

2007 Land Rover Range Rover HSE

ENGINE Engine (4.4L)

ENGINE (4.4L)**SPECIFICATIONS****SEALERS**

Item	Land Rover Part No.
Valve cover gasket	8510303
Sump pan	8510303
Oil strainer pick-up pipe bolts	STC 50553
Cylinder block core plugs	STC 50554
Timing cover seal apertures	8510303
Cylinder block coolant outlet elbow	STC 50554
Bedplate to cylinder block	8510303

LUBRICANT - UK, EUROPE AND ROW - NOT NAS/JAPAN

Item	Specification
* Recommended lubricant	5W/30 Preferred: WSS-M2C913-B Alternative: ACEA A3/B3

* WSS is a Ford prefix to the oil specification

LUBRICANT - NAS/JAPAN

Item	Specification
* Recommended lubricant	5W/30 - ILSAC GF4 and API SM

CAPACITY

Item	Capacity
Dry fill including filter	8 liters (14 pints) (8.5 US quarts)
Oil and filter change	7.7 liters (13.6 pints) (8.1 US quarts)
Amount of oil required to bring the level from the lower to the upper holes on the oil level indicator	1.4 liters (2.4 pints) (1.5 US quarts)

CONNECTING ROD BEARING CLEARANCES

Crank pin diameter	Bearing grade color	Part number
From 52.982 up to and including 52.987	Yellow	2W93-6211-BCA
From 52.988 up to and including 52.993	Green	2W93-6211-BBA
From 52.994 up to and including 53.000	Blue	2W93-6211-BAA

GENERAL SPECIFICATION

Item	Specification

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Type	4.4 liter, 90 degree 'V', petrol engine, twin overhead camshafts per cylinder head, 4 valves per cylinder
Cylinder arrangement	V8, numbers 1 and 5 cylinders at front of engine when engine is viewed from rear
Cylinder numbering	Number 1 cylinder - right hand bank; Number 5 cylinder - left hand bank
Bore - nominal	88 mm (3.465 in)
Stroke	90.3 mm (3.55 in)
Capacity	4396 cm ³ (268.3 in ³)
Firing order	1 - 2 - 7 - 3 - 4 - 5 - 6 - 8
Compression ratio	10.5:1
Direction of rotation	Anti-clockwise viewed from rear of engine
Maximum power:	
UK/Europe and ROW - Not NAS/Japan	225 kW (302 bhp) @ 5750 rev/min
NAS/Japan	305 bhp (227 kW) @ 5750 rev/min
Maximum torque:	
UK/Europe and ROW - Not NAS/Japan	440 Nm (324 lb-ft) @ 4000 rev/min
NAS/Japan	325 lb-ft (440.8 Nm) @ 4000 rev/min
Dimensions:	
Length	669 mm (26.3 in)
Width	712 mm (28.0 in)
Height	747 mm (29.4 in)
* Engine oil pressure:	
At Idle	1.0 bar (100 kPa) (15.0 lb/in ²)
At 3500 rev/min	3.0 bar (300 kPa) (44.0 lb/in ²)
** Valve clearances:	
Inlet	0.18 to 0.22 mm (0.007 to 0.008 in)
Exhaust	0.23 to 0.27 mm (0.009 to 0.010 in)
Cylinder Head	
Maximum permitted warp	0.125 mm (0.005 in)

*** Note:** prior to checking the engine oil pressure, a road test of 6 miles (10 kilometers) must be carried out. Do not attempt to attain engine normal operating temperature by allowing the engine to idle

**** Note:** there are 50 different thicknesses of graded tappet available ranging from 2.950 to 3.685 mm (0.116 to 0.145 in) rising in increments of 0.015 mm (0.005 in)

TORQUE SPECIFICATIONS

Description	Nm	lb-ft
Exhaust manifold gasket heat shield bolt	13	10
* Exhaust manifold to cylinder	23	17

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head bolts		
* Cylinder head bolts:		
Stage 1 - Tighten bolts 1 to 10	20	15
Stage 2 - Tighten bolts 1 to 10	35	26
Stage 3 - Tighten bolts 1 to 10	Further 90°	Further 90°
Stage 4 - Tighten bolts 1 to 10	Further 90°	Further 90°
Stage 5 - Tighten bolts 11 and 12	25	18
EGR pipe to exhaust manifold flange nuts	25	18
CMP sensor Torx screw	7	5
++ Oil filter	18	13
Oil drain plug	25	18
Oil cooler Allen bolt	60	44
Primary timing chain tensioner guide bolts	12	9
Primary timing chain tensioner bolts	12	9
Secondary timing chain tensioner bolts	12	9
Primary timing chain tensioner guide stud	12	9
** VCT oil control unit bolts	22	16
Left-hand VCT oil control unit nut	10	7
* Camshaft bearing cap bolts	10	7
** Intake camshaft sprocket retaining bolt	120	88
** Exhaust camshaft sprocket retaining bolt	120	88
Engine ground cable bolt	25	18
+ Steering column universal joint to steering gear bolt	24	18
+ Crankshaft pulley bolt	380	280
PCV valve bolts	6	4
Right-hand and left-hand valve cover bolts	12	9
* Engine oil pan bolts	20	15
Transmission retaining bolts	45	33
HO2S mounting bracket bolt	10	7
Oil pump to cylinder block bolts	12	9
*** Oil strainer pick-up pipe bolts M5	6	4
Oil strainer pick-up pipe bolt - M6	12	9
Coolant pump pulley bolts	25	18

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Front End Accessory Drive (FEAD) belt idler pulley bolt	25	18
Cooling fan drive belt tensioner pulley bolt	25	18
Cooling fan drive belt tensioner bolt	40	30
Exhaust manifold EGR pipe to flange nuts/bolts	21	16
Battery positive cable to battery junction box (BJB) bolt	25	18
Torque converter flexplate bolts:		
Stage 1	15	11
Stage 2	110	81
Engine front cover bolts	12	9
Generator mounting bracket bolts	45	33
** Catalytic converter to exhaust manifold nuts	20	15
Air conditioning compressor low pressure line	10	7
Heater coolant hoses	6	4
Engine cover mounting bracket nuts	6	4
Right-hand engine mount bracket to engine mount nut	100	74
Left-hand engine mount bracket to engine mount bolt	100	74
** Steering gear tie rod end ball joint nut	80	59
Stabilizer bar link nuts	100	74
Suspension height sensor link arm nut	8	6
** Lower suspension arm nut/bolt:		
Stage 1	165	122
Stage 2	Further 90°	Further 90°
** Lower suspension tie rod nut/bolt:		
Stage 1	165	122
Stage 2	Further 90°	Further 90°
Engine cooling fan (Left-hand thread)	65	48
Engine harness to oil pan retaining bracket bolts	6	4

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Starter motor heat shield bolts	45	33
Coolant expansion tank	10	7
Brake vacuum pump bracket bolts	10	7
Brake vacuum pump nuts	5	4
Purge valve assembly bolt	45	33
Oil filter housing	20	15
Air conditioning refrigerant lines	10	7
Battery compartment side wall nuts	5	4
Battery positive cable to battery compartment side wall nut	25	18
Flexplate to torque converter bolts	45	33
** Air suspension spring to hub nuts/bolts	250	184
** Brake caliper to hub assembly:		
Stage 1	50	37
Stage 2	Further 60°	Further 60°
ABS sensor bolt	10	7
Crankshaft position (CKP) sensor	10	7
Front driveshaft CV joint heat shield nut	10	7

*** Bolts/Torx bolts/studs/nuts must be tightened in sequence**

**** New nuts/bolts/Torx bolts must be installed**

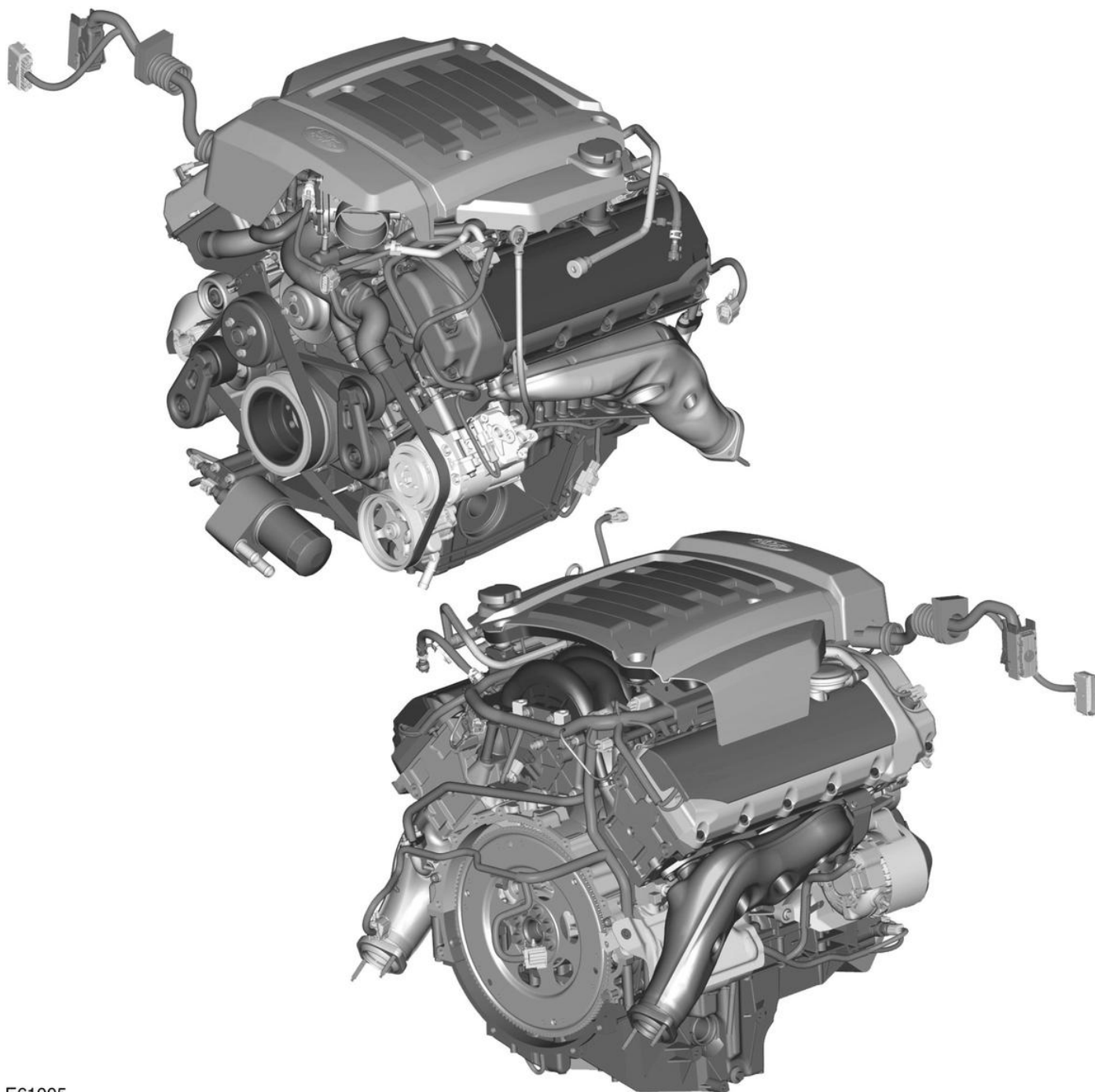
***** Apply sealant to threads**

+ New Patchlok bolt(s) must be installed

++ Apply engine oil to seal

DESCRIPTION AND OPERATION**ENGINE**

External View



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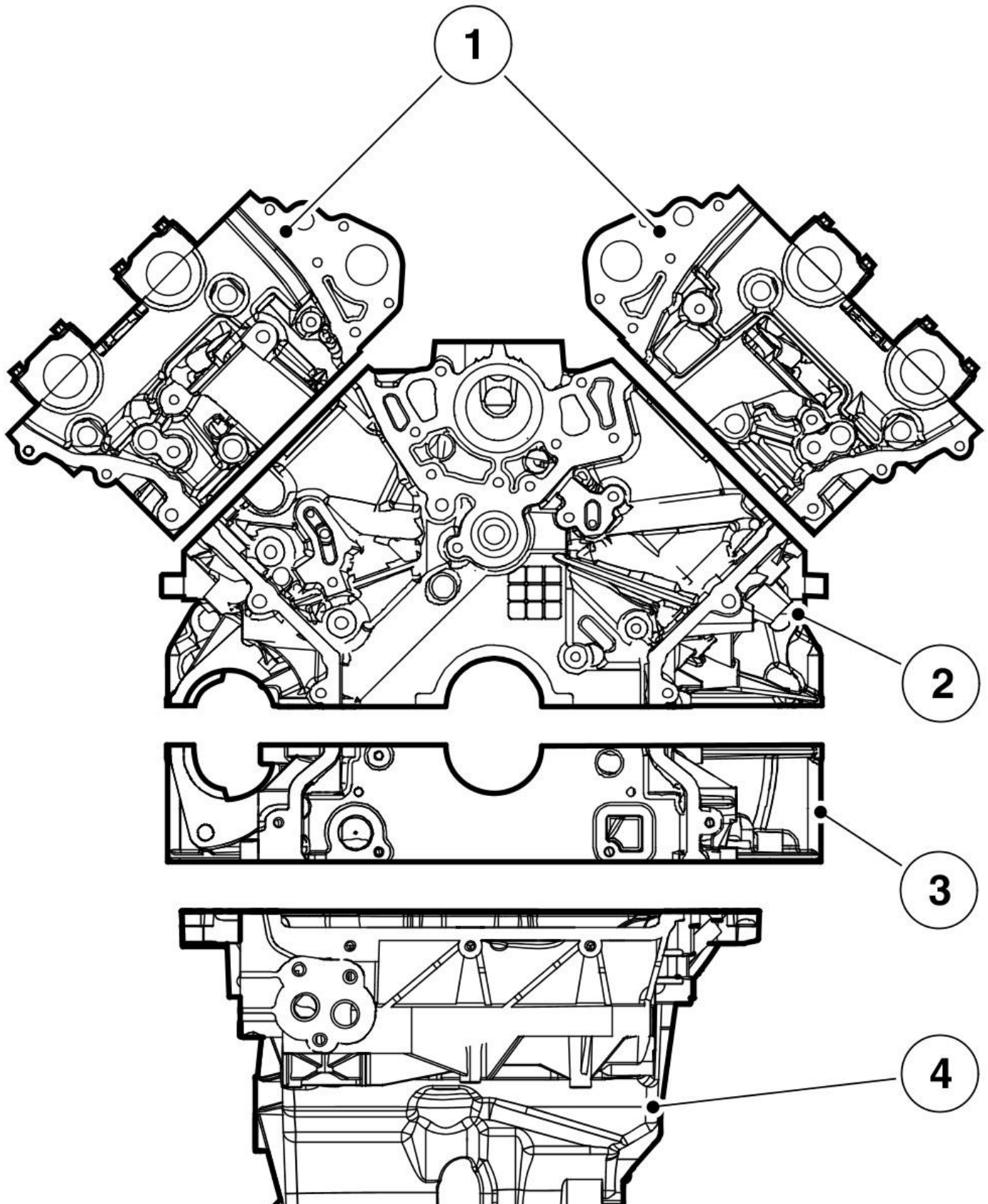
GENERAL

The V8 petrol engine is a 4.4 liter, 8 cylinder, 90 degrees 'Enclosed' V unit, with 4 valves per cylinder, operated by 2 overhead camshafts. The engine emissions comply with ECD3 (European Commission Directive) and US Federal Tier2 Bin 8 legislative requirements and employs catalytic converters, electronic engine management control, positive crankcase ventilation and exhaust gas re-circulation to limit the emission of pollutants. The

cooling system is a low volume, high velocity system. The Engine Control Module (ECM) controls the fuel injection system.

The cylinder block is of aluminum alloy construction with cast iron liners and a cast aluminum bedplate bolted to the bottom of the block to improve lower structure rigidity. The cylinder heads are cast aluminum with thermo-plastic camshaft covers. The single-piece oil sump is also cast aluminum. The fabricated stainless steel twin skin exhaust manifolds are unique for each cylinder bank and a molded plastic acoustic cover is fitted over the upper engine to reduce engine-generated noise.

Engine Structure



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ENGINE Engine (4.4L)

Item	Description
1	Cylinder heads
2	Cylinder block
3	Bed plate
4	Structural sump

TECHNICAL FEATURES

The technical features include:

- An 8 cylinder 90 degree 'Enclosed V' configuration liquid cooled aluminum cylinder block with cast iron liners
- Pistons are of open-ended skirt design, with 2 compression rings and a 3 piece oil control ring
- Two aluminum cylinder heads, each incorporating 2 hollow camshafts manufactured in chilled cast iron
- Four valves per cylinder
- Aluminum graded valve lifters (shimless)
- Variable Valve Timing (VVT) (inlet only)
- Top fed, 8-hole fuel injectors
- Engine front cover manufactured from aluminum which accommodates the crankshaft front oil seal
- Primary and secondary chains drive the camshafts
- An aluminum bed plate
- A cast iron crankshaft
- Fracture-split connecting rods in sintered-forged steel
- A twin multi-vee belt, which drives the front end accessories
- Fabricated stainless steel twin skin exhaust manifolds
- Electronic Exhaust Gas Recirculation (EGR) valve
- An advanced engine management system incorporating electronic throttle control
- Meets with the fault handling requirements, as detailed in the European On-Board Diagnostic (EOBD) III, US Federal OBD and California OBDII legislation.

ENGINE DATA

DESCRIPTION	TYPE
Configuration	90 degree V8
Maximum power	220 kW at 6000 rpm
Maximum torque	425 Nm at 4000 rpm
Displacement	4.396 liters
Stroke/bore	90.3/88.0 mm
Compression ratio	10.50 : 1
Firing order	1 2 7 3 4 5 6 8
Engine weight	208 kg (approx.)

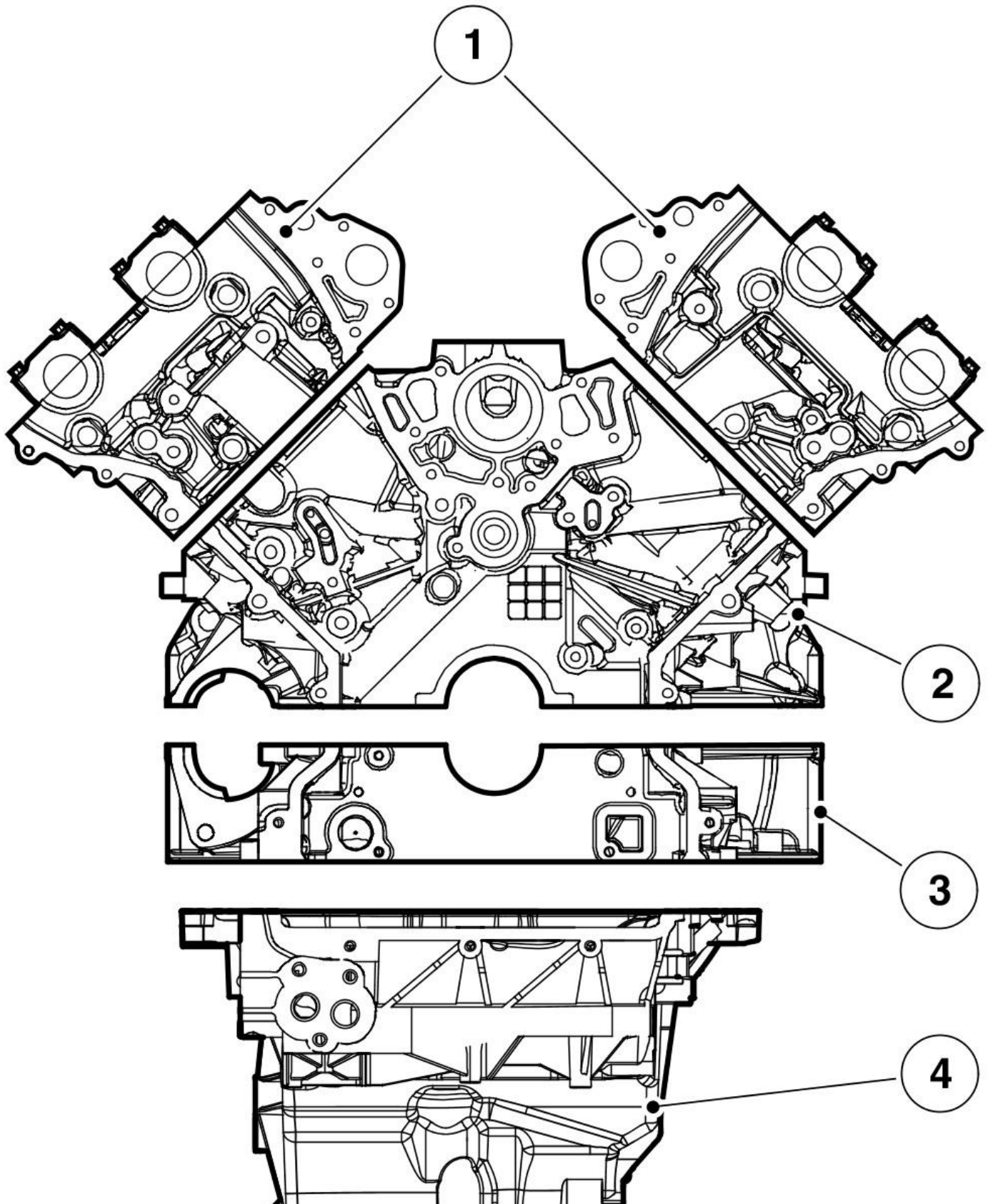
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ENGINE Engine (4.4L)

Oil volume

7.5 liters (wet)

CYLINDER BLOCK COMPONENTS



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Item	Description
1	Piston rings
2	Piston
3	Circlip
4	Connecting rod
5	Bolts
6	Connecting rod bearing shells
7	Bearing
8	Gudgeon pin
9	Circlip
10	Cylinder block
11	Pistons
12	Bolts
13	Flywheel
14	Seal
15	Dowel
16	Crankshaft
17	Thrust washer
18	Thrust washer
19	Bearing shells - upper
20	Bearing shells - lower
21	Oil level gauge tube
22	Oil level gauge
23	Bedplate
24	Bolts
25	Bolts
26	Windage tray
27	Bolts
28	Bolts
29	Bolts
30	Bolt
31	Bolt
32	Oil pick-up pipe
33	Bolts
34	Engine sump
35	Bolts
36	Bolts
37	Bolts
38	Oil filter
39	Oil cooler assembly
40	Bolts
41	

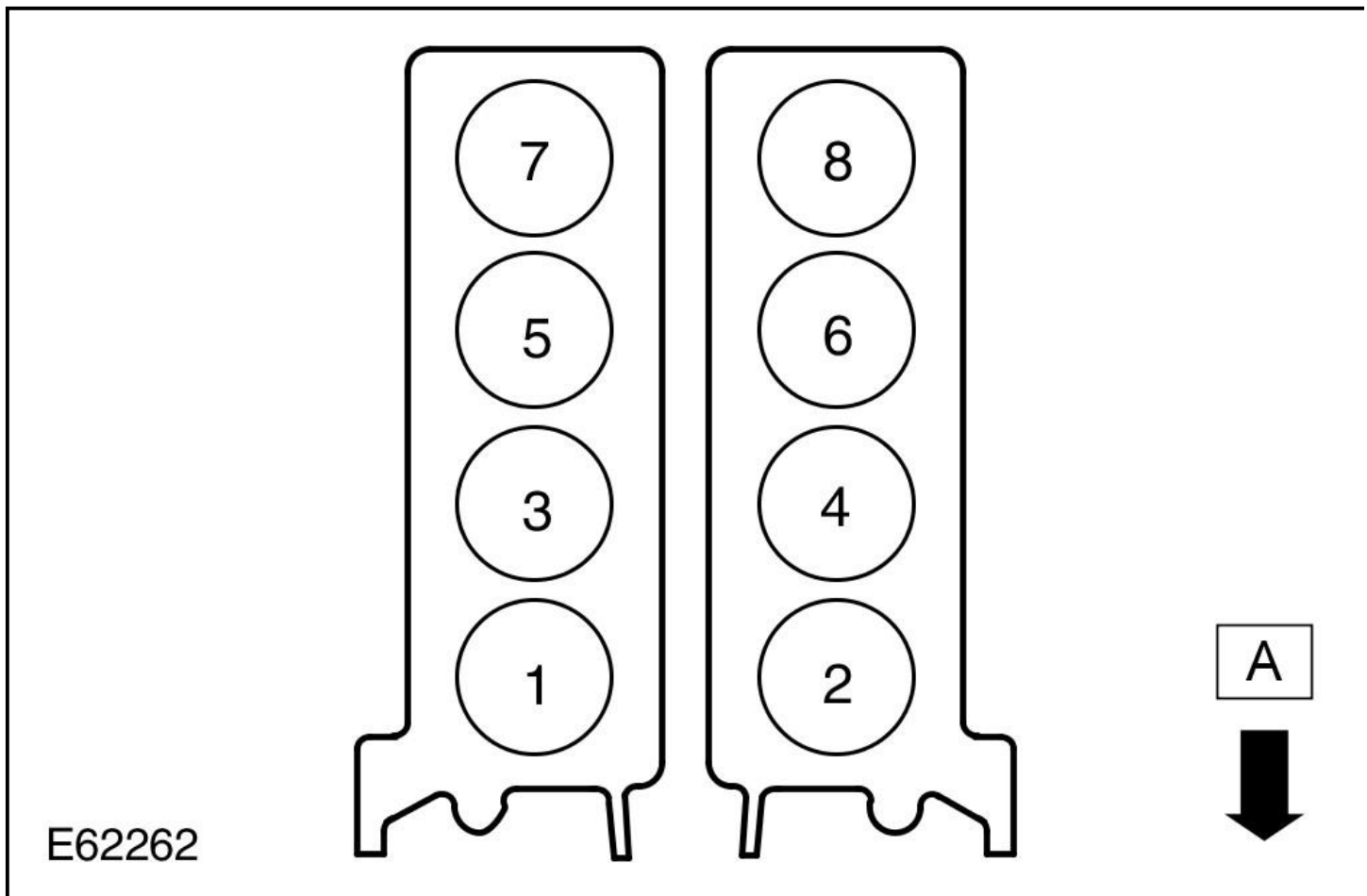
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ENGINE Engine (4.4L)

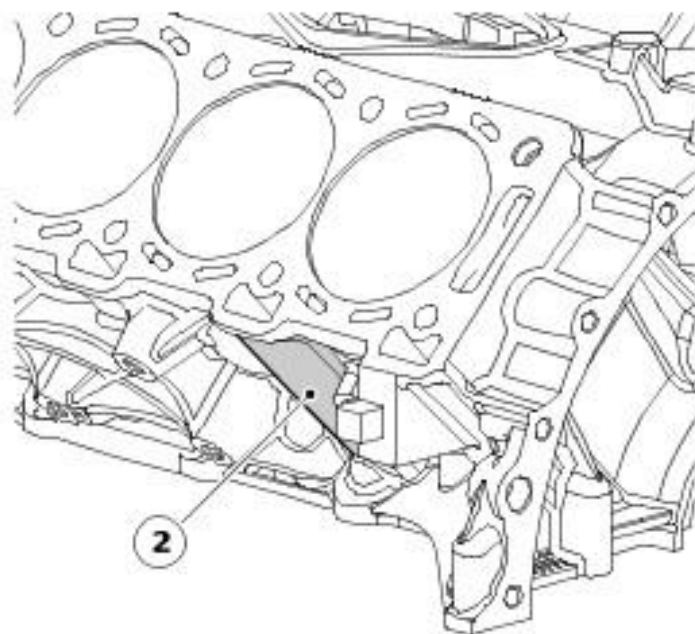
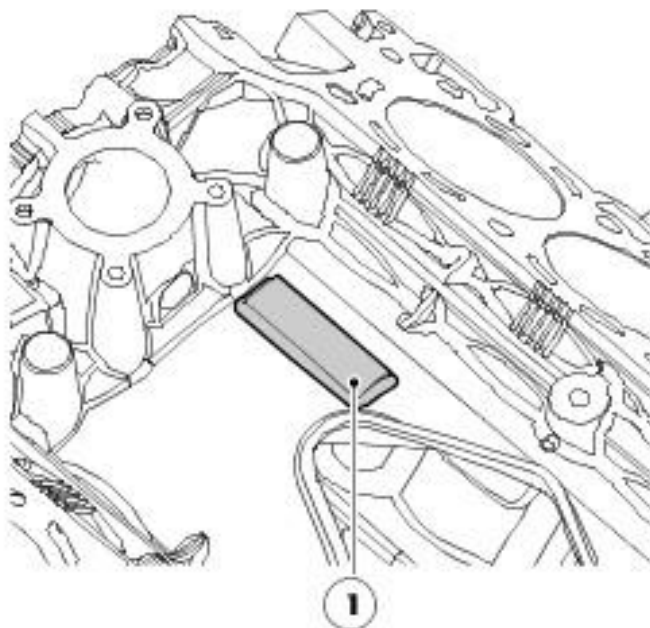
	Oil filter head assembly
42	Seals
43	Bolts
44	Oil pump
45	Crankshaft bolt
46	Taper collet
47	Crankshaft pulley
48	Crankshaft sprocket

CYLINDER BLOCK

The cylinder block is an 'Enclosed V' design, which provides an inherently rigid structure with good vibration levels. A low volume coolant jacket improves warm-up times and piston noise levels; the longitudinal flow design of the jacket, with a single cylinder head coolant transfer port in each bank, improves rigidity and head gasket sealing.



Item	Description
A	Front of engine

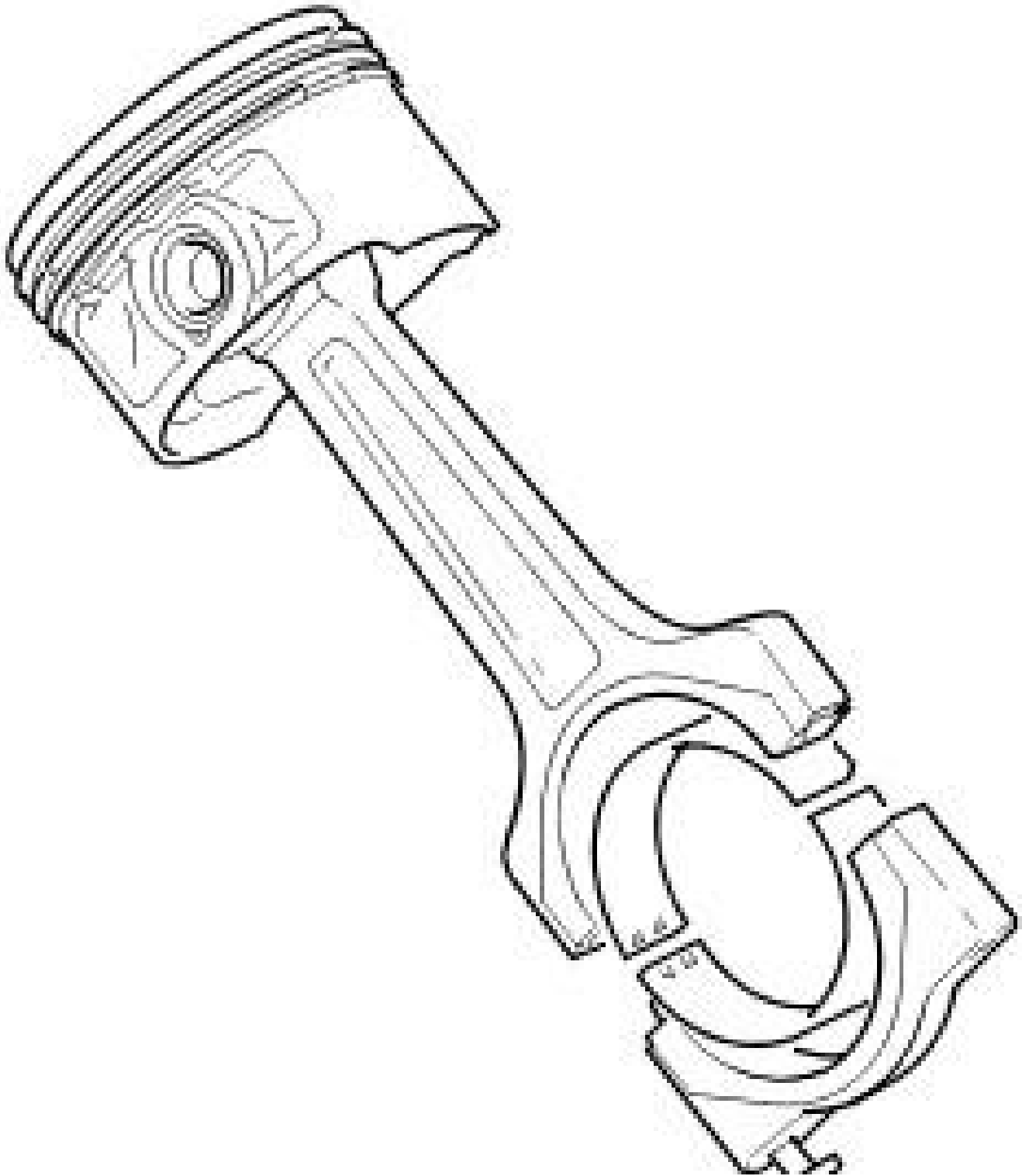


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Item	Description
1	Engine part number
2	Engine data (main bearing diameters, cylinder bore diameters, etc.), emissions code and engine number

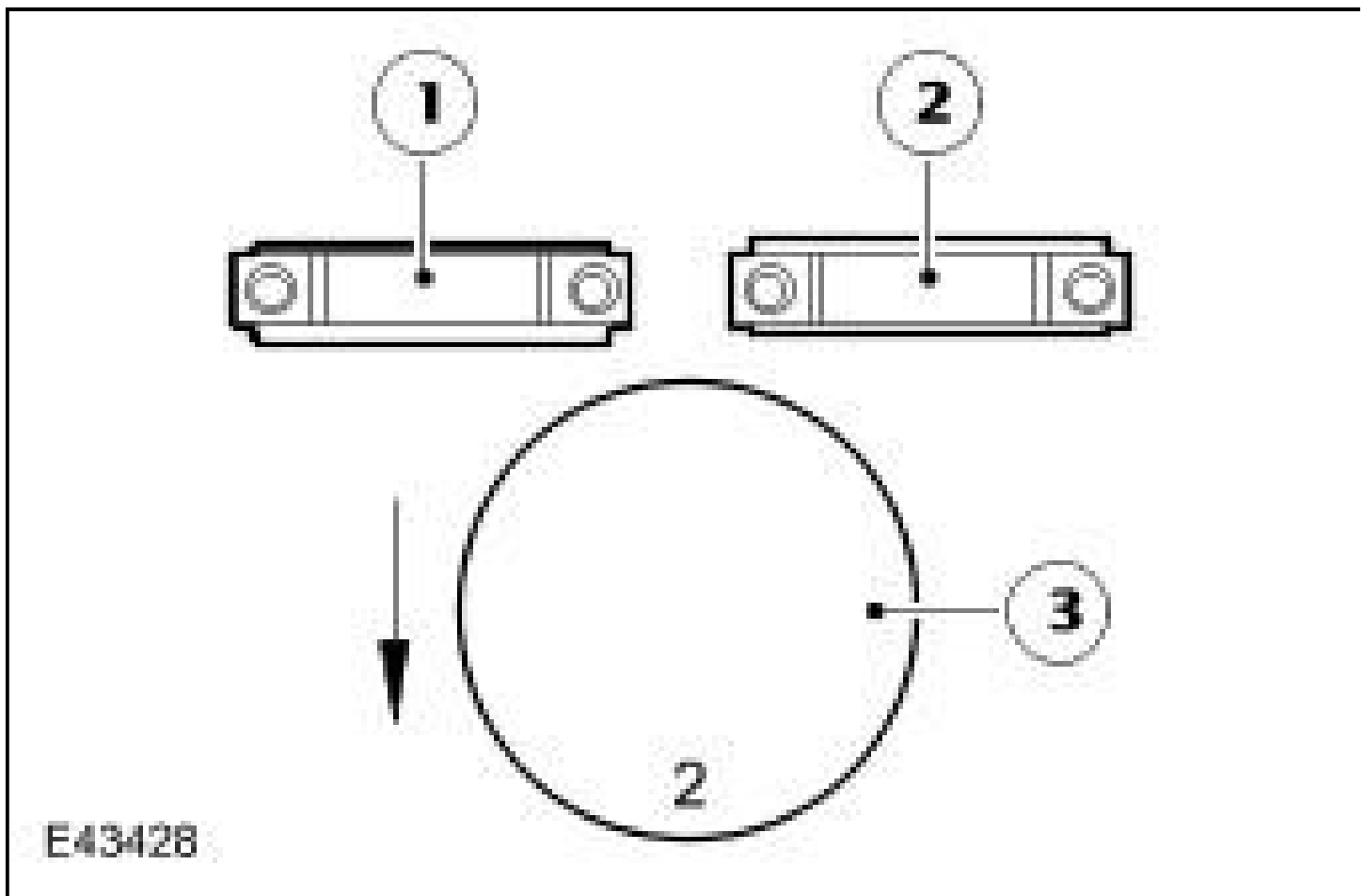
Engine data is marked at 3 locations, 2 on the cylinder block (shown) and 1 on the engine front cover, which consists a label displaying the engine number. Component diameters are represented by alphabetical and numerical codes; keys to the codes are in the Service Repair Procedures (SRP) Information.

CONNECTING RODS AND PISTONS



The connecting rods are manufactured from sinter-forged steel and have fracture-split bearing caps. The bearing caps are produced by fracturing the opposing sides of the connecting rod at the bearing horizontal center line. As well as being easier to manufacture, when reassembled the fractured surfaces interlock to form a strong seamless joint. The cylinder position is marked on adjoining sides of the joint to identify matching connecting rods and bearing caps. The connecting rod bearings are aluminum/tin split plain bearings.

The pistons are of the open-ended skirt design. Three piston rings, 2 compression and 1 oil control, are installed on each piston. Each piston is installed on a gudgeon pin located in a aluminum/tin bushing in the connecting rod.



Item	Description
1	RH bank of cylinders
2	LH bank of cylinders
3	Piston

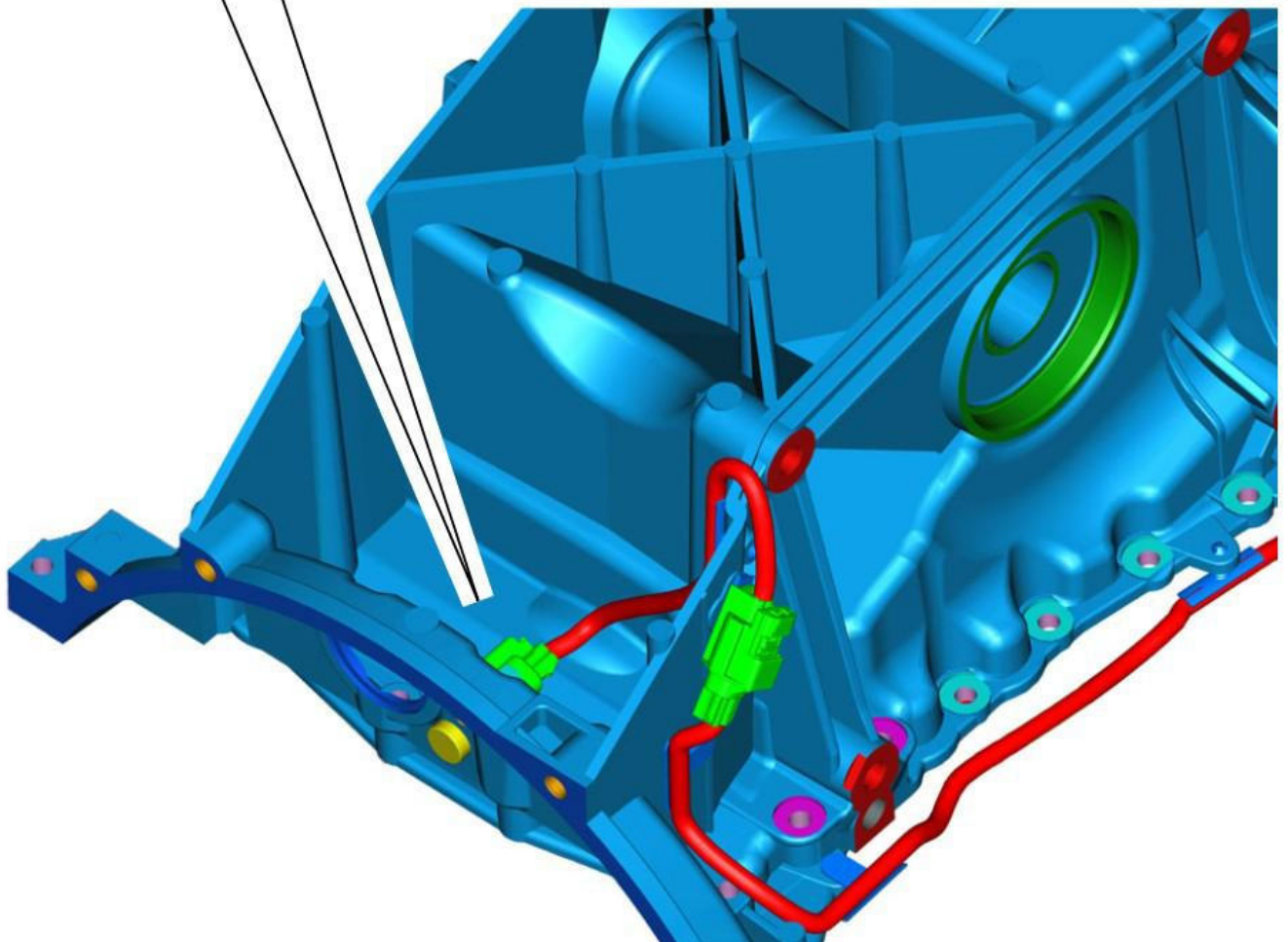
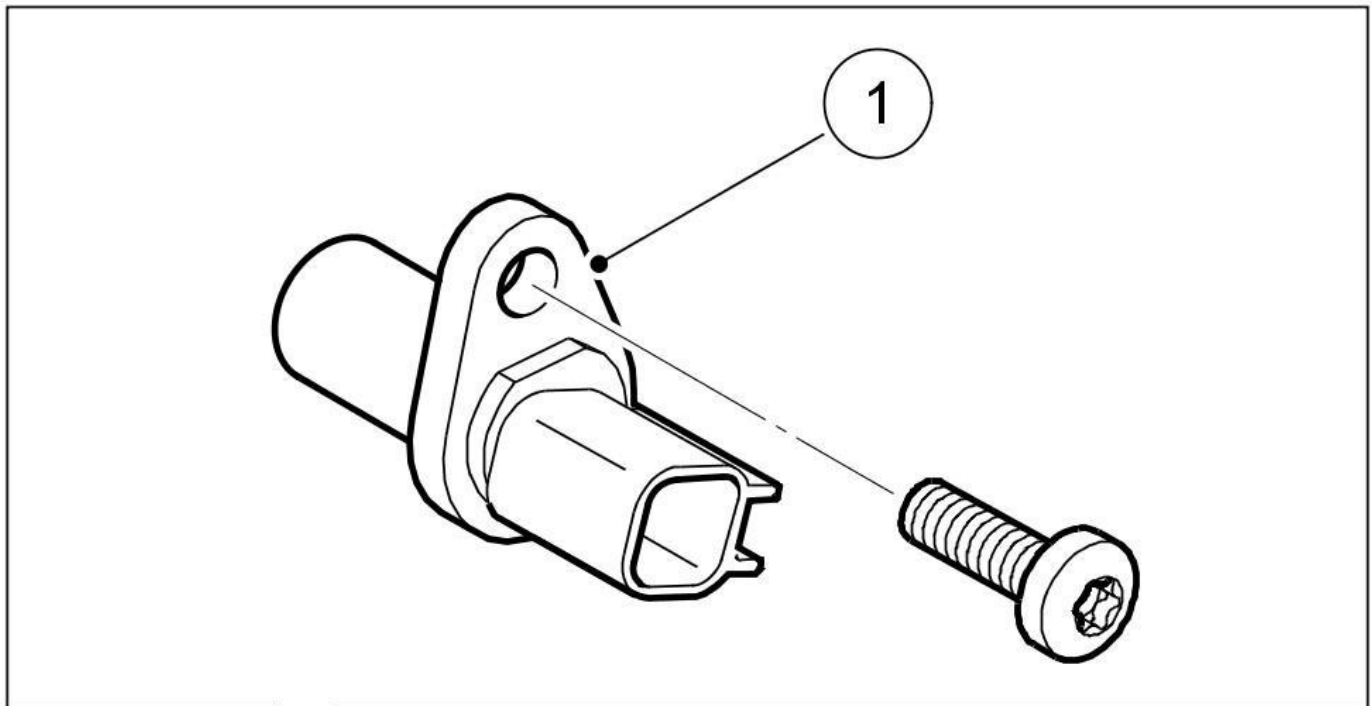
The piston grade number is stamped on the crown of the piston and must coincide with that for each cylinder bore. The piston must be assembled in the correct orientation for the designated cylinder bore:

- RH bank of cylinders - piston grade number and the thick flange of the connecting rod must face the front

of the engine

- LH bank of cylinders - piston grade number and the thin flange of the connecting rod must face the front of the engine

CRANKSHAFT POSITION SENSOR



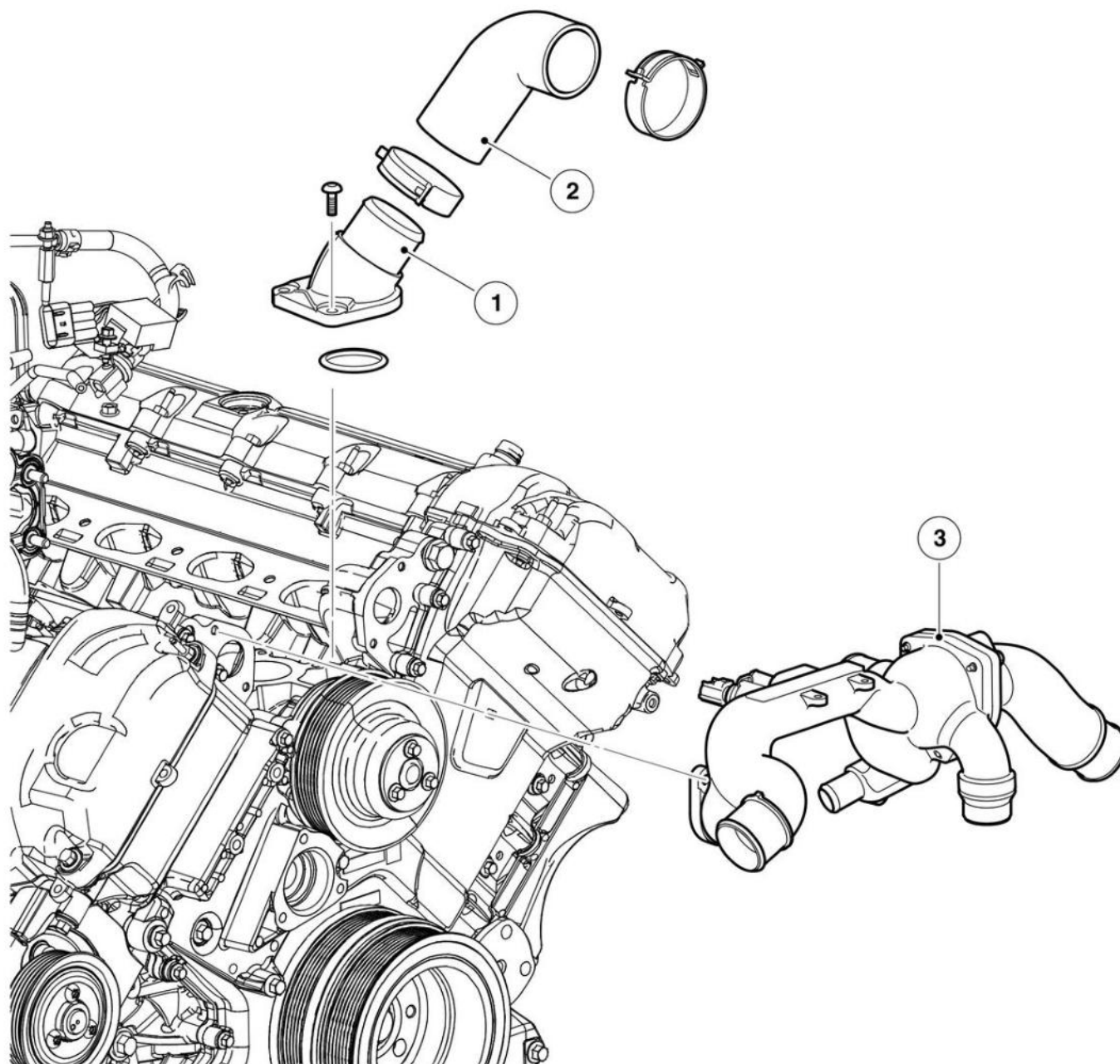
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ENGINE Engine (4.4L)

Item	Description
1	Crankshaft position sensor (CKP)

The CKP sensor is installed at the rear of the sump. It is a variable reluctance sensor that provides an input of engine crankshaft speed and position. For additional information, refer to: **ELECTRONIC ENGINE CONTROLS** (Description and Operation).

KNOCK SENSORS



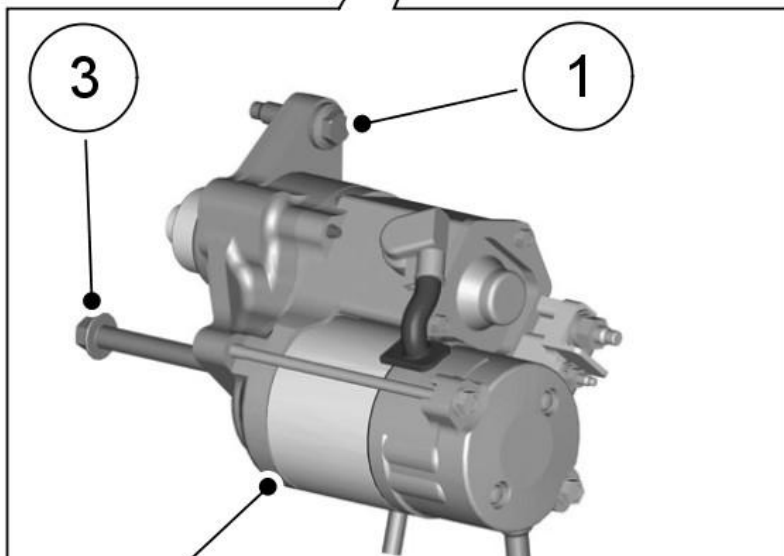
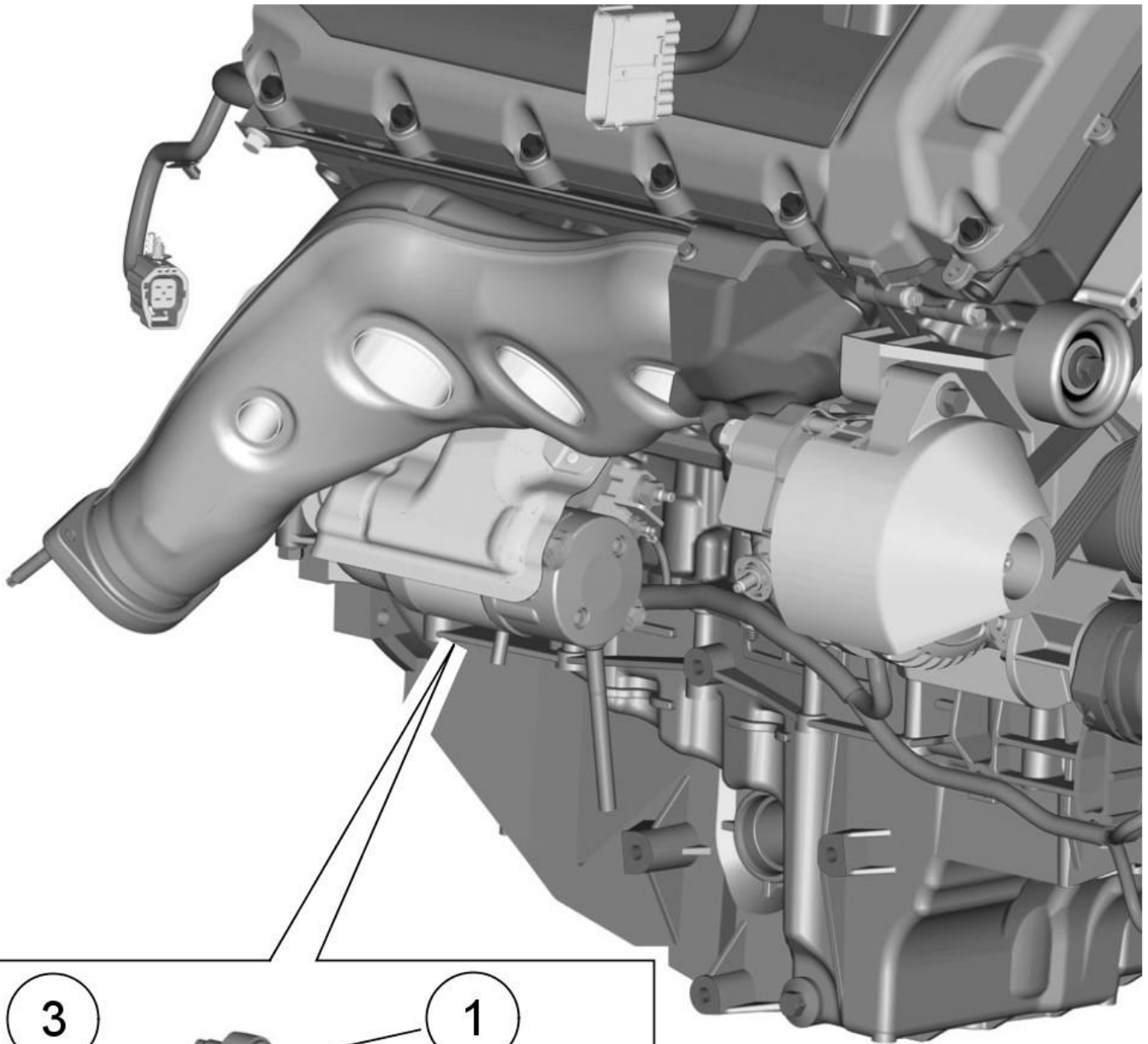
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Item	Description
1	Bolt
2	Knock sensor

The knock sensors are installed in the cylinder block on the inboard side of each cylinder bank. They are piezo-electric sensors that provide inputs to detect and locate detonation during combustion. For additional

information, refer to: **ELECTRONIC ENGINE CONTROLS** (Description and Operation).

STARTER



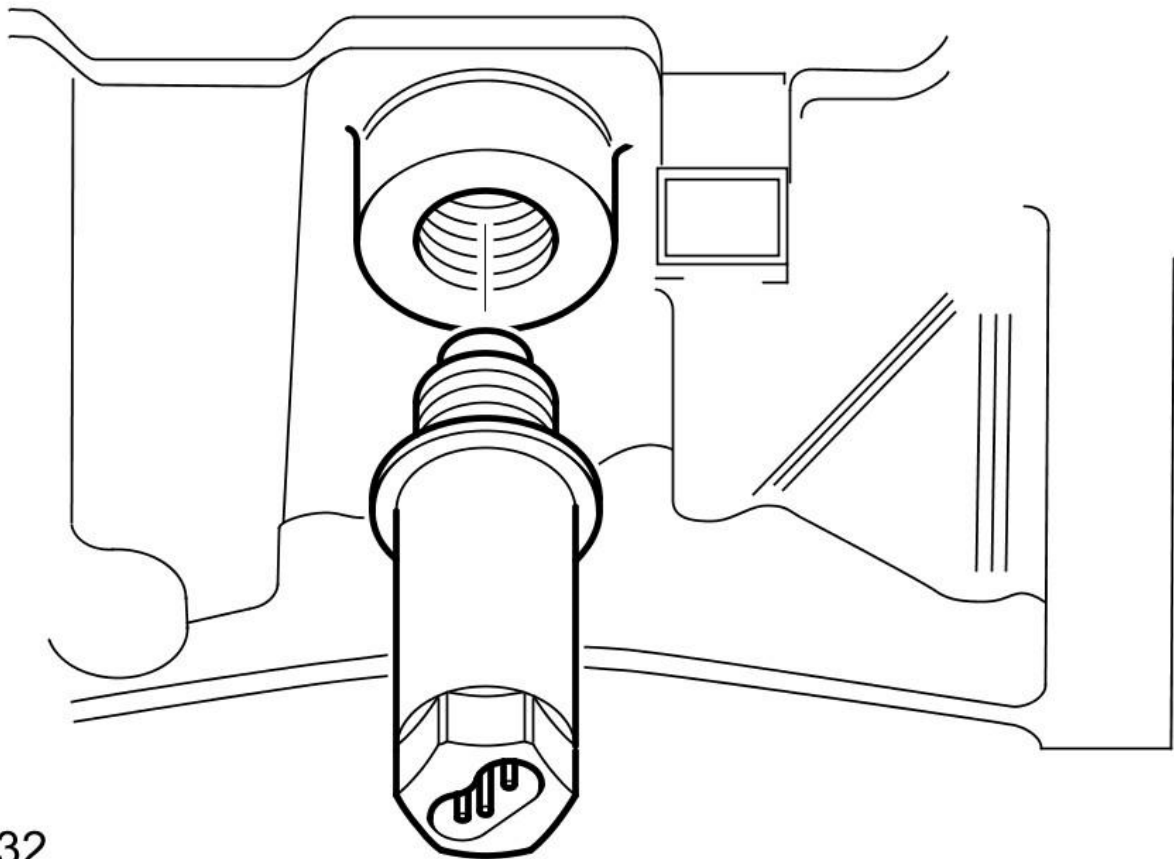
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ENGINE Engine (4.4L)

Item	Description
1	Bolt
2	Starter motor
3	Bolt

The engine starter motor is installed at the rear right side of the engine, at the cylinder block to bedplate split line. For additional information, refer to: **Starting System (4.4L)** (Description and Operation).

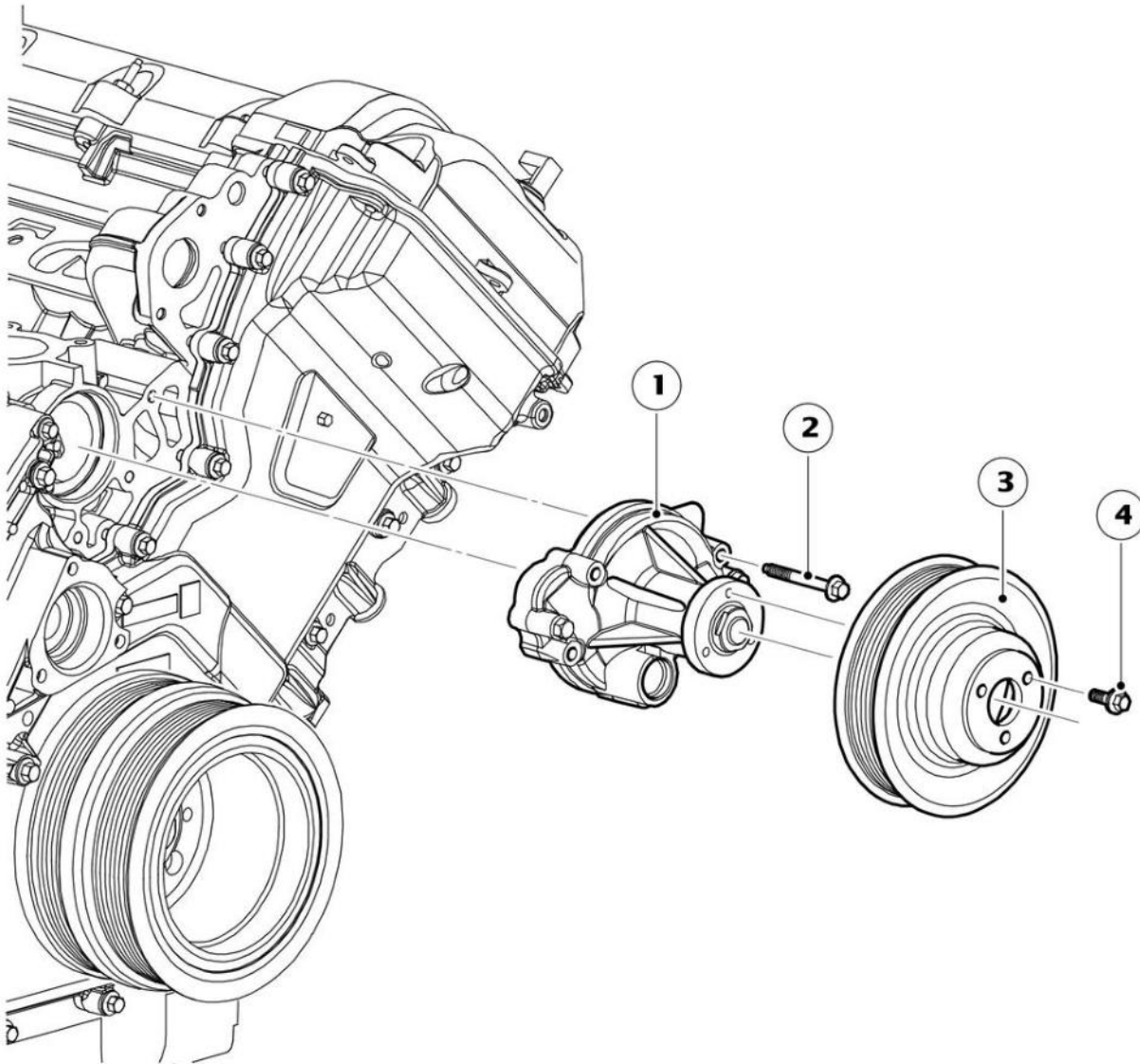
COOLANT DRAIN PLUG/HEATER



A coolant drain plug is installed on the rear left side of the cylinder block. On vehicles with the cold climate package, the cylinder block heater replaces the drain plug.

On vehicles destined for Canada, the coolant heater is installed during engine manufacture, but for Scandinavian vehicles the heater is supplied in kit form to be installed at the dealership.

COOLANT PUMP

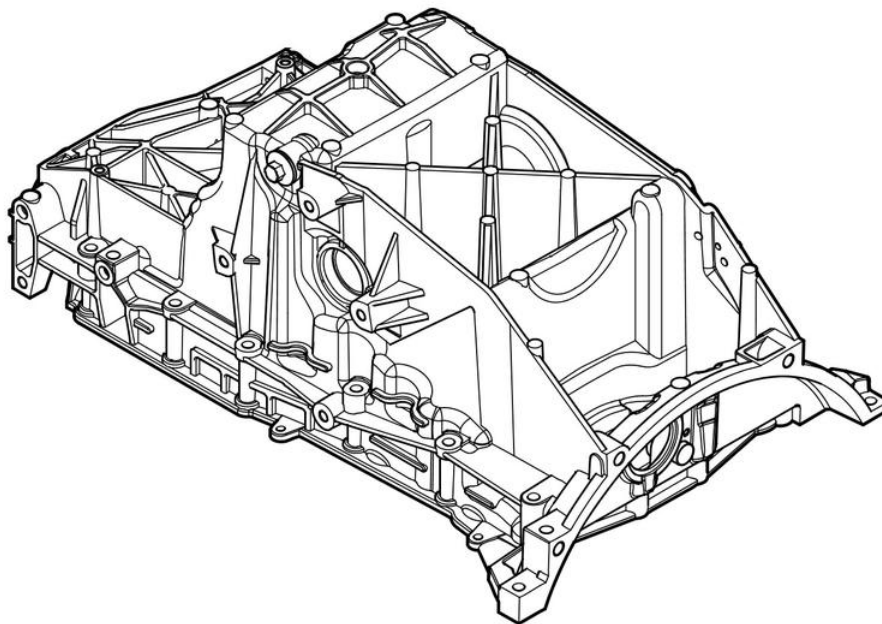


E43433

Item	Description
1	Coolant pump
2	Bolt
3	Pulley
4	Bolt

The coolant pump is installed between the 2 cylinder banks, on the front face of the cylinder block.

THERMOSTAT HOUSING



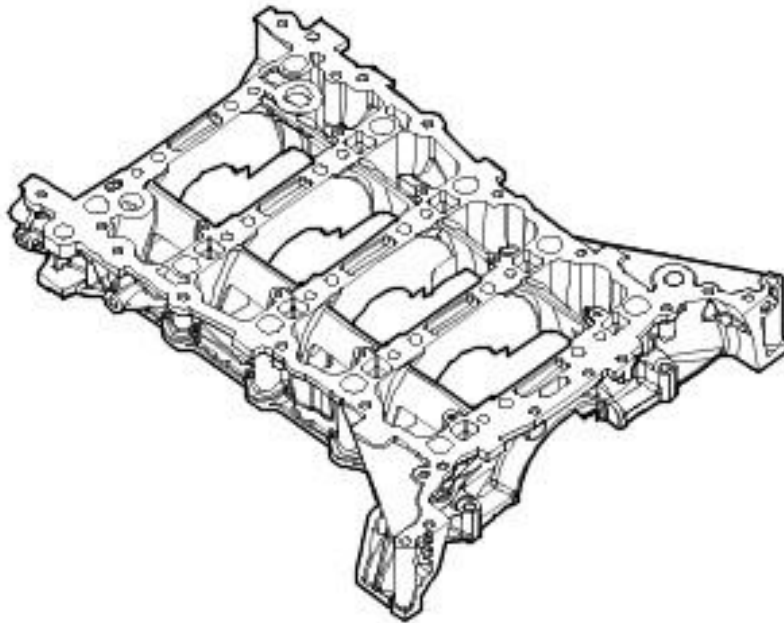
Item	Description
1	Coolant outlet elbow
2	Bolt
3	Thermostat housing
4	Bolt

The composite thermostat housing is installed between the 2 cylinder banks, immediately above the coolant pump. The thermostat controls the flow of coolant through the radiator.

CRANKSHAFT AND SUMP COMPONENTS

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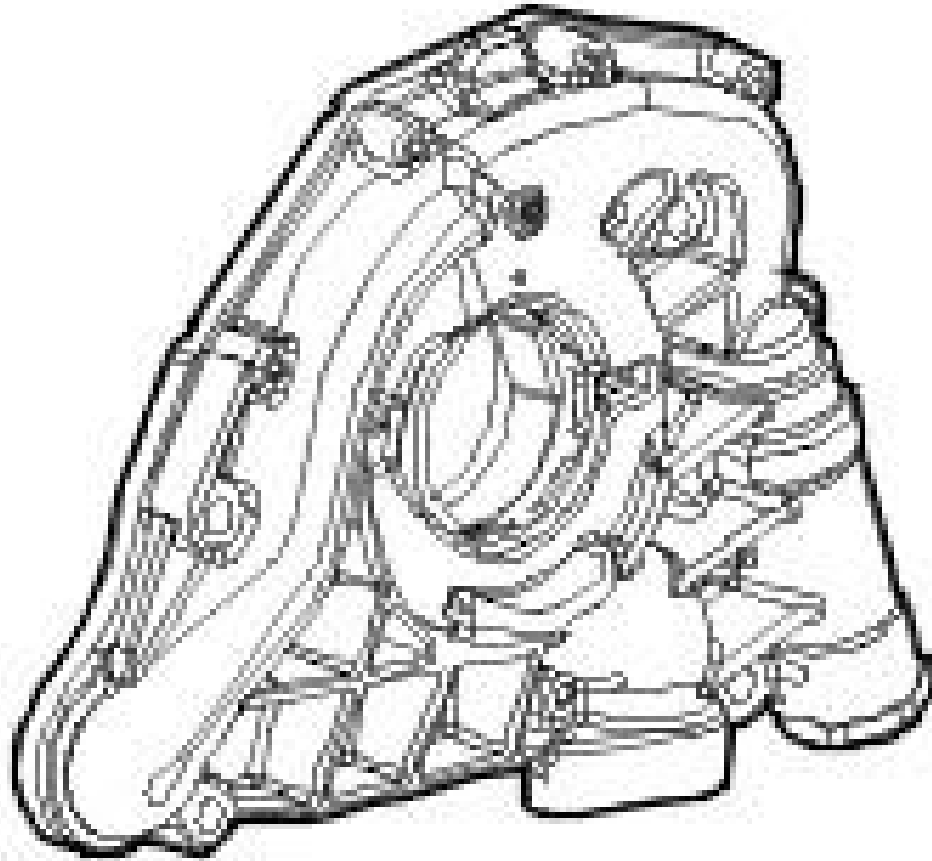
ENGINE Engine (4.4L)



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Item	Description
1	Bedplate
2	Main bearings - lower

CRANKSHAFT AND MAIN BEARINGS



E43439

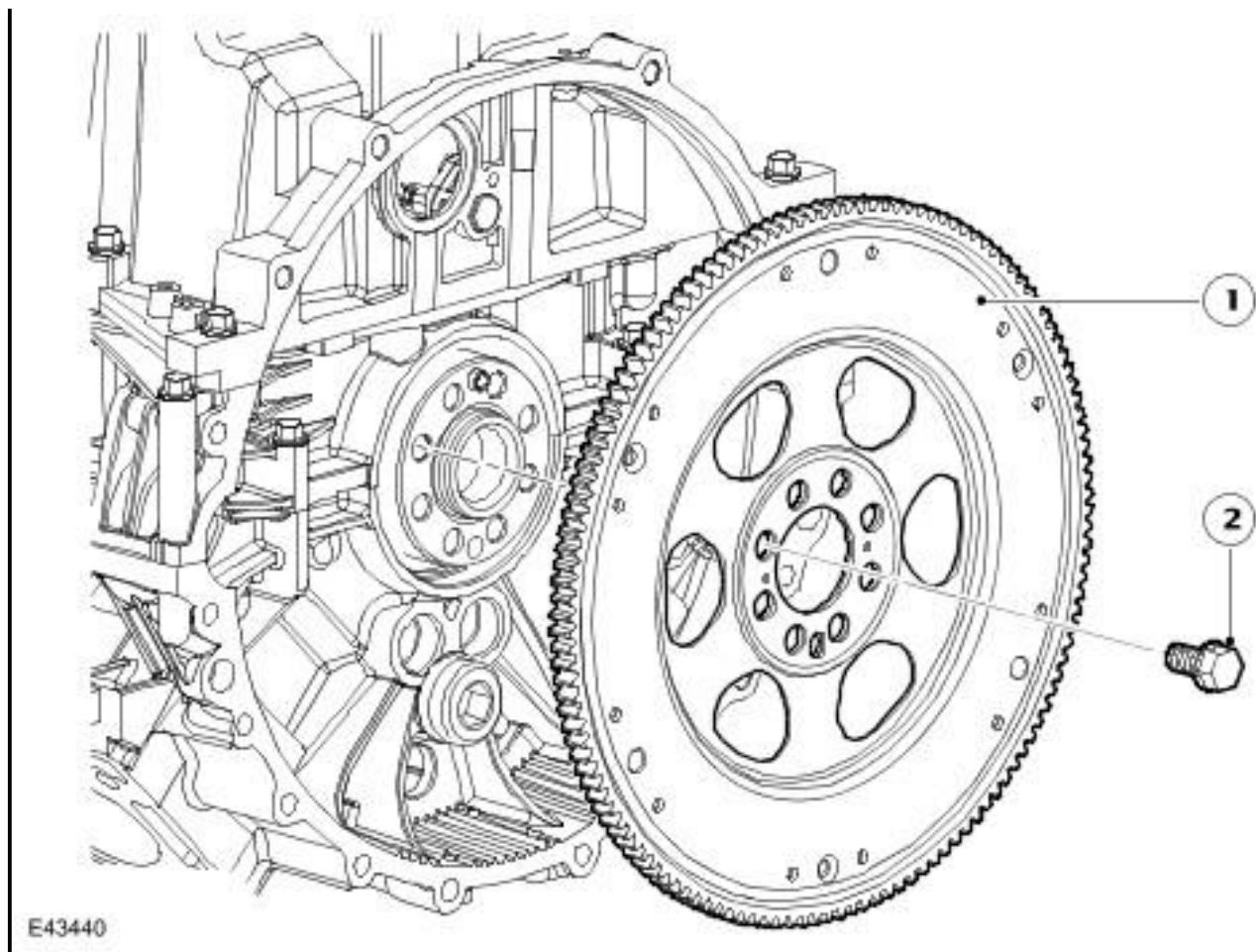
Item	Description
1	Crankshaft
2	Thrust washer
3	Thrust washer
4	Main bearings - upper

Six counter-balance weights ensure good vibration levels from the 4 throw, 5 bearing crankshaft. Manufactured in cast iron, the crankshaft also has undercut and rolled fillets for improved strength.

The crankshaft rear oil seal is a press fit in the bedplate to cylinder block interface.

The main bearings are aluminum/tin split plain bearings. An oil groove in the upper half of each bearing transfers the oil into the crankshaft for lubrication of the connecting rod bearings. A aluminum/tin thrust washer is installed each side of the top half of the center main bearing.

BEDPLATE

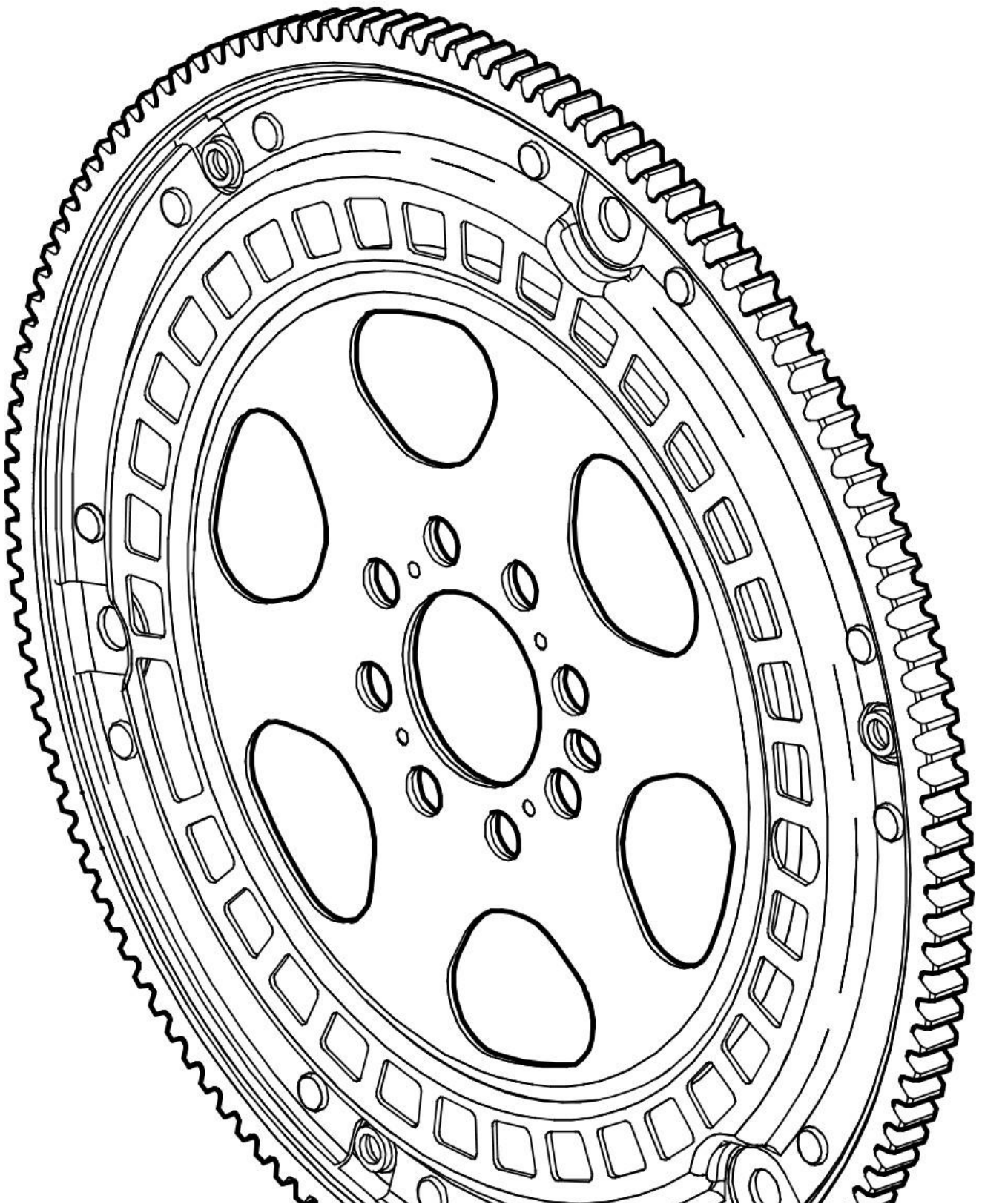


The bedplate is a structural casting bolted to the bottom of the cylinder block to retain the crankshaft. The use of a bedplate further improves rigidity. Iron inserts, cast into the main bearing supports of the bedplate, minimize main bearing clearance changes due to heat expansion.

Two hollow dowels align the bedplate with the cylinder block.

Beads of sealant seal the joint between the bedplate and the cylinder block.

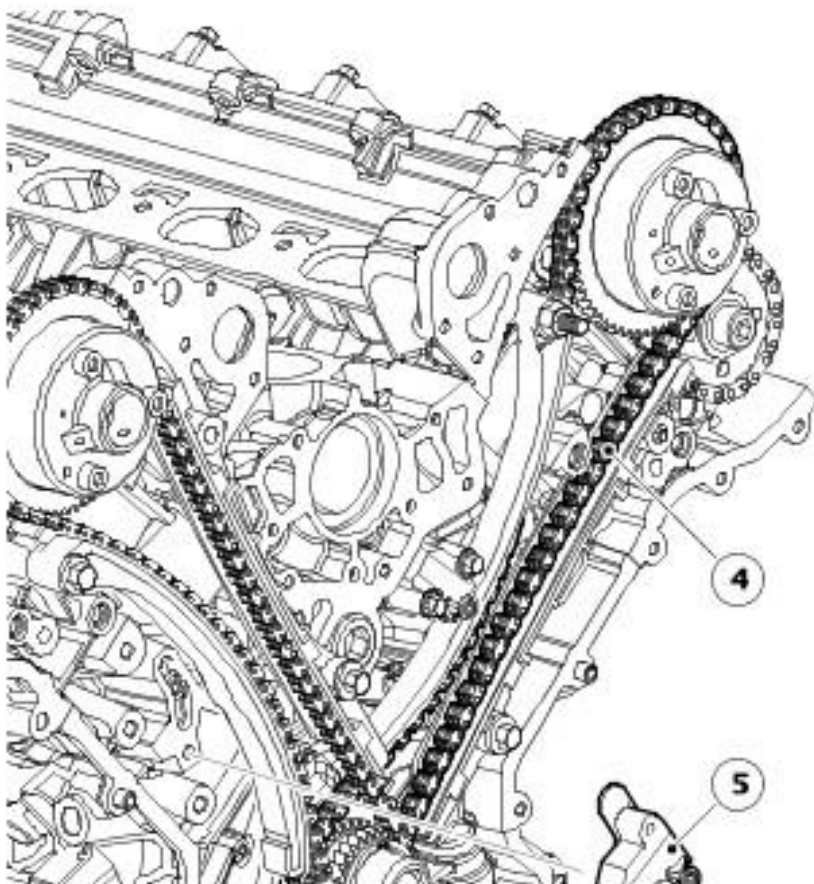
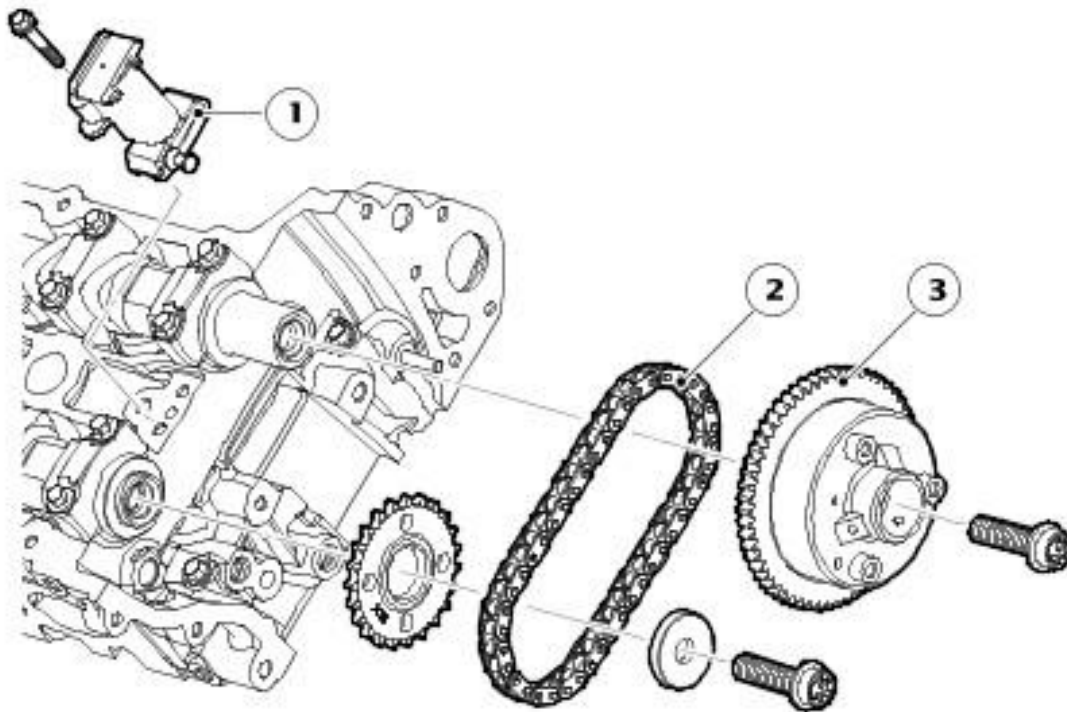
SUMP



The aluminum alloy structural sump is bolted to the bedplate. A windage tray attached to the underside of the bedplate isolates the oil pan from the disturbed air produced by the rotation of the crankshaft, to prevent oil aeration and improve oil drainage. A rubber plug at the rear of the structural sump seals the port that provides access to the torque converter securing bolts. The engine oil drain plug is located at the front right corner of the oil pan.

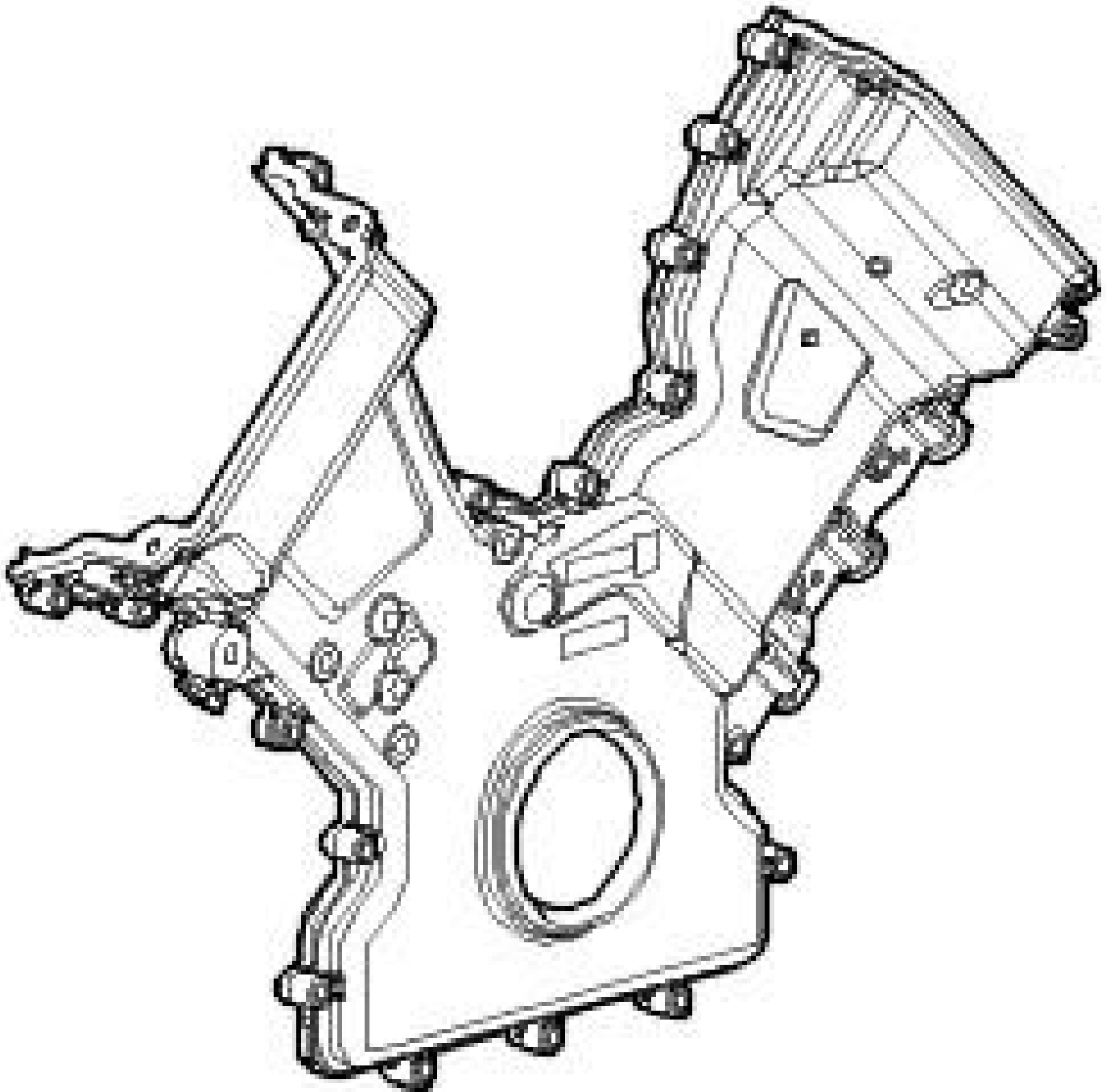
A bead of sealant seals the joint between the structural sump and the bedplate.

OIL PUMP



The oil pump is installed on the crankshaft at the front of the engine. The pump inlet and outlet ports align with oil passages in the bedplate.

STARTER DRIVE PLATE

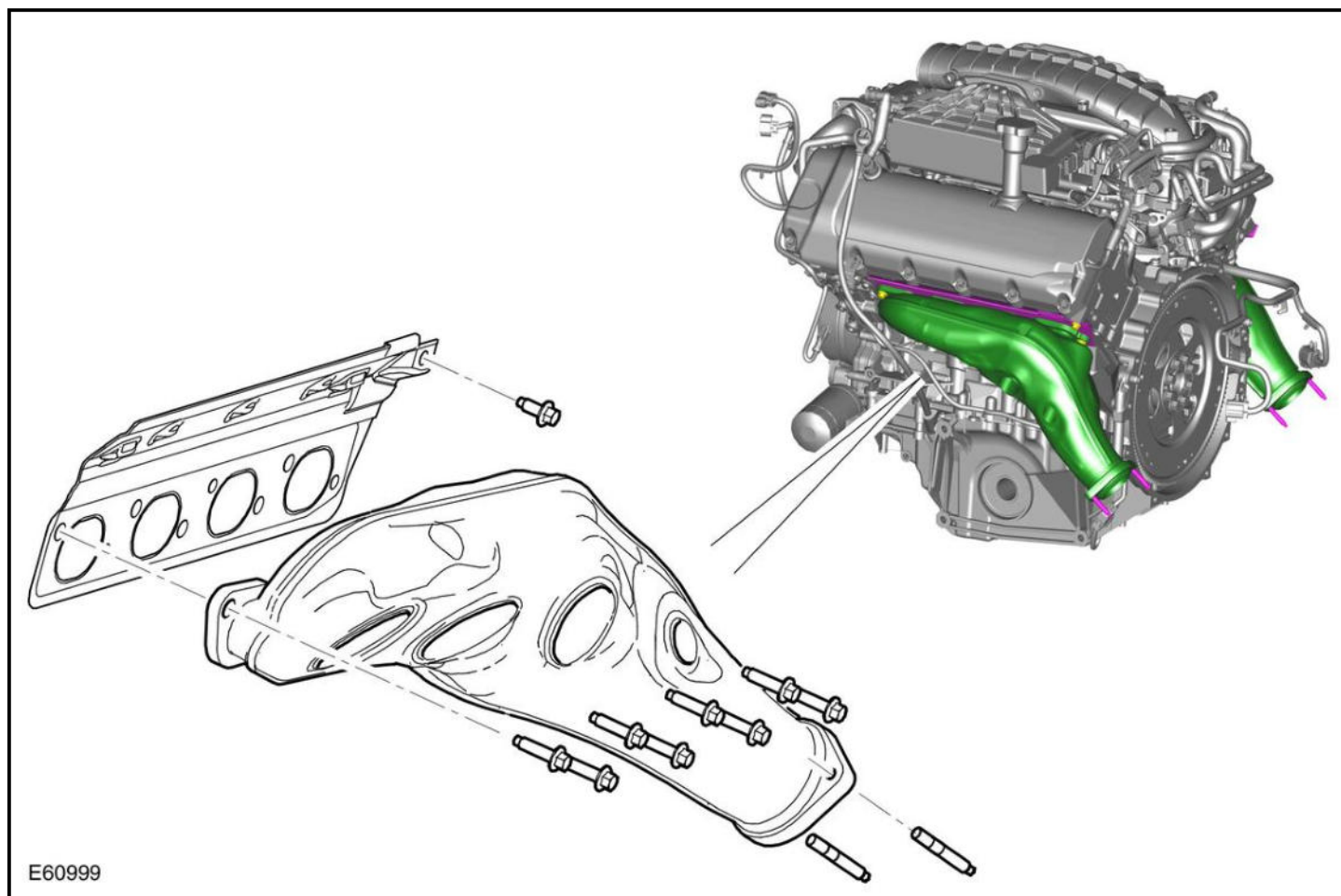


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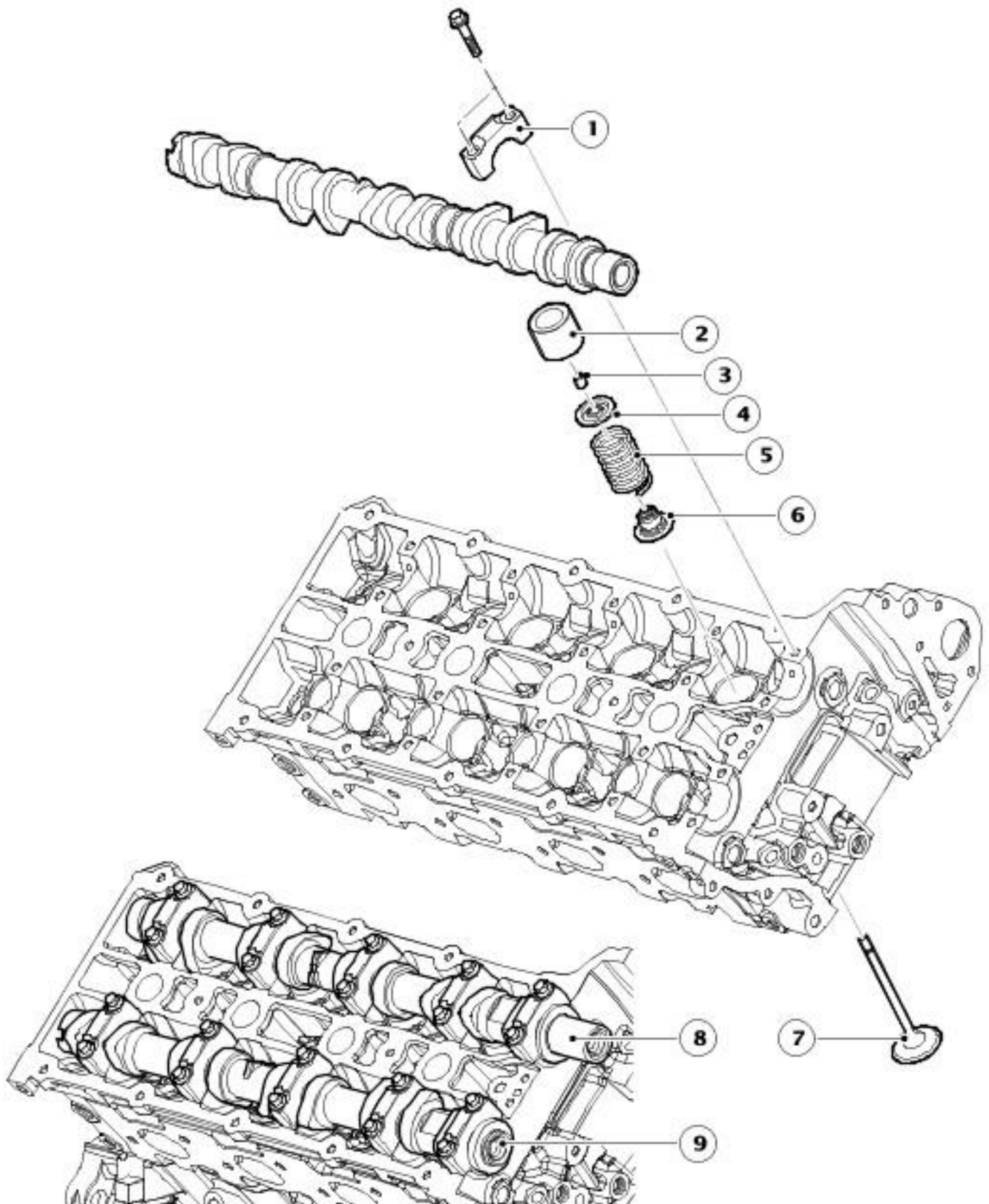
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Item	Description
1	Starter drive plate
2	Bolt

The starter drive plate is attached to the rear of the crankshaft. A timing disc, for the engine speed sensor, is spot welded to the front face of the drive plate.



CAMSHAFT TIMING COMPONENTS



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Item	Description
1	Secondary chain tensioner
2	Secondary chain
3	Variable valve timing unit
4	Primary chain
5	Primary chain tensioner

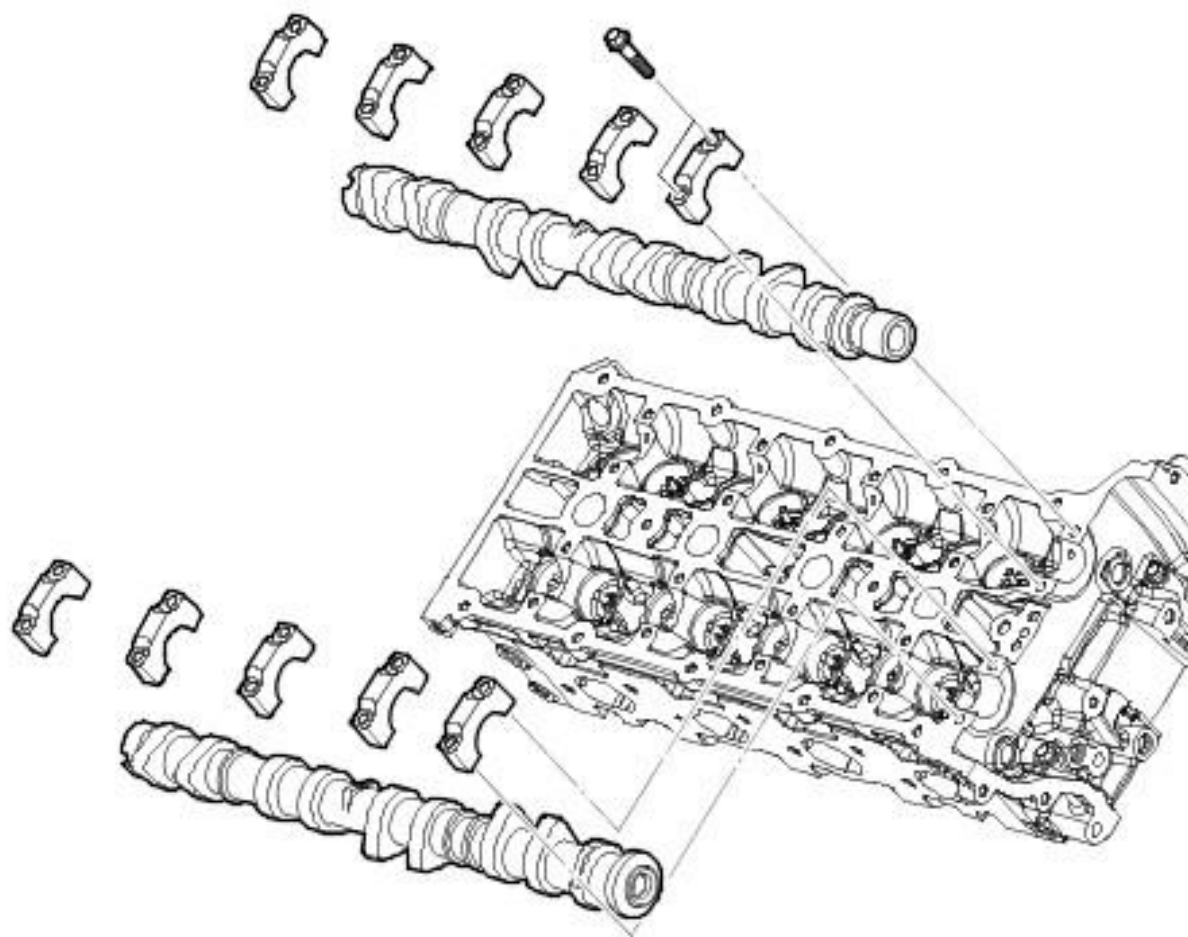
TIMING GEAR

Multiple link primary and single row secondary chains drive the camshafts of each cylinder bank. The primary chains transmit the drive from 2 sprockets on the crankshaft to variable valve timing units on the intake camshafts. The secondary chains transmit the drive from the variable valve-timing units to sprockets on the exhaust camshafts.

A key locates the 2 drive sprockets on the crankshaft. The crankshaft's torsional vibration damper retains the sprockets in position. The variable valve timing units and the exhaust camshaft sprockets are non-interference, non-keyed fits on their respective camshafts; the drive being transmitted by the face to face friction load produced by the valve timing unit/sprocket securing bolt.

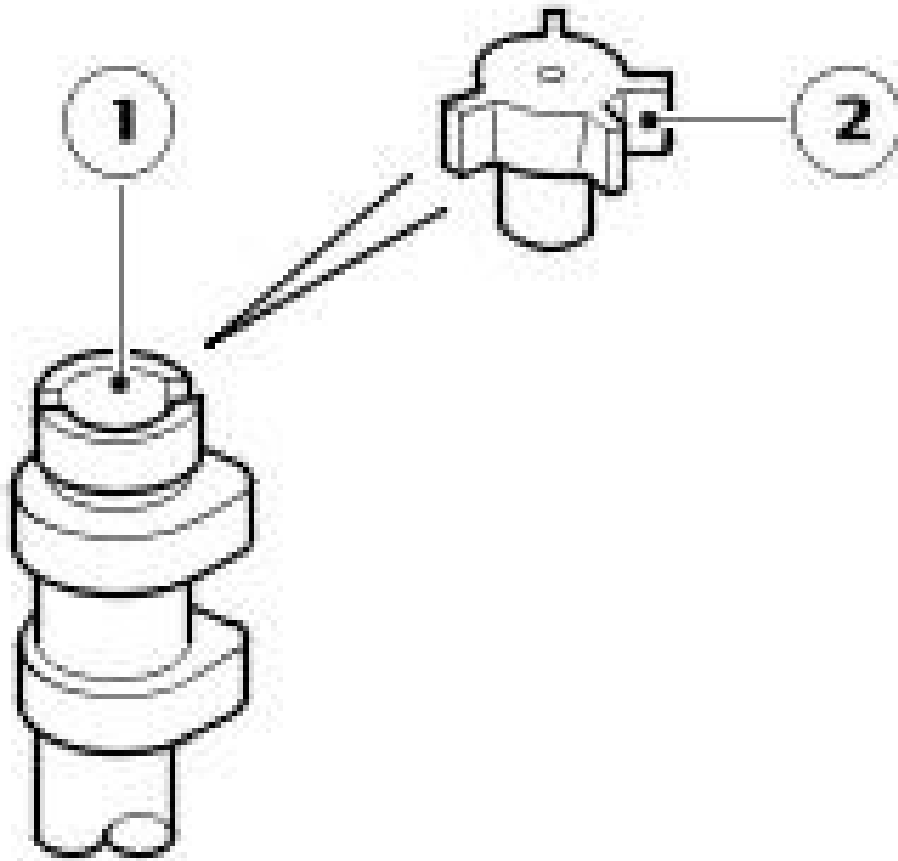
Each chain has a hydraulic tensioner operated by engine oil. The primary chains are lubricated via oil squirt tubes located at the front of the engine block, near the crankshaft drive sprockets. A jet of oil from the end of each secondary chain tensioner lubricates the secondary chains. The primary chain tensioners act on pivoting flexible tensioner blades. The secondary chain tensioners act directly on the chains. Guide rails are installed on the drive side of the primary chains.

TIMING COVER



The aluminum alloy timing cover accommodates the crankshaft front oil seal (a PTFE lip seal). Silicon rubber in-groove gaskets seal the joint between the timing cover and the front face of the engine.

CYLINDER HEAD COMPONENTS



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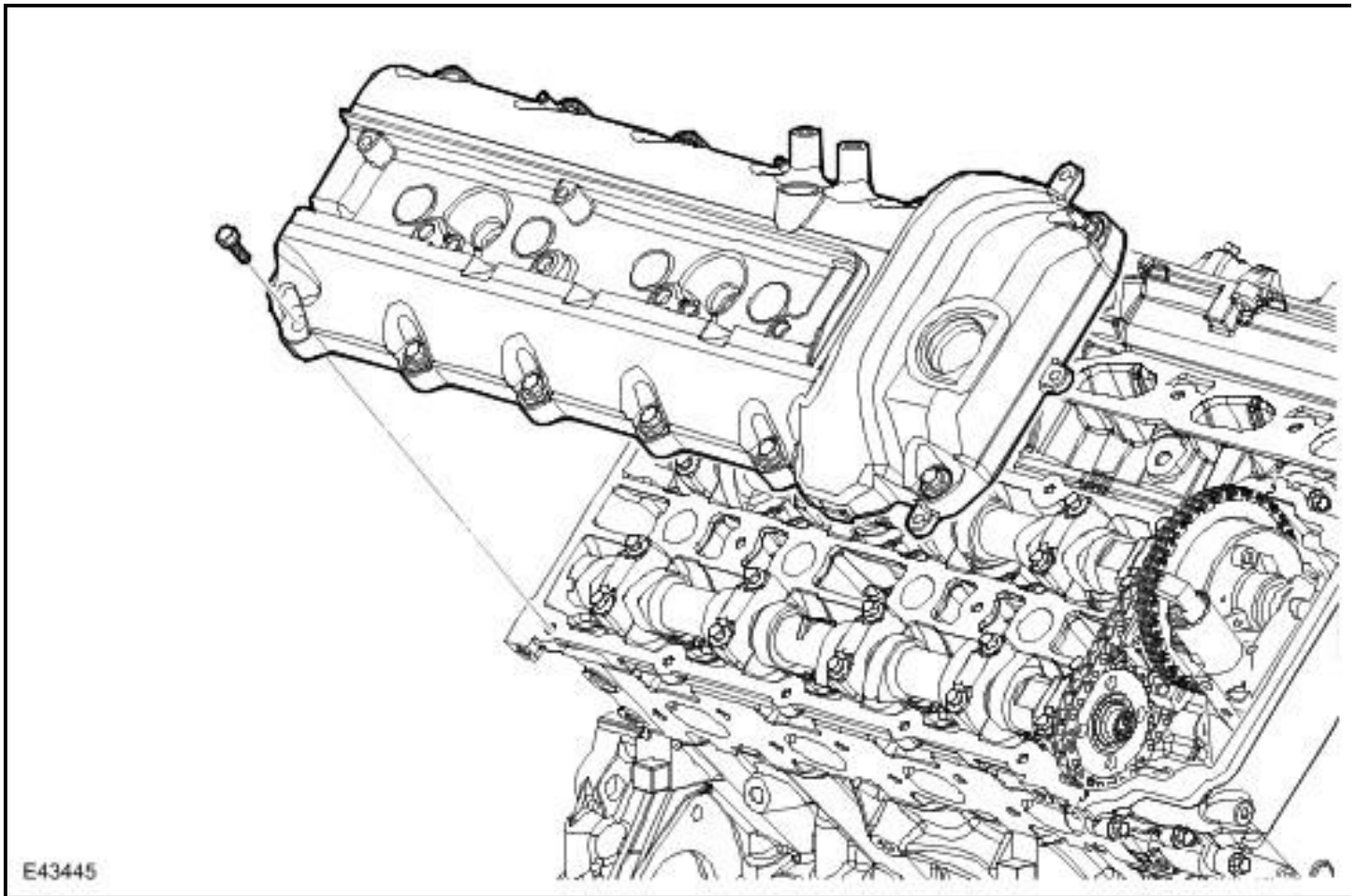
Item	Description
1	Camshaft bearing cap
2	Tappet (shimless)
3	Collet
4	Valve spring cap
5	Valve spring
6	Valve stem oil seal
7	Valve
8	Inlet camshaft
9	Exhaust camshaft

CYLINDER HEADS

The cylinder heads are unique to each cylinder bank. Deep-seated bolts, to reduce distortion, secure the cylinder heads to the cylinder block. Two hollow dowels align each cylinder head with the cylinder block.

The 14 mm spark plugs, 1 per cylinder, locate in recesses down the center line of each cylinder head.

The engine-lifting eyes are bolted to the cylinder heads; 2 on the rear (1 per head) and one at the front.

CAMSHAFT COVERS

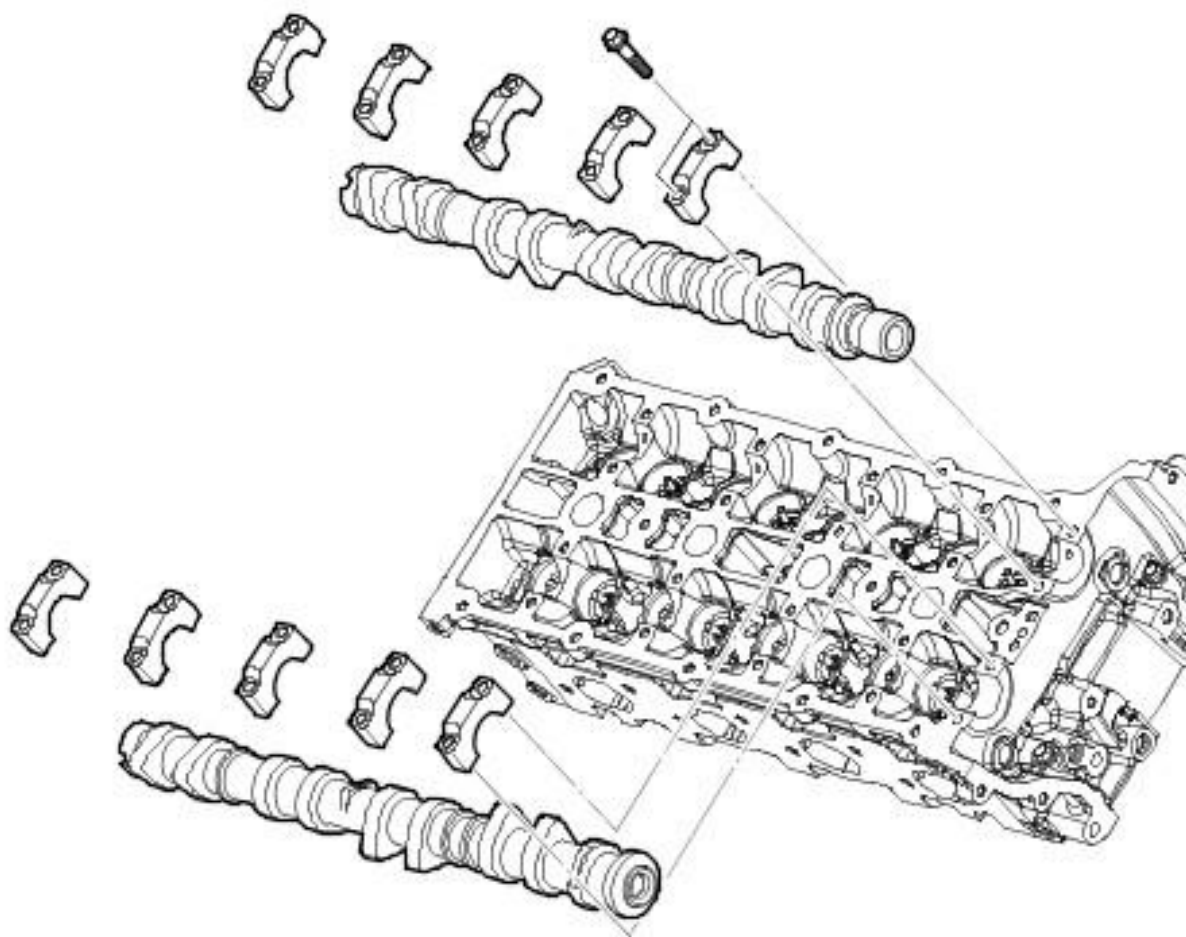
The camshaft covers are manufactured from thermo-plastic. The RH camshaft cover incorporates an outlet for the part load engine breather. The LH camshaft cover incorporates an outlet for the full load engine breather and the engine oil filler cap. Identical oil separators are incorporated below the breather outlet in each cover. For additional information, refer to: **ELECTRONIC ENGINE CONTROLS** (Description and Operation).

Silicon rubber in-groove gaskets seal the joints between the camshaft covers and the cylinder heads. Together with spacers and seals on the camshaft cover fasteners, they also isolate the covers from direct contact with the cylinder heads, to reduce noise.

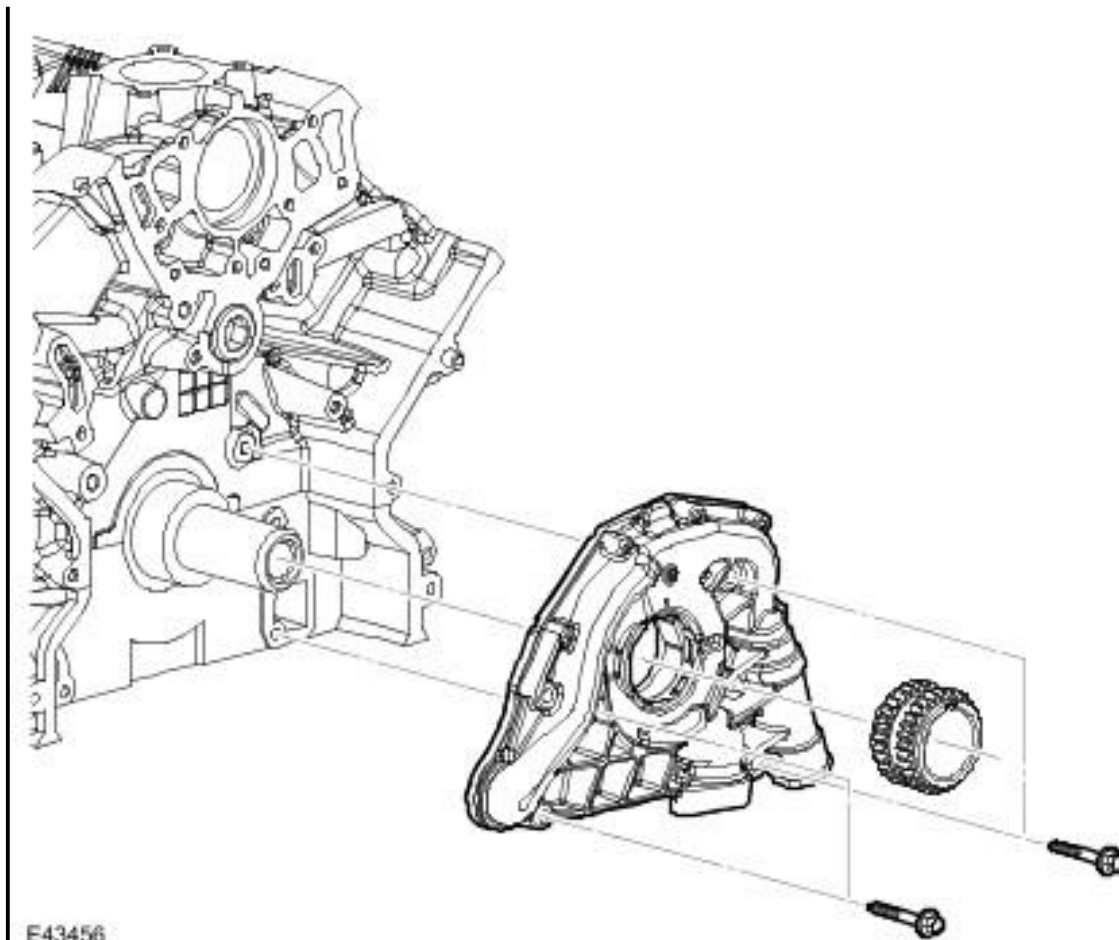
CYLINDER HEAD GASKET

The multi-layered steel cylinder head gasket has cylinder specific water flow cross-sections for uniform coolant flow.

CAMSHAFTS



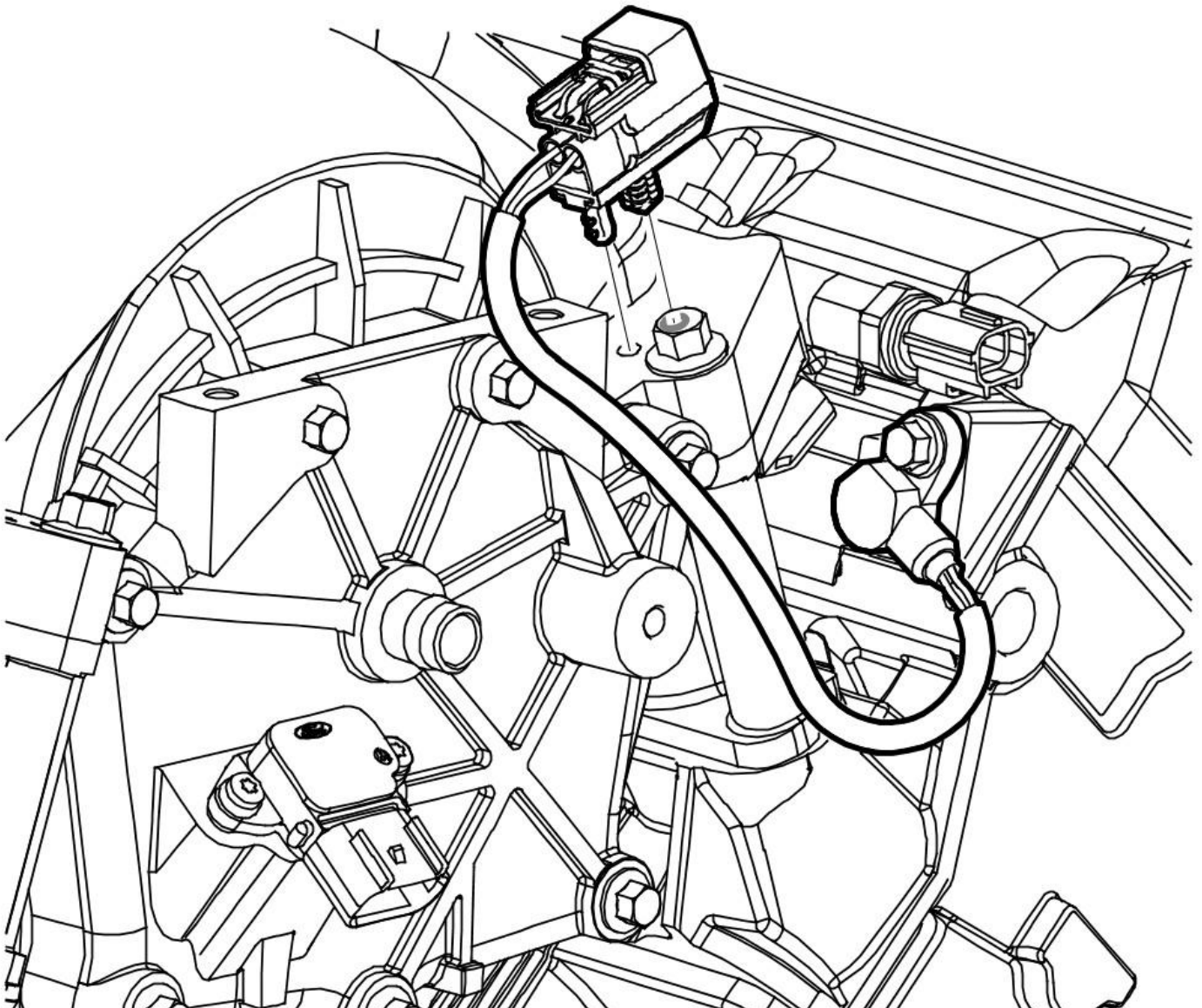
The camshafts are manufactured in chilled cast iron. Five aluminum alloy caps retain each camshaft. Location numbers, 0 to 4 for the intake camshaft and 5 to 9 for the exhaust camshaft, are marked on the outer faces of the caps.



Item	Description
1	Inlet camshaft
2	Sensor ring

Timing rings for each camshaft position sensor are located at the rear of both intake camshafts. A flat, machined near the front of each camshaft, enables the camshafts to be locked during the valve timing procedure.

CAMSHAFT POSITION SENSOR



The camshaft position sensors are installed in each cylinder head at the rear of the intake camshaft. It is a variable reluctance sensor that provides an input to the ECM regarding the position of the camshaft. For additional information, refer to: **ELECTRONIC ENGINE CONTROLS** (Description and Operation).

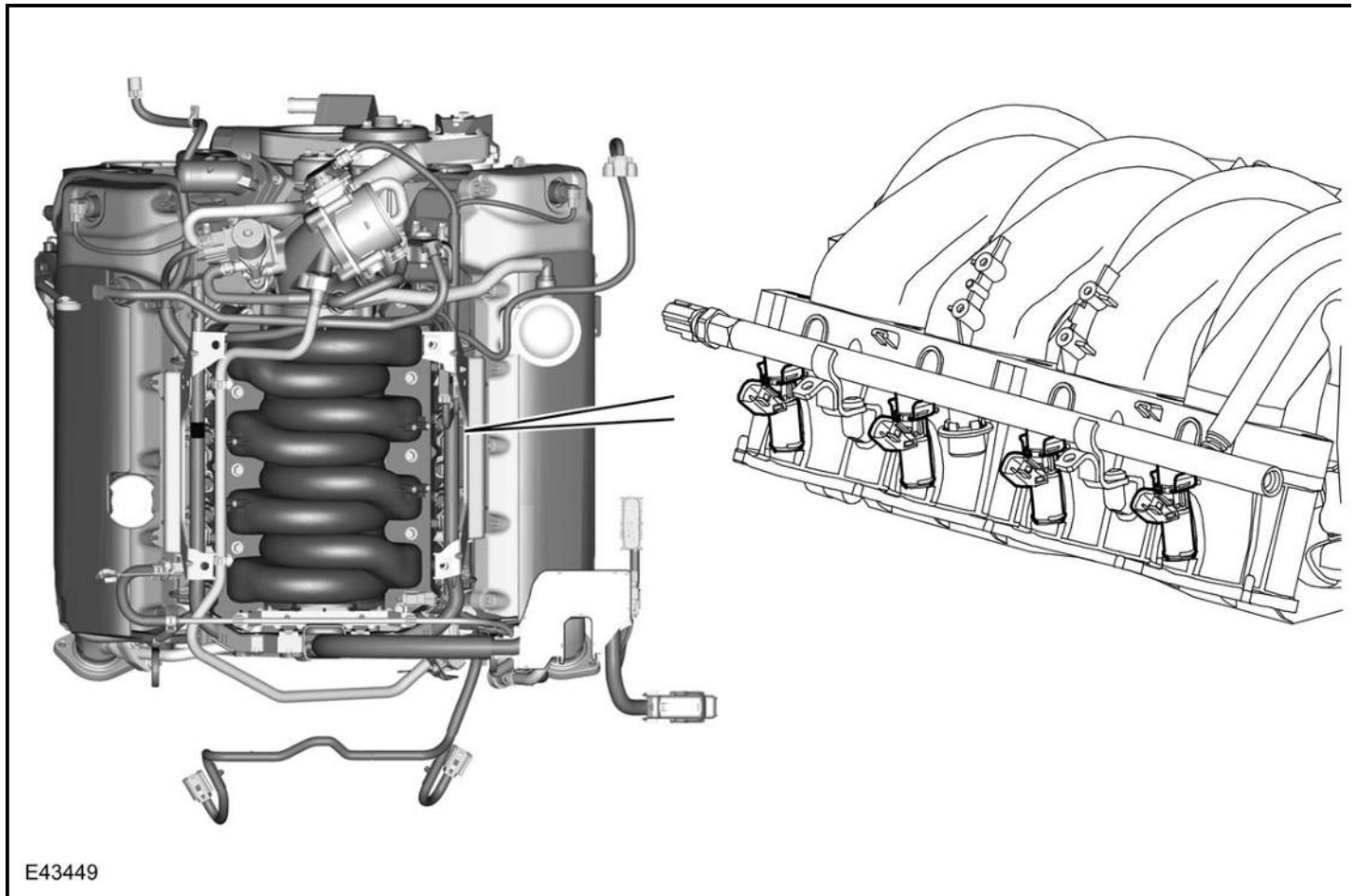
INLET AND EXHAUST VALVES

Each cylinder head incorporates dual overhead camshafts operating 4 valves per cylinder via solid shimless aluminum alloy valve lifters.

The lightweight valve gear provides good economy and noise levels. Valve head diameters are 31mm (1.220 in) for the exhaust and 35mm (1.378 in) for the intake. All valves have 5mm (0.197 in) diameter stems supported in sintered metal seats and guide inserts. Collets, valve collars and spring seats locate single valve springs on both intake and exhaust valves. Valve stem seals are integrated into the spring seats.

CAUTION: Due to slight variations in length, the valves are not interchangeable between marques (Land Rover, Jaguar and Aston Martin).

FUEL INJECTORS



Eight, top fed, 8-hole, fuel injectors are installed in the fuel rails. The injectors are electromagnetic solenoid valves controlled by the ECM. Two O-rings seal each injector to manifold interface. The fuel jets from the injectors are directed onto the back of the intake valves. For additional information, refer to: **ELECTRONIC ENGINE CONTROLS** (Description and Operation).

VARIABLE VALVE TIMING (VVT)

The continuously VVT unit turns the intake camshaft in relation to the primary chain to advance and retard the timing.

The system improves low and high-speed engine performance, engine idle quality and exhaust emission.

The VVT system changes the phasing of the intake valves, relative to the fixed timing of the exhaust valves, to alter:

- the mass of air flow into the engine's cylinders,
- and the engine's torque response and emissions.

The VVT unit uses a vane device to control the camshaft angle (refer to VVT operation). The system operates over a range of 48° and is advanced or retarded to the optimum angle within this range.

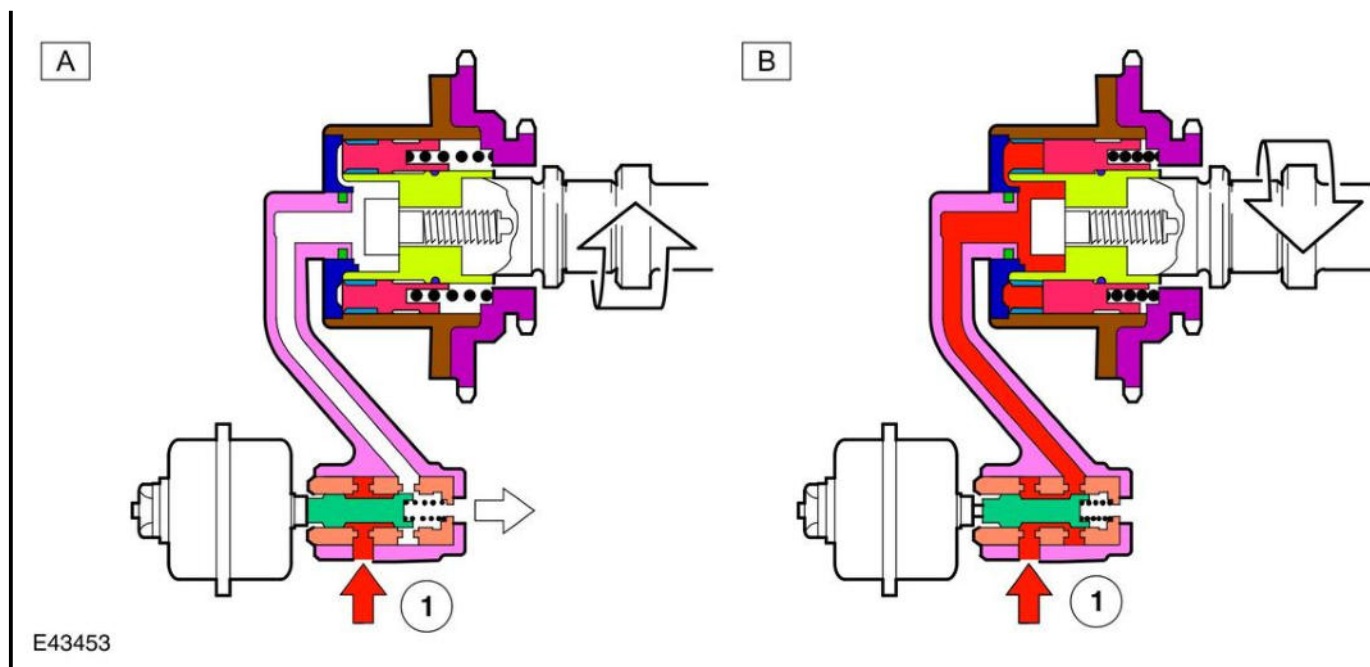
The ECM controls the VVT, using engine speed and load, and engine oil temperature signals to calculate the appropriate camshaft position. For additional information, refer to: Electronic Engine Controls (303-14B Electronic Engine Controls - 4.4L, Description and Operation).

The continuous VVT system provides the following advantages:

- Reduces engine emissions and fuel consumption by further optimizing the camshaft timing, this improves the engine's internal exhaust gas re-circulation (EGR) effect over a wider operating range
- Improves full-load torque characteristics as the camshaft timing is optimized at all engine speeds for superior volumetric efficiency
- Improves fuel economy by optimizing torque over the engine's speed range.

This system also has the added benefits of operating at a lower oil-pressure and faster response time when compared to a non-VVT system.

VARIABLE VALVE TIMING OPERATION



Item	Description
A	Retarded
B	Advanced
1	Engine oil pressure

The VVT unit is a hydraulic actuator mounted on the end of the intake camshaft, which advances or retards the intake camshaft timing and thereby alters the camshaft to crankshaft phasing. The oil control solenoid, controlled by the ECM, routes oil pressure to either the advance or retard chambers located either side of the 3 vanes interspersed within the machined housing of the unit.

The VVT unit is driven by the primary chain and rotates relative to the exhaust camshaft sprocket. When the ECM requests the camshaft timing to advance, the oil control solenoid is energized moving the shuttle valve to the relevant position to allow engine oil pressure, via a filter, into the VVT unit's advance chambers. When the camshaft timing is requested to retard, the shuttle valve moves position to allow oil pressure to exit the advance chambers, while simultaneously routing the oil pressure into the retard chambers.

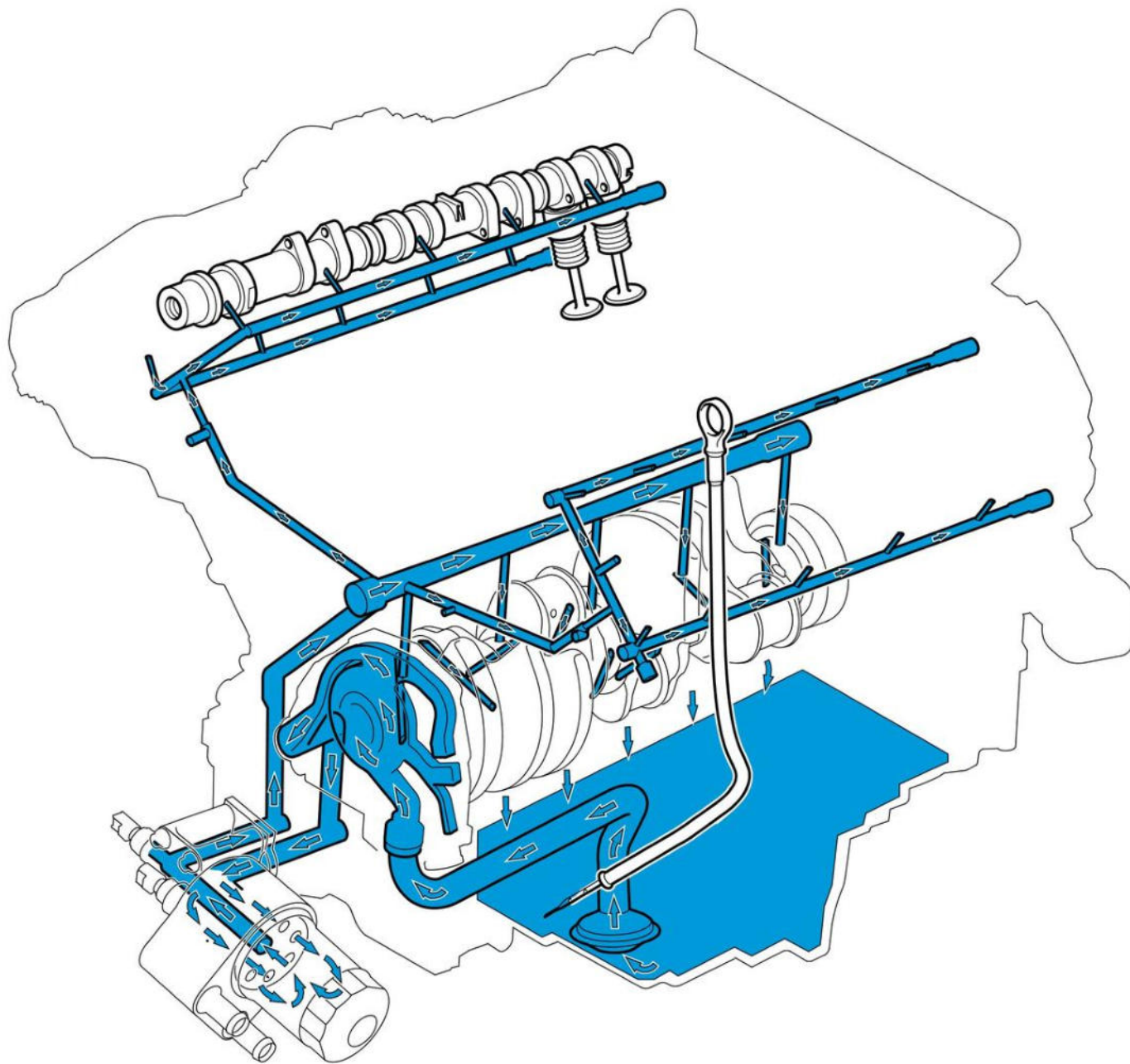
When directed by the ECM, the VVT unit will be set to the optimum position between full advance and retard for a particular engine speed and load. This is achieved when the ECM sends the energizing signal to the oil control solenoid until the target position is met. At this point, the energizing signal is reduced to hold the solenoid position, and as a result the position of the shuttle valve. This function is under closed-loop control, where the ECM will assess any decrease in shuttle-valve oil-pressure, via signals from the camshaft position sensor. The ECM will increase the energizing signal, when required, to maintain the shuttle-valve hold position.

Engine oil properties and temperature can affect the ability of the VVT mechanism to follow demand changes to the cam phase angle. At very low oil-temperatures, movement of the VVT mechanism is sluggish due to increased viscosity, and at high oil-temperatures the reduced viscosity may impair operation if the oil pressure is too low. To maintain satisfactory VVT performance, an increased capacity oil pump is installed, plus an

engine oil temperature sensor to enable monitoring by the ECM. The VVT system is normally under closed-loop control except in extreme temperature conditions, such as cold starts below 0°C. At extremely high oil-temperatures, the ECM may limit the amount of VVT advance to prevent the engine from stalling when returning to idle speed.

The VVT does not operate when engine oil-pressure is below 1.25 bar, as there is insufficient pressure to release the VVT unit's internal stopper pin. This usually occurs when the engine is shutting-down and the VVT has returned to the retarded position. The stopper pin locks the camshaft to the VVT unit to ensure camshaft stability during the next engine start-up.

LUBRICATION SYSTEM



E43454

GENERAL

Oil is drawn from the reservoir in the oil pan and pressurized by the oil pump. The output from the oil pump is then filtered, cooled and distributed through internal oil passages.

All moving parts are lubricated by pressure or splash oil. Pressurized oil is also provided for operation of the

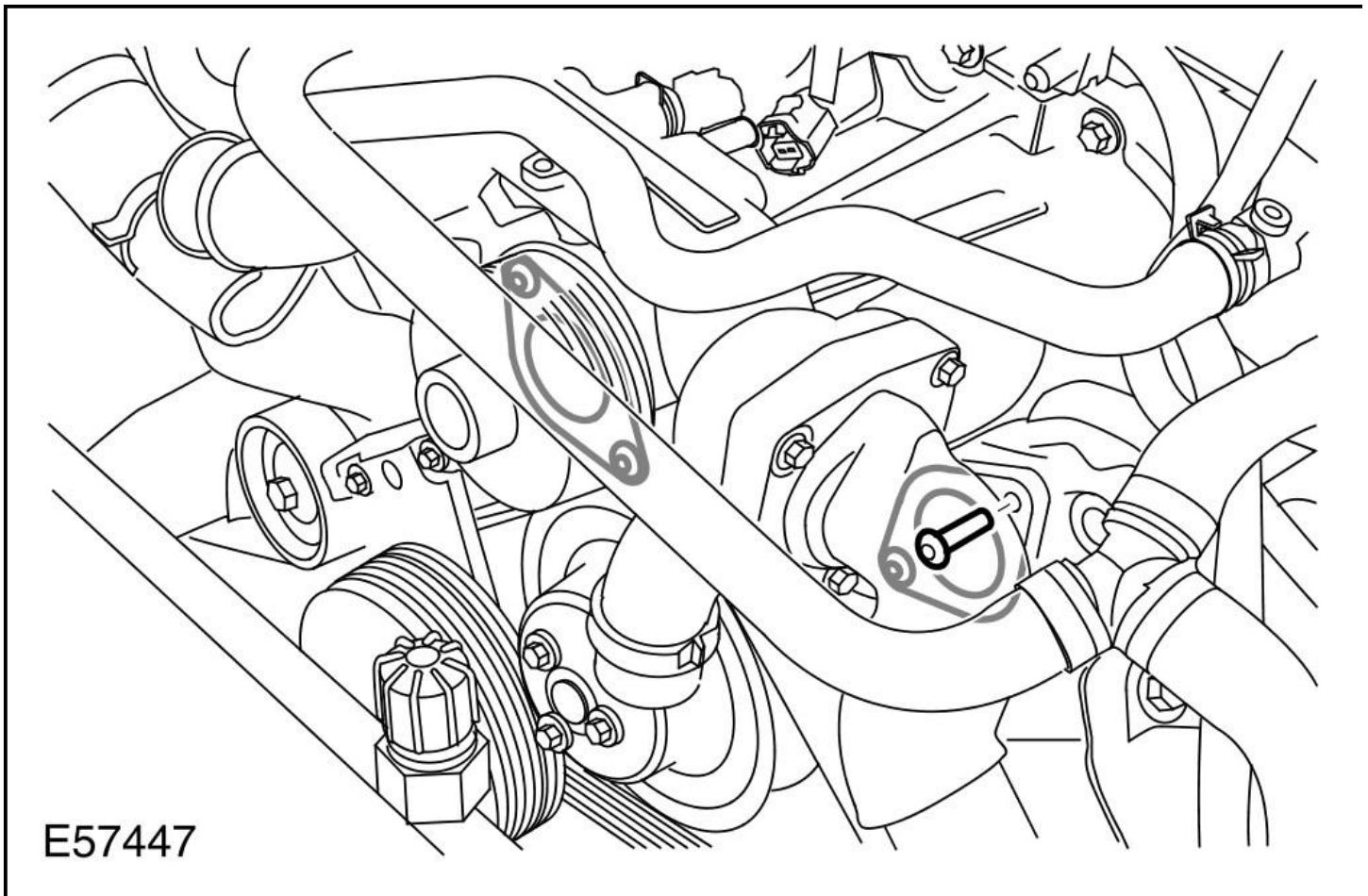
variable valve timing units and the timing gear chain tensioners.

The oil returns to the oil pan under gravity. Large drain holes through the cylinder heads and cylinder block ensure the quick return of the oil, reducing the volume of oil required and enabling an accurate check of the contents soon after the engine stops.

System replenishment is through the oil filler cap on the LH camshaft cover.

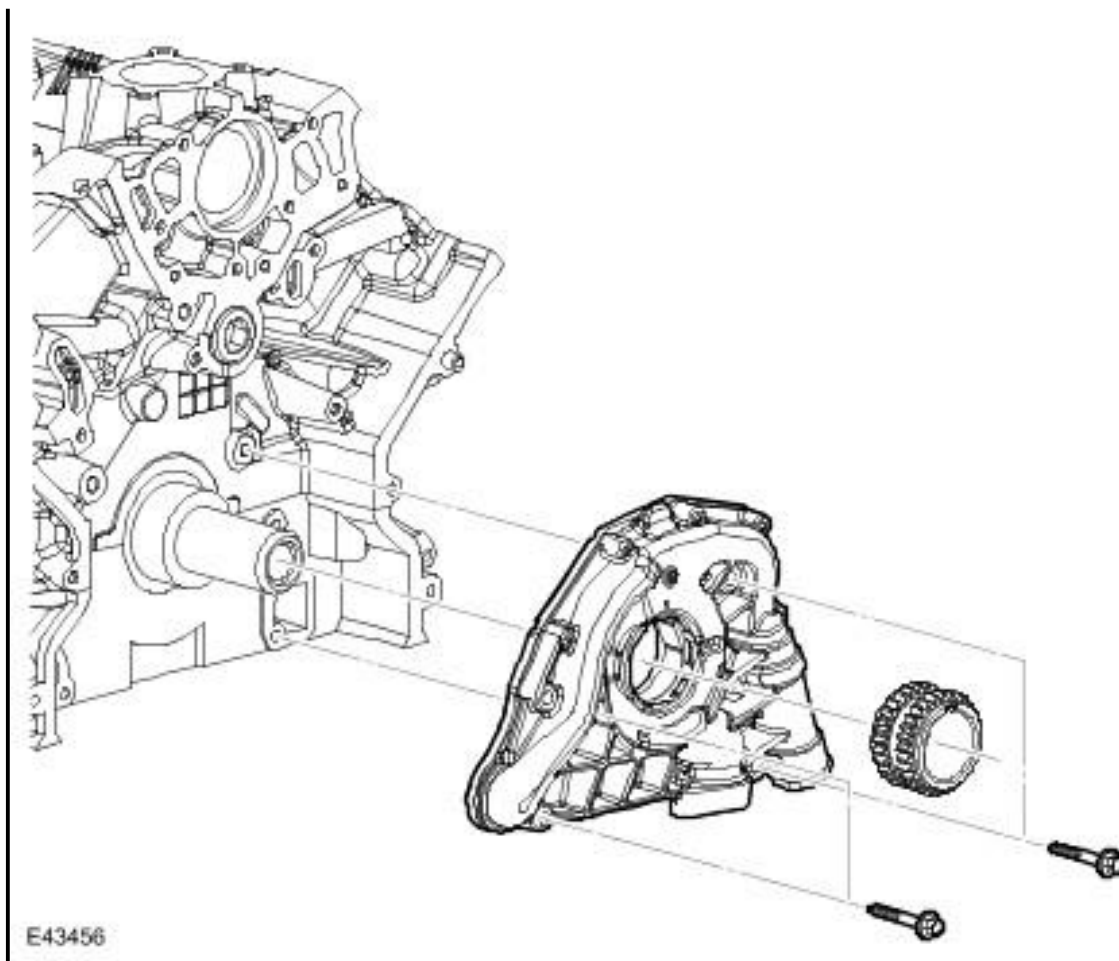
With the exception of the pump, all oil system components are installed on the structural sump.

OIL PICK-UP



The fabricated steel oil pick-up is immersed in the oil reservoir to provide a supply to the oil pump during all normal vehicle attitudes. A mesh screen in the inlet prevents debris from entering the oil system.

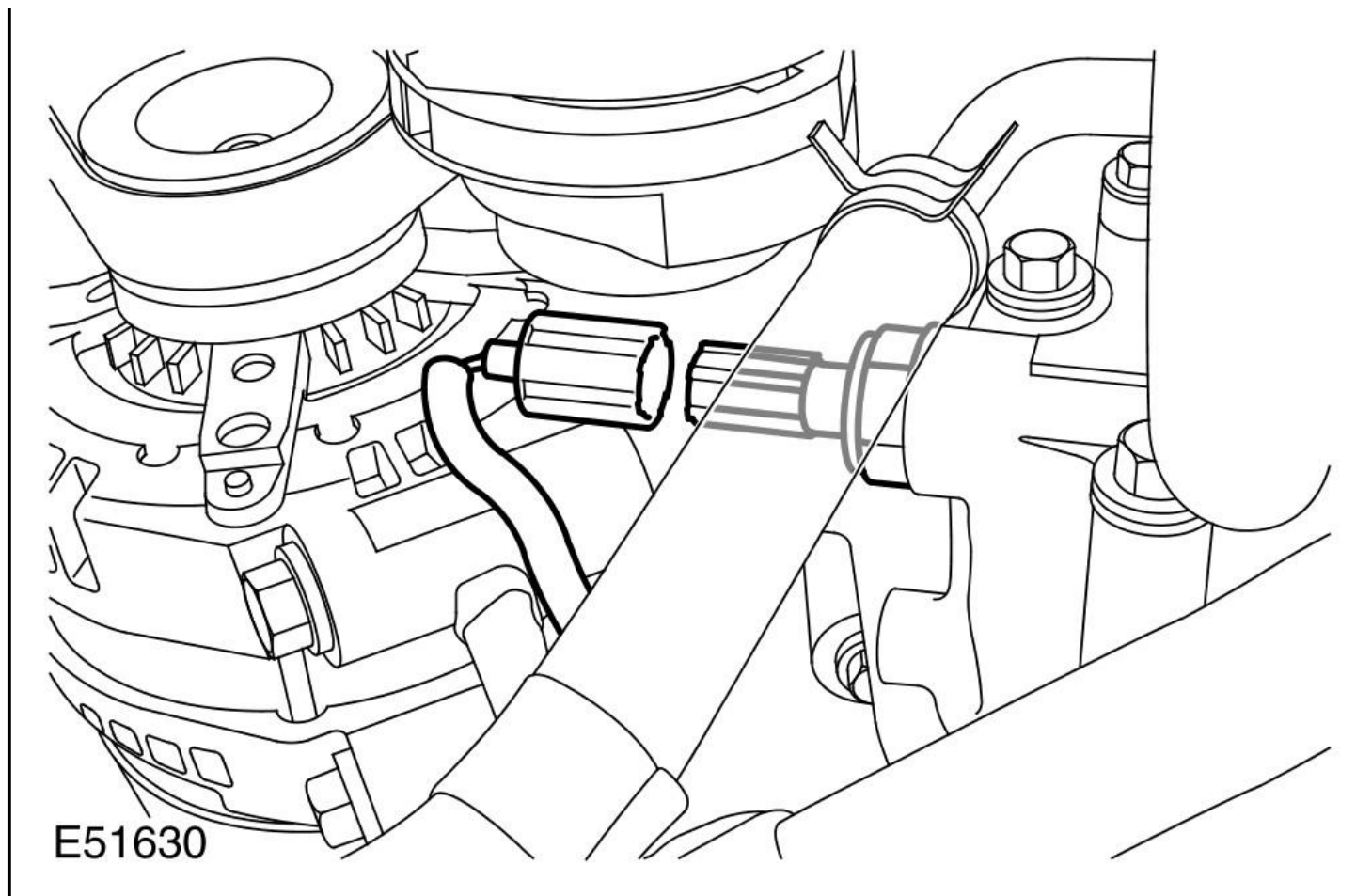
OIL PUMP



The oil pump is installed on the crankshaft at the front of the engine. The pump inlet and outlet ports align with oil passages in the bedplate.

The pumping element is an eccentric rotor, which is directly driven by flats on the crankshaft. An integral pressure relief valve regulates pump outlet pressure at 4.5 bar (65.25 psi).

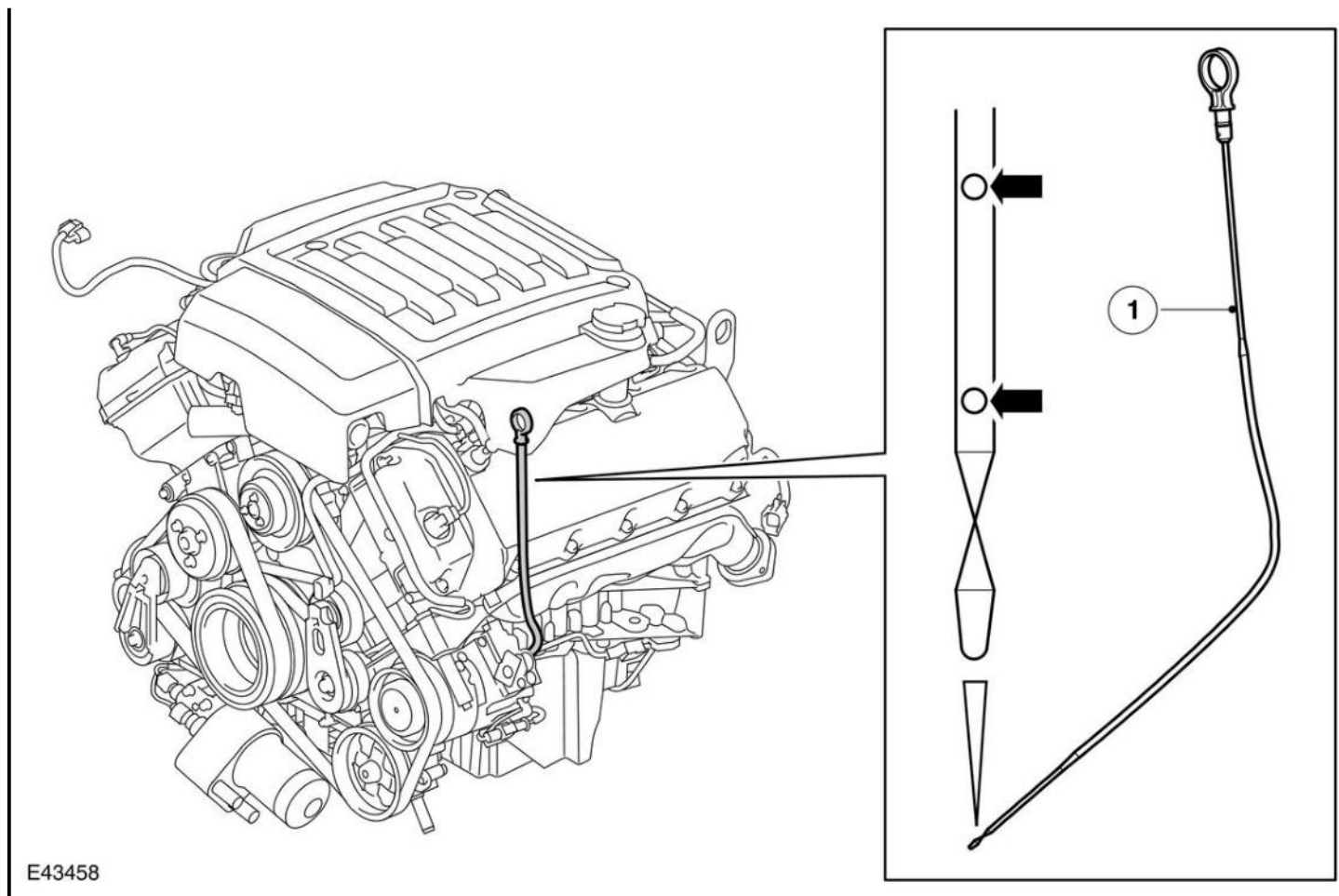
OIL FILTER AND OIL PRESSURE SWITCH



The oil filter is a replaceable cartridge installed on an adapter. An internal bypass facility permits full flow bypass if the filter is blocked.

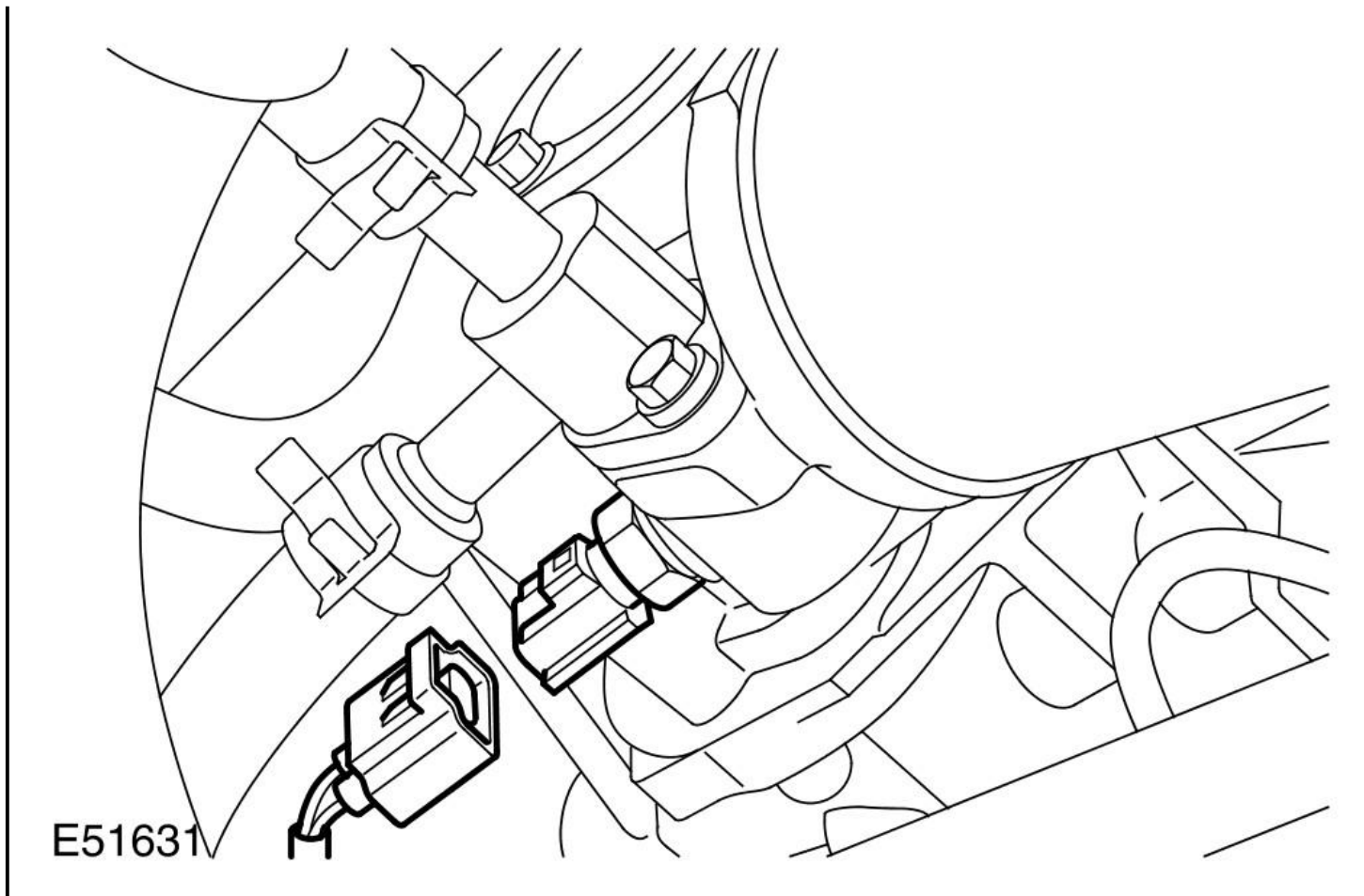
The oil pressure switch connects a ground input to the instrument cluster when oil pressure is present. The switch operates at a pressure of 0.15 to 0.41 bar (2.2 to 5.9 psi).

OIL LEVEL GAUGE



The oil level gauge locates along the left side of the oil pan, supported in a tube installed in the sump. Two holes in the end of the gauge indicate the minimum and maximum oil levels. There is a difference of approximately 1.5 liters (1.58 US quart) between the 2 levels.

EXHAUST MANIFOLD



The fabricated stainless steel twin skin exhaust manifolds are unique for each bank of cylinders. The LH manifold has a connection for the EGR transfer pipe.

Spacers on the securing bolts allow the manifolds to expand and retract with changes of temperature while maintaining the clamping loads.

Heat shields are integrated into the exhaust manifold gaskets.

GENERAL PROCEDURES

ENGINE OIL DRAINING AND FILLING

1. Disconnect the battery ground cable. Refer to [Specifications](#) .

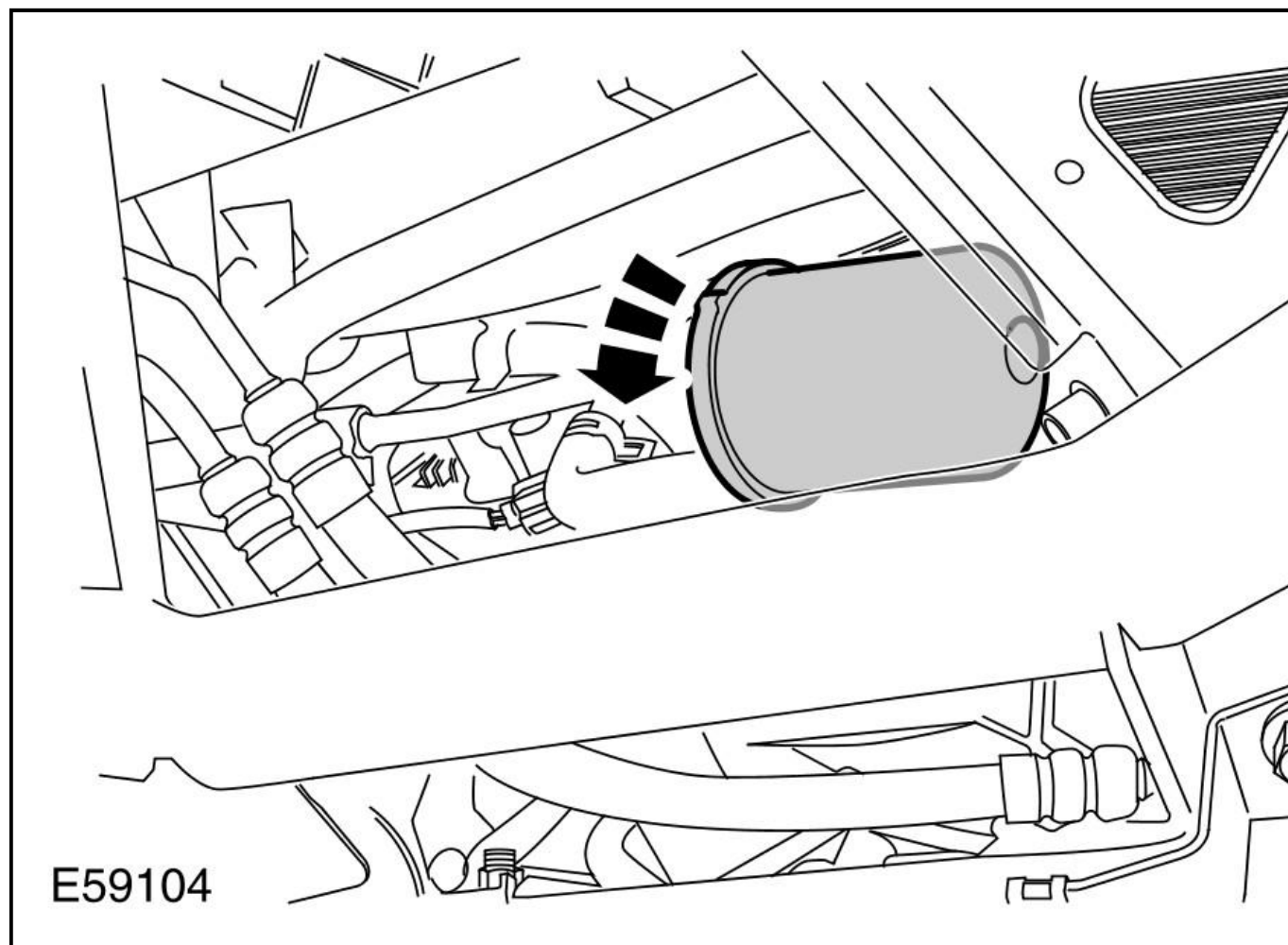
WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the engine undershield. Refer to [Engine Undershield](#) .

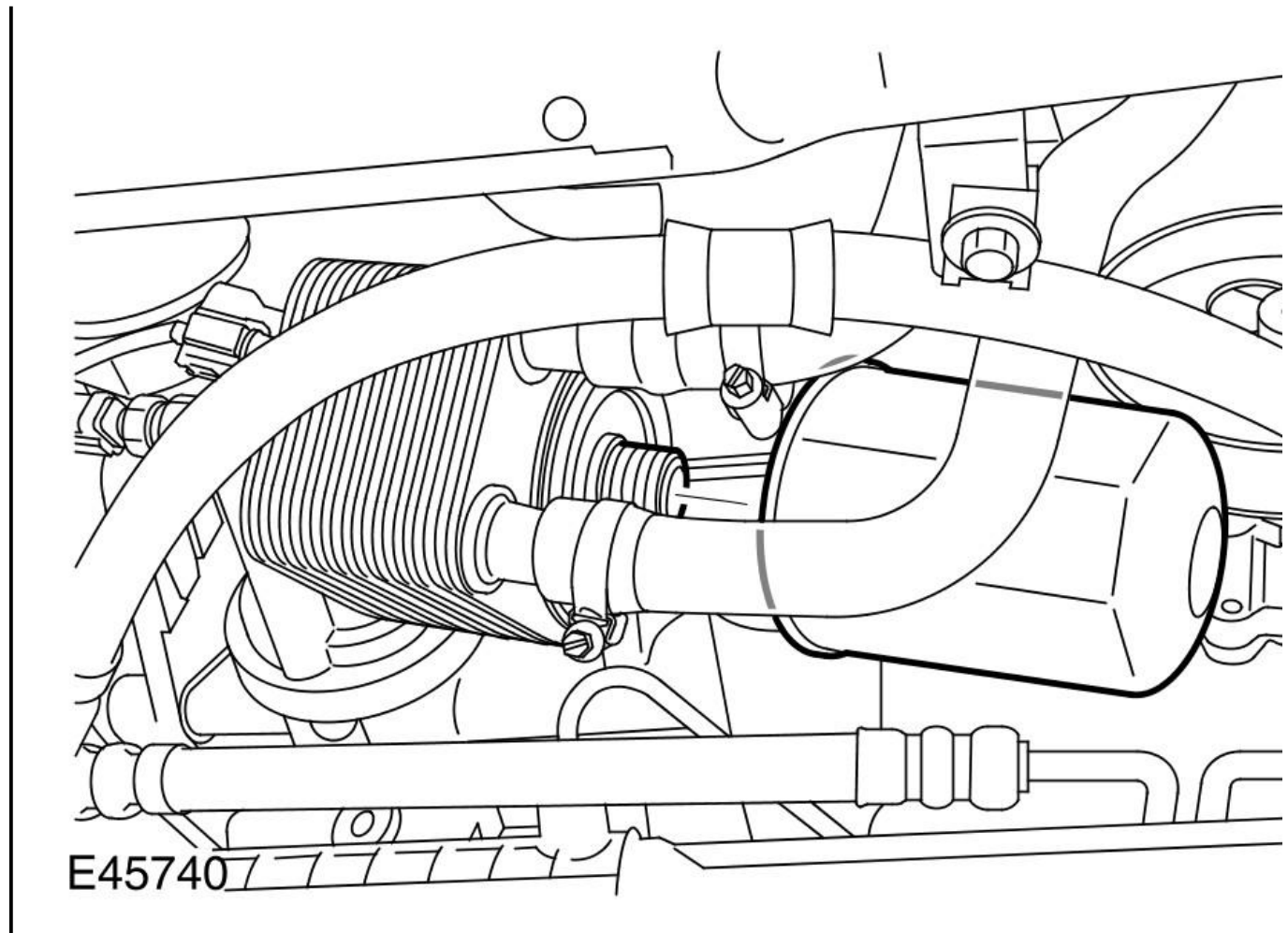
4. Remove the radiator splash shield. Refer to **Radiator Splash Shield** .

WARNING: Observe due care when draining engine oil as the oil can be very hot.

5. Remove the oil pan drain plug.
- Position a container to collect the fluid.
 - Discard the oil pan drain plug seal.



6. Remove the engine oil filter.
- Position a container to collect the fluid.
 - Discard the oil filter.



7. Install the engine oil filter.
 - Lubricate the oil filter seal with clean engine oil and tighten to 18 Nm (13 lb.ft).
8. Tighten the drain plug to 25 Nm (18 lb.ft).
 - Install a new seal.
9. Install the radiator splash shield. Refer to **Radiator Splash Shield** .
10. Install the engine undershield. Refer to **Engine Undershield** .
11. Fill the engine with oil.
12. Connect the battery ground cable. Refer to **Specifications** .
13. Check and top-up the engine oil.

VALVE CLEARANCE CHECK

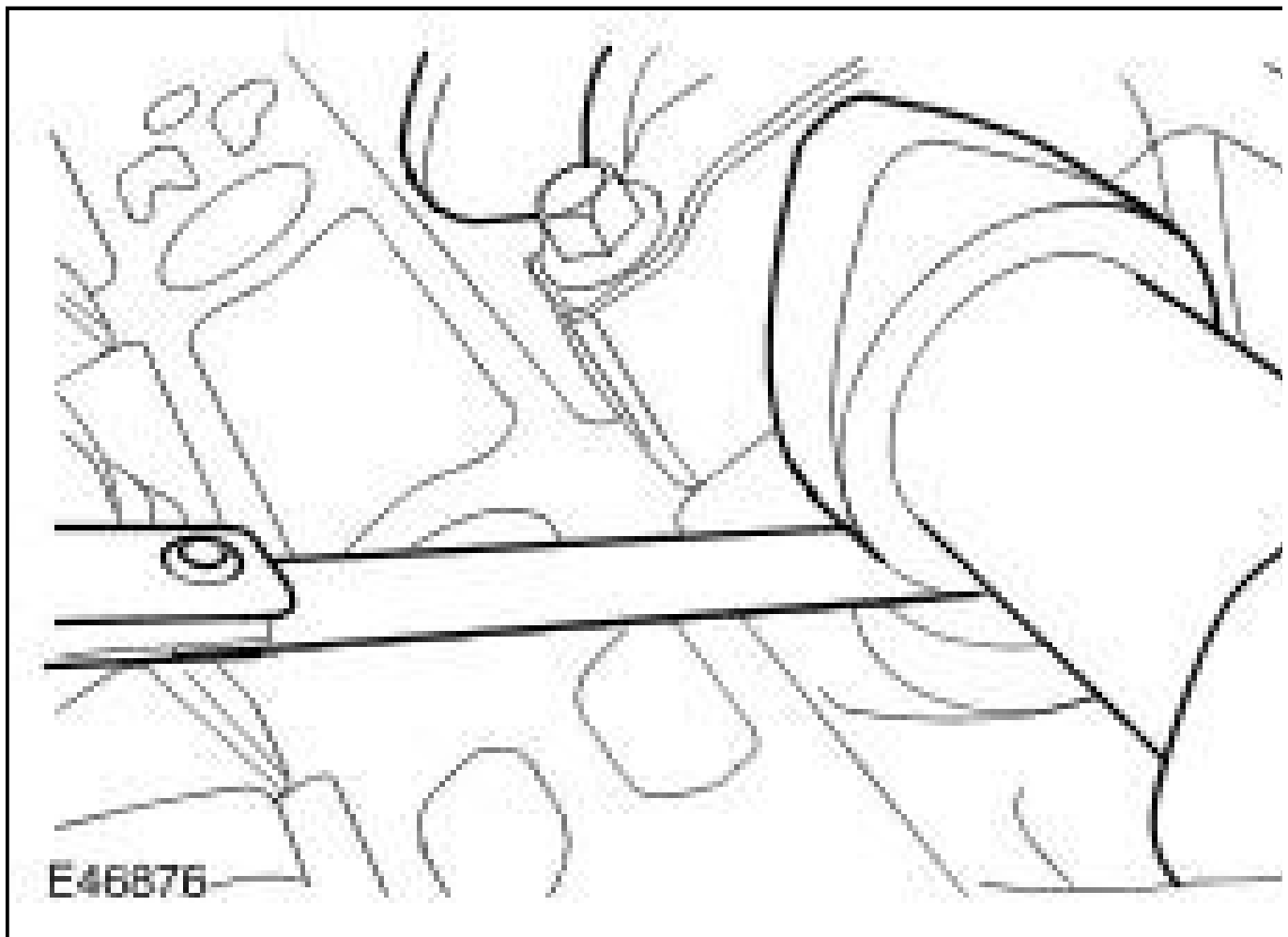
1. Disconnect the battery ground cable. Refer to **Specifications** .

WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the cooling fan. Refer to Cooling Fan.
4. Remove the LH valve cover. See Valve Cover LH.
5. Remove the RH valve cover. See Valve Cover RH.

CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

6. Rotate the engine clockwise to position the camshaft lobe away from the valve tappet
7. Using the feeler gauge set, measure the clearance between the camshaft and the valve tappet.



8. Repeat the above procedure for the remaining 31 tappets.
9. Adjust the clearance as necessary.
10. For cylinder head data, refer to specifications. See Specifications.
11. Install the RH valve cover. See Valve Cover RH.
12. Install the LH valve cover. See Valve Cover LH.

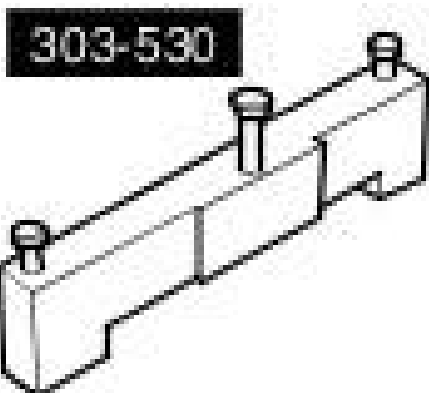
13. Install the cooling fan. Refer to **Cooling Fan** .
14. Connect the battery ground cable. Refer to **Specifications** .

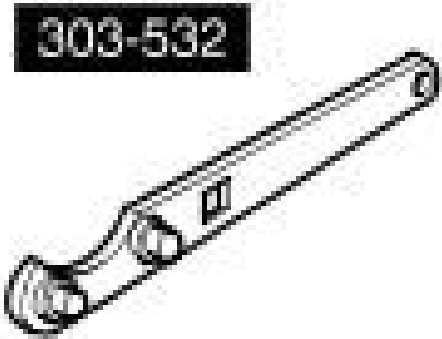
VALVE CLEARANCE ADJUSTMENT

NOTE: The process to adjust the valve clearances is shown in the camshaft install procedure.

1. Install the LH bank camshafts. See **Camshaft LH**.

IN-VEHICLE REPAIR**CAMSHAFT LH****SPECIAL TOOLS**

Tool Illustration	Tool Name	Tool Number
 303-645 E46881	Timing Setting tool	303-645
 303-530 E46879	Camshaft setting/locking tool	303-530
	Timing chain tensioning tool	303-532

 303-532 E46880		
 303-530/04 E115082	Timing shim tool	303-530/04

REMOVAL

1. Disconnect the battery ground cable. Refer to **Specifications** .

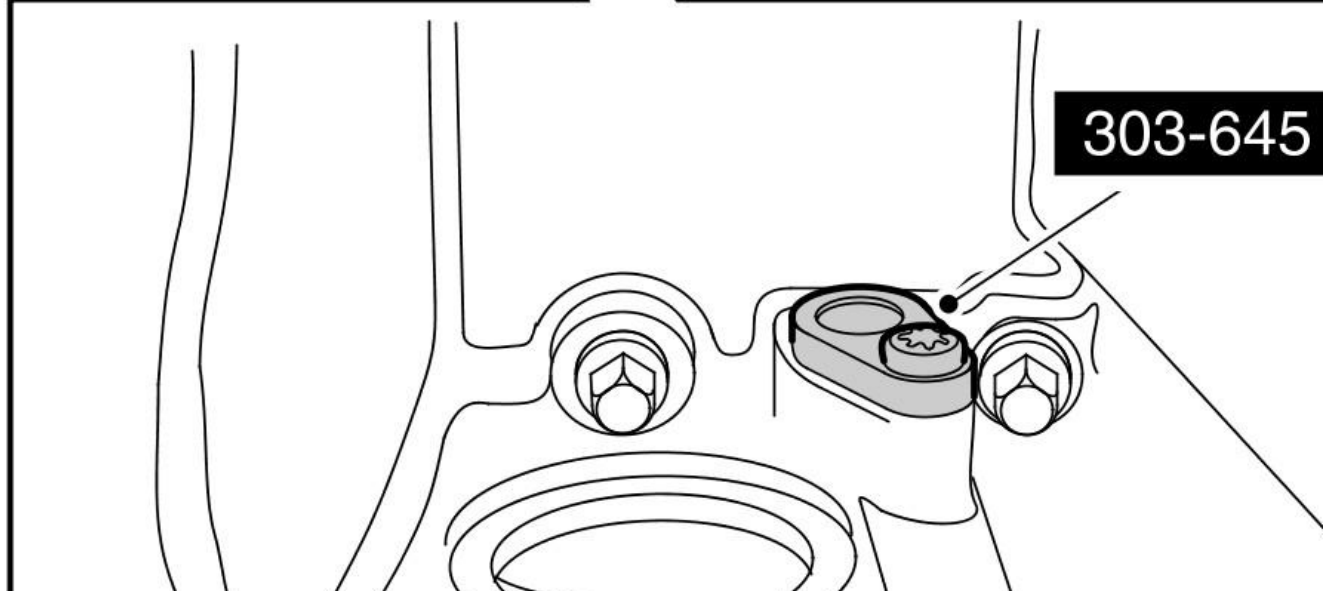
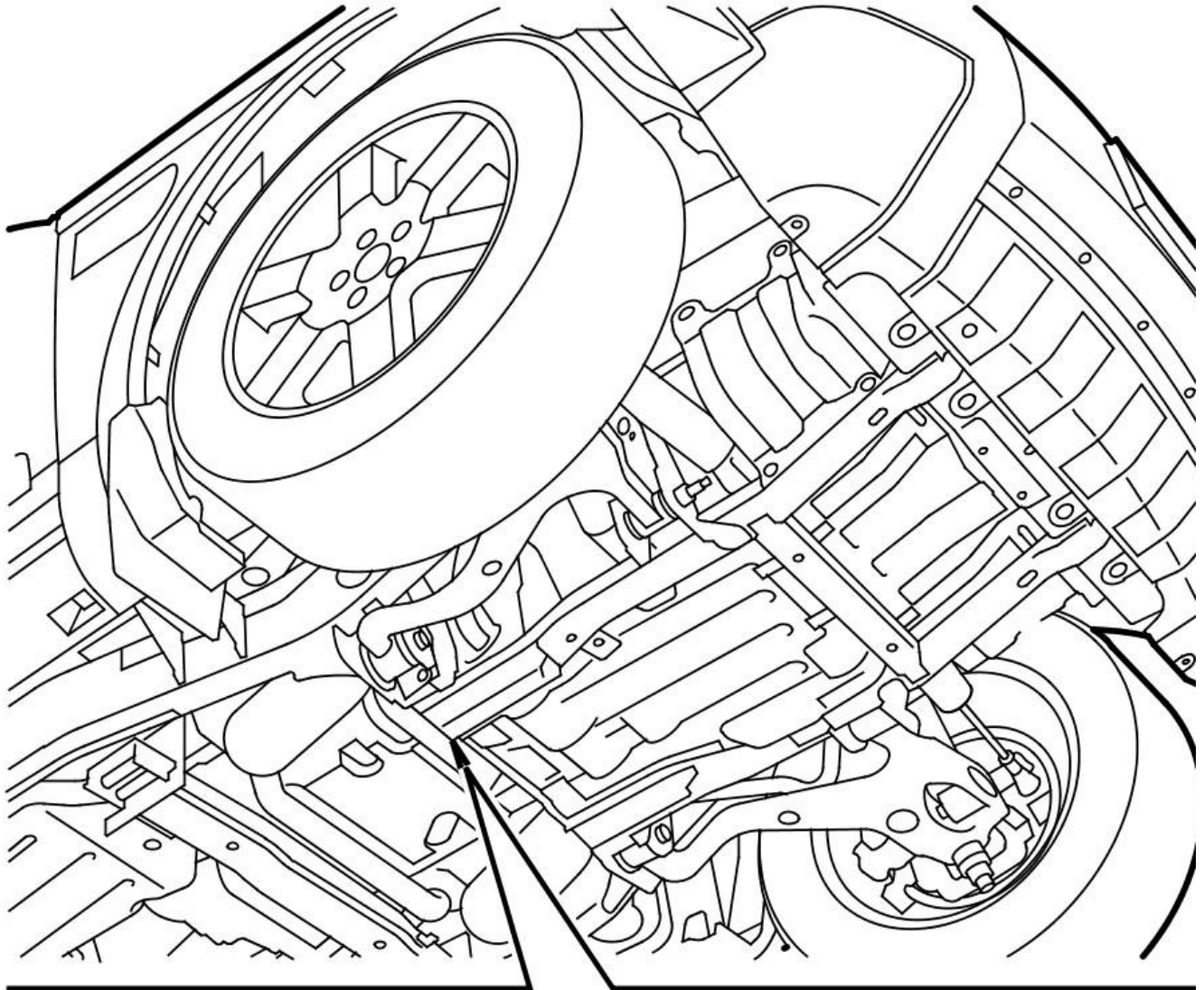
WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the engine front cover. See **Engine Front Cover**.
4. Remove the crankshaft position (CKP) sensor. Refer to **Crankshaft Position (CKP) Sensor** .
5. Rotate the crankshaft until the flats on the camshafts are parallel with the cylinder head joint faces.

NOTE: The engine is now in the **SAFE** position.

6. Lock the crankshaft.
 - Install the special tool.

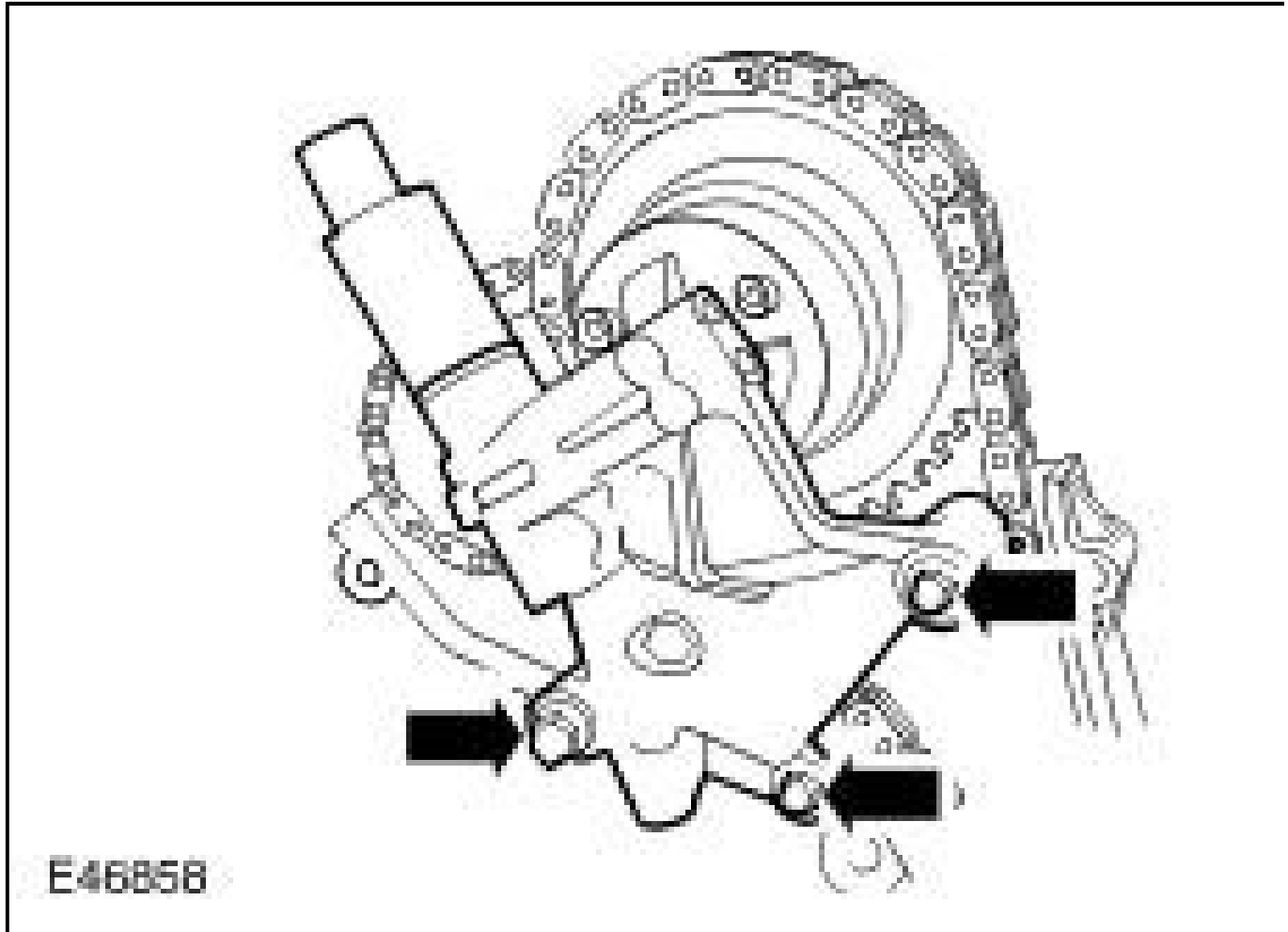
- Install the screw.



303-645

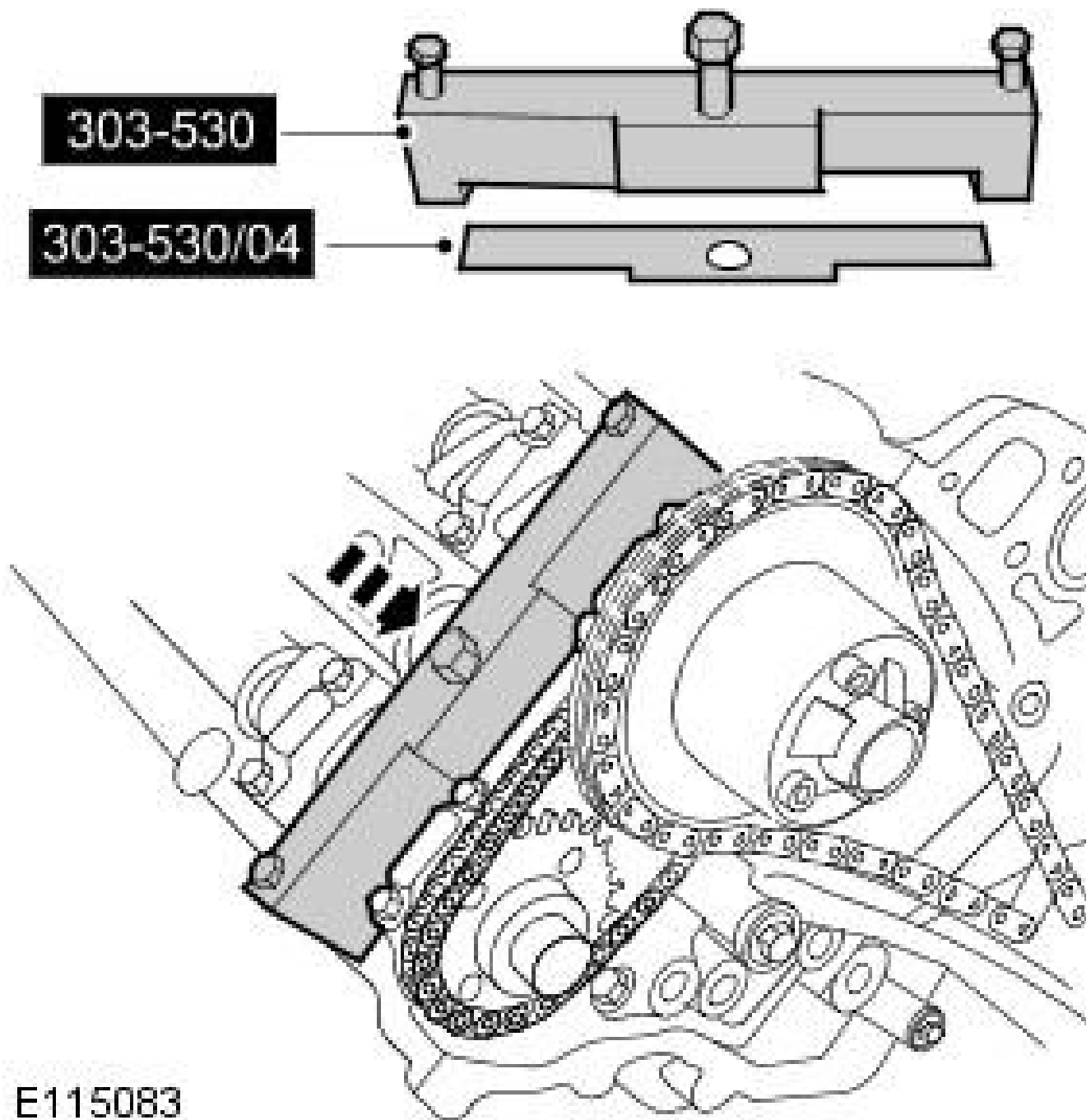
7. Remove the RH variable camshaft timing (VCT) control unit.

- Remove the 3 bolts.
- Remove and discard the O-ring seals.

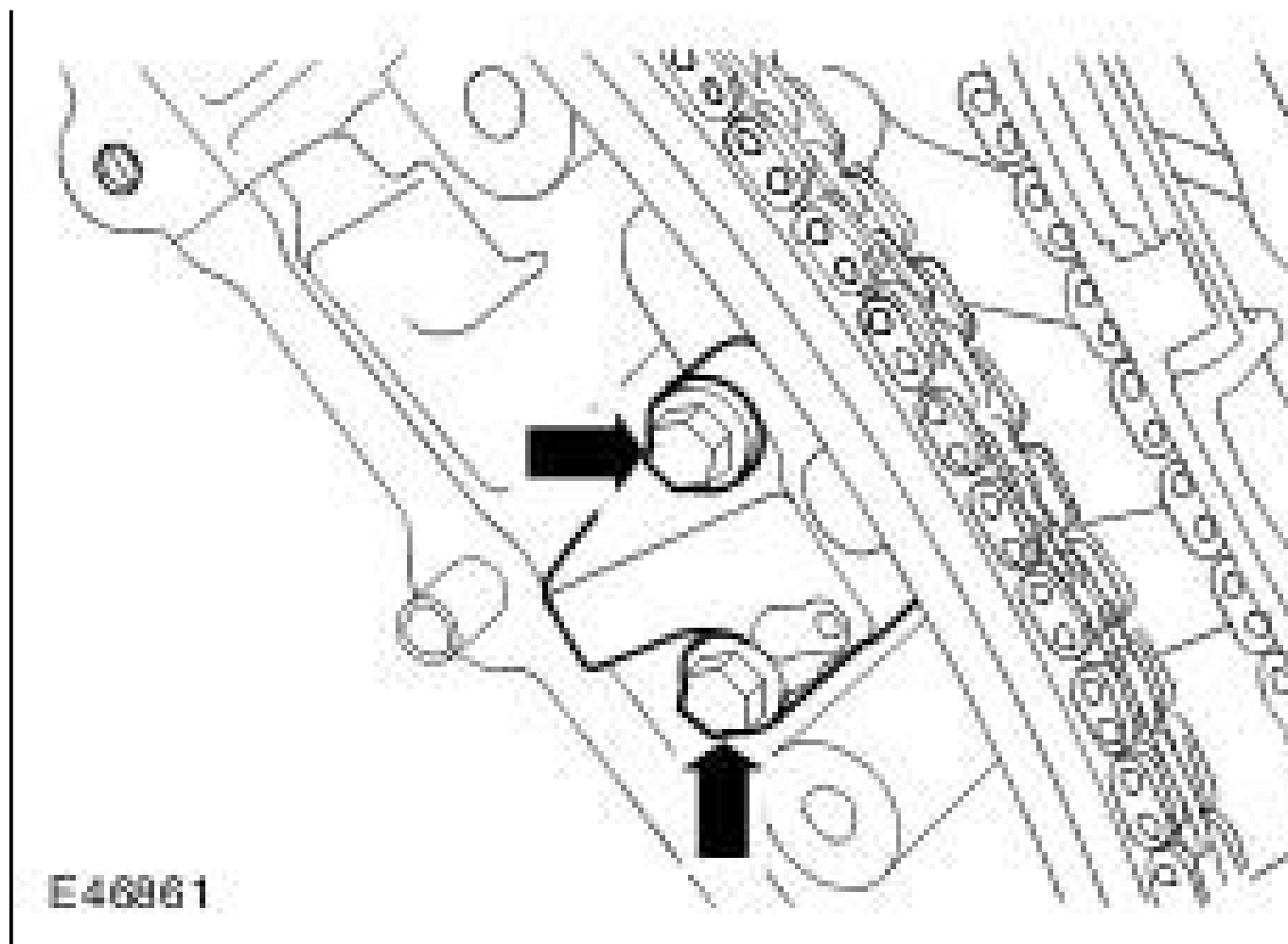


8. Install the special tool to the RH cylinder head.

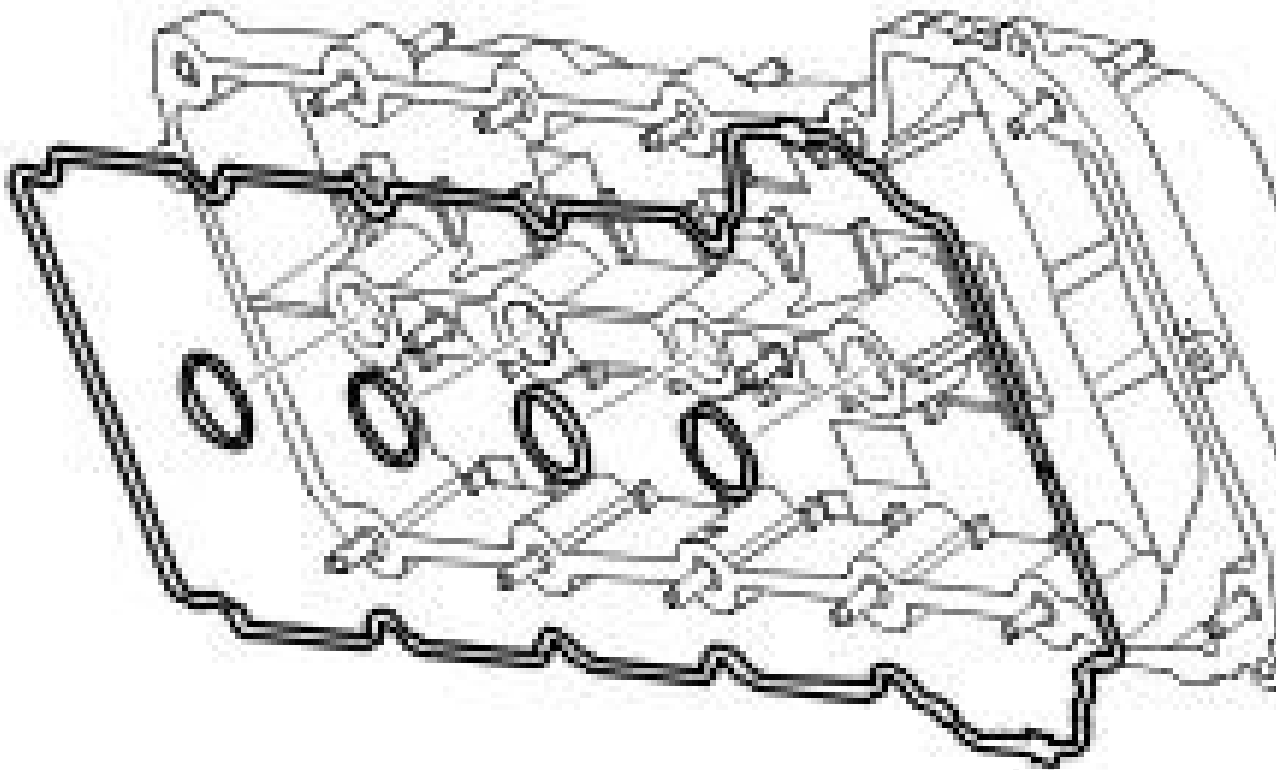
- Install the 3 bolts.



9. Remove the RH primary timing chain tensioner assembly.
 - Remove the 2 bolts.

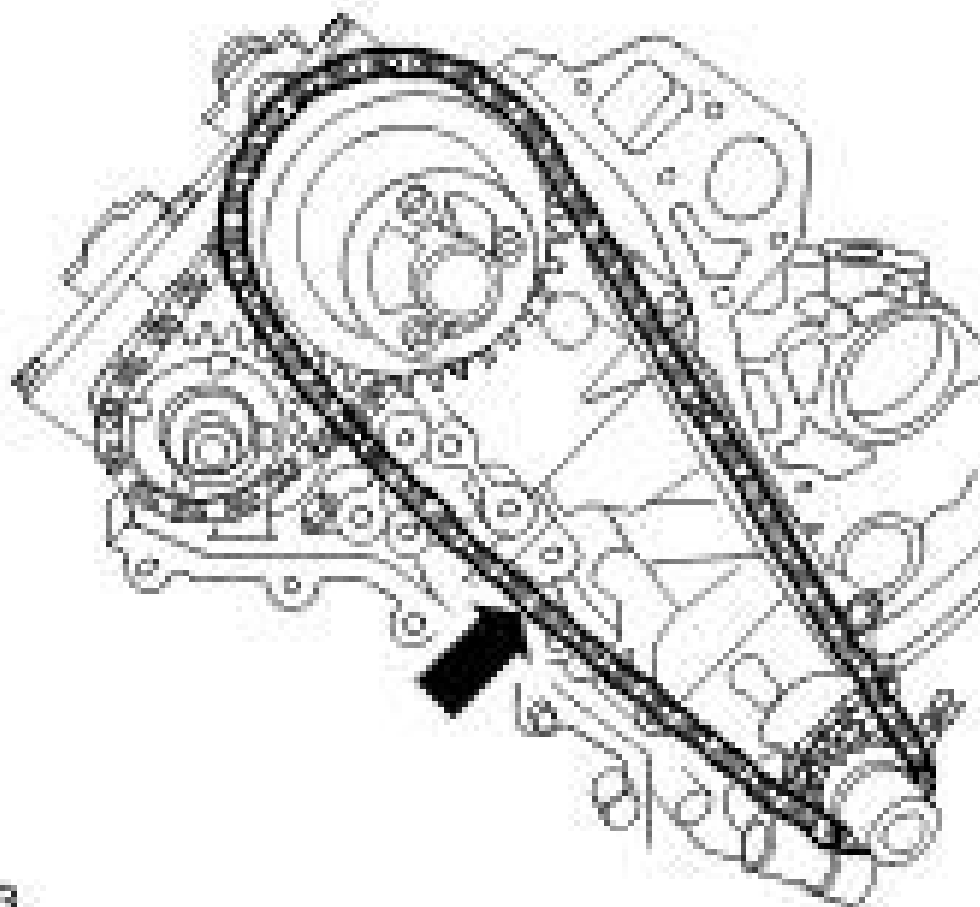


10. Remove the RH primary timing chain tensioner guide.
 - Remove the bolt.



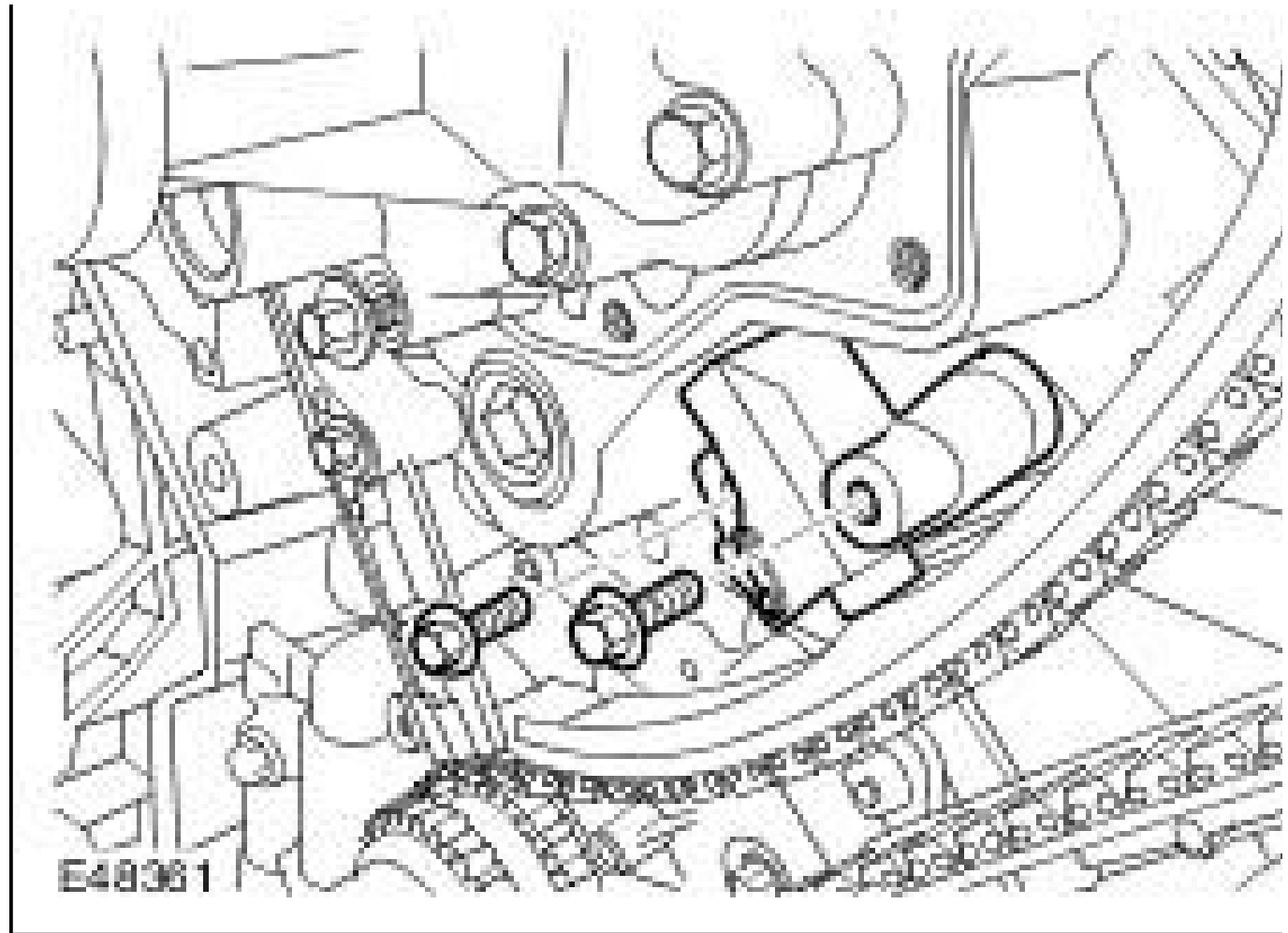
E46652

11. Remove the RH primary timing chain.

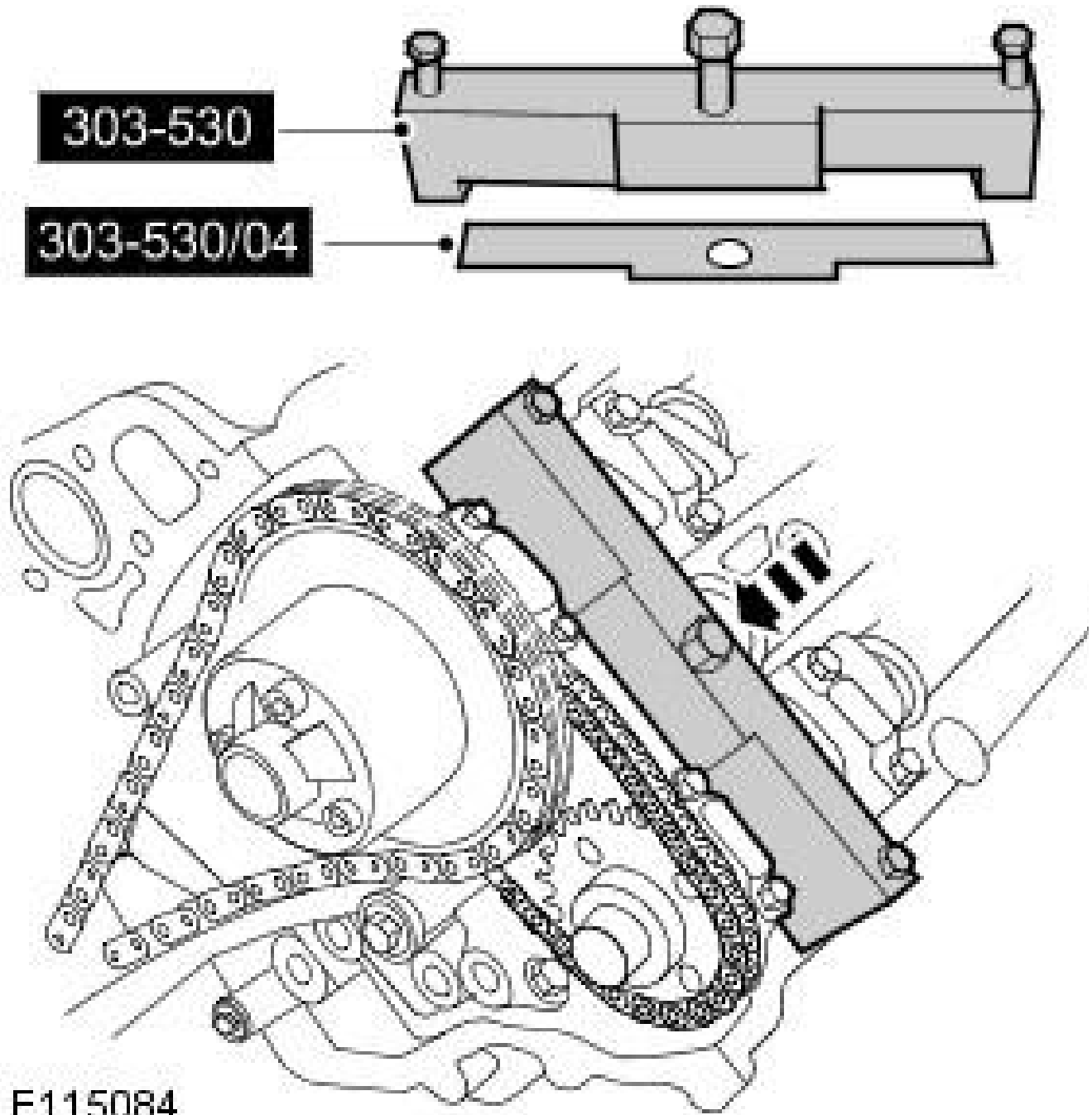


E46863

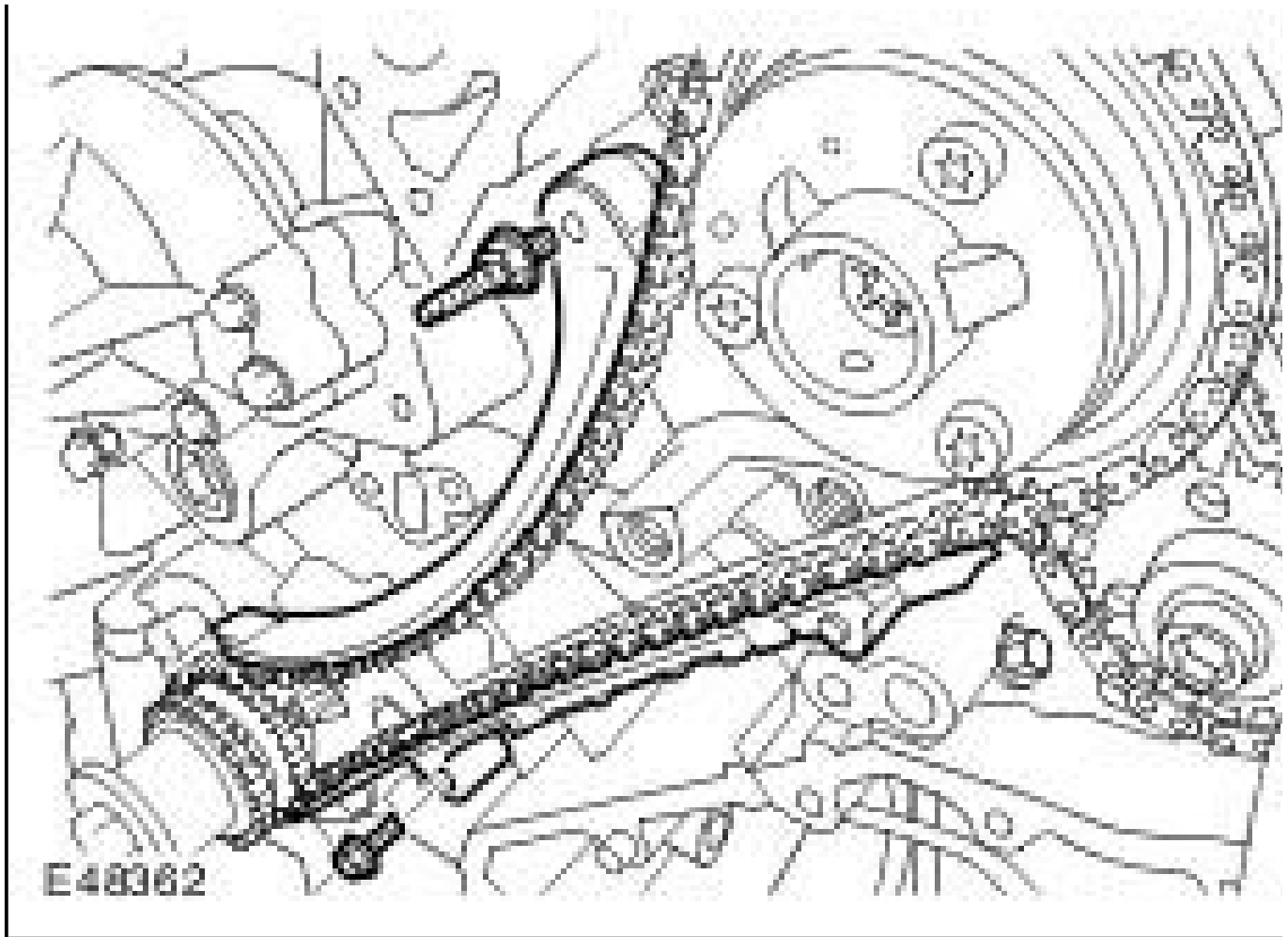
12. Remove the special tools from the RH cylinder head.
 - Remove the 3 bolts.
13. Remove the LH variable camshaft timing (VCT) control unit.
 - Remove the 2 bolts.
 - Remove the nut.
 - Remove and discard the O-ring seals.



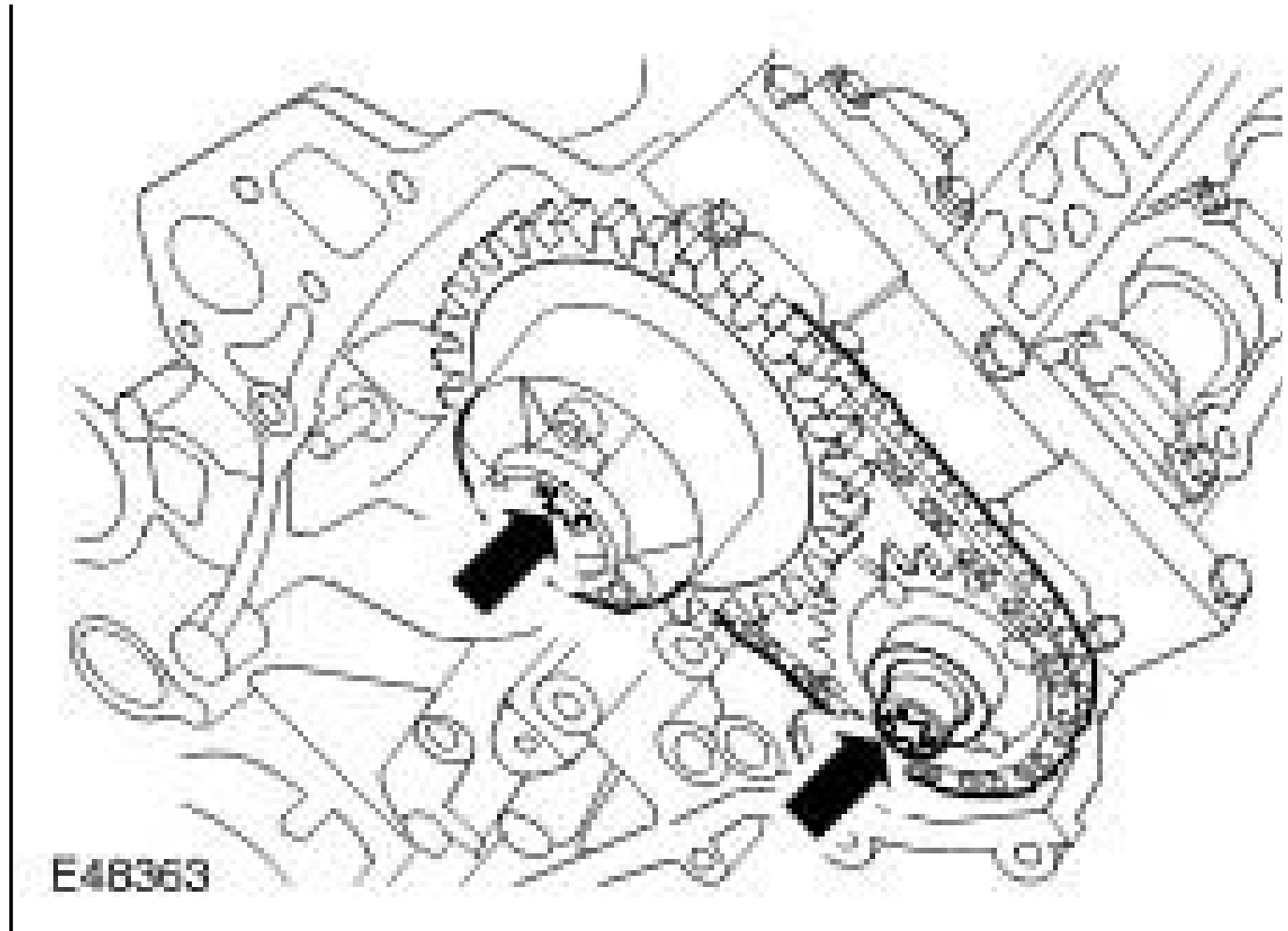
14. Install the special tool to the LH cylinder head.
 - Install the 3 bolts.



15. Remove the LH primary timing chain tensioner.
 - Remove the 2 bolts.



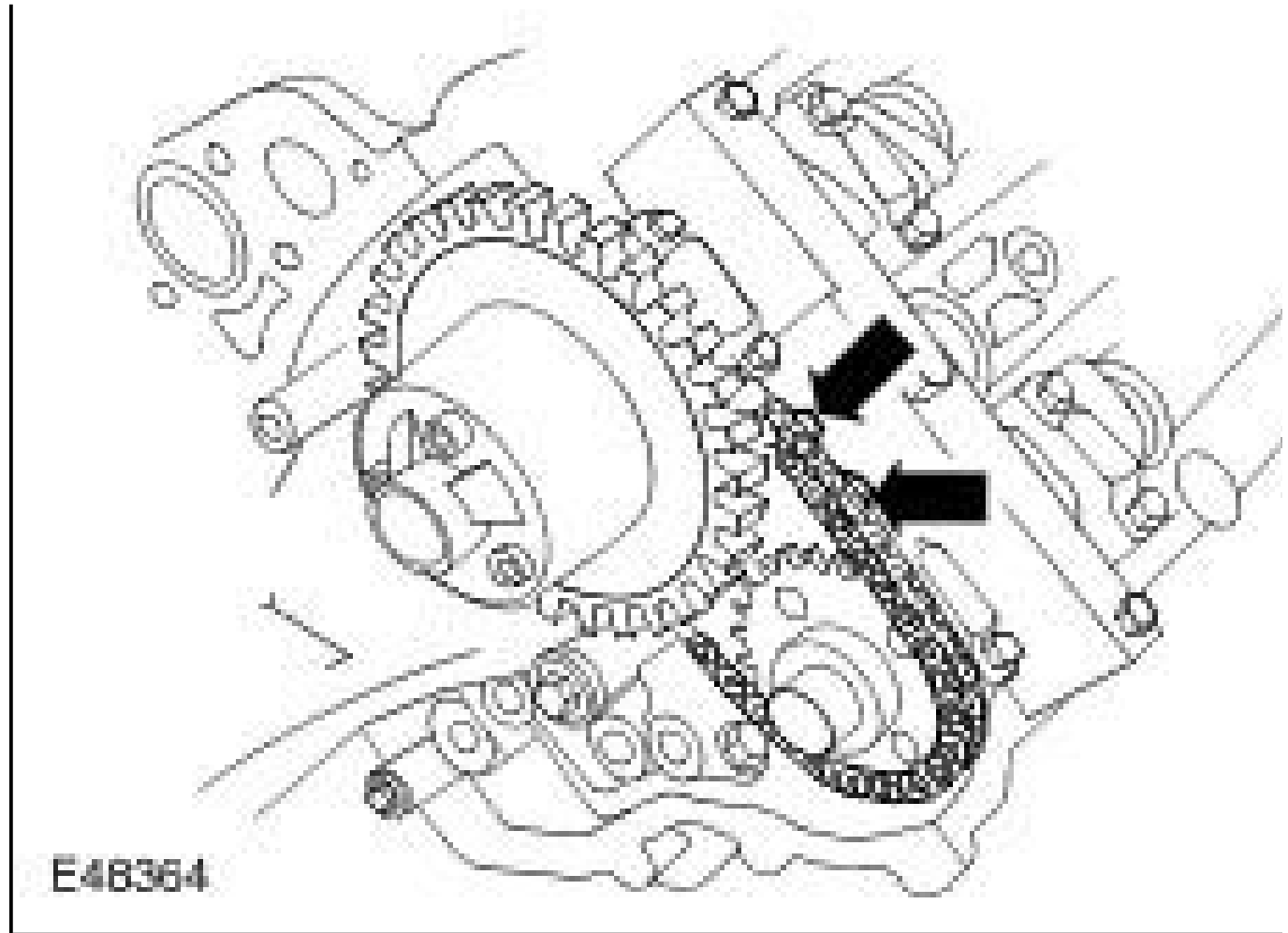
16. Remove the LH upper and lower primary timing chain tensioner guides.
- Remove the stud.
 - Remove the bolt.



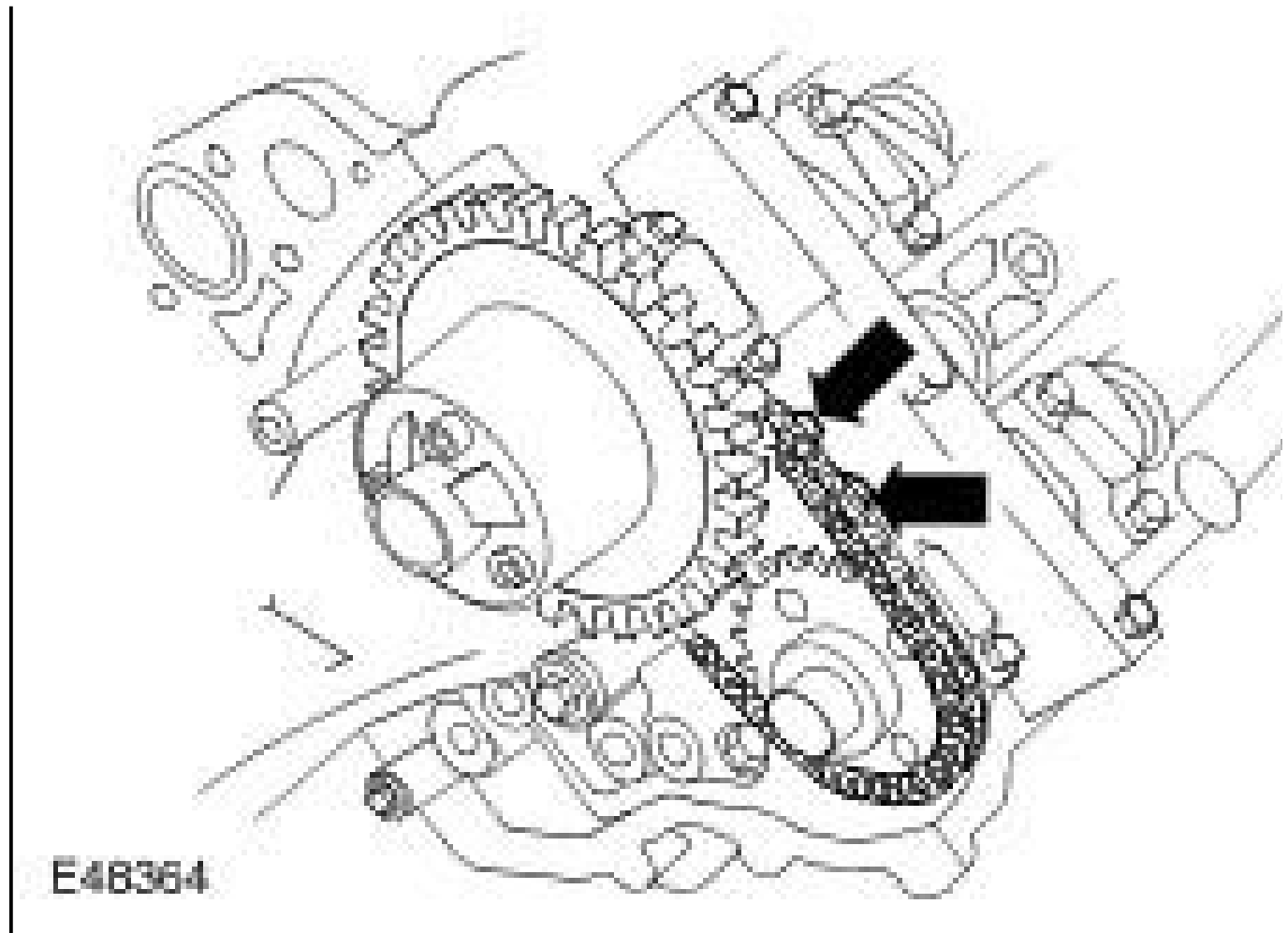
17. Remove the LH primary timing chain.

CAUTION: Discard the bolts.

18. Remove the LH camshaft sprockets.
- Remove the 2 bolts.



19. Remove the LH secondary timing chain tensioner and the secondary timing chain.
- Remove the 2 bolts.

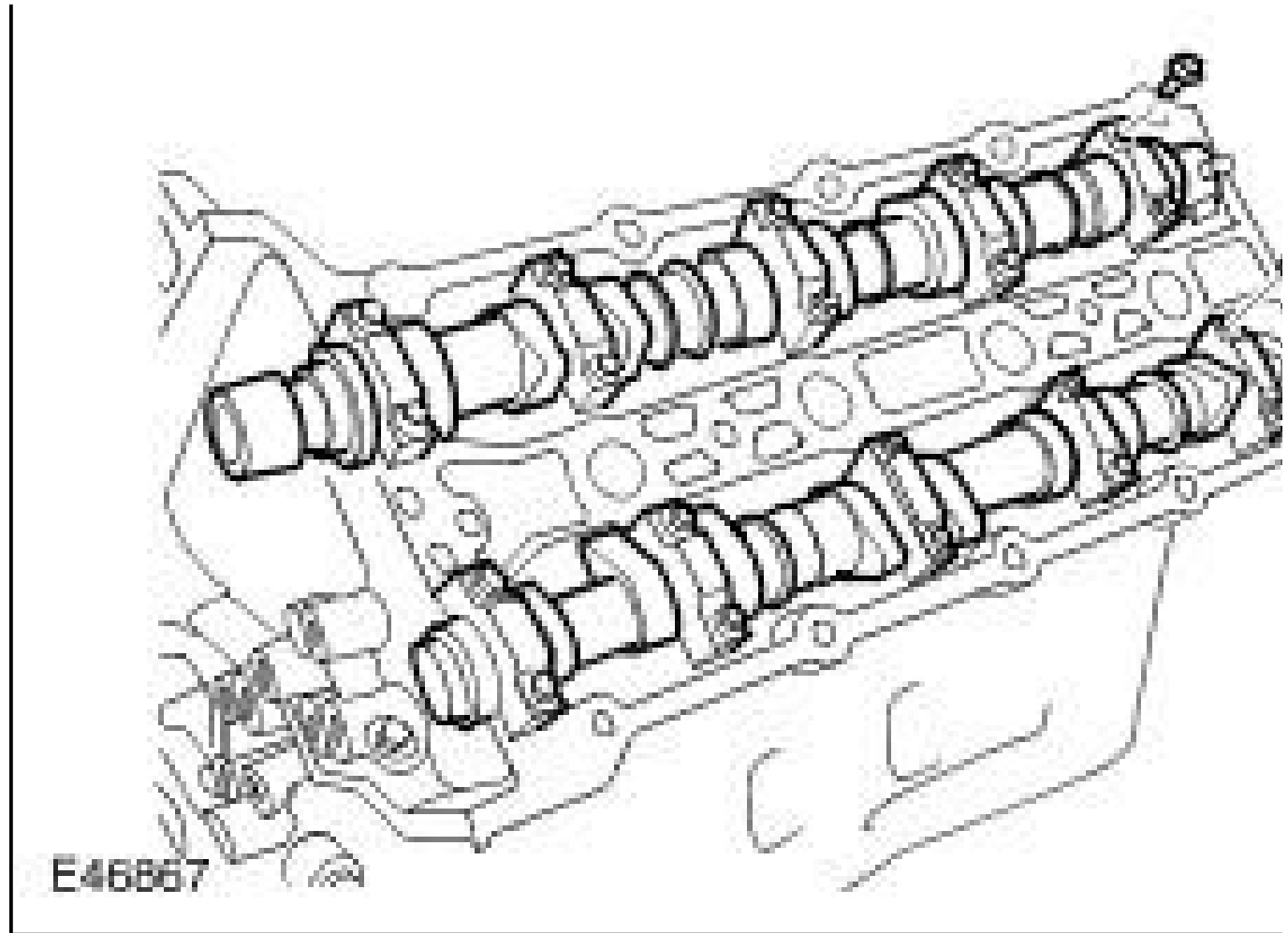


20. Remove the special tool from the LH cylinder head.
- Remove the 3 bolts.

CAUTION: Evenly and progressively, release the camshaft bearing caps.

NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

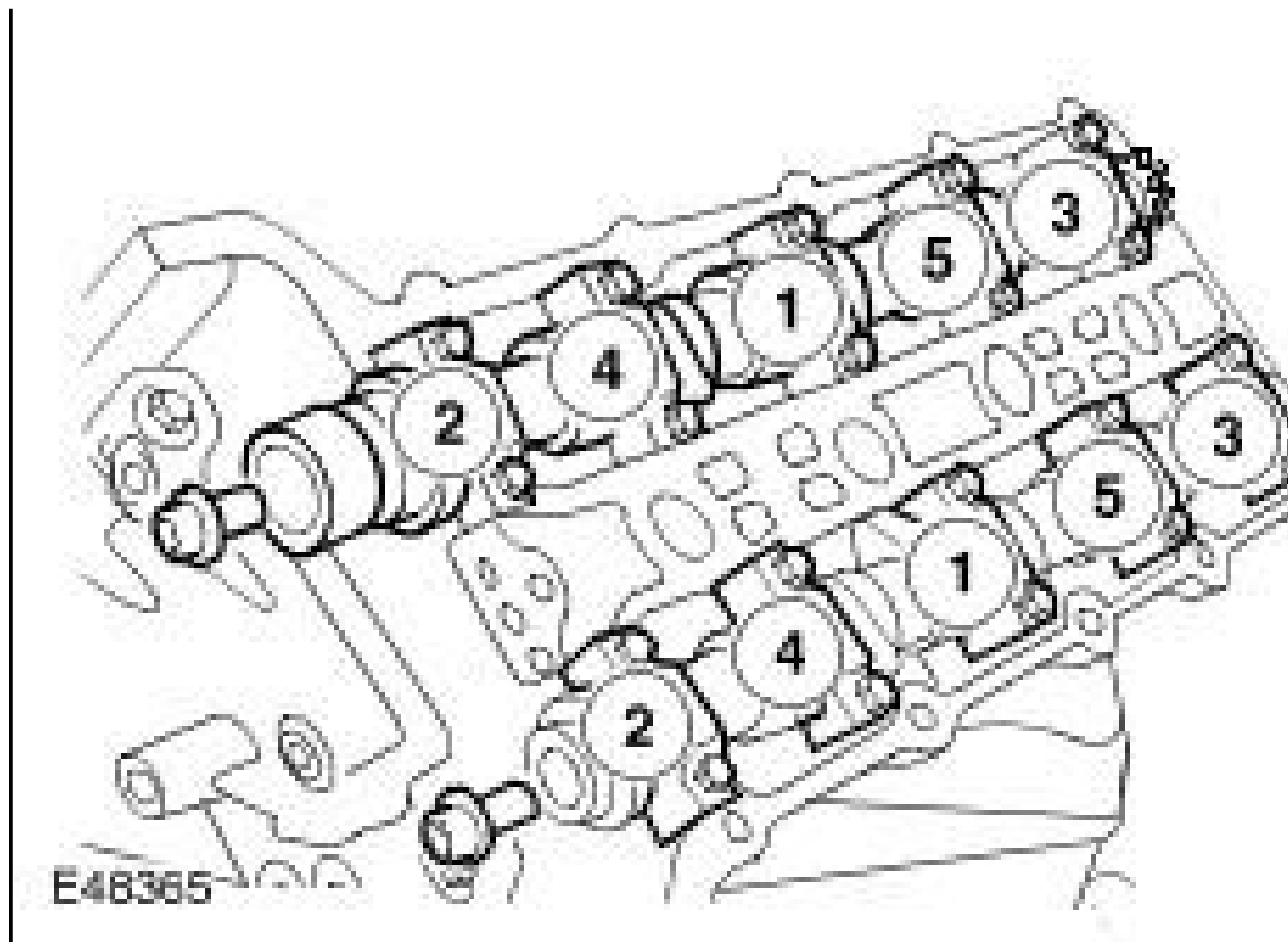
21. Remove the camshaft bearing caps.
- Remove the 20 bolts.



22. Remove the camshafts.

INSTALLATION

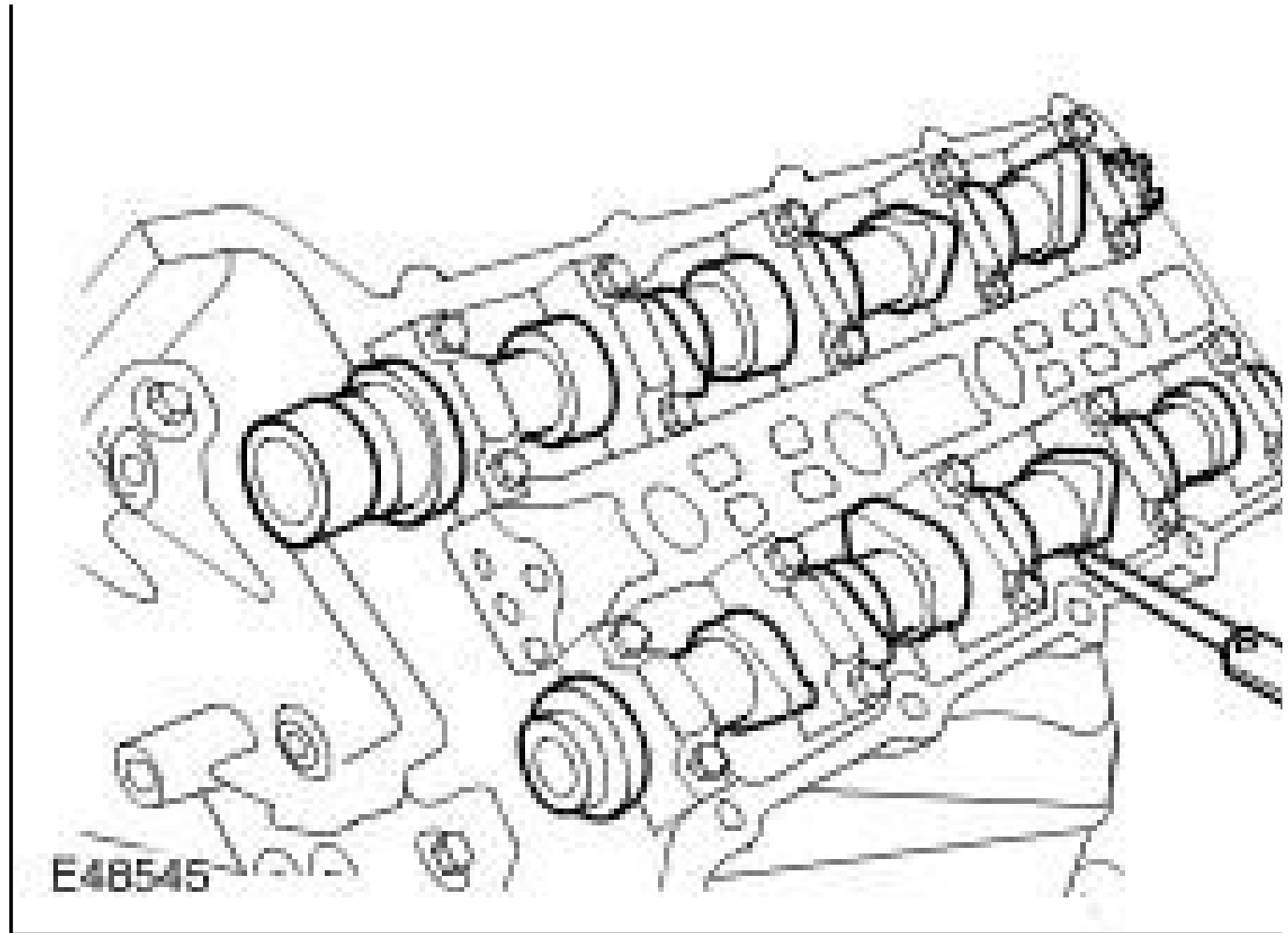
1. Check and adjust the valve tappet clearances.
2. Replace the valve shims, with the smallest shim available.
 - Apply a light coat of clean engine oil to the replacement valve shims.
3. Install the camshafts.
 - Clean the component mating faces.
 - Lubricate the journals and camshaft lobes.
4. Install the camshaft bearing caps.
 - Evenly and progressively tighten the bolts in the sequence shown to 10 Nm (7 lb.ft).



5. Install the sprocket retaining Torx bolts to the camshafts.

CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

6. Measure and record the tappet clearances.
 - Rotate the camshafts using the Torx bolts.



NOTE: Remove the camshaft bearing caps evenly and in stages.

NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

7. Remove the camshafts.
 - Remove the 20 bolts.
8. Remove the valve tappets, replace with selected tappets.
9. Install the camshafts.
 - Lubricate the journals and camshaft lobes.
 - Clean the component mating faces.
10. Install the camshaft bearing caps.
 - Evenly and progressively tighten the bolts in the sequence shown to 10 Nm (7 lb.ft).

CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or

valve clearance will be incorrect.

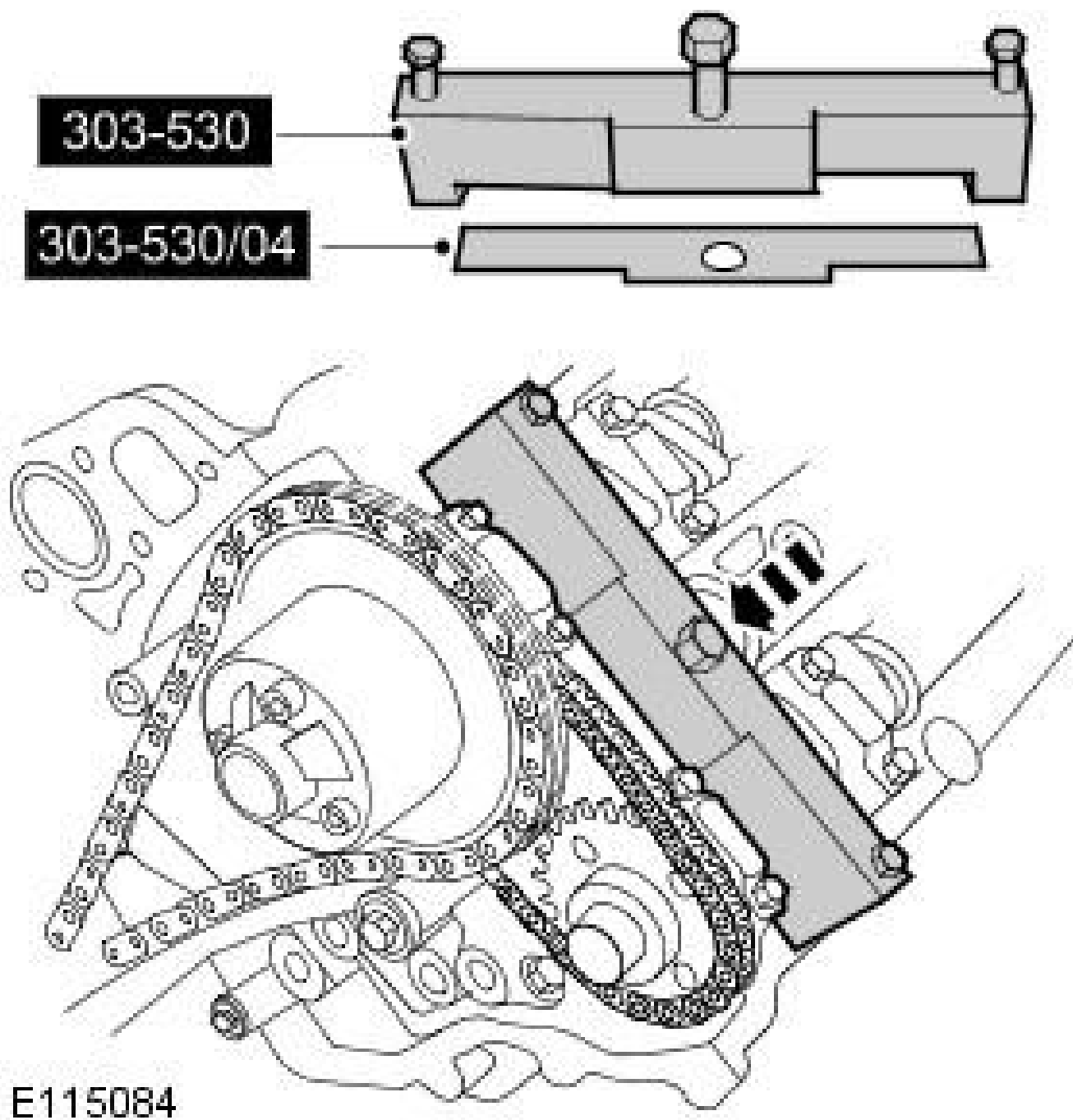
11. Check valve tappet clearances are correct.

- Rotate the camshafts using the Torx bolts.
- Remove the camshaft Torx bolts after the check is complete.

NOTE: **Some variation in the illustrations may occur, but the essential information is always correct.**

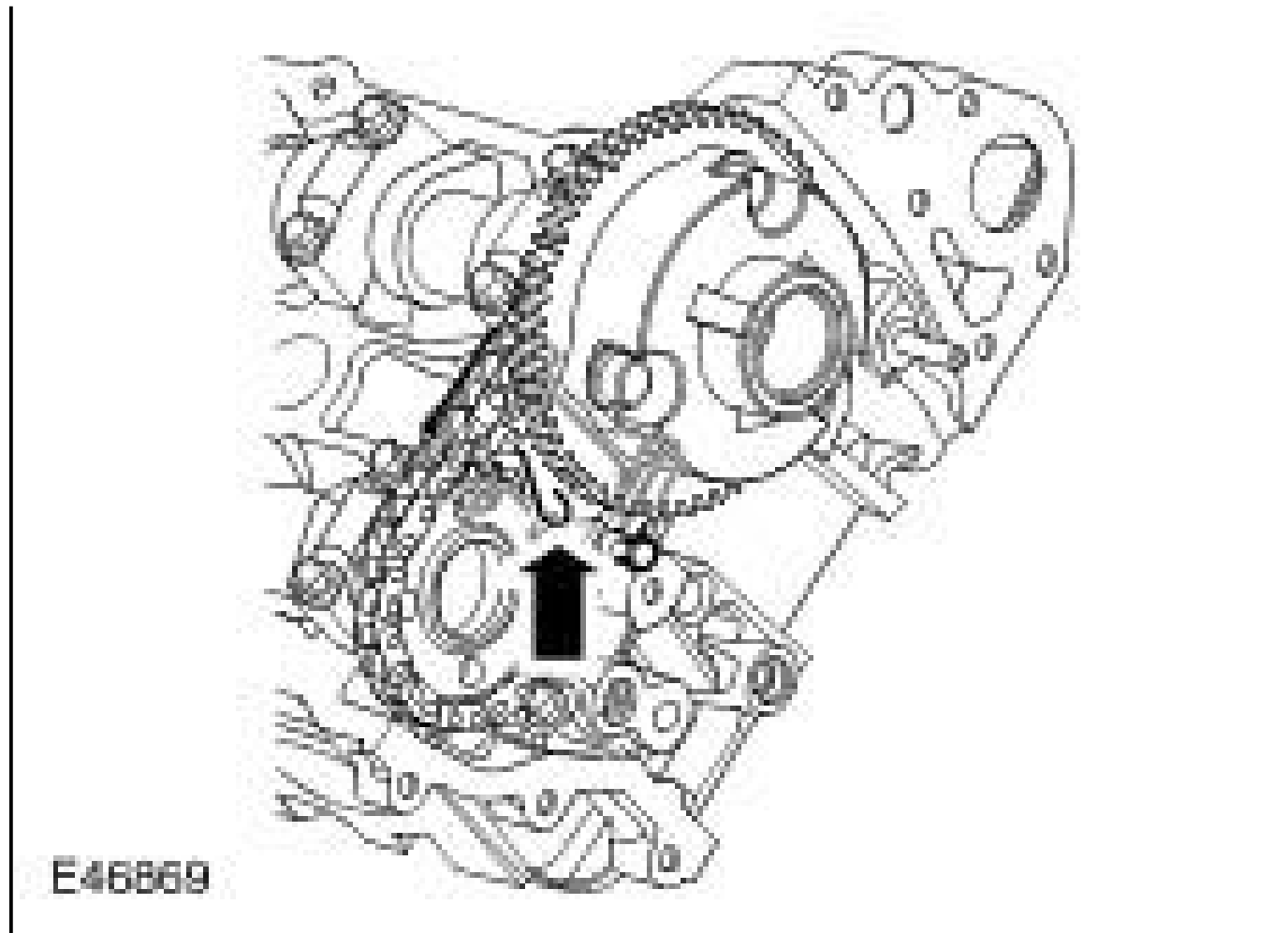
12. Install the special tools to the LH cylinder head.

- Install the 3 bolts.



NOTE: RH illustration shown, LH is similar

13. Depress the LH secondary timing chain tensioner piston.
 - Using 1 mm diameter metal rod, retain the chain tensioner piston.



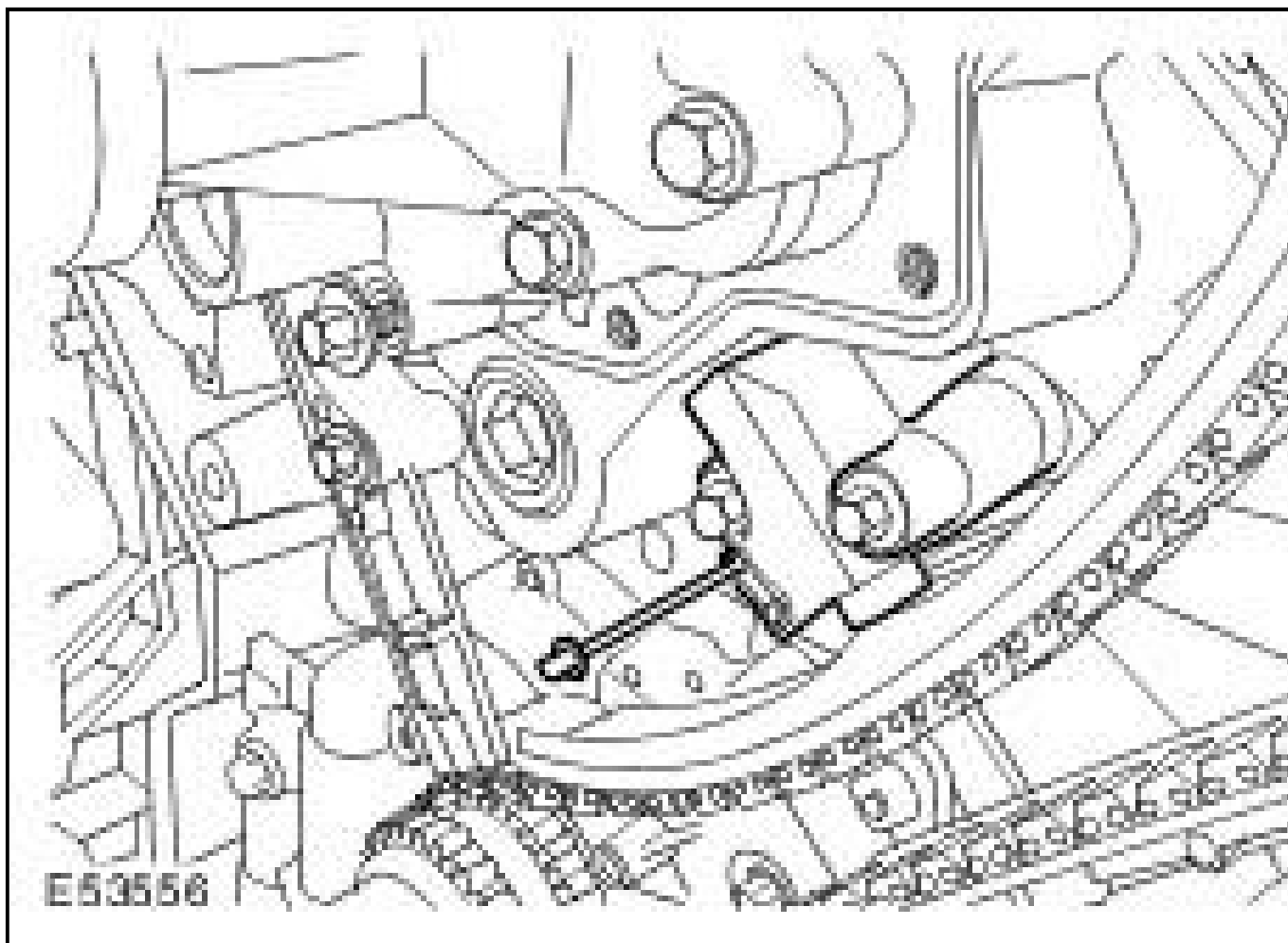
14. Install the LH secondary timing chain tensioner and chain to the camshaft sprockets.
15. Install the LH secondary timing chain tensioner retaining bolts.
 - Tighten the bolts to 12 Nm (9 lb.ft).

NOTE: **Lightly tighten the camshaft sprocket Torx bolts, the sprockets MUST be free to move.**

16. Install the LH secondary timing chain and sprockets to the camshafts.
 - Install the sprocket retaining Torx bolts to the camshafts.
17. Tension the LH secondary timing chain.
 - Remove the retaining rod.
18. Install the LH primary timing chain.
 - Make sure the timing chain slack is on the tensioner side of the timing chain.
19. Install the LH primary chain tensioner guide.
 - Tighten the stud to 12 Nm (9 lb.ft).

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.

20. Install the LH primary timing chain tensioner.
- Using 3 mm diameter metal rod, retain the chain tensioner piston.
 - Tighten the bolts to 12 Nm (9 lb.ft).
 - Remove the retaining rod.

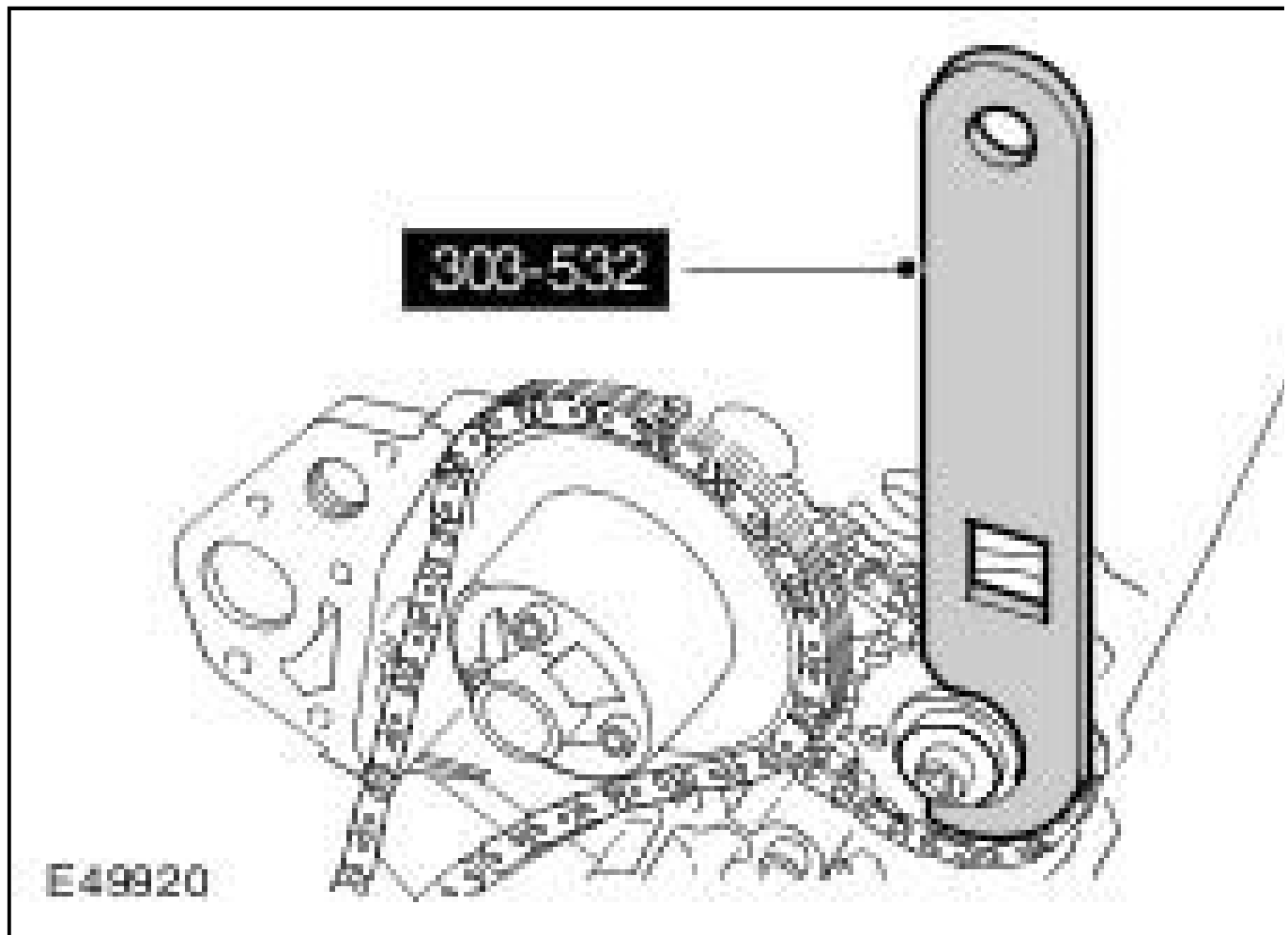


CAUTION: Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

CAUTION: The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

CAUTION: Make sure that new bolts are installed.

21. Install the special tool to the exhaust camshaft sprocket.
- Tighten the intake camshaft sprocket retaining bolt to 20 Nm + 90 deg.
 - Tighten the exhaust camshaft sprocket retaining bolt to 20 Nm + 90 deg.

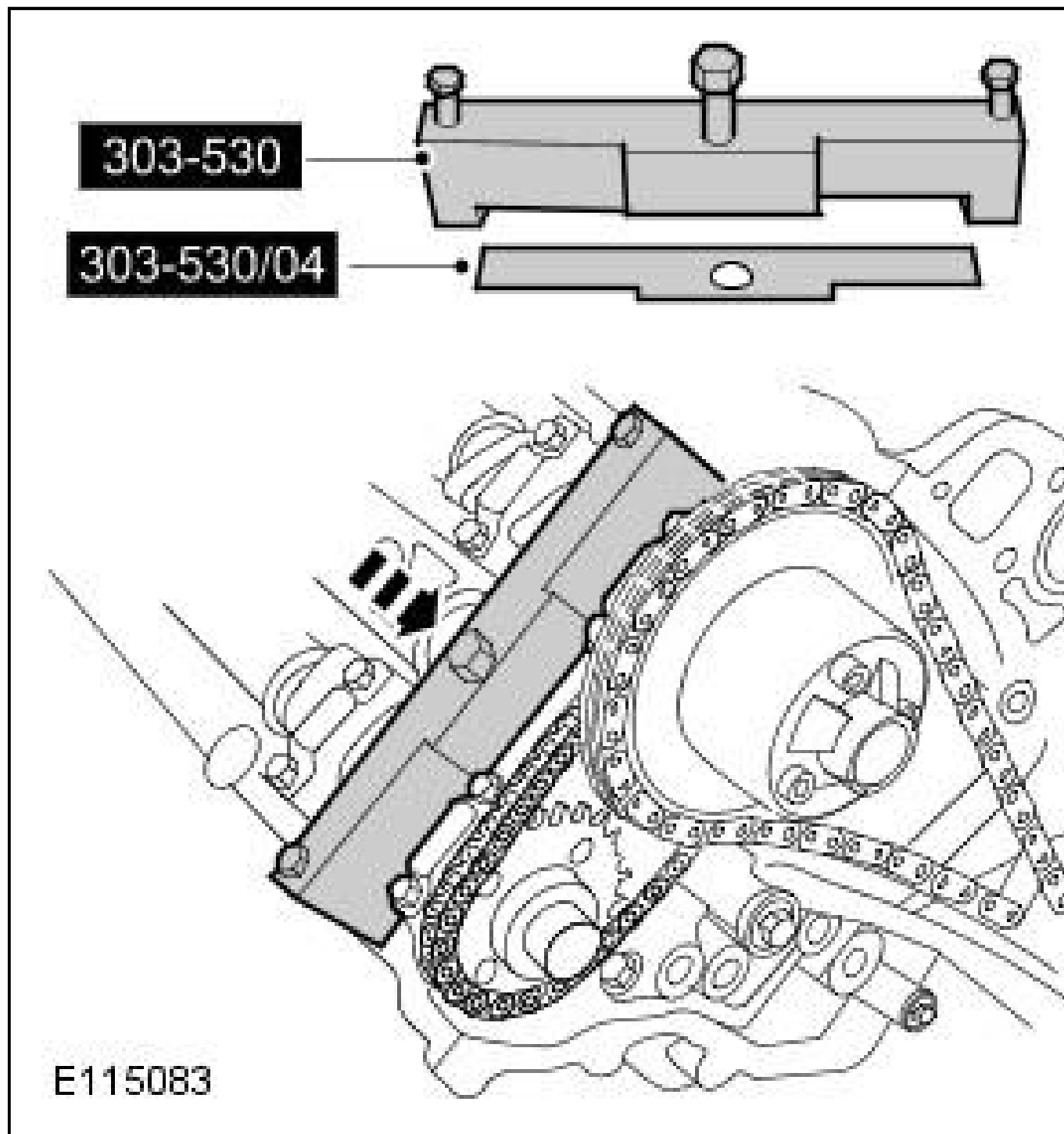


22. Install the LH VCT oil control unit.
- Install the new O-ring seals.
 - Tighten the new bolts to 22 Nm (16 lb.ft).
 - Tighten the nut to 10 Nm (7 lb.ft).
23. Remove the special tools from the LH cylinder head.
- Remove the 3 bolts.

NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

24. Remove the special tools from the LH cylinder head.

- Remove the 3 bolts.



25. Install the RH primary timing chain.

- Make sure the timing chain slack is on the tensioner side of the timing chain.

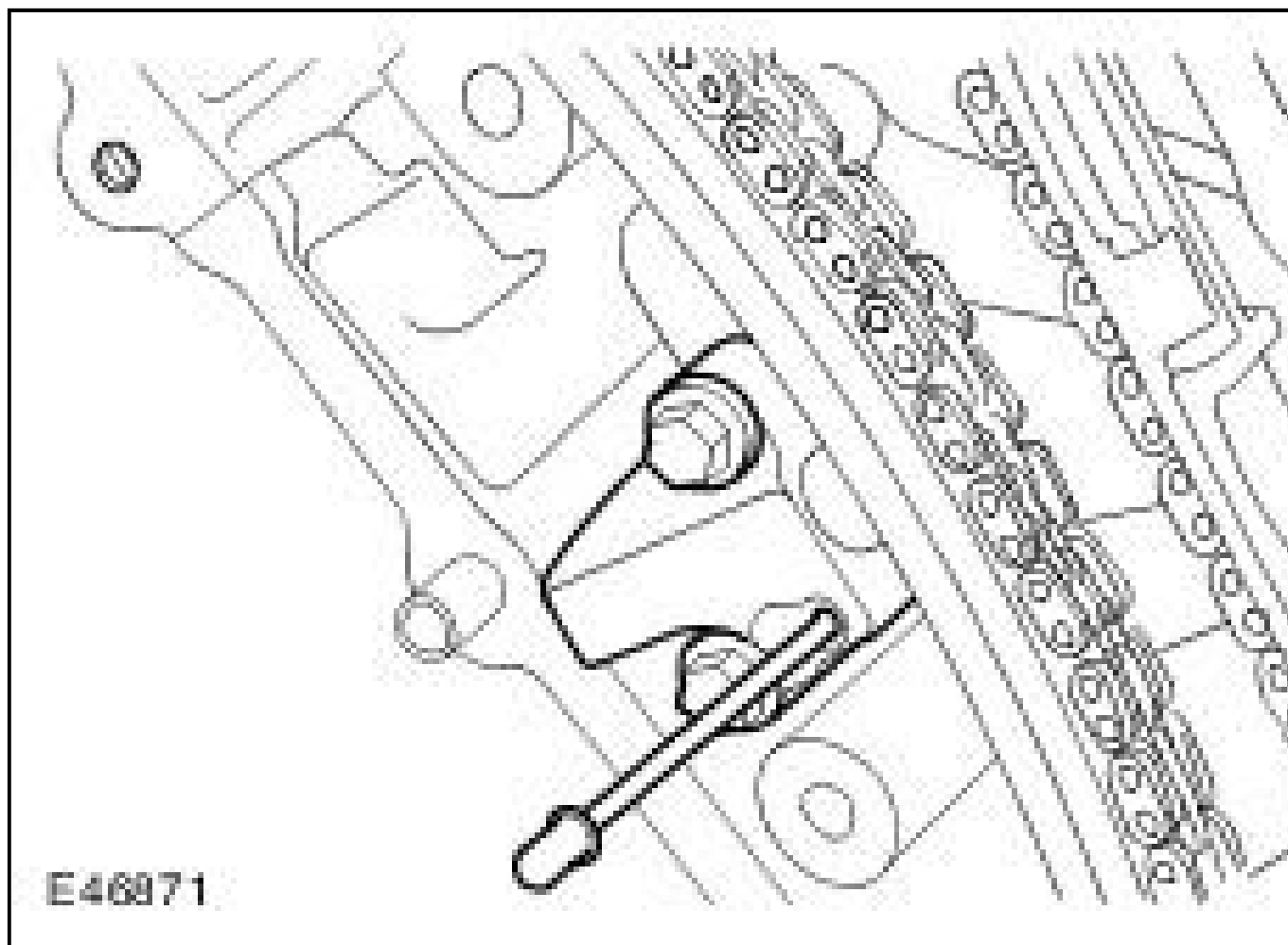
26. Install the RH primary timing chain tensioner guide.

- Tighten the bolts to 12 Nm (9 lb.ft).

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.

27. Install the RH primary timing chain tensioner.

- Using 3 mm diameter metal rod, retain the chain tensioner piston.
- Tighten the bolts to 12 Nm (9 lb.ft).
- Remove the retaining rod.



CAUTION: Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

CAUTION: The intake camshaft sprocket retaining bolt **MUST** be tightened

before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

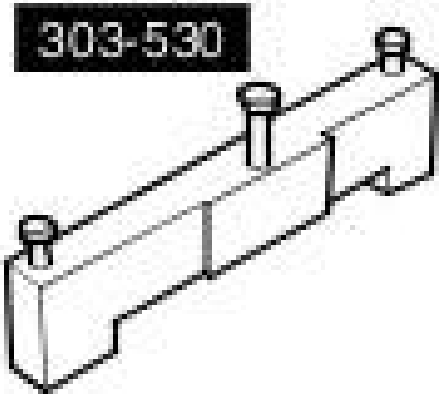
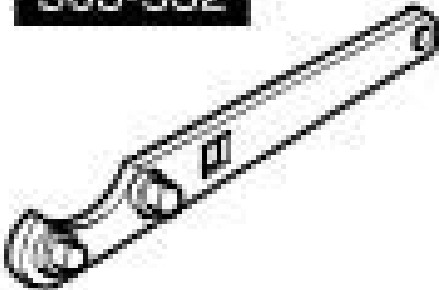
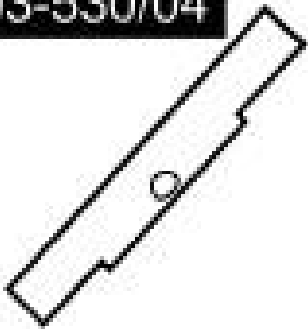
CAUTION: Make sure that new bolts are installed.

28. Install the special tool to the RH exhaust camshaft sprocket.
 - Tighten the intake camshaft sprocket retaining bolt to 20 Nm + 90 deg.
 - Tighten the exhaust camshaft sprocket retaining bolt to 20 Nm + 90 deg.
29. Install the RH VCT oil control unit.
 - Install the new O-ring seals.
 - Tighten the new bolts to 22 Nm (16 lb.ft).
30. Remove the special tool from the RH cylinder head.
 - Remove the 3 bolts.
31. Remove the crankshaft locking tool.
 - Remove the screw.
32. Install the CKP sensor. Refer to Crankshaft Position (CKP) Sensor .
33. Install the engine front cover. See Engine Front Cover.
34. Connect the battery ground cable. Refer to Specifications .

CAMSHAFT RH

SPECIAL TOOLS

Tool Illustration	Tool Name	Tool Number
	Timing Setting tool	303-645
	Camshaft setting/locking tool	303-530

 303-530 E46879		
 303-532 E46880	Timing chain tensioning tool	303-532
 303-530/04 E115082	Timing shim tool	303-530/04

REMOVAL

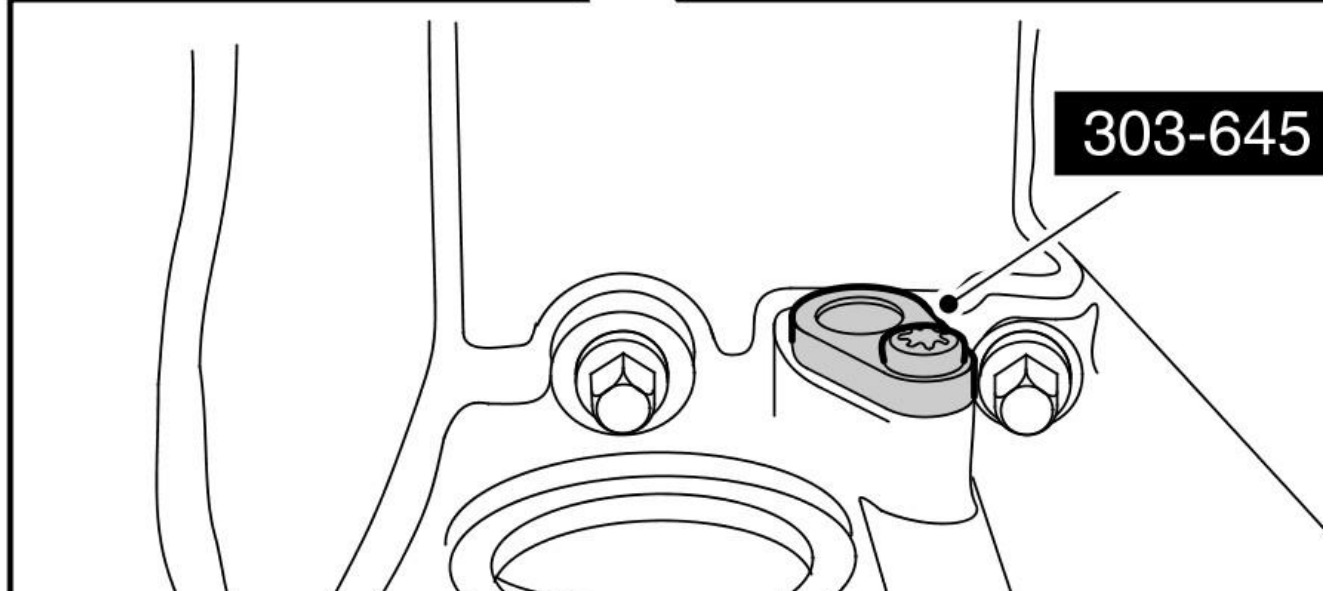
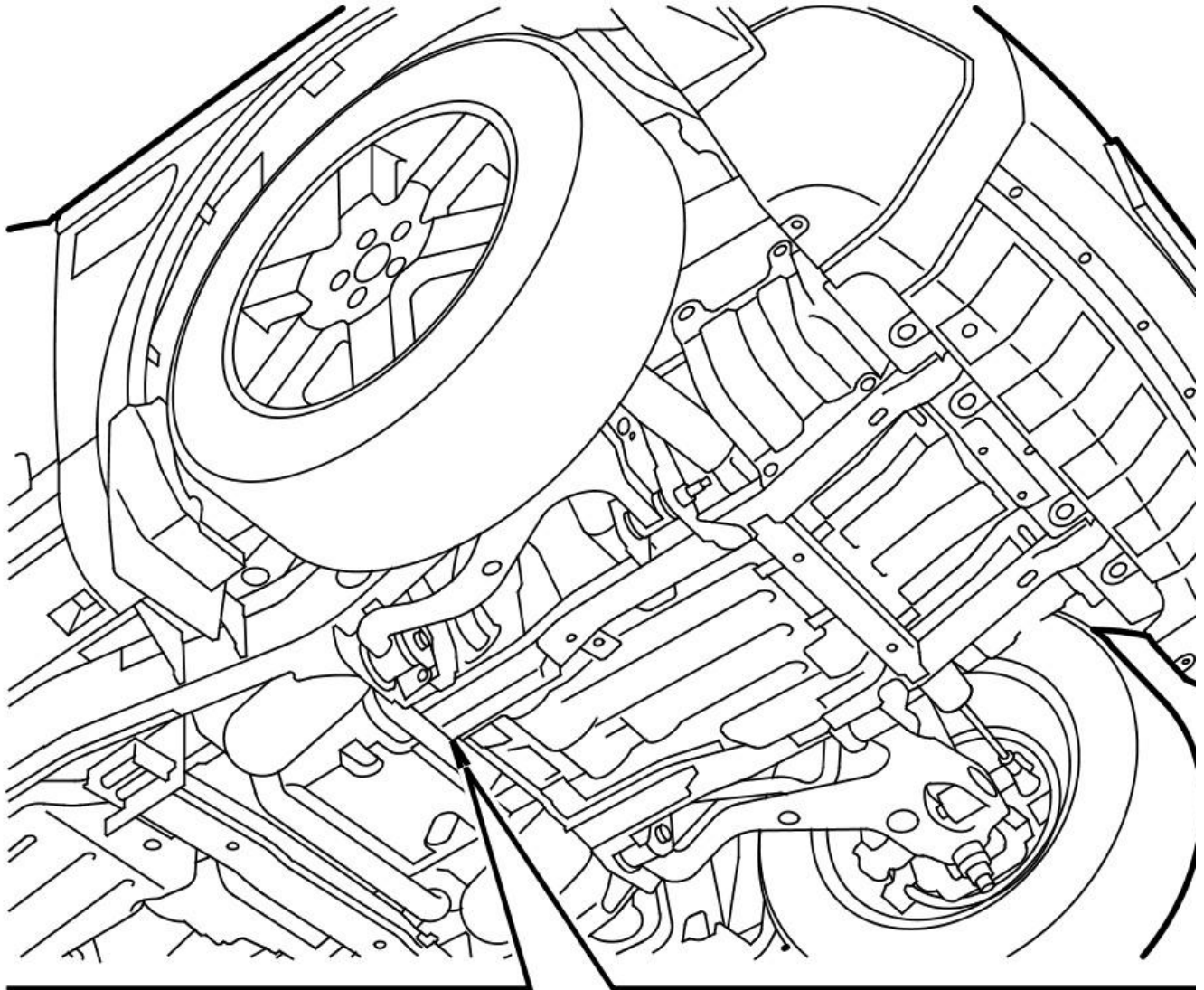
1. Disconnect the battery ground cable. Refer to **Specifications** .

WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the engine front cover. See **Engine Front Cover**.
4. Remove the crankshaft position (CKP) sensor. Refer to **Crankshaft Position (CKP) Sensor** .
5. Rotate the crankshaft until the flats on the camshafts are parallel with the cylinder head joint faces.

NOTE: **The engine is now in the SAFE position.**

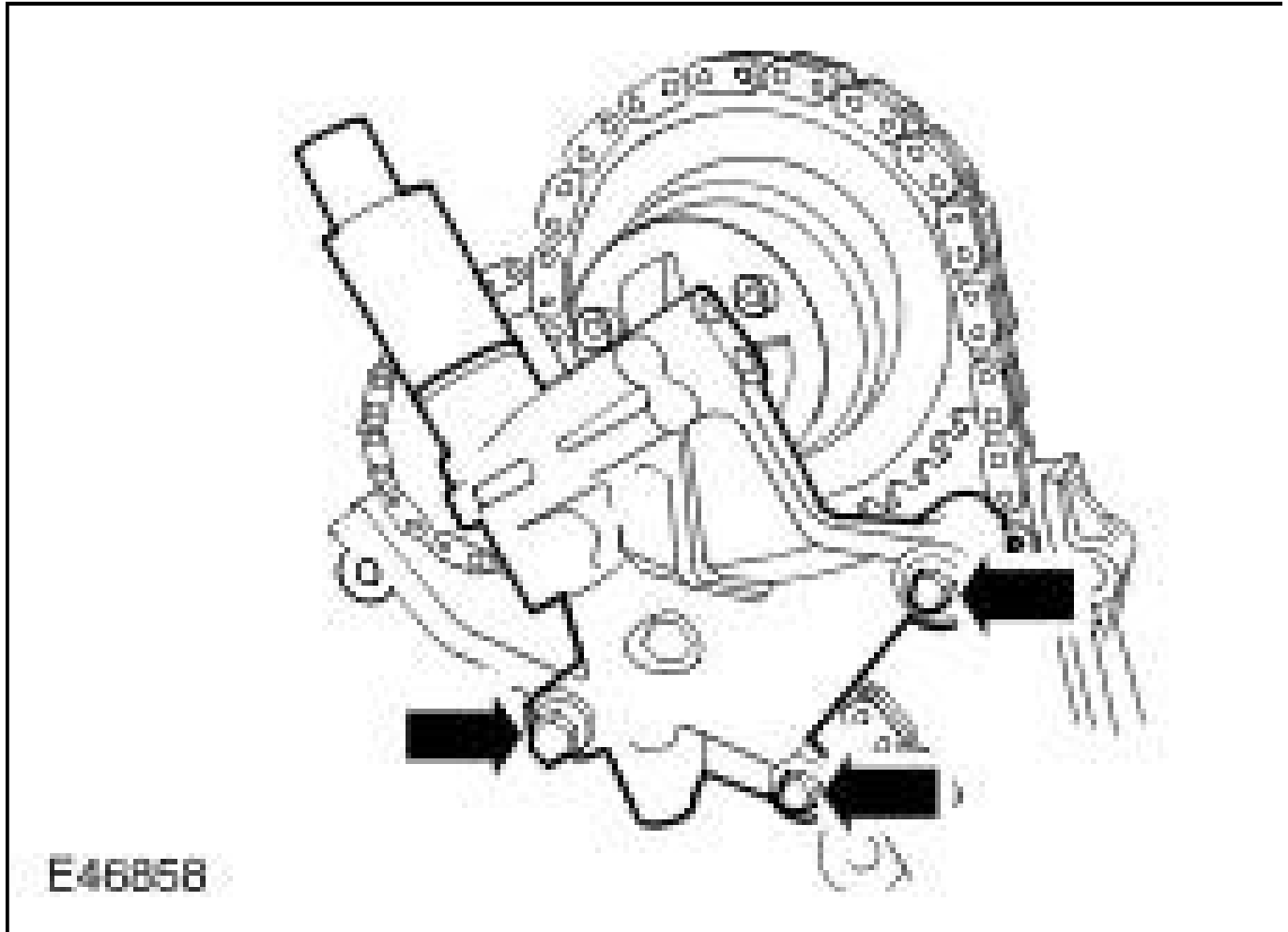
6. Lock the crankshaft.
 - Install the special tool.
 - Install the screw.



303-645

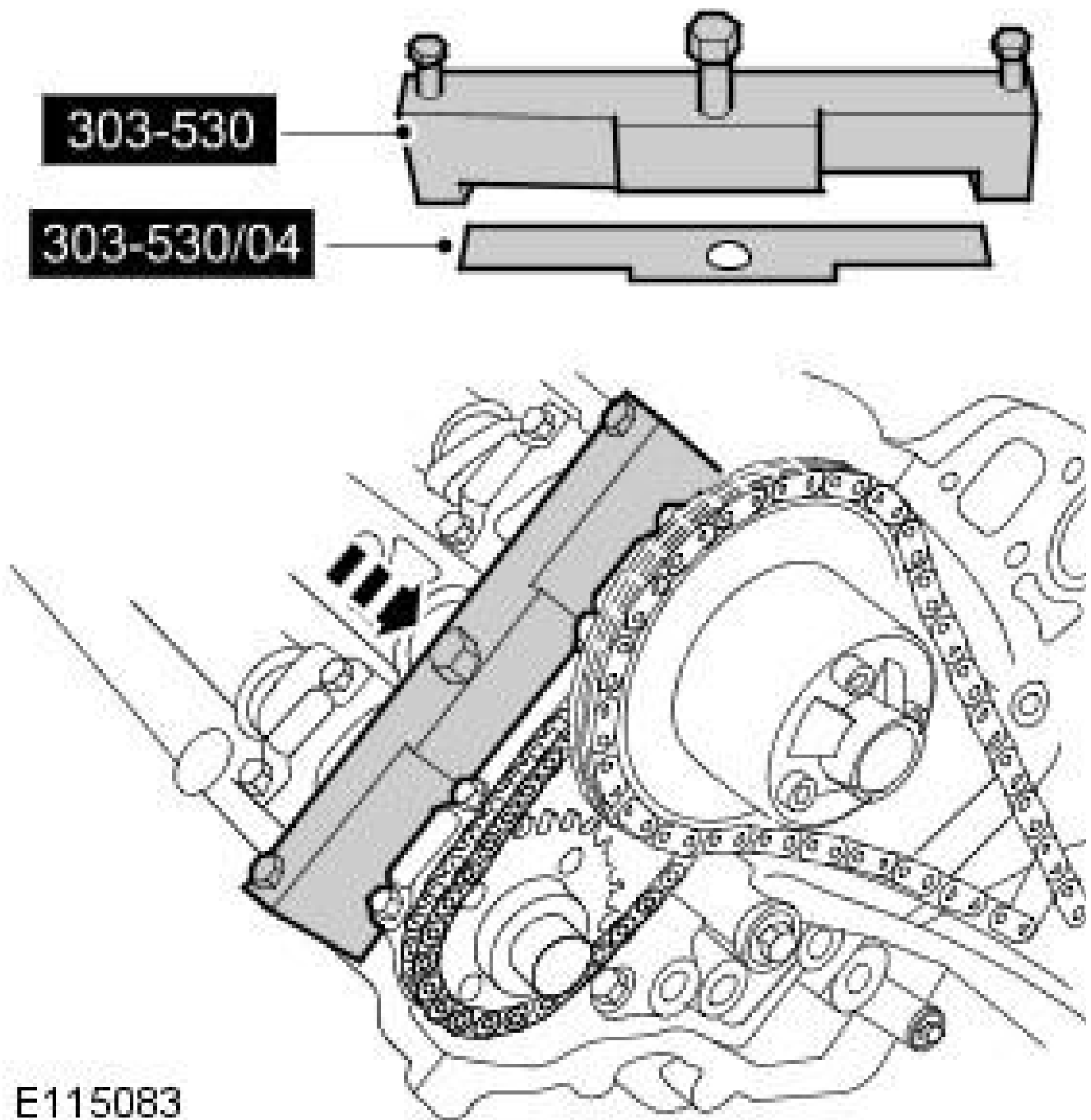
7. Remove the RH variable camshaft timing (VCT) control unit.

- Remove the 3 bolts.
- Remove and discard the O-ring seals.

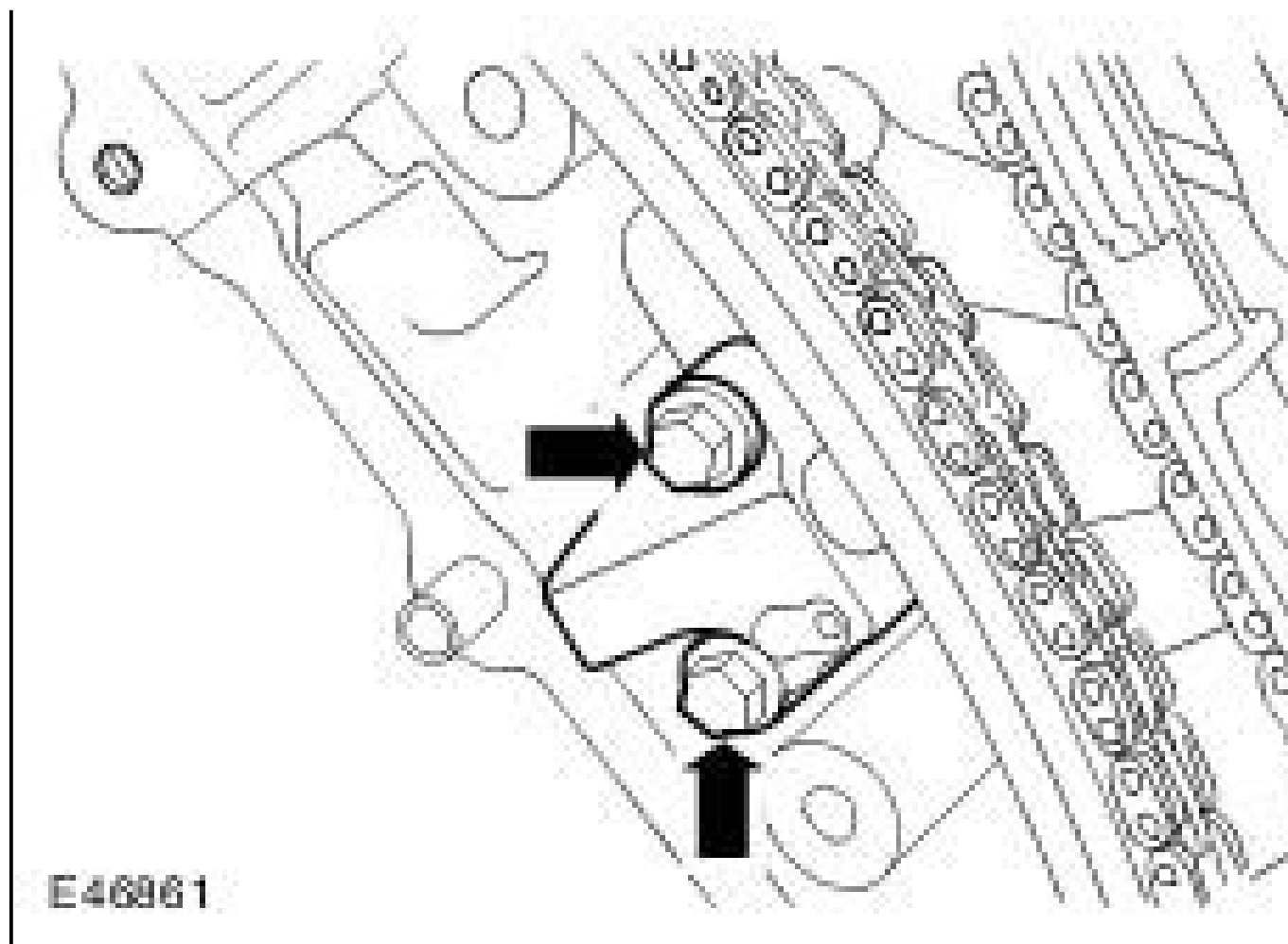


8. Install the special tool to the RH cylinder head.

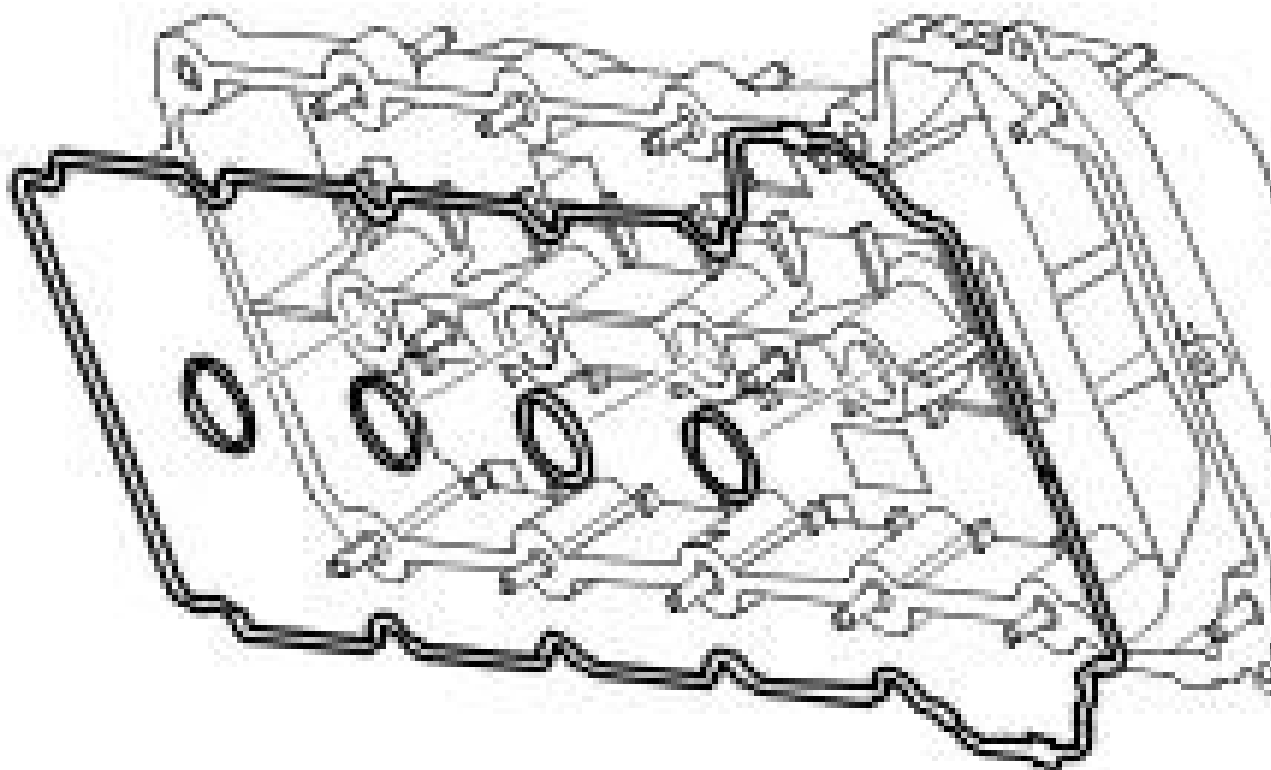
- Install the 3 bolts.



9. Remove the primary timing chain tensioner.
 - Remove the 2 bolts.

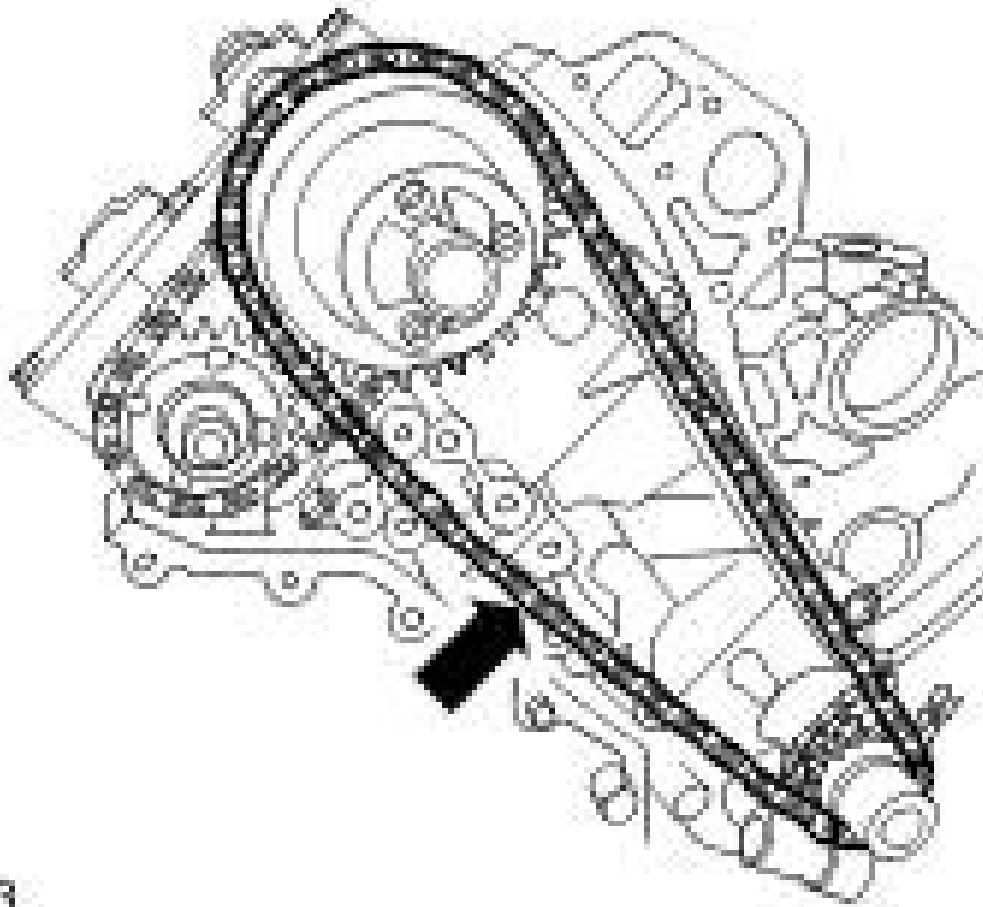


10. Remove the primary timing chain tensioner guide.
 - Remove the bolt.



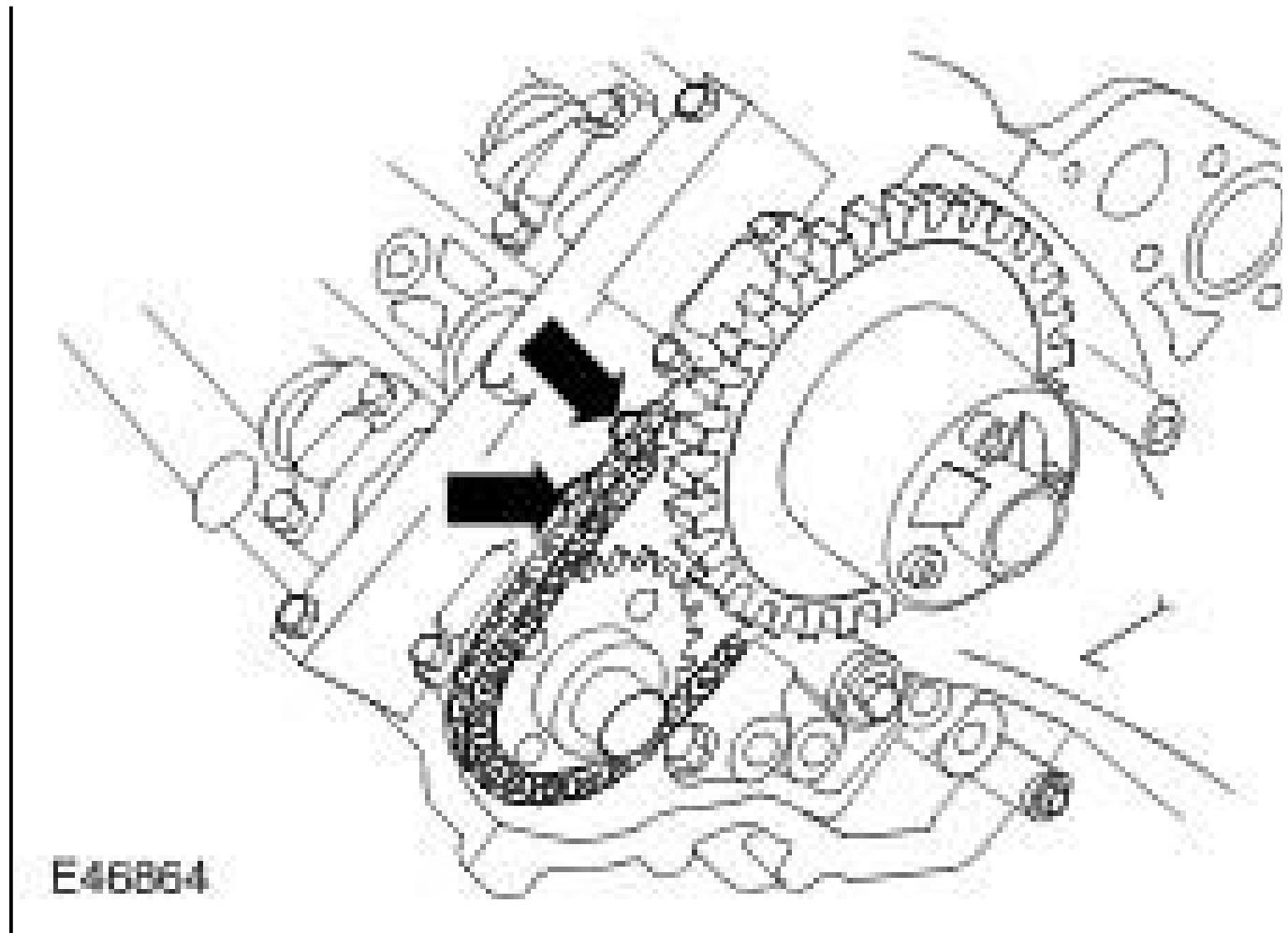
E46652

11. Remove the primary timing chain.



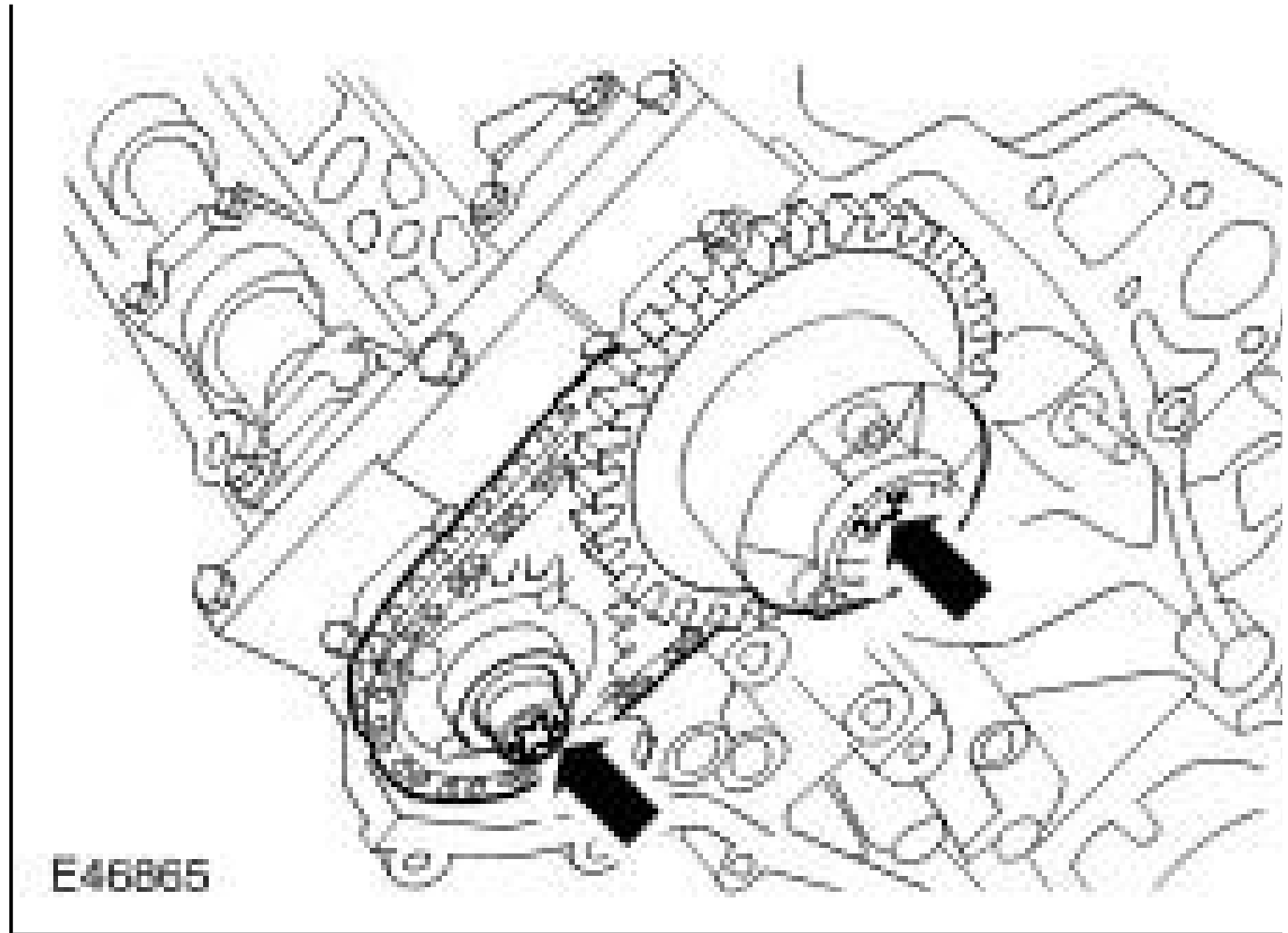
E46863

12. Remove the secondary timing chain tensioner and the secondary timing chain.
 - Remove the 2 retaining bolts.

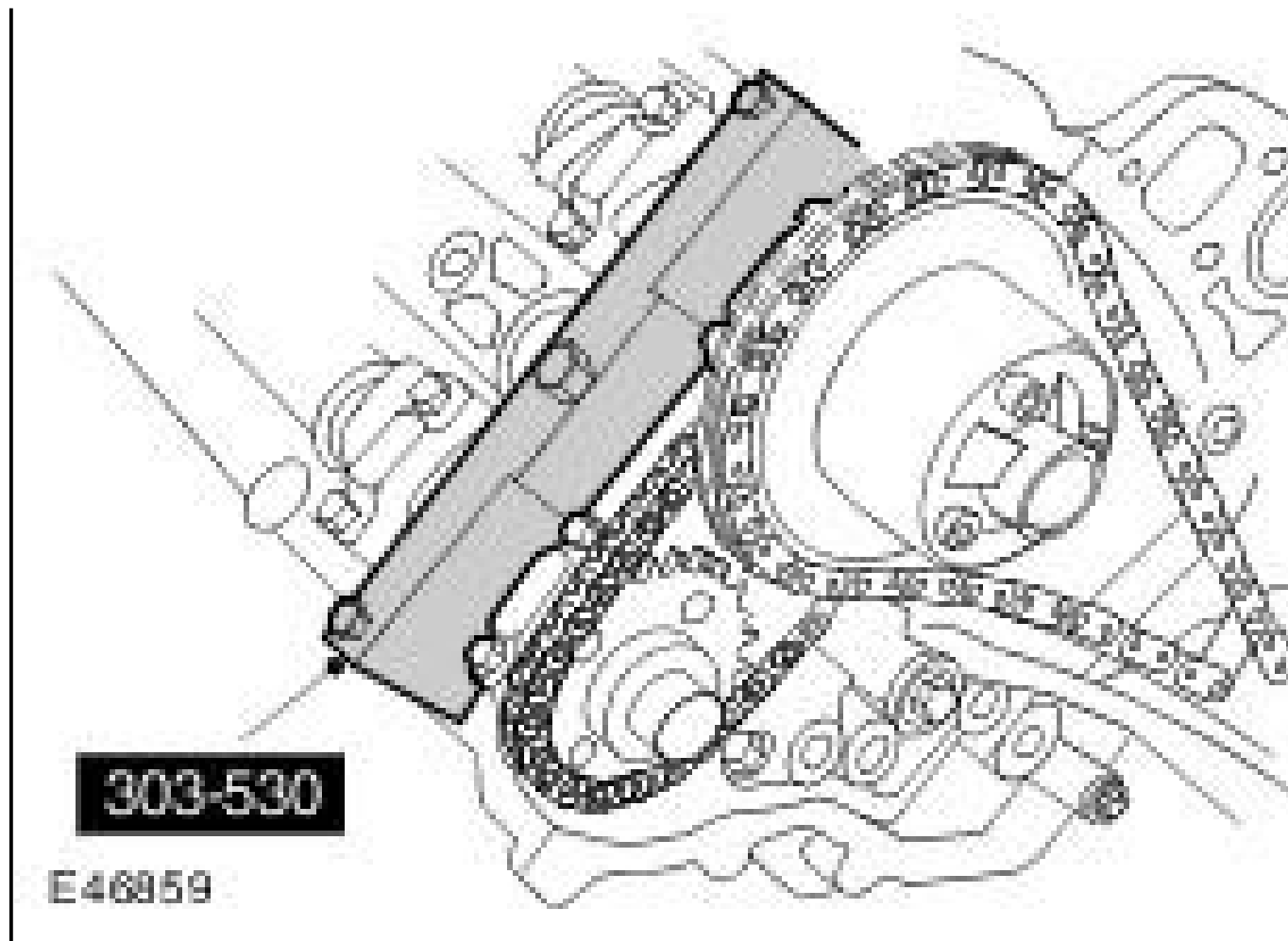


CAUTION: Discard the bolts.

13. Remove the camshaft sprockets.
 - Remove the 2 bolts.



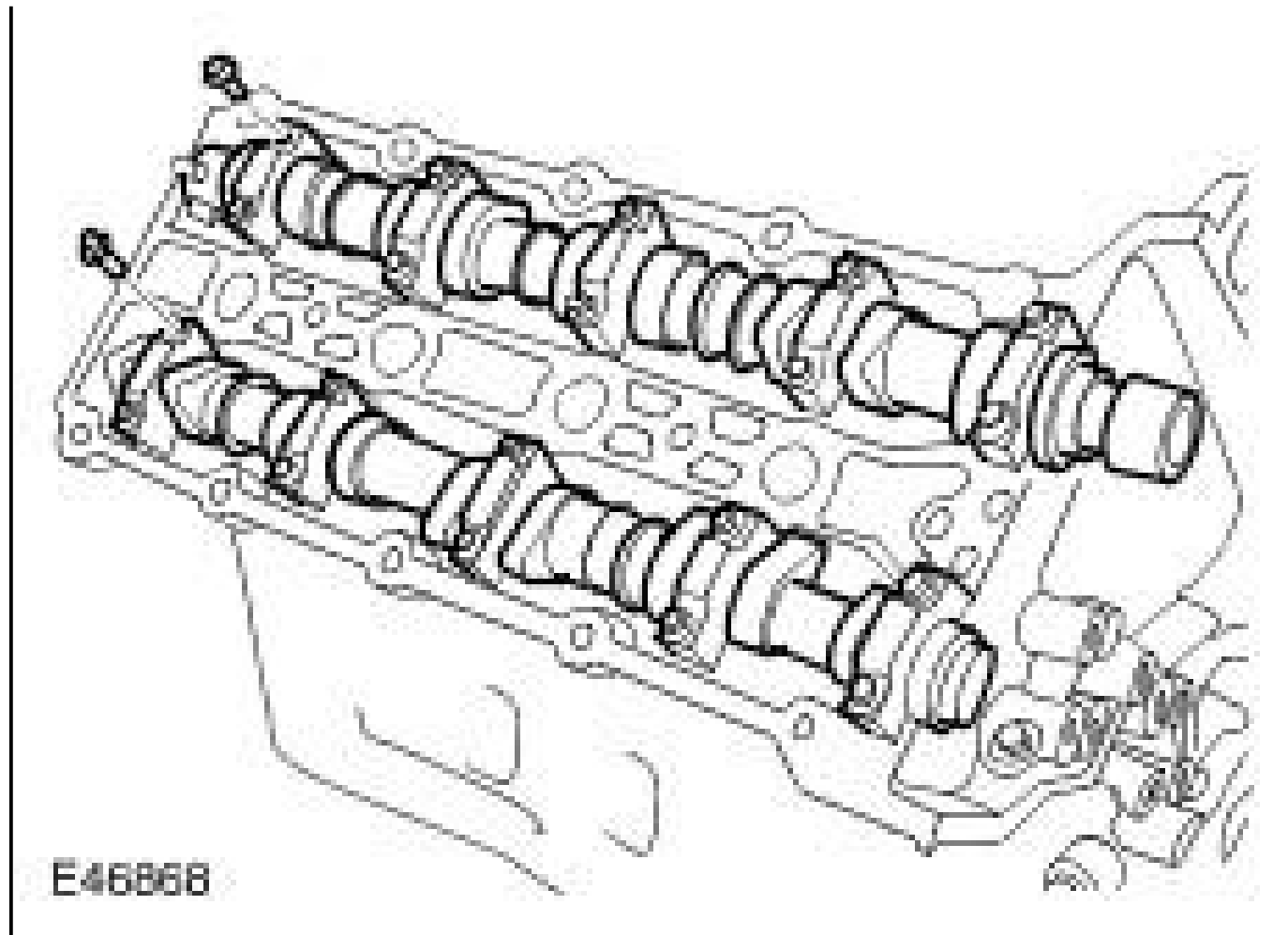
14. Remove the special tool from the RH cylinder head.
 - Remove the 3 bolts.



CAUTION: Evenly and progressively, release the camshaft bearing caps.

NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

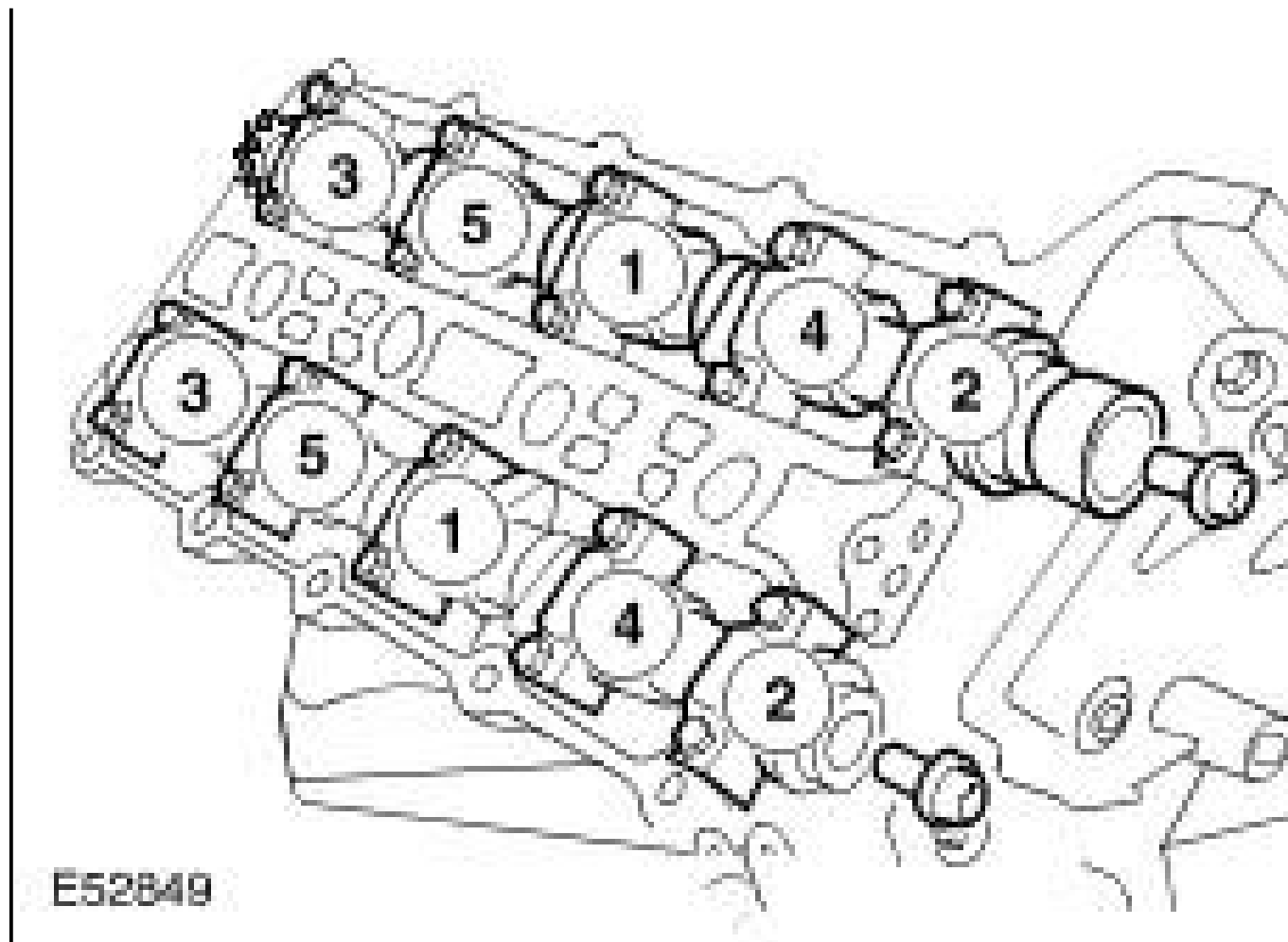
15. Remove the camshaft bearing caps.
 - Remove the 20 bolts.



16. Remove the camshafts.

INSTALLATION

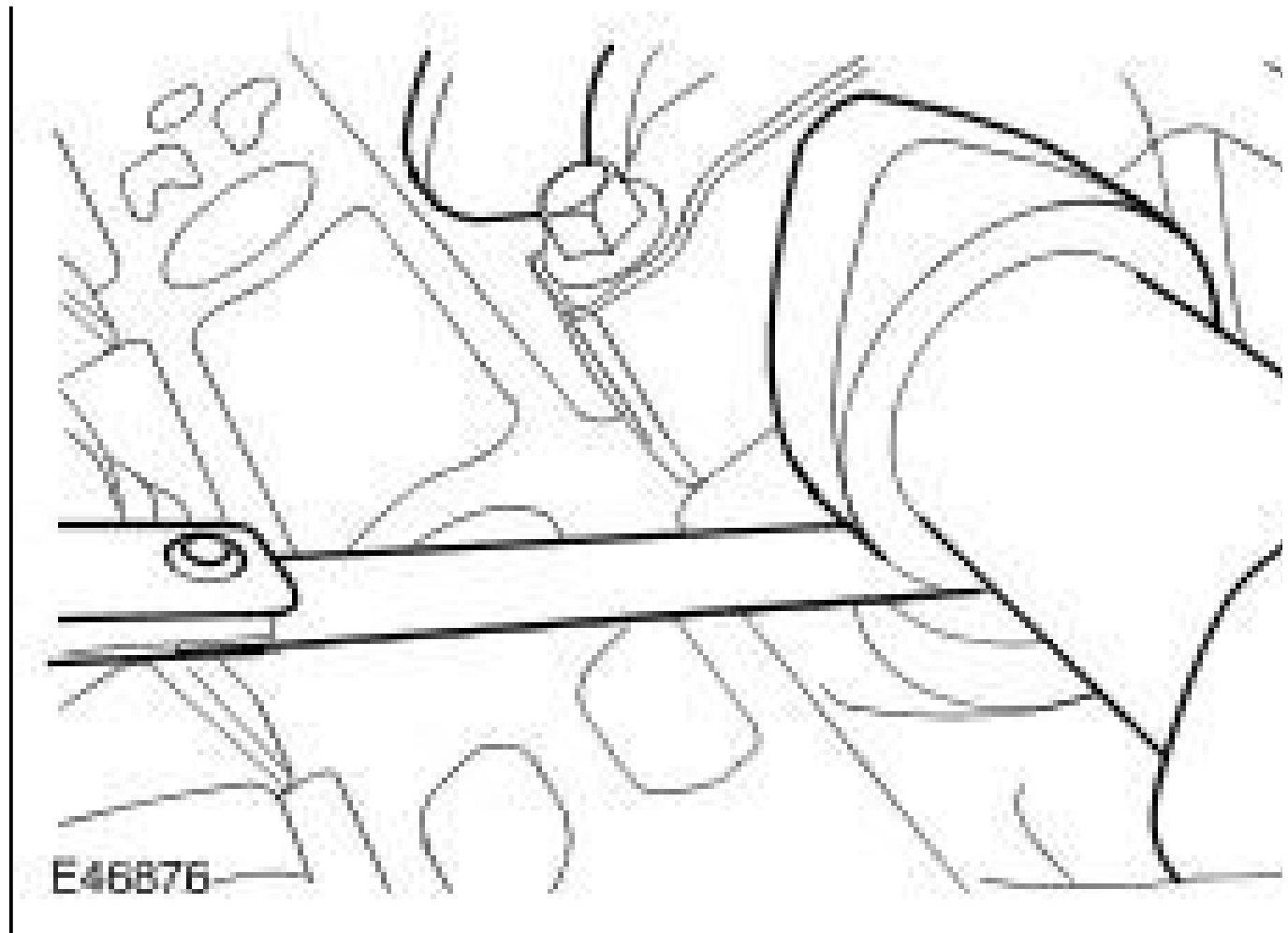
1. Check and adjust the valve tappet clearances.
2. Replace the valve shims, with the smallest shim available.
 - Apply a light coat of clean engine oil to the replacement valve shims.
3. Install the camshafts.
 - Clean the component mating faces.
 - Lubricate the journals and camshaft lobes.
4. Install the camshaft bearing caps.
 - Evenly and progressively tighten the bolts in the sequence shown to 10 Nm.



5. Install the sprocket retaining Torx bolts to the camshafts.

CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

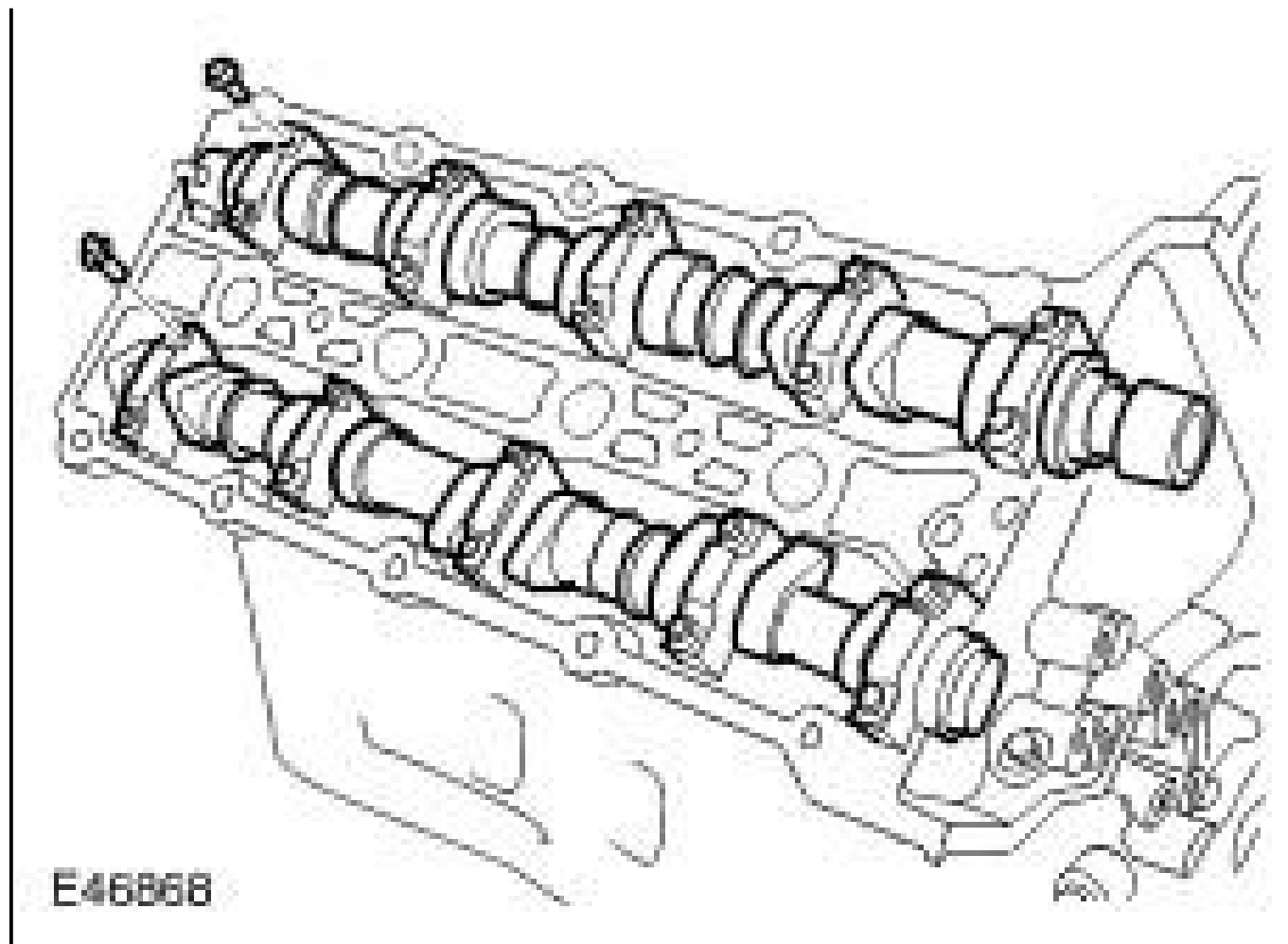
6. Measure and record the tappet clearances.
- Rotate the camshafts using the Torx bolts.



CAUTION: Evenly and progressively, release the camshaft bearing caps.

NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

7. Remove the camshaft bearing caps.
 - Remove the 20 bolts.

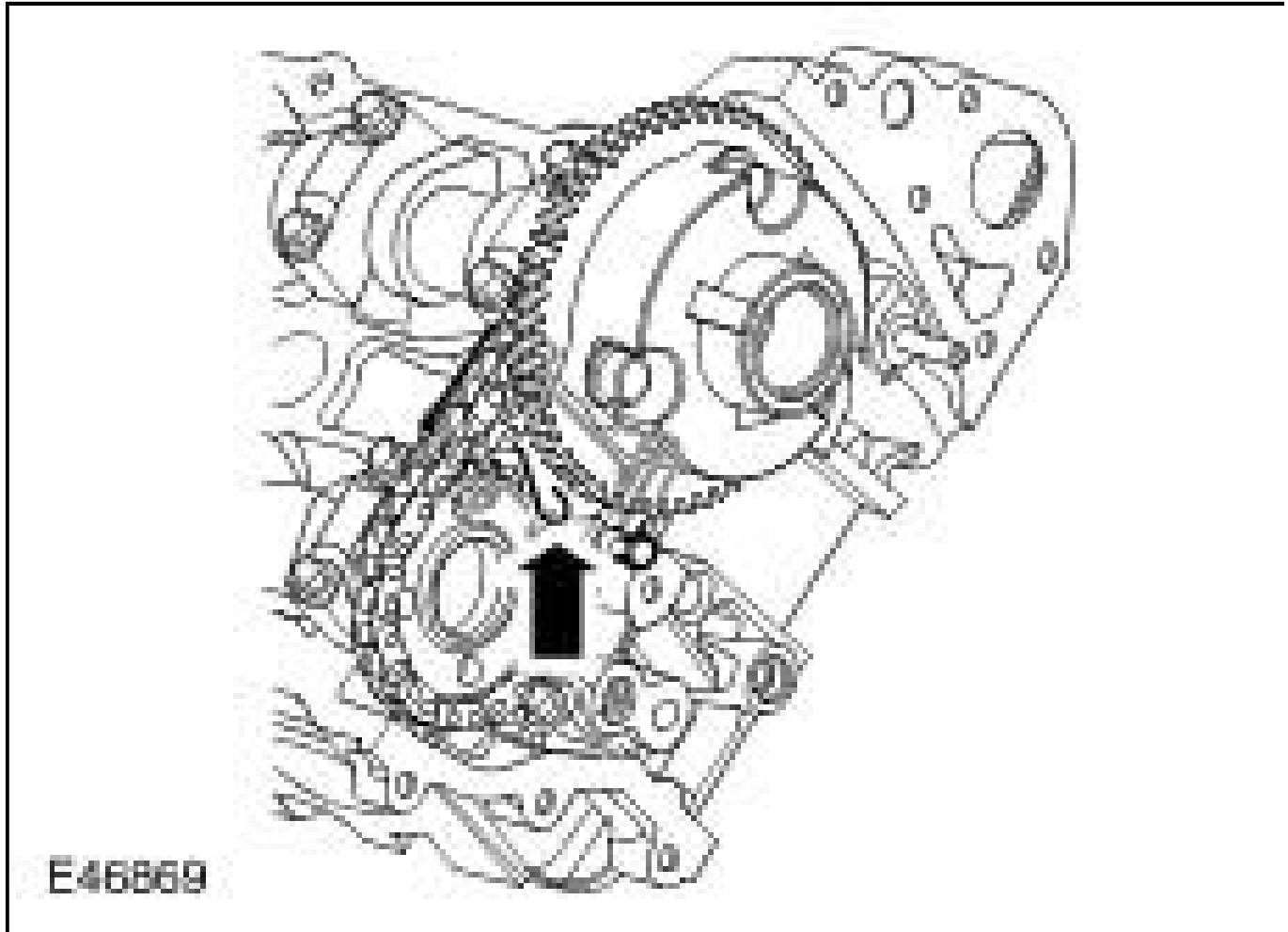


8. Remove the camshafts.
9. Remove the valve tappets, replace with selected tappets.
10. Install the camshafts.
 - Lubricate the journals and camshaft lobes.
 - Clean the component mating faces.
11. Install the camshaft bearing caps.
 - Evenly and progressively tighten the bolts in the sequence shown to 10 Nm.

CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

12. Check valve tappet clearances are correct.
 - Rotate the camshafts using the Torx bolts.
 - Remove the camshaft Torx bolts after the check is complete.
13. Install the special tool to the RH cylinder head.

- Install the 3 bolts.
14. Retain the LH secondary timing chain tensioner piston.
 - Using 1 mm diameter metal rod, retain the chain tensioner piston.



15. Install the secondary timing chain tensioner and chain to the camshaft sprockets.

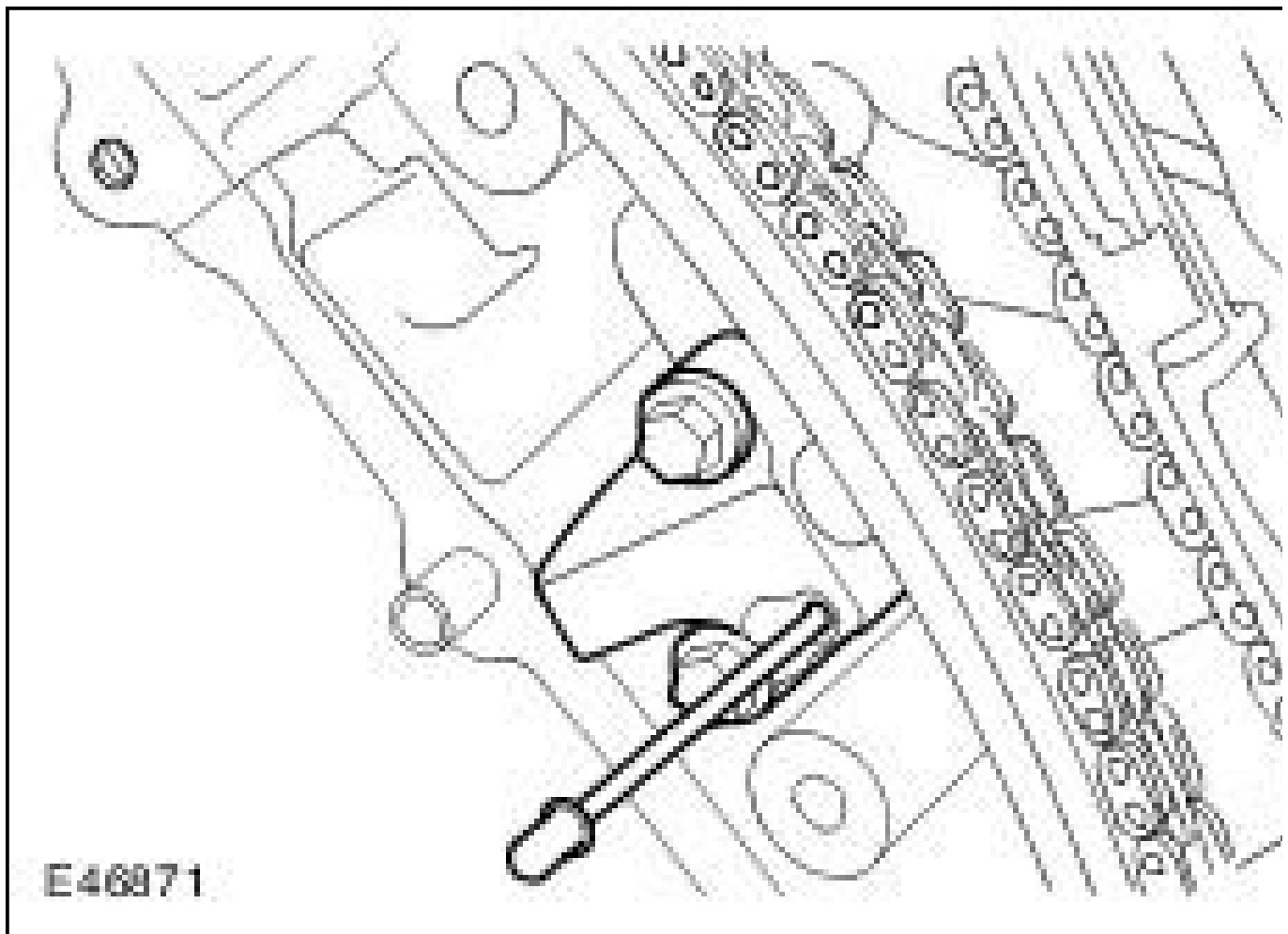
NOTE: Lightly tighten the camshaft sprocket Torx bolts, the sprockets **MUST** be free to move.

16. Install the secondary timing chain and sprockets to the camshafts.
 - Install the sprocket retaining Torx bolts to the camshafts.
17. Install the secondary timing chain tensioner retaining bolts.
 - Tighten the bolts to 12 Nm.
18. Tension the secondary timing chain.
 - Remove the retaining rod.
19. Install the primary timing chain.

- Make sure the timing chain slack is on the tensioner side of the timing chain.
20. Install the primary tensioner guide.
- Tighten the bolts to 12 Nm.

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.

21. Install the primary chain tensioner.
- Using 3 mm diameter metal rod, retain the chain tensioner piston.
 - Tighten the bolts to 12 Nm (9 lb.ft).
 - Remove the retaining rod.

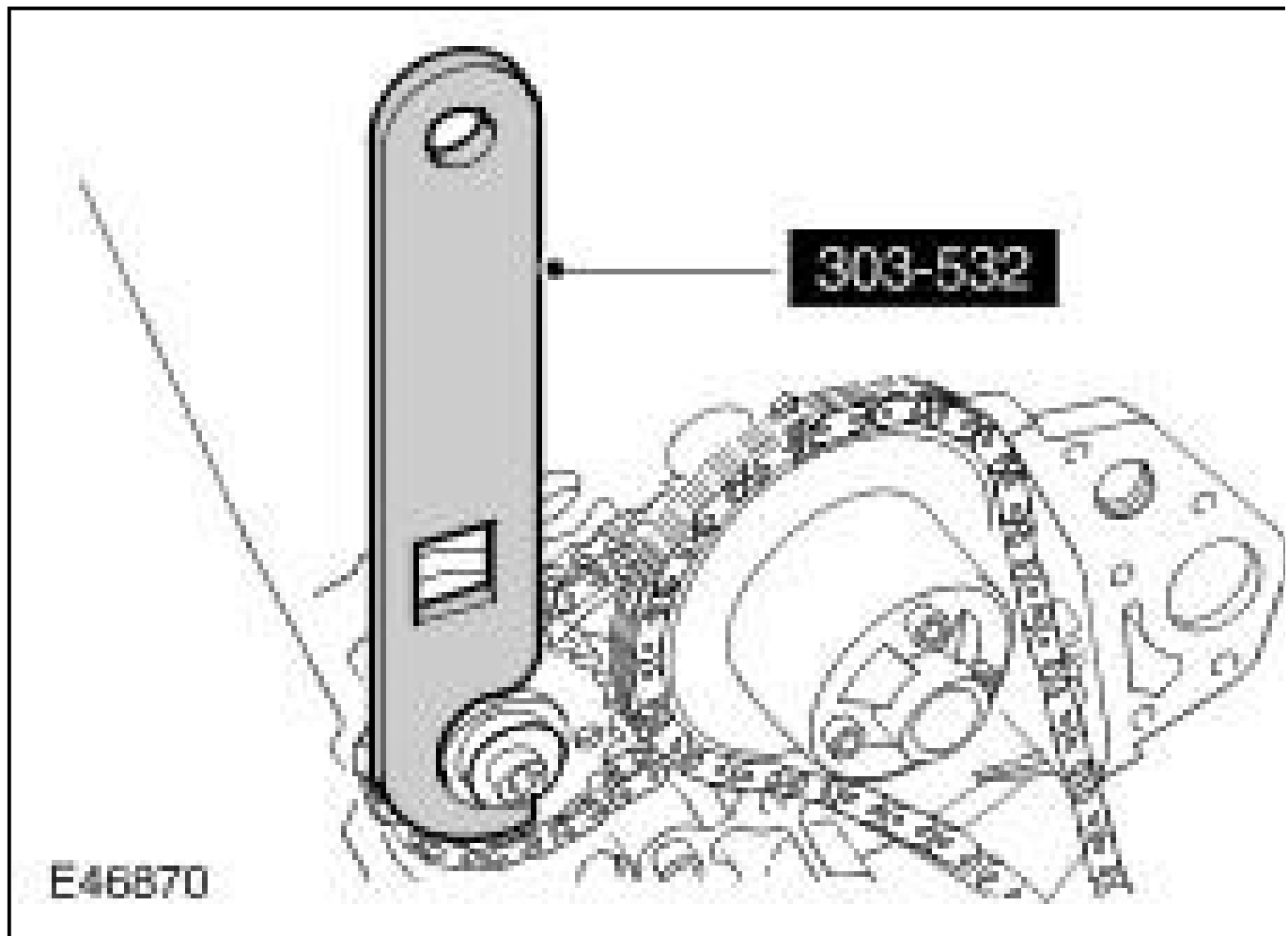


CAUTION: The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

CAUTION: Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

CAUTION: Make sure that new bolts are installed.

22. Install the special tool to the exhaust camshaft sprocket.
- Tighten the intake camshaft sprocket retaining bolt to 120 Nm (88 lb.ft).
 - Tighten the exhaust camshaft retaining bolt to 120 Nm (88 lb.ft).



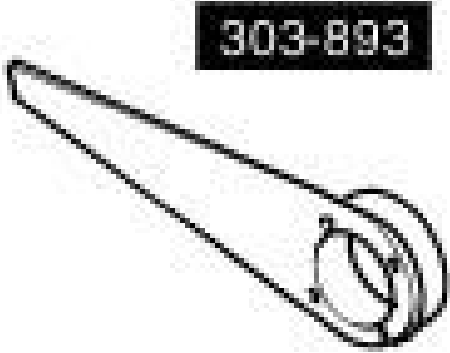
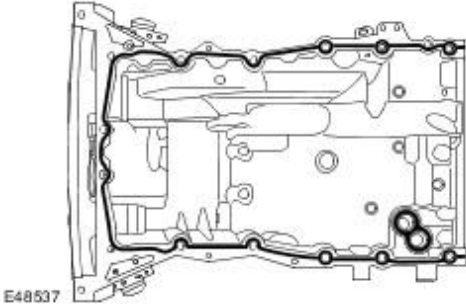
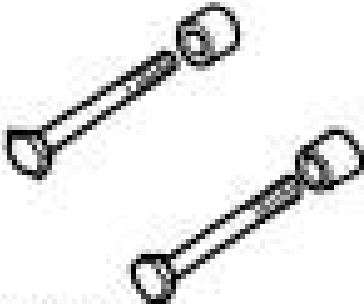
23. Remove the special tool from the RH cylinder head.
24. Install the RH VCT oil control unit.
- Install the new O-ring seals.
 - Tighten the new bolts to 22 Nm (16 lb.ft).
25. Remove the crankshaft locking tool.

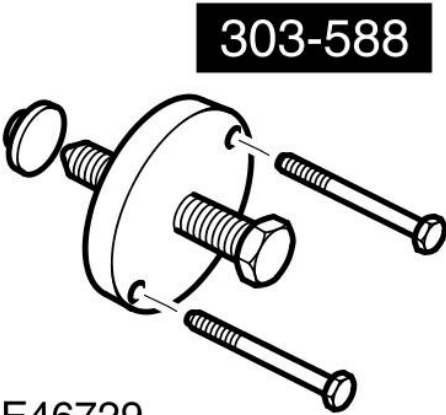
- Remove the screw.

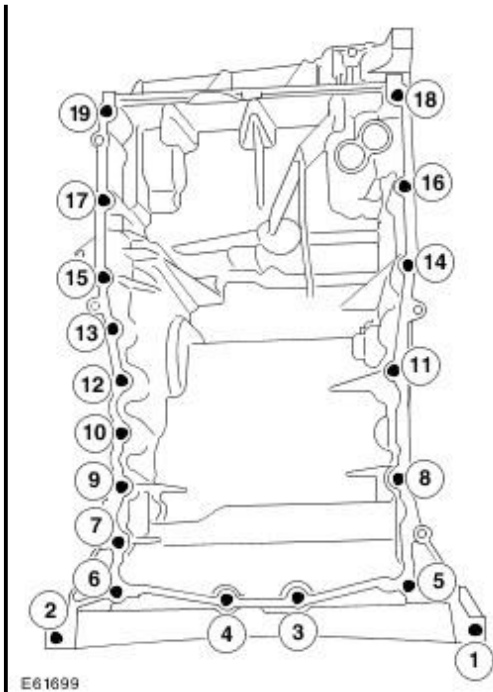
26. Install the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor** .
27. Install the engine front cover. See **Engine Front Cover**.
28. Connect the battery ground cable. Refer to **Specifications** .

CRANKSHAFT PULLEY

SPECIAL TOOLS

Tool Illustration	Tool Name	Tool Number
 303-893 E46728	Holding Tool Crankshaft Pulley	303-893(LRT-12-080)
 E48537	Adapter	303-191-03
 303-191-04 E59251	Bolts and spacers	303-191-04

 303-588 E46729	Remover, crankshaft pulley	303-588
 303-D121 E84849	Remover, crankshaft seal	303-D121
 303-1100 E46732	Installer, crankshaft seal	303-1100
	Adapter - Crankshaft seal installer	303-1100-01

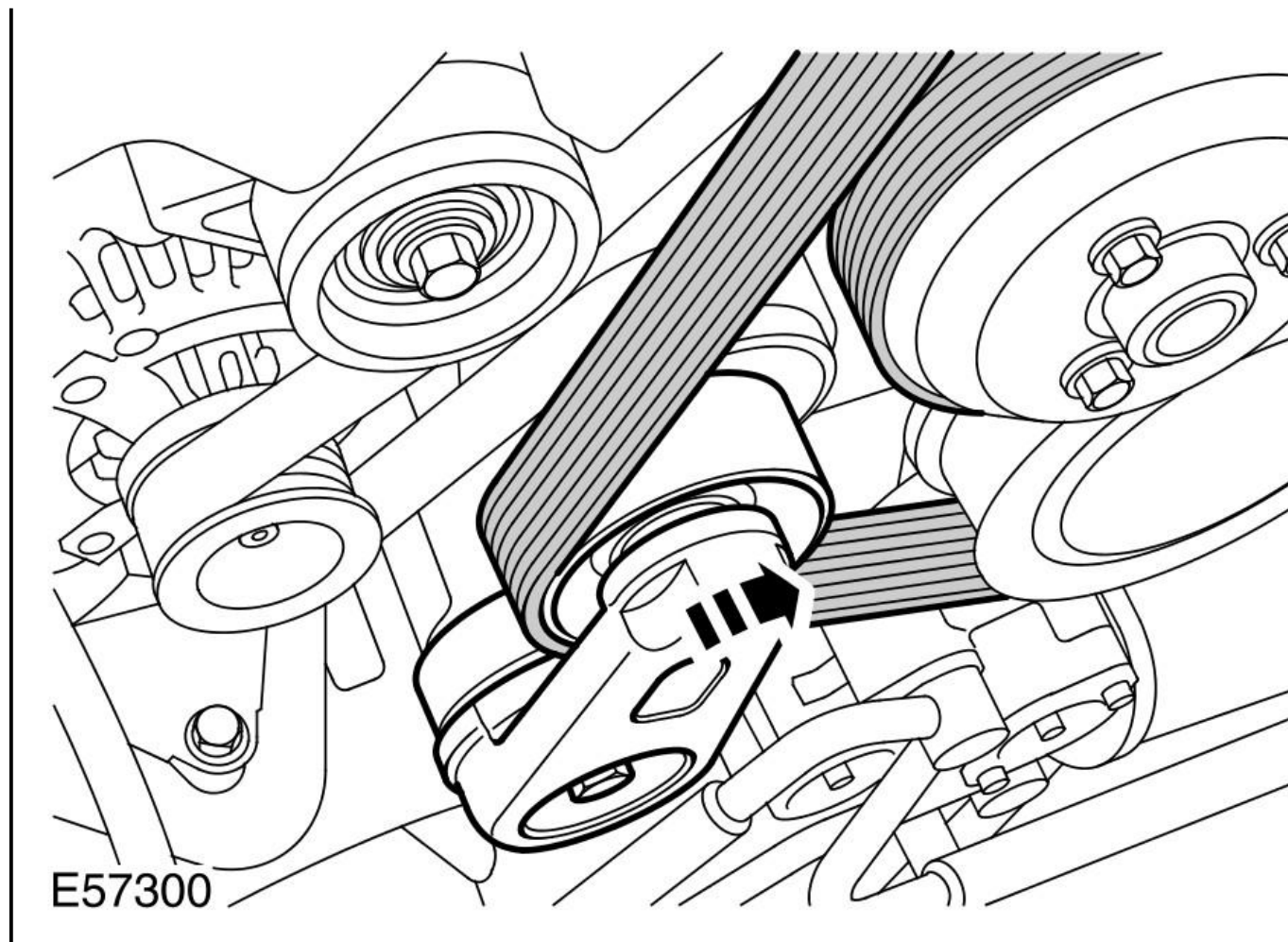


REMOVAL

1. Disconnect the battery ground cable. Refer to Specifications .

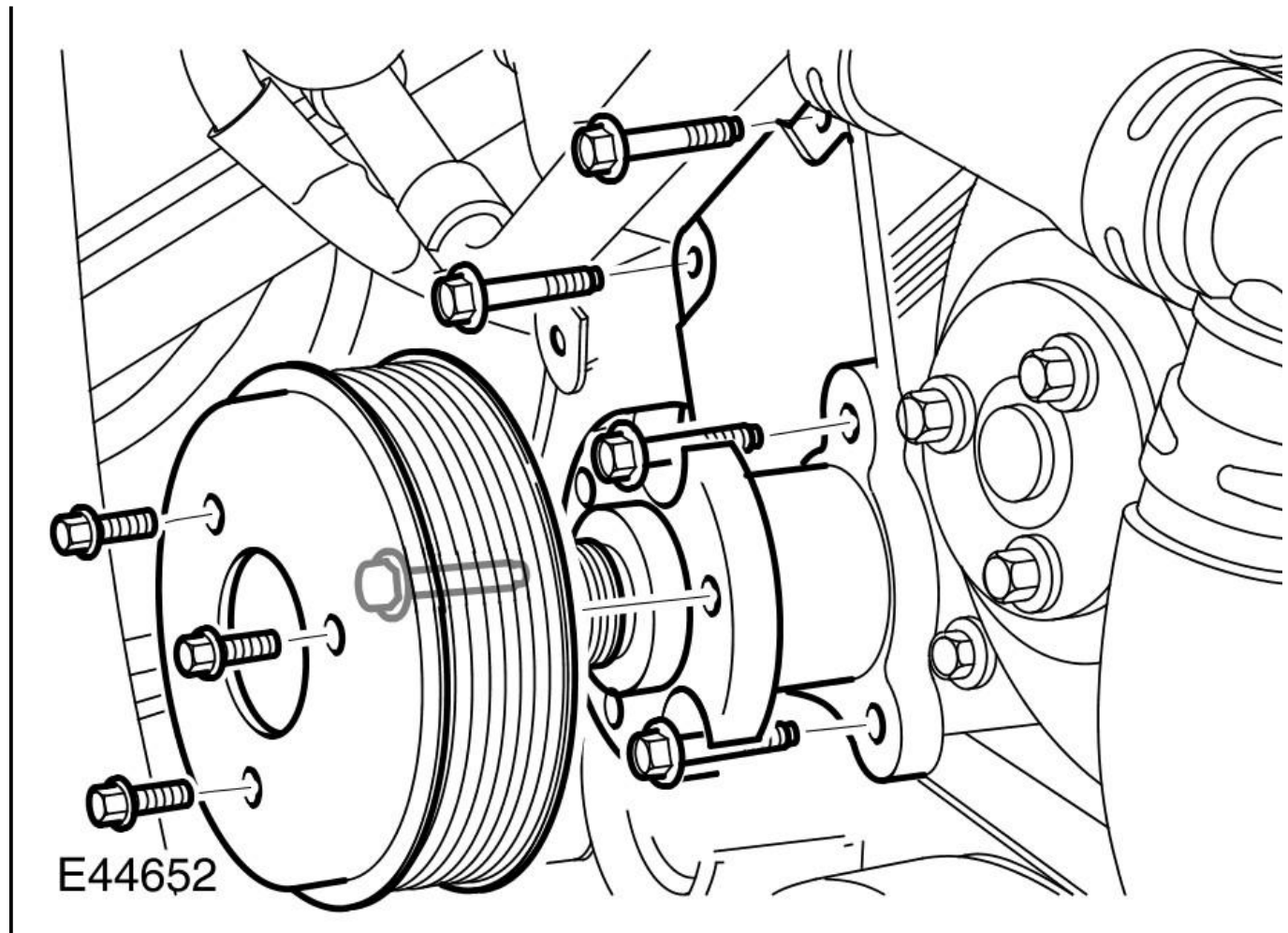
WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the cooling fan. Refer to Cooling Fan .
4. Remove the cooling fan drive belt.
 - Note the fitted position.
 - Rotate the cooling fan belt tensioner clockwise.
 - Loosen the cooling fan belt tensioner bolt to aid the removal of the belt.

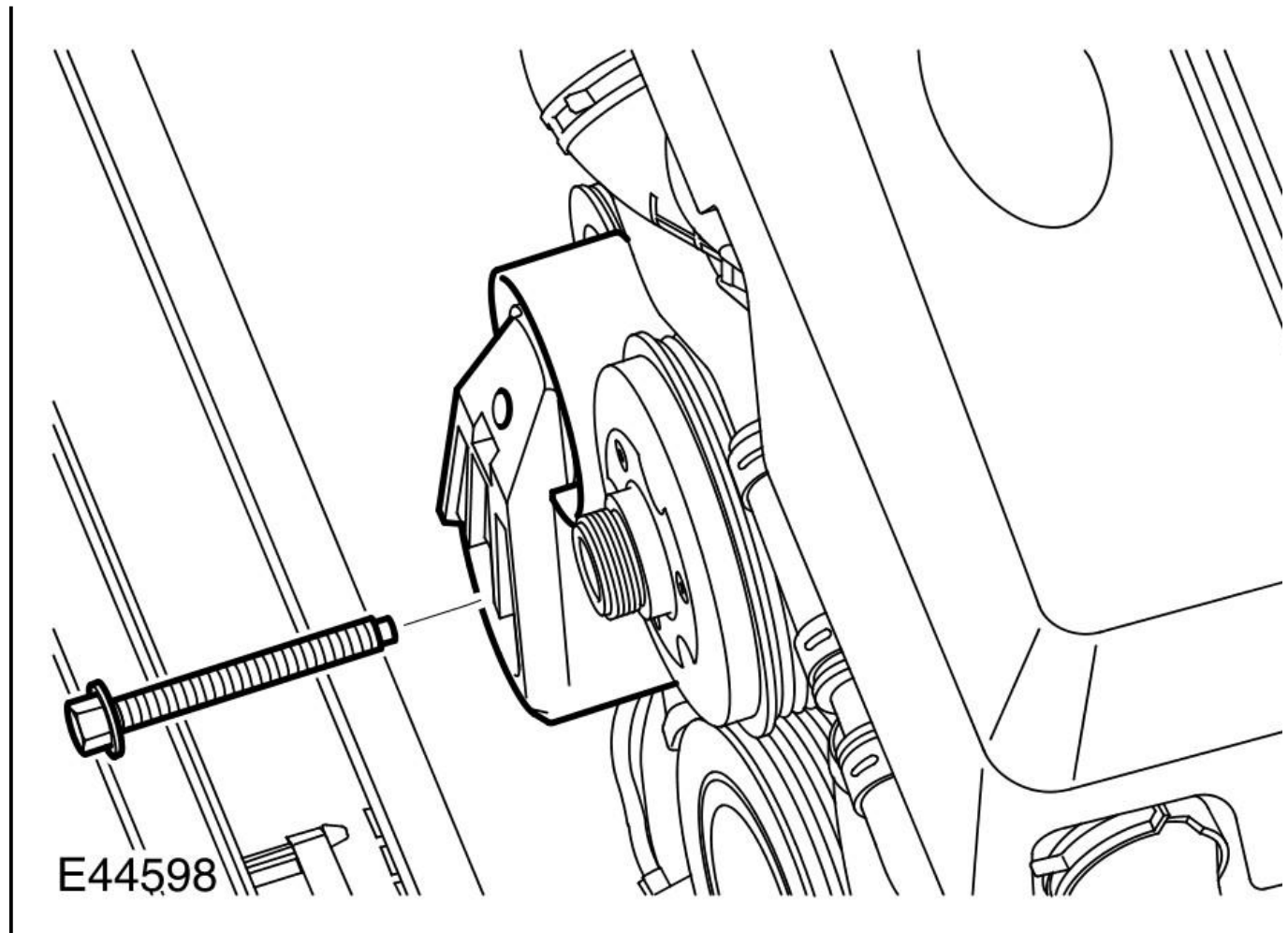


NOTE: **Restrain the pulley to aid the removal of the bolts.**

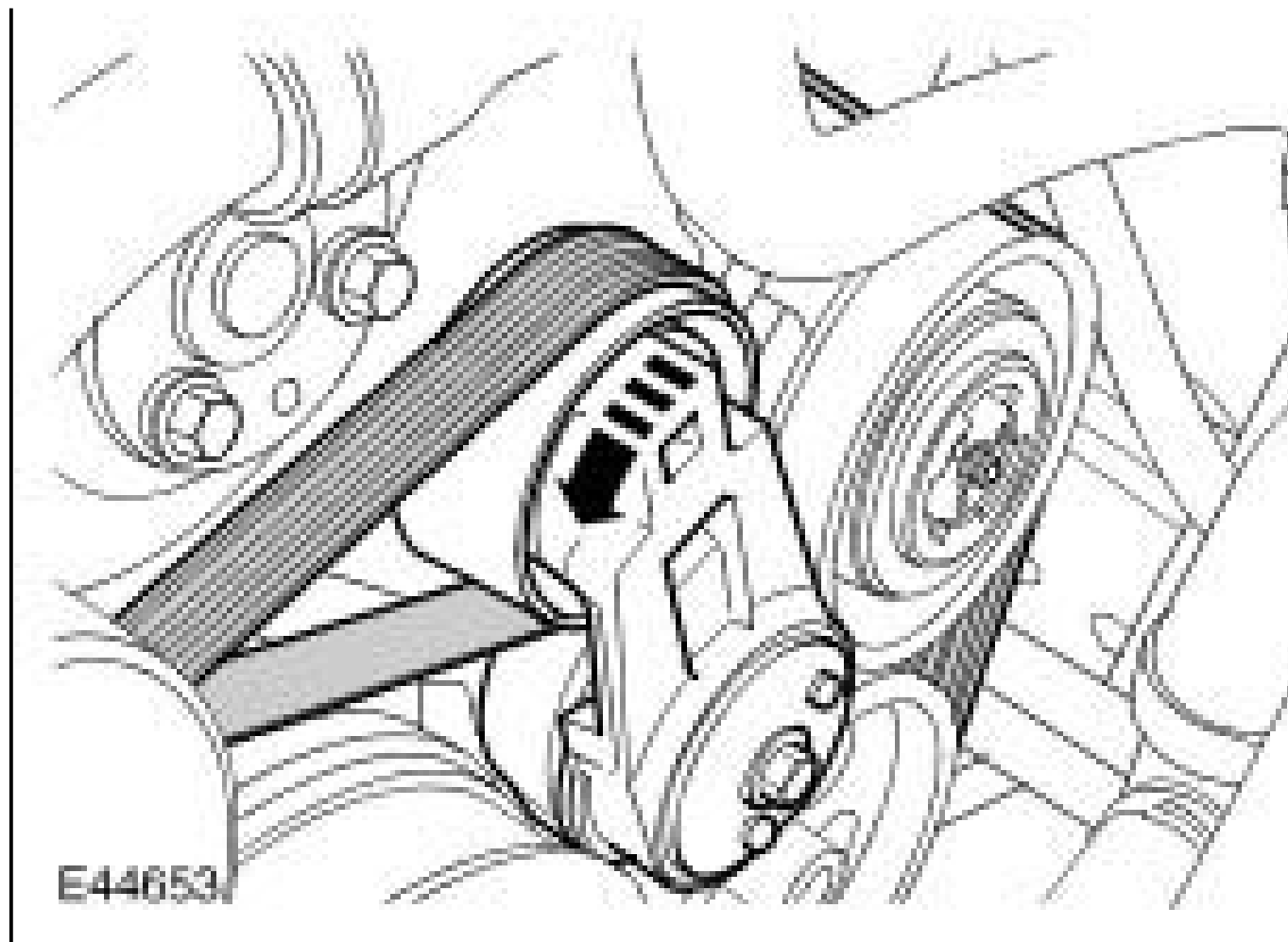
5. Remove the cooling fan pulley.
 - Remove the 3 bolts.
6. Remove the cooling fan drive hub bearing.
 - Remove the 5 bolts.



7. Remove the cooling fan belt tensioner.
 - Remove the bolt.



8. Release the accessory drive belt.
 - Rotate the accessory drive belt tensioner counter-clockwise, using a 3/8 " drive wrench.

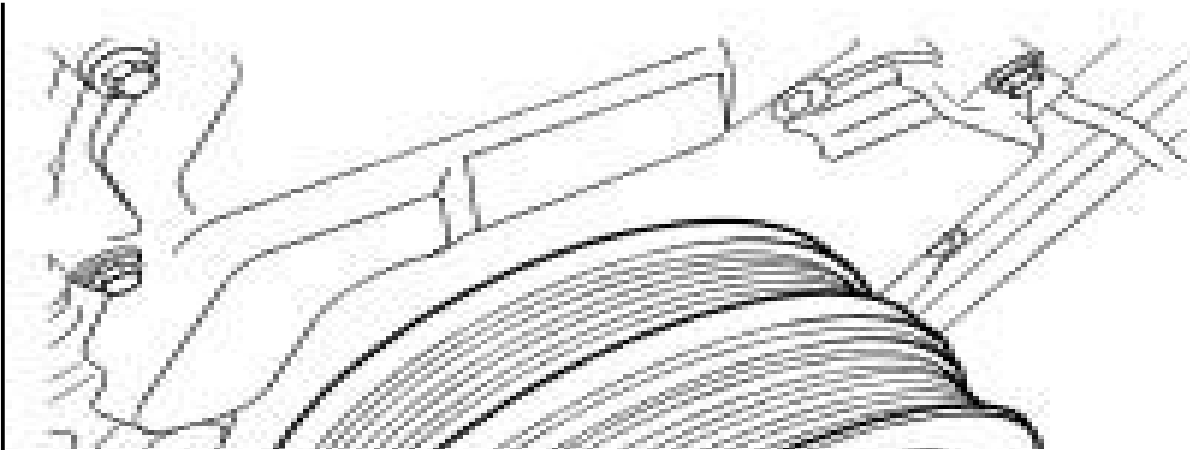


NOTE: Note the fitted position.

9. Remove the accessory drive belt.

CAUTION: Under no circumstances should the crankshaft setting peg, 303-645, be used in the following operations, to restrain the crankshaft.

10. Using the special tools, retain the crankshaft pulley.



NOTE: The crankshaft pulley retaining bolt will be very tight.

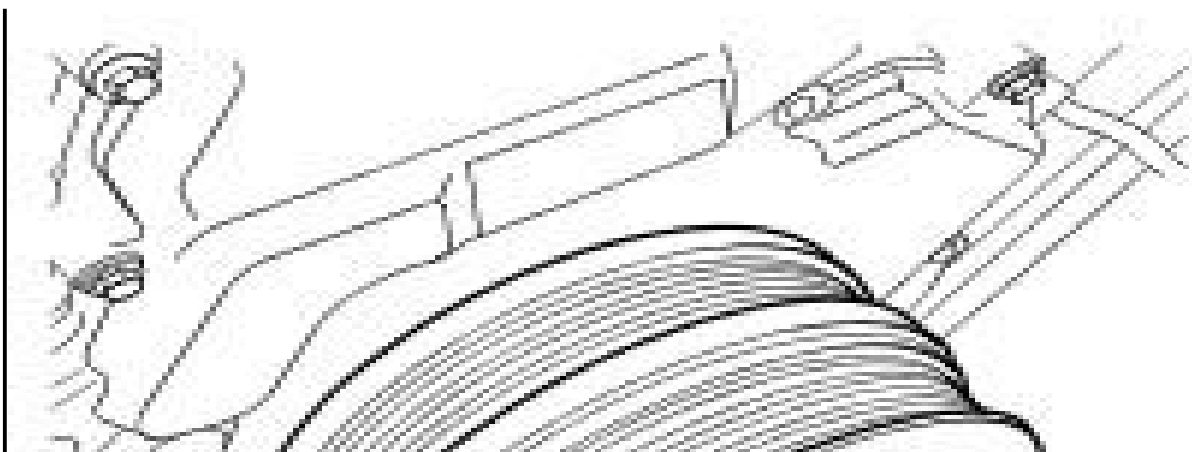
11. Remove the crankshaft pulley retaining bolt.
 - Discard the bolt.

- Remove the special tools.

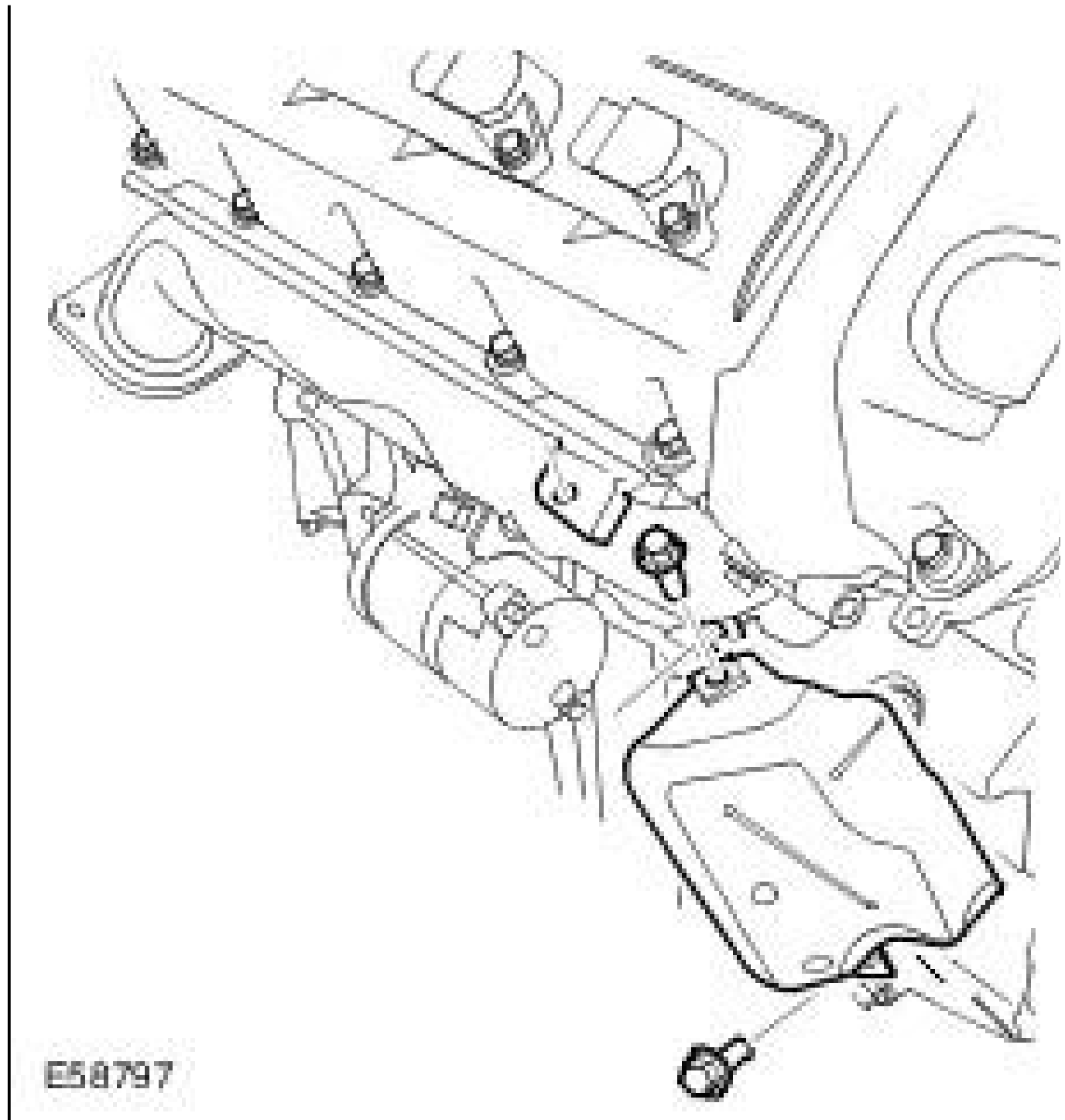
NOTE: **The crankshaft pulley will be very tight.**

12. Using the special tools, remove the crankshaft pulley.

- Collect the locking ring.
- Remove the special tools.



13. Using the special tool, remove the crankshaft front seal.

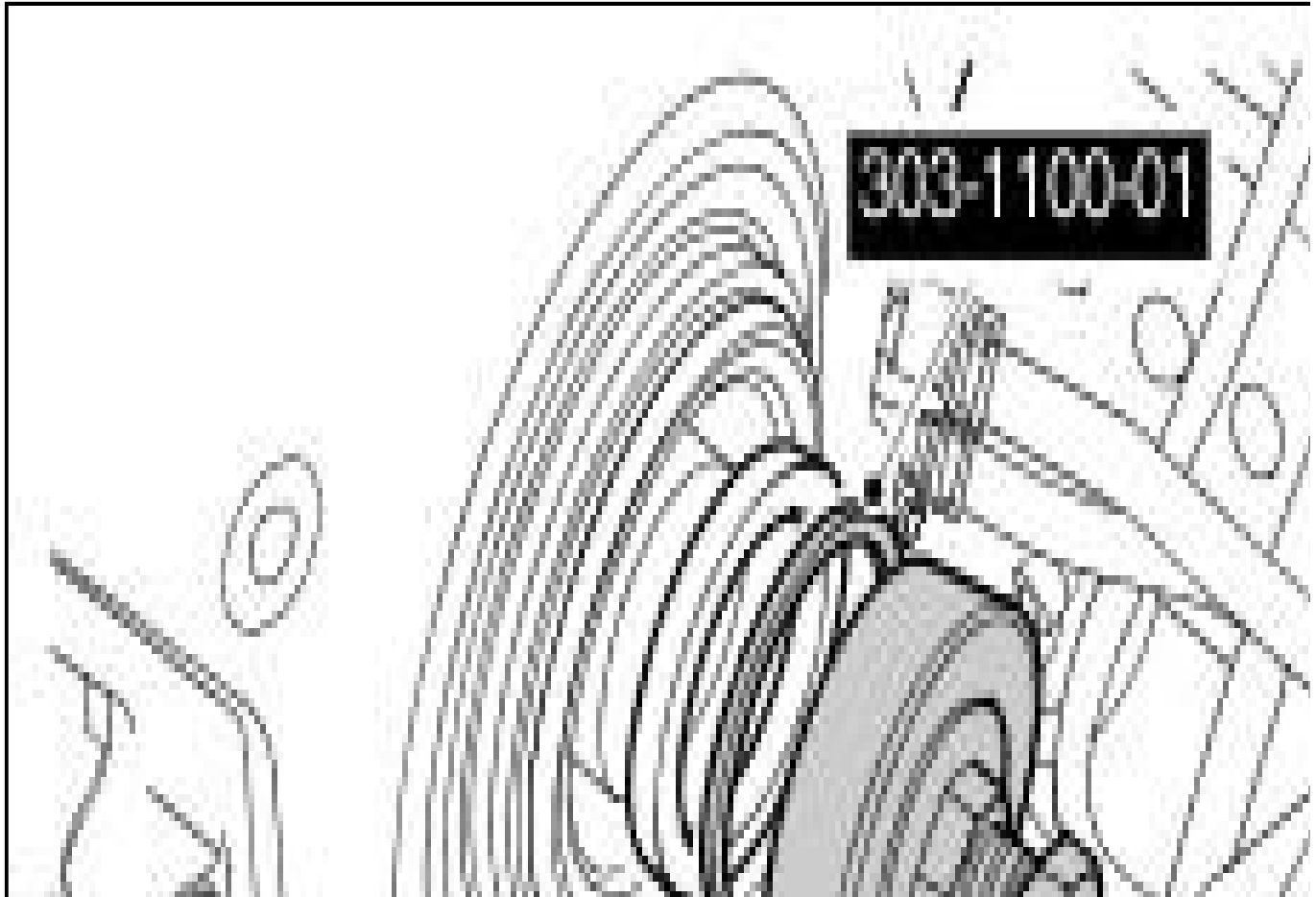


14. Check the crankshaft damper pulley and locking ring for damage.

INSTALLATION

1. Clean all the crankshaft pulley mating faces.
2. Using the special tools, install the crankshaft front seal.

- Lubricate the seal with clean engine oil.
- Use the discarded crankshaft bolt with the service tool.
- Remove the special tools.



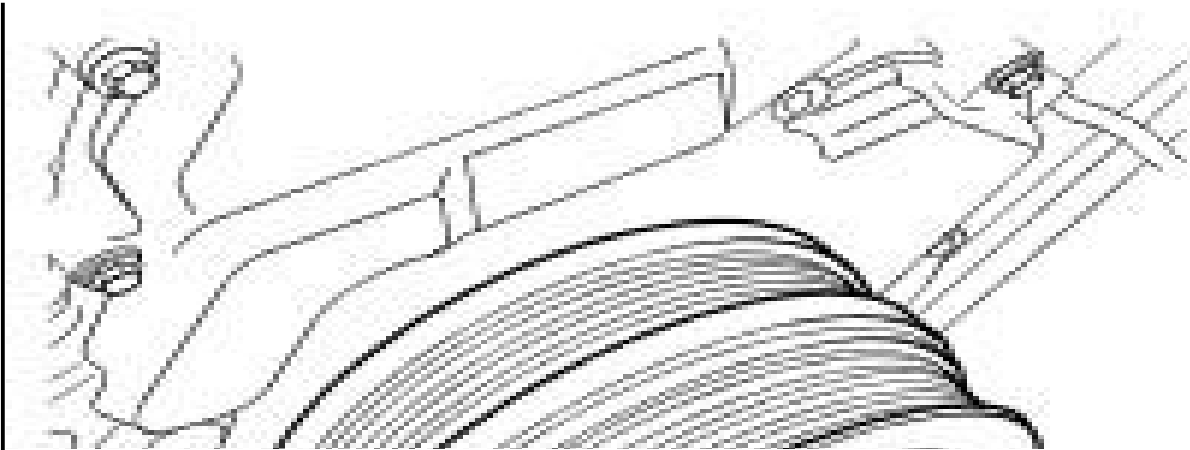
3. Install the crankshaft pulley.
 - Lubricate the seal with clean engine oil.
4. Install the crankshaft pulley locking ring.

CAUTION: The screw thread in the crankshaft pulley must be cleaned out before installing a new crankshaft pulley bolt.

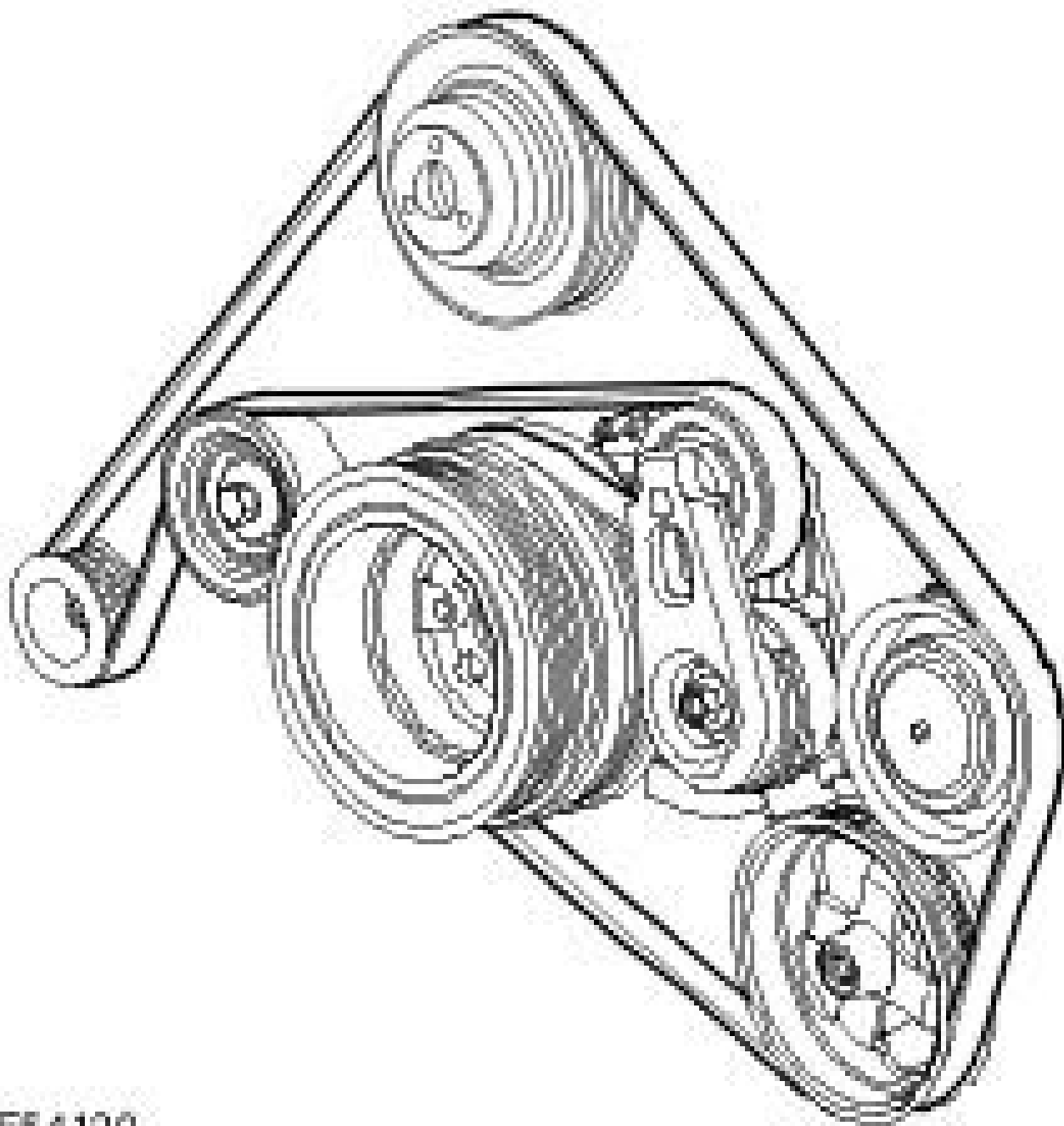
5. Install, but do not tighten, the new crankshaft pulley bolt.

CAUTION: Under no circumstances should the crankshaft setting peg, 303-645, be used in the following operations, to restrain the crankshaft.

6. Using the special tools, retain the crankshaft pulley.
 - Tighten the crankshaft pulley bolt to 380 Nm (280 lb.ft).
 - Remove the special tools.



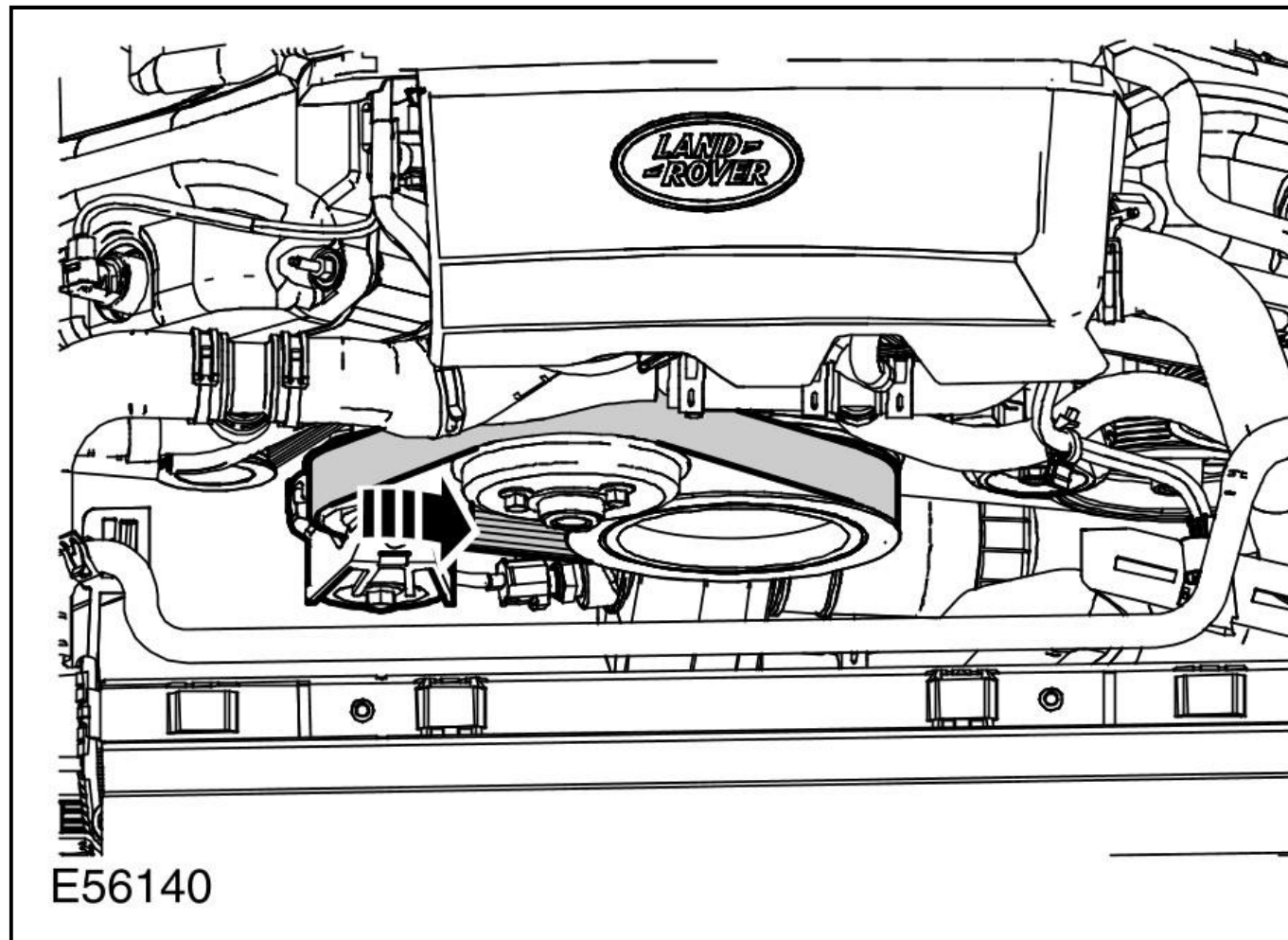
7. Install the accessory drive belt.



E54120

8. Install the cooling fan belt tensioner.
 - Tighten the M10 bolt to 45 Nm (33 lb.ft).
9. Install the cooling fan drive hub bearing.
 - Tighten the bolts to 10 Nm (7 lb.ft).
10. Install the cooling fan drive pulley.

- Tighten the bolts evenly to 25 Nm (18 lb.ft).
11. Install the cooling fan drive belt.
 - Using a 1/2 inch square drive bar, rotate the drive belt tensioner clockwise.

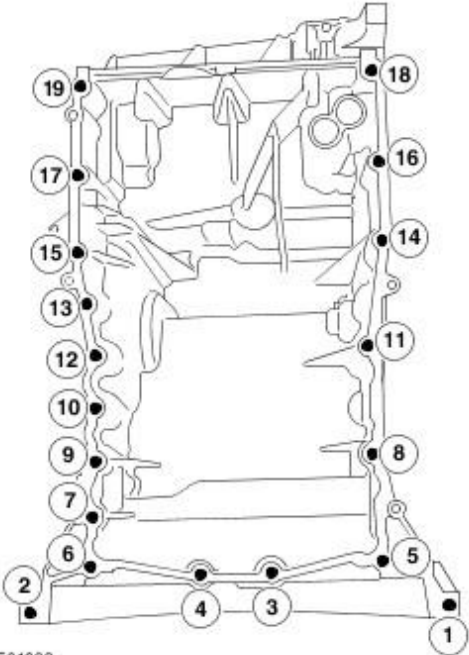


12. Install the cooling fan. Refer to **Cooling Fan**.
13. Connect the battery ground cable. Refer to **Specifications**.

CRANKSHAFT FRONT SEAL

SPECIAL TOOLS

Tool Illustration	Tool Name	Tool Number
	Remover, crankshaft seal	303-D121

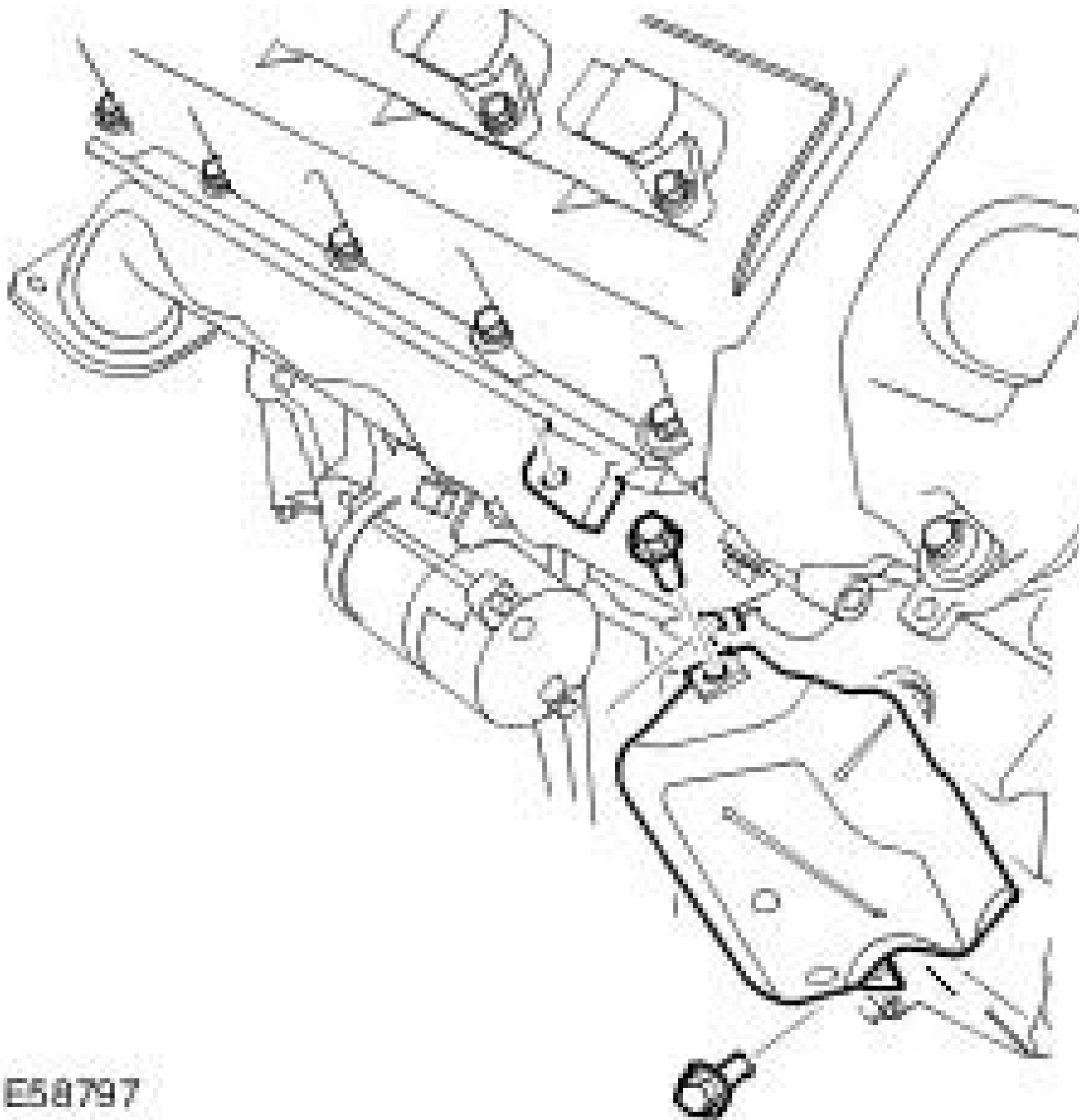
 303-D121 E64849		
 303-1100 E46732	Installer, crankshaft seal	303-1100
 E61699	Adapter - Crankshaft seal installer	303-1100-01

REMOVAL

1. Disconnect the battery ground cable. Refer to **Specifications** .
2. Remove the crankshaft pulley. See **Crankshaft Pulley**.

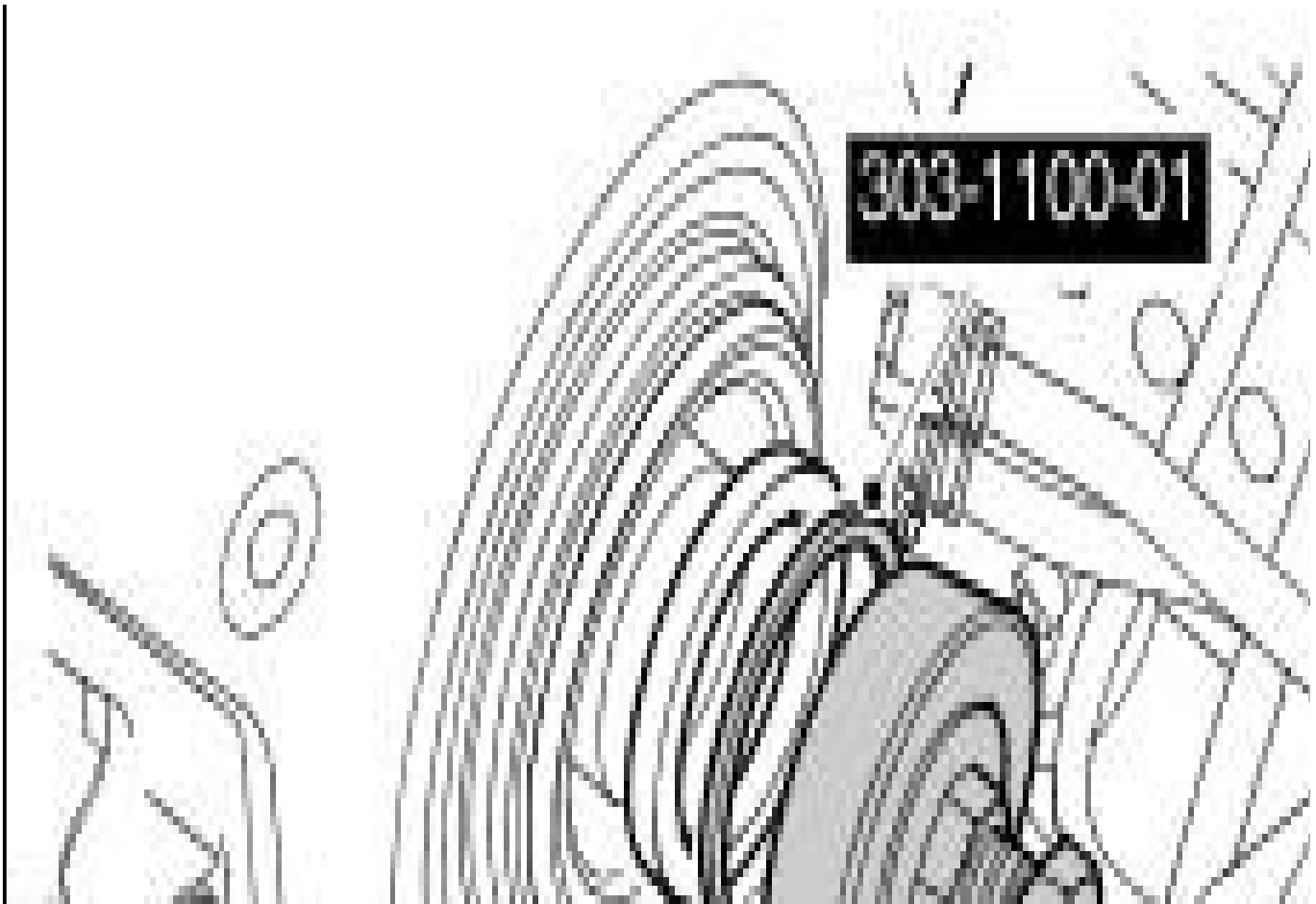
CAUTION: Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

3. Using the special tool, remove the crankshaft front seal.



INSTALLATION

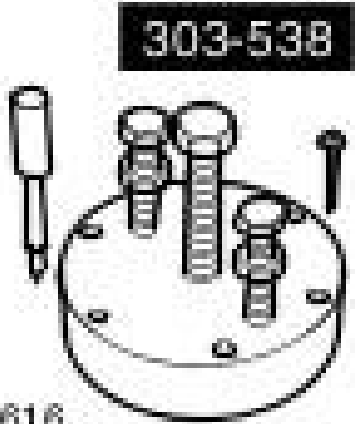
1. Using the special tools, install the crankshaft front seal.
 - Clean the component mating faces.



2. Install the crankshaft pulley. See **Crankshaft Pulley**.
3. Connect the battery ground cable. Refer to **Specifications** .

CRANKSHAFT REAR SEAL

SPECIAL TOOLS

Tool Illustration	Tool Name	Tool Number
 E46616	Crankshaft rear oil seal remover/installer	303-538

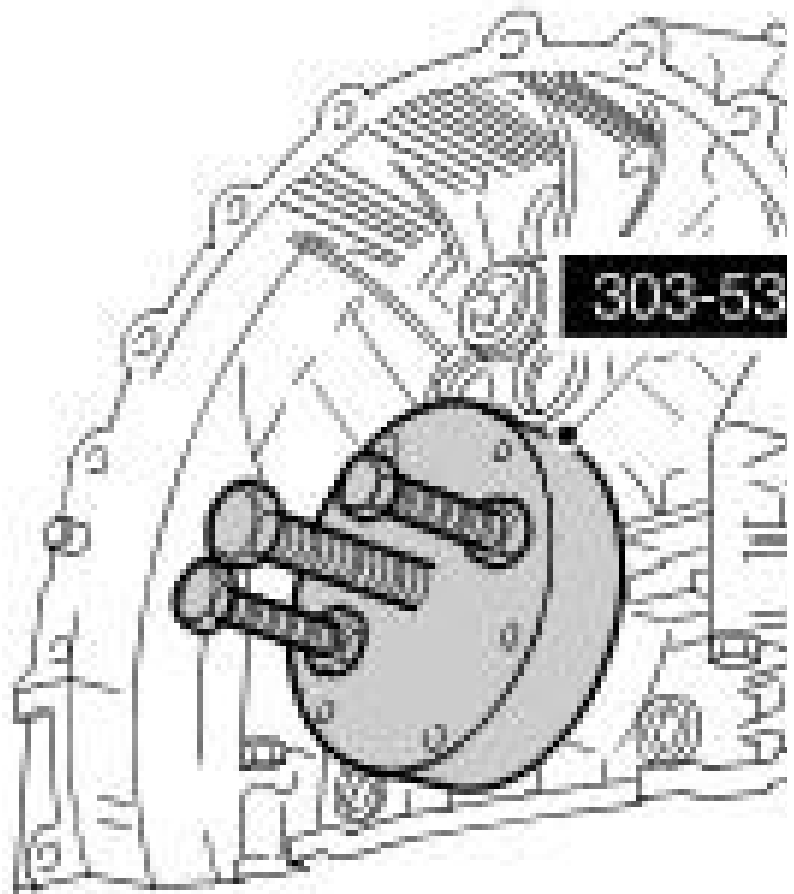
REMOVAL

1. Disconnect the battery ground cable. Refer to Specifications .

WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

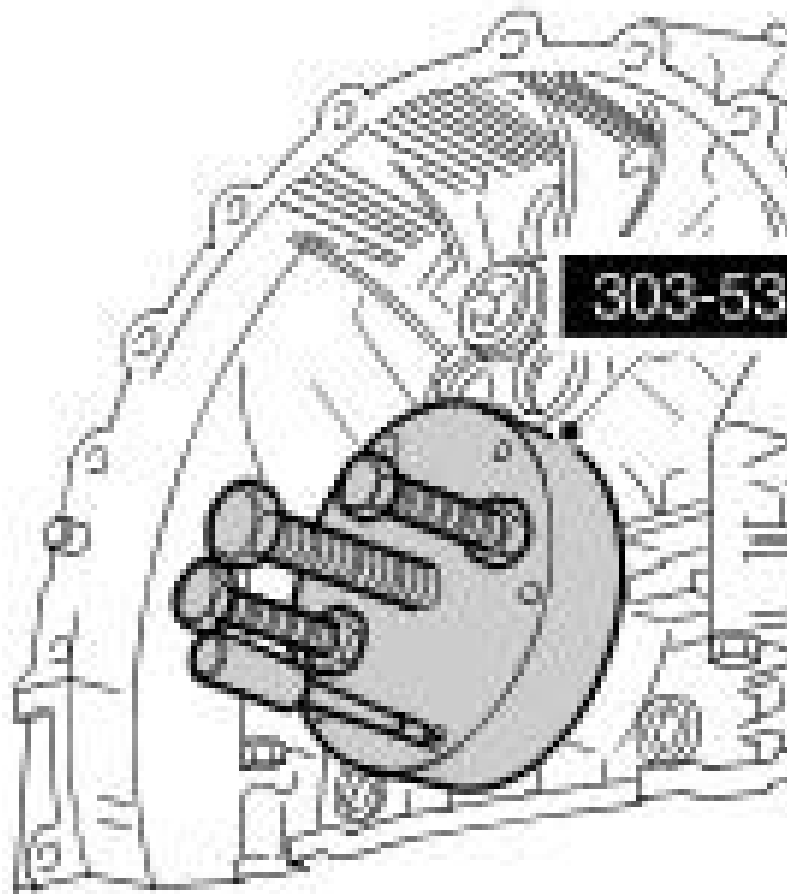
2. Raise and support the vehicle.
3. Remove the torque converter flexplate. See Flexplate.
4. Install the special tools.
 - Install the 2 bolts.
 - Tighten the 2 nuts to retain the special tool.

E46613

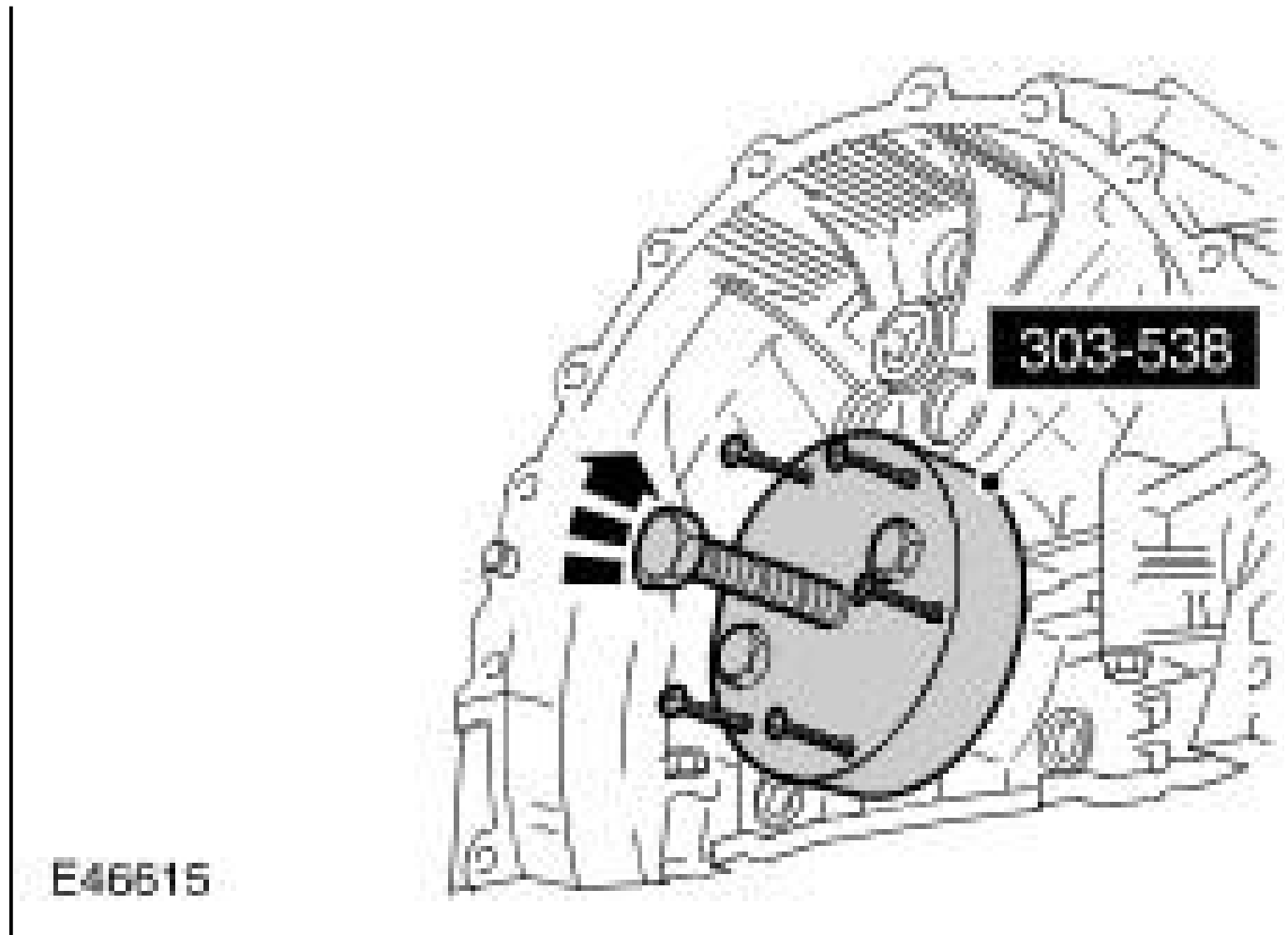


5. Using the special tool, pierce the seal to create holes for the 6 self-tapping screws.

E46614



6. Using the special tools, remove and discard the crankshaft rear oil seal.
- Install the 6 self-tapping screws.
 - Adjust the 2 nuts.
 - Tighten the center bolt.



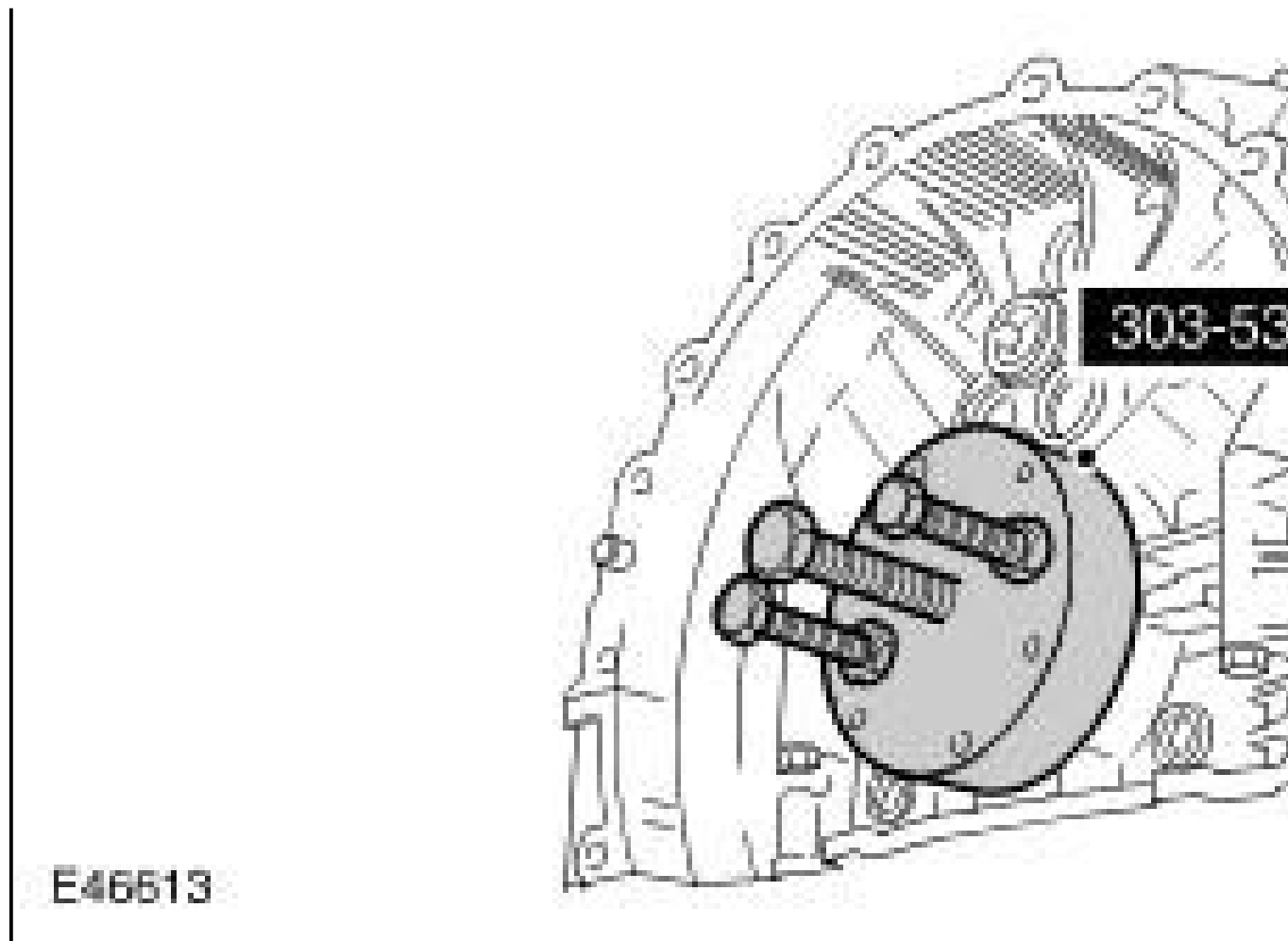
INSTALLATION

CAUTION: Do not lubricate the components.

1. Partially install the crankshaft rear oil seal.
 - Make sure the components are clean and dry.
 - Carefully remove the transit sleeve, leaving the seal on the crankshaft.

CAUTION: Make sure the seal is installed parallel

2. Using the special tool, install the crankshaft rear oil seal.
 - Tighten the special tool nuts evenly and progressively to fully install the seal.

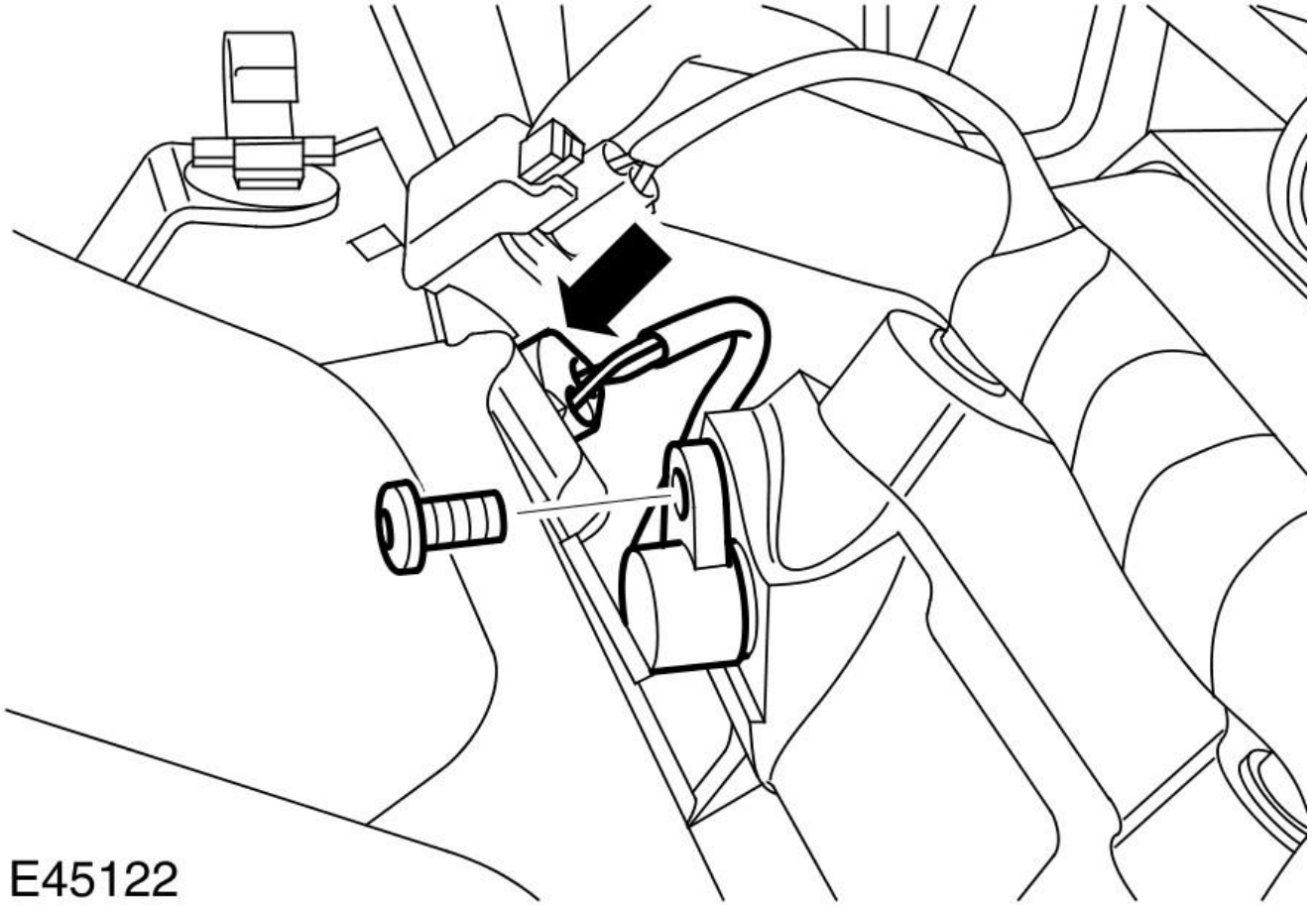


3. Install the torque converter flexplate. See **Flexplate**.
4. Check and top-up the engine oil.
5. Connect the battery ground cable. Refer to **Specifications** .

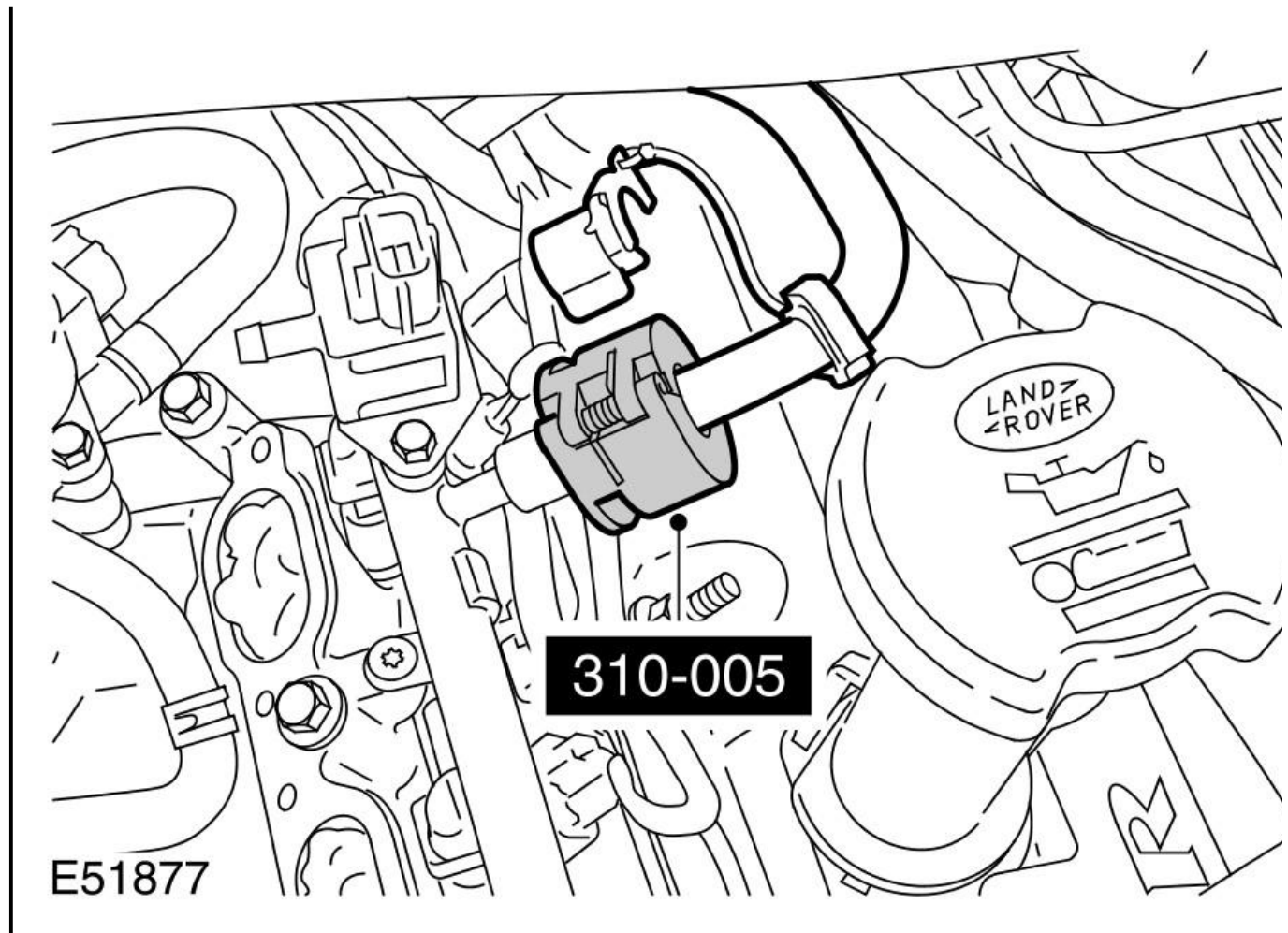
CYLINDER HEAD LH

REMOVAL

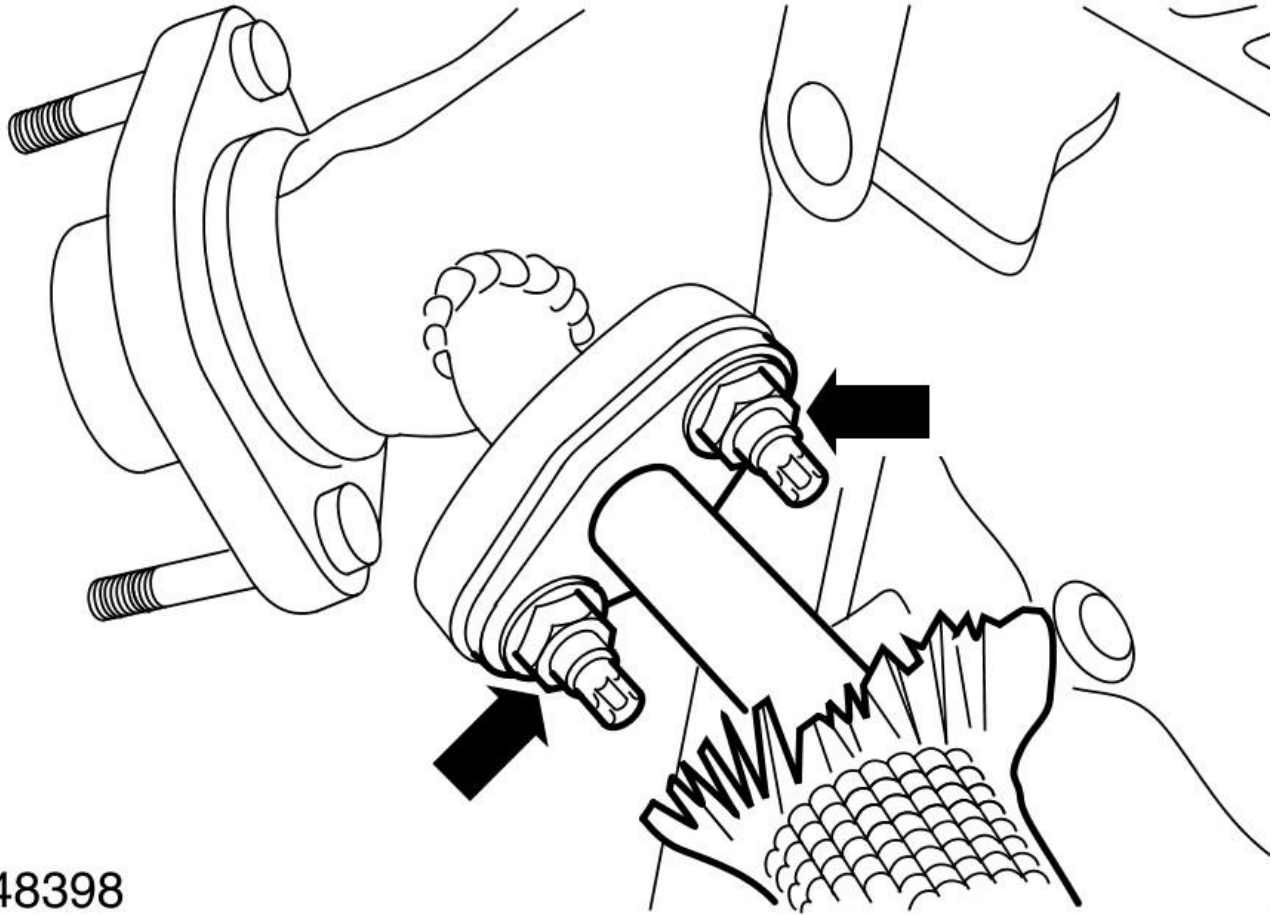
1. Disconnect the battery ground cable. Refer to **Specifications** .
2. Remove the intake manifold. See **Intake Manifold**.
3. Remove the LH bank camshafts. See **Camshaft LH**.
4. Remove the camshaft position (CMP) sensor.
 - Remove the Torx screw.
 - Disconnect the electrical connector.



5. Disconnect the LH catalytic converter from the exhaust manifold.
 - Remove and discard the 2 nuts.
6. Disconnect the RH catalytic converter from the exhaust manifold.
 - Remove and discard the 2 nuts.



7. Disconnect the exhaust manifold EGR pipe flange.
 - Remove the 2 nuts.



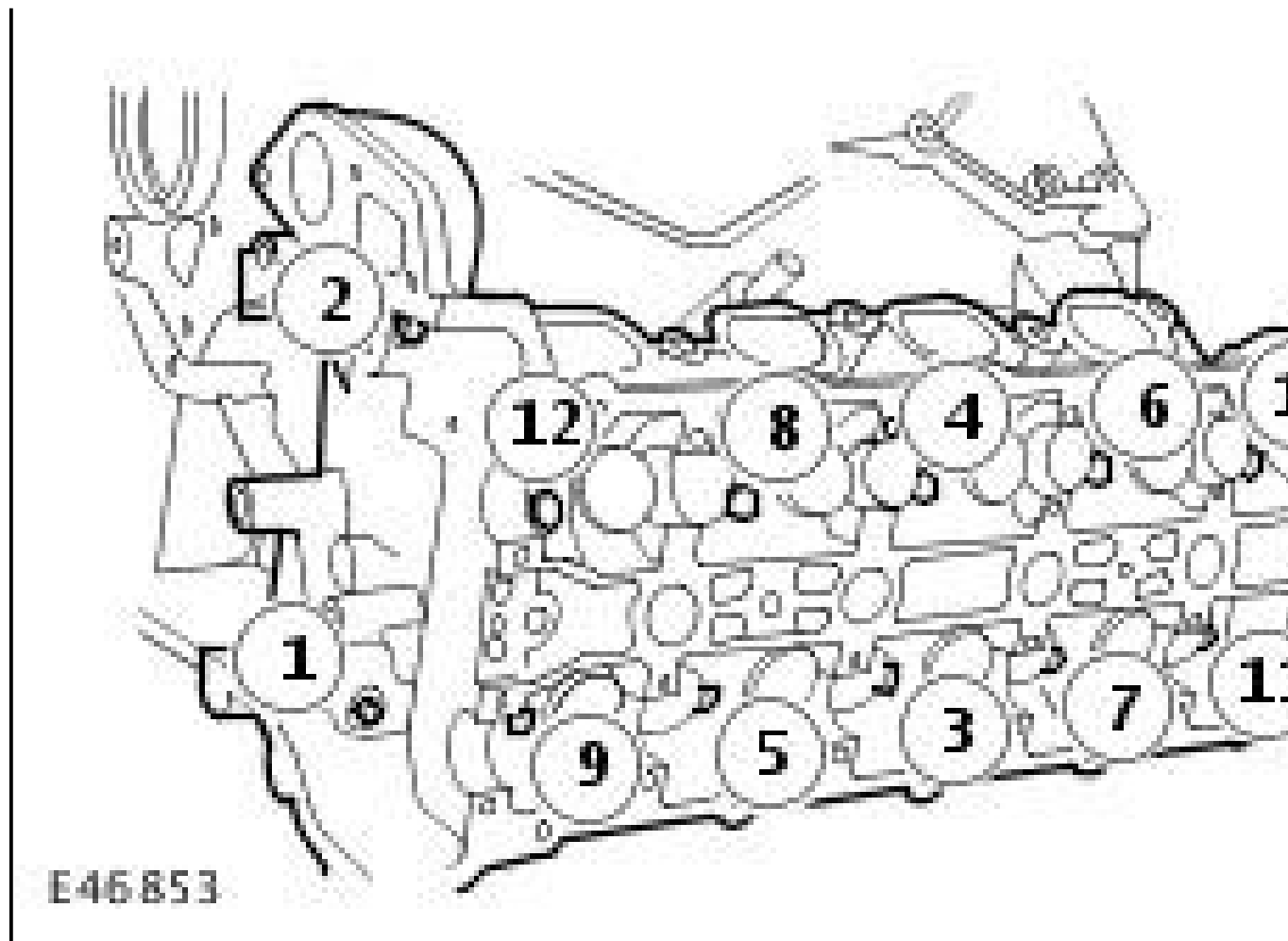
E48398

CAUTION: The bolts can only be used twice, mark the bolts with a center punch. If two punch marks are visible, discard the bolts.

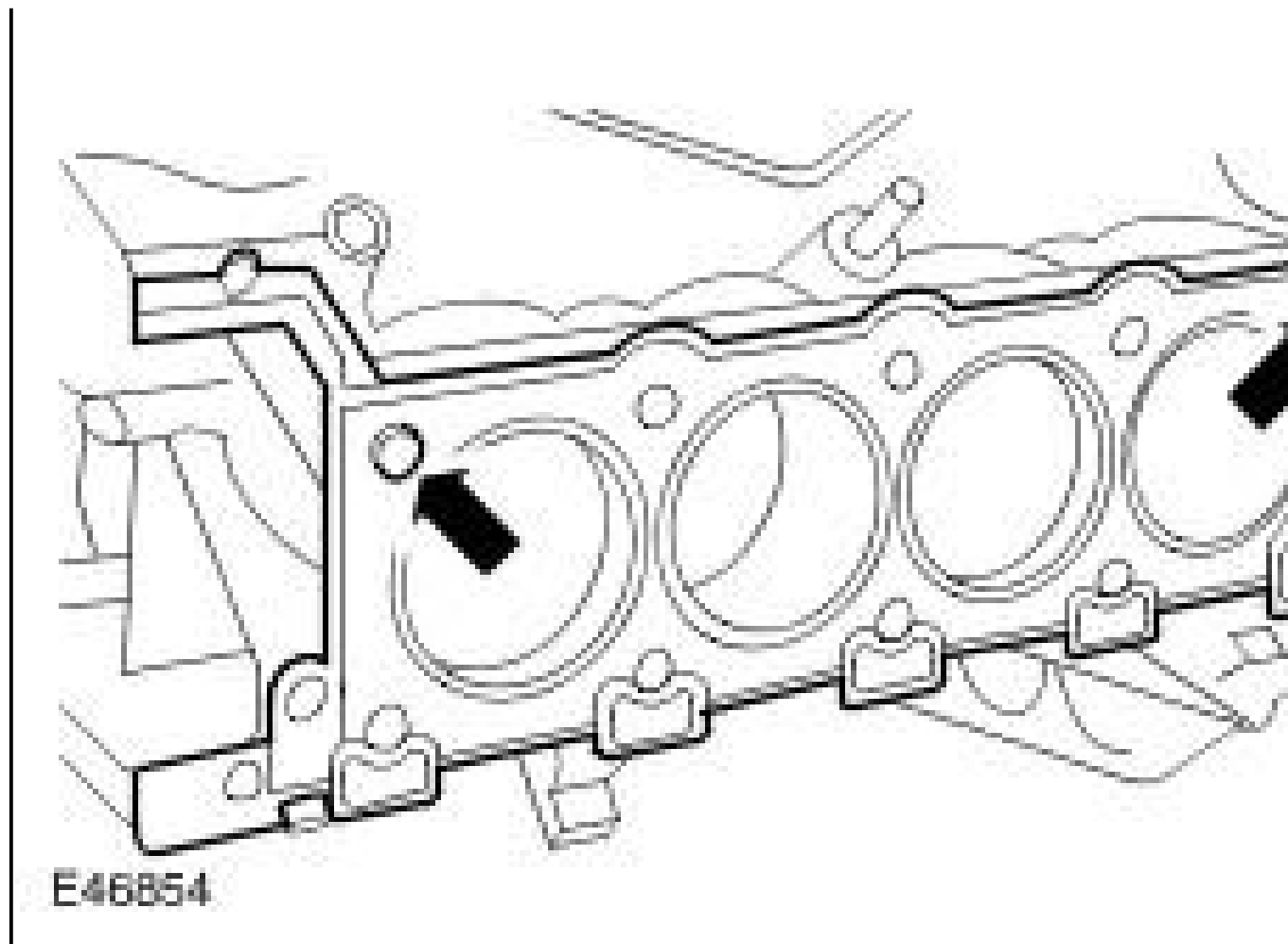
CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be removed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.

NOTE: Remove the bolts in the indicated sequence.

8. Remove the 12 cylinder head bolts.

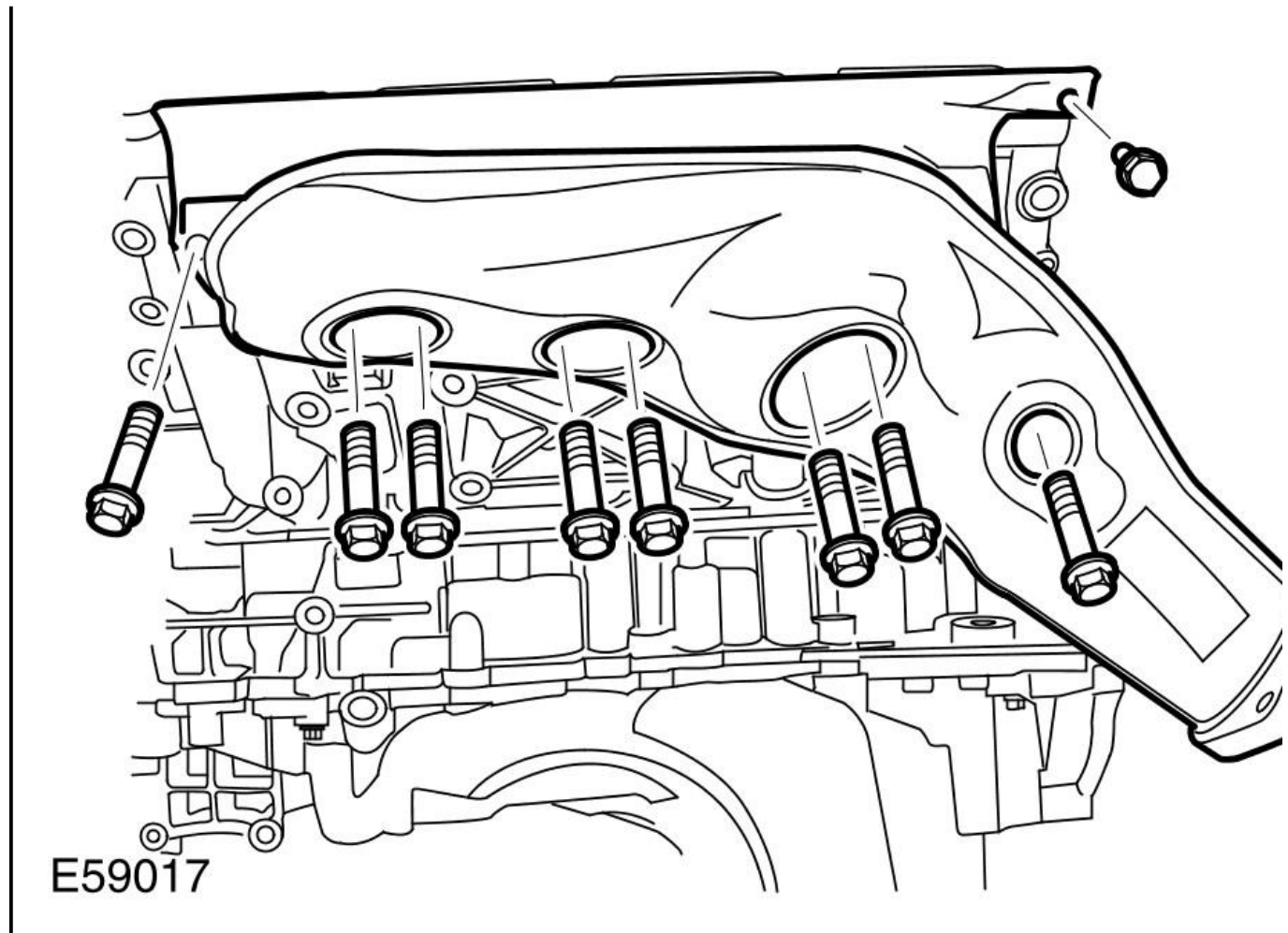


9. Remove the LH cylinder head assembly.
 - With assistance remove the cylinder head.
10. Remove and discard the cylinder head gasket.
 - Clean the cylinder head locating dowels.



NOTE: Do not disassemble further if the component is removed for access only.

11. Remove the exhaust manifold.
 - Remove the 8 bolts.
 - Discard the gasket and the bolts.

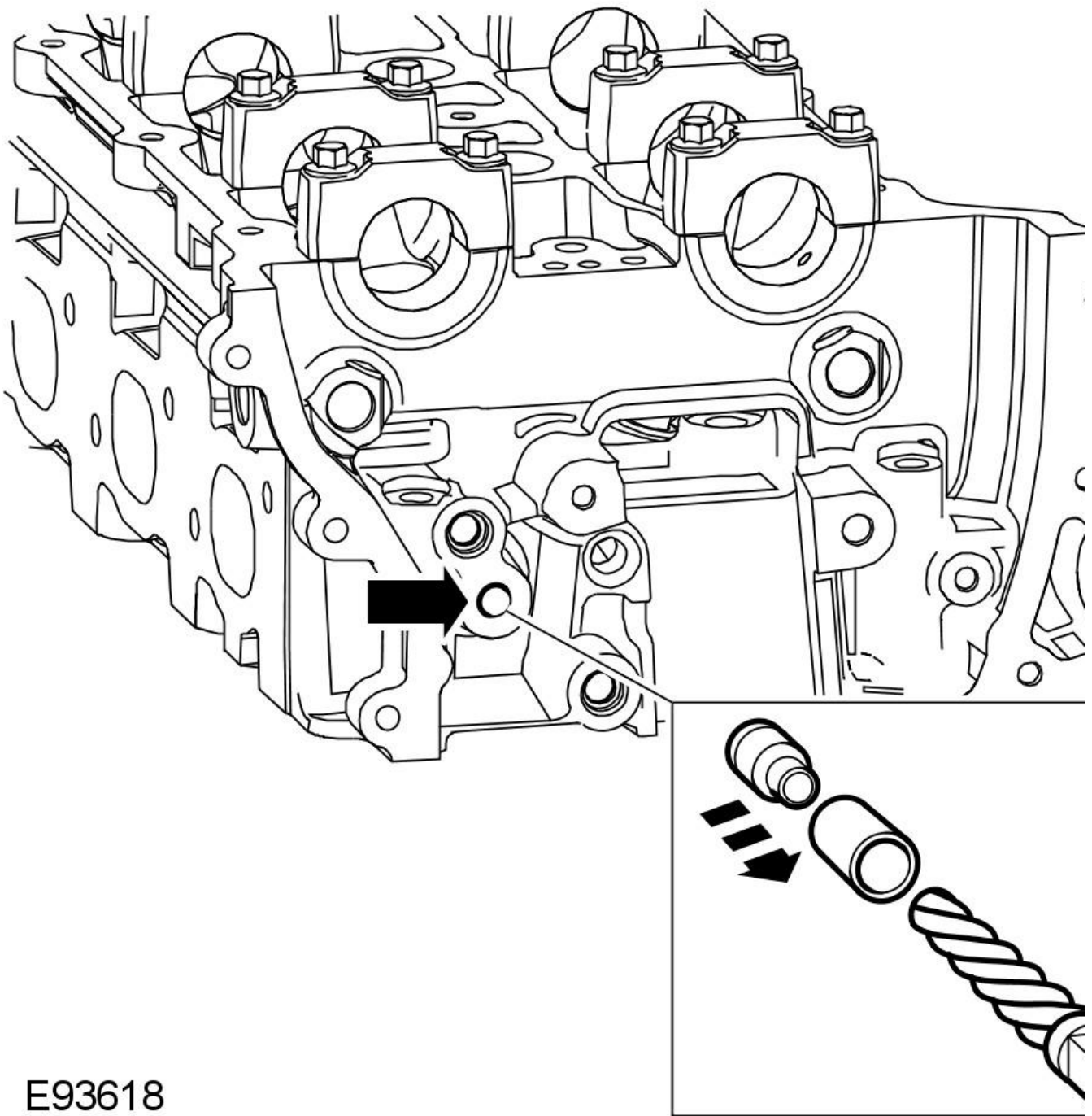
**INSTALLATION**

CAUTION: If a new cylinder head is to be installed to a vehicle with variable valve timing (VVT), the cylinder head must have the oil gallery blind rivet removed before installation.

CAUTION: Make sure that all debris and foreign material is removed from the cylinder head and cylinder head oil gallery.

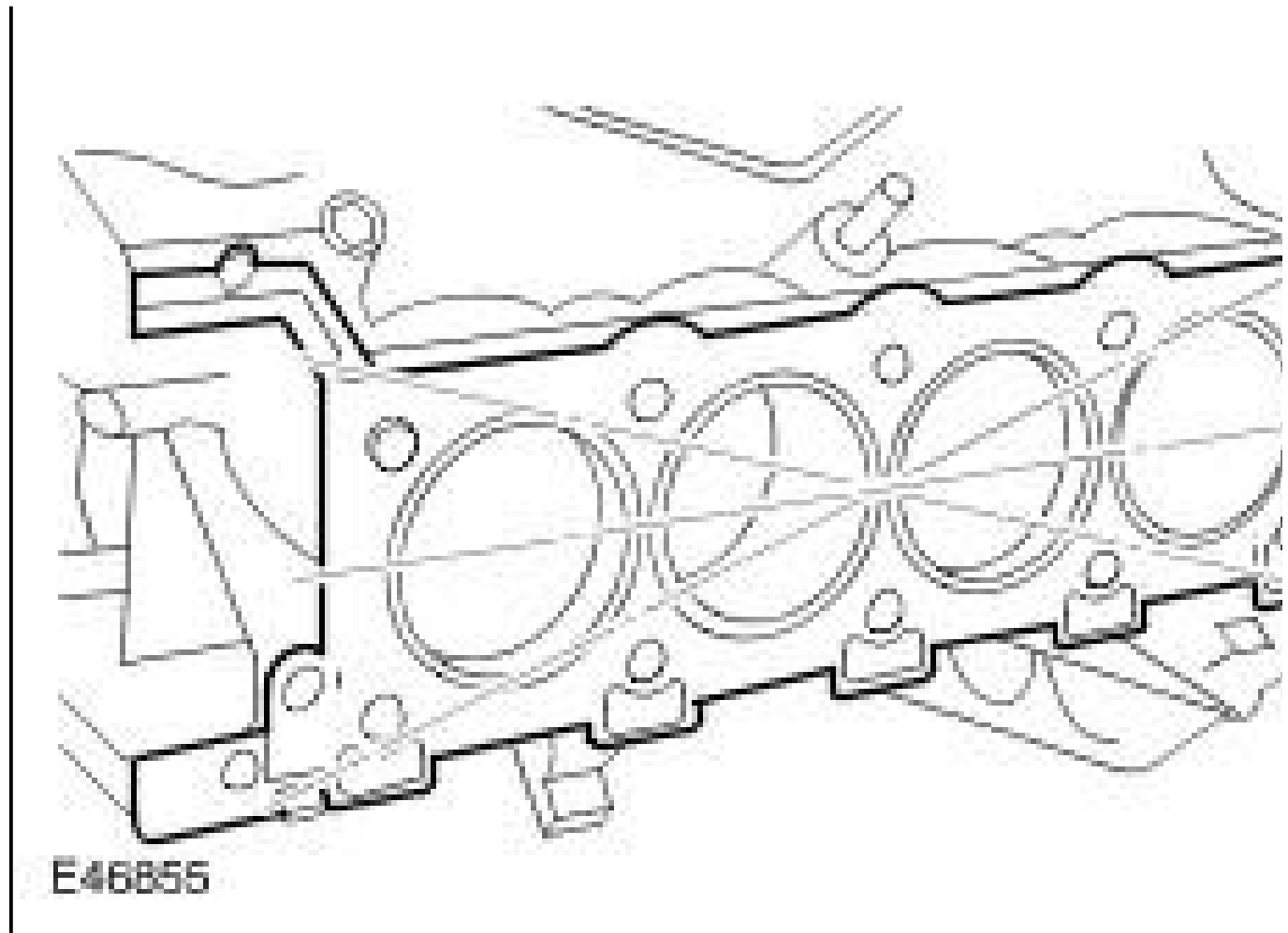
NOTE: The center bore of the blind rivet is 6 mm (0.24 inch) diameter.

1. Vehicles fitted with VVT: remove the blind rivet from the VVT oil gallery.
 - Identify the VVT oil supply gallery and the 8 mm (0.31 inch) blind rivet.
 - Using a suitable 3 mm (0.12 inch) punch release the center of the blind rivet until it is released from the outer part of the blind rivet.
 - Using a suitable extraction tool, remove the remaining part of the blind rivet.



E93618

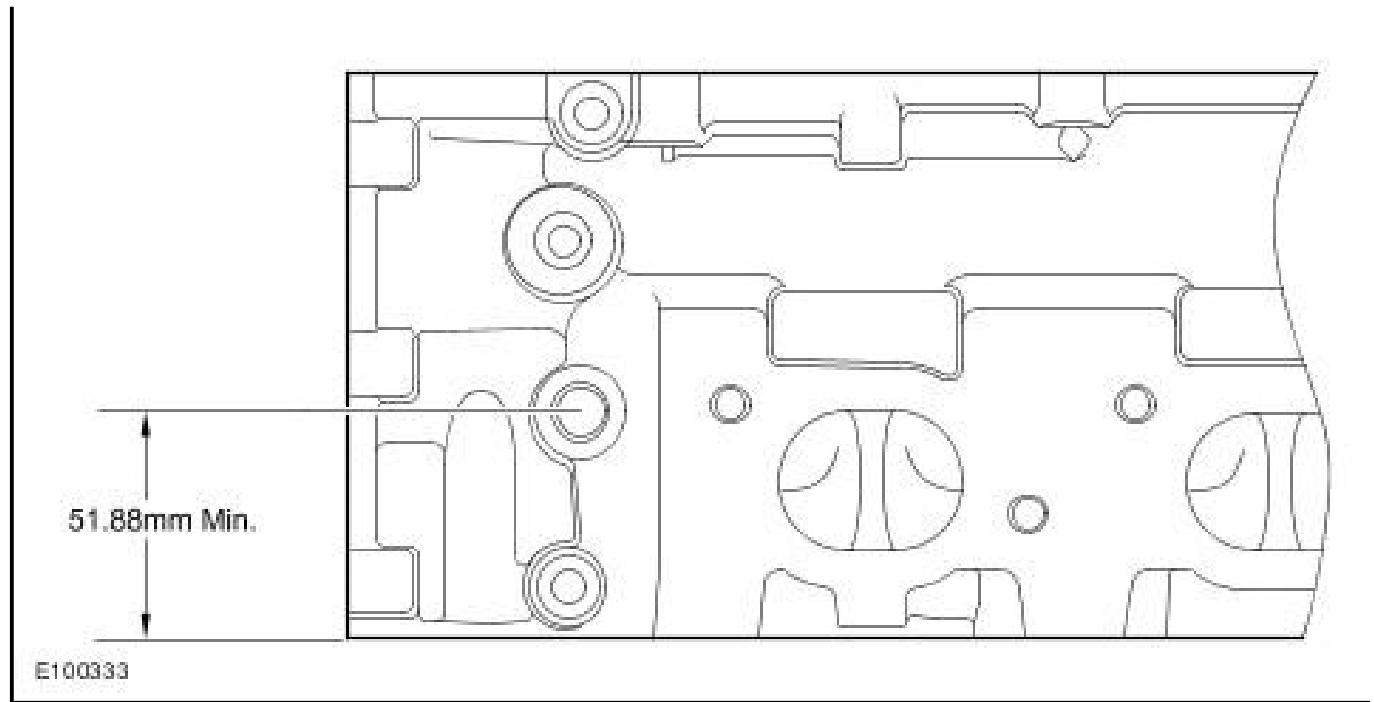
2. Clean the component mating faces.
3. Check cylinder head face for distortion, across the center and from corner to corner.



4. For cylinder head face distortion data, refer to specifications. See **Specifications**.

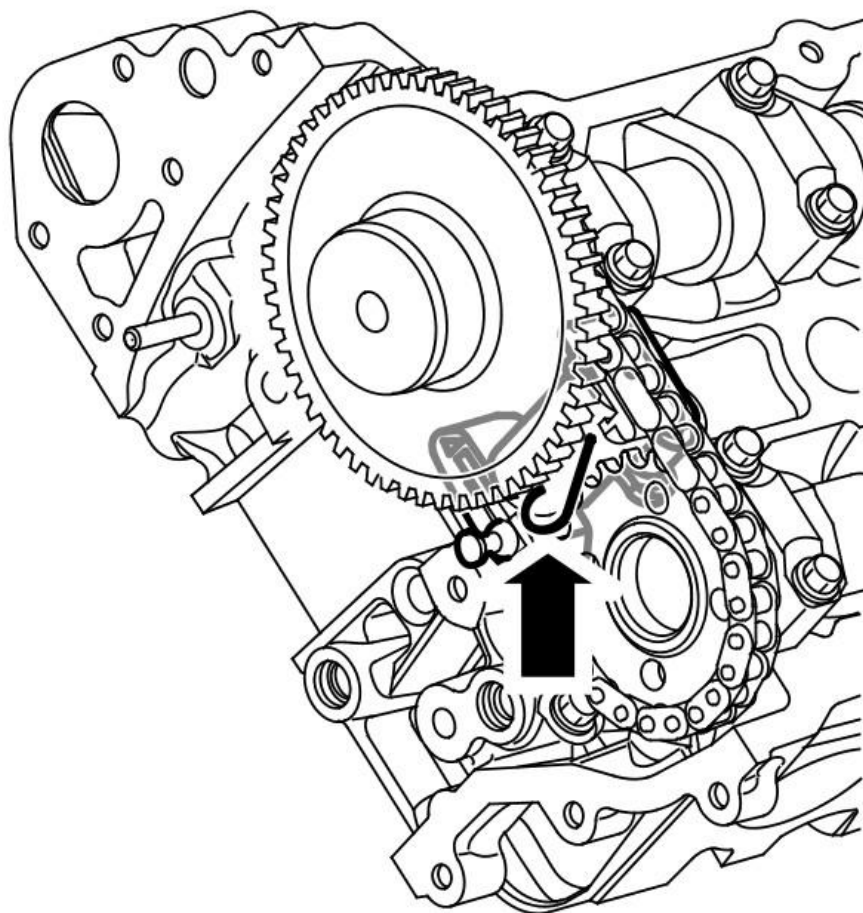
NOTE: For cylinder head with distortion above the maximum allowance, the cylinder head material must be measured.

5. Measure the cylinder head material.
- Check measurement from the center of the exhaust dowel to the cylinder head face as shown.
 - If the measurement is less than 51.88 mm the cylinder head requires replacement.



6. Install the exhaust manifold.

- Clean the component mating faces.
- Install the gasket/heat shield.
- Tighten the heat shield bolt to 25 Nm (18 lb.ft).
- Evenly and progressively, tighten the bolts in the sequence shown to 20 Nm (15 lb.ft).



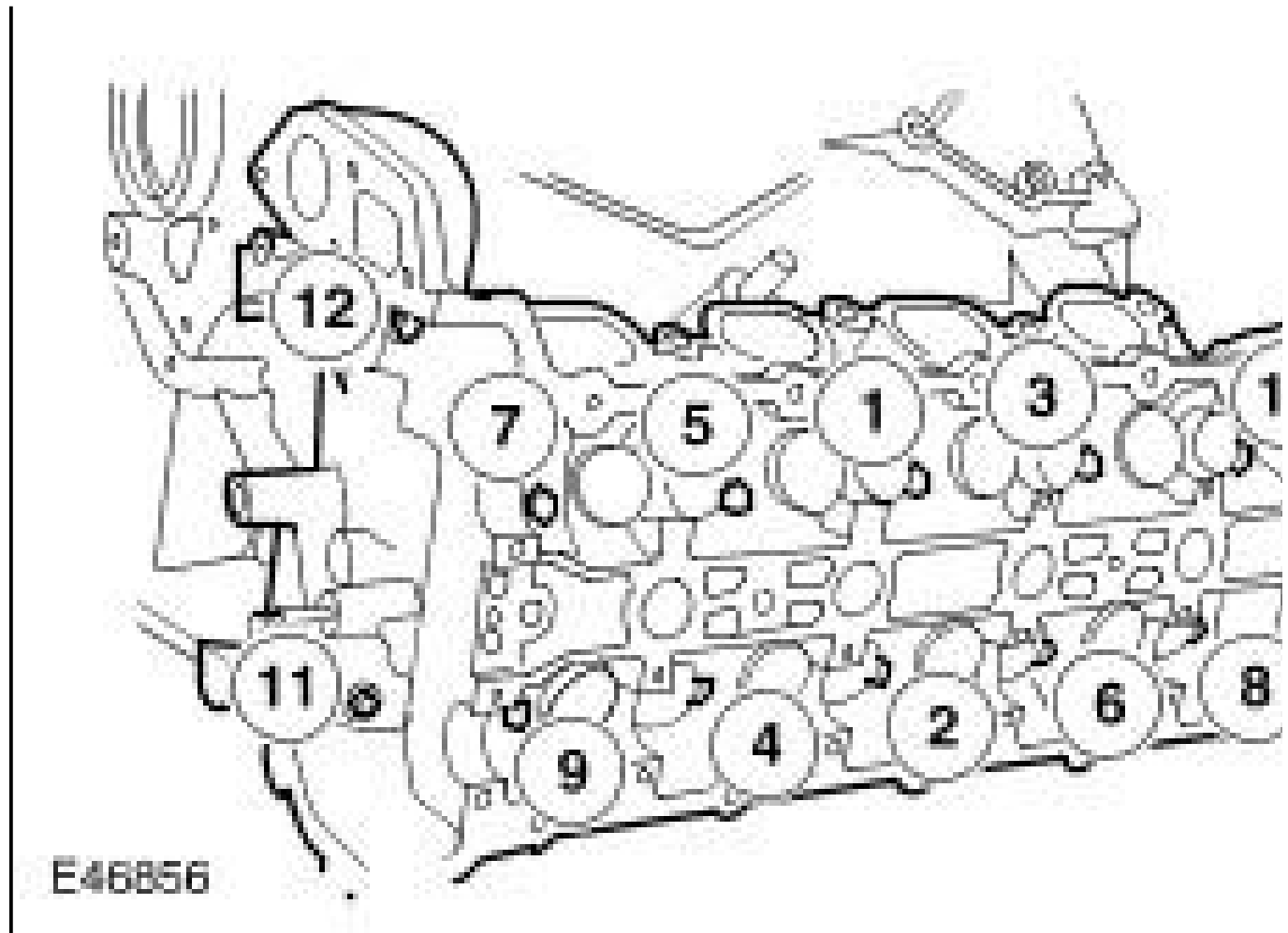
E58311

CAUTION: The head gasket must be installed over the cylinder block dowels.

7. Install a new cylinder head gasket.
8. With assistance install the cylinder head.

NOTE: Tighten the bolts 1 to 10 in the sequence shown.

9. Install the cylinder head bolts.
 - Lubricate the new cylinder head bolt threads with clean engine oil.
 - Tighten the bolts to 20 Nm (15 lb.ft).
 - Tighten the bolts to 35 Nm (26 lb.ft).
 - Tighten the bolts 1 to 10, a further 90 degrees.
 - Tighten the bolts 1 to 10, a further 90 degrees.
 - Tighten the M8 bolts 11 and 12, to 25 Nm (18 lb.ft).



10. Position the RH catalytic converter to the exhaust manifold.
 - Clean the components.
 - Tighten the new nuts to 20 Nm (15 lb.ft).
11. Position the LH catalytic converter to the exhaust manifold.
 - Clean the components.
 - Tighten the new nuts to 20 Nm (15 lb.ft).
12. Connect the EGR pipe and exhaust manifold flanges.
 - Tighten the nuts to 25 Nm (18 lb.ft).
13. Install the CMP sensor.
 - Tighten the Torx screw to 7 Nm (5 lb.ft).
 - Connect the electrical connector.
14. Install the LH bank camshafts. See **Camshaft LH**.
15. Install the intake manifold. See **Intake Manifold**.
16. Connect the battery ground cable. Refer to **Specifications** .

VALVE COVER LH

SPECIAL TOOLS

Tool Illustration	Tool Name	Tool Number
	Fuel spring lock decoupling tool	310-005

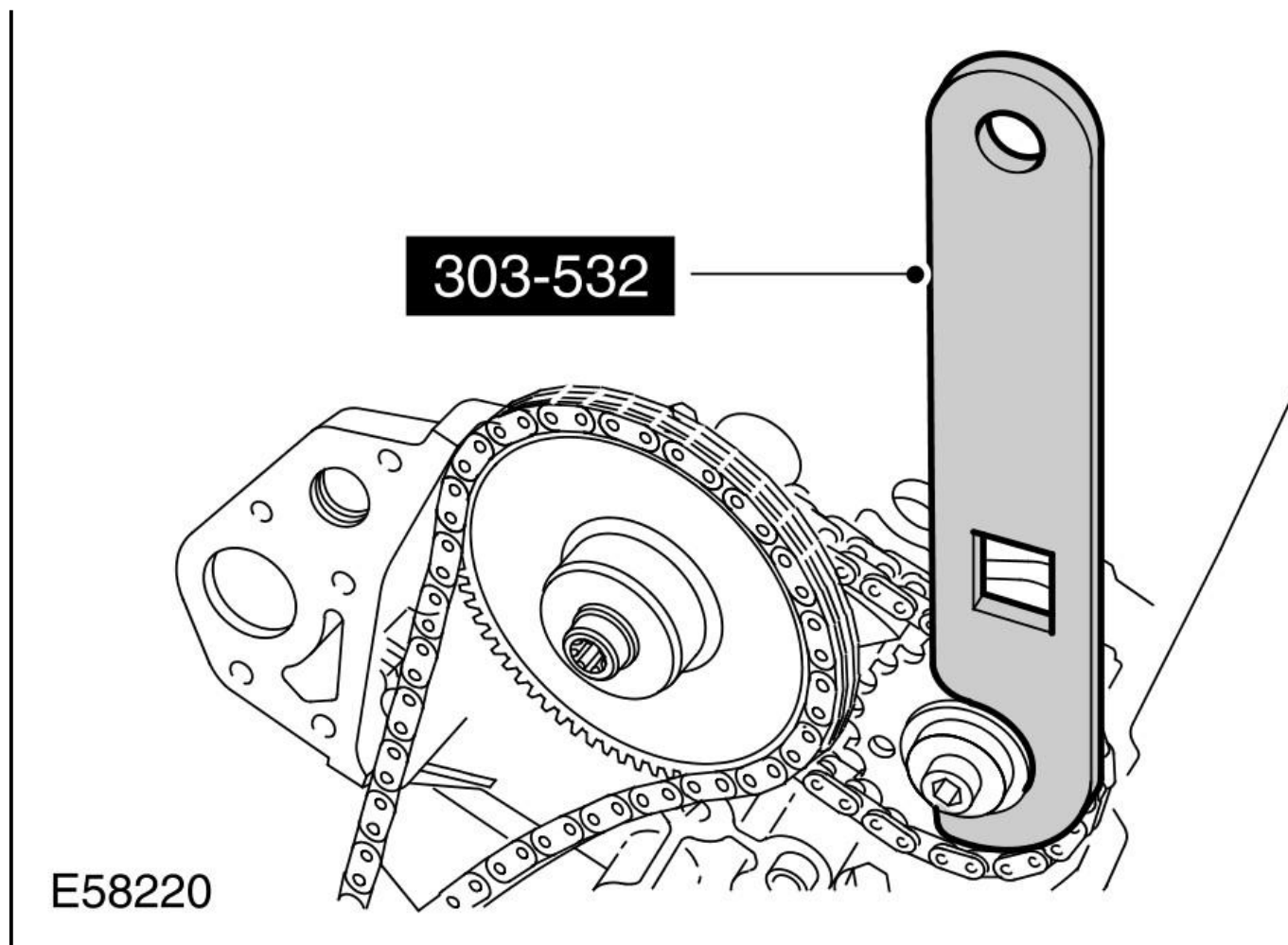
REMOVAL

1. Disconnect the battery ground cable. Refer to Specifications .
2. Remove the air intake resonator. Refer to Intake Air Resonator .
3. Recover the A/C refrigerant. Refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging .

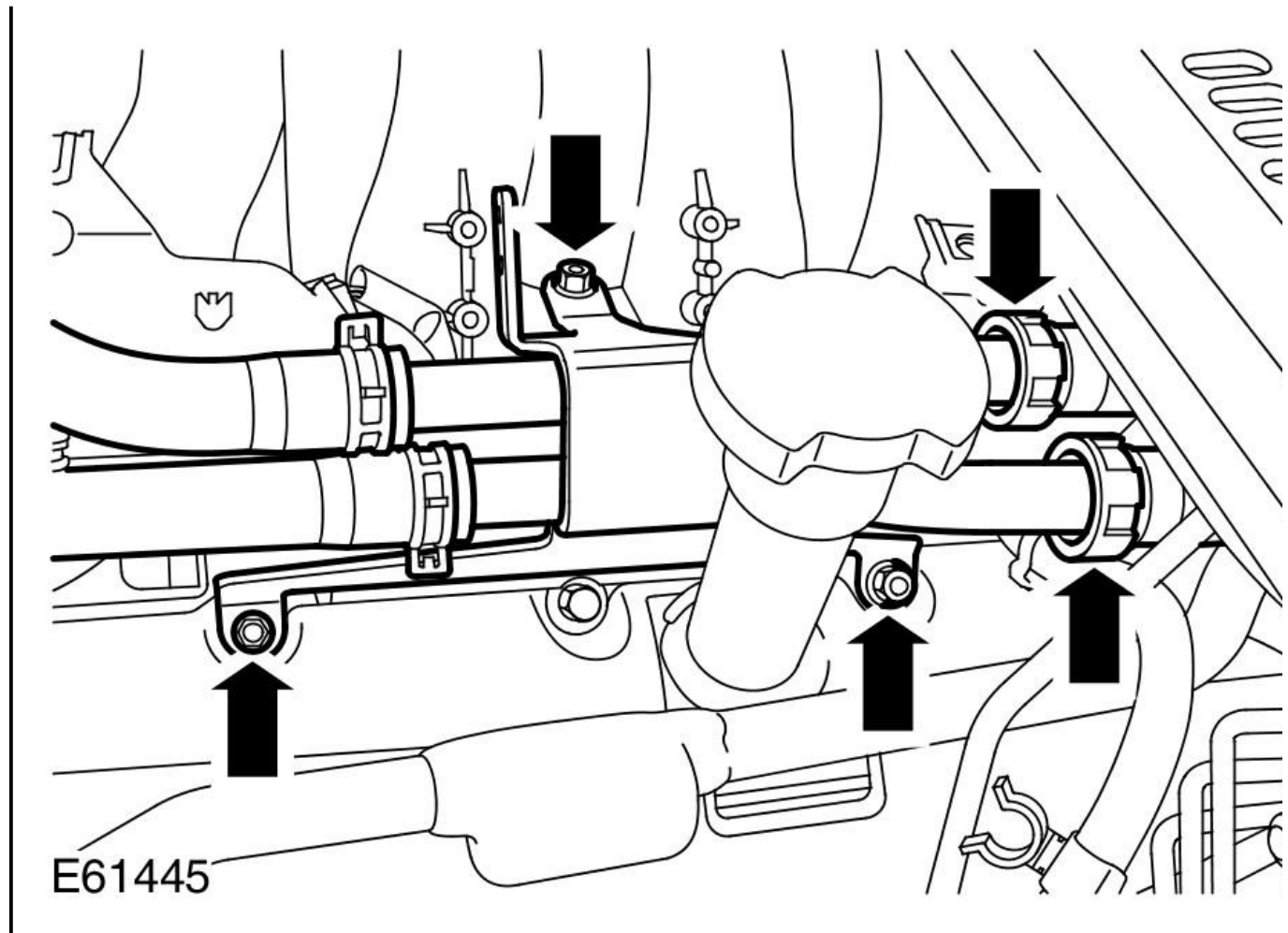
CAUTION: Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

NOTE: Supercharged engine graphic shown.

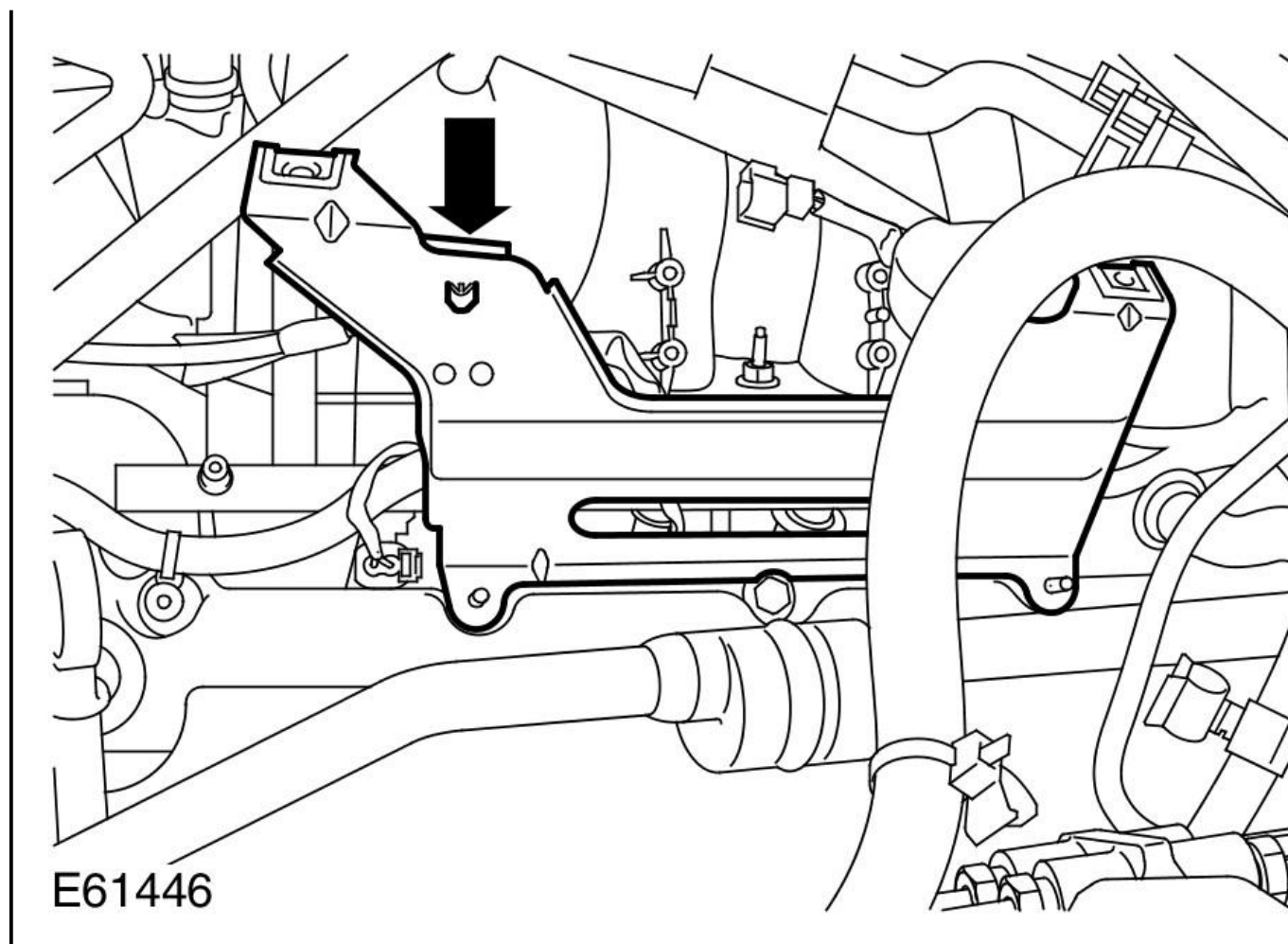
4. Disconnect the A/C compressor low pressure line.
 - Remove the Allen bolt.
 - Remove and discard the O-ring seal.



5. Remove the oil level indicator and tube. See [Oil Level Indicator and Tube](#).
6. Remove the purge valve assembly.
7. Position the coolant hoses aside for access.
 - Position a container to collect the fluid.
 - Remove the 3 nuts.
 - Disconnect the 2 heater coolant hoses.
 - Position the coolant hose assembly aside for access.



8. Remove the engine cover mounting bracket.
 - Release the knock sensor (KS) electrical connector.



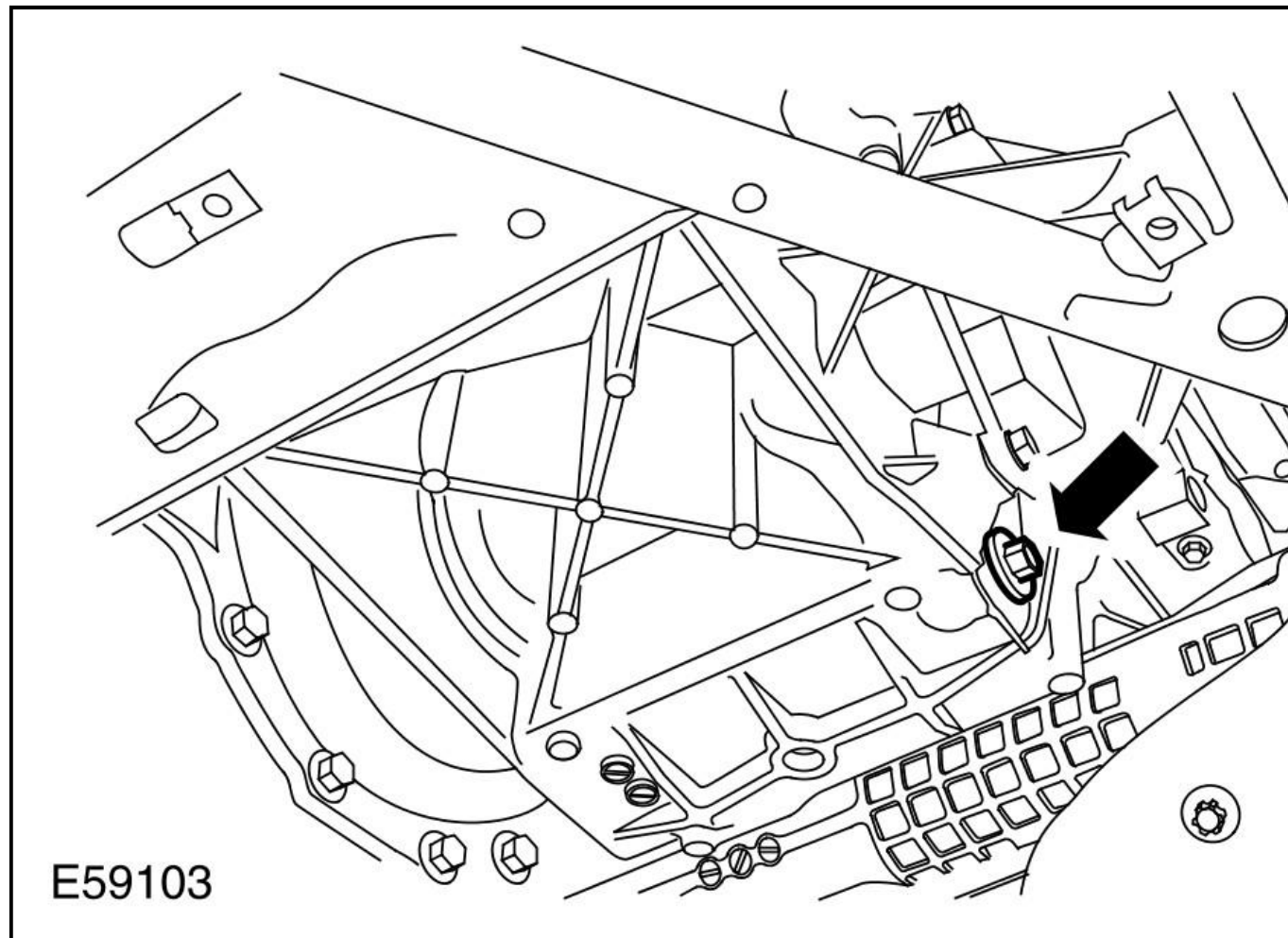
WARNING: Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

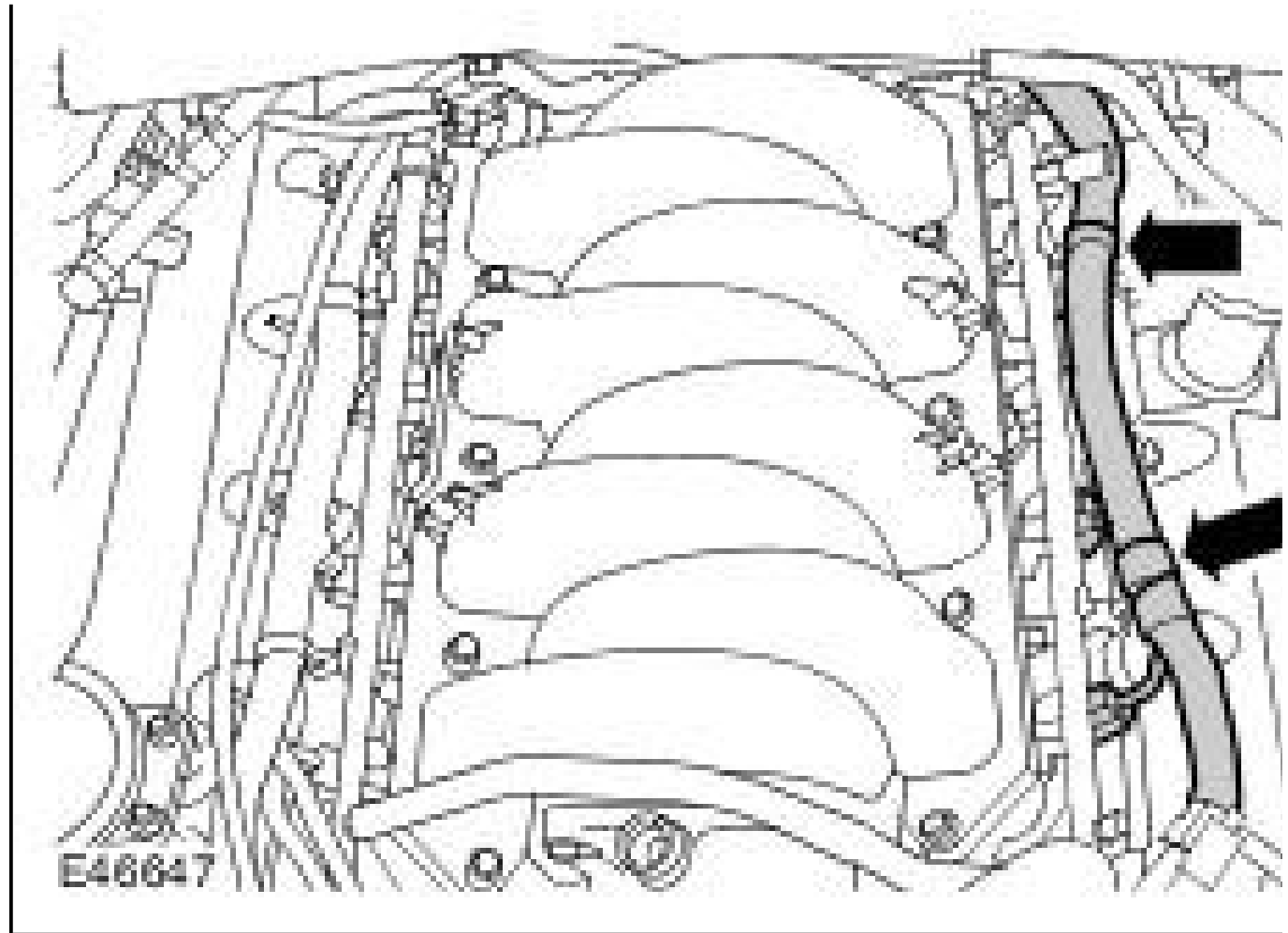
WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

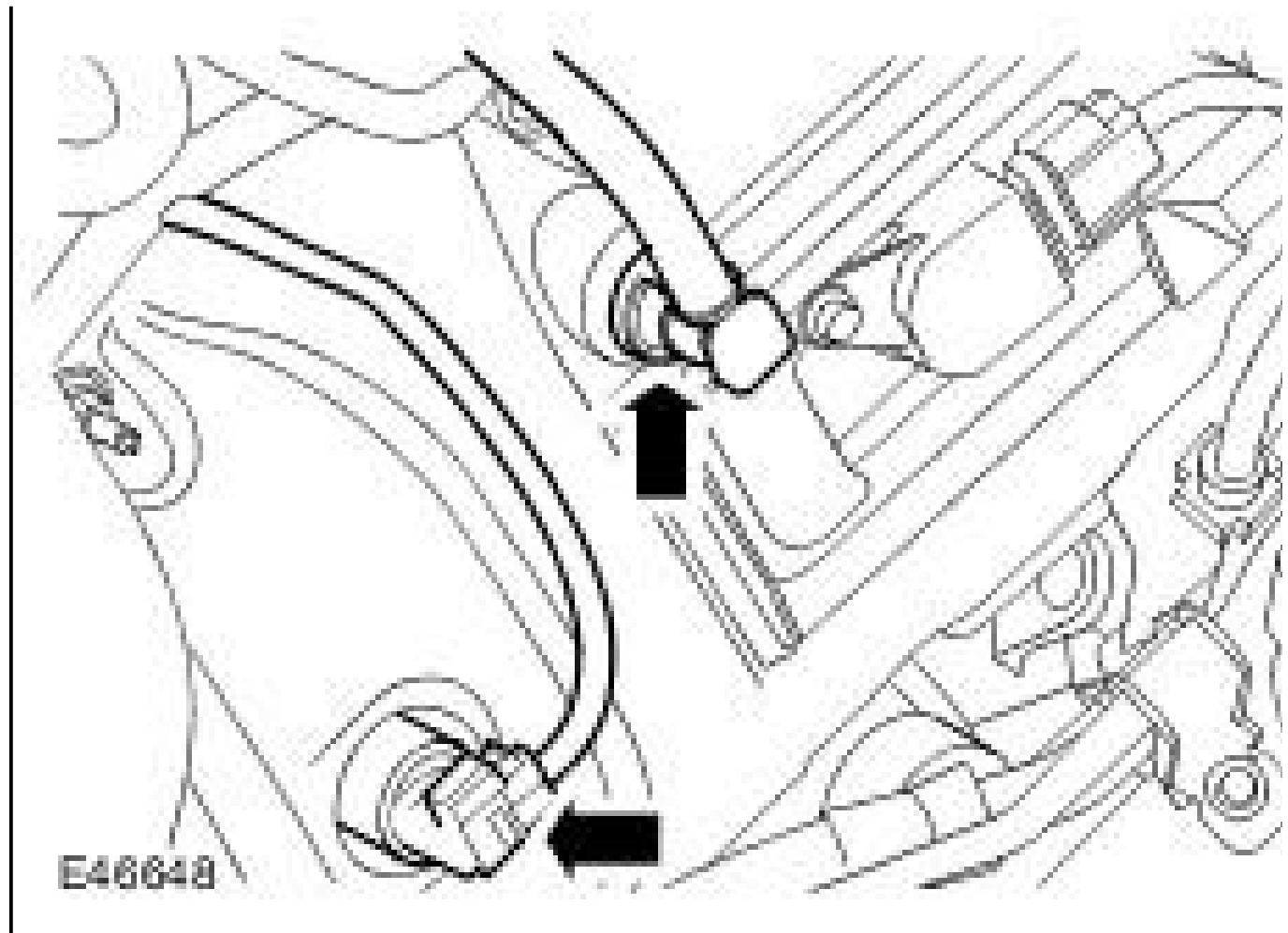
9. Using the special tool, disconnect the fuel line.
- Release the clip.
 - Position an absorbent cloth to collect fluid spillage.



10. Remove the ignition coil-on-plug. Refer to **Ignition Coil** .
11. Remove the remaining ignition coil-on-plugs.
12. Release the engine wiring harness.
- Release the 4 clips.



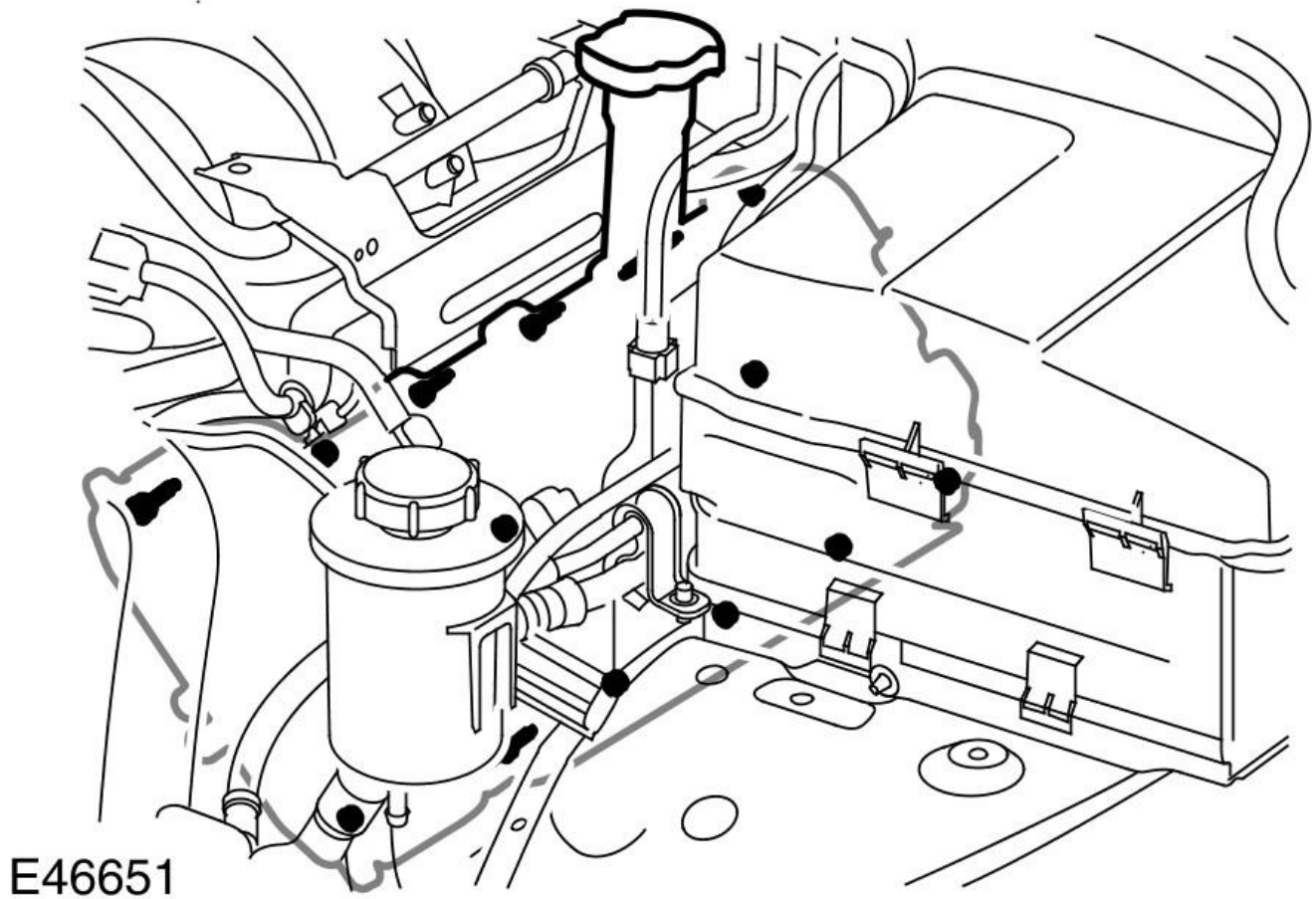
13. Disconnect the variable camshaft timing (VCT) oil solenoid electrical connector.



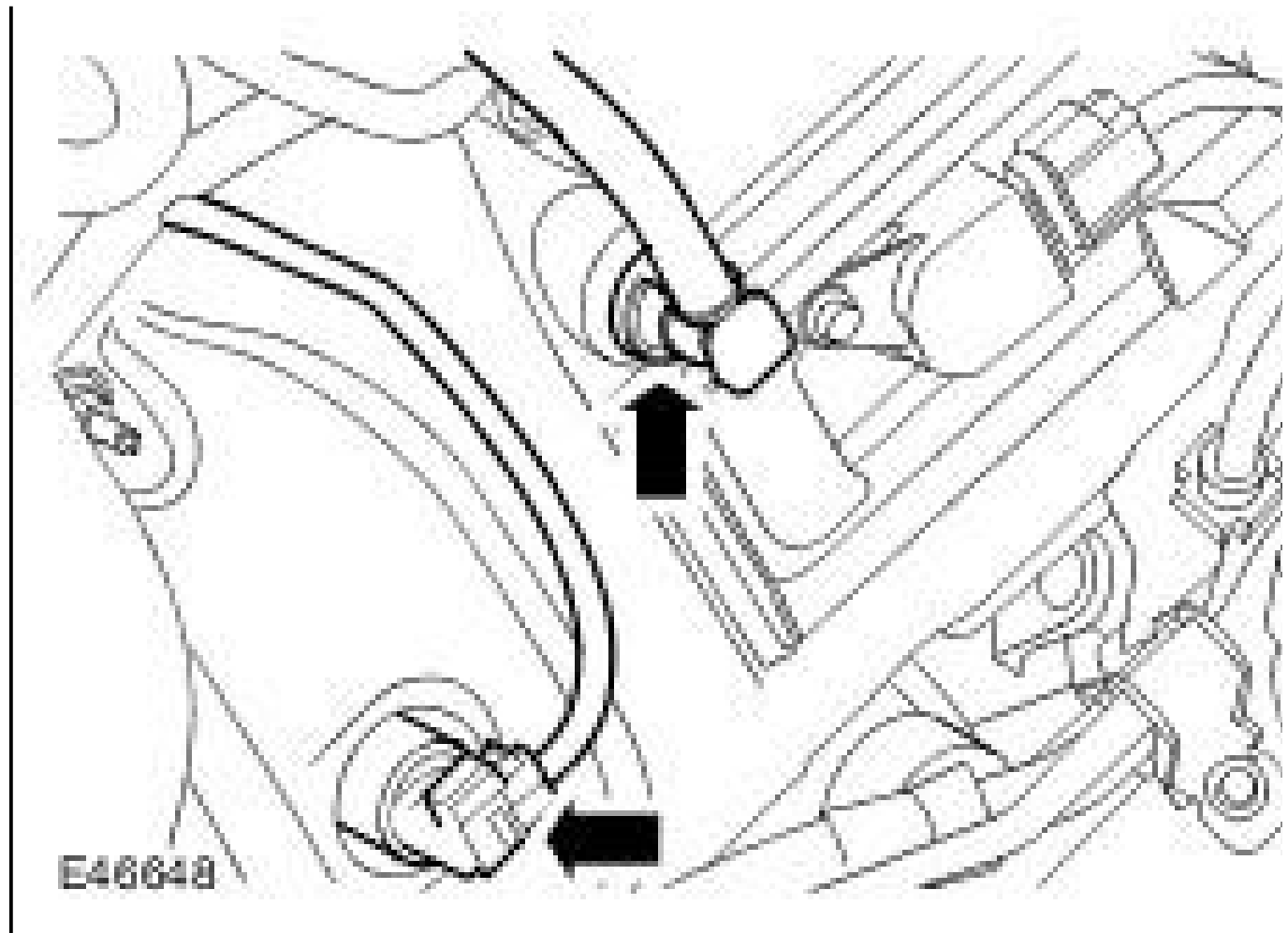
14. Disconnect the valve cover breather hose.

NOTE: Note the fitted position of the retaining bolts prior to removal.

15. Remove the valve cover assembly.
- Remove the 14 valve cover retaining bolts.

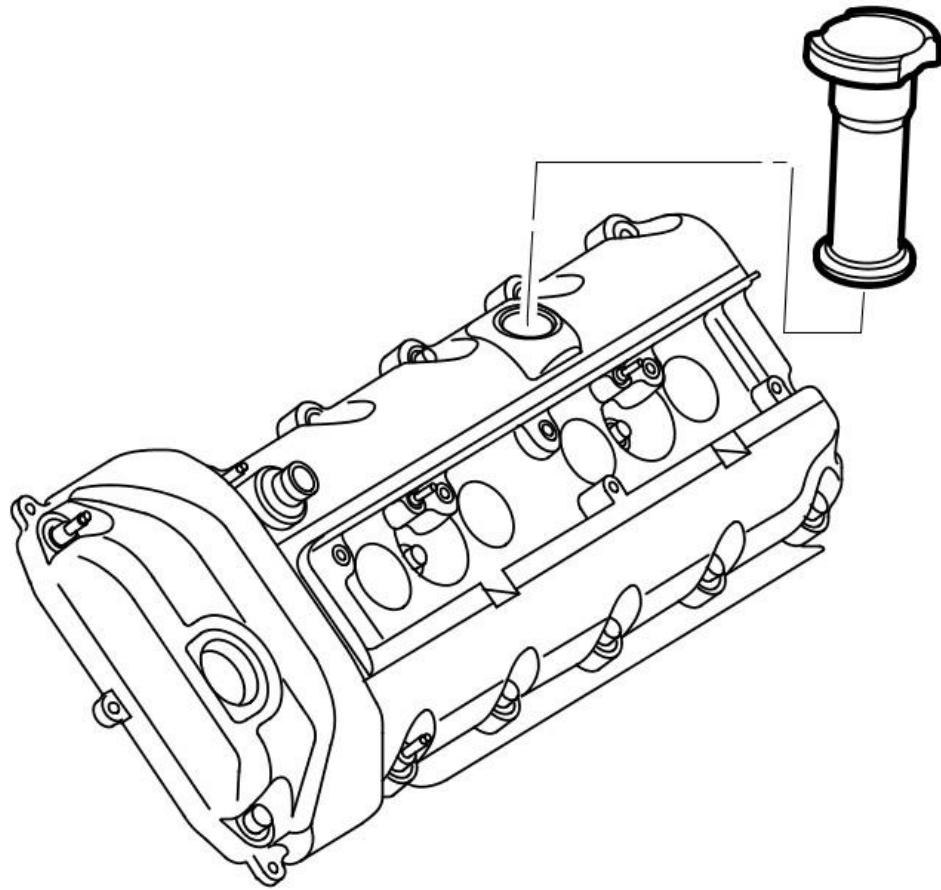


16. Remove and discard the valve cover gaskets.



NOTE: Do not disassemble further if the component is removed for access only.

17. Remove the oil filler pipe.
 - Remove and discard the O-ring seal.



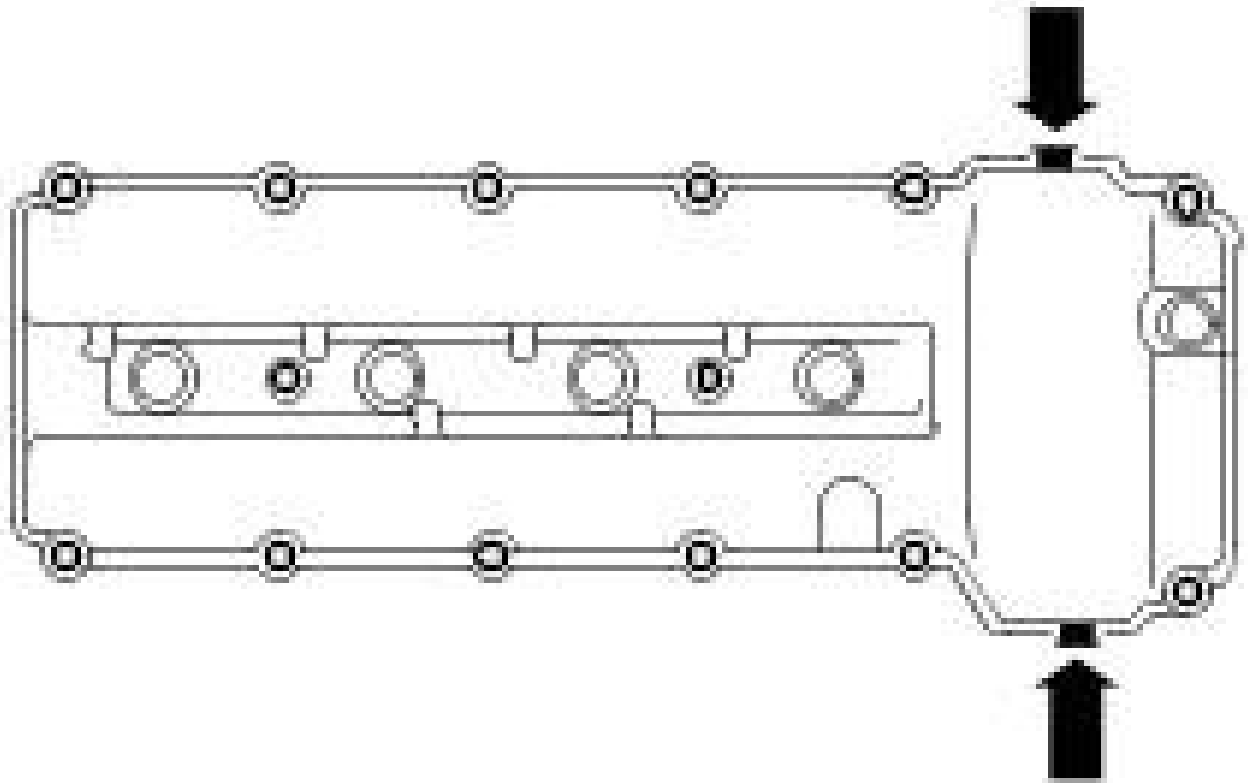
E61763

INSTALLATION

1. Install the oil filler pipe.
 - Install a new O-ring seal.
2. Install new valve cover plug aperture gaskets.
3. Install a new valve cover gasket.

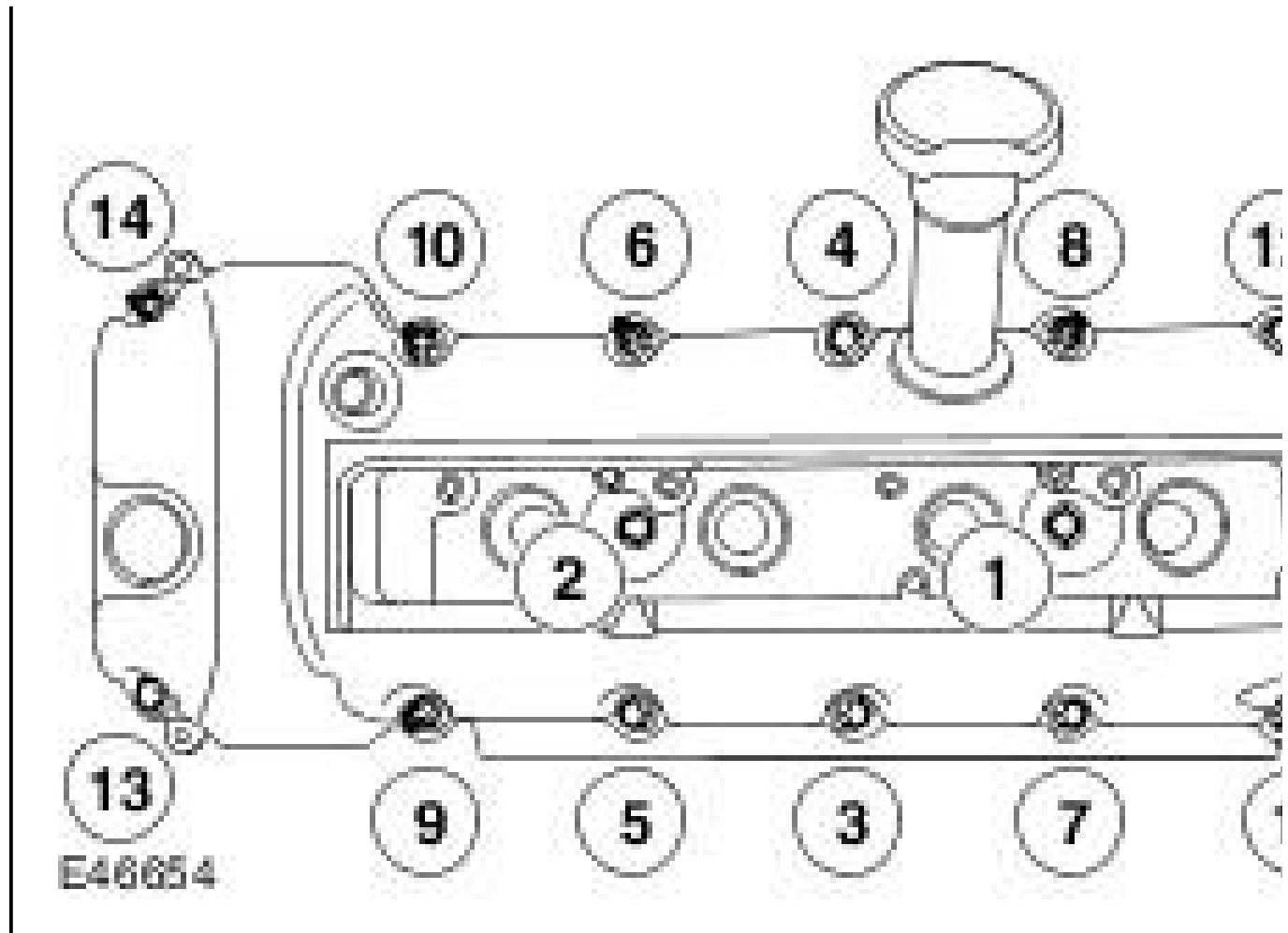
NOTE: Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

4. Install the valve cover.
 - Clean the component mating faces.



E49922

5. Install the valve cover retaining bolts.
 - Install valve cover retaining bolts to their position previously noted.
 - Complete the tightening sequence as illustrated.
 - Tighten the bolts to 12 Nm (9 lb.ft).



6. Connect the VCT oil solenoid electrical connector.

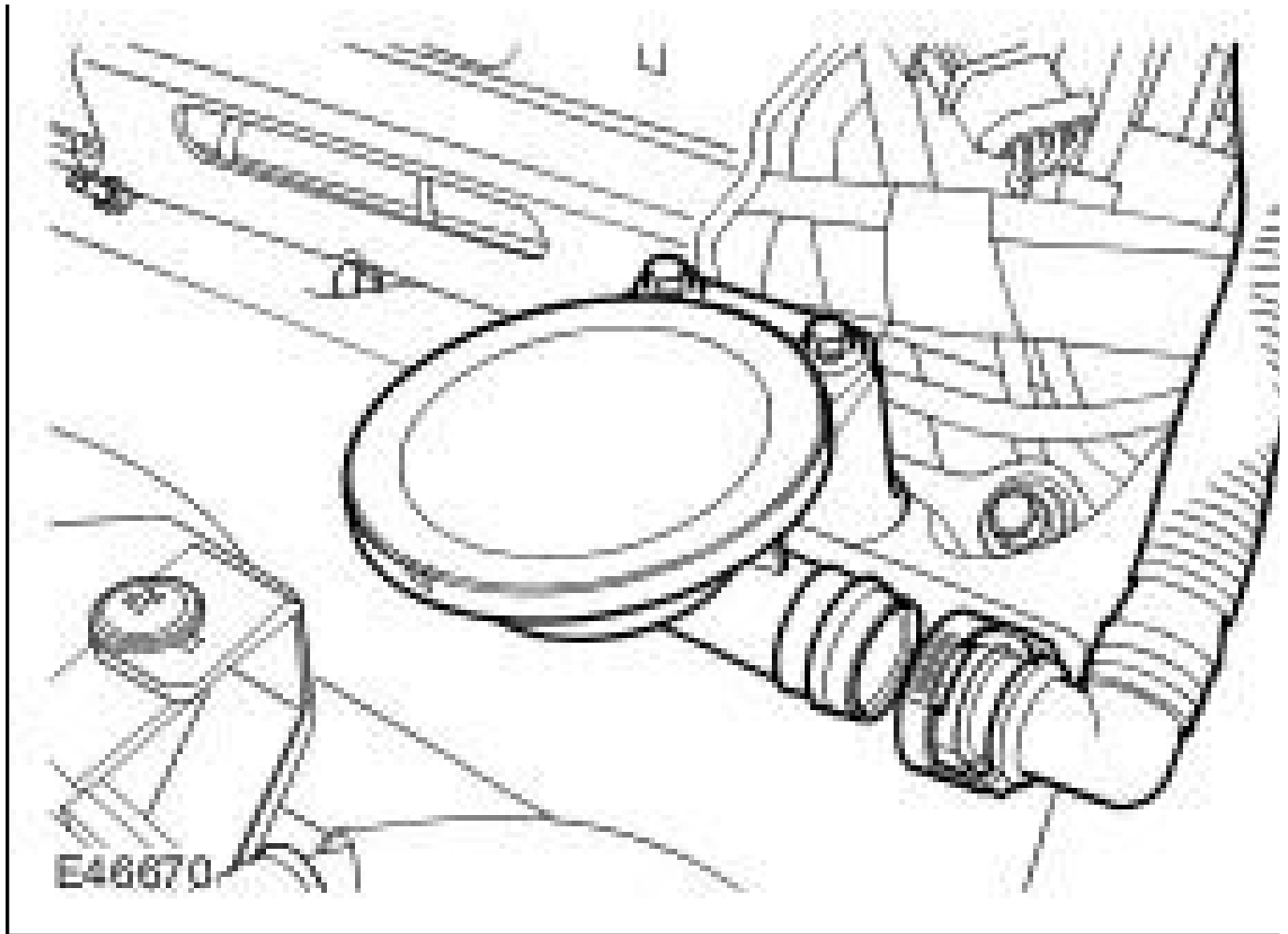
CAUTION: Lubricate the new seals with clean refrigerant oil.

7. Connect the A/C compressor low pressure line.
 - Install a new O-ring seal.
 - Tighten the Allen bolt to 10 Nm (7 lb.ft).
8. Connect the fuel line to the fuel rail.
 - Clean the component mating faces.
 - Secure the clip.
9. Attach the engine wiring harness to the retaining bracket.
10. Install the engine cover mounting bracket.
 - Secure the KS electrical connector.
11. Install the coolant hoses.

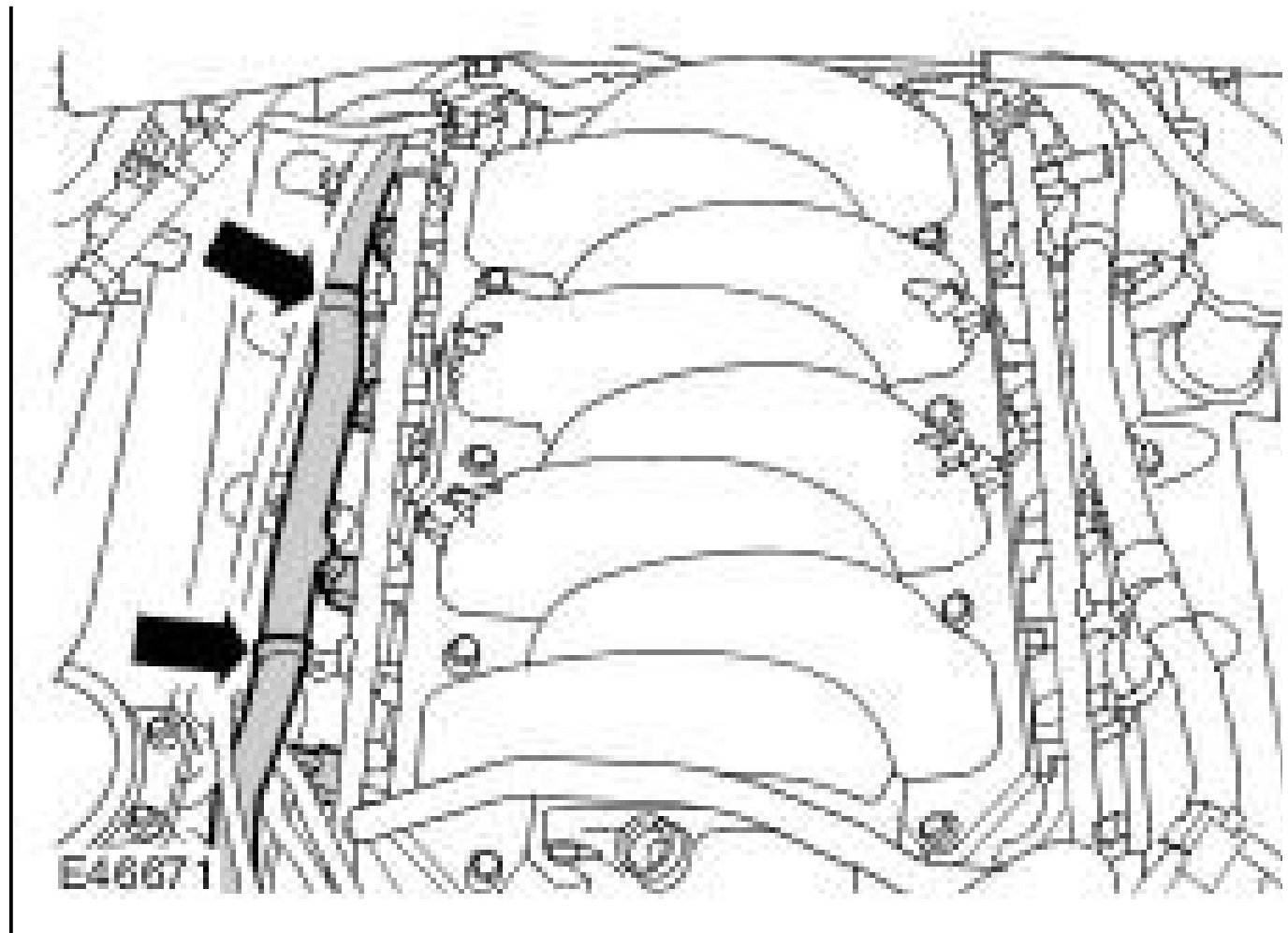
- Connect the heater coolant hoses.
 - Tighten the nuts to 6 Nm (4 lb.ft).
12. Install the purge valve assembly.
 13. Install the ignition coil-on-plug. Refer to **Ignition Coil** .
 14. Install the remaining ignition coil-on-plugs.
 15. Install the oil level indicator and tube. See **Oil Level Indicator and Tube**.
 16. Install the air intake resonator. Refer to **Intake Air Resonator** .
 17. Recharge the A/C system. Refer to **Air Conditioning (A/C) System Recovery, Evacuation and Charging** .
 18. Connect the battery ground cable. Refer to **Specifications** .

VALVE COVER RH**REMOVAL**

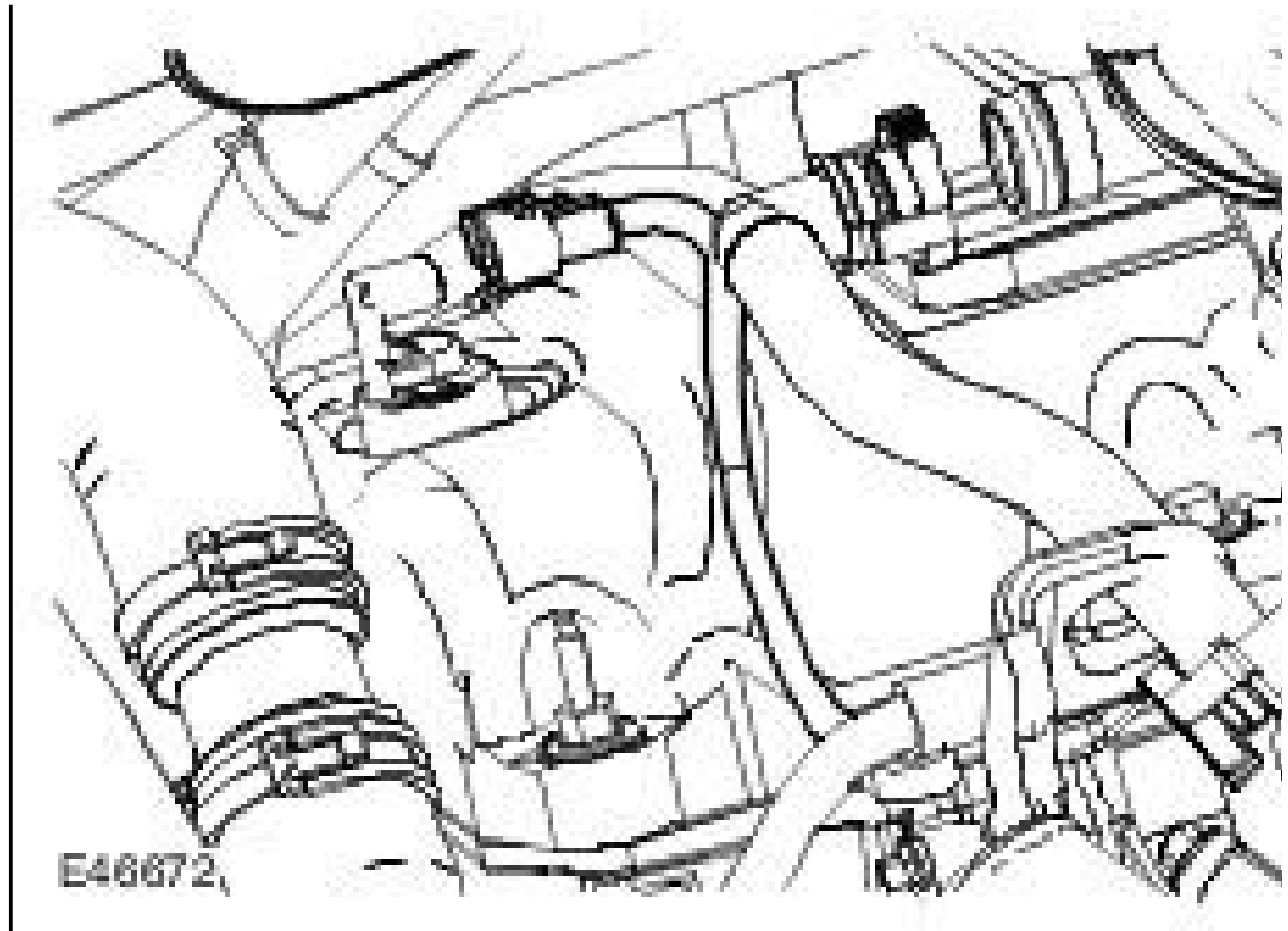
1. Disconnect the battery ground cable. Refer to **Specifications** .
2. Remove the ignition coil-on-plug. Refer to **Ignition Coil** .
3. Remove the remaining ignition coil-on-plugs.
4. Disconnect the positive crankcase ventilation (PCV) line.



5. Release the engine wiring harness from the valve cover.
- Remove the 2 nuts.
 - Release the 4 clips.
 - Position the engine cover mounting bracket aside.



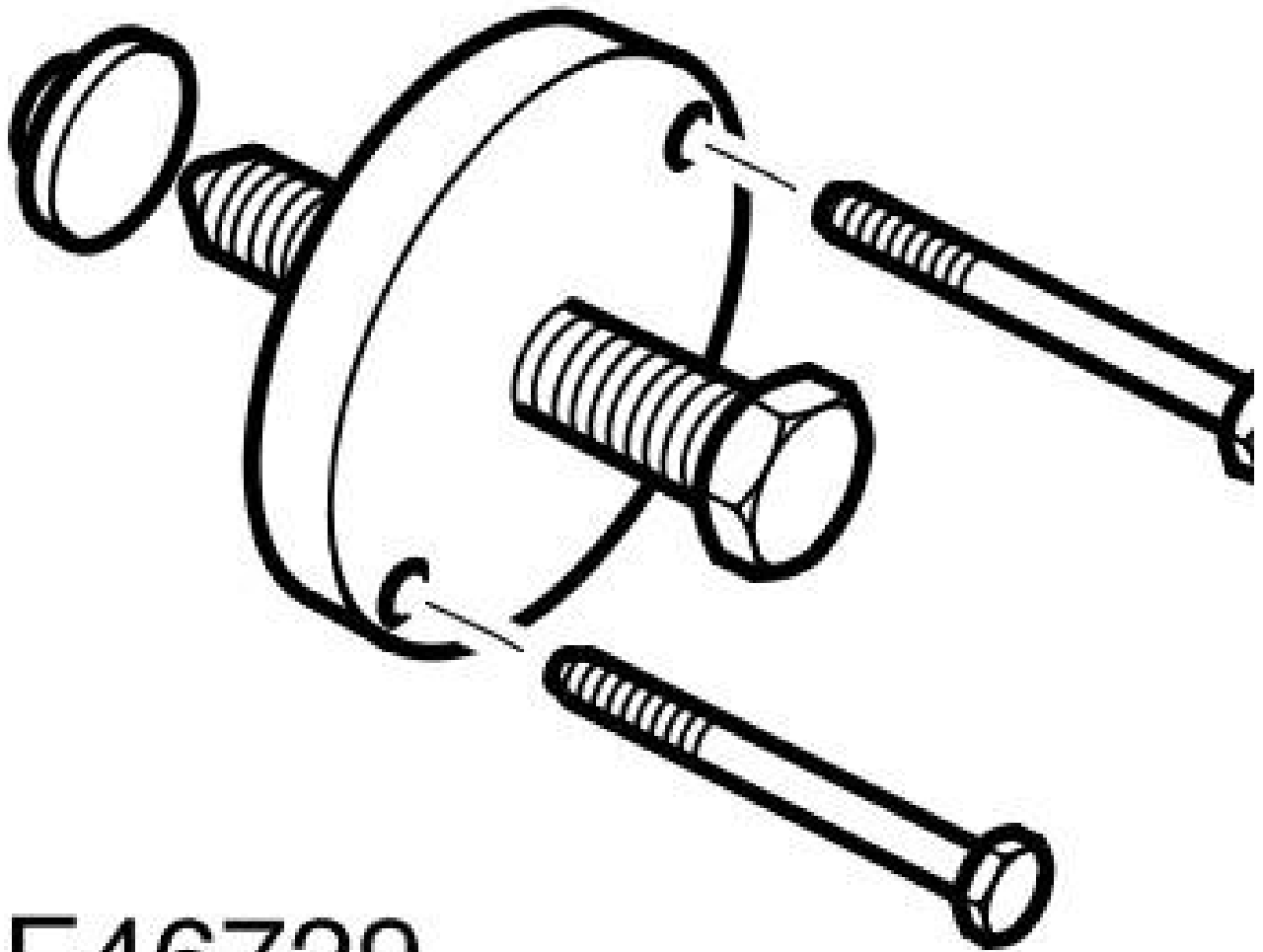
6. Disconnect the variable camshaft timing (VCT) oil solenoid electrical connector.



NOTE: Note the fitted position of the retaining bolts prior to removal.

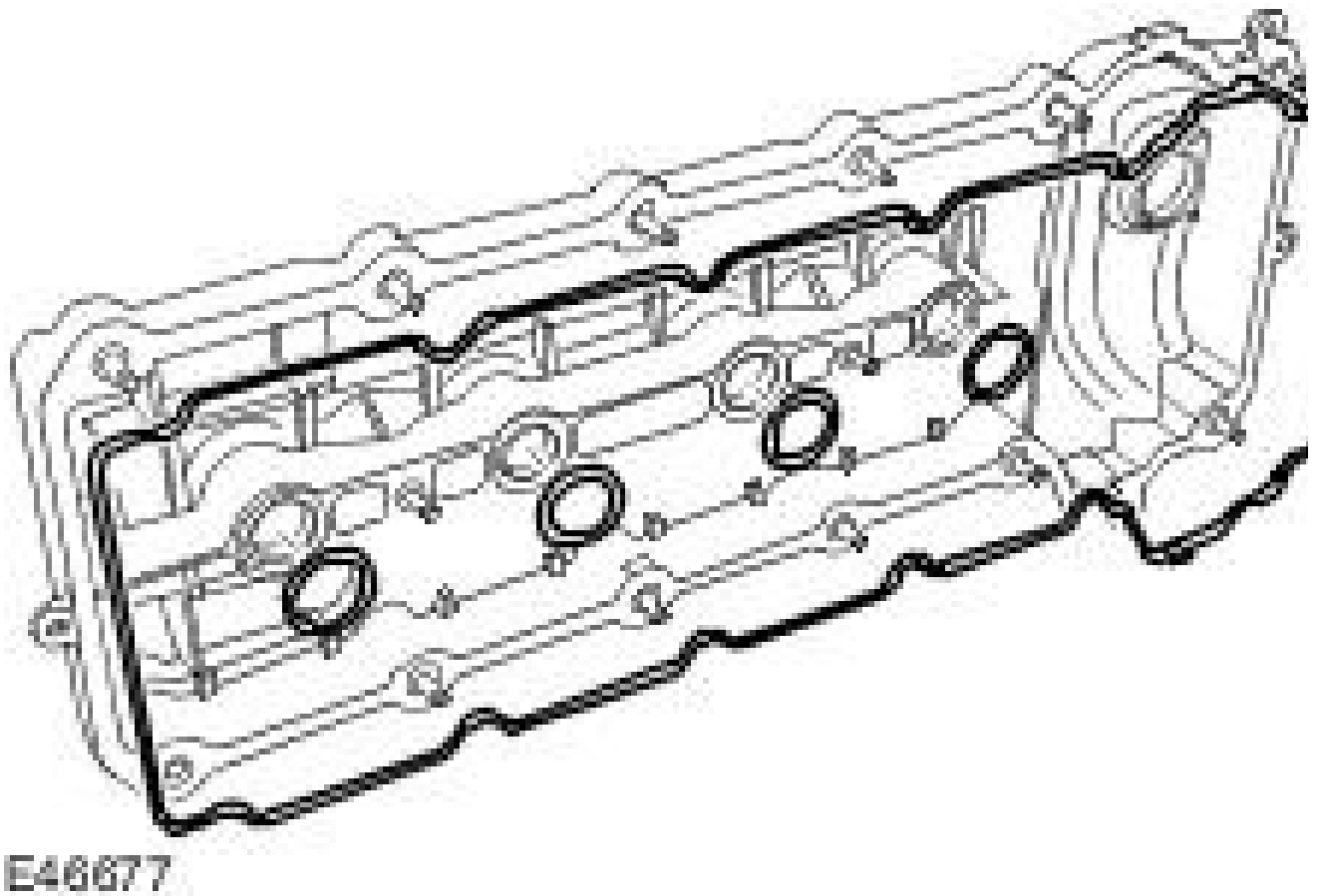
7. Remove the valve cover assembly.
 - Remove the 14 valve cover retaining bolts.
 - Remove the engine cover bracket.

303-588



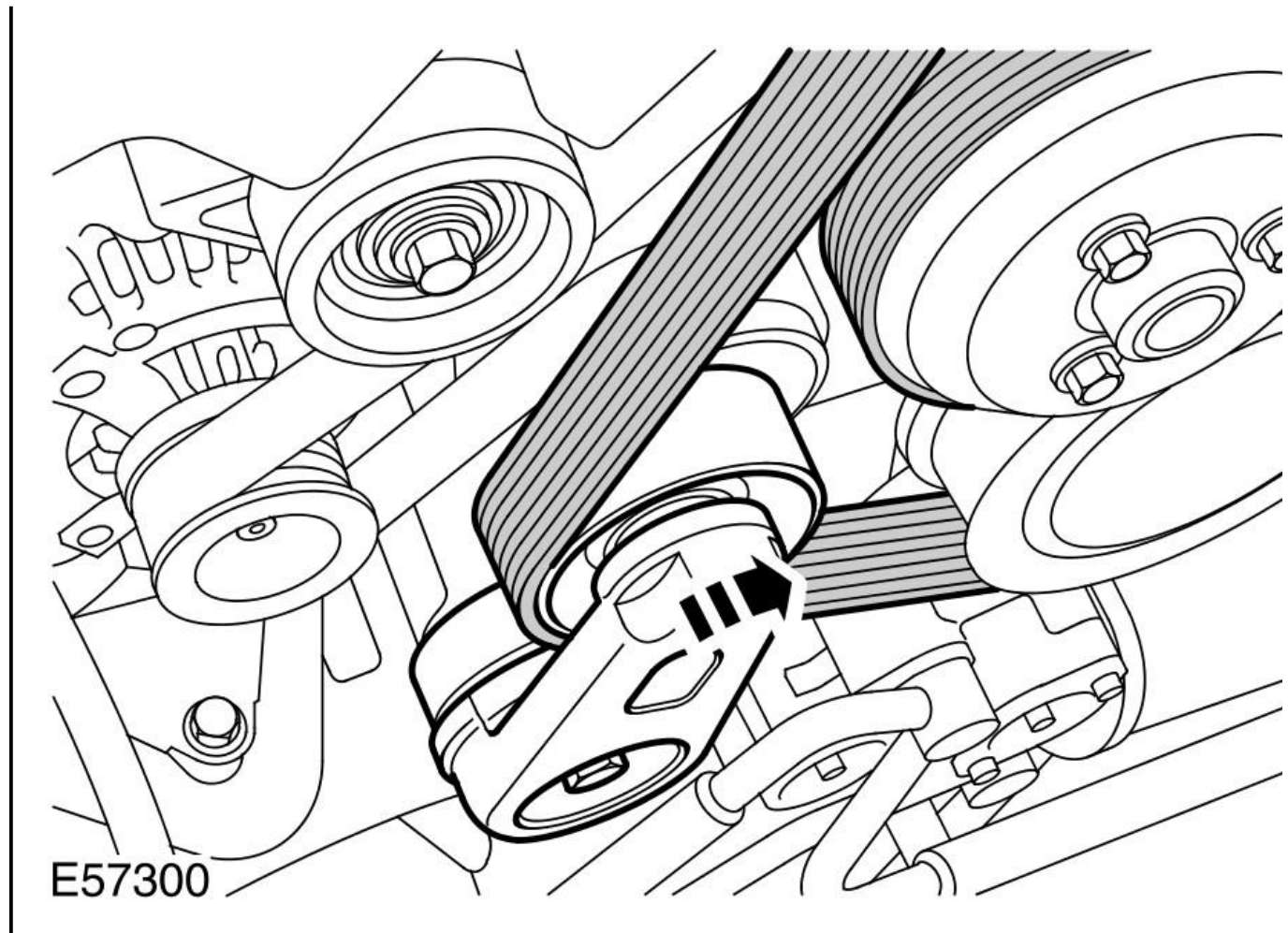
E46729

8. Remove and discard the valve cover gasket.
9. Remove the valve cover plug aperture seals.



NOTE: Do not disassemble further if the component is removed for access only.

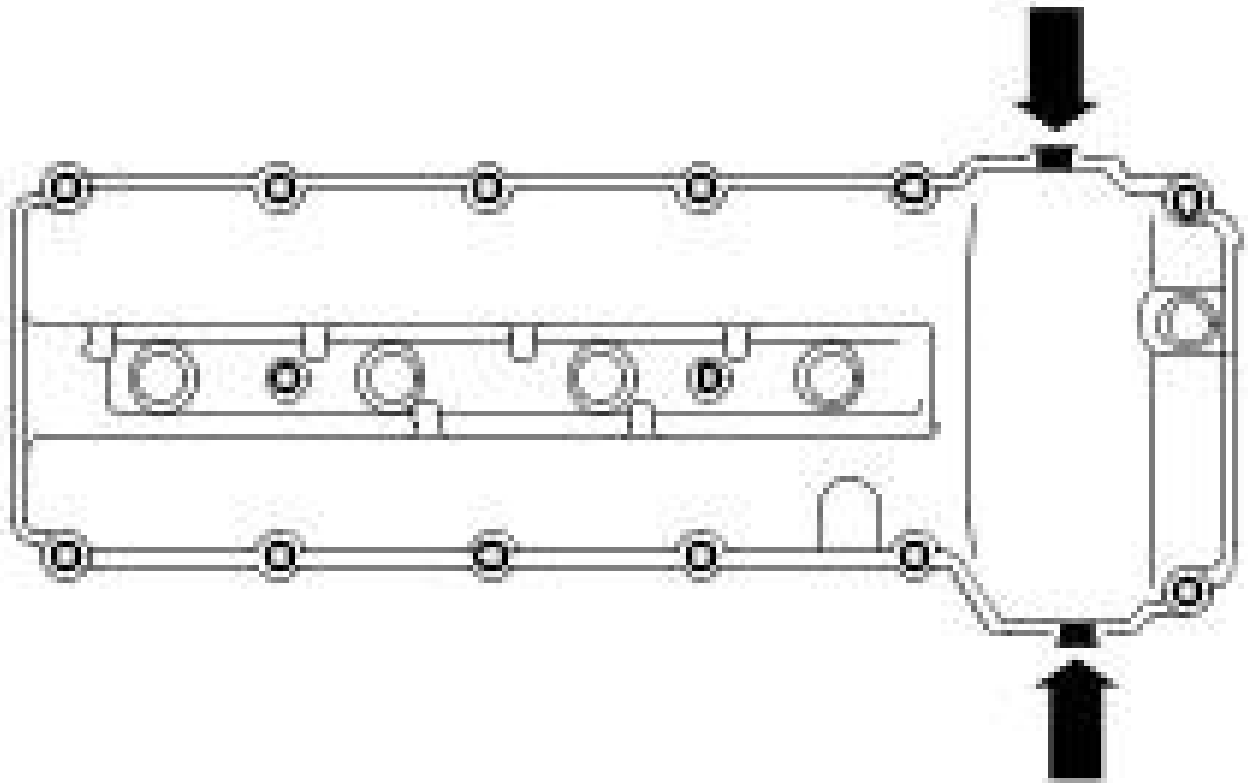
10. Remove the PCV valve.
 - Remove the 2 bolts.
 - Remove and discard the O-ring seal.

**INSTALLATION**

1. Install the PCV valve.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 6 Nm (4 lb.ft).
2. Install new valve cover plug aperture gaskets.
3. Install a new valve cover gasket.

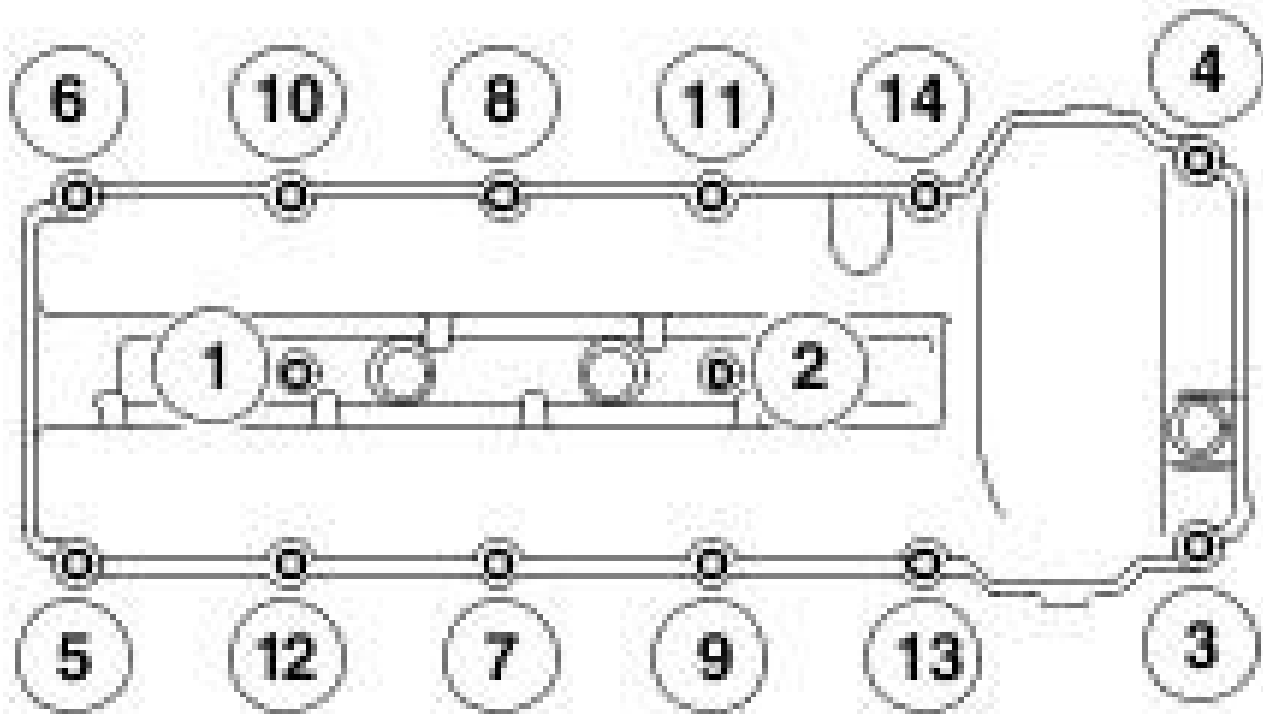
NOTE: Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

4. Install the valve cover.
 - Clean the component mating faces.



E49922

5. Install the valve cover retaining bolts.
 - Install valve cover retaining bolts to their position previously noted.
 - Tighten the bolts to 12 Nm (9 lb.ft).
 - Complete the tightening sequence as illustrated.



E46679

6. Connect the VCT oil solenoid electrical connector.
7. Install the ignition coil-on-plugs. Refer to **Ignition Coil** .
8. Install the remaining ignition coil-on-plugs.
9. Install the engine wiring harness.
 - Secure the clips.
 - Install the engine cover mounting bracket.
 - Tighten the nuts to 6 Nm (4 lb.ft).
10. Connect the PCV line.
11. Connect the battery ground cable. Refer to **Specifications** .

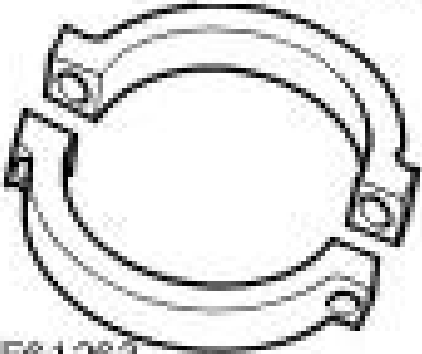
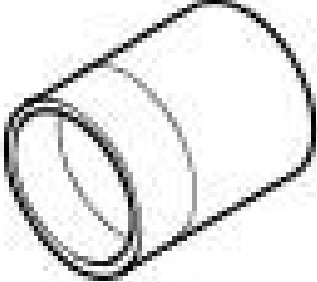
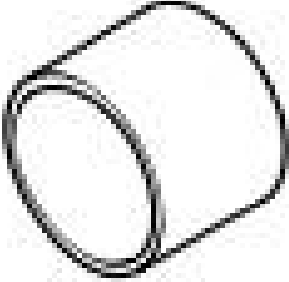
ENGINE MOUNT LH

SPECIAL TOOLS

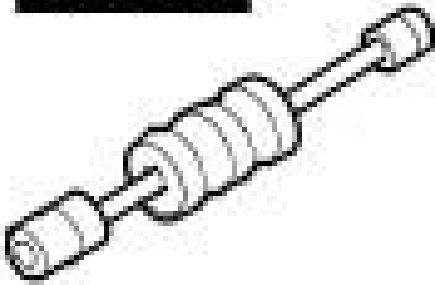
Tool Illustration	Tool Name	Tool Number
	Remover halfshaft inboard joint (LRT-54-026)	205-735

2007 Land Rover Range Rover HSE

ENGINE Engine (4.4L)

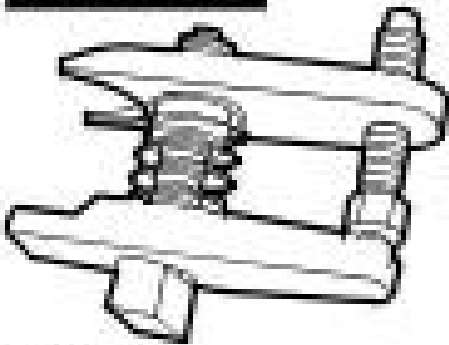
 205-735 E61263		
 308-626/1 E54136	Installer halfshaft oil seal	308-626/1
 308-626/2 E54137	Installer/Guide halfshaft oil seal	308-626/2
	Impulse extractor (LRT-99-004)	100-012

100-012



E54135

205-754A



E45276

Ball joint separator (LRT-54-027)

205-754

REMOVAL**ALL VEHICLES**

1. Disconnect the battery ground cable. Refer to **Specifications** .

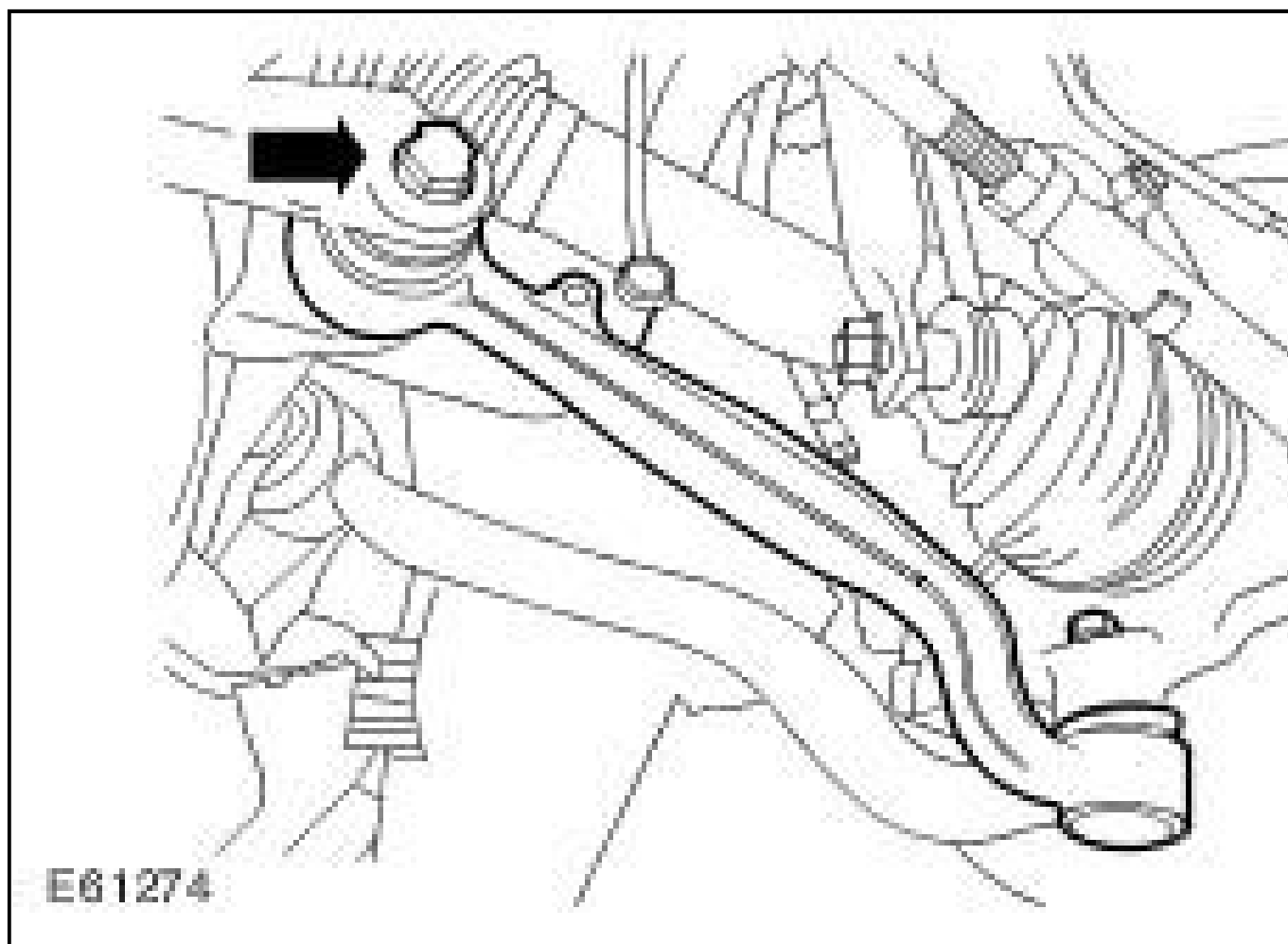
WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the radiator splash shield. Refer to **Radiator Splash Shield** .
4. Remove the exhaust system. Refer to **Exhaust System** .
5. Drain the differential fluid. Refer to **Differential Draining and Filling** .
6. Remove the front wheels and tires.

LEFT-HAND DRIVE VEHICLES

CAUTION: Do not turn the steering wheel with the lower steering column disconnected as damage to the clock spring and steering wheel switches may occur.

7. Disconnect the lower steering column from the steering gear.
 - Note the fitted position.
 - Align the steering wheel to straight ahead.
 - Remove and discard the Torx bolt.



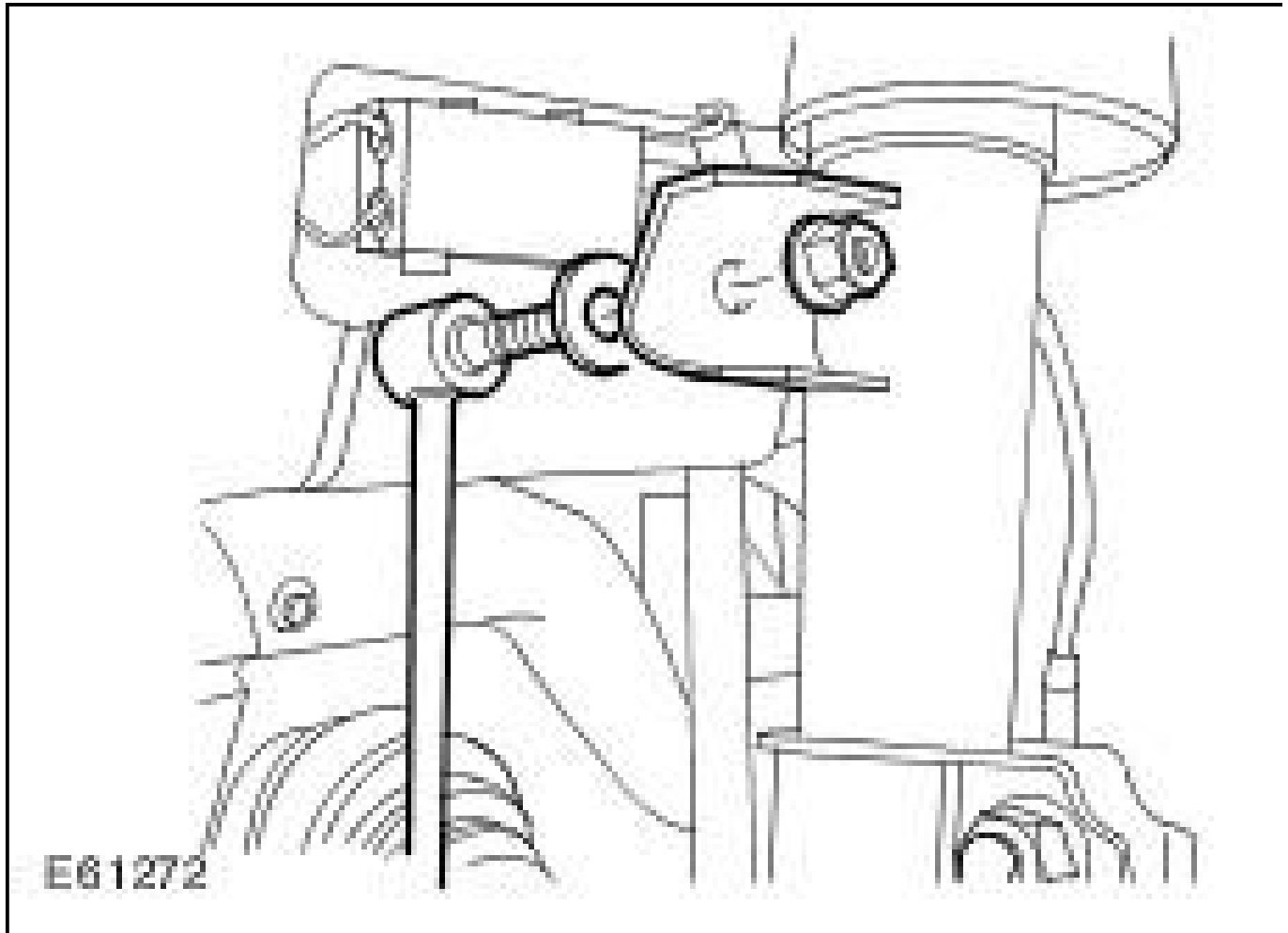
ALL VEHICLES

NOTE: Use an additional wrench to prevent the ball joint rotating.

NOTE: Note the fitted position of the washers.

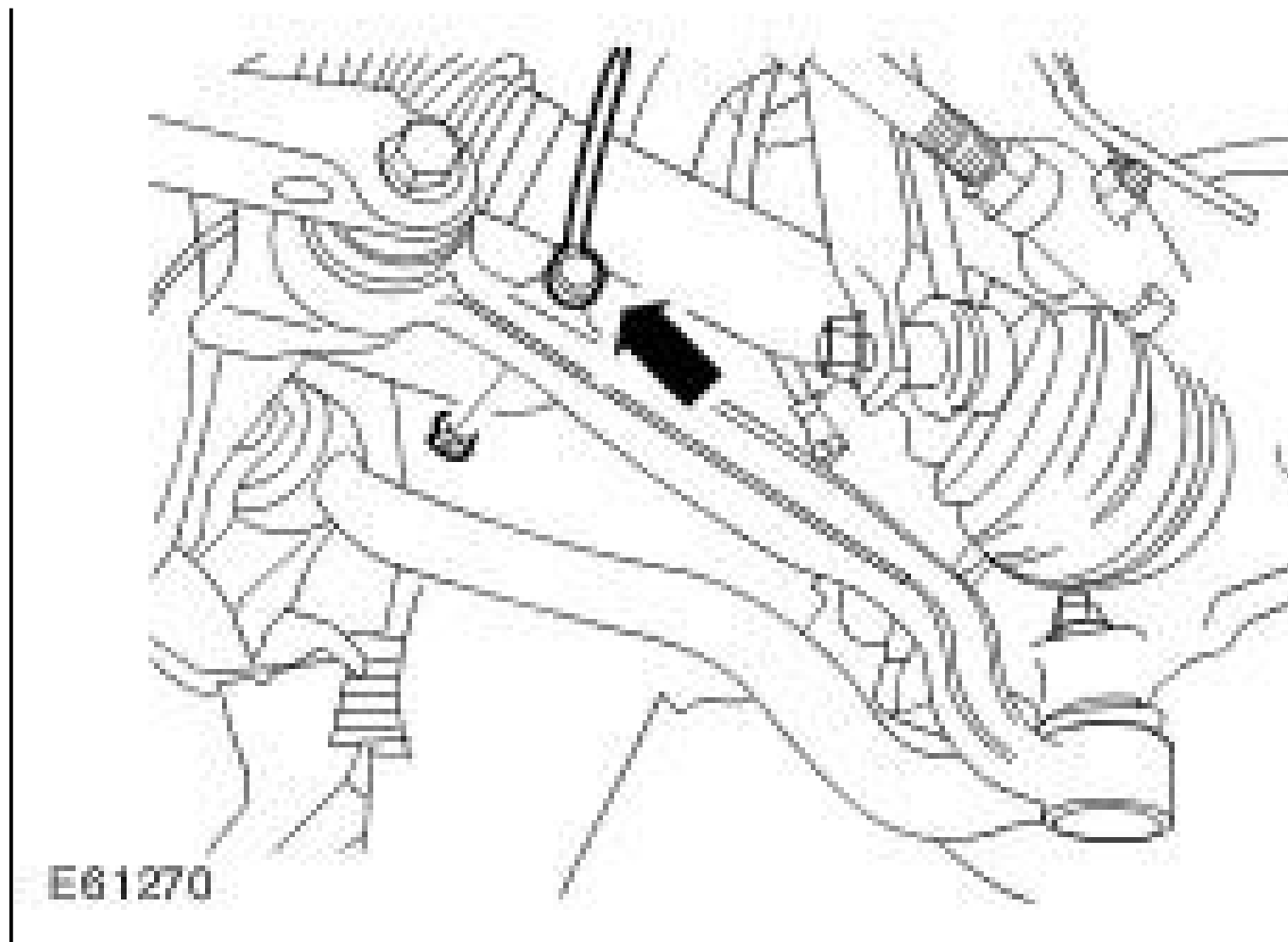
8. LH side: Disconnect the stabilizer bar link.
 - Remove the nut.

- Remove the flat washer.



NOTE: Use an additional wrench to prevent the ball joint rotating.

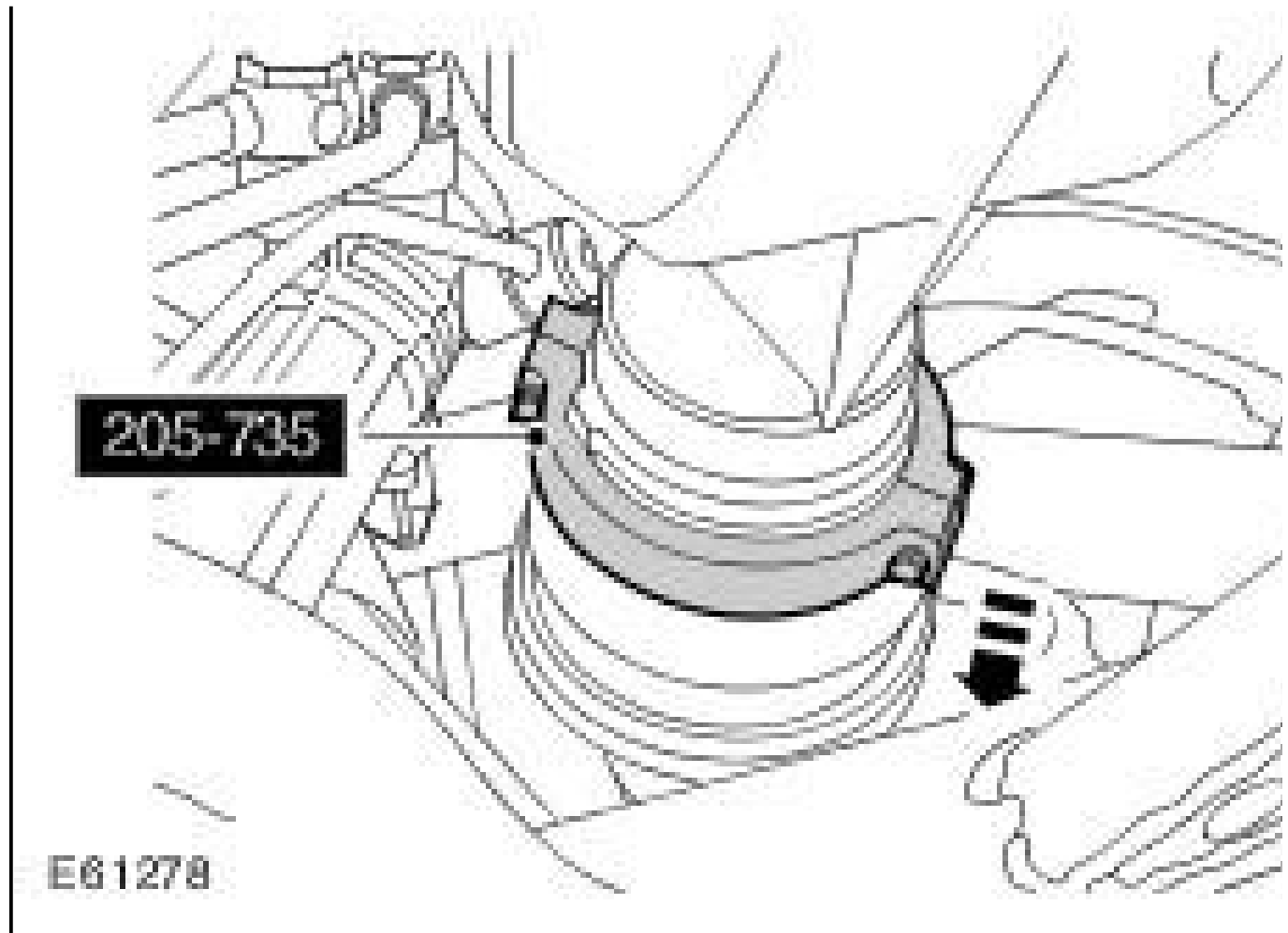
9. LH side: Disconnect the suspension height sensor link arm.
 - Remove the nut.



CAUTION: Ensure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

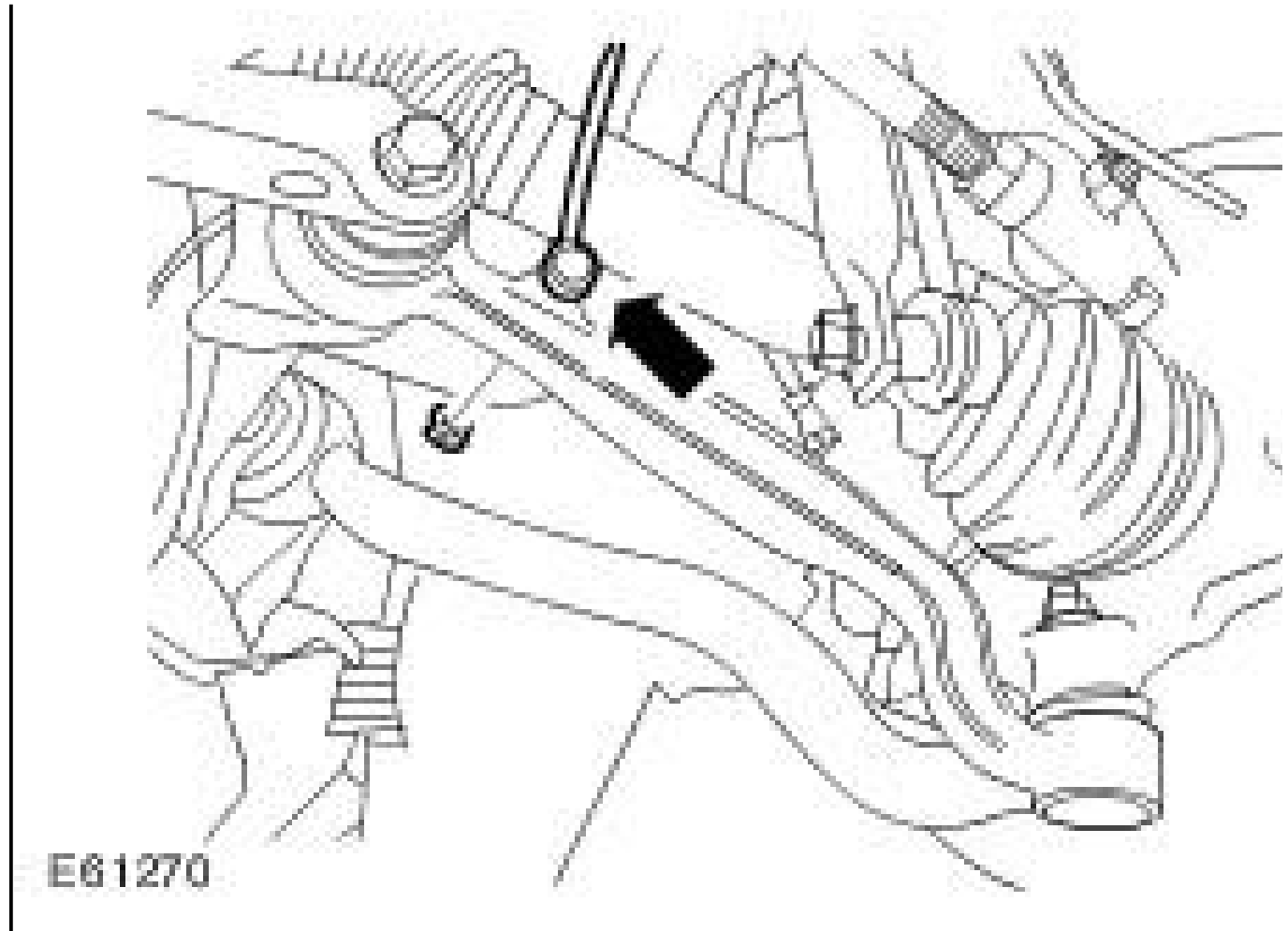
10. LH side: Disconnect the steering gear tie rod end ball joint.

- Loosen the tie-rod end ball joint retaining nut.
- Discard the nut.



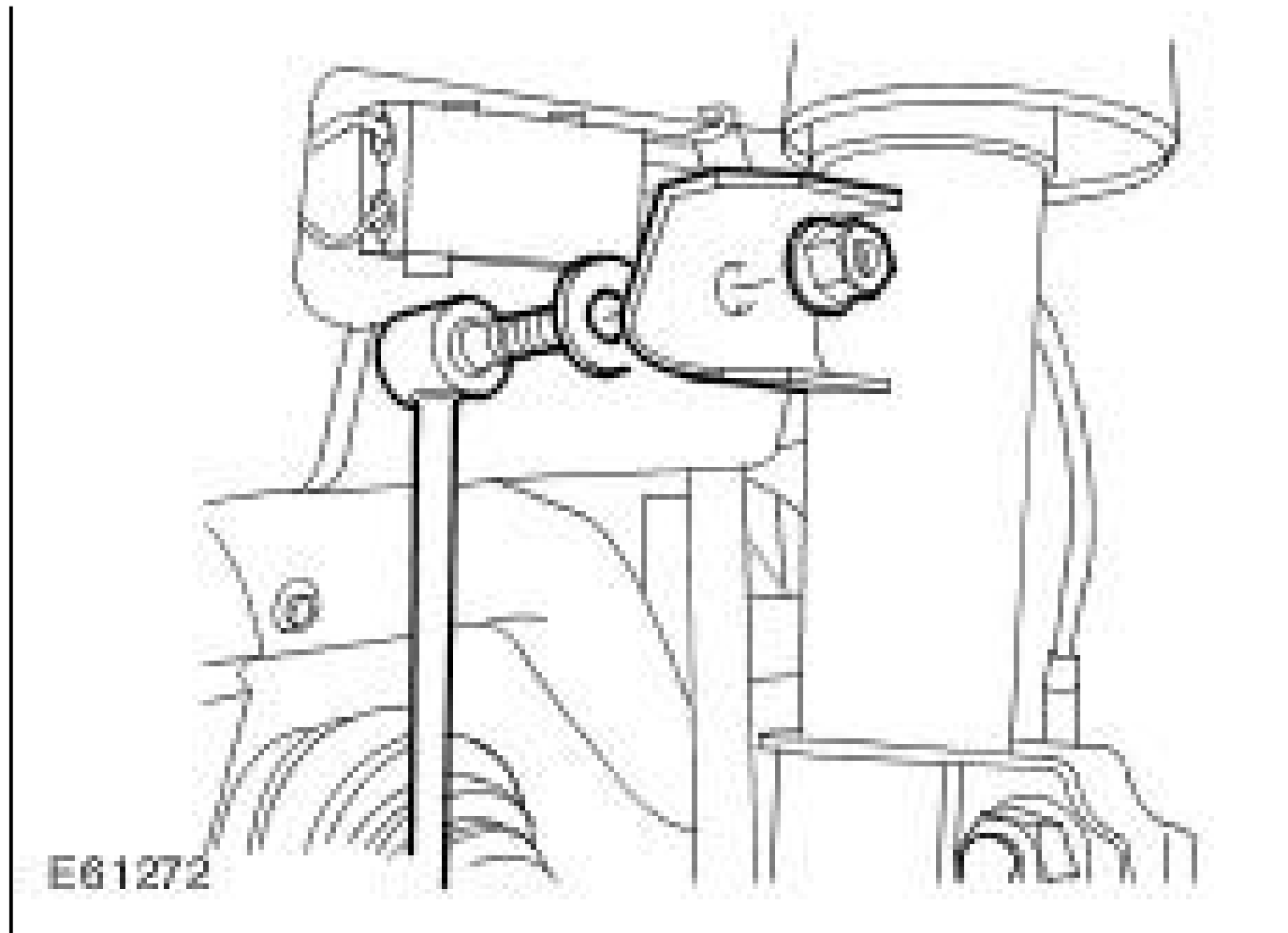
CAUTION: Support the lower arm.

11. LH side: Disconnect the lower arm.
 - Remove the bolt and discard the nut.



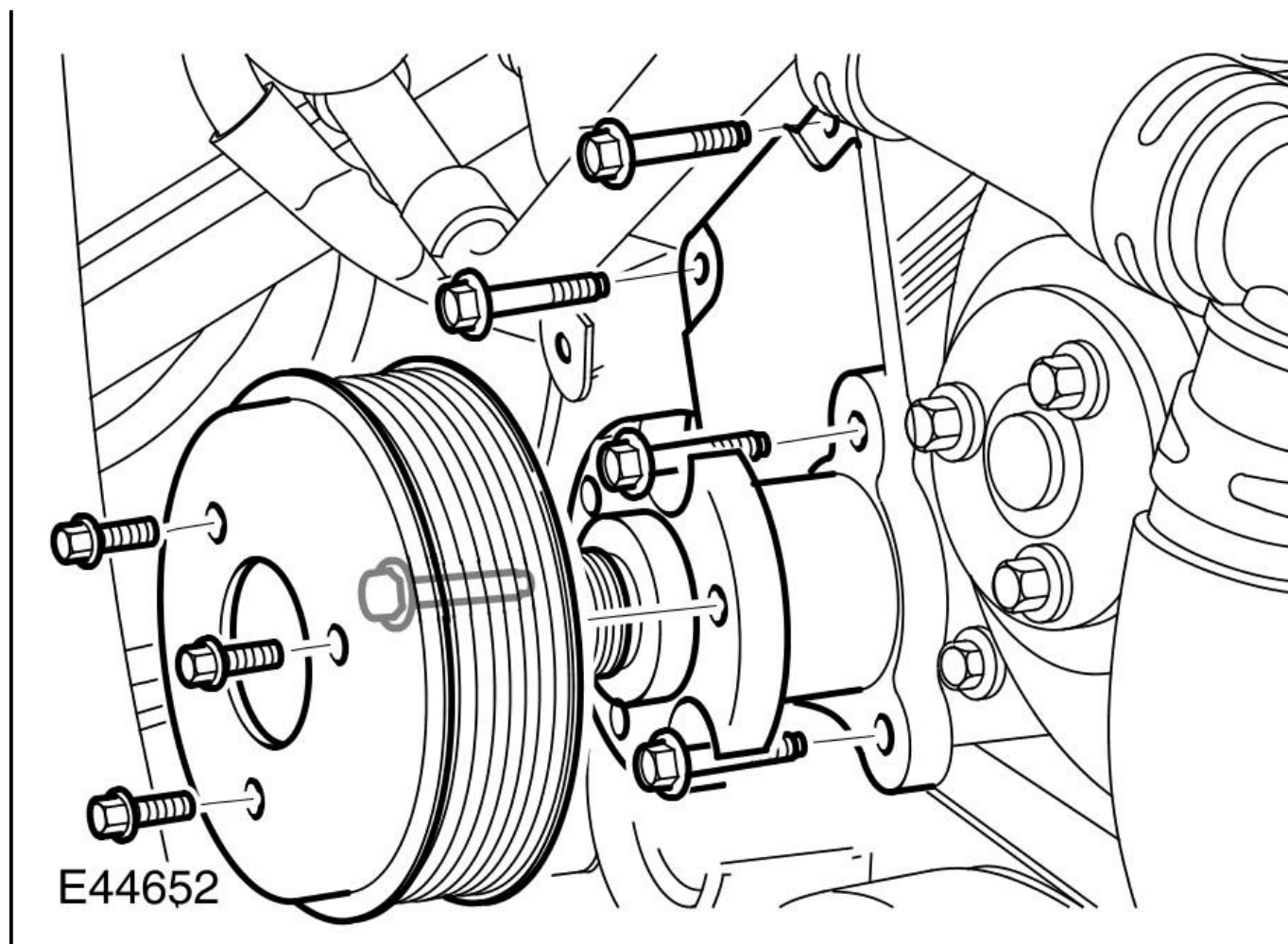
CAUTION: Support the tie rod.

12. LH side: Disconnect the tie rod.
 - Remove the bolt and discard the nut.



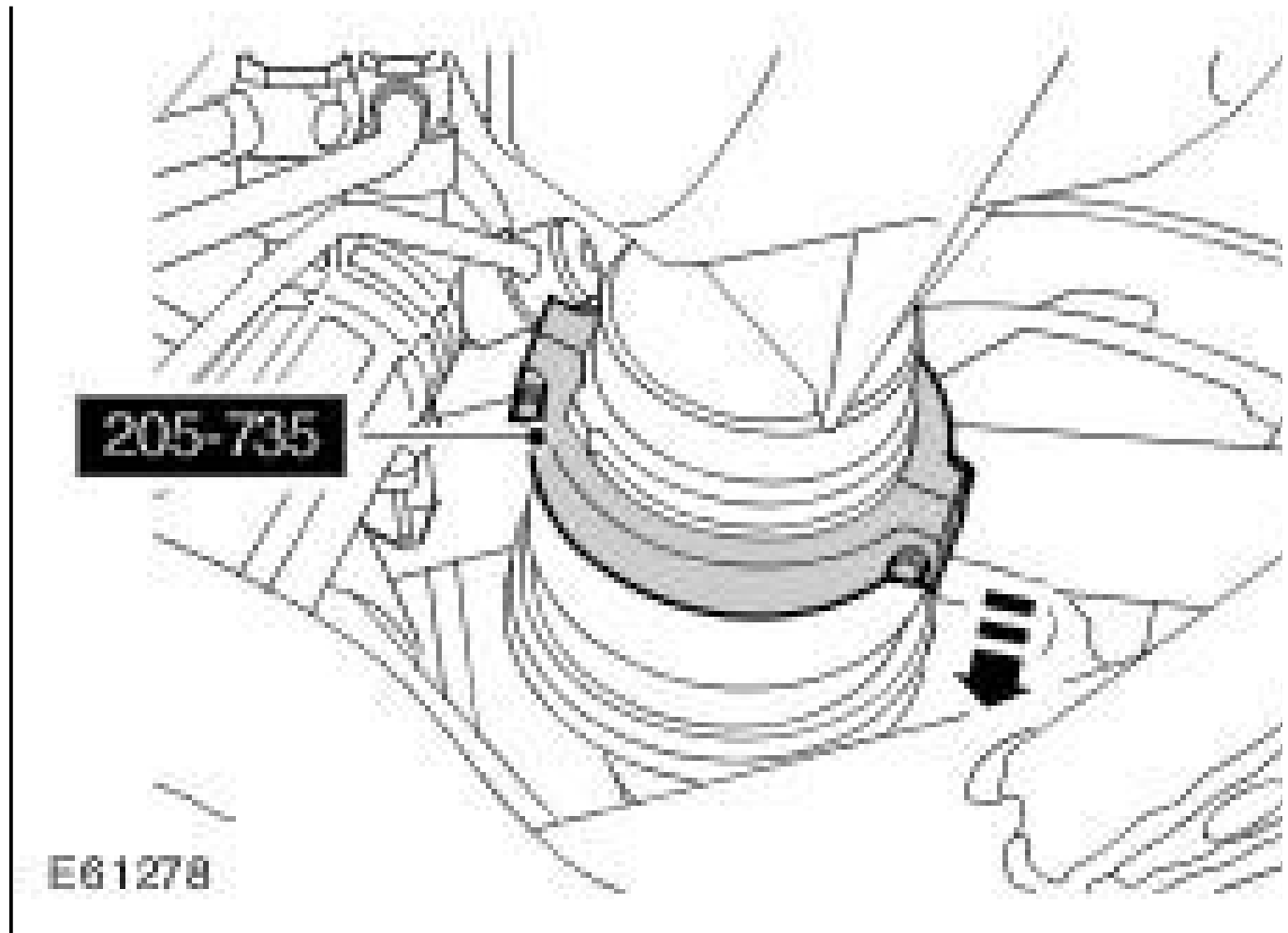
WARNING: Do not remove the nuts.

13. LH side: Release the air suspension spring.
 - Loosen the 3 nuts.

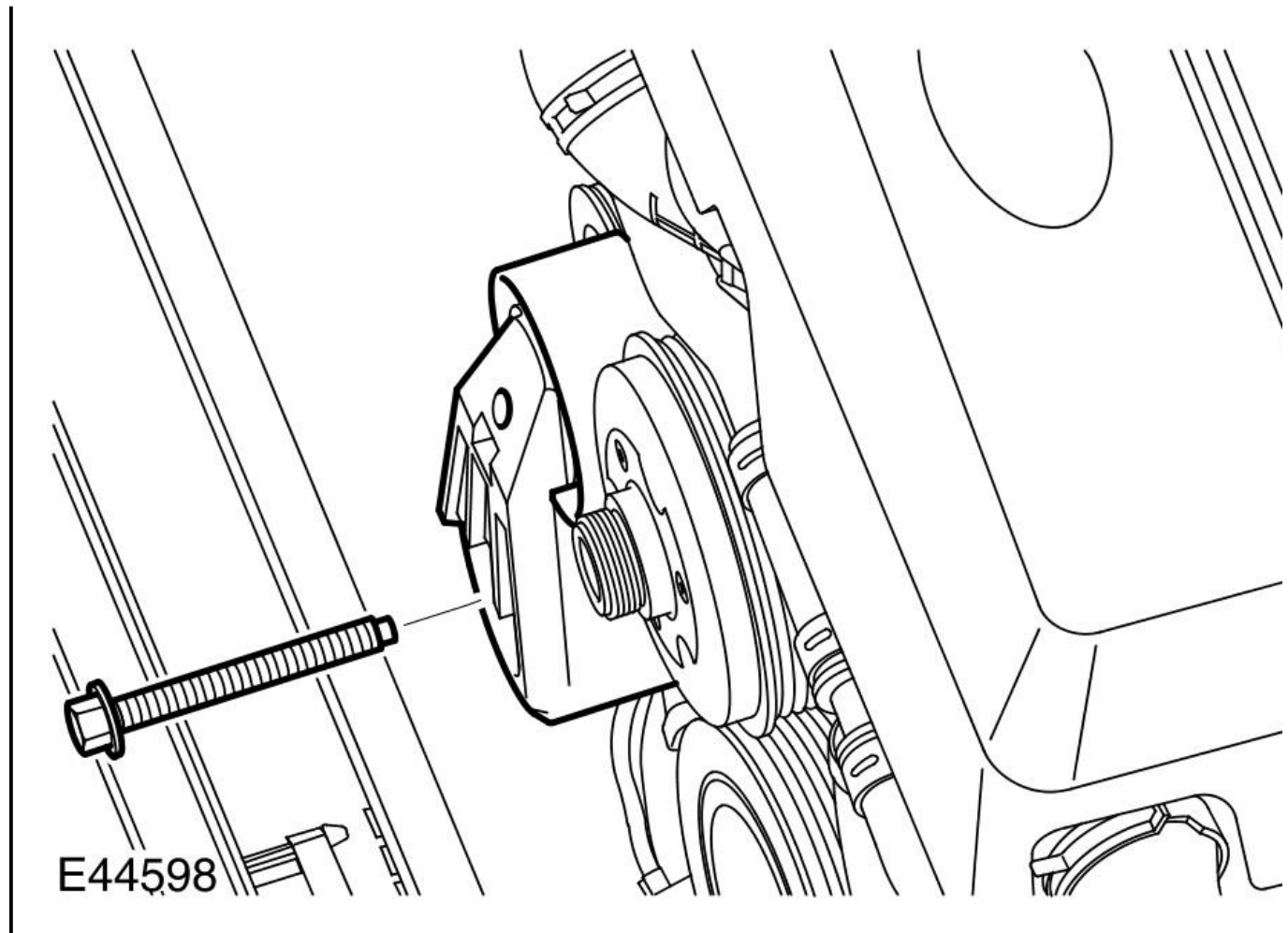


CAUTION: Support the halfshaft.

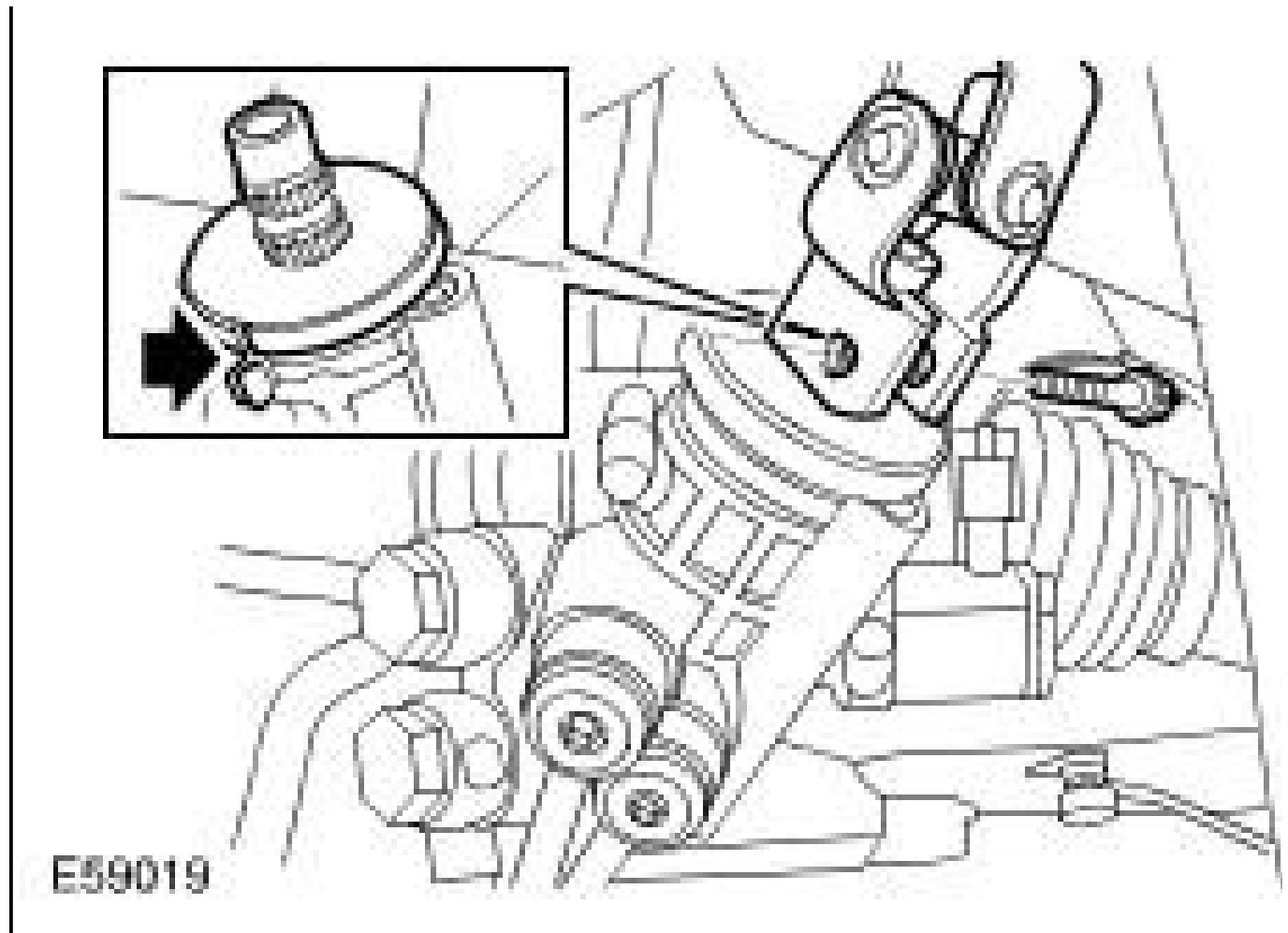
14. LH side: Using the special tool, disconnect the halfshaft from the differential.
 - Remove and discard the retaining clip.



15. LH side: Remove and discard the halfshaft oil seal.
16. LH side: Remove the engine compartment heat shield.
 - Remove the 2 nuts.
 - Remove the 2 screws.

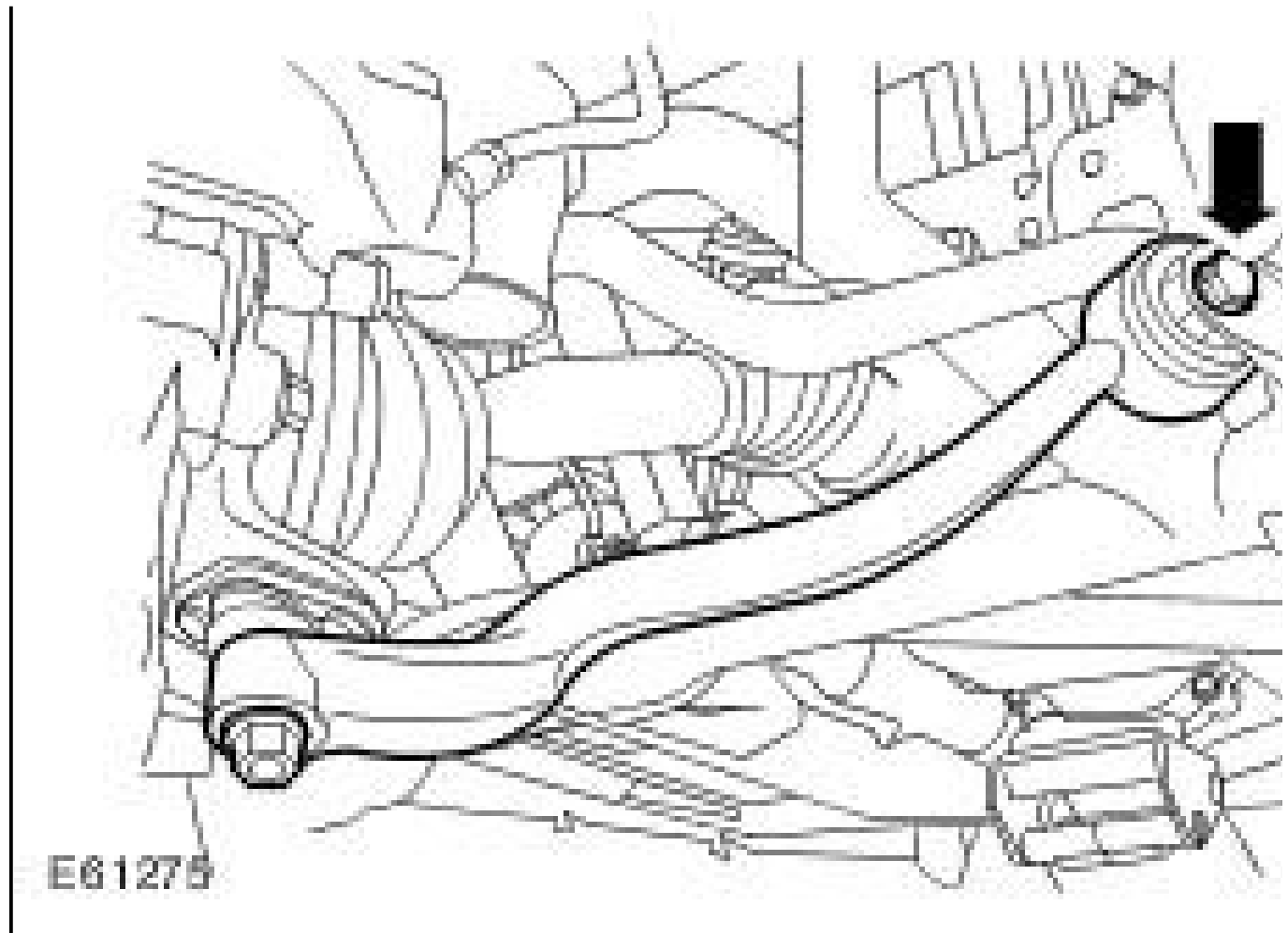


17. LH side: Remove the engine mount heat shield.
- Remove the 2 screws.

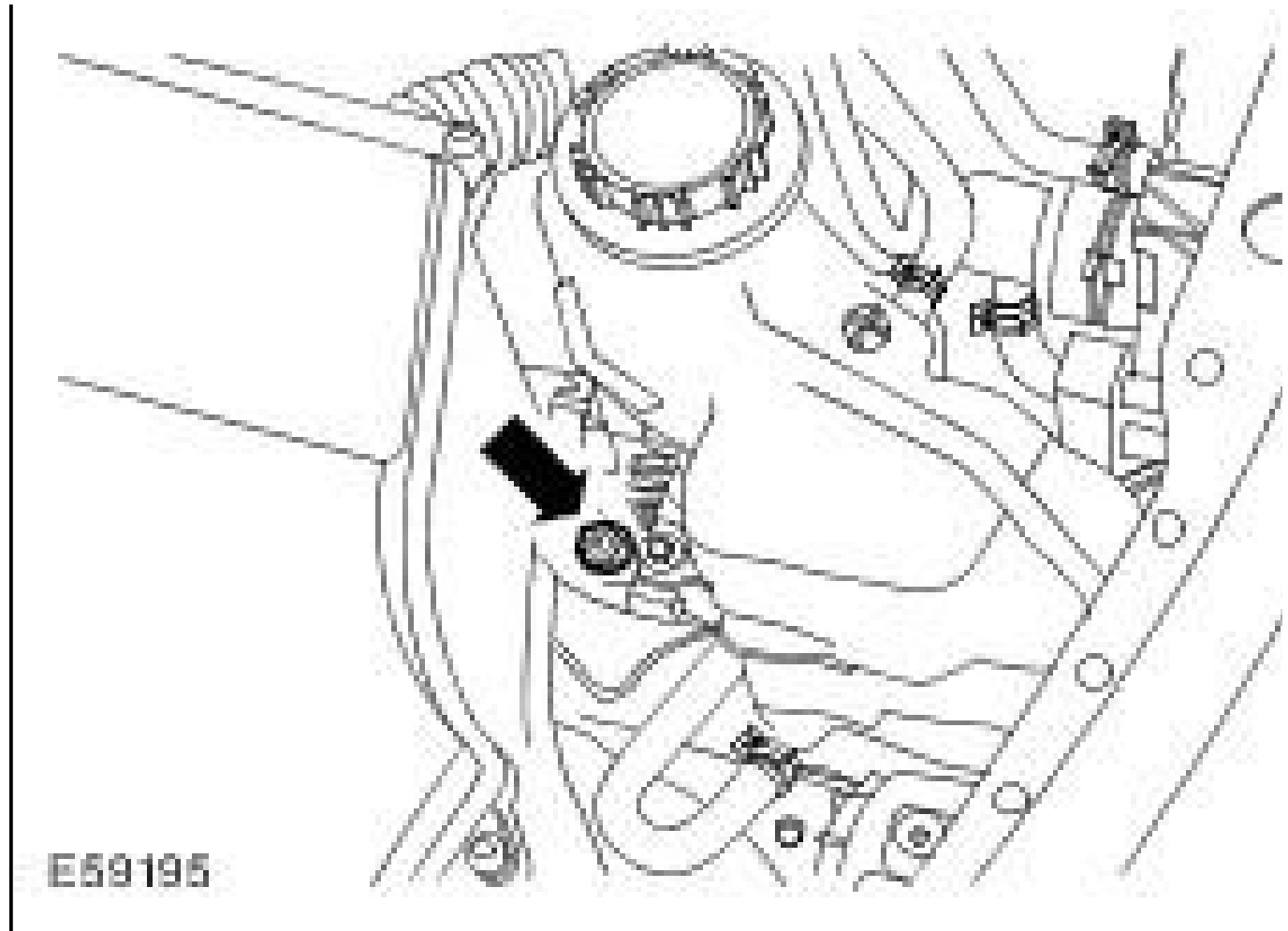


18. RH side: Release the engine mount.

- Support the engine.
- Remove the nut.

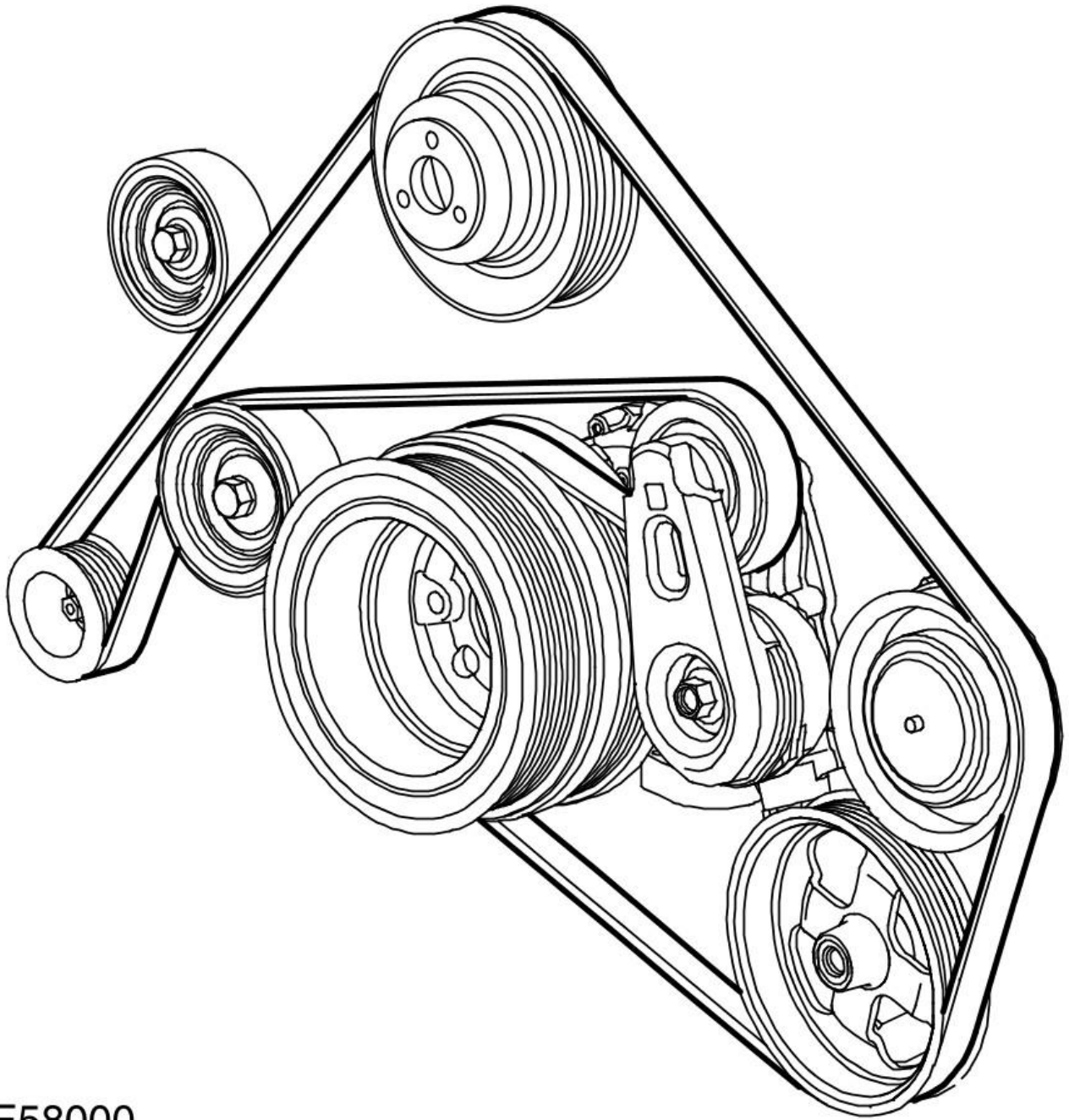


19. LH side: Release the engine mount.
- Remove the bolt.



20. LH side: Remove the engine mount.

- Using a transmission jack, raise the engine clear of the engine mount.
- Remove the 2 bolts.



E58000

INSTALLATION

ALL VEHICLES

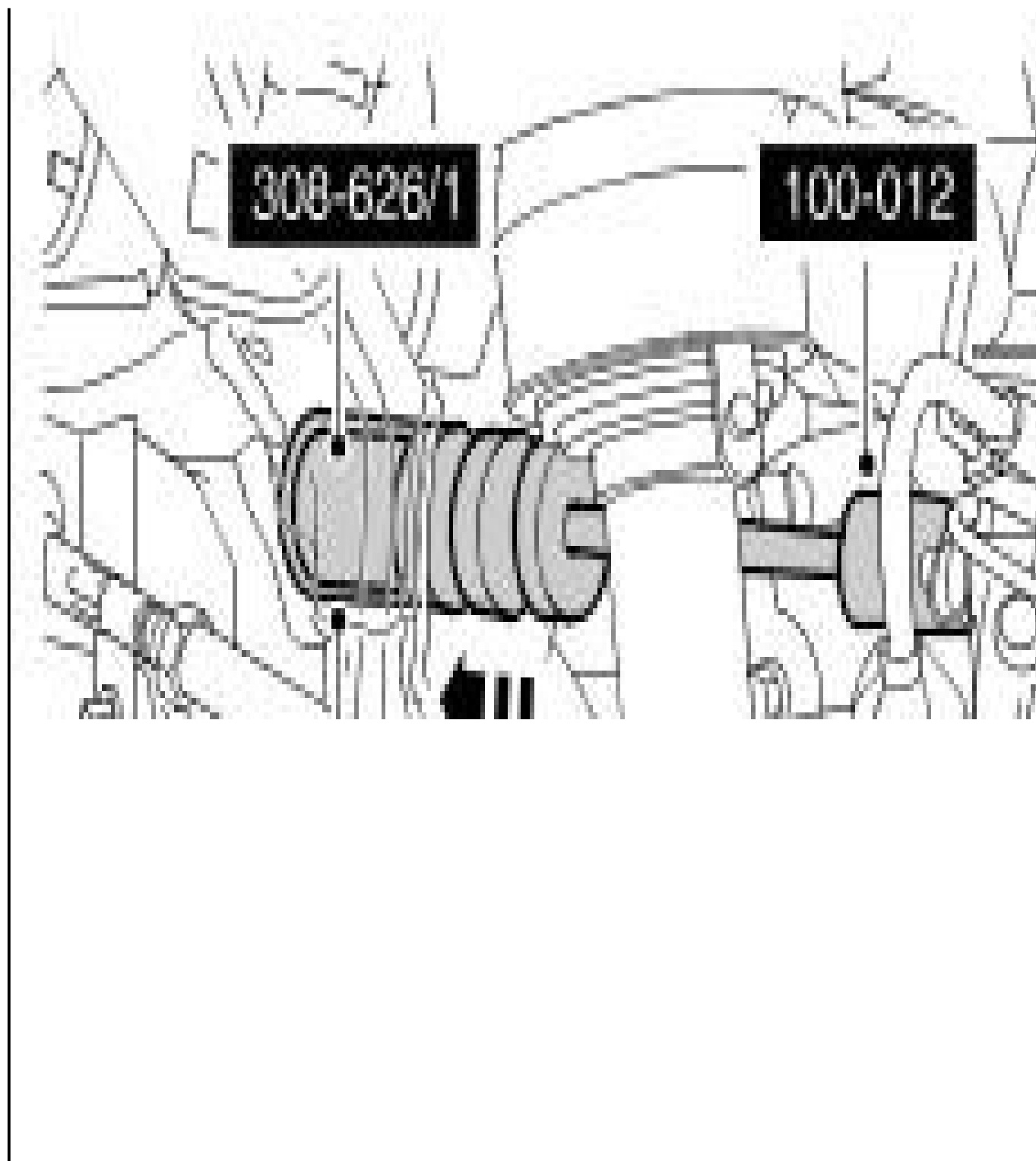
1. LH side: Install the engine mount.
 - Tighten the engine mount to subframe bolts to 56 Nm (41 lb.ft).

2. LH side: Install the engine mount heat shield.
 - Tighten the screws.
3. Lower the engine onto its mounts.
 - Tighten the bolt to 100 Nm (74 lb.ft).
 - Tighten the nut to 100 Nm (74 lb.ft).
4. LH side: Install the engine compartment heat shield.
 - Tighten the screws.
 - Tighten the nuts.

CAUTION: The seal protector must be left in place until the halfshaft has been installed.

NOTE: LH illustration shown, RH is similar.

5. LH side: Using the special tools, install a new halfshaft oil seal.
 - Clean the component mating faces.



CAUTION: Keep the halfshaft horizontal to avoid damaging the oil seal.

CAUTION: Pull on the halfshaft to make sure the clip has fully engaged and retains the halfshaft inboard joint within the differential case.

NOTE: Do not fully engage the halfshaft until the oil seal protector has been removed.

6. LH side: Fully install the halfshaft.
- Clean the component.
 - Install a new retaining clip.
 - Open the halfshaft oil seal protector.
 - Lubricate the seal with clean differential fluid.
 - Remove and discard the halfshaft oil seal protector.

NOTE: Do not tighten the locking nut at this stage.

7. LH side: Connect the tie rod.
- Install the bolt with a new nut.

NOTE: Do not tighten the locking nut at this stage.

8. LH side: Connect the lower arm.
- Install the bolt with a new nut.

CAUTION: Ensure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

9. LH side: Connect the steering gear tie rod end ball joint.
- Clean the component mating faces.
 - Tighten the new nut to 80 Nm (59 lb.ft).

CAUTION: Make sure the hardened steel washer is fitted against the stabilizer bar link.

NOTE: Use an additional wrench to prevent the ball joint rotating.

10. LH side: Connect the stabilizer bar link.
- Install the washer.
 - Tighten the nut to 100 Nm (74 lb.ft).

NOTE: Use an additional wrench to prevent the ball joint rotating.

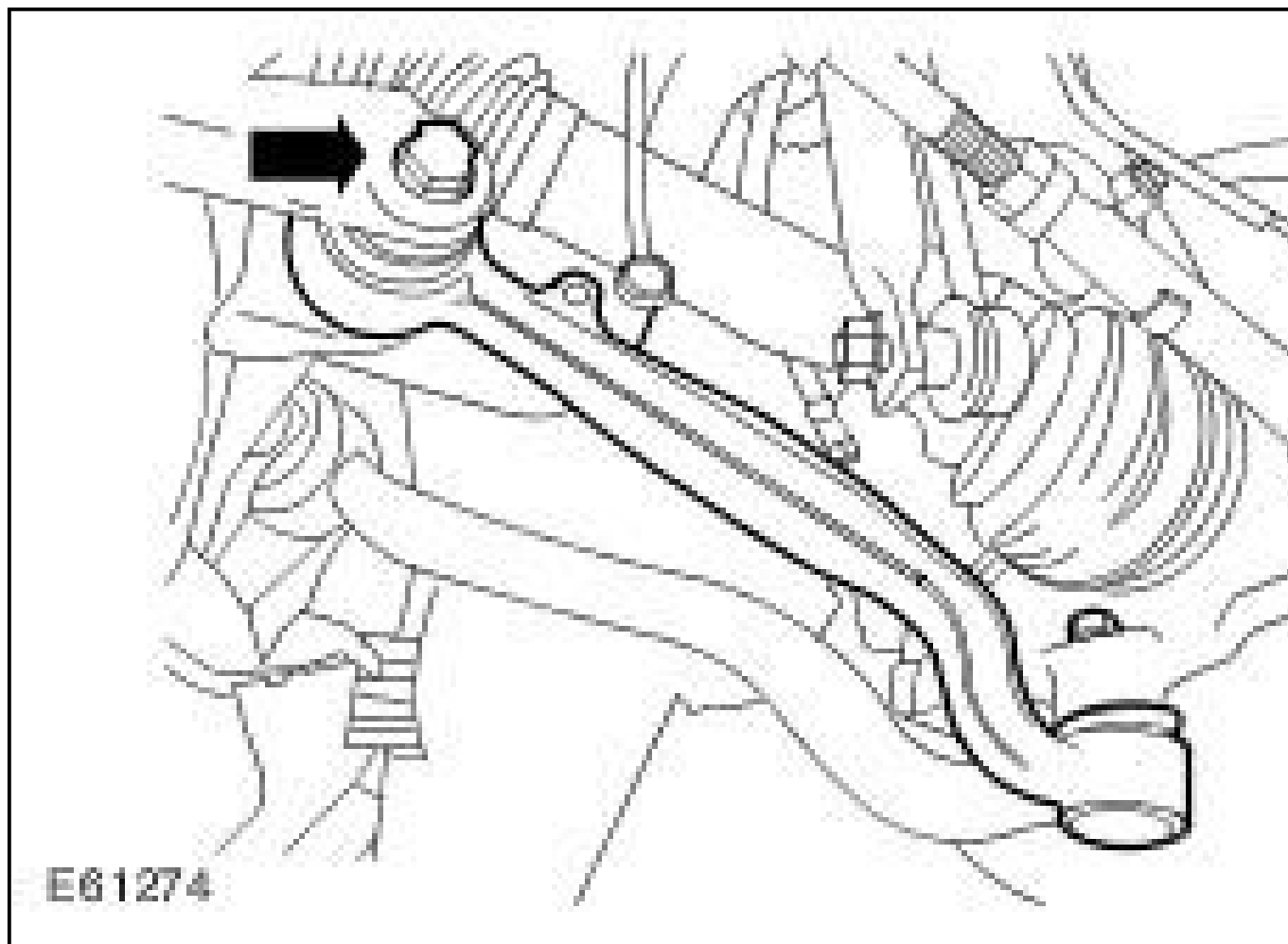
11. LH side: Connect the suspension height sensor link arm.

- Tighten the nut to 8 Nm (6 lb.ft).

LEFT-HAND DRIVE VEHICLES

12. Attach the lower steering column.

- Make sure that the steering gear tag is aligned correctly, as shown.
- Install a new Torx bolt and tighten to 24 Nm (18 lb.ft).



13. Install the front wheels and tires.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

CAUTION: Nuts and bolts must be tightened with the weight of the vehicle on the suspension.

14. Tighten the lower arm nuts and bolts to 165 Nm (122 lb.ft) plus a further 90 degrees.

CAUTION: Nuts and bolts must be tightened with the weight of the vehicle on the suspension.

15. Tighten the tie rod nuts and bolts to 165 Nm (122 lb.ft) plus a further 90 degrees.

ALL VEHICLES

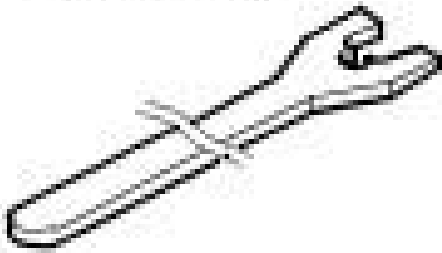
16. Install the exhaust system. Refer to **Exhaust System** .
17. Install the radiator splash shield. Refer to **Radiator Splash Shield** .
18. Connect the battery ground cable. Refer to **Specifications** .
19. Fill the front differential case with the correct amount of fluid. Refer to **Differential Draining and Filling** .
20. Carry out a complete vehicle geometry check and adjustment.

ENGINE MOUNT RH

SPECIAL TOOLS

Tool Illustration	Tool Name	Tool Number
	Viscous coupling spanner	303-1142
	Viscous coupling pulley retaining tool	303-1143

303-1143



E55382

REMOVAL

1. Disconnect the battery ground cable. Refer to Specifications .

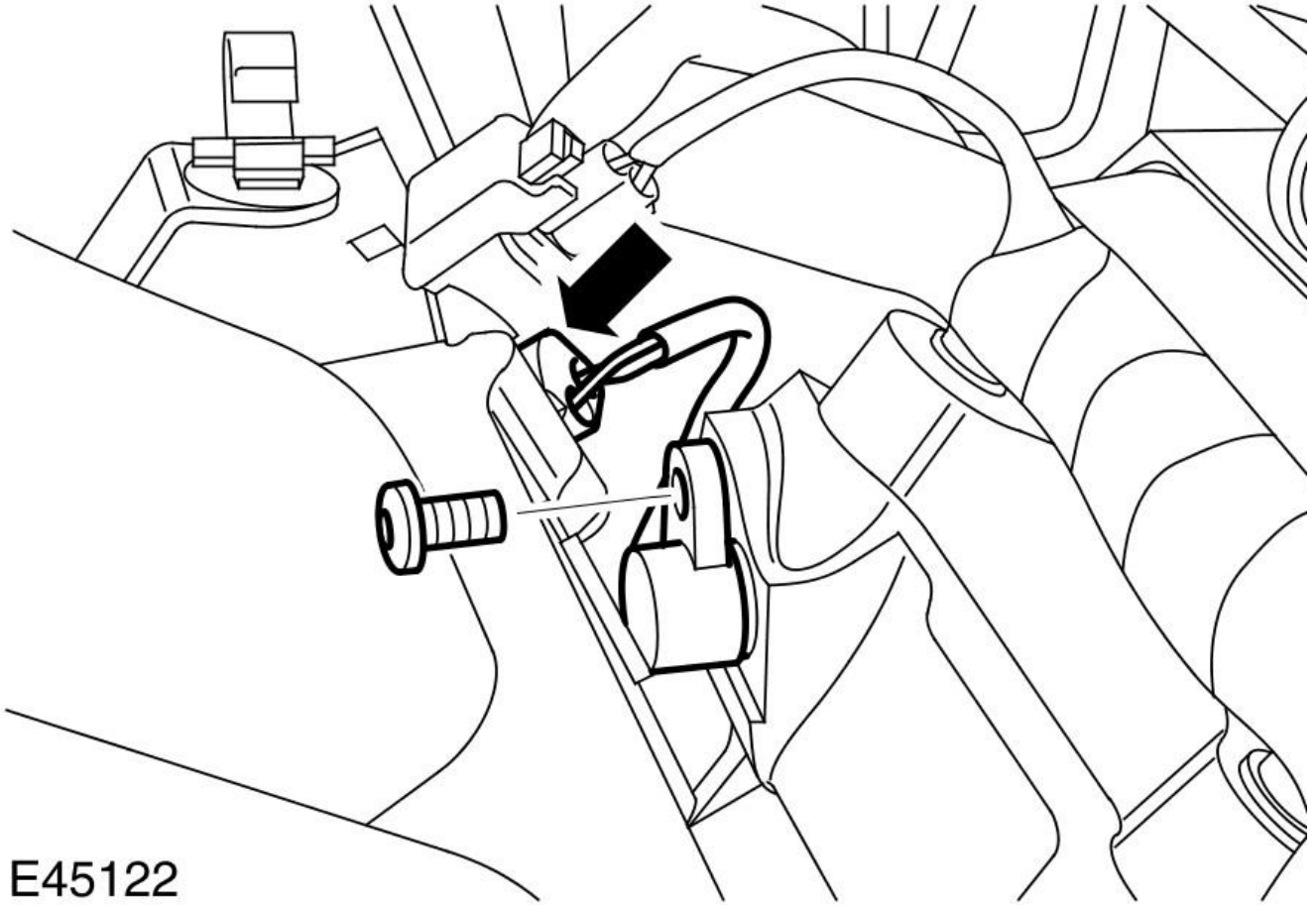
WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the air intake resonator. Refer to Intake Air Resonator .
4. Remove the coolant expansion tank. Refer to Coolant Expansion Tank .

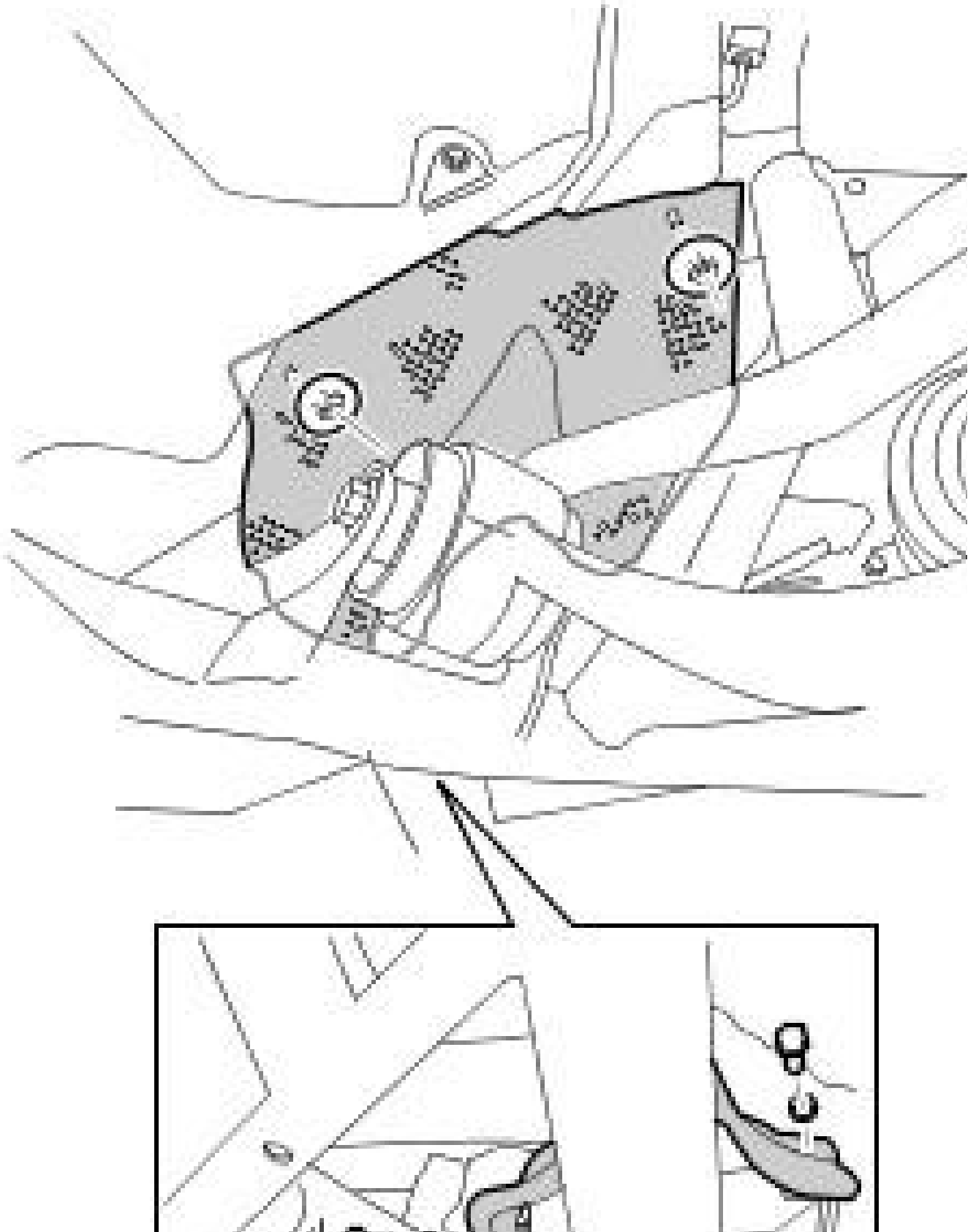
CAUTION: Always protect the cooling pack elements to prevent accidental damage.

NOTE: The thread is left handed.

5. Using the special tools, release the cooling fan.

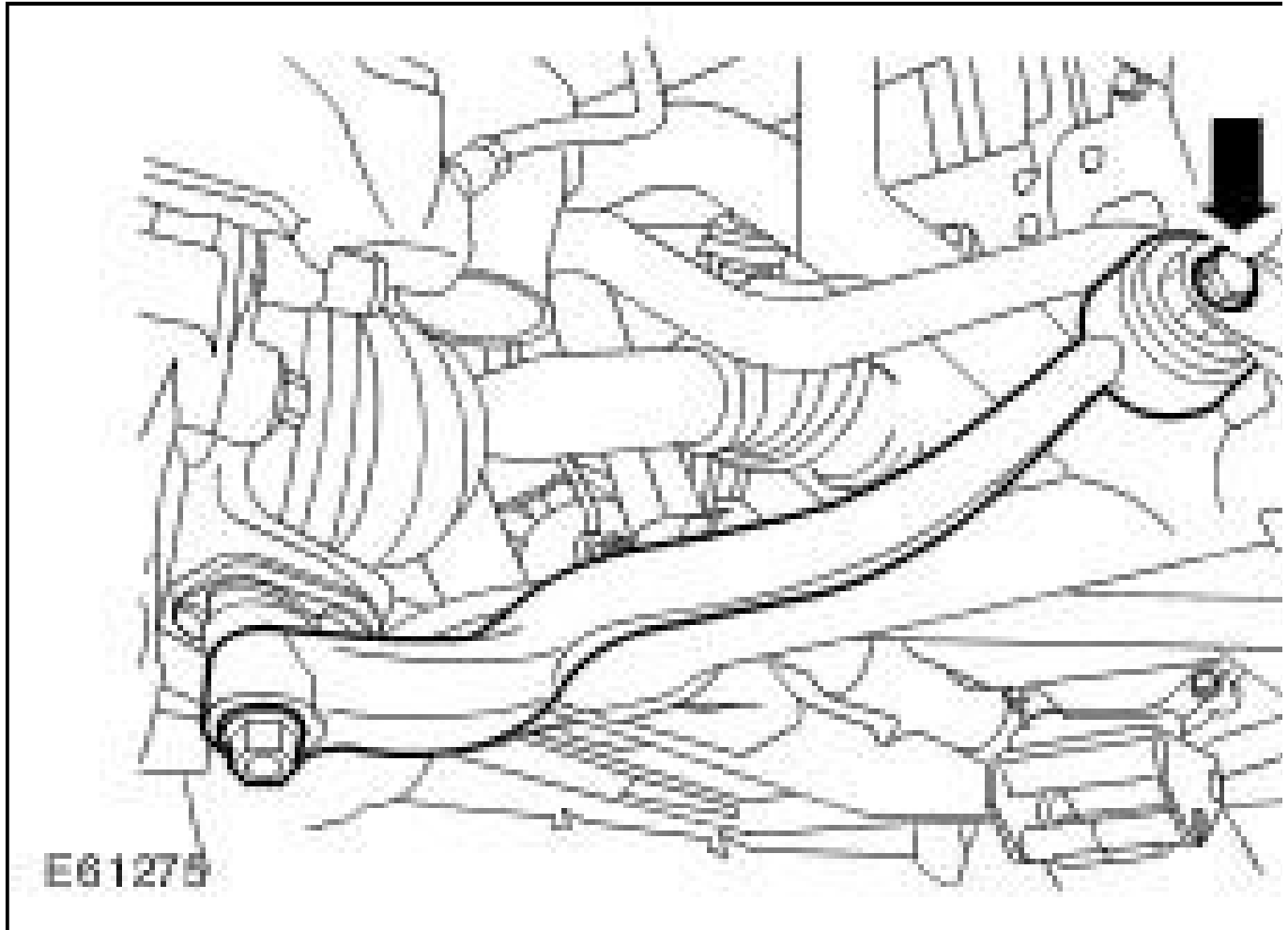


6. Remove the engine undershield. Refer to **Engine Undershield** .
7. Remove the engine compartment RH heat shield.
 - Remove the 2 nuts.
 - Remove the 2 screws.



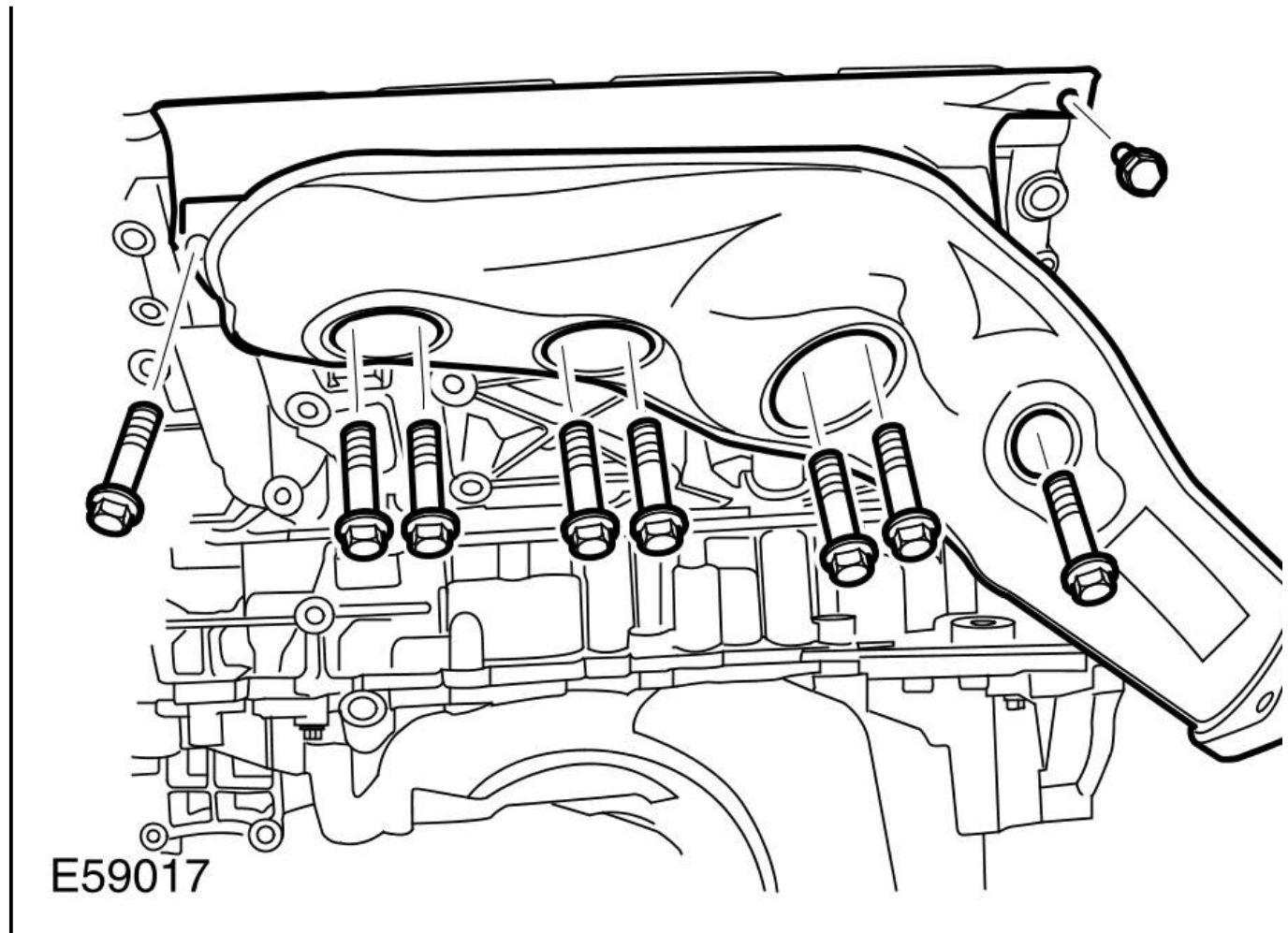
8. Release the engine mount.

- Support the engine.
- Remove the nut.



9. Remove the engine mount.

- Using a transmission jack, raise the engine clear of the engine mount.
- Remove the 2 bolts.



INSTALLATION

1. Install the engine mount.
 - Clean the component mating faces.
 - Lower the engine onto the mount.
 - Tighten the nut to 100 Nm (74 lb.ft).
 - Tighten the bolts to 56 Nm (41 lb.ft).
2. Install the engine compartment RH heat shield.
 - Tighten the screws.
 - Tighten the nuts.
3. Install the engine undershield. Refer to **Engine Undershield** .
4. Install the cooling fan.
 - Tighten the cooling fan to 65 Nm (48 lb.ft).
5. Install the air intake resonator. Refer to **Intake Air Resonator** .
6. Install the coolant expansion tank. Refer to **Coolant Expansion Tank** .
7. Connect the battery ground cable. Refer to **Specifications** .

FLEXPLATE**REMOVAL**

1. Disconnect the battery ground cable. Refer to Specifications .

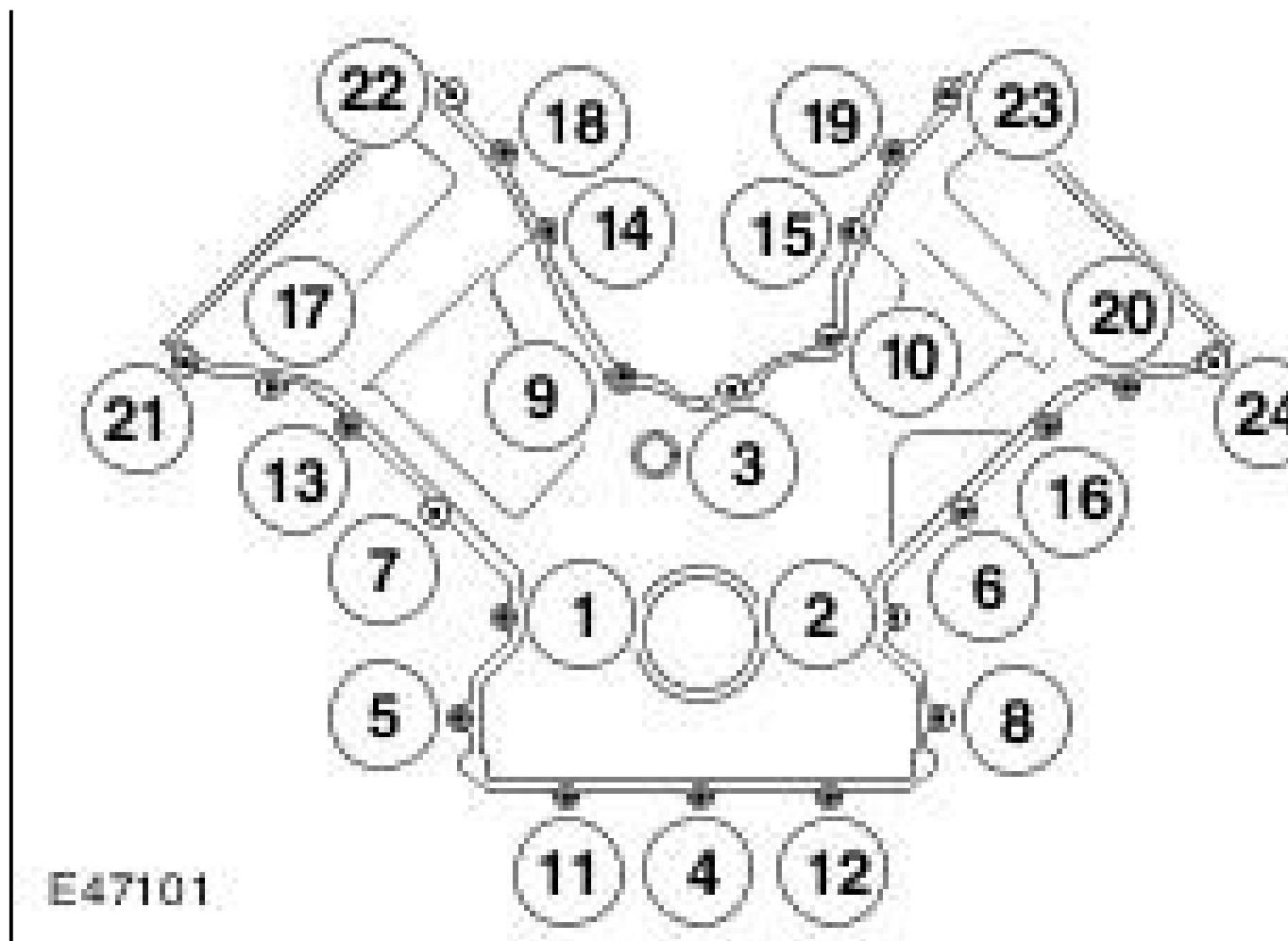
WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the transmission. Refer to Transmission .

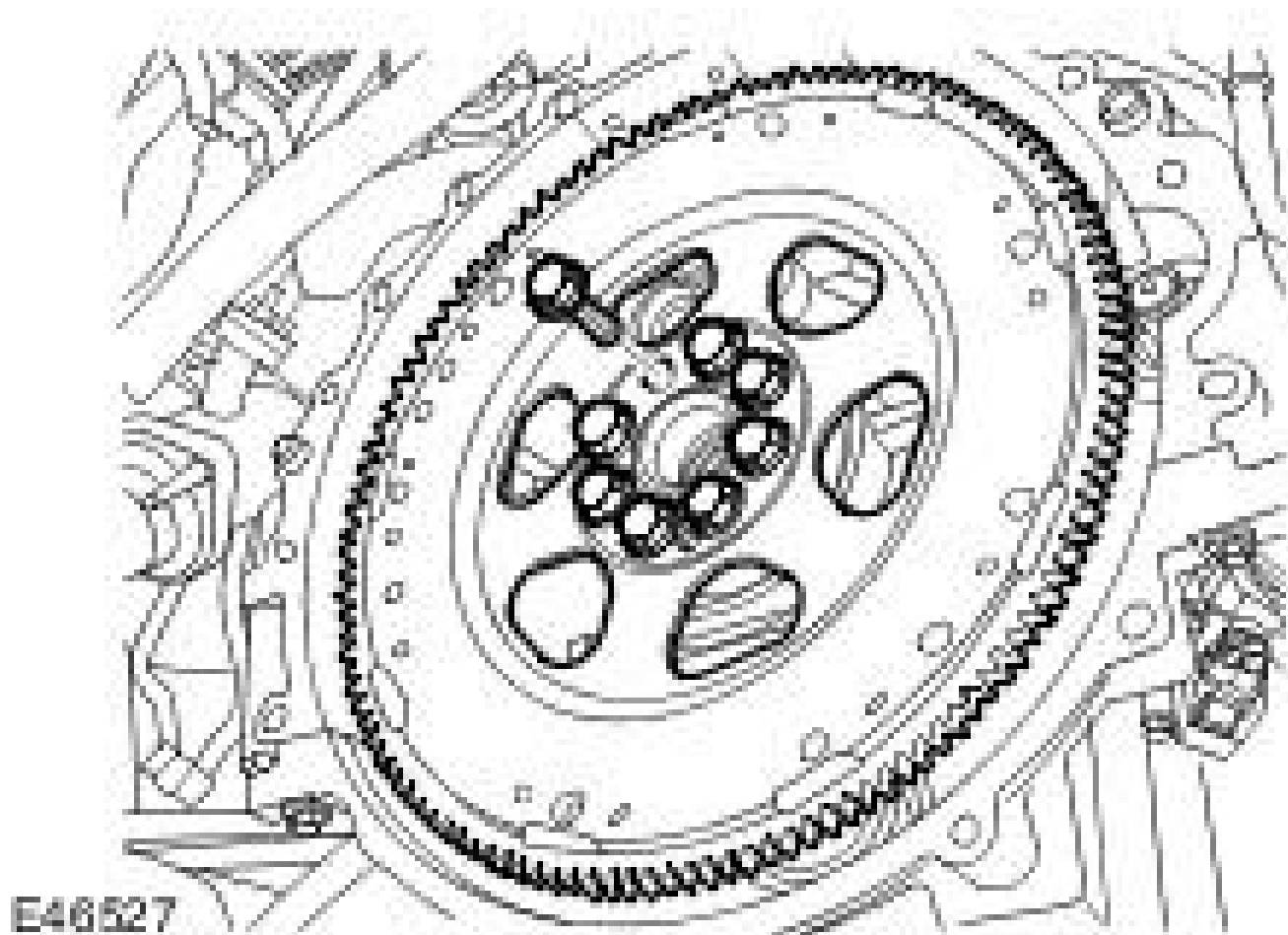
CAUTION: The bolts can only be used 3 times, mark the bolts with a center punch. If 2 punch marks are visible, discard the bolts.

NOTE: Prevent the flexplate from rotating.

4. Remove the torque converter flexplate.
 - Remove the 8 bolts.



INSTALLATION



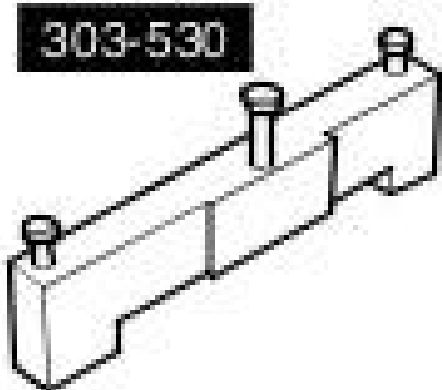
NOTE: Prevent the flexplate from rotating.

1. Install the torque converter flexplate.
 - Clean the component mating faces.
 - Tighten the bolts evenly in 2 stages to the sequence shown.
 - Tighten the bolts to 15 Nm (11 lb ft).
 - Tighten the bolts to 110 Nm (81 lb.ft).
2. Install the transmission. Refer to **Transmission** .
3. Connect the battery ground cable. Refer to **Specifications** .

OIL PUMP

SPECIAL TOOLS

Tool Illustration	Tool Name	Tool Number
	Camshaft setting/locking tool	303-530

 E46879		
 E46881	Crankshaft locking tool	303-645

REMOVAL

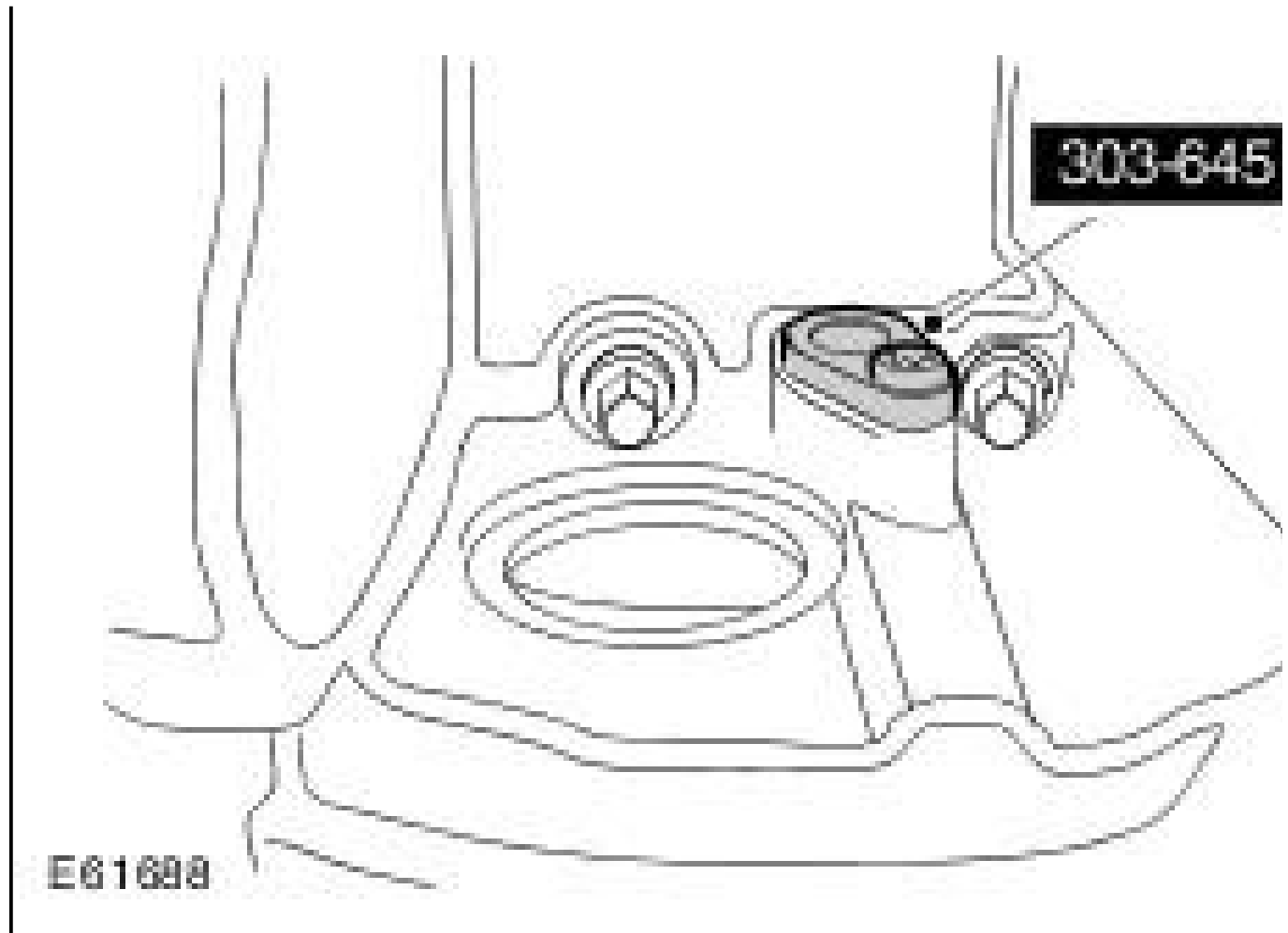
1. Disconnect the battery ground cable. Refer to [Specifications](#) .

WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

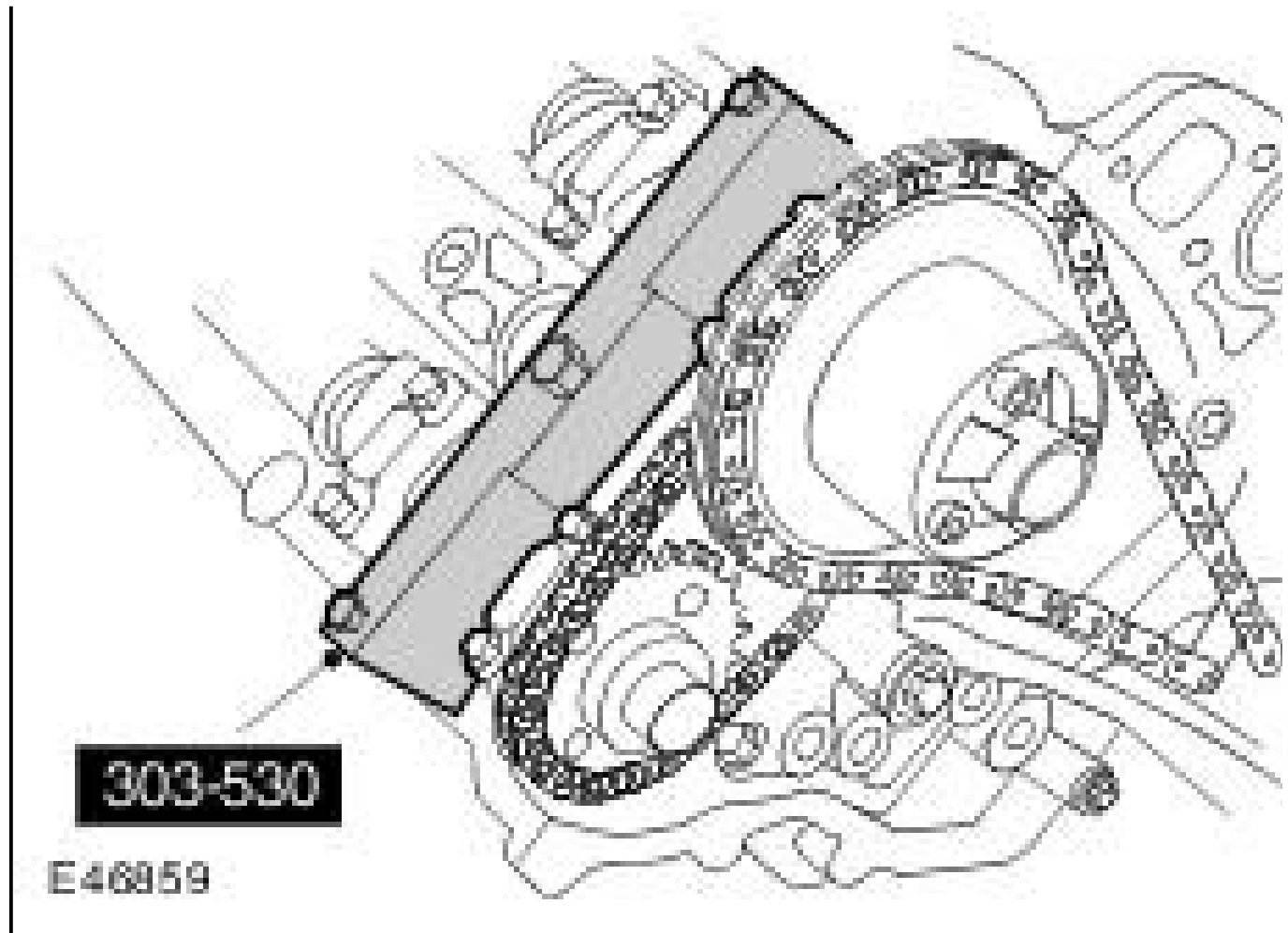
2. Raise and support the vehicle.
3. Remove the oil pan. See [Oil Pan](#).

NOTE: Install the special tool place of the crankshaft sensor.

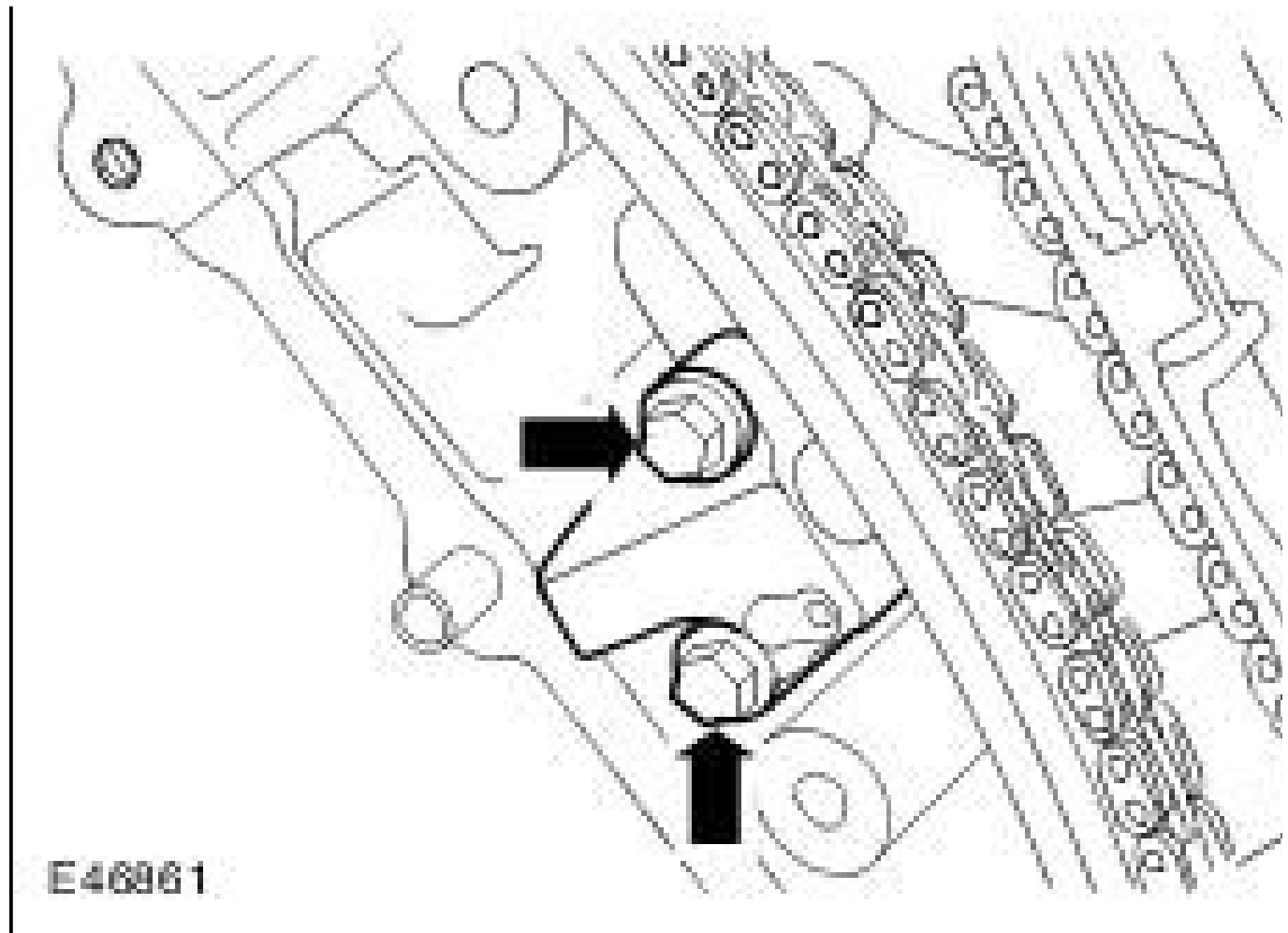
4. Lock the crankshaft.
 - Install the special tool.
 - Install the screw.



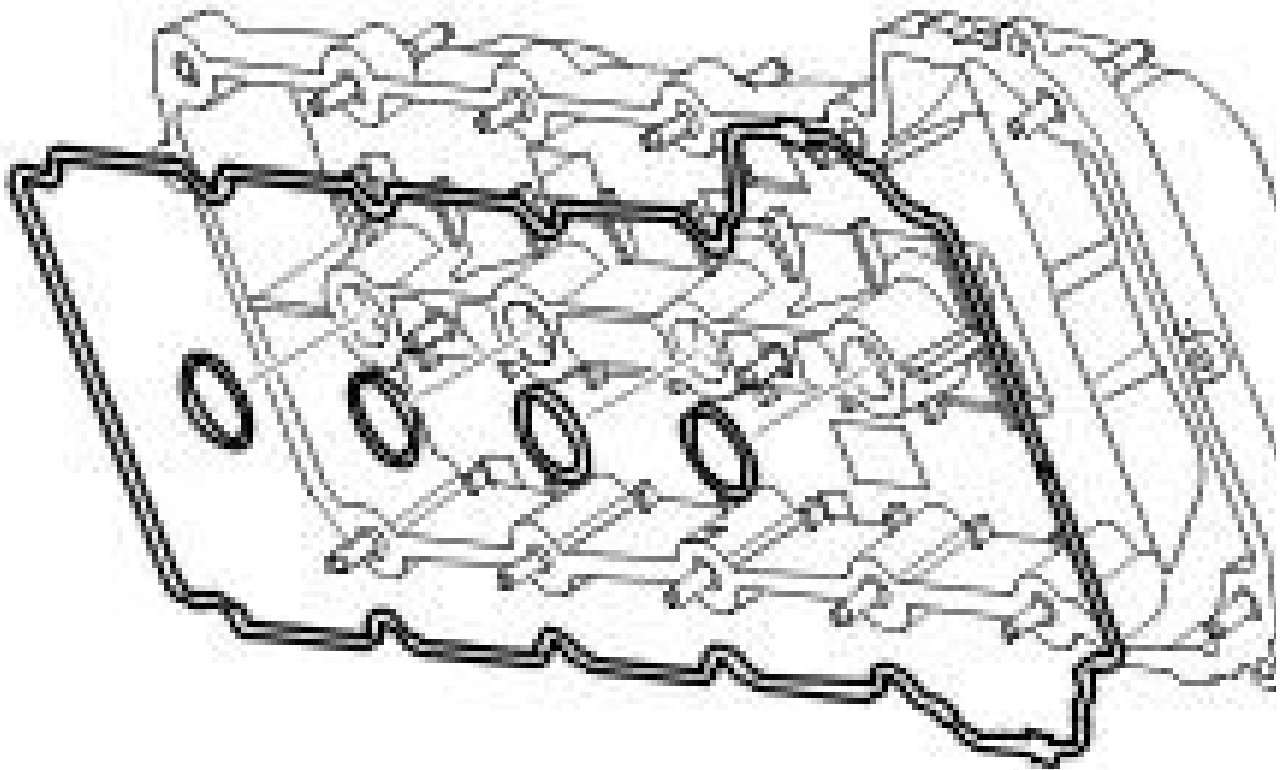
5. Install the special tool to the RH cylinder head.
 - Install the 3 bolts.



6. Remove the RH primary timing chain tensioner assembly.
 - Remove the 2 bolts.

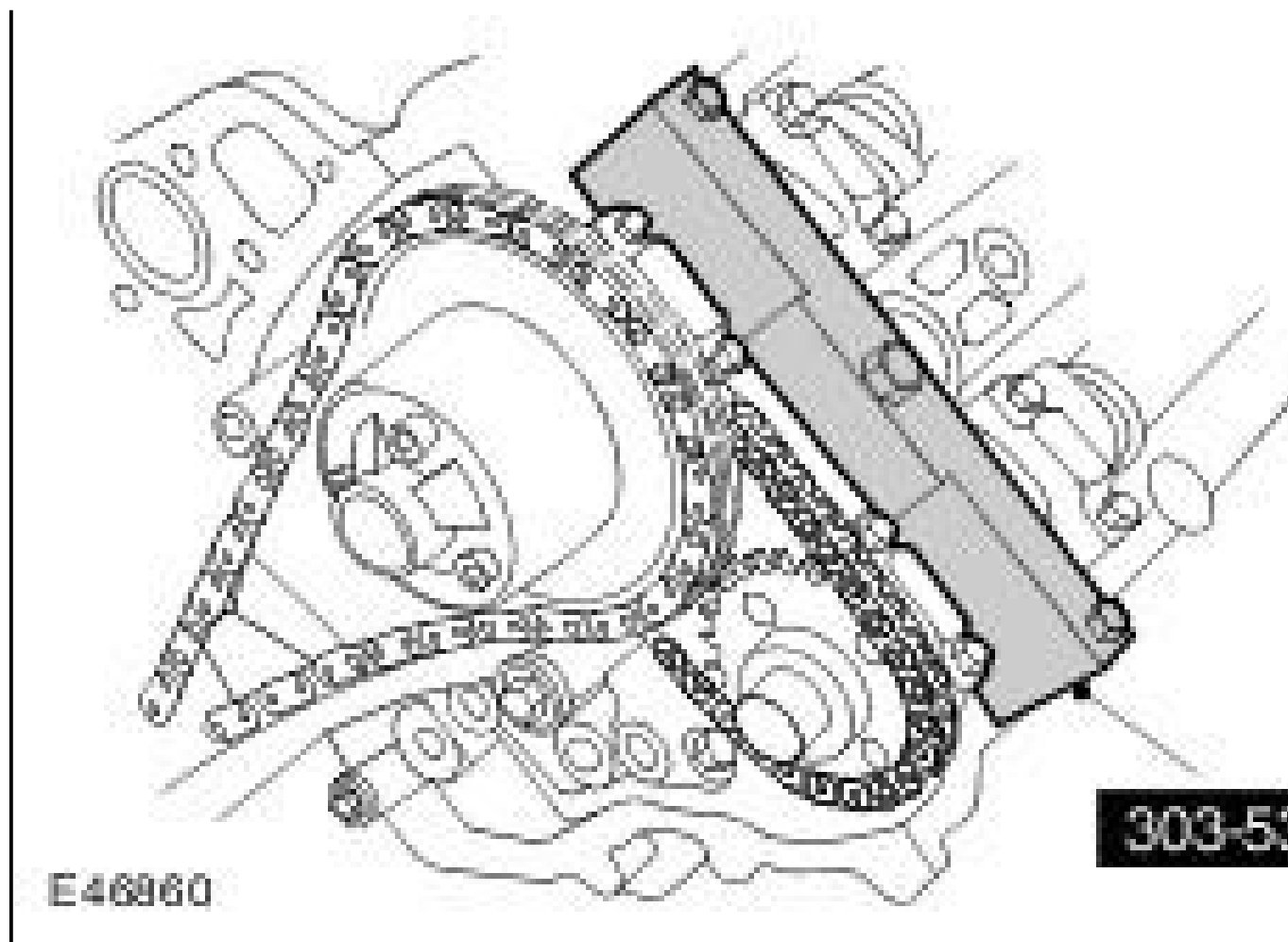


7. Remove the RH primary timing chain tensioner guide.
 - Remove the bolt.

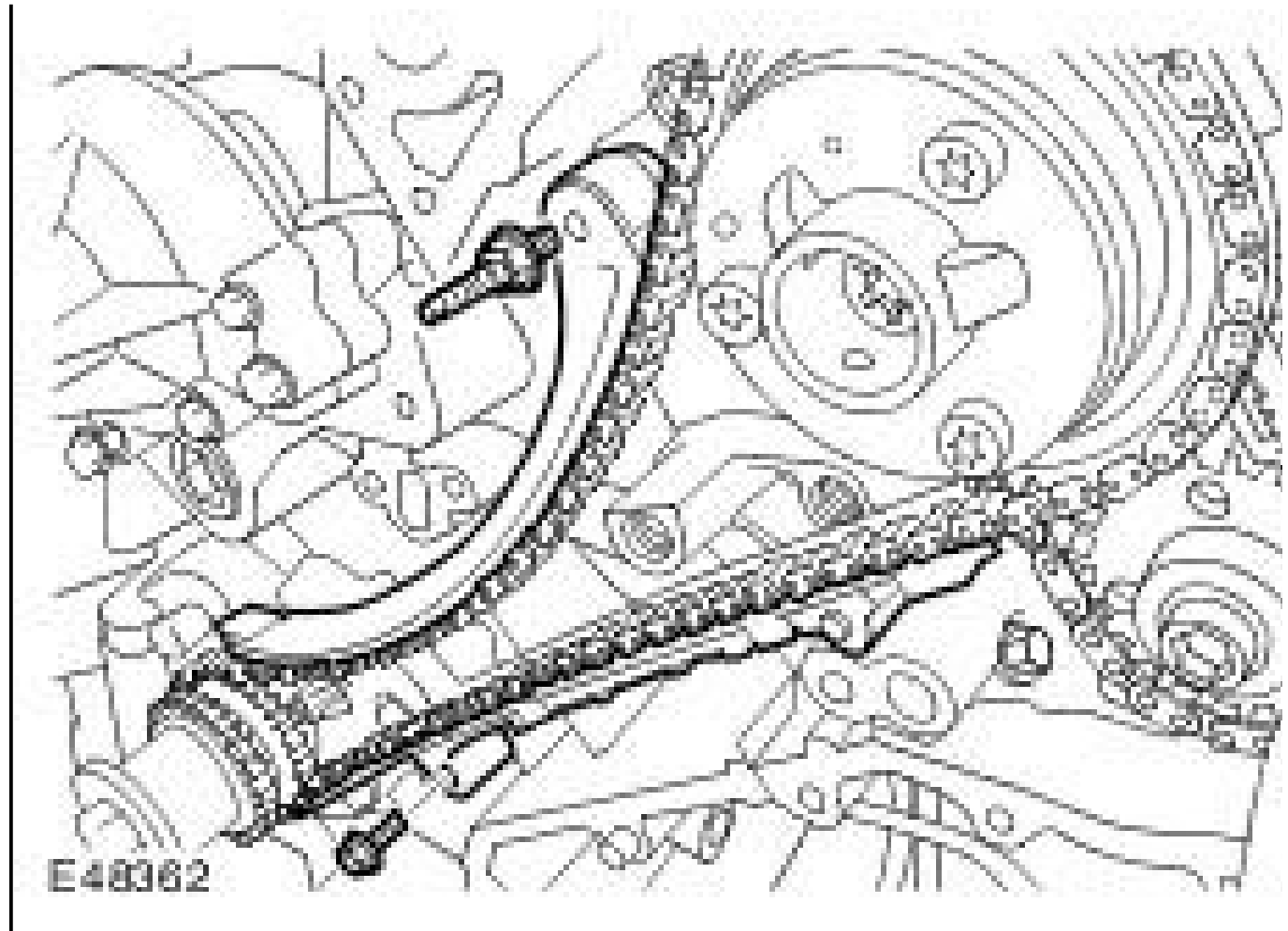


E46652

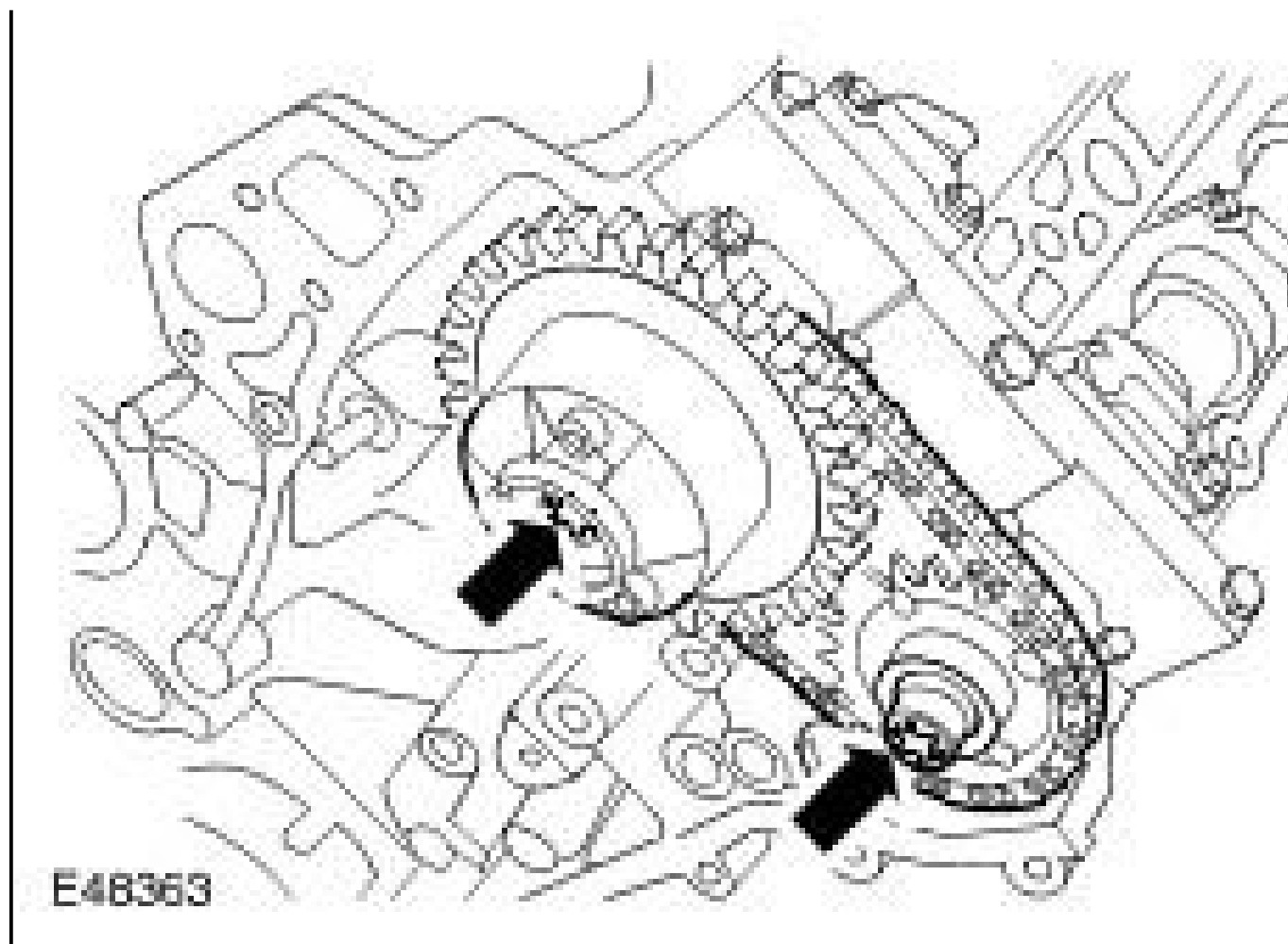
8. Remove the RH primary timing chain.
9. Install the special tool to the LH cylinder head.
 - Install the 3 bolts.



10. Remove the LH primary timing chain tensioner.
 - Remove the 2 bolts.



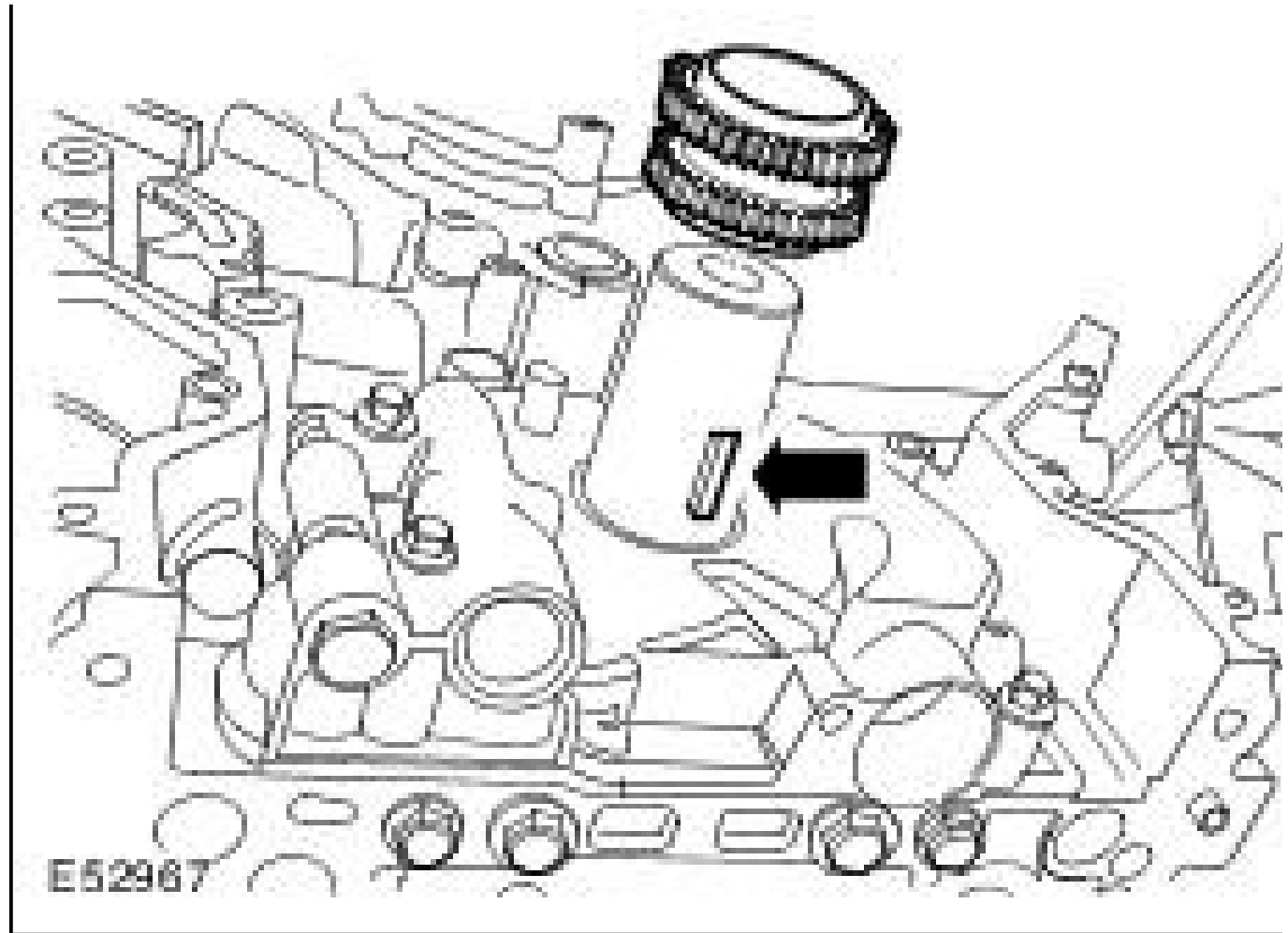
11. Remove the LH upper and lower primary timing chain tensioner guides.
 - Remove the 2 bolts.



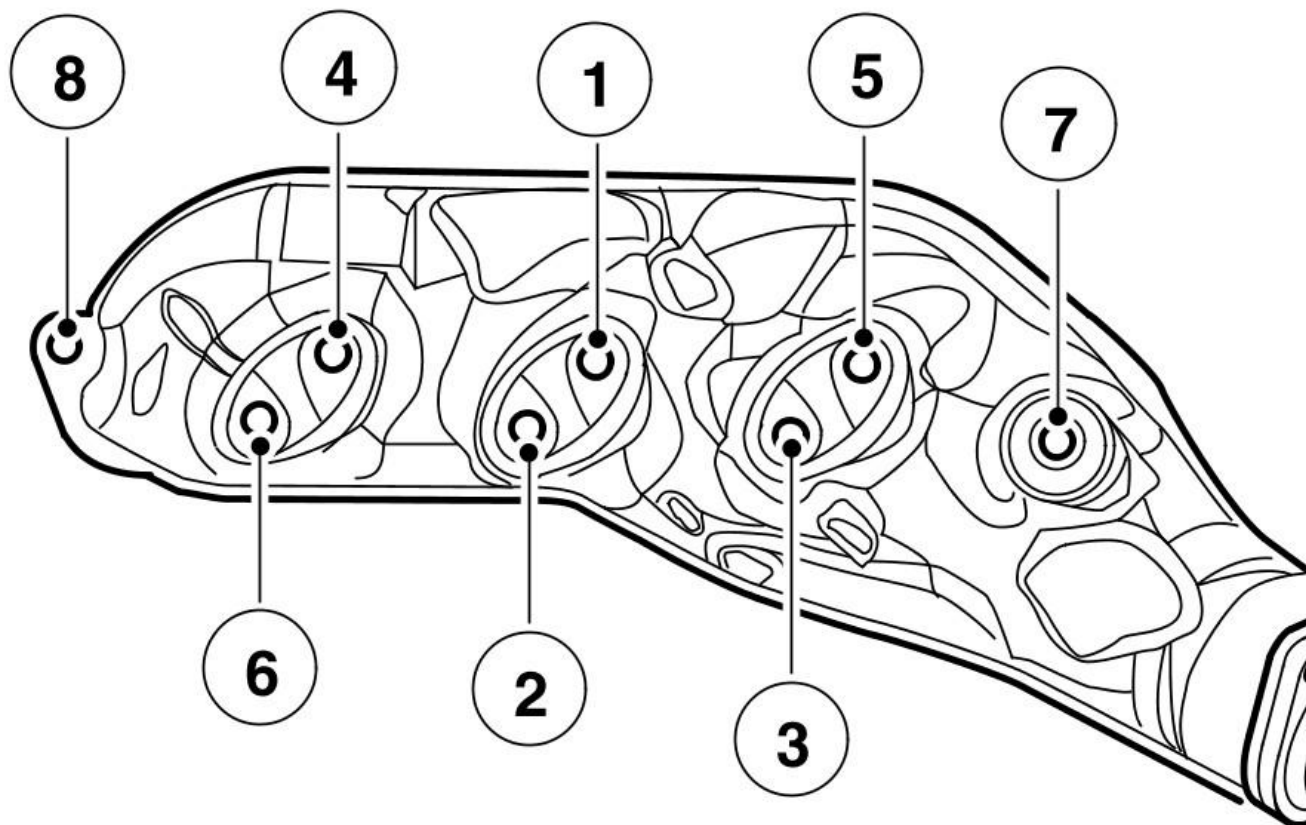
12. Remove the LH primary timing chain.

NOTE: **Note the orientation of the crankshaft sprocket.**

13. Remove the crankshaft sprocket.
 - Remove the crankshaft sprocket key.



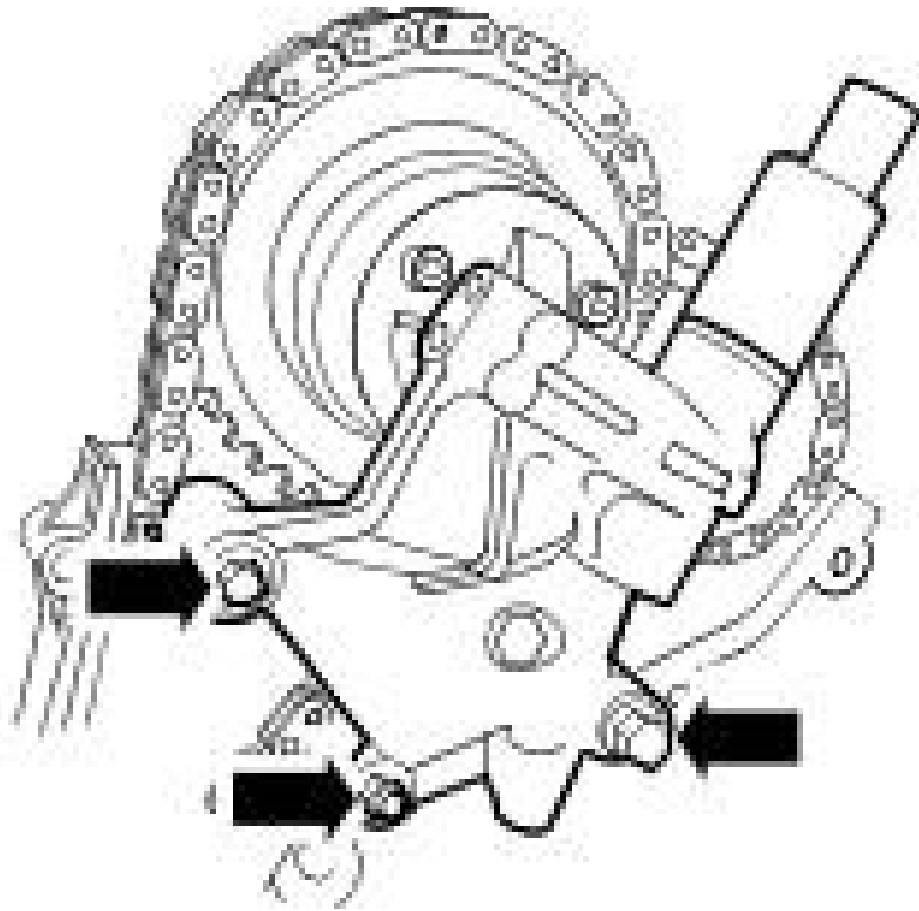
14. Remove the oil strainer pick-up assembly.
 - Remove the 3 bolts.
 - Remove and discard the O-ring seal.



E59024

15. Remove the oil pump assembly.

- Remove the 4 bolts.
- Remove and discard the gasket.
- Clean the component mating faces.



E48360

INSTALLATION

1. Install the oil pump assembly.
 - Install the new gasket.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Install the oil strainer pick-up assembly.
 - Install the O-ring seal.
 - Tighten the M6 bolt to 10 Nm (7 lb.ft).
 - Apply sealant to the M5 bolts.
 - Tighten the M5 bolts to 6 Nm (4 lb.ft).
3. Install the crankshaft sprocket.
 - Install the crankshaft sprocket key.
4. Install the LH primary timing chain.
 - Make sure the timing chain slack is on the tensioner side of the timing chain.
5. Install the LH primary timing chain tensioner guides.
 - Tighten the bolts to 12 Nm (9 lb.ft).

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.

6. Install the LH primary timing chain tensioner.
 - Using 3 mm diameter metal rod, retain the chain tensioner piston.
 - Tighten the bolts to 12 Nm (9 lb.ft).
 - Remove the retaining rod.
7. Install the RH primary timing chain.
 - Make sure the timing chain slack is on the tensioner side of the timing chain.
8. Install the RH primary timing chain tensioner guide.
 - Tighten the bolts to 12 Nm (9 lb.ft).

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.

9. Install the RH primary timing chain tensioner.
 - Using 3 mm diameter metal rod, retain the chain tensioner piston.
 - Tighten the bolts to 12 Nm (9 lb.ft).
 - Remove the retaining rod.
10. Remove the special tool from the RH cylinder head.
11. Remove the special tool from the LH cylinder head.
12. Install the oil pan. See **Oil Pan**.
13. Connect the battery ground cable. Refer to **Specifications**.

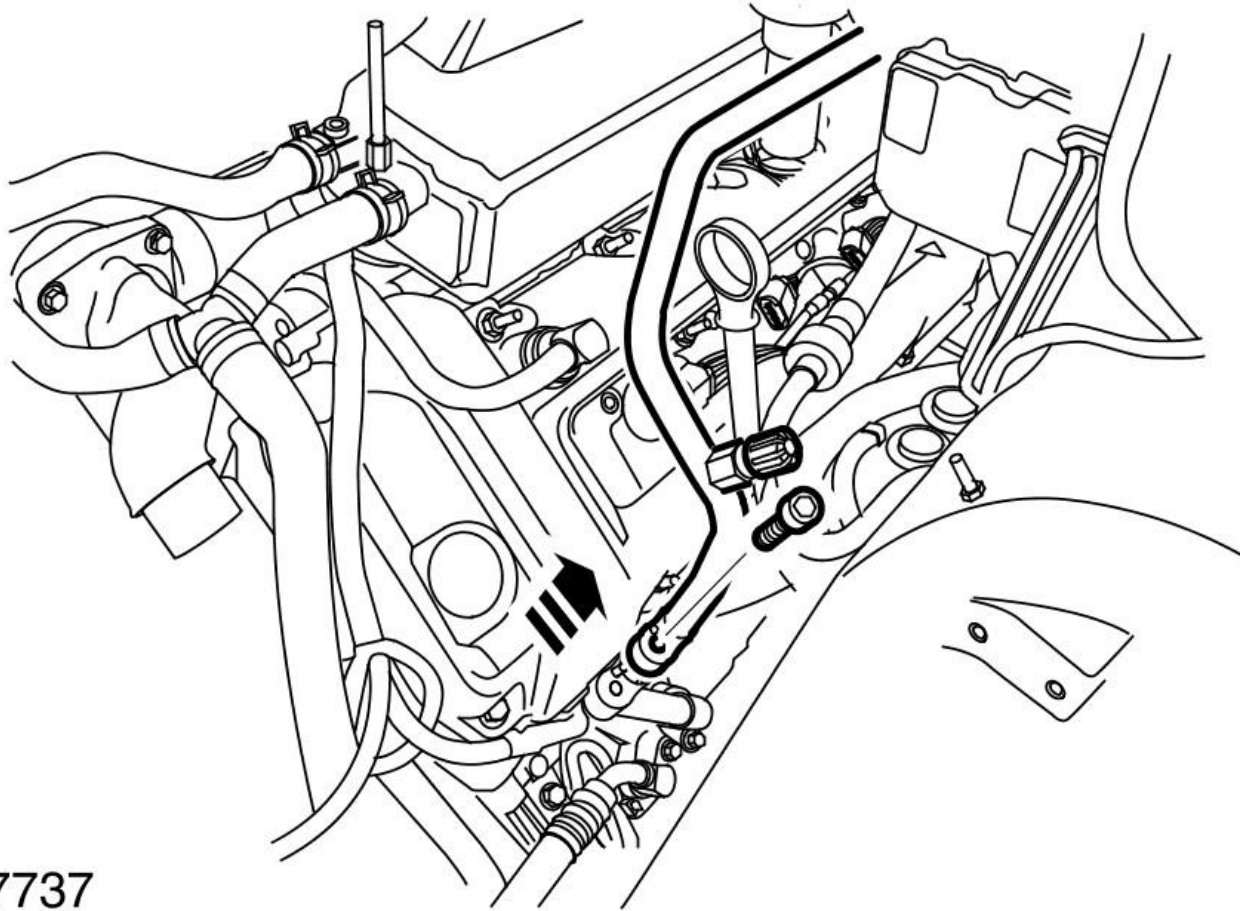
OIL PAN

REMOVAL

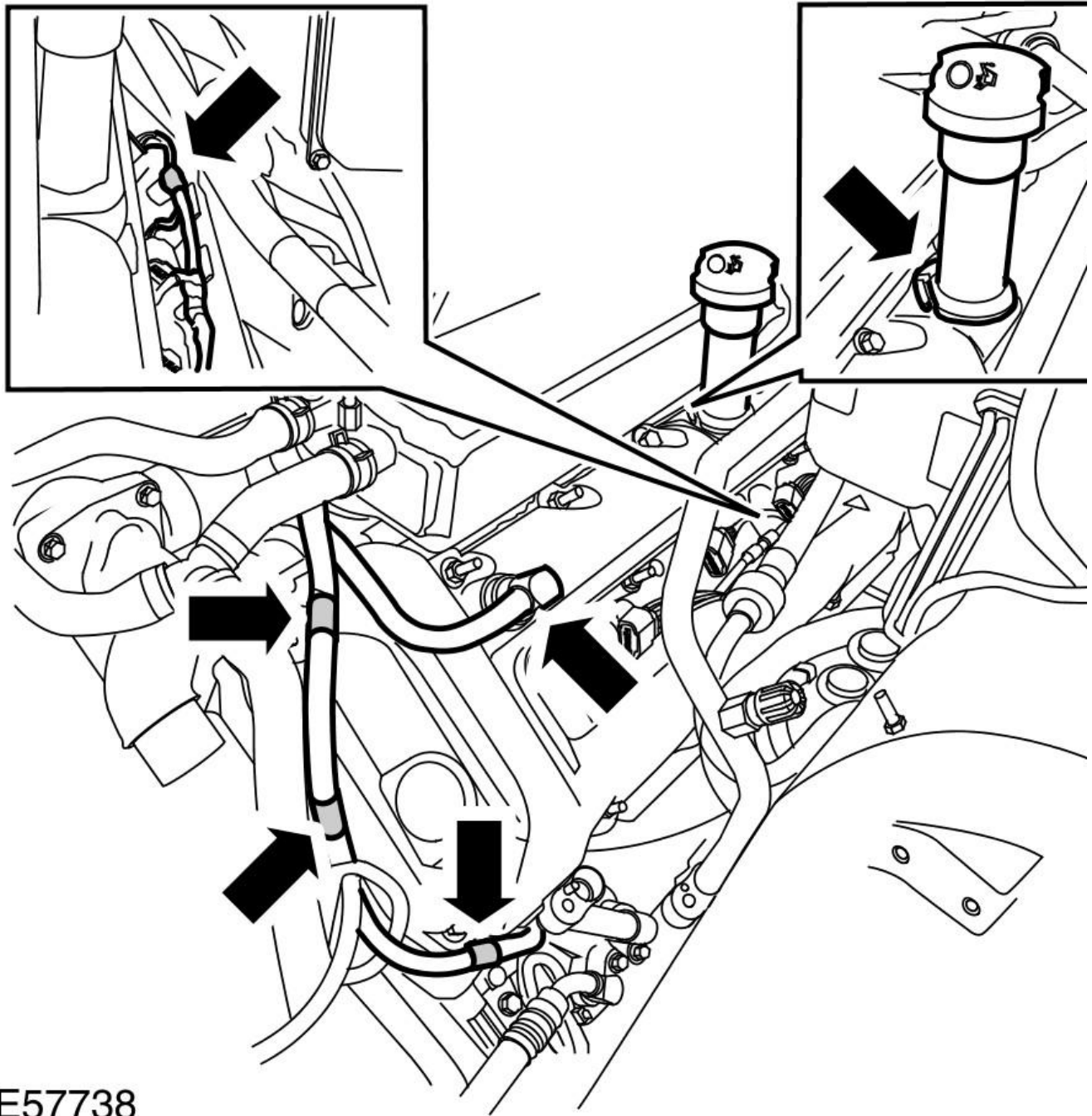
1. Disconnect the battery ground cable. Refer to **Specifications**.

WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the engine. See **Engine**.
4. Remove the engine front cover. See **Engine Front Cover**.
5. Remove the power steering pump and bracket.
 - Remove the 3 bolts.



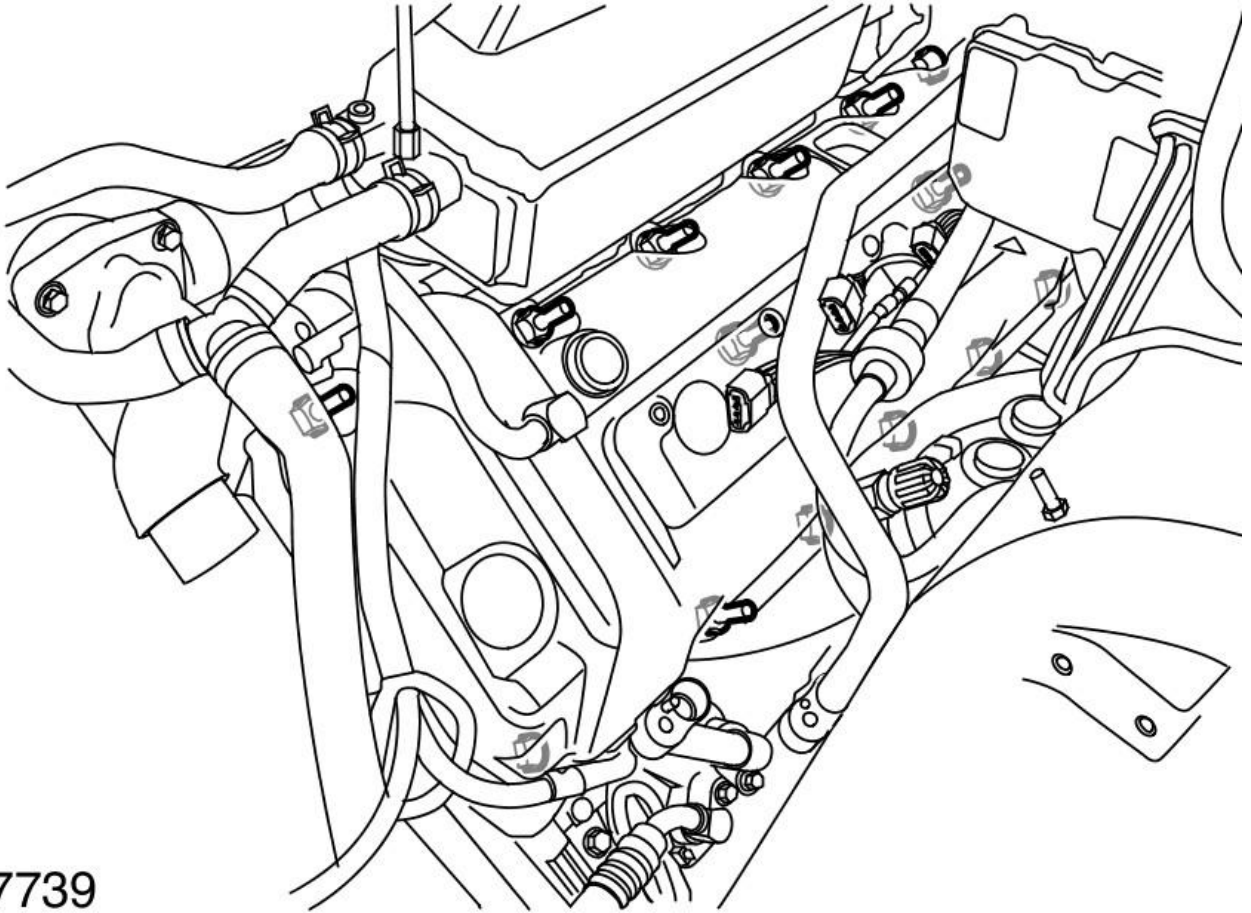
6. LH side: Release the wiring harness.
 - Release the 3 clips.



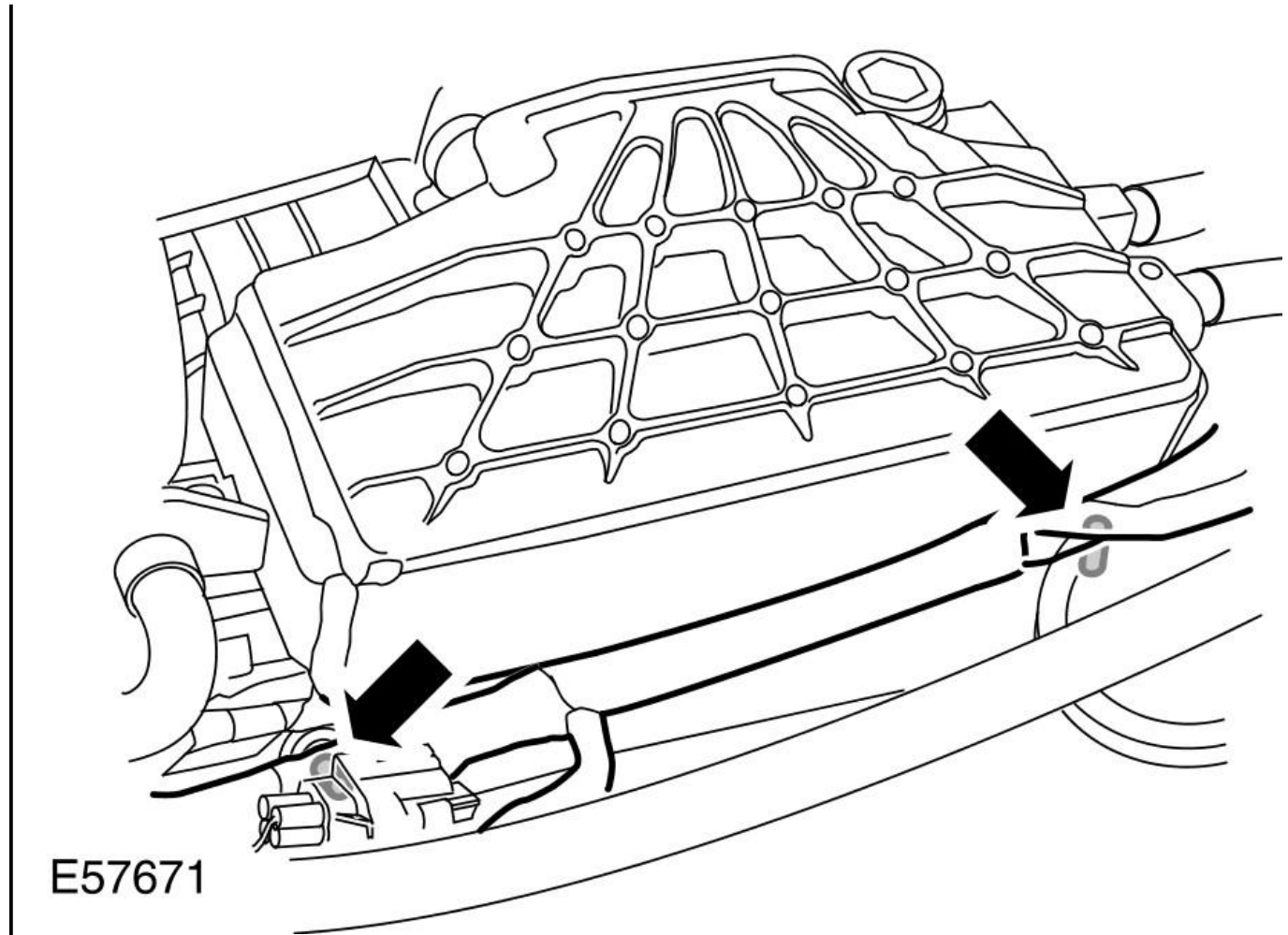
E57738

7. RH side: Release the wiring harness.
 - Release the 3 clips.

E57739

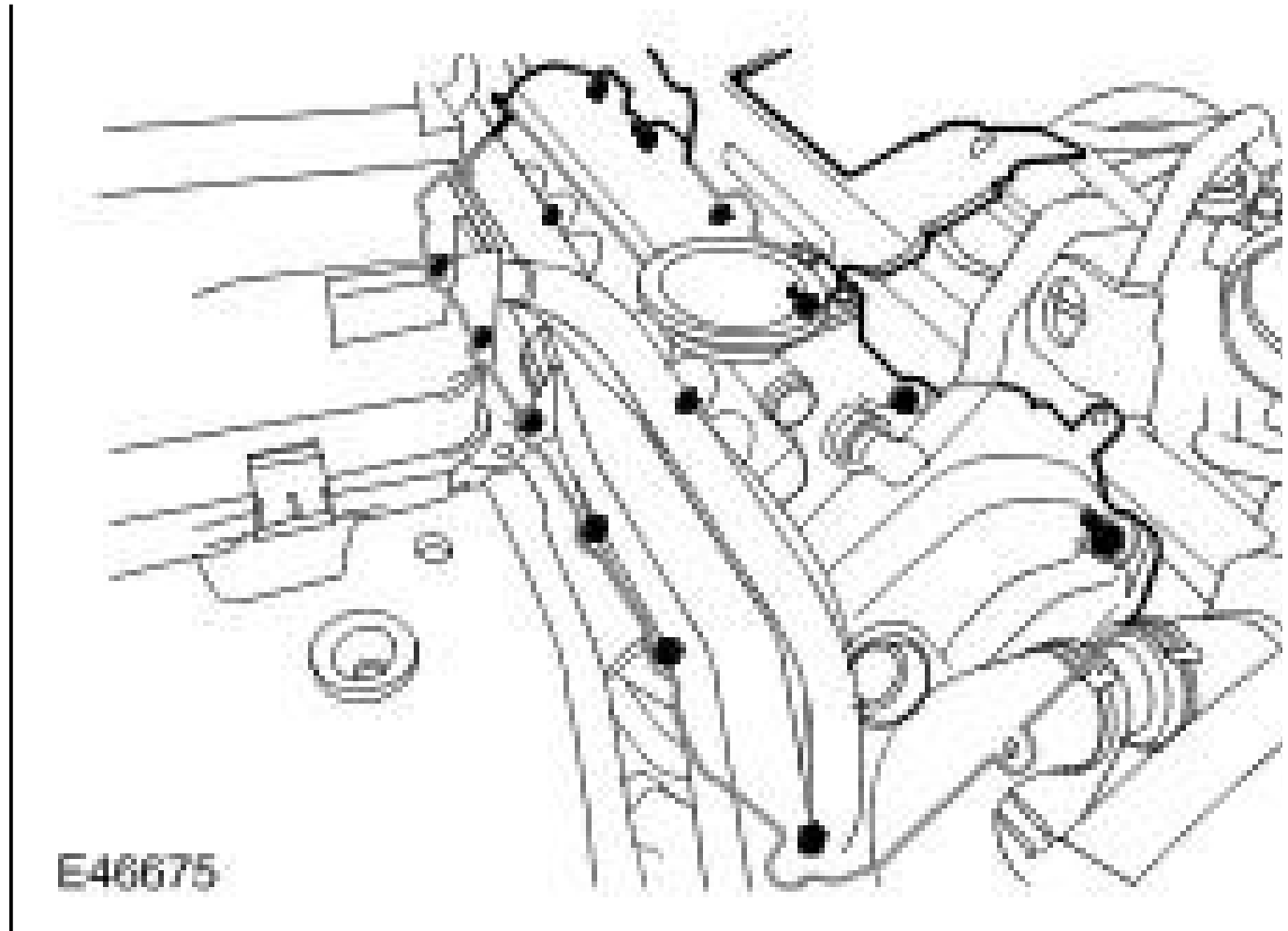


8. Remove the halfshaft support bearing housing.
 - Remove the 4 bolts.
 - Remove and discard the O-ring seal.



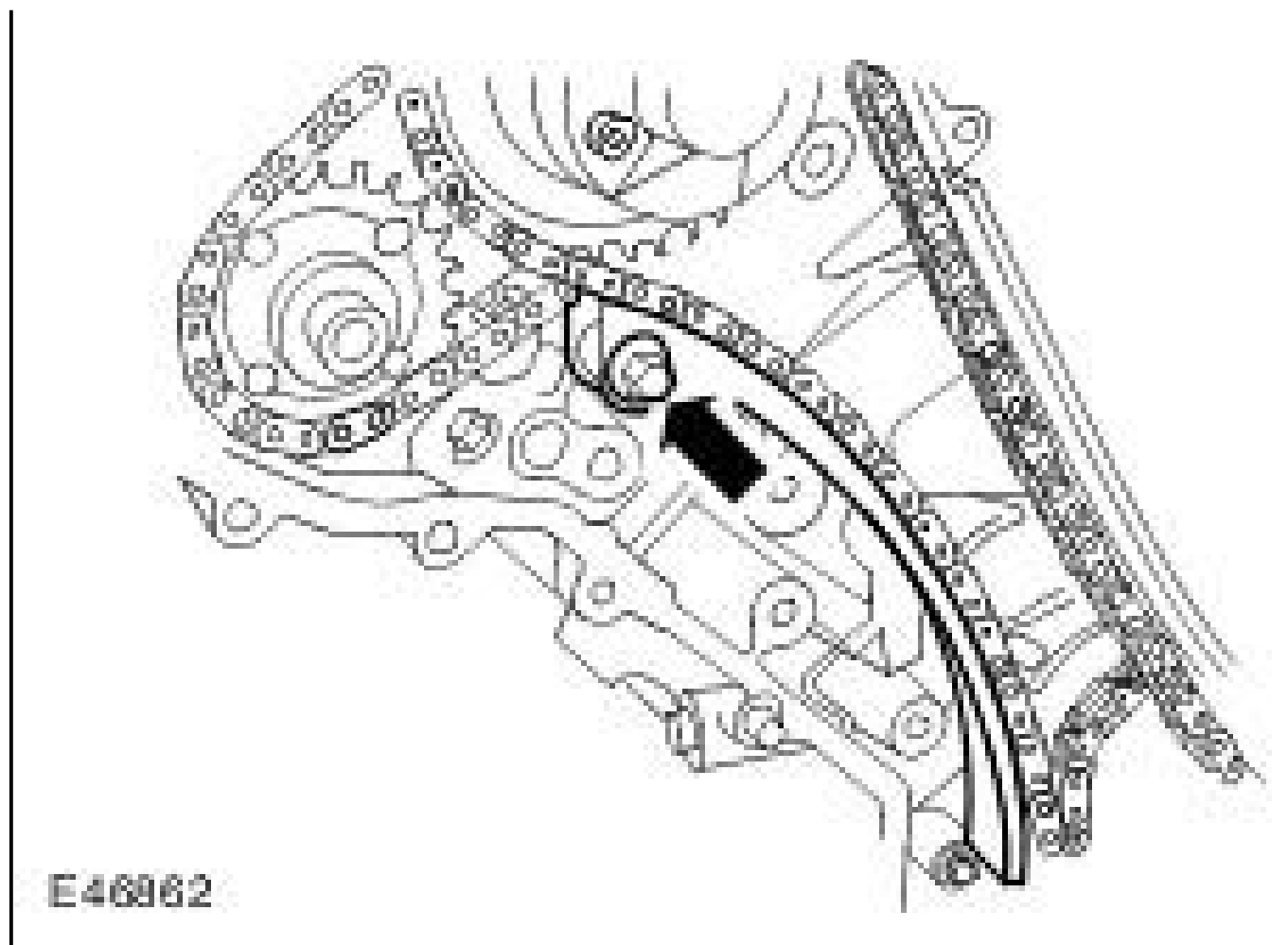
CAUTION: Note the position of the bolts, prior to removal.

9. Remove the oil pan.
 - Remove the 19 bolts.
 - Carefully remove the sealant.

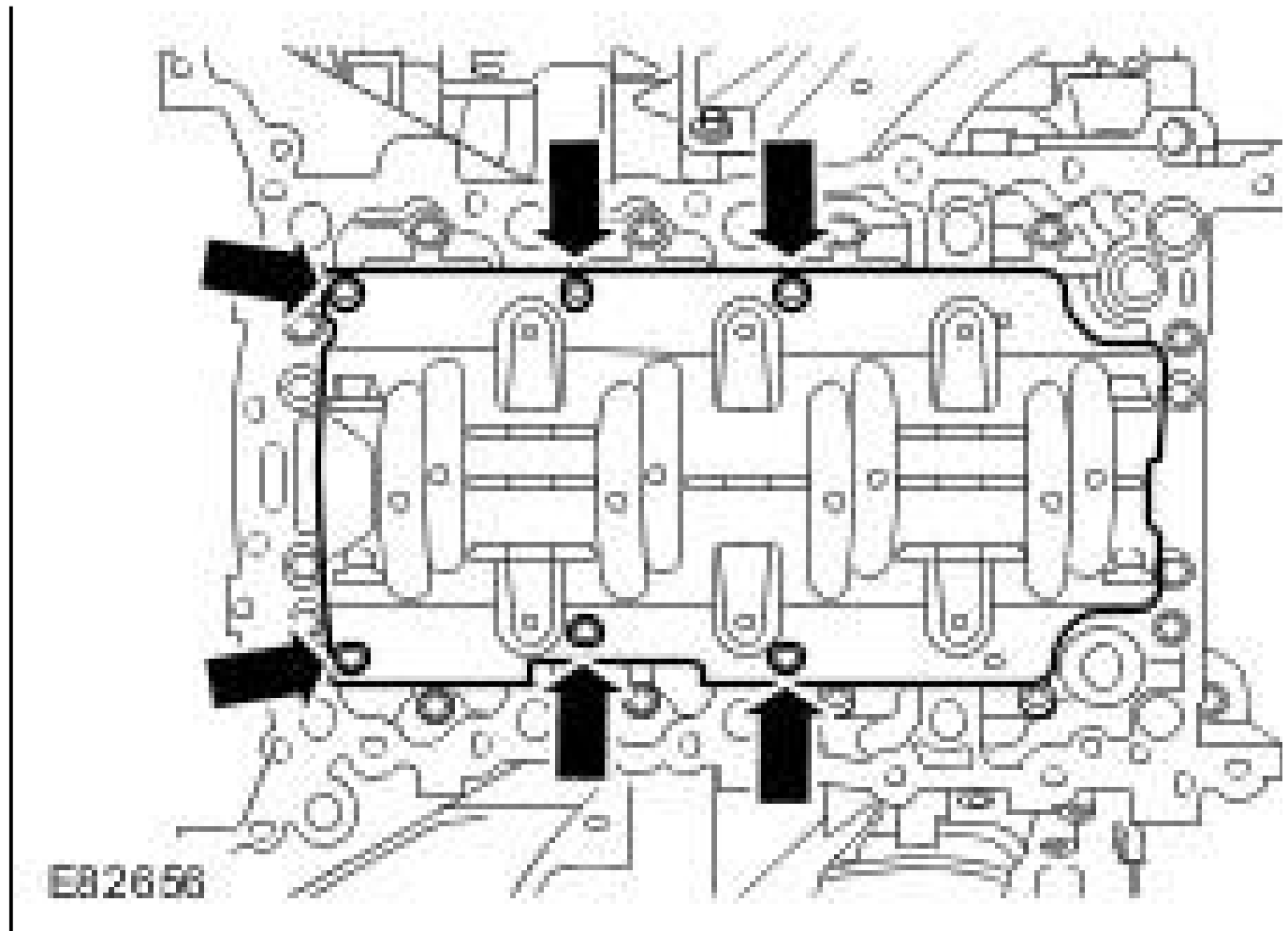


INSTALLATION

1. Install the oil pan.
 - Clean the component mating faces.
 - Apply a bead of sealant, 3 mm diameter, to the area indicated.
 - Install the bolts, but do not tighten fully at this stage.



2. Tighten the oil pan bolts in the sequence shown to 20 Nm (15 lb.ft).
3. Install the halfshaft support bearing housing.
 - Install a new O-ring seal.
 - Lubricate the O-ring seal with petroleum jelly.
 - Tighten the bolts evenly to 25 Nm (18 lb.ft).



4. RH side: Attach the wiring harness.
 - Secure the clips.
5. LH side: Attach the wiring harness.
 - Secure the clips.
6. Install the power steering pump and bracket.
 - Tighten the bolts to 25 Nm (18 lb.ft).
7. Install the engine front cover. See **Engine Front Cover**.
8. Install the engine. See **Engine**.
9. Connect the battery ground cable. Refer to **Specifications**.

OIL COOLER

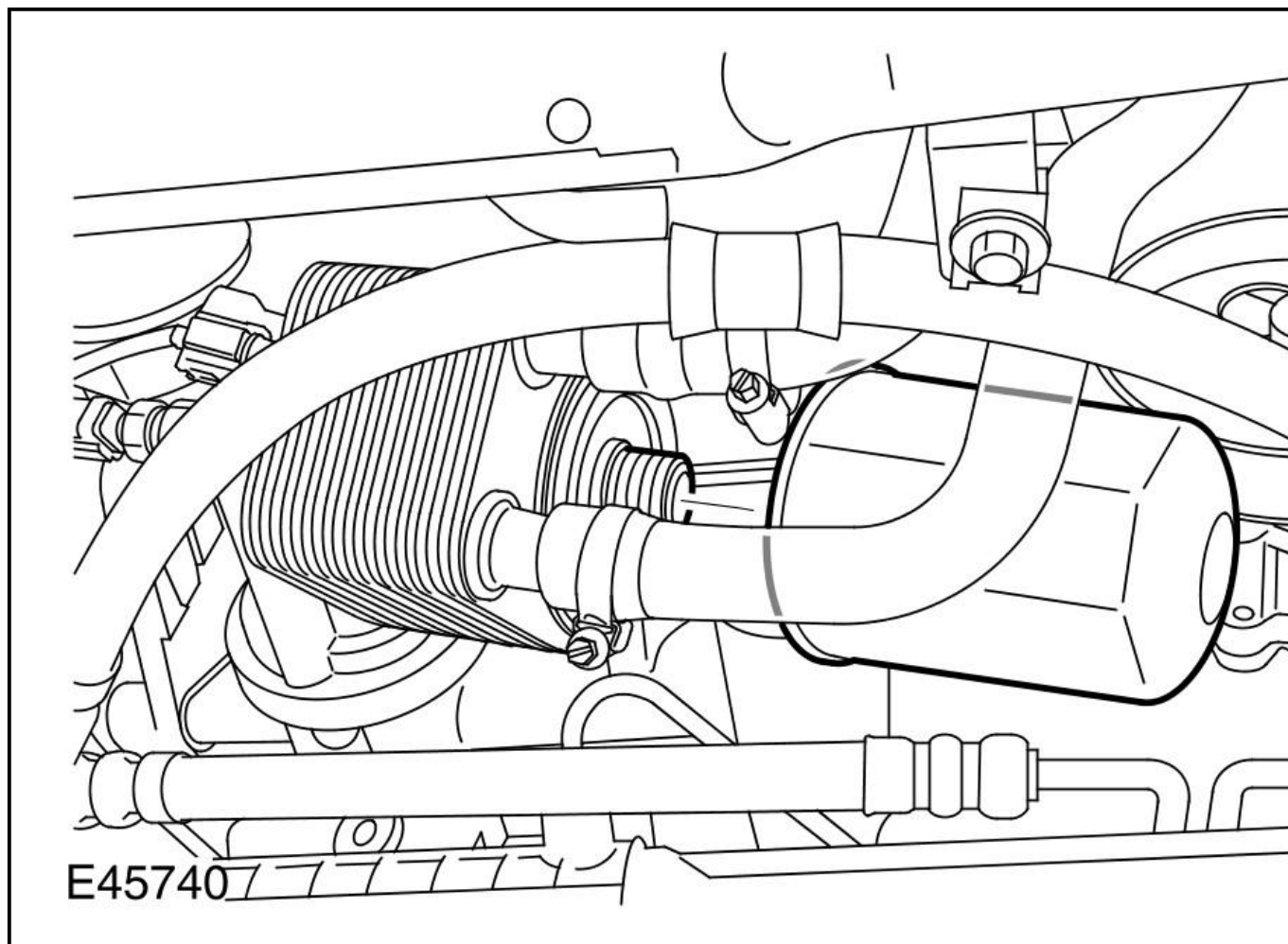
REMOVAL

1. Disconnect the battery ground cable. Refer to **Specifications**.

WARNING: Do not work on or under a vehicle supported only by a jack. Always

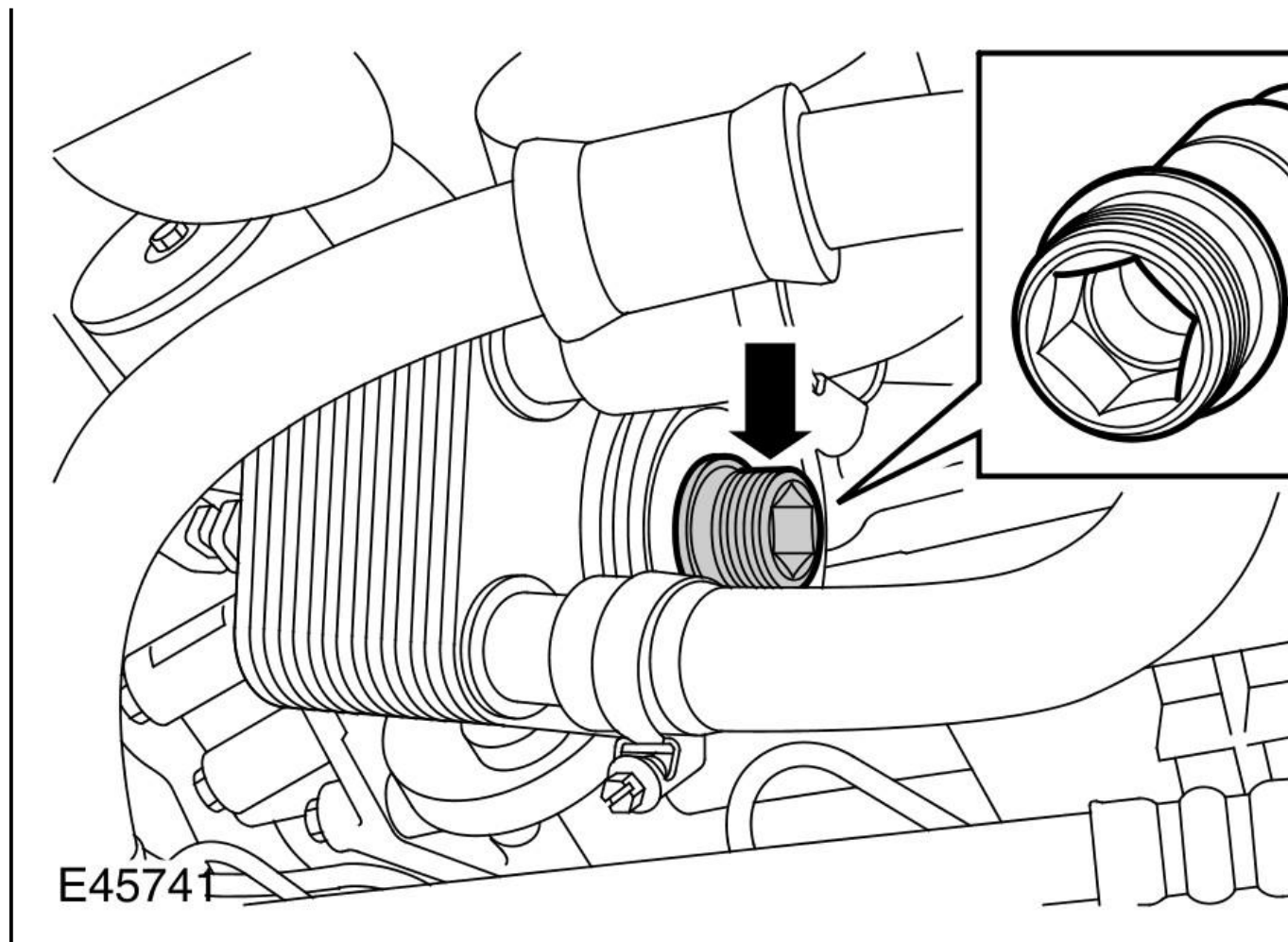
support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the radiator access panel. Refer to **Radiator Splash Shield** .
4. Remove the oil filter.
 - Position a container to collect the fluid.



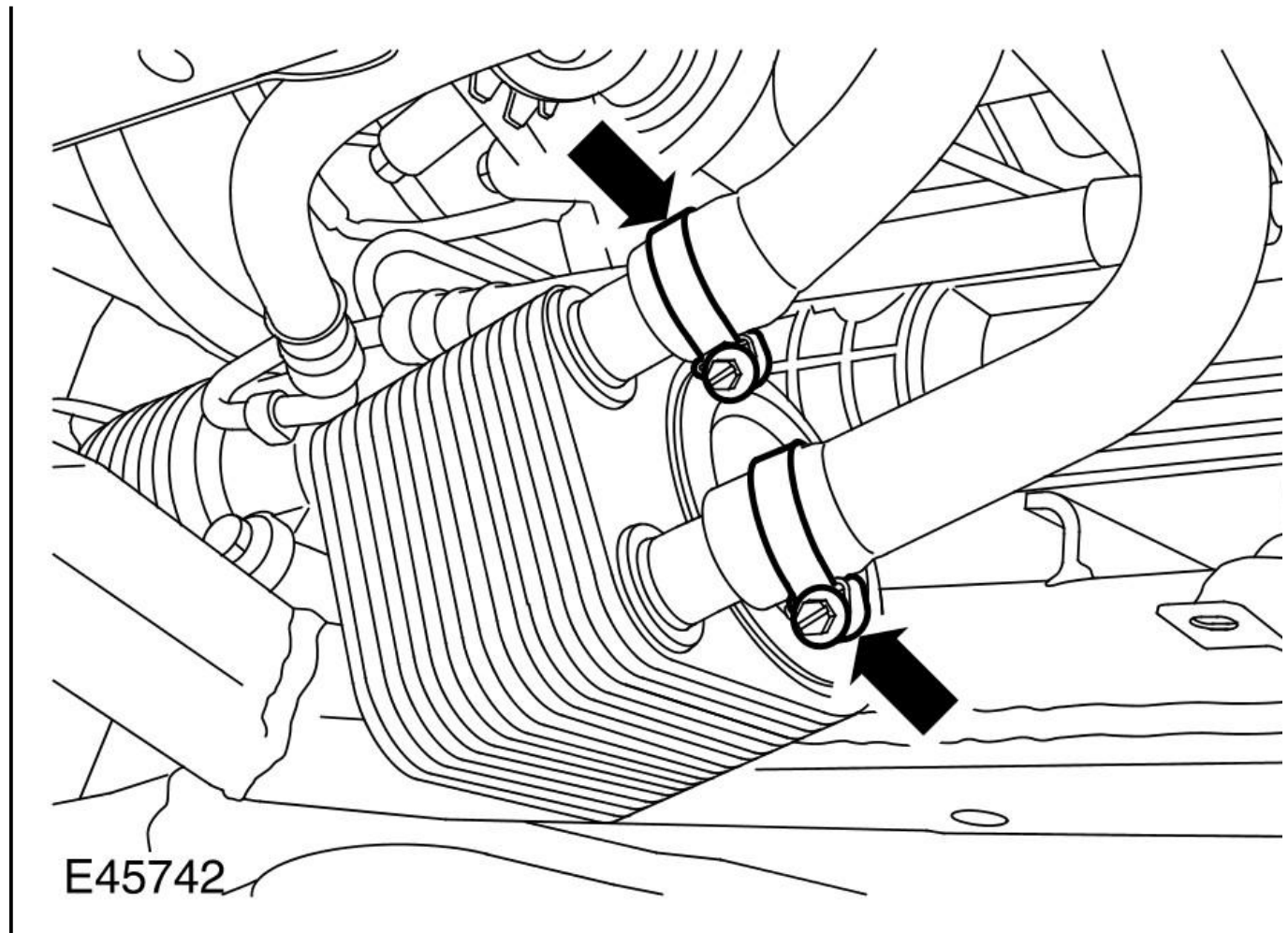
NOTE: **Note the fitted position of the oil cooler assembly.**

5. Remove the oil filter adapter.
 - Release the cooler from the oil filter head.



CAUTION: Engine coolant will damage the paint finished surfaces. If spilled, immediately remove the coolant and clean the area with water.

6. Clamp, then disconnect the coolant hoses from the oil cooler.
 - Position container to collect fluid loss.



7. Remove the oil cooler.

INSTALLATION

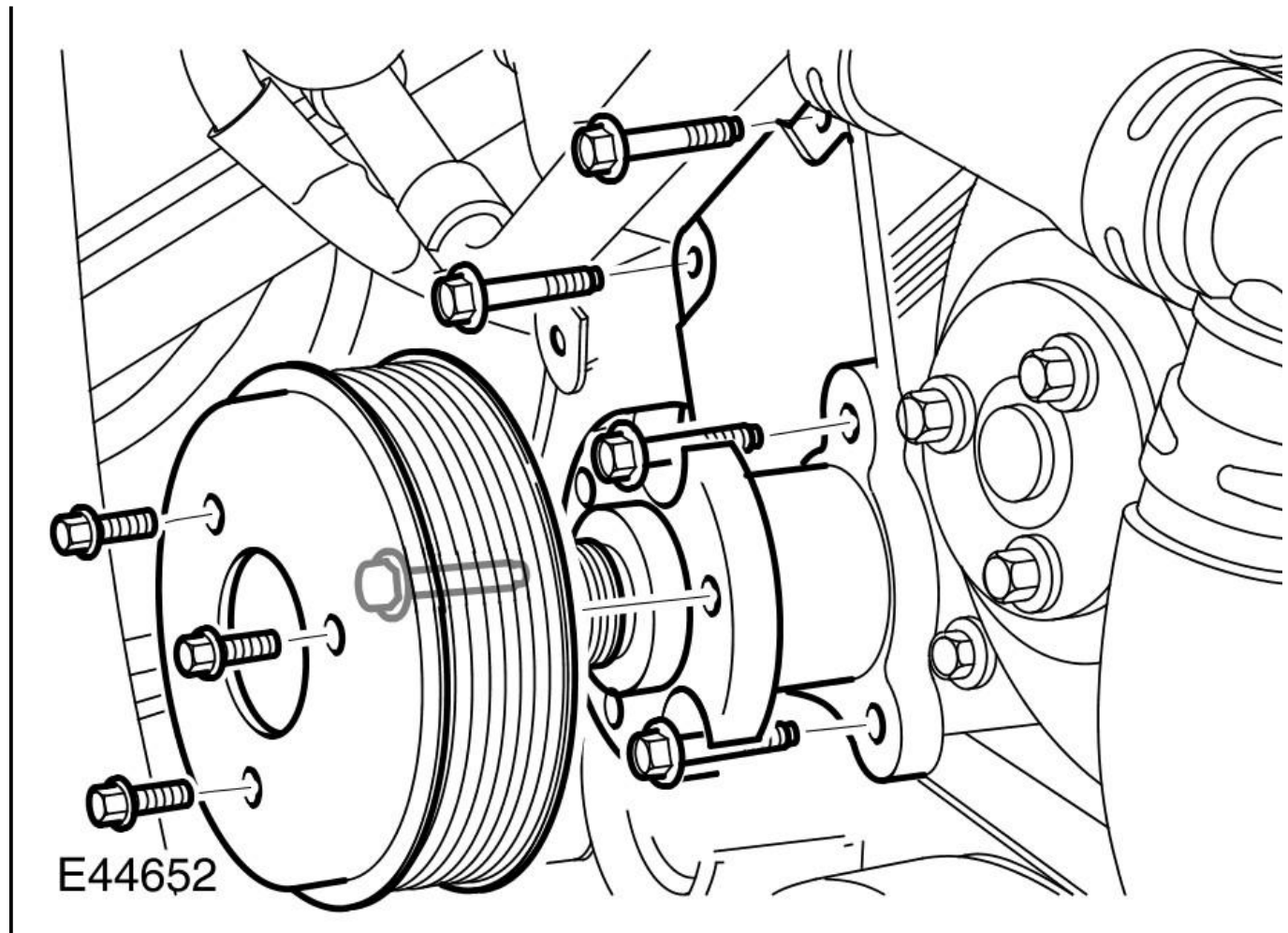
1. Install the oil cooler.
 - Tighten the adapter to 60 Nm (44 lb.ft)
2. Connect the coolant hoses.
 - Position and secure the clips.
 - Remove the hose clamps.
3. Install the engine oil filter.
 - Lubricate the oil filter seal with clean engine oil and tighten to 18 Nm (13 lb.ft).
4. Connect the battery ground cable. Refer to **Specifications** .
5. Check and top-up the engine oil.
6. Top-up and bleed the coolant.
7. Install the radiator access panel. Refer to **Radiator Splash Shield** .

ENGINE FRONT COVER**REMOVAL**

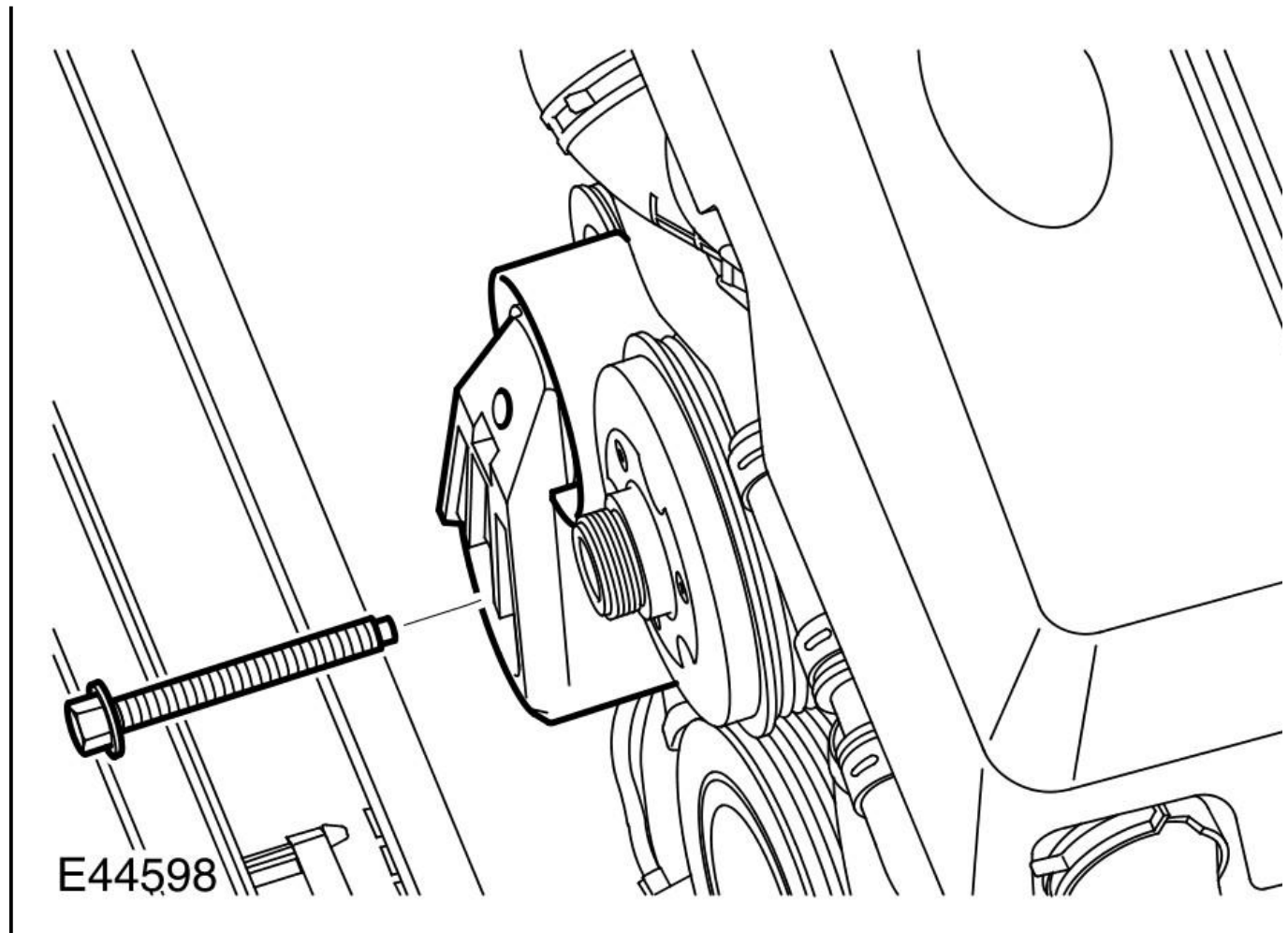
1. Disconnect the battery ground cable. Refer to Specifications .

WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Drain the cooling system. Refer to Cooling System Draining, Filling and Bleeding .
4. Remove the coolant manifold. Refer to Coolant Manifold .
5. Remove the RH air cleaner assembly. Refer to Air Cleaner .
6. Remove the cooling fan drive pulley.
 - Remove the 3 bolts.
7. Remove the cooling fan drive hub bearing.
 - Remove the 5 bolts.

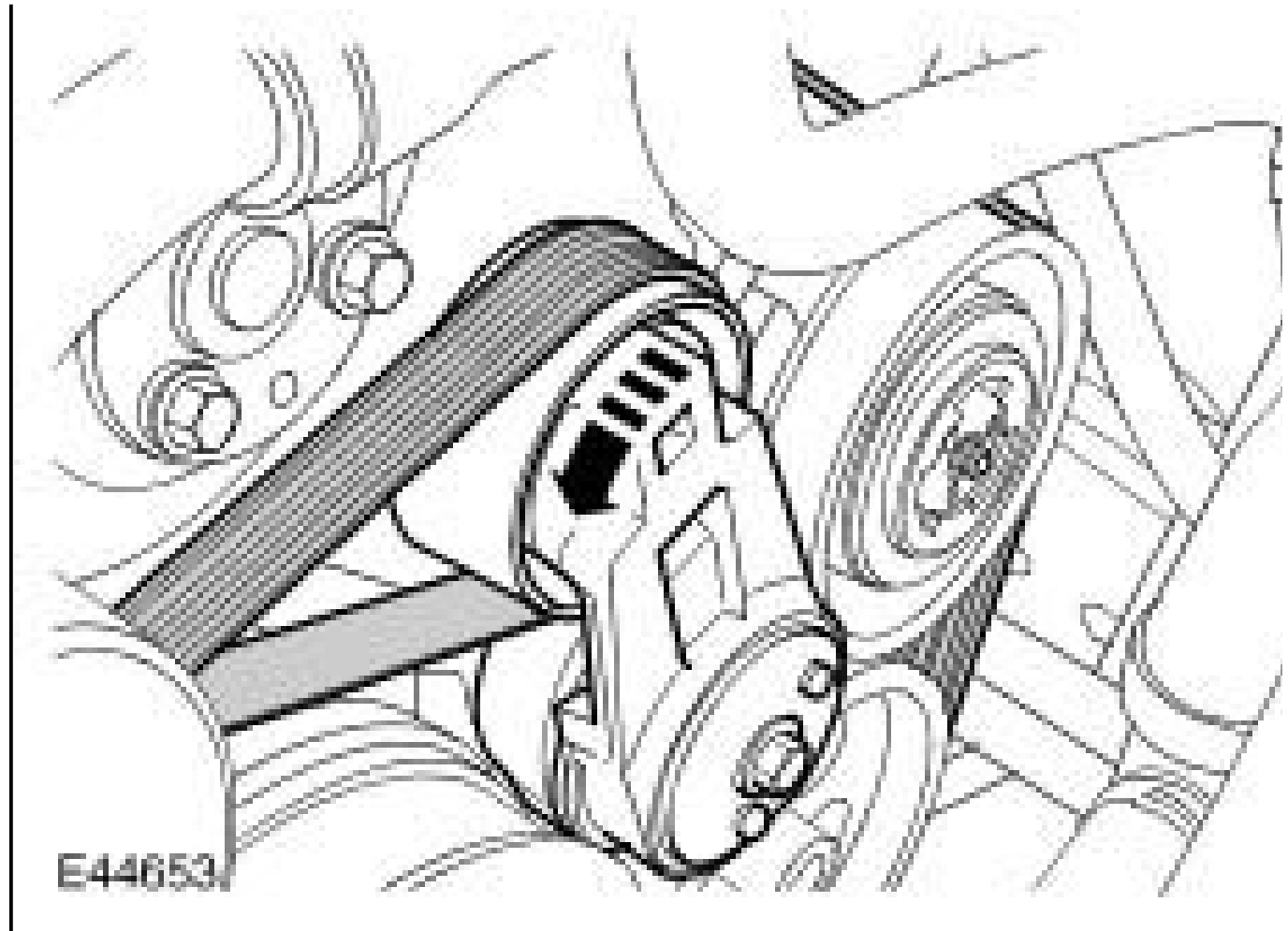


8. Remove the cooling fan belt tensioner.
 - Remove the bolt.



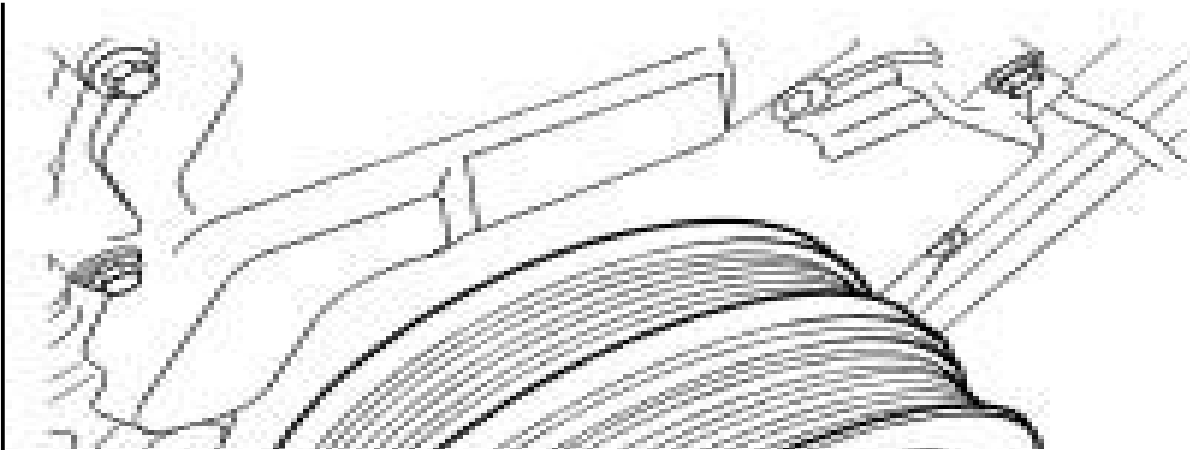
9. Release the accessory drive belt.

- Rotate the accessory drive belt tensioner counter-clockwise, using a 3/8 " drive wrench.



NOTE: **Note the fitted position.**

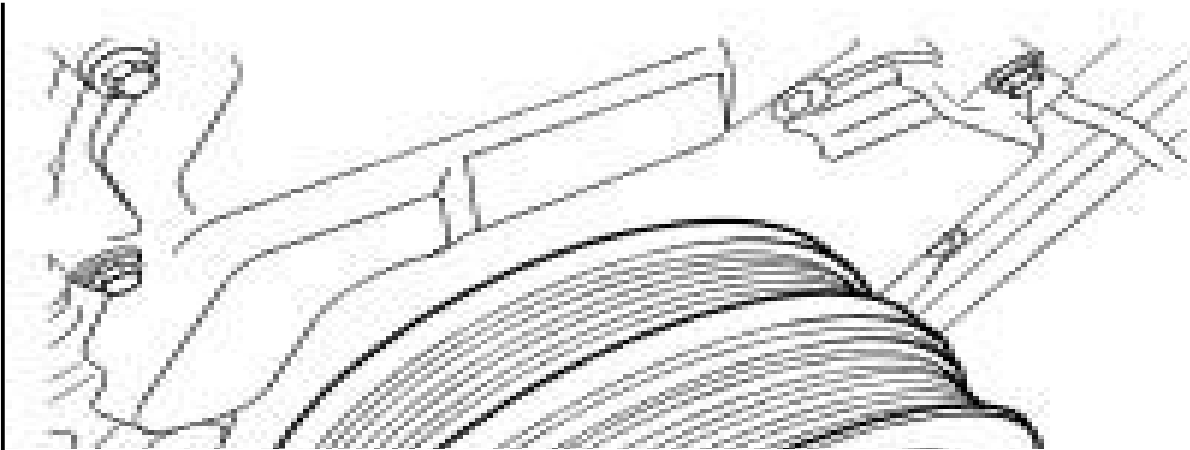
10. Remove the accessory drive belt.
11. Using the special tools, retain the crankshaft pulley.



CAUTION: Under no circumstances should the crankshaft setting peg, 303-645, be used in the following operations, to restrain the crankshaft.

NOTE: **The crankshaft pulley retaining bolt will be very tight.**

12. Remove the crankshaft pulley retaining bolt.
 - Discard the bolt.
13. Remove the special tools.



14. Using the special tools, remove the crankshaft pulley.
 - Collect the locking ring.
15. Remove the special tools from the crankshaft pulley.

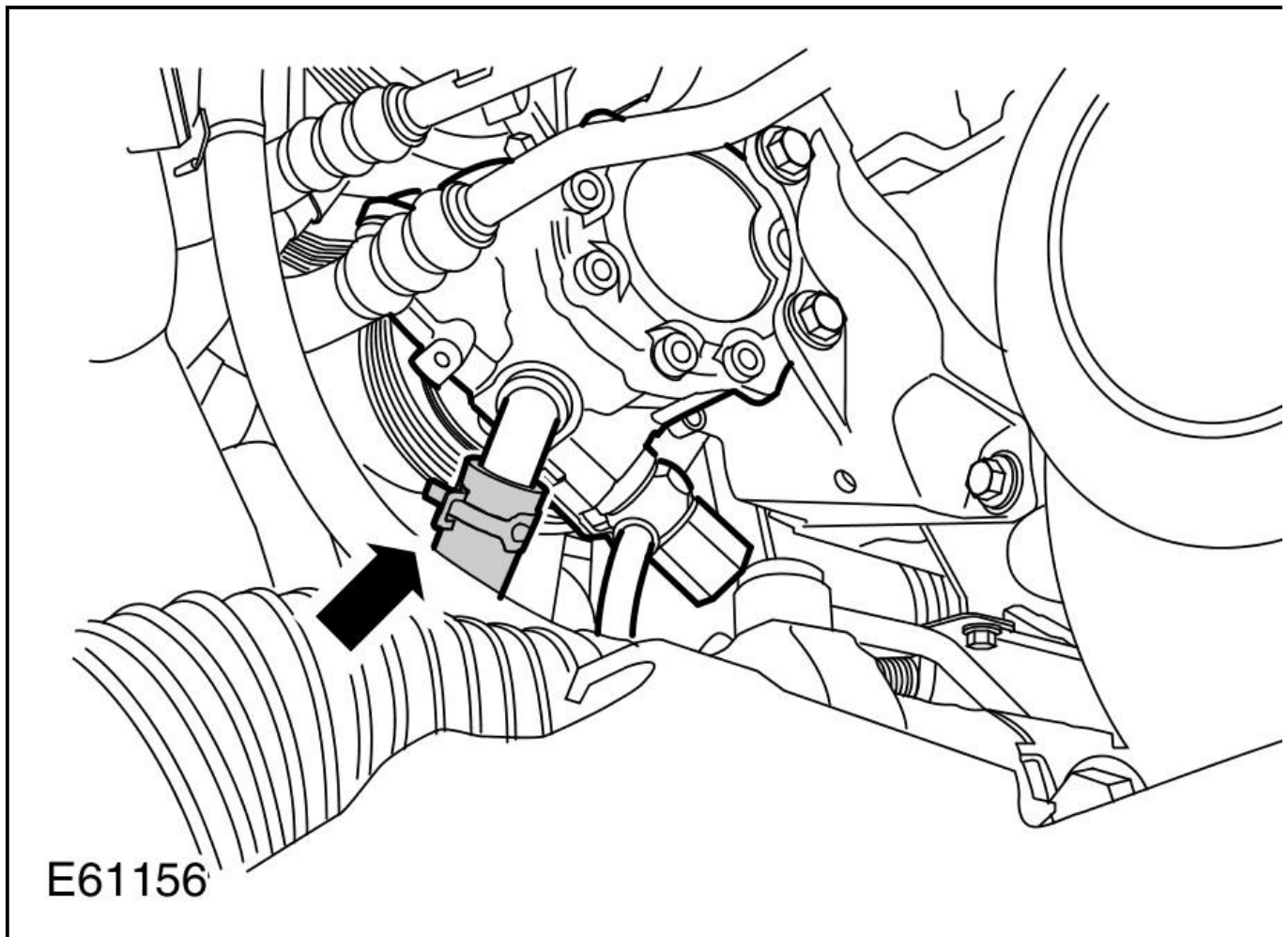


16. Using the special tool, remove the crankshaft front seal.
 - Remove the outer section of the seal.
 - Repeat the process to remove the inner section of seal.
17. Check the crankshaft damper pulley and locking ring for damage.
18. Remove the LH front wheel.

CAUTION: Always plug any open connections to prevent contamination.

19. Disconnect the low pressure line.

- Release the clip.
- Allow the fluid to drain into a container.



20. Disconnect the high pressure line.

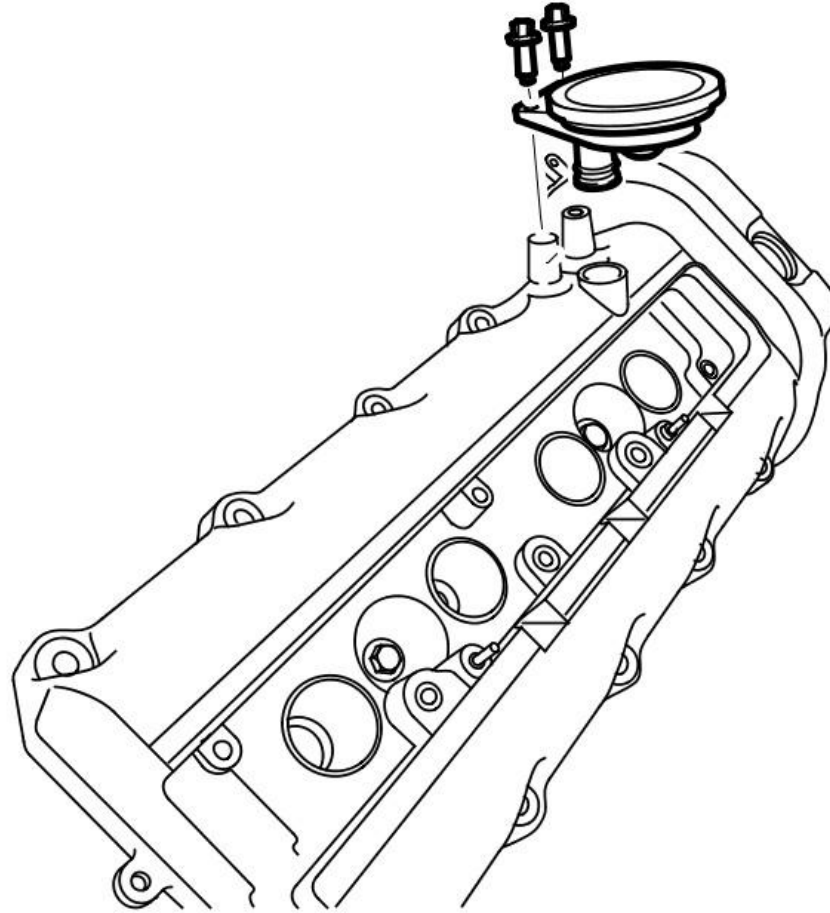
- Remove and discard both O-ring seals.

21. Remove the power steering pump.

- Remove the 4 bolts.

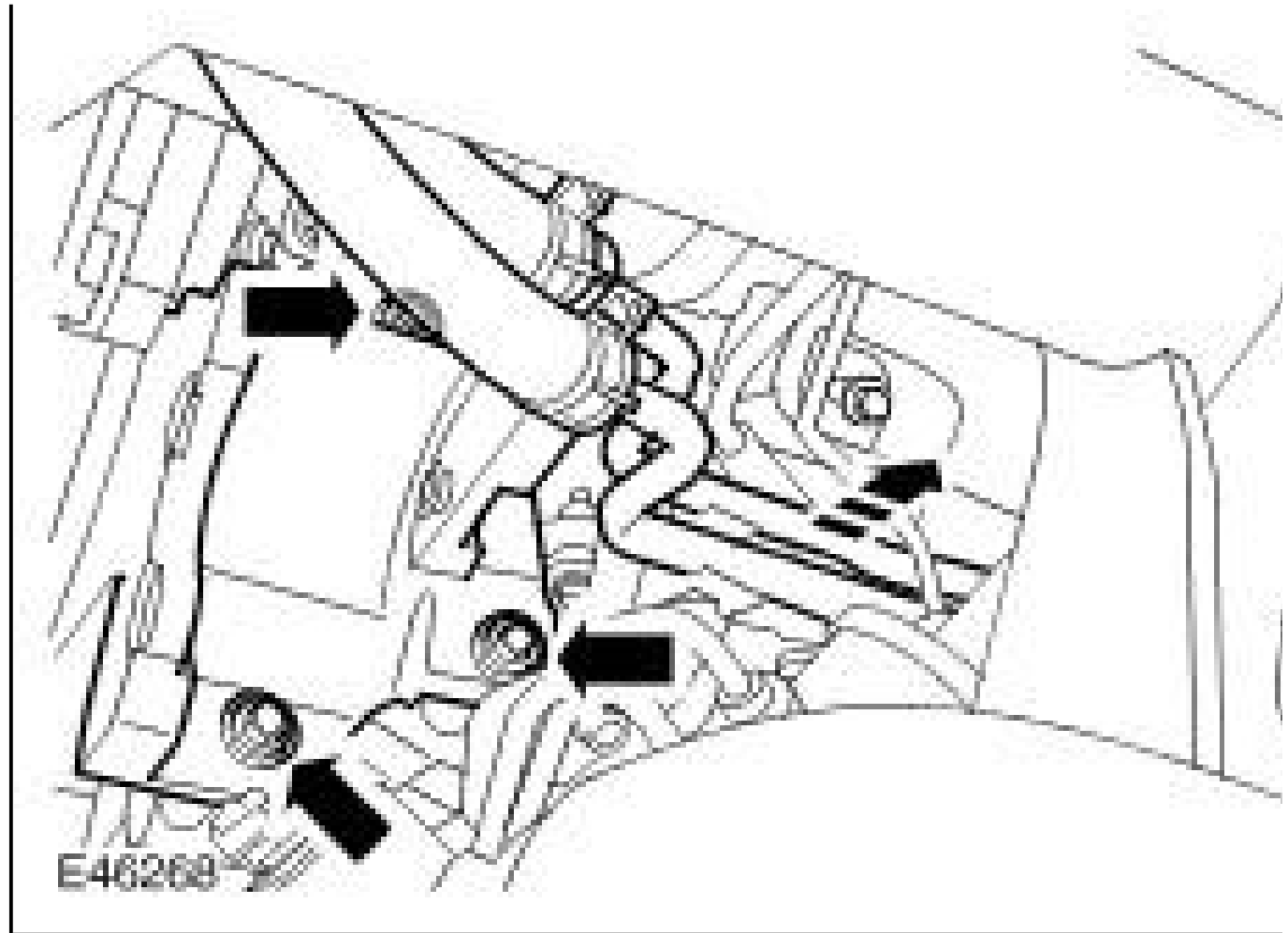
22. Remove the accessory drive belt tensioner.

- Remove the bolt.



E46678

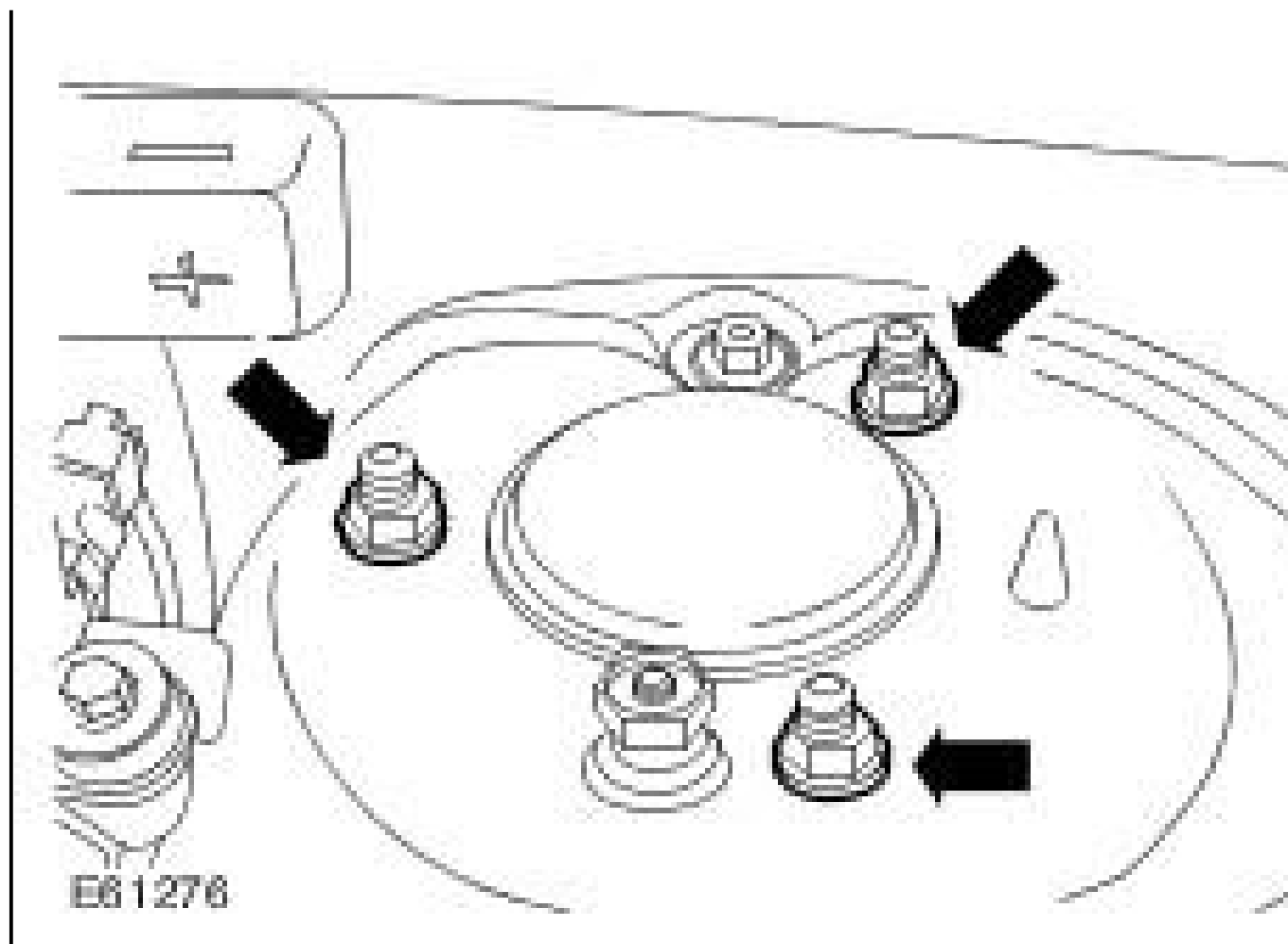
23. Release the transmission cooler pipe clips.
24. Remove the power steering pump mounting bracket.
 - Remove the 3 bolts.



CAUTION: Always plug any open connections to prevent contamination.

25. Disconnect the refrigerant lines from the A/C compressor.

- Remove the 2 bolts.
- Remove and discard the O-ring seal.



26. Disconnect the A/C clutch electrical connector.



NOTE: **1 A/C compressor bolt will remain captive until the mounting bracket is removed.**

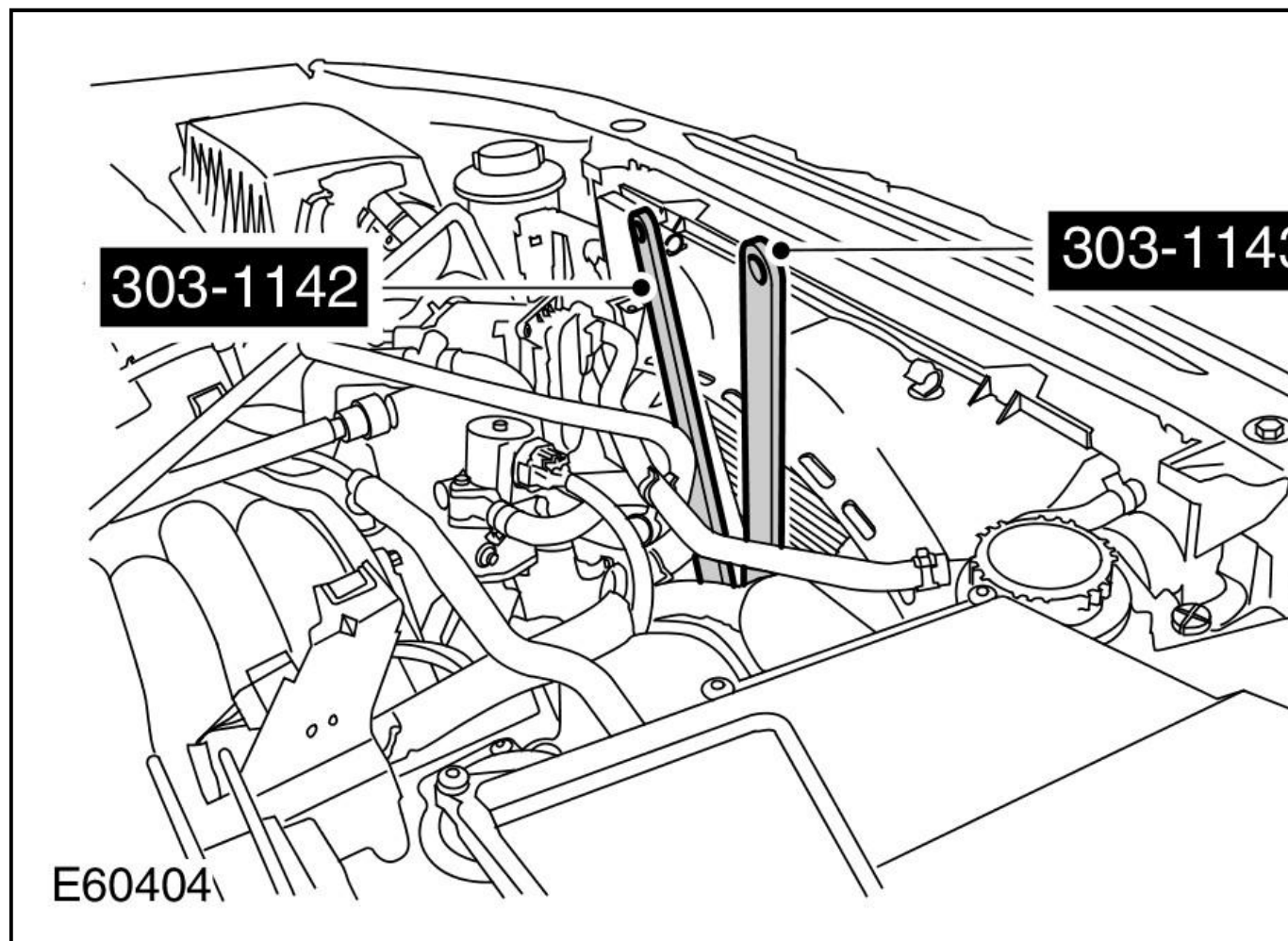
27. Release the A/C compressor.

- Fully loosen the upper front bolt.
- Remove the remaining 2 bolts.



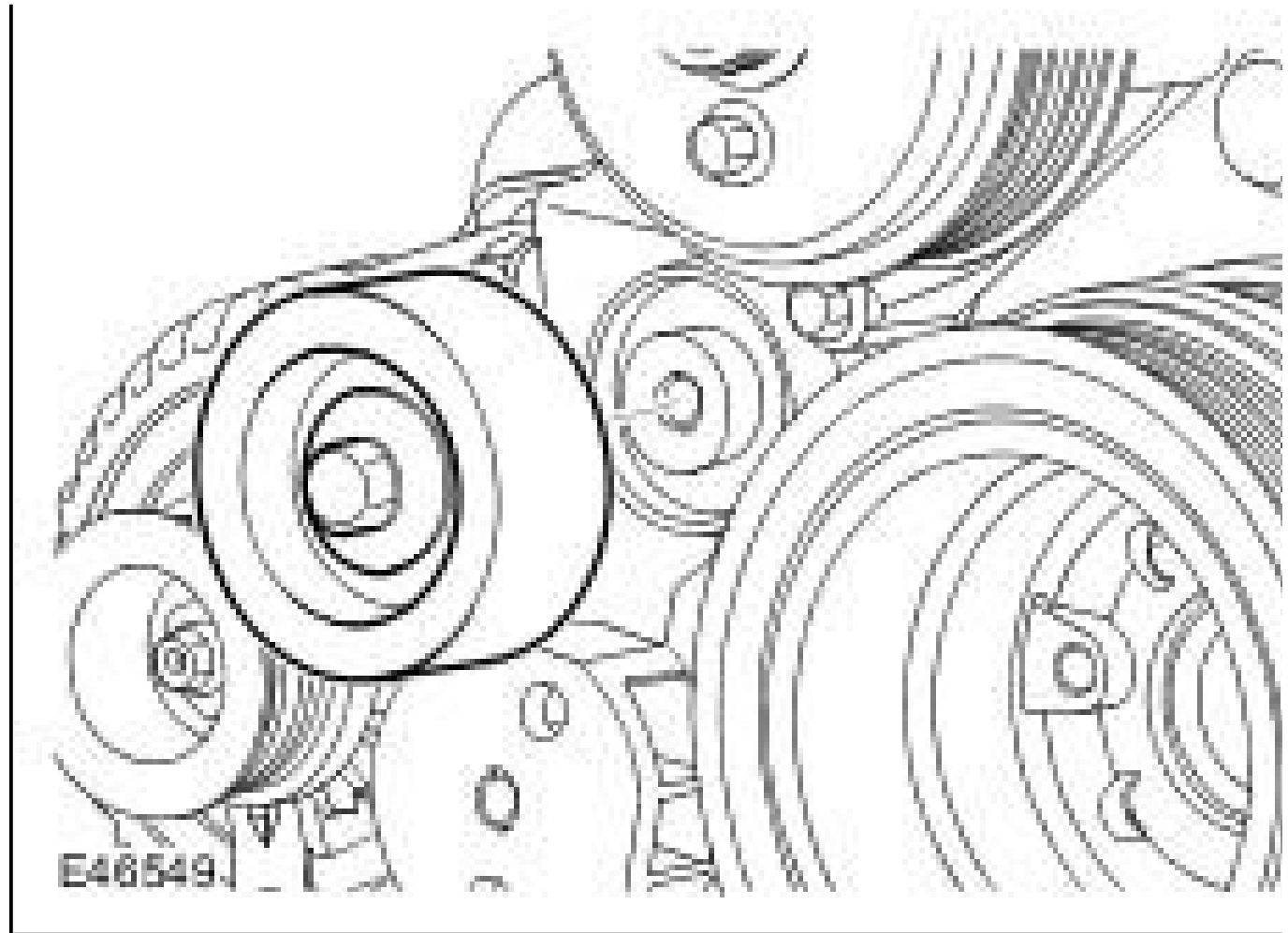
28. Remove the A/C compressor mounting bracket and the A/C compressor.

- Remove the 2 bolts.

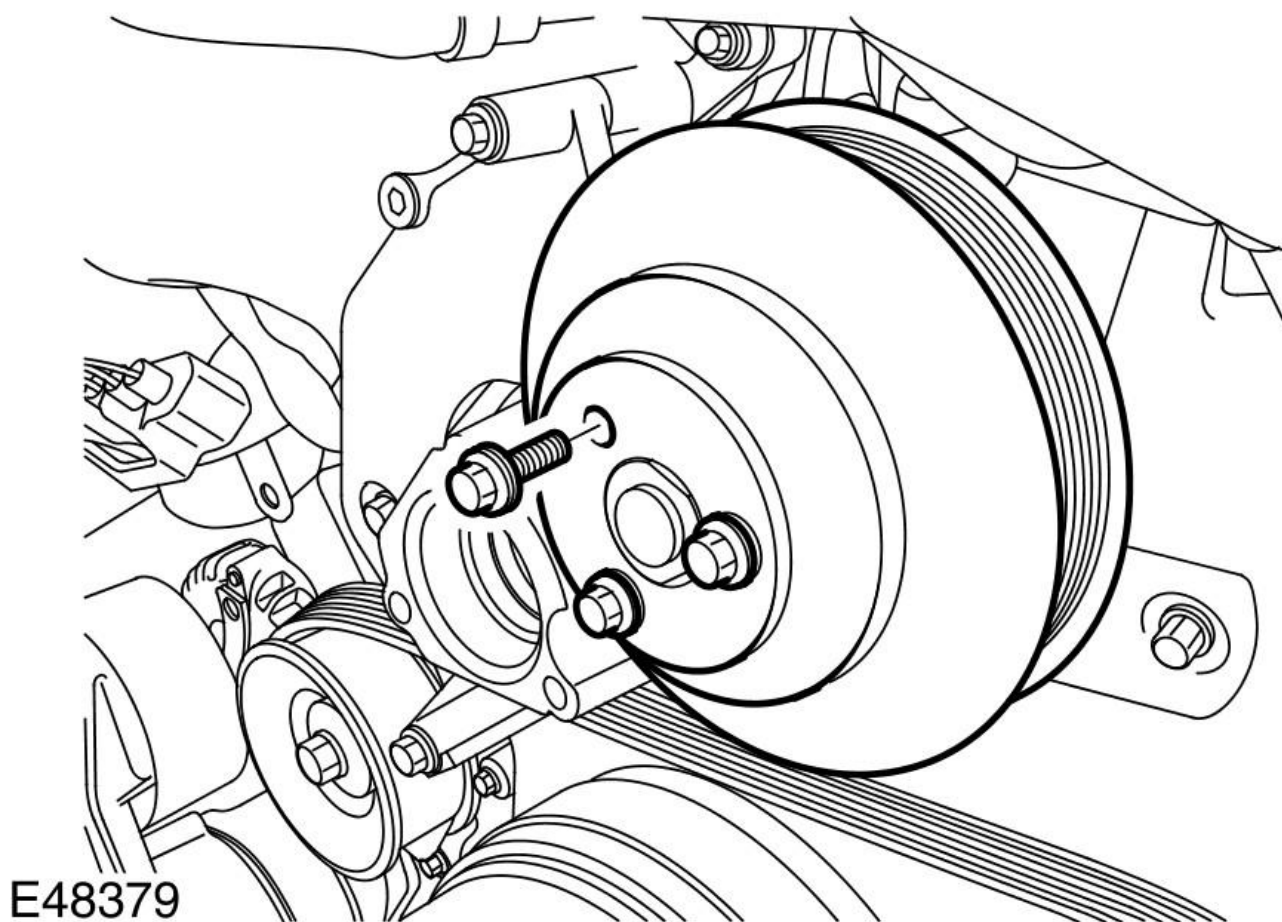


29. Remove the accessory drive belt idler pulley.

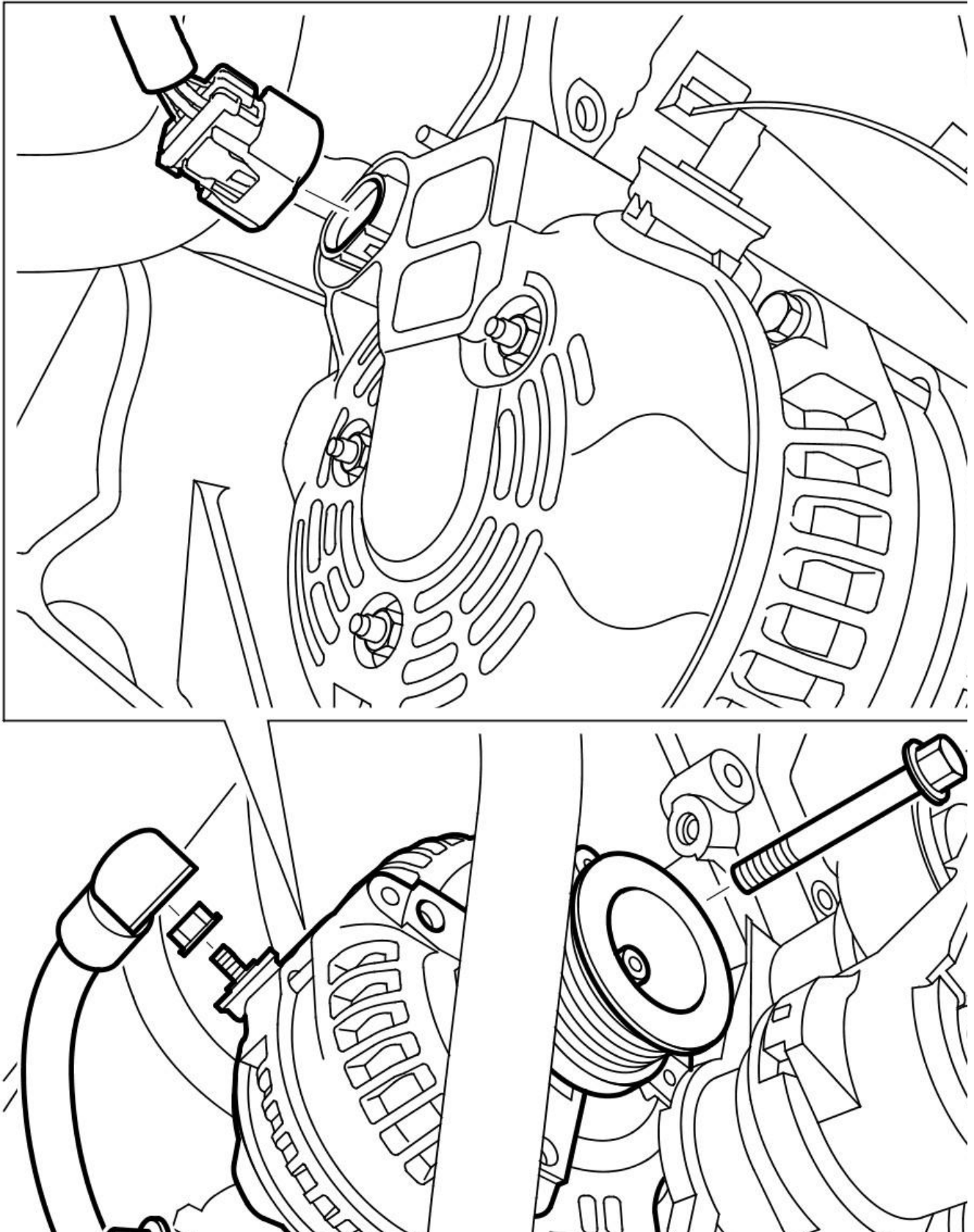
- Remove the bolt.



30. Remove the coolant pump pulley.
- Remove the 3 bolts.

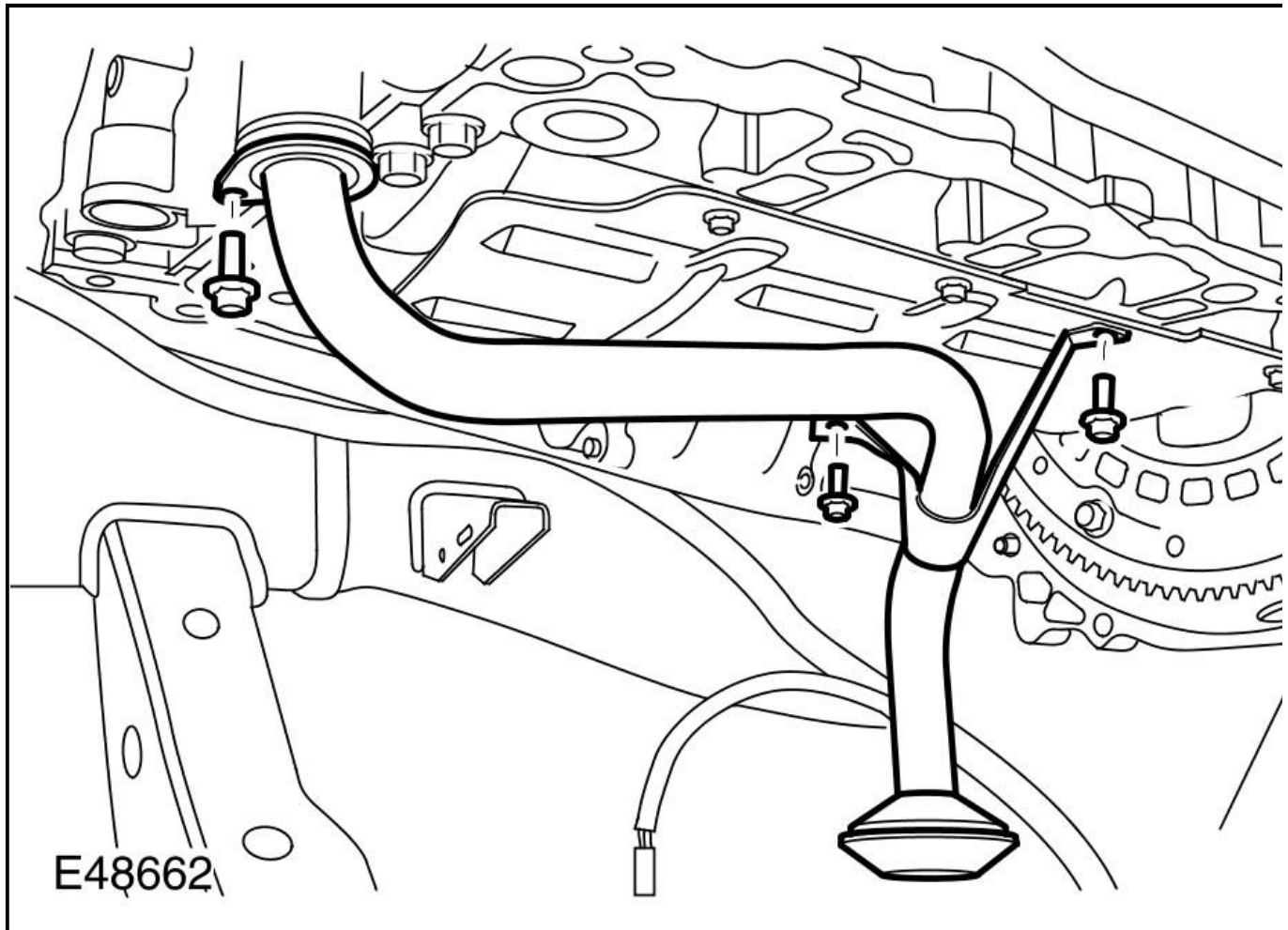


31. Remove the battery positive cable.
 - Release the battery positive cable cover.
 - Remove the retaining nut.
 - Disconnect the generator electrical connectors.
32. Remove the generator.
 - Remove the 3 bolts.



33. Release the generator mounting bracket.

- Loosen the lower rear bolt.
- Remove the 3 remaining bolts.

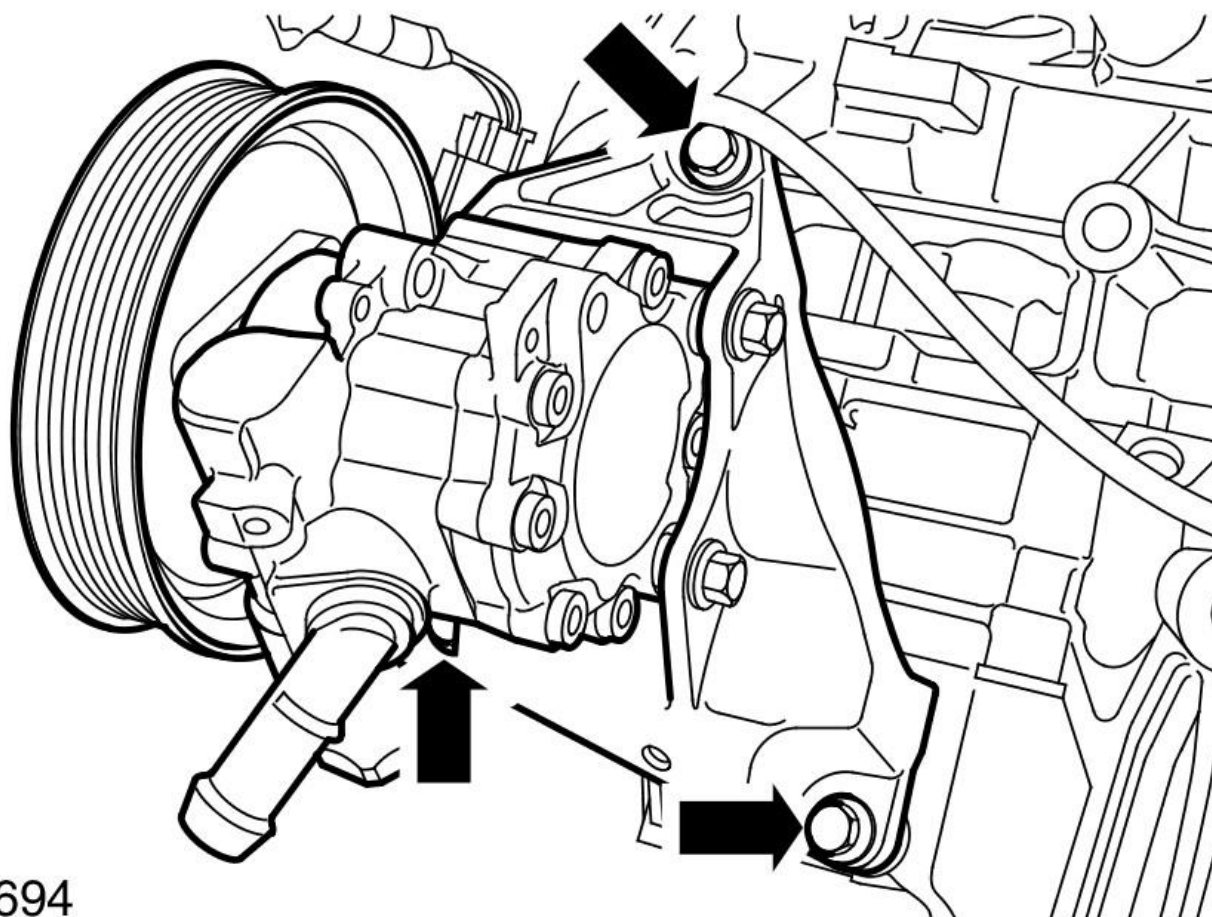


34. Remove the RH valve cover. See **Valve Cover RH**.

35. Remove the LH valve cover. See **Valve Cover LH**.

36. Remove the engine front cover.

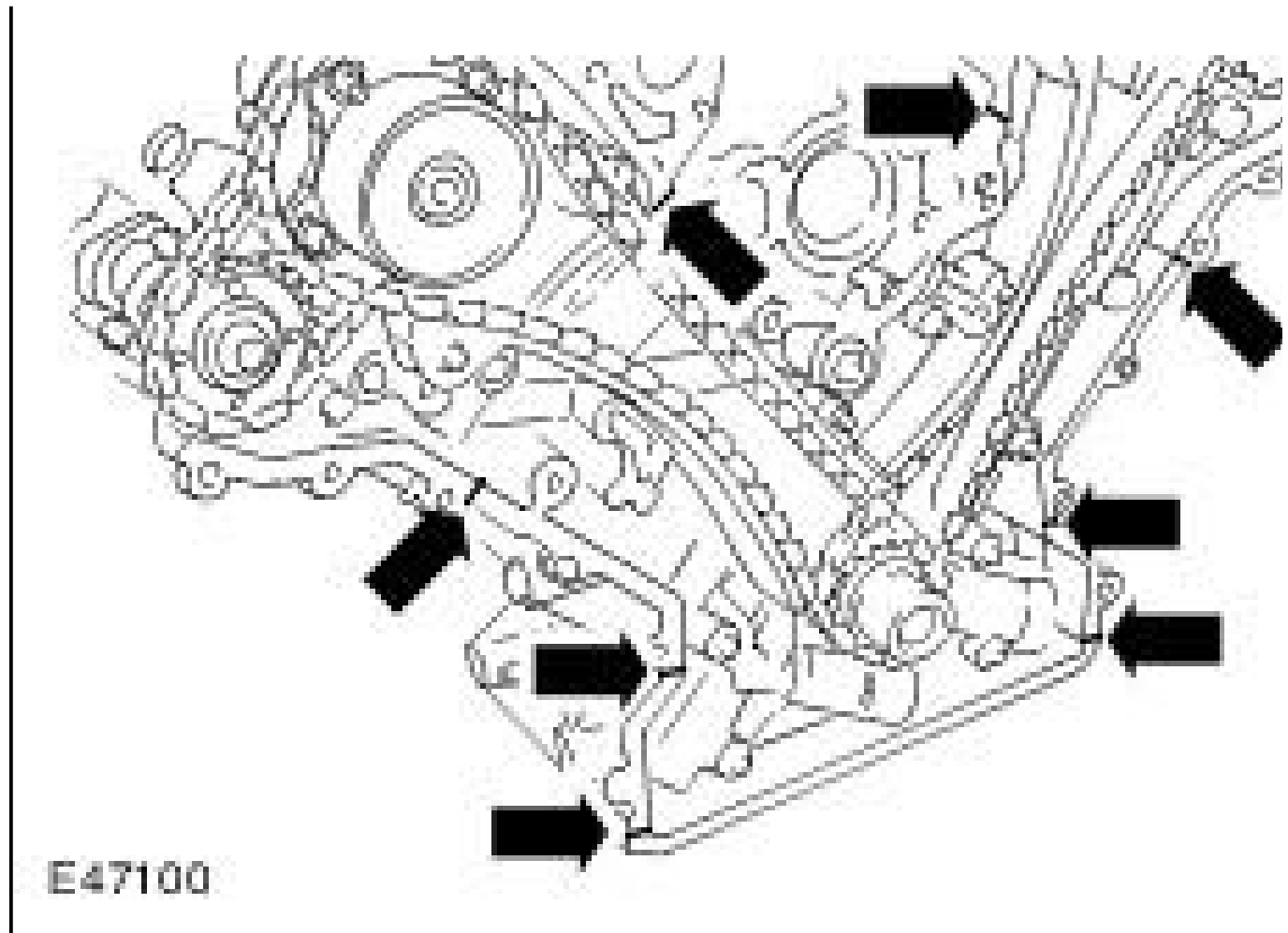
- Release the engine wiring harness clips.
- Remove the 24 bolts.
- Remove and discard the gasket.



E61694

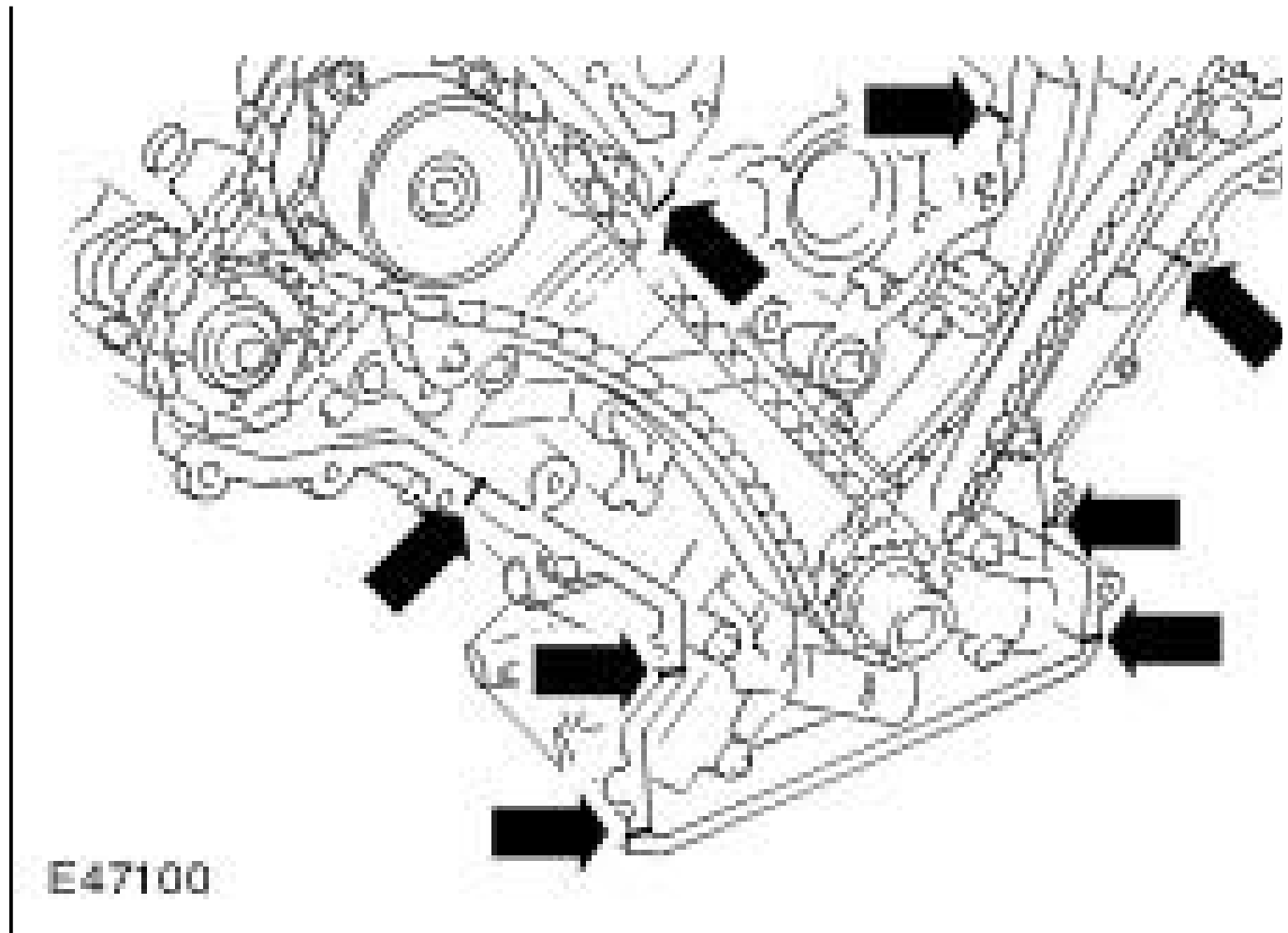
INSTALLATION

1. Install the engine front cover.
 - Clean the component mating faces.
 - Apply a bead of sealant 3 mm diameter, by 12 mm long, to the 8 places indicated.



CAUTION: Tighten the bolts in the sequence shown.

2. Secure the engine front cover.
 - Tighten the bolts to 12 Nm (9 lb.ft).

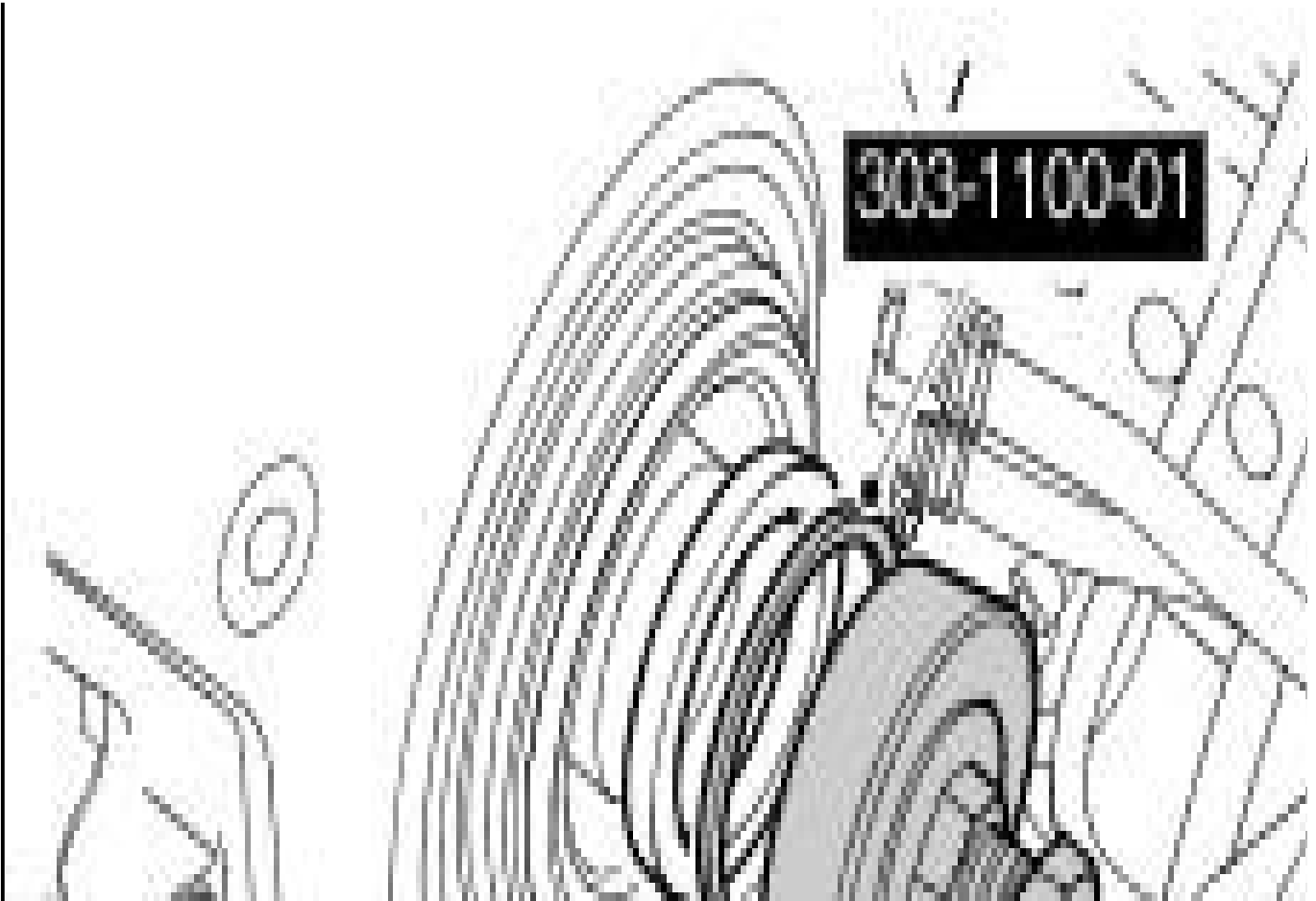


3. Install the LH valve cover. See Valve Cover LH.
4. Install the RH valve cover. See Valve Cover RH.
5. Secure the generator mounting bracket.
 - Clean the locating dowels.
 - Clean the component mating faces.
 - Tighten the bolts to 45 Nm (33 lb.ft).
6. Install the generator.
 - Install and tighten the generator upper fixing bolt, before the lower bolts.
 - Tighten the 3 bolts to 48 Nm (35 lb.ft).
7. Install the battery positive cable.
 - Connect the battery positive cable.
 - Tighten the nut to 10 Nm (7 lb.ft).
 - Connect the generator electrical connector.
8. Install the coolant pump pulley.
 - Tighten the bolts to 10 Nm (7 lb.ft).

9. Install the accessory drive belt idler pulley.
 - Tighten the bolt to 25 Nm (18 lb.ft).
10. Install the A/C compressor and the A/C compressor mounting bracket.
 - If a new compressor is being installed, the required amount of refrigerant oil must be drained from it.
11. Secure the A/C compressor mounting bracket.
 - Tighten the bolts to 25 Nm (18 lb.ft).
12. Secure the A/C compressor.
 - Tighten the bolts to 25 Nm (18 lb.ft).
13. Connect the A/C clutch electrical connector.

CAUTION: Lubricate the new seals with clean refrigerant oil.

14. Connect the refrigerant lines.
 - Clean the component mating faces.
 - Install the new O-ring seals.
 - Tighten the bolts to 10 Nm (7 lb.ft).
15. Secure the transmission cooler pipes into clips.
16. Install the power steering pump.
 - Tighten the bolts to 25 Nm (18 lb.ft).
17. Connect the high pressure line.
 - Clean the component mating faces.
 - Install the new O-ring seals.
 - Tighten the union to 25 Nm (18 lb.ft).
18. Connect the low pressure line.
 - Clean the component mating faces.
 - Secure with the clip.
19. Clean all the crankshaft pulley mating faces.
20. Using the special tools, install the crankshaft front seal.
 - Lubricate the seal with clean engine oil.
 - Use the discarded crankshaft bolt with the service tool.



21. Install the front wheel.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).
22. Install the crankshaft pulley.

- Lubricate the seal with clean engine oil.

23. Install the crankshaft pulley locking ring.

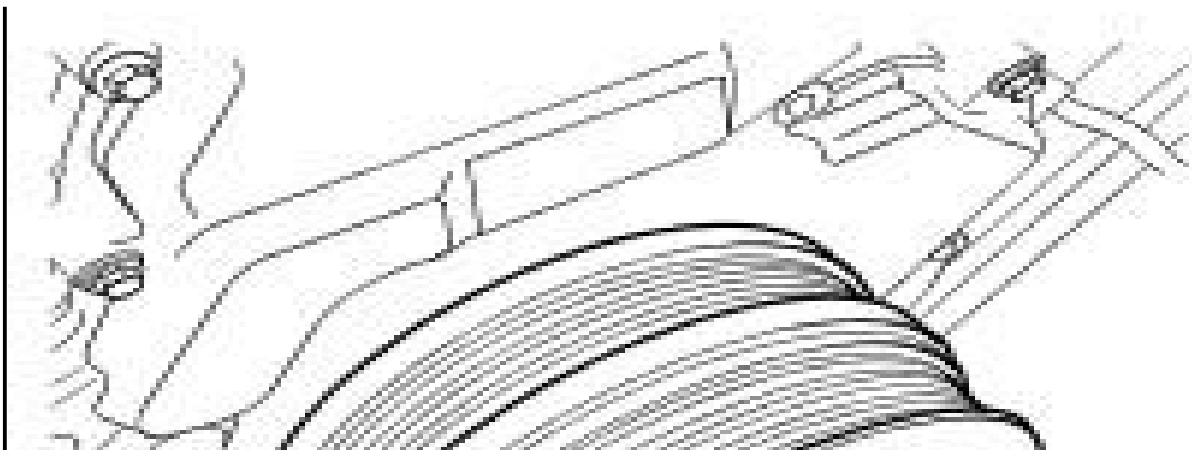
CAUTION: The screw thread in the crankshaft pulley must be cleaned out before installing a new crankshaft pulley bolt.

24. Install, but do not tighten, the new crankshaft pulley bolt.

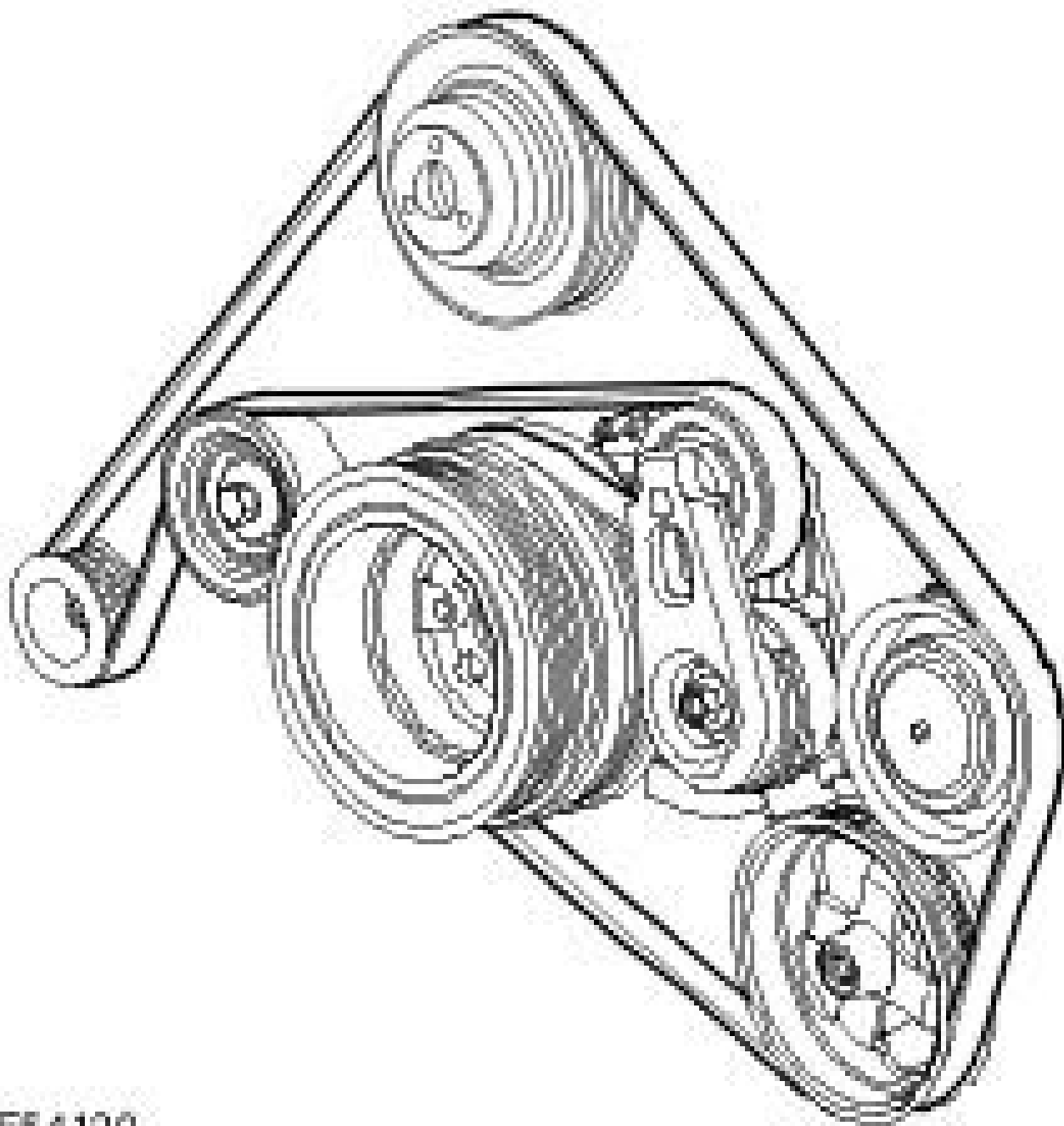
CAUTION: Under no circumstances should the crankshaft setting peg, 303-645, be used in the following operations, to restrain the crankshaft.

25. Using the special tools, retain the crankshaft pulley.

- Tighten the crankshaft pulley bolt to 380 Nm (280 lb.ft).



26. Remove the special tools.
27. Install the accessory drive belt.



E54120

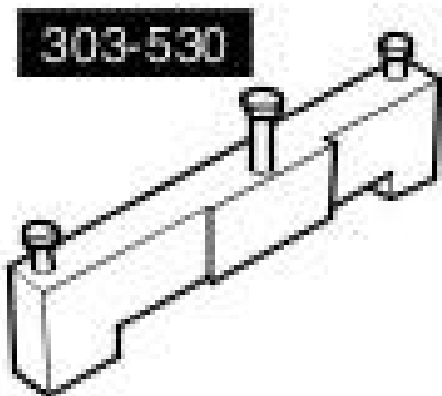
28. Install the cooling fan belt tensioner.
 - Tighten the M10 bolt to 45 Nm (33 lb.ft).
29. Install the cooling fan drive hub bearing.
 - Tighten the bolts to 10 Nm (7 lb.ft).
30. Install the cooling fan drive pulley.

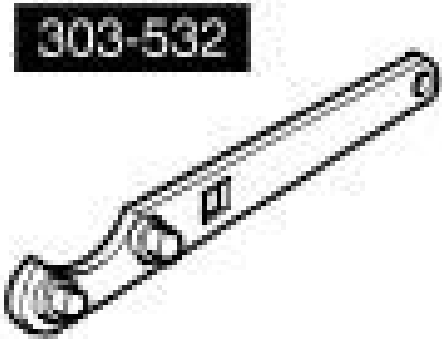
- Tighten the bolts evenly to 25 Nm (18 lb.ft).

31. Install the RH air cleaner assembly. Refer to **Air Cleaner** .
32. Install the coolant manifold. Refer to **Coolant Manifold** .
33. Refill and bleed the cooling system. Refer to **Cooling System Draining, Filling and Bleeding** .

TIMING DRIVE COMPONENTS

SPECIAL TOOLS

Tool Illustration	Tool Name	Tool Number
 303-530 E46879	Camshaft setting/locking tool	303-530
 303-645 E46881	Timing Setting tool	303-645
	Timing chain tensioning tool	303-532

 E46880		
 E115082	Timing shim tool	303-530/04

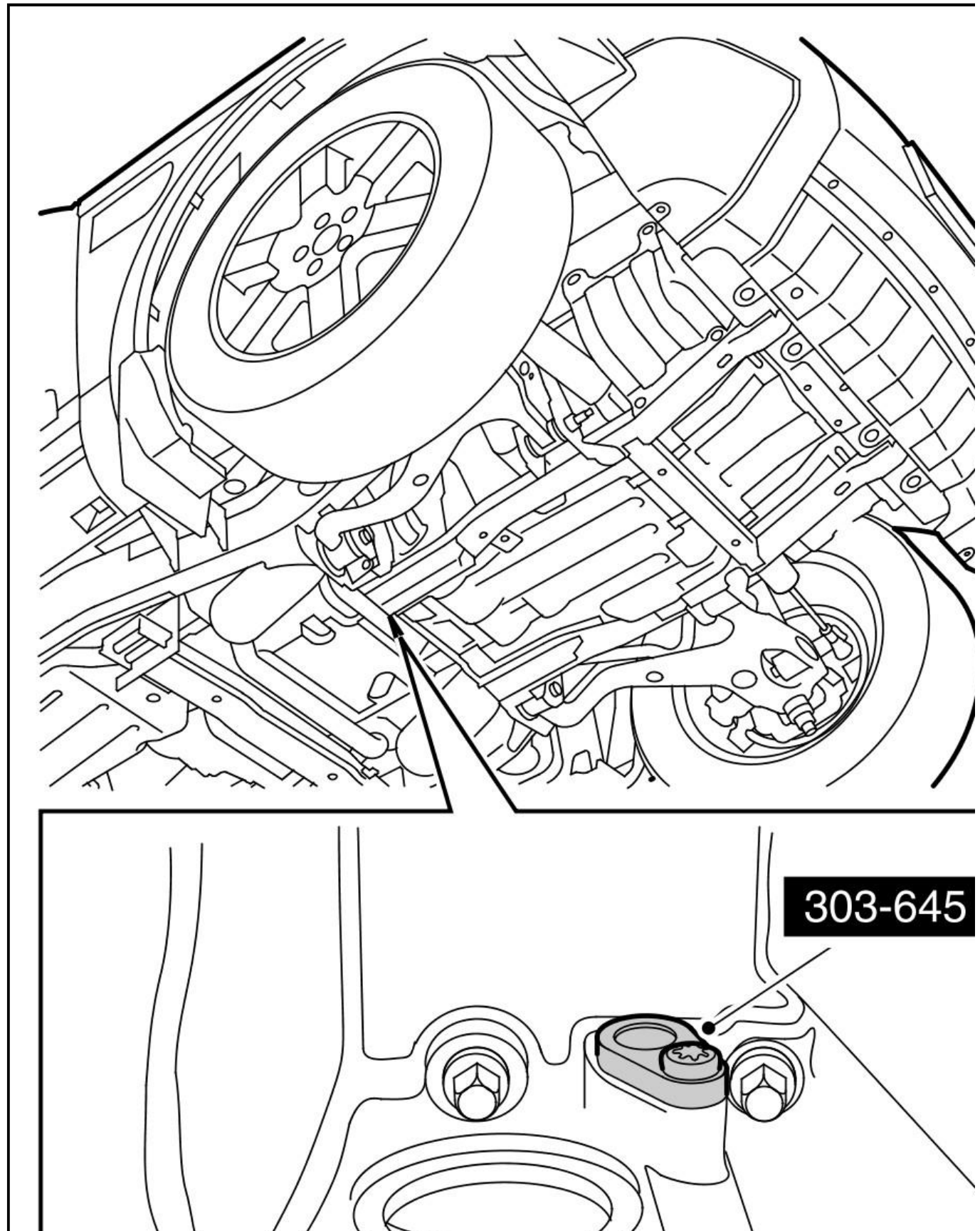
REMOVAL

NOTE: This procedure covers the removal and installation of the following components: timing chains, chain guides, tensioners and sprockets.

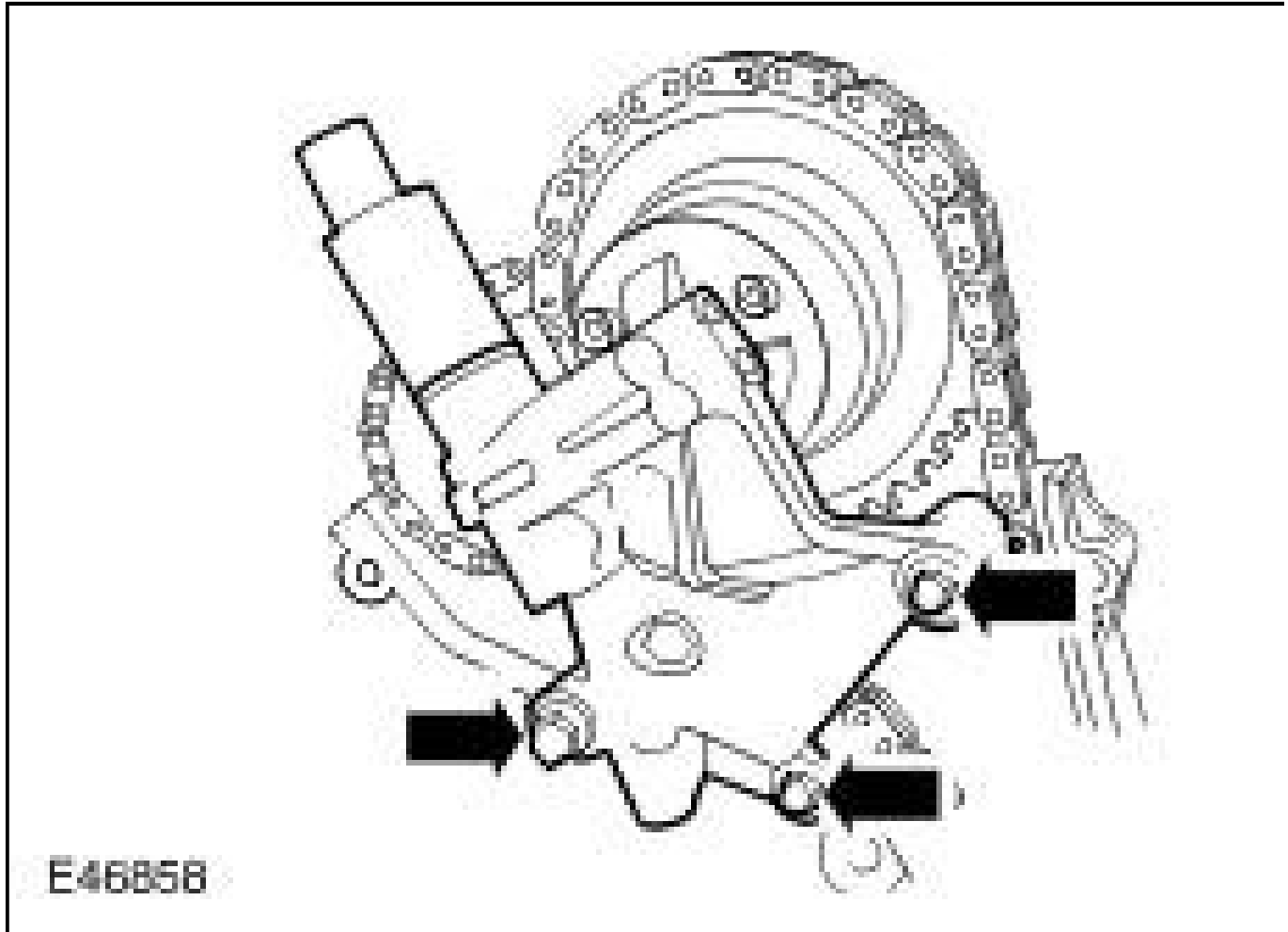
1. Disconnect the battery ground cable. Refer to Specifications .

WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

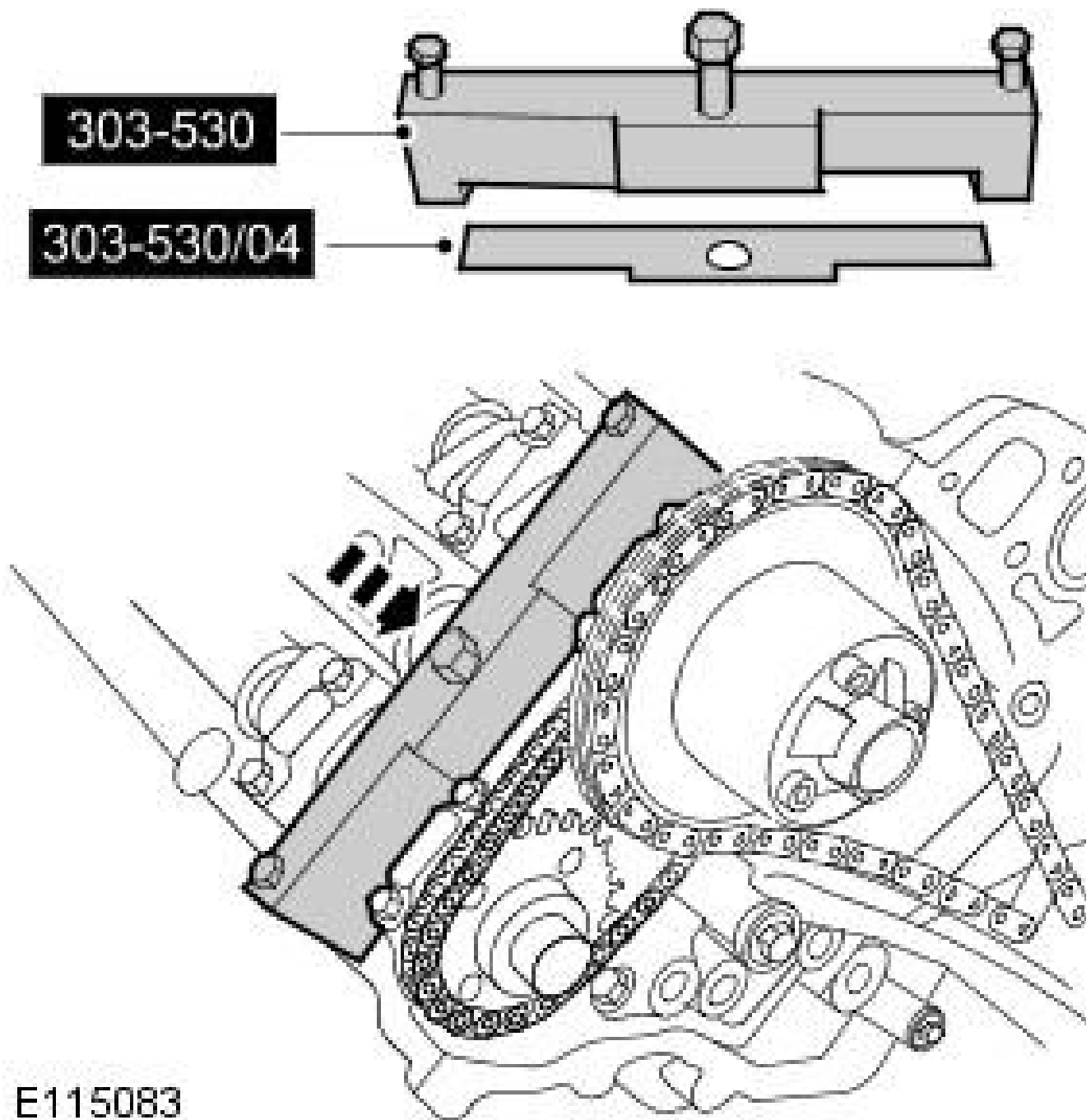
2. Raise and support the vehicle.
3. Remove the engine front cover. See Engine Front Cover.
4. Remove the crankshaft position (CKP) sensor. Refer to Crankshaft Position (CKP) Sensor .
5. Lock the crankshaft.
 - Install the special tool.
 - Install the screw.



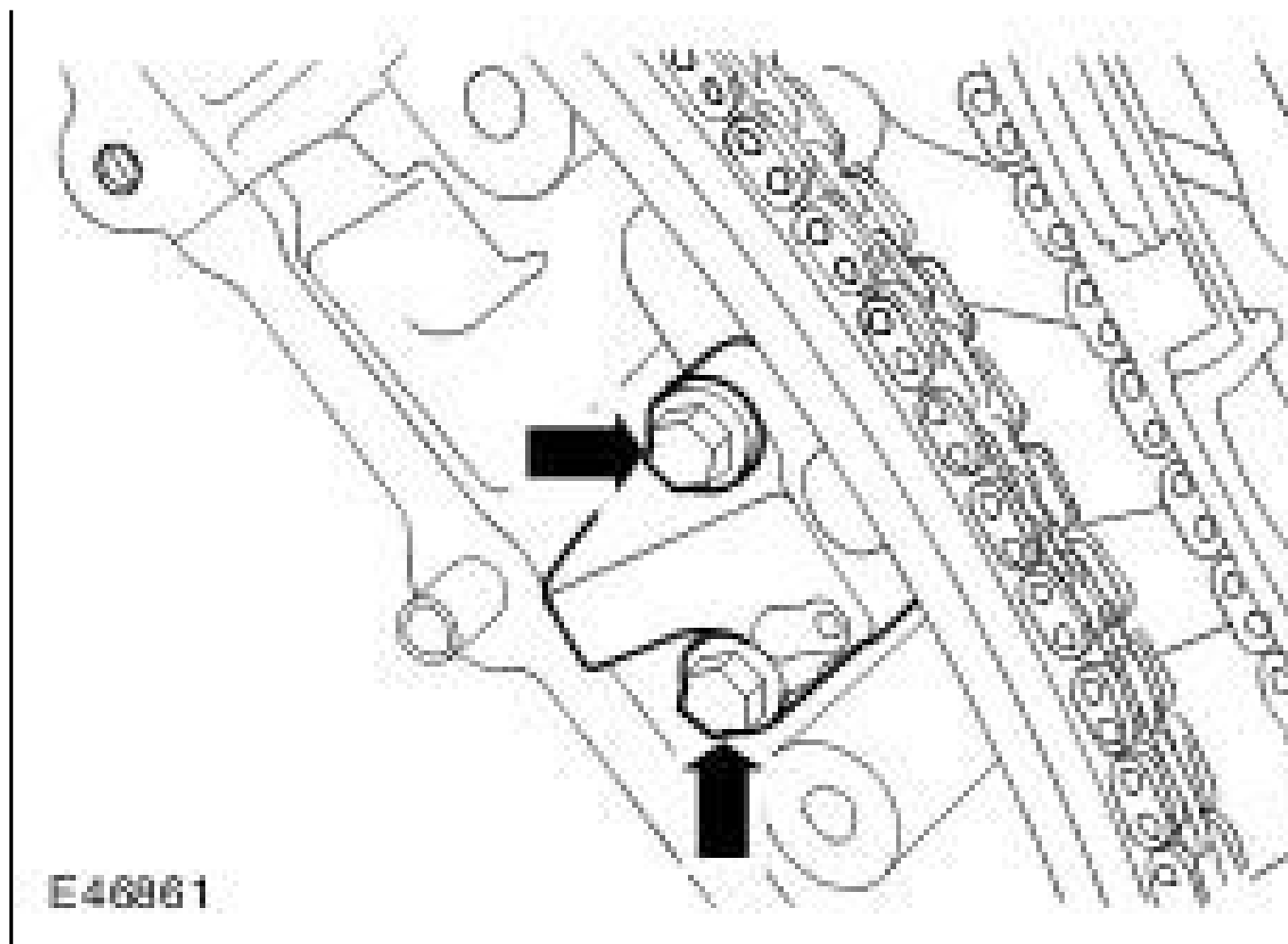
6. Remove the RH variable camshaft timing (VCT) control solenoid housing.
- Remove the 3 bolts.
 - Remove and discard the O-ring seals.



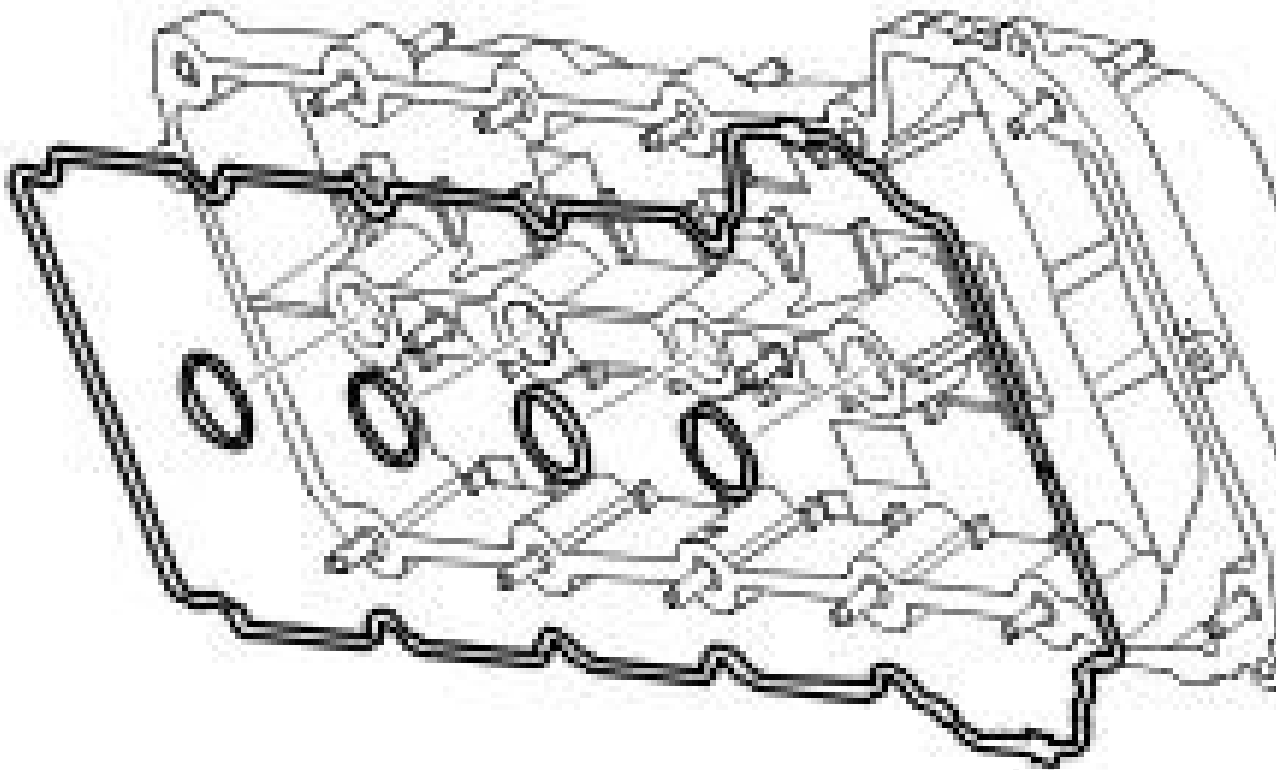
7. Install the special tool to the RH cylinder head.
- Install the 3 bolts.



8. Remove the RH primary timing chain tensioner assembly.
 - Remove the 2 bolts.

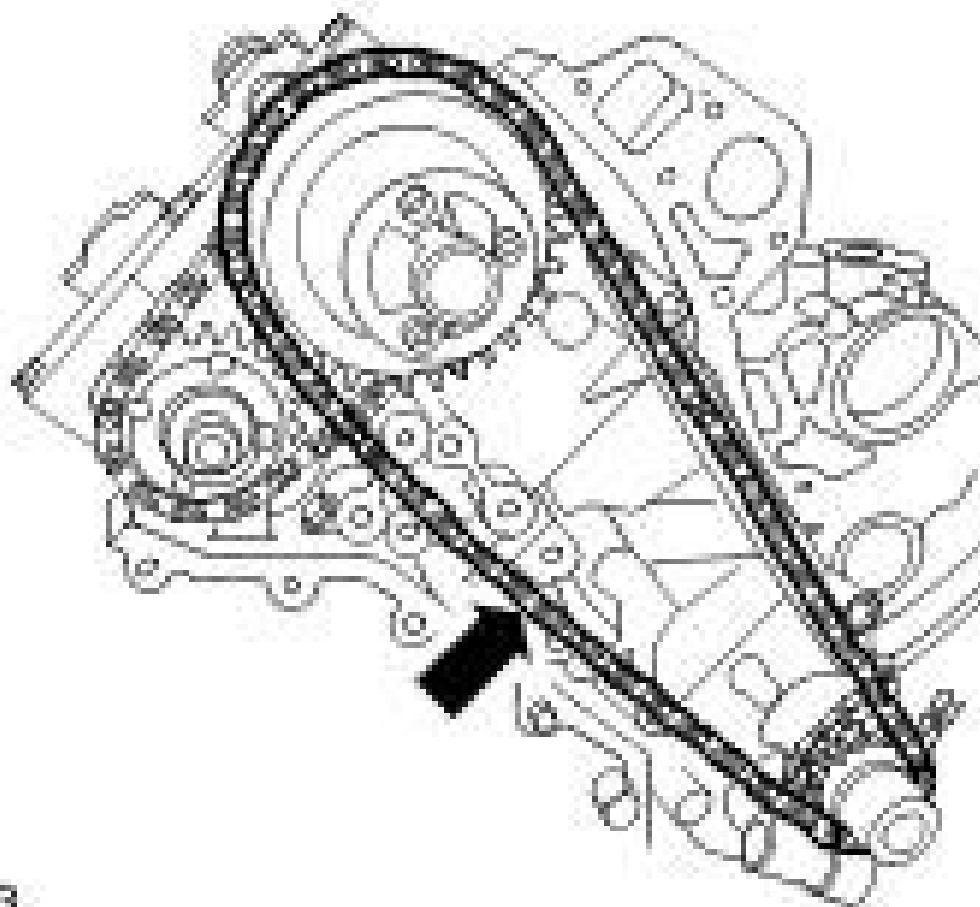


9. Remove the RH primary timing chain tensioner guide.
 - Remove the bolt.



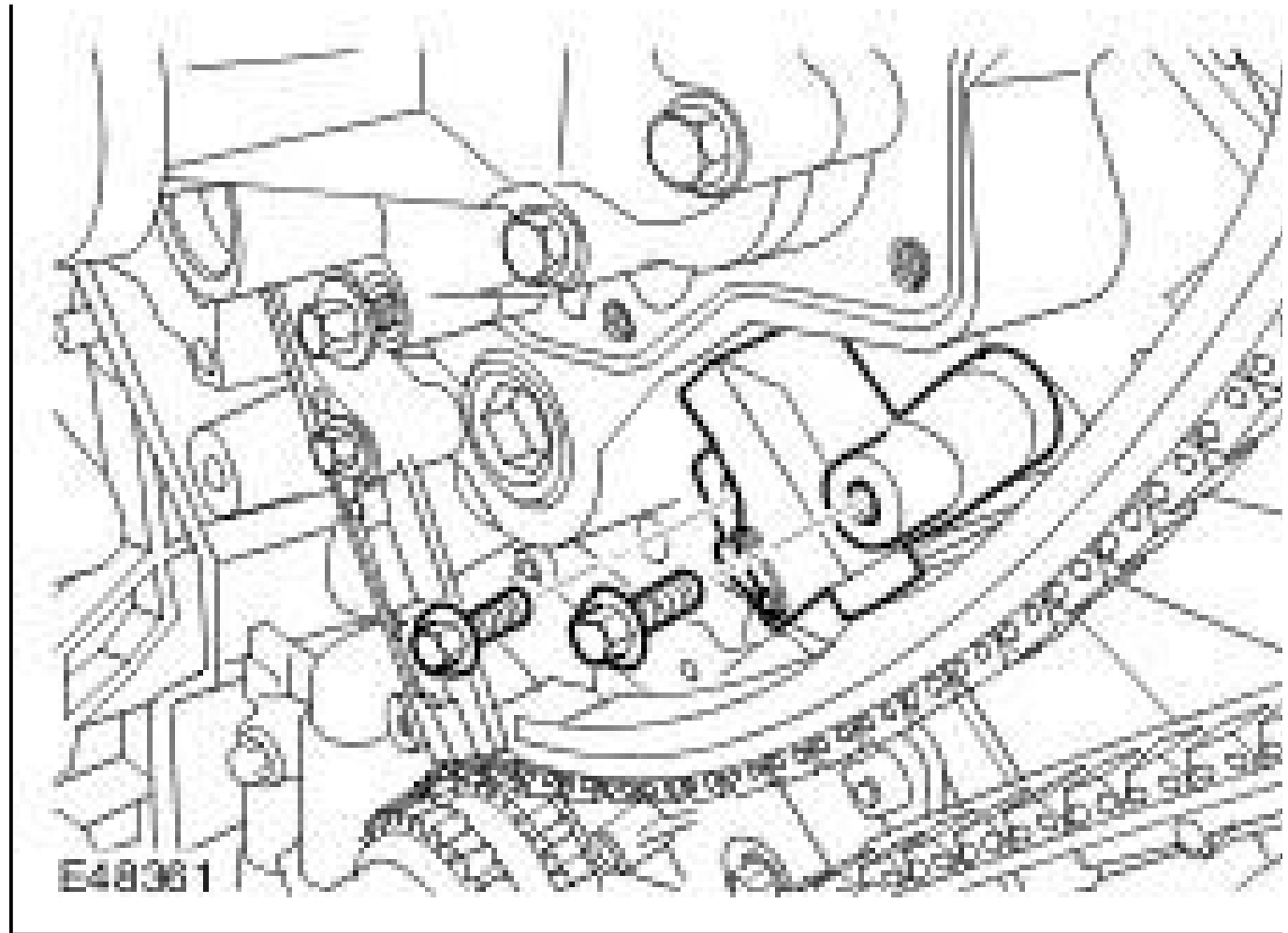
E46652

10. Remove the RH primary timing chain.
 - Remove the bolt retaining the chain guide.

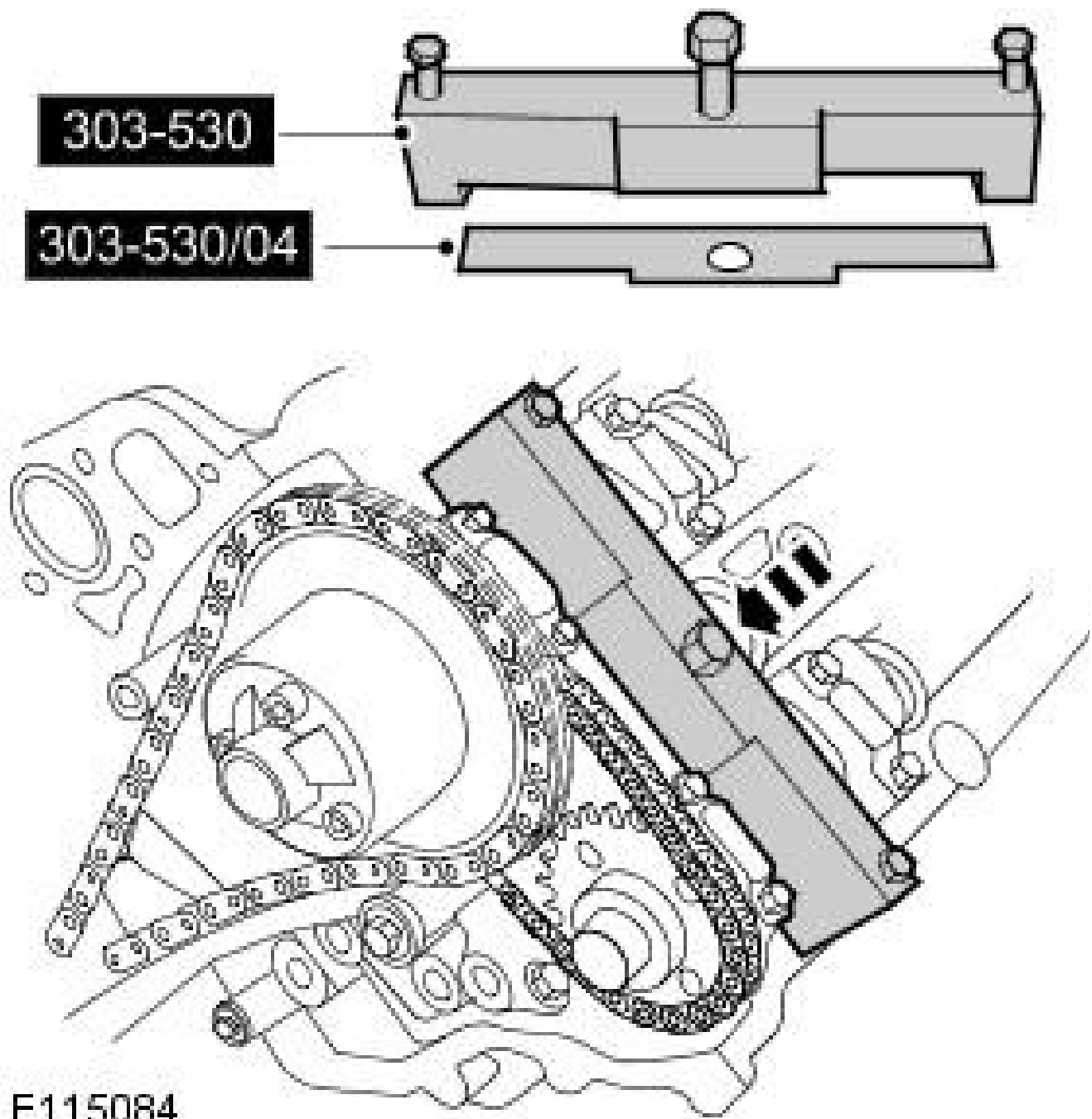


E46863

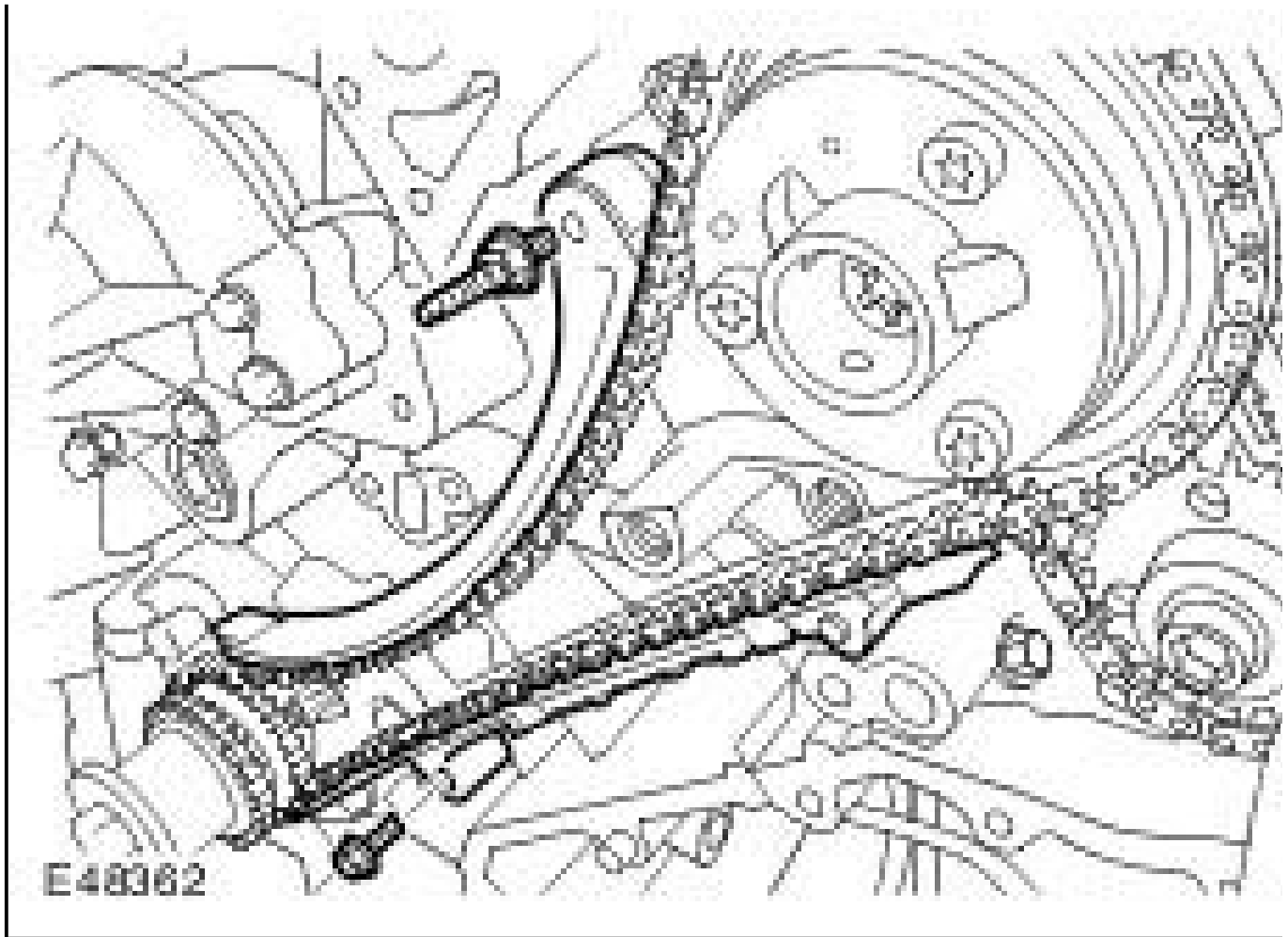
11. Remove the special tools from the RH cylinder head.
12. Remove the LH variable camshaft timing (VCT) control solenoid housing.
 - Remove the 2 bolts.
 - Remove the nut.
 - Remove and discard the O-ring seals.



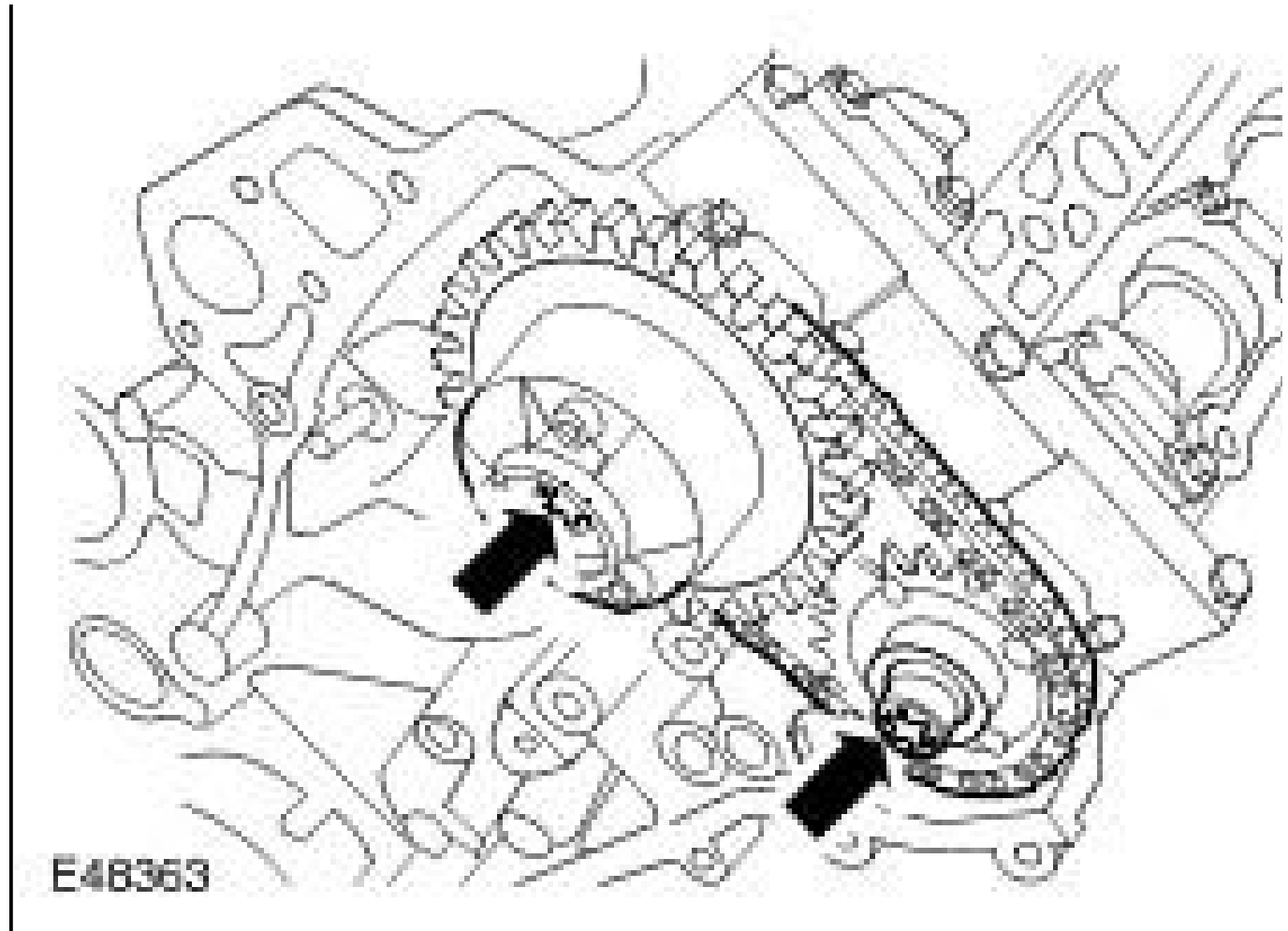
13. Install the special tool to the LH cylinder head.
 - Install the 3 bolts.



14. Remove the LH primary timing chain tensioner.
 - Remove the 2 bolts.



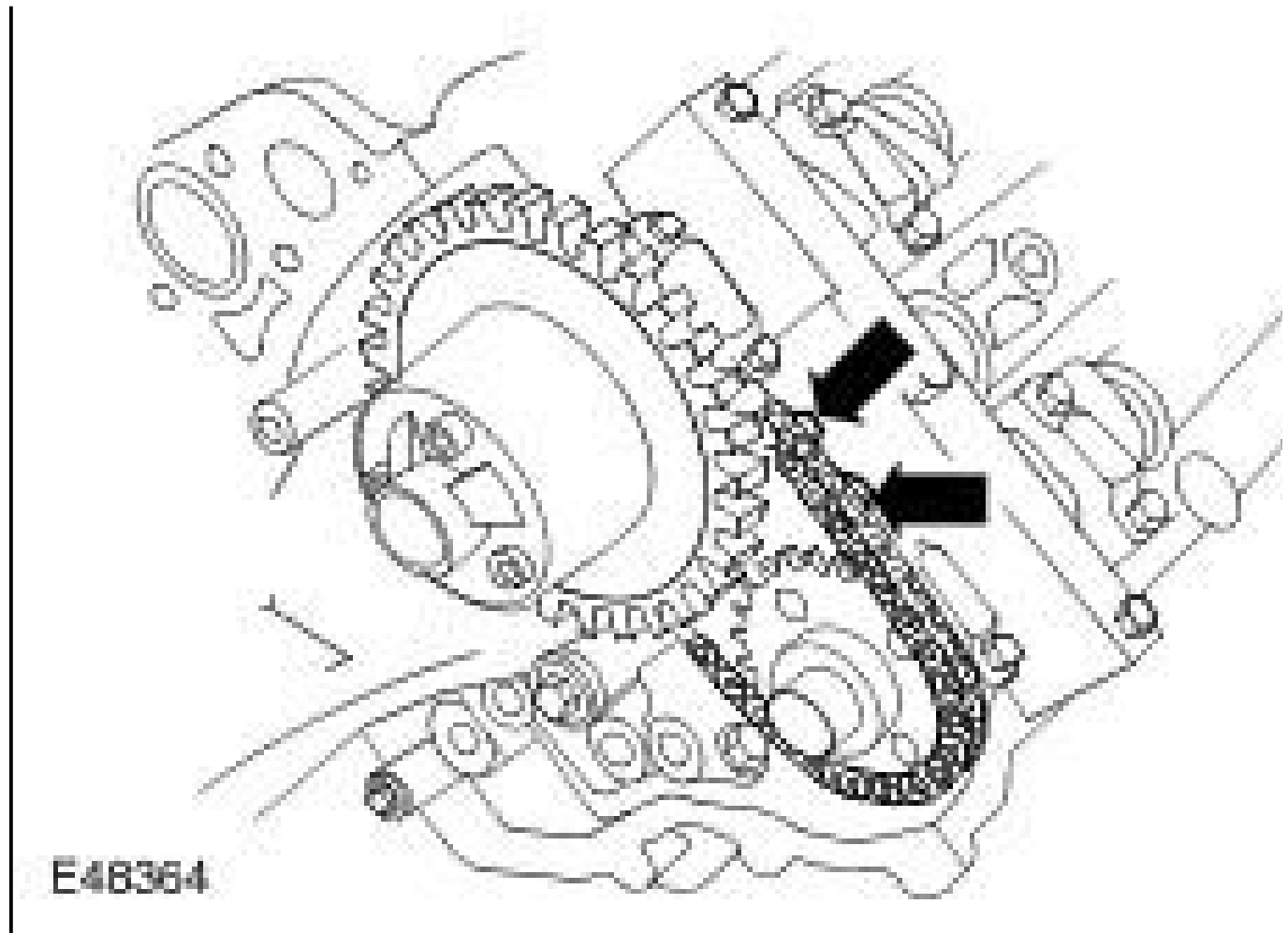
15. Remove the LH upper and lower primary timing chain tensioner guides.
- Remove the 2 bolts.



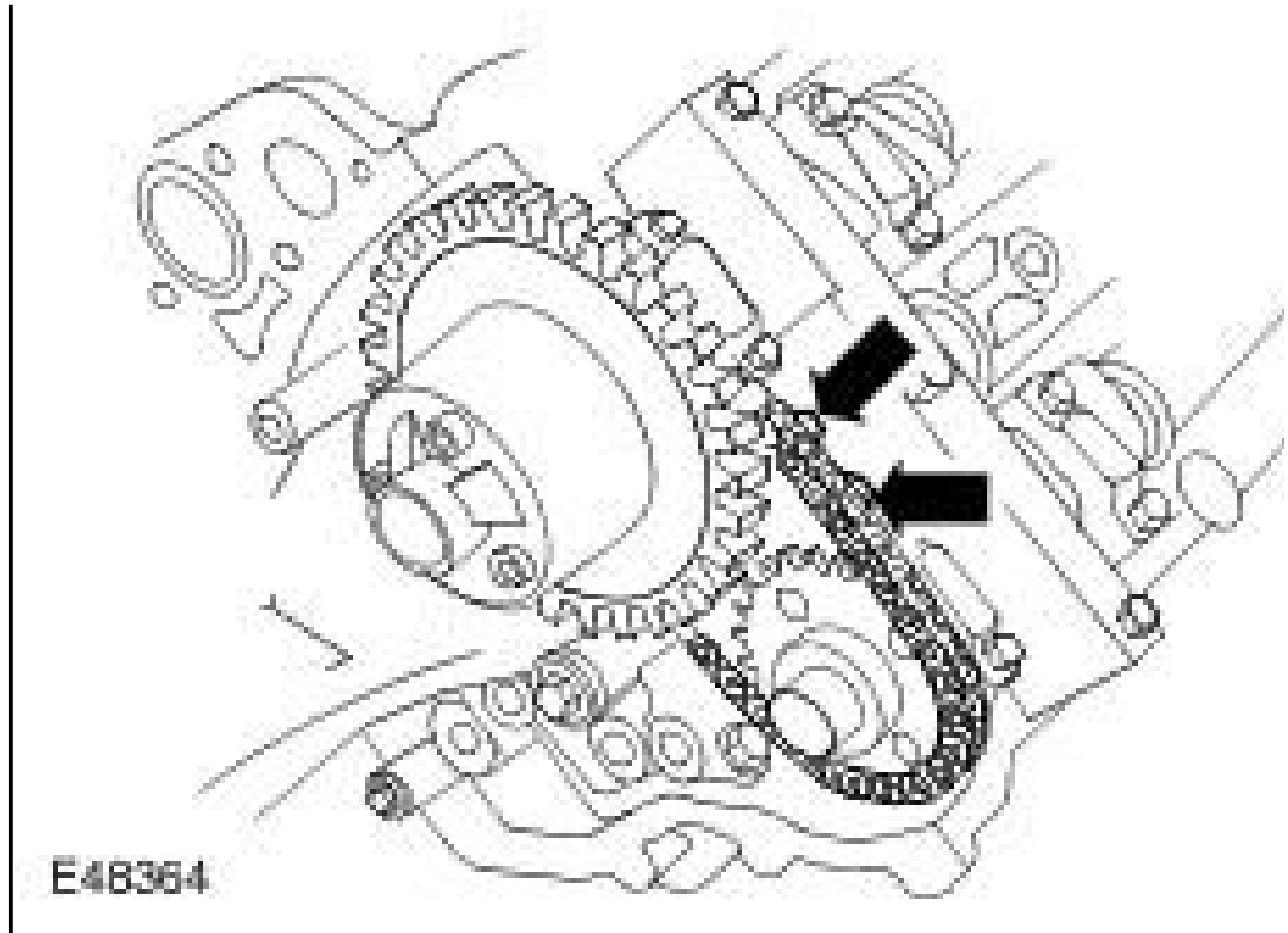
16. Remove the LH primary timing chain.

CAUTION: Discard the bolts.

17. Remove the LH camshaft sprocket assembly.
- Remove the 2 Torx bolts.

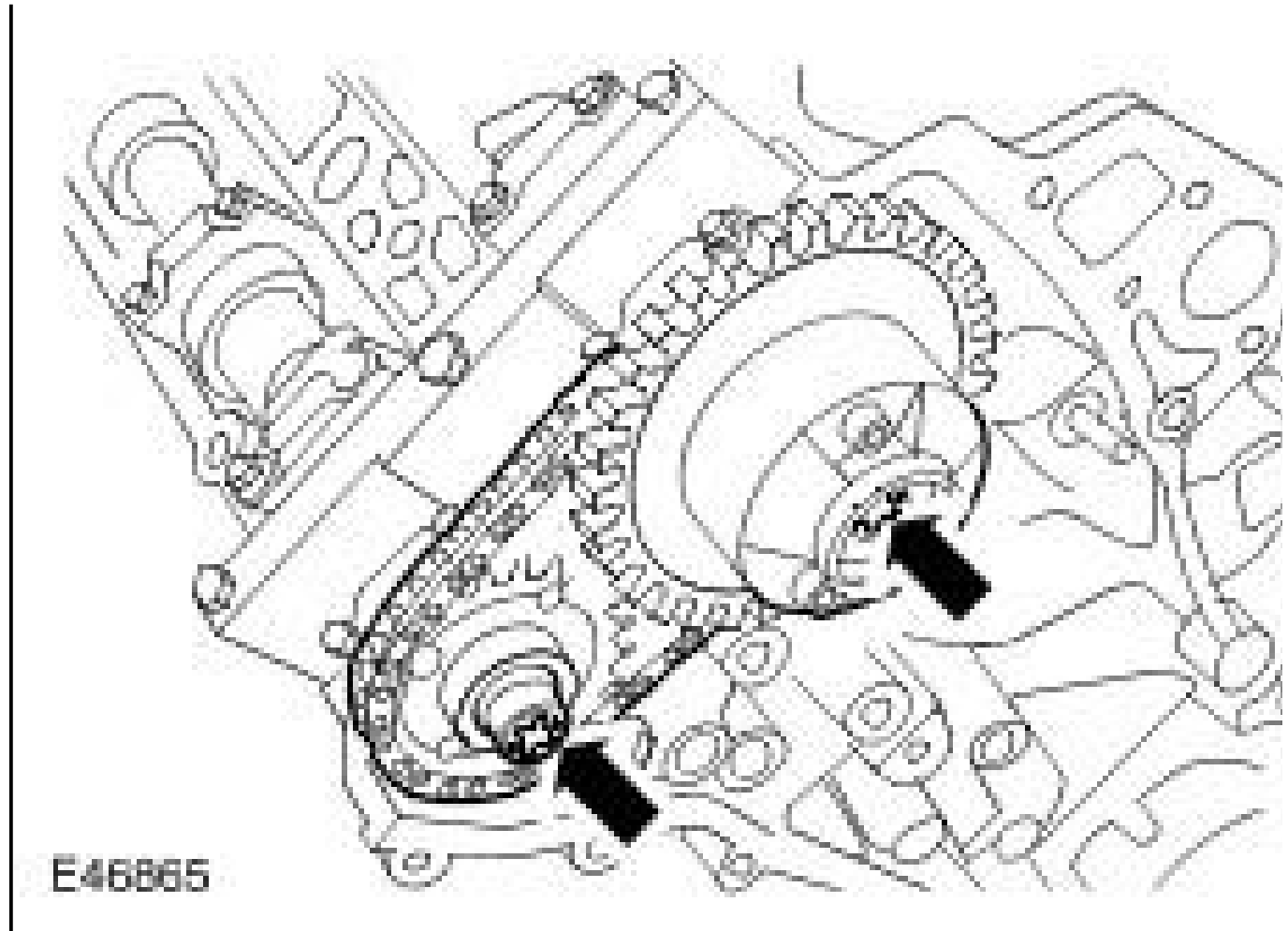


18. Remove the LH secondary timing chain tensioner and the secondary timing chain.
- Remove the 2 bolts.

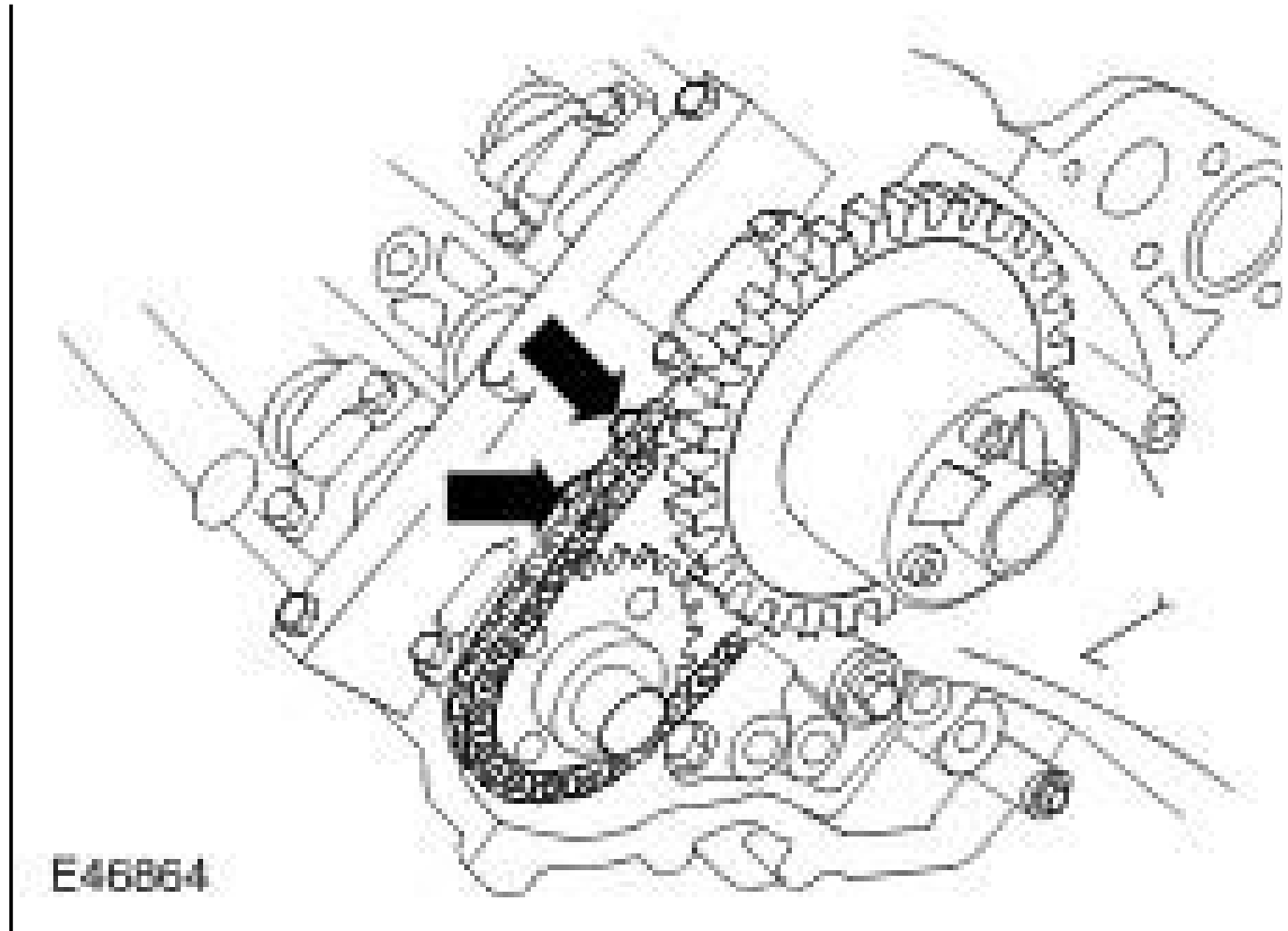


CAUTION: Discard the bolts.

19. Remove the RH camshaft sprocket assembly.
 - Remove the 2 Torx bolts.

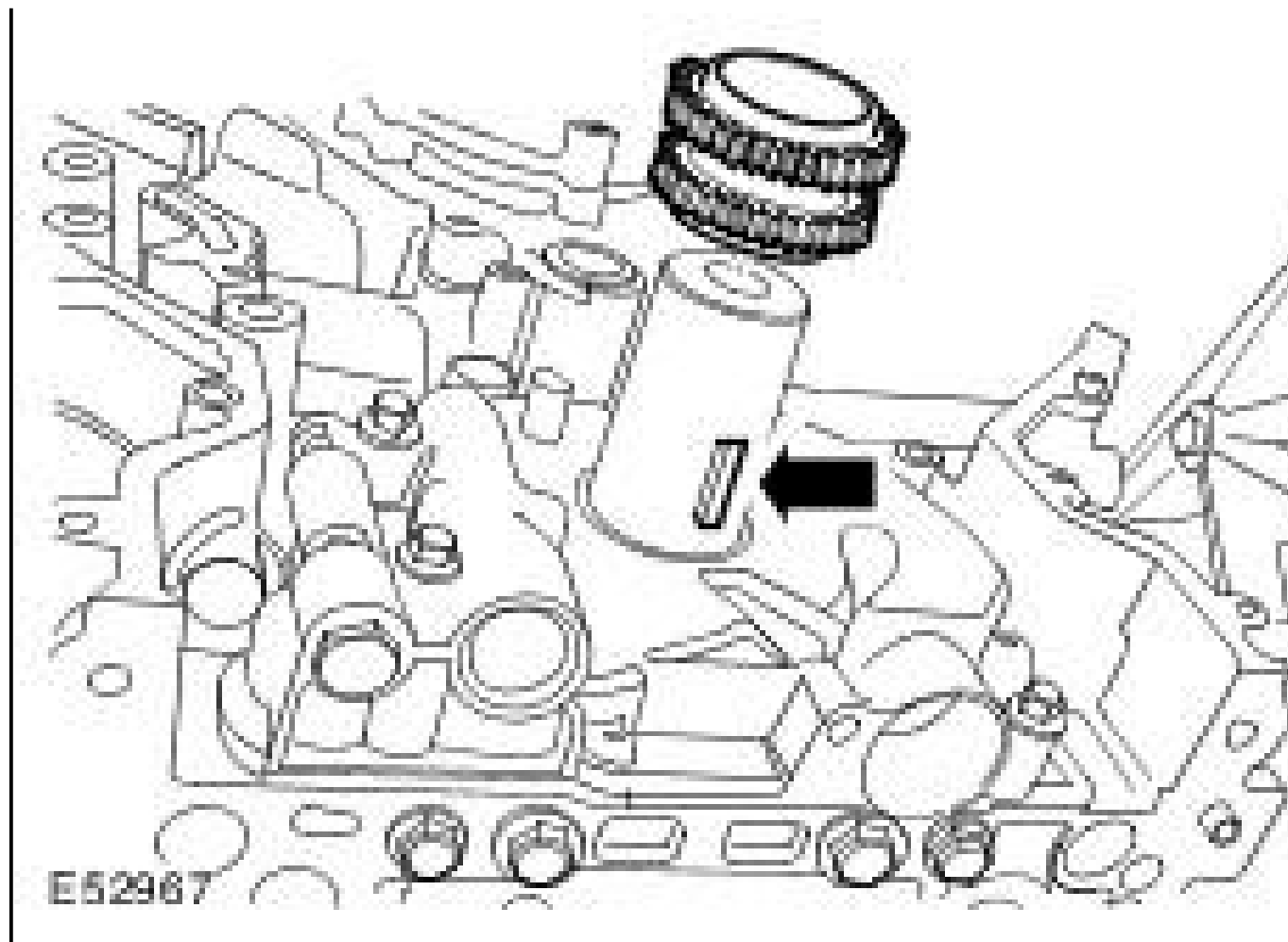


20. Remove the RH secondary timing chain tensioner and the secondary timing chain.
- Remove the 2 retaining bolts.



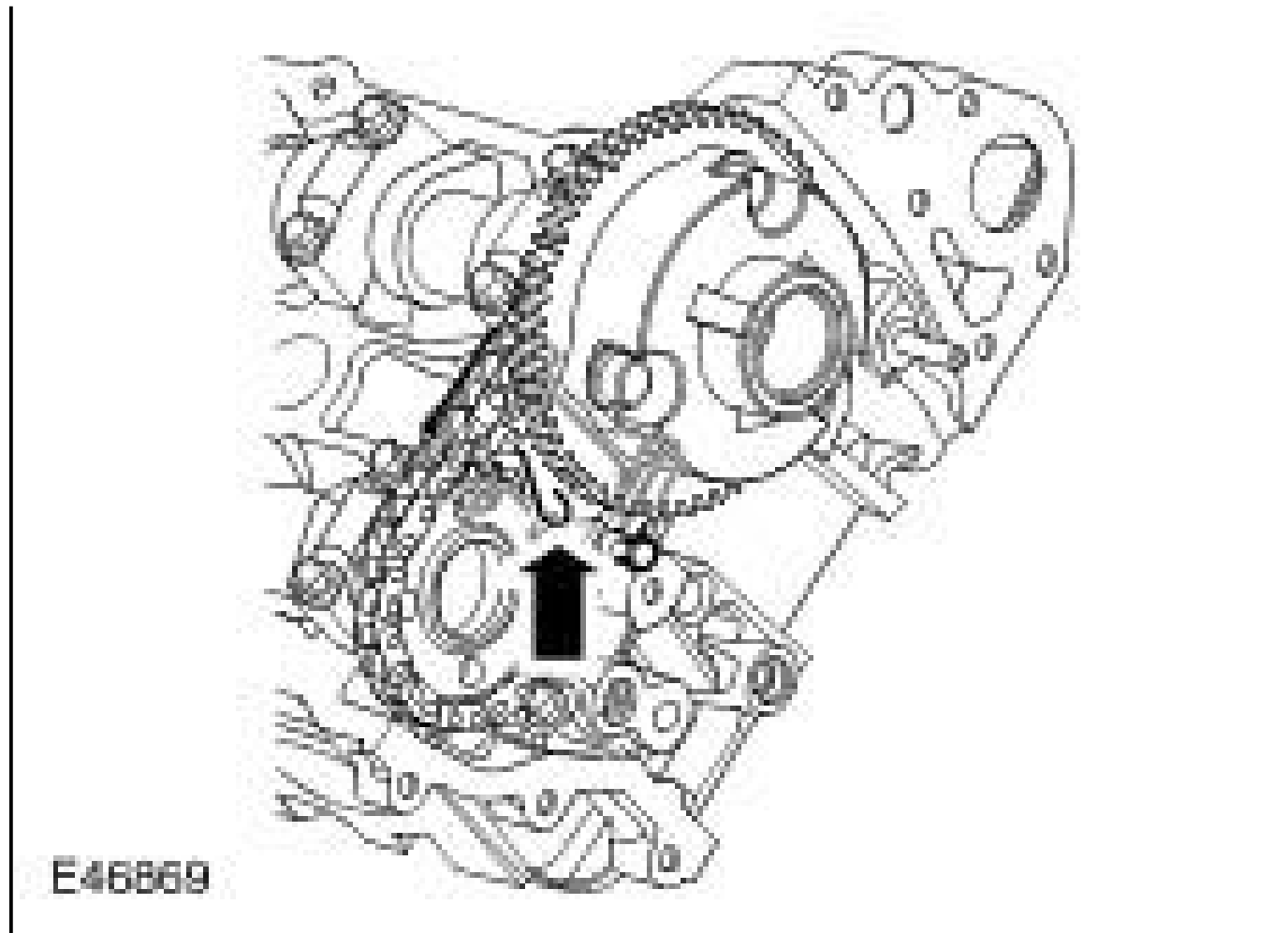
NOTE: Note the orientation of the crankshaft sprocket.

21. Remove the crankshaft sprocket.
 - Remove the crankshaft sprocket key.



INSTALLATION

1. Install the crankshaft sprocket key.
 - Clean the component mating faces.
2. Install the crankshaft sprocket.
3. Depress the LH secondary timing chain tensioner piston.
 - Using 1 mm diameter metal rod, retain the chain tensioner piston.



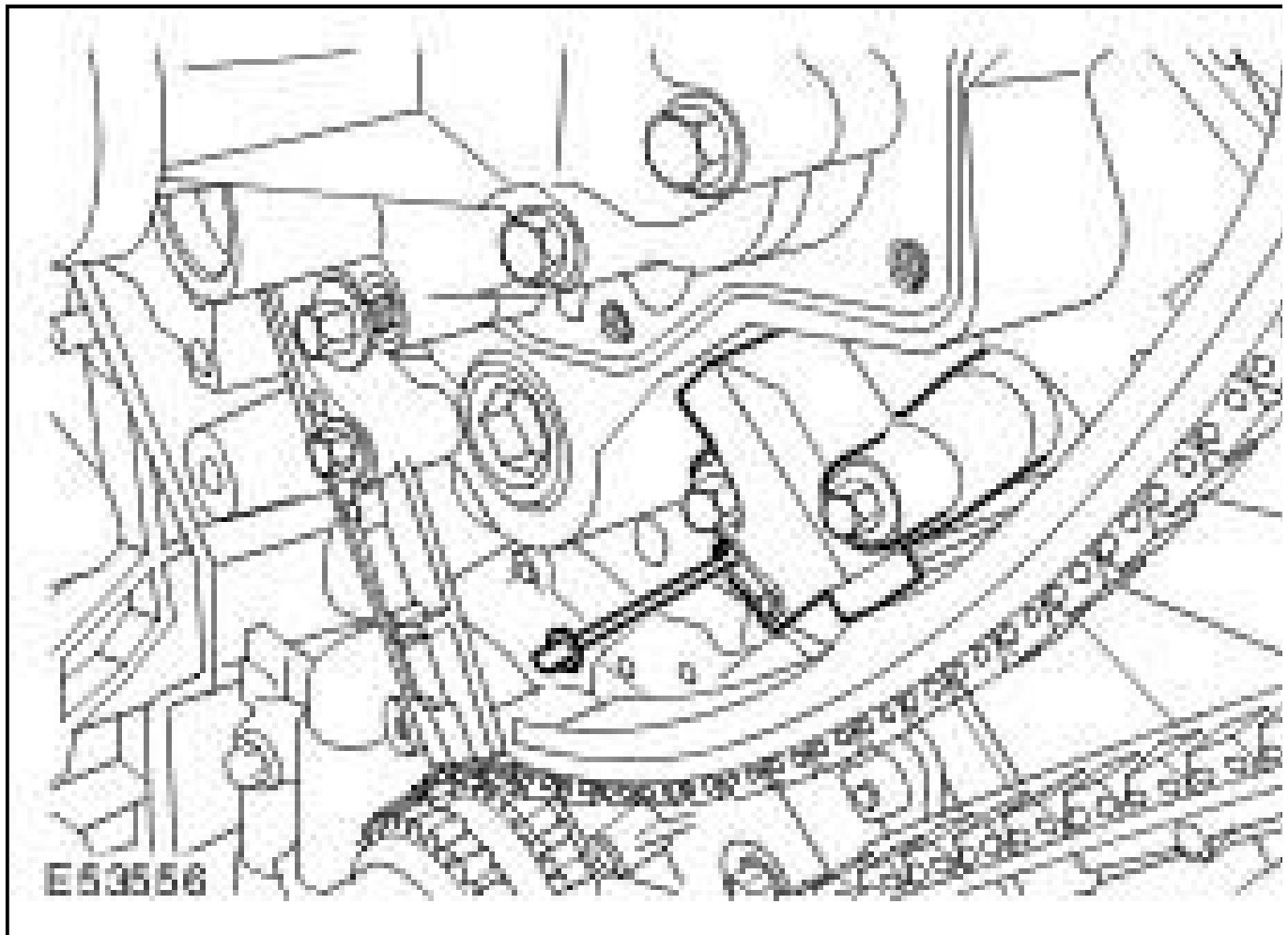
NOTE: RH illustration shown, LH is similar

4. Install the LH secondary timing chain tensioner and chain to the camshaft sprockets.
5. Install the LH secondary timing chain tensioner retaining bolts.
 - Tighten the bolts to 12 Nm.
6. Install the LH primary timing chain.
 - Make sure the timing chain slack is on the tensioner side of the timing chain.
7. Install the LH primary timing chain tensioner guides.
 - Tighten the bolts to 12 Nm.

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.

8. Install the LH primary timing chain tensioner.
 - Using 3 mm diameter metal rod, retain the chain tensioner piston.

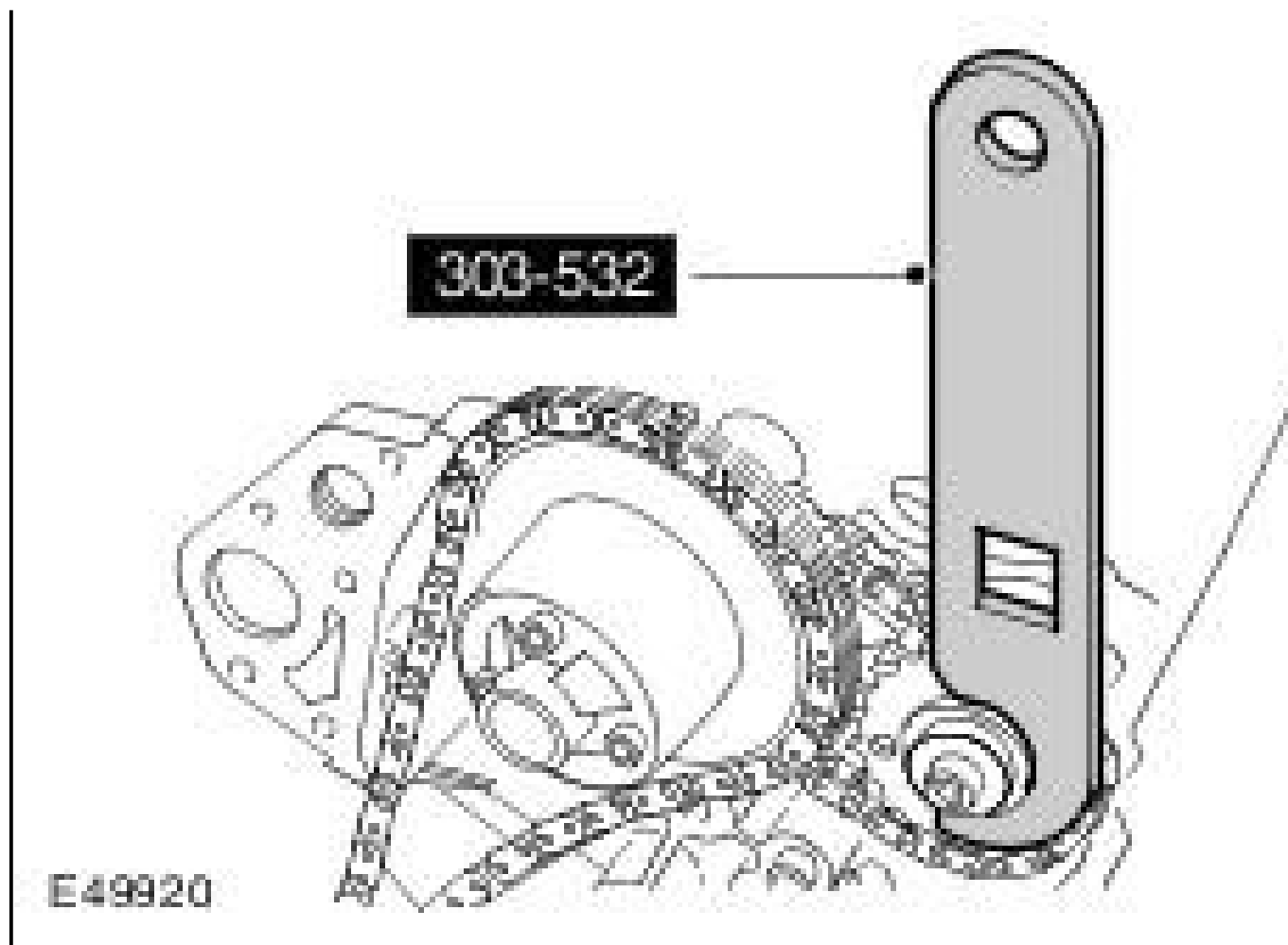
- Tighten the bolts to 12 Nm (9 lb.ft).
- Remove the retaining rod.



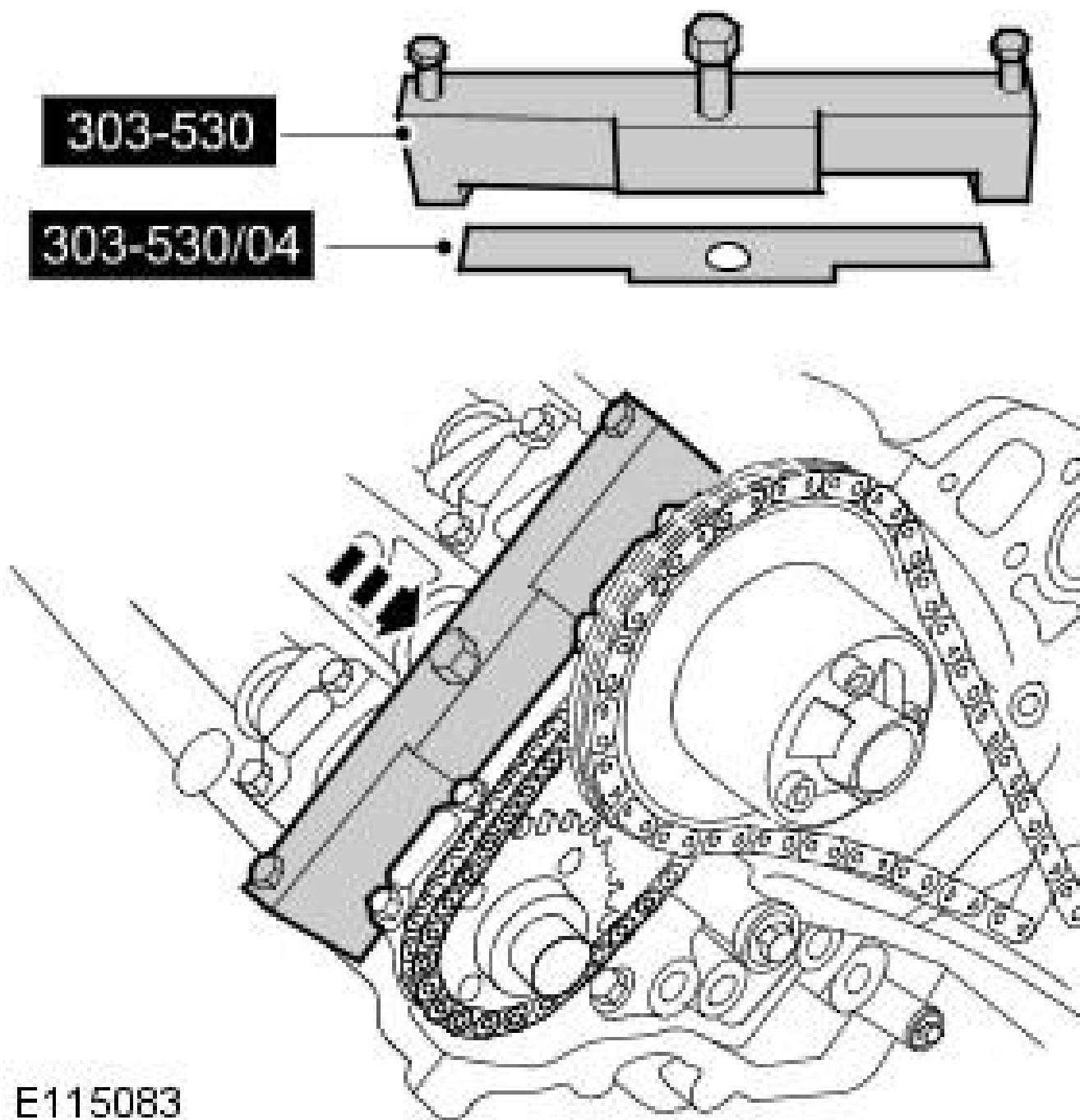
CAUTION: Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

CAUTION: The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

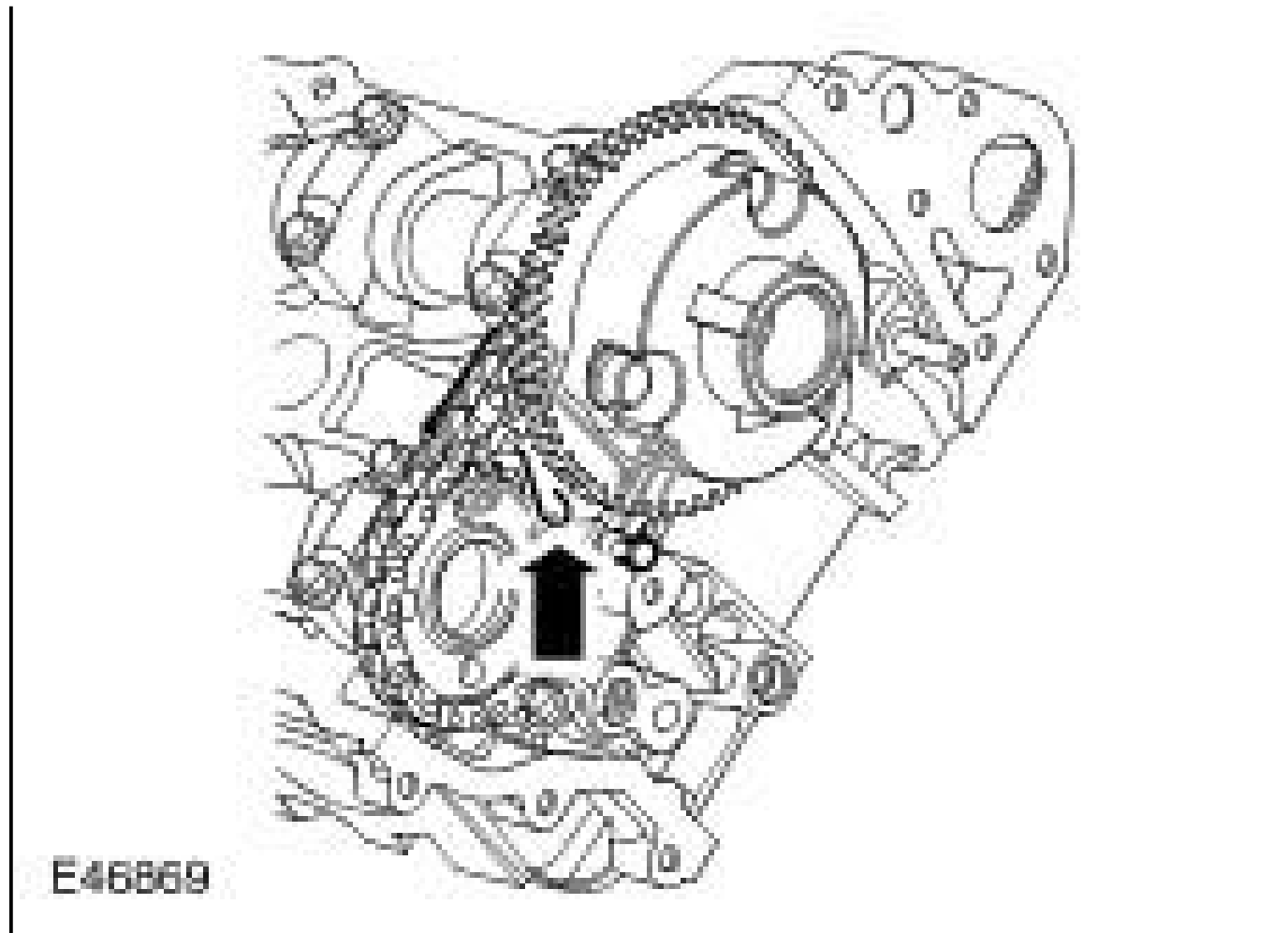
9. Install the special tool to the LH exhaust camshaft sprocket.
 - Tighten the intake camshaft sprocket retaining bolt to 120 Nm (88 lb.ft).
 - Tighten the exhaust camshaft retaining bolt to 120 Nm (88 lb.ft).



10. Install the LH VCT control solenoid housing.
 - Install the new O-ring seals.
 - Tighten the new bolts to 22 Nm (16 lb.ft).
 - Tighten the nut to 10 Nm (7 lb.ft).
11. Remove the special tools from the LH cylinder head.
12. Install the special tools to the RH cylinder head.
 - Install the 3 bolts.



13. Retain the RH secondary timing chain tensioner piston.
 - Using 1 mm diameter metal rod, retain the chain tensioner piston.



14. Install the RH secondary timing chain tensioner and the secondary timing chain to the camshaft sprockets.

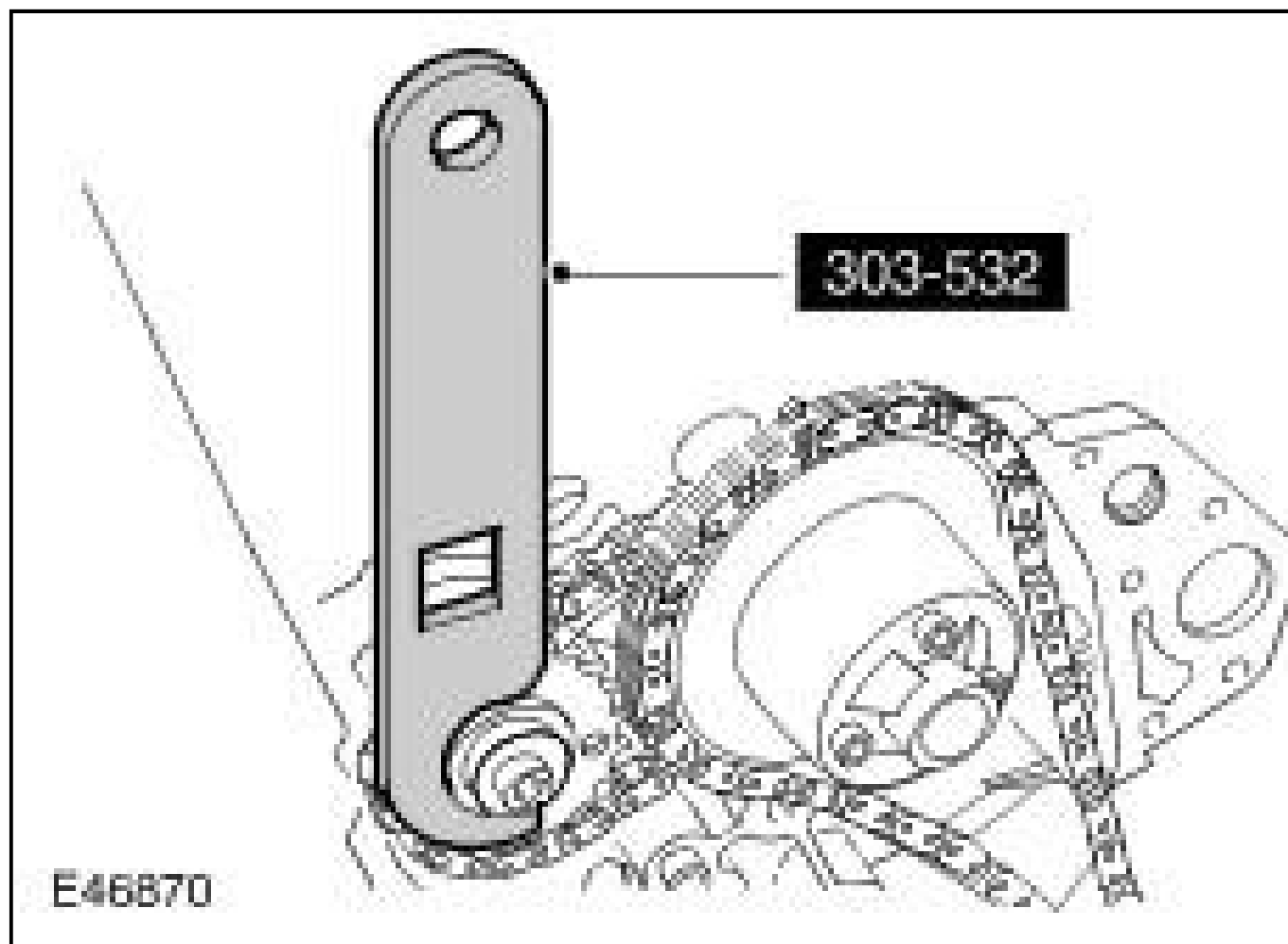
NOTE: **Lightly tighten the camshaft sprocket Torx bolts, the sprockets MUST be free to move.**

15. Install the RH secondary timing chain and sprockets to the camshafts.
- Install the sprocket retaining Torx bolts to the camshafts.
16. Install the RH secondary timing chain tensioner retaining bolts.
- Tighten the bolts to 12 Nm.
17. Tension the secondary timing chain.
- Remove the retaining rod.
18. Install the RH primary timing chain.
- Make sure the timing chain slack is on the tensioner side of the timing chain.
19. Install the RH primary timing chain tensioner guide.
- Tighten the bolts to 12 Nm.

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.

20. Install the RH primary timing chain tensioner.

- Using 3 mm diameter metal rod, retain the chain tensioner piston.
- Tighten the bolts to 12 Nm (9 lb.ft).
- Remove the retaining rod.



CAUTION: The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

CAUTION: Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

CAUTION: Make sure that new bolts are installed.

21. Install the special tool to the RH exhaust camshaft sprocket.
 - Tighten the intake camshaft sprocket retaining bolt to 120 Nm (88 lb.ft).
 - Tighten the exhaust camshaft retaining bolt to 120 Nm (88 lb.ft).
22. Install the RH VCT control solenoid housing.
 - Install the new O-ring seals.
 - Tighten the new bolts to 22 Nm (16 lb.ft).
23. Remove the special tools from the RH cylinder head.
24. Install the engine front cover. See **Engine Front Cover**.
25. Remove the crankshaft locking tool.
 - Remove the screw.
26. Install the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor** .
27. Connect the battery ground cable. Refer to **Specifications** .

INTAKE MANIFOLD

SPECIAL TOOLS

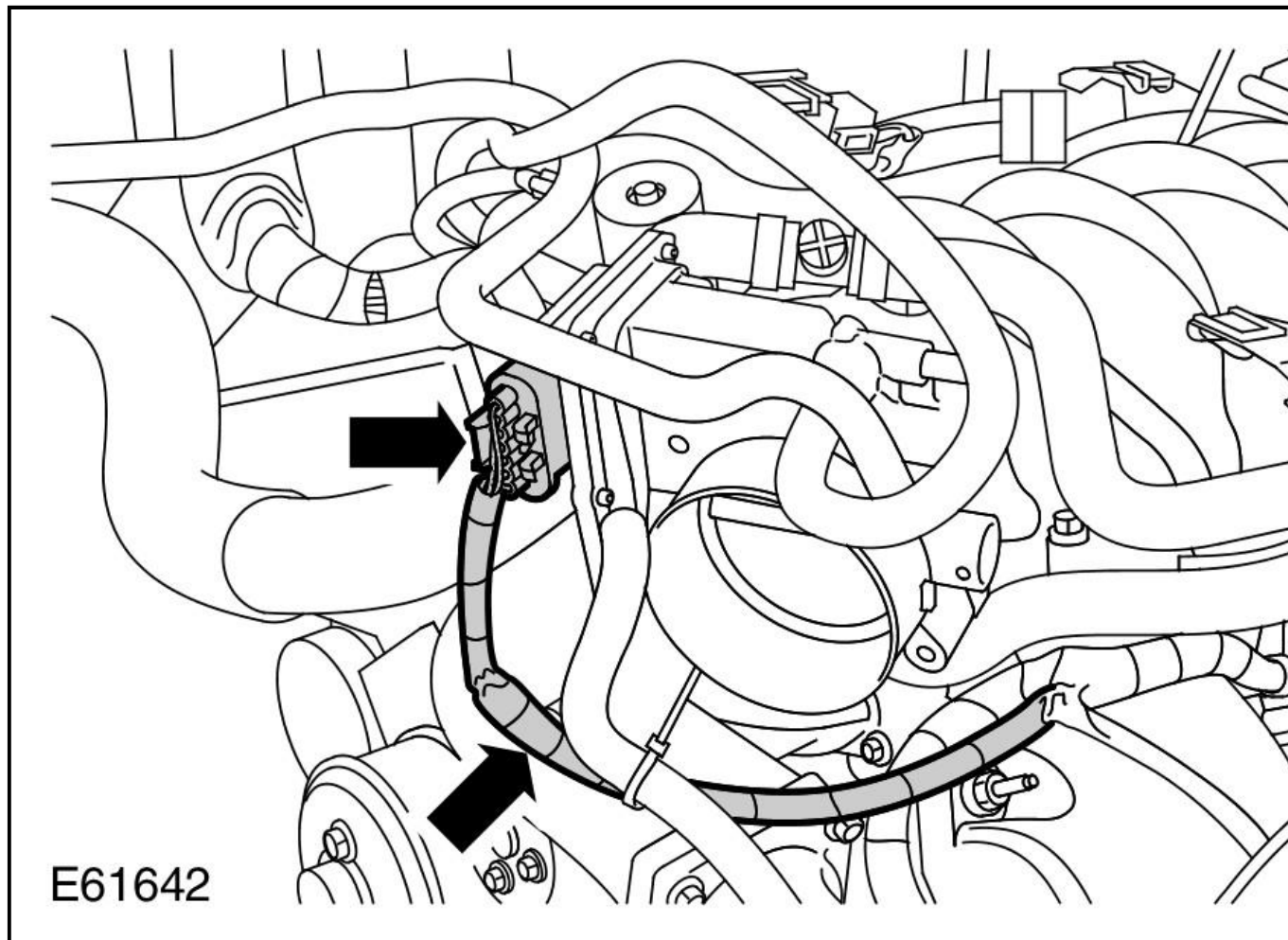
Tool Illustration	Tool Name	Tool Number
	Fuel spring lock decoupling tool	310-005

REMOVAL

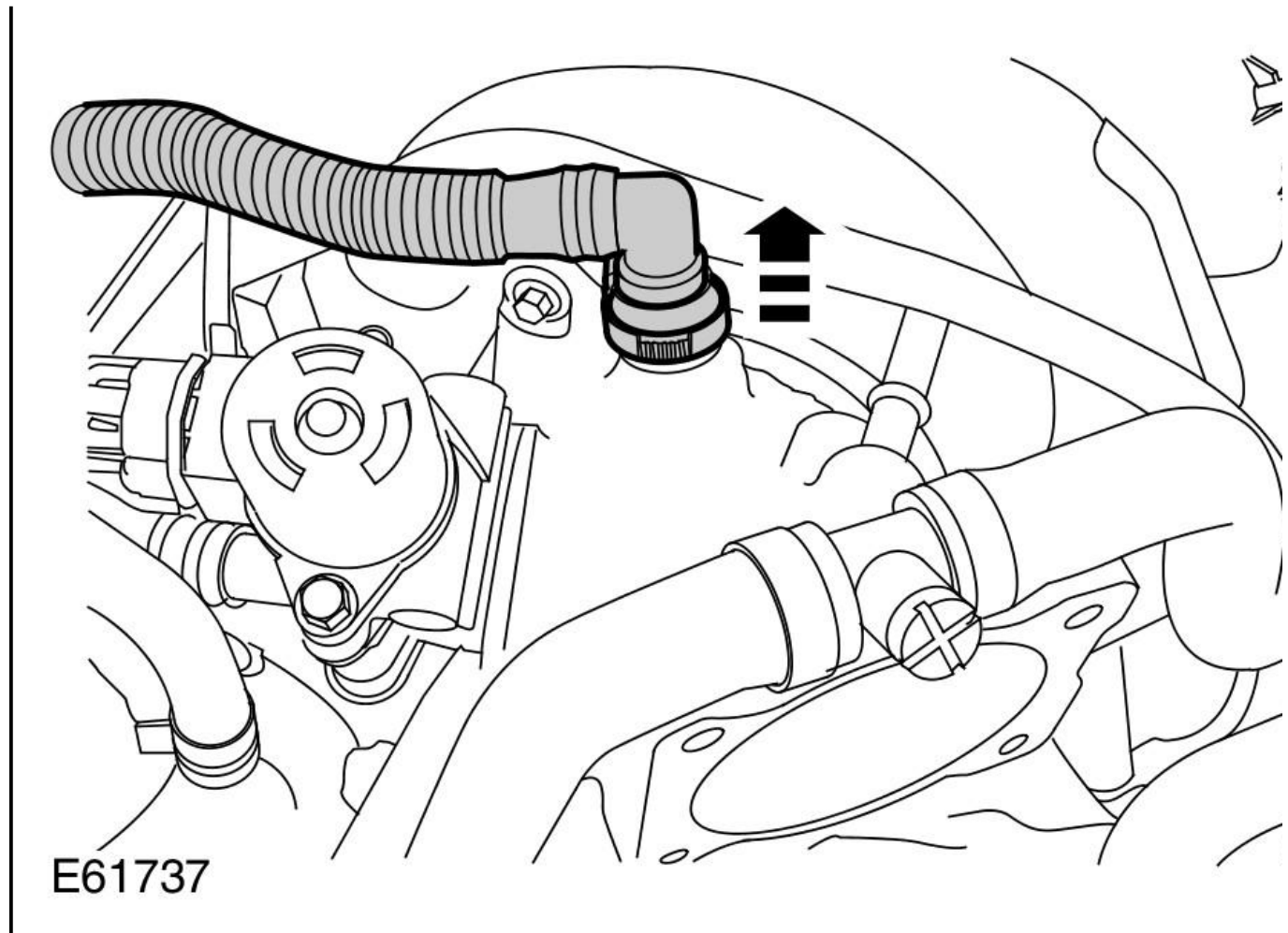
CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.

1. Disconnect the battery ground cable. Refer to **Specifications** .
2. Remove the plenum chamber. Refer to **Plenum Chamber** .
3. Remove the purge valve assembly. Refer to **Evaporative Emission Canister Purge Valve** .

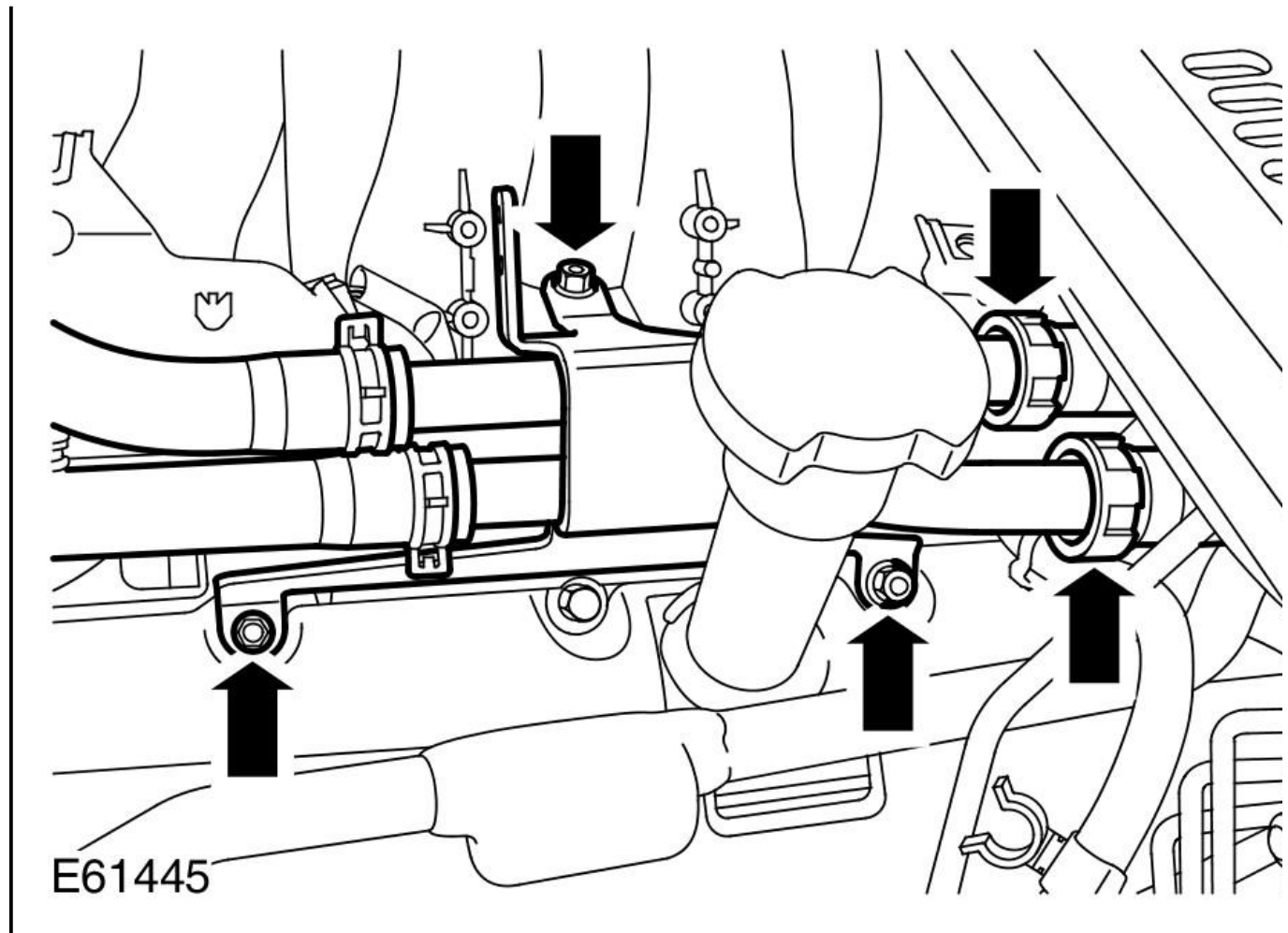
4. Release the throttle body. Refer to **Throttle Body Gasket** .
5. Disconnect the throttle body electrical connector.
 - Position the throttle body aside for access.



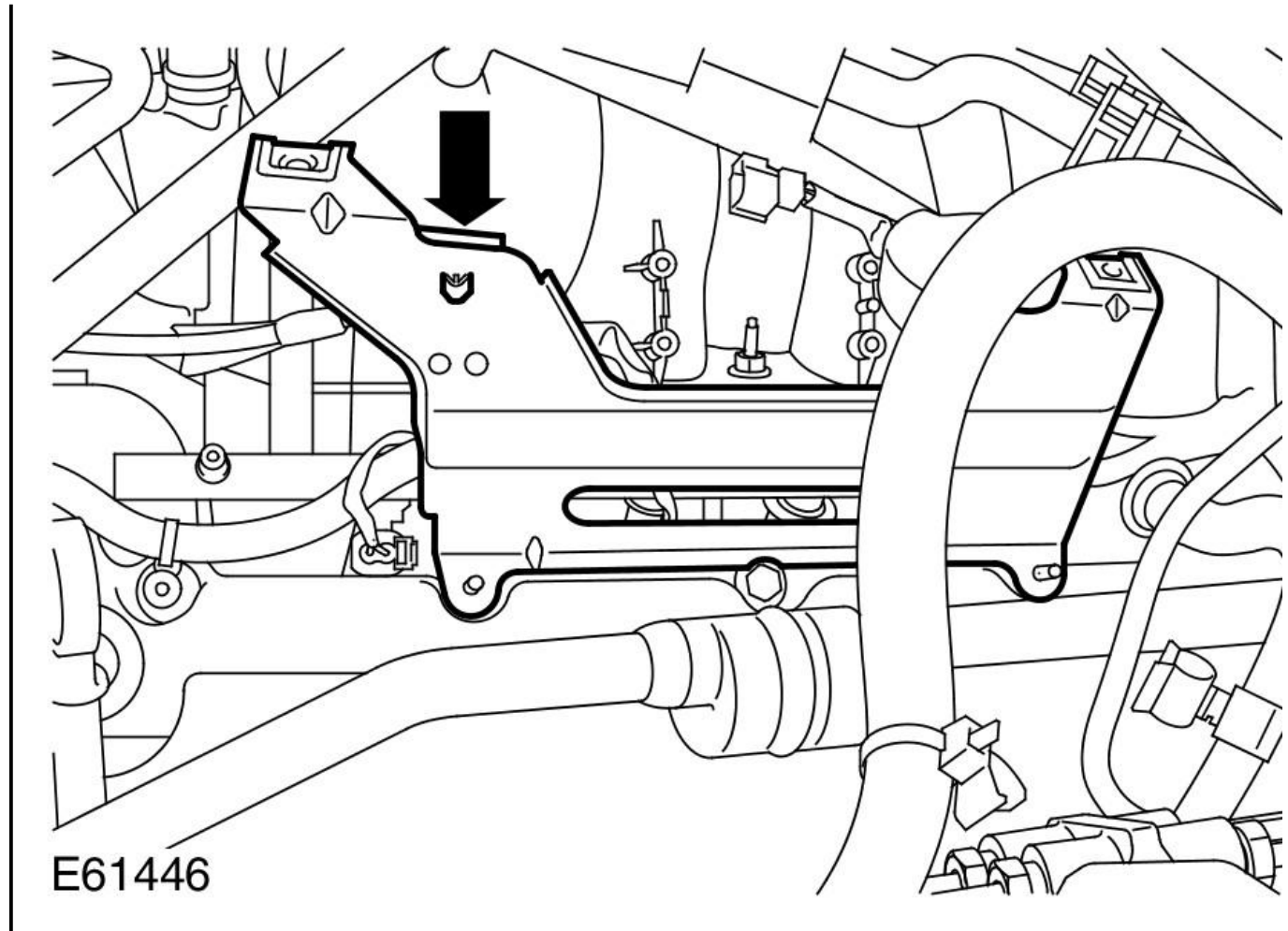
6. Disconnect the crankcase vent hose.
 - Position aside.



7. Disconnect the 2 heater coolant hoses.
 - Release the 2 clips.
 - Clamp the relevant hose, to minimize coolant loss.
 - Position an absorbent cloth to collect fluid spillage.
8. Release the heater hose support bracket.
 - Remove the 3 nuts.
 - Tie the bracket aside.

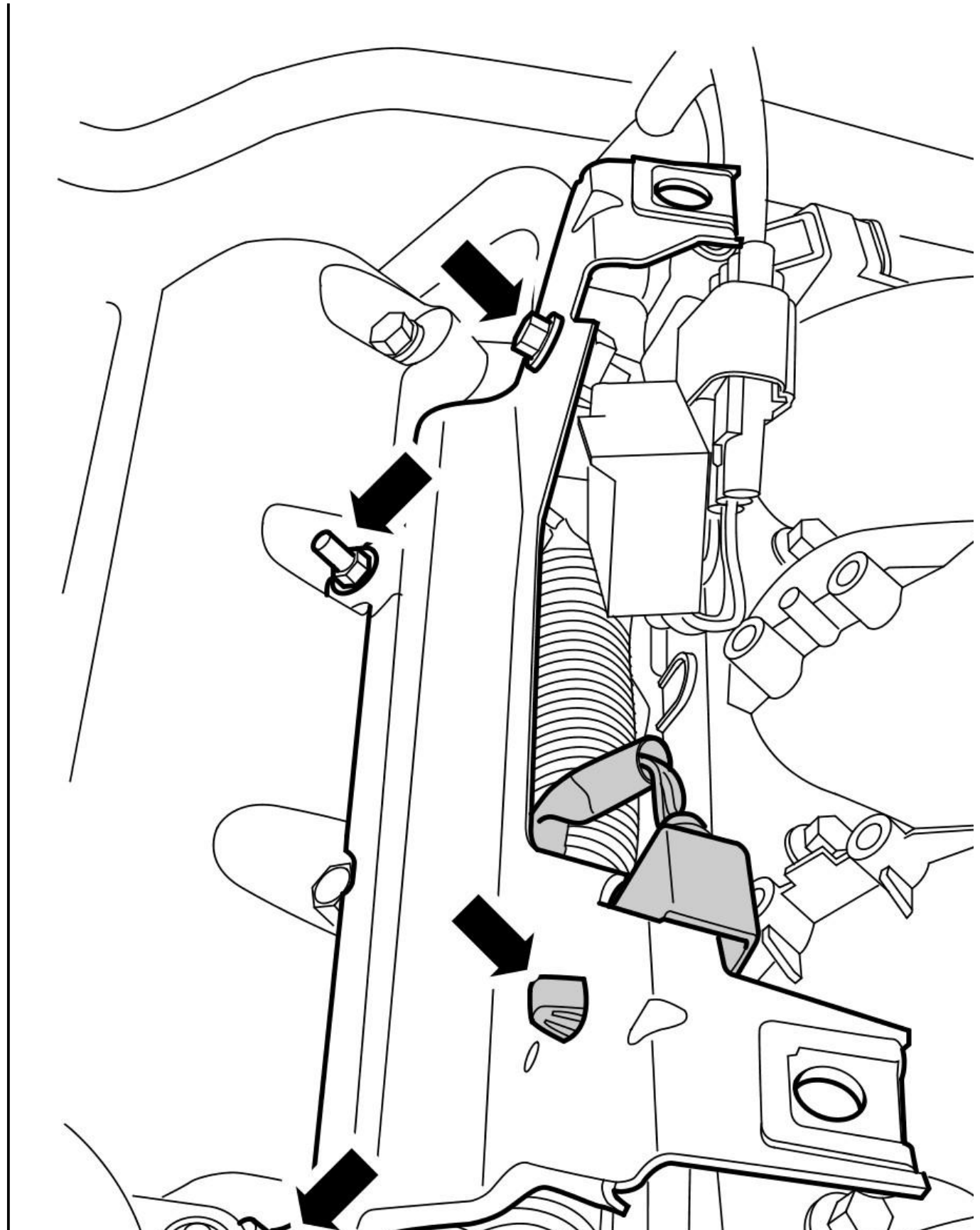


9. Remove the LH engine cover bracket.
 - Release the electrical connector.

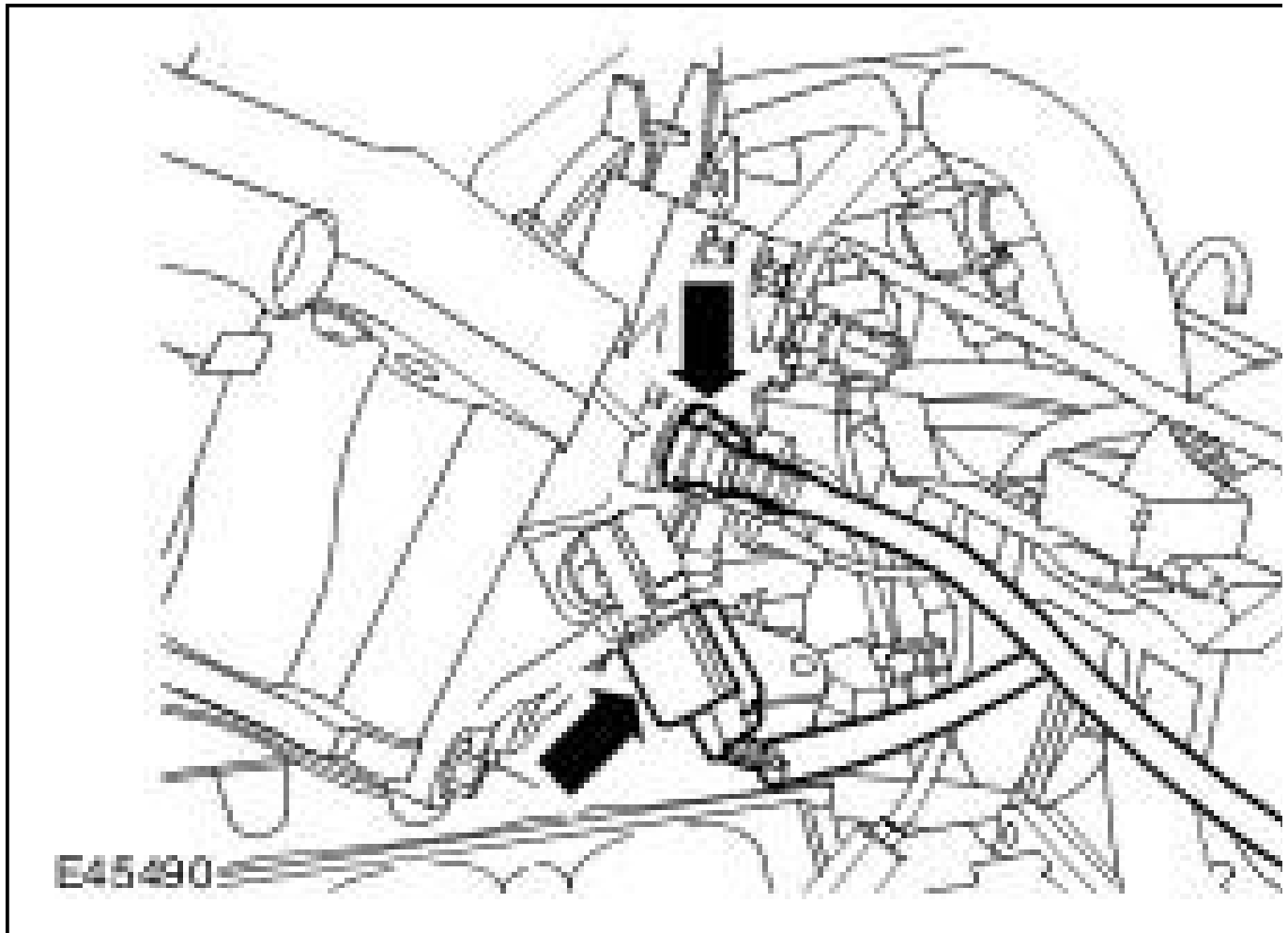


10. Remove the RH engine cover bracket.

- Remove the 2 nuts.
- Remove the bolt.
- Release the electrical connector.

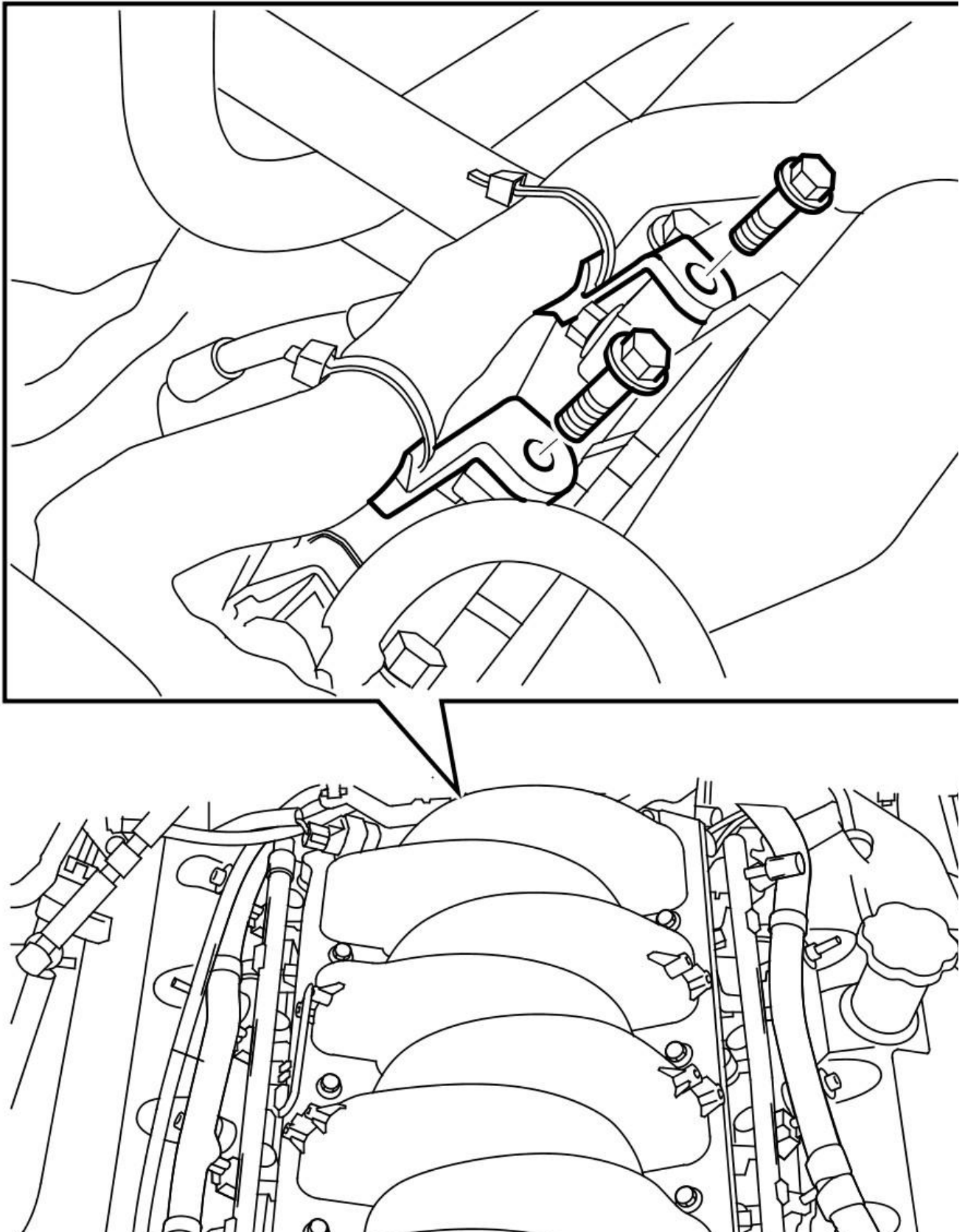


11. Release the EGR valve.
 - Remove the 2 bolts.
 - Discard the gasket.
12. Disconnect the manifold absolute pressure (MAP) sensor electrical connector.



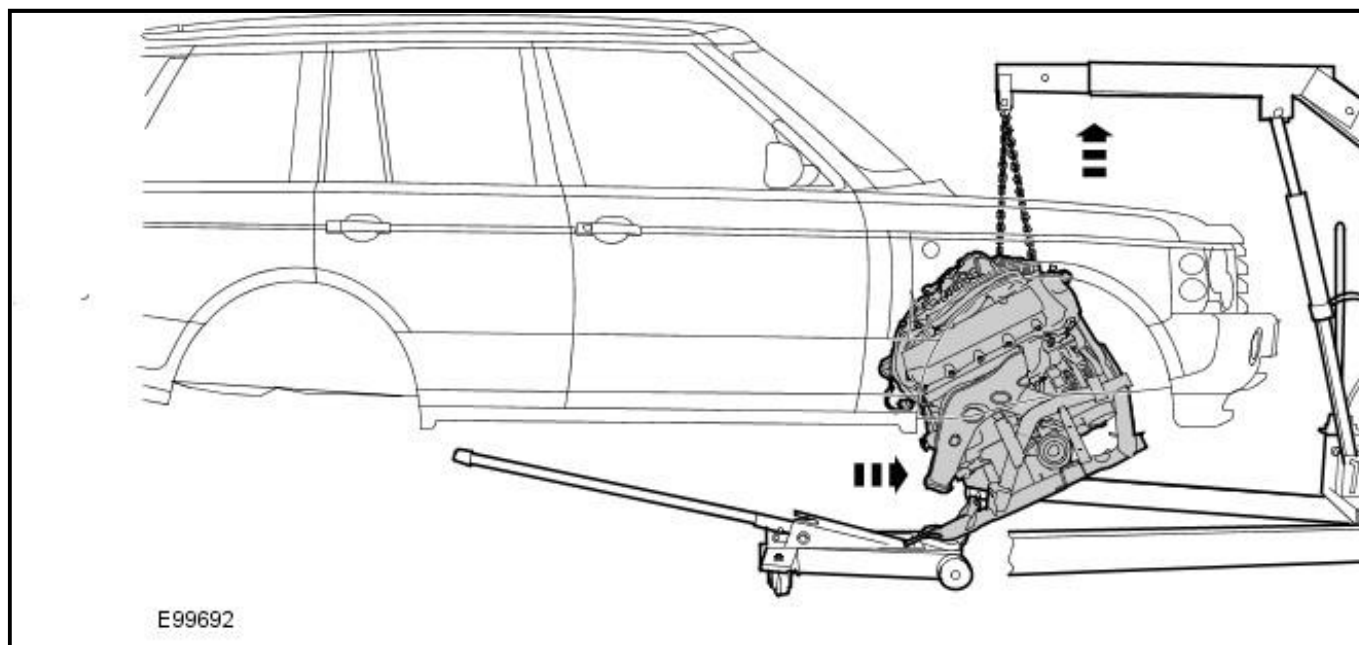
13. Disconnect the brake booster vacuum hose from the intake manifold.

14. Disconnect the fuel temperature sensor electrical connector.
15. Release the wiring harness bridge.
 - Remove the 2 bolts.



16. Release the engine wiring harness clips.

- Release the 4 clips.

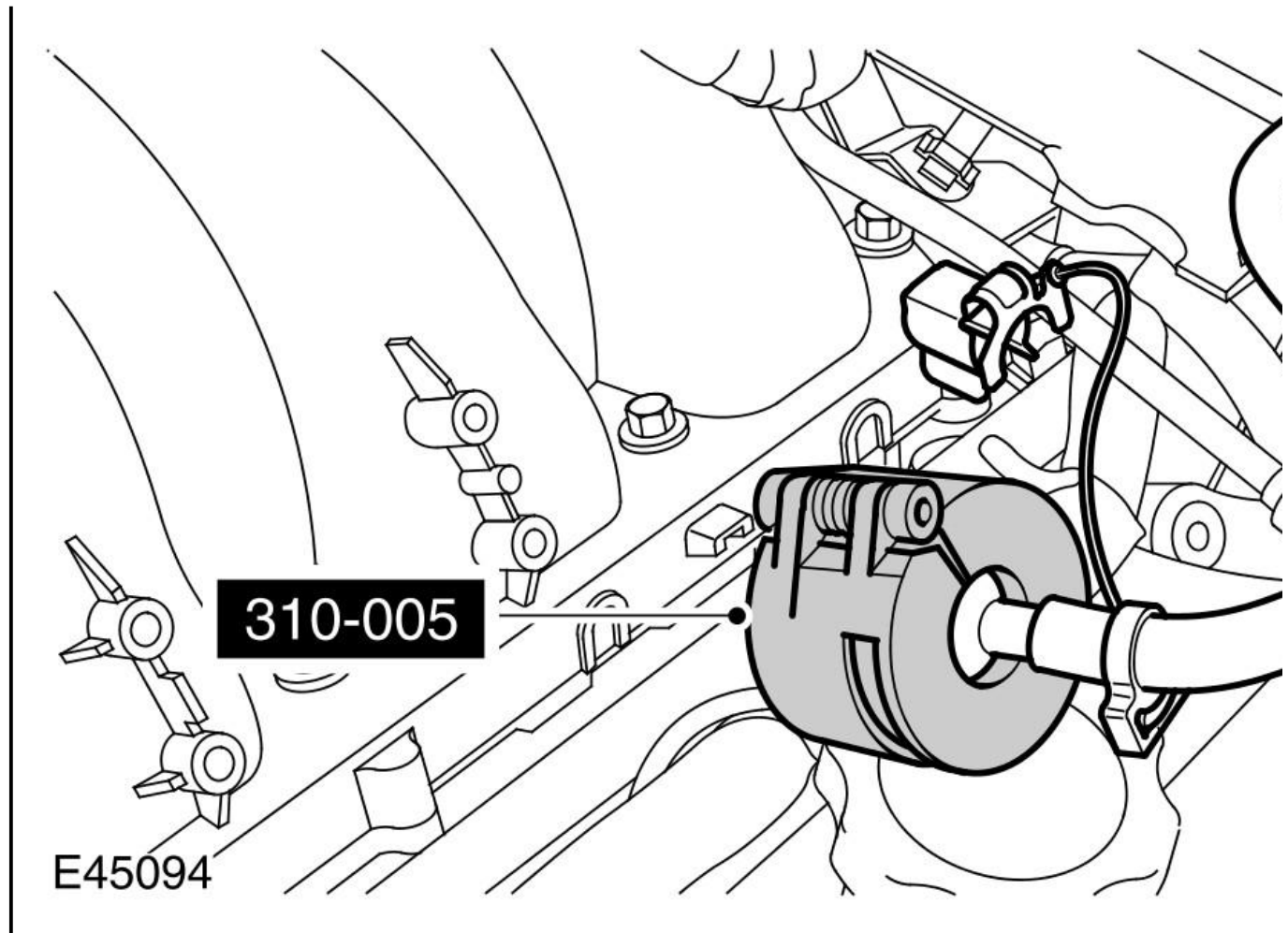


17. Disconnect the fuel injector electrical connectors.

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

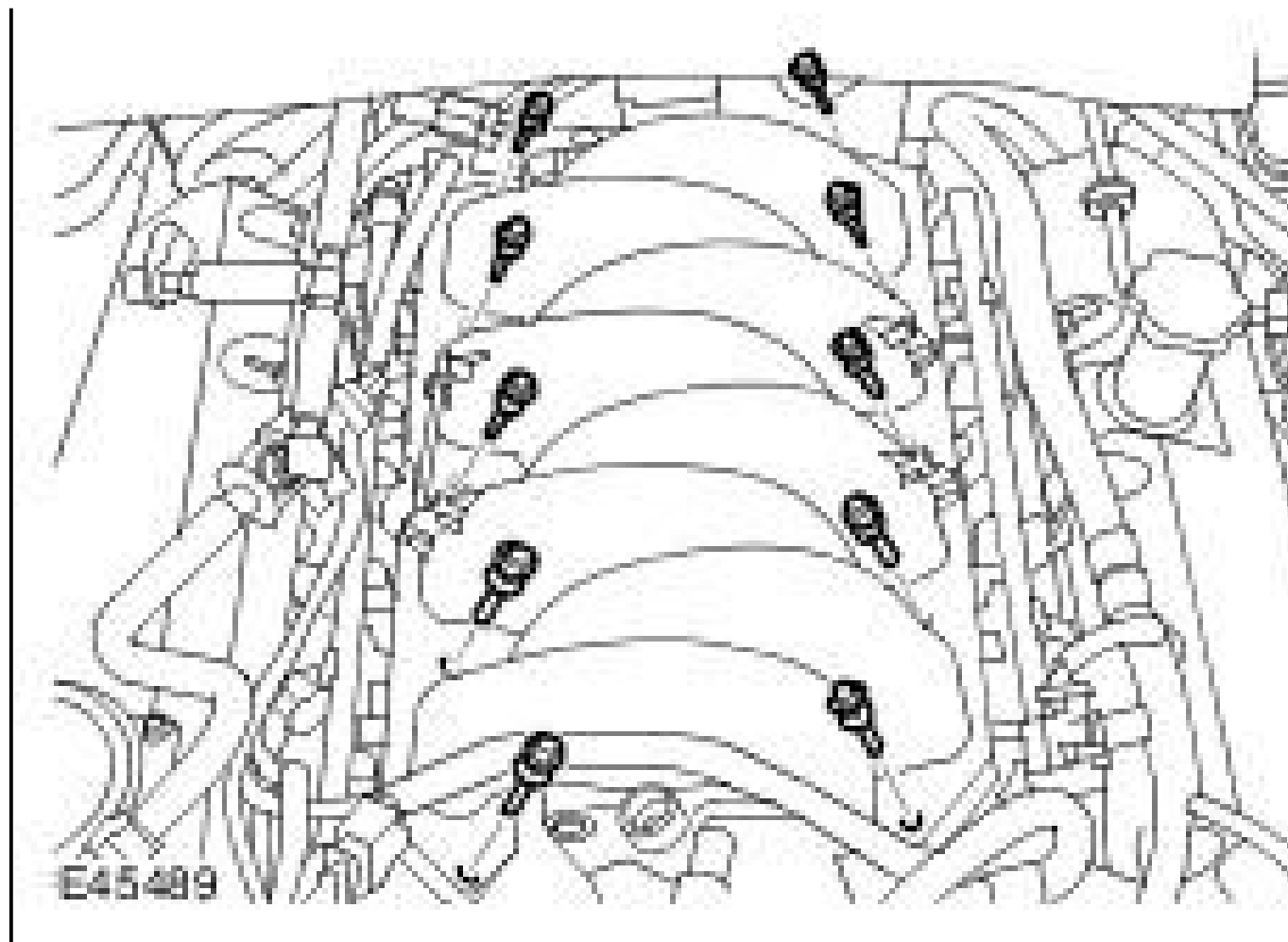
18. Using the special tool, disconnect the fuel line.

- Remove the clip.



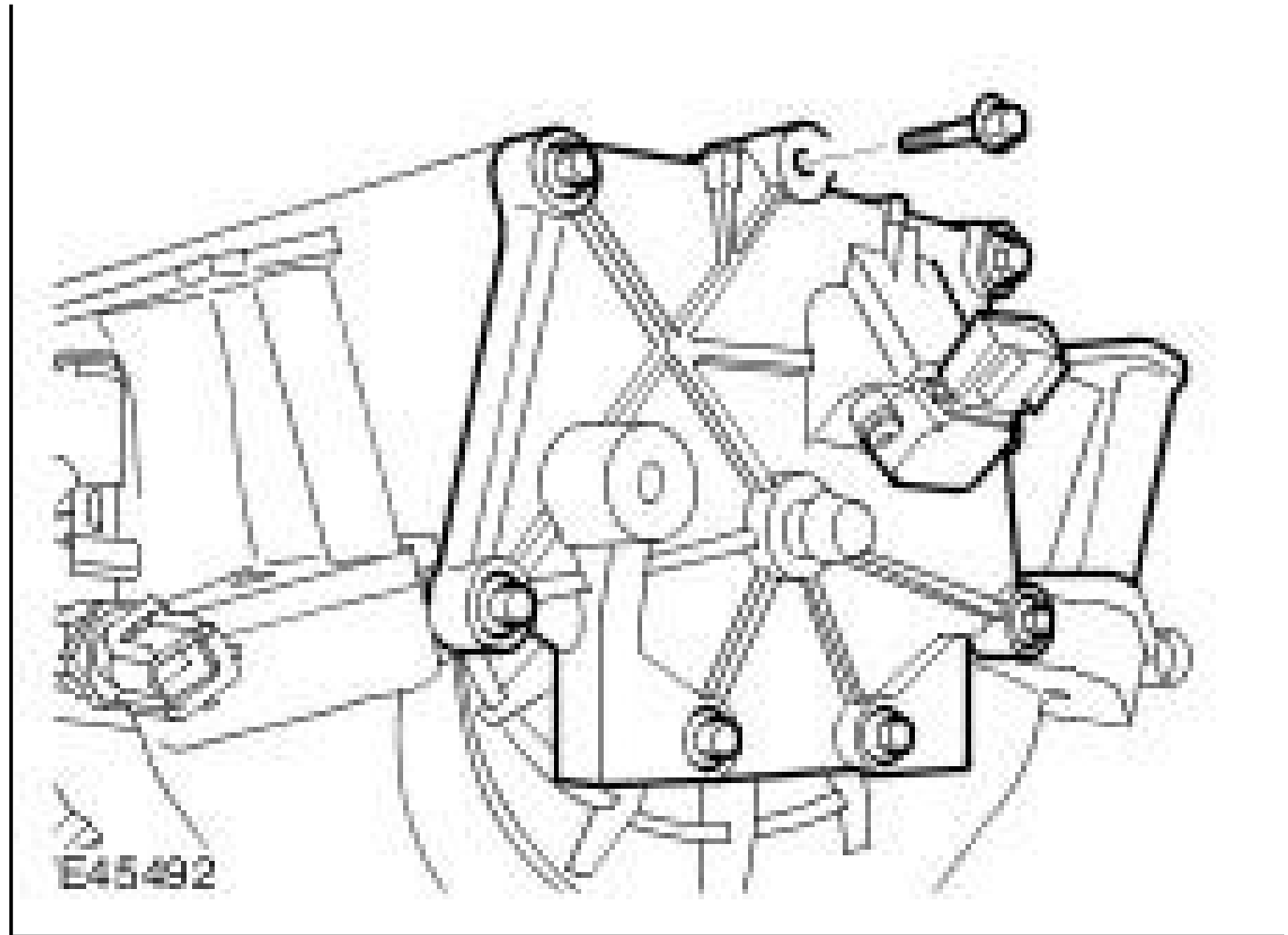
19. Remove the intake manifold assembly.

- Remove the 10 bolts.
- Discard the 2 gaskets.

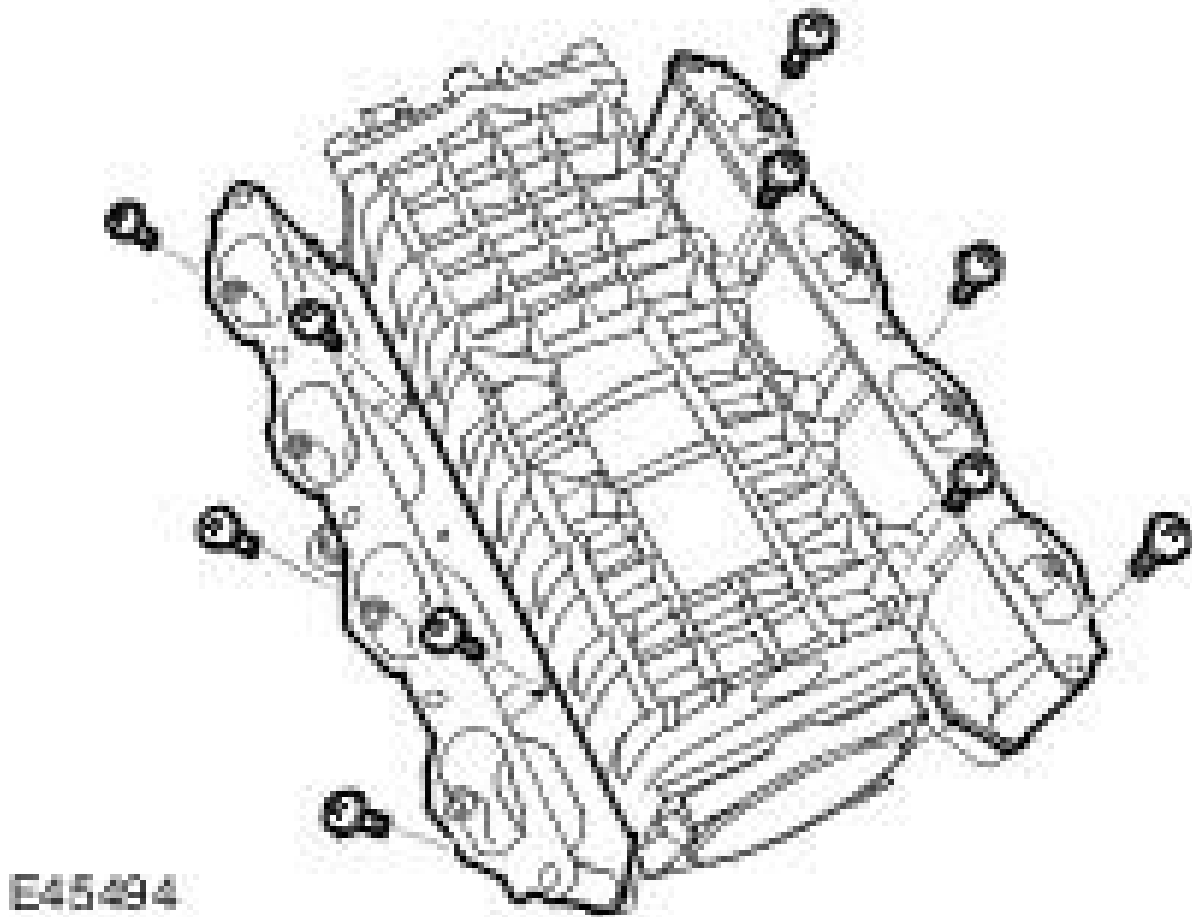


NOTE: Do not disassemble further if the component is removed for access only.

20. Remove the intake manifold casting.
 - Disconnect the vacuum hose from the intake manifold.
 - Remove the 4 bolts.
21. Remove the NVH pad from the RH side of the intake manifold.
22. Remove the intake manifold MAP sensor housing.
 - Remove the 7 bolts.



23. Remove the fuel rail.
 - Remove the 4 Torx bolts.
 - Release the fuel injectors.
 - Remove and discard the fuel injector O-ring seals.
24. Remove the fuel injector housings.
 - Remove the 10 Torx screws.
 - Release the fuel injector housings and discard the gaskets.



INSTALLATION

1. Install the fuel injector housings.
 - Clean the component mating faces.
 - Install the gaskets.
 - Install the Torx screws.
2. Install the fuel rail.
 - Clean the component mating faces.
 - Install fuel injector O-ring seals.
 - Lubricate the O-ring seals with clean engine oil.
 - Tighten the 4 Torx bolts to 10 Nm (7 lb.ft).
3. Install the intake manifold MAP sensor housing.
 - Clean the component mating faces.
 - Tighten the 7 bolts to 10 Nm (7 lb.ft).
4. Install the intake manifold casting.
 - Clean the component mating faces.

- Install the 4 bolts and tighten to 10 Nm (7 lb.ft).
- 5. Install the NVH pad to the RH side of the intake manifold.
- 6. Install the intake manifold assembly.
 - Install the gaskets.
- 7. Install the bolts.
 - Evenly and progressively tighten the bolts to 20 Nm (15 lb.ft).
- 8. Connect the MAP sensor electrical connector.
- 9. Connect the fuel temperature sensor electrical connector.
- 10. Connect the brake booster vacuum hose.
- 11. Connect the fuel injector electrical connectors.
- 12. Secure the engine wiring harness.
 - Position and secure the clips.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
- 13. Install the EGR valve.
 - Install a new gasket.
 - Tighten the bolts to 10 Nm (7 lb.ft).

WARNING: After carrying out repairs, the fuel system must be checked visually for leaks. Failure to follow this instruction may result in personal injury.

- 14. Connect the fuel line to the fuel rail.
 - Clean the component mating faces.
 - Position the fuel pipe into clips.
- 15. Install the engine cover mounting brackets.
 - Tighten the nuts to 6 Nm (4 lb.ft).
 - Attach the wiring harness connector blocks to the brackets.
- 16. Install the heater hose support bracket.
 - Tighten the nuts to 10 Nm (7 lb.ft).
- 17. Connect the heater coolant hoses.
 - Remove the hose clamps.
- 18. Connect the crankcase vent hoses.
 - Clean the component mating faces.
- 19. Install the throttle body. Refer to **Throttle Body Gasket** .
- 20. Connect the throttle body electrical connector.
- 21. Install the purge valve. Refer to **Evaporative Emission Canister Purge Valve** .
- 22. Install the plenum chamber. Refer to **Plenum Chamber** .
- 23. Connect the battery ground cable. Refer to **Specifications** .

24. Check and top-up the coolant if required.

EXHAUST MANIFOLD LH

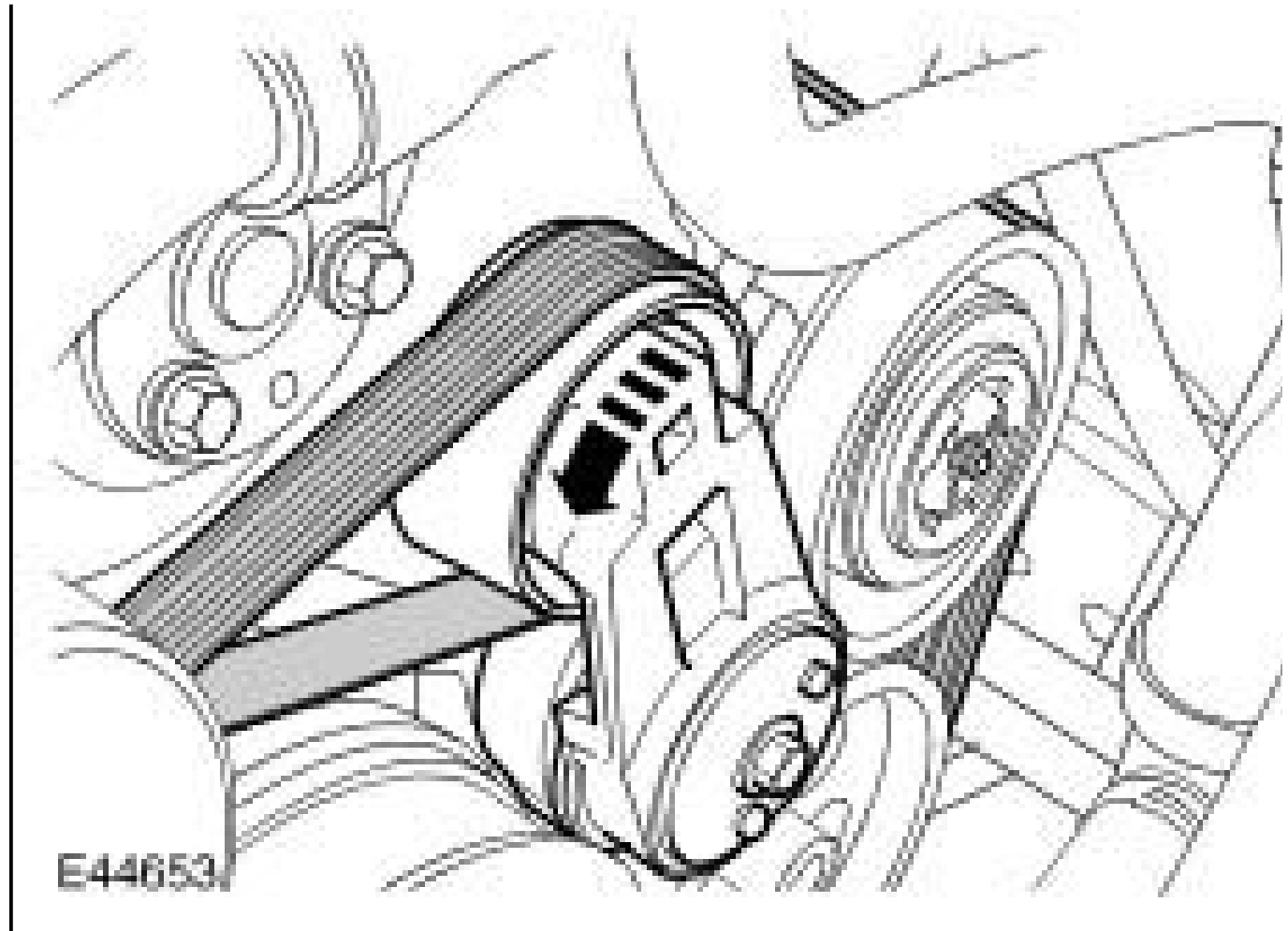
REMOVAL

ALL VEHICLES

1. Disconnect the battery ground cable. Refer to Specifications .

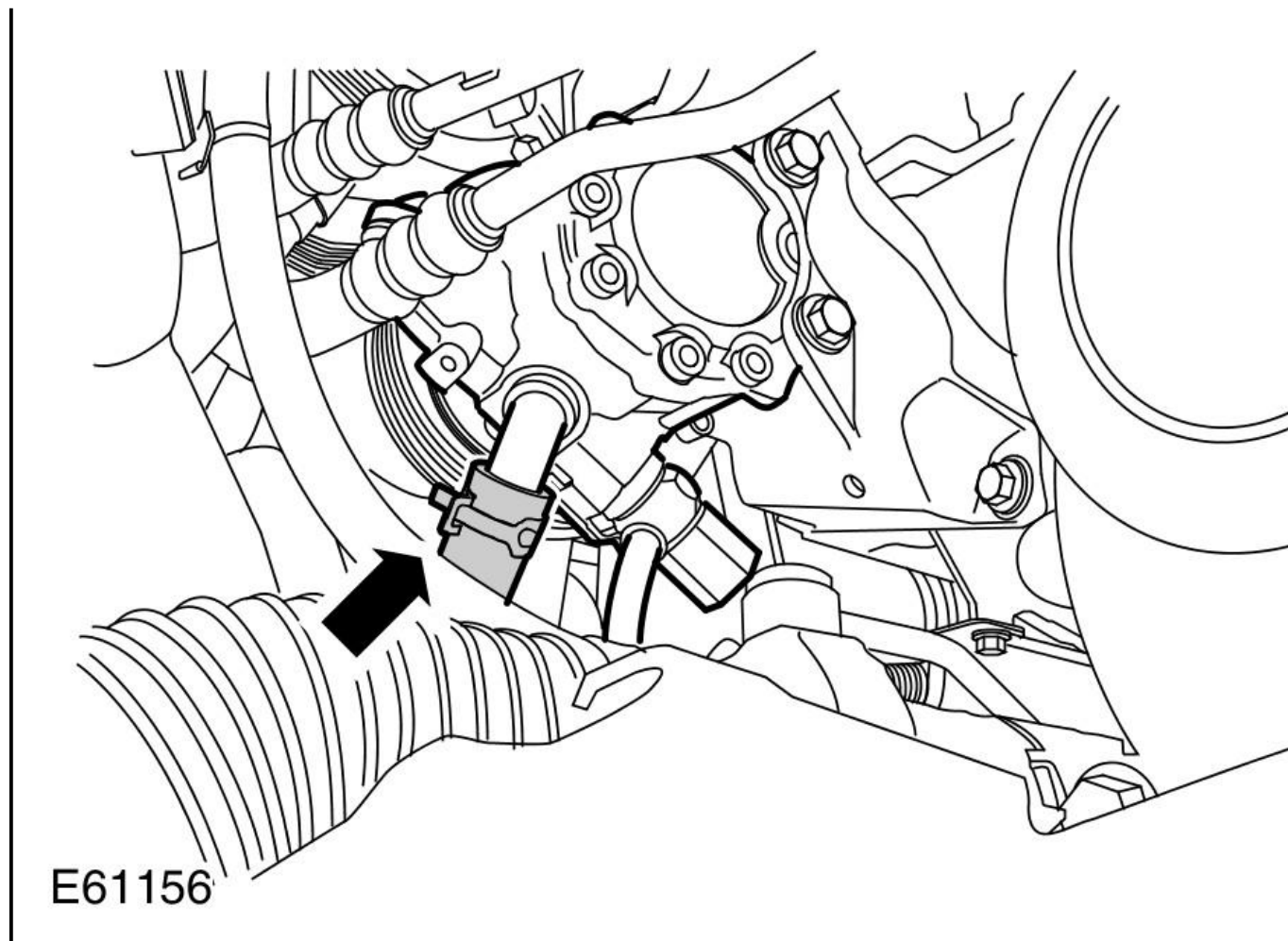
WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the exhaust system. Refer to Exhaust System .
4. Remove the engine undershield. Refer to Engine Undershield .
5. Remove the RH air cleaner assembly. Refer to Air Cleaner .
6. Remove the cooling fan and shroud. Refer to Cooling Fan .
7. Remove the LH front wheel.
8. Release the accessory drive belt.
 - Rotate the tensioner assembly counter-clockwise.
 - Release the power steering pump pulley.

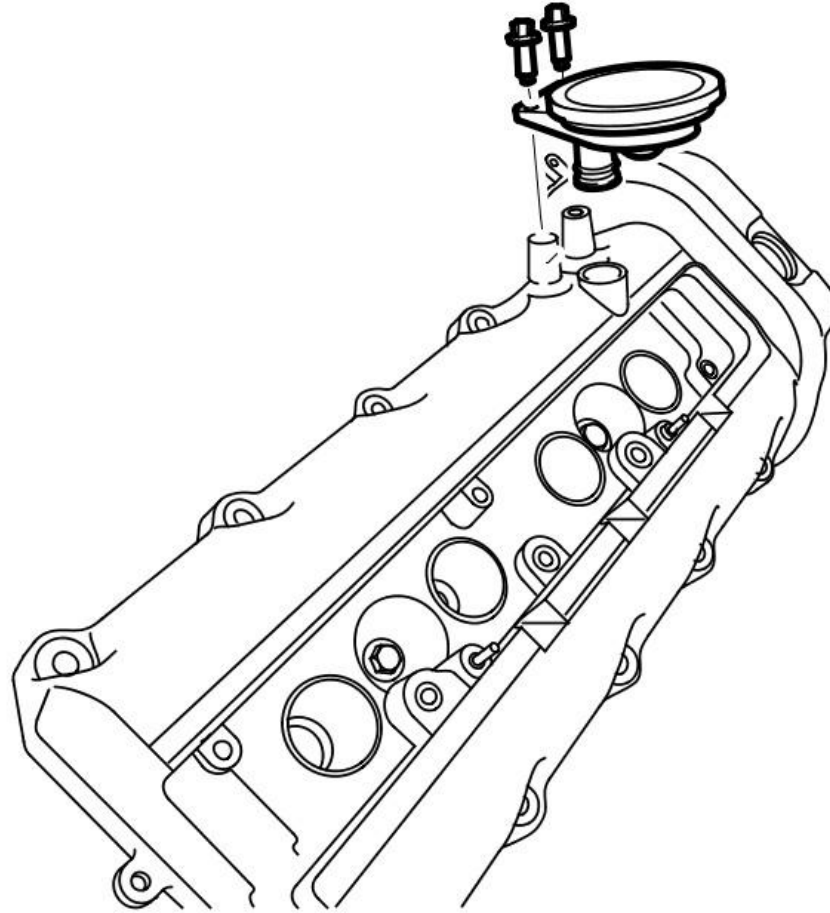


CAUTION: Always plug any open connections to prevent contamination.

9. Disconnect the low pressure line.
 - Release the clip.
 - Allow the fluid to drain into a container.

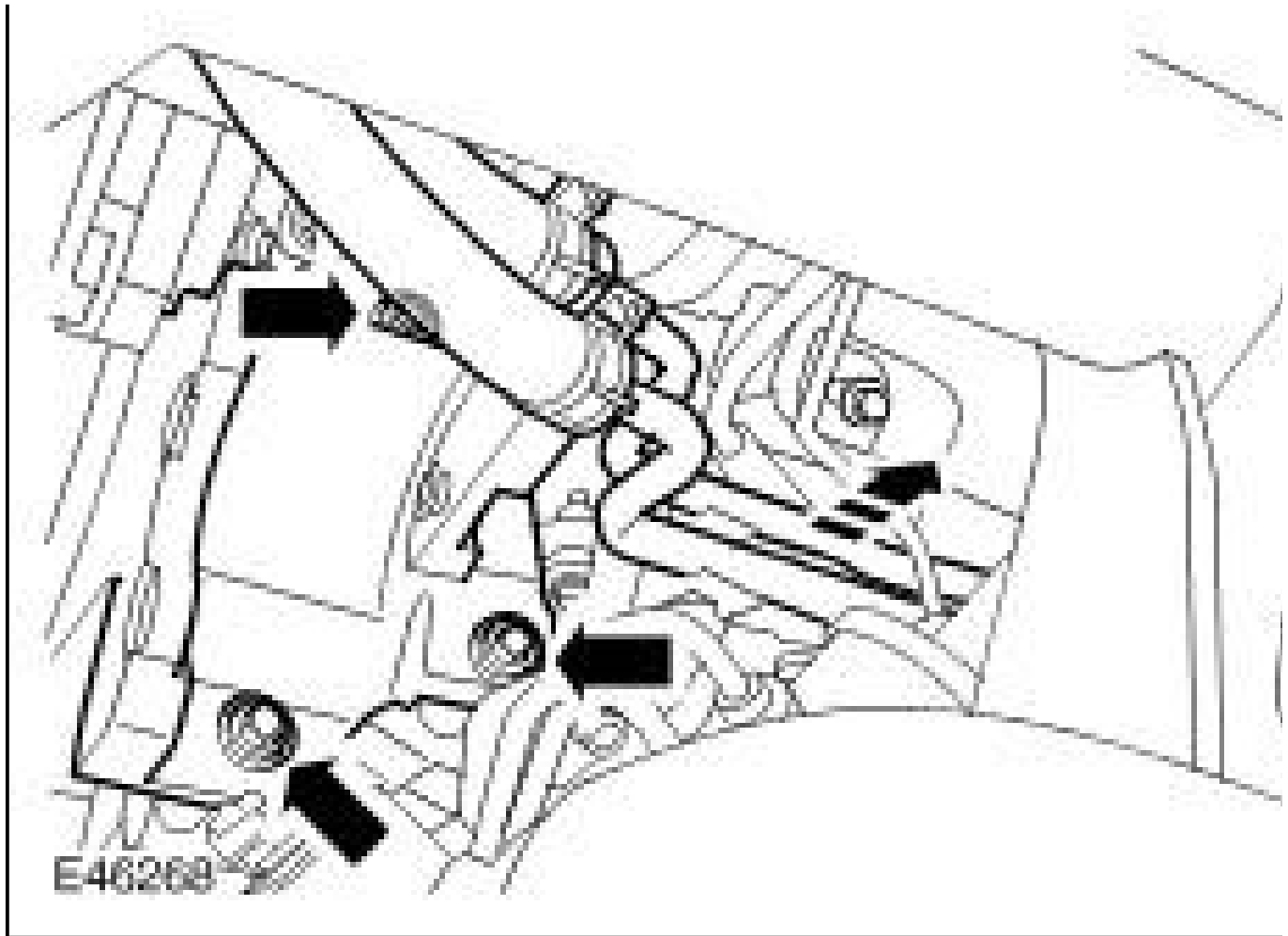


10. Disconnect the high pressure line.
 - Remove and discard both O-ring seals.
11. Remove the accessory drive belt tensioner.
 - Remove the bolt.



E46678

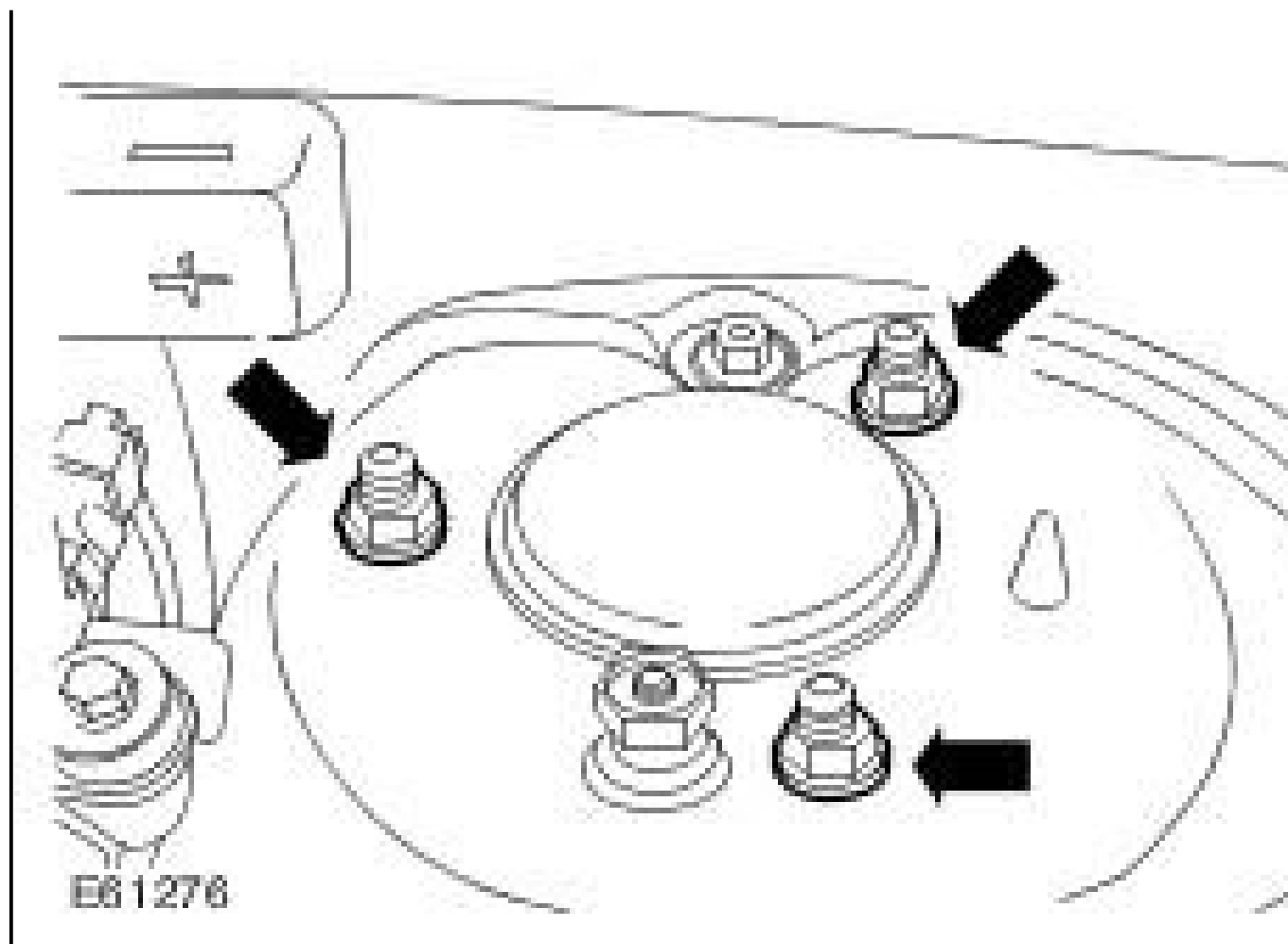
12. Release the transmission cooler pipe clips.
13. Remove the power steering pump mounting bracket.
 - Remove the 3 bolts.



CAUTION: Always plug any open connections to prevent contamination.

14. Disconnect the refrigerant lines from the A/C compressor.

- Remove the 2 bolts.
- Remove and discard the O-ring seal.



15. Disconnect the A/C clutch electrical connector.



NOTE: **1 A/C compressor bolt will remain captive until the mounting bracket is removed.**

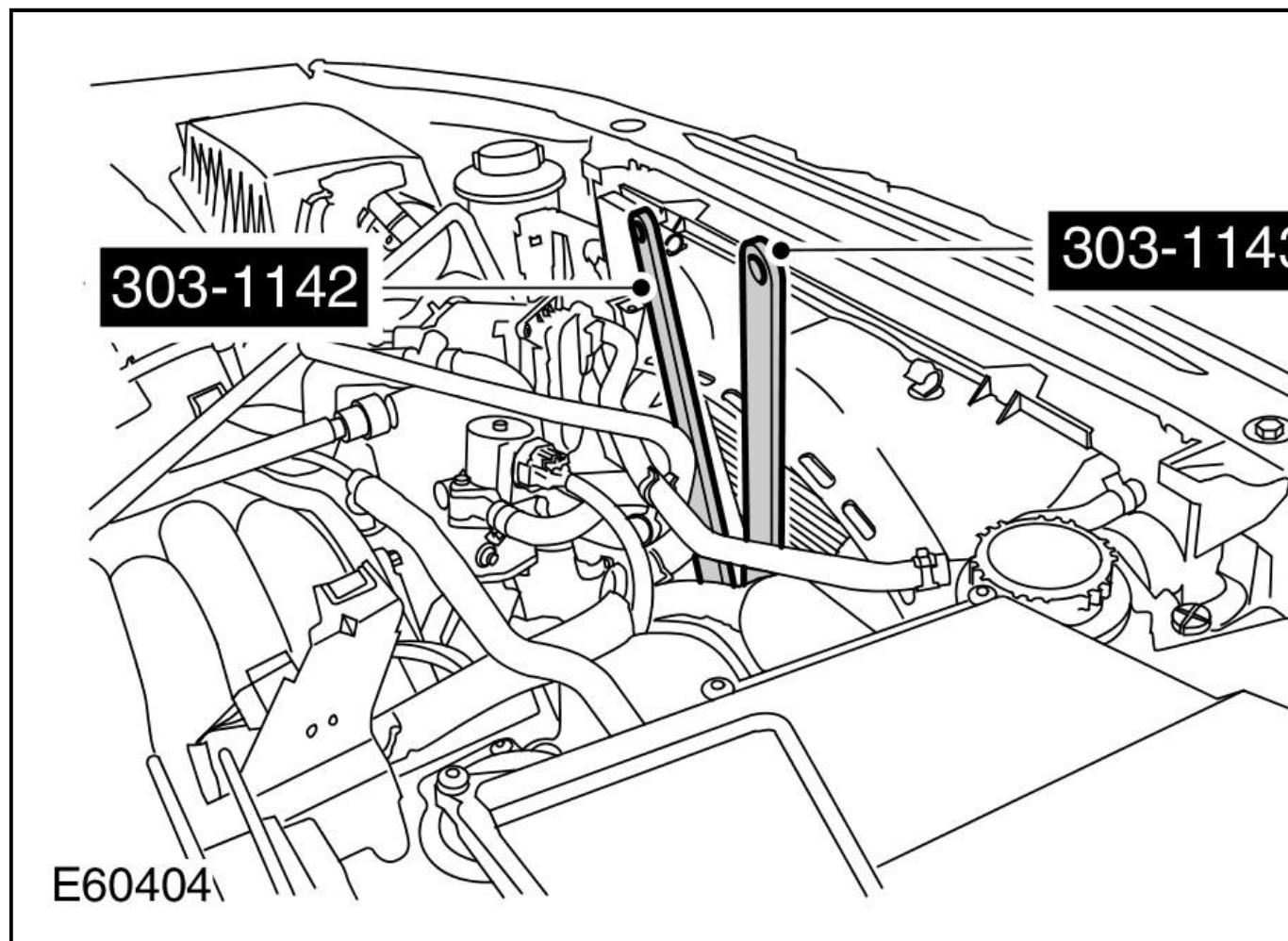
16. Release the A/C compressor.

- Fully loosen the upper front bolt.
- Remove the remaining 2 bolts.



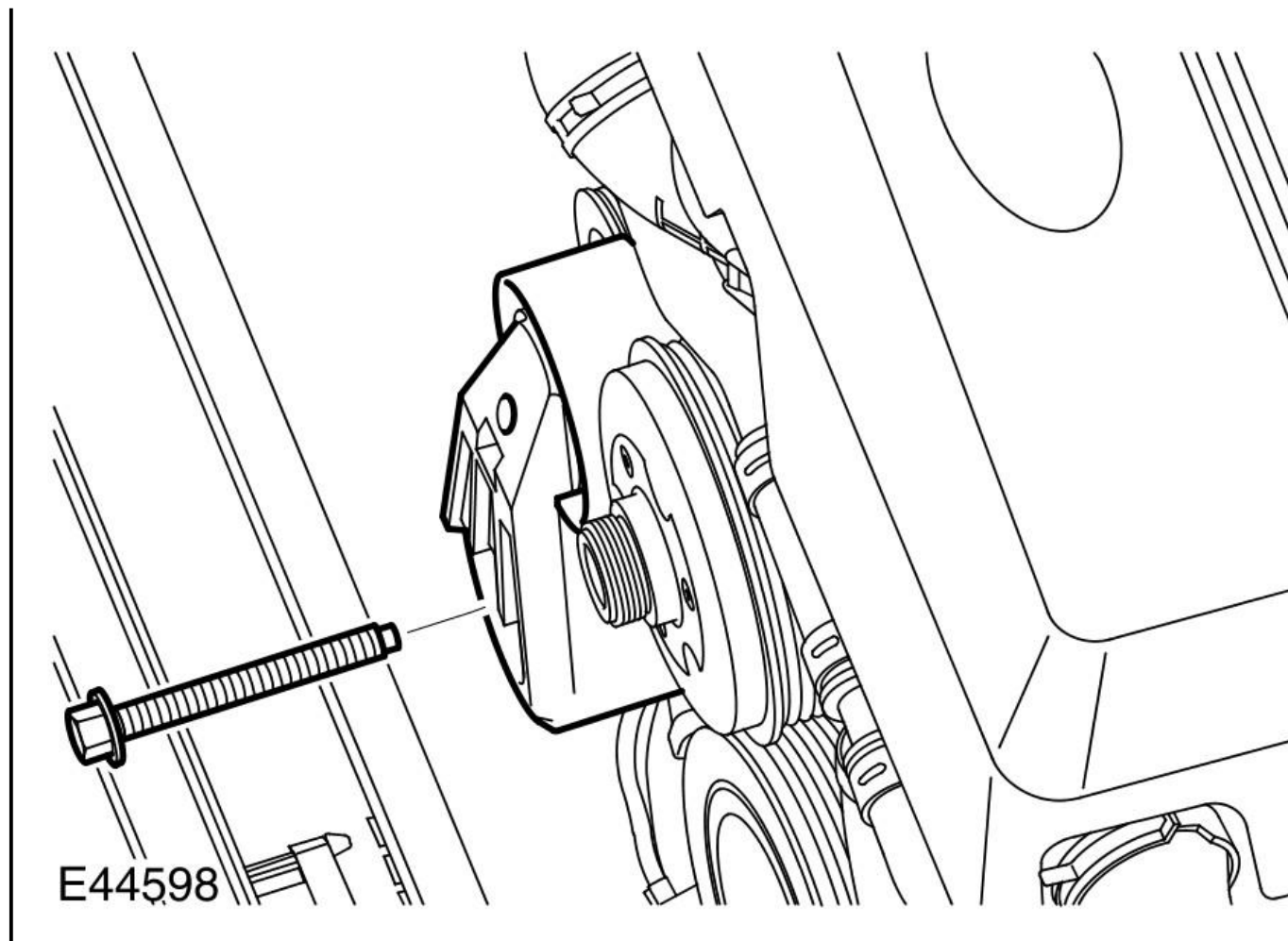
17. Remove the A/C compressor mounting bracket and the A/C compressor.

- Remove the 2 bolts.



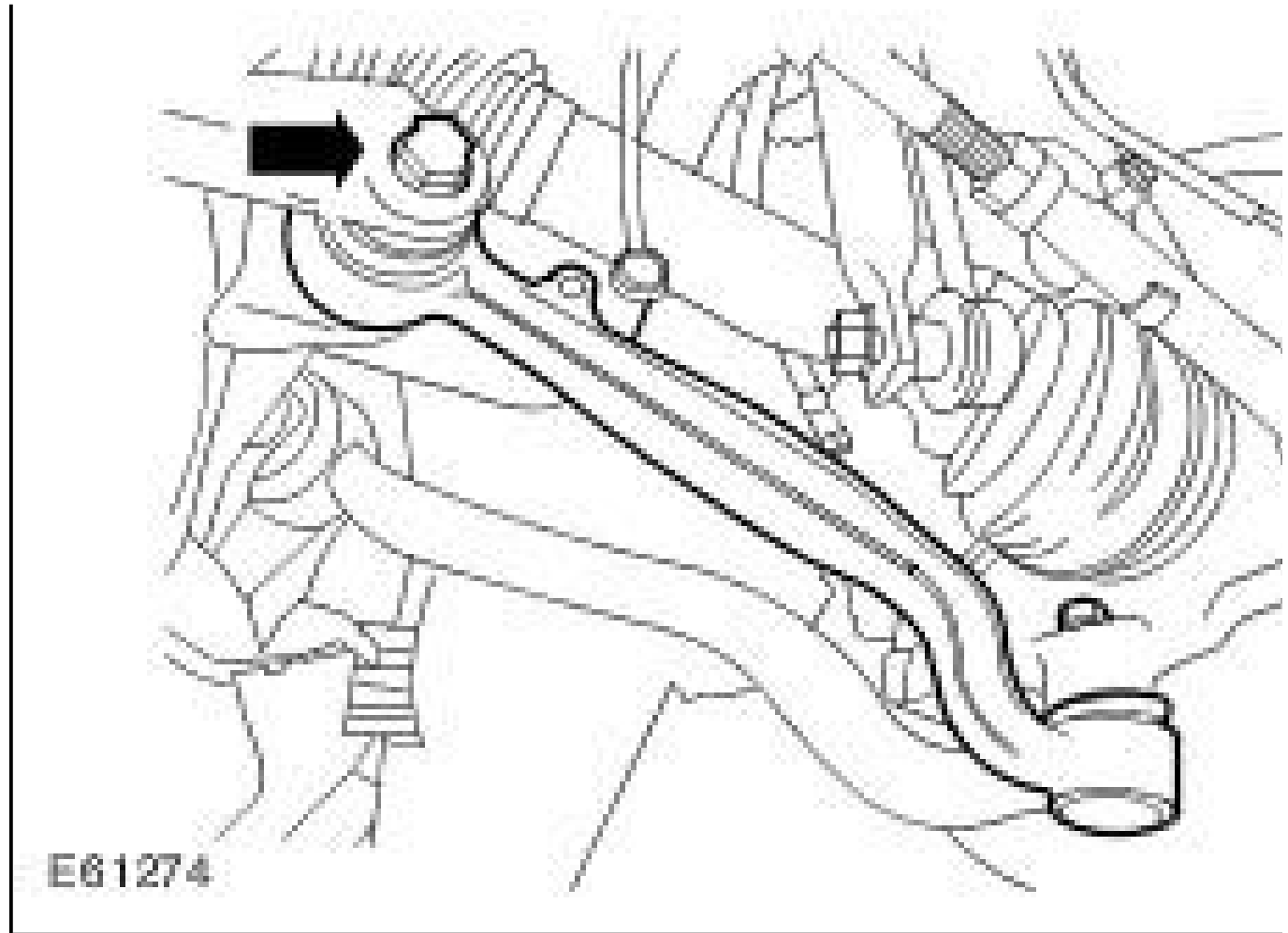
18. Remove the engine compartment LH heat shield.

- Remove the 2 nuts.
- Remove the 2 screws.

**LEFT-HAND DRIVE VEHICLES**

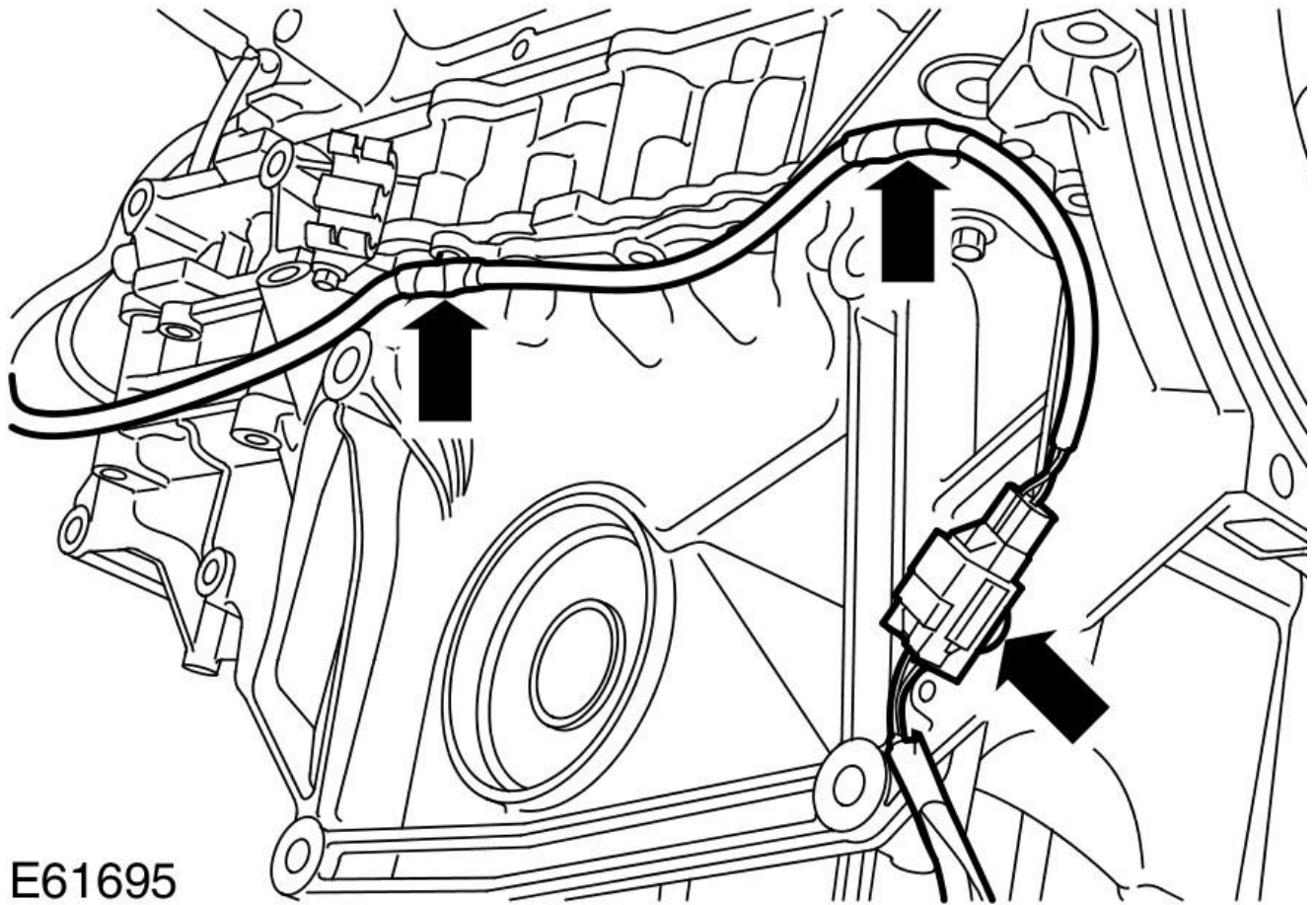
CAUTION: Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.

19. Disconnect the lower steering column from the steering gear.
 - Note the fitted position.
 - Align the steering wheel to straight ahead.
 - Remove and discard the Torx bolt.



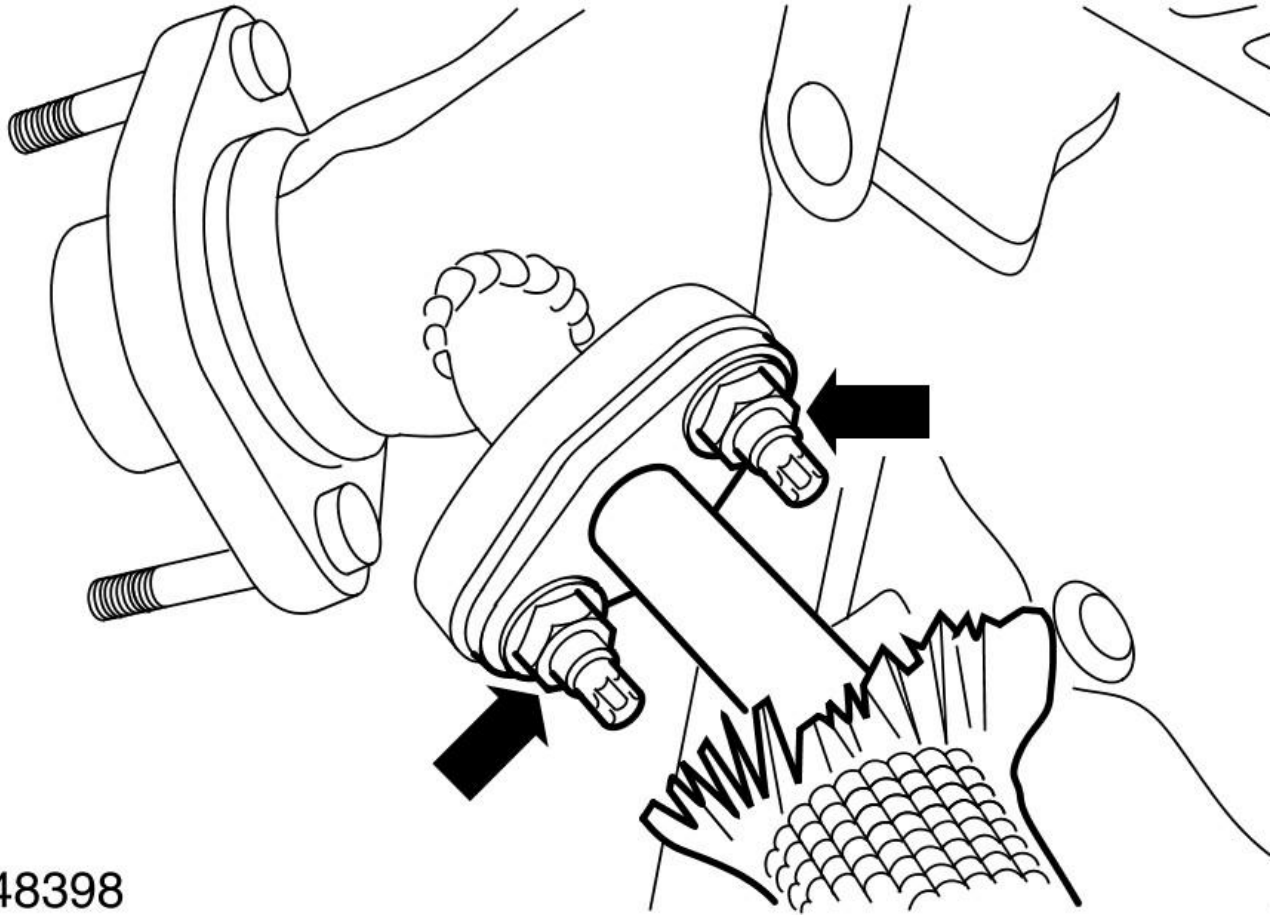
ALL VEHICLES

20. Remove the LH front sidemember exhaust heat shield.
 - Remove the 4 nuts.



21. Disconnect the exhaust manifold EGR pipe flange.

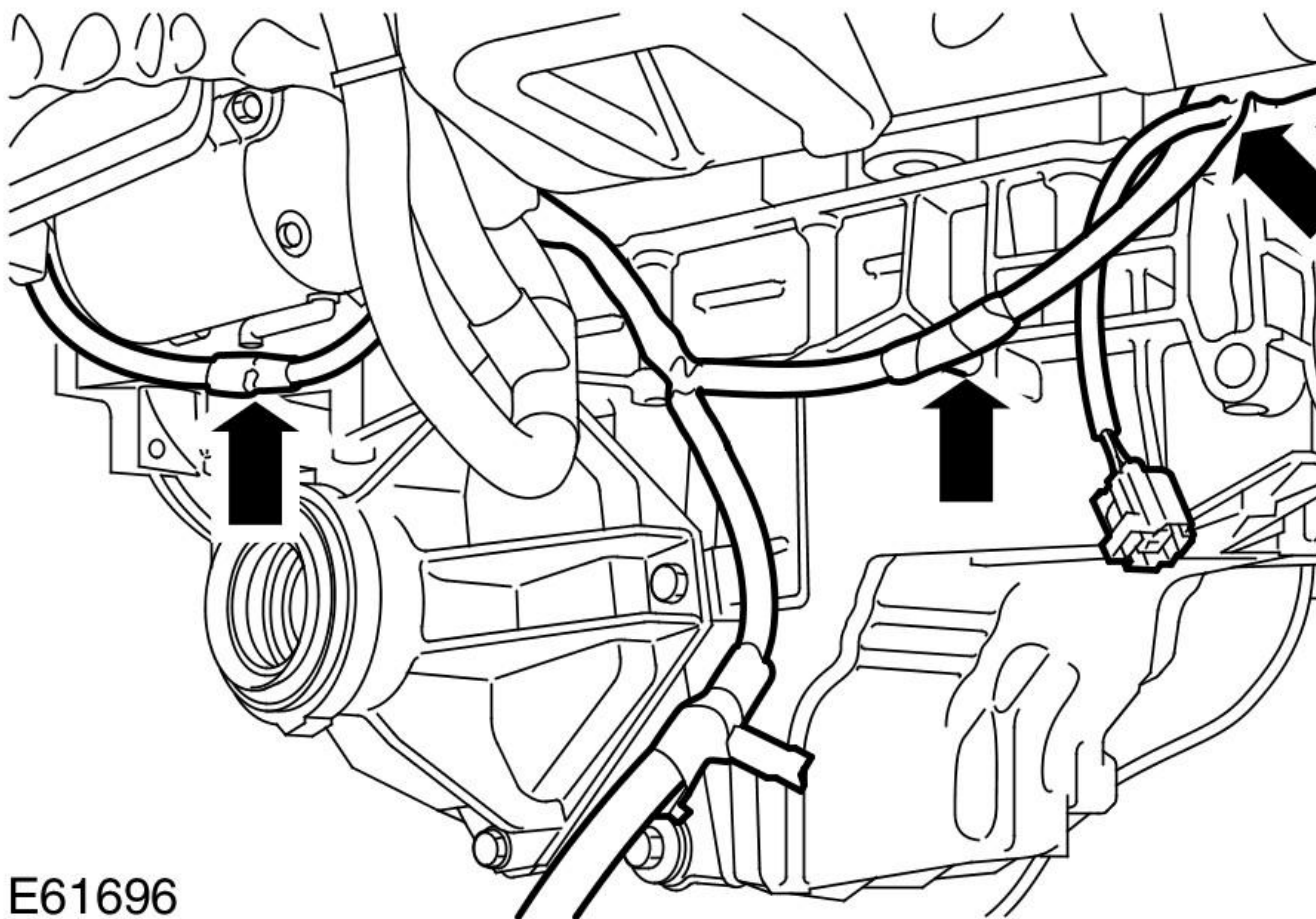
- Remove the 2 nuts.
- Discard the gasket.



E48398

22. Remove the exhaust manifold.

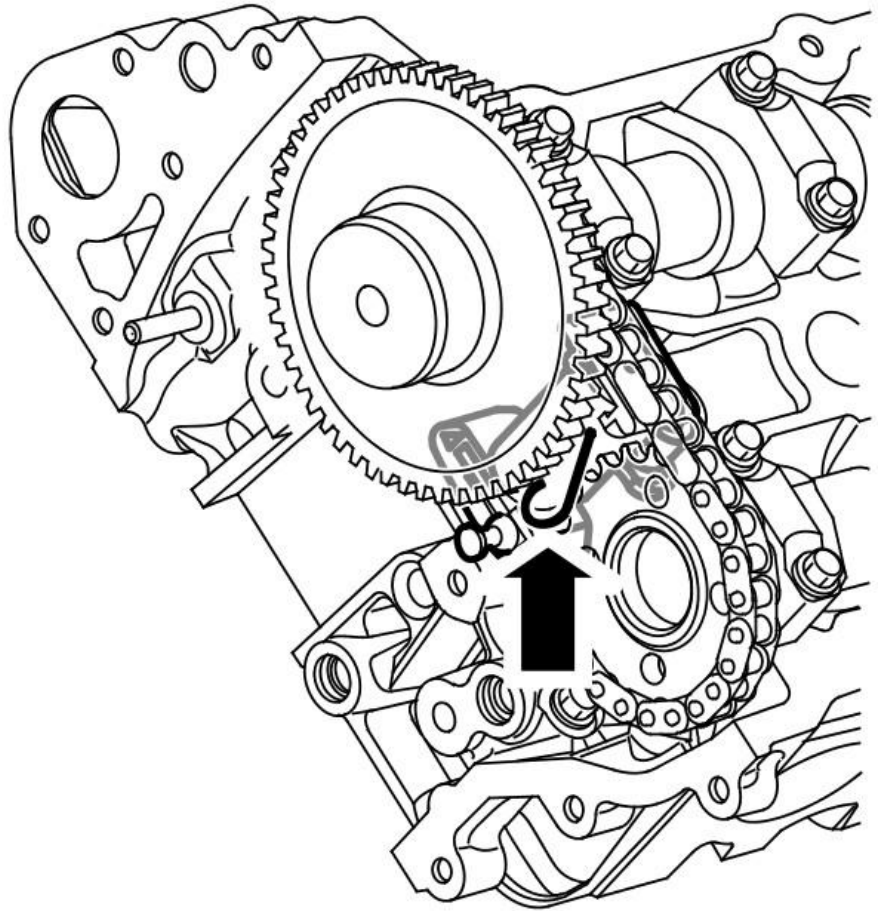
- Remove and discard the 8 bolts.
- Remove the gasket/heat shield retaining bolt.
- Discard the gasket/heat shield.



INSTALLATION

ALL VEHICLES

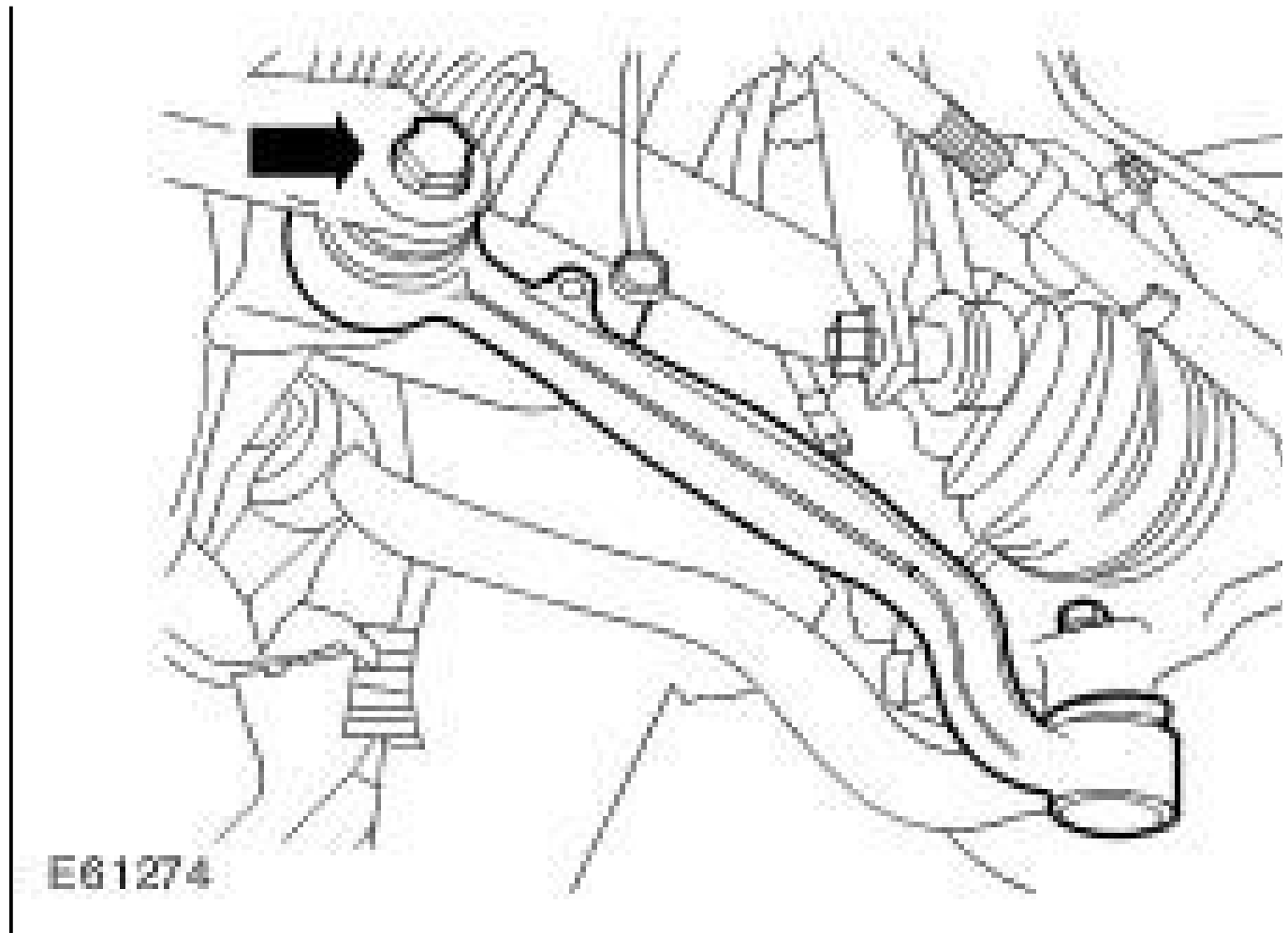
1. Install the exhaust manifold.
 - Clean the component mating faces.
 - Install the gasket/heat shield and tighten the bolt to 10 Nm (7 lb.ft).
 - Install, and lightly tighten the bolts.
 - Evenly and progressively, tighten the bolts in the sequence shown to 20 Nm (15 lb.ft).

**E58311**

2. Connect the EGR pipe and exhaust manifold flanges.
 - Install a new gasket.
 - Tighten the nuts to 25 Nm (18 lb.ft).
3. Install the LH front sidemember exhaust heat shield.
 - Tighten the nuts.

LEFT-HAND DRIVE VEHICLES

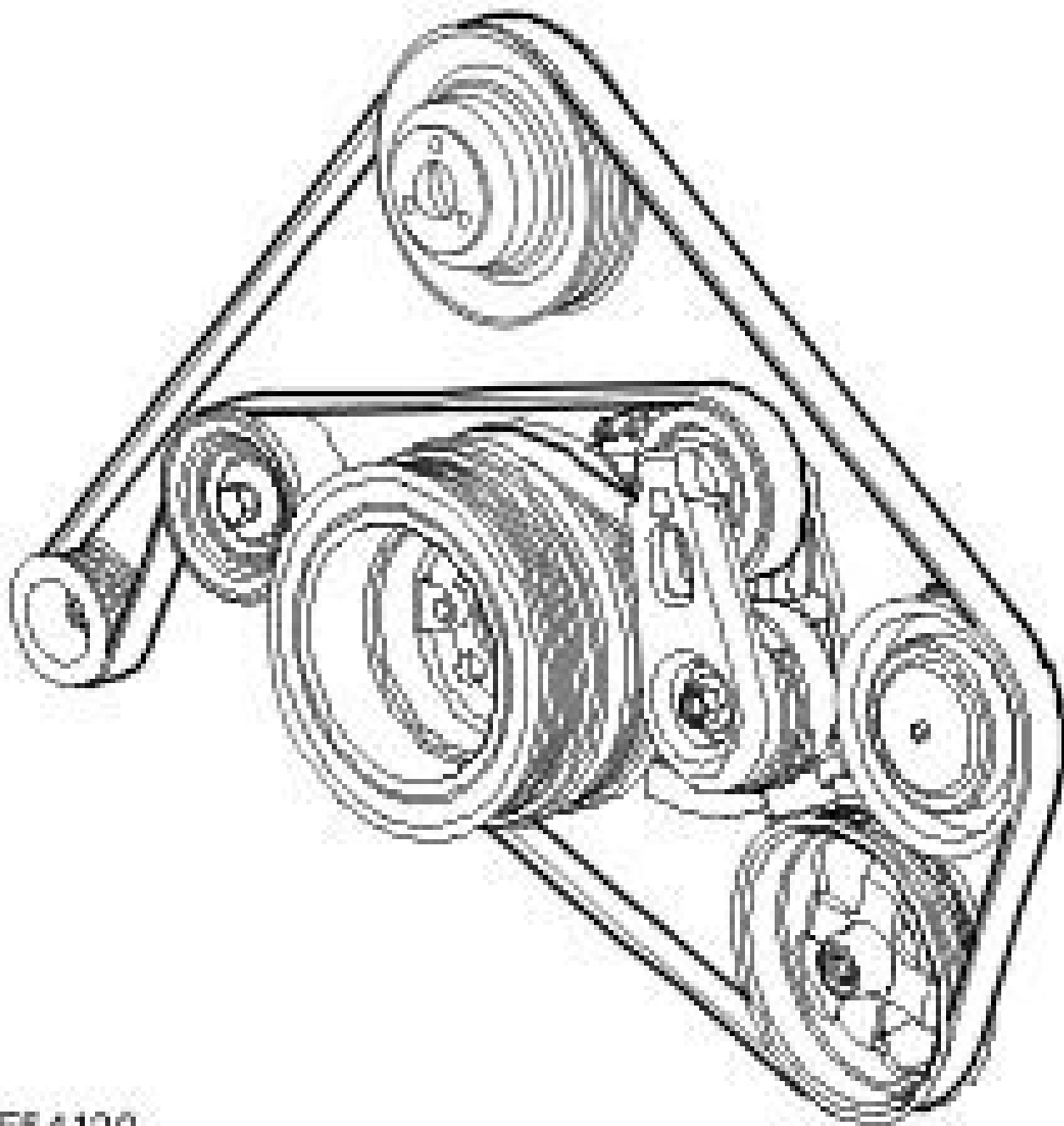
4. Attach the lower steering column.
 - Make sure that the steering gear tag is aligned correctly, as shown.
 - Install a new Torx bolt and tighten to 24 Nm (18 lb.ft).

**ALL VEHICLES**

5. Install the engine compartment LH heat shield.
 - Tighten the screws.
 - Tighten the nuts.
6. Install the A/C compressor and the A/C compressor mounting bracket.
 - If a new compressor is being installed, the required amount of refrigerant oil must be drained from it.
7. Secure the A/C compressor mounting bracket.
 - Tighten the bolts to 25 Nm (18 lb.ft).
8. Secure the A/C compressor.
 - Tighten the bolts to 25 Nm (18 lb.ft).
9. Connect the A/C clutch electrical connector.

CAUTION: Lubricate the new seals with clean refrigerant oil.

10. Connect the refrigerant lines.
 - Clean the component mating faces.
 - Install the new O-ring seals.
 - Tighten the bolts to 10 Nm (7 lb.ft).
11. Secure the transmission cooler pipes into clips.
12. Install the power steering pump.
 - Tighten the bolts to 25 Nm (18 lb.ft).
13. Connect the high pressure line.
 - Clean the component mating faces.
 - Install the new O-ring seals.
 - Tighten the union to 25 Nm (18 lb.ft).
14. Connect the low pressure line.
 - Clean the component mating faces.
 - Secure with the clip.
15. Install the accessory drive belt.
 - Rotate the tensioner assembly counter-clockwise.



E54120

16. Install the cooling fan and shroud. Refer to **Cooling Fan** .
17. Install the RH air cleaner assembly. Refer to **Air Cleaner** .
18. Install the front wheel.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).
19. Install the engine undershield. Refer to **Engine Undershield** .

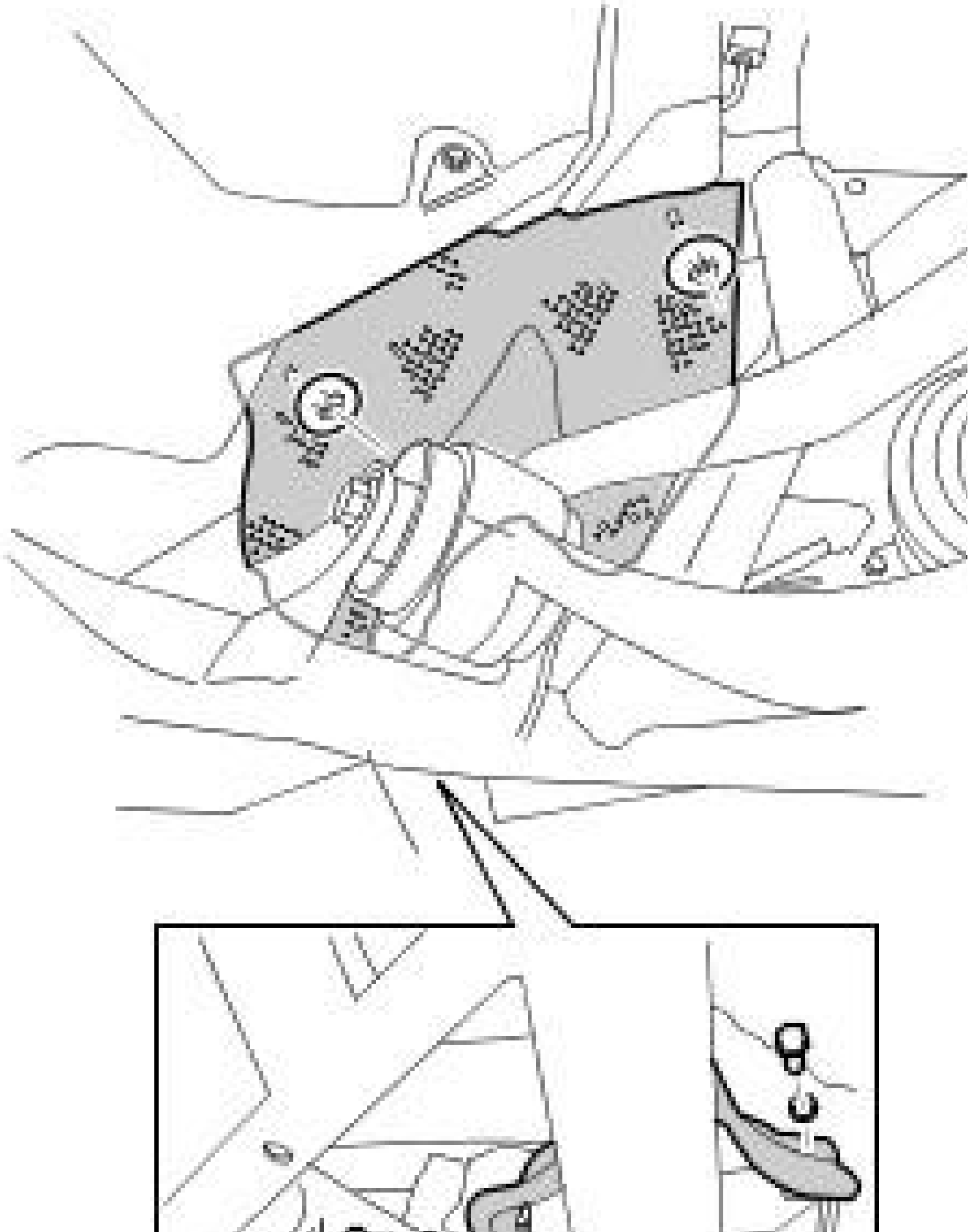
20. Install the exhaust system. Refer to **Exhaust System** .
21. Connect the battery ground cable. Refer to **Specifications** .
22. Fill and bleed the power steering system. Refer to **Power Steering System Filling and Bleeding** .

EXHAUST MANIFOLD RH**REMOVAL****ALL VEHICLES**

1. Disconnect the battery ground cable. Refer to **Specifications** .

WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

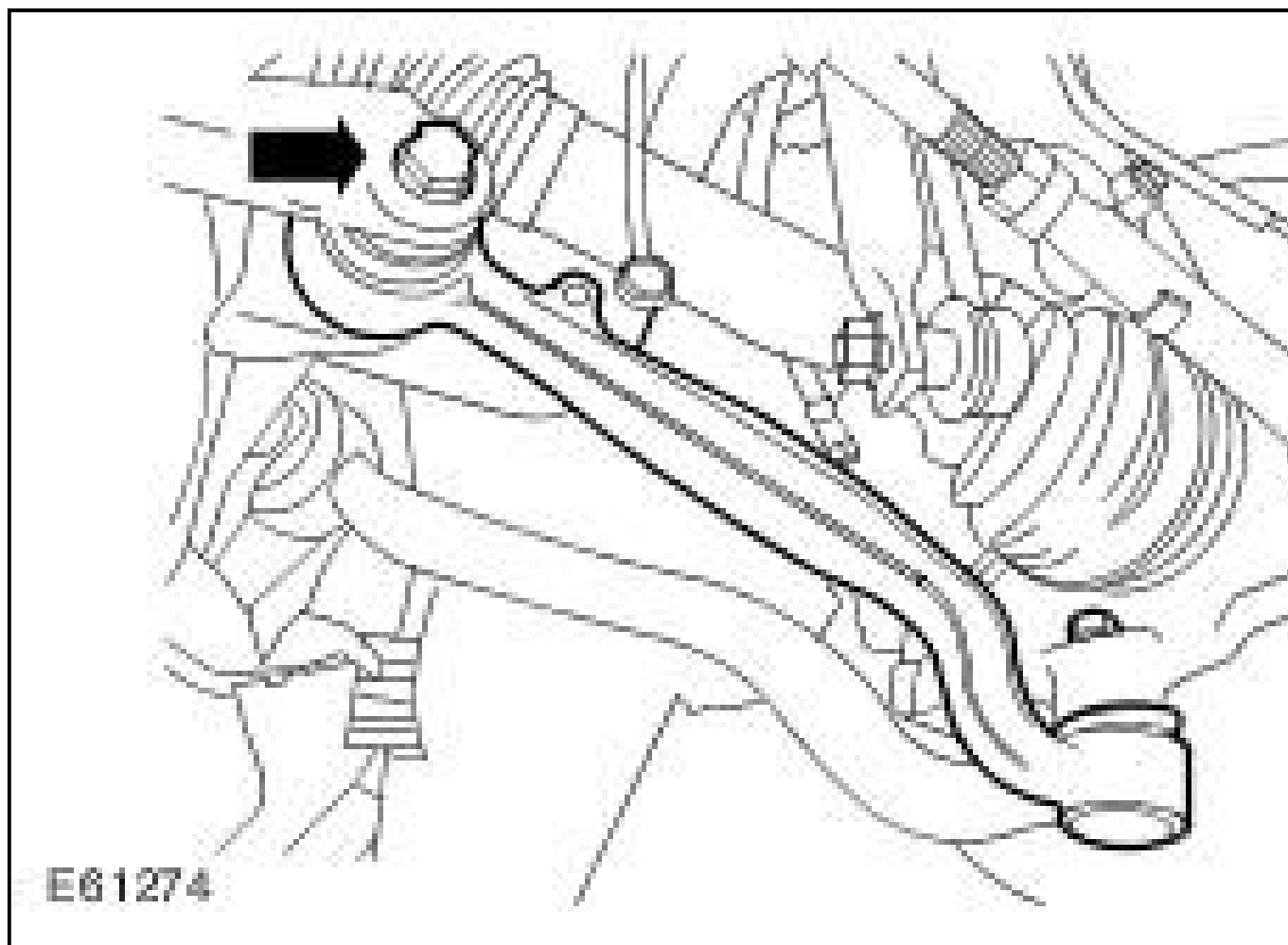
2. Raise and support the vehicle.
3. Remove the RH front wheel.
4. Remove the RH fender splash shield. Refer to **Fender Splash Shield** .
5. Remove the engine undershield. Refer to **Engine Undershield** .
6. Remove the engine compartment RH heat shield.
 - Remove the 2 nuts.
 - Remove the 2 screws.



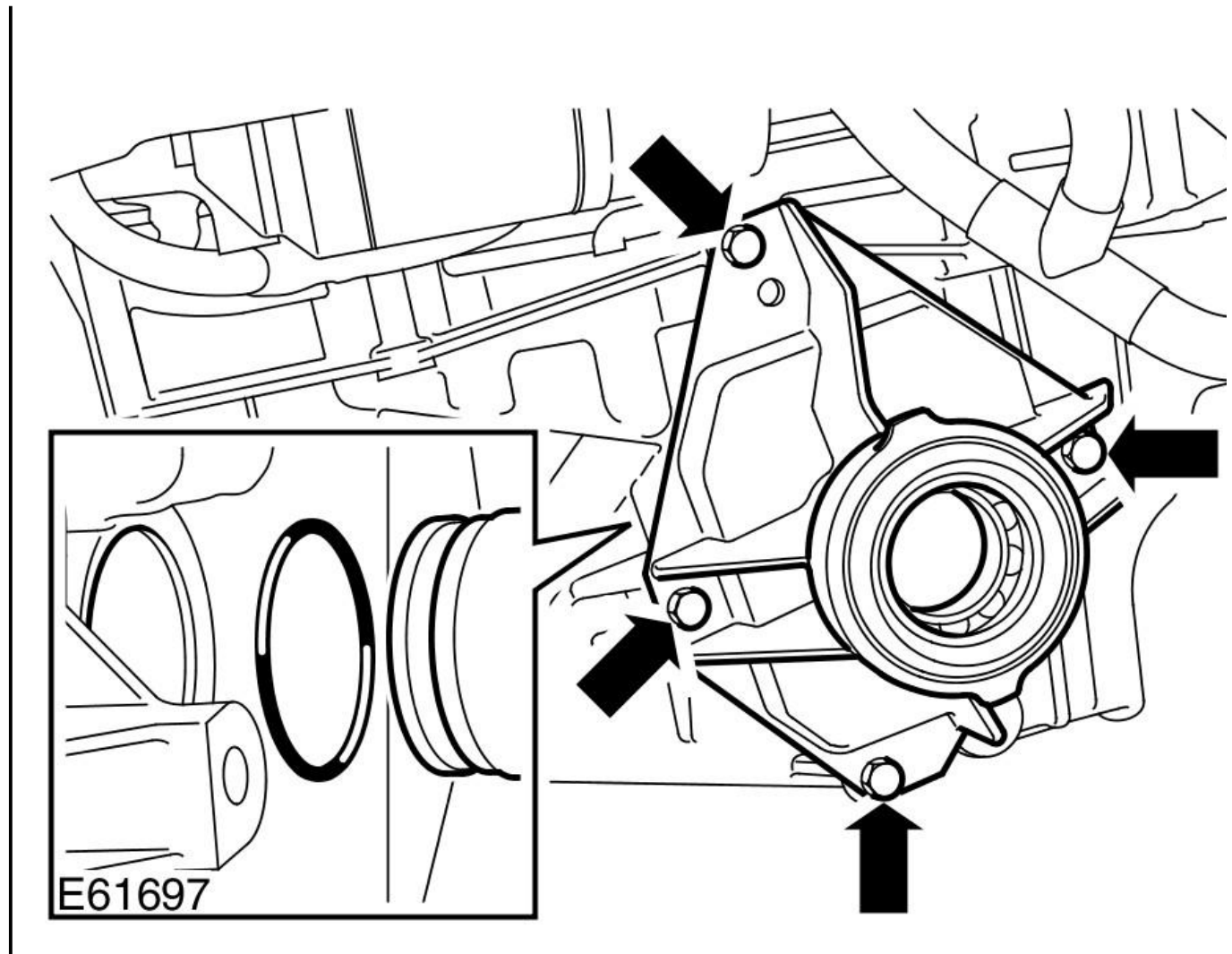
RIGHT-HAND DRIVE VEHICLES

CAUTION: Do not turn the steering wheel with the lower steering column disconnected as damage to the clock spring and steering wheel switches may occur.

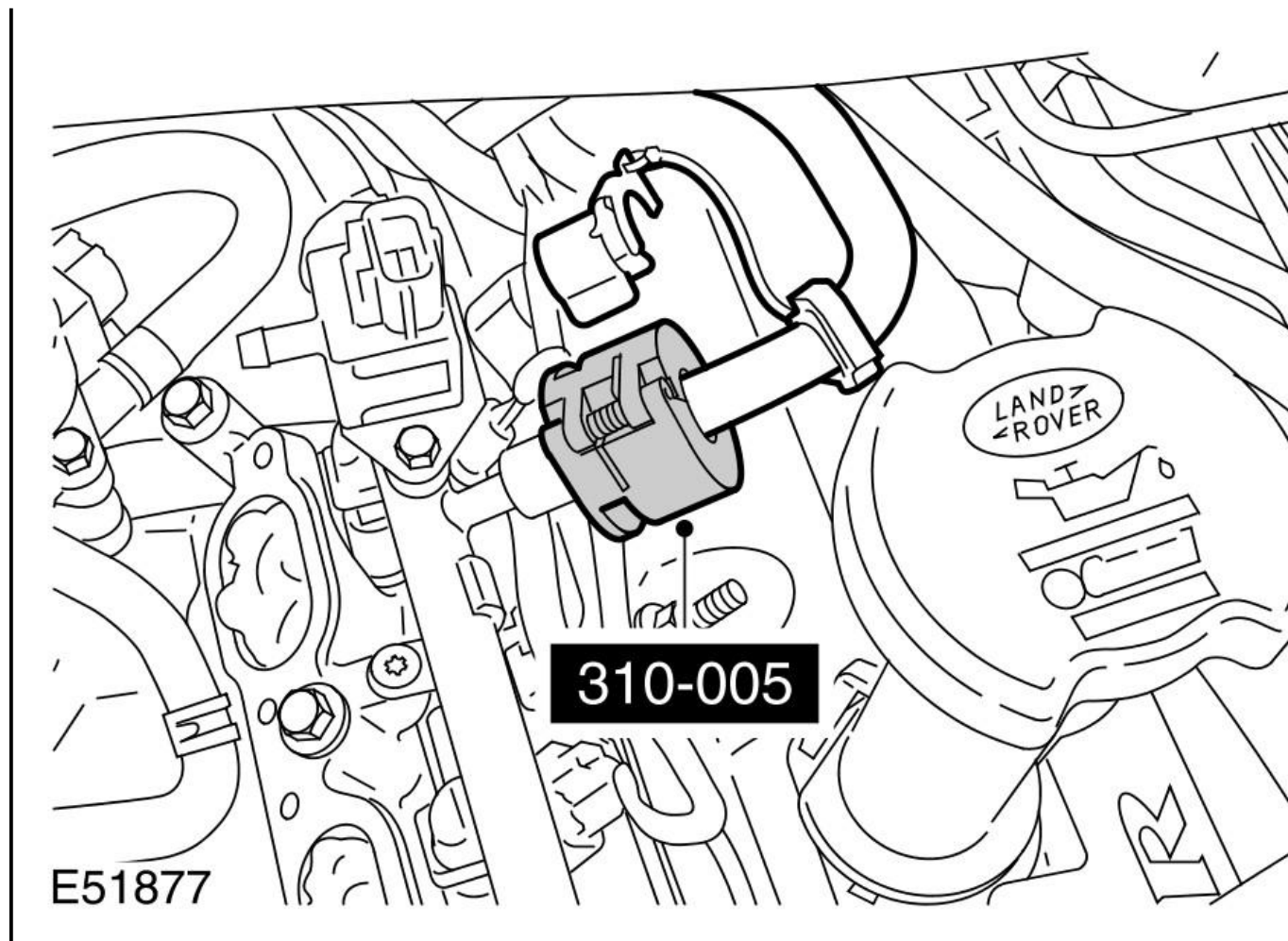
7. Disconnect the lower steering column from the steering gear.
 - Note the fitted position.
 - Align the steering wheel to straight ahead.
 - Remove and discard the Torx bolt.

**ALL VEHICLES**

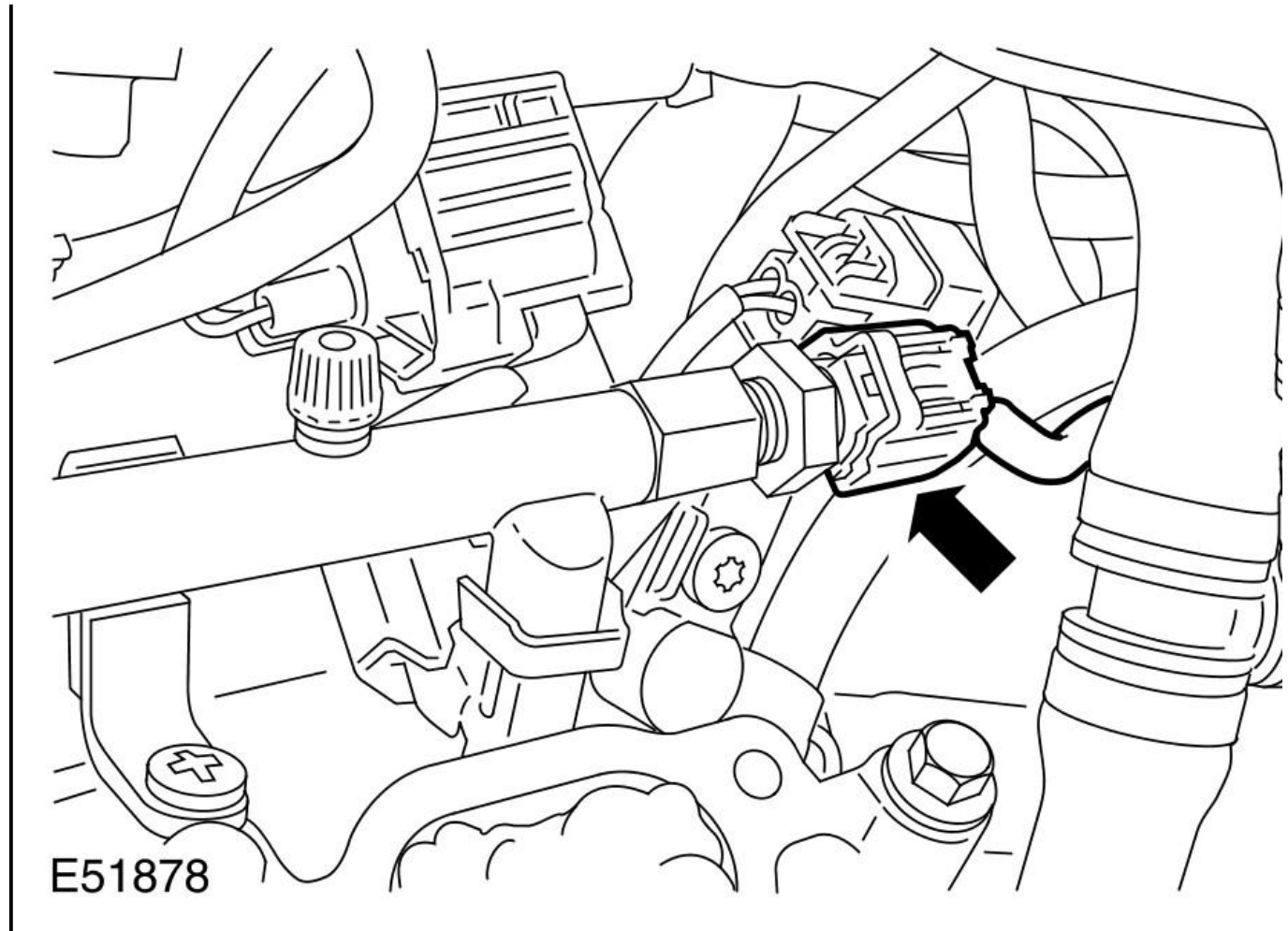
8. Remove the starter motor heat shield.
 - Remove the 2 bolts.



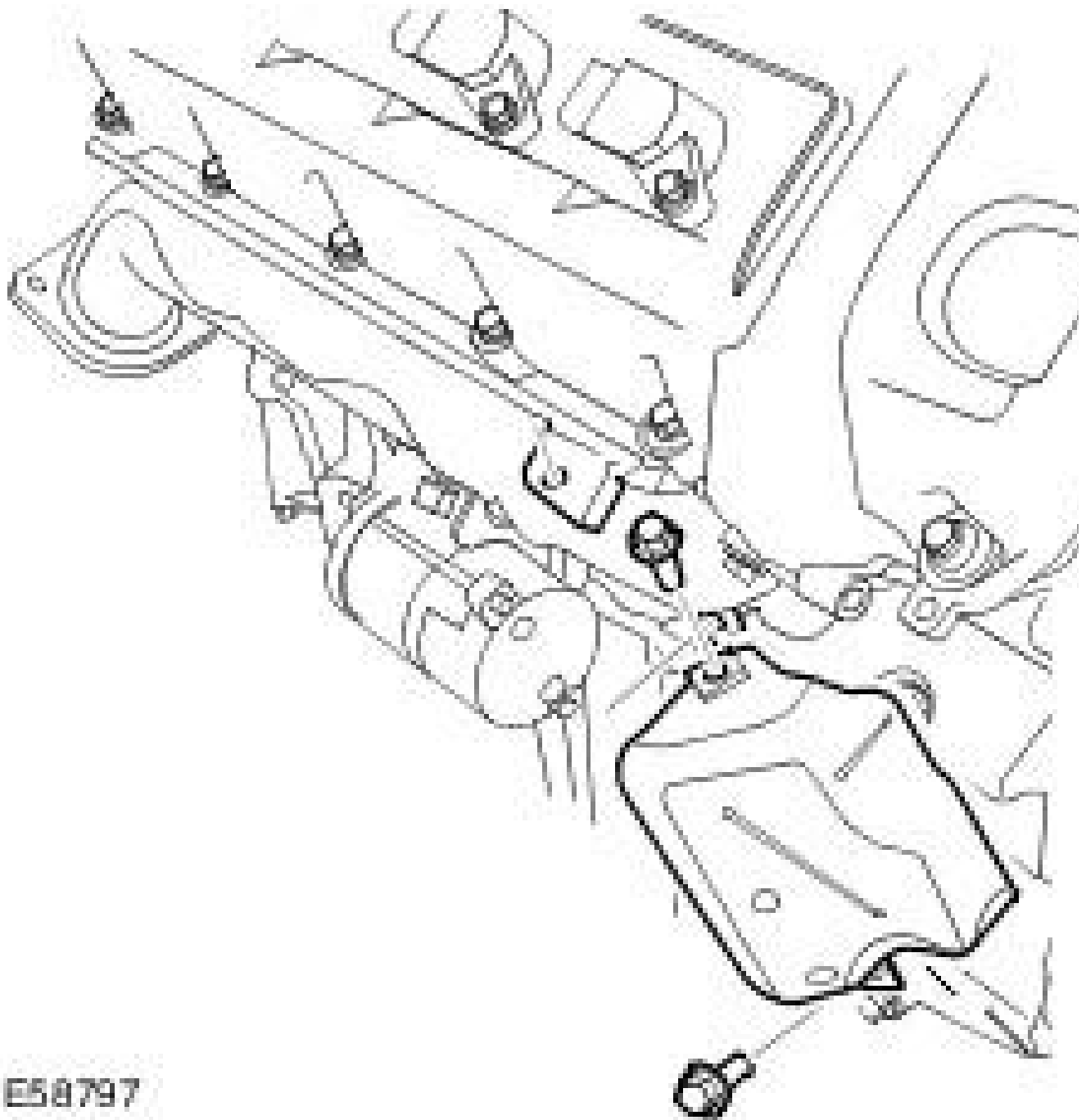
9. Disconnect the LH catalytic converter from the exhaust manifold.
 - Remove and discard the 2 nuts.



10. Disconnect the RH catalytic converter from the exhaust manifold.
 - Remove and discard the 2 nuts.
11. Disconnect the 2 front exhaust hangers.

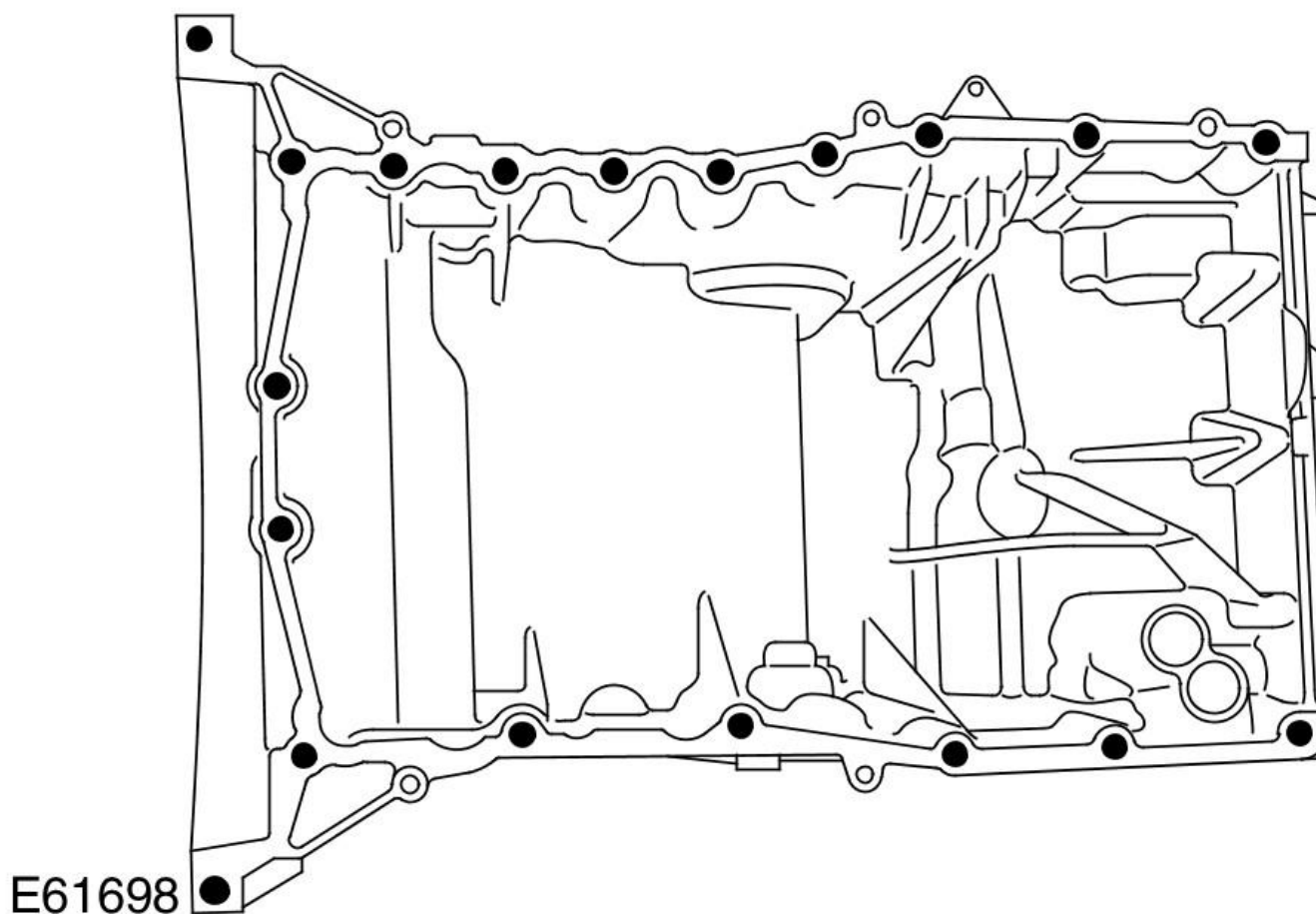


12. Remove the exhaust manifold heat shield.
 - Remove the 2 screws.



13. Remove the exhaust manifold.

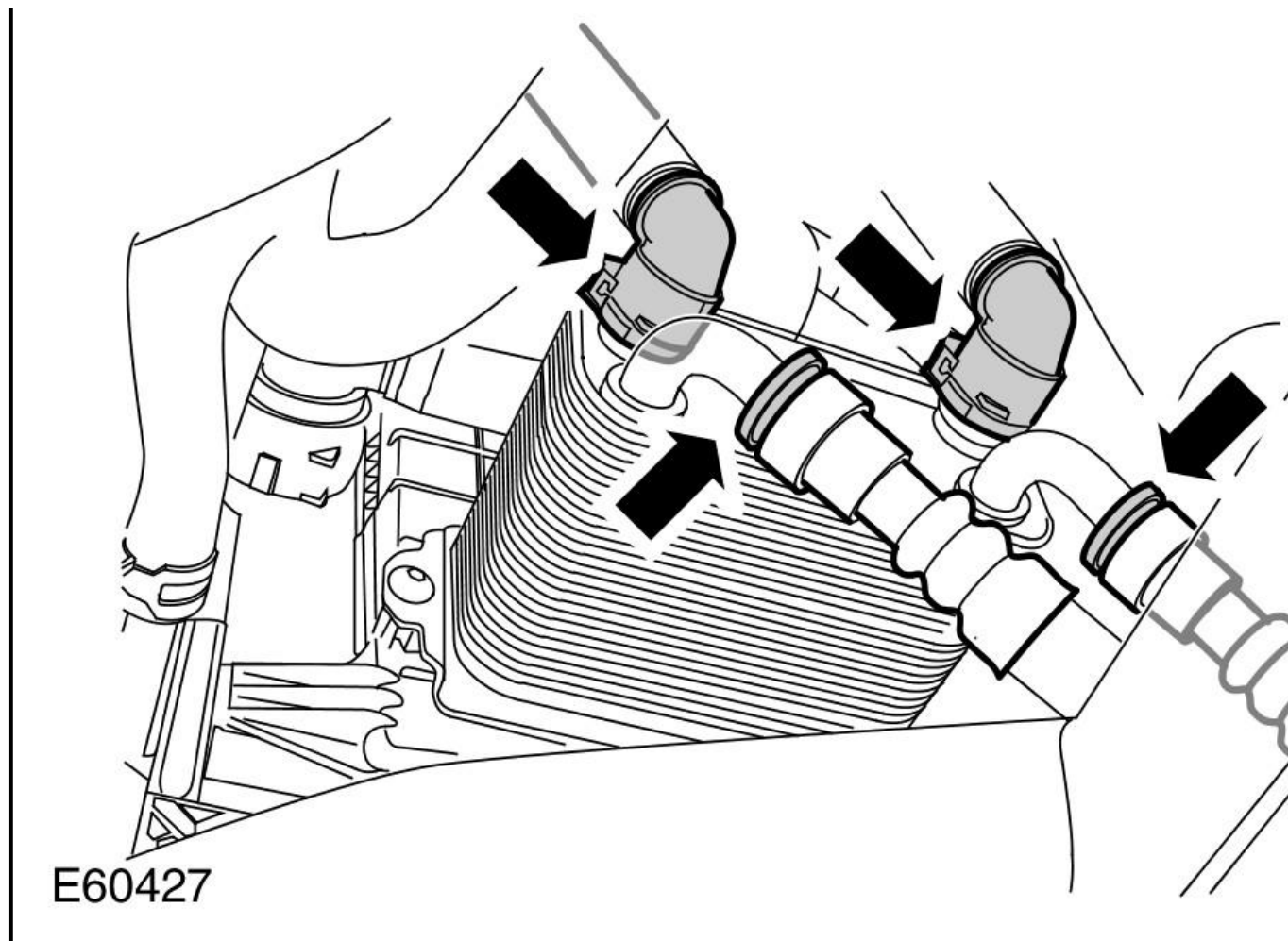
- Remove and discard the 8 bolts.
- Remove the gasket/heat shield retaining bolt.
- Discard the gasket/heat shield.



INSTALLATION

ALL VEHICLES

1. Install the exhaust manifold.
 - Clean the component mating faces.
 - Install the gasket/heat shield and tighten the bolt to 10 Nm (7 lb.ft).
 - Install, and lightly tighten the bolts.
 - Evenly and progressively, tighten the bolts in the sequence shown to 20 Nm (15 lb.ft).

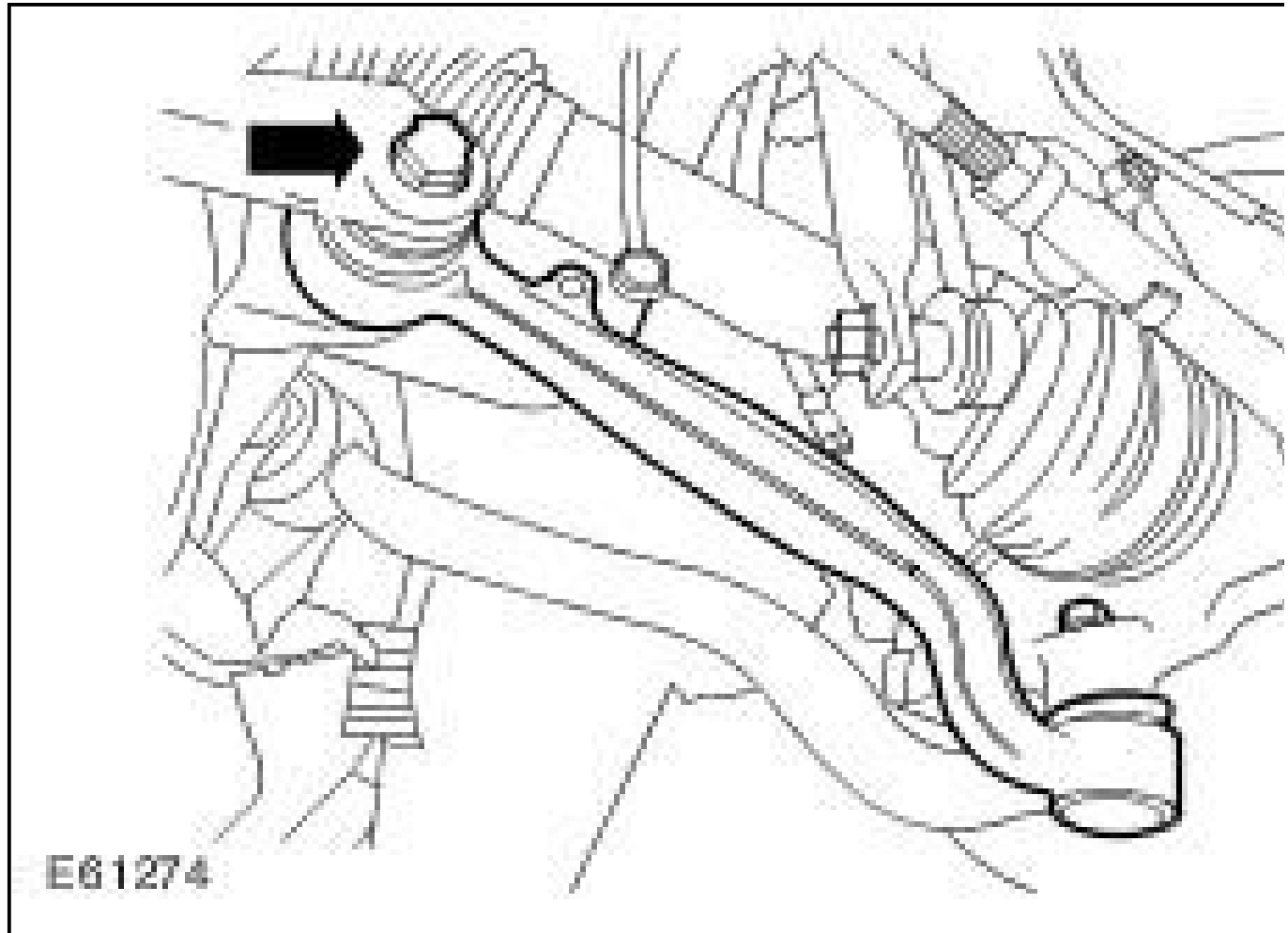


2. Install the exhaust manifold heat shield.
 - Tighten the screws.
3. Attach the exhaust hangers.
4. Position the RH catalytic converter to the exhaust manifold.
 - Clean the components.
 - Tighten the new nuts to 20 Nm (15 lb.ft).
5. Position the LH catalytic converter to the exhaust manifold.
 - Clean the components.
 - Tighten the new nuts to 20 Nm (15 lb.ft).
6. Install the starter motor heat shield.
 - Tighten the bolts to 45 Nm (33 lb.ft).

RIGHT-HAND DRIVE VEHICLES

7. Attach the lower steering column.
 - Make sure that the steering gear tag is aligned correctly, as shown.

- Install a new Torx bolt and tighten to 24 Nm (18 lb.ft).



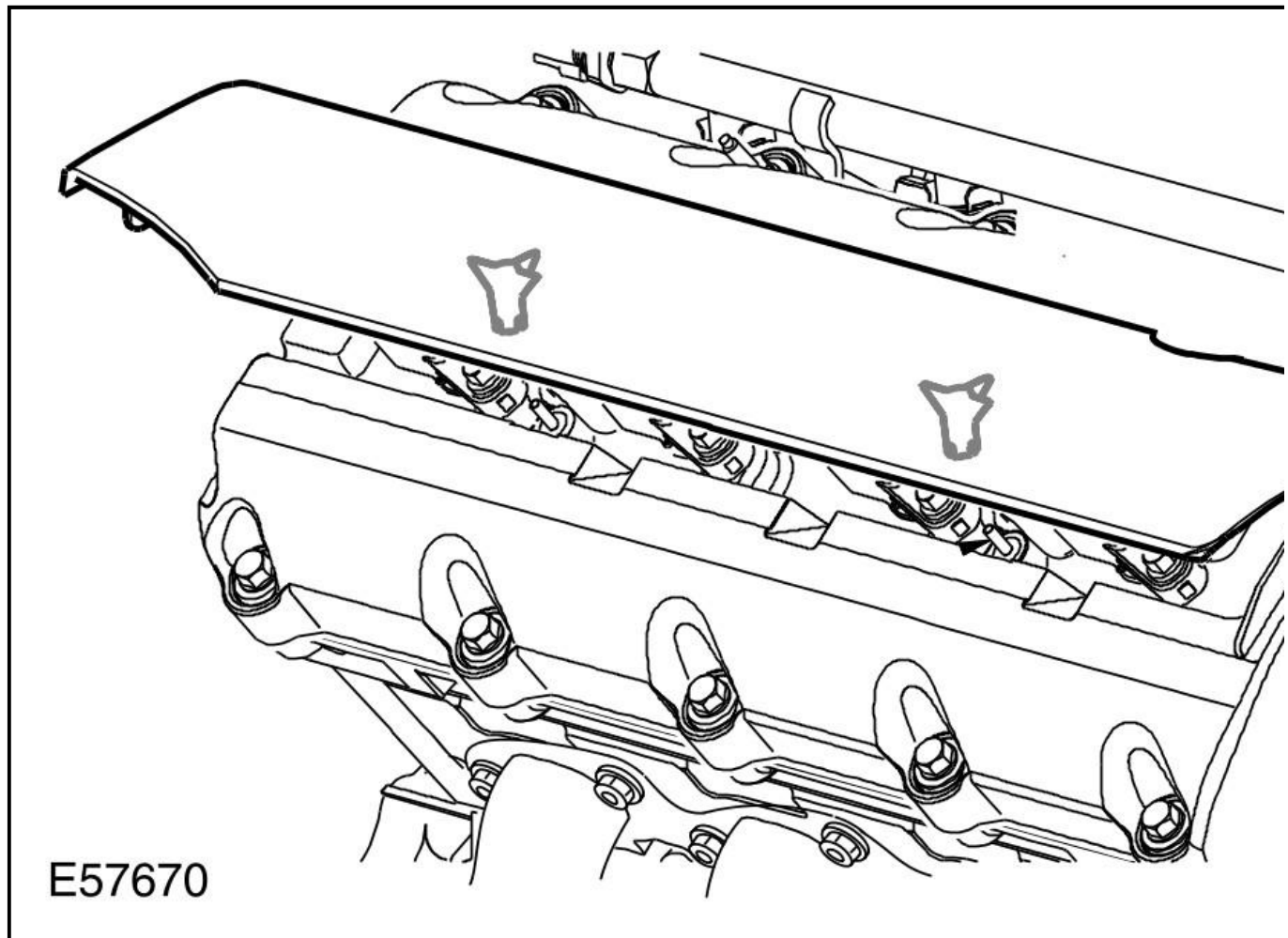
ALL VEHICLES

8. Install the engine compartment RH heat shield.
 - Tighten the screws.
 - Tighten the nuts.
9. Install the engine undershield. Refer to **Engine Undershield** .
10. Install the fender splash shield. Refer to **Fender Splash Shield** .
11. Install the front wheel.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).
12. Connect the battery ground cable. Refer to **Specifications** .

OIL LEVEL INDICATOR AND TUBE

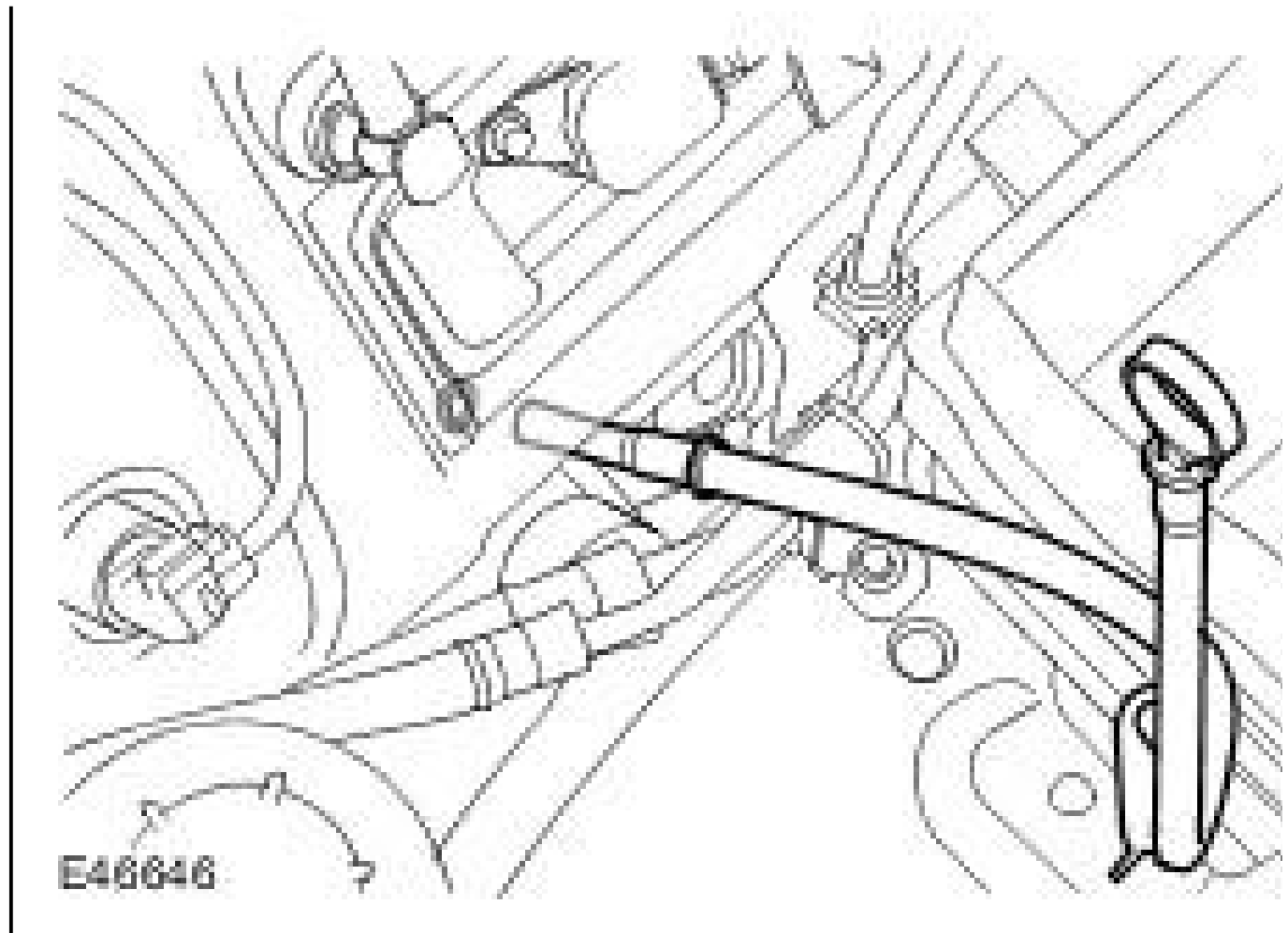
REMOVAL

1. Disconnect the battery ground cable. Refer to Specifications .
2. Remove the engine cover. Refer to Engine Cover - 4.4L .
3. Remove the air cleaner. Refer to Air Cleaner .
4. Remove the LH ignition coil-on-plug cover.
 - Release the 2 clips.



WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

5. Raise and support the vehicle.
6. Turn the steering on to full lock for access.
7. Remove the oil level indicator and tube.
 - Remove the nut.
 - Discard the O-ring seal.



INSTALLATION

1. With assistance, install the oil level indicator and tube.
 - Clean the components.
 - Install a new O-ring seal.
 - Lubricate the O-ring seal with clean engine oil.
 - Tighten the nut to 6 Nm (4 lb.ft).
2. Install the LH ignition coil-on-plug cover.
3. Install the air cleaner. Refer to **Air Cleaner** .
4. Install the engine cover. Refer to **Engine Cover - 4.4L** .
5. Connect the battery ground cable. Refer to **Specifications** .

VARIABLE CAMSHAFT TIMING (VCT) UNIT

REMOVAL

NOTE: The removal and installation of the RH VCT unit is similar to the LH and is

covered within the timing drive component procedure.

1. Disconnect the battery ground cable. Refer to Specifications .
2. Remove the timing drive components. See Timing Drive Components.

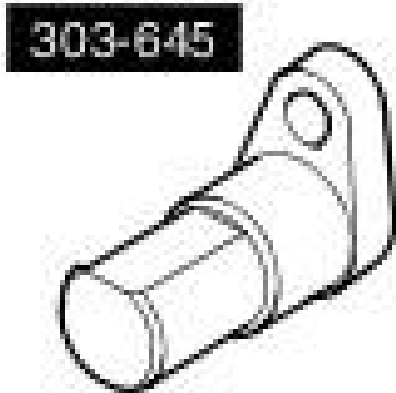
INSTALLATION

1. Install the timing drive components. See Timing Drive Components.
2. Connect the battery ground cable. Refer to Specifications .

REMOVAL AND INSTALLATION

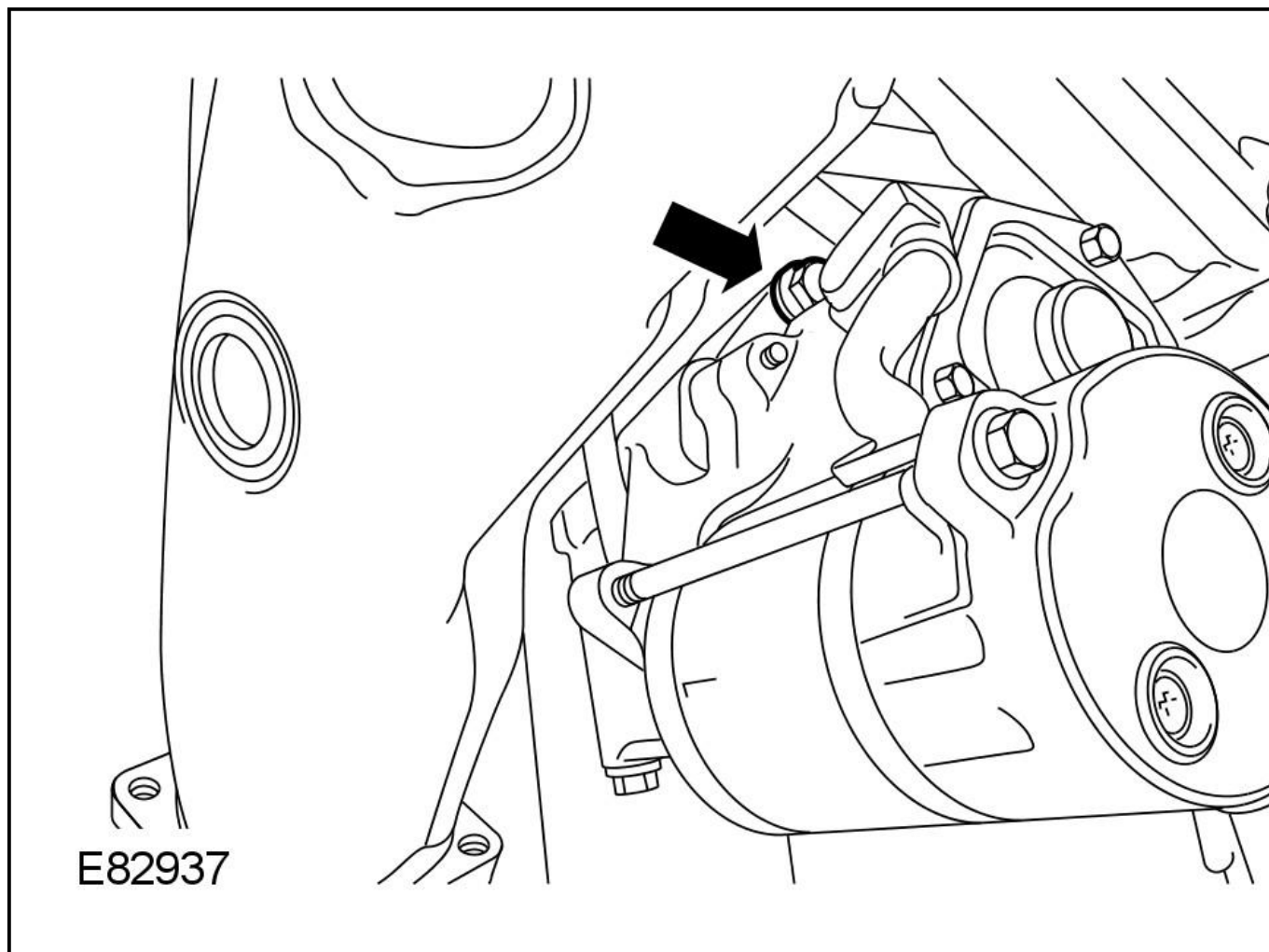
CRANKSHAFT MAIN BEARING CARRIER

SPECIAL TOOLS

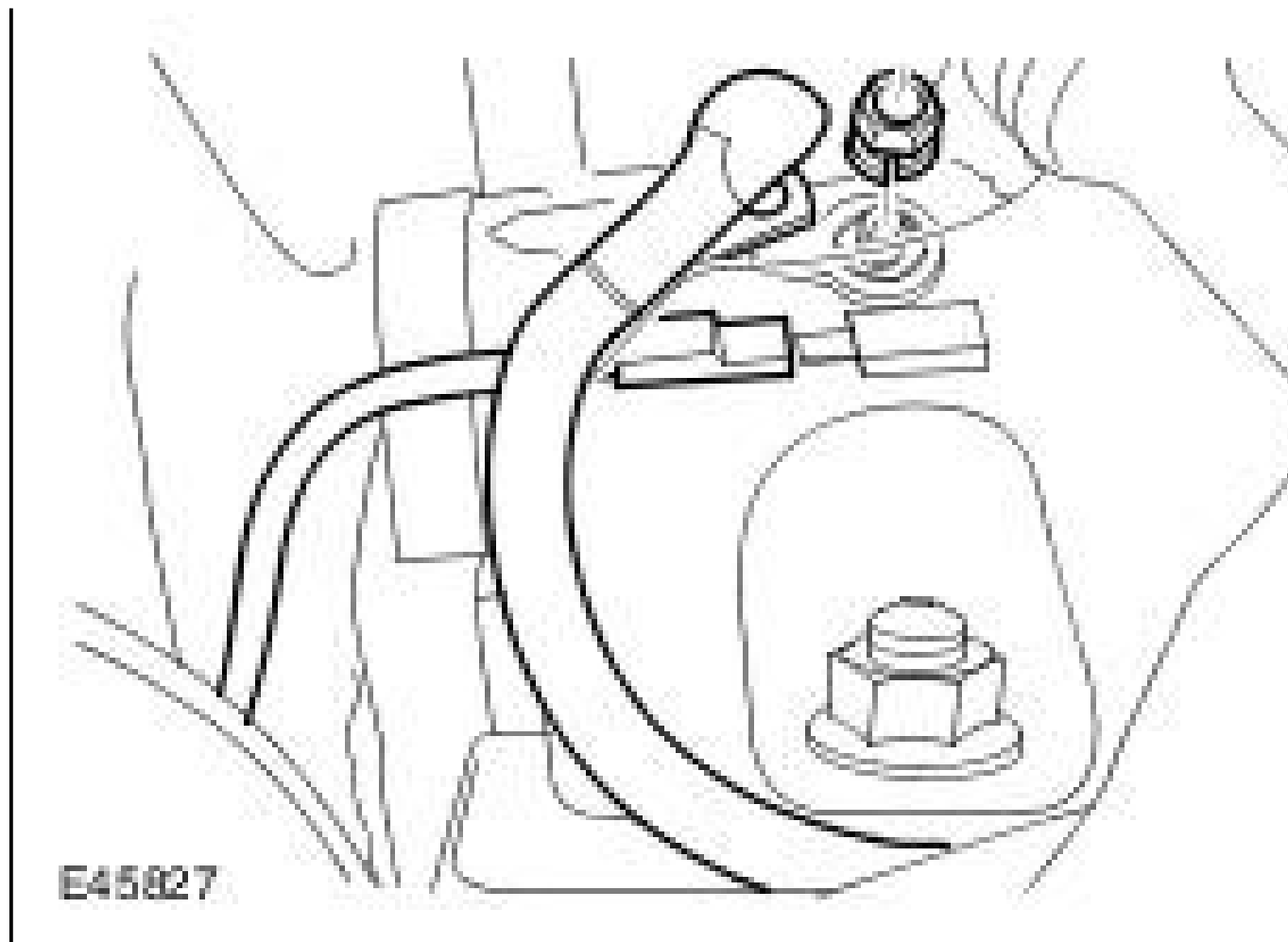
Tool Illustration	Tool Name	Tool Number
 303-645 E46881	Timing Setting tool	303-645
 303-538 E46816	Crankshaft rear oil seal remover/installer	303-538

REMOVAL

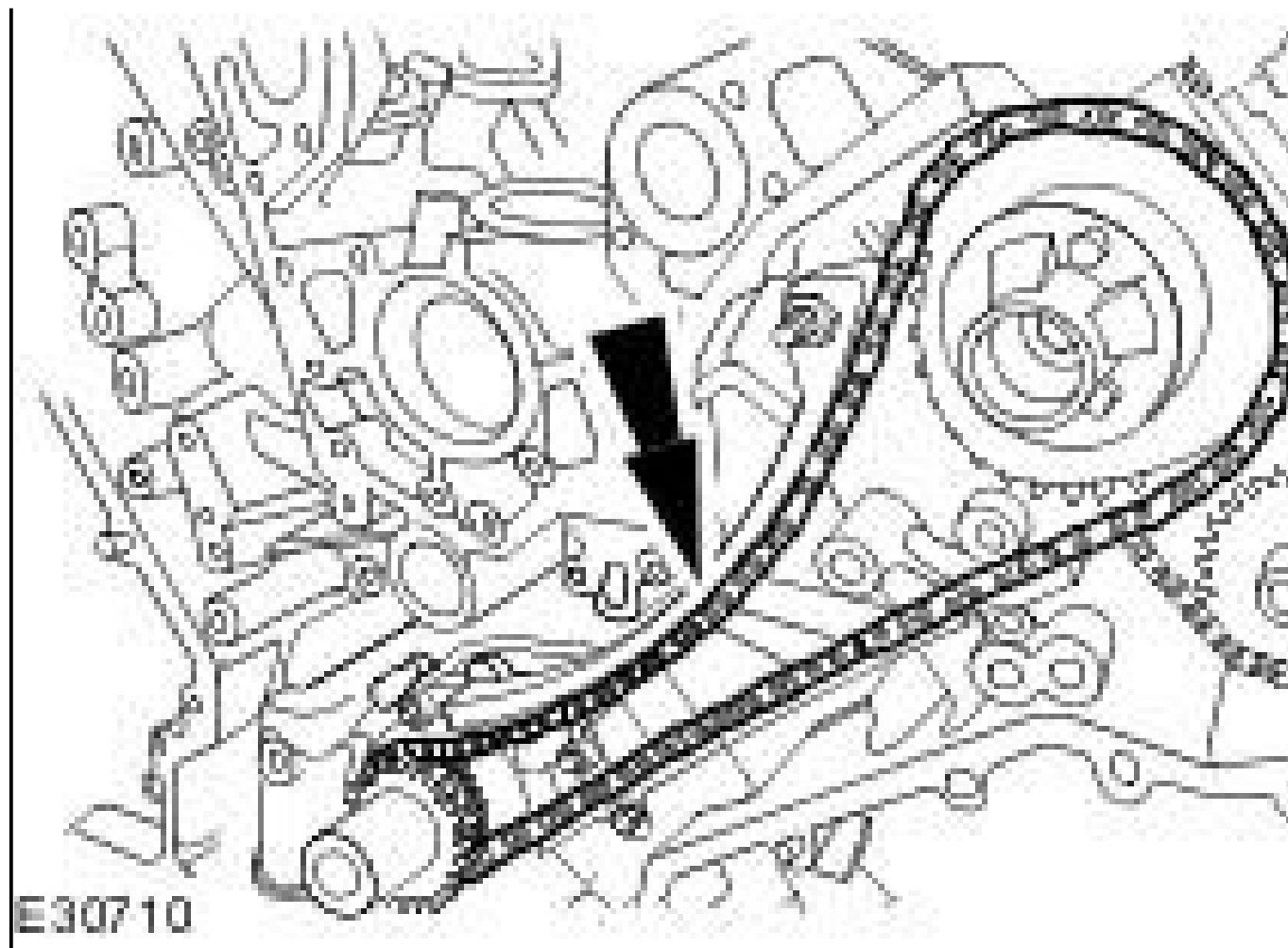
1. Disconnect the battery ground cable. Refer to **Specifications** .
2. Remove the oil pump. See **Oil Pump**.
3. Release the starter motor.
 - Remove the bolt.



4. Remove the starter motor.
 - Release the battery positive cable cover.
 - Remove the nut.
 - Disconnect the battery positive cable.
 - Disconnect the electrical connector.

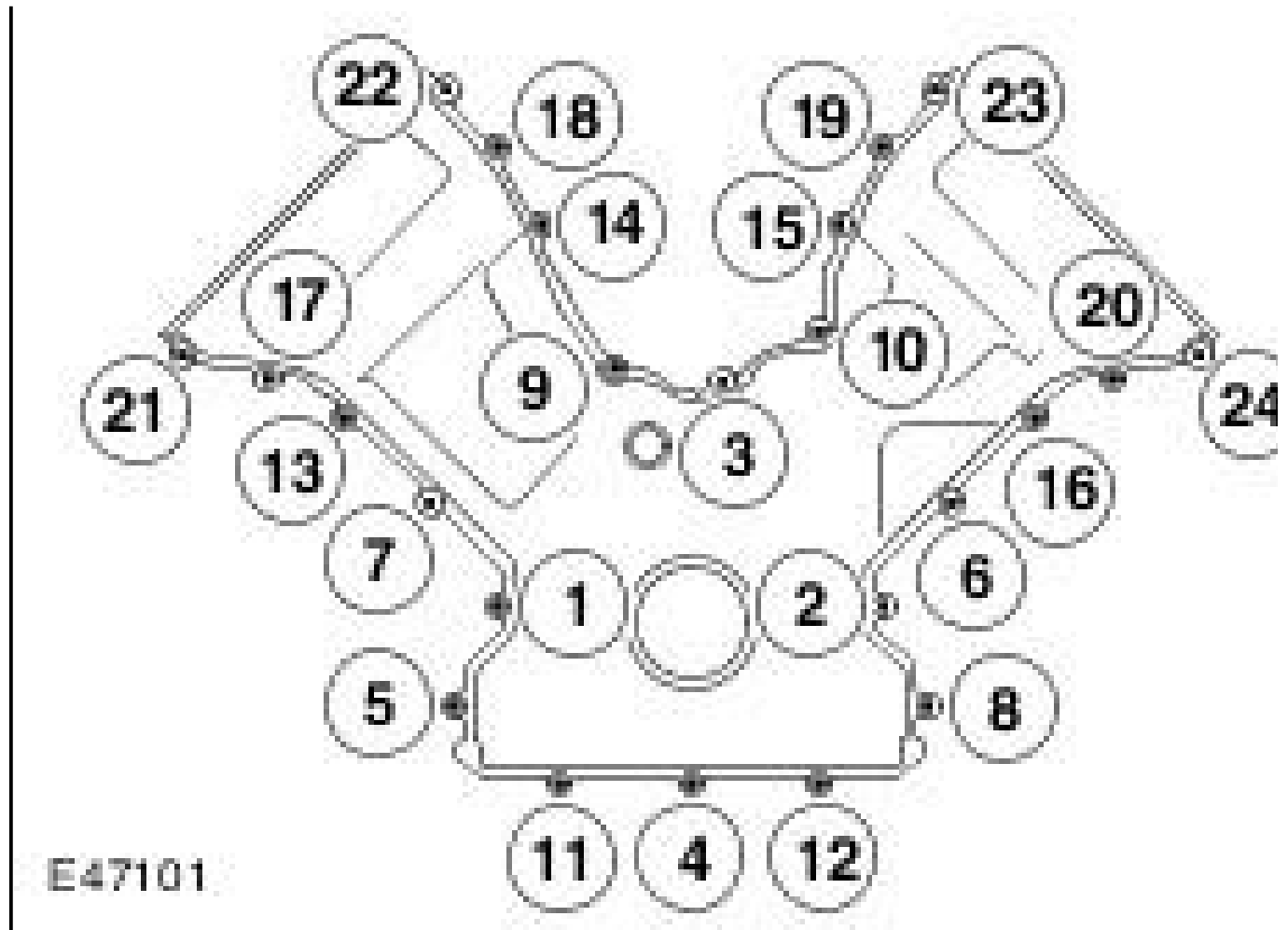


5. Remove the special tool.

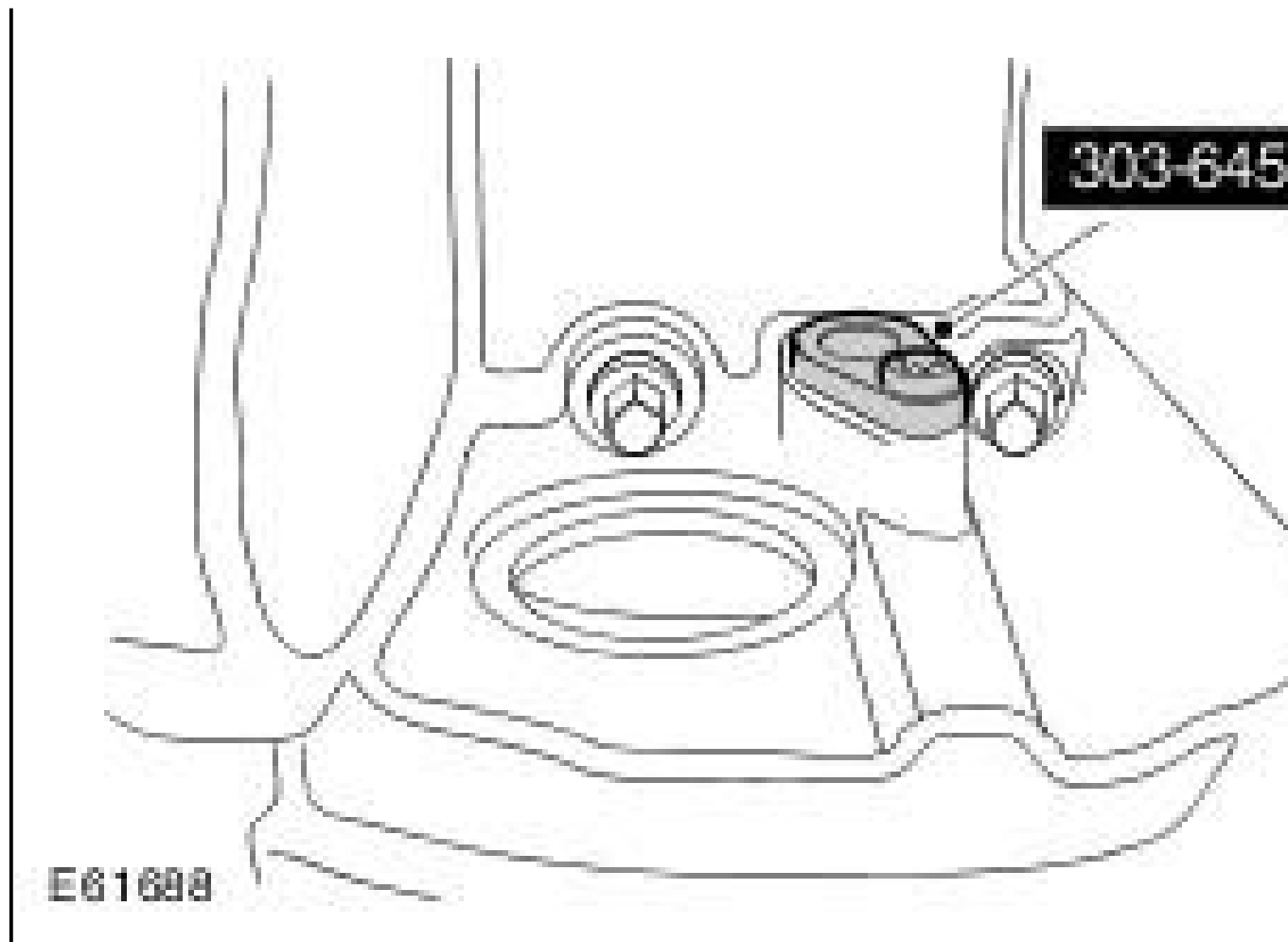


CAUTION: The bolts can only be used 3 times, mark the bolts with a center punch. If 2 punch marks are visible, discard the bolts.

6. Remove the torque converter flexplate.
 - Remove the 8 bolts.



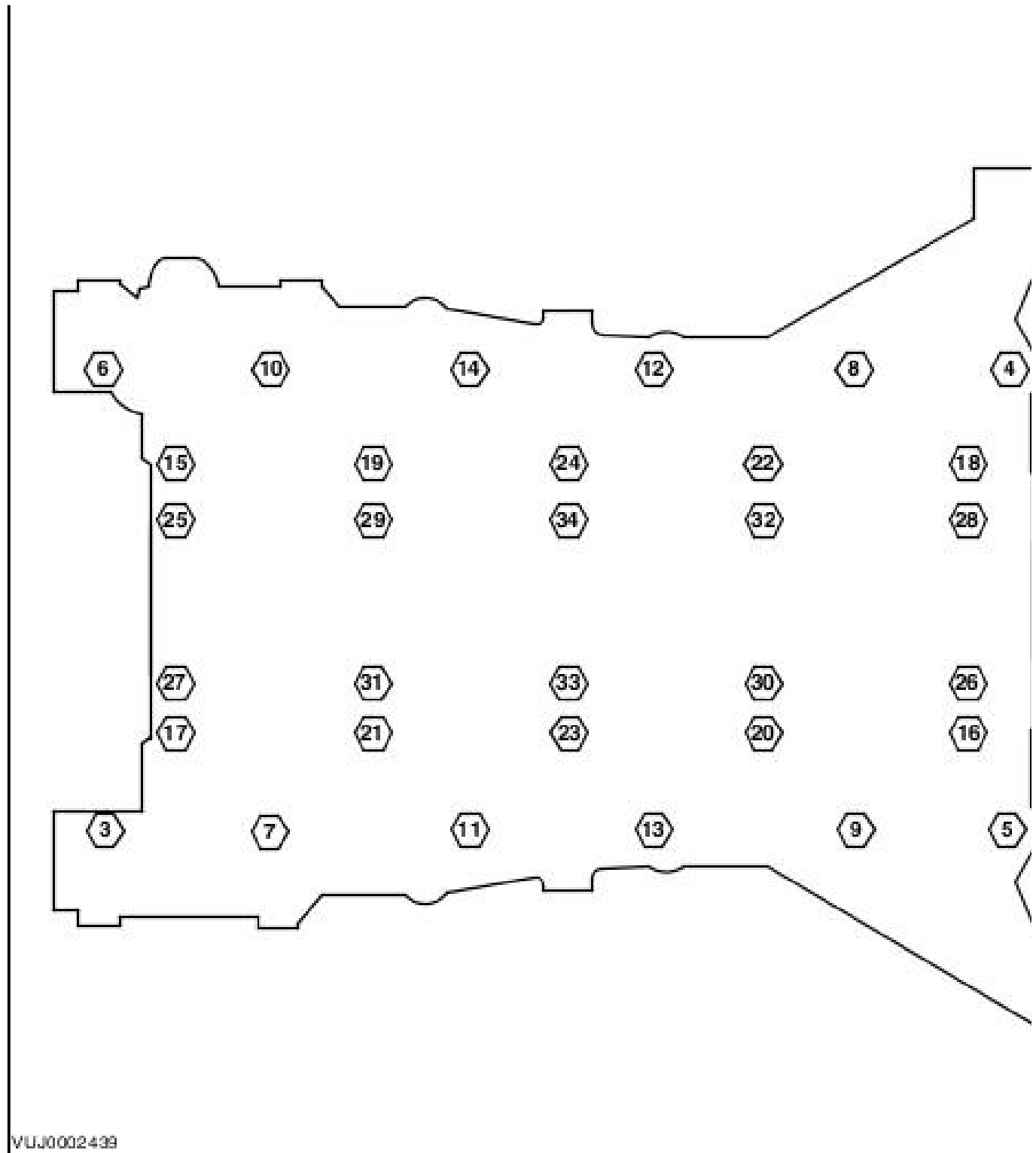
7. Remove the baffle plate.
 - Remove the 6 bolts.



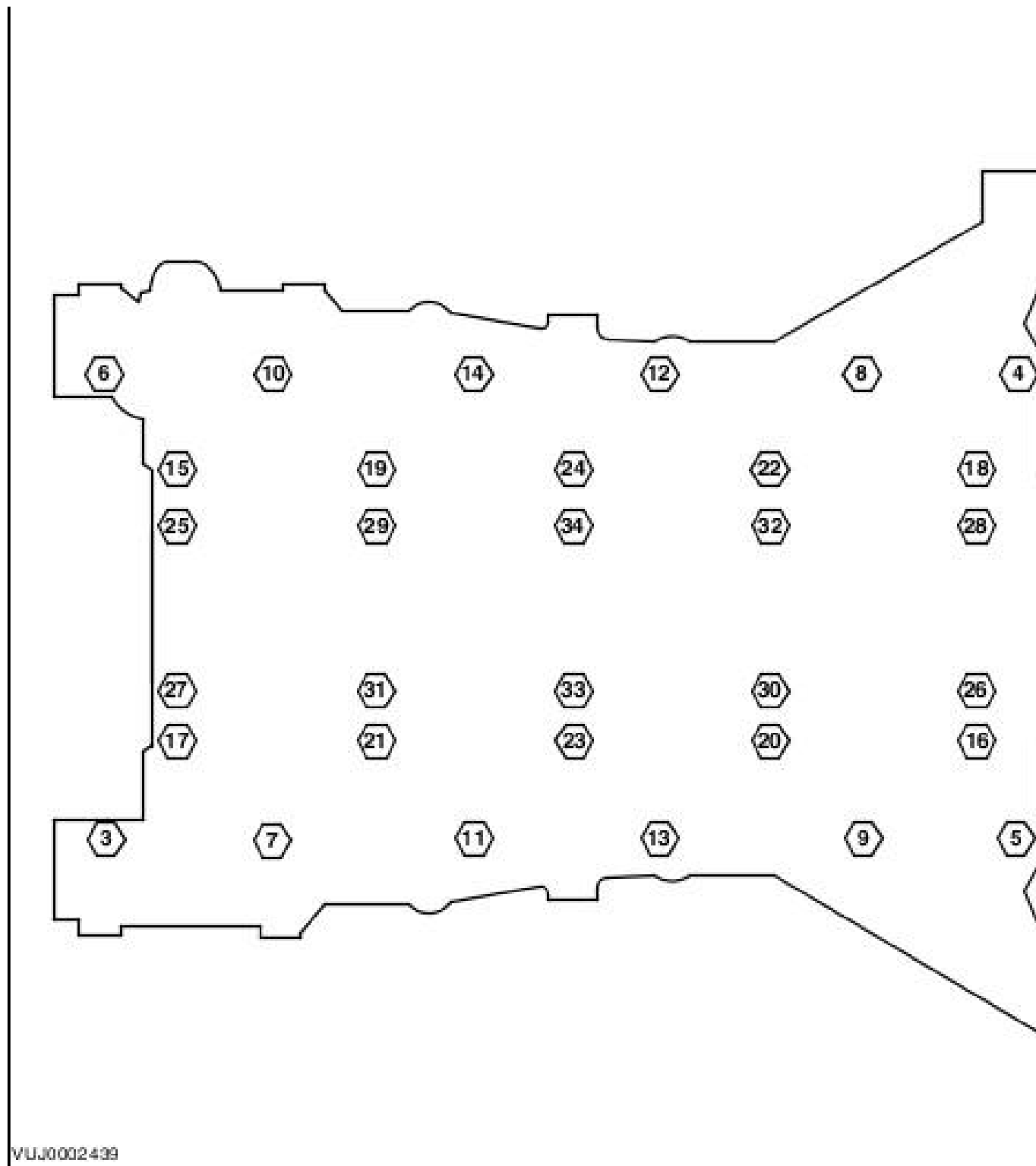
CAUTION: To make sure damage does not occur to the crankshaft and piston components, the engine must be inverted on the engine stand. Failure to follow this instruction may result in damage to the engine.

NOTE: If the crankshaft main bearing carrier retaining bolts have been marked with a center punch dot, they must be discarded and new bolts installed.

8. Remove the crankshaft main bearing carrier.
 - Remove the crankshaft main bearing carrier retaining bolts in the indicated sequence.



9. Remove and discard the rear crankshaft oil seal.



VUJ0002439

INSTALLATION

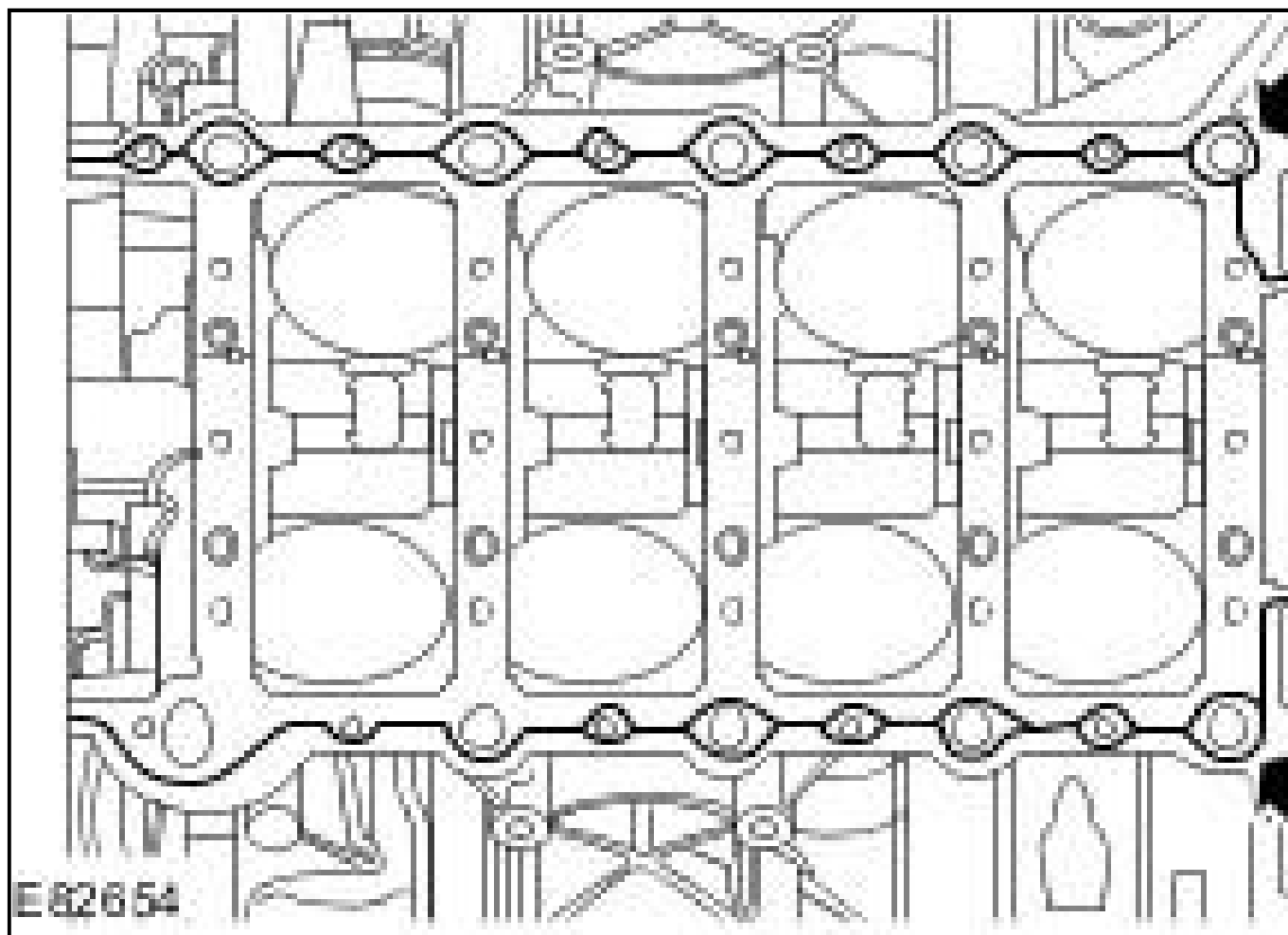
CAUTION: Use only a plastic scraper when removing the sealing material.

CAUTION: If any new bolts are to be installed to retain the crankshaft main bearing carrier, pre-stress the retaining bolts by installing the crankshaft main bearing carrier without any sealant and tightening the new retaining bolts to the specified torque. Remove the crankshaft main bearing carrier once the bolts have been pre-stressed. Failure to follow this instruction may result in damage to the vehicle.

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

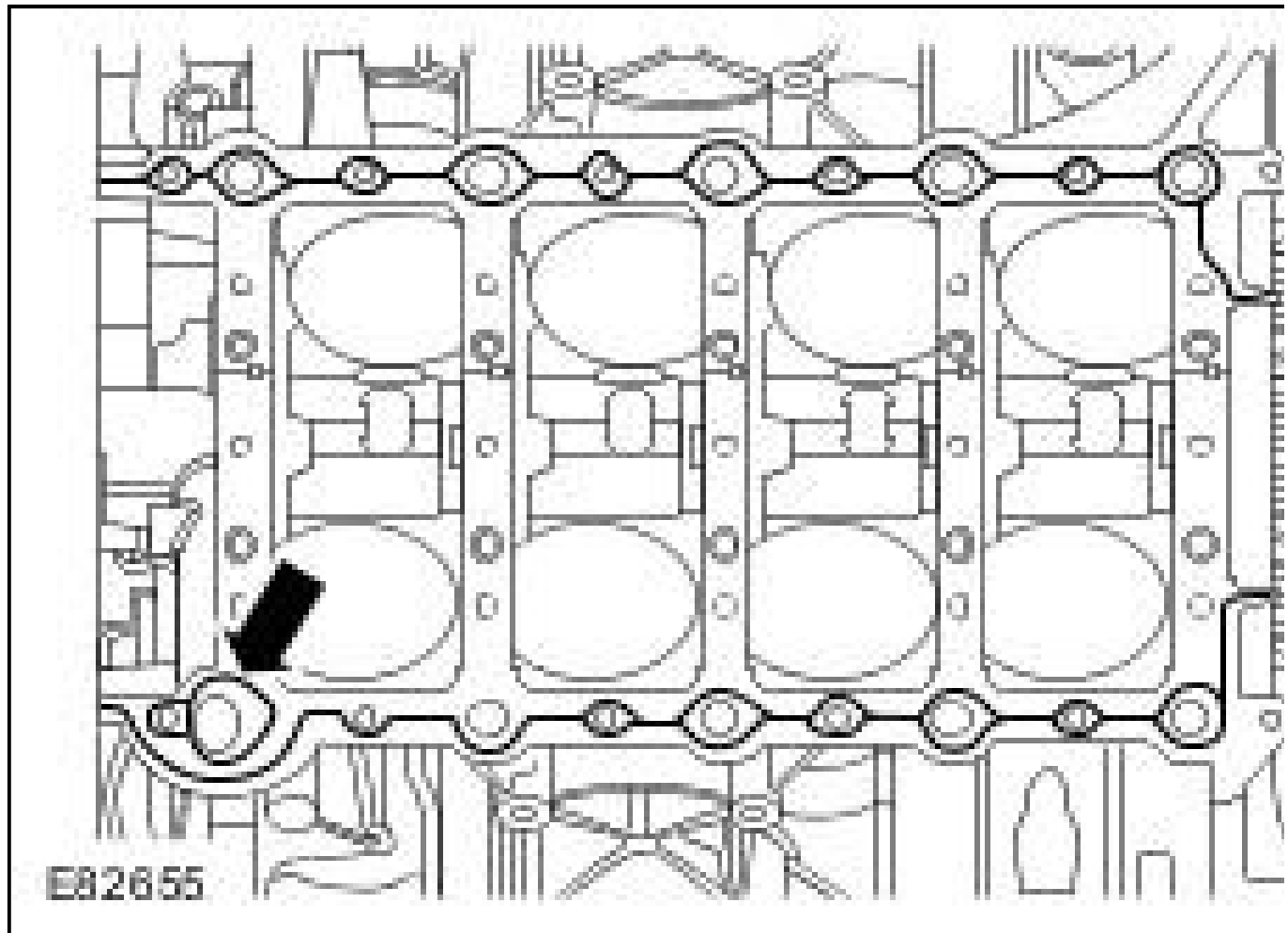
NOTE: Install the crankshaft main bearing carrier and tighten bolts to specification within twenty minutes of applying the sealant.

2. Apply a 2 mm (0.08in) bead of sealant to the cylinder block in the area shown.
 - Use WSS-M4G323-A4-RTV sealant.



NOTE: Install the crankshaft main bearing carrier and tighten bolts to specification within twenty minutes of applying the sealant.

3. Apply a 1 mm (0.039in) bead of sealant to the cylinder block in the area shown.
 - Use WSS-M4G323-A4-RTV sealant.



CAUTION: Make sure all dowels are fully seated into the crankshaft main bearing carrier prior to tightening the bolts.

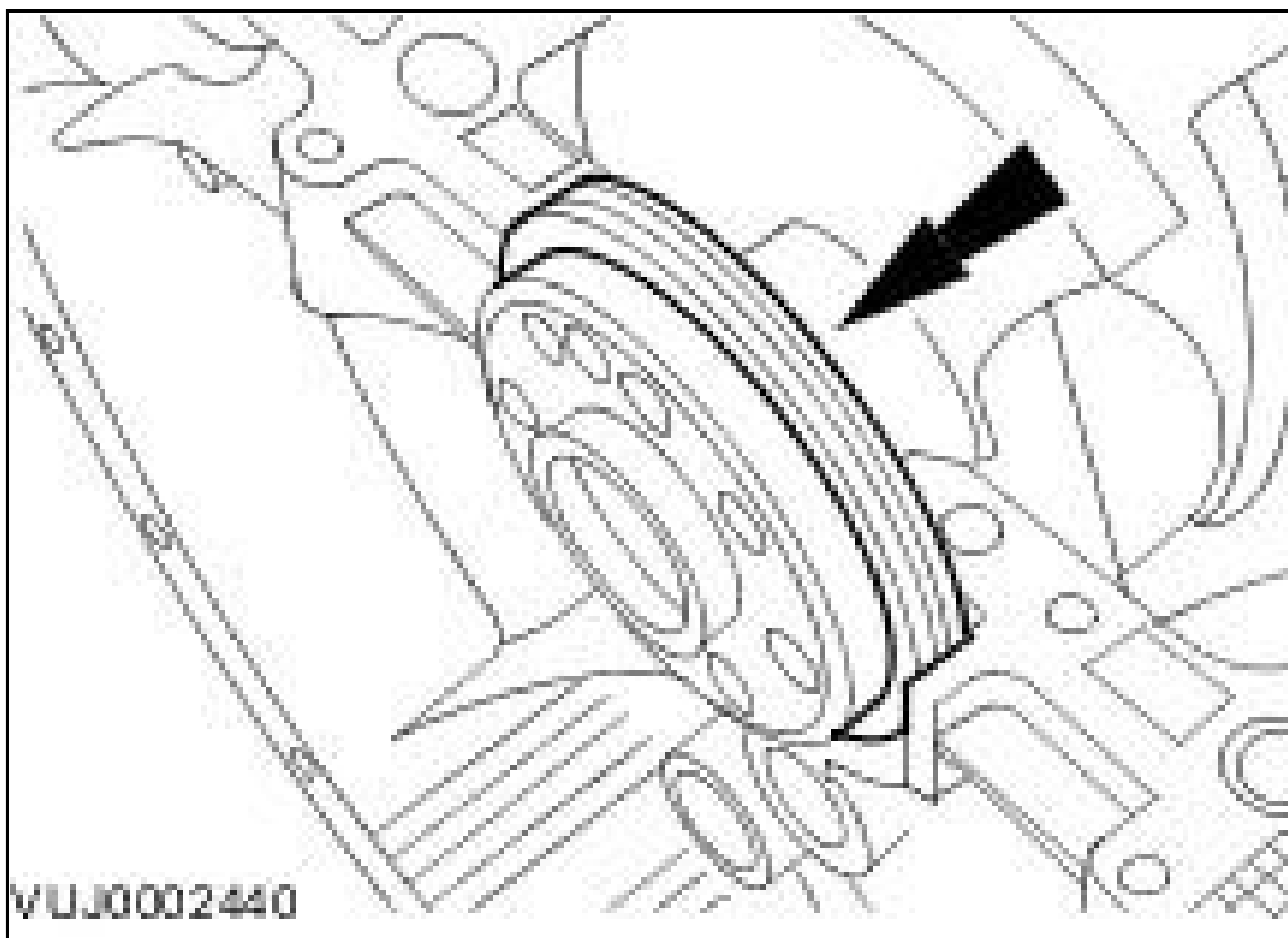
NOTE: Do not lubricate the crankshaft main bearing carrier retaining bolts.

NOTE: Do not rotate the crankshaft until all the retaining bolts are tightened to specification.

NOTE: The retaining bolts must be tightened within twenty minutes of applying the sealant.

NOTE: Tighten the retaining bolts in the sequence shown.

4. Install the crankshaft main bearing carrier to the cylinder block.
 - Stage 1: Bolts 21 to 32, tighten to 15 Nm (11 lb.ft).
 - Stage 2: Bolts 33 to 34, tighten to 15 Nm (11 lb.ft).
 - Stage 3: Bolts 1 to 10, tighten to 25 Nm (18 lb.ft).
 - Stage 4: Bolts 11 to 20, tighten to 15 Nm (11 lb.ft).
 - Stage 5: Bolts 1 to 10, tighten to 35 Nm (26 lb.ft), then a further 135 degrees.
 - Stage 6: Bolts 11 to 20, tighten to 20 Nm (15 lb.ft), then a further 150 degrees.
 - Stage 7: Bolts 21 to 32, tighten to 20 Nm (15 lb.ft), then a further 90 degrees.
 - Stage 8: Bolts 33 to 34, tighten to 20 Nm (15 lb.ft), then a further 150 degrees.
 - Stage 9: Center punch each of the bolt heads to indicate it has been reused.



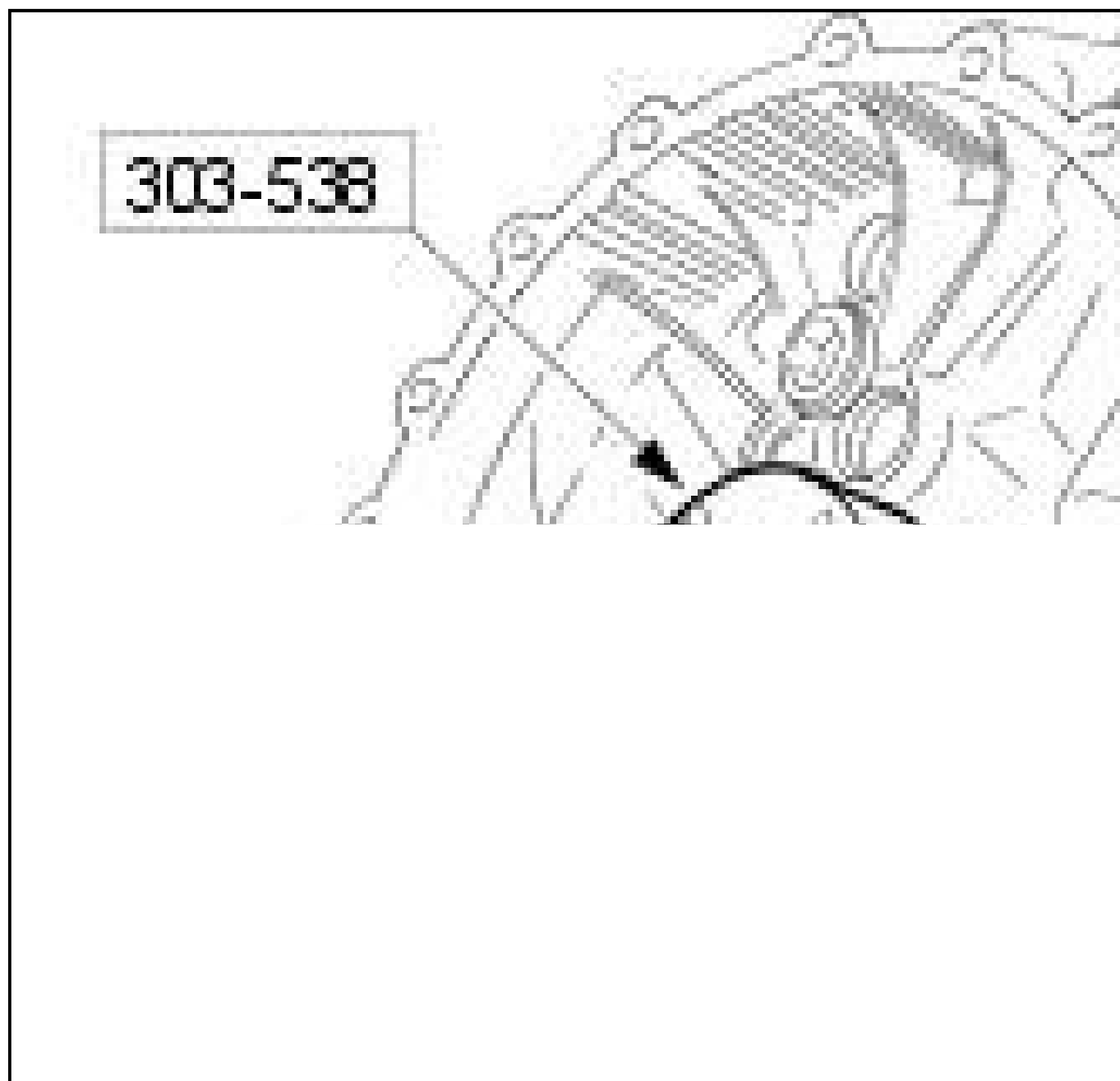
5. Rotate the crankshaft to check correct operation.
6. Remove excess sealant which may squeeze out at the front cover sealing surfaces.
7. Install the baffle plate.

- Tighten the 6 bolts to 6 Nm (4 lb.ft).

NOTE: Make sure that the transit sleeve is correctly positioned and install the new seal over the crankshaft. Do not use any lubricant on the seal, the transit sleeve or the crankshaft.

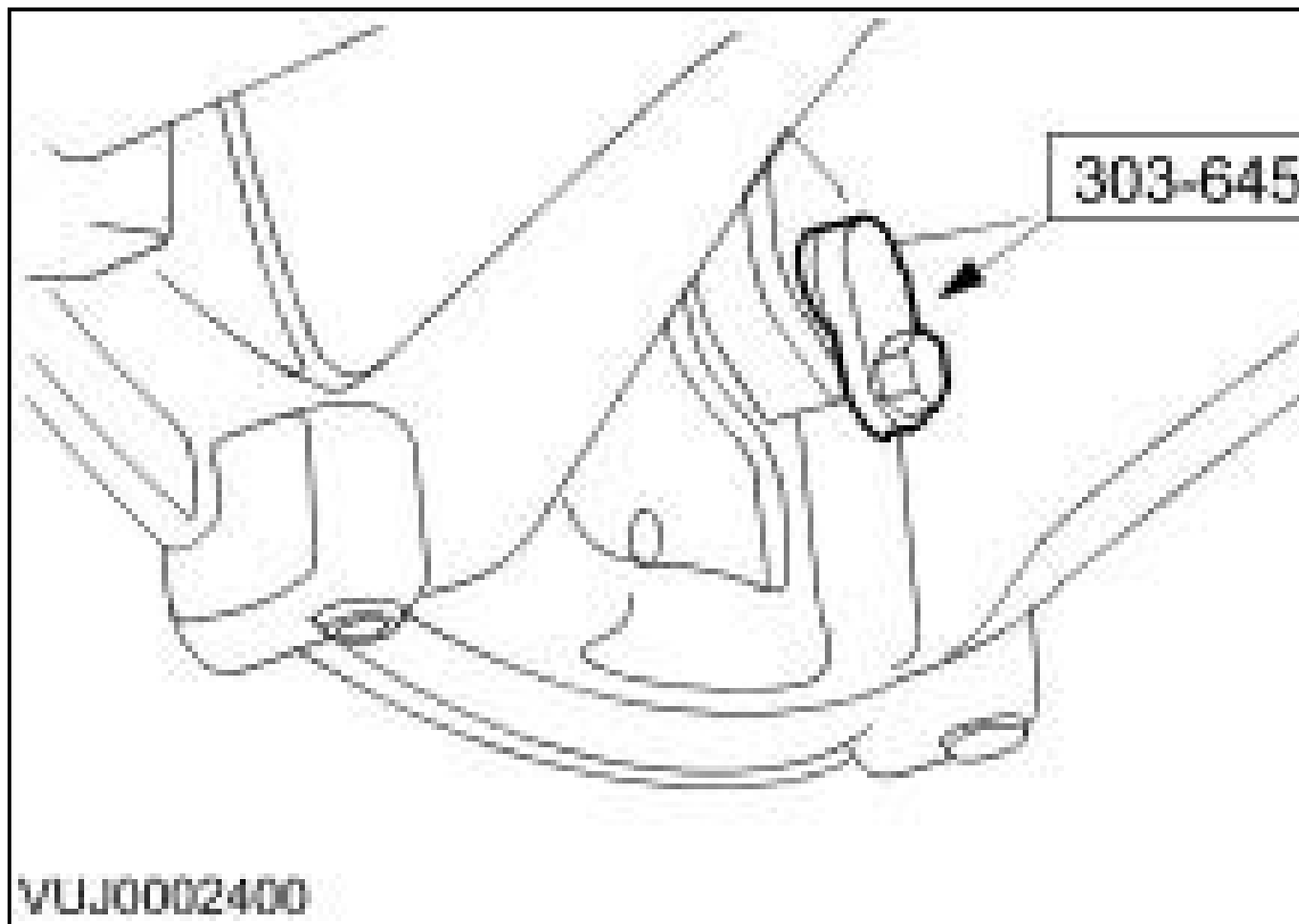
NOTE: Carefully remove the transit sleeve, leaving the seal in place.

8. Using the special tool, position the crankshaft rear oil seal.



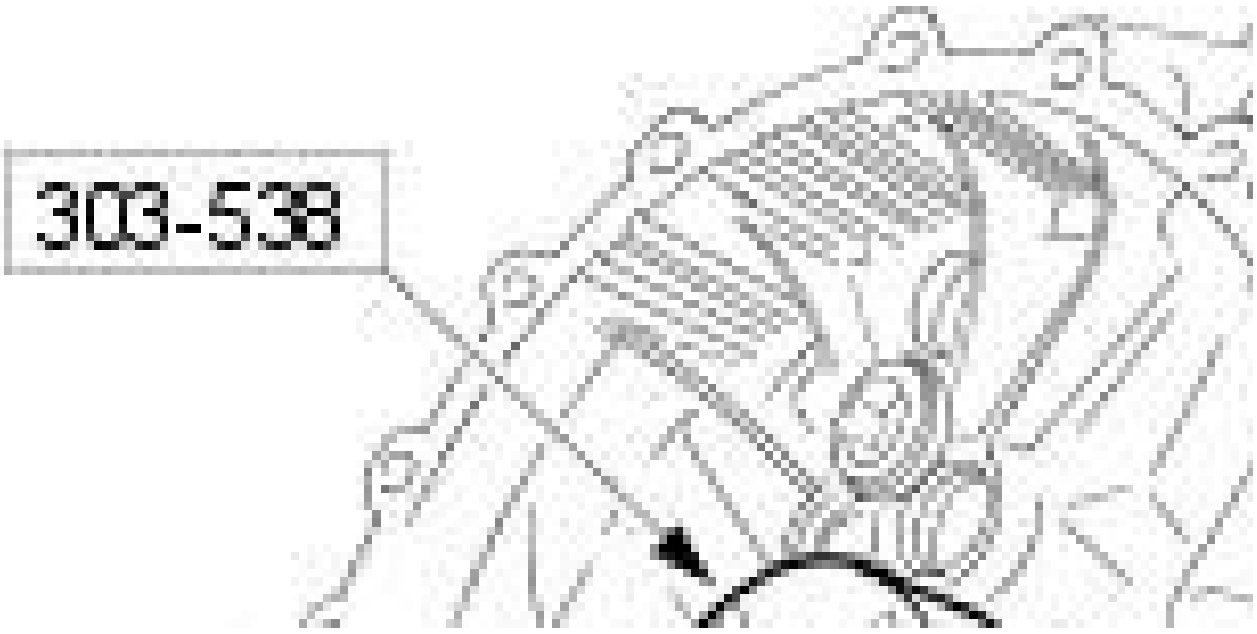
CAUTION: Alternate the nut tightening to correctly seat the crankshaft rear oil seal.

9. Using the special tool, install the crankshaft rear oil seal.



CAUTION: Make sure that the crankshaft rear oil seal is correctly located.

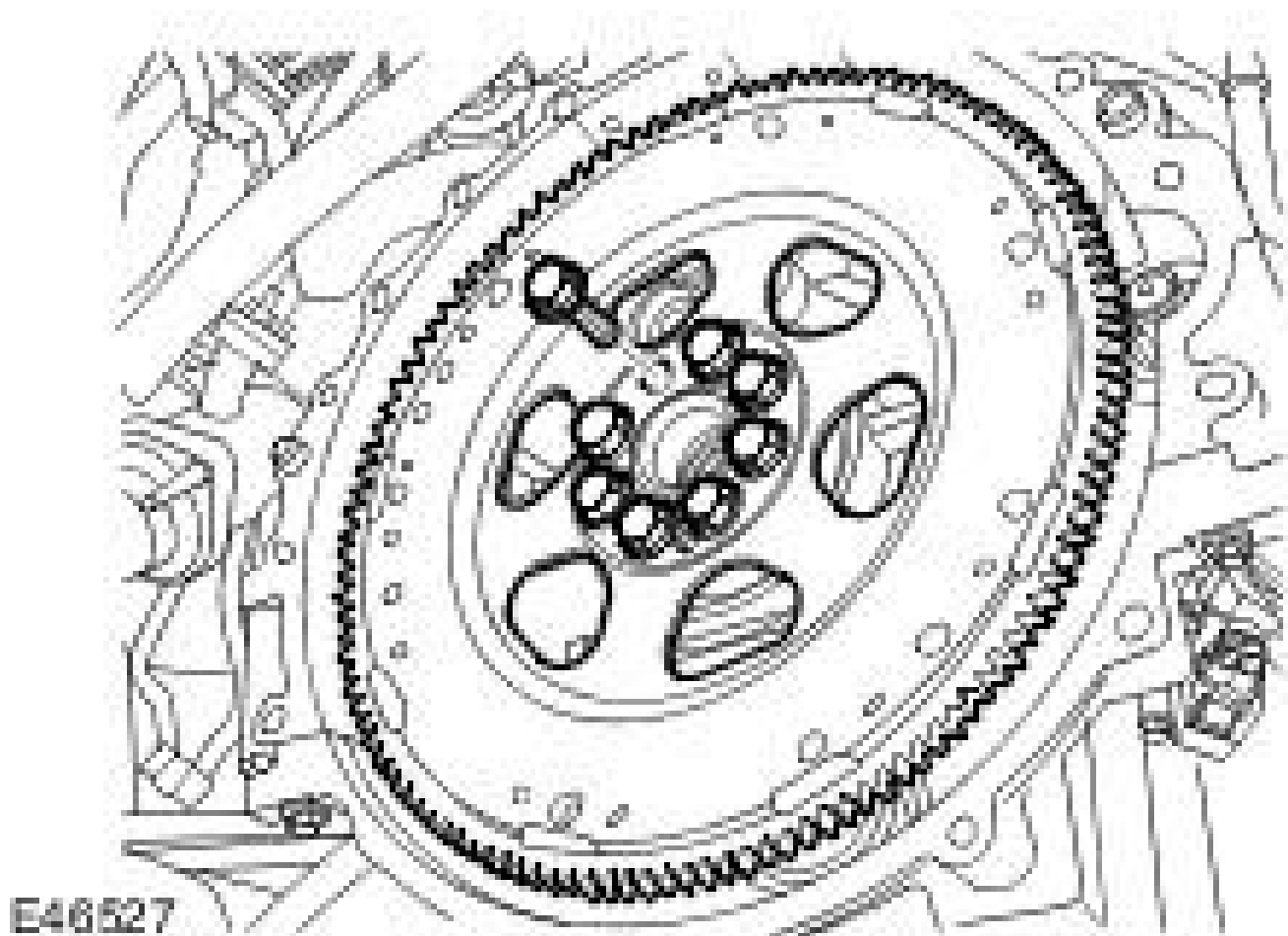
10. Remove the special tool.



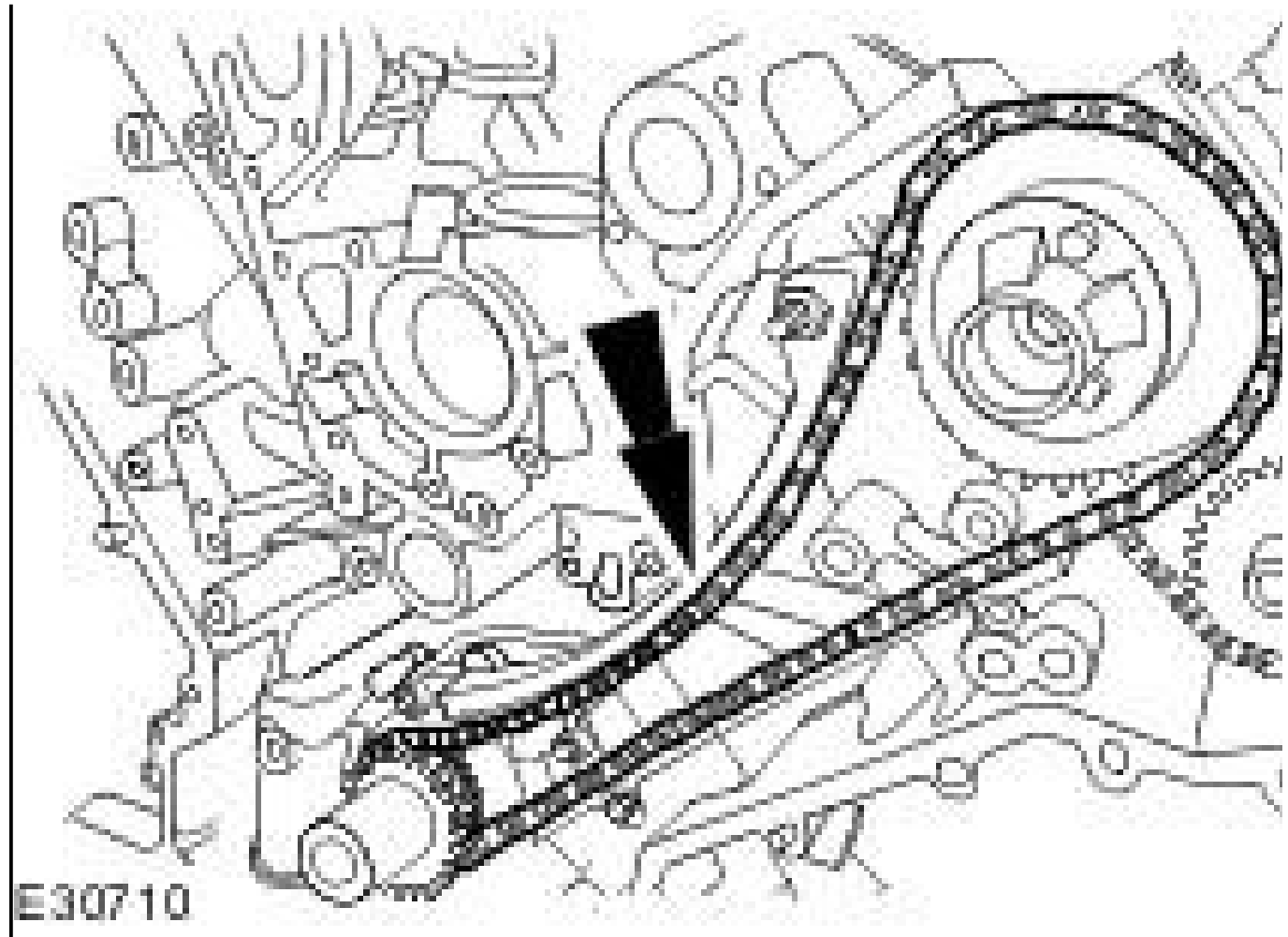
303-538

NOTE: Prevent the flexplate from rotating.

11. Install the torque converter flexplate.
 - Clean the component mating faces.
 - Tighten the bolts evenly in 2 stages to the sequence shown.
 - Tighten the bolts to 15 Nm (11 lb ft).
 - Tighten the bolts to 110 Nm (81 lb.ft).



12. Install the special tool.



13. Connect the battery positive cable and the switch lead to the starter motor solenoid.

- Connect the battery positive cable.
- Connect the electrical connector.
- Install the battery positive cable cover.

14. Install the starter motor.

- Clean the component mating faces.
- Tighten the bolt to 45 Nm (33 lb.ft).

15. Install the oil pump. See **Oil Pump**.

16. Connect the battery ground cable. Refer to **Specifications** .

REMOVAL

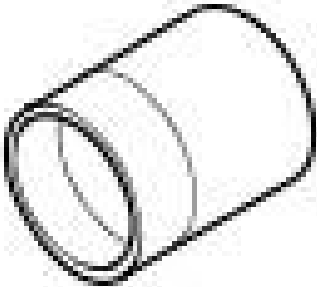
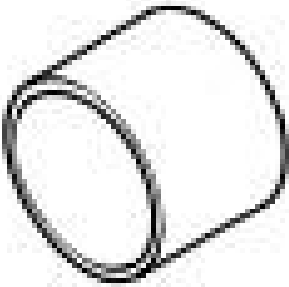
ENGINE

SPECIAL TOOLS

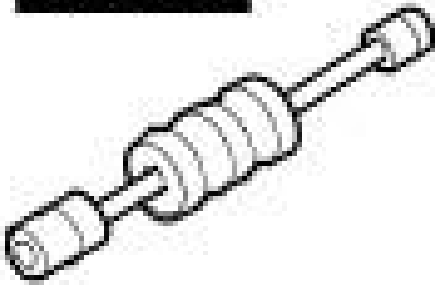
Tool Illustration	Tool Name	Tool Number

2007 Land Rover Range Rover HSE

ENGINE Engine (4.4L)

 205-735 E61263	Remover halfshaft inboard joint	205-735(LRT-54-026)
 308-626/1 E54136	Installer halfshaft oil seal	308-626/1
 308-626/2 E54137	Installer/Guide halfshaft oil seal	308-626/2
	Impulse extractor	100-012(LRT-99-004)

100-012

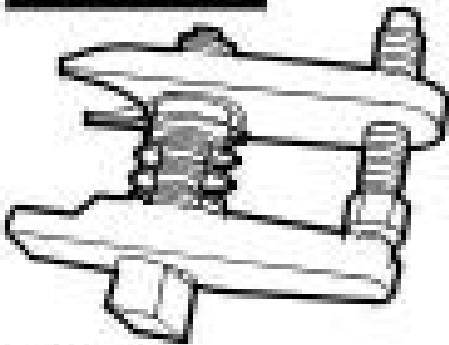


E54135

Ball joint separator

205-754(LRT-54-027)

205-754A



E45276

Fuel spring lock decoupling tool

310-D005

310-D005



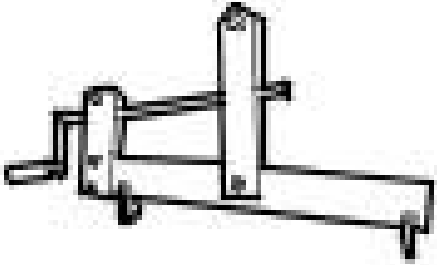
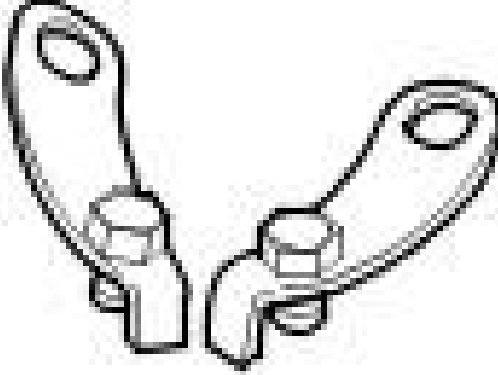
E45289

Engine lift and tilt bracket

303-940(LRT-12-138)

2007 Land Rover Range Rover HSE

ENGINE Engine (4.4L)

 303-940 E61659		
 303-940/1 E61731	Engine lift and tilt bracket chains	303-940/1
 303-536	Engine lifting brackets	303-536
	Engine lifting brackets	303-749

**REMOVAL**

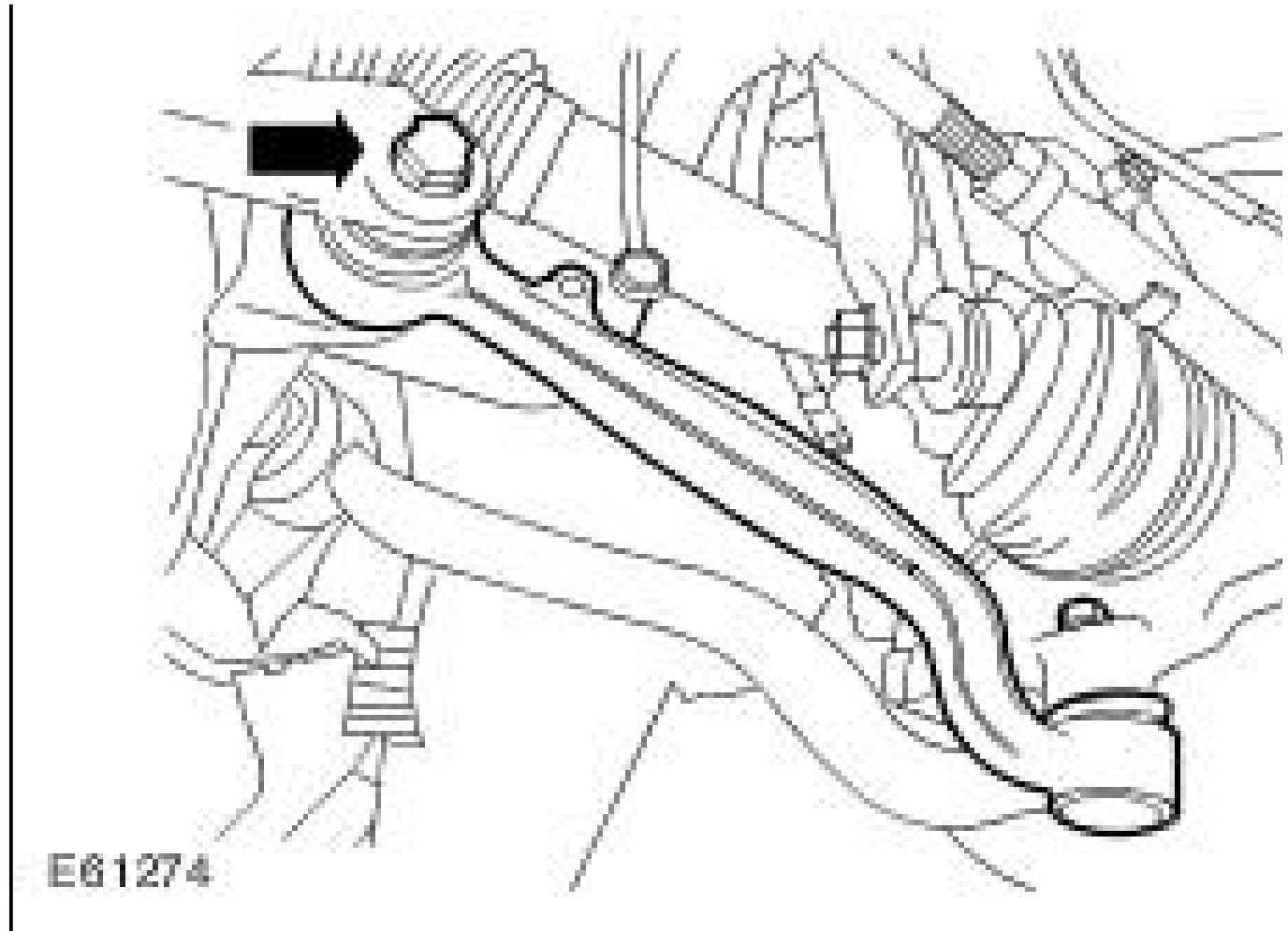
1. Disconnect the battery ground cable. Refer to Specifications .

WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

2. Raise and support the vehicle.
3. Remove the engine cover. Refer to Engine Cover - 4.4L .
4. Evacuate the air conditioning (A/C) system. Refer to Air Conditioning (A/C) System Recovery, Evacuation and Charging .
5. Remove the throttle body gasket. Refer to Throttle Body Gasket .
6. Remove the transmission fluid cooler. Refer to Transmission Fluid Cooler - 4.4L .
7. Remove the RH air cleaner assembly. Refer to Air Cleaner .
8. Drain the cooling system. Refer to Cooling System Draining, Filling and Bleeding .
9. Drain the engine oil. See Engine Oil Draining and Filling .
10. Drain the differential fluid. Refer to Differential Draining and Filling .
11. Remove the RH driveshaft. Refer to Halfshaft Bearing .
12. Remove the LH driveshaft. Refer to Halfshaft Seal LH .

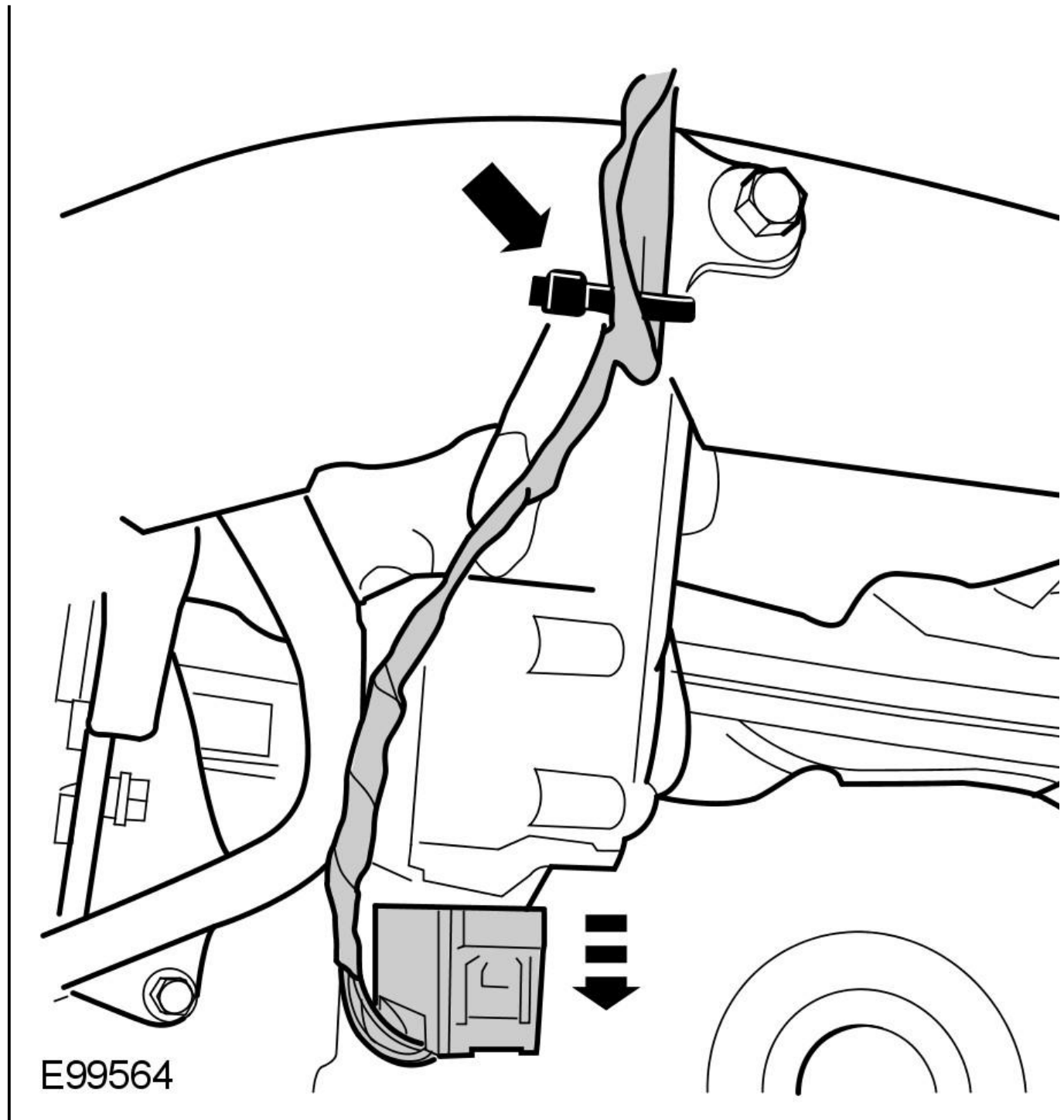
CAUTION: Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.

13. Disconnect the lower steering column from the steering gear.
 - Note the fitted position.
 - Align the steering wheel to straight ahead.
 - Remove and discard the Torx bolt.



NOTE: LH illustration shown, RH is similar.

14. Disconnect the height sensor electrical connector.
 - Cut the cable tie.
 - Release and reposition the wiring harness.

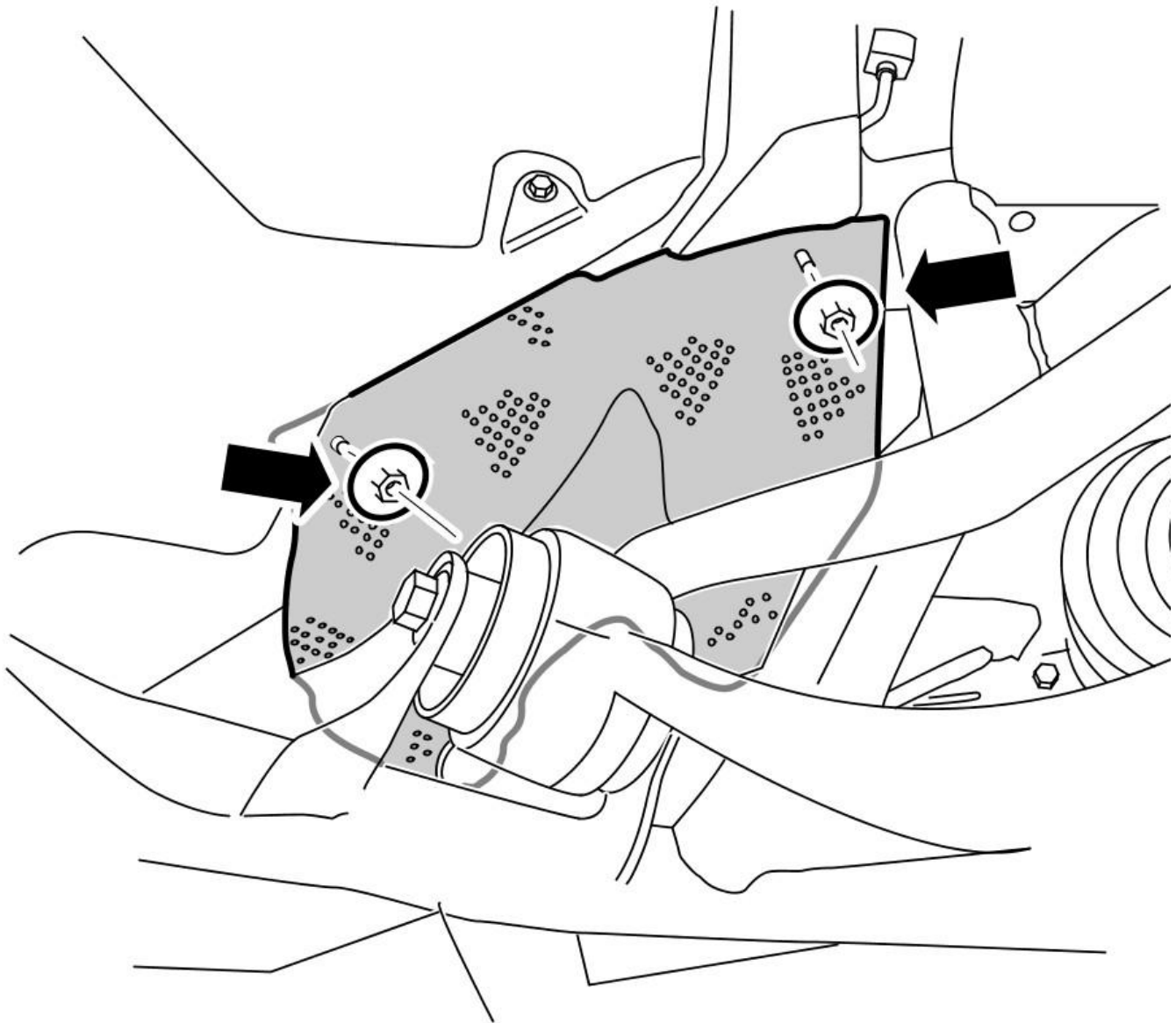


15. Disconnect the steering gear electrical connector.
 - Release and reposition the wiring harness.



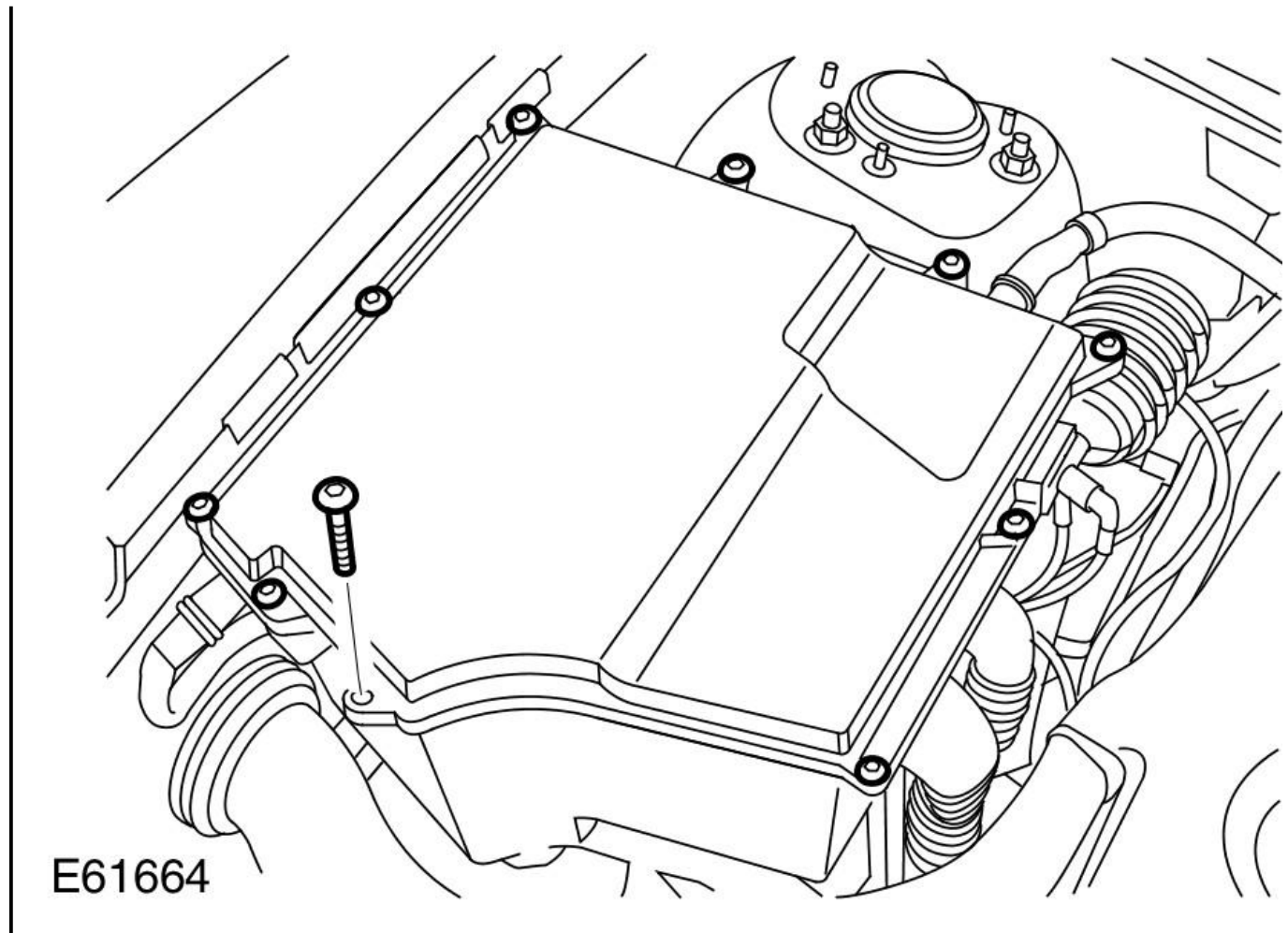
NOTE: RH illustration shown, LH is similar.

16. Release the stabilizer bar heat shields from body.
 - Remove the 2 nuts.

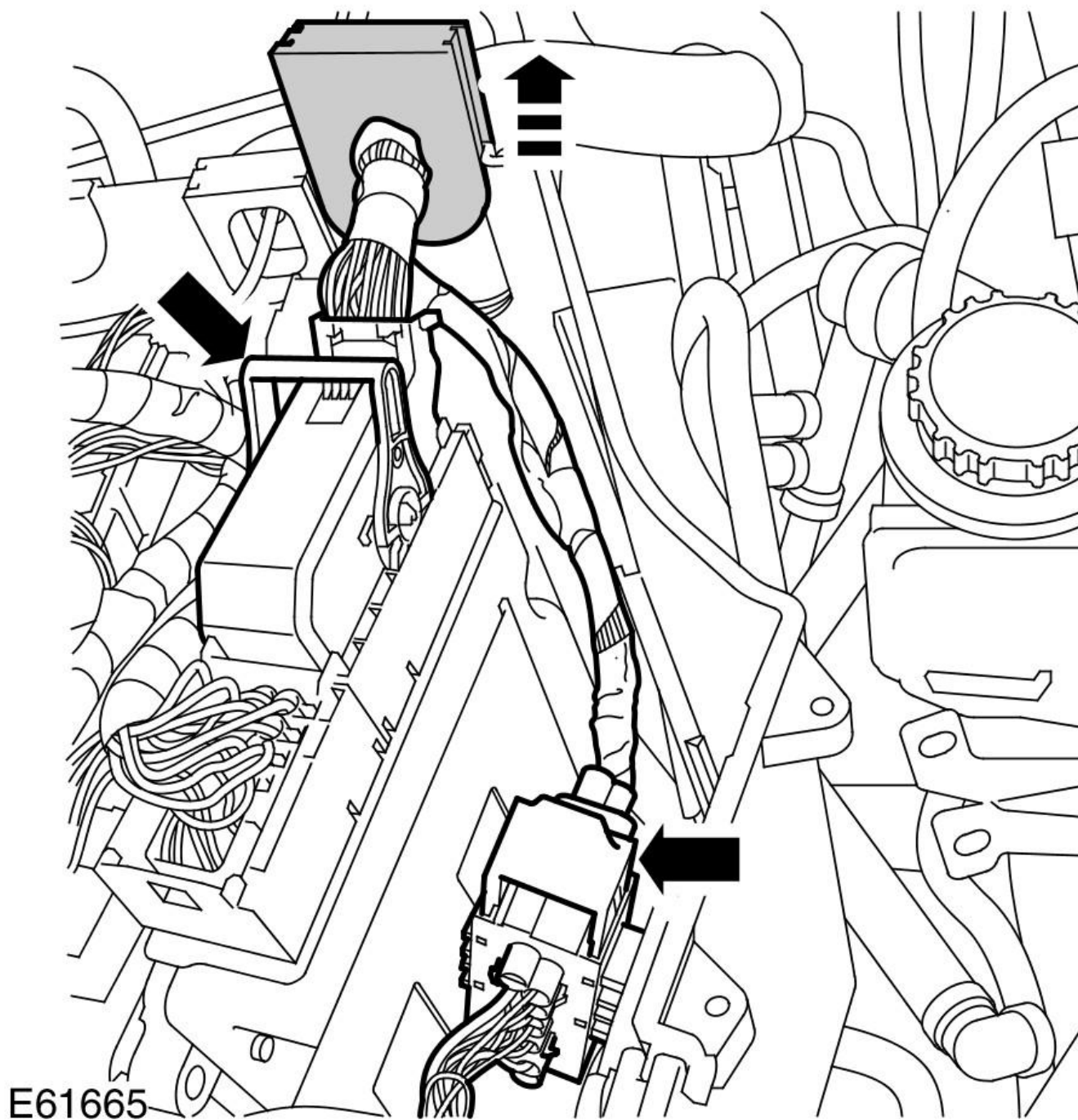


E99568

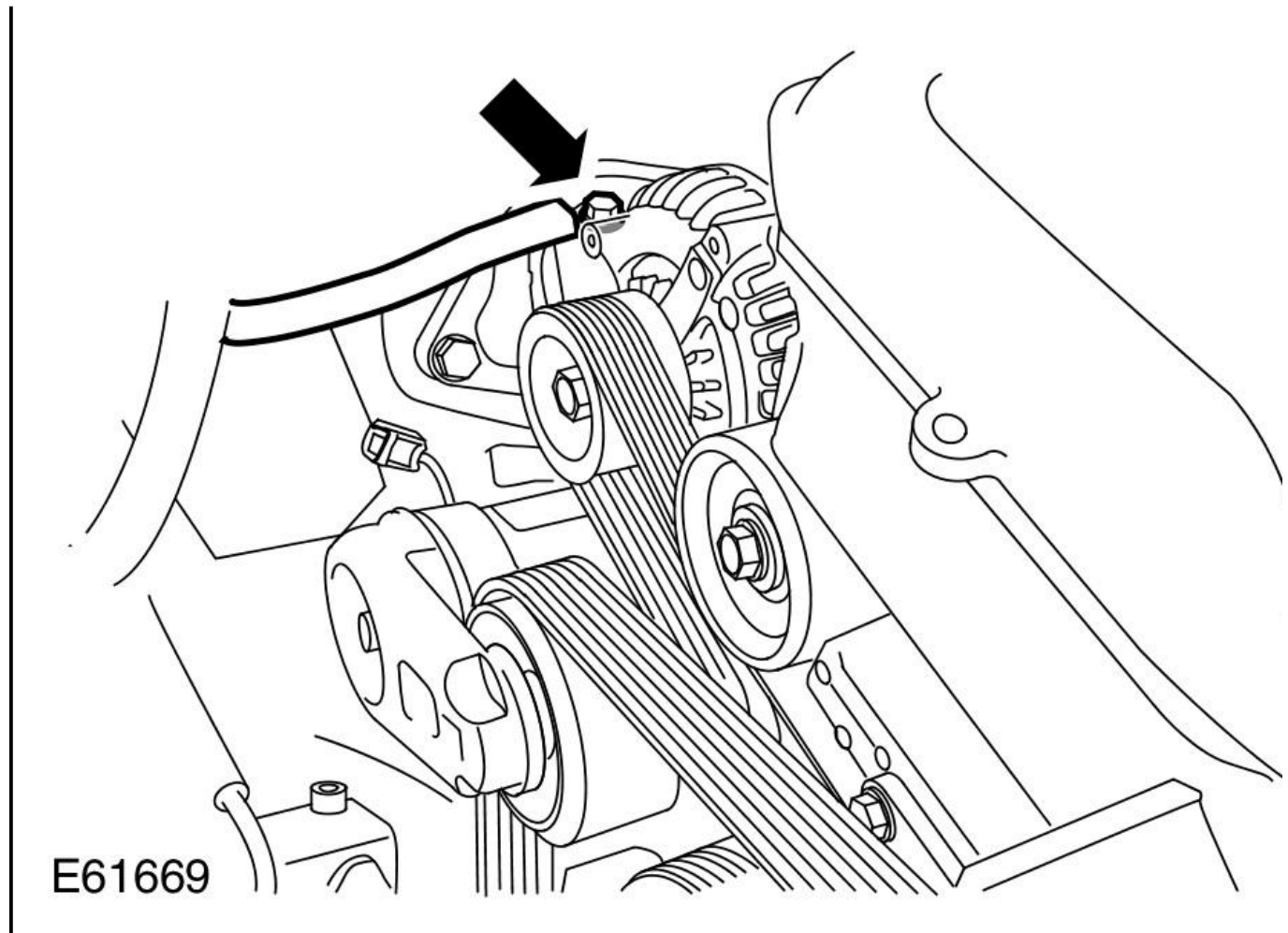
17. Remove the transmission assembly. Refer to **Transmission** .
18. Remove the engine control module (ECM) cover.
 - Remove the 10 Torx screws.



19. Release the engine wiring harness.
- Disconnect the 2 electrical connectors.
 - Release the grommet.

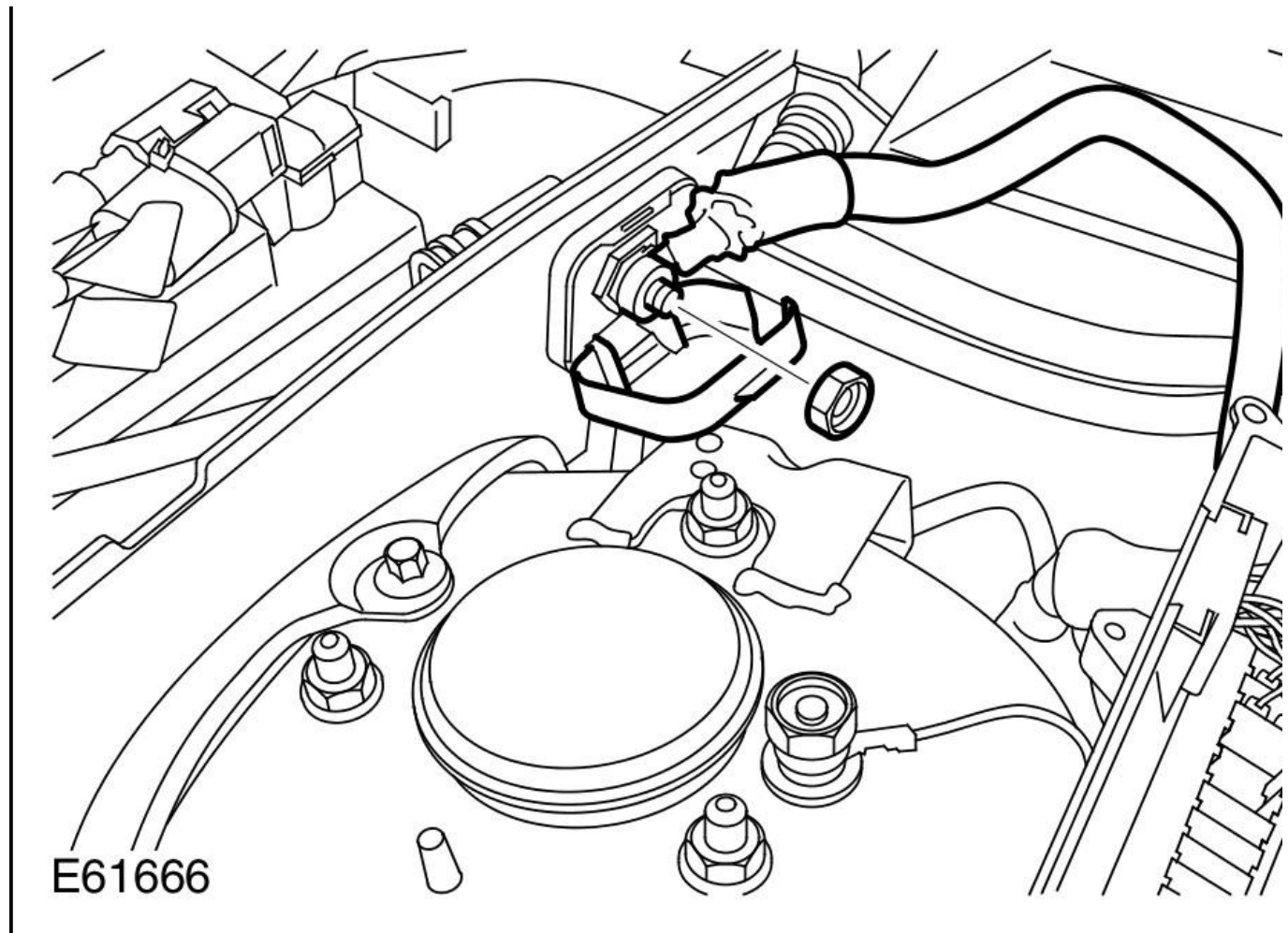


20. Disconnect the engine ground cable from the RH mounting bracket.
 - Remove the bolt.



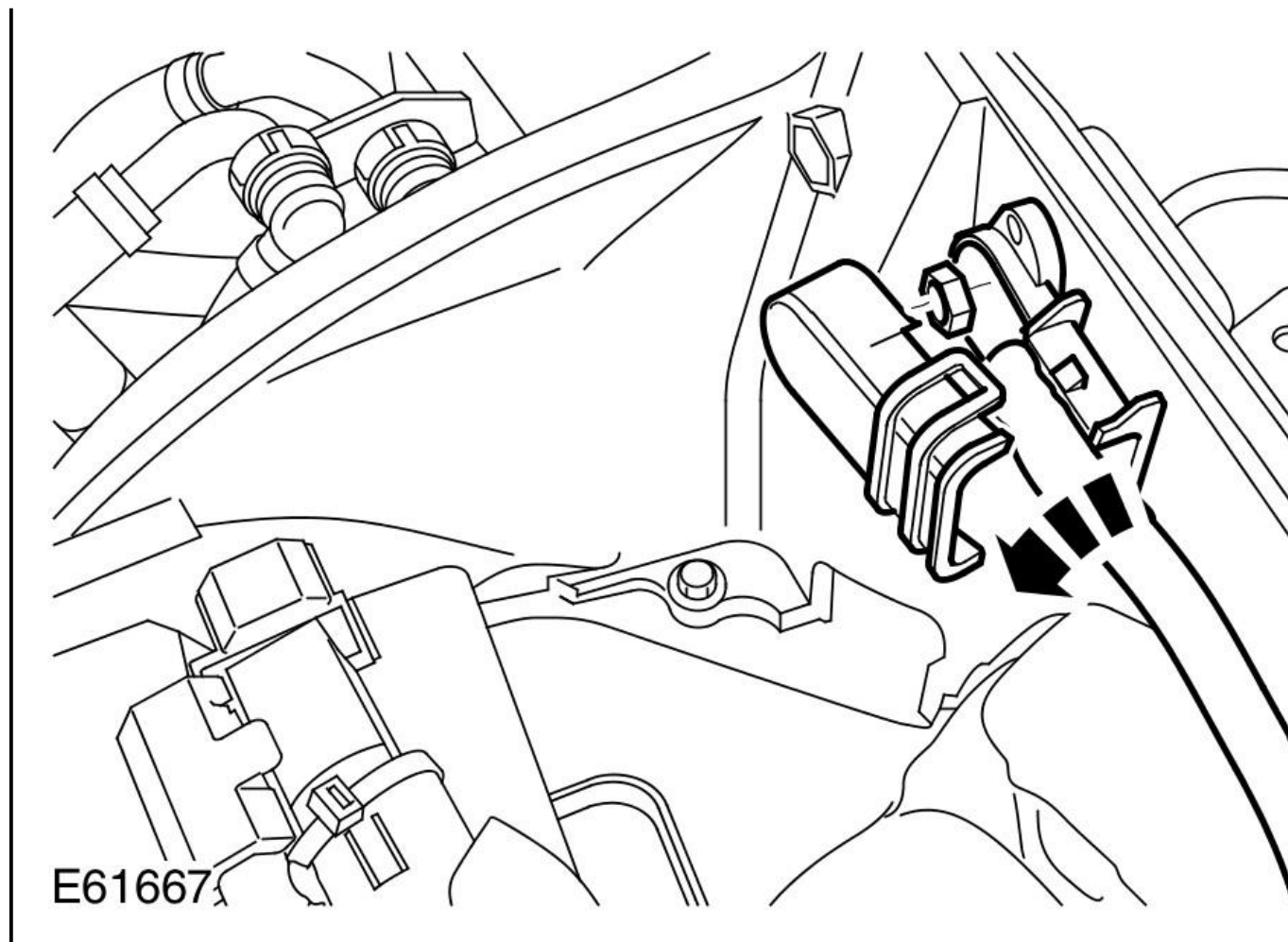
21. Disconnect the battery positive cable from the junction box.

- Open the cover.
- Remove the nut.



22. Release the battery positive cable from the battery compartment side wall.

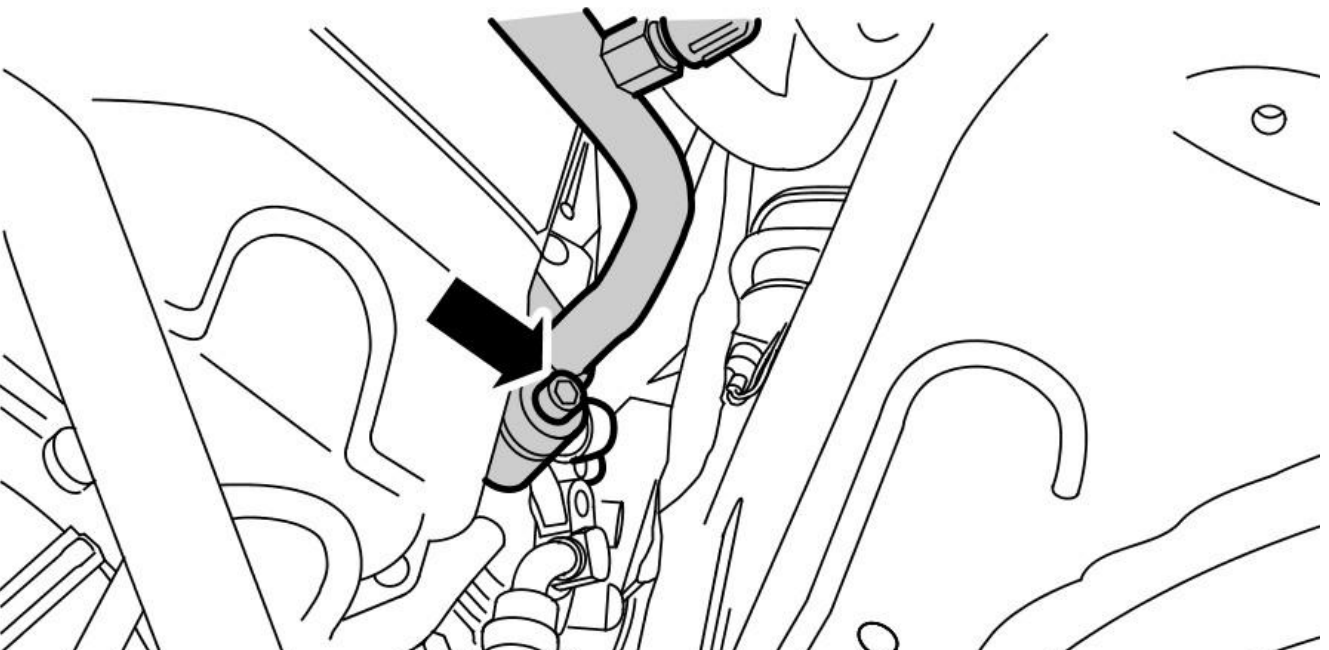
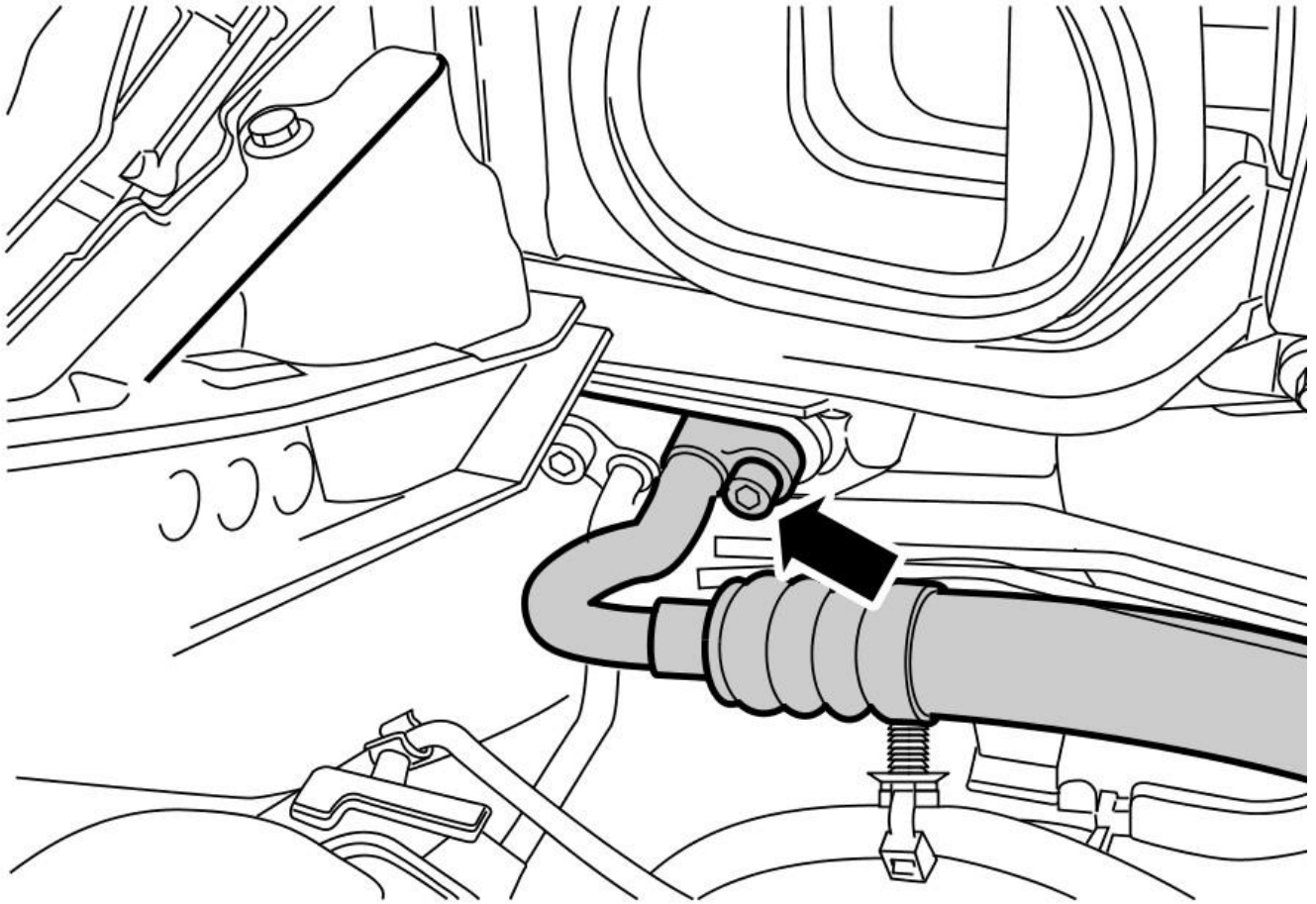
- Remove the cover.
- Remove the nut.



CAUTION: Immediately cap all refrigerant lines to prevent ingress of dirt and moisture.

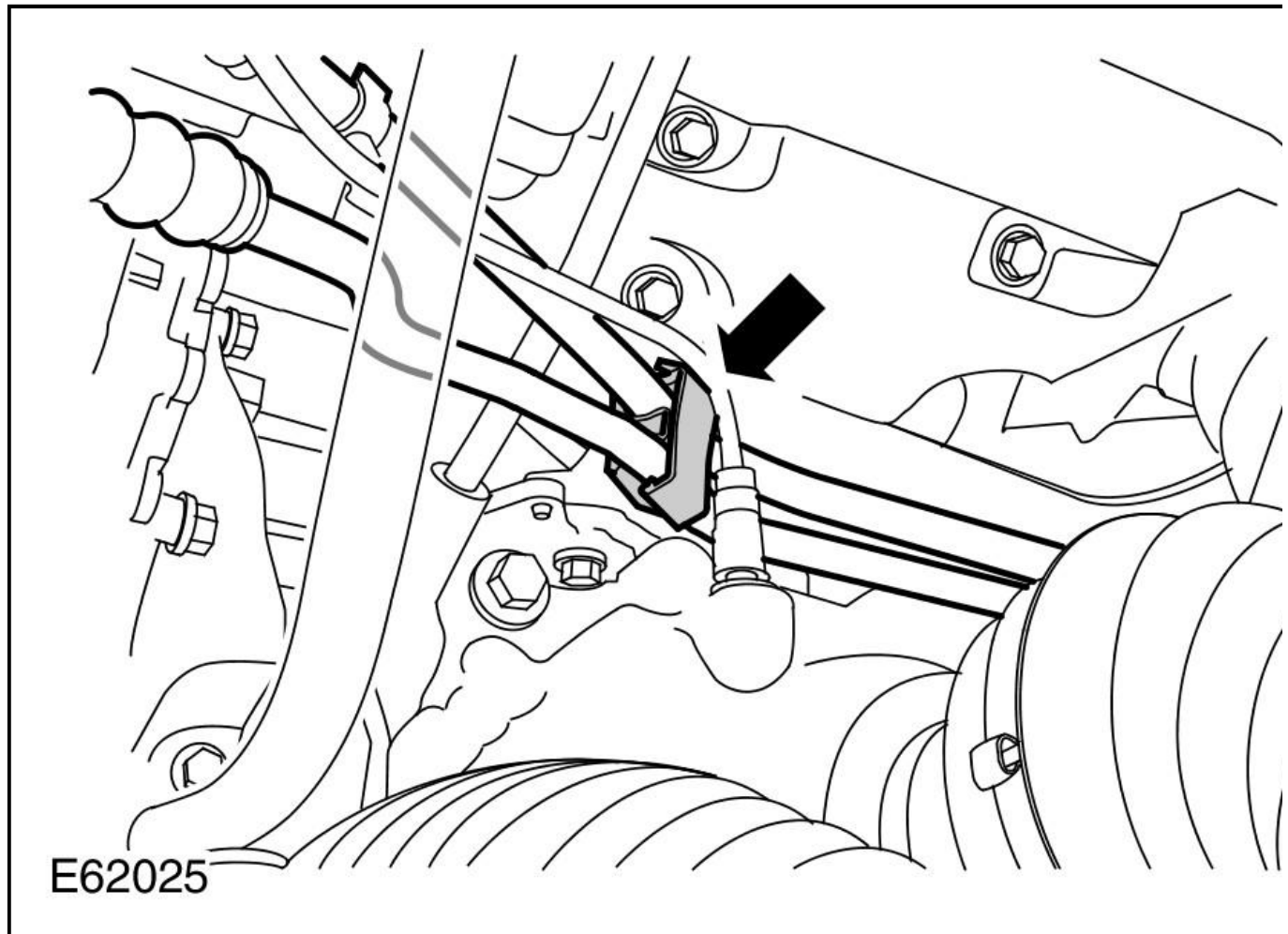
23. Remove the A/C compressor low-pressure refrigerant line.

- Remove the 2 bolts.
- Remove and discard the 2 O-ring seals.



24. Release the transmission fluid lines from the engine.

- Release from the clip.



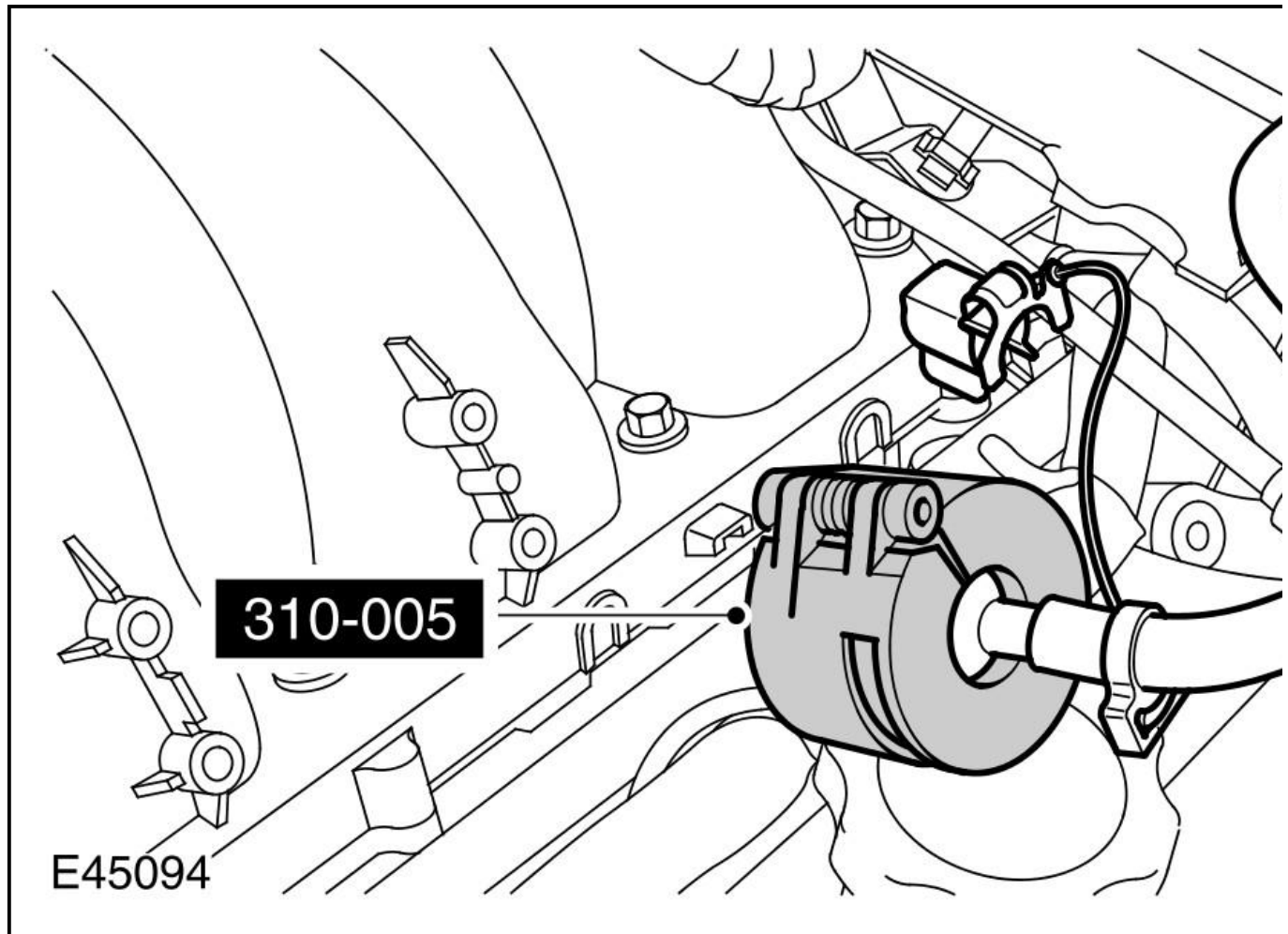
WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

WARNING: Do not carry or operate cellular phones when working on or near any fuel related components. Highly flammable vapors are always present and may ignite. Failure to follow these instructions may result in personal injury.

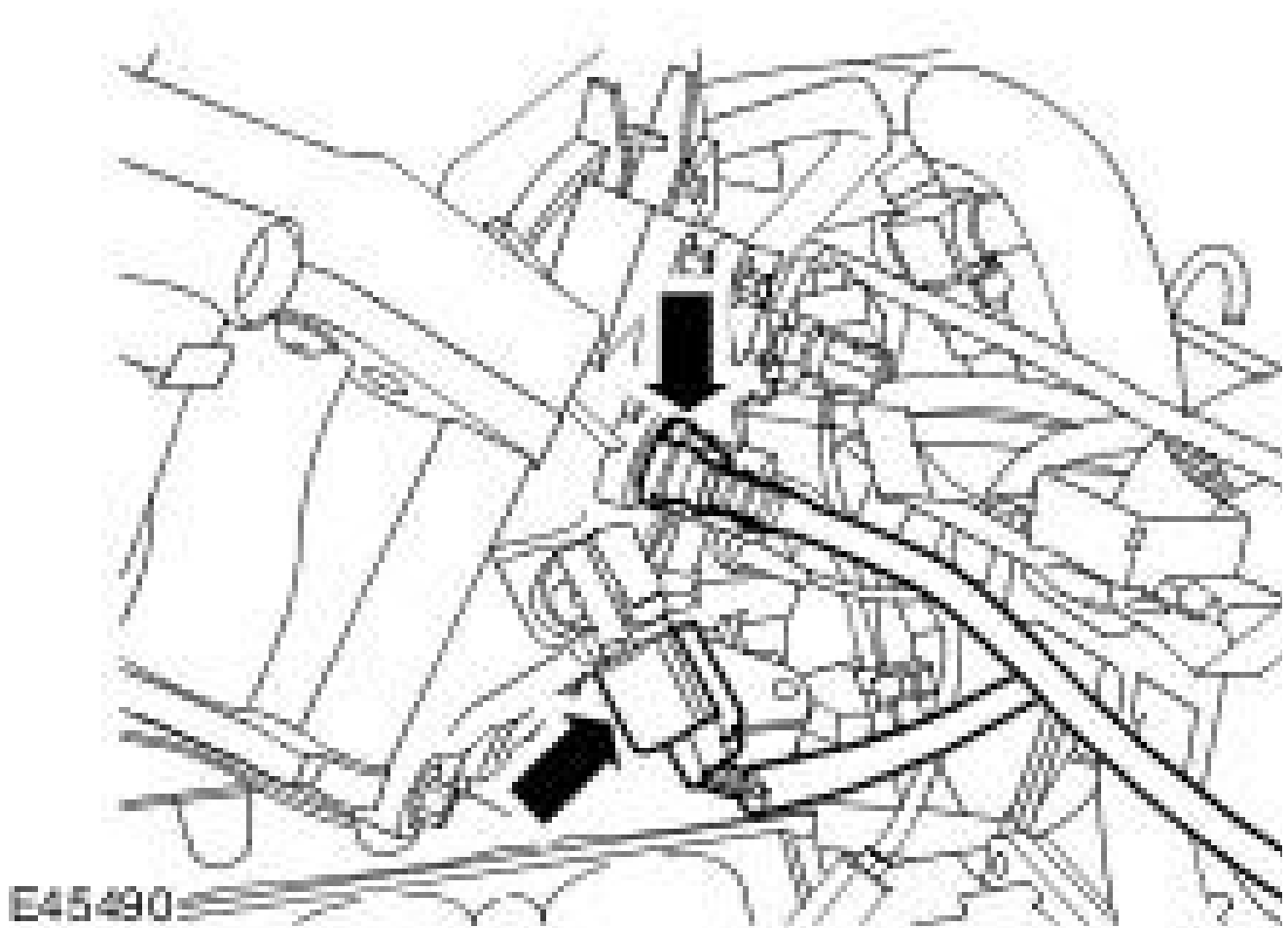
WARNING: The spilling of fuel is unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

25. Using the special tool, disconnect the fuel line.

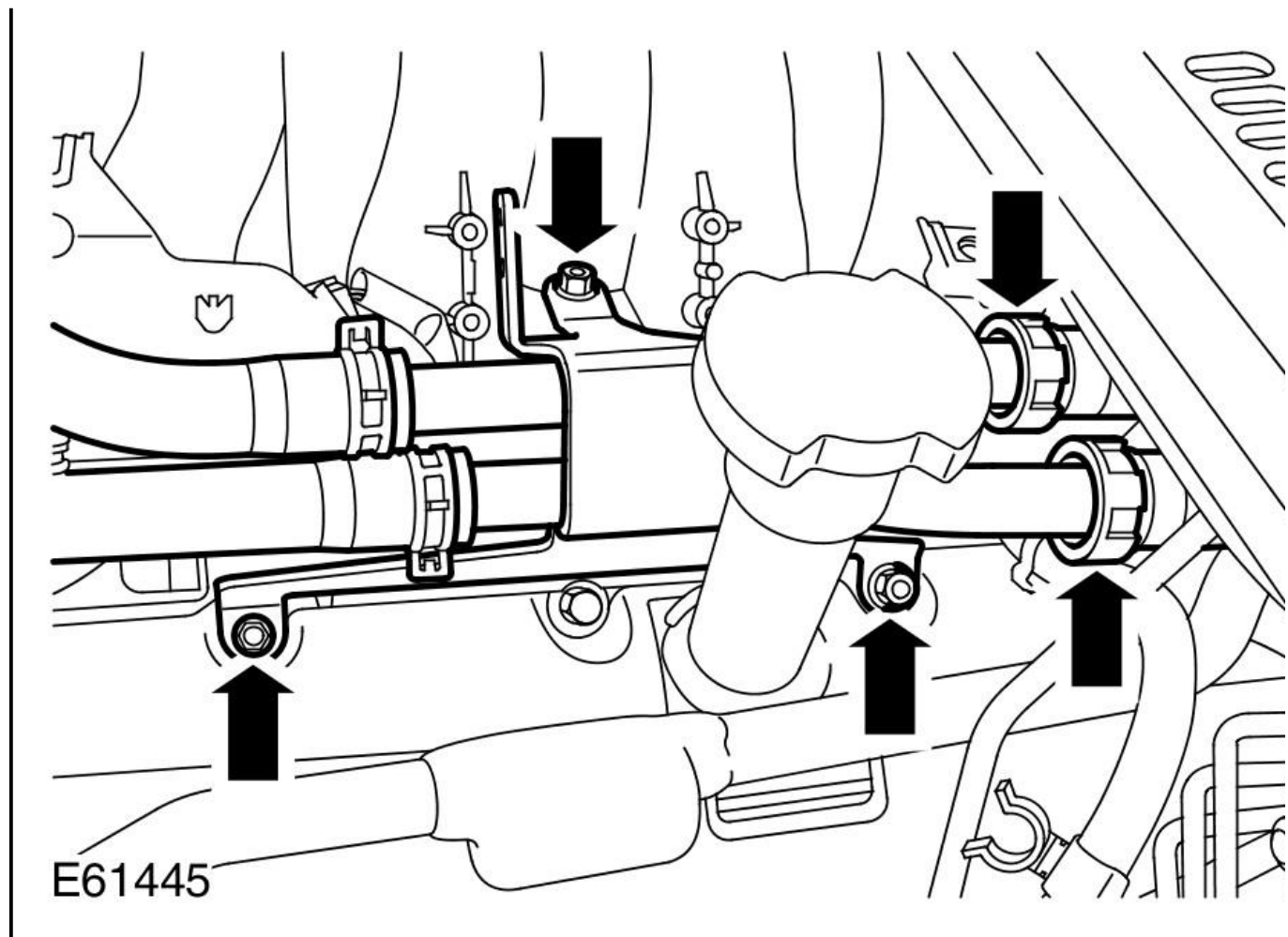
- Remove the clip.



26. Disconnect the brake booster vacuum hose from the intake manifold.
- Disconnect the quick release connector.

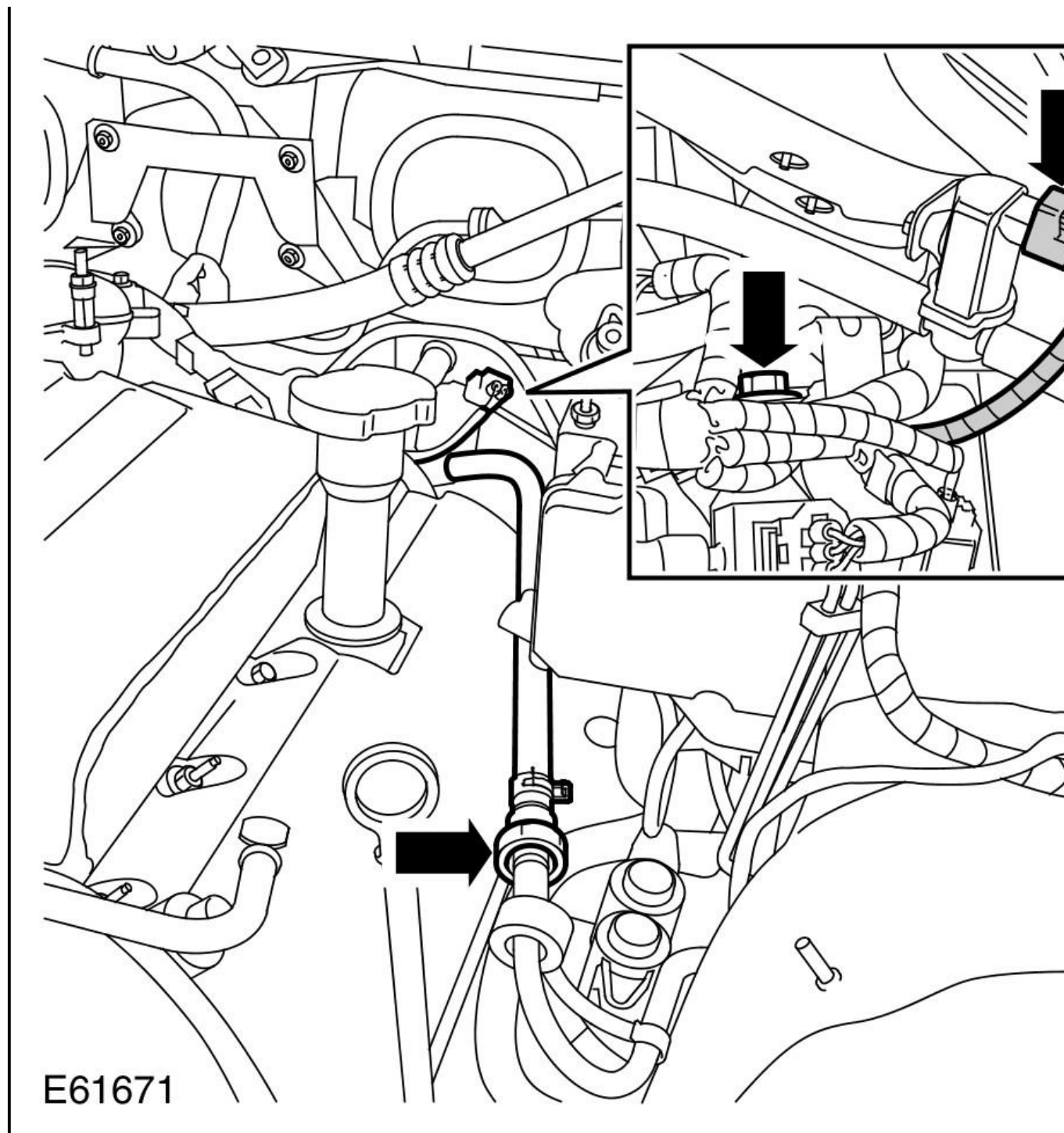


27. Disconnect the 2 heater coolant hoses.
- Disconnect the 2 quick release connectors.



28. Release the purge valve assembly.

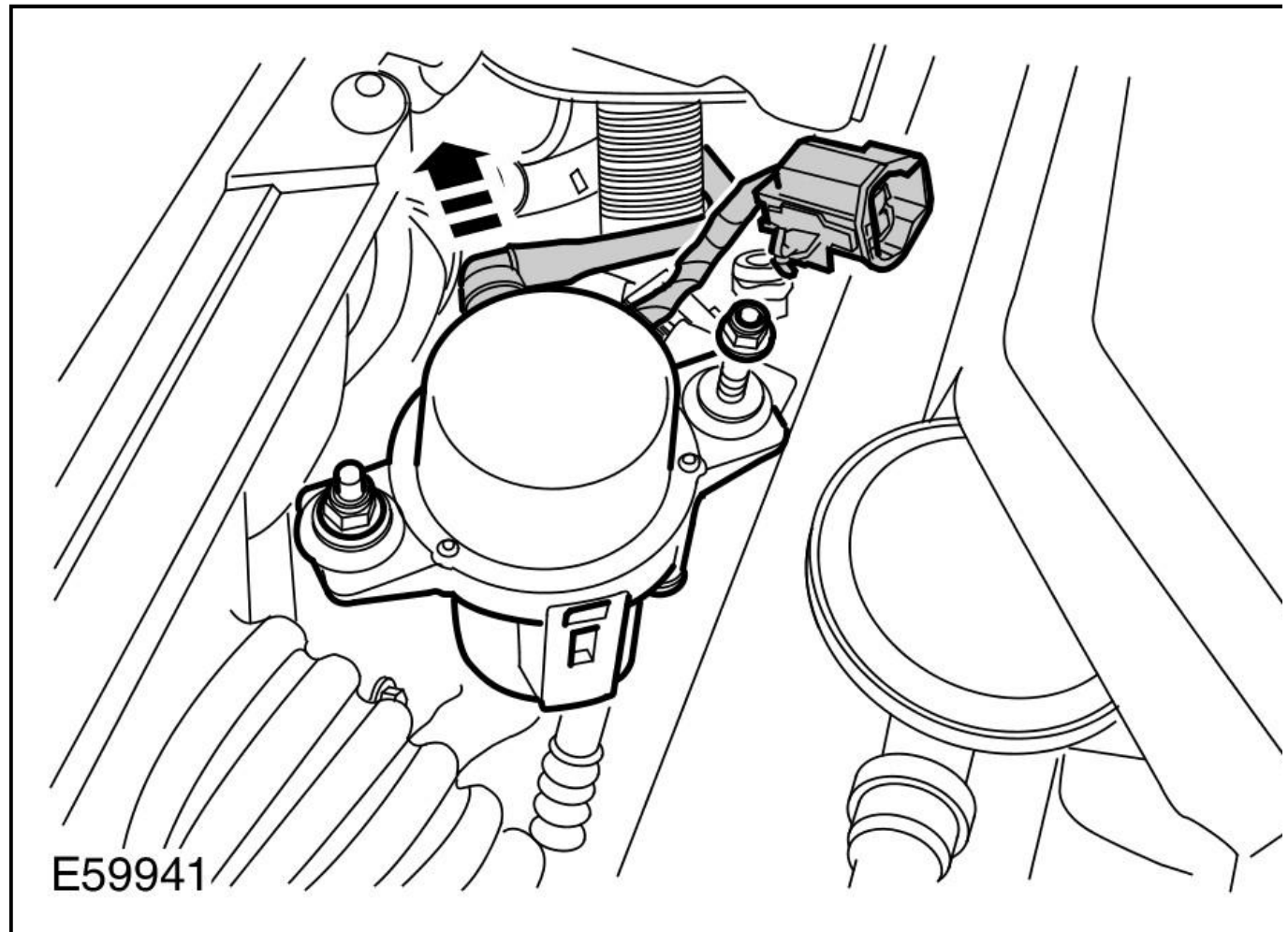
- Disconnect the electrical connector.
- Depress the quick release connector.
- Remove the bolt.



CAUTION: Always plug any open connections to prevent contamination.

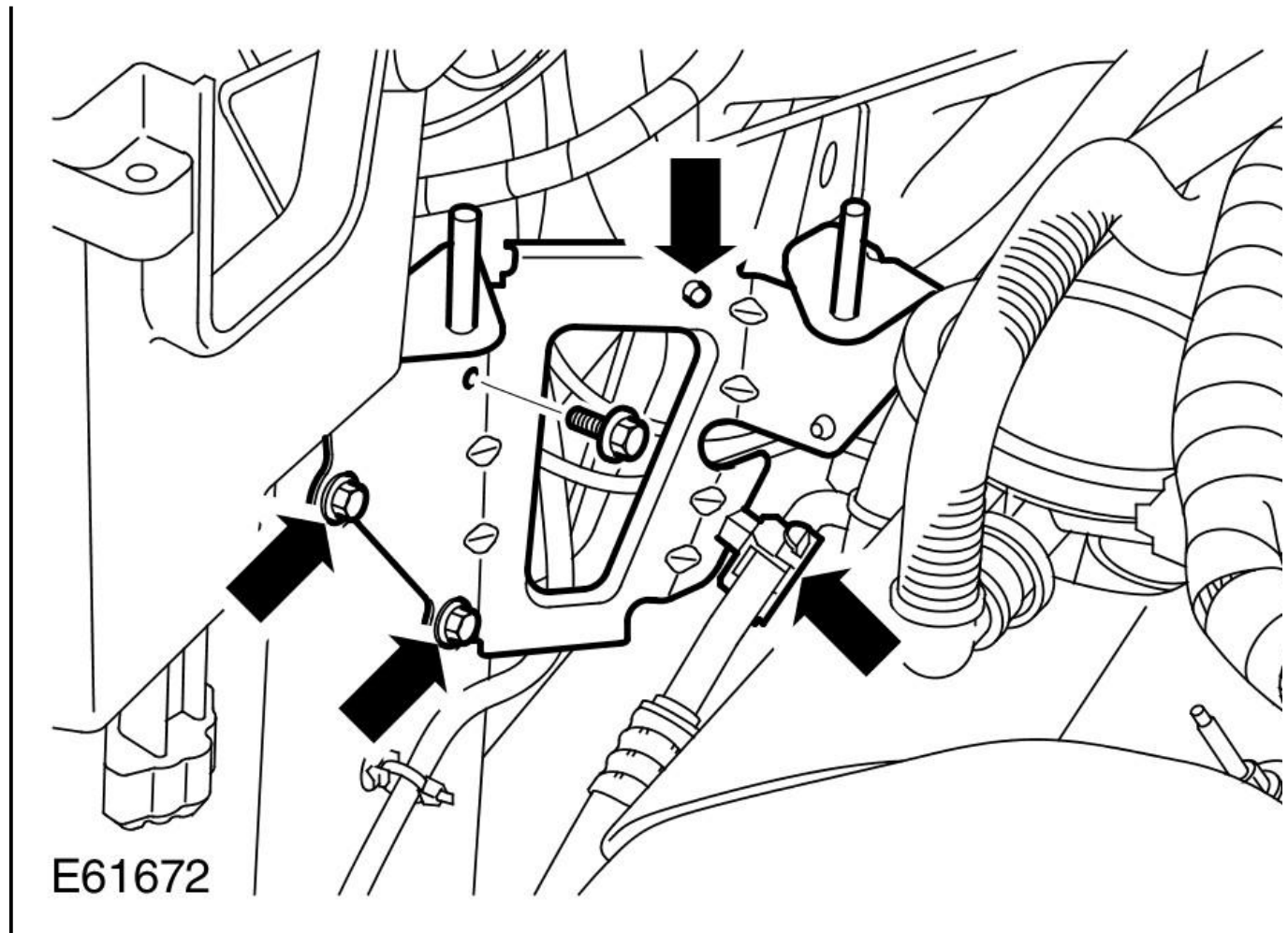
29. Remove the brake vacuum pump.
 - Release and disconnect the electrical connector.

- Disconnect the vacuum line.
- Remove the 2 nuts.

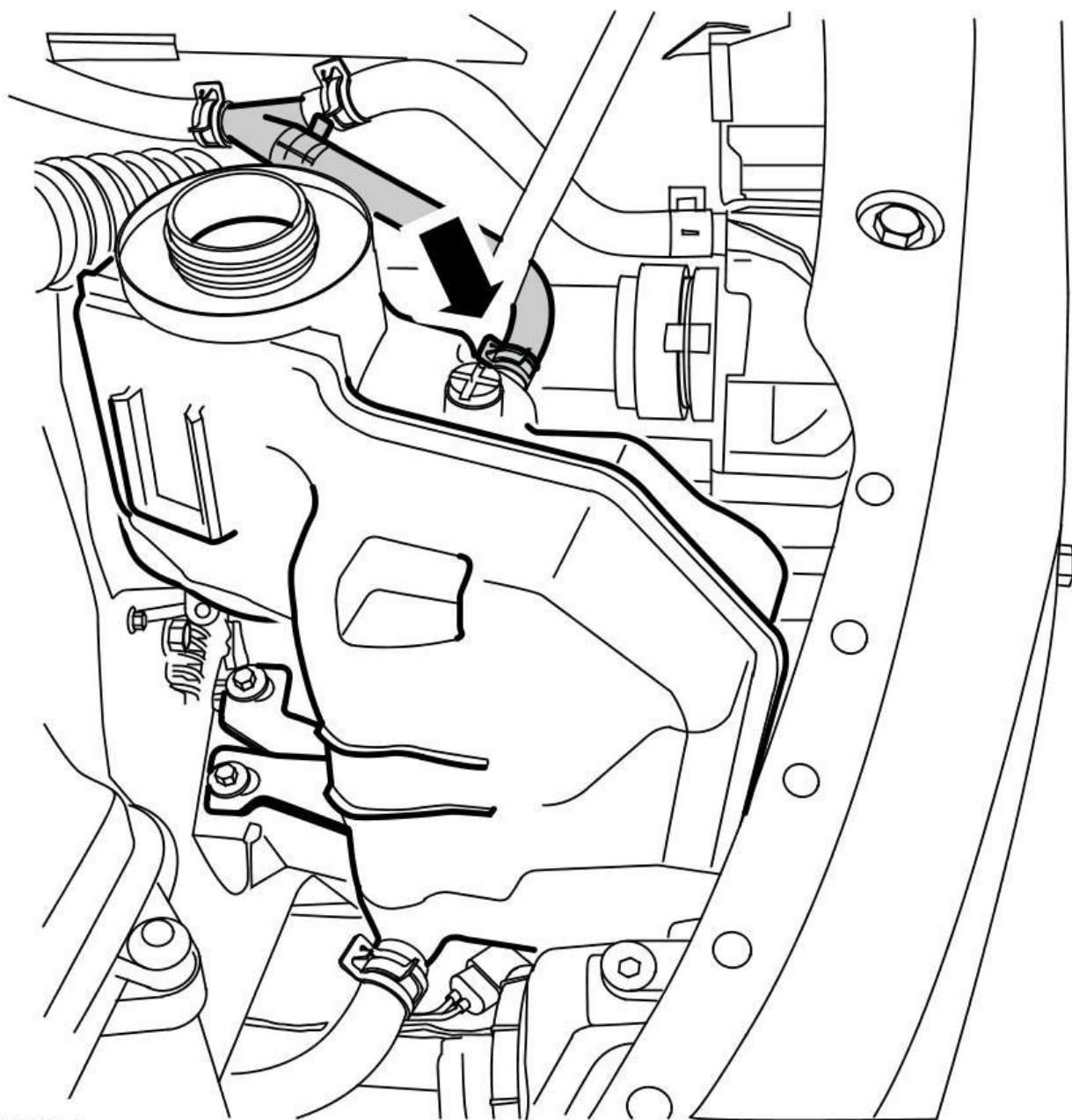


30. Remove the brake vacuum pump bracket.

- Remove the 3 bolts.
- Release the refrigerant line clip.
- Release the wiring harness clip.



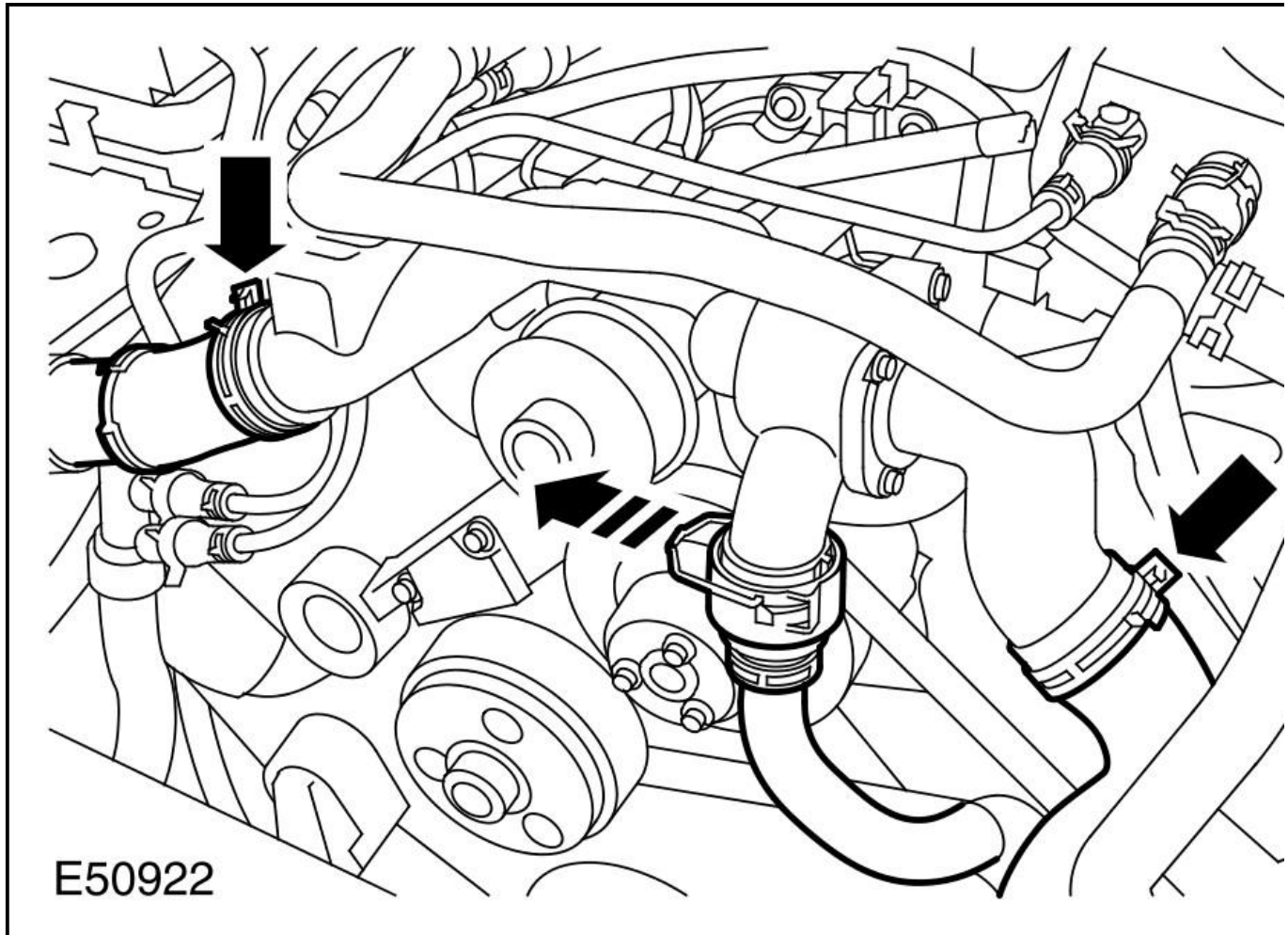
31. Disconnect the coolant hose from the coolant expansion tank.
- Release the clip and disconnect the hose.



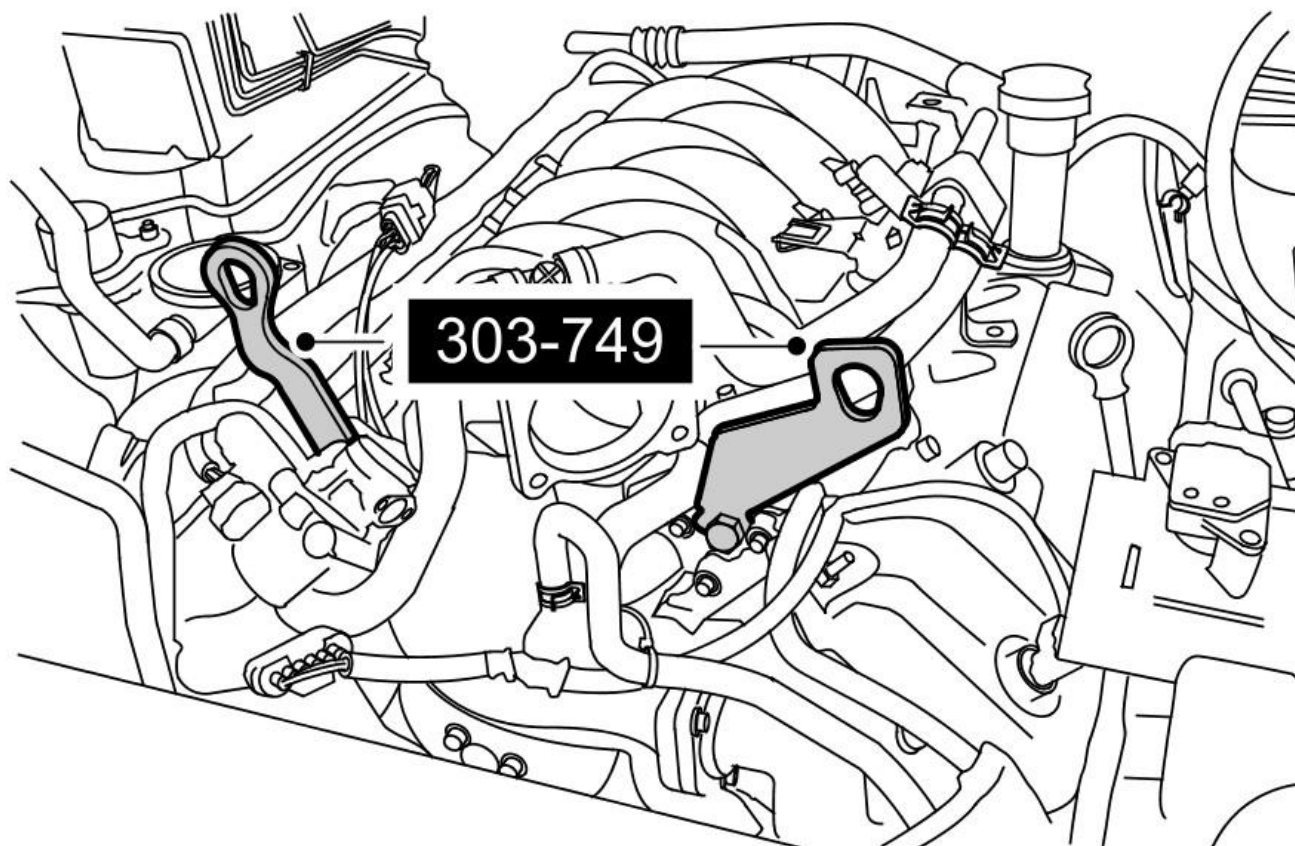
E99567

32. Disconnect the coolant manifold to radiator hose.
 - Remove the clip.
33. Disconnect the thermostat housing to radiator hose.
 - Release the clip.
34. Disconnect the coolant manifold to coolant reservoir hose.

- Release the clip.



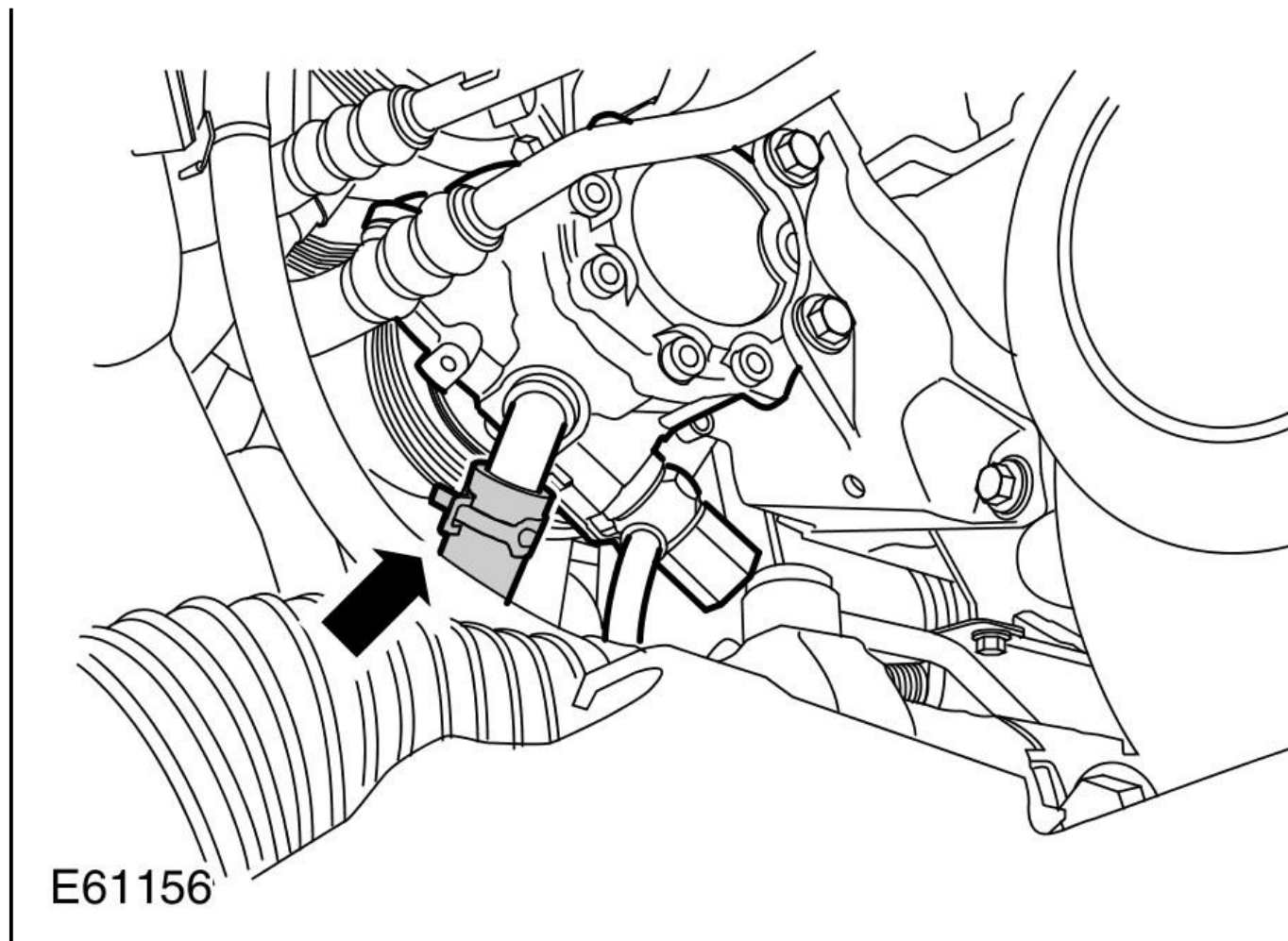
35. Install the special tools to the engine.



E99569

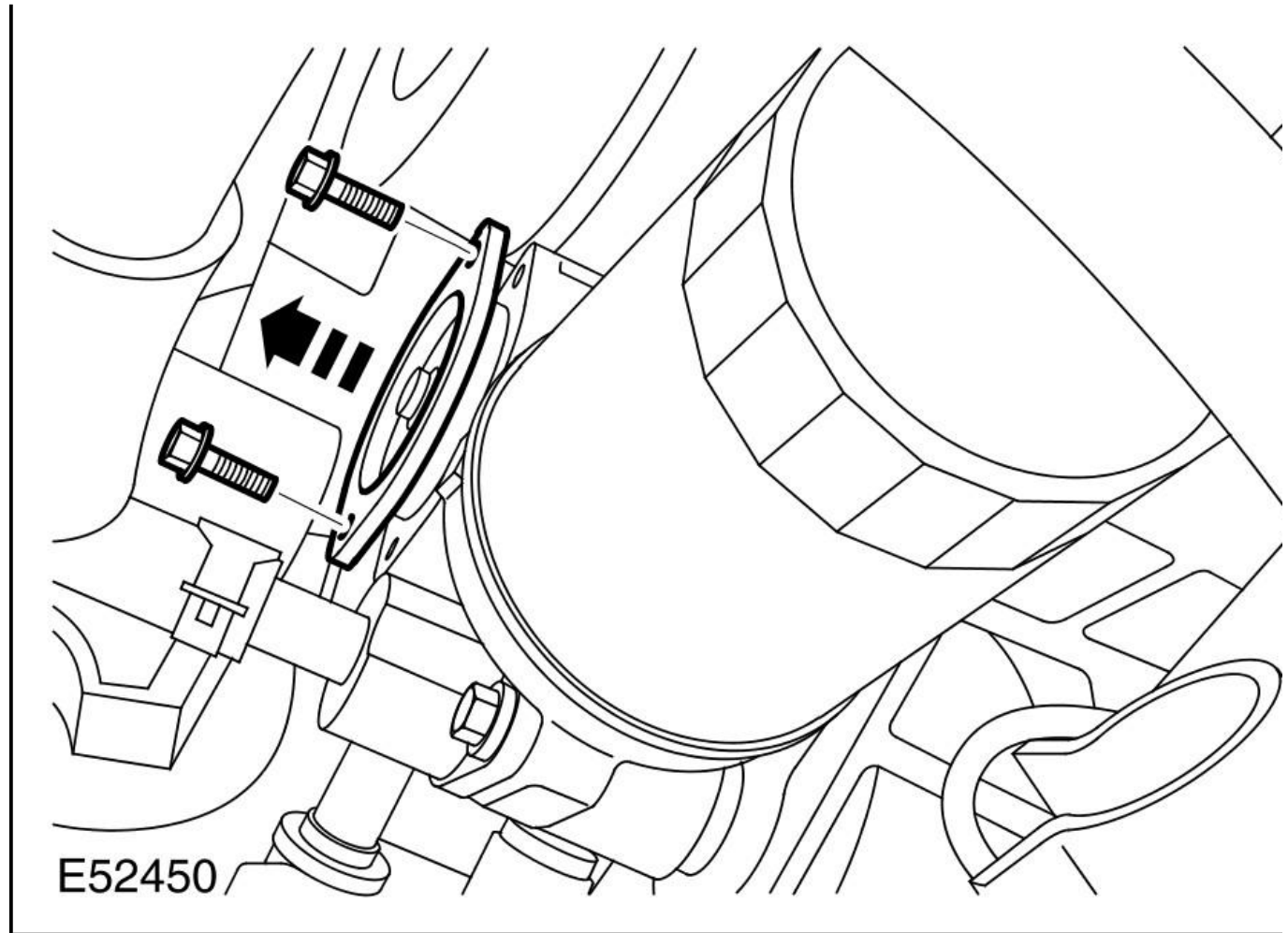
CAUTION: Make sure that all openings are sealed. Use new blanking caps.

36. Disconnect the power steering pump supply hose.
- Position a container to collect the fluid spillage.
 - Release the clip.



CAUTION: Make sure that all openings are sealed. Use new blanking caps.

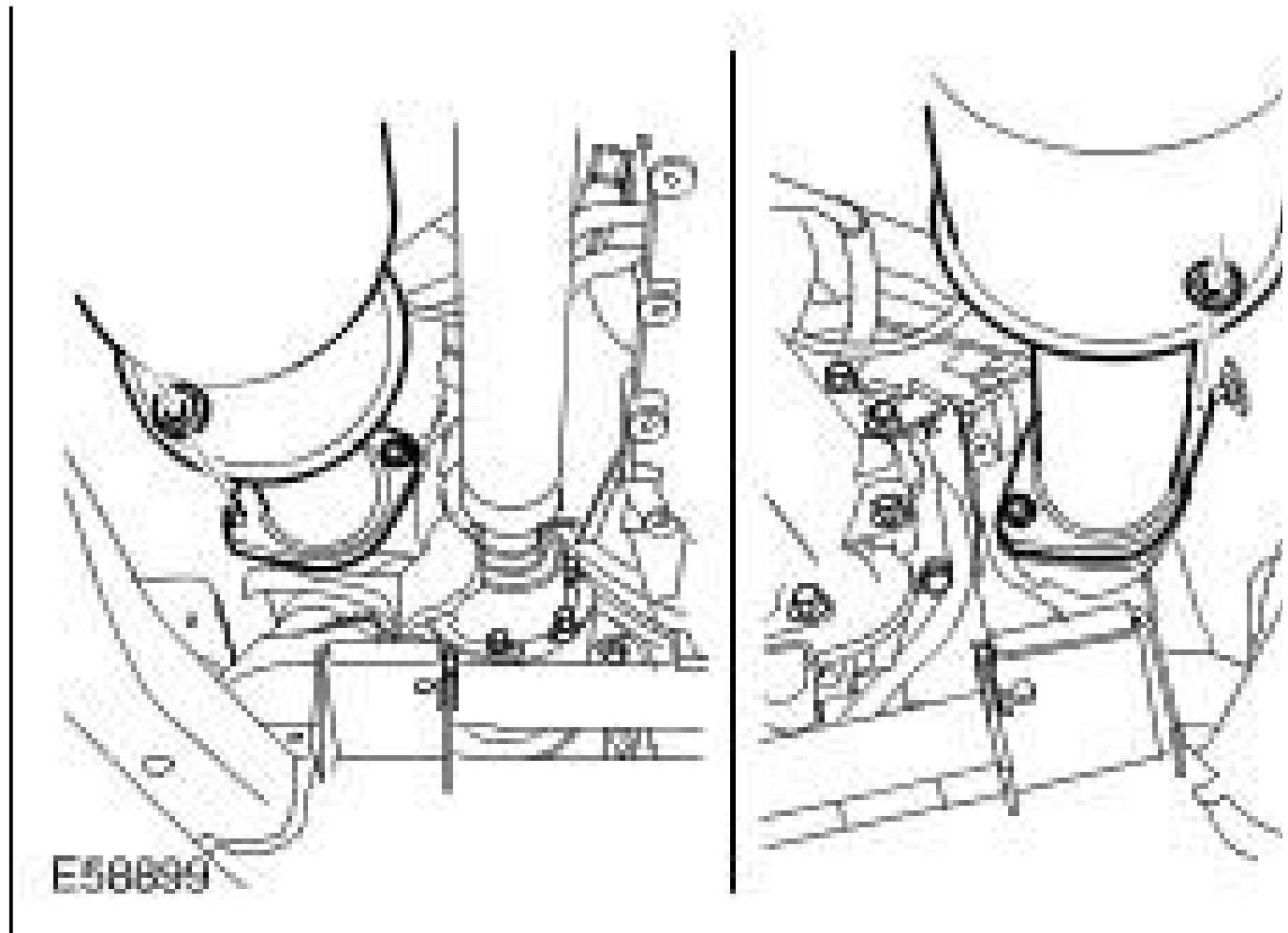
37. Disconnect the power steering pump high-pressure line.
 - Remove and discard the 2 sealing washers.



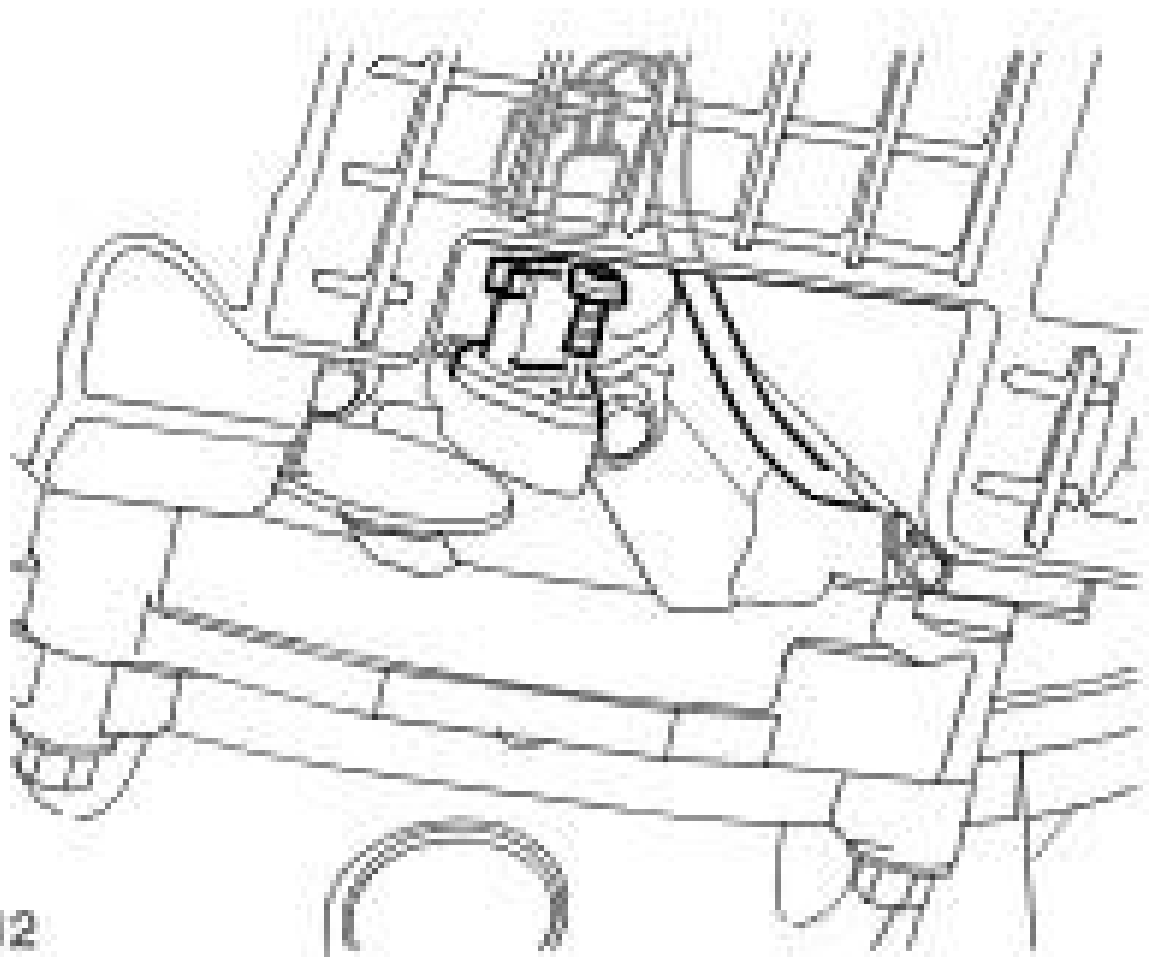
38. Release and reposition the power steering high-pressure pipe.
- Remove the nut.



39. Disconnect the engine oil temperature sensor electrical connector.



40. Disconnect the engine oil pressure (EOP) sensor electrical connector.



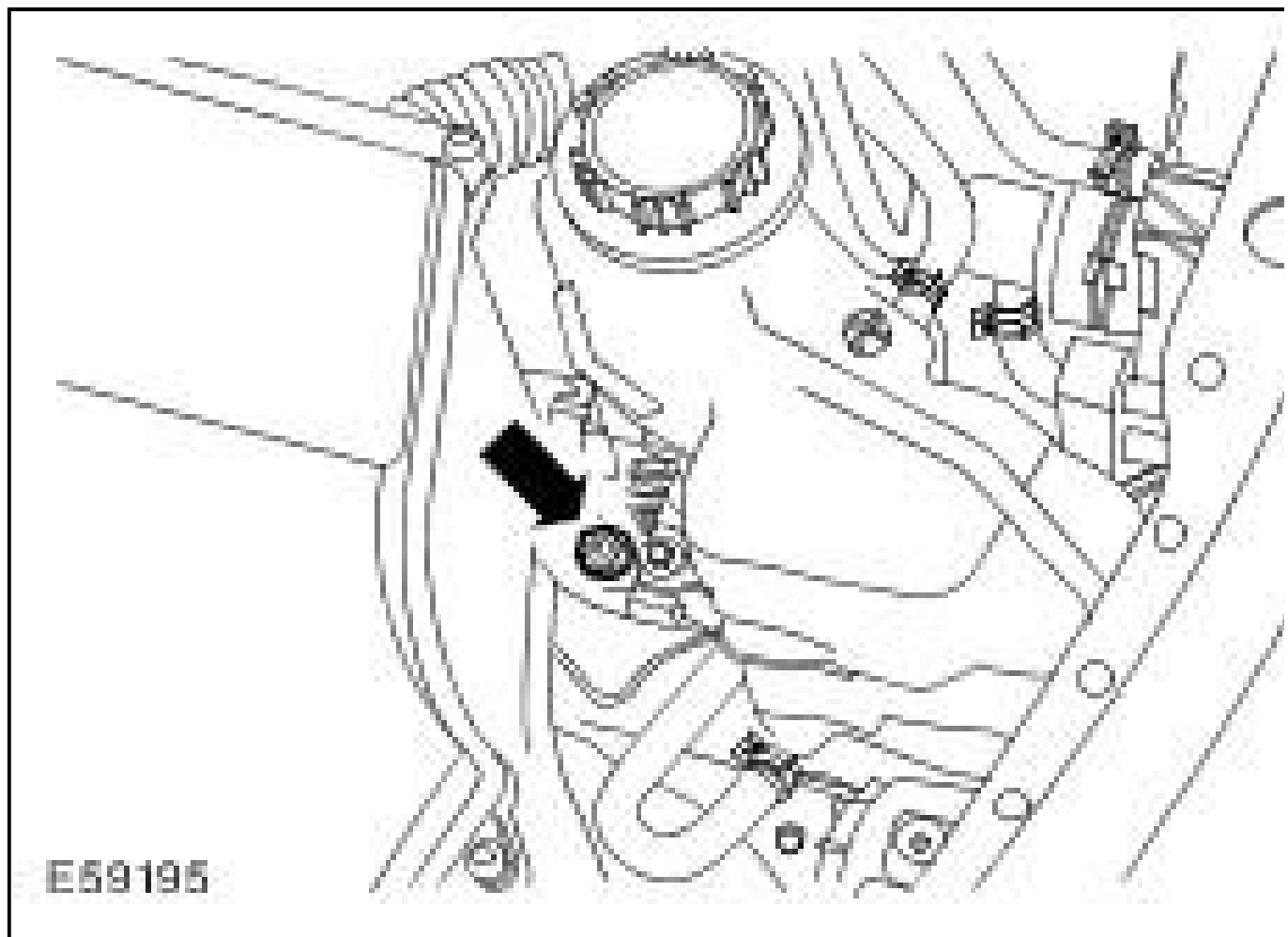
41. Release the oil filter housing.

- Remove the 3 bolts.
- Remove and discard the O-ring seal.
- Tie aside.

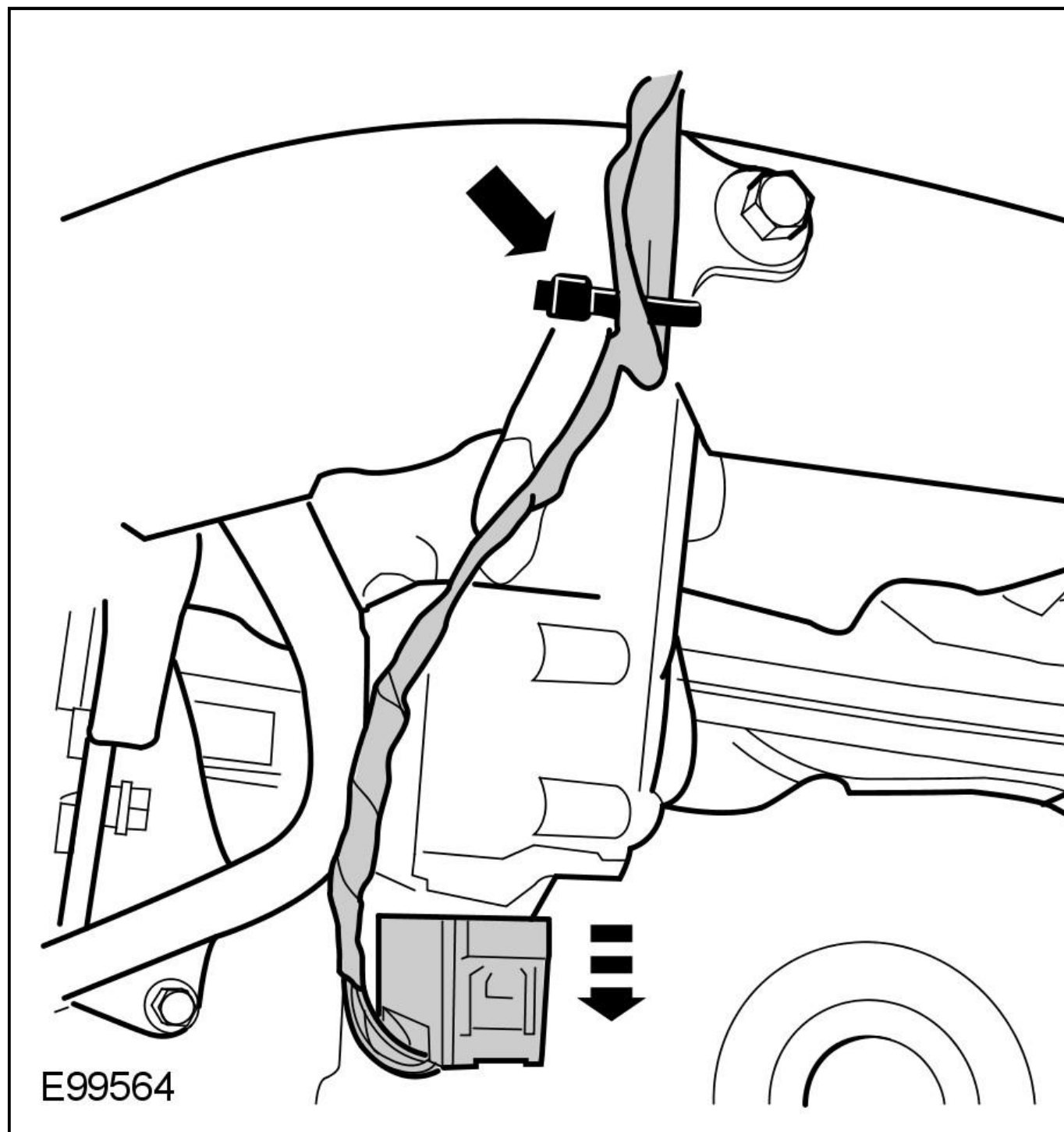


42. With assistance, carefully remove the engine.
- Connect the lifting chains.
 - Support the engine with the lifting equipment.

- Remove the front subframe mounting bolts.
 - Using a suitable hydraulic jack, support the rear of the front subframe.
 - Lower engine and allow assembly to tilt rearwards.
 - Lower the engine to the ground.
 - Remove the engine lifting equipment.
43. LH side: Remove the engine mount heat shield.
- Remove the 2 screws.
44. LH side: Release the engine mount.
- Remove the bolt.



45. Release the RH engine mount.
- Remove the nut.
 - Lift engine clear of subframe.
46. With assistance, remove the differential.
- Remove the 4 bolts.

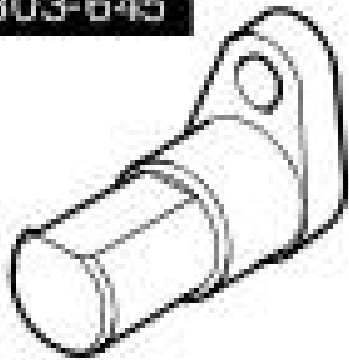
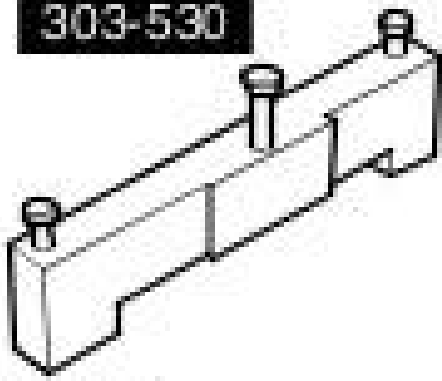
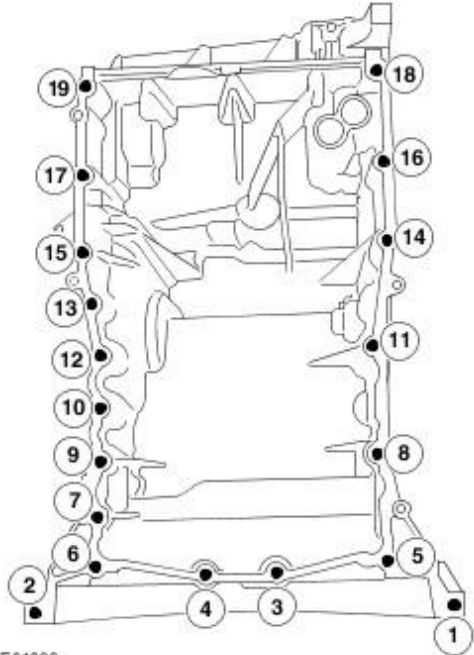


DISASSEMBLY

ENGINE

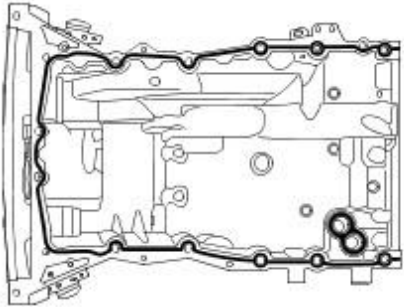
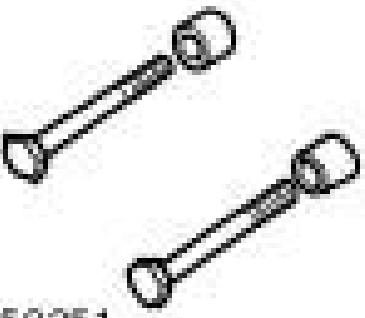
SPECIAL TOOLS

Tool Illustration	Tool Name	Tool Number
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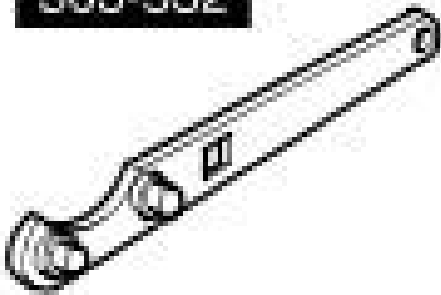
303-645  E46881	Timing Setting tool	303-645
303-530  E46879	Camshaft setting/locking tool	303-530
 E61699	Adapter - Crankshaft seal installer	303-1100-01

2007 Land Rover Range Rover HSE

ENGINE Engine (4.4L)

 E48537	Adapter	303-191-03
 303-893 E46728	Holding Tool Crankshaft Pulley	303-893(LRT-12-080)
 303-191-04 E59251	Bolts and spacers	303-191-04
	Timing chain tensioning tool	303-532

303-532



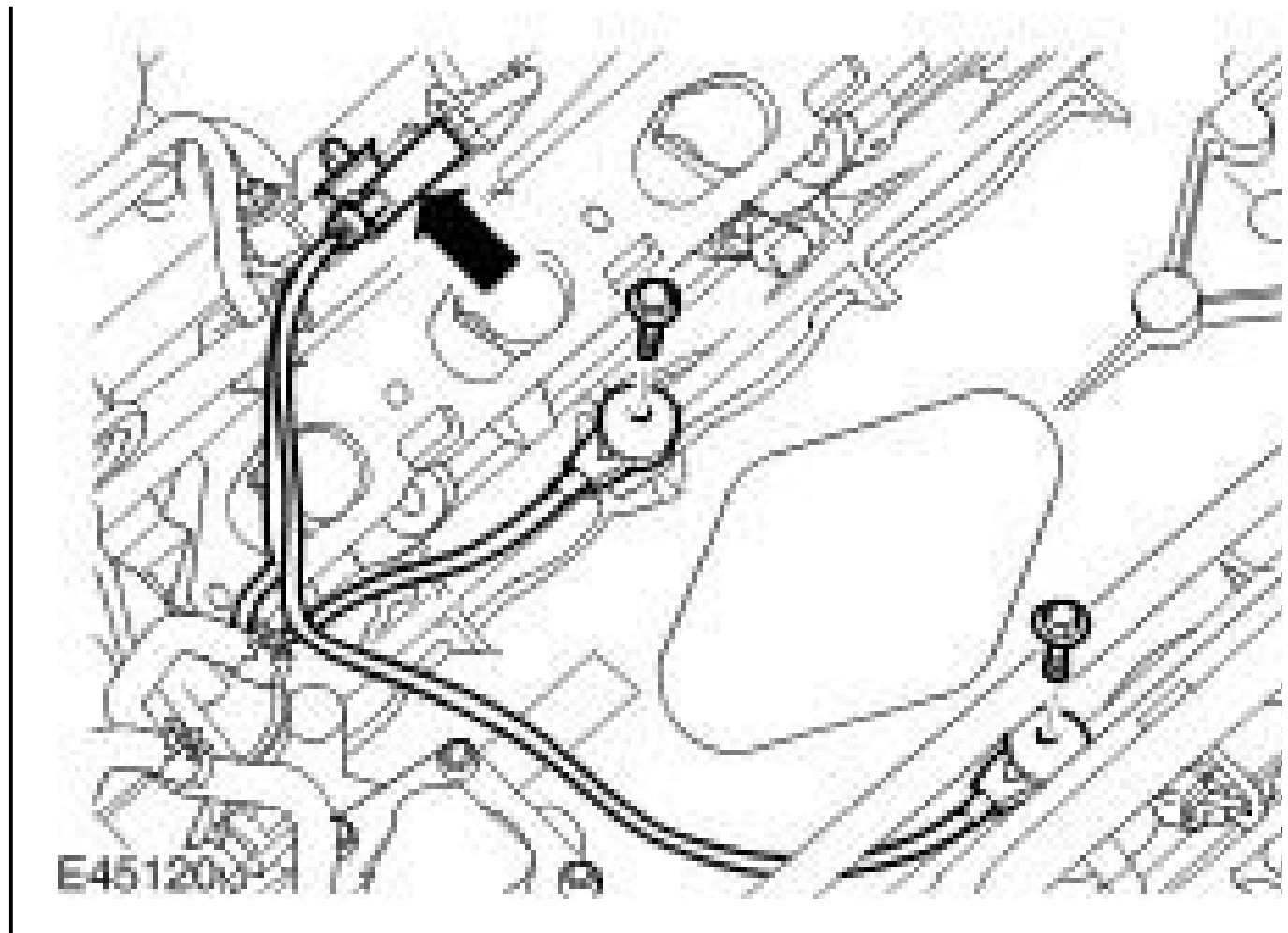
E46880

DISASSEMBLY

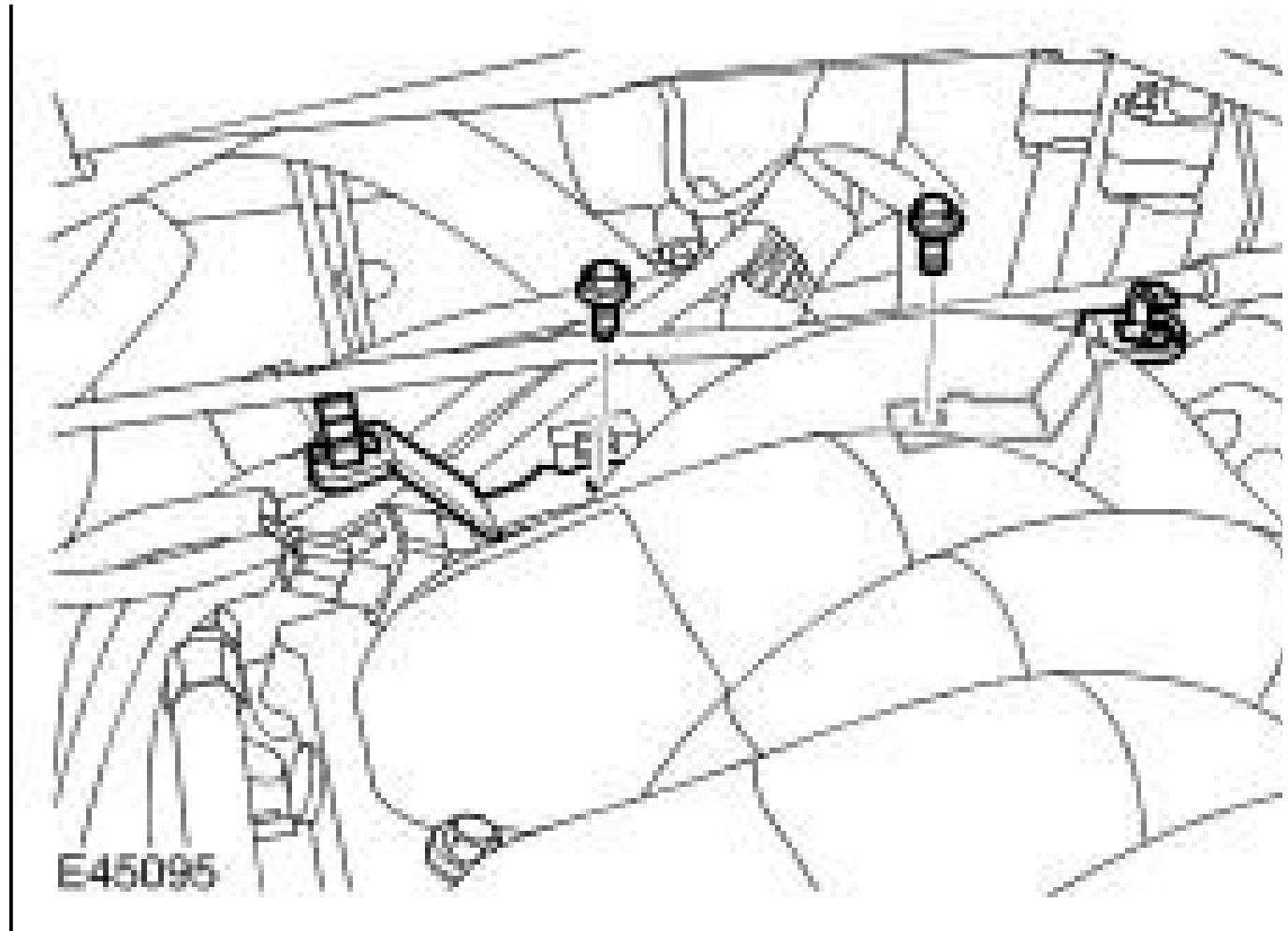
1. Remove the engine assembly.
2. Secure the engine to the engine stand.
 - Align the engine to the engine stand.
 - Adjust the engine stand legs into position.
 - Mount the engine to an engine stand.
 - Fully tighten the engine stand leg nuts.
3. Release the camshaft position (CMP) sensor connector block from the intake manifold assembly.



4. Remove the coolant manifold.
 - Remove the 4 bolts.
 - Disconnect the electrical connector.

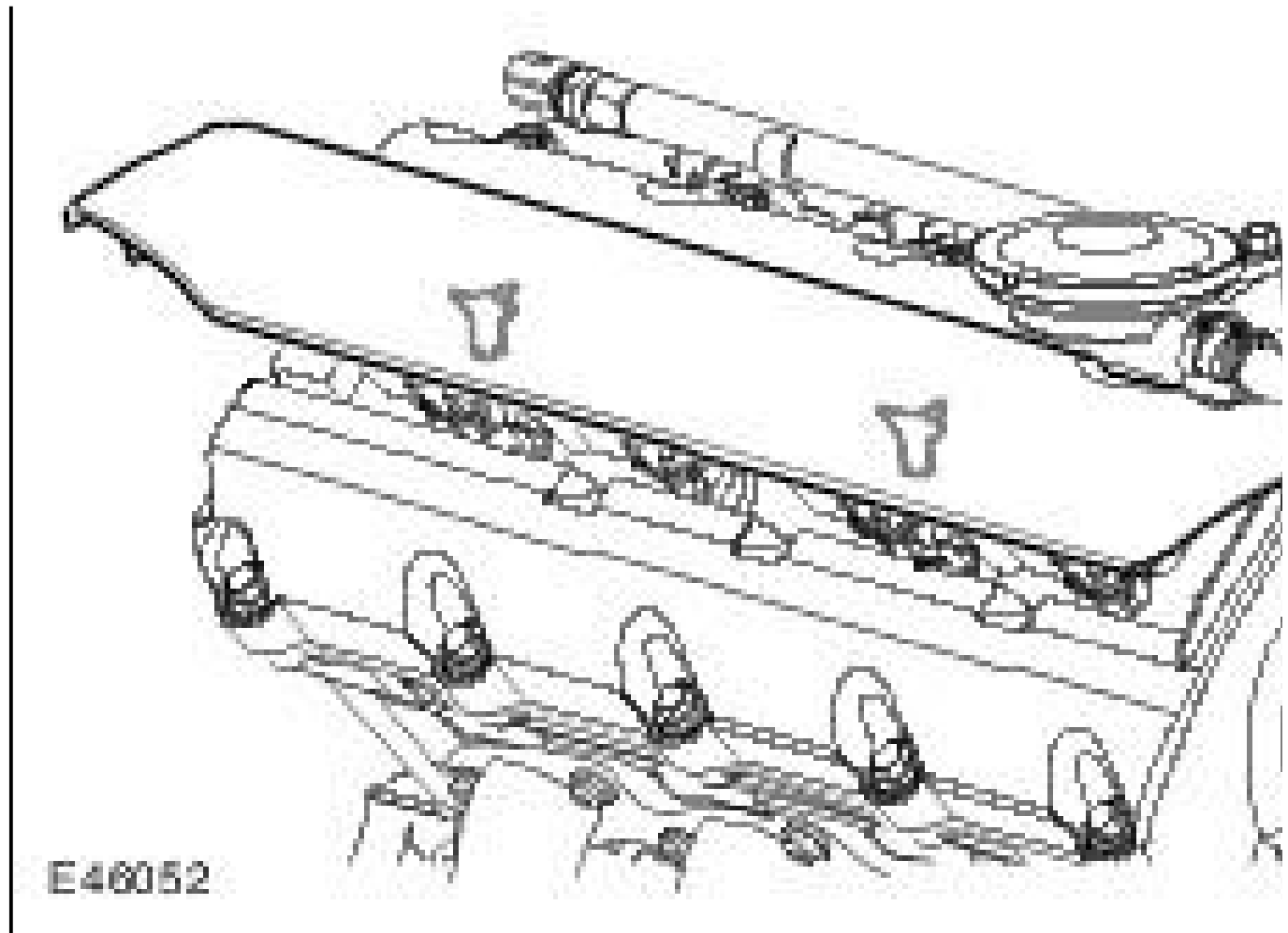


5. Position the wiring harness support bracket aside for access.
 - Remove the 2 bolts.



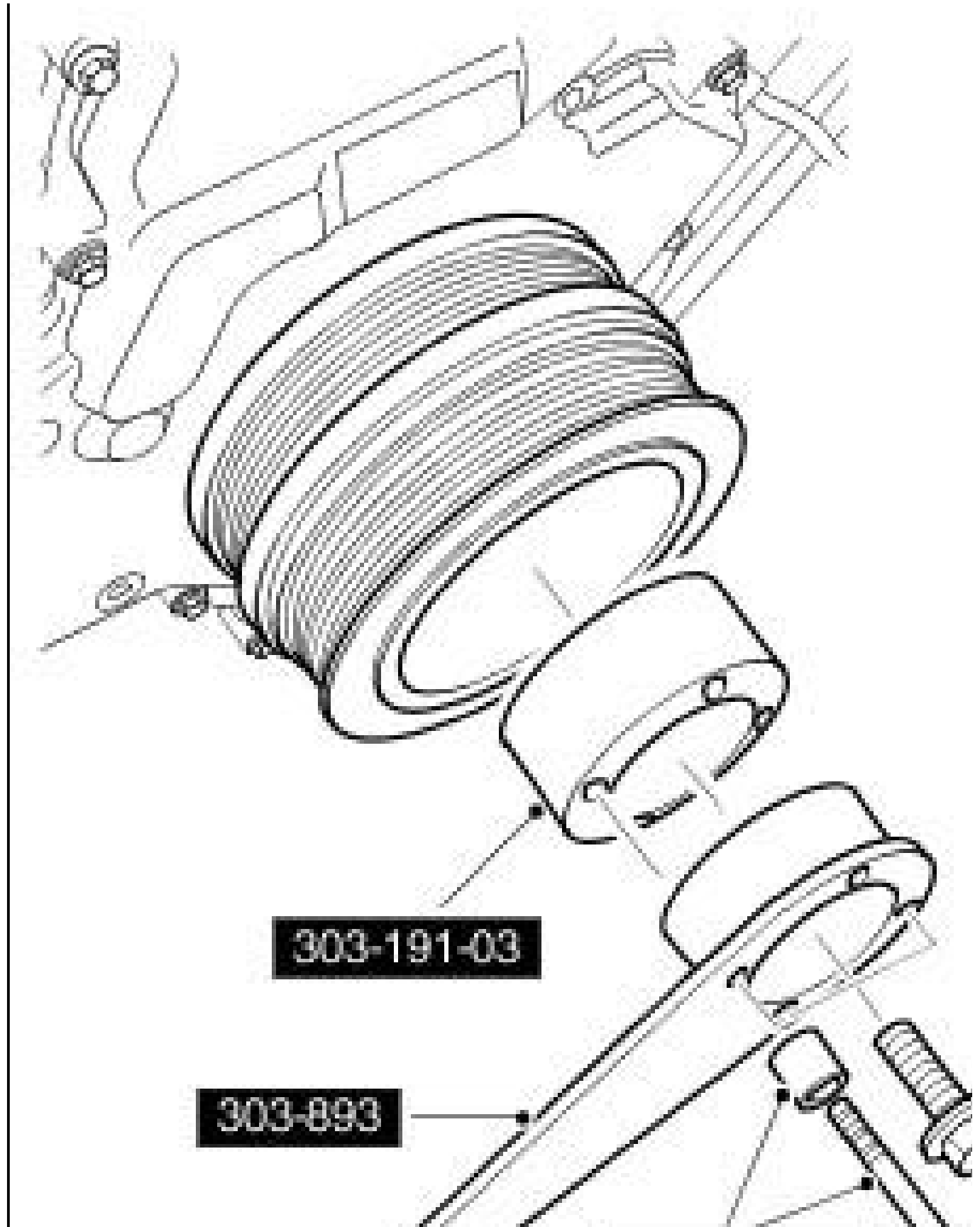
NOTE: RH illustration shown, LH is similar.

6. Remove both the ignition coil-on-plug covers.
 - Release from the 2 clips.

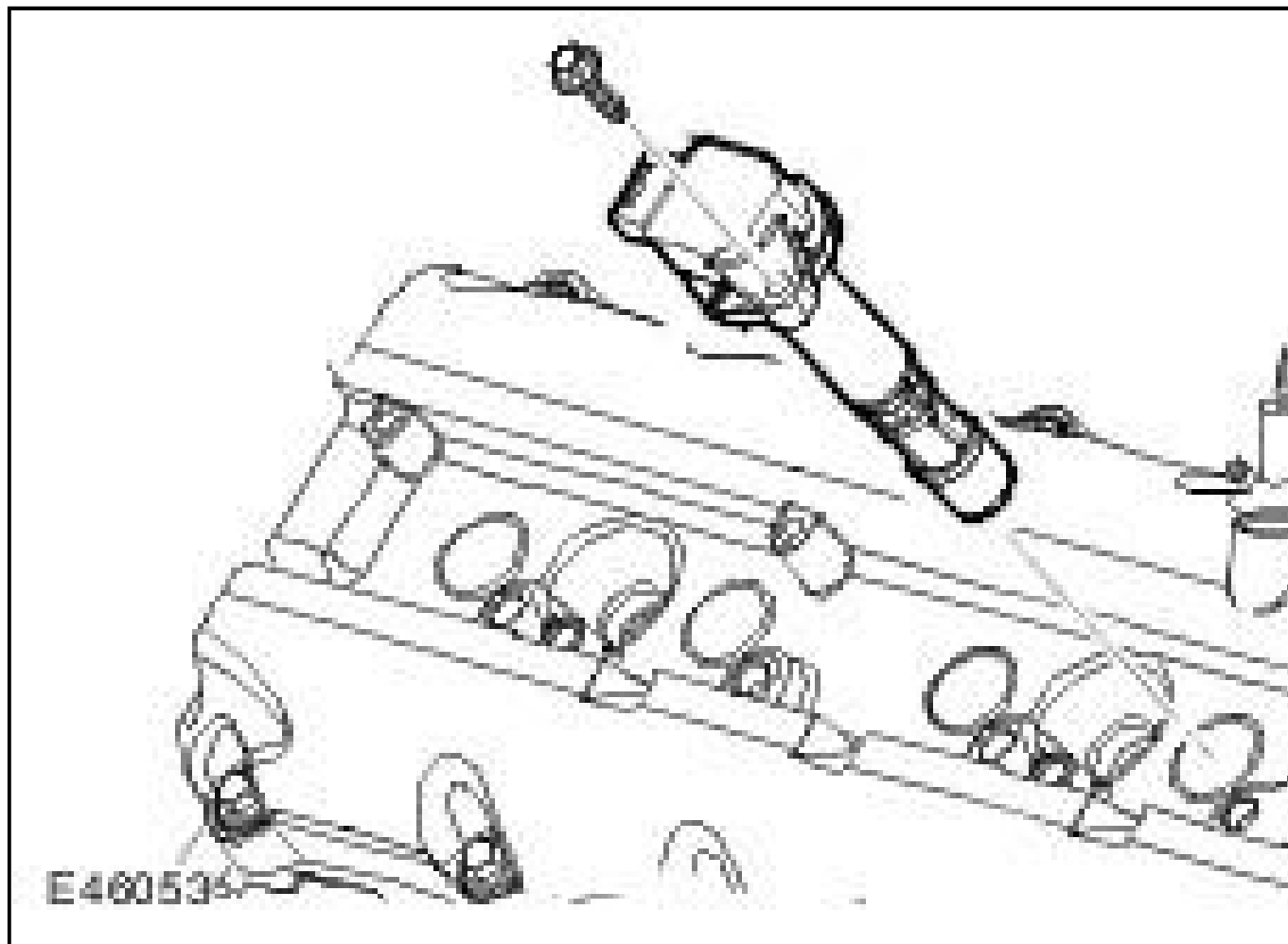


NOTE: RH illustration shown, LH is similar.

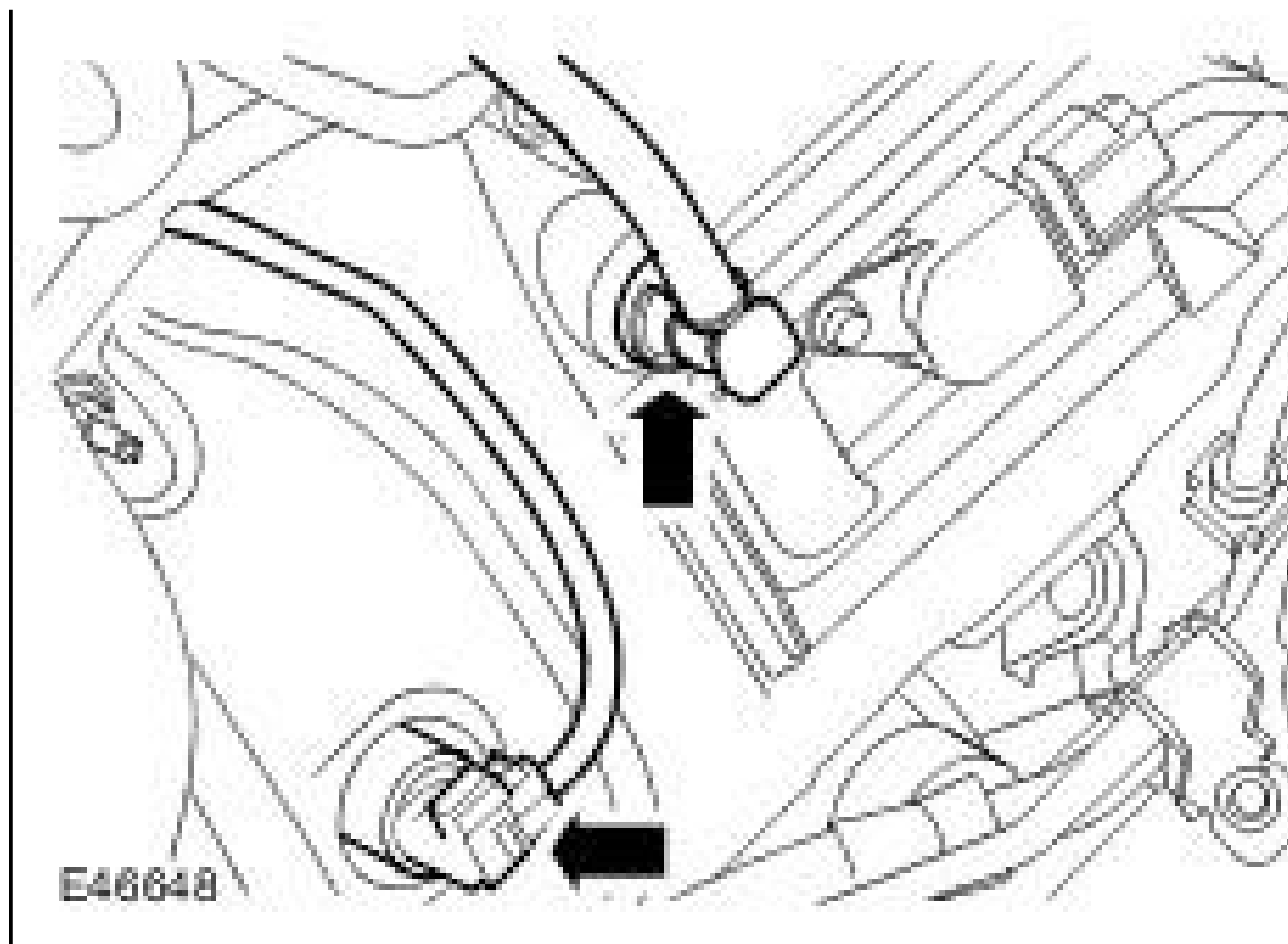
7. Disconnect the 8 ignition coil-on-plug electrical connectors.



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



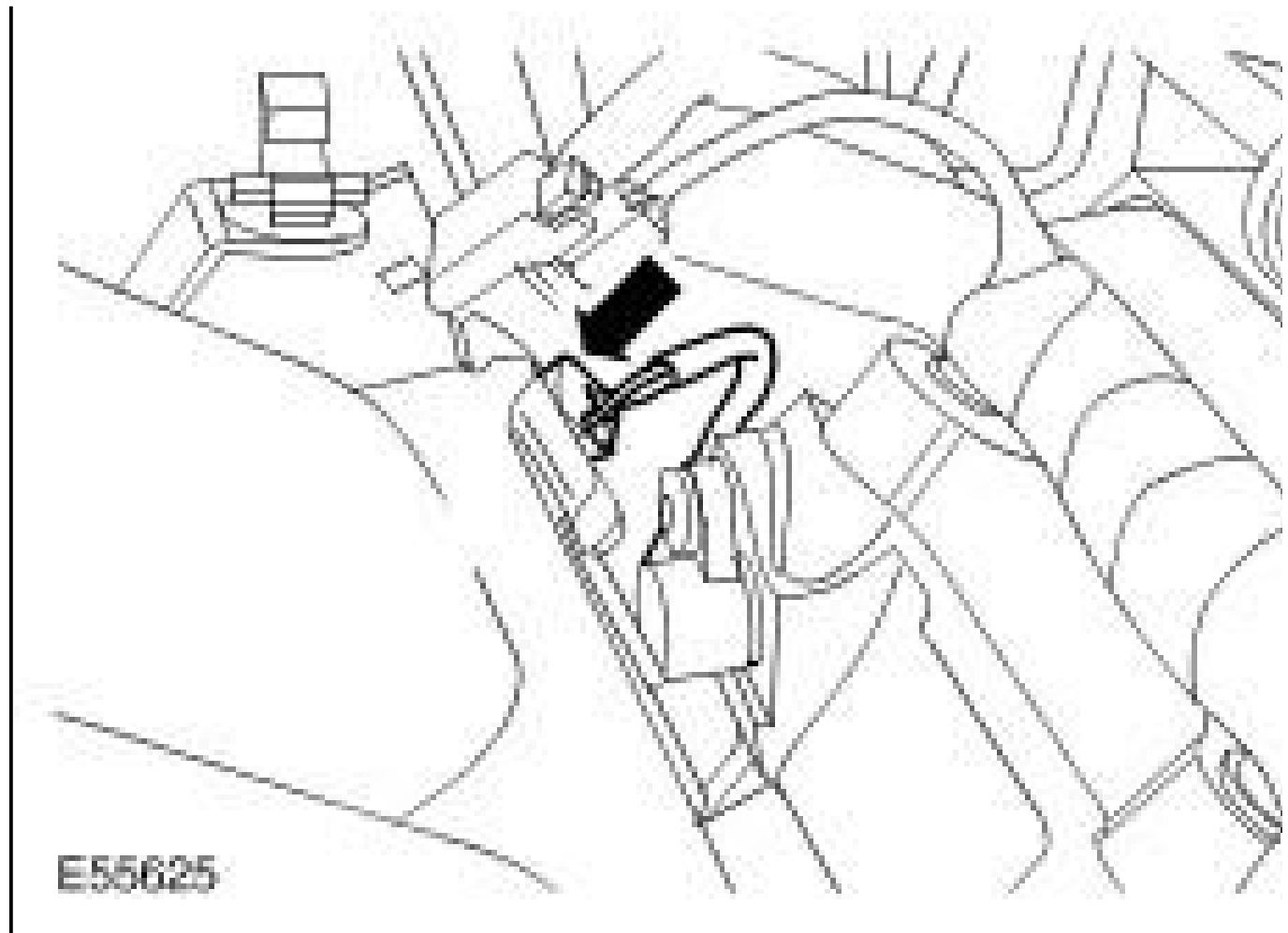
9. Disconnect the valve cover breather hose.
- Disconnect the variable camshaft timing (VCT) oil control solenoid electrical connector.
 - Repeat the operation for the other side.



10. Disconnect the engine coolant temperature (ECT) sensor electrical connector.

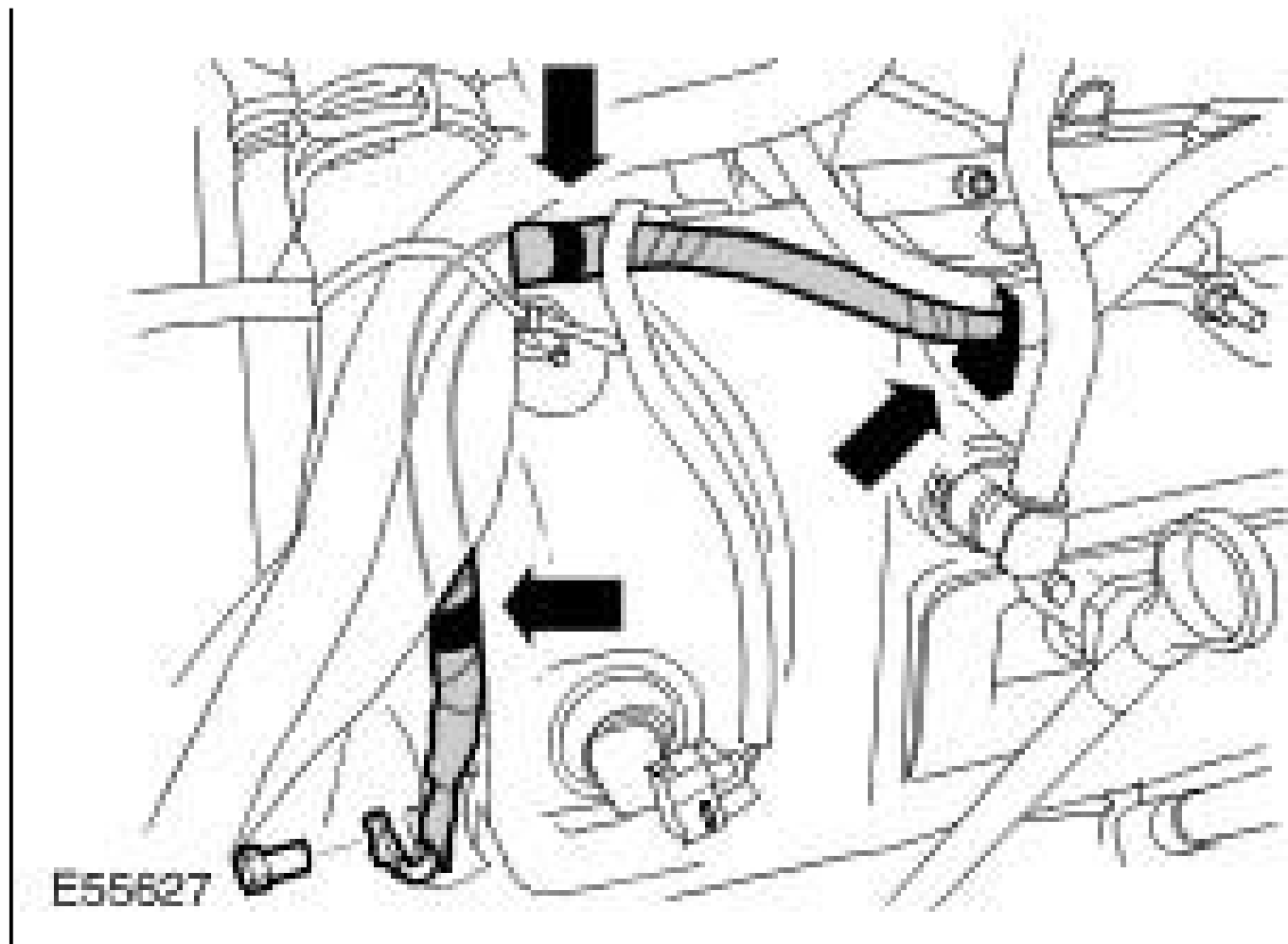


11. Disconnect the CMP sensor electrical connector.
 - Repeat the above procedure for the RH side.

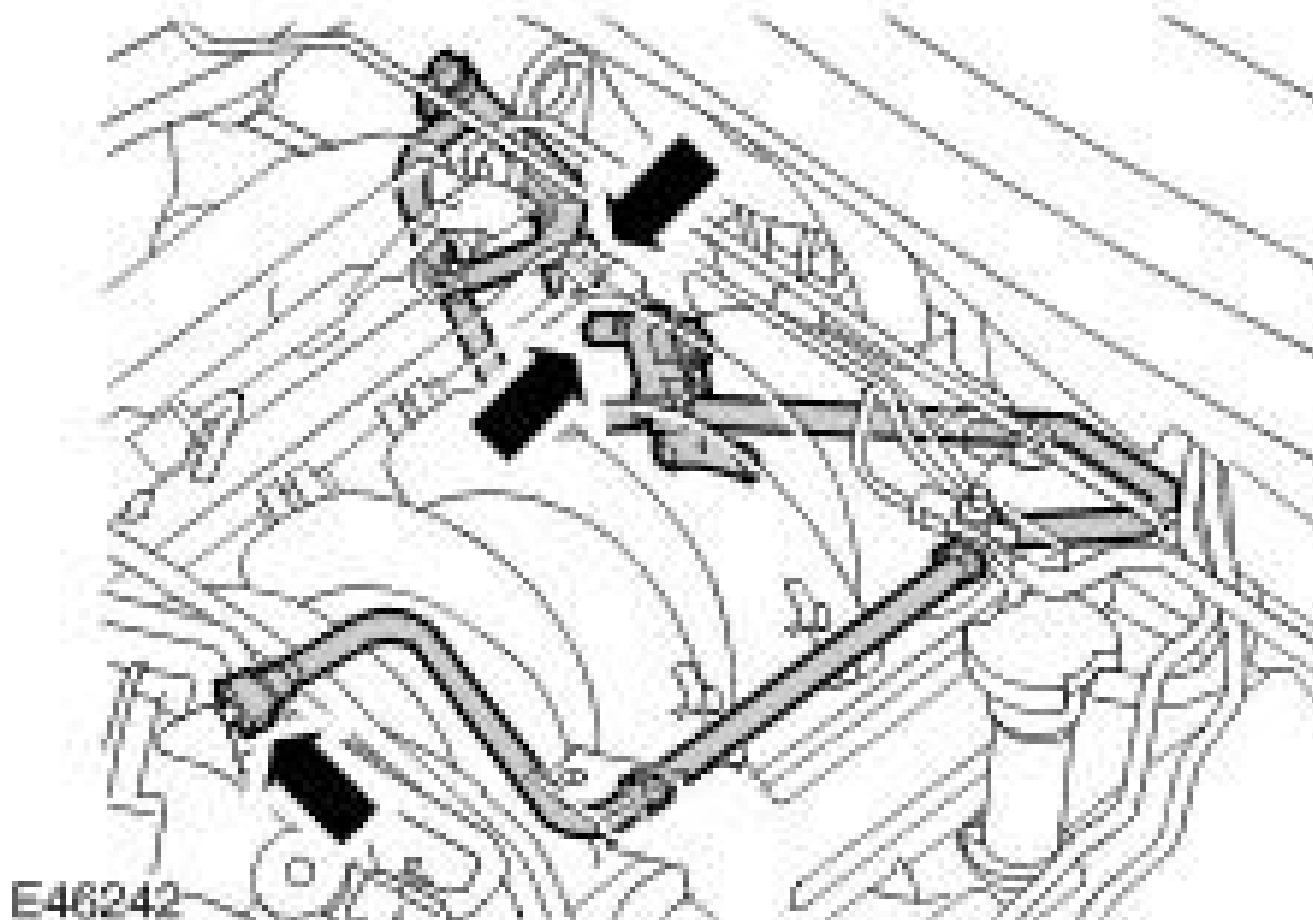


12. Disconnect the cylinder head earth connector.

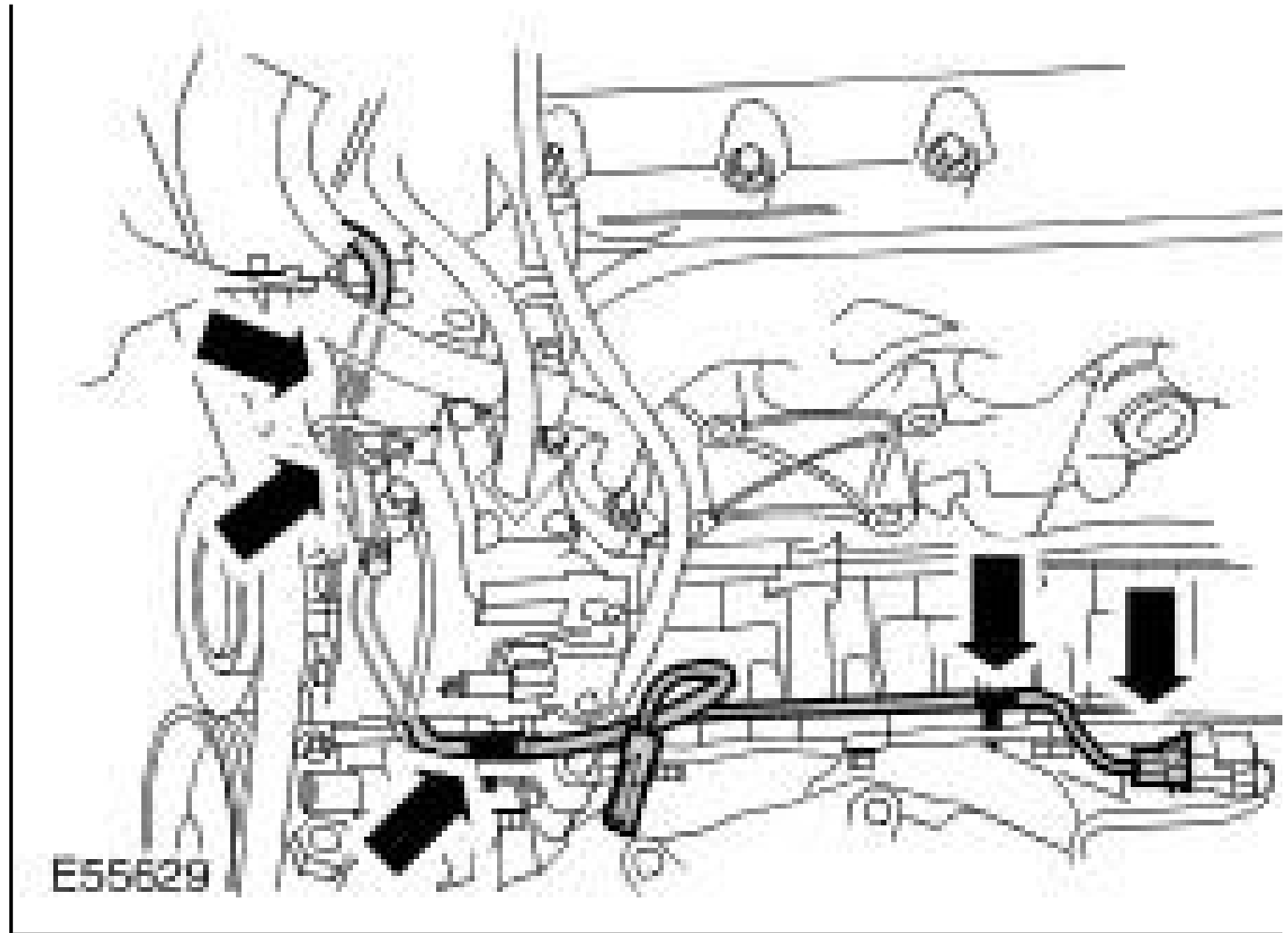
- Remove the bolt.
- Release the 3 clips.



13. Disconnect the knock sensors (KS) electrical connector.
14. Release the purge valve from the mounting bracket.
 - Disconnect the quick release connector.
 - Disconnect the electrical connector.
 - Remove the bolt.

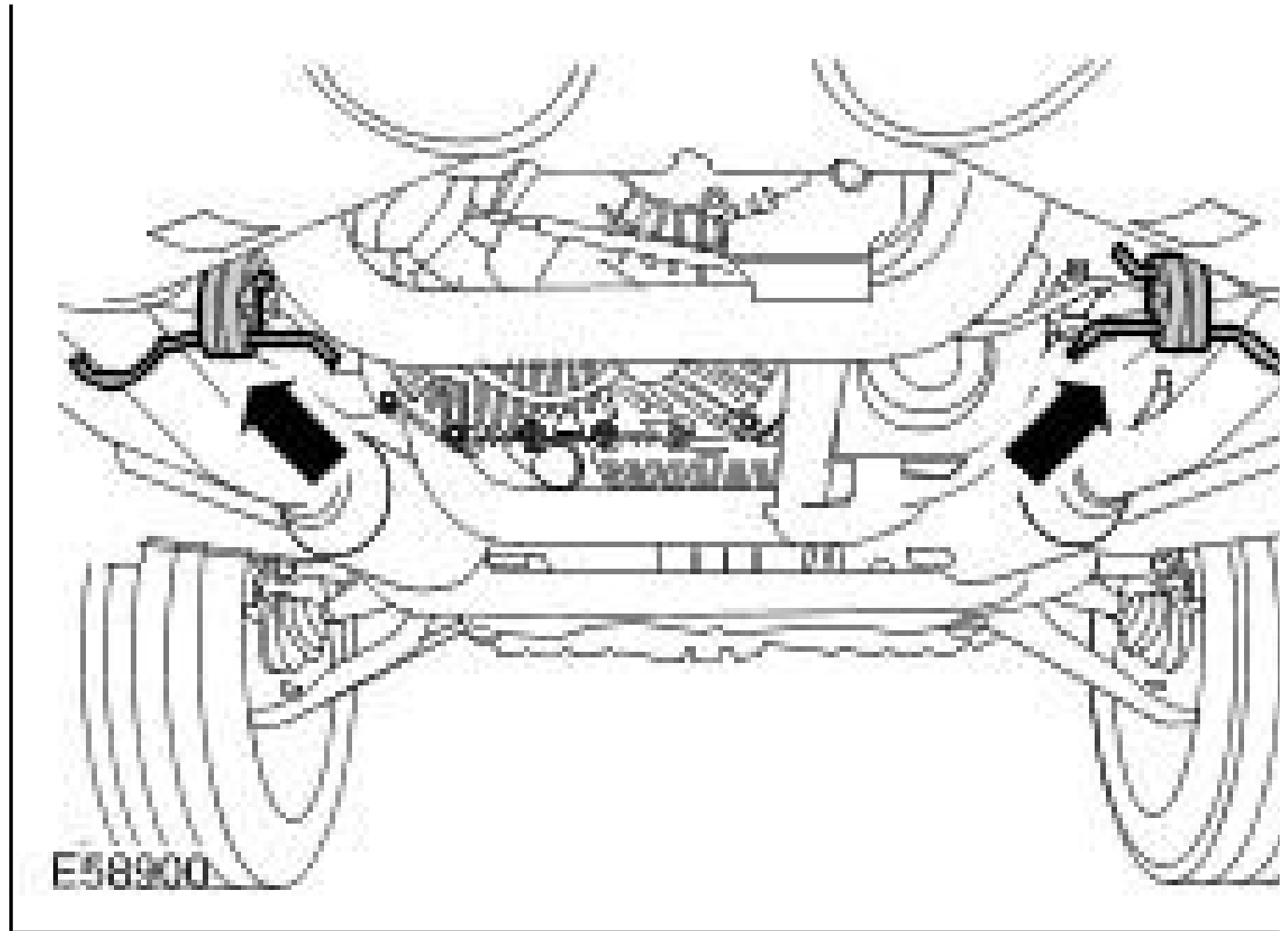


15. Release the 5 air conditioning (A/C) harness retaining clips.



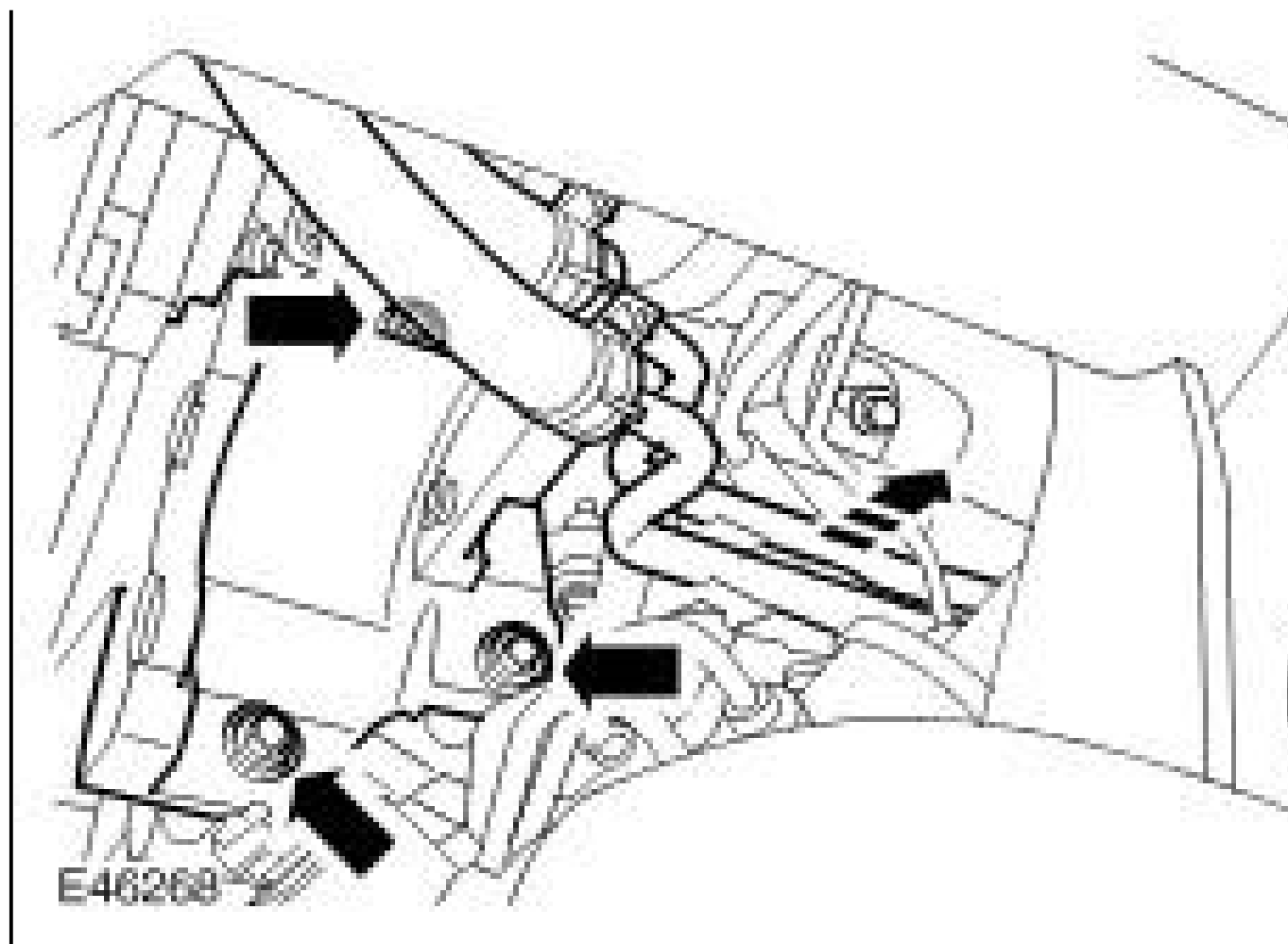
16. Remove the crankshaft position (CKP) sensor.

- Disconnect the electrical connector.
- Remove the Torx screw.

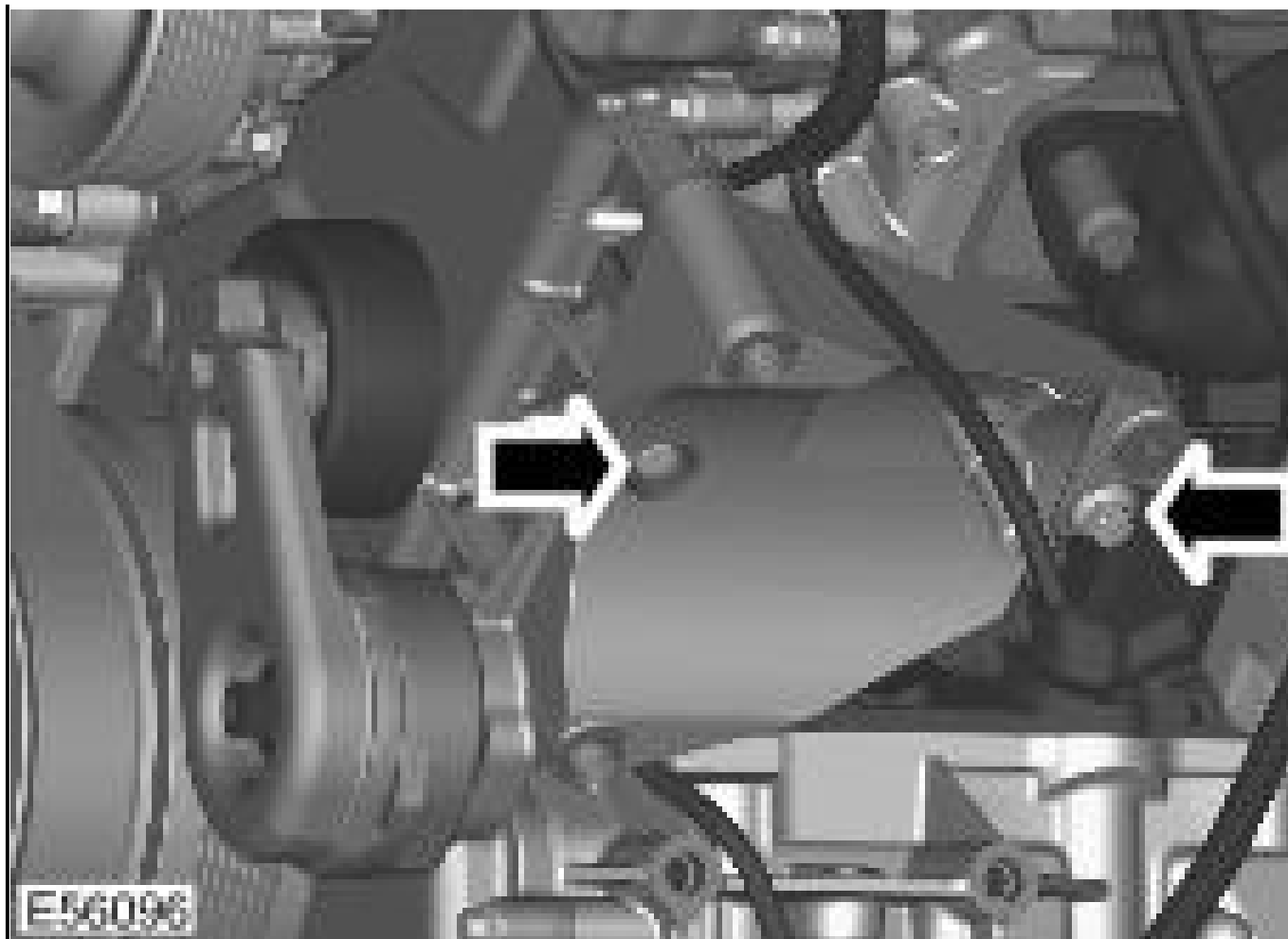


17. Remove the power steering pump mounting bracket.

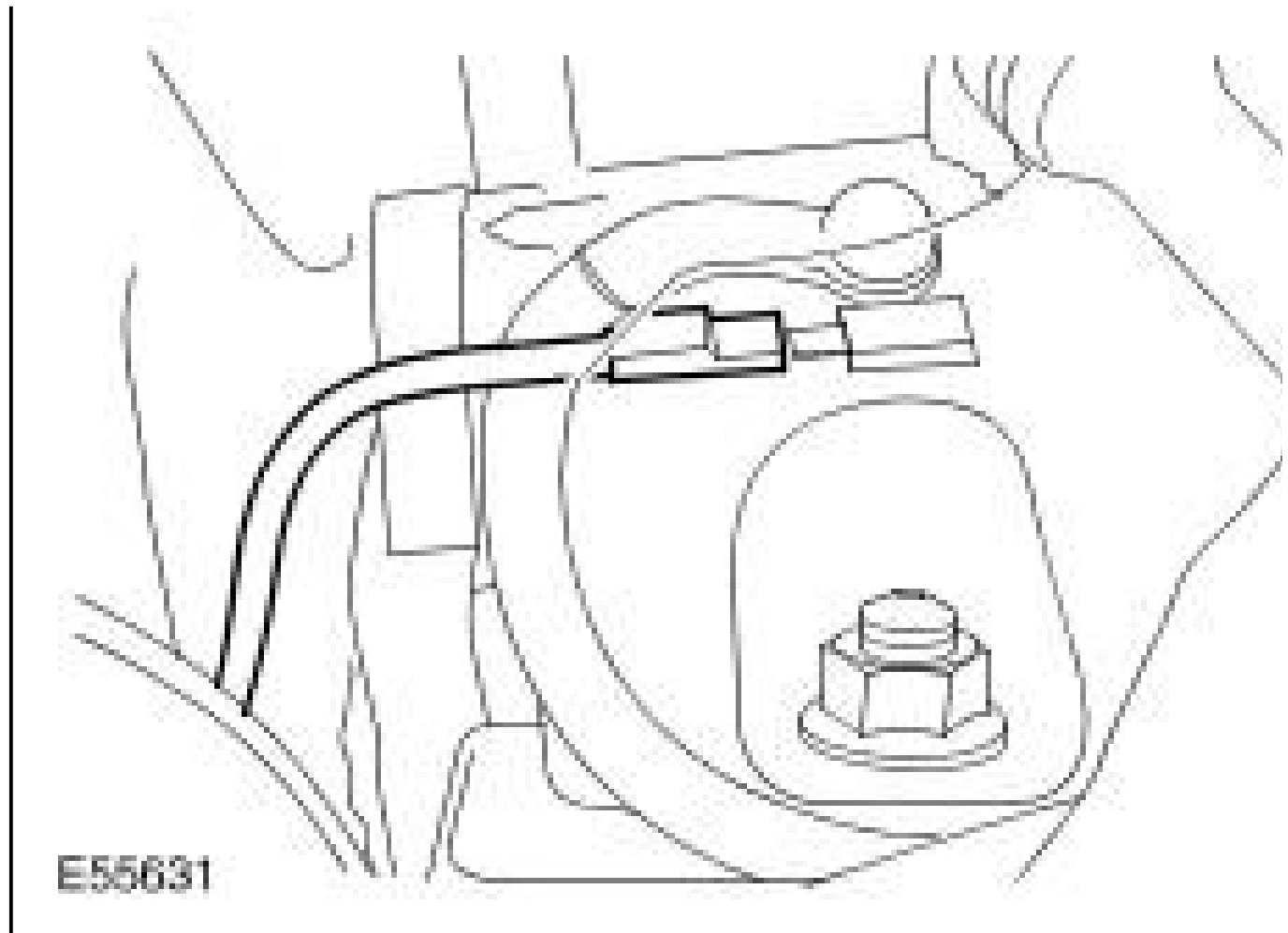
- Remove the 3 bolts.
- Release the transmission cooler pipe clips.



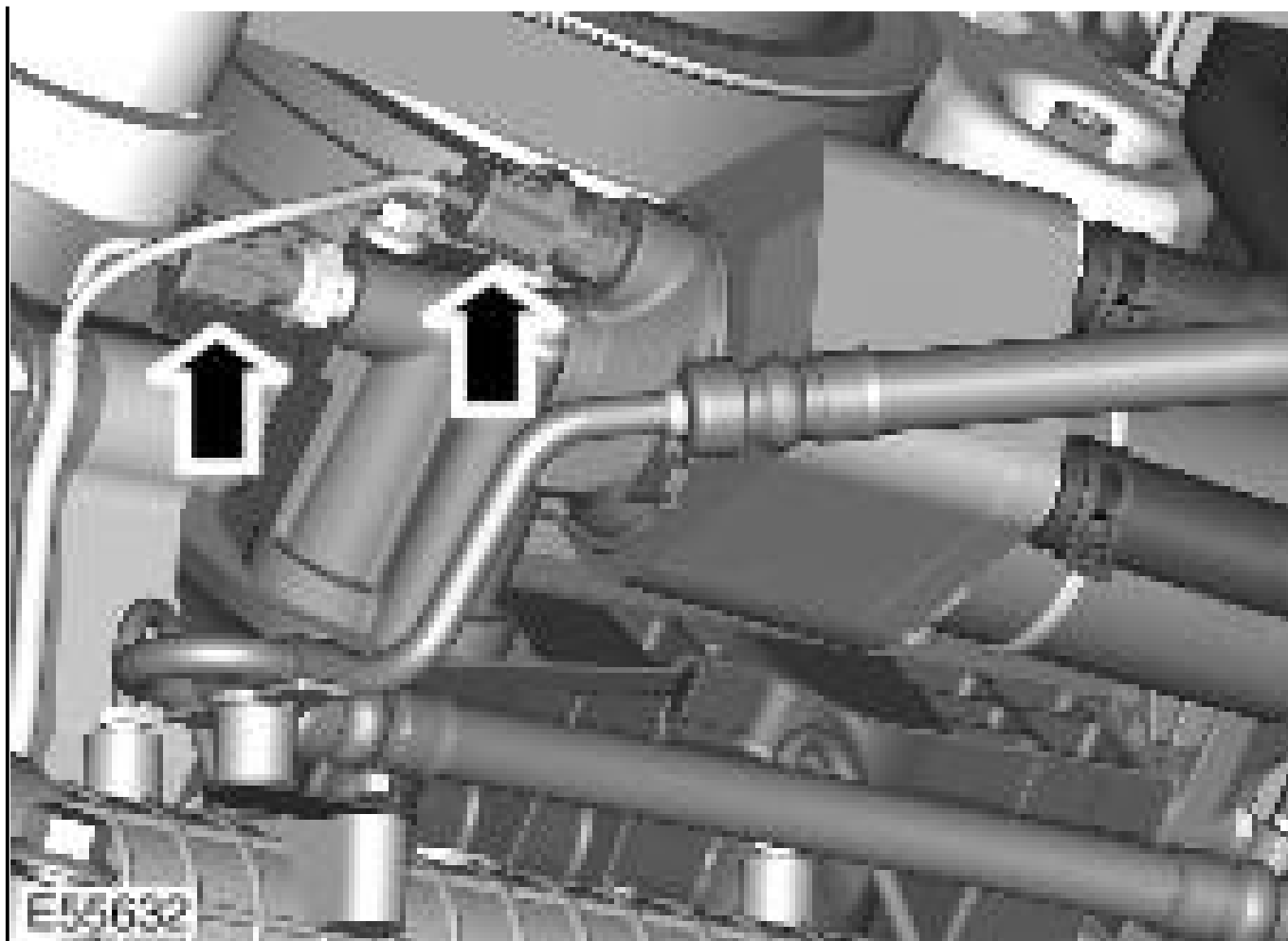
18. Remove the A/C compressor mounting bracket.
- Remove the 2 bolts.



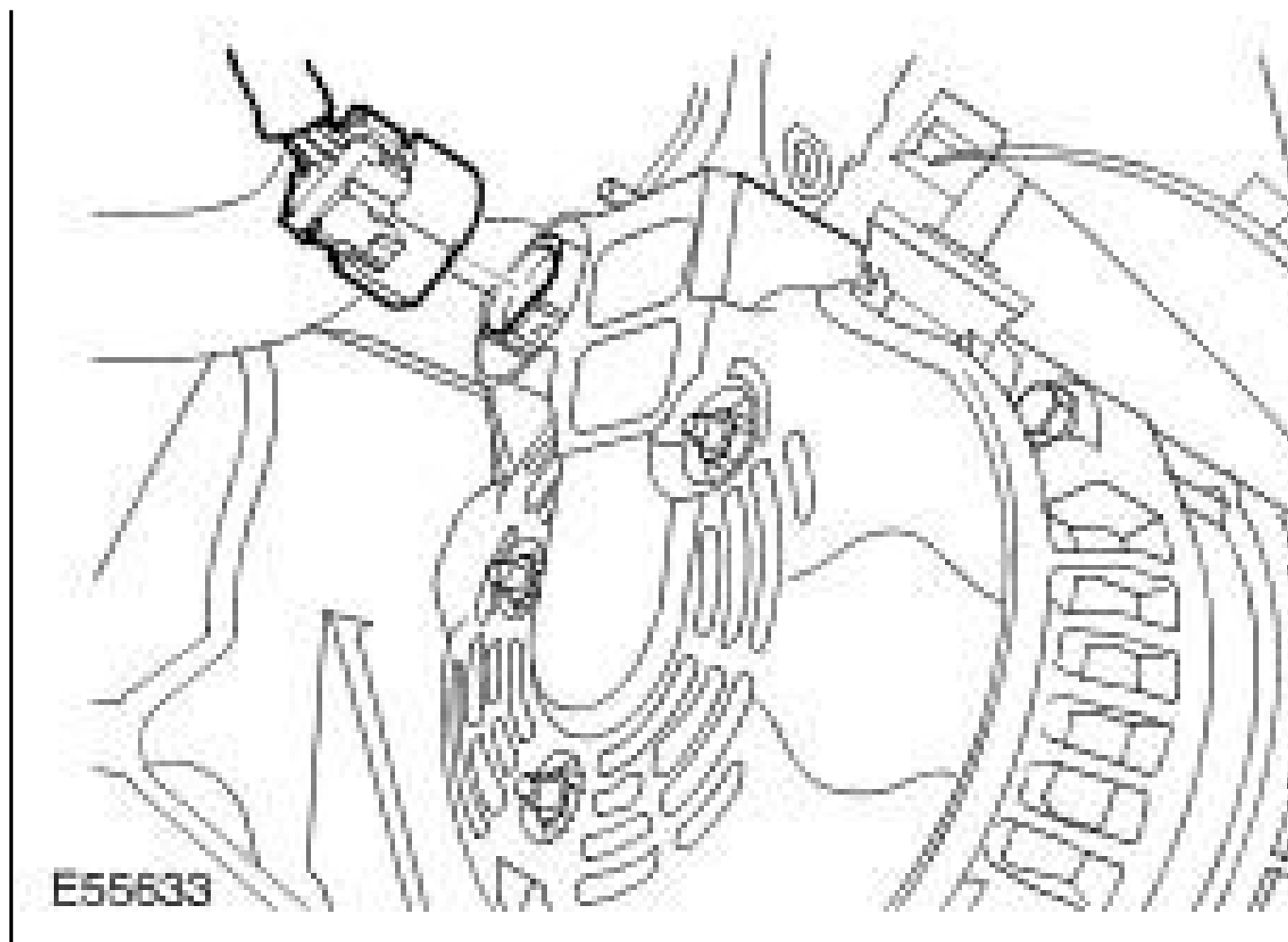
19. Disconnect the starter motor connector.



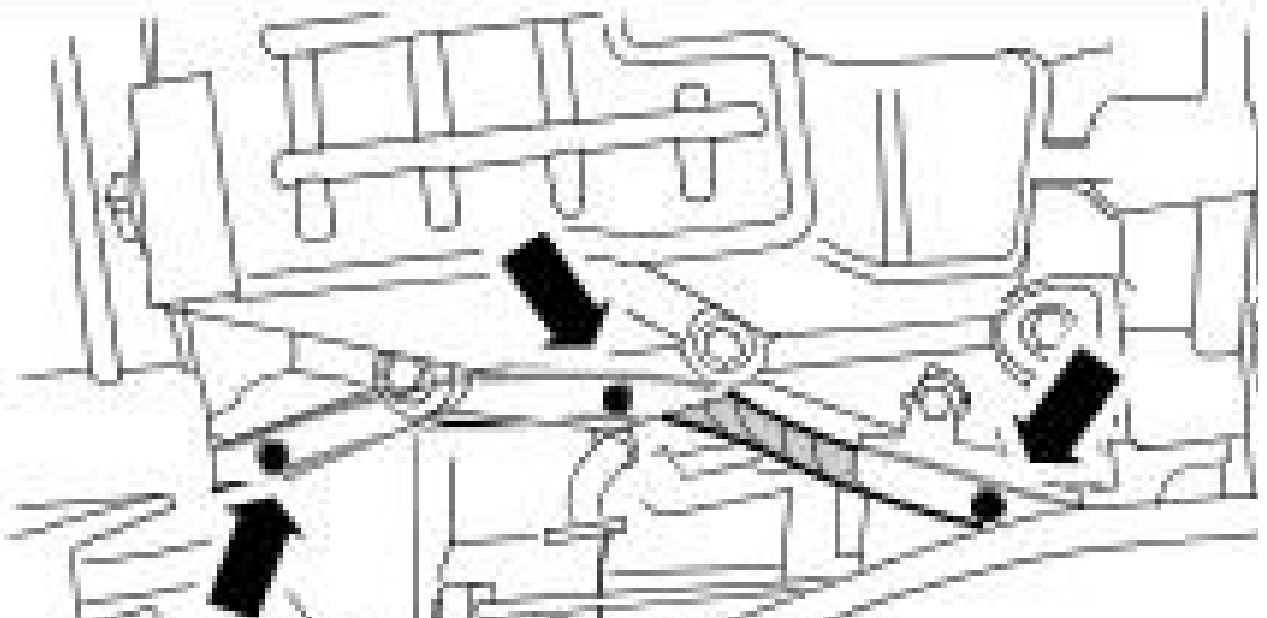
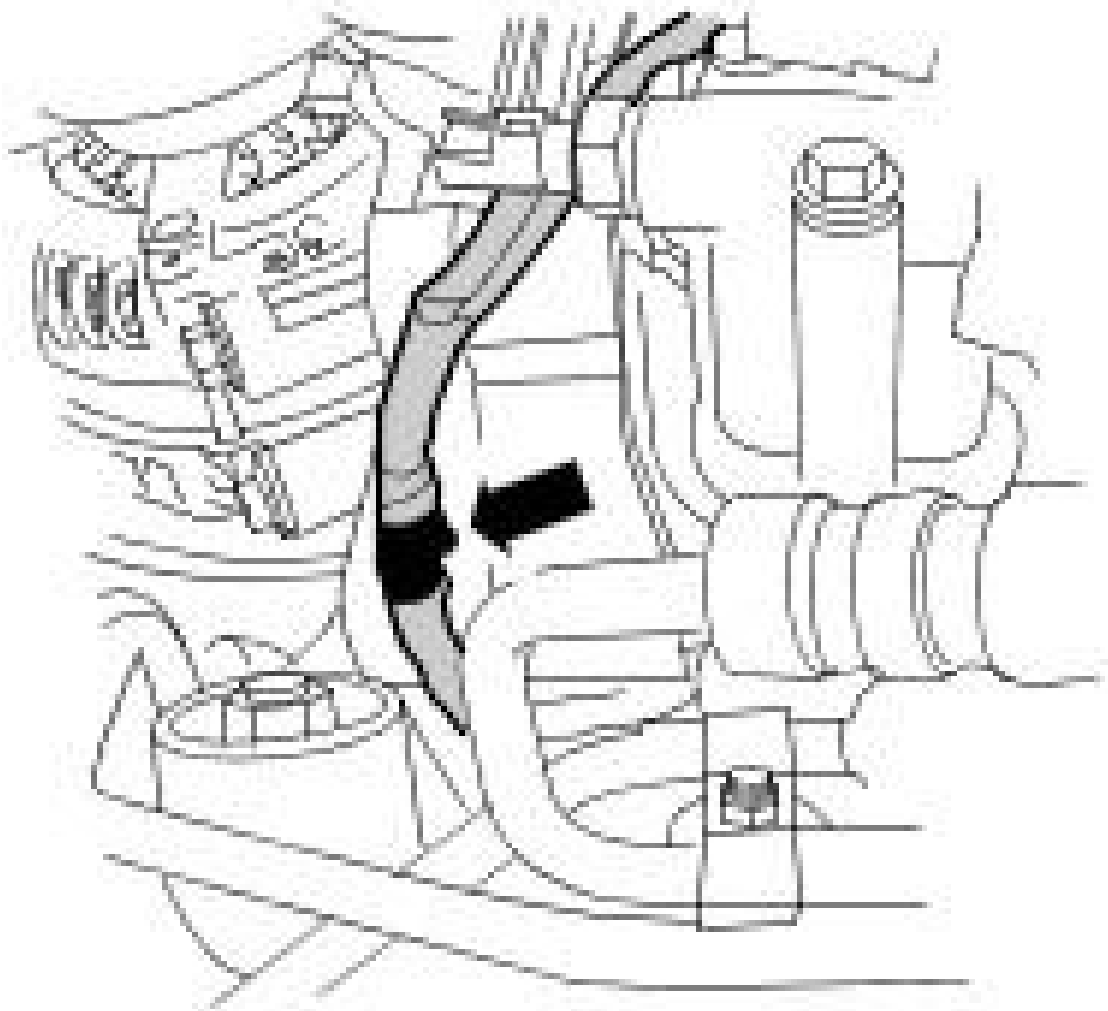
20. Disconnect the oil temperature and oil pressure sensors.



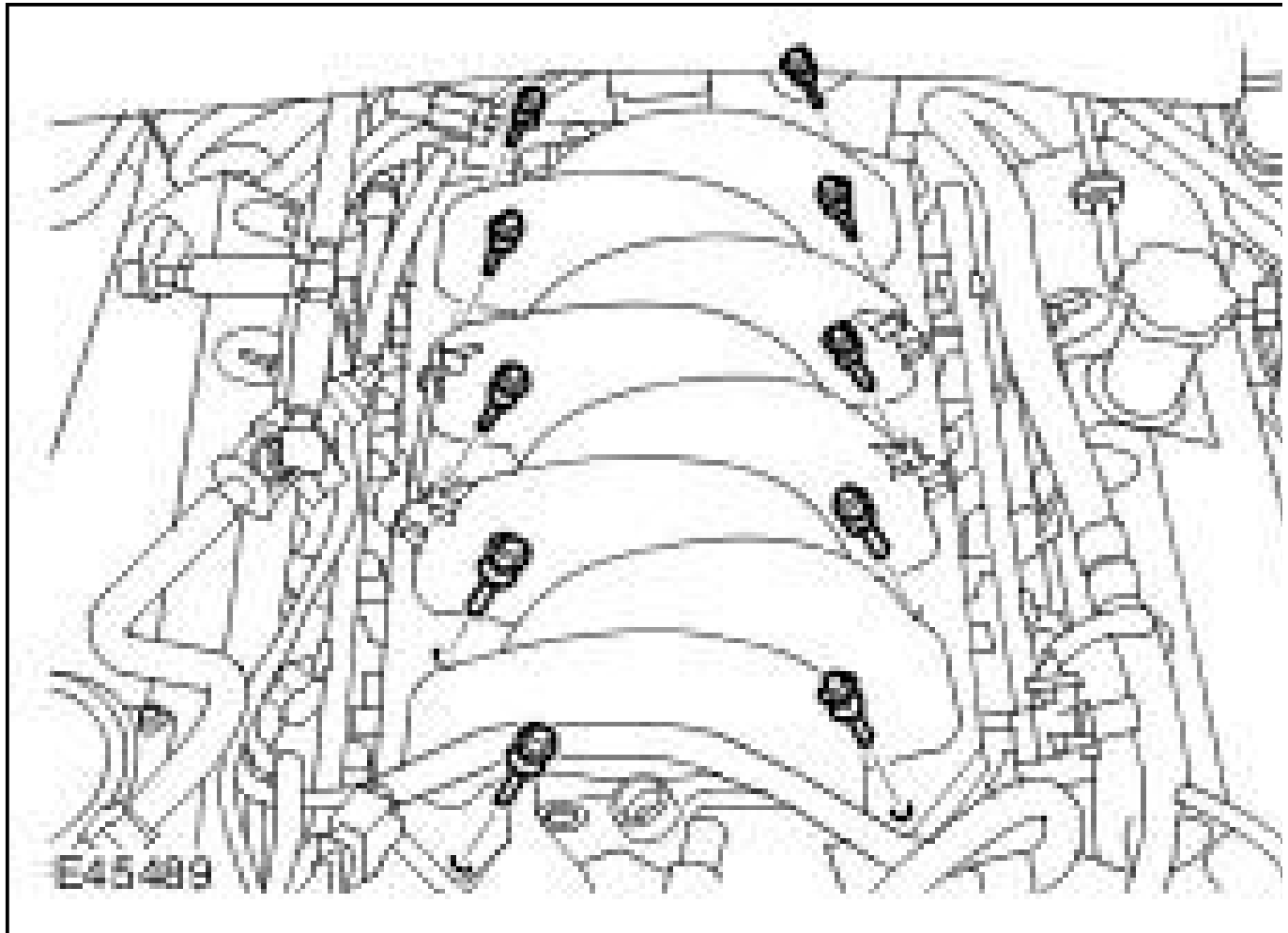
21. Disconnect the generator connector.



22. Release the 4 clips securing the generator harness.



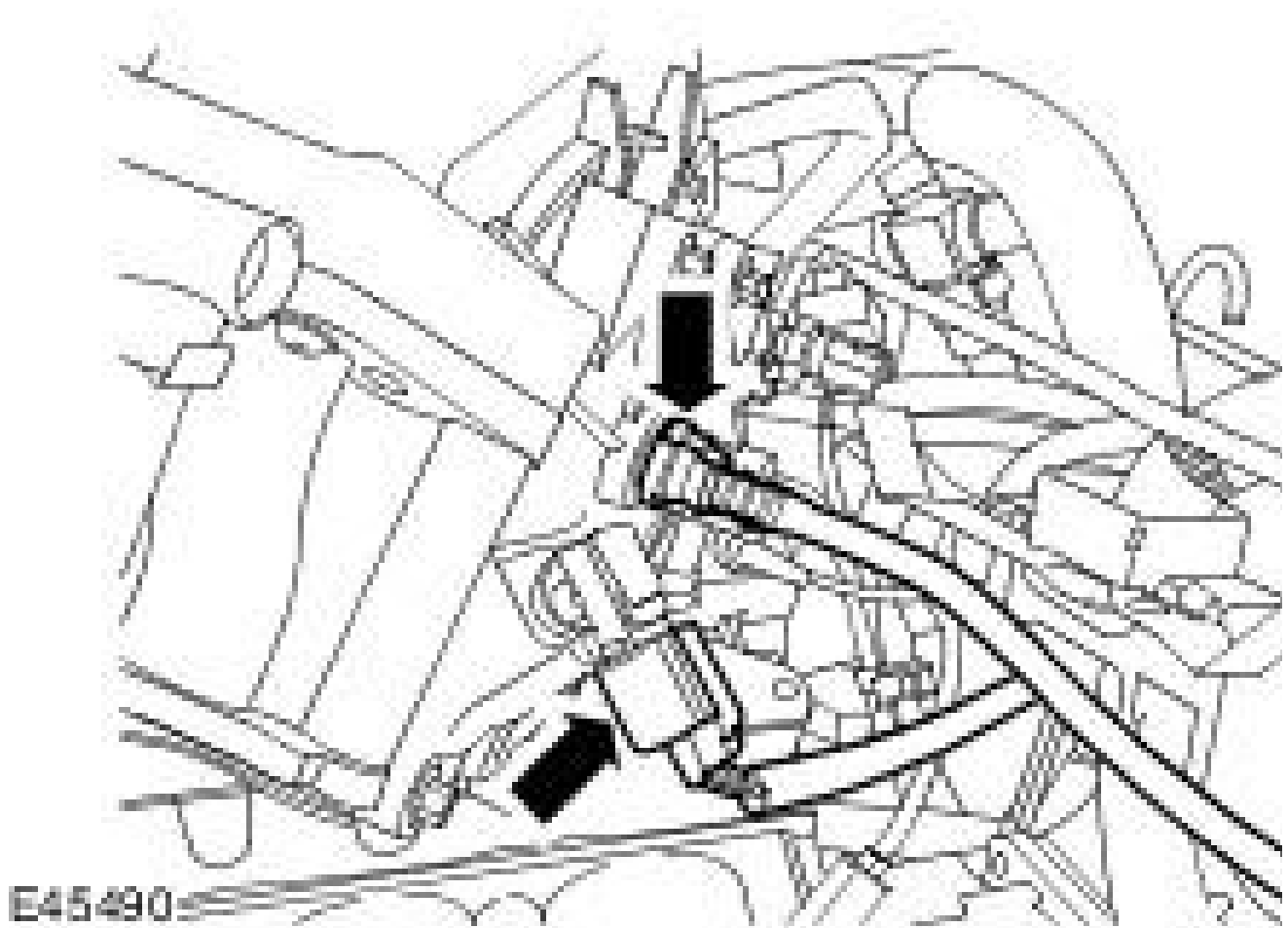
23. Remove the 10 intake manifold bolts.



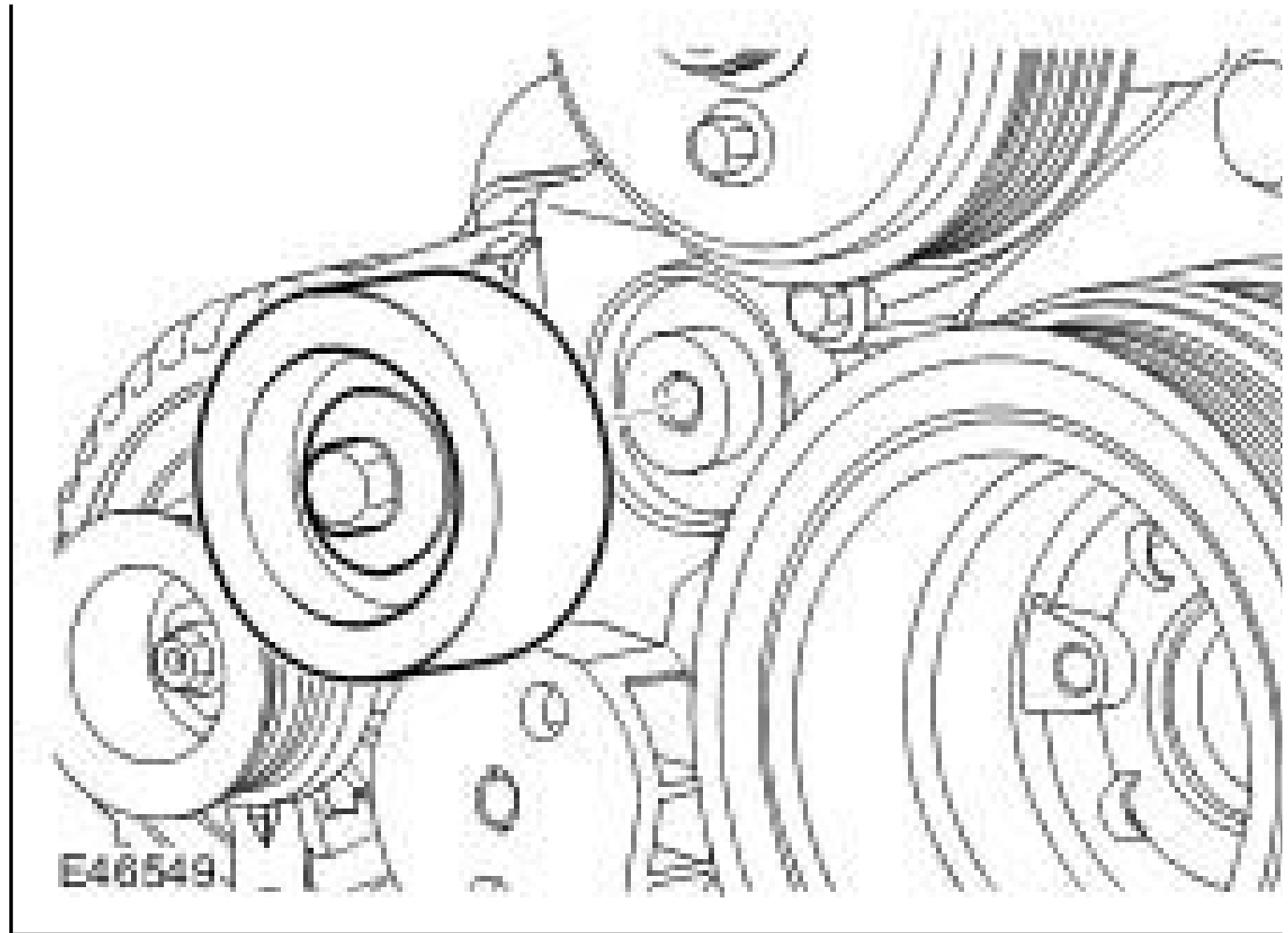
CAUTION: Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

24. Remove the intake manifold.

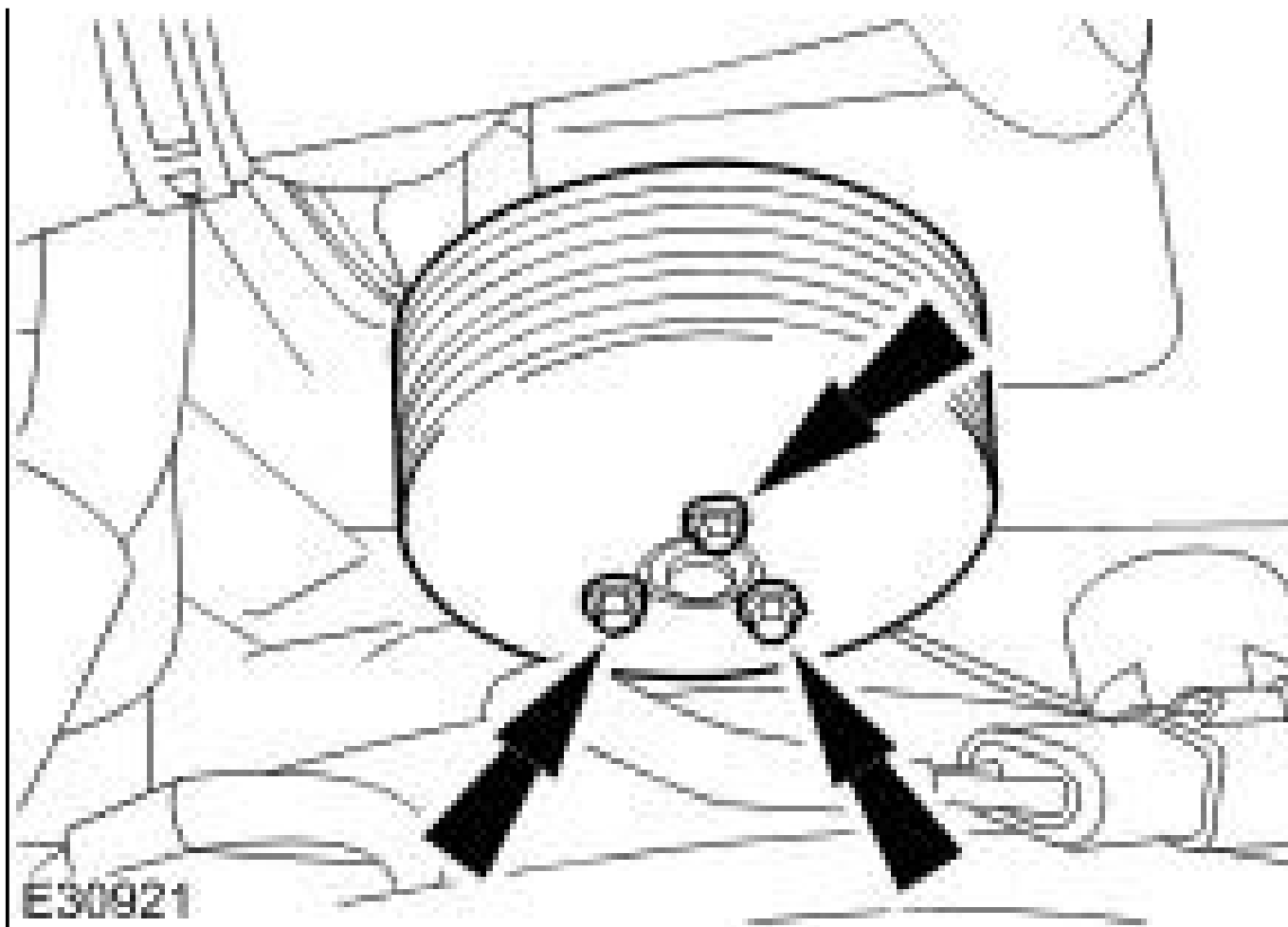
- Disconnect the brake booster vacuum hose from the intake manifold.
- Discard the gaskets.
- Disconnect the manifold absolute pressure (MAP) sensor electrical connector.



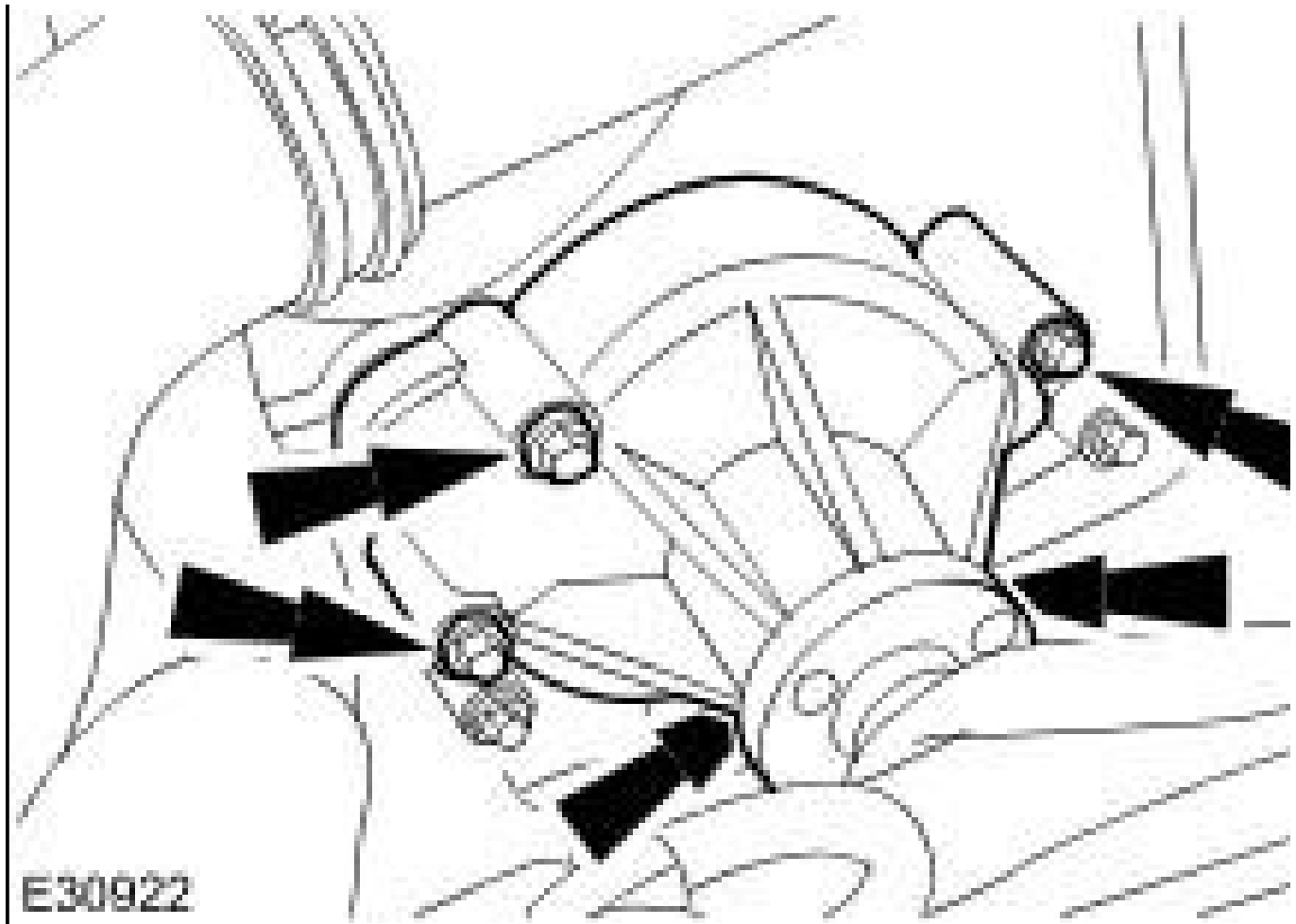
25. Remove the accessory drive belt idler pulley.
- Remove the bolt.



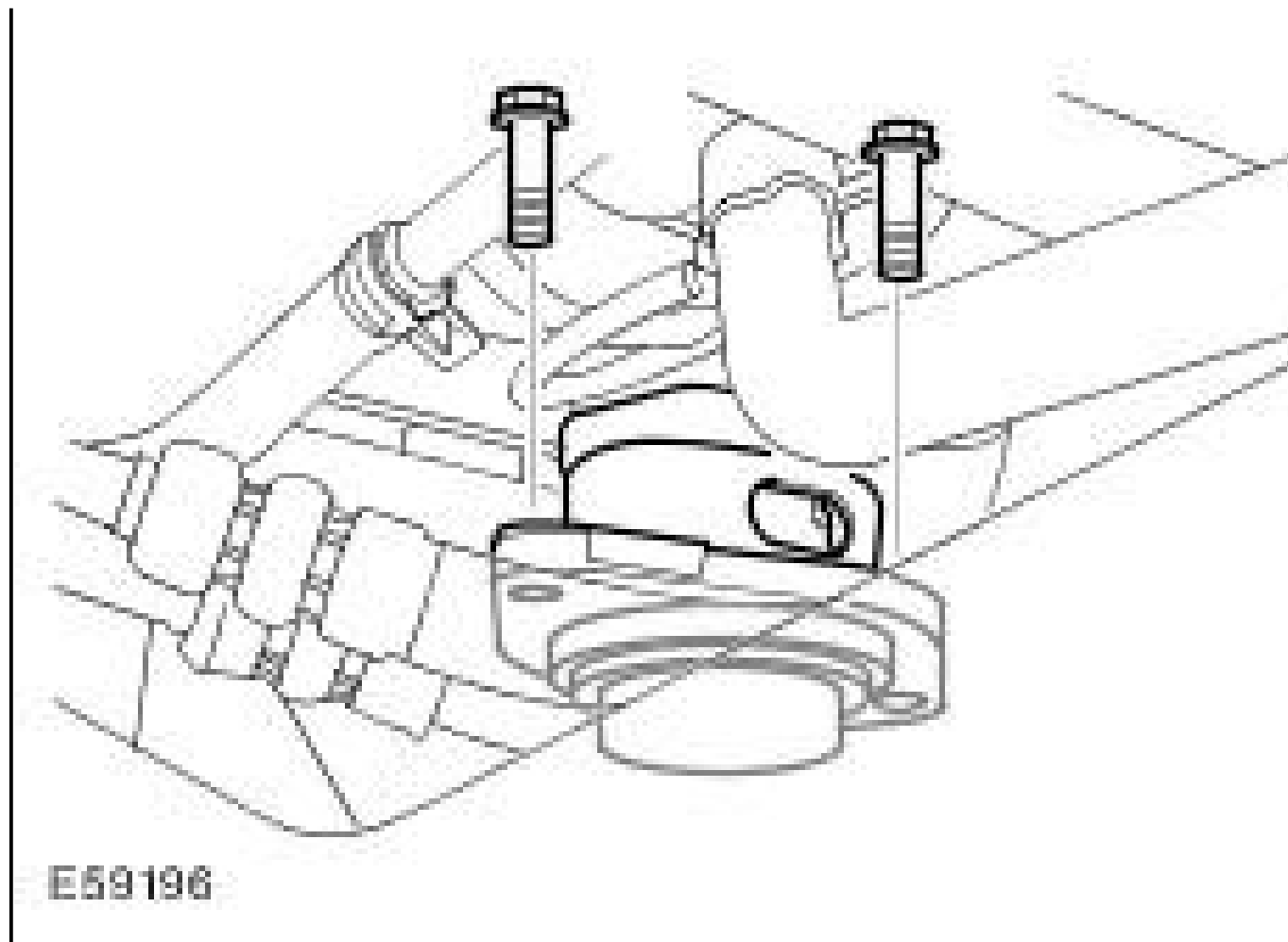
26. Remove the coolant pump pulley.
- Remove the 3 bolts.



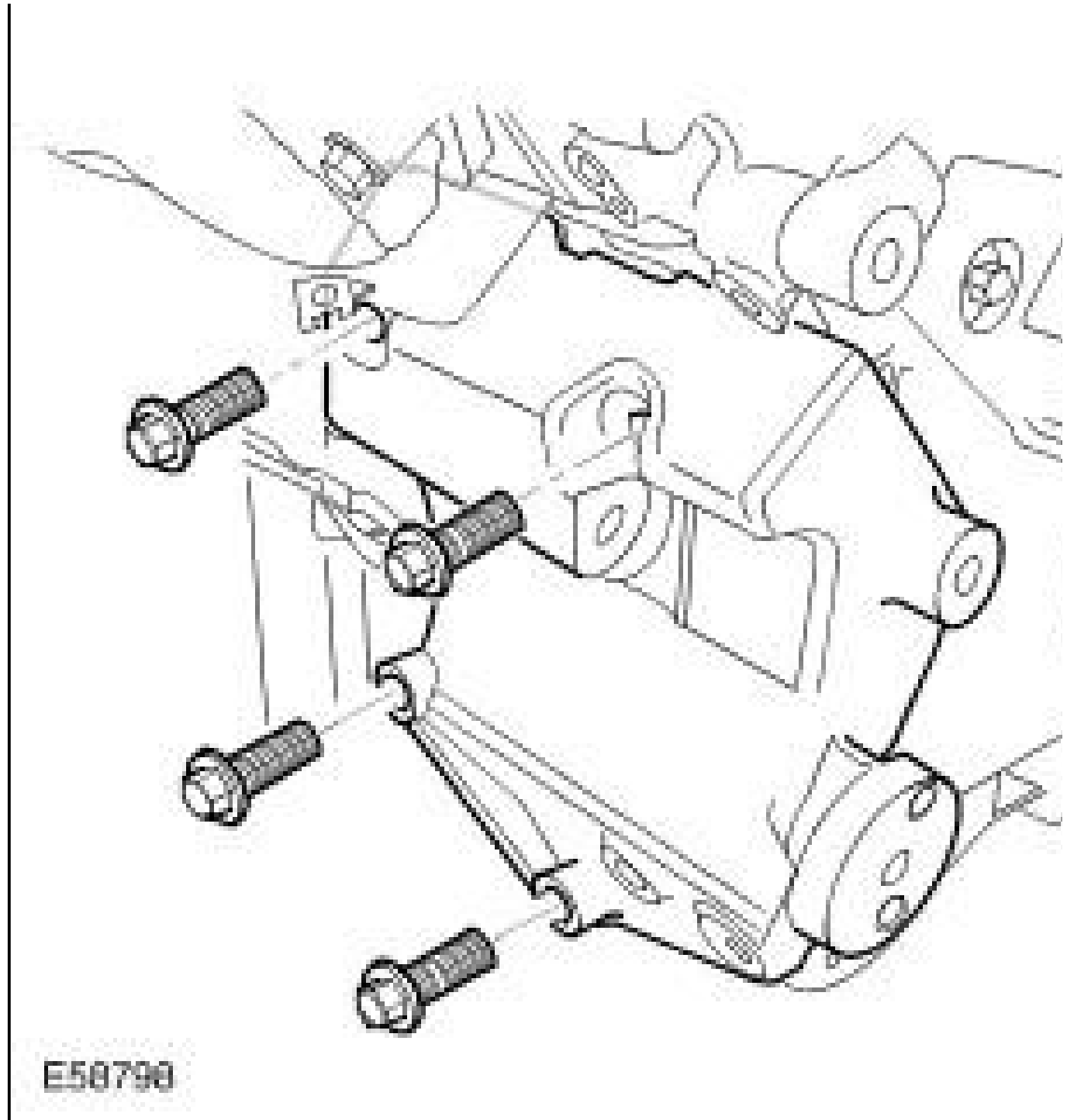
27. Remove the coolant pump.



28. Remove the generator.
- Disconnect the electrical connector.
 - Remove the 3 bolts.

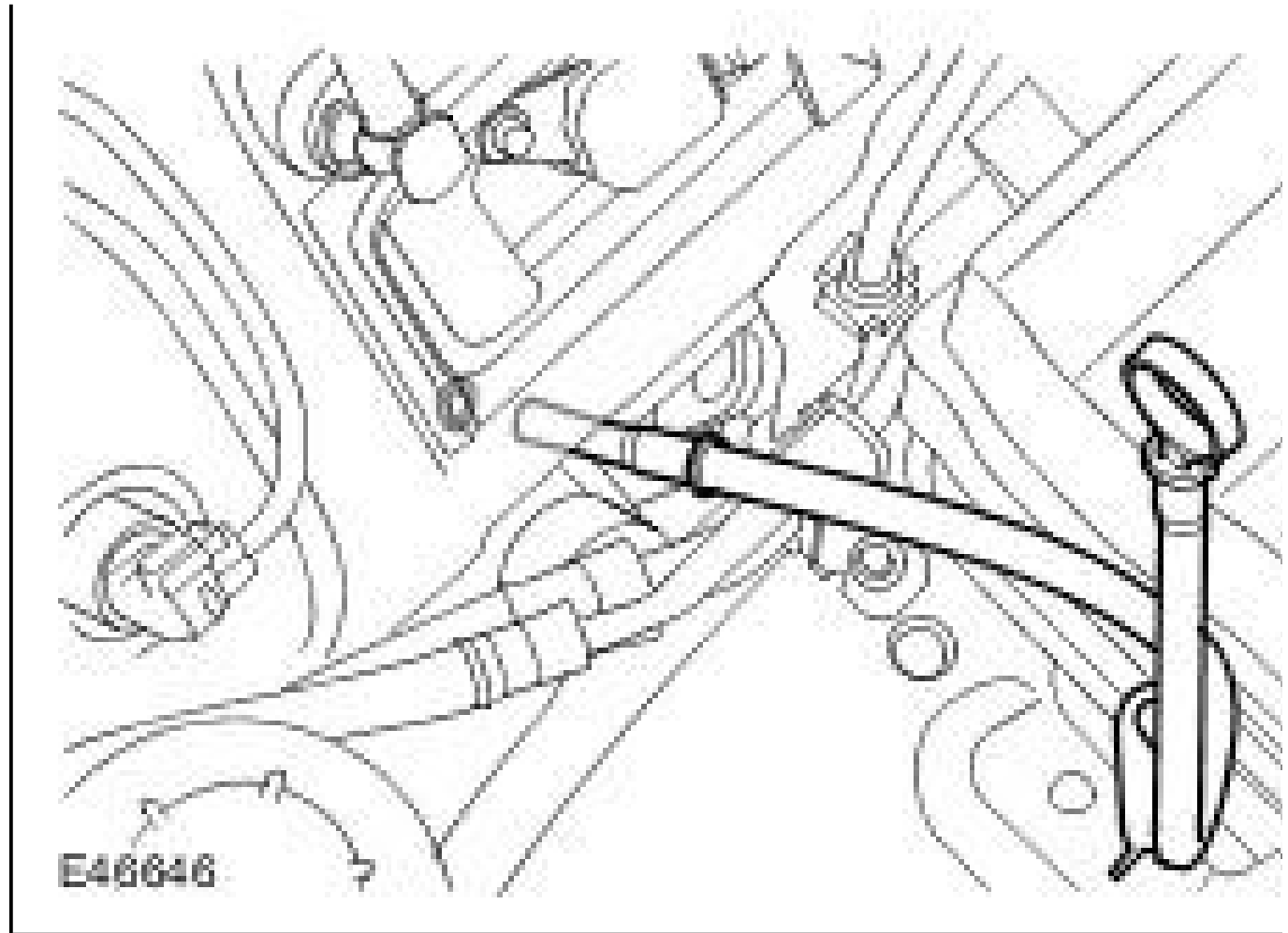


29. Remove the generator mounting bracket.
- Remove the 4 bolts.



30. Remove the oil level indicator and tube.

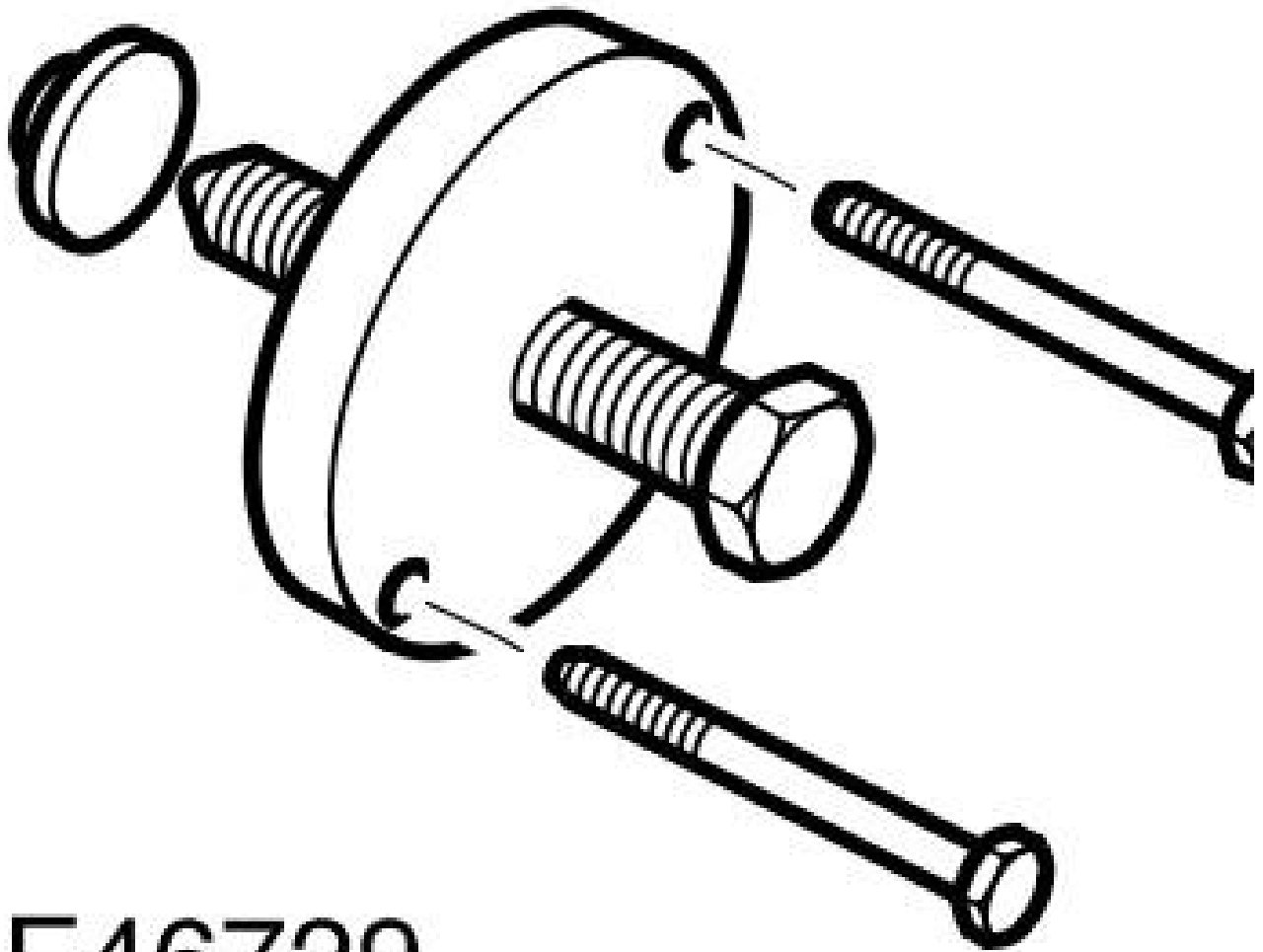
- Remove the nut.
- Discard the O-ring seal.



31. Remove the RH valve cover.

- Remove the 14 valve cover retaining bolts.
- Remove and discard the valve cover gasket.
- Remove and discard the valve cover plug aperture seals.
- Repeat the operation for the LH side.

303-588

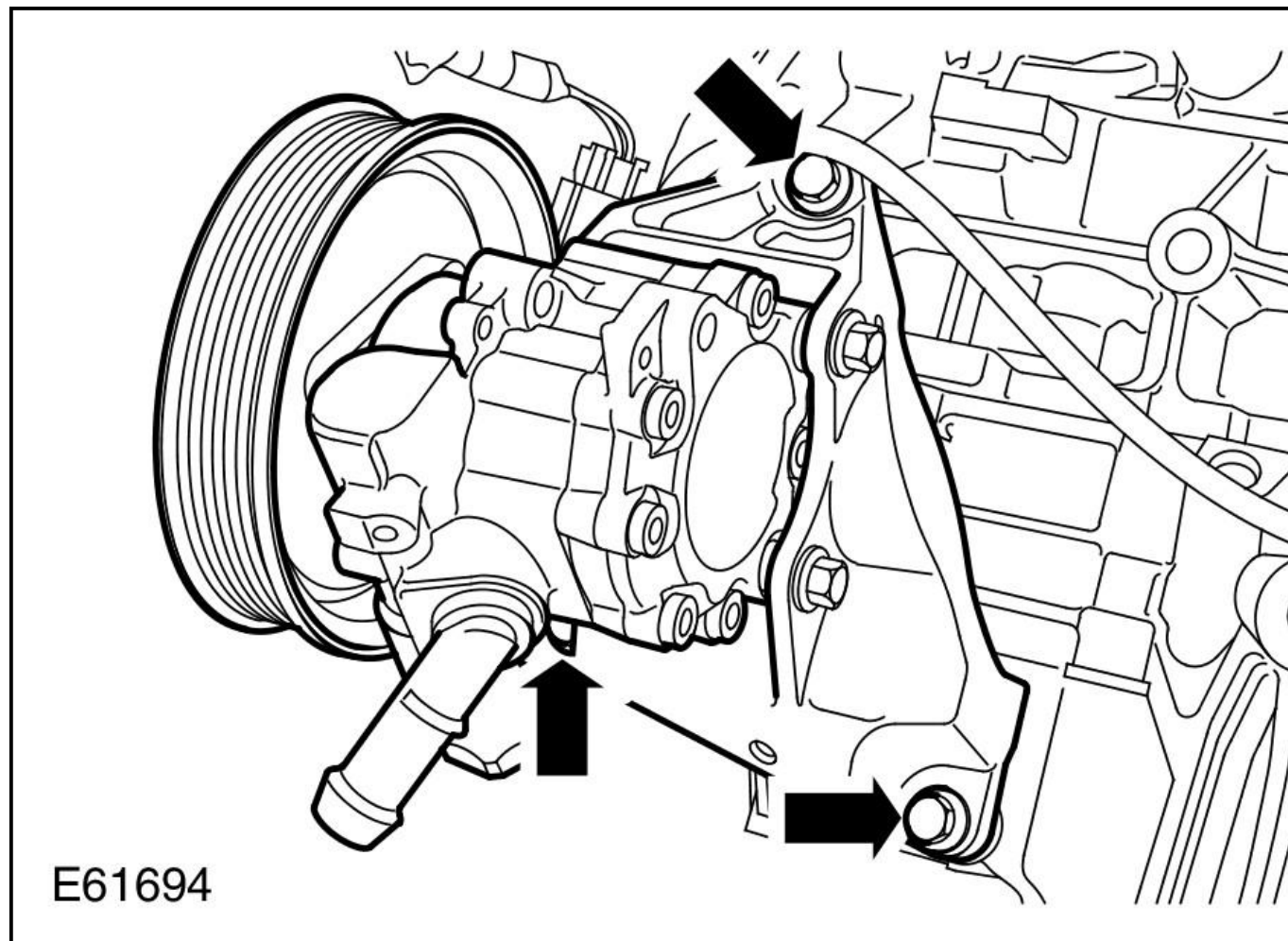


E46729

32. Remove the engine front cover.

- Release the engine wiring harness clips.
- Remove the 24 bolts.

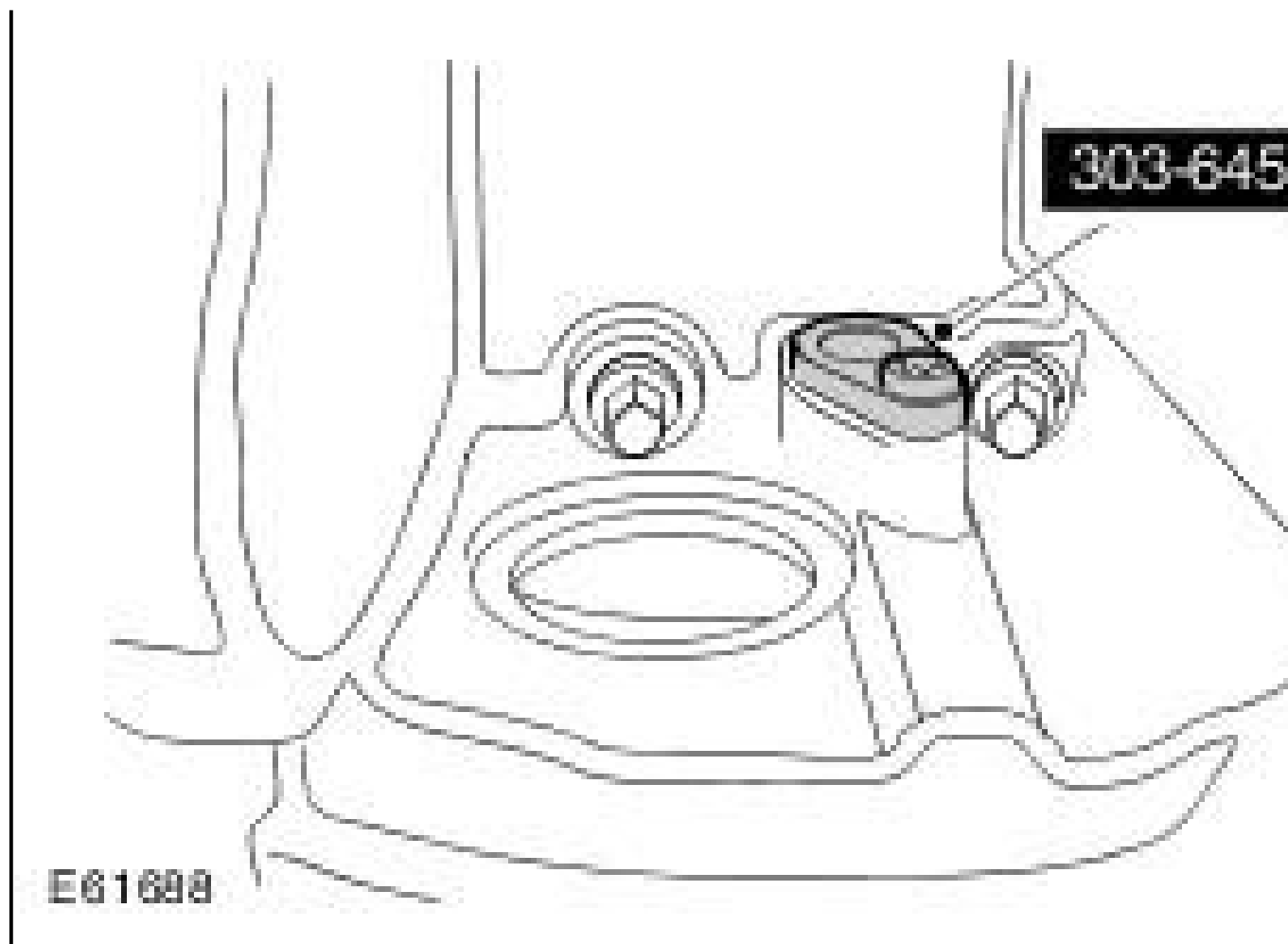
- Remove and discard the gasket.



33. Rotate the crankshaft until the flats on the camshafts are parallel with the cylinder head joint faces.

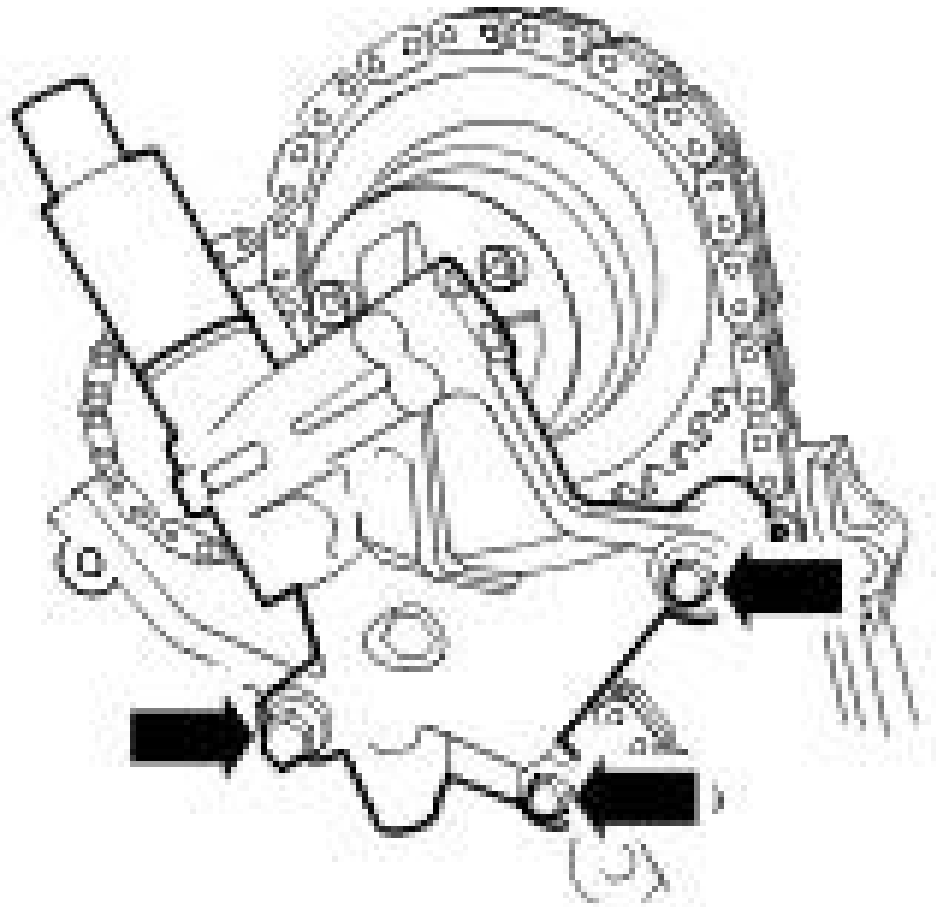
NOTE: The engine is now in the **SAFE** position.

34. Lock the crankshaft.
- Install the special tool.
 - Install the screw.



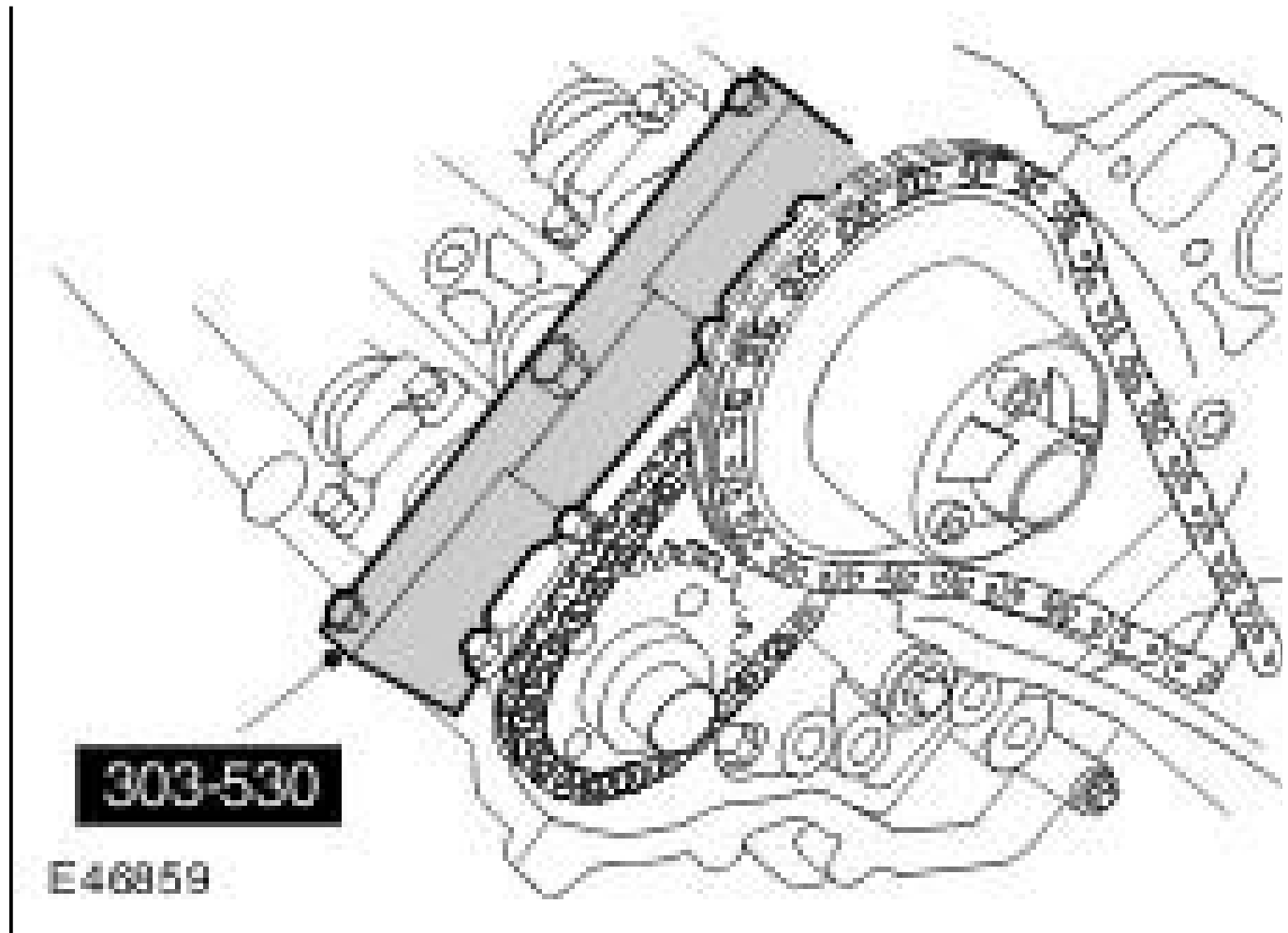
35. Remove the RH VCT control unit.

- Remove the 3 bolts.
- Remove and discard the O-ring seals.

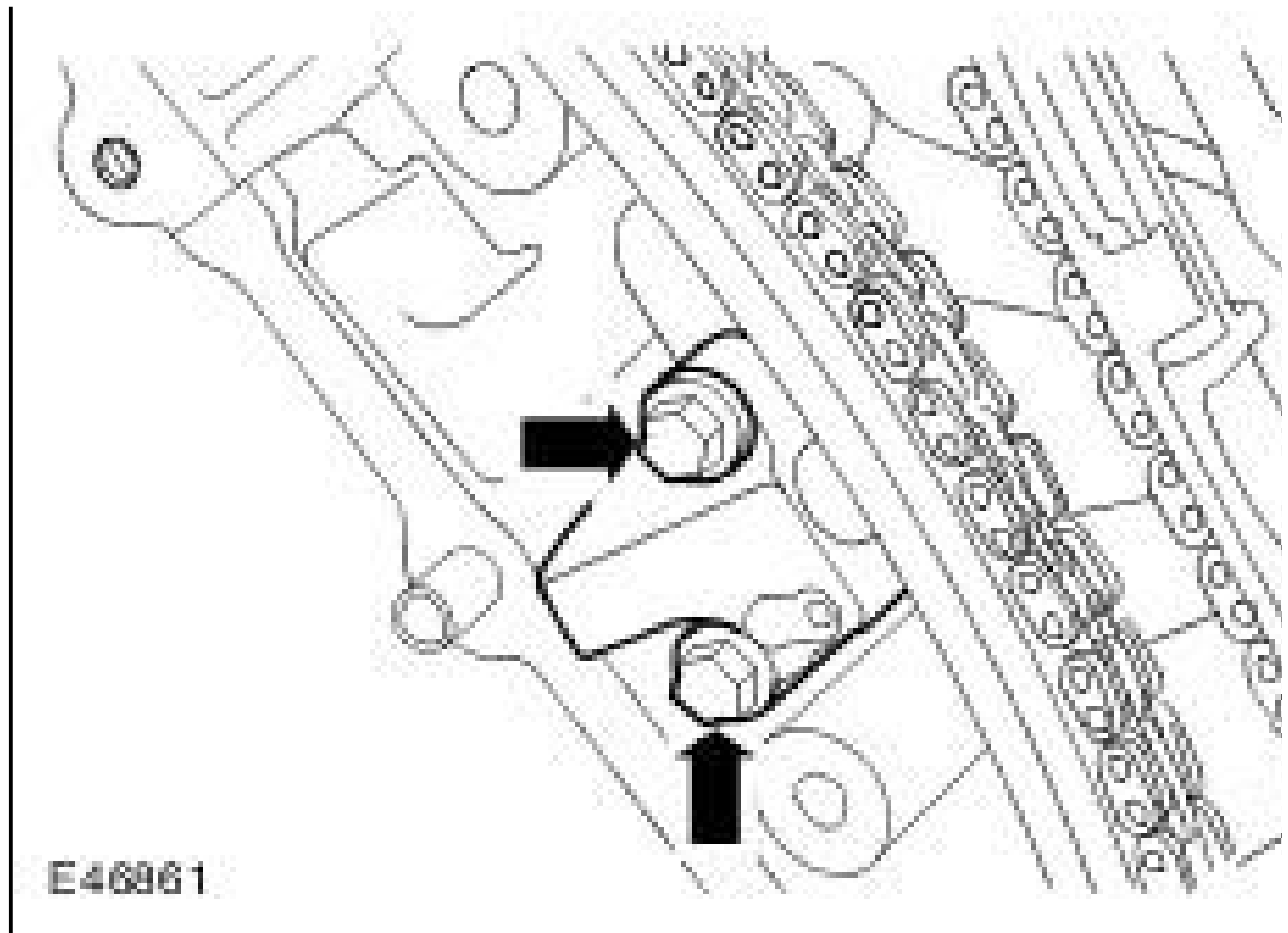


E46858

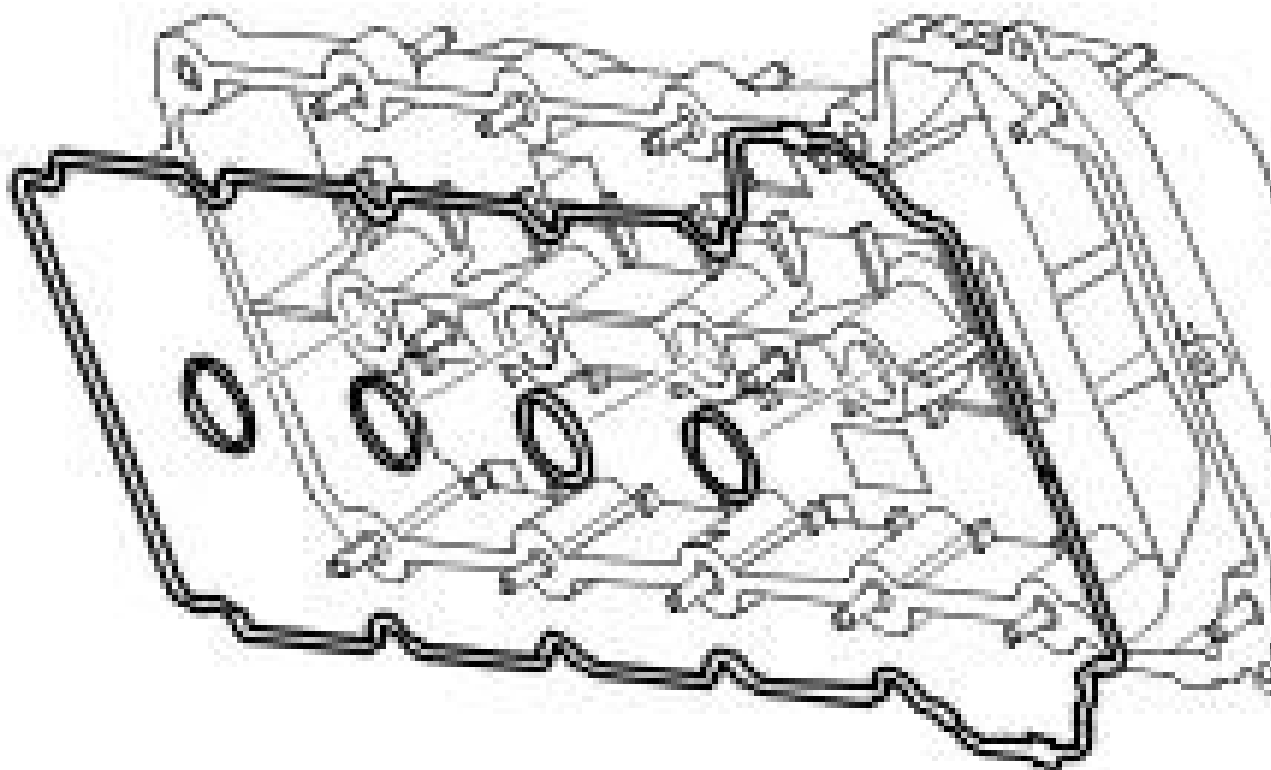
36. Install the special tool to the RH cylinder head.
- Install the 3 bolts.



37. Remove the RH primary timing chain tensioner assembly.
- Remove the 2 bolts.

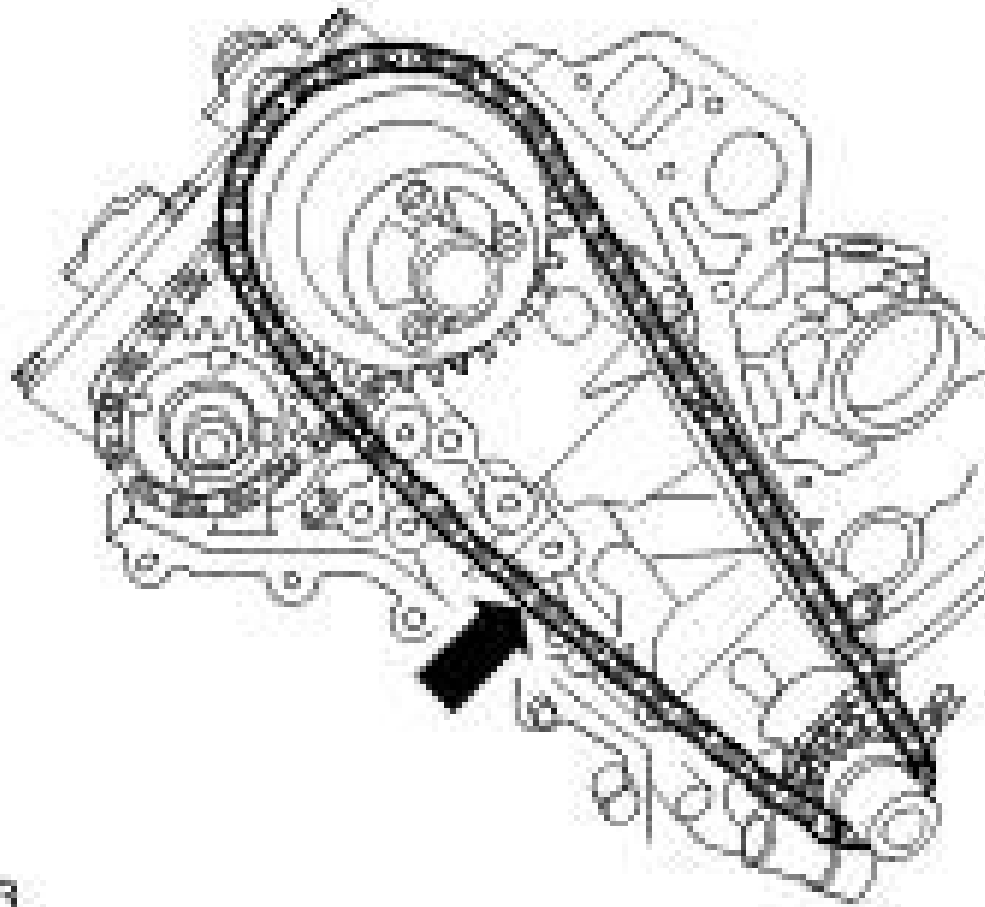


38. Remove the RH primary timing chain tensioner guide.
- Remove the bolt.



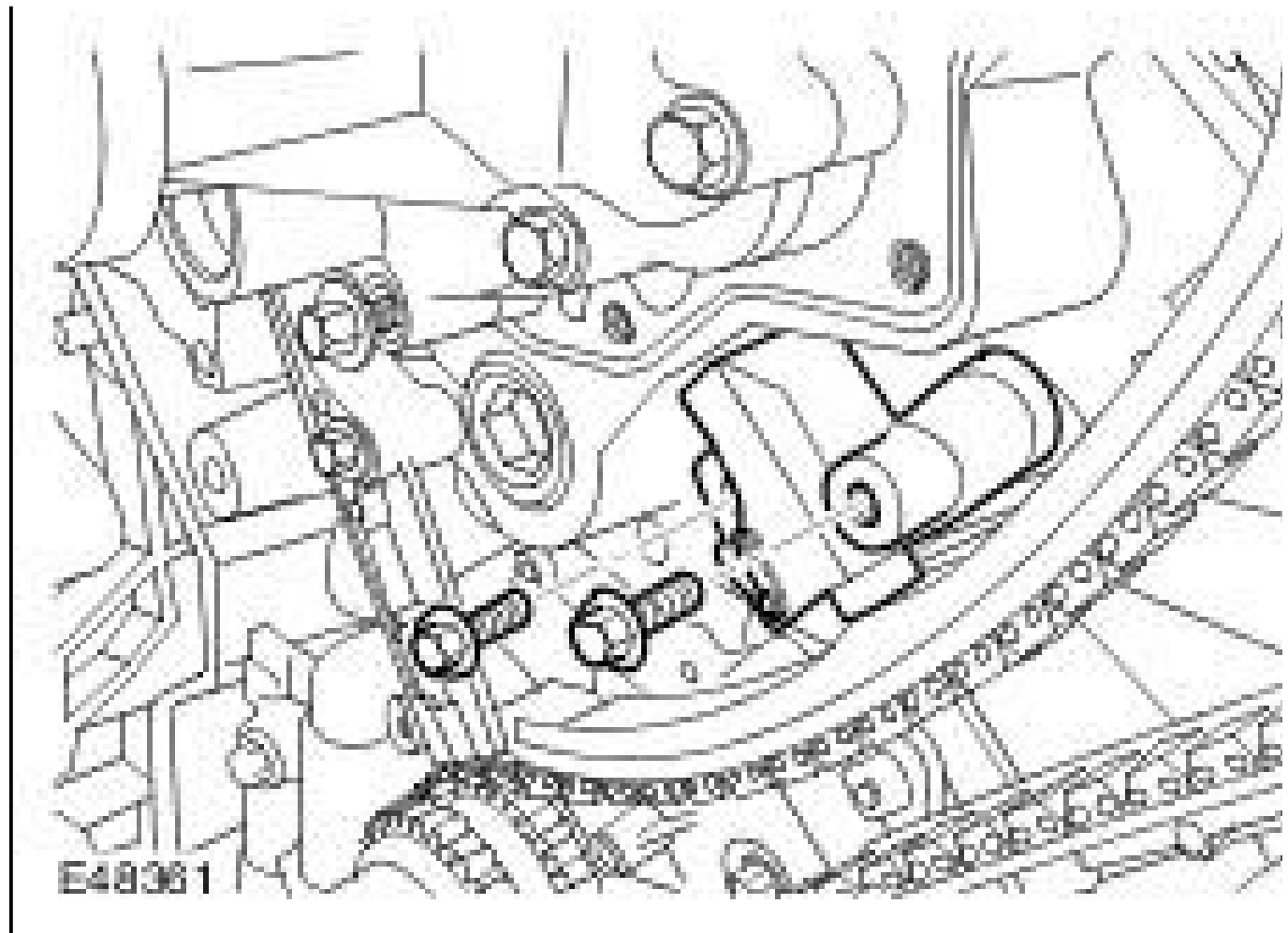
E46652

39. Remove the RH primary timing chain.

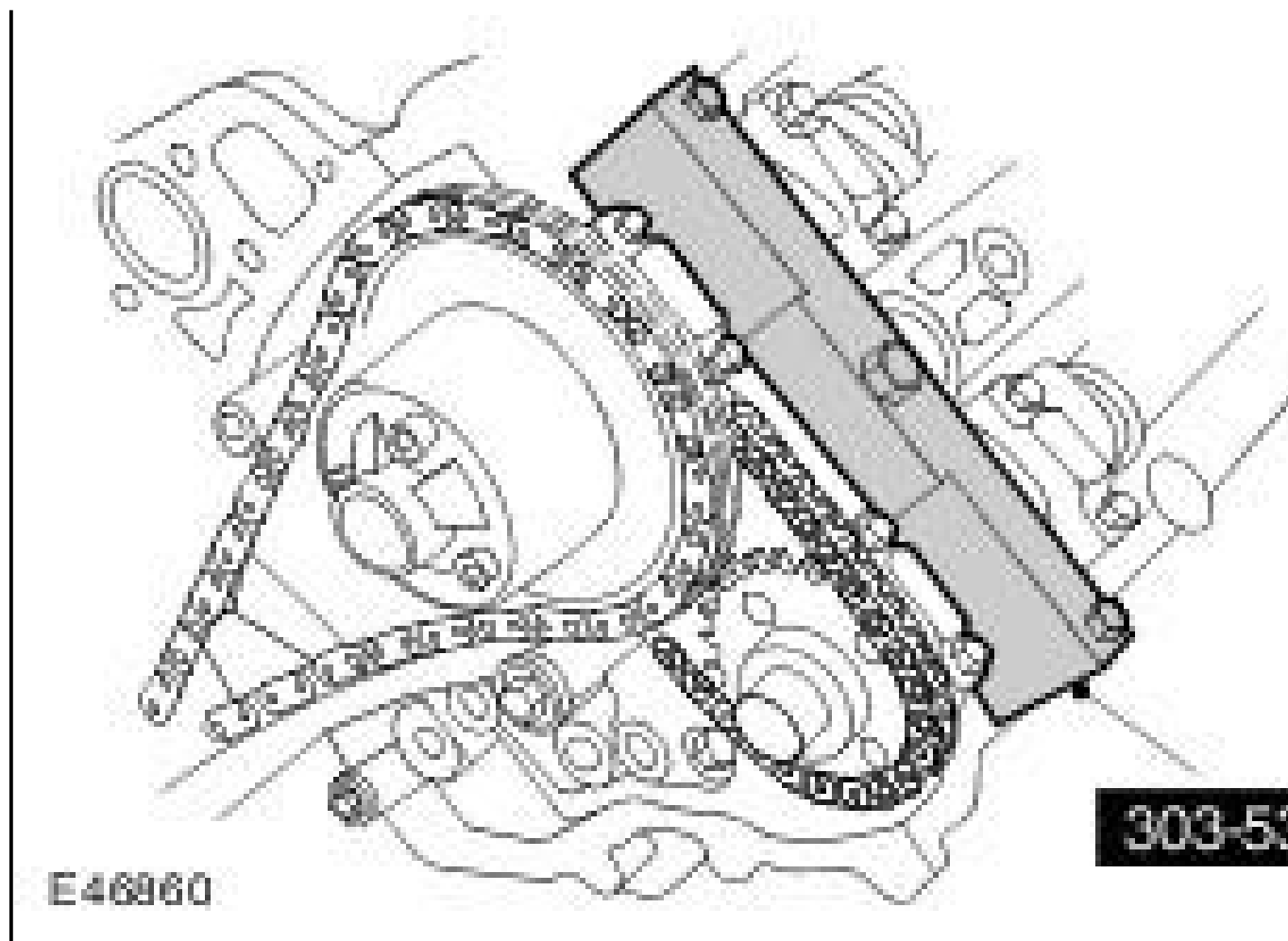


E46863

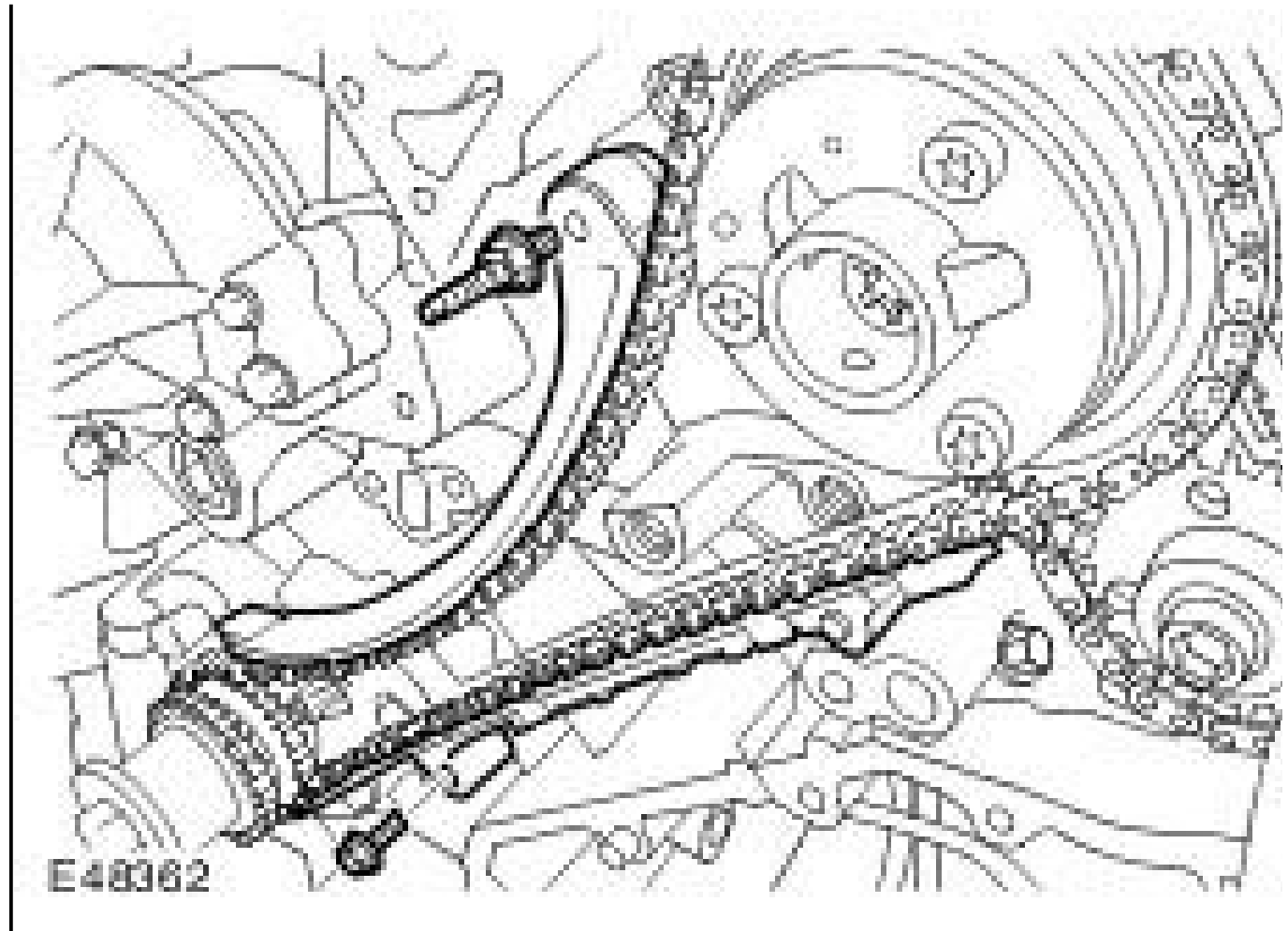
40. Remove the LH VCT control unit.
- Remove the 2 bolts.
 - Remove the nut.
 - Remove and discard the O-ring seals.



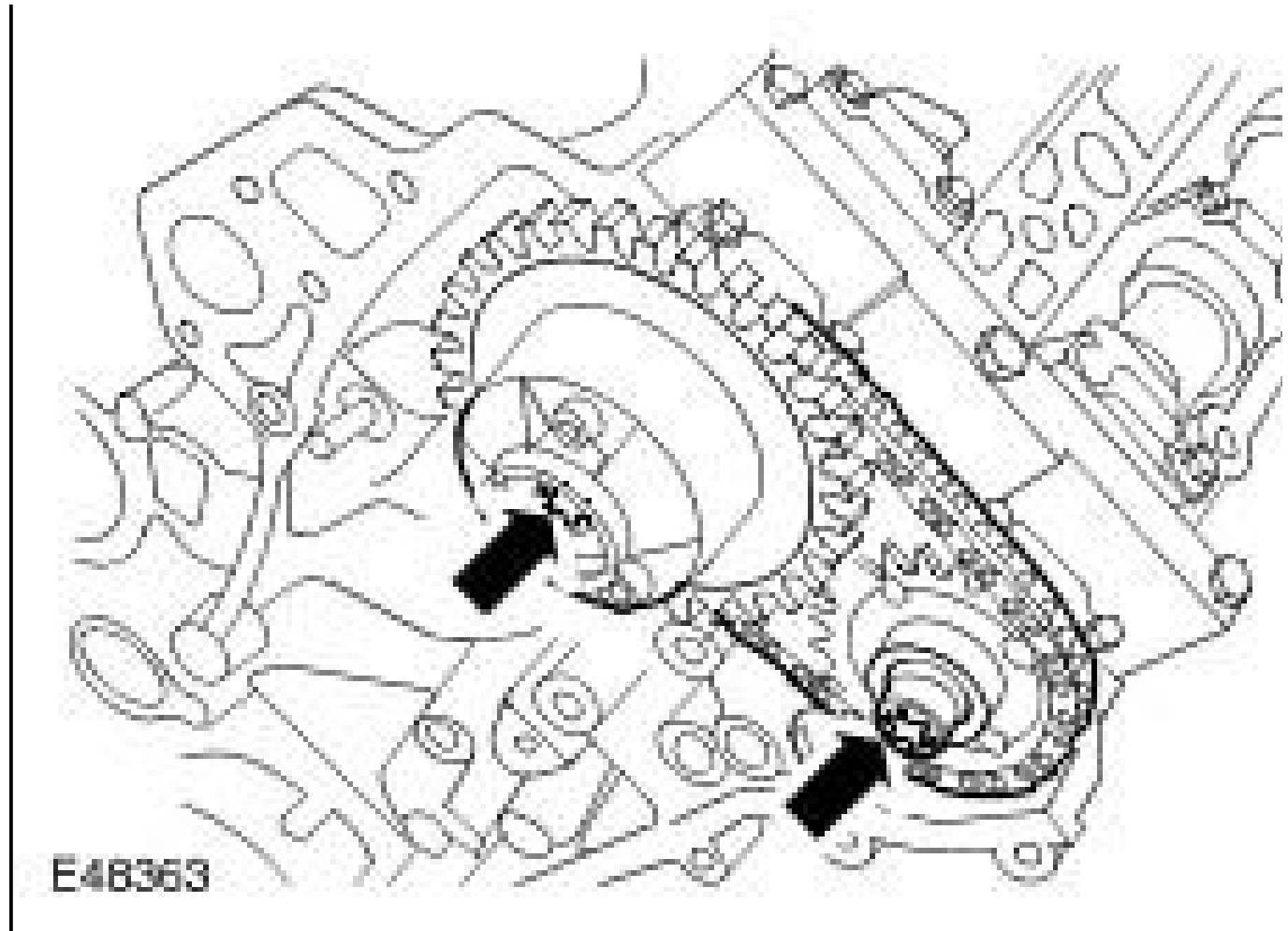
41. Install the special tool to the LH cylinder head.
- Install the 3 bolts.



42. Remove the LH primary timing chain tensioner.
- Remove the 2 bolts.



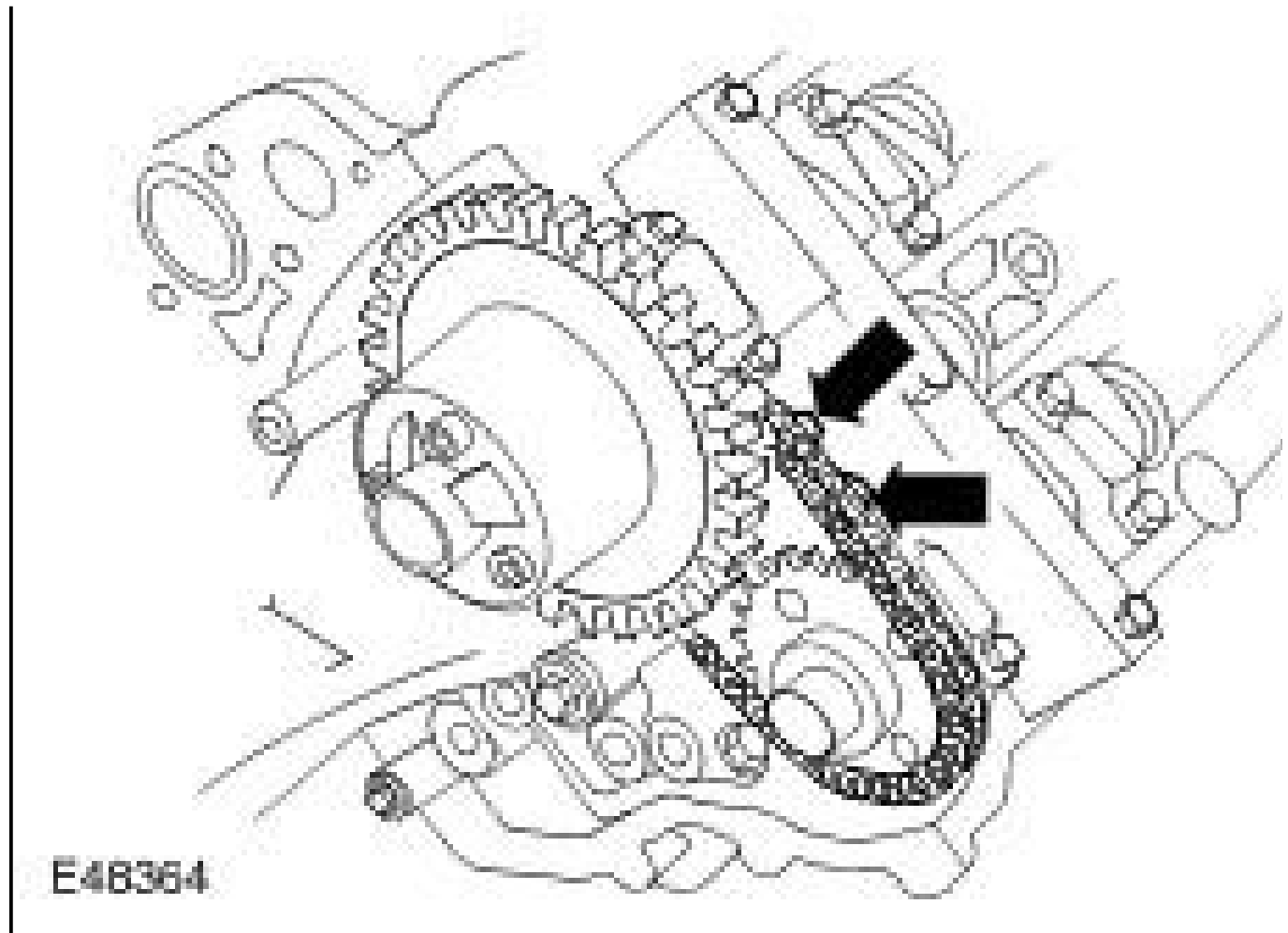
43. Remove the LH upper and lower primary timing chain tensioner guides.
- Remove the stud.
 - Remove the bolt.



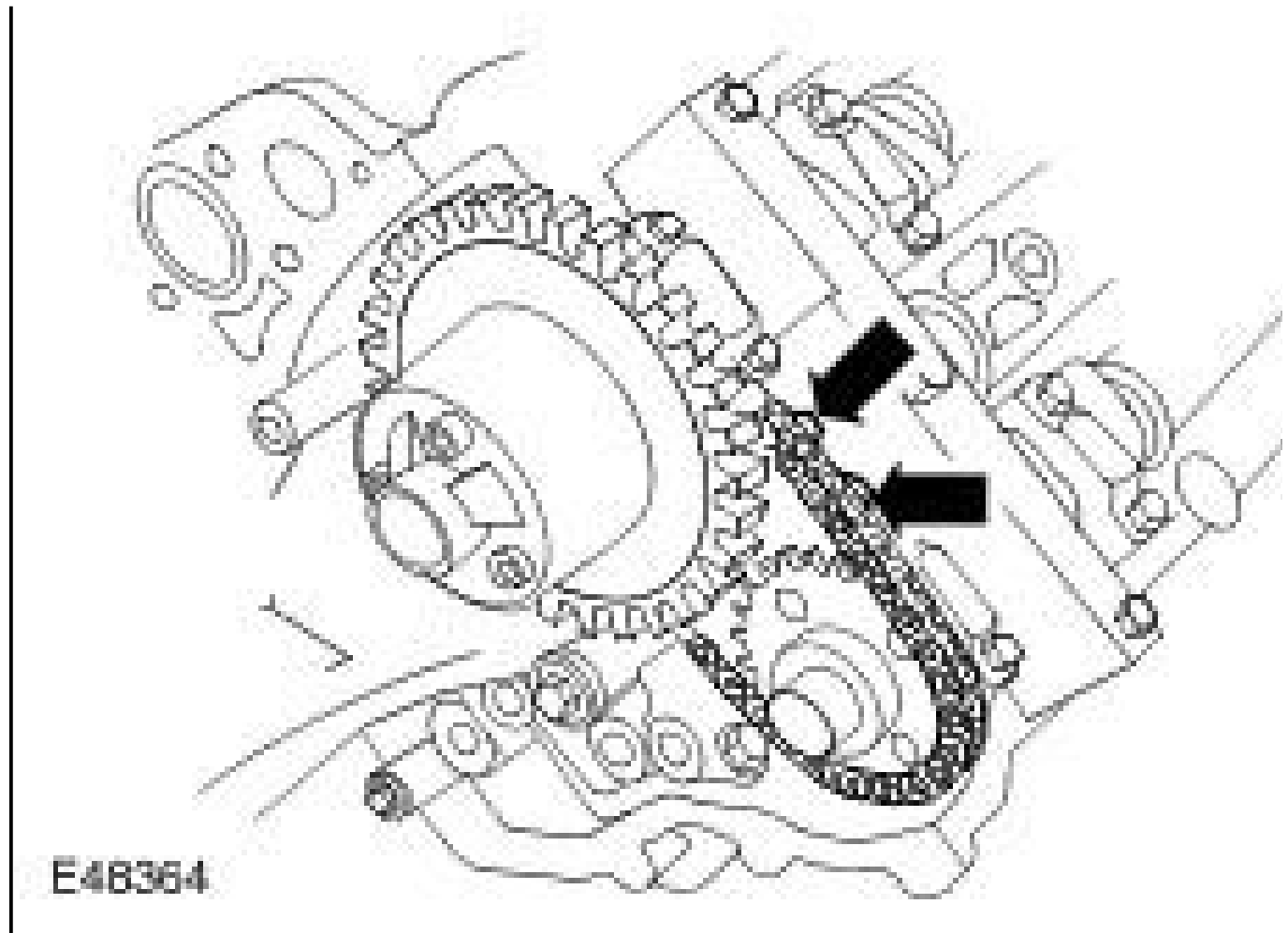
44. Remove the LH primary timing chain.

CAUTION: Discard the bolts.

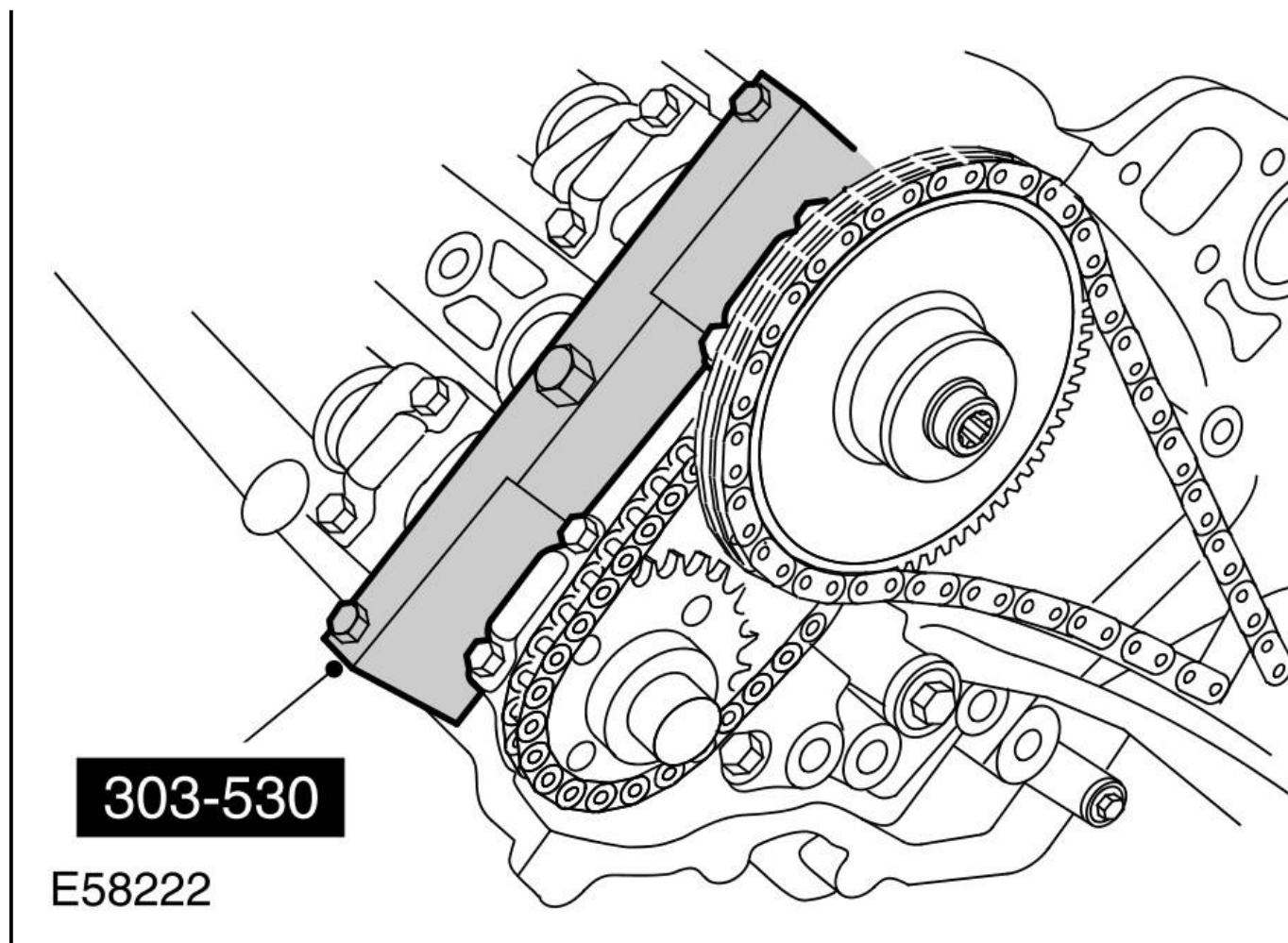
45. Remove the camshaft sprockets.
- Remove the 2 bolts.



46. Remove the secondary timing chain tensioner and the secondary timing chain.
- Remove the 2 bolts.



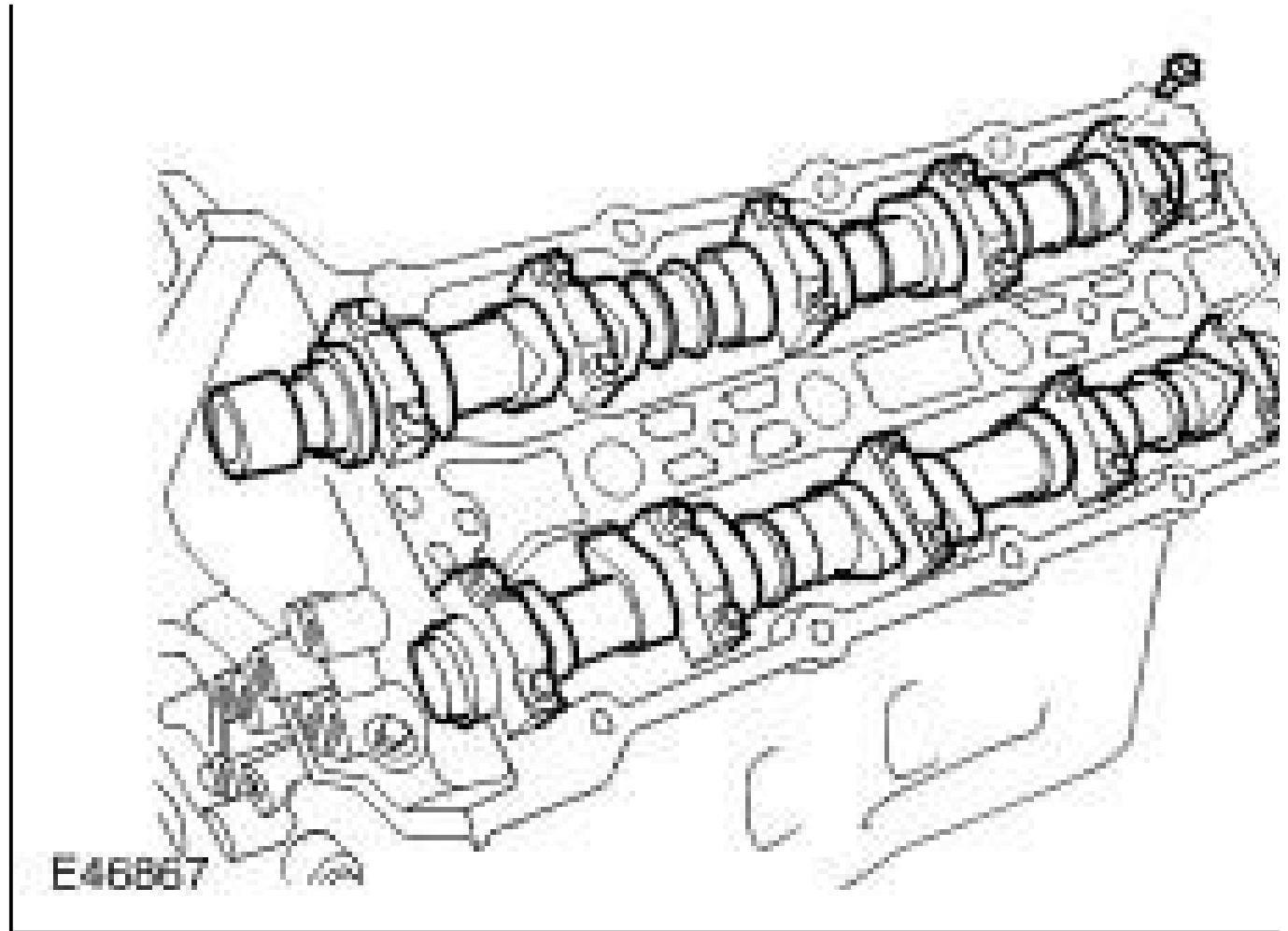
47. Remove the special tool from the LH cylinder head.
- Remove the 3 bolts.



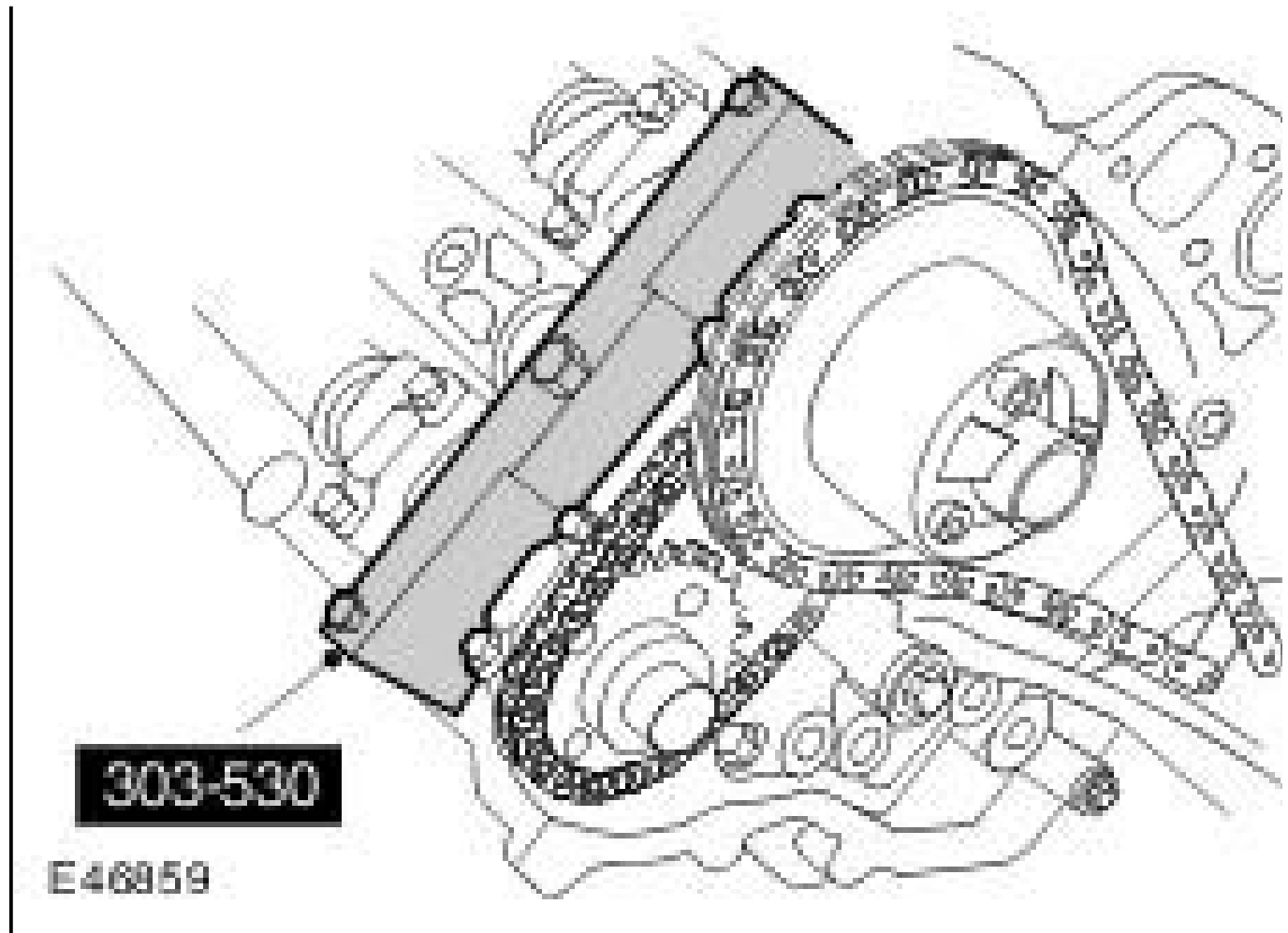
CAUTION: Evenly and progressively, release the camshaft bearing caps.

NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

48. Remove the camshaft bearing caps.
 - Remove the 20 bolts.



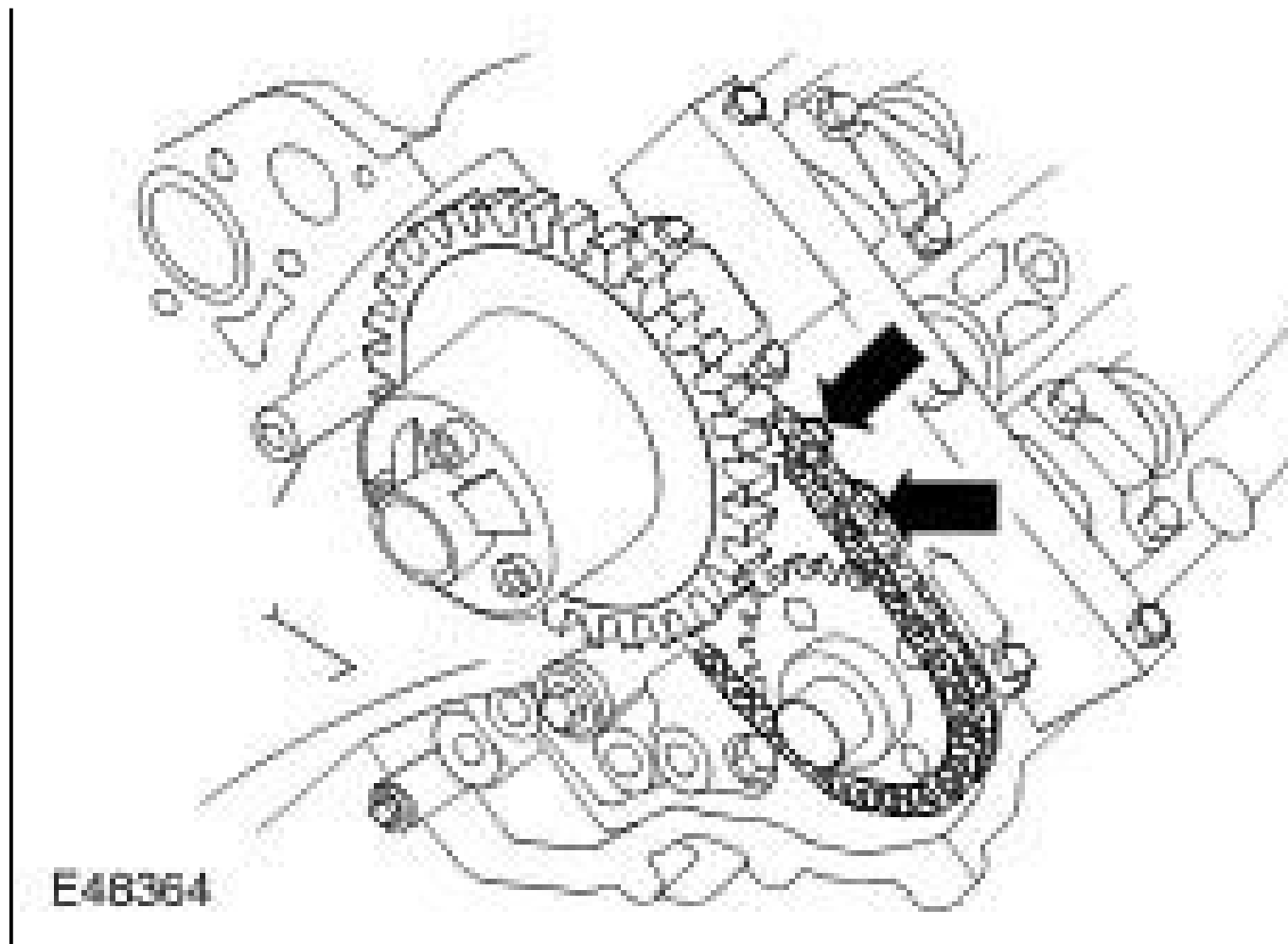
49. Remove the camshafts.
50. Install the special tool to the RH cylinder head.
 - Install the 3 bolts.



CAUTION: Discard the bolts.

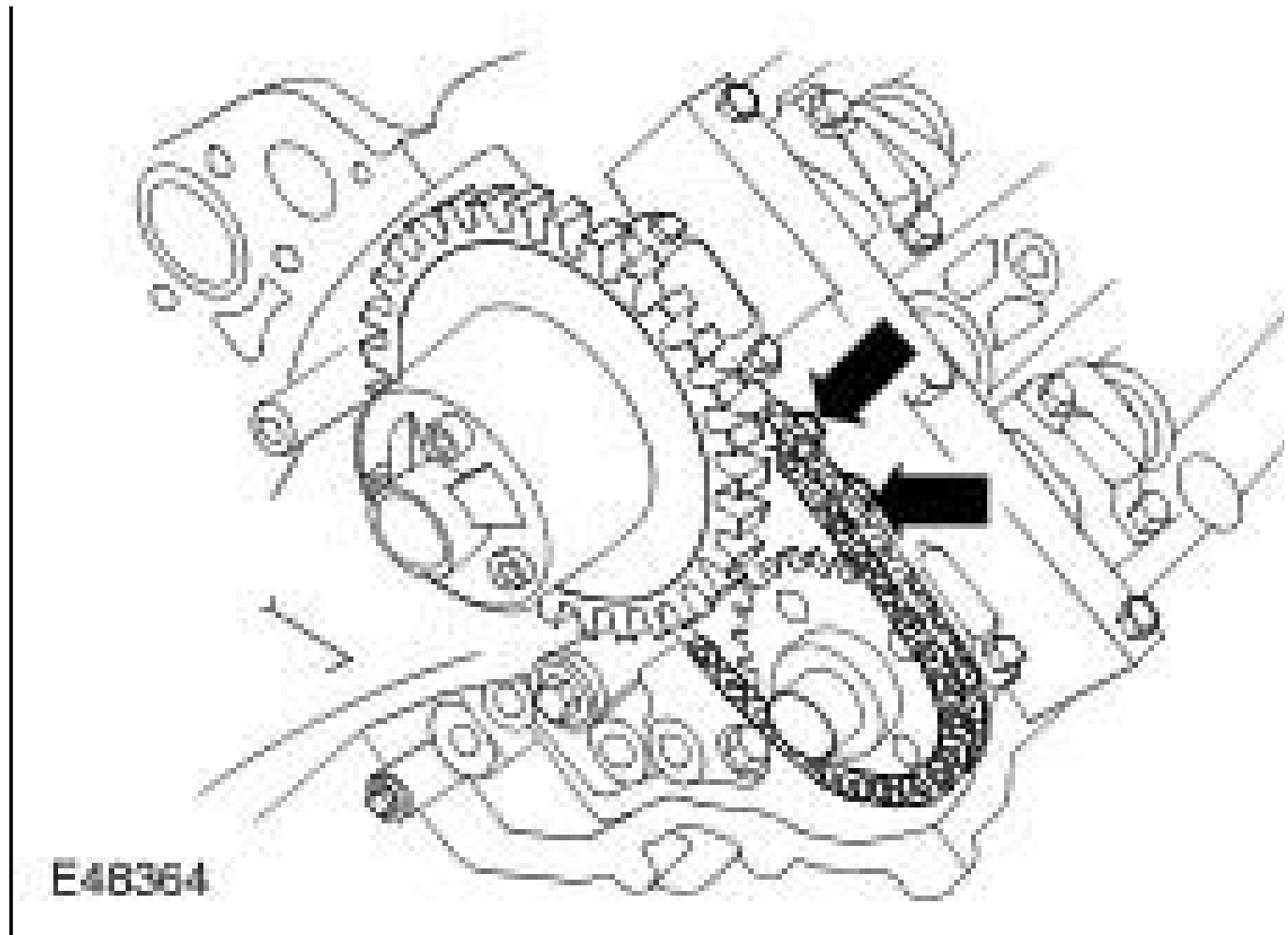
NOTE: LH illustration shown, RH is similar.

51. Remove the camshaft sprockets.
 - Remove the 2 bolts.



NOTE: LH illustration shown, RH is similar.

52. Remove the secondary timing chain tensioner and the secondary timing chain.
- Remove the 2 bolts.

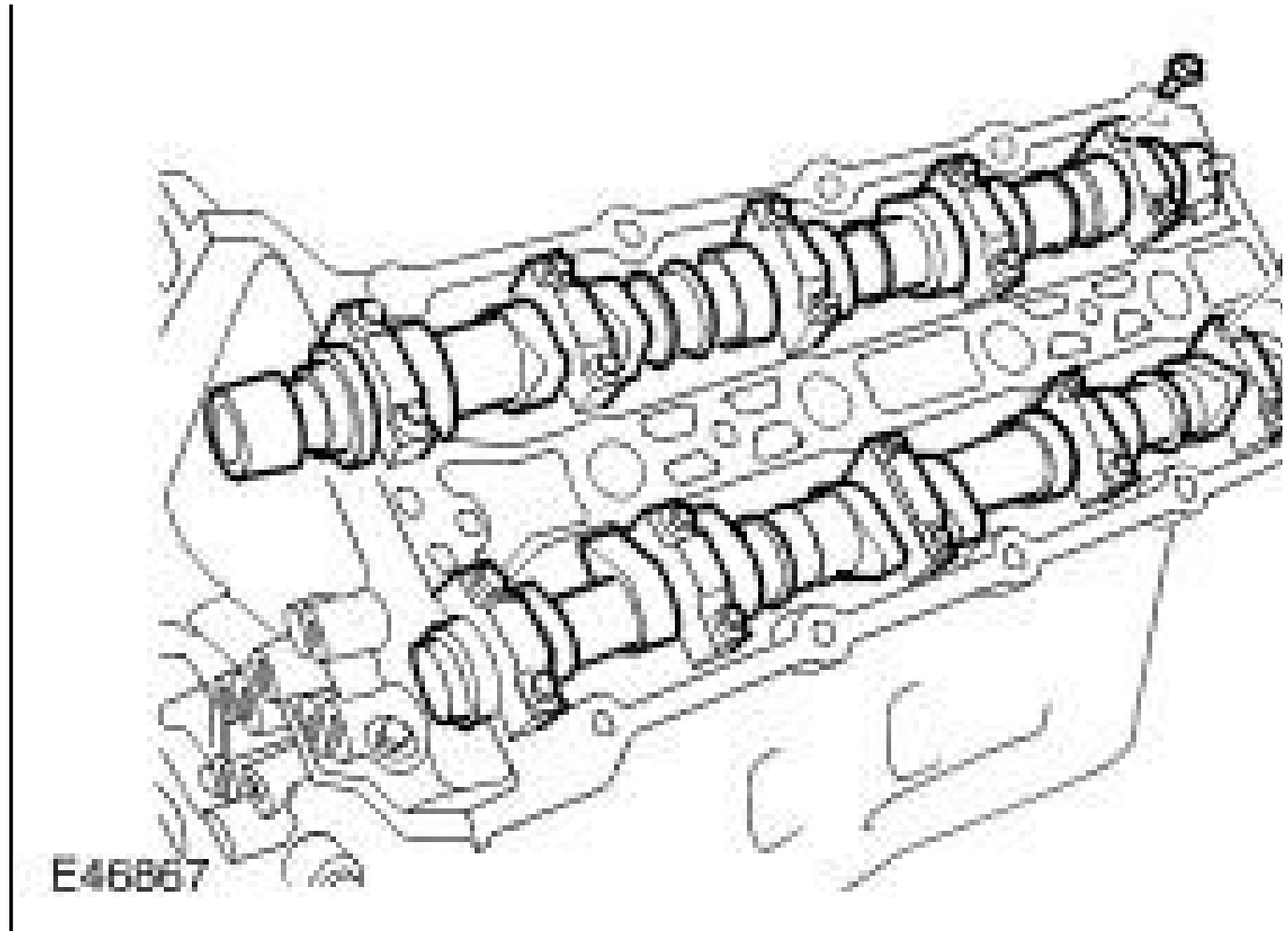


CAUTION: Evenly and progressively, release the camshaft bearing caps.

NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

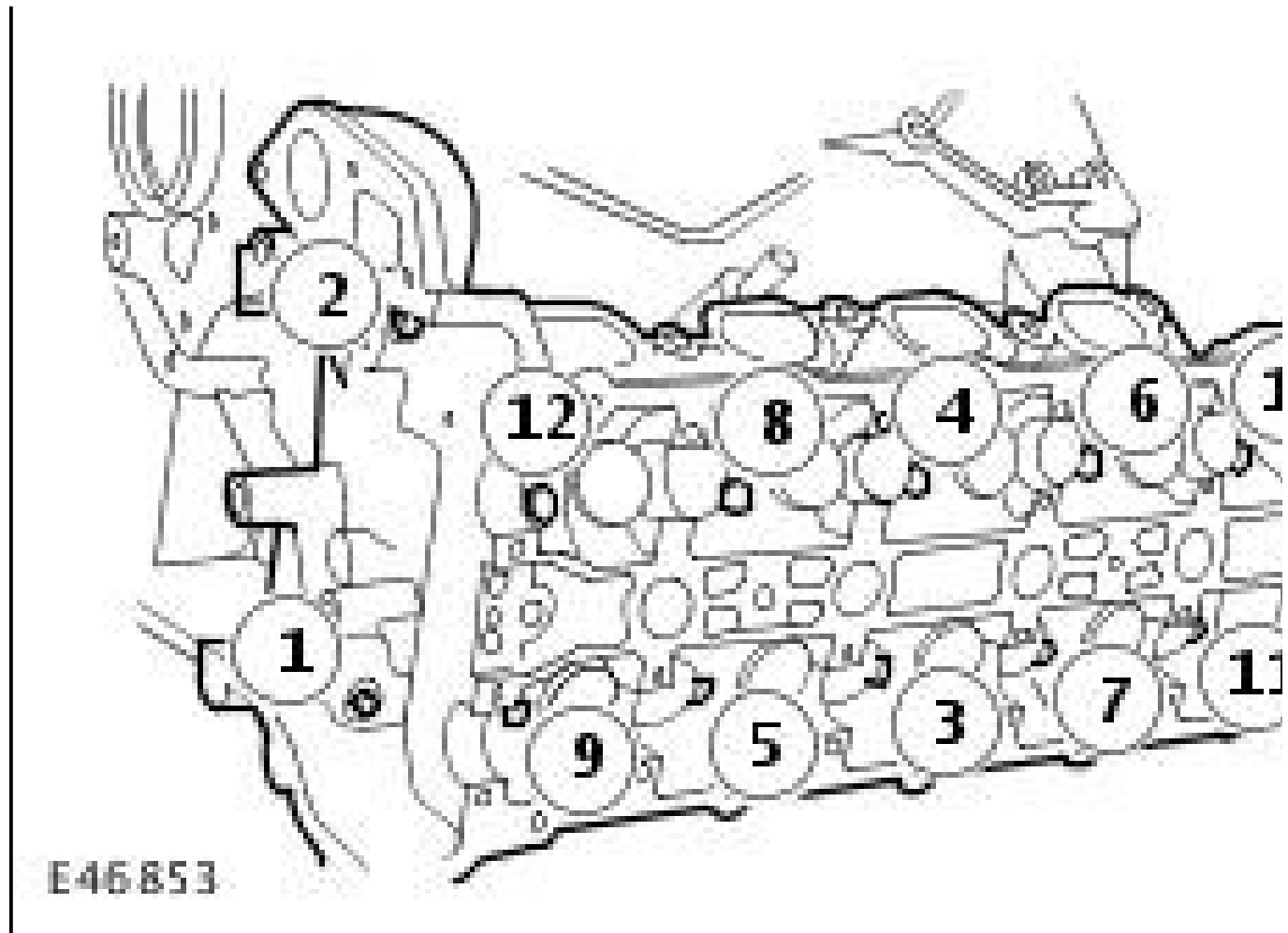
NOTE: LH illustration shown, RH is similar.

53. Remove the camshaft bearing caps.
 - Remove the 20 bolts.

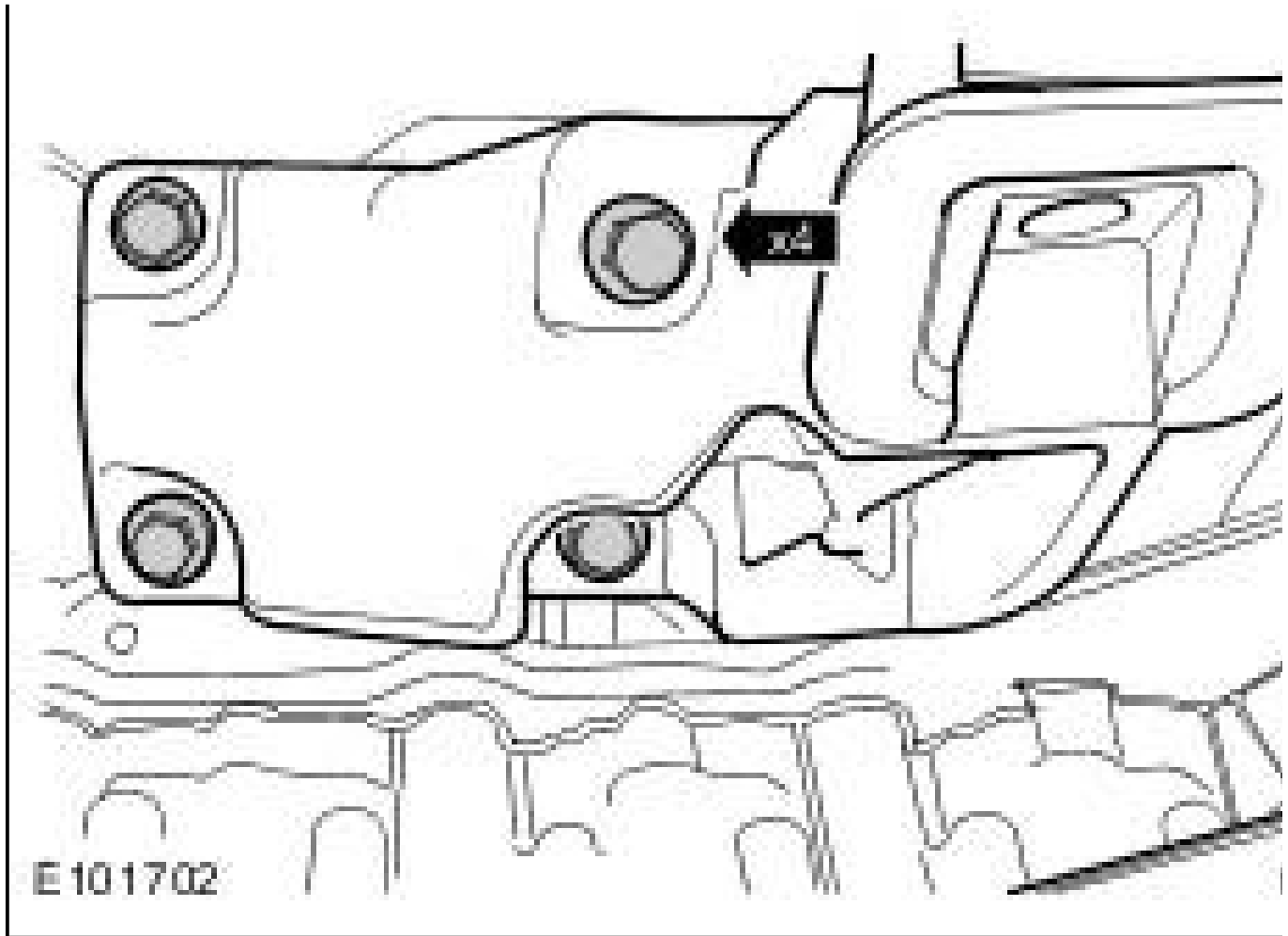


CAUTION: The bolts can only be used twice, mark the bolts with a center punch. If two punch marks are visible, discard the bolts.

54. Remove the LH cylinder head assembly.
- Remove the 12 cylinder head bolts.
 - With assistance remove the cylinder head.
 - Remove and discard the cylinder head gasket.
 - Clean the cylinder head locating dowels.
 - Clean the component mating faces.
 - Repeat the operation for the RH side.

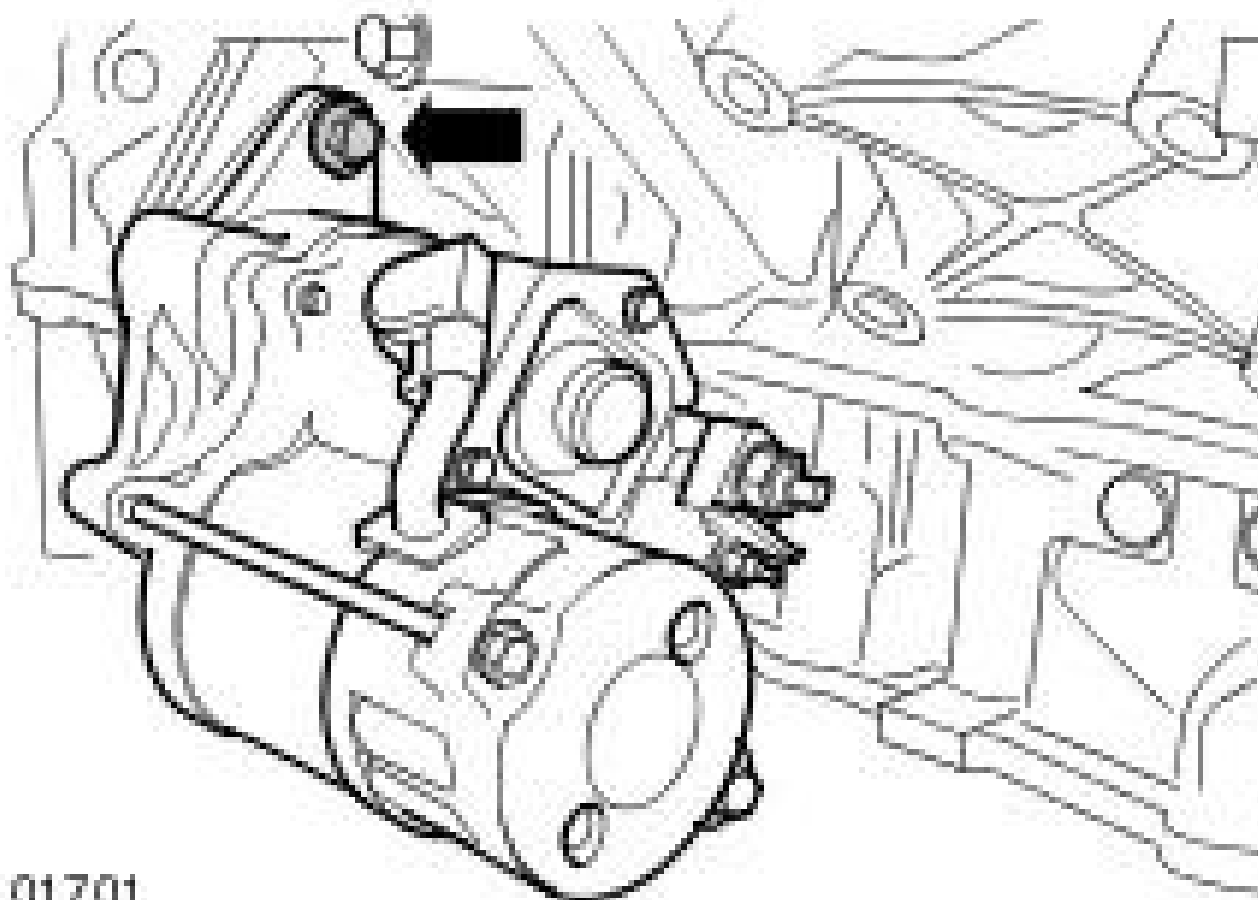


55. Remove 4 bolts securing the engine mount bracket to the cylinder block.



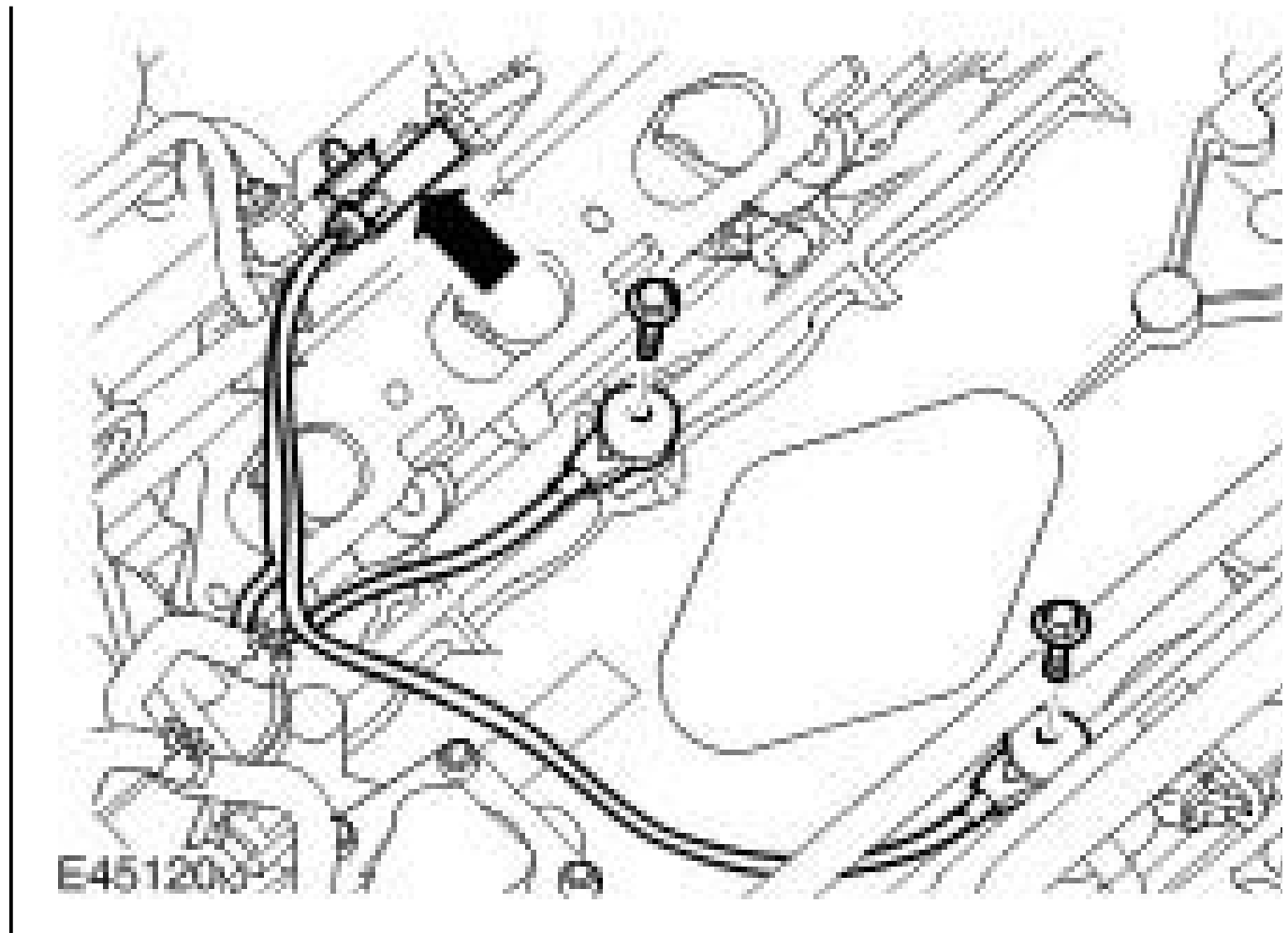
CAUTION: Note the position of the bolt.

56. Remove the starter motor.
- Remove the remaining starter motor bolt.

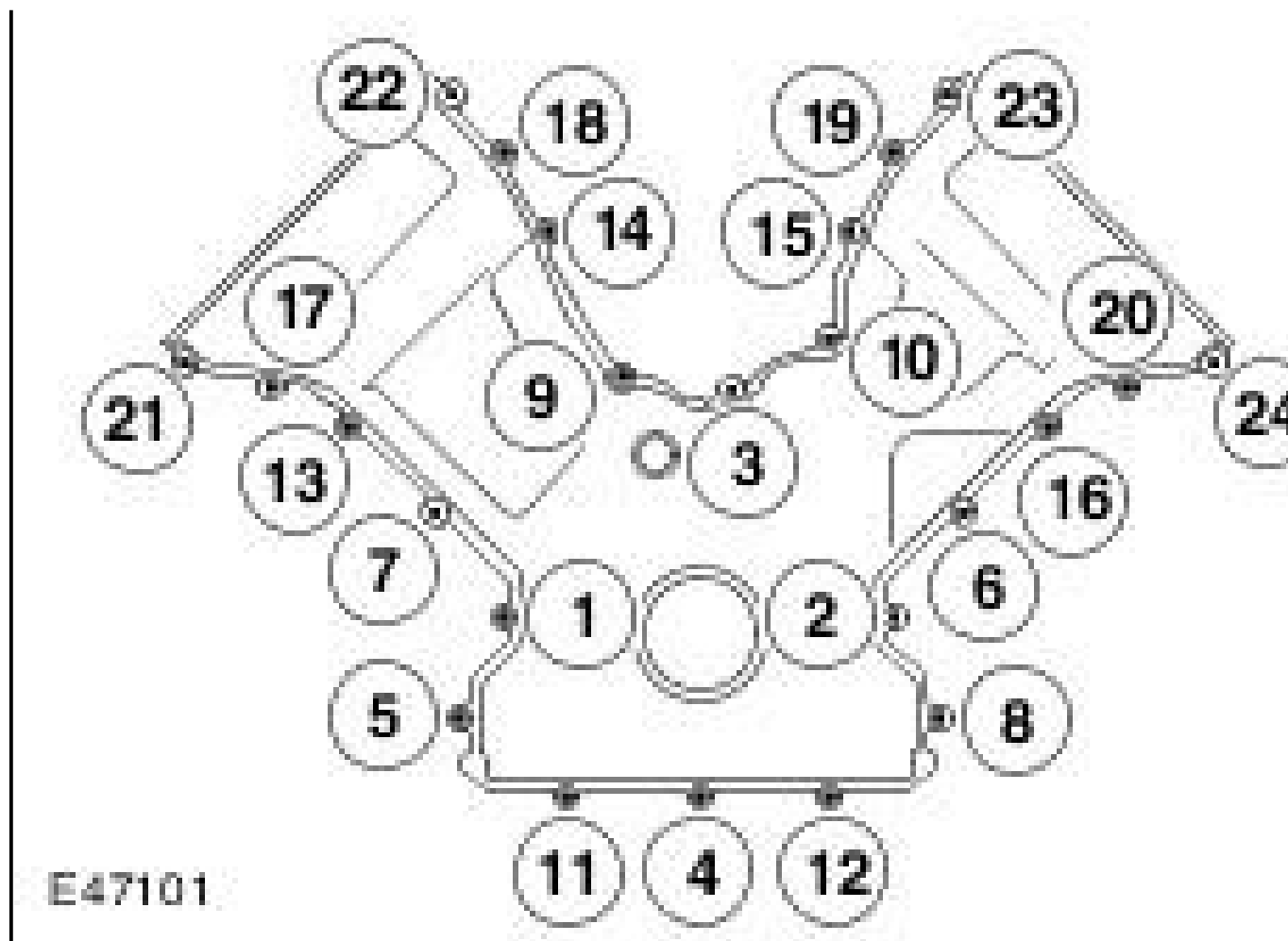


E101701

57. Remove the KS.



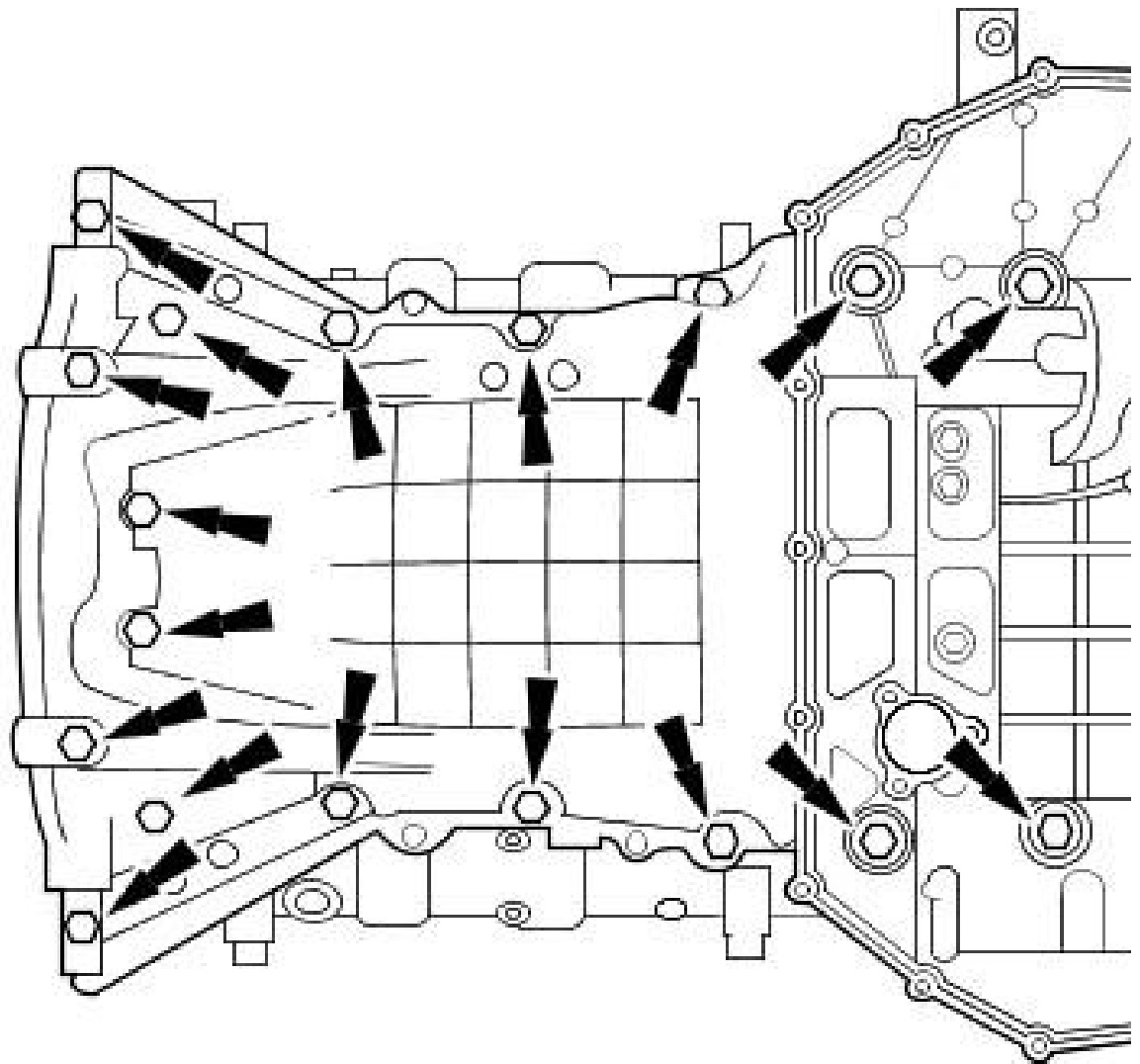
58. Remove the flexplate.
- Remove and discard the 8 bolts.



NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

59. Remove the oil pan.

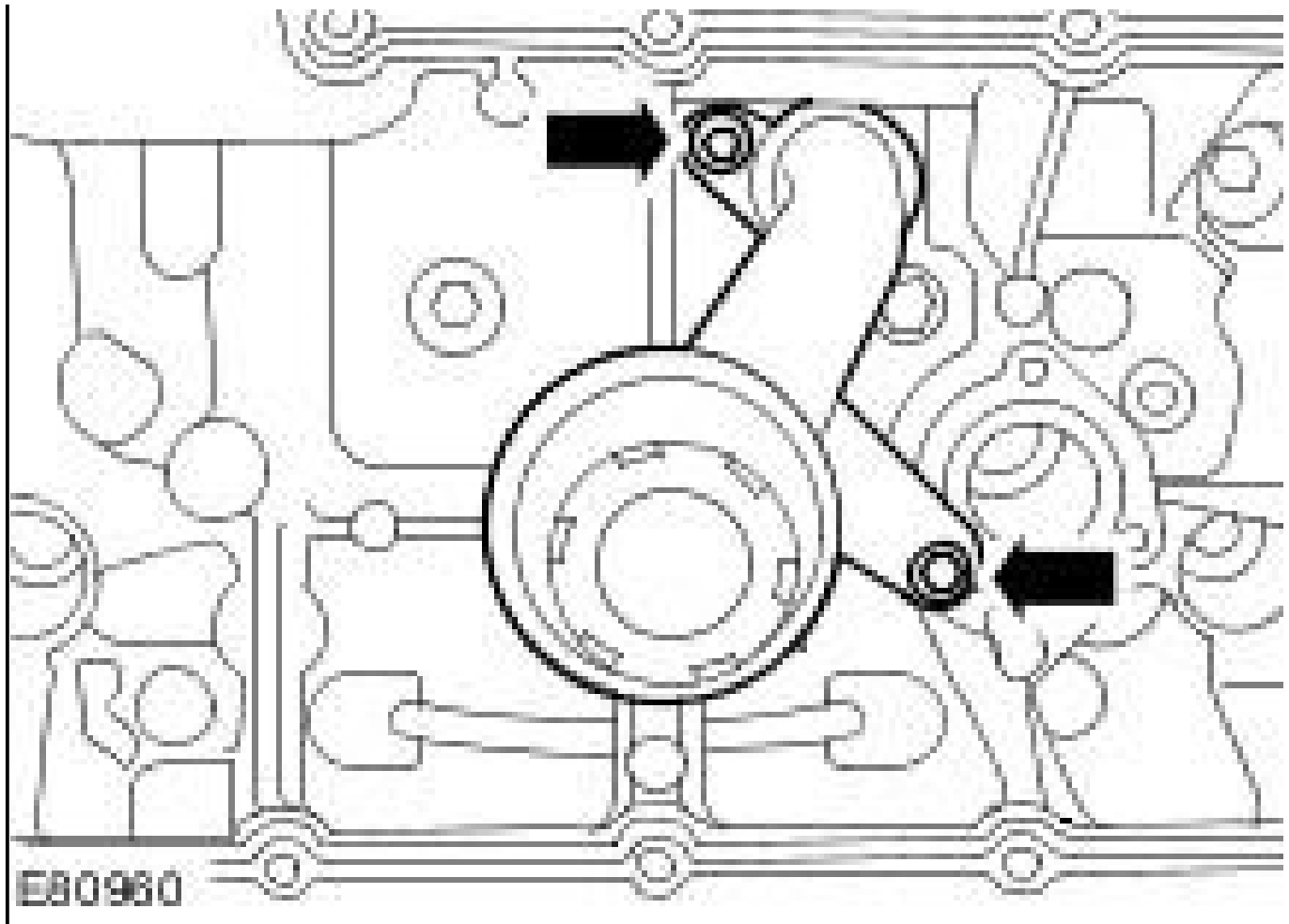
- Remove the 18 bolts.
- Clean all the mating faces and reusable parts thoroughly and check for damage.



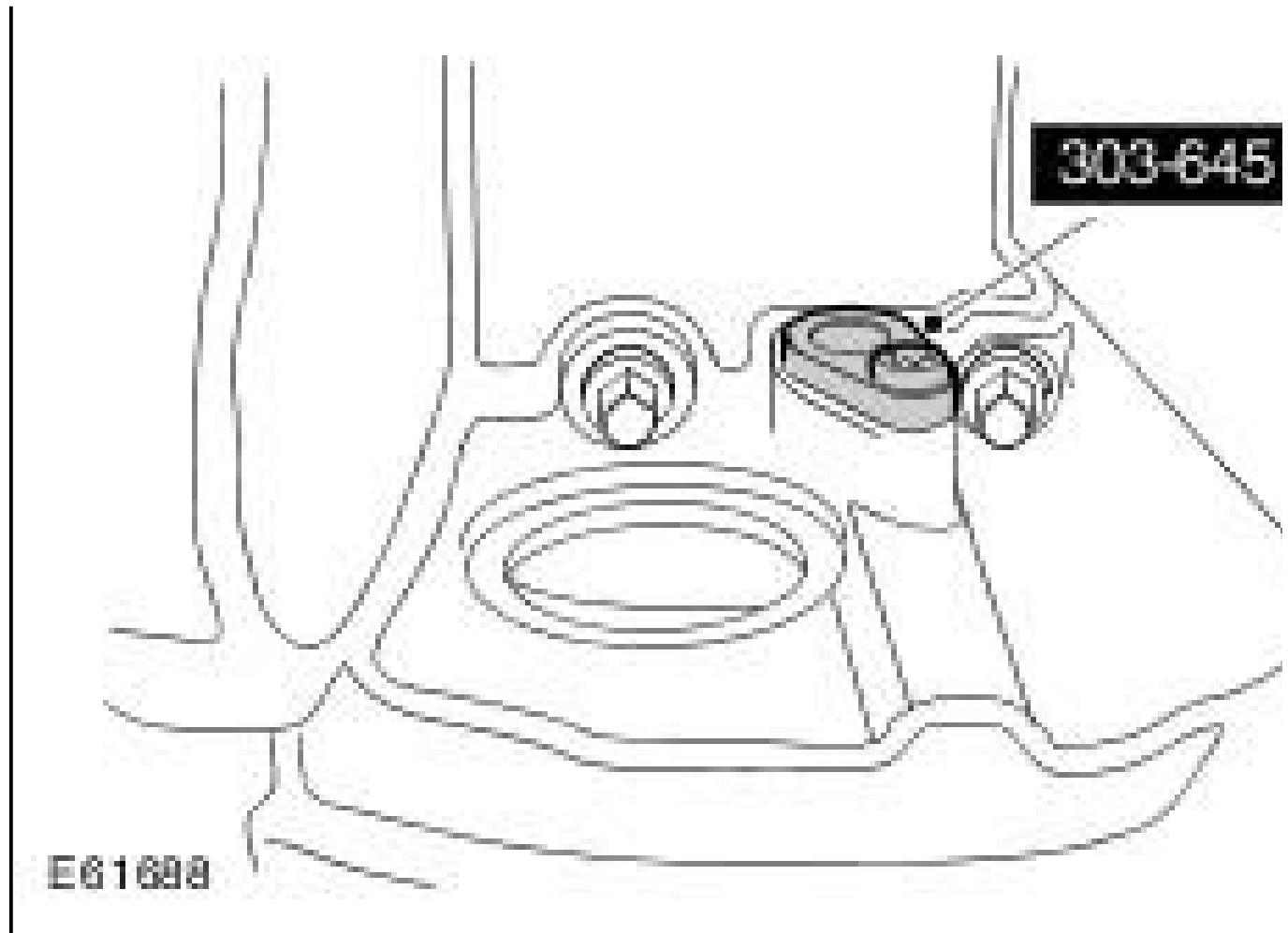
VUJ0002435

60. Remove the oil strainer pick-up assembly.

- Remove the 2 bolts.
- Remove and discard the O-ring seal.

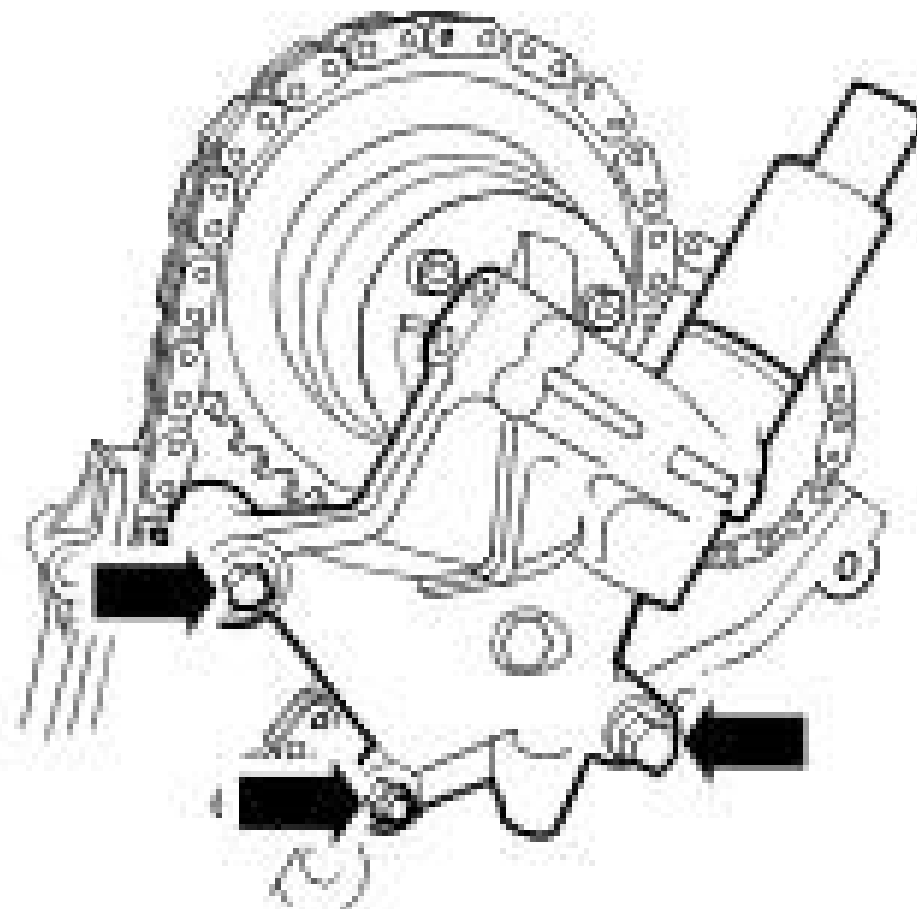


61. Remove the baffle plate.
 - Remove the 6 bolts.



62. Remove the oil pump assembly.

- Remove the 4 bolts.
- Remove and discard the gasket.
- Clean the component mating faces.



E48360

63. Remove the engine from the engine stand.
- With assistance, remove the engine block from the stand.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

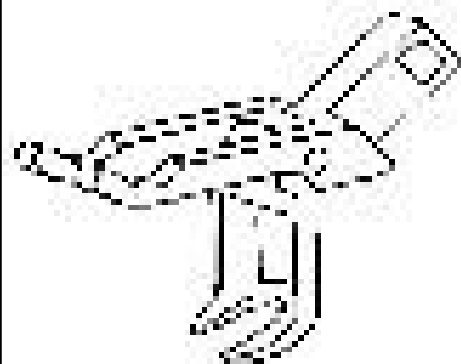
CYLINDER HEAD

SPECIAL TOOLS

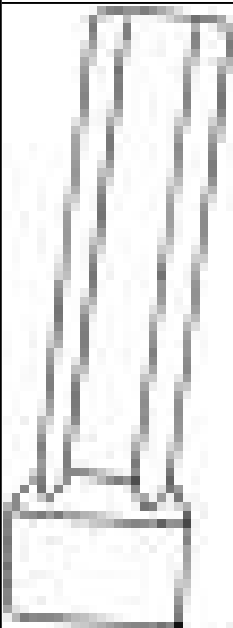
Tool Illustration	Tool Name	Tool Number
	Compressor, Valve Spring	303-581 (T97T-6565-A)

2007 Land Rover Range Rover HSE

ENGINE Engine (4.4L)



ST1830-A



ST1824-A

Installer, Valve Stem Oil Seal

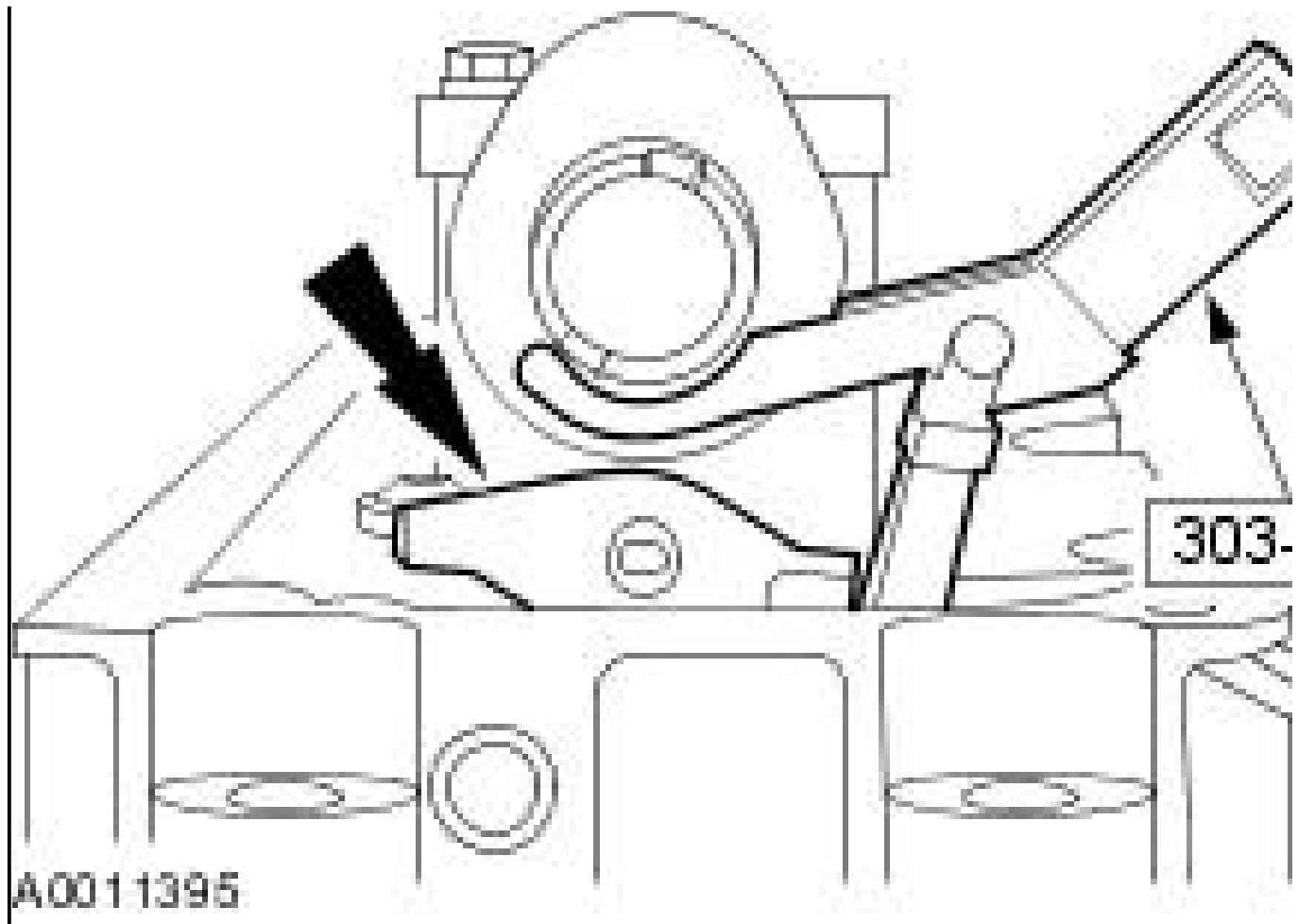
303-370 (T90T-6571-A)

MATERIALS

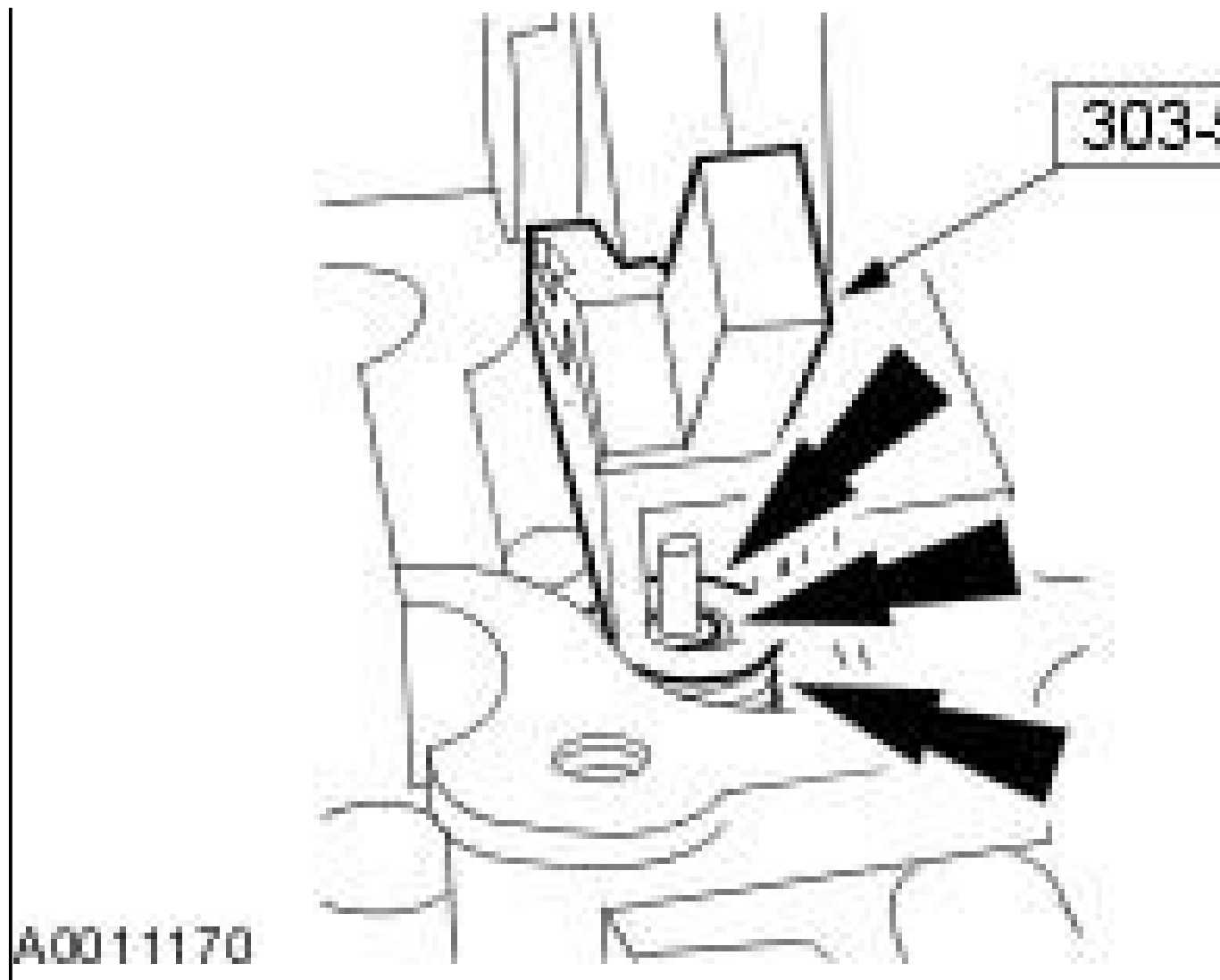
Name	General Specification	Ford Specification
Super Premium SAE 5W-30 Motor Oil	XO-5W30-QSP or equivalent	WSS-M2C153-G

DISASSEMBLY

1. Remove the spark plugs.
2. Using the special tool, remove the camshaft roller followers.



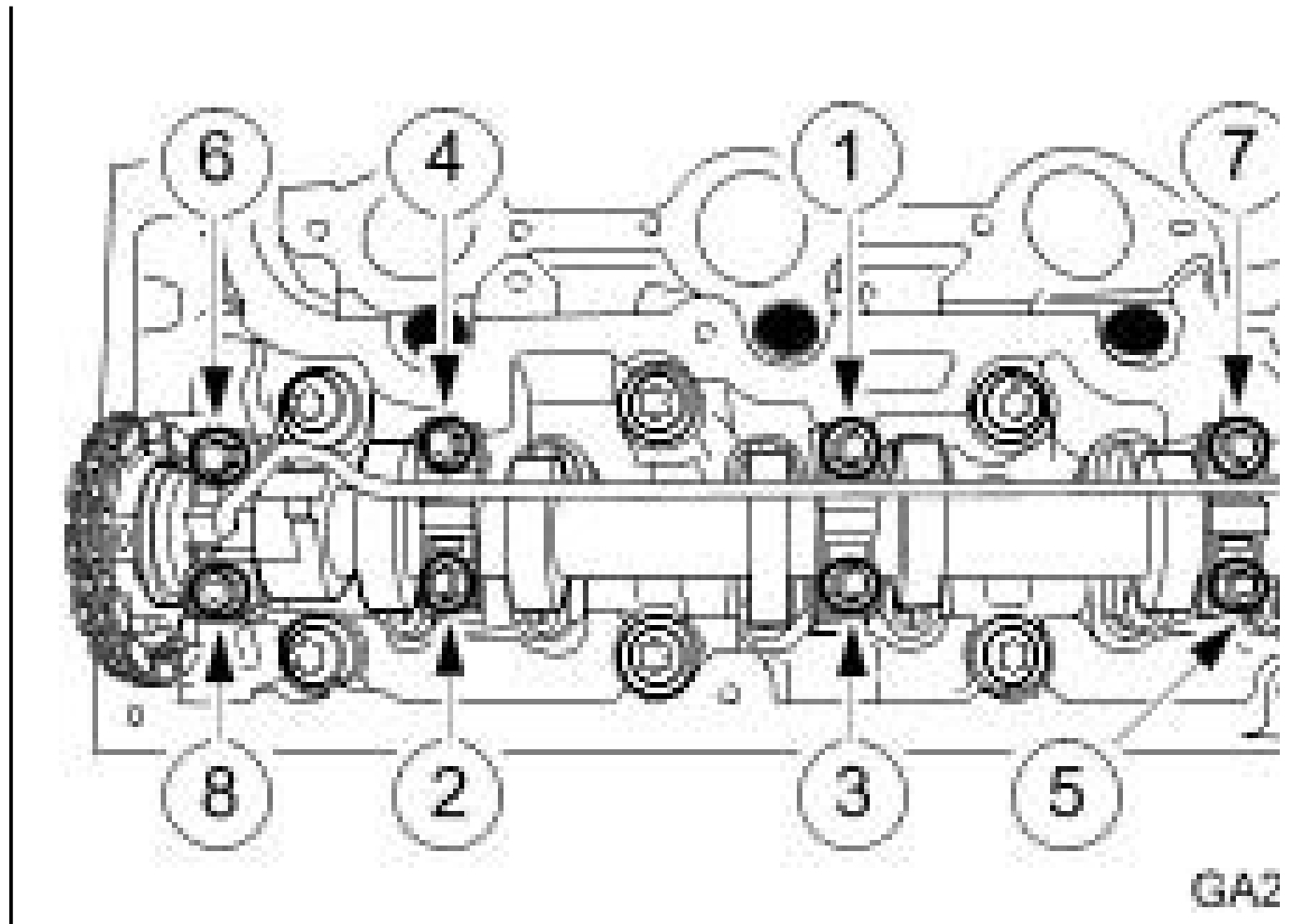
3. Using the special tool, remove the valve spring retainer keys, the valve spring and the retainer.



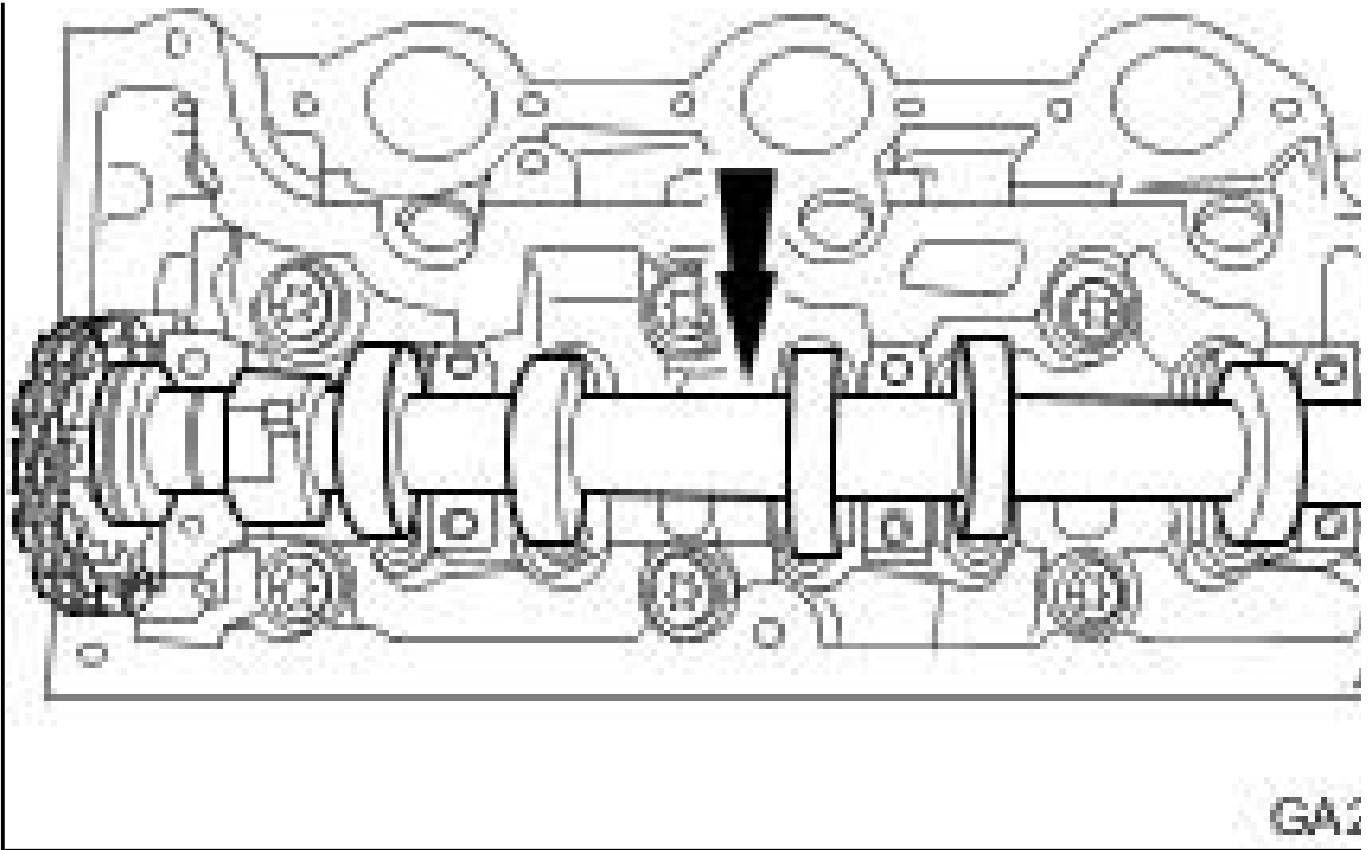
4. Remove the valve.
5. Repeat the procedure until all of the valves are removed.
6. Remove the valve stem seals.

NOTE: Mark the position of the camshaft bearing caps so they can be installed in the original position.

7. Remove the bolts in the sequence shown and remove the camshaft bearing caps.



8. Remove the camshaft.

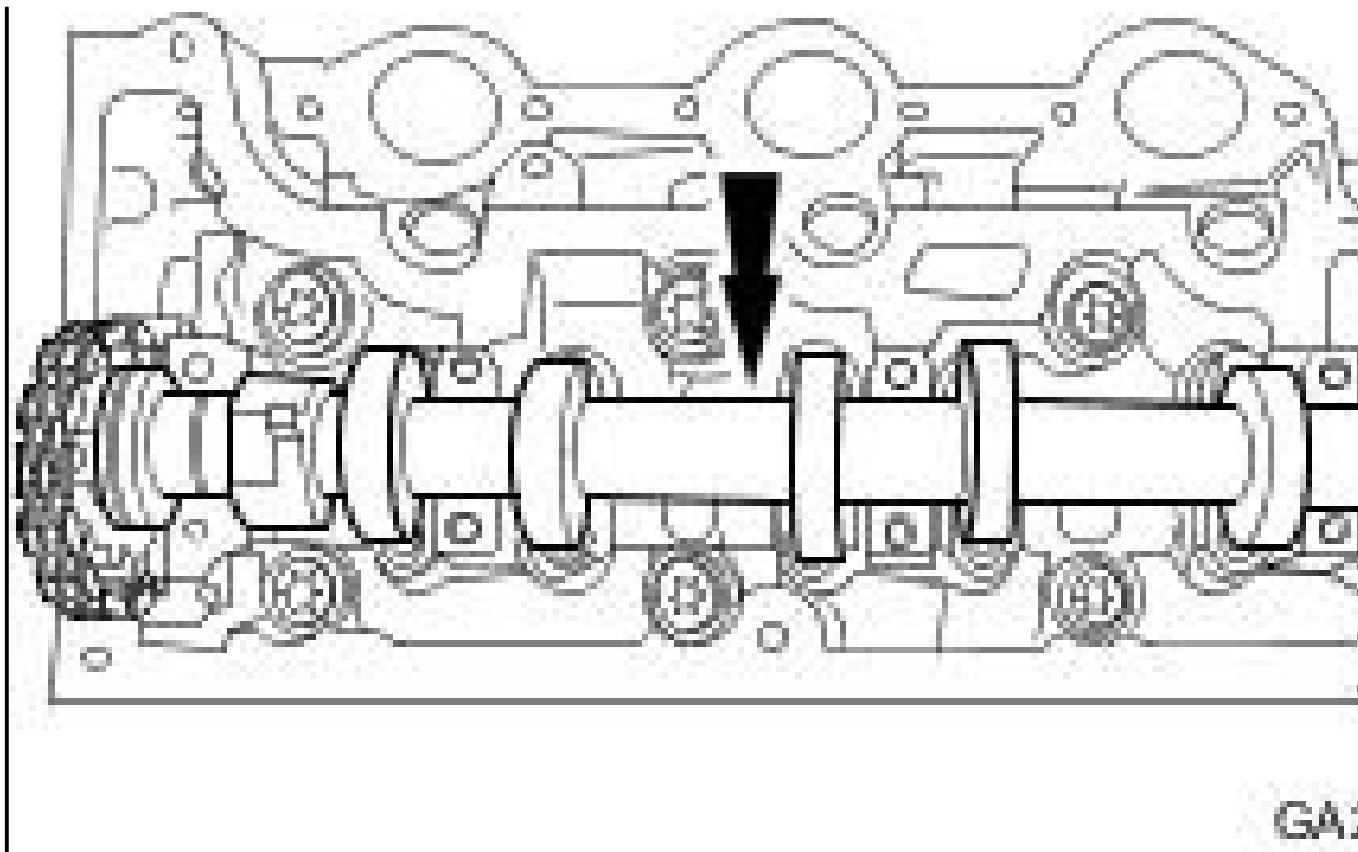


9. Inspect the cylinder head. For additional information, refer to [Engine System - General Information](#) ..

ASSEMBLY

NOTE: Prior to assembly, coat all of the valve train components with clean engine oil.

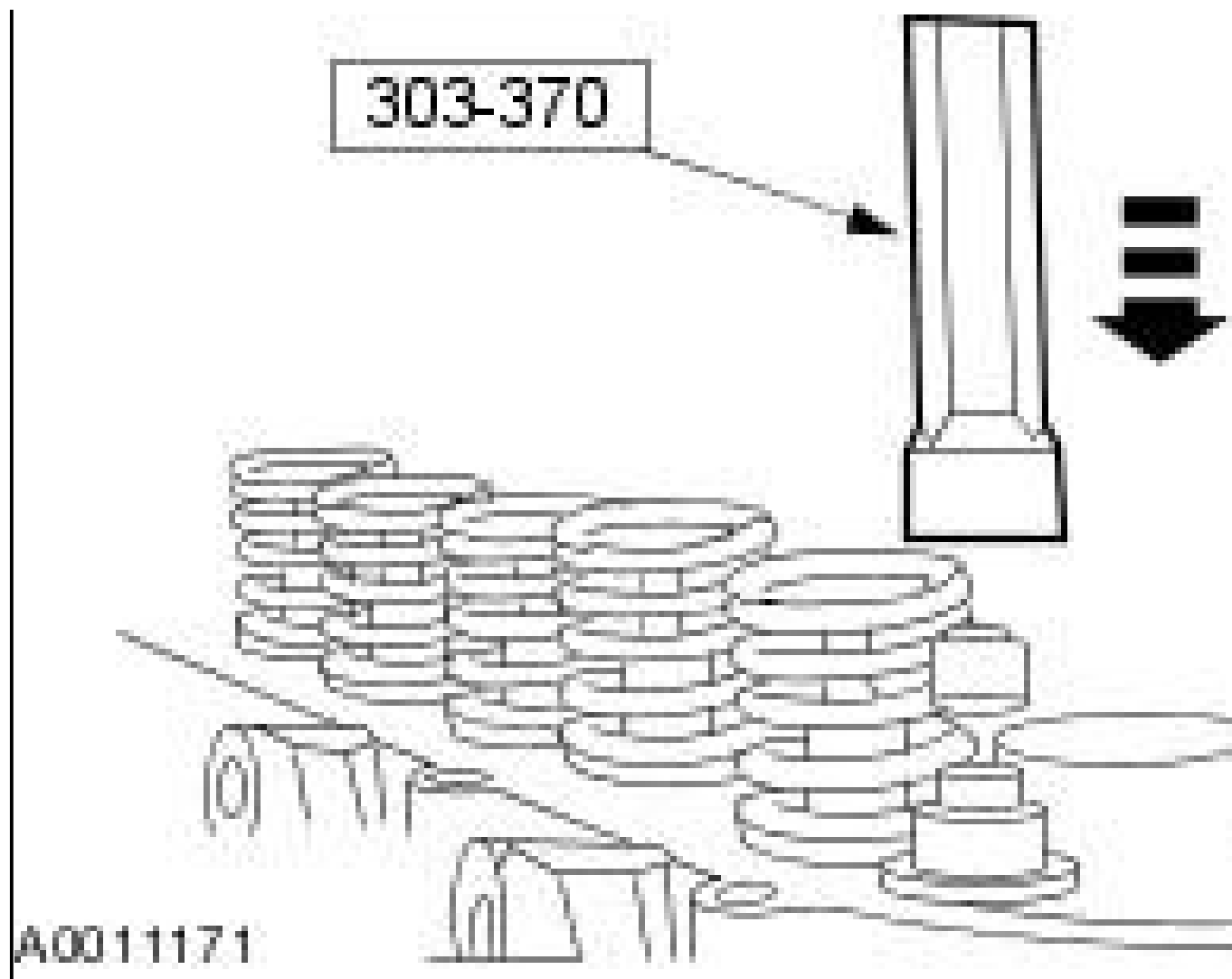
1. Install the camshaft.



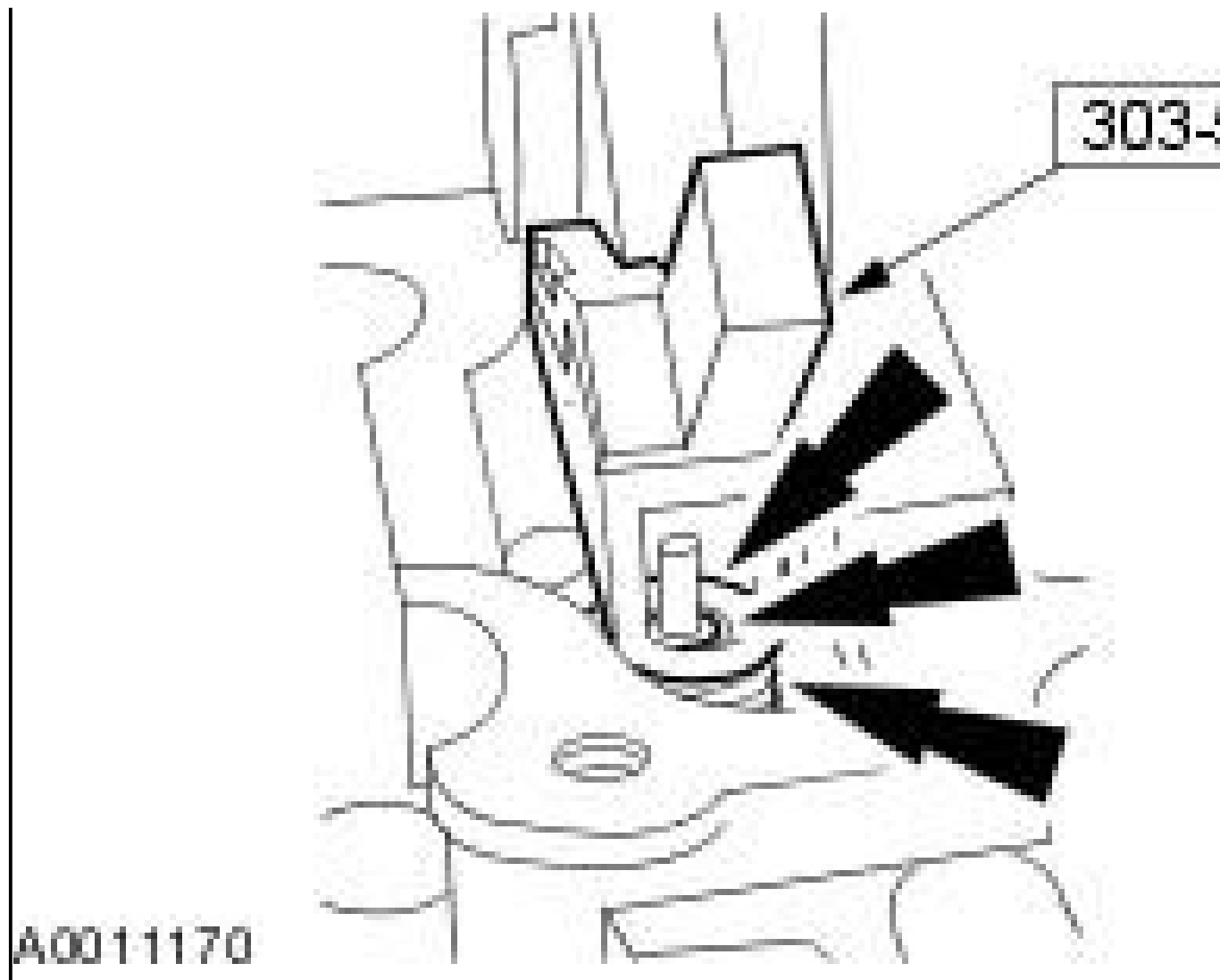
NOTE: The camshaft bearing caps must be installed in the original position.

NOTE: After installing the bolts, check the camshaft for free rotation.

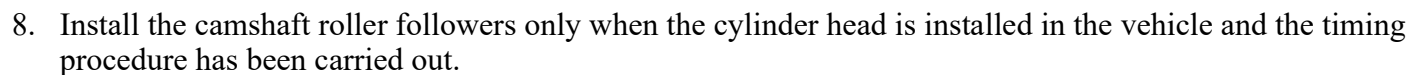
2. Position the oil supply tube, the camshaft bearing caps, and bolts.
 - Tighten in the sequence shown in two stages:
 - Stage 1: Tighten to 6 Nm (53 lb-in).
 - Stage 2: Tighten to 16 Nm (12 lb-ft).
3. Install the valve.
4. Using the special tool, install the valve stem seals.



5. Using the special tool, install the valve spring, the retainer and the retainer keys.



6. Repeat the procedure until all of the valves are installed.
7. Install the spark plugs.



ENGINE

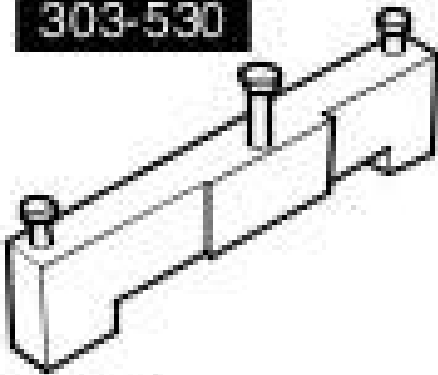
Tool Illustration	Tool Name	Tool Number
	Timing Setting tool	303-645

303-645



E46881

303-530



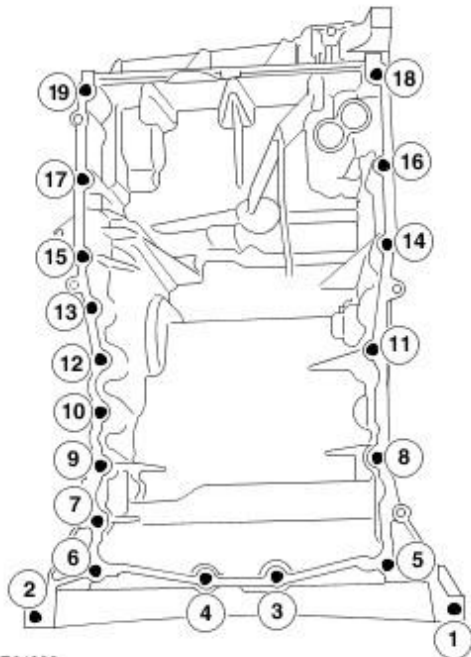
E46879

Camshaft setting/locking tool

303-530

Adapter - Crankshaft seal
installer

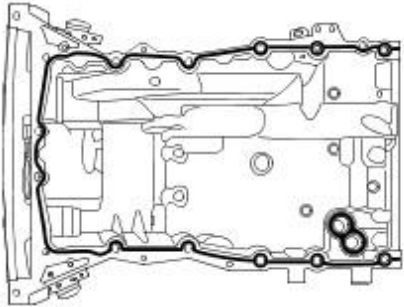
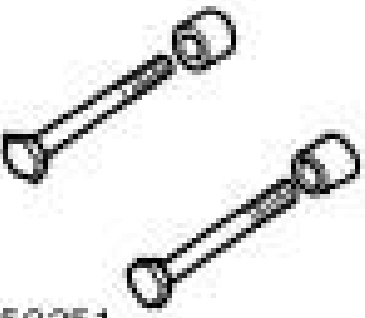
303-1100-01



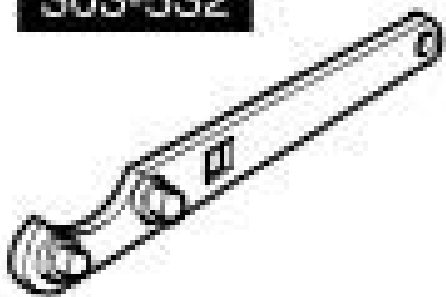
E61699

2007 Land Rover Range Rover HSE

ENGINE Engine (4.4L)

 E48537	Adapter	303-191-03
 303-893 E46728	Holding Tool Crankshaft Pulley	303-893(LRT-12-080)
 303-191-04 E59251	Bolts and spacers	303-191-04
	Timing chain tensioning tool	303-532

303-532



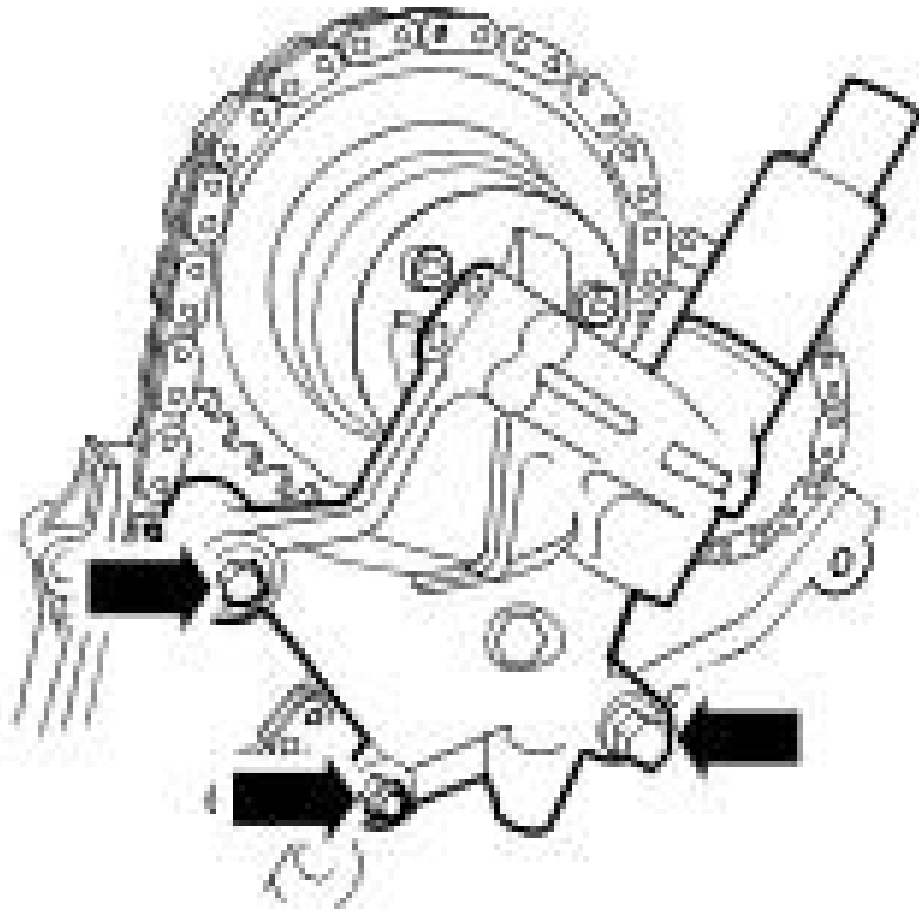
E46880

ASSEMBLY

1. Secure the engine to the engine stand.
 - Align the engine to the engine stand.
 - Adjust the engine stand legs into position.
 - Mount the engine to an engine stand.
 - Fully tighten the engine stand leg nuts.

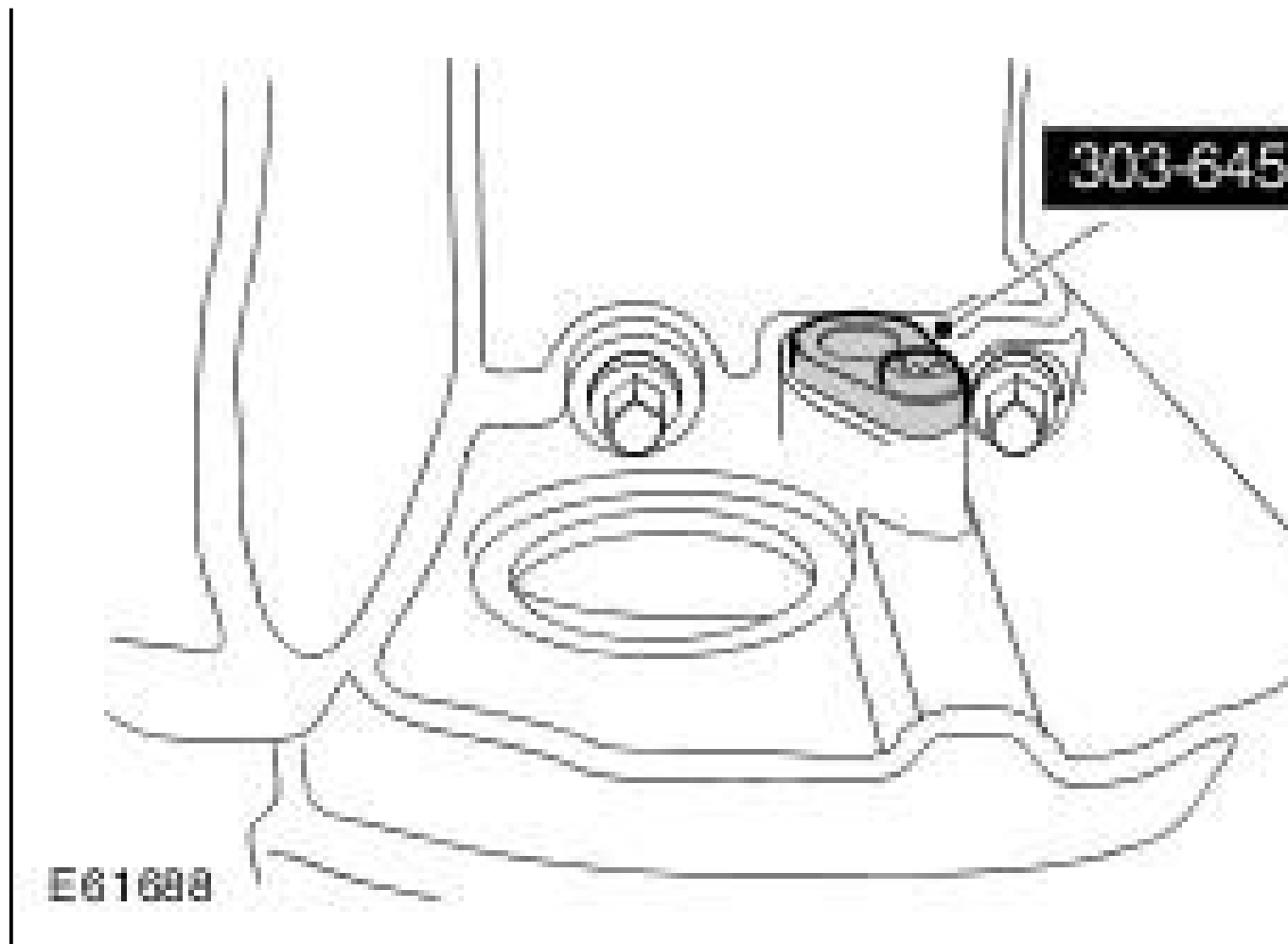
NOTE: **Install a new gasket.**

2. Install the oil pump assembly.
 - Clean the component mating faces.
 - Install the gasket.
 - Tighten the bolts to 10 Nm (7 lb.ft).



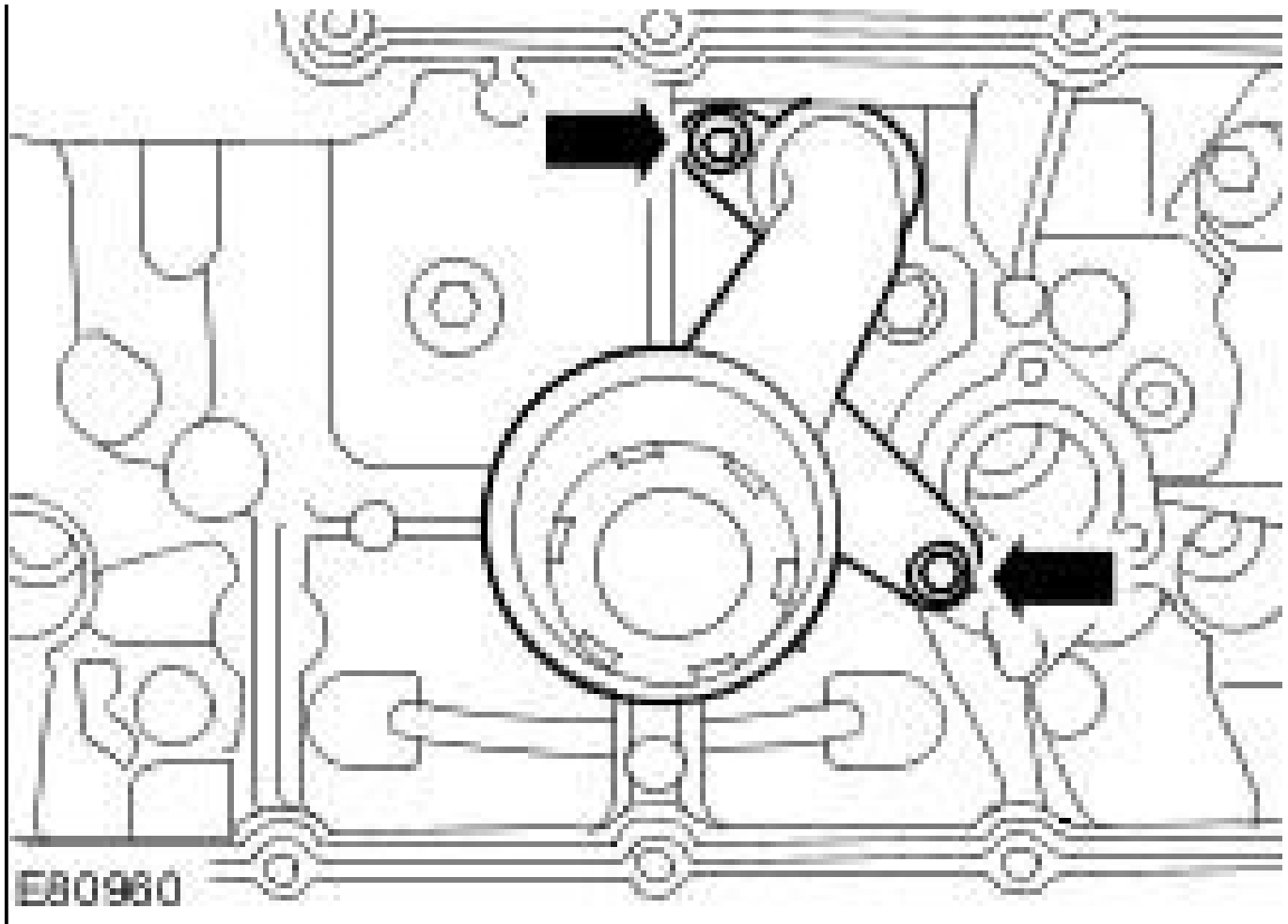
E48360

3. Install the baffle plate.
 - Tighten the 6 bolts to 6 Nm (4 lb.ft).



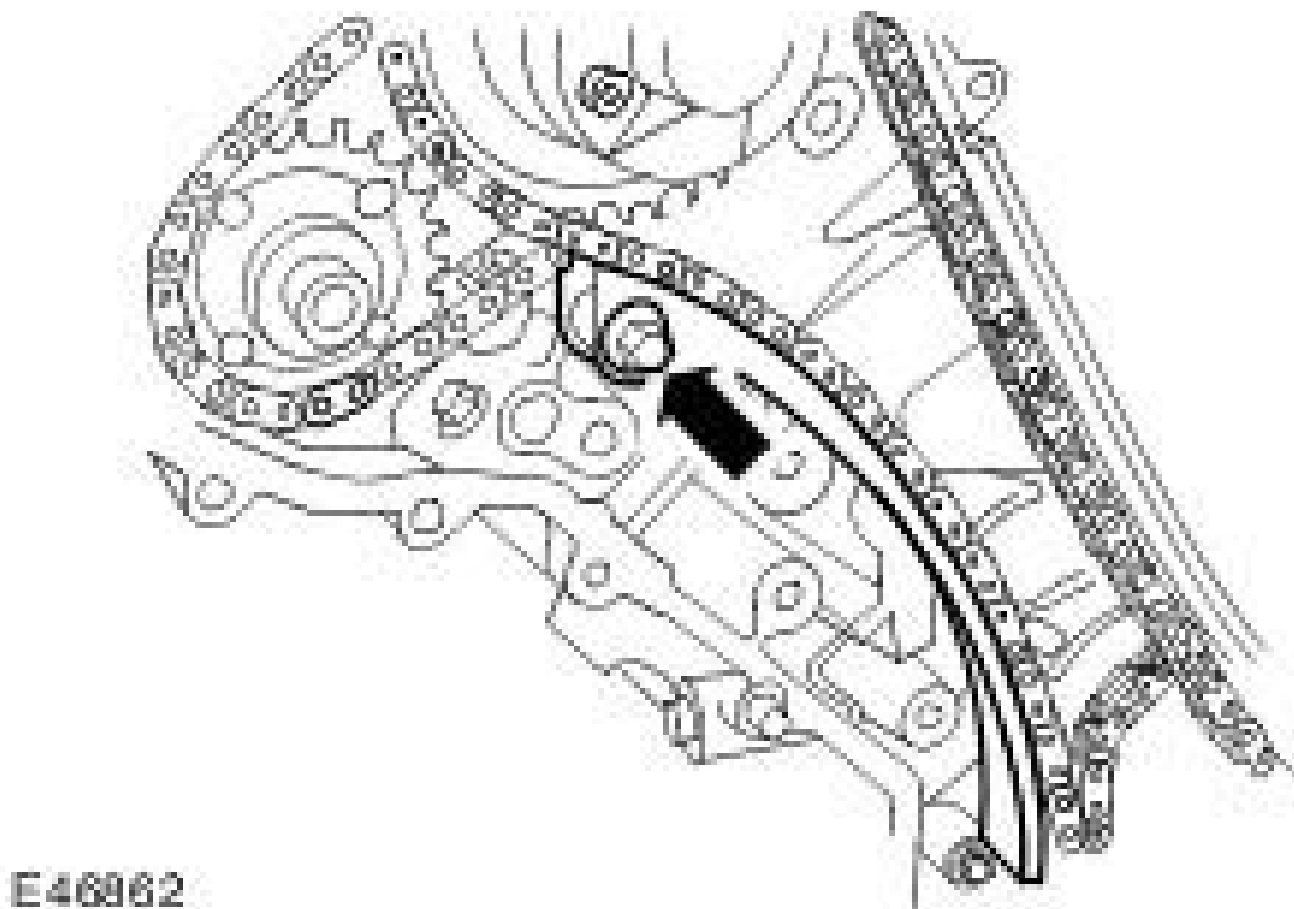
NOTE: Install a new O-ring seal.

4. Install the oil strainer pick-up assembly.
 - Install the O-ring seal.
 - Tighten the M6 bolt to 10 Nm (7 lb.ft).
 - Apply sealant to the M5 bolts.
 - Tighten the M5 bolts to 6 Nm (4 lb.ft).

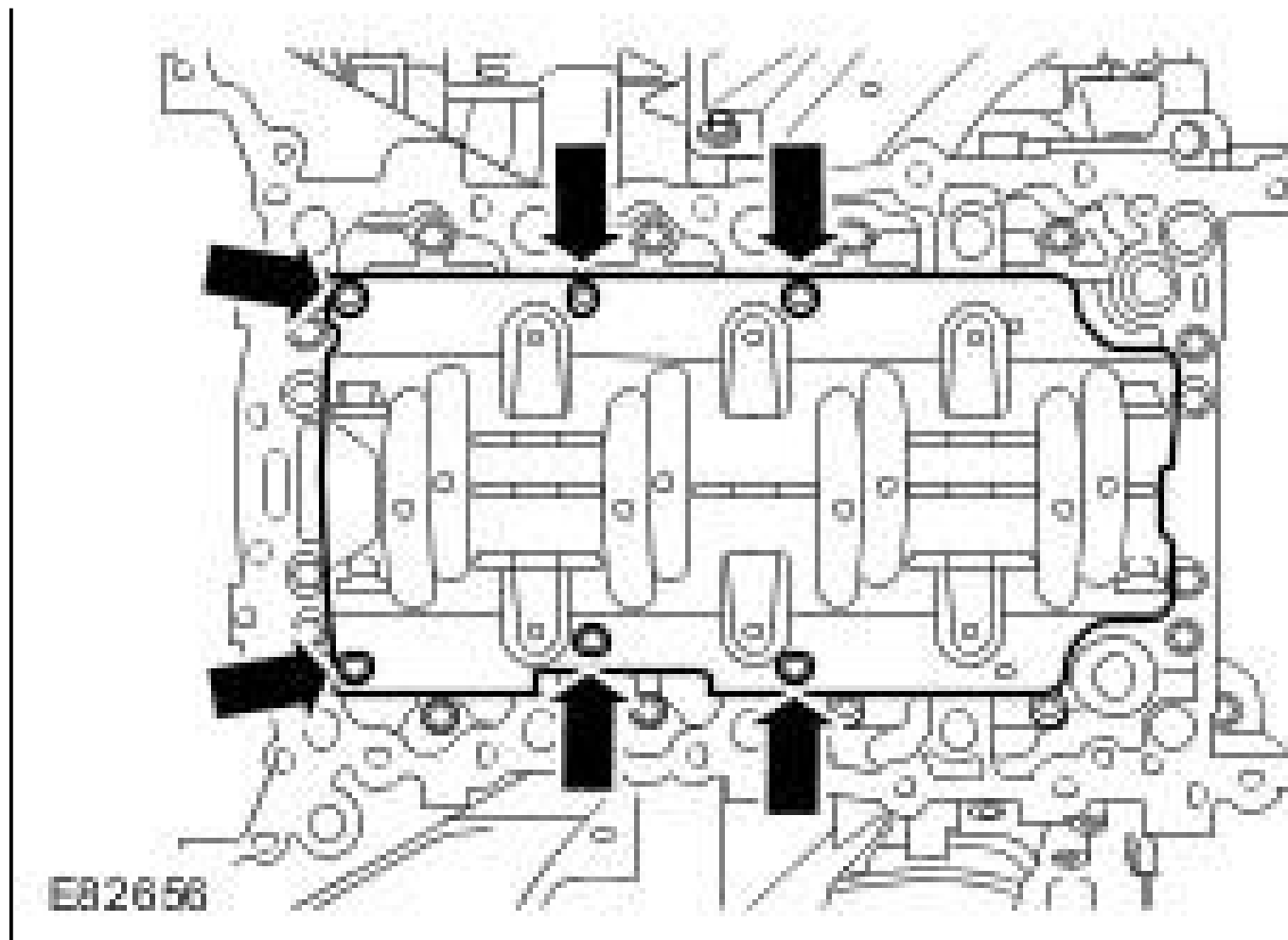


5. Install the oil pan.

- Clean the component mating faces.
- Apply a 3 mm (0.118 in) diameter bead of sealant, to the area indicated.
- Install the bolts, but do not tighten fully at this stage.

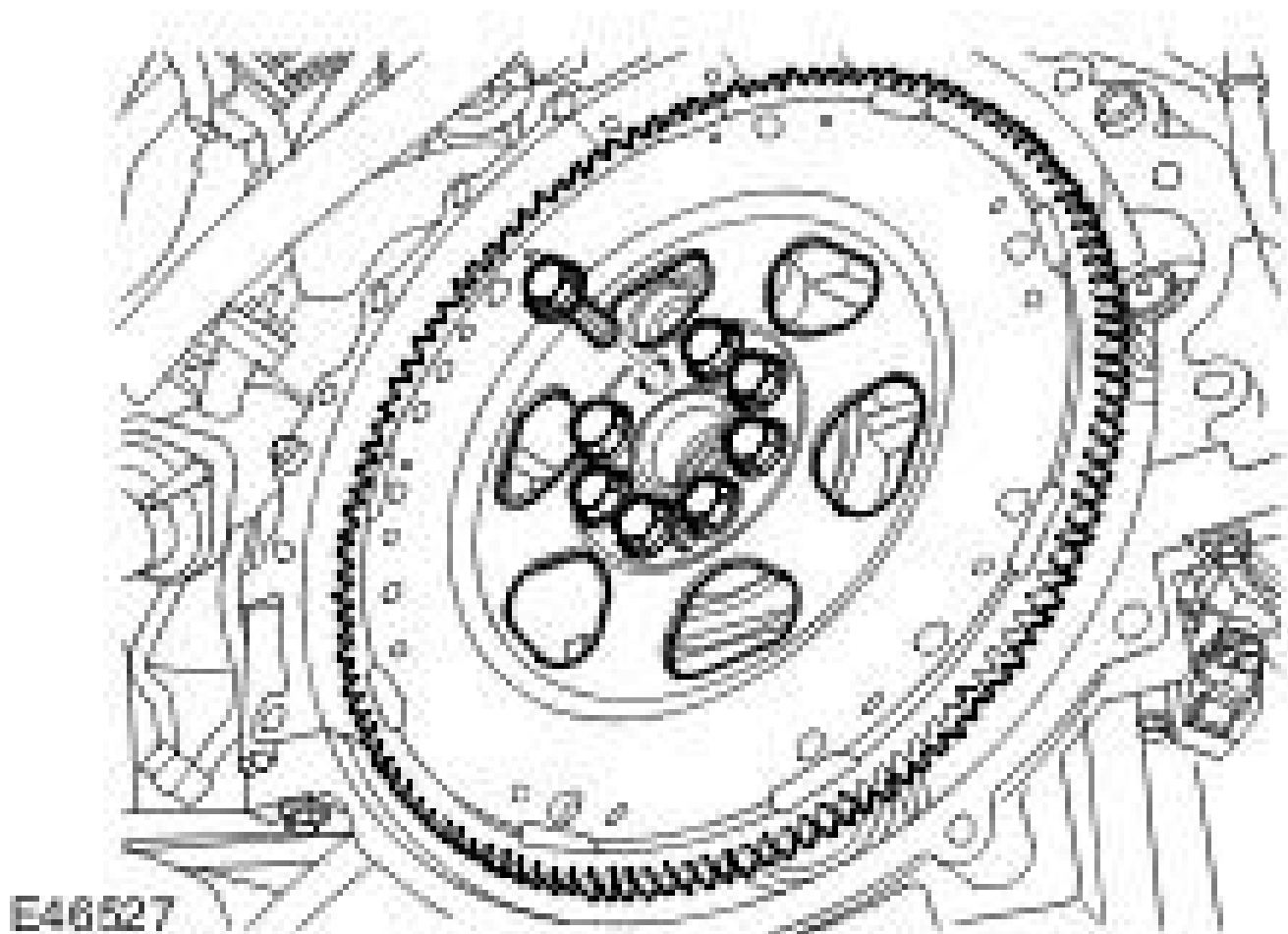


6. Tighten the oil pan bolts in the sequence shown to 20 Nm (15 lb.ft).

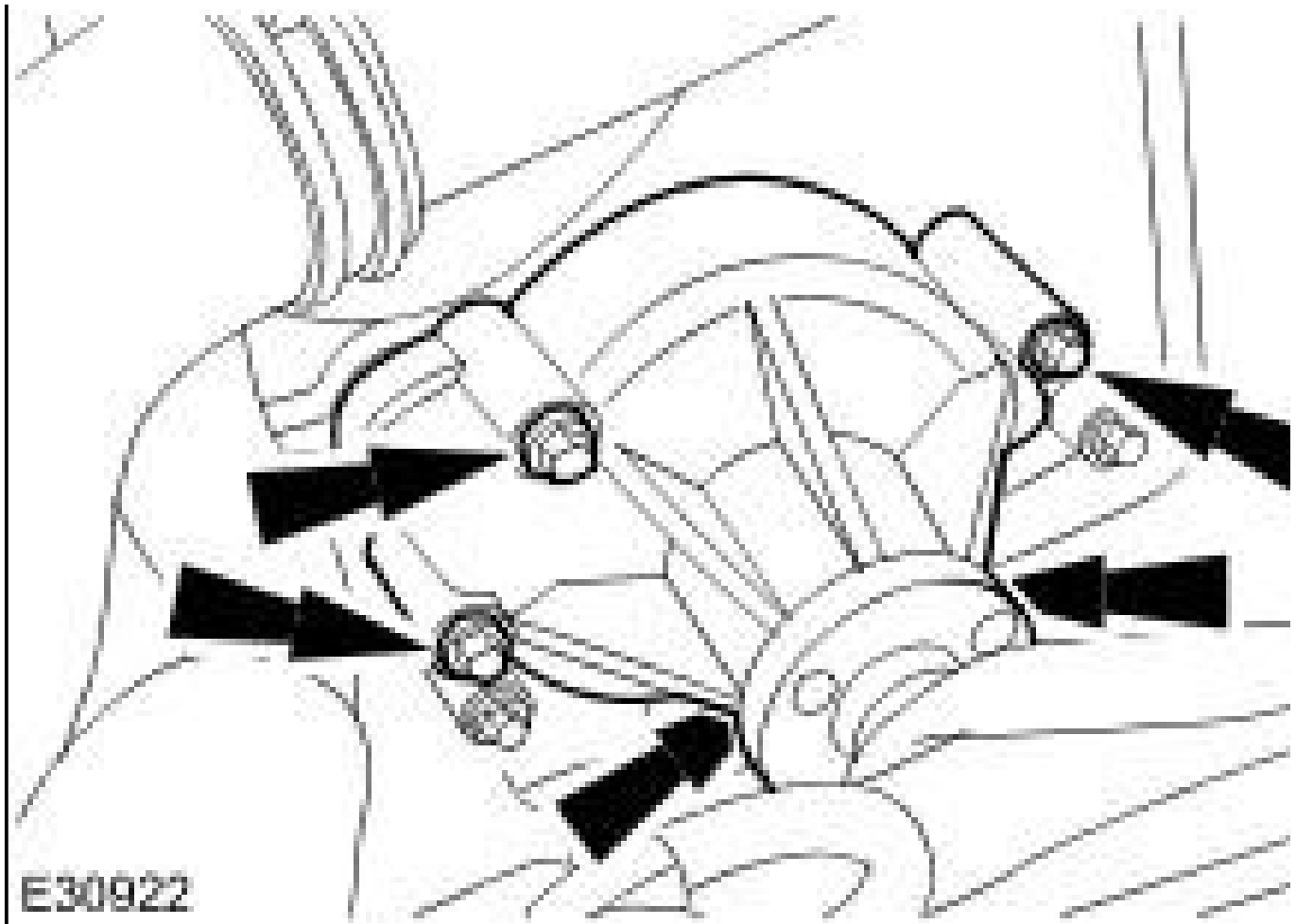


NOTE: Prevent the flexplate from rotating.

7. Install the flexplate.
 - Clean the component mating faces.
 - Tighten the bolts evenly in 2 stages to the sequence shown.
 - Tighten the bolts to 15 Nm (11 lb ft).
 - Tighten the bolts to 110 Nm (81 lb.ft).

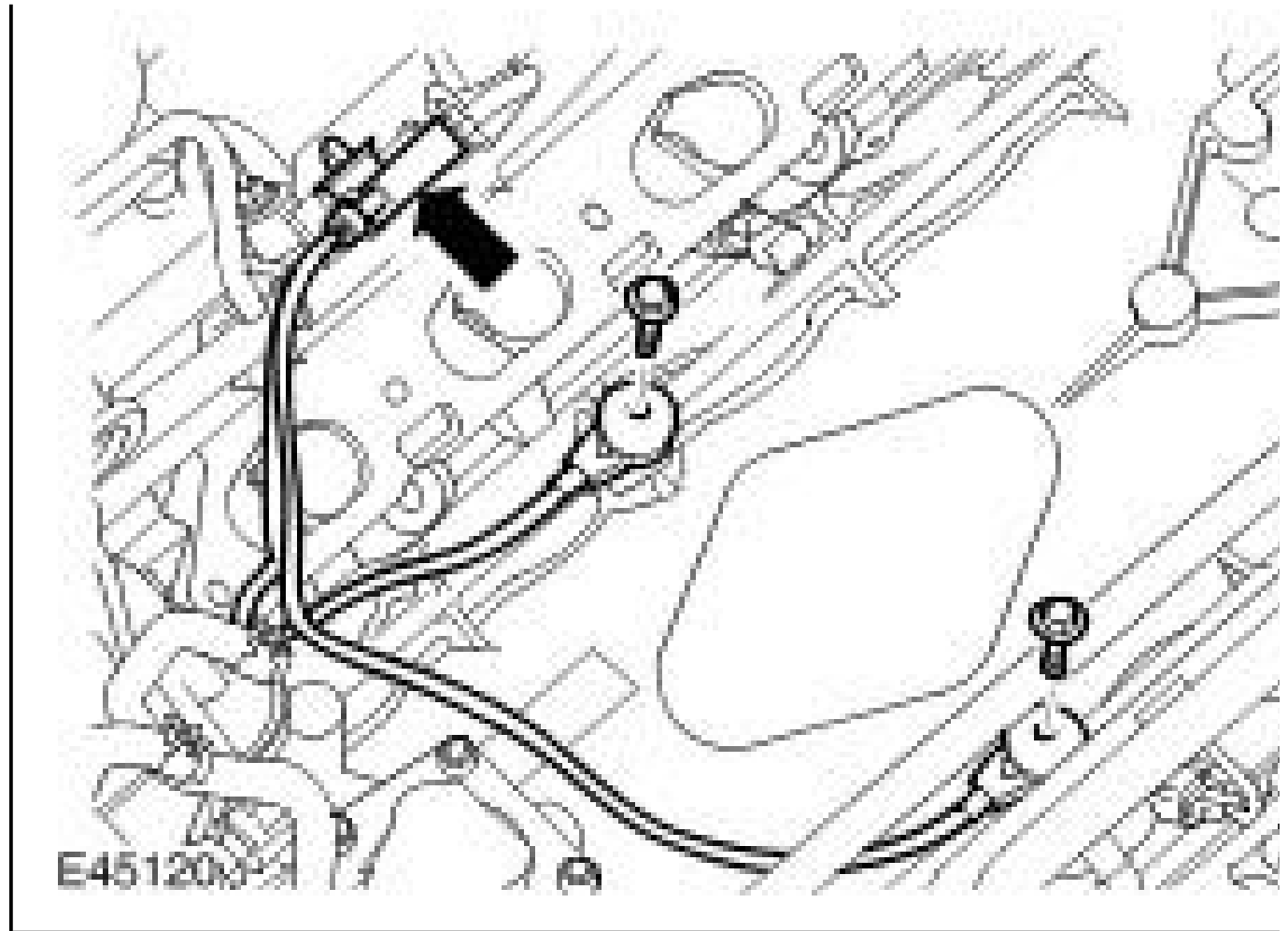


8. Install the coolant pump.
 - Tighten the 5 bolts to 10 Nm (7 lb.ft).



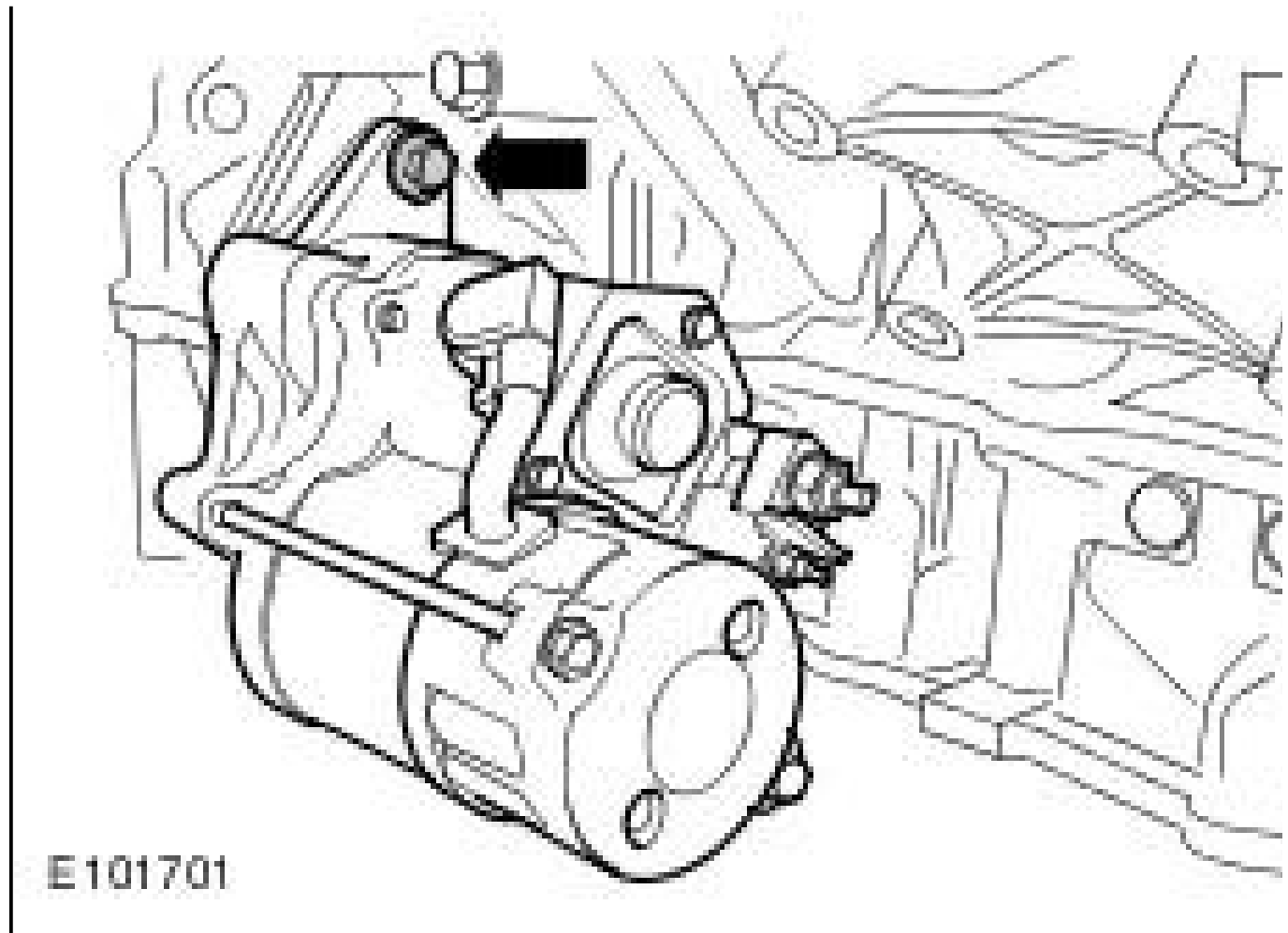
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

9. Install the knock sensors (KS).
 - Tighten the bolts to 20 Nm.

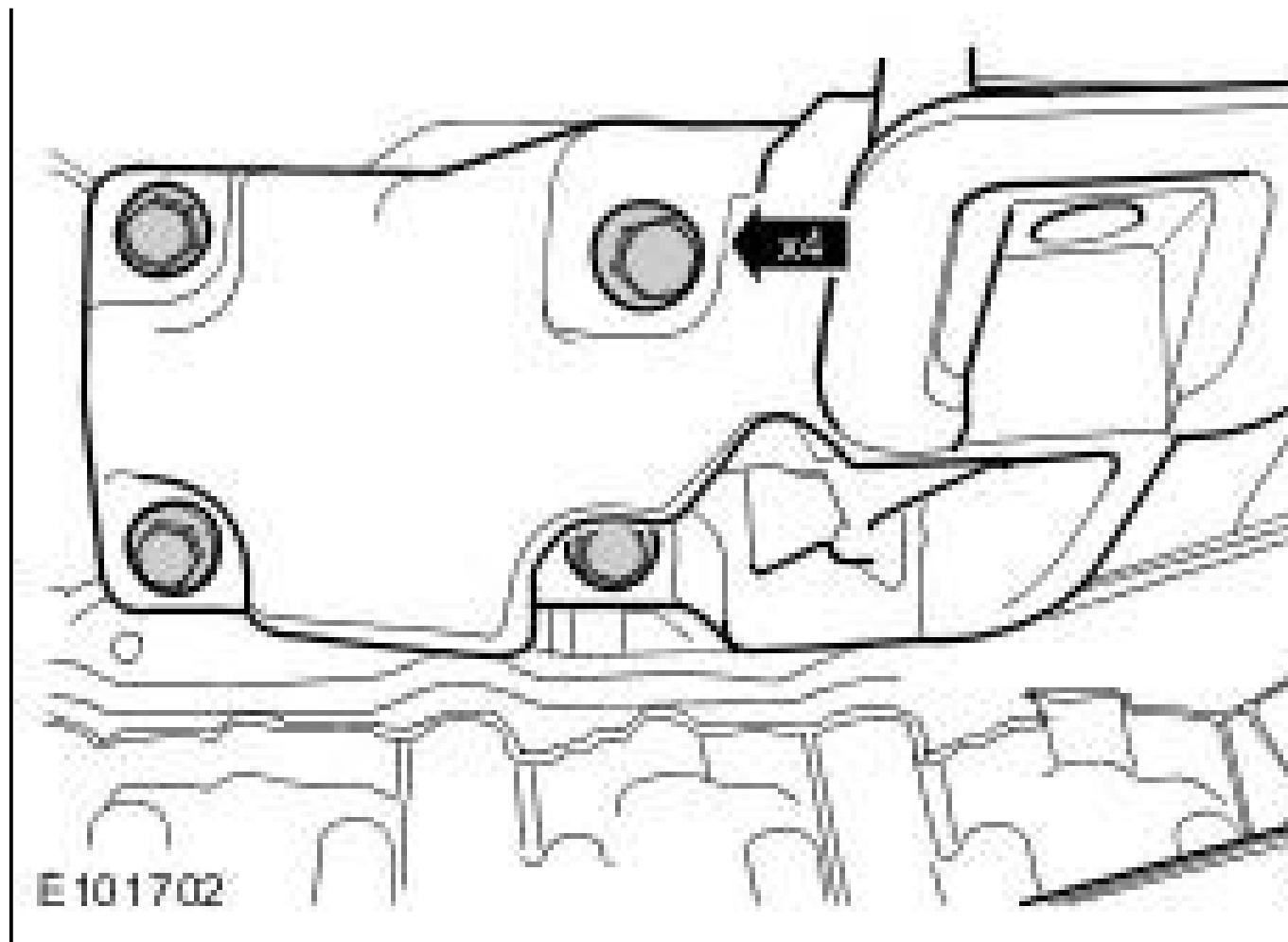


10. Position the starter motor.

- Install the starter motor.
- Tighten the bolt to 45 Nm (33 lb.ft).



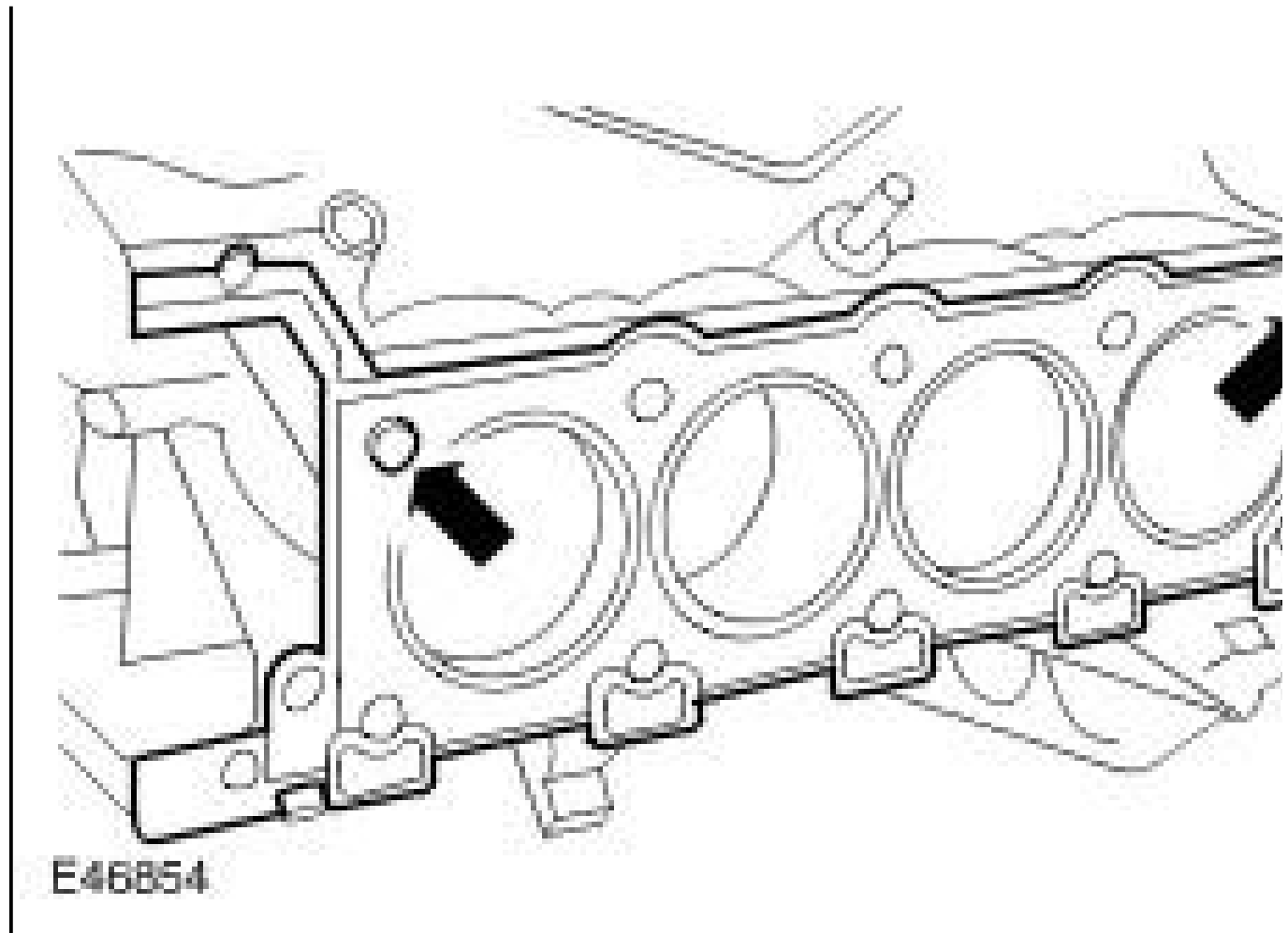
11. Attach the engine mounting bracket.



NOTE: The cylinder head gaskets must be installed over the cylinder head to block dowels.

12. Install the RH cylinder head.

- Clean the component mating faces.
- Clean the cylinder head locating dowels.
- Install a new cylinder head gasket.
- With assistance install the cylinder head.
- Repeat the operation for the LH side.

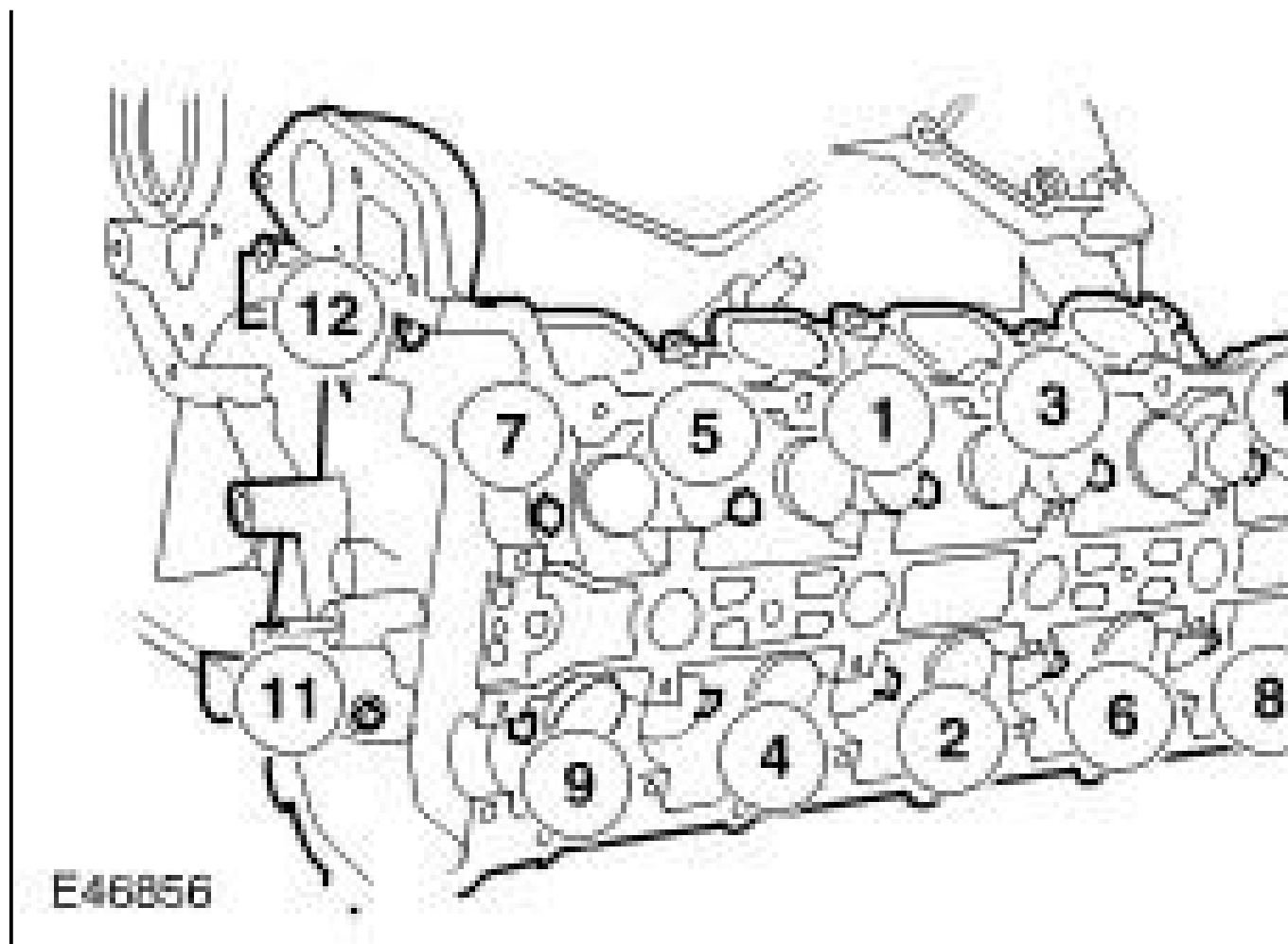


NOTE: Tighten the bolts 1 to 10 in the sequence shown.

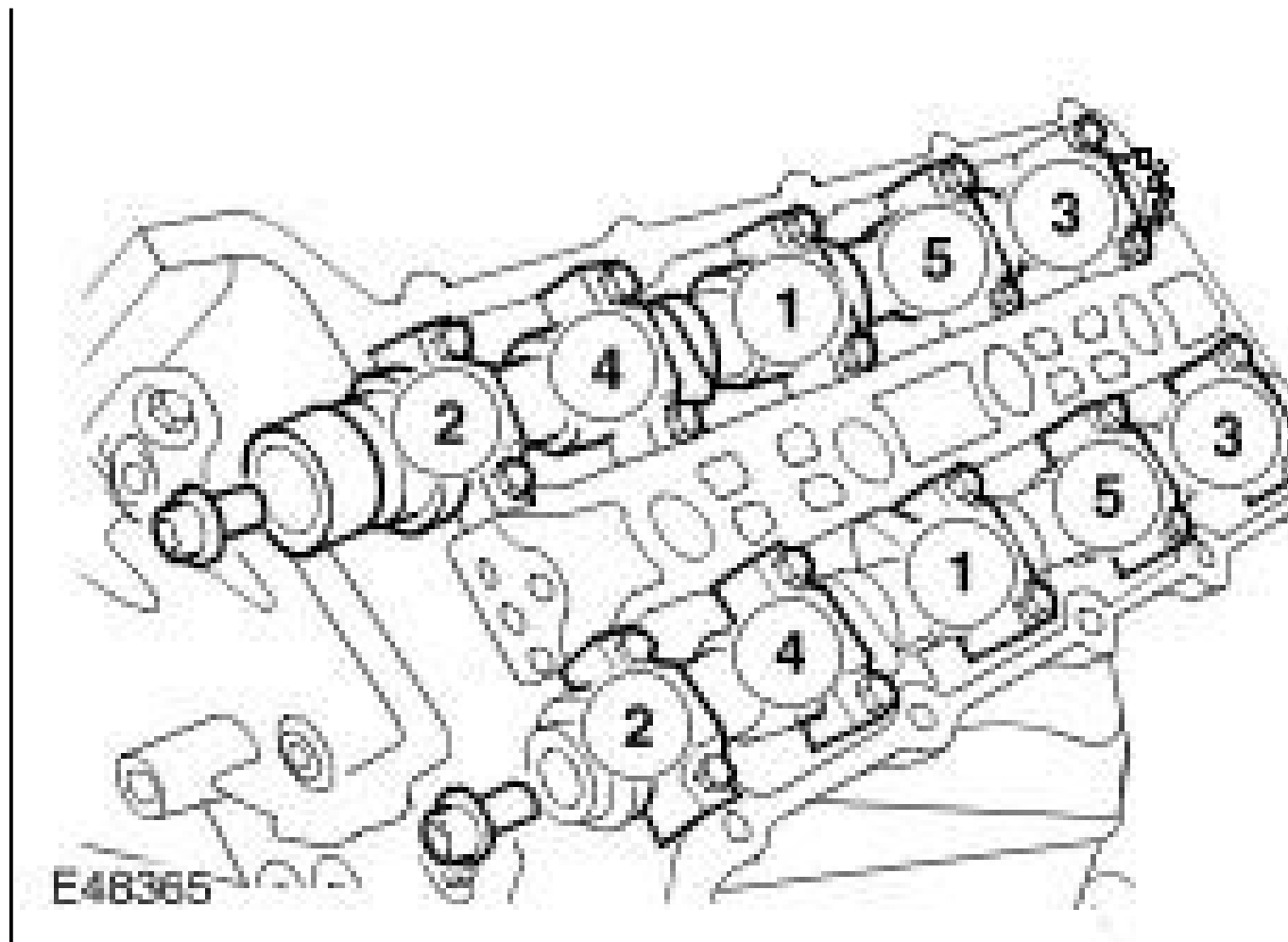
NOTE: LH illustration shown, RH is similar.

13. Install the cylinder head bolts.

- Tighten the bolts to 20 Nm (15 lb.ft).
- Tighten the bolts to 35 Nm (26 lb.ft).
- Tighten the bolts 1 to 10, a further 90 degrees.
- Tighten the bolts 1 to 10, a further 90 degrees.
- Tighten the M8 bolts 11 and 12, to 25 Nm (18 lb.ft).
- Repeat the operation for the LH side.



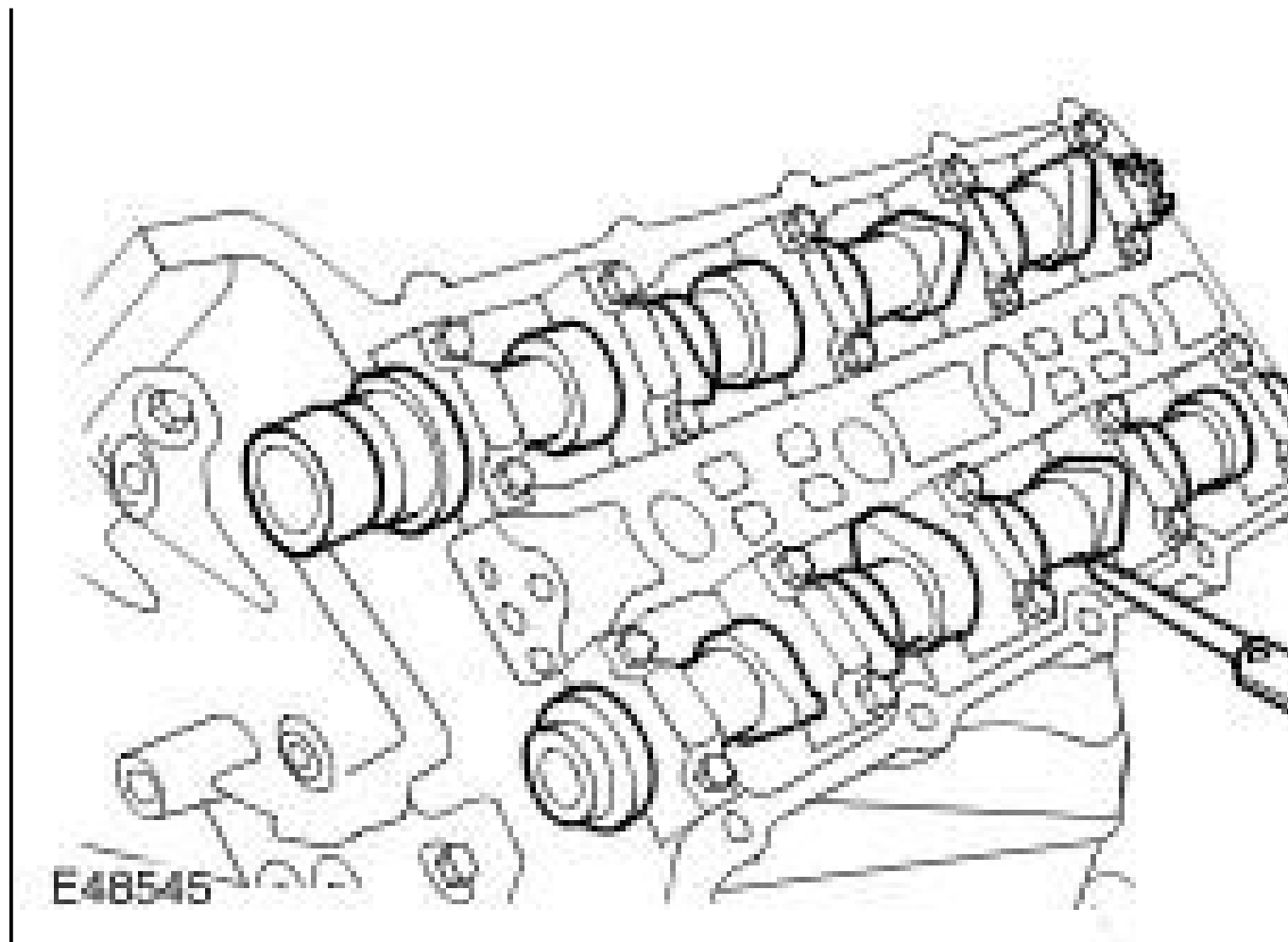
14. Install the LH camshafts.
 - Clean the component mating faces.
 - Lubricate the journals and camshaft lobes.
15. Install the camshaft bearing caps.
 - Evenly and progressively tighten the bolts in the sequence shown to 10 Nm (7 lb.ft).



16. Install the sprocket retaining Torx bolts to the camshafts.

CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

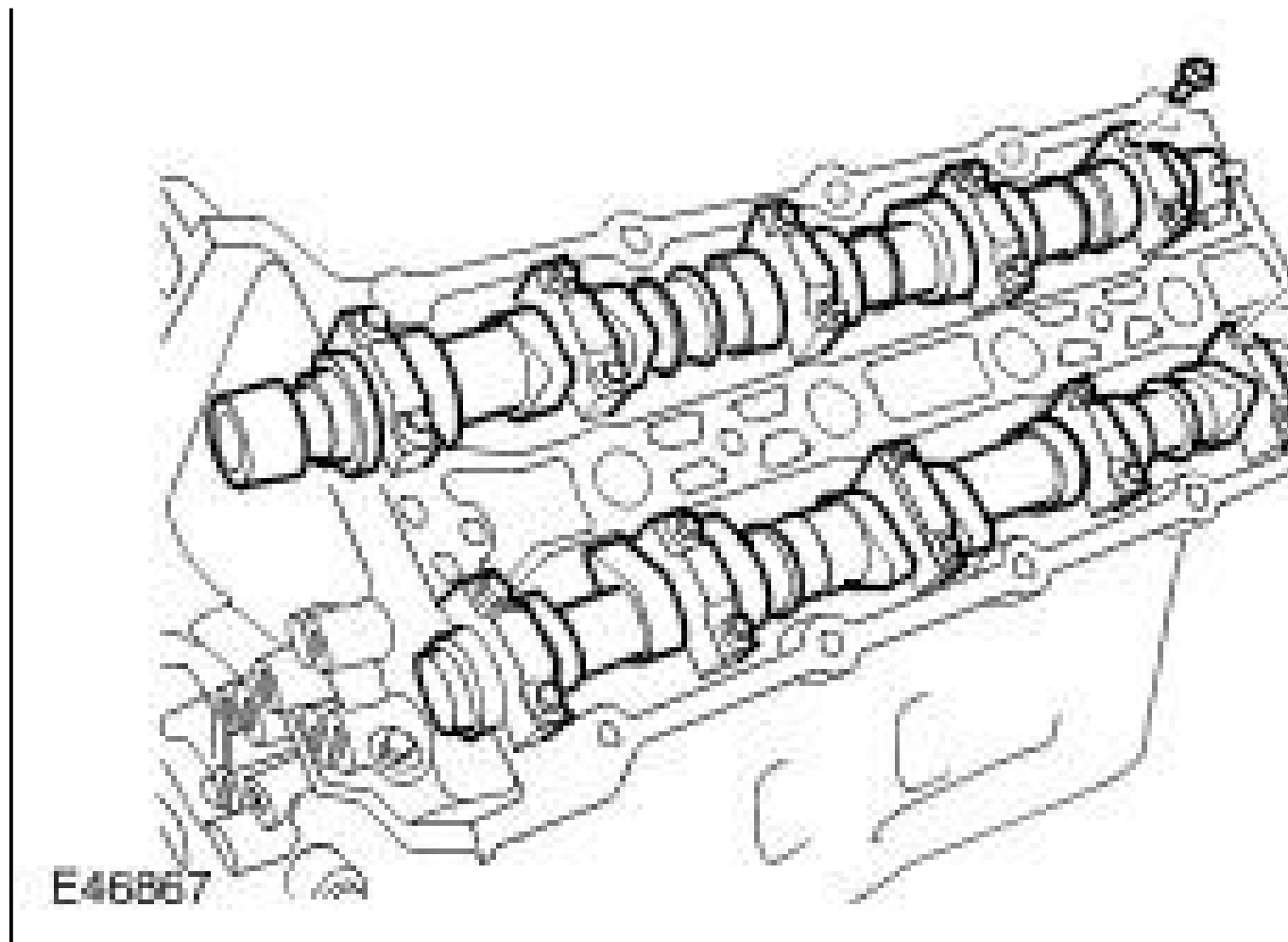
17. Measure and record the tappet clearances.
- Rotate the camshafts using the Torx bolts.



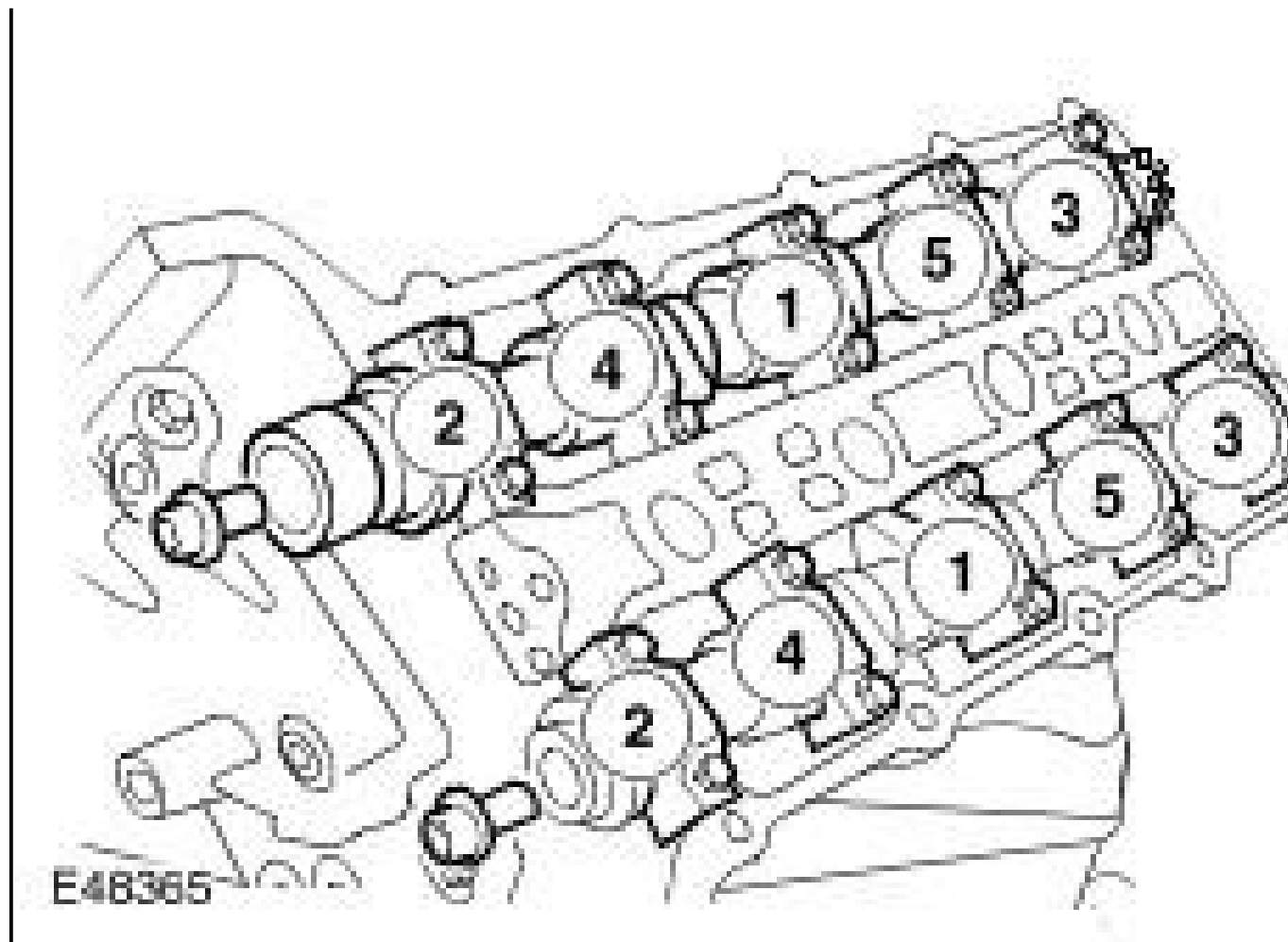
NOTE: Remove the camshaft bearing caps evenly and in stages.

NOTE: Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

18. Remove the camshafts.
 - Remove the 20 bolts.

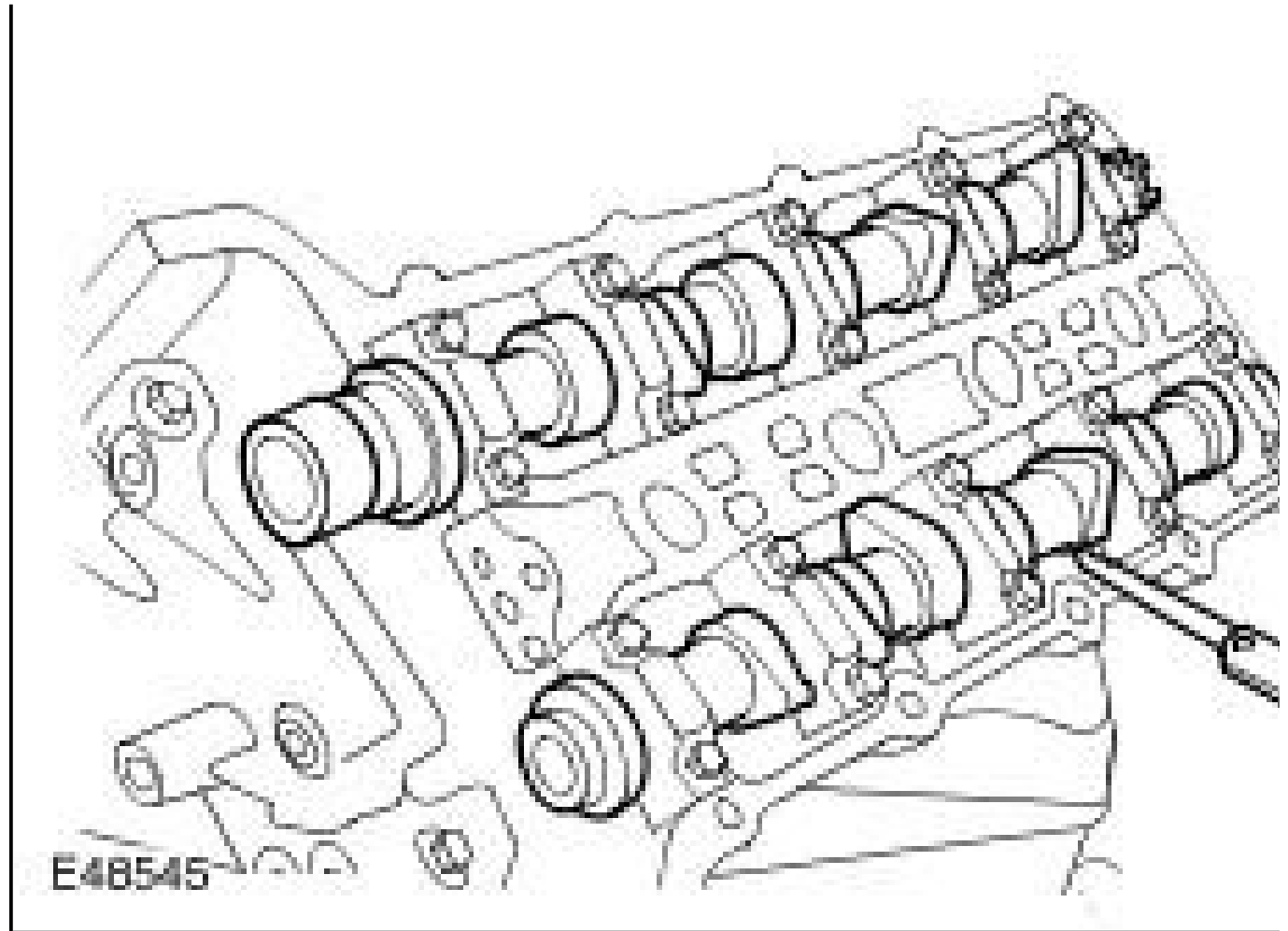


19. Remove the valve tappets, replace with selected tappets.
20. Install the camshafts.
 - Lubricate the journals and camshaft lobes.
 - Clean the component mating faces.
21. Install the camshaft bearing caps.
 - Evenly and progressively tighten the bolts in the sequence shown to 10 Nm (7 lb.ft).

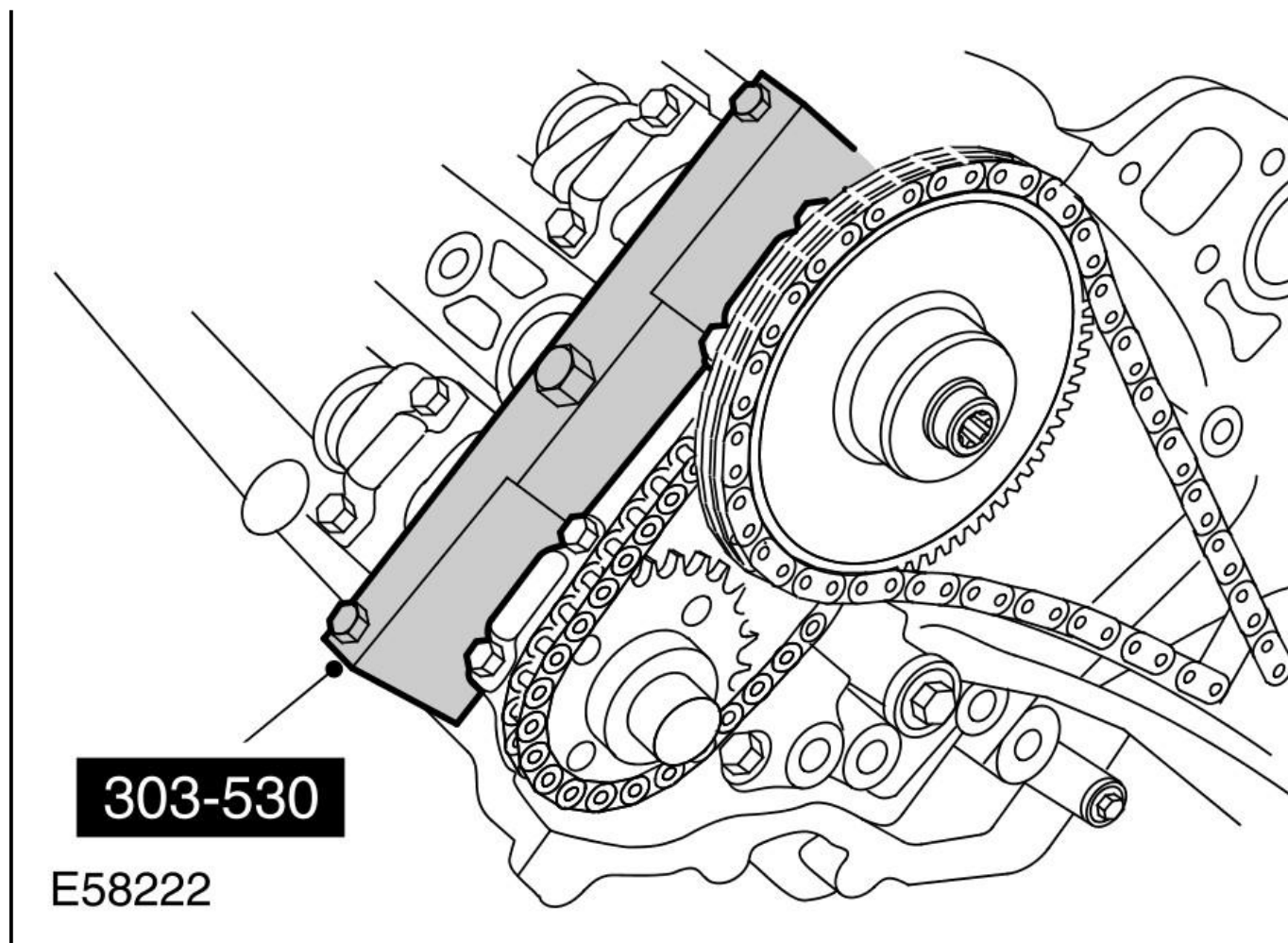


CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

22. Check valve tappet clearances are correct.
- Rotate the camshafts using the Torx bolts.
 - Remove the camshaft Torx bolts after the check is complete.

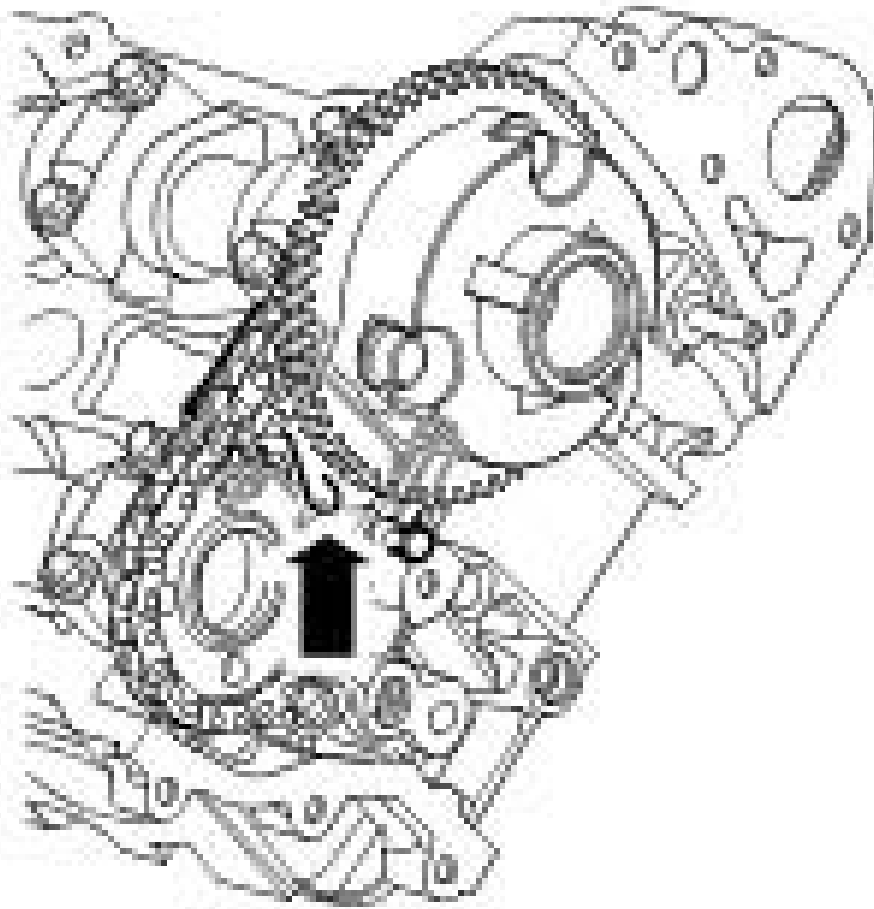


23. Repeat the operation for the RH camshafts.
24. Install the special tool to the LH cylinder head.

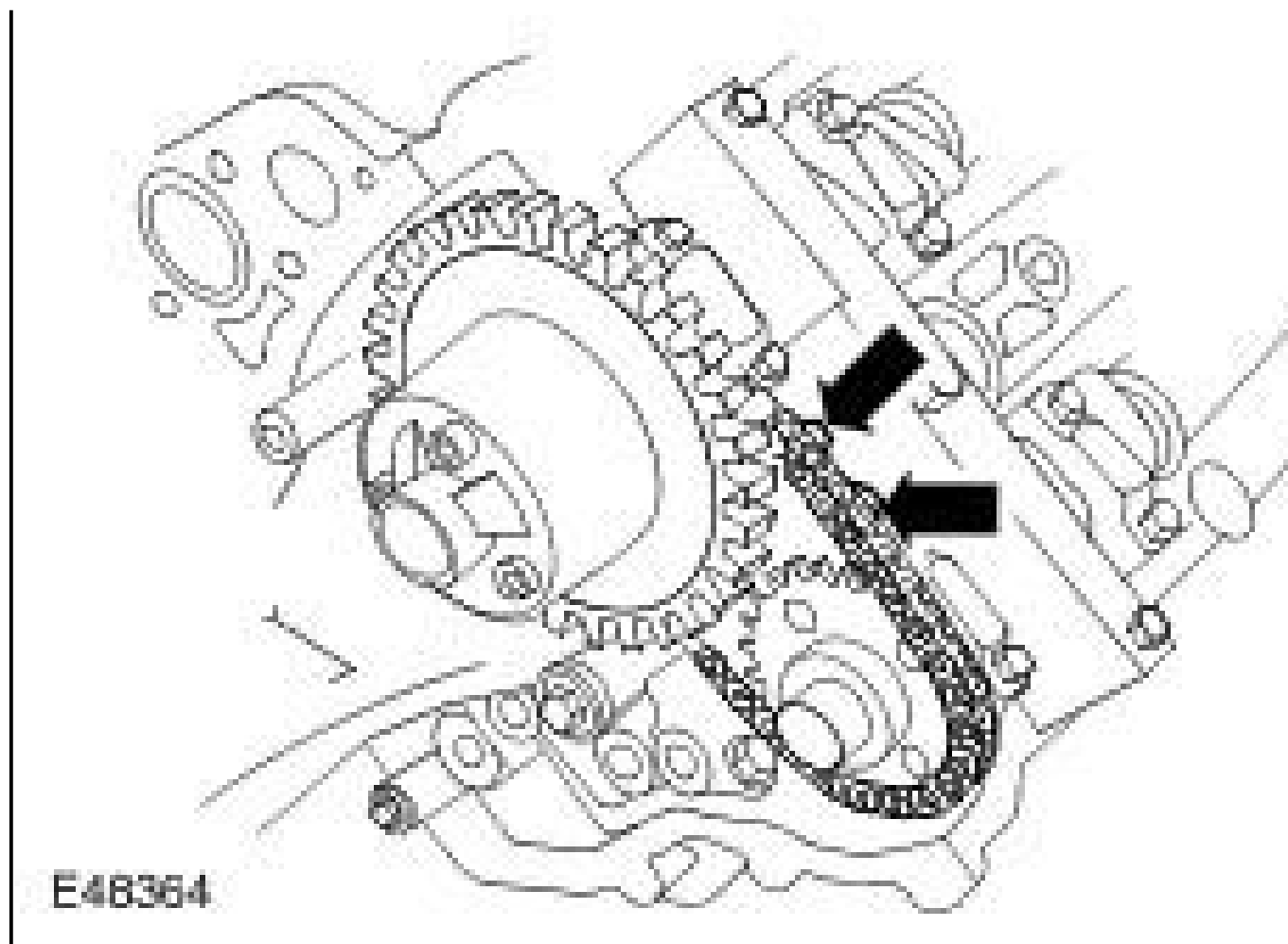


NOTE: RH illustration shown, LH is similar.

25. Depress the LH secondary timing chain tensioner piston.
 - Using 1 mm diameter metal rod, retain the chain tensioner piston.

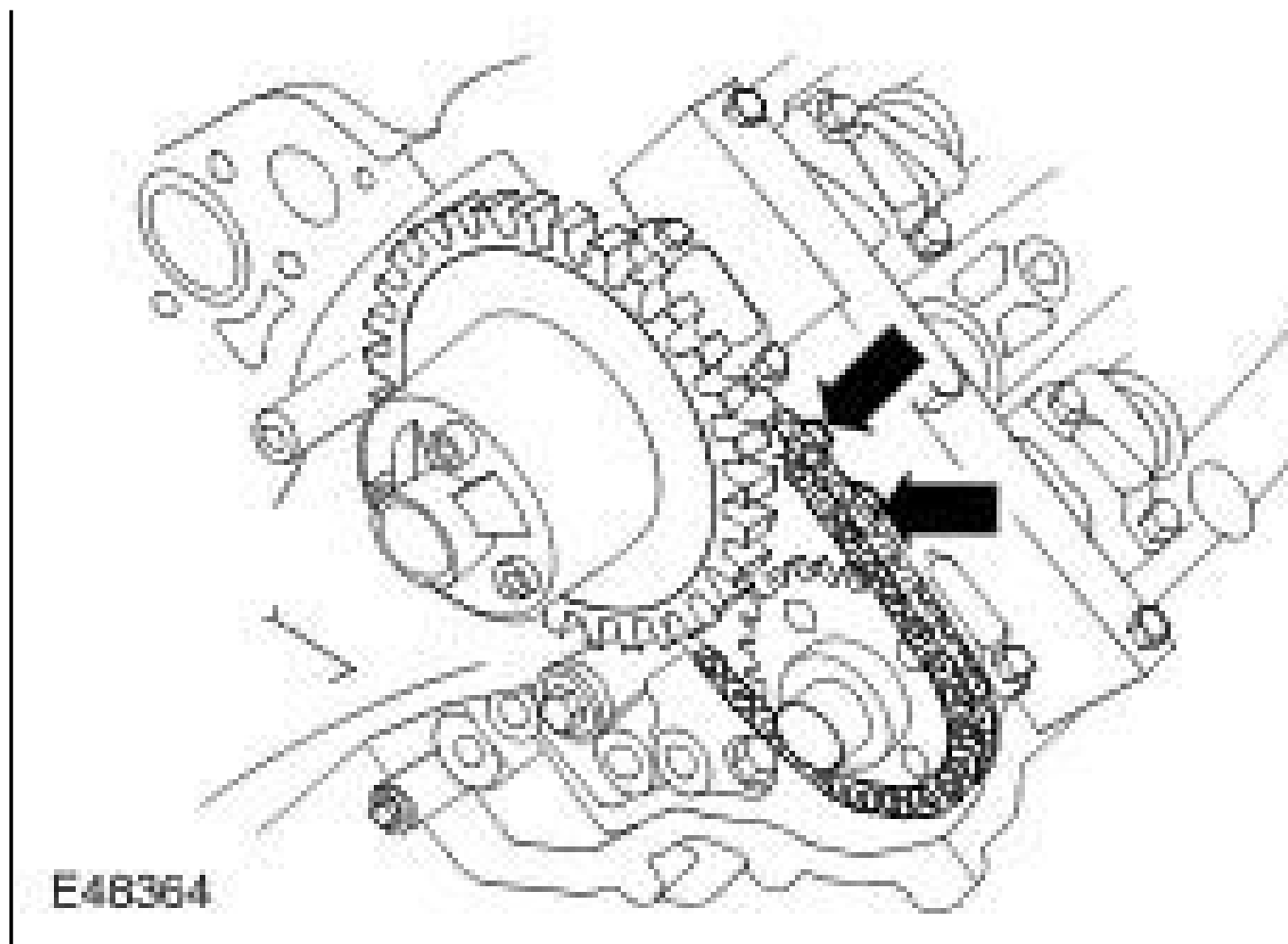


26. Install the LH secondary timing chain tensioner retaining bolts.
- Tighten the bolts to 12 Nm (9 lb.ft).

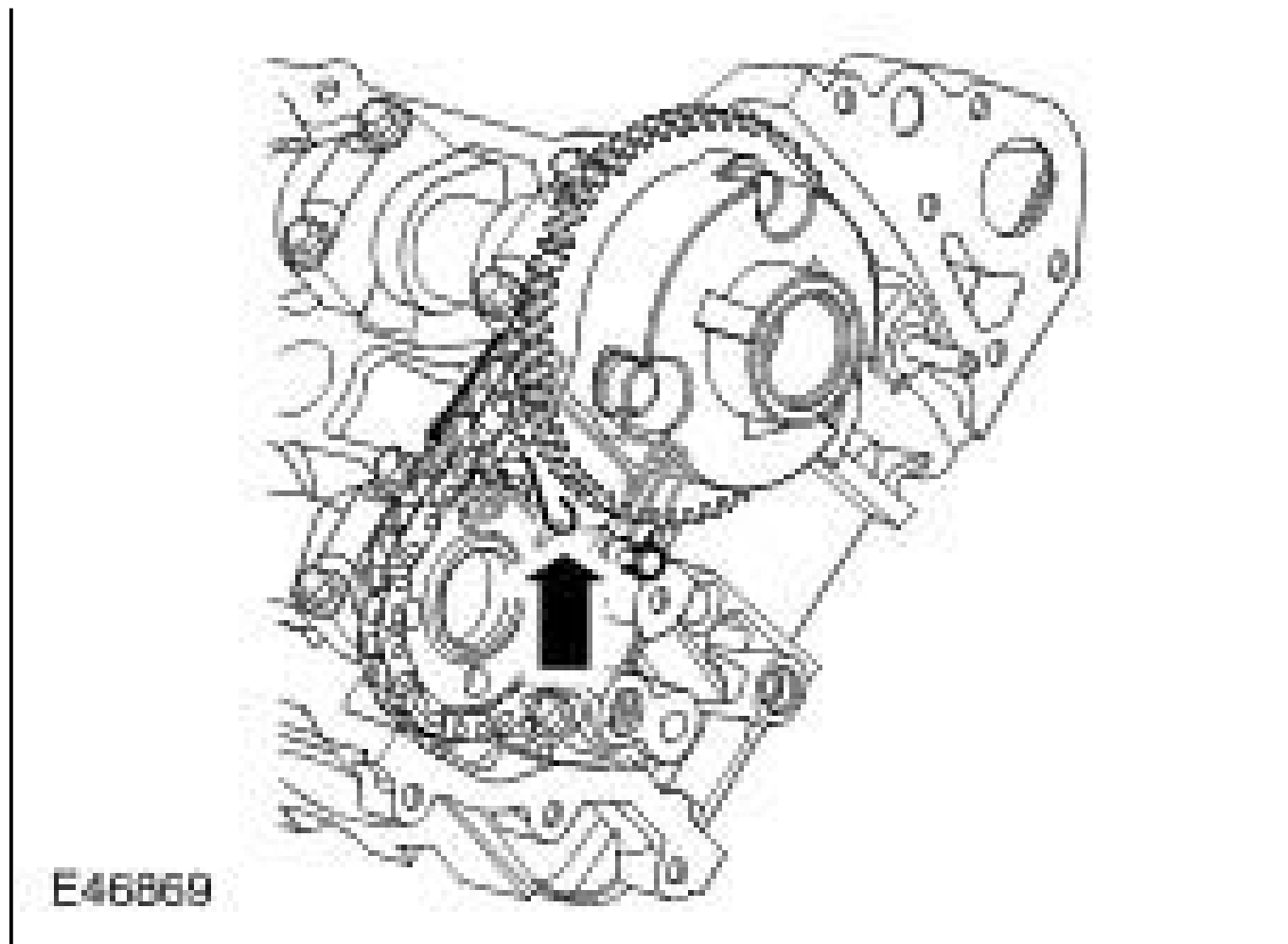


NOTE: Lightly tighten the camshaft sprocket Torx bolts, the sprockets **MUST** be free to move.

27. Install the LH secondary timing chain and sprockets to the camshafts.
 - Install the sprocket retaining Torx bolts to the camshafts.



28. Tension the secondary timing chain.
- Remove the retaining rod.

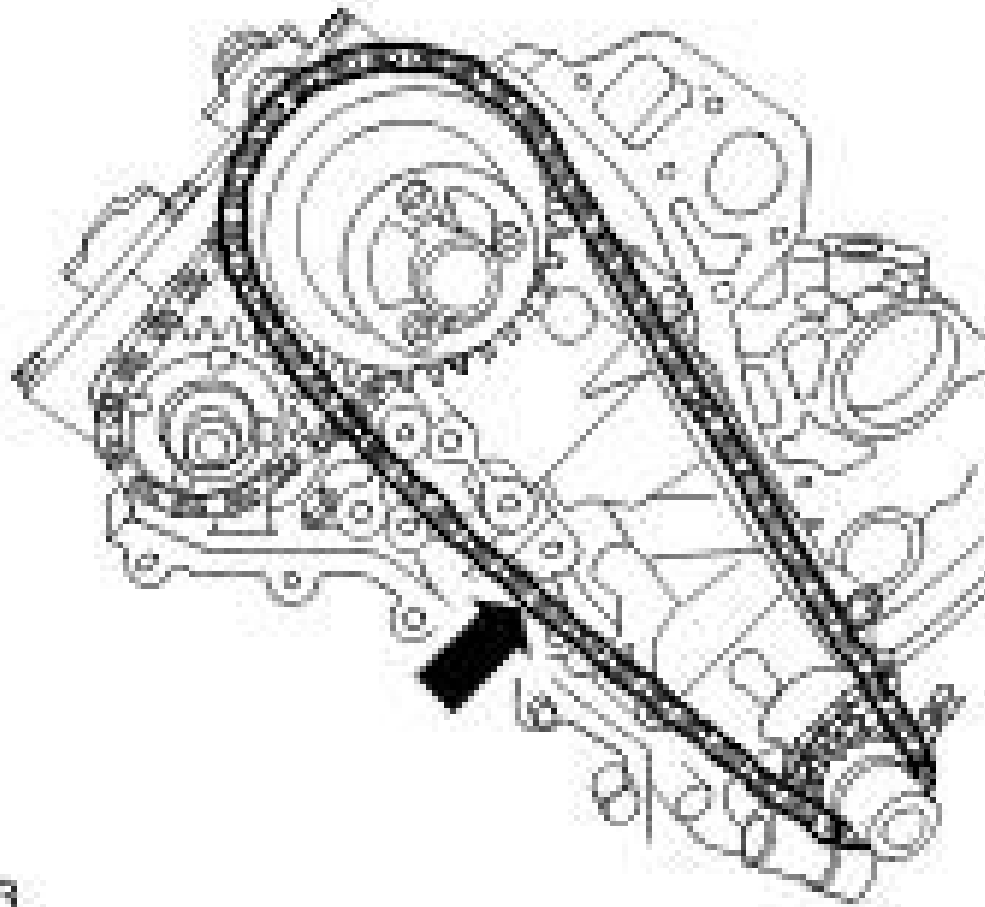


29. Repeat the operation for the RH camshafts.

NOTE: RH illustration shown, LH is similar.

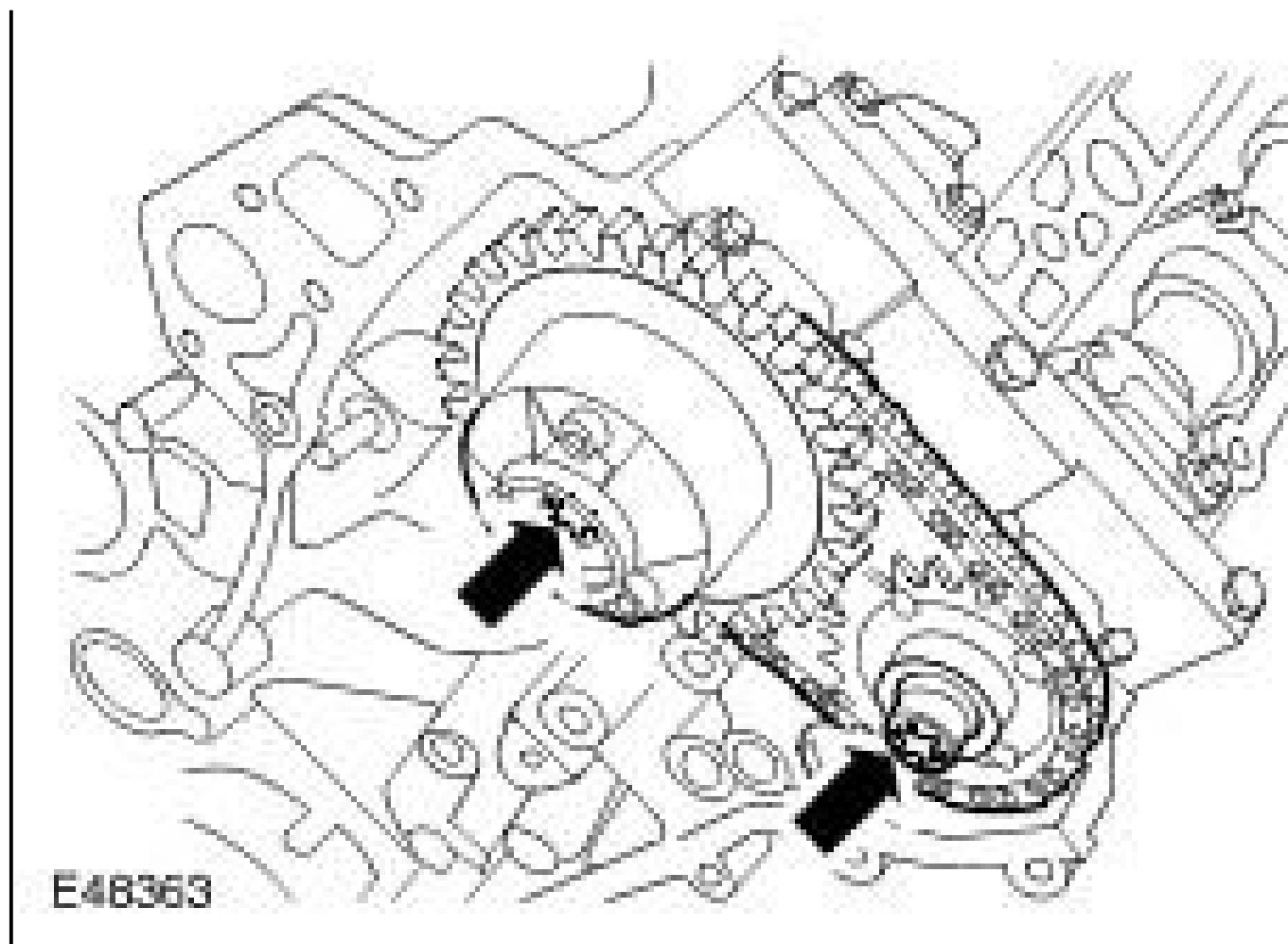
30. Install the LH primary timing chain.

- Make sure the timing chain slack is on the tensioner side of the timing chain.



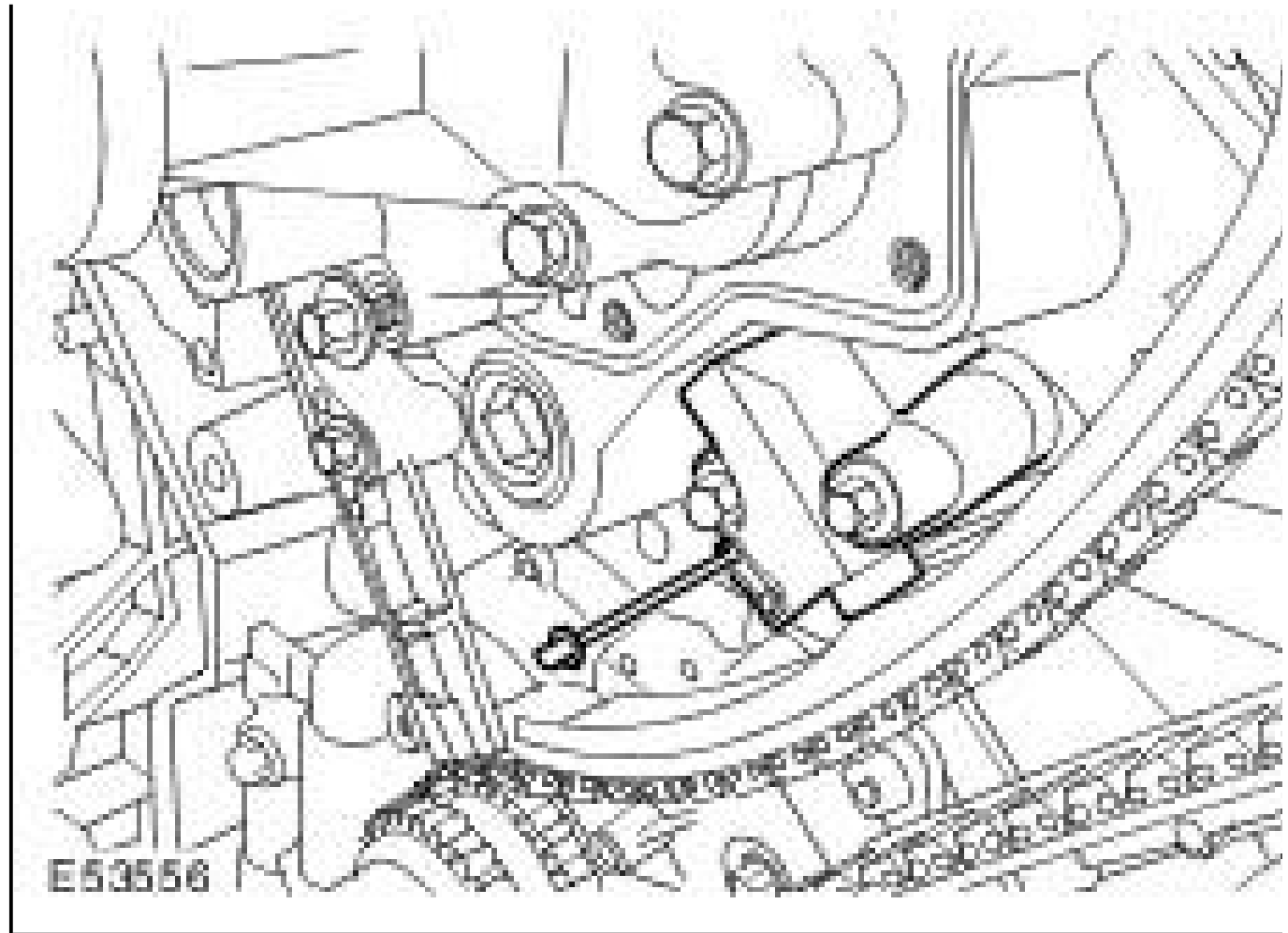
E46863

31. Install the LH primary chain tensioner guide.
 - Tighten the stud to 12 Nm (9 lb.ft).



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.

32. Install the LH primary timing chain tensioner.
- Using 3 mm diameter metal rod, retain the chain tensioner piston.
 - Tighten the bolts to 12 Nm (9 lb.ft).
 - Remove the retaining rod.

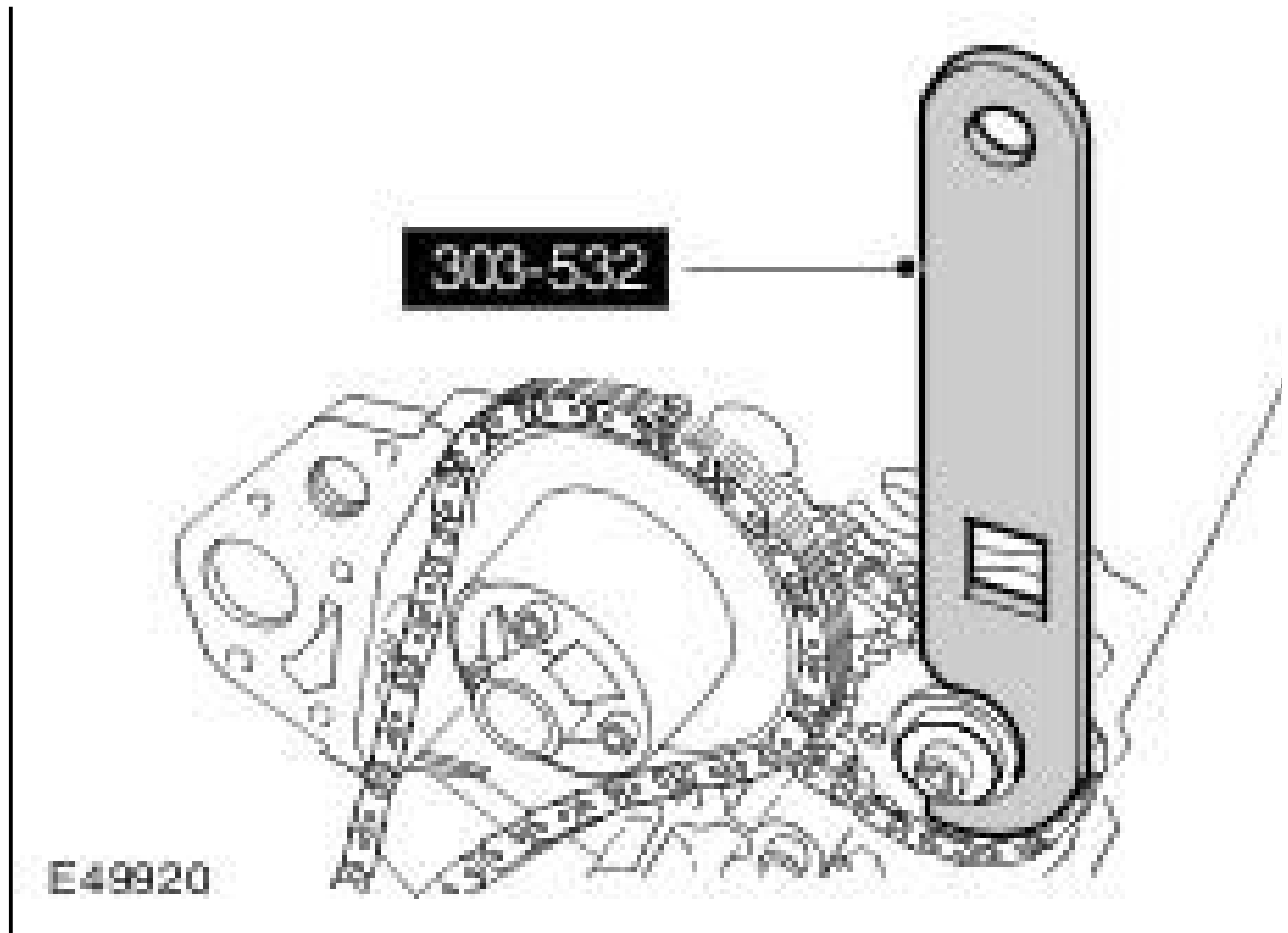


CAUTION: Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

CAUTION: The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

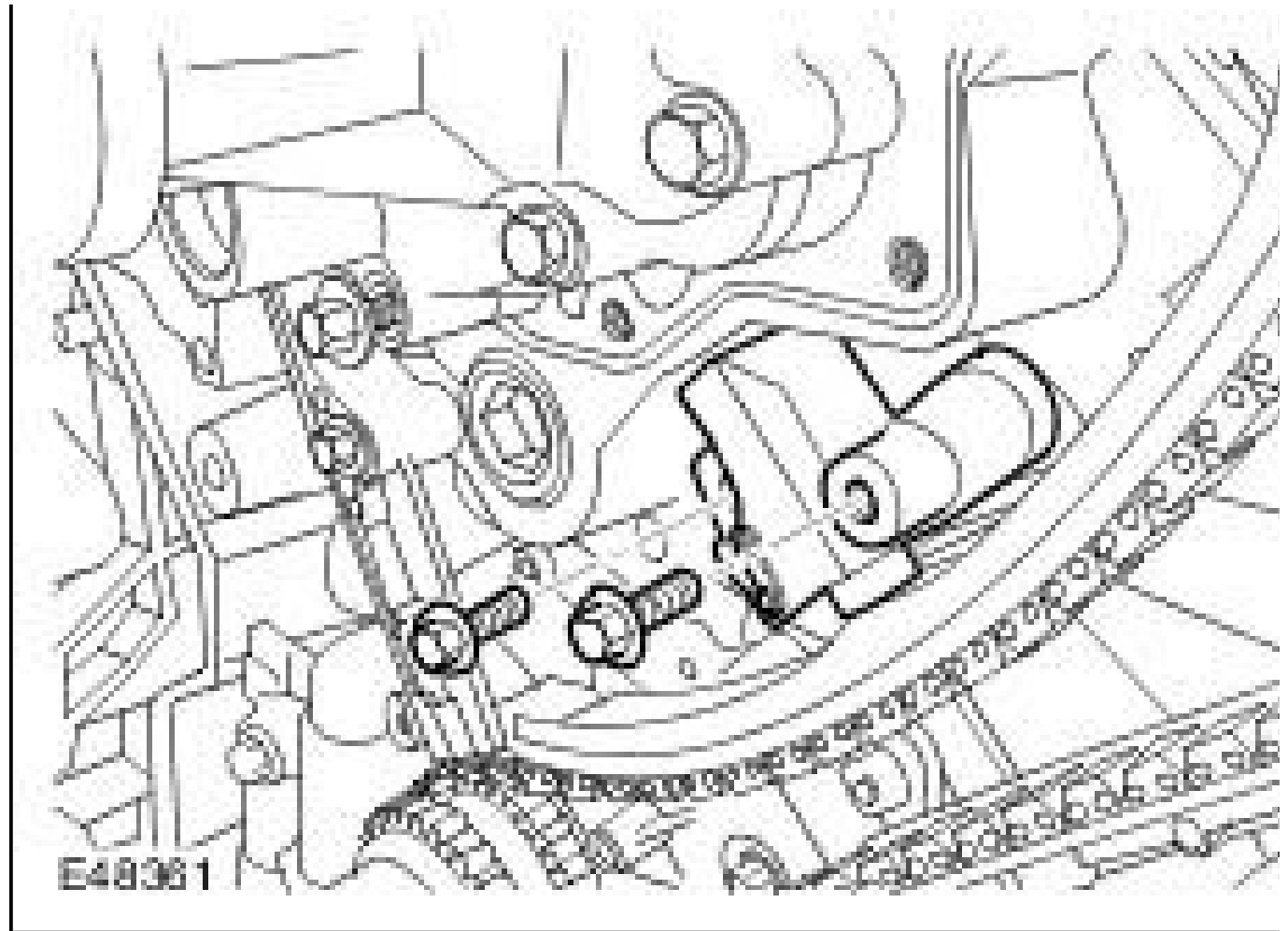
33. Install the special tool to the exhaust camshaft sprocket.

- Tighten the intake camshaft sprocket bolt to 20 Nm (15 lb.ft) then a further 90 degrees.
- Tighten the exhaust camshaft sprocket bolt to 20 Nm (15 lb.ft) then a further 90 degrees.

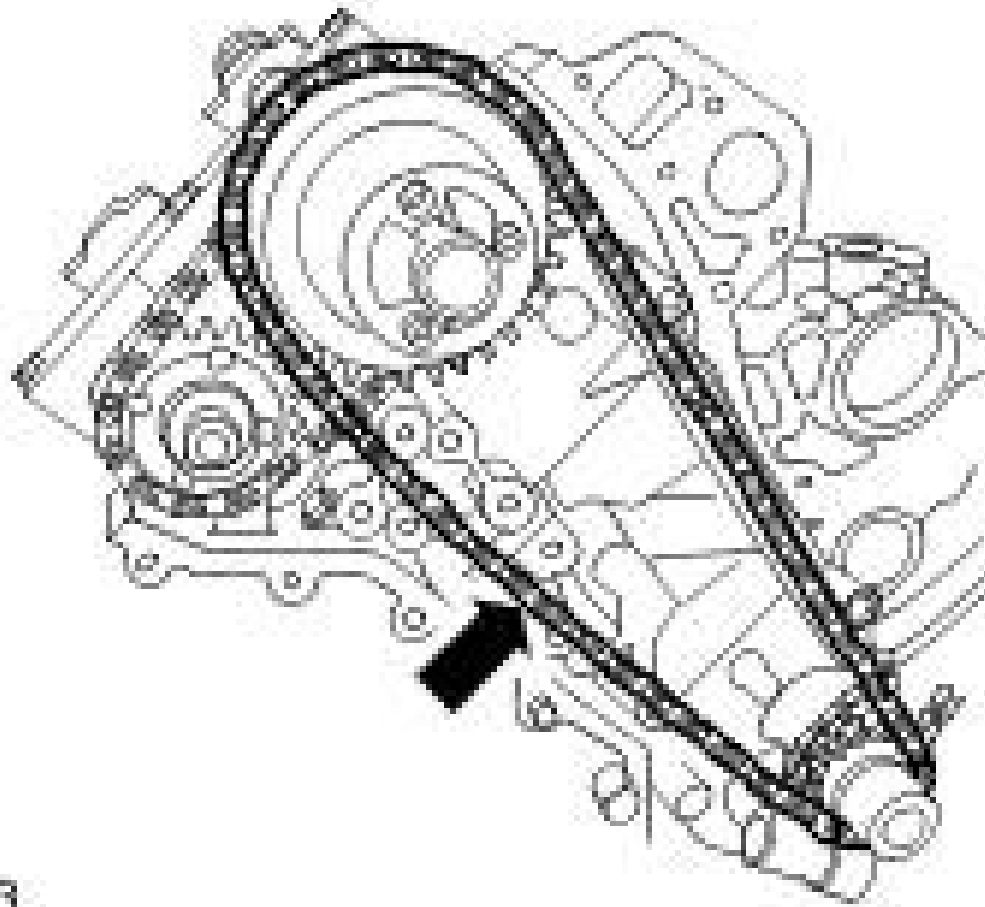


34. Install the LH variable camshaft timing (VCT) oil control unit.

- Install the new O-ring seals.
- Tighten the new bolts to 22 Nm (16 lb.ft).
- Tighten the nut to 10 Nm (7 lb.ft).

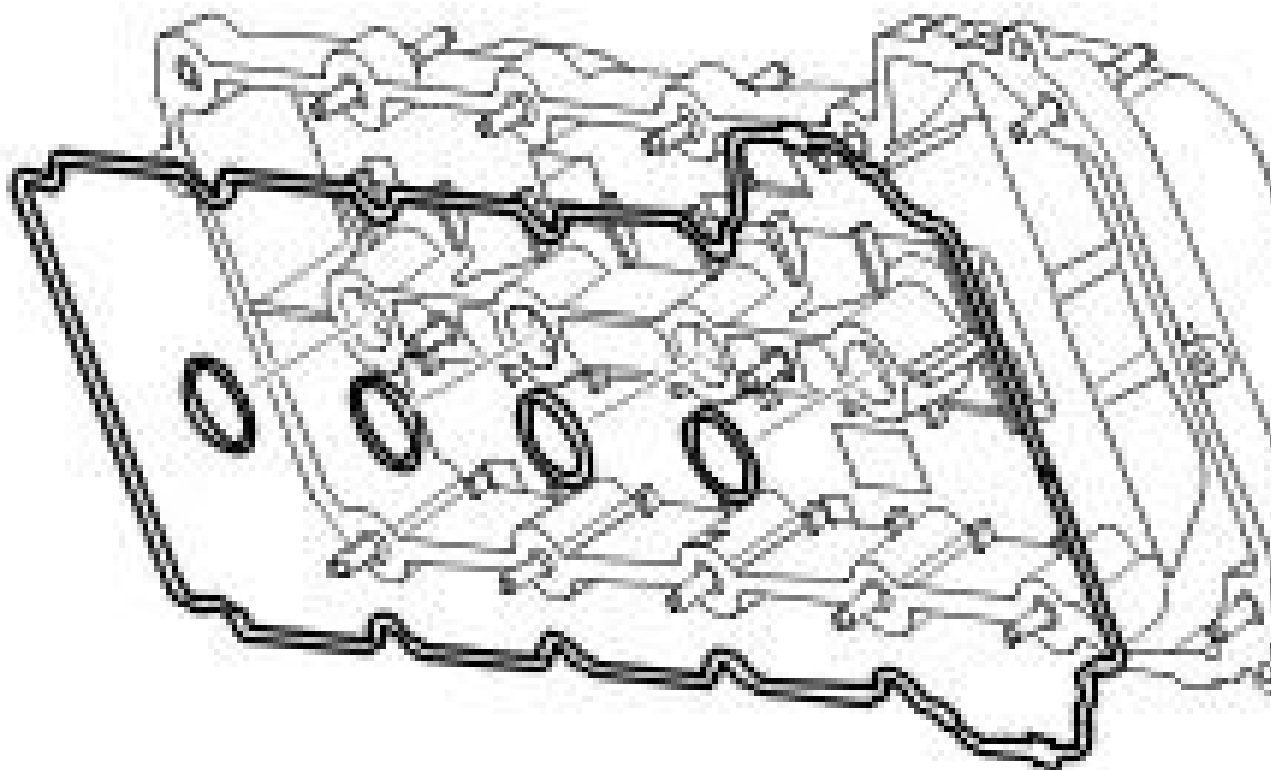


35. Install the RH primary timing chain.
- Make sure the timing chain slack is on the tensioner side of the timing chain.



E46863

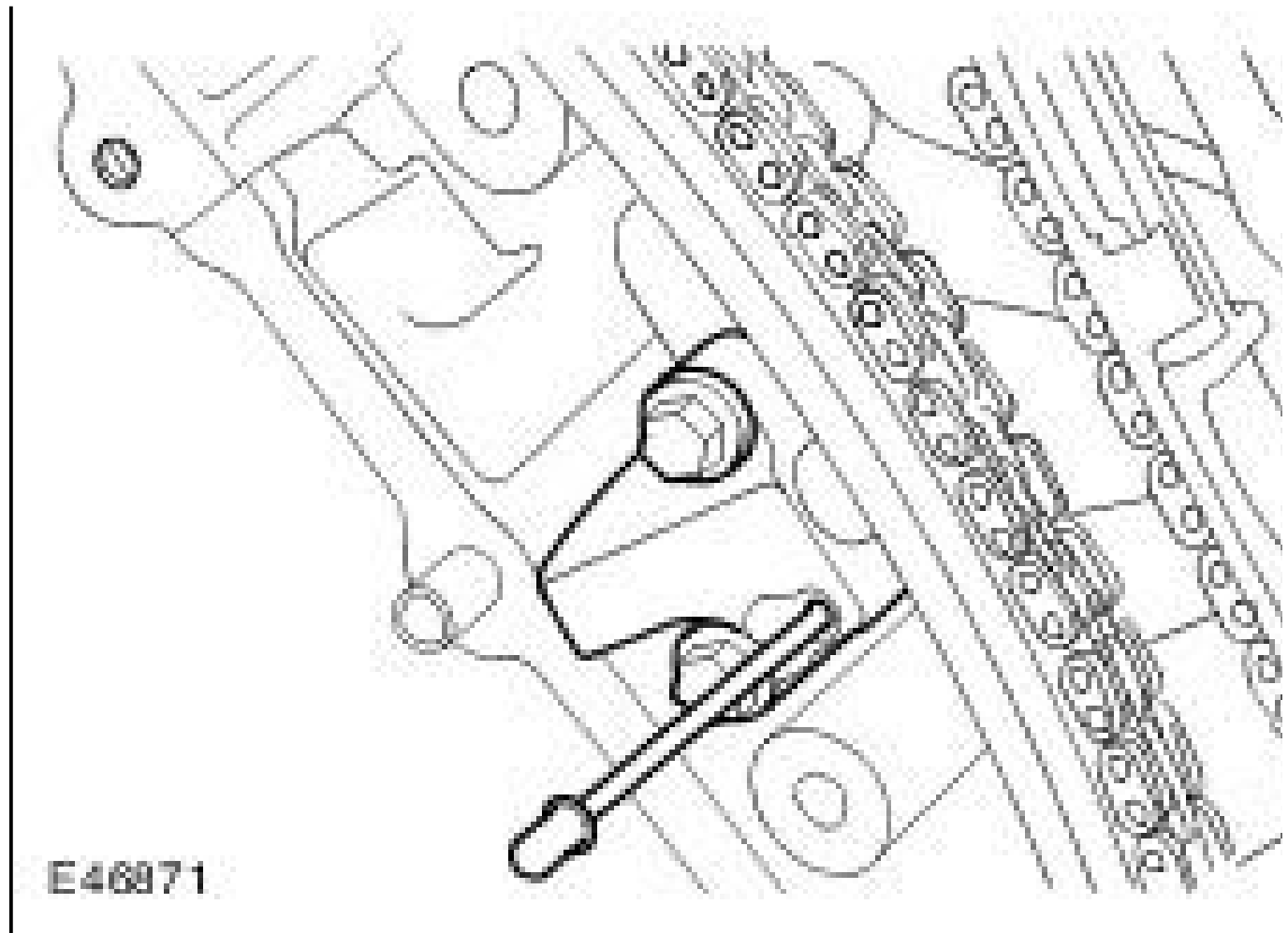
36. Install the RH primary timing chain tensioner guide.
- Tighten the bolts to 12 Nm (9 lb.ft).



E46652

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.

37. Install the RH primary timing chain tensioner.
- Using 3 mm diameter metal rod, retain the chain tensioner piston.
 - Tighten the bolts to 12 Nm (9 lb.ft).
 - Remove the retaining rod.



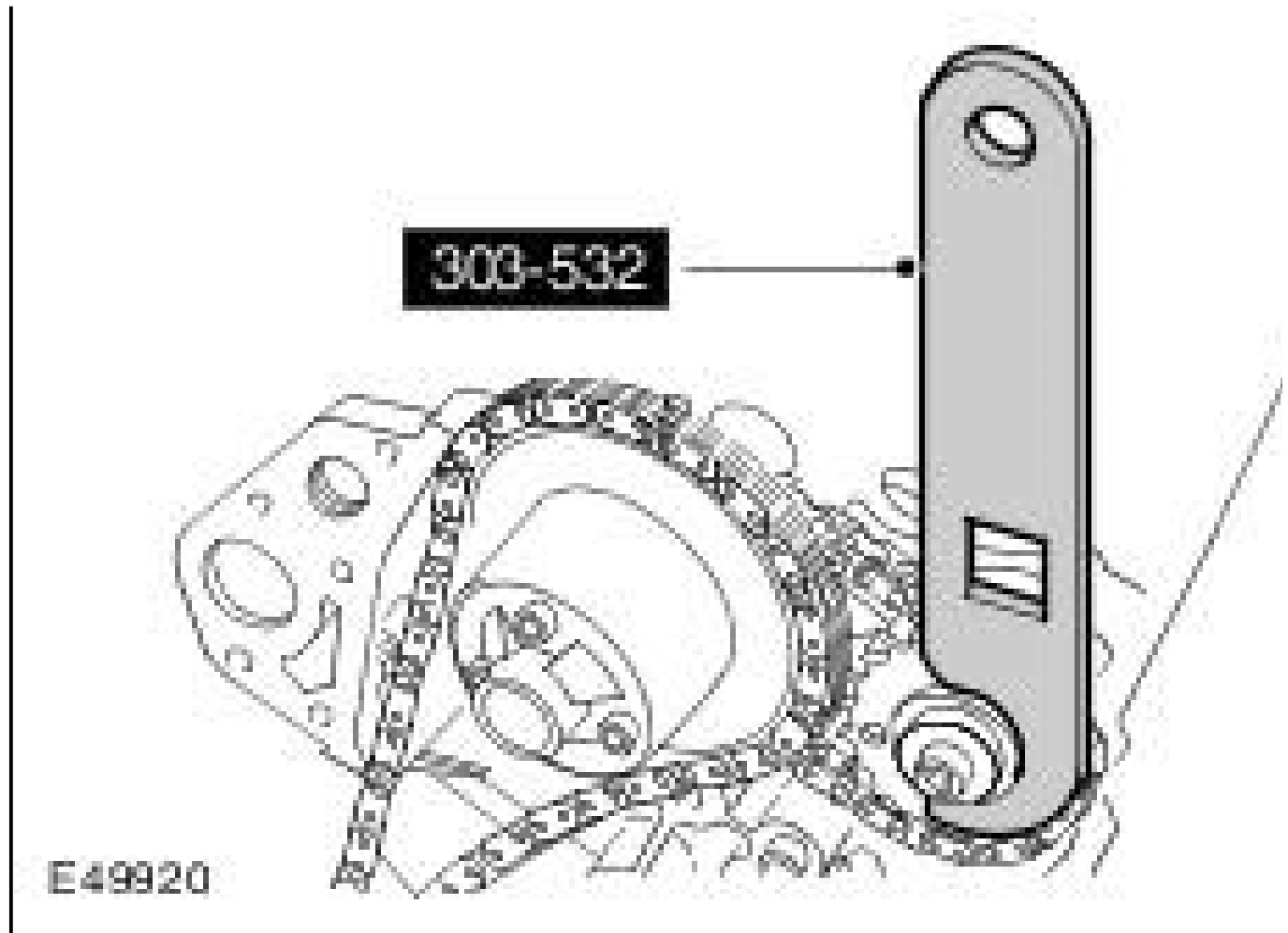
CAUTION: Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

CAUTION: The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

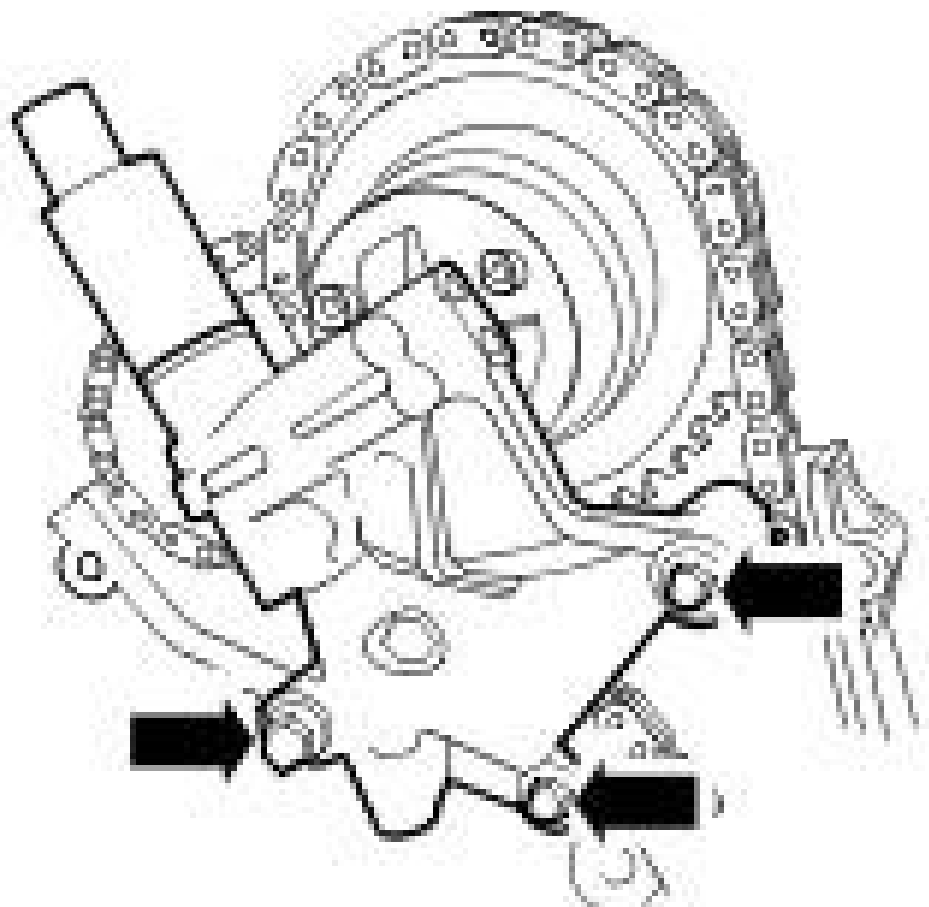
CAUTION: Make sure that new bolts are installed.

38. Install the special tool to the exhaust camshaft sprocket.

- Tighten the intake camshaft sprocket bolt to 20 Nm (15 lb.ft) then a further 90 degrees.
- Tighten the exhaust camshaft sprocket bolt to 20 Nm (15 lb.ft) then a further 90 degrees.

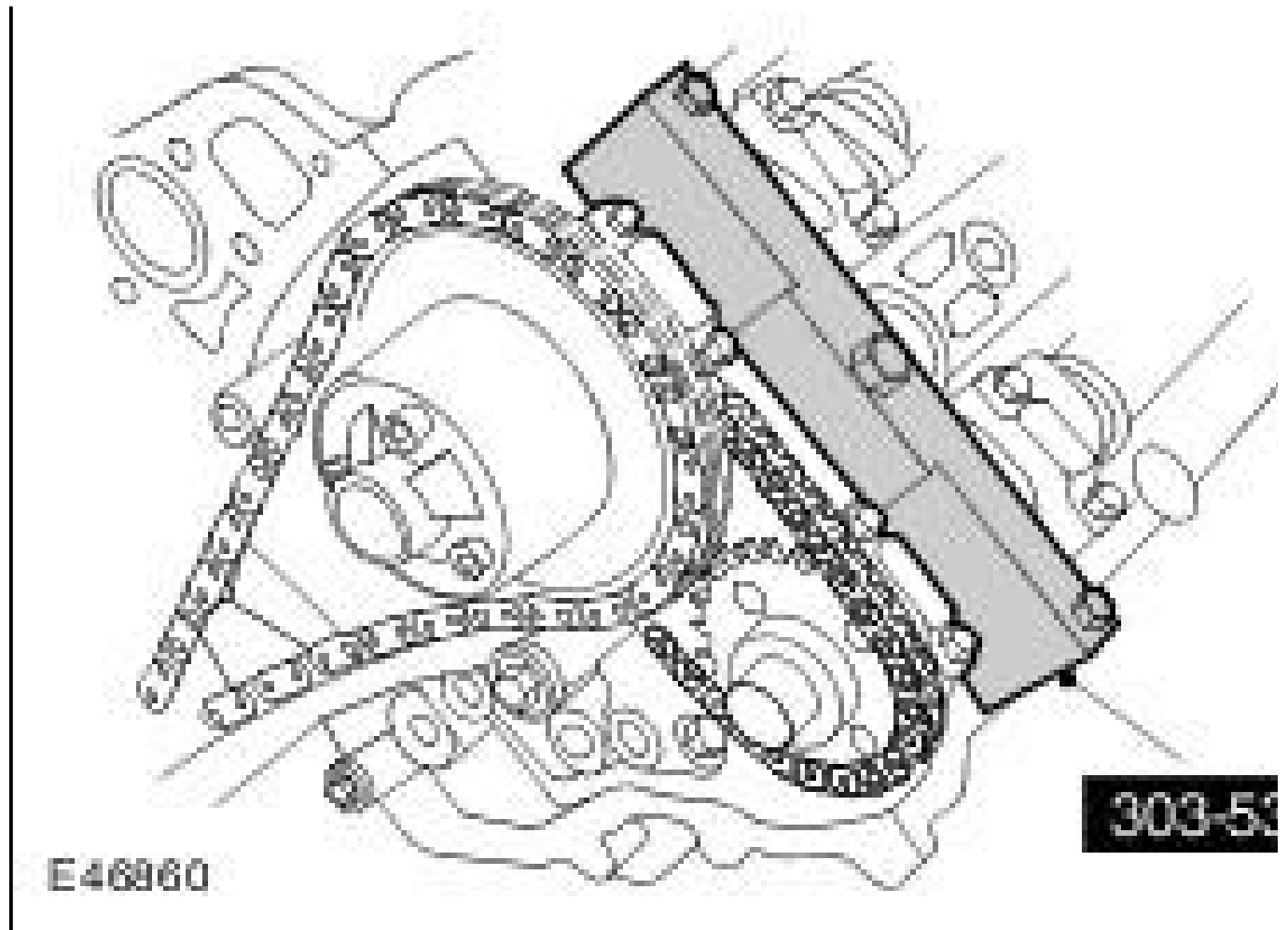


39. Install the RH VCT oil control unit.
- Install the new O-ring seals.
 - Tighten the new bolts to 22 Nm (16 lb.ft).

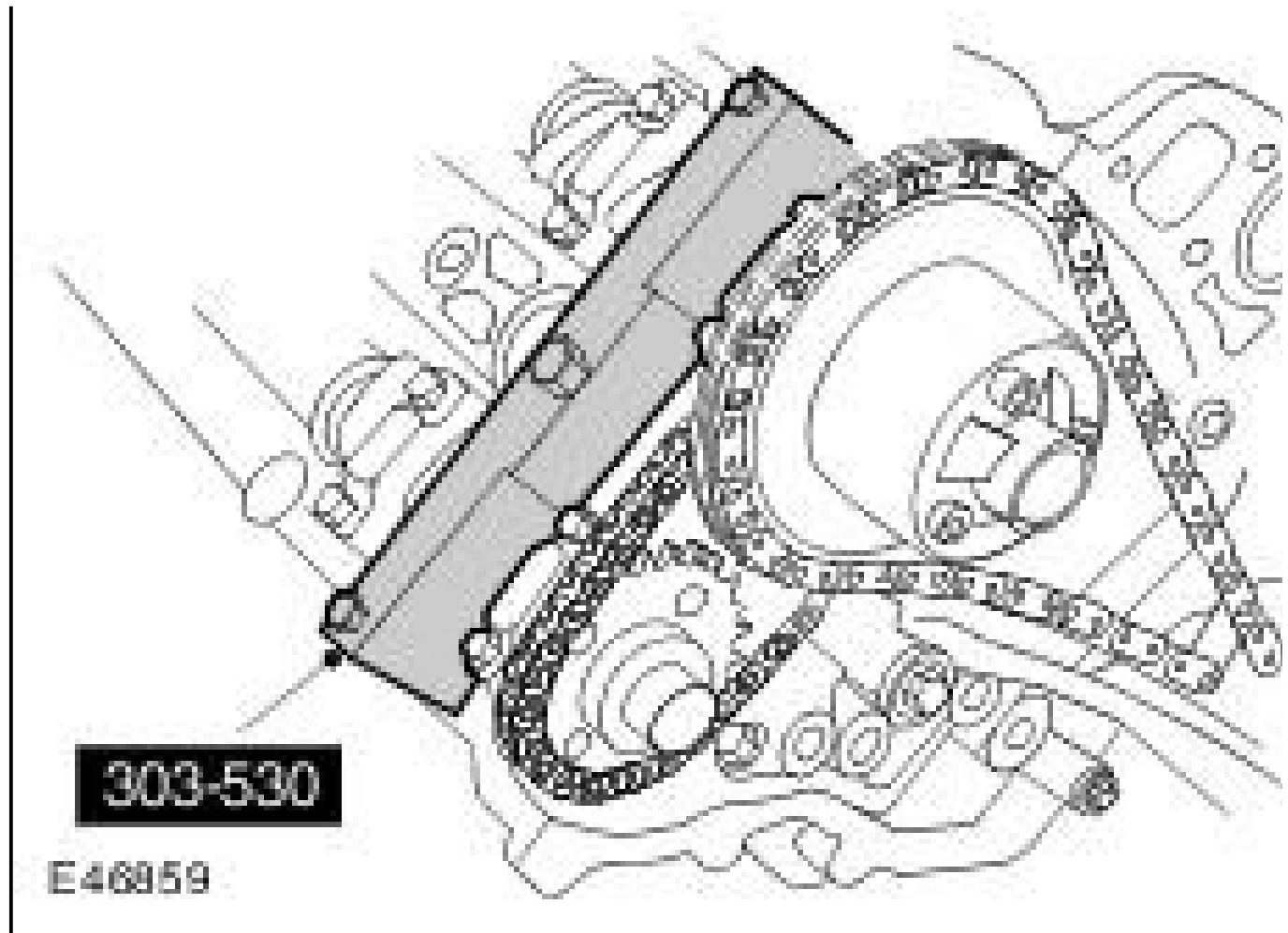


E46858

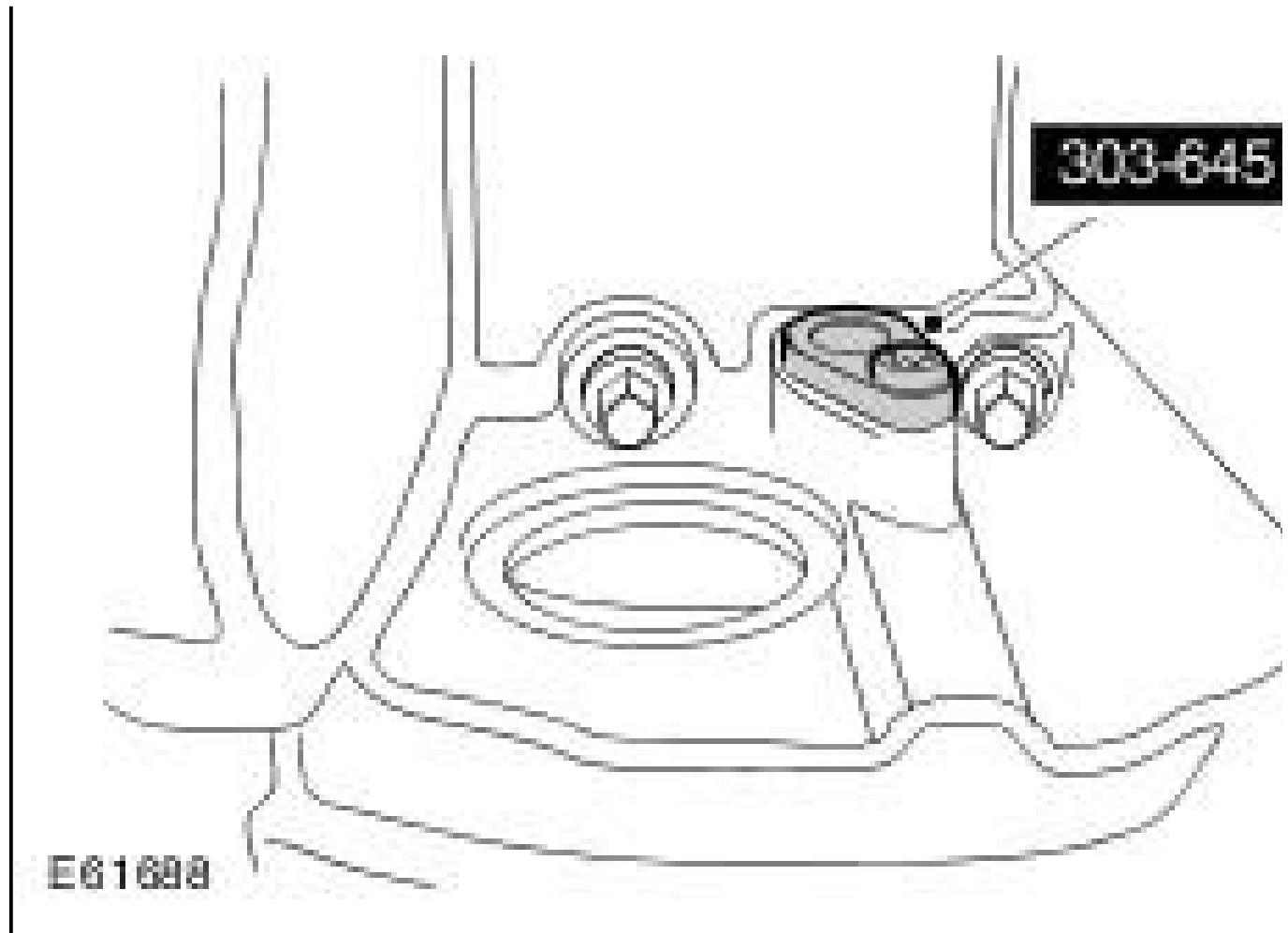
40. Remove the special tool from the LH cylinder head.



41. Remove the special tool from the RH cylinder head.

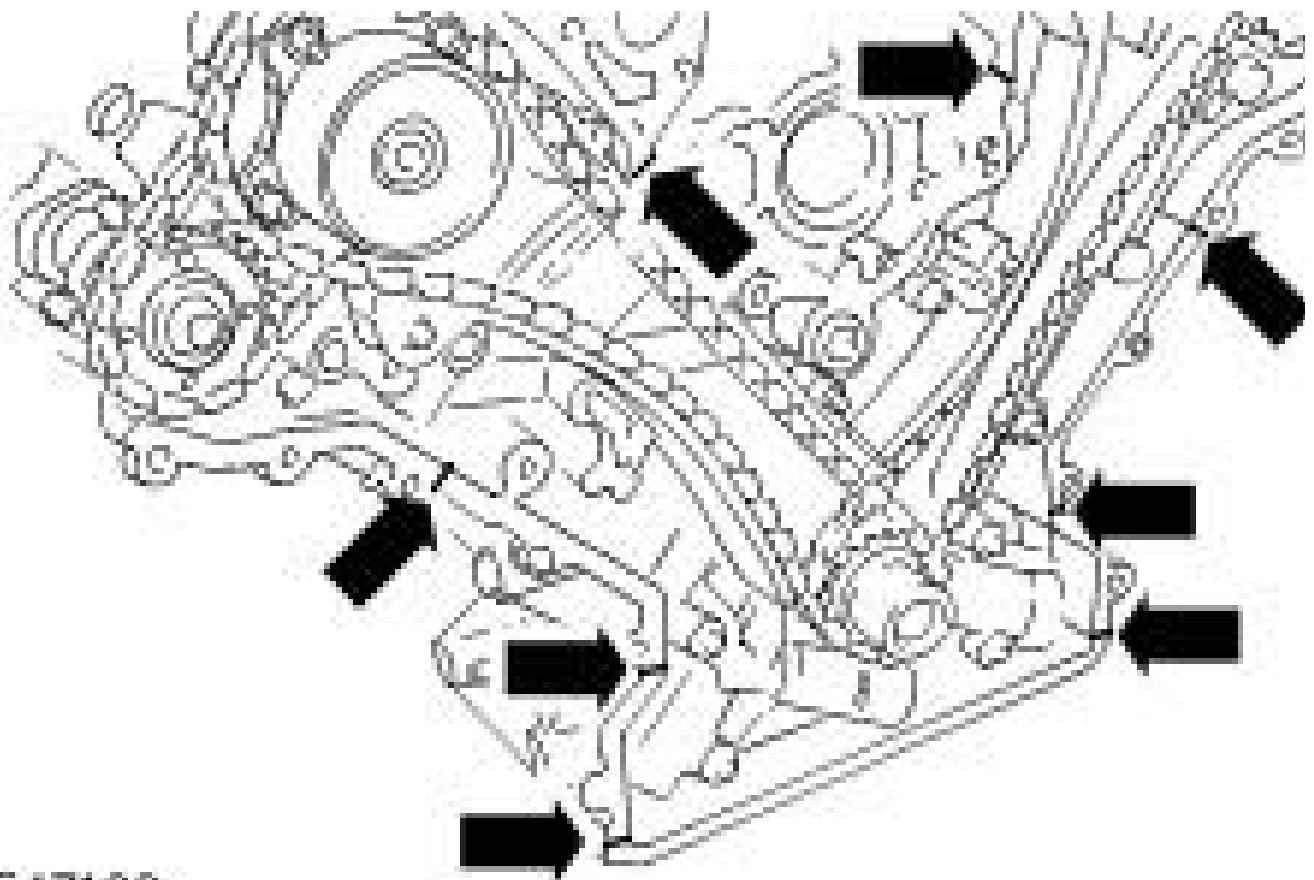


42. Remove the crankshaft locking tool.
- Remove the screw.



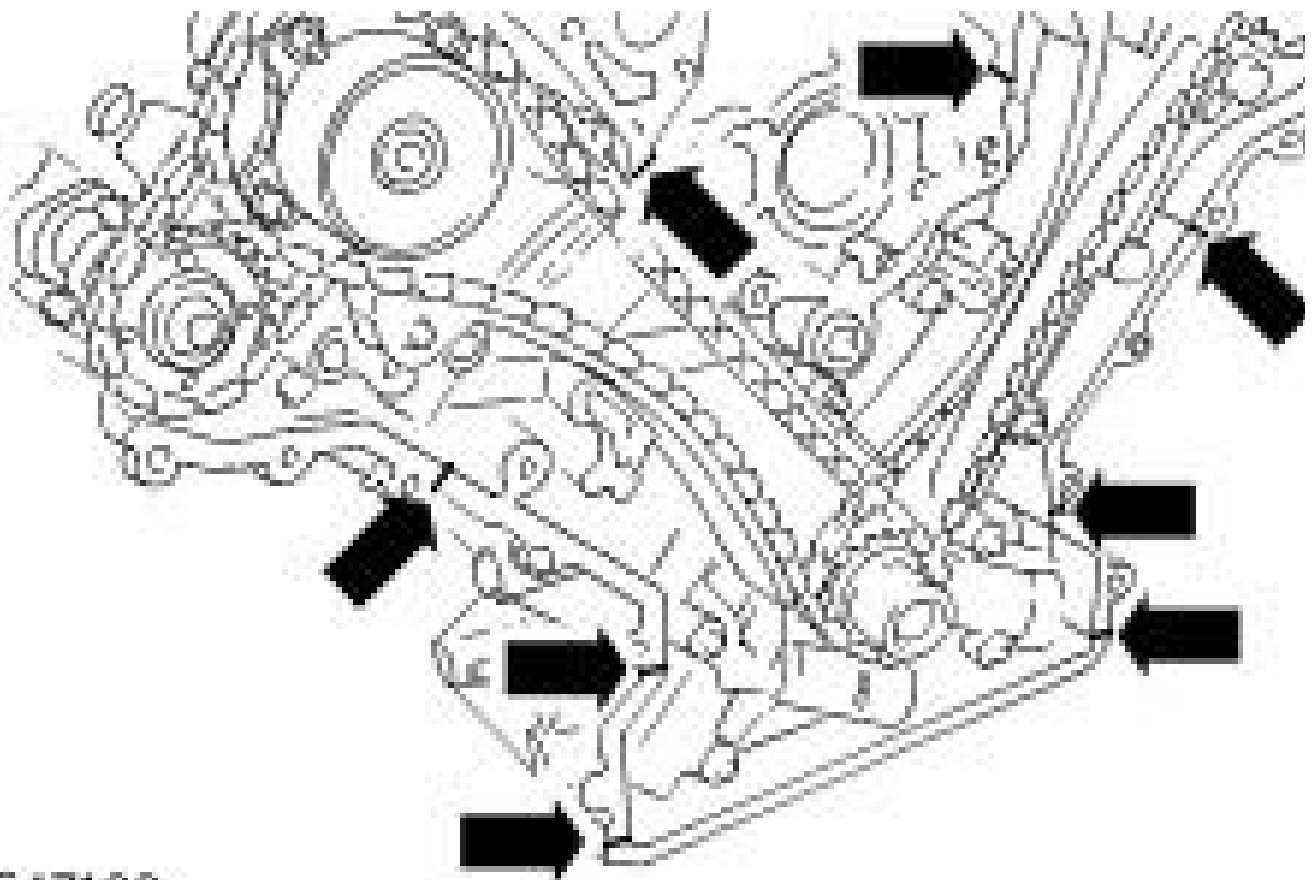
43. Install the engine front cover.

- Clean the component mating faces.
- Apply a bead of sealant 3 mm diameter, by 12 mm long, to the 8 places indicated.



E47100

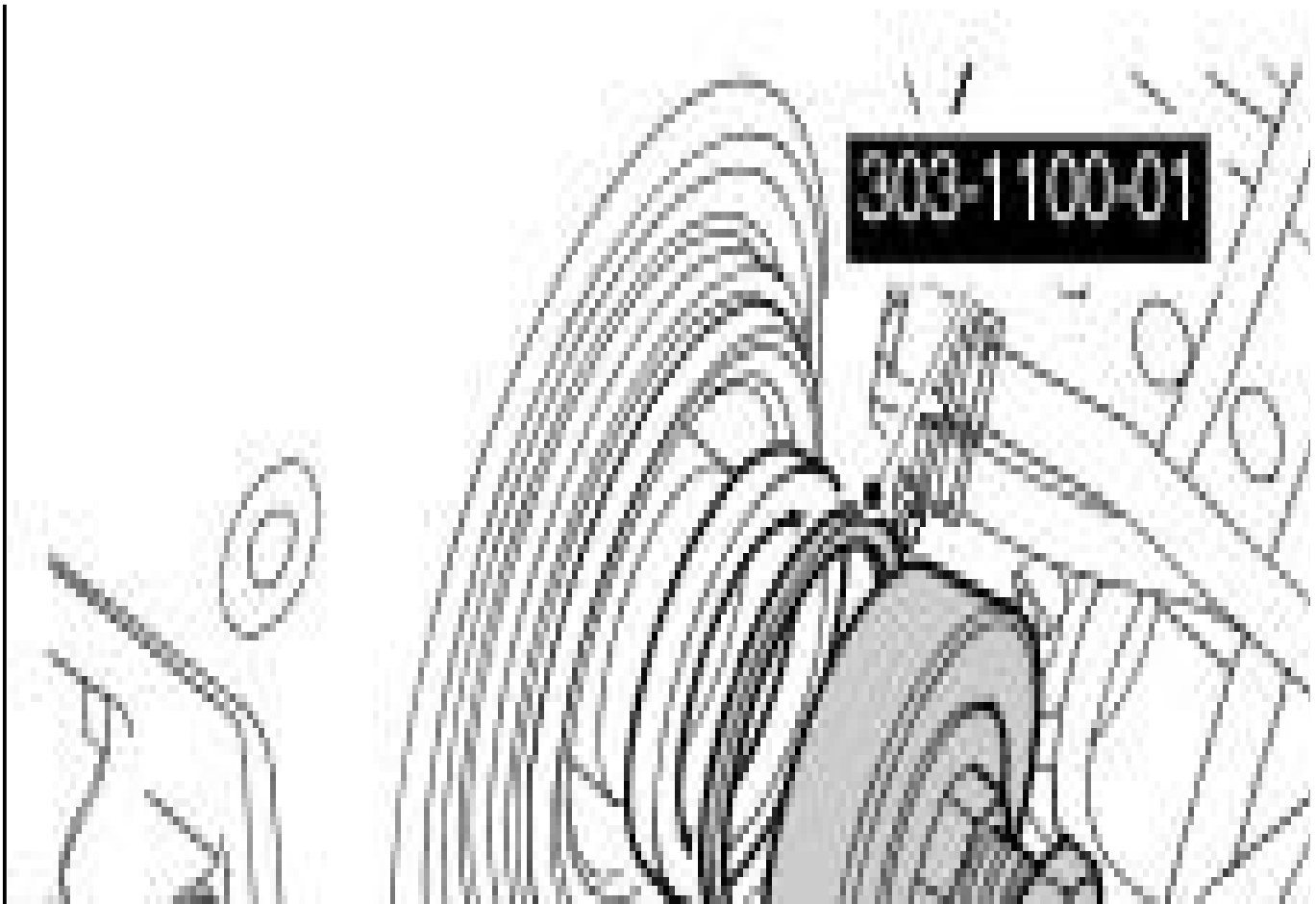
44. Evenly and progressively tighten the bolts in the sequence shown to 12 Nm (9 lb.ft).



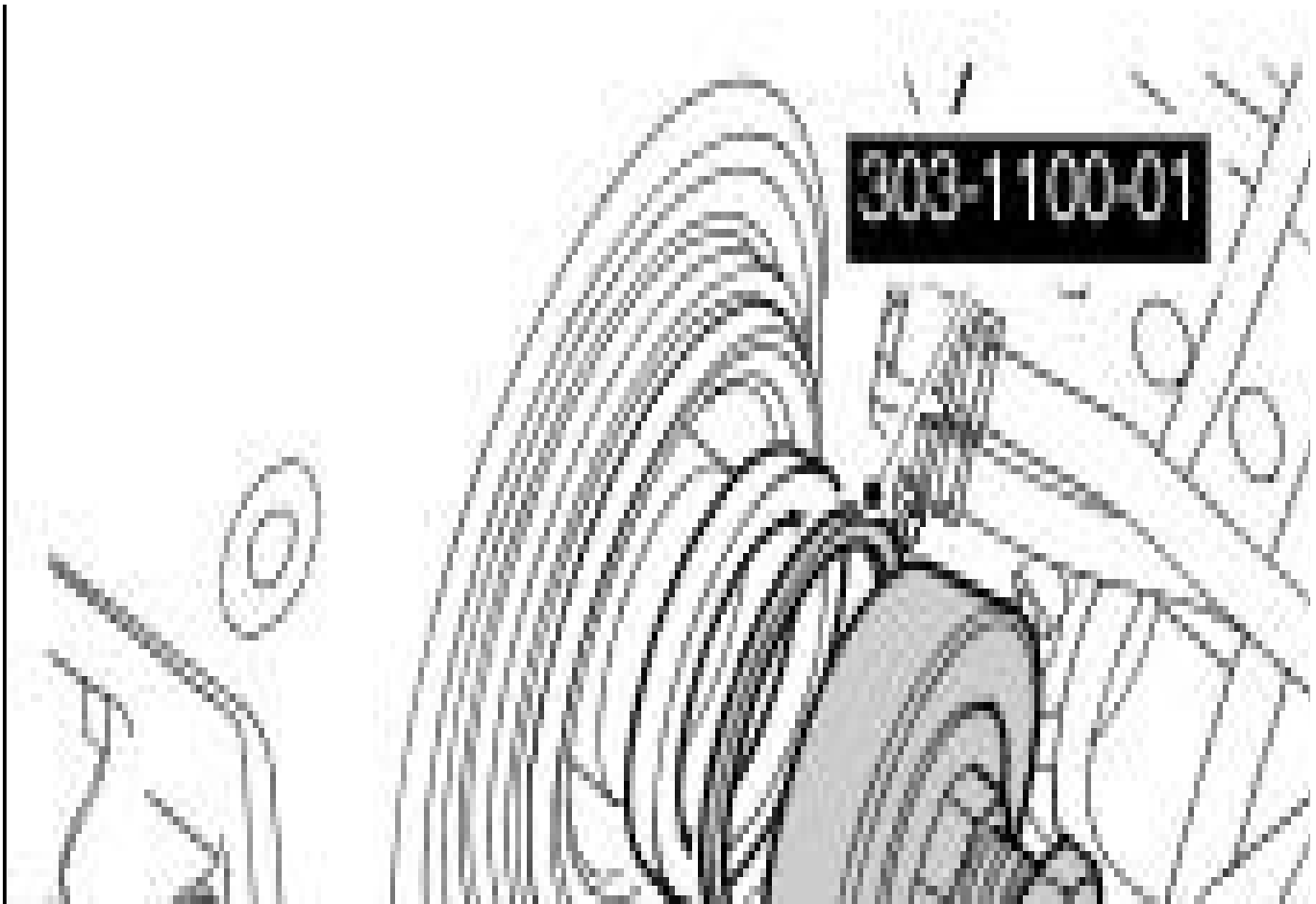
E47100

45. Using the special tools, install the crankshaft front seal.

- Clean the component mating faces.
- Lubricate the seal with clean engine oil.
- Use the discarded crankshaft bolt with the service tool.



46. Using the special tools, install the crankshaft front seal.
- Clean the component mating faces.



47. Install the crankshaft pulley.
 - Lubricate the seal with clean engine oil.
48. Install the crankshaft pulley locking ring.

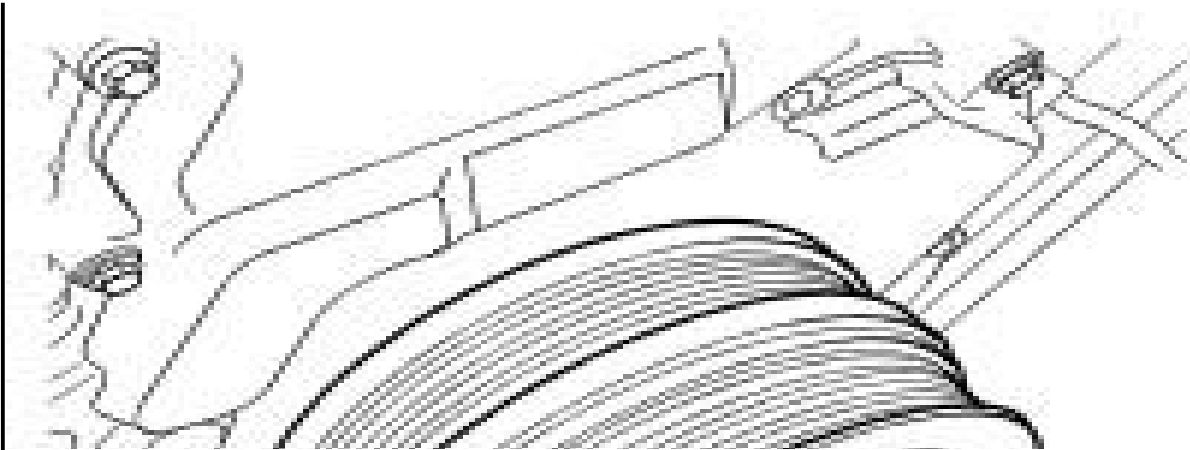
CAUTION: The screw thread in the crankshaft pulley must be cleaned out before installing a new crankshaft pulley bolt.

49. Install, but do not tighten, the new crankshaft pulley bolt.

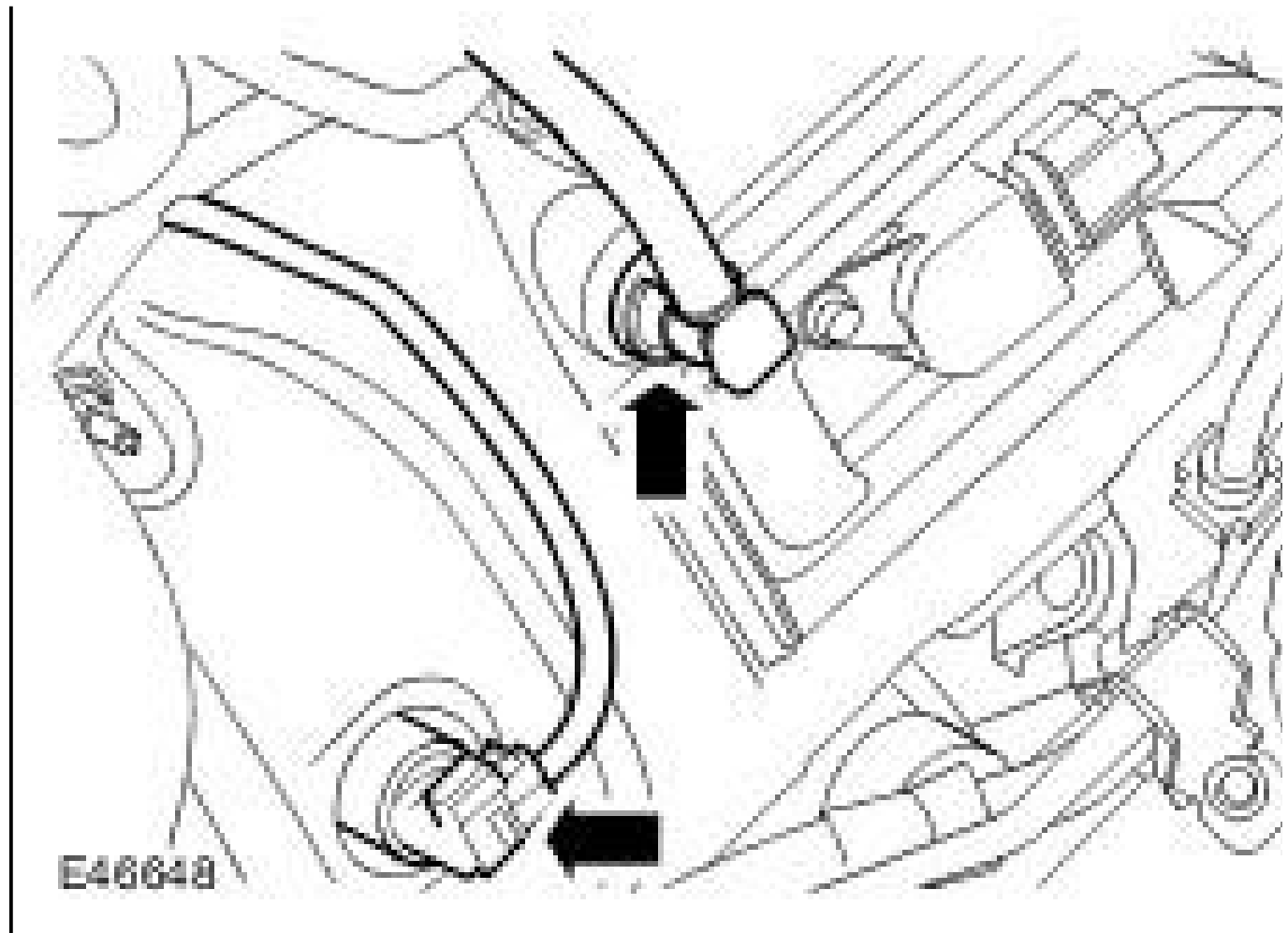
CAUTION: Under no circumstances should the crankshaft setting peg, 303-645, be used in the following operations, to restrain the crankshaft.

50. Using the special tools, retain the crankshaft pulley.

- Tighten the crankshaft pulley bolt to 380 Nm (280 lb.ft).



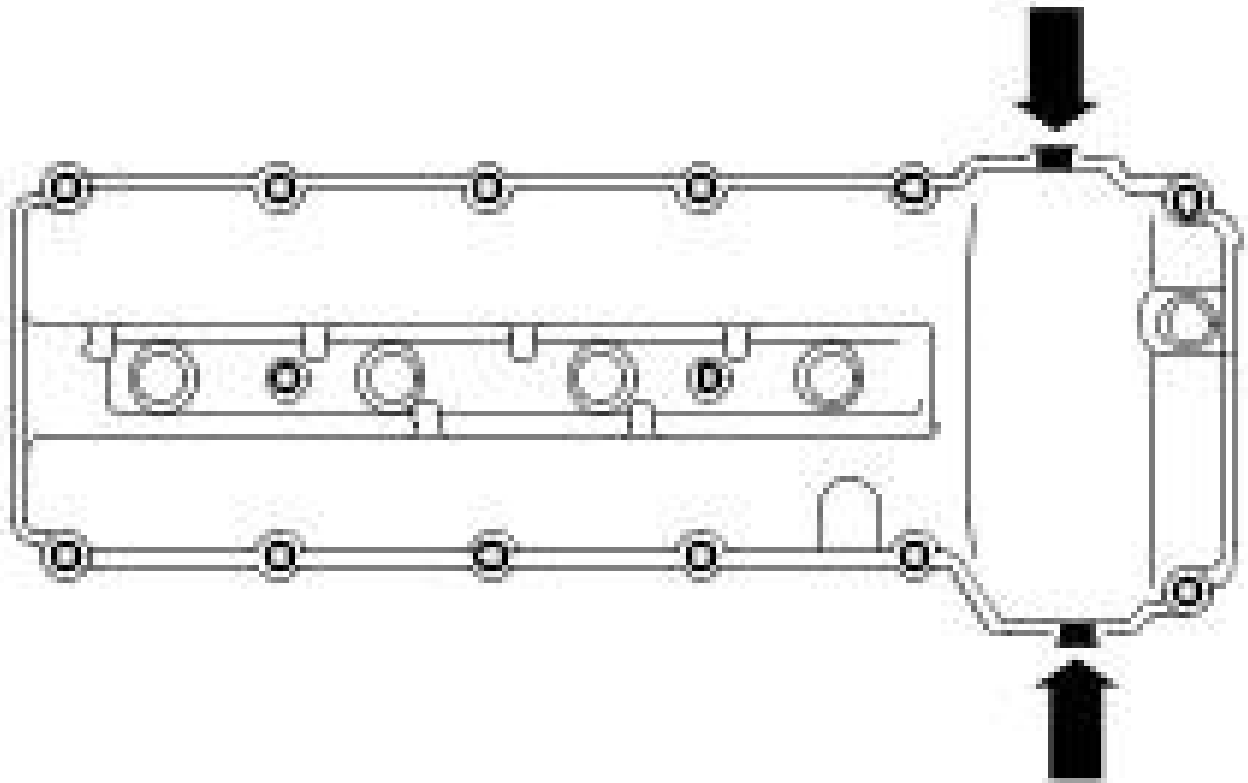
51. Remove the special tools.
52. Install new valve cover plug aperture gaskets.
 - Install a new valve cover gasket.



NOTE: Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

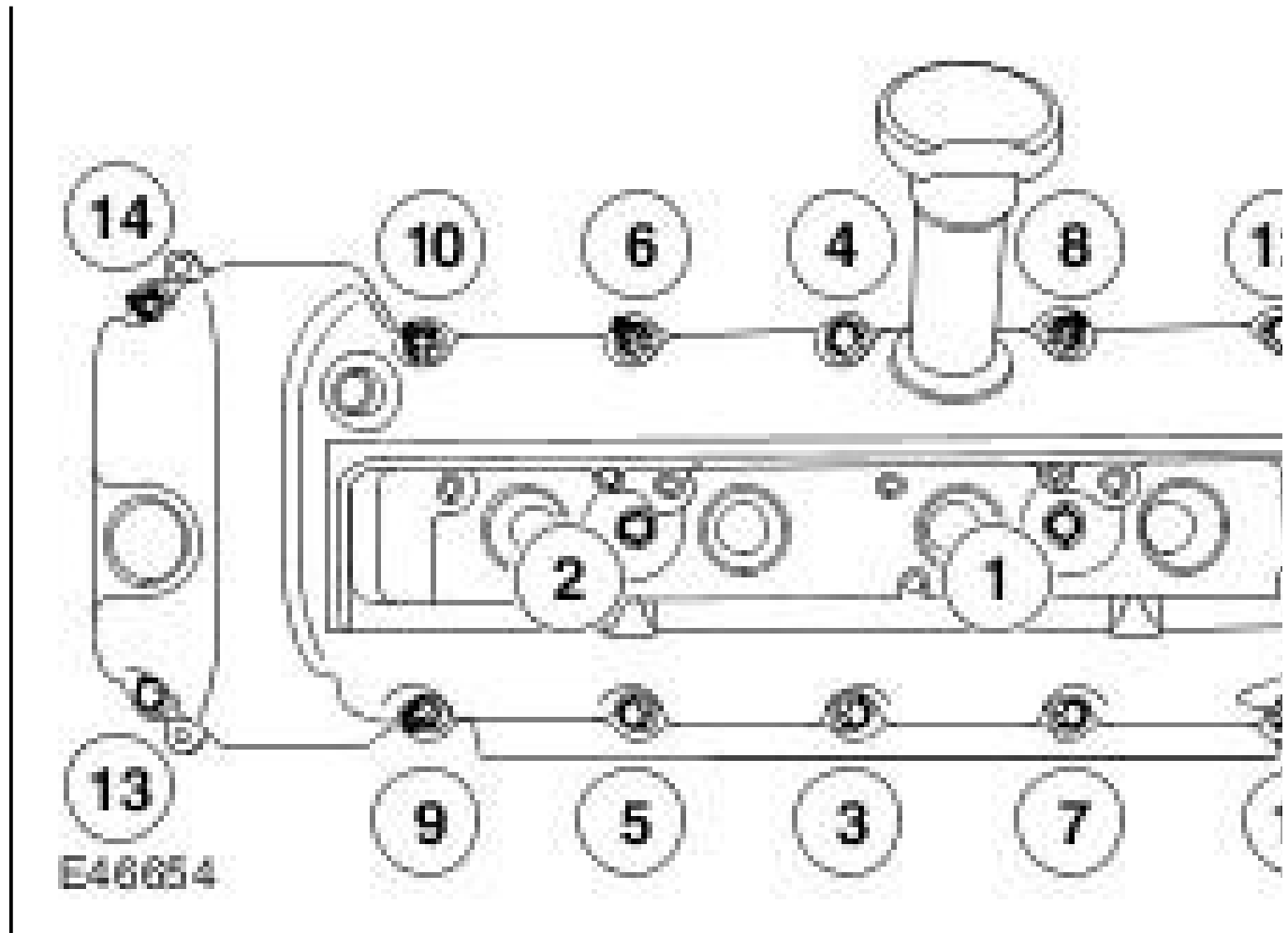
53. Install the valve cover.

- Clean the component mating faces.

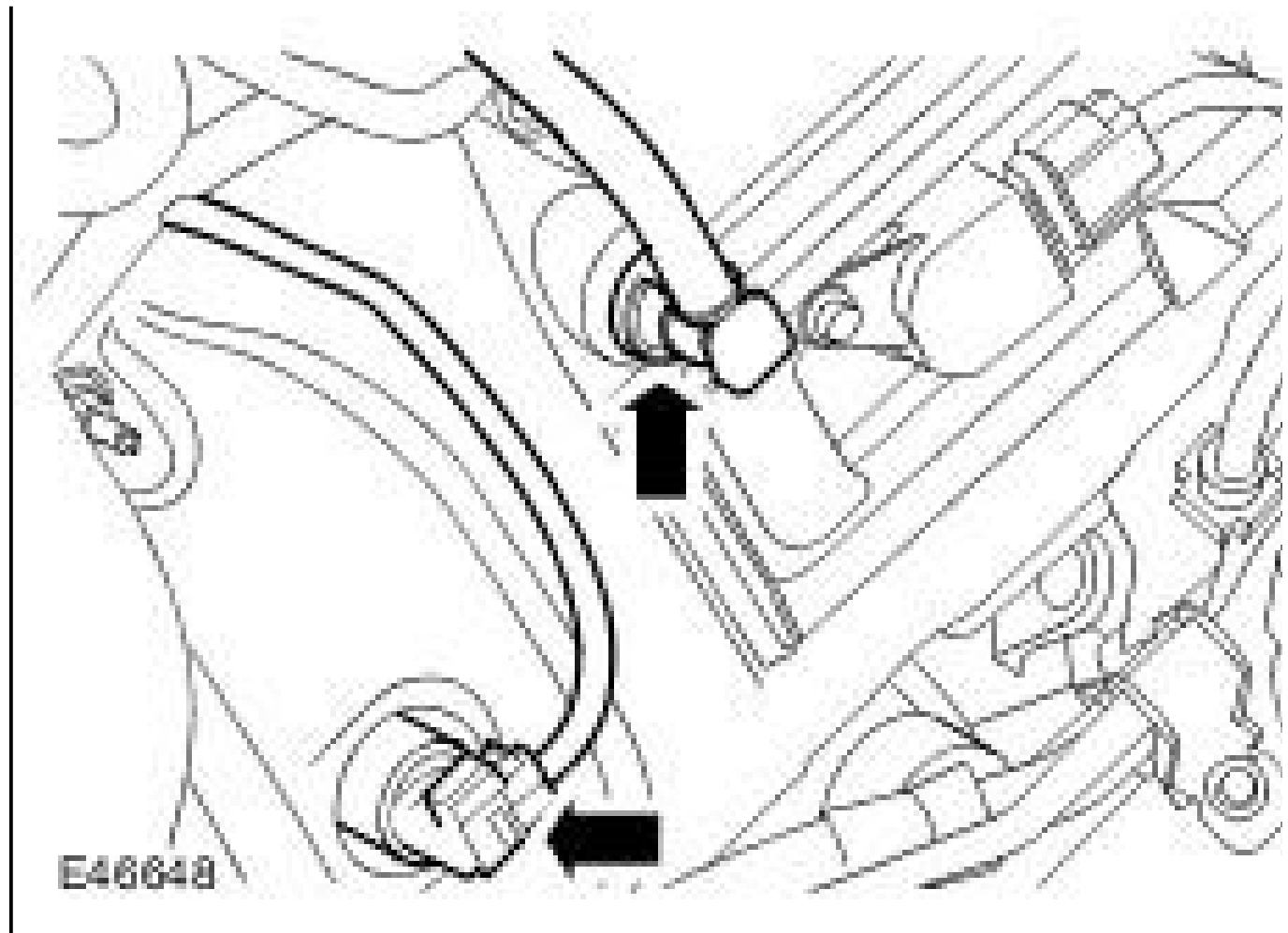
**E49922**

54. Install the valve cover retaining bolts.

- Install valve cover retaining bolts to their position previously noted.
- Complete the tightening sequence as illustrated.
- Tighten the bolts to 12 Nm (9 lb.ft).

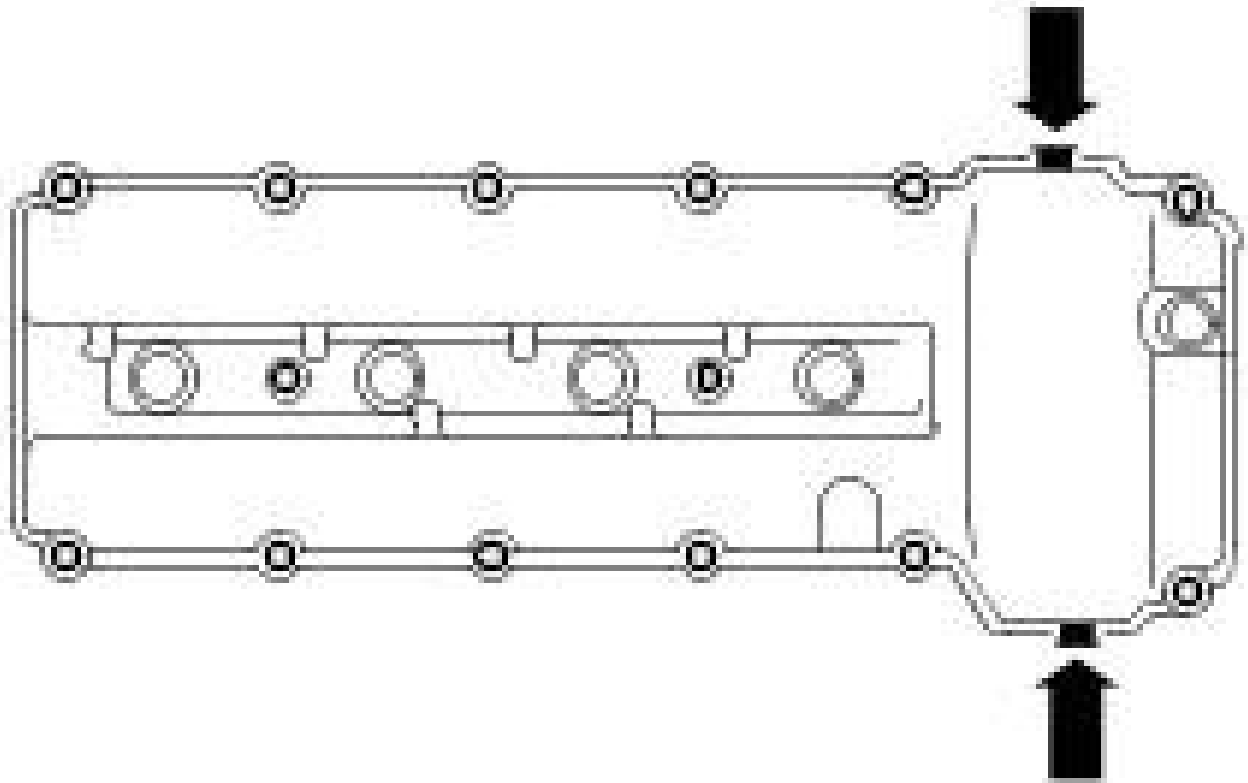


55. Install new valve cover plug aperture gaskets.
- Install a new valve cover gasket.



NOTE: Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

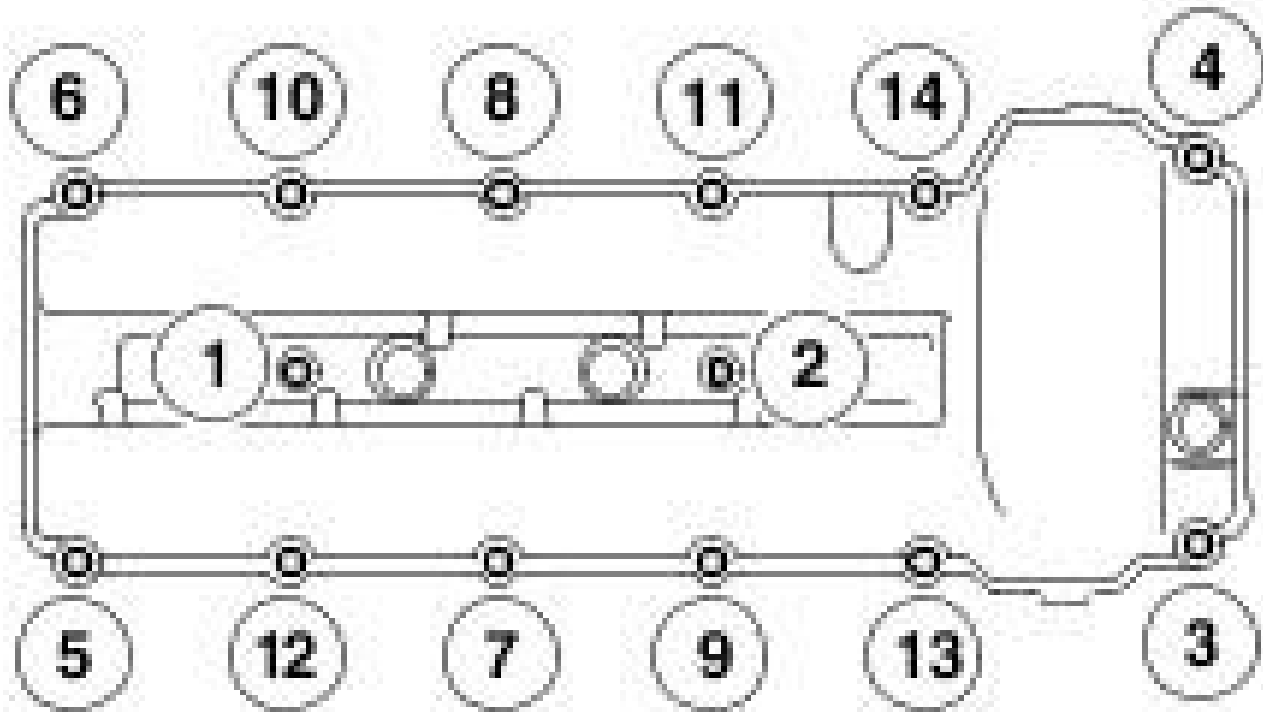
56. Install the valve cover.
- Clean the component mating faces.



E49922

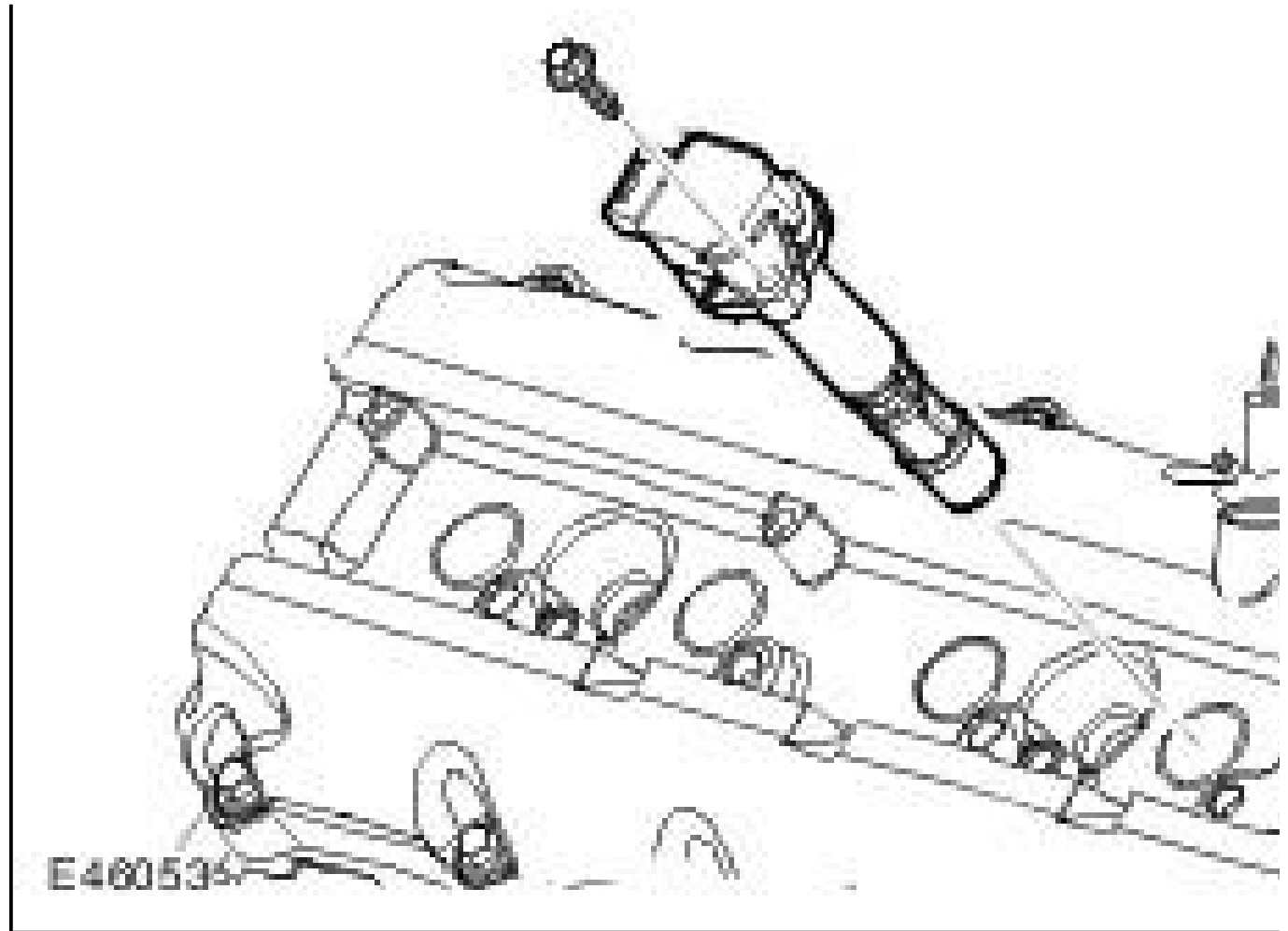
57. Install the valve cover retaining bolts.

- Install valve cover retaining bolts to their position previously noted.
- Tighten the bolts to 12 Nm (9 lb.ft).
- Complete the tightening sequence as illustrated.



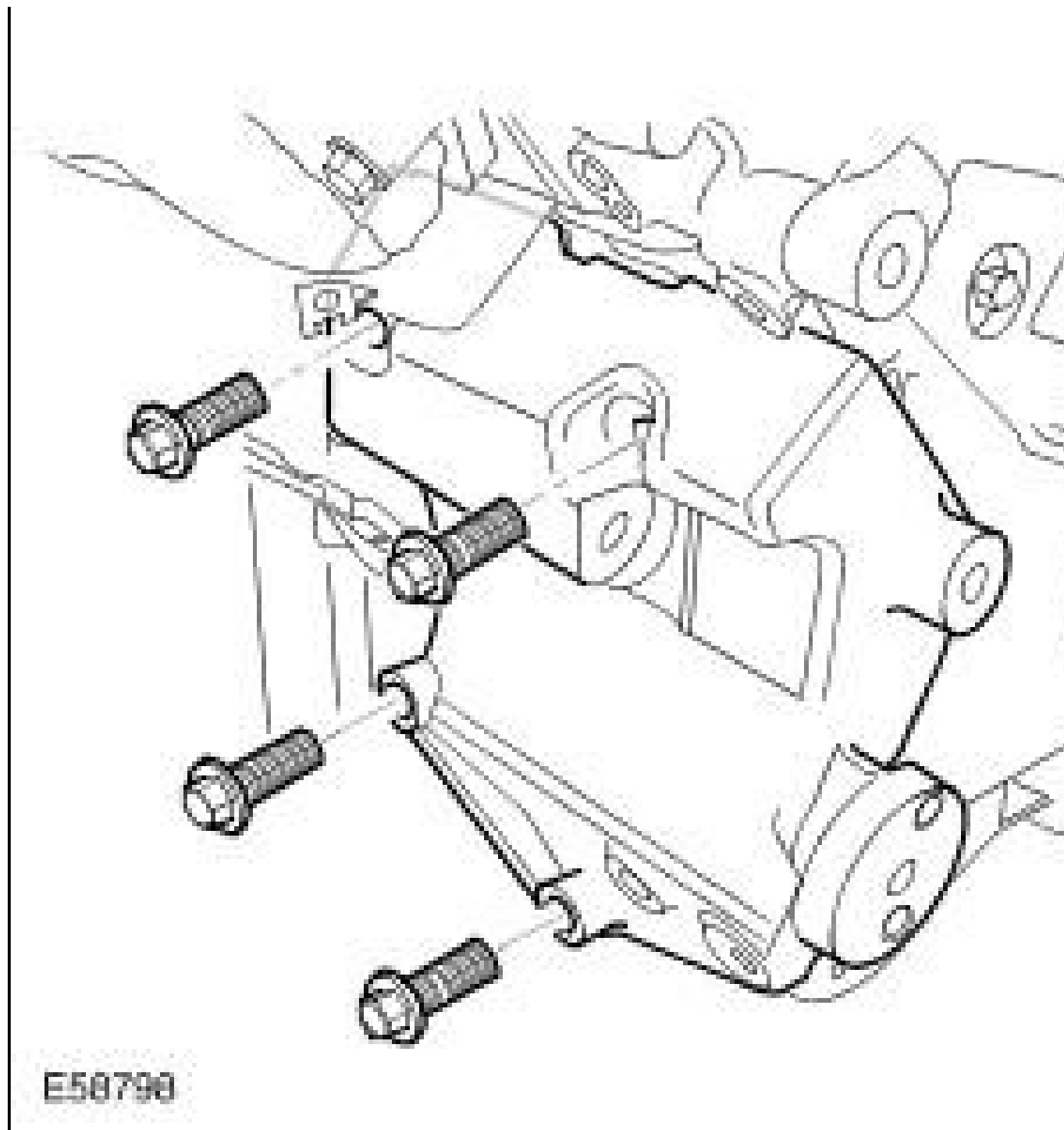
E46679

58. Install the 8 ignition coil-on-plugs.
- Install the 8 bolts.
 - Tighten the bolts to 6 Nm (4 lb.ft).

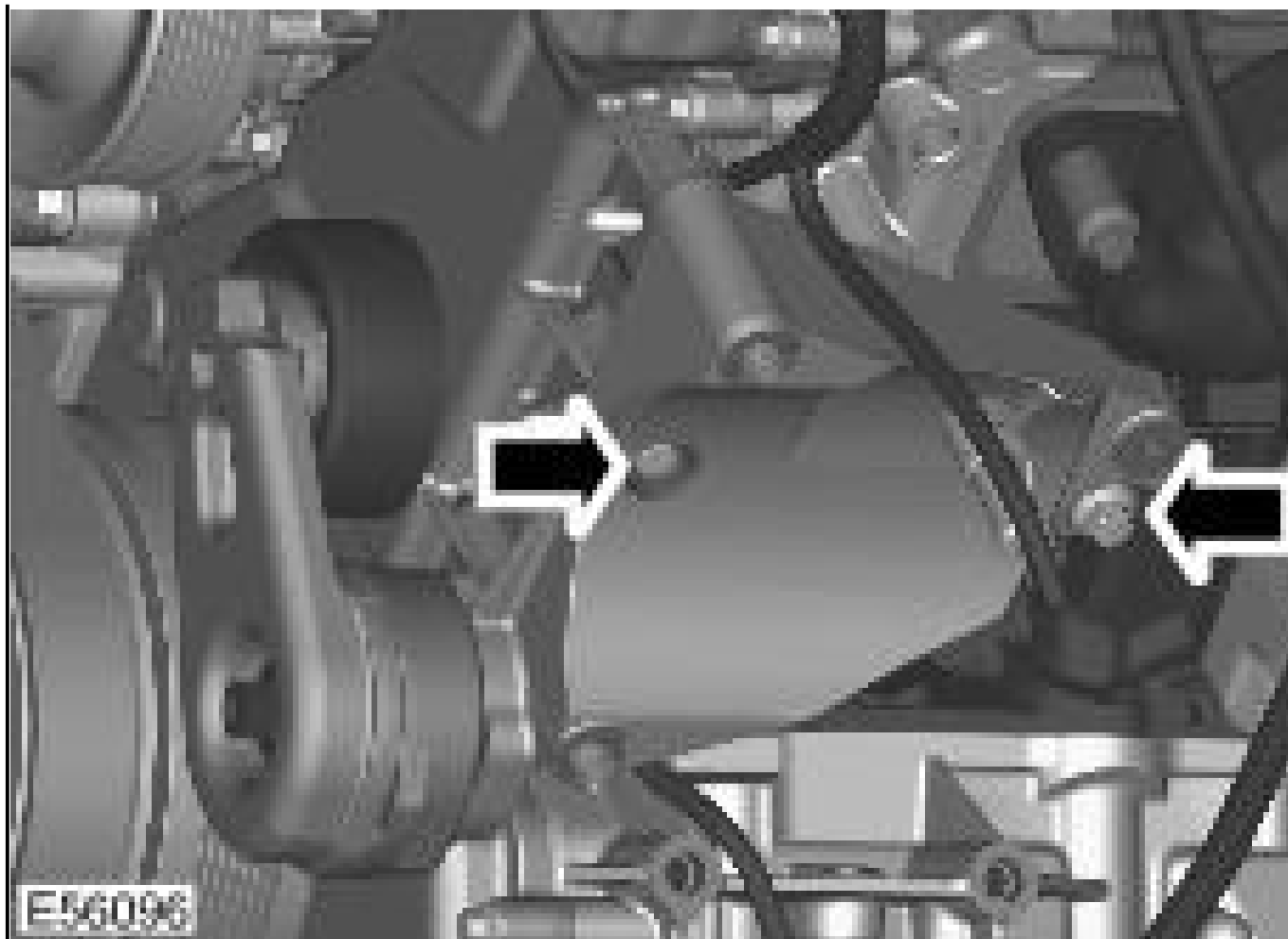


59. Install the generator mounting bracket.

- Clean the locating dowels.
- Clean the component mating faces.
- Tighten the bolts to 45 Nm (33 lb.ft).

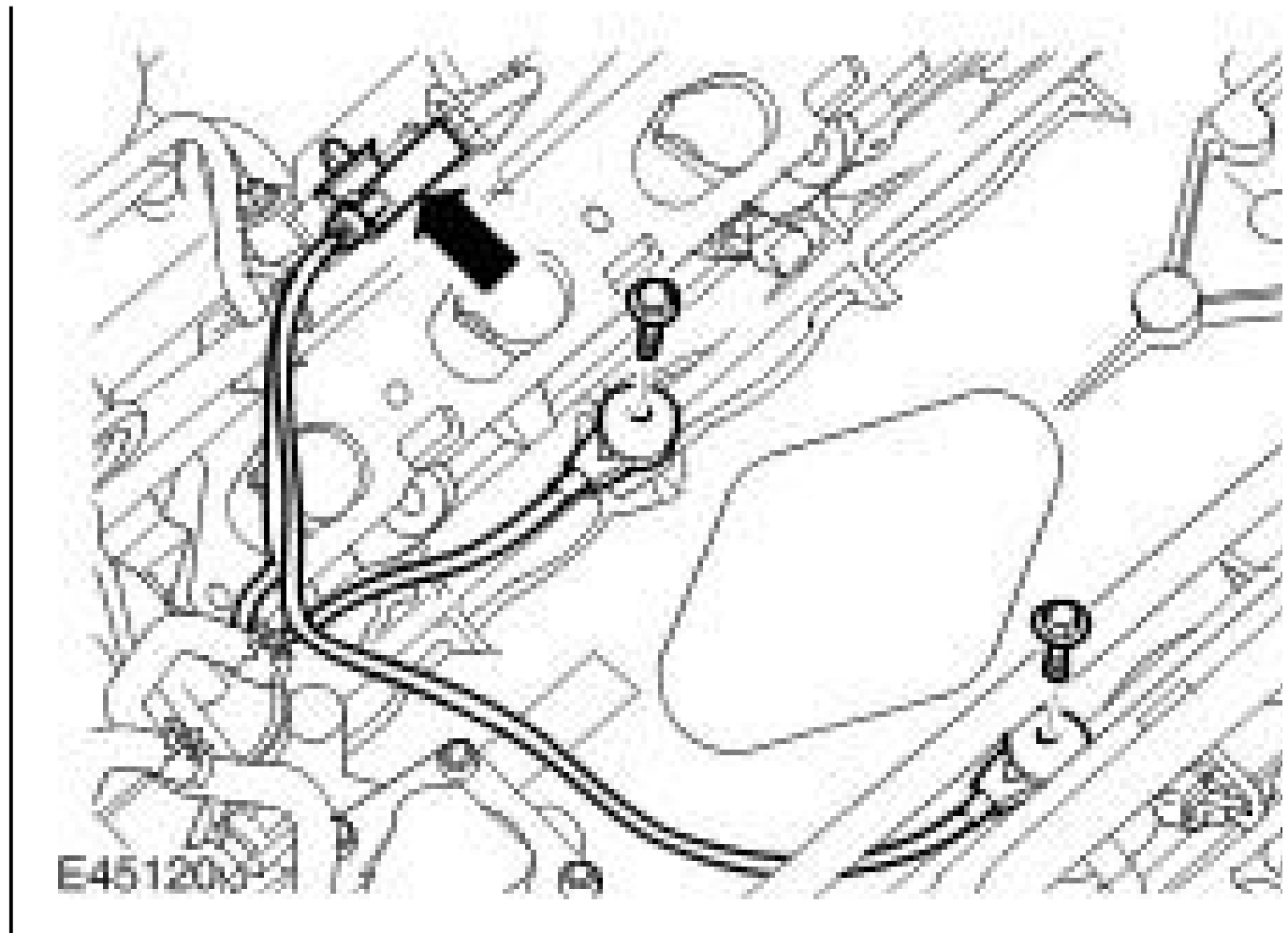


60. Install the A/C mounting bracket.

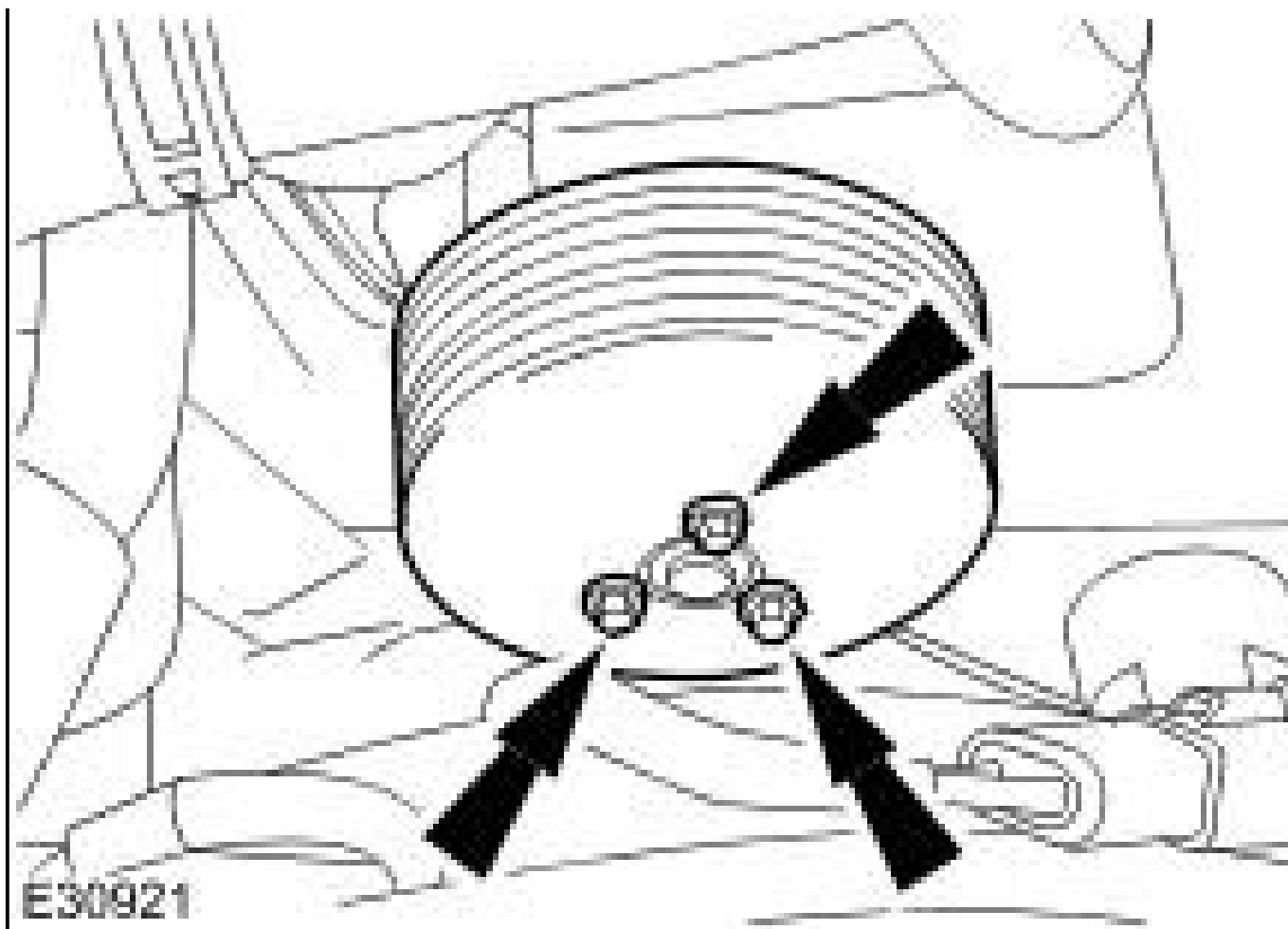


61. Install the coolant manifold.

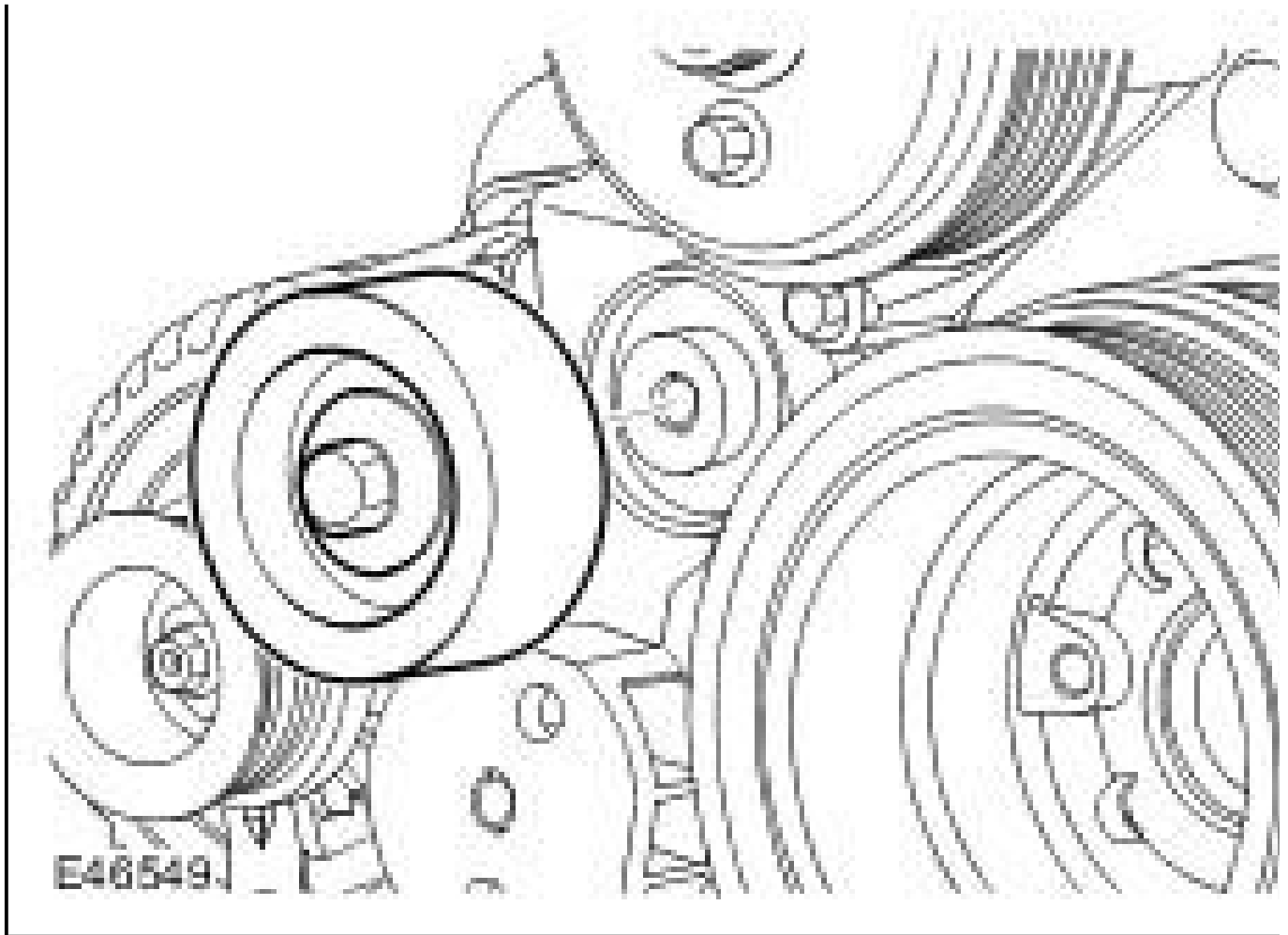
- Tighten the bolts to 6 Nm (4 lb.ft).



62. Install the coolant pump pulley.
- Tighten the bolts to 10 Nm (7 lb.ft).

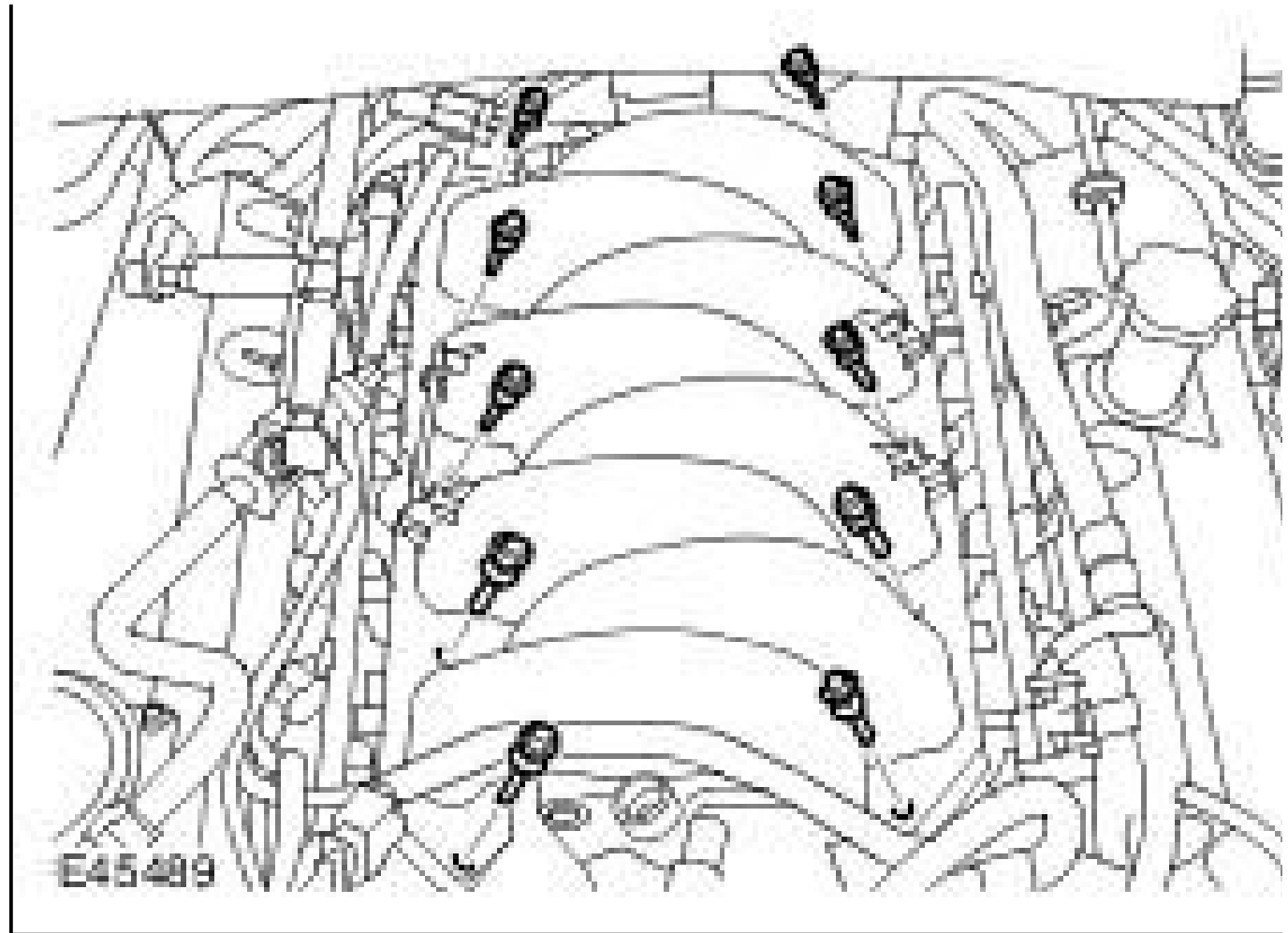


63. Install the accessory drive belt idler pulley.
- Tighten the bolt to 25 Nm (18 lb.ft).



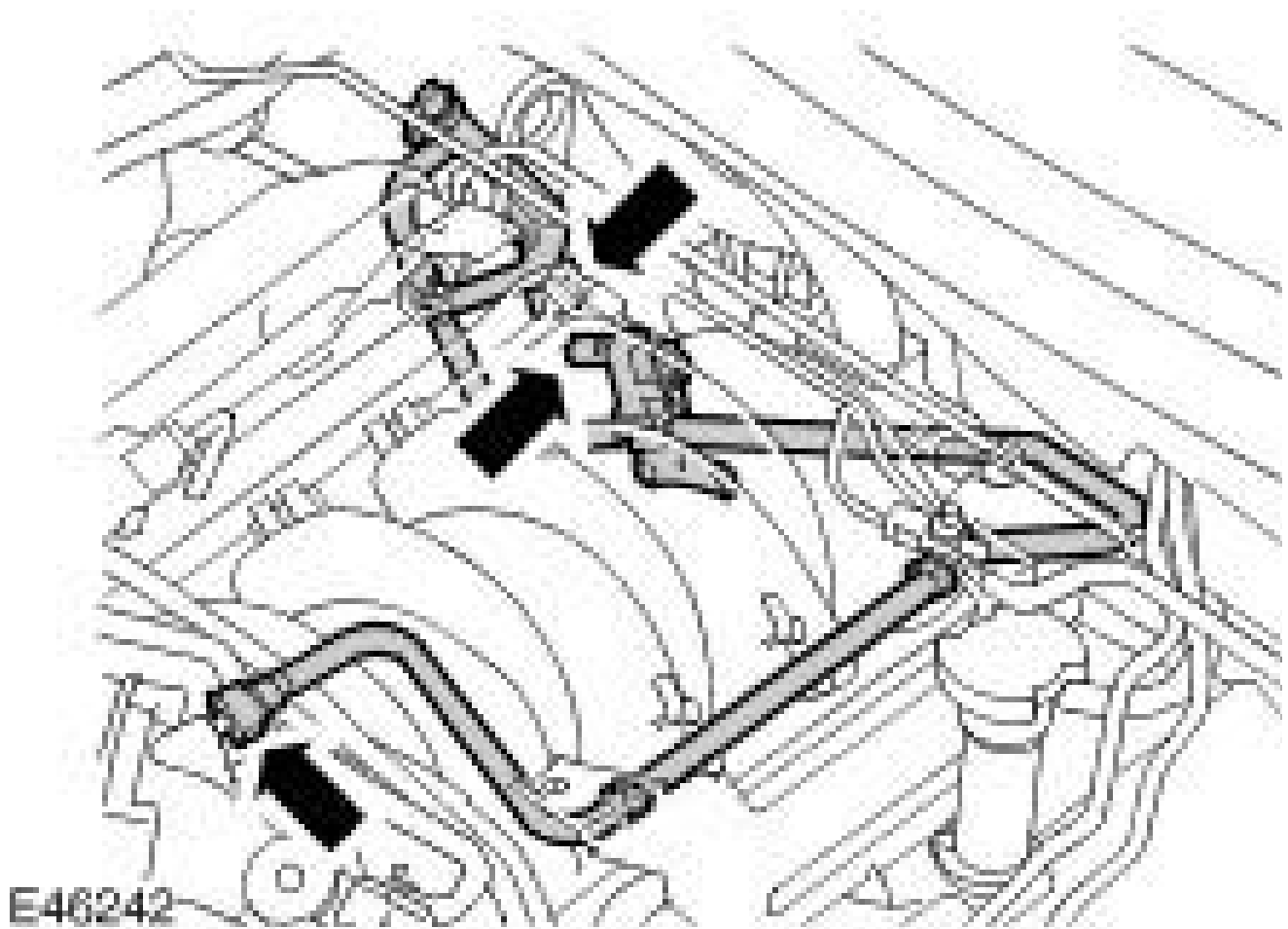
64. With assistance, install the intake manifold.

- Install the gaskets.
- Evenly and progressively tighten the bolts to 20 Nm (15 lb.ft).

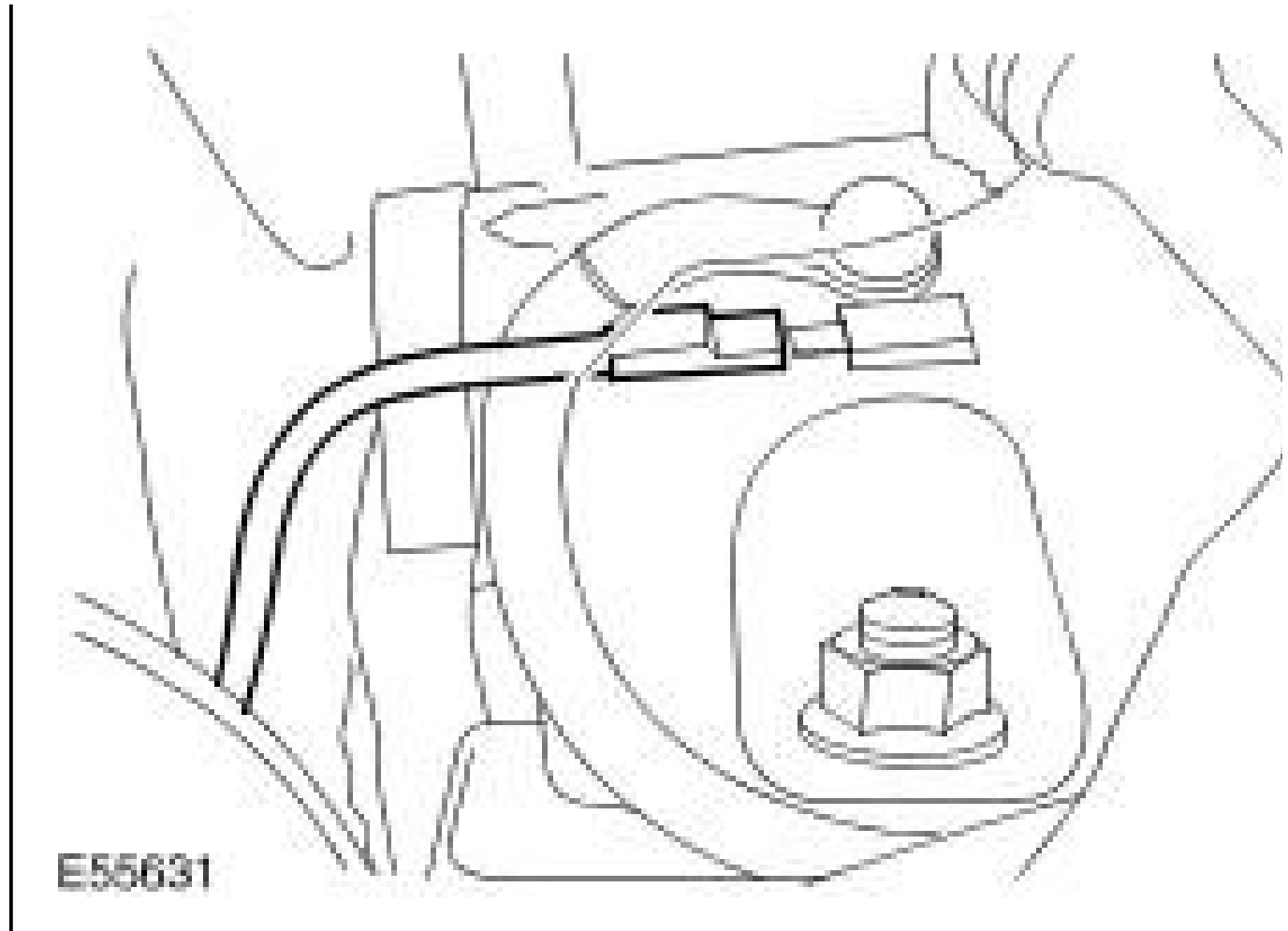


65. Install the purge valve.

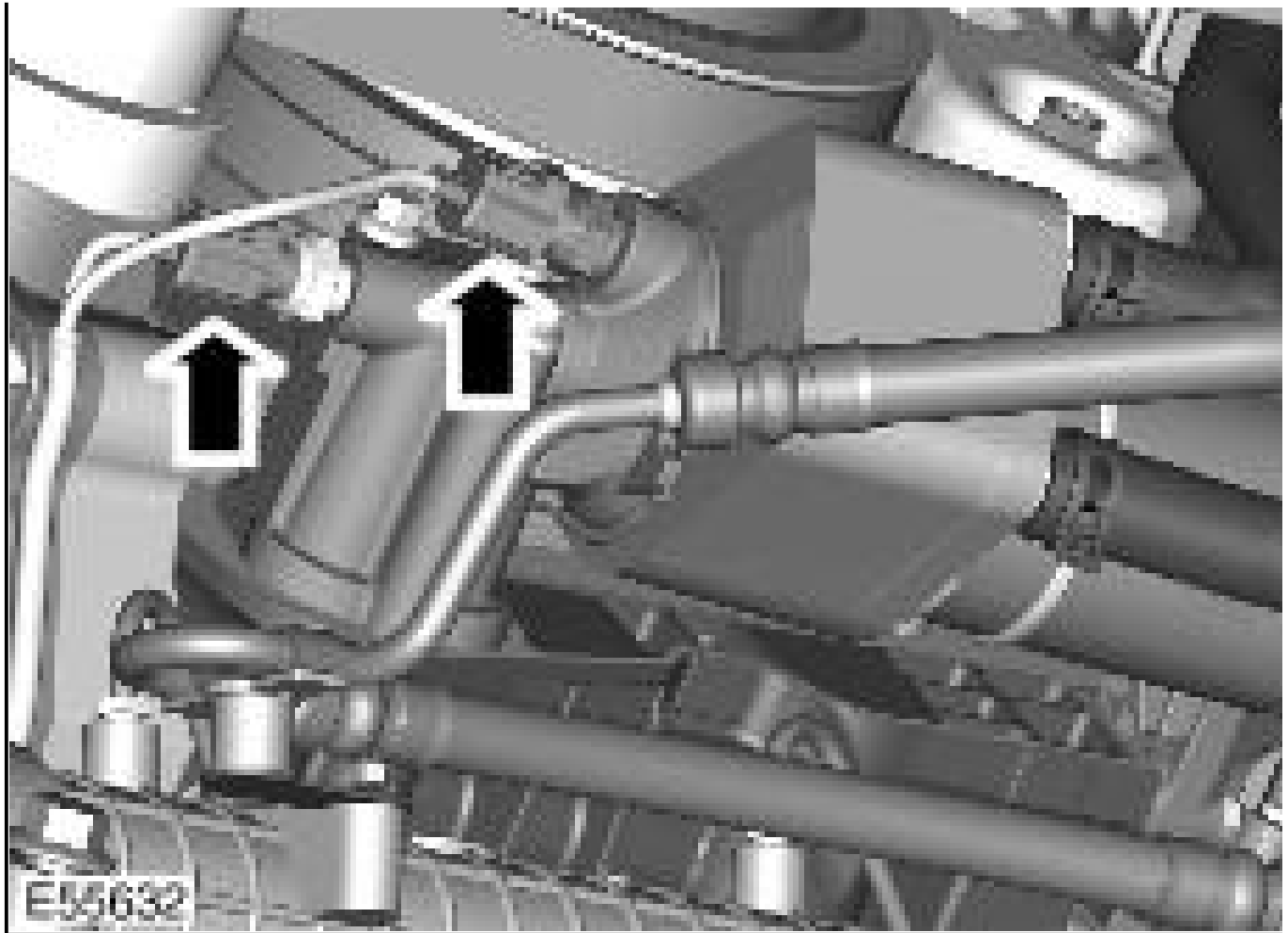
- Secure the electrical harness with the clip.
- Tighten the bolt to 6 Nm (4 lb.ft).
- Connect and secure the electrical connector.



66. Connect the starter motor positive cable.
- Secure the cover.

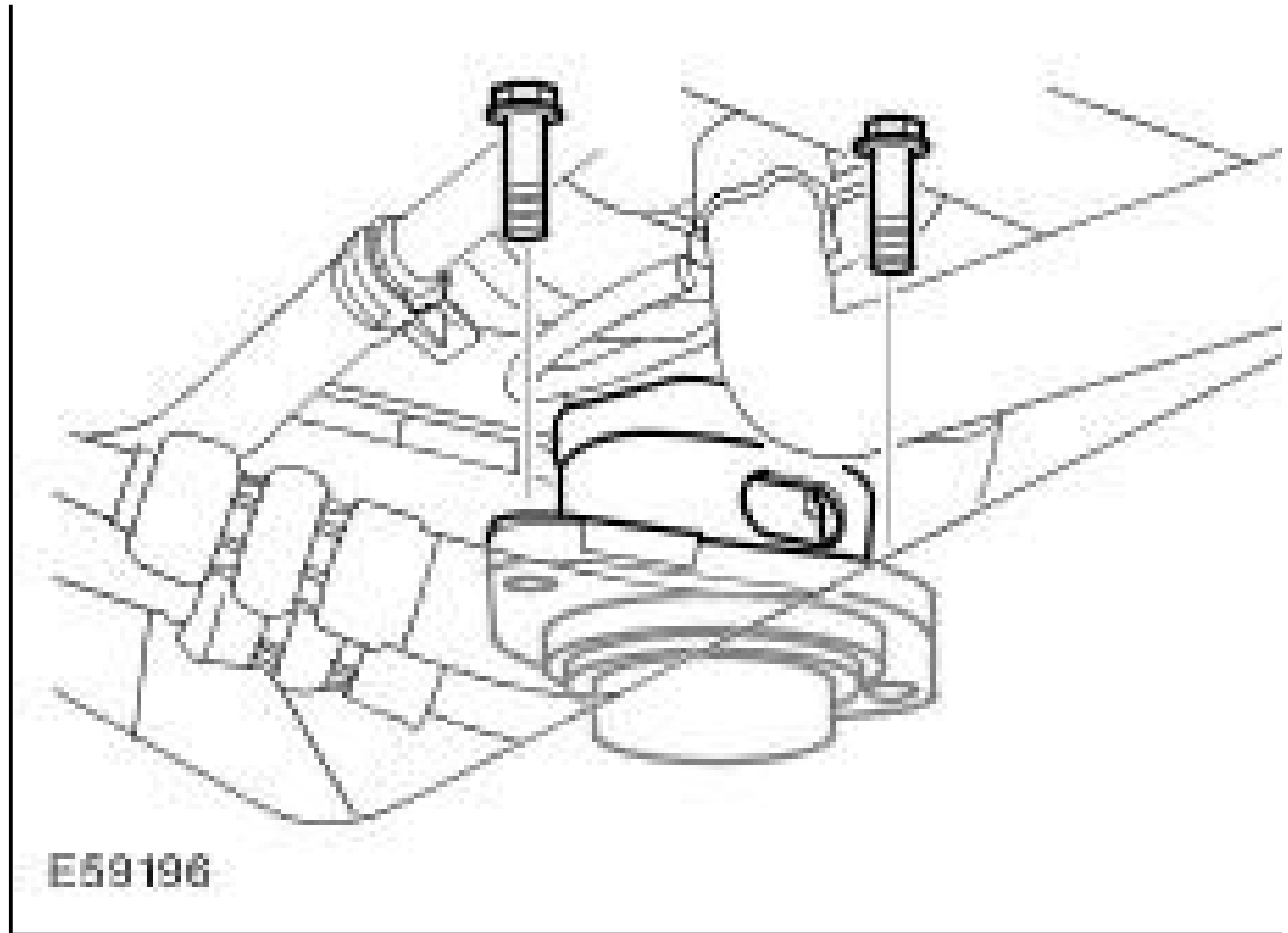


67. Connect the oil temperature and oil pressure sensors.

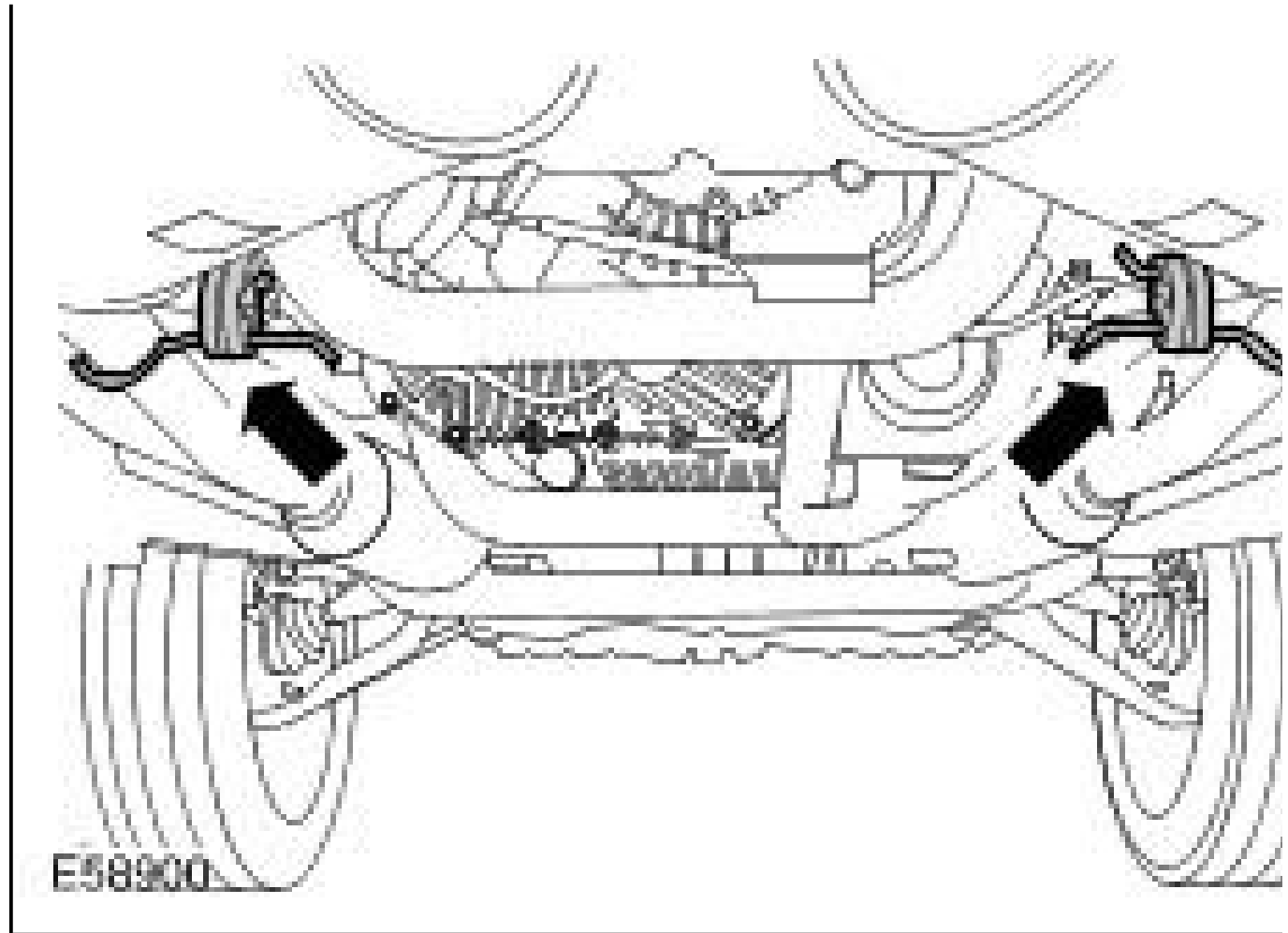


68. Install the generator.

- Clean the component mating faces.
- Tighten the bolts to 48 Nm (35 lb.ft).
- Connect the generator electrical connector.
- Secure the clips.

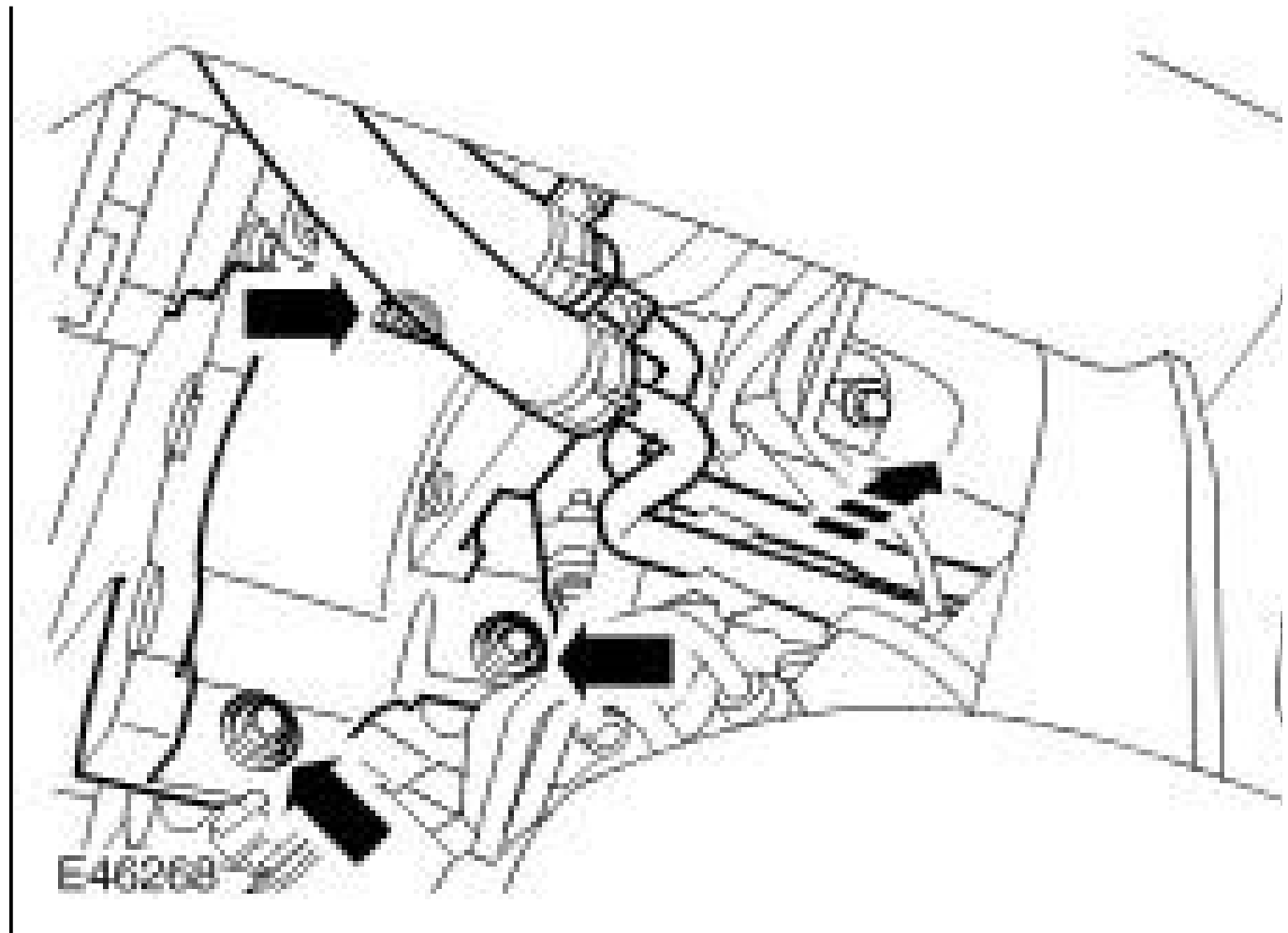


69. Install the crankshaft position (CKP) sensor electrical connector.
- Connect the CKP sensor electrical connector.

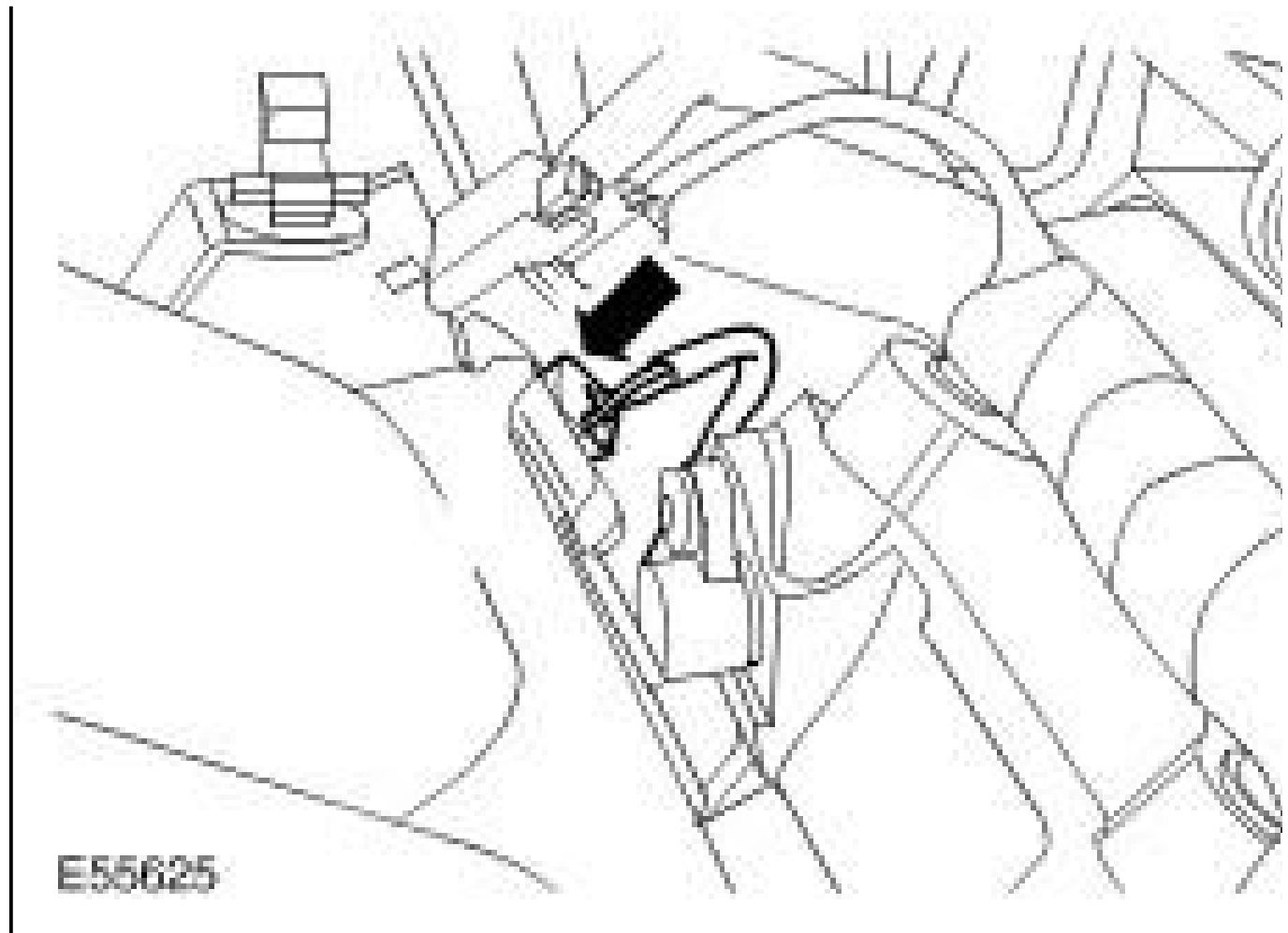


70. Install the power steering pump mounting bracket.

- Clean the component mating faces.
- Tighten the bolts to 25 Nm (18 lb.ft).
- Secure the transmission cooler pipes into clips.

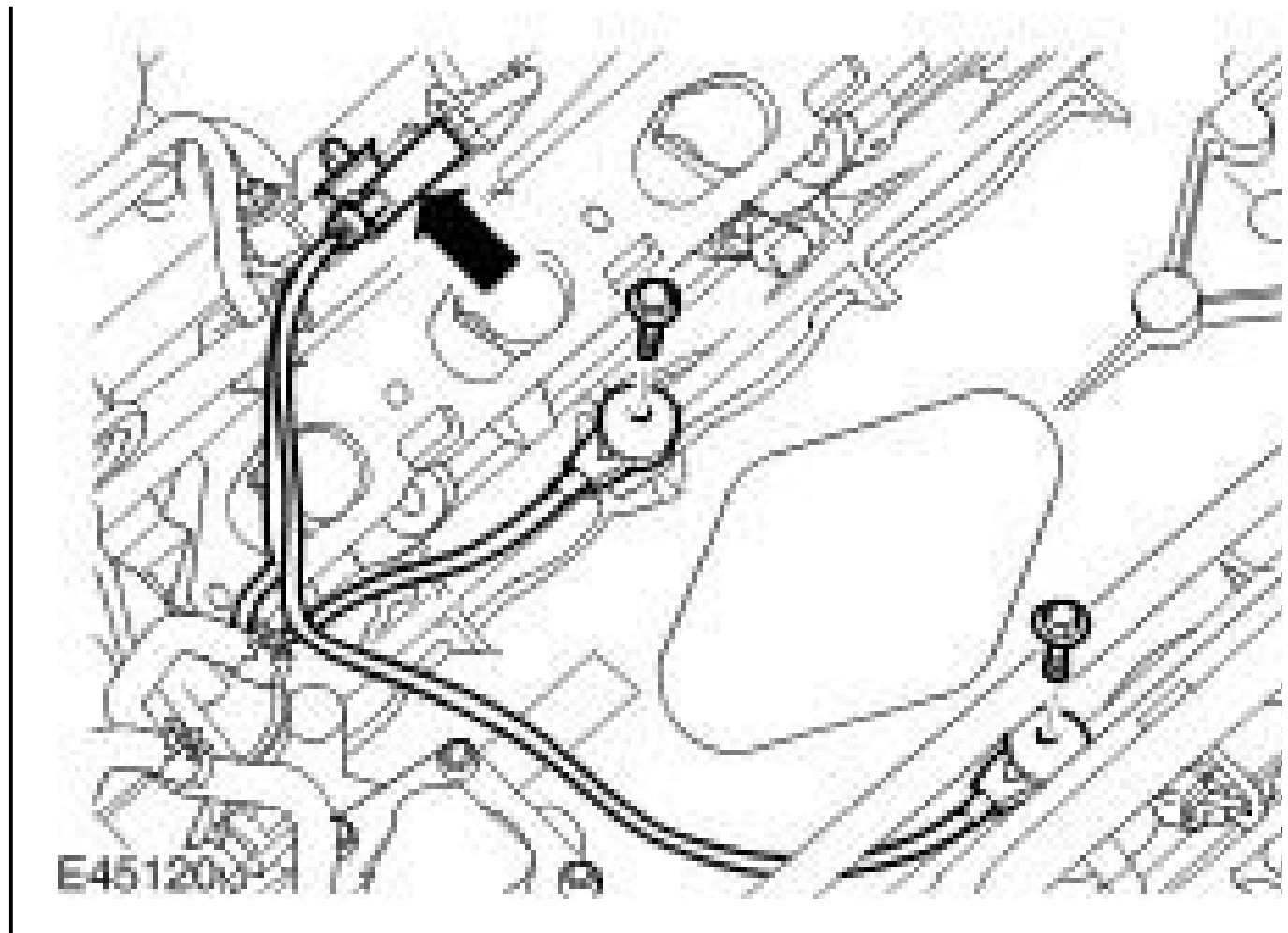


71. Connect and secure the CMP sensor electrical connectors.
- Repeat the operation for the RH side.



NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

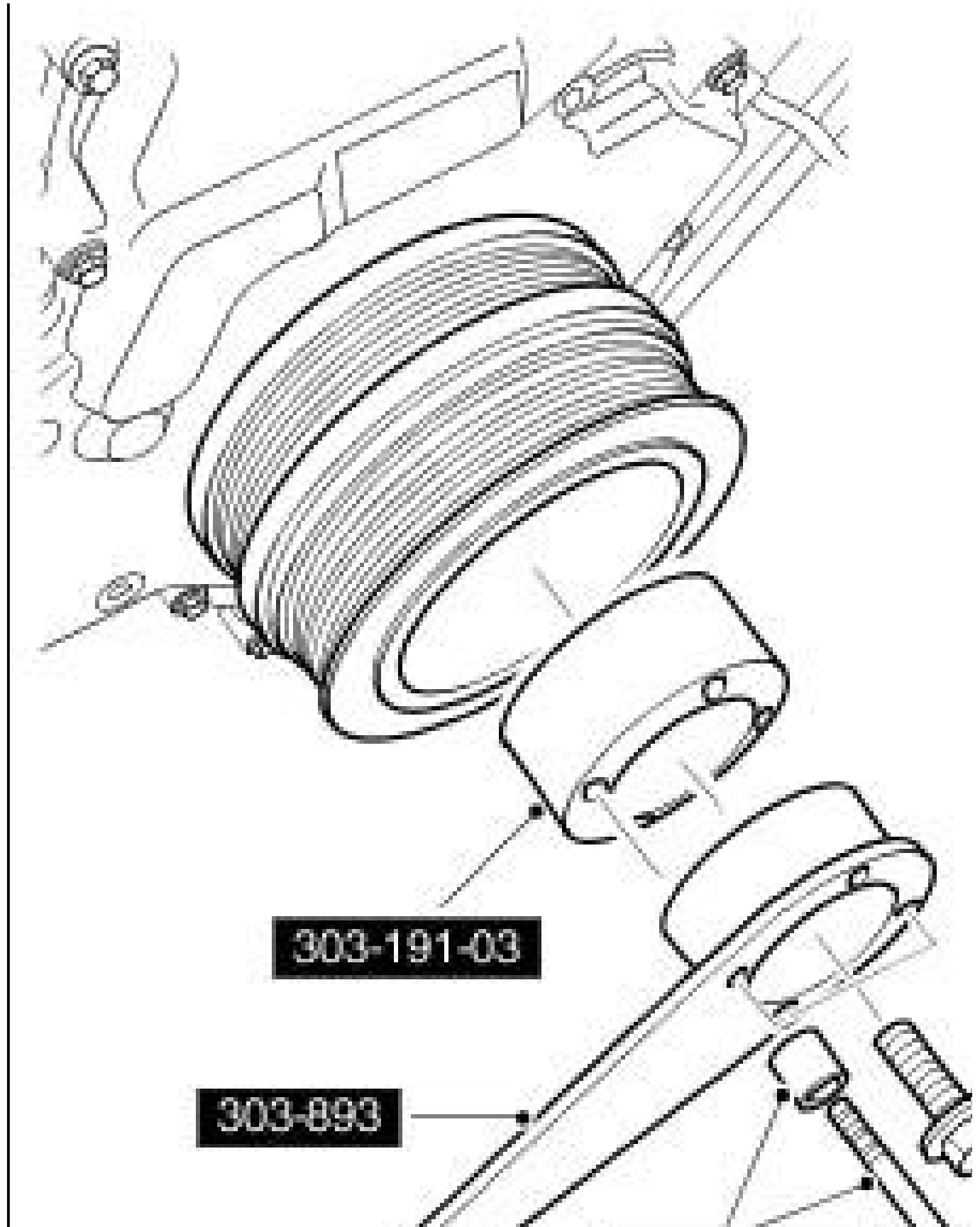
72. Connect the KS electrical connector.



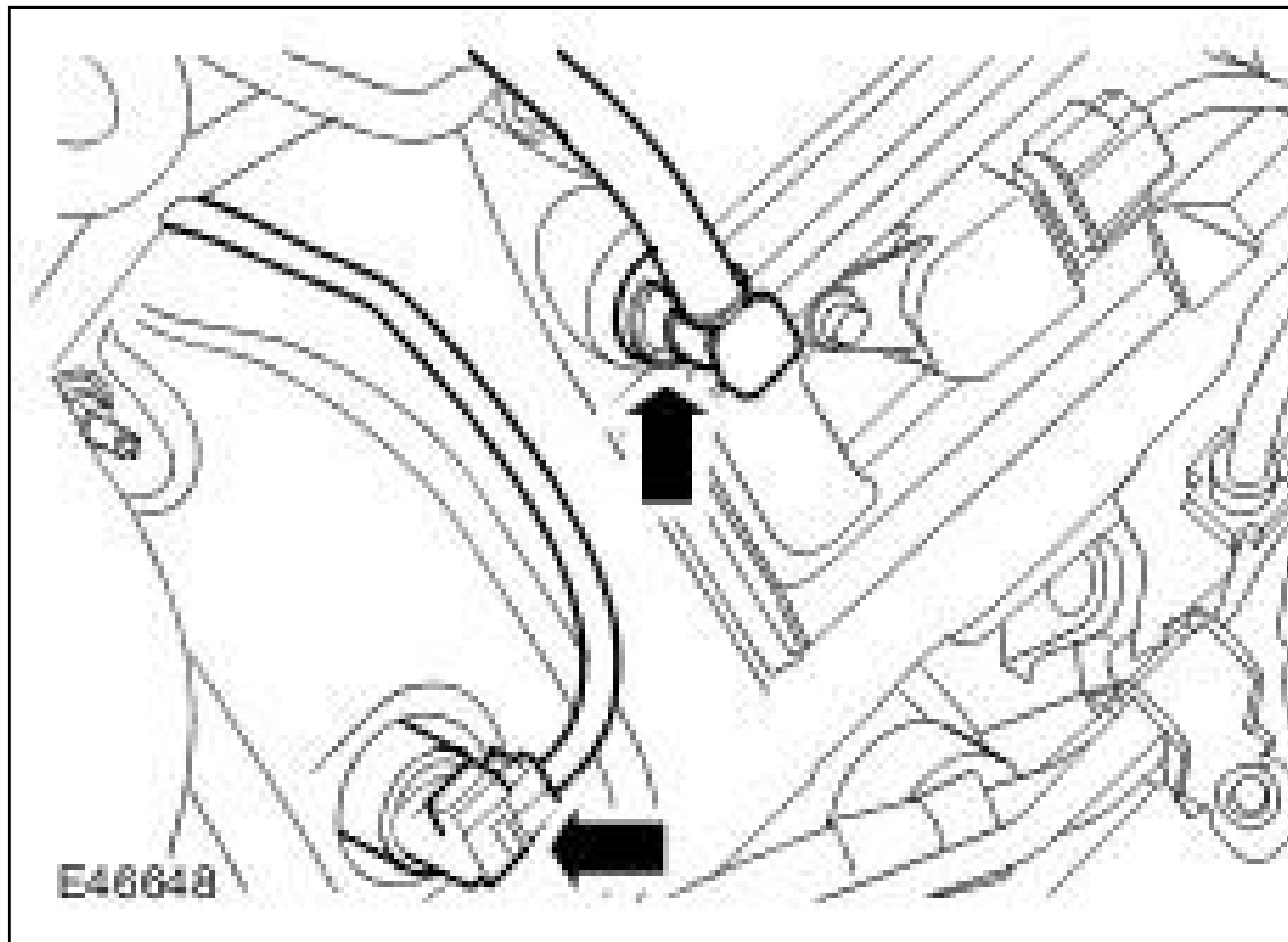
73. Connect the engine coolant temperature (ECT) sensor electrical connector.



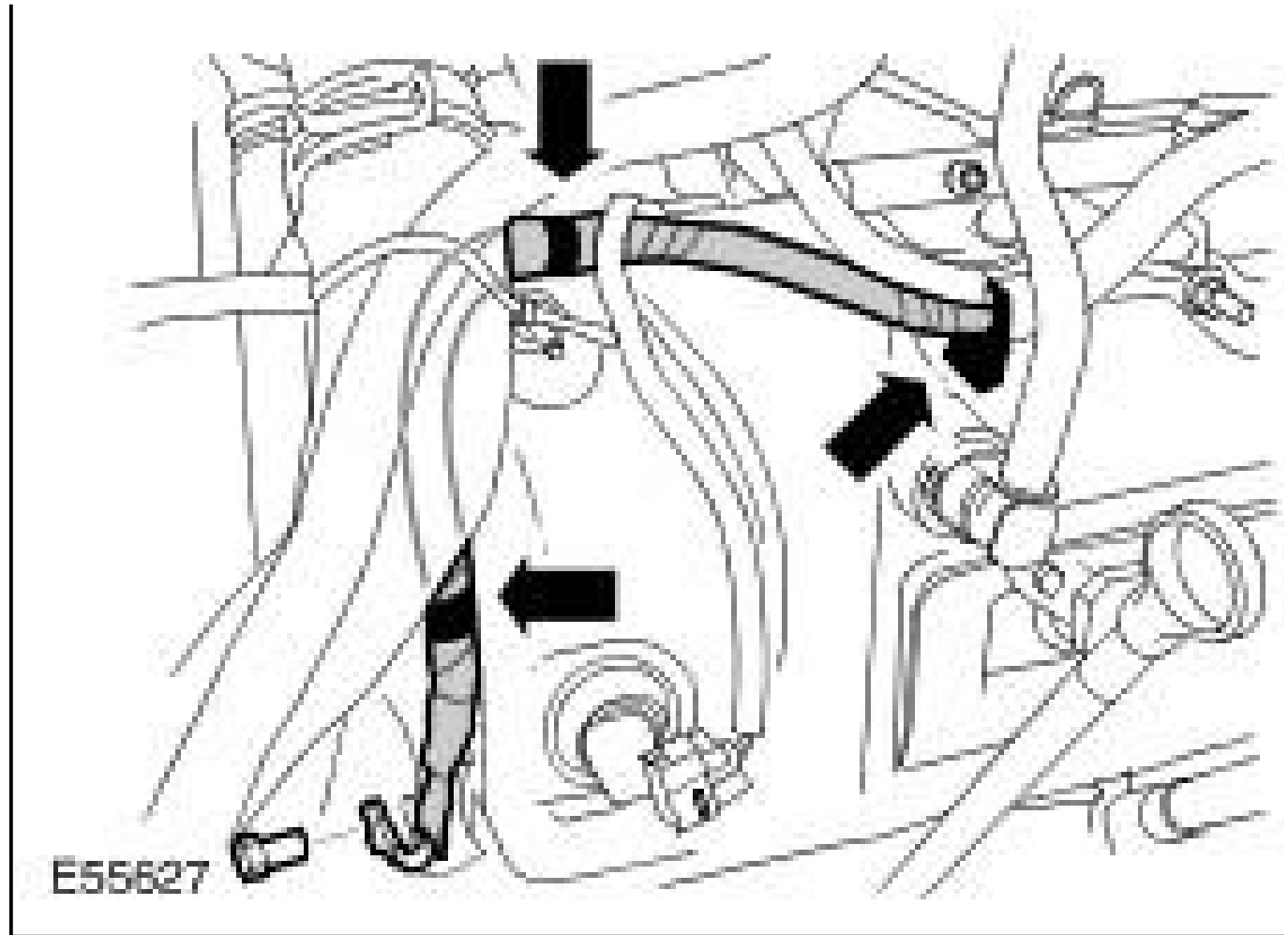
74. Connect the ignition coil-on-plug electrical connections.
- Install the clips.
 - Repeat the above procedure for the other side.



75. Connect the VCT oil solenoid electrical connector.
- Repeat the above procedure for the other side.
 - Connect the valve cover breather hose.

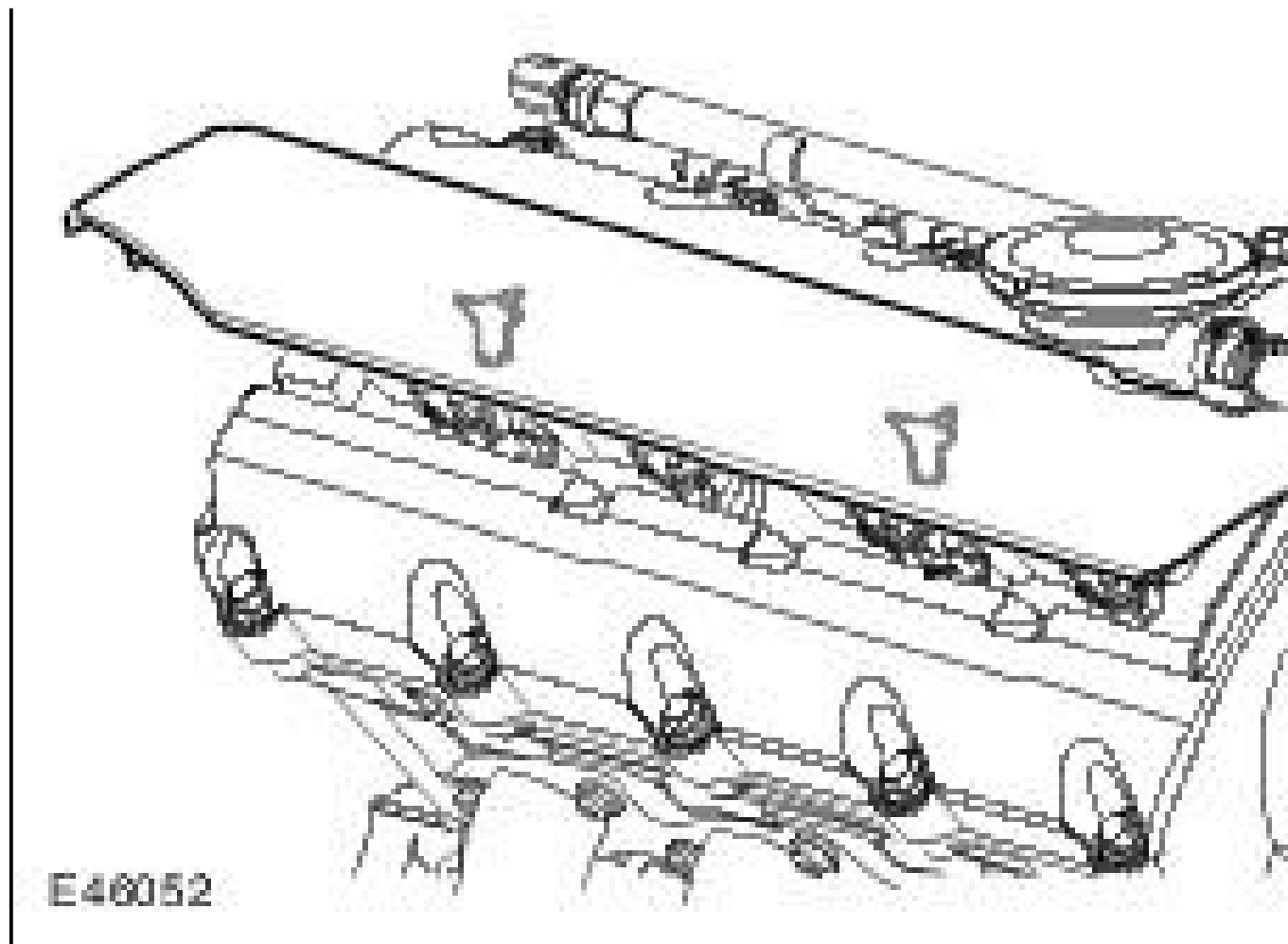


76. Connect the cylinder head earth ground connector.
- Install the bolt.
 - Secure the 3 clips.



77. Install the ignition coil-on-plug cover.

- Secure the clips.
- Repeat the above procedure for the other side.



78. Remove the engine from the engine stand.

79. Install the engine assembly.

INSTALLATION

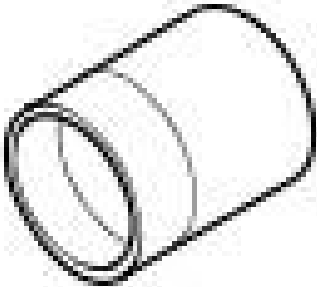
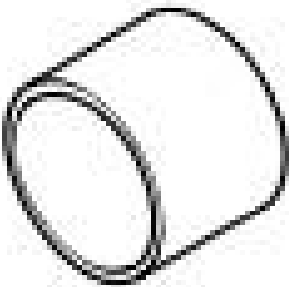
ENGINE

SPECIAL TOOLS

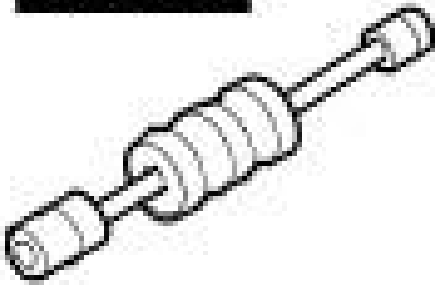
Tool Illustration	Tool Name	Tool Number
	Remover halfshaft inboard joint	205-735(LRT-54-026)

2007 Land Rover Range Rover HSE

ENGINE Engine (4.4L)

 205-735 E61263		
 308-626/1 E54136	Installer halfshaft oil seal	308-626/1
 308-626/2 E54137	Installer/Guide halfshaft oil seal	308-626/2
	Impulse extractor	100-012(LRT-99-004)

100-012

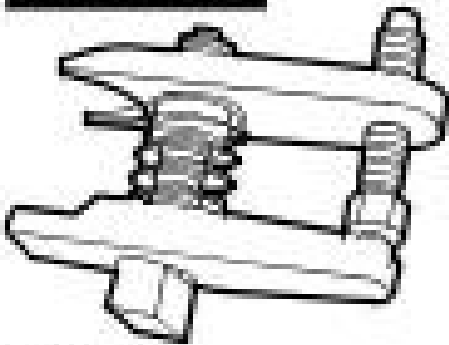


E54135

Ball joint separator

205-754(LRT-54-027)

205-754A



E45276

Fuel spring lock decoupling tool

310-D005

310-D005



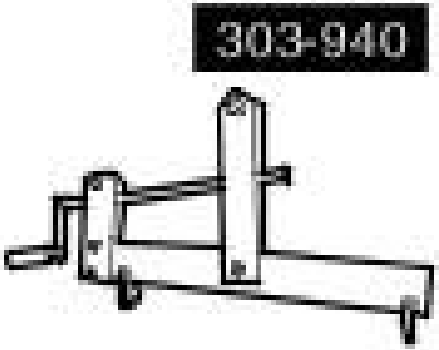
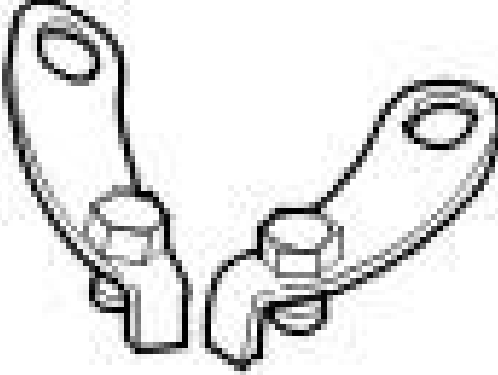
E45289

Engine lift and tilt bracket

303-940(LRT-12-138)

2007 Land Rover Range Rover HSE

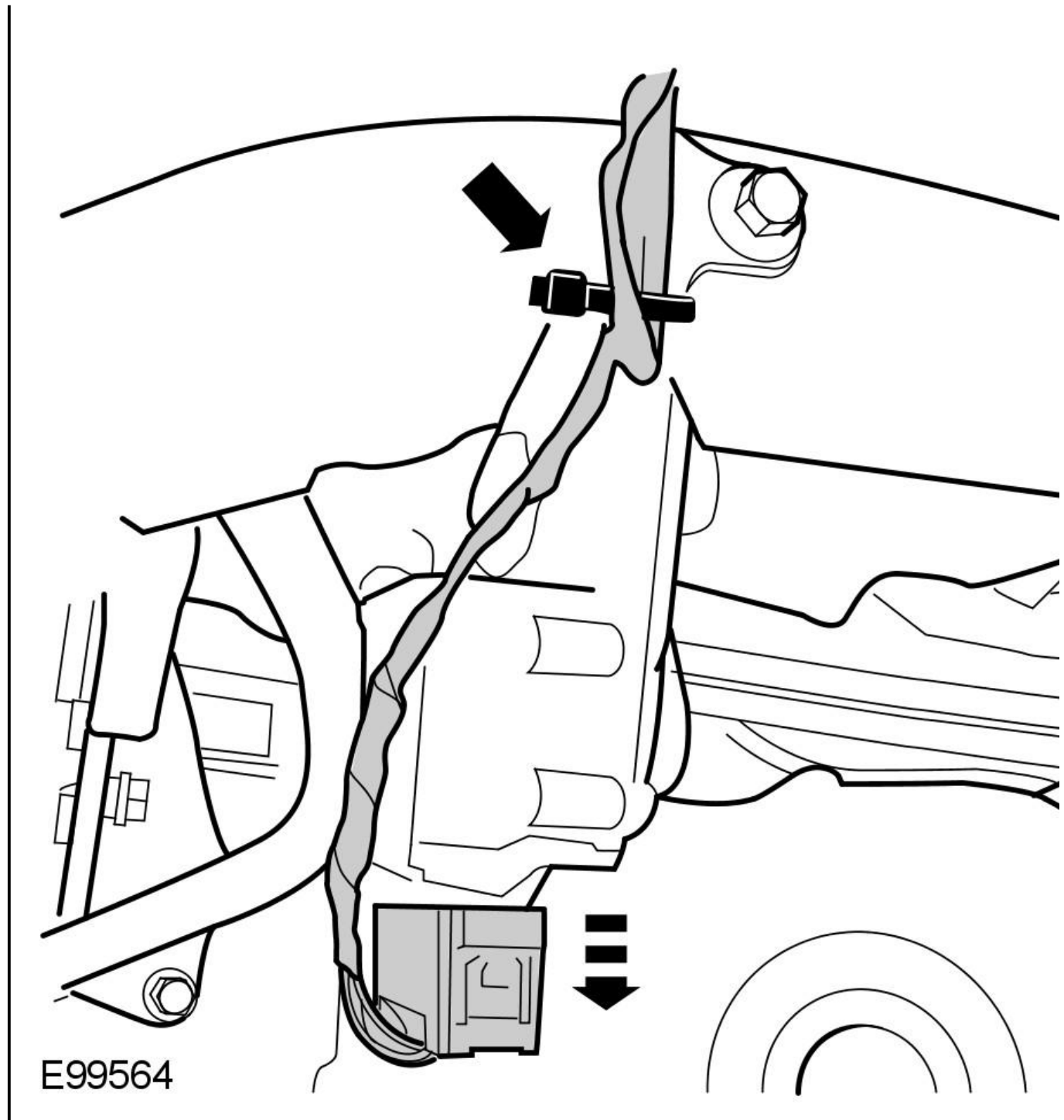
ENGINE Engine (4.4L)

 303-940 E61659		
 303-940/1 E61731	Engine lift and tilt bracket chains	303-940/1
 303-536	Engine lifting brackets	303-536
	Engine lifting brackets	303-749

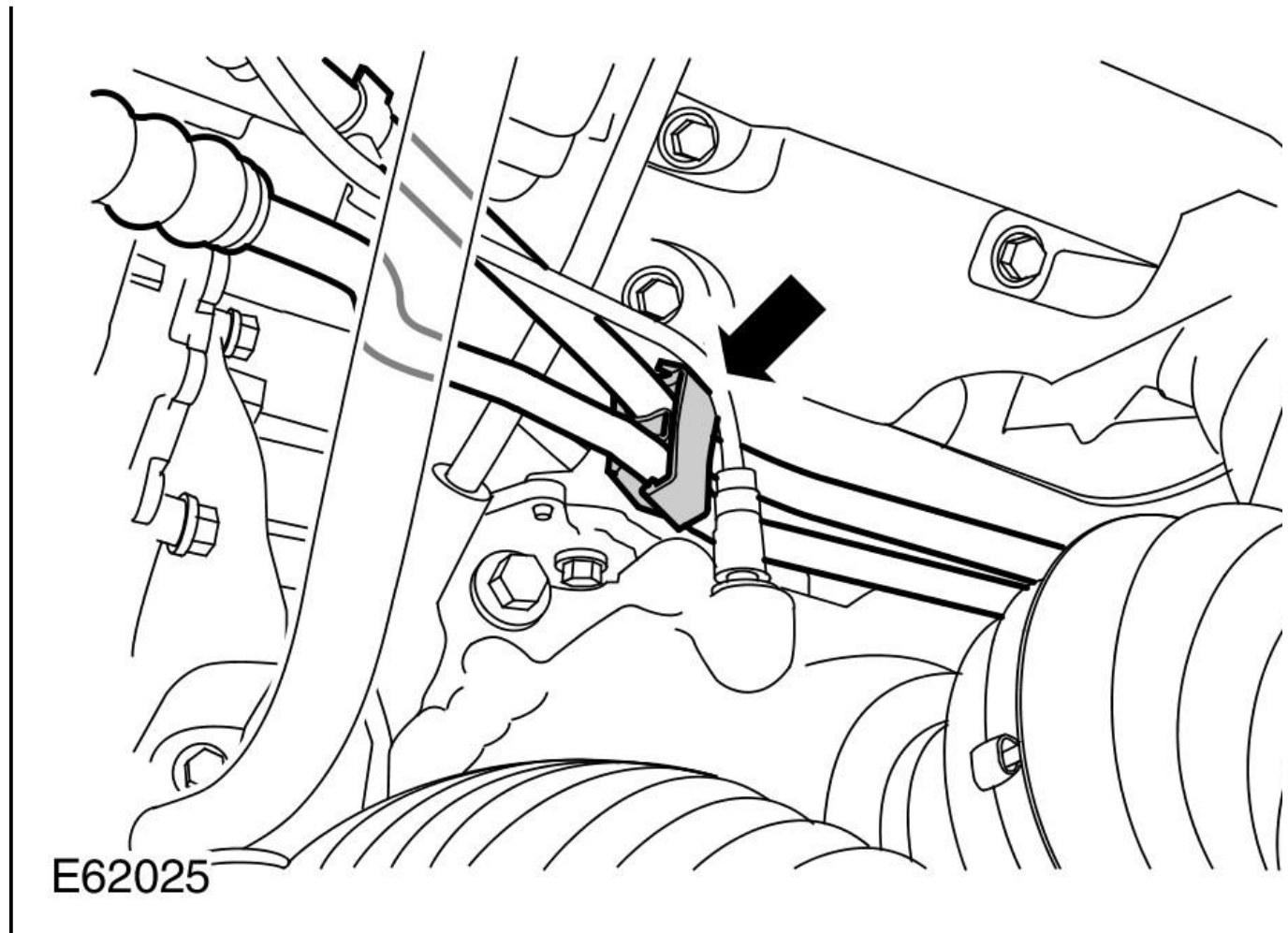
**INSTALLATION**

CAUTION: Make sure the O ring seal remains in its fitted position.

1. Install the front differential.
 - Align the dowel and tighten the bolts to 115 Nm (85 lb.ft).



2. Attach the transmission fluid lines to the engine.
 - Secure with the clip.

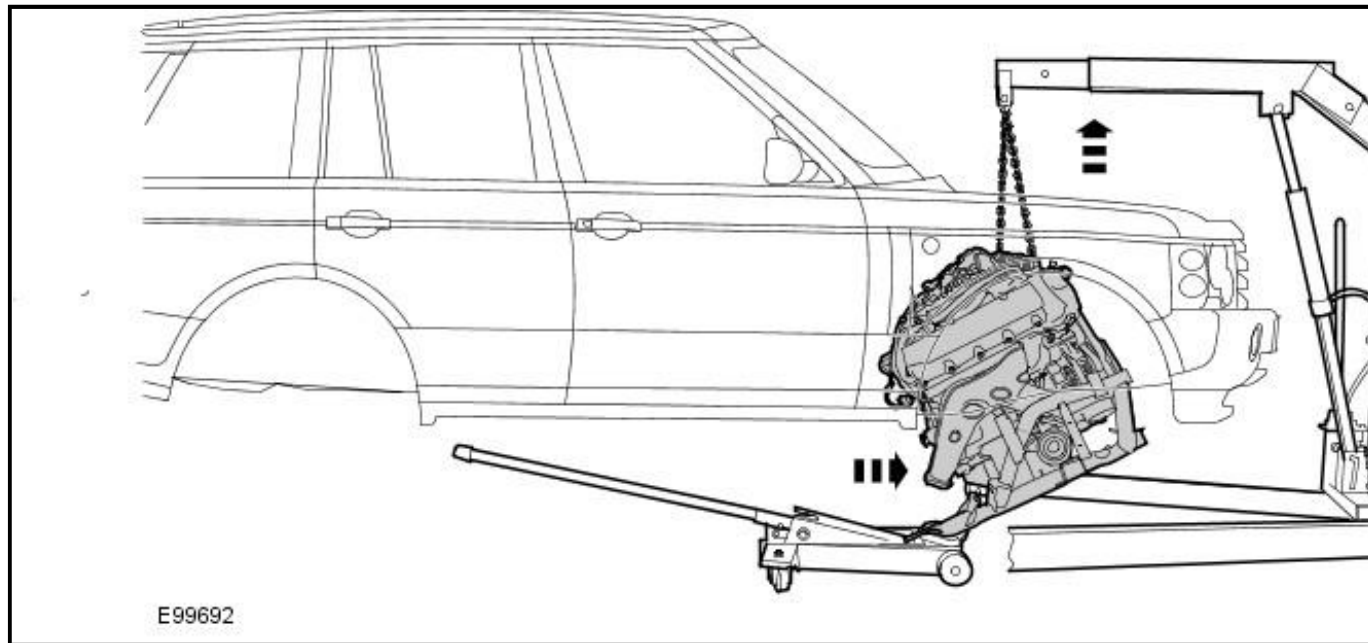


3. Lower the engine onto its mounts.
 - Tighten the engine mount bolts to 100 Nm (74 lb.ft).
4. Install the LH engine mount heat shield.

CAUTION: Support the engine on a jack. The angle may need to be adjusted during this procedure.

5. Lift engine and sub frame into position.
 - Connect the lifting chains.
 - Raise the engine.
 - Using a suitable hydraulic jack, support the rear of the front subframe.
 - With assistance, position and secure the subframe.
 - Tighten the 6 subframe bolts.
 - Stage 1: Tighten to 165 Nm (122 lb.ft).
 - Stage 2: Turn a further 90 degrees

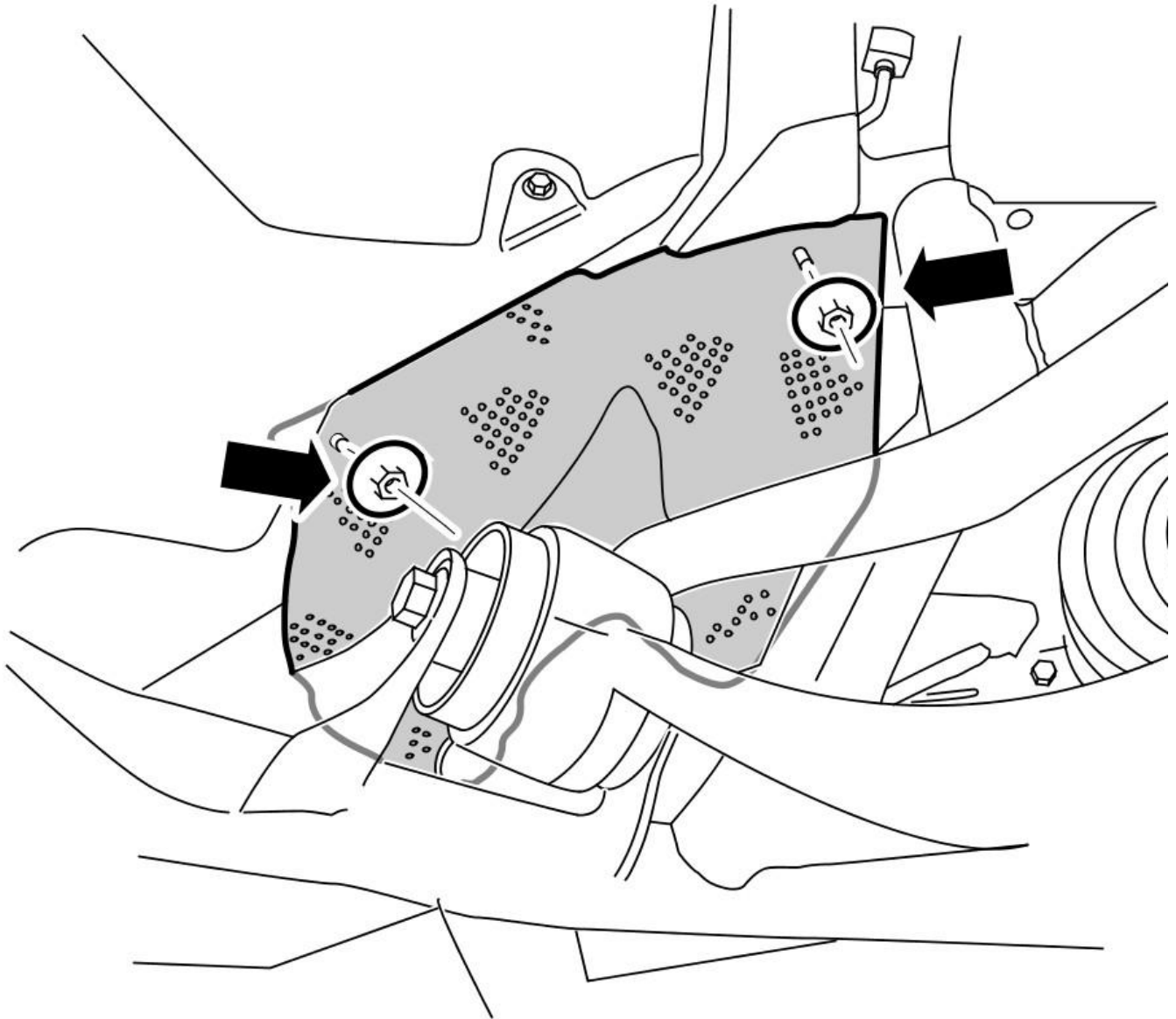
- Tighten the two front subframe bolts.
- Tighten nuts to 140 Nm (103 lb.ft).



6. Install the transmission. Refer to [Transmission](#) .

NOTE: **Left-hand shown, right-hand similar.**

7. Install the stabilizer bar heat shields.



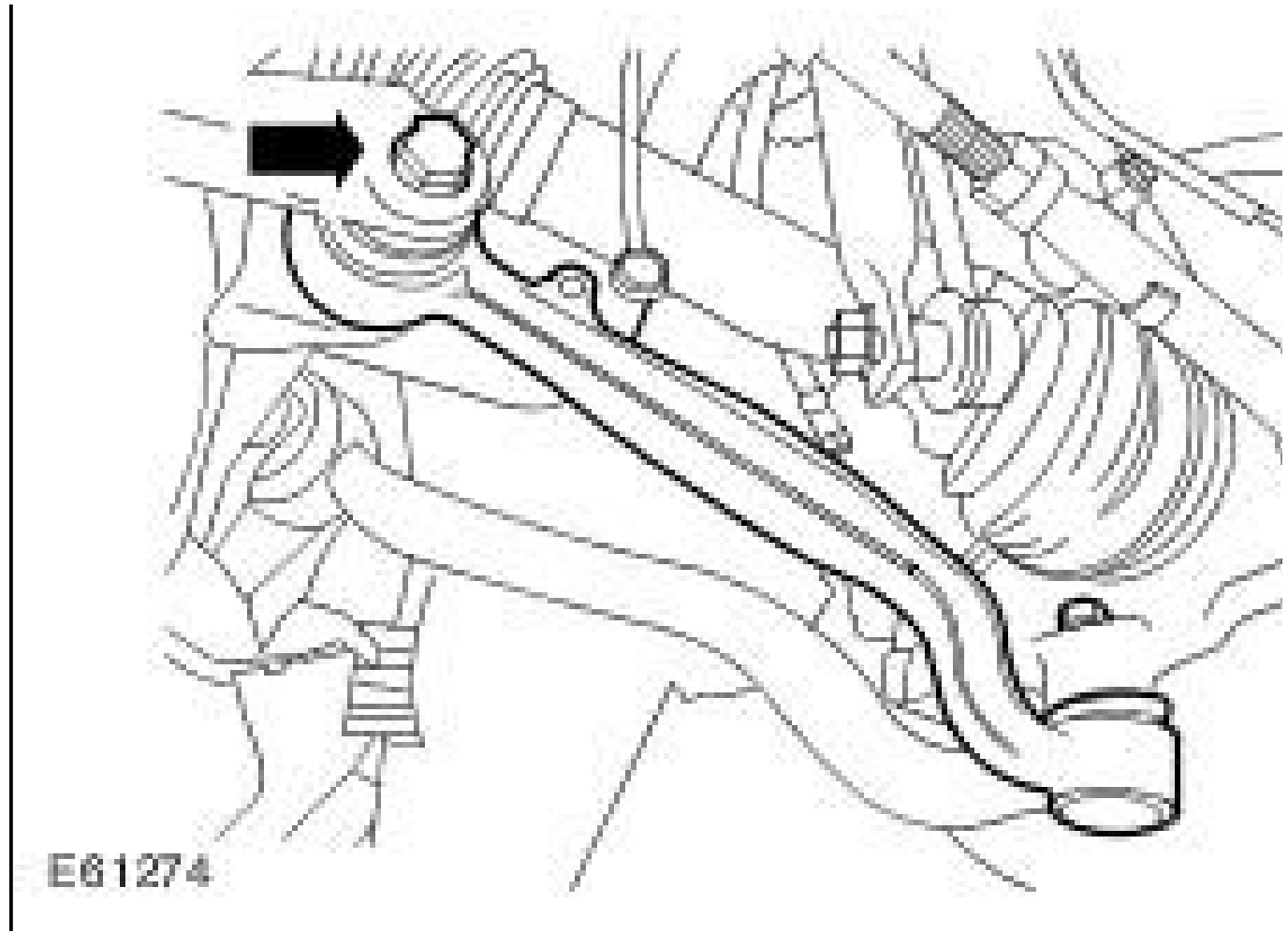
E99568

8. Connect the steering gear electrical connector.



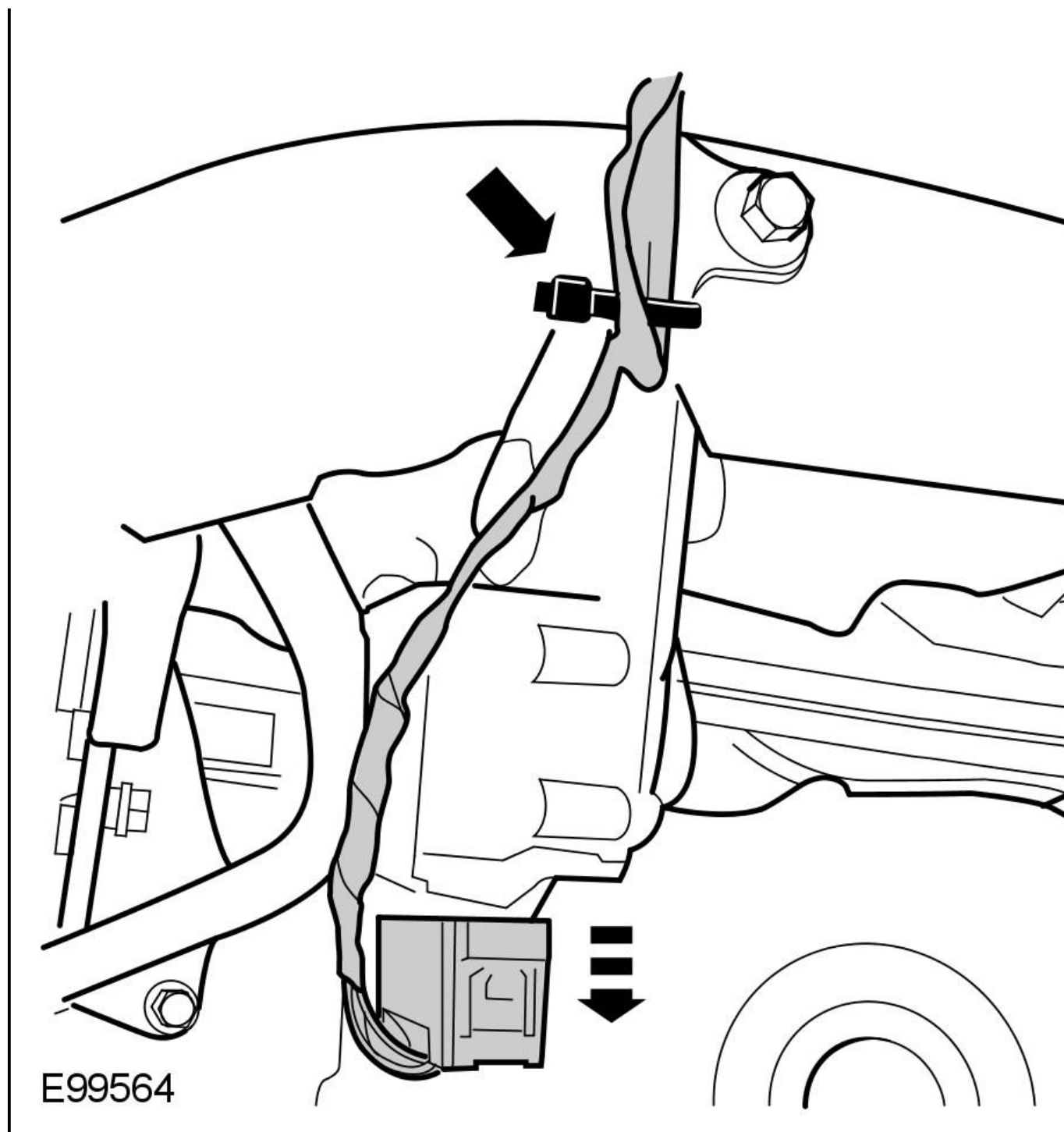
9. Attach the lower steering column.

- Make sure that the steering gear tag is aligned correctly, as shown.
- Install a new Torx bolt and tighten to 24 Nm (18 lb.ft).



NOTE: LH illustration shown, RH is similar.

10. Connect the height sensor electrical connector.
 - Align the wiring harness and secure with a cable tie.

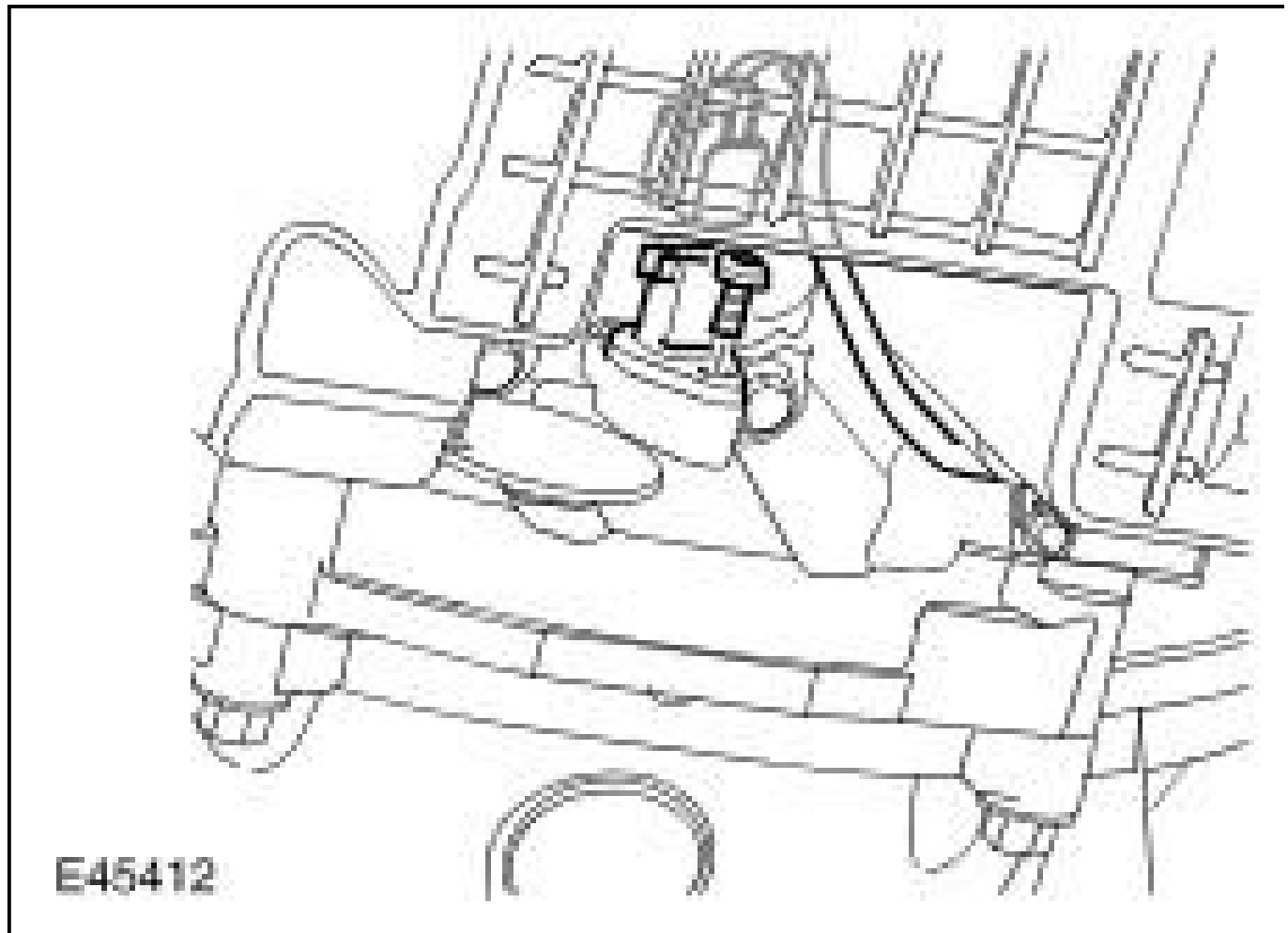


11. Install the RH driveshaft. Refer to **Halfshaft Bearing**.
12. Install the LH driveshaft. Refer to **Halfshaft Seal LH**.
13. Fill the front differential case with the correct amount of fluid. Refer to **Differential Draining and Filling**.
14. Install the oil filter housing.

- Clean the component mating faces.
- Install a new O-ring seal.
- Tighten the bolts to 20 Nm (15 lb.ft).

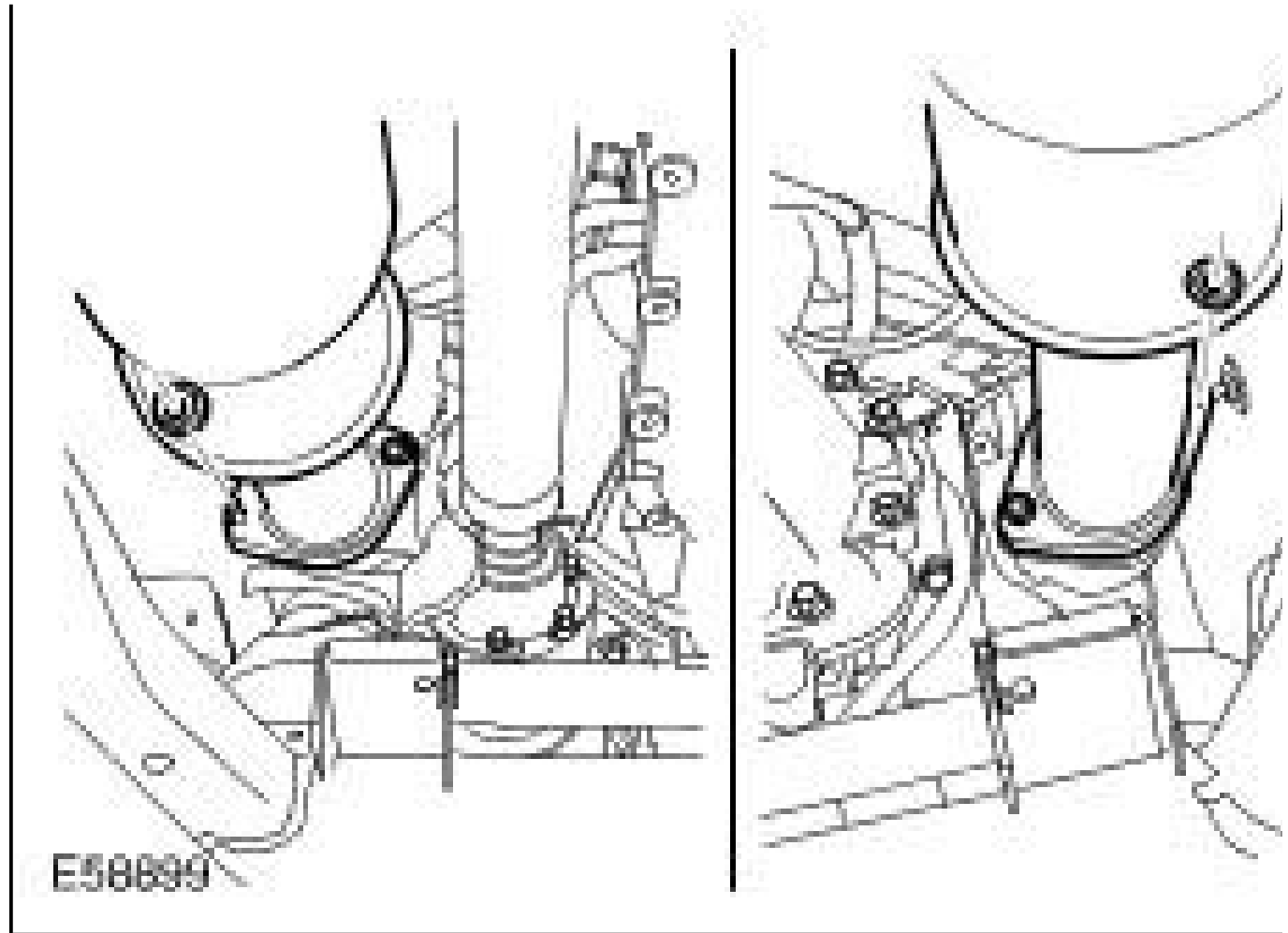


15. Connect the EOP sensor electrical connector.



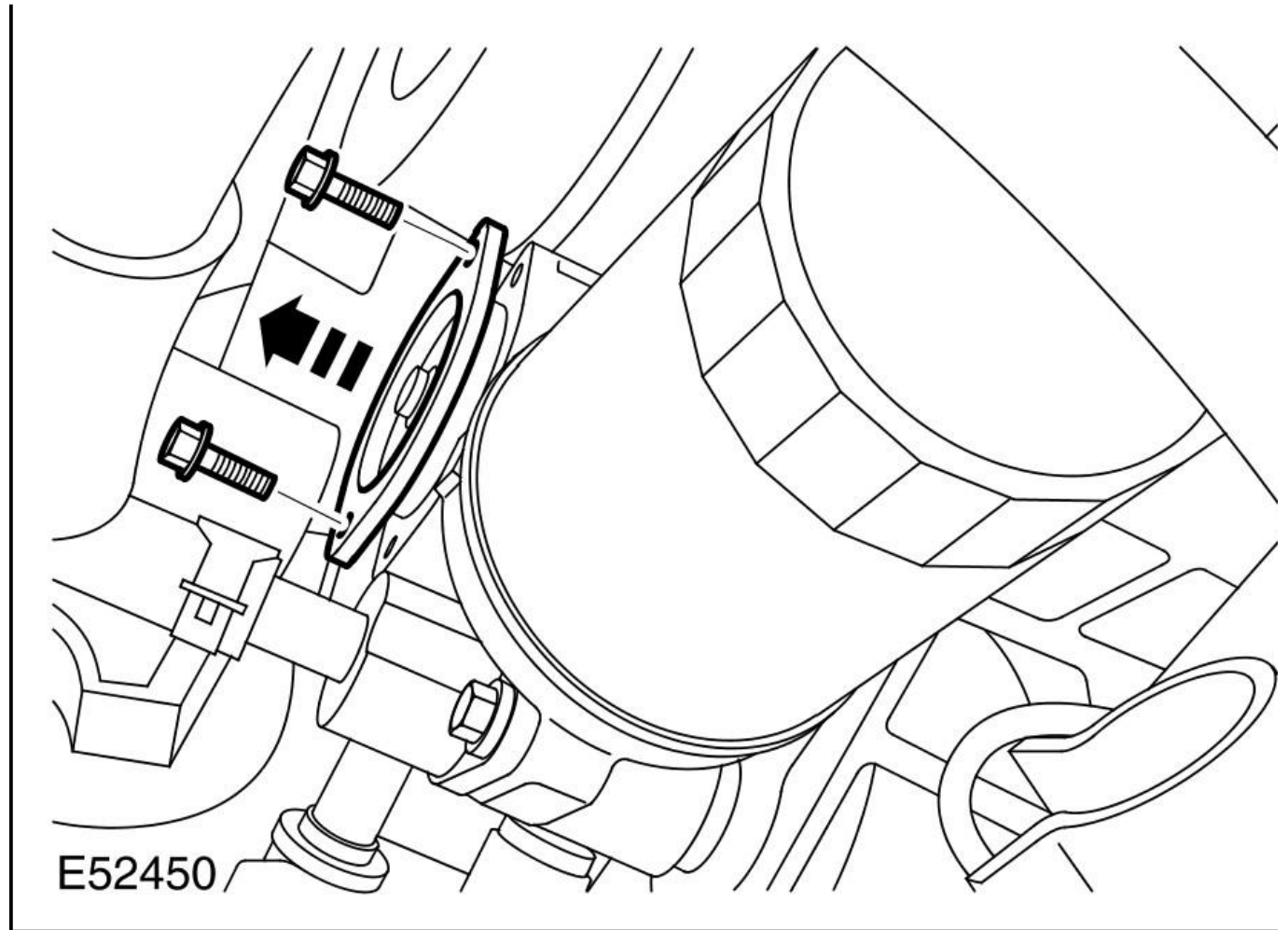
16. Connect the engine oil temperature sensor electrical connector.



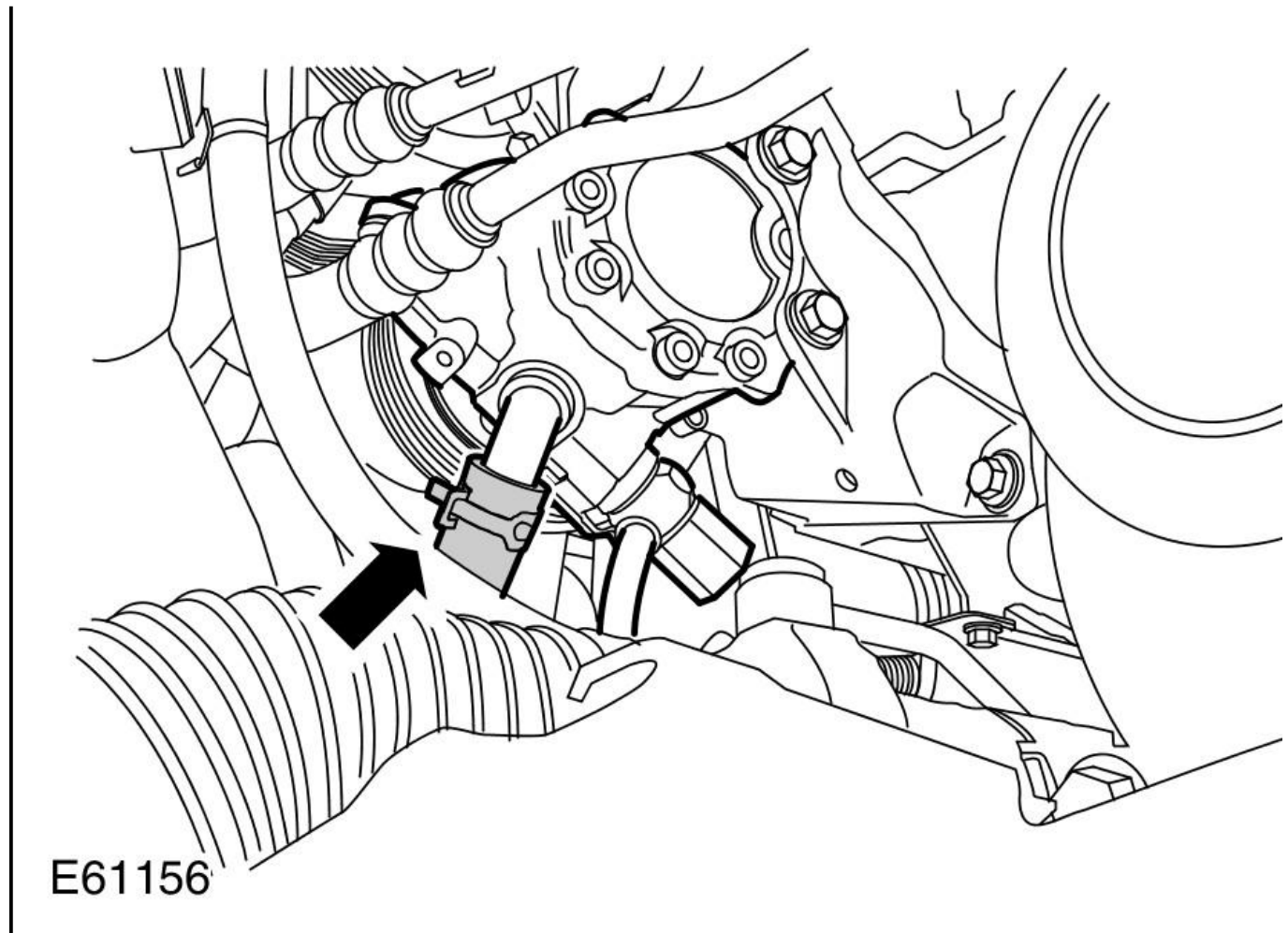


17. Connect the power steering pump high-pressure line.

- Clean the component mating faces.
- Install new sealing washers.
- Tighten the union to 25 Nm (18 lb.ft).



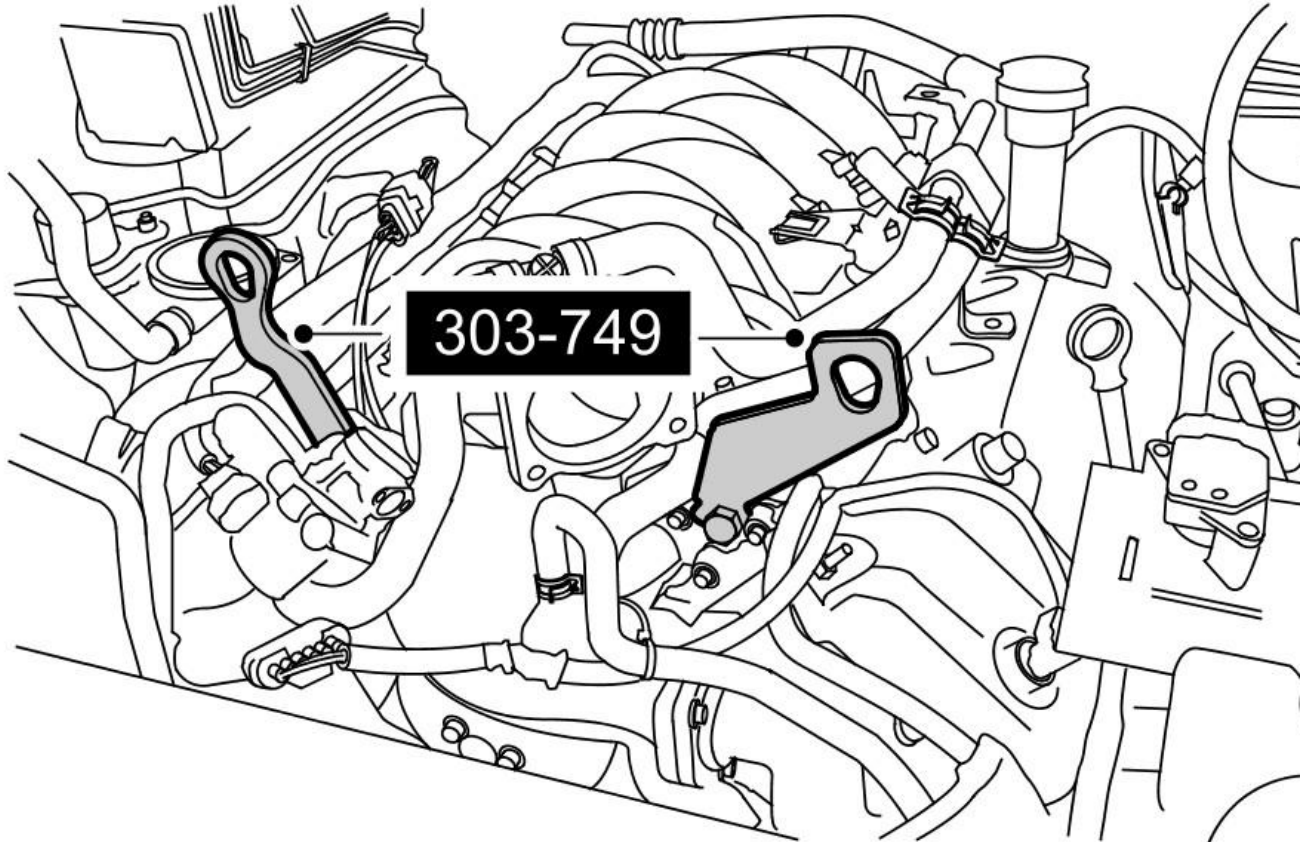
18. Connect the power steering supply hose to the steering pump.
- Clean the component mating faces.
 - Secure with the clip.



19. Secure the PAS pipe.

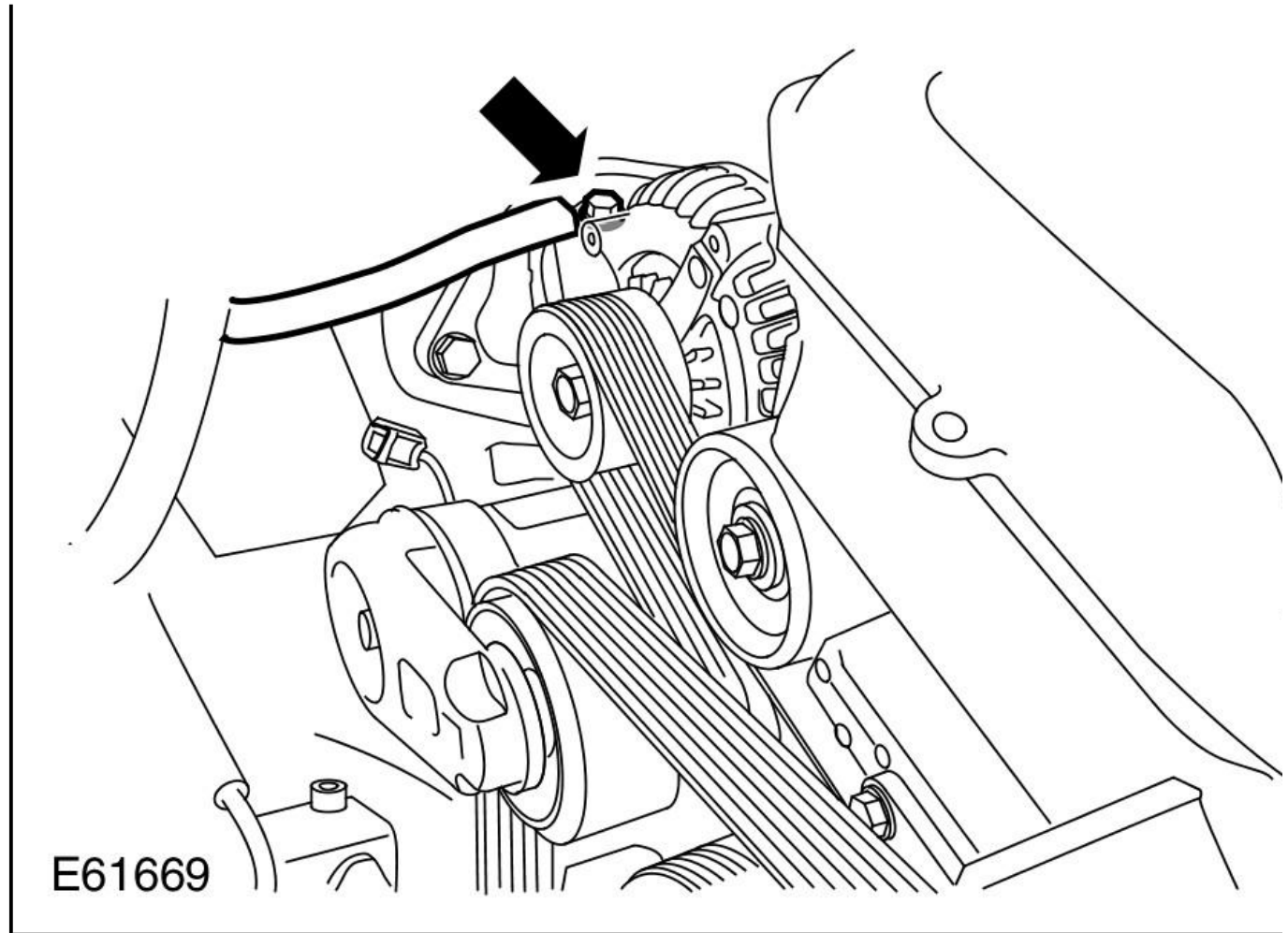


20. Remove the special tools.

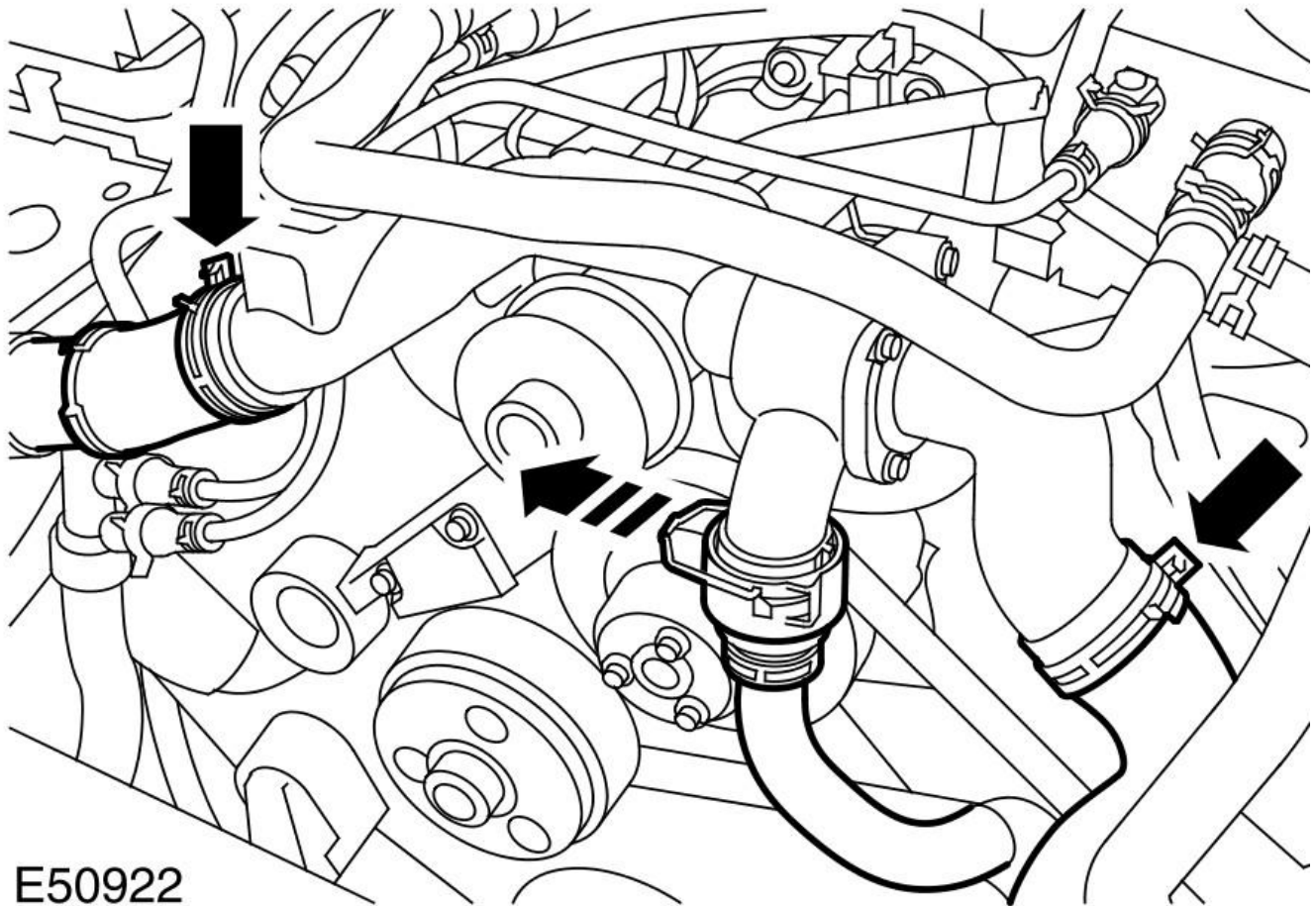


E99569

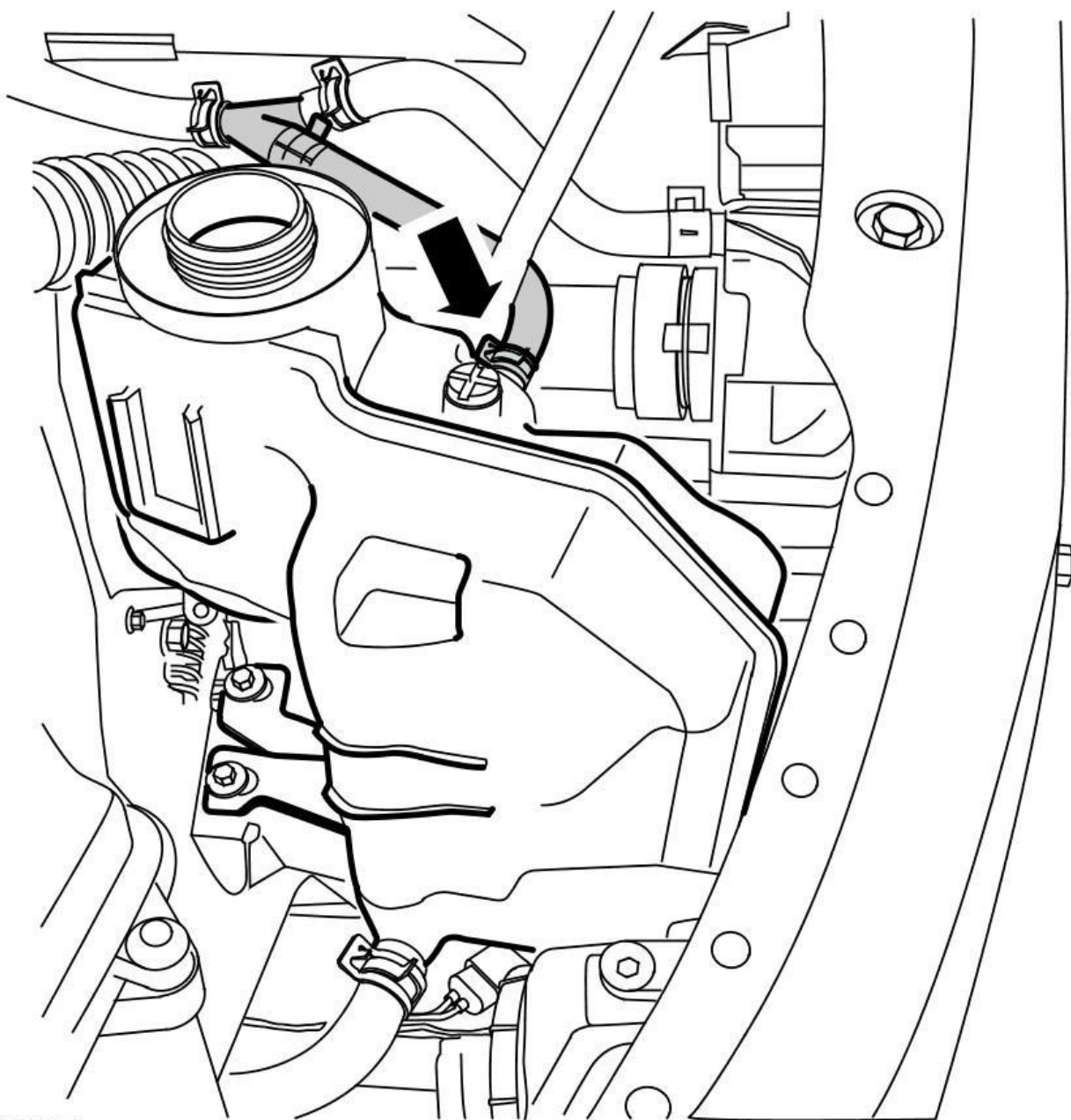
21. Connect the engine ground cable.
 - Tighten the bolt to 25 Nm (18 lb.ft).



22. Connect the coolant manifold hoses.
- Secure with the clips.

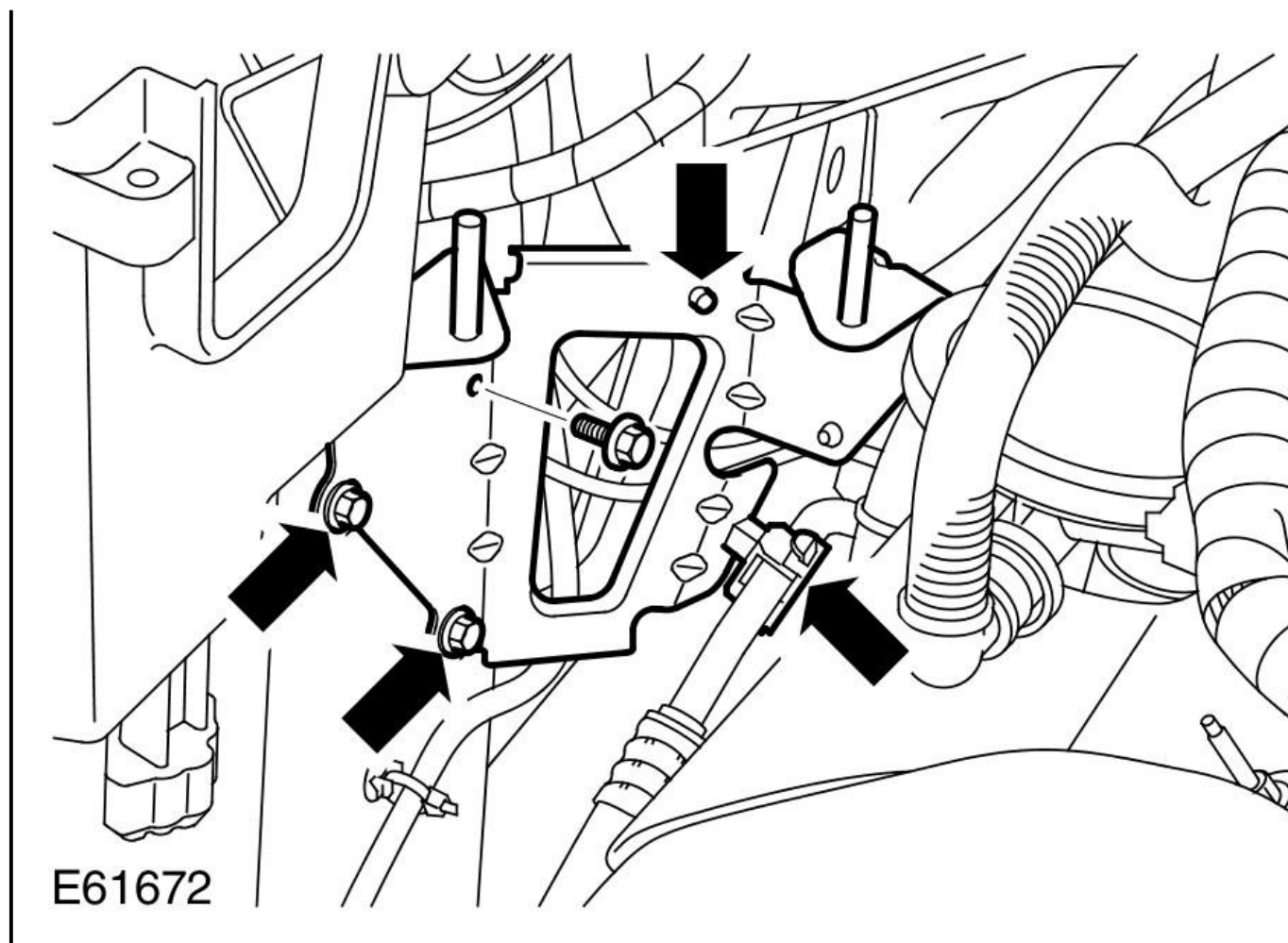


23. Install the transmission fluid cooler. Refer to **Transmission Fluid Cooler - 4.4L** .
24. Connect the coolant expansion tank hose.
 - Secure with the clip.



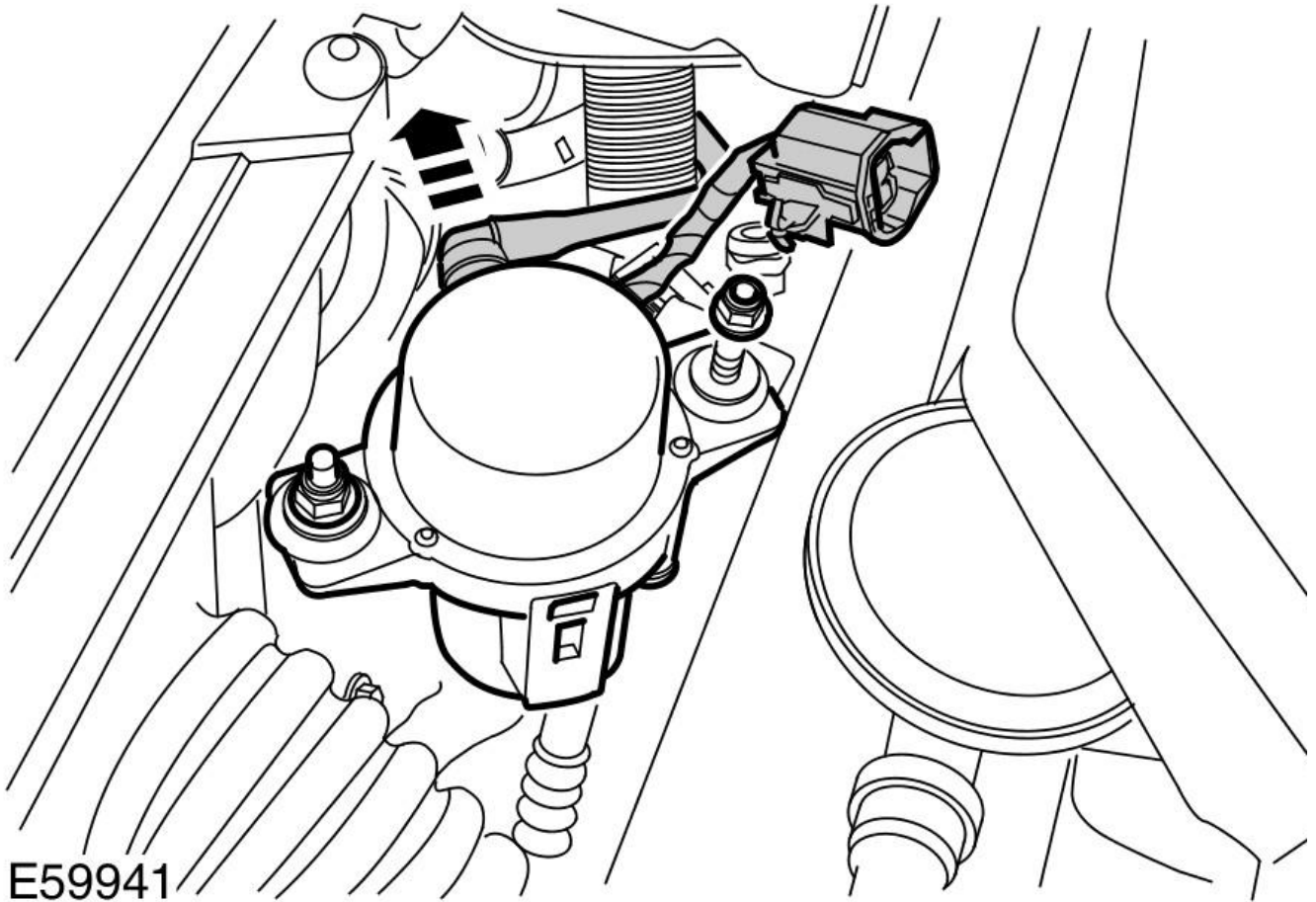
E99567

25. Install the brake vacuum pump bracket.
- Attach the wiring harness clip.
 - Attach the refrigerant line clip.
 - Tighten the bolts to 10 Nm (7 lb.ft).



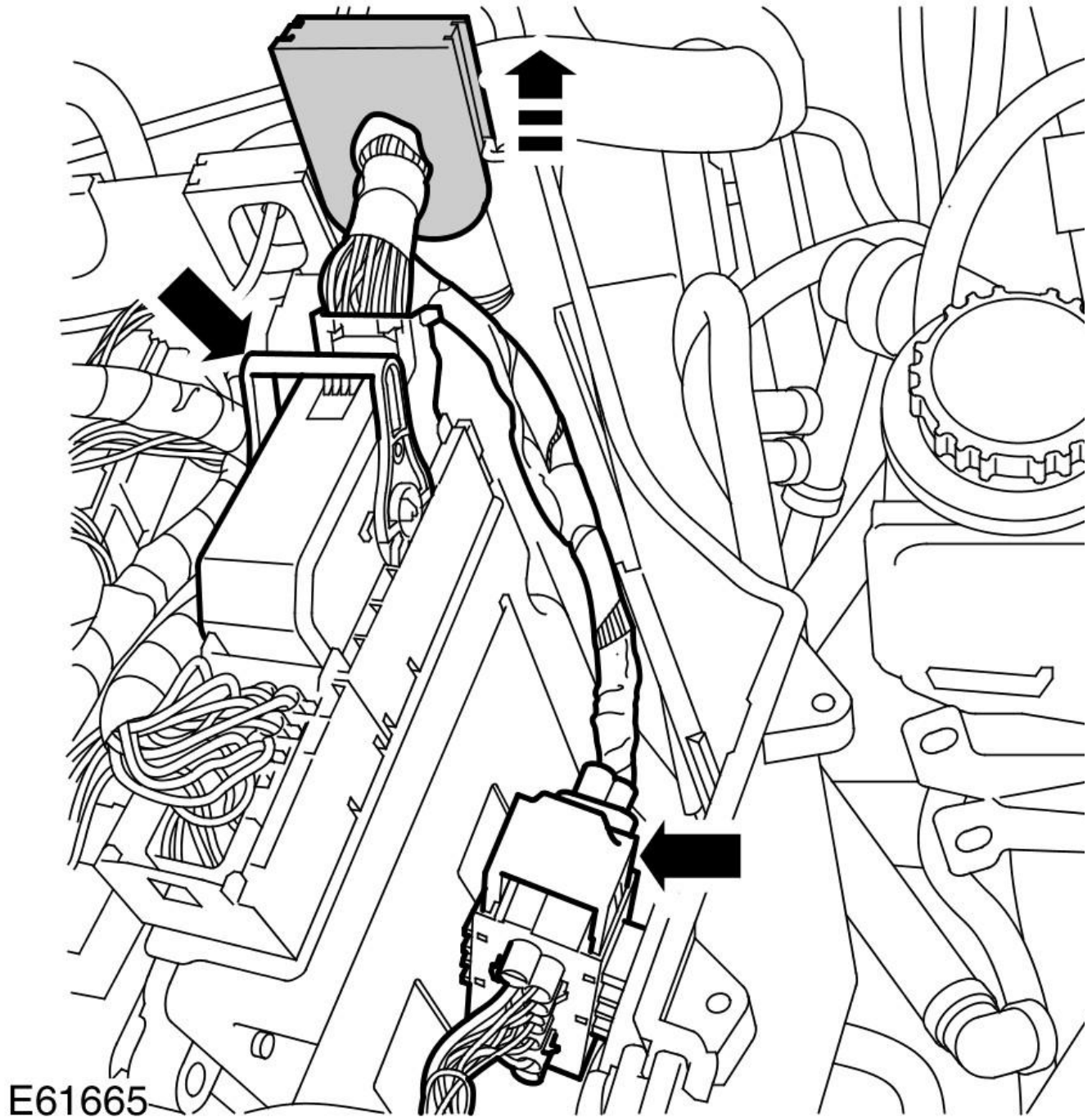
26. Install the brake vacuum pump.

- Tighten the nuts to 5 Nm (4 lb.ft).
- Connect the vacuum line.
- Connect the electrical connector.

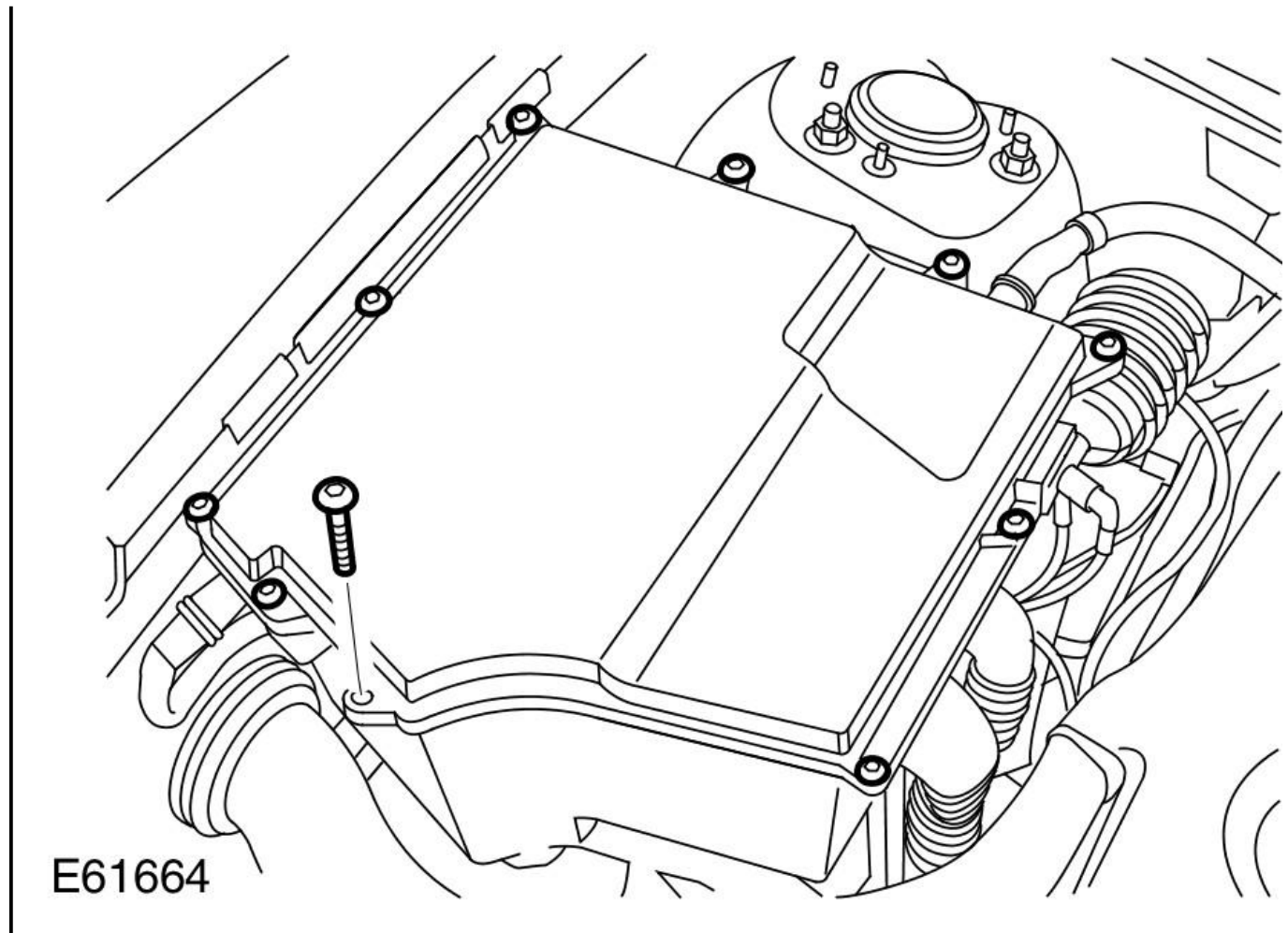


27. Secure the engine wiring harness.

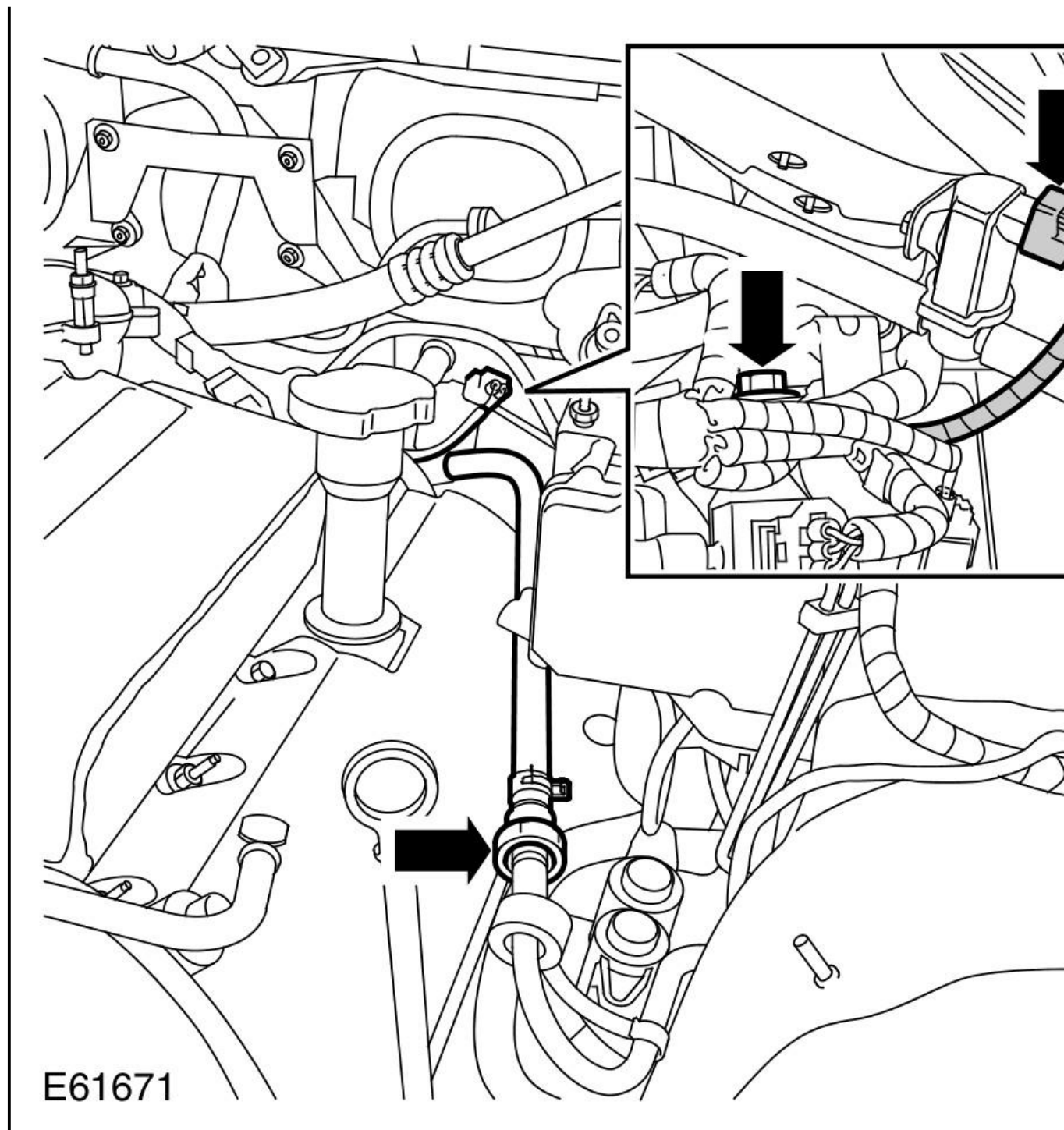
- Install the grommet.
- Connect the electrical connectors.



28. Install the ECM cover.
 - Tighten the Torx screws.

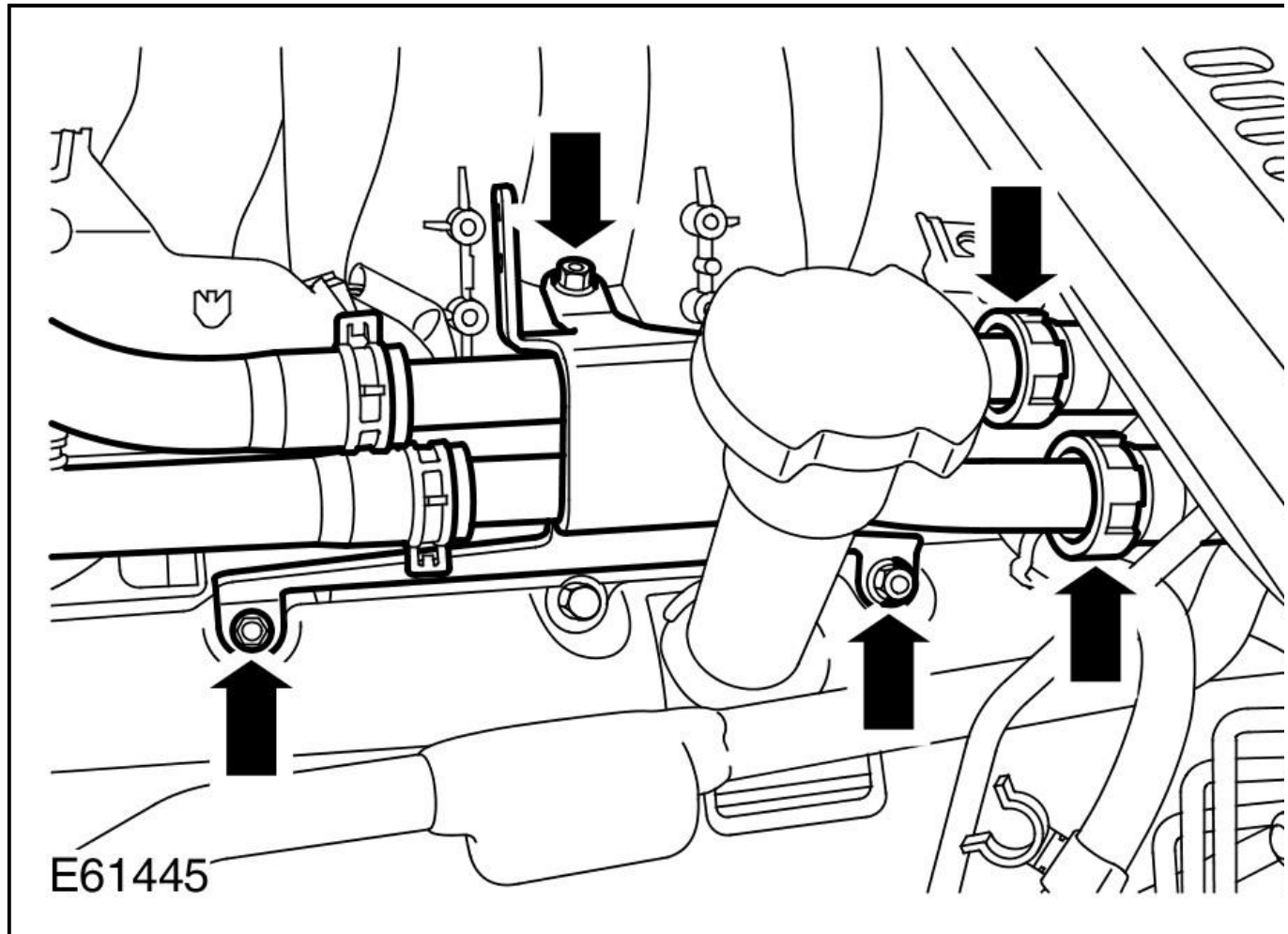


29. Attach the purge valve assembly.
- Tighten the bolt to 45 Nm (33 lb.ft).
 - Connect the quick release connector.
 - Connect the electrical connector.

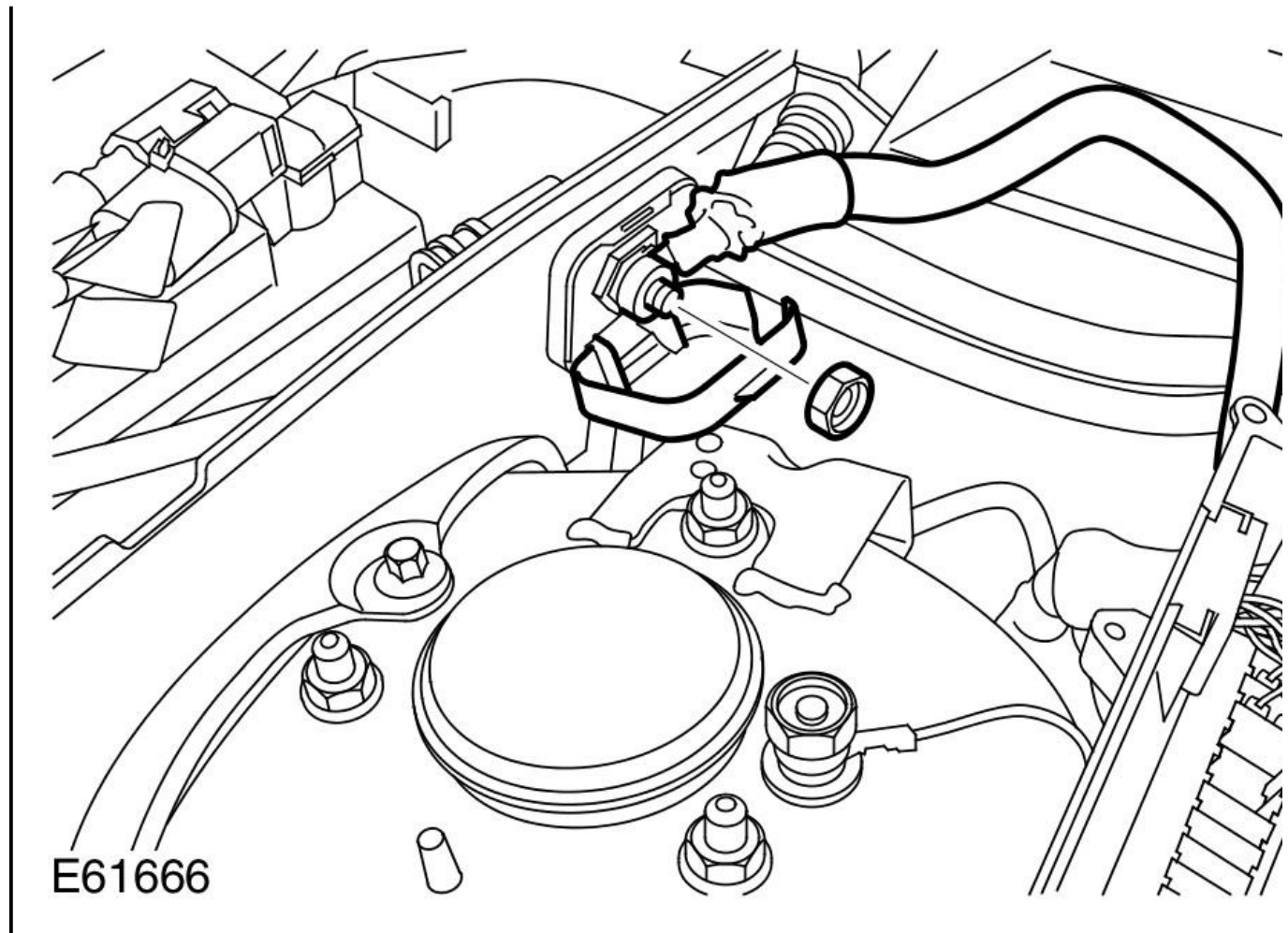


30. Connect the brake booster vacuum hose.
 - Connect the quick release connector.
31. Connect the fuel line to the fuel rail.
 - Clean the component mating faces.
 - Secure the clip.

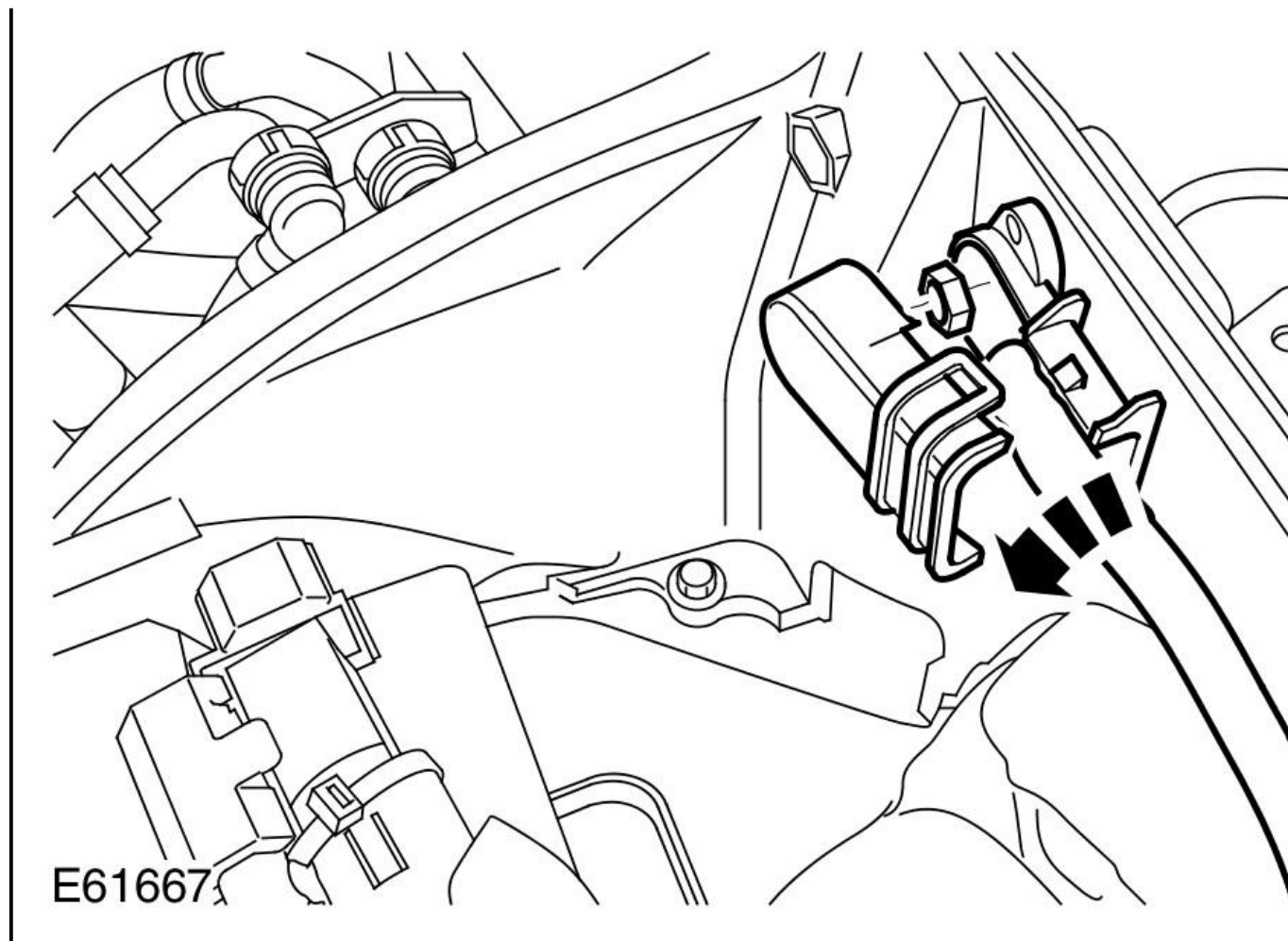
32. Install the throttle body gasket. Refer to **Throttle Body Gasket**.
33. Install the EGR valve.
 - Install a new gasket.
 - Tighten the bolts to 10 Nm (7 lb.ft).
34. Connect the heater coolant hoses.
 - Remove the hose clamps.



35. Connect the battery positive cable to the junction box.
 - Tighten the nut to 25 Nm (18 lb.ft).
 - Close the cover.



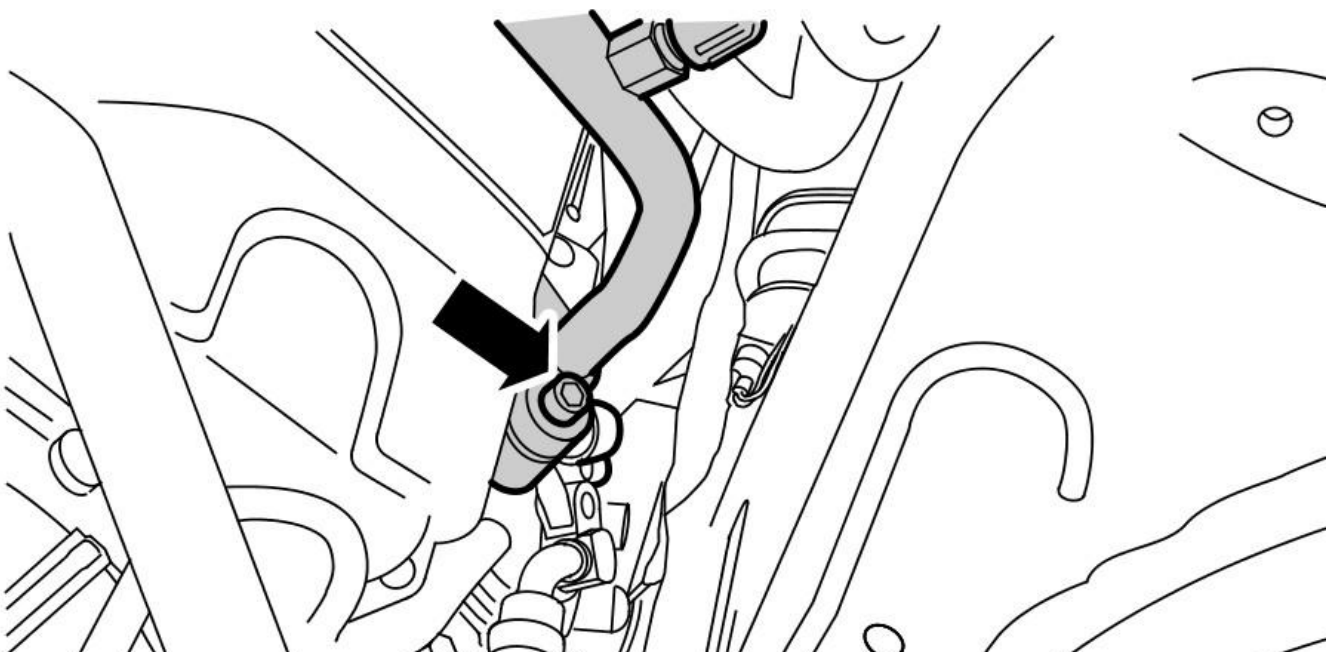
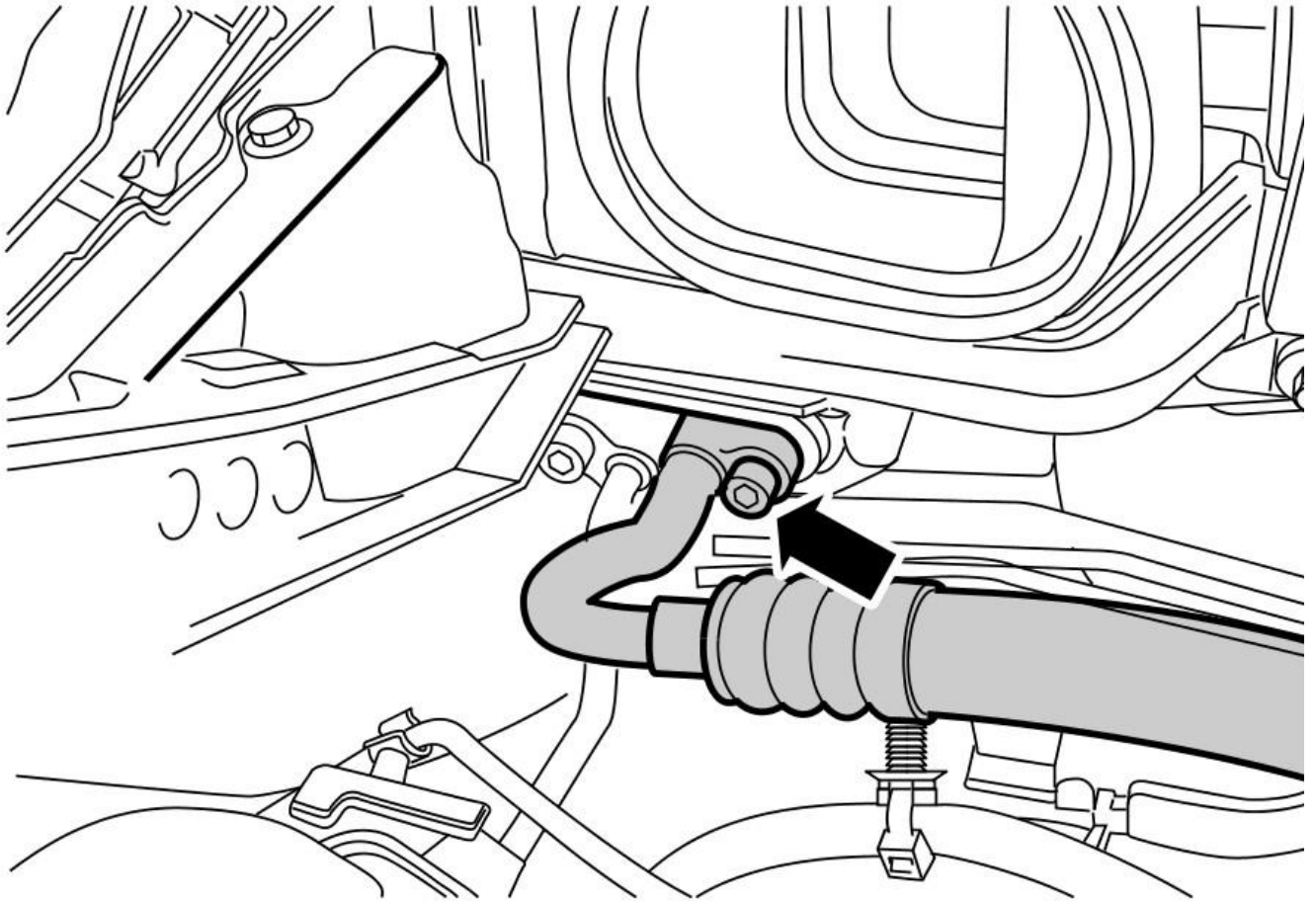
36. Connect the battery positive cable to the battery compartment side wall.
- Tighten the nut to 25 Nm (18 lb.ft).
 - Install the cover.



CAUTION: Lubricate the new seals with clean refrigerant oil.

37. Connect the A/C compressor low-pressure refrigerant line.

- Clean the component mating faces.
- Install the new O-ring seals.
- Tighten the bolts to 10 Nm (7 lb.ft).



38. Connect the battery ground cable. Refer to **Specifications** .
39. Install the RH air cleaner assembly. Refer to **Air Cleaner** .
40. Fill the engine with oil. See **Engine Oil Draining and Filling**.
41. Refill the cooling system. Refer to **Cooling System Draining, Filling and Bleeding** .
42. Re-charge the air conditioning system. Refer to **Air Conditioning (A/C) System Recovery, Evacuation and Charging** .
43. Install the engine cover. Refer to **Engine Cover - 4.4L** .
44. Carry out a complete vehicle geometry check and adjustment.
45. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.