attach the starter motor wiring harness retainer to the oil pan.



9. Install the transmission cooler line bracket and the nut to the engine front cover stud bolt.
- Tighten to 13 Nm (115 lb-in).

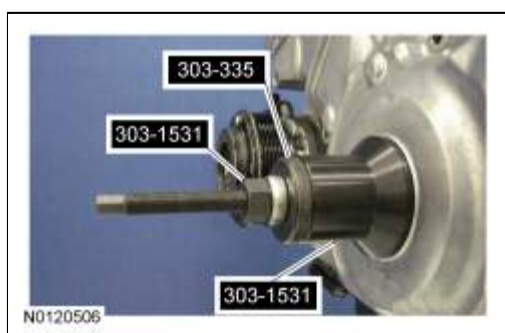


10. Install the oil drain gutter and the 3 bolts.
- Tighten to 10 Nm (89 lb-in).



11. Install the skid plate and the 4 bolts.
 - Tighten to 48 Nm (35 lb-ft).
12. **NOTE:** Lubricate the engine front cover bore and the crankshaft front oil seal inner lip with clean engine oil.

Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft front oil seal.



13. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

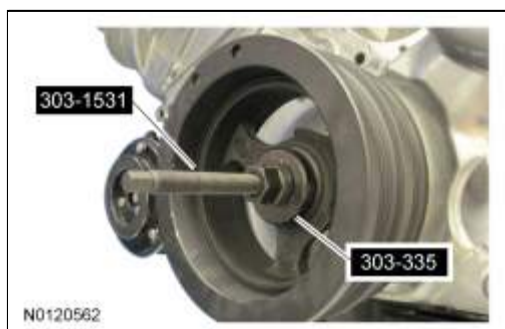
Apply silicone gasket and sealant to the Woodruff key slot in the crankshaft pulley.



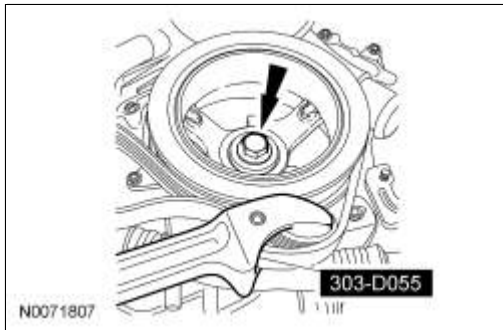
14. Lubricate the crankshaft pulley sealing surface with clean engine oil prior to installation.



15. Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft pulley.



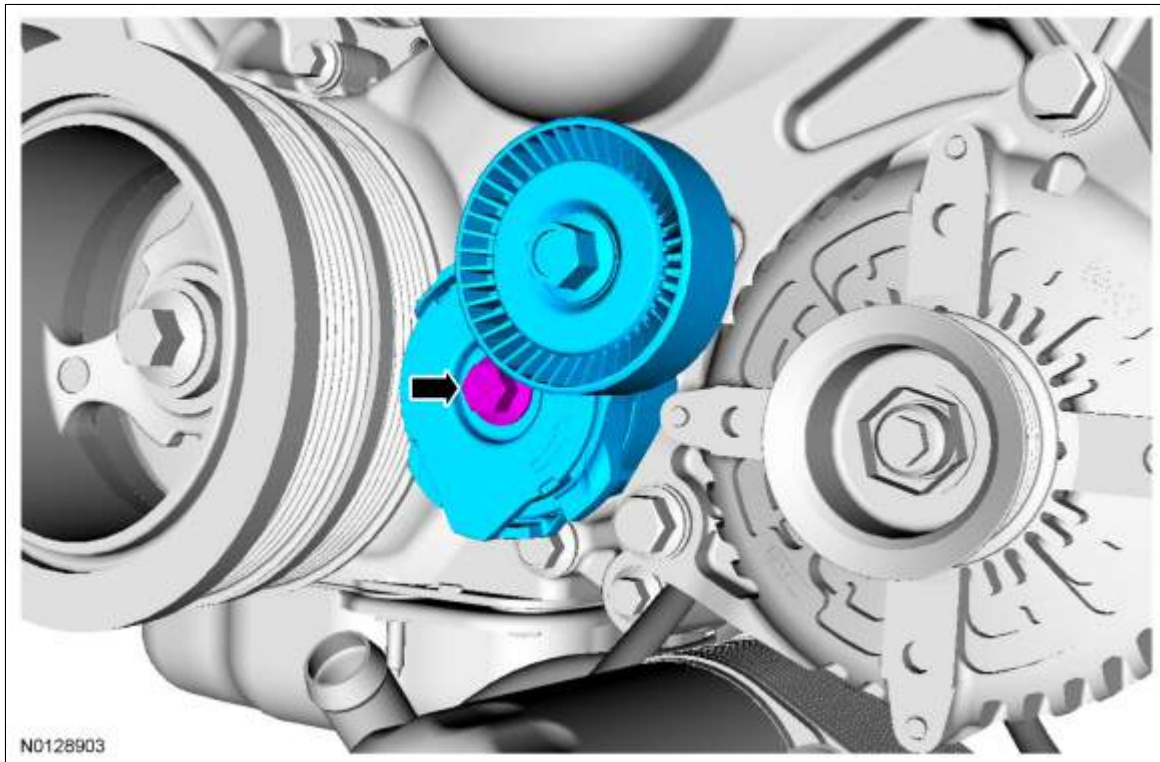
16. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 4 stages:
- Stage 1: Tighten to 140 Nm (103 lb-ft).
 - Stage 2: Loosen 360 degrees.
 - Stage 3: Tighten to 100 Nm (74 lb-ft).
 - Stage 4: Tighten an additional 90 degrees.



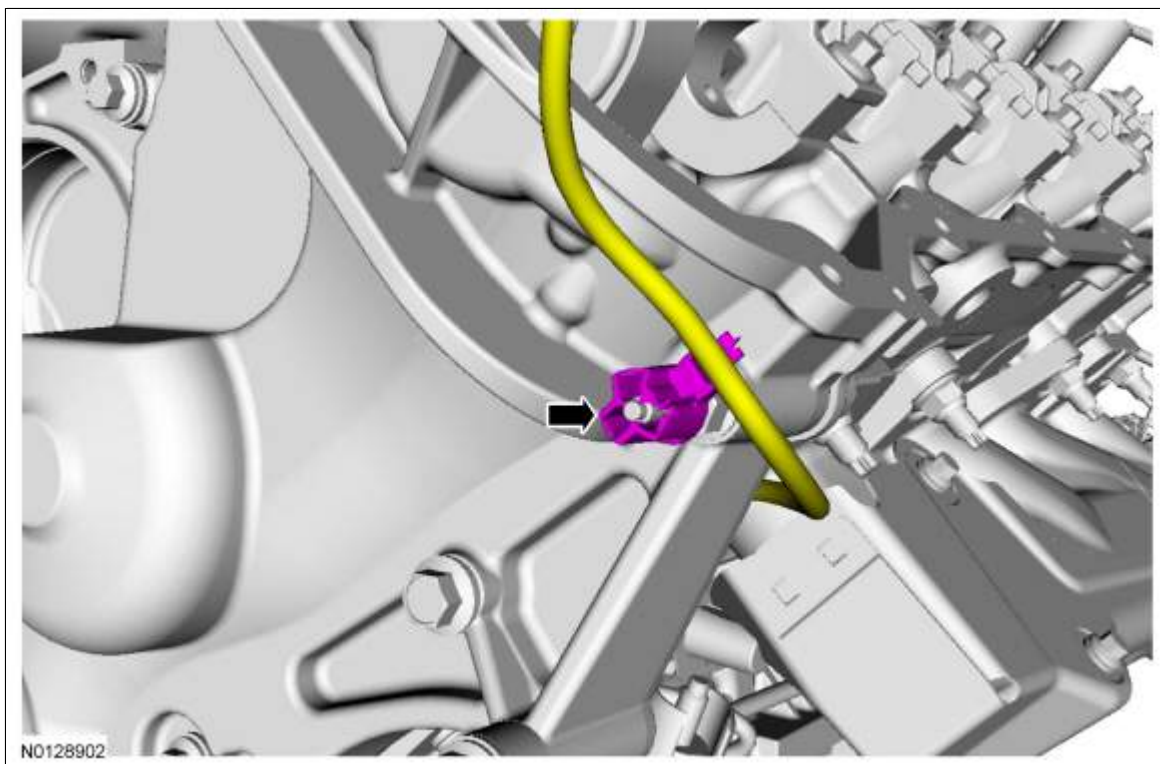
17. Install the generator and the 2 bolts.
 - Tighten to 48 Nm (35 lb-ft).



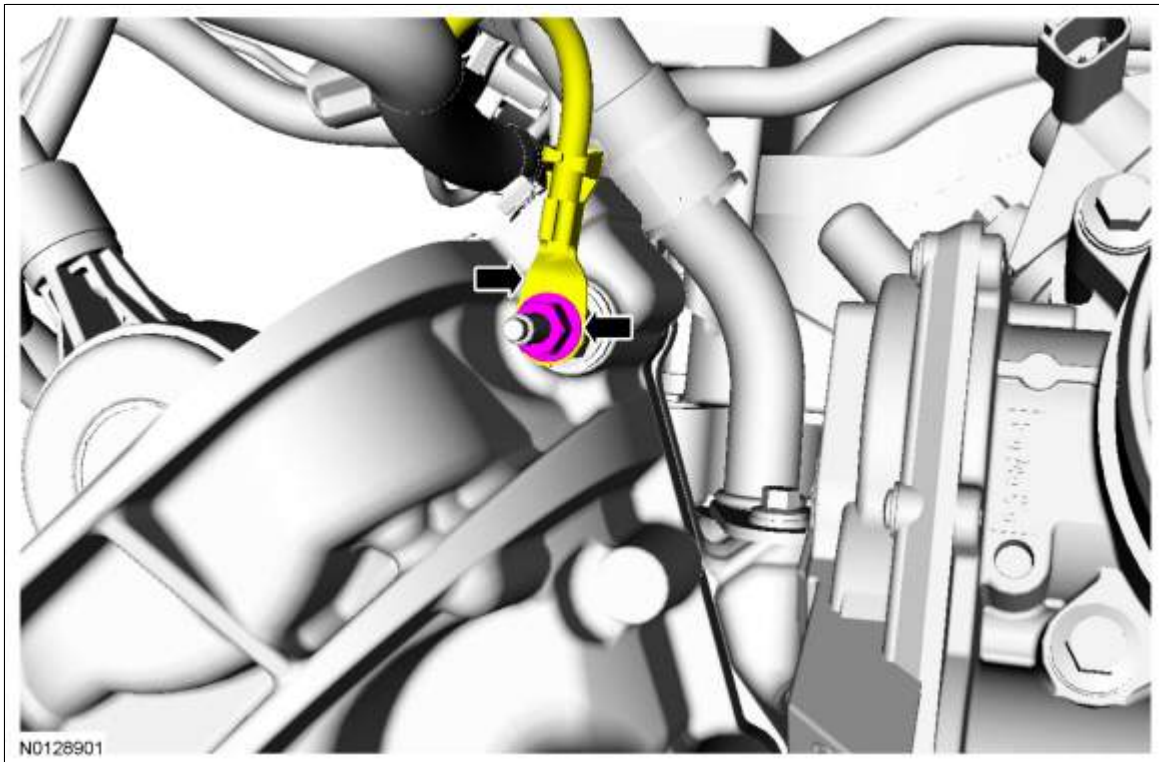
18. Install the accessory drive belt tensioner and bolt.
 - Tighten to 48 Nm (35 lb-ft).



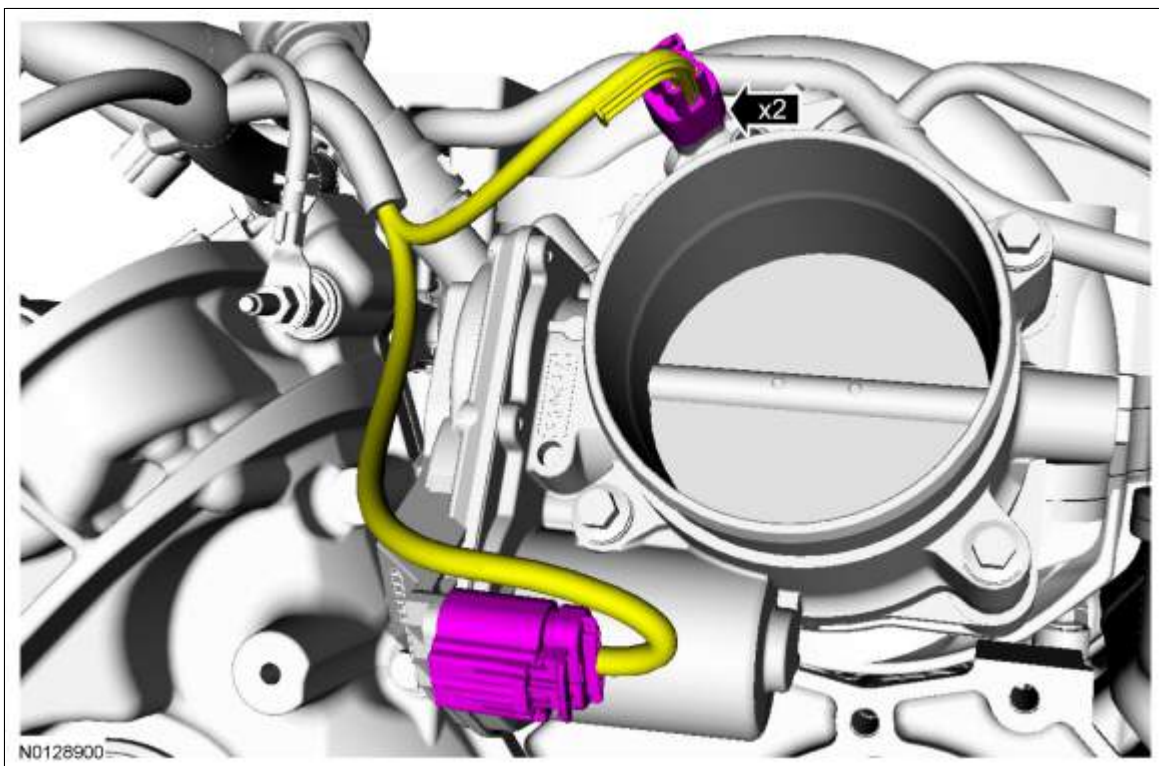
19. Attach the wiring harness retainer to the engine front cover stud bolt.



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



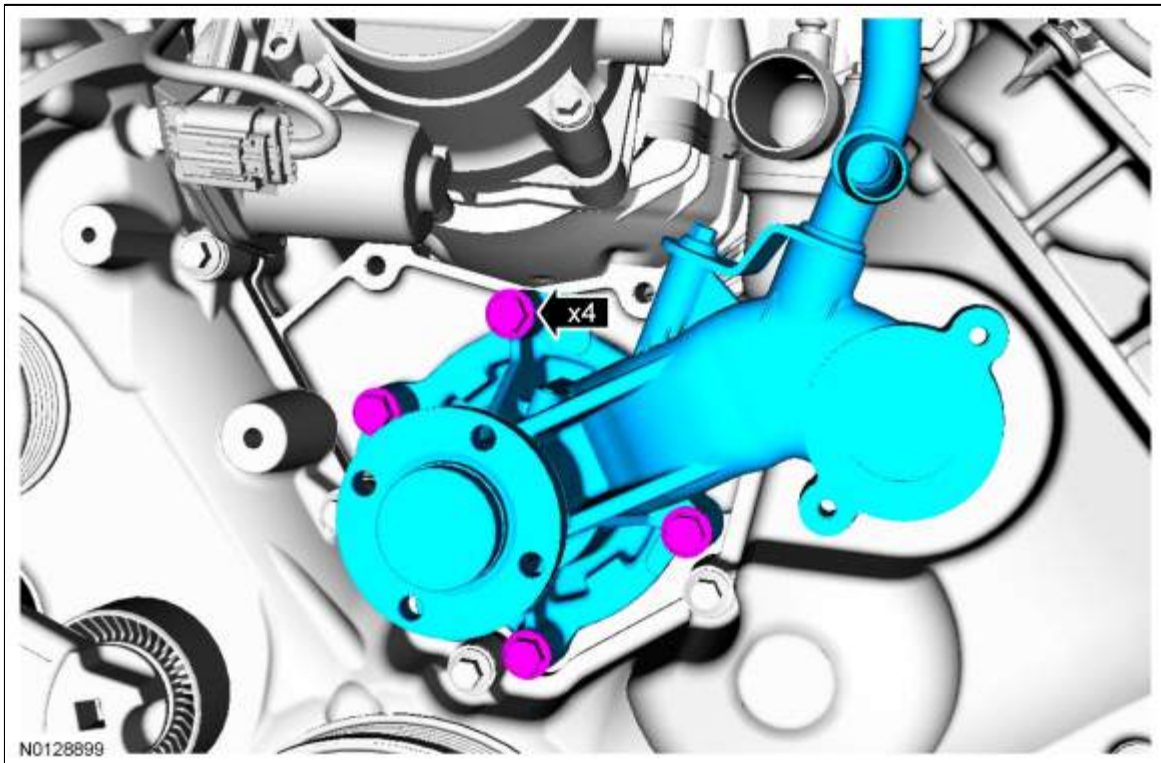
21. Connect the throttle body and EVAP purge valve electrical connectors.



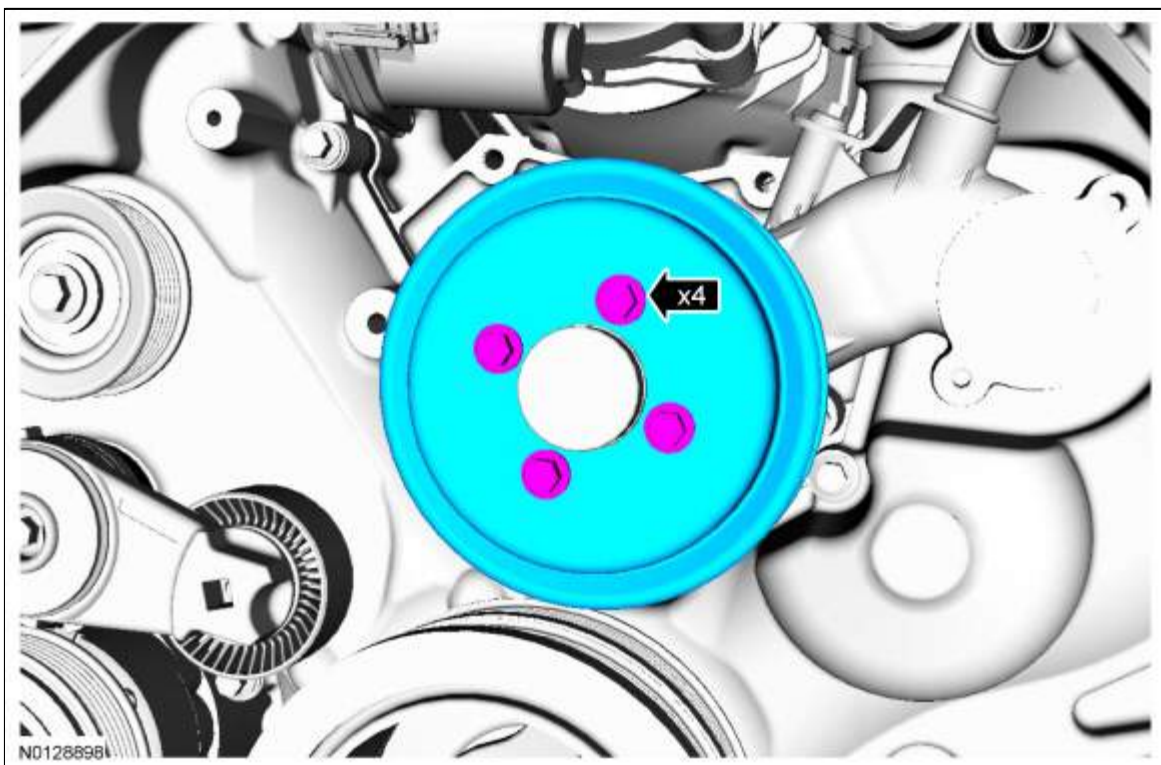
22. **NOTE:** Lubricate the new coolant pump O-ring seal with clean engine coolant.

Using a new O-ring seal, install the coolant pump and the 4 bolts.

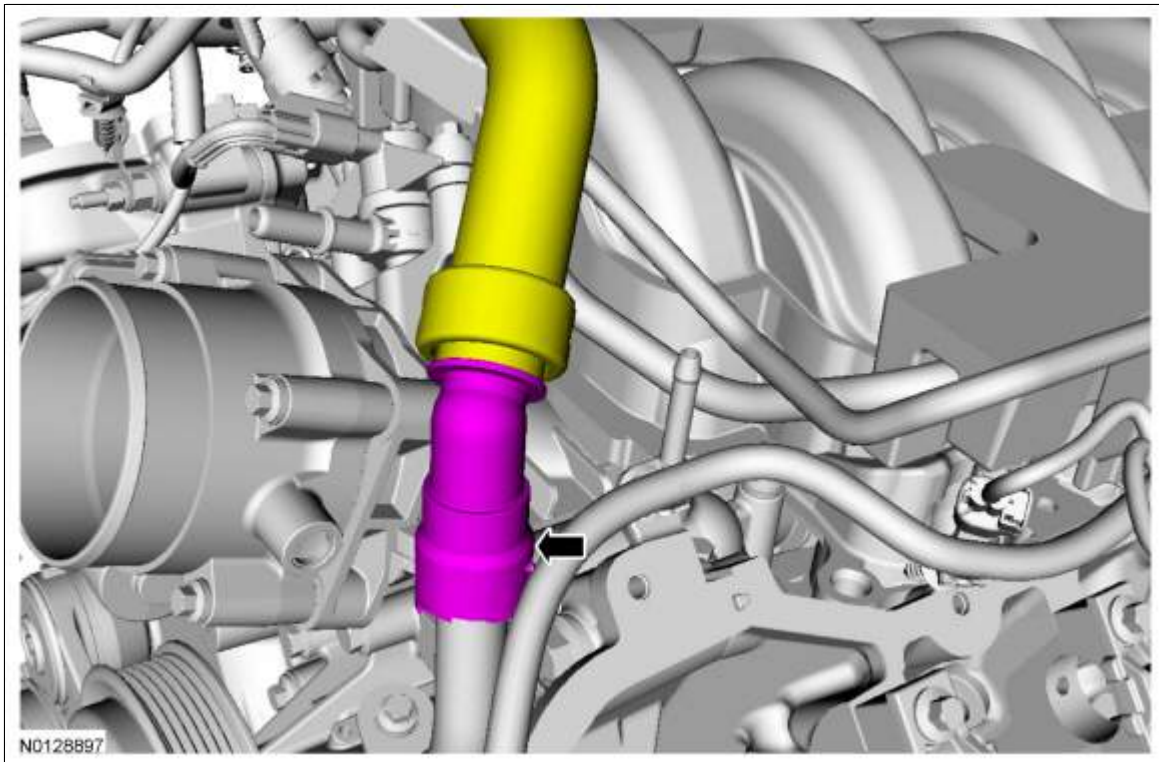
- Tighten to 20 Nm (177 lb-in) plus an additional 60 degrees.



23. Install the coolant pump pulley and the 4 bolts.

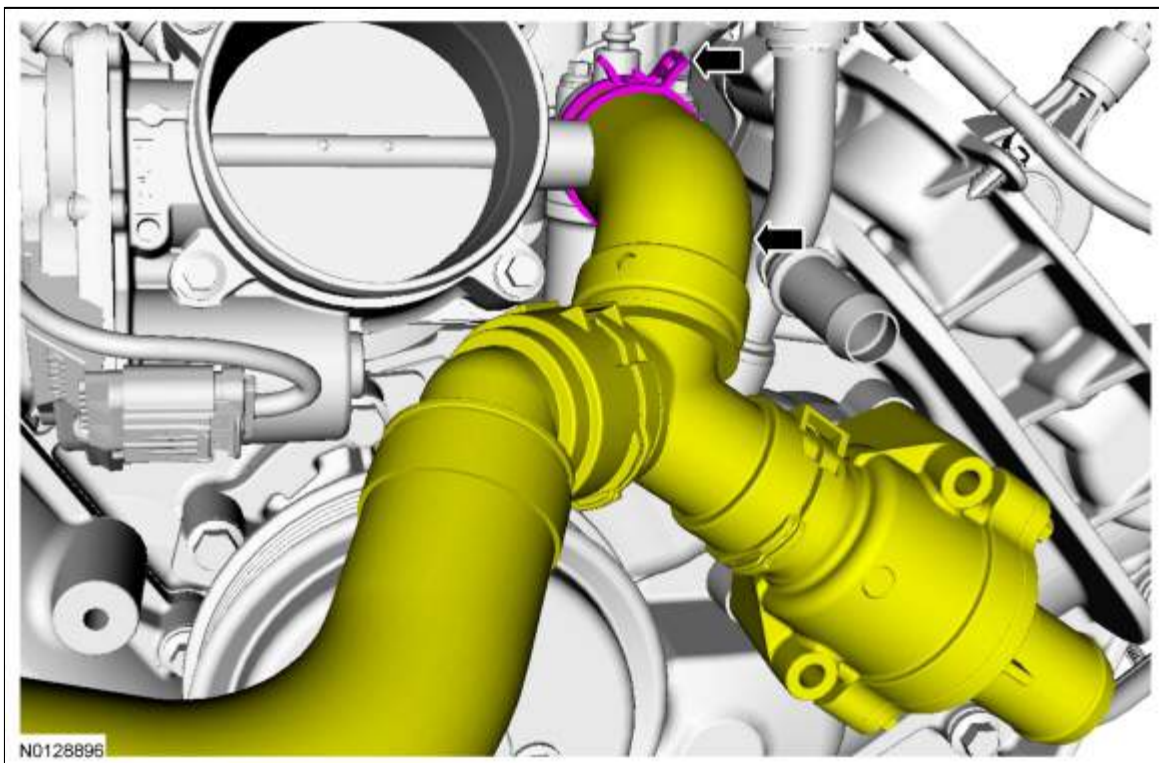


24. Connect the heater hose.

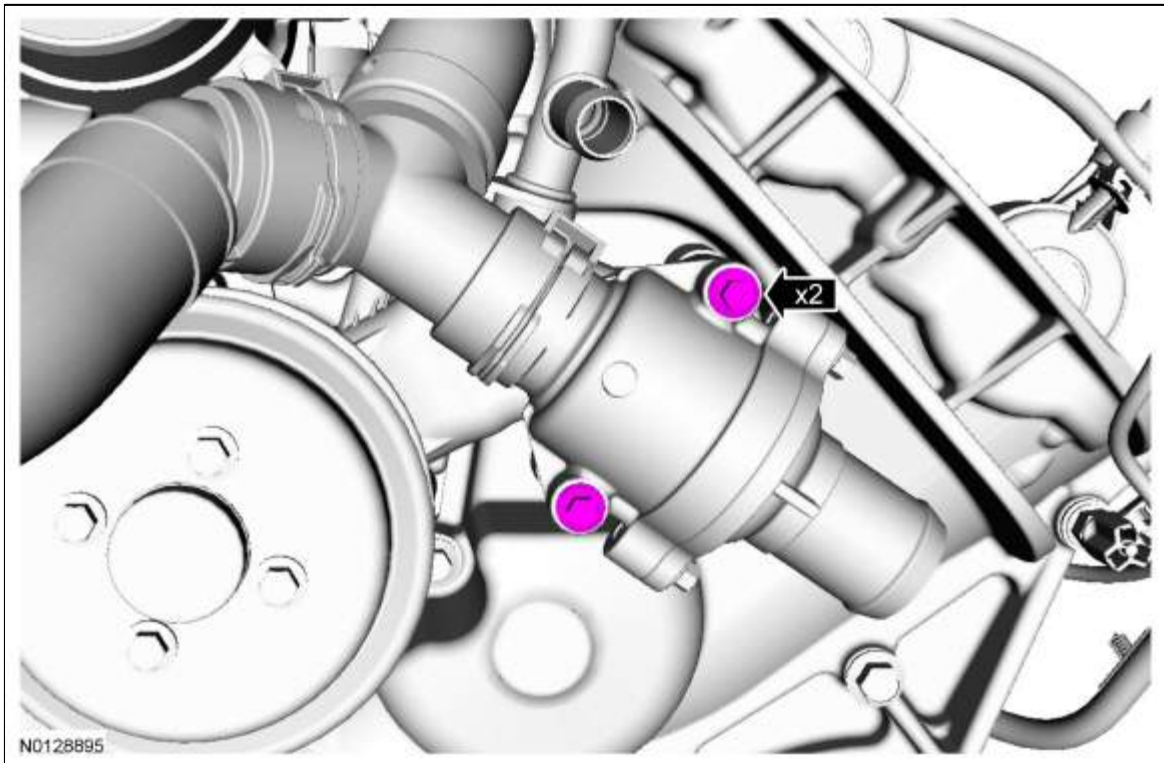


25. **NOTE:** Lubricate the new thermostat housing O-ring seal with clean engine coolant.

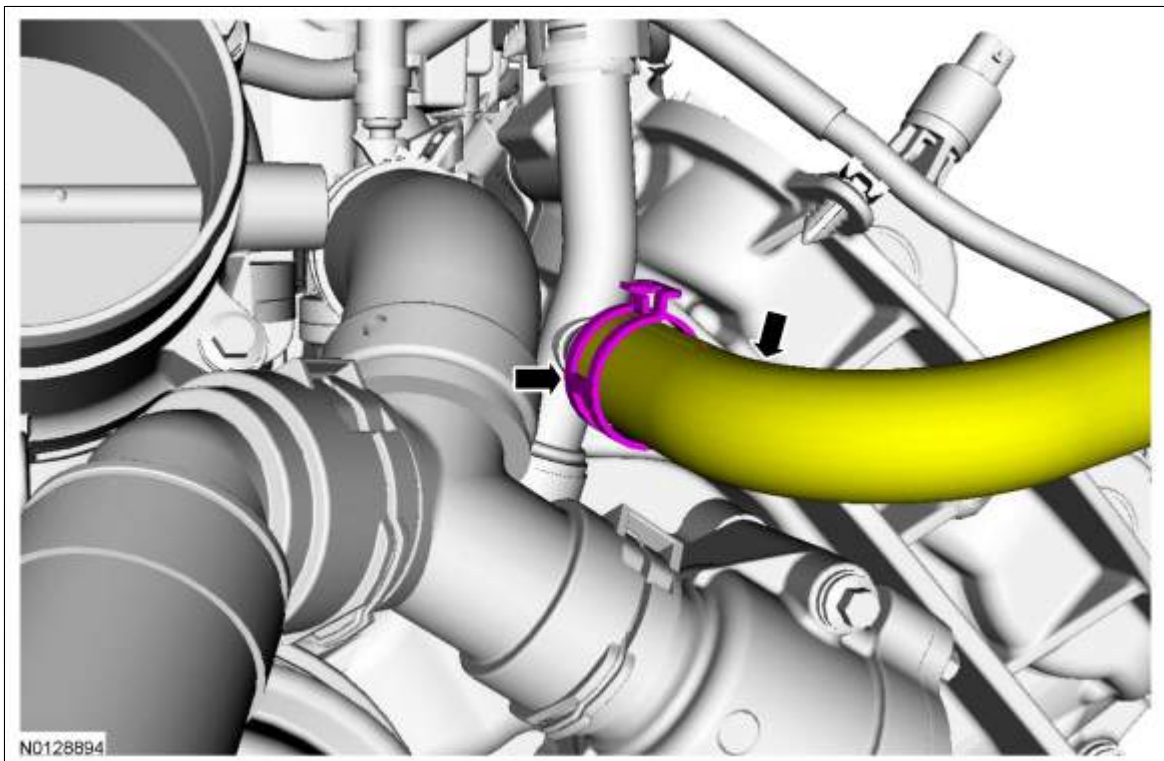
Using a new thermostat housing O-ring seal, install the upper radiator hose T-connector/thermostat housing assembly and clamp.



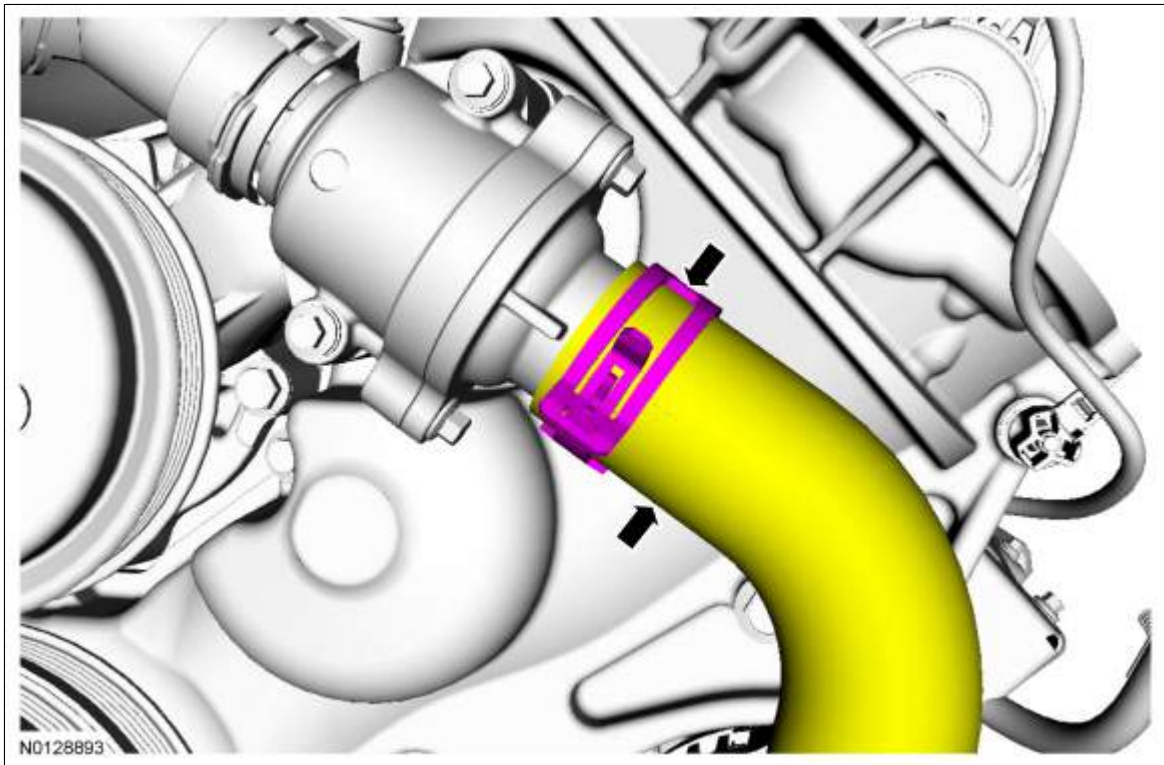
26. Install the 2 thermostat housing bolts.
- Tighten to 10 Nm (89 lb-in).



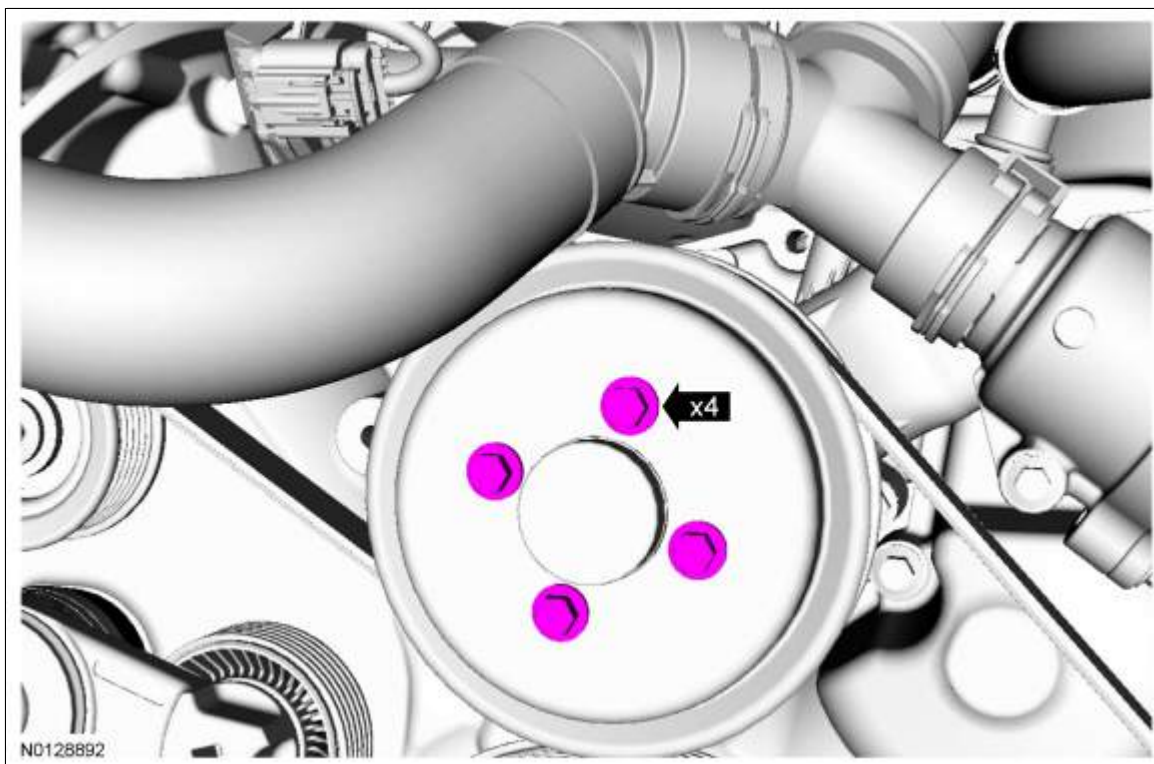
27. Connect the degas coolant hose and clamp.



28. Connect the lower radiator hose and clamp to the thermostat housing assembly.



29. Install the accessory drive and A/C compressor belts. For additional information, refer to [Section 303-05](#).
30. Tighten the 4 coolant pump pulley bolts to 25 Nm (18 lb-ft).



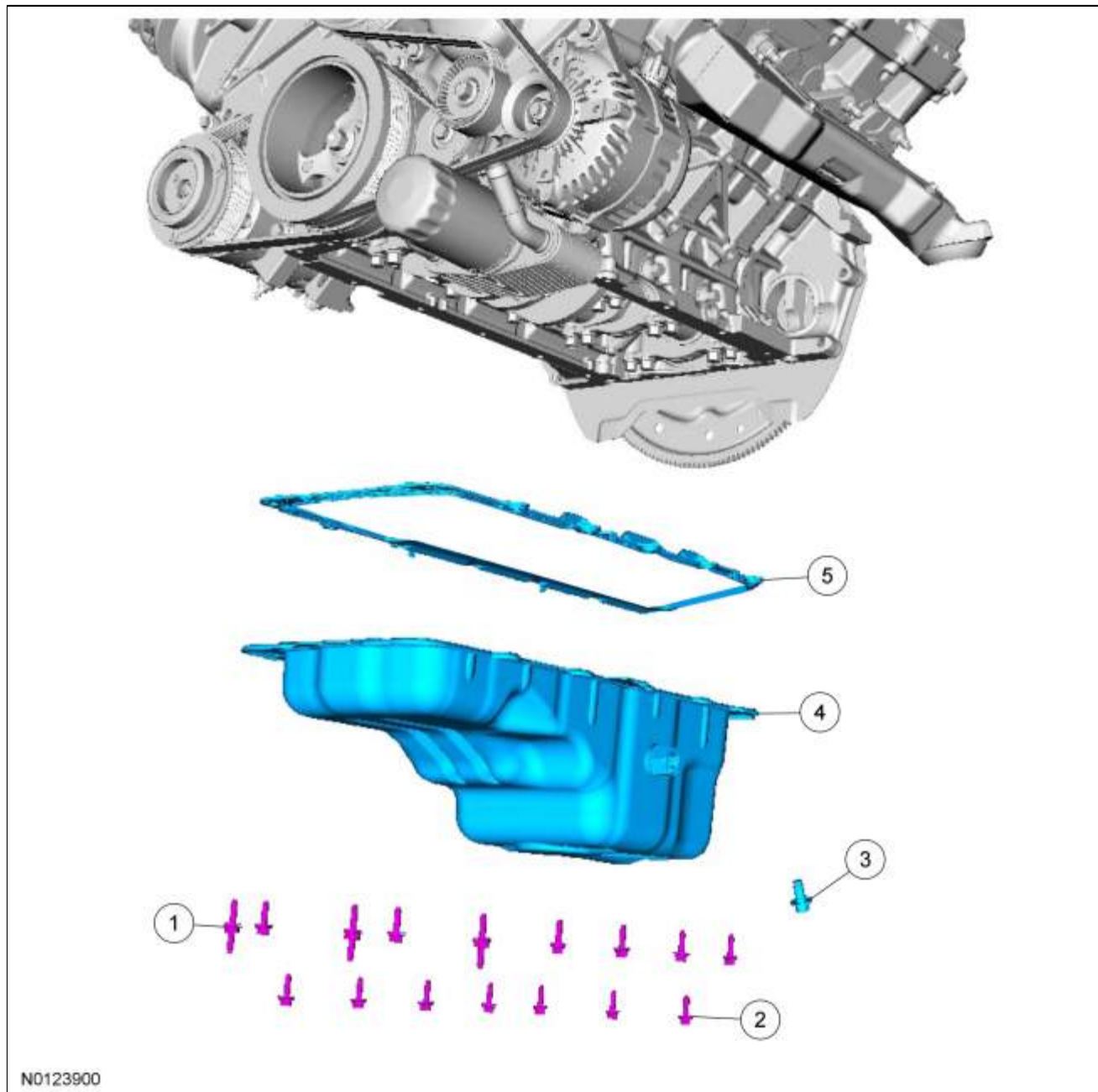
31. Install the RH and LH valve covers. For additional information, refer to [Valve Cover — RH](#) and [Valve Cover — LH](#) in this section.
 32. Fill the crankcase with clean engine oil.
 33. Connect the battery ground cable. For additional information, refer [Section 414-01](#).
 34. Fill and bleed the engine cooling system. For additional information, refer to [Section 303-03](#).
 35. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.
-

SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Engine Lubrication Components — Exploded View

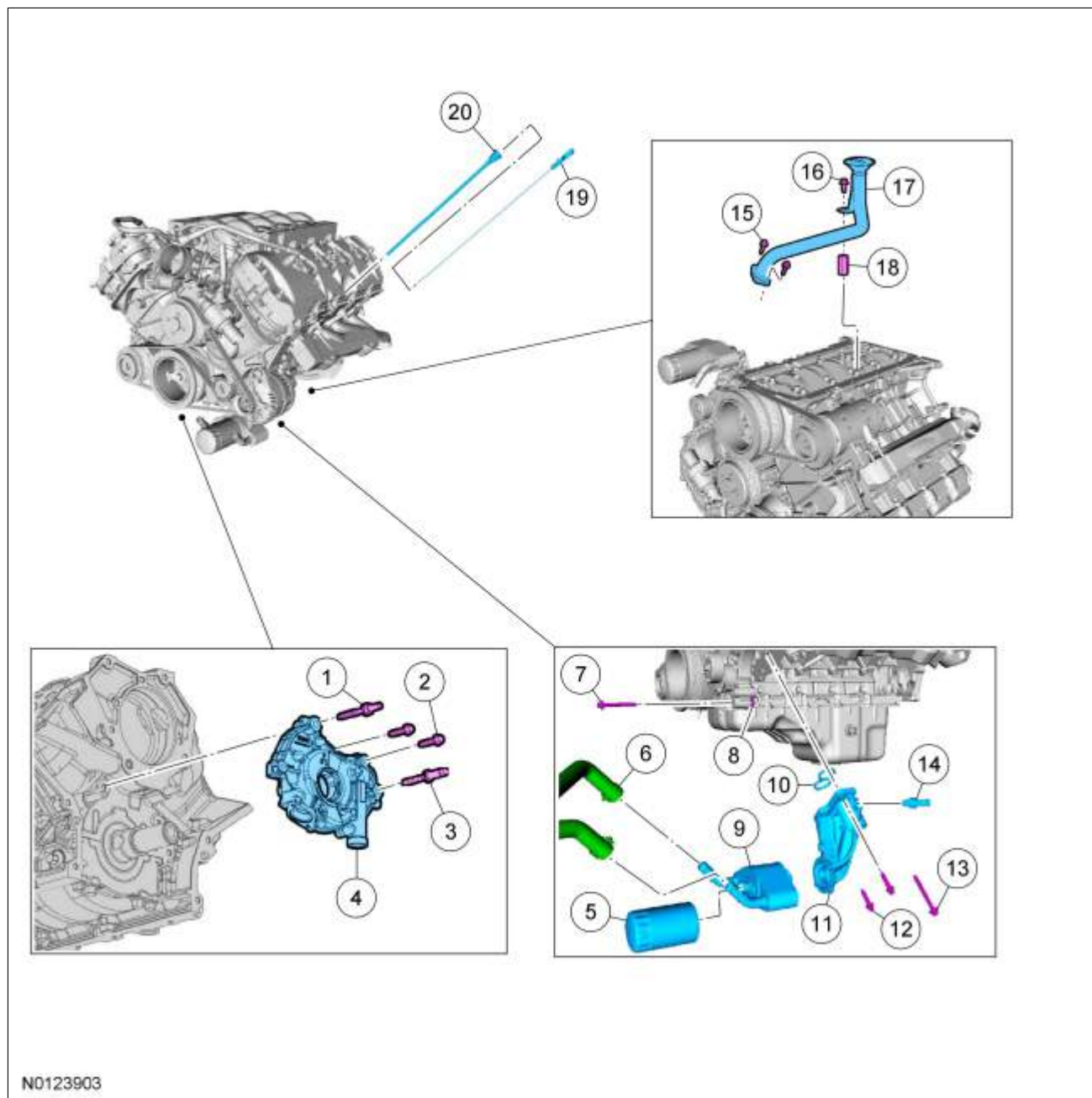
Oil Pan and Gasket



Item	Part Number	Description
1	W714963	Oil pan stud bolt (3 required)

2	W714962	Oil pan bolt (13 required)
3	—	Oil drain plug (part of 6675) - 26 Nm (19 lb-ft)
4	6675	Oil pan
5	6710	Oil pan gasket

Oil Pump, Oil Filter Adapter, Oil Pump Screen and Pickup Tube and Oil Level Indicator and Tube



Item	Part Number	Description
------	-------------	-------------

1	W714251	Oil pump stud bolt
2	N806183	Oil pump bolt (2 required)
3	W714252	Oil pump stud bolt
4	6600	Oil pump
5	6731	Oil filter
6	—	Coolant hoses (2 required)
7	W503304	Engine front cover-to-oil filter adapter bolt
8	W715209	Engine front cover-to-oil filter adapter jackscrew (part of 6019)
9	6A642	Oil cooler - 57 Nm (42 lb-ft)
10	6840	Oil filter adapter gasket
11	6881	Oil filter adapter
12	W714974	Oil filter adapter bolt (2 required)
13	W503306	Oil filter adapter bolt
14	9278	Engine Oil Pressure (EOP) switch
15	W714962	Oil pump screen and pickup tube bolt (2 required)
16	N605904	Oil pump screen and pickup tube bolt
17	6622	Oil pump screen and pickup tube
18	N806180	Oil pump screen and pickup tube spacer - 25 Nm (18 lb-ft)
19	6750	Oil indicator
20	6754	Oil indicator tube



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

SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

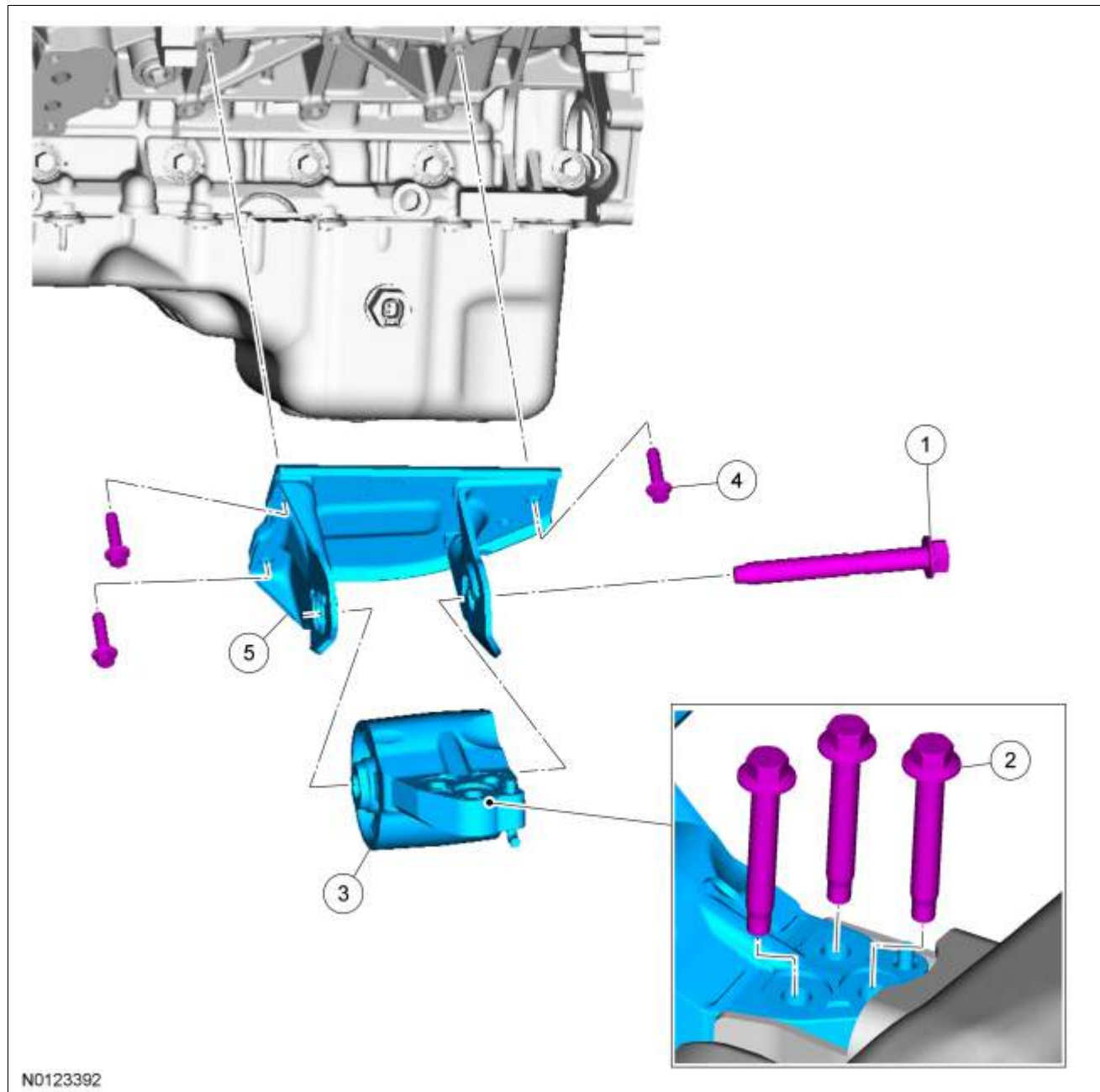
Engine Support Insulators — LH

Special Tool(s)

 ST1595-A	Lifting Bracket, Engine 303-050 (T70P-6000)
 ST2175-B	Support Bar, Engine 303-F070

Material

Item	Specification
Threadlock 262 TA-26	WSK-M2G351-A6



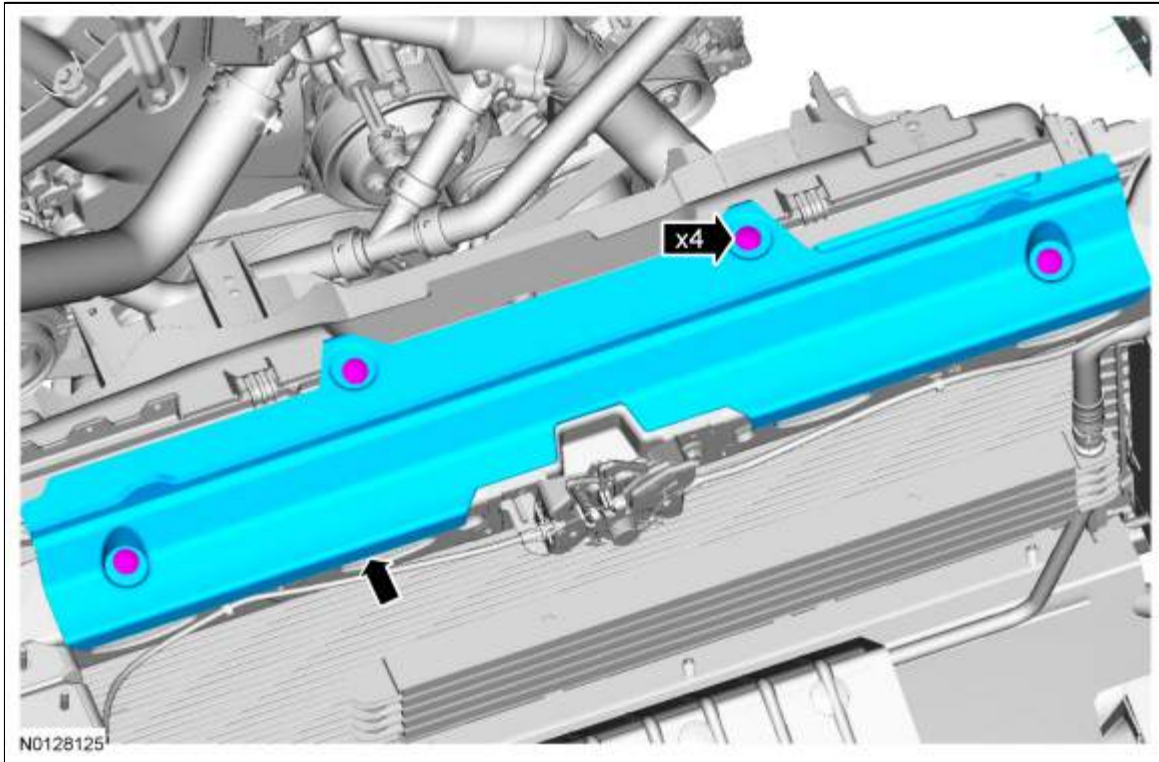
Item	Part Number	Description
1	W715211	LH engine support insulator through bolt - 350 Nm (258 lb-ft)
2	W713244	LH engine support insulator bolt (3 required)
3	6038	LH engine support insulator
4	W714735	LH engine support insulator bracket bolt (3 required) - 63 Nm (46 lb-ft)
5	—	LH engine support insulator bracket (part of 6038)

Removal

NOTE: Apply threadlock to the LH and RH engine support insulator through bolt threads prior to installation.

All vehicles

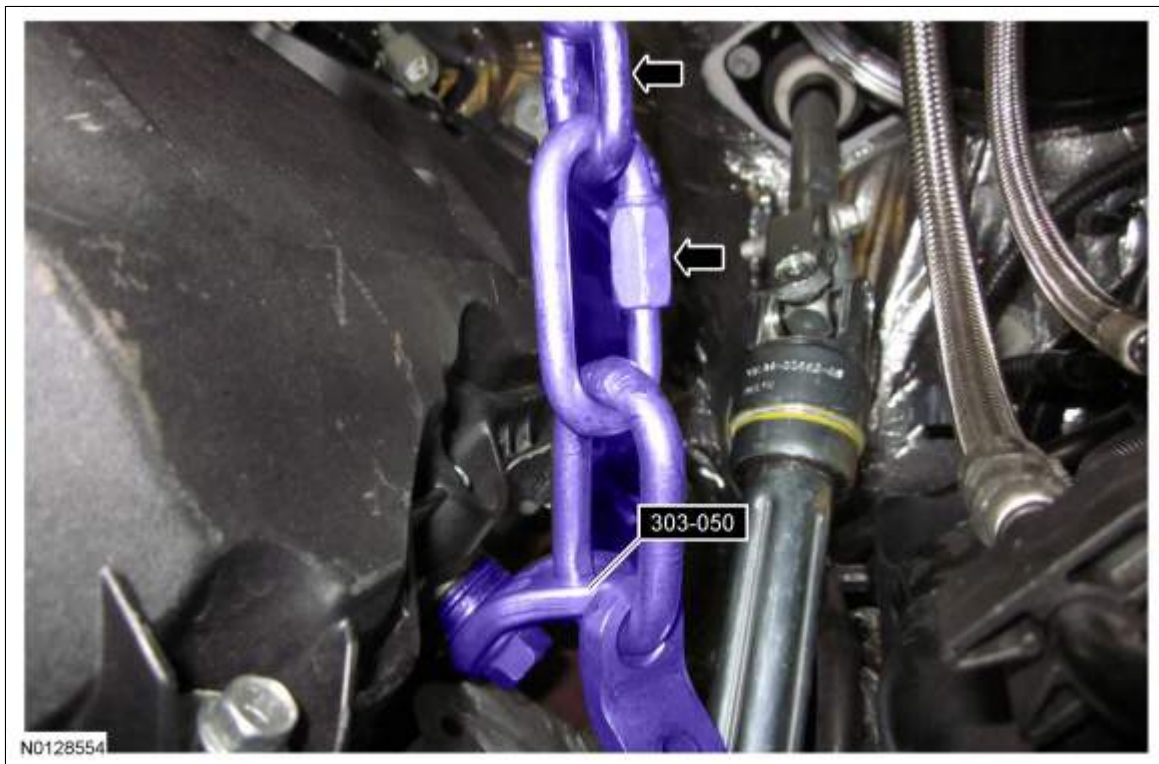
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the 4 pin-type retainers and the upper radiator air deflector.



3. Remove the Air Cleaner (ACL) outlet pipe and ACL cover as an assembly. For additional information, refer to [Section 303-12](#).
4. **NOTE:** It may be necessary to install washers between the Engine Lifting Bracket and the cylinder head to prevent the Engine Lifting Bracket from contacting the valve cover while supporting the engine.

Install an Engine Lifting Bracket on the side of the LH cylinder head.

- Attach a length of chain and a connecting link to the Engine Lifting Bracket.



5. Install the Engine Support Bar.

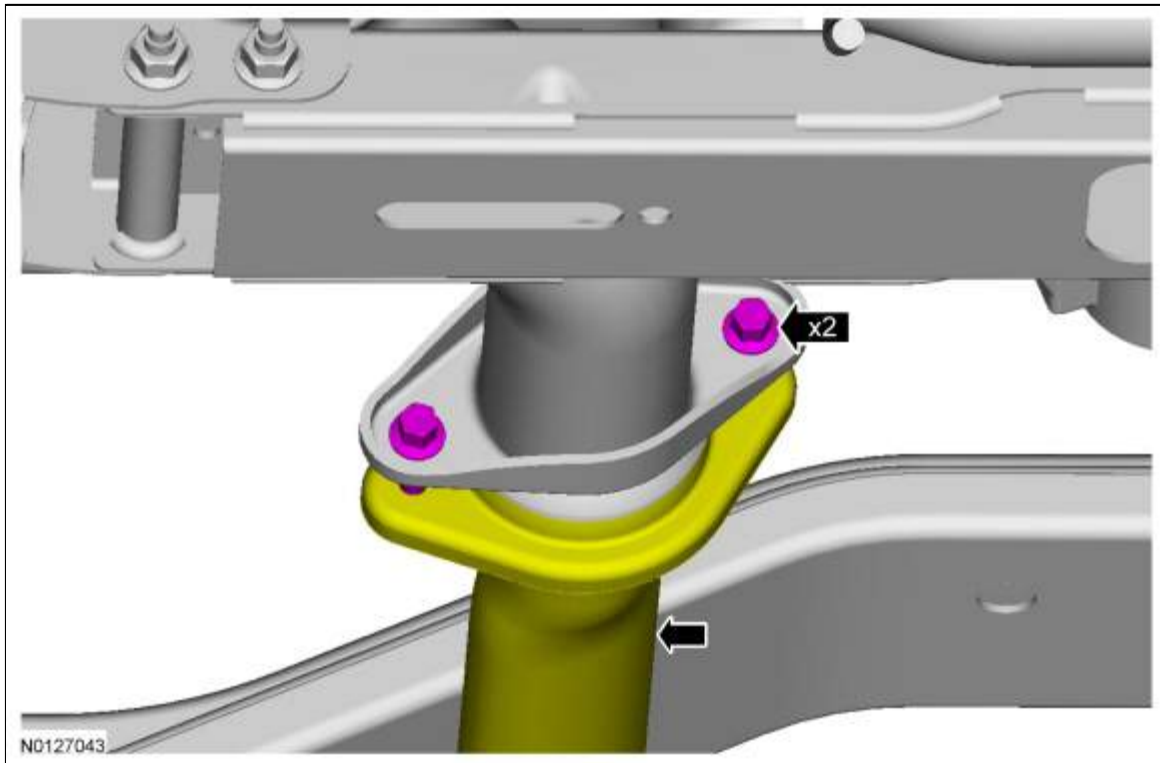
- Attach the chain installed in the previous step to the Engine Support Bar hook to support the engine.



6. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and

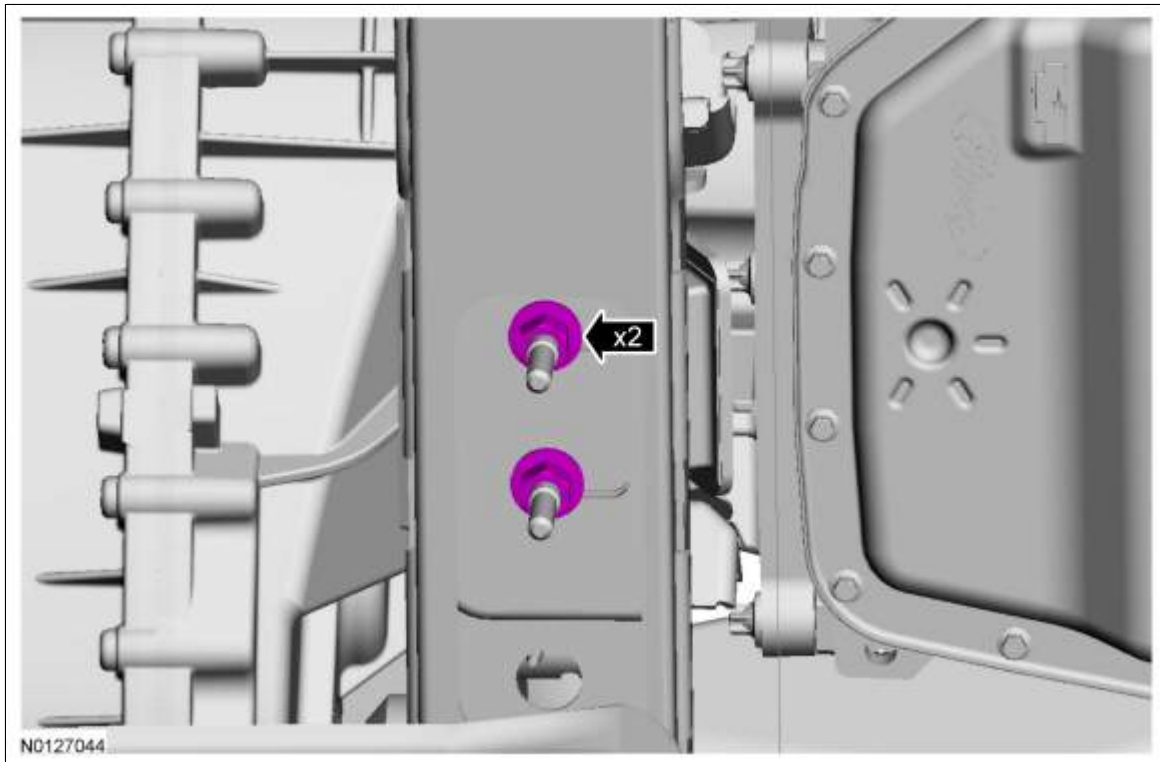
separate.

- Discard the 2 bolts.



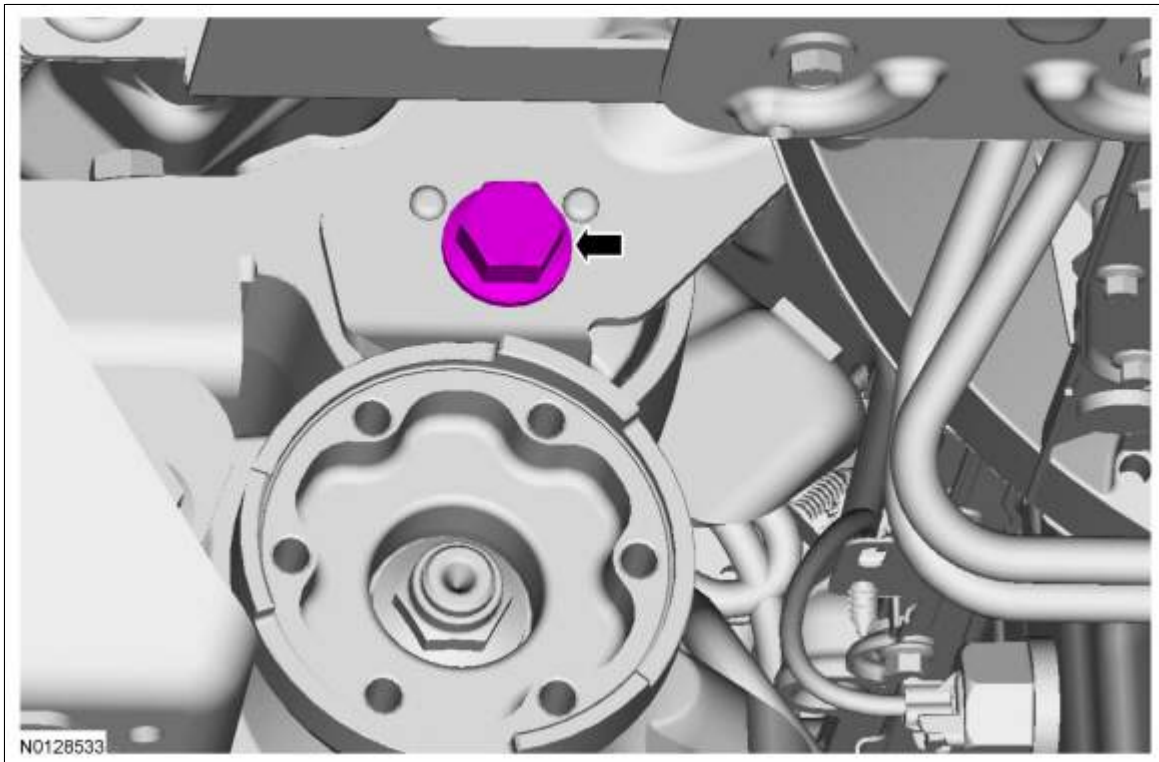
7. **NOTICE:** Only use hand tools when removing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.

Loosen the 2 transmission mount-to-crossmember nuts.



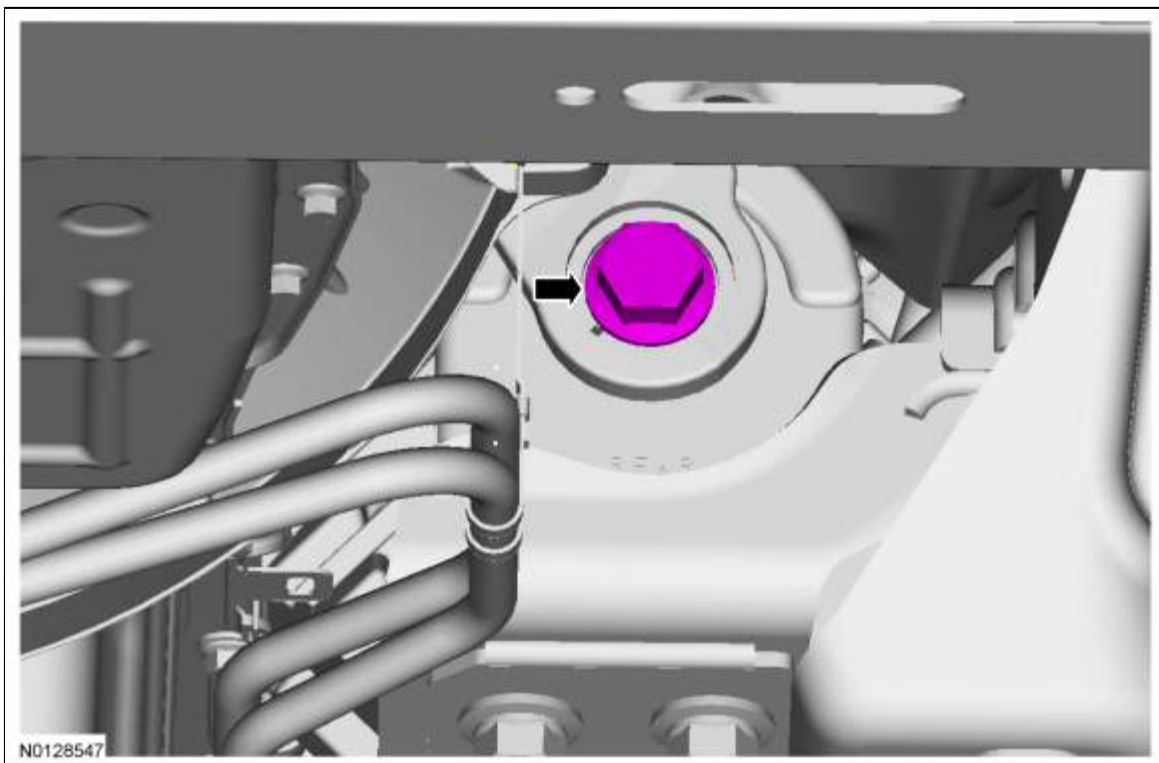
8. Remove the starter. For additional information, refer to [Section 303-06](#).
9. If equipped, remove the front driveshaft. For additional information, refer to [Section 205-01](#).
10. **NOTICE:** Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.

Remove the LH engine support insulator through bolt.



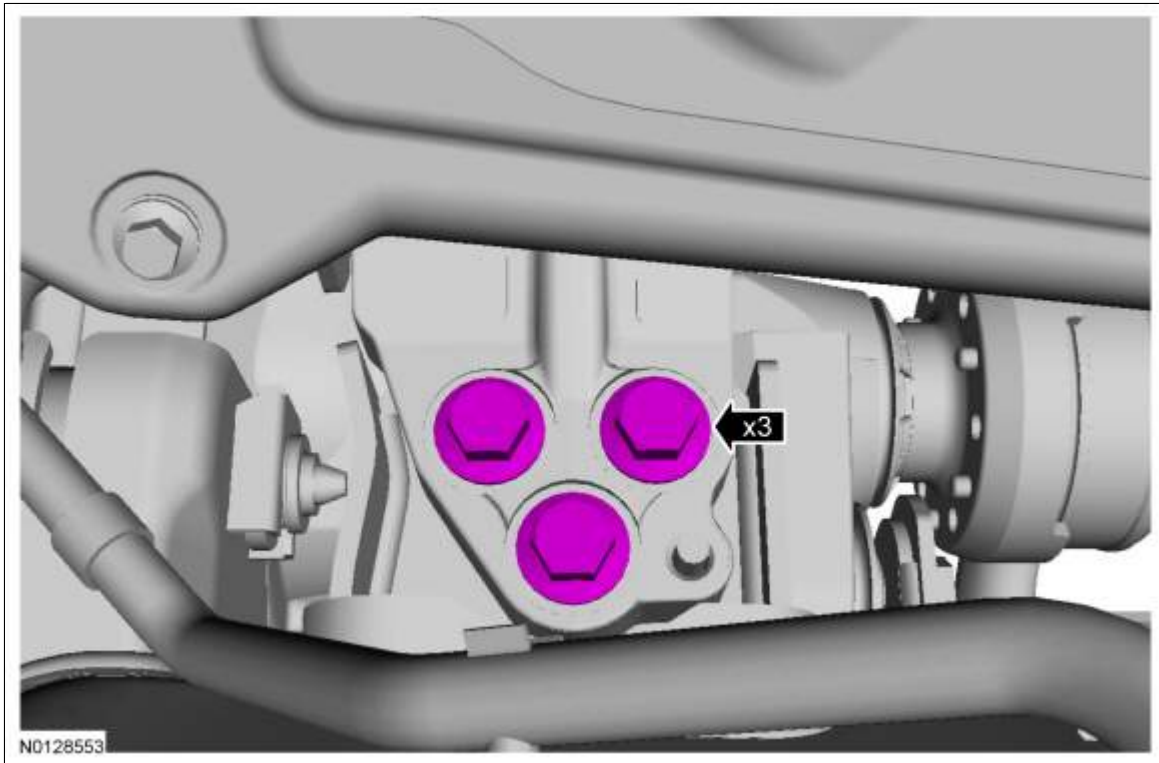
11. **NOTICE:** Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.

Loosen the RH engine support insulator through bolt.



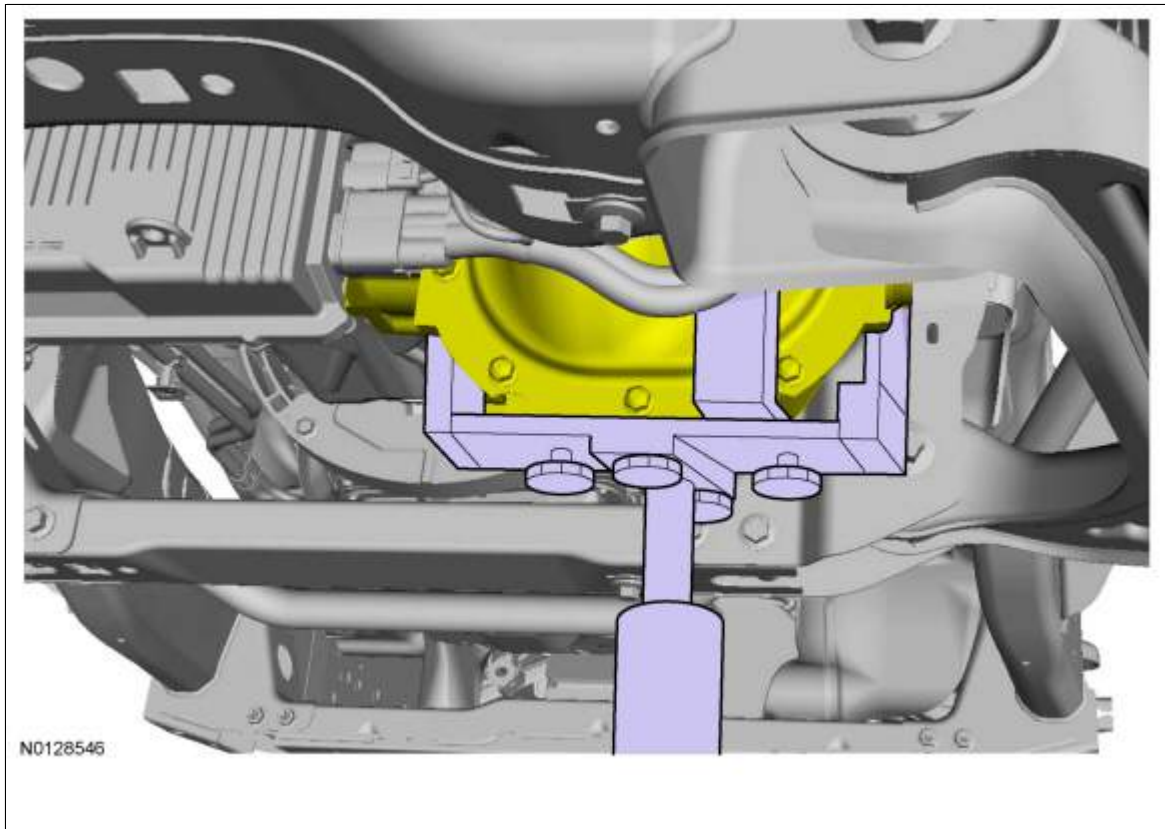
12. Raise the LH side of the engine 50 mm (1.968 in).
13. **NOTICE:** Only use hand tools when removing or installing the engine support insulator-to-frame bolts or damage to the engine support insulator-to-frame nut plate can occur.

Remove the 3 LH engine support insulator-to-frame bolts.

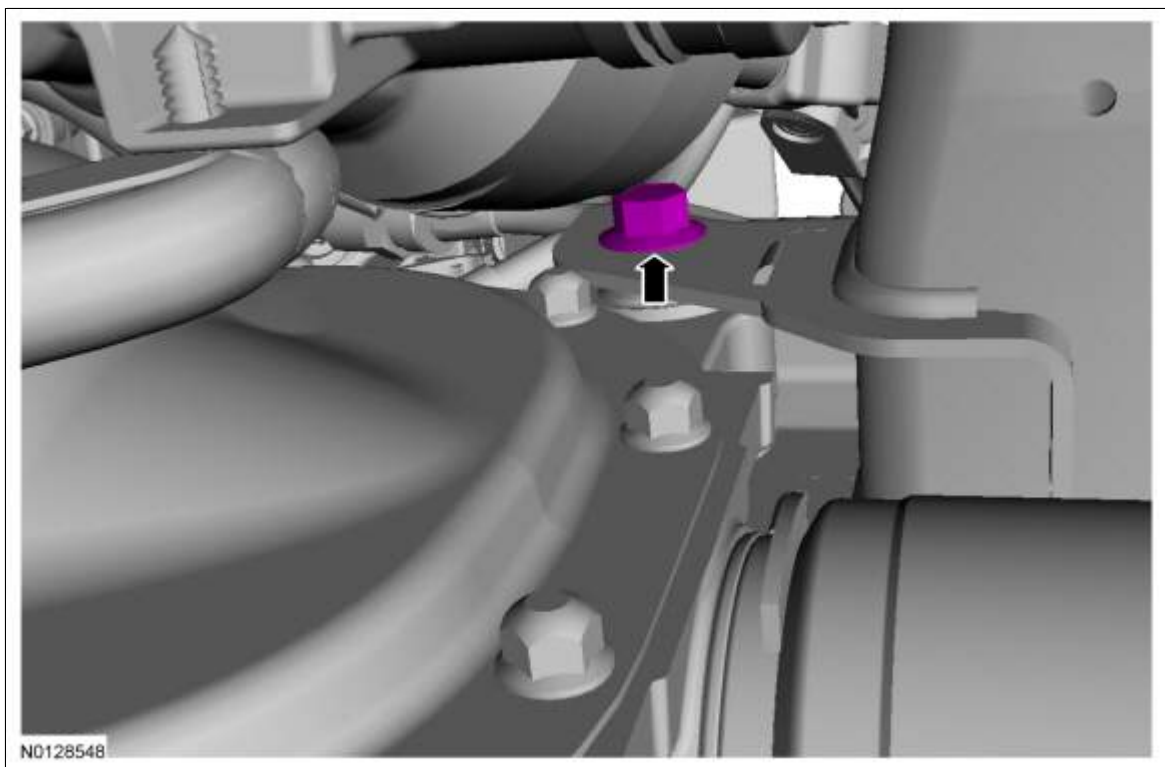


Four-Wheel Drive (4WD) vehicles

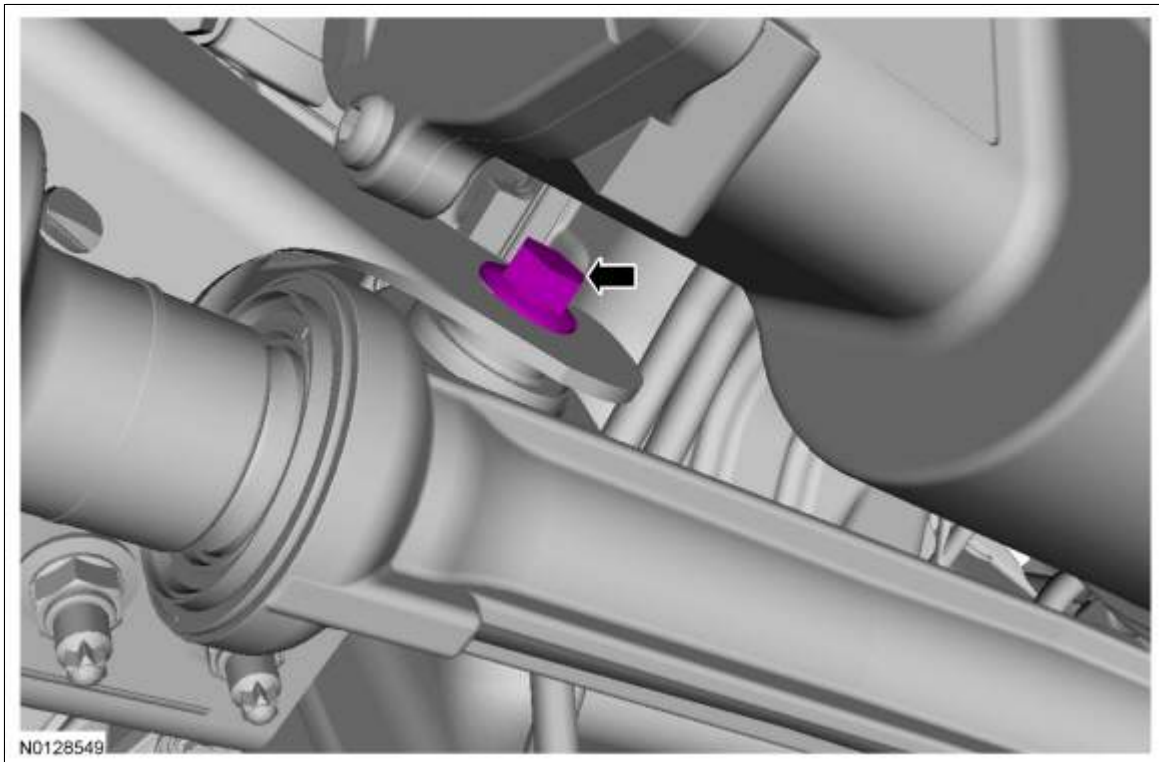
14. Position a suitable hydraulic jack under the front axle. Securely strap the jack to the axle.



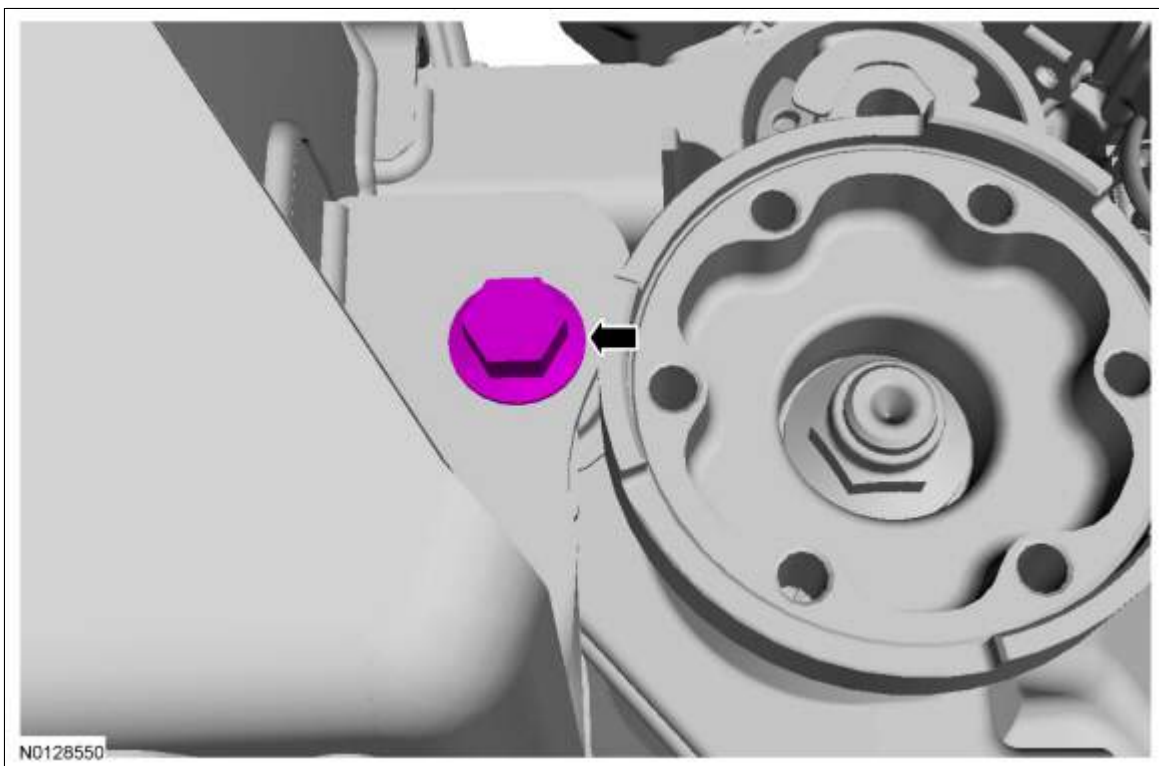
15. Remove the upper front axle carrier mounting bushing bolt.



16. Remove the axle shaft housing carrier bushing bolt.



17. Remove the lower front axle carrier mounting bushing bolt.

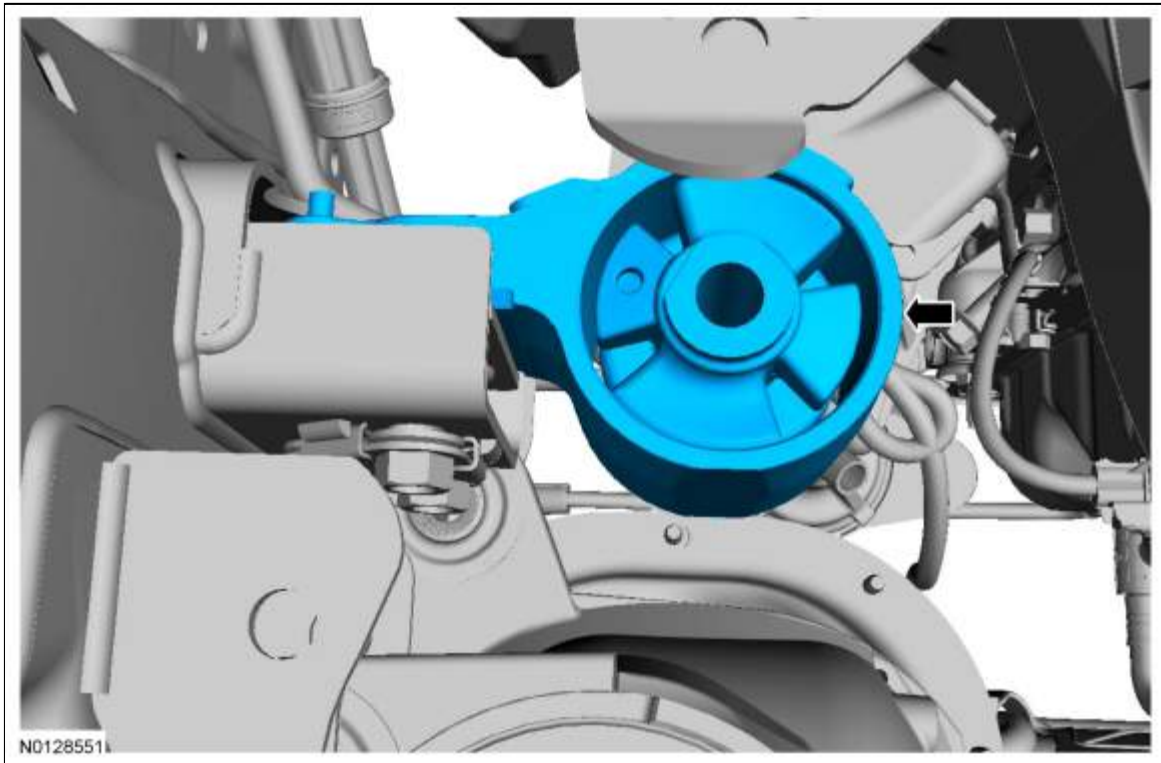


18. **NOTICE:** Use care when positioning the front axle housing or the vacuum lines to the axle solenoid may become disconnected or damaged.

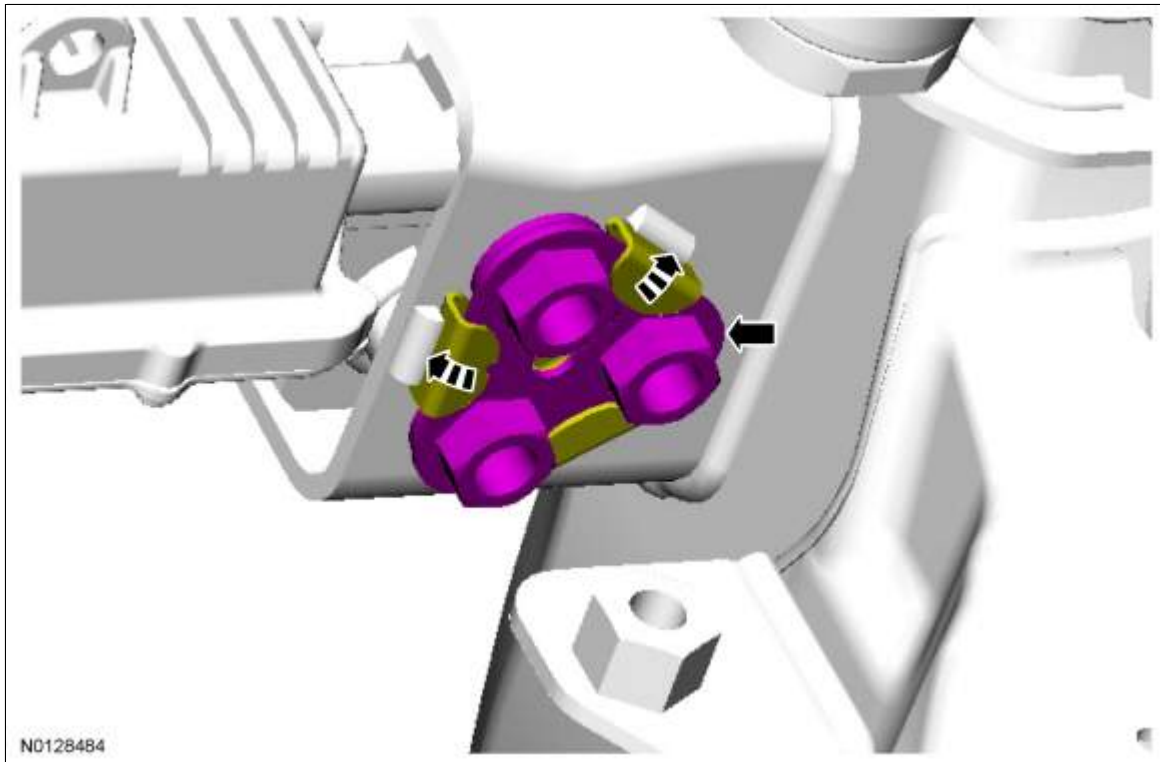
Lower the front axle to allow clearance to the LH engine support insulator.

All vehicles

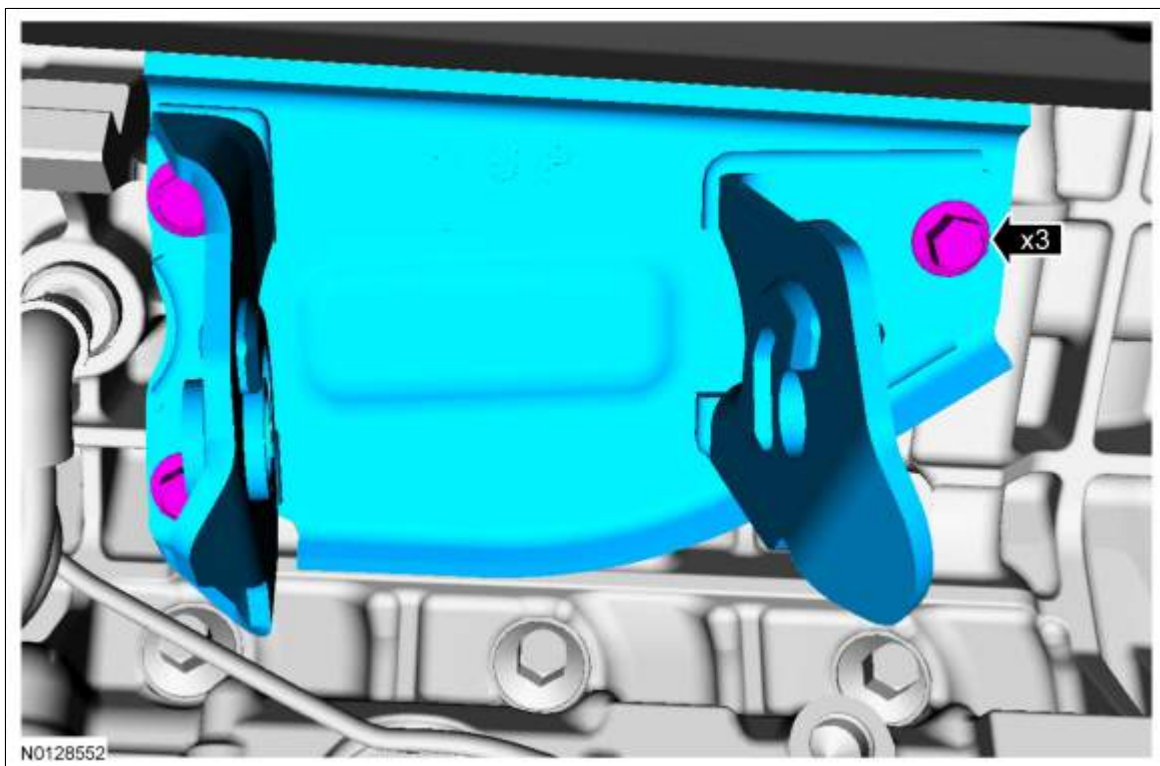
19. Remove the LH engine support insulator.



20. Inspect the engine support insulator-to-frame nut plate for thread damage. If the nut plate is damaged, bend 2 tabs back and remove the nut plate. Replace the nut plate with service part number 56190 and bend the 2 tabs back to the original position.



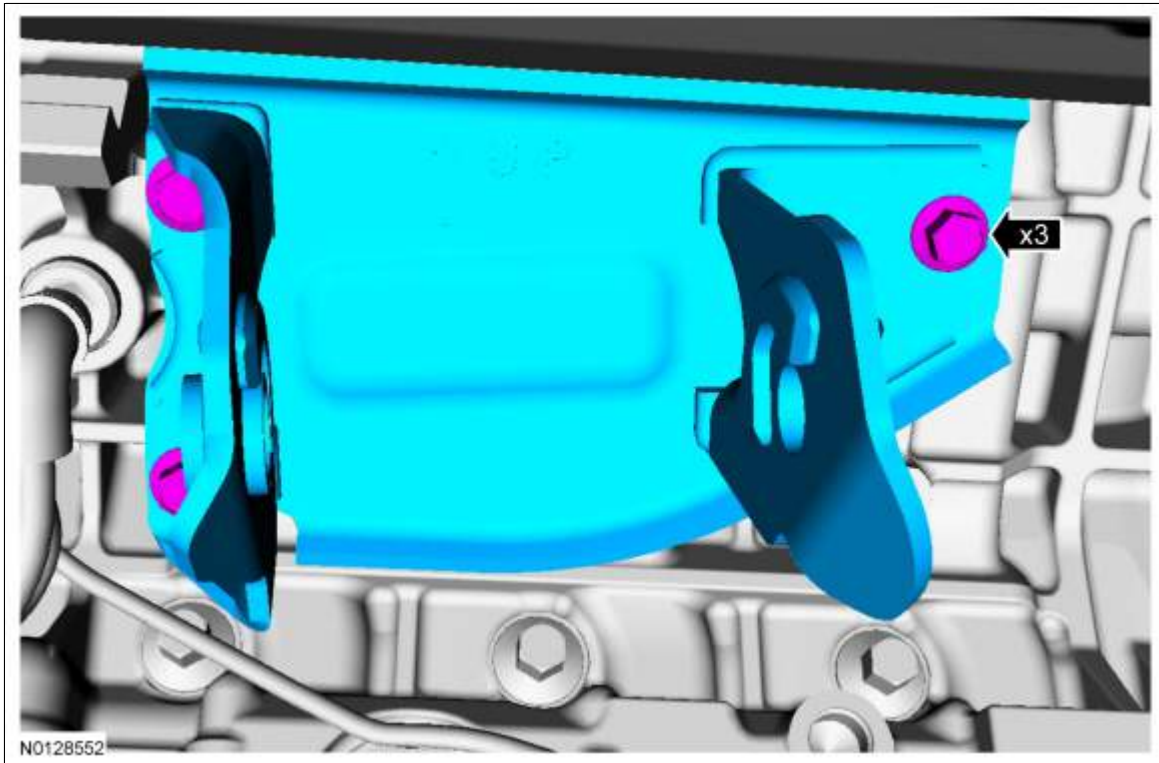
21. If necessary, remove the 3 bolts and the LH engine support insulator-to-cylinder block bracket.



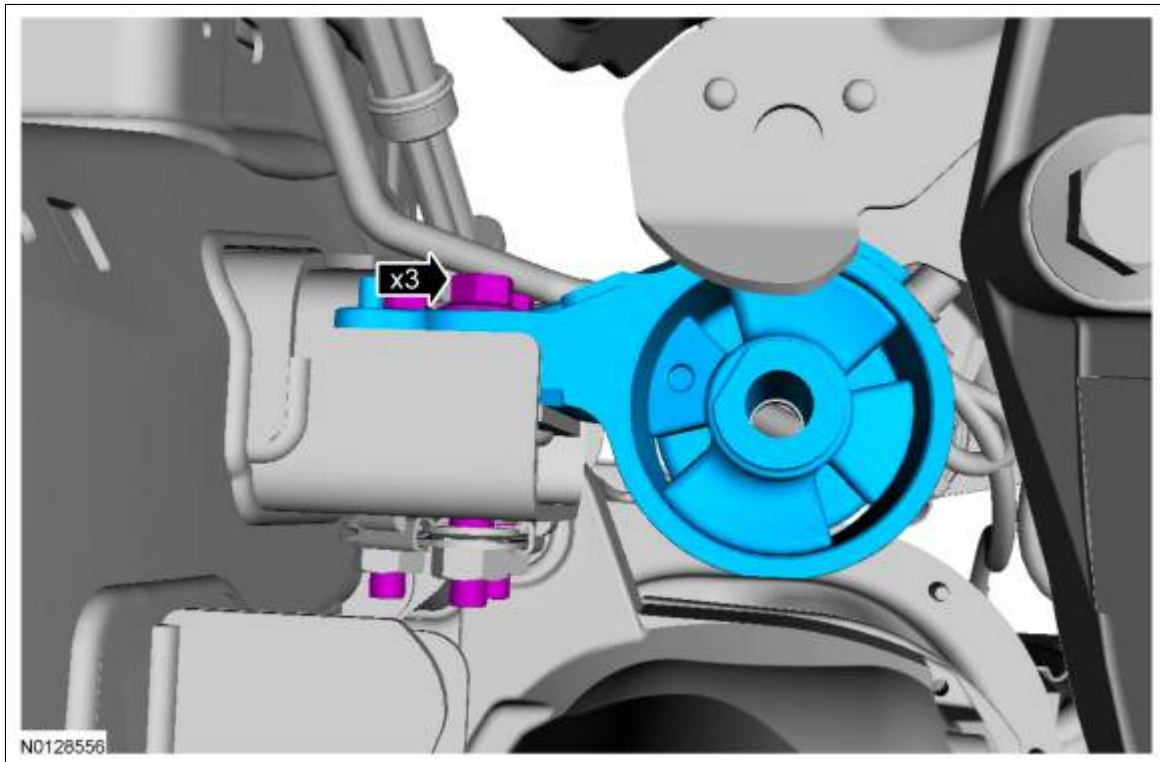
Installation

All vehicles

1. Clean the engine support insulator-to-cylinder block and engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.
2. If removed, install the LH engine support insulator-to-cylinder block bracket and install the 3 bolts.
 - Tighten to 63 Nm (46 lb-ft).



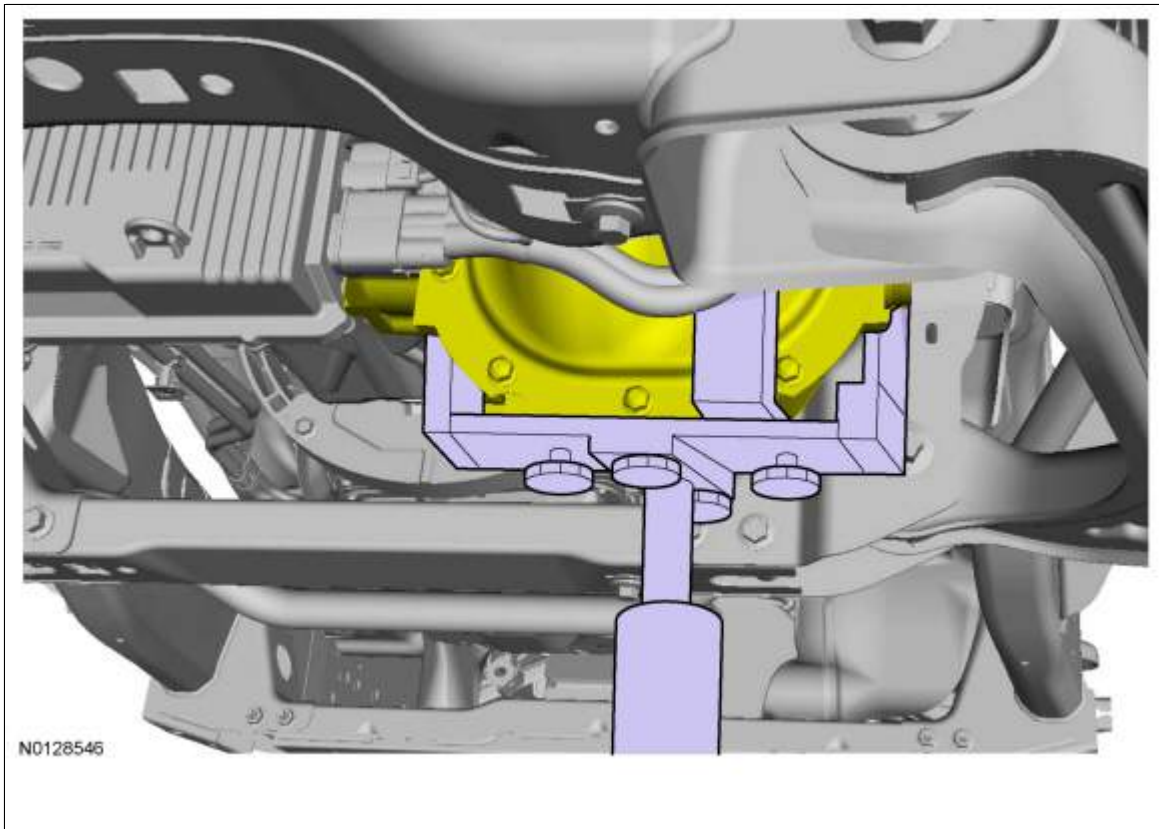
3. Position the LH engine support insulator and hand start the 3 new engine support insulator-to-frame bolts.
 - Do not tighten at this time.



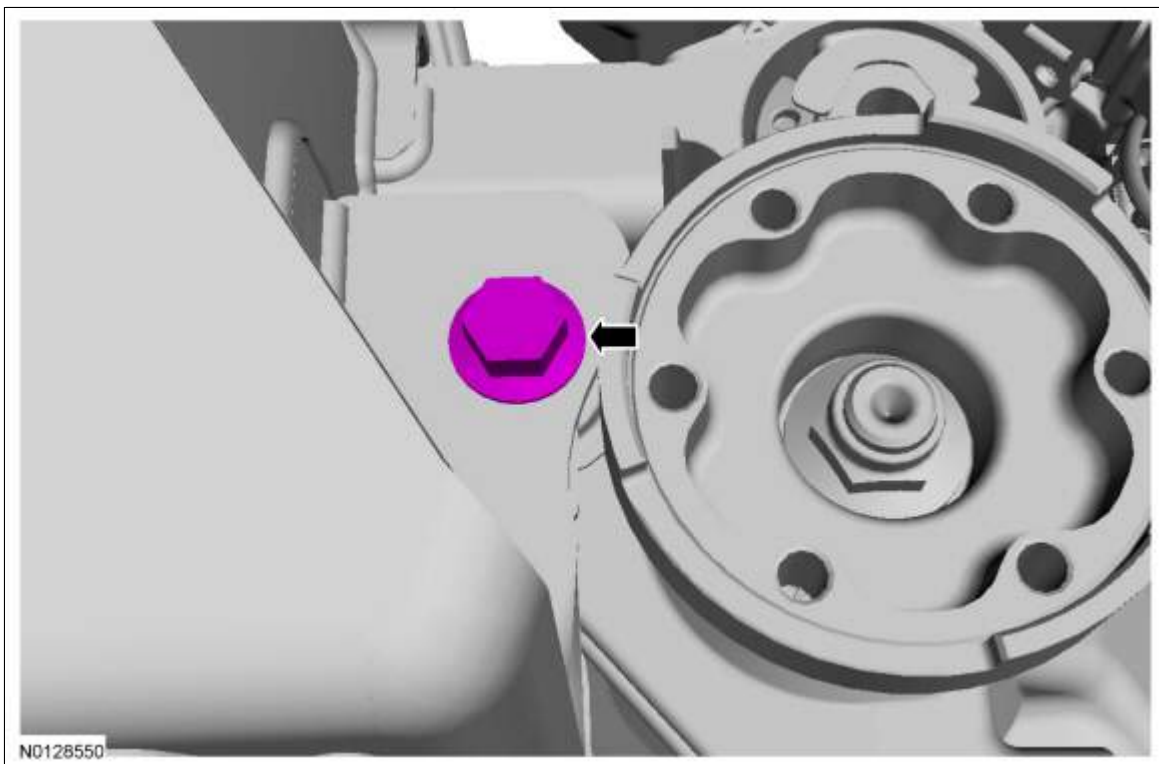
Four-Wheel Drive (4WD) vehicles

4. **NOTICE:** Use care when positioning the front axle housing or the vacuum lines to the axle solenoid may become disconnected or damaged.

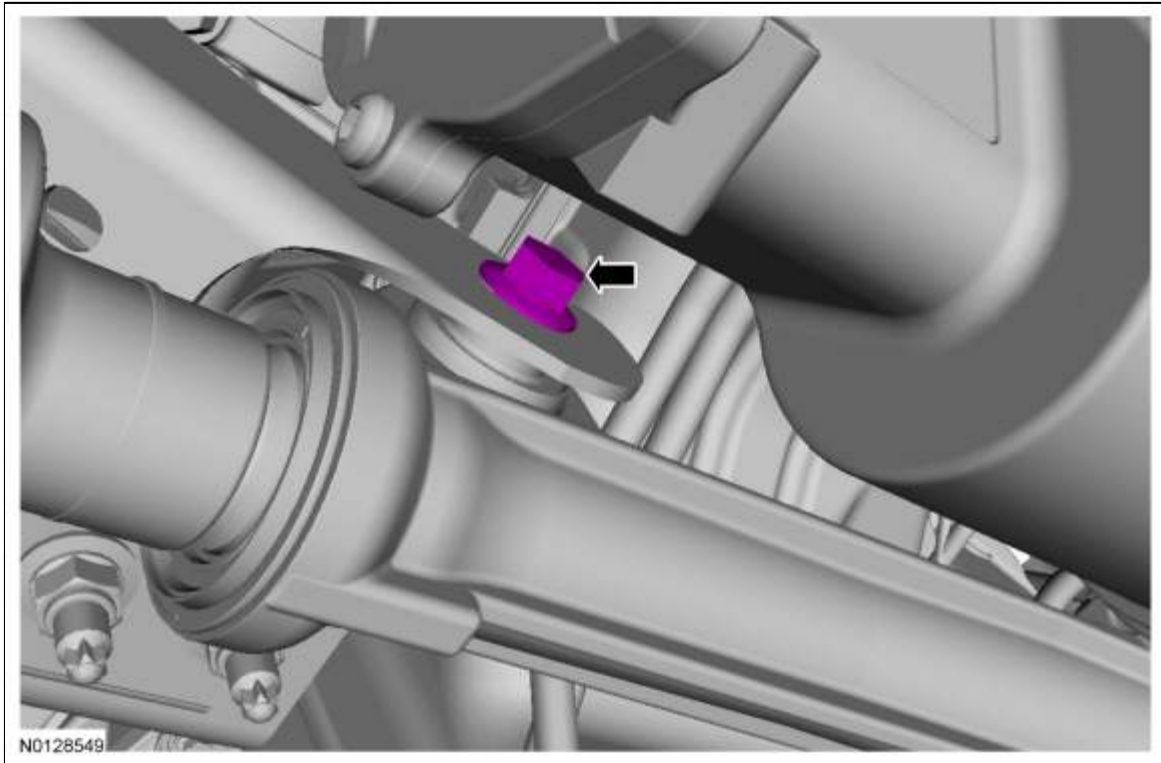
Raise the front axle carrier into position.



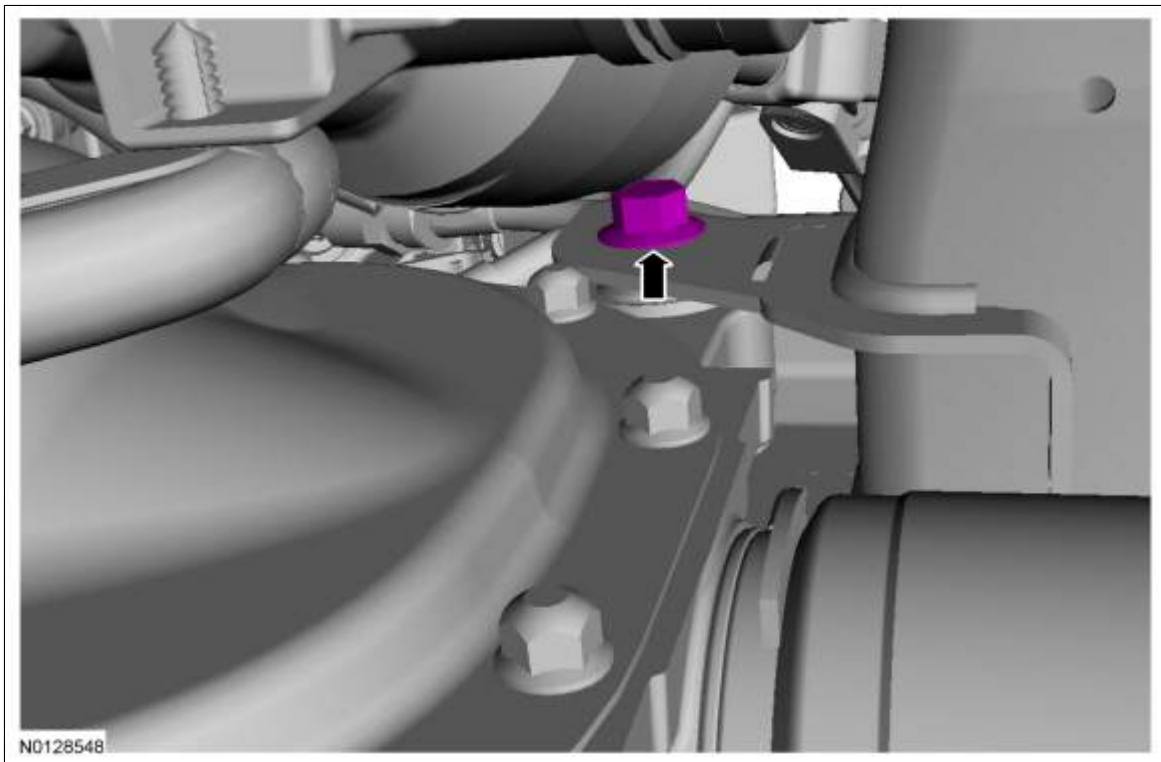
5. Install the lower front axle carrier mounting bushing bolt.
 - Tighten to 115 Nm (85 lb-ft).



6. Install the axle shaft housing carrier bushing bolt.
 - Tighten to 115 Nm (85 lb-ft).

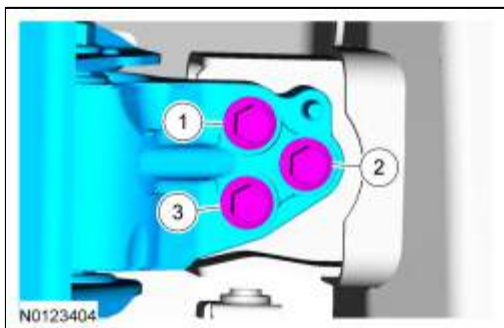


7. Install the upper front axle carrier mounting bushing bolt.
 - Tighten to 115 Nm (85 lb-ft).



All vehicles

8. Tighten the 3 LH engine support insulator bolts in the sequence shown to 175 Nm (129 lb-ft).

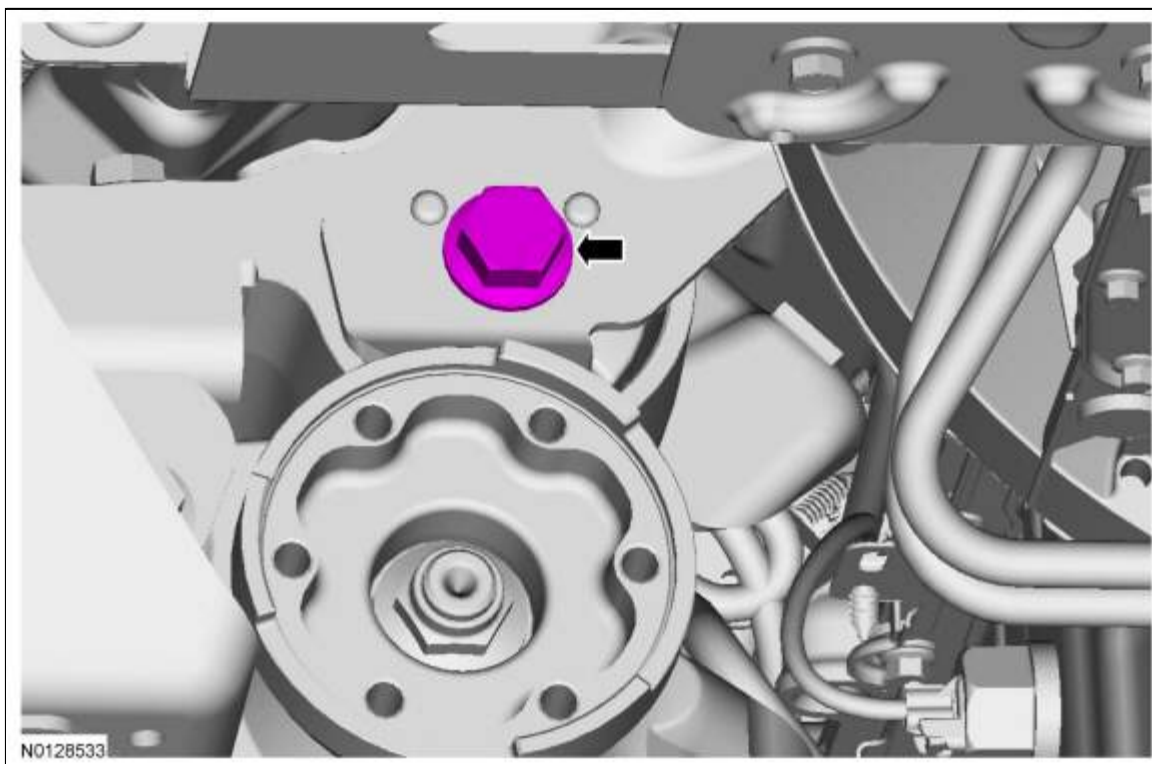


9. Lower the engine to the installed position.
10. **NOTICE:** Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.

NOTE: Apply threadlock to the bolt threads prior to installation.

Install the LH engine support insulator through bolt.

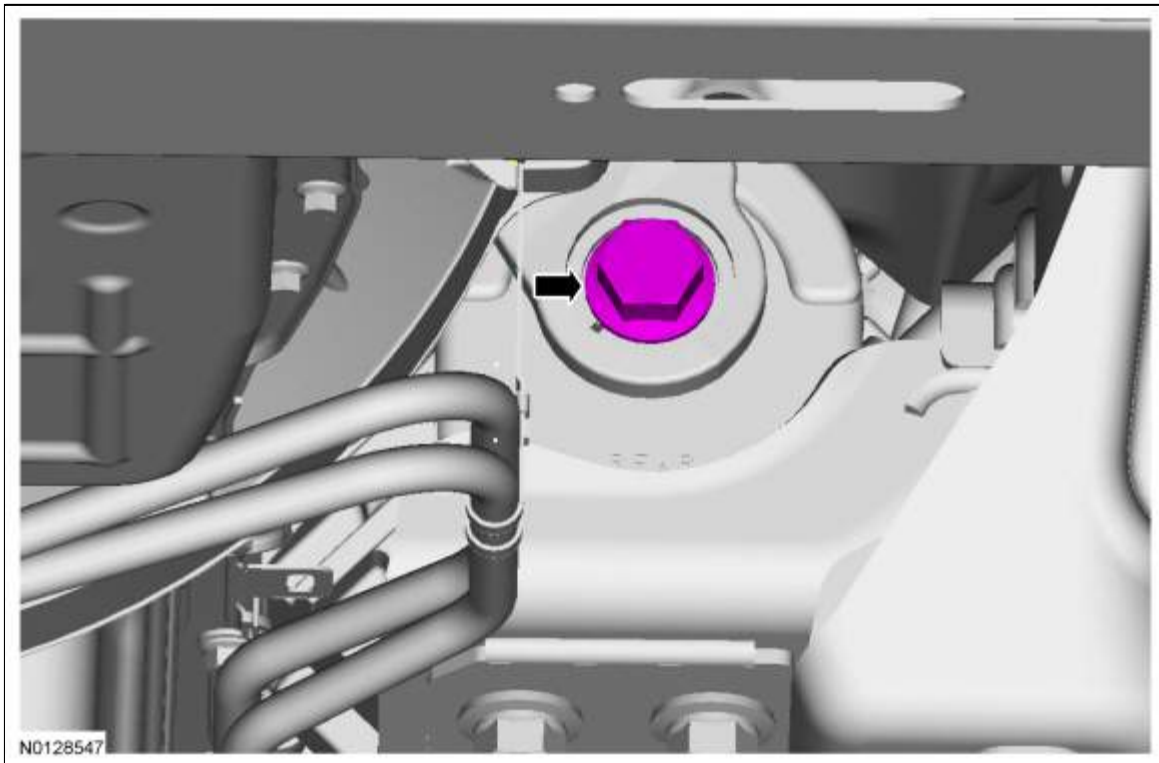
- Tighten to 350 Nm (258 lb-ft).



11. **NOTICE:** Only use hand tools when loosening or tightening the engine support insulator through bolt or damage to the engine support insulator-to-cylinder block bracket can occur.

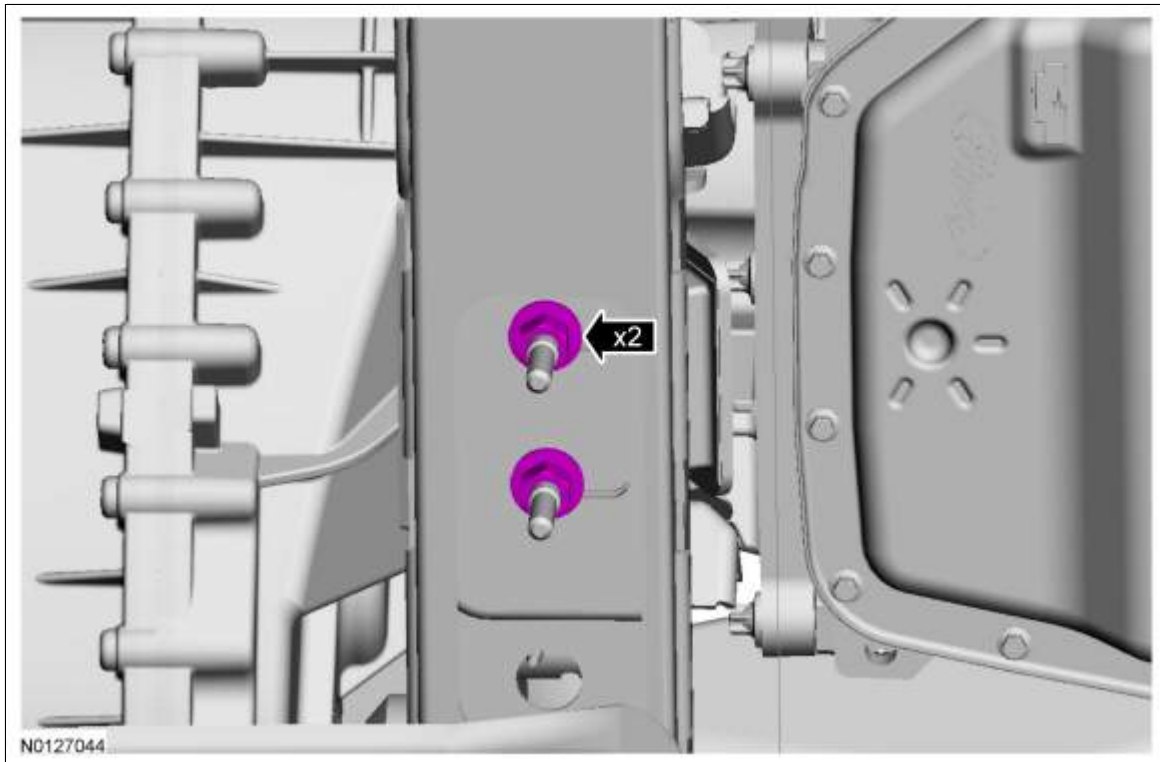
Remove the RH engine support insulator through bolt and apply threadlock to the bolt threads.

- Install the through bolt and tighten to 350 Nm (258 lb-ft).

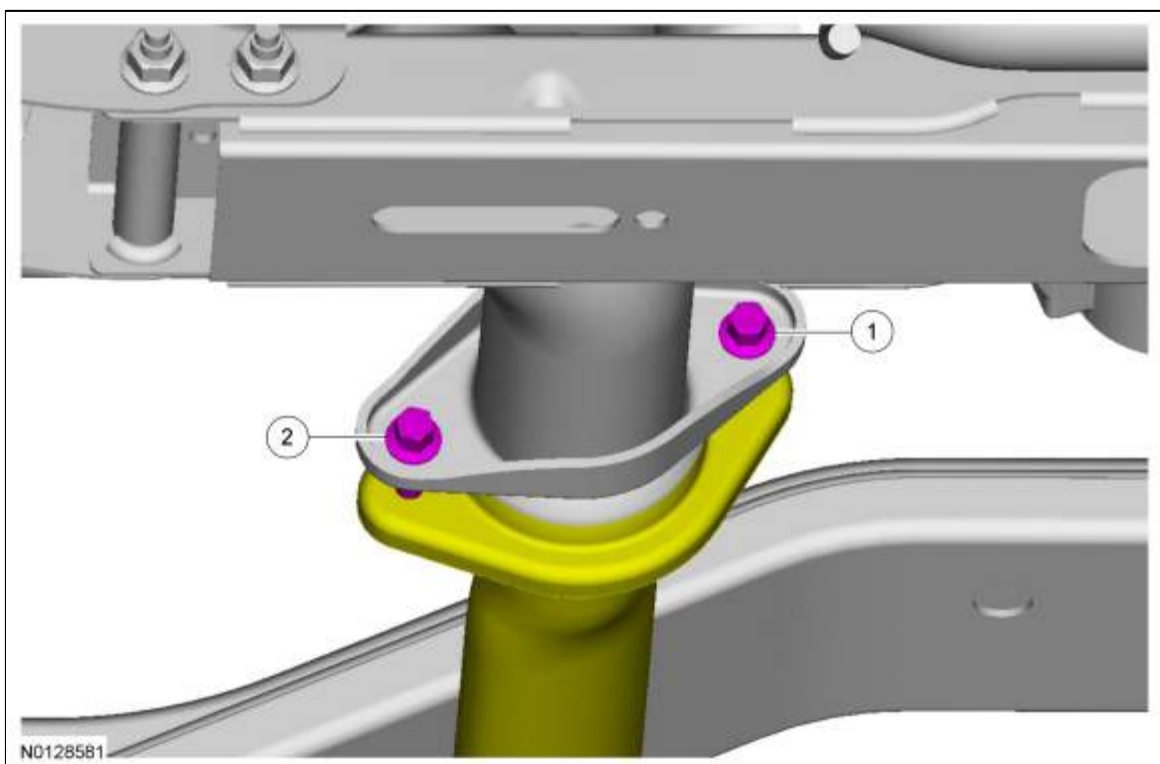


12. If equipped, install the front driveshaft. For additional information, refer to [Section 205-01](#).
13. Install the starter. For additional information, refer to [Section 303-06](#).
14. **NOTICE:** Only use hand tools when installing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.

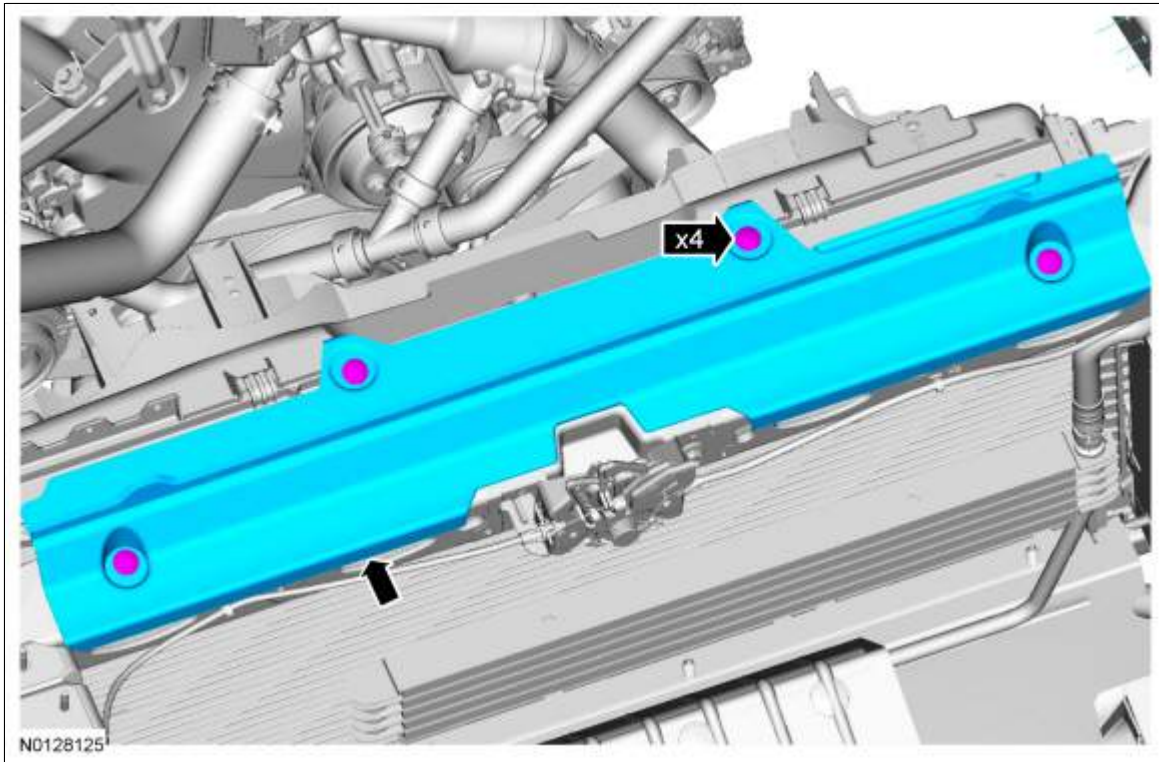
Tighten the transmission mount-to-crossmember nuts to 103 Nm (76 lb-ft).



15. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
1. Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
 2. Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).



16. Install the Air Cleaner (ACL) outlet pipe and ACL cover assembly. For additional information, refer to [Section 303-12](#).
17. Install the upper radiator air deflector and the 4 pin-type retainers.


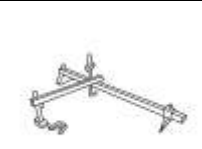


SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

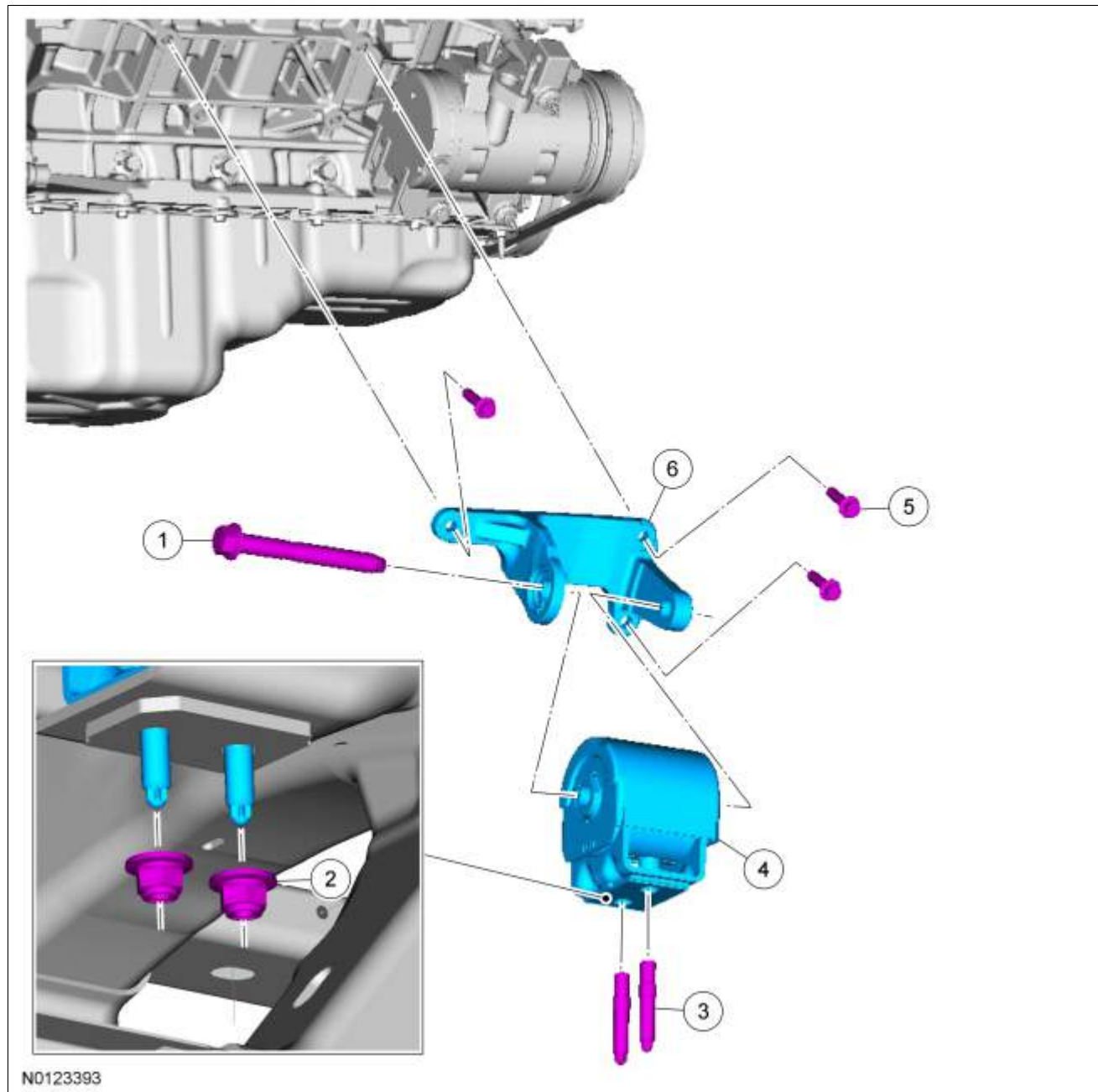
Engine Support Insulators — RH

Special Tool(s)

 ST1659-A	Engine Lifting Bracket (D94T-6000-C) 303-D099
 ST2175-B	Support Bar, Engine 303-F070

Material

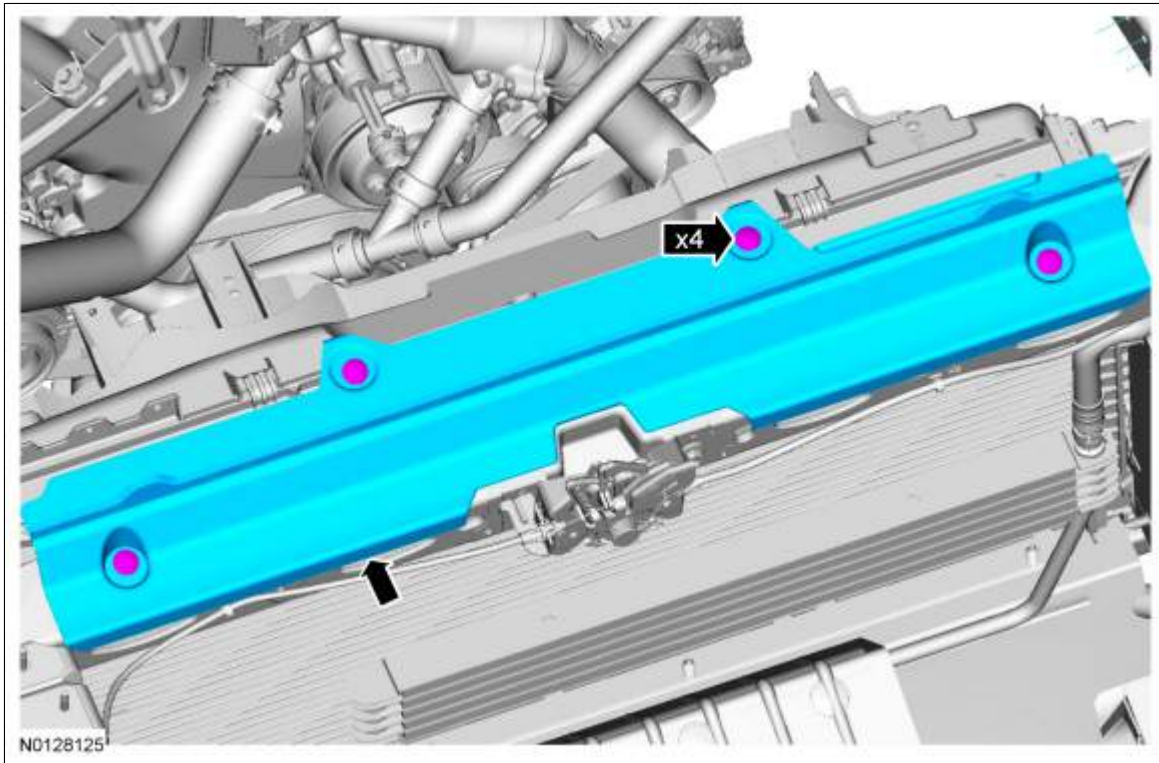
Item	Specification
Threadlock 262 TA-26	WSK-M2G351-A6



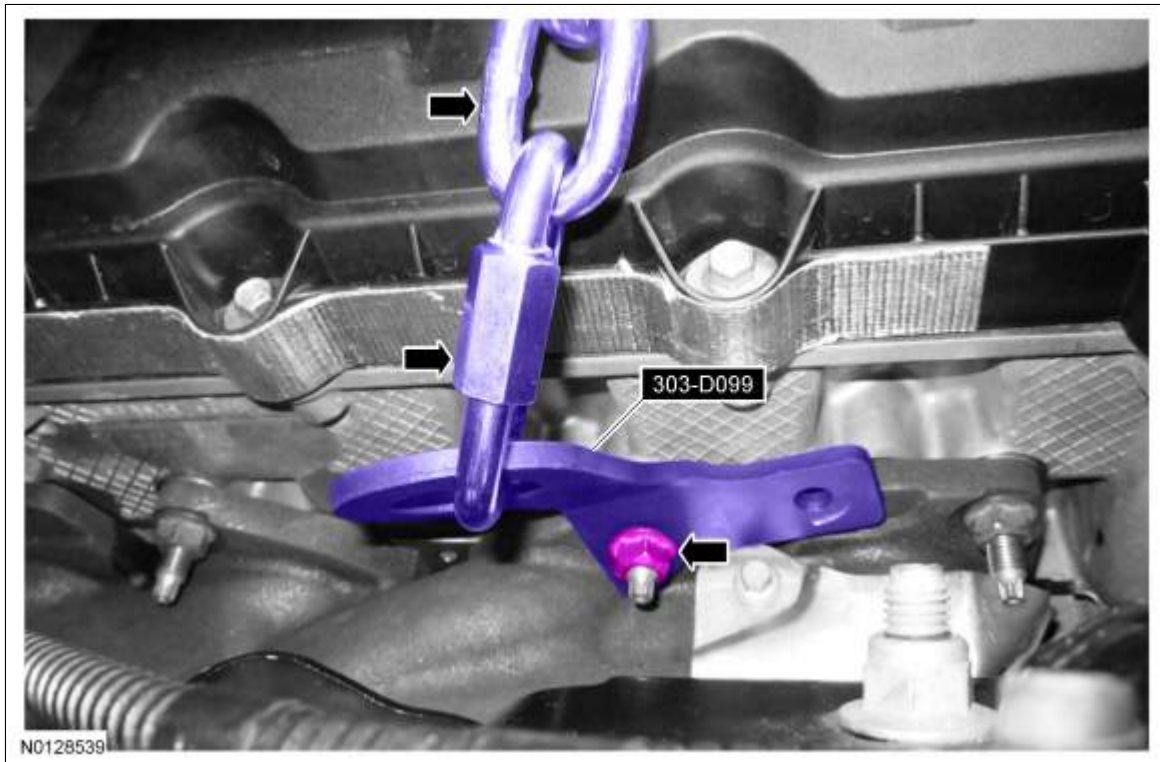
Item	Part Number	Description
1	—	RH engine support insulator through bolt (part of 6038) - 350 Nm (258 lb-ft)
2	W707251	RH engine support insulator nut (2 required) - 175 Nm (129 lb-ft)
3	—	RH engine support insulator stud (part of 6038) (2 required) - 15 Nm (133 lb-in)
4	6038	RH engine support insulator
5	W714735	RH engine support insulator bracket bolt (3 required) - 63 Nm (46 lb-ft)
6	—	RH engine support insulator bracket (part of 6038)

Removal and Installation

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the 4 pin-type retainers and the upper radiator air deflector.



3. Remove the Air Conditioning (A/C) compressor belt . For additional information, refer to [Section 303-05](#).
4. Remove the exhaust manifold nut and install the Engine Lifting Bracket and nut on the RH exhaust manifold stud.
 - Attach a length of chain and a connecting link to the Engine Lifting Bracket.



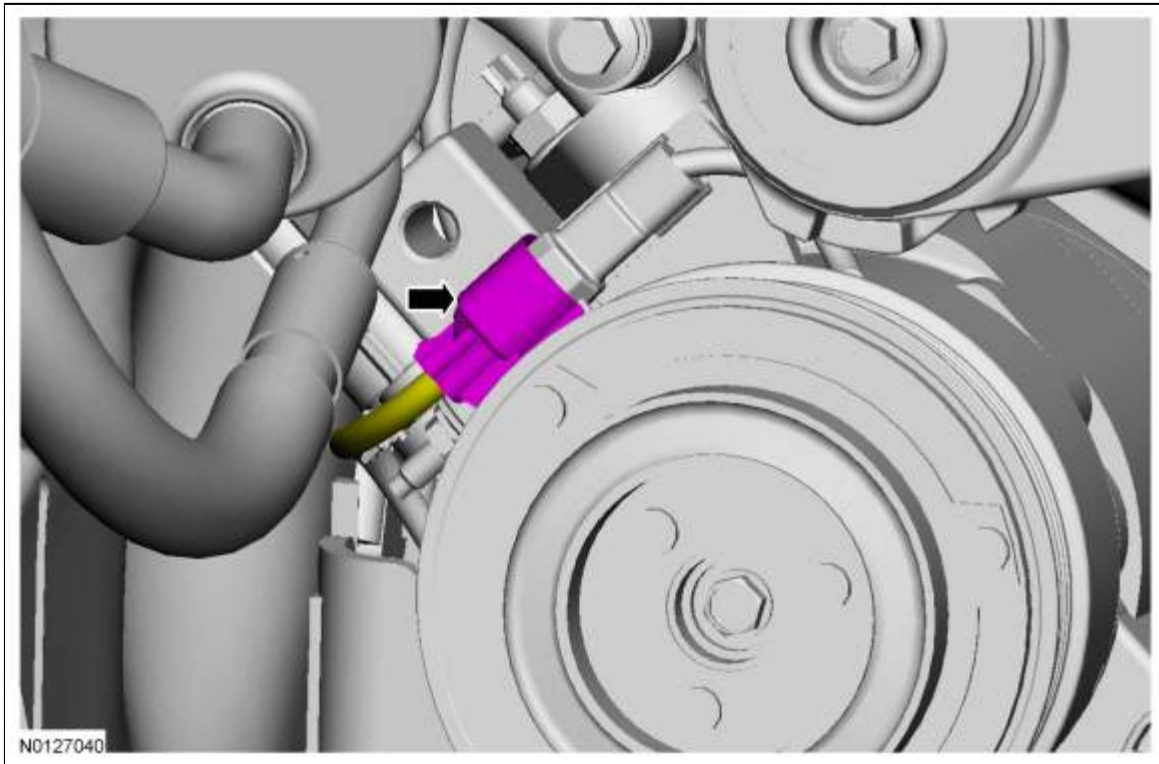
5. Install the Engine Support Bar.

- Attach the chain installed in the previous step to the Engine Support Bar hook to support the engine.



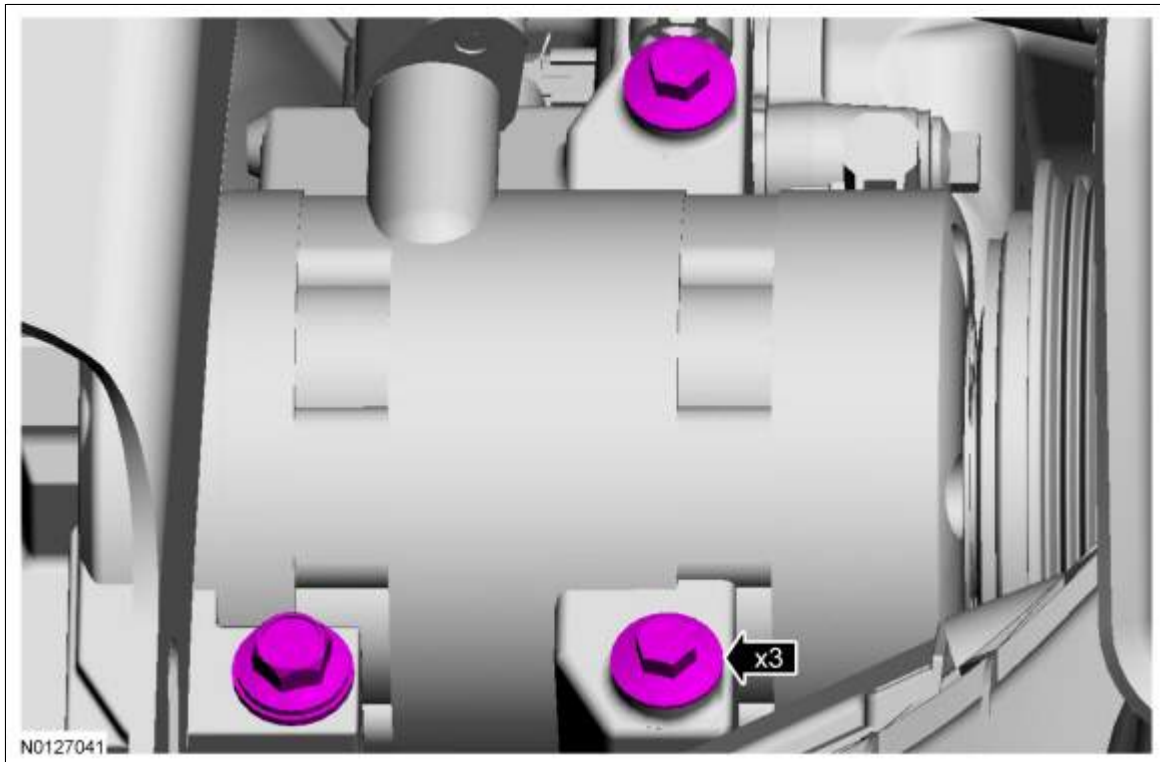
6. Remove the starter. For additional information, refer to [Section 303-06](#).

7. If equipped, remove the front driveshaft. For additional information, refer to [Section 205-01](#).
8. Disconnect the A/C compressor electrical connector.



9. **NOTICE:** The upper bolt cannot be completely removed and will remain with the A/C compressor.

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

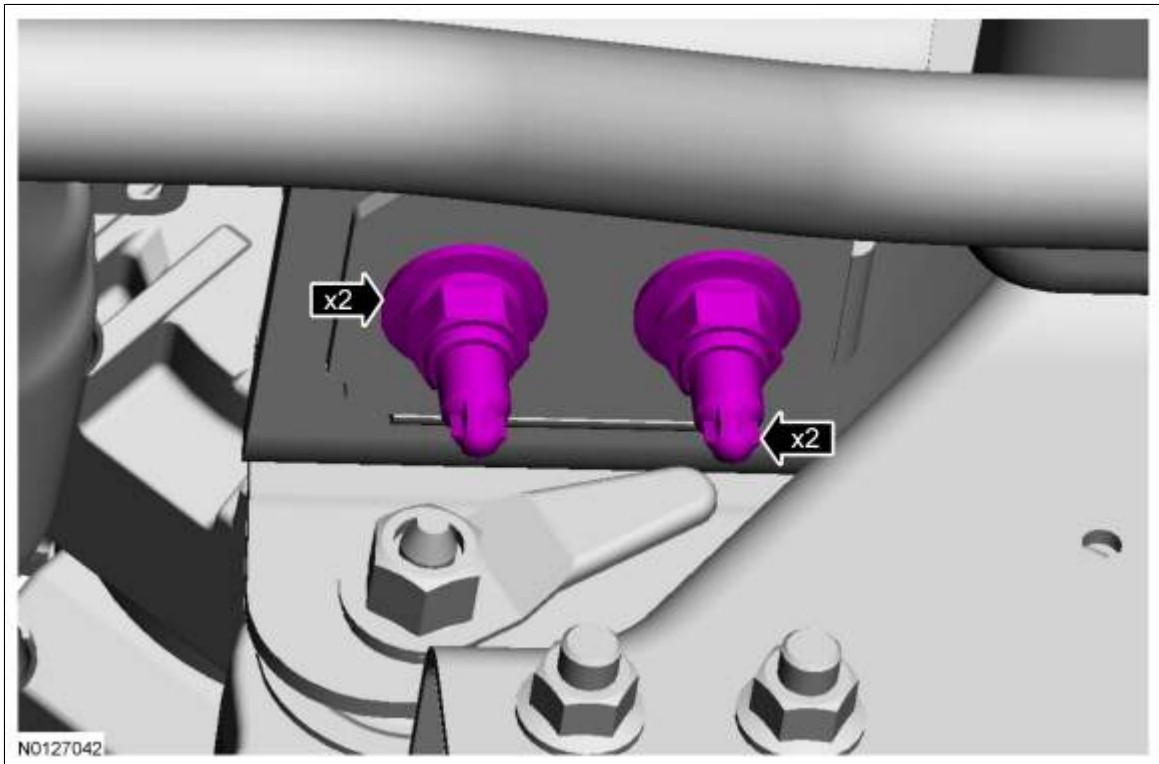


10. **NOTICE:** Only use hand tools when removing or installing the engine support insulator nuts or damage to the engine support insulator can occur.

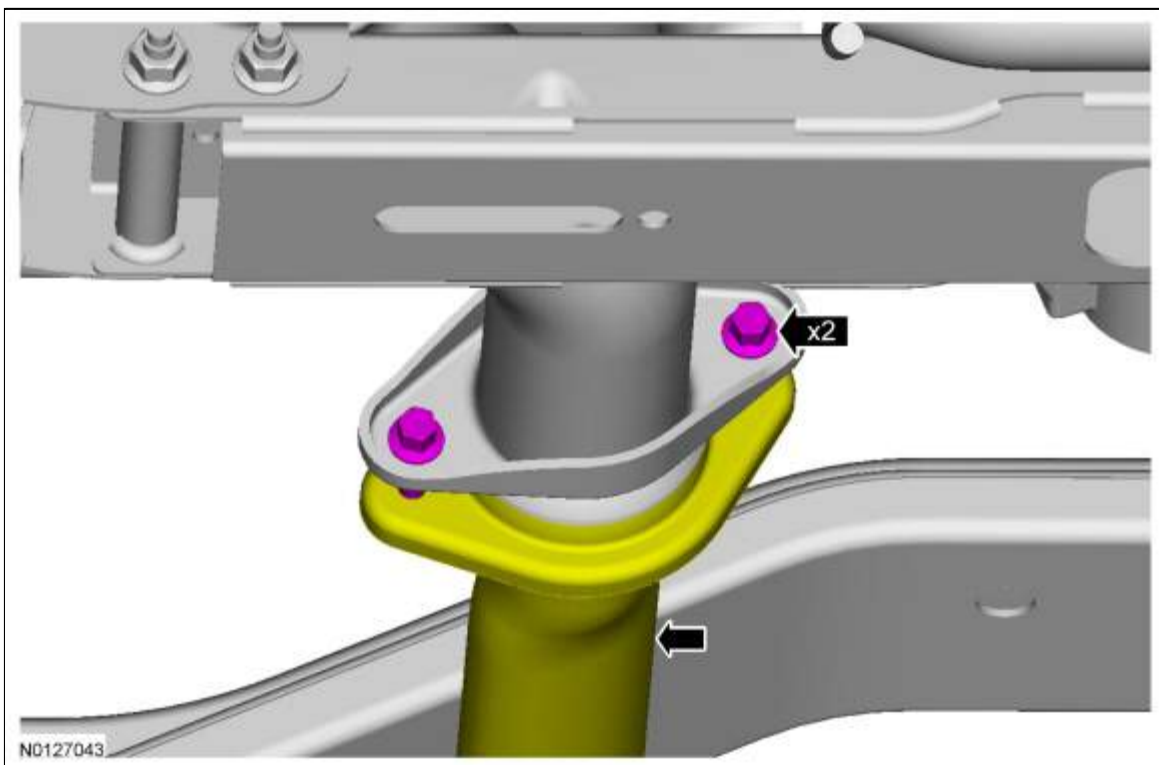
NOTICE: Only use hand tools when removing or installing the engine support insulator stud bolts or damage to the engine support insulator can occur.

NOTE: If during nut removal the stud is extracted from the engine support insulator, separate the nut from the stud bolt prior to stud installation.

Remove the 2 RH engine support insulator nuts and studs.



11. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
- Discard the 2 bolts.



12. **NOTICE:** Only use hand tools when removing the transmission mount-to-crossmember nuts or

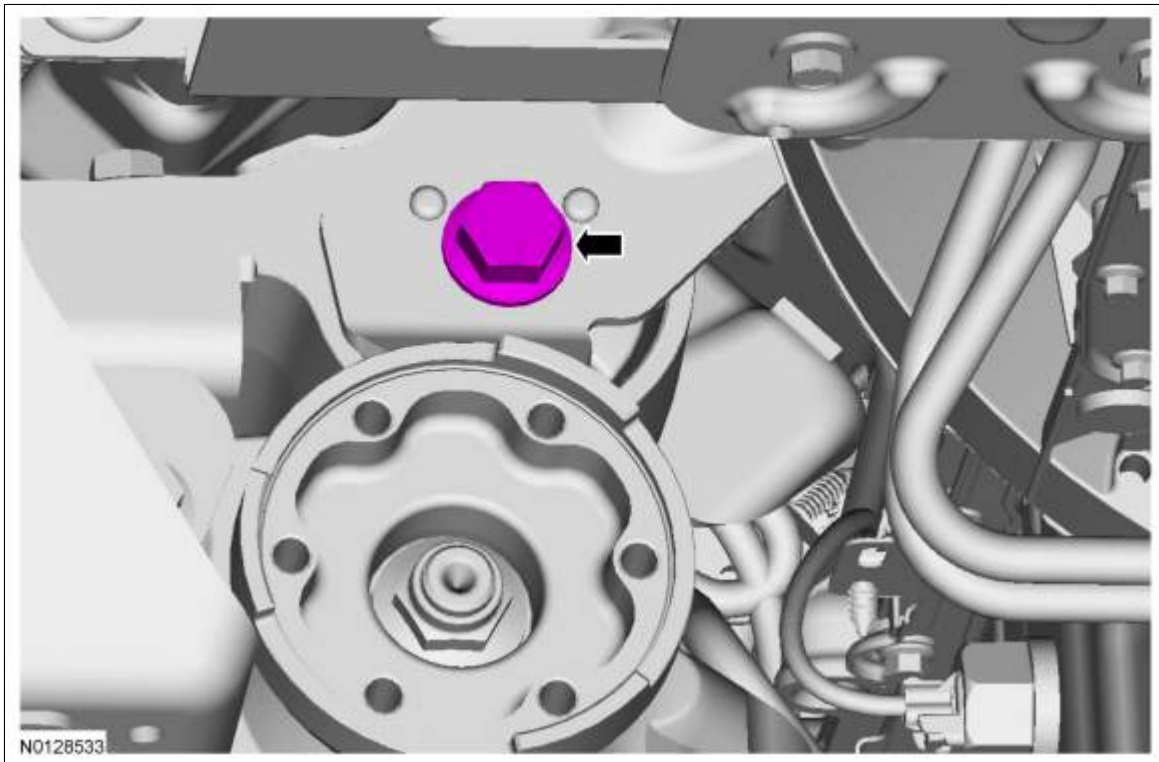
damage to the transmission mount can occur.

Loosen the 2 transmission mount-to-crossmember nuts.

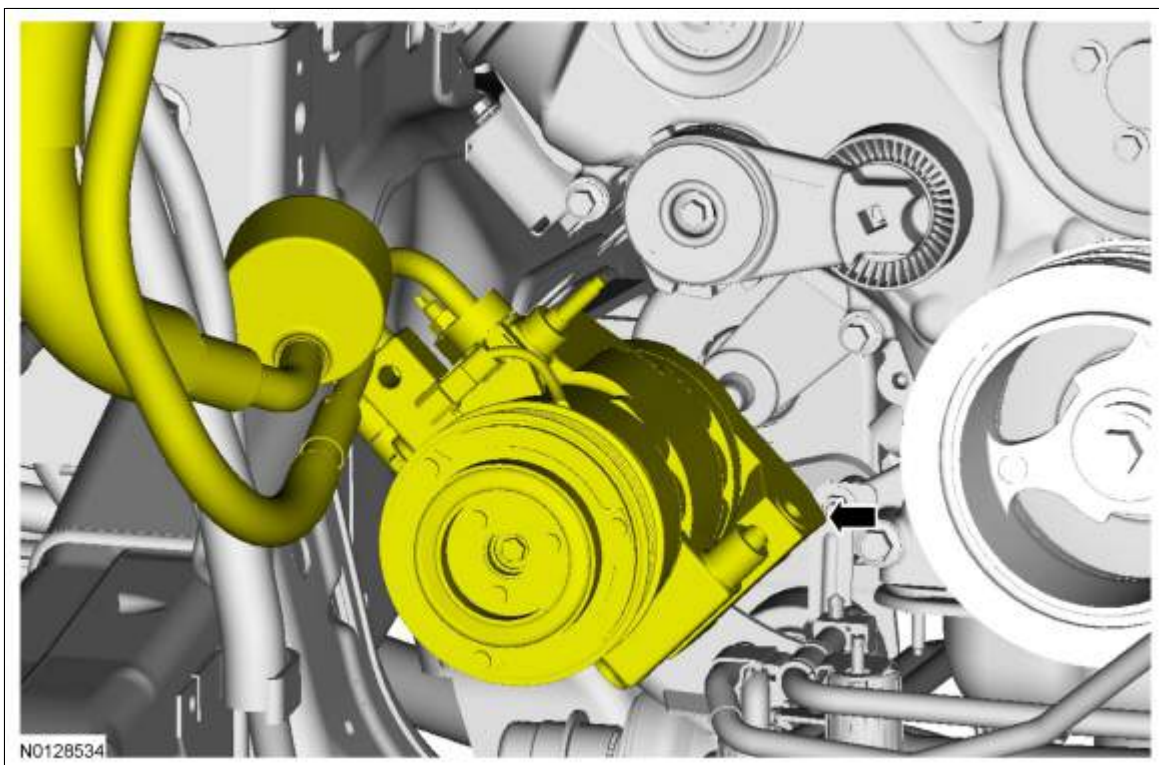


13. **NOTICE:** Only use hand tools when loosening or tightening the engine support insulator through bolts or damage to the engine support insulator-to-cylinder block bracket can occur.

Loosen the LH engine support insulator through bolt.

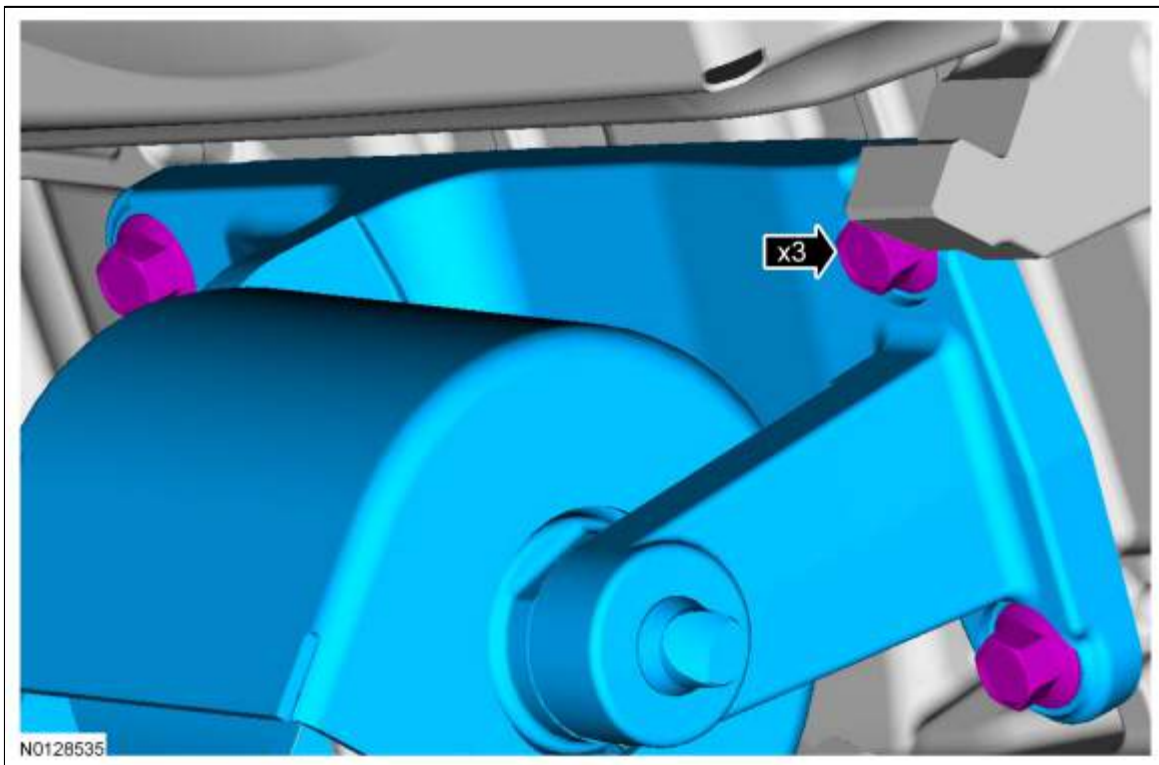


14. Raise the RH side of the engine 50 mm (1.968 in).
15. Position the A/C compressor aside to access the 2 front engine support insulator bracket bolts.



16. Remove the 3 RH engine support insulator bracket-to-engine bolts.

- Remove the RH engine support insulator and bracket as an assembly.

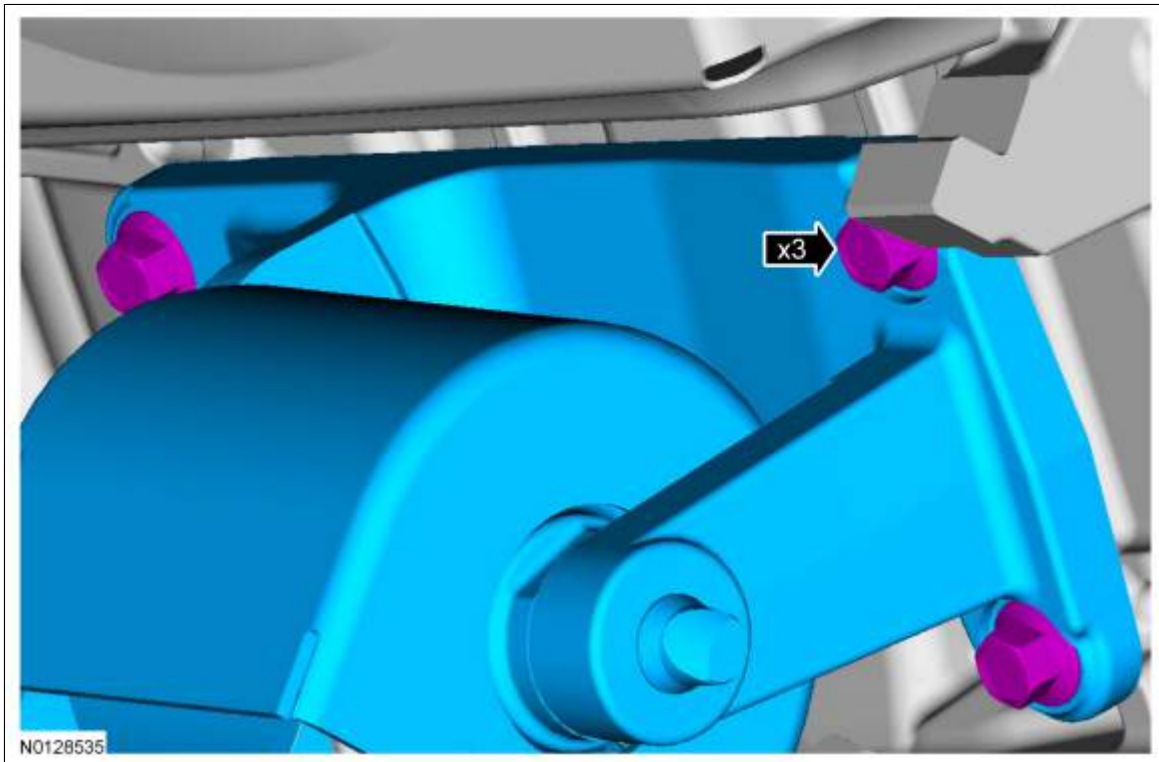


Installation

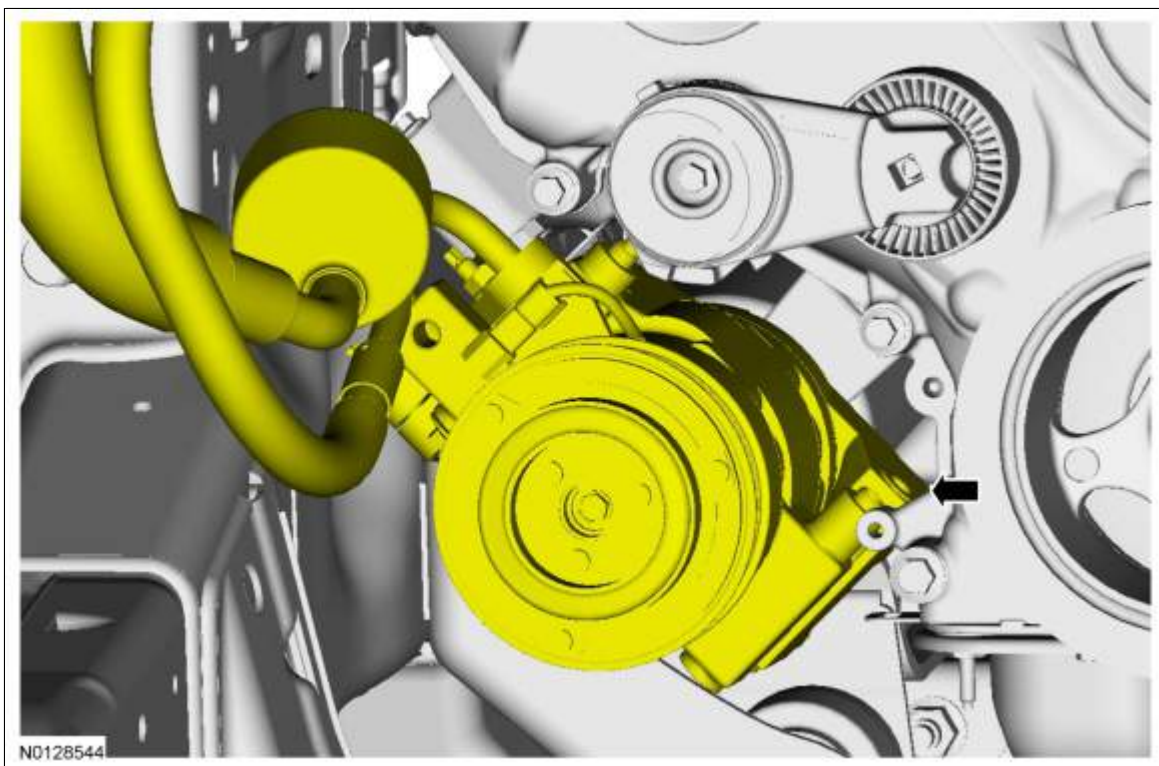
1. Clean the engine support insulator bracket-to-cylinder block and engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.
2. **NOTE:** If a new RH engine support insulator is installed, remove the 2 studs prior to positioning the assembly in the vehicle.

Install the RH engine support insulator and bracket assembly and install the 3 bolts.

- Tighten to 63 Nm (46 lb-ft).



3. Position the A/C compressor below the RH side of the engine.

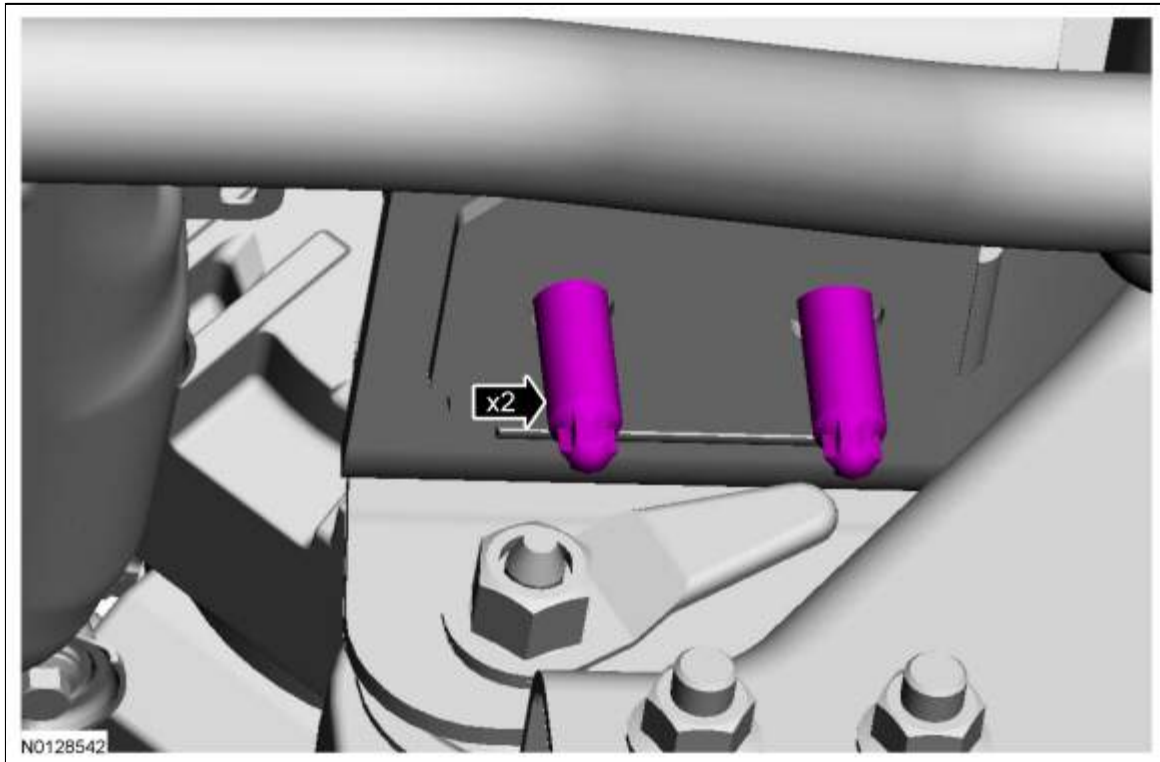


4. Lower the engine to the installed position.
5. **NOTICE:** Only use hand tools when installing the engine support insulator studs or damage to

the engine support insulator can occur.

Install the 2 RH engine support insulator studs.

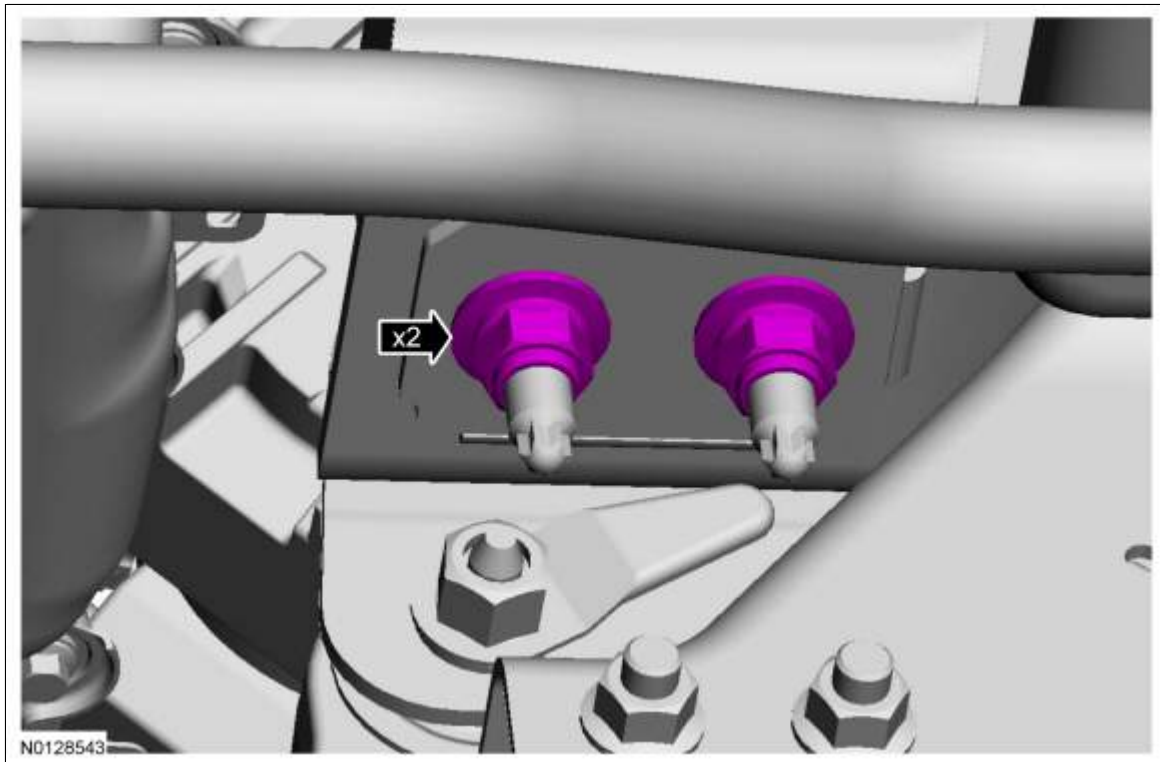
- Tighten to 15 Nm (133 lb-in).



6. **NOTICE:** Only use hand tools when installing the RH engine support insulator nuts or damage to the engine support insulator can occur.

Install the 2 RH engine support insulator nuts.

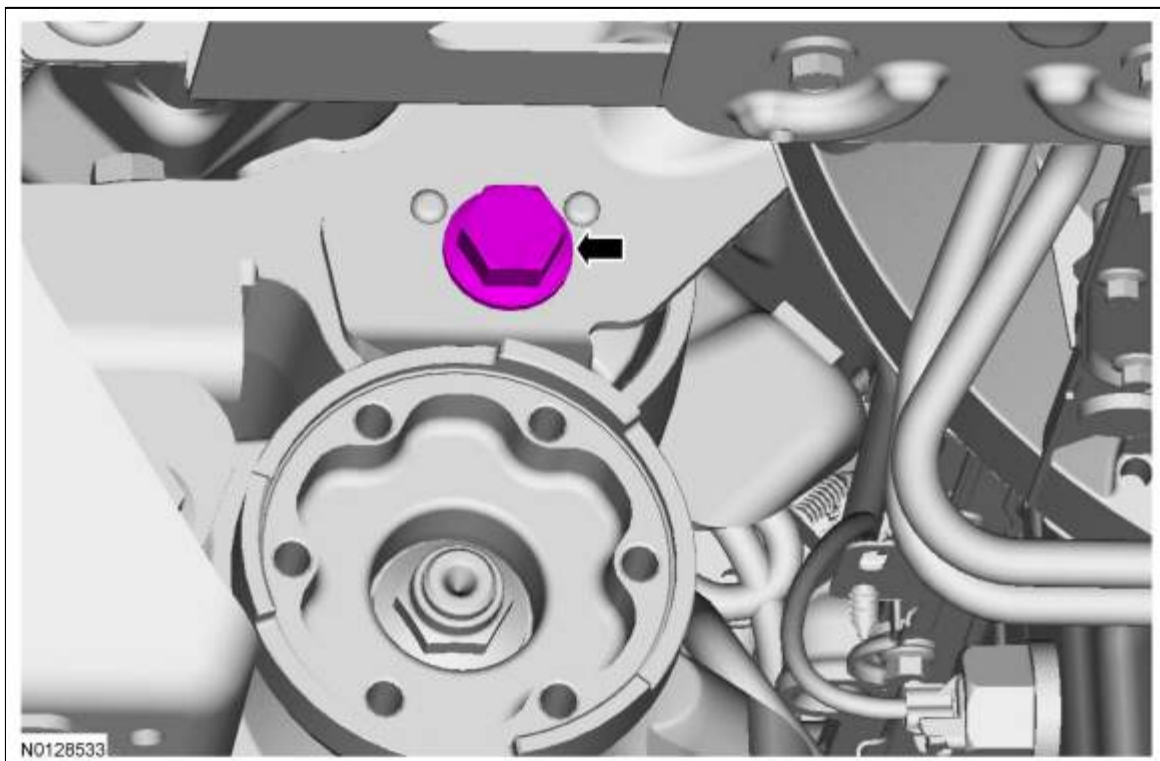
- Tighten to 175 Nm (129 lb-ft).



7. **NOTICE:** Only use hand tools when loosening or tightening the engine support insulator through bolt or damage to the engine support insulator-to-cylinder block bracket can occur.

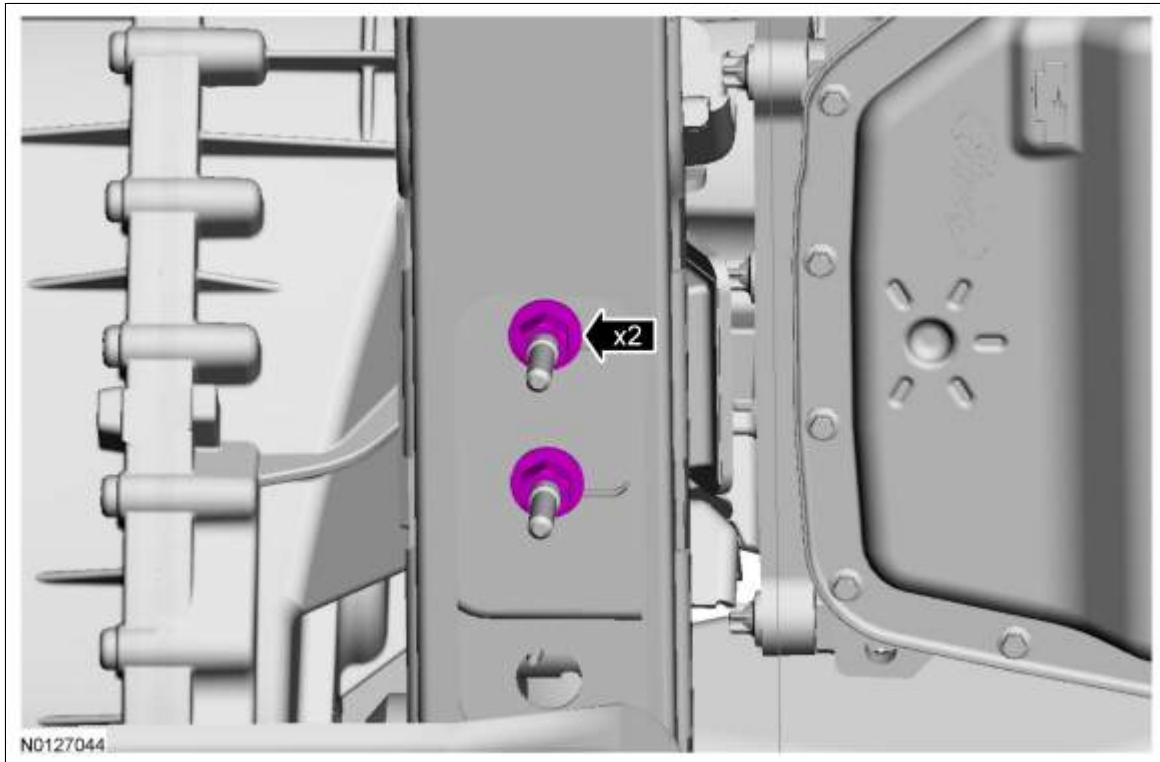
Remove the LH engine support insulator through bolt and apply threadlock to the bolt threads.

- Install the through bolt and tighten to 350 Nm (258 lb-ft).

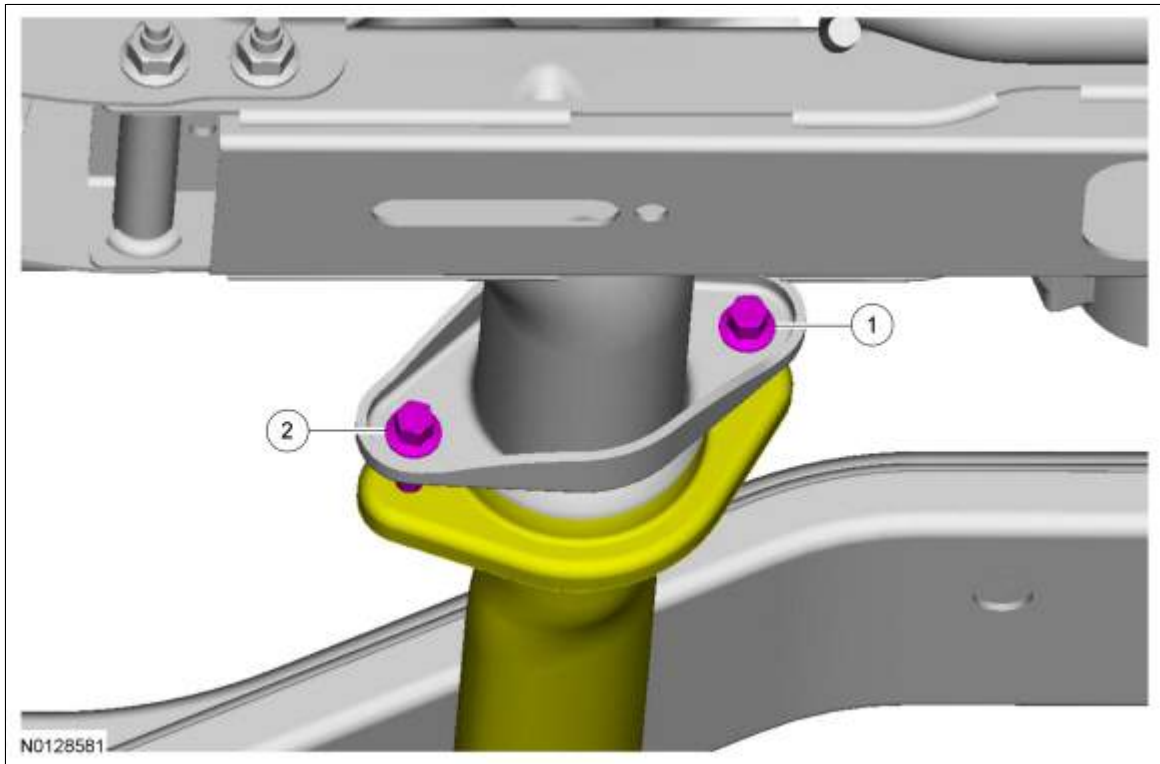


8. **NOTICE:** Only use hand tools when installing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.

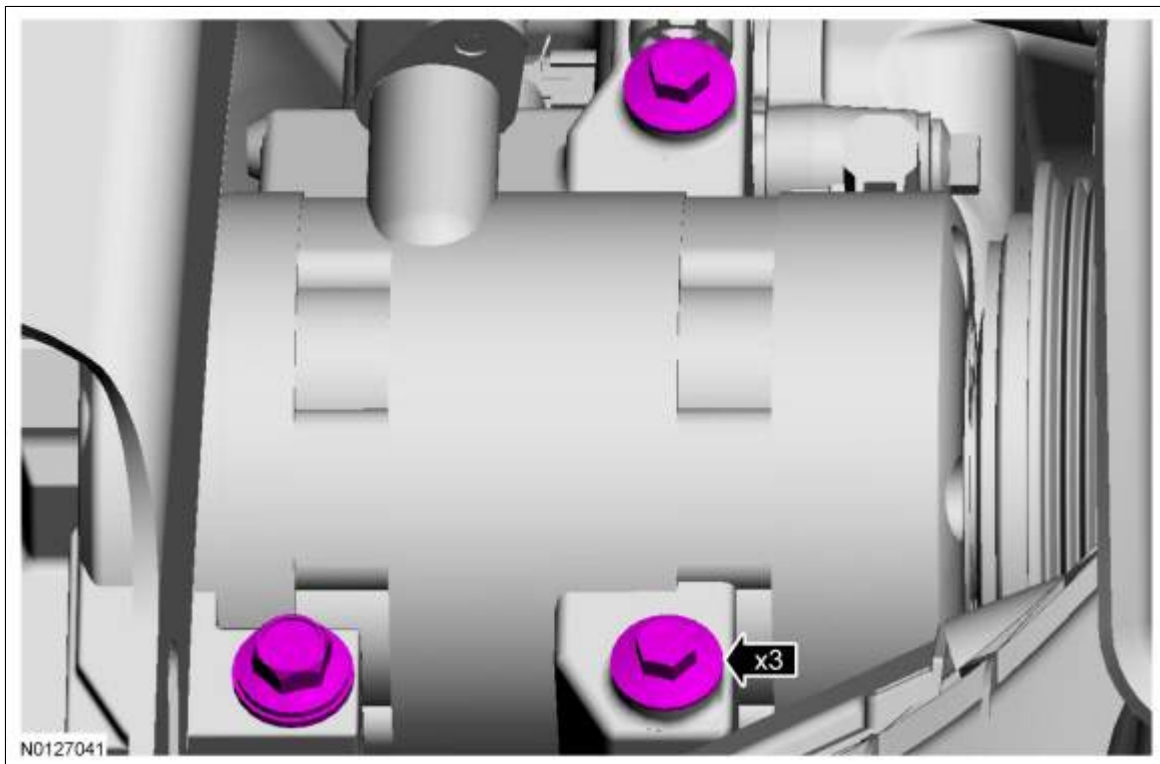
Tighten the transmission mount-to-crossmember nuts to 103 Nm (76 lb-ft).



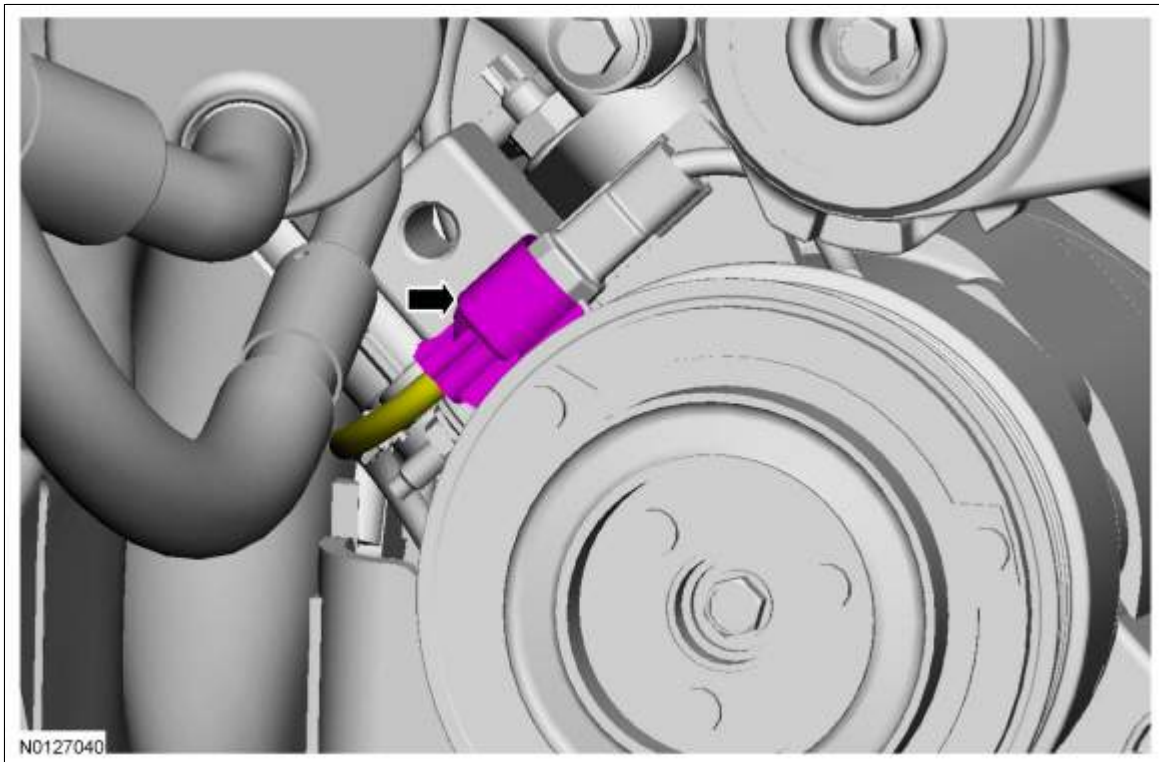
9. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
1. Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
 2. Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).



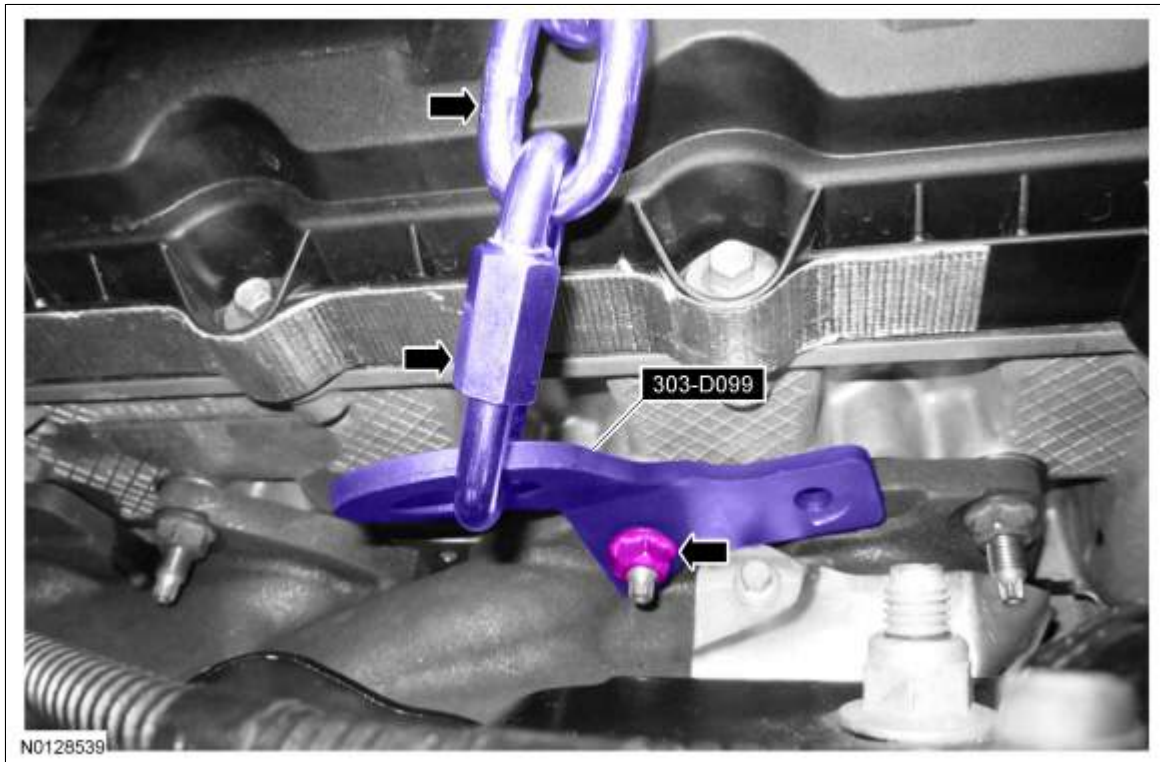
10. Install the A/C compressor and the 3 bolts.
- Tighten to 25 Nm (18 lb-ft).



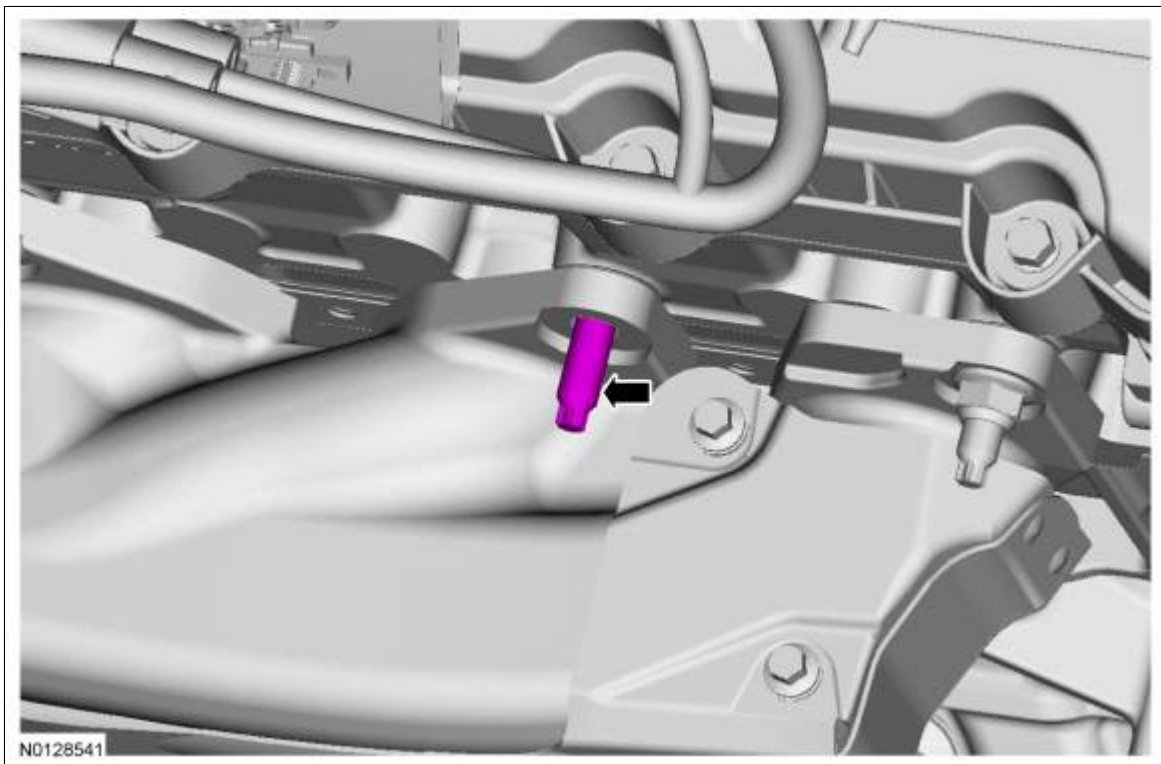
11. Connect the A/C compressor electrical connector.



12. If equipped, install the front driveshaft. For additional information, refer to [Section 205-01](#).
13. Install the starter. For additional information, refer to [Section 303-06](#).
14. Install the A/C compressor belt. For additional information, refer to [Section 303-05](#).
15. Remove the Engine Support Bar.
16. Remove the nut, the Engine Lifting Bracket, the connecting link and chain.

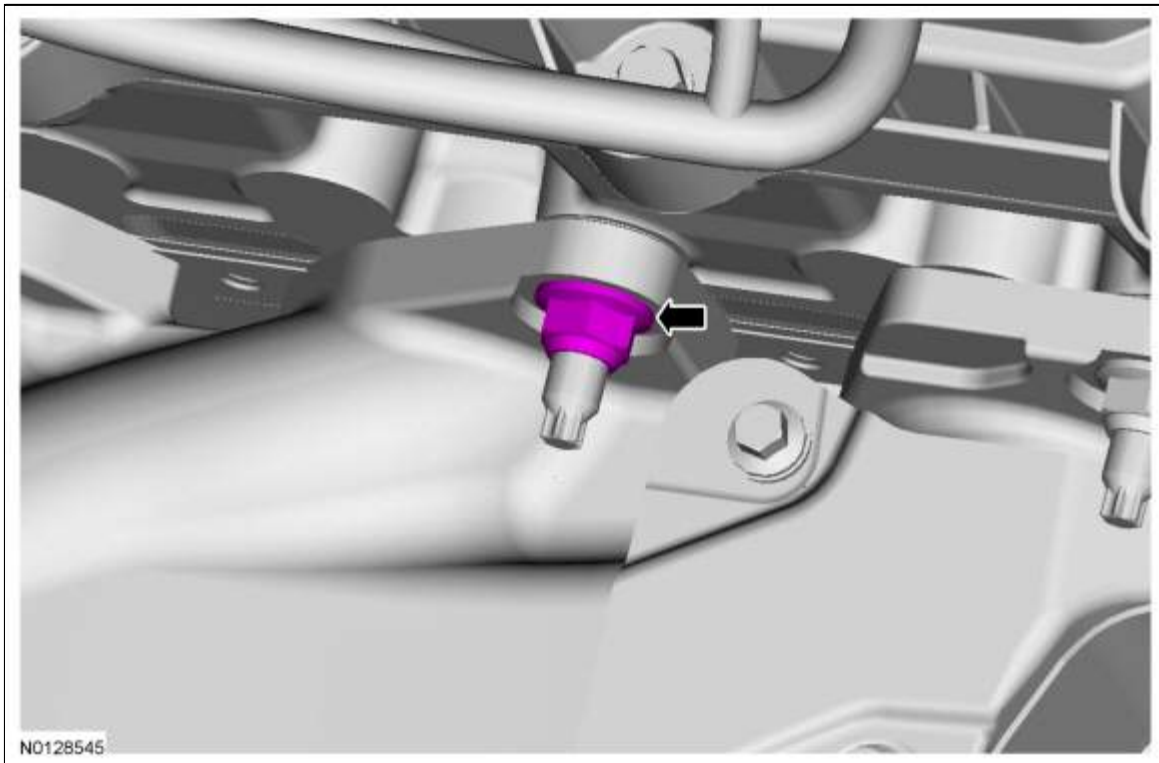


17. Remove and discard the exhaust manifold stud.
- Install a new exhaust manifold stud and tighten to 25 Nm (18 lb-ft).

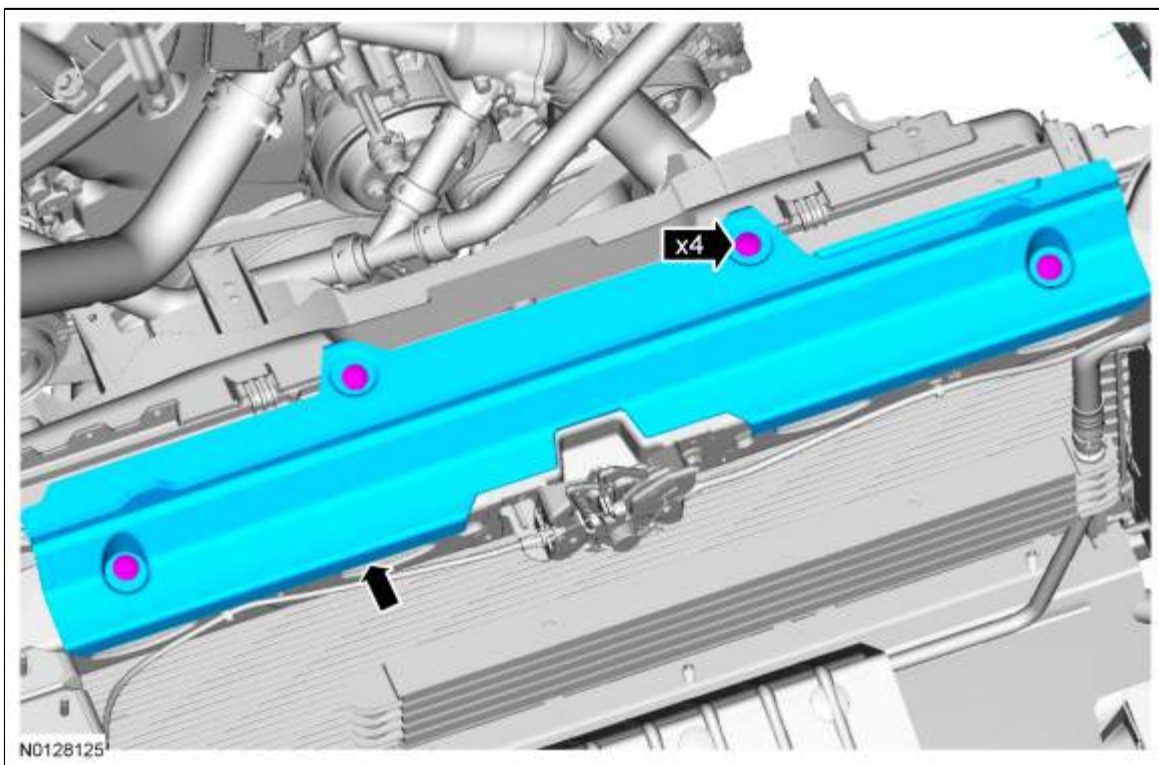


18. Install a new exhaust manifold nut and tighten in 2 stages.
- Stage 1: Tighten to 24 Nm (18 lb-ft).

- Stage 2: Tighten to 32 Nm (24 lb-ft).



19. Install the upper radiator air deflector and the 4 pin-type retainers.



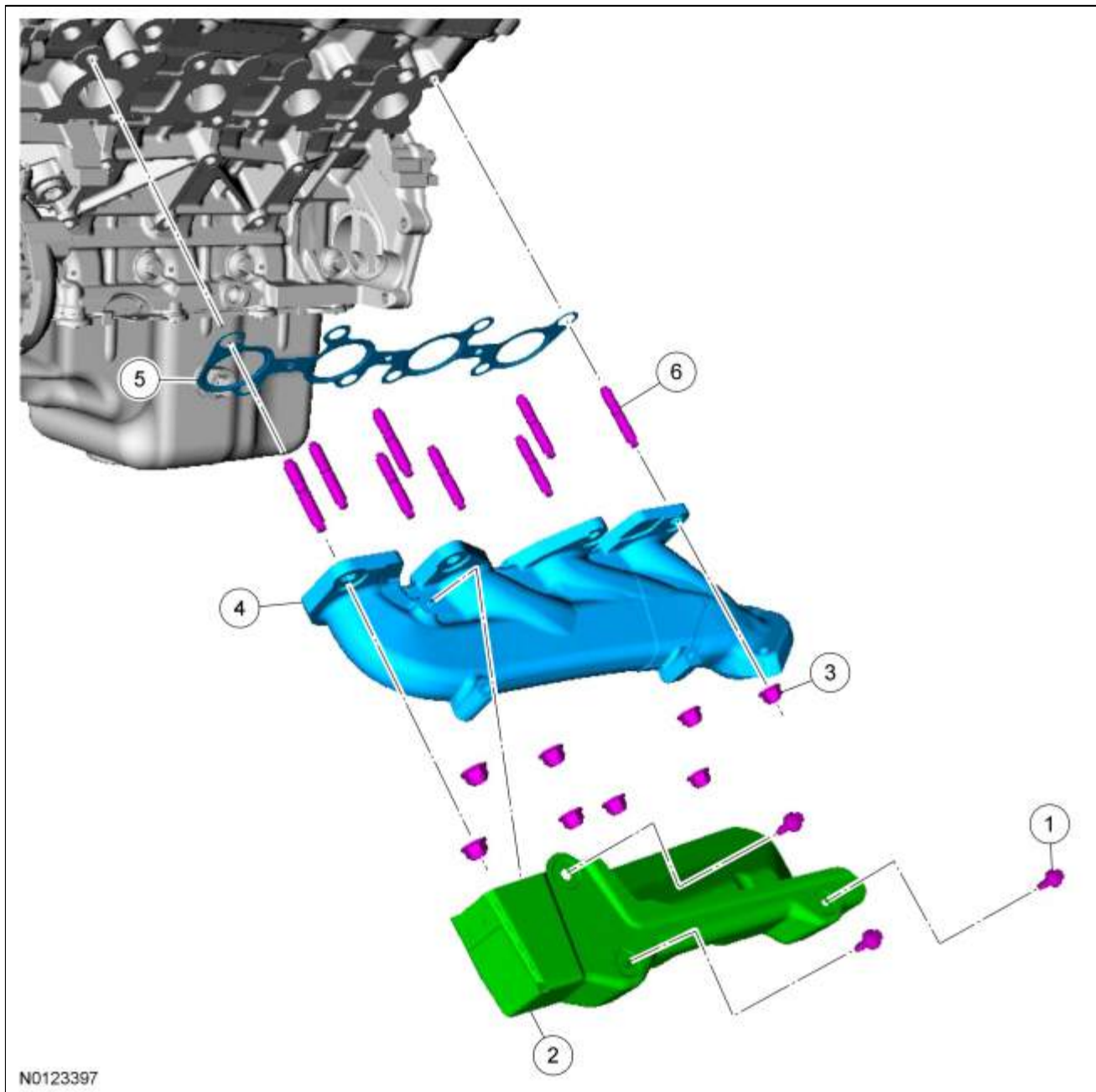
SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Exhaust Manifold — LH

Material

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



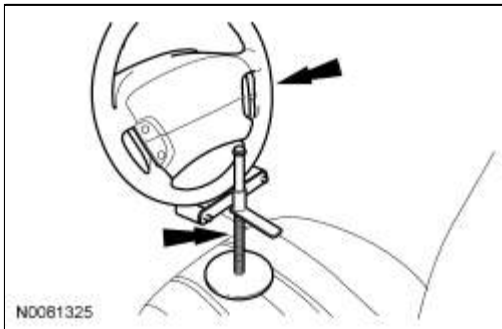
Item	Part Number	Description
1	W714133	LH exhaust manifold heat shield bolts (3 required) - 12 Nm (106 lb-in)
2	9Y427	LH exhaust manifold heat shield
3	W714870	LH exhaust manifold nuts (8 required)
4	9431	LH exhaust manifold
5	9448	LH exhaust manifold gasket
6	W714869	LH exhaust manifold studs (8 required) - 25 Nm (18 lb-ft)

Removal

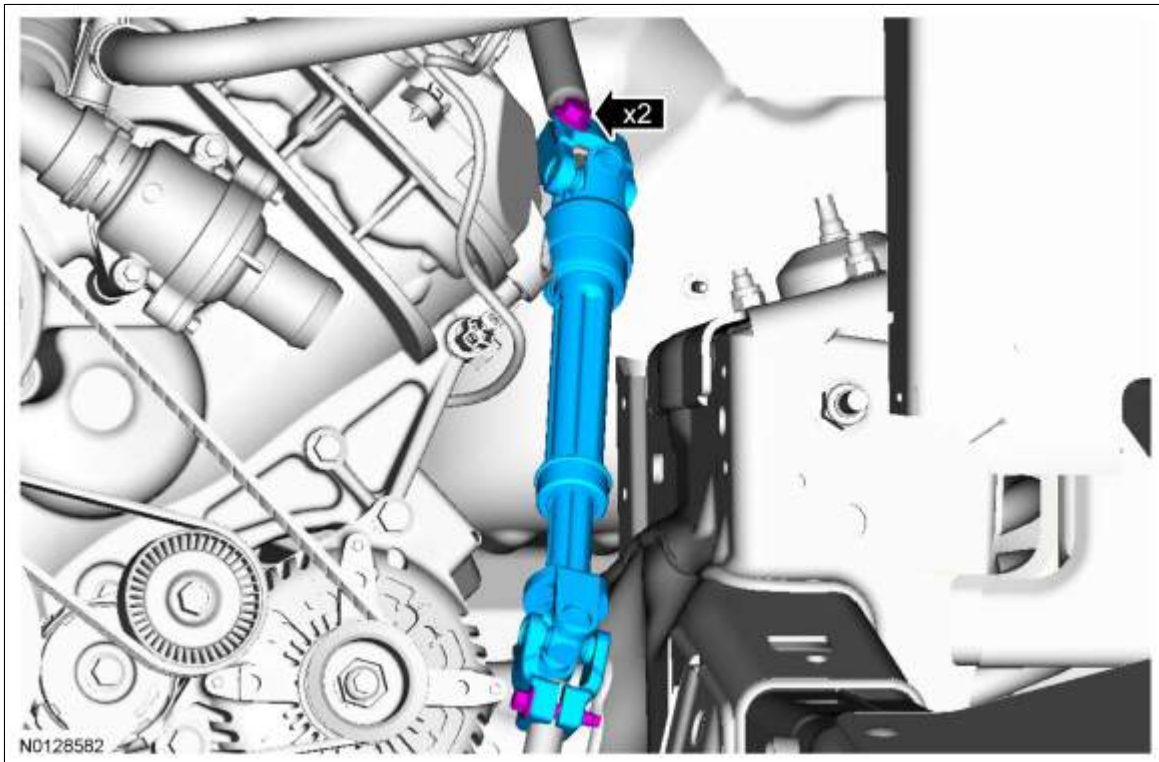
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).

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

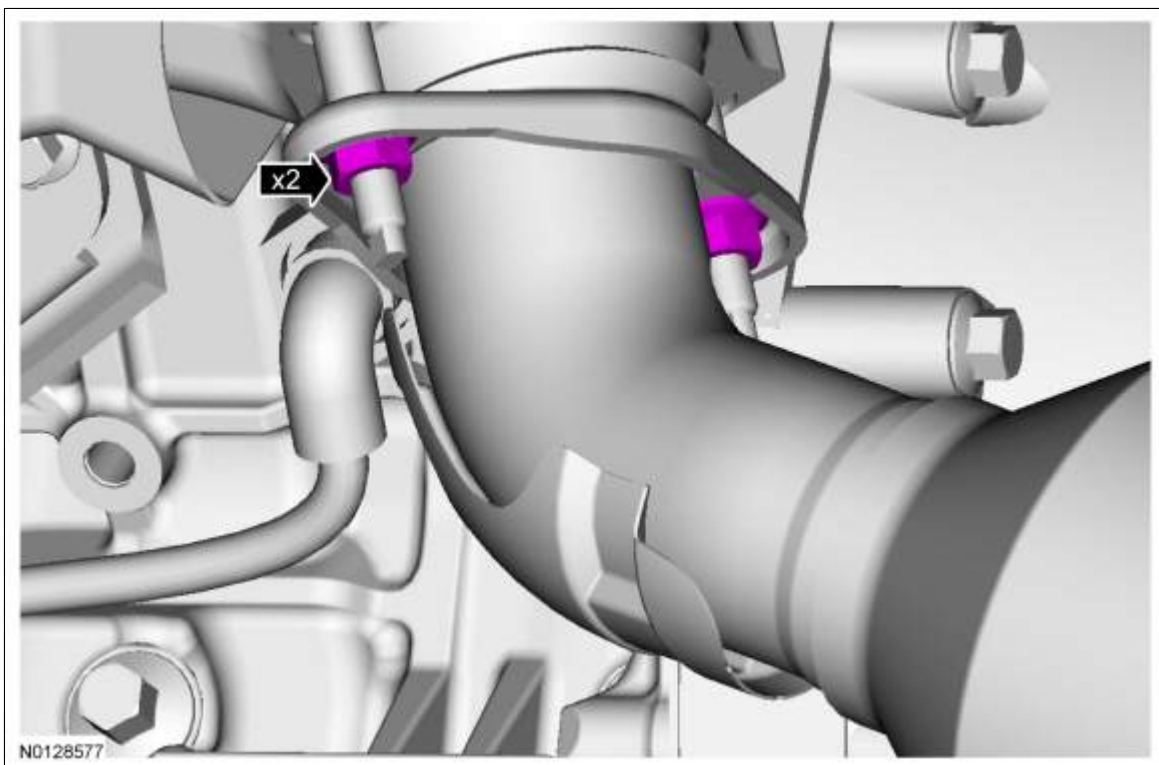
Using a suitable holding device, hold the steering wheel in the straight-ahead position.



3. Remove the air cleaner outlet pipe and air cleaner cover as an assembly. For additional information, refer to [Section 303-12](#).
4. Remove the 2 bolts and remove the lower steering column shaft.

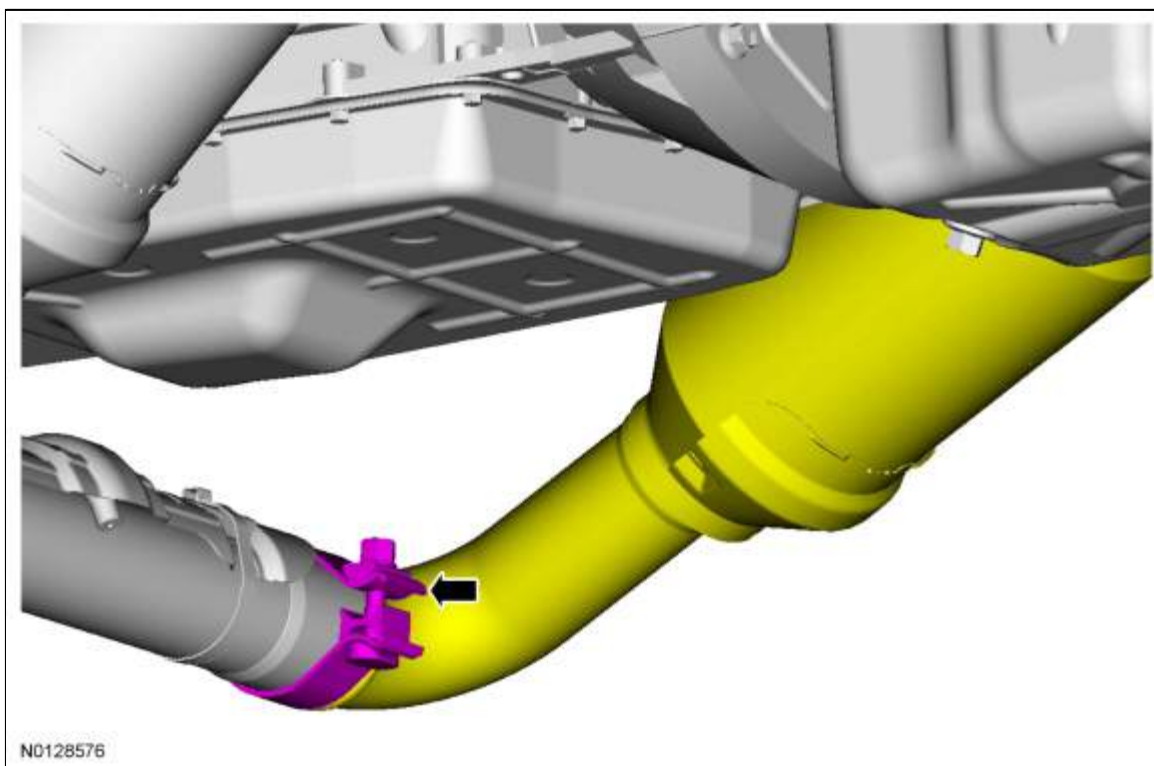


5. Remove the 3 bolts and the LH exhaust manifold heat shield.
6. Remove the 2 catalytic converter-to-LH exhaust manifold nuts.



7. Loosen the LH catalytic converter-to-RH catalytic converter Torca® clamp.

- Lower the catalytic converter to disengage the catalytic converter flange from the LH exhaust manifold studs.

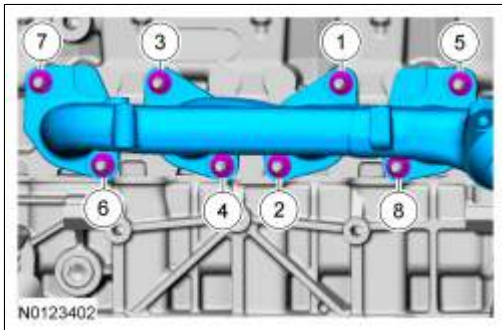


8. Remove the 8 LH exhaust manifold nuts.
9. Working from under the hood, remove the LH exhaust manifold and gasket.
 - Discard the gasket.
10. Clean and inspect the LH exhaust manifold. For additional information, refer to [Section 303-00](#).
11. Remove and discard the 8 LH exhaust manifold studs.
12. **NOTICE: 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 scraper to clean the sealing surfaces.**

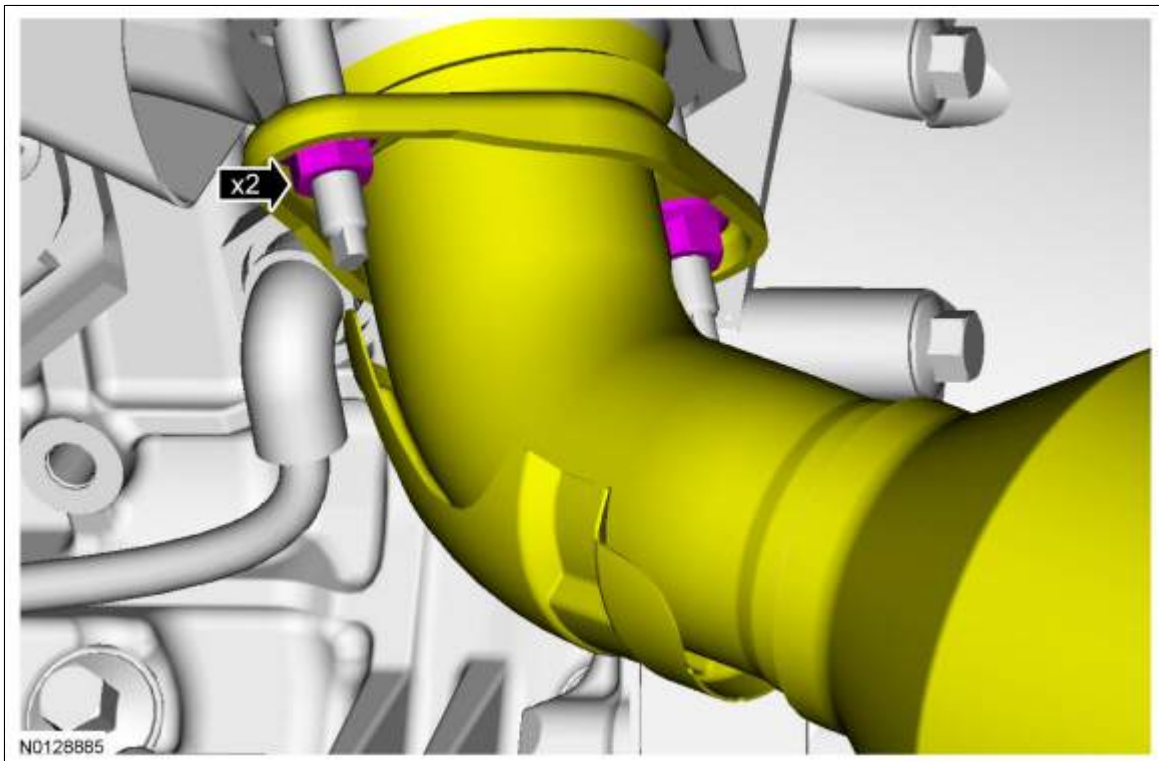
Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

Installation

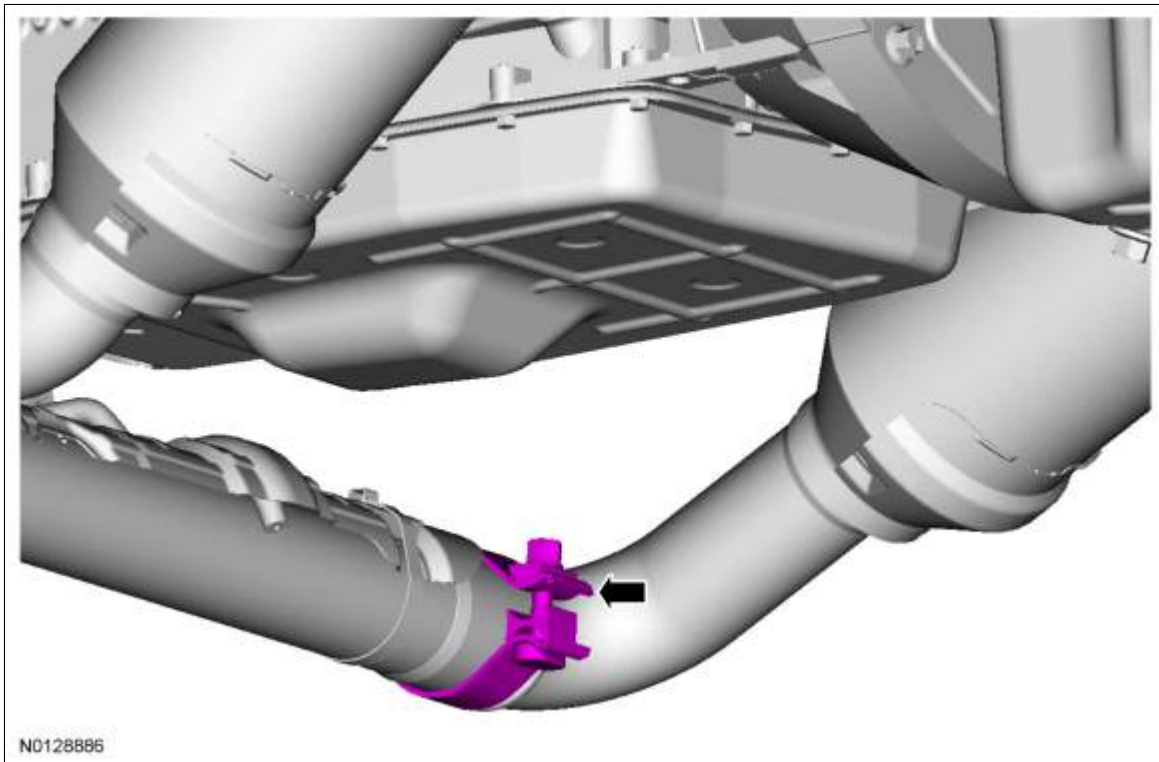
1. Install 8 new LH exhaust manifold studs.
 - Tighten to 25 Nm (18 lb-ft).
2. Install a new gasket, the LH exhaust manifold and 8 new nuts.
 - Tighten in the sequence shown in 2 stages.
 - Stage 1: Tighten to 24 Nm (18 lb-ft).
 - Stage 2: Tighten to 32 Nm (24 lb-ft).



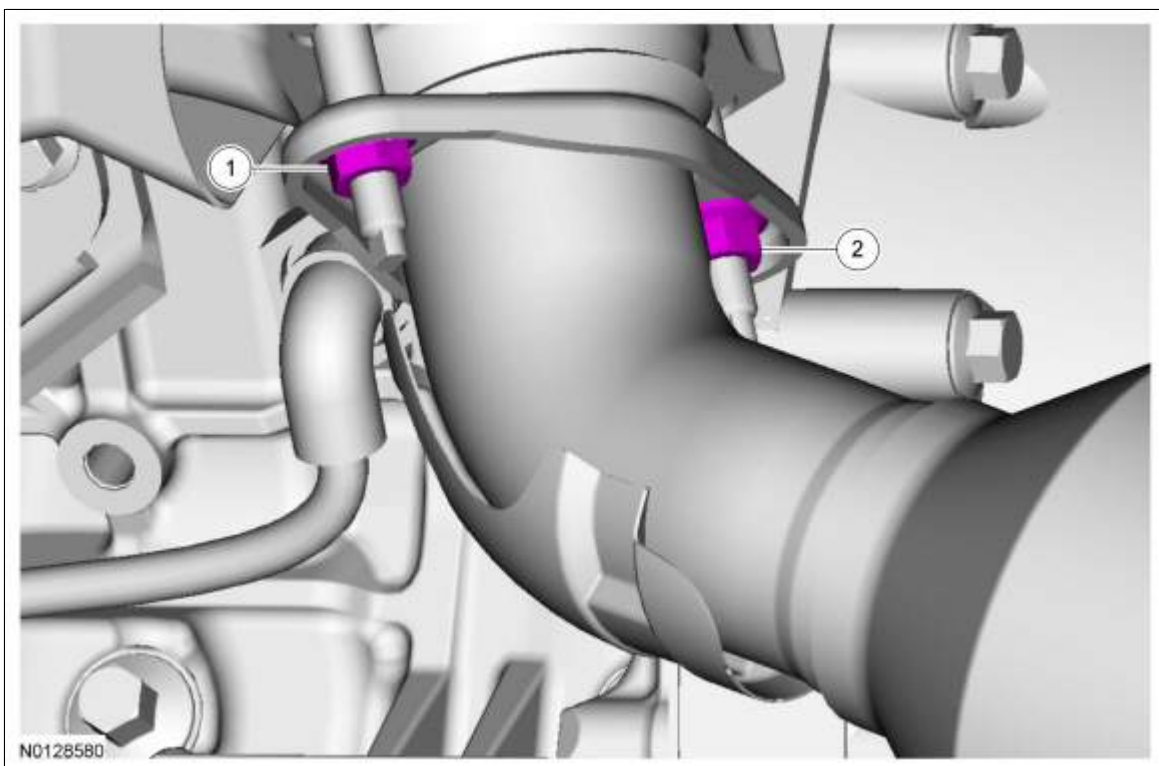
3. Position the LH catalytic converter onto the LH exhaust manifold and loosely install the 2 nuts.



4. Tighten the LH catalytic converter-to-RH catalytic converter Torca® clamp to 55 Nm (41 lb-ft).

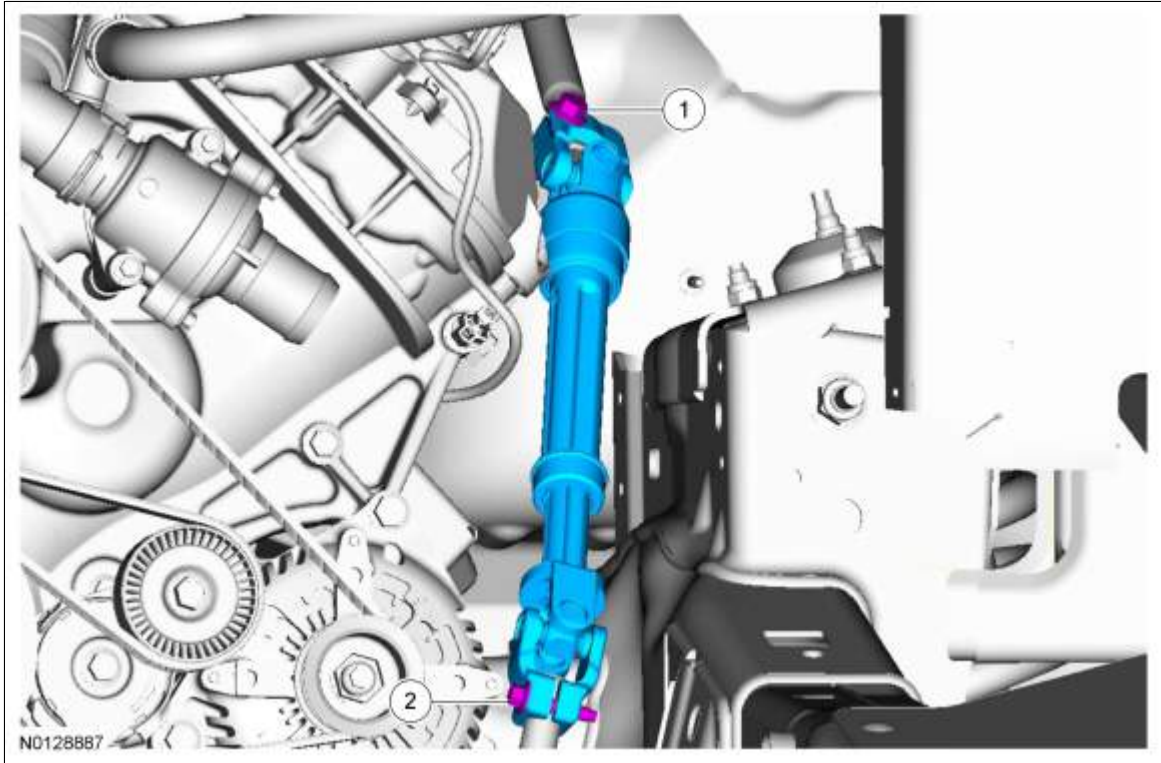


5. Tighten the 2 new LH catalytic converter-to-exhaust manifold nuts in the following sequence.
 1. Tighten the LH outer catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).
 2. Tighten the LH inner catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).



6. Install the LH exhaust manifold heat shield and the 3 bolts.

- Tighten to 12 Nm (106 lb-in).
7. Install the lower steering column shaft and the 2 bolts.
 1. Tighten the upper bolt to 48 Nm (35 lb-ft).
 2. Tighten the lower bolt to 30 Nm (22 lb-ft).



8. Install the air cleaner outlet pipe and air cleaner cover assembly. For additional information, refer to [Section 303-12](#).

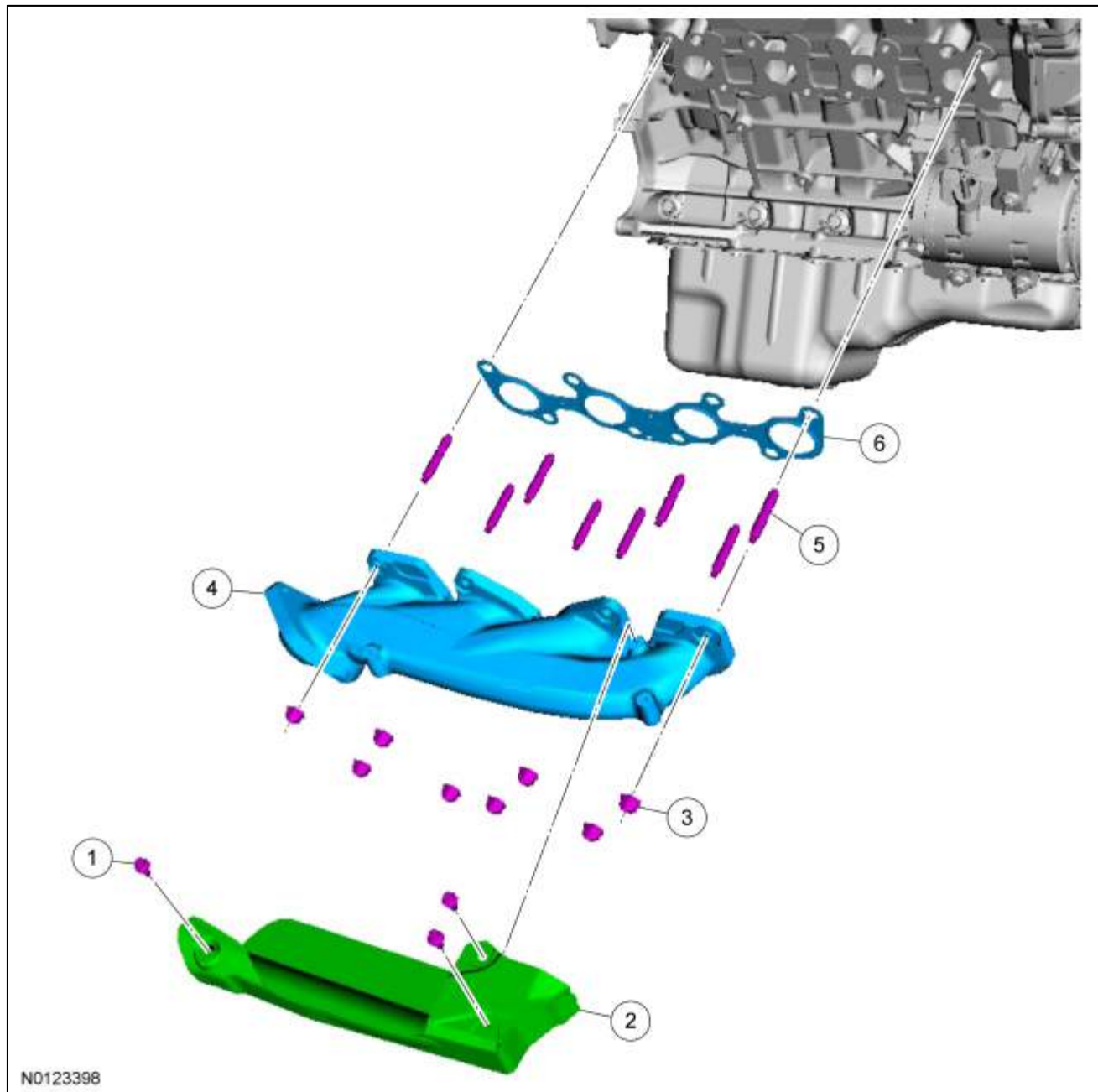
SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Exhaust Manifold — RH

Material

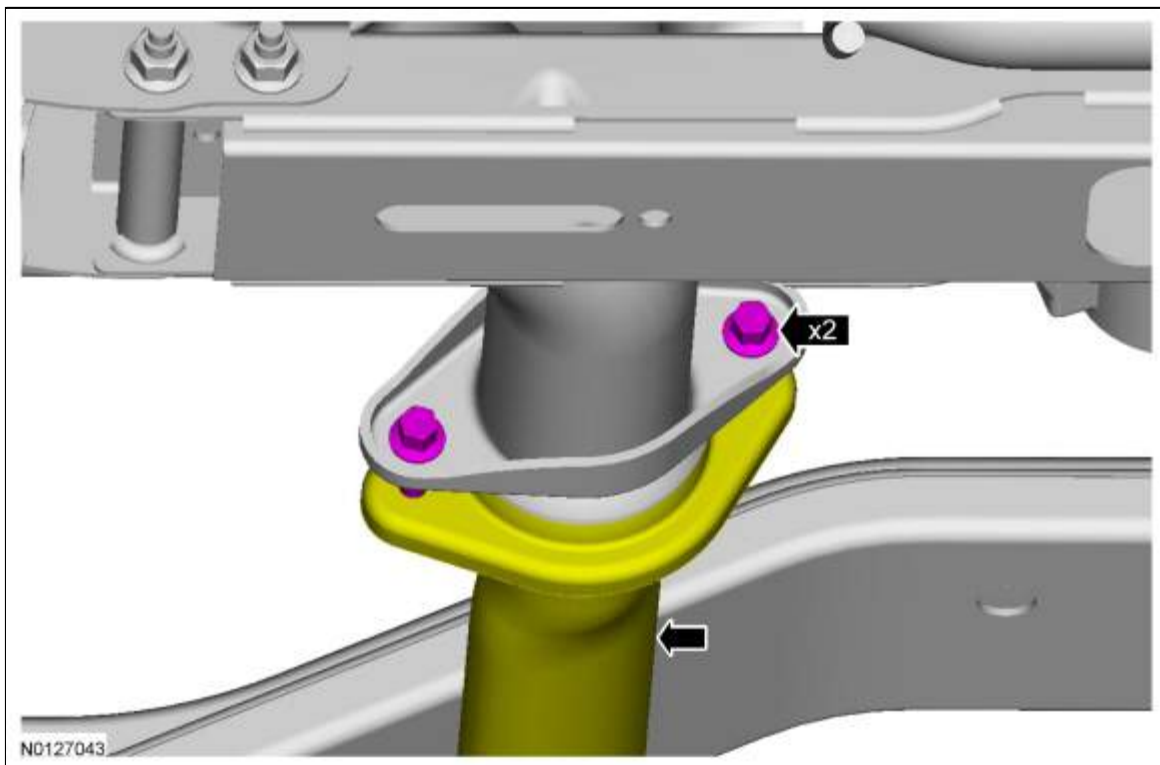
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—



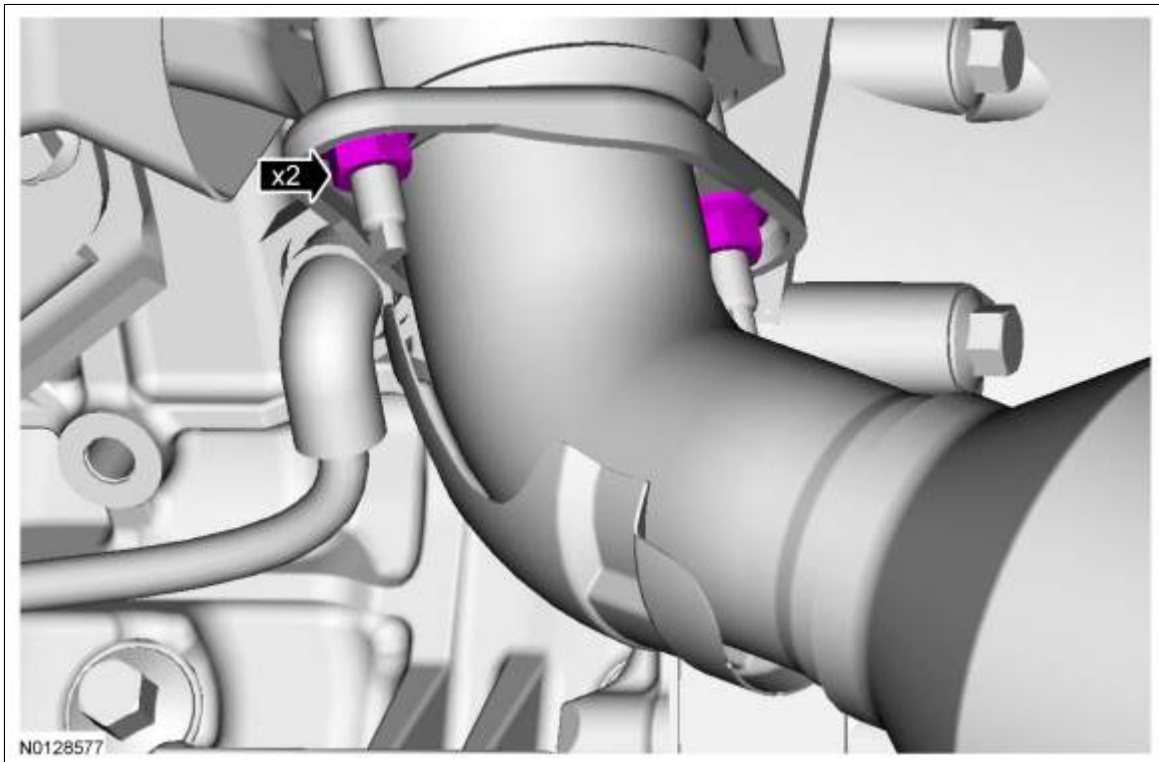
Item	Part Number	Description
1	W714133	RH exhaust manifold heat shield bolts (3 required) - 12 Nm (106 lb-in)
2	9A462	RH exhaust manifold heat shield
3	W714870	RH exhaust manifold nuts (8 required)
4	9430	RH exhaust manifold
5	W714869	RH exhaust manifold studs (8 required) - 25 Nm (18 lb-ft)
6	9448	RH exhaust manifold gasket

Removal

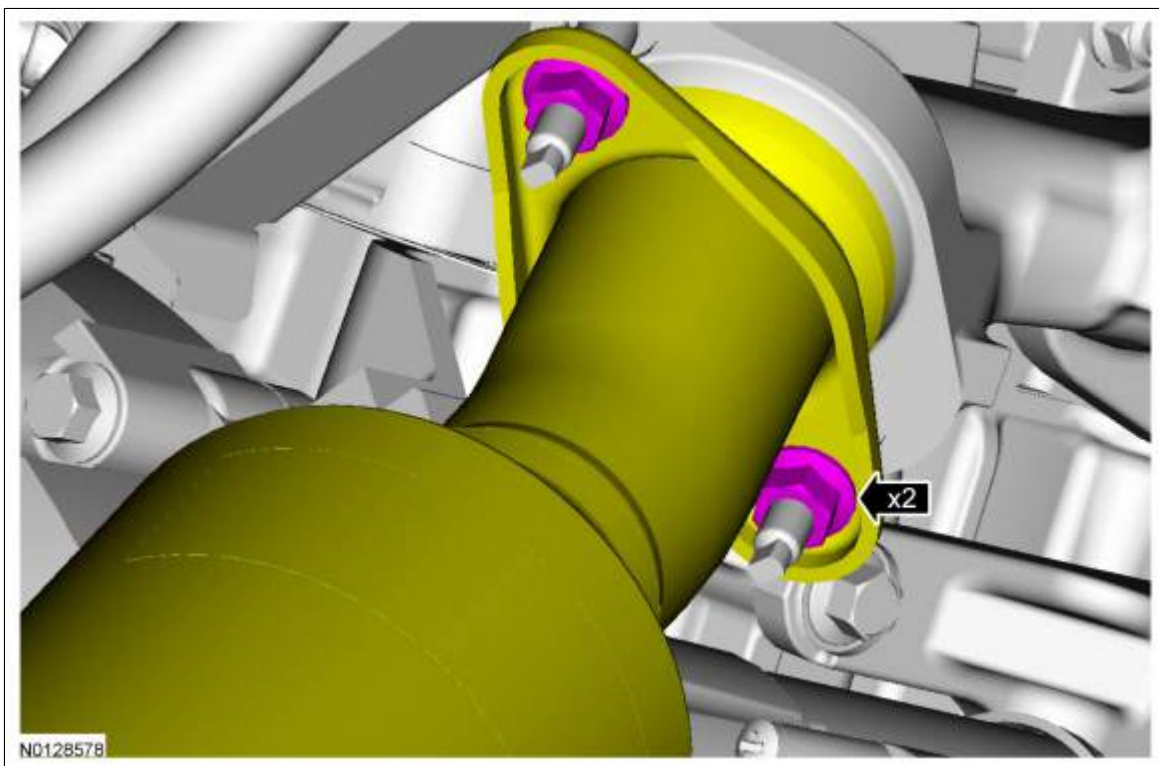
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the A/C compressor. For additional information, refer to [Section 412-01](#).
3. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
4. Remove the 3 bolts and the RH exhaust manifold heat shield.
5. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
 - Discard the bolts.



6. Remove the 2 catalytic converter-to-LH exhaust manifold nuts.



7. Remove the 2 catalytic converter-to-RH exhaust manifold nuts.
 - Separate the exhaust Y-pipe dual catalytic converter from the exhaust manifolds.



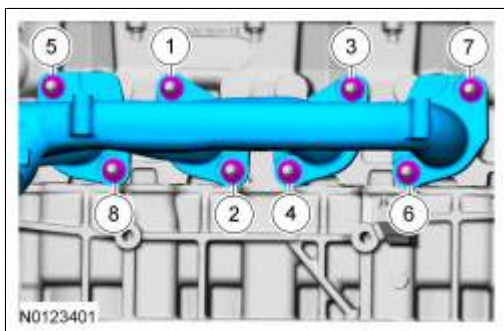
8. Remove the 4 lower RH exhaust manifold nuts.

9. Remove the 4 top RH exhaust manifold nuts.
 - Remove and discard the 4 top RH exhaust manifold studs.
10. Working from under the hood, remove the RH exhaust manifold and gasket.
 - Discard the gasket.
11. Clean and inspect the RH exhaust manifold. For additional information, refer to [Section 303-00](#).
12. Remove and discard the 4 lower RH exhaust manifold studs.
13. **NOTICE: 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 scraper to clean the sealing surfaces.**

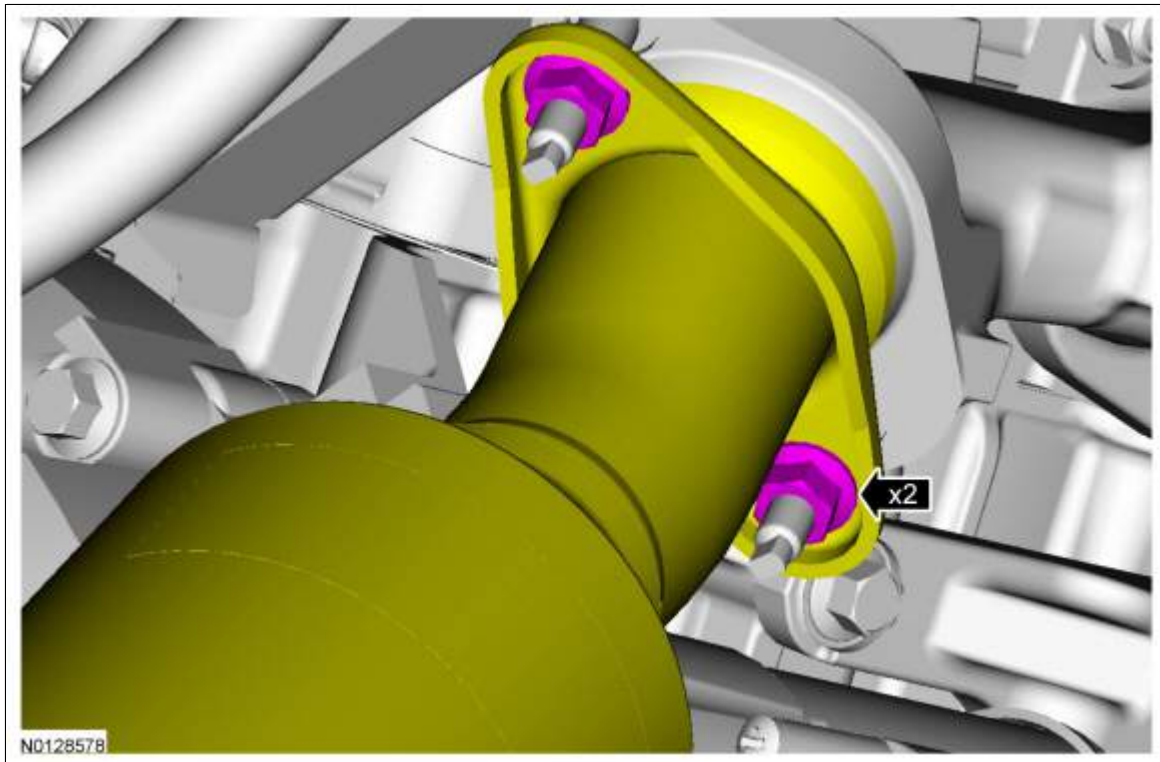
Clean the exhaust manifold mating surface of the cylinder head with metal surface prep. Follow the directions on the packaging.

Installation

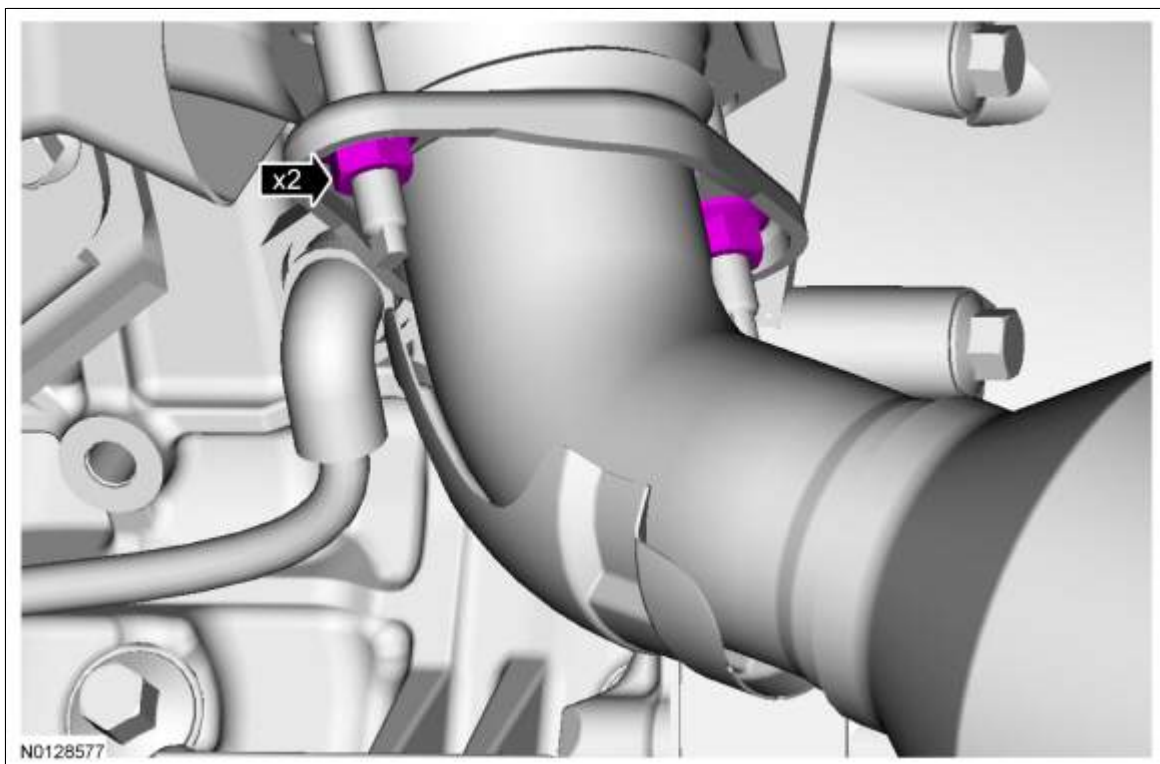
1. Install 4 new lower RH exhaust manifold studs.
 - Tighten to 25 Nm (18 lb-ft).
2. Install a new gasket, the RH exhaust manifold and 4 new lower exhaust manifold nuts.
 - Do not tighten the nuts at this time.
3. Install 4 new upper RH exhaust manifold studs.
 - Tighten to 25 Nm (18 lb-ft).
4. Install 4 new upper RH exhaust manifold nuts.
 - Do not tighten the nuts at this time.
5. Tighten the nuts in the sequence shown in 2 stages.
 - Stage 1: Tighten to 24 Nm (18 lb-ft).
 - Stage 2: Tighten to 32 Nm (24 lb-ft).



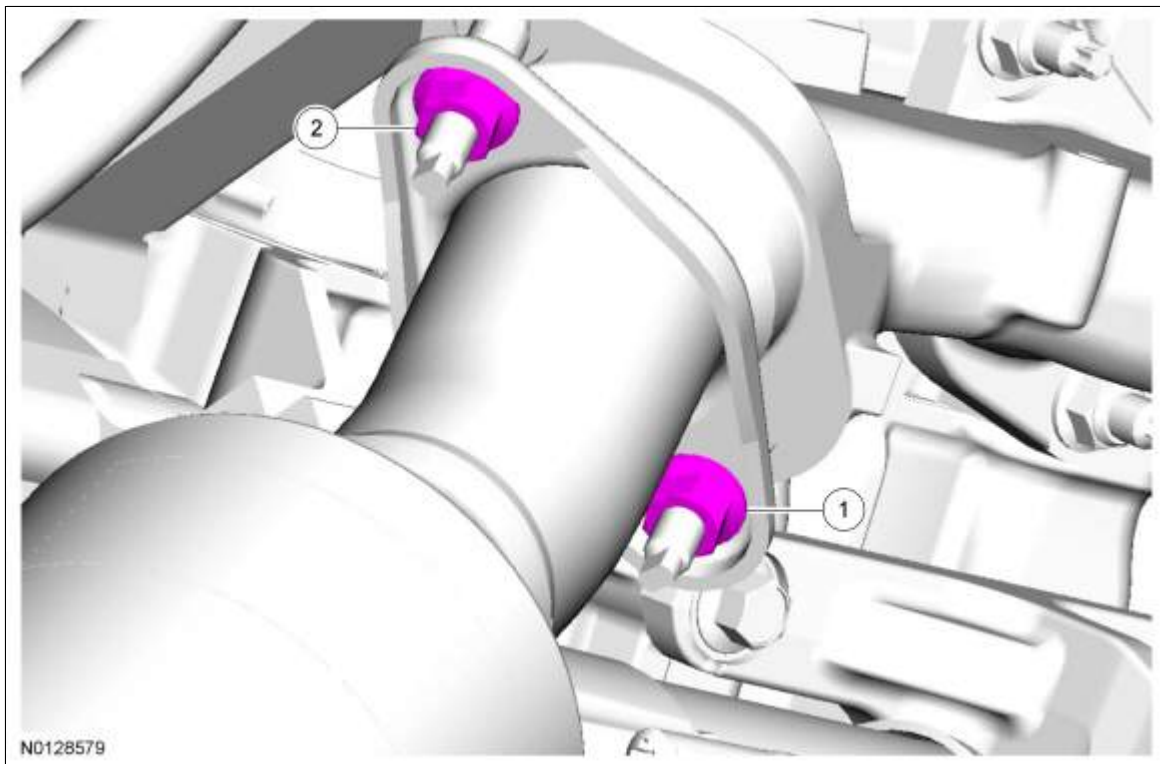
6. Position the exhaust Y-pipe dual catalytic converter onto the exhaust manifolds and loosely install 2 new RH catalytic converter-to-exhaust manifold nuts.



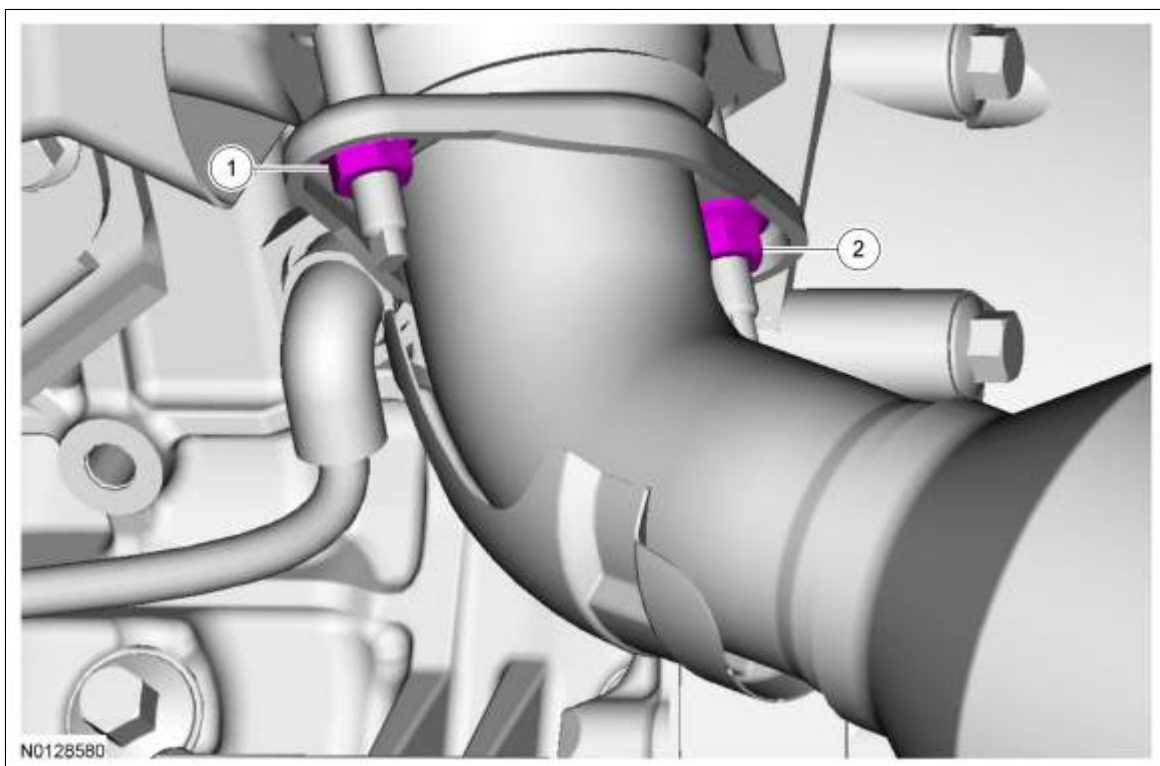
7. Loosely install 2 new LH catalytic converter-to-exhaust manifold nuts.



8. Tighten the 2 new RH catalytic converter-to-exhaust manifold nuts in the following sequence.
 1. Tighten the RH lower catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).
 2. Tighten the RH upper catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).

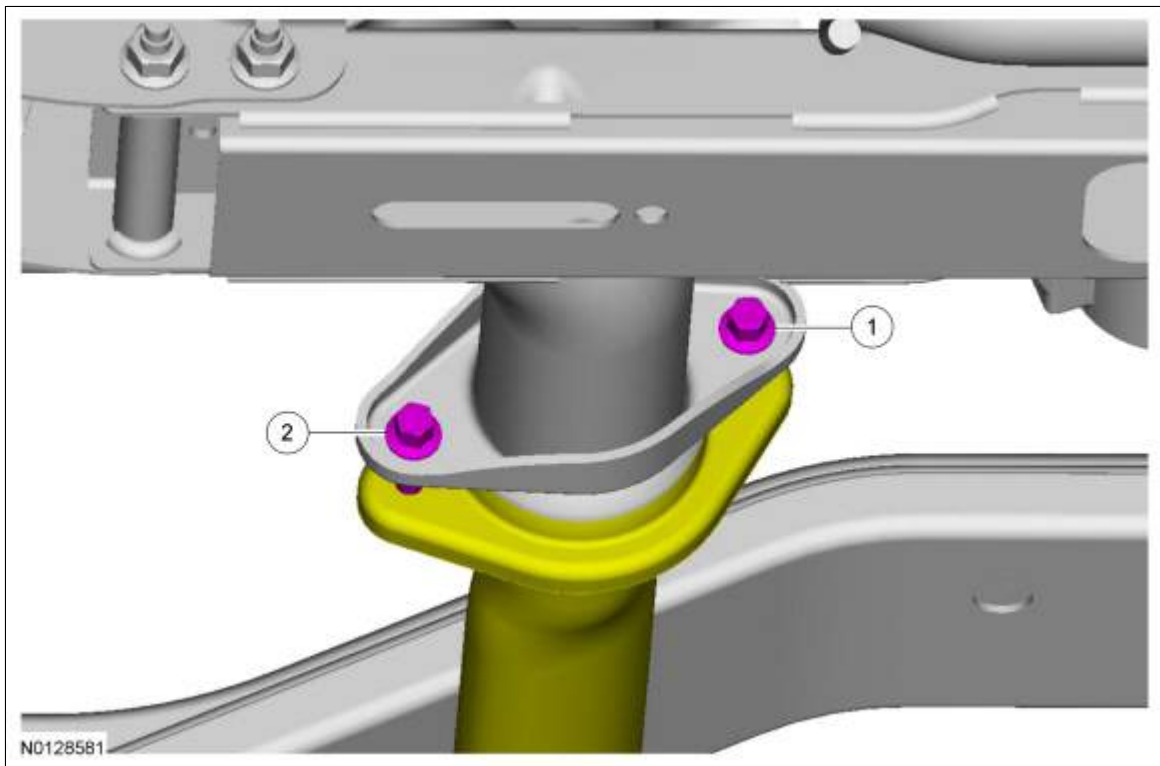


9. Tighten the 2 new LH catalytic converter-to-exhaust manifold nuts in the following sequence.
1. Tighten the LH outer catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).
 2. Tighten the LH inner catalytic converter-to-exhaust manifold nut to 40 Nm (30 lb-ft).



10. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.

1. Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
2. Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).

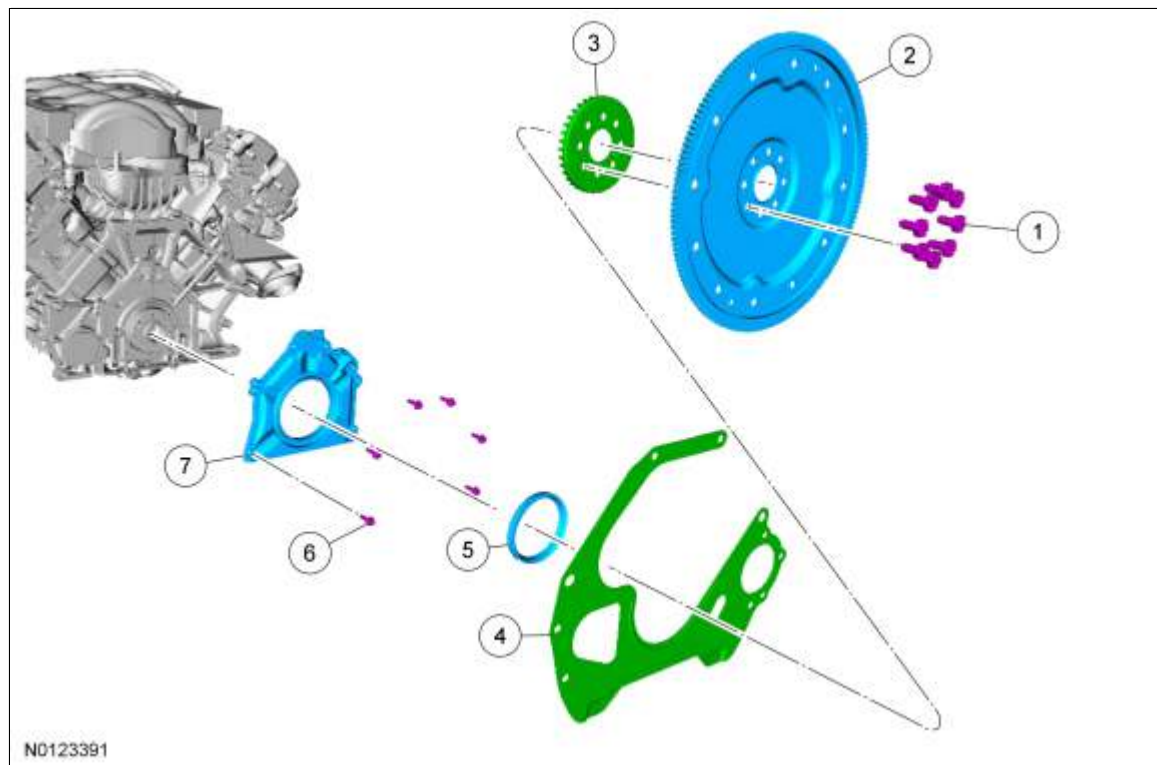


11. Install the RH exhaust manifold heat shield and the 3 bolts.
 - Tighten to 12 Nm (106 lb-in).
 12. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
 13. Install the A/C compressor. For additional information, refer to [Section 412-01](#).
-

SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Flexplate or Flywheel and Crankshaft Rear Seal — Exploded View



Item	Part Number	Description
1	6379	Flexplate bolt (8 required)
2	6375	Flexplate
3	12A227	Crankshaft sensor ring
4	6A373	Separator plate
5	6701	Crankshaft rear seal
6	W714962	Crankshaft rear seal retainer plate bolt (6 required)
7	6K318	Crankshaft rear seal retainer plate


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

SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

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Flexplate

Special Tool(s)

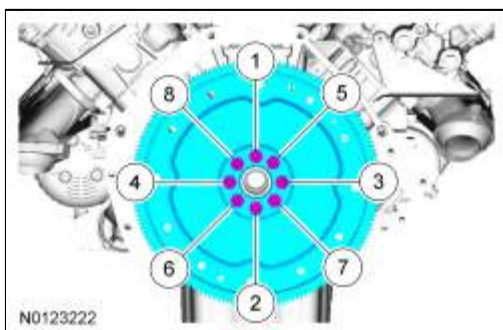
	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool
---	---

Removal and Installation

1. Remove the transmission. For additional information, refer to [Section 307-01](#).
2. **NOTE:** The flexplate bolts are torque-to-yield design and are not reusable.

Remove the 8 bolts and the flexplate.

- Discard the bolts.
- To install, tighten in the sequence shown in 2 stages.
 - Stage 1: Tighten to 20 Nm (177 lb-in).
 - Stage 2: Tighten an additional 60 degrees.



3. To install, reverse the removal procedure.
 - After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure, following the on-screen instructions.

SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

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Hydraulic Lash Adjuster

Material

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

Removal and Installation

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

NOTE: If the components are to be reinstalled, they must be installed in their original locations. Mark the components for installation into their original locations.

1. Remove the camshaft for the hydraulic lash adjuster being serviced. For additional information, refer to [Camshaft — RH](#) and/or [Camshaft — LH](#) in this section.
 2. Remove the camshaft roller follower and hydraulic lash adjuster as an assembly.
 3. Separate the hydraulic lash adjuster from the spring clip on the camshaft roller follower.
 4. To install, reverse the removal procedure.
 - Lubricate the camshaft roller follower and hydraulic lash adjuster assembly with clean engine oil prior to installation.
-

SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

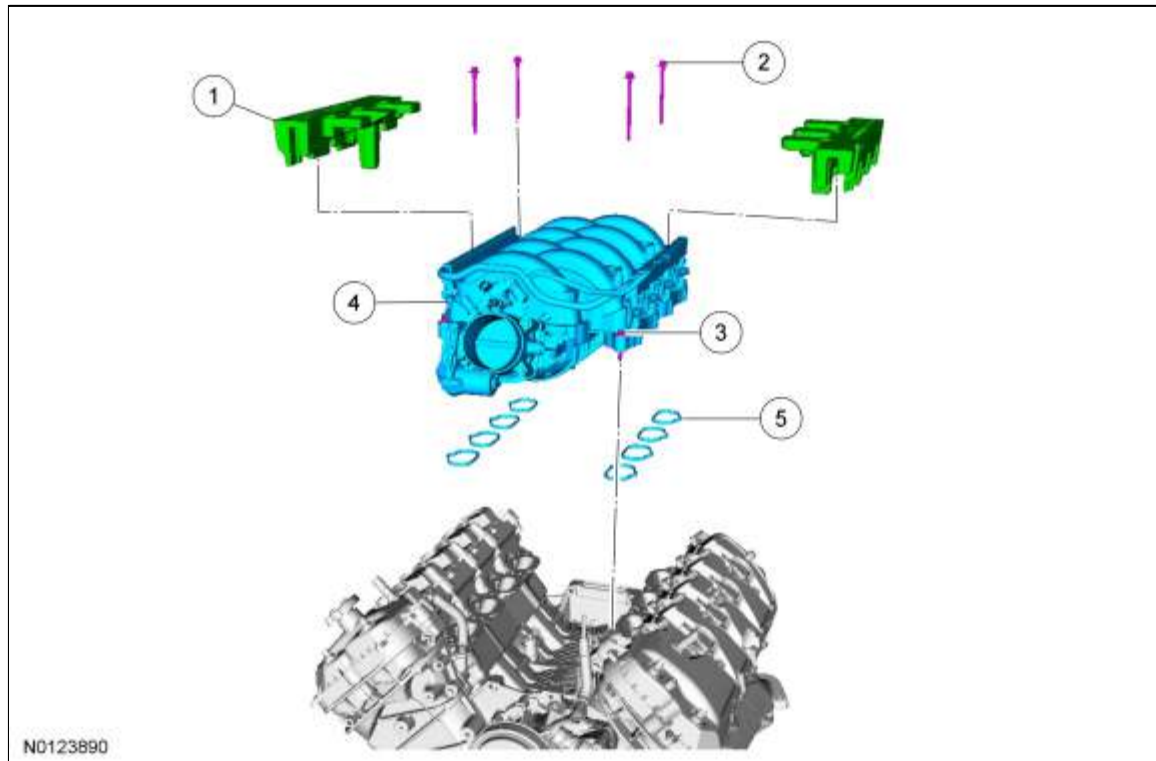
Intake Manifold

Material

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

NOTE: [Refer to the on-line Workshop Manual to view this illustration as an interactive exploded view, requires Adobe® Acrobat® 8.0 or higher.](#)

NOTE: [Refer to the on-line Workshop Manual to learn about using an Interactive Illustration.](#)



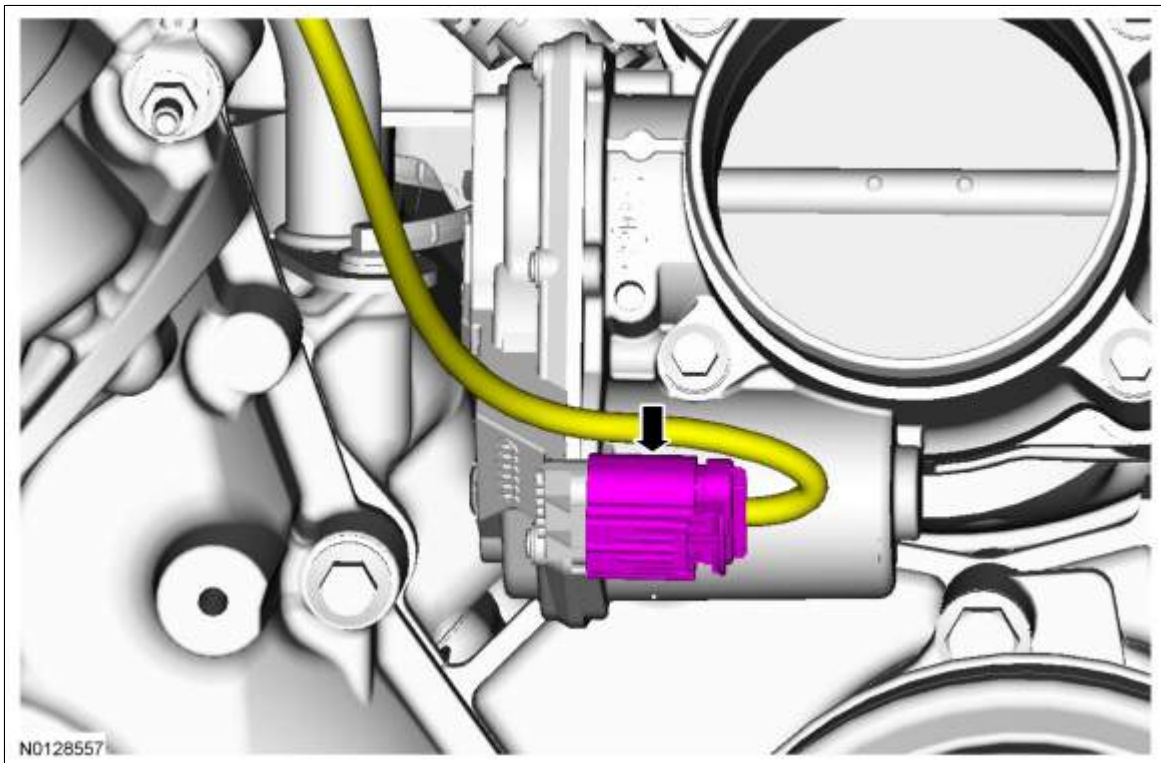
Item	Part Number	Description
1	6P013	Fuel rail insulator (2 required)
2	W714864	Fuel rail bolt (4 required)
3	9Y450	Intake manifold bolt (part of 9424) (6 required)
4	9424	Intake manifold
5	9439	Intake manifold gasket

Removal

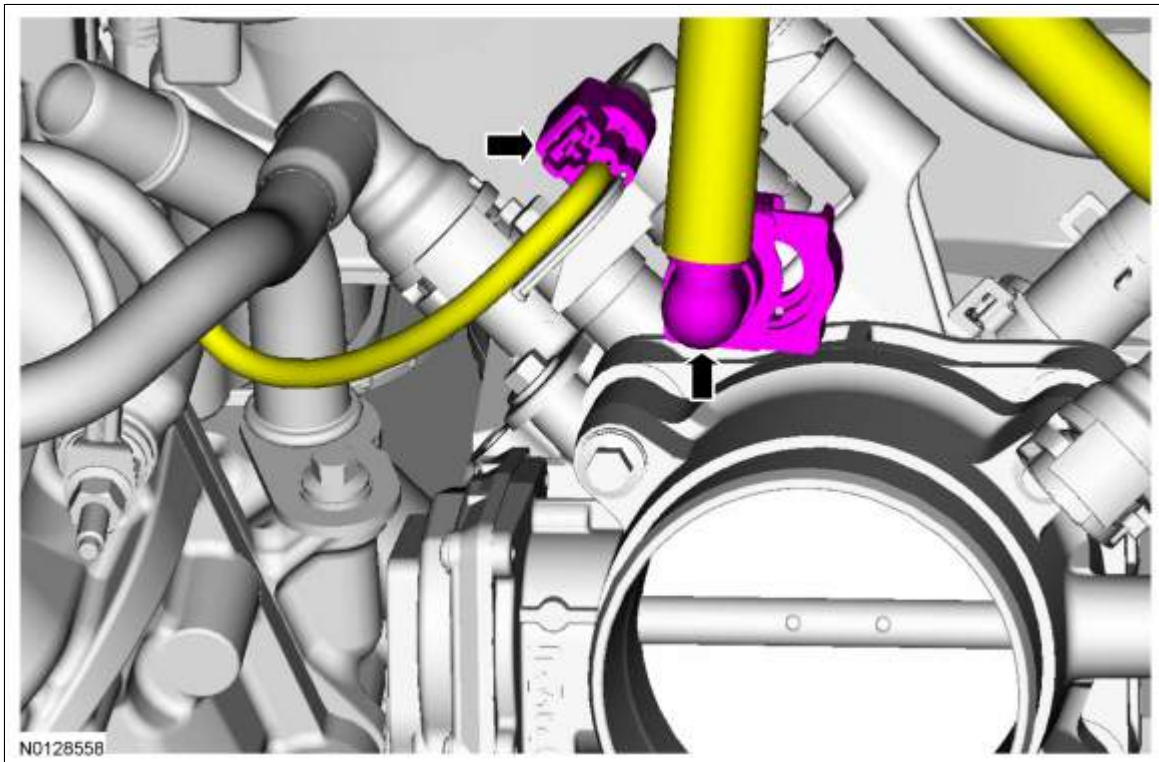
⚠ WARNING: Do not smoke, carry lighted tobacco or have an open flame of any type when working on or near any fuel-related component. Highly flammable mixtures are always present and may be ignited. Failure to follow these instructions may result in serious personal injury.

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

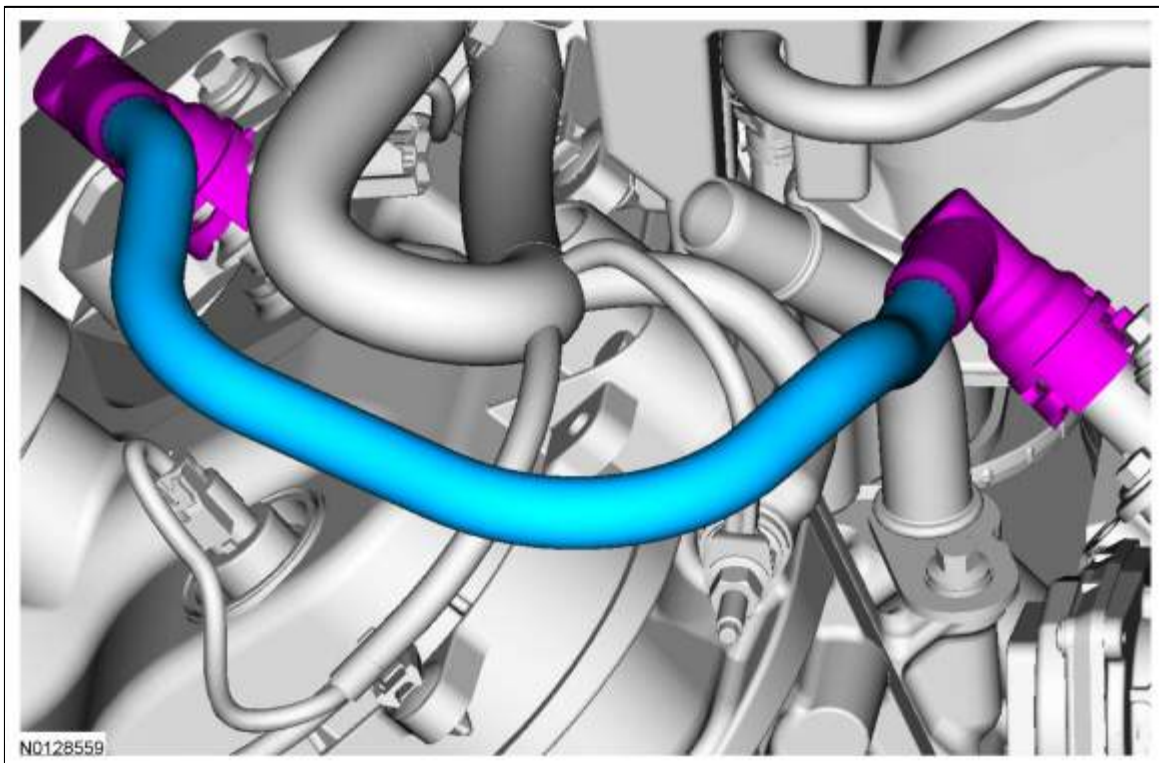
1. Release the fuel system pressure. For additional information, refer to [Section 310-00](#).
2. Remove the Air Cleaner (ACL) outlet pipe. For additional information, refer to [Section 303-12](#).
3. Disconnect the Throttle Body (TB) electrical connector.



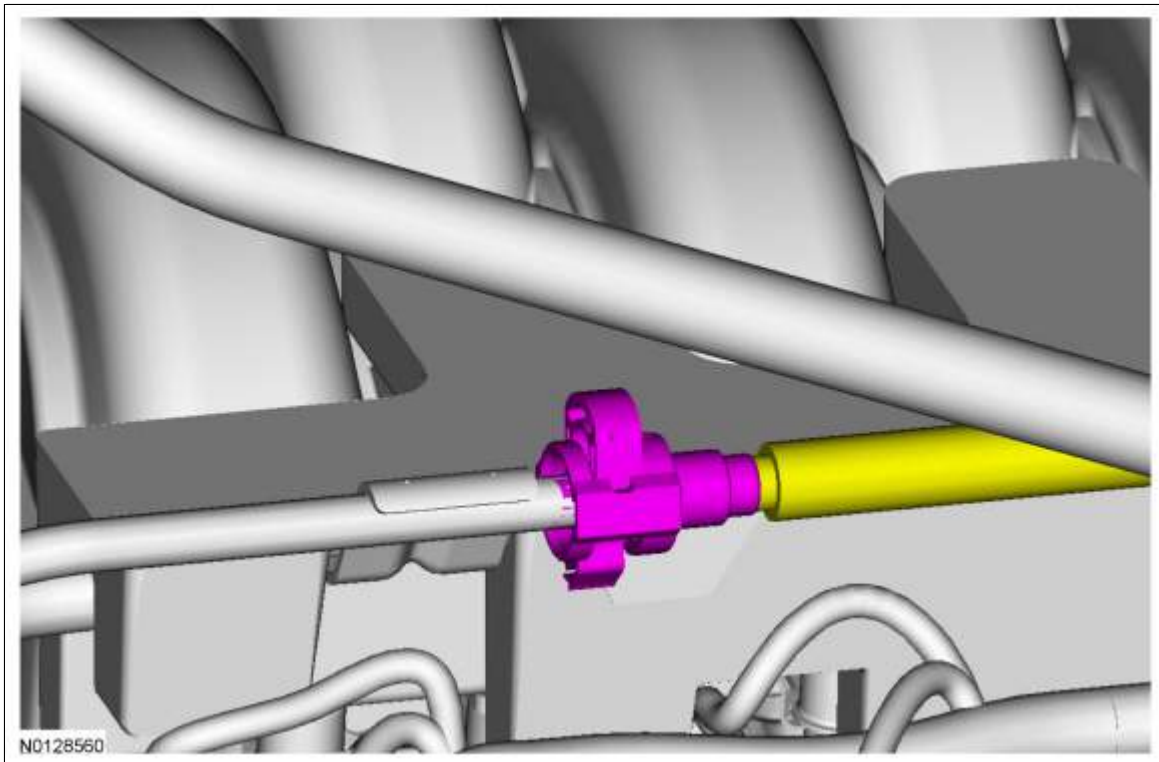
4. Disconnect the Evaporative Emission (EVAP) canister purge valve tube and electrical connector. For additional information, refer to the quick connect coupling procedure in [Section 310-00](#).
 - Detach the EVAP tube retainer from the fuel rail.



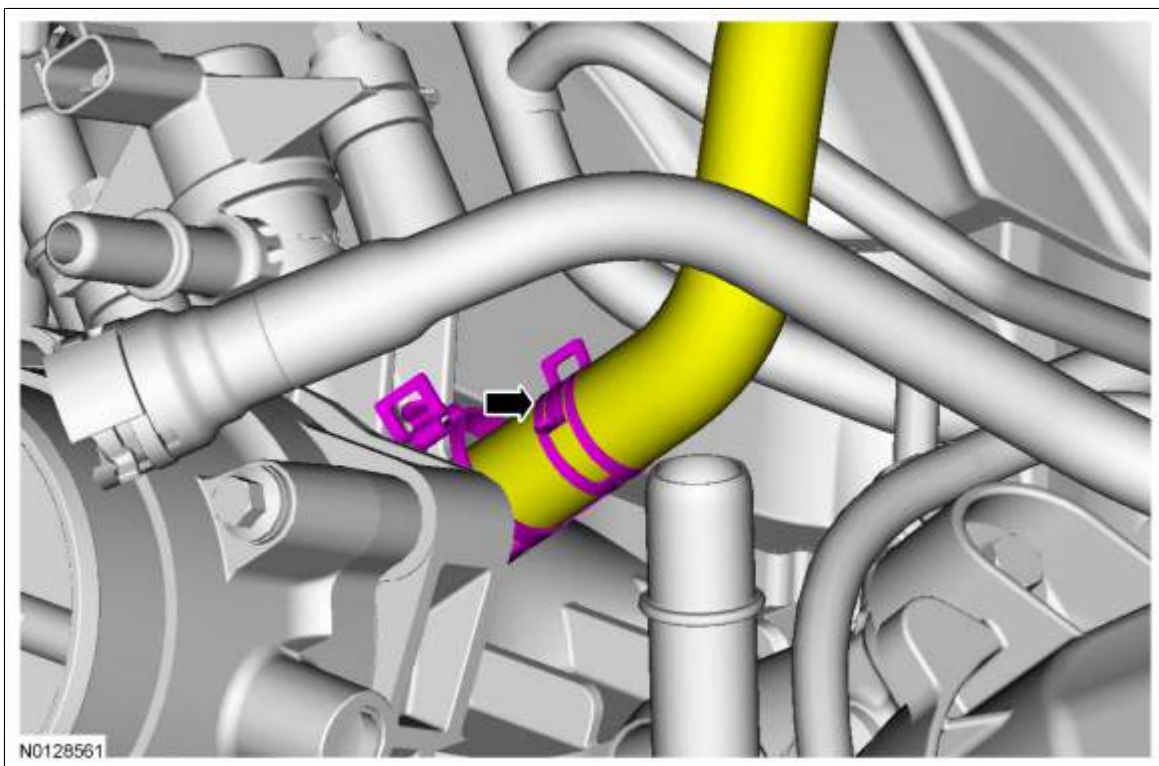
5. Remove the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in [Section 310-00](#).



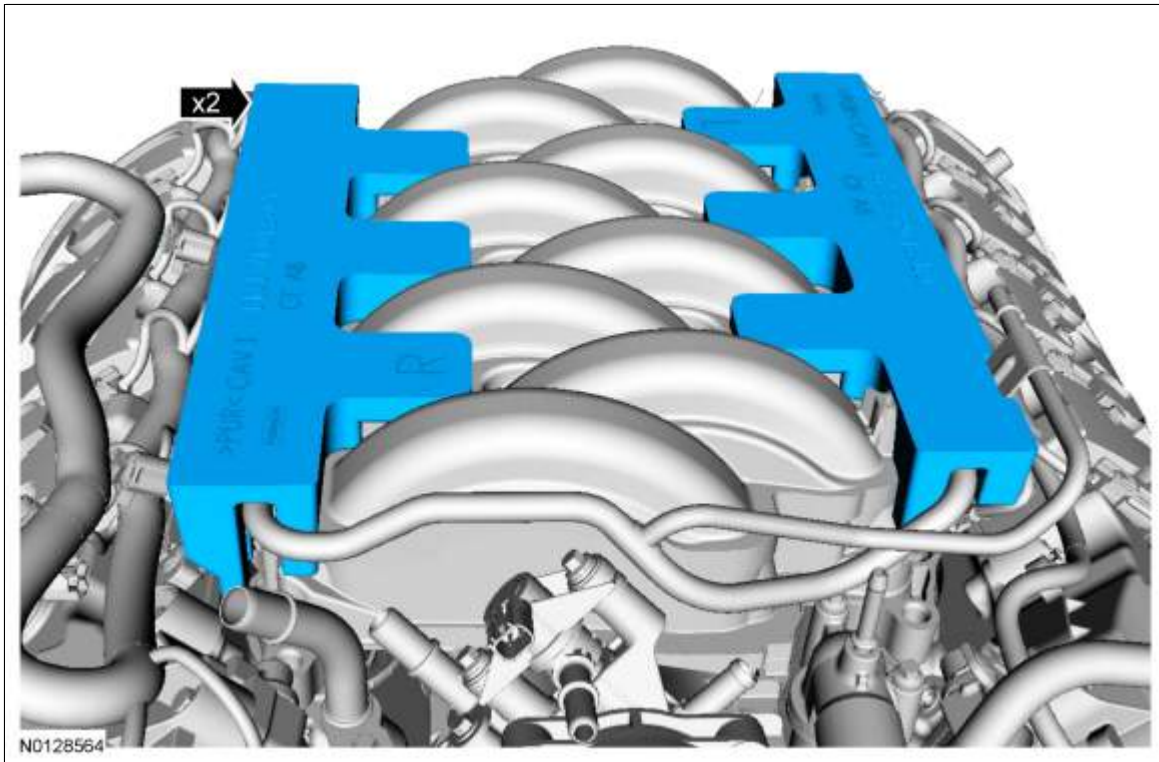
6. Disconnect the fuel supply tube. For additional information refer to the quick connect procedure in [Section 310-00](#).



7. Release the clamp and disconnect the vacuum tube from the intake manifold.

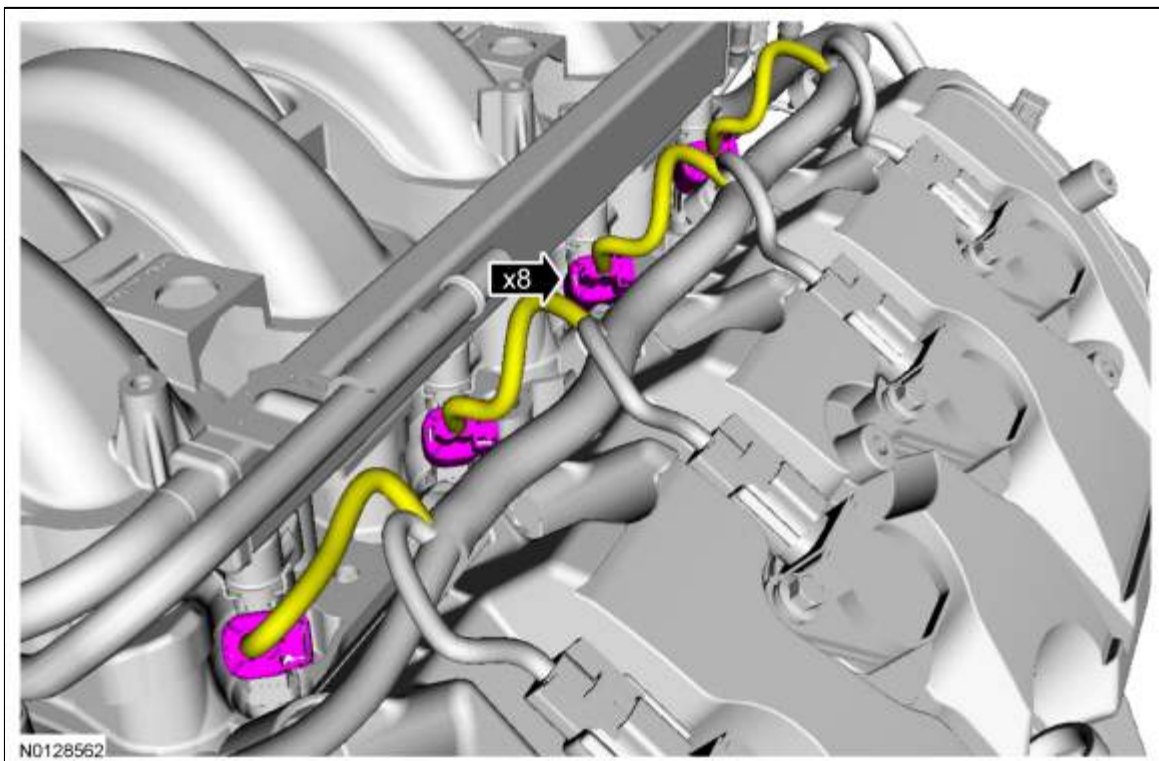


8. Remove the LH and RH fuel rail insulators.

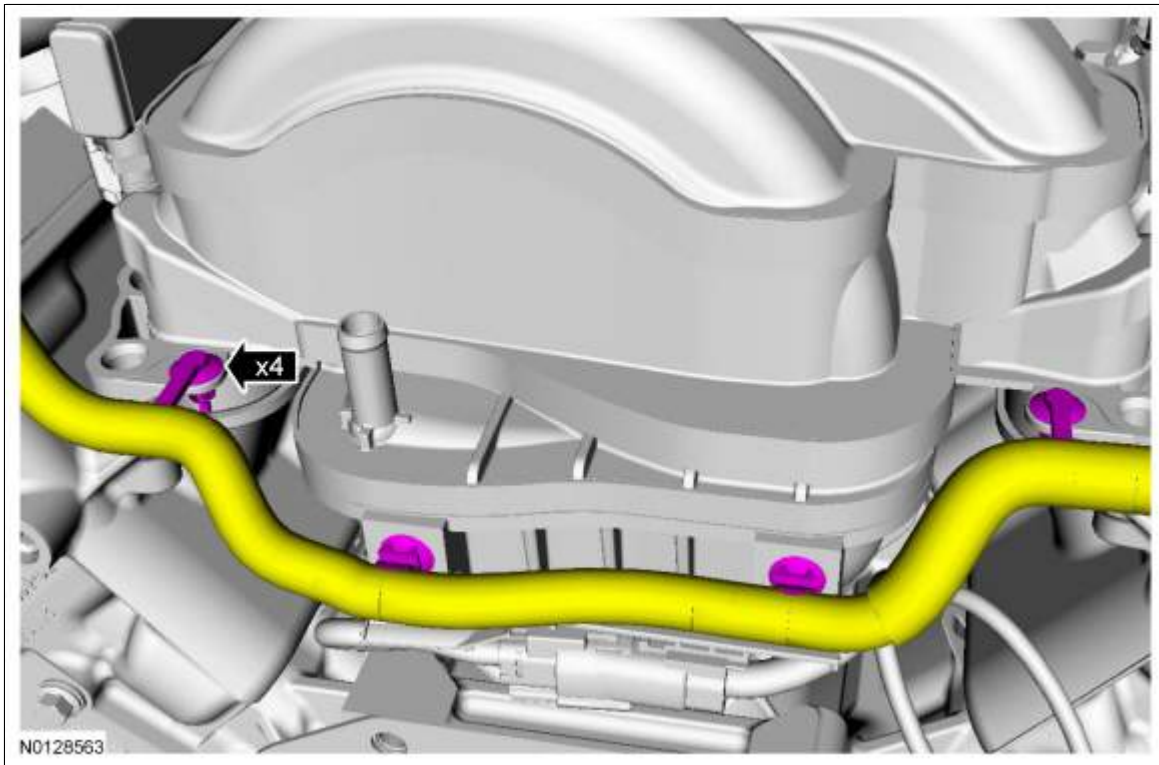


9. **NOTE:** The 4 LH fuel injector electrical connectors are shown, the 4 RH fuel injector electrical connectors are similar.

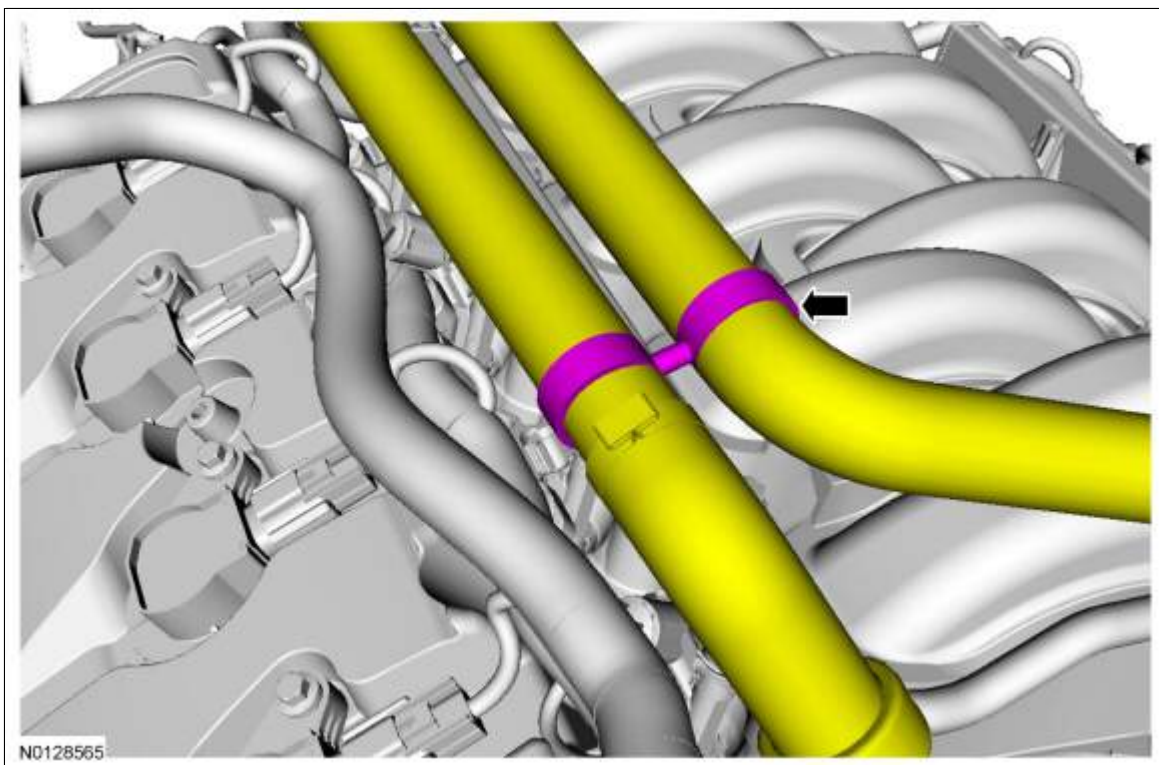
Disconnect the 8 fuel injector electrical connectors.



10. Detach the 4 wiring harness retainers from the rear of the intake manifold.

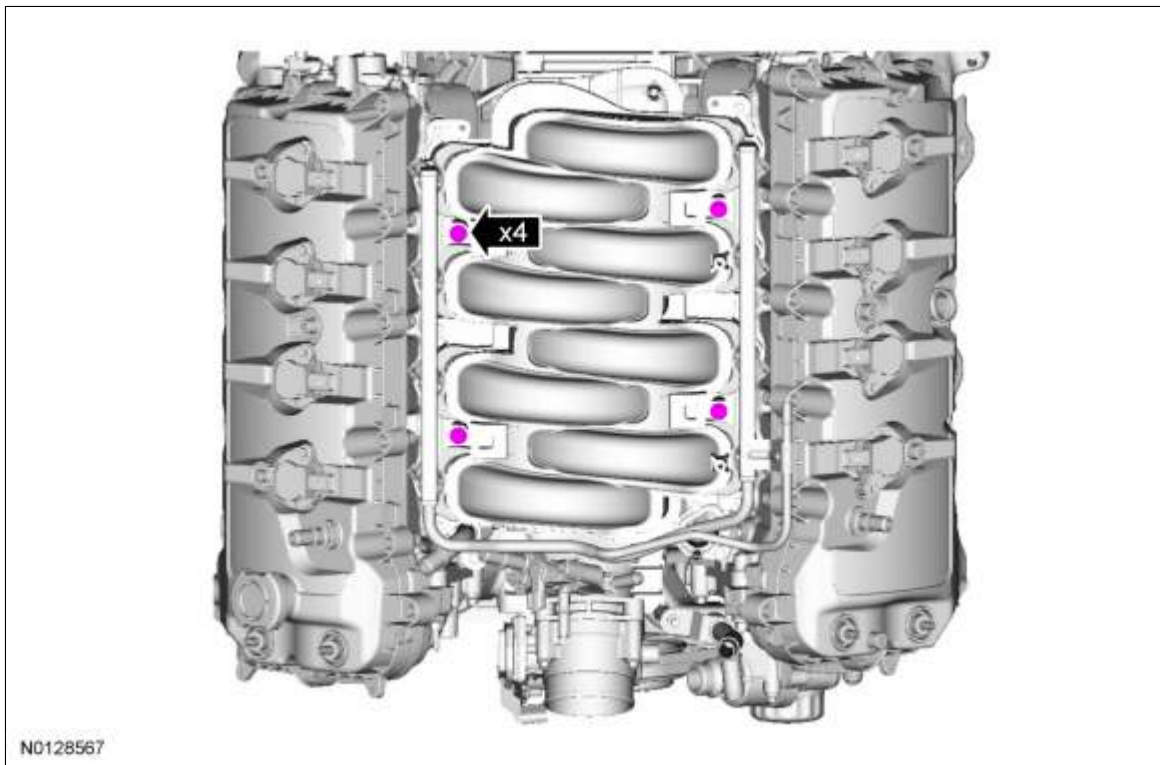


11. Detach the heater hose retainer and position the heater hose aside.

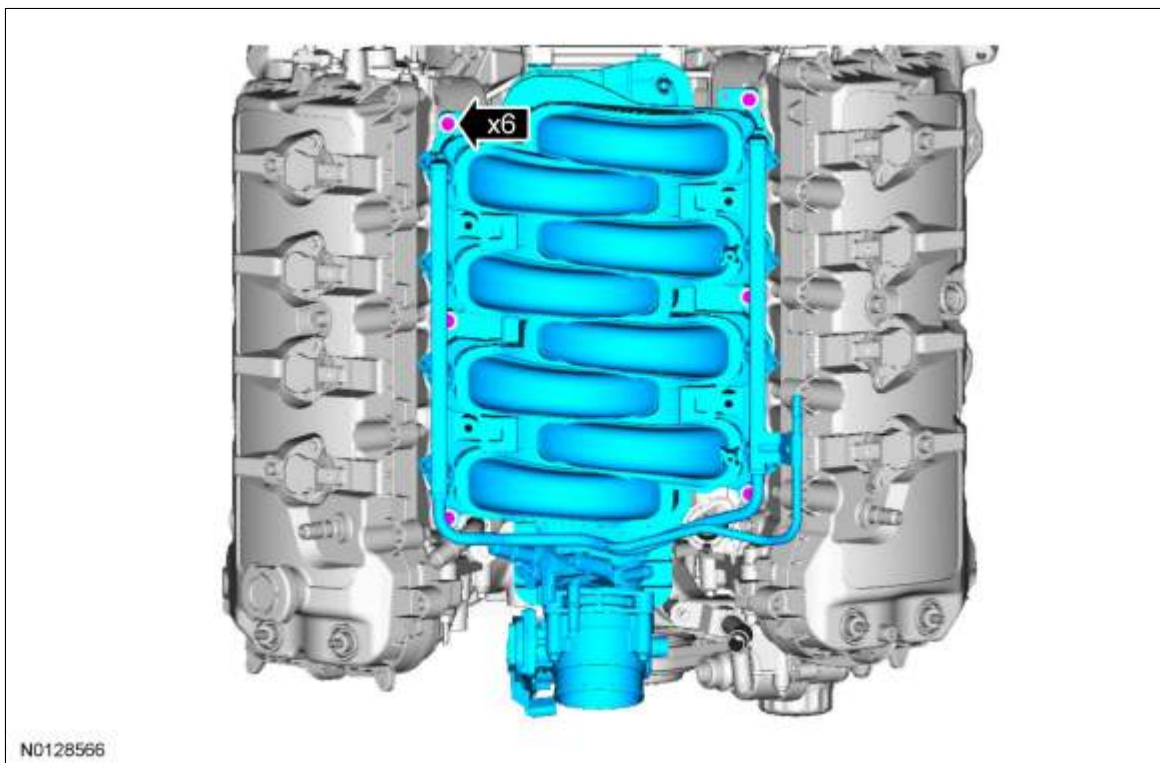


12. **NOTE:** It is not necessary to remove the fuel rail from the intake manifold assembly.

Remove the 4 fuel rail bolts.



13. Loosen the 6 bolts and remove the intake manifold.
- Discard the gaskets.



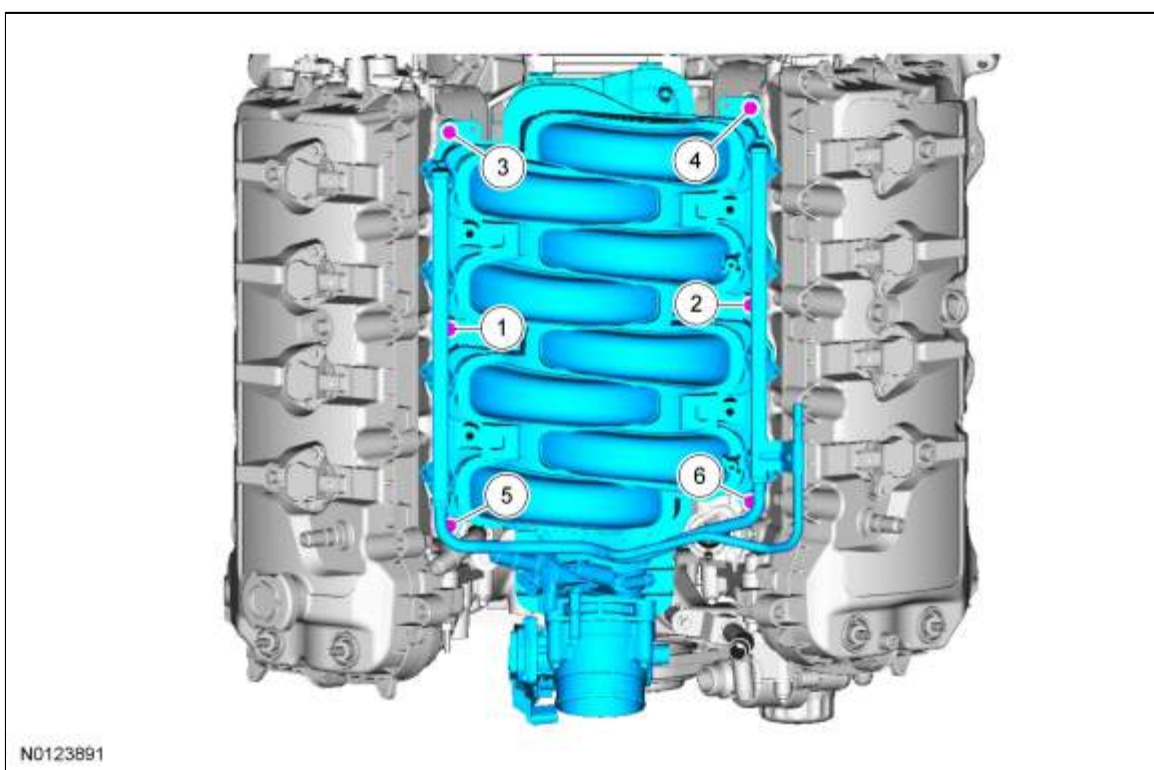
Installation

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

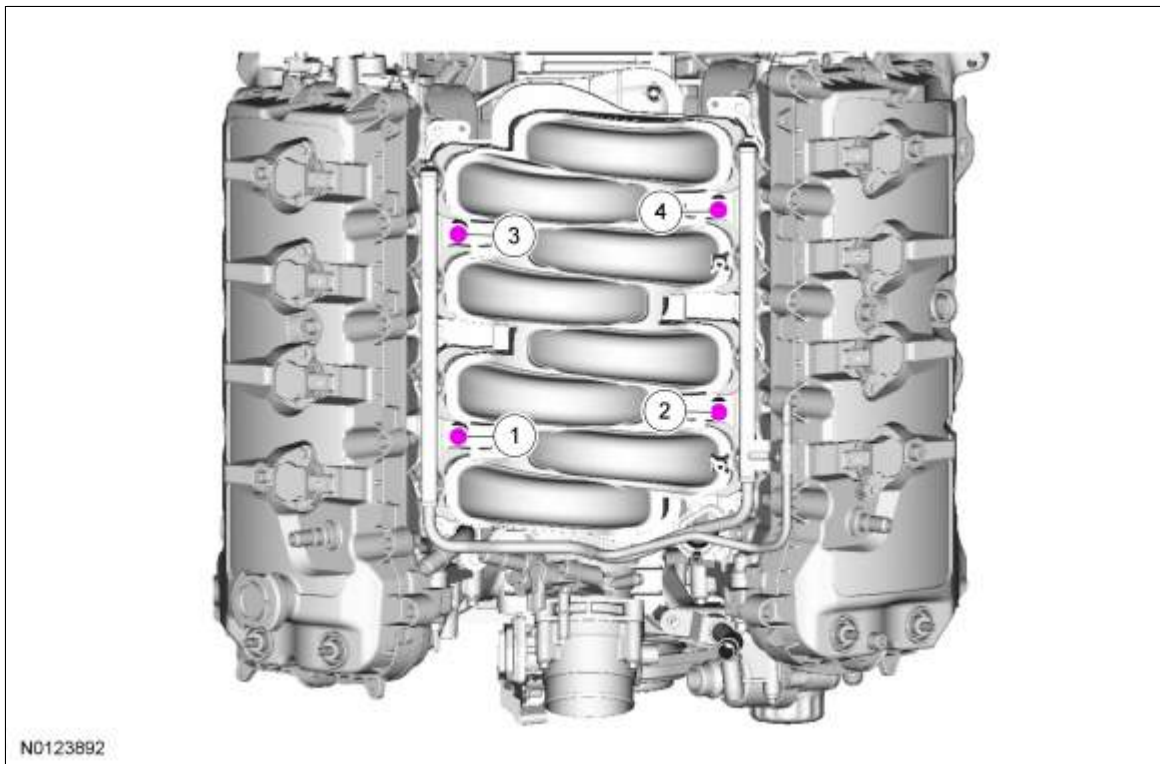
NOTE: Clean the sealing surfaces with metal surface prep. Follow the directions on the packaging. Inspect the mating surfaces.

Using new gaskets, install the intake manifold.

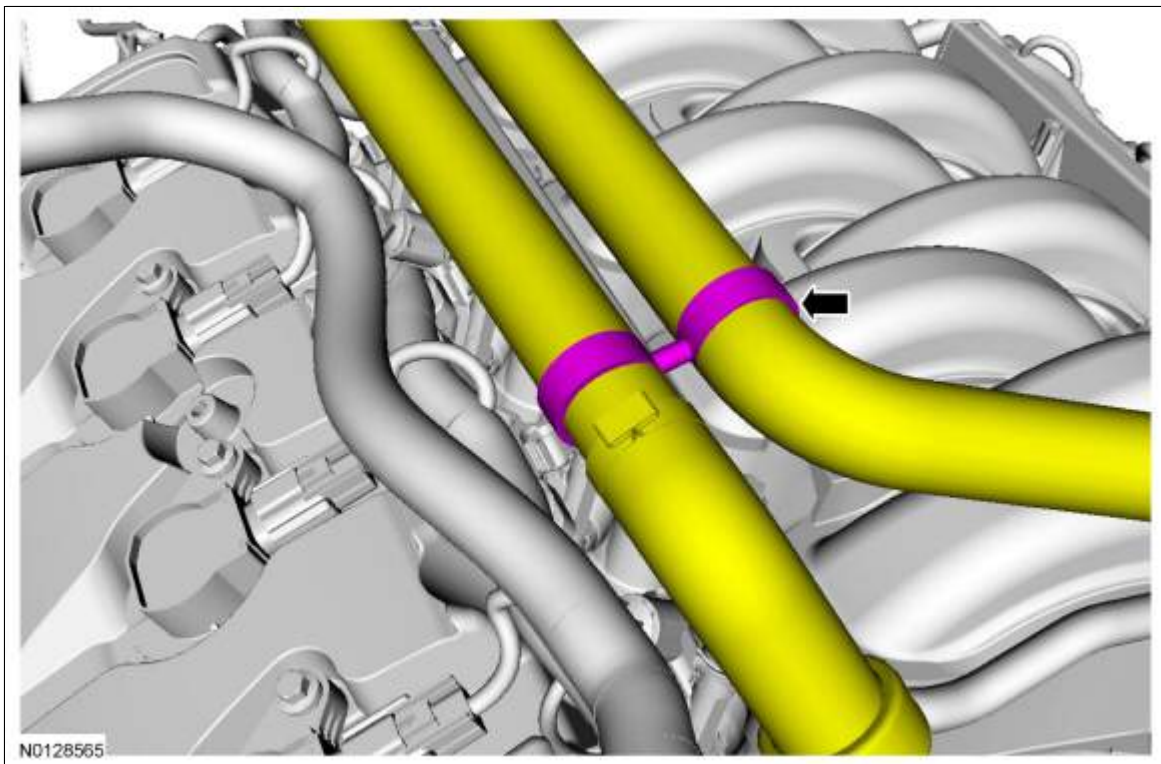
- Tighten the 6 intake manifold bolts in the sequence shown in 2 stages.
 - Stage 1: Tighten to 10 Nm (89 lb-in).
 - Stage 2: Tighten an additional 45 degrees.



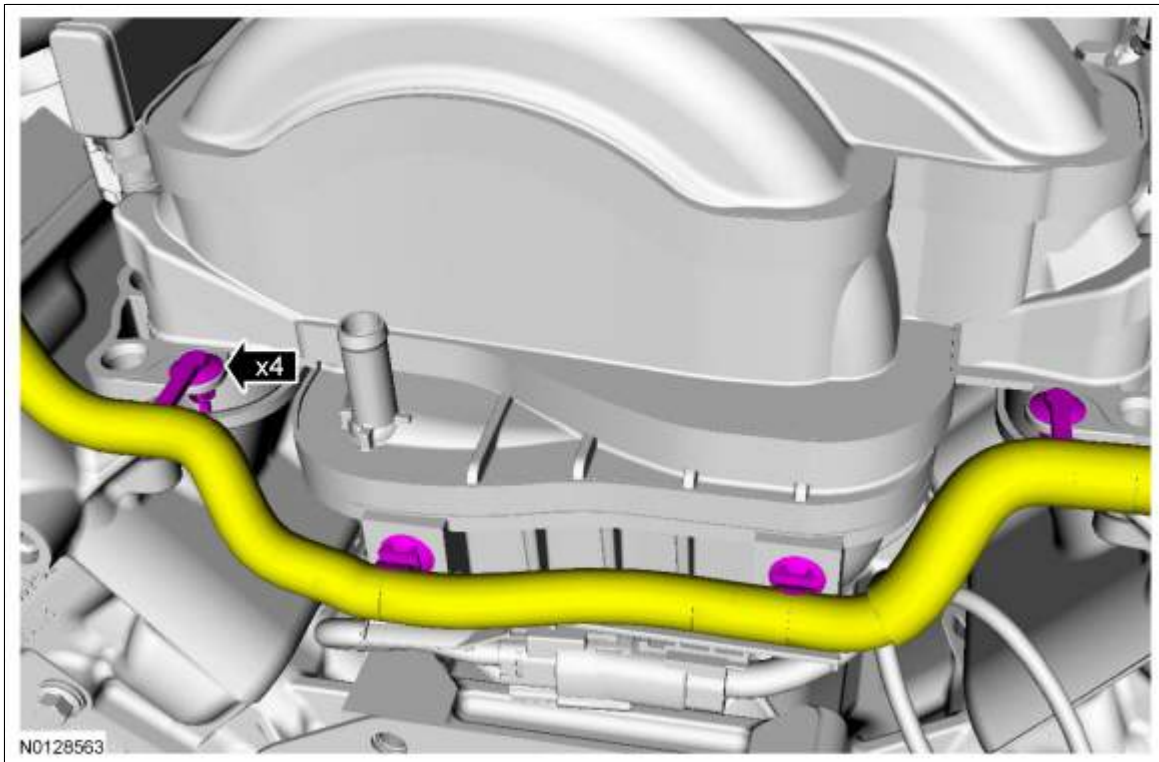
2. Install the 4 fuel rail bolts.
 - Tighten in the sequence shown in 3 stages.
 - Stage 1: Hand tighten.
 - Stage 2: Tighten to 10 Nm (89 lb-in).
 - Stage 2: Tighten an additional 90 degrees.



3. Position the heater hoses and attach the heater hose retainer.

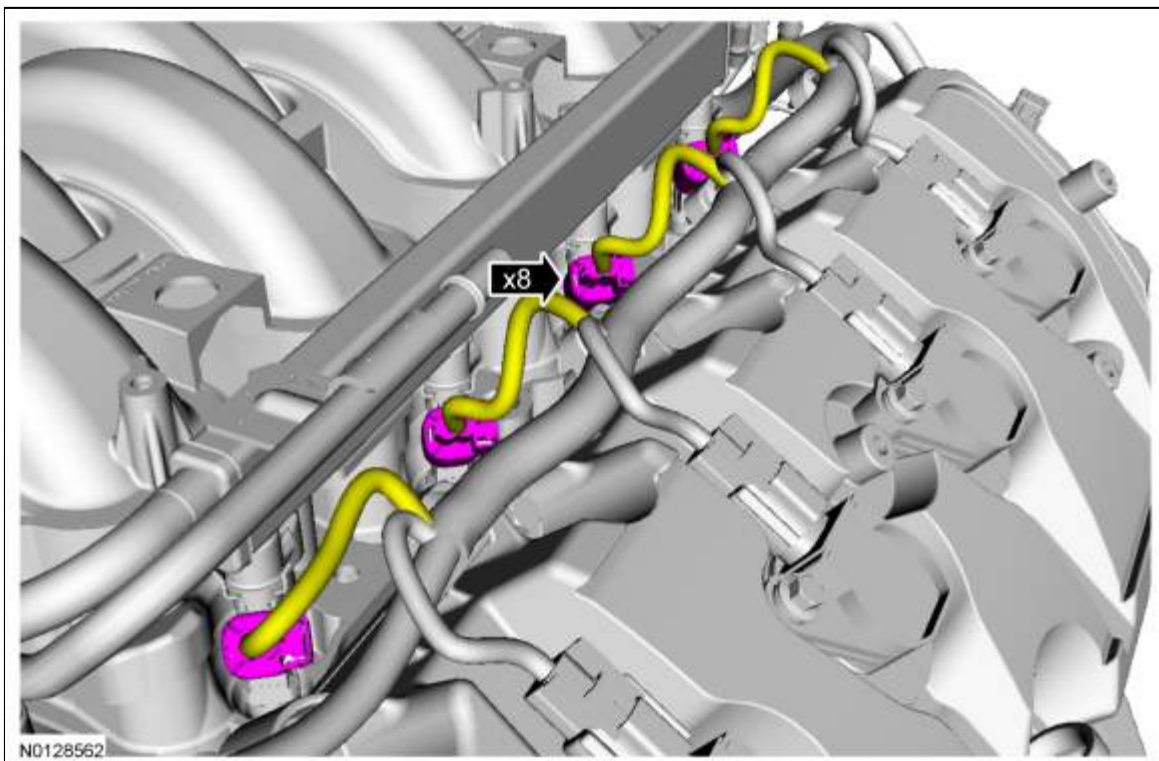


4. Attach the 4 wiring harness retainers to the rear of the intake manifold.

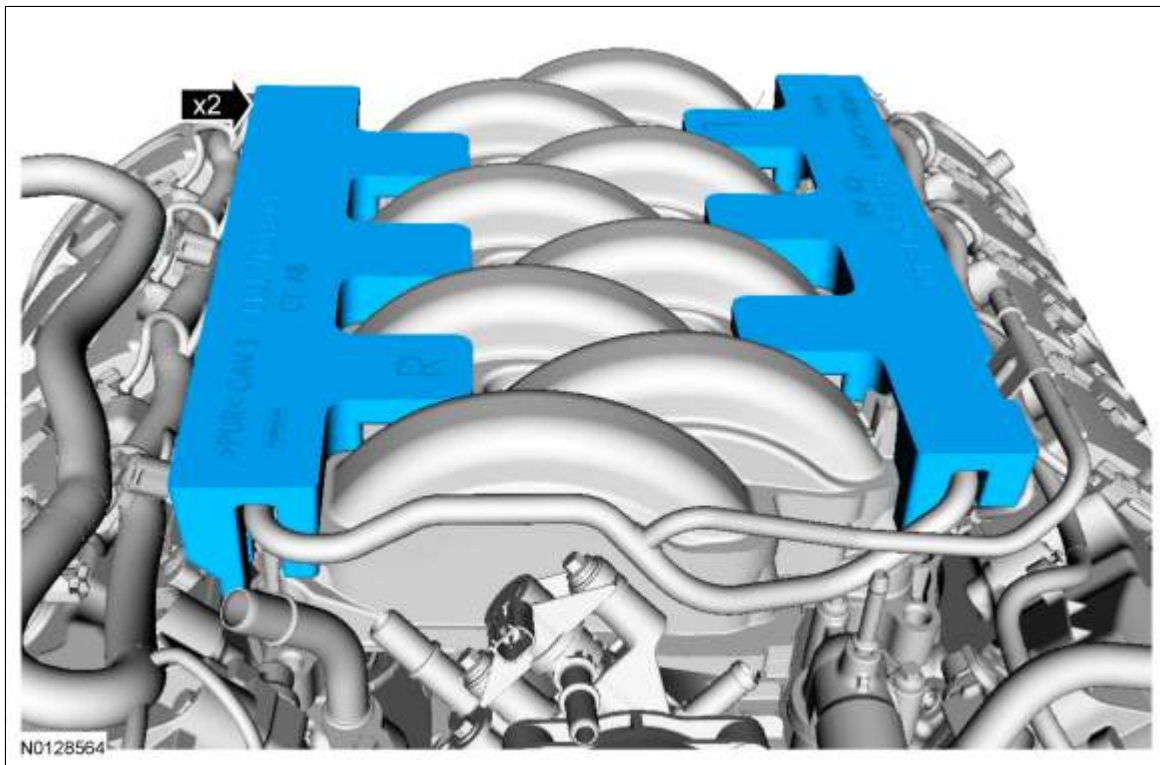


5. **NOTE:** The 4 LH fuel injector electrical connectors are shown, the 4 RH fuel injector electrical connectors are similar.

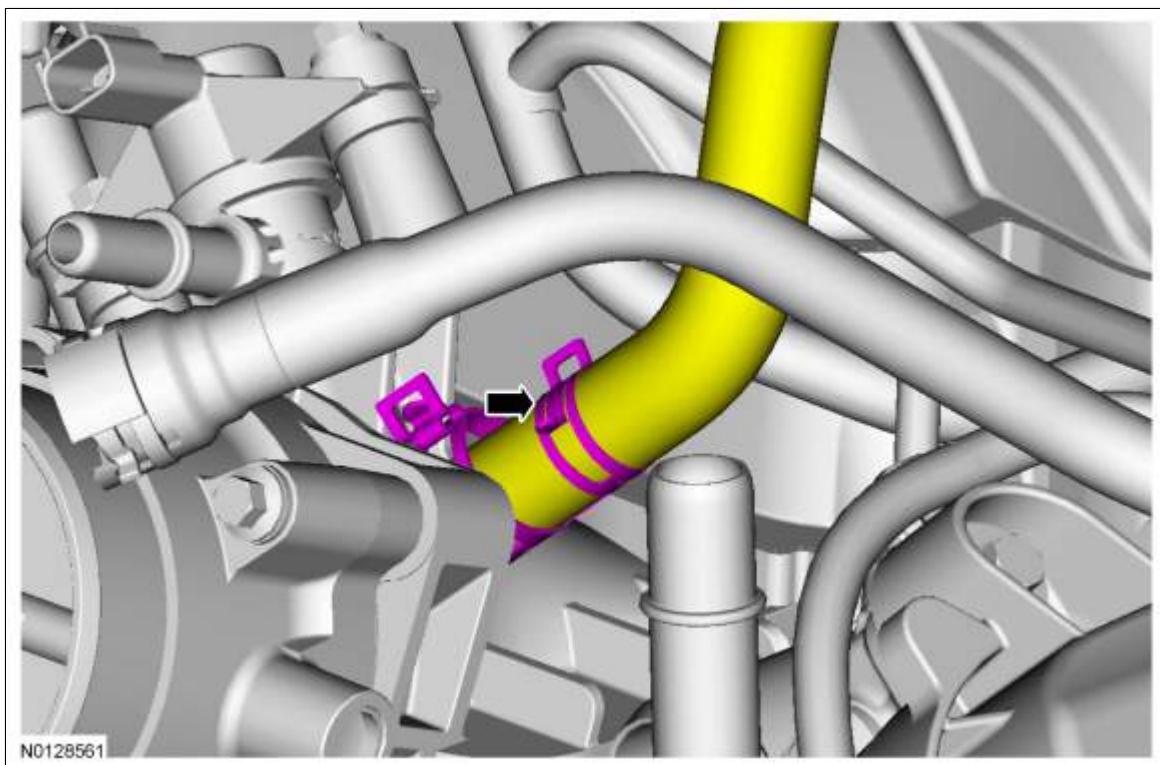
Connect the 8 fuel injector electrical connectors.



6. Install the LH and RH fuel rail insulators.

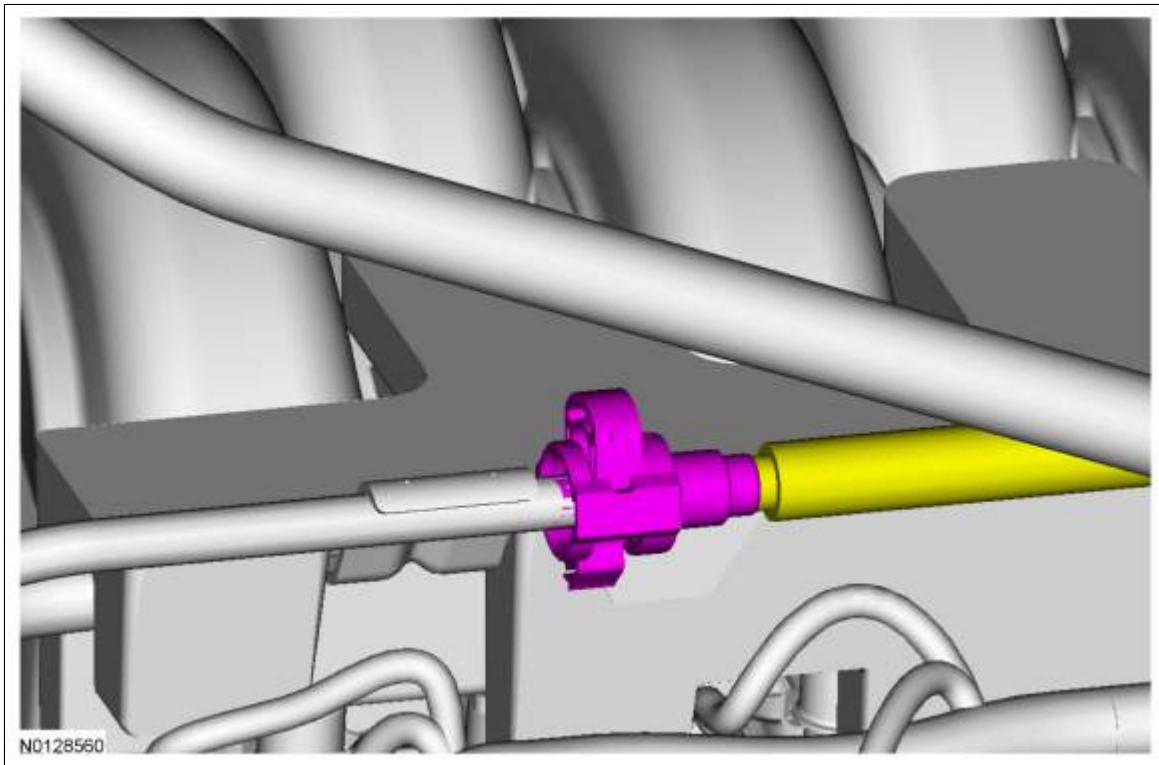


7. Connect the vacuum tube to the intake manifold.

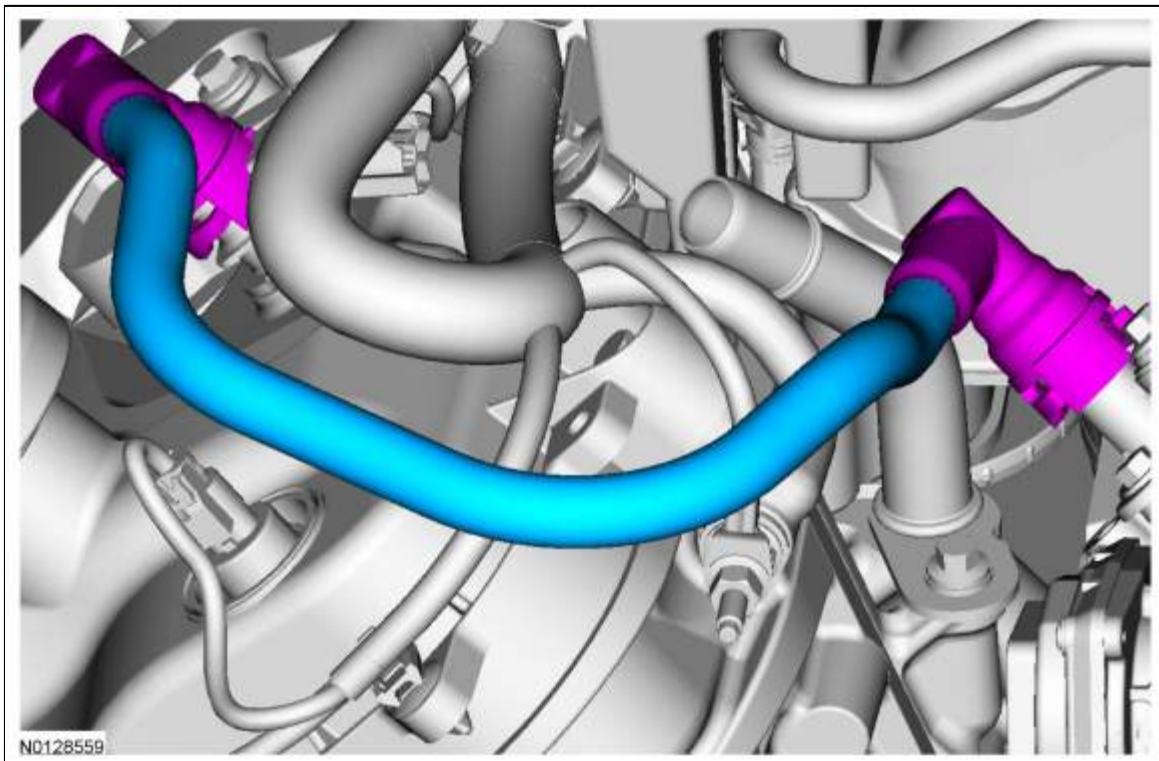


8. Connect the fuel supply tube. For additional information, refer to the quick connect coupling

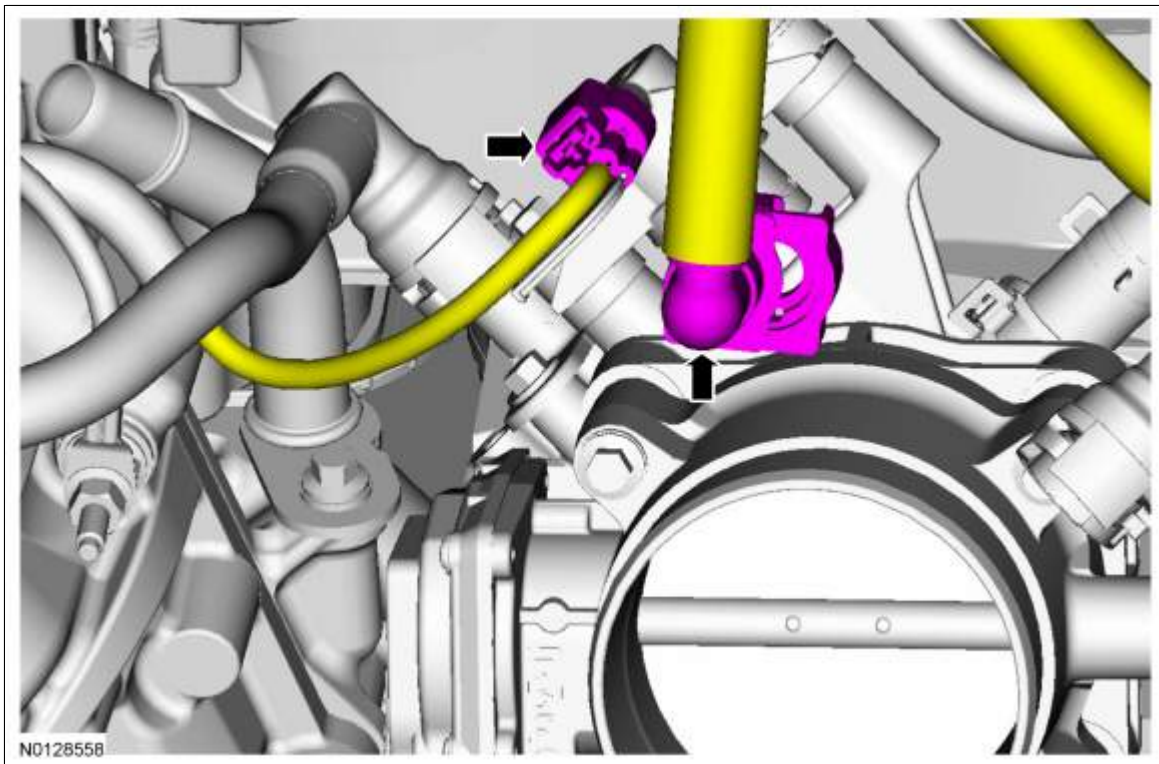
procedure in [Section 310-00](#).



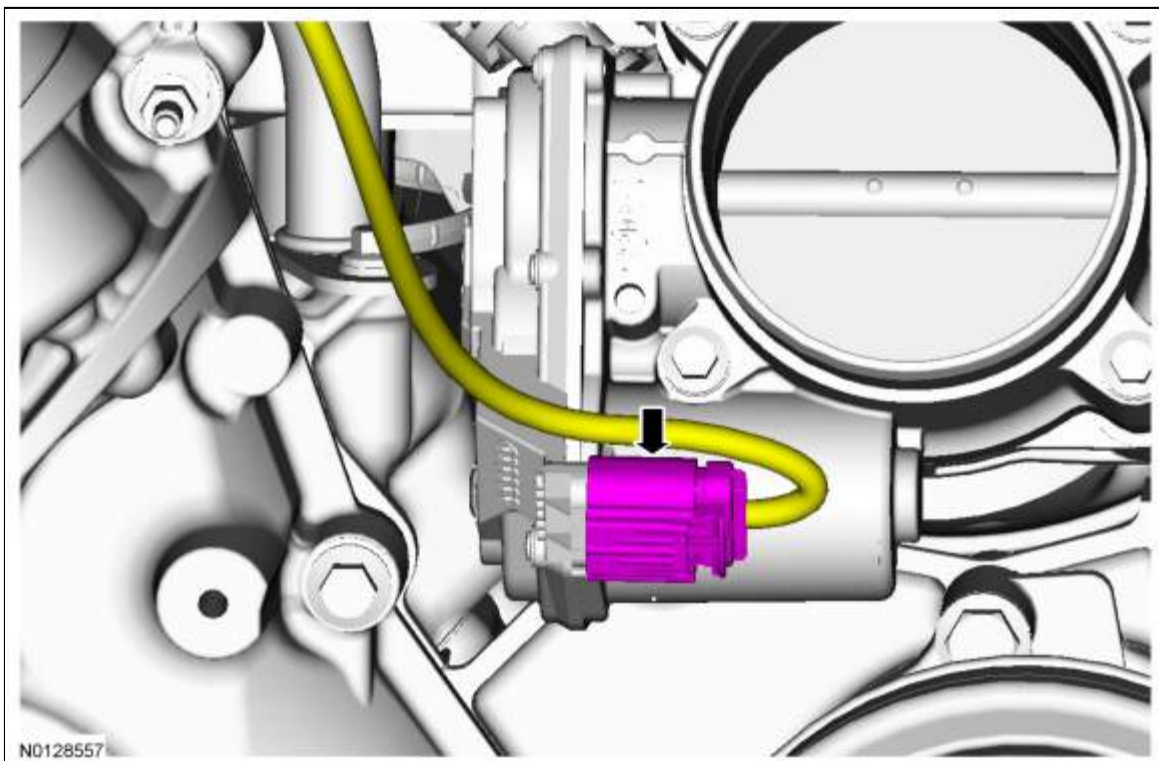
9. Install the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in [Section 310-00](#).



10. Connect the Evaporative Emission (EVAP) purge valve tube and electrical connector. For additional information, refer to the quick connect coupling procedure in [Section 310-00](#).
 - Attach the EVAP tube retainer to the fuel rail.



11. Connect the TB electrical connector.

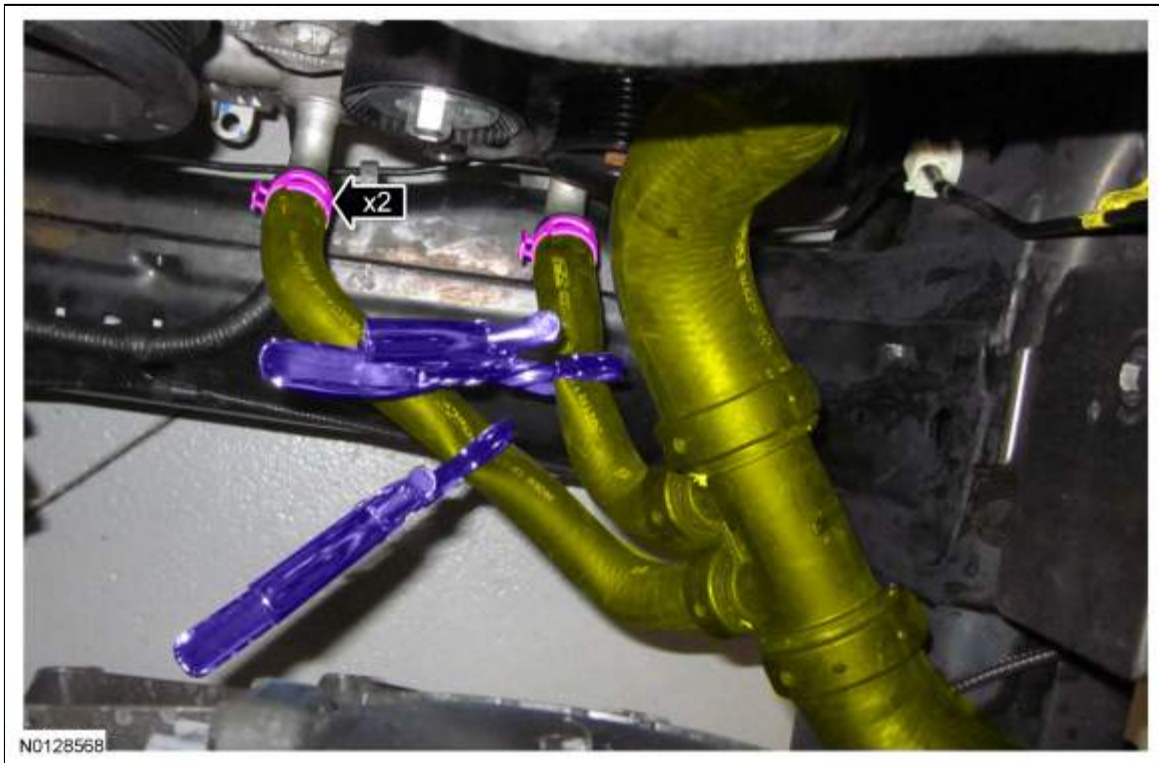


12. Install the Air Cleaner (ACL) outlet pipe. For additional information, refer to [Section 303-12](#).
-

Oil Cooler

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove and discard the engine oil filter.
3. Using hose clamp pliers, clamp the 2 oil cooler coolant hoses.
 - Disconnect the 2 coolant hoses from the oil cooler.



4. **NOTICE:** If metal or aluminum material is present in the oil cooler, mechanical concerns exist. Failure to correct these concerns may cause engine failure. To diagnose mechanical concerns, refer to [Section 303-00](#).

Remove the oil cooler threaded insert and the oil cooler.

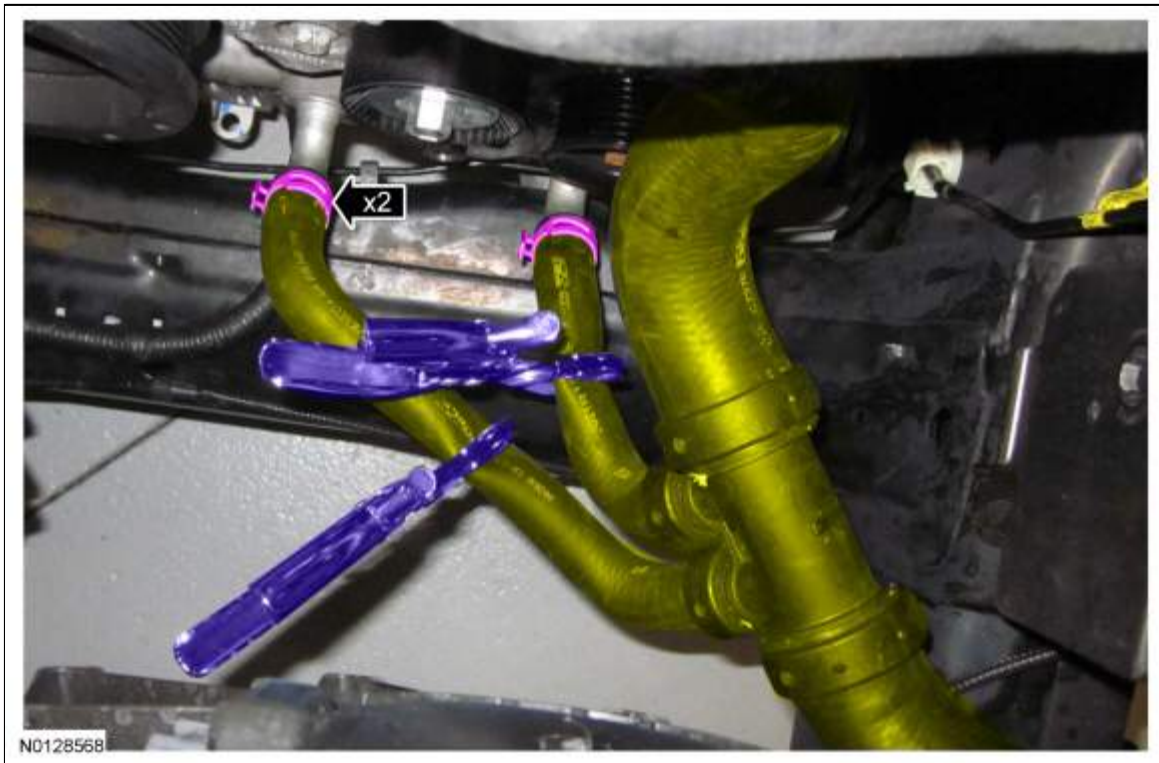


Installation

1. Install the oil cooler and threaded insert.
 - Tighten to 57 Nm (42 lb-ft).



2. Connect the 2 coolant hoses.
 - Release the hose clamp pliers.



3. **NOTE:** Do not lubricate the O-ring seal.

Install a new oil filter.

- Tighten to 16 Nm (142 lb-in).

SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

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Oil Filter Adapter

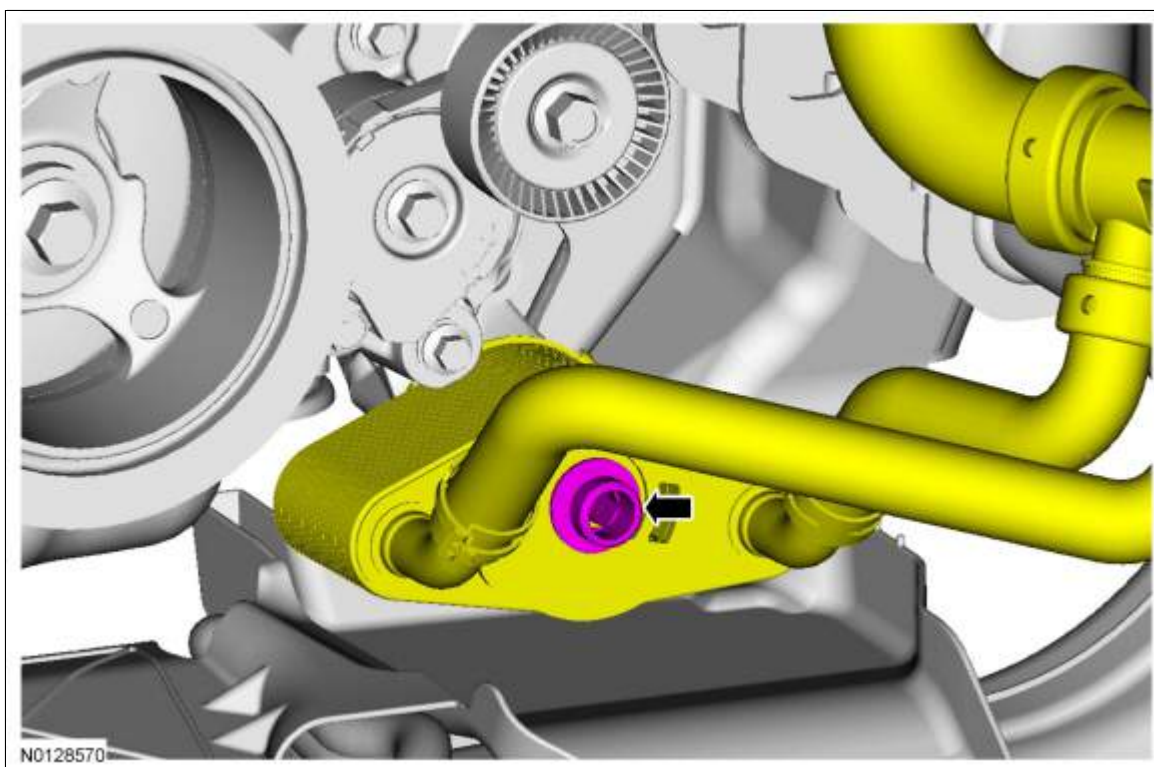
Removal

NOTICE: 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.

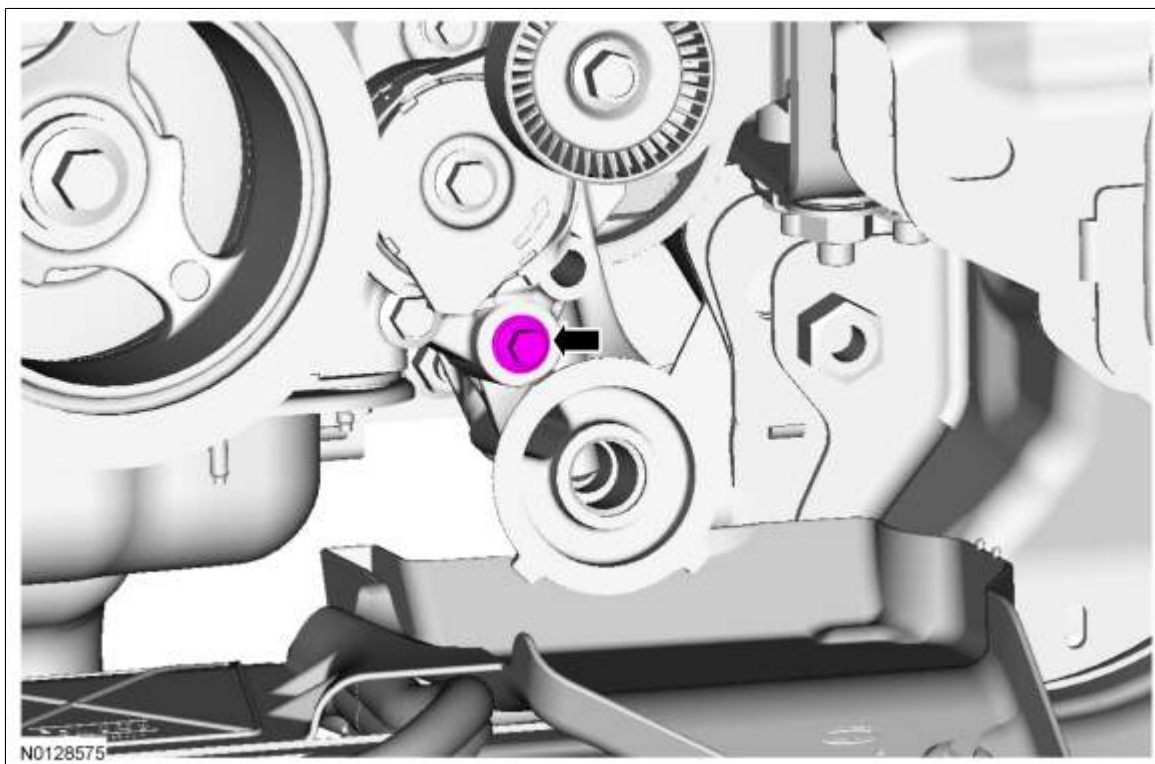
NOTICE: The engine front cover-to-oil filter adapter bolt must be removed and the engine front cover-to-oil filter adapter jackscrew loosened before removing the oil filter adapter

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the generator. For additional information, refer to [Section 414-00](#).
3. Remove and discard the engine oil filter.
4. **NOTICE:** If metal or aluminum material is present in the oil cooler, mechanical concerns exist. Failure to correct these concerns may cause engine failure. To diagnose mechanical concerns, refer to [Section 303-00](#).

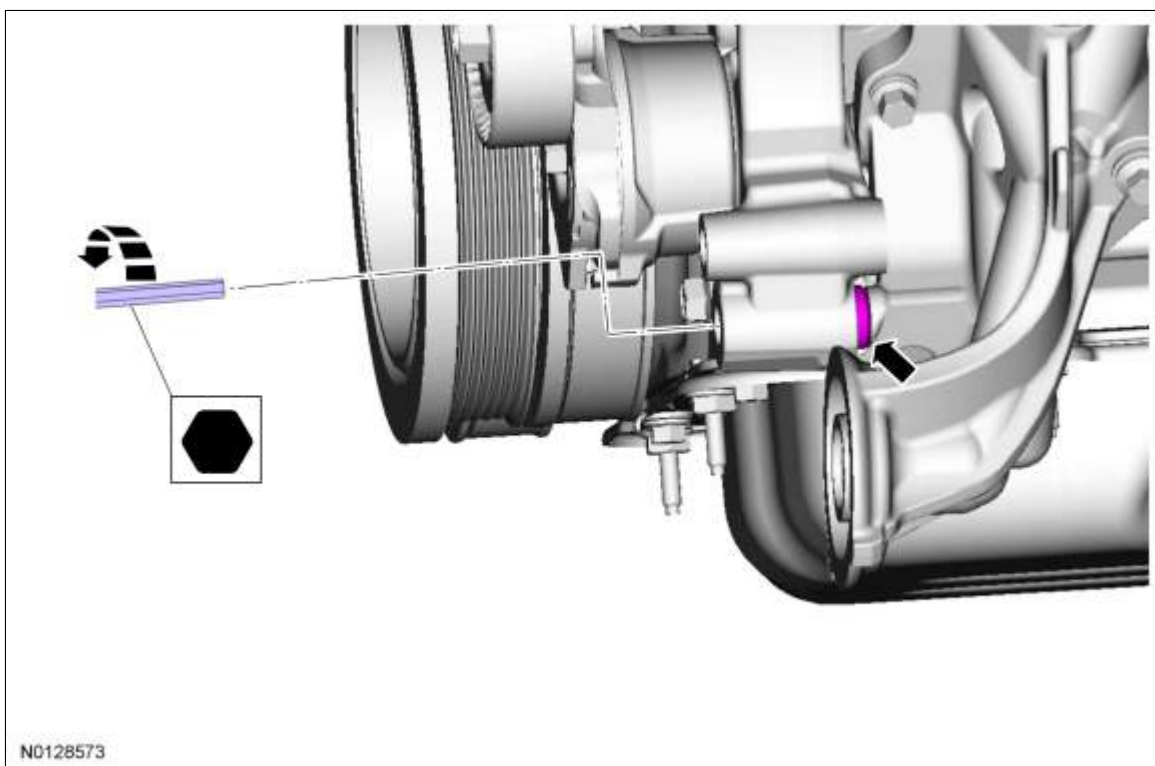
Remove the oil cooler threaded insert and position the oil cooler and hoses aside.



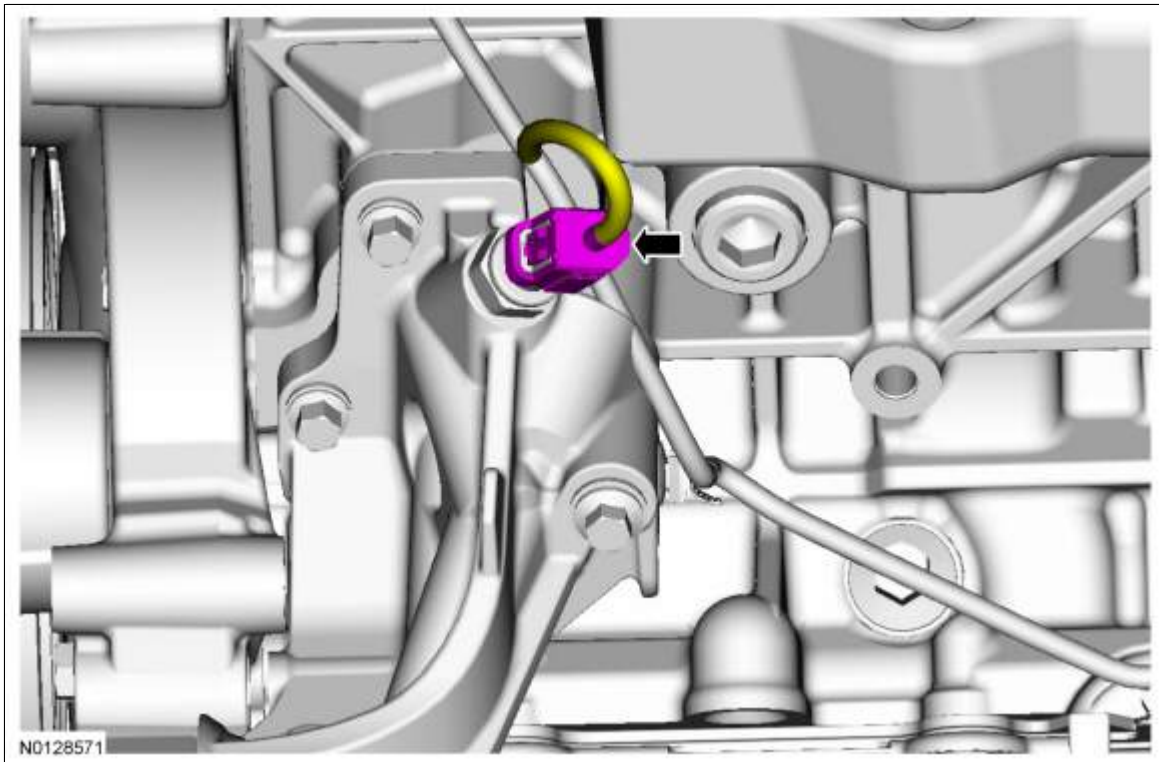
5. Remove the engine front cover-to-oil filter adapter bolt.



6. Using a 10 mm (0.393 in) Hex Bit loosen the engine front cover-to-oil filter adapter jack screw.



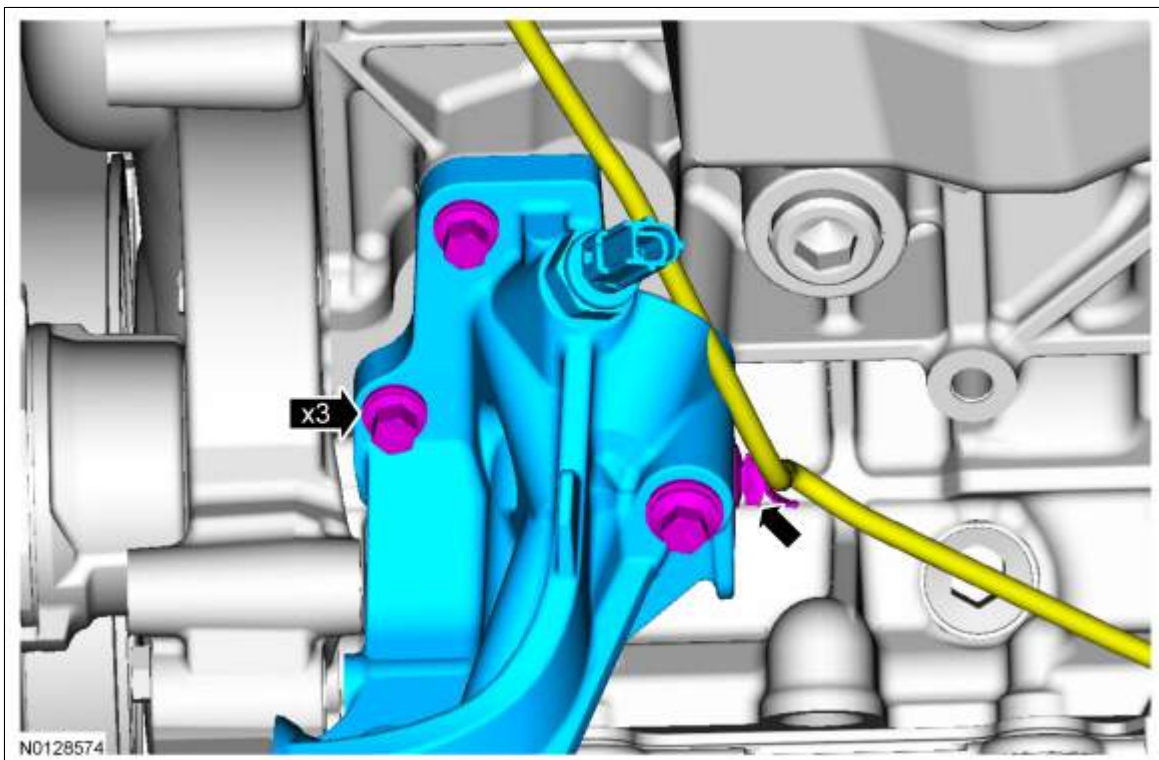
7. Disconnect the engine oil pressure switch electrical connector.



8. **NOTE:** On 4x4 vehicles, the rear bolt must be removed with the oil filter adapter.

Remove the 3 oil filter adapter bolts .

- Position the oil filter adapter aside and detach the wiring harness retainer.
- Remove the oil filter adapter and discard the gasket.



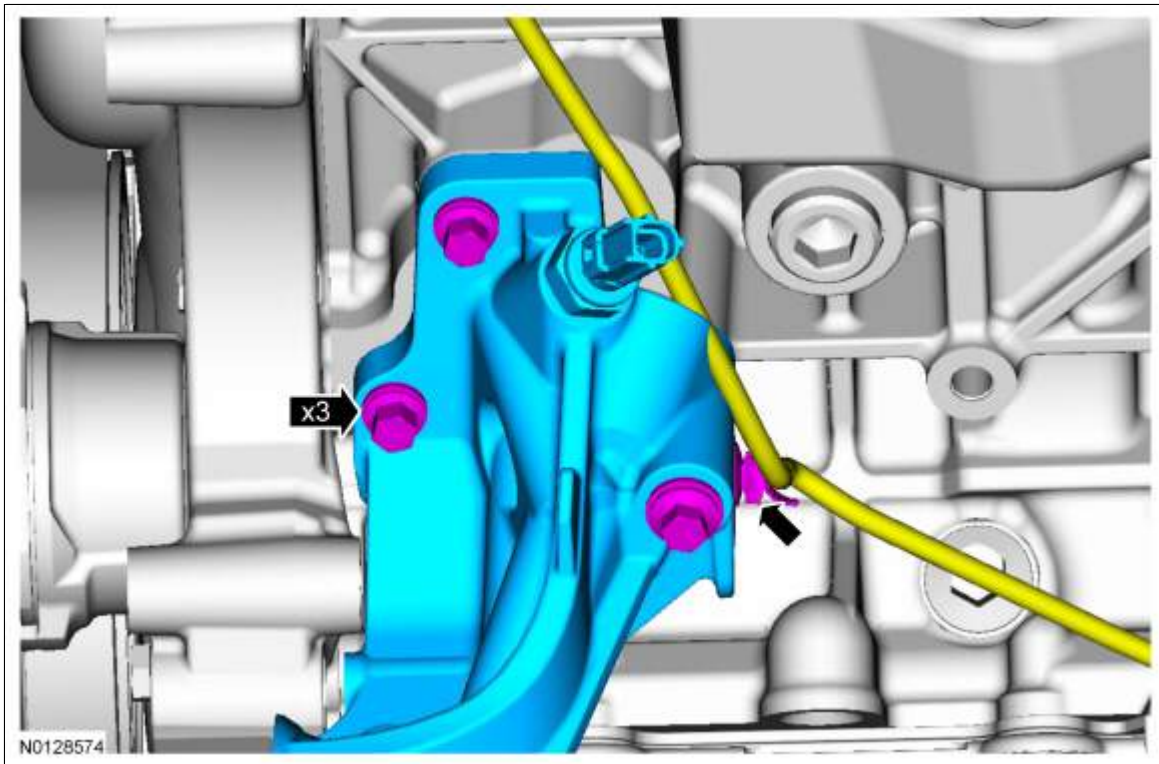
Installation

1. **NOTE:** Install a new oil filter adapter gasket.

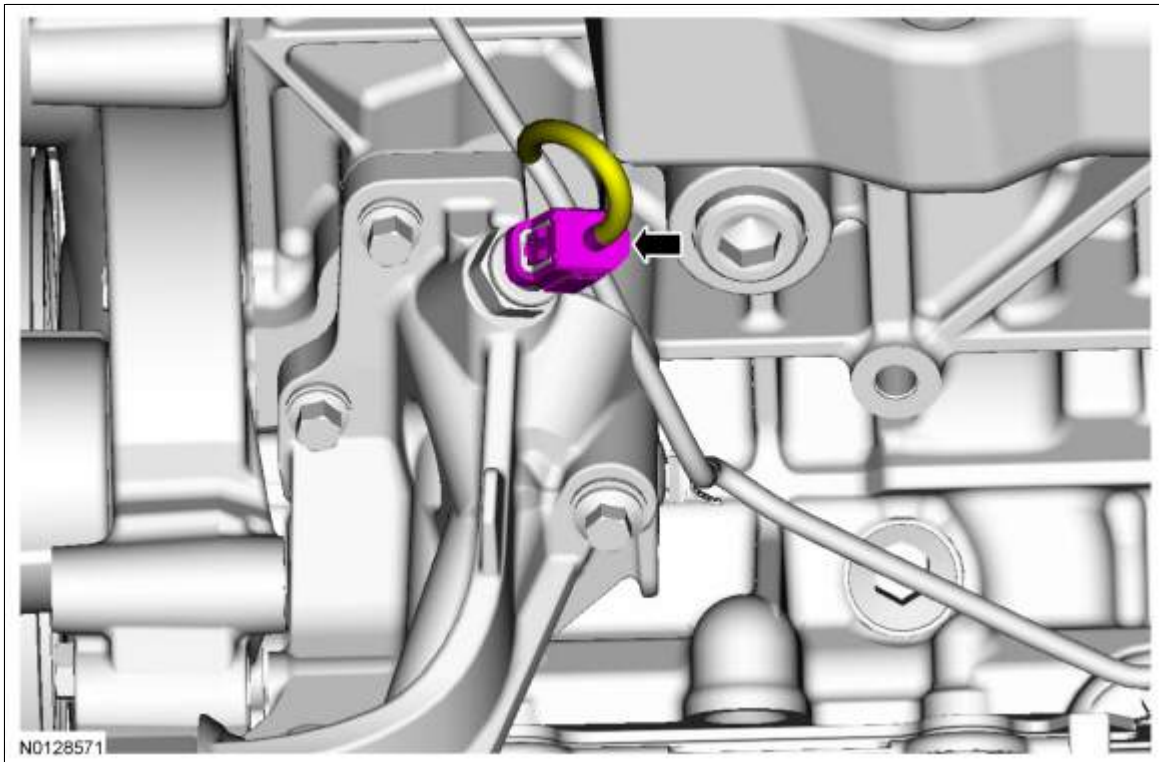
NOTE: On 4x4 vehicles, the rear bolt must be positioned with the oil filter adapter.

Using a new gasket, position the oil filter adapter and attach the wiring harness retainer.

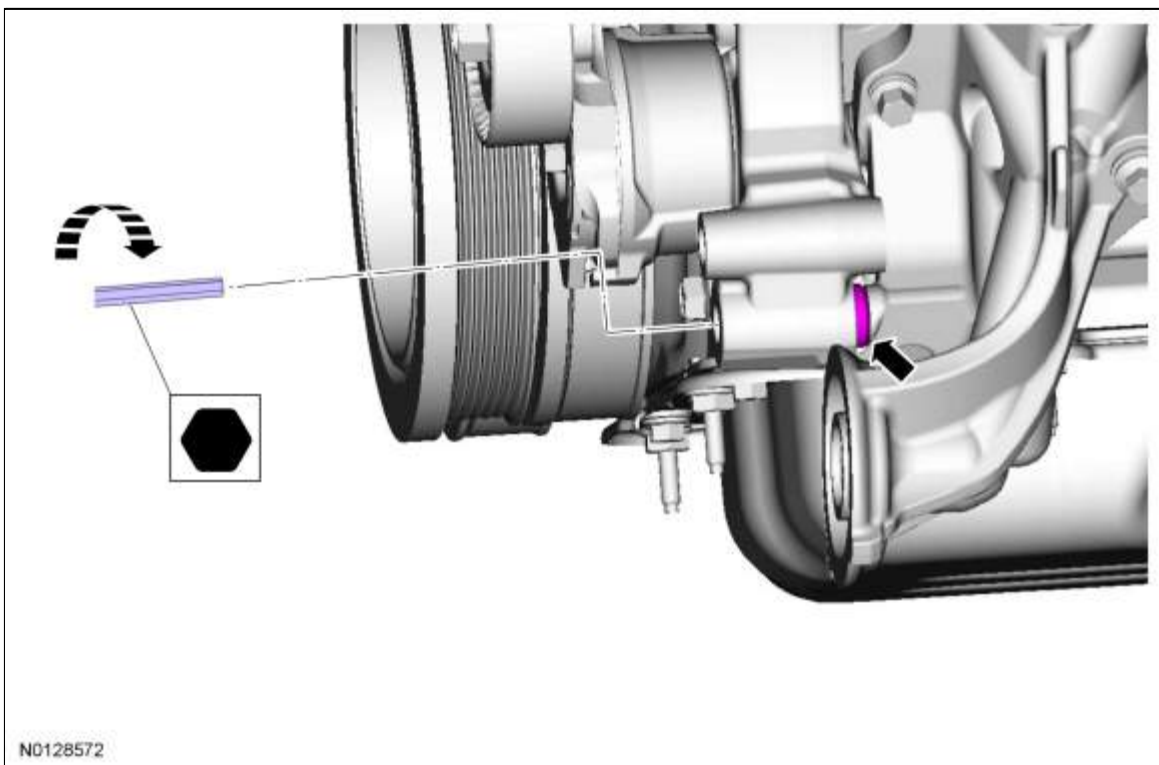
- Install the 3 bolts and tighten to 20 Nm (177 lb-in) plus an additional 60 degrees.



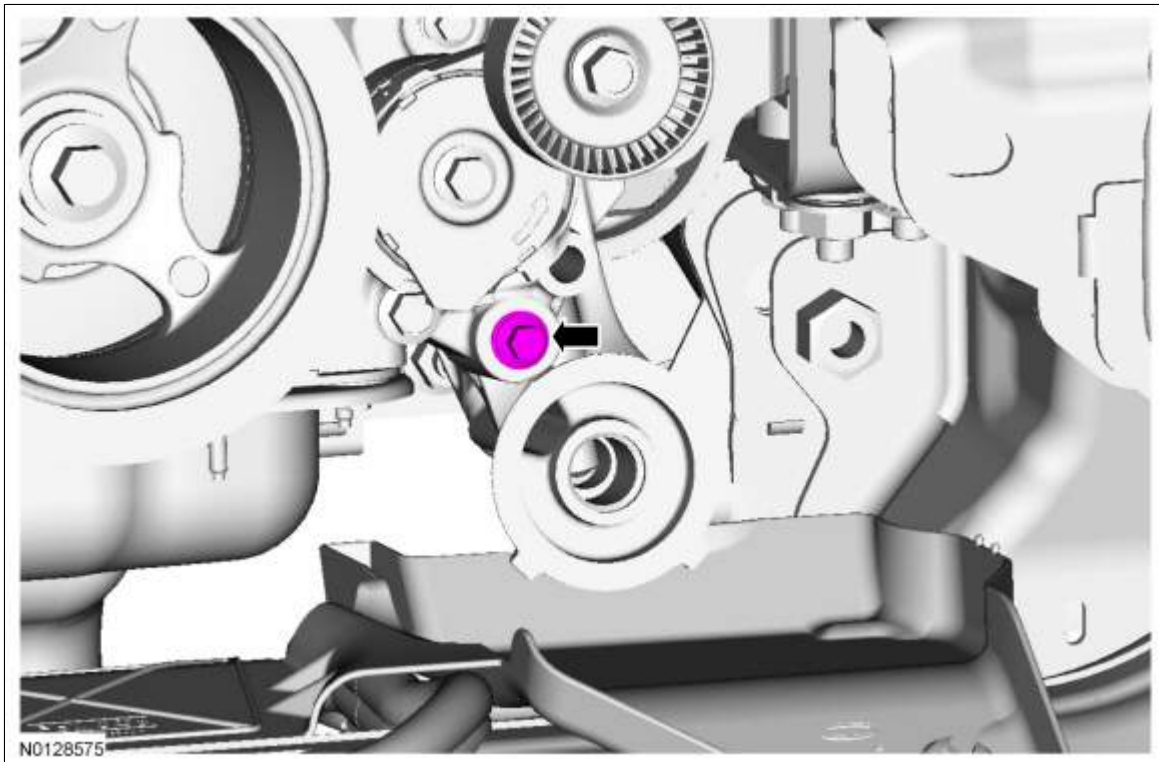
2. Connect the engine oil pressure switch electrical connector.



3. Using a 10 mm Hex Bit, rotate the engine front cover jackscrew into contact with the oil filter adapter to 5 Nm (44 lb-in).



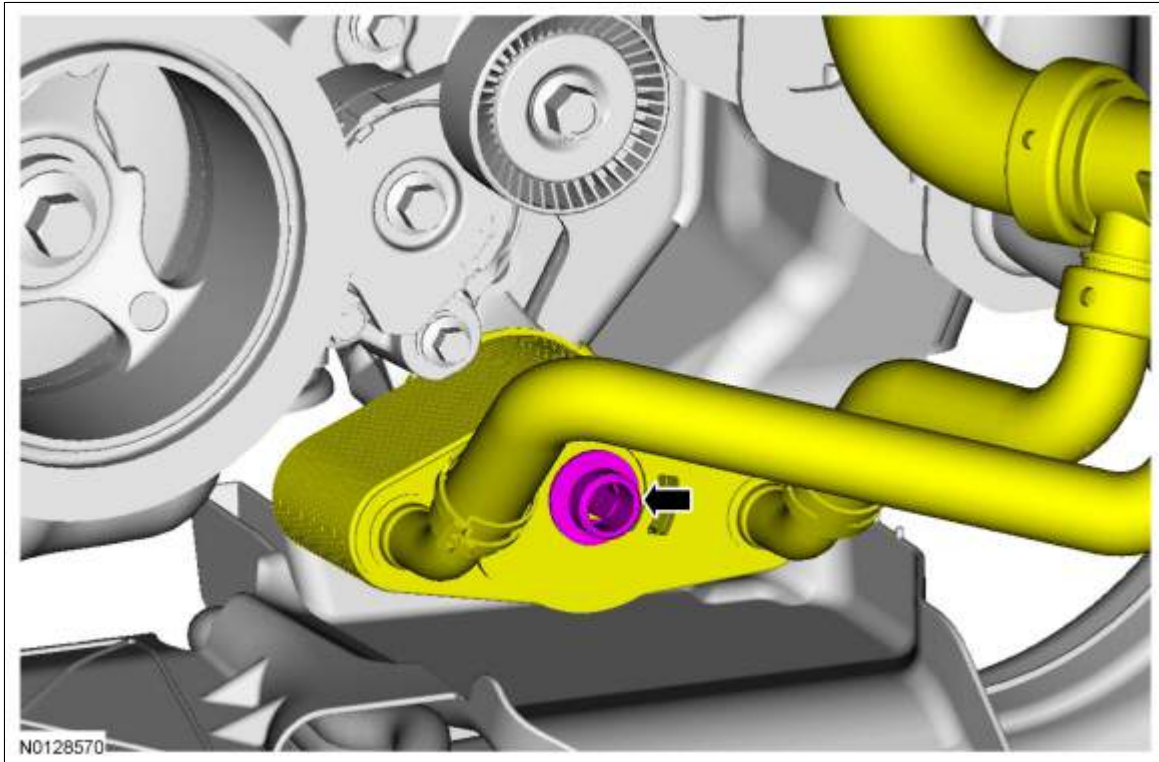
4. Tighten the engine front cover-to-oil filter adapter bolt to 25 Nm (18 lb-ft) plus an additional 60 degrees.



5. **NOTICE:** If metal or aluminum material is present in the oil cooler, mechanical concerns exist. Failure to correct these concerns may cause engine failure. To diagnose mechanical concerns, refer to [Section 303-00](#).

Position the oil cooler and hoses and install the oil cooler threaded insert.

- Tighten to 57 Nm (42 lb-ft).



6. **NOTE:** Do not lubricate the O-ring seal.

Install a new oil filter.

- Tighten to 16 Nm (142 lb-in).

7. Install the generator. For additional information, refer to [Section 414-00](#).

SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Oil Level Indicator and Tube

Removal

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

1. Remove the LH valve cover. For additional information, refer to [Valve Cover — LH](#) in this section.
2. Depress the 4 tabs and remove the oil level indicator tube.



Installation

1. Install the oil level indicator tube.
 - Push the oil level indicator tube into the valve cover until it clicks into place.
 2. Install the LH valve cover. For additional information, refer to [Valve Cover — LH](#) in this section.
-

SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Oil Pan

Material

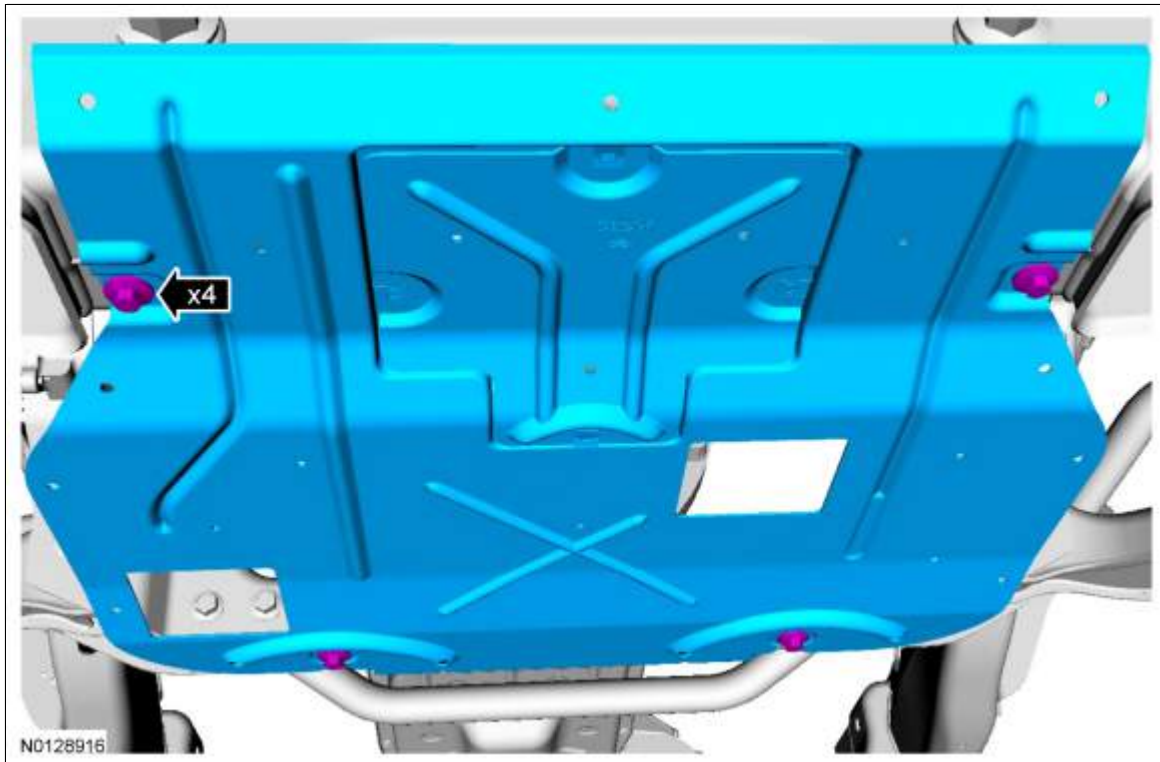
Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® Silicone Gasket Remover ZC-30	—
Silicone Gasket and Sealant TA-30	WSE-M4G323- A4

Removal

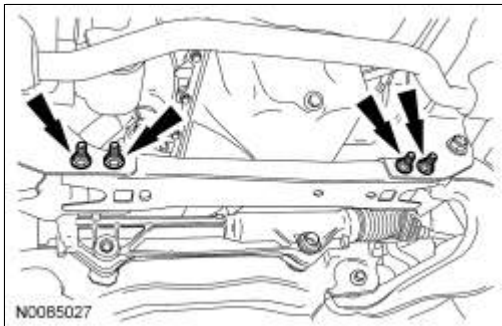
NOTICE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

All vehicles

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
3. Remove the oil level indicator.
4. If equipped, remove the 4 bolts and the skid plate.

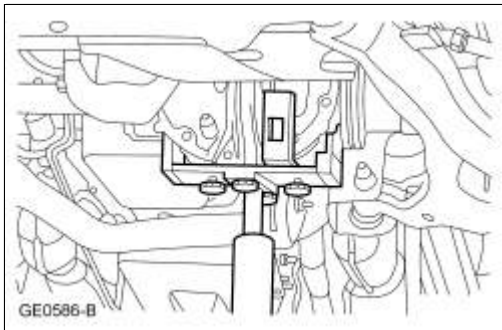


5. Remove the drain plug and drain the engine oil.
 - Install the drain plug and tighten to 26 Nm (19 lb-ft).
6. Remove the 4 nuts and bolts and the crossmember.

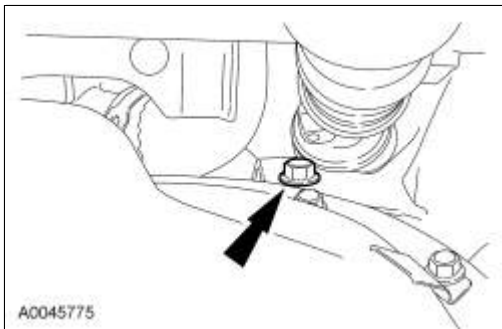


Four Wheel Drive (4X4) vehicles

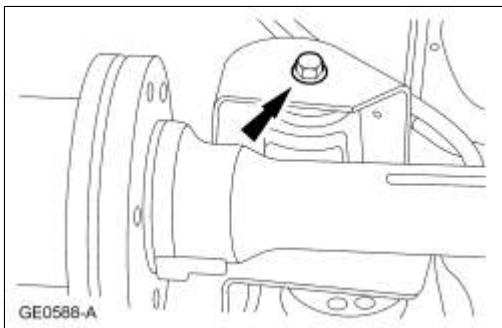
7. Position a suitable hydraulic jack under the front axle.
 - Securely strap the jack to the axle.



8. Remove the upper front axle carrier mounting bushing bolt.

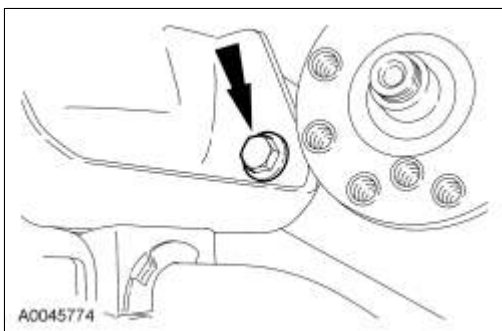


9. Remove the axle shaft housing carrier bushing bolt.



10. **NOTE:** Front driveshaft removed for clarity only.

Remove the lower front axle carrier mounting bushing bolt.

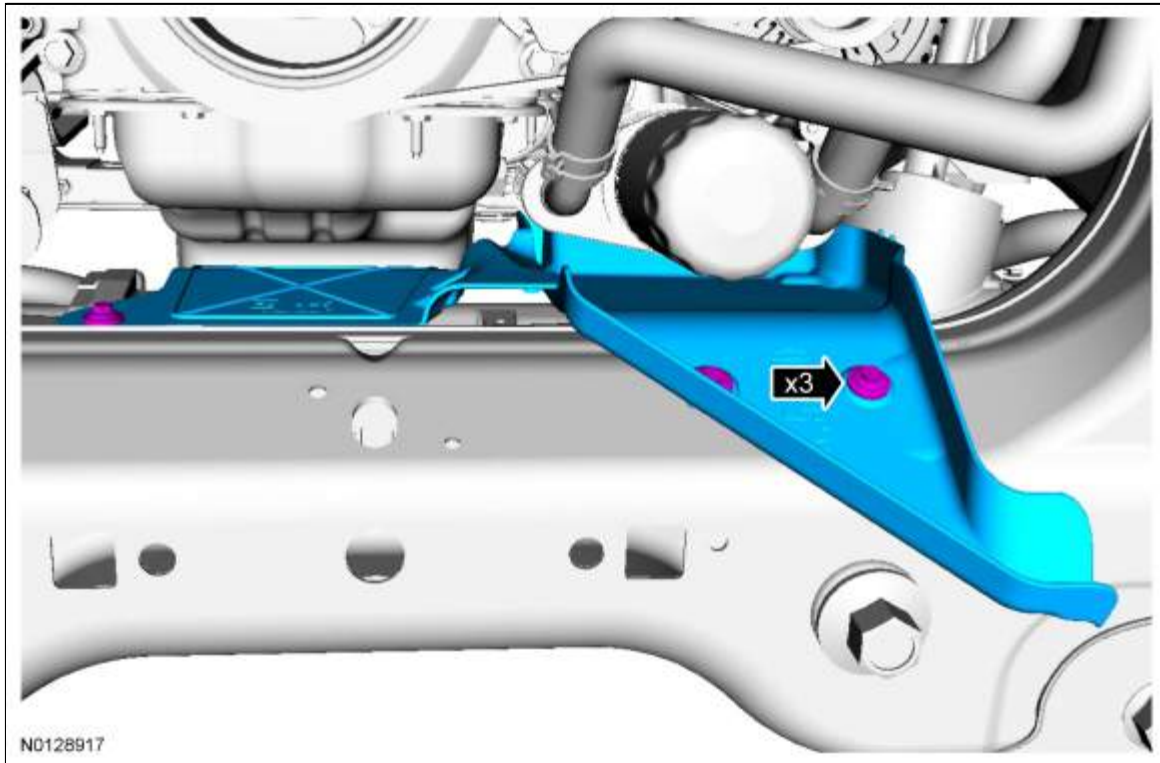


11. **NOTICE:** Use care when lowering the front axle housing, or the vacuum lines to the axle solenoid may become disconnected or damaged.

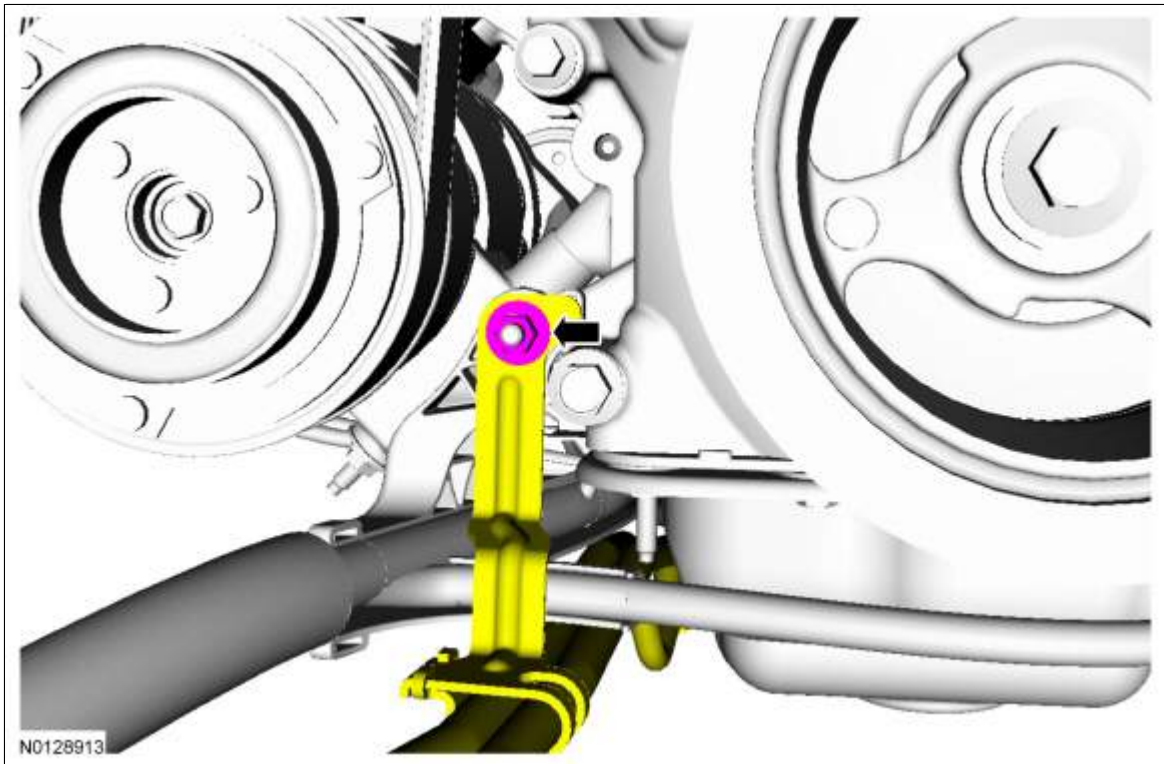
Lower the axle to allow clearance for the oil pan to be removed.

All vehicles

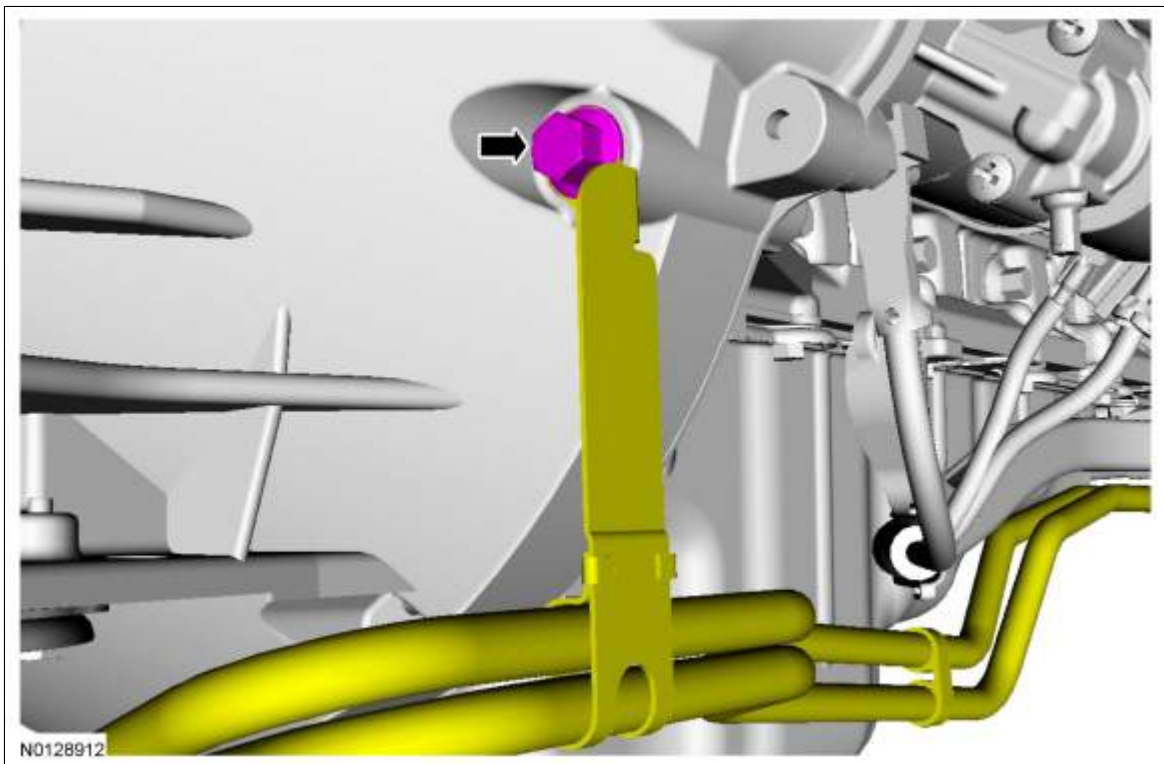
12. Remove the 3 bolts and the oil drain gutter.



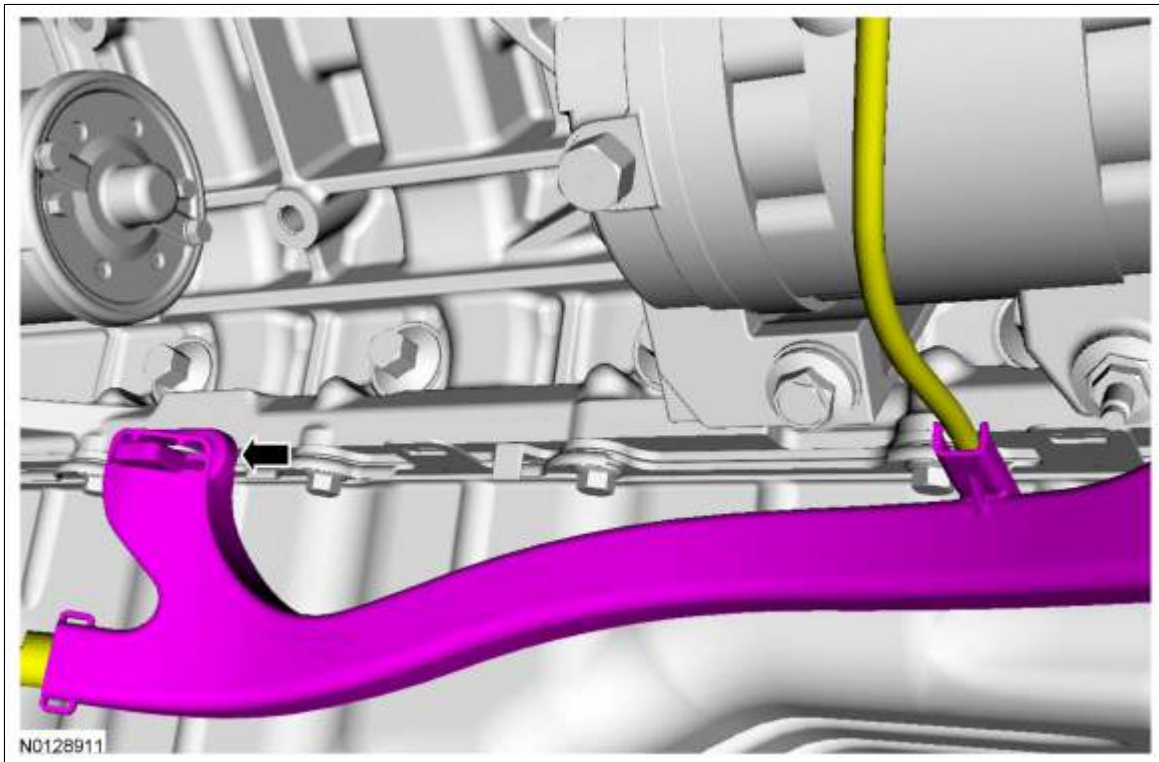
13. Remove the nut and the transmission cooler tube bracket from the engine front cover stud bolt.



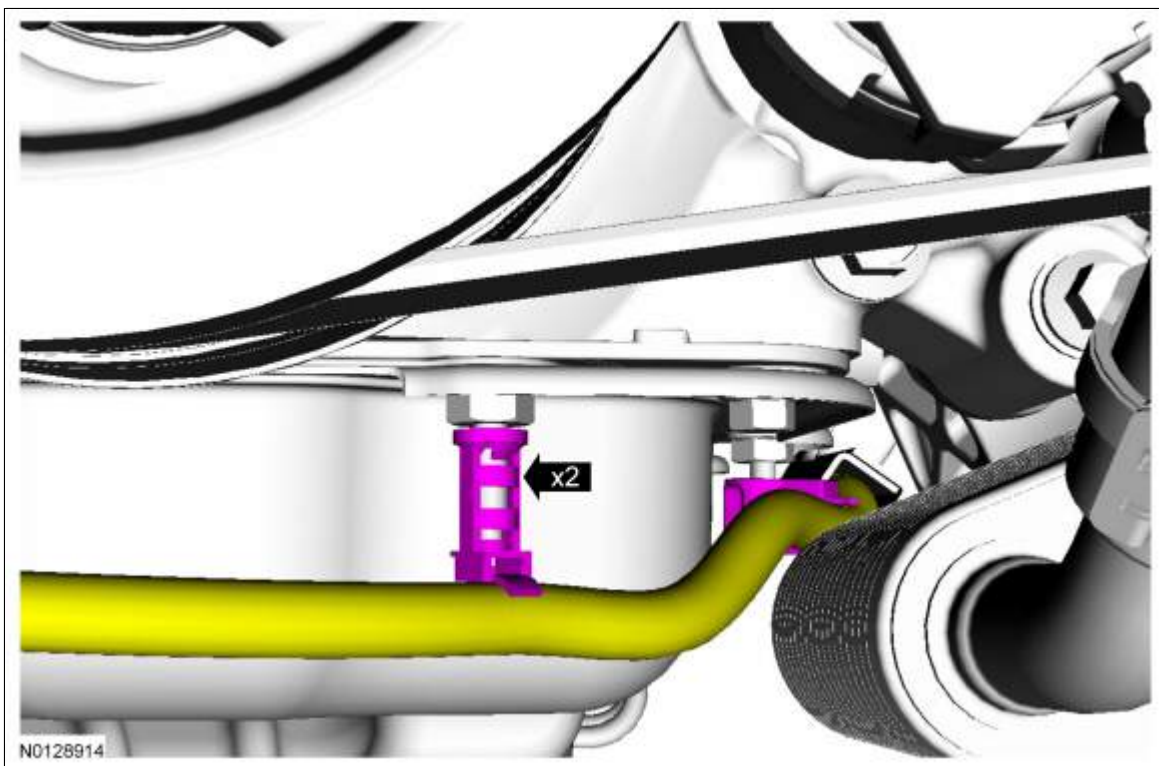
14. Remove the bolt and the transmission cooler tube bracket from the bellhousing.



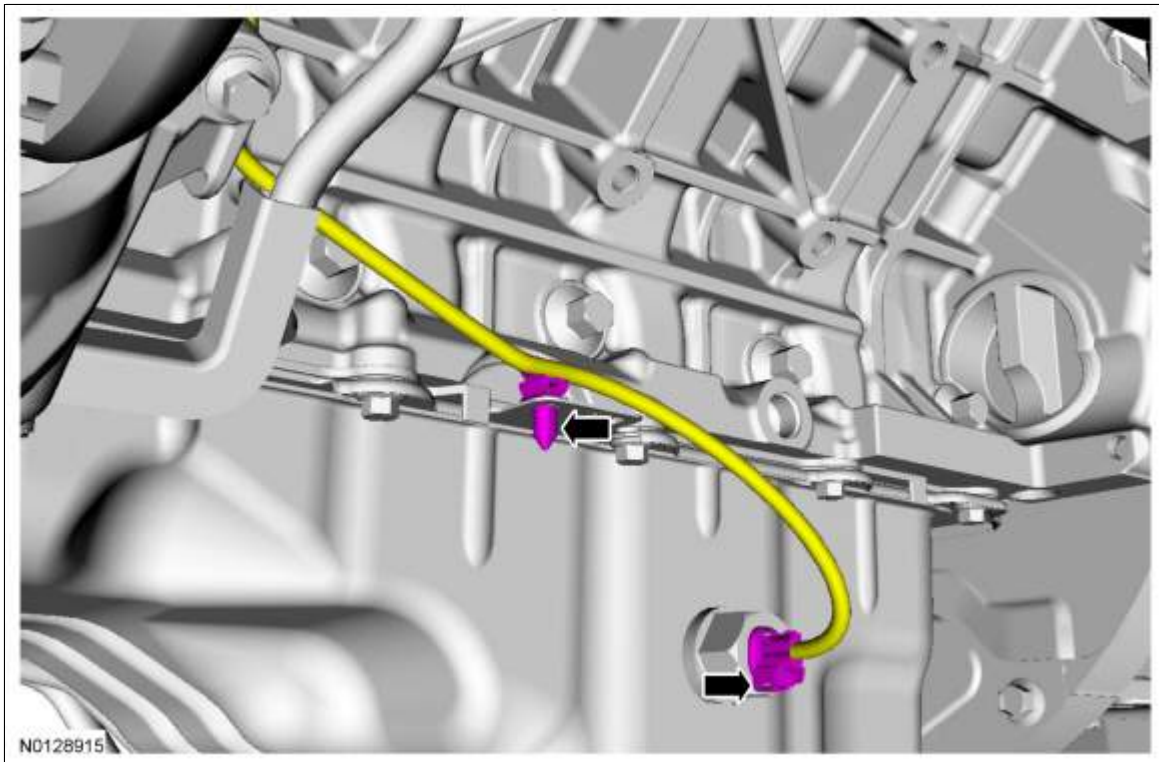
15. Detach the starter motor wiring harness retainer from the oil pan.



16. Detach the 2 wiring harness retainers from the oil pan stud bolts.



17. Disconnect the oil level sensor electrical connector and wiring harness retainer.



18. Remove the 3 stud bolts, the 13 bolts and the oil pan.

Installation

All vehicles

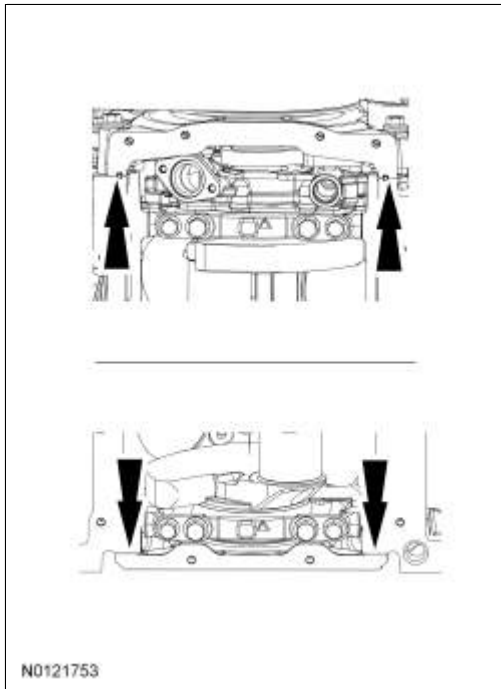
1. **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Inspect the oil pan and engine sealing surfaces. Clean the mating surfaces of the engine and oil pan with silicone gasket remover and metal surface prep. Follow the directions on the packaging.

2. **NOTE:** If the oil pan is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage. If this timing cannot be met, tighten fasteners 7, 8, 9 and 10 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer and final torque all of the fasteners within 1 hour of applying the sealer.

NOTE: If the engine front cover has been removed, it is only necessary to apply sealant to the crankshaft rear seal retainer plate-to-cylinder block sealing surfaces.

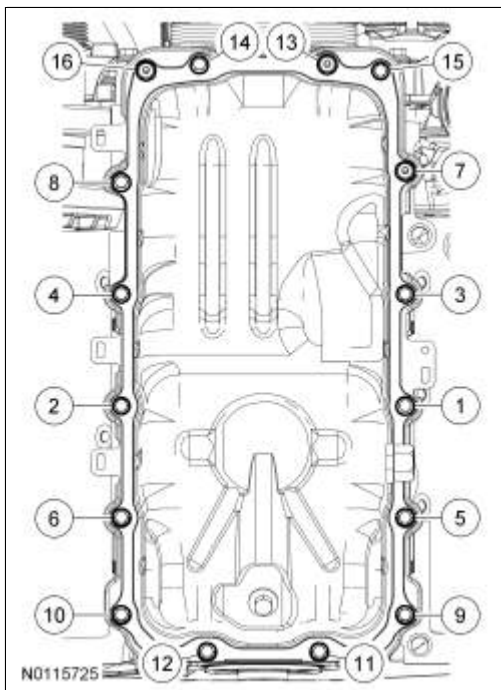
Apply an 8 mm (0.31 in) bead of silicone sealant to the crankshaft rear seal retainer plate-to-cylinder block sealing surfaces and the engine front cover-to-cylinder block sealing surfaces.



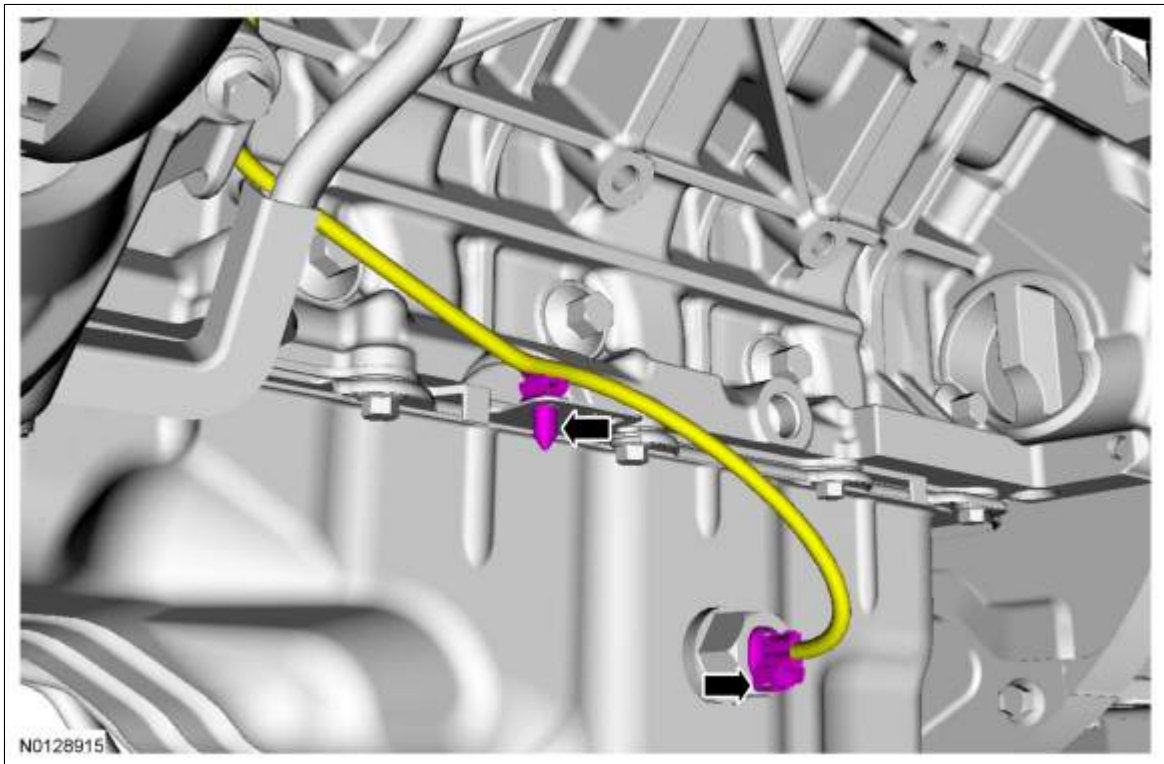
3. **NOTE:** Fastener locations 7, 13 and 16 are stud bolts.

Using a new gasket, install the oil pan and tighten the fasteners in sequence in 3 stages.

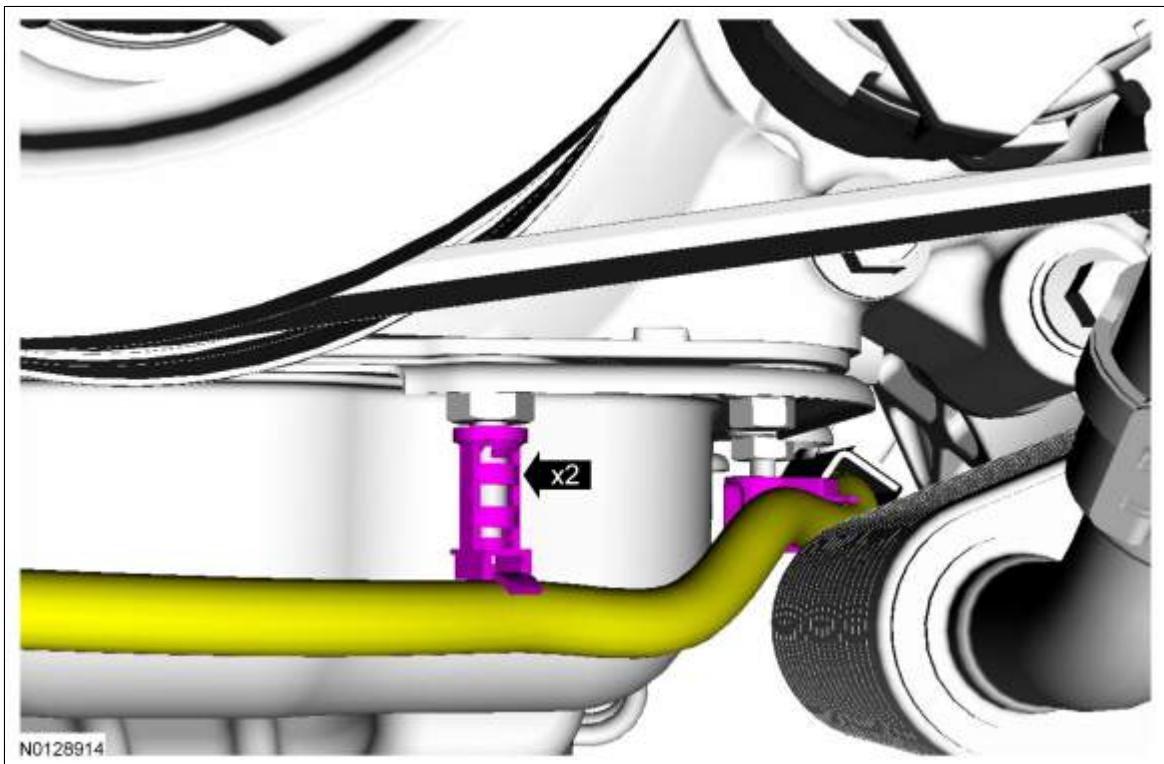
- Stage 1: Tighten to 2 Nm (18 lb-in)
- Stage 2: Tighten to 10 Nm (89 lb-in).
- Stage 3: Tighten an additional 45 degrees.



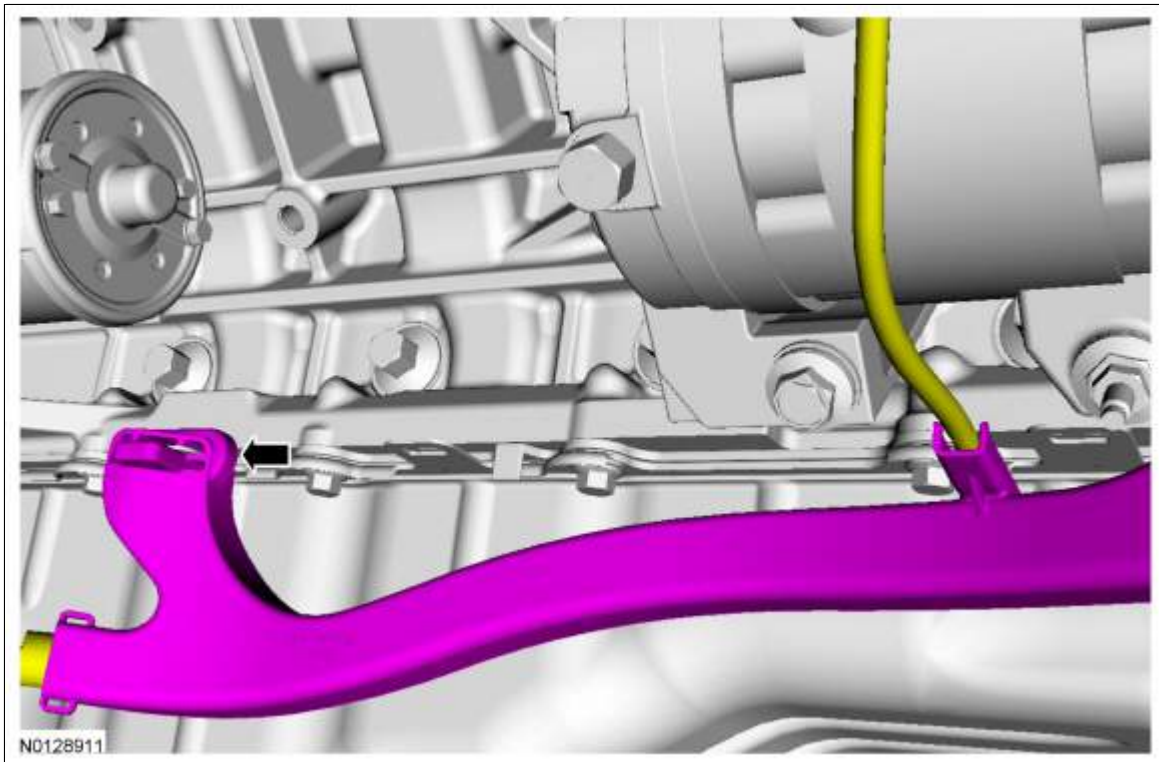
4. Connect the oil level sensor electrical connector and wiring harness retainer.



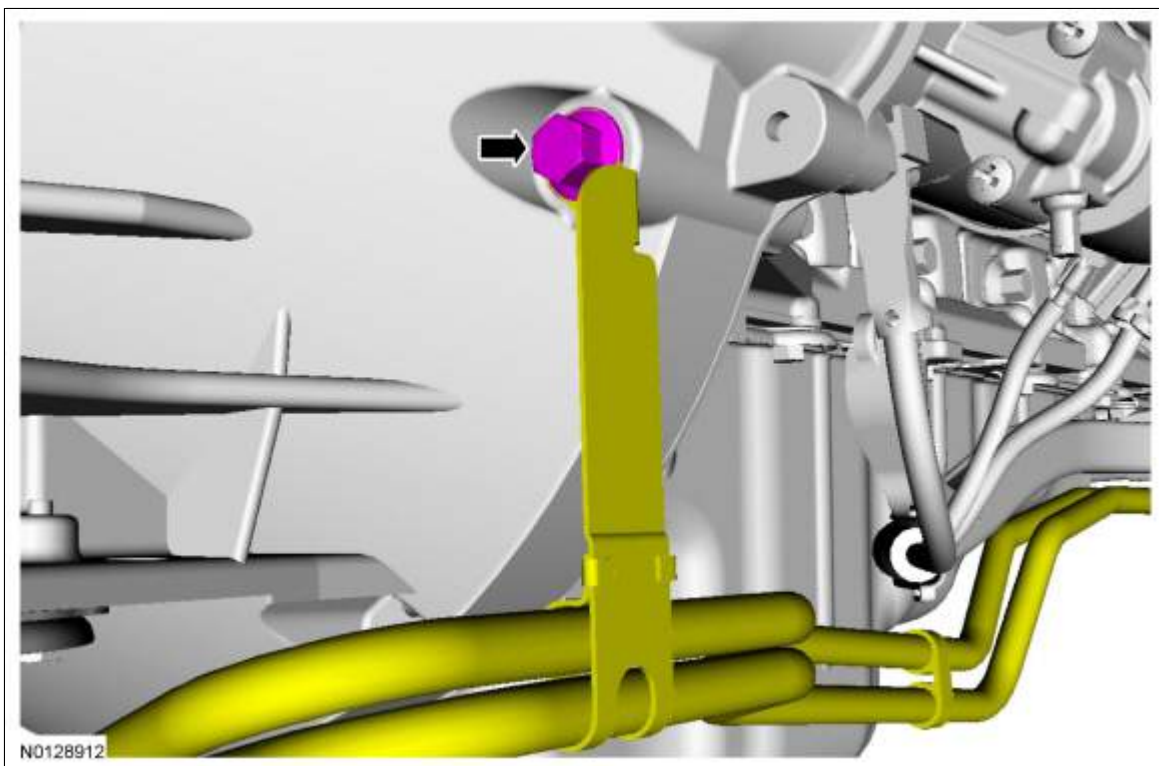
5. Attach the 2 wiring harness retainers to the oil pan stud bolts.



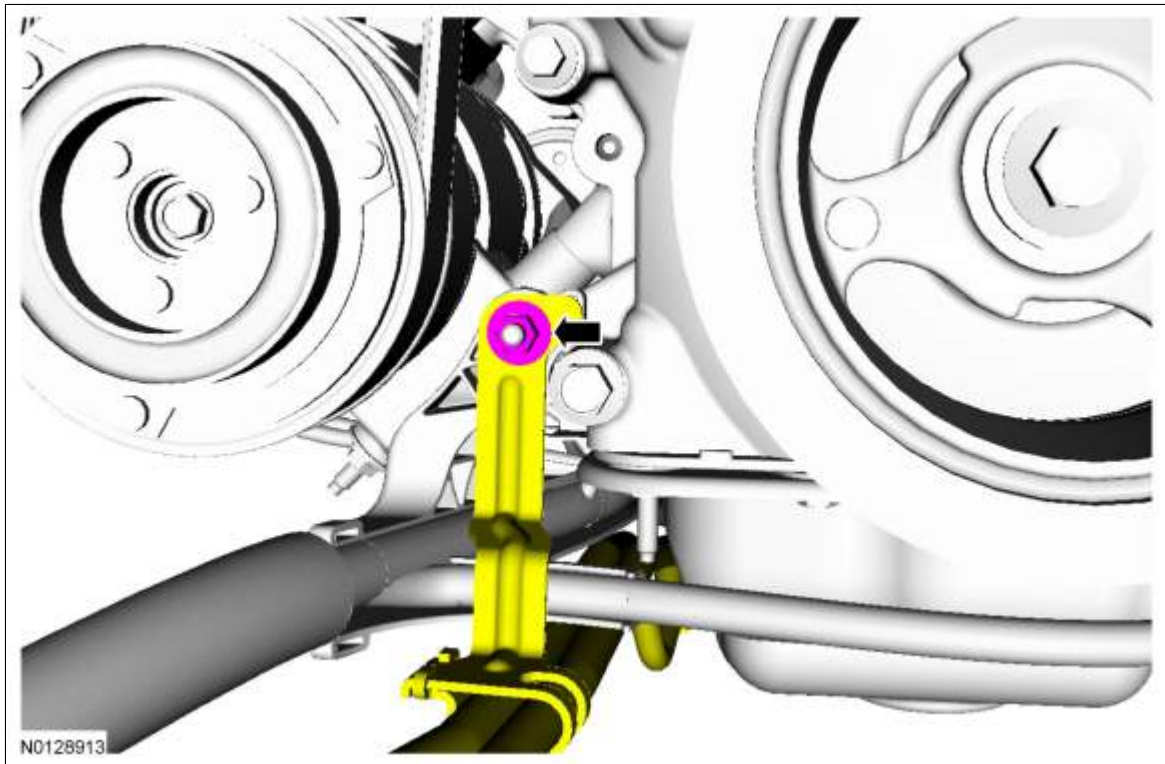
6. Attach the starter motor wiring harness retainer to the oil pan.



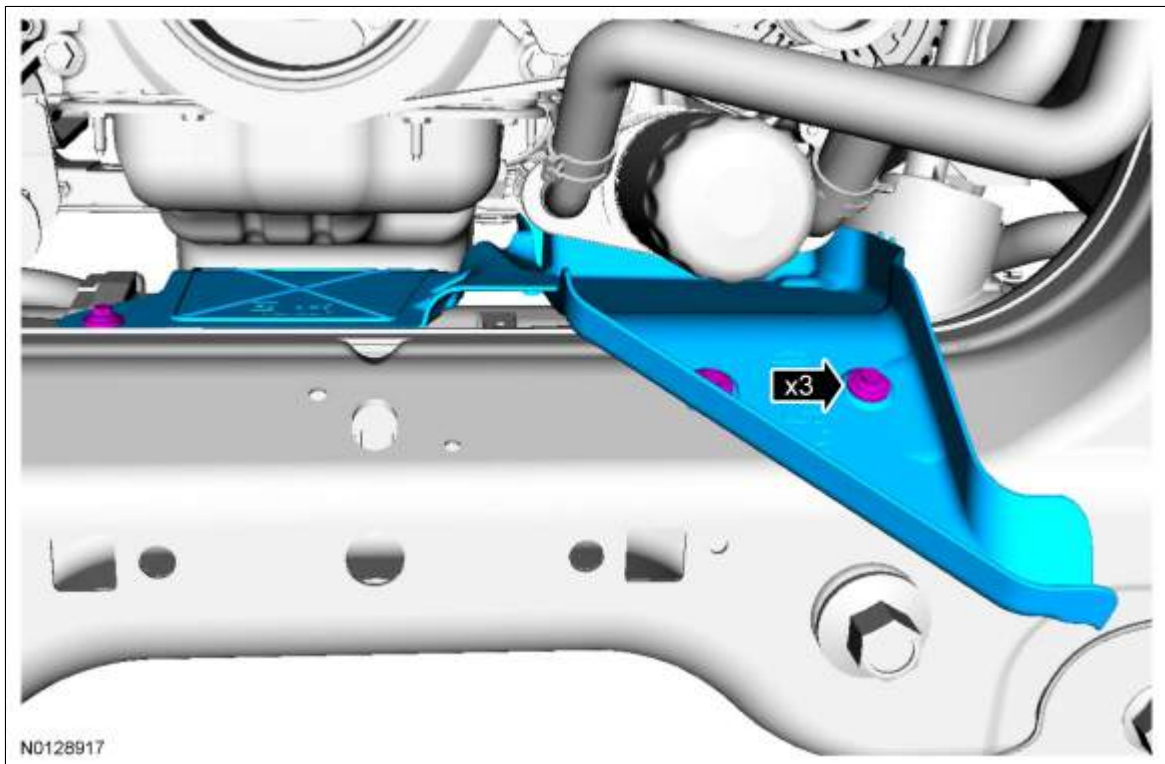
7. Install the transmission cooler tube bracket and the bolt onto the bellhousing.
 - Tighten to 48 Nm (35 lb-ft).



8. Install the transmission cooler tube bracket and the nut onto the engine front cover stud bolt.
 - Tighten to 13 Nm (115 lb-in).



9. Install the oil drain gutter and the 3 bolts.
- Tighten to 10 Nm (89 lb-in).

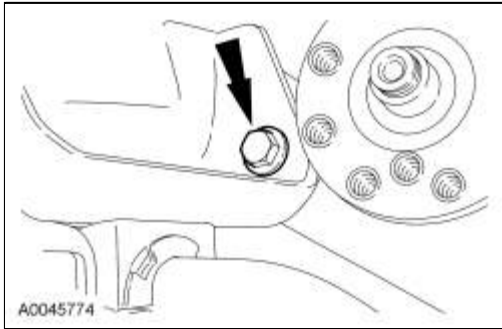


Four Wheel Drive (4X4) vehicles

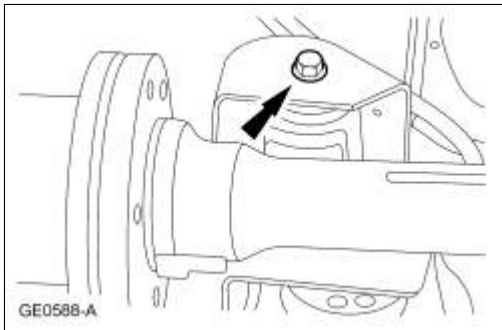
10. **NOTICE:** Use care when positioning the front axle housing, or the vacuum tubes to the axle solenoid may become disconnected or damaged.

Raise the front axle carrier into position.

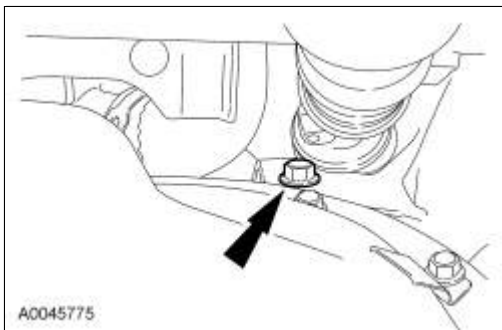
11. Install the lower front axle carrier mounting bushing bolt.
- Tighten to 115 Nm (85 lb-ft).



12. Install the axle shaft housing carrier bushing bolt.
- Tighten to 115 Nm (85 lb-ft).

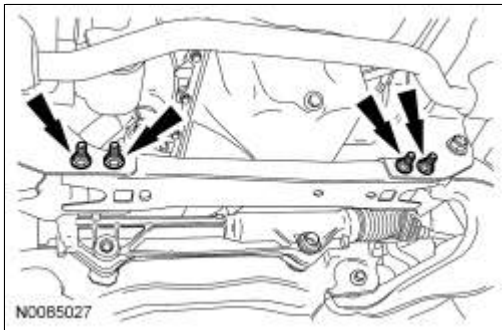


13. Install the upper front axle carrier mounting bushing bolt.
- Tighten to 115 Nm (85 lb-ft).

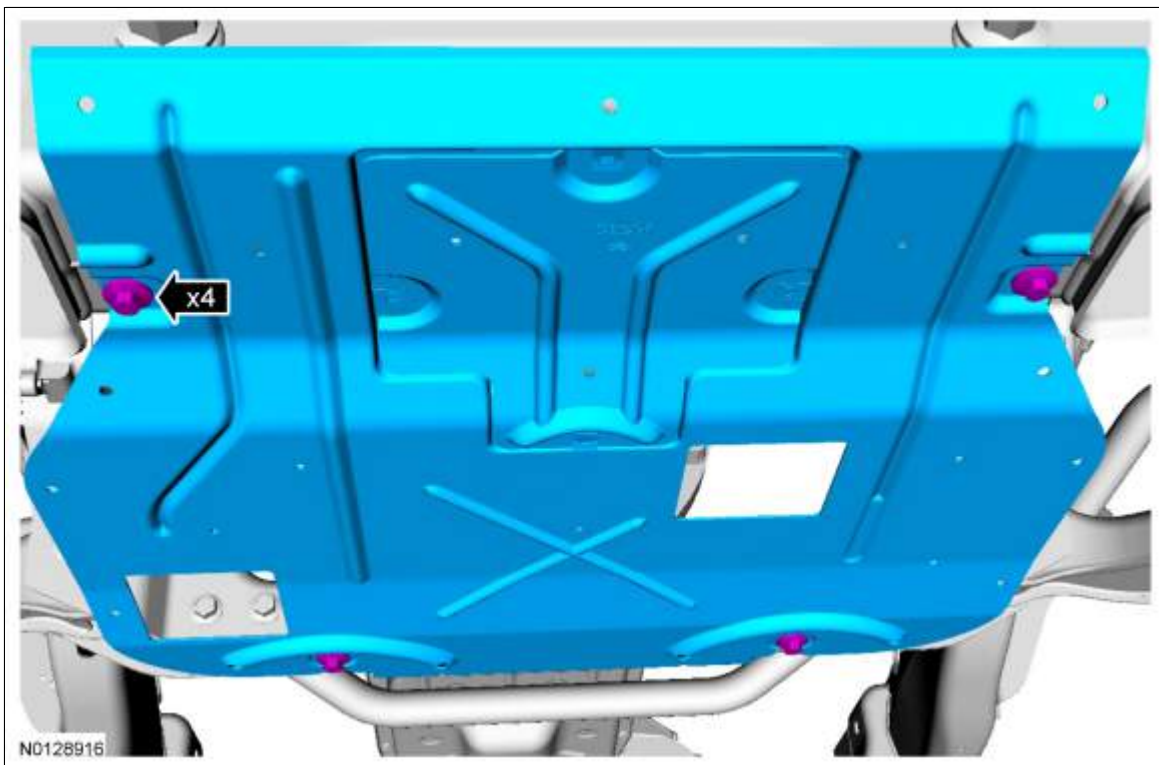


All vehicles

14. Position the crossmember and install the 4 nuts and bolts.
- Tighten to 90 Nm (66 lb-ft).



15. If equipped, install the skid plate and the 4 bolts.
 - Tighten to 48 Nm (35 lb-ft).



16. Install the oil level indicator.
 17. Fill the engine with clean engine oil.
 18. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
-

Oil Pump Screen and Pickup Tube

Removal

NOTICE: 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 [Section 100-02](#).
2. Remove the oil pan. For additional information, refer to [Engine Lubrication Components — Exploded View](#) and [Oil Pan](#) in this section.
3. Remove the 3 bolts and the oil pump screen and pickup tube assembly.
 - Discard the O-ring seal.

Installation

1. **NOTE:** The 2 oil pump screen and pickup tube-to-oil pump bolts must be tightened prior to tightening the oil pump screen and pickup tube-to-spacer bolt.

Using a new O-ring seal, install the oil pump screen and pickup tube and the 3 bolts. Tighten the 2 oil pump screen and pickup tube-to-oil pump bolts in 2 stages.


- Stage 1: Tighten to 10 Nm (89 lb-in).
 - Stage 2: Tighten an additional 45 degrees.
2. Tighten the oil pump screen and pickup tube-to-spacer bolt to 25 Nm (18 lb-ft).
 3. Install the oil pan. For additional information, refer to [Engine Lubrication Components — Exploded View](#) and [Oil Pan](#) in this section.
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SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Oil Pump

Special Tool(s)

 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
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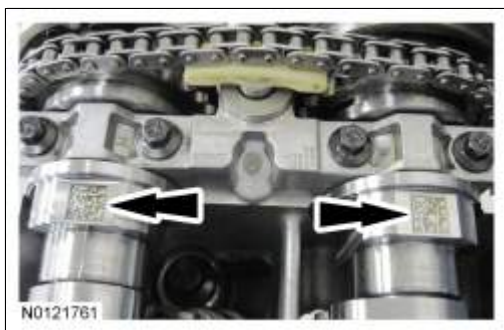
Removal

NOTICE: 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.

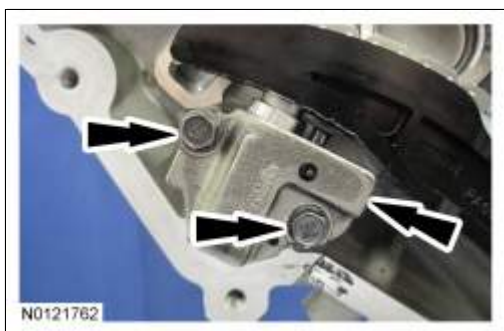
1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. Remove the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.
3. Using the crankshaft holding tool, rotate the crankshaft clockwise until the keyway is at the 12 o'clock position.



4. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.



5. Remove the 2 bolts and the RH primary timing chain tensioner.



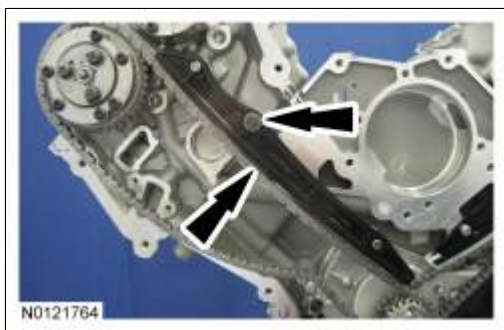
6. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

Remove the RH timing chain tensioner arm.



7. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

Remove the bolt and the RH timing chain guide.



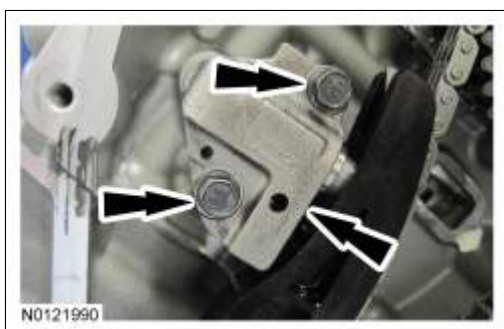
8. Remove the RH primary timing chain.



9. Using the crankshaft holding tool, rotate the crankshaft counterclockwise until the crankshaft keyway is at the 9 o'clock position.



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



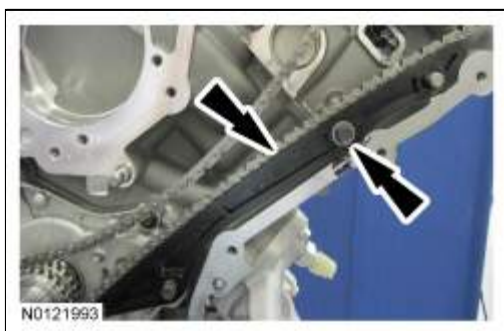
11. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain tensioner arm.

Remove the LH timing chain tensioner arm.



12. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain guide.

Remove the bolt and the LH timing chain guide.



13. Remove the LH primary timing chain.



14. Remove the crankshaft sprocket.



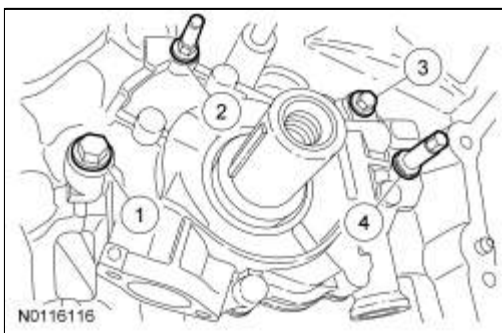
15. Remove the oil pump screen and pickup tube. For additional information, refer to [Engine Lubrication Components — Exploded View](#) and [Oil Pump Screen and Pickup Tube](#) in this section.
16. Remove the 2 bolts, the 2 stud bolts and the oil pump.

Installation

1. Rotate the inner rotor of the oil pump assembly to align the flats on the crankshaft and slip the oil pump over the crankshaft until seated against the block.
 - Rotate the oil pump until the bolt holes are aligned to the block and install the fasteners.
2. **NOTE:** Oil pump must be held against the cylinder block until all bolts are tightened.

Tighten the fasteners in the sequence shown in 3 stages:

- Stage 1: Hand tighten.
- Stage 2: Tighten the bolt (1) to 10 Nm (89 lb-in), the stud bolt (2) to 25 Nm (18 lb-ft), the bolt (3) to 10 Nm (89 lb-in) and the stud bolt (4) to 20 Nm (177 lb-in).
- Stage 3: Tighten the bolt (1) an additional 45 degrees, the stud bolt (2) an additional 75 degrees, the bolt (3) an additional 45 degrees and the stud bolt (4) an additional 60 degrees.



3. Install the oil pump screen and pickup tube. For additional information, refer to [Engine Lubrication Components — Exploded View](#) and [Oil Pump Screen and Pickup Tube](#) in this section.
4. Install the crankshaft sprocket with the flange facing forward.



5. Install the LH primary timing chain.
 - Align the colored link on the timing chain with the timing mark on the LH VCT assembly.



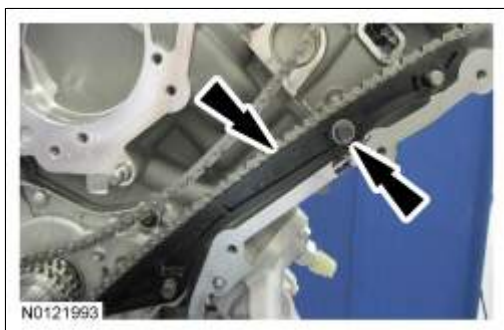
6. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



7. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain guide.

Install the LH timing chain guide and bolt.

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



8. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain tensioner arm.

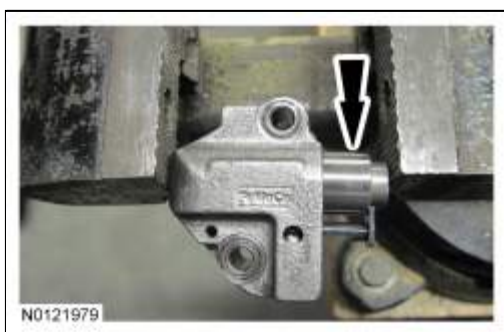
Install the LH timing chain tensioner arm.



NOTE: Complete the following 3 steps on both the LH and RH primary timing chain tensioners.

9. **NOTICE:** Do not compress the ratchet assembly or damage to the tensioner will occur.

Compress the primary timing chain tensioner plunger, using an edge of a vise.



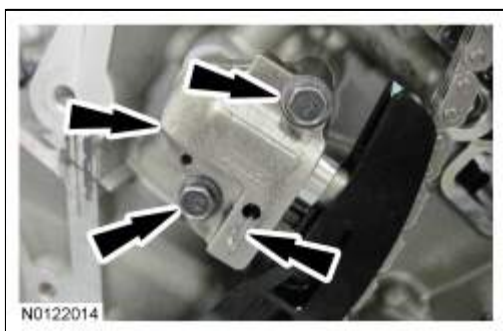
10. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.



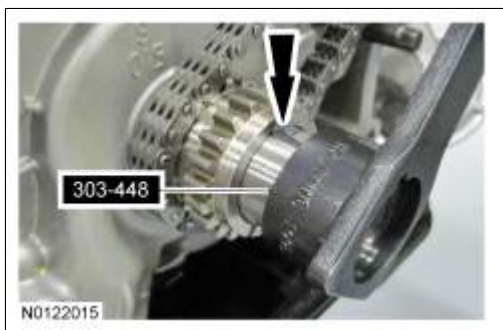
11. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.



12. Install the LH primary timing chain tensioner and 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Remove the holding pin from the tensioner.



13. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.



14. Install the RH primary timing chain.
 - Align the colored link on the timing chain with the timing mark on the RH VCT assembly.



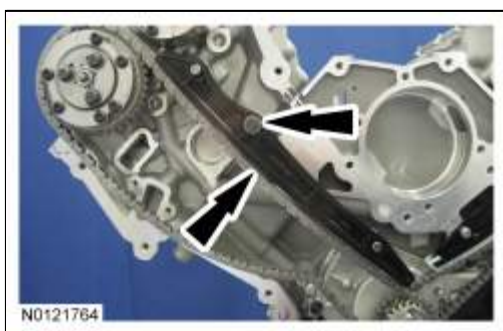
15. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



16. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

Install the RH timing chain guide and bolt.

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



17. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

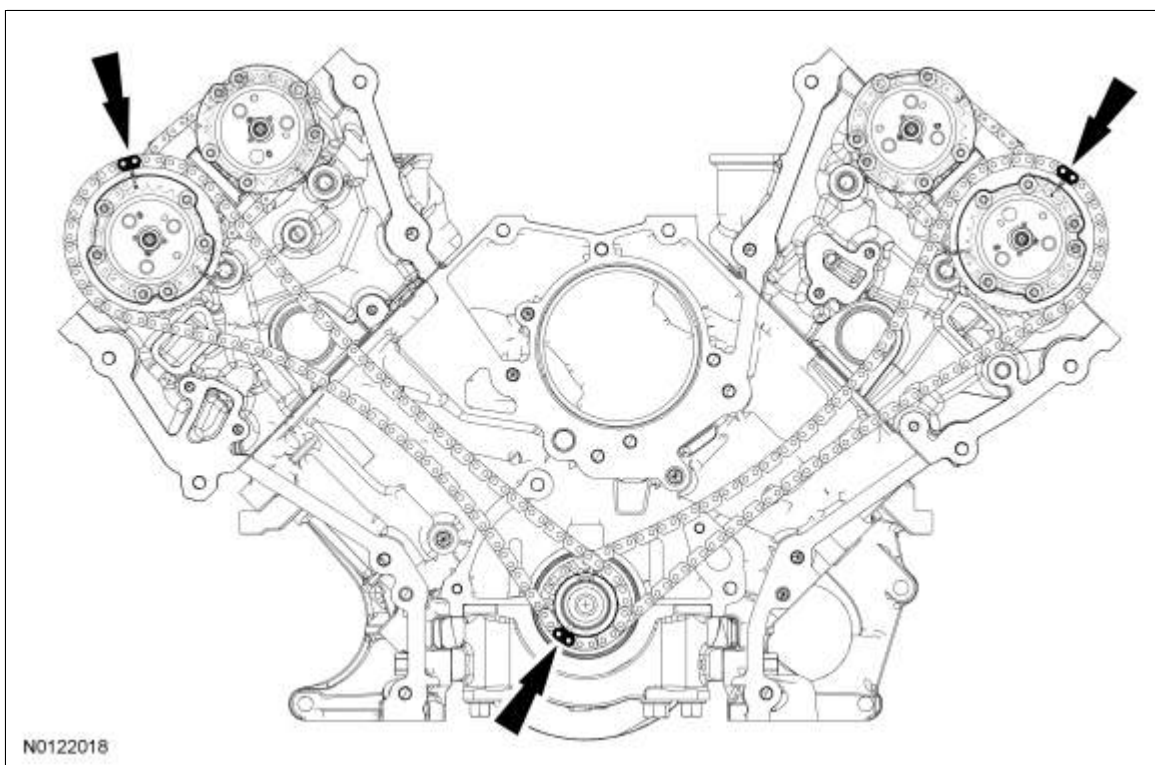
Install the RH timing chain tensioner arm.



18. Install the RH primary timing chain tensioner and 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Remove the holding pin from the tensioner.



19. With the crankshaft keyway still at the 12 o'clock position, verify the timing mark alignment is correct.



20. Install the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.

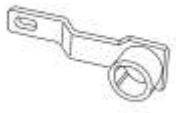


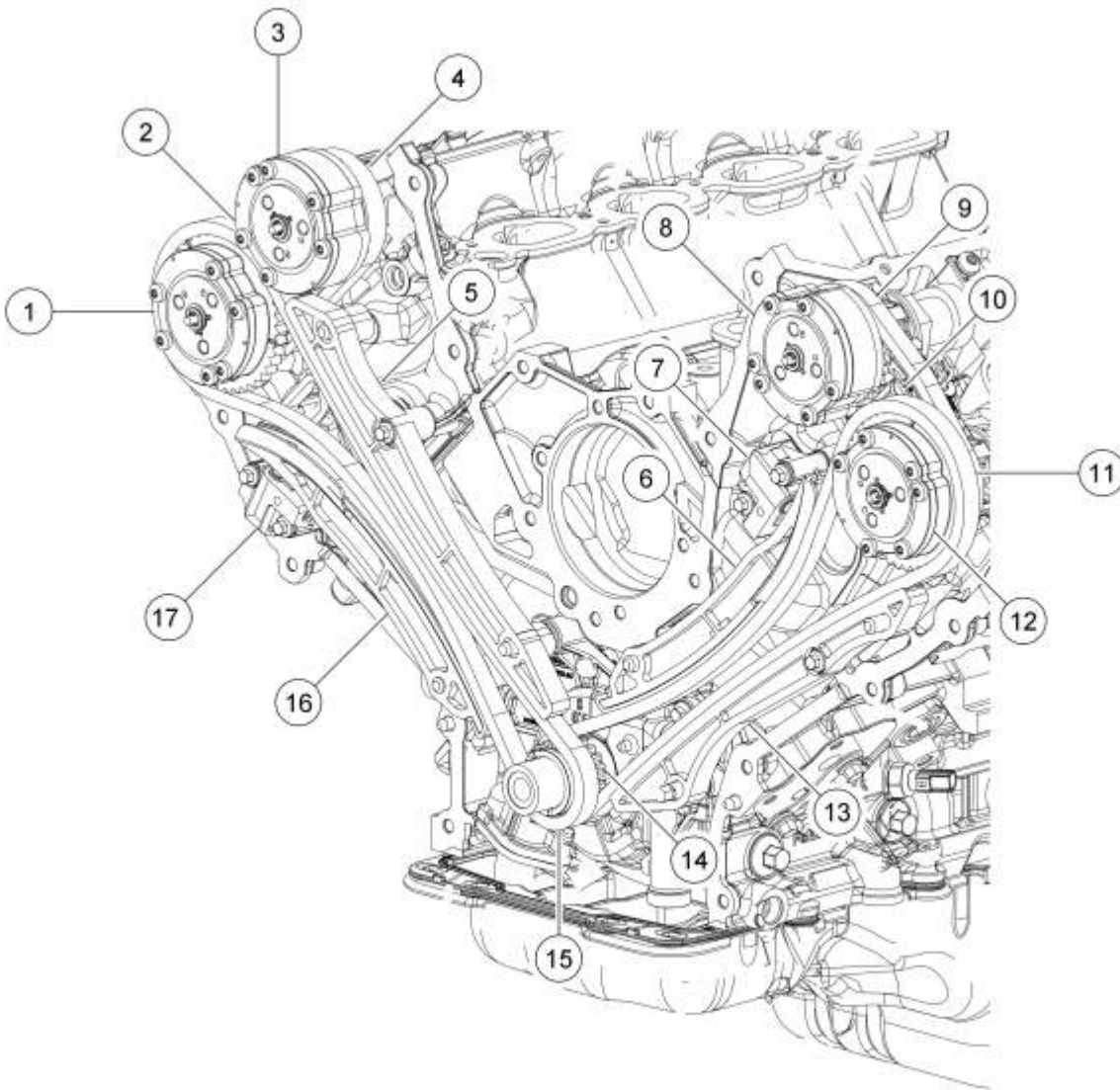
SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Timing Drive Components

Special Tool(s)

 <p>ST1335-A</p>	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
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N0115713

Item	Part Number	Description
1	6256	RH exhaust camshaft Variable Camshaft Timing (VCT)
2	6K254	RH secondary tensioner
3	6256	RH intake camshaft <u>VCT</u>
4	6268	RH secondary timing chain
5	6M256	RH timing chain guide
6	6K255	LH timing chain tensioner arm
7	6L266	LH primary tensioner
8	6256	LH intake camshaft <u>VCT</u>

9	6268	LH secondary timing chain
10	6K254	LH secondary tensioner
11	6268	LH primary timing chain
12	6256	LH exhaust camshaft <u>VCT</u>
13	6B274	LH timing chain guide
14	6306	Crankshaft sprocket
15	6268	RH timing chain
16	6K255	RH timing chain tensioner arm
17	6L266	RH primary tensioner

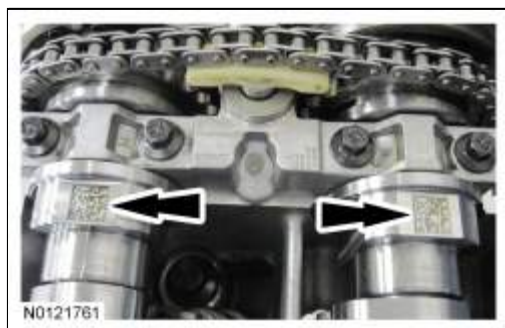
Removal

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

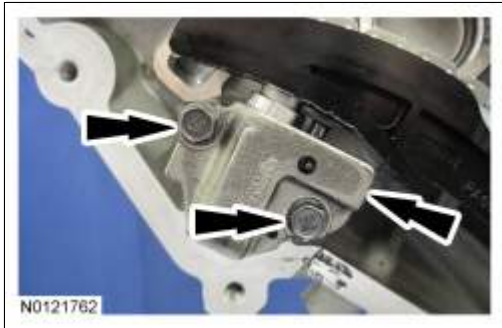
1. Remove the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.
2. Using the crankshaft holding tool, rotate the crankshaft clockwise until the keyway is at the 12 o'clock position.



3. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.



4. Remove the 2 bolts and the RH primary timing chain tensioner.



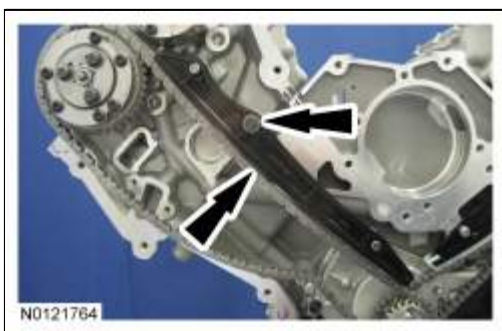
5. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

Remove the RH timing chain tensioner arm.



6. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

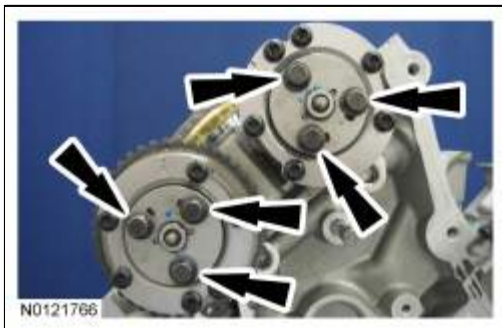
Remove the bolt and the RH timing chain guide.



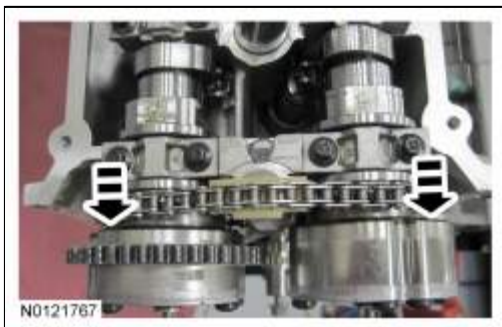
7. Remove the RH primary timing chain.



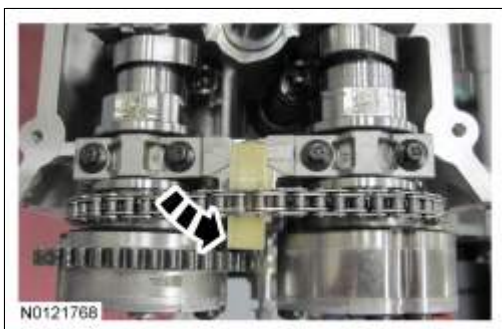
8. Remove the 3 RH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 RH exhaust VCT assembly bolts.



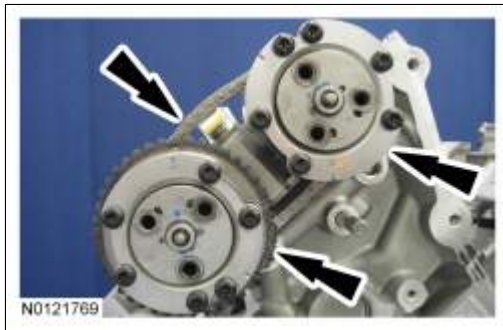
9. Slide the RH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



10. Depress the RH secondary timing chain tensioner and turn the tensioner 90 degrees.



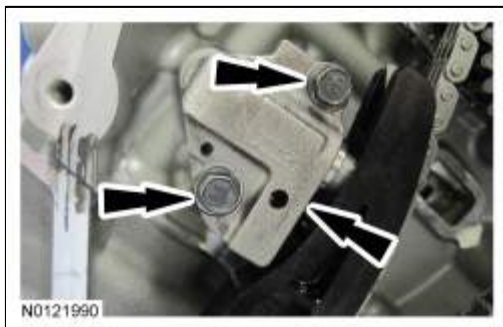
11. Remove the RH VCT assemblies and the RH secondary timing chain.



12. Using the crankshaft holding tool, rotate the crankshaft counterclockwise until the crankshaft keyway is at the 9 o'clock position.



13. Remove the 2 bolts and the LH primary timing chain tensioner.



14. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain tensioner arm.

Remove the LH timing chain tensioner arm.



15. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain guide.

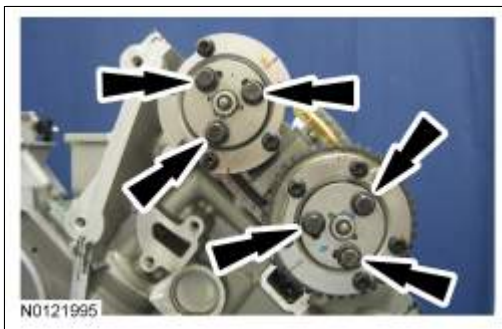
Remove the bolt and the LH timing chain guide.



16. Remove the LH primary timing chain.



17. Remove the 3 LH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 LH exhaust VCT assembly bolts.



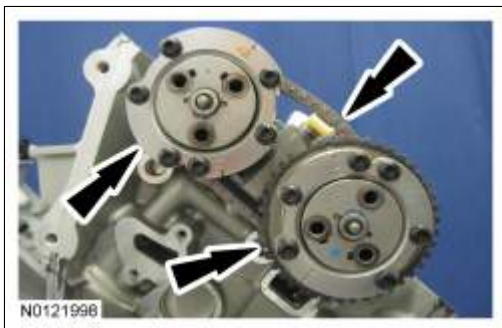
18. Slide the LH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



19. Depress the LH secondary timing chain tensioner and turn the tensioner 90 degrees.



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



21. Remove the crankshaft sprocket.

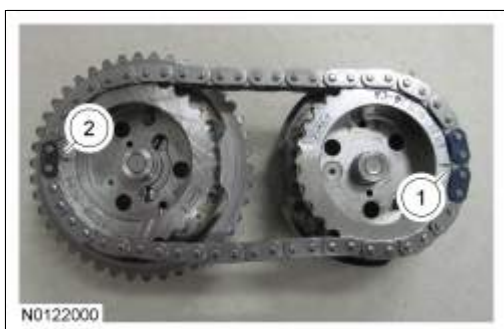


Installation

1. Install the crankshaft sprocket with the flange facing forward.



2. Install the secondary timing chain onto the LH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
 1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
 2. The timing mark on the exhaust VCT assembly should align with the single colored link.



3. Install the LH VCT assemblies and the secondary timing chain onto the LH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 11 o'clock position.



4. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.

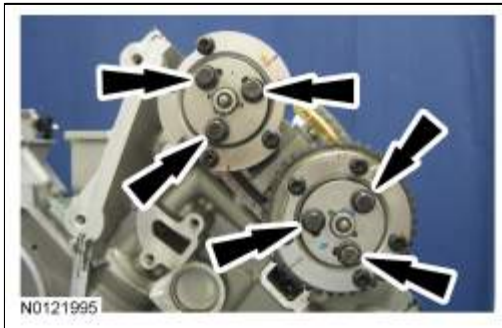
- If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



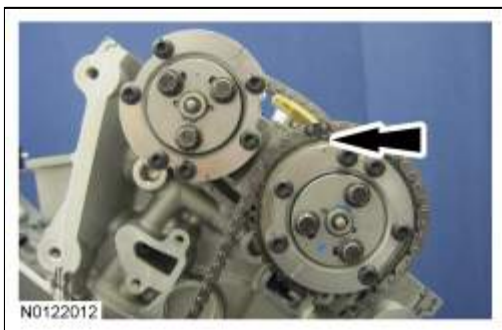
5. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

Install the 3 LH intake VCT assembly bolts and the 3 LH exhaust VCT assembly bolts.

- Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.



6. Install the LH primary timing chain.
- Align the colored link on the timing chain with the timing mark on the LH VCT assembly.



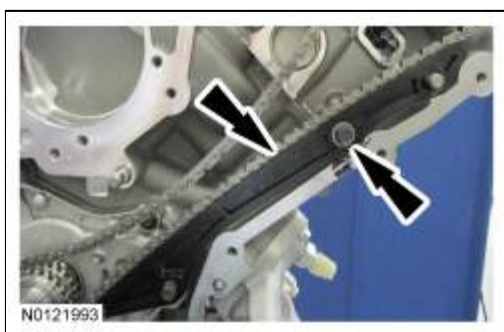
7. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



8. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain guide.

Install the LH timing chain guide and bolt.

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



9. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain tensioner arm.

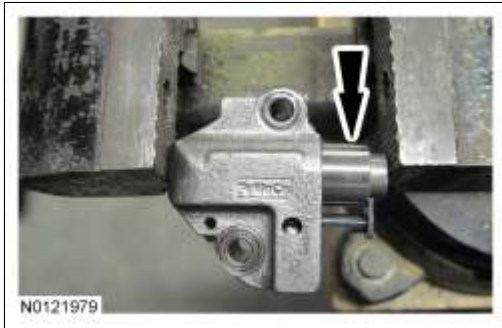
Install the LH timing chain tensioner arm.



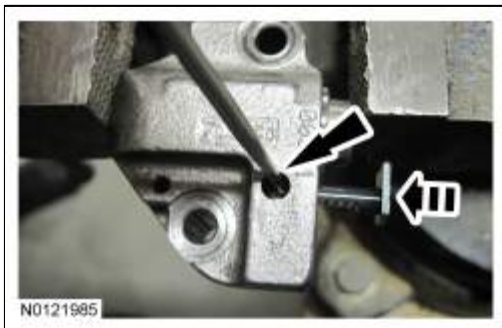
NOTE: Complete the following 3 steps on both the LH and RH primary timing chain tensioners.

10. **NOTICE:** Do not compress the ratchet assembly or damage to the tensioner will occur.

Compress the primary timing chain tensioner plunger, using an edge of a vise.



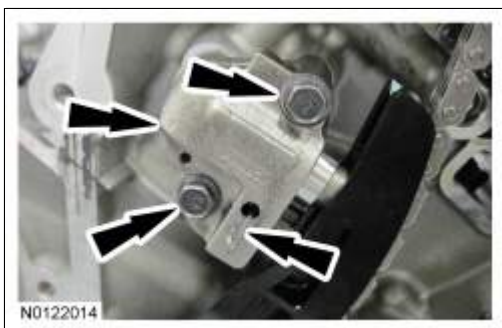
11. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.



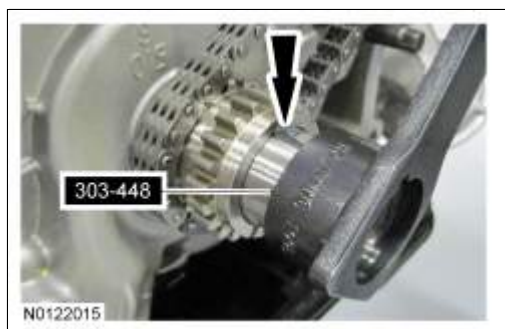
12. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.



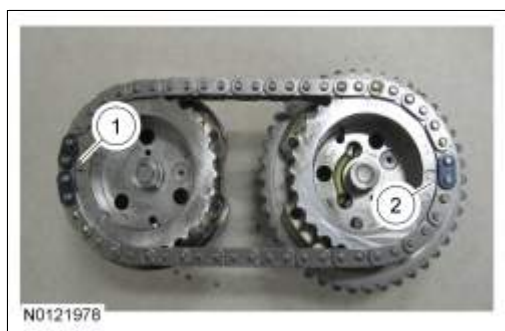
13. Install the LH primary timing chain tensioner and 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Remove the holding pin from the tensioner.



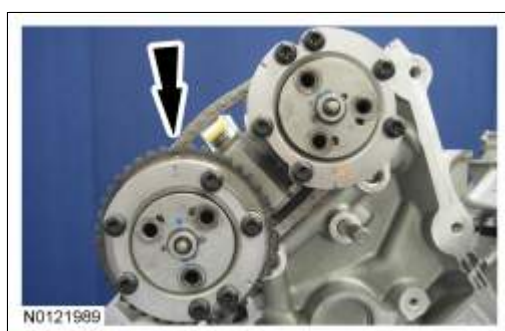
14. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.



15. Install the secondary timing chain onto the RH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
 2. The timing mark on the exhaust VCT assembly should align with the single colored link.



16. Install the RH VCT assemblies and the secondary timing chain onto the RH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 1 o'clock position.



17. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.

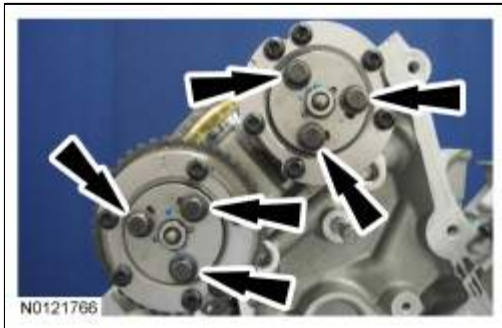
- If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



18. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

Install the 3 RH intake VCT assembly bolts and the 3 RH exhaust VCT assembly bolts.

- Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.



19. Install the RH primary timing chain.
- Align the colored link on the timing chain with the timing mark on the RH VCT assembly.



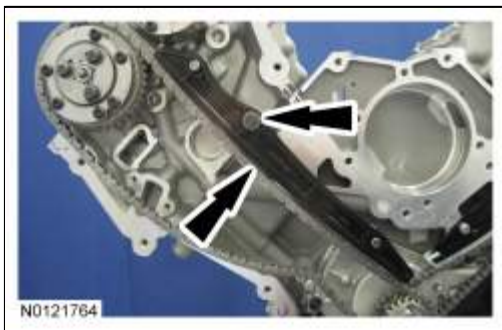
20. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



21. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

Install the RH timing chain guide and bolt.

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



22. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

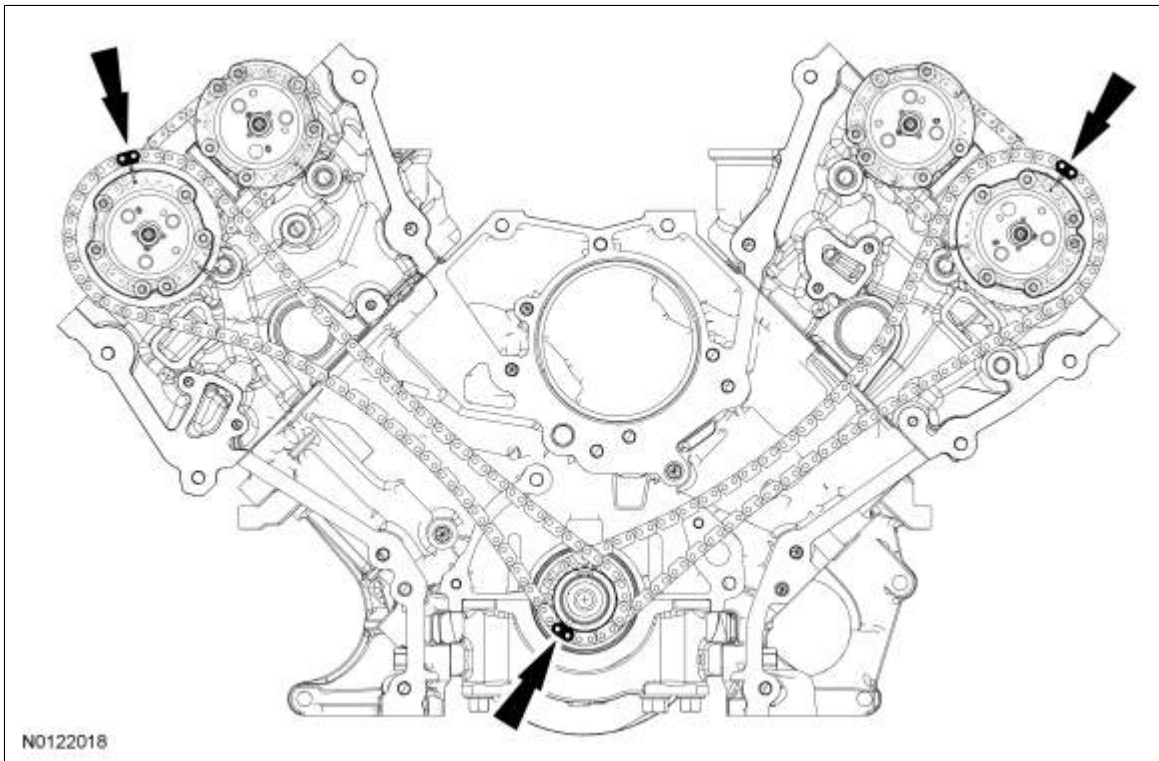
Install the RH timing chain tensioner arm.



23. Install the RH primary timing chain tensioner and 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Remove the holding pin from the tensioner.



24. With the crankshaft keyway still at the 12 o'clock position, verify the timing mark alignment is correct.



25. Install the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.

SECTION 303-01C: Engine — 5.0L (4V)
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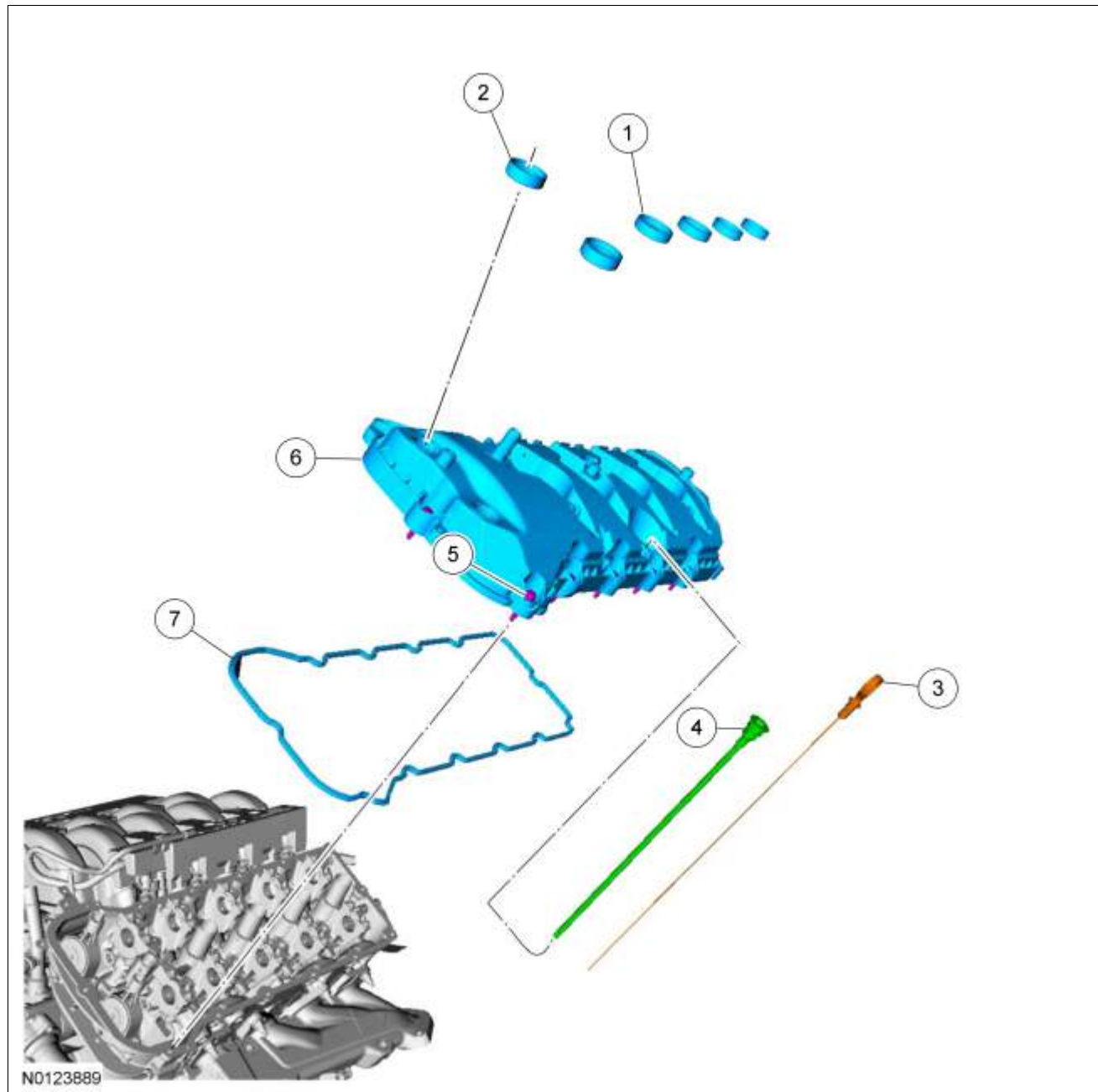
Valve Cover — LH

Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST2983-A	Installer, Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1

Material

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

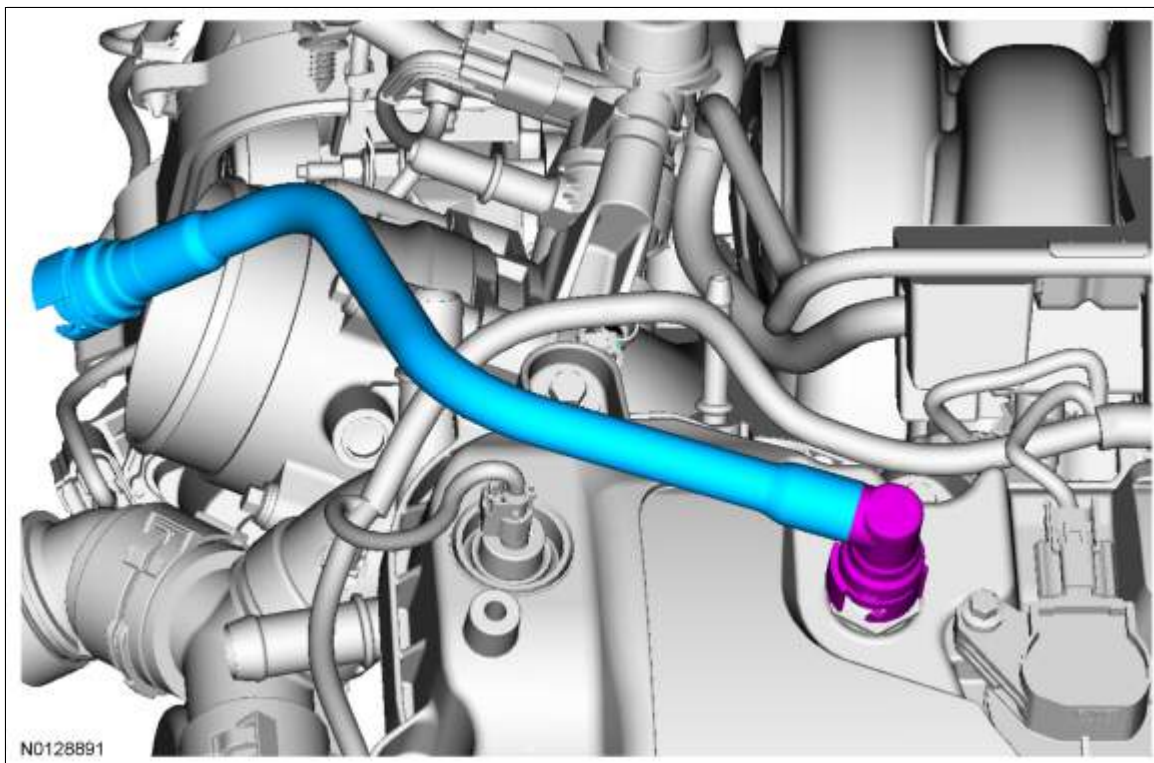


Item	Part Number	Description
1	6C535	Spark plug tube seal (4 required)
2	6C535	Variable Camshaft Timing (VCT) solenoid seal (2 required)
3	6750	Oil level indicator
4	6754	Oil level indicator tube
5	6C519	Valve cover bolt (part of 6582) (14 required)
6	6582	LH valve cover
7	6584	LH valve cover gasket

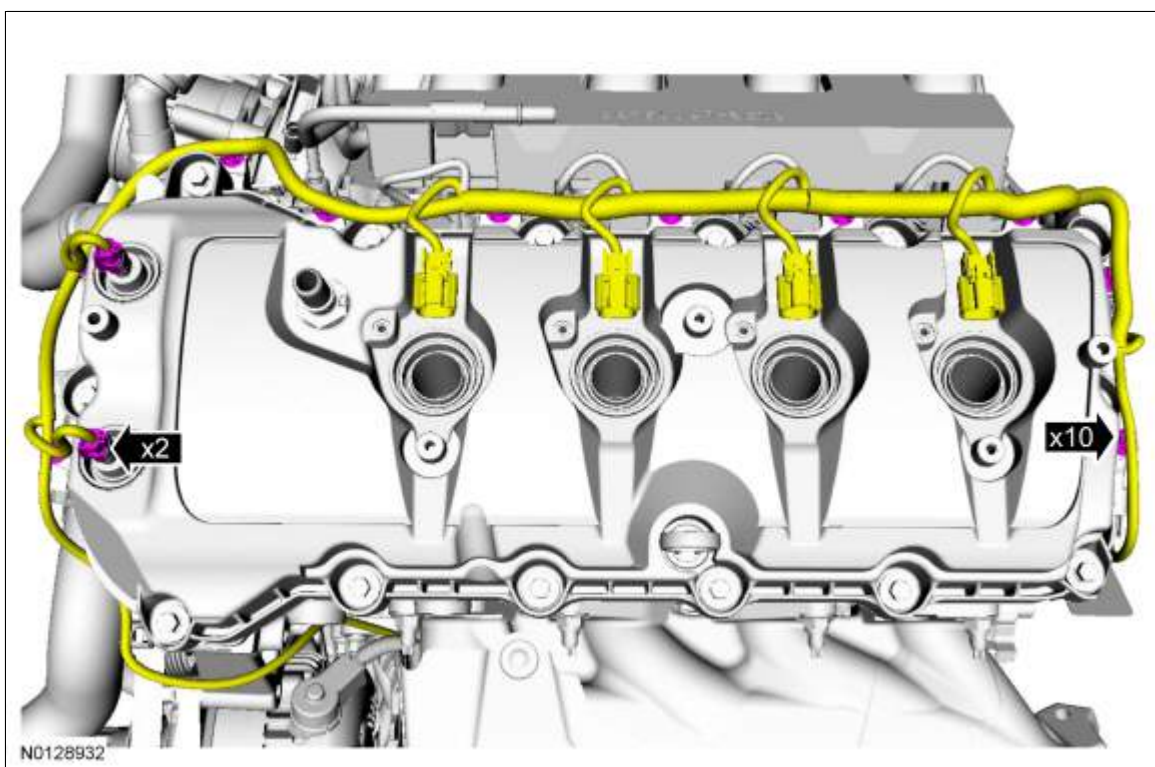
Removal

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

1. Remove the Air Cleaner (ACL) outlet pipe and the ACL cover as an assembly. For additional information, refer to [Section 303-12](#).
2. Remove the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in [Section 310-00](#).



3. Remove the LH ignition coils. For additional information, refer to [Section 303-07C](#).
4. Disconnect the 2 LH Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.
 - Detach the 10 wiring harness retainers.



5. Remove the oil level indicator.
6. **NOTICE:** 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.

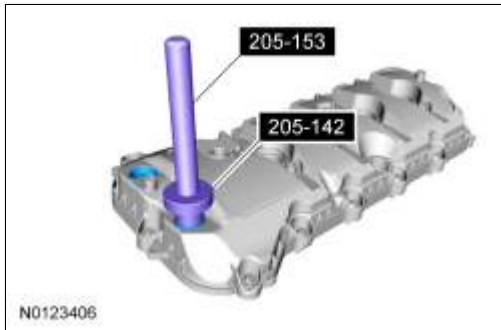
Loosen the 14 bolts and remove the LH valve cover and gasket.

- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.

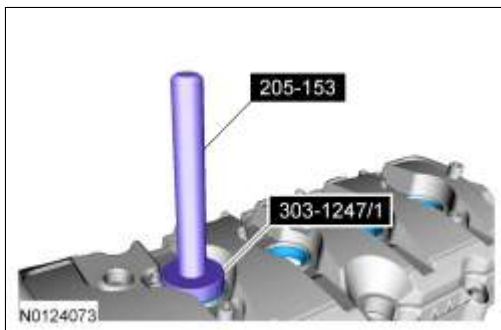
7. Depress the 4 tabs and remove the oil level indicator tube.



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



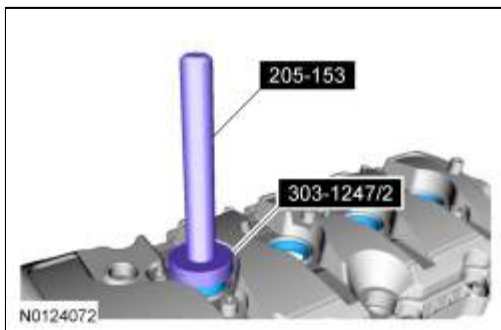
9. Inspect the spark plug tube seals. Remove any damaged seals.
 - Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



Installation

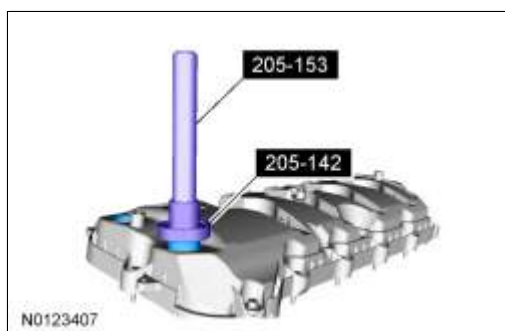
1. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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



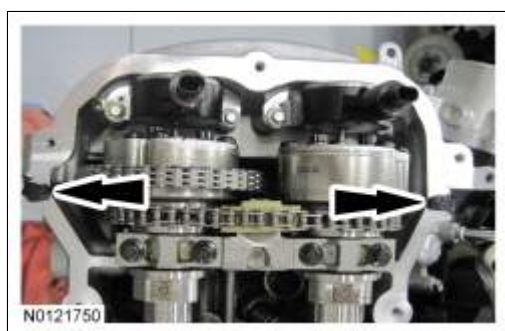
2. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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

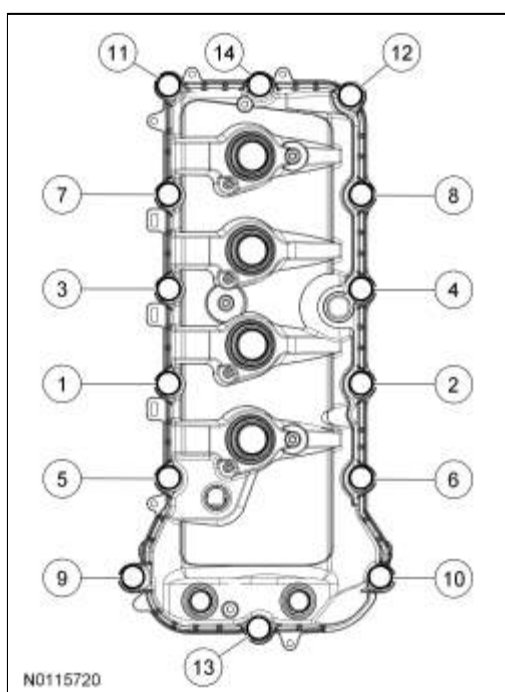


3. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

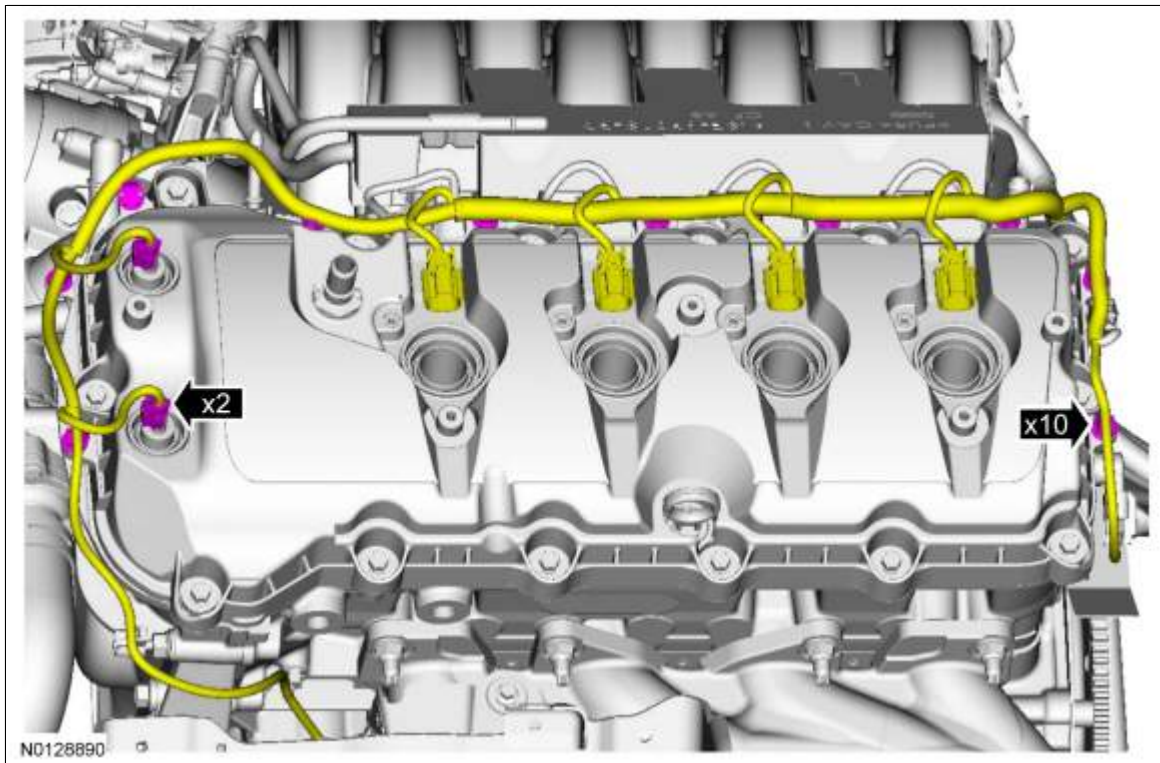
Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-LH cylinder head joints.



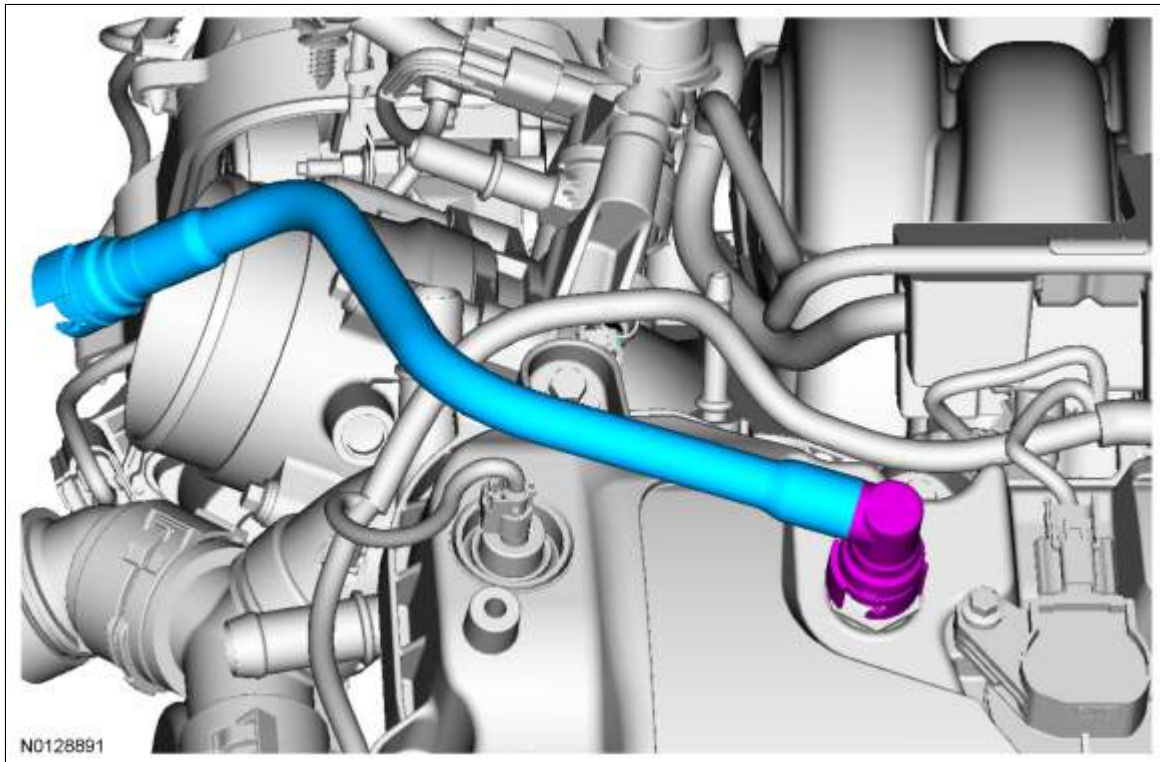
4. Position the LH valve cover and new gasket on the cylinder head.
- Tighten the bolts in the sequence shown to 10 Nm (89 lb-in).



5. Install the oil level indicator tube.
 - Push the oil level indicator tube into the valve cover until it clicks into place.
6. Install the oil level indicator.
7. Connect the 2 LH VCT variable force solenoid electrical connectors.
 - Attach the 10 wiring harness retainers.



8. Install the LH ignition coils. For additional information, refer to [Section 303-07C](#).
9. Install the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in [Section 310-00](#).






10. Install the Air Cleaner (ACL) outlet pipe and ACL cover assembly. For additional information, refer to [Section 303-12](#).
-

SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

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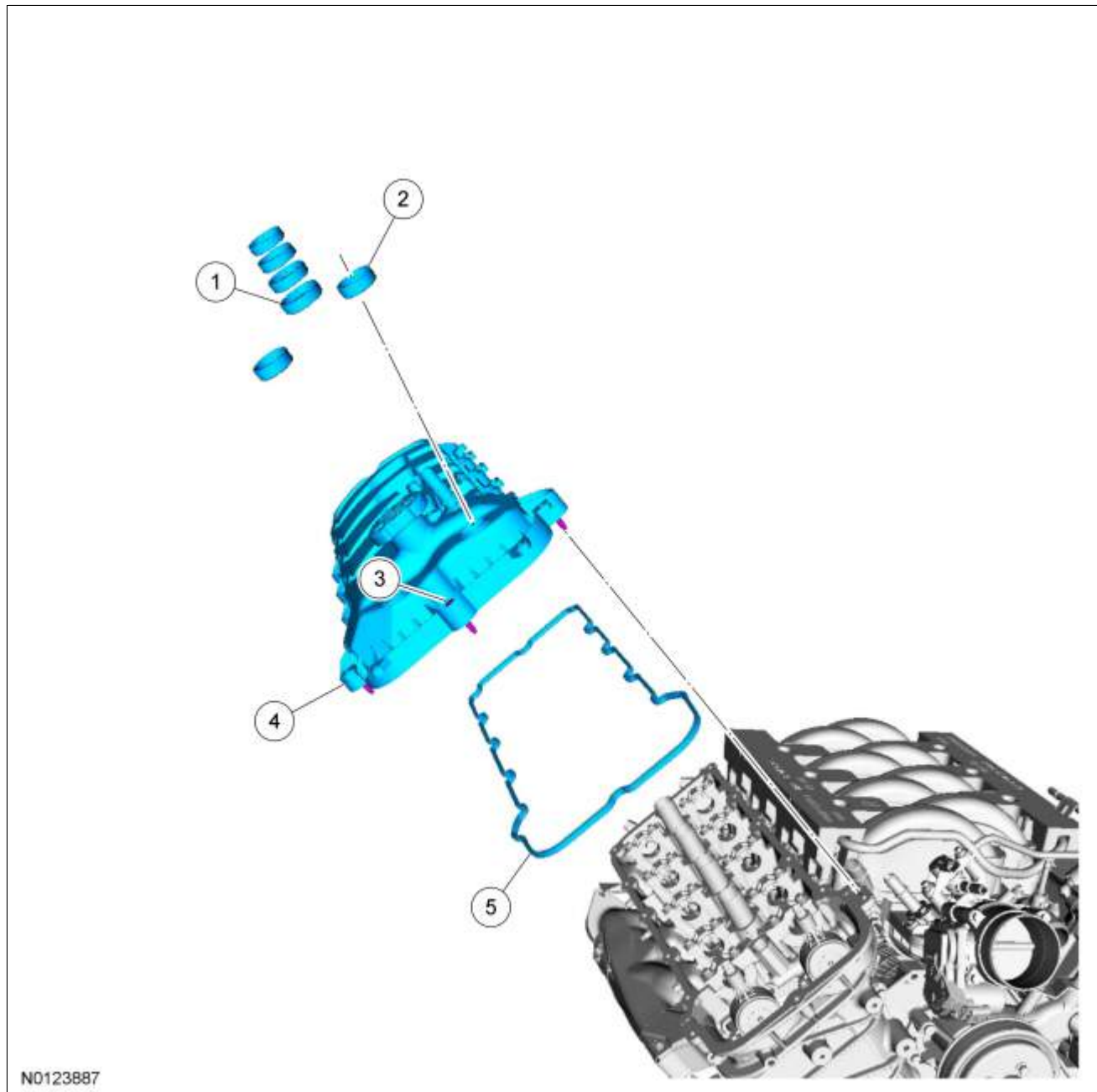
Valve Cover — RH

Special Tool(s)

 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST2983-A	Installer, Spark Plug Tube Seal 303-1247/2
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1

Material

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



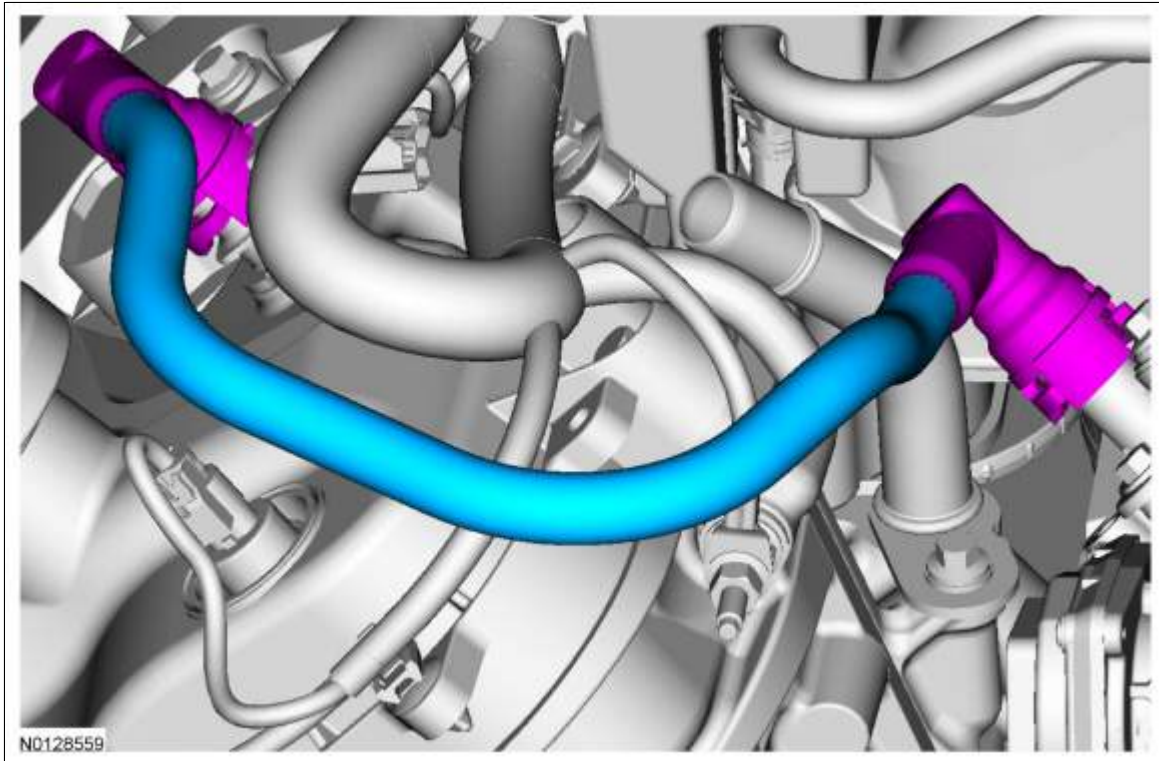
Item	Part Number	Description
1	6C535	Spark plug tube seal (4 required)
2	6C535	Variable Camshaft Timing (VCT) solenoid seal (2 required)
3	—	Valve cover bolt (part of 6582) (14 required)
4	6582	RH valve cover
5	6584	RH valve cover gasket

Removal

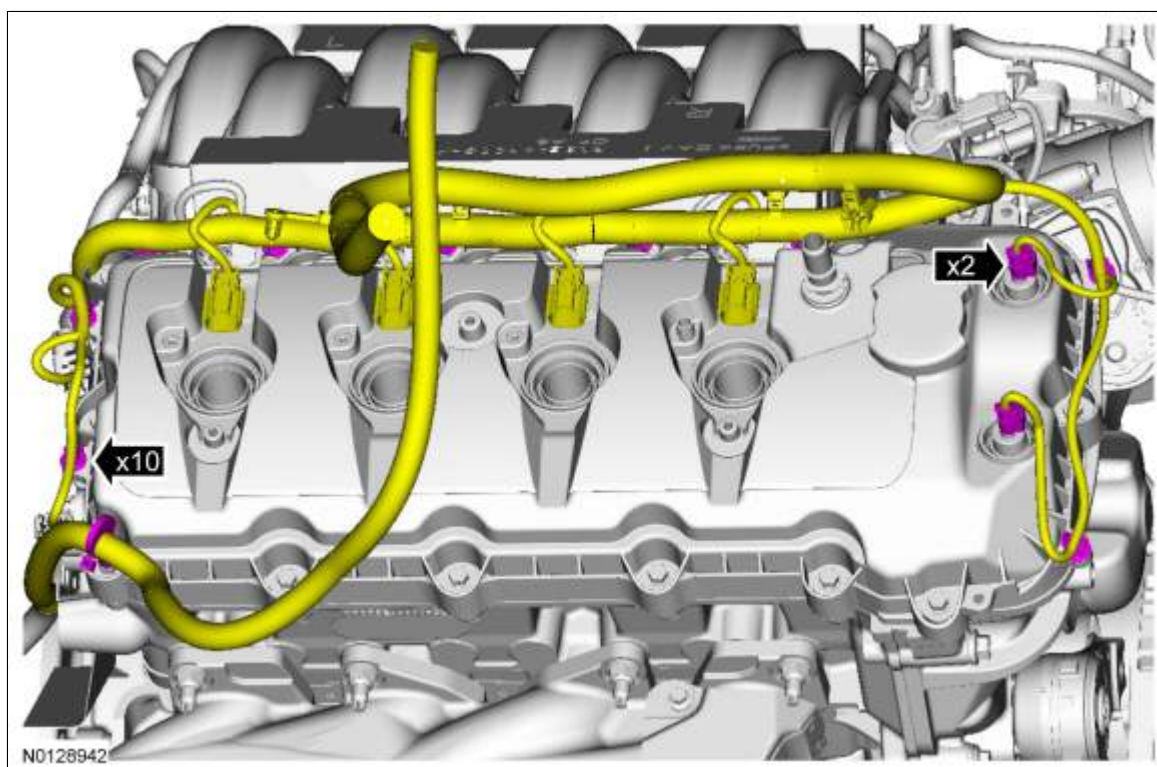
NOTICE: During engine repair procedures, cleanliness is extremely important. Any foreign material,

including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

1. Remove the RH ignition coils. For additional information, refer to [Section 303-07C](#).
2. Remove the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in [Section 310-00](#).



3. Disconnect the 2 RH Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.
 - Detach the 10 wiring harness retainers.

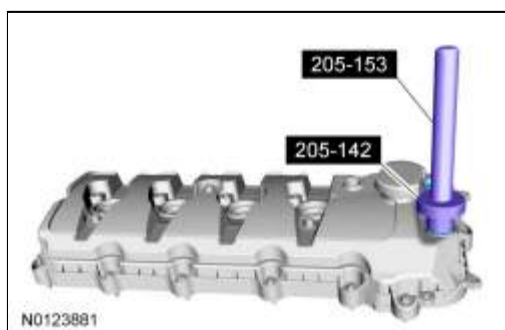


4. **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

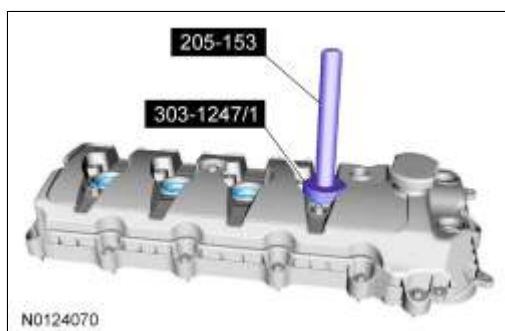
Loosen the 14 fasteners and remove the RH valve cover and gasket.

- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.

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



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

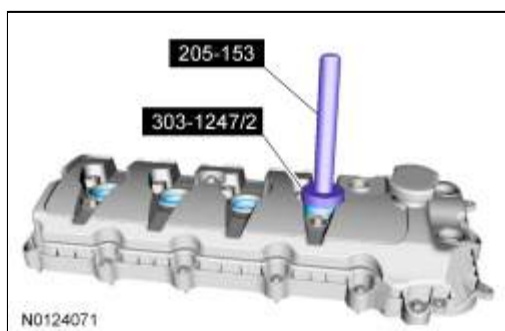


7. Clean the valve cover, cylinder head and engine front cover sealing surfaces with metal surface prep.

Installation

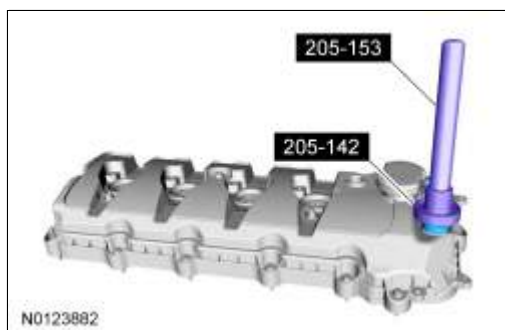
1. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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



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

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

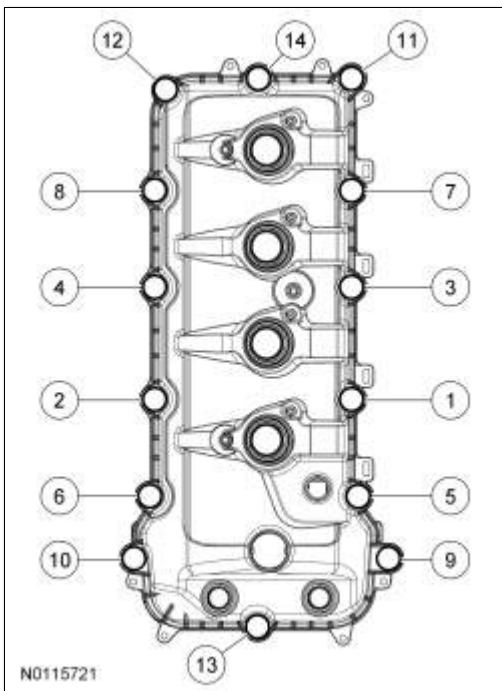


3. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

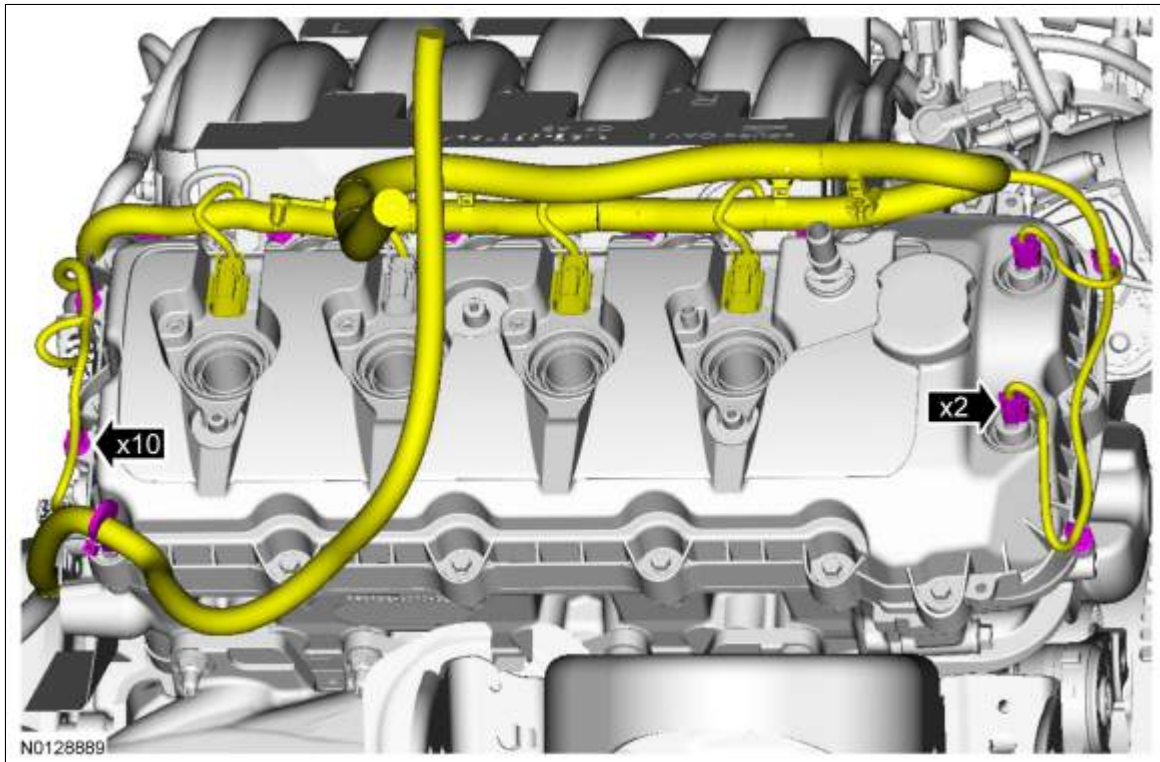
Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-RH cylinder head joints.



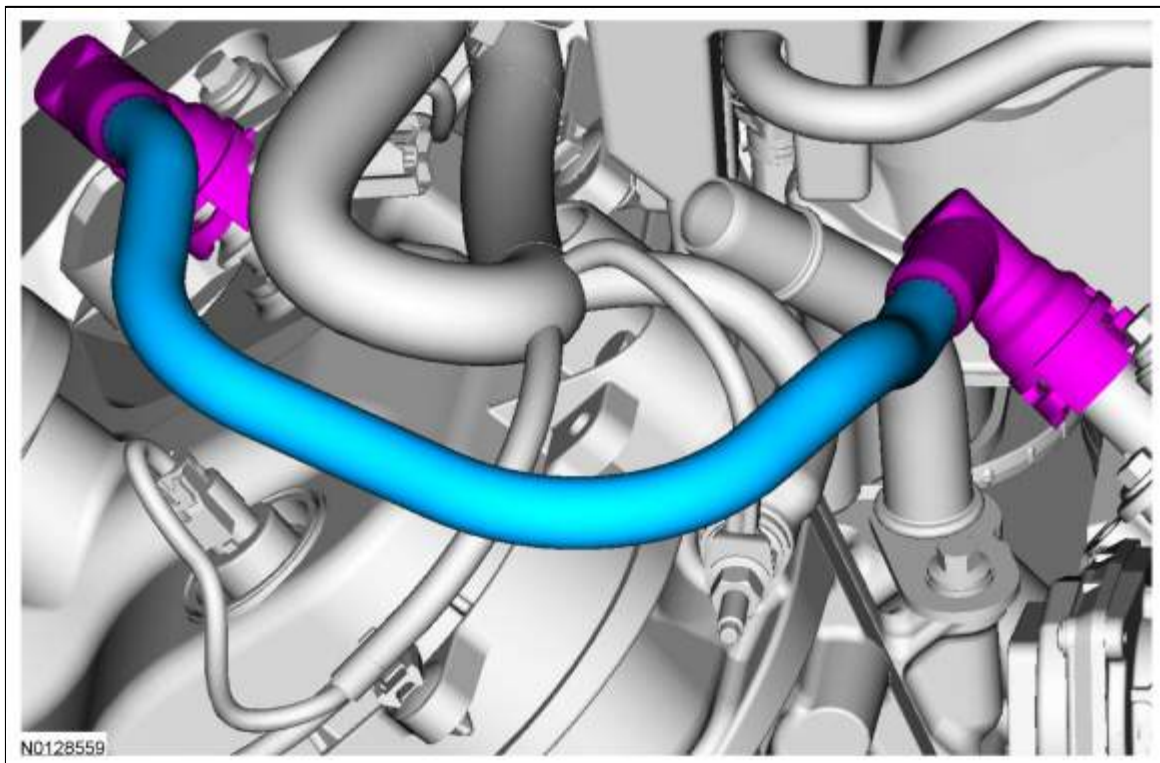
4. Position the RH valve cover and new gasket on the cylinder head.
 - Tighten the fasteners in the sequence shown to 10 Nm (89 lb-in).



5. Connect the 2 RH VCT variable force solenoid electrical connectors.
 - Attach the 10 wiring harness retainers.



6. Install the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in [Section 310-00](#).



7. Install the RH ignition coils. For additional information, refer to [Section 303-07C](#).


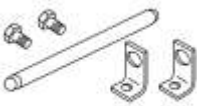

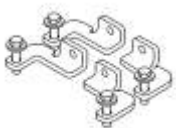


SECTION 303-01C: Engine — 5.0L (4V)
IN-VEHICLE REPAIR

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Valve Seals

Special Tool(s)

 ST1902-A	Compressor, Valve Spring 303-1418
 ST1981-A	Compressor, Valve Spring 303-300 (T87C-6565-A)
 ST1907-A	Compressor, Valve Spring 303-350 (T89P-6565-A)
 ST3028-A	Compressor, Valve Spring 303-1249

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

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

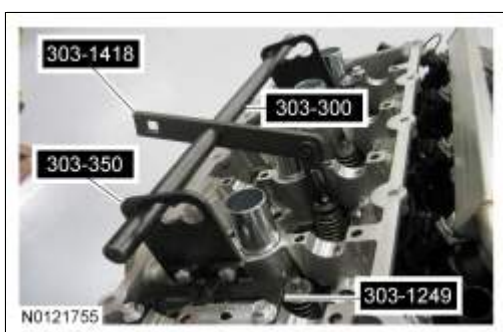
NOTE: If the components are to be reinstalled, they must be installed in their original locations. Mark the components for installation into their original locations.

1. Remove the camshaft for the valve seal being serviced. For additional information, refer to [Camshaft — RH](#) and/or [Camshaft — LH](#) in this section.
2. Remove the roller follower and hydraulic lash adjuster assembly for the valve seal being serviced.
3. **NOTICE:** If air pressure must be removed, support the valve prior to removal or engine damage may occur.

NOTE: If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to [Cylinder Head](#) in this section.

Pressurize the cylinder using compressed air.

4. Using the Valve Spring Compressors, remove the keys, retainer and spring.



5. Remove and discard the valve seal.




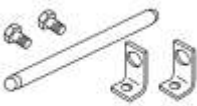

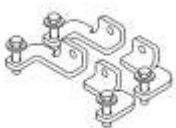
6. To install, reverse the removal procedure.
 - Lubricate the valve seal and the roller follower and hydraulic lash adjuster assembly with clean engine oil prior to installation.

SECTION 303-01C: Engine — 5.0L (4V)
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Valve Springs

Special Tool(s)

 <p>ST1902-A</p>	Compressor, Valve Spring 303-1418
 <p>ST1981-A</p>	Compressor, Valve Spring 303-300 (T87C-6565-A)
 <p>ST1907-A</p>	Compressor, Valve Spring 303-350 (T89P-6565-A)
 <p>ST302B-A</p>	Compressor, Valve Spring 303-1249

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

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

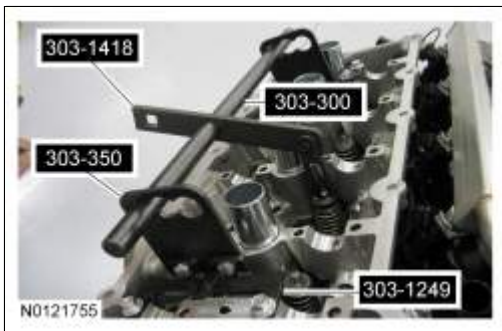
NOTE: If the components are to be reinstalled, they must be installed in their original locations. Mark the components for installation into their original locations.

1. Remove the camshaft for the valve spring being serviced. For additional information, refer to [Camshaft — RH](#) and/or [Camshaft — LH](#) in this section.
2. Remove the roller follower and hydraulic lash adjuster assembly for the valve spring being serviced.
3. **NOTICE:** If air pressure must be removed, support the valve prior to removal or engine damage may occur.

NOTE: If a valve drops into the cylinder, remove the cylinder head. For additional information, refer to [Cylinder Head](#) in this section.

Pressurize the cylinder using compressed air.

4. Using the Valve Spring Compressors, remove the keys, retainer and spring.



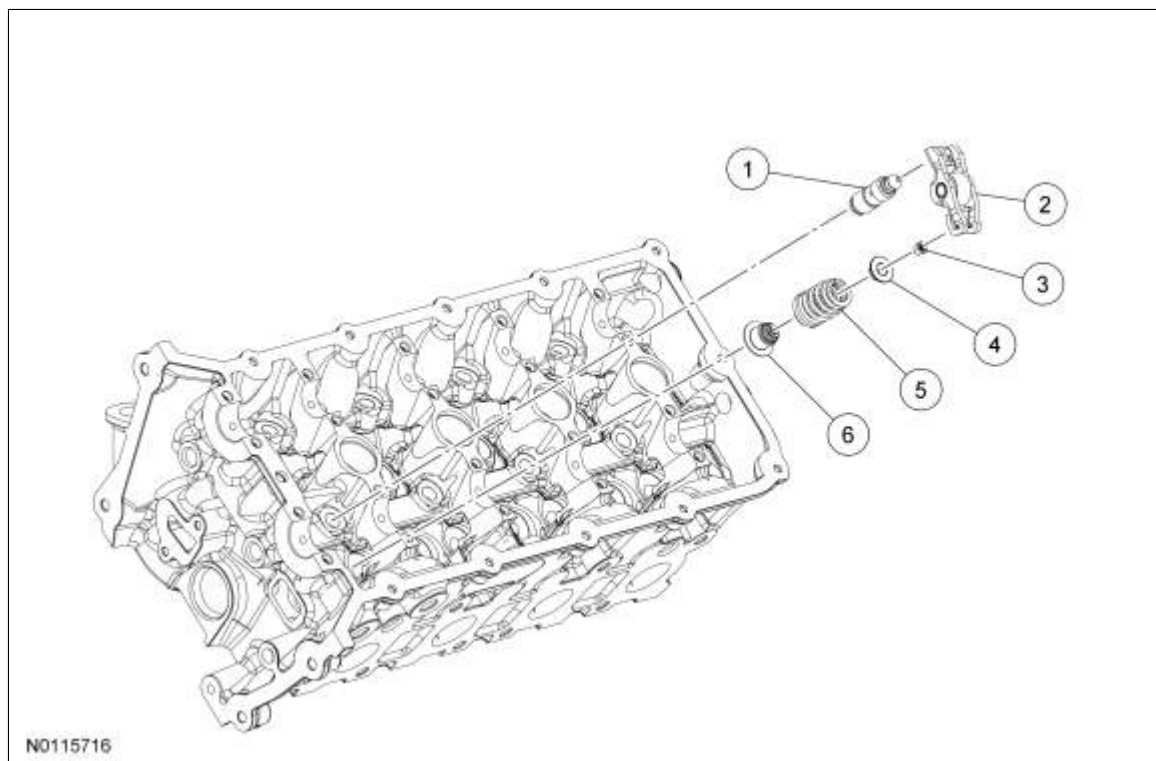
5. To install, reverse the removal procedure.
 - Lubricate the roller follower and hydraulic lash adjuster assembly with clean engine oil prior to installation.

SECTION 303-01C: Engine — 5.0L (4V)
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Procedure revision date: 10/25/2013

Valve Train Components — Exploded View

NOTE: LH cylinder head shown, RH cylinder head similar.



Item	Part Number	Description
1	6500	Hydraulic lash adjuster (32 required)
2	6564	Camshaft roller follower (32 required)
3	6518	Valve spring retainer key (64 required)
4	6514	Valve spring retainer (32 required)
5	6513	Valve spring (32 required)
6	6571	Valve seal (32 required)



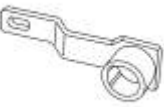

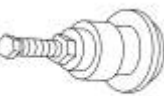

1. Refer to the procedures and/or exploded views in this section for any Warnings, Notices, Notes, Materials, Specifications, and Special Tools. Items in the exploded views may not be listed in order of removal.



SECTION 303-01C: Engine — 5.0L (4V)
INSTALLATION

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Cylinder Head

Special Tool(s)

 ST2806-A	Alignment Pins, Cylinder Head 303-1040 (SR-015486)
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A2 plate only)
 ST3249-A	Installer, Front Crank Seal and Damper 303-1531
	Installer, Spark Plug Tube Seal 303-1247/2

 ST2983-A	
 ST1438-A	Strap Wrench 303-D055 (D85L-6000-A) or equivalent

Material

Item	Specification
Motorcraft® Metal Surface Prep ZC-31-A	—
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20- LSP12 (Canada)	WSS- M2C945-A
Motorcraft® SAE 5W-50 Full Synthetic Motor Oil XO-5W50-QGT or equivalent	WSS- M2C931-B
Motorcraft® Silicone Gasket Remover ZC-30	—
Motorcraft® Specialty Orange Engine Coolant VC-3-B (US); CVC-3-B (Canada)	WSS- M97B44-D
Silicone Brake Caliper Grease and Dielectric Compound XG-3-A	ESE-M1C171- A
Silicone Gasket and Sealant TA-30	WSE- M4G323-A4

Installation

NOTE: The Boss® 302 requires Motorcraft® SAE 5W-50 Full Synthetic Motor Oil, all other 5.0L (4V) engines require Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil.

All cylinder heads

1. Verify the crankshaft keyway is in the 9 o'clock position.



2. **NOTICE:** Make sure all coolant residue and foreign material are cleaned from the block surface and cylinder bore. Failure to follow these instructions may result in engine damage.

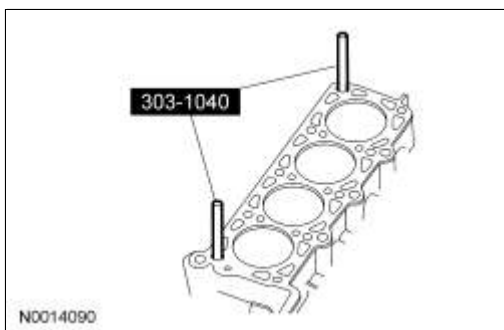
NOTICE: The use of sealing aids (aviation cement, copper spray and glue) is not permitted. The gasket must be installed dry. Failure to follow these instructions may result in future oil leakage.

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

NOTE: Do not turn the crankshaft until instructed to do so.

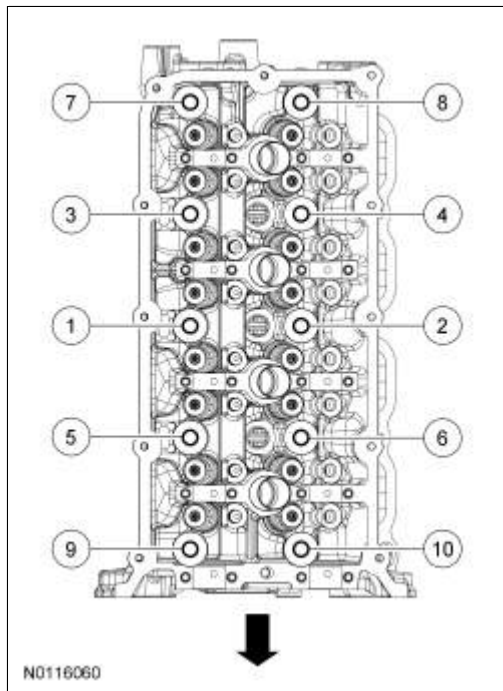
NOTE: LH shown, RH similar.

Using the Cylinder Head Alignment Pins, position the cylinder head gaskets and cylinder heads over the dowels and install the cylinder head bolts loosely.



RH cylinder head

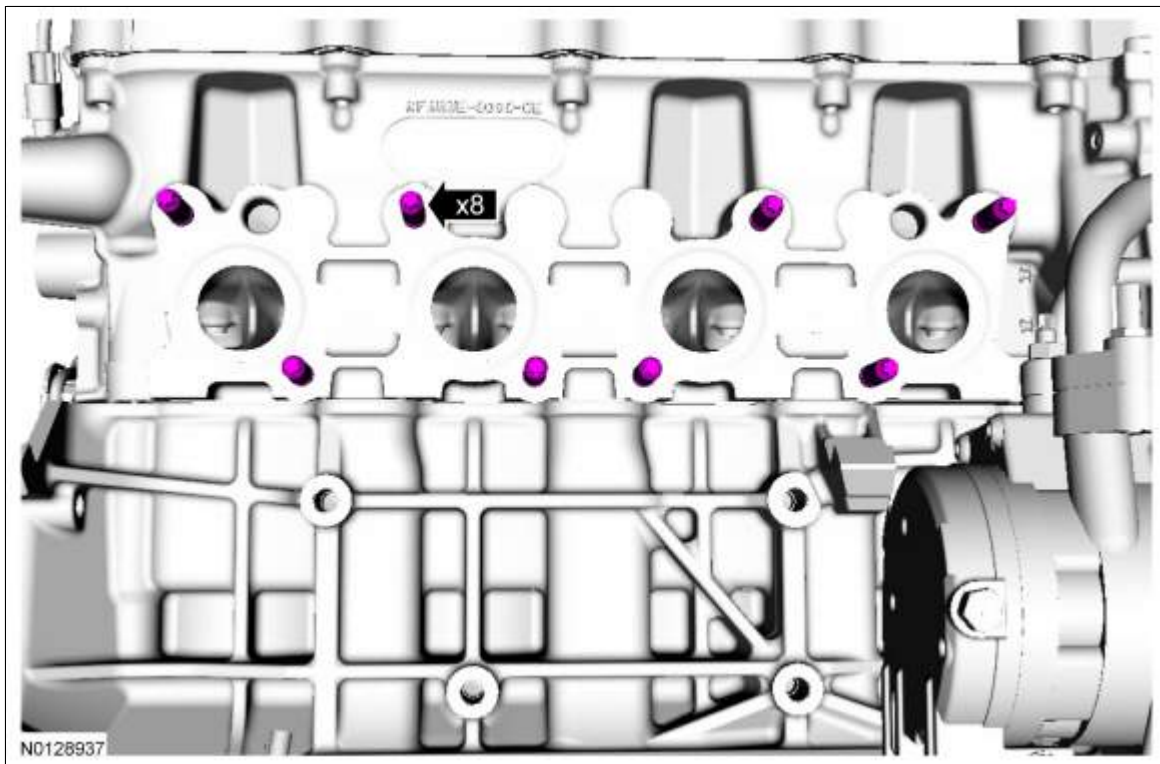
3. Tighten the new RH cylinder head bolts in 4 stages in the sequence shown.
- Stage 1: Tighten to 25 Nm (18 lb-ft).
 - Stage 2: Tighten to 40 Nm (30 lb-ft).
 - Stage 3: Tighten an additional 90 degrees.
 - Stage 4: Tighten an additional 90 degrees.



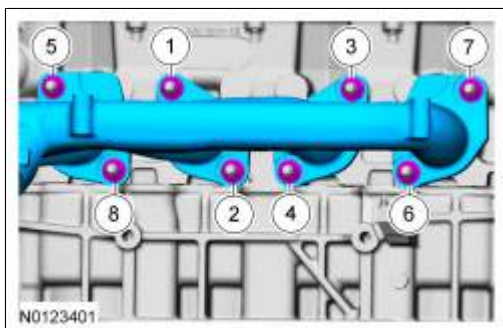
4. **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraper to clean the sealing surfaces.

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

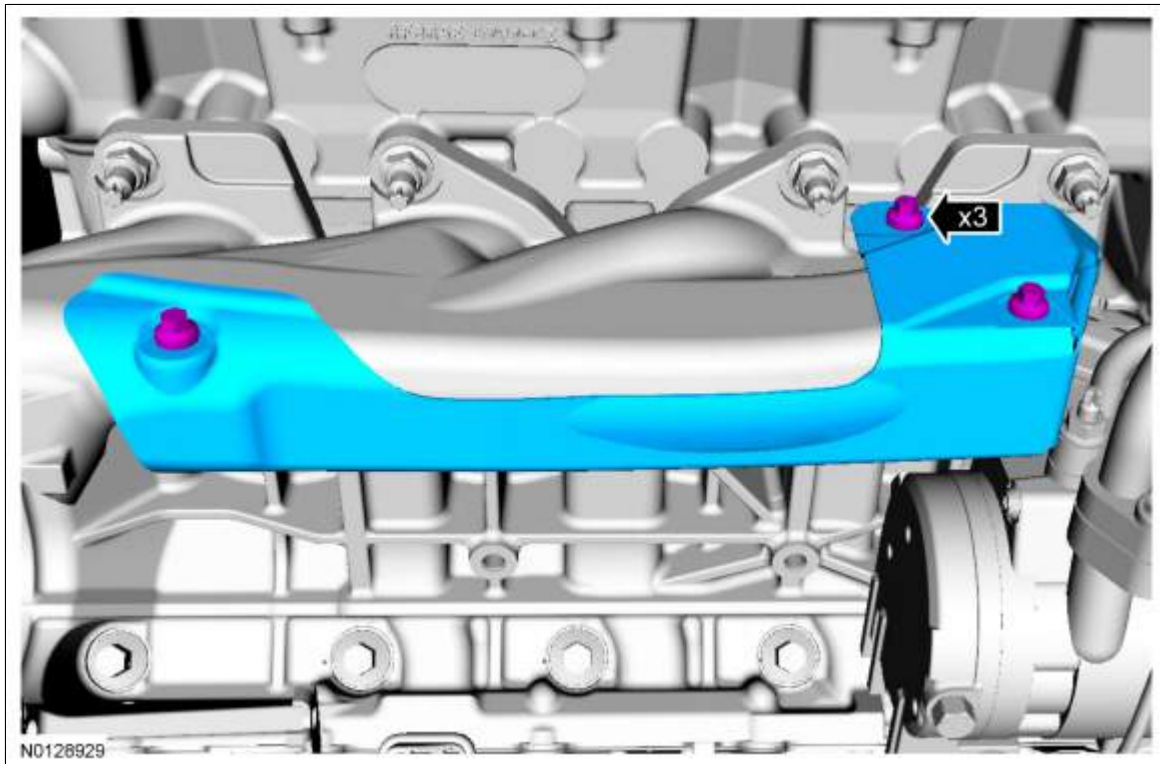
5. Install 8 new RH exhaust manifold studs.
- Tighten to 25 Nm (18 lb-ft).



6. Install a new gasket, the RH exhaust manifold and 8 new nuts.
 - Tighten the nuts in the sequence shown in 2 stages.
 - Stage 1: Tighten to 24 Nm (18 lb-ft).
 - Stage 2: Tighten to 32 Nm (24 lb-ft).



7. Install the RH exhaust manifold heat shield and the 3 bolts.
 - Tighten to 12 Nm (106 lb-in).



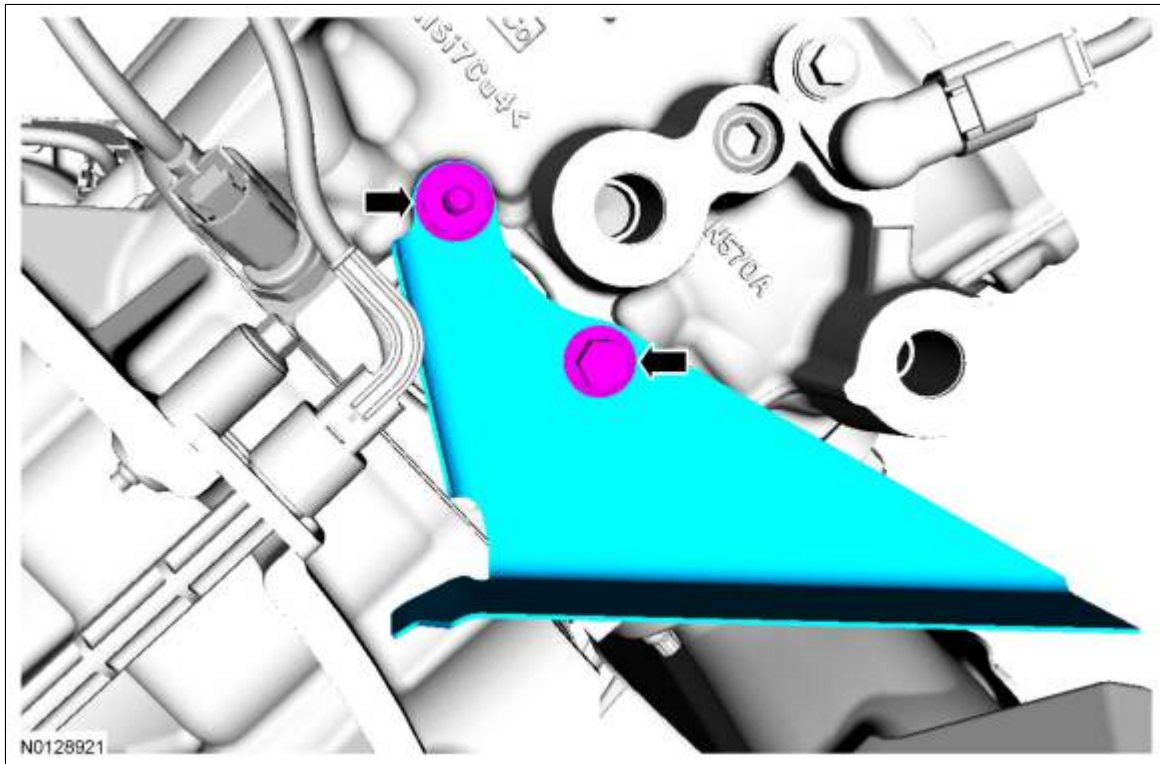
8. Install the Cylinder Head Temperature (CHT) sensor.
 - Tighten to 11 Nm (97 lb-in).



9. Connect the Cylinder Head Temperature (CHT) sensor electrical connector.



10. Install the heat shield, the bolt and the stud bolt on the RH cylinder head.
 - Tighten to 10 Nm (89 lb-in).



11. **NOTICE:** Lubricate the O-ring seal with clean engine coolant prior to installing.

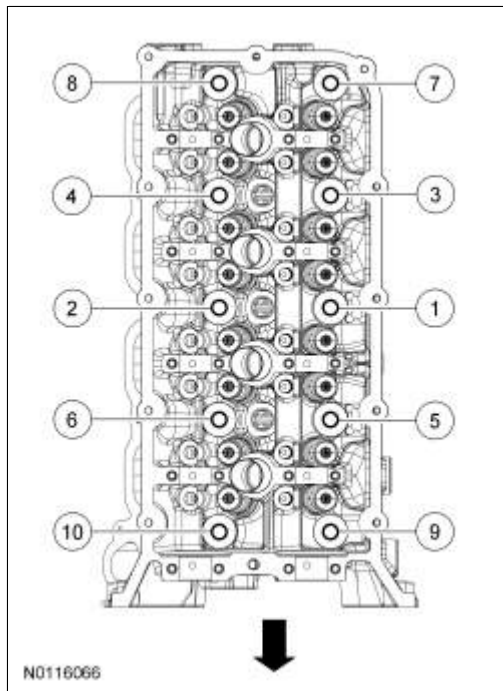
Using a new O-ring seal, install the coolant outlet pipe.

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



LH cylinder head

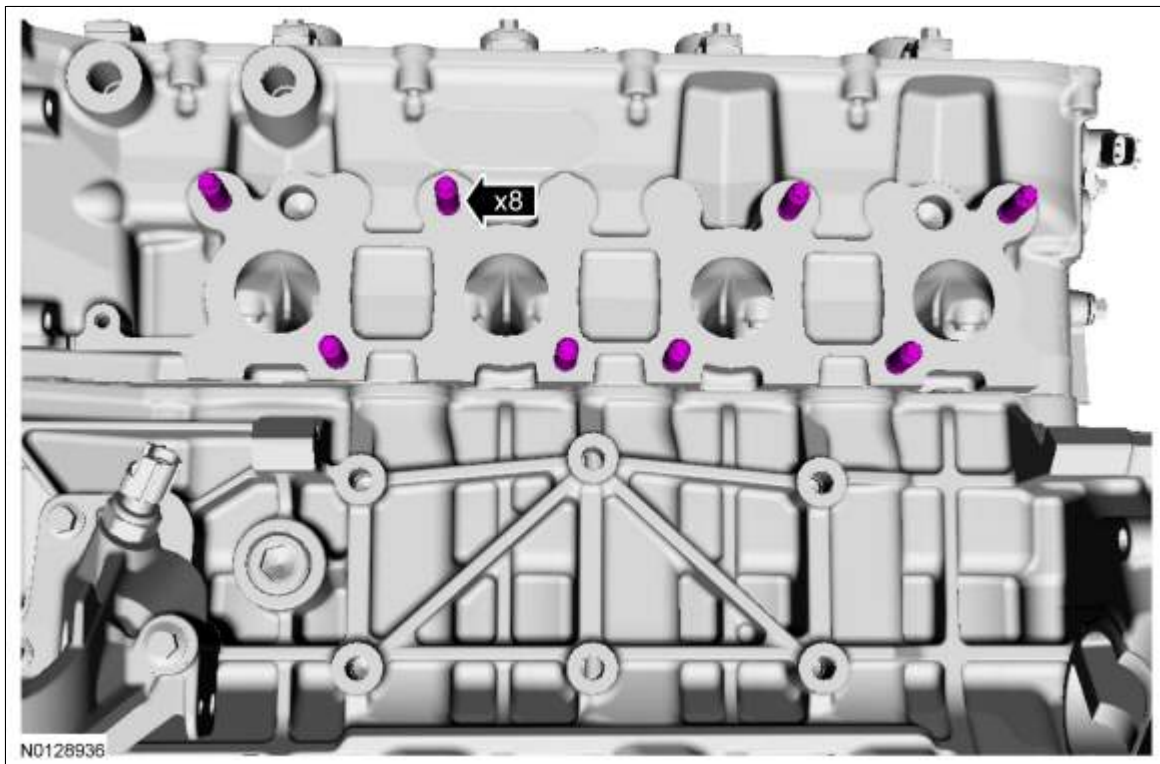
12. Tighten the new LH cylinder head bolts in 4 stages in the sequence shown.
- Stage 1: Tighten to 25 Nm (18 lb-ft).
 - Stage 2: Tighten to 40 Nm (30 lb-ft).
 - Stage 3: Tighten an additional 90 degrees.
 - Stage 4: Tighten an additional 90 degrees.



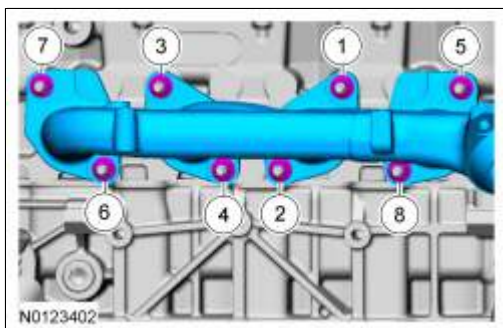
13. **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraper to clean the sealing surfaces.

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

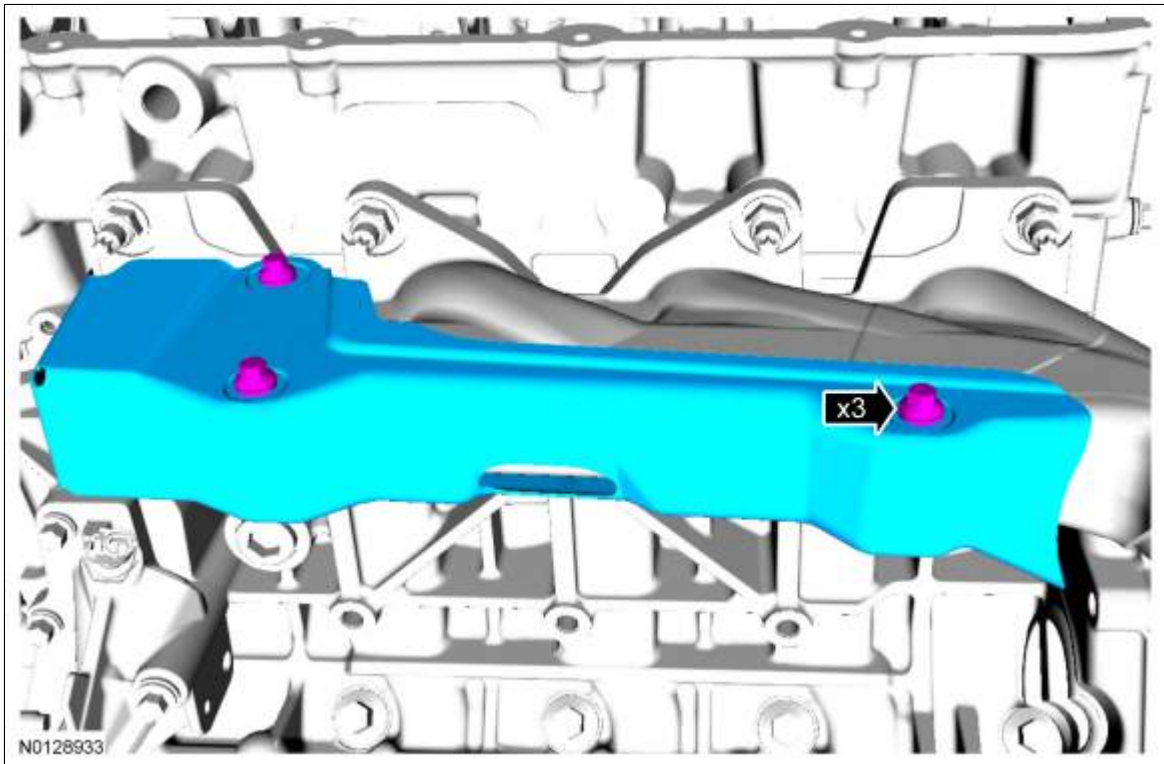
14. Install 8 new LH exhaust manifold studs.
- Tighten to 25 Nm (18 lb-ft).



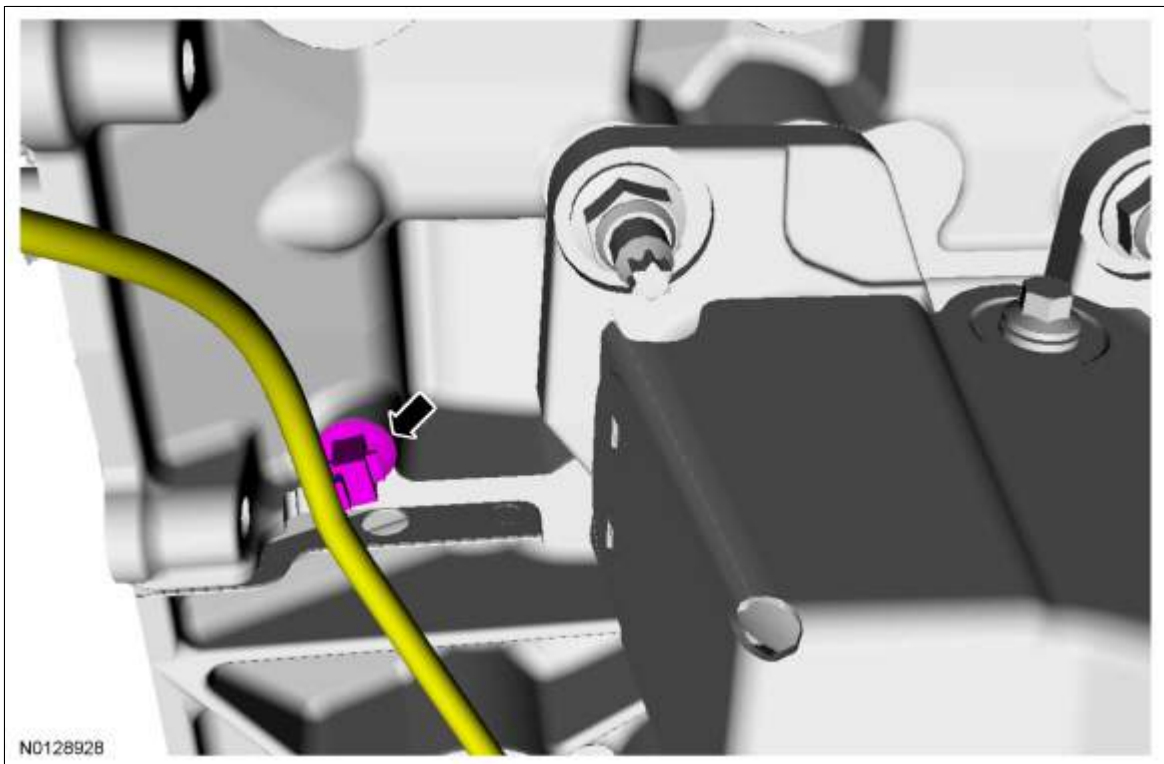
15. Install a new gasket, the LH exhaust manifold and 8 new nuts.
- Tighten in the sequence shown in 2 stages.
 - Stage 1: Tighten to 24 Nm (18 lb-ft).
 - Stage 2: Tighten to 32 Nm (24 lb-ft).



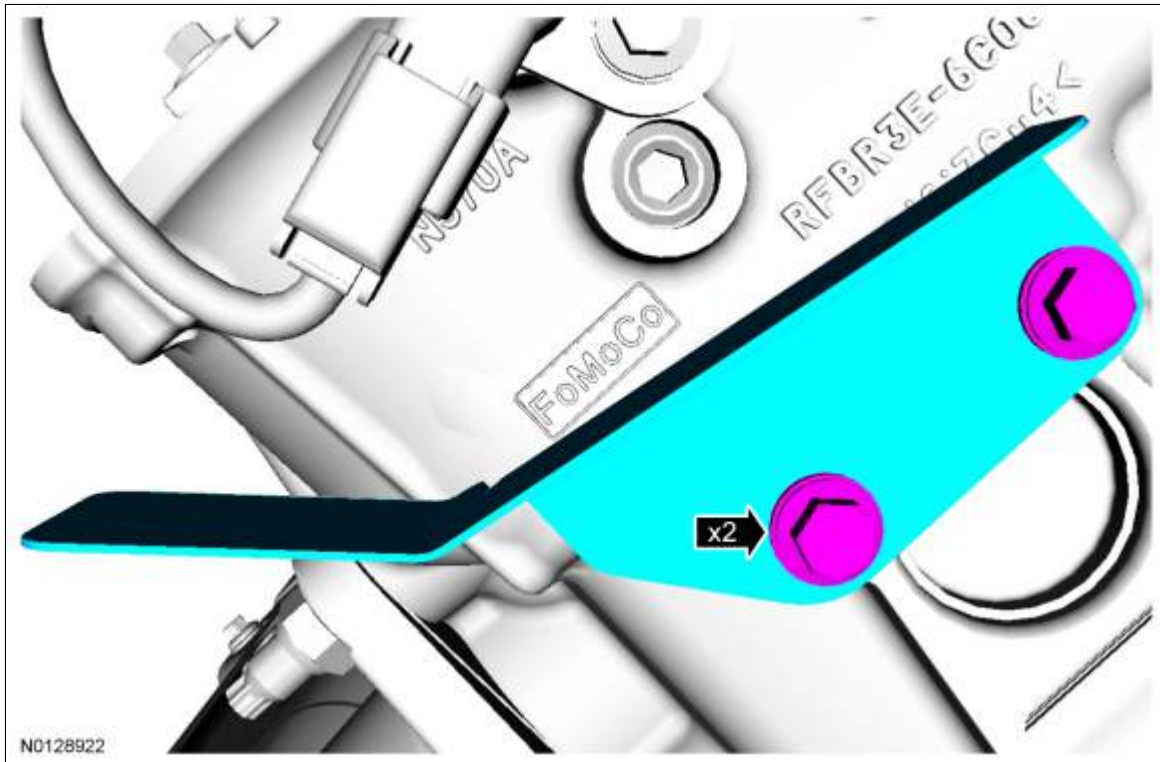
16. Install the LH exhaust manifold heat shield and the 3 bolts.
- Tighten to 12 Nm (106 lb-in).



17. Attach the wiring harness retainer to the LH cylinder head.



18. Install the heat shield and the 2 bolts to the LH cylinder head.
- Tighten to 10 Nm (89 lb-in).

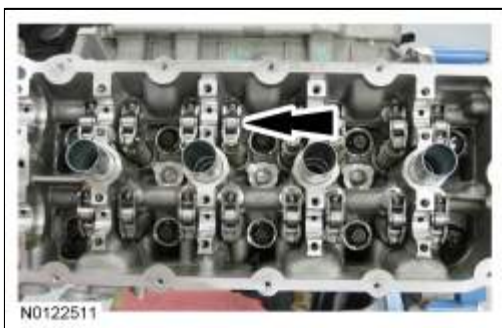


19. Using a new gasket, install the coolant outlet and 2 bolts.
- Tighten to 10 Nm (89 lb-in).



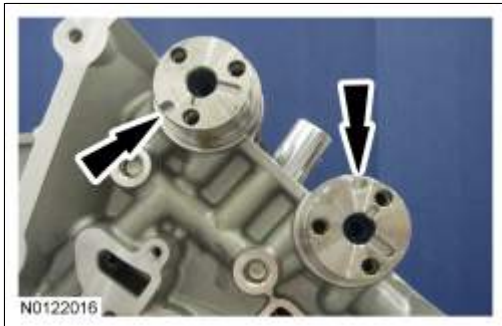
20. **NOTE:** Lubricate the camshaft roller follower and hydraulic lash adjuster assemblies with clean engine oil prior to installation.

Install the 16 camshaft roller follower and hydraulic lash adjuster assemblies.

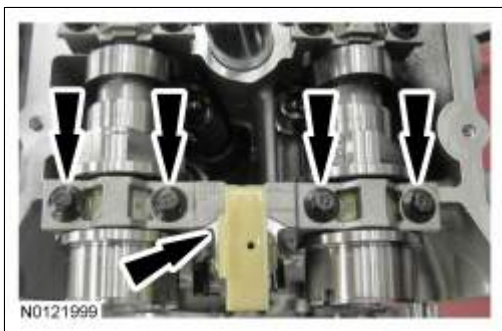


21. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

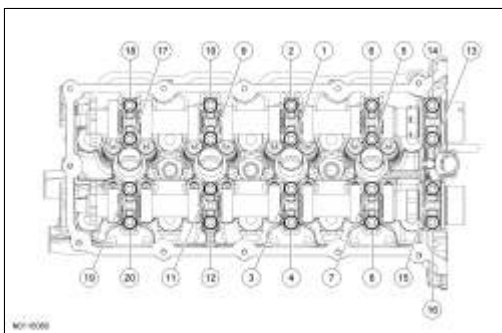
Install the LH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.



22. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.
23. Install the LH front camshaft bearing mega cap and the 4 bolts. Do not tighten the bolts at this time



24. Tighten the bolts in the sequence shown in 2 stages.
- Stage 1: Tighten to 6 Nm (53 lb-in).
 - Stage 2: Tighten an additional 45 degrees.

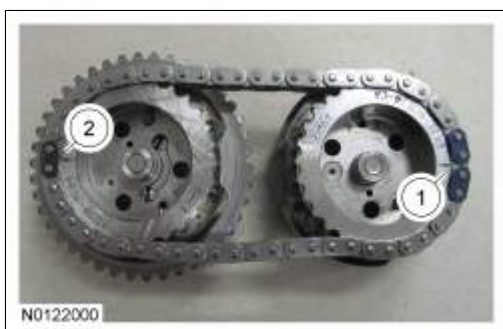


25. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

Install the Variable Camshaft Timing (VCT) system oil filter in the intake and exhaust camshafts.



26. Install the secondary timing chain onto the LH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
 2. The timing mark on the exhaust VCT assembly should align with the single colored link.



27. Install the LH VCT assemblies and the secondary timing chain onto the LH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 11 o'clock position.



28. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.

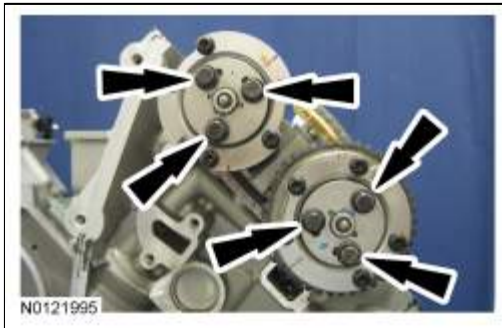
- If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



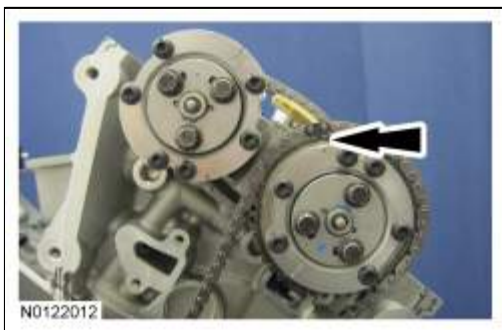
29. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

Install the 3 LH intake VCT assembly bolts and the 3 LH exhaust VCT assembly bolts.

- Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.



30. Install the LH primary timing chain.
- Align the colored link on the timing chain with the timing mark on the LH VCT assembly.



31. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



32. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain guide.

Install the LH timing chain guide and bolt.

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



33. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after installing the LH timing chain tensioner arm.

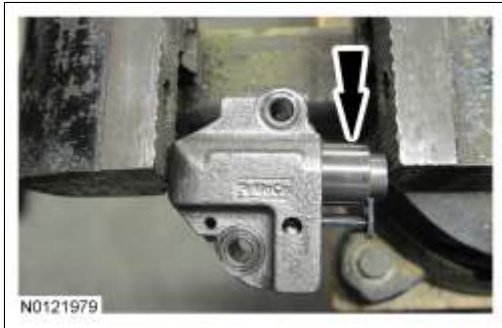
Install the LH timing chain tensioner arm.



NOTE: Complete the following 3 steps on both the LH and RH primary timing chain tensioners.

34. **NOTICE:** Do not compress the ratchet assembly or damage to the tensioner will occur.

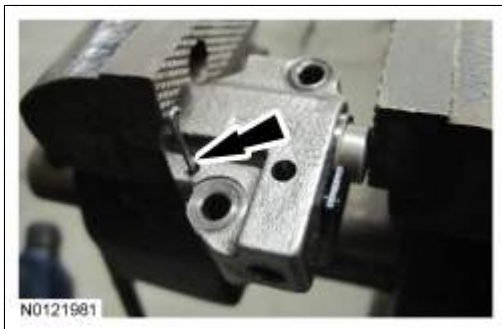
Compress the primary timing chain tensioner plunger, using an edge of a vise.



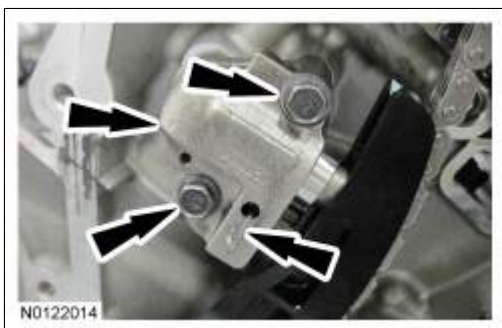
35. Using a small screwdriver or pick, push back and hold the ratchet mechanism, then push the ratchet arm back into the tensioner housing.



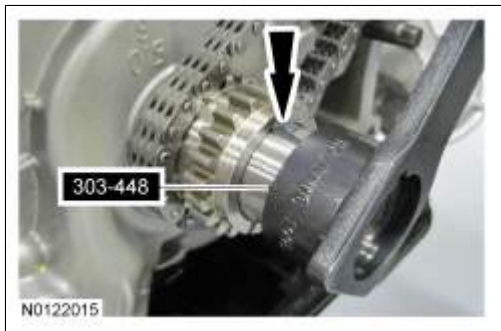
36. Install a suitable pin into the hole of the tensioner housing to hold the ratchet assembly and plunger in place during installation.



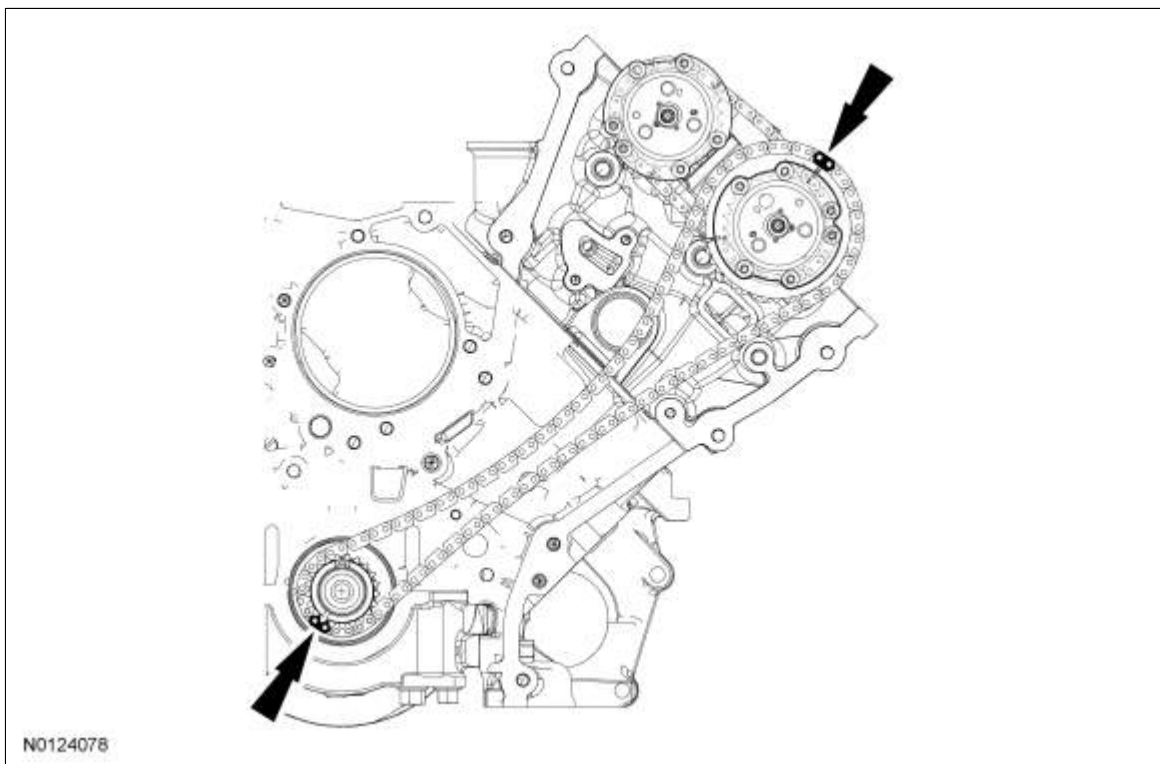
37. Install the LH primary timing chain tensioner and 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Remove the holding pin from the tensioner.



38. Using the crankshaft holding tool, rotate the crankshaft clockwise until the crankshaft keyway is at the 12 o'clock position.



39. With the crankshaft keyway at the 12 o'clock position, verify the timing mark alignment is correct.



RH cylinder head

40. **NOTE:** Lubricate the camshaft roller follower and hydraulic lash adjuster assemblies with clean engine oil prior to installation.

Install the 16 camshaft roller follower and hydraulic lash adjuster assemblies.

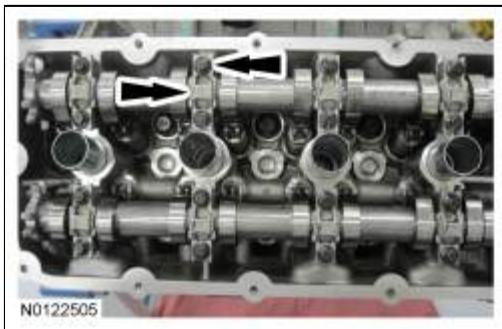


41. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

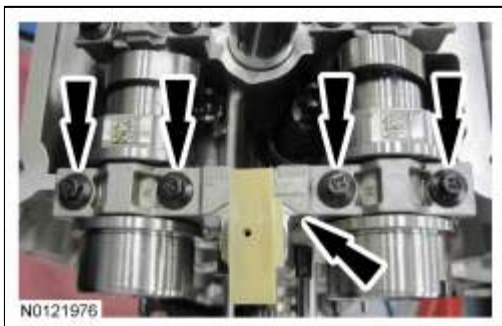
Install the RH intake and exhaust camshafts in the neutral position. Align the D-slots as shown in the illustration.



42. Install the 8 camshaft bearing caps and the 16 bolts. Do not tighten the bolts at this time.

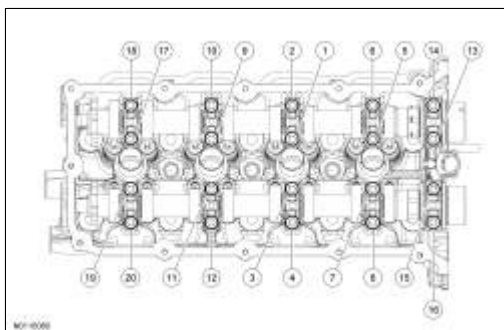


43. Install the RH front camshaft bearing mega cap and the 4 bolts. Do not tighten at this time



44. Tighten the bolts in the sequence shown in 2 stages.

- Stage 1: Tighten to 6 Nm (53 lb-in).
- Stage 2: Tighten an additional 45 degrees.

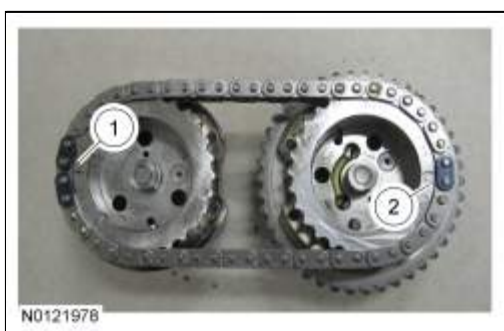


45. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

Install the VCT system oil filter in the intake and exhaust camshafts.



46. Install the secondary timing chain onto the RH VCT assemblies. Align the colored links on the secondary timing chain with the timing marks on the VCT assemblies as shown in the illustration.
1. The timing mark on the intake VCT assembly should align between the 2 consecutive colored links.
 2. The timing mark on the exhaust VCT assembly should align with the single colored link.



47. Install the RH VCT assemblies and the secondary timing chain onto the RH camshafts to a position 2 mm (0.078 in) from fully seated. The timing mark on the exhaust VCT assembly should be in the 1 o'clock position.



48. **NOTE:** It may be necessary to rotate the exhaust camshaft slightly (using a wrench on the flats of the camshaft) to seat the VCT assemblies onto the camshafts.

Rotate the secondary timing chain tensioner 90 degrees so the ramped area is facing forward and fully seat the VCT assemblies onto the camshafts.

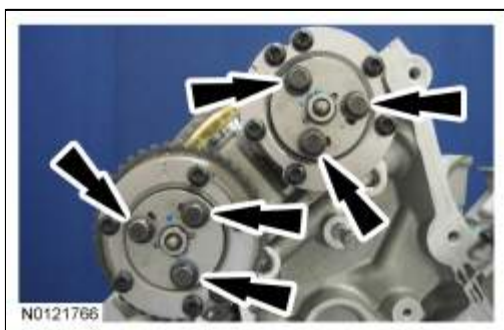
- If the secondary timing chain is not centered over the tensioner, reposition the VCT assemblies until they are fully seated on the camshafts.



49. **NOTE:** Use a wrench on the flats of the camshaft to hold the camshafts while tightening the VCT assembly bolts.

Install the 3 RH intake VCT assembly bolts and the 3 RH exhaust VCT assembly bolts.

- Tighten to 15 Nm (133 lb-in) plus an additional 90 degrees.



All cylinder heads

50. Install the RH primary timing chain.
- Align the colored link on the timing chain with the timing mark on the RH VCT assembly.



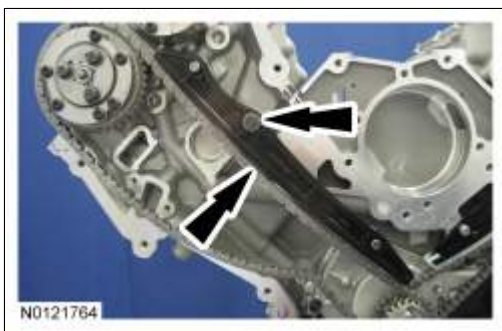
51. Align the remaining colored link on the timing chain with the timing mark on the crankshaft sprocket.



52. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain guide.

Install the RH timing chain guide and bolt.

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



53. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to install the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after installing the RH timing chain tensioner arm.

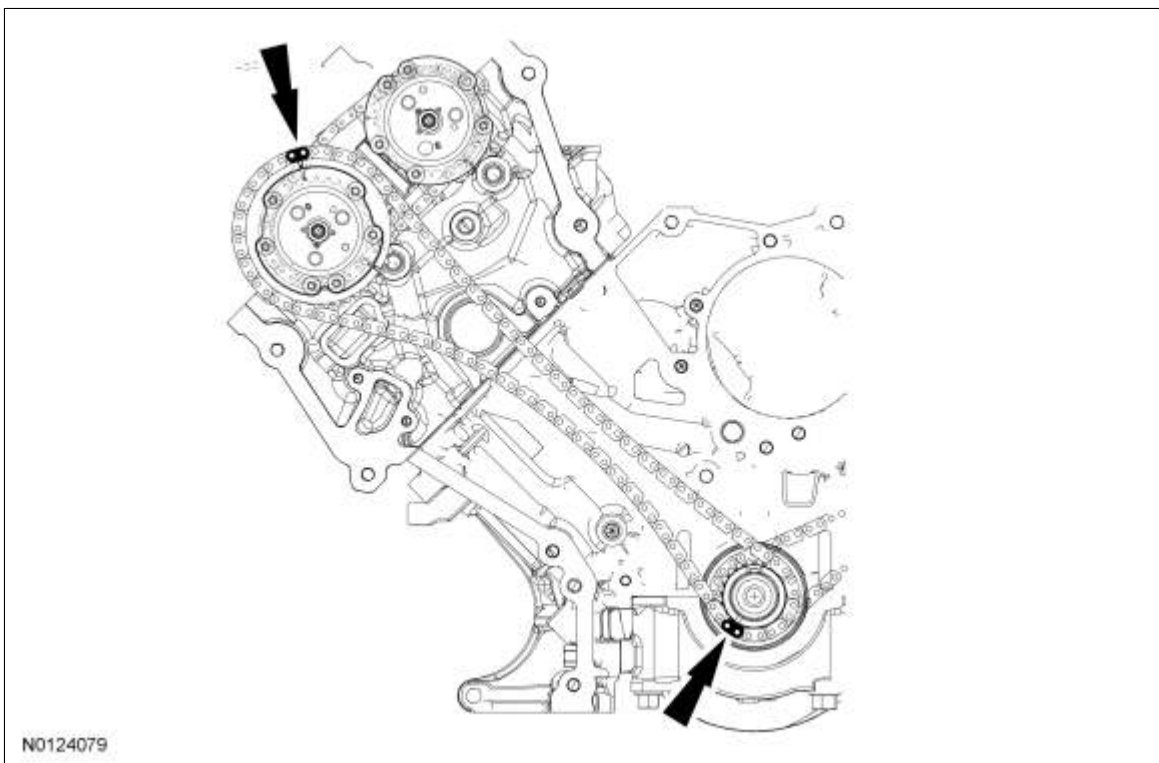
Install the RH timing chain tensioner arm.



54. Install the RH primary timing chain tensioner and 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Remove the holding pin from the tensioner.



55. With the crankshaft keyway still at the 12 o'clock position, verify the timing mark alignment is correct.



56. **NOTICE:** The Variable Camshaft Timing (VCT) variable force solenoid pins must be fully

depressed to avoid interference with the VCT valve tips when installing the engine front cover. Failure to follow these instructions can result in damage to the engine.

NOTE: LH shown, RH similar.

Fully depress the VCT variable force solenoid pins.



57. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

Apply a bead of silicone gasket and sealant to the cylinder head-to-cylinder block joints and the oil pan-to-cylinder block joints as illustrated.

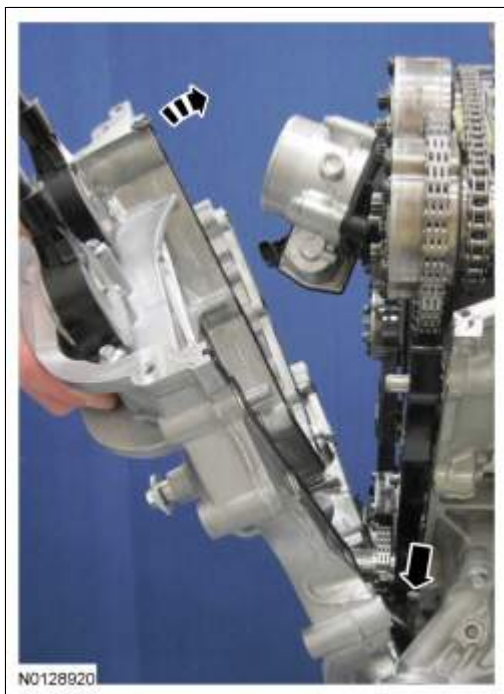


58. **NOTE:** Make sure that the engine front cover gasket is in place on the engine front cover before

installation.

Using new gaskets, position the engine front cover onto the dowels.

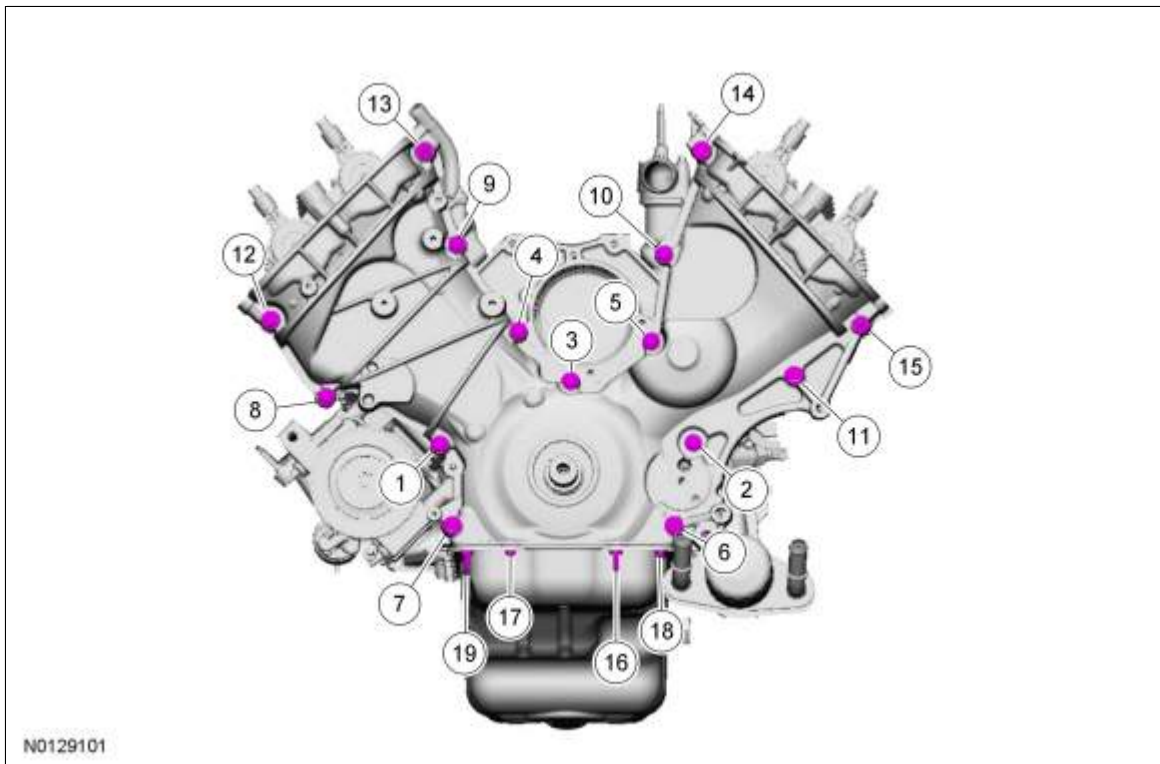
- Install the 13 engine front cover bolts, 2 stud bolts, 2 oil pan-to-engine front cover bolts and 2 oil pan-to-engine front cover stud bolts finger-tight.



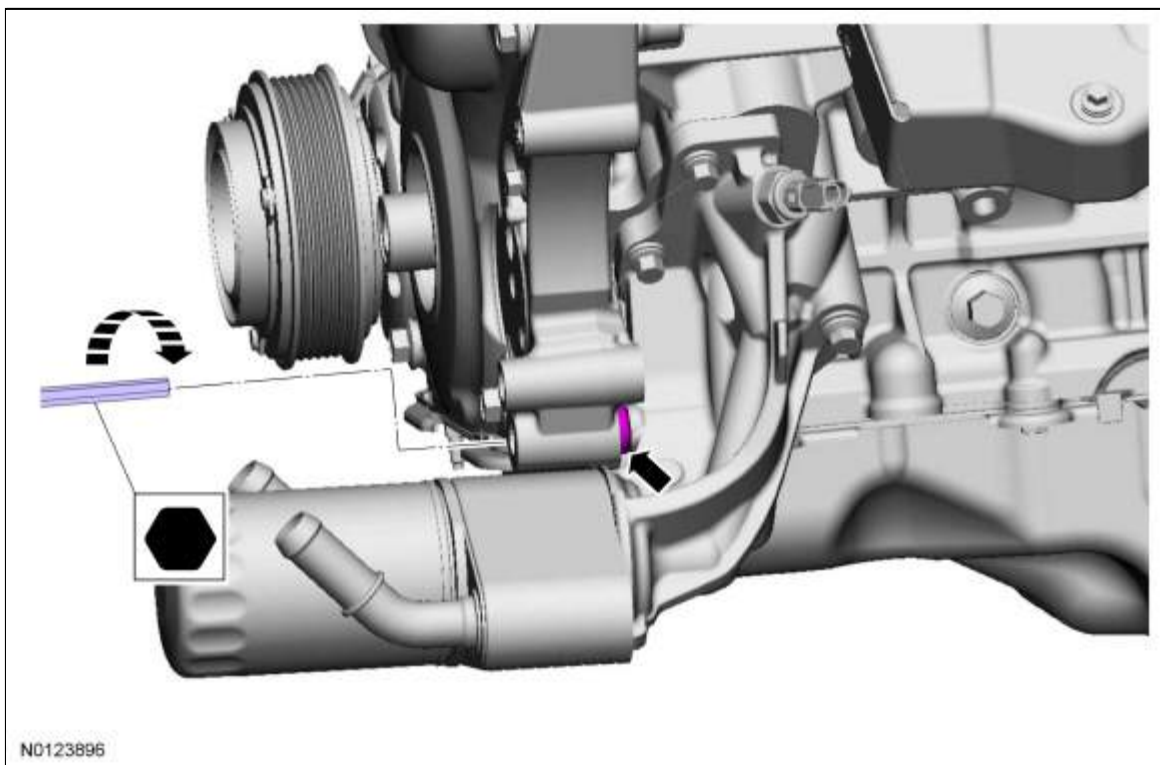
59. **NOTE:** The engine front cover must be installed and all fasteners final tightened within 5 minutes of applying the sealer. If this cannot be accomplished, install the engine front cover and tighten fasteners 6, 7, 8, 9, 10 and 11 to 8 Nm (71 lb-in) within 5 minutes of applying the sealer. All of the fasteners must then be final tightened within 1 hour of applying the sealer. If this time limit is exceeded, all sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Follow the directions on the packaging. Failure to follow this procedure can cause future oil leakage.

Tighten the bolts in the sequence shown in 2 stages.

- Stage 1: Tighten bolts 1-15 to 25 Nm (18 lb-ft) and bolts 16-19 to 10 Nm (89 lb-in).
- Stage 2: Tighten bolts 1-15 an additional 60 degrees and bolts 16-19 an additional 45 degrees.



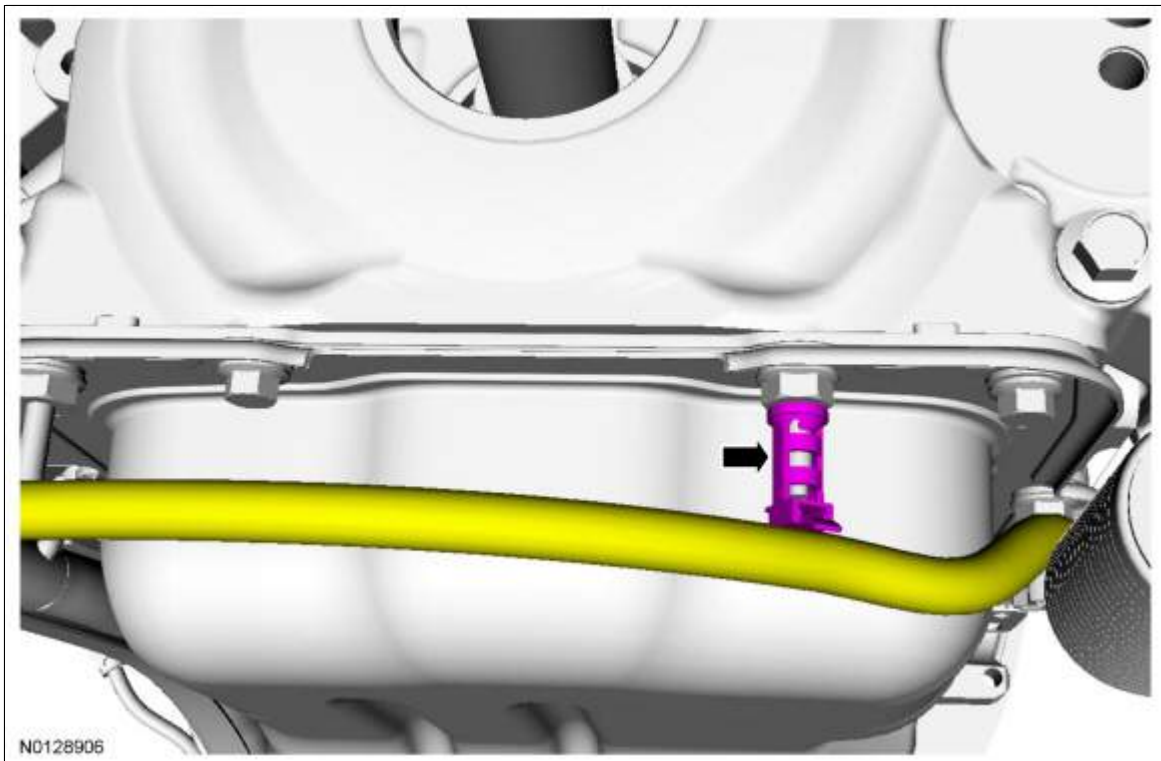
60. Using a 10 mm Hex Bit, rotate the engine front cover jackscrew into contact with the oil filter adapter to 5 Nm (44 lb-in).



61. Install the engine front cover-to-oil filter adapter bolt and tighten to 25 Nm (18 lb-ft) plus an additional 60 degrees.

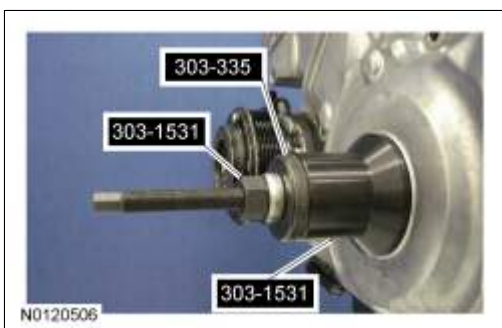


62. Position the wiring harness and install the wiring harness retainer to the oil pan stud bolt.



63. **NOTE:** Lubricate the engine front cover bore and the crankshaft front oil seal inner lip with clean engine oil.

Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft front oil seal.



64. **NOTE:** If not secured within 5 minutes, the sealant must be removed and the sealing area cleaned with silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

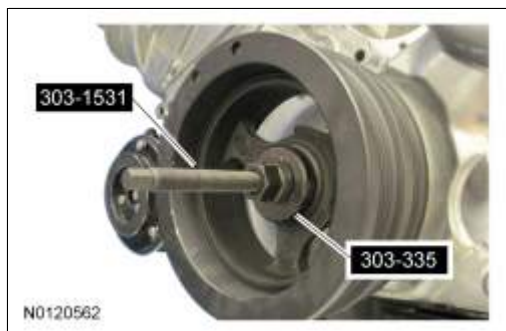
Apply silicone gasket and sealant to the Woodruff key slot in the crankshaft pulley.



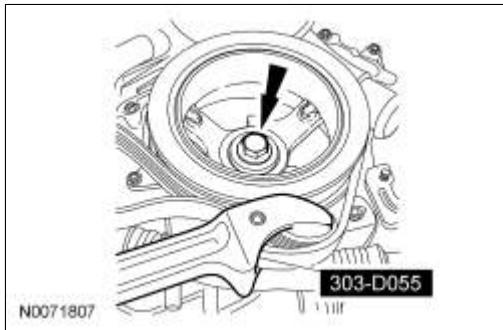
65. Lubricate the crankshaft pulley sealing surface with clean engine oil prior to installation.



66. Using the Front Crank Seal and Damper Installer and the Front Cover Oil Seal Installer (plate only), install the crankshaft pulley.



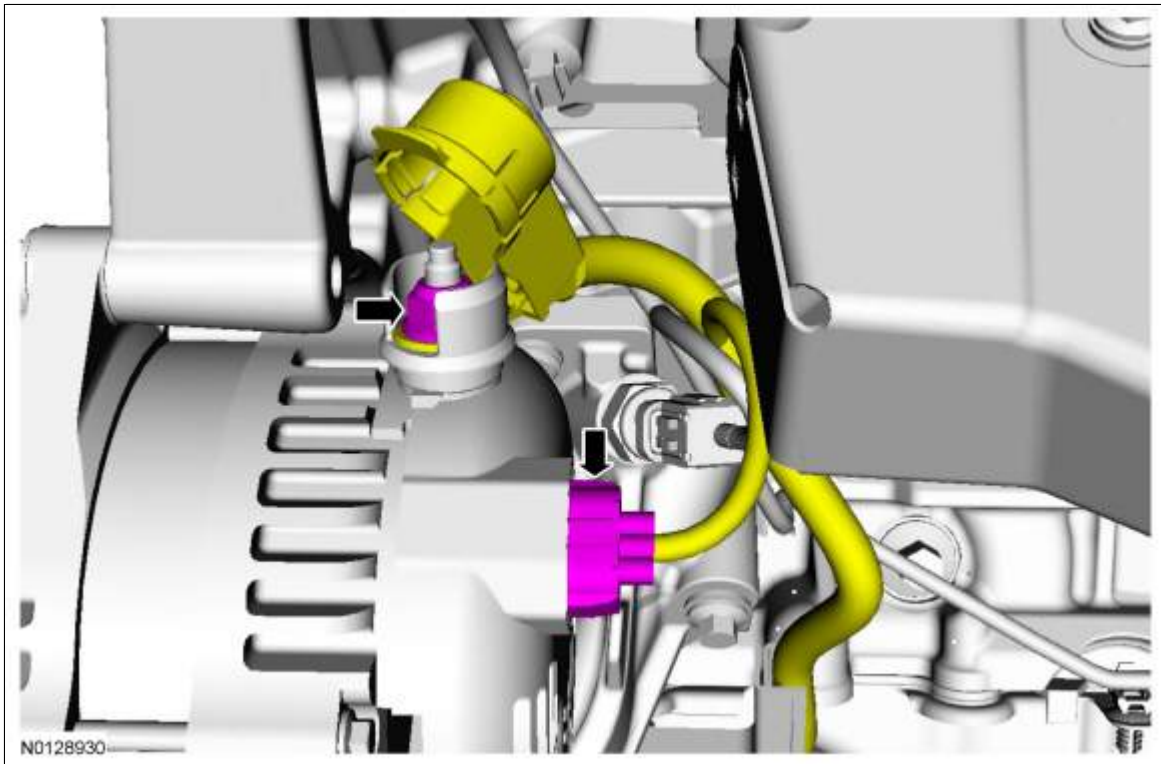
67. Using the Strap Wrench, install a new crankshaft pulley bolt and the original washer, tighten the bolt in 4 stages:
- Stage 1: Tighten to 140 Nm (103 lb-ft).
 - Stage 2: Loosen 360 degrees.
 - Stage 3: Tighten to 100 Nm (74 lb-ft).
 - Stage 4: Tighten an additional 90 degrees.



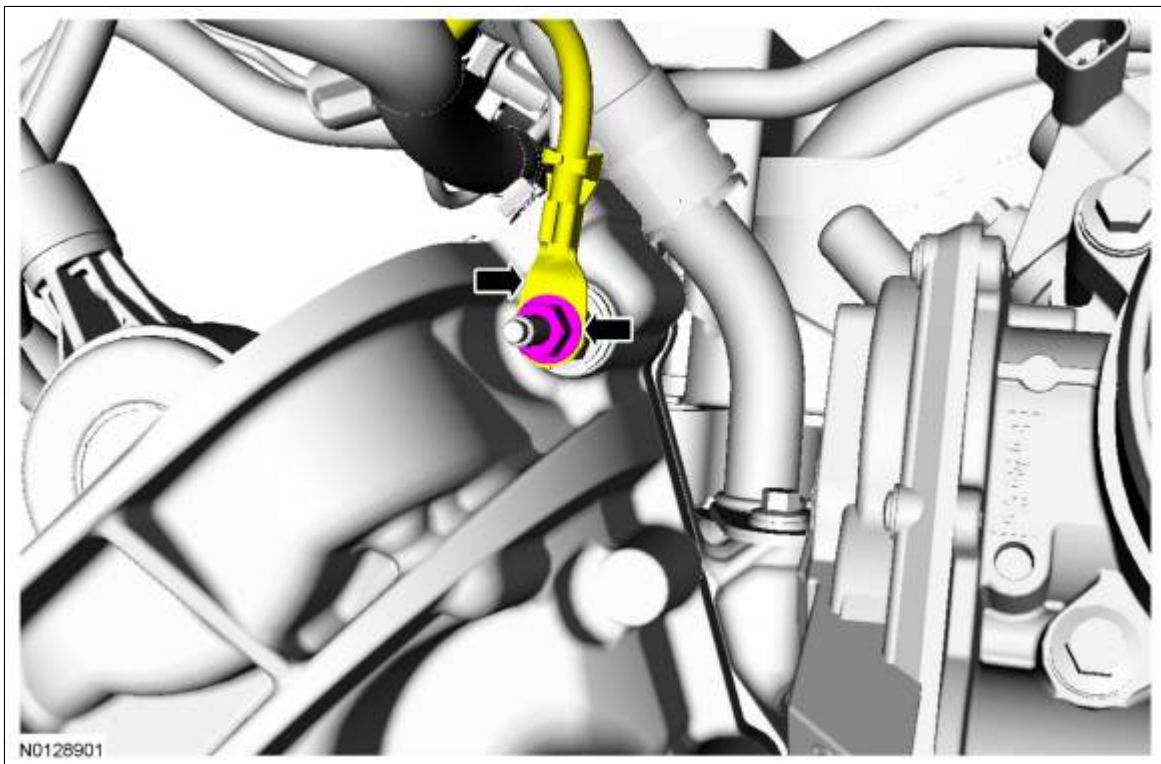
68. Install the generator and the 2 bolts.
- Tighten to 48 Nm (35 lb-ft).



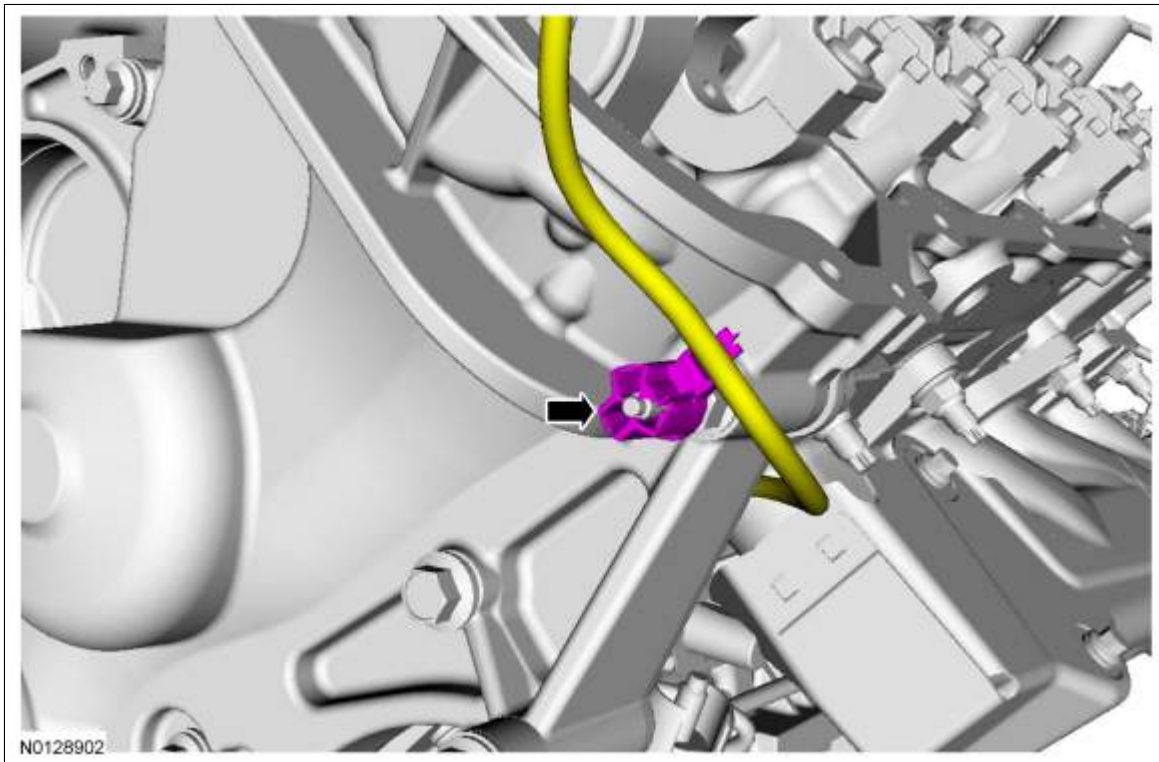
69. Connect the wiring harness connector to the generator.
- Install the B+ wire and nut onto the generator.
 - Tighten to 17 Nm (150 lb-in).



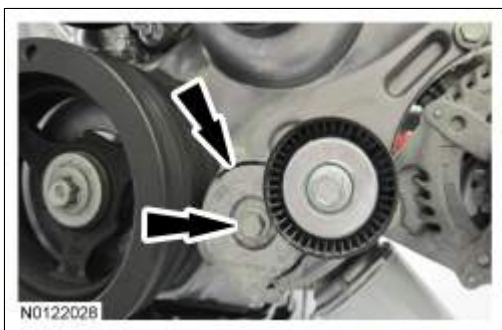
70. Install the ground wire and nut to the engine front cover stud bolt.
- Tighten to 10 Nm (89 lb-in).



71. Attach the wiring harness retainer to the engine front cover stud bolt.



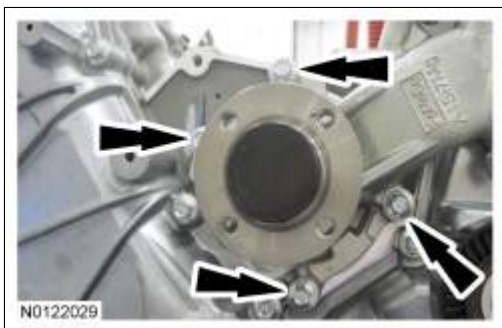
72. Install the accessory drive belt tensioner and the bolt.
- Tighten to 48 Nm (35 lb-ft).



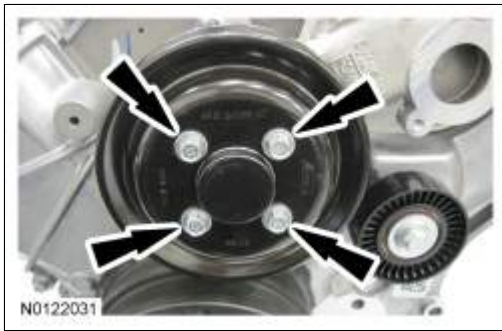
73. **NOTE:** Lubricate the new coolant pump O-ring seal with clean engine coolant.

Using a new O-ring seal, install the coolant pump and the 4 bolts.

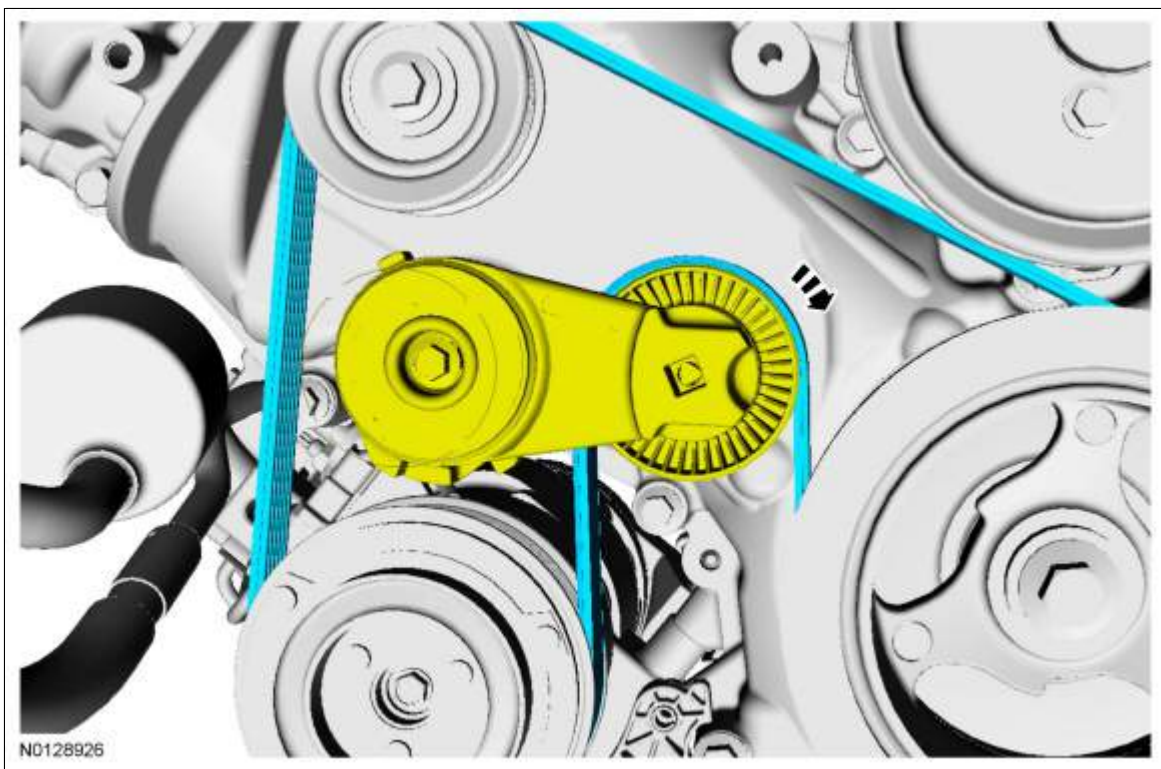
- Tighten to 20 Nm (177 lb-in) plus an additional 60 degrees.



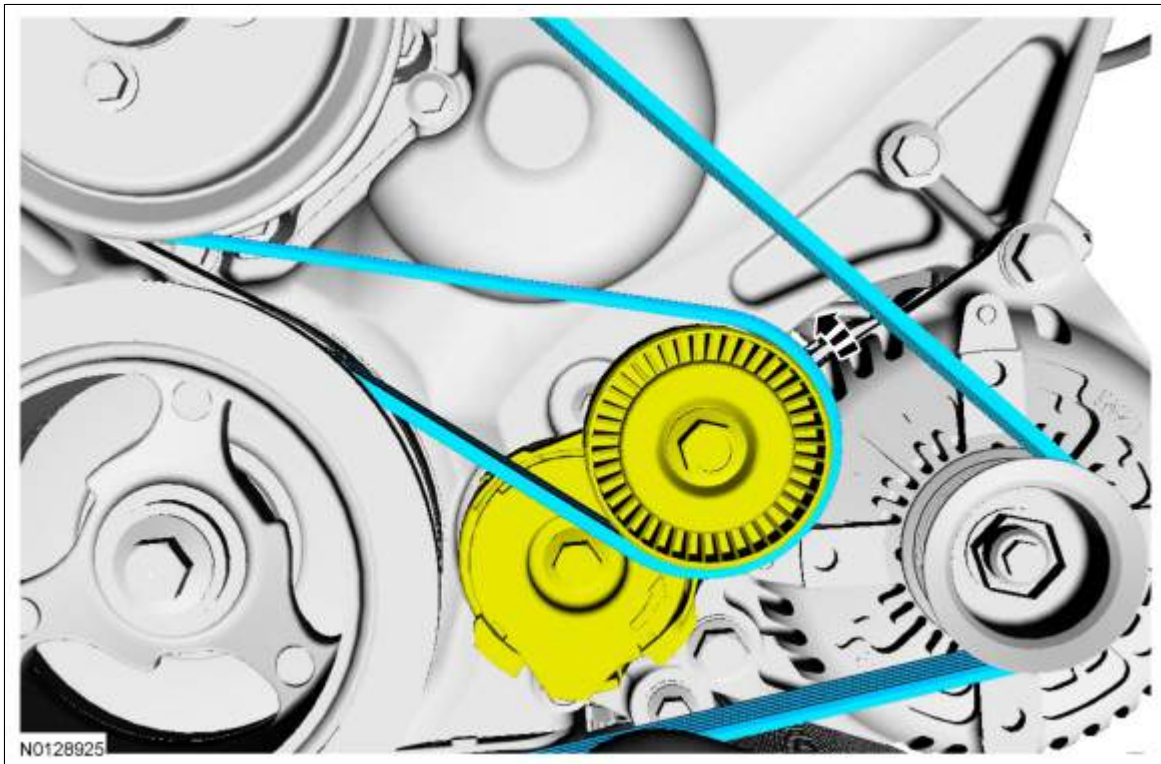
74. Install the coolant pump pulley and the 4 bolts.



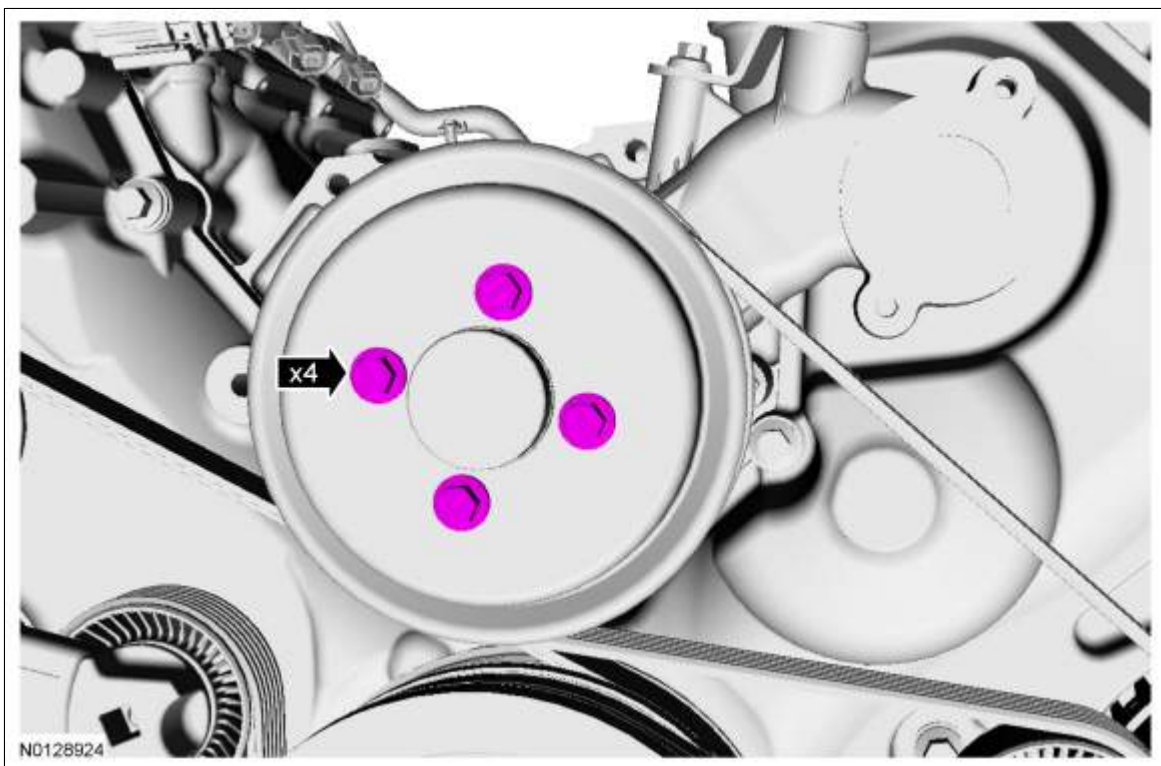
75. Rotate the A/C compressor belt tensioner clockwise and install the A/C compressor belt.



76. Rotate the accessory drive belt tensioner counterclockwise and install the accessory drive belt.



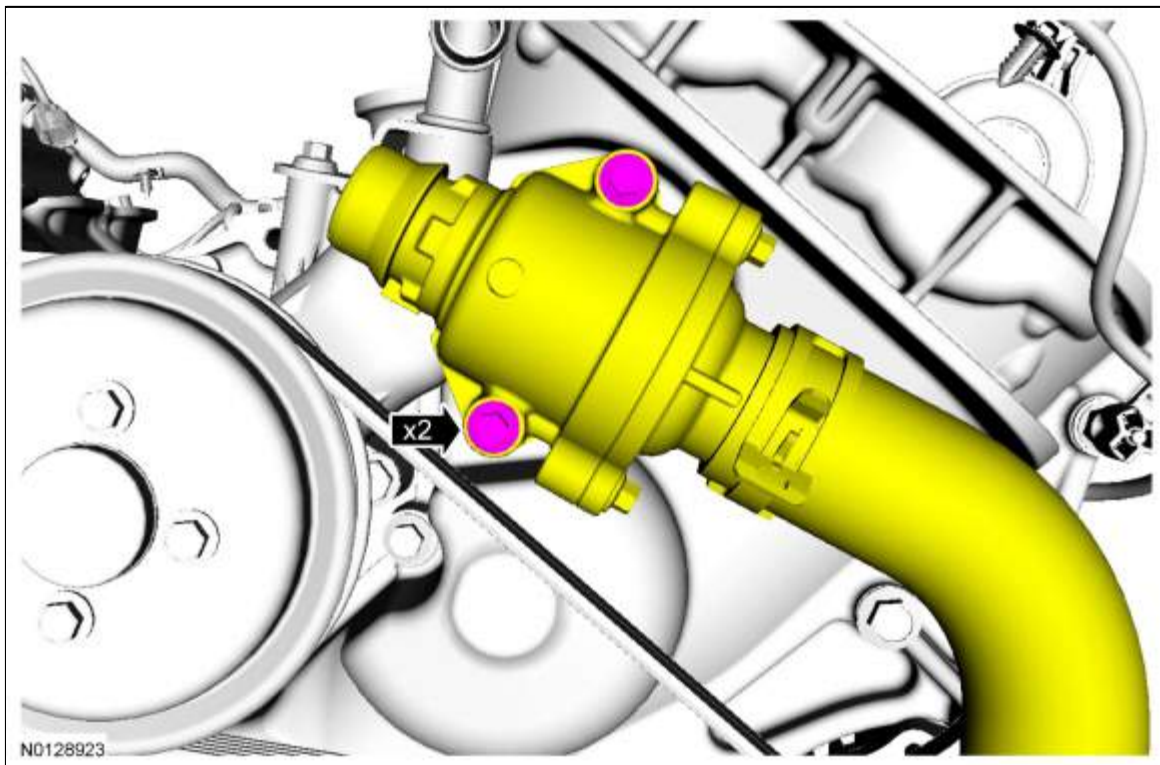
77. Tighten the 4 coolant pump pulley bolts to 25 Nm (18 lb-ft).



78. **NOTE:** Lubricate the new thermostat housing O-ring seal with clean engine coolant.

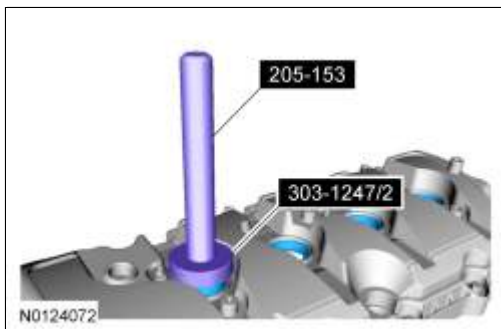
Using a new thermostat housing O-ring seal, install the thermostat housing and the 2 bolts.

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



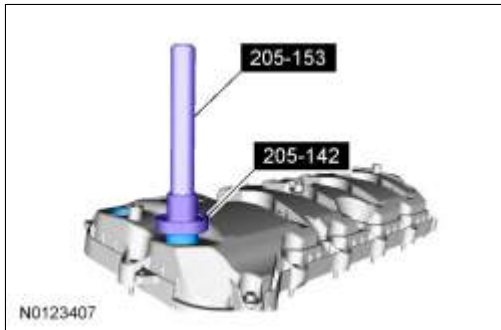
79. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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



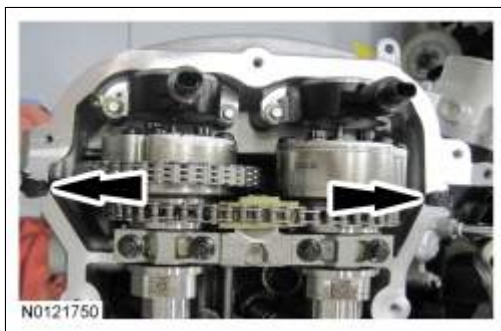
80. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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

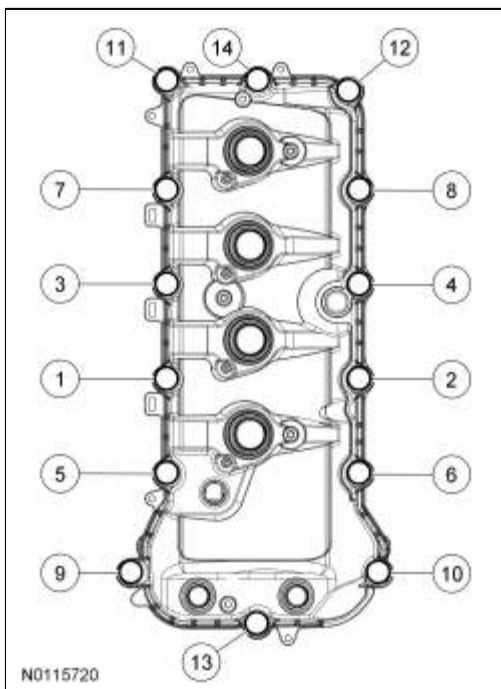


81. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

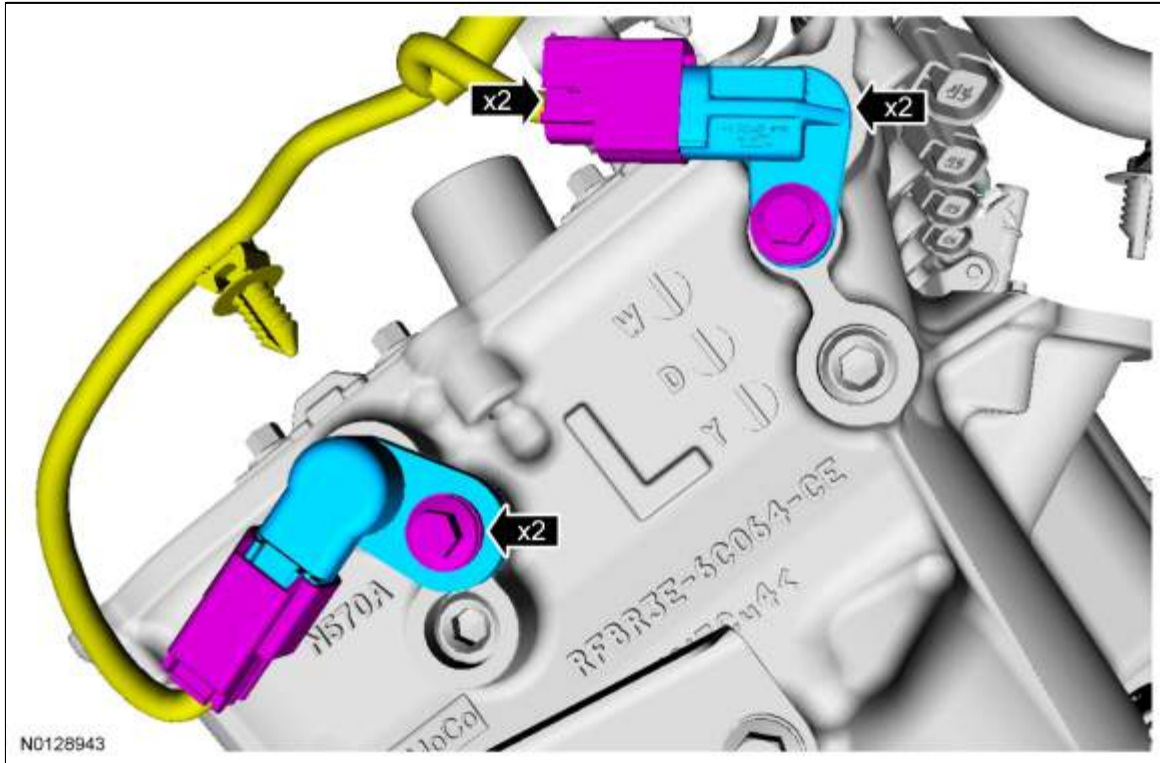
Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-LH cylinder head joints.



82. Position the LH valve cover and new gasket on the cylinder head.
- Tighten the fasteners in the sequence shown to 10 Nm (89 lb-in).

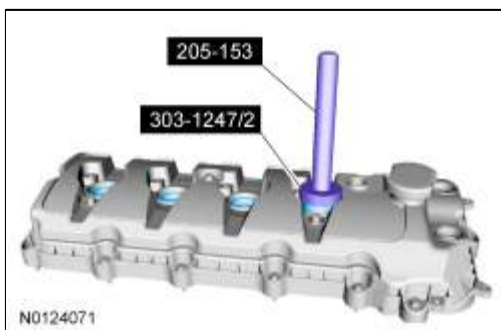


83. Install the oil level indicator.
84. If removed, install the LH intake and exhaust Camshaft Position (CMP) sensors and the 2 bolts.
 - Tighten to 10 Nm (89 lb-in).
 - Connect the LH intake and exhaust CMP sensor electrical connectors.



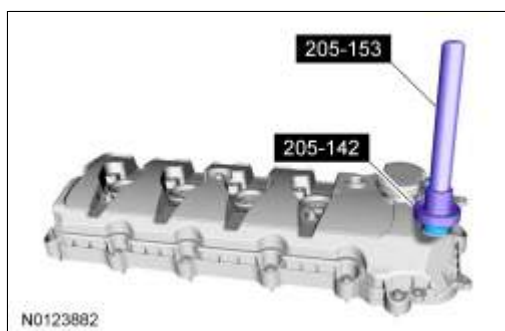
85. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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



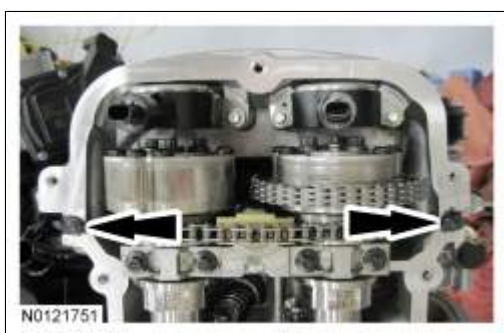
86. **NOTE:** Installation of new seals is only required if damaged seals were removed.

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

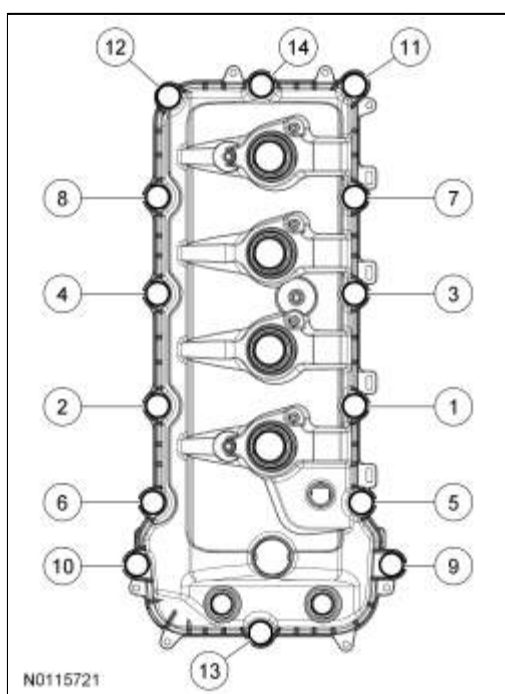


87. **NOTE:** If the valve cover is not installed and the fasteners tightened within 5 minutes, the sealant must be removed and the sealing area cleaned. To clean the sealing area, use silicone gasket remover and metal surface prep. Failure to follow this procedure can cause future oil leakage.

Apply an 8 mm (0.31 in) bead of silicone gasket and sealant to the engine front cover-to-RH cylinder head joints.



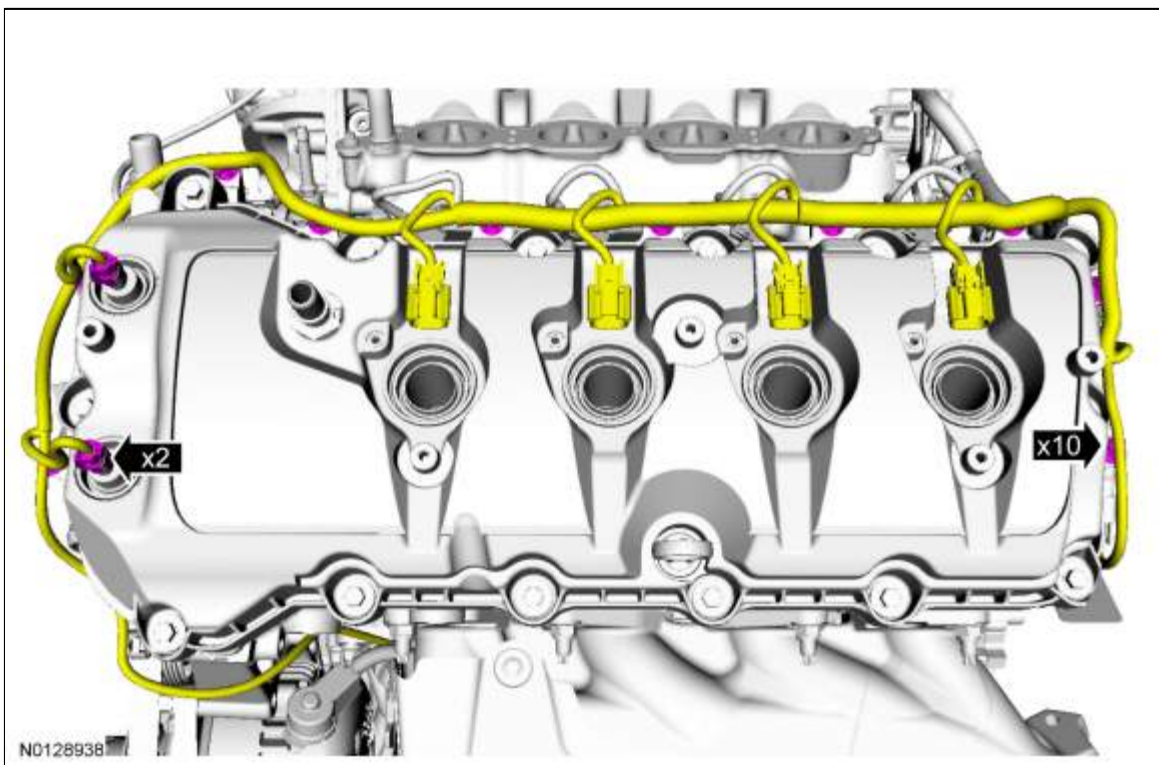
88. Position the RH valve cover and new gasket on the cylinder head.
- Tighten the bolts in the sequence shown to 10 Nm (89 lb-in).



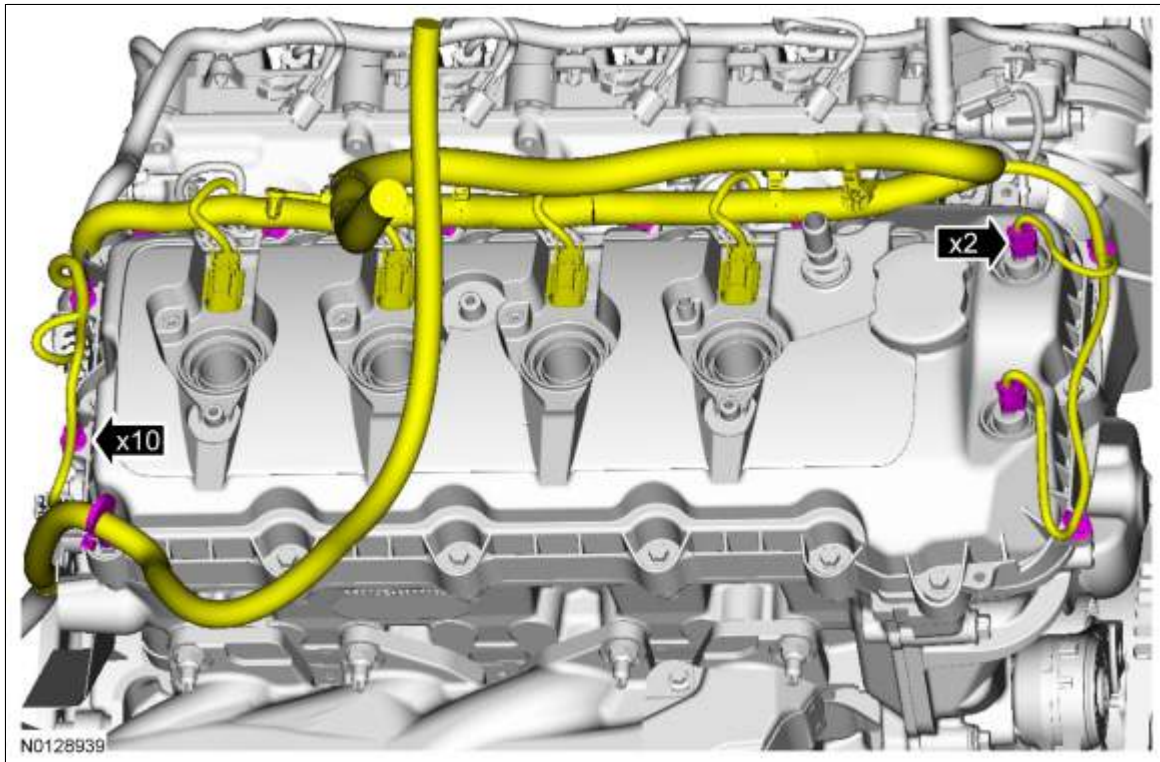
89. If removed, install the RH intake and exhaust CMP sensors and the 2 bolts.
- Tighten to 10 Nm (89 lb-in).
 - Connect the RH intake and exhaust CMP sensor electrical connectors.



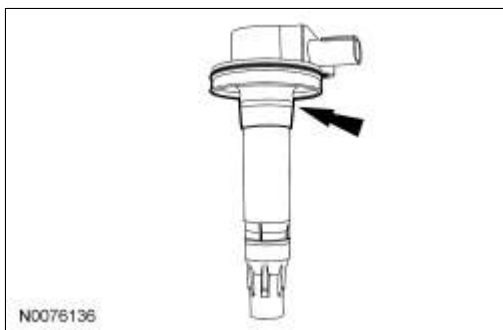
90. Connect the 2 VCT variable force solenoid electrical connectors.
- Attach the 10 wiring harness retainers to the LH valve cover.



91. Connect the 2 Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.
- Attach the 10 wiring harness retainers to the RH valve cover.



92. Inspect the coil seals for rips, nicks or tears. Remove and discard any damaged coil seals.
- To install, slide the new coil seal onto the coil until it is fully seated at the top of the coil.



93. **NOTE:** RH shown, LH similar.

NOTE: Apply a small amount of dielectric grease to the inside of the ignition coil-on-plug boots before attaching to the spark plugs. RH shown, LH similar.

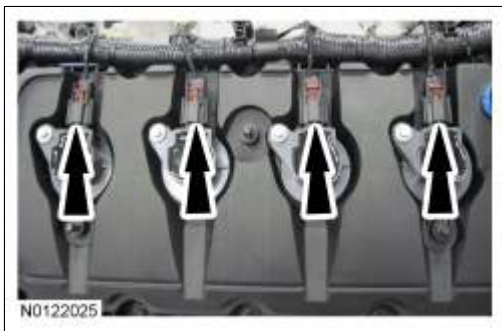
Install the 8 ignition coils and 8 bolts.

- Tighten to 6 Nm (53 lb-in).



94. **NOTE:** RH shown, LH similar.

Connect the 8 ignition coil electrical connectors.






95. Install the engine. For additional information, refer to [Engine](#) in this section.
-

SECTION 303-01C: Engine — 5.0L (4V)
INSTALLATION

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST1377-A	Lifting Bracket, Engine 303-F047 (014-00073)
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool

Material

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada) XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)	WSS-M2C945-A
Threadlock 262 TA-26	WSK-M2G351-A6



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

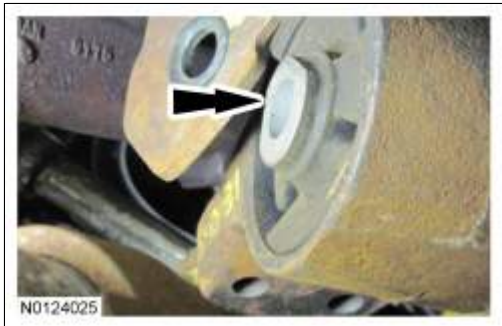


WARNING: Before working on or disconnecting any of the fuel tubes or fuel system components, relieve the fuel system pressure to prevent accidental spraying of fuel. Fuel in the fuel system remains under high pressure, even when the engine is not running. Failure to follow this instruction may result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

1. Using the Heavy Duty Floor Crane and the Engine Lifting Bracket, position the engine in the engine compartment leaving access to the LH engine support insulator bolts.

2. **NOTE:** Clean the LH and RH engine support insulator-to-frame mating surfaces of any dirt or foreign material prior to installation.

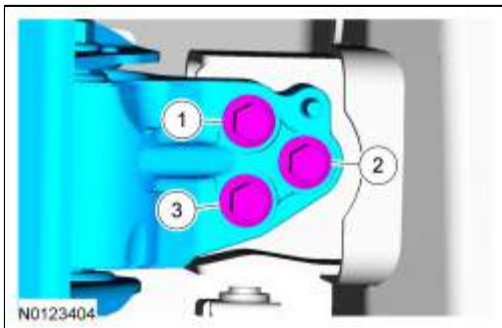
Install the LH engine support insulator from under the vehicle.



3. **NOTE:** Apply threadlock to the bolt threads prior to installation.

Using a suitable floor crane, raise the engine assembly to gain access to install the 3 LH engine support insulator bolts.

- Tighten the 3 LH engine support insulator bolts in the sequence shown to 175 Nm (129 lb-ft).



4. Lower the engine.
5. **NOTICE:** Use only hand tools when installing the LH engine support insulator through bolt or the engine support insulator may be damaged.

NOTE: Apply threadlock to the bolt threads prior to installation.

Install the LH engine mount through bolt.

- Tighten to 350 Nm (258 lb-ft).



6. **NOTICE:** Use only hand tools when installing the RH engine support insulator studs or the engine support insulator may be damaged.

NOTE: Apply threadlock to the stud threads prior to installation.

Install the 2 RH engine support insulator studs.

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



7. **NOTICE:** Use only hand tools when installing the RH engine support insulator nuts or the engine support insulator may be damaged.

NOTE: Apply threadlock to the nut threads prior to installation.

Install the 2 RH engine support insulator nuts.

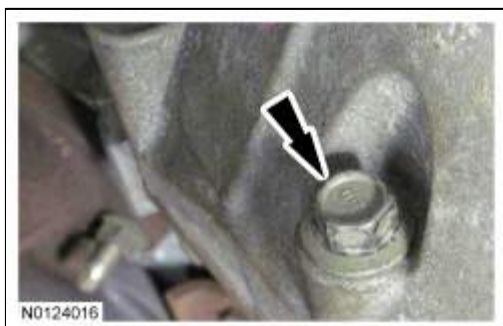
- Tighten to 175 Nm (129 lb-ft).



8. **NOTE:** The 2 upper transmission-to-engine bolt will be installed later.

Install the lower transmission-to-engine bolt.

- Tighten to 48 Nm (35 lb-ft).



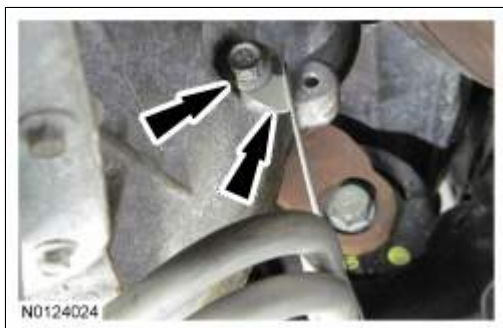
9. Install the 2 lower transmission-to-engine bolts.
 - Tighten to 48 Nm (35 lb-ft).



10. Install the lower transmission-to-engine bolt.
 - Tighten to 48 Nm (35 lb-ft).



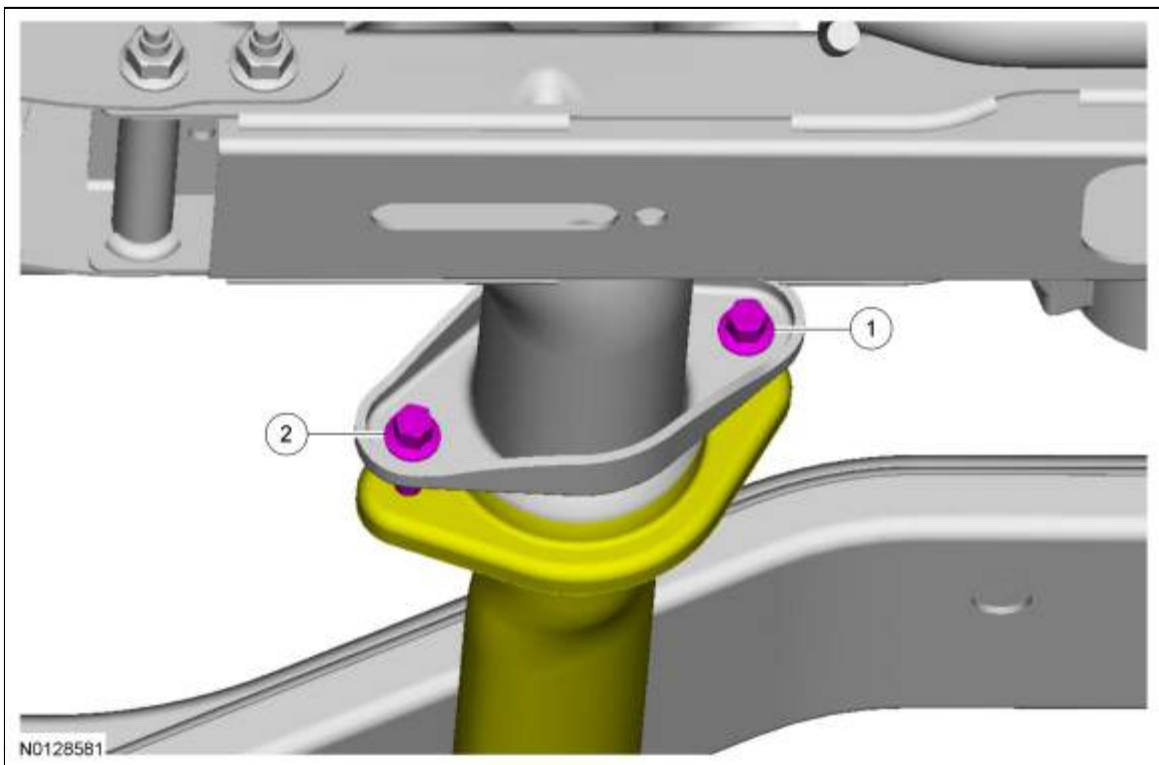
11. Install the transmission cooler tube support bracket and the transmission-to-engine bolt.
 - Tighten to 48 Nm (35 lb-ft).



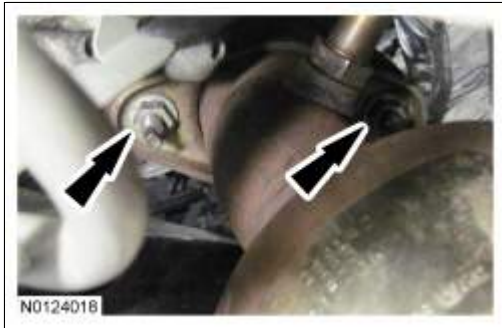
12. Tighten the 2 transmission mount-to-crossmember nuts.
 - Tighten to 25 Nm (18 lb-ft).



13. Position the exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe and install the 2 new bolts.
 1. Tighten the inner exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).
 2. Tighten the outer exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolt to 63 Nm (46 lb-ft).



14. Install 2 new RH catalytic converter-to-exhaust manifold nuts.
 - Tighten to 40 Nm (30 lb-ft).



15. Install 2 new LH catalytic converter-to-exhaust manifold nuts.
- Tighten to 40 Nm (30 lb-ft).



16. Install 4 new torque converter-to-flexplate nuts.
- Tighten to 35 Nm (26 lb-ft).



17. Install the cylinder block opening cover.



18. Install the flexplate inspection cover and the 2 bolts.

- Tighten to 35 Nm (26 lb-ft).



19. **NOTE:** Do not lubricate the O-ring seal.

Install a new oil filter.

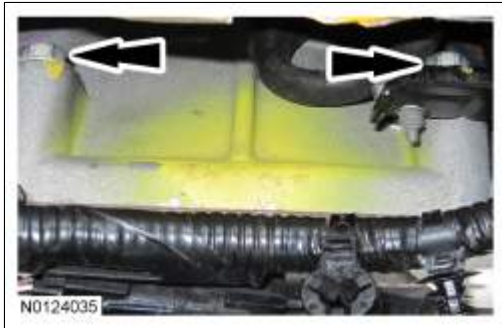
- Tighten to 16 Nm (142 lb-in).



20. Connect the oil level sensor electrical connector.



21. Install the starter. For additional information, refer to [Section 303-06](#).
22. If equipped, install the front driveshaft. For additional information, refer to [Section 205-01](#).
23. Install the 2 upper transmission-to-engine bolts.
- Tighten to 48 Nm (35 lb-ft).



24. Attach the PCM wiring harness retainer to the valve cover bolt stud.



25. Attach and connect the engine harness electrical connector.



26. Connect the middle PCM electrical connector.



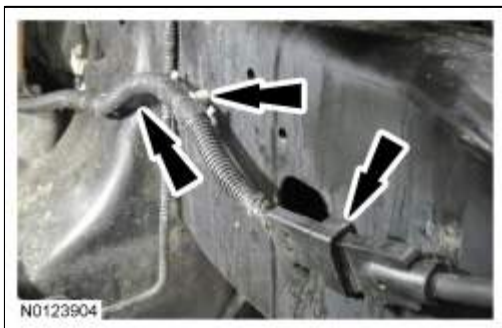
27. Install the crankcase ventilation tube. For additional information, refer to the quick connect coupling procedure in [Section 310-00](#).



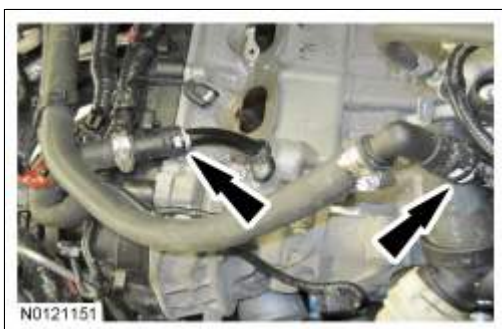
28. Install the ground strap and bolt to the cowl.
- Tighten to 10 Nm (89 lb-in).



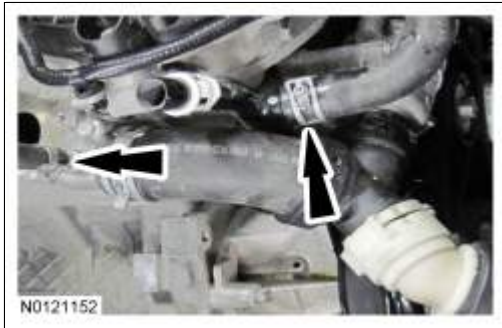
29. If equipped, attach and connect the block heater electrical connector and the 2 wiring harness retainers.



30. Connect the 2 heater hose quick connect couplings. For additional information, refer to [Section 412-00](#).



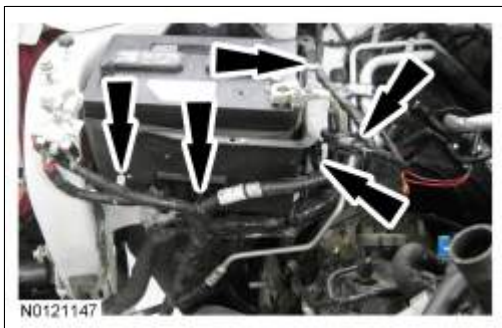
31. Connect the 2 coolant hoses.



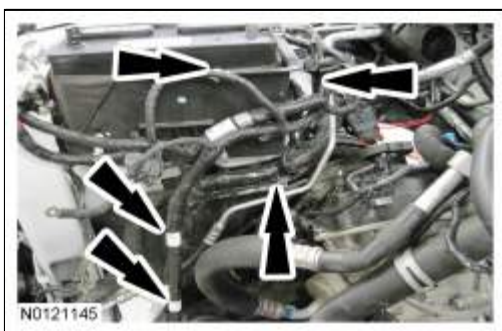
32. Install the spring clip, the clamp and connect the coolant bypass T assembly to the engine.



33. Connect the 2 wiring harness connectors and attach the 3 wiring harness retainers.



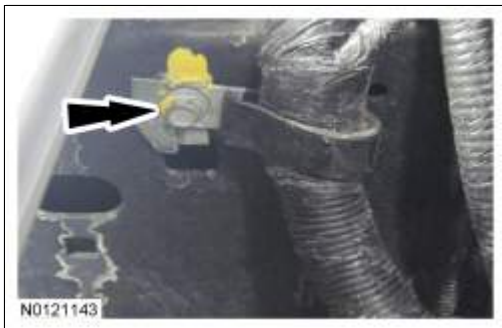
34. Attach the 5 wiring harness retainers.



35. Connect the B+ wire and nut.
- Tighten to 17 Nm (150 lb-in).
 - Attach the wiring harness retainer to the battery tray.



36. Install the wiring harness bracket and the bolt to the RH frame rail.
- Tighten to 20 Nm (177 lb-in).



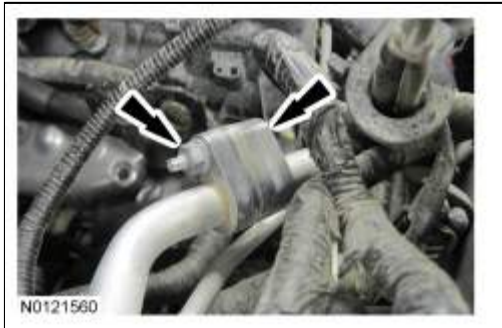
37. Install the ground wire and the bolt to the RH frame rail.
- Tighten to 12 Nm (106 lb-in).



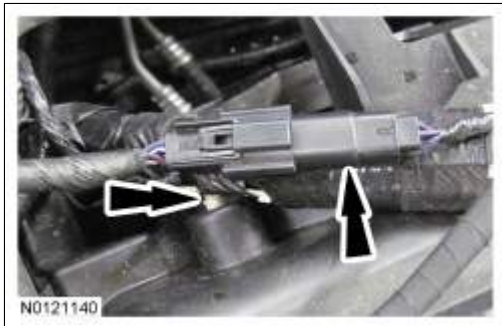
38. Install the transmission cooler line bracket and the nut to the engine front cover stud bolt.
- Tighten to 13 Nm (115 lb-in).



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



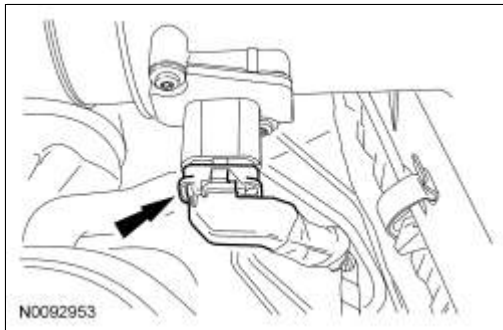
40. Connect the wiring harness electrical connector and pin-type retainer.
- Position the Power Distribution Box (PDB) and wiring harness toward the engine.



41. Connect the A/C pressure transducer electrical connector.



42. Install the cooling module. For additional information, refer to [Section 303-03](#).
43. Install the Air Cleaner (ACL) element and ACL upper tray. For additional information, refer to [Section 303-12](#)
44. Connect the Mass Air Flow (MAF) sensor electrical connector.



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

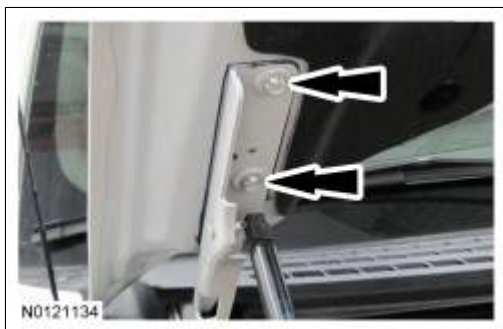
Install the intake manifold. For additional information, refer to [Intake Manifold](#) in this section.

46. Fill the engine with clean engine oil.
47. Connect the battery ground cable. For additional information, refer to [Section 414-01](#).
48. **NOTE:** Align the index marks made during hood removal.

NOTE: RH shown, LH similar.

Install the hood and the 4 bolts.

- Tighten to 12 Nm (106 lb-in).



49. After completing the repairs, use the scan tool to perform the Misfire Monitor Neutral Profile Correction procedure following the on-screen instructions.

SECTION 303-01C: Engine — 5.0L (4V)
REMOVAL

2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Cylinder Head

Special Tool(s)

 ST1184-A	3 Jaw Puller 303-D121 or equivalent
 ST1326-A	Handle 205-153 (T80T-4000-W)
 ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST2212-A	Installer, Differential Bearing Cone 205-142 (T80T-4000-J)
 ST1385-A	Remover, Oil Seal 303-409 (T92C-6700-CH)
 ST2982-A	Remover, Spark Plug Tube Seal 303-1247/1

Material

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

Motorcraft® Silicone Gasket Remover ZC-30	—
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Removal

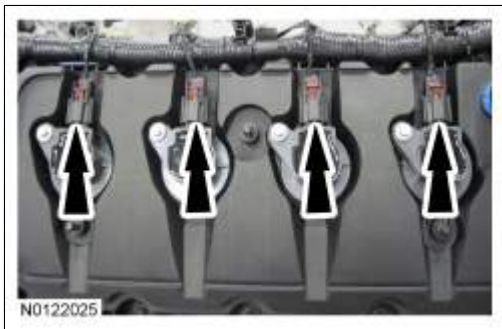
NOTICE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

NOTE: If the components are to be reinstalled, they must be installed in their original location. Mark the components for installation into their original location.

All cylinder heads

1. Remove the engine. For additional information, refer to [Engine](#) in this section.
2. Mount the engine on a work stand.
3. **NOTE:** RH shown, LH similar.

Disconnect the 8 ignition coil electrical connectors.



4. **NOTE:** RH shown, LH similar.

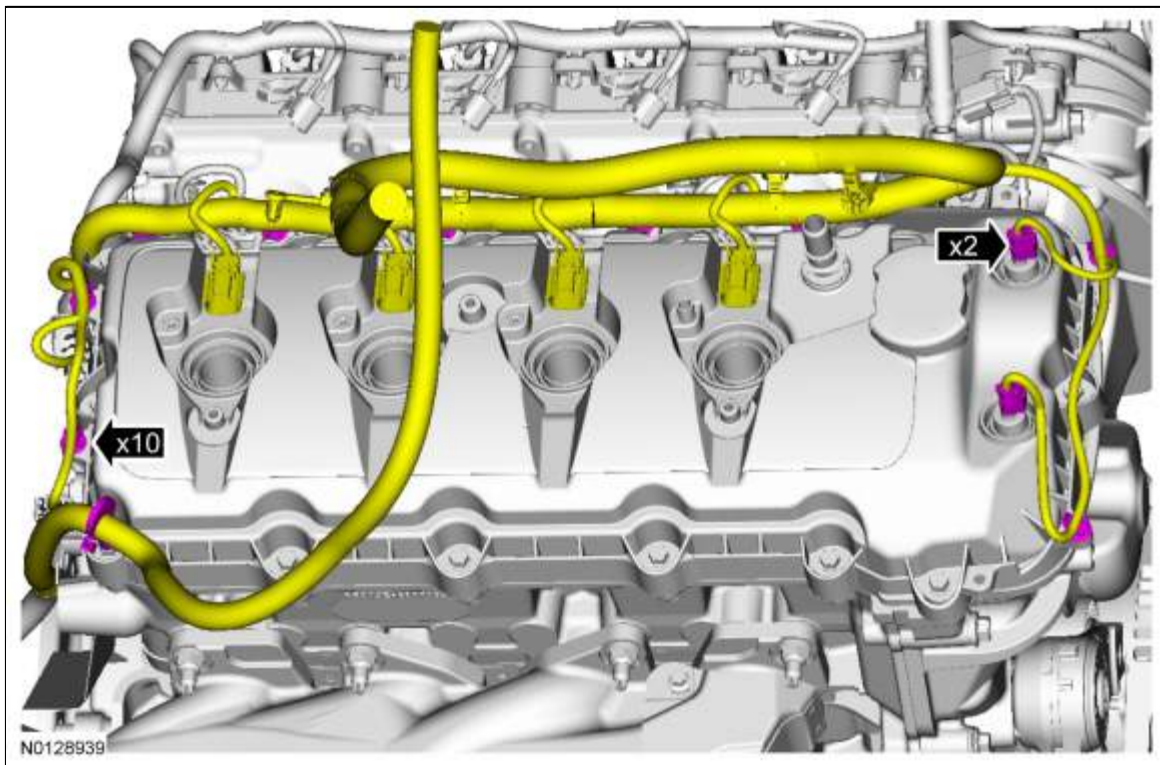
NOTE: When removing the ignition coils, a slight twisting motion will break the seal and ease removal. RH shown, LH similar.

Remove the 8 bolts and the 8 ignition coils.

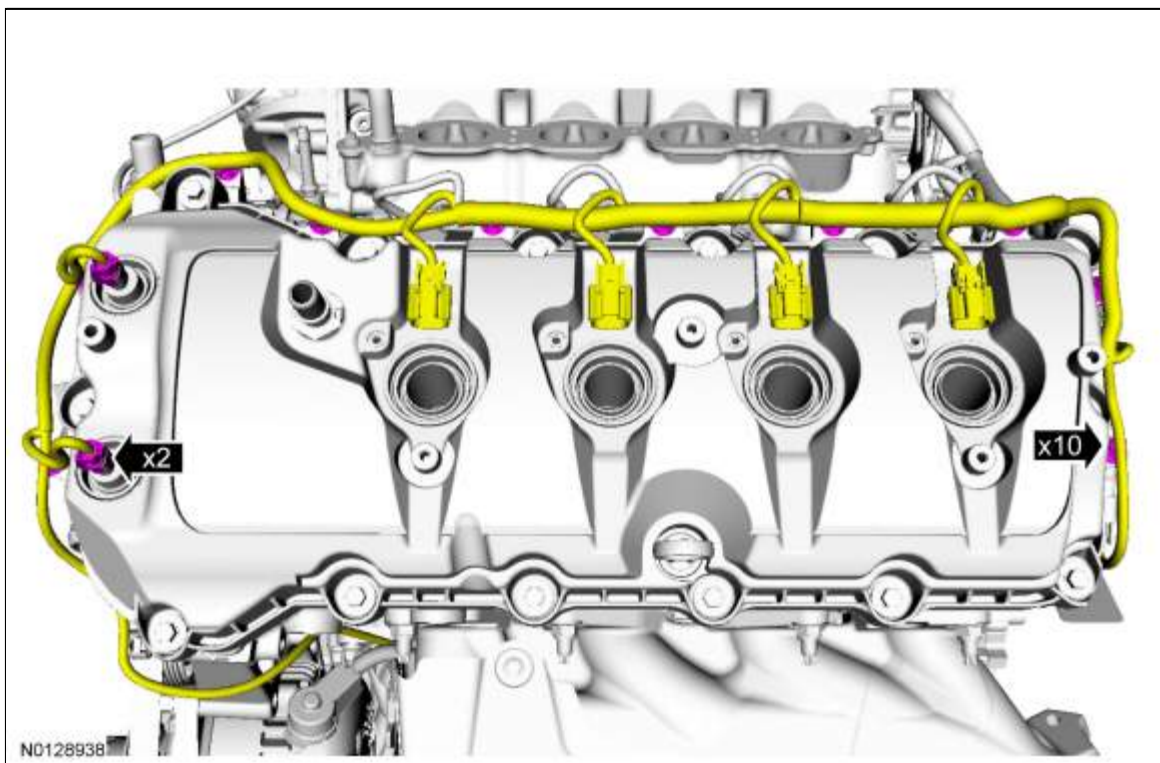


5. Disconnect the 2 Variable Camshaft Timing (VCT) variable force solenoid electrical connectors.

- Detach the 10 wiring harness retainers from the RH valve cover.



6. Disconnect the 2 VCT variable force solenoid electrical connectors.
- Detach the 10 wiring harness retainers from the LH valve cover.



7. **NOTICE:** 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.

Loosen the 14 fasteners and remove the RH valve cover and gasket.

- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



8. Remove the oil level indicator.

9. **NOTICE:** 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.

Loosen the 14 fasteners and remove the LH valve cover and gasket.

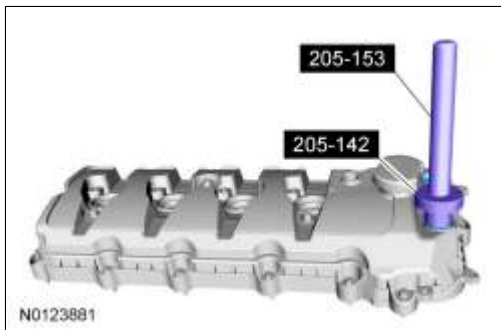
- Clean the valve cover mating surface of the cylinder head with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Discard the valve cover gasket. Clean the valve cover gasket groove with soap and water or a suitable solvent.



10. **NOTE:** RH shown, LH similar.

Inspect the 2 VCT variable force solenoid seals. Remove any damaged seals.

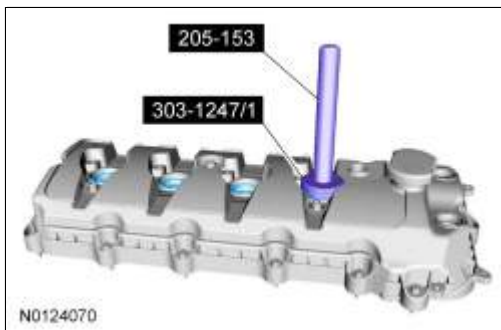
- Using the Differential Bearing Cone Installer and Handle, remove the seal(s).



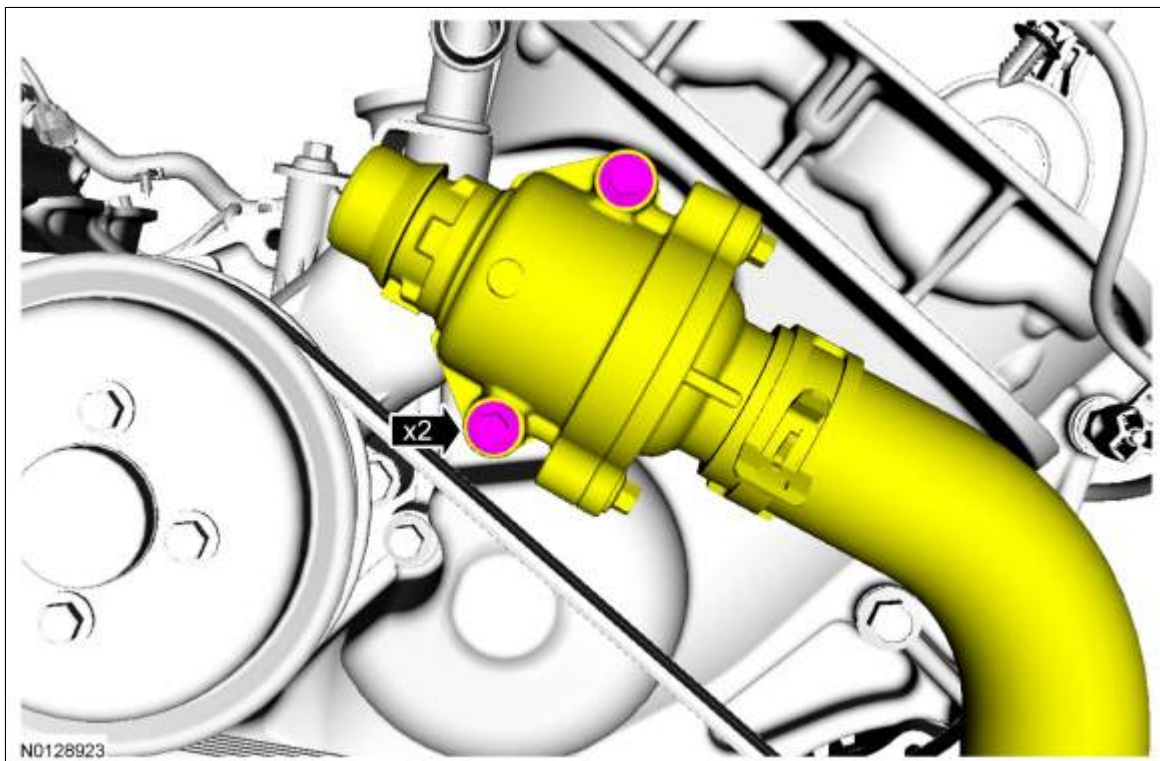
11. **NOTE:** RH shown, LH similar.

Inspect the spark plug tube seals. Remove any damaged seals.

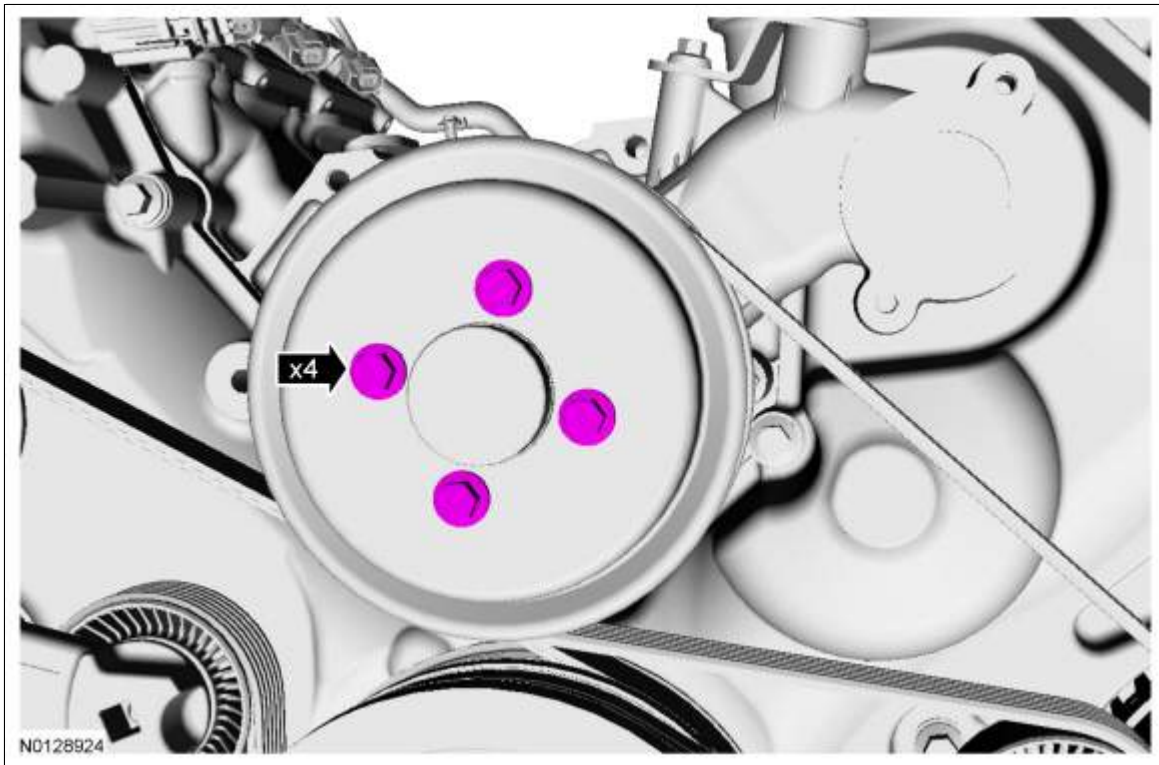
- Using the VCT Spark Plug Tube Seal Remover and Handle, remove the seal(s).



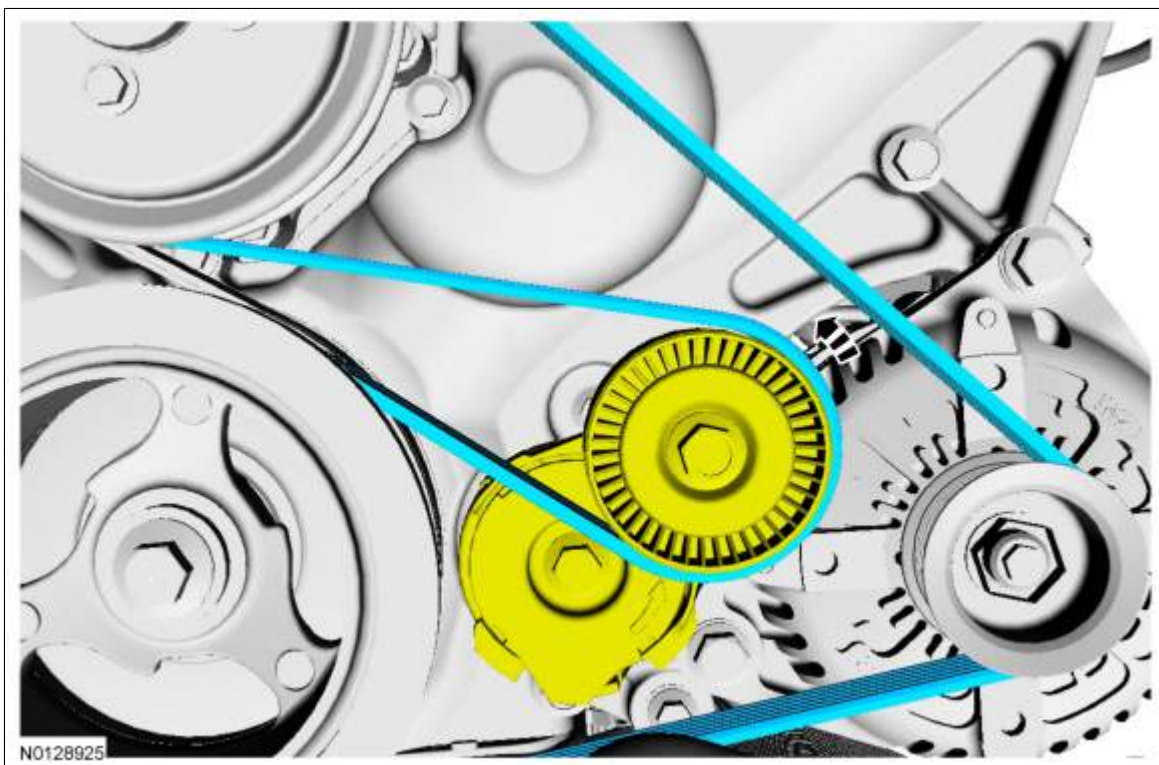
12. Remove the 2 bolts and position the thermostat housing and lower radiator hose aside.
- Remove and discard the thermostat housing O-ring seal.



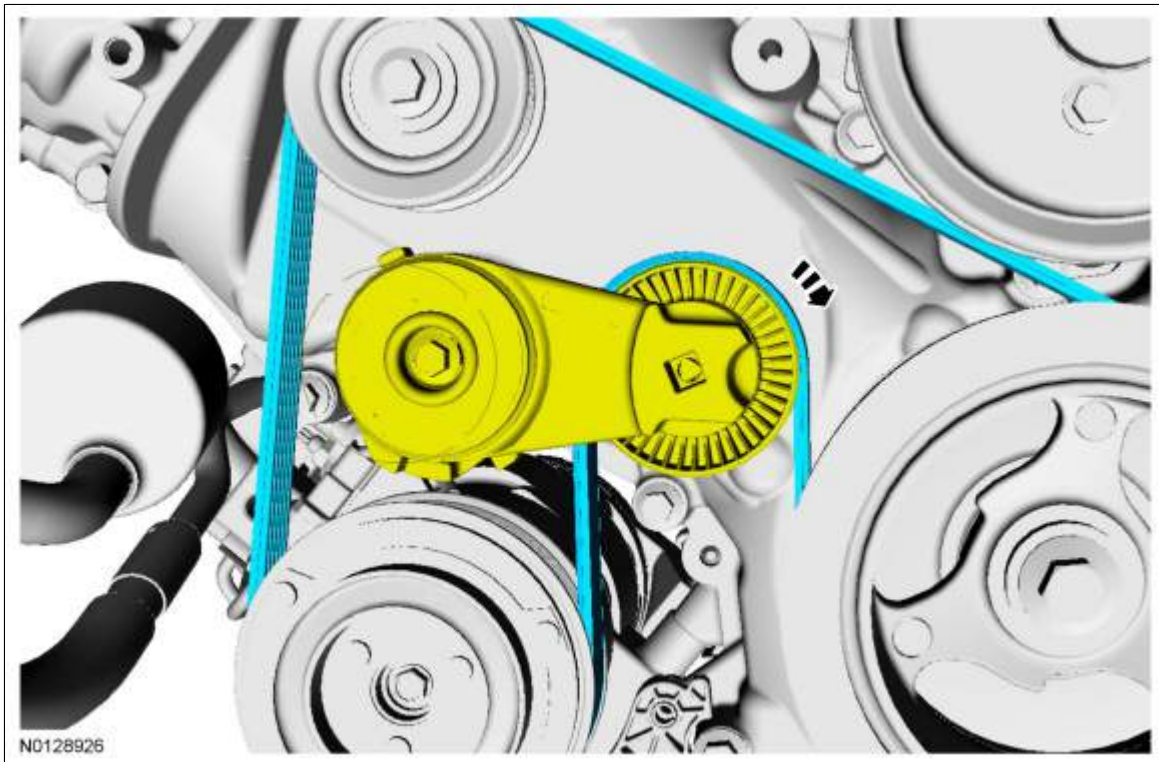
13. Loosen the 4 coolant pump pulley bolts.



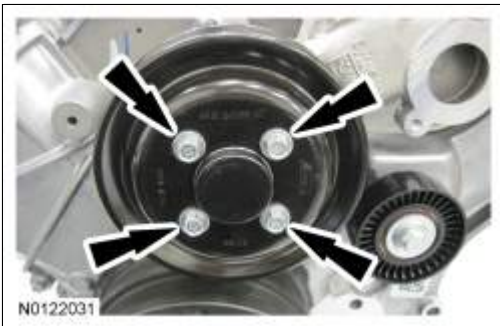
14. Rotate the accessory drive belt tensioner counterclockwise and remove the accessory drive belt.



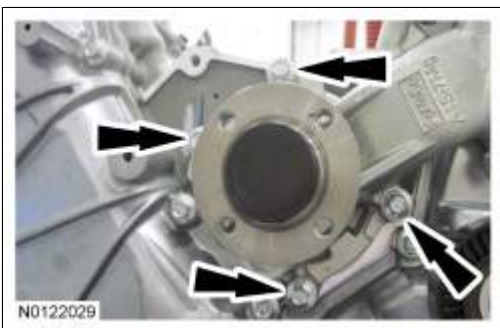
15. Rotate the A/C compressor belt tensioner clockwise and remove the A/C compressor belt.



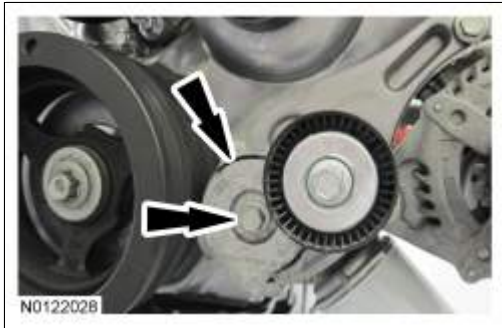
16. Remove the 4 bolts and the coolant pump pulley.



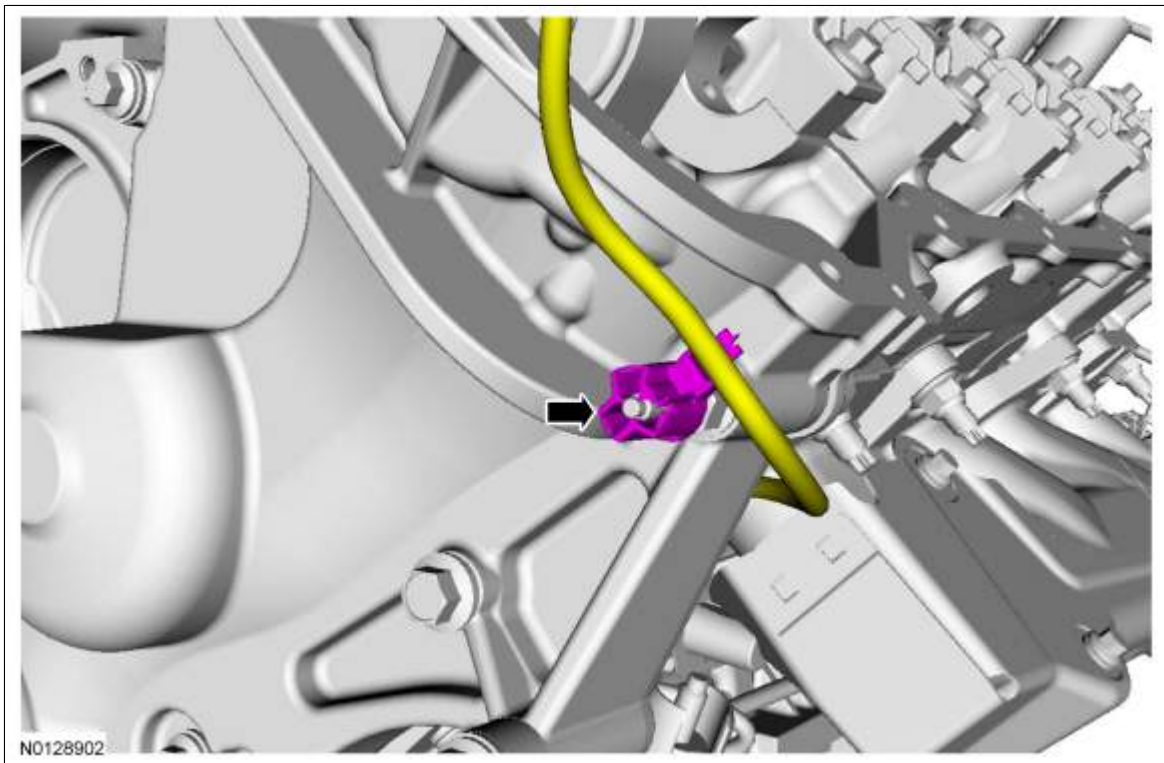
17. Remove the 4 bolts and the coolant pump.
- Remove and discard the O-ring seal.



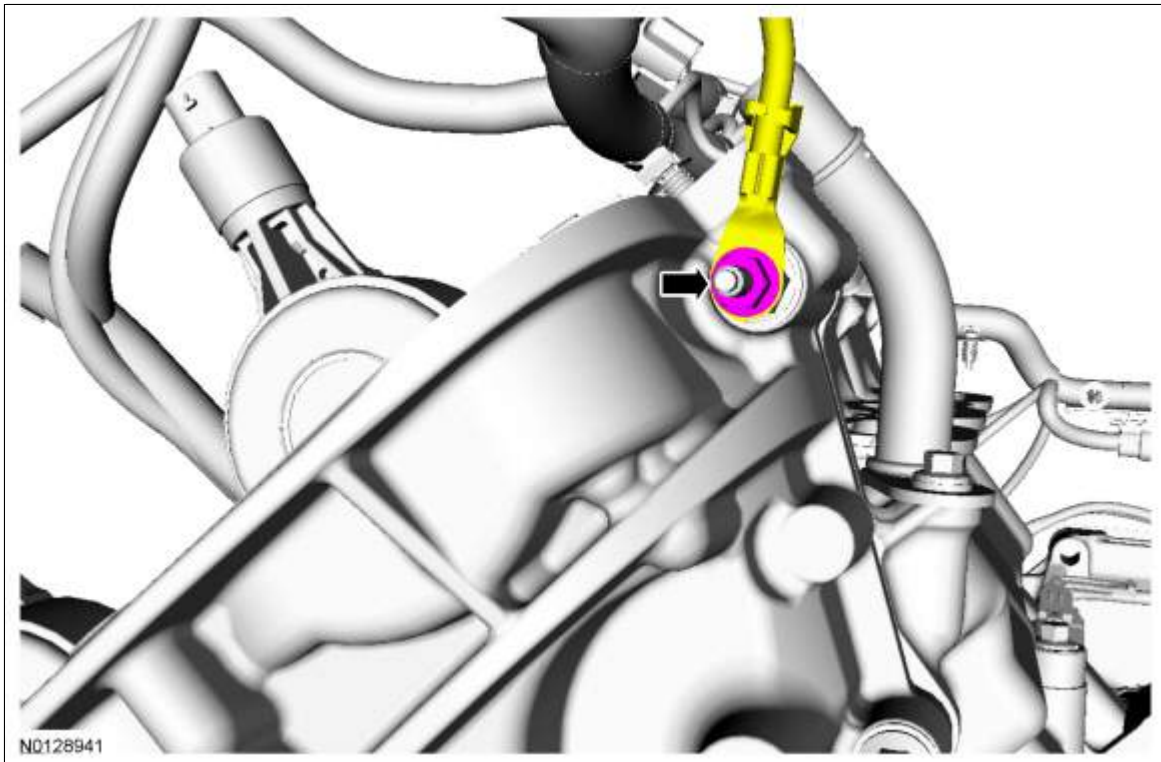
18. Remove the bolt and the accessory drive belt tensioner.



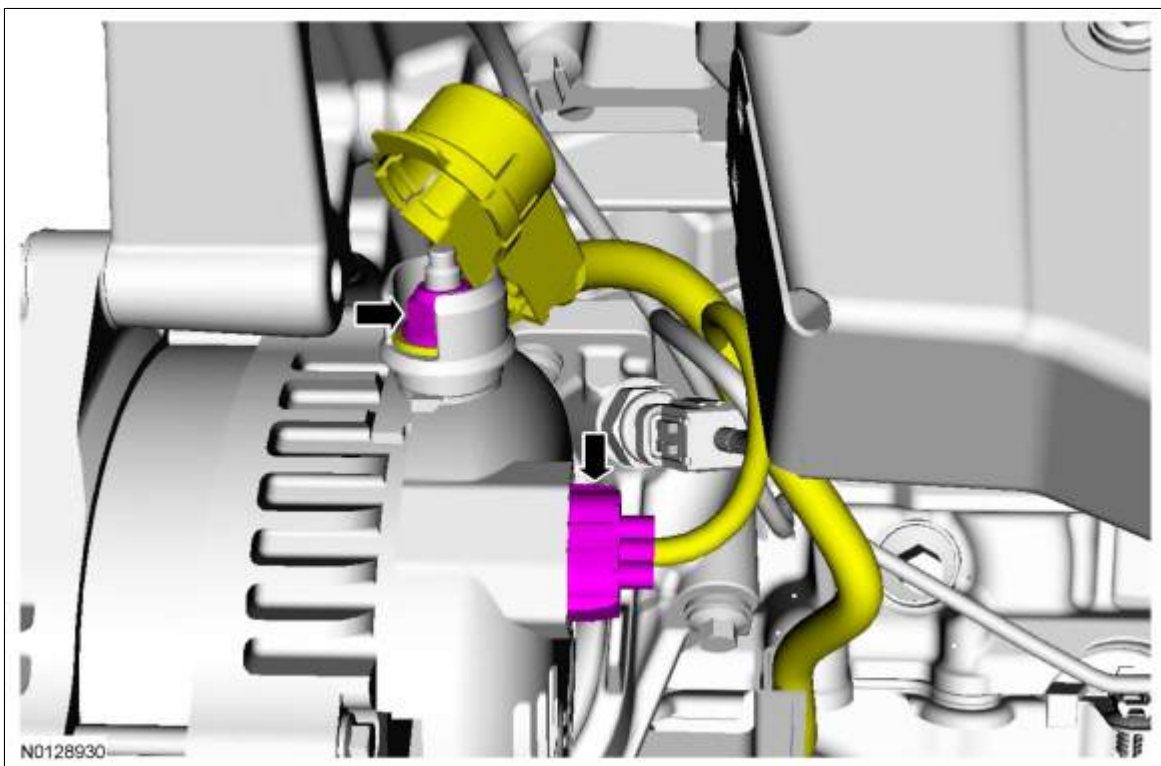
19. Detach the wiring harness retainer from the engine front cover stud bolt.



20. Remove the nut and the ground wire from the engine front cover stud bolt.



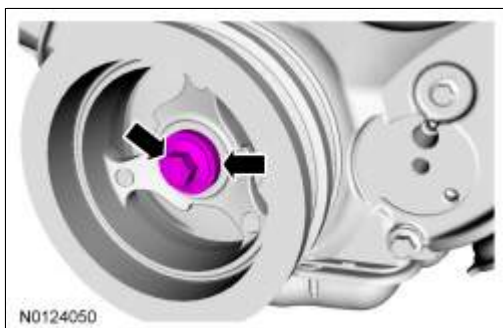
21. Remove the nut and the B+ wire from the generator.
- Disconnect the wiring harness connector from the generator.



22. Remove the 2 bolts and the generator.



23. Remove the crankshaft pulley bolt and washer.



24. Using the 3 Jaw Puller and the crankshaft pulley bolt, remove the crankshaft pulley.
- Discard the crankshaft pulley bolt.

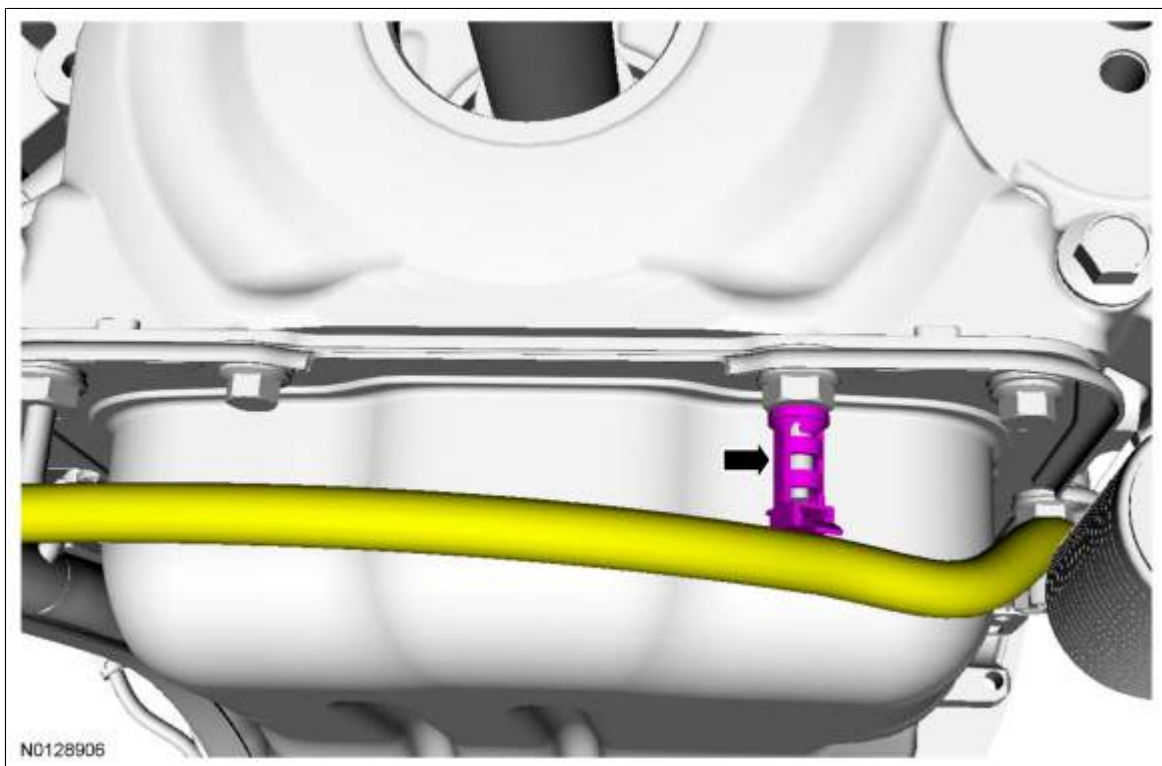


25. **NOTICE:** Use care not to damage the engine front cover or the crankshaft when removing the seal.

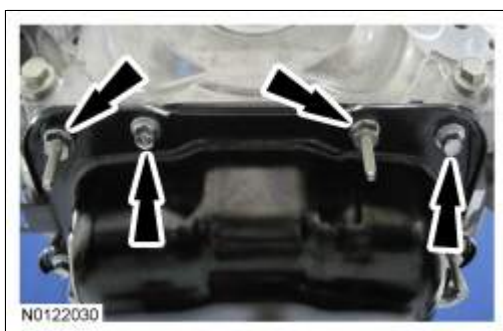
Using the Oil Seal Remover, remove the crankshaft front oil seal.



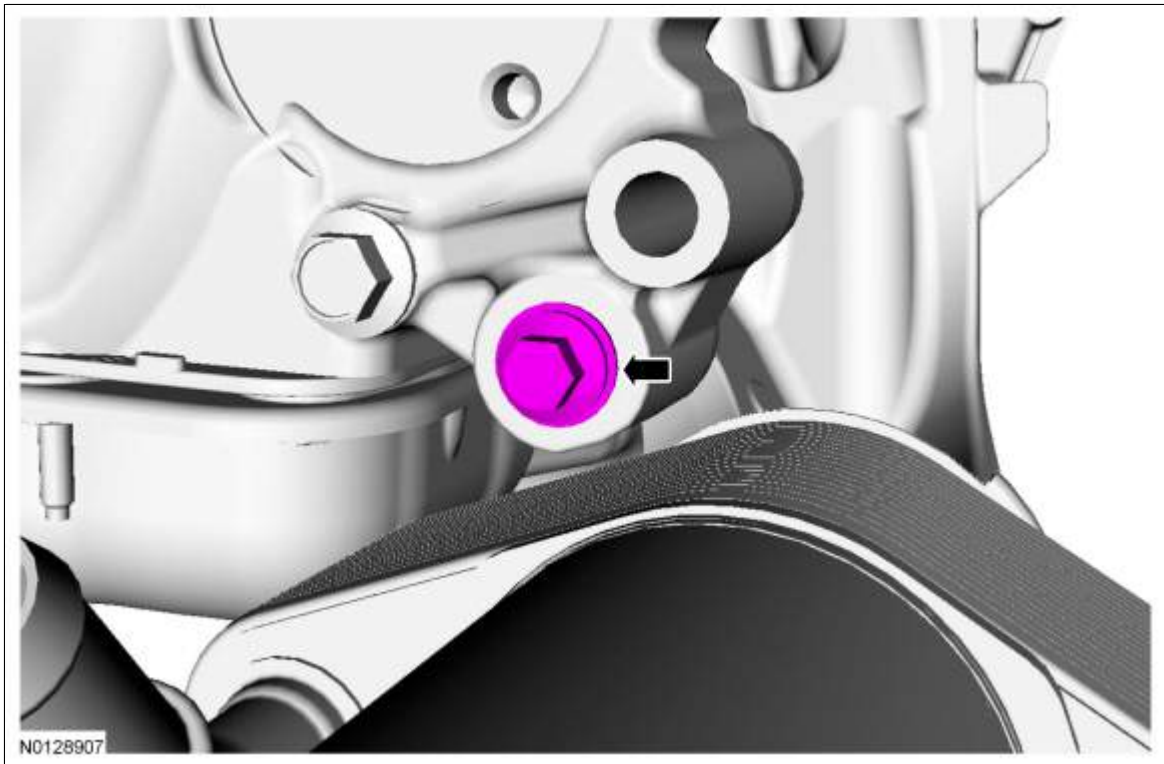
26. Detach the wiring harness retainer from the oil pan stud bolt.



27. Remove the 2 front oil pan stud bolts and 2 front oil pan bolts.



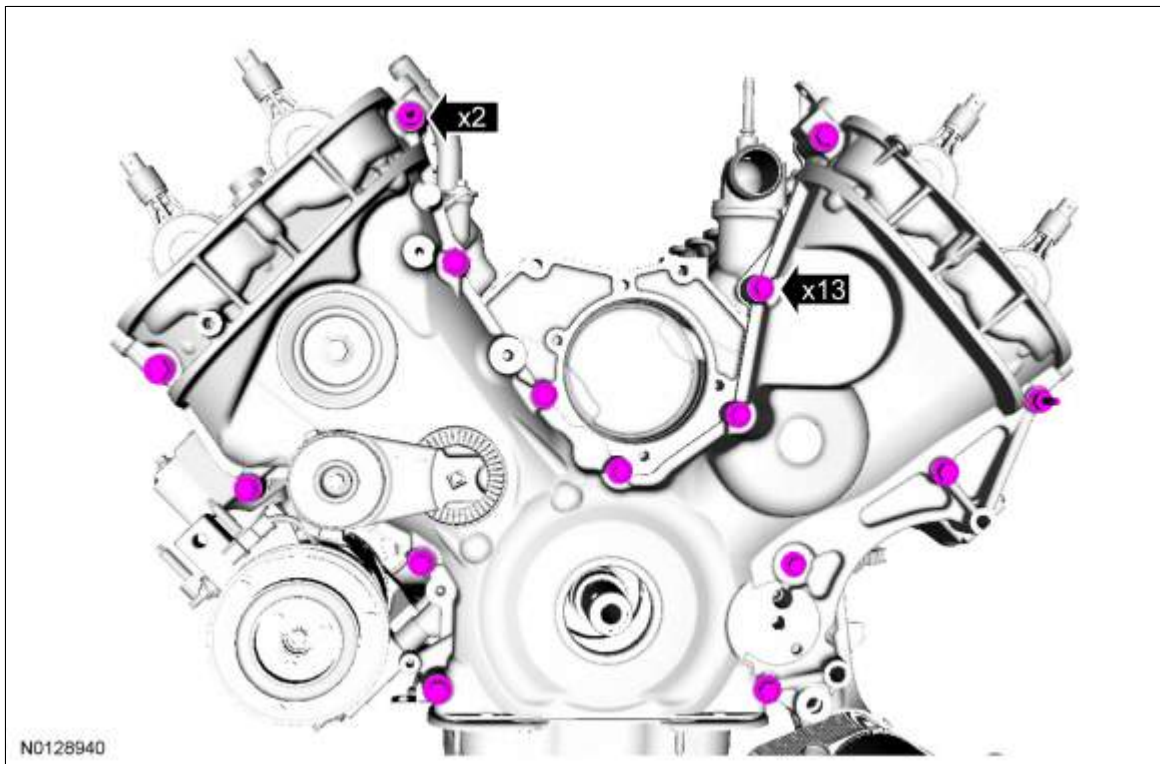
28. Remove the engine front cover-to-oil filter adapter bolt.



29. Using a 10 mm (0.393 in) Hex Bit loosen the engine front cover-to-oil filter adapter jack screw.



30. Remove the 13 engine front cover bolts and the 2 stud bolts.



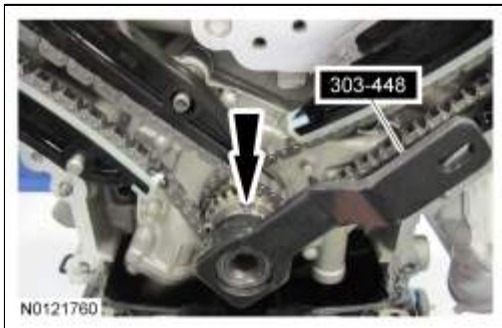
31. **NOTICE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

Remove the engine front cover.

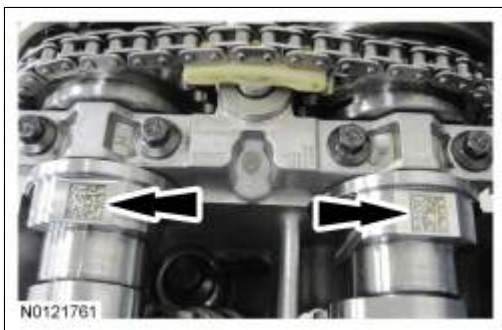
- Remove and discard the engine front cover gaskets.
- Clean the mating surfaces with silicone gasket remover and metal surface prep. Follow the directions on the packaging.
- Inspect the mating surfaces.



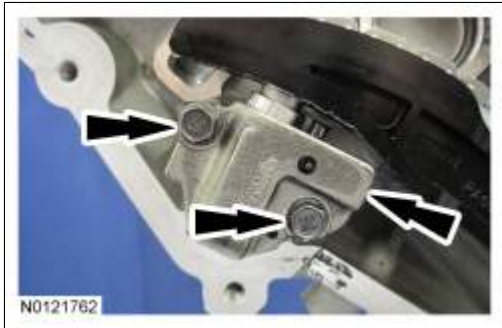
32. Using the crankshaft holding tool, rotate the crankshaft clockwise until the keyway is at the 12 o'clock position.



33. Verify the data matrix on the camshafts is facing up, if not, rotate the crankshaft clockwise one revolution.

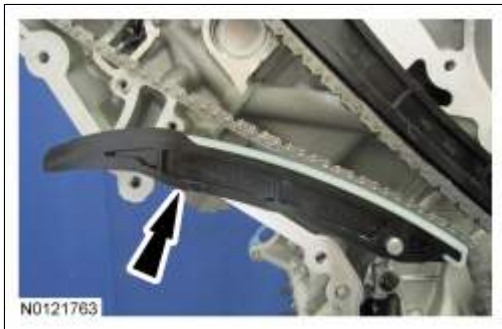


34. Remove the 2 bolts and the RH primary timing chain tensioner.



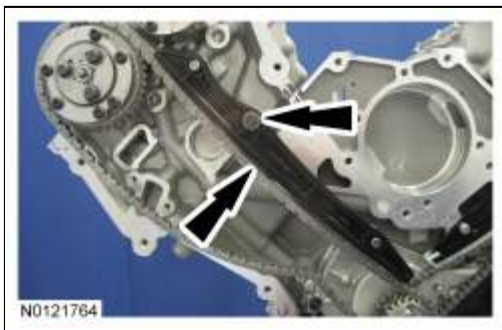
35. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain tensioner arm. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain tensioner arm.

Remove the RH timing chain tensioner arm.



36. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the RH timing chain guide. Return the crankshaft keyway to the 12 o'clock position after removing the RH timing chain guide.

Remove the bolt and the RH timing chain guide.



37. Remove the RH primary timing chain.

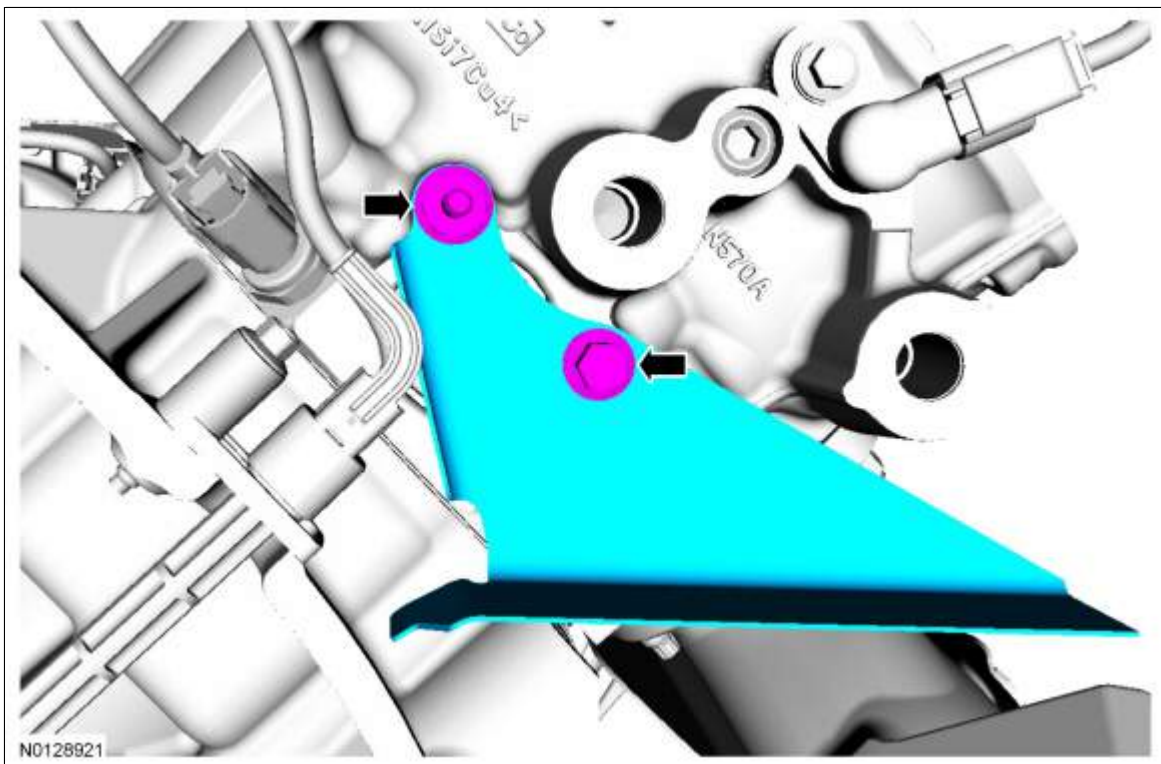


RH cylinder head

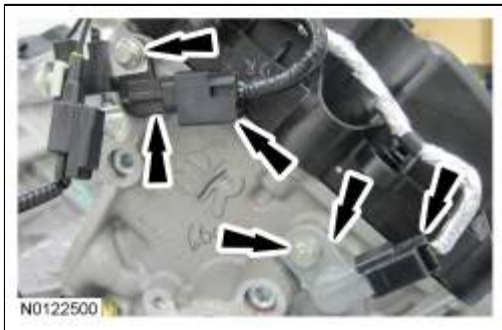
38. Remove the bolt and the coolant outlet pipe from the RH cylinder head.
- Remove and discard the O-ring seal.



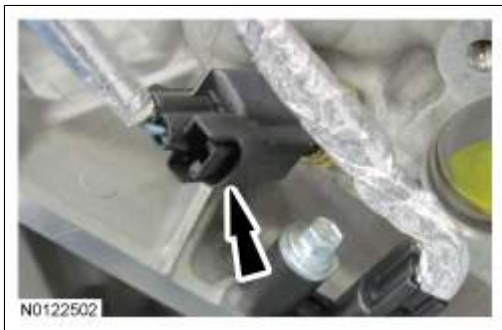
39. Remove the bolt, stud bolt and heat shield from the RH cylinder head.



40. Disconnect the RH intake and exhaust Camshaft Position (CMP) sensor electrical connectors.
- Remove the 2 bolts and the RH intake and exhaust CMP sensors.



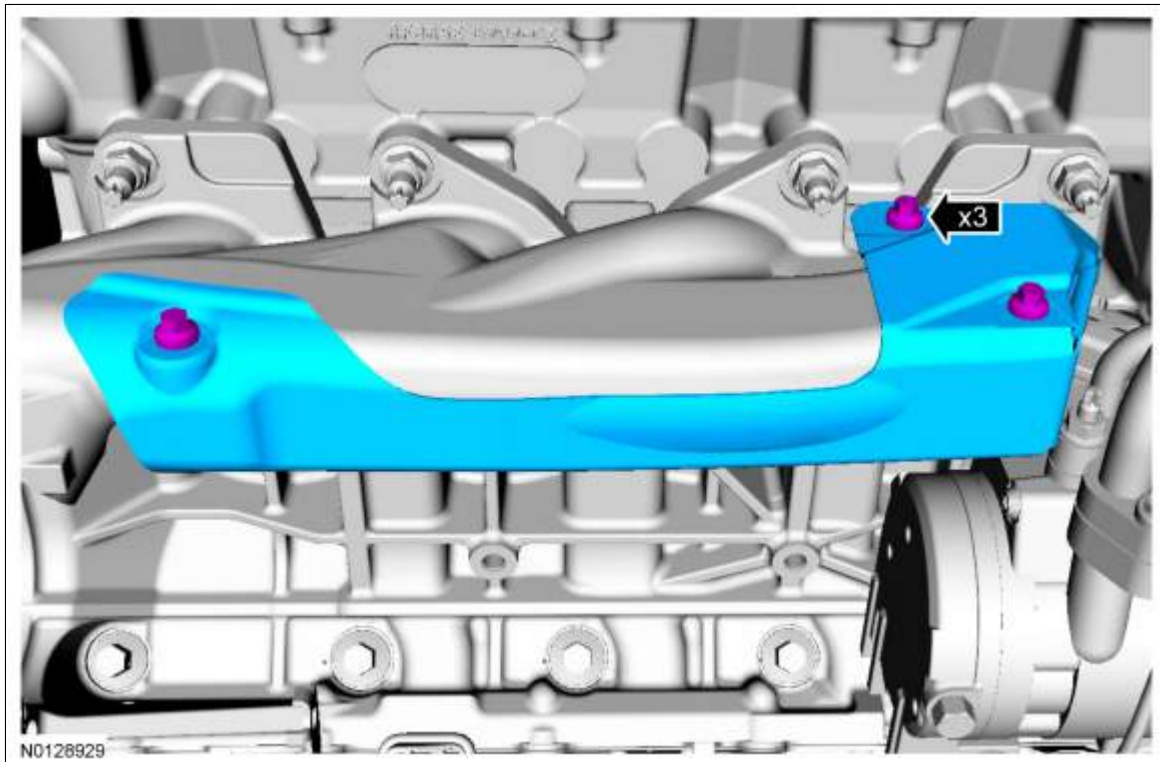
41. Disconnect the Cylinder Head Temperature (CHT) sensor electrical connector.



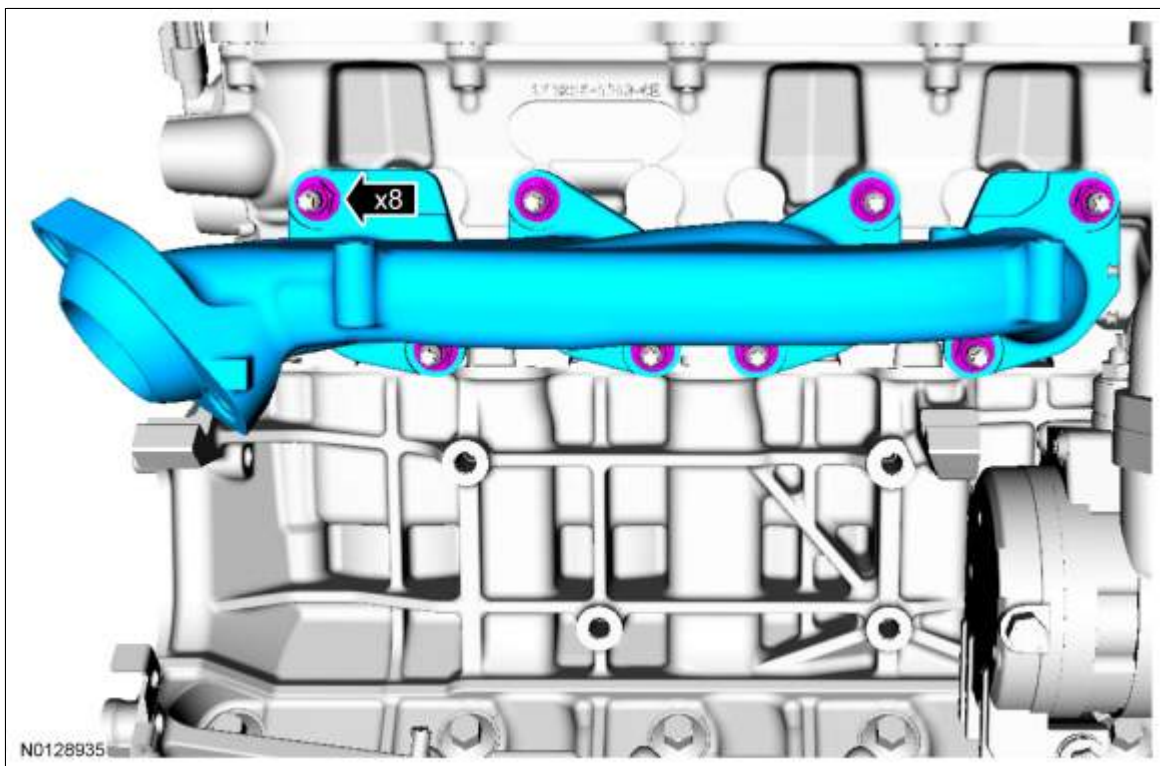
42. Remove the CHT sensor.



43. Remove the 3 bolts and the RH exhaust manifold heat shield.

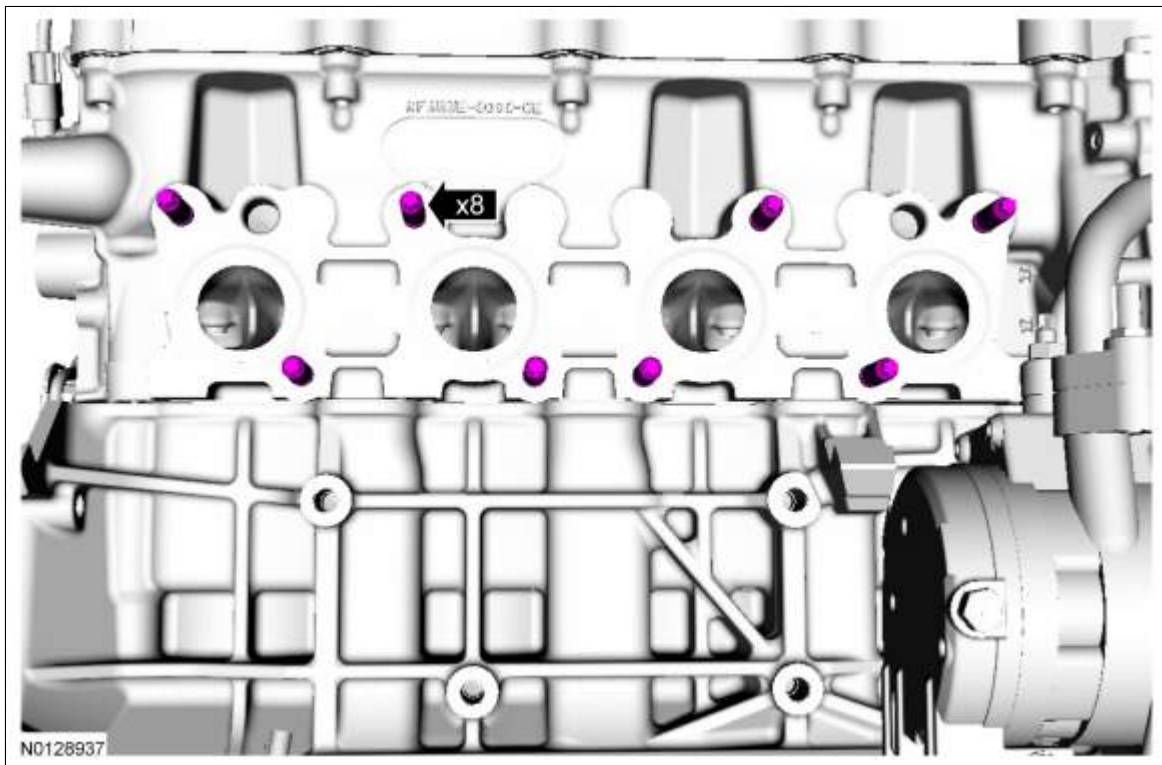


44. Remove the 8 nuts and the RH exhaust manifold.
- Discard the gasket.

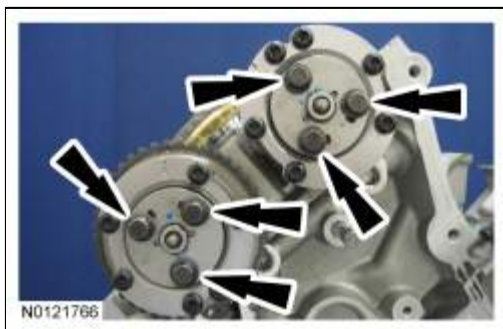


45. Clean and inspect the RH exhaust manifold. For additional information, refer to [Section 303-00](#).

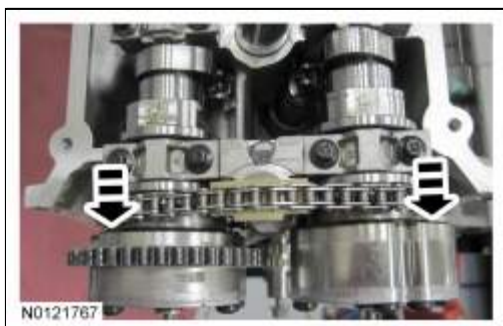
46. Remove and discard the 8 RH exhaust manifold studs.



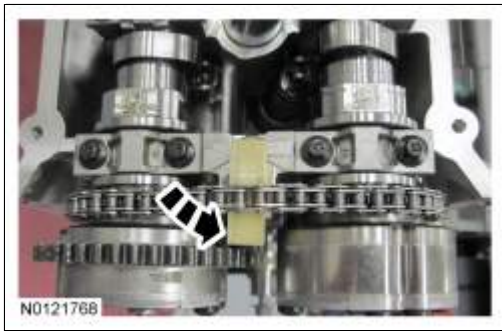
47. Remove the 3 RH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 RH exhaust VCT assembly bolts.



48. Slide the RH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



49. Depress the RH secondary timing chain tensioner and turn the tensioner 90 degrees.

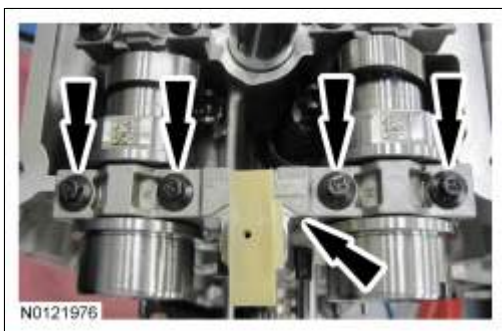


50. Remove the RH VCT assemblies and the RH secondary timing chain.

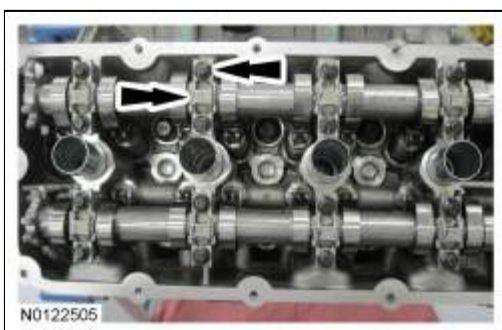


51. **NOTICE:** The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.

Remove the 4 bolts and the RH front camshaft bearing mega cap.



52. Remove the 16 bolts and the 8 camshaft bearing caps.

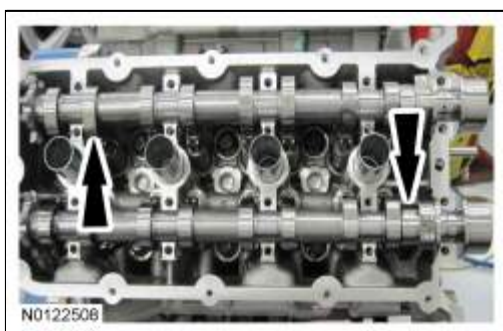


53. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

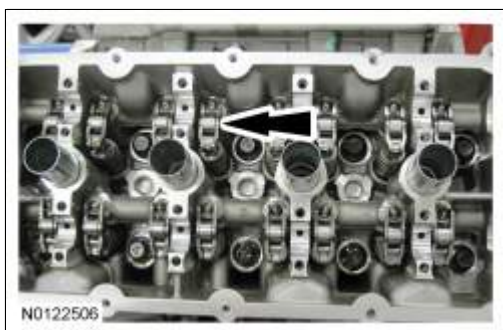
Remove the VCT system oil filter from the intake and exhaust camshafts.



54. Remove the RH intake and exhaust camshafts.



55. Remove the 16 camshaft roller follower and hydraulic lash adjuster assemblies.



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

NOTICE: Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.

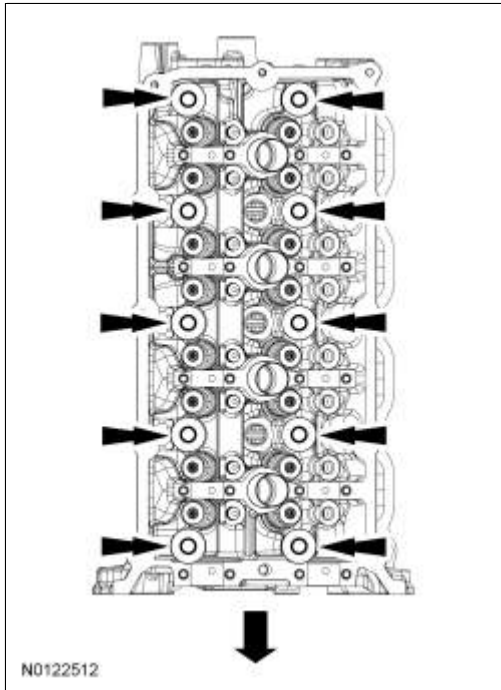
NOTICE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

NOTICE: 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.

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

Remove the 10 bolts and the RH cylinder head.

- Discard the bolts and the cylinder head gasket.



57. **NOTICE:** 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 notices 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.

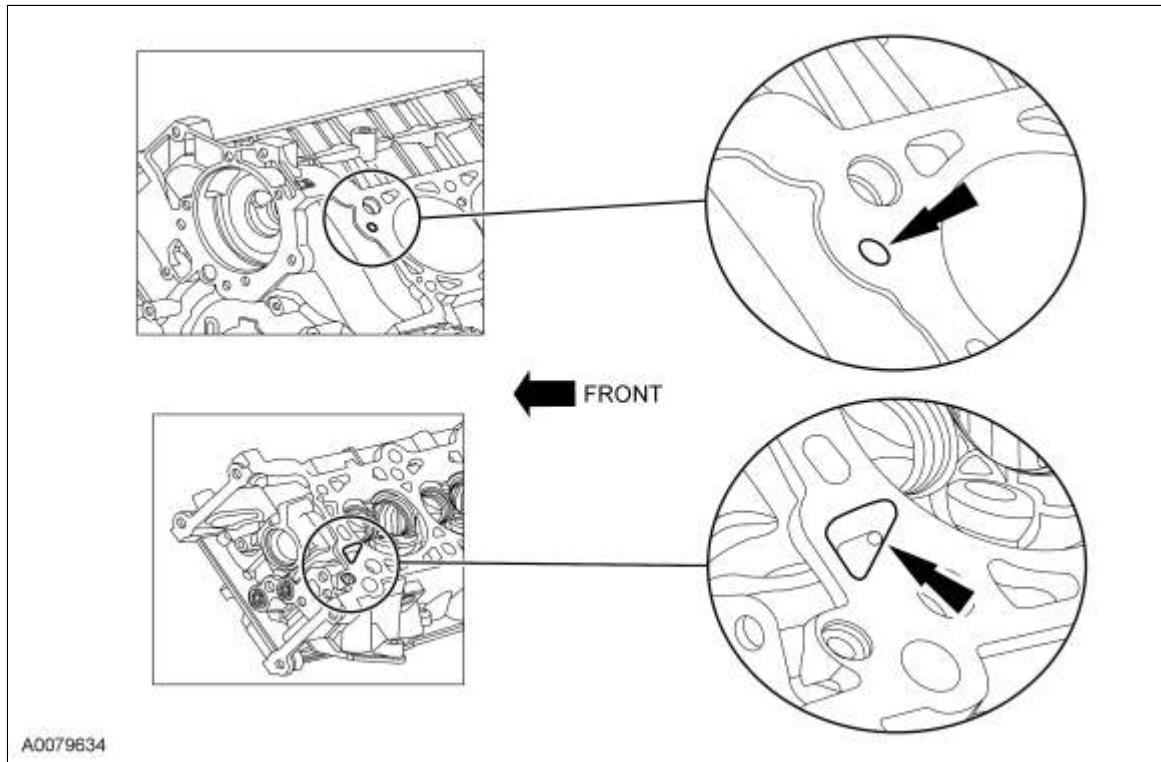
Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder head and the cylinder block in the following sequence.

1. Remove any large deposits of silicone or gasket material with a plastic scraper.
2. Apply silicone gasket remover, following package directions and allow to set for several minutes.
3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

58. **NOTE:** Make sure all cylinder head surfaces are clear of any gasket material, RTV, oil and coolant. The cylinder head surface must be clean and dry before running a flatness check.

NOTE: Use a straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot length. For example, if the straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion, paying particular attention to the oil pressure feed area. For additional information, refer to [Section 303-00](#).

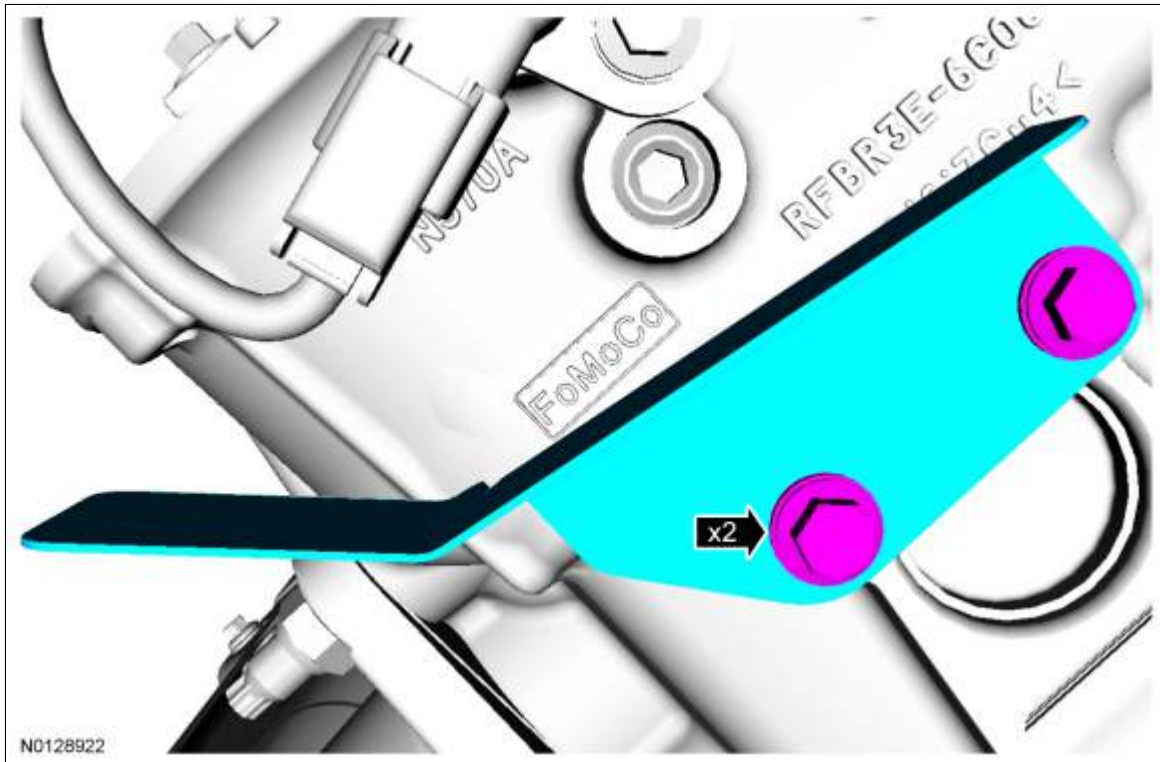


LH cylinder head

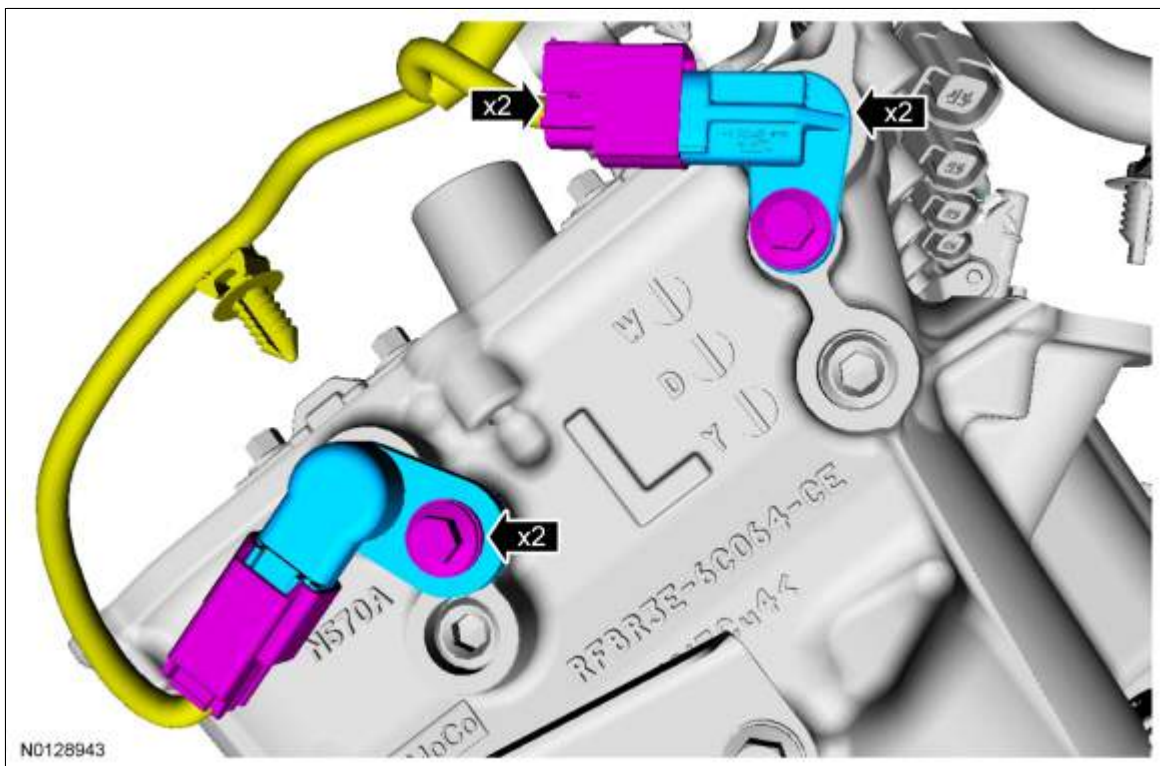
59. Remove the 2 bolts and the coolant outlet from the LH cylinder head.
- Remove and discard the gasket.



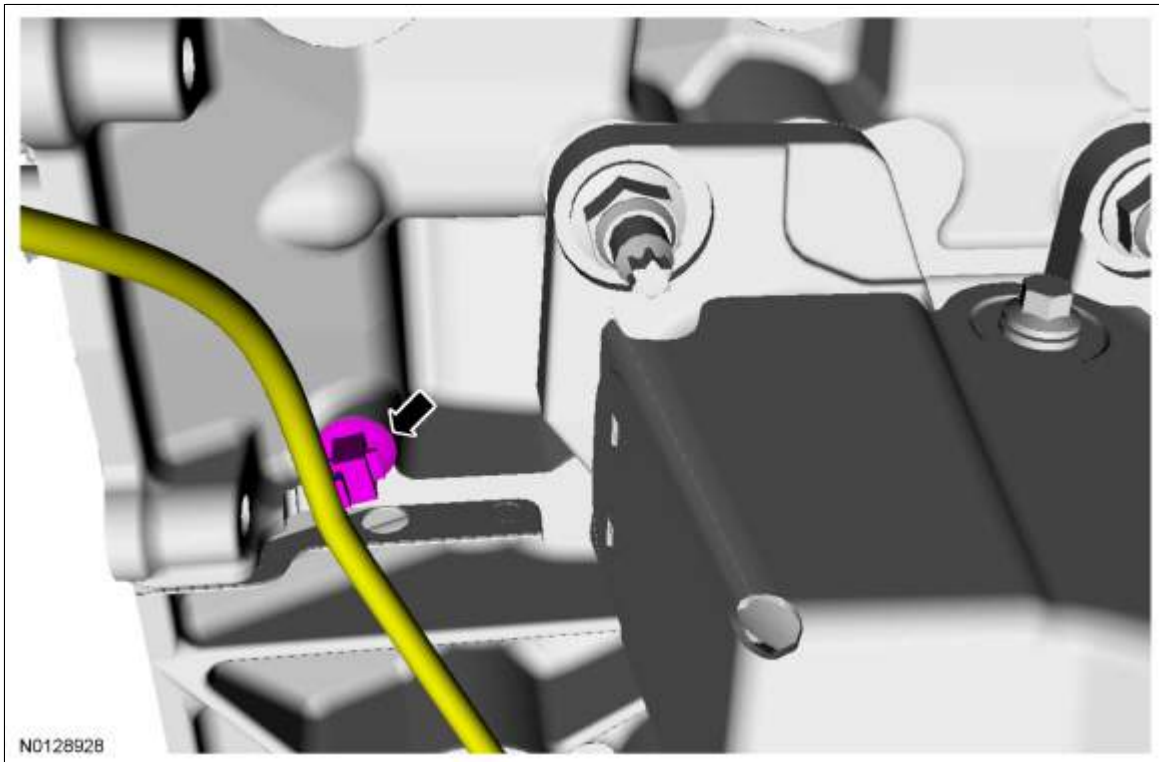
60. Remove the 2 bolts and the heat shield from the LH cylinder head.



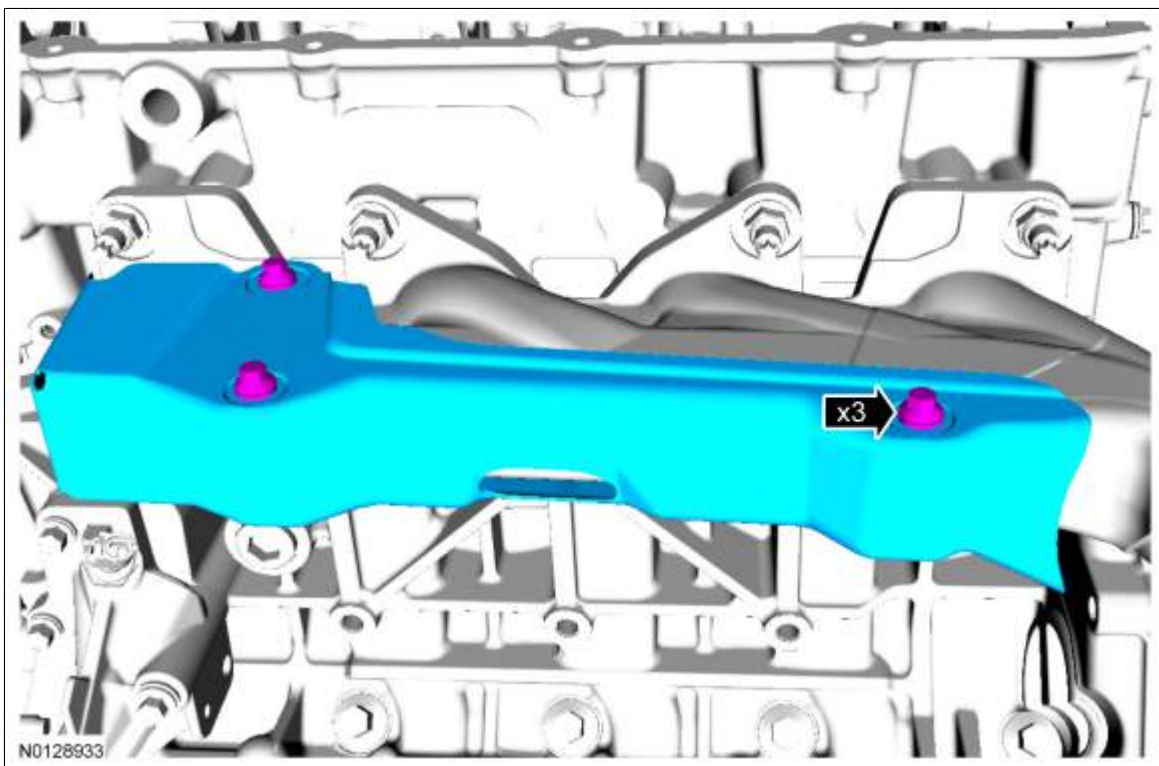
61. Disconnect the LH intake and exhaust Camshaft Position (CMP) sensor electrical connectors.
- Remove the 2 bolts and the LH intake and exhaust CMP sensors.



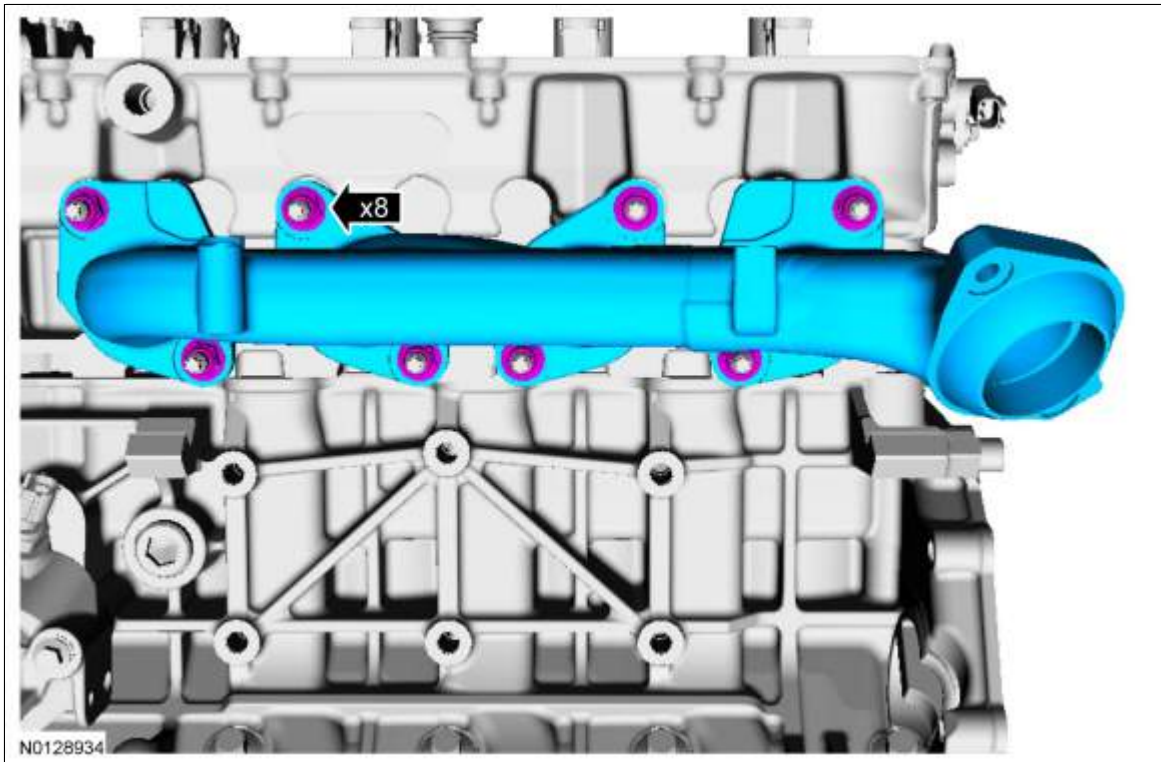
62. Detach the wiring harness retainer from the LH cylinder head.



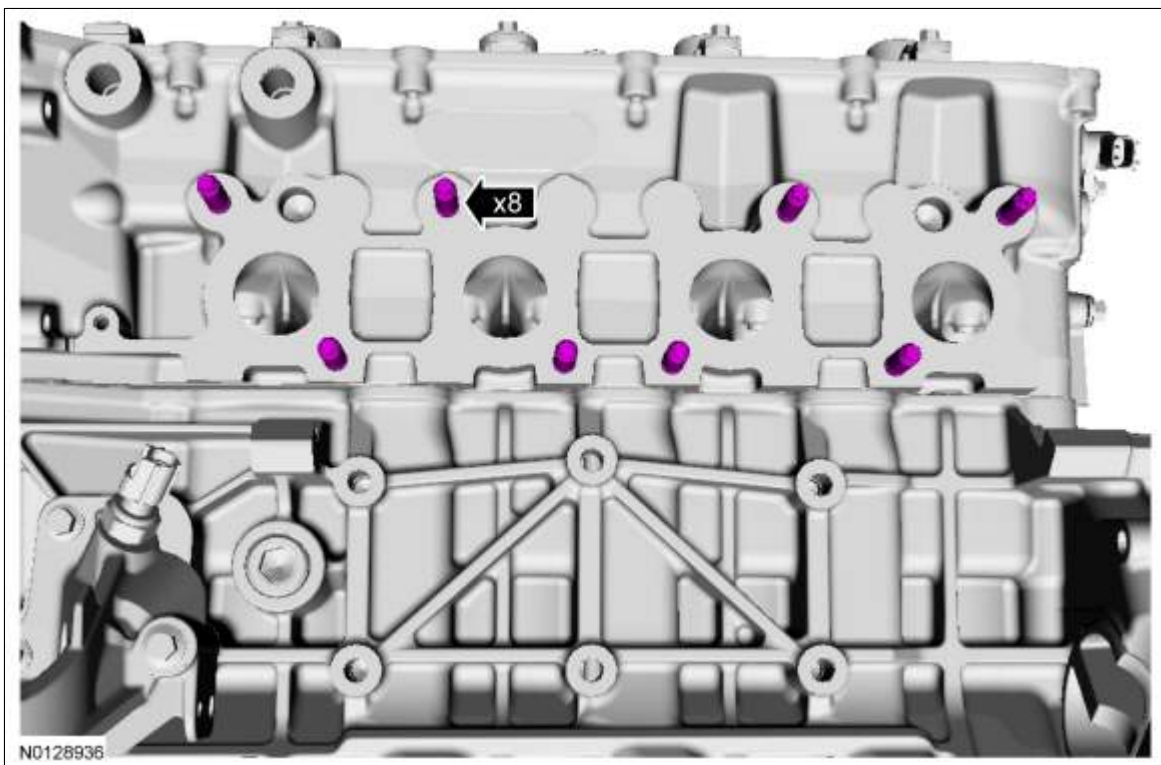
63. Remove the 3 bolts and the LH exhaust manifold heat shield.



64. Remove the 8 nuts and the LH exhaust manifold.
- Discard the gasket.



65. Clean and inspect the LH exhaust manifold. For additional information, refer to [Section 303-00](#).
66. Remove and discard the 8 LH exhaust manifold studs.

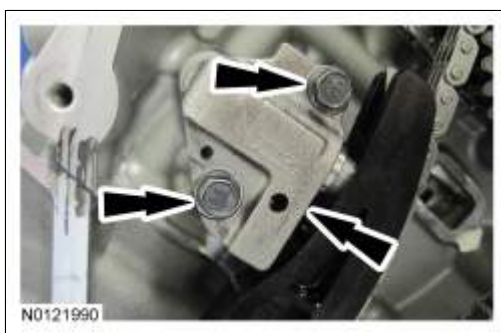


67. Using the crankshaft holding tool, rotate the crankshaft counterclockwise until the crankshaft keyway

is at the 9 o'clock position.



68. Remove the 2 bolts and the LH primary timing chain tensioner.



69. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain tensioner arm. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain tensioner arm.

Remove the LH timing chain tensioner arm.



70. **NOTE:** It may be necessary to rotate the crankshaft slightly to provide enough slack in the chain to remove the LH timing chain guide. Return the crankshaft keyway to the 9 o'clock position after removing the LH timing chain guide.

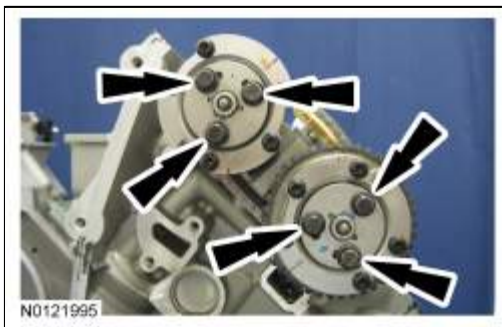
Remove the bolt and the LH timing chain guide.



71. Remove the LH primary timing chain.



72. Remove the 3 LH intake Variable Camshaft Timing (VCT) assembly bolts and the 3 LH exhaust VCT assembly bolts.



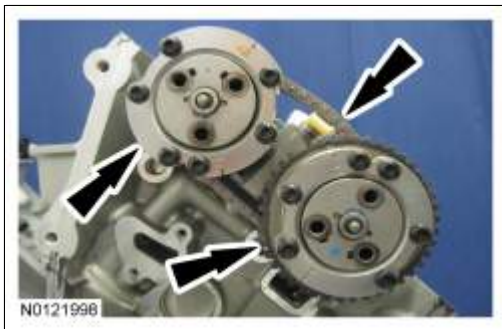
73. Slide the LH VCT assemblies and secondary timing chain forward 2 mm (0.078 in).



74. Depress the LH secondary timing chain tensioner and turn the tensioner 90 degrees.

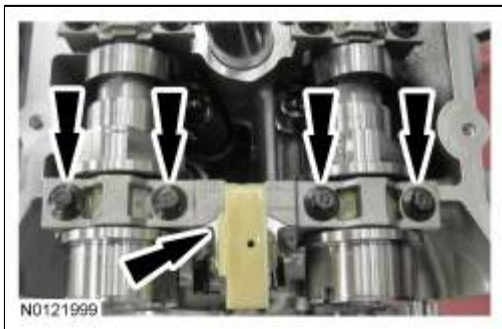


75. Remove the LH VCT assemblies and the LH secondary timing chain.

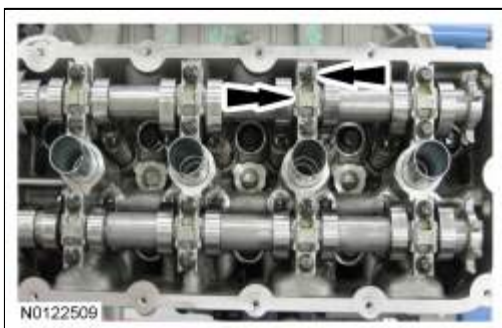


76. **NOTICE:** The front camshaft bearing mega cap must be removed first and then the remaining camshaft bearing caps. Failure to follow this direction may result in damage to the engine.

Remove the 4 bolts and the LH front camshaft bearing mega cap.



77. Remove the 16 bolts and the 8 camshaft bearing caps.

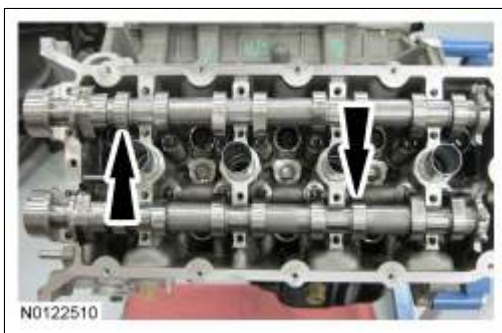


78. **NOTE:** Intake camshaft shown, exhaust camshaft similar.

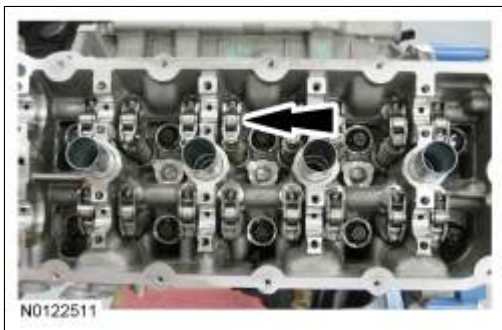
Remove the VCT system oil filter from the intake and exhaust camshafts.



79. Remove the LH intake and exhaust camshafts.



80. Remove the 16 camshaft roller follower and hydraulic lash adjuster assemblies.



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

NOTICE: Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine.

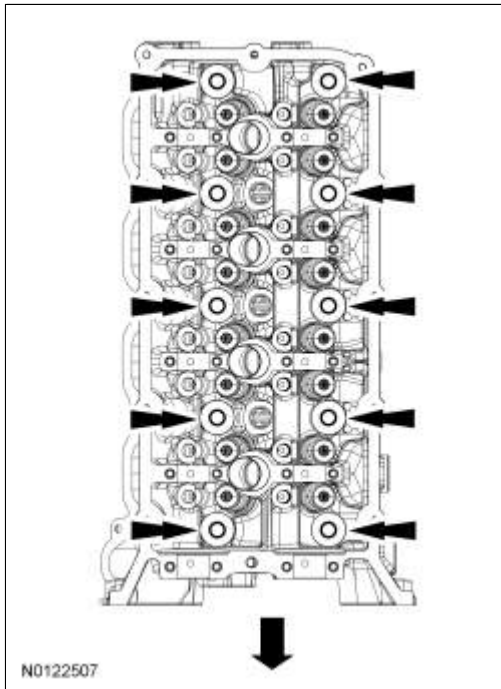
NOTICE: The cylinder head bolts must be discarded and new bolts must be installed. They are a tighten-to-yield design and cannot be reused.

NOTICE: 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.

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

Remove the 10 bolts and the LH cylinder head.

- Discard the bolts and the cylinder head gasket.



82. **NOTICE:** 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 notices 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.

Clean the cylinder head-to-cylinder block mating surfaces of both the cylinder head and the cylinder block in the following sequence.

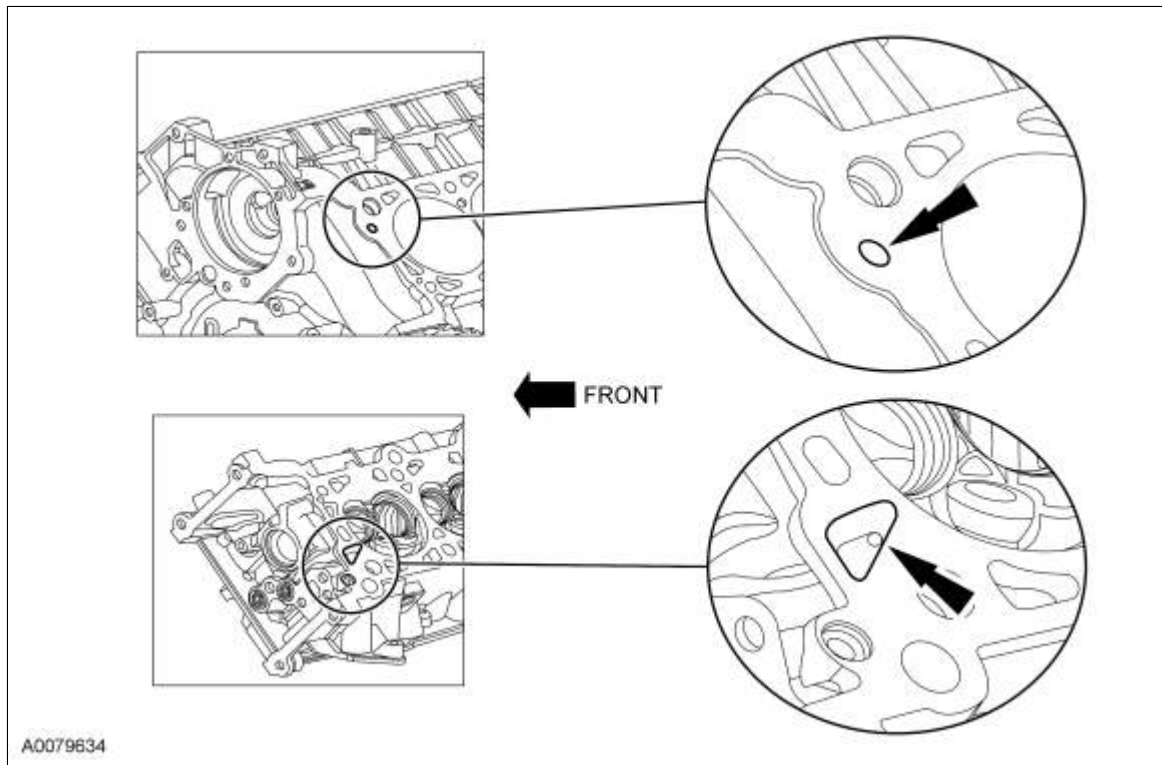
1. Remove any large deposits of silicone or gasket material with a plastic scraper.
2. Apply silicone gasket remover, following package directions and allow to set for several minutes.
3. Remove the silicone gasket remover with a plastic scraper. A second application of silicone gasket remover may be required if residual traces of silicone or gasket material remain.
4. Apply metal surface prep, following package directions, to remove any remaining traces of oil or coolant and to prepare the surfaces to bond with the new gasket. Do not attempt to make the metal shiny. Some staining of the metal surfaces is normal.

83. **NOTE:** Make sure all cylinder head surfaces are clear of any gasket material, RTV, oil and coolant. The cylinder head surface must be clean and dry before running a flatness check.

NOTE: Use a straightedge that is calibrated by the manufacturer to be flat within 0.005 mm (0.0002 in) per running foot length. For example, if the straightedge is 61 cm (24 in) long, the machined edge must be flat within 0.010 mm (0.0004 in) from end to end.

Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion, paying particular attention to the oil pressure feed area.

For additional information, refer to [Section 303-00](#).






SECTION 303-01C: Engine — 5.0L (4V)
REMOVAL


2014 F-150 Workshop Manual
Procedure revision date: 10/25/2013

Engine

Special Tool(s)

 ST1341-A	2,200# Floor Crane, Fold Away 300-OTC1819E
 ST1377-A	Lifting Bracket, Engine 303-F047 (014-00073)

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

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

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to [Section 100-02](#).
2. **NOTE:** Index-mark the hood hinge location to aid in hood installation.

NOTE: RH shown, LH similar.

Remove the 4 bolts (2 shown) and the hood.

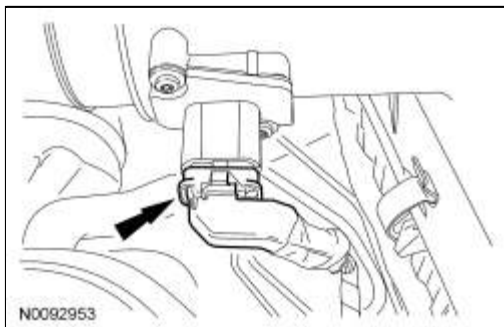


3. Release the fuel system pressure. For additional information, refer to [Section 310-00](#).

4. Disconnect the battery ground cable. For additional information, refer to [Section 414-01](#).
5. **NOTICE:** If the engine is repaired or replaced because of upper engine failure, typically including valve or piston damage, check the intake manifold for metal debris. If metal debris is found, install a new intake manifold. Failure to follow these instructions can result in engine damage.

Remove the intake manifold. For additional information, refer to [Intake Manifold](#) in this section.

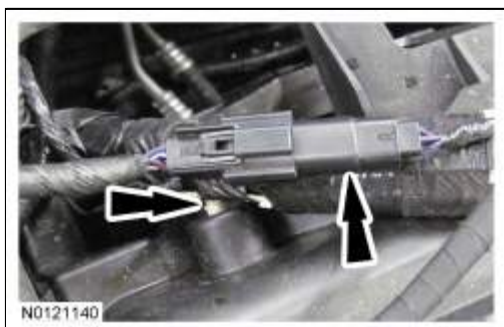
6. Disconnect the Mass Air Flow (MAF) sensor electrical connector.



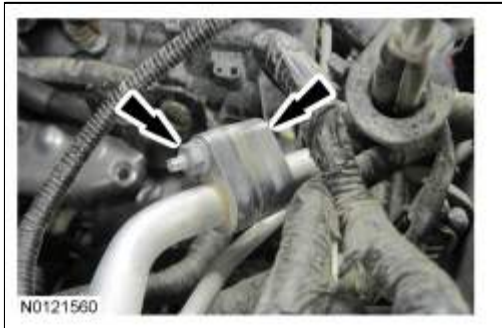
7. Remove the Air Cleaner (ACL) upper tray and the ACL element. For additional information, refer to [Section 303-12](#).
8. Remove the cooling module. For additional information, refer to [Section 303-03](#).
9. Disconnect the A/C pressure transducer electrical connector.



10. Disconnect the wiring harness electrical connector and pin-type retainer.
 - Position the Power Distribution Box (PDB) and wiring harness aside.



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



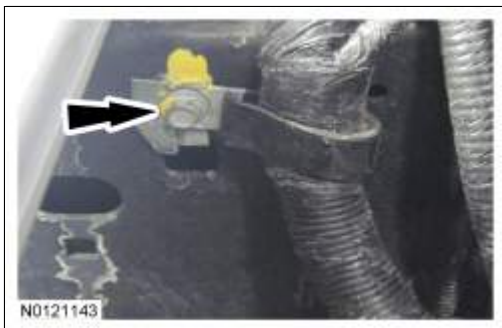
12. Remove the nut and the transmission cooler line bracket from the engine front cover stud bolt.



13. Remove the bolt and the ground wire from the RH frame rail.



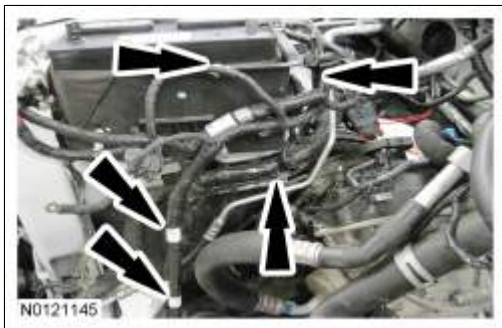
14. Remove the bolt and the wiring harness bracket from the RH frame rail.



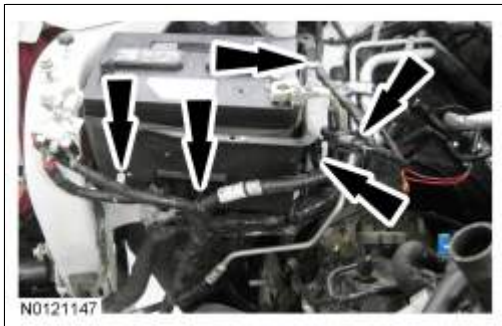
15. Remove the nut and disconnect the B+ wire.
 - Detach the wiring harness retainer from the battery tray.



16. Detach the 5 wiring harness retainers.



17. Disconnect the 2 wiring harness connectors and detach the 3 wiring harness retainers.



18. Disconnect the middle PCM electrical connector.



19. Detach and disconnect the engine harness electrical connector.



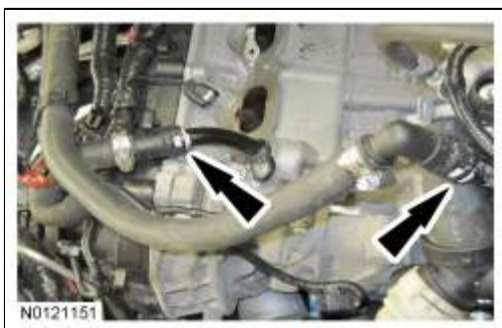
20. Detach the PCM wiring harness retainer from the valve cover bolt stud.



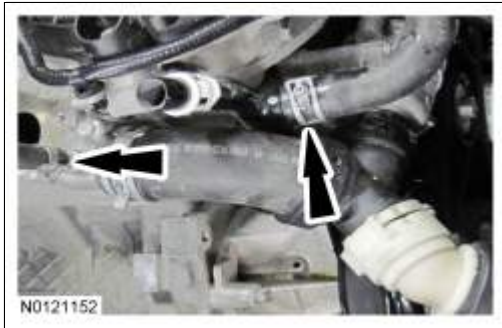
21. Remove the bolt and the ground strap from the cowl.



22. Disconnect the 2 heater hose quick connect couplings. For additional information, refer to [Section 412-00](#).



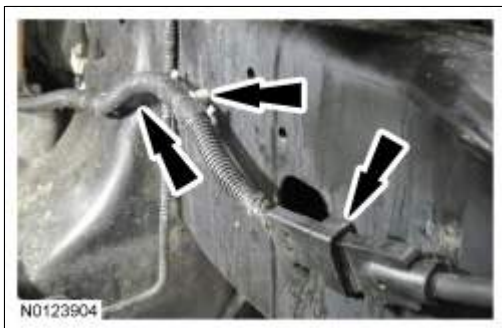
23. Disconnect the 2 coolant hoses and position aside.



24. Remove the spring clip, the clamp and disconnect the coolant bypass T assembly from the engine.



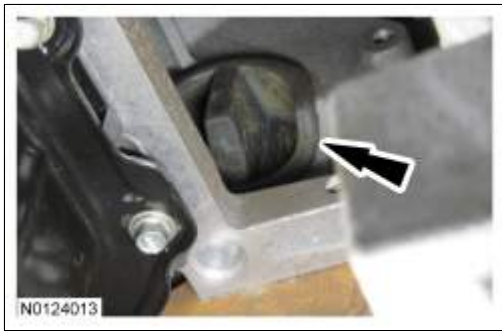
25. If equipped, disconnect the block heater electrical connector and the 2 wiring harness retainers.



26. If equipped, remove the front driveshaft. For additional information, refer to [Section 205-01](#).
27. Remove the starter. For additional information, refer to [Section 303-06](#).
28. Remove the 2 bolts and the flexplate inspection cover.



29. Remove the cylinder block opening cover.



30. **NOTE:** Index-mark the end of one torque converter stud and the flexplate for installation.

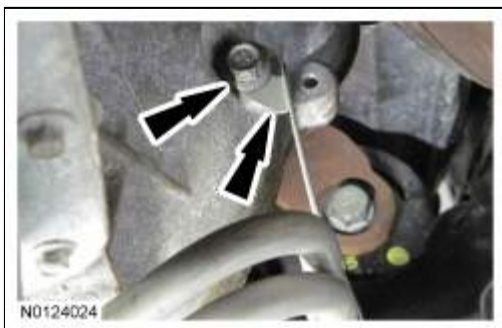
Remove the 4 torque converter-to-flexplate nuts.

- Discard the nuts.

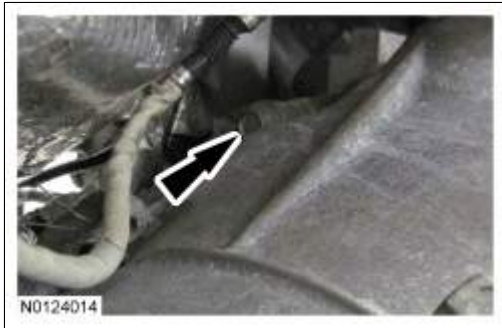


31. **NOTE:** The 2 upper transmission-to-engine bolts will be removed later.

Remove the transmission-to-engine bolt and transmission cooler tube support bracket.



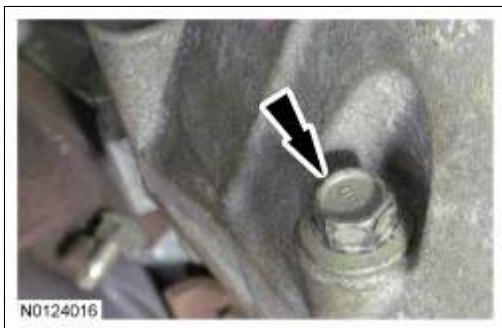
32. Remove the lower transmission-to-engine bolt.



33. Remove the 2 lower transmission-to-engine bolts.



34. Remove the lower transmission-to-engine bolt.



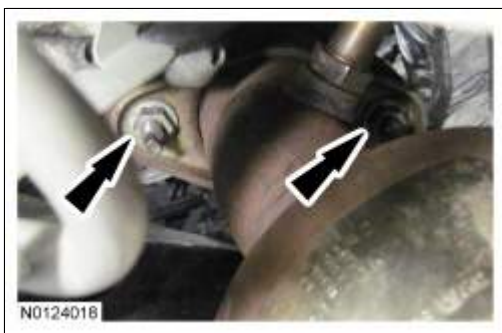
35. Remove the drain plug and drain the engine oil.
- Install the drain plug and tighten to 26 Nm (19 lb-ft).
36. Remove and discard the engine oil filter.



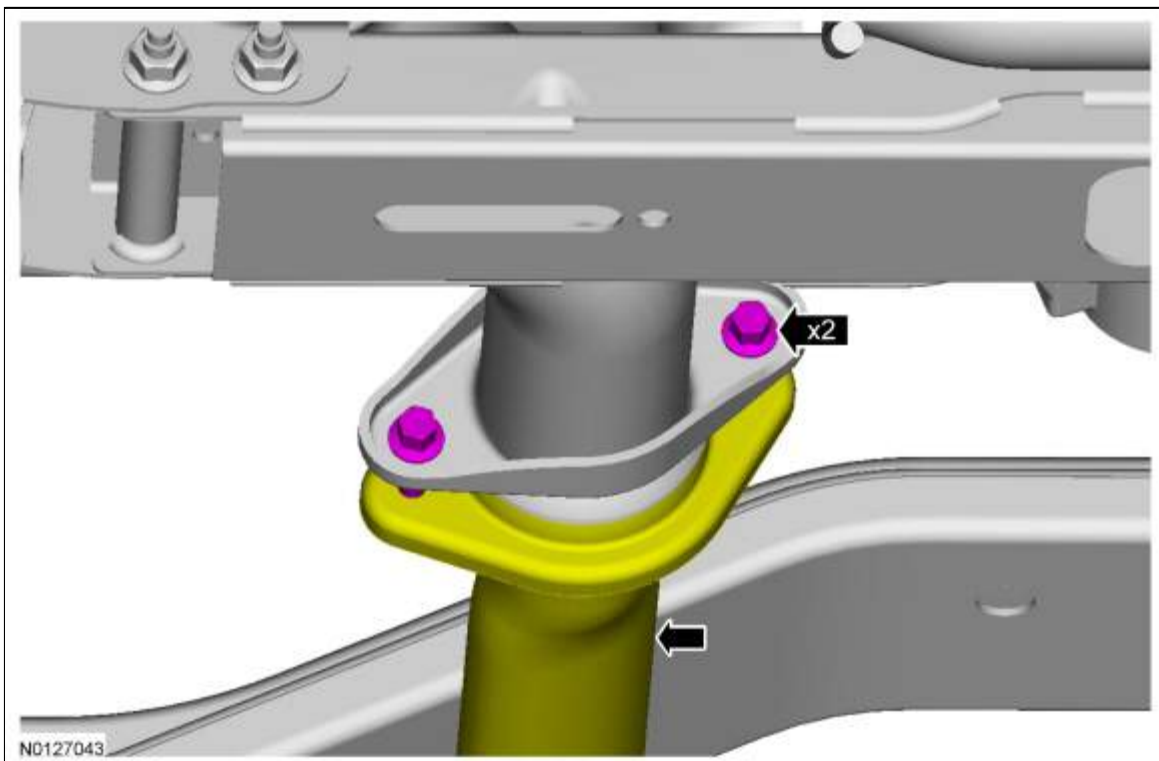
37. Remove and discard the 2 LH catalytic converter-to-exhaust manifold nuts.



38. Remove and discard the RH catalytic converter-to-exhaust manifold nut.



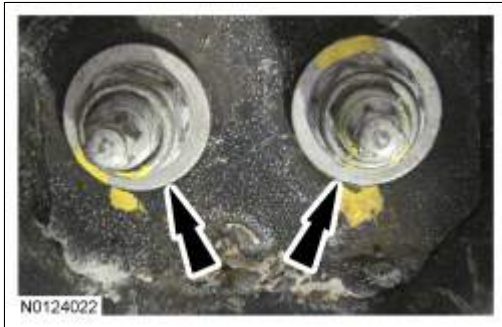
39. Remove the 2 exhaust Y-pipe dual catalytic converter-to-exhaust intermediate pipe bolts and separate.
- Discard the 2 bolts.



40. **NOTICE:** Only use hand tools when removing the engine support insulator nuts or the engine support insulator may be damaged.

NOTE: If during nut removal the stud is extracted from the engine support insulator, separate the nut from the stud prior to installing the stud.

Remove the 2 RH engine support insulator nuts.



41. **NOTICE:** Only use hand tools when removing the engine support insulator stud or the engine support insulator may be damaged.

Remove the 2 RH engine support insulator studs.



42. **NOTICE:** Only use hand tools when loosening the engine support insulator through bolt or the engine support insulator may be damaged.

Remove the LH engine support insulator bolt.



43. Loosen the 2 transmission mount-to-crossmember nuts.



44. Disconnect the oil level sensor electrical connector.



45. Disconnect the quick connect coupling and remove the crankcase ventilation tube. For additional information, refer to [Section 310-00](#).

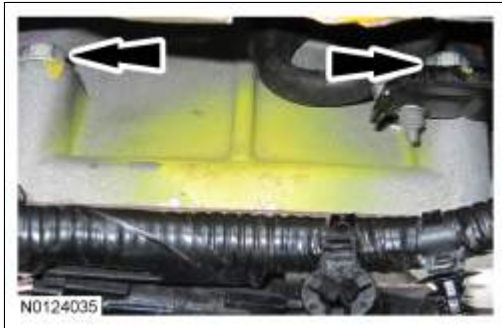


46. **NOTICE:** Do not support the transmission by the fluid pan, failure to follow this instruction may result in serious damage to the transmission.

Support the bellhousing of the transmission with a suitable floor jack and a block of wood.

47. **NOTE:** On Four-Wheel Drive (4WD) vehicles, it may be necessary to reposition the transfer case vent hose to access the bolts.

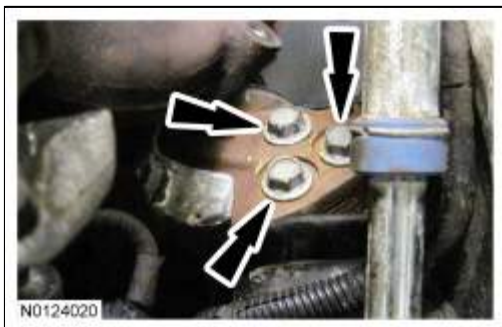
Remove the upper 2 transmission-to-engine bolts.



48. Install the Engine Lifting Bracket.



49. Using the Heavy Duty Floor Crane and the Engine Lifting Bracket, raise the engine assembly to gain access to the 3 LH engine support insulator bolts.



50. Remove the LH engine support insulator from under the vehicle.



51. Using the Heavy Duty Floor Crane and the Engine Lifting Bracket, remove the engine assembly from the vehicle.

