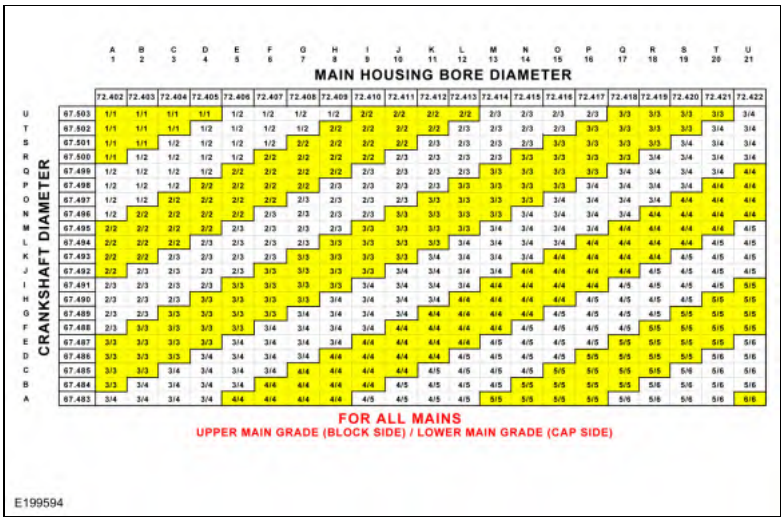
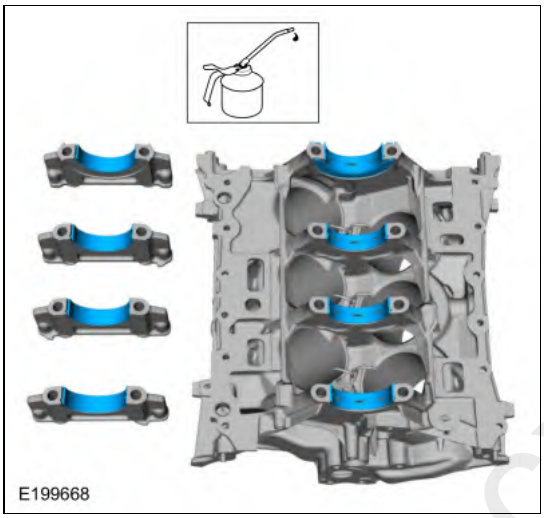
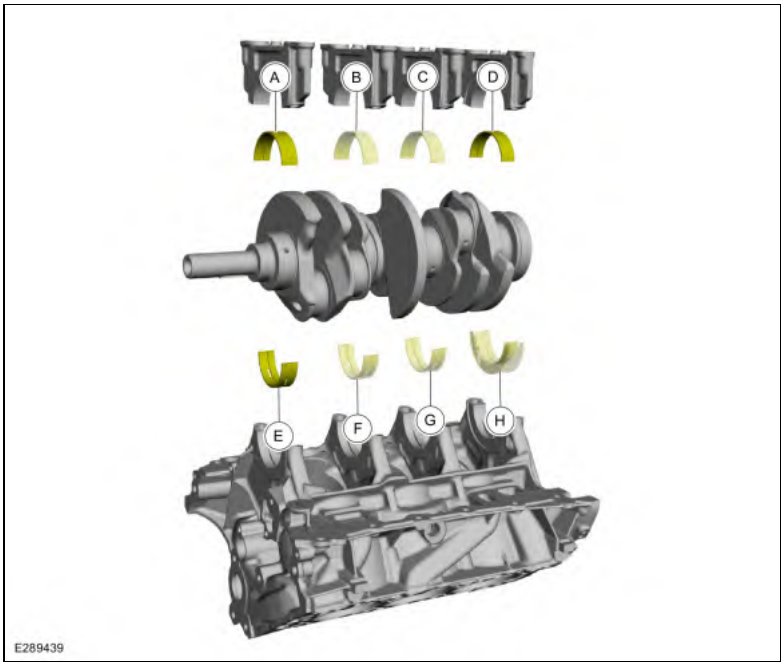
No. 3 should be assembled with grade 3 upper and grade 4 lower bearings. Main No. 4 should be assembled with grade 2 upper and lower bearings.



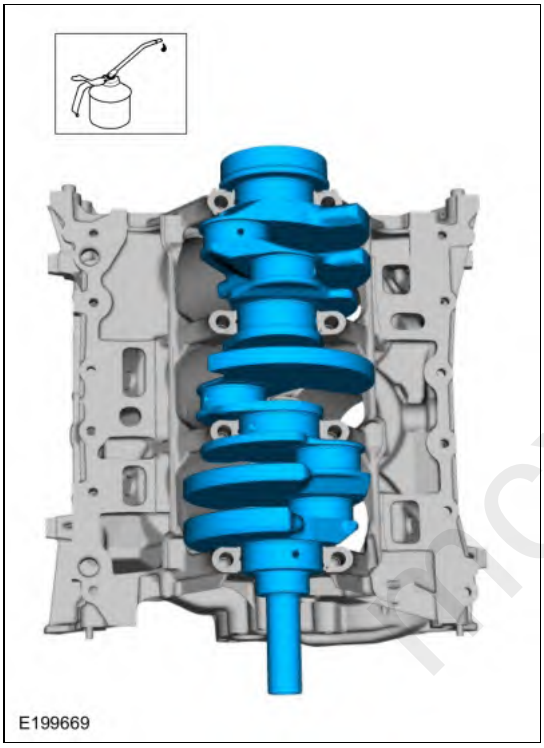
5. Install the crankshaft main bearings.
   - Install the crankshaft upper main bearings and thrust bearing into the cylinder block.
   - Install the crankshaft lower main bearings into the bearing caps.
   - Make sure all oil passages are aligned.
   - Lubricate all main bearings with clean engine oil.



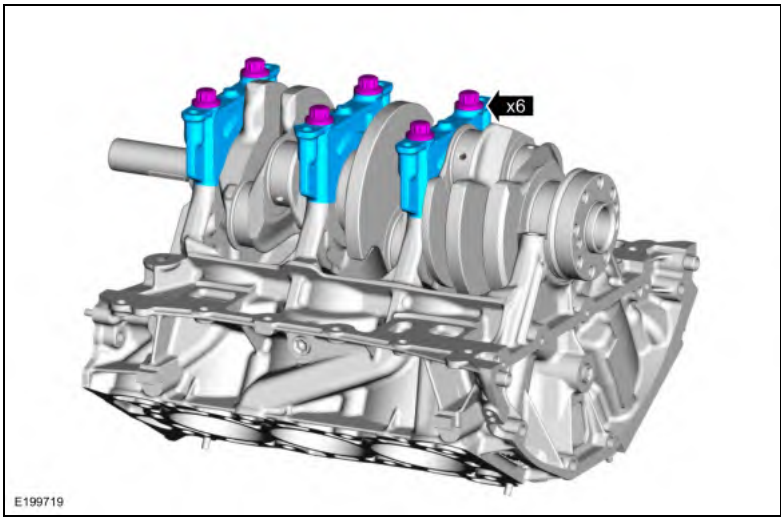
6. The engine is assembled with a combination of poly coated AND non-coated bearings. The placement of the correct type bearings in the positions indicated is critical.
   - A: No. 1 lower bearing â€" **poly coated** bearing
   - B: No. 2 lower bearing â€" non-coated bearing
   - C: No. 3 lower bearing â€" non-coated bearing
   - D: No. 4 lower bearing â€" **poly coated** bearing
   - E: No. 1 upper bearing â€" **poly coated** bearing
   - F: No. 2 upper bearing â€" non-coated bearing
   - G: No. 3 upper bearing â€" non-coated bearing
   - H: No. 4 upper bearing â€" non-coated bearing



7. Lubricate the crankshaft bearing journals with clean engine oil and install the crankshaft into the cylinder block.

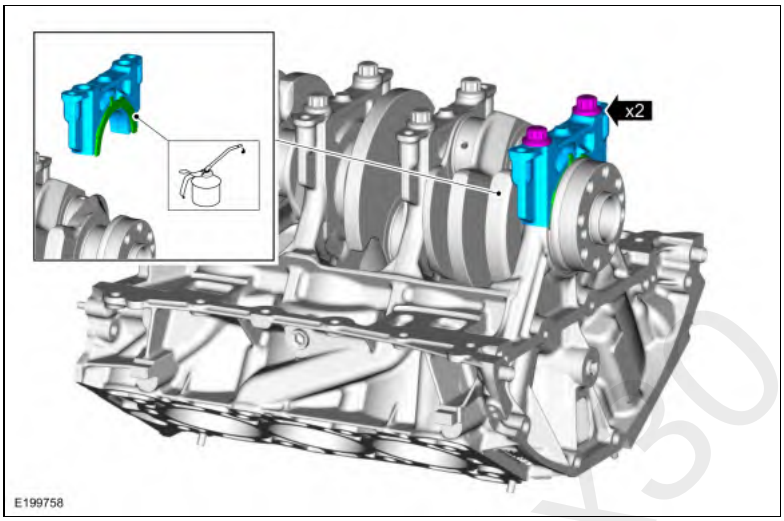


8. Install the No. 1, 2 and 3 main bearing caps and bolts on the cylinder block and, keeping the caps as square as possible, alternately draw the caps down evenly using the cap bolts.

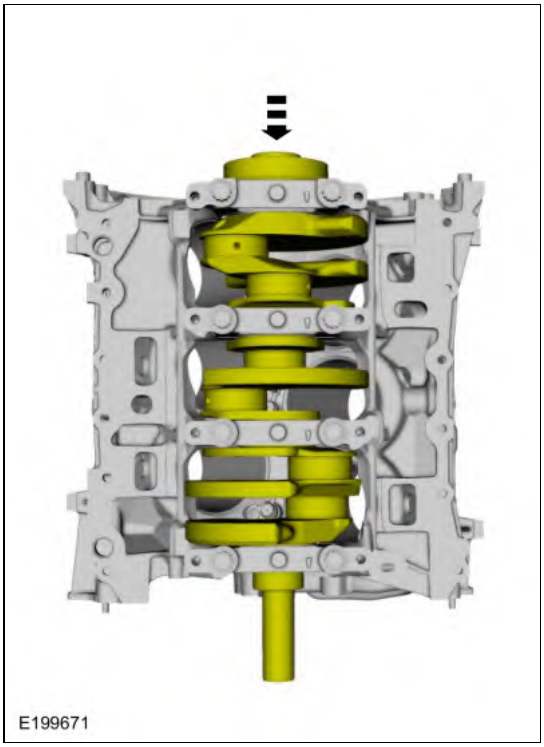


9.

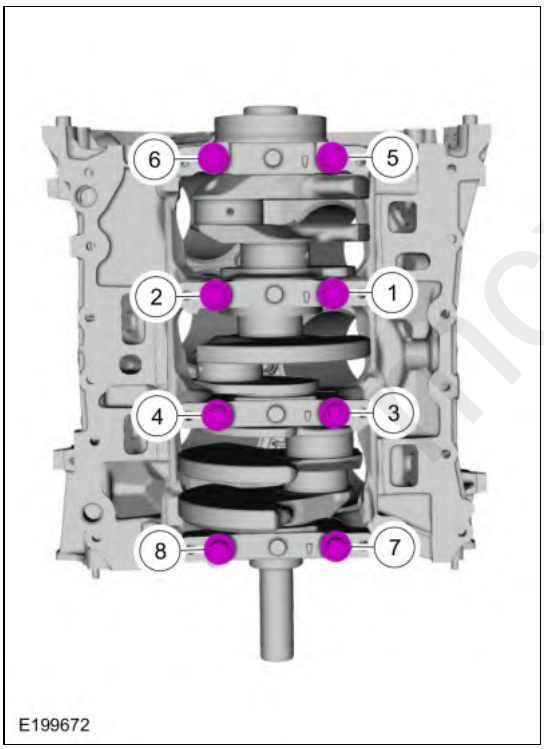
1. Lubricate the lower thrust washer with clean engine oil.
2. Install the lower thrust washer and the No. 4 main bearing cap and, keeping the cap as square as possible, alternately draw the cap down evenly using the cap bolts.



10. Push the crankshaft forward to seat the crankshaft thrust washer.

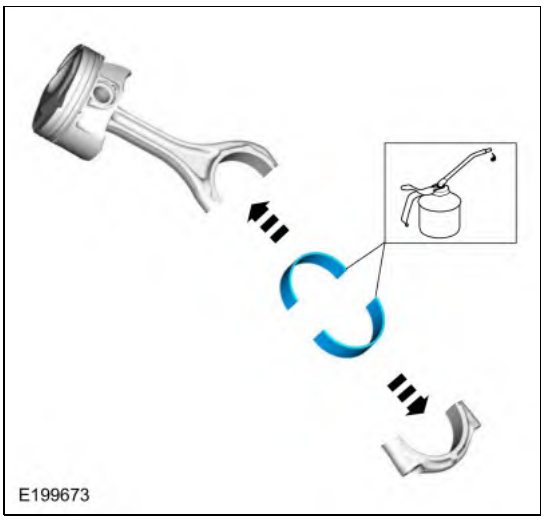


11. Tighten the main bearing cap bolts.
    Torque:
    Stage 1: 30 lb.ft (40 Nm)
    Stage 2: Loosen: 360Â°
    Stage 3: 26 lb.ft (35 Nm)
    Stage 4: 180Â°



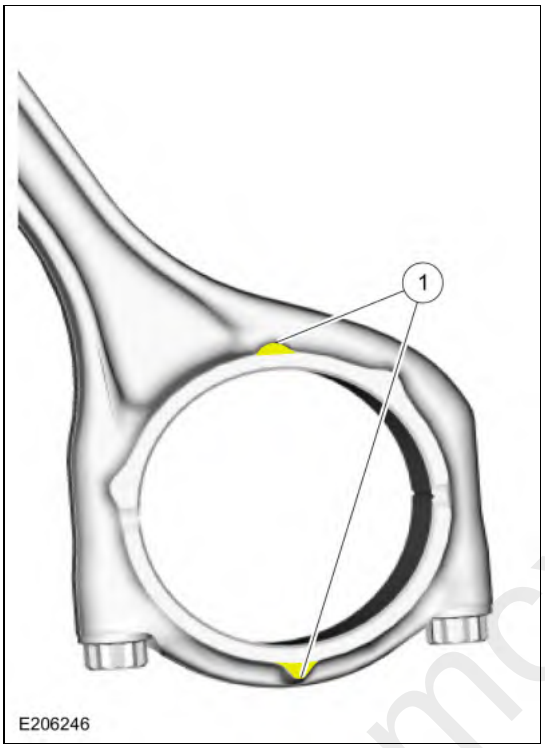
12.
- Check the crankshaft end play.
  Refer to: Specifications (303-01B Engine - 2.7L EcoBoost (238kW/324PS), Specifications).
- Check the piston-to-cylinder block and piston ring clearances.
  Refer to: Specifications (303-01B Engine - 2.7L EcoBoost (238kW/324PS), Specifications).
- Assemble the pistons and position the piston ring gaps.
  Refer to: Piston (303-01B Engine - 2.7L EcoBoost (238kW/324PS), Disassembly and Assembly of Subassemblies).

13. Lubricate with clean engine oil and install the connecting rod bearings.



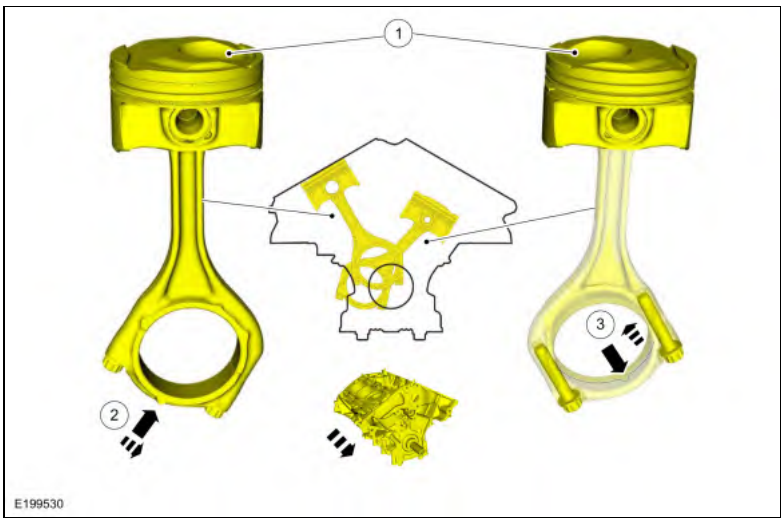
14.

1. For assembly purposes the bump on the connecting rod will face the same way as the bump on the connecting rod cap.



15.

1. For assembly purposes the bowl on the dome of the piston should be facing toward the intake of the engine.
2. On the RH bank the bump on the connecting rod should face the front of the engine.
3. On the LH bank the bump on the connecting rod should face the rear of the engine.



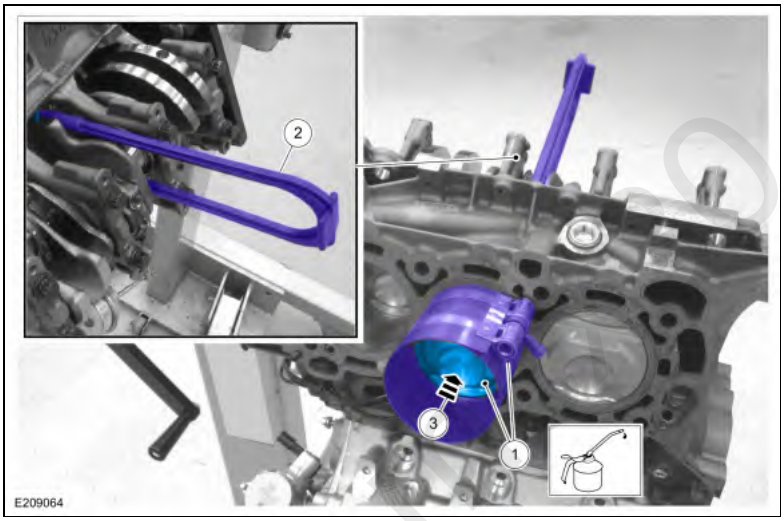
16. **NOTICE: Do not scratch the cylinder walls or crankshaft journals with the connecting rod or engine damage may occur.**

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

    1. Lubricate the piston with clean engine oil.
    2. Position the piston assembly and piston ring installer into the cylinder.
       Use the General Equipment: Piston Ring Compressor

    3. **NOTE:** *A commercially available piston rod installer must be used to prevent damage to the crankshaft journal.*

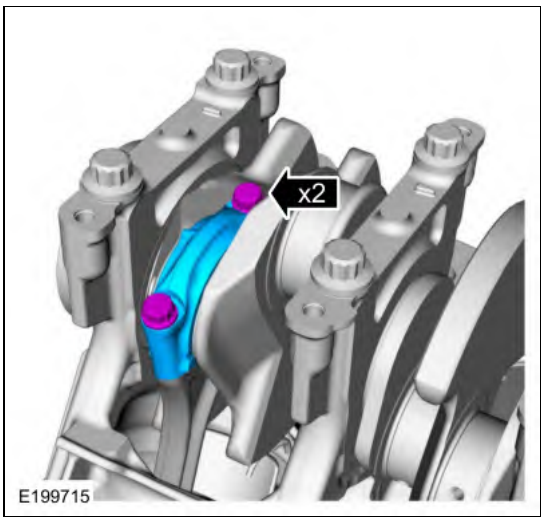
       Install a piston rod installer over the crankshaft journal and into the bolt holes of the connecting rod.
    4. Push the piston into the cylinder bore and guide the connecting rod onto the crankshaft journal.



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

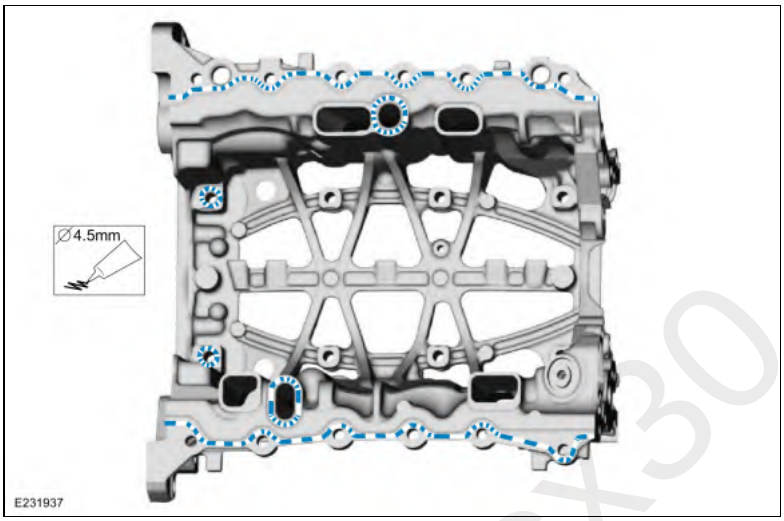
    NOTE: *The connecting rod caps are of the "cracked" design and must mate with the connecting rod ends. Excessive bearing clearance will result if not mated correctly.*

    1. Install the connecting rod cap and bearing.
       Torque:
       Stage 1: 24 lb.ft (32 Nm)
       Stage 2: Loosen: 180Â°
       Stage 3: 24 lb.ft (32 Nm)
       Stage 4: 90Â°
    2. Repeat the steps for each of the remaining pistons.

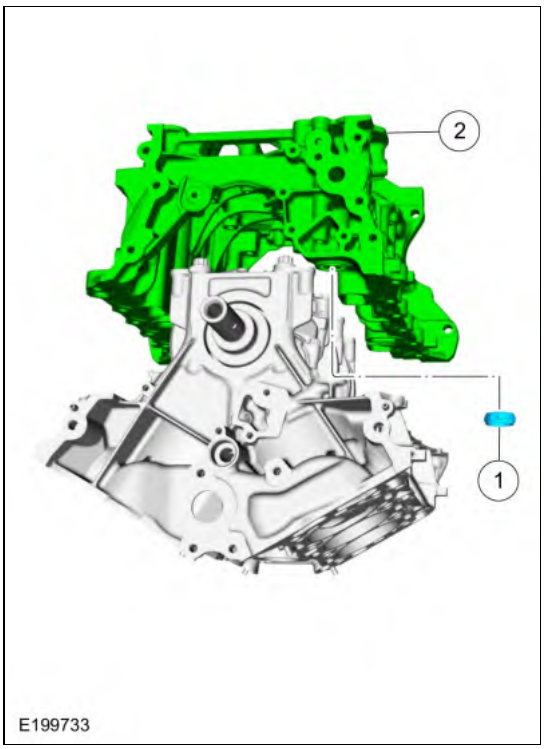


18. **NOTICE: If the engine block skirt stiffener is not installed, aligned and the bolts tightened to minimum specification within 10 minutes, the sealant must be removed and the sealing area cleaned.**

    Apply a 4.5 mm (0.18 in) bead of MotorcraftÂ® High Performance Engine RTV Silicone to the engine block skirt stiffener.
    Material: MotorcraftÂ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)

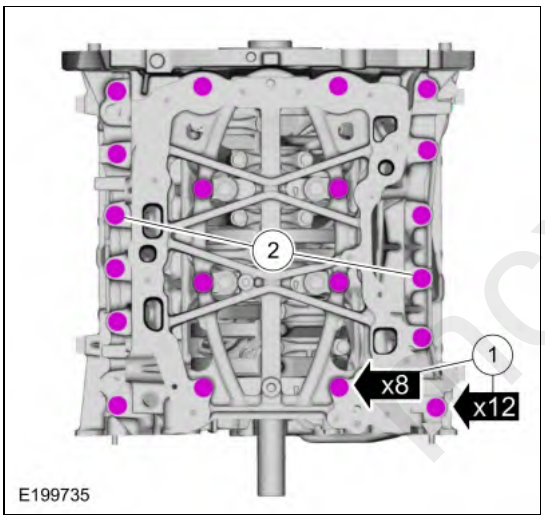


19.
    1. Position the oil seal.
    2. Install the engine block skirt stiffener.



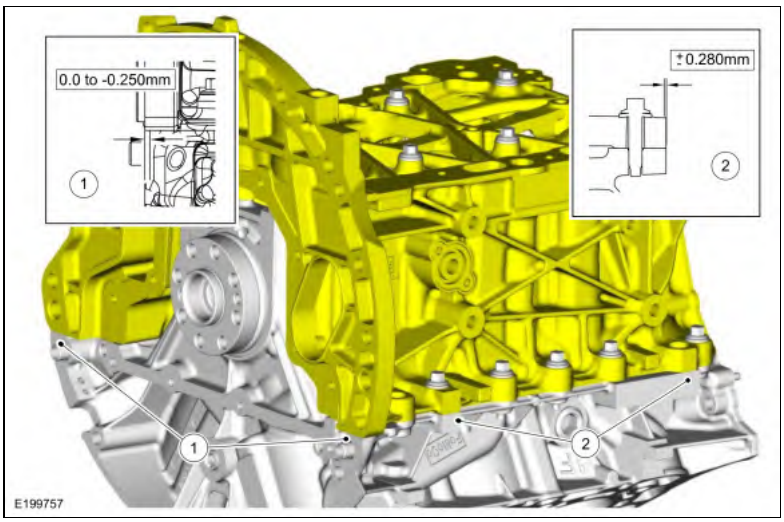
20.

1. Install the bolts finger tight.
2. Tighten the 2 bolts.
   Torque:
   Stage 1: 177 lb.in (20 Nm)
   Stage 2: Loosen: 360Â°



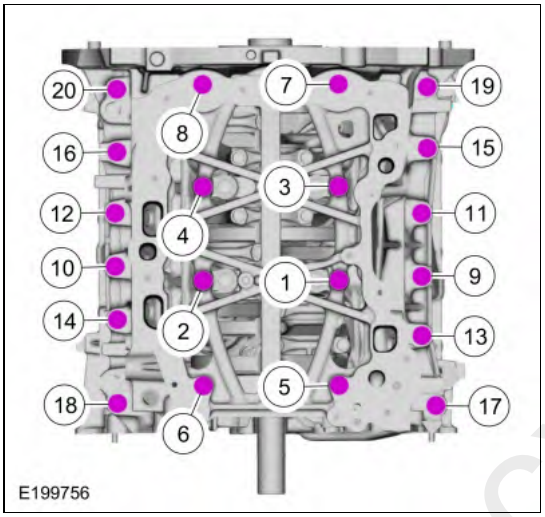
21.

1. Using a straight edge, align the rear face of the engine block skirt stiffener to the rear face of the engine block, flush or up to 0.250 mm (0.01 in) underflush.
2. Using a straight edge, align the machined bosses on the left side of the engine block skirt stiffener to the machined bosses on the left side of the engine block flush or within 0.280 mm (0.011) of flush.



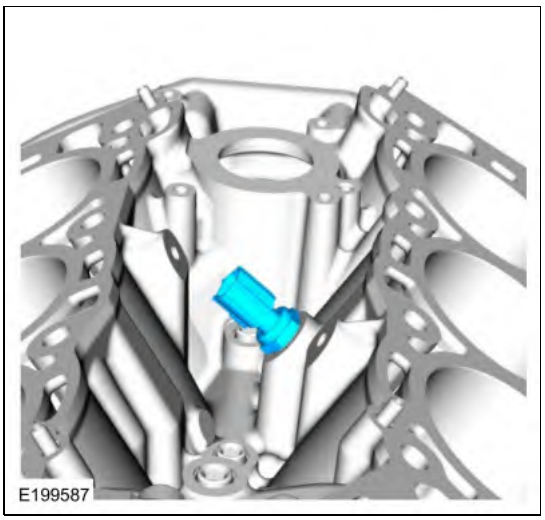
22. **NOTICE: If the engine block skirt stiffener bolts minimal torque is not completed within 10 minutes of sealant application, or if final torque is not met within 60 minutes of sealant application the parts must be removed and the sealant must be removed and the sealing area cleaned.**

    Tighten the engine block skirt stiffener bolts.
    Torque:
    Stage 1: 177 lb.in (20 Nm)
    Stage 2: 18 lb.ft (24 Nm)



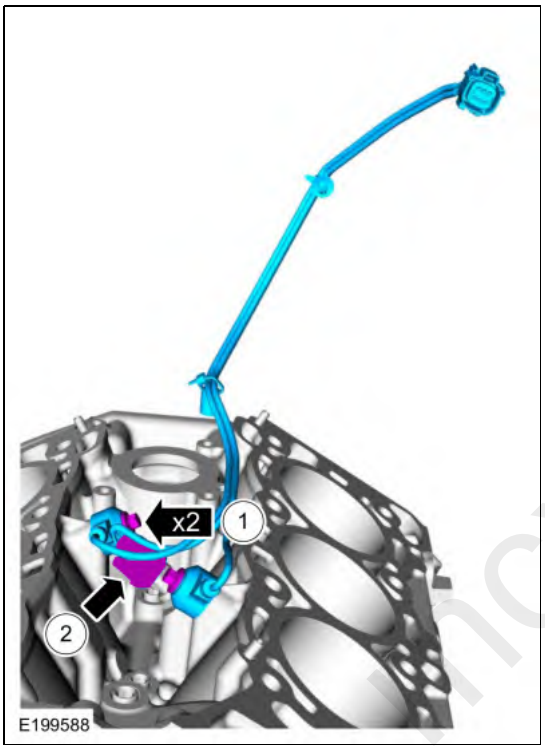
23. **NOTE:** *Do not reuse the ECT sensor, install a new sensor.*

    Install a new ECT sensor.
    Torque: 20 lb.ft (27 Nm)

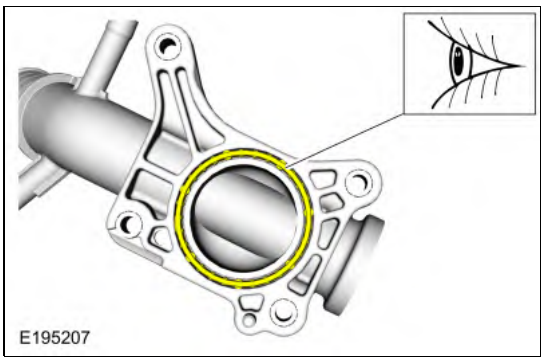


24.

1. Install the KS assembly and the bolts.
   Torque: 89 lb.in (10 Nm)
2. Connect the ECT sensor electrical connector.

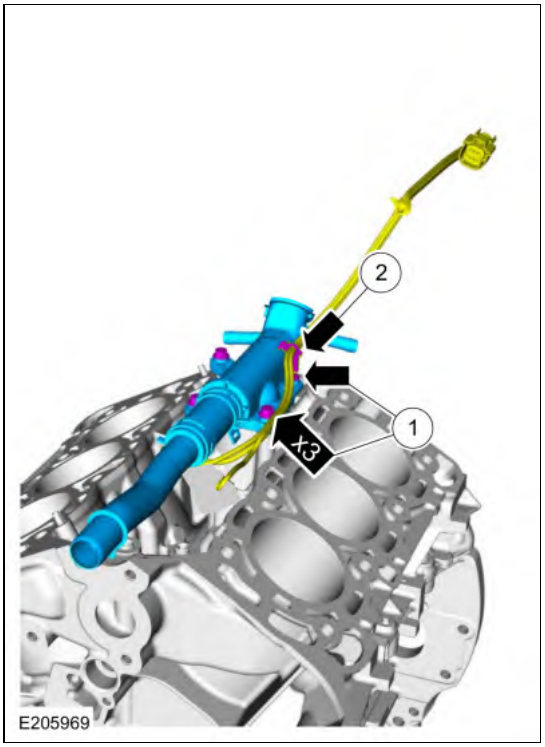


25. Inspect the coolant outlet connector pipe gasket and replace if damaged.



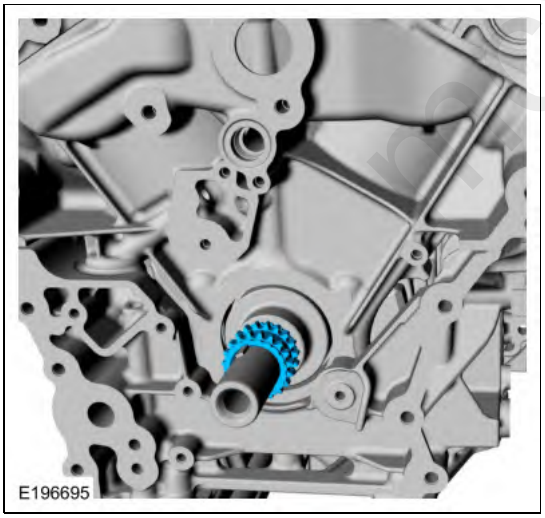
26.

1. Install the coolant outlet connector pipe, the bolts and the stud bolt.
   Torque: 89 lb.in (10 Nm)
2. Attach the wiring harness retainer to the stud bolt.



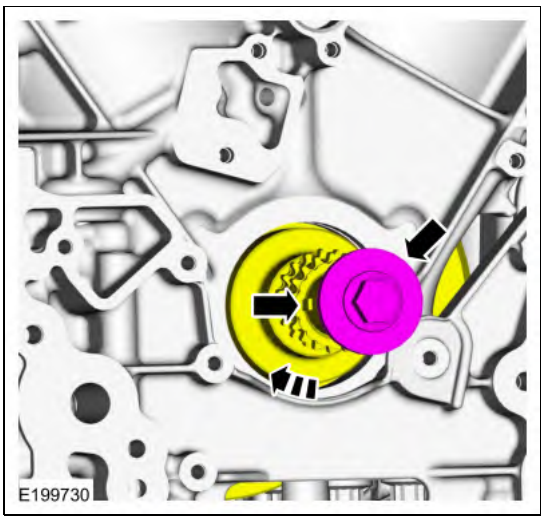
27. **NOTE:** *A timing mark is stamped on both faces of the crankshaft sprocket. The sprocket can be installed with either of the faces positioned outward.*

    Install the crankshaft sprocket.

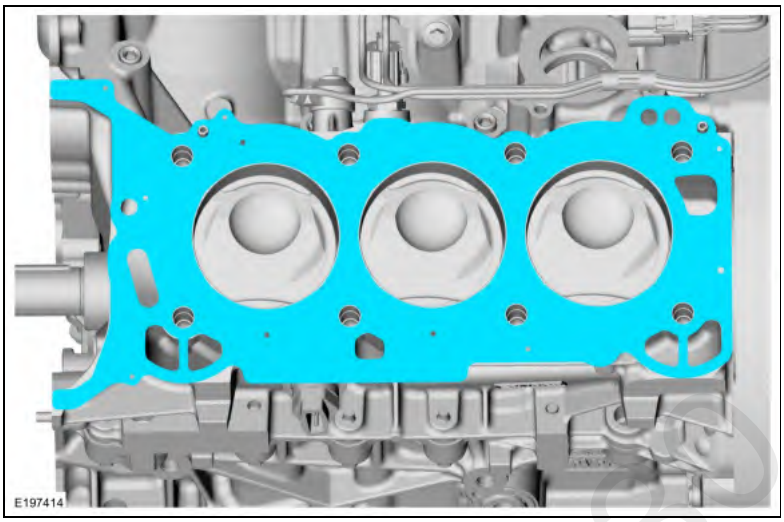


28. **NOTICE: Rotate the crankshaft utilizing only the original crankshaft pulley bolt. Failure to follow this direction may cause damage to the crankshaft and result in engine failure.**

    Install the original crankshaft pulley bolt and rotate the crankshaft clockwise until the keyway is at the 9 o'clock position.

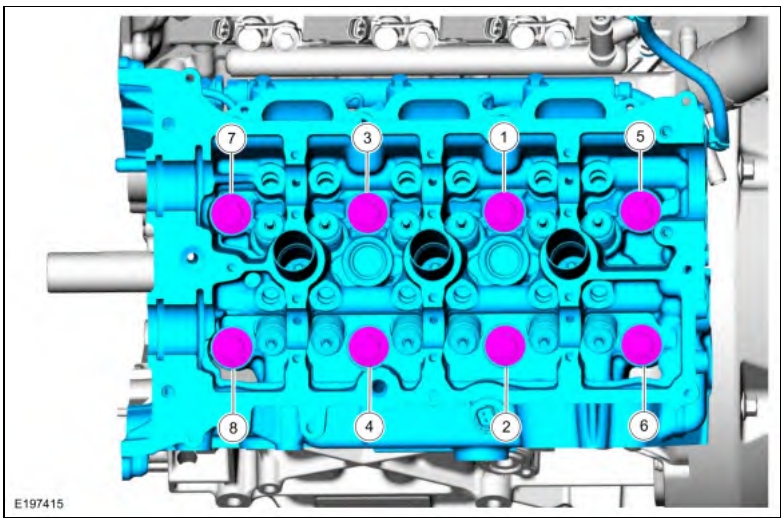


29. Install a new cylinder head gasket.

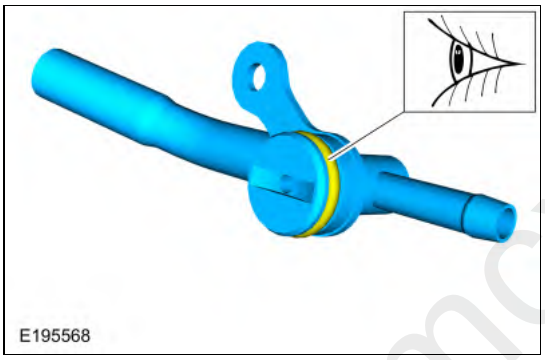


30.

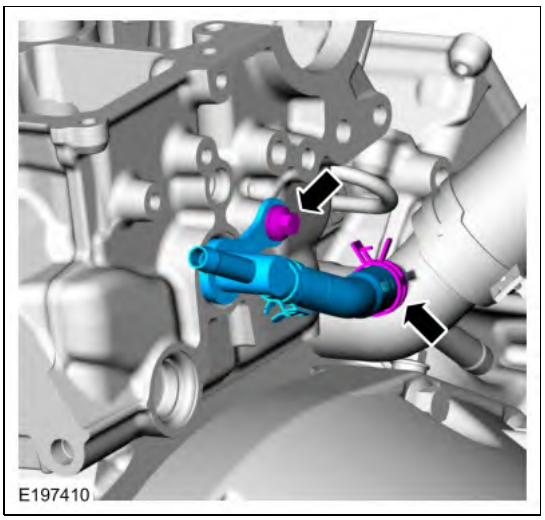
- Install the cylinder head.
- Install new cylinder head bolts.
  Torque:
  Stage 1: 177 lb.in (20 Nm)
  Stage 2: Loosen: 2 turn(s)
  Stage 3: 37 lb.ft (50 Nm)
  Stage 4: 180Â°



31. Inspect the O-ring and replace if damaged.



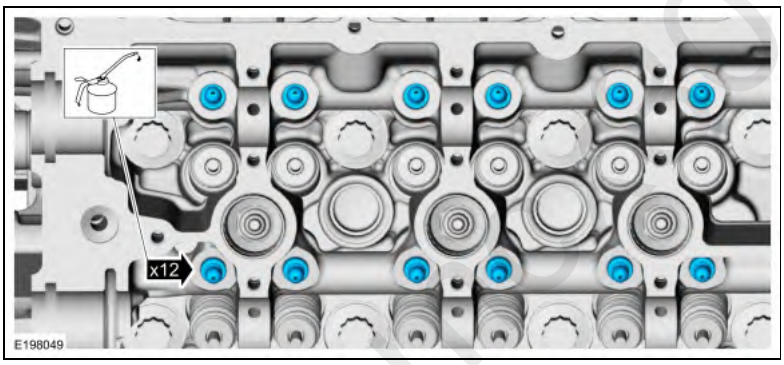
32.
    1. Install the cylinder head to coolant outlet connector hose assembly and the bolt.
       Torque: 89 lb.in (10 Nm)
    2. Connect the coolant hose and the clamp.
       Use the General Equipment: Hose Clamp Remover/Installer



33. **NOTICE: Do not install the camshaft roller followers at this time. The roller followers will be installed later in the procedure. If the roller followers are installed prior to the camshafts, the camshaft caps can become distorted during the camshaft tightening process and result in upper end engine noise or severe damage to the engine.**

    NOTE: *If the original hydraulic lash adjusters are to be reinstalled, they must be installed in their original locations.*

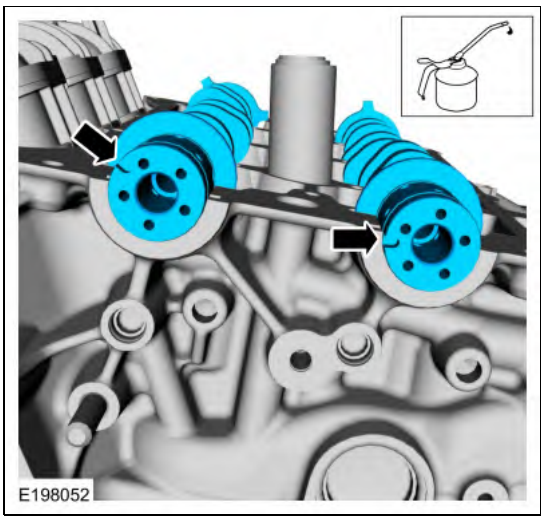
    1. Lubricate the hydraulic lash adjusters with clean engine oil.
    2. Install the hydraulic lash adjusters.



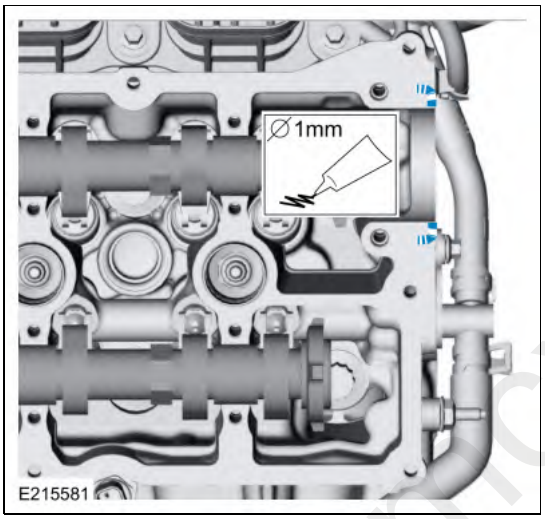
34. **NOTE:** *Lubricate the camshafts with clean engine oil prior to installation.*

    NOTE: *It is not necessary to position the scarf-cut seal ends when installing the camshafts.*

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

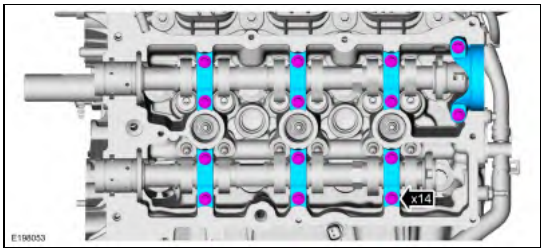


35. Apply a 1 mm bead of sealant to the rear camshaft cap mounting surface of the cylinder head.
Material: Flange Sealant / CU7Z-19B508-A (WSS-M2G348-A11)



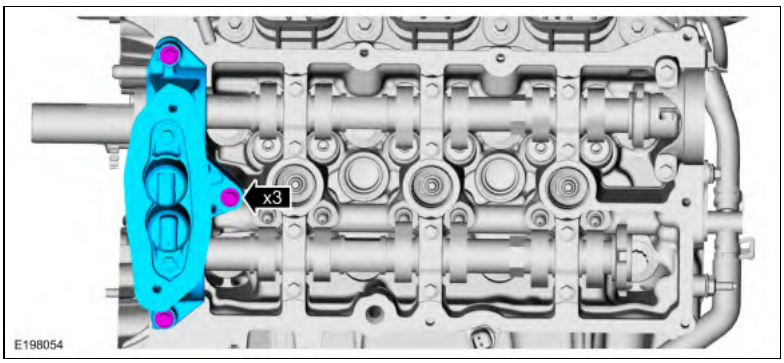
36. **NOTE:** *Do not tighten at this time.*

Install the camshaft bearing caps and the bolts.

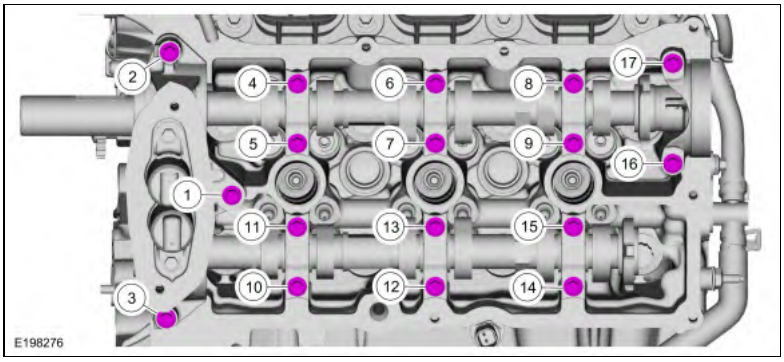


37. **NOTE:** *Do not tighten at this time.*

Install the front camshaft bearing mega cap and the bolts.

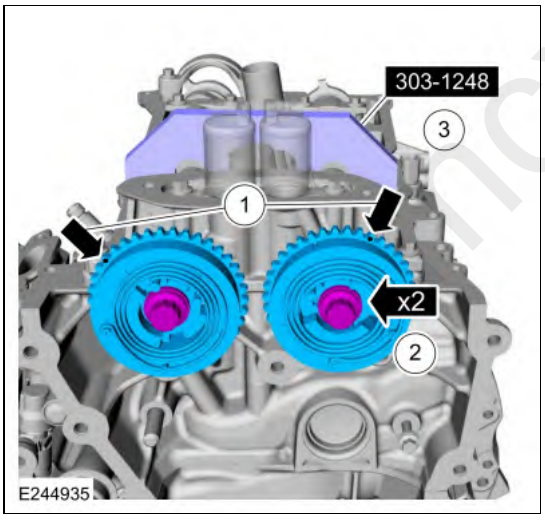


38. Tighten the bolts.
    Torque: 133 lb.in (15 Nm)

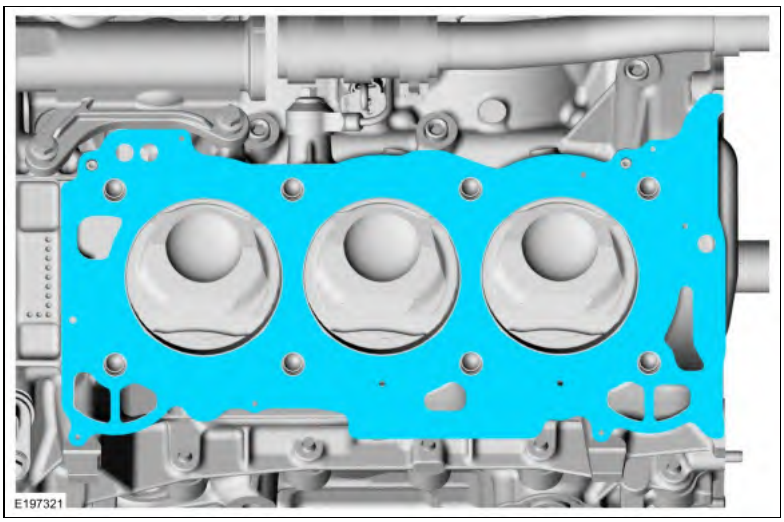


39. **NOTICE: The VCT units have 2 timing marks on them, a triangle and a circle. For installation of the LH side the circle marks are used.**

    1. Install the VCT units. The **circle** timing marks on the VCT units will be at the 10 o'clock (intake) and 12:30 (exhaust) positions as shown in the illustration.
    2. Install the new VCT unit bolts.
       Torque:
       Stage 1: 30 lb.ft (40 Nm)
       Stage 2: Loosen: 360Â°
       Stage 3: 37 lb.ft (50 Nm)
       Stage 4: 90Â°
    3. Remove Special Service Tool: 303-1248 Camshaft holding tools.

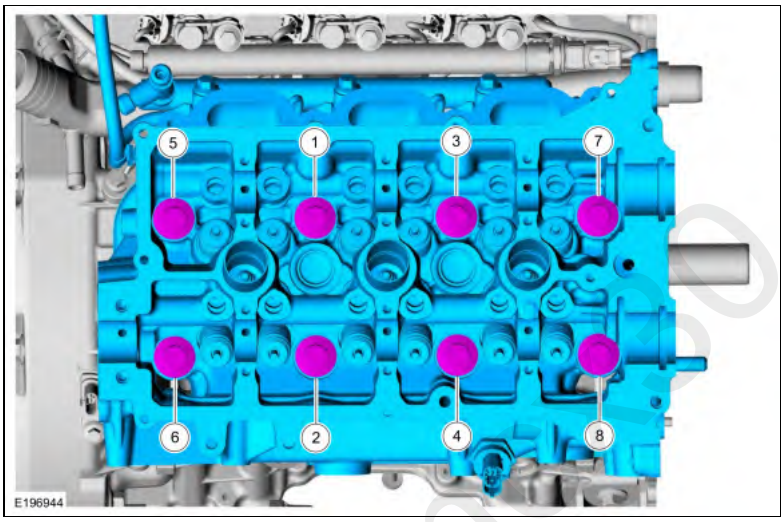


40. Install a new cylinder head gasket.

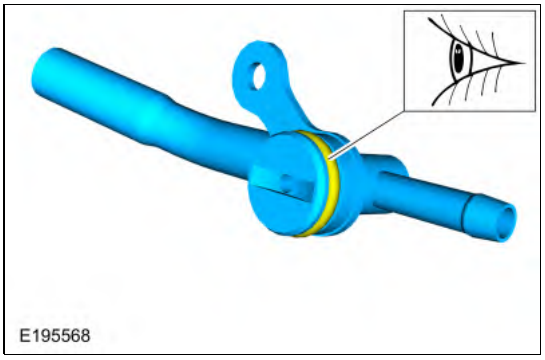


41.

- Install the cylinder head.
- Install new cylinder head bolts.
  Torque:
  Stage 1: 177 lb.in (20 Nm)
  Stage 2: Loosen: 2 turn(s)
  Stage 3: 37 lb.ft (50 Nm)
  Stage 4: 180Â°



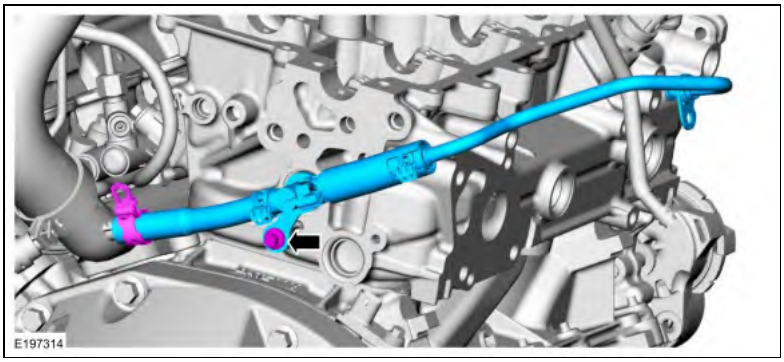
42. Inspect the O-ring and replace if damaged.



43.

1. Install the cylinder head to coolant outlet connector hose assembly and the bolt.
   Torque: 89 lb.in (10 Nm)

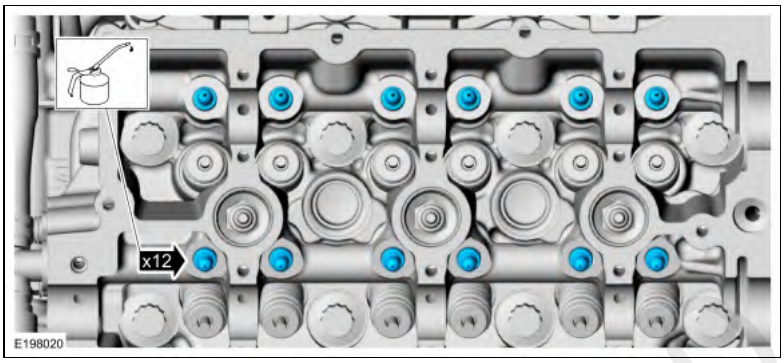
2. Connect the coolant hose and the clamp.
   Use the General Equipment: Hose Clamp Remover/Installer



44. **NOTICE: Do not install the camshaft roller followers at this time. The roller followers will be installed later in the procedure. If the roller followers are installed prior to the camshafts, the camshaft caps can become distorted during the camshaft tightening process and result in upper end engine noise or severe damage to the engine.**

    NOTE: *If the original hydraulic lash adjusters are to be reinstalled, they must be installed in their original locations.*

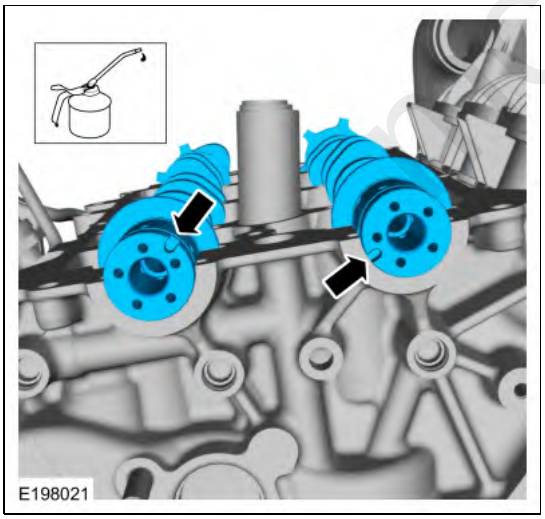
    1. Lubricate the hydraulic lash adjusters with clean engine oil.
    2. Install the hydraulic lash adjusters.



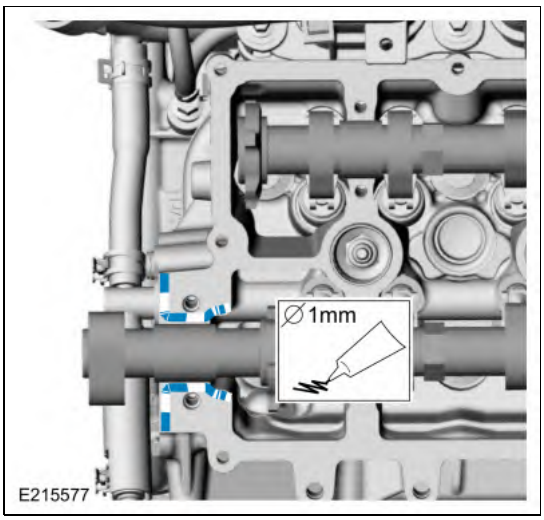
45. **NOTE:** *Lubricate the camshafts with clean engine oil prior to installation.*

    NOTE: *It is not necessary to position the scarf-cut seal ends when installing the camshafts.*

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

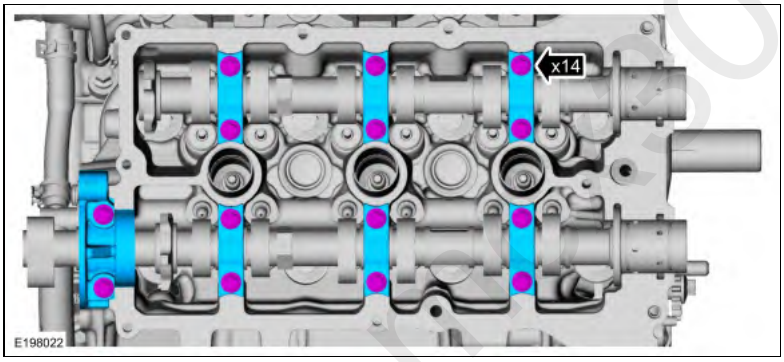


46. Apply a 1 mm bead of sealant to the rear camshaft cap mounting surface of the cylinder head.
    Material: Flange Sealant / CU7Z-19B508-A (WSS-M2G348-A11)



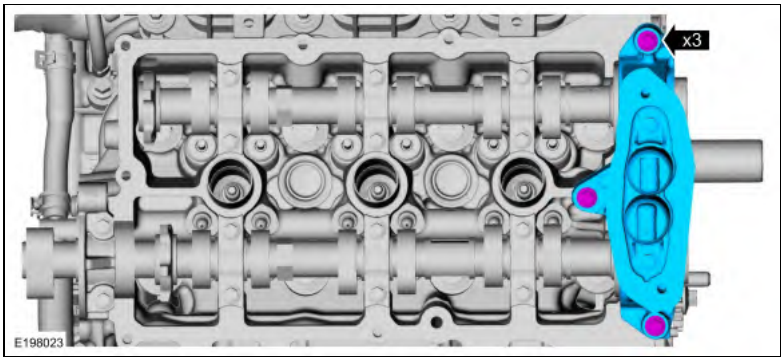
47. **NOTE:** *Do not tighten at this time.*

    Install the camshaft bearing caps and the bolts.

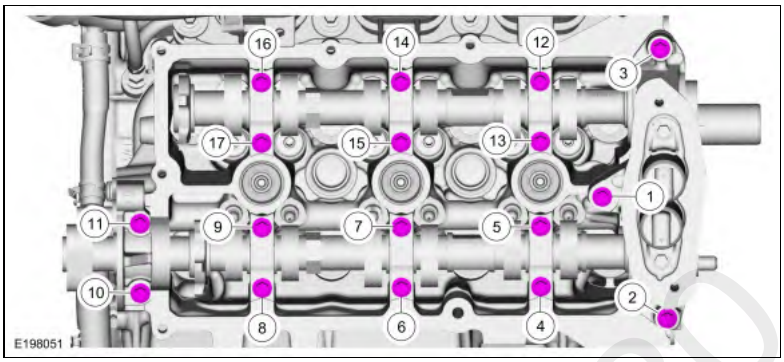


48. **NOTE:** *Do not tighten at this time.*

    Install the front camshaft bearing mega cap and the bolts.

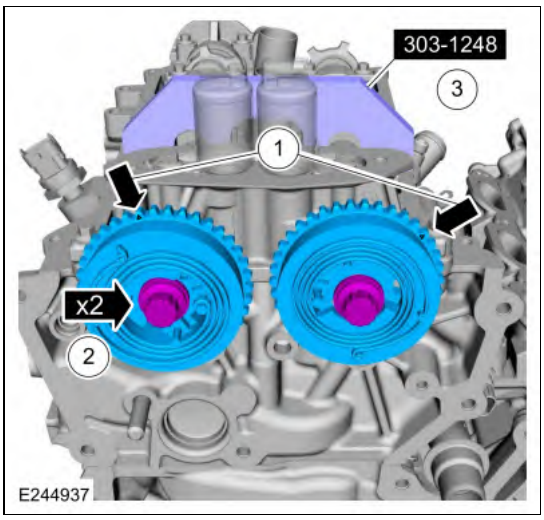


49. Tighten the bolts.
    Torque: 133 lb.in (15 Nm)

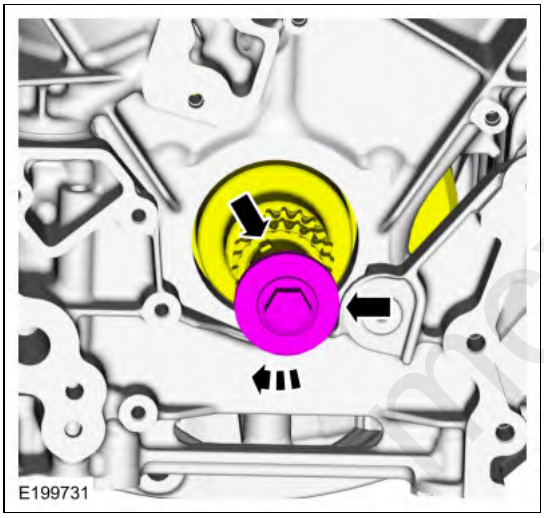


50. **NOTICE: The VCT units have 2 timing marks on them, a triangle and a circle. For installation of the RH side the triangle marks are used.**

    1. Install the VCT units. The **triangle** timing marks on the VCT units will be at the 2 o'clock (intake) and 11 o'clock (exhaust) positions as shown in the illustration.
    2. Install new VCT unit bolts.
       Torque:
       Stage 1: 30 lb.ft (40 Nm)
       Stage 2: Loosen: 360Â°
       Stage 3: 37 lb.ft (50 Nm)
       Stage 4: 90Â°
    3. Remove Special Service Tool: 303-1248 Camshaft holding tools.

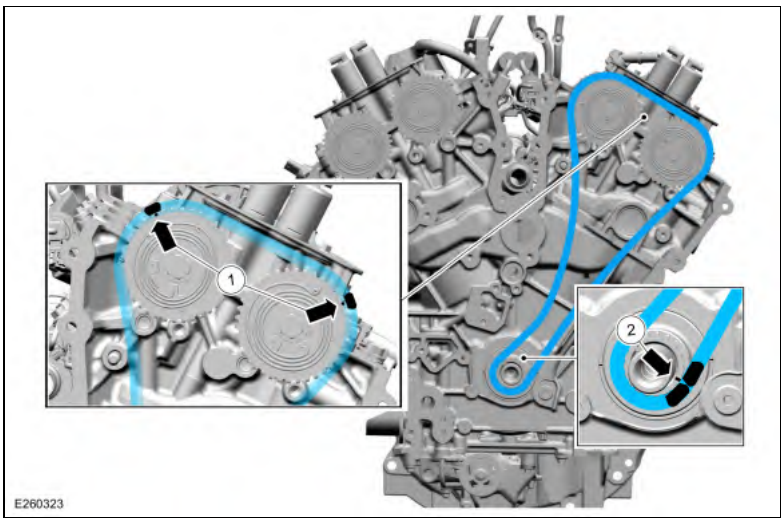


51. Using the original crankshaft pulley bolt, rotate the crankshaft clockwise until the keyway is at the 11 o'clock position.
    - Remove the original crankshaft pulley bolt.

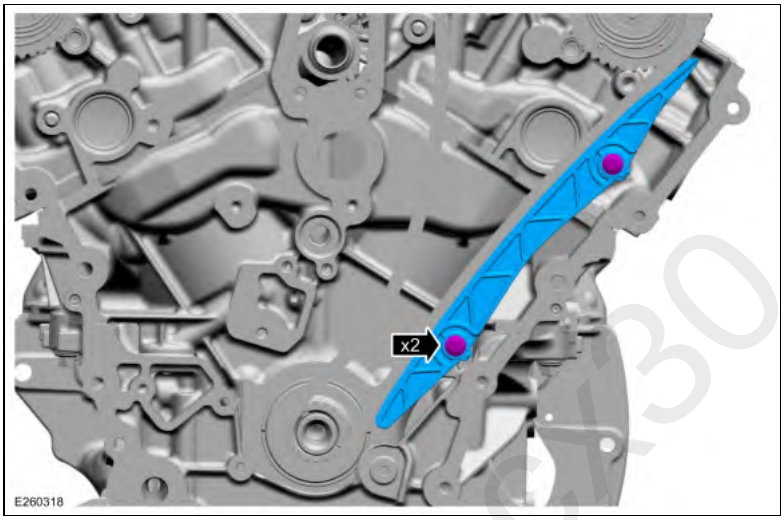


52. **NOTICE: The VCT units have 2 timing marks on them, a triangle and a circle. For removal and installation of the LH side the circle marks are used.**

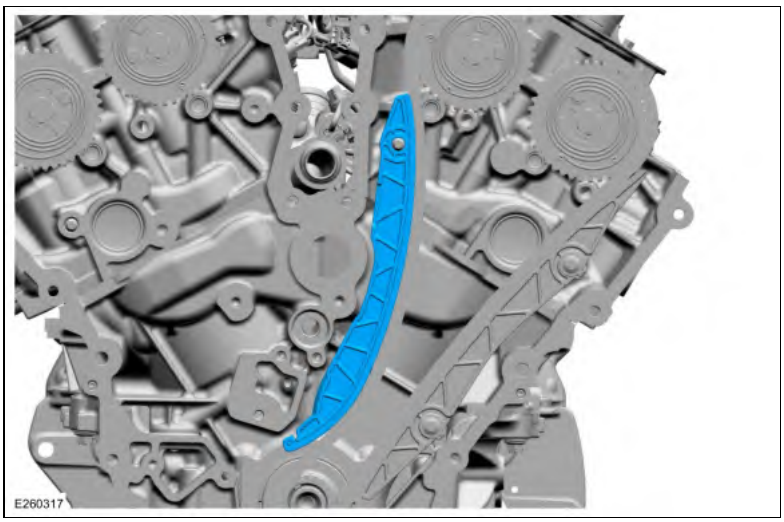
    1. Install the LH timing chain with the single colored links aligned with the **circle** timing marks on the VCT units.
    2. Install the double colored links so they straddle the timing mark on the crankshaft sprocket.



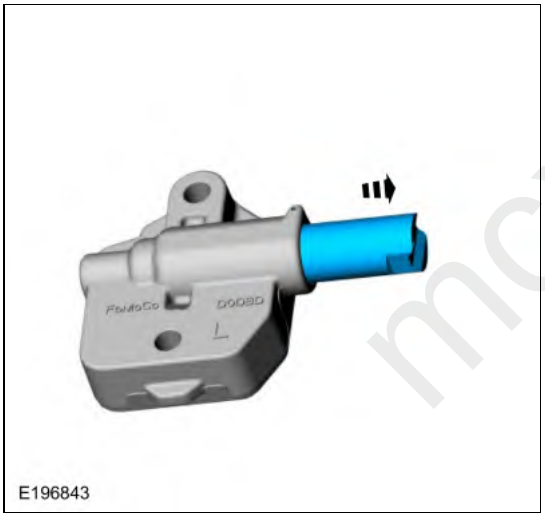
53. Install the LH timing chain guide and bolts.
Torque: 89 lb.in (10 Nm)



54. Install the LH timing chain tensioner arm.

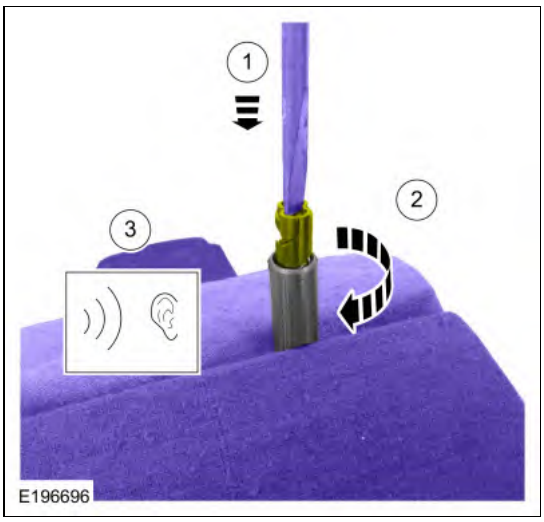


55. Slide the tensioner cylinder out of the LH timing chain tensioner housing.

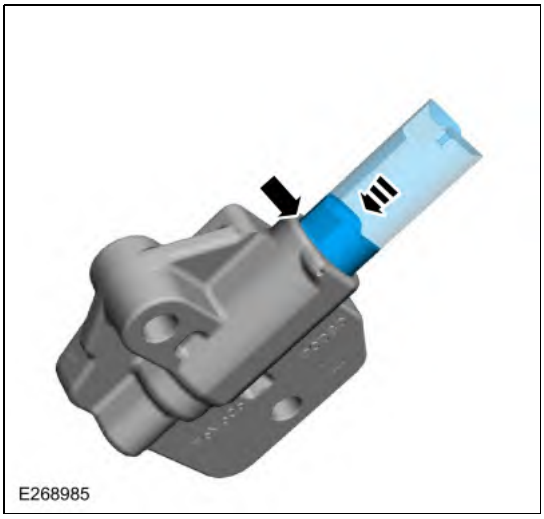


56. **NOTICE: Use vise jaw protectors or cover the jaws of the vise with clean shop towels to prevent damage to the surface of the tensioner ratchet mechanism.**

    Mount the flat machined surfaces on the end of the tensioner cylinder into a vise.
    1. Using a flat-bladed screwdriver apply light downward pressure on the end of the tensioner ratchet mechanism.
       Use the General Equipment: Vise
       Use the General Equipment: Vise Jaw Protectors
       Use the General Equipment: Flat-Bladed Screwdriver
    2. Rotate the screwdriver clockwise approximately one turn.
    3. An audible click will be heard when the tensioner ratchet mechanism locks into place.

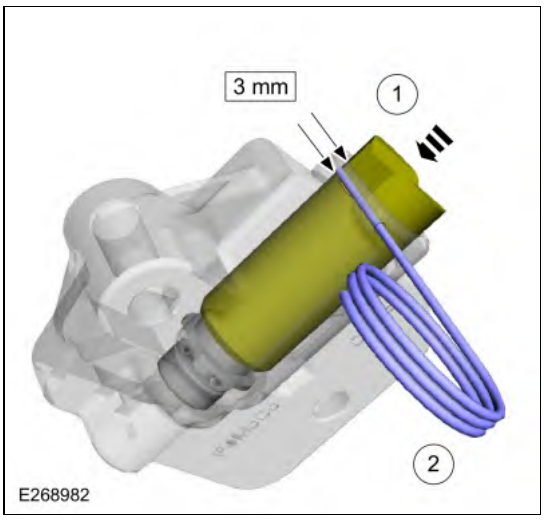


57. Slide the tensioner cylinder into the tensioner housing until it contacts the bottom of the bore. The shoulder of the tensioner cylinder will be flush with the top of the housing.



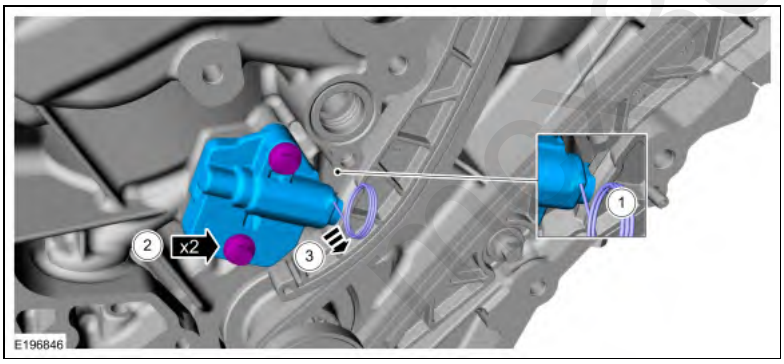
58.

1. Firmly press the tensioner cylinder into the tensioner housing until the shoulder of the tensioner cylinder is approximately 3 mm (0.125 in) below the top of the housing.
2. Install a retaining pin into the hole in the housing to lock the tensioner cylinder in the retracted position.

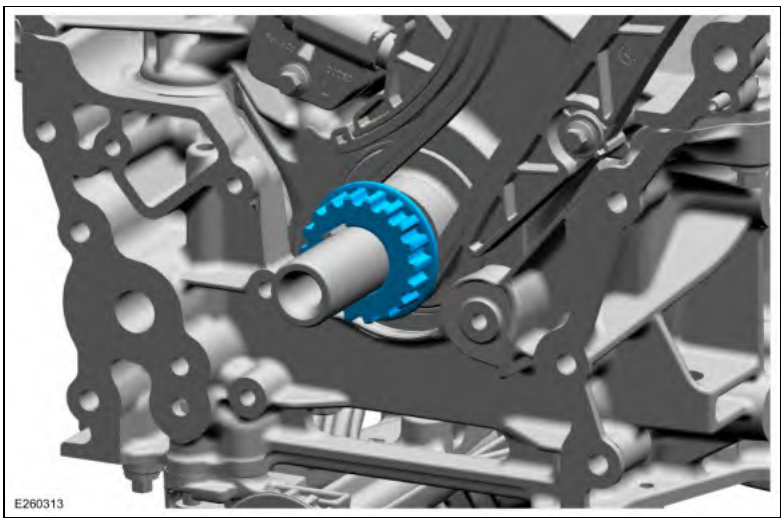


59.

1. Position the LH timing chain tensioner with the end of the tensioner correctly engaged to the tensioner arm.
2. Install the bolts.
   Torque: 89 lb.in (10 Nm)
3. Remove the pin to allow the tensioner cylinder to extend and press against the timing chain tensioner arm.

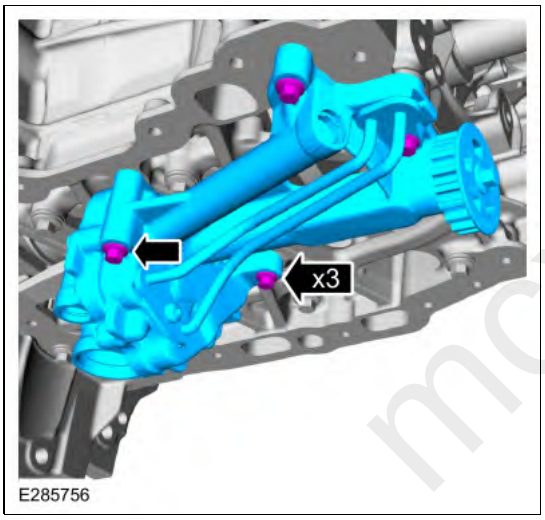


60. Install the crankshaft sprocket.

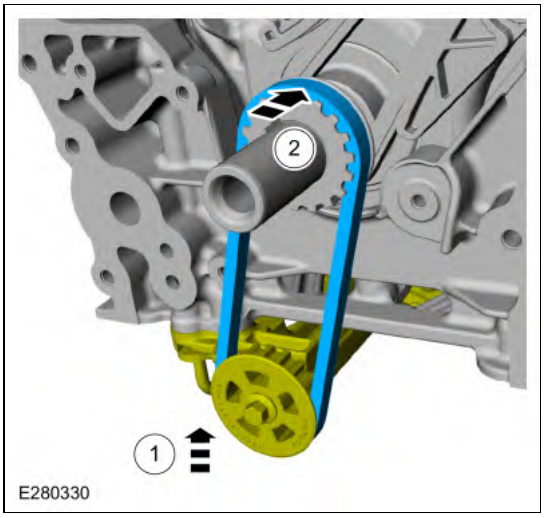


61. Prime the oil pump. Add 2 tablespoons of clean engine oil to the oil pump and rotate the oil pump by hand.
62. **NOTE:** *Do not tighten the bolts at this time.*

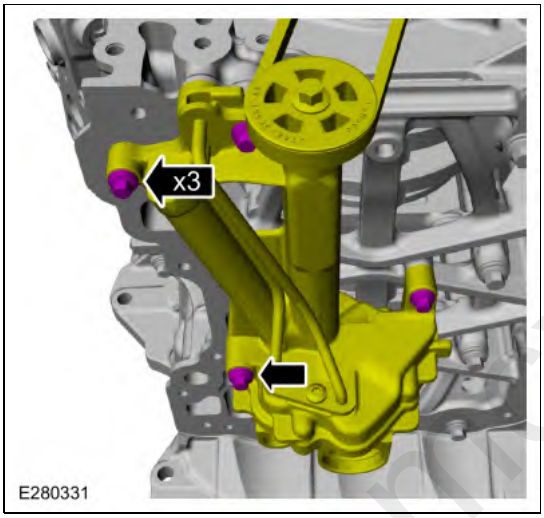
    Position the oil pump and loosely install the bolts.



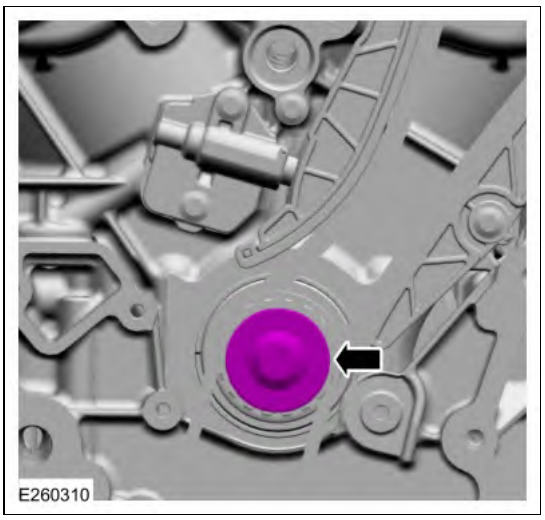
63.
    1. Position the oil pump drive belt onto the oil pump sprocket and raise the front of the oil pump.
    2. Slide the oil pump drive belt onto the crankshaft sprocket.



64. Tighten the oil pump bolts.
    Torque:
    Stage 1: 89 lb.in (10 Nm)
    Stage 2: 45Â°

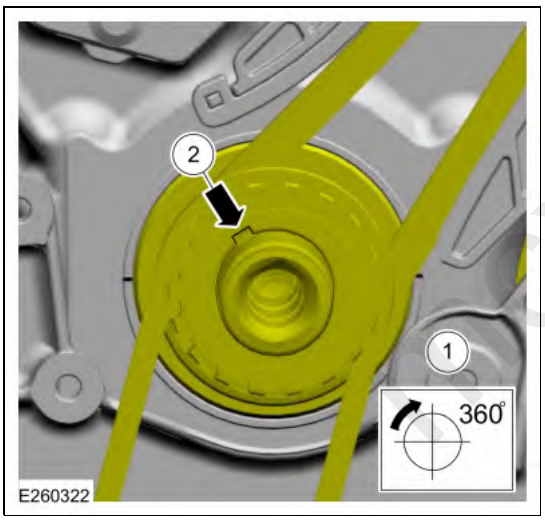


65. Install the original crankshaft pulley bolt.

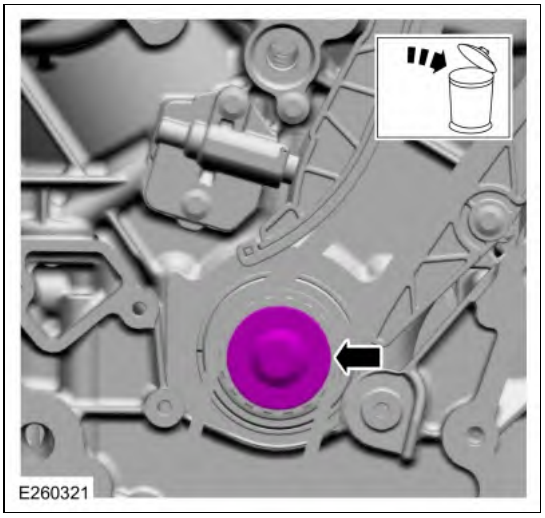


66. **NOTICE: The crankshaft must be rotated clockwise one revolution (360 degrees). Failure to do so will result in incorrect camshaft timing.**

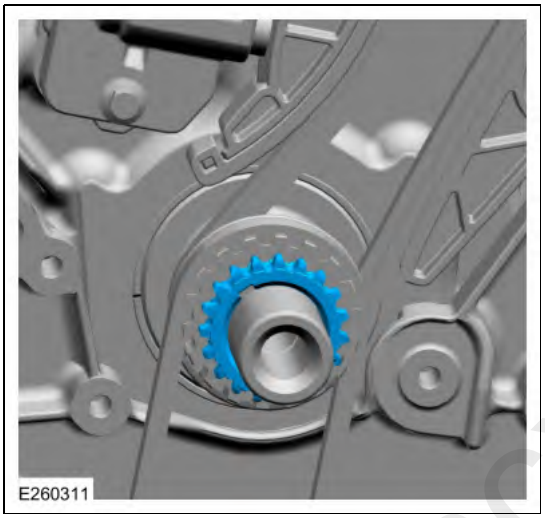
    1. Rotate the crankshaft clockwise one revolution (360 degrees).
    2. Position the crankshaft sprocket keyway at the 11 o'clock position.



67. Remove and discard the original crankshaft pulley bolt.

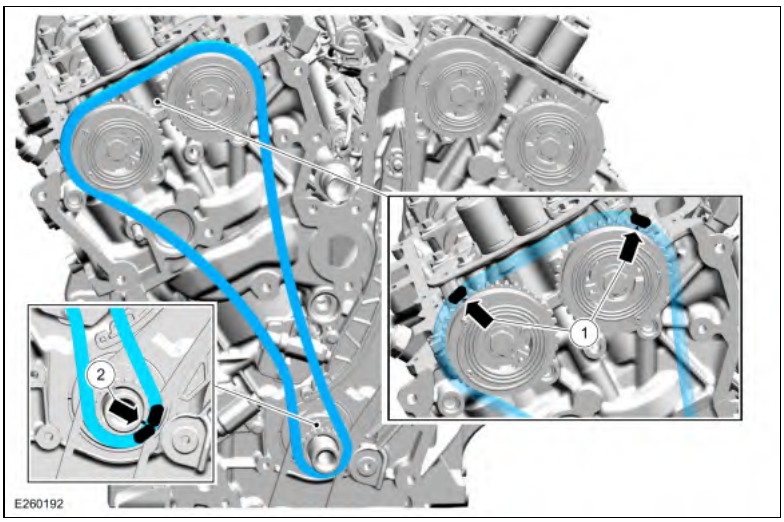


68. Install the timing chain sprocket.

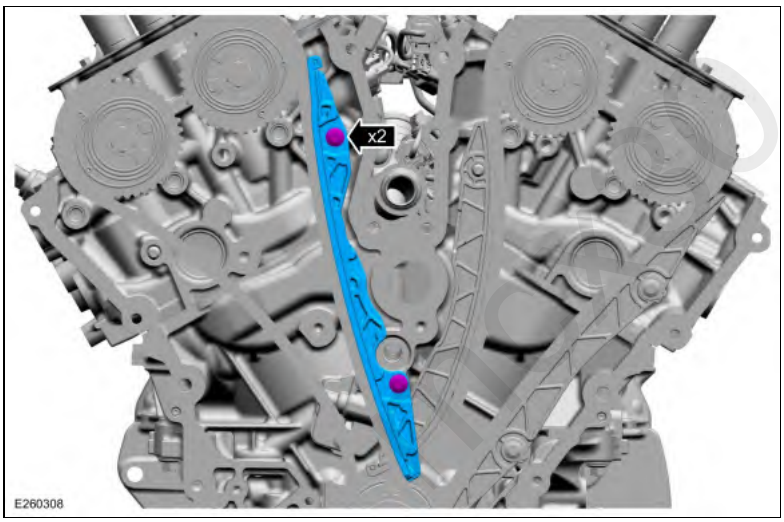


69. **NOTICE: The VCT units have 2 timing marks on them, a triangle and a circle. For removal and installation of the RH side the triangle marks are used.**

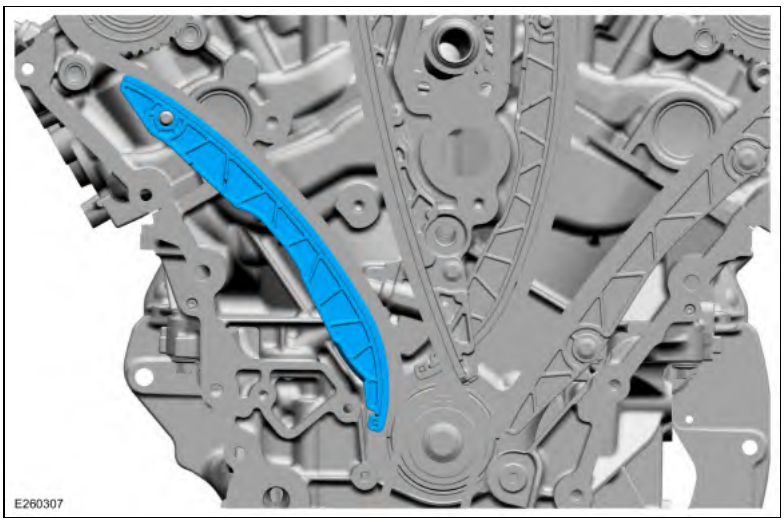
1. Install the RH timing chain with the single colored links aligned with the **triangle** timing marks on the VCT units.
2. Install the double colored links so they straddle the timing mark on the crankshaft sprocket.



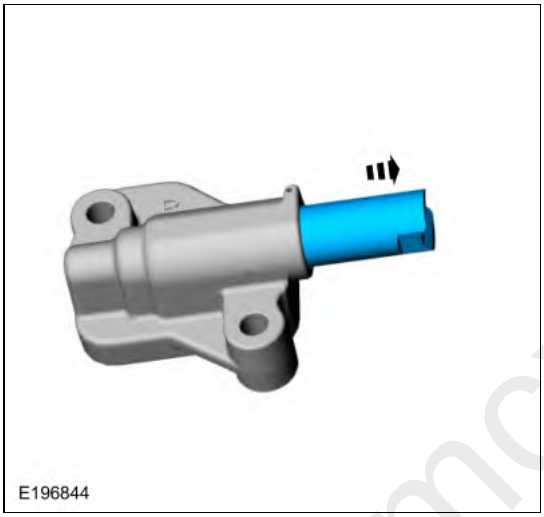
70. Install the RH timing chain guide and bolts.
Torque: 89 lb.in (10 Nm)



71. Install the RH timing chain tensioner arm.



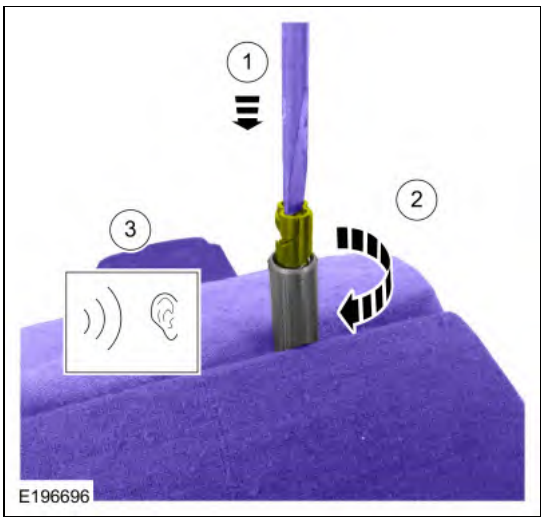
72. Slide the tensioner cylinder out of the RH timing chain tensioner housing.



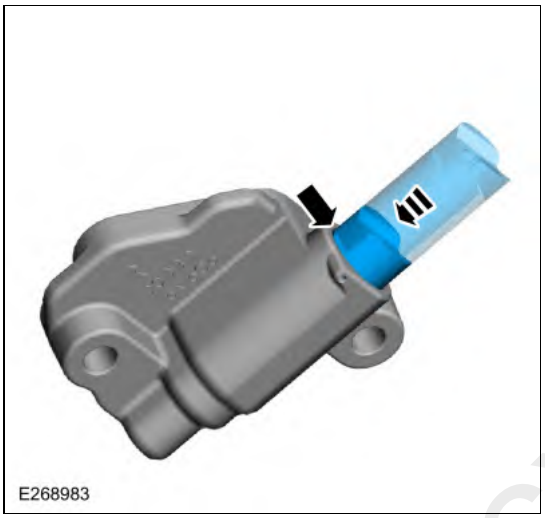
73. **NOTICE: Use vise jaw protectors or cover the jaws of the vise with clean shop towels to prevent damage to the surface of the tensioner ratchet mechanism.**

Mount the flat machined surfaces on the end of the tensioner cylinder into a vise.

1. Using a flat-bladed screwdriver apply light downward pressure on the end of the tensioner ratchet mechanism.
   Use the General Equipment: Vise
   Use the General Equipment: Vise Jaw Protectors
   Use the General Equipment: Flat-Bladed Screwdriver
2. Rotate the screwdriver clockwise approximately one turn.
3. An audible click will be heard when the tensioner ratchet mechanism locks into place.

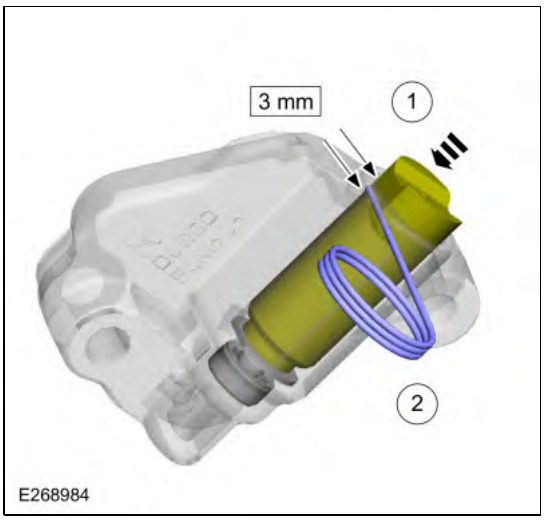


74. Slide the tensioner cylinder into the tensioner housing until it contacts the bottom of the bore. The shoulder of the tensioner cylinder will be flush with the top of the housing.



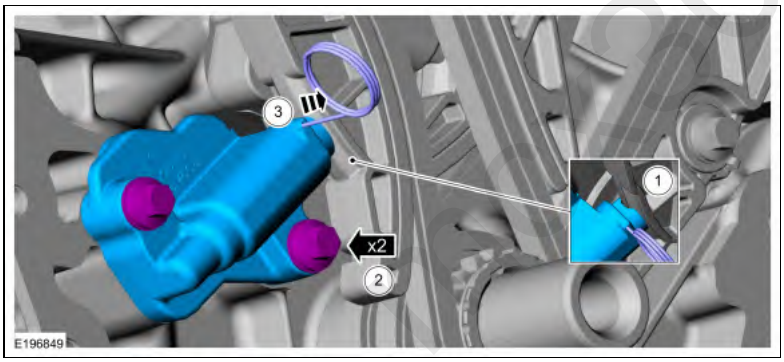
75.

1. Firmly press the tensioner cylinder into the tensioner housing until the shoulder of the tensioner cylinder is approximately 3 mm (0.125 in) below the top of the housing.
2. Install a retaining pin into the hole in the housing to lock the tensioner cylinder in the retracted position.

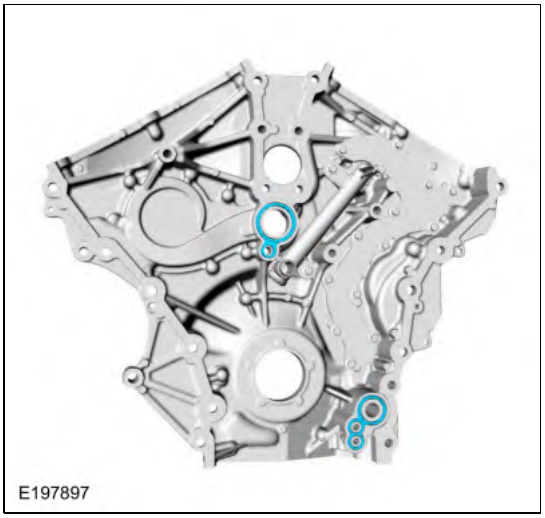


76.

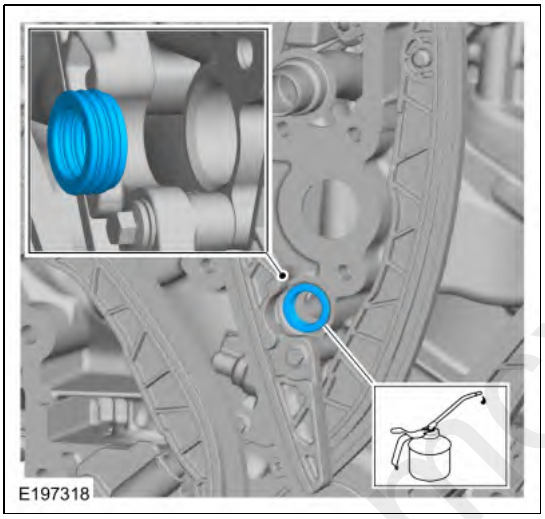
1. Position the RH timing chain tensioner with the end of the tensioner correctly engaged to the tensioner arm.
2. Install the bolts.
   Torque: 89 lb.in (10 Nm)
3. Remove the pin to allow the tensioner cylinder to extend and press against the timing chain tensioner arm.



77. Install new engine front cover gaskets.



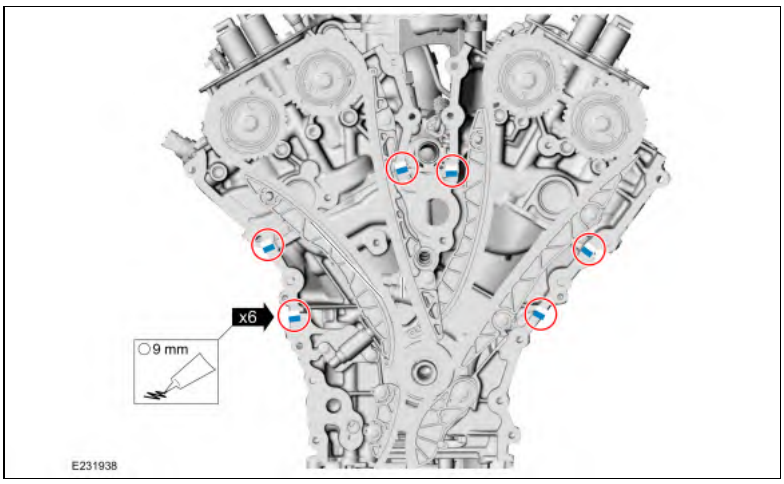
78. Lubricate with clean engine oil and install a new oil gallery seal (6G068).



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

    NOTE: *The engine front cover must be installed within 10 minutes of applying the sealer and the bolts must be installed and tightened to 2-5 Nm (18-44 lb-in) within 15 of applying the sealer. Final tightening of the bolts must be completed within 60 minutes of applying the sealer. Failure to follow this procedure can cause future oil leakage.*

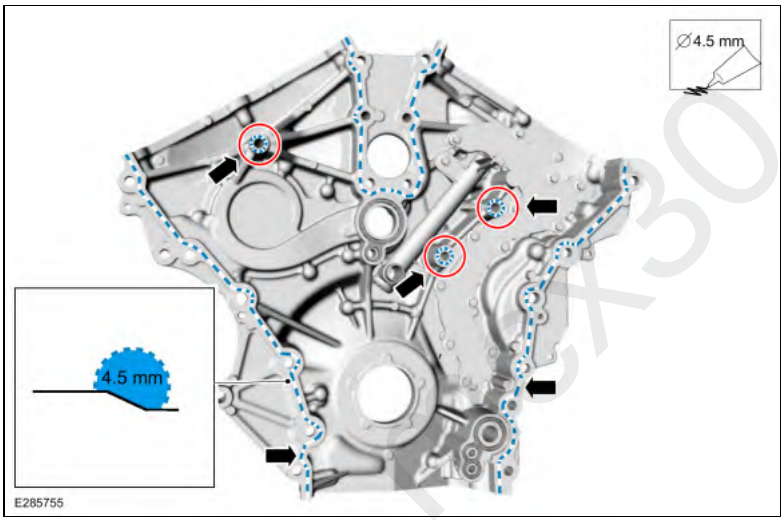
    Apply a 9 mm (0.35 in) bead of MotorcraftÂ® High Performance Engine RTV Silicone to the cylinder block skirt-to-cylinder block joint and the cylinder head-to-cylinder block joint areas as indicated.
    Material: MotorcraftÂ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



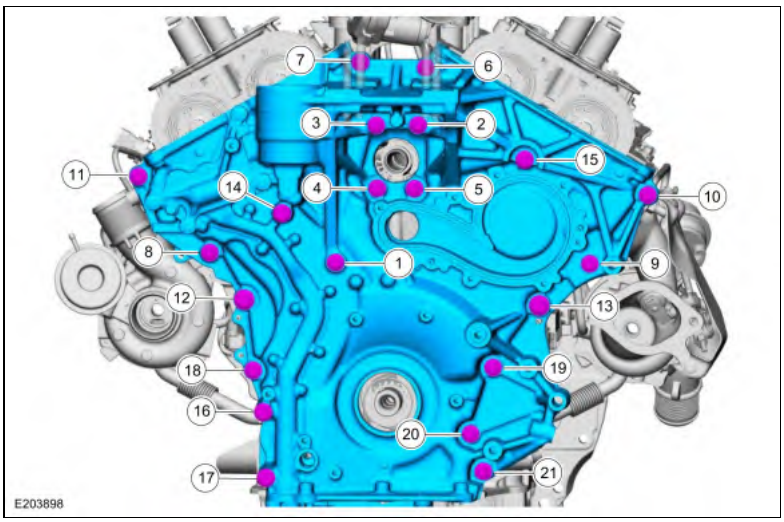
80. **NOTICE: Failure to use MotorcraftÂ® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

    NOTE: *The engine front cover must be installed within 10 minutes of applying the sealer and the bolts must be installed and tightened to 2-5 Nm (18-44 lb-in) within 15 of applying the sealer. Final tightening of the bolts must be completed within 60 minutes of applying the sealer. Failure to follow this procedure can cause future oil leakage.*

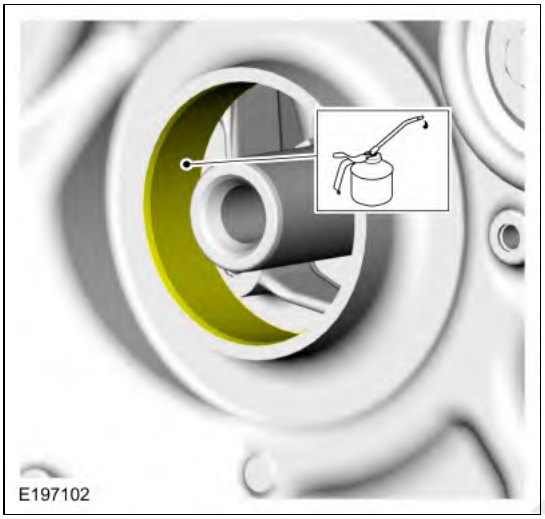
    1. Apply a 4.5 mm (0.18 in) bead of MotorcraftÂ® High Performance Engine RTV Silicone to the engine front cover sealing surfaces of the inner bolt bosses.
       Material: MotorcraftÂ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)
    2. Apply a 4.5 mm (0.18 in) bead of MotorcraftÂ® High Performance Engine RTV Silicone to the chamfer of the engine front cover sealing surfaces.
       Material: MotorcraftÂ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



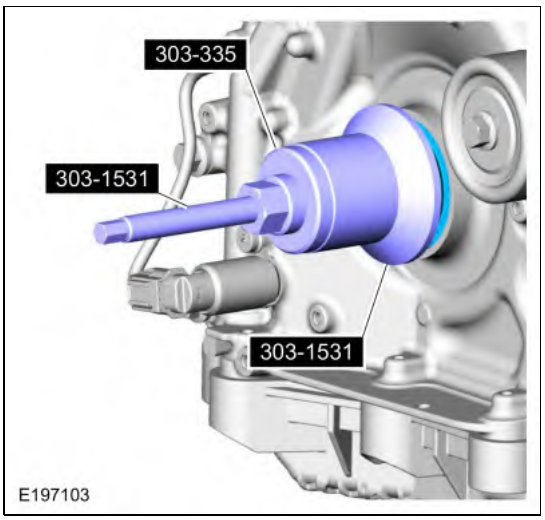
81. .
    Install the engine front cover and the fasteners.
    Torque:
    Stage 1: Tighten bolts 1 thru 11 to: 18 lb.ft (24 Nm)
    Stage 2: Tighten bolts 12 thru 13 to: 35 lb.ft (48 Nm)
    Stage 3: Tighten bolts 14 thru 21 to: 18 lb.ft (24 Nm)



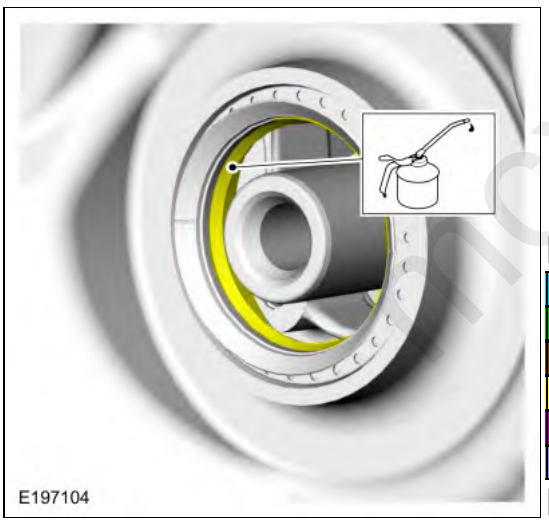
82. Lubricate the engine front cover bore with clean engine oil.



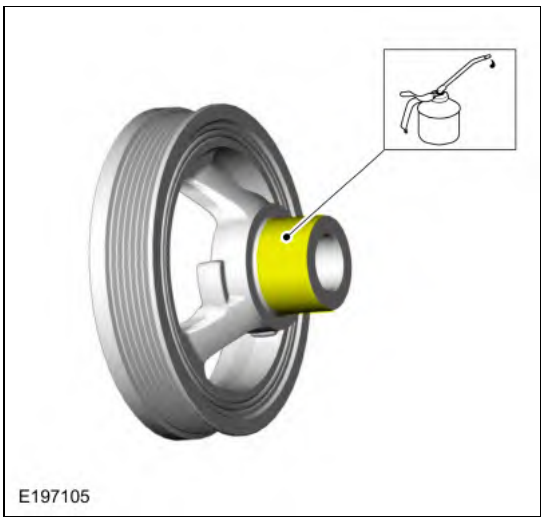
83. Using the special tools, install the new crankshaft front oil seal.
Use Special Service Tool: 303-335 (T88T-6701-A) Installer, Front Cover Oil Seal. , 303-1531 Installer, Front Crank Seal and Damper.



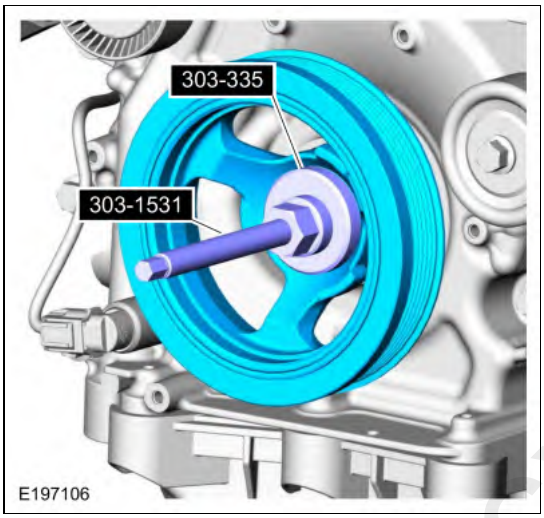
84. Lubricate the crankshaft front seal inner lip with clean engine oil.



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

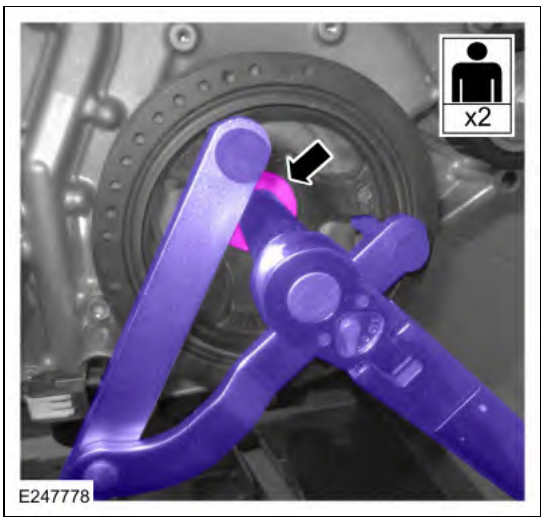


86. Using the special tools, install the crankshaft pulley.
Use Special Service Tool: 303-335 (T88T-6701-A) Installer, Front Cover Oil Seal. , 303-1531 Installer, Front Crank Seal and Damper.

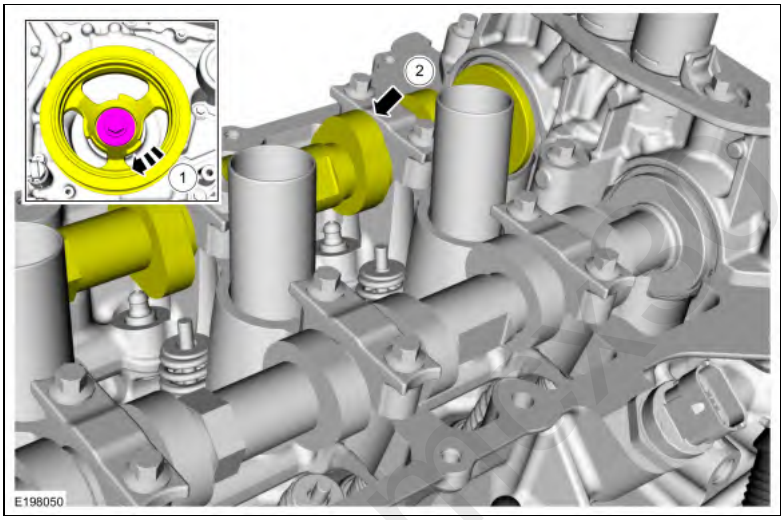


87. **NOTE:** *Use a universal pulley holder (such as an OTC 4754, or equivalent).*

Using a universal pulley holder, install and tighten a new crankshaft pulley bolt.
Torque:
Stage 1: 166 lb.ft (225 Nm)
Stage 2: Loosen: 360Â°
Stage 3: 26 lb.ft (35 Nm)
Stage 4: 270Â°

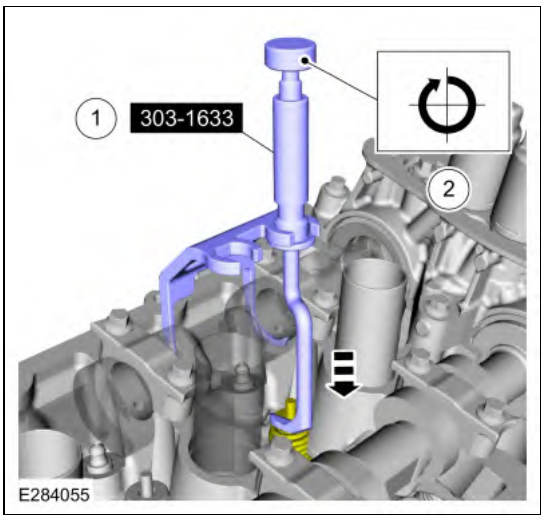


88. Rotate the crankshaft pulley bolt clockwise to position the camshaft lobe upward for the camshaft roller follower to be installed.



89.

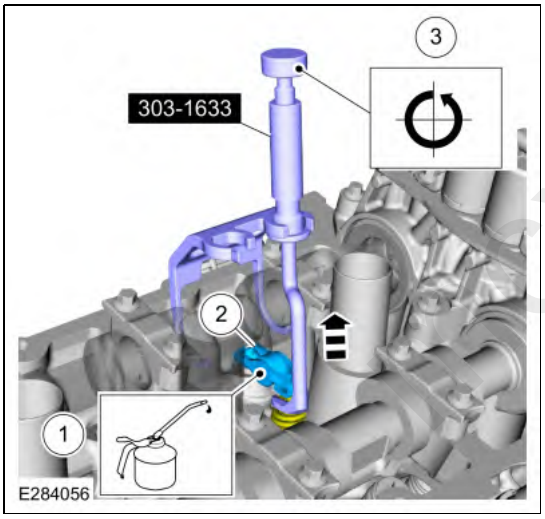
1. Install Special Service Tool: 303-1633 Remover, Roller Rocker Follower.
2. Turn the knob on the special tool clockwise to depress the valve and spring.



90.

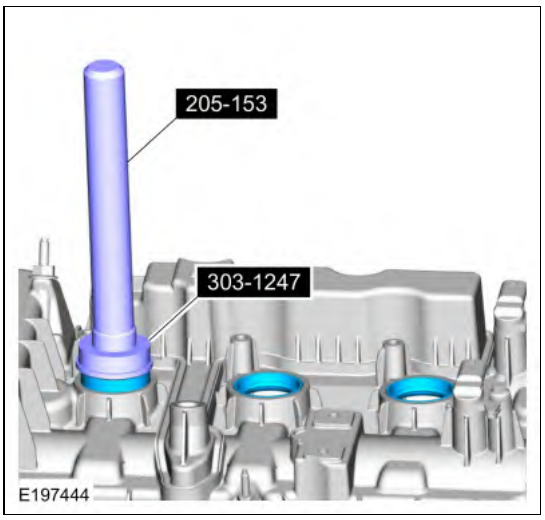
1. Lubricate the camshaft roller follower with clean engine oil.
2. Install the camshaft roller follower.
3. Turn the knob on the special tool counterclockwise to raise the valve and spring. Remove Special Service Tool: 303-1633 Remover, Roller Rocker Follower.

- Repeat steps for the remaining camshaft roller followers.

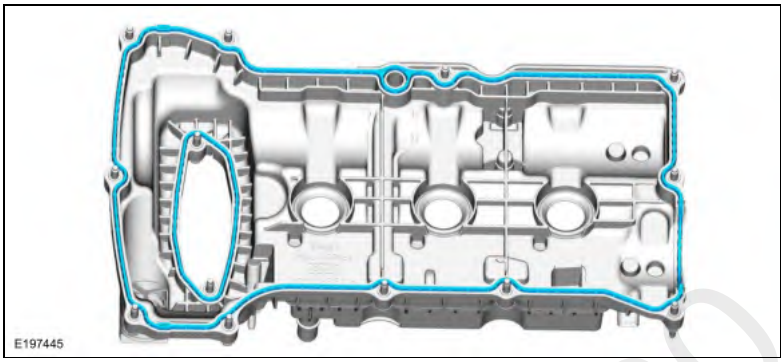


91. **NOTE:** *Installation of new seals is only required if damaged seals were removed.*

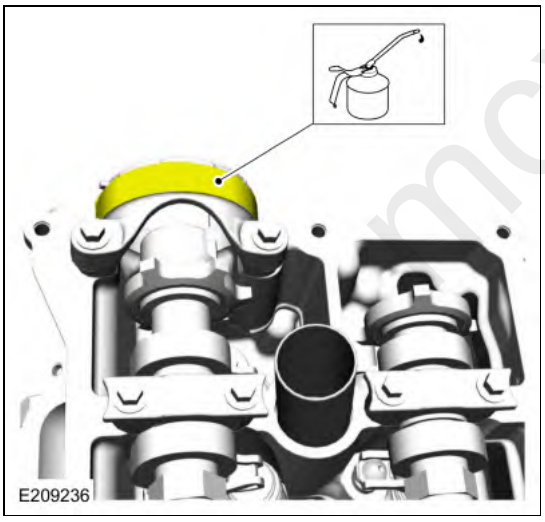
Using the special tools, install new spark plug tube seals.
Use Special Service Tool: 205-153 (T80T-4000-W) Handle. , 303-1247 VCT Spark Plug Tube Seal Remover and Installer.



92. Install a new gasket.

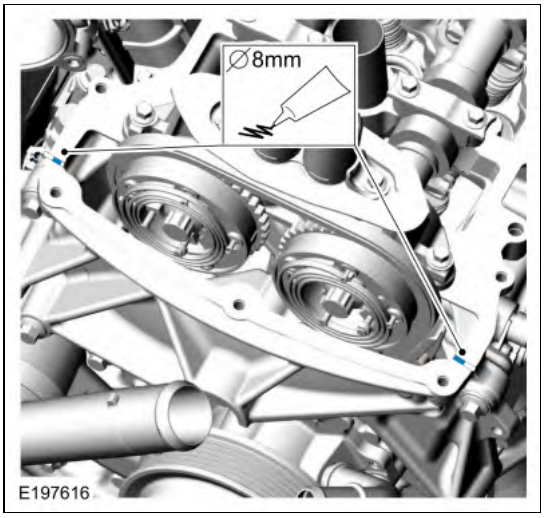


93. Apply clean engine oil to the surface.

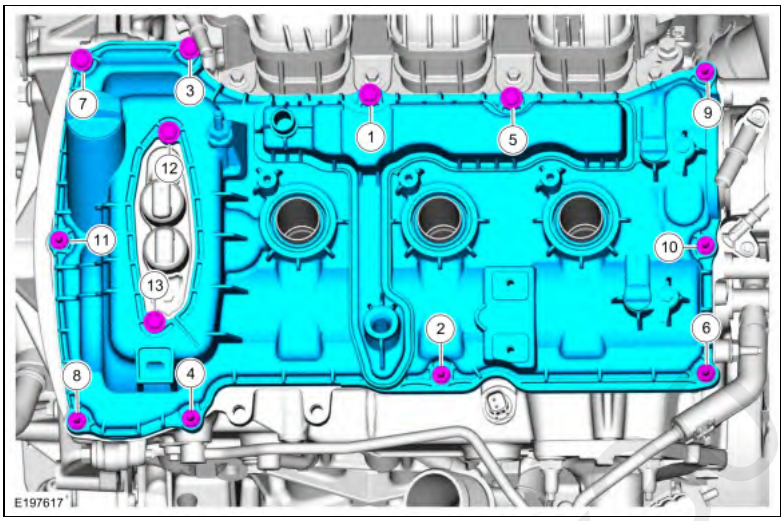


94. **NOTICE: If the valve cover is not installed and the fasteners tightened within 10 minutes, the sealant must be removed and the sealing area cleaned.**

Apply an 8 mm (0.31 in) bead of MotorcraftÂ® High Performance Engine RTV Silicone to the engine front cover-to-cylinder head joints.
Material: MotorcraftÂ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)

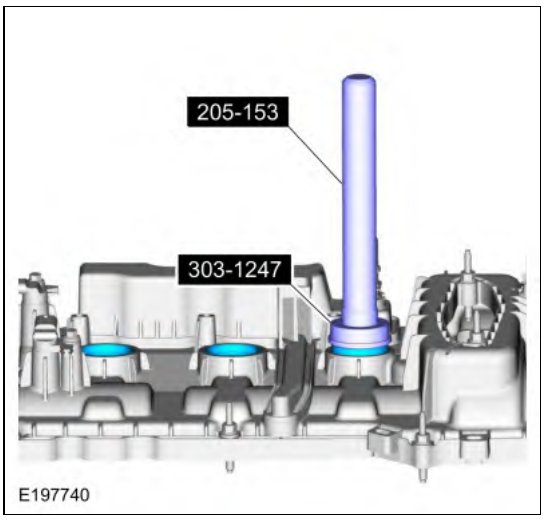


95. Install the valve cover and tighten the bolts.
Torque: 89 lb.in (10 Nm)

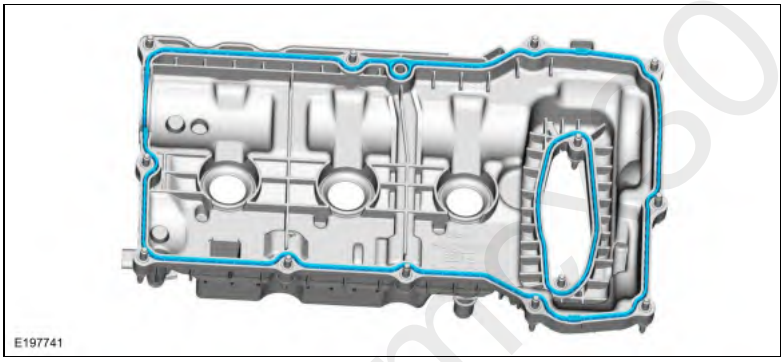


96. **NOTE:** *Installation of new seals is only required if damaged seals were removed.*

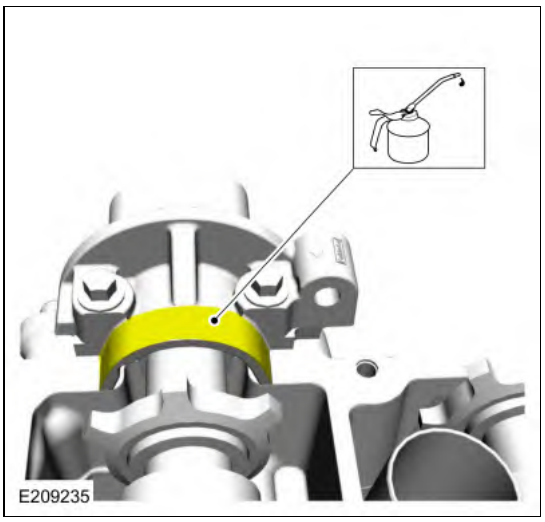
Using the special tools, install new spark plug tube seals.
Use Special Service Tool: 205-153 (T80T-4000-W) Handle. , 303-1247 VCT Spark Plug Tube Seal Remover and Installer.



97. Install a new gasket.

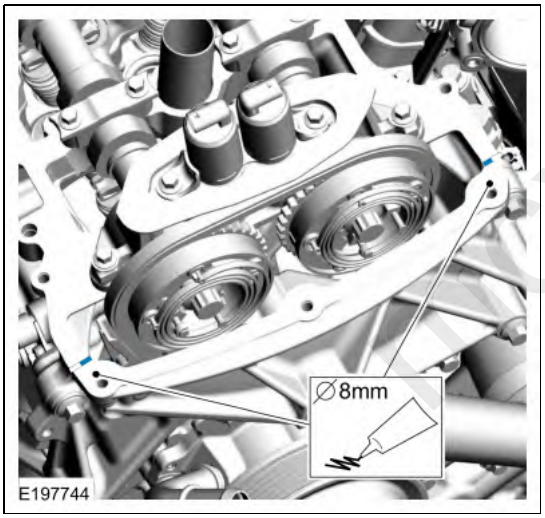


98. Apply clean engine oil to the surface.

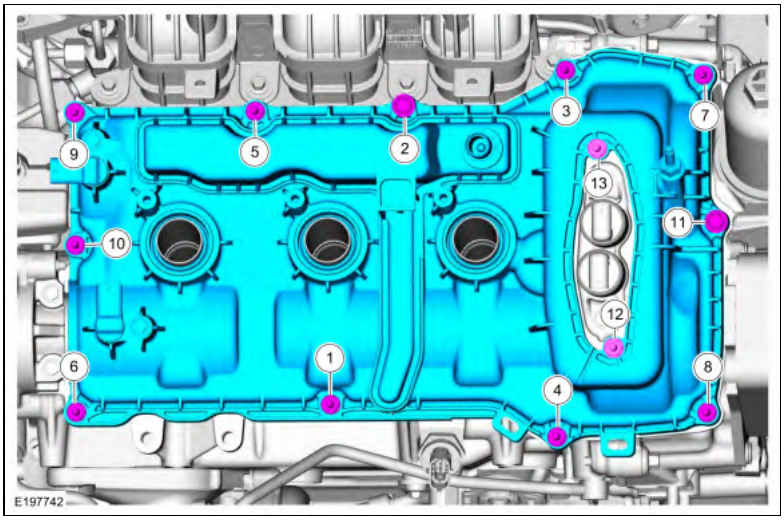


99. **NOTICE: If the valve cover is not installed and the fasteners tightened within 10 minutes, the sealant must be removed and the sealing area cleaned.**

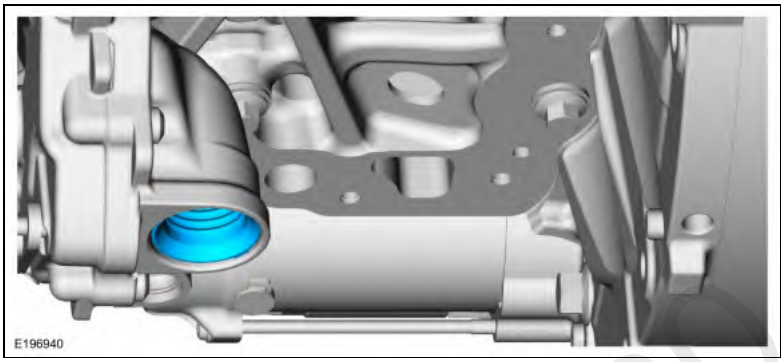
    Apply an 8 mm (0.31 in) bead of MotorcraftÂ® High Performance Engine RTV Silicone to the engine front cover-to-cylinder head joints.
    Material: MotorcraftÂ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



100. Install the valve cover and tighten the bolts.
    Torque: 89 lb.in (10 Nm)



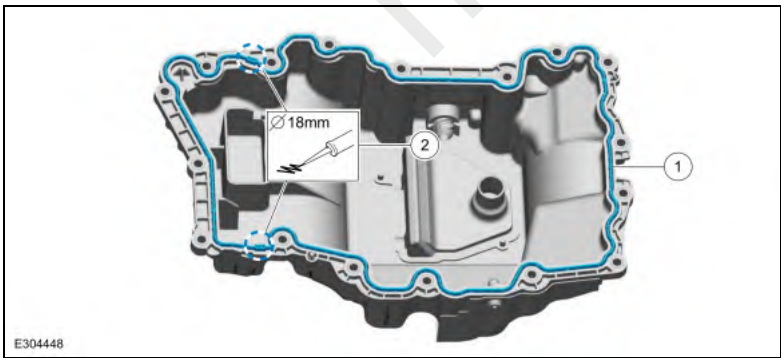
101. Install a new oil pump seal.



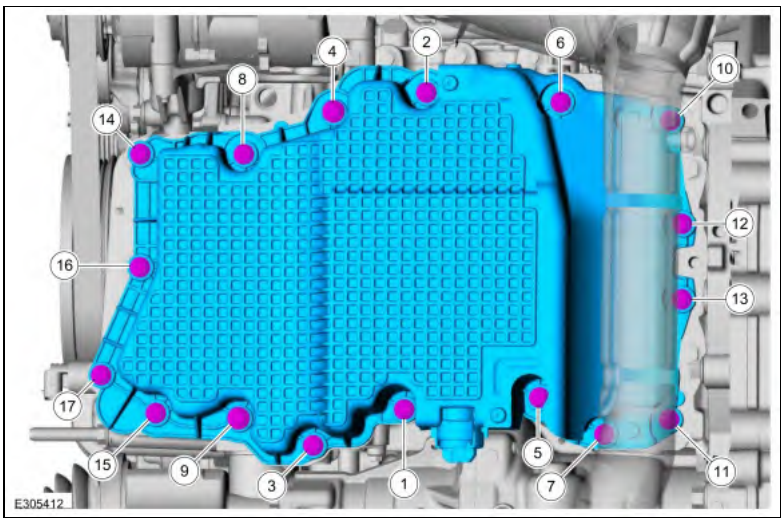
102. **NOTICE: Failure to use MotorcraftÂ® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.**

NOTE: *The oil pan must be installed within 10 minutes of applying the sealer and the bolts must be installed and tightened to 2-5 Nm (18-44 lb-in) within 15 minutes of applying the sealer. Final tightening of the bolts must be completed within 60 minutes of applying the sealer. Failure to follow this procedure can cause future oil leakage.*

1. Install a new oil pan press-in-place gasket.
2. Apply a 18 mm (0.708 in) bead of MotorcraftÂ® High Performance Engine RTV Silicone to the engine front cover-to-cylinder block joint areas on the oil pan.
   Material: MotorcraftÂ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



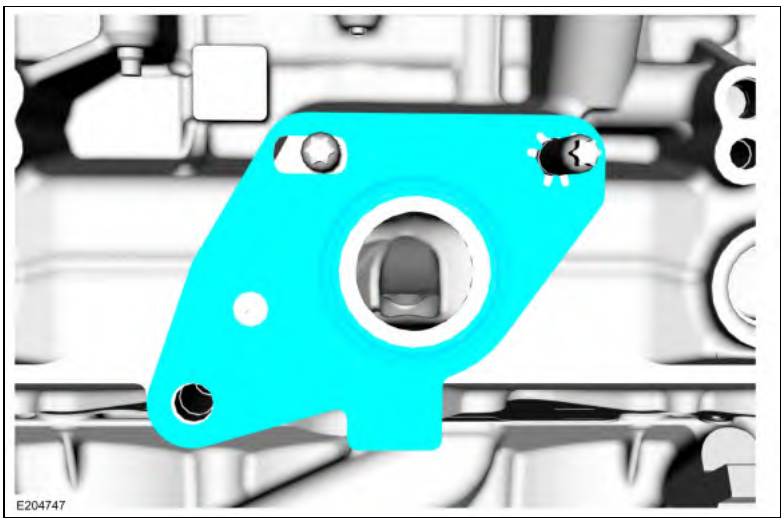
103. Install the oil pan and the bolts.
   Torque:
   Stage 1: 31 lb.in (3.5 Nm)
   Stage 2: 89 lb.in (10 Nm)



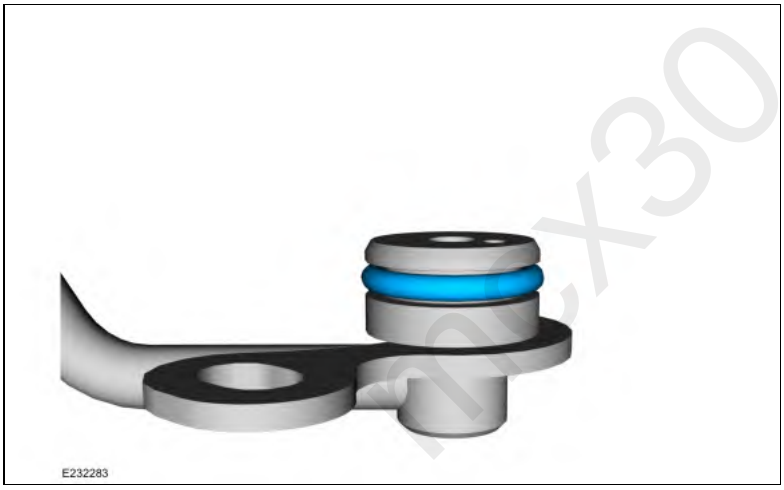
104. **NOTE:** *Install short end of stud into engine cylinder head.*

If removed install and tighten the turbocharger mounting studs.
Torque: 106 lb.in (12 Nm)

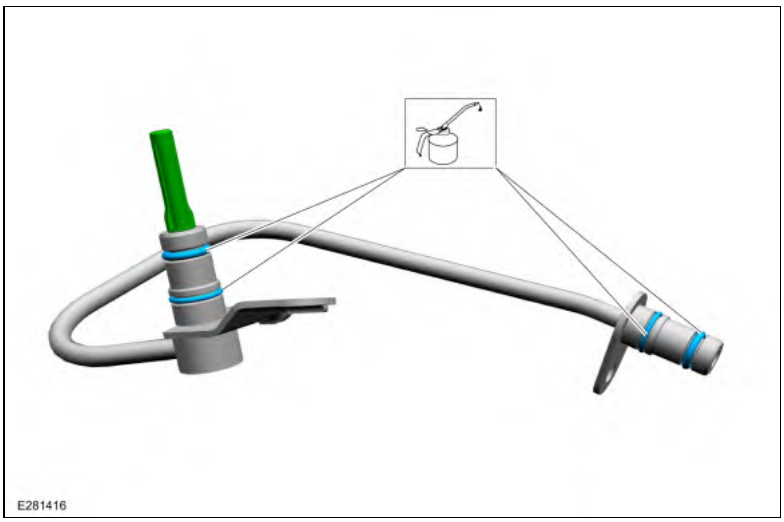
105. Install the new TC gasket.



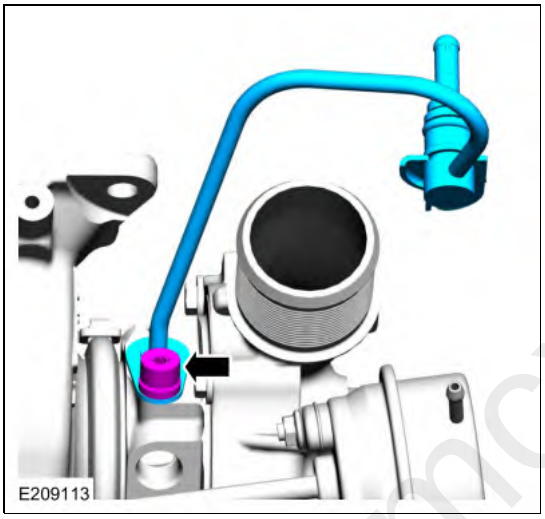
106. Install a new turbocharger coolant supply tube O-ring seal and lubricate with clean engine coolant.



107. Install the new turbocharger oil supply tube O-ring seals and the new turbocharger oil supply tube oil filter. Lubricate the O-ring seals with clean engine oil.

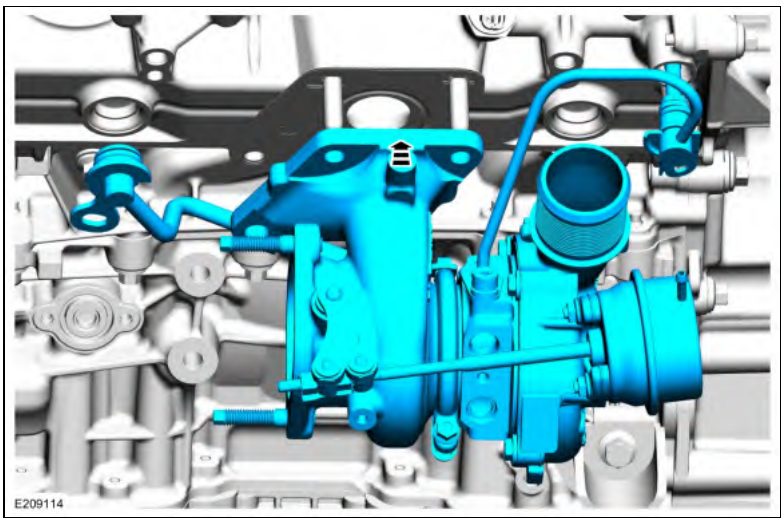


108. Install the TC oil supply tube and the bolt.
Torque: 89 lb.in (10 Nm)

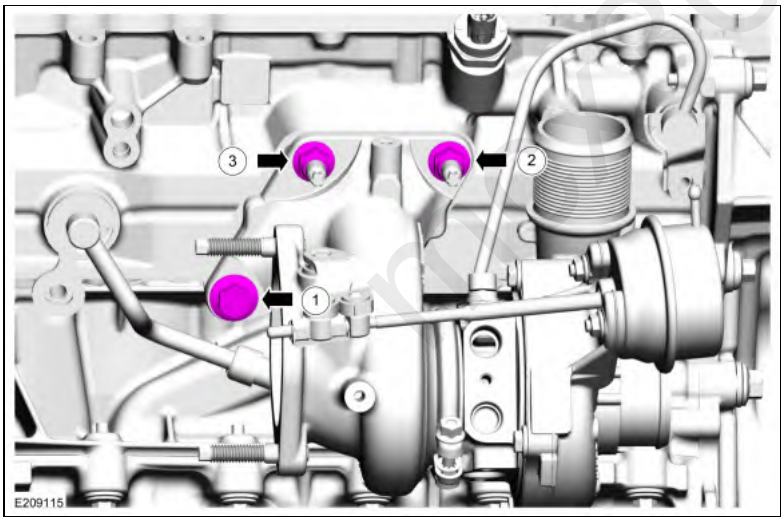


109. **NOTICE: Be careful not to damage the new filter when installing the oil supply tube into the engine block.**

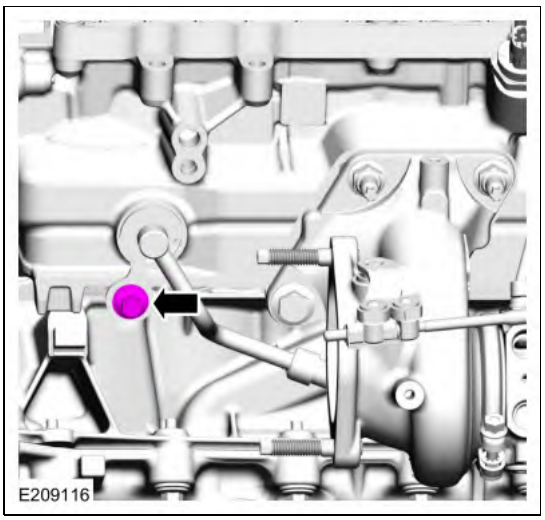
Position the TC assembly onto the studs. Install the coolant supply and oil supply tubes into the engine block while installing the TC.



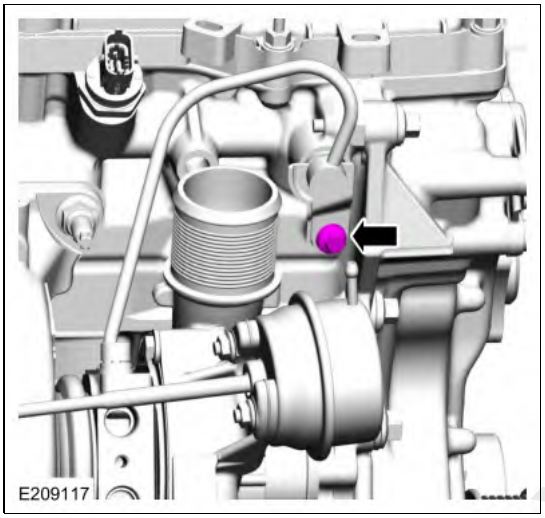
110. Install the nuts and bolt.
Torque:
1: 44 lb.ft (60 Nm)
2: 44 lb.ft (60 Nm)
3: 27 lb.ft (37 Nm)
Re-tighten 1: 44 lb.ft (60 Nm)
Re-tighten 2: 44 lb.ft (60 Nm)
Re-tighten 3: 27 lb.ft (37 Nm)



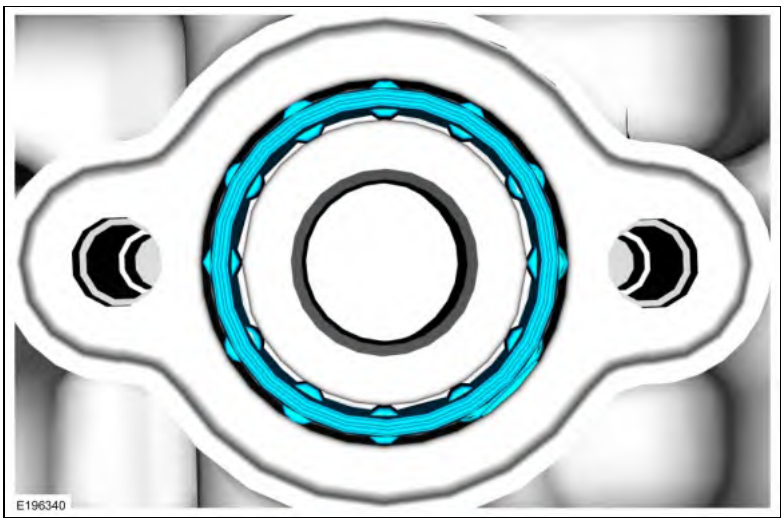
111. Install the TC coolant supply tube bolt.
Torque: 89 lb.in (10 Nm)



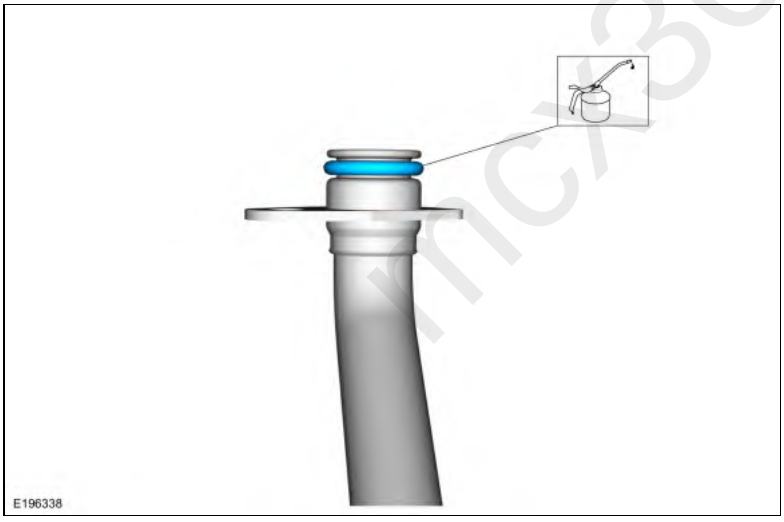
112. Install the TC oil supply tube bolt.
Torque: 89 lb.in (10 Nm)



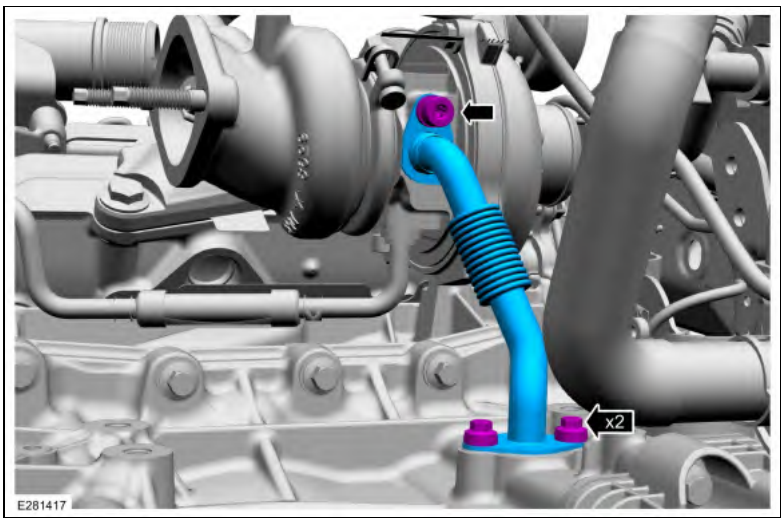
113. Install the new TC oil return tube-to-engine block gasket.



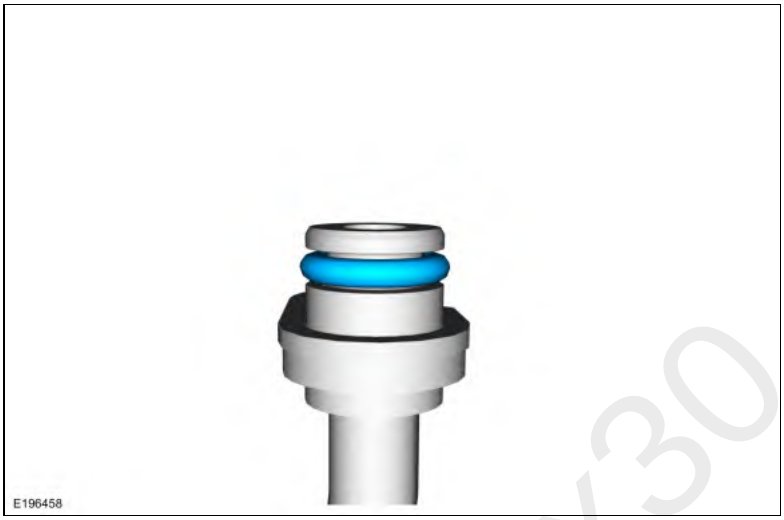
114. Install a new TC oil return tube O-ring seal and then lubricate with clean engine oil.



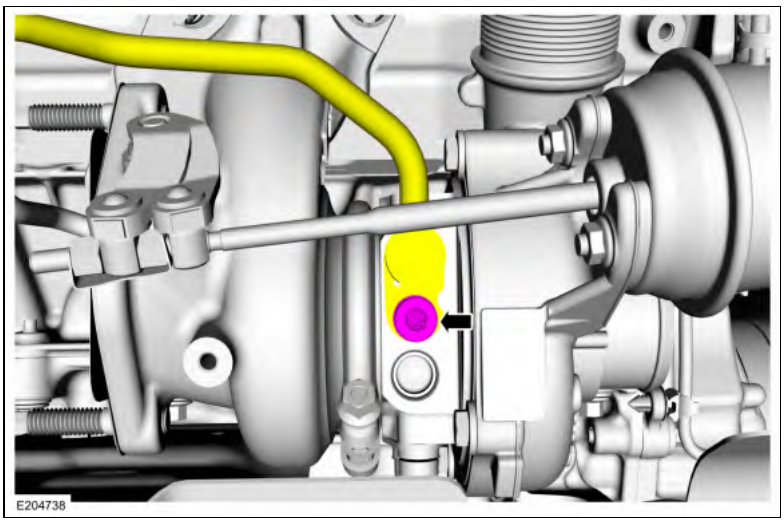
115. Install the TC oil return tube and the bolts.
Torque: 89 lb.in (10 Nm)



116. Install a new TC coolant return tube O-ring seal. Lubricate the new O-ring seal with clean engine coolant.



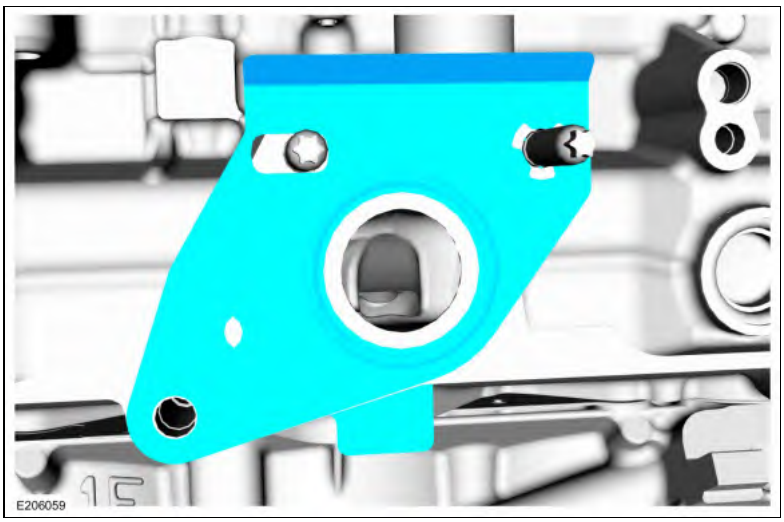
117. Install the TC coolant return tube to the TC and install the bolt.
Torque: 89 lb.in (10 Nm)



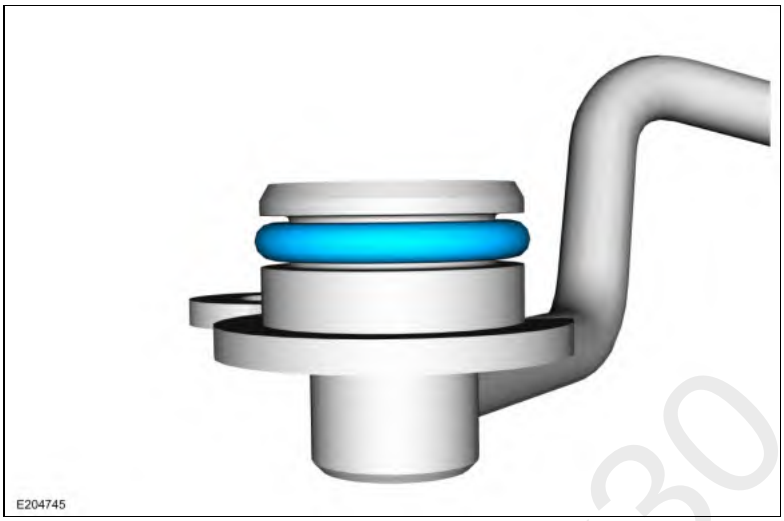
118. **NOTE:** *Install short end of stud into engine cylinder head.*

    If removed, install and tighten the turbocharger mounting studs.
    Torque: 106 lb.in (12 Nm)

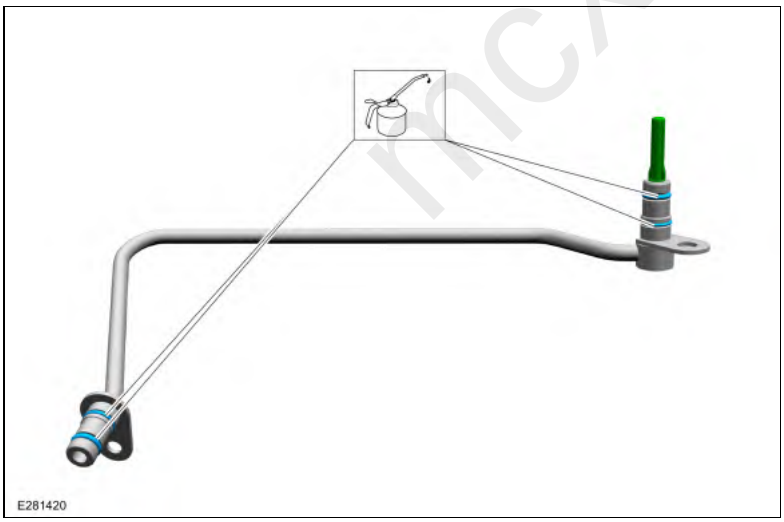
119. Install the new turbocharger gasket.



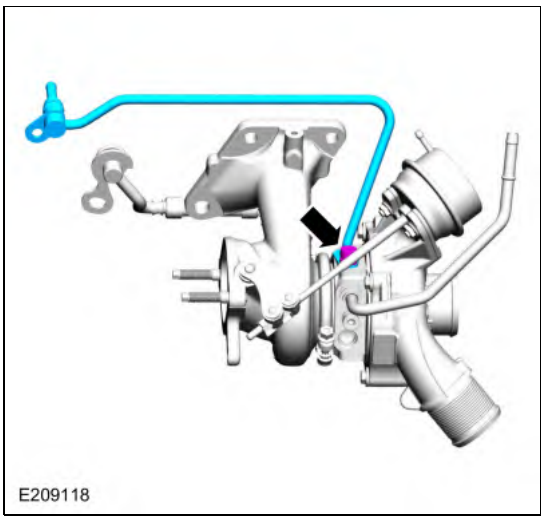
120. Install a new TC coolant supply tube O-ring seal. Lubricate the new O-ring seal with clean engine coolant.



121. Install the new turbocharger oil supply tube O-ring seals and the new turbocharger oil supply tube oil filter. Lubricate the new O-ring seals with clean engine oil.

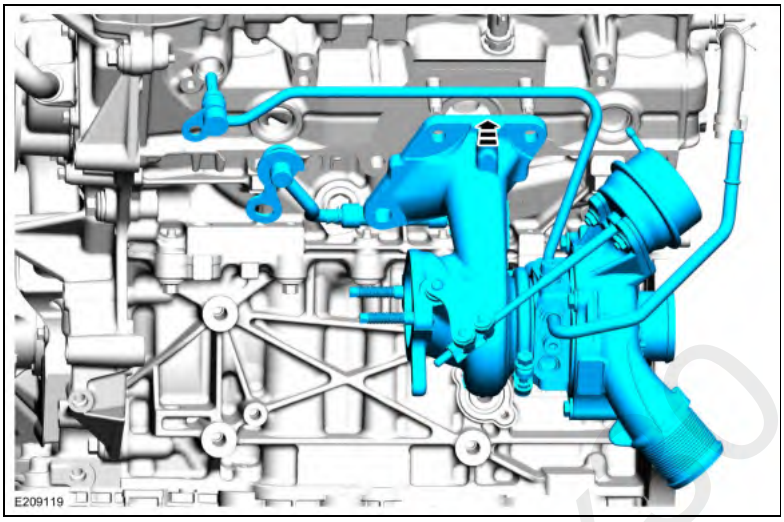


122. Install the TC oil supply tube and the bolt.
Torque: 89 lb.in (10 Nm)

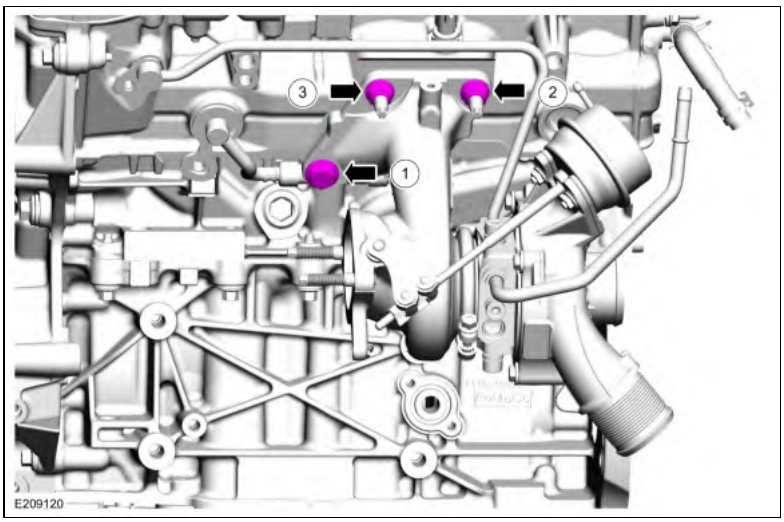


123. **NOTICE: Be careful not to damage the new filter when installing the oil supply tube into the engine block.**

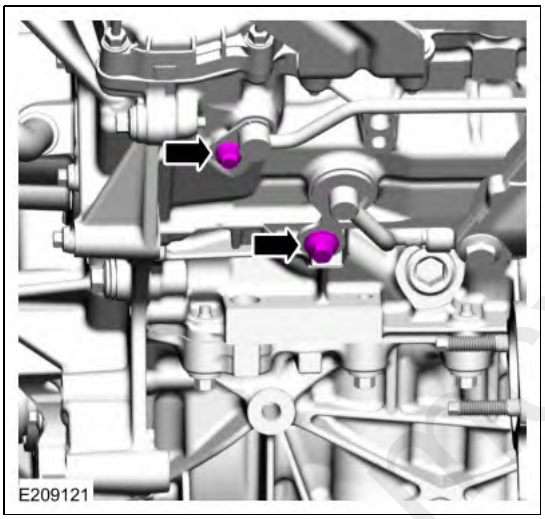
Position the TC assembly onto the studs. Install the coolant supply and oil supply tubes into the engine block while installing the TC.



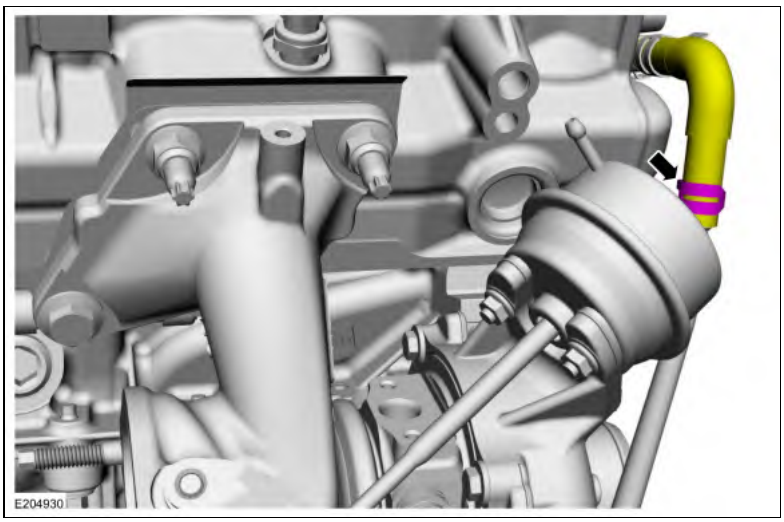
124. Install the nuts and bolt.
Torque:
1: 44 lb.ft (60 Nm)
2: 44 lb.ft (60 Nm)
3: 27 lb.ft (37 Nm)
Re-tighten 1: 44 lb.ft (60 Nm)
Re-tighten 2: 44 lb.ft (60 Nm)
Re-tighten 3: 27 lb.ft (37 Nm)



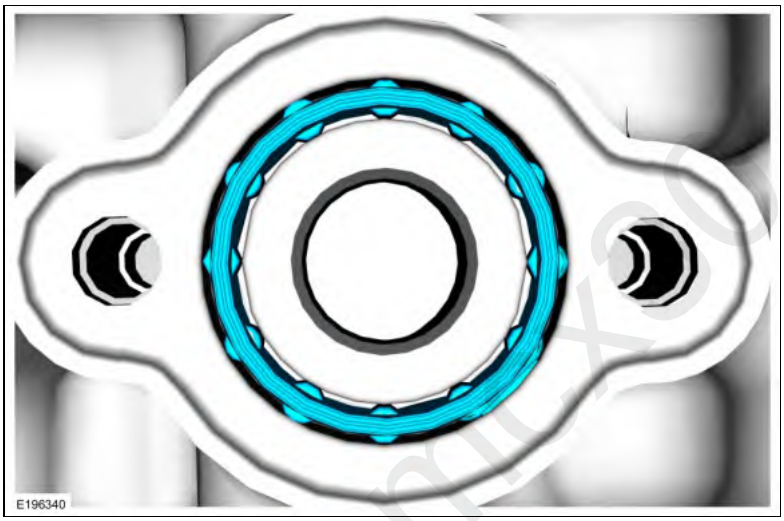
125. Install the TC coolant supply and oil supply tube bolts.
Torque: 89 lb.in (10 Nm)



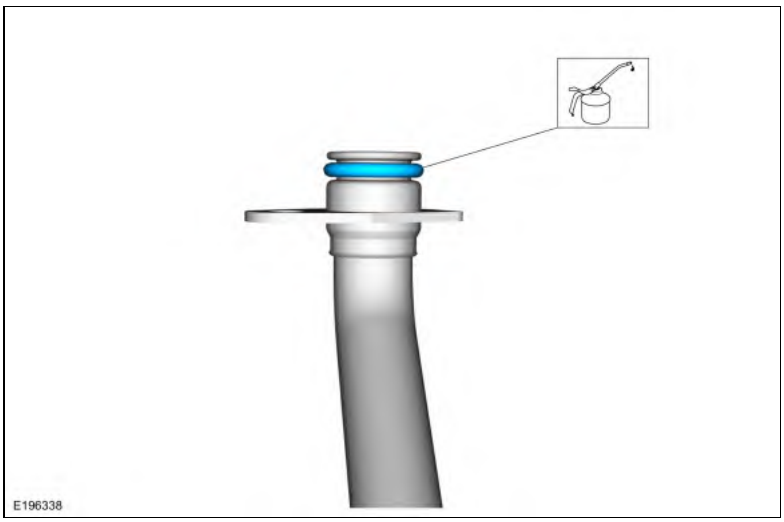
126. Connect the TC coolant return hose.
Use the General Equipment: Hose Clamp Remover/Installer



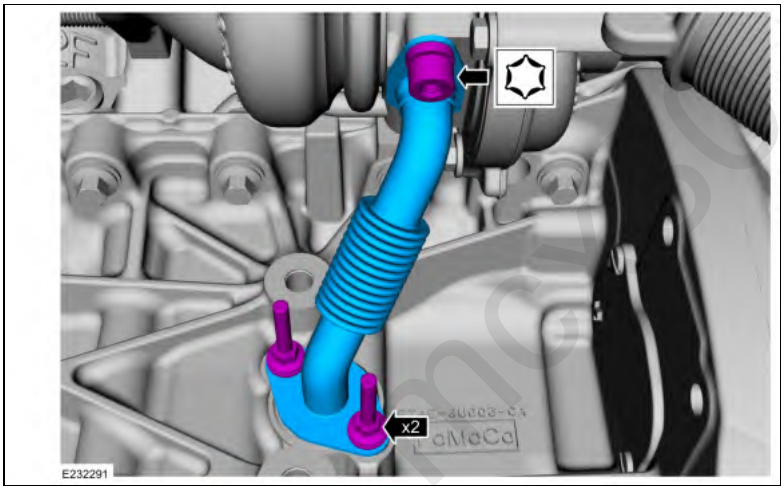
127. Install the new TC oil return tube-to-engine block gasket.



128. Install a new TC oil return tube O-ring seal and then lubricate with clean engine oil.

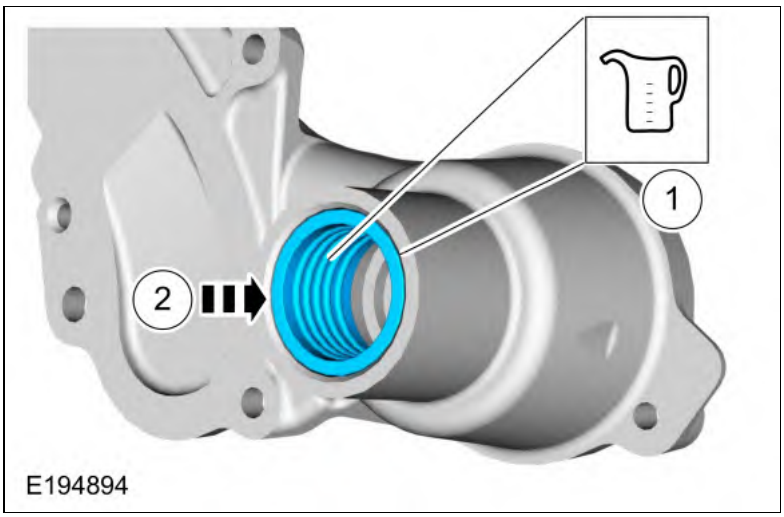


129. Install the TC oil return tube, then install and tighten the bolts.
Torque: 89 lb.in (10 Nm)



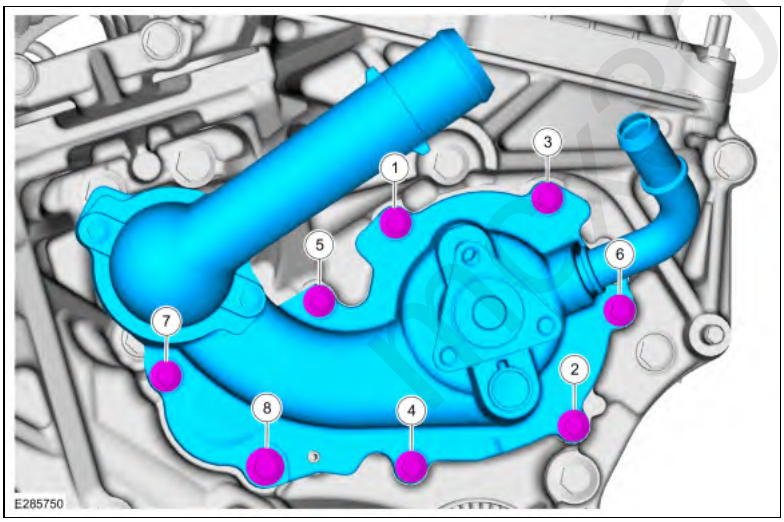
130.

- Lubricate the inside and the outside diameter of the grommet with clean engine coolant.
- Install the grommet so it is flush with the rear of the coolant pump housing.

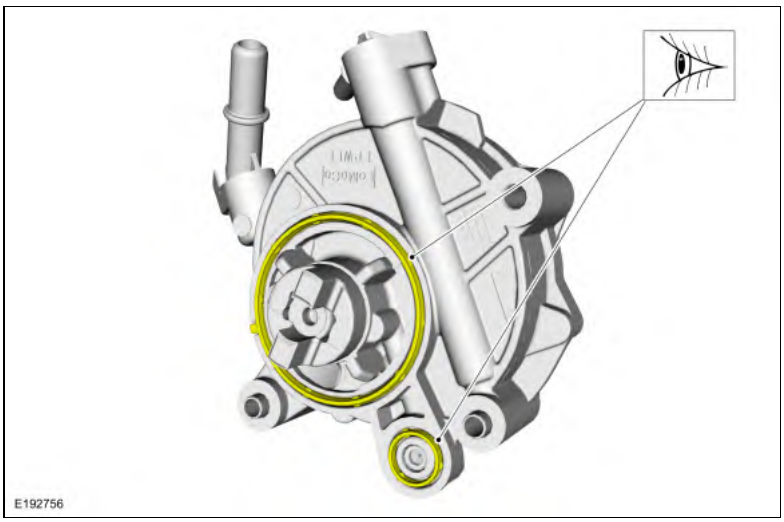


131. **NOTE:** *Verify the front cover dowel pins are aligned to the coolant pump and that the coolant pump is fully seated prior to installing the fasteners.*

- Using a new gasket, install the coolant pump and the fasteners.
  Torque:
  Fasteners 1-7:
  Stage 1: 89 lb.in (10 Nm)
  Stage 2: 45Â°
- *Torque*:
  Fastener 8: 18 lb.ft (24 Nm)

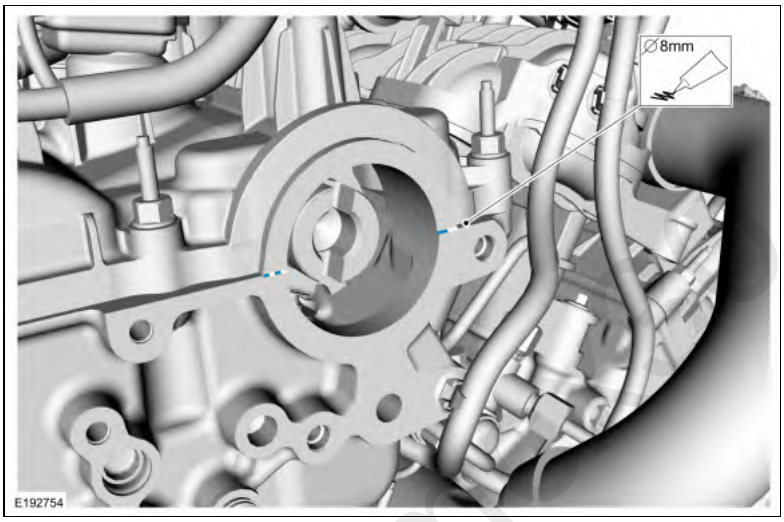


132. Inspect the gaskets and replace if damaged.

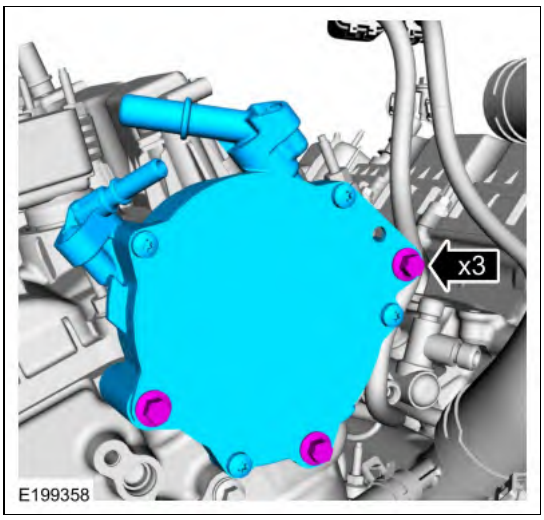


133. **NOTE:** *If the brake vacuum pump is not secured within 10 minutes of sealant application, the sealant must be removed and the sealing area cleaned with metal surface prep. Failure to follow this procedure can cause future oil leakage.*

Apply 8 mm (0.14 in) beads of MotorcraftÂ® High Performance Engine RTV Silicone as shown.

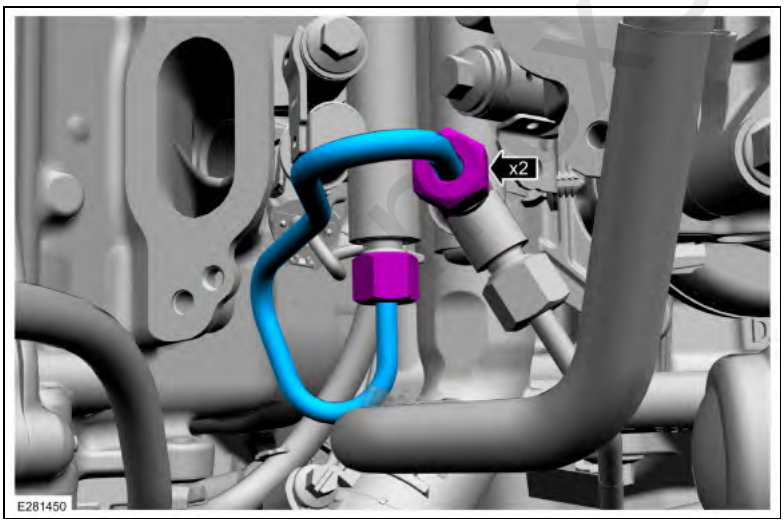


134. Install the brake vacuum pump and the bolts.
Torque: 89 lb.in (10 Nm)

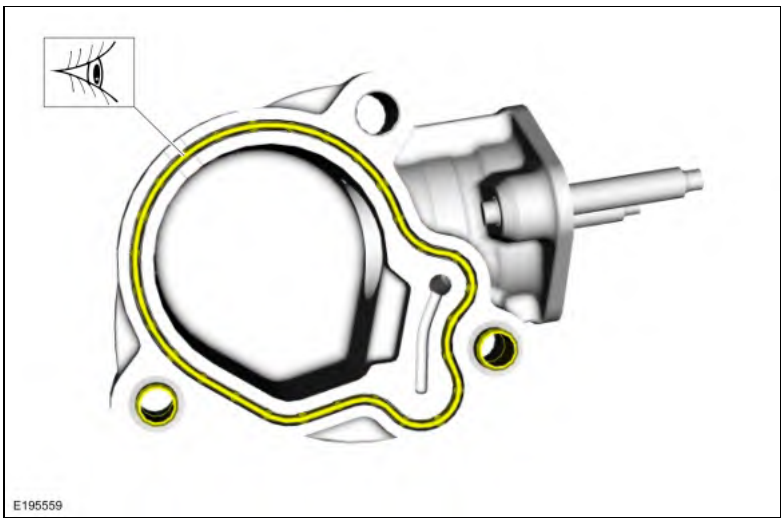


135. **NOTICE: In stage 3, if the torque required to tighten any flare nut on the new high-pressure fuel tube reaches or exceeds 55 lb.ft (75 Nm), then that high pressure fuel tube must be discarded and replaced with another new high-pressure fuel tube.**

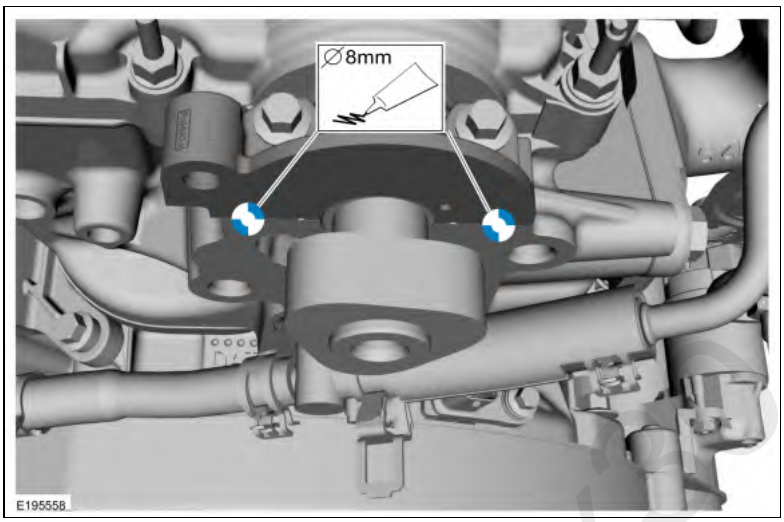
    Install a new fuel rail-to-fuel rail high-pressure fuel tube and finger tighten the flare nuts.
    - Final tighten the flare nuts.
      Torque:
      Stage 1: 62 lb.in (7 Nm)
      Stage 2: 89 lb.in (10 Nm)
      Stage 3: 25Â°



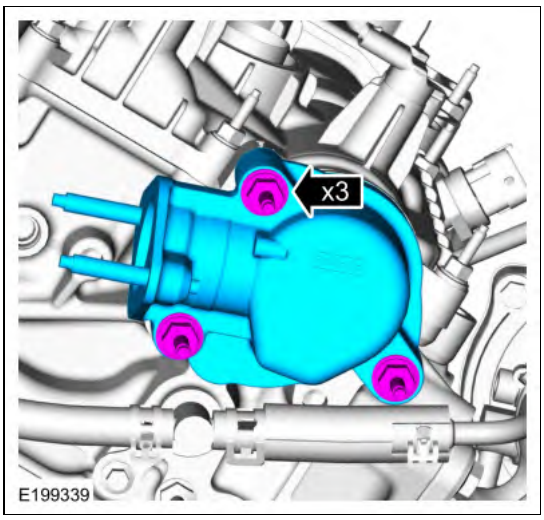
136. Inspect the high-pressure fuel pump drive unit gasket and replace if damaged.



137. Apply 8 mm dots of sealant to the camshaft bearing cap and cylinder head seam as shown.
Material: MotorcraftÂ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



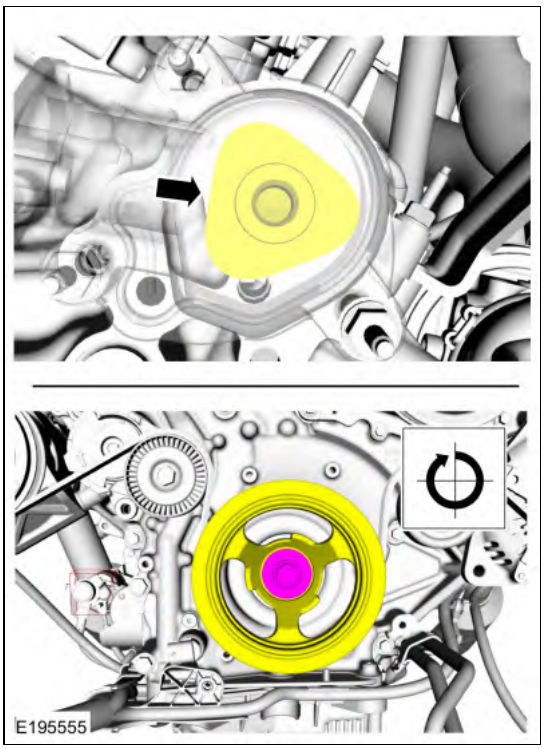
138. Install the high-pressure fuel pump drive unit and stud bolts.
Torque:
Stage 1: 177 lb.in (20 Nm)
Stage 2: 45Â°



139. **NOTICE: Only rotate the crankshaft Clockwise (CW) or damage to the engine may occur.**

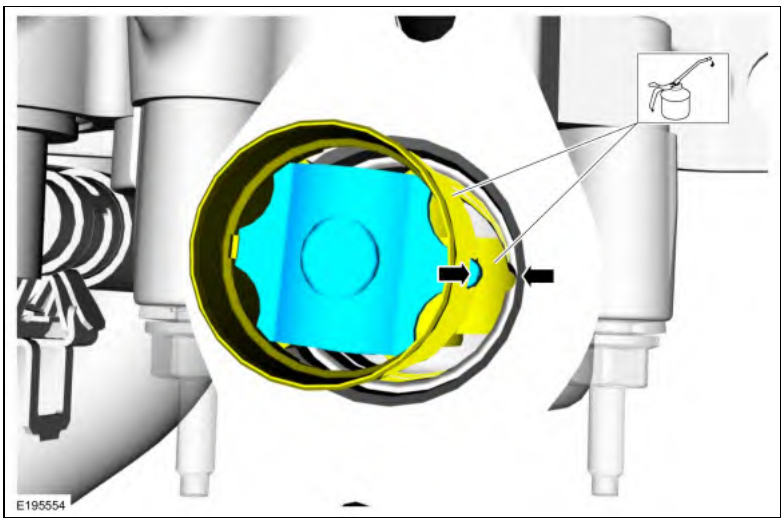
NOTICE: The drive lobe for the high-pressure fuel pump must be at BDC (bottom dead center) for the high-pressure fuel pump installation.

Using the crankshaft pulley bolt, turn the crankshaft until the high-pressure fuel pump drive lobe is at BDC.



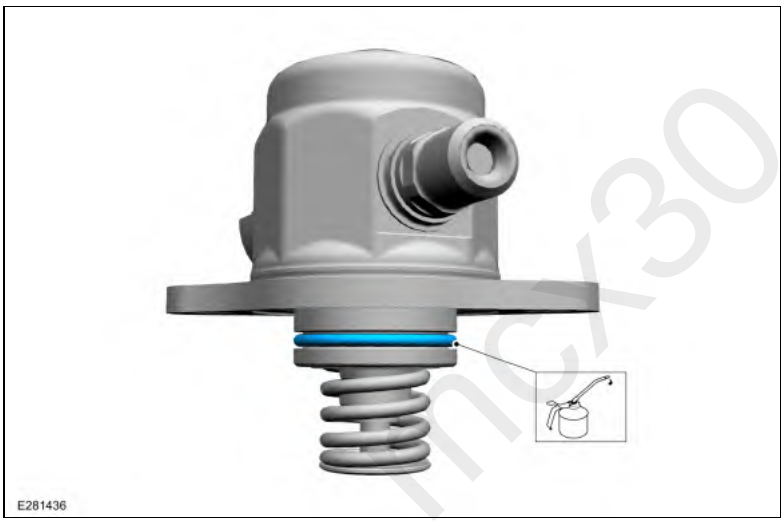
140. **NOTE:** *Align the notch on the high-pressure fuel pump tappet and with the groove in the high-pressure fuel pump drive unit bore.*

Apply clean engine oil to the high-pressure fuel pump drive unit bore, the drive lobe and the roller tappet. Install the high-pressure fuel pump tappet.

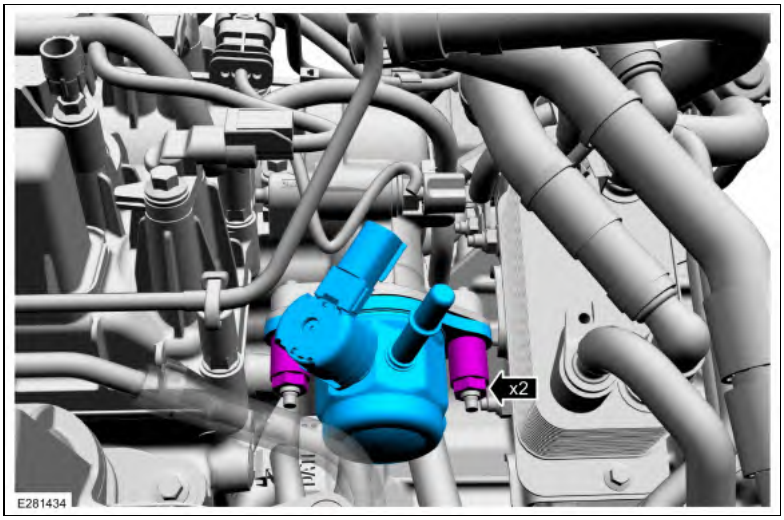


141. **NOTE:** *Apply clean engine oil to the high-pressure fuel pump O-ring seals.*

Install a new high-pressure fuel pump O-ring seal and lubricate with clean engine oil.

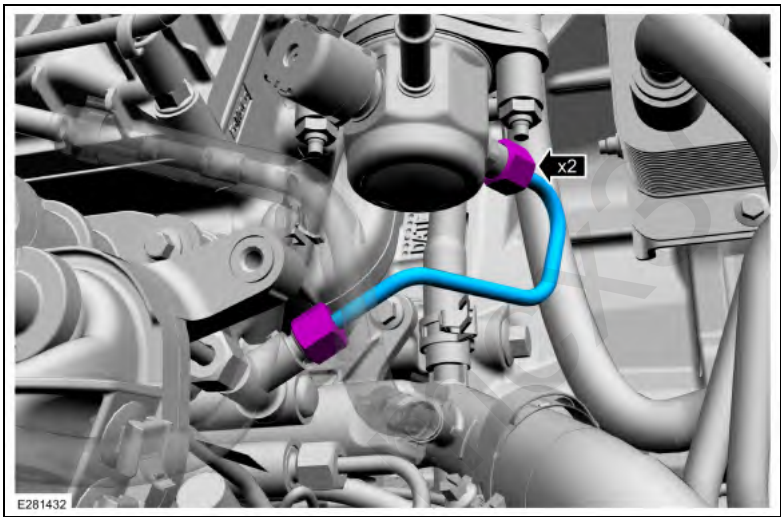


142. Install the high-pressure fuel pump, then install and finger tighten the high-pressure fuel pump nuts. Alternately tighten each of the high-pressure fuel pump nuts one complete revolution until seated. Then tighten the fuel high-pressure fuel pump nuts in the following 2 stages.
Torque:
Stage 1: 177 lb.in (20 Nm)
Stage 2: 45Â°

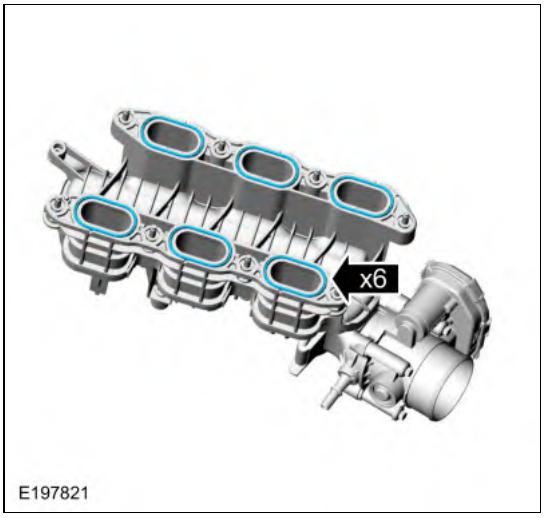


143. **NOTE:** *Make sure that a new high-pressure fuel pump-to-fuel rail high-pressure fuel tube is installed.*

Install the high-pressure fuel pump-to-fuel rail high-pressure fuel tube and tighten the flare nuts finger tight, then tighten the flare nuts in the following 3 stages.
Torque:
Stage 1: 62 lb.in (7 Nm)
Stage 2: 89 lb.in (10 Nm)
Stage 3: 25Â°

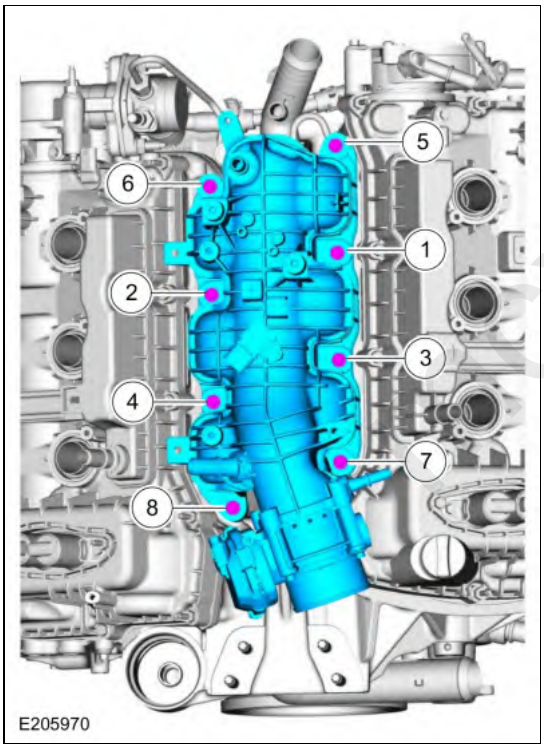


144. Install the gaskets.



145. **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 if found, install a new intake manifold. Failure to follow these instructions can result in engine damage.**

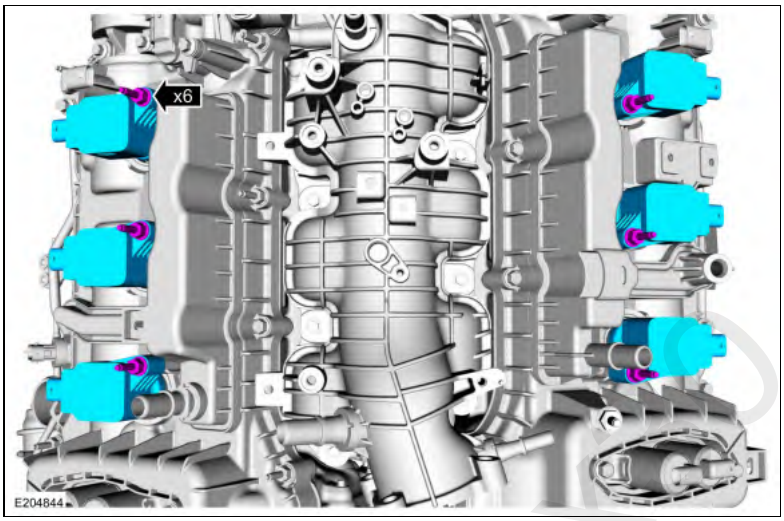
Install the intake manifold and tighten the bolts.
Torque: 89 lb.in (10 Nm)



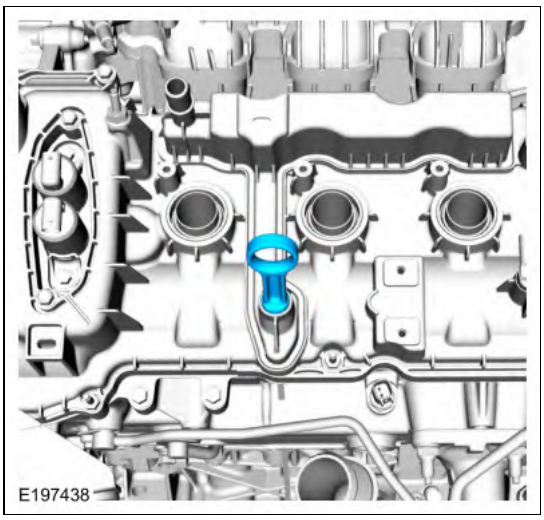
146. Inspect and replace any ignition coil-on-plugs that have rubber boots with cracks, rips or tears.

147.

1. Install the ignition coil-on-plugs.
2. Install and tighten the ignition coil-on-plug stud bolts.
   Torque: 53 lb.in (6 Nm)

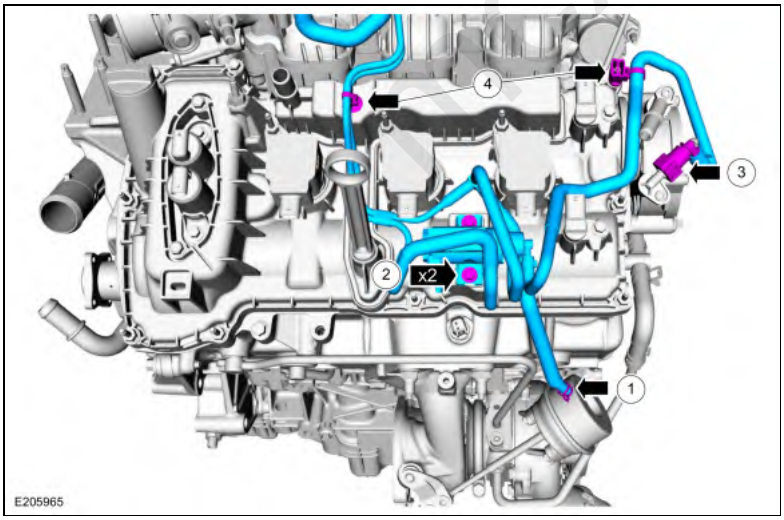


148. Install the oil level indicator.



149.

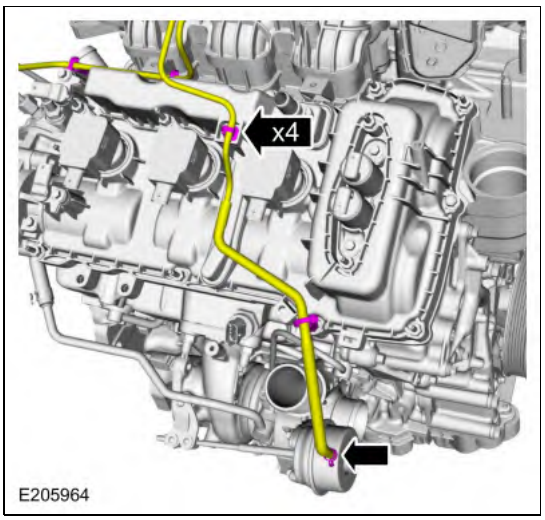
1. Install the vacuum tube assembly onto the engine and connect the vacuum hose and clamp to the TC.
2. Install the vacuum control solenoid bolts.
   Torque: 62 lb.in (7 Nm)
3. Connect the vacuum tube quick release coupling.
   Refer to: Quick Release Coupling (310-00 Fuel System - General Information - 2.7L EcoBoost (238kW/324PS)) .
4. Attach the vacuum hose retainers.



150.

Connect the vacuum hose and clamp to the TC.

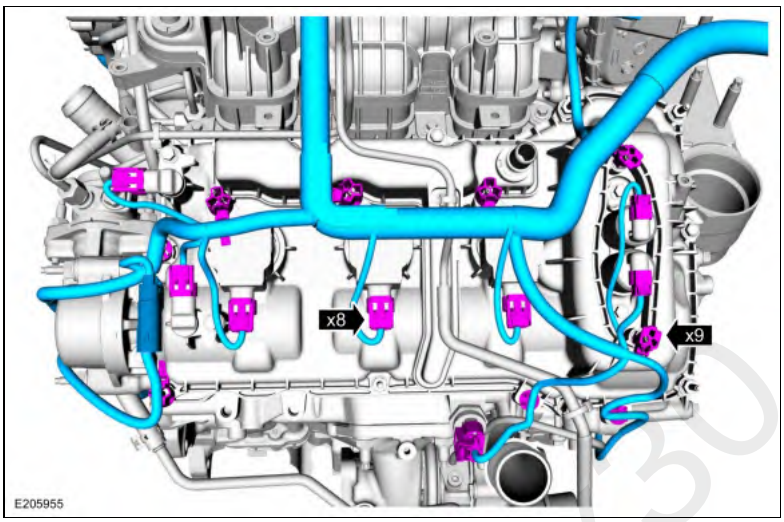
- Attach the vacuum hose retainers.



151.

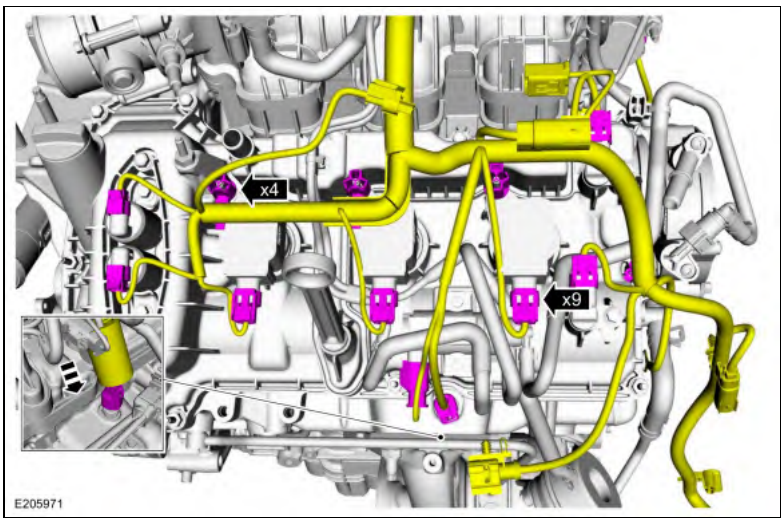
Install the engine wiring harness onto the engine.

- Connect the engine wiring harness electrical connectors and attach the retainers.



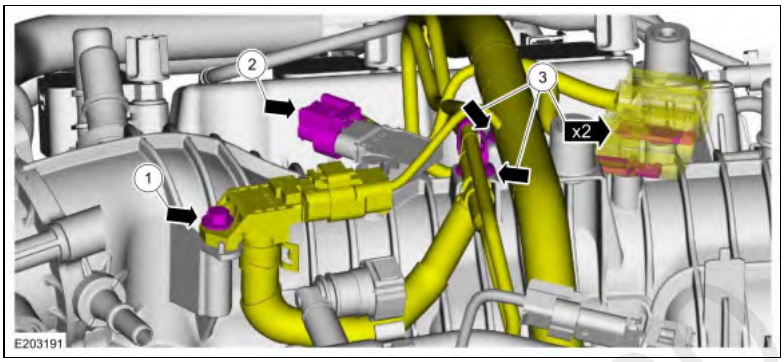
152.

- Connect the engine wiring harness electrical connectors and attach the wiring harness retainers.
- Slide the insulator down over the CHT electrical connector.

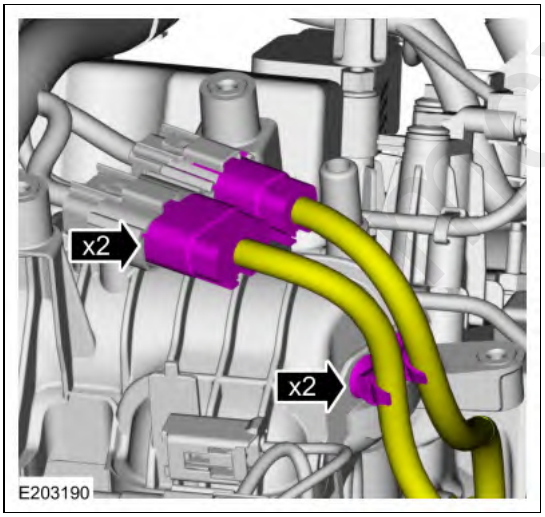


153.

1. Install the vacuum harness pressure sensor bolt.
   Torque: 62 lb.in (7 Nm)
2. Connect the MAP sensor electrical connector.
3. Attach the wiring harness and vacuum harness retainers.

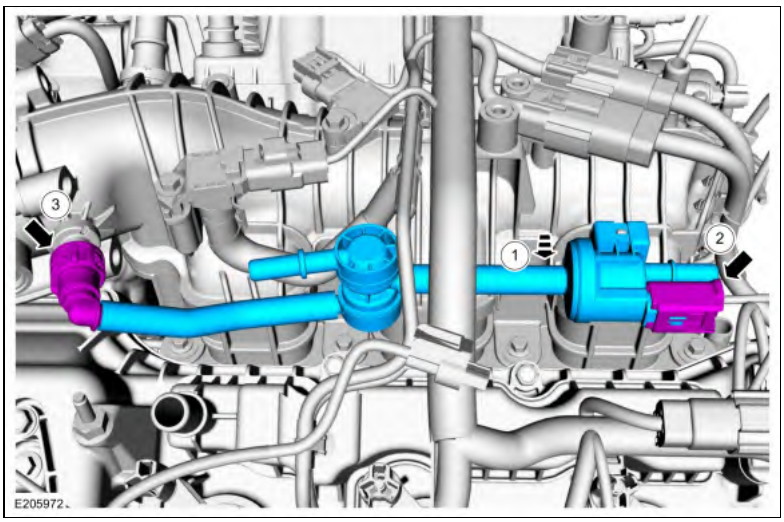


154. Connect the engine wiring harness electrical connectors and attach the retainers.



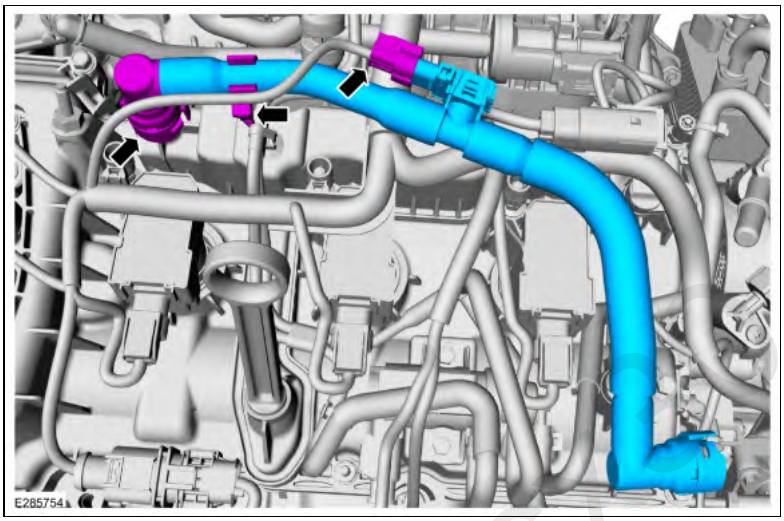
155.

1. Install the EVAP purge valve onto the intake manifold mounting tab.
2. Disconnect the EVAP tube quick release coupling.
   Refer to: Quick Release Coupling (310-00 Fuel System - General Information - 2.7L EcoBoost (238kW/324PS)) .
3. Connect the EVAP purge valve electrical connector.



156.

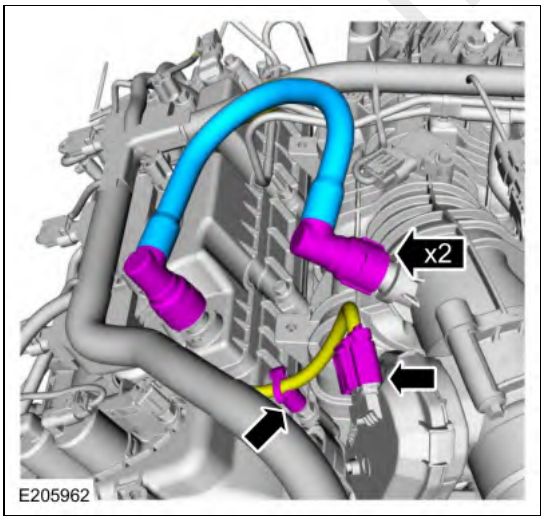
- Install the PCV tube and connect the quick release coupling.
  Refer to: Quick Release Coupling (310-00 Fuel System - General Information - 2.7L EcoBoost (238kW/324PS)) .
- Connect the crankcase pressure sensor electrical connector.
- Attach the PCV tube retainer.



157.

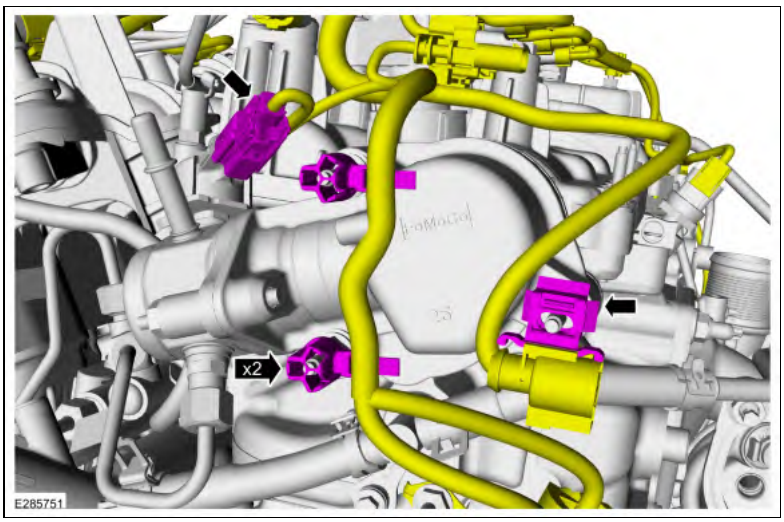
- Install the PCV tube and connect the quick release couplings.
  Refer to: Quick Release Coupling (310-00 Fuel System - General Information - 2.7L EcoBoost (238kW/324PS)) .

1. Connect the throttle body electrical connector and attach the wiring harness retainer.

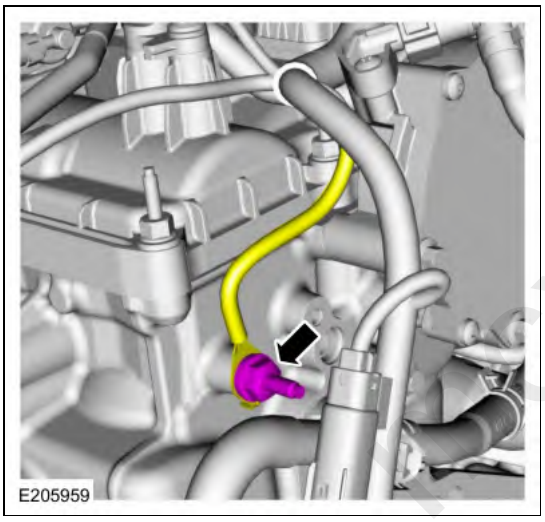


158.

- Connect the high pressure fuel pump electrical connector.
- Attach the wiring harness retainers.

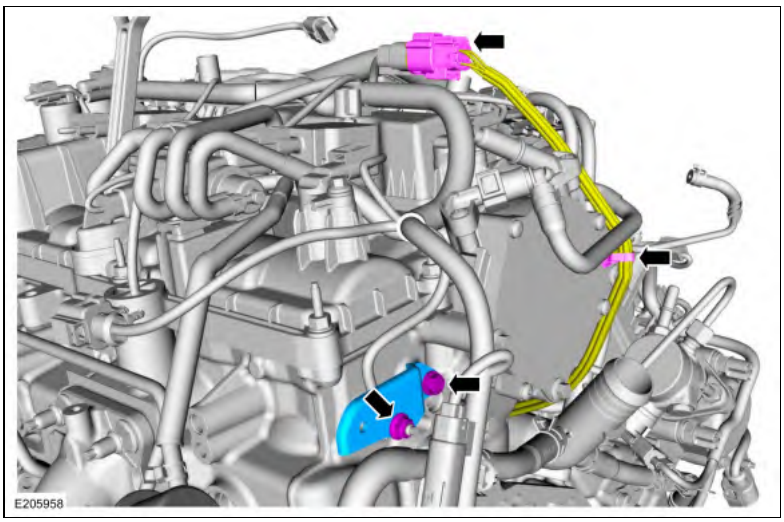


159. Install the ground wire and stud bolt.
Torque: 89 lb.in (10 Nm)

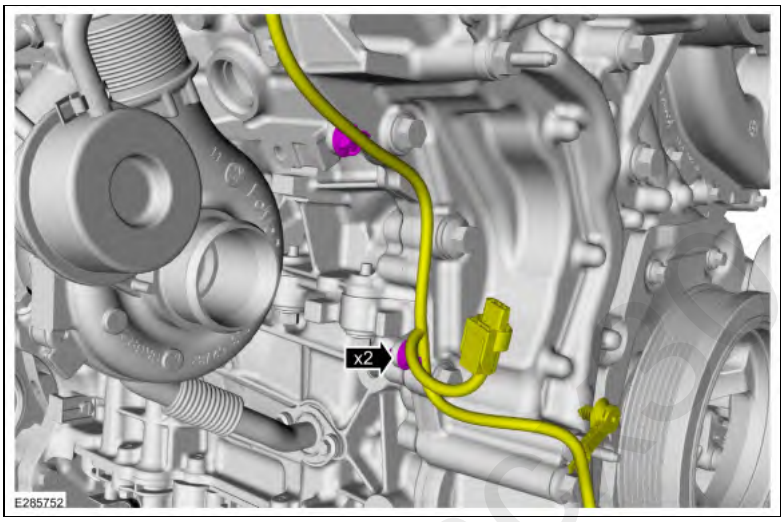


160.

- Install the bracket, the nut and bolt.
Torque: 53 lb.in (6 Nm)
- Connect the KS electrical connector.
- Attach the wiring harness retainer.

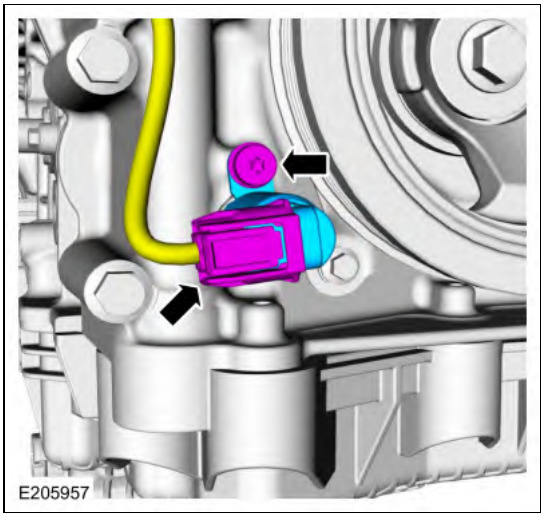


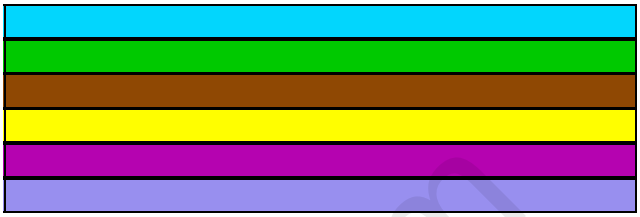
161. Attach the wiring harness retainers.



162.

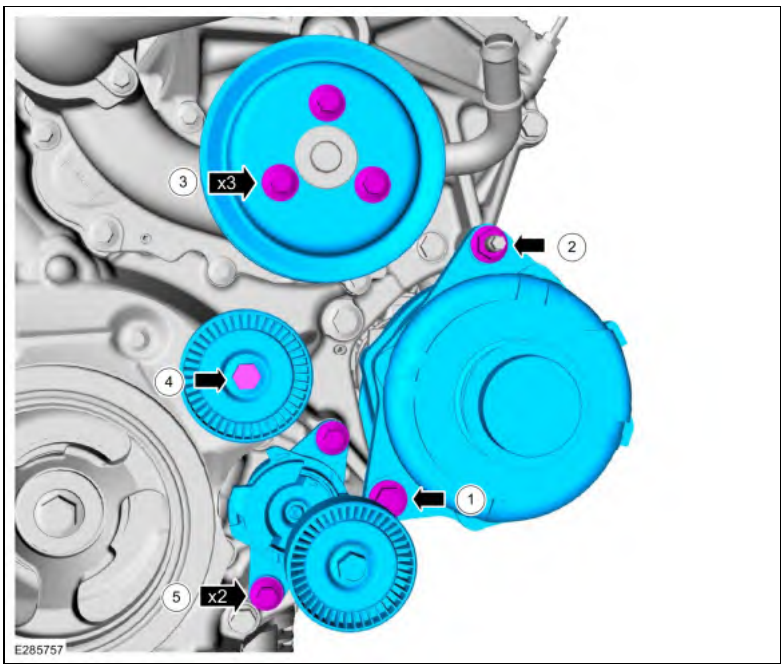
- Install the oil pressure control solenoid and the retainer.
  Torque: 89 lb.in (10 Nm)
- Connect the oil pressure control solenoid electrical connector.





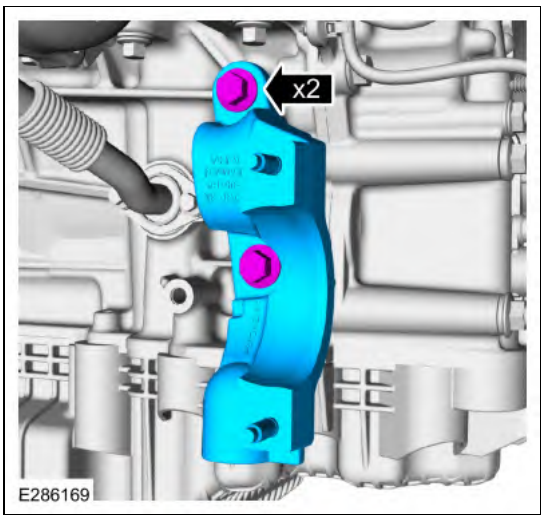
163.

- Install the generator and the bolt.
  Torque: 35 lb.ft (47 Nm)
- Install the generator nut.
  Torque: 35 lb.ft (47 Nm)
- Install the coolant pump pulley and the bolts.
  Torque: 89 lb.in (10 Nm)
- Install the idler pulley and bolt.
  Torque: 35 lb.ft (48 Nm)
- Install the accessory drive belt tensioner and the bolts.
  Torque: 18 lb.ft (25 Nm)



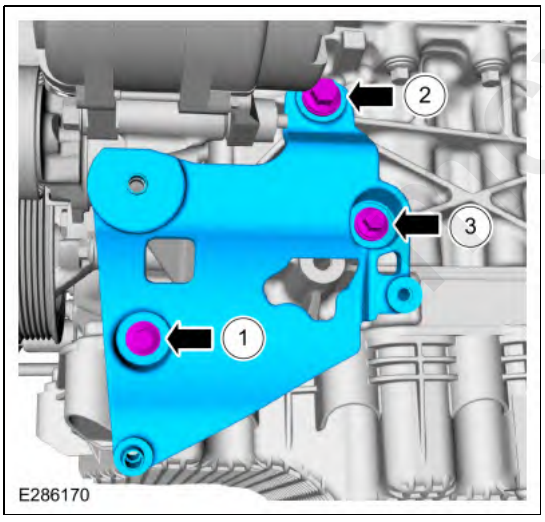
164. **NOTE:** *If equipped.*

Install the axle shaft bracket and the bolts.
Torque: 35 lb.ft (48 Nm)

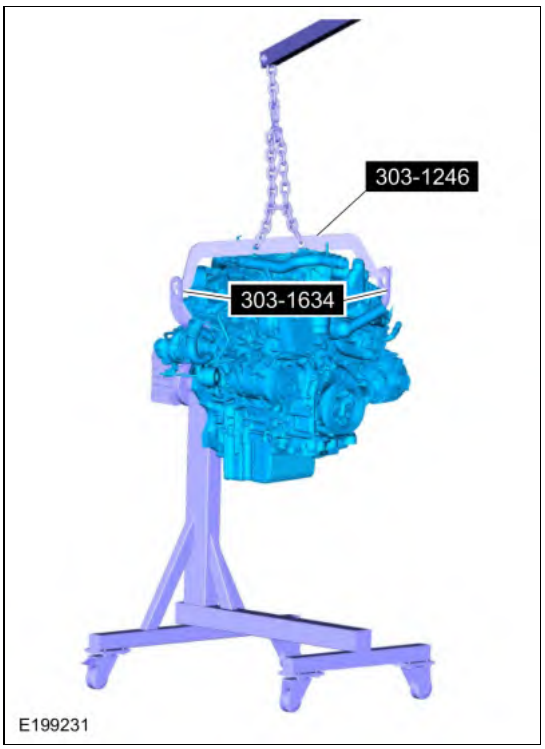


165.

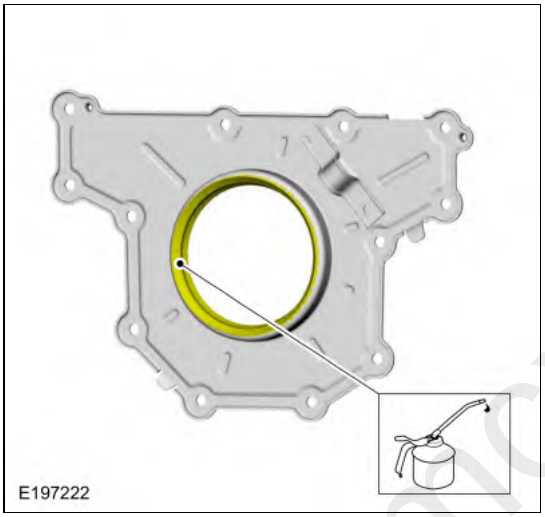
1. Install the A/C compressor mounting bracket and the M8 x 50mm bolt.
   Torque: 18 lb.ft (25 Nm)
2. Install the M10 x 43mm bolt.
   Torque: 35 lb.ft (47 Nm)
3. Install the M8 x 30mm bolt.
   Torque: 18 lb.ft (25 Nm)



166. Using a floor crane, remove the engine from the mounting stand.
   Install Special Service Tool: 303-1634 Lift Eyes (2). , 303-1246 Engine Spreader Bar.
   Use the General Equipment: Floor Crane
   Use the General Equipment: Mounting Stand

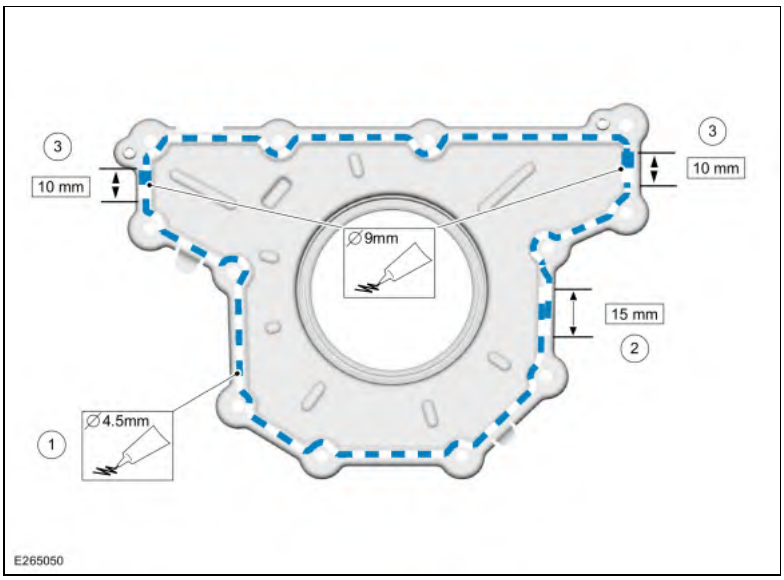


167. Lubricate the crankshaft rear seal lips with clean engine oil.



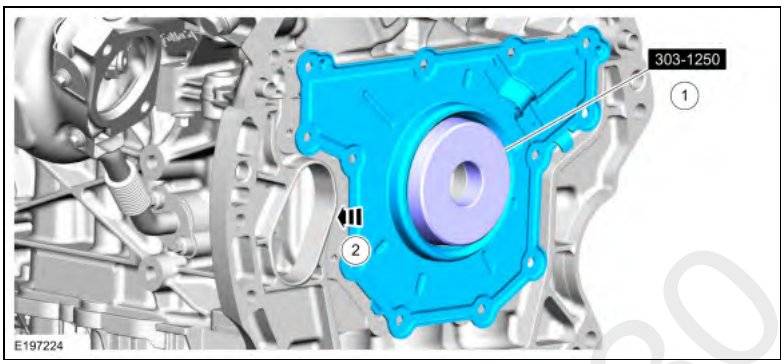
168. **NOTE:** *The crankshaft rear seal and retainer plate must be installed within 10 minutes of applying the sealer and the bolts must be installed and tightened to 2-5 Nm (18-44 lb-in) within 15 of applying the sealer. Final tightening of the bolts must be completed within 60 minutes of applying the sealer. Failure to follow this procedure can cause future oil leakage.*

1. Apply a 4.5 mm (0.18 in) bead of MotorcraftÂ® High Performance Engine RTV Silicone to the crankshaft rear seal and retainer plate.
   Material: MotorcraftÂ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)
2. Overlap the beginning and ending of the sealant bead 15 mm (0.59 in).
   Material: MotorcraftÂ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)
3. Apply 9 mm (0.35 in) beads of MotorcraftÂ® High Performance Engine RTV Silicone that are 10 mm (0.40 in) in length as indicated in the graphic.
   Material: MotorcraftÂ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)

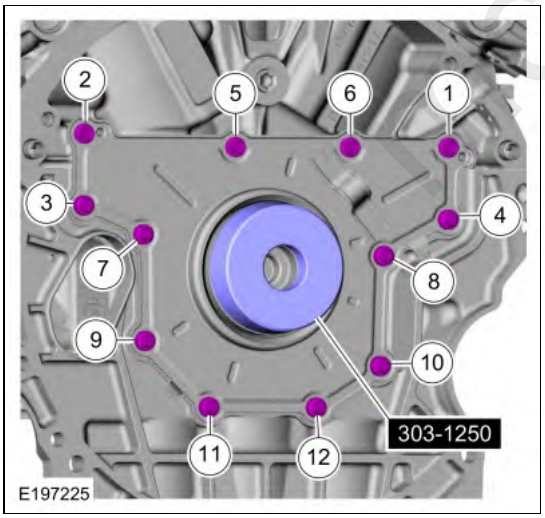


169.

- Position the special tool onto the end of the crankshaft.
  Use Special Service Tool: 303-1250 Seal Installer, Rear Main.
- Slide the new crankshaft rear seal and retainer plate onto the tool and into the installed position.

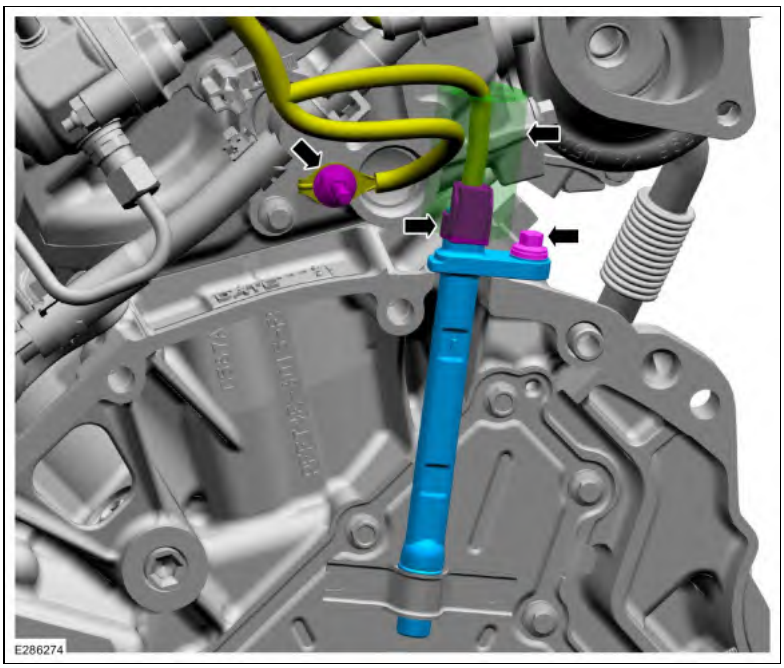


170. Install the crankshaft rear seal retainer plate bolts.
Remove Special Service Tool: 303-1250 Seal Installer, Rear Main.
Torque: 89 lb.in (10 Nm)

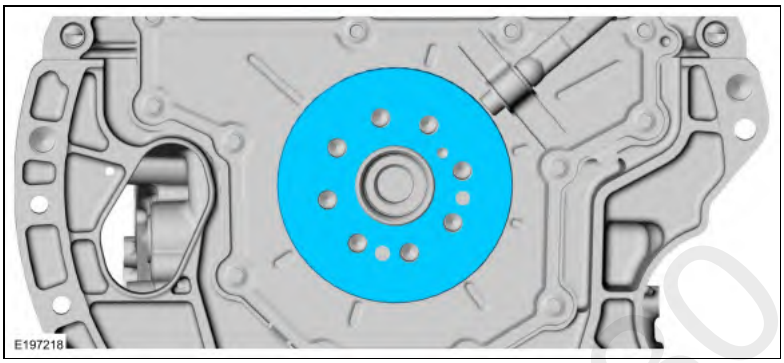


171.

1. Install the CKP sensor and tighten the bolt.
   Torque: 89 lb.in (10 Nm)
2. Connect the CKP sensor electrical connector.
3. Install the CKP sensor electrical connector insulator.
4. Install the wiring harness ground and the stud bolt.
   Torque: 89 lb.in (10 Nm)

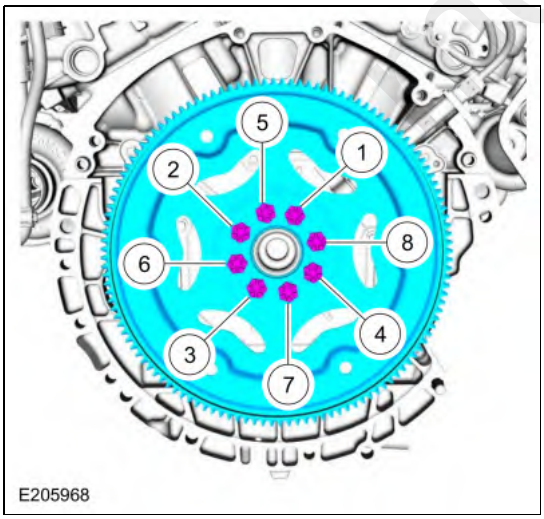


172. Install the crankshaft sensor ring.



173.

1. Position the flexplate on the crankshaft.
2. Install the bolts then rundown the bolts one turn at a time in sequence shown until the flexplate is snug against the rear face of the crankshaft.
3. Final tighten the bolts in sequence shown.
   Torque: 59 lb.ft (80 Nm)



Installation

Engine

Special Tool(s) / General Equipment

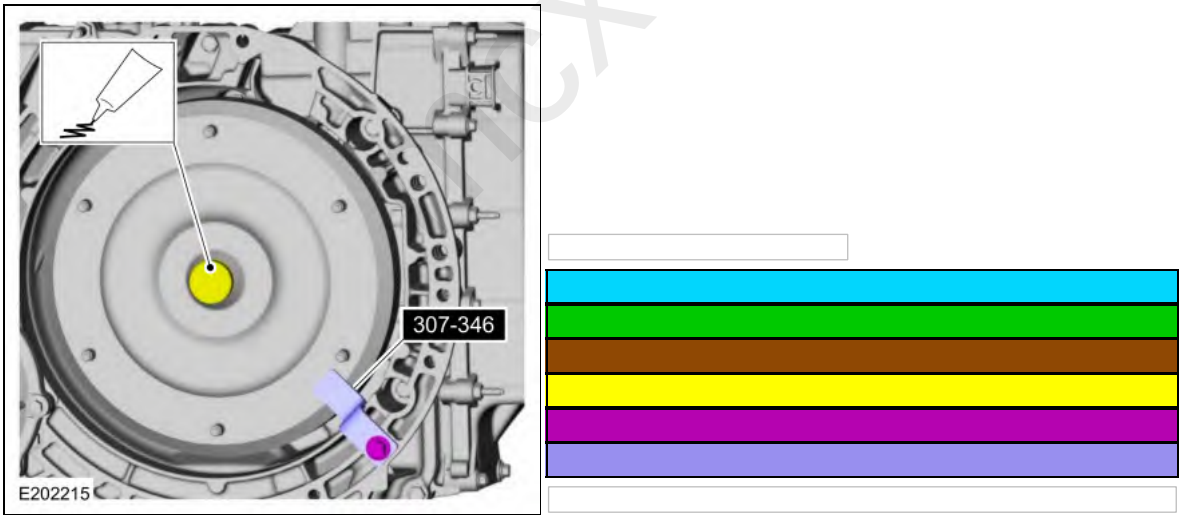
	303-1246 Engine Spreader Bar TKIT-2006UF-FLM TKIT-2006UF-ROW
	303-1634 Lift Eyes (2) TKIT-2014D-ROW3 TKIT-2014D-FL_ROW
	307-346 (T97T-7902-A) Retainer, Torque Converter TKIT-1998-LM (NavigatoR) TKIT-1997-F/FLM/LT
Floor Crane	
Adjustable Mounting Arm	
Hose Clamp Remover/Installer	
Powertrain Jack	
Wooden Block	

Materials

Name	Specification
MotorcraftÂ® Multi-Purpose Grease Spray XL-5-A	ESB-M1C93-B

LHD AWD/LHD FWD

1. Lubricate the torque converter hub with multi-purpose grease.
   Remove Special Service Tool: 307-346 (T97T-7902-A) Retainer, Torque Converter.
   Material: MotorcraftÂ® Multi-Purpose Grease Spray / XL-5-A (ESB-M1C93-B)



2.
   - Inspect the torque converter stud and flexplate for paint marks.
   - Align the torque converter stud and flexplate hole near the paint marks to the 12 o'clock position.