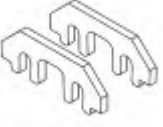


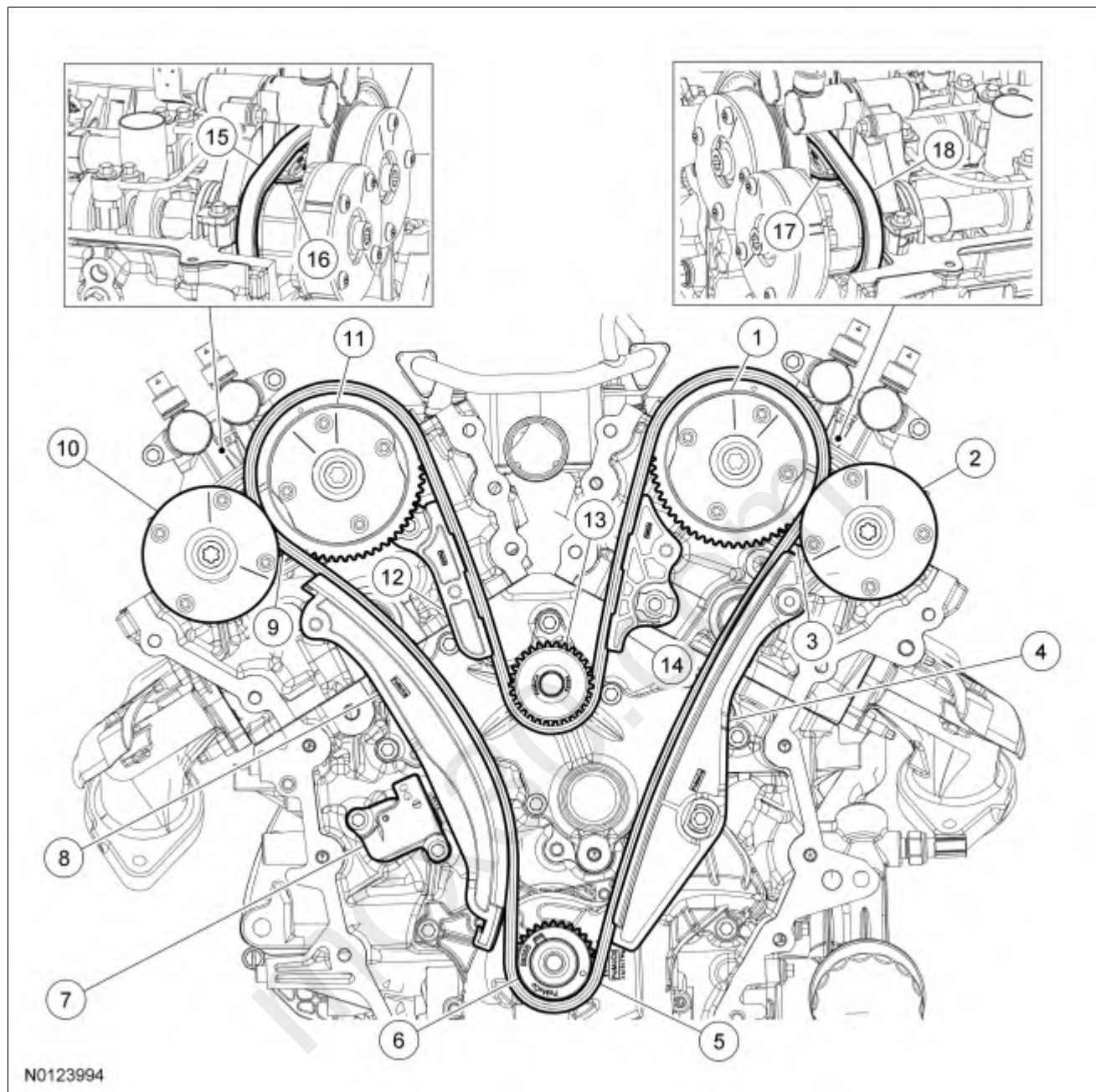
SECTION 303-01B: Engine — 3.7L
IN-VEHICLE REPAIR

2014 F-150 Workshop Manual
Procedure revision date: 04/11/2013

Timing Drive Components

Special Tool(s)

 ST3234-A	Hold Down, Secondary Chain 303-1530
 ST2979-A	Tool, Camshaft Holding 303-1248



Item	Part Number	Description
1	6256	LH intake Variable Camshaft Timing (VCT) assembly
2	6C525	LH exhaust VCT assembly
3	6K297	LH secondary timing chain tensioner shoe
4	6B274	LH primary timing chain guide
5	6268	Primary timing chain
6	6306	Crankshaft timing chain sprocket
7	6L266	Primary timing chain tensioner
8	6K255	RH primary timing chain tensioner arm
9	6K297	RH secondary timing chain tensioner shoe

10	6C525	RH exhaust <u>VCT</u> assembly
11	6256	RH intake <u>VCT</u> assembly
12	6K297	RH primary timing chain guide
13	8501	Channel cover plate
14	6K297	LH primary timing chain guide
15	6268	RH secondary timing chain
16	6K254	RH secondary timing chain tensioner
17	6K254	LH secondary timing chain tensioner
18	6268	LH secondary timing chain

Removal

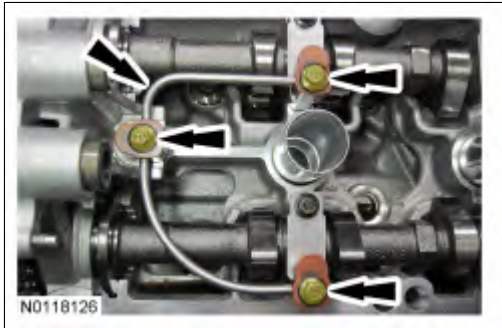
NOTICE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan may cause engine failure.

All engines

1. Remove the engine front cover. For additional information, refer to [Engine Front Cover](#) in this section.
2. Rotate the crankshaft clockwise and align the timing marks on the intake Variable Camshaft Timing (VCT) assemblies as shown.



3. Remove the 3 bolts and the LH valve train oil tube.

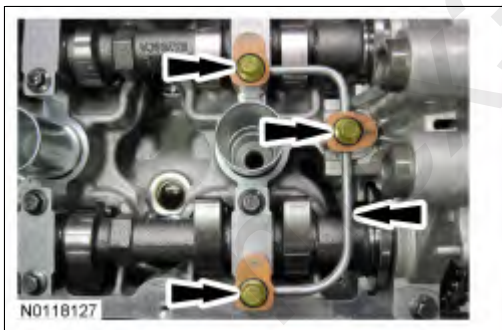


4. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the Top Dead Center (TDC) position.

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



5. Remove the 3 bolts and the RH valve train oil tube.



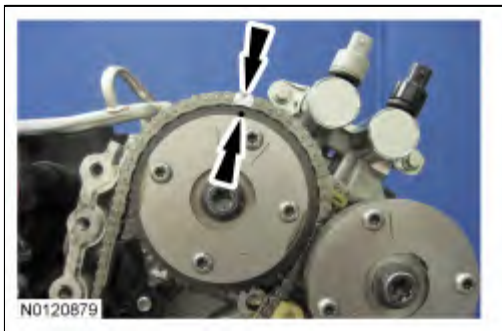
6. **NOTE:** The Camshaft Holding Tool will hold the camshafts in the TDC position.

Install the Camshaft Holding Tool onto the flats of the RH camshafts.

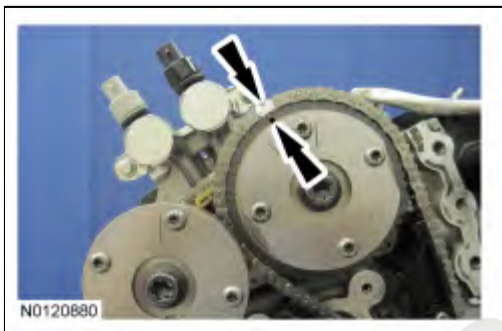


NOTE: The following 3 steps are for primary timing chains that the colored links are not visible.

7. Mark the timing chain link that aligns with the timing mark on the LH intake VCT assembly as shown.

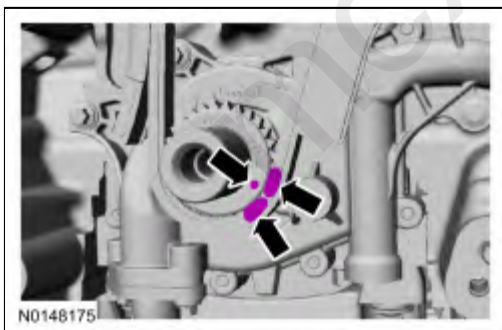


8. Mark the timing chain link that aligns with the timing mark on the RH intake VCT assembly as shown.

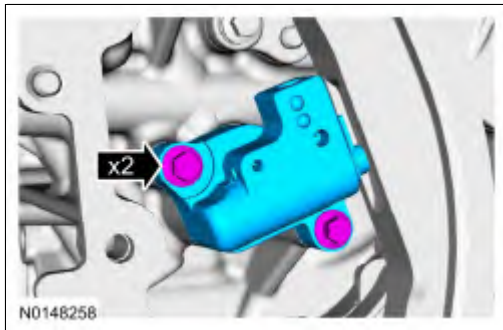


9. **NOTE:** The crankshaft sprocket timing mark should be between the 2 colored links.

Mark the 2 timing chain links that align with the timing mark on the crankshaft sprocket as shown.



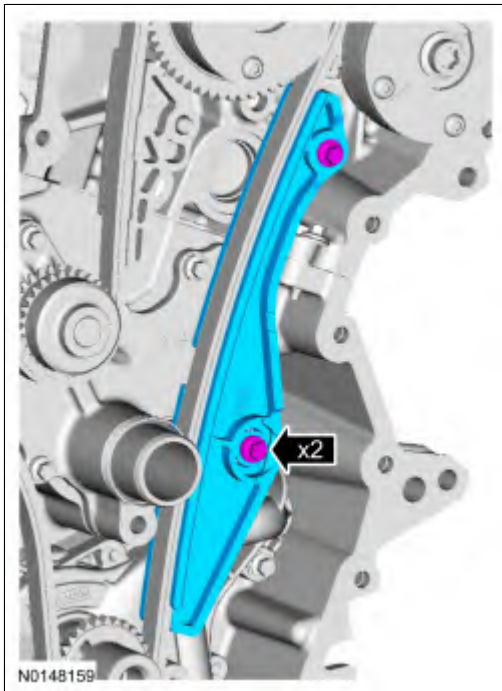
10. Remove the 2 bolts and the primary timing chain tensioner.



11. Remove the primary timing chain tensioner arm.



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

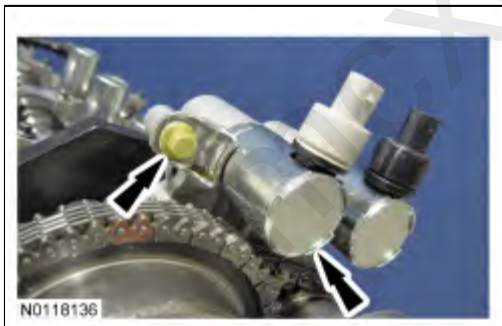


13. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Remove the bolt and the LH intake VCT oil control solenoid.



14. **NOTE:** Removal of the VCT oil control solenoid will aid in the removal of the primary timing chain.

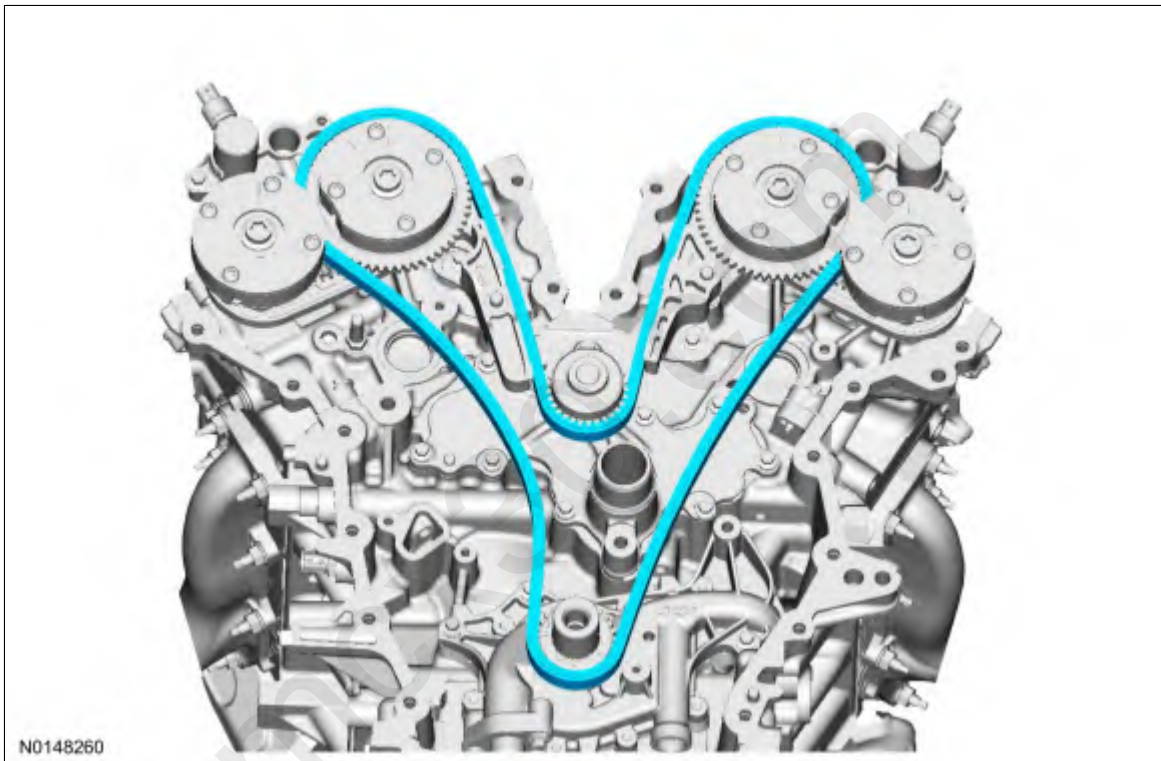
NOTE: A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

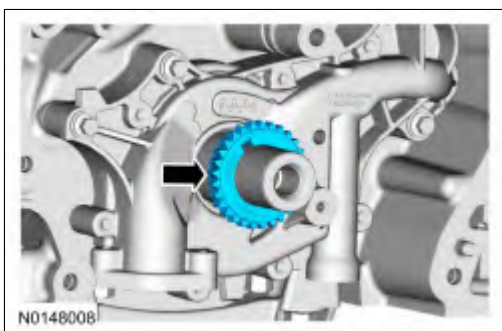
Remove the bolt and the RH intake VCT oil control solenoid.



15. Remove the primary timing chain.

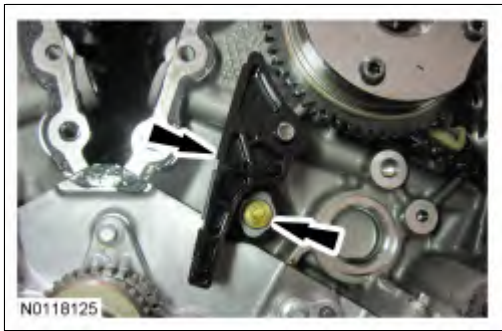


16. Remove the crankshaft timing chain sprocket.



17. **NOTICE:** Do not use power tools to remove the bolt or damage to the LH primary timing chain guide may occur.

Remove the bolt and the upper LH primary timing chain guide.



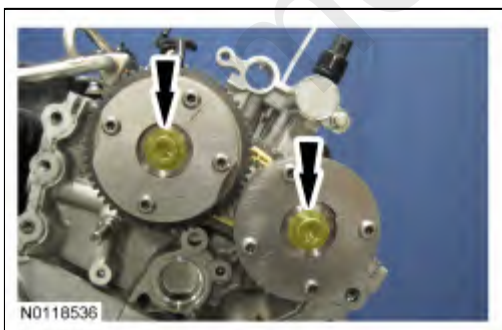
18. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.



19. Remove and discard the 2 LH VCT assembly bolts.



20. Remove the 2 LH VCT assemblies and secondary timing chain.



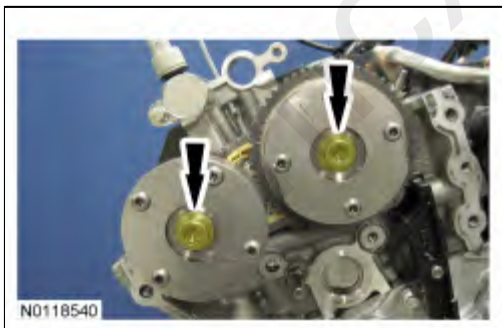
21. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

NOTE: The Secondary Chain Hold Down is inserted through a hole in the top of the mega cap.

Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down in the hole on the rear of the secondary timing chain tensioner guide and let it hold against the mega cap to retain the tensioner in the collapsed position.



22. Remove and discard the 2 RH VCT assembly bolts.



23. Remove the 2 RH VCT assemblies and secondary timing chain.



24. **NOTICE:** Do not use power tools to remove the bolt or damage to the RH primary timing chain guide may occur.

Remove the bolt and the RH primary timing chain guide.



25. Remove the 9 bolts and the channel cover plate.
- Discard the gaskets.



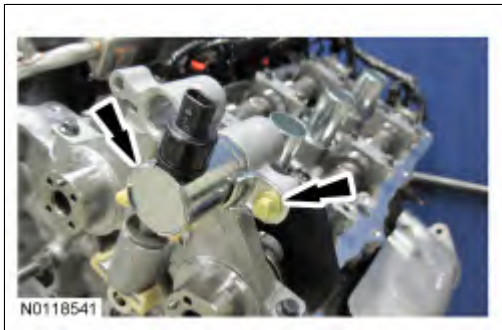
Engines with secondary timing chain tensioner removed

NOTICE: The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed, or damage to the engine may occur.

26. **NOTE:** A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Remove the LH exhaust VCT oil control solenoid.



27. Remove the LH secondary timing chain tensioner shoe.



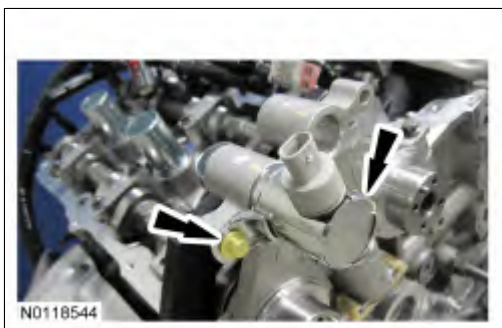
28. Remove the LH secondary timing chain tensioner by pushing up from the bottom and remove.



29. **NOTE:** A slight twisting motion will aid in the removal of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

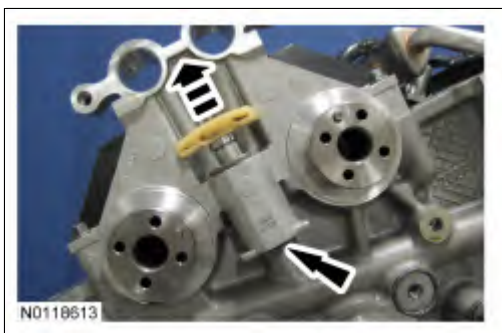
Remove the RH exhaust VCT oil control solenoid.



30. Remove the RH secondary timing chain tensioner shoe.



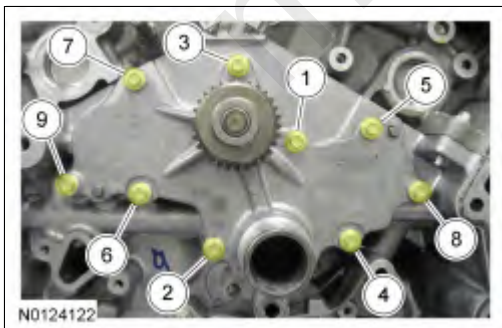
31. Remove the RH secondary timing chain tensioner by pushing up from the bottom and remove.



Installation

All engines

1. Using new gaskets, install the channel cover plate and the 9 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.



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



Engines with secondary timing chain tensioner removed

NOTICE: The following steps are only for the replacement of the secondary timing chain tensioners. Do not reuse the secondary timing chain tensioners if removed or damage to the engine may occur.

3. **NOTE:** Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

Install the RH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.



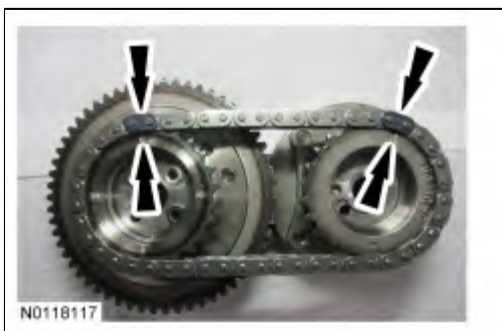
4. Install the RH secondary timing chain tensioner shoe.



5. Remove and discard the RH secondary timing chain tensioner shipping clip.



6. Assemble the RH Variable Camshaft Timing (VCT) assembly, the RH exhaust camshaft sprocket and the RH secondary timing chain.
- Align the colored links with the timing marks.



7. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



8. Install the 2 new RH VCT bolts and tighten in 4 stages.
- Stage 1: Tighten to 40 Nm (30 lb-ft).
 - Stage 2: Loosen one full turn.
 - Stage 3: Tighten to 25 Nm (18 lb-ft).
 - Stage 4: Tighten an additional 180 degrees.



9. Activate the RH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.



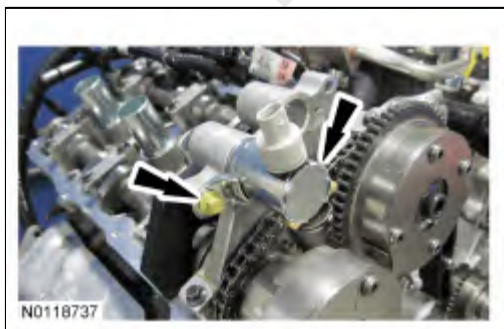
10. **NOTICE:** Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the RH exhaust VCT oil control solenoid.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



11. **NOTE:** Apply clean engine oil to the secondary timing chain tensioner O-ring seals and mega cap bore.

NOTE: Do not remove the secondary timing chain tensioner shipping clip, until instructed to do so.

Install the LH secondary timing chain tensioner by pushing it down all the way until a snap is heard and the tensioner is seated all the way down the mega cap bore.



12. Install the LH secondary timing chain tensioner shoe.



13. Remove and discard the LH secondary timing chain tensioner shipping clip.



14. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
- Align the colored links with the timing marks.

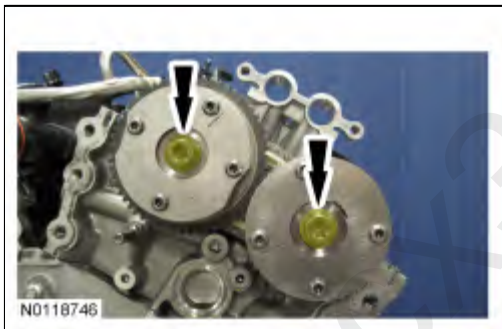


15. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



16. Install the 2 new LH VCT bolts and tighten in 4 stages.
- Stage 1: Tighten to 40 Nm (30 lb-ft).
 - Stage 2: Loosen one full turn.
 - Stage 3: Tighten to 25 Nm (18 lb-ft).
 - Stage 4: Tighten an additional 180 degrees.



17. Activate the LH secondary timing chain tensioner by pressing down on the secondary tensioner shoe until it bottoms out, let go of the tensioner and it will spring up putting tension on the chain.



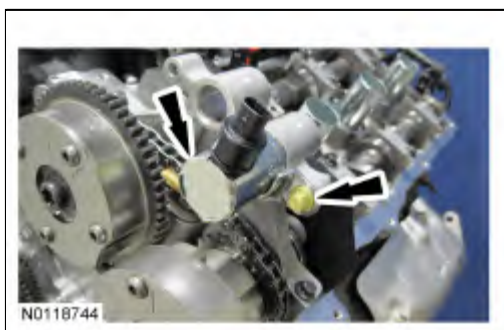
18. **NOTICE:** Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

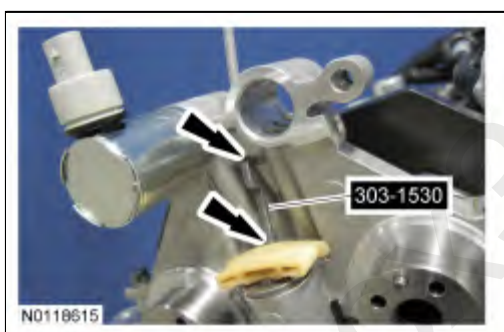
Install the LH exhaust VCT oil control solenoid.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



Engines with secondary timing chain tensioner not removed

19. Compress the RH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.



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

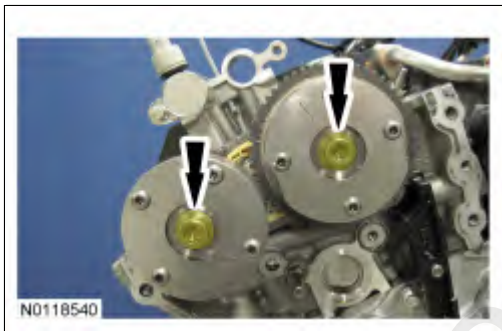


21. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the RH secondary timing assembly.

Position the 2 RH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



22. Install the 2 new RH VCT bolts and tighten in 4 stages.
- Stage 1: Tighten to 40 Nm (30 lb-ft).
 - Stage 2: Loosen one full turn.
 - Stage 3: Tighten to 25 Nm (18 lb-ft).
 - Stage 4: Tighten an additional 180 degrees.



23. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

Compress the RH secondary timing chain tensioner and remove the Secondary Chain Hold Down.

- Make sure the secondary timing chain is centered on the timing chain tensioner guides.



24. Compress the LH secondary timing chain tensioner and install the Secondary Chain Hold Down to retain the tensioner in the collapsed position.



25. Assemble the 2 LH VCT assemblies and the LH secondary timing chain.
- Align the colored links with the timing marks.

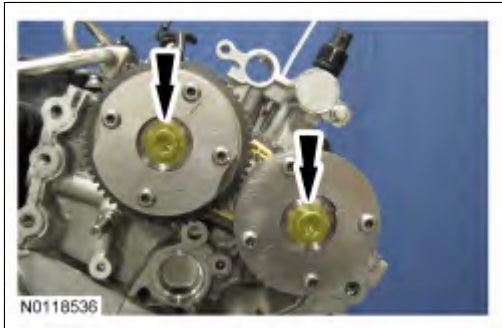


26. **NOTE:** It may be necessary to rotate the camshafts slightly, to install the LH secondary timing assembly.

Position the 2 LH VCT assemblies and secondary timing chain onto the camshafts by aligning the holes in the VCT assemblies with the dowel pins in the camshafts.



27. Install the 2 new LH VCT bolts and tighten in 4 stages.
- Stage 1: Tighten to 40 Nm (30 lb-ft).
 - Stage 2: Loosen one full turn.
 - Stage 3: Tighten to 25 Nm (18 lb-ft).
 - Stage 4: Tighten an additional 180 degrees.



28. **NOTE:** The 2 VCT oil control solenoids are removed for clarity.

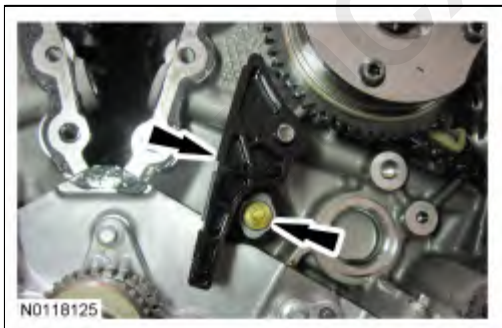
Compress the LH secondary timing chain tensioner and remove the Secondary Chain Hold Down.

- Make sure the secondary timing chain is centered on the timing chain tensioner guides.

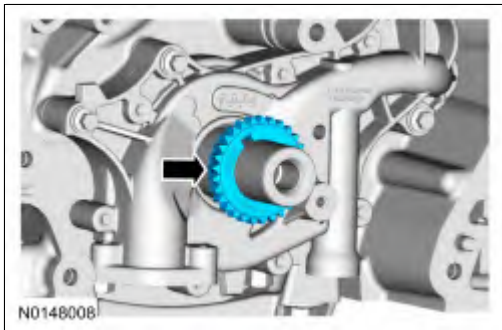


All engines

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



30. Install the crankshaft timing chain sprocket with timing dot mark out.

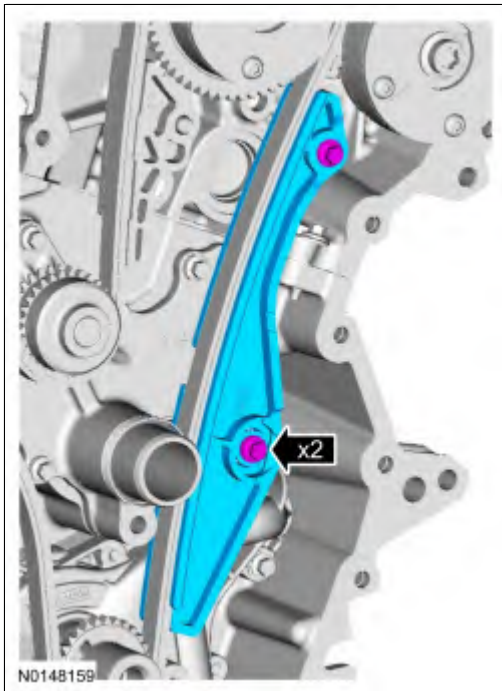


31. **NOTE:** It may be necessary to rotate the camshafts slightly, to align the timing marks.

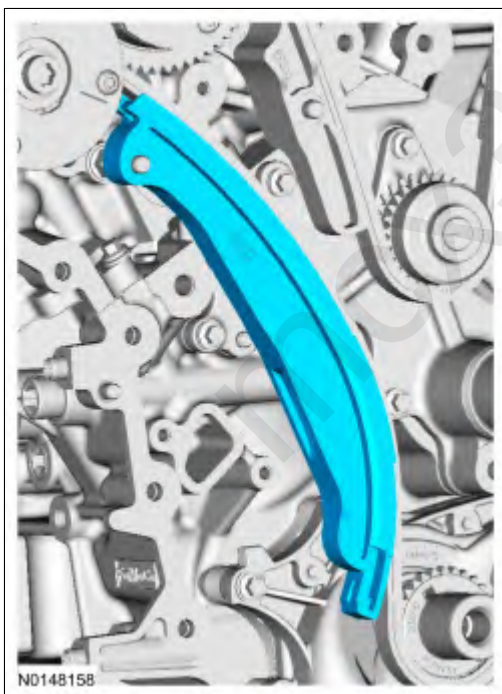
Install the primary timing chain with the colored links aligned with the timing marks on the VCT assemblies and the crankshaft sprocket.



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



33. Install the primary timing chain tensioner arm.



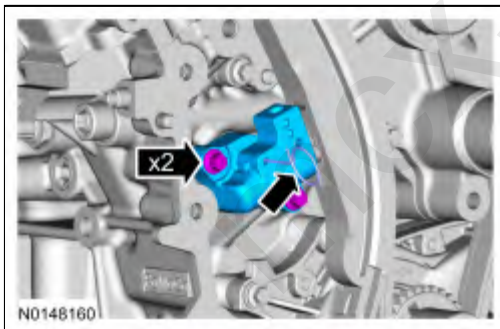
34. Reset the primary timing chain tensioner.
- Release the ratchet detent.
 - Using a soft-jawed vise, compress the ratchet plunger.
 - Align the hole in the ratchet plunger with the hole in the tensioner housing.
 - Install a suitable lockpin.



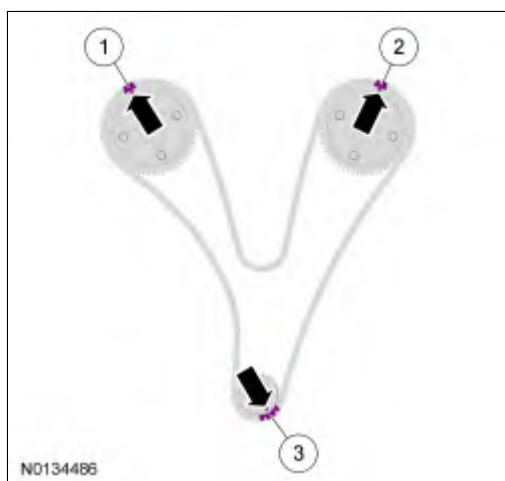
35. **NOTE:** It may be necessary to rotate the camshafts slightly to remove slack from the timing chain to install the tensioner.

Install the primary tensioner and the 2 bolts.

- Tighten to 10 Nm (89 lb-in).
- Remove the lockpin.



36. As a post-check, verify correct alignment of all timing marks.
- There are 48 links in between the RH intake VCT assembly colored link (1) and the LH intake VCT assembly colored link (2).
 - There are 35 links in between LH intake VCT assembly colored link (2) and the 2 crankshaft sprocket links (3).



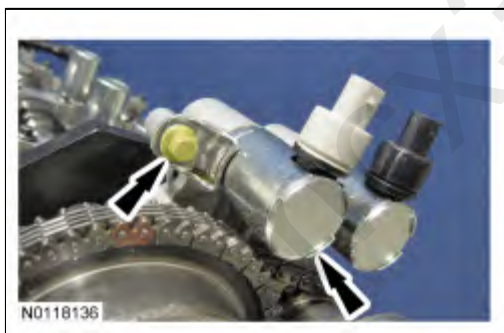
37. **NOTICE:** Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the LH intake VCT oil control solenoid and the bolt.

- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



38. **NOTICE:** Do not use excessive force when installing the Variable Camshaft Timing (VCT) oil control solenoid. Damage to the mega cap could cause the cylinder head to be inoperable. If difficult to install the VCT oil control solenoid, inspect the bore and VCT oil control solenoid to ensure there are no burrs, sharp edges or contaminants present on the mating surface. Only clean the external surfaces as necessary.

NOTE: A slight twisting motion will aid in the installation of the VCT oil control solenoid.

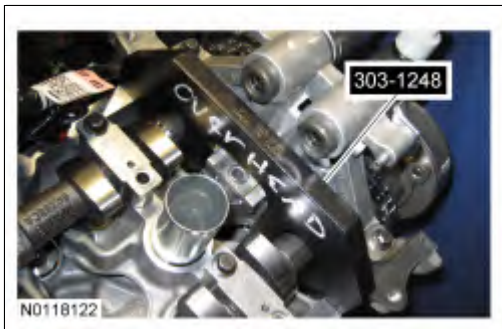
NOTE: Keep the VCT oil control solenoid clean of dirt and debris.

Install the RH intake VCT oil control solenoid and the bolt.

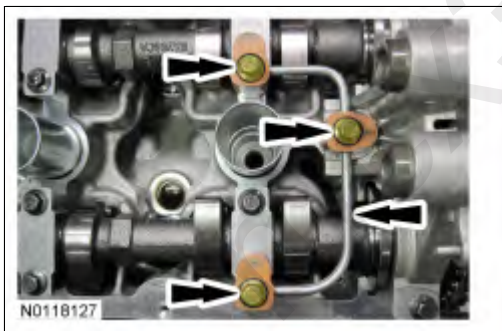
- Tighten to 8 Nm (71 lb-in) then an additional 20 degrees.



39. Remove the RH Camshaft Holding Tool.



40. Install the RH valve train oil tube and the 3 bolts and tighten in 2 stages.
- Stage 1: Tighten to 8 Nm (71 lb-in).
 - Stage 2: Tighten an additional 45 degrees.

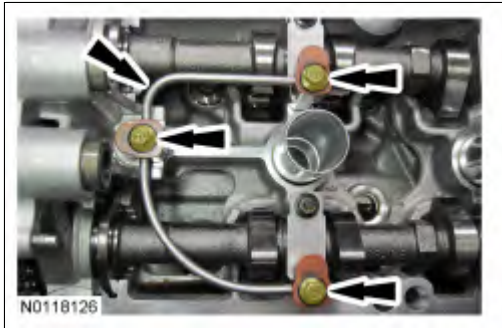


41. Remove the LH Camshaft Holding Tool.



42. Install the LH valve train oil tube and the 3 bolts and tighten in 2 stages.

- Stage 1: Tighten to 8 Nm (71 lb-in).
- Stage 2: Tighten an additional 45 degrees.



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