

SHORT ENGINE ASSEMBLY RENEW - ASSEMBLY

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ASSEMBLY

SPECIAL TOOL(S)

 E107678	303-1442 Rear Crankshaft Seal Installer
 E154451	JLR-303-1622 Alignment Tool, Engine Rear Oil Seal
 E240790	JLR-303-1653 Cylinder Head Bolt Remover/Installer
 E152575	JLR-303-1303 Timing Tool
 E152576	JLR-303-1304 Locking Tool
 E115270	303-1452 Camshaft Rotating Tool

	303-1445 Timing Tool – Camshaft Alignment
	303-1433 Lower Timing Cover Alignment tool

PART(S)

STEP	PART NAME	QUALIFICATION	QUANTITY
Step 1	Rear dynamic balancer		1
Step 1	Rear dynamic balancer idler sprocket		1
Step 2	Rear dynamic balancer and idler sprocket nuts		2
Step 4	Oil pump outlet tube O-ring seal(s)		2
Step 6	Oil pump connector bolt		1
Step 7	Oil pump inlet tube O-ring seal(s)		1
Step 8	Crankshaft pulley bolts		1
Step 9	Crankshaft sprocket friction washer		1
Step 11	Oil pump gear bolt		1
Step 12	Lower timing chain tensioner		1
Step 14	Balance sprocket bolt		1
Step 15	Lower timing chain		1
Step 19	Oil pan bolts M8 x 35		11
Step 19	Oil pan bolts M8 x 80		5
Step 22	Crankshaft rear cover		1
Step 31	Cylinder head gasket		2
Step 32	Cylinder head bolts		8
Step 51	Drive plate bolts		10
Step 52	Upper timing chain guide		1
Step 53	Upper timing chain tensioner		1
Step 58	Upper timing chain		1
Step 74	Valve cover gasket		1
Step 74	Spark plug boss seals		1

This is a "Trustmark Authoring Standards (TAS) Repair Procedure"

TAS style procedures can be identified by steps that have no accompanying step text and the magenta color of the electrical connectors and fasteners such as nuts, bolts, clamps or clips.

TAS removal and installation procedures use a sequence of color illustrations to indicate the order to be followed when removing/disassembling or installing/assembling a component.

Many of the TAS procedures will have the installation information within the removal steps.

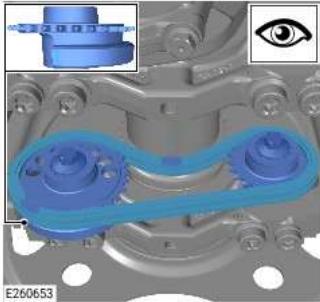
The TAS color illustrations use a variety of symbols to indicate important details of the procedures. It is important to understand these symbols in order to properly use the TAS procedures.



NOTE:

- This procedure contains some variation in the illustrations depending on the vehicle specification, but the essential information is always correct.
- This procedure contains illustrations showing certain components removed to provide extra clarity.

1.

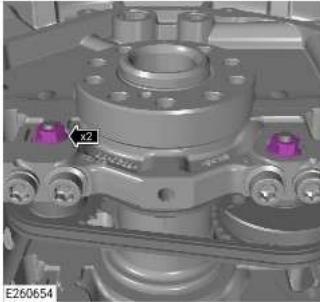


CAUTION:

The timing marks on the chain must align to the timing marks on the crankshaft and rear dynamic balancer as illustrated.

- Install a new rear dynamic balancer and idler sprocket to the rear dynamic balancer chain.
Renew Part: Rear dynamic balancer Quantity: 1.
Renew Part: Rear dynamic balancer idler sprocket Quantity: 1.
- Install the rear dynamic balancer sprocket, idler sprocket and rear dynamic balancer chain.
- Make sure the timing marks align as illustrated.

2.



CAUTION:

The timing marks on the chain must align to the timing marks on the crankshaft and rear dynamic balancer as illustrated in the previous step.

Install and tighten 2 new nuts.

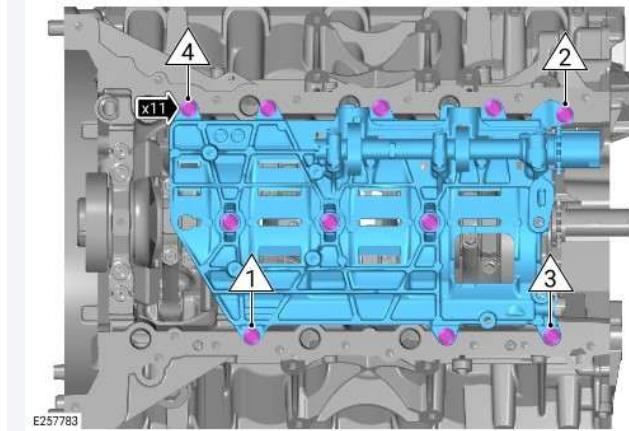
Renew Part: Rear dynamic balancer and idler sprocket nuts Quantity: 2.

Torque:

Stage1: **24.5 Nm**

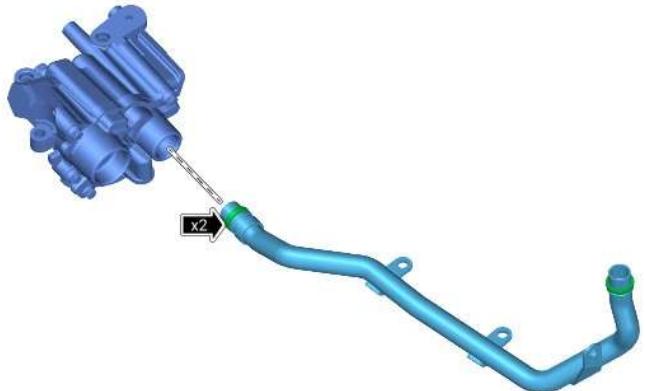
Stage2: **38 degree**

3.



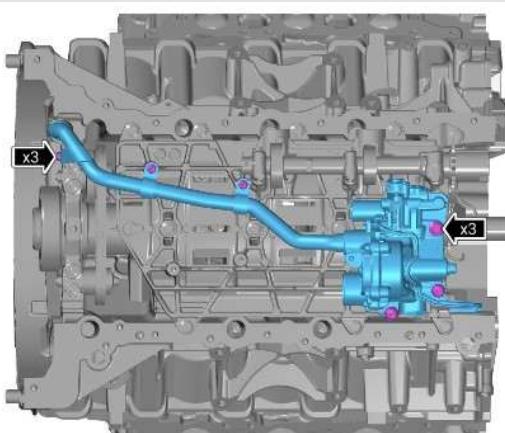
- Install the windage tray.
- Install and tighten the 4 bolts in the illustrated sequence.
Torque: 25 Nm
- Install and tighten the remaining 7 bolts.
Torque: 25 Nm

4.



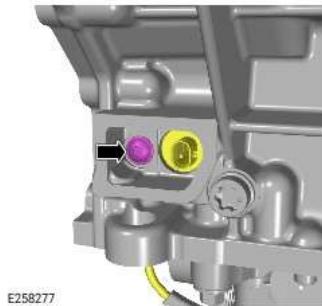
- Install 2 new O-ring seals.
Renew Part: Oil pump outlet tube O-ring seal(s) Quantity: 2.
- Connect the oil pump outlet pipe to the oil pump.

5.



- Install the oil pump.
- Install and tighten the 3 oil pump mounting bolts.
Torque: 25 Nm
- Install and tighten the 3 oil pump outlet pipe bolts.
Torque: 11.5 Nm

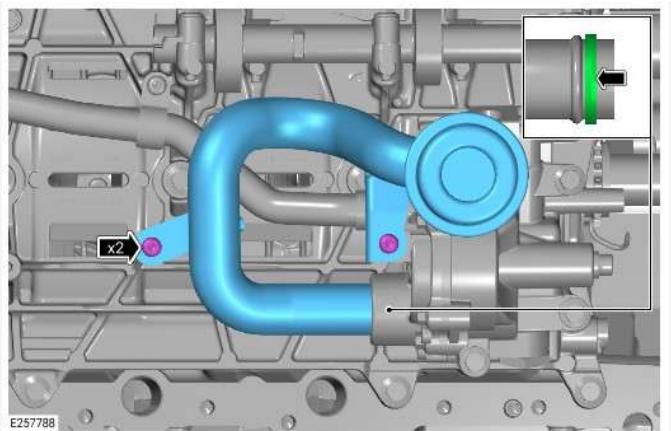
6.



- Install the electrical connector to the cylinder block.
- Install and tighten a new bolt.

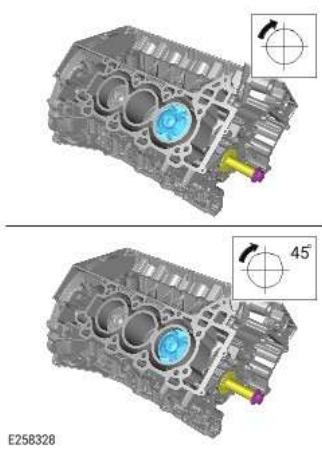
Renew Part: Oil pump connector bolt Quantity: 1.

7.



- Install a new O-ring seal.
- Renew Part: Oil pump inlet tube O-ring seal(s) Quantity: 1.*
- Install the oil pump inlet pipe.
- Install and tighten the 2 bolts.

8.

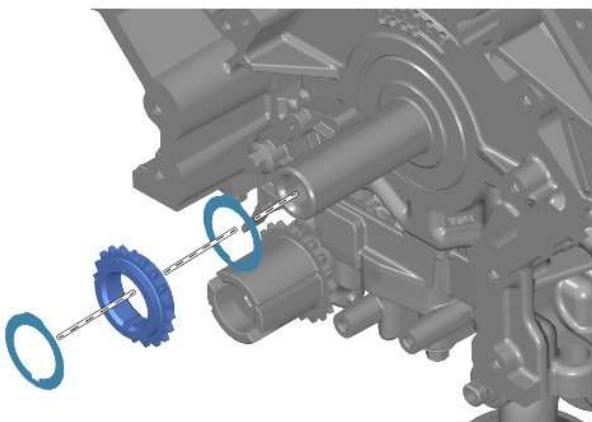


CAUTION:

The crankshaft must be set at 45° After Top Dead Center (ATDC) for cylinder 1.

- Install a new crankshaft pulley bolt.
- Renew Part: Crankshaft pulley bolts Quantity: 1.*
- Rotate the crankshaft in a clockwise direction until on cylinder 1 as illustrated.
- Rotate the crankshaft in a clockwise direction by 45°.

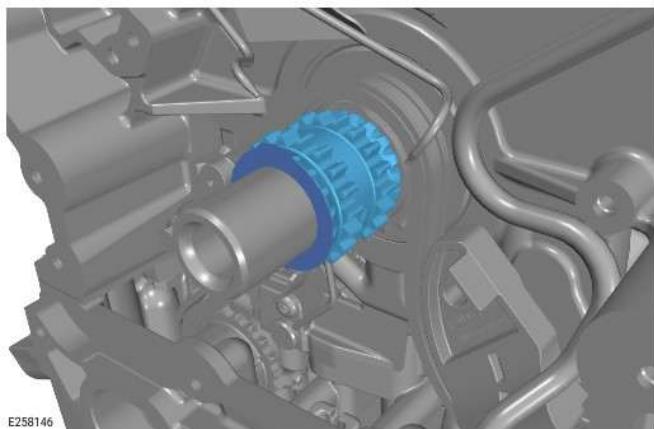
9.

**CAUTION:**

The crankshaft must be set at 45° After Top Dead Center (ATDC) for cylinder 1.

- Install a new friction washer.
Renew Part: Crankshaft sprocket friction washer Quantity: 1.
- Install the crankshaft sprocket.
- Install a new friction washer.
Renew Part: Crankshaft sprocket friction washer Quantity: 1.

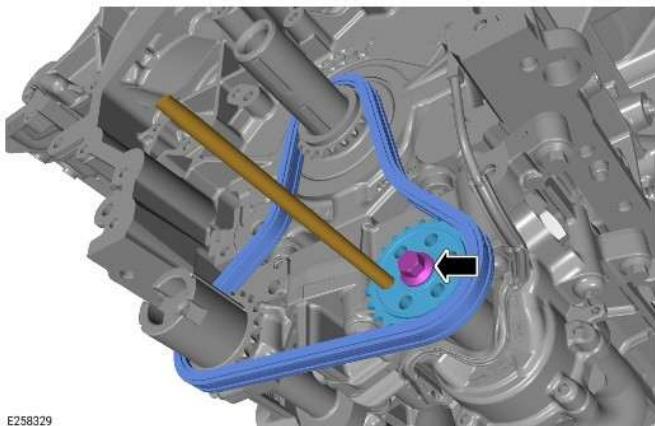
10.

**CAUTION:**

The crankshaft must be set at 45° After Top Dead Center (ATDC) for cylinder 1.

- Install the crankshaft sprocket.
- Install a new friction washer.
Renew Part: Crankshaft sprocket friction washer Quantity: 1.

11.



E258329

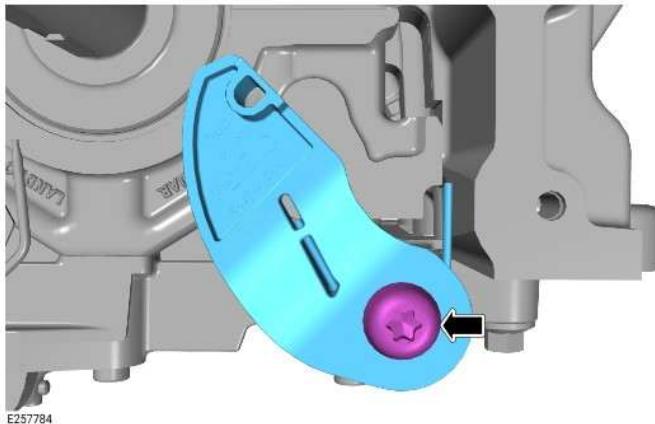
**CAUTION:**

The crankshaft must be set at 45° After Top Dead Center (ATDC) for cylinder 1.

- Install the oil pump drive sprocket.
- Install, but do not fully tighten a new bolt.
Renew Part: Oil pump gear bolt Quantity: 1.
- Use a suitable tool to hold the oil pump drive sprocket.
- Tighten the bolt.

Torque: 21 Nm

12.



E257784

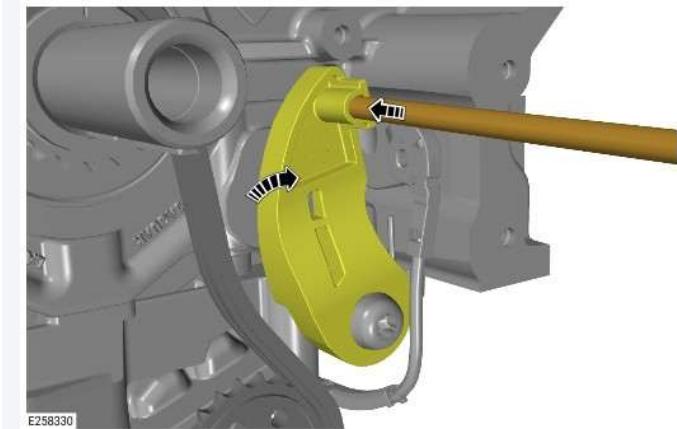
**CAUTION:**

The crankshaft must be set at 45° After Top Dead Center (ATDC) for cylinder 1.

- Install a new lower timing chain tensioner.
Renew Part: Lower timing chain tensioner Quantity: 1.
- Install and tighten the bolt.

Torque: 21 Nm

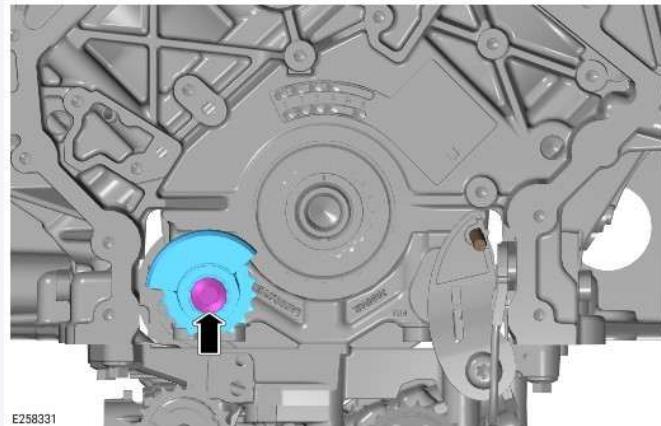
13.

**CAUTION:**

The crankshaft must be set at 45° After Top Dead Center (ATDC) for cylinder 1.

- Reposition the lower timing chain tensioner as illustrated.
- Install a suitable tool to hold the lower timing chain tensioner.

14.

**CAUTION:**

The crankshaft must be set at 45° After Top Dead Center (ATDC) for cylinder 1.

- Install the balance sprocket.
- Install and tighten a new bolt.

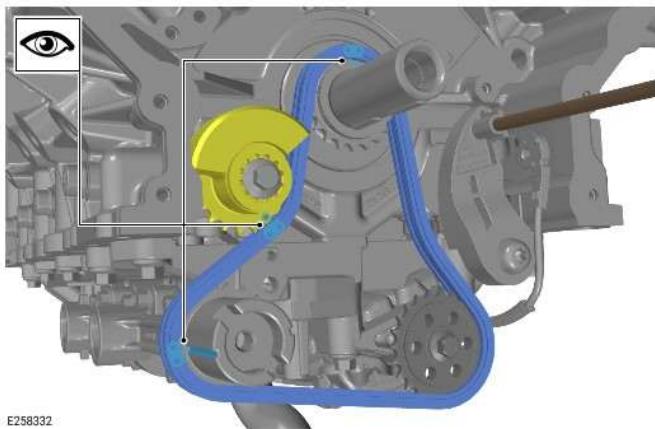
Renew Part: Balance sprocket bolt Quantity: 1.

Torque:

Stage1: 24.5 Nm

Stage2: 29 degree

15.



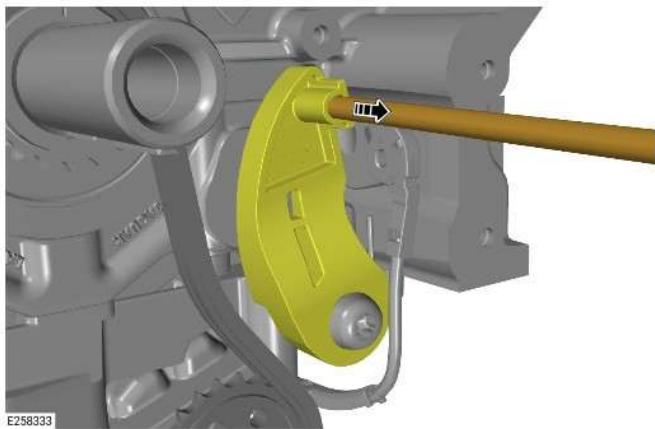
E258332

**CAUTION:**

The crankshaft must be set at 45° After Top Dead Center (ATDC) for cylinder 1.

- Install a new lower timing chain.
Renew Part: Lower timing chain Quantity: 1.
- Make sure the orange link (2) aligns with the timing mark on the HP (High Pressure) fuel pump camshaft.
- Make sure the blue link (1) aligns with the timing mark on the crankshaft sprocket.
- Make sure the blue link (3) aligns with the timing mark on the balance sprocket.

16.



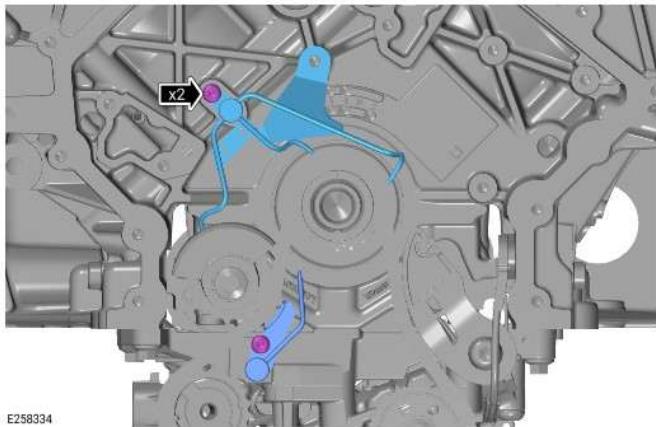
E258333

**CAUTION:**

The crankshaft must be set at 45° After Top Dead Center (ATDC) for cylinder 1.

- Remove the holding tool.
- Slowly release the lower timing chain tensioner.

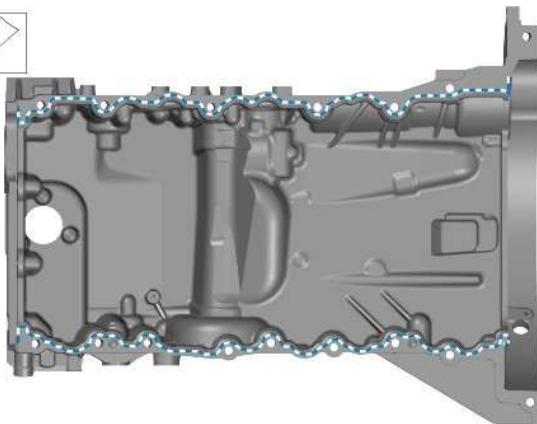
17.



- Install the 2 timing chain lubrication pipes.
- Install and tighten the 2 bolts.

Torque: 11 Nm

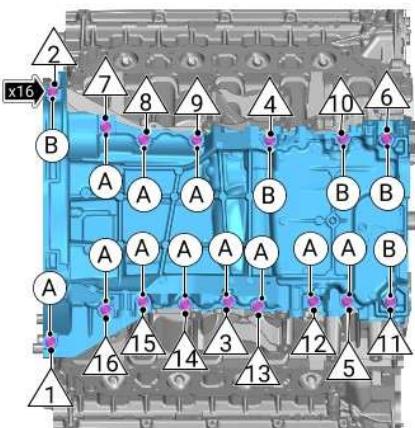
18.



E257904

Apply RTV sealant WSE-M4G323-A6 (Loctite 5901G or Loctite 59000) to the areas shown.

19.



CAUTION:

The installation of the oil pan and tightening of the bolts must be completed within 7 minutes of applying the RTV sealant.



NOTE:

AWD (All Wheel Drive) graphic shown, RWD (Rear Wheel Drive) is similar.

- Install the oil pan.
- Install and tighten 16 new bolts in the illustrated sequence.
Renew Part: Oil pan bolts M8 x 35 Quantity: 11.
Renew Part: Oil pan bolts M8 x 80 Quantity: 5.
Torque: 25 Nm

20.



E257920



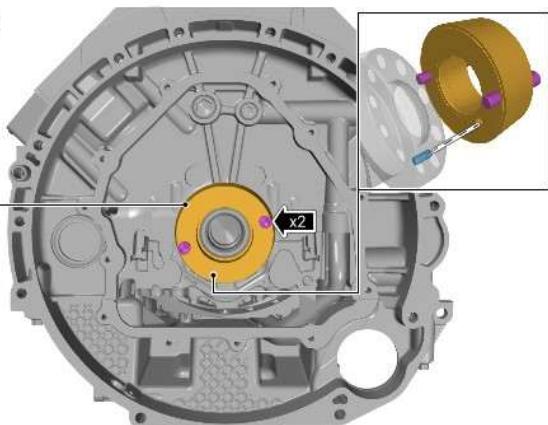
CAUTION:

The installation of the engine rear cover and tightening of the bolts must be completed within 7 minutes of applying the RTV sealant.

Apply RTV sealant (Loctite 5901G) in a 2-3mm diameter to the areas shown.

21.

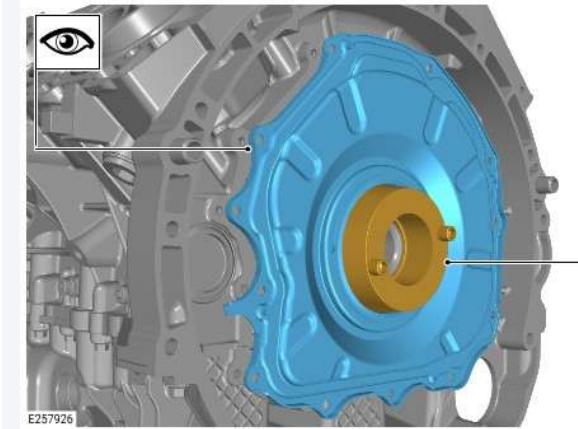
303-1442



E257925

- Install the special tool.
Special Tool(s): 303-1442
- Install and tighten the 2 bolts.

22.



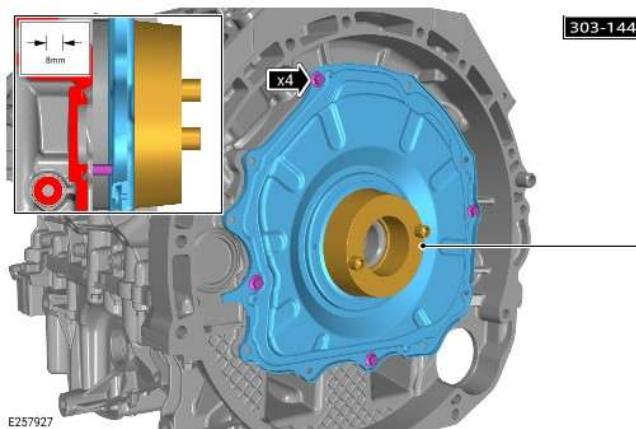
303-1442

E257926

Install a new engine rear cover with a space of 8 mm between the engine rear cover and the mating face.

Renew Part: Crankshaft rear cover Quantity: 1.

23.

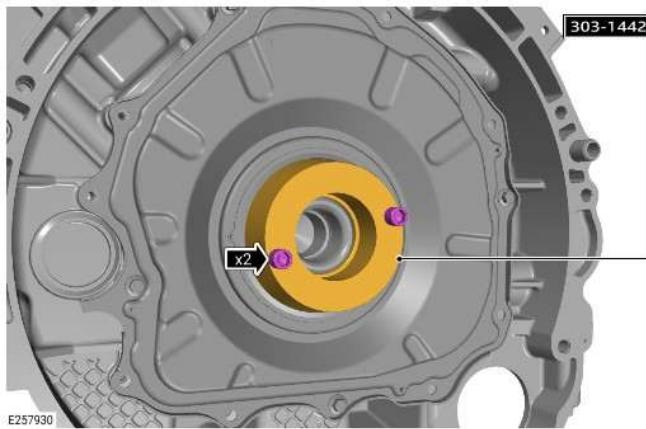


303-1442

E257927

- Install, but do not fully tighten the 4 bolts.
- Make sure there is a space of 8 mm between the engine rear cover and the mating face.

24.

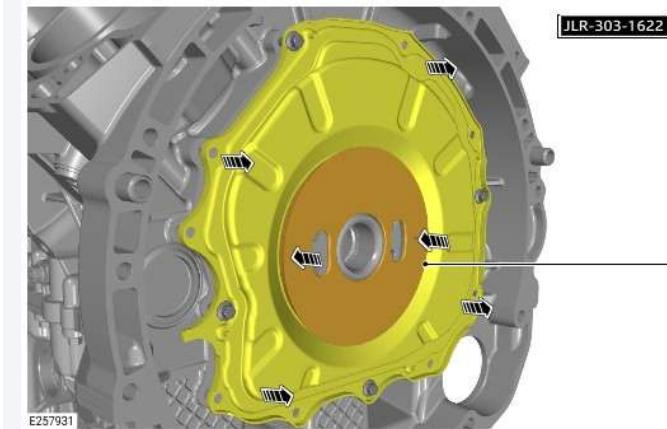


303-1442

E257930

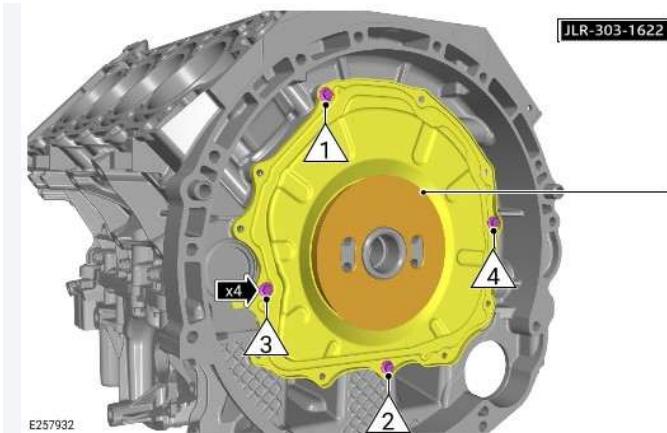
- Remove the 2 bolts.
 - Remove the special tool.
- Special Tool(s): 303-1442*

25.



- Apply pressure to the engine rear cover and install the special tool.
Special Tool(s): JLR-303-1622
- Make sure there is a space of 8 mm between the engine rear cover and the mating face.

26.



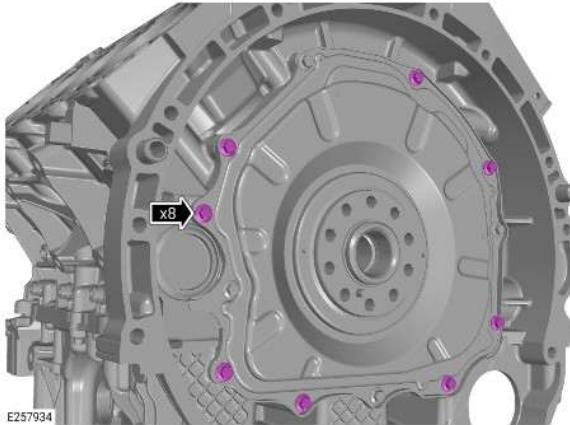
- Use the special tool to fully install the engine rear cover.
Special Tool(s): JLR-303-1622
- Tighten the 4 bolts in the illustrated sequence.
Torque: 11.5 Nm

27.



Remove the special tool.
Special Tool(s): JLR-303-1622

28.

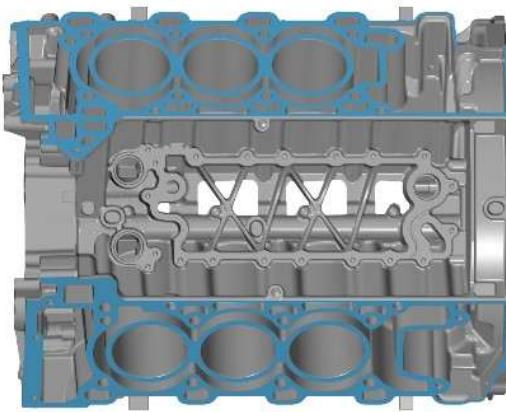


Install and tighten the 8 bolts.

Torque: 11.5 Nm

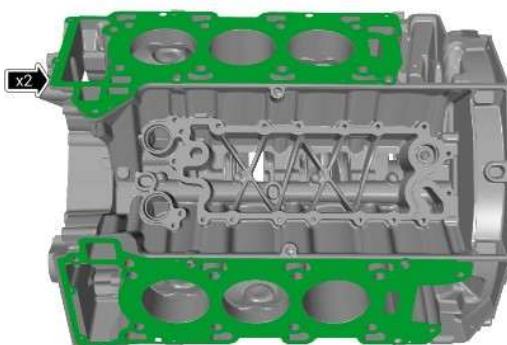
29. Check the 2 cylinder heads for distortion. For additional information, refer to: Cylinder Head Distortion (303-00 Engine System - General Information, General Procedures)

30.



Make sure that the mating faces are clean and free of foreign material.

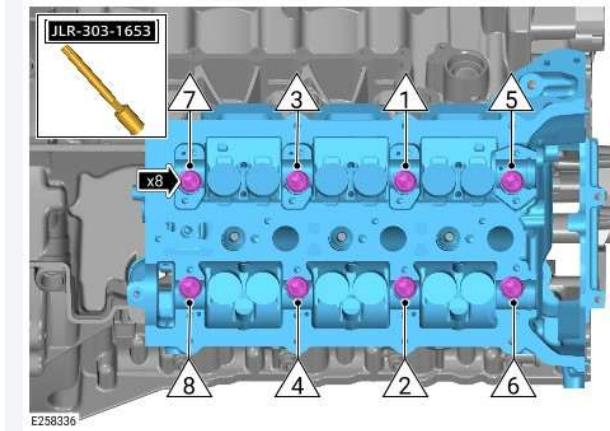
31.



Install 2 new cylinder head gaskets.

Renew Part: Cylinder head gasket Quantity: 2.

32.



- Install the right cylinder head.
- Use the special tool to install and tighten 8 new cylinder head bolts in the illustrated sequence.

Special Tool(s): JLR-303-1653

Renew Part: Cylinder head bolts Quantity: 8.

Torque:

Stage1: **20 Nm**

Stage2: **35 Nm**

- Loosen each bolt and then tighten each bolt in the illustrated sequence.

Torque: 35 Nm

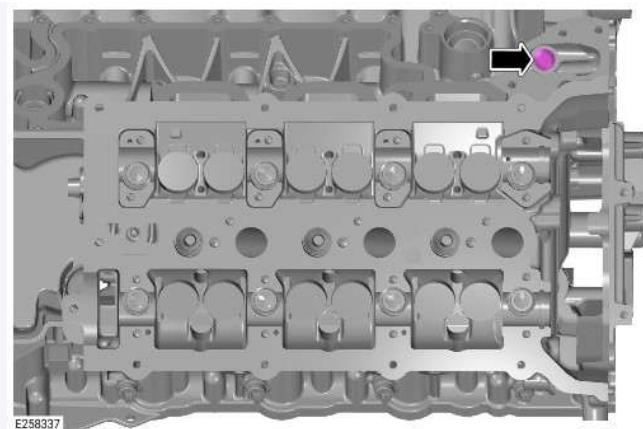
- Tighten the 10 bolts in the illustrated sequence.

Torque: 90 degree

- Tighten the 10 bolts in the illustrated sequence.

Torque: 120 degree

33.

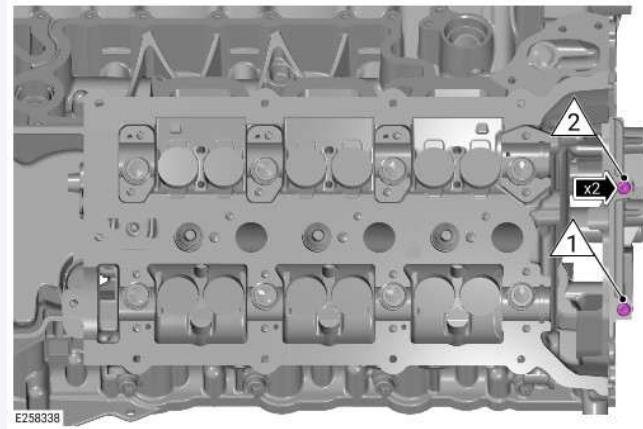


Install and tighten a new bolt.

Renew Part: Cylinder head bolts Quantity: 1.

Torque: 25 Nm

34.

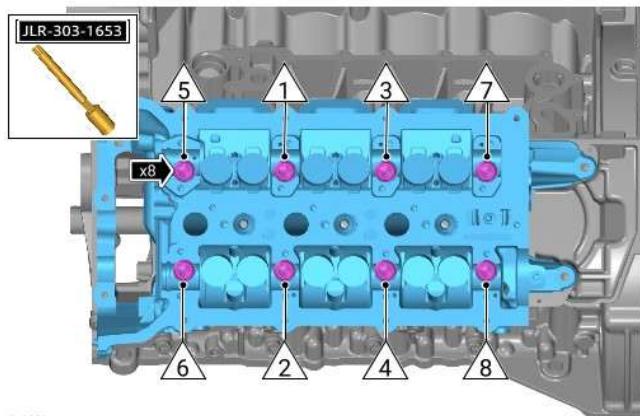


Install and tighten 2 new cylinder head bolts in the illustrated sequence.

Renew Part: Cylinder head bolts Quantity: 2.

Torque: 11.5 Nm

35.



- Install the left cylinder head.
- Use the special tool to install and tighten 8 new cylinder head bolts in the illustrated sequence.

Special Tool(s): JLR-303-1653

Renew Part: Cylinder head bolts Quantity: 8.

Torque:

Stage1: 20 Nm

Stage2: 35 Nm

- Loosen each bolt and then tighten each bolt in the illustrated sequence.

Torque: 35 Nm

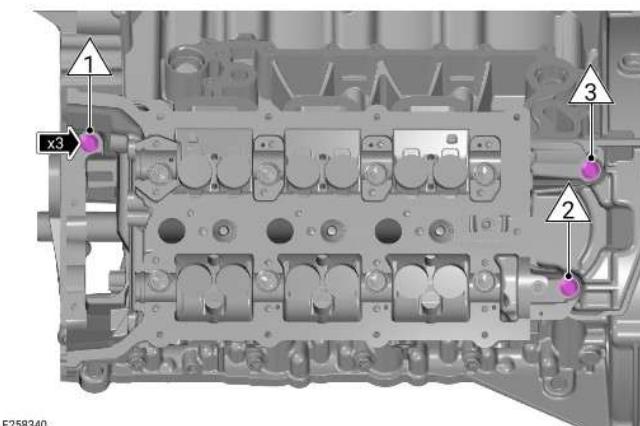
- Tighten the 10 bolts in the illustrated sequence.

Torque: 90 degree

- Tighten the 10 bolts in the illustrated sequence.

Torque: 120 degree

36.

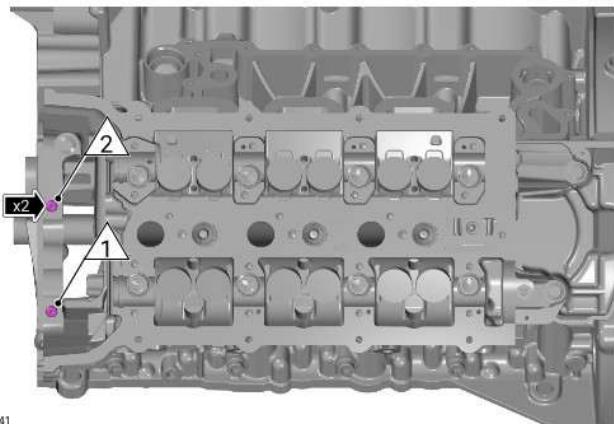


Install and tighten the 3 new bolts in the illustrated sequence.

Renew Part: Cylinder head bolts Quantity: 3.

Torque: 25 Nm

37.



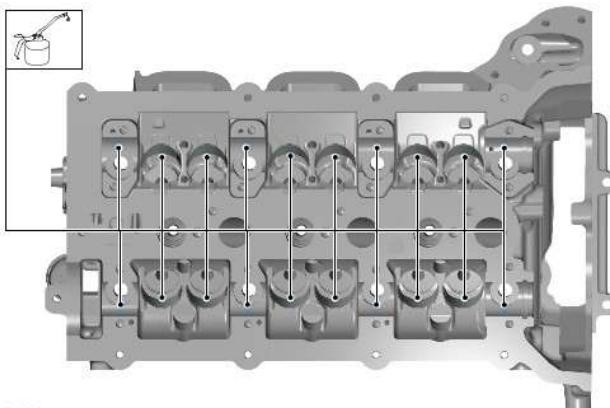
E258341

Install and tighten 2 new cylinder head bolts in the illustrated sequence.

Renew Part: Cylinder head bolts Quantity: 2.

Torque: 11.5 Nm

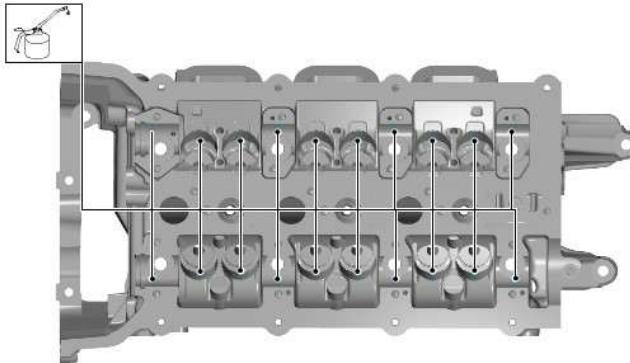
38.



E258342

Lubricate each of the areas shown with a drop of clean engine oil. For additional information, refer to: Specifications (303-01A Engine - V6 S/C 3.0L Petrol , Specifications)

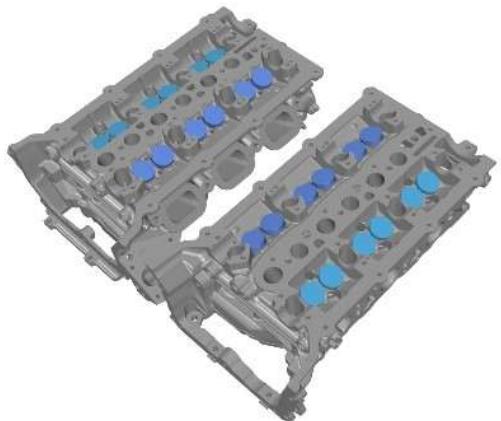
39.



E258343

Lubricate each of the areas shown with a drop of clean engine oil. For additional information, refer to: Specifications (303-01A Engine - V6 S/C 3.0L Petrol , Specifications)

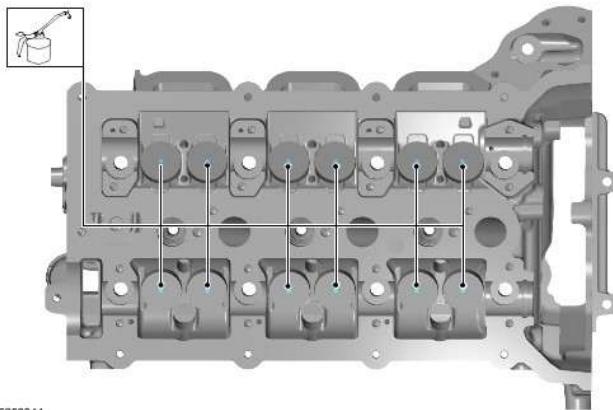
40.



E258290

Install the 24 valve tappets to their noted removal position.

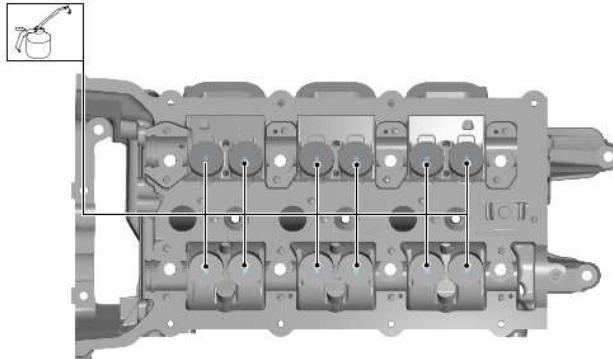
41.



E258344

Lubricate each of the areas shown with a drop of clean engine oil. For additional information, refer to: Specifications (303-01A Engine - V6 S/C 3.0L Petrol , Specifications)

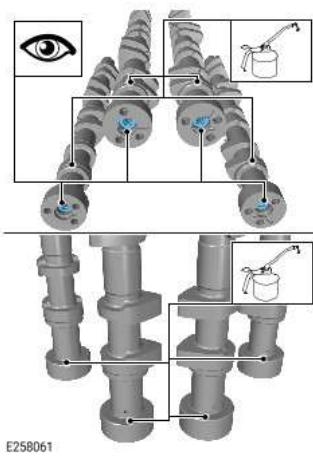
42.



E258345

Lubricate each of the areas shown with a drop of clean engine oil. For additional information, refer to: Specifications (303-01A Engine - V6 S/C 3.0L Petrol , Specifications)

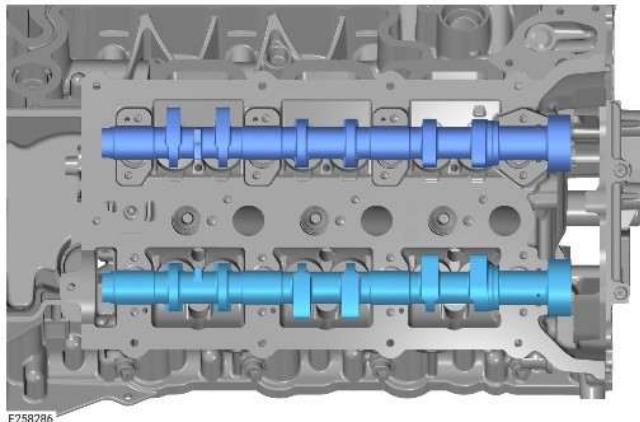
43.



E258061

- Make sure a filter is installed on each camshaft prior to installing the camshafts.
- Lubricate each of the areas shown with a drop of clean engine oil. For additional information, refer to: Specifications (303-01A Engine - V6 S/C 3.0L Petrol , Specifications)

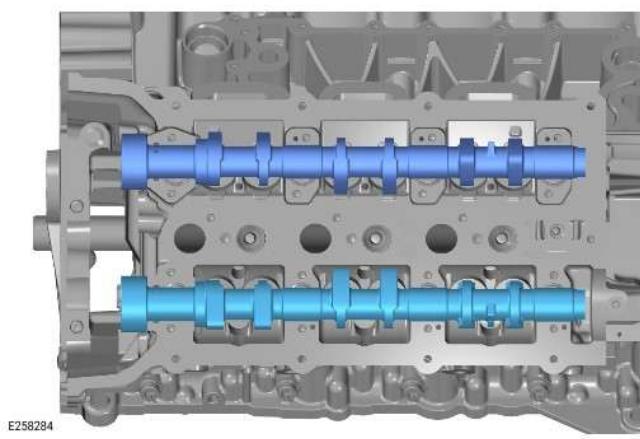
44.



E258286

Install the 2 right camshafts to their noted removal position.

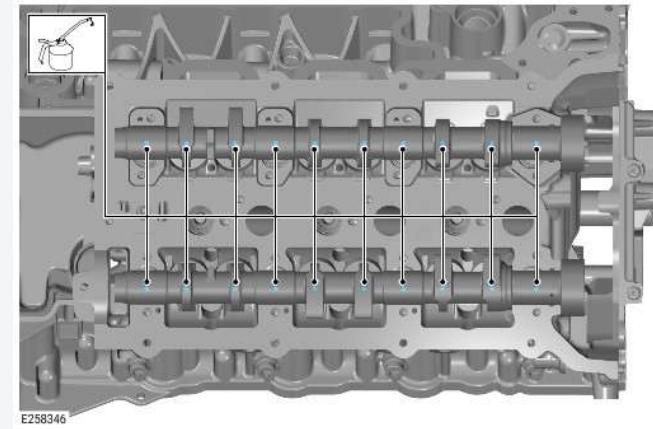
45.



E258284

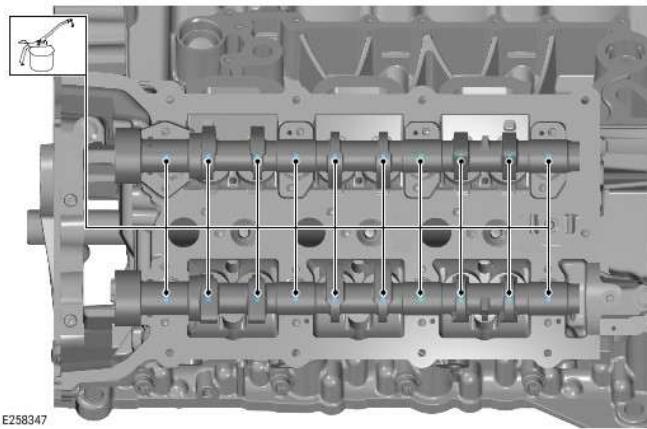
Install the 2 left camshafts to their noted removal position.

46.



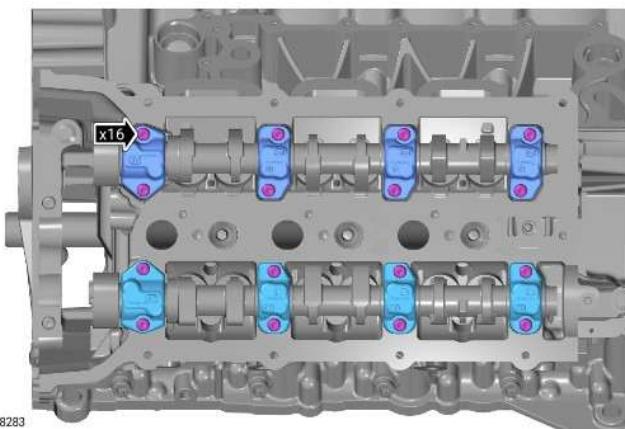
Lubricate each of the areas shown with a drop of clean engine oil. For additional information, refer to: Specifications (303-01A Engine - V6 S/C 3.0L Petrol , Specifications)

47.



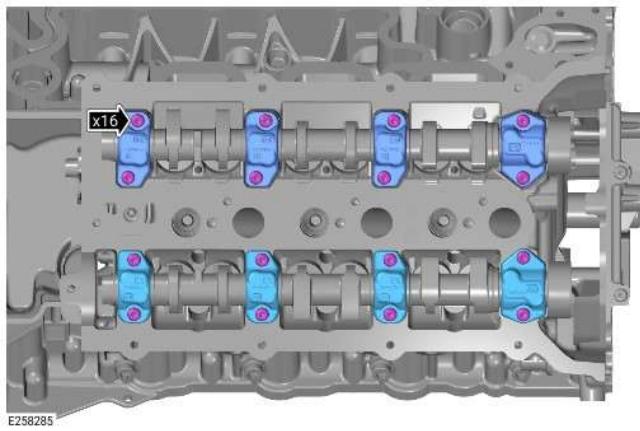
Lubricate each of the areas shown with a drop of clean engine oil. For additional information, refer to: Specifications (303-01A Engine - V6 S/C 3.0L Petrol , Specifications)

48.



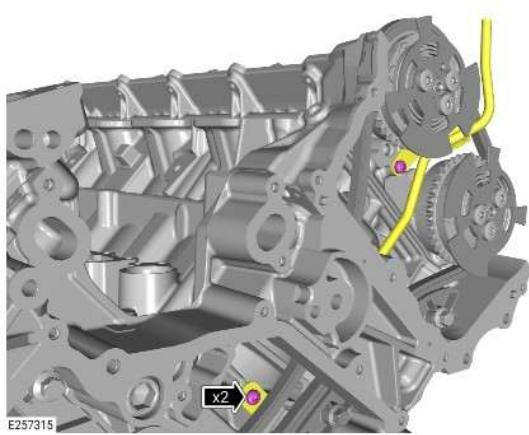
- Install the 8 camshaft bearing caps to their noted removal position.
- Working from the front of the engine to the rear, install and tighten the 20 bolts.
Torque: 11 Nm
- Make sure each camshaft can rotate freely.

49.



- Install the 8 camshaft bearing caps to their noted removal position.
- Working from the front of the engine to the rear, install and tighten the 20 bolts.
Torque: 11 Nm
- Make sure each camshaft can rotate freely.

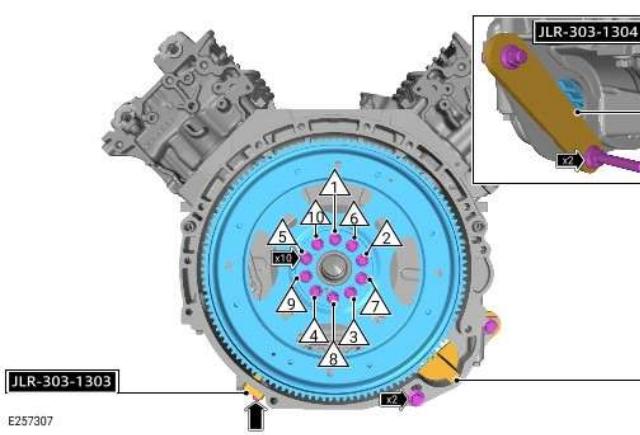
50.



Install and tighten the 2 bolts.

Torque: 11.5 Nm

51.



CAUTION:

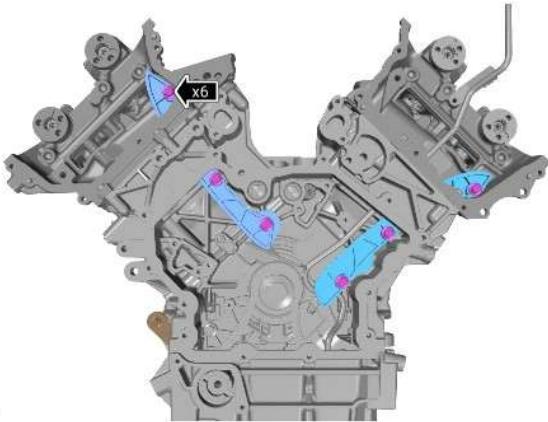
- Only rotate the crankshaft clockwise.
- The crankshaft must be set at 45° After Top Dead Center (ATDC) for cylinder 1.

- Install the drive plate.
- Install, but do not fully tighten 10 new bolts.

Renew Part: Drive plate bolts Quantity: 10.

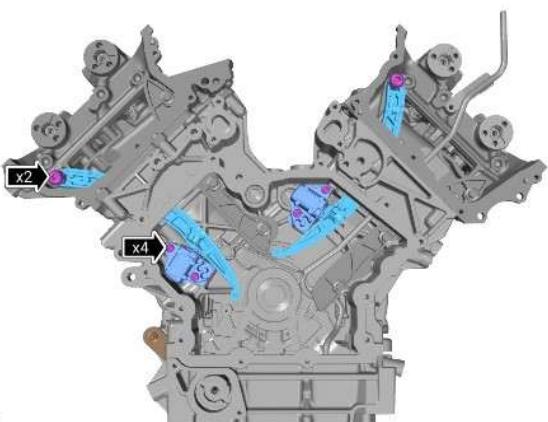
- Install the special tools as illustrated.
Special Tool(s): JLR-303-1303 , JLR-303-1304
- Tighten the 10 bolts in the illustrated sequence.
Torque:
Stage1: **45 Nm**
Stage2: **90 degree**

52.



- Install a new upper right upper timing chain guide.
Renew Part: Upper timing chain guide Quantity: 1.
- Install and tighten the 3 bolts.
Torque: 11.5 Nm
- Install a new lower left upper timing chain guide.
Renew Part: Upper timing chain guide Quantity: 1.
- Install and tighten the 3 bolts.
Torque: 11.5 Nm

53.



WARNING:

Do not remove the timing chain tensioner locking pins.

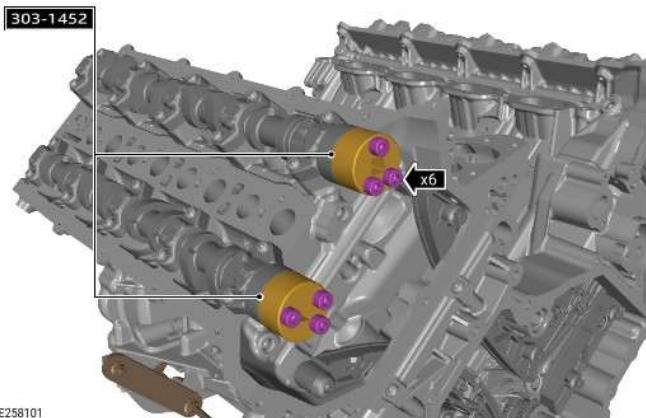
- Install a new lower right upper timing chain guide.
Renew Part: Upper timing chain guide Quantity: 1.
- Install and tighten the bolt.
Torque: 25 Nm
- Install a new upper left upper timing chain guide.
Renew Part: Upper timing chain guide Quantity: 1.
- Install and tighten the bolt.
Torque: 25 Nm
- Install a new right upper timing chain tensioner.
Renew Part: Upper timing chain tensioner Quantity: 1.
- Install and tighten the 2 bolts.
Torque: 11.5 Nm
- Install a new left upper timing chain tensioner.

Renew Part: Upper timing chain tensioner Quantity: 1.

- Install and tighten the 2 bolts.

Torque: 11.5 Nm

54.



- Install the special tools as illustrated.

Special Tool(s): 303-1452

- Install and tighten the 6 bolts.

Torque: 10 Nm

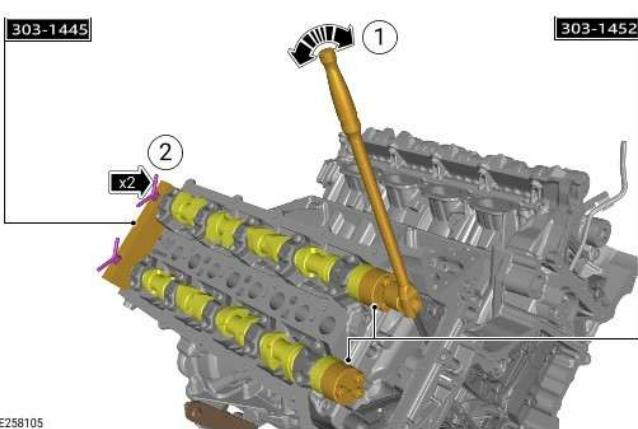
- Repeat this step for the other side.

55.



Make sure all the camshafts are oriented as illustrated.

56.



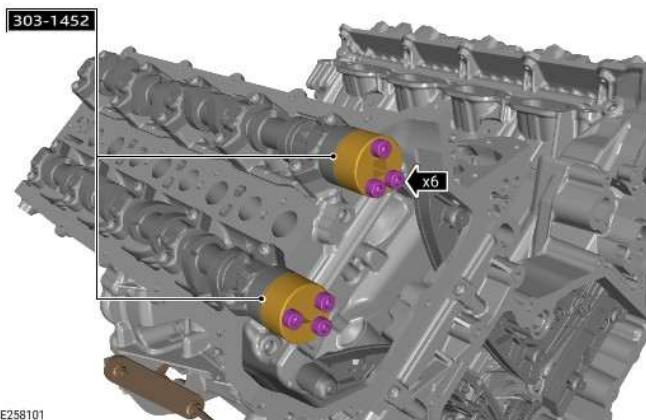
- Install the special tools as illustrated.

Special Tool(s): 303-1445

- Use a suitable tool to carefully rock the camshaft clockwise then counter clockwise. Turn the special tool locking nuts until there is no movement left in the camshaft.

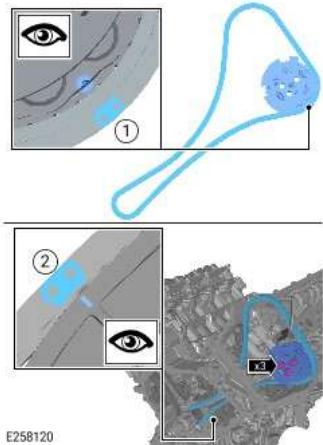
- Repeat this step for the other camshafts.

57.



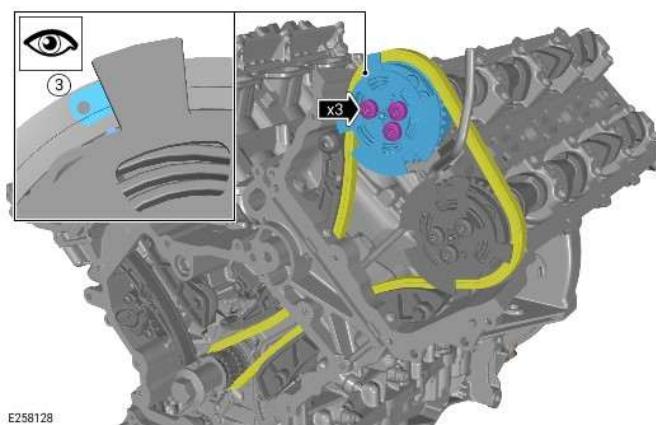
- Remove the 3 bolts.
- Remove the special tool.
Special Tool(s): 303-1452
- Remove the 3 bolts.
- Remove the special tool.
Special Tool(s): 303-1445
- Repeat this step for the other side.

58.



- Install a new left upper timing chain to the left exhaust VCT (Variable Camshaft Timing) actuator.
Renew Part: Upper timing chain Quantity: 1.
- Make sure the yellow left upper timing chain link (1) aligns with the notch on the VCT (Variable Camshaft Timing) actuator.
- Install the left upper timing chain and the left exhaust VCT (Variable Camshaft Timing) actuator.
- Make sure the white left upper timing chain link (2) aligns with the timing mark on the lower left upper timing chain guide.
- Install, but do not fully tighten the 3 bolts.

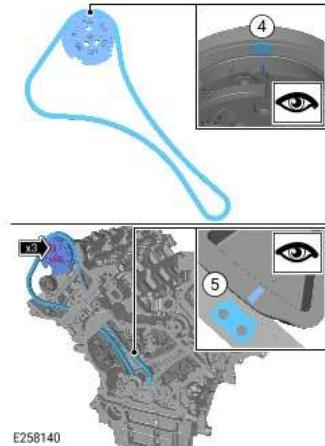
59.



- Install the left intake VCT (Variable Camshaft Timing) actuator.
- Make sure the yellow left upper timing chain link (3) aligns with the timing mark on the left intake VCT (Variable Camshaft Timing) actuator.

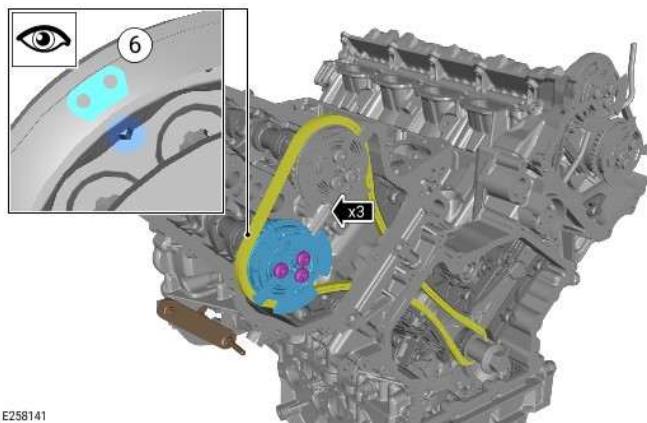
- Install, but do not fully tighten the 3 bolts.

60.



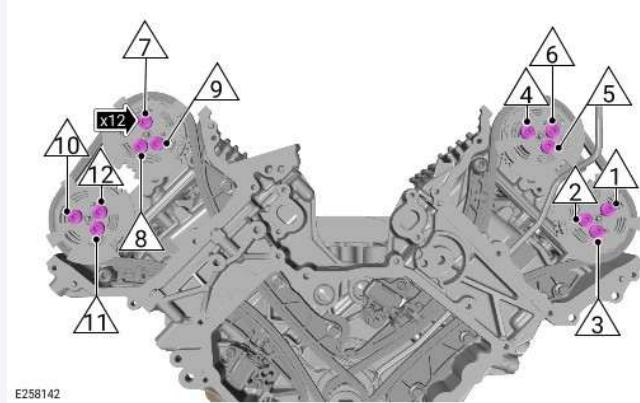
- Install a new right upper timing chain to the right intake VCT (Variable Camshaft Timing) actuator.
Renew Part: Upper timing chain Quantity: 1.
- Make sure the yellow right upper timing chain link (4) aligns with the timing mark on the VCT (Variable Camshaft Timing) actuator.
- Install the right upper timing chain and the right intake VCT (Variable Camshaft Timing) actuator.
- Install, but do not fully tighten the 3 bolts.
- Make sure the white right upper timing chain link (5) aligns with the timing mark on the upper right upper timing chain guide.

61.



- Install the right exhaust VCT (Variable Camshaft Timing) actuator.
- Make sure the yellow right upper timing chain link (6) aligns with the the notch on the VCT (Variable Camshaft Timing) actuator.
- Install, but do not fully tighten the 3 bolts.

62.



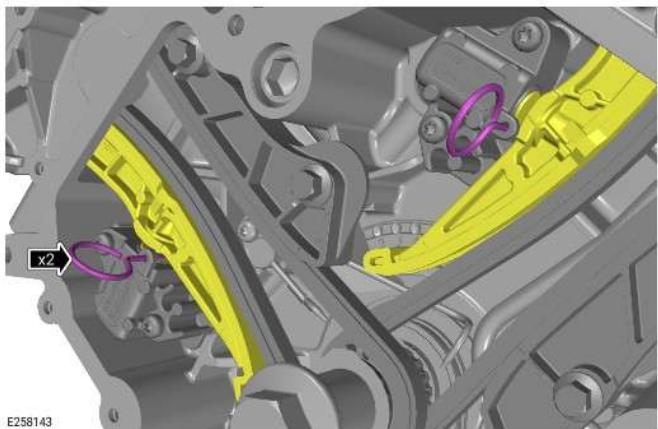
- Tighten the 12 bolts in the illustrated sequence.

Torque: 10 Nm

- Loosen the 12 bolts.

Torque: 720 degree

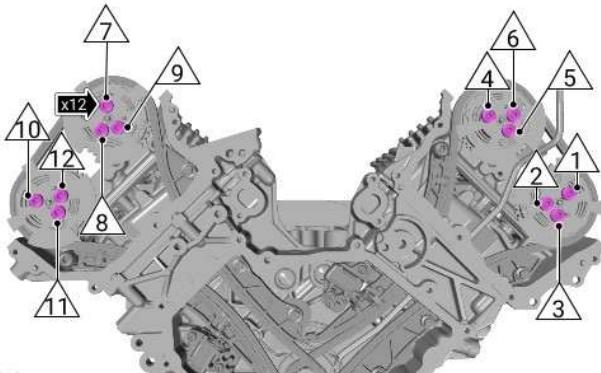
63.



E258143

Remove and discard the 2 locking pins.

64.

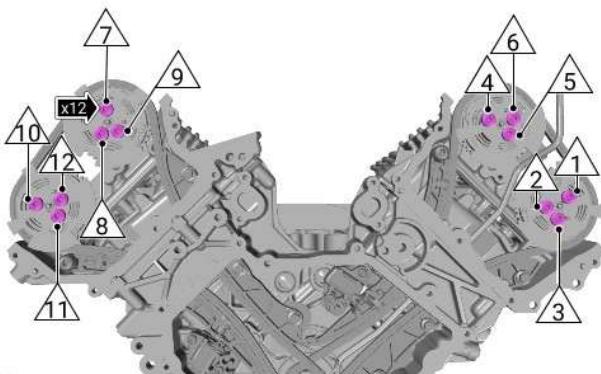


E258142

Tighten the 12 bolts in the illustrated sequence.

Torque: 10 Nm

65.

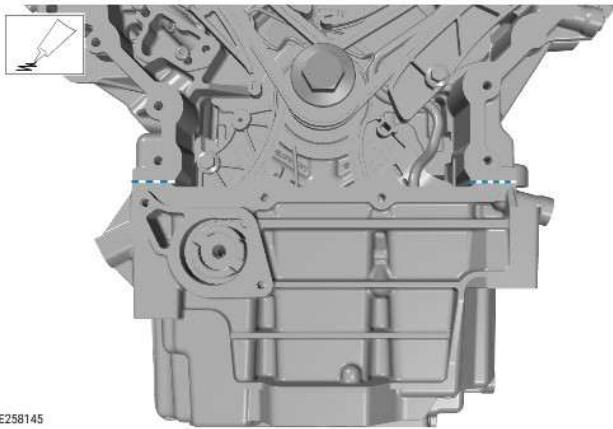


E258142

Tighten the 12 bolts in the illustrated sequence.

Torque: 32 Nm

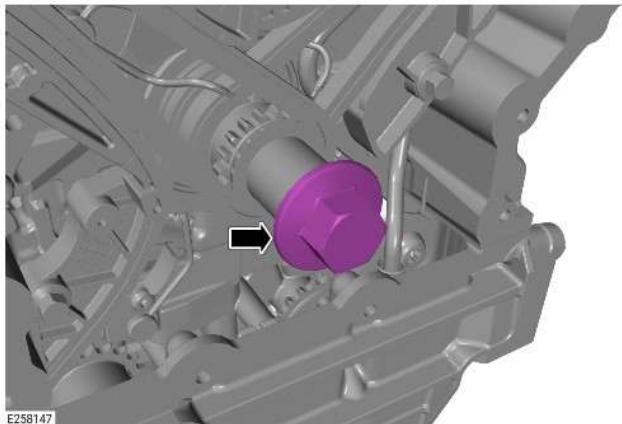
66.



E258145

Apply RTV sealant (Loctite 5901G) in a 3mm diameter to the areas shown, and install the engine front cover within 7 minutes.

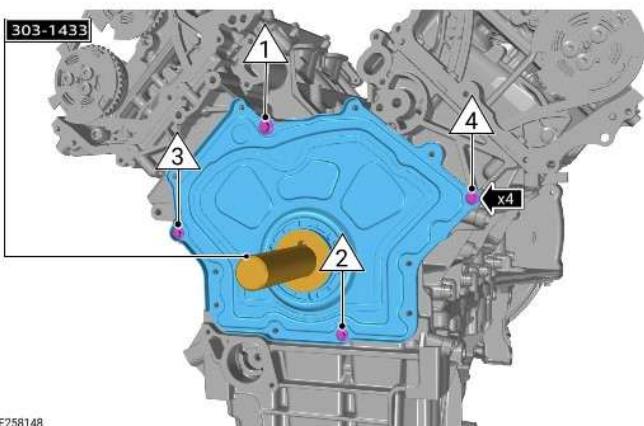
67.



E258147

Remove and discard the bolt.

68.



E258148

- Use the special tool to install and align the engine front cover.

Special Tool(s): 303-1433

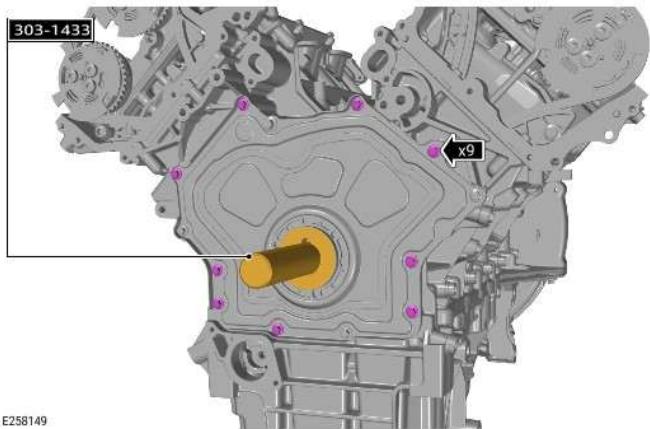
- Install, but do not fully tighten the 4 bolts.
- Tighten the 4 bolts in the illustrated sequence.

Torque:

Stage1: M6 11.5 Nm

Stage2: M8 20 Nm

69.



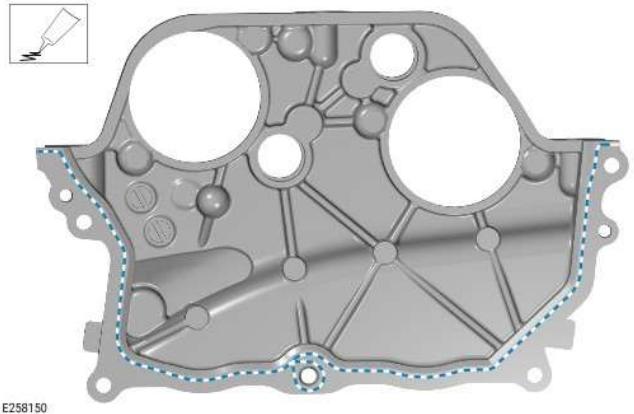
- Install and tighten the 9 bolts.

Torque: 11 Nm

- Remove the special tool.

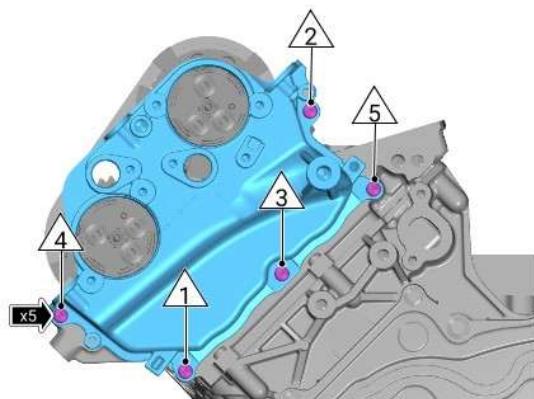
Special Tool(s): 303-1433

70.



Apply RTV sealant (Loctite 5901G) in a 3mm diameter to the areas shown, and install the upper timing cover within 7 minutes.

71.

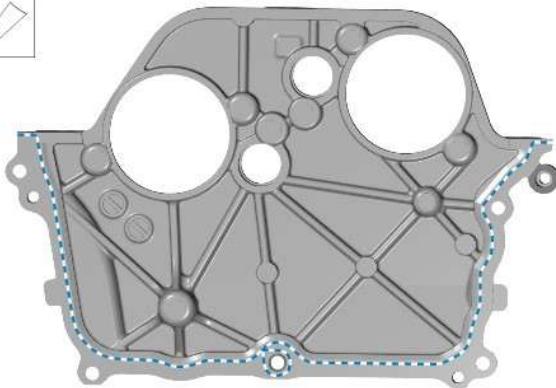


- Install the upper timing cover.

- Install and tighten the 5 bolts in the illustrated sequence.

Torque: 11.5 Nm

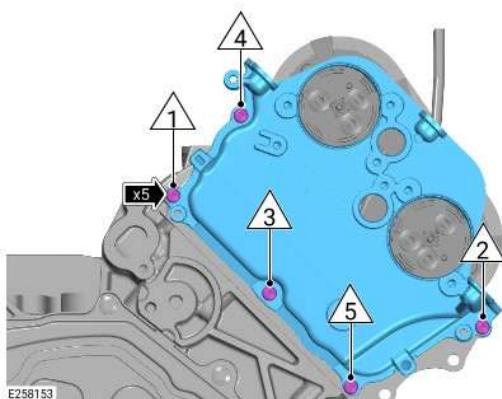
72.



E258152

Apply RTV sealant (Loctite 5901G) in a 3mm diameter to the areas shown, and install the upper timing cover within 7 minutes.

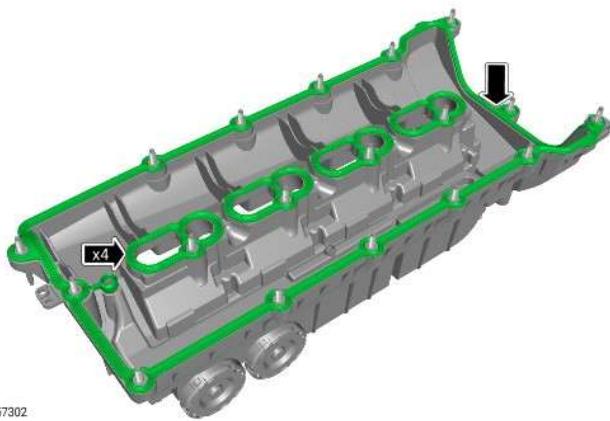
73.



- Install the upper timing cover.
- Install and tighten the 5 bolts in the illustrated sequence.

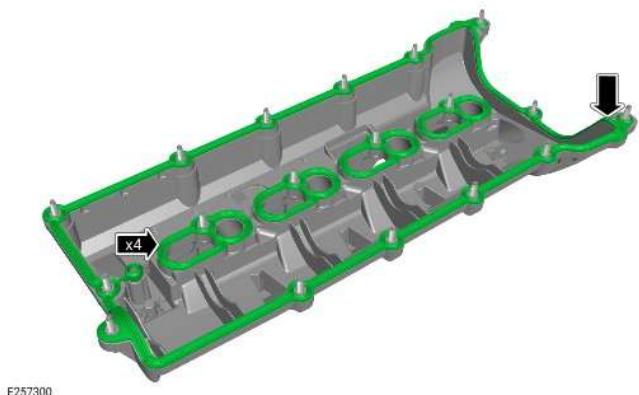
Torque: 11.5 Nm

74.



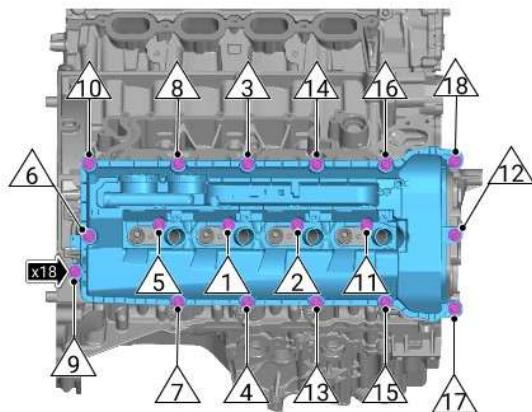
- Install a new right valve cover gasket.
Renew Part: Valve cover gasket Quantity: 1.
- Install 4 new spark plug boss seals.
Renew Part: Spark plug boss seals Quantity: 1.

75.



- Install a new leftt valve cover gasket.
Renew Part: Valve cover gasket Quantity: 1.
- Install 4 new spark plug boss seals.
Renew Part: Spark plug boss seals Quantity: 1.

76.

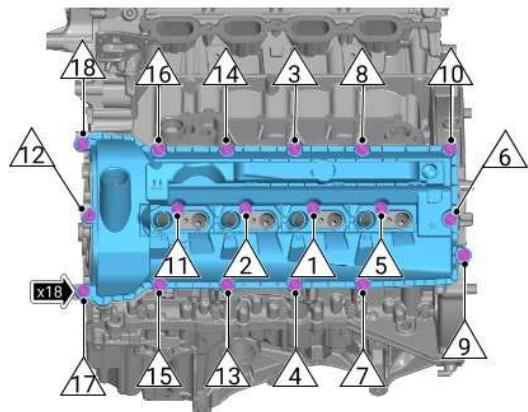


NOTE:

The bolts are captive.

- Install the right valve cover.
 - Tighten the 18 bolts.
- Torque: 13 Nm*

77.



NOTE:

- The bolts are captive.
 - The bolts are captive.
- Install the left valve cover.
- Tighten the 18 bolts.

Torque: 13 Nm

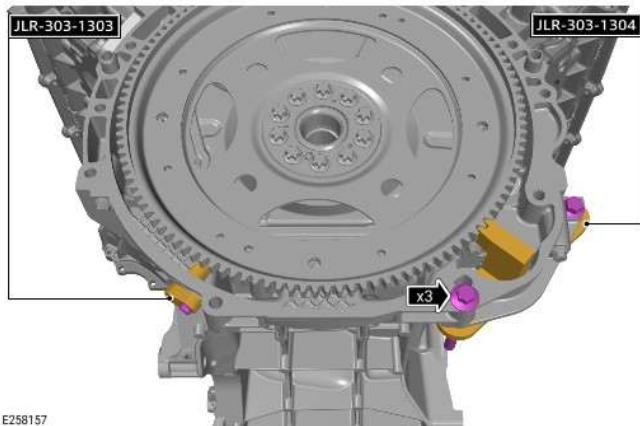
78.



E257298

Install the oil filler cap.

79.



E258157

- Remove the bolt.
- Remove the special tool.

Special Tool(s): JLR-303-1303

- Remove the 2 bolts.
- Remove the special tool.

Special Tool(s): JLR-303-1304

80.

Install the engine and ancillaries. For additional information, refer to: Engine Accessories (303-01 Engine - V6 S/C 3.0L Petrol , Installation)