

Engine

Special Service Tools



303D055

Wrench strap-universal
303-D055



303D121

Crankshaft Pulley Remover
303-D121

303 102



303 102

Crankshaft Pulley Installer
303-102



303D12101

Trust Pad
303-D121-01

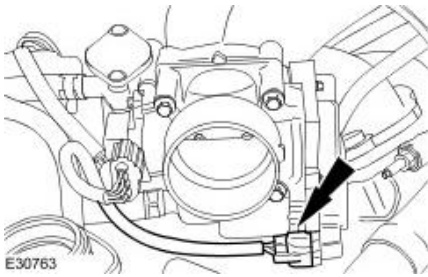


303-335/2

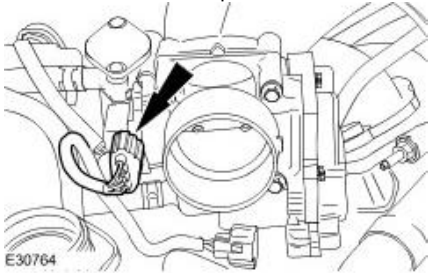
Crankshaft pulley installer
303-335/2

Disassembly

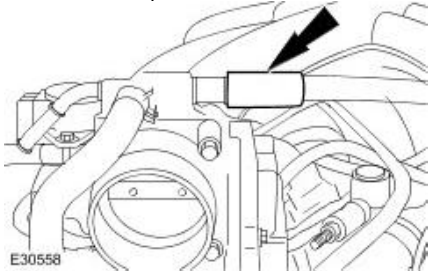
- 1 . Disconnect the throttle motor electrical connector.



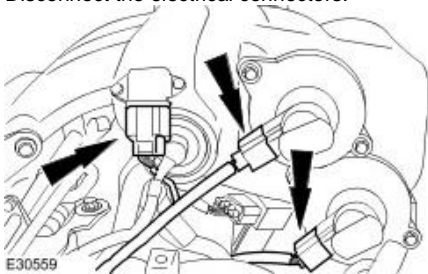
2 . Disconnect the throttle position sensor.



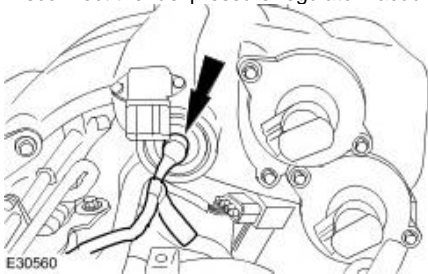
3 . Disconnect the positive crankcase ventilation (PCV) hose.



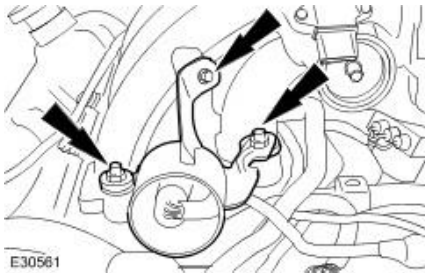
4 . Disconnect the electrical connectors.



5 . Disconnect the fuel pressure regulator vacuum hose.



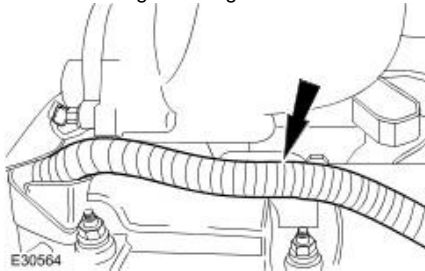
6 . Remove the fuel pressure regulator bracket.



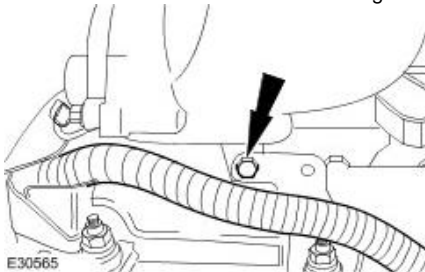
7 . Detach the intake manifold front retaining bracket.



8 . Detach the engine wiring harness from the intake manifold rear retaining bracket.



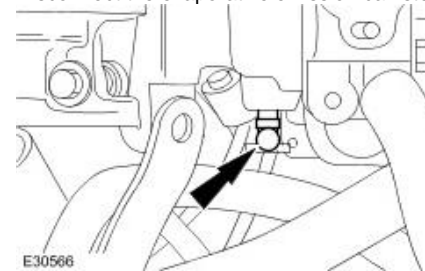
9 . Detach the intake manifold rear retaining bracket.



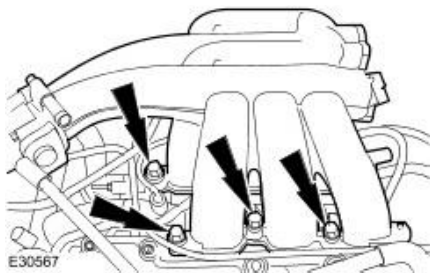
10 **NOTE:**

- The evaporative emission canister purge valve transfer pipe is attached to the induction manifold by a quick release coupling.

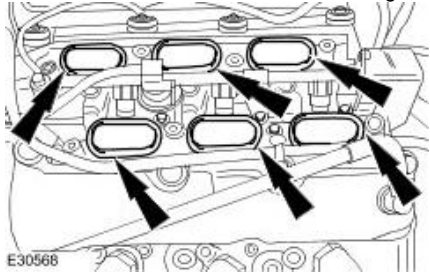
Disconnect the evaporative emission canister purge valve transfer pipe.



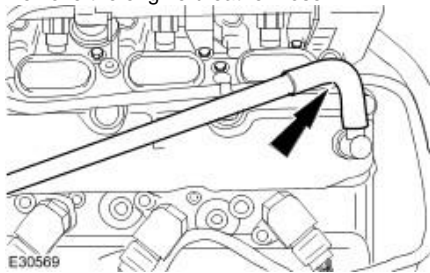
11 . Remove the intake manifold.



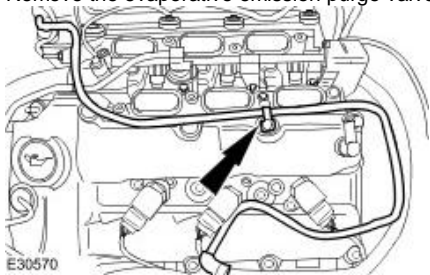
12 . Remove and discard the intake manifold gaskets.



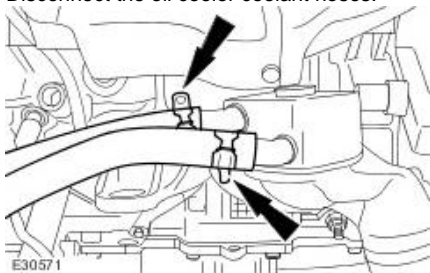
13 . Remove the engine breather hose.



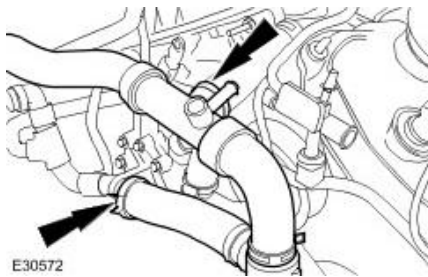
14 . Remove the evaporative emission purge valve hose.



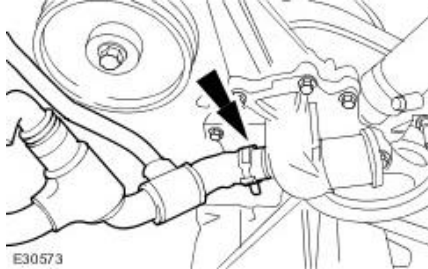
15 . Disconnect the oil cooler coolant hoses.



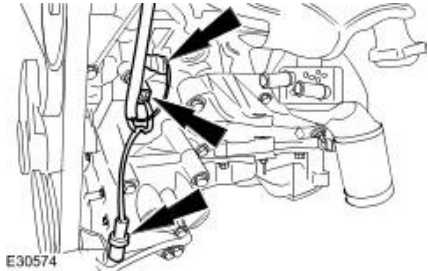
16 . Remove the coolant hose.



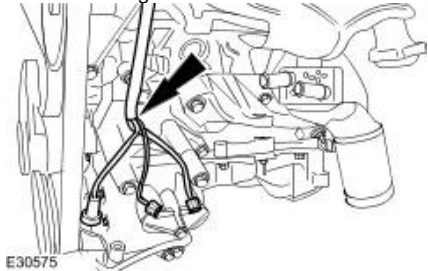
17 . Remove the coolant hose.



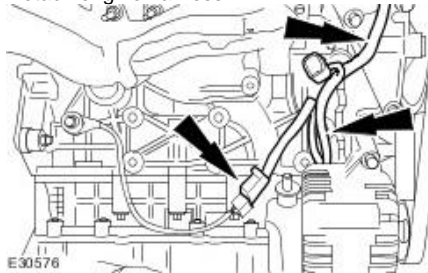
18 . Disconnect the electrical connectors.



19 . Detach the engine harness.

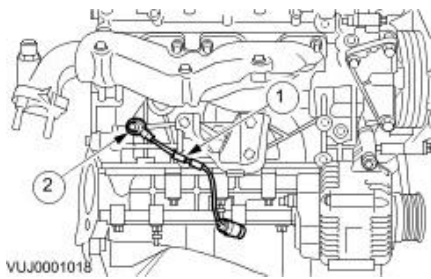


20 . Detach engine harness.

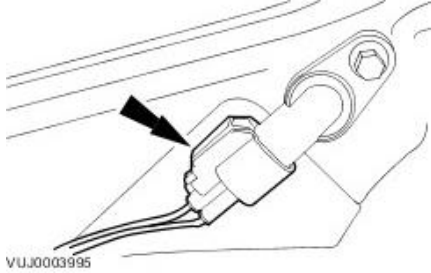


21 . Remove the rear knock sensor.

1. Detach the knock sensor wiring harness.
2. Remove the rear knock sensor.



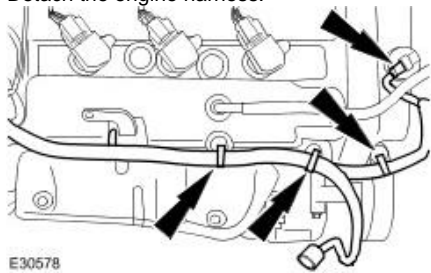
22 . Disconnect the right-hand camshaft position sensor.



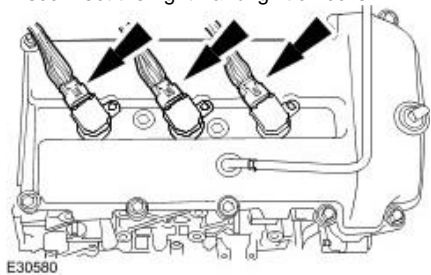
23 . Detach the engine harness retaining bracket.



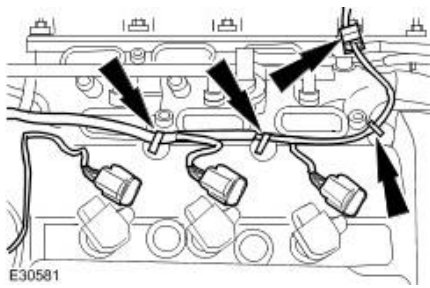
24 . Detach the engine harness.



25 . Disconnect the right-hand ignition coils.



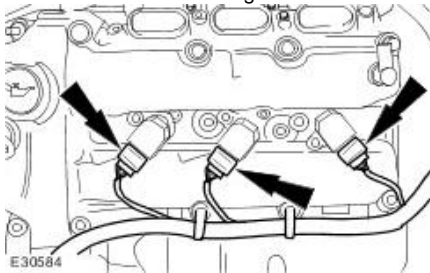
26 . Detach the engine harness.



27 . Disconnect the left-hand camshaft position sensor.



28 . Disconnect the left-hand ignition coils.



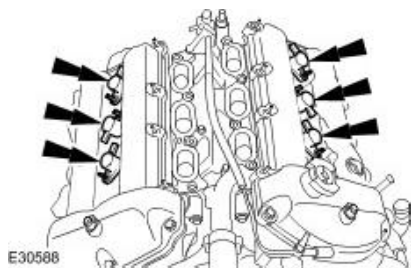
29 . Disconnect the engine wiring harness electrical connectors.



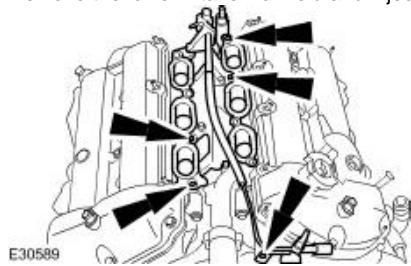
30 . Remove the engine wiring harness.



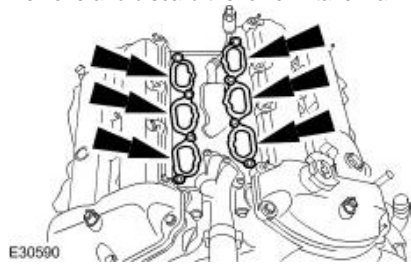
31 . Remove the ignition coils.



32 . Remove the lower intake manifold and injector supply manifold.



33 . Remove and discard the lower intake manifold gaskets.

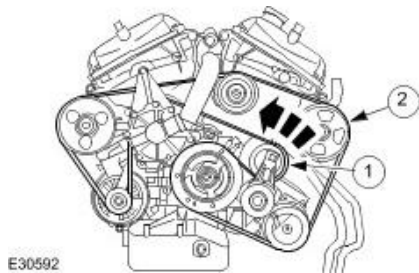


34 . Remove the left-hand knock sensor.

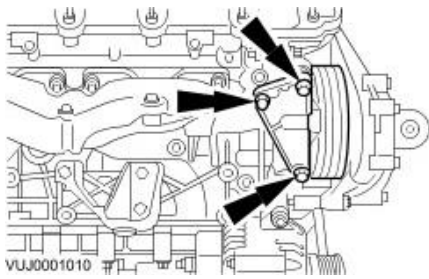


35 . Remove the accessory drive belt.

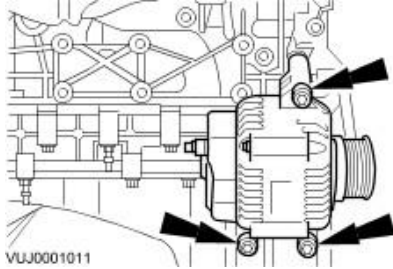
- Use a 3/8 inch drive bar to release the accessory drive belt tensioner.
- Remove the accessory drive belt.



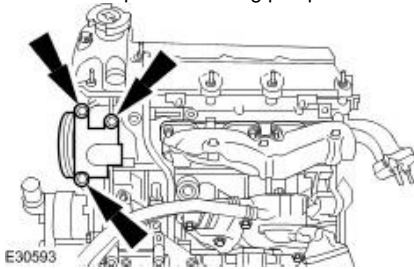
36 . Remove the right-hand idler pulley.



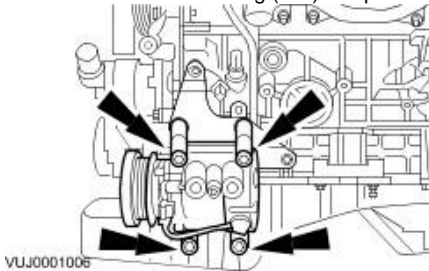
37 . Remove the generator.



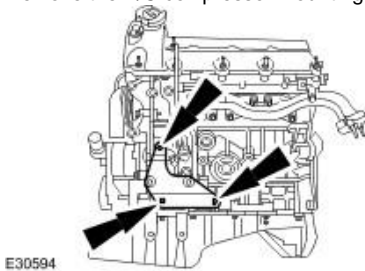
38 . Remove the power steering pump.



39 . Remove the air conditioning (A/C) compressor.

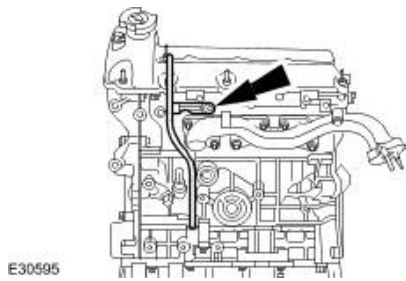


40 . Remove the A/C compressor mounting bracket.



41 . Remove the oil level indicator tube.

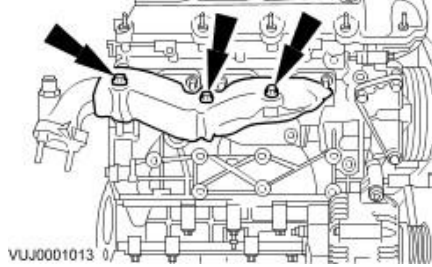
- Remove and discard the O-ring seal.



42 . **NOTE:**

Right-hand shown, Left-hand similar.

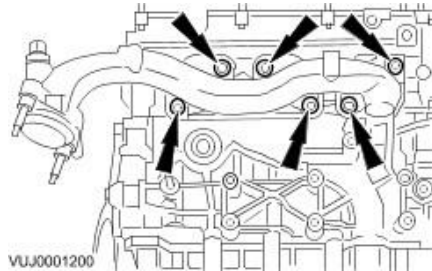
Remove the exhaust manifold heat shields.



43 . **NOTE:**

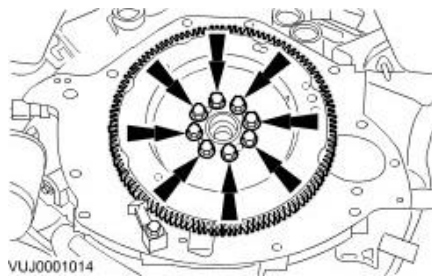
Right-hand shown, Left-hand similar.

Remove the exhaust manifolds.

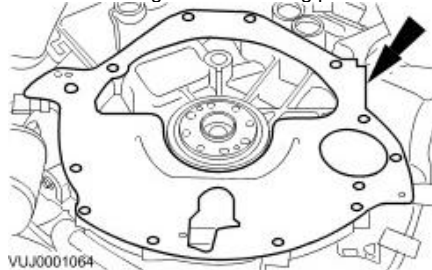


44 . Remove the flywheel.

- Prevent the engine from rotating.

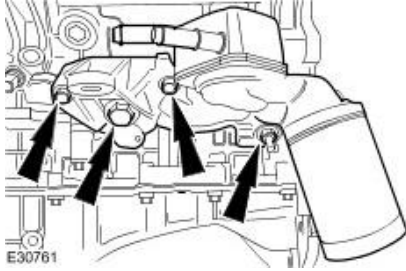


45 . Remove the engine rear backing plate.

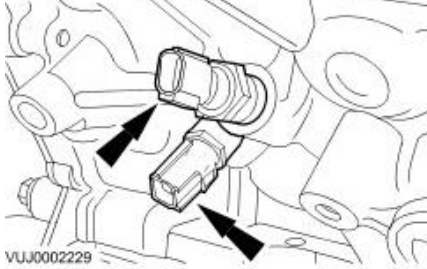


46 . Remove the oil filter housing assembly.

- Remove and discard the O-ring seal.

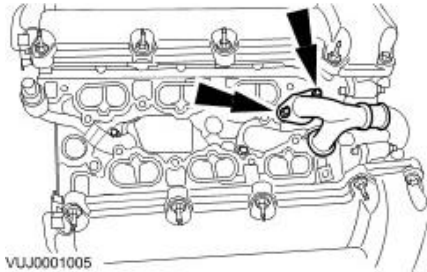


47 . Remove the engine oil pressure and oil temperature sensors.



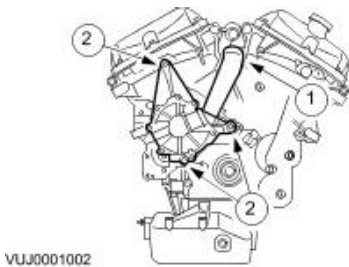
48 . Remove the coolant crossover tube.

- Remove and discard the O-ring seals.

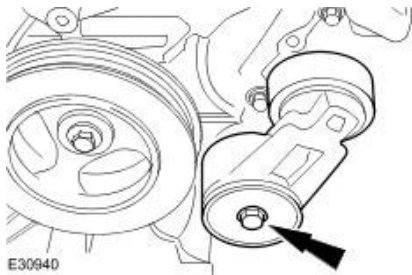


49 . Remove the water pump and coolant hose assembly.

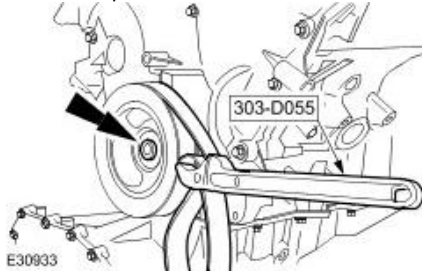
3. Detach the hose.
4. Remove the water pump and coolant hose assembly.



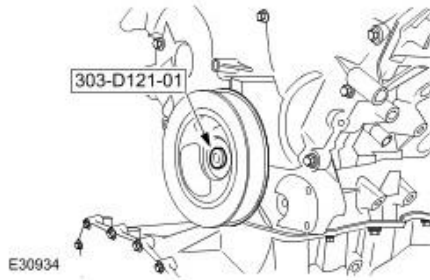
50 . Remove the accessory drive belt tensioner.



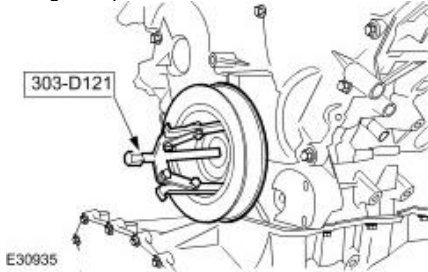
51 . Install the special tool, loosen the crankshaft pulley retaining bolt.



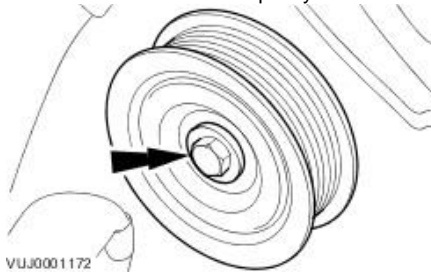
52 . Install the special tool.



53 . Using the special tool, remove the crankshaft vibration damper.

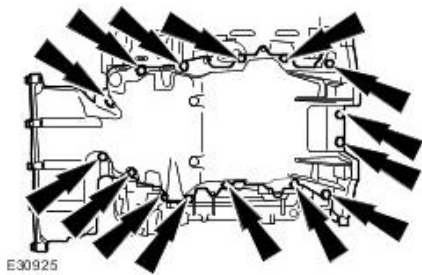


54 . Remove the left-hand idler pulley.



55 Remove the oil pan.

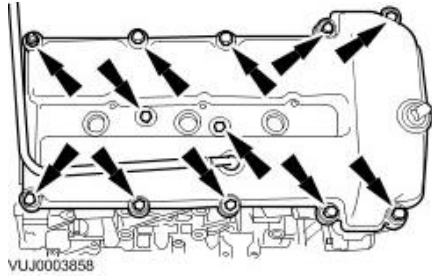
- Remove and discard the oil pan gasket.
- Clean and inspect the oil pan and cylinder block sealing surfaces using Metal surface cleaner or equivalent meeting Jaguar specification.



56 . **NOTE:**

Right-hand shown, left-hand similar.

Remove the valve covers.

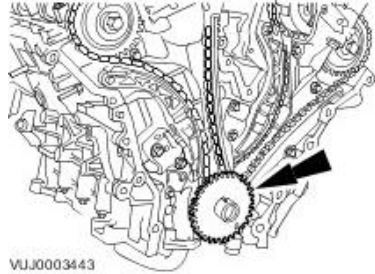


57 . Remove the engine front cover

- Remove and discard the engine front cover gaskets.



58 . Remove the crankshaft position (CKP) sensor pulse wheel.

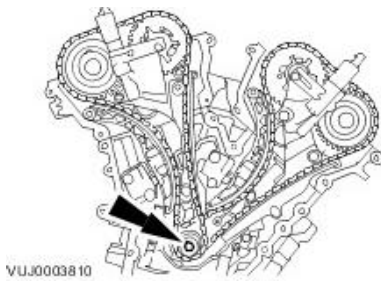


59



CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

Install the crankshaft pulley retaining bolt and washer.

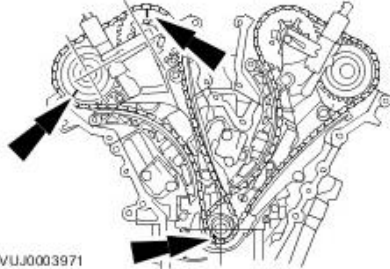


60



CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

Rotate the crankshaft clockwise until the crankshaft keyway is at the 7 O'clock position, the alignment mark on the right-hand intake camshaft sprocket is at the 1 O'clock position and the alignment mark on the right-hand exhaust camshaft sprocket is at the 8 O'clock position.

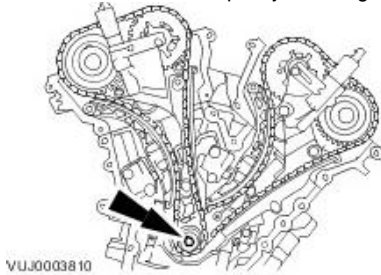


61

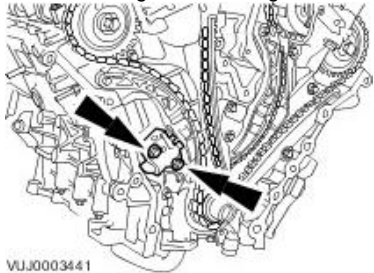


CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

Remove the crankshaft pulley retaining bolt and washer.



62 . Remove the right-hand timing chain tensioner.

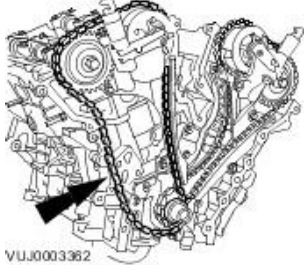


63 . Remove the right-hand timing chain outer guide.



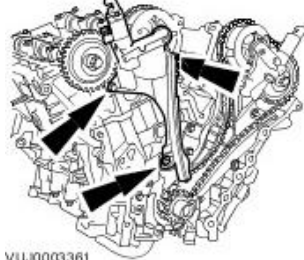
VUJ0003440

- 64 . Remove the right-hand timing chain.



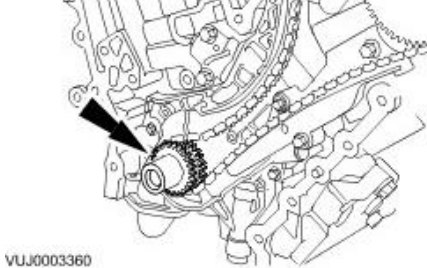
VUJ0003362

- 65 . Remove the right-hand timing chain inner guide.



VUJ0003361

- 66 . Remove the crankshaft outer sprocket.



VUJ0003360

67



CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

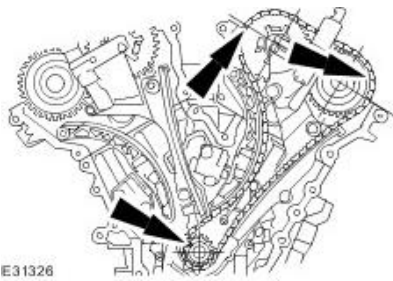
Install the crankshaft pulley retaining bolt and washer.

68



CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

Rotate the crankshaft clockwise until the crankshaft keyway is at the 11 O'clock position, the alignment mark on the left-hand intake camshaft sprocket is at the 9 O'clock position and the alignment mark on the left-hand exhaust camshaft sprocket is at the 2 O'clock position.



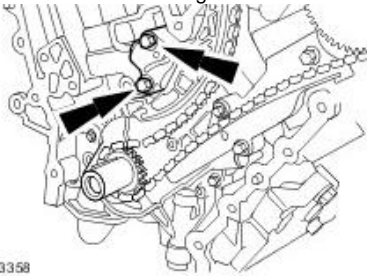
69



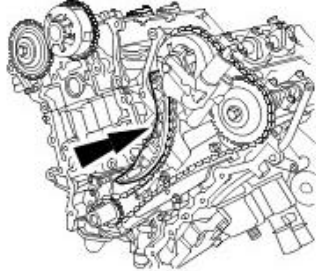
CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

Remove the crankshaft pulley retaining bolt and washer.

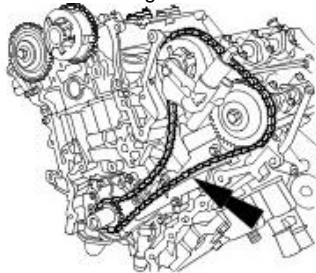
70 . Remove the left-hand timing chain tensioner.



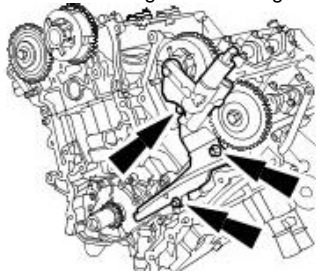
71 . Remove the left-hand timing chain inner guide.



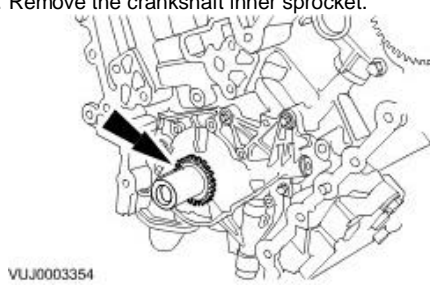
72 . Remove the left-hand timing chain.



73 . Remove the left-hand timing chain outer guide.

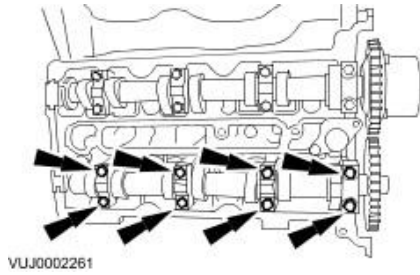


74 . Remove the crankshaft inner sprocket.

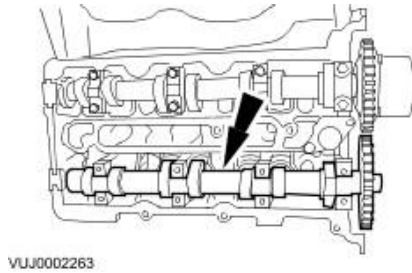


75 . Remove the RH exhaust camshaft bearing cap bolts evenly.

- Remove the exhaust camshaft bearing caps.

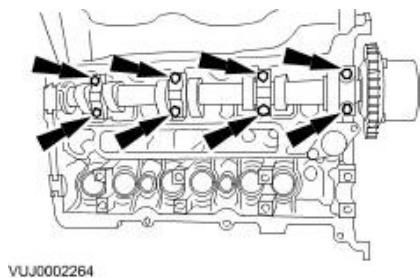


76 . Remove the RH exhaust camshaft.

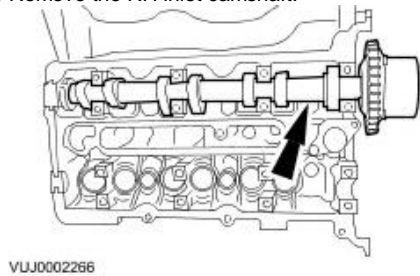


77 . Remove the RH inlet camshaft bearing cap bolts evenly.

- Remove the inlet camshaft bearing caps.

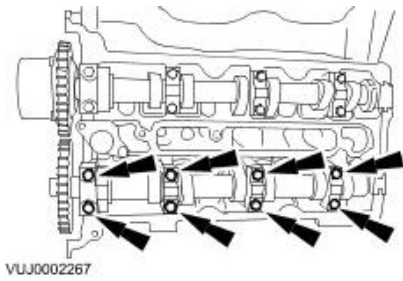


78 . Remove the RH inlet camshaft.

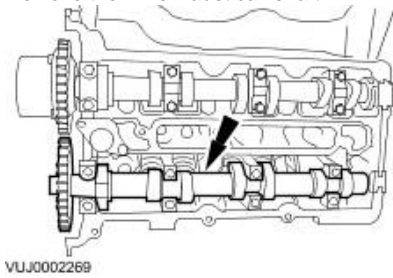


79 . Remove the LH exhaust camshaft bearing cap bolts evenly.

- Remove the exhaust camshaft bearing caps.

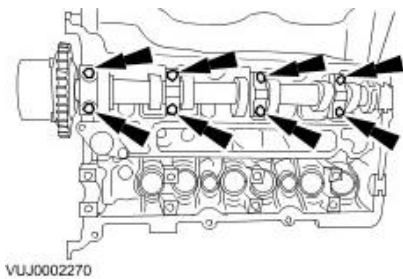


- 80 . Remove the LH exhaust camshaft.

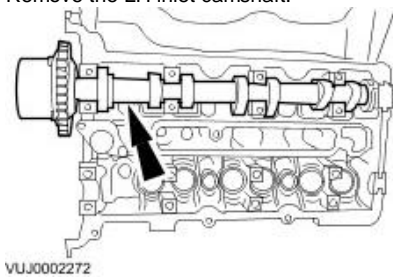


- 81 . Remove the LH inlet camshaft bearing cap bolts evenly.

- Remove the inlet camshaft bearing caps.



- 82 . Remove the LH inlet camshaft.

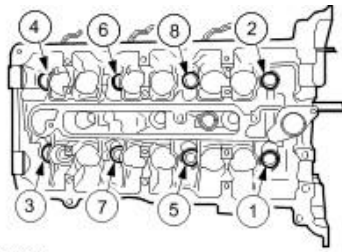


- 83 . **NOTE:**

Remove the bolts in the indicated sequence.

Remove the RH cylinder head.

- Discard the gasket.



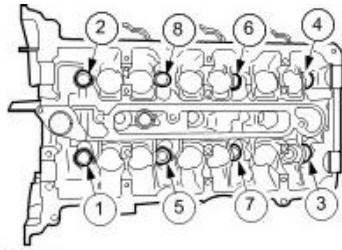
VUJ0002273

84 . **NOTE:**

Remove the bolts in the indicated sequence.

Remove the LH cylinder head.

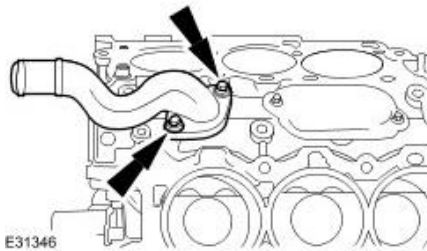
- Discard the gasket.



VUJ0002275

85 . Remove the engine coolant housing.

- Discard the 'O' ring seals.



E31346

86 . **NOTE:**

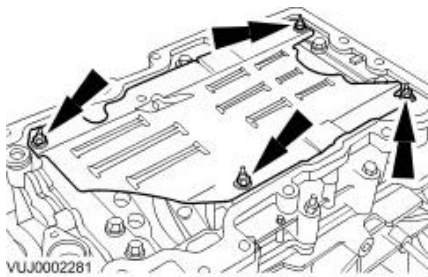
Engine inverted for clarity.

Remove the oil pump tube.



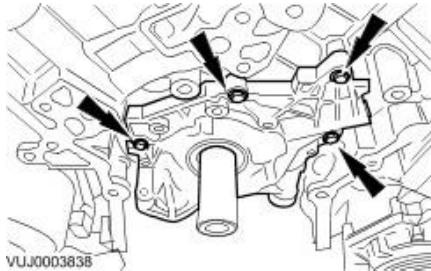
VUJ0003458

87 . Remove the oil pan baffle.



88 . Remove the oil pump.

- Remove and discard the O-ring seal.
- Inspect the oil pump for damage and wear.



89



CAUTION: Pistons, connecting rods and connecting rod bearings should be numbered to make sure they are reassembled in the same position.

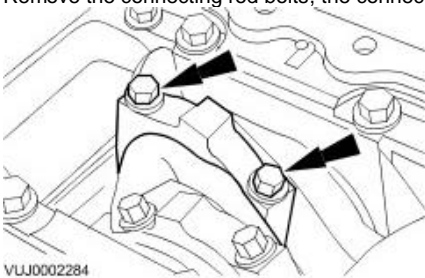
NOTE:

Mark the position of the connecting rod caps to the connecting rods to make sure correct insulation.

NOTE:

Discard the connecting rod bolts after removal.

Remove the connecting rod bolts, the connecting rod caps and the lower connecting rod bearings.



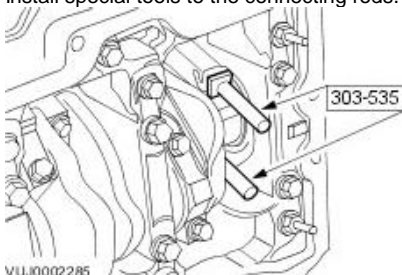
90 . Inspect the tops of the cylinder bores. As necessary remove ridge and carbon build up from each cylinder.

91



CAUTION: Use appropriate protection to prevent damage to the crankshaft bearing journals and cylinder bore surfaces.

Install special tools to the connecting rods.



92



CAUTION: Care should be taken not to damage the connecting rod and cap joint face surfaces or possible engine damage may occur. Avoid contaminating the fracture joint surfaces with dirt or grease.

NOTE:

Reattach the connecting rods and caps after removal to avoid mismatch.

Remove the pistons.

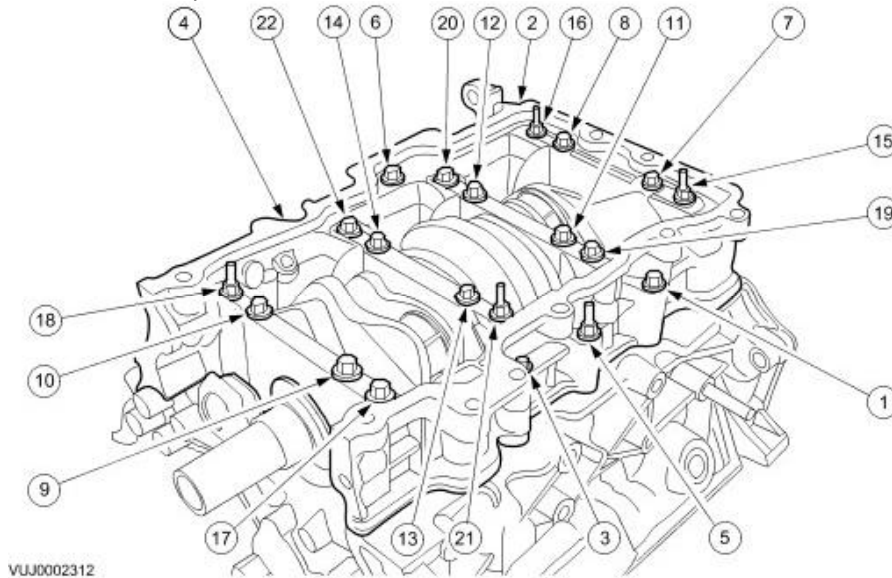
- Rotate the crankshaft to locate pistons at the bottom of travel.
- Push the piston, connecting rod and upper bearing through the top of the cylinder.



93 . **NOTE:**

Remove the lower cylinder block bolts in the indicated sequence.

Remove the lower cylinder block.

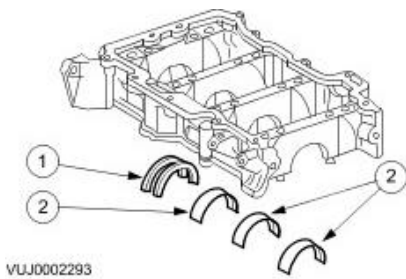


94 . **NOTE:**

Mark the position of the upper and lower crankshaft main bearing and the crankshaft thrust bearing for reassembly.

Remove the lower crankshaft bearings.

5. Remove the lower crankshaft thrust main bearing.
6. Remove the lower crankshaft main bearings.



95 .



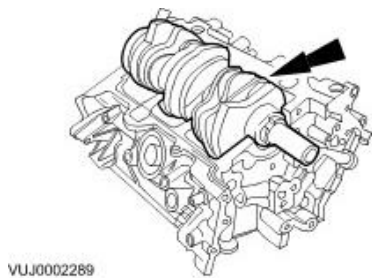
CAUTION: Avoid damage to any crankshaft bearing surfaces.

NOTE:

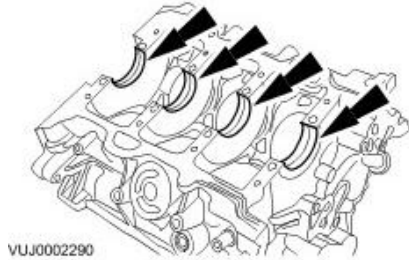
Never remove any pipe plugs or dowels unless they are to be newly installed or the cylinder block is to be washed.

Remove the crankshaft.

- Discard the crankshaft rear main oil seal.

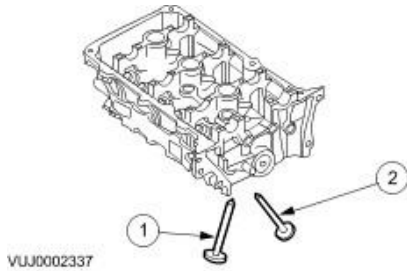


96 . Remove the upper crankshaft main bearings.



97 . Clean the cylinder block with a soap and water solution. Dry the cylinder block completely with compressed air.

- 4 . Remove the valves from the cylinder heads.
 4. Remove the intake valves.
 5. Remove the exhaust valves.



- 5 . Inspect the cylinder heads and the related components. <<303-00>>
- 6 . Remove the pipe plugs and alignment dowels as necessary to clean the cylinder heads.

Assembly

1



WARNING: Eye protection is required during use of compressed air. Failure to follow these instructions may result in personal injury.



CAUTION: The cylinder head surface finish is measured in microns. For correct head gasket sealing, avoid any contact of finish with metallic objects.

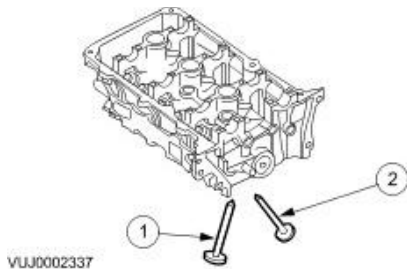
Clean gasket material, dirt and foreign material from cylinder heads. Wash with a suitable soap and water solution and dry completely using compressed air if pipe plugs have been removed.

- 2 . Install the pipe plugs and alignment dowels to cylinder heads.
 - Apply pipe sealant to plugs prior to installation.

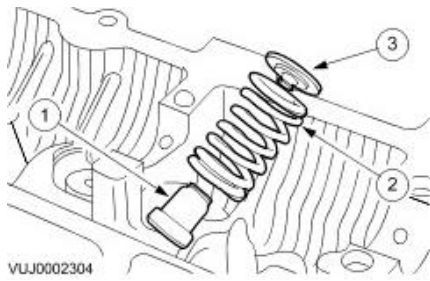
- 3 . **NOTE:**
 - Lubricate the valve stems before assembly.

Install the valves into the cylinder heads.

6. Install the intake valves.
7. Install the exhaust valves.

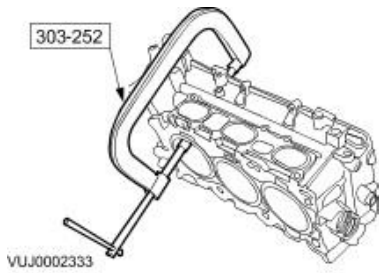


- 4 . Install the valve spring retainers and valve springs.
 8. Install the valve stem oil seals.
 9. Install the valve springs.
 10. Install the valve spring retainers.

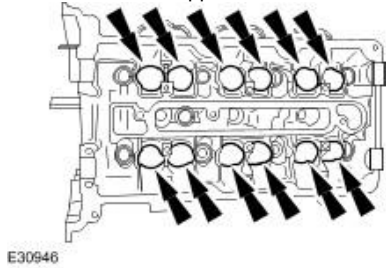


5 . Using the special tool, compress the valve springs.

- Install the valve collets.



6 . Install the bucket tappet and shim assemblies.



Cylinder Head (12.29.22)

Special Service Tools



303252

Valve Spring Compressor
303-252

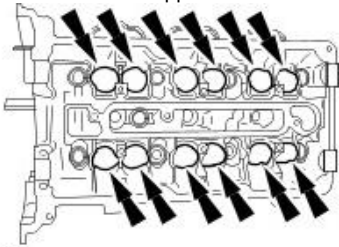
Disassembly

1



CAUTION: If the cylinder head valve components are to be reused, mark position of the valve components to make sure they are reassembled in the same position.

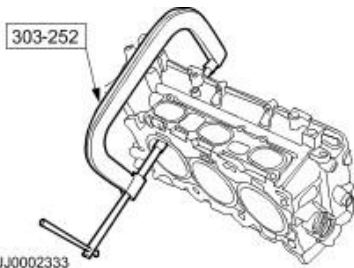
Remove the bucket tappet and shim assemblies.



E30946

2. Using the special tool, compress the valve springs.

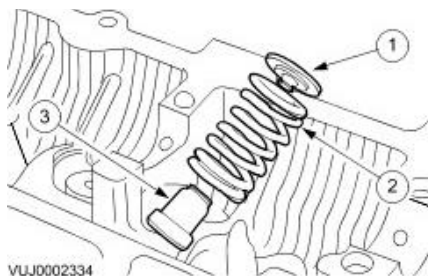
- Remove the valve collets.



VUJ0002333

3. Remove the valve spring retainers and valve springs.

1. Remove the valve spring retainers.
2. Remove the valve springs.
3. Remove the valve stem oil seals.



VUJ0002334

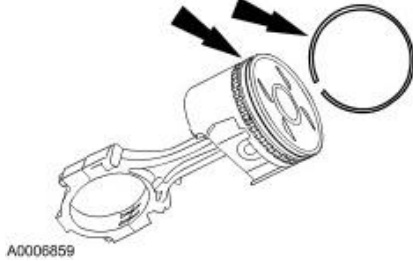
Piston (12.17.02)

Disassembly

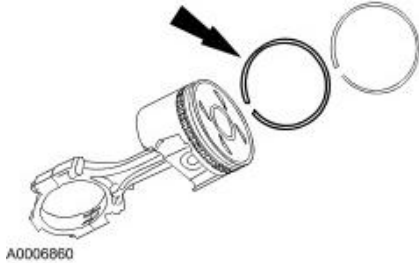
1 **NOTE:**

- Mark the pistons to the original connecting rods to make sure correct installation in the same cylinders from which they were removed.

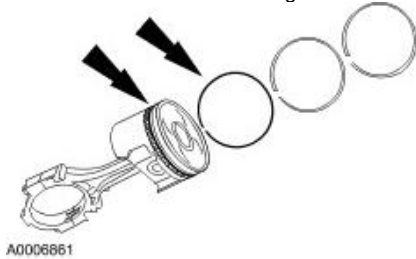
Remove the top compression ring.



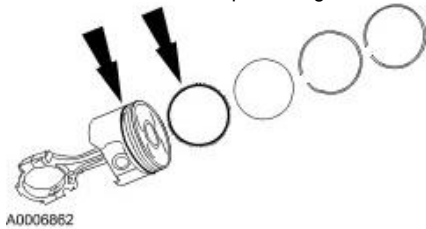
2 . Remove the second compression ring.



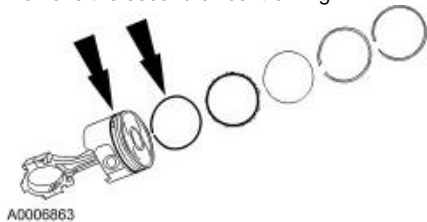
3 . Remove the first oil control ring.



4 . Remove the oil control spacer ring.



5 . Remove the second oil control ring.

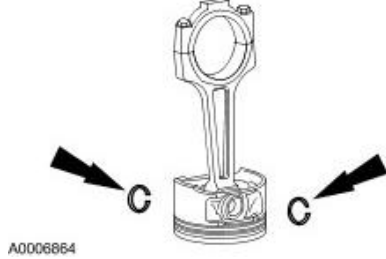


6



WARNING: The retaining rings have a tendency to spring out during removal. Cover the end of the pin bore with a hand or a rag when removing the retaining ring. Eye protection should be worn. Failure to follow these instructions may result in personal injury.

Remove the retaining clips.



7. Remove the piston pin and the connecting rod from the piston.

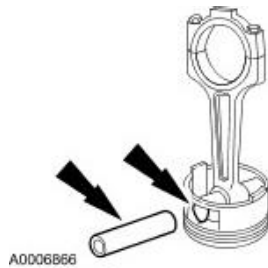


8. Clean and inspect the connecting rod and the piston. For additional information, refer to [<<303-00>>](#).

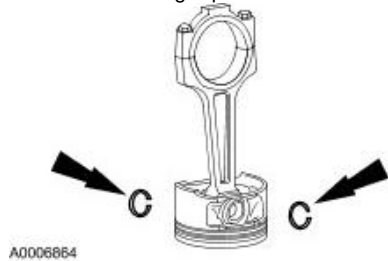
Assembly

1. Install the piston pin.

- Lubricate the piston pin and piston bore.



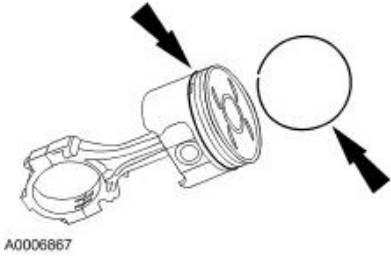
2. Install the retaining clips.



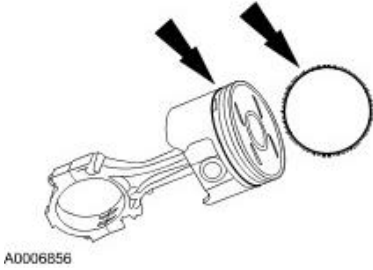
3. Check the piston ring end gap. For additional information, refer to [<<303-00>>](#).

4. Lubricate the piston and piston rings.

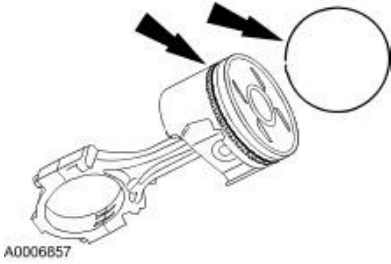
5 . Install the second oil control ring.



6 . Install the oil control spacer ring.

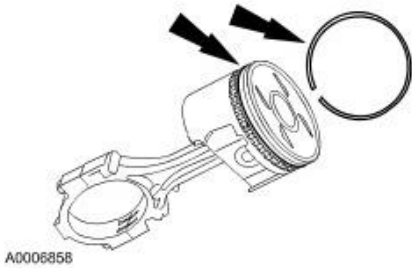


7 . Install the first oil control ring.



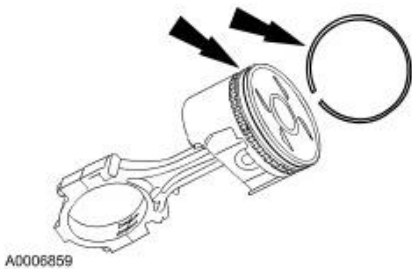
8 . Install the second compression ring.

- The top of the second compression ring has a "0" marked on it. Position this side of the ring towards the top of the piston.



9 . Install the top compression ring.

- The top compression ring can be installed with either side up.



Engine

Special Service Tools

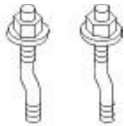


303D055

Wrench Strap-Universal
303-D055



Crankshaft Rear Seal Installer
303-178



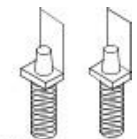
303384

Crankshaft Rear Seal Installer Adapter Bolts
303-384



303372

Piston Ring Compressor
303-372



303535

Cylinder Bore Protector
303-535

Assembly

1 .



CAUTION: Use only plastic scraper when removing old gasket material.

Clean all the mating faces and reusable parts thoroughly and check for damage.



If gasket material remains on the cylinder head after cleaning, use a plastic tipped scraper to remove remaining material.

2 . **NOTE:**

Never remove pipe plugs or alignment dowels unless they are to be serviced.

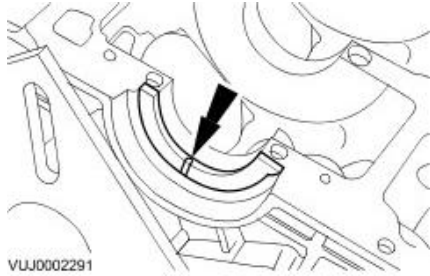
Reseal oil passage blanking plugs, as necessary.

3 . **NOTE:**

The main bearings are precision selective fit. For additional information, refer to [<<303-00>>](#).

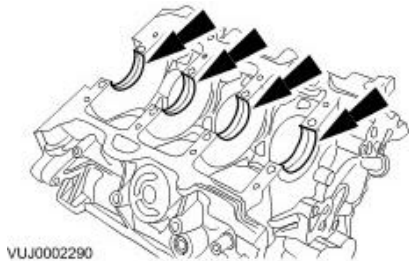
Install the upper crankshaft thrust washer.

- Align assembly tab on thrust bearing to machining spot face on cylinder block.



4 . Install the upper crankshaft main bearings.

- Lubricate the bearings and thrust washer.

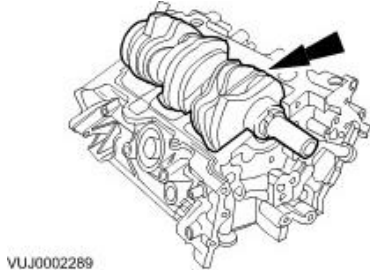


5 .



CAUTION: Avoid damage to any crankshaft journal bearing surfaces.

Install the crankshaft.



6 . **NOTE:**

Push the crankshaft rearward prior to installation of upper thrust bearings.

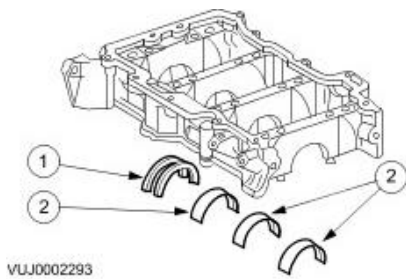
NOTE:

Visually inspect the bearings to verify that the bearing oiling holes align with cylinder block oil feed holes.

Install the lower crankshaft bearings into the cylinder block.

1. Install the lower crankshaft thrust main bearing into lower cylinder block.
2. Install the lower crankshaft main bearings into lower cylinder block.

- Lubricate the bearings and thrust washer.



7 . **NOTE:**

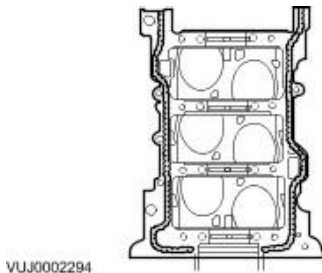
Sealant application must stop 6 mm from the rear crankshaft bore on each side.

NOTE:

Install lower cylinder block and tighten all bolts to specification within four minutes of applying sealer.

Apply a bead of sealant to the cylinder block housing.

- Use Silicone gasket and sealant.



8 .



CAUTION: Make sure all dowels are fully seated into lower cylinder block prior to tightening the bolts.

NOTE:

Before installing the bolts lightly seat the crankshaft forward.

NOTE:

Do not lubricate the lower cylinder block bolts.

NOTE:

Loosely install the lower cylinder block bolts.

NOTE:

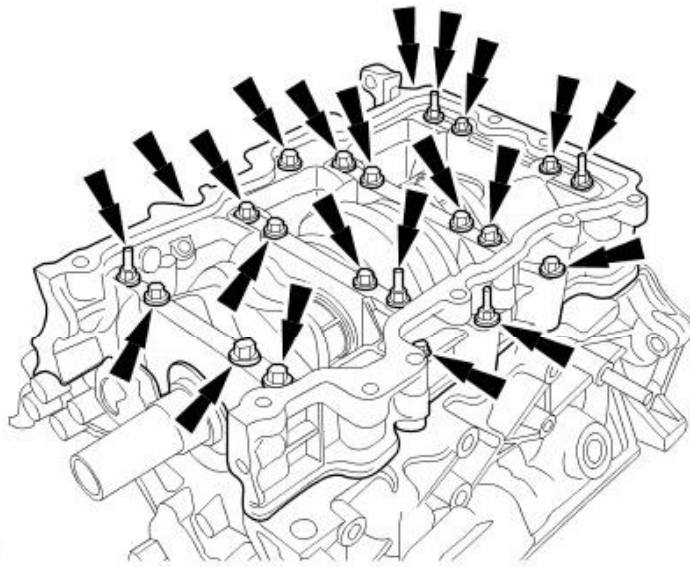
Do not rotate crankshaft until all bolts are tightened to specification.

NOTE:

Bolts must be tightened within 4 minutes of applying sealant.

Install the lower cylinder block on the cylinder block.

- Push crankshaft rearward to seat the crankshaft thrust washer.



VUJ0002287

9.



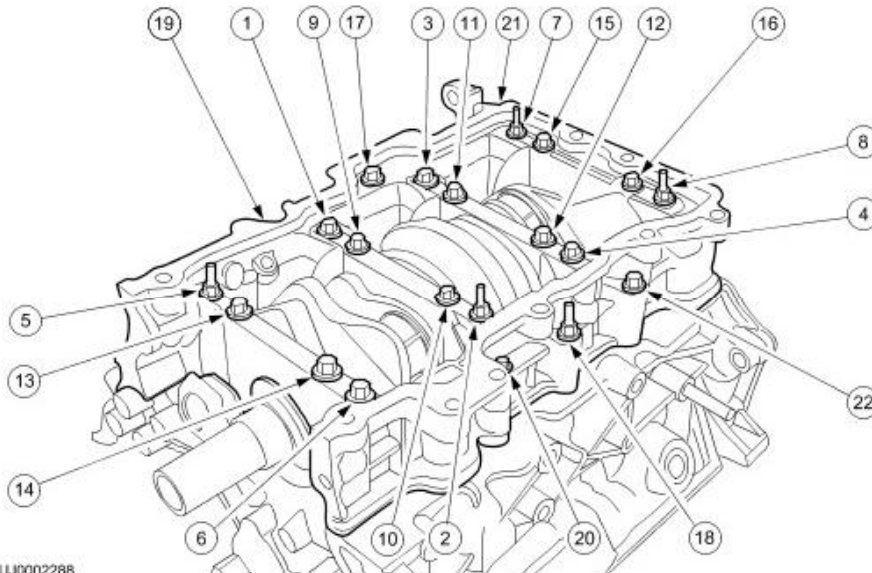
CAUTION: Bolts 1 through 16 are tighten-to-yield and must be replaced.

NOTE:

Tighten the bolts in the indicated sequence in four stages.

Complete the tightening sequence.

- Stage 1: Bolts 1-8, 25 Nm
- Stage 2: Bolts 9-16, 40 Nm
- Stage 3: Bolts 1-16, 90°
- Stage 4: Bolts 17-22, 25 Nm
- Verify the crankshaft rotates freely.



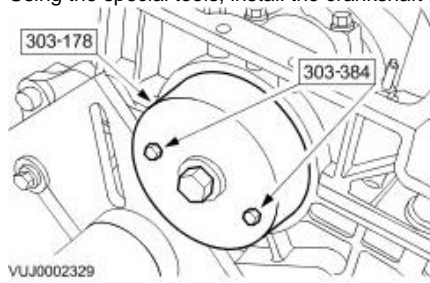
VUJ0002288

10. Remove excess sealant which may squeeze out at the front cover sealing surface.

11. **NOTE:**

Alternate bolt tightening to correctly seat the crankshaft rear oil seal until it is flush with the cylinder block.

Using the special tools, install the crankshaft rear oil seal.



12



CAUTION: Use appropriate protection to prevent damage to the crankshaft bearing journals and cylinder bore surfaces.

Install special tools to the connecting rods.

- Position the crankshaft journal at the bottom of the stroke.

13 **NOTE:**

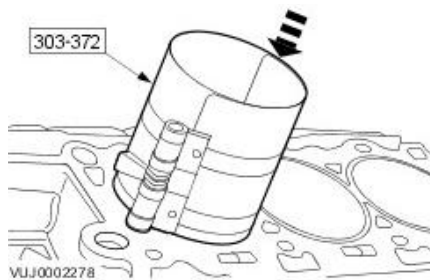
Make sure the piston ring gaps are positioned at different locations opposite the thrust side of the piston before installation.

NOTE:

Install pistons with arrow to front of engine.

Using the special tool compress the rings and install the piston and connecting rod.

- Lubricate all piston components.



14



CAUTION: When assembling the connecting rods and connecting rod caps, it is imperative that bearing slots and tangs be located on the same side of the connecting rods.



CAUTION: Connecting rod bolts are torqued to yield and must be replaced.

NOTE:

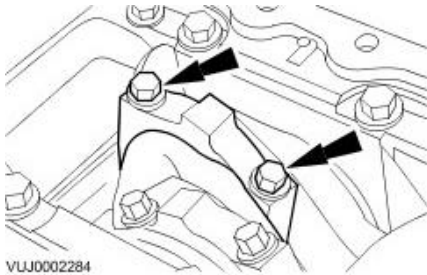
Remove the special tools from the connecting rods.

NOTE:

Tighten the bolts in the indicated sequence in three stages.

Position the connecting rod cap on the appropriate connecting rod.

- Stage 1: 23 Nm
- Stage 2: 43 Nm
- Stage 3: 105°



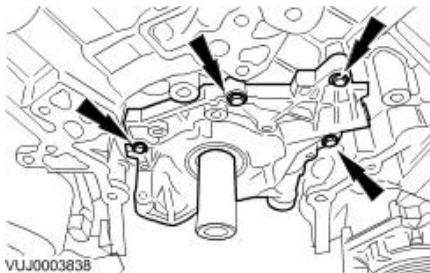
15 . Rotate the crankshaft to check correct operation.


16 .  **CAUTION:** Install the oil pump flush to the cylinder block for correct sealing.

 **CAUTION:** Rotate the inner rotor of the oil pump to align with the flats on the crankshaft before installation.

Install the oil pump.

- Tighten to 10 Nm.



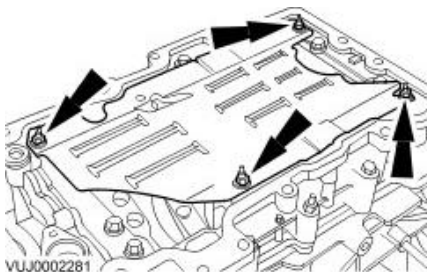
17 .  **CAUTION:** Oil pan baffle nuts are tightened to yield and must not be reused.

NOTE:

Tighten the bolts in the indicated sequence in two stages.

Install the oil pan baffle.

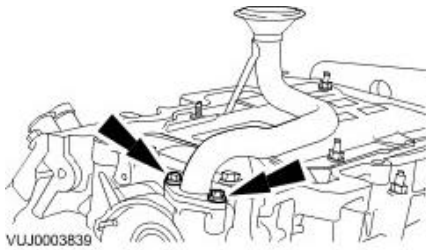
- Stage 1: 5 Nm
- Stage 2: 45°



18 . **NOTE:**
Engine inverted for clarity.

Install the oil pump tube.

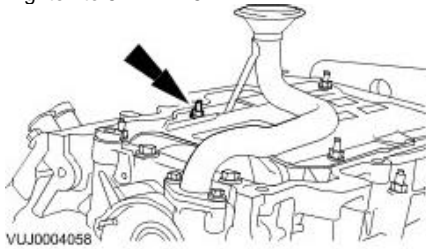
- Install a new O-ring seal.
- Tighten to 10 Nm.



19 . **NOTE:**

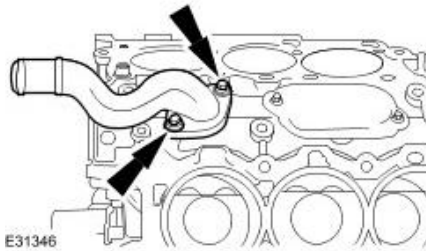
Engine inverted for clarity.

Tighten to 5 Nm + 45°.



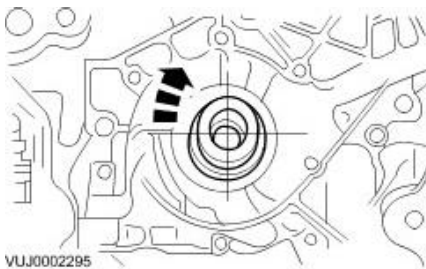
20 . Install the engine coolant housing.

- Install new 'O' ring seals.
- Tighten to 25 Nm.



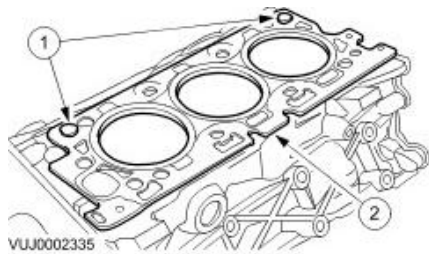
21 . Position the crankshaft.

- Turn the crankshaft until the key is in the 11 o'clock position.
- Remove the crankshaft pulley bolt and washer.



22 . Install a new cylinder head gasket (LH shown - RH similar).

3. Make sure the cylinder head dowels are correctly located.
4. Install a new cylinder head gasket.

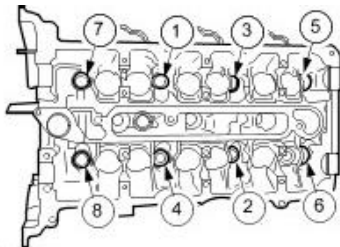


23 . **NOTE:**

Install the bolts in the indicated sequence.

Install the LH cylinder head.

- Tighten to 30 Nm.
- Tighten 90°.
- Loosen 360°.
- Tighten to 30 Nm.
- Tighten 90°.
- Tighten 90°.

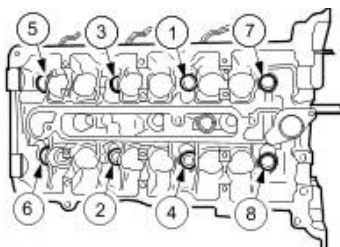


24 . **NOTE:**

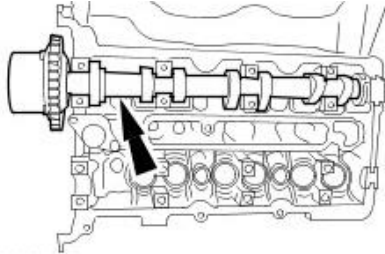
Install the bolts in the indicated sequence.

Install the RH cylinder head.

- Tighten to 30 Nm.
- Tighten 90°.
- Loosen 360°.
- Tighten to 30 Nm.
- Tighten 90°.
- Tighten 90°.



25 . Install the LH inlet camshaft.



VUJ0002272

26



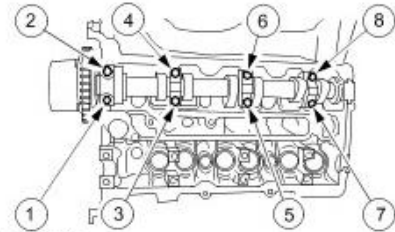
CAUTION: Do not install the cylinder head camshaft journal thrust caps until the camshaft journal caps are installed or damage to the thrust caps may occur.

NOTE:

Lubricate the camshafts and the camshaft bearing caps with oil WSE-M2C908-A or equivalent meeting Jaguar specification prior to installation.

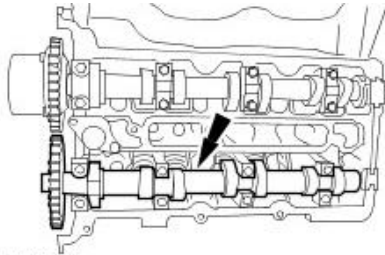
Install the LH inlet camshaft bearing cap bolts evenly.

- Install the inlet camshaft bearing caps.
- Tighten to 10 Nm.



VUJ0002271

27 . Install the LH exhaust camshaft.



VUJ0002269

28



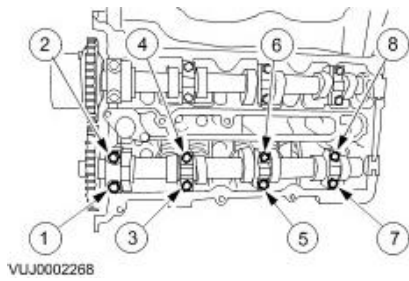
CAUTION: Do not install the cylinder head camshaft journal thrust caps until the camshaft journal caps are installed or damage to the thrust caps may occur.

NOTE:

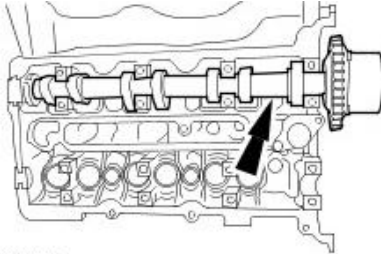
Lubricate the camshafts and the camshaft bearing caps with oil WSE-M2C908-A or equivalent meeting Jaguar specification prior to installation.

Install the LH exhaust camshaft bearing cap bolts evenly.

- Install the exhaust camshaft bearing caps.

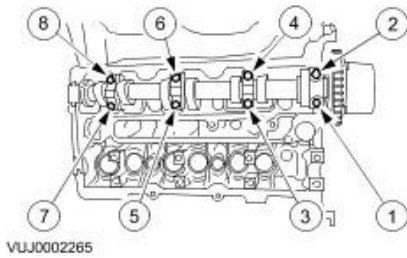


29 . Install the RH inlet camshaft.

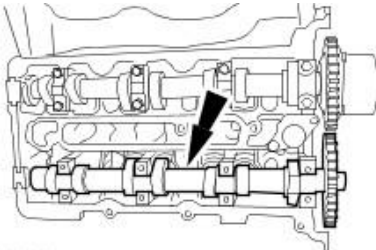


30 . Install the RH inlet camshaft bearing cap bolts evenly.

- Install the inlet camshaft bearing caps.

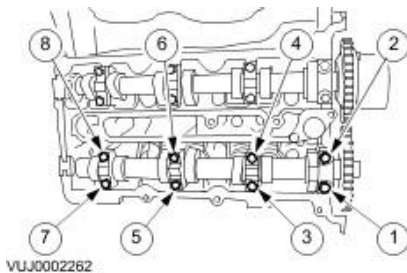


31 . Install the RH exhaust camshaft.

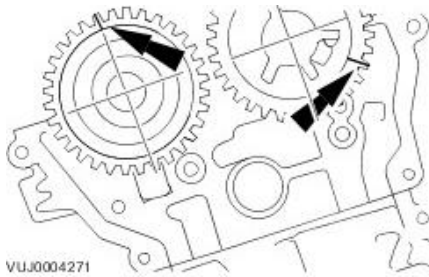


32 . Install the RH exhaust camshaft bearing cap bolts evenly.

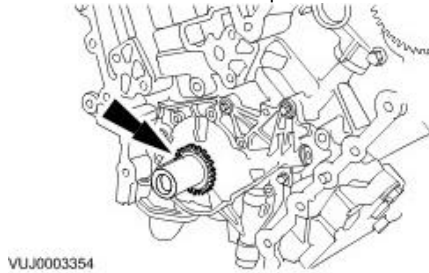
- Install the exhaust camshaft bearing caps.



33 Rotate the right-hand intake camshaft clockwise until the camshaft sprocket alignment mark is at the 5 O'clock position and rotate the right-hand exhaust camshaft sprocket clockwise until the camshaft sprocket alignment mark is at the 12 O'clock position.

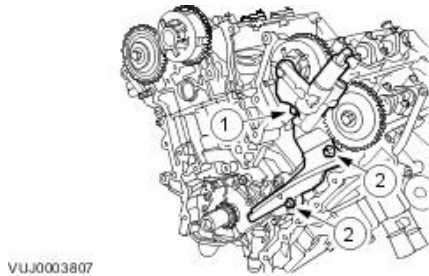



34 . Install the crankshaft inner sprocket.




35 . Install the left-hand timing chain outer guide.

- Tighten the retaining bolts in the sequence shown in two stages.
- Stage 1: Tighten bolt 1 to 25 Nm.
- Stage 2: Tighten bolts 2 to 25 Nm.

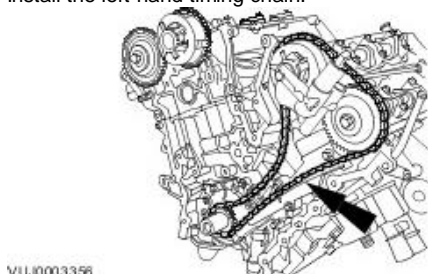


36  **CAUTION:** Make sure the crankshaft keyway is at the 11 O'clock position, the alignment mark on the left-hand intake camshaft sprocket is at the 9 O'clock position and the alignment mark on the left-hand exhaust camshaft sprocket is at the 2 O'clock position.

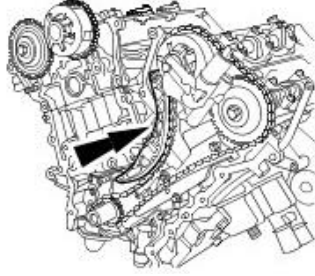
 **CAUTION:** Make sure the timing chain alignment marks are correctly positioned to the crankshaft sprocket and camshaft sprocket alignment marks.

 **CAUTION:** Make sure the timing chain slack is on the tensioned side of the timing chain.

Install the left-hand timing chain.



37 . Install the left-hand timing chain inner guide.



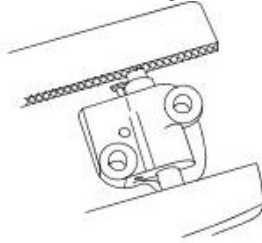
VUJ0003357

38 .



CAUTION: Use suitable protective covers on the vice jaws to protect the timing chain tensioner.

Secure the left-hand timing chain tensioner in the vice jaws.



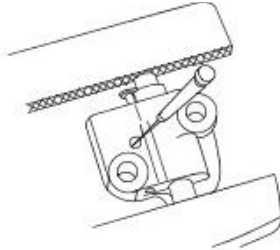
GA3138-B

39 .



CAUTION: During timing chain tensioner compression, do not release the ratchet stem until the timing chain tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.

Using a suitable tool, hold the left-hand timing chain tensioner ratchet lock mechanism away from the ratchet stem.



GA3139-B

40 **NOTE:**

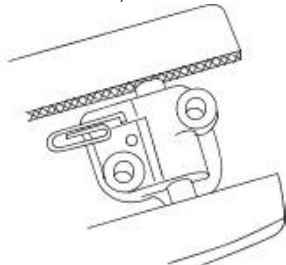
The timing chain tensioner piston should retract with minimal force. If binding occurs, reposition the timing chain tensioner to eliminate side loading.

Slowly compress the left-hand timing chain tensioner.

41 **NOTE:**

The retaining tool must remain in the timing chain tensioner until the timing chain tensioner is installed to the engine with the piston bottomed in the bore.

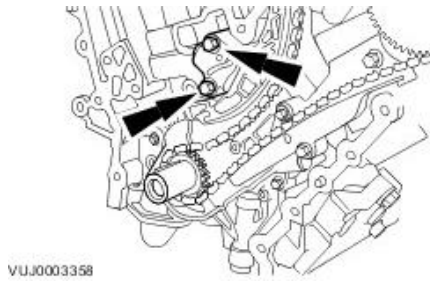
Using a suitable tool, retain the left-hand timing chain tensioner piston.



GA3140-A

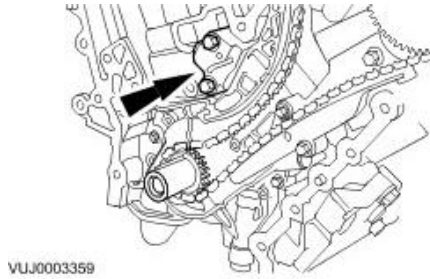
42 . Install the left-hand timing chain tensioner.

- Tighten to 25 Nm.

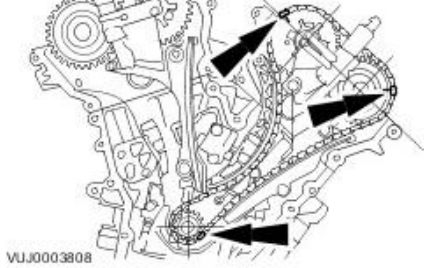


- 43 . Release the tension in the left-hand timing chain tensioner.

- Remove the retaining tool.



- 44 Make sure the left-hand timing chain alignment marks have remained correctly positioned to the camshaft sprocket and crankshaft sprocket alignment marks.



- 45  **CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.**

Install the crankshaft pulley retaining bolt and washer.

- 46  **CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.**

Rotate the crankshaft clockwise until the crankshaft keyway is at the 3 O'clock position.



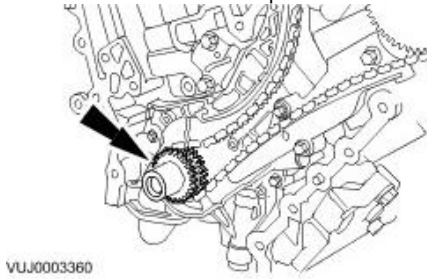
47



CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

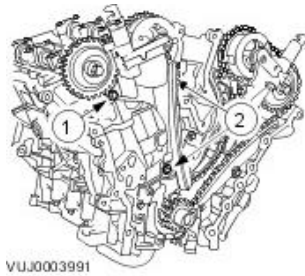
Remove the crankshaft pulley retaining bolt and washer.

48 . Install the crankshaft outer sprocket.



49 . Install the right-hand timing chain inner guide.

- Tighten the retaining bolts in the sequence shown in two stages.
- Stage 1: Tighten bolt 1 to 25 Nm.
- Stage 2: Tighten bolts 2 to 25 Nm.



50



CAUTION: Make sure the crankshaft keyway is at the 3 O'clock position, the alignment mark on the right-hand intake camshaft sprocket is at the 5 O'clock position and the alignment mark on the right-hand exhaust camshaft sprocket is at the 12 O'clock position.

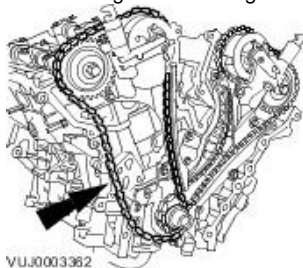


CAUTION: Make sure the timing chain alignment marks are correctly positioned to the crankshaft sprocket and camshaft sprocket alignment marks.



CAUTION: Make sure the timing chain slack is on the tensioned side of the timing chain.

Install the right-hand timing chain.



51 . Install the right-hand timing chain outer guide.



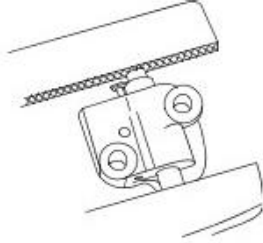
VUJ0003440

52 .



CAUTION: Use suitable protective covers on the vice jaws to protect the timing chain tensioner.

Secure the right-hand timing chain tensioner in the vice jaws.



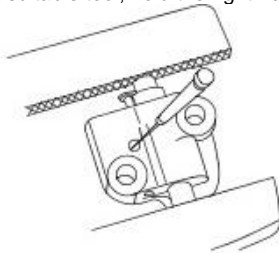
GA3138-B

53 .



CAUTION: During timing chain tensioner compression, do not release the ratchet stem until the timing chain tensioner piston is fully bottomed in its bore or damage to the ratchet stem will result.

Using a suitable tool, hold the right-hand timing chain tensioner ratchet lock mechanism away from the ratchet stem.



GA3139-B

54 **NOTE:**

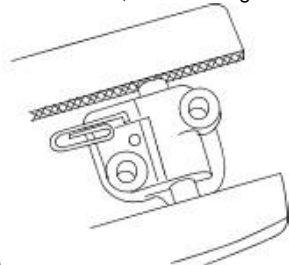
The timing chain tensioner piston should retract with minimal force. If binding occurs, reposition the timing chain tensioner to eliminate side loading.

Slowly compress the right-hand timing chain tensioner.

55 **NOTE:**

The retaining tool must remain in the timing chain tensioner until the timing chain tensioner is installed to the engine with the piston bottomed in the bore.

Using a suitable tool, retain the right-hand timing chain tensioner piston.

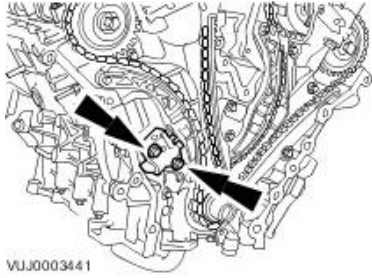


GA3140-A

56 . Install the right-hand timing chain tensioner.

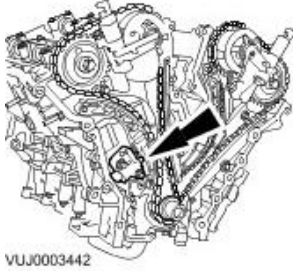


Tighten to 25 Nm.



57 . Release the tension in the right-hand timing chain tensioner.

- Remove the retaining tool.

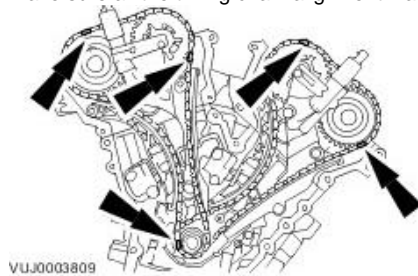


58



CAUTION: Make sure the right-hand timing chain alignment marks have remained correctly positioned to the camshaft sprocket and crankshaft sprocket alignment marks.

Make sure all the timing chain alignment marks are in the positions shown.

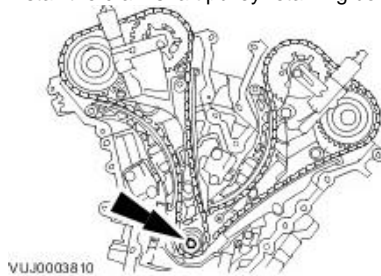


59



CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

Install the crankshaft pulley retaining bolt and washer.



60

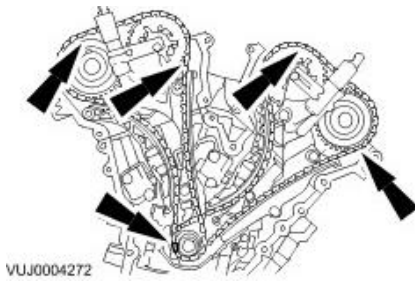


CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

Check the engine valve timing is correctly set.

-

Rotate the crankshaft two complete turns clockwise. Make sure the alignment marks on the camshaft sprockets are in the positions shown when the crankshaft keyway is at the 11 O'clock position.

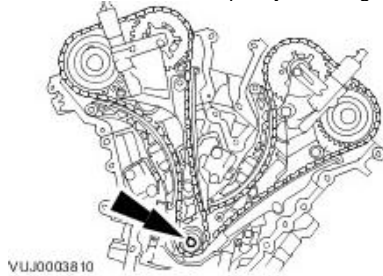


61



CAUTION: Do not rotate the crankshaft counterclockwise. The timing chains may bind causing engine damage.

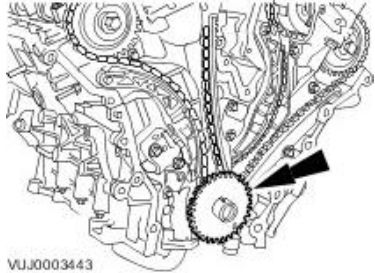
Remove the crankshaft pulley retaining bolt and washer.



62 . **NOTE:**

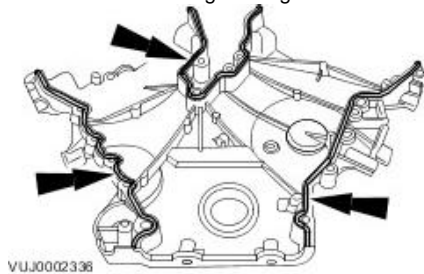
Make sure the CKP sensor pulse wheel is correctly installed with the teeth pointing outwards.

Install the CKP sensor pulse wheel.



63 . Carry out a valve clearance check.
For additional information, refer to

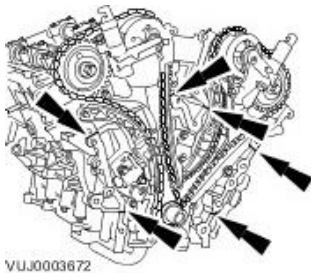
64 . Install new front timing cover gaskets.



65 **NOTE:**

Prior to applying sealer clean the front cover to engine block and cylinder head sealing surfaces with metal surface cleaner.

Apply a 6 mm diameter dot of silicone sealant meeting Jaguar specification to the indicated locations.



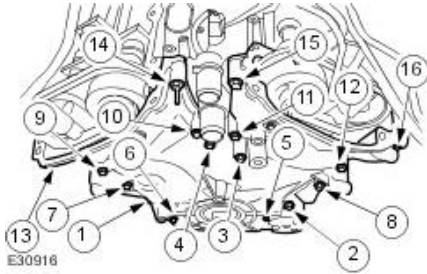
VUJ0003672

66 NOTE:

- The engine front cover retaining bolts numbered 3,4,10 and 11 are longer than the retaining bolts numbered 1,2,5,6,7,8,9,12,13,15 and 16. The retaining bolt numbered 14 is a retaining bolt with a stud head.

Install the engine front cover, completing the tightening sequence .

- Tighten to 25 Nm.



E30916

67 NOTE:

- Apply an 10 mm dot of silicone gasket and sealant meeting Jaguar specification to the engine block and front cover mating surface.

NOTE:

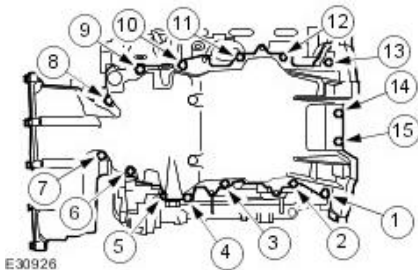
Loosely install the oil pan to transmission housing bolts.

NOTE:

Tighten all oil pan retaining bolts with in six minutes of applying the sealer.

Install the oil pan rear retaining bolts.

- Complete the tightening sequence.
- Tighten to 25 Nm.



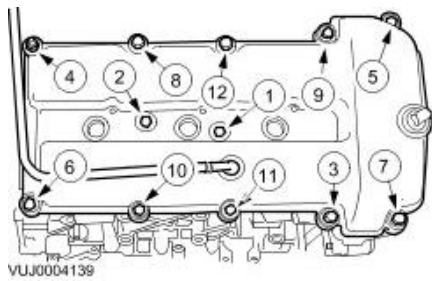
E30926

68 . NOTE:

Right-hand shown, left-hand similar.

Install the valve covers.

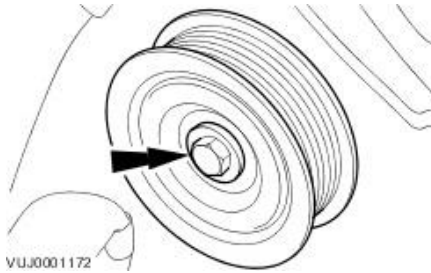
- Complete the tightening sequence.
- Tighten to 10 Nm.



VUJ0004139

69 . Install the left-hand idler pulley.

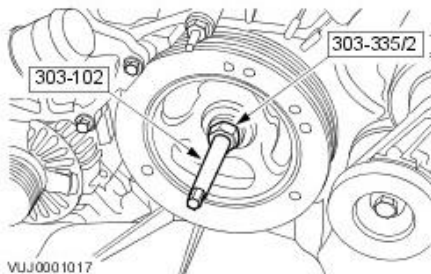
- Tighten to 25 Nm.



VUJ0001172

70 . Using the special tools, install the crankshaft pulley.

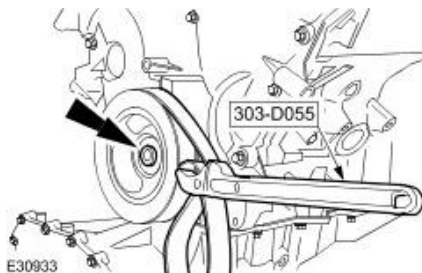
- Coat the crankshaft pulley keyway with silicone gasket sealant meeting Jaguar specification.
- Coat the sealing surfaces of the crankshaft pulley with silicone gasket sealant meeting Jaguar specification.



VUJ0001017

71 . Install the crankshaft pulley retaining bolt.

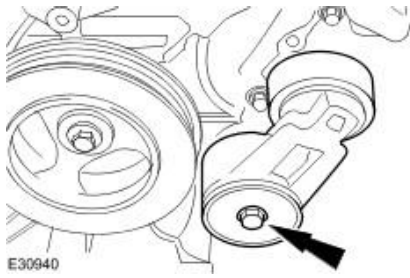
- Torque to 120 Nm.
- Loosen the bolt (minimum 1 turn).
- Torque to 50 Nm.
- Angle Torque to 90°.



E30933

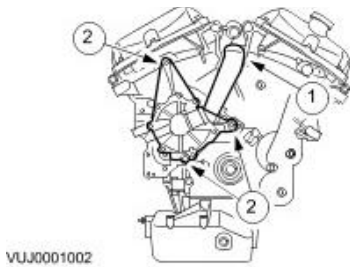
72 . Install the accessory drive belt tensioner.

- Tighten 45 Nm.



- 73 . Install the water pump and coolant hose assembly.
5. Attach the hose.
 6. Install the water pump and coolant hose assembly.

- Tighten to 25 Nm.

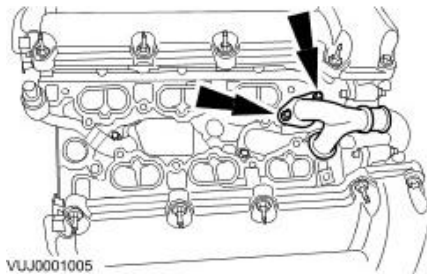


74 . **NOTE:**

Install new coolant crossover O-ring seals.

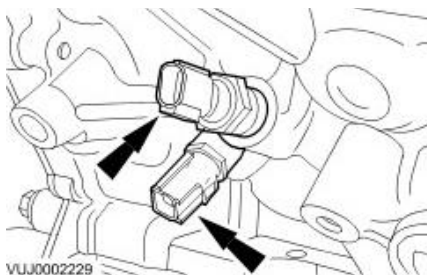
Install the coolant crossover tube.

- Tighten to 10 Nm,



- 75 . Install the engine oil pressure and oil temperature sensors.

- Tighten to 14Nm.

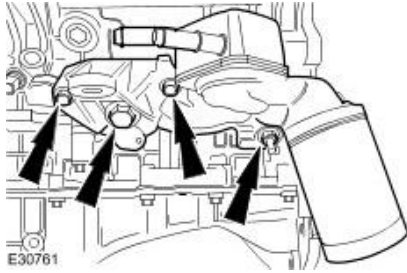


76 . **NOTE:**

Install new O-ring seals.

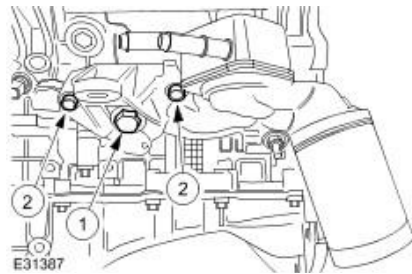
Install the oil filter housing assembly.

- Tighten all oil filter housing retaining bolts to 25 Nm.

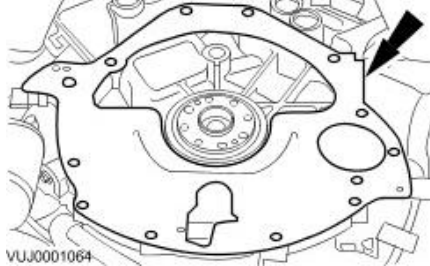


77 . Tighten the oil filter housing assembly retaining bolts in sequence.

- Tighten to 150 Nm.
- Tighten to 40 Nm + 90 degrees.

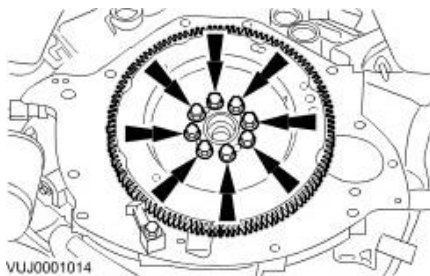


78 . Install the engine rear backing plate.



79 . Install the flywheel.

- Prevent the engine from rotating.
- Tighten to 80 Nm.



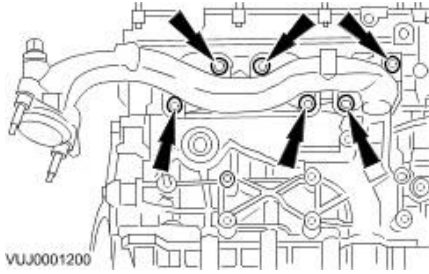
80 . **NOTE:**

Right-hand shown, Left-hand similar.

Install the exhaust manifolds.

-

Tighten to 25 Nm.

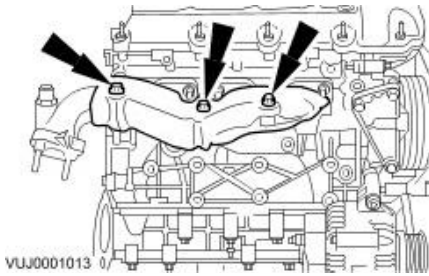


81 . **NOTE:**

Right-hand shown, Left-hand similar.

Install the exhaust manifold heat shields.

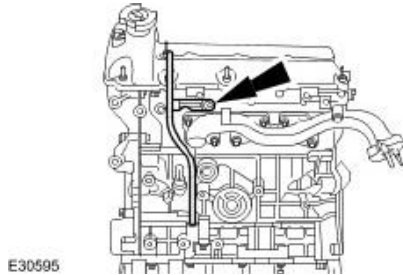
- Tighten to 10 Nm.



82 . **NOTE:**

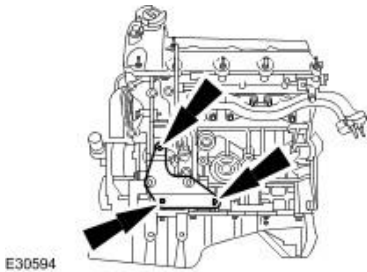
Install a new O-ring seal.

Install the oil level indicator tube.



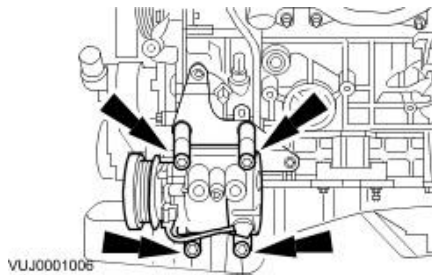
83 . Install the A/C compressor mounting bracket.

- Tighten to 25 Nm.



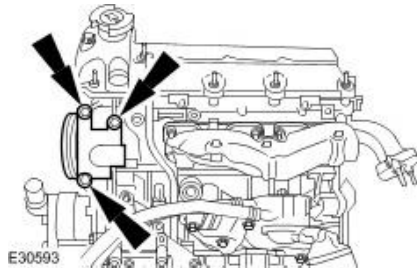
84 . Install the air conditioning (A/C) compressor.

- Tighten to 25 Nm.



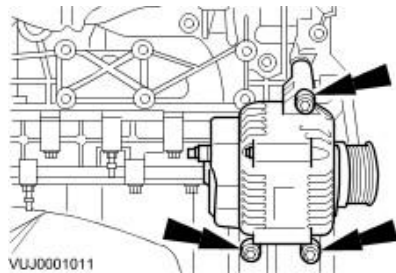
85 . Install the power steering pump.

- Tighten to 25 Nm.



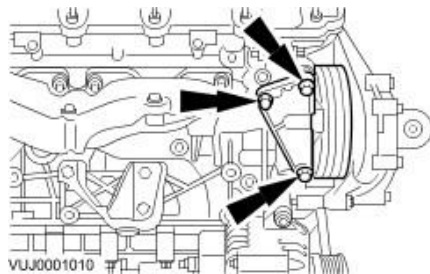
86 . Install the generator.

- Tighten to 48 Nm.



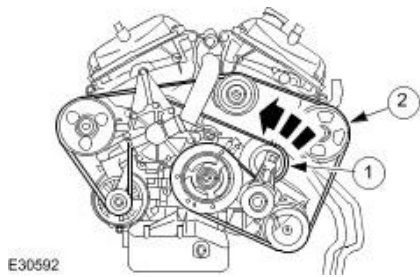
87 . Install the right-hand idler pulley.

- Tighten to 25 Nm.



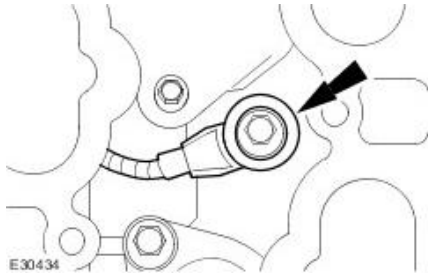
88 . Install the accessory drive belt.

- Use a 3/8 inch drive bar to release the accessory drive belt tensioner.
- Install the accessory drive belt.

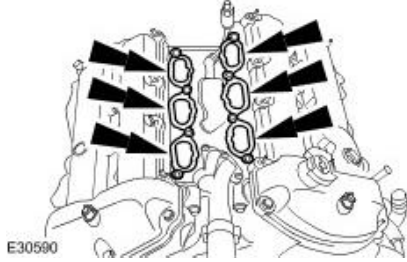


89 . Install the left-hand knock sensor.

- Tighten to 25 Nm.

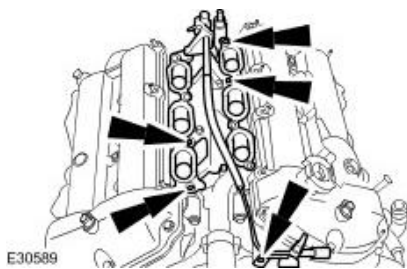


90 . Install new lower intake manifold gaskets.



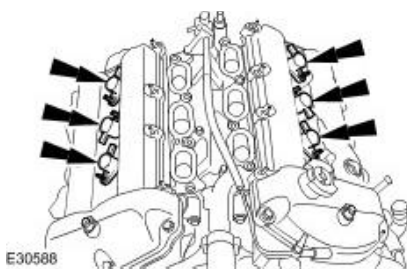
91 . Install the lower intake manifold and injector supply manifold.

- Tighten to 10 Nm.



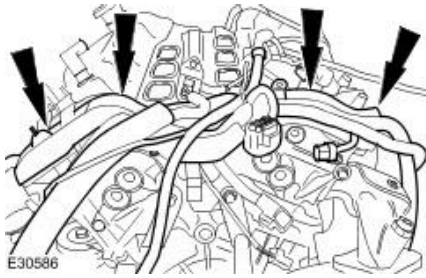
92 . Install the ignition coils.

- Tighten to 10 Nm.



93 . Install the engine wiring harness.

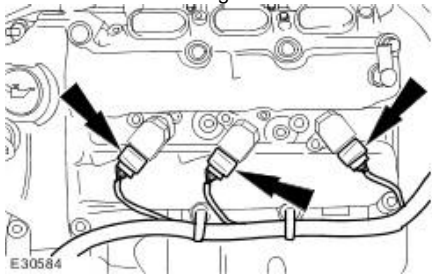
- Tighten to 10 Nm.



94 . Connect the engine wiring harness electrical connectors.



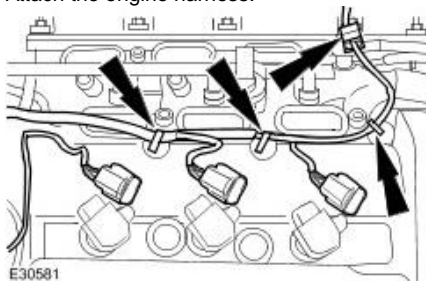
95 . Connect the left-hand ignition coils.



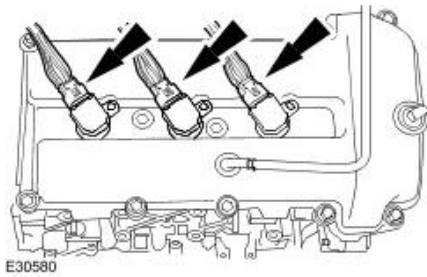
96 . Connect the left-hand camshaft position sensor.



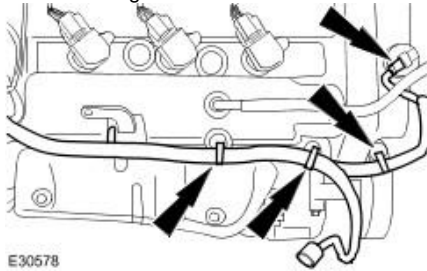
97 . Attach the engine harness.



98 . Connect the right-hand ignition coils.



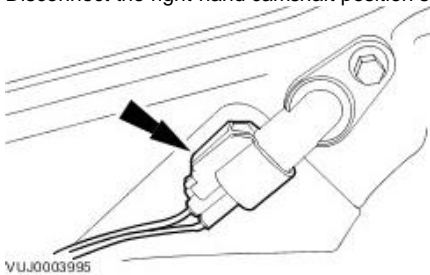
99 . Attach the engine harness.



100 . Attach the engine harness retaining bracket.



101 . Disconnect the right-hand camshaft position sensor.

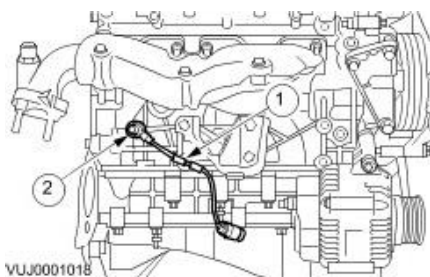


102 . Install the rear knock sensor.

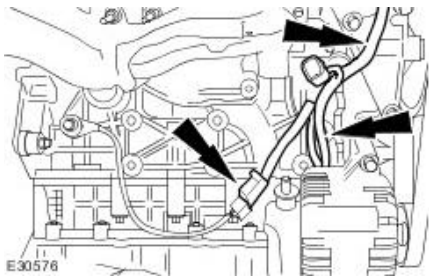
7. Attach the knock sensor wiring harness.

8. Install the rear knock sensor.

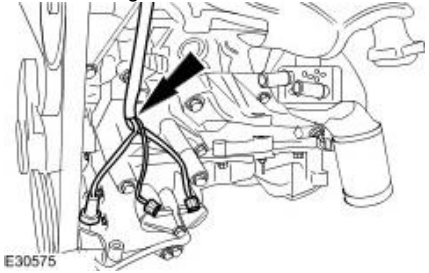
- Tighten to 25 Nm.



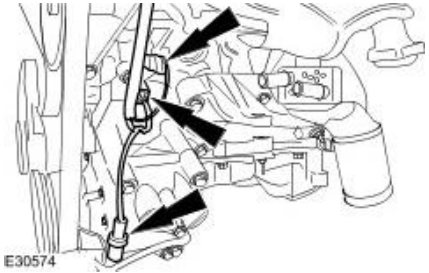
103 . Attach engine harness.



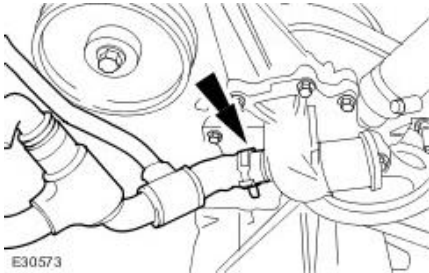
104 . Attach the engine harness.



105 . Connect the electrical connectors.



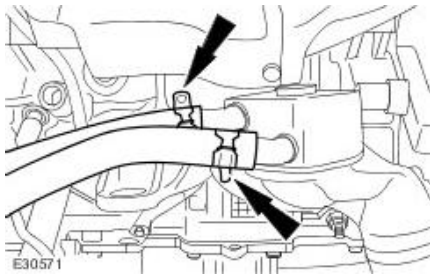
106 . Install the coolant hose.



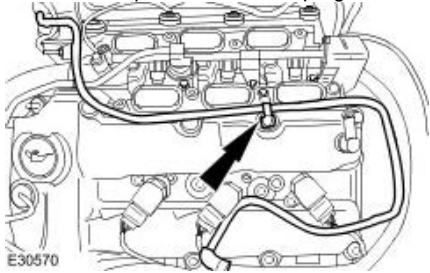
107 . Install the coolant hose.



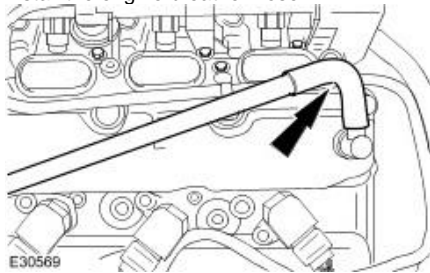
108 . Connect the oil cooler coolant hoses.



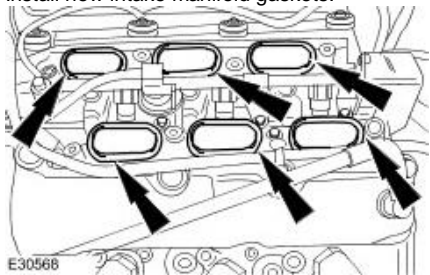
109 . Install the evaporative emission purge valve hose.



110 . Install the engine breather hose.



111 . Install new intake manifold gaskets.

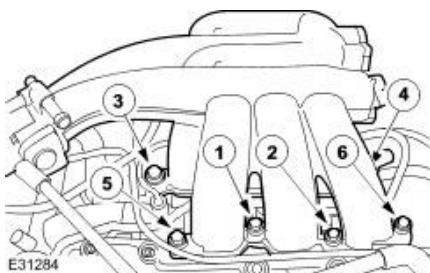


112 . **NOTE:**

The intake manifold retaining bolts in position 1,2,3 and are longer than the retaining bolts in position 4,5 and 6.

To install, reverse the removal procedure.

- Install new intake manifold gaskets.
- Tighten to 10 Nm.

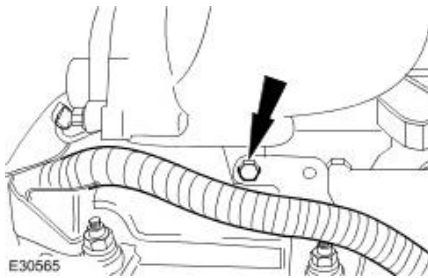


113 . Connect the evaporative emission canister purge valve transfer pipe.

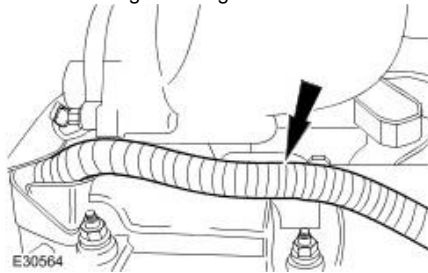


114 . Attach the intake manifold rear retaining bracket.

•
Tighten to 10 Nm.

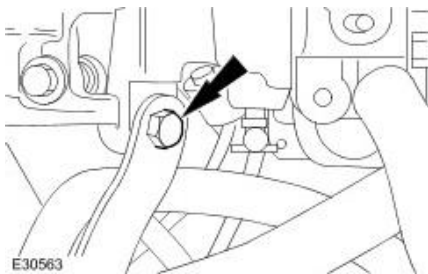


115 . Attach the engine wiring harness from the intake manifold rear retaining bracket.



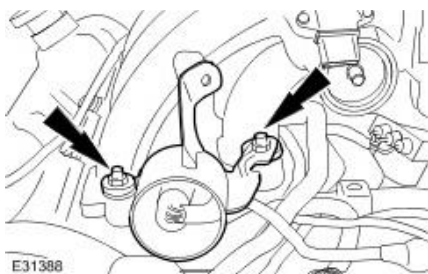
116 . Attach the intake manifold front retaining bracket.

•
Tighten to 10 Nm.

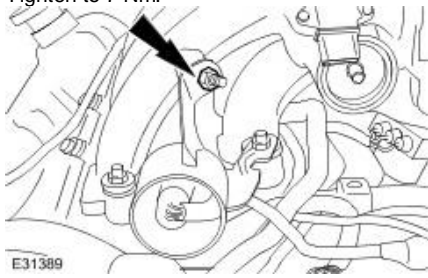


117 . Install the fuel pressure regulator bracket.

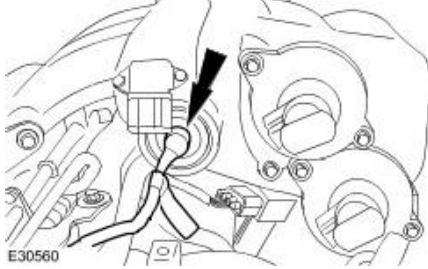
•
Tighten to 10 Nm.



118 . Tighten to 7 Nm.



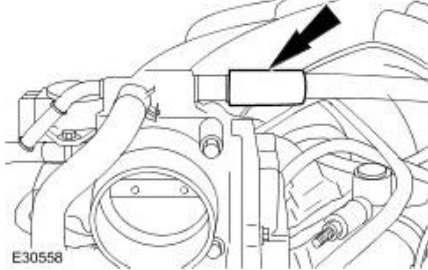
119 . Connect the fuel pressure regulator vacuum hose.



120 . Connect the electrical connectors.



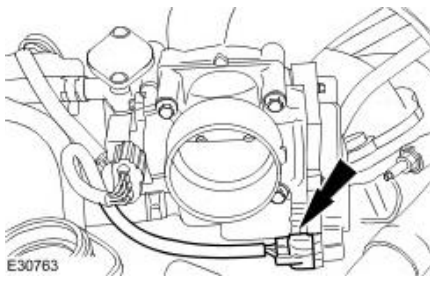
121 . Connect the positive crankcase ventilation (PCV) hose.



122 . Connect the throttle position sensor.



123 . Connect the throttle motor electrical connector.



E30763

Specifications

Engine Oil Capacity

Description	Liters
Initial fill including oil filter	6-7
Service fill including oil filter	6-0
Service fill without oil filter	5-8

Lubricants, Sealers and Adhesives

Item	Specification
SAE 5W-30 engine oil	WSS-M2C913-B
Sealant – Loctite 5910	WSE-M4G323-A4

Oil Pressure – Specifications

Description	Bar
Maximum oil pressure at idle speed	1-2
Maximum oil pressure at 2000 rpm	2-0

Tightening Torques

Description	Nm	lb-ft	lb-in
Engine to transmission retaining bolts	40	30	-
Rear engine mount retaining stud	133	98	-
Front engine mounting	80	59	-
Engine roll restrictor to transmission	80	59	-
Front subframe rear bolts	142	105	-
Front subframe rear bracket bolts	70	52	-
Steering gear to subframe	133	98	-
Engine roll restrictor to subframe	80	59	-
Lower suspension arm ball joint	83	61	-
Axle driveshaft center bearing	25	18	-
Engine ground cable	13	10	-
Thermostat housing	23	17	-
Thermostat cover	10	-	89
Crankshaft pulley	a	-	-
Crankshaft rear oil seal carrier	10	-	89
Flywheel	a	-	-
Crankshaft bearing caps	a	-	-
Big-end bearing caps	a	-	-
Fuel injectors	47	35	-
Injection pump sprocket	33	24	-
Injector tubes	38	28	-
Lower crankcase	a	-	-
Camshaft carrier (M8)	a	-	-
Camshaft carrier (M6)	a	-	-
Rocker shafts	a	-	-
Timing chain guides	15	11	-
Timing chain tensioner	15	11	-
Oil pump chain tensioner	16	12	-
Camshaft sprocket	33	24	-
Auxiliary unit drive belt tensioner	23	17	-