

2009 Land Rover Range Rover Sport Supercharged

ENGINE Engine - V8 S/C 4.2L Petrol

ENGINE**Engine - V8 S/C 4.2L Petrol****ENGINE - V8 S/C 4.2L PETROL****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 aperture	8510303
Cylinder block coolant outlet elbow stub pipe	STC 50554
Bedplate to cylinder block	8510303

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

Item	Specification
(1) Recommended lubricant	5W/30 Preferred: WSS-M2C913-B Alternative: ACEA A3/B3
(1) WSS is a Ford prefix to the oil specification	

LUBRICANT - NAS/JAPAN

Item	Specification
(1) Recommended lubricant	5W/30 - ILSAC GF4 and API SM
(1) WSS is a Ford prefix to the oil specification	

CAPACITY

Item	Capacity
Dry fill including filter and cooler	9.4 litres (16.5 pints) (9.9 US quarts)
Oil and filter change	7.7 litres (13.6 pints) (8.1 US quarts)
Amount of oil required to bring the level from the lower to the upper holes on the dipstick	1.5 litres (2.6 pints) (1.5 US quarts)

GENERAL SPECIFICATION

Item	Specification
Type	4.2 liter, 90 degree 'V', supercharged, petrol engine, twin overhead camshafts per cylinder head, 4 valves per cylinder
Cylinder arrangement	For additional information, refer to: ENGINE (303-

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	01A Engine - V8 S/C 4.2L Petrol, Description and Operation).
Cylinder numbering	For additional information, refer to: ENGINE (303-01A Engine - V8 S/C 4.2L Petrol, Description and Operation).
Bore - nominal	86.0 mm (3.386 in)
Stroke	90.3 mm (3.555 in)
Capacity	4196 cm ³ (256.0 in ³)
Firing order (pre 2006)	1 - 5 - 4 - 2 - 6 - 3 - 7 - 8
Firing order (2006 onwards)	1 - 2 - 7 - 3 - 4 - 5 - 6 - 8
Compression ratio	9.1:1
Direction of rotation	Anti-clockwise viewed from rear of engine
Maximum power:	
UK/Europe and ROW - Not NAS/Japan	287 kW (385 bhp) @ 5750 rev/min
NAS/Japan	390 bhp (291 kW) @ 5750 rev/min
Maximum torque:	
UK/Europe and ROW - Not NAS/Japan	550 Nm (406 lb-ft) @ 3500 rev/min
NAS/Japan	410 lb-ft (555 Nm) @ 3500 rev/min
Dimensions:	
Length	720 mm (28.3 in)
Width	720 mm (28.3 in)
Height	785 mm (30.9 in)
(1) 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)
(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: (1) 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: (2) 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 (0.0005 in)	

TORQUE SPECIFICATIONS

Description	Nm	lb-ft
Exhaust manifold heat shield bolt	25	18

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(1) Exhaust manifold to cylinder head bolts	20	15
Battery clamp bolt	10	7
(4) 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 the M8 bolts 11 and 12	25	18
CMP sensor Torx screw	7	5
(6) Oil filter	18	13
Oil drain plug	25	18
Oil cooler bolts	10	7
Primary timing chain tensioner guide bolts	12	9
Primary timing chain tensioner bolts	12	9
Secondary timing chain tensioner bolts	12	9
(1) Camshaft bearing cap bolts	10	7
(2) Intake camshaft sprocket retaining bolt		
Stage 1	20	15
Stage 2	Further 90°	Further 90°
(2) Exhaust camshaft sprocket retaining bolt		
Stage 1	20	15
Stage 2	Further 90°	Further 90°
Engine front mount bolts:		
Stage 1	45	33
Stage 2	Further 60°	Further 60°
Engine to front mount nut	90	66
Engine ground cable bolt	25	18
Starter motor bolts	45	33
(7) Starter motor cable nut	10	7
(4) Steering column lower universal joint bolt	25	18
(4) Crankshaft pulley bolt	380	280
PCV valve bolt	6	4
Valve cover bolts	12	9

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Oil level indicator tube nut	6	4
(1) Sump pan bolts	20	15
Transmission retaining bolts	45	33
Transmission cooler pipes retaining clamp bolt	25	18
A/C compressor mounting bracket bolts	25	18
Power steering pump bolts	25	18
Differential extension bolts	45	33
Oil pump to cylinder block bolts	10	7
(3) Oil strainer pick-up pipe bolts - M5	6	4
Oil strainer pick-up pipe bolts - M6	10	7
Coolant pump pulley bolts	10	7
Accessory drive belt idler pulley bolt	25	18
(1) Engine front cover bolts	12	9
Generator mounting bracket bolts	48	35
Accessory drive belt tensioner bolt	40	30
Viscous fan drive pulley bolts	25	18
Viscous fan drive belt tensioner bolt	40	30
Radiator access panel bolts	10	7
Engine oil pressure sensor	12	9
Upper suspension arm and brake line heat shield nuts and bolts	10	7
Flexplate to torque converter bolts:		
Stage 1	15	11
Stage 2	110	81
Hood bolts	25	18
Auxiliary oil cooler thermostat bolts	10	7
Engine oil temperature sensor	20	15
Oil filter housing	20	15
Oil cooler hose adaptors	10	7
Fuel pressure sensor	6	4
Fuel temperature sensor	7	5
Dynamic Response pump mounting bolts	25	18

(1) Bolts must be tightened in sequence

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- (2) New nuts/bolts must be installed
- (3) Apply sealant to threads
- (4) New Patchlok bolts must be installed
- (5) Lightly oil bolt threads
- (6) Apply engine oil to seal
- (7) Damage to internal connections will result if this torque is exceeded

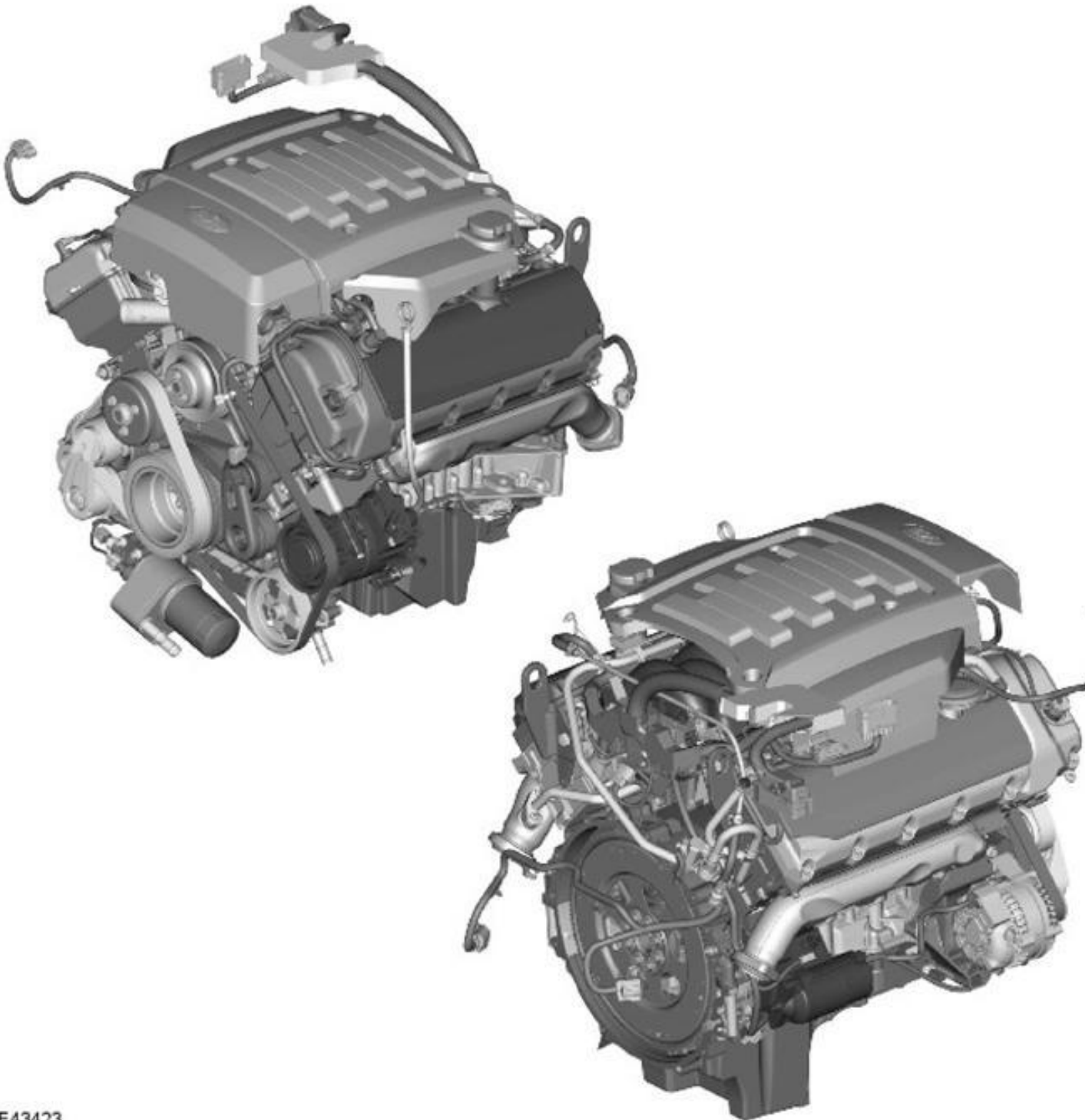
DESCRIPTION AND OPERATION

ENGINE

EXTERNAL VIEW

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E43423

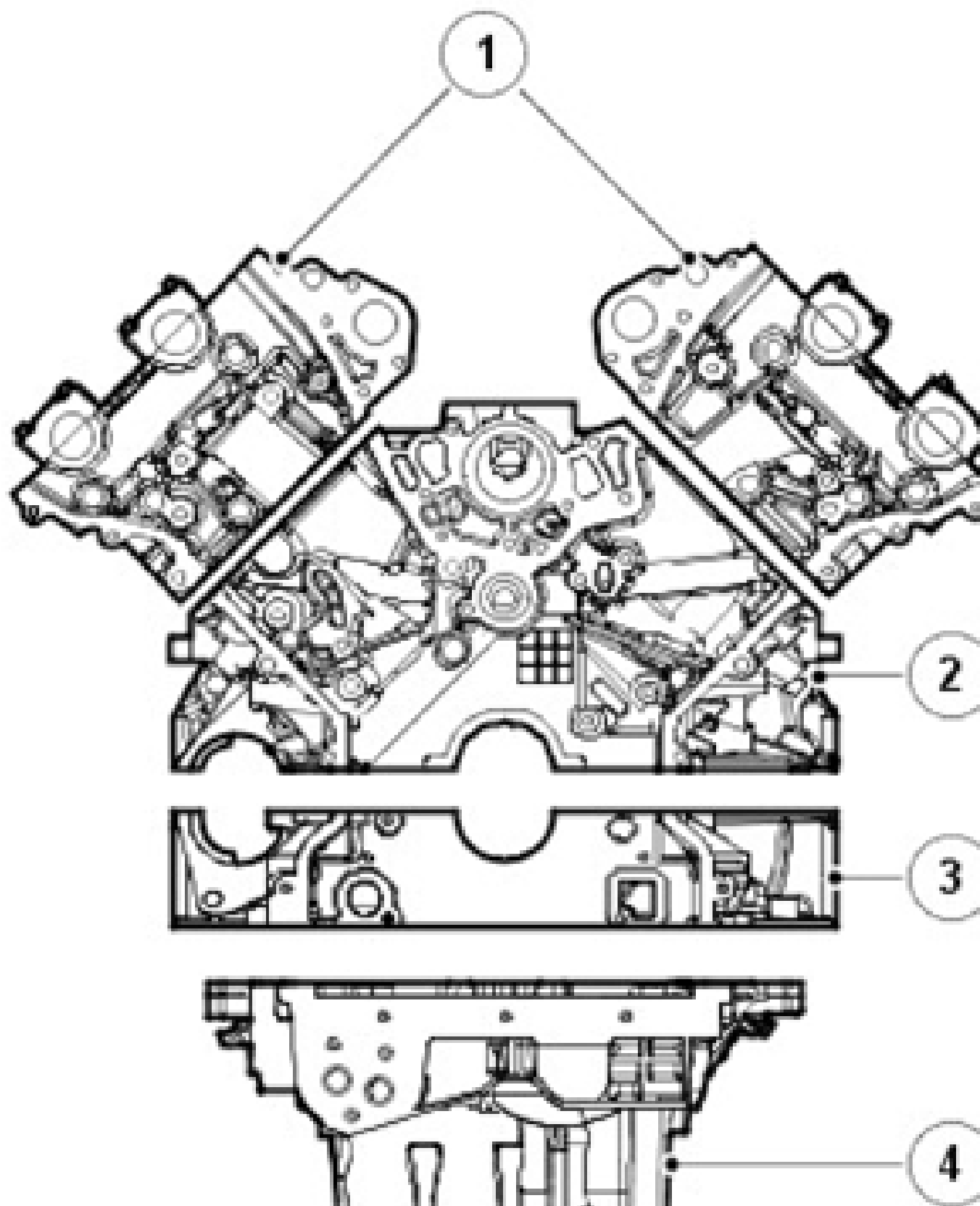
GENERAL

The V8 supercharged petrol engine is a 4.2 liter, 8 cylinder, 90 degrees 'Enclosed' V unit, with 4 valves per cylinder, operated by two overhead camshafts per cylinder head. 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 and positive crankcase ventilation 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 ignition system and the electric throttle.

The cylinder block is of aluminum alloy construction with cast iron liners. A cast aluminum bedplate is 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. A molded plastic acoustic cover is fitted over the upper engine to reduce engine-generated noise.

Engine Structure



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Item	Part Number	Description
1	-	Cylinder heads
2	-	Cylinder block
3	-	Bedplate
4	-	Structural sump

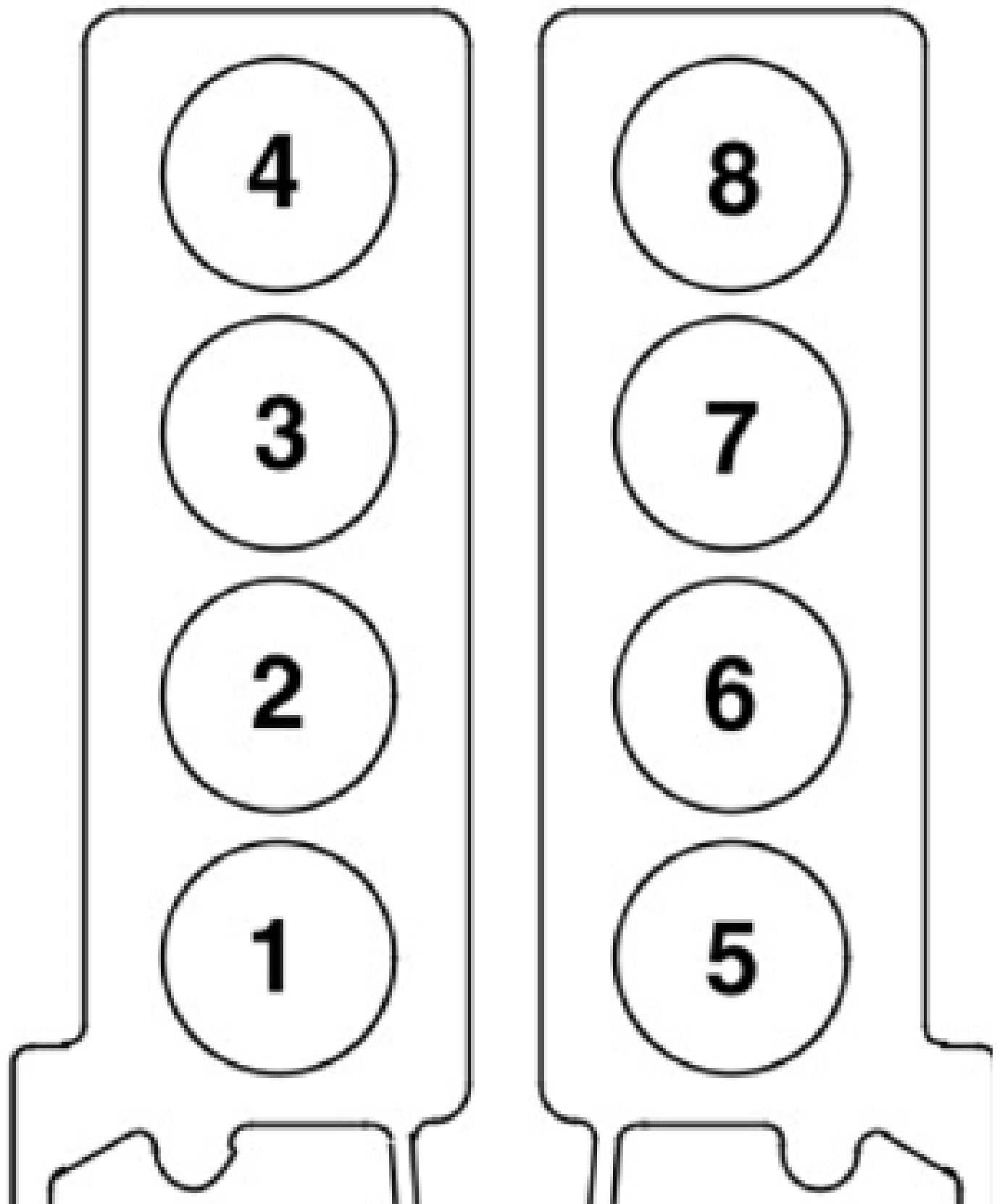
TECHNICAL FEATURES

The technical features include:

- An eight-cylinder 90-degree 'Enclosed V' configuration liquid cooled aluminum cylinder block with cast iron liners
- Pistons are of open-ended skirt design, with two compression rings and a three-piece oil control ring
- Two aluminum cylinder heads, each incorporating two camshafts manufactured in chilled cast iron
- Four valves per cylinder
- Graded valve lifters (shimless)
- Belt driven supercharger
- Top fed, 12-hole fuel injectors
- Engine front cover manufactured from aluminum, accommodating the crankshaft front oil seal
- Primary and secondary chain drive for the camshafts
- An aluminum bedplate
- A cast iron crankshaft
- Fracture-split connecting rods in sintered-forged steel
- A twin multi-vee belt, driving the front-end accessories
- Fabricated stainless steel twin skin exhaust manifolds
- 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.

CYLINDER NUMBERING CONVENTION

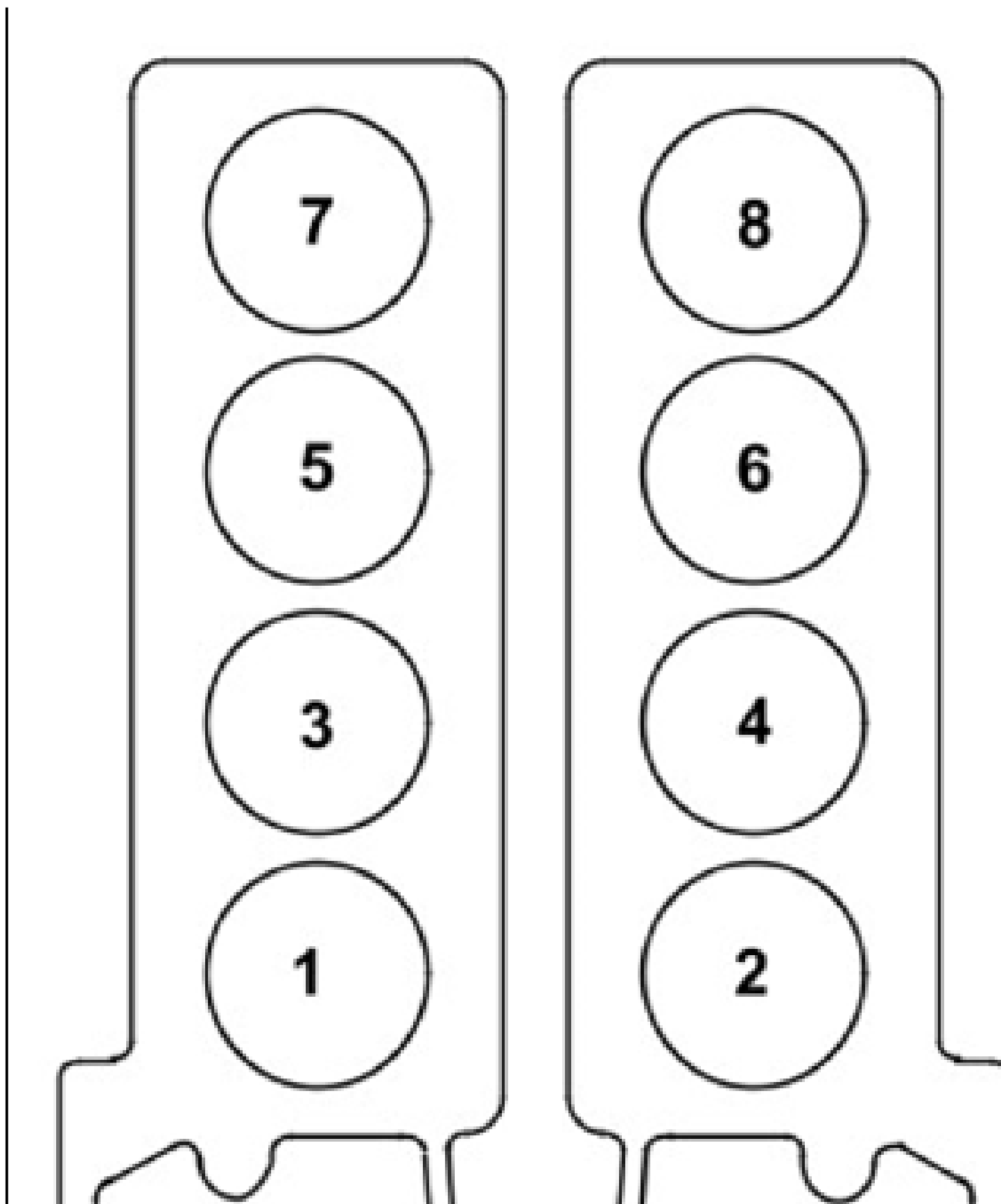
Pre 2006



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2006 onwards



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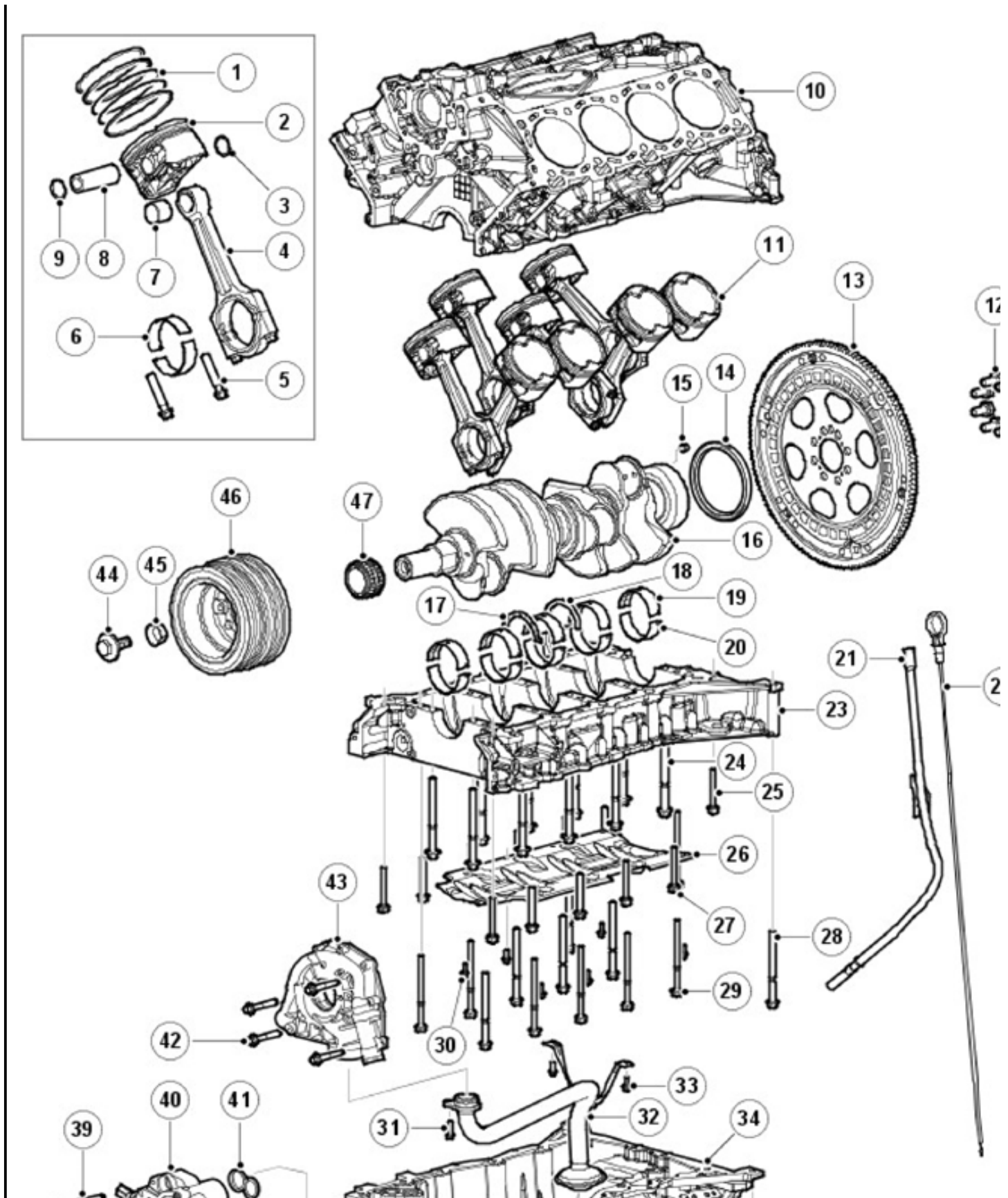
ENGINE DATA

DESCRIPTION	TYPE
Configuration	90 degree V8
Maximum power	283 kW at 5750 rpm
Maximum torque	550 Nm at 3500 rpm
Displacement	4196 liters
Stroke/bore	90.3/86 mm
Compression ratio	9.1: 1
Firing order (pre 2006)	1 5 4 2 6 3 7 8
Firing order (2006 onwards)	1 2 7 3 4 5 6 8
Engine weight	220 kg (approx.)
Oil volume	7.5 liters (wet)

CYLINDER BLOCK COMPONENTS

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Item	Part Number	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 gage tube
22	-	Oil level gage
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	-	Sump
35	-	Bolts
36	-	Bolts
37	-	Bolts
38	-	Oil filter
39	-	Bolts
40	-	Oil filter head assembly
41		

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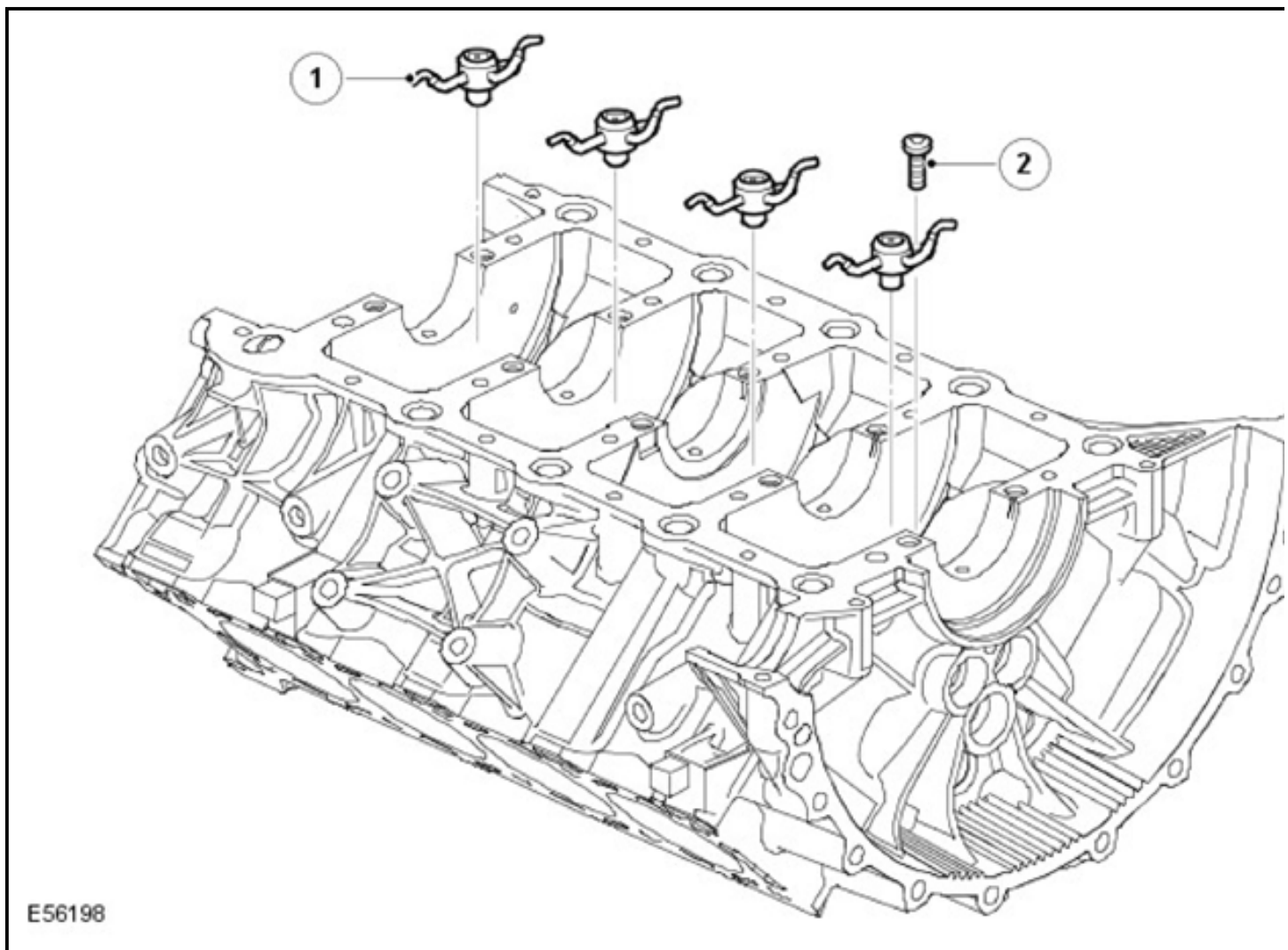
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	-	Seals
42	-	Bolts
43	-	Oil pump
44	-	Crankshaft bolt
45	-	Taper collet
46	-	Crankshaft pulley
47	-	Crankshaft sprocket

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. The right hand cylinder bank is designated as 'A' bank, and the left hand as 'B' bank.

Piston Cooling Jets



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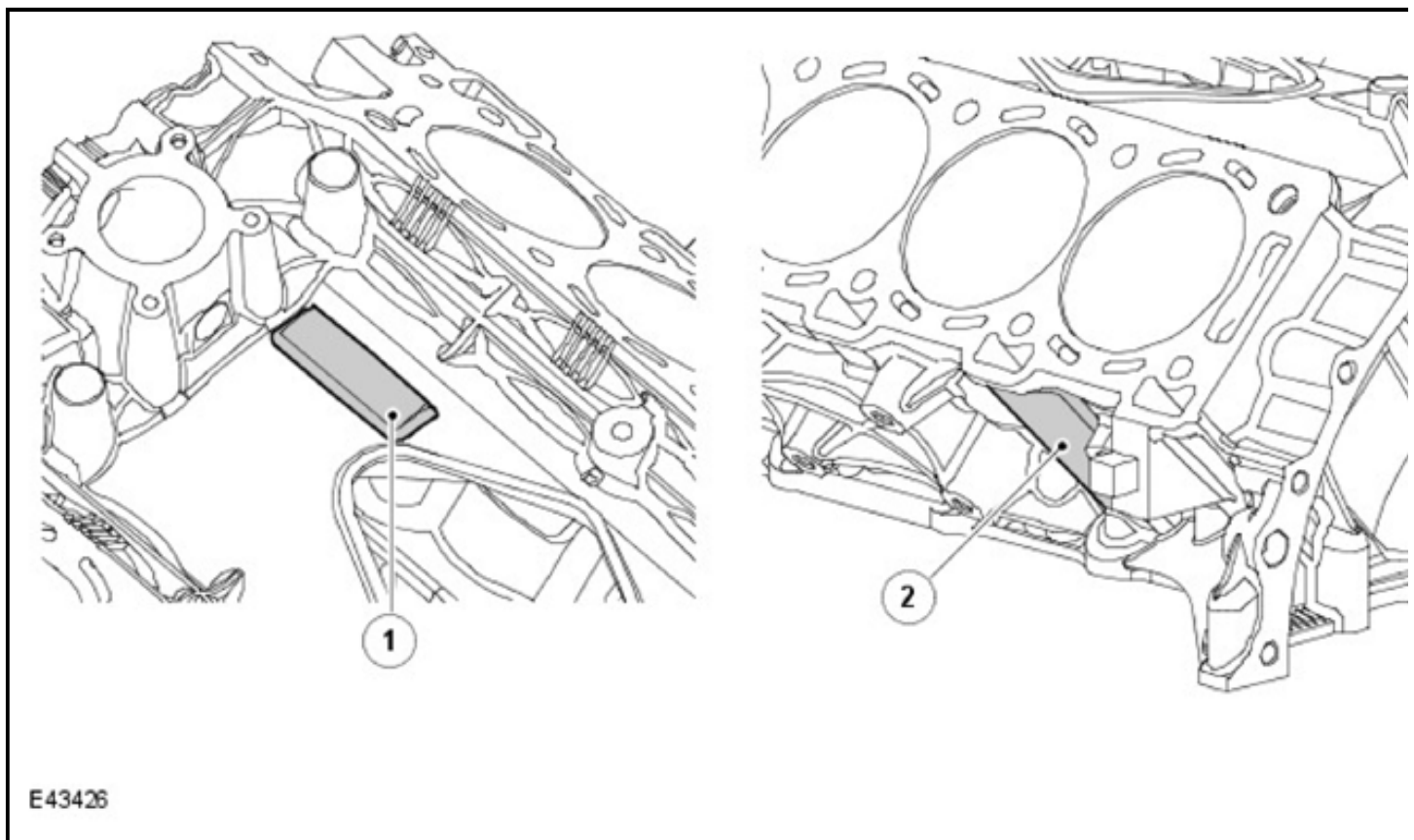
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Item	Part Number	Description
1	-	Piston cooling jets
2	-	Bolt

Jets located in the cylinder block provide piston and gudgeon pin lubrication and cooling. These jets spray oil on the underside of the piston.

Lubrication oil is distributed through the cylinder block, via the main oil gallery and channels bored in the block, to all critical moving parts. These channels divert oil to the main and big-end bearings via holes machined into the crankshaft.

Engine Data Locations

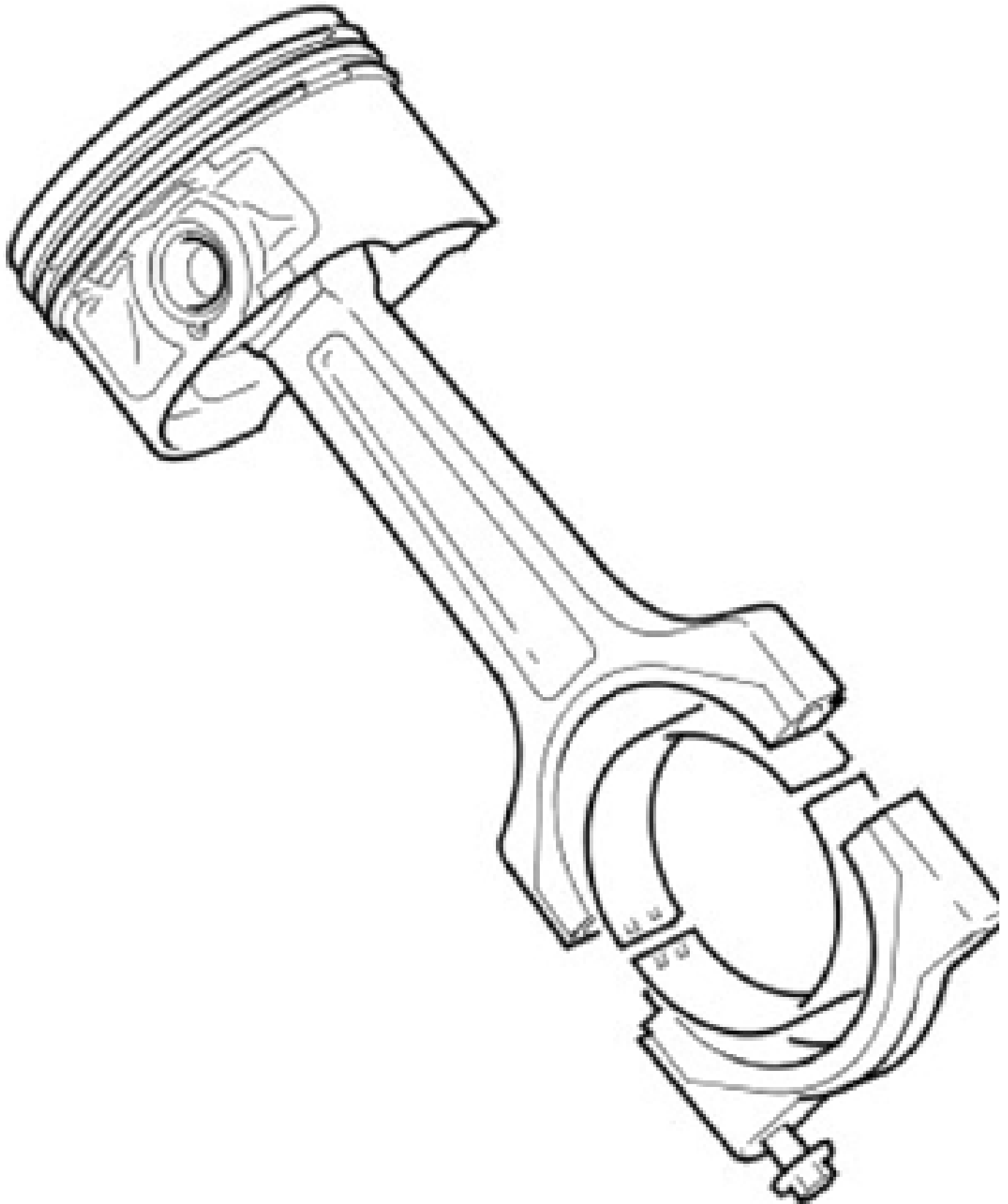


Item	Part Number	Description
1	-	Engine part number
2	-	Engine data (main bearing diameters, cylinder bore diameters, etc), emissions code and engine number

Engine data is marked at three locations, two on the cylinder block (shown) and one 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) Manual.

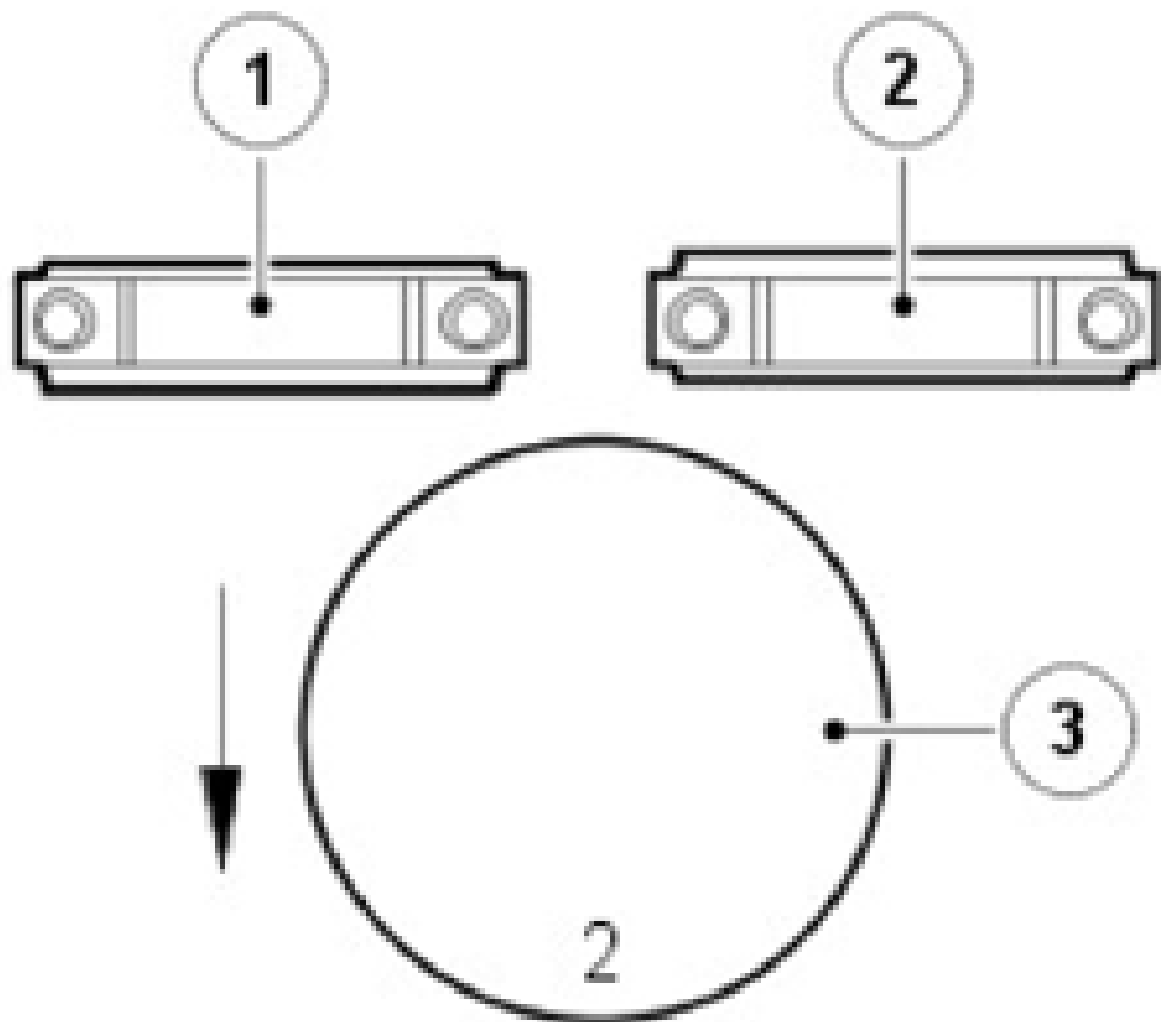
Connecting Rods and Pistons



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 with a dished crown. They are also manufactured from a higher strength aluminum alloy and incorporate a thicker top land to resist the increased thermal and mechanical loads produced by supercharging. Three piston rings, two compression and one solid oil control ring, are installed on each piston. Each piston is installed on a gudgeon pin located in an bronze bushing in the connecting rod.

Connecting Rod and Piston Installation



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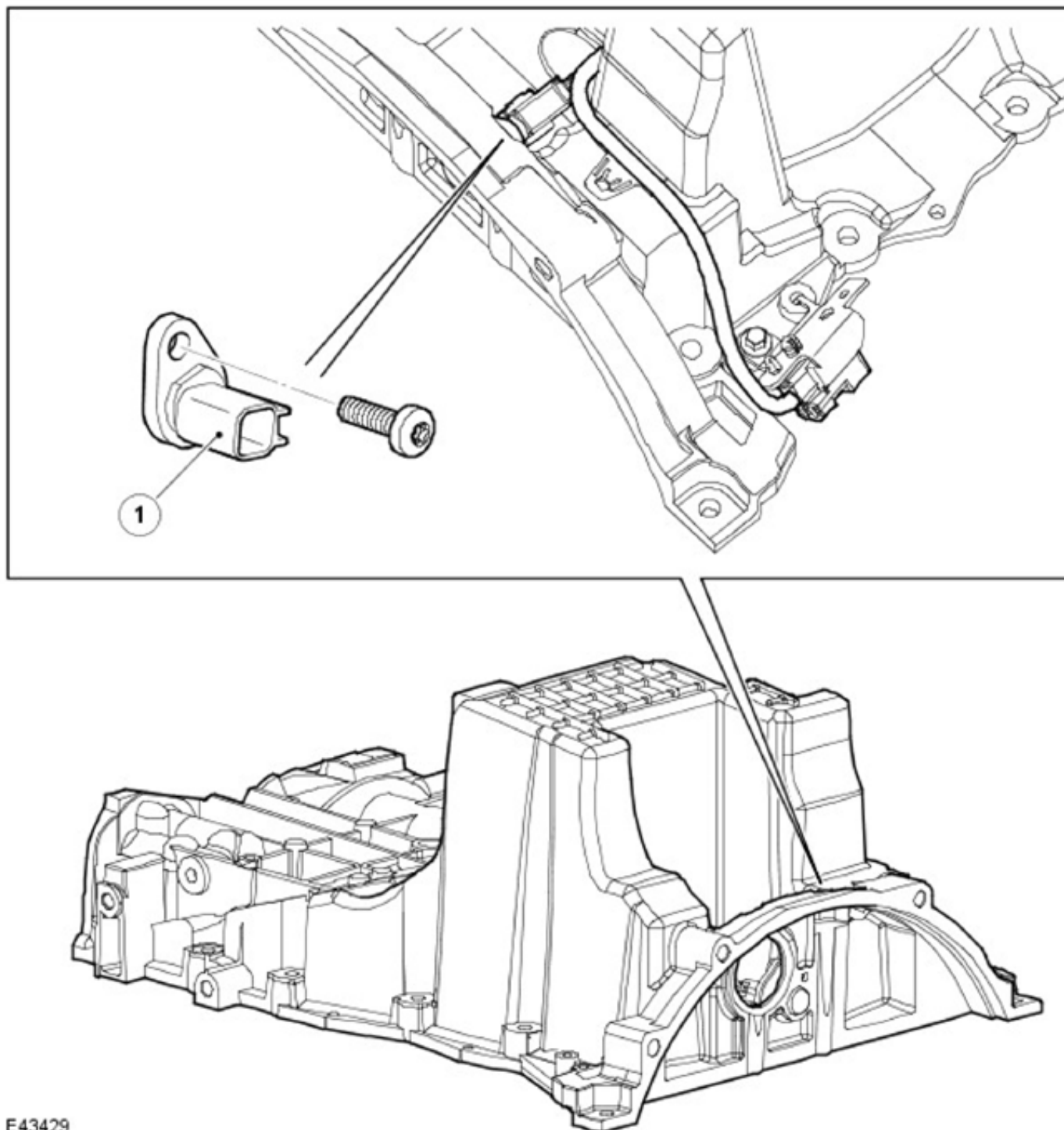
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Item	Part Number	Description
1	-	Bank A (RHS)
2	-	Bank B (LHS)
3	-	Piston

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:

- Bank 'A' - piston grade number and the thick flange of the connecting rod must face the front of the engine
- Bank 'B' - piston grade number and the thin flange of the connecting rod must face the front of the engine

Crankshaft Position Sensor



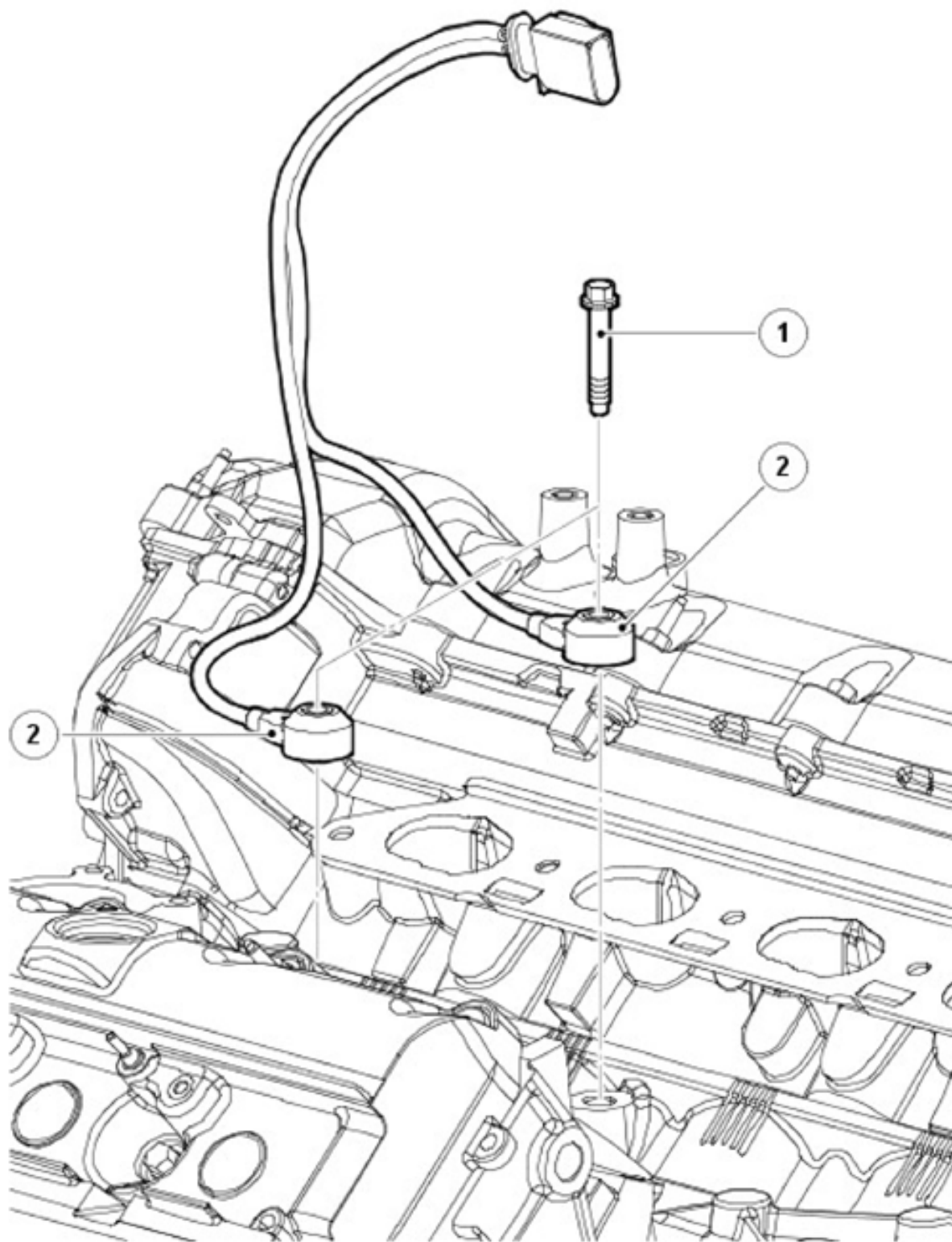
Item	Part Number	Description
1	-	Crankshaft position sensor (CKP)

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** . .

Knock Sensors



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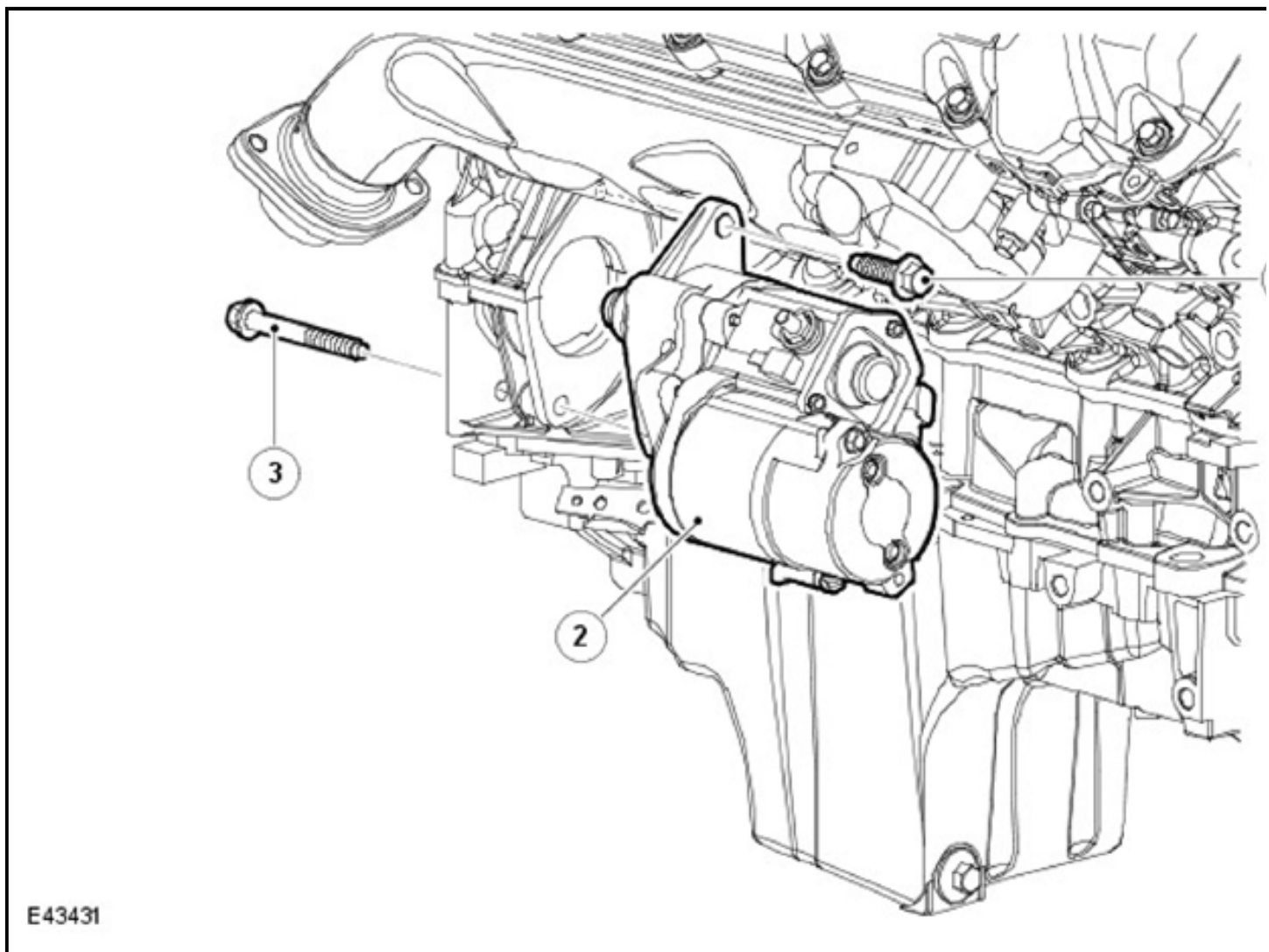
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Item	Part Number	Description
1	-	Bolt
2	-	Knock sensor

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](#) .

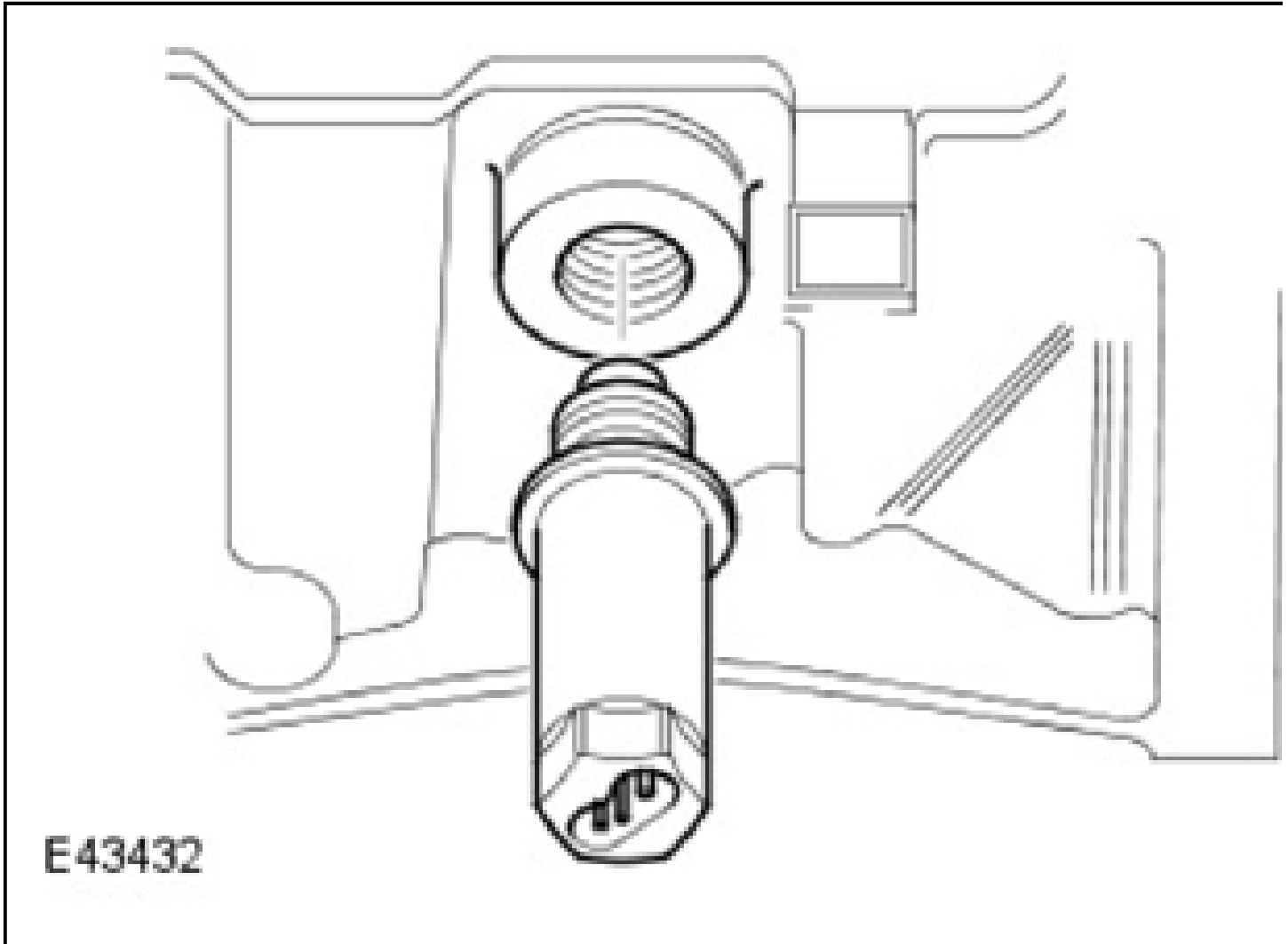
Starter



Item	Part Number	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** .

Coolant Drain Plug/Heater

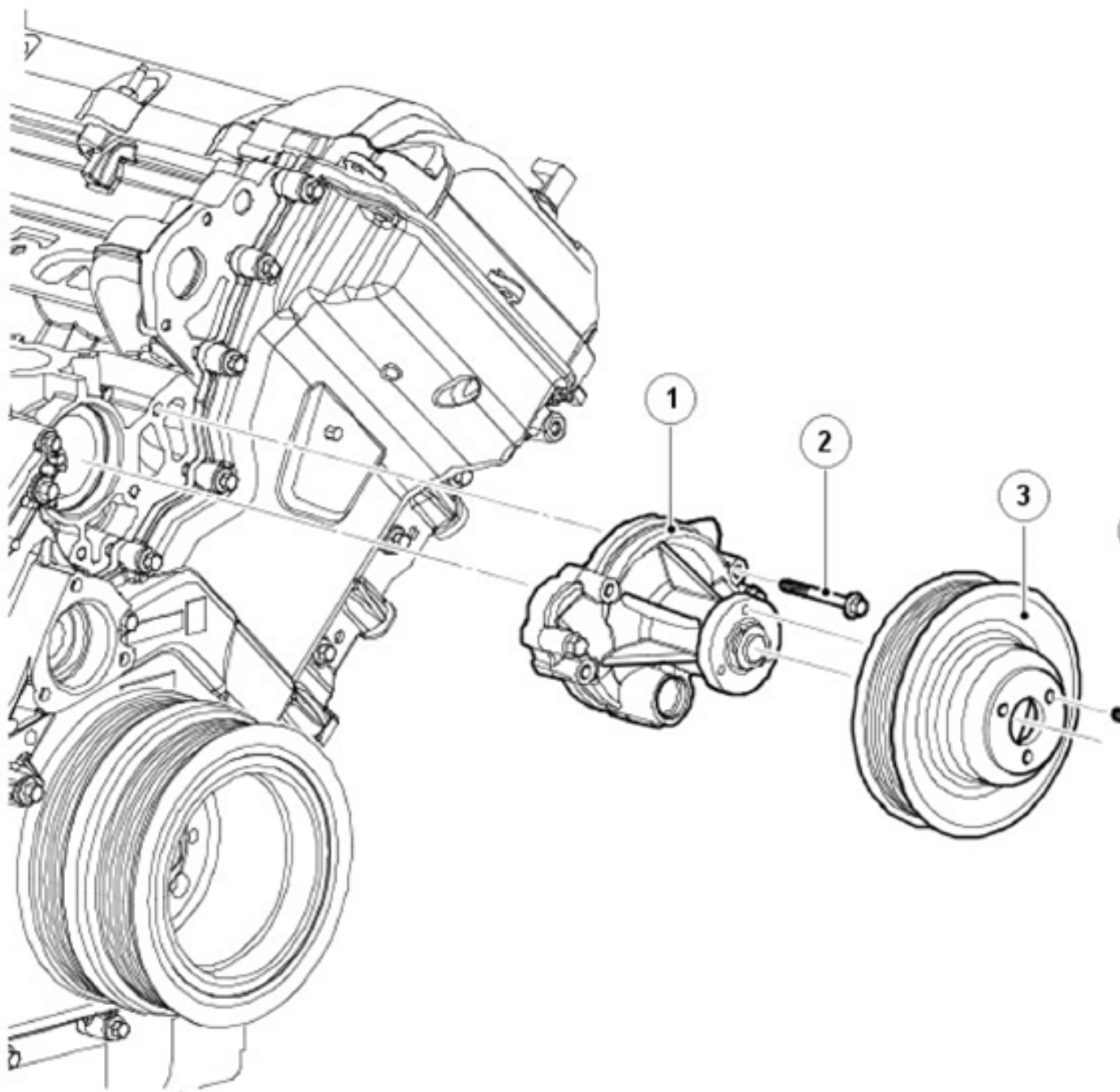
A coolant drain plug is installed on the rear left side of the cylinder block. On vehicles with the cold climate package, the cylinder block heater replaces the drain plug.

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

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Item	Part Number	Description
1	-	Coolant pump

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2	-	Bolt
3	-	Pulley
4	-	Bolt

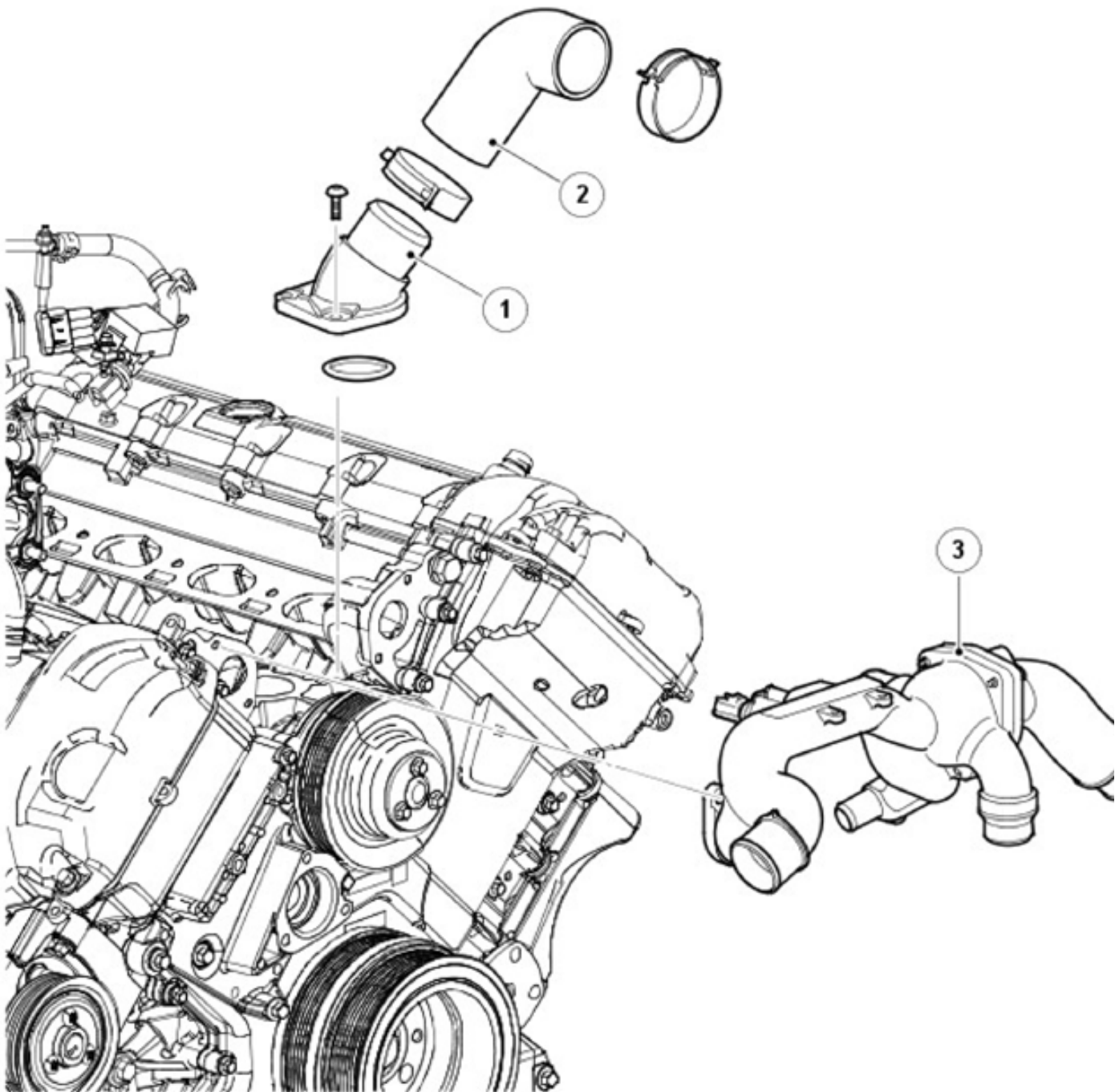
The coolant pump is installed between the two cylinder banks, on the front face of the cylinder block.

Coolant Inlet and Outlet Assembly



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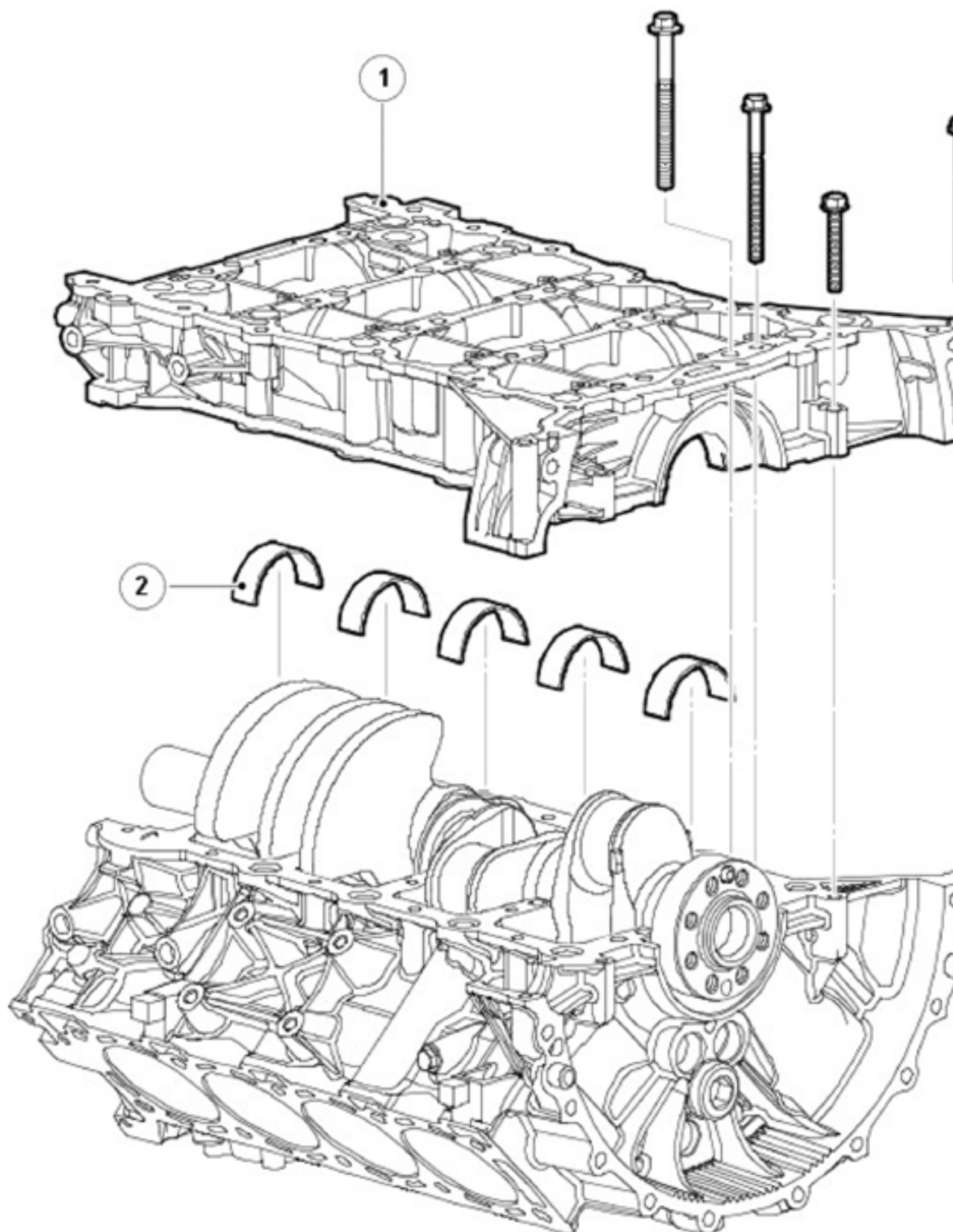


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Item	Part Number	Description
1	-	Coolant outlet elbow
2	-	Coolant hose
3	-	Thermostat housing

To accommodate the installation of the supercharger, the thermostat housing and coolant outlet duct are combined into an aluminum alloy coolant outlet assembly, which is installed between the two cylinder banks, immediately above the coolant pump. A hose connects the coolant outlet assembly to a coolant inlet housing attached to the coolant pump intake on the cylinder block. The thermostat controls the flow of coolant through the radiator.

CRANKSHAFT AND SUMP COMPONENTS

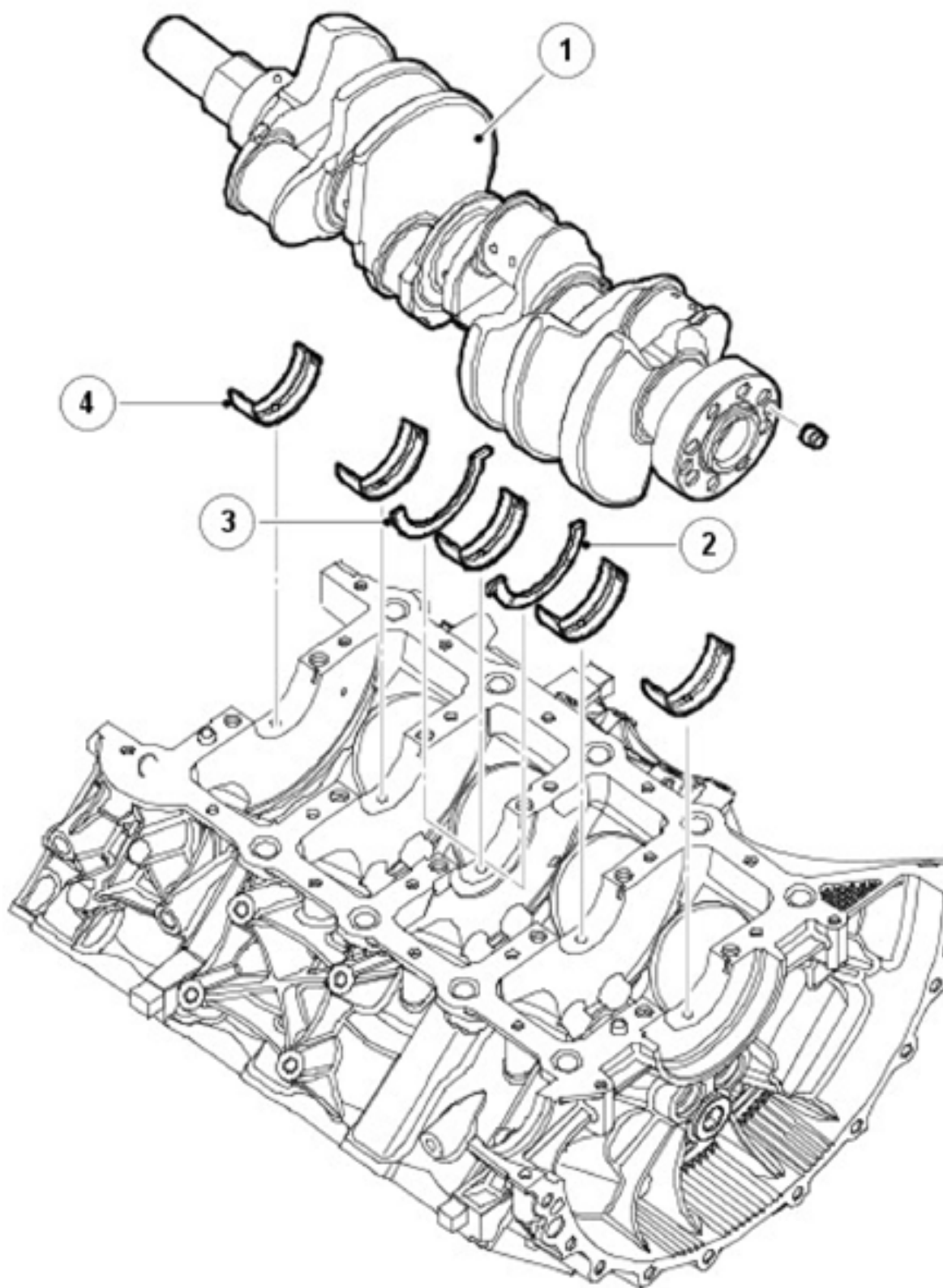


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Item	Part Number	Description
1	-	Bedplate
2	-	Main bearings - lower

Crankshaft and Main Bearings



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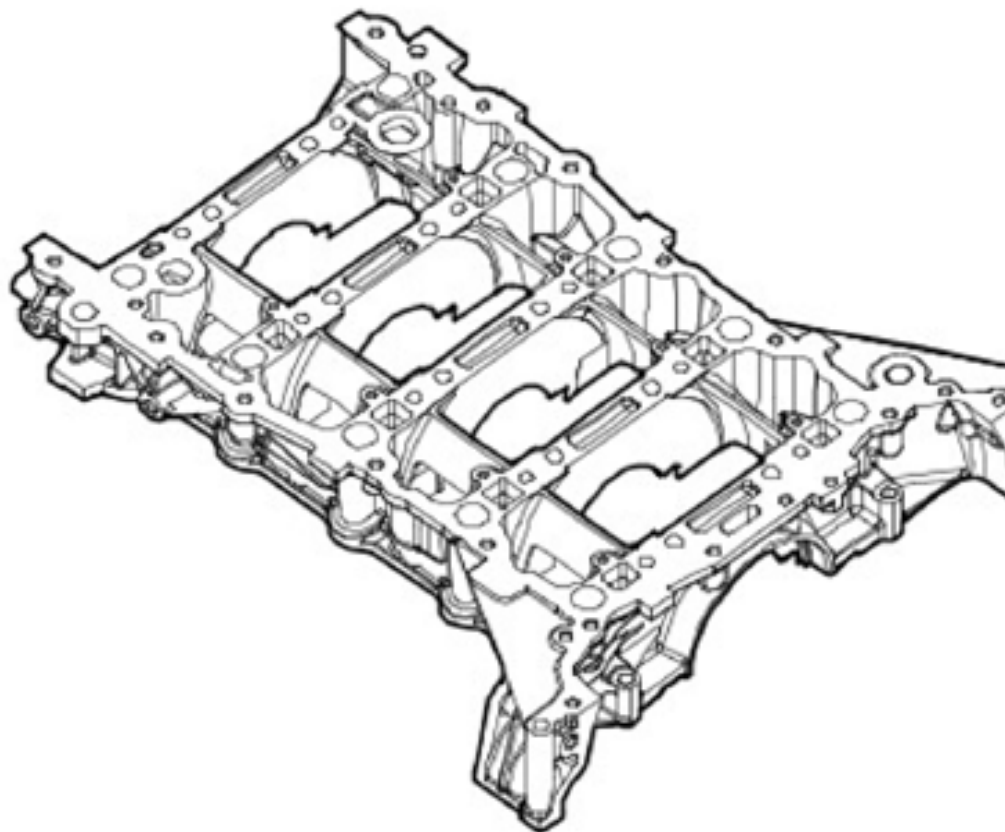
Item	Part Number	Description
1	-	Crankshaft
2	-	Thrust washer
3	-	Thrust washer
4	-	Main bearings - upper

Six counter-balance weights ensure good vibration levels from the four throw, five 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. An aluminum/tin thrust washer is installed each side of the top half of the center main bearing.

Bedplate



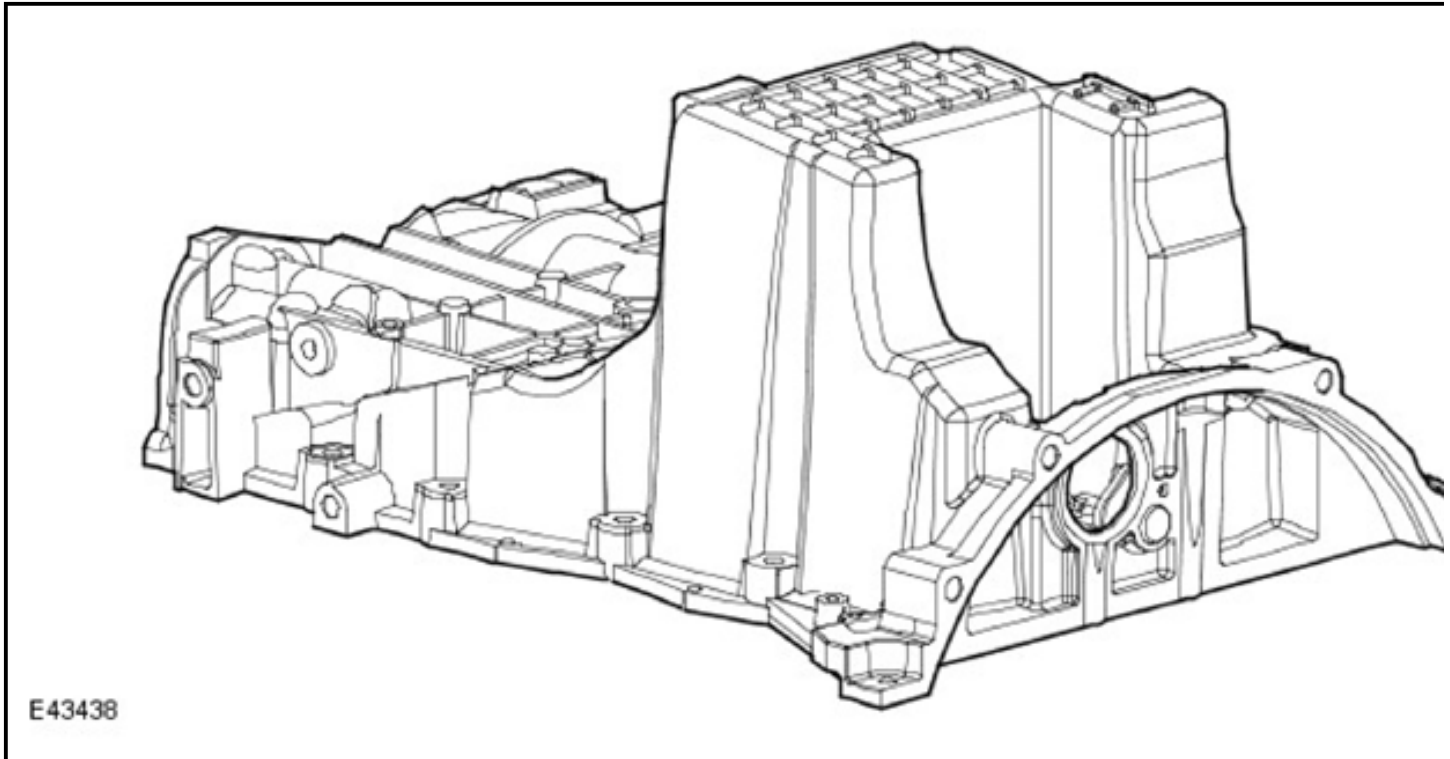
E43437

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.

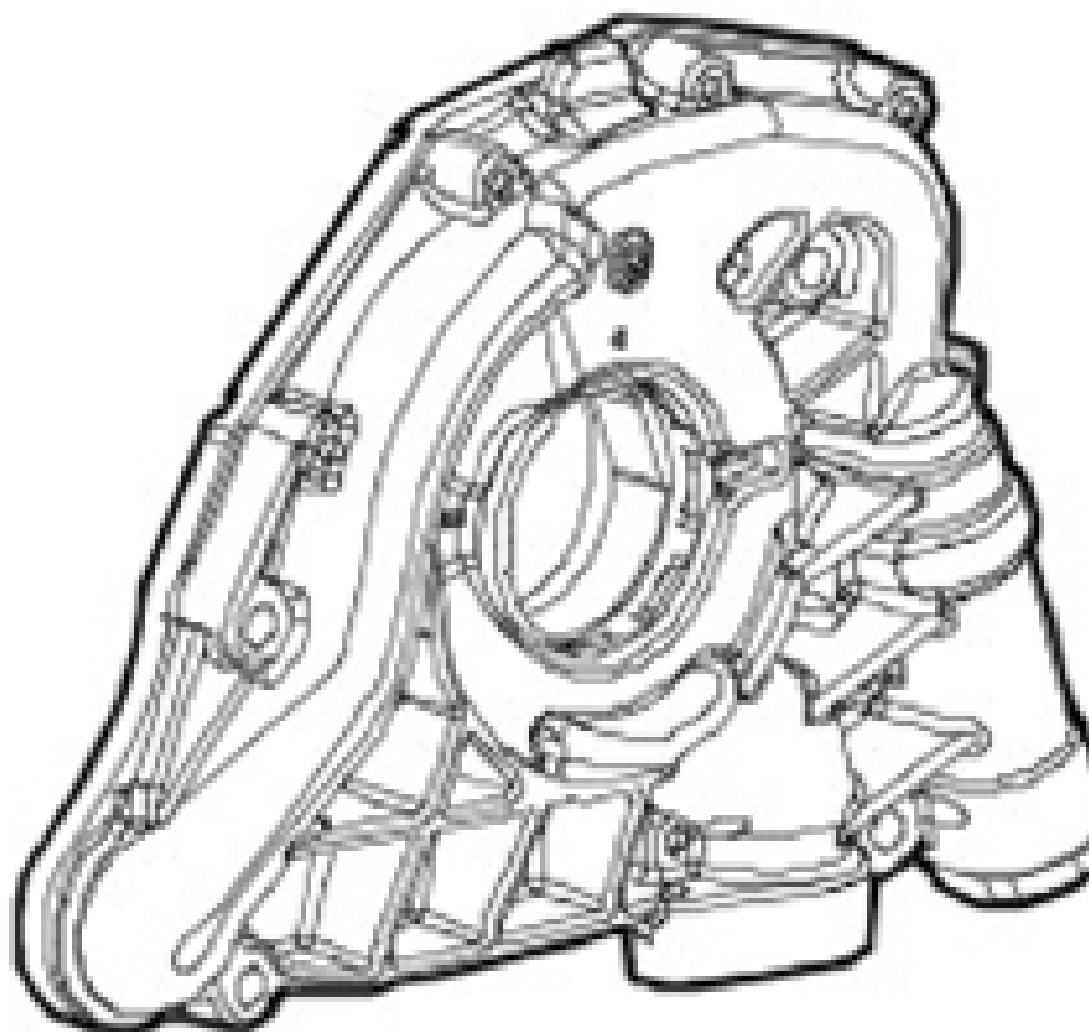
Sump



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.

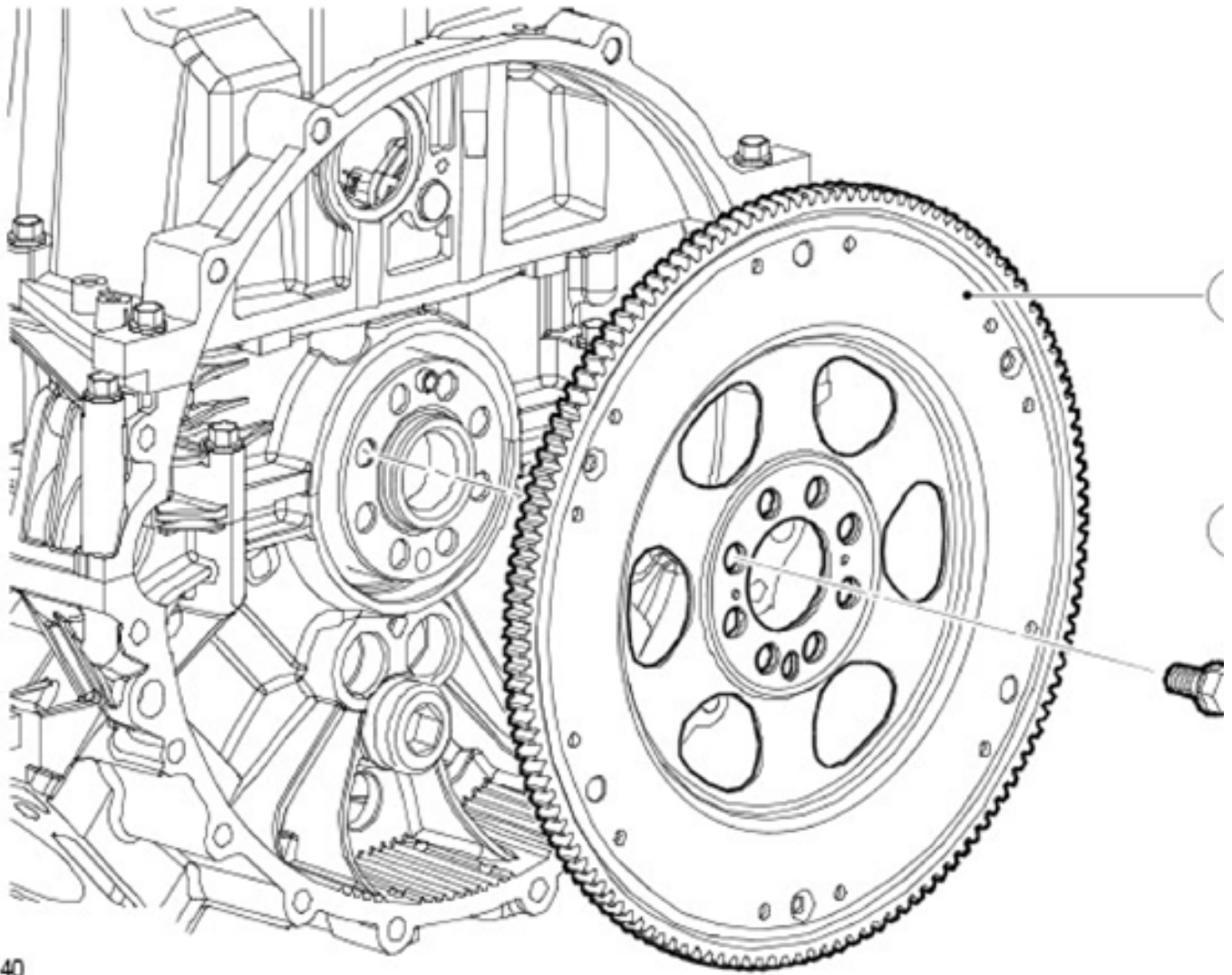
A bead of sealant seals the joint between the structural sump and the bedplate.

Oil Pump

**E43439**

The oil pump is installed on the crankshaft at the front of the engine. The pump outlet port aligns with oil passages in the bedplate.

Starter Drive Plate



Item	Part Number	Description
1	-	Starter drive plate
2	-	Bolt

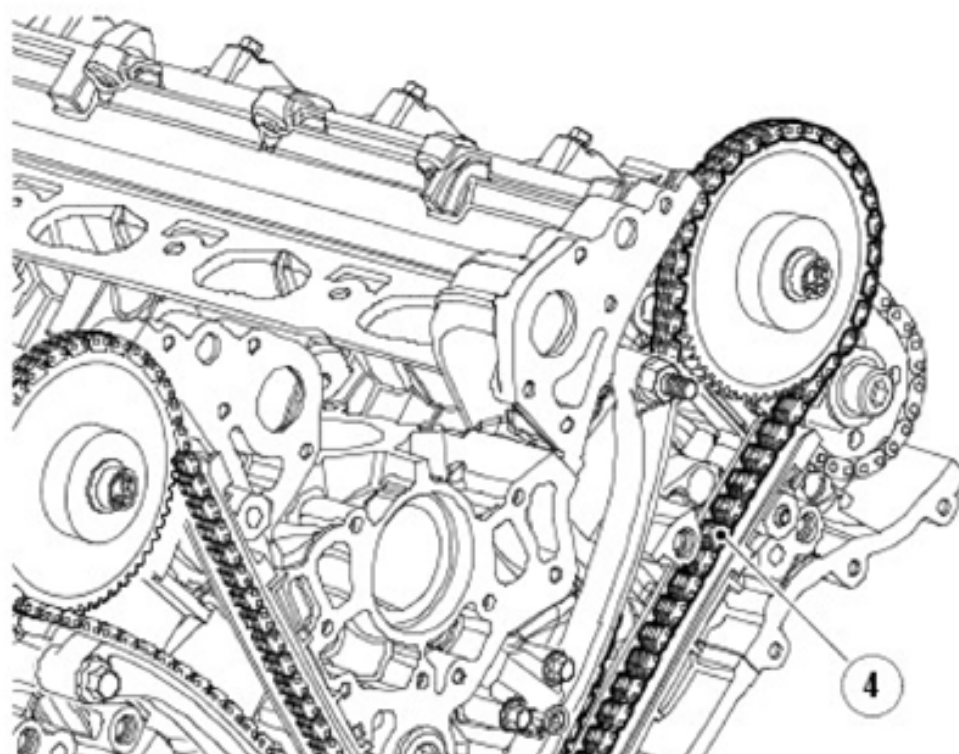
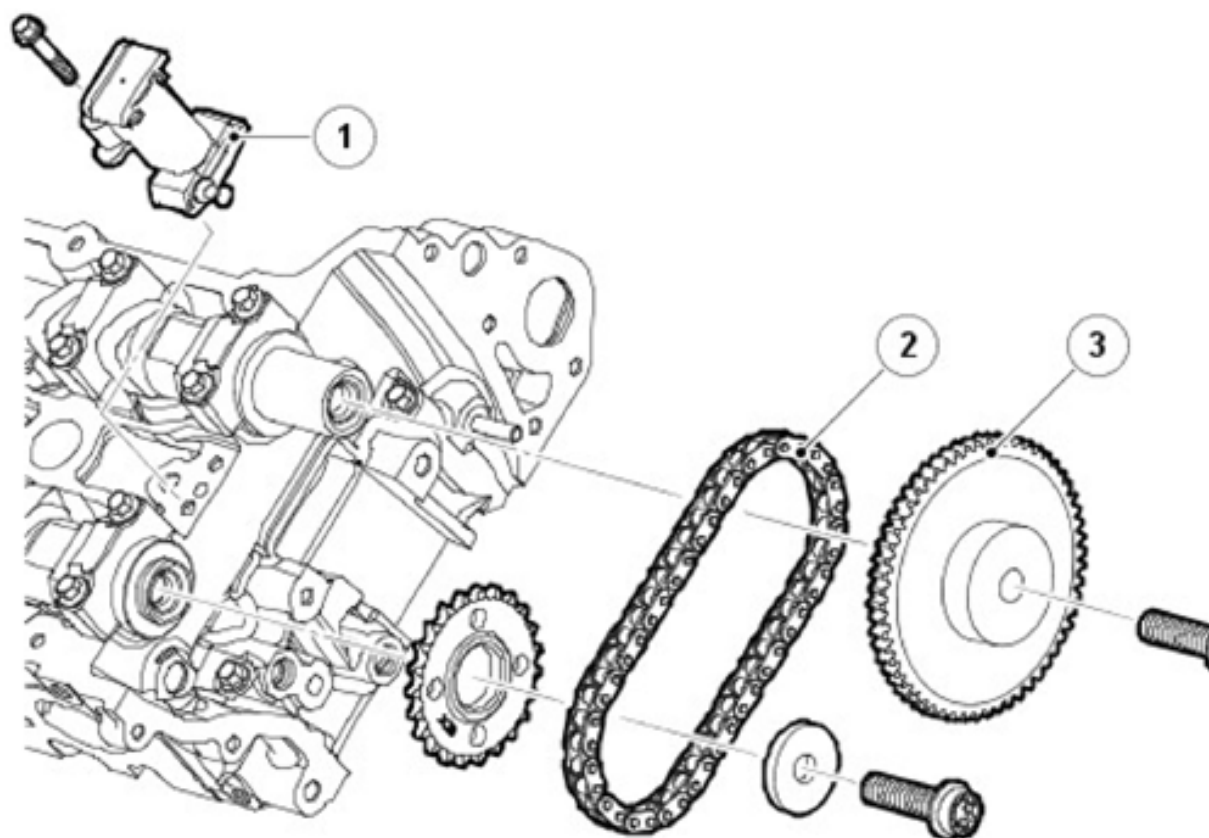
The starter drive plate is attached to the rear of the crankshaft. A timing disc, for the engine speed sensor, is spot welded to the front face of the drive plate.

Timing Disc



CAMSHAFT TIMING COMPONENTS



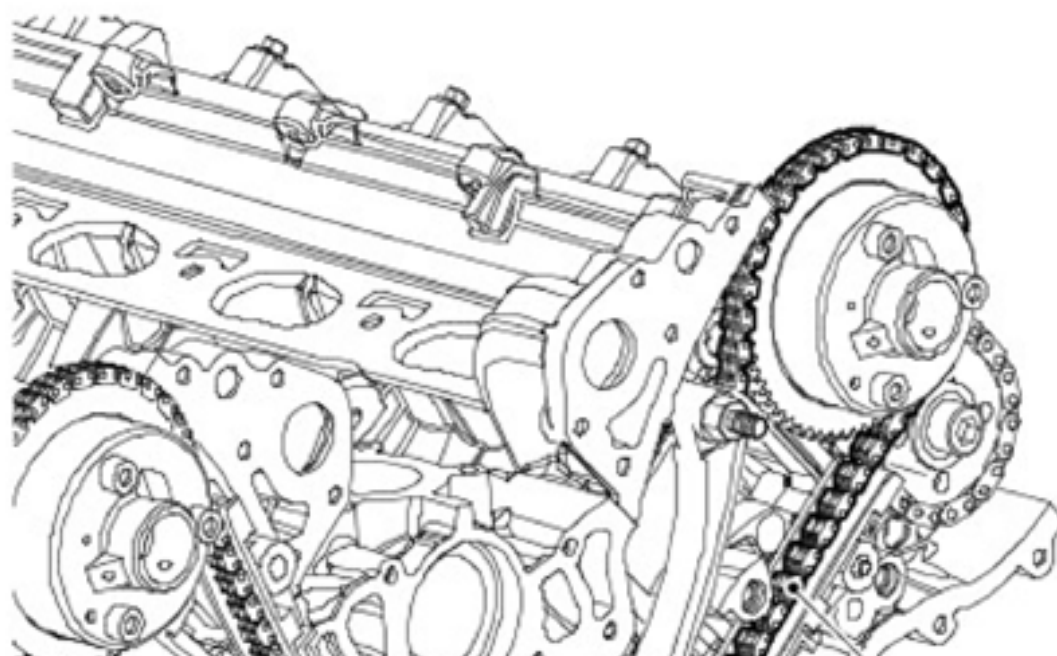
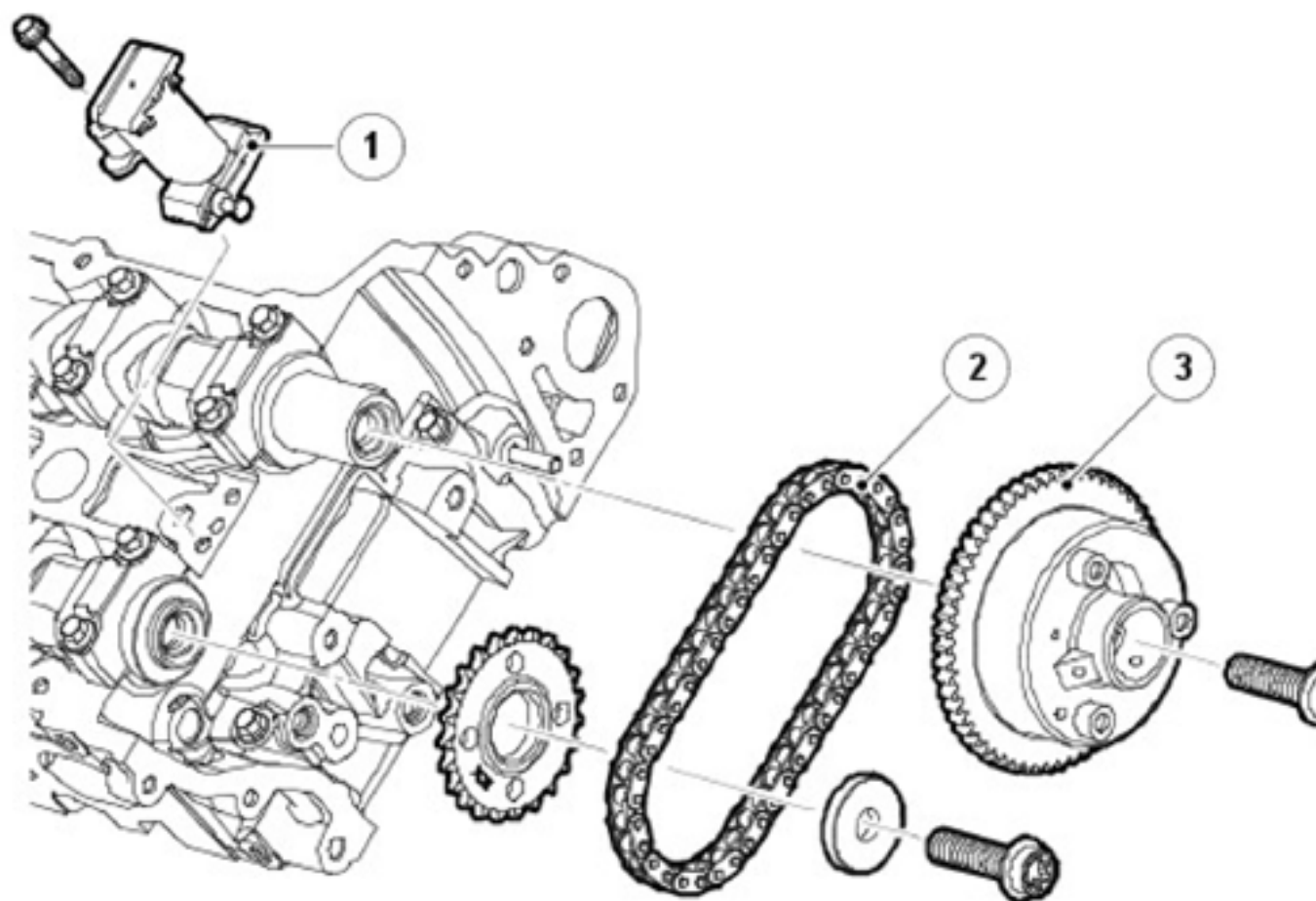


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Item	Part Number	Description
1	-	Secondary chain tensioner
2	-	Secondary chain
3	-	Inlet camshaft sprocket
4	-	Primary chain
5	-	Primary chain tensioner

NOTE: Vehicles fitted with Variable valve timing.



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Item	Part Number	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 drive from two sprockets on the crankshaft to each intake camshaft sprocket. The secondary chains transmit drive from the intake camshaft sprockets to the exhaust camshafts.

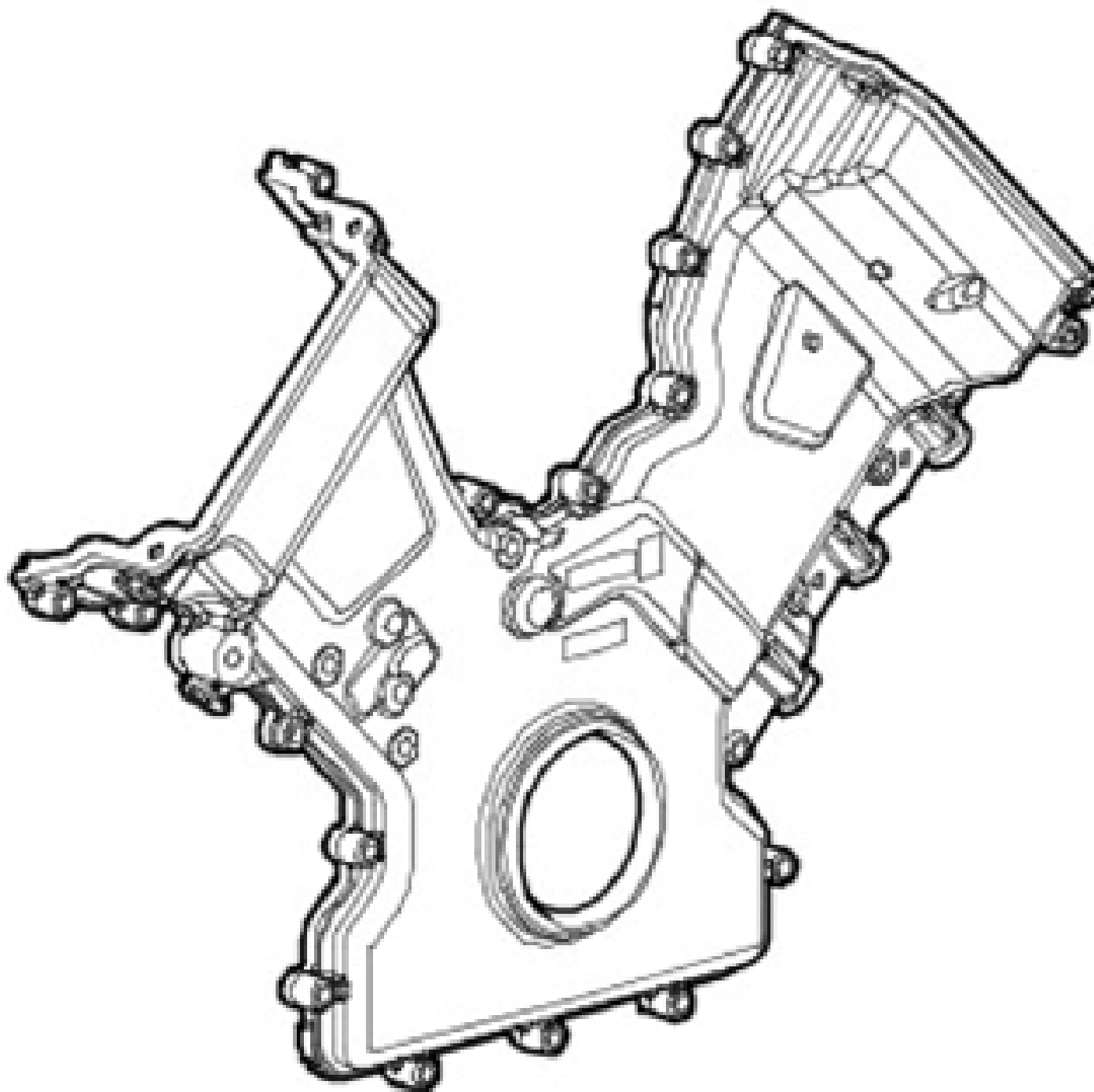
A key locates the two drive sprockets on the crankshaft. The crankshaft's torsional vibration damper retains the sprockets in position. The intake and exhaust camshaft sprockets are non-interference, non-keyed fit on their respective camshafts; the drive being transmitted by the face-to-face friction load produced by the 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.

In certain markets some engines are equipped with VVT timing gear.

For additional information, refer to: **ENGINE** .

Timing Cover



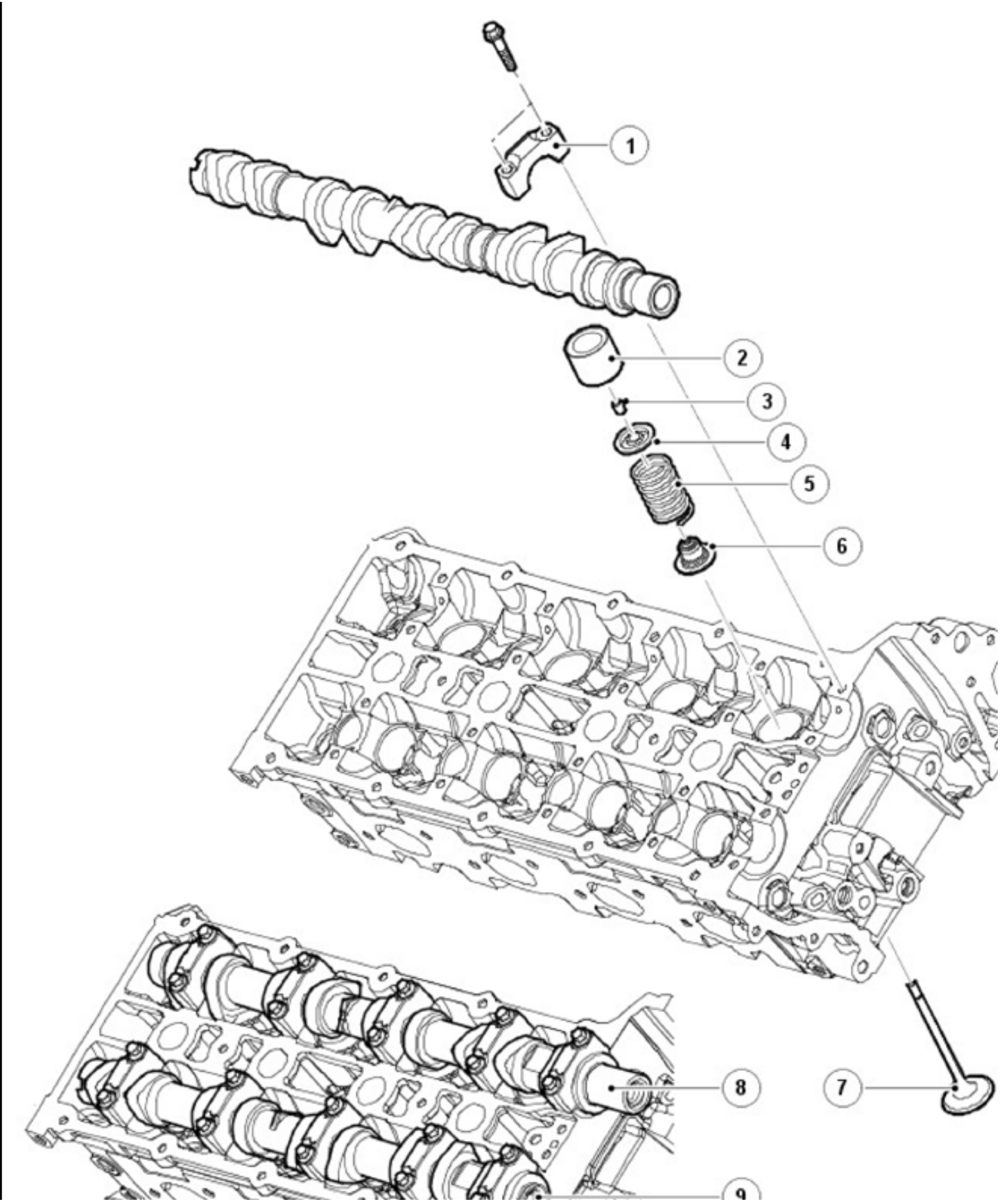
E43443

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

2009 Land Rover Range Rover Sport Supercharged

ENGINE Engine - V8 S/C 4.2L Petrol



2009 Land Rover Range Rover Sport Supercharged

ENGINE Engine - V8 S/C 4.2L Petrol

Item	Part Number	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

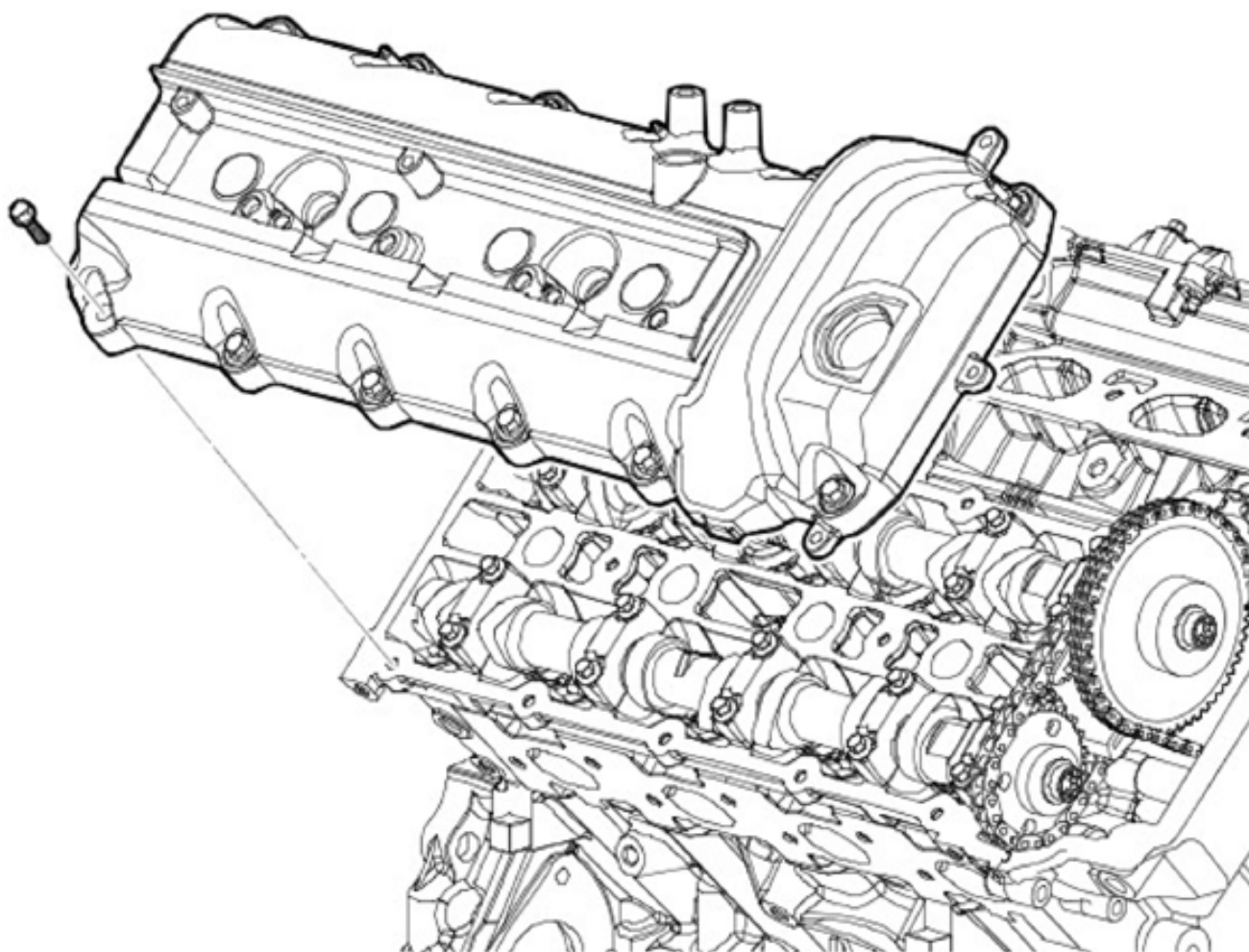
Cylinder Heads

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, one per cylinder, locate in recesses down the center line of each cylinder head.

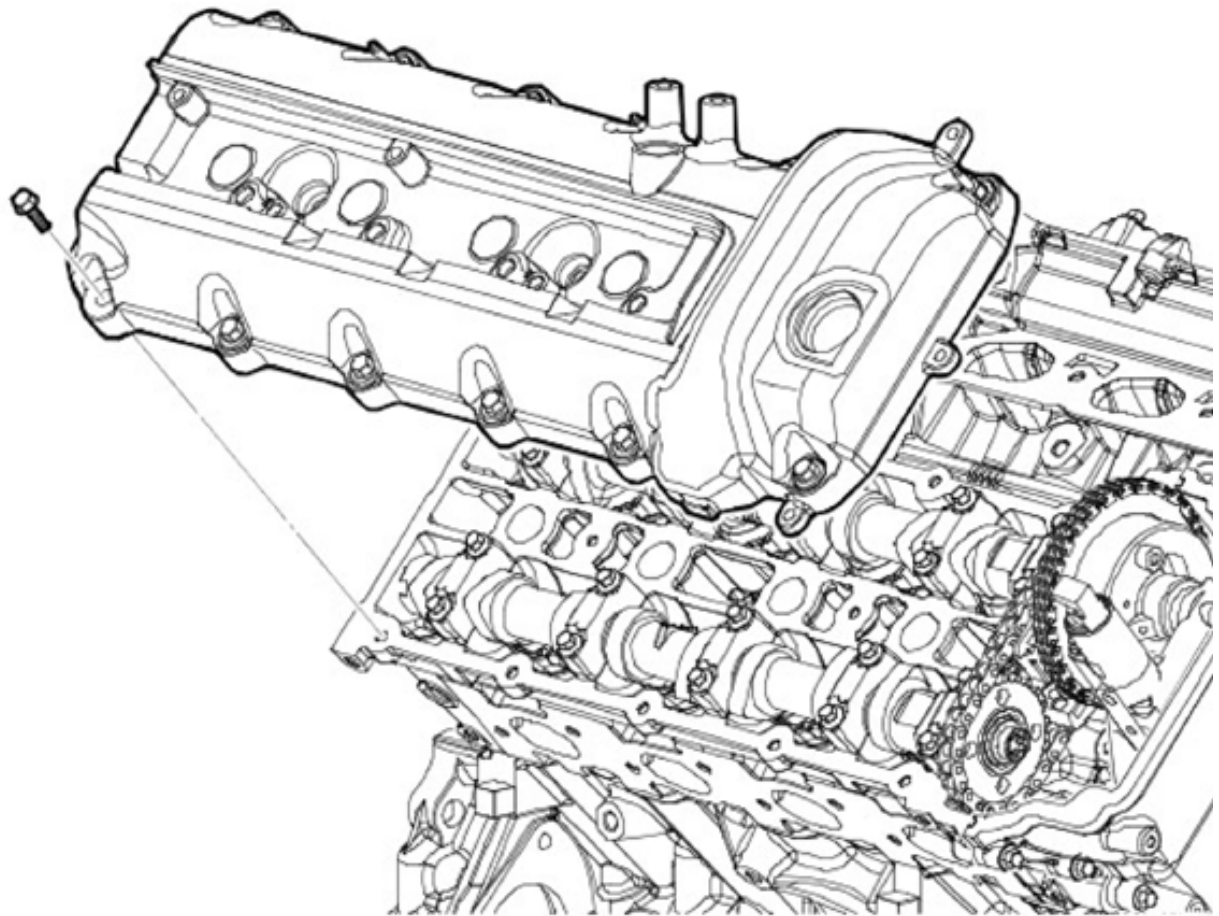
The engine-lifting eyes are bolted to the cylinder heads; two on the rear (one per head) and one at the front.

Camshaft Covers



E56201

NOTE: Vehicles fitted with Variable Valve Timing (VVT).



E43445

The camshaft covers are manufactured from thermo-plastic. The A bank camshaft cover incorporates an outlet for the part load engine breather and the Pressure Control Valve (PCV). The B bank 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.

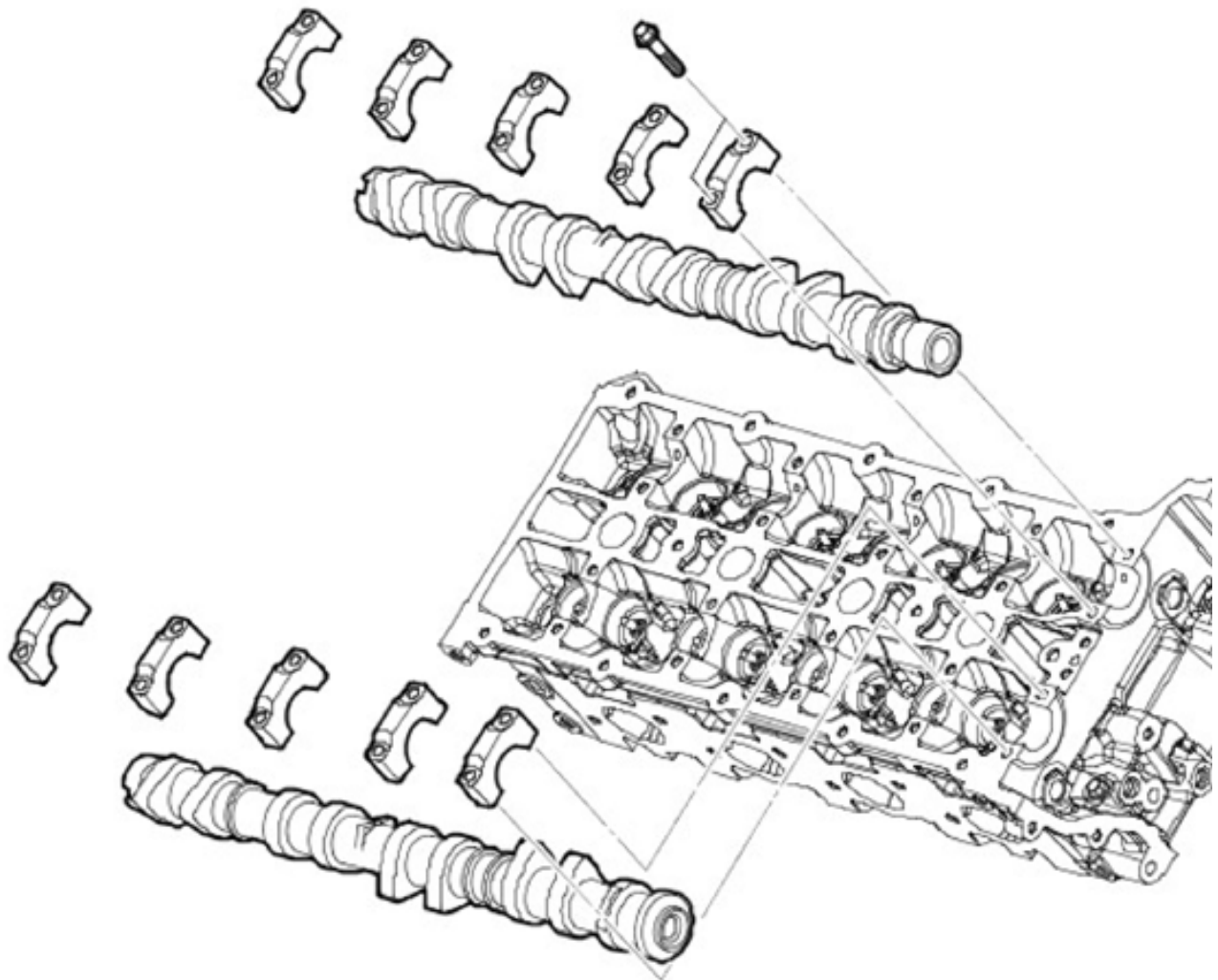
For additional information, refer to: **Electronic Engine Controls** .

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

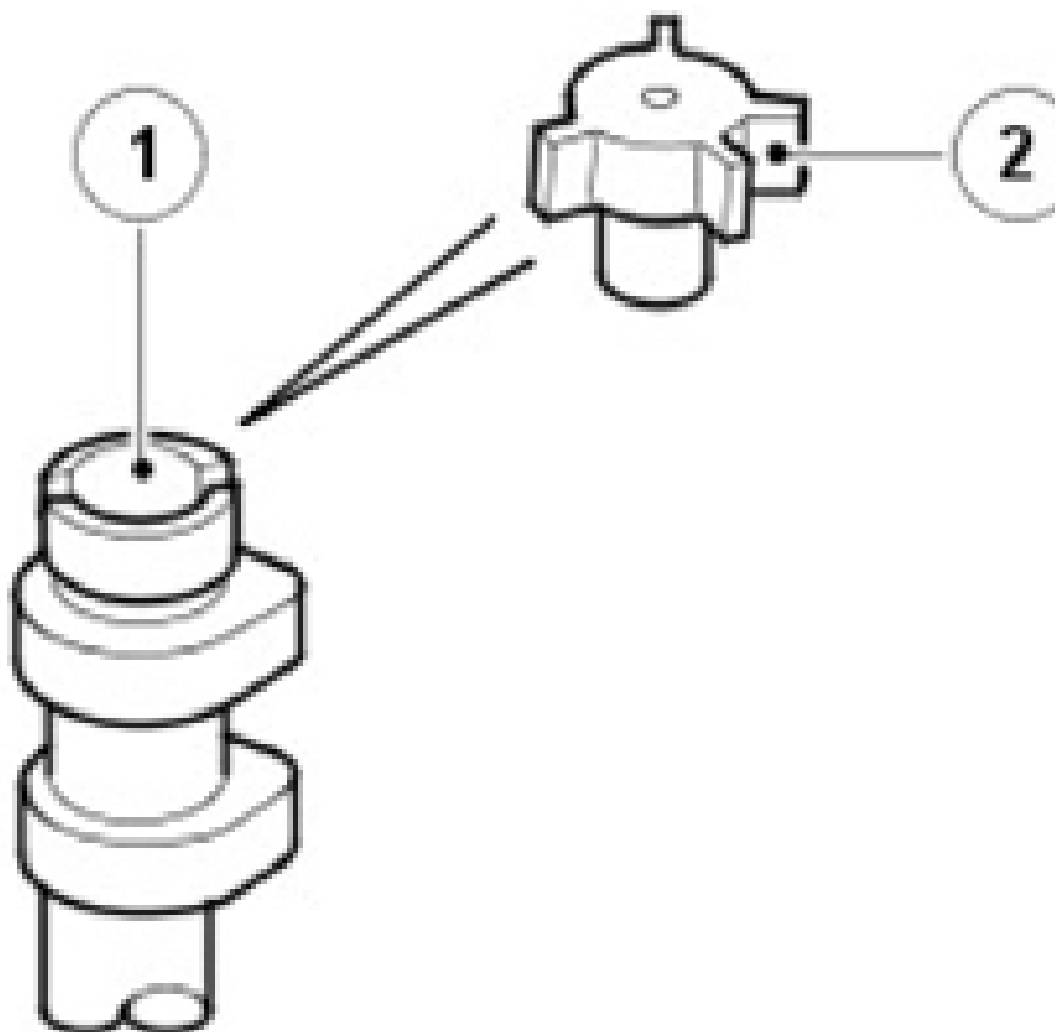
The multi-layered steel cylinder head gasket has cylinder specific water flow cross-sections for uniform coolant flow.

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.

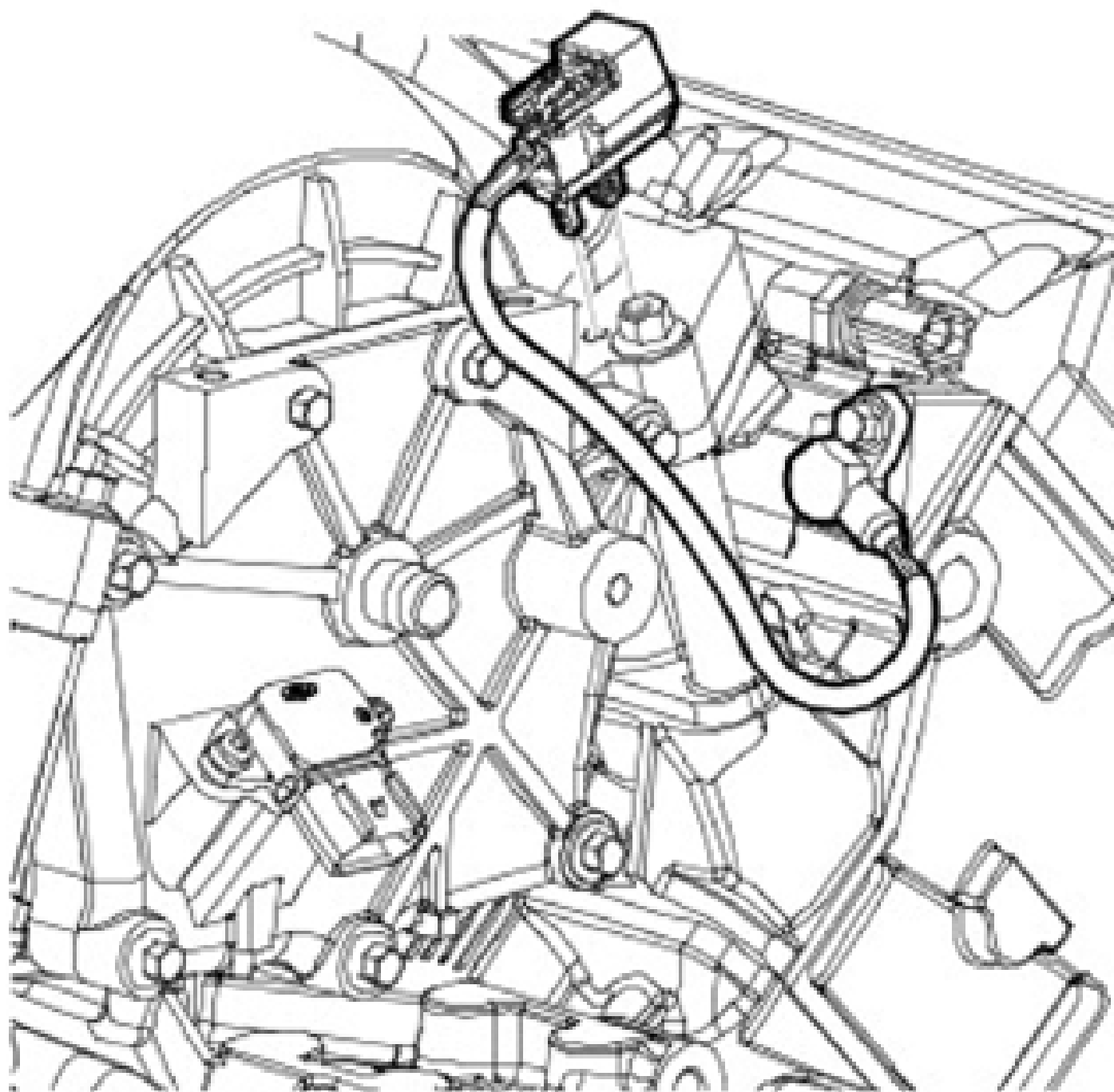
Sensor Ring

**E43447**

Item	Part Number	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

**E43448**

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** .

Inlet and Exhaust Valves

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

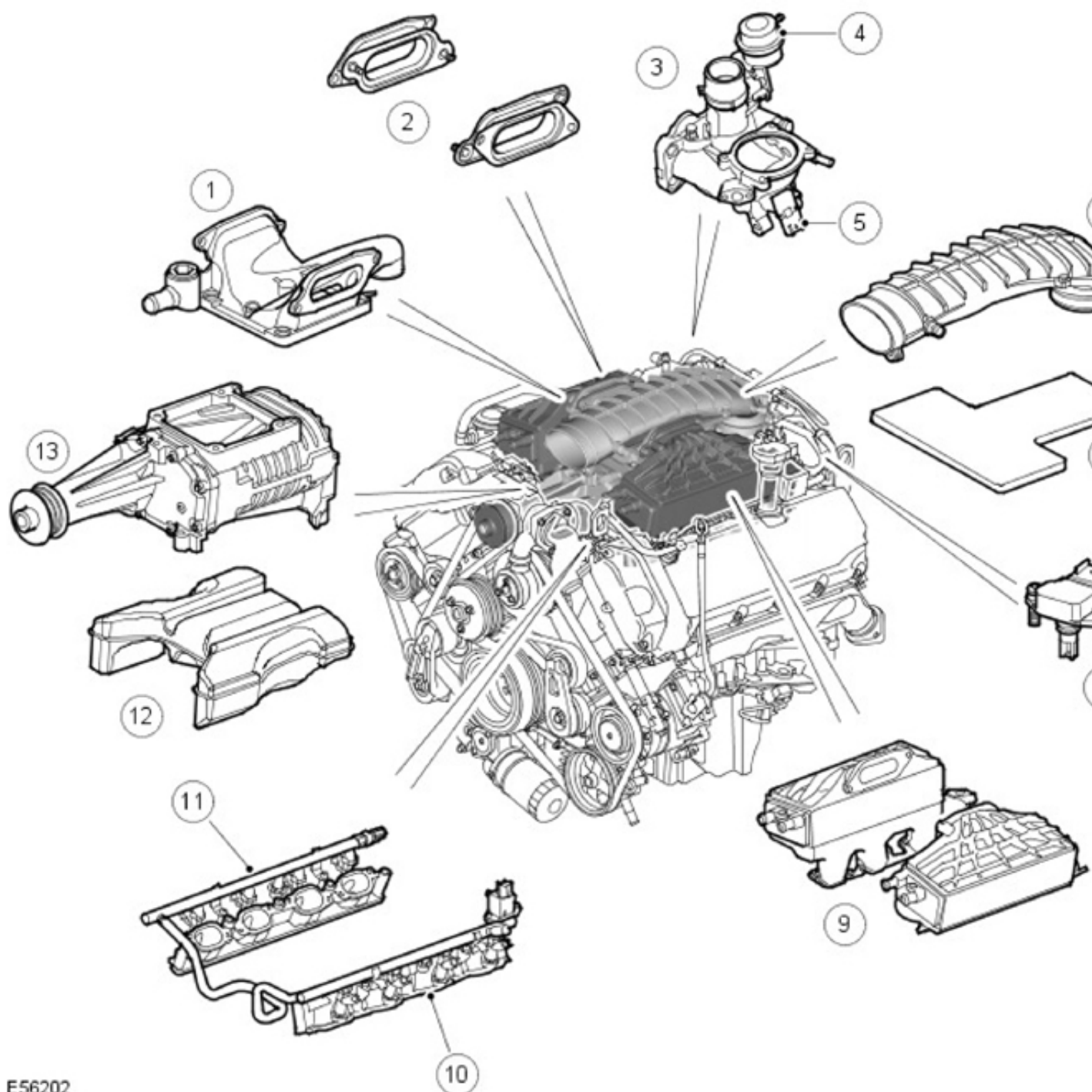
The lightweight valve gear provides good fuel economy and noise levels. Valve head diameters are 31mm (1.220 in) for the exhaust and 35mm (1.378 in) for the intake. All valves have 5mm (0.197 in) diameter stems supported in sintered metal seats and guide inserts. Collets, valve collars and spring seats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

SUPERCHARGER

2009 Land Rover Range Rover Sport Supercharged

ENGINE Engine - V8 S/C 4.2L Petrol



E56202

Item	Part Number	Description
1	-	Outlet duct
2	-	Gaskets
3	-	Intake elbow assembly

2009 Land Rover Range Rover Sport Supercharged

ENGINE Engine - V8 S/C 4.2L Petrol

4	-	Bypass valve and actuator
5	-	Manifold Absolute Pressure (MAP) sensor
6	-	Throttle body intake
7	-	Noise isolator
8	-	Temperature and Absolute Pressure (TMAP) sensor
9	-	Intercoolers
10	-	Intercooler adaptor
11	-	Fuel rail
12	-	Noise isolator
13	-	Supercharger

The supercharger is a compressor used to pump an air into the cylinders. This increases the concentration of oxygen and fuel in the charge to create a more powerful combustion inside the cylinder. This increases cylinder pressure upon ignition and creates more power.

As the supercharger compresses the air its temperature increases. This raise in air temperature reduces the potential for power gains. By installing intercoolers the air is cooled to overcome this.

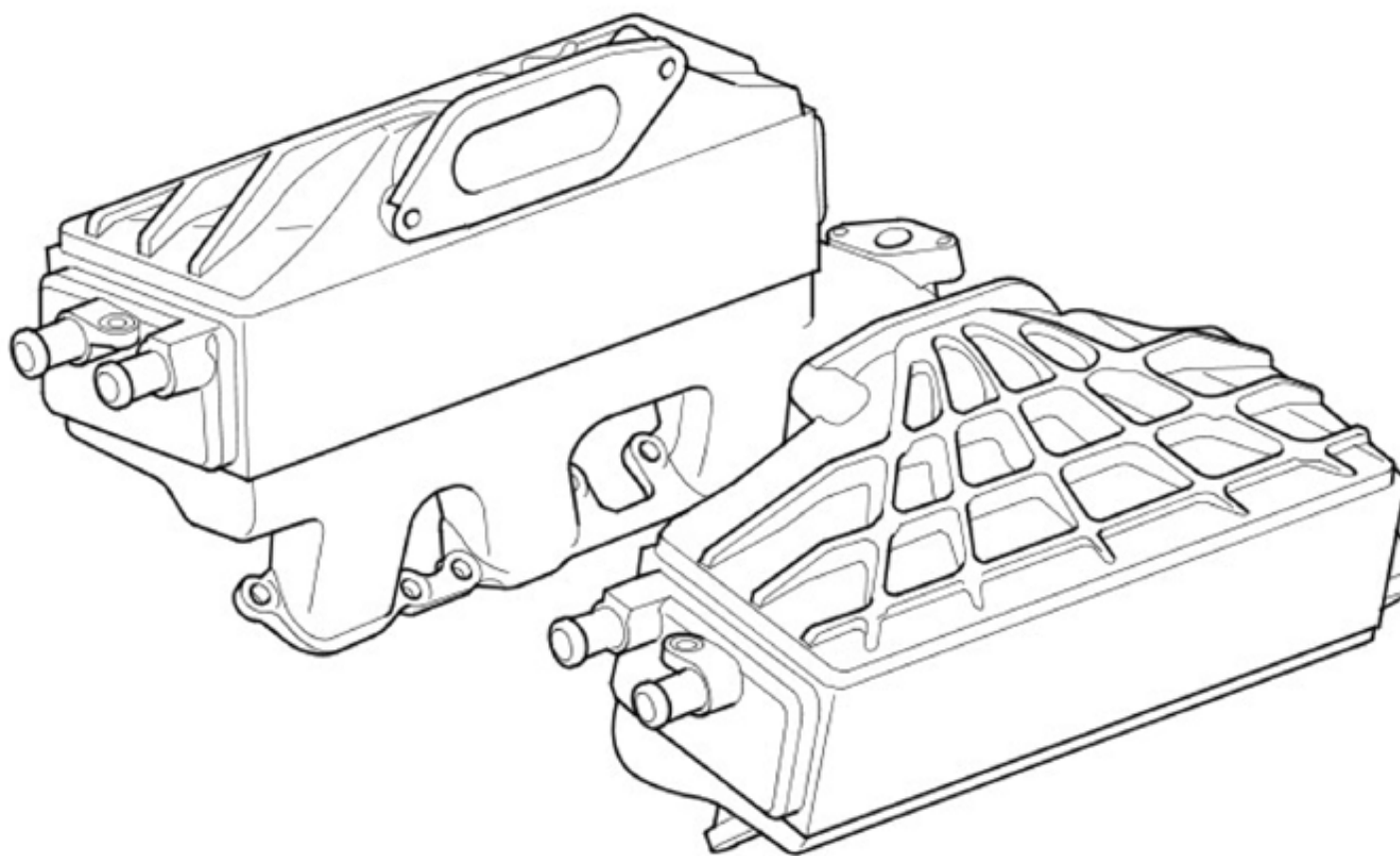
The supercharger is an Eaton M112 unit attached to the three mounting bosses between the 'V' of the cylinder block. Positive alignment with the drive belt is provided by a doweled mounting bracket. An eight-ribbed belt drives the supercharger, via the crankshaft, at 2.1 engine speed. The maximum pressure increase is approximately 0.8 bar.

On the 4.2L V8 supercharged engine the intake manifold is replaced by:

- A supercharger.
- Two intercoolers.
- An outlet duct.
- A bypass valve.
- A bypass valve actuator.
- Two intercooler adapters.
- Fuel rails.

The supercharger has a sealed-for-life internal lubrication system.

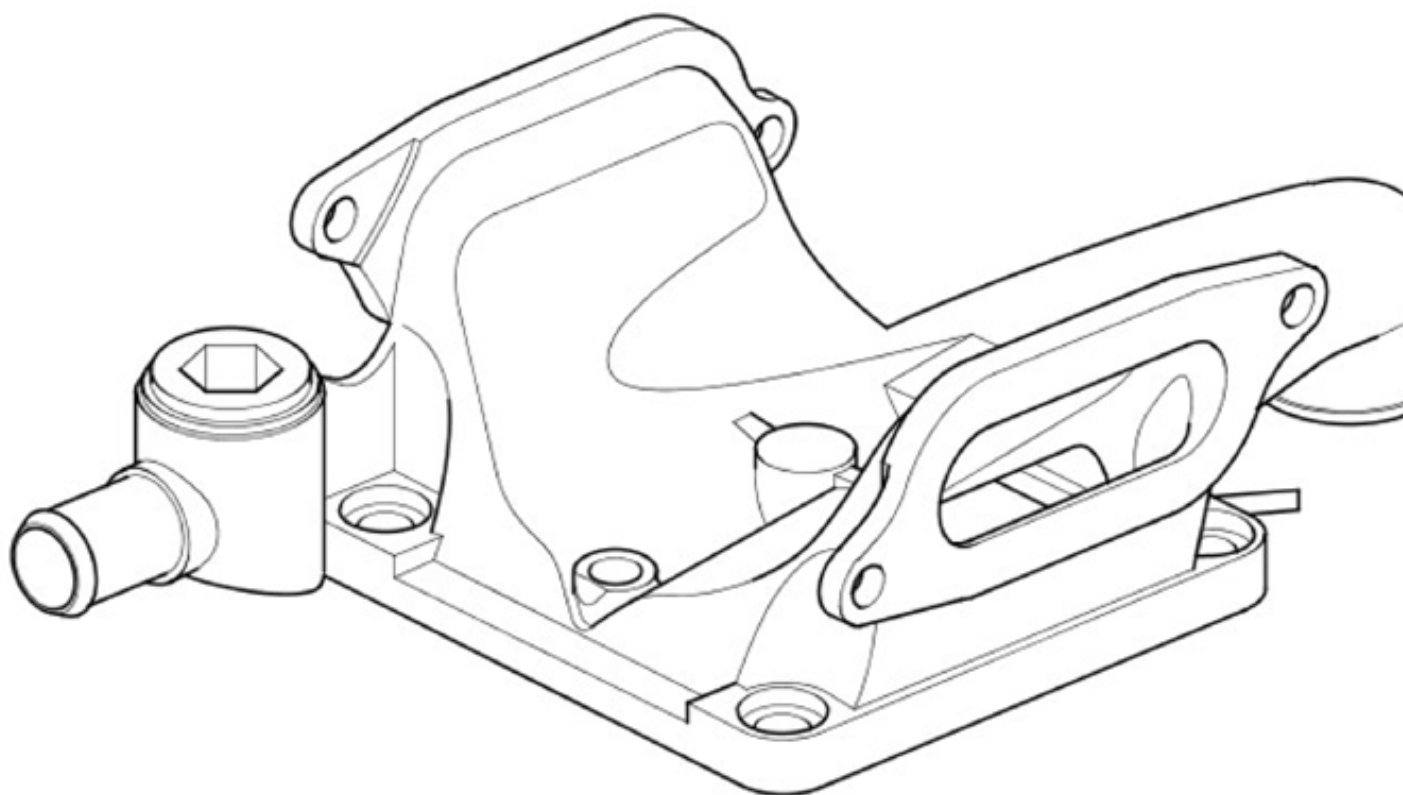
Intercooler



E56203

Each of the two intercoolers is a fin and tube air-to-liquid heat exchanger. Two rubber ducts, secured by clamp plates, provide the interfaces between the outlet duct and the intercoolers. After passing through the heat exchanger core, the air flows into individual outlets to the cylinders. At the rear of the B bank intercooler there is a mounting boss for an air intake temperature sensor.

Outlet Duct



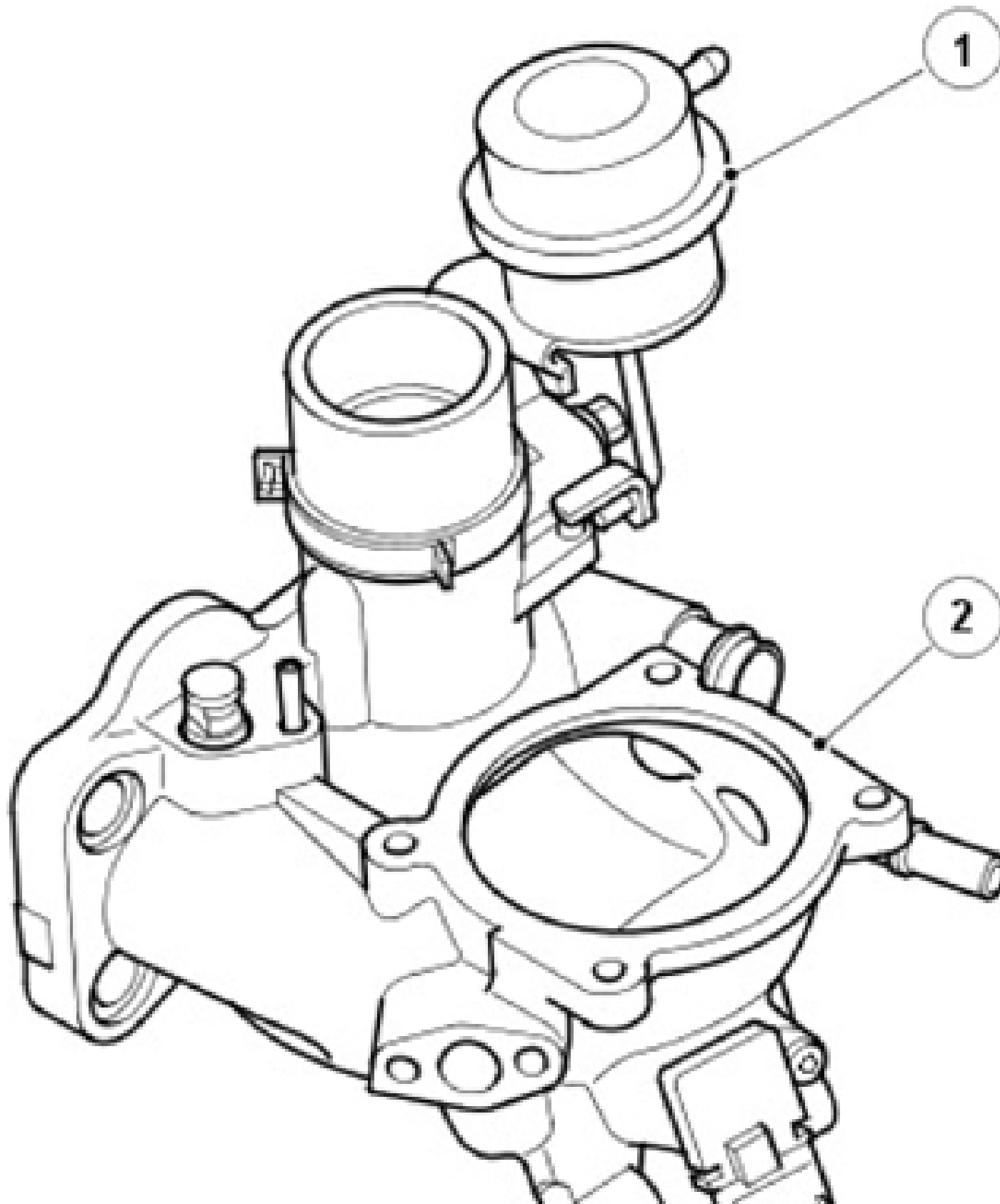
E56204

The outlet duct directs air from the supercharger into the two intercoolers. A filler point for the intercooler coolant system is integrated into the front and right side of the outlet duct. **This connection is not used on Land Rover vehicles.** A vacuum take-off for the fuel pressure regulator/cruise control system is located on the right side of the outlet duct. Isolating bolts, to reduce noise, secure the outlet duct to the supercharger and a rubber gasket seals the supercharger to the outlet duct interface.

Bypass Valve

The bypass valve attaches to an opening in the induction elbow and controls a bypass flow from the intercoolers back to the inlet side of the supercharger. At closed or partially open throttle settings (i.e. idle and most cruise conditions), the bypass valve is fully open to provide maximum bypass and optimum fuel economy. As the throttle opens, the bypass valve progressively closes to reduce the bypass flow and increase the pressure of air supplied to the engine for optimum power output.

Bypass Valve and Actuator



2009 Land Rover Range Rover Sport Supercharged

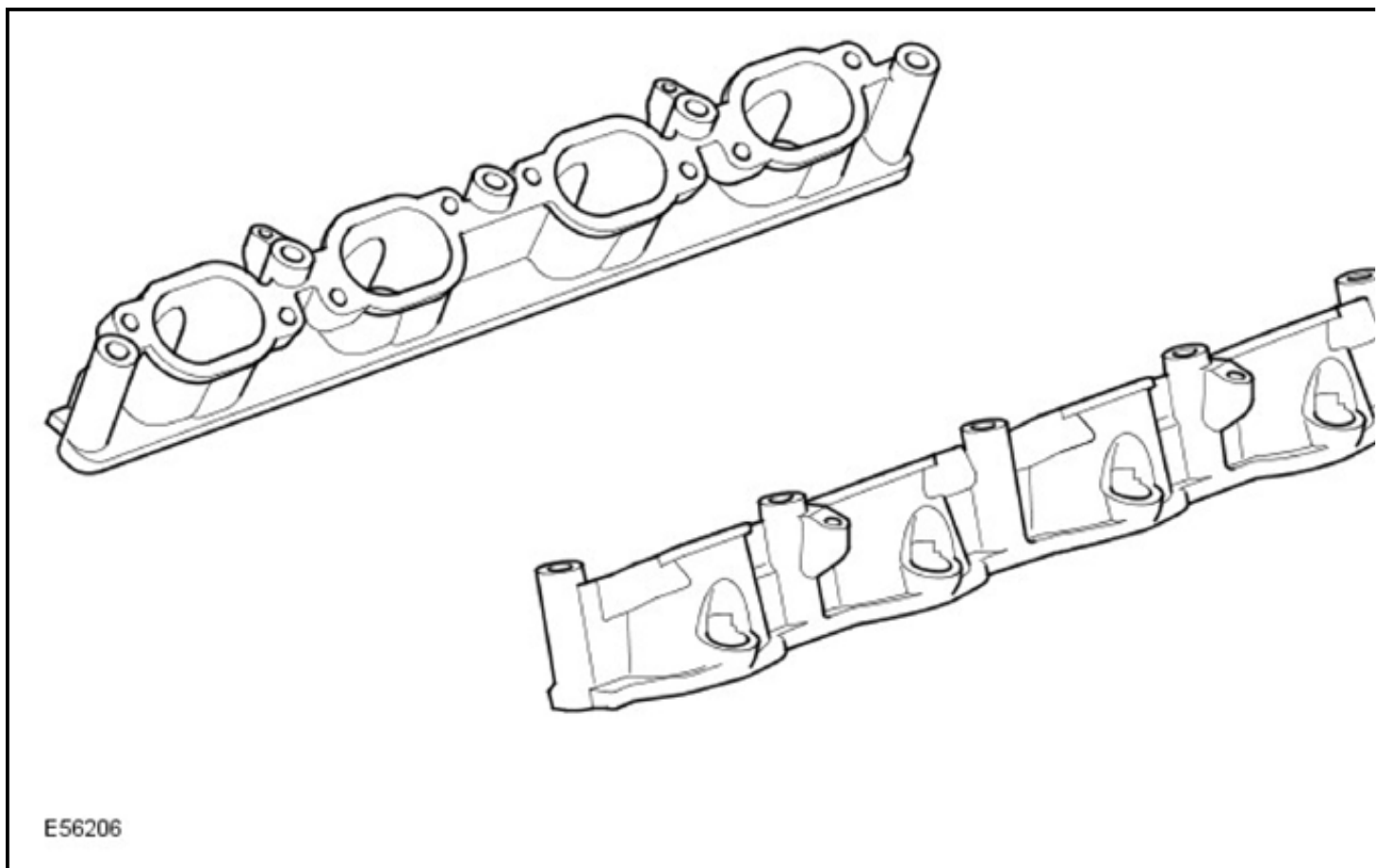
ENGINE Engine - V8 S/C 4.2L Petrol

Item	Part Number	Description
1	-	Bypass valve actuator
2	-	Induction elbow
3	-	Map sensor

Bypass Valve Actuator

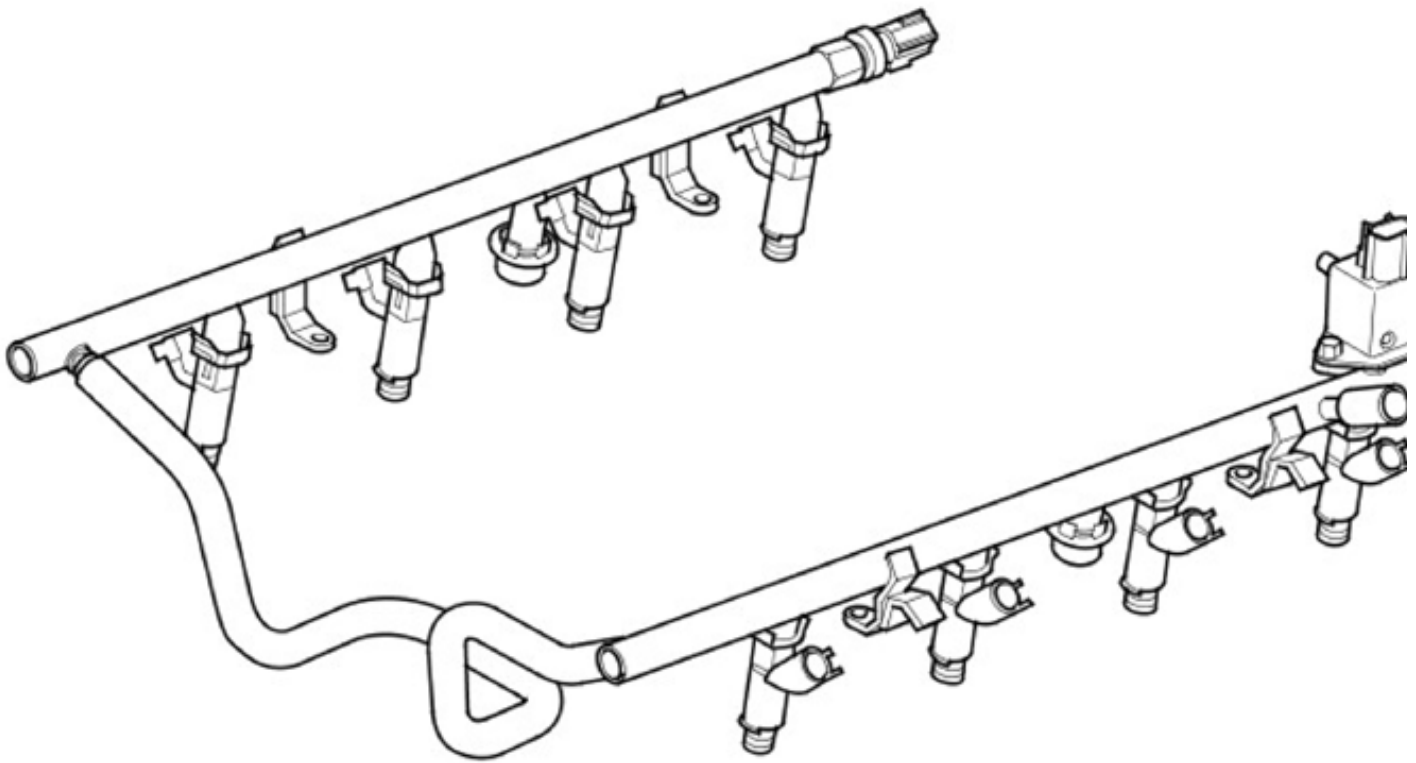
The bypass valve actuator is a diaphragm-operated actuator attached to the valve spindle of the bypass valve. A vacuum pipe connects the actuator to the induction elbow.

Intercooler Adapters



The intercooler adapters provide an interface between the intercoolers and the cylinder heads, and also locate the fuel rails and injectors. One-piece gaskets seal the joints between the intercoolers and the intercooler adapters, and between the intercooler adapters and the cylinder heads.

Fuel Rails



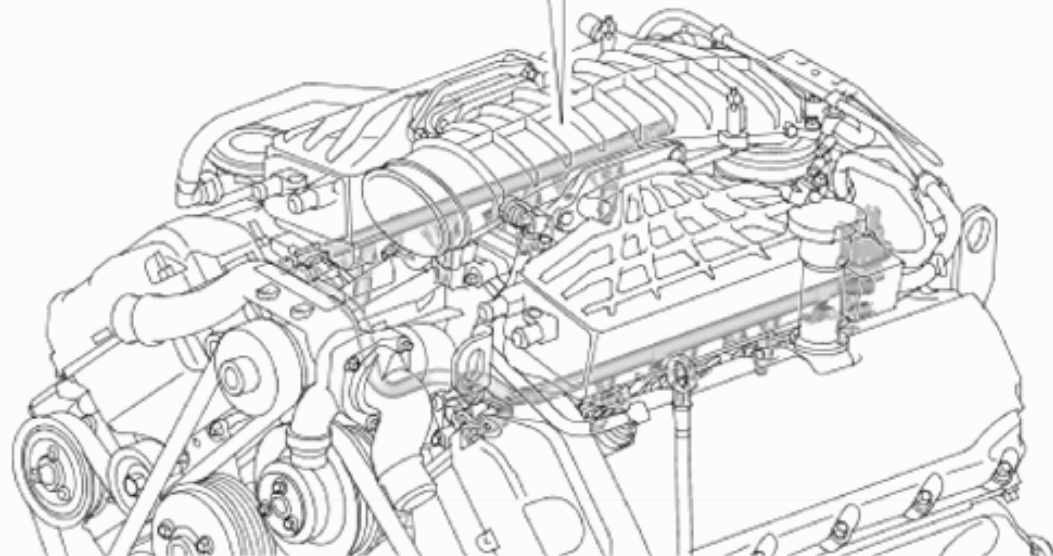
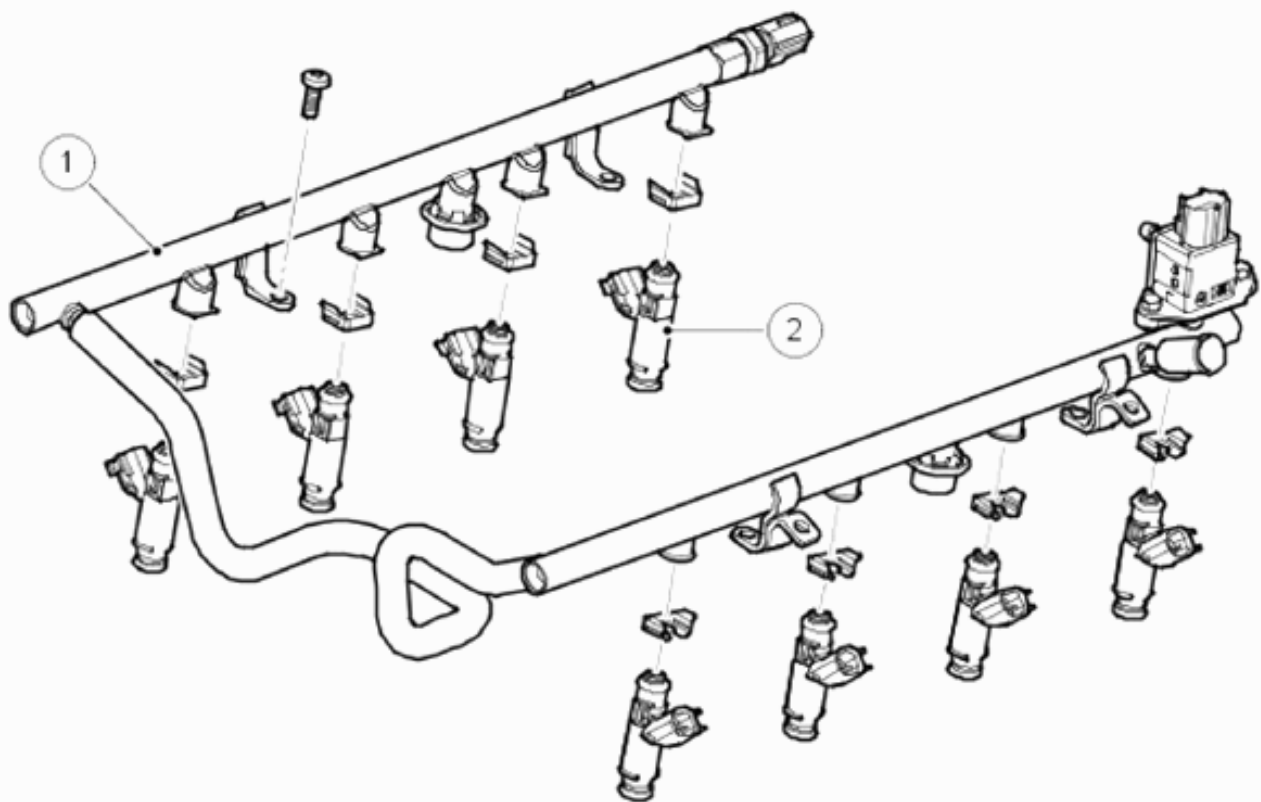
E56207

The fuel rails are installed on the intercooler adapters. A fuel crossover pipe connects the fuel rails together at the front of the engine.

Fuel Injectors

2009 Land Rover Range Rover Sport Supercharged

ENGINE Engine - V8 S/C 4.2L Petrol



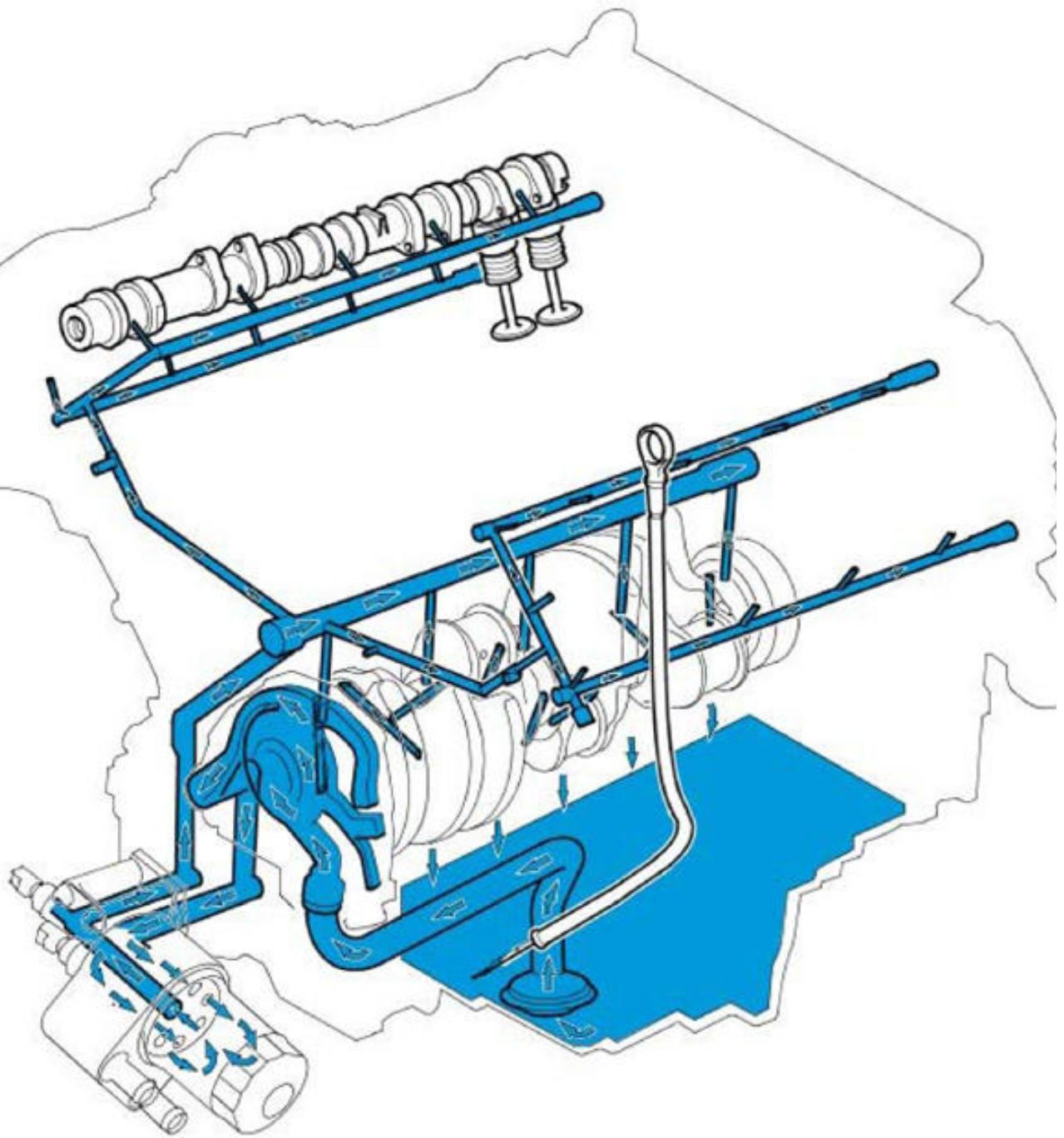
E56228

Item	Part Number	Description
1	-	Fuel rail
2	-	Injectors

Eight, top fed, 12-hole, fuel injectors are installed in the fuel rails and are held in position by spring clips. Two O-rings are installed between the injector mounts of the fuel rails and the related recesses in the intercooler adapters. The injectors are electromagnetic solenoid valves controlled by the ECM. The fuel jets from the injectors are directed onto the back of the intake valves.

For additional information, refer to: **Electronic Engine Controls** .

LUBRICATION SYSTEM



E43454

General

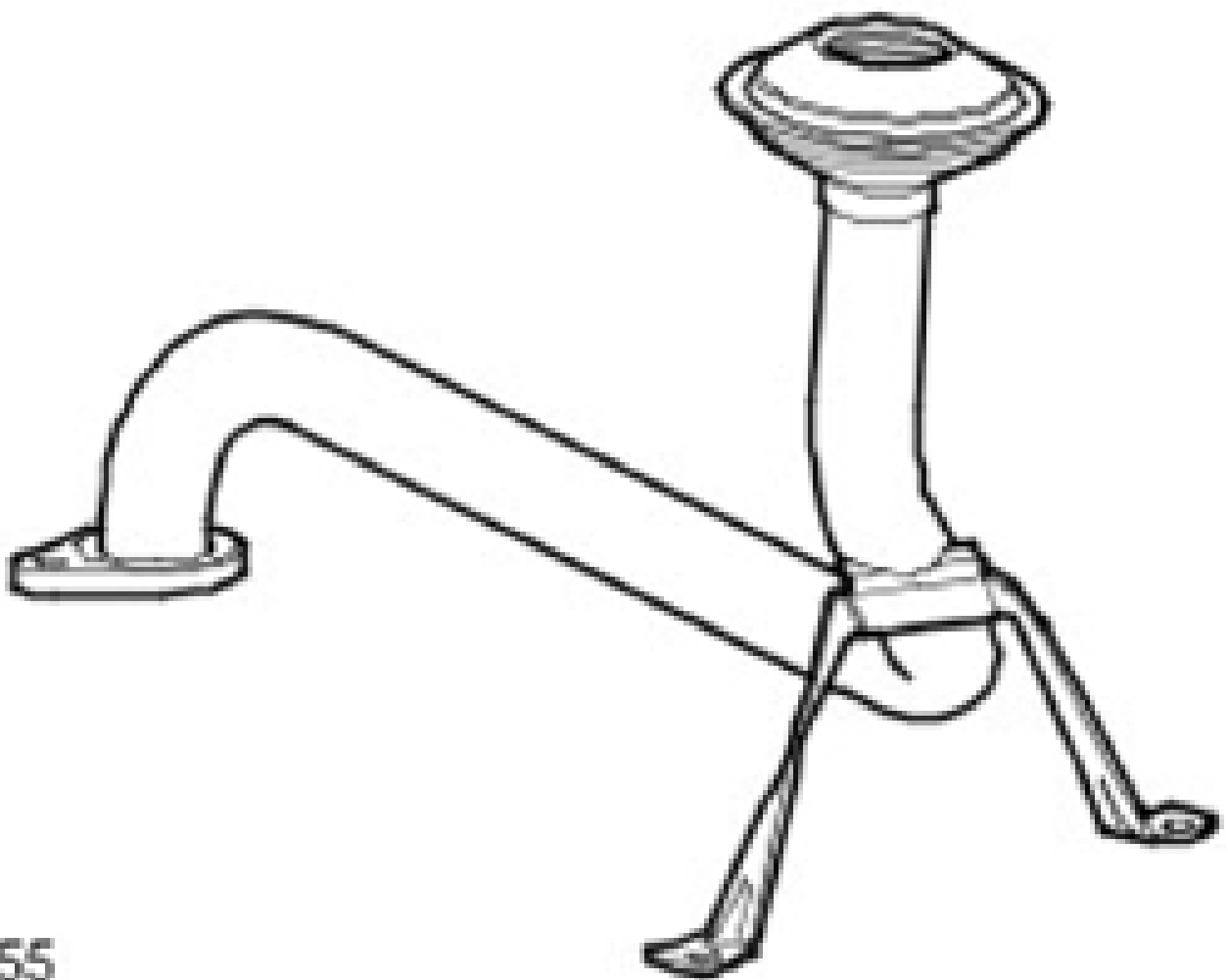
Oil is drawn from the reservoir in the oil pan and pressurized by the oil pump. The output from the oil pump is then filtered, cooled and distributed through internal oil passages.

All moving parts are lubricated by pressure or splash oil. Pressurized oil is also provided for the timing gear chain tensioners and the piston cooling jets.

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.

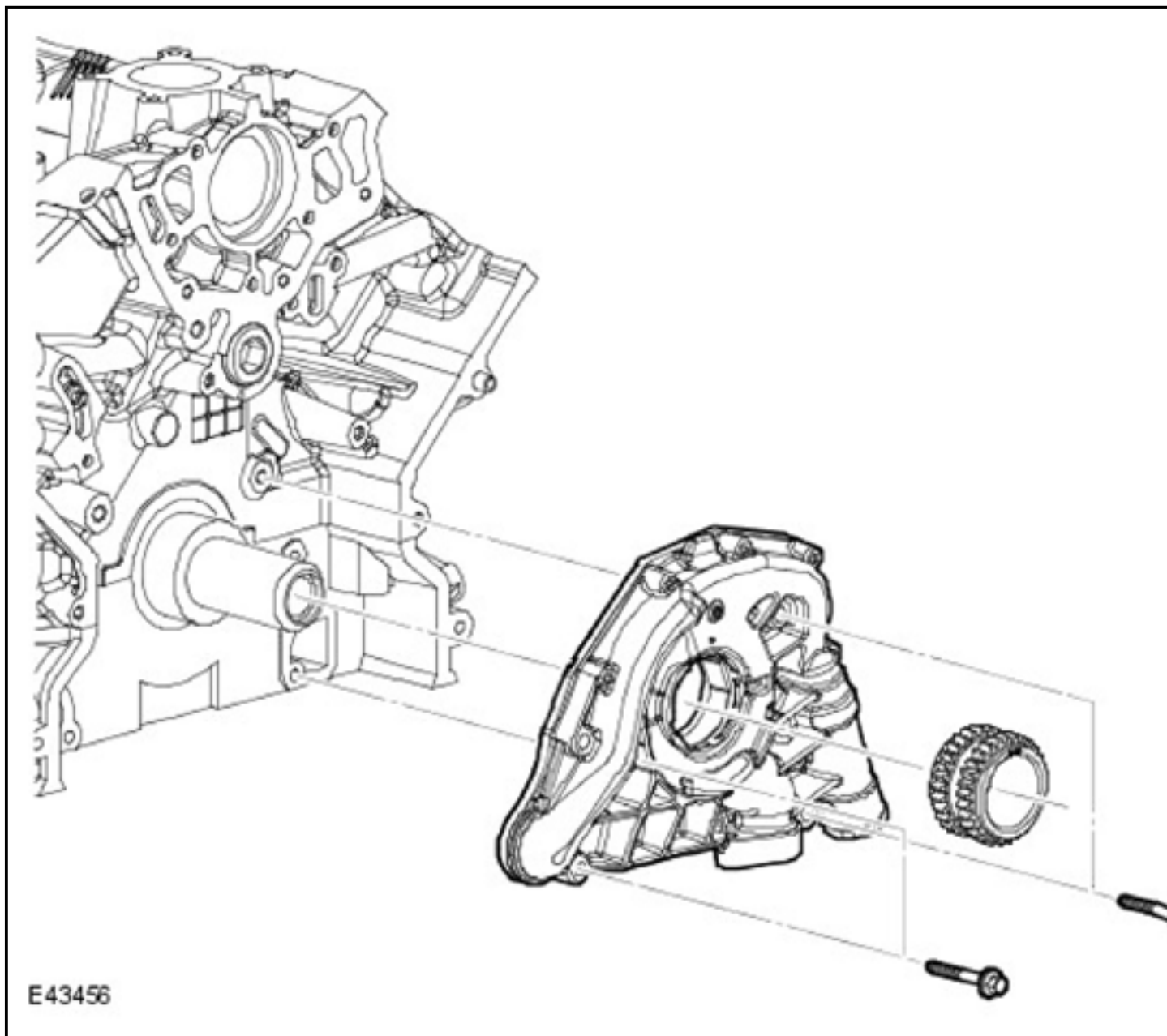
System replenishment is through the oil filler cap on the 'B' bank camshaft cover.

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.

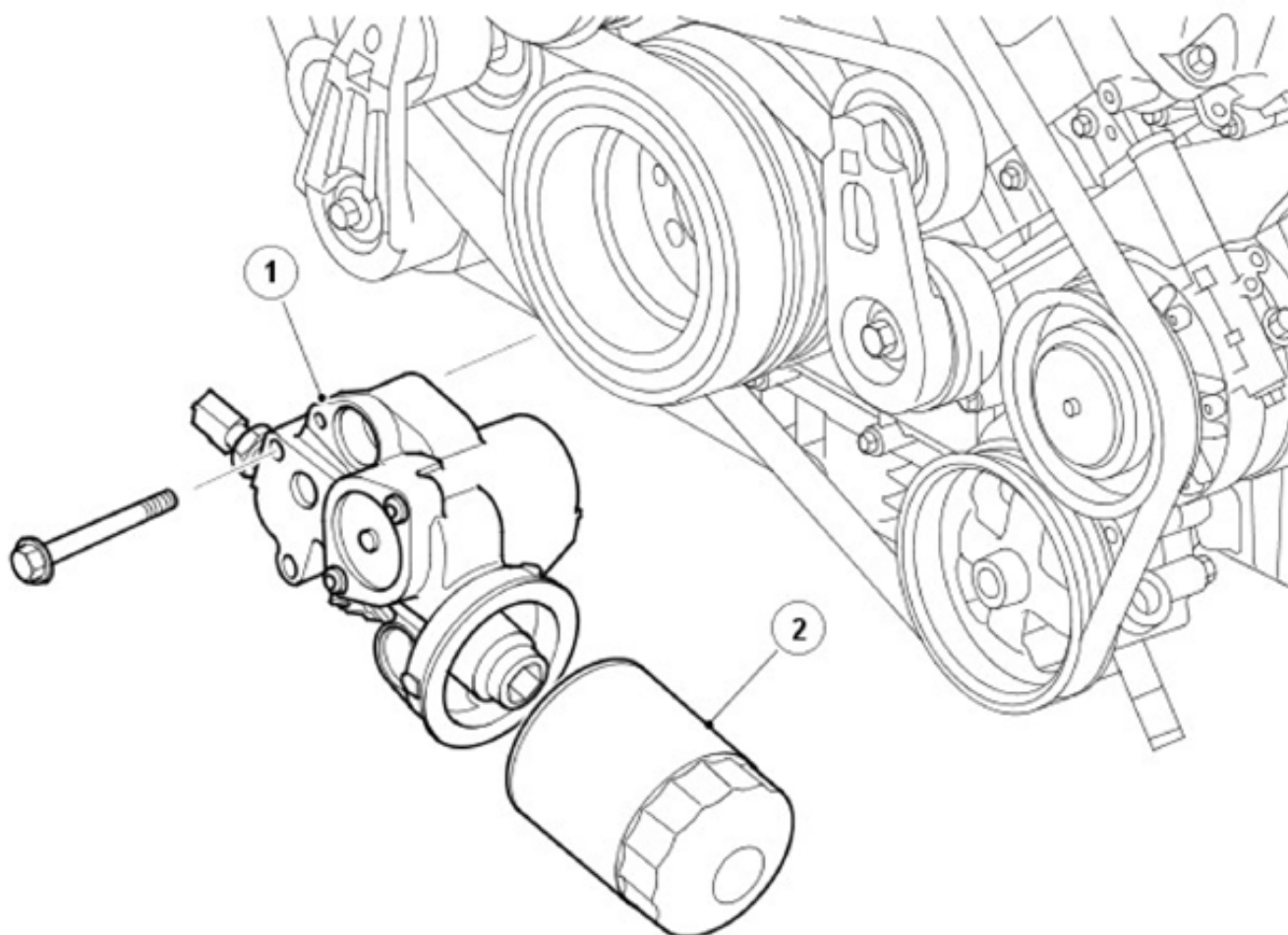
Oil Pump



The oil pump is installed on the crankshaft at the front of the engine. The pump outlet port aligns 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 Assembly



E56208

Item	Part Number	Description
1	-	Oil bypass tube
2	-	Oil filter head assembly
3	-	Oil filter

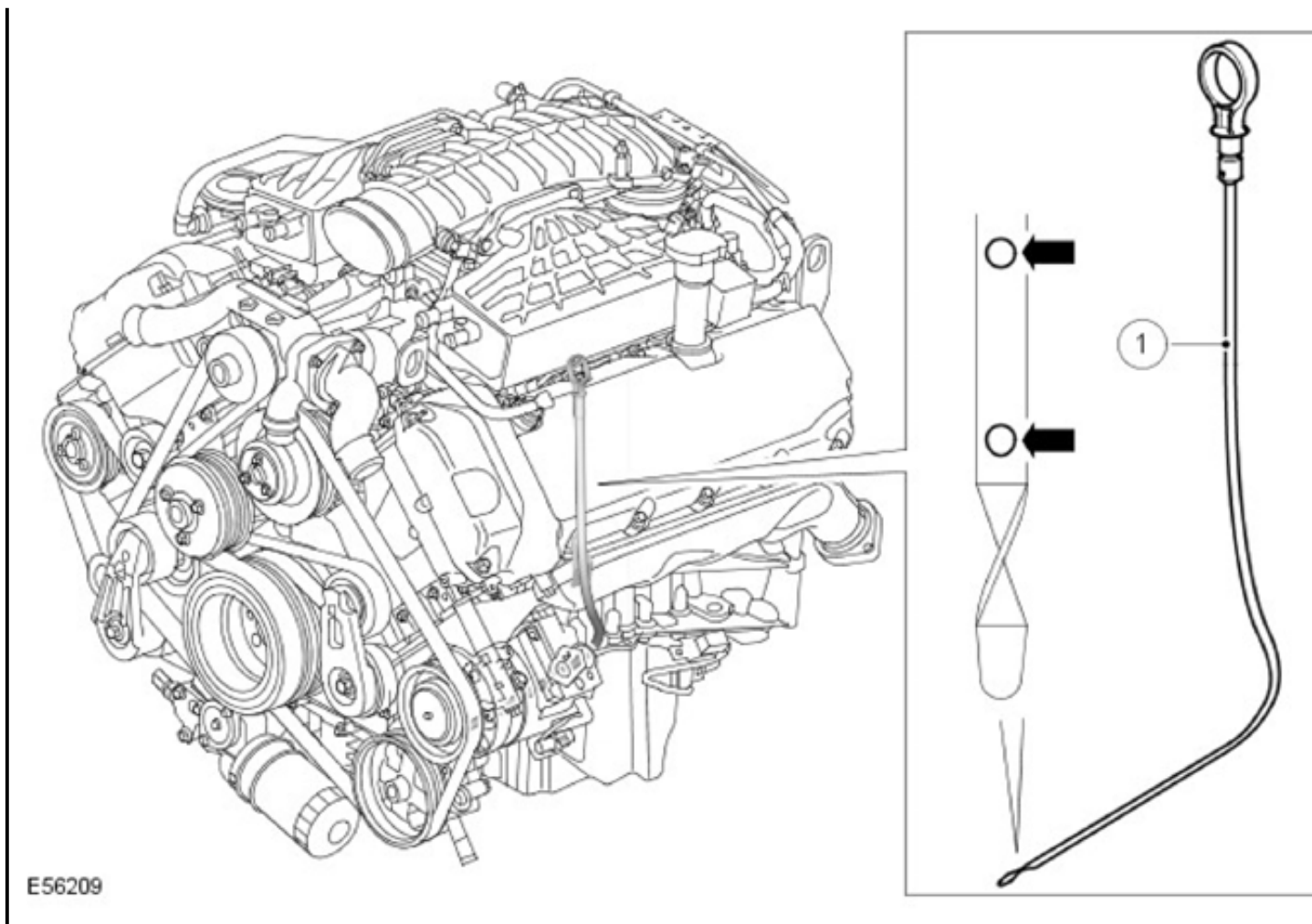
The oil filter is a replaceable cartridge installed on an adapter. An internal bypass facility permits full flow bypass if the filter is blocked.

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 Gage

2009 Land Rover Range Rover Sport Supercharged

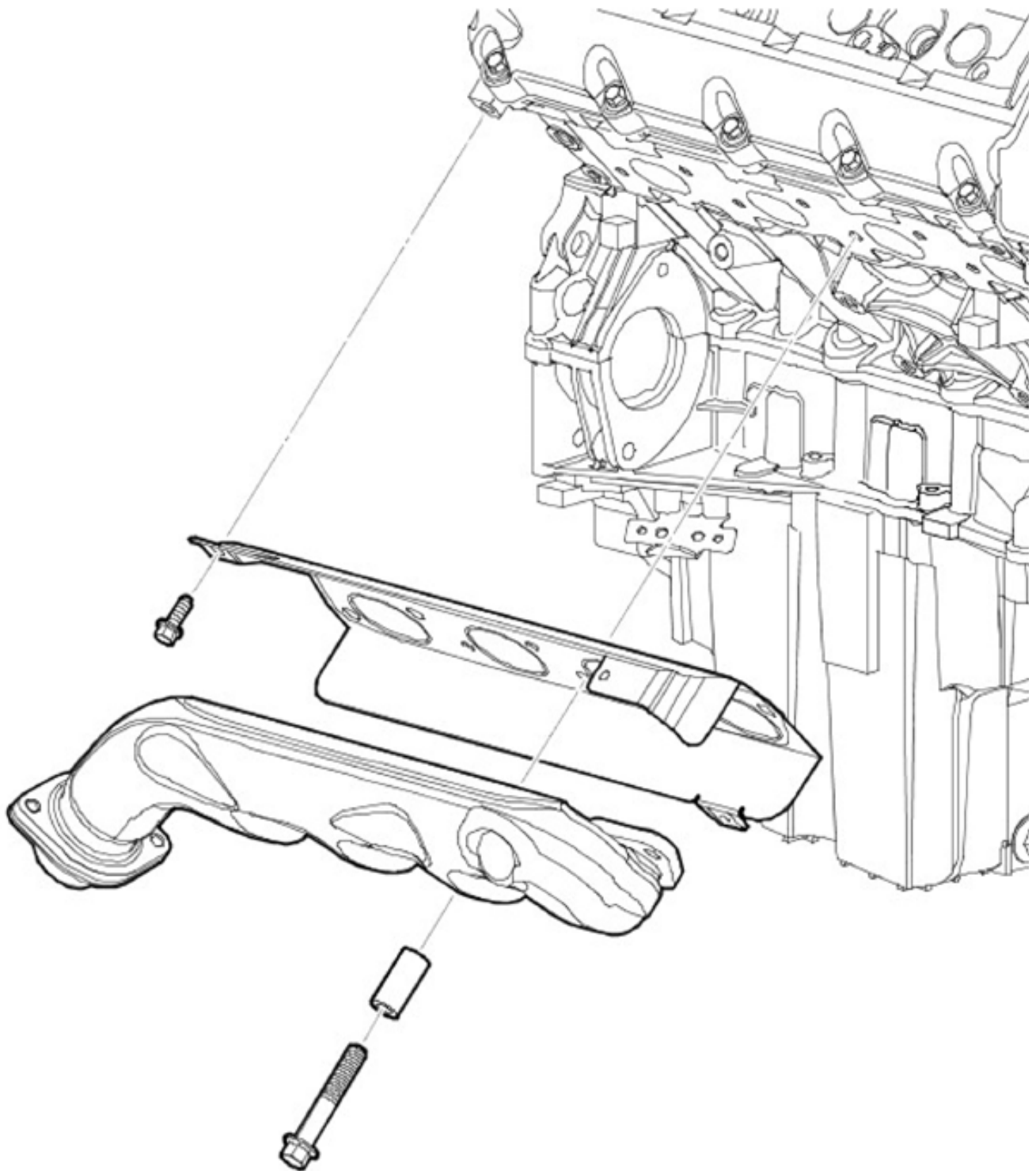
ENGINE Engine - V8 S/C 4.2L Petrol



Item	Part Number	Description
1	-	Oil level gage

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

EXHAUST MANIFOLD



E43459

The fabricated stainless steel twin skin exhaust manifolds are unique for each cylinder bank.

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.

DIAGNOSIS AND TESTING

ENGINE

For additional information:

REFER to: **DIAGNOSIS AND TESTING** .

GENERAL PROCEDURES

VALVE CLEARANCE CHECK

1. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

2. Remove the cooling fan.

For additional information, refer to: **Cooling Fan** .

3. Remove the LH valve cover.

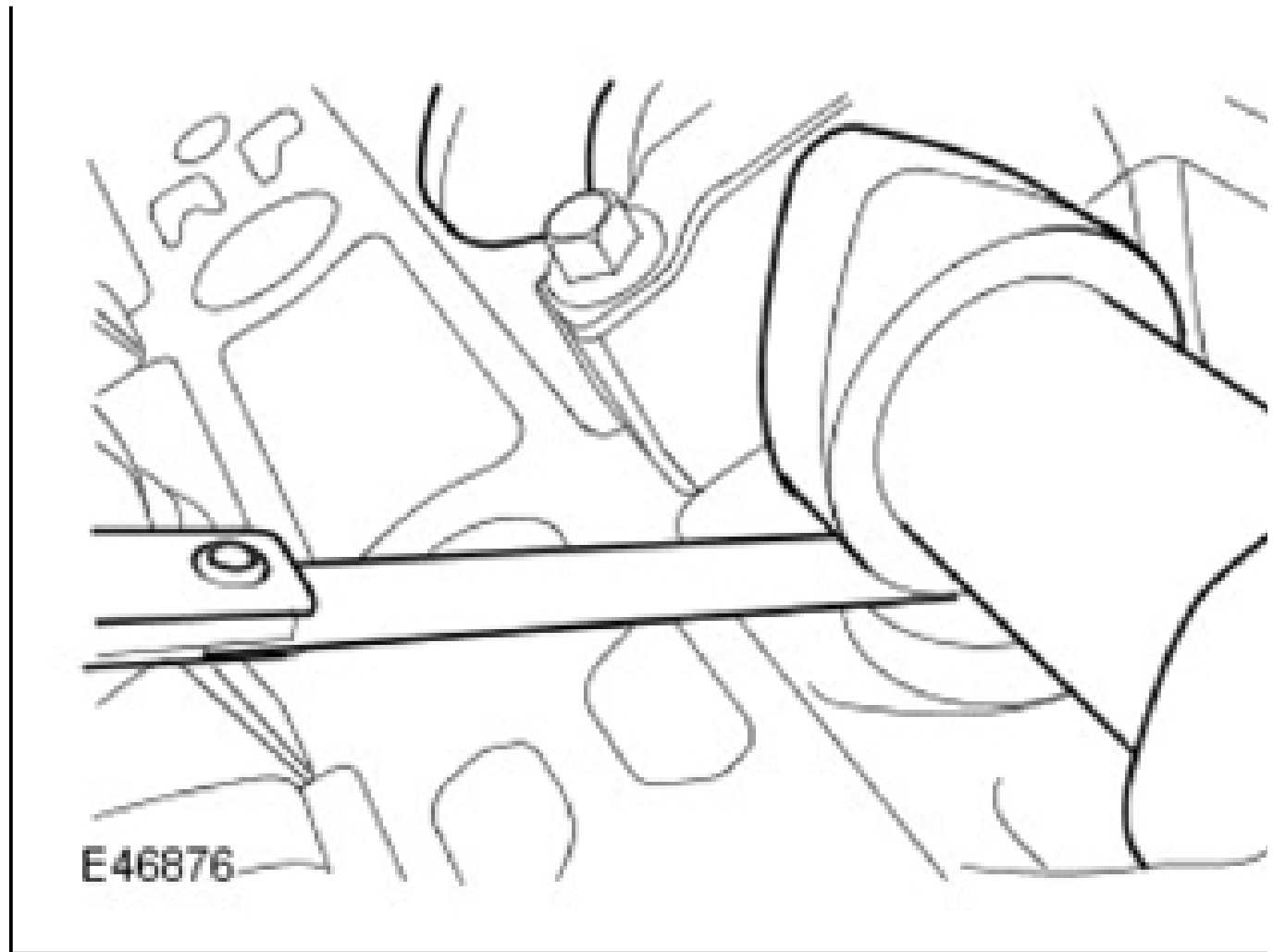
For additional information, refer to: **VALVE COVER LH**.

4. Remove the RH valve cover.

For additional information, refer to: **VALVE COVER RH** .

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

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



7. Repeat the above procedure for the remaining 31 tappets.
8. Adjust the clearance as necessary.
9. For cylinder head data, refer to **SPECIFICATIONS**.

For additional information, refer to: **SPECIFICATIONS**.

10. Install the RH valve cover.

For additional information, refer to: **VALVE COVER RH**.

11. Install the LH valve cover.

For additional information, refer to: **VALVE COVER LH**.

12. Install the cooling fan.

For additional information, refer to: **Cooling Fan** .

13. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

VALVE CLEARANCE ADJUSTMENT

NOTE: **The valve clearance adjustment procedure is part of the camshafts removal and installation procedure.**

1. Remove the camshafts.

For additional information, refer to: **CAMSHAFTS RH**.

2. Install the camshafts.

For additional information, refer to: **CAMSHAFTS RH**.

ENGINE OIL DRAINING AND FILLING

1. Disconnect the battery ground cable.

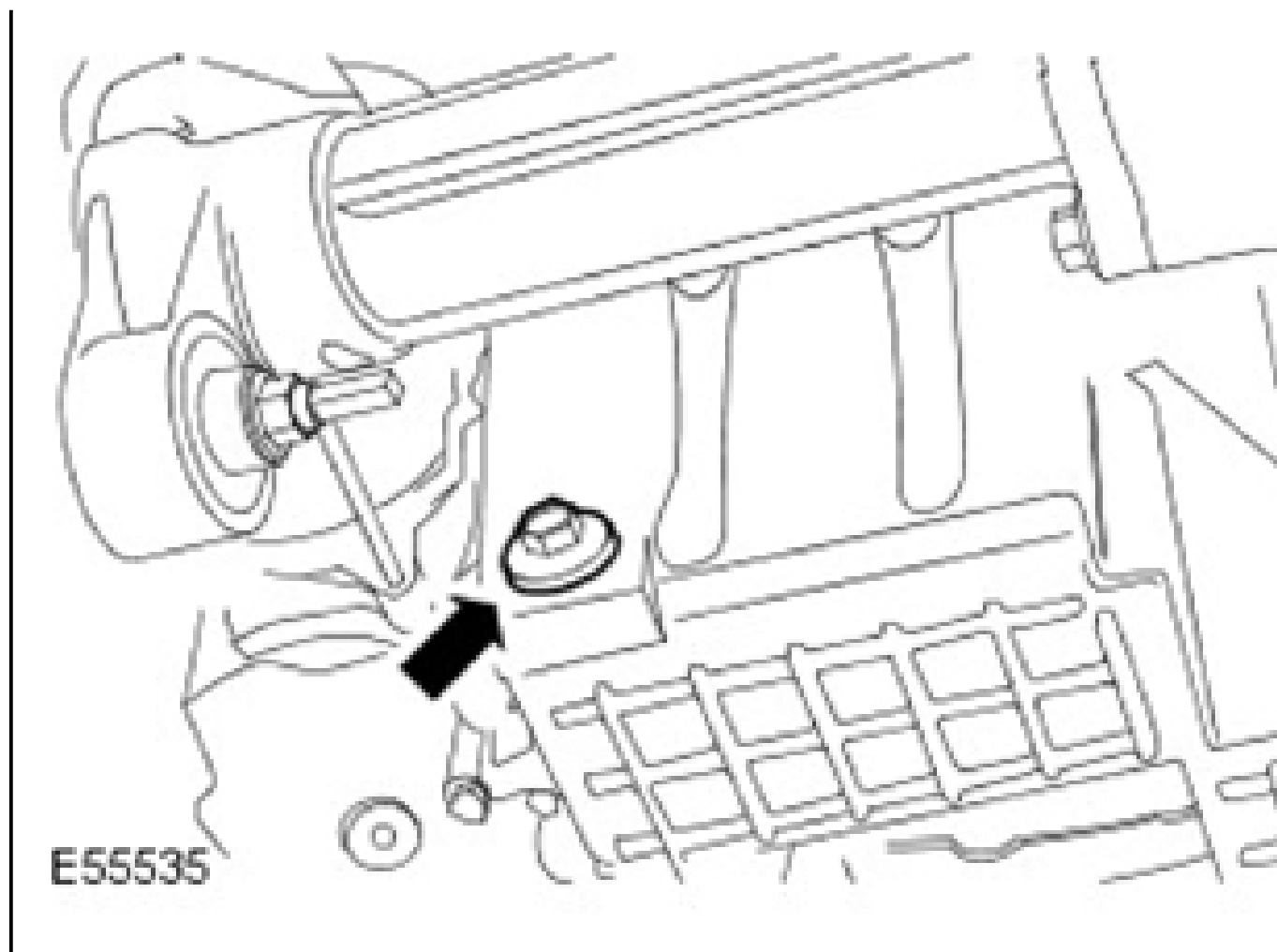
For additional information, refer to: **SPECIFICATIONS** .

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

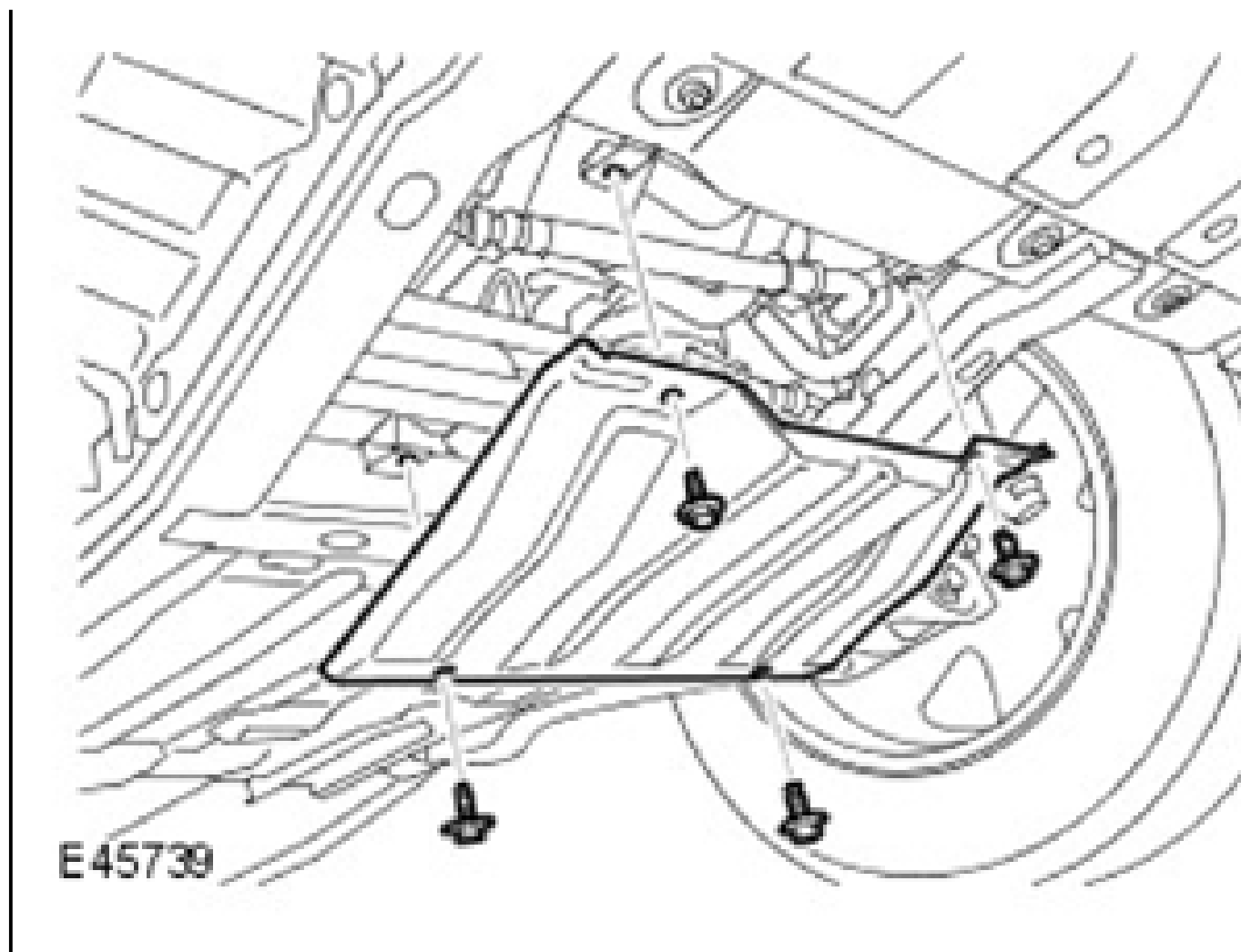
2. Raise and support the vehicle.
3. Remove the engine undershield.

For additional information, refer to: **ENGINE UNDERSHIELD** .

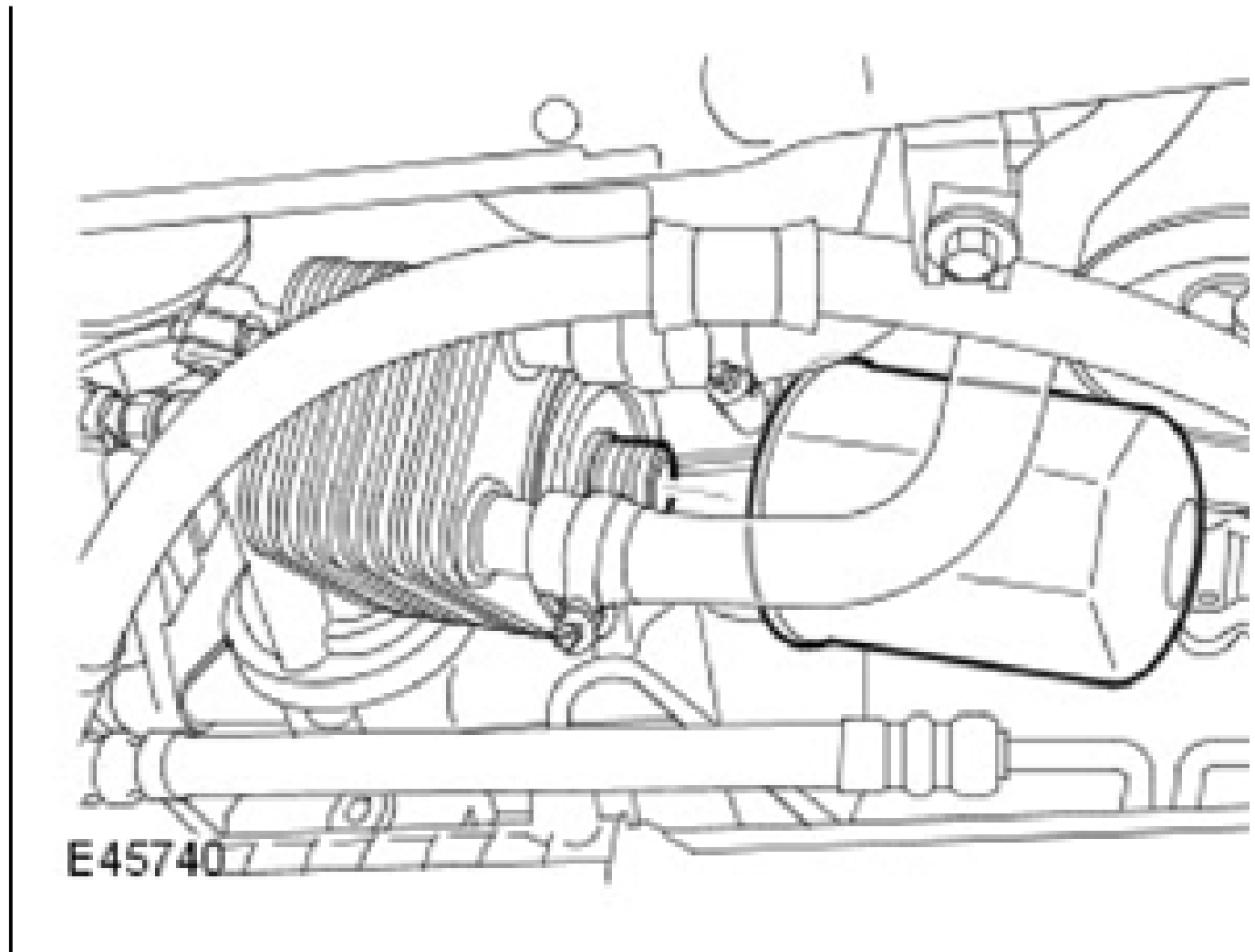
4. Remove the oil pan drain plug.
 - Position a container to collect the fluid.
 - Discard the oil drain plug seal.



5. Remove the radiator access panel.
 - Remove the 4 bolts.



6. Remove the 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).
 - Install a new seal.
 - Tighten the drain plug to 25 Nm (18 lb.ft).
8. Tighten the drain plug to 25 Nm (18 lb.ft).
 - Install a new seal.
9. Install the engine undershield.

For additional information, refer to: **ENGINE UNDERSHIELD**

10. Fill the engine with oil.
11. Check and top-up the engine oil.
12. Connect the battery ground cable.

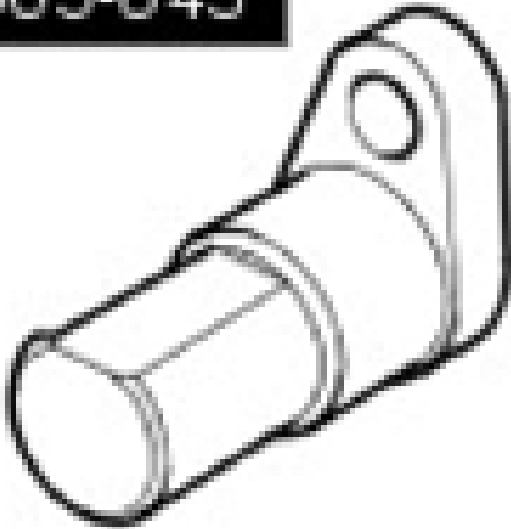
For additional information, refer to: **SPECIFICATIONS** .

IN-VEHICLE REPAIR

CAMSHAFTS RH

SPECIAL TOOL(S)

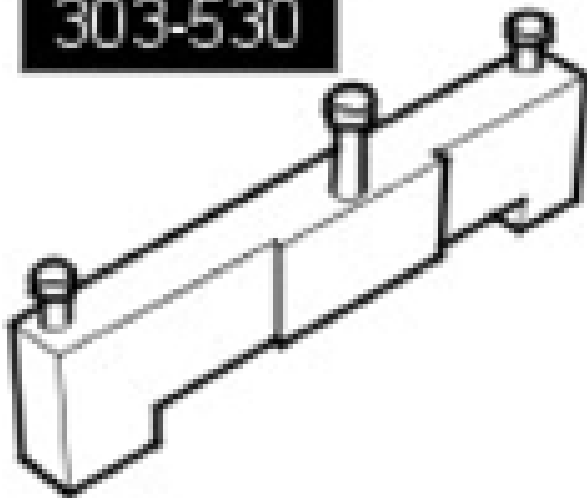
303-645



E46881

Timing Setting tool
303-645

303-530



E46879

Camshaft setting/locking tool
303-530

303-532



E46880

Timing chain tensioning tool
303-532**REMOVAL**

1. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

2. Remove the battery tray.

For additional information, refer to: **BATTERY TRAY** . .

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

3. Raise and support the vehicle.
4. Remove the engine front cover.

For additional information, refer to: **ENGINE FRONT COVER**.

5. Remove the crankshaft position (CKP) sensor.

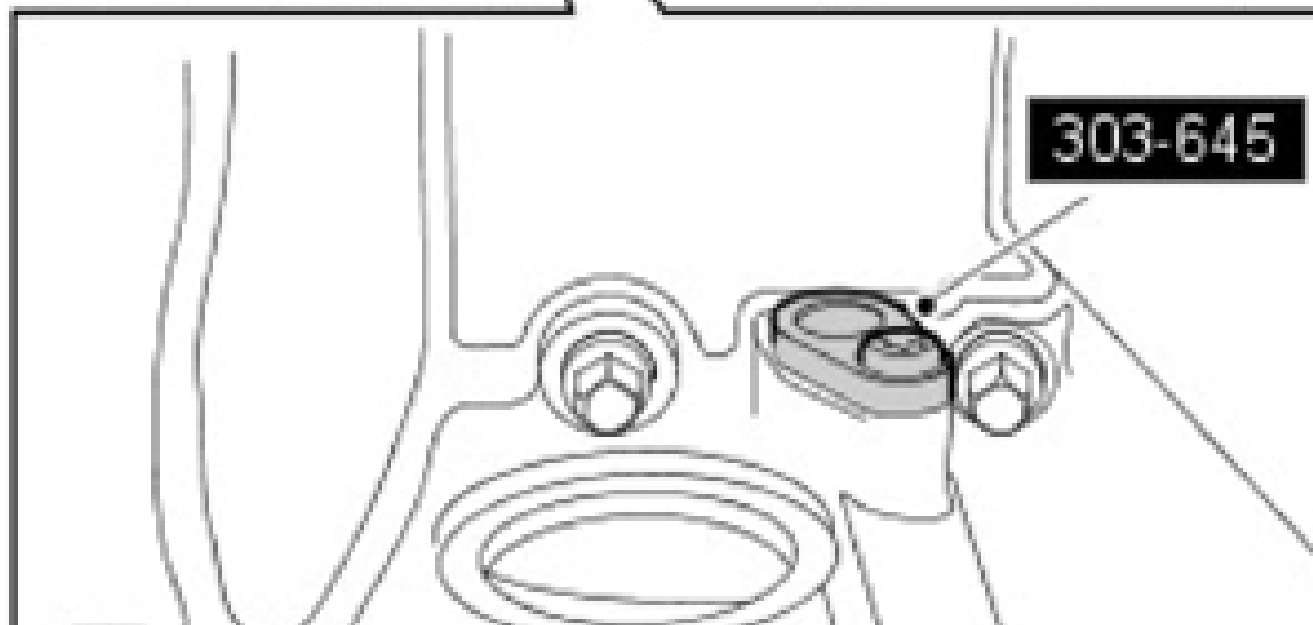
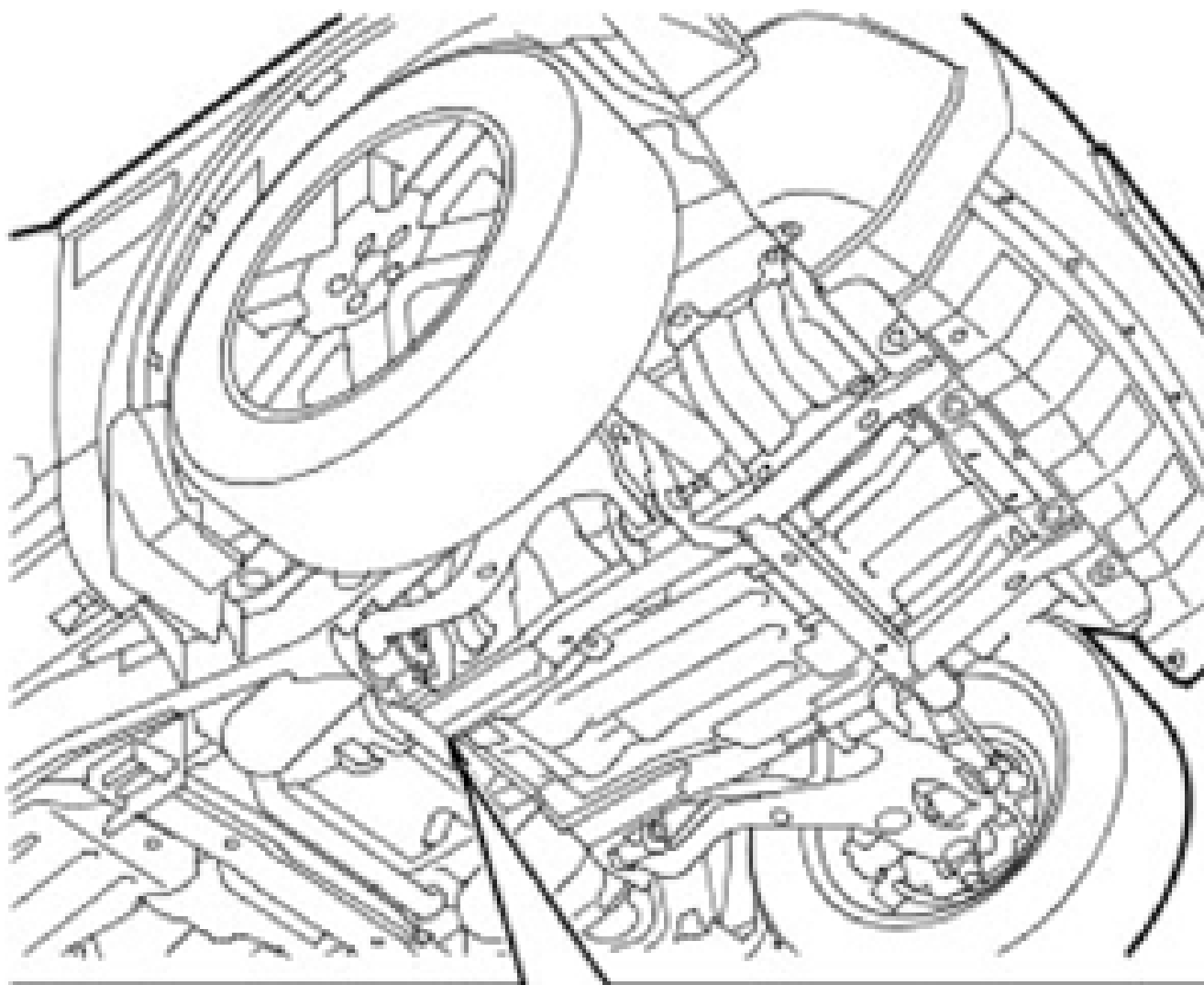
For additional information, refer to: **Crankshaft Position (CKP) Sensor** .

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

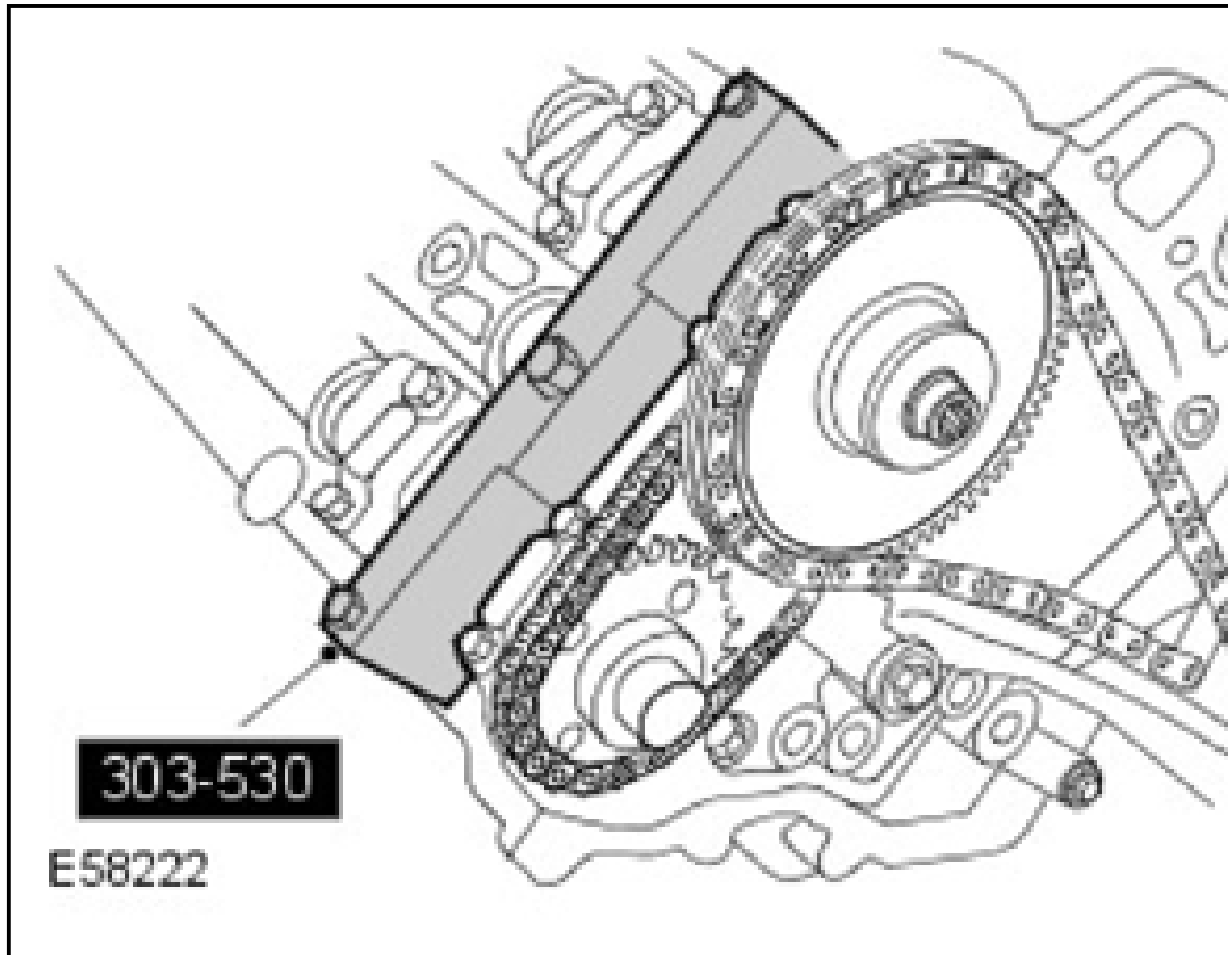
NOTE: The engine is now in the **SAFE** position.

7. Lock the crankshaft.

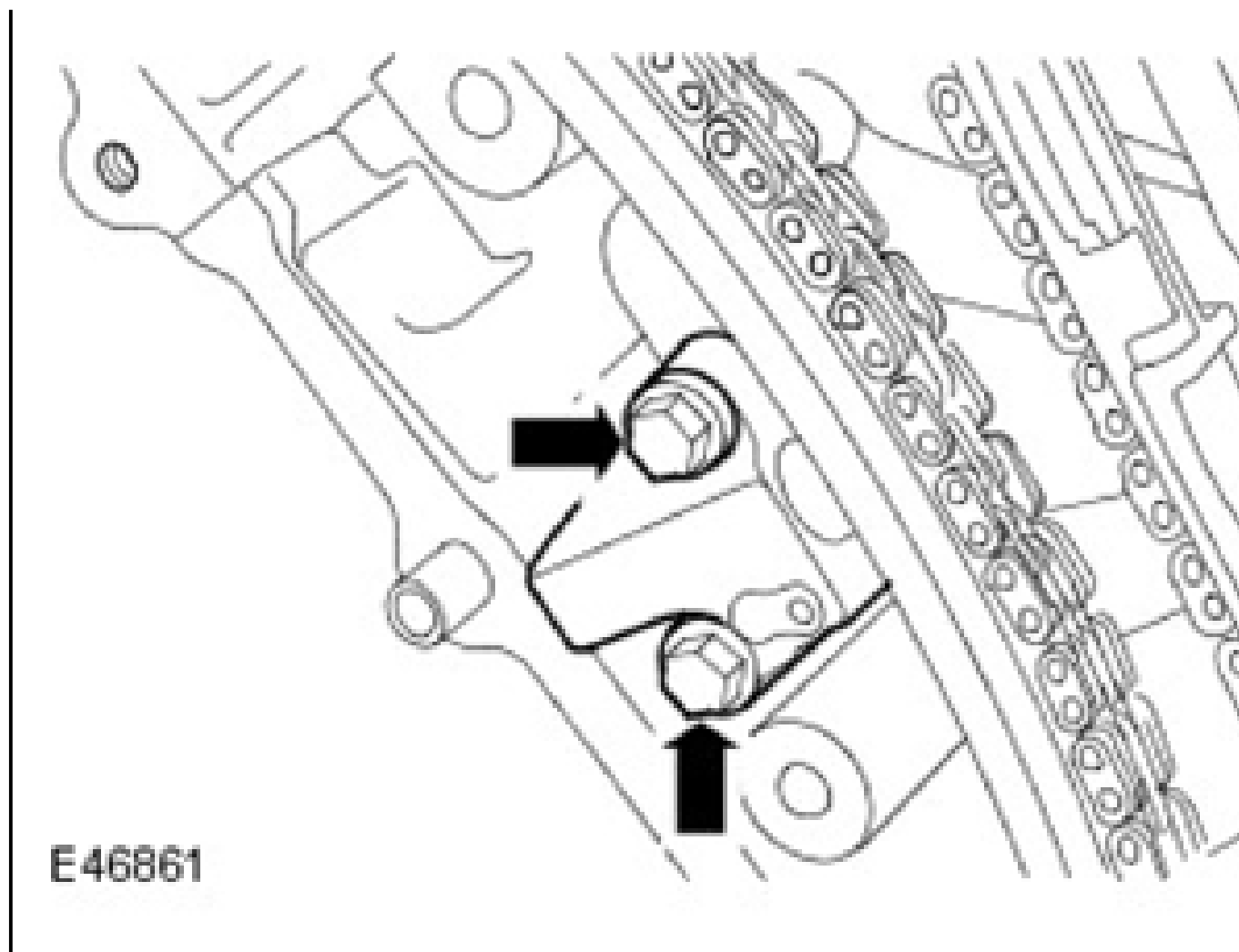
- Install the special tool.
- Install the screw.



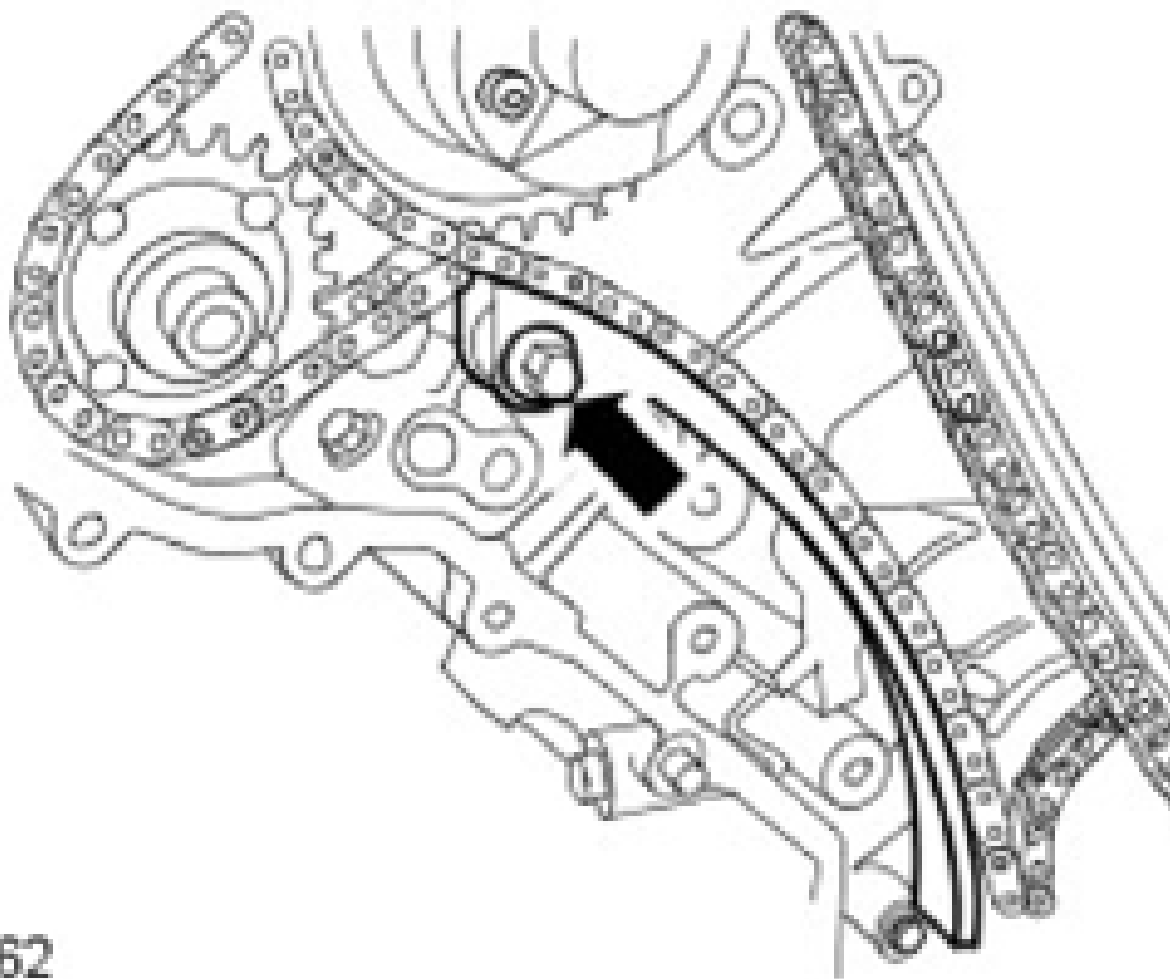
8. Install the special tool to the RH cylinder head.
 - Install the 3 bolts.



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

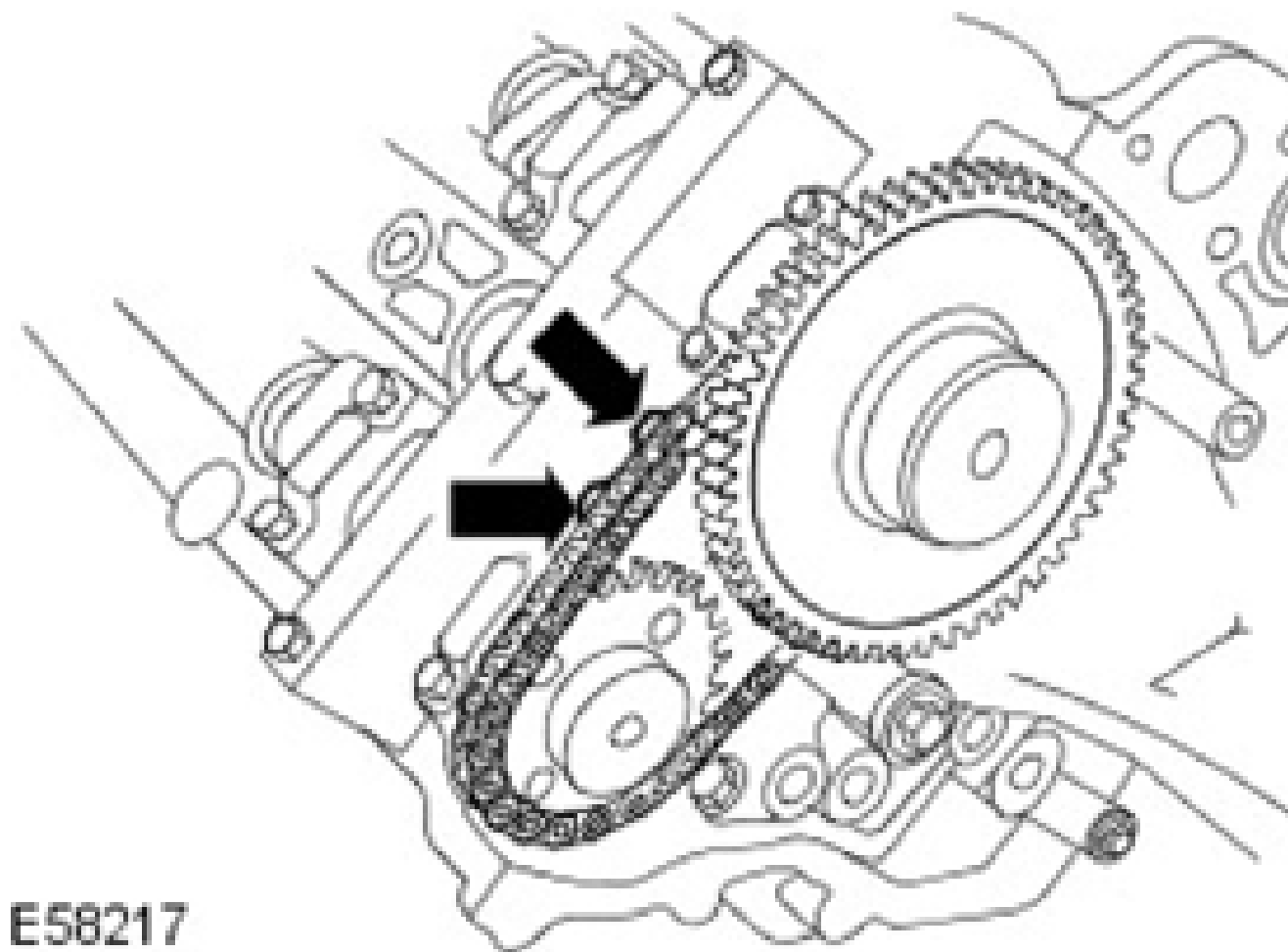


10. Remove the primary timing chain tensioner guide.
 - Remove the bolt.



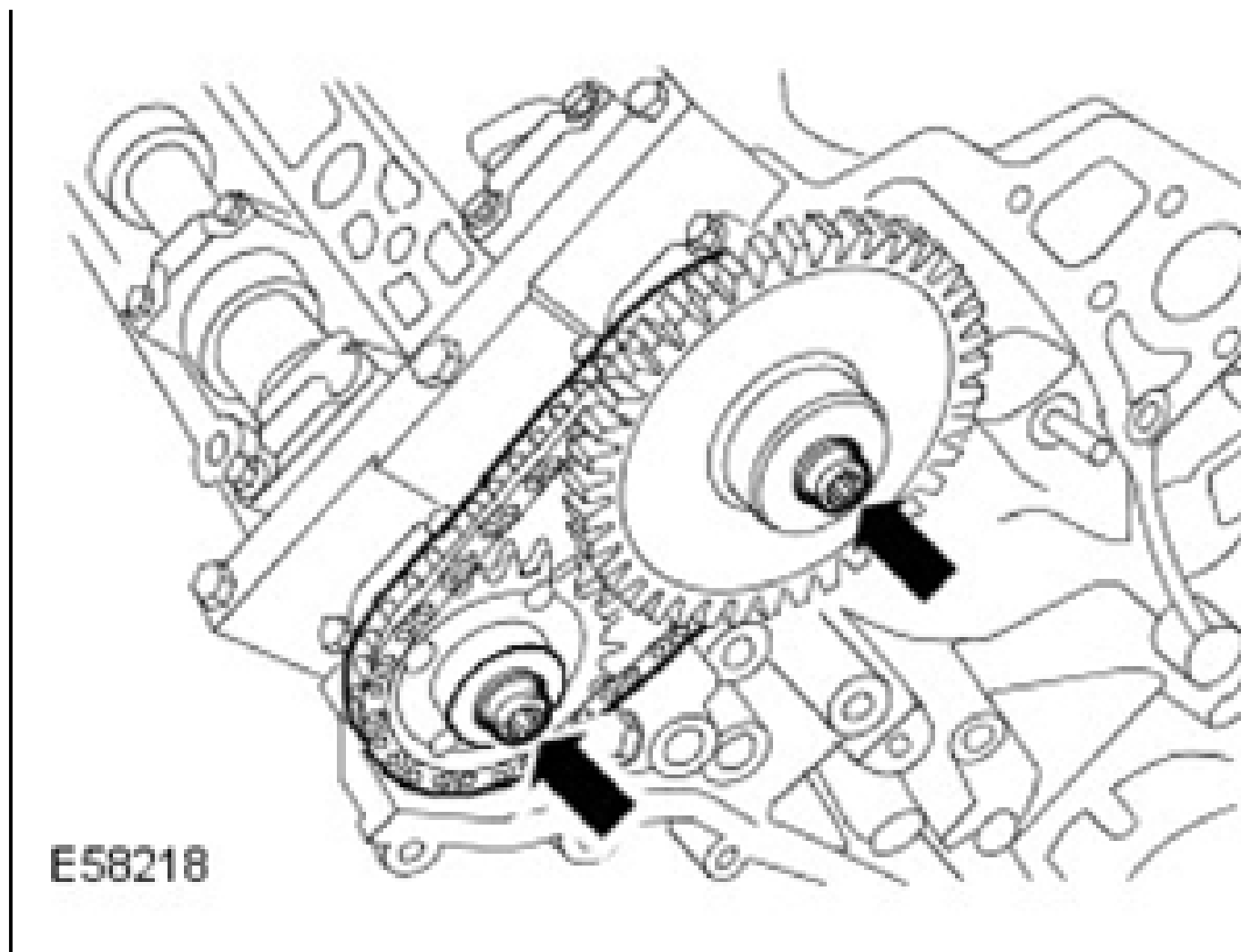
E46862

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

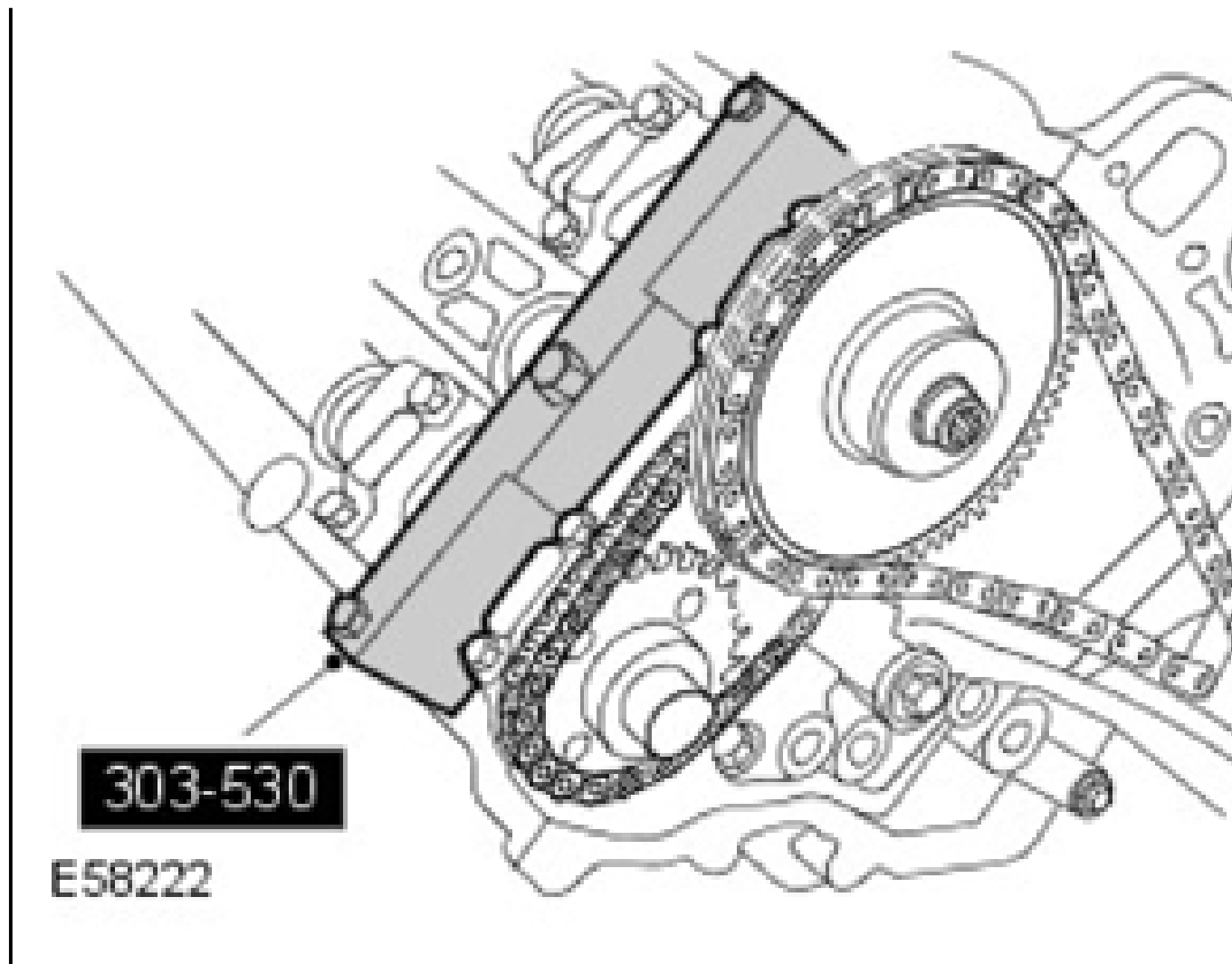


CAUTION: Discard the bolts.

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



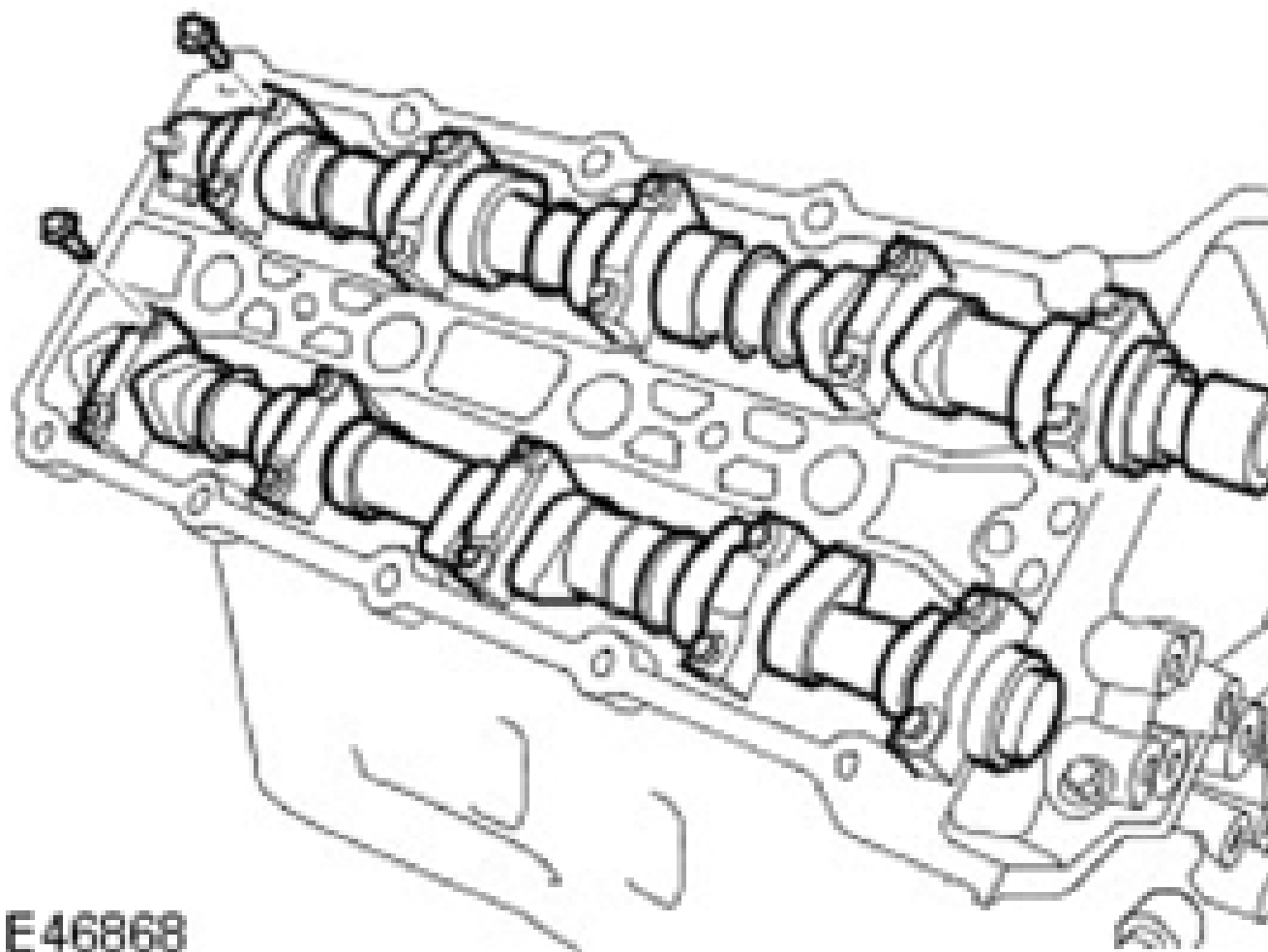
14. Remove the special tool from the RH cylinder head.
 - Remove the 3 bolts.



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

CAUTION: Make sure that new bolts are installed.

4. 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.

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

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

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

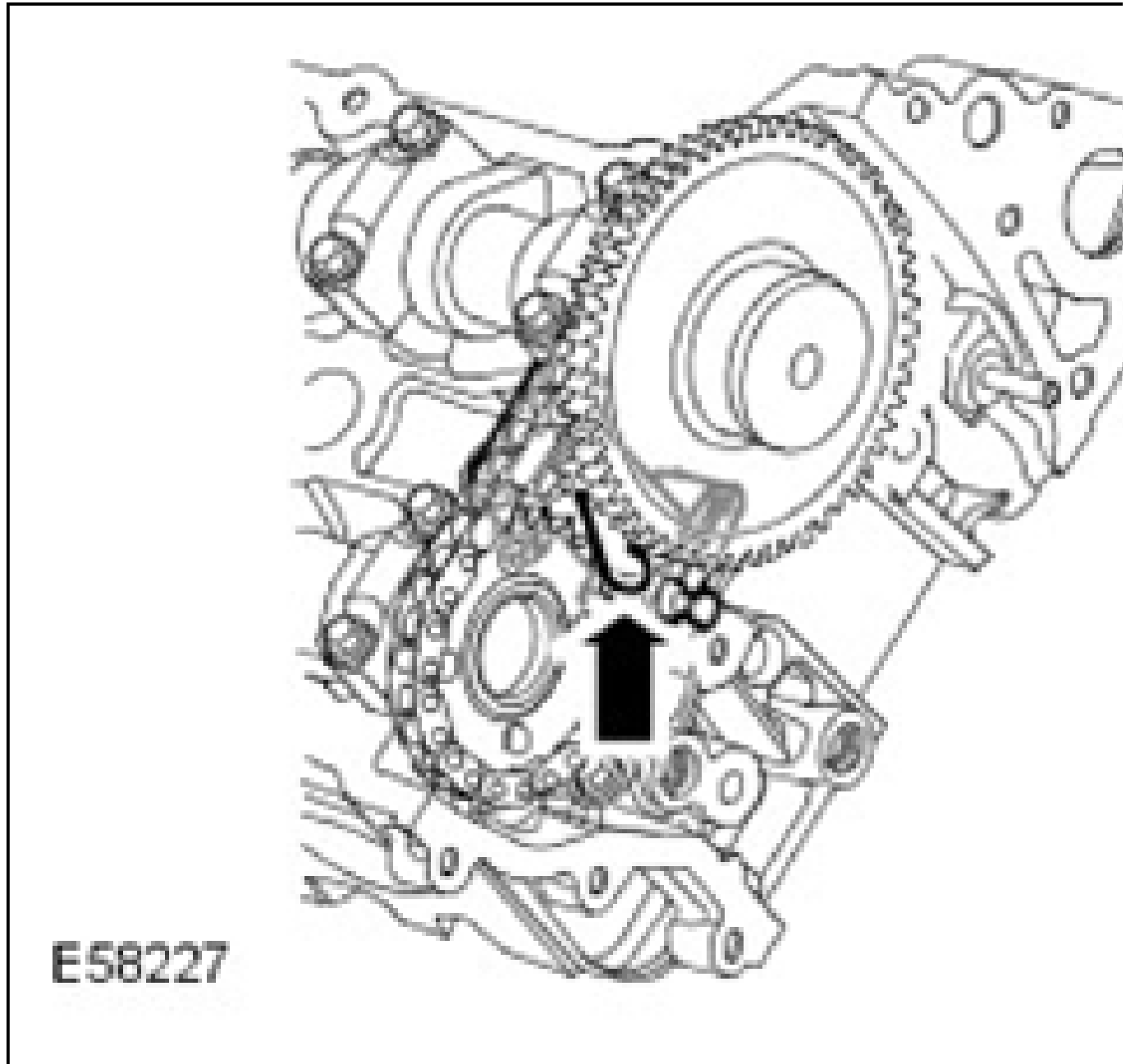
CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

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

NOTE: Apply clean engine oil to the camshaft and bearing surfaces, as follows: upper surface in the cylinder head, upper face of each bearing surface on each bearing cap, on the cam lobes ONLY and not on the base circle area.

11. Install the camshafts.
 - Clean the component mating faces.
12. Install the camshaft bearing caps.
 - Evenly and progressively tighten the bolts in the sequence shown to 10 Nm (7 lb.ft).
13. Install the special tool to the RH cylinder head.
 - Install the 3 bolts.
14. Retain the LH secondary timing chain tensioner piston.

- Install a metal rod.



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.

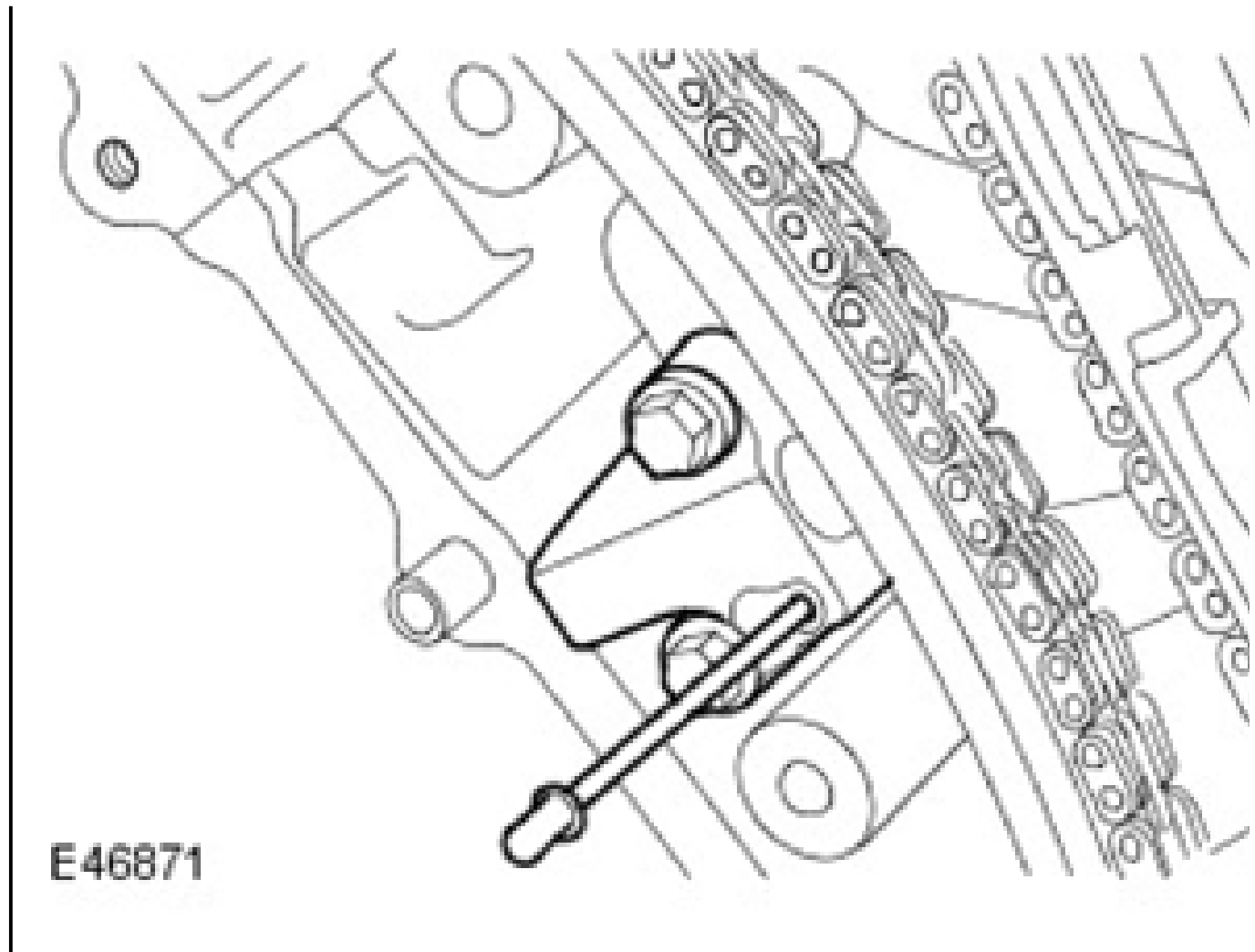
16. Install the secondary timing chain and sprockets to the camshafts.
 - Install the sprocket retaining Torx bolts to the camshafts.

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

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

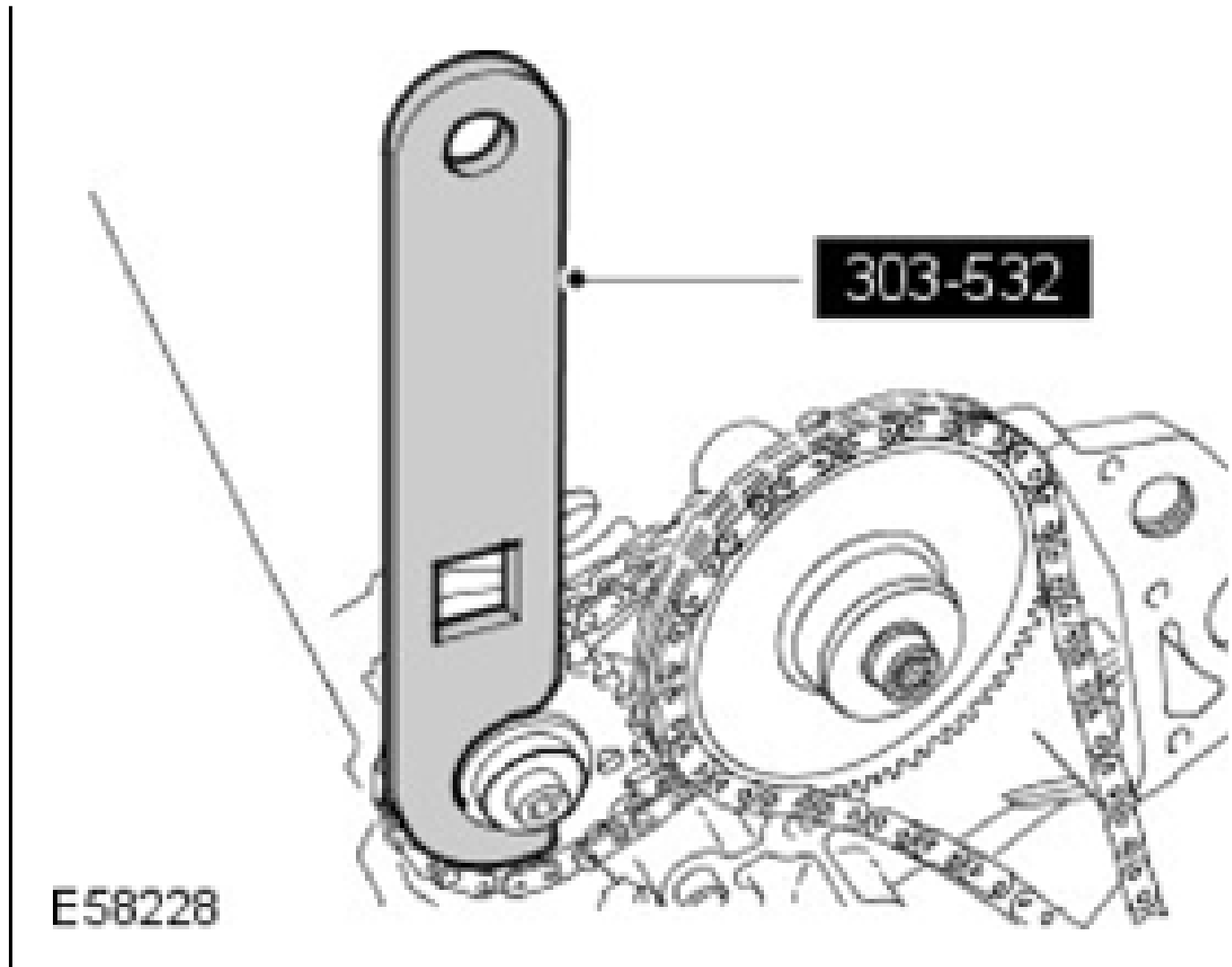
21. Install the primary chain tensioner.
 - Using a metal rod, retain the tensioner piston.
 - Tighten the bolts to 12 Nm (9 lb.ft).
 - Release the retaining rod.



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.

22. 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.



23. Remove the special tool from the RH cylinder head.
24. Remove the crankshaft locking tool.
 - Remove the screw.
25. Install the CKP sensor.

For additional information, refer to: **Crankshaft Position (CKP) Sensor** .

26. Install the engine front cover.

For additional information, refer to: **ENGINE FRONT COVER**.

27. Install the battery tray.

For additional information, refer to: **BATTERY TRAY** .

CAMSHAFTS LH

SPECIAL TOOL(S)

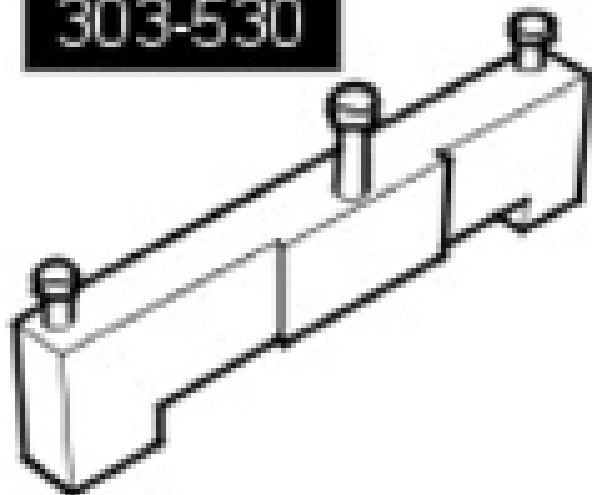
303-645



E46881

Timing Setting tool
303-645

303-530



E46879

Camshaft setting/locking tool
303-530

Timing chain tensioning tool
303-532

**REMOVAL**

1. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

2. Remove the battery tray.

For additional information, refer to: **BATTERY TRAY** .

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

3. Raise and support the vehicle.
4. Remove the engine front cover.

For additional information, refer to: **ENGINE FRONT COVER**

5. Remove the crankshaft position (CKP) sensor.

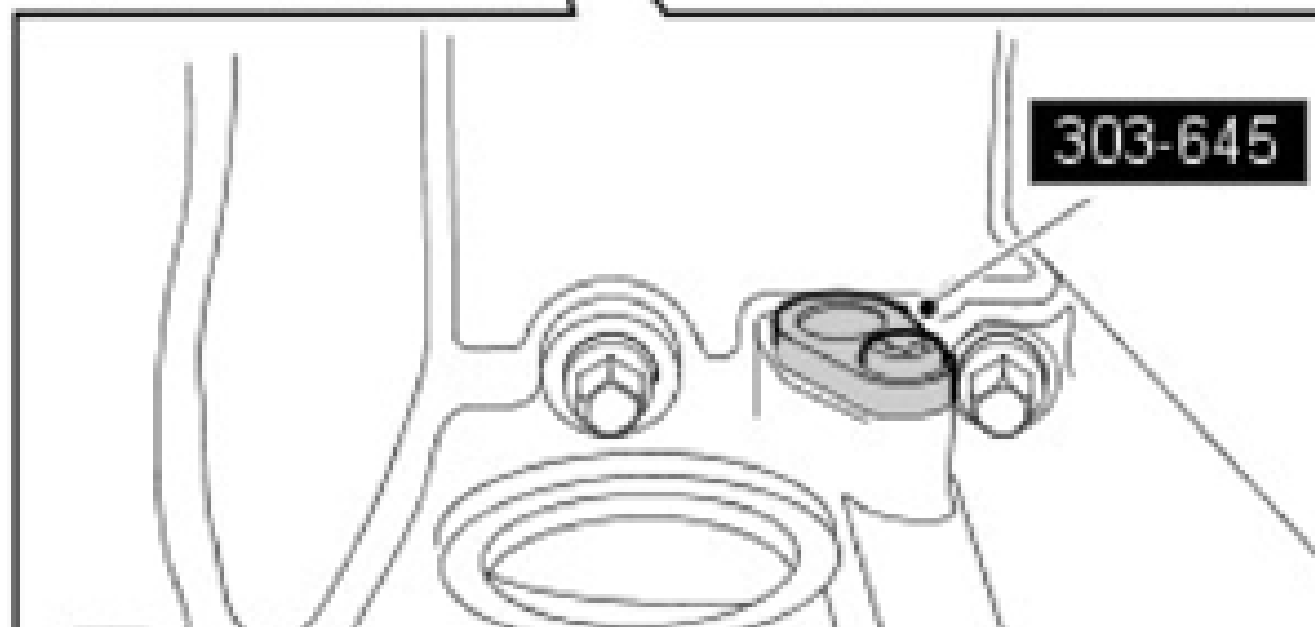
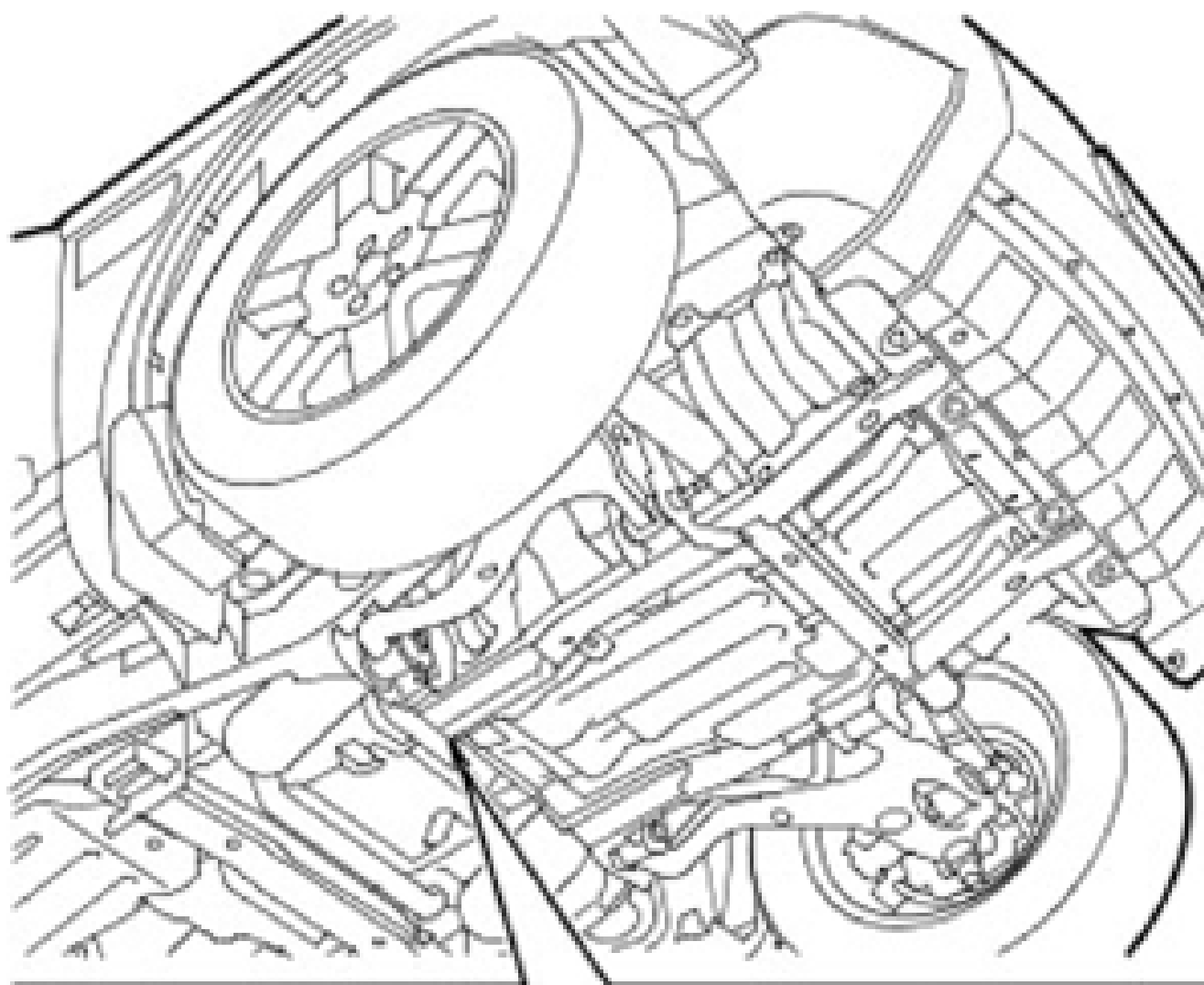
For additional information, refer to: **Crankshaft Position (CKP) Sensor** .

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

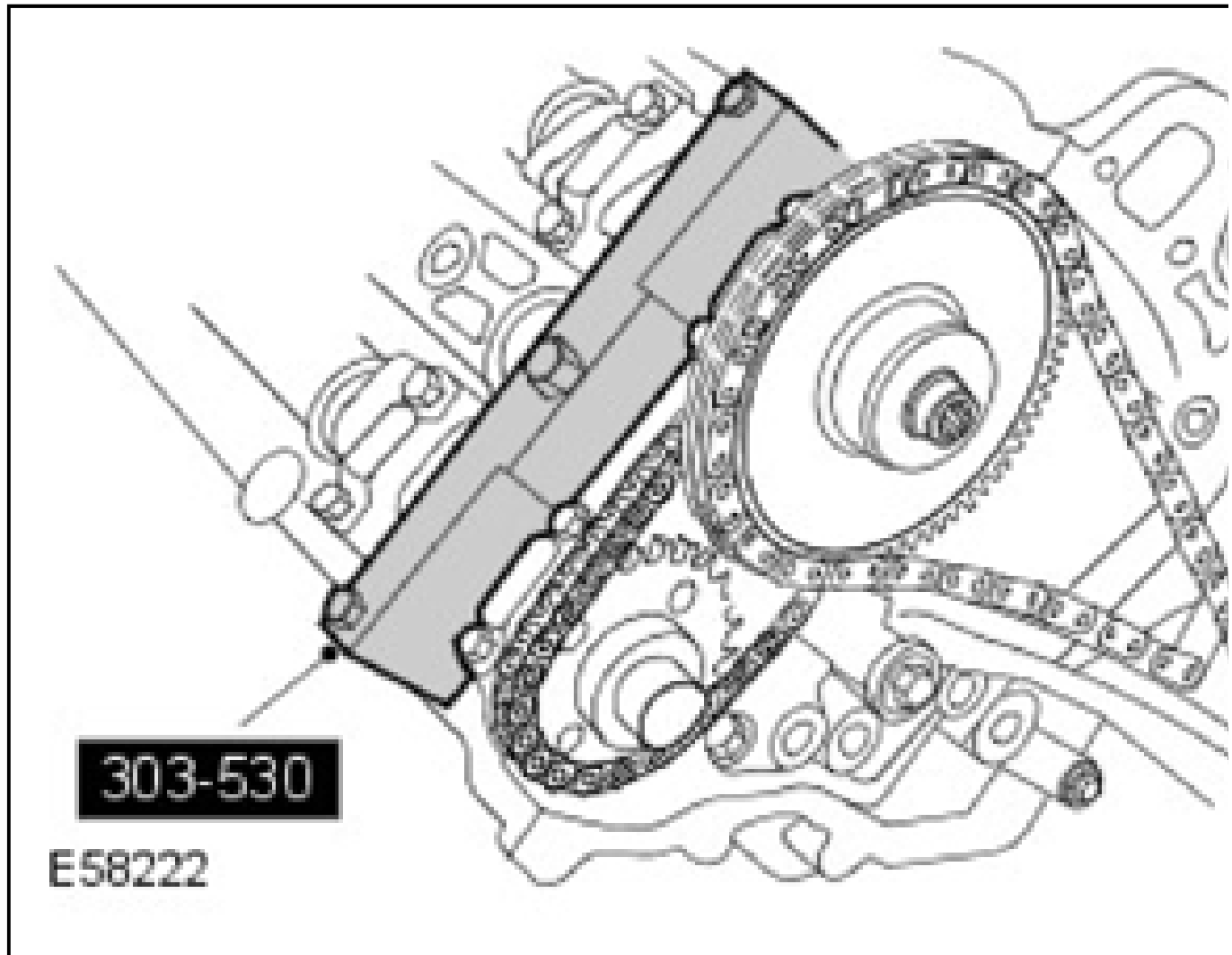
NOTE: The engine is now in the **SAFE** position.

7. Rotate the crankshaft for access.

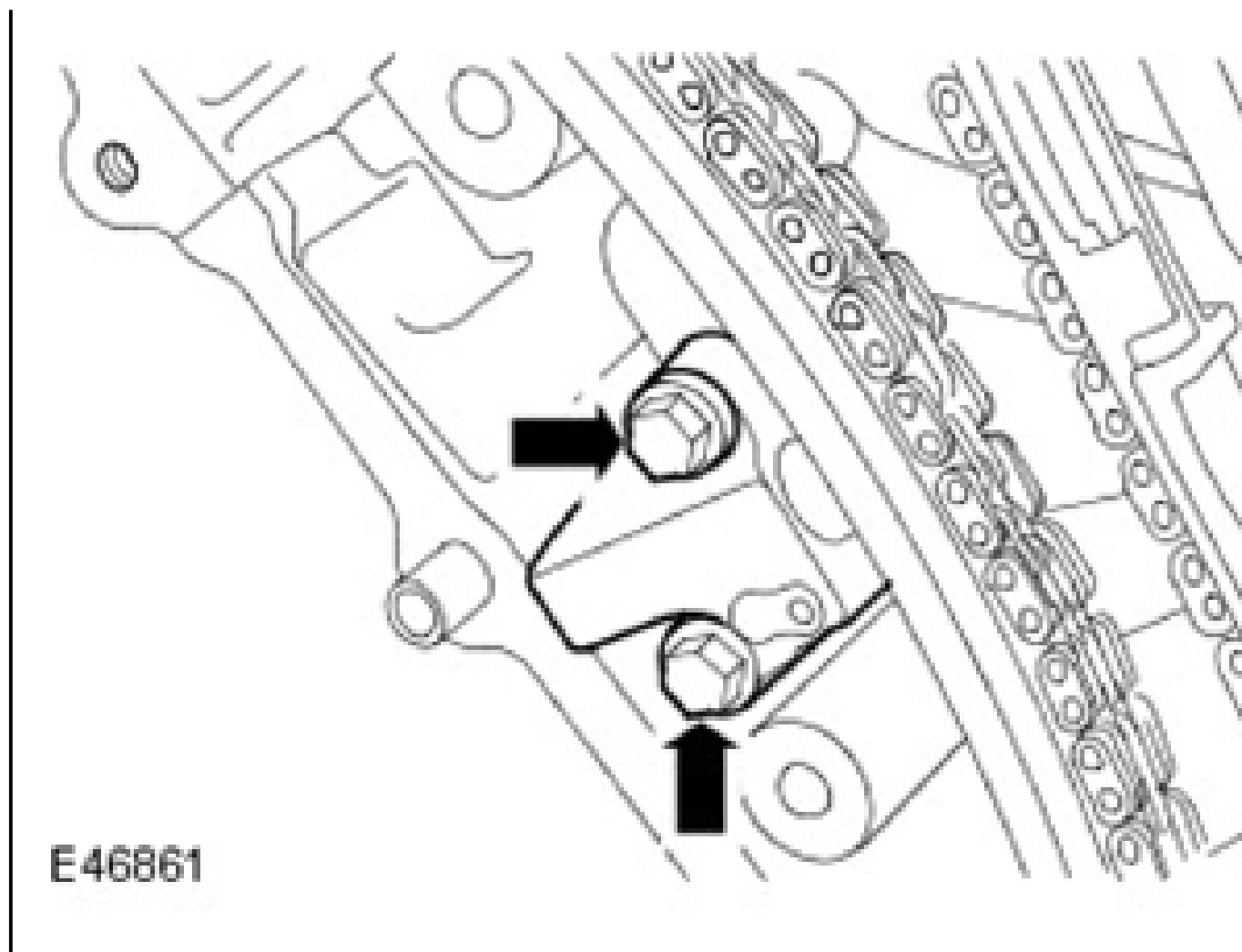
- Install the special tool.
- Install the screw.



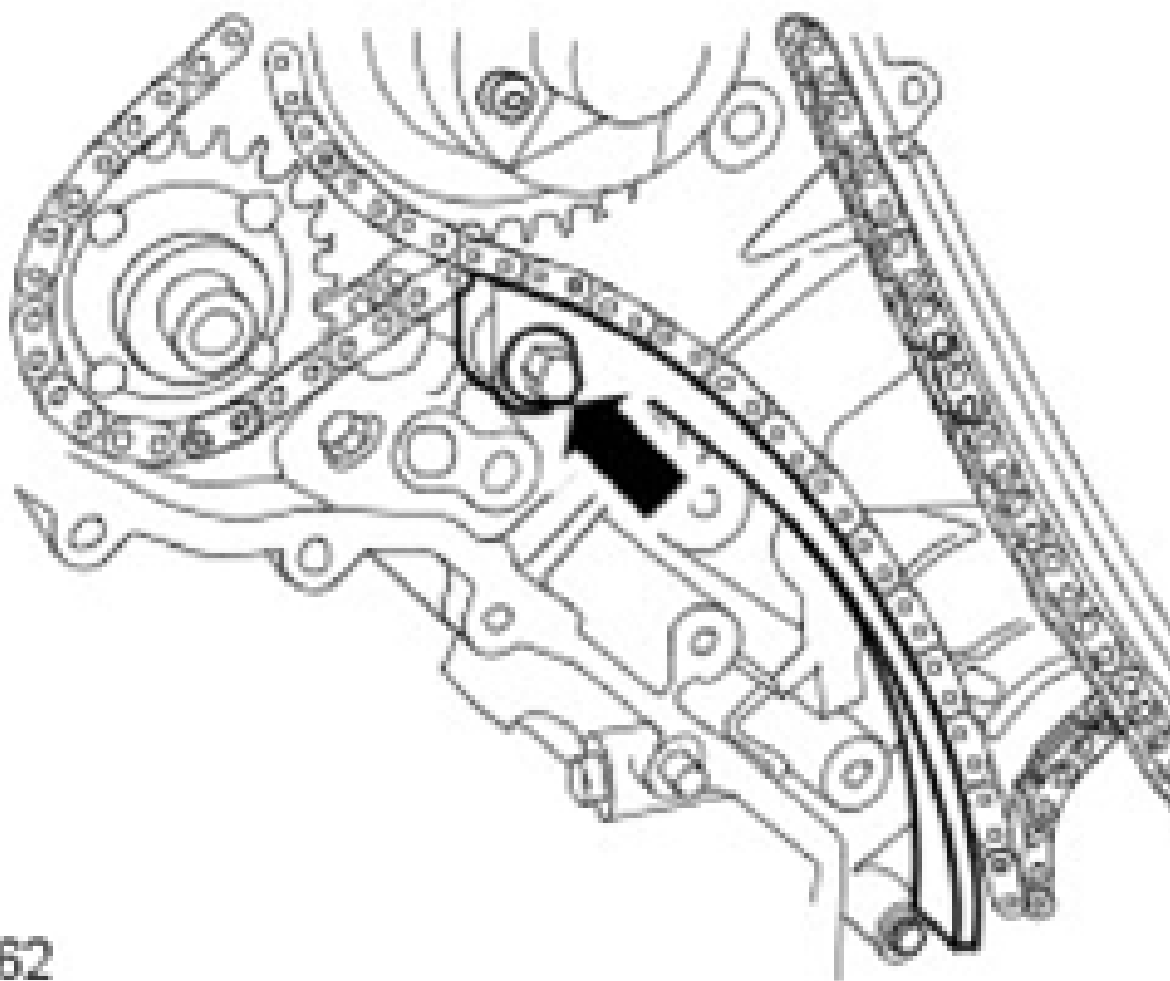
8. Install the special tool to the RH cylinder head.
 - Install the 3 bolts.



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

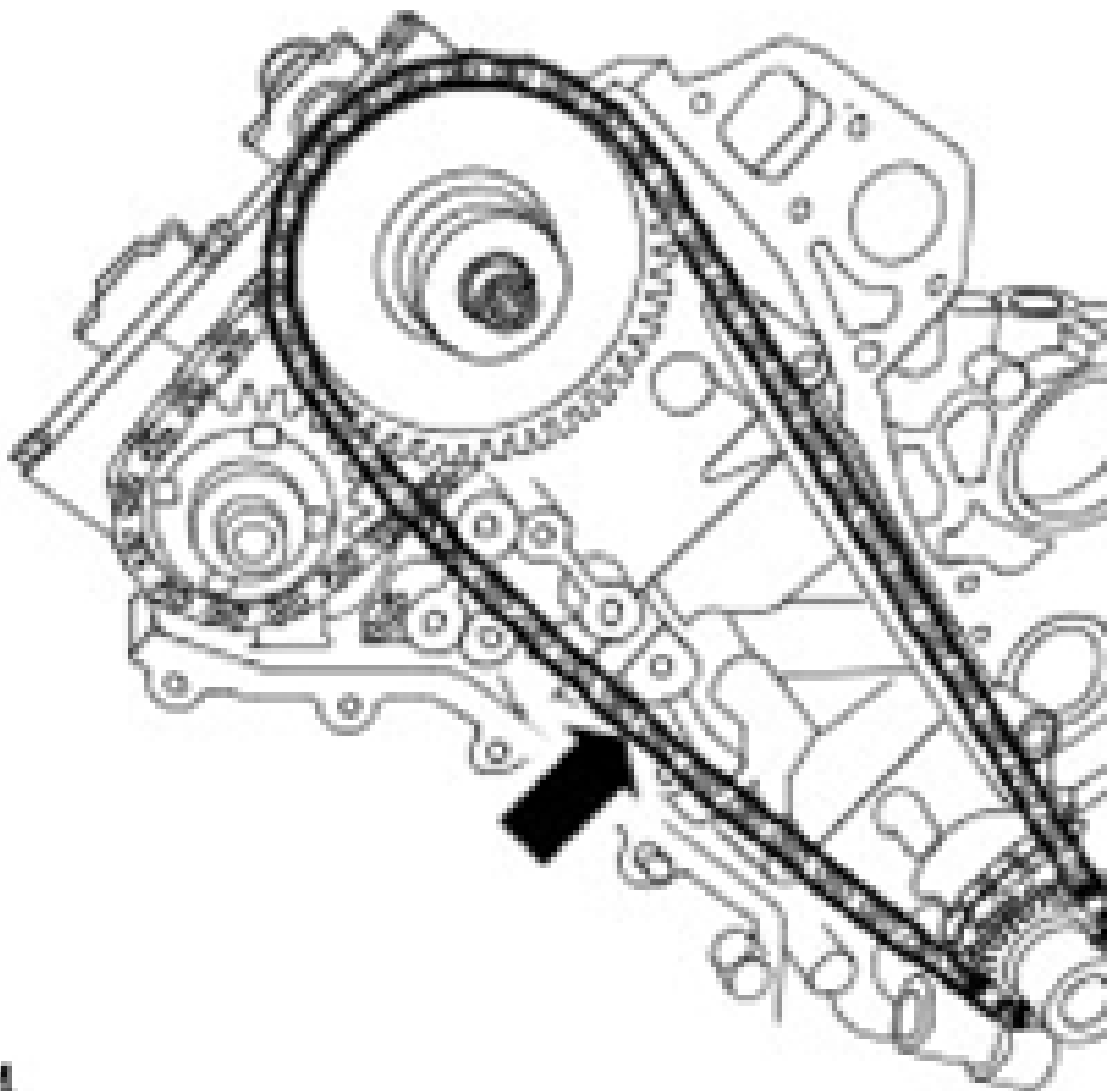


10. Remove the RH primary timing chain tensioner guide.
 - Remove the bolt.



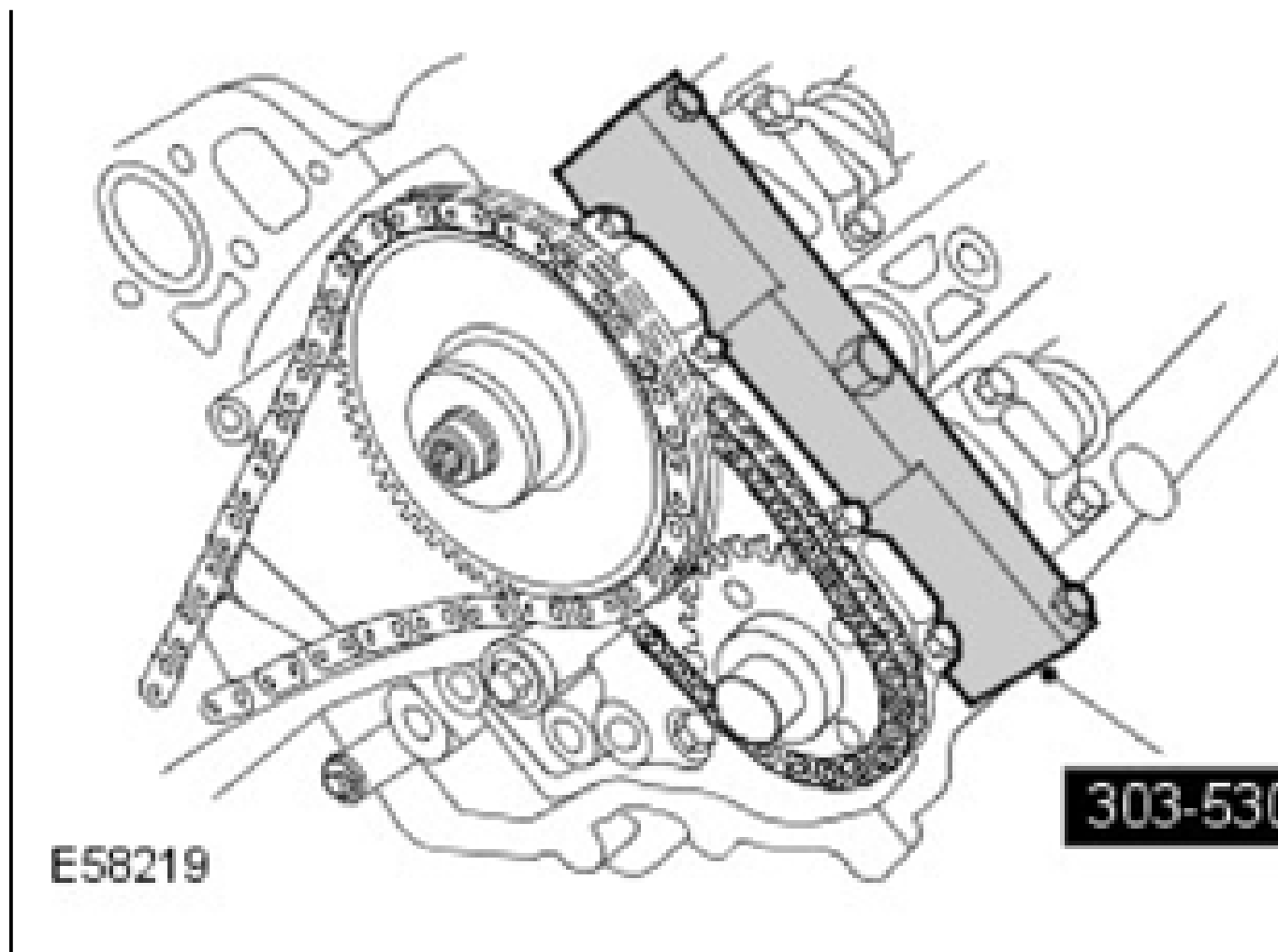
E46862

11. Remove the RH primary timing chain.

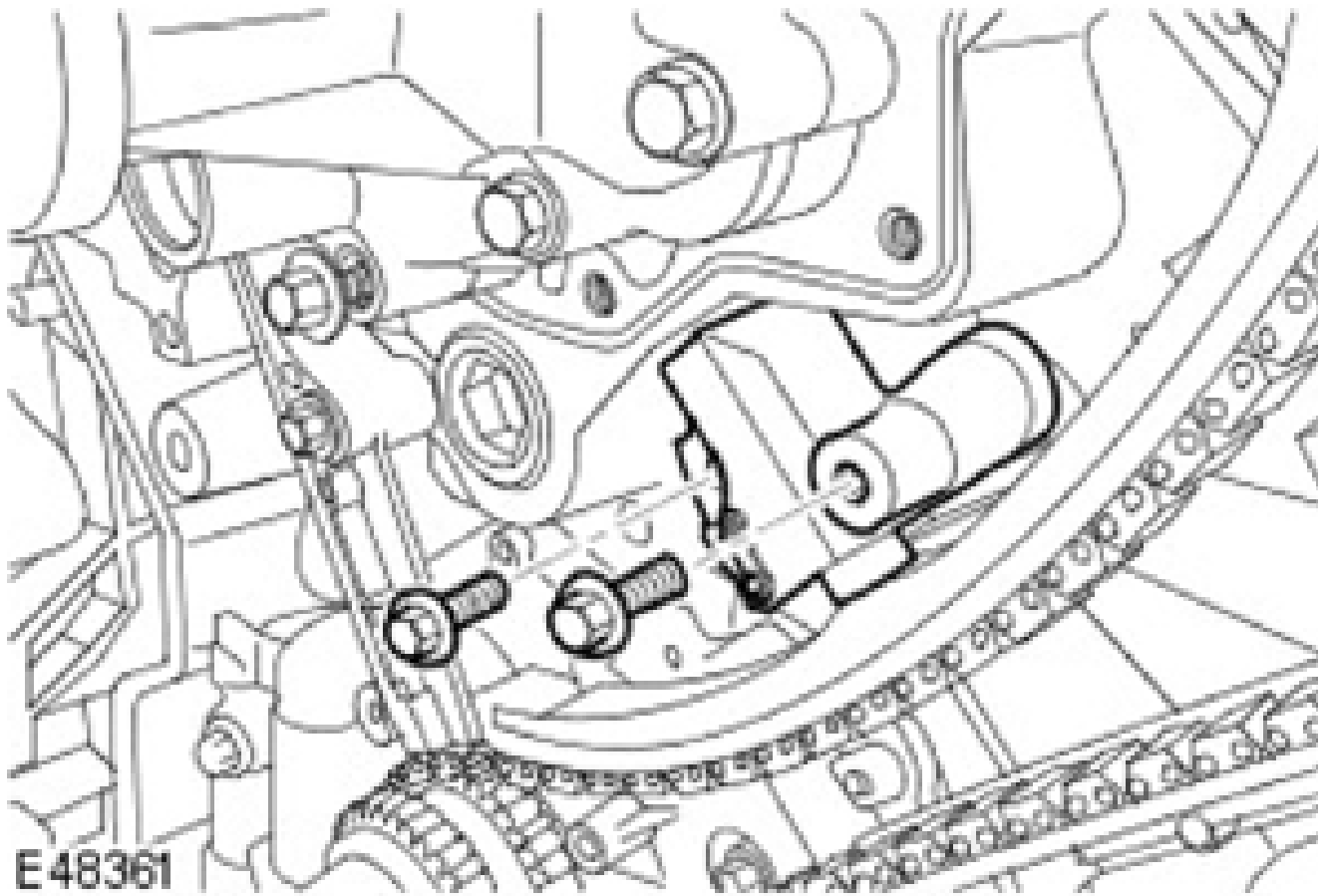


E58224

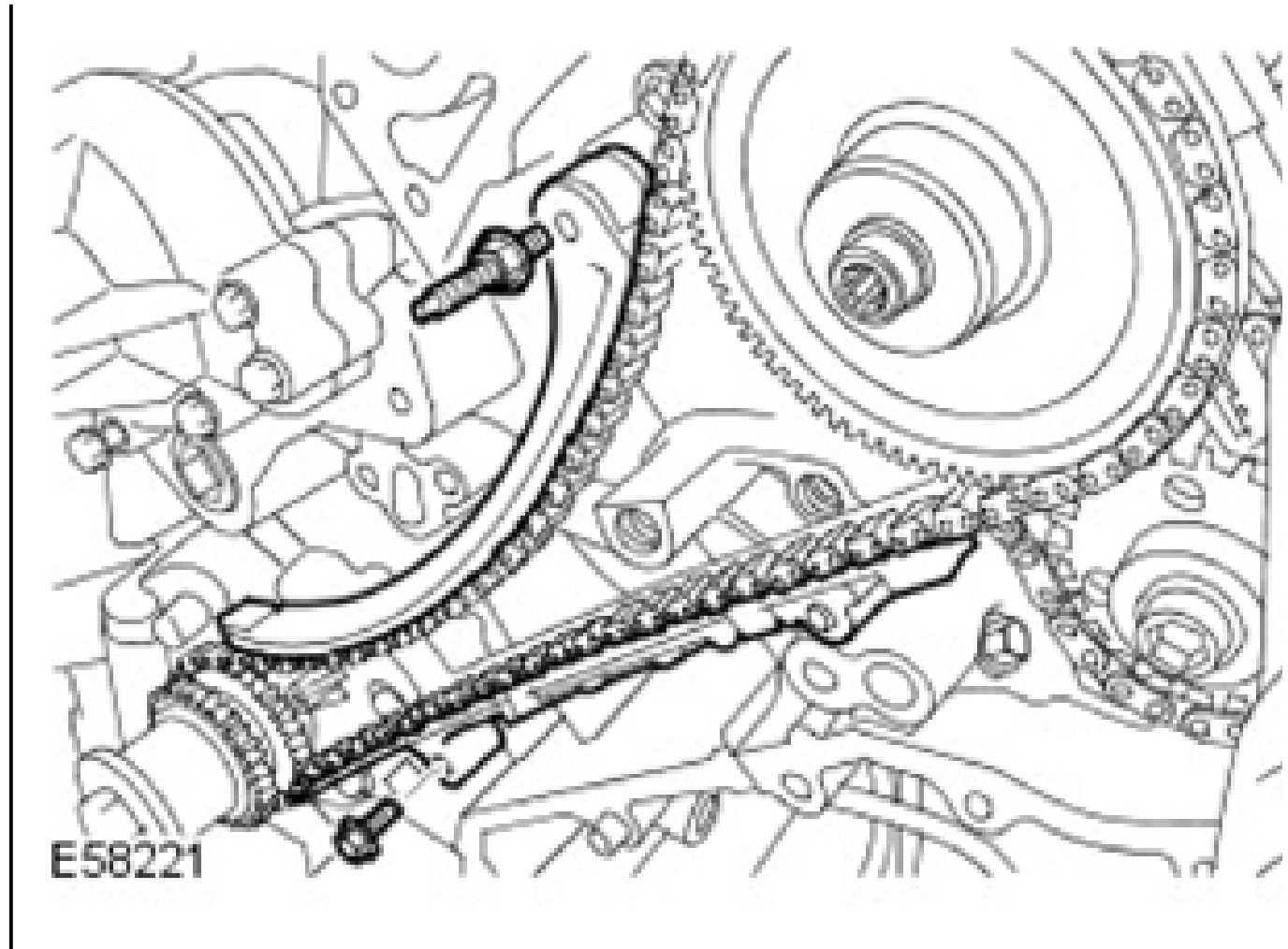
12. Install the special tool to the LH cylinder head.
 - Install the 3 bolts.



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



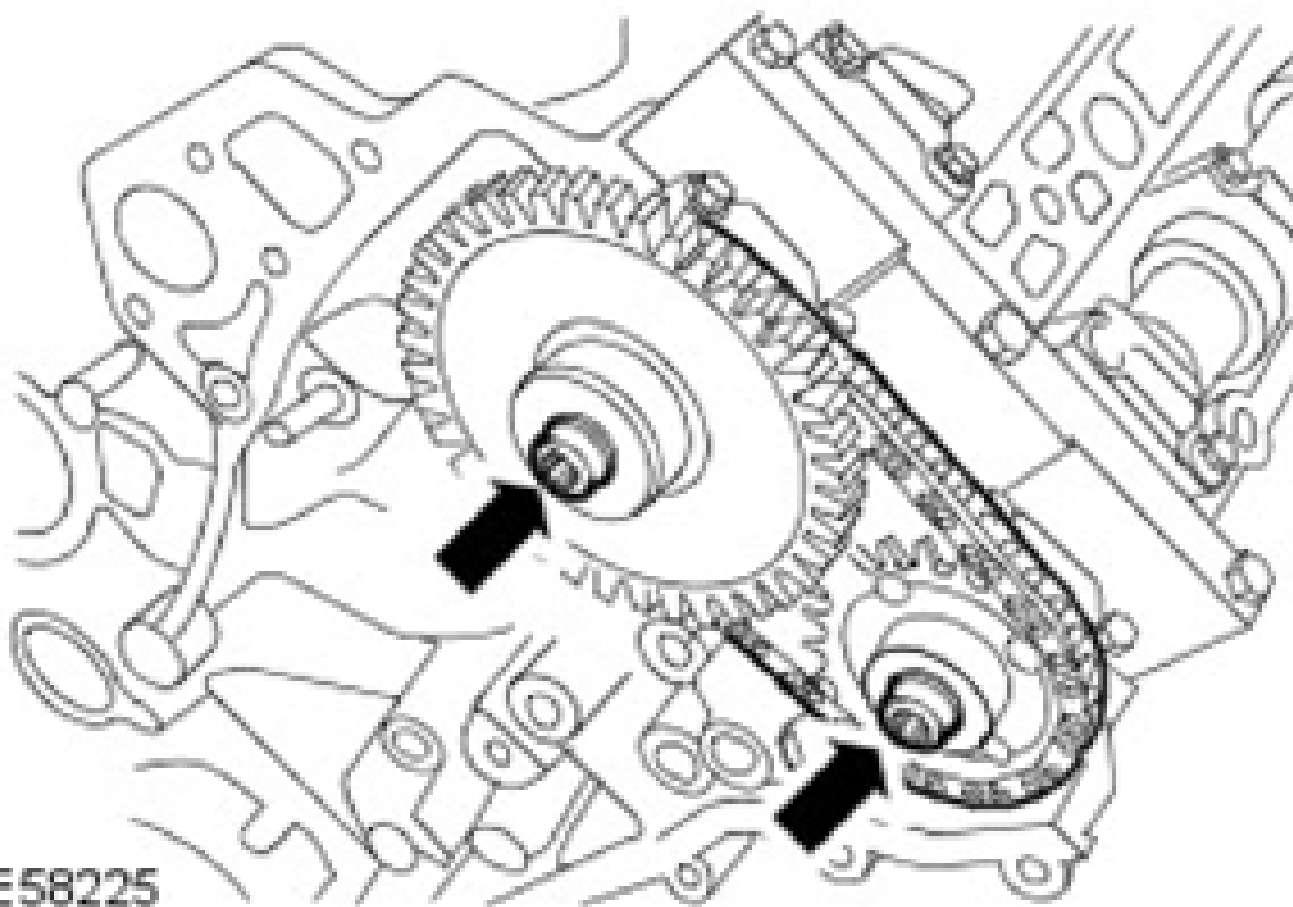
14. Remove the LH upper and lower primary timing chain tensioner guides.
- Remove the stud.
 - Remove the bolt.



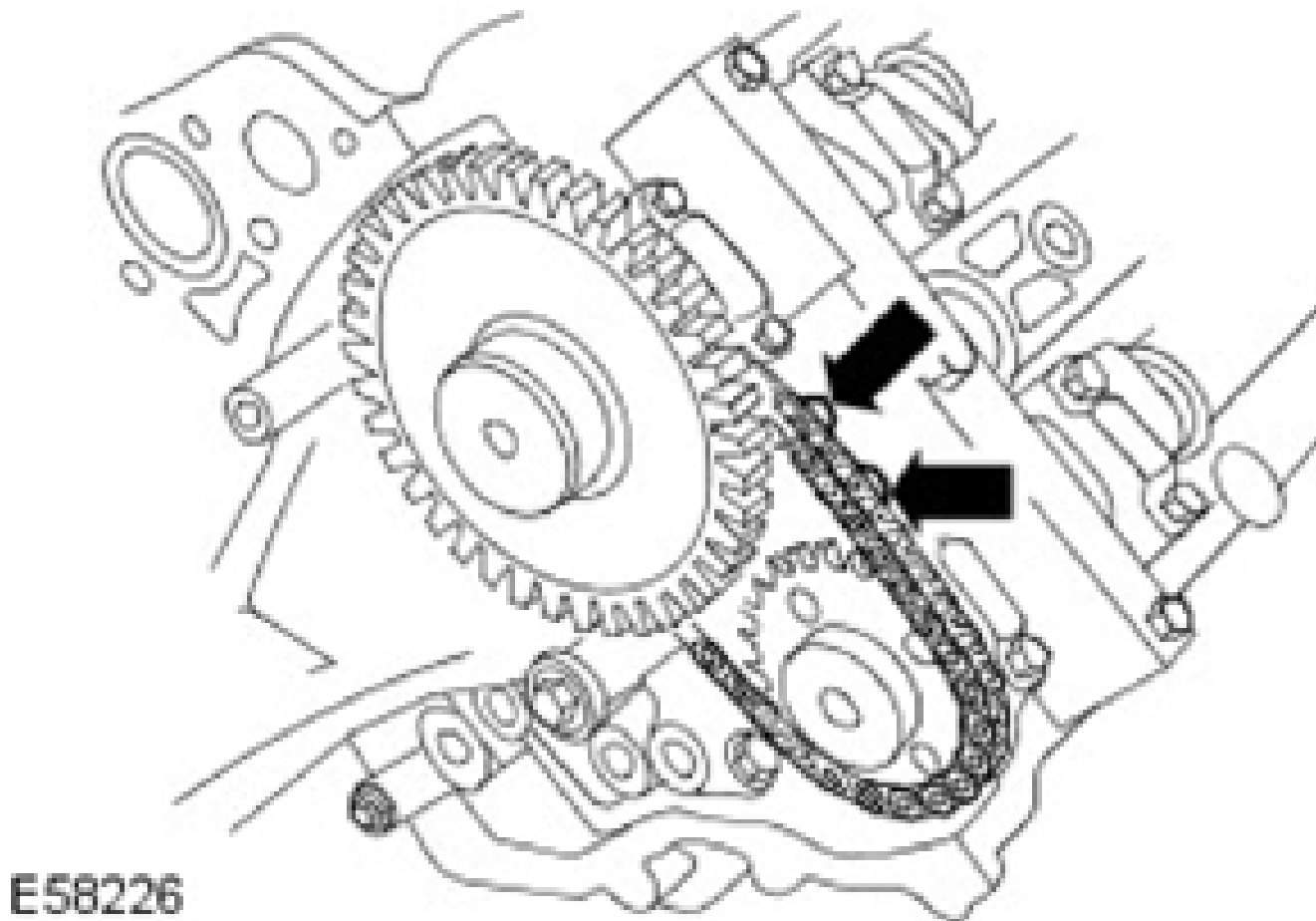
15. Remove the LH primary timing chain.

CAUTION: Discard the bolts.

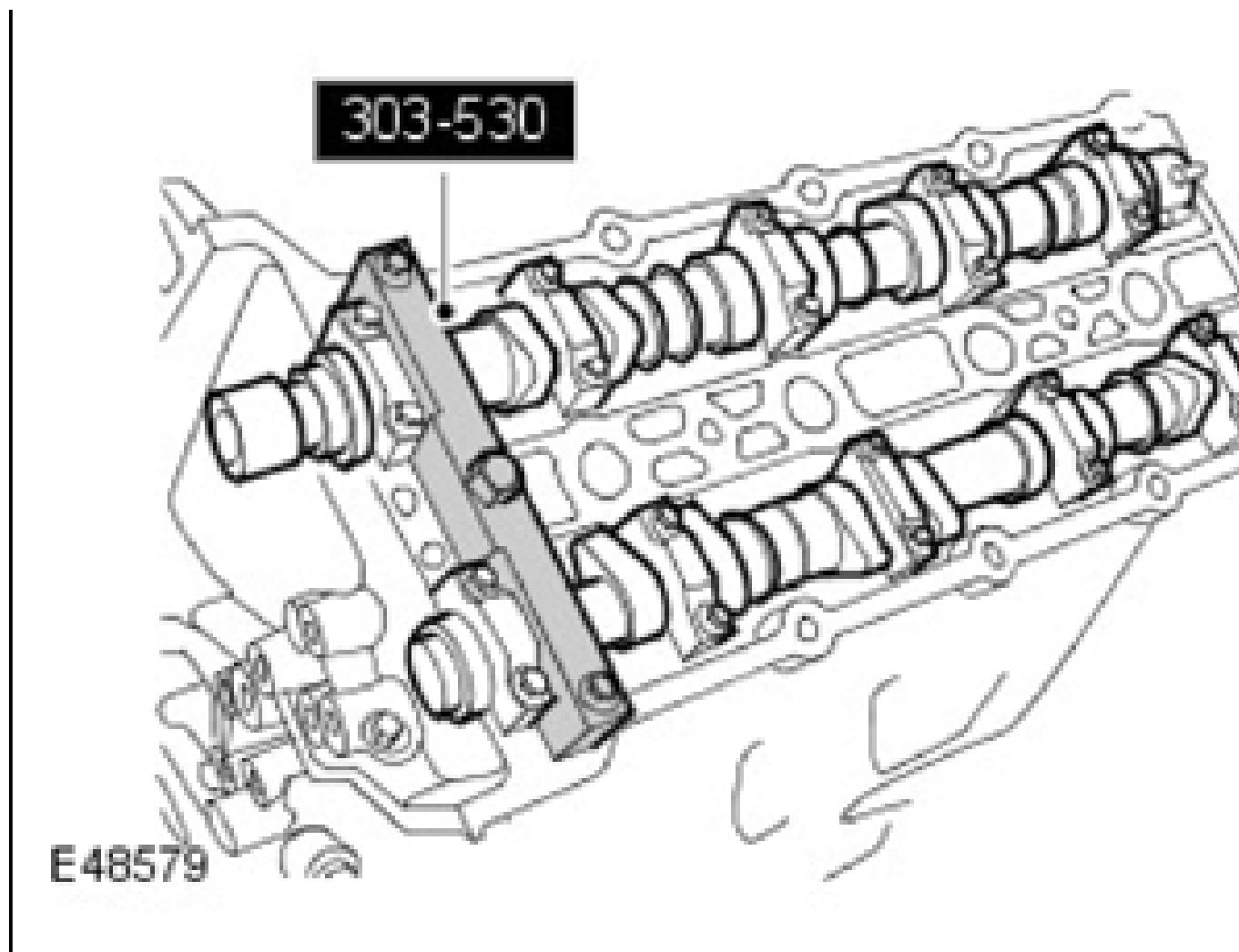
16. Remove the camshaft sprockets.
- Remove the 2 bolts.



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



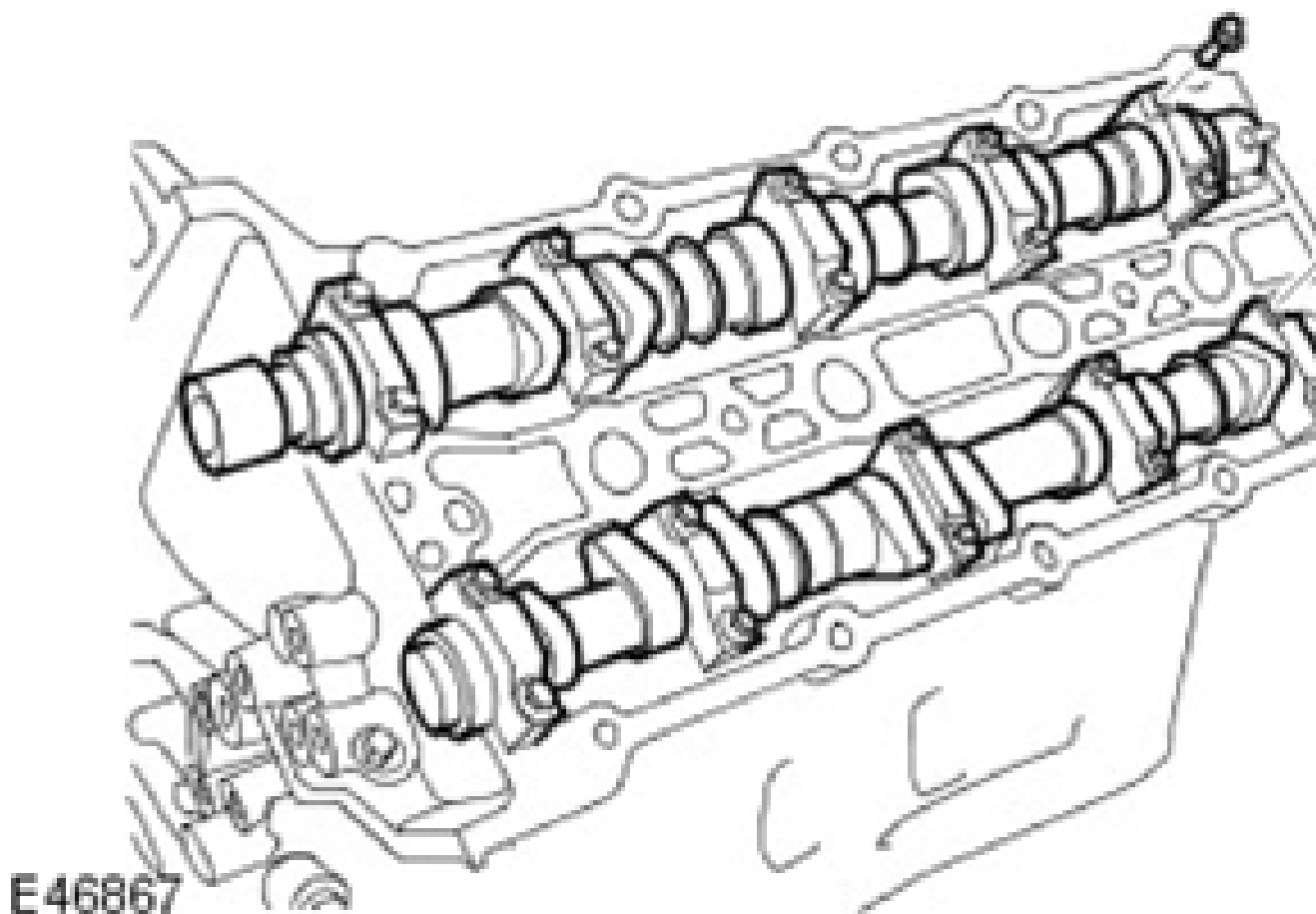
18. Remove the special tool from the LH cylinder head.
- Remove the 3 bolts.



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).

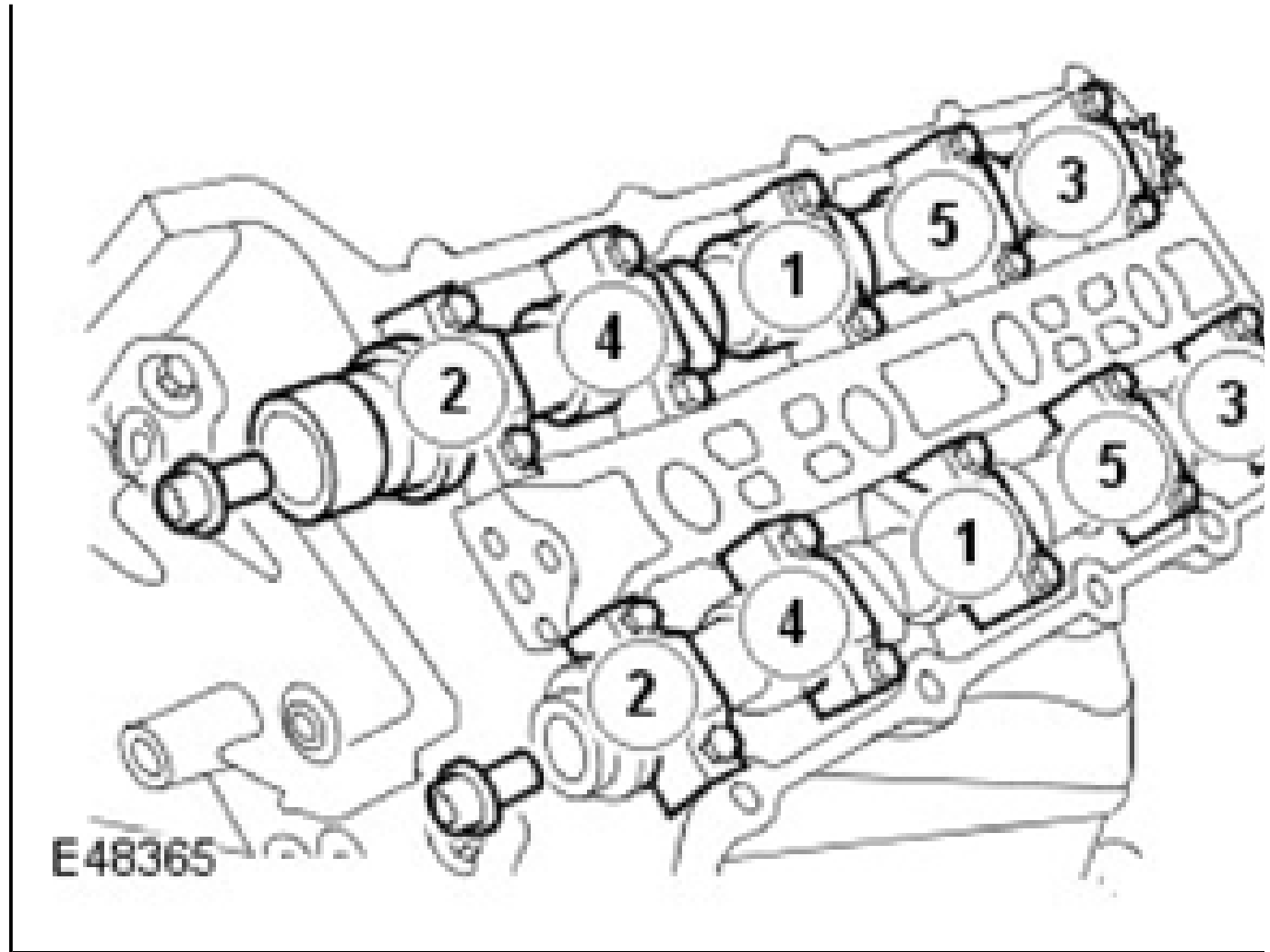
19. Remove the camshaft bearing caps.
 - Remove the 20 bolts.



20. Remove the camshafts.

INSTALLATION

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

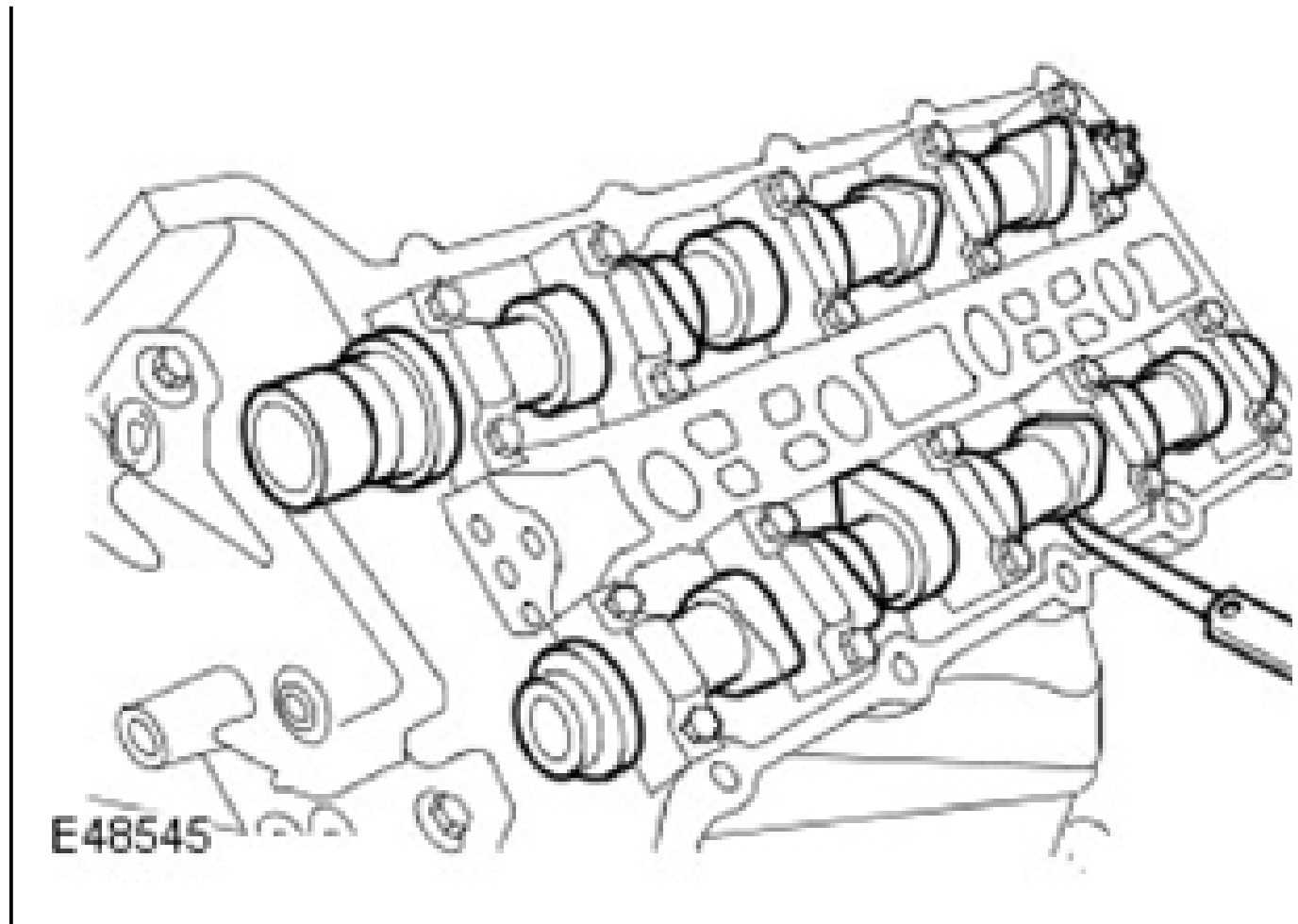


CAUTION: Make sure that new bolts are installed.

4. 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.

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



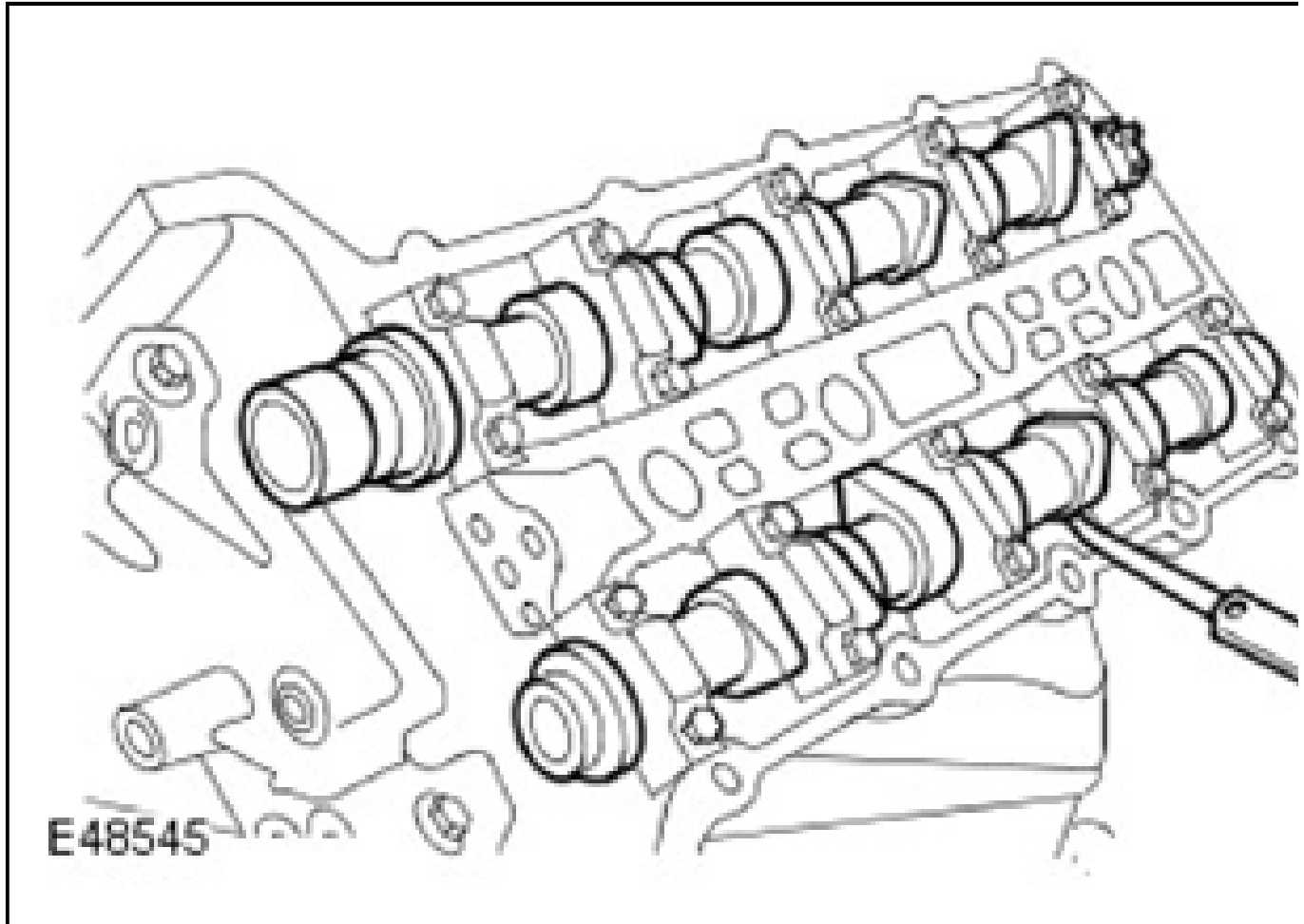
NOTE: Remove the camshaft bearing caps evenly and in stages. Remove the camshaft bearing caps. Note: their position, orientation and markings. Each is marked with its position (number) and an orientation (arrow).

6. Remove the camshafts.
 - Remove the 20 bolts.
7. Remove the valve tappets, replace with selected tappets.
8. Install the camshafts.
 - Lubricate the journals and camshaft lobes.
 - Clean the component mating faces.
9. 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.

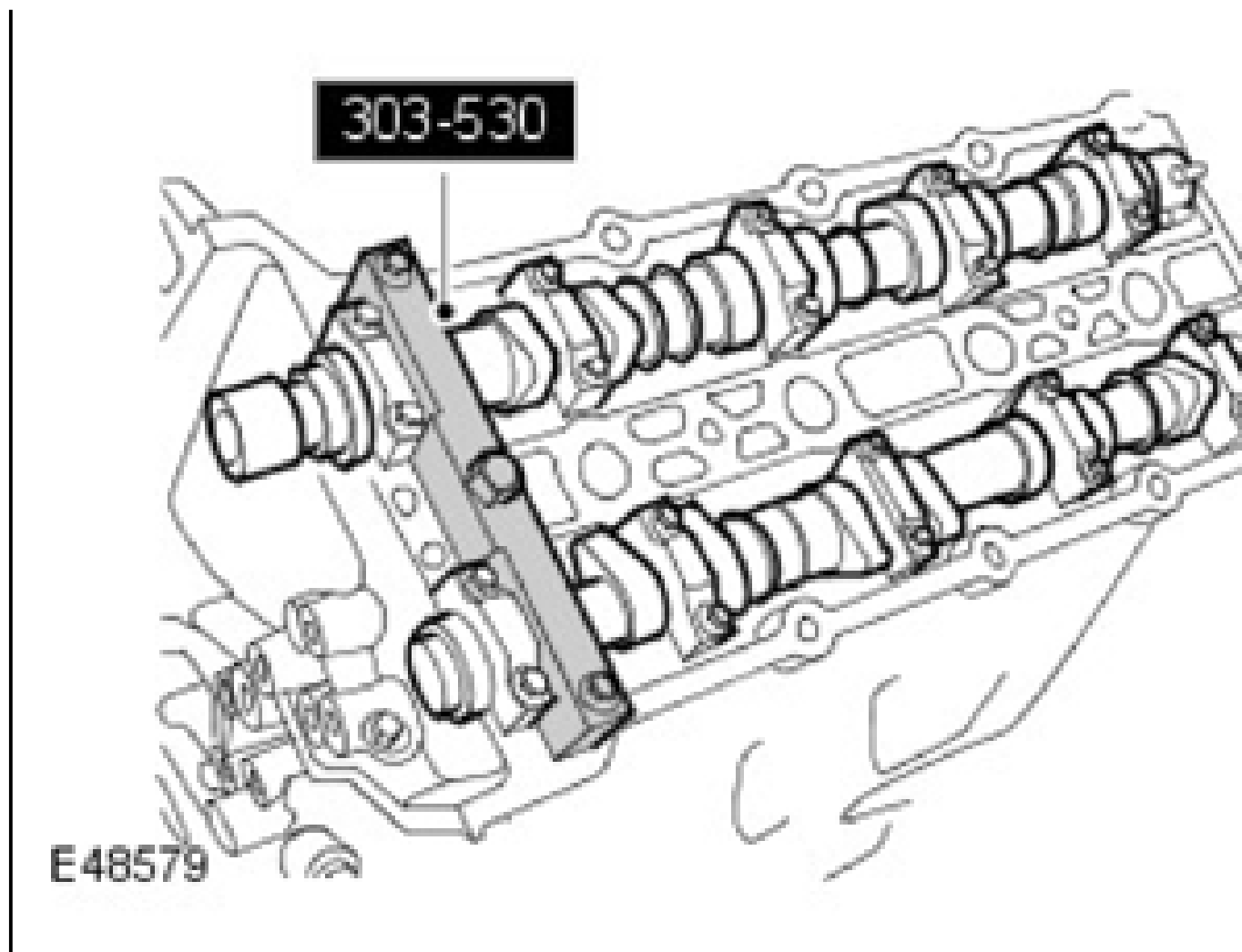
10. Check valve tappet clearances are correct.

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

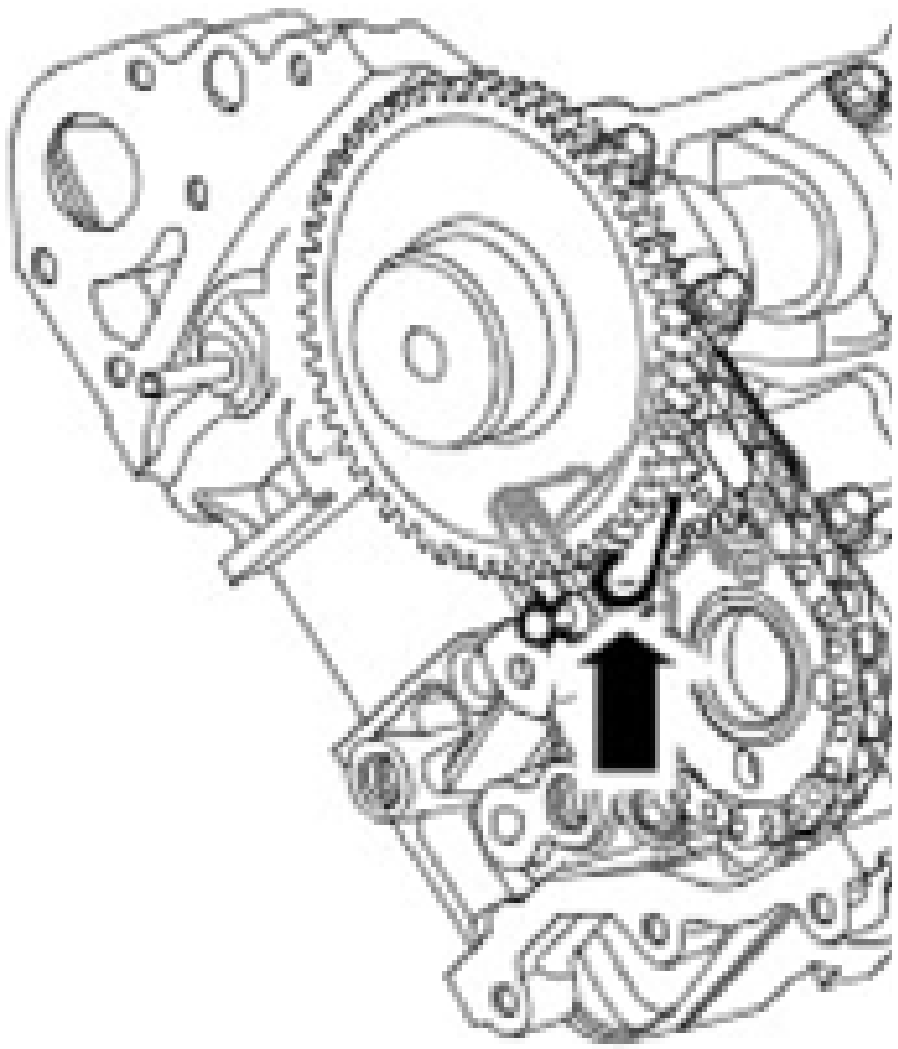


11. Install the special tool to the LH cylinder head.





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



E58311

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

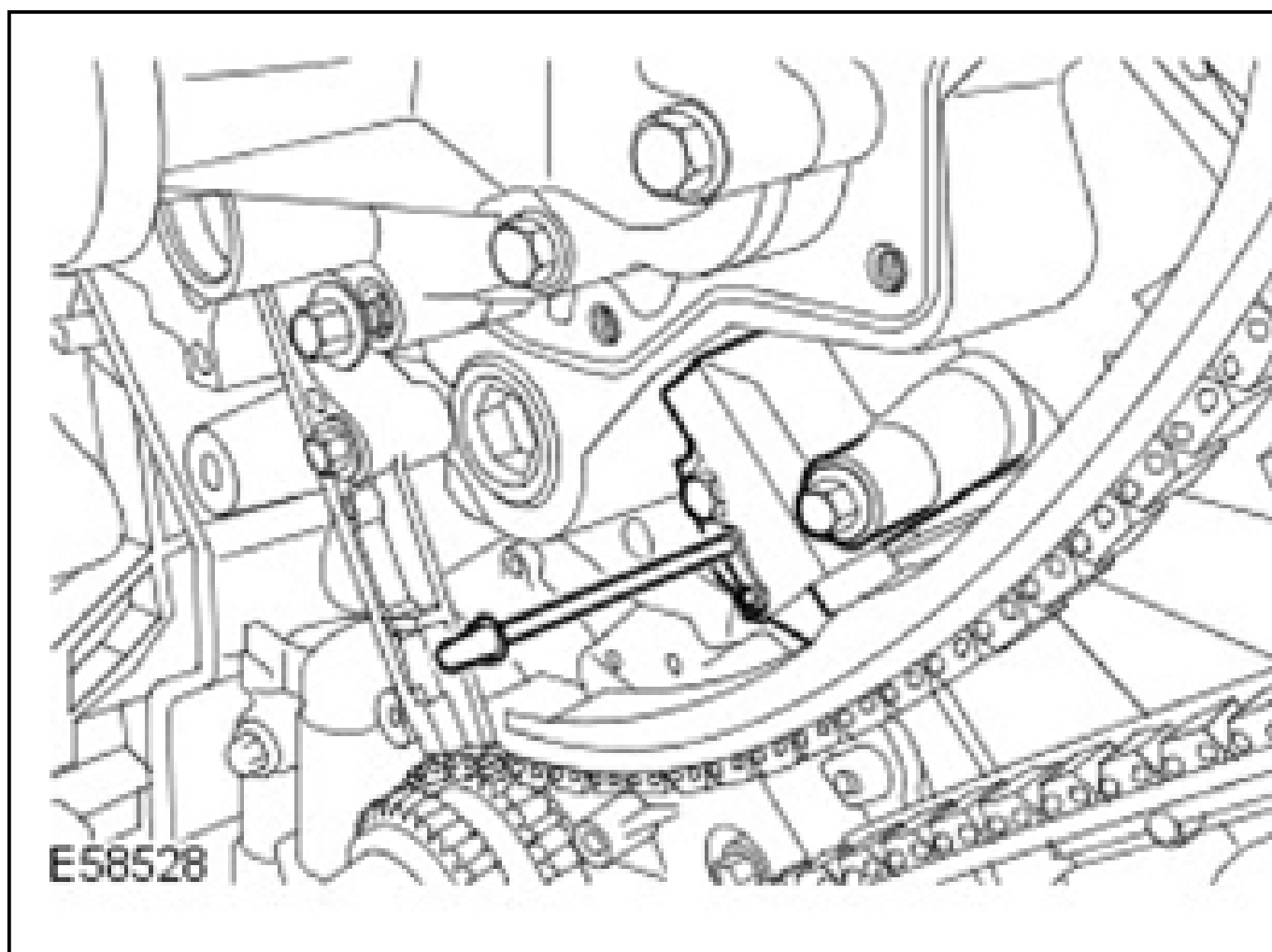
NOTE: **Lightly tighten the camshaft sprocket Torx bolts, the sprockets MUST be free to move.**

15. Install the LH secondary timing chain and sprockets to the camshafts.
 - Install the sprocket retaining Torx bolts to the camshafts.
16. Tension the secondary timing chain.
 - Remove the retaining rod.
17. Install the LH primary timing chain.

- Make sure the timing chain slack is on the tensioner side of the timing chain.
18. 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.

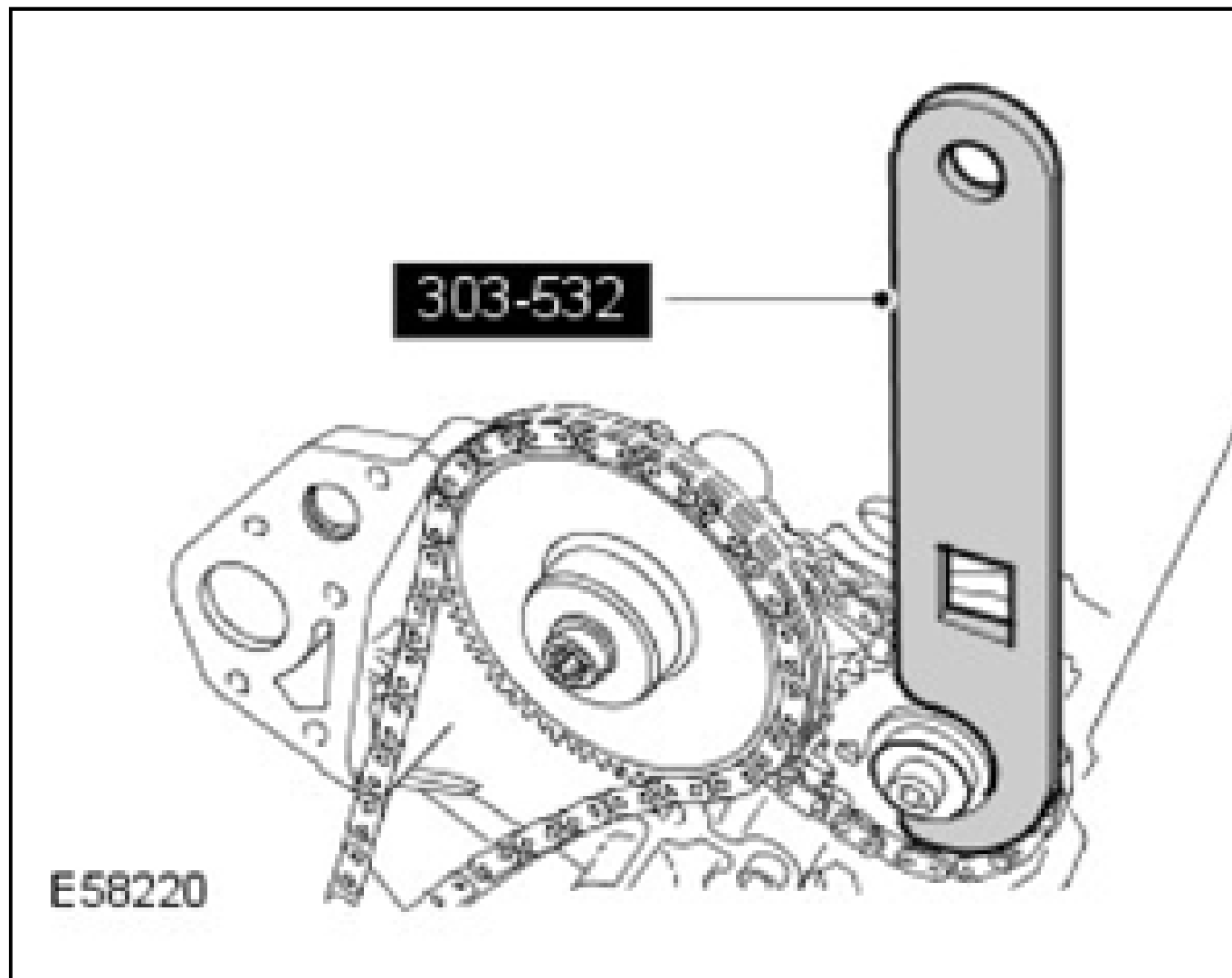
19. Install the LH primary timing chain tensioner.
- Using 3 mm diameter metal rod, retain the chain tensioner piston.
 - Tighten the bolts to 12 Nm (9 lb.ft).
 - Remove the retaining rod.



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.

20. 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.



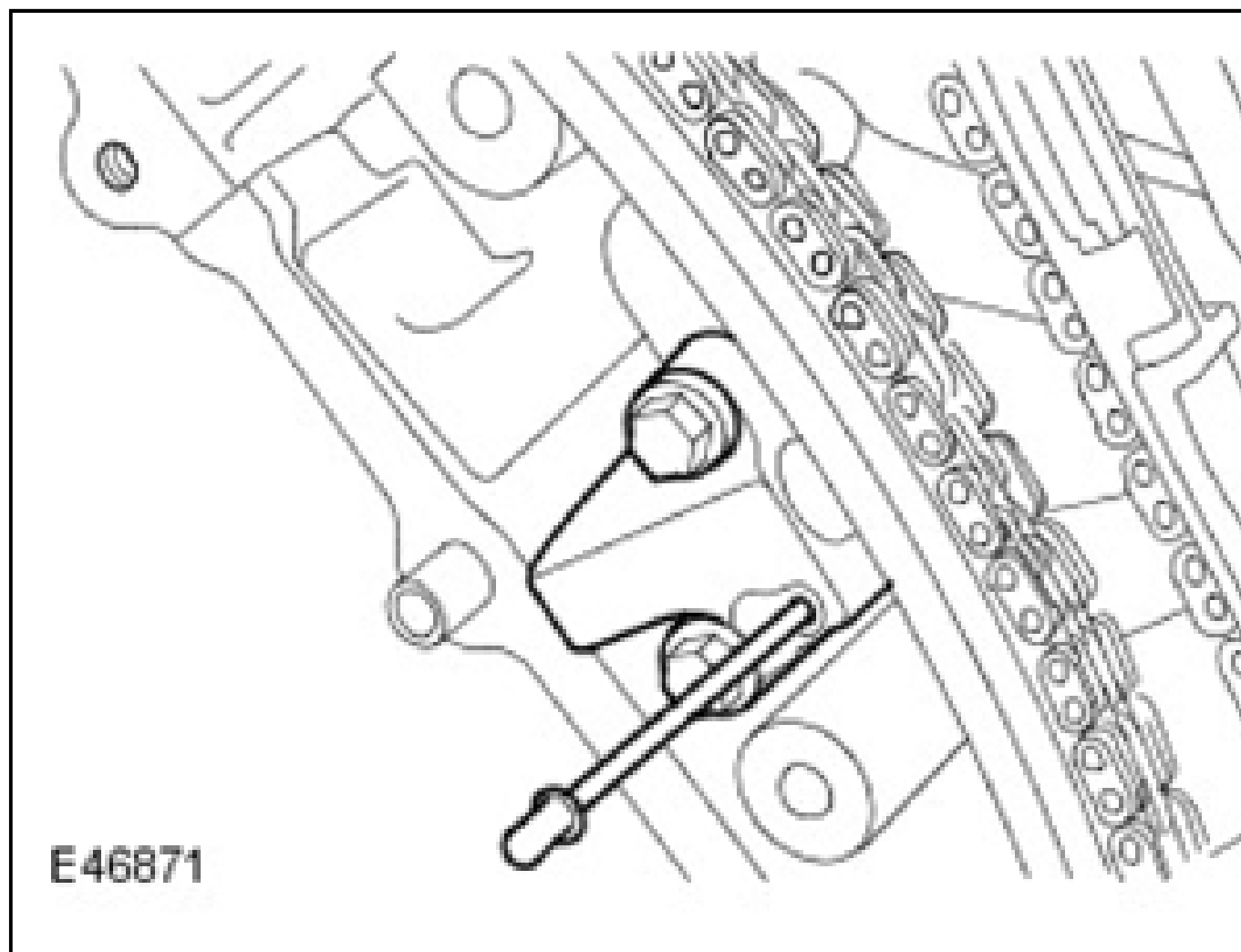
21. Install the RH primary timing chain.
- Make sure the timing chain slack is on the tensioner side of the timing chain.
22. Install the RH primary timing chain tensioner guide.
- Tighten the bolts to 12 Nm (9 lb.ft).

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.

23. 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.

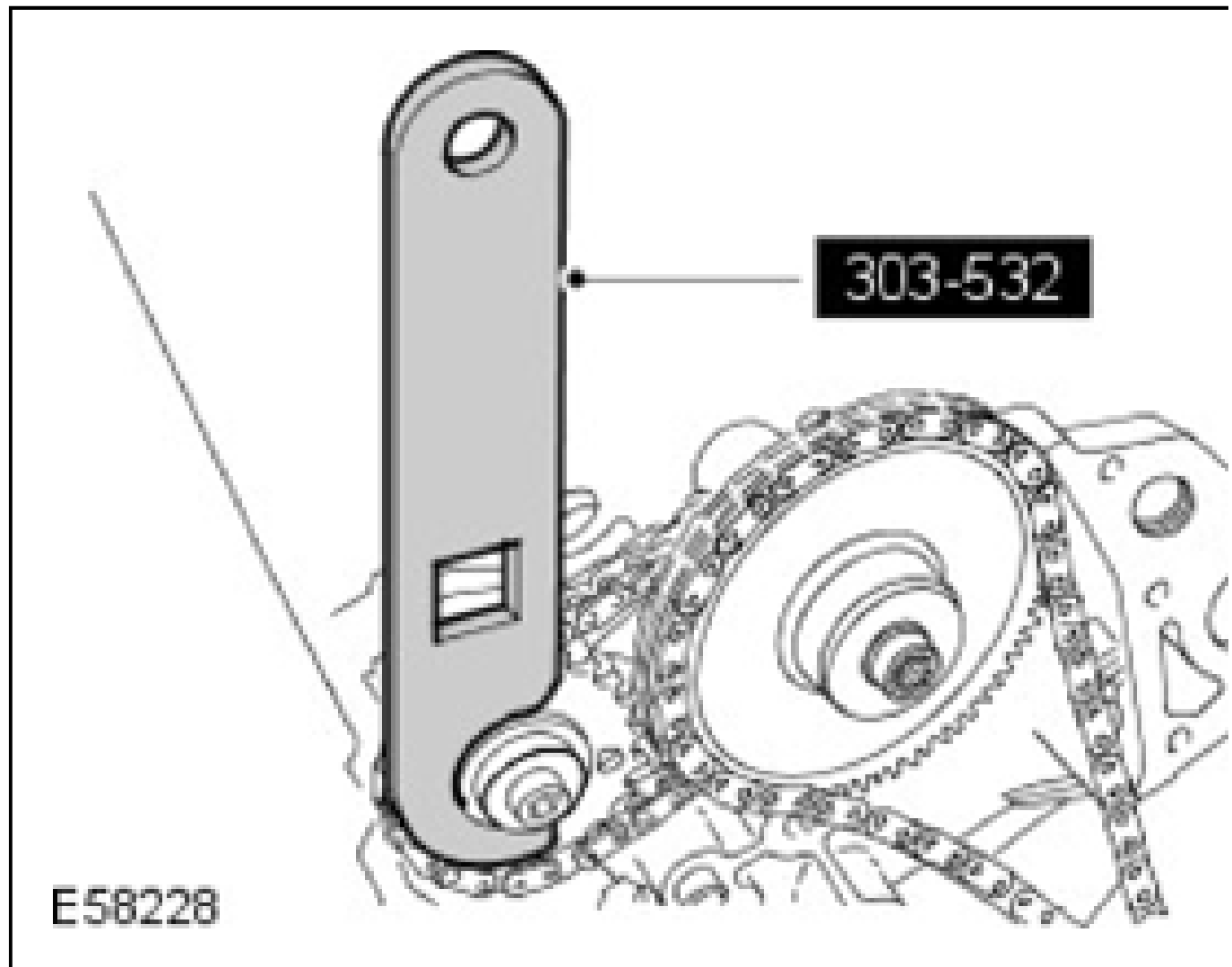


CAUTION: The intake camshaft sprocket retaining bolt **MUST** be tightened before the exhaust camshaft sprocket retaining bolt. Engine damage will occur if this procedure is not followed.

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.

24. 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.



25. Remove the special tool from the LH cylinder head.
26. Remove the special tool from the RH cylinder head.
27. Remove the crankshaft locking tool.

- Remove the screw.

28. Install the CKP sensor.

For additional information, refer to: **Crankshaft Position (CKP) Sensor** .

29. Install the engine front cover.

For additional information, refer to: **ENGINE FRONT COVER**.

30. Install the battery tray.

For additional information, refer to: **BATTERY TRAY** .

31. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

Crankshaft Pulley

SPECIAL TOOL(S)

 303-588 E46729	Remover, crankshaft pulley 303-588
	Holding Tool Crankshaft Pulley 303-893 (LRT-12-080)

303-893



E46728

Adapter
303-191-03

303-191-03



E46730

Remover, crankshaft seal
303-D121

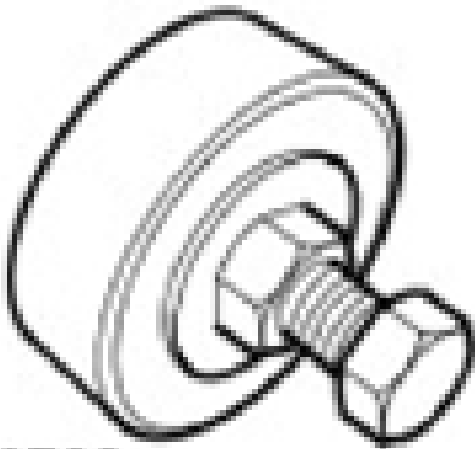
303-D121



E64849

Installer, crankshaft seal
303-1100

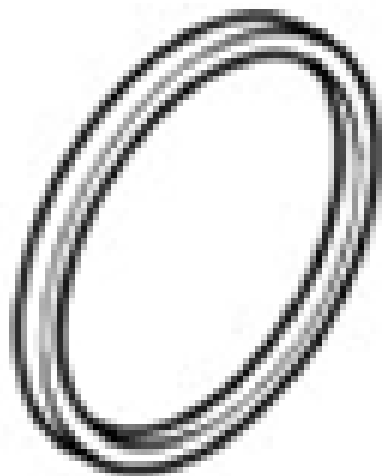
303-1100



E46732

Adapter - Crankshaft seal installer
303-1100-01

303-1100-01



E67144

REMOVAL

1. Disconnect the battery ground cable.

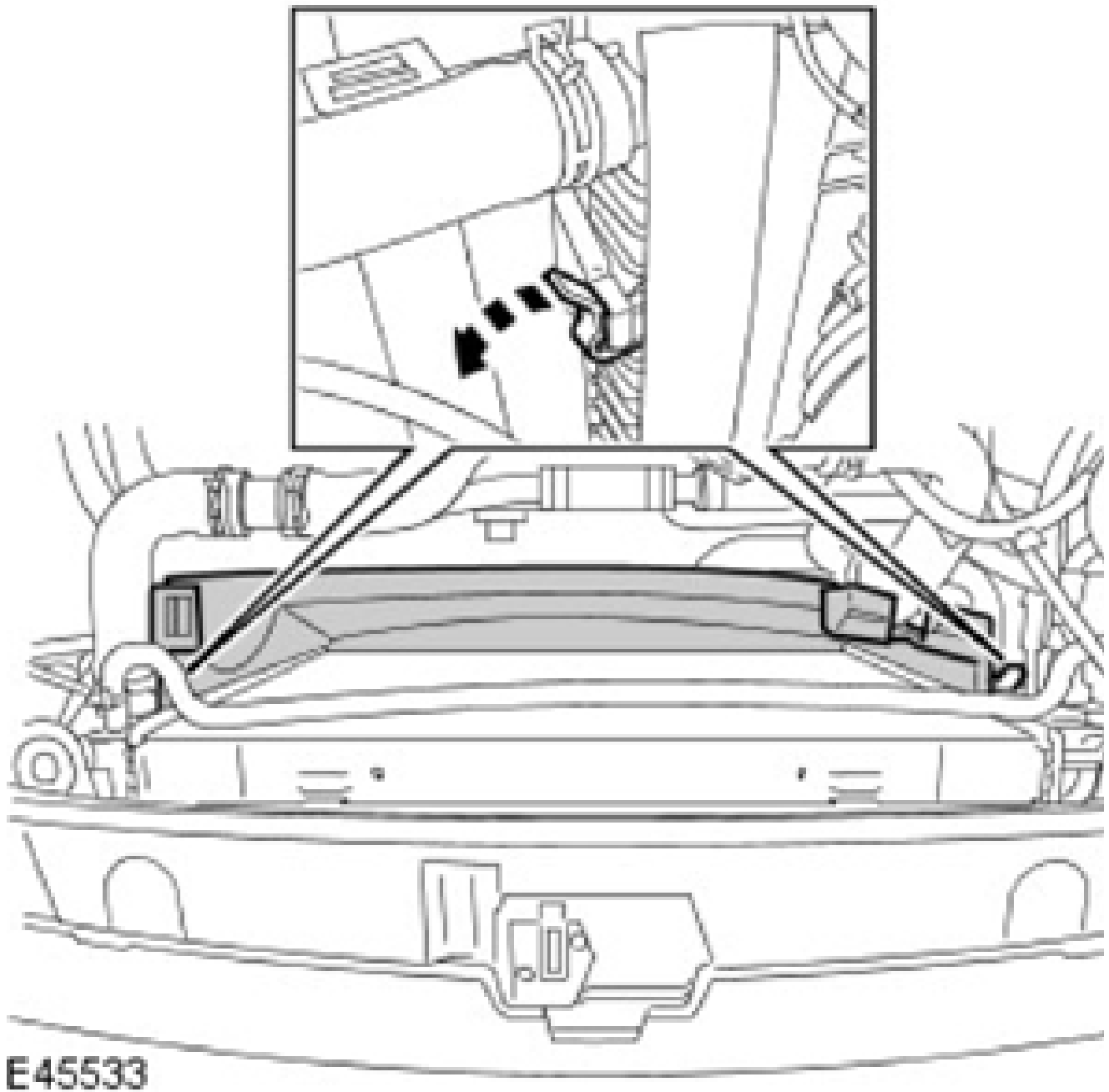
For additional information, refer to: **SPECIFICATIONS** .

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 accessory drive belt.

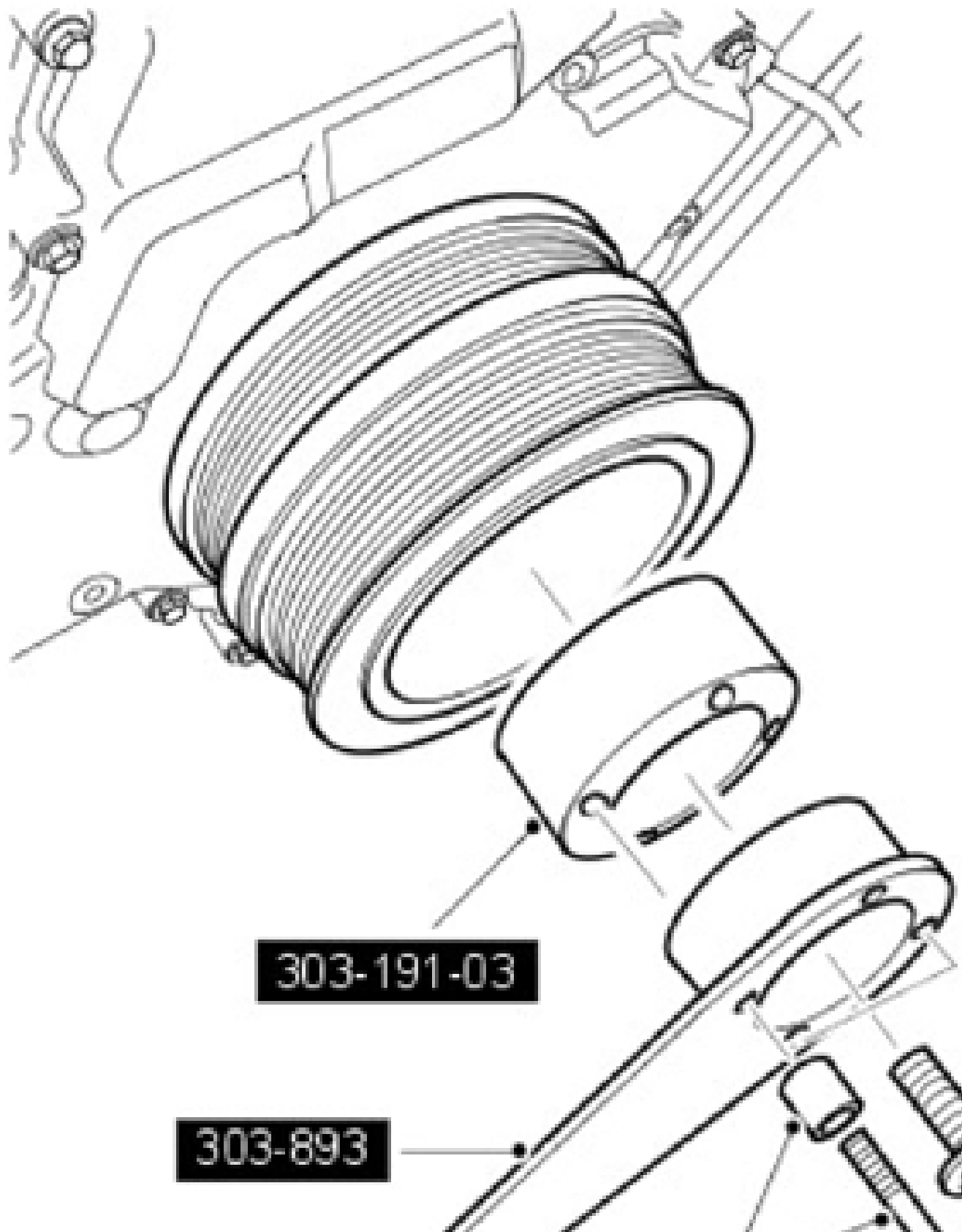
For additional information, refer to: **Accessory Drive Belt** .

4. Remove the cooling fan lower shroud.
 - Release the 2 clips.



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

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



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

6. Remove the crankshaft pulley retaining bolt.

- Discard the bolt.

7. Remove the special tools.

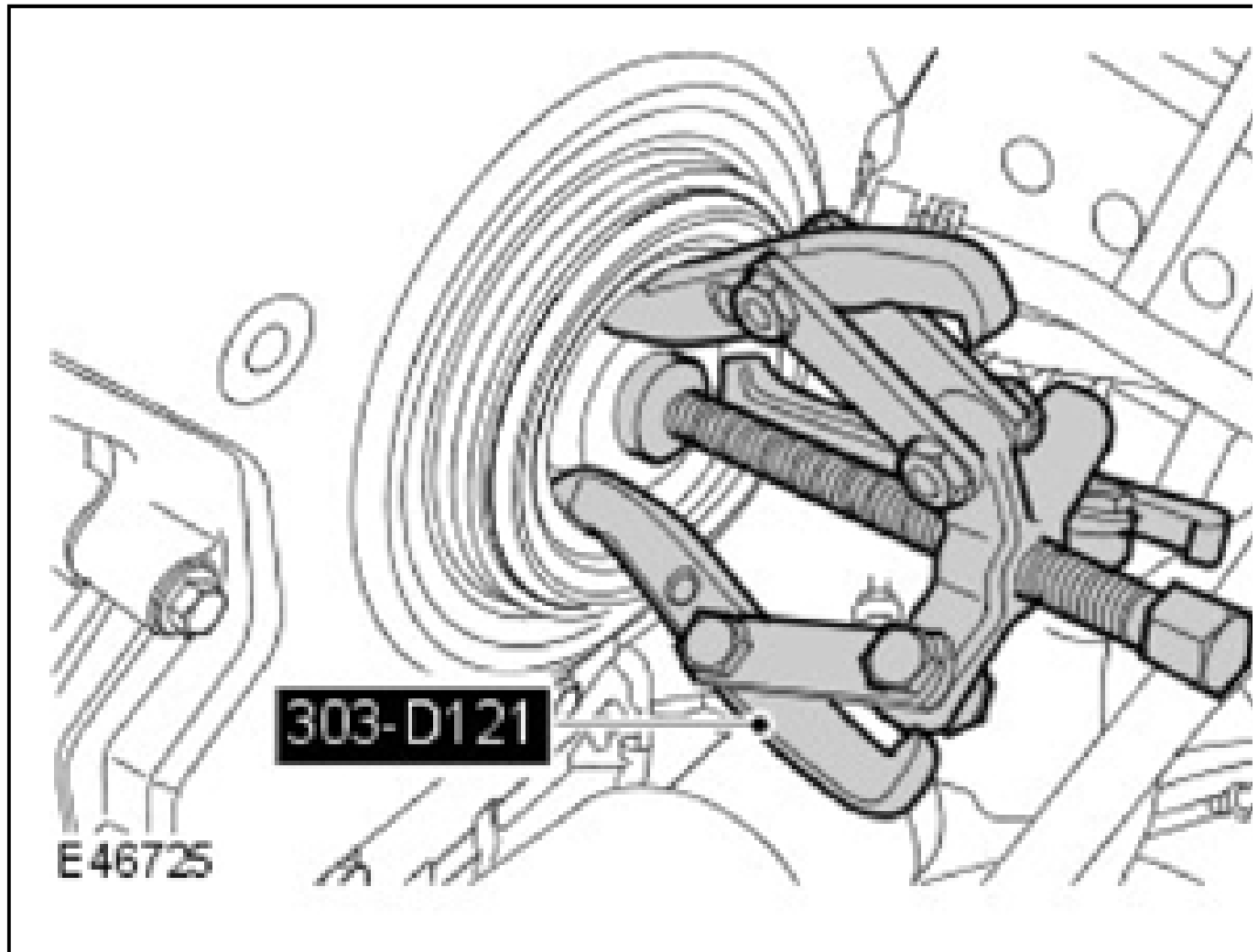
NOTE: **The crankshaft pulley will be very tight.**

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

- Collect the locking ring.

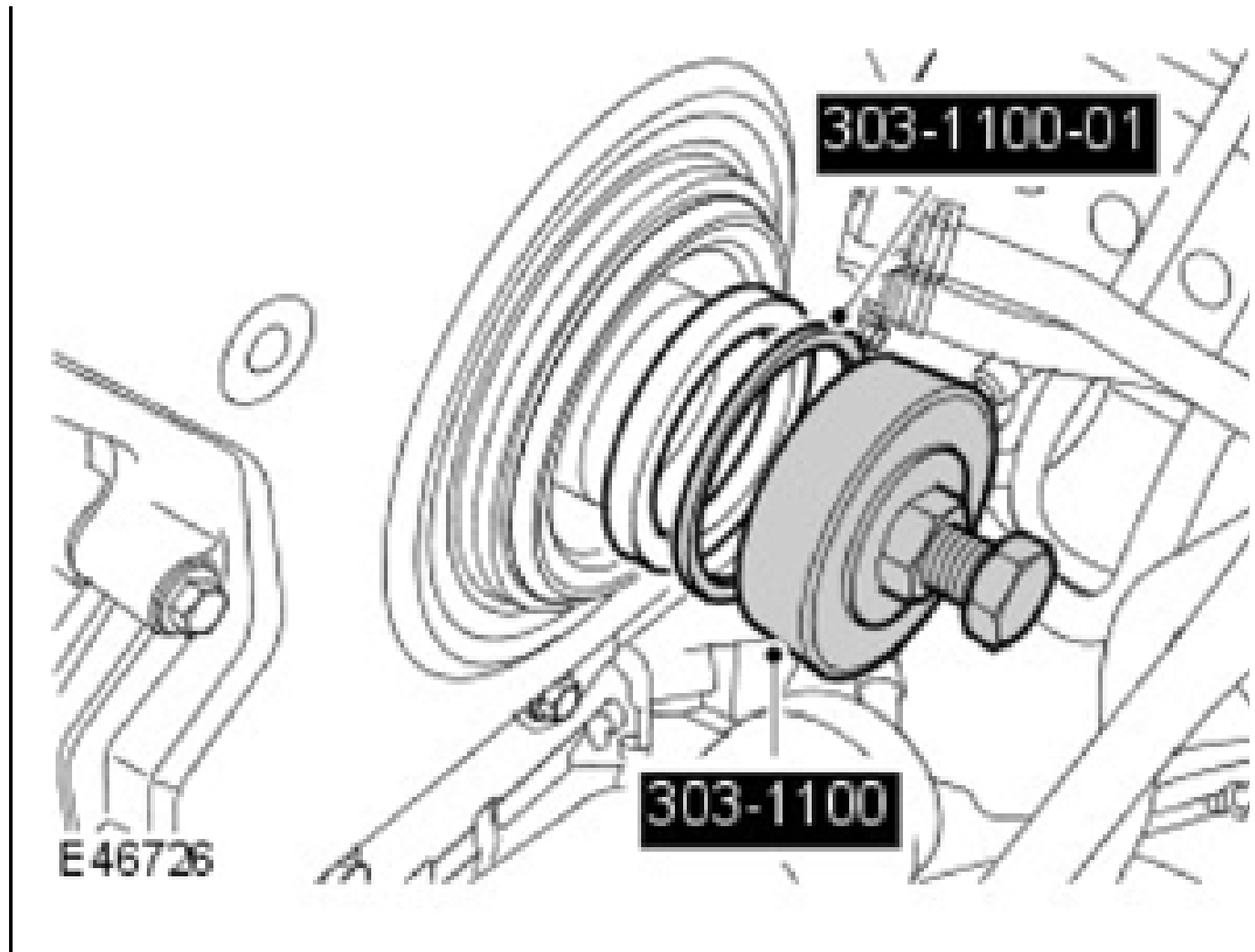


9. Remove the special tools.
10. Using the special tool, remove the crankshaft front seal.



INSTALLATION

1. Clean all the crankshaft pulley mating faces.
2. Using the special tools, install the crankshaft front seal.
 - Lubricate the new crankshaft front seal with clean engine oil.



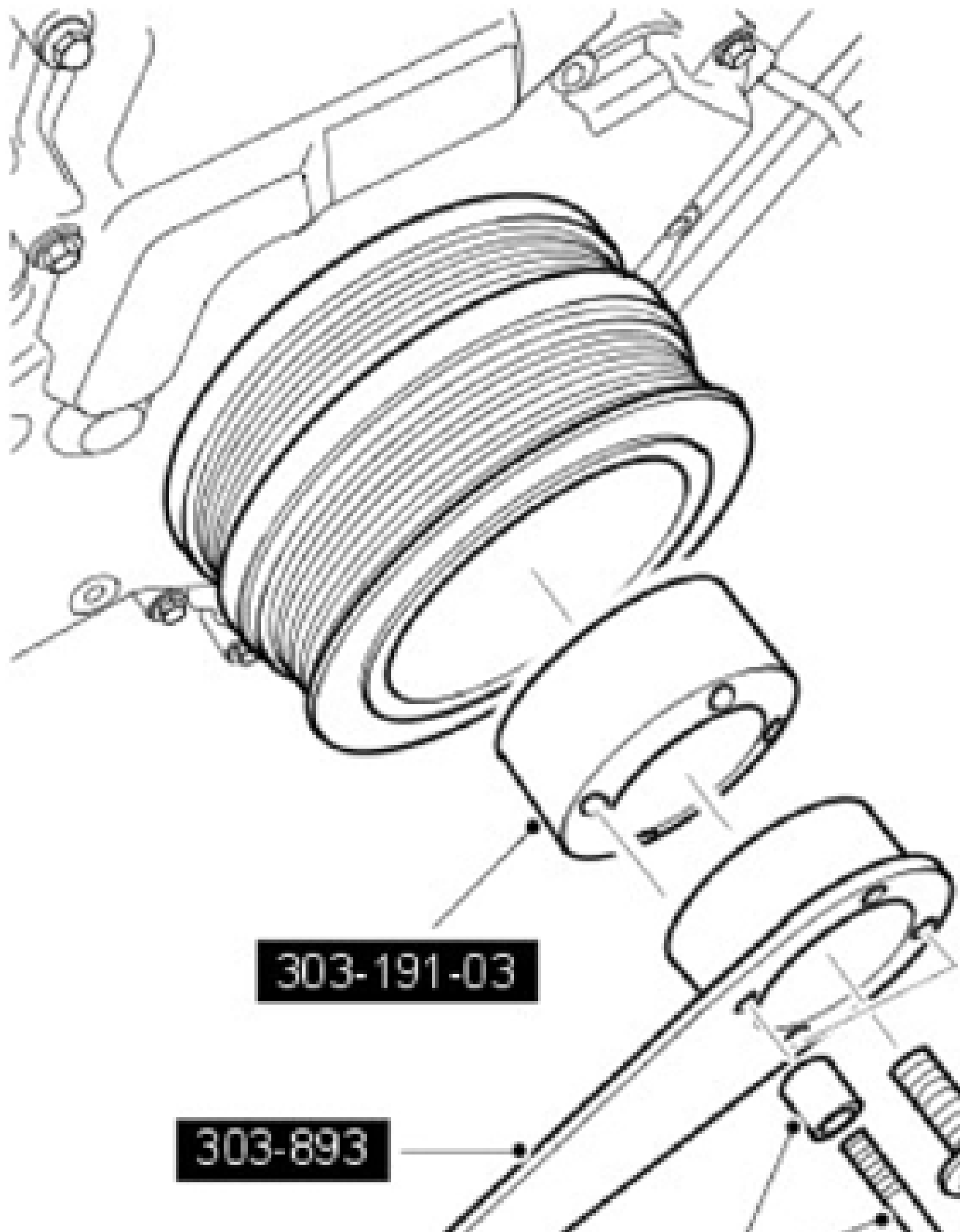
3. Install the crankshaft pulley.
 - Lubricate the new crankshaft front seal with clean engine oil.
4. Remove the special tools.
5. Install the crankshaft pulley locking ring.

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

6. Install a new crankshaft pulley bolt.
 - A new crankshaft pulley bolt must be installed.
 - 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.

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



8. Remove the special tools.
9. Install the cooling fan lower shroud.
 - Secure the clips.
10. Install the accessory drive belt.

For additional information, refer to: **Accessory Drive Belt** .

11. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

CRANKSHAFT FRONT SEAL

SPECIAL TOOL(S)

	Remover, crankshaft seal 303-D121
	Installer, crankshaft seal 303-1100

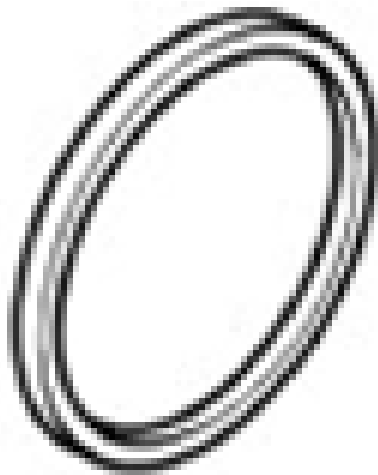
303-1100



E46732

Adapter - Crankshaft seal installer
303-1100-01

303-1100-01



E67144

REMOVAL

1. Disconnect the battery ground cable.

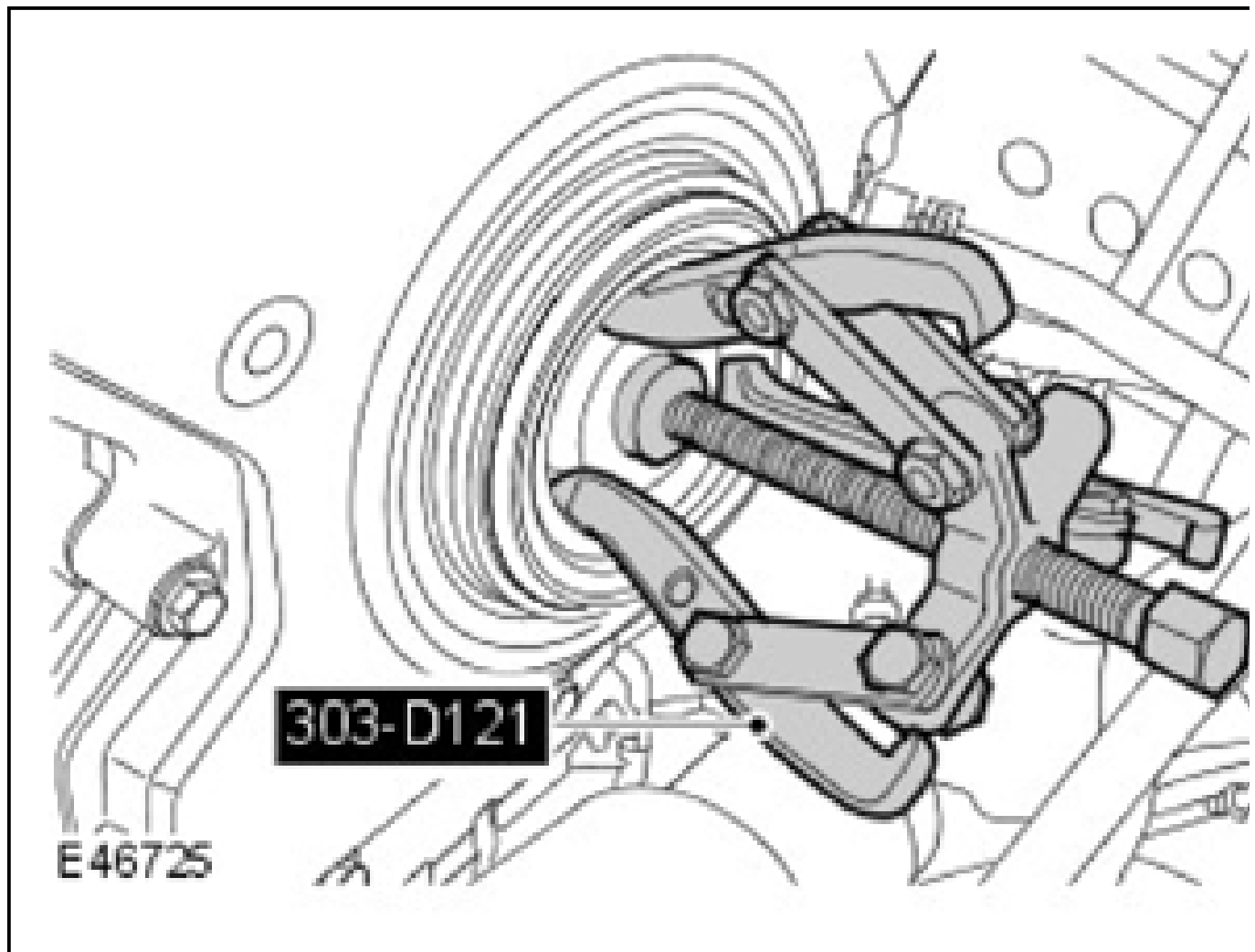
For additional information, refer to: **SPECIFICATIONS** .

2. Remove the crankshaft pulley.

For additional information, refer to: **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.

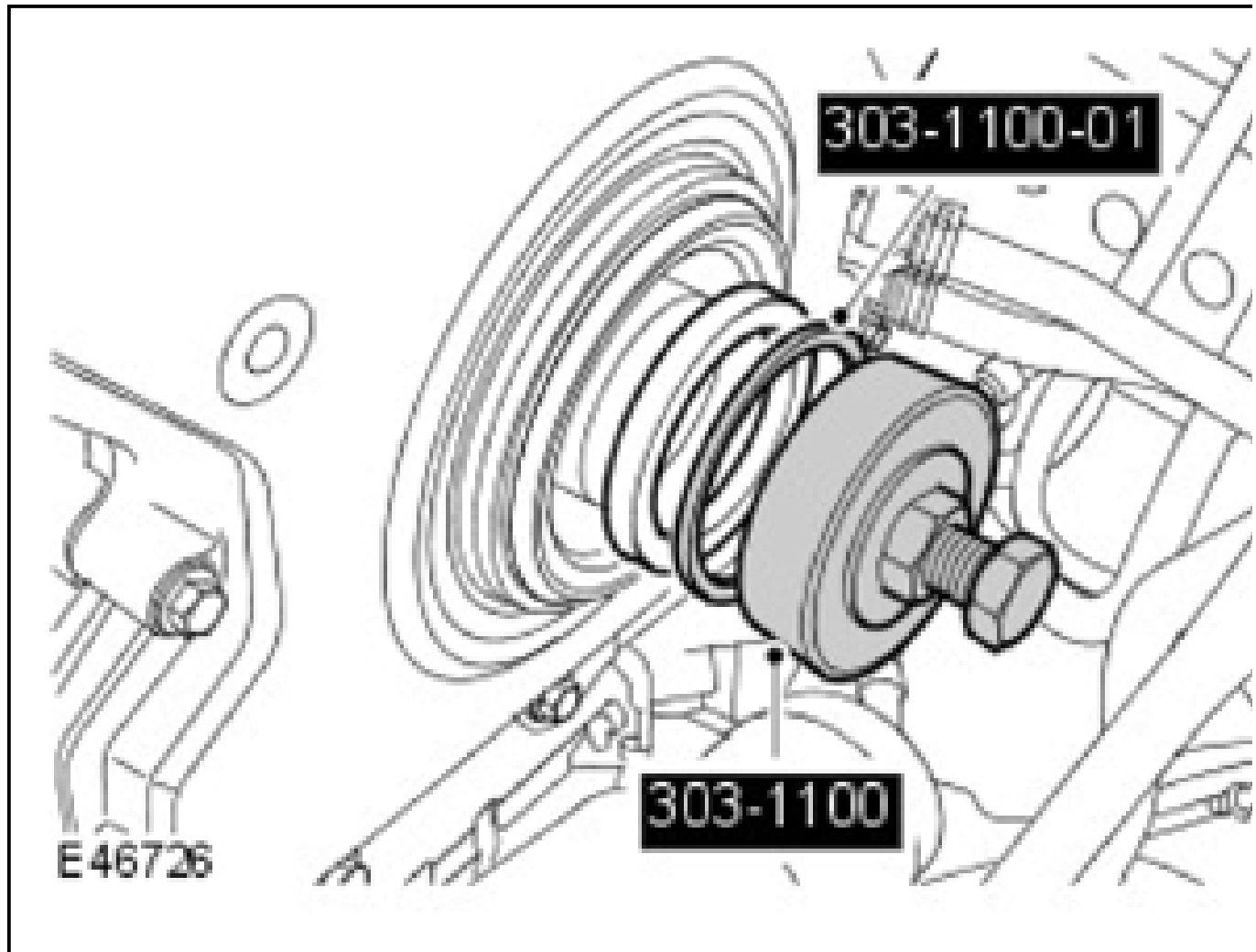
3. Using the special tool, remove the crankshaft front seal.



INSTALLATION

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

- Clean the component mating faces.



2. Install the crankshaft pulley.

For additional information, refer to: **CRANKSHAFT PULLEY**.

3. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

CRANKSHAFT REAR SEAL

SPECIAL TOOL(S)

	Crankshaft rear oil seal remover/installer 303-538
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REMOVAL

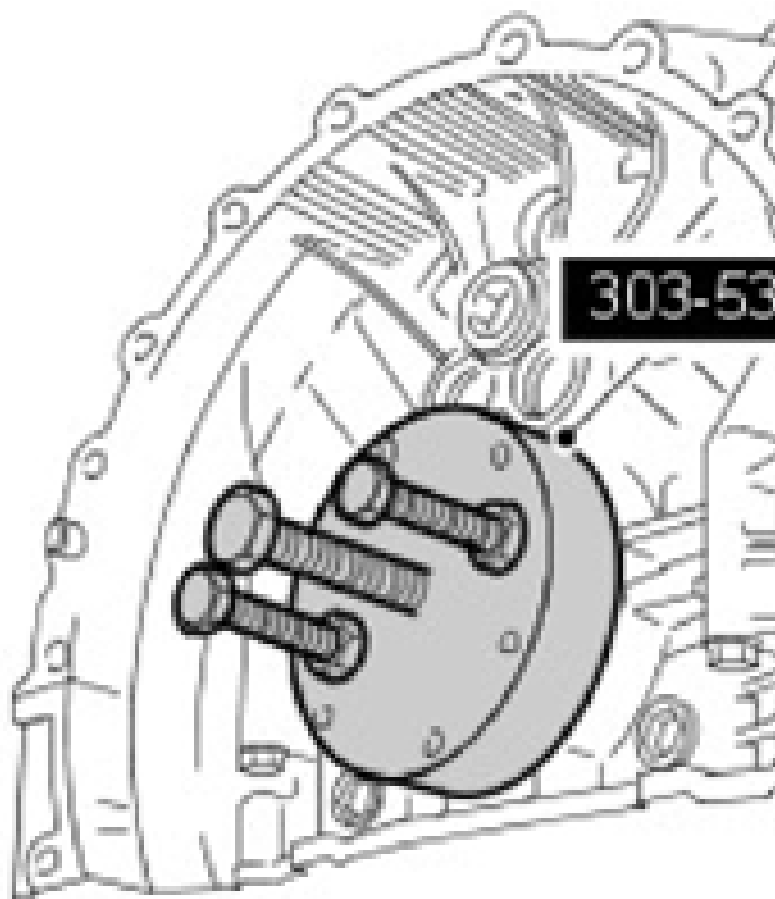
WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

1. Raise and support the vehicle.
2. Remove the torque converter flexplate.

For additional information, refer to: **FLEXPLATE** .

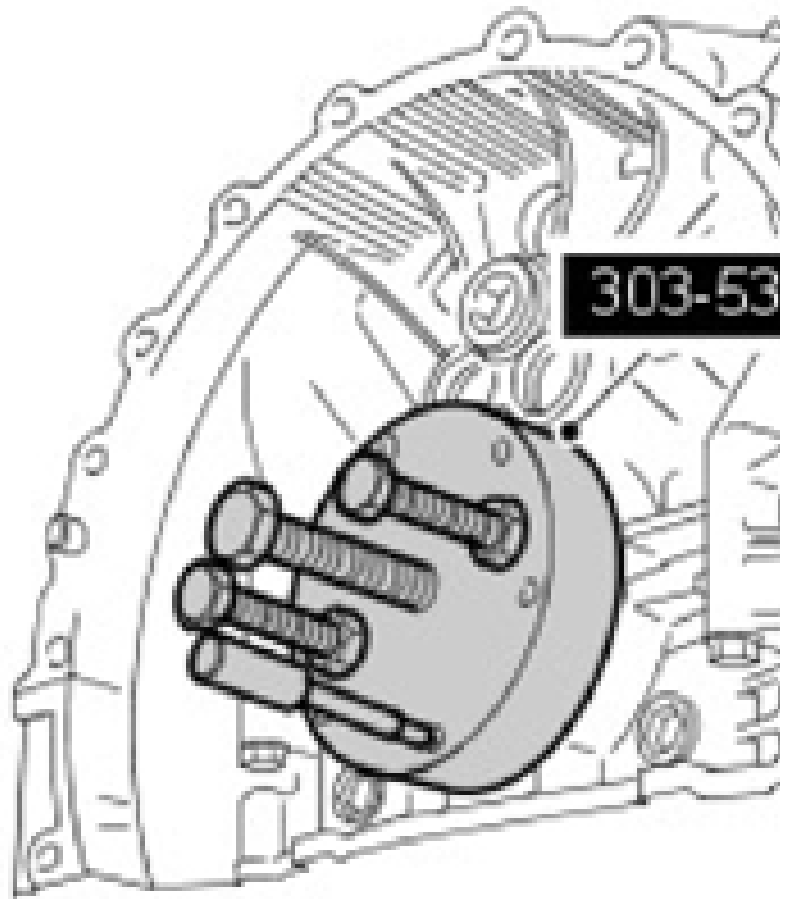
3. Install the special tools.
 - Install the 2 bolts.
 - Tighten the 2 nuts to retain the special tool.

E46613



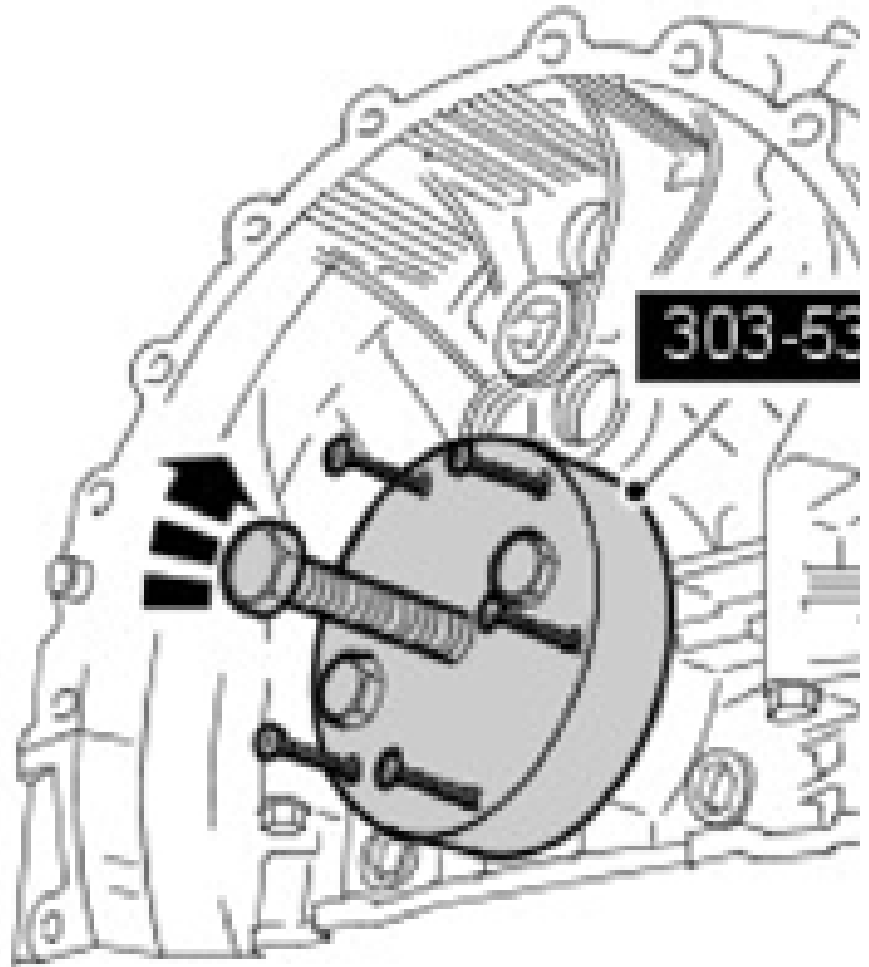
4. Using the special tool, pierce the seal to create holes for the 6 self-tapping screws.

E46614



5. 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.

E46615



INSTALLATION

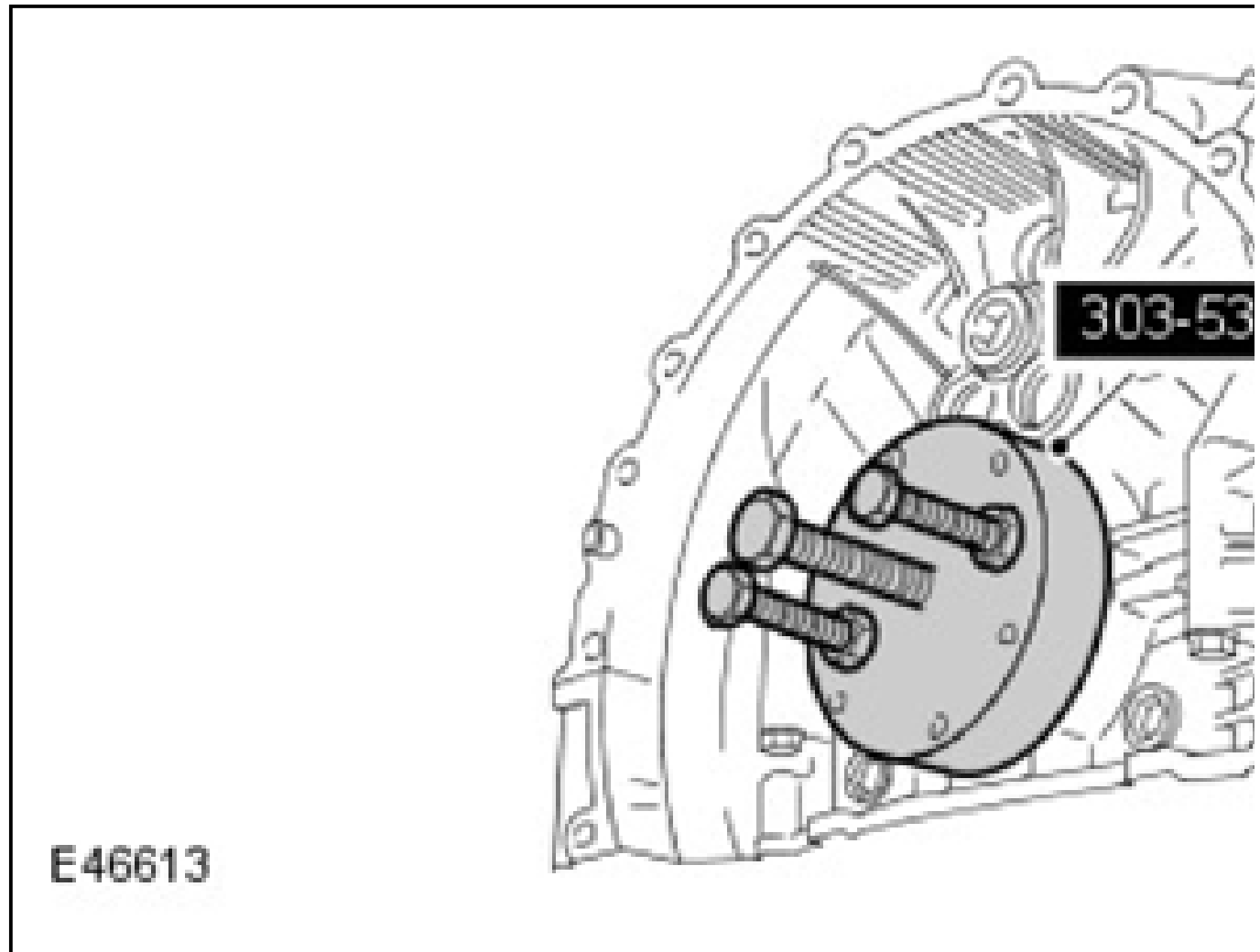
CAUTION: Do not lubricate the components.

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.

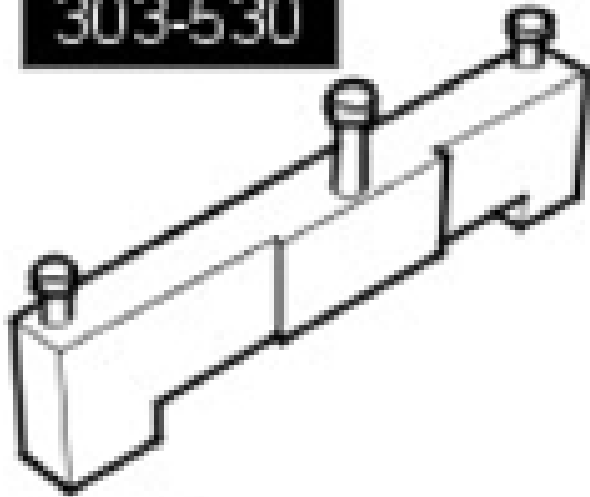
For additional information, refer to: **FLEXPLATE** .

TIMING DRIVE COMPONENTS

SPECIAL TOOL(S)

Camshaft setting/locking tool
303-530

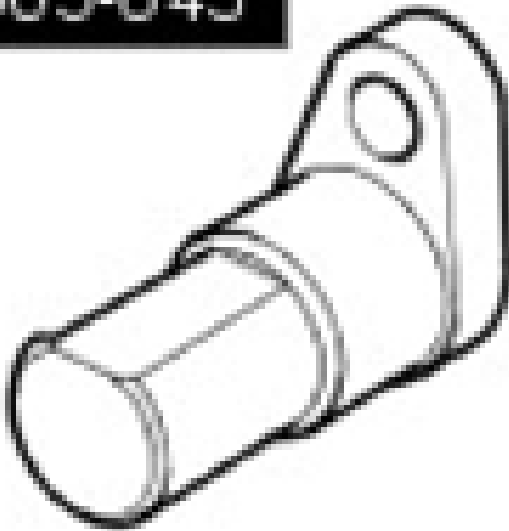
303-530



E46879

Crankshaft setting tool
303-645

303-645



E46881

REMOVAL

NOTE: This procedure covers the removal and installation of both primary chains, tensioners, guides and the crankshaft sprocket.

1. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

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

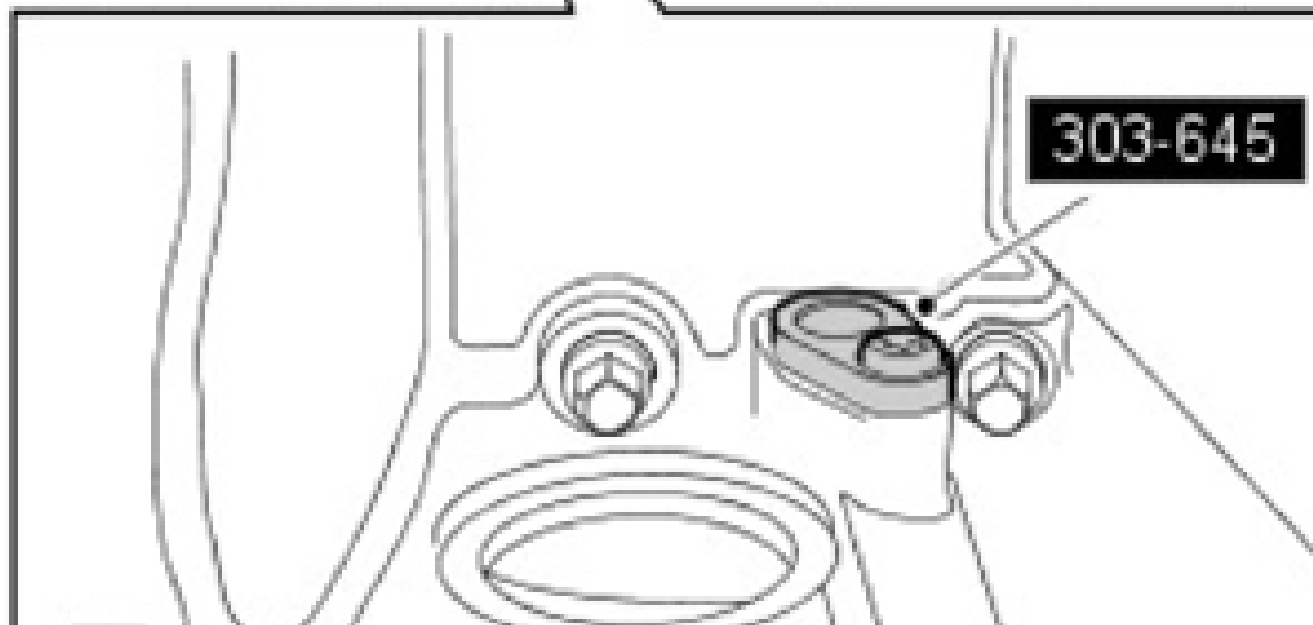
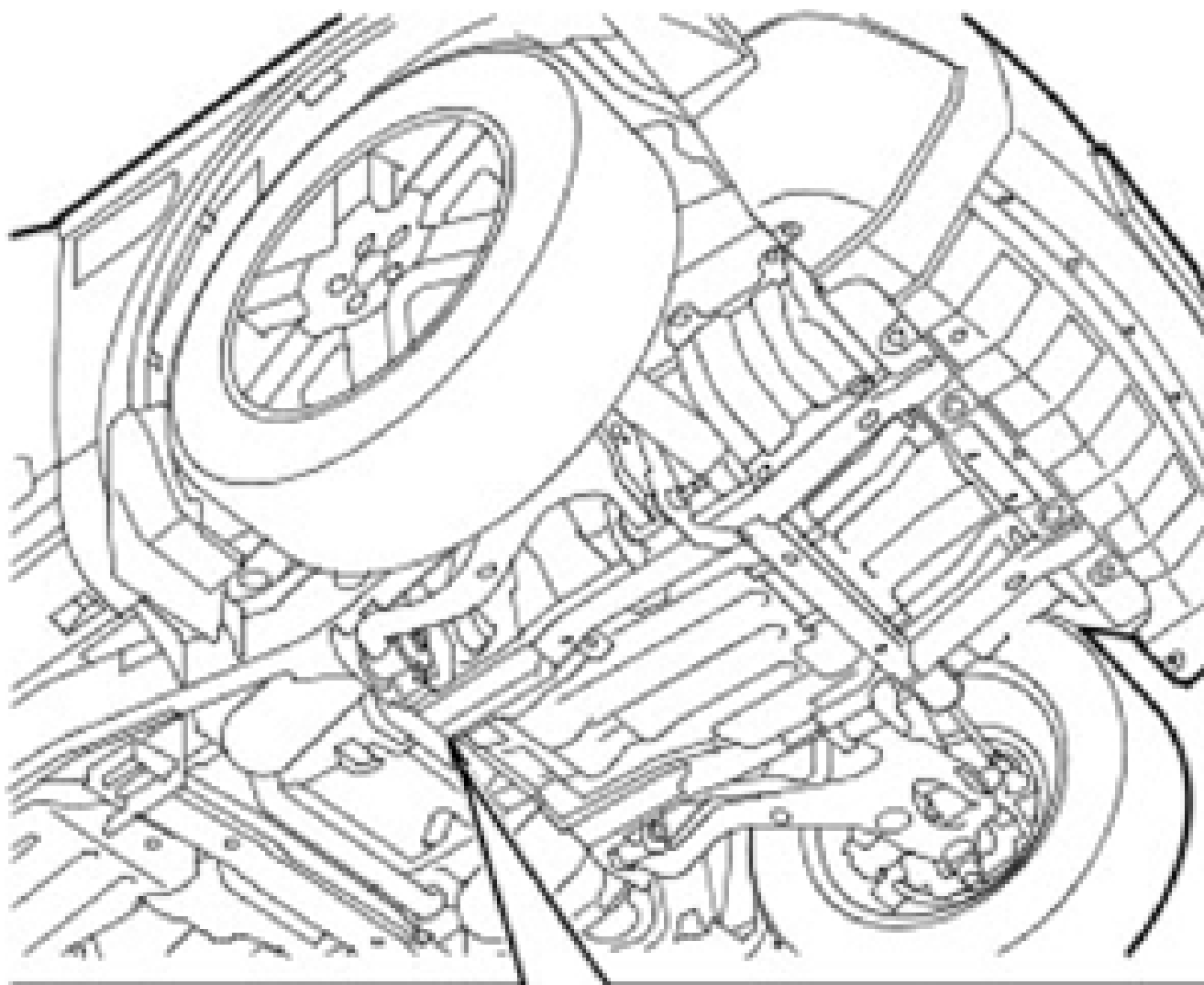
2. Raise and support the vehicle.
3. Remove the engine front cover.

For additional information, refer to: **ENGINE FRONT COVER**.

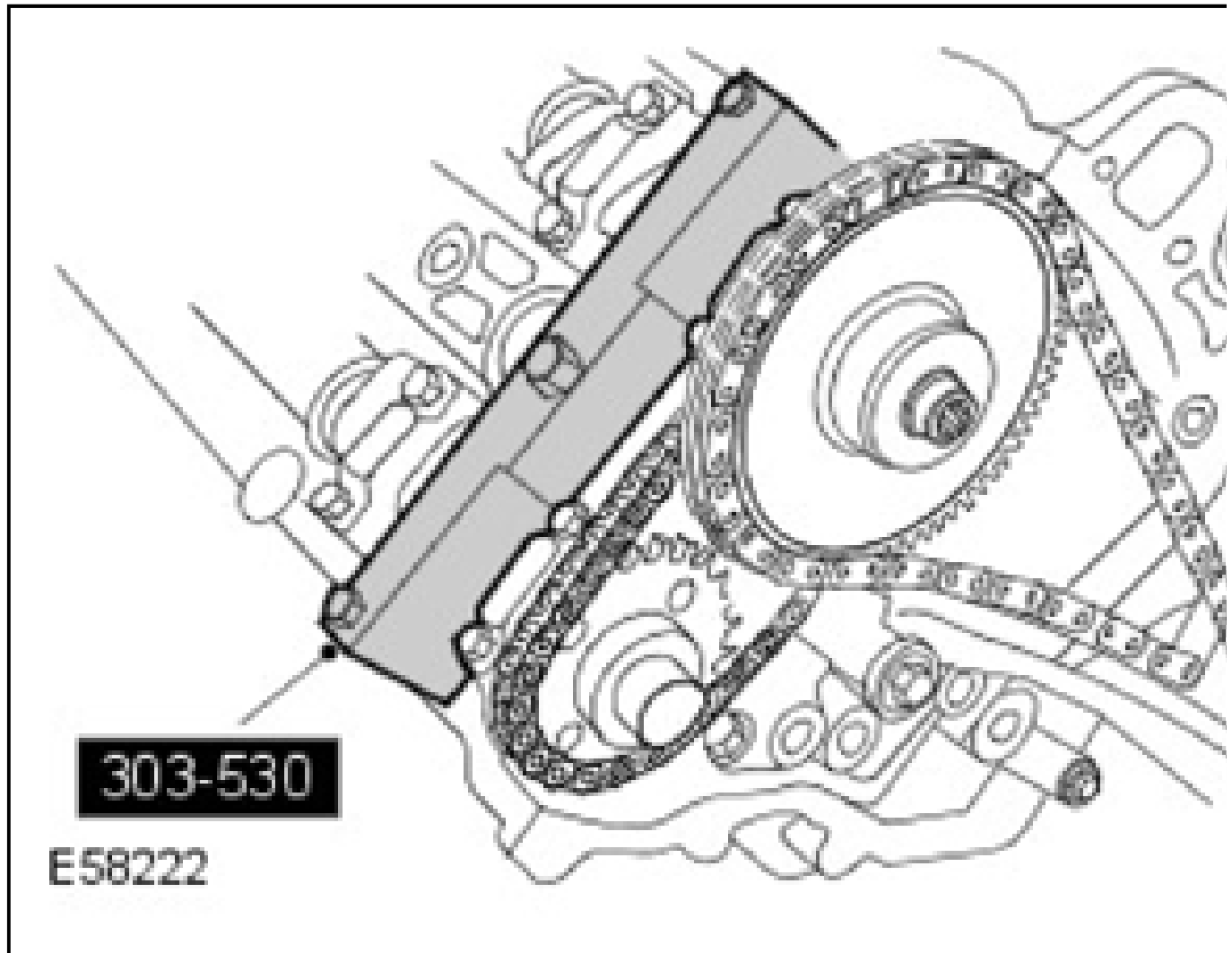
4. Remove the crankshaft position (CKP) sensor.

For additional information, refer to: **Crankshaft Position (CKP) Sensor** .

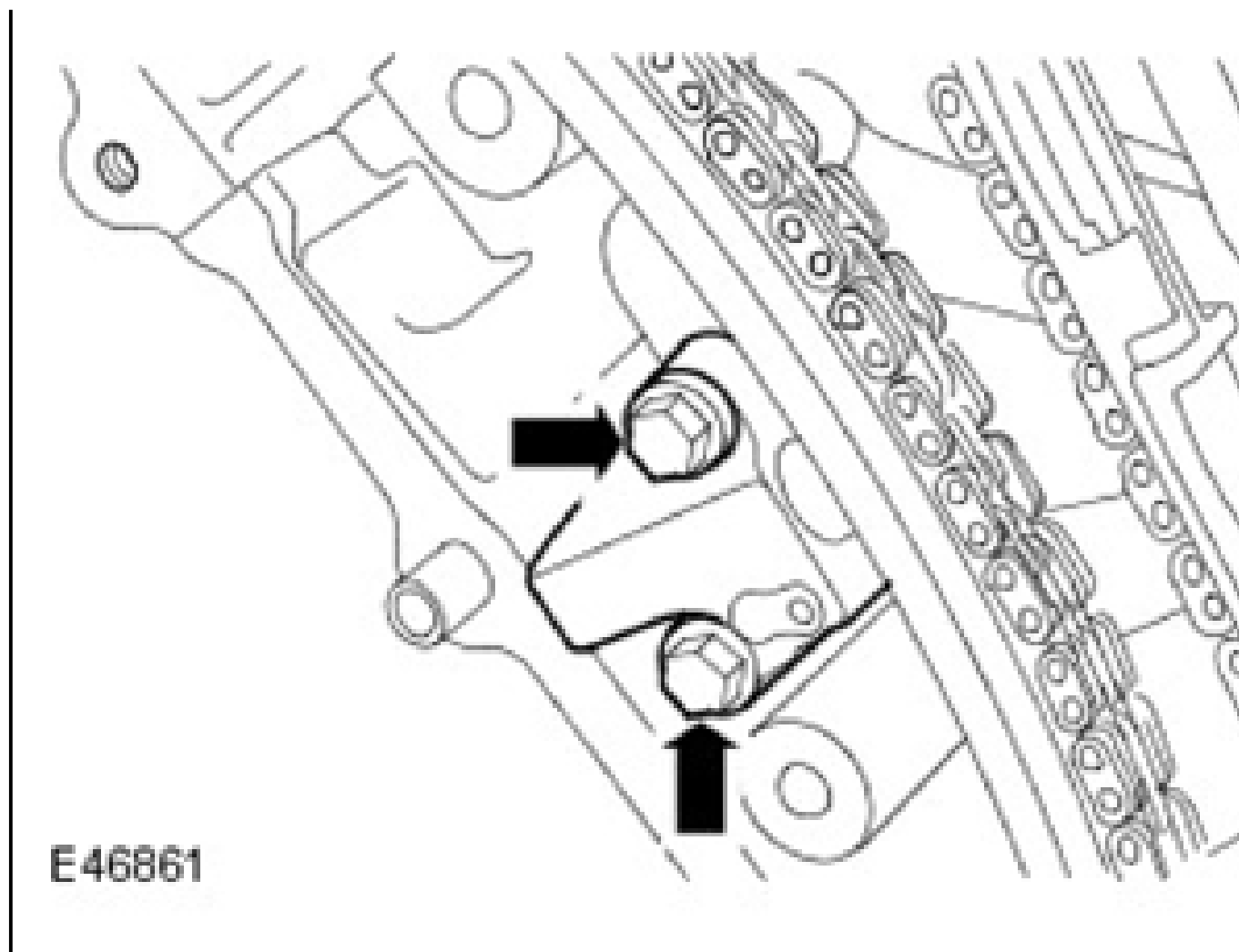
5. Install the crankshaft setting tool.
 - Install the screw.



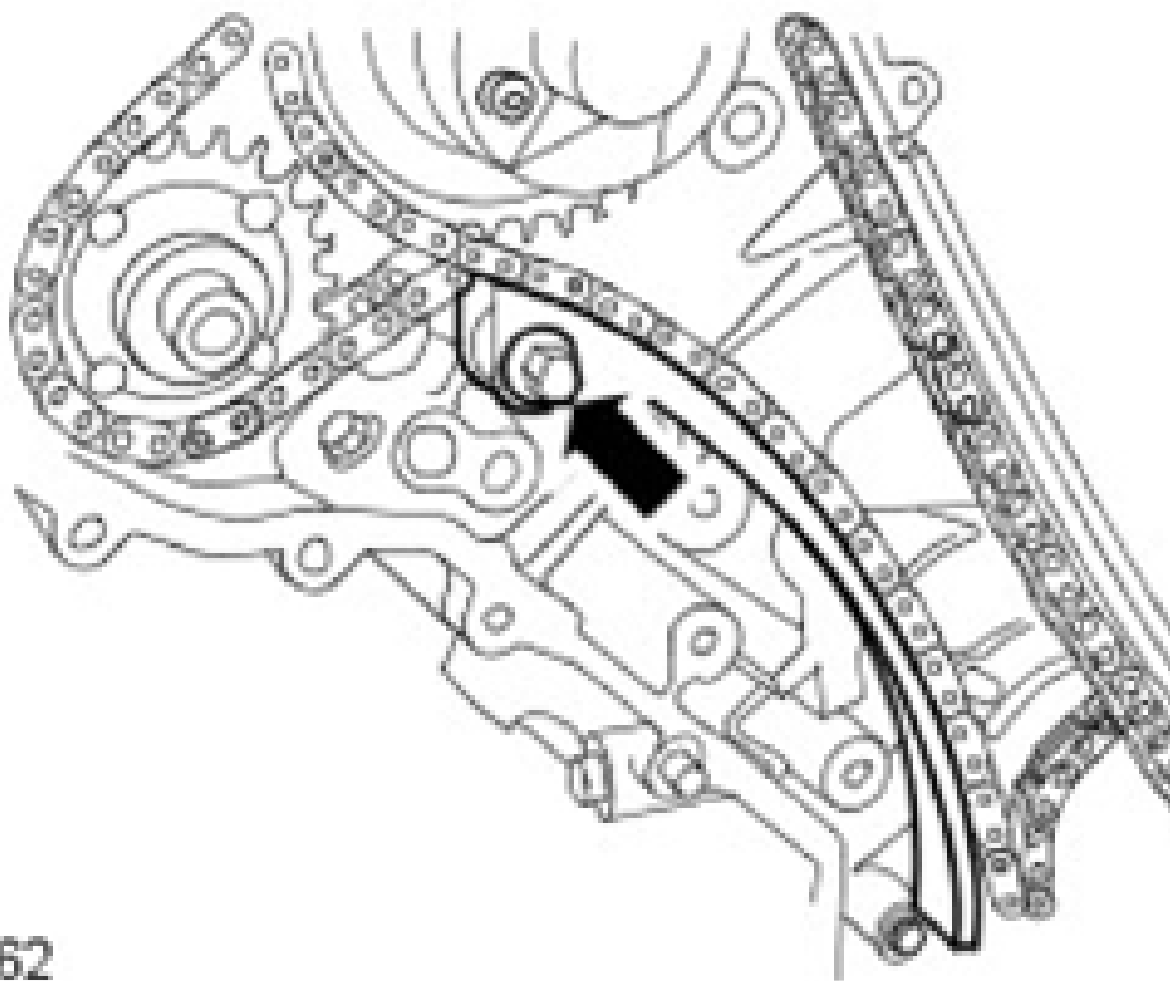
6. Install the special tool to the RH cylinder head.
 - Install the 3 bolts.



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

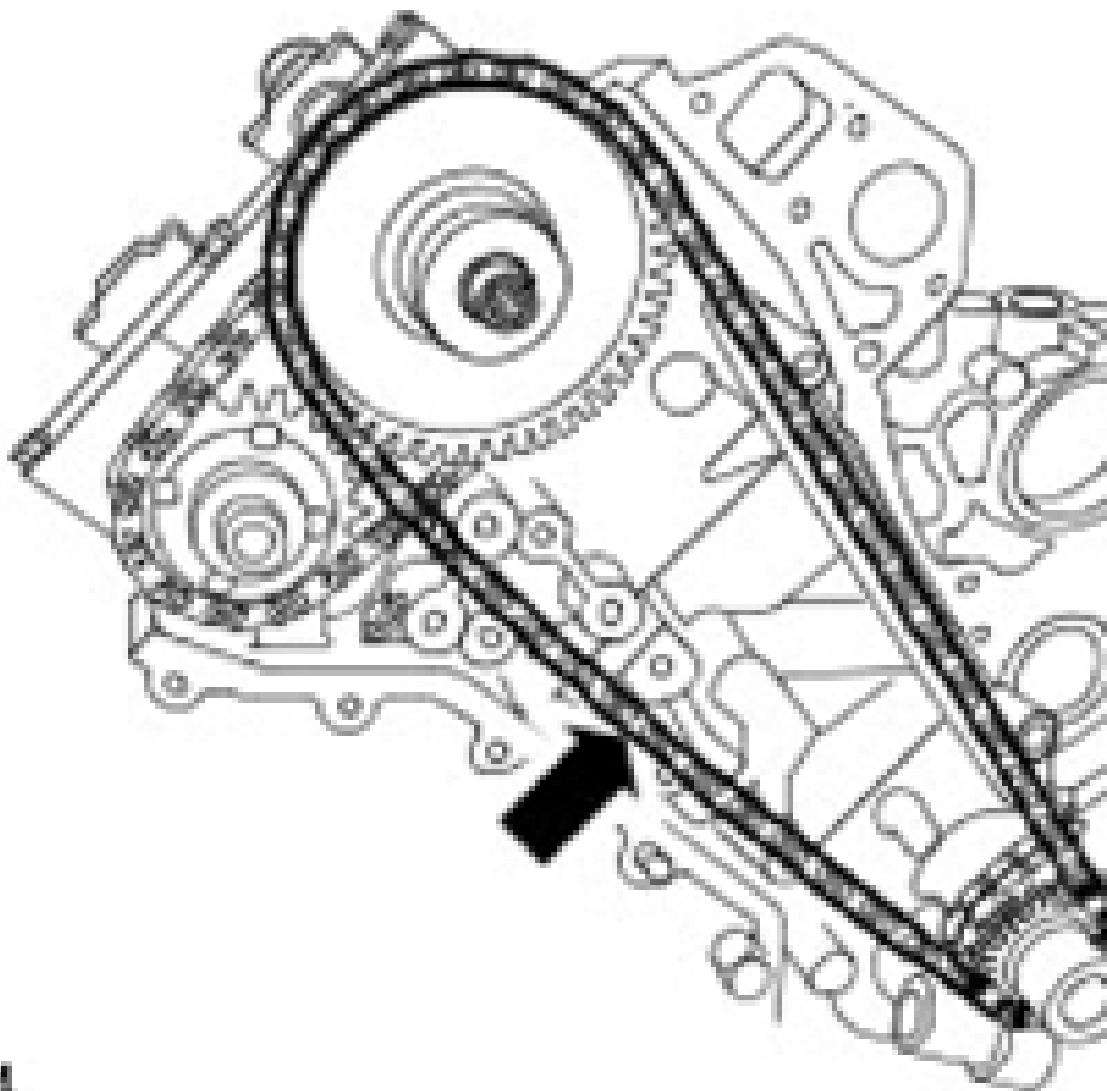


8. Remove the RH primary timing chain tensioner guide.
 - Remove the bolt.



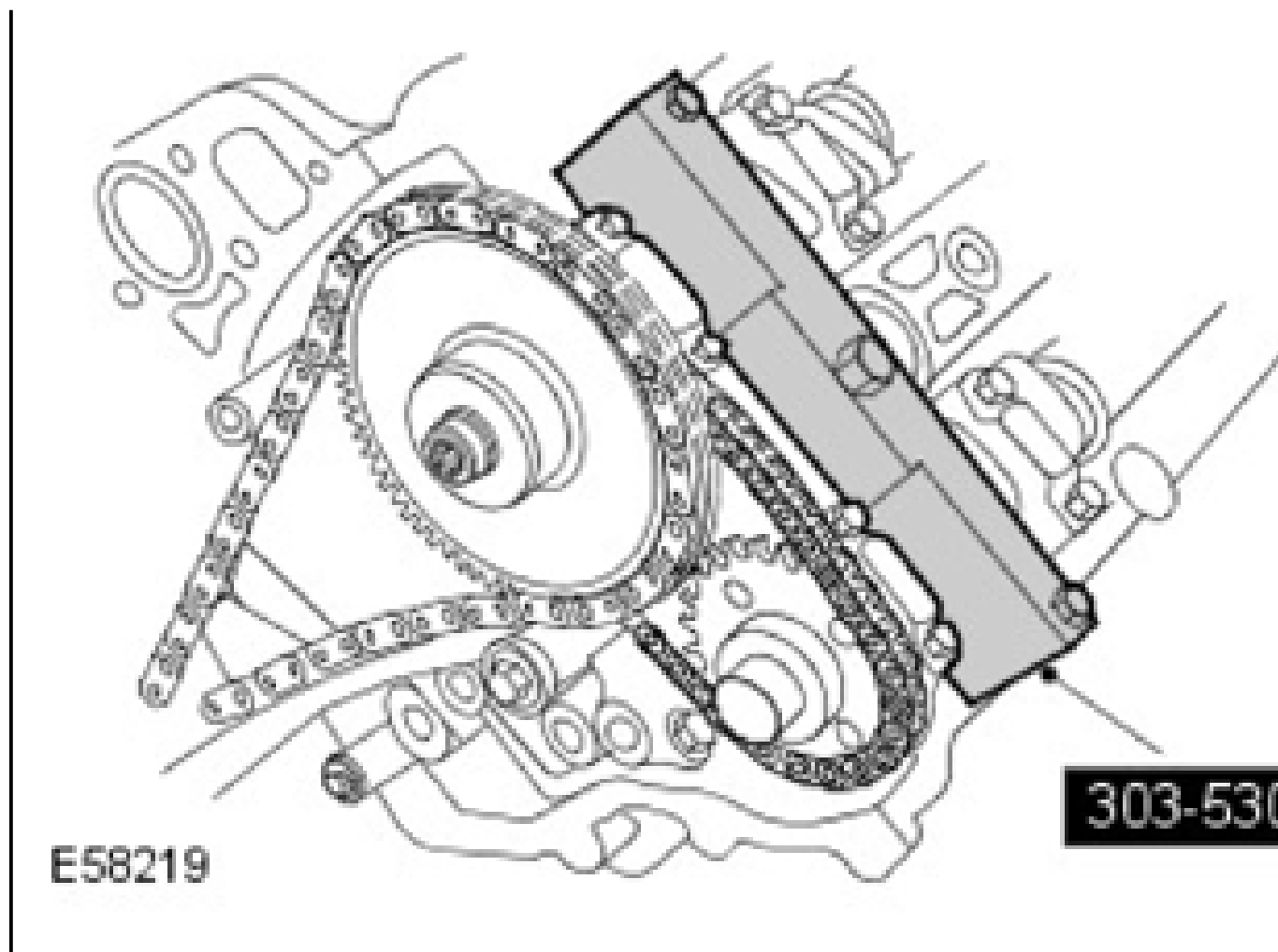
E46862

9. Remove the RH primary timing chain.

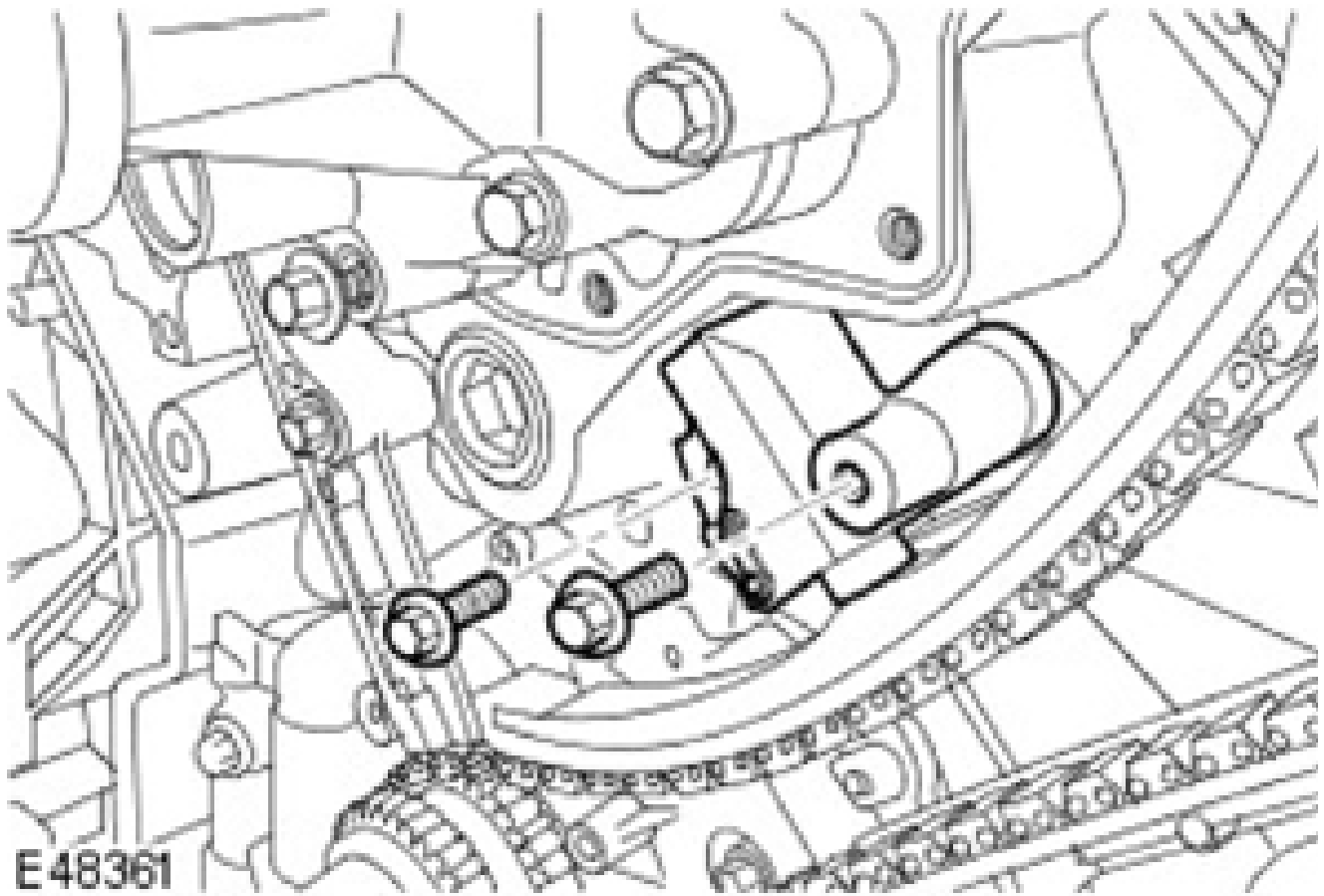


E58224

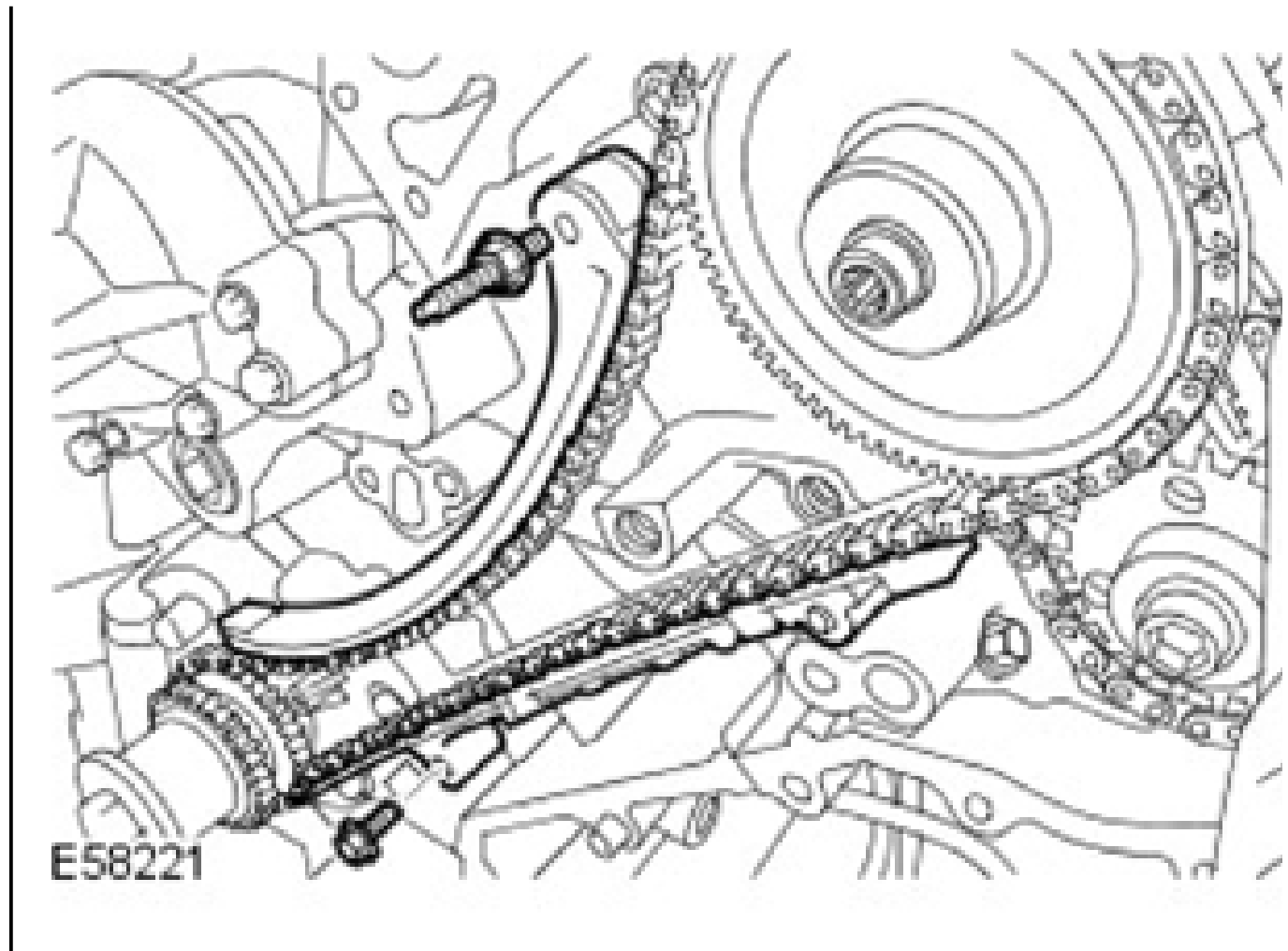
10. Install the special tool to the LH cylinder head.
 - Install the 3 bolts.



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

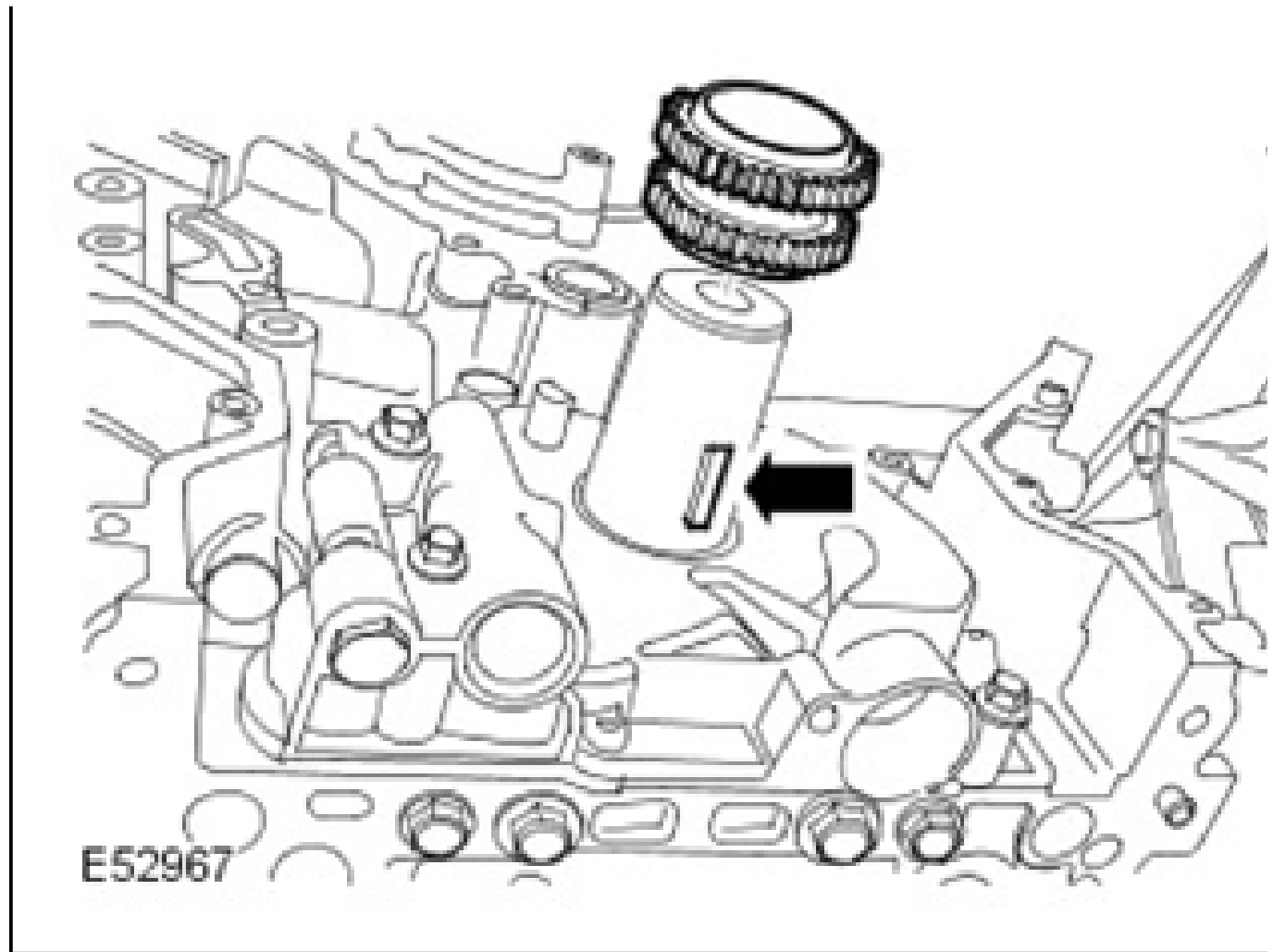


12. Remove the LH upper and lower primary timing chain tensioner guides.
 - Remove the 2 bolts.
13. Remove the LH primary timing chain.



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

14. Remove the crankshaft sprocket.
 - Remove the crankshaft sprocket key.



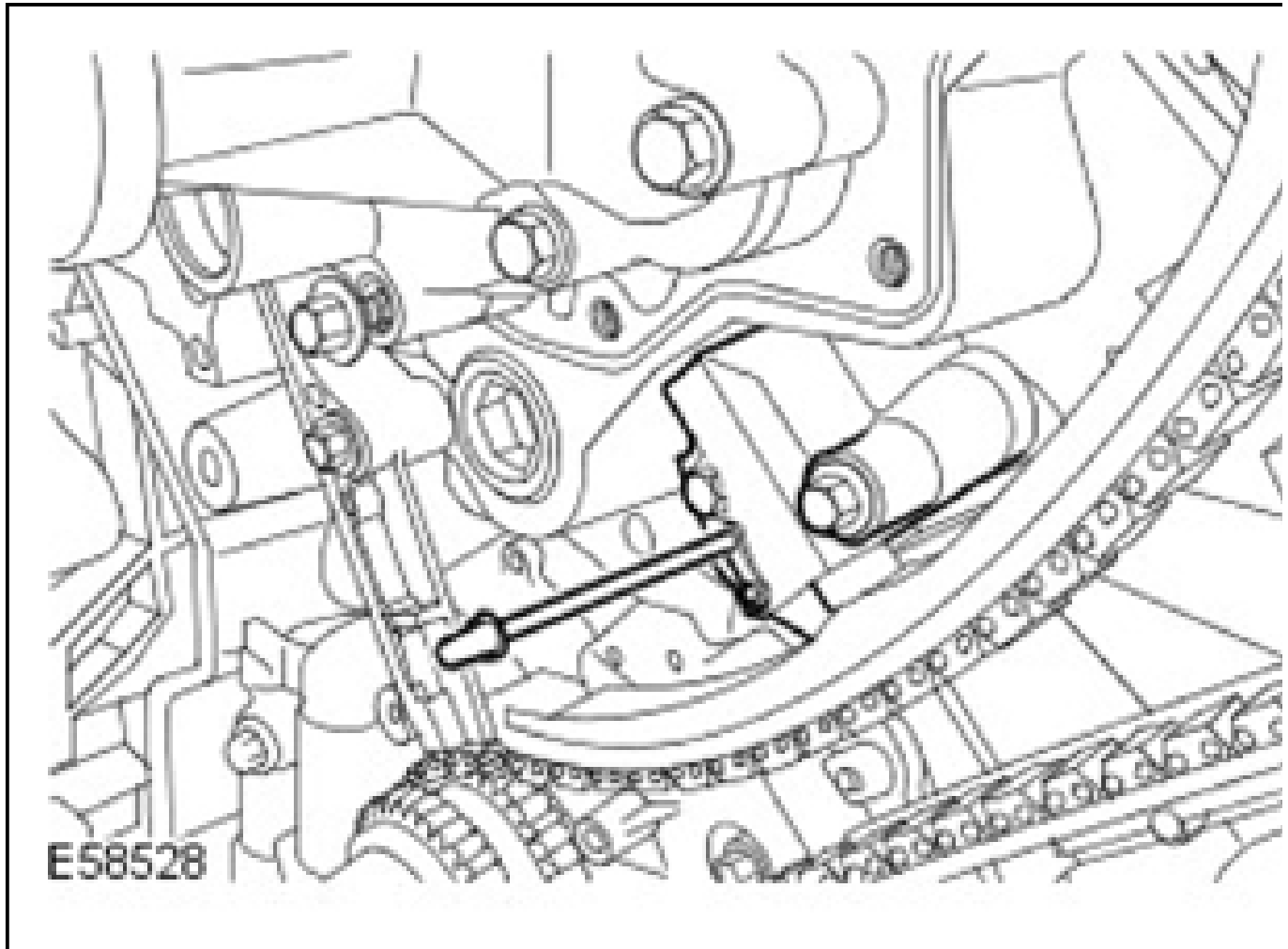
INSTALLATION

1. Install the crankshaft sprocket.
 - Install the crankshaft sprocket key.
2. Install the LH primary timing chain.
 - Make sure the timing chain slack is on the tensioner side of the timing chain.
3. 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.

4. 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).

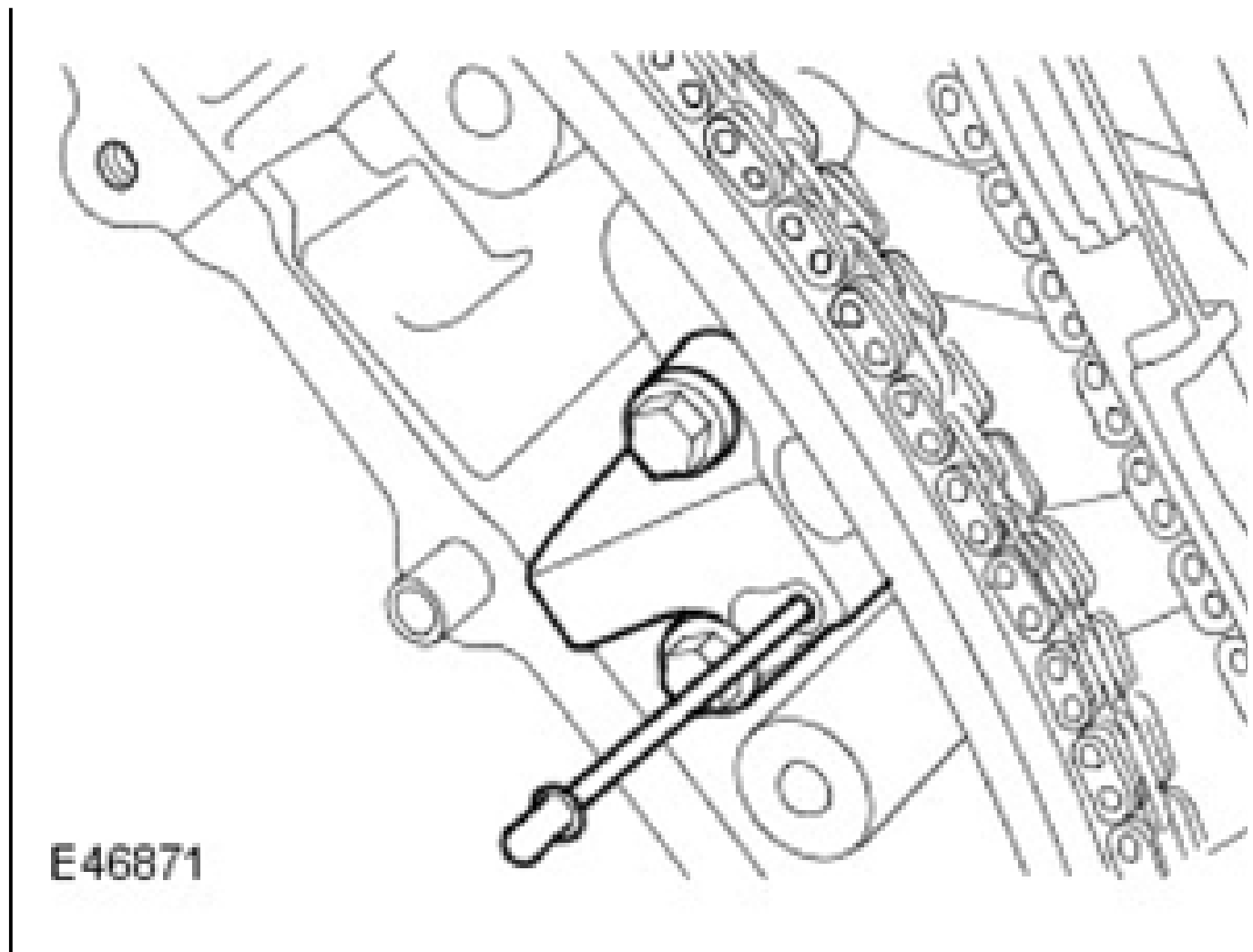
- Remove the retaining rod.



5. Install the RH primary timing chain.
 - Make sure the timing chain slack is on the tensioner side of the timing chain.
6. 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.

7. 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.



8. Remove the special tool from the RH cylinder head.
9. Remove the special tool from the LH cylinder head.
10. Install the engine front cover.

For additional information, refer to: **ENGINE FRONT COVER**.

11. Remove the crankshaft setting tool.
 - Remove the screw.
12. Install the CKP sensor.

For additional information, refer to: **Crankshaft Position (CKP) Sensor** .

13. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

CYLINDER HEAD LH

REMOVAL

1. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

2. Remove the fuel rail.

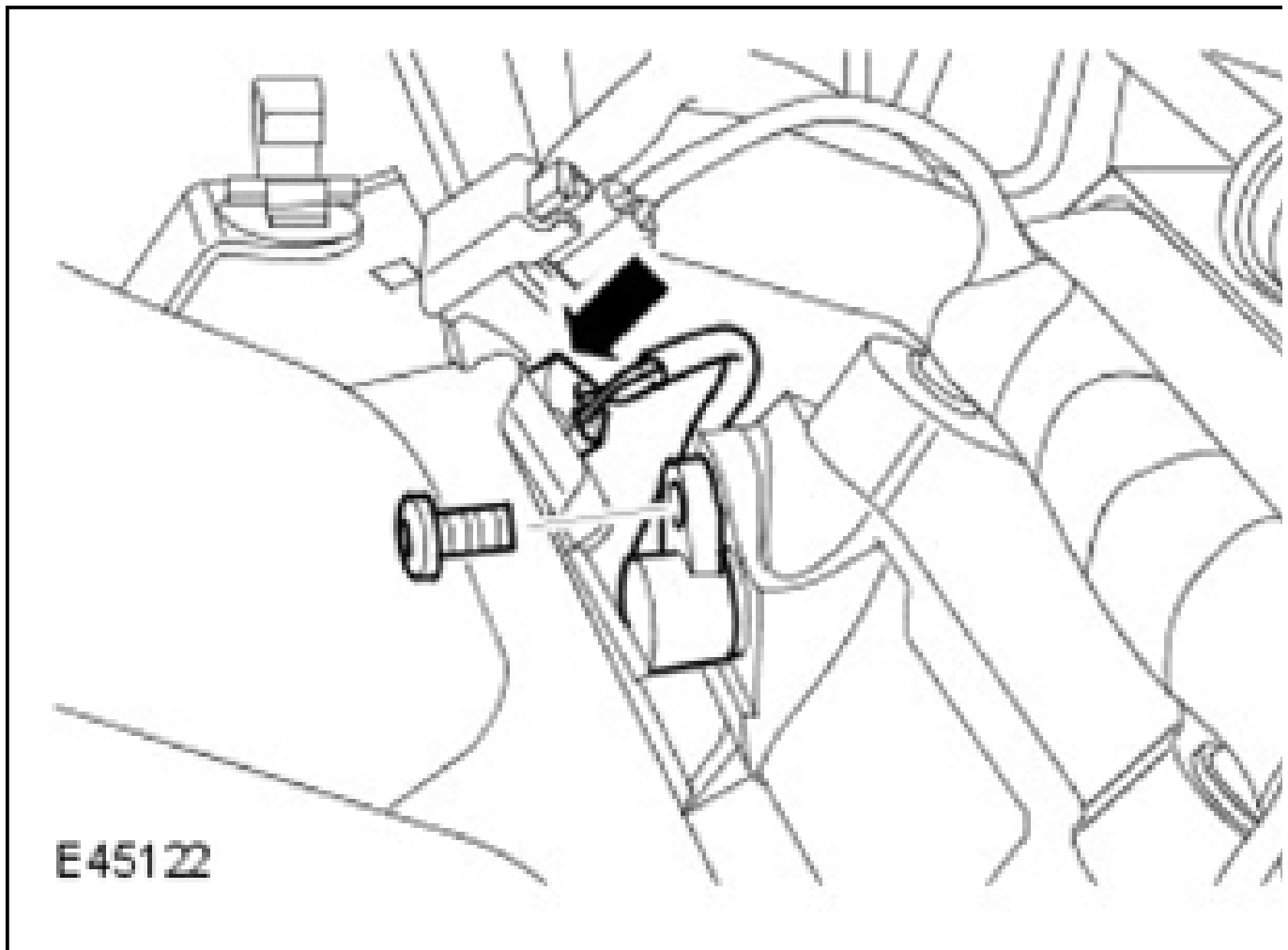
For additional information, refer to: **FUEL RAIL** .

3. Remove the LH bank camshafts.

For additional information, refer to: **CAMSHAFTS LH**.

4. Remove the camshaft position (CMP) sensor.

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

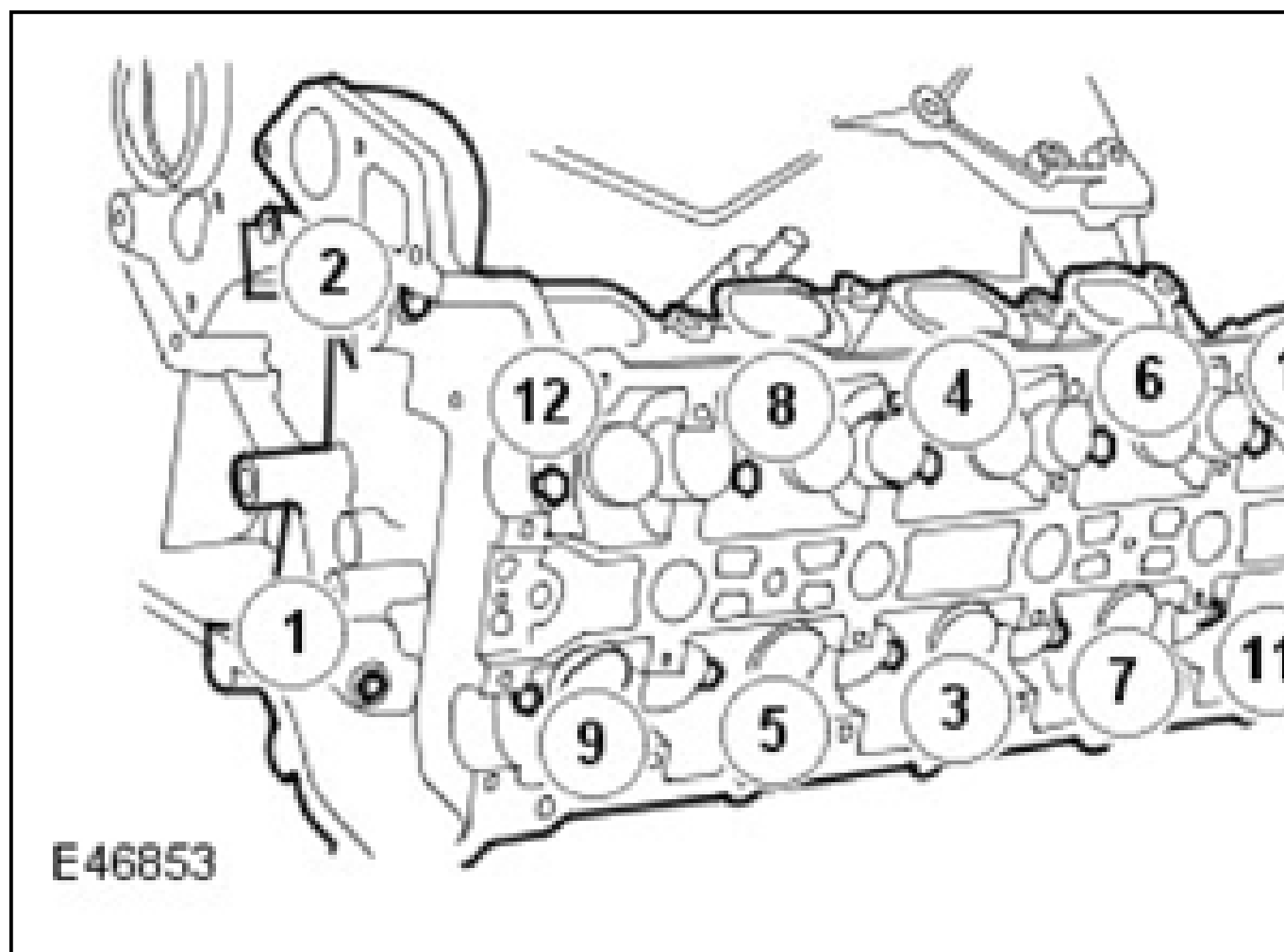


CAUTION: The bolts can only be used twice, mark the bolts with a center punch. If two punch marks are visible, discard the bolts.

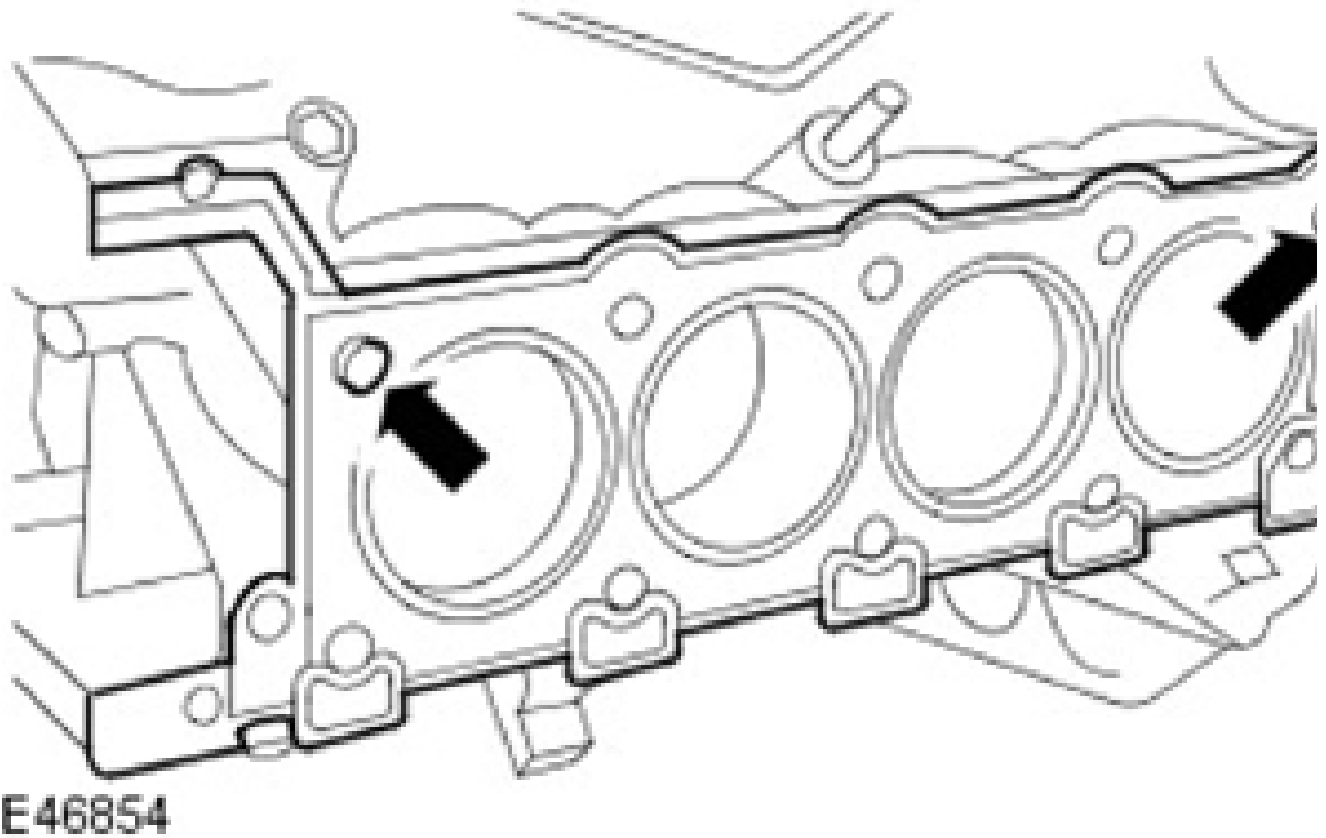
CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be removed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.

NOTE: Remove the bolts in the indicated sequence.

5. Remove the 12 cylinder head bolts.

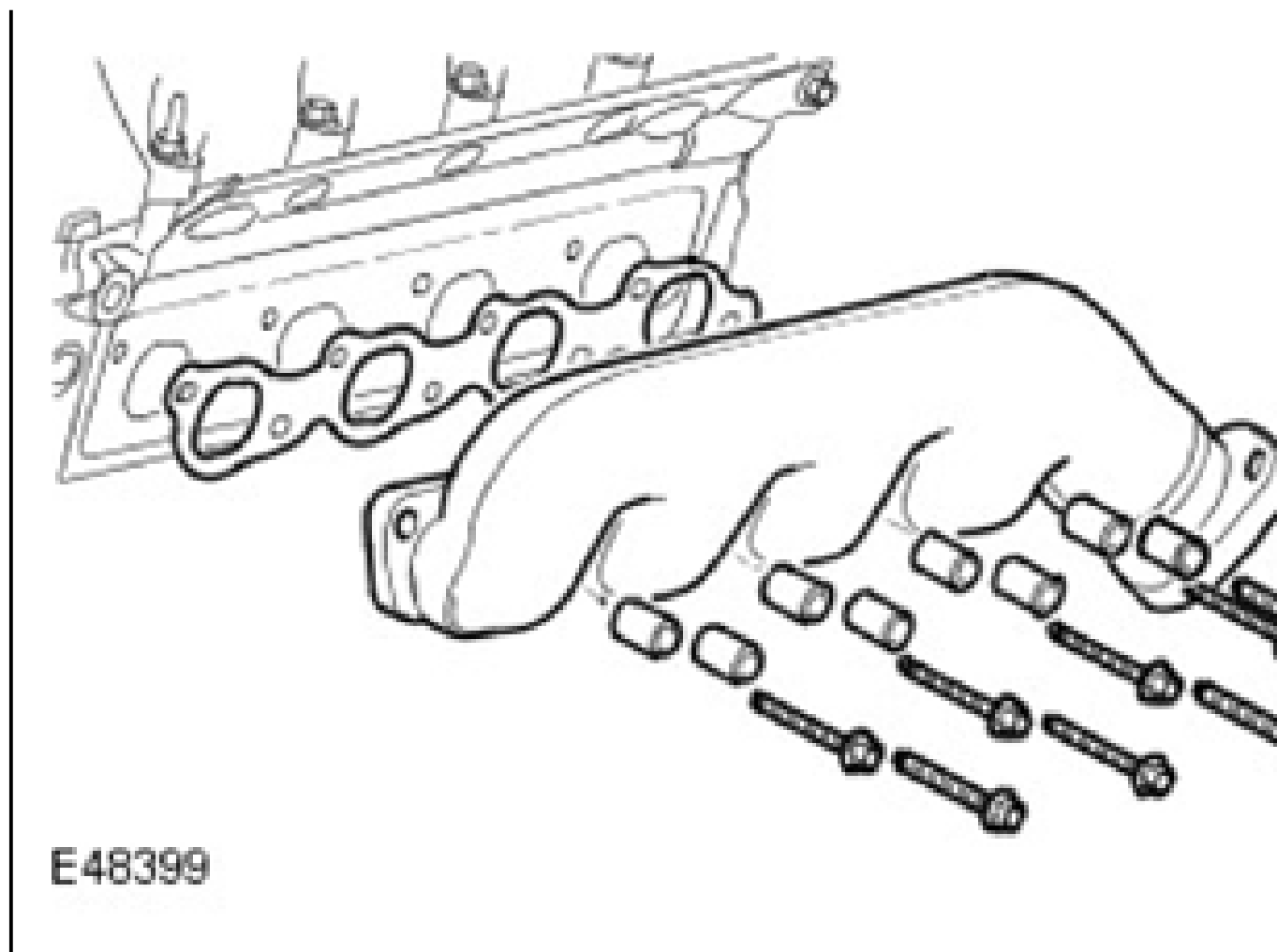


6. With assistance remove the cylinder head.
7. Remove and discard the cylinder head gasket.



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

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



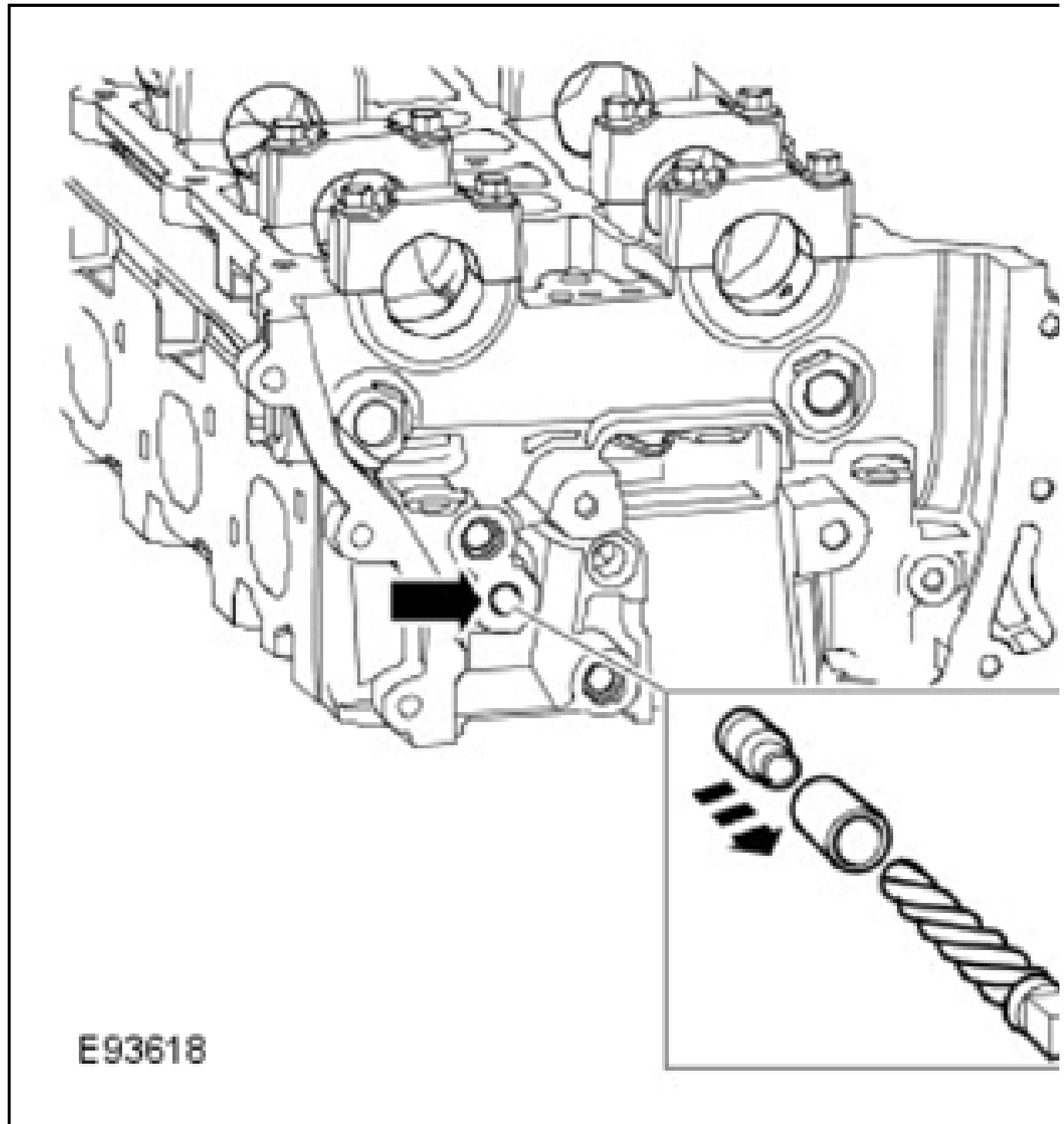
INSTALLATION

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.

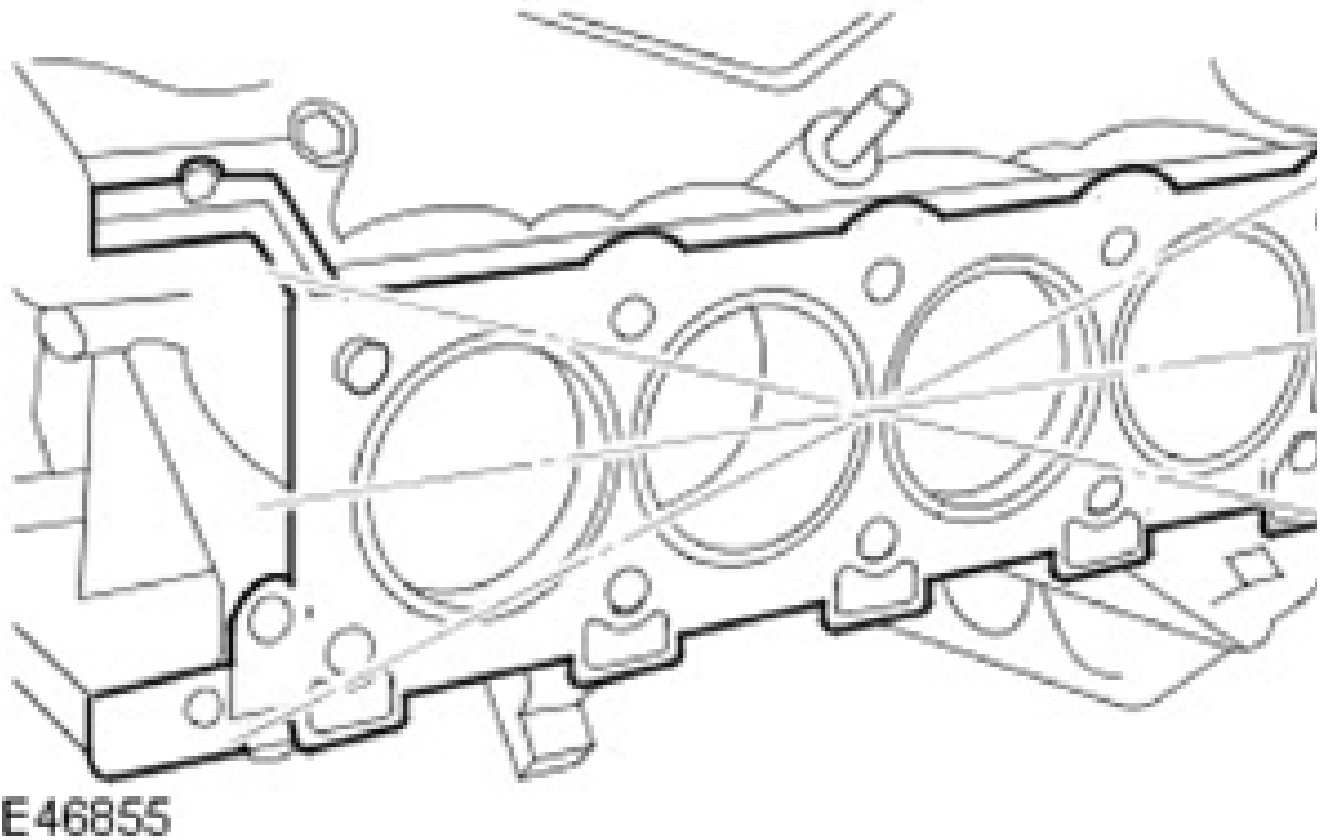
NOTE: The center bore of the blind rivet is 6 mm (0.24 inch) diameter.

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.



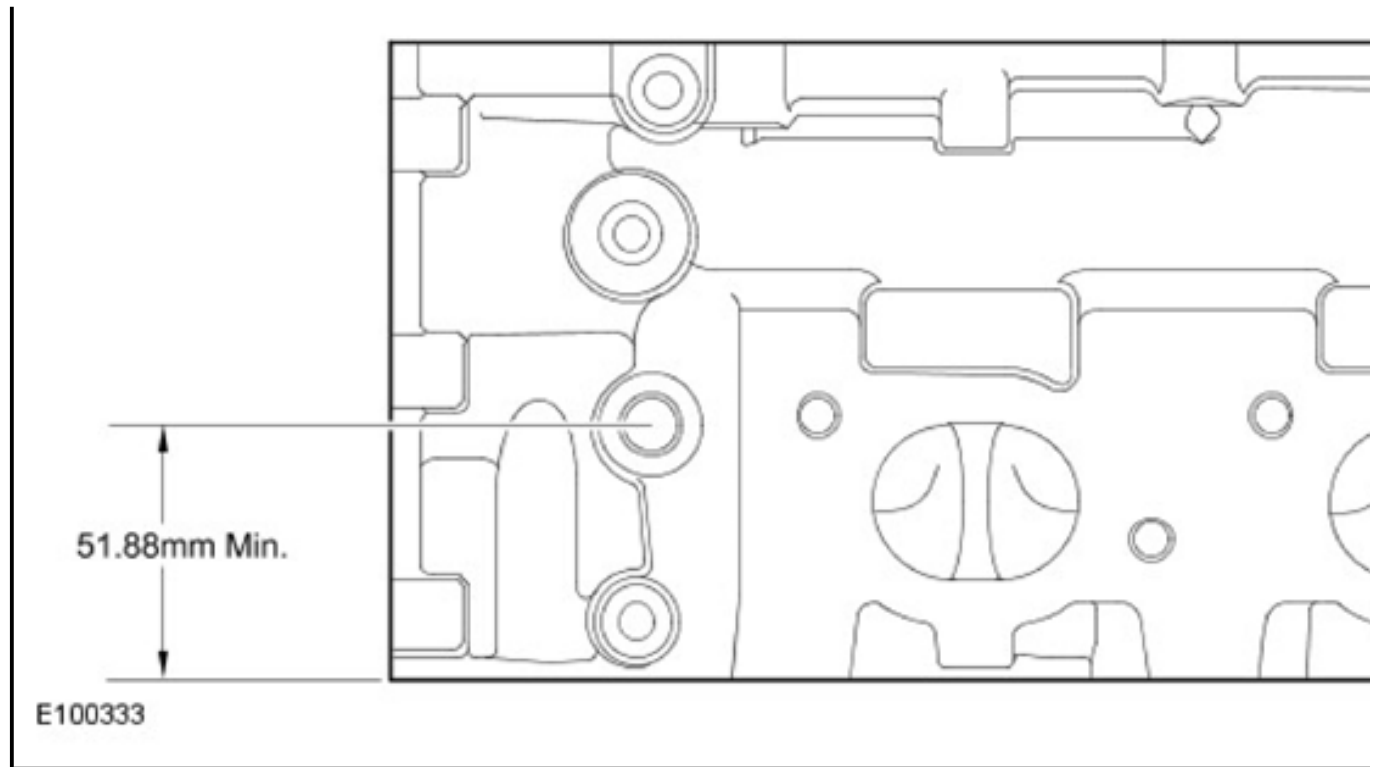
2. Clean the component mating faces.
3. Check cylinder head face for distortion, across the center and from corner to corner.

For additional information, refer to: **SPECIFICATIONS**.



4. For cylinder head face distortion data, refer to **SPECIFICATIONS**.

For additional information, refer to: **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 a new gasket.
 - Tighten the bolts to 20 Nm (15 lb.ft).

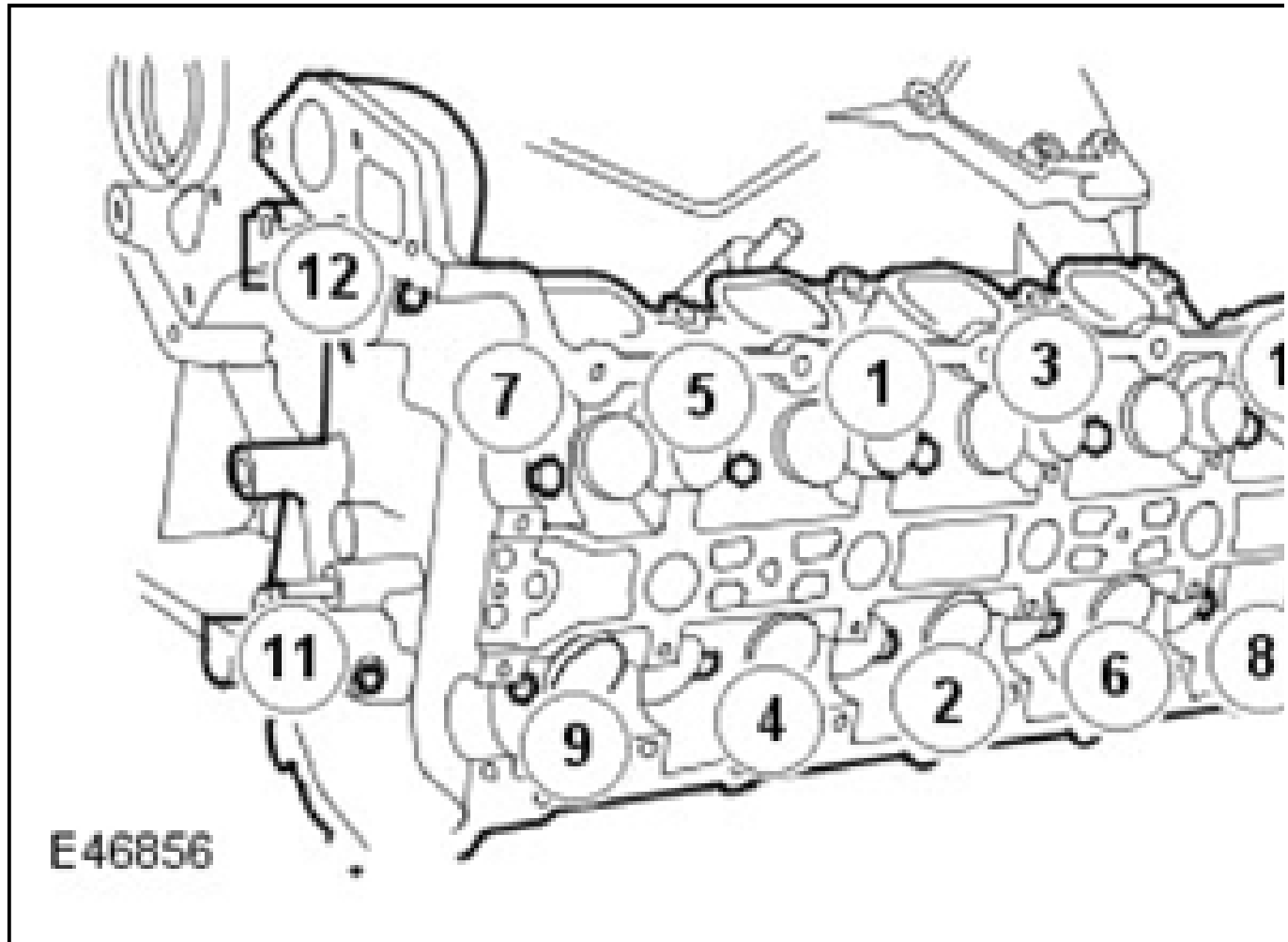
CAUTION: The head gasket must be installed over the cylinder block dowels.

7. Install a new cylinder head gasket.
 - Clean the cylinder head locating dowels.
8. With assistance install the cylinder head.

NOTE: Tighten the bolts 1 to 12 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. Install the CMP sensor.
 - Tighten the Torx screw to 7 Nm (5 lb.ft).
 - Connect the electrical connector.
11. Install the LH bank camshafts.

For additional information, refer to: **CAMSHAFTS LH.**

12. Install the fuel rail.

For additional information, refer to: **Fuel Rail** .

13. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

VALVE COVER LH

REMOVAL

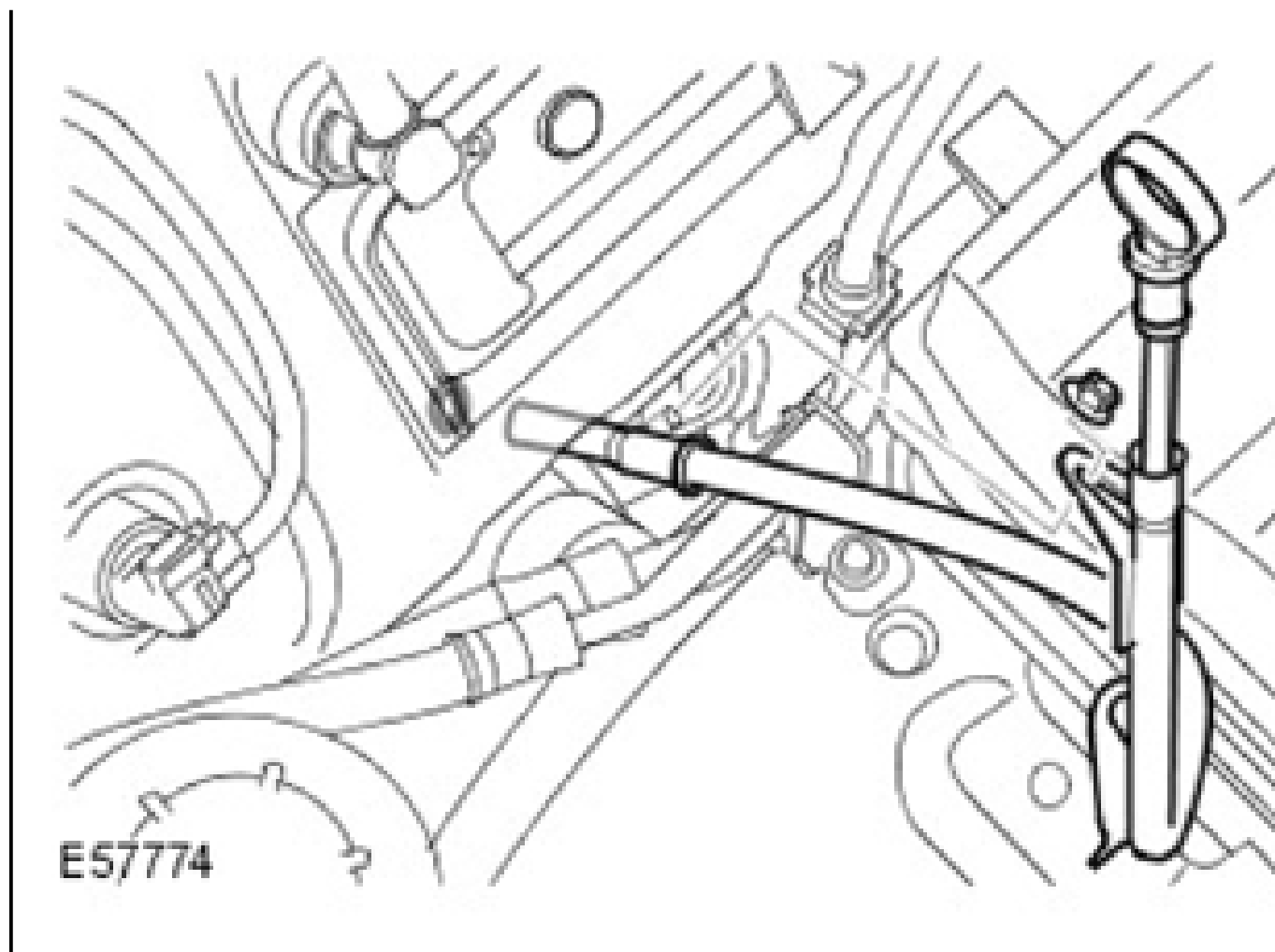
1. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

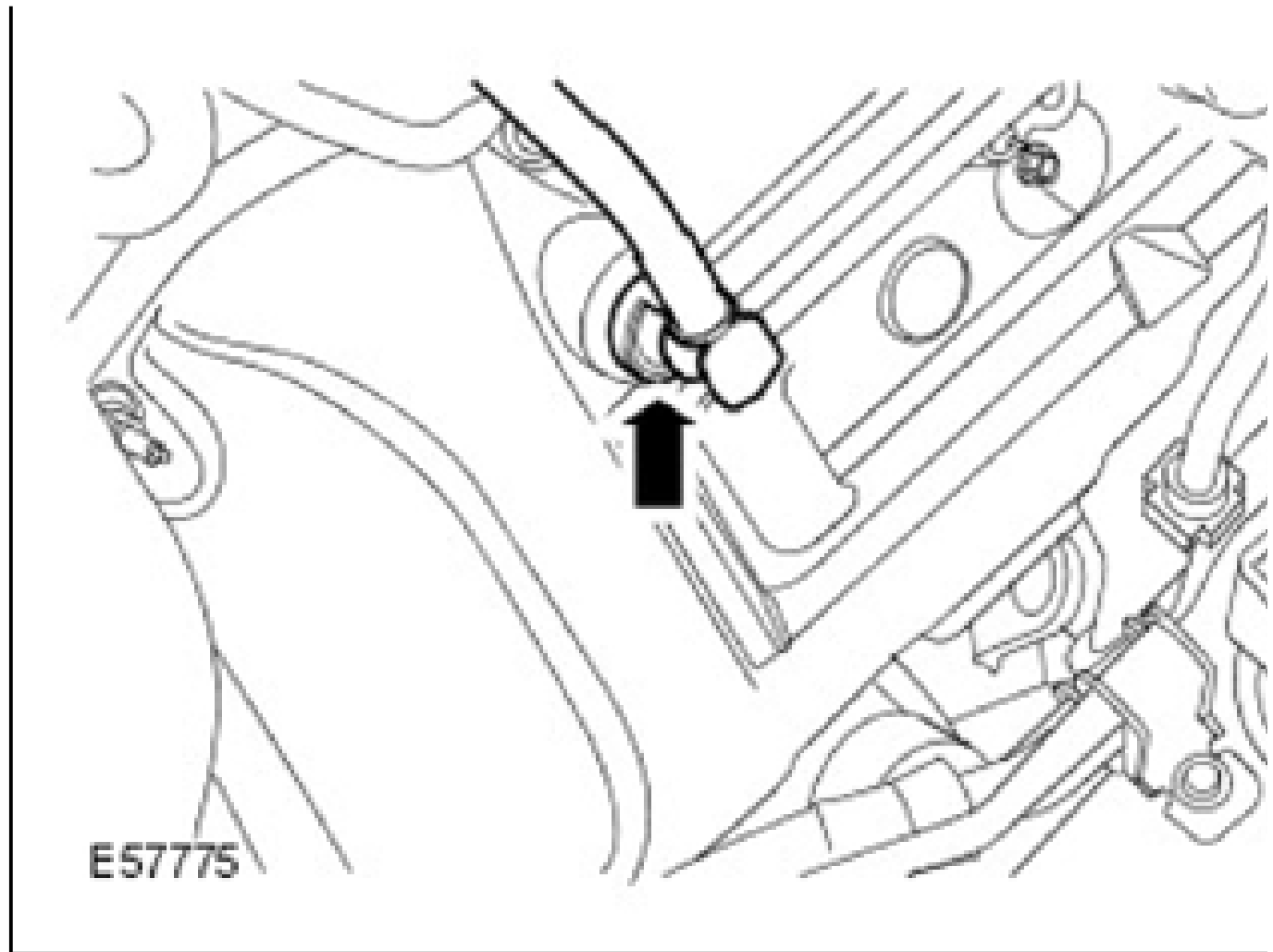
2. Remove the ignition coil-on-plug.

For additional information, refer to: **Ignition Coil-On-Plug** .

3. Remove the remaining ignition coil-on-plugs.
4. Remove the oil level indicator and tube.
 - Remove the dipstick.
 - Remove the nut.
 - Discard the O-ring seal.



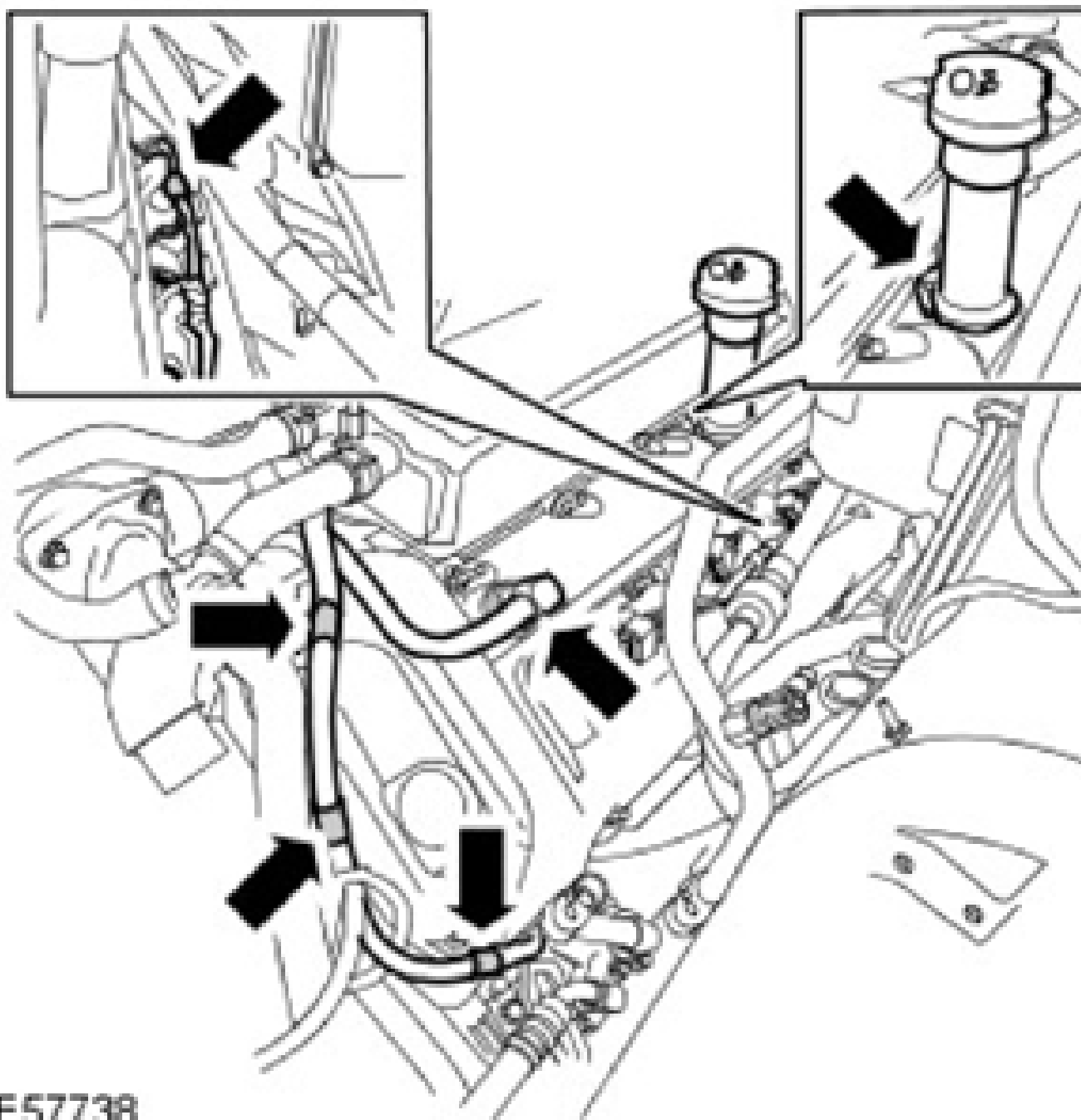
5. Disconnect the valve cover breather hose.



6. Release the engine wiring harness.
 - Release from the 4 clips.

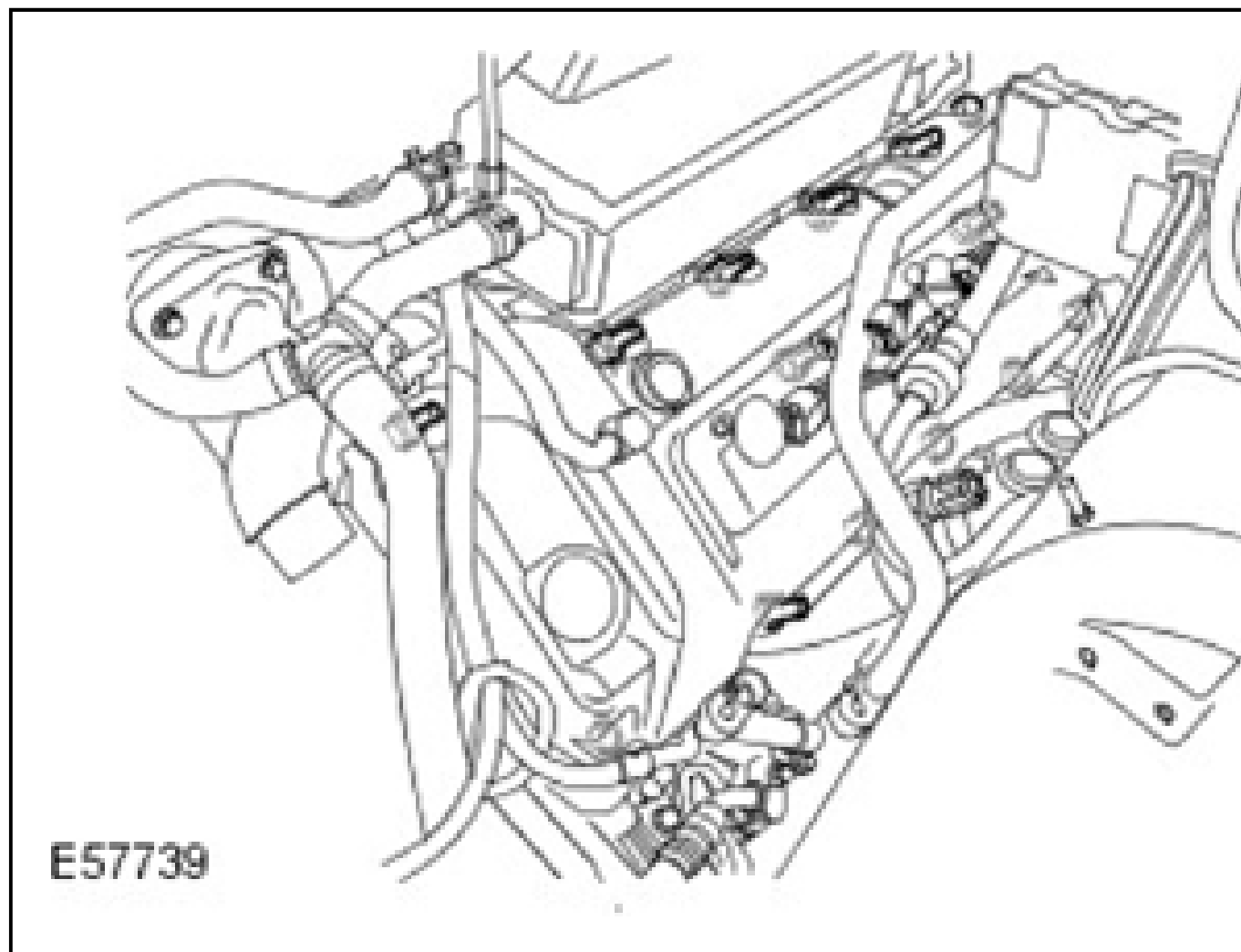
NOTE: Rotate the oil filler pipe counter-clockwise to remove.

7. Remove the oil filler pipe.
 - Release the clip.

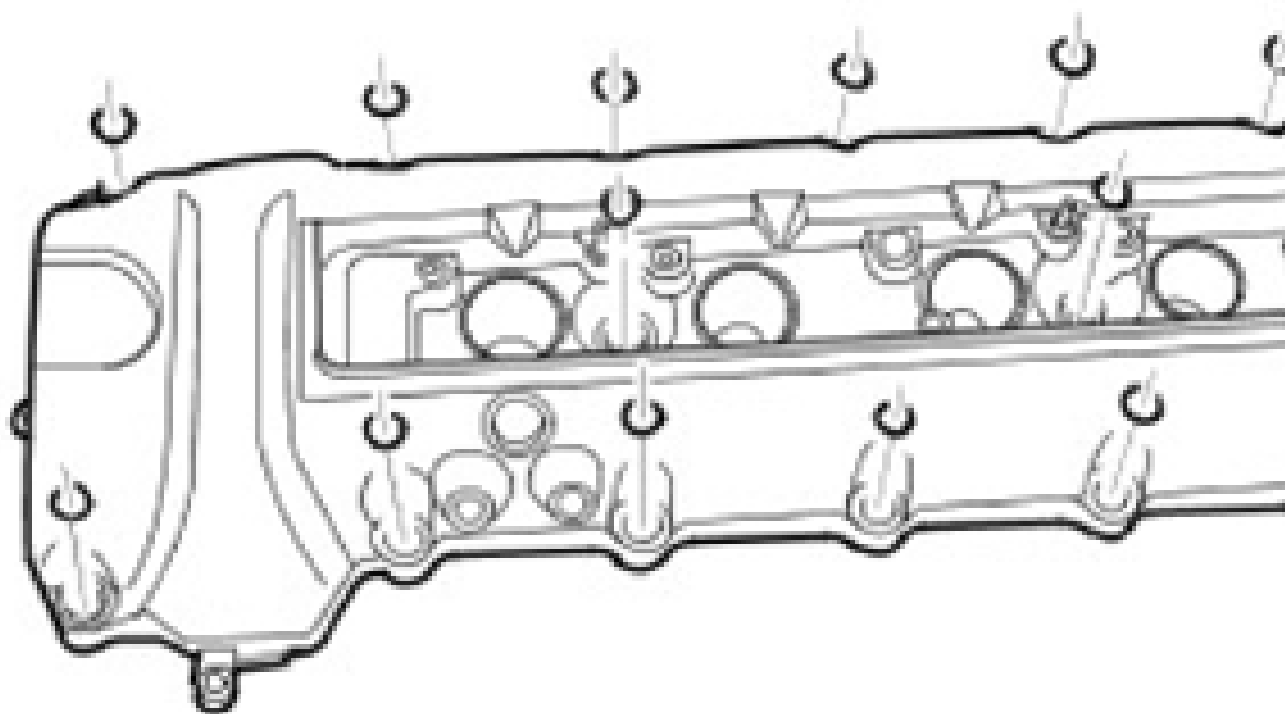


NOTE: Note the fitted position of the retaining bolts prior to removal.

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

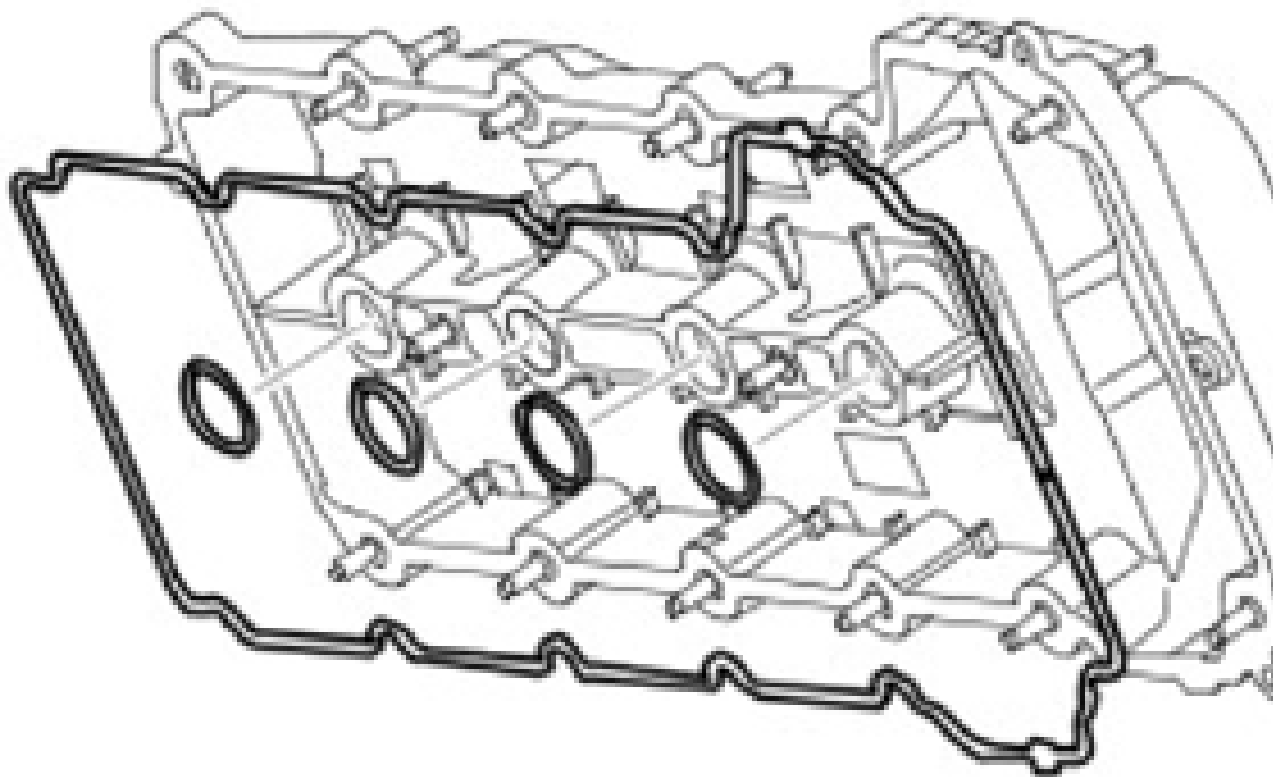


9. Remove and discard the valve cover retaining bolt O-ring seals.



E46676

10. Remove and discard the valve cover gaskets.



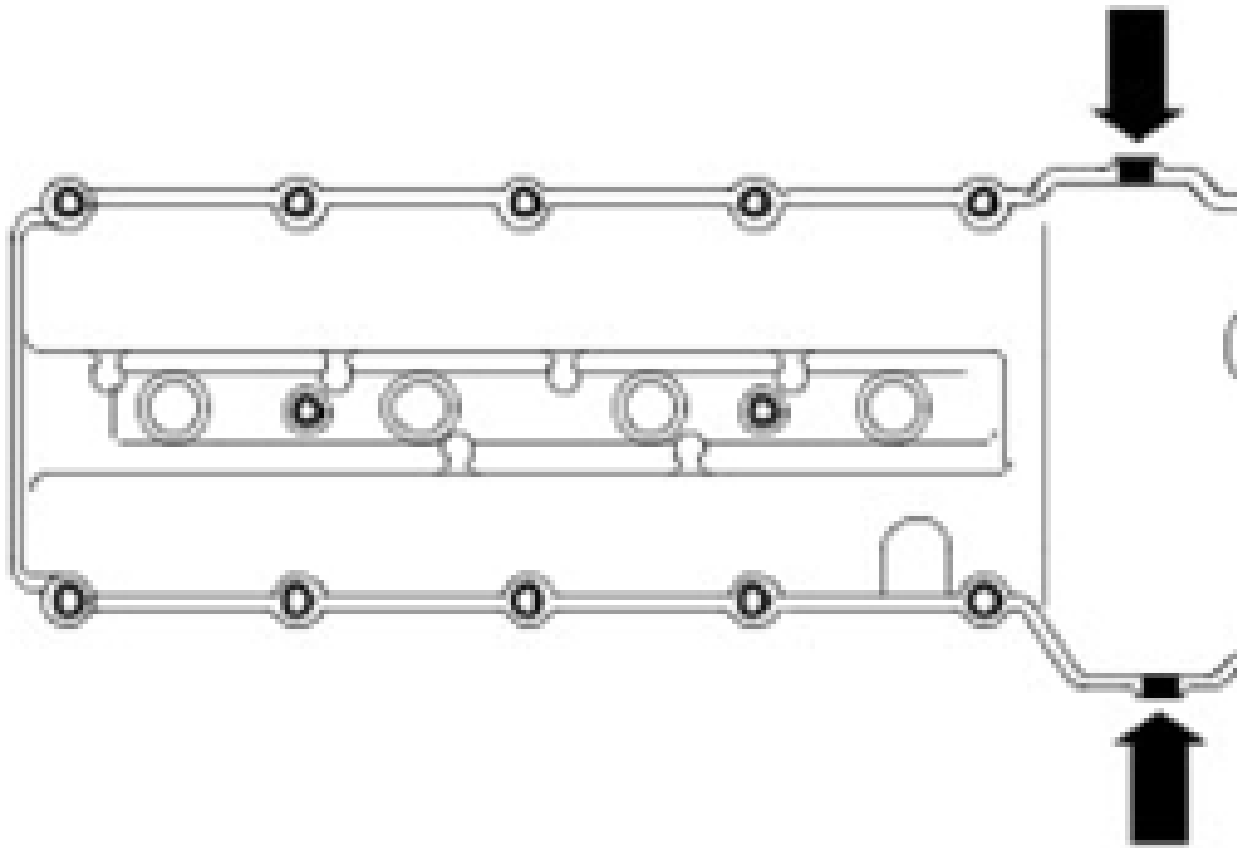
E 46652

INSTALLATION

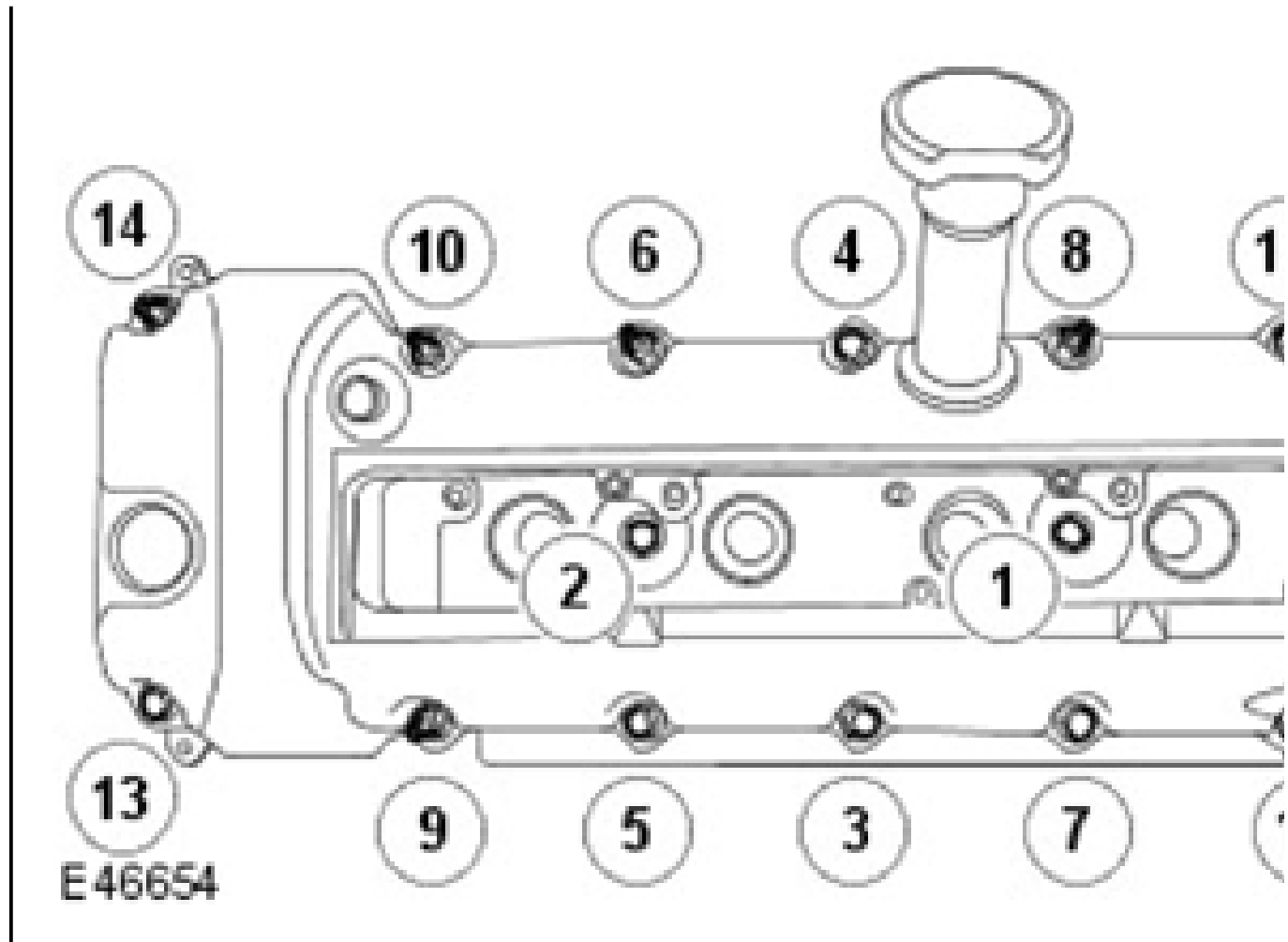
1. Install new valve cover plug aperture gaskets.
2. Install a new valve cover gasket.

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.

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

**E49922**

4. Install the valve cover retaining bolts.
 - Install new O-ring seals.
 - 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).



5. Install the oil filler pipe.
 - Install a new O-ring seal.
6. Attach the engine wiring harness.
7. With assistance, install the oil level indicator and tube.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Lubricate the seal with clean engine oil.
 - Tighten the nut to 6 Nm (4 lb.ft).
8. Install the ignition coil-on-plug.

For additional information, refer to: **Ignition Coil-On-Plug** .

9. Install the remaining ignition coil-on-plugs.
10. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

VALVE COVER RH**REMOVAL**

1. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

2. Remove the air cleaner assembly.

For additional information, refer to: **Air Cleaner Element** .

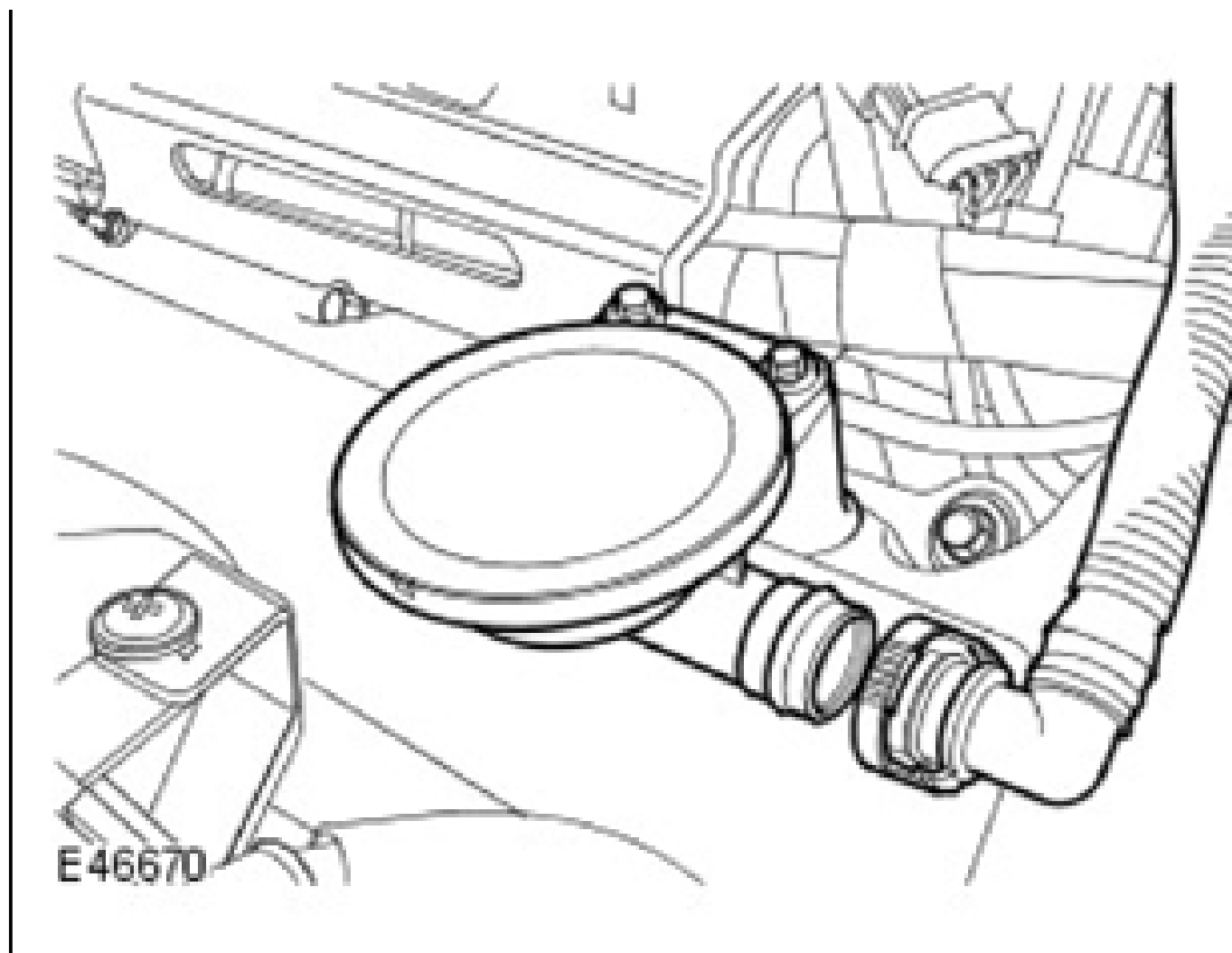
3. Remove the air intake resonator.

For additional information, refer to: **INTAKE AIR RESONATOR** .

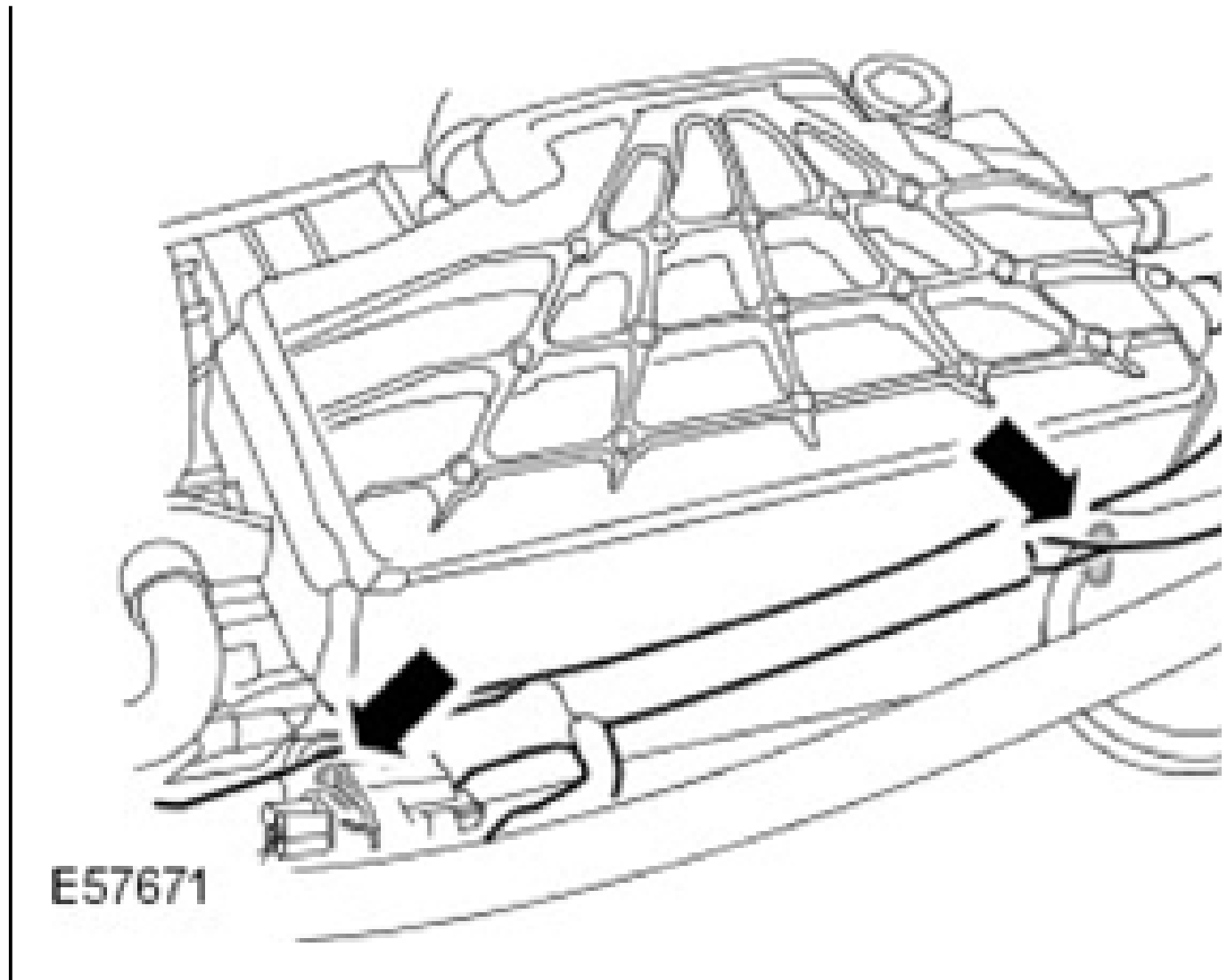
4. Remove the ignition coil-on-plug.

For additional information, refer to: **Ignition Coil-On-Plug** .

5. Remove the remaining ignition coil-on-plugs.
6. Disconnect the positive crankcase ventilation (PCV) line.

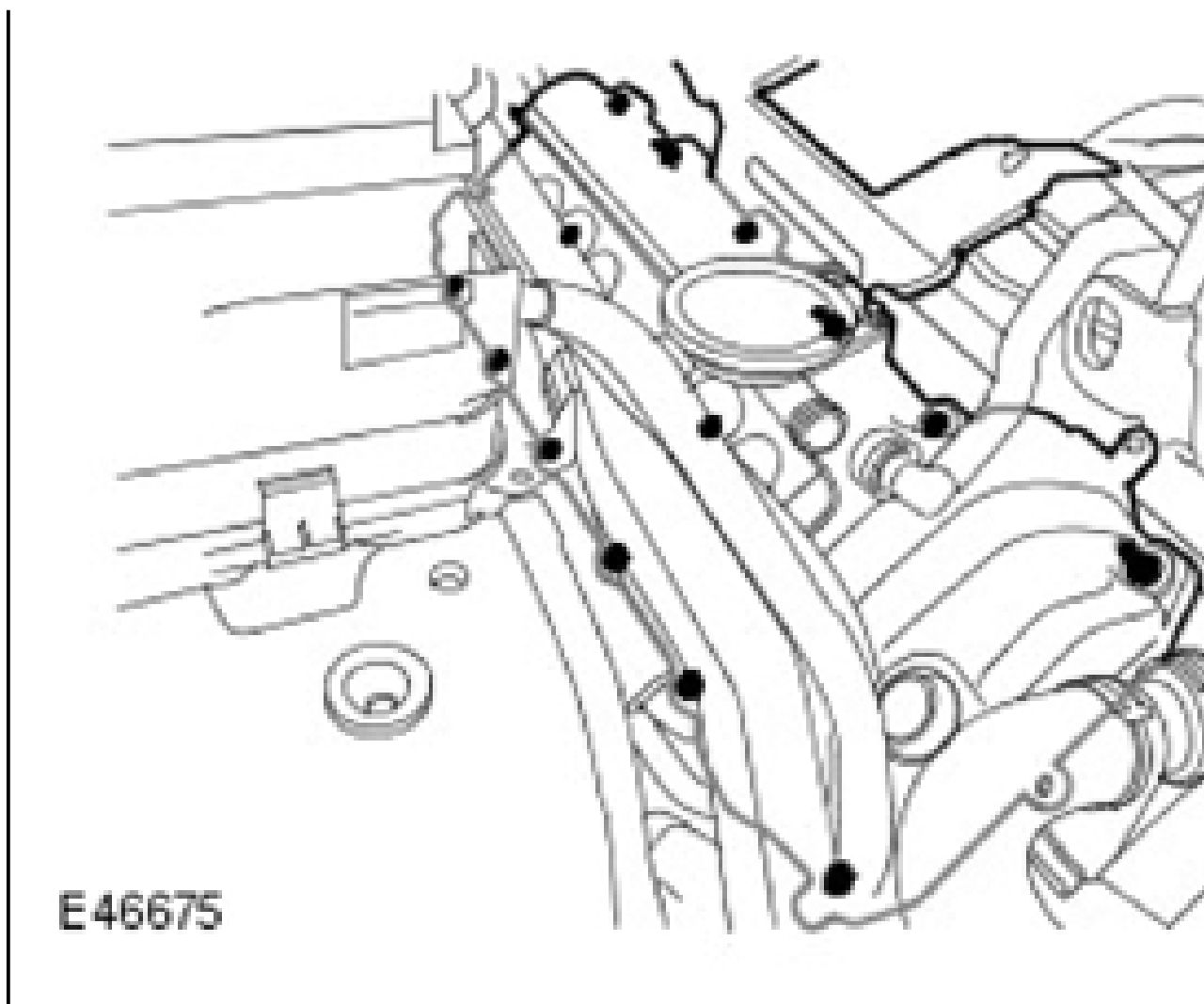


7. Release the engine wiring harness from the retaining bracket.

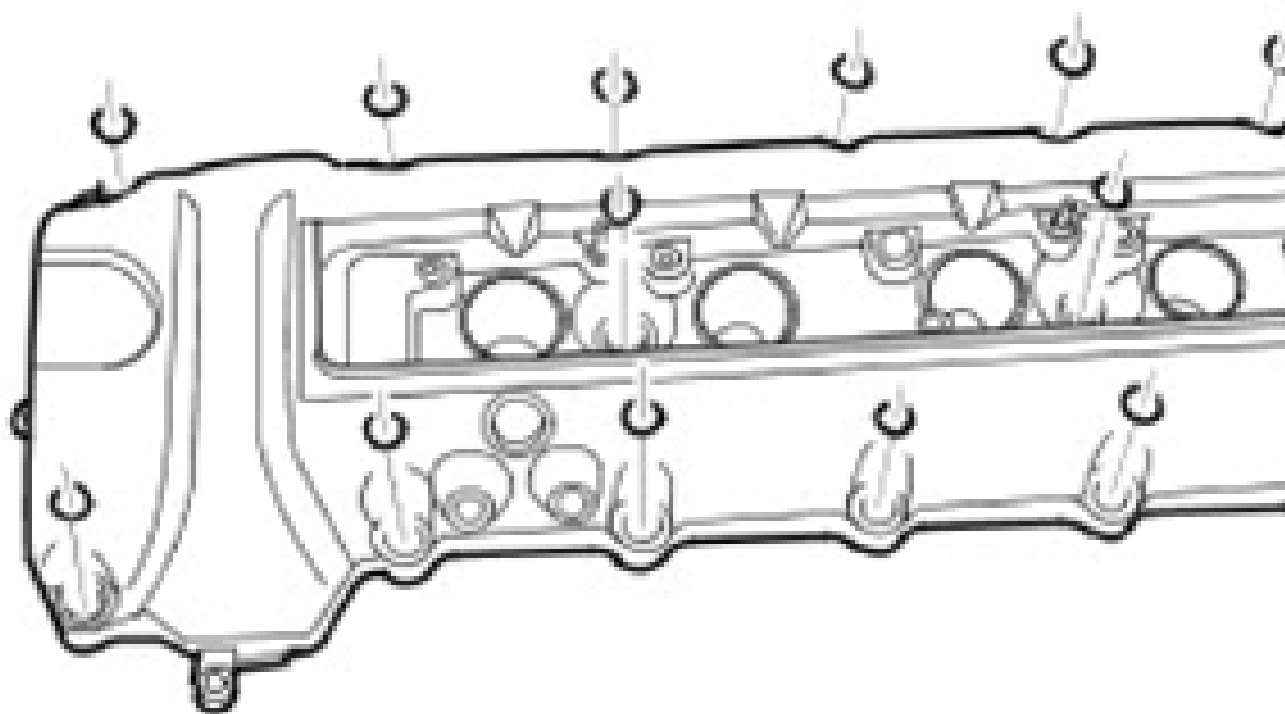


NOTE: Note the fitted position of the retaining bolts prior to removal.

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

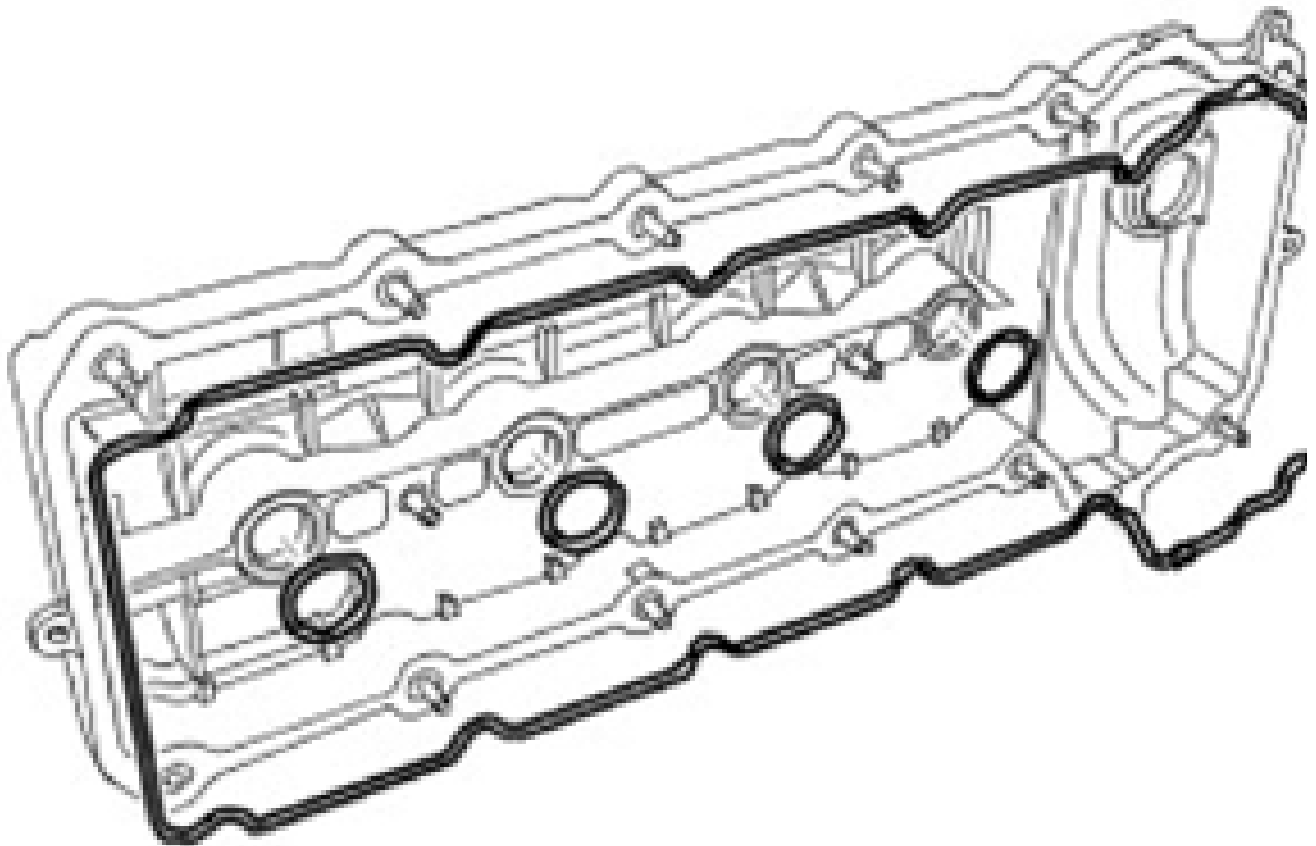


9. Remove and discard the valve cover retaining bolt O-ring seals.



E46676

10. Remove and discard the valve cover gasket.
11. Remove the valve cover plug aperture seals.

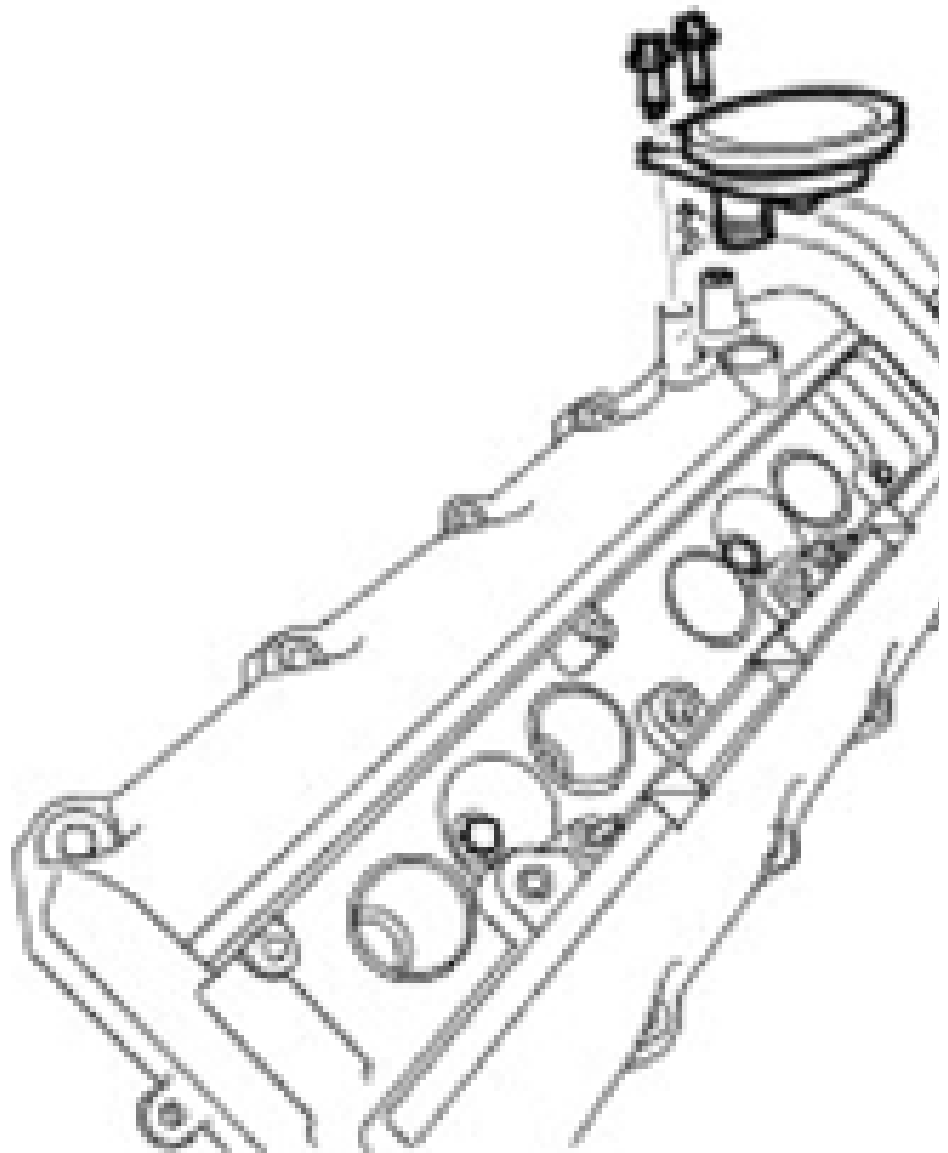


E46677

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

12. Remove the PCV valve.
 - Remove the 2 bolts.
 - Remove and discard the 2 O-ring seals.

E46678



INSTALLATION

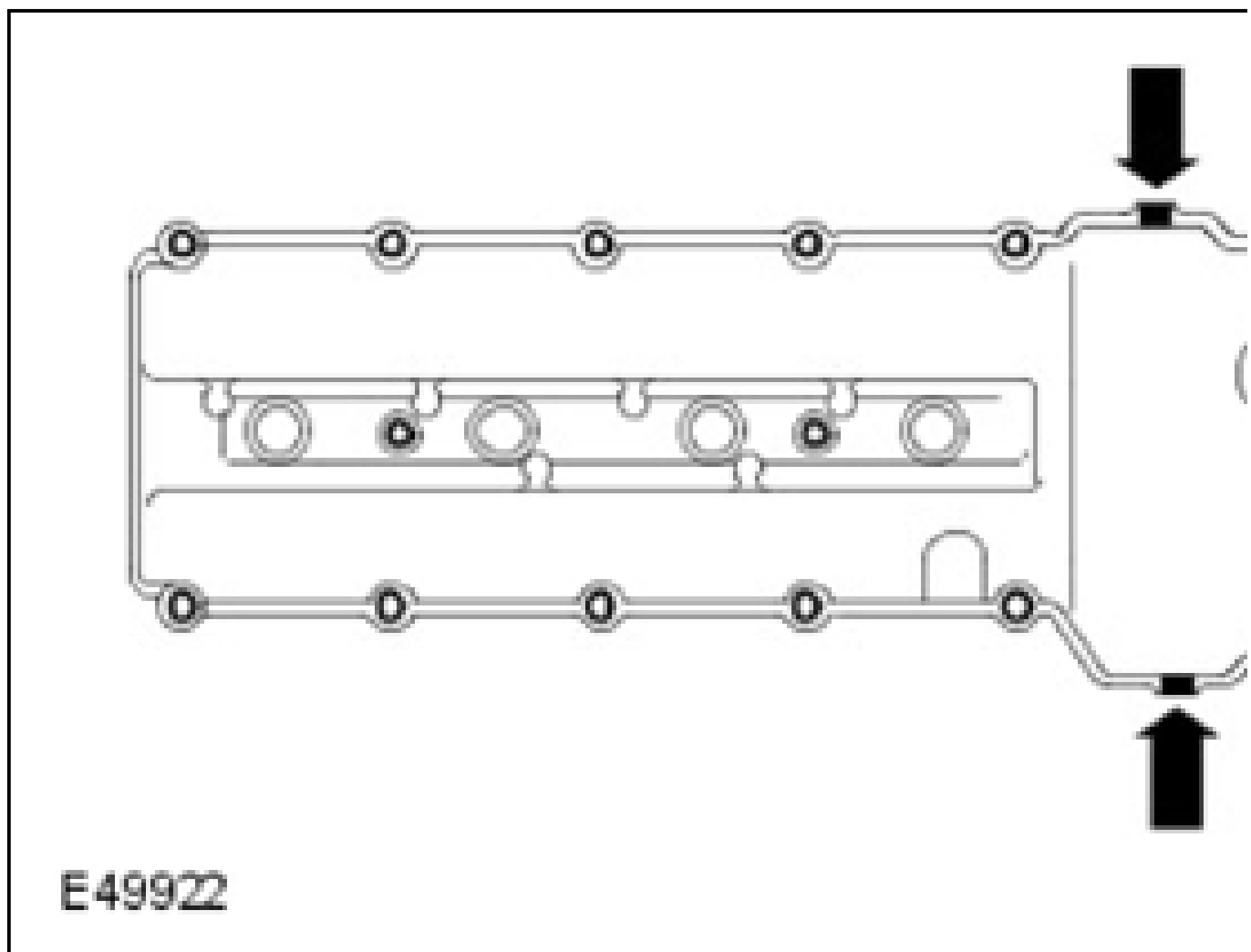
NOTE: Lubricate new seals with clean engine oil.

1. Install the PCV valve.
 - Clean the component mating faces.
 - Install new O-ring seals.
 - Tighten the bolts to 6 Nm (4 lb.ft).

2. Install new valve cover plug aperture seals
3. Install a new valve cover gasket.
4. Install new valve cover retaining bolt O-ring seals

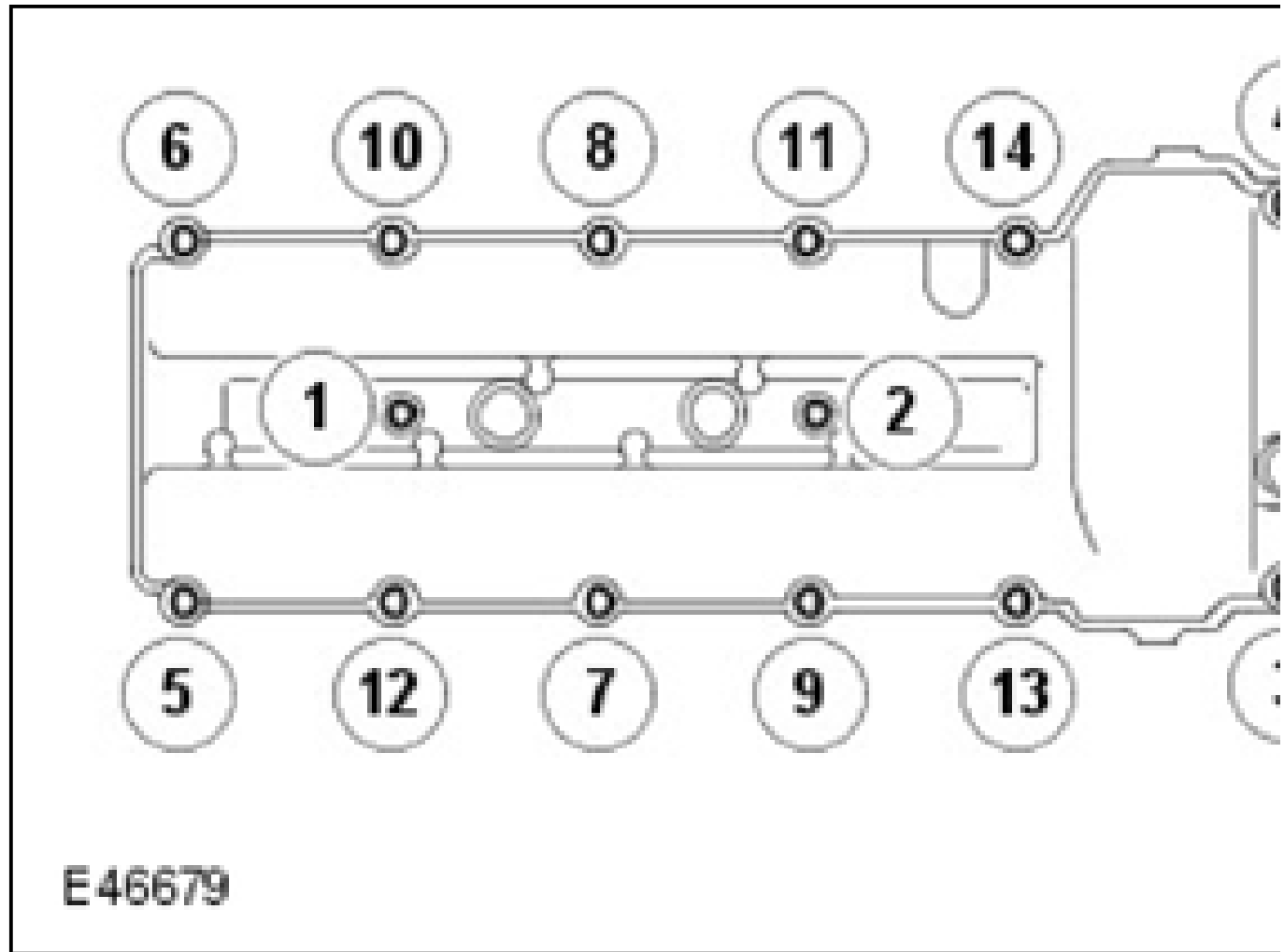
NOTE: Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

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



6. 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.



7. Attach the engine wiring harness to the retaining bracket.
8. Connect the PCV line.
 - Clean the component mating faces.
9. Install the air intake resonator.

For additional information, refer to: **INTAKE AIR RESONATOR** .

10. Install the air cleaner assembly.

For additional information, refer to: **Air Cleaner Element** .

11. Install the ignition coil-on-plugs.

For additional information, refer to: **Ignition Coil-On-Plug** .

12. Install the remaining ignition coil-on-plugs.
13. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

ENGINE MOUNT LH LHD AWD

REMOVAL

1. Disconnect the battery ground cable.

For additional information, 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 front wheel.
4. Remove the engine undershield.

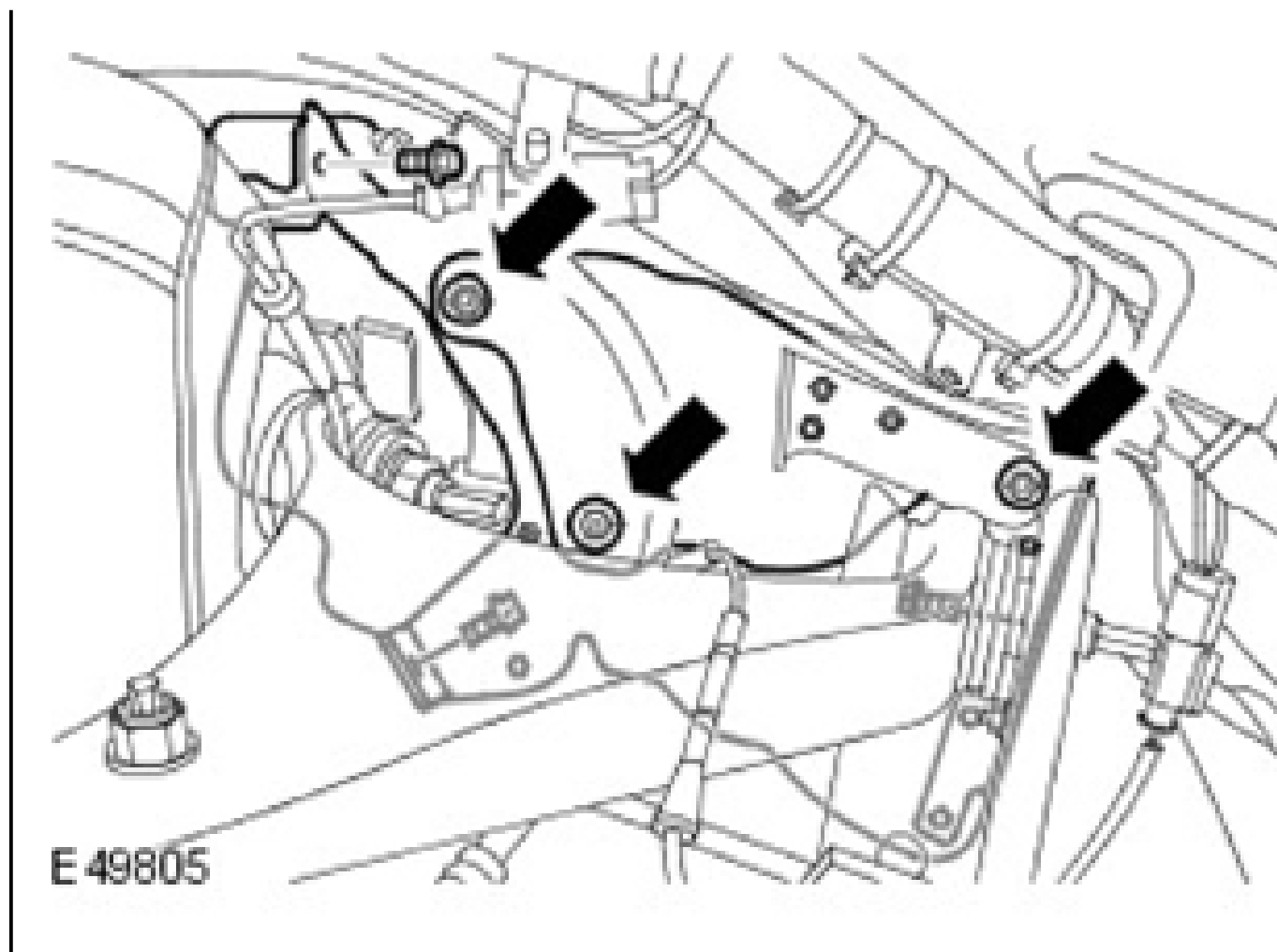
For additional information, refer to: **ENGINE UNDERSHIELD** .

5. Remove the exhaust system.

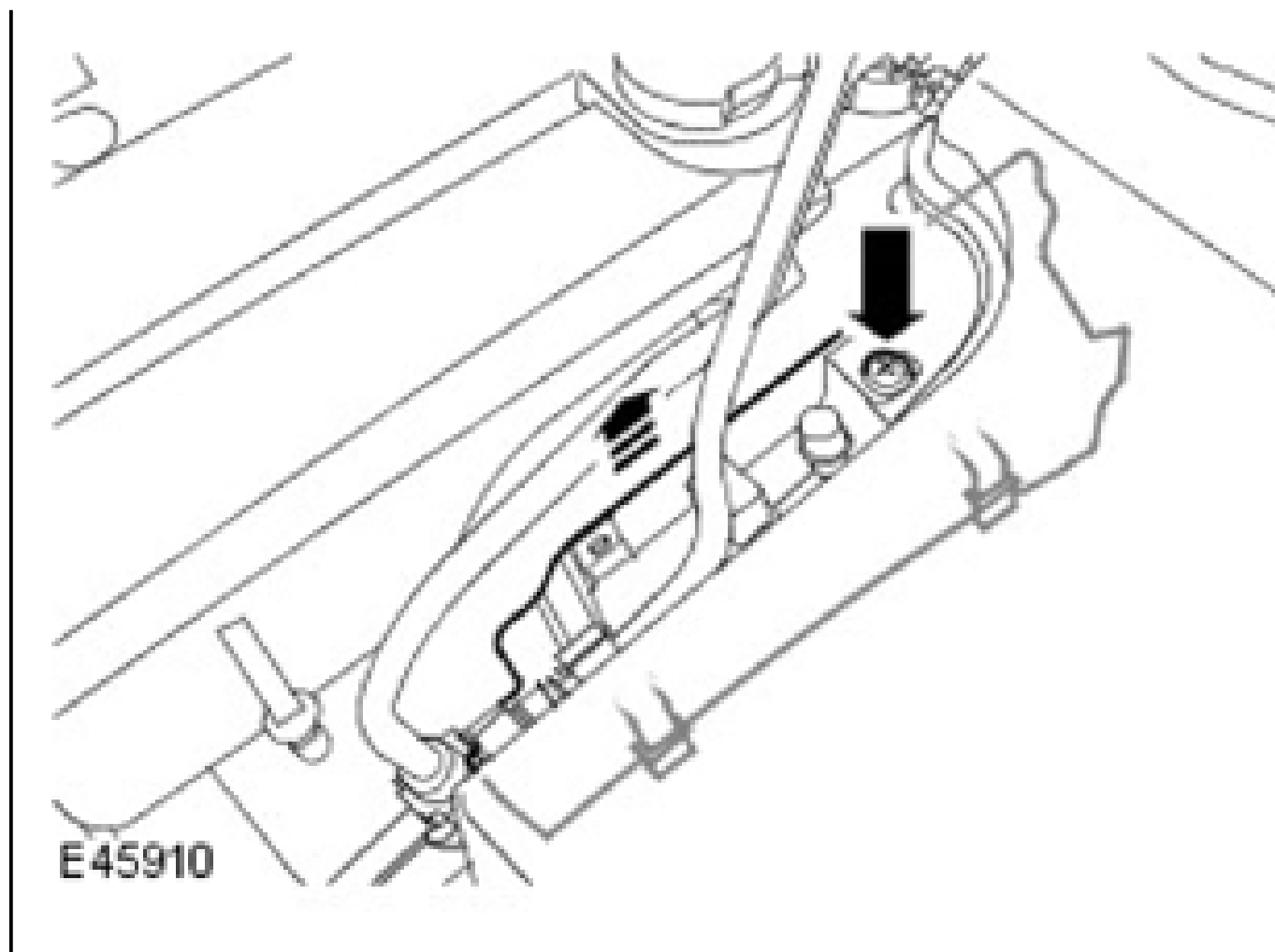
For additional information, refer to: **EXHAUST SYSTEM** .

NOTE: The heatshield consists of 3 parts.

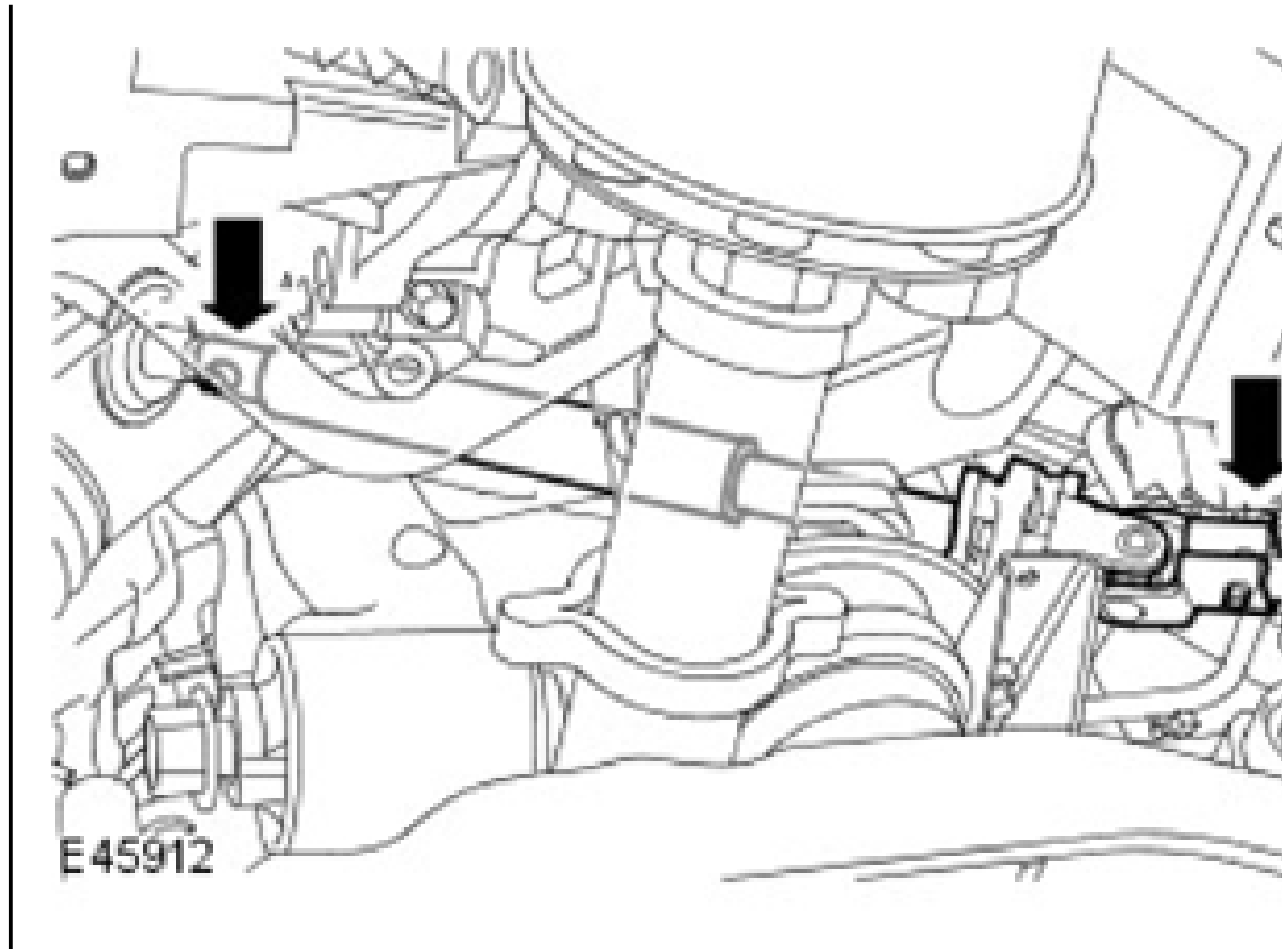
6. Remove the upper suspension arm and brake line heat shields for access.
 - Remove the 3 nuts.
 - Remove the 3 bolts.



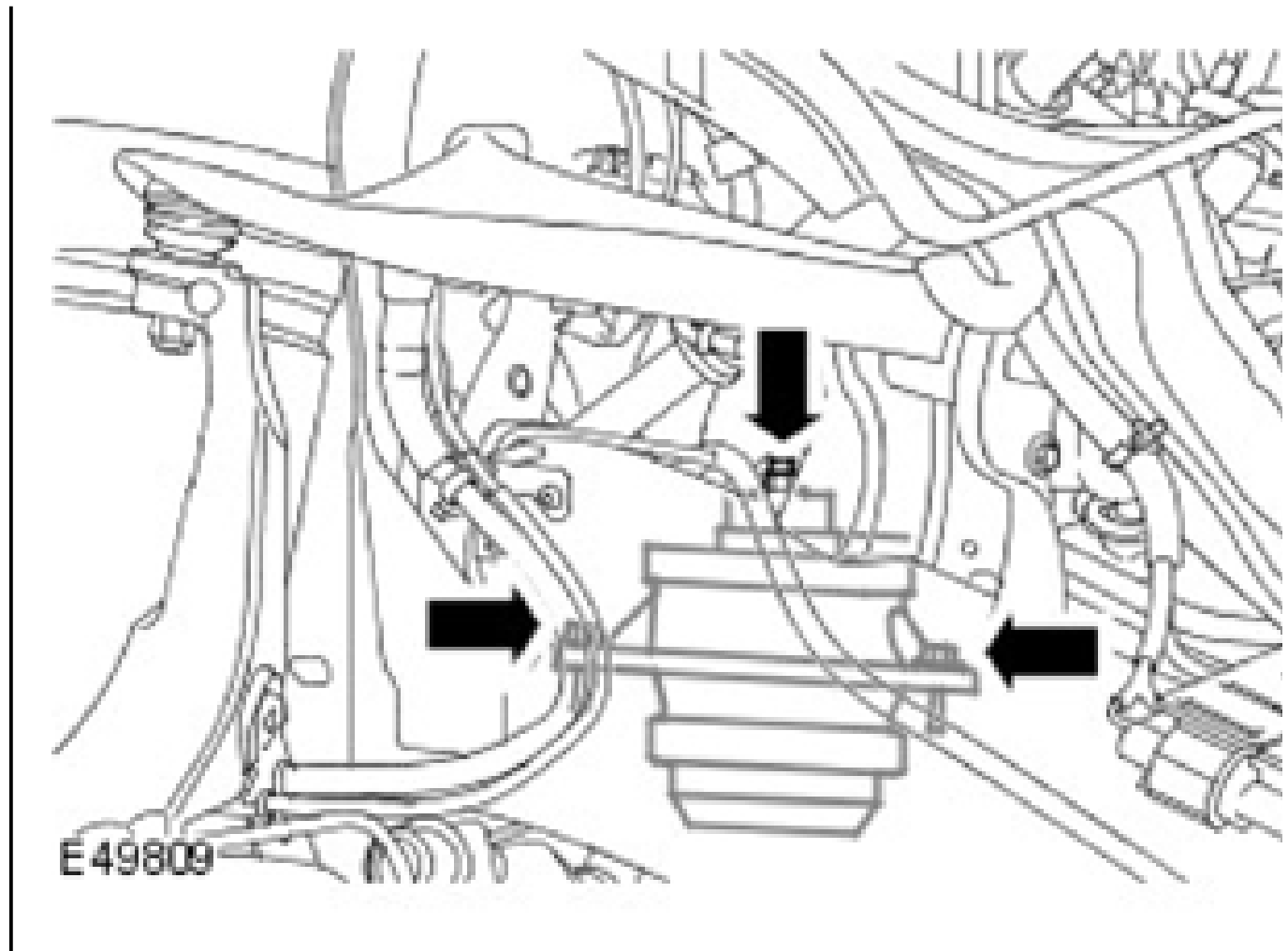
7. Remove the engine compartment LH upper heat shield.
 - Remove the screw.



8. Remove the steering column lower universal joint assembly for access.
 - Remove and discard the bolts.



9. Support the engine.
10. Raise the engine.
 - Remove the nut.
11. Remove the engine front mount.
 - With assistance remove the 2 bolts.



INSTALLATION

1. Install the engine front mount.
 - Clean the component mating faces.
 - Tighten the bolts to 45 Nm (33 lb.ft), then a further 60 degrees.
2. Lower the engine onto the mount.
 - Tighten the nut to 90 Nm (66 lb.ft).
3. Remove the engine support.
4. Install the steering column lower universal joint assembly.
 - Install new patchlock bolts and tighten to 25 Nm (18 lb.ft).
5. Install the exhaust system.

For additional information, refer to: **EXHAUST SYSTEM**.

6. Install the engine undershield.

For additional information, refer to: **ENGINE UNDERSHIELD** .

NOTE: **The heatshield consists of 3 parts.**

7. Install the upper suspension arm and brake line heat shields.
 - Install the bolts.
 - Install the nuts.
 - Tighten to 6 Nm (4 lb.ft).
8. Install the engine compartment upper LH heat shield.
 - Install the screw.
9. Install the front wheel.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).
10. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

ENGINE MOUNT LH RHD AWD

REMOVAL

1. Disconnect the battery ground cable.

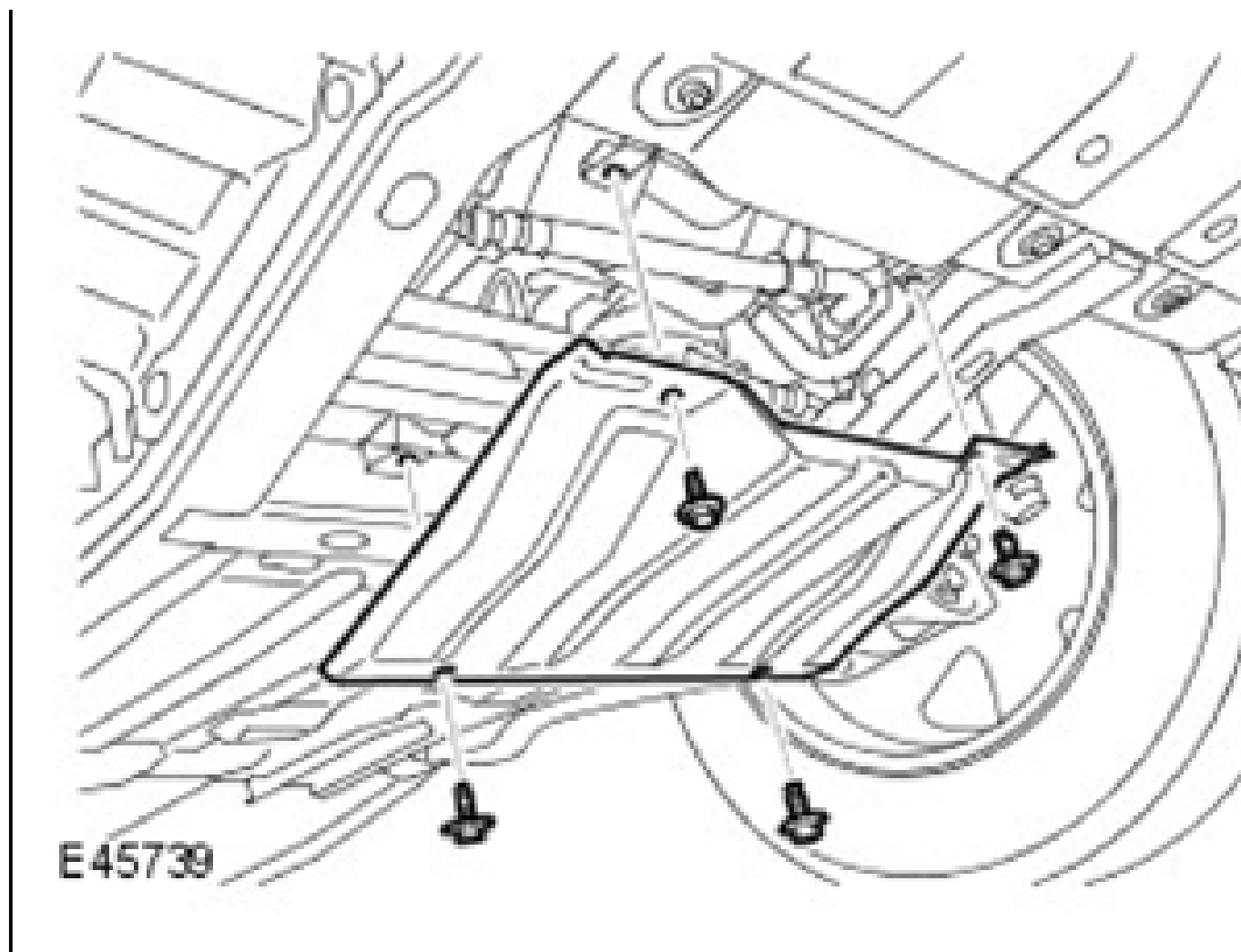
For additional information, refer to: **SPECIFICATIONS** .

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

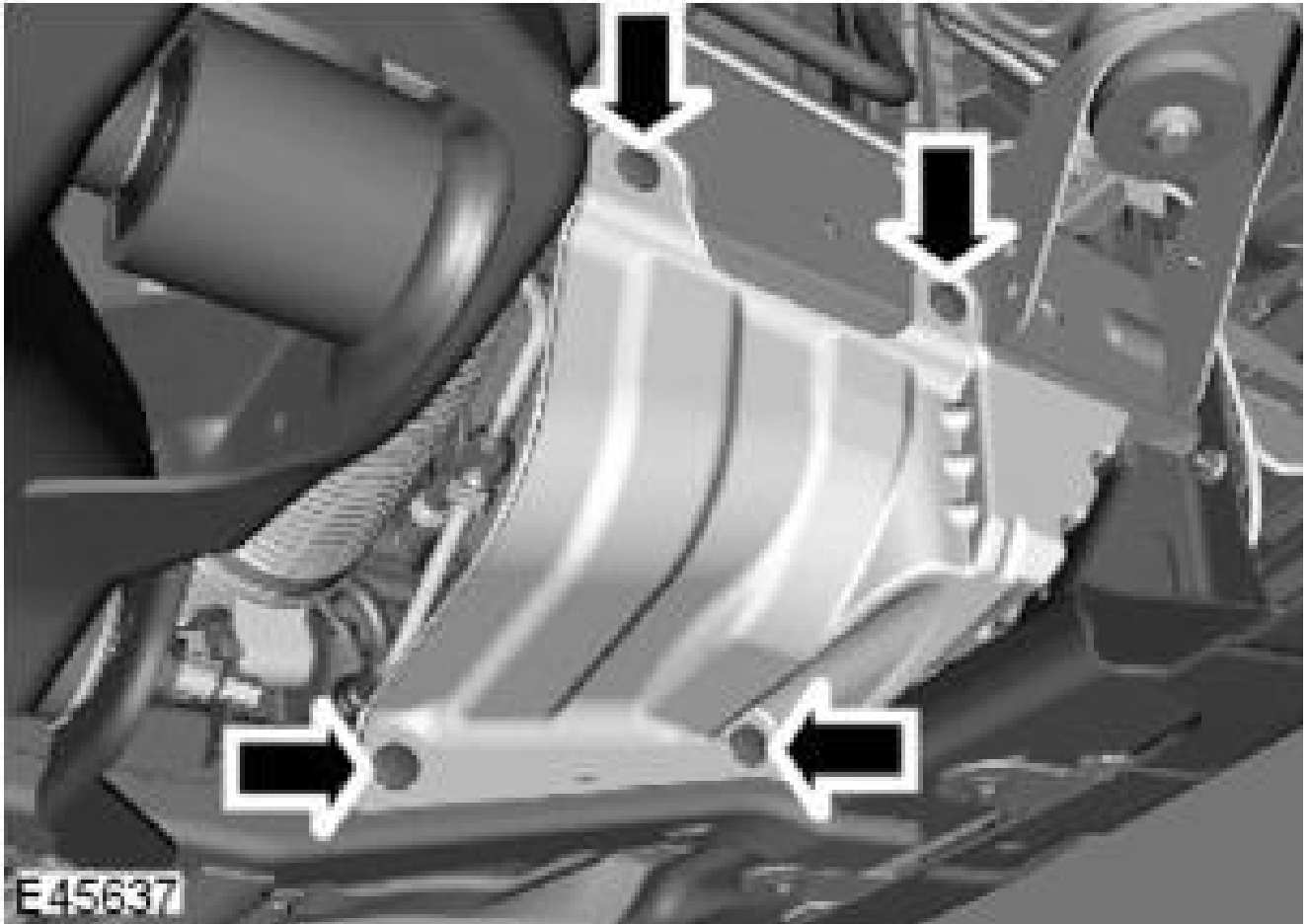
2. Raise and support the vehicle.
3. Remove the front wheel.
4. Remove the engine undershield.

For additional information, refer to: **ENGINE UNDERSHIELD** .

5. Remove the radiator access panel.

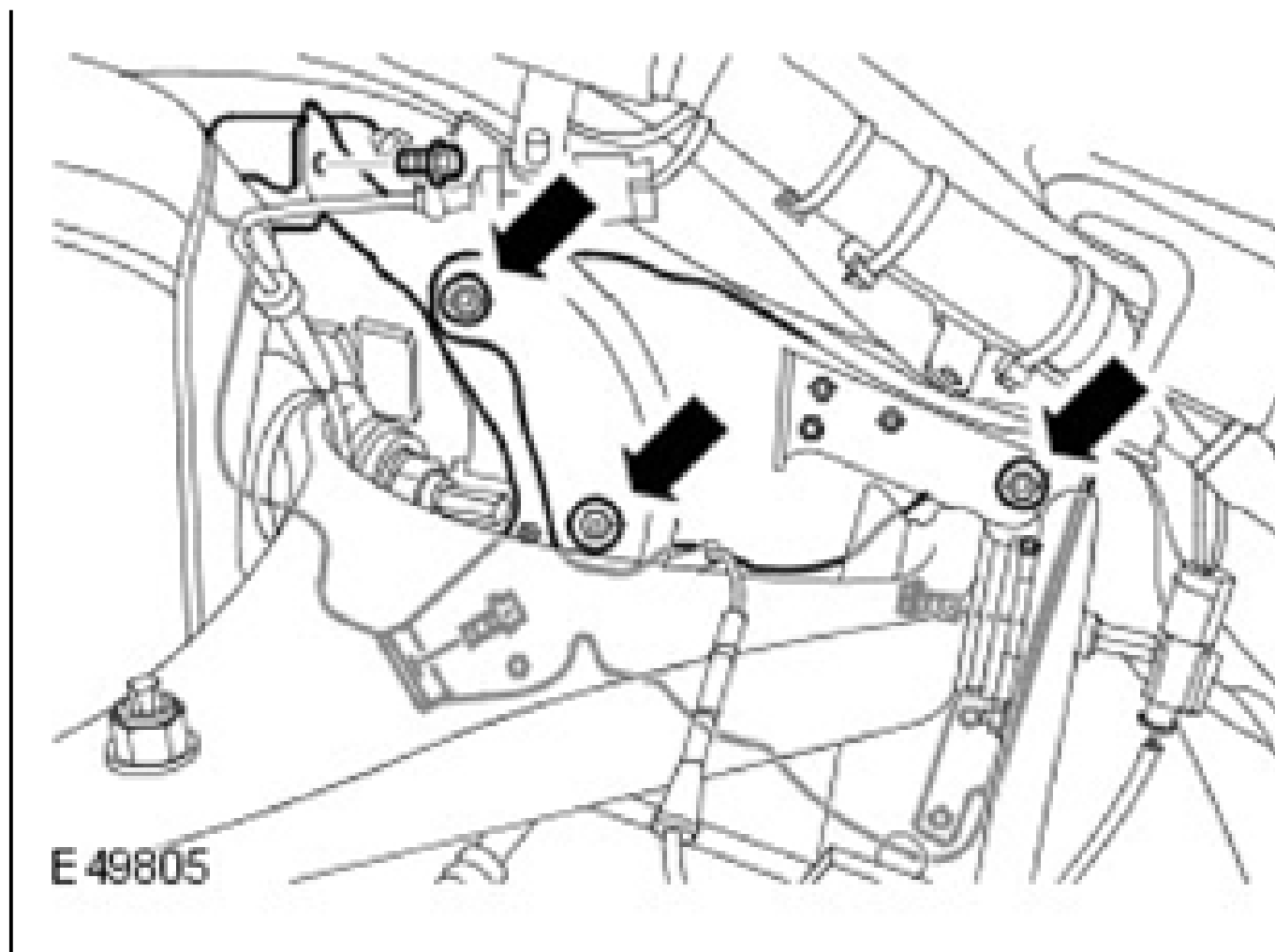


6. Remove the front LH splash shield.

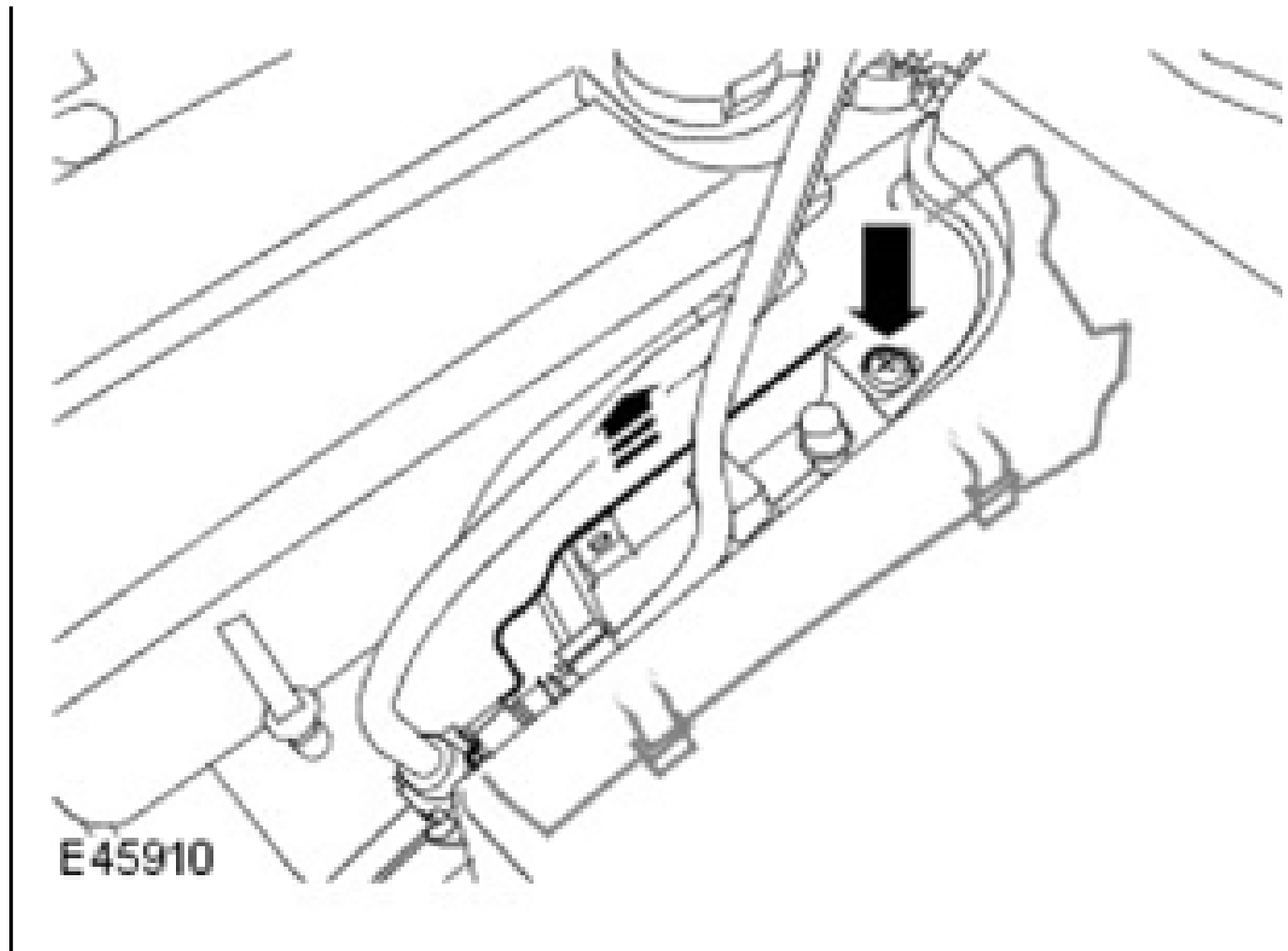


NOTE: The heatshield consists of 3 parts.

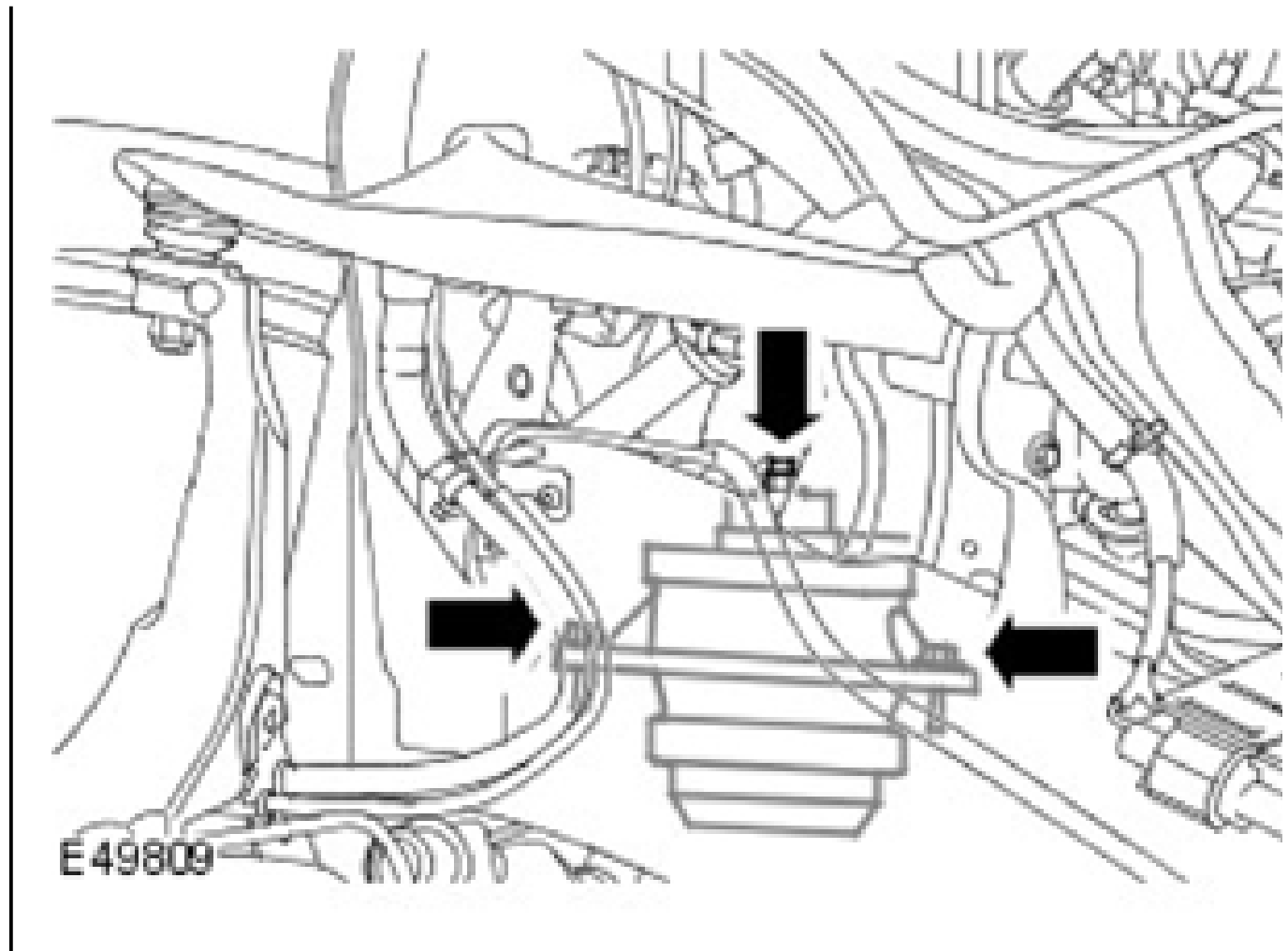
7. Remove the upper suspension arm and brake line heat shields for access.
 - Remove the 3 nuts.
 - Remove the 3 bolts.



8. Remove the engine compartment LH upper heat shield.
 - Remove the screw.



9. Support the engine.
10. Raise the engine.
 - Remove the nut.
11. Remove the engine front mount.
 - With assistance remove the 2 bolts.



INSTALLATION

1. Install the engine front mount.
 - Clean the component mating faces.
 - Tighten the bolts to 45 Nm (33 lb.ft), then a further 60 degrees.
2. Lower the engine onto the mount.
 - Tighten the nut to 90 Nm (66 lb.ft).
3. Remove the engine support.
4. Install the engine undershield.

For additional information, refer to: **ENGINE UNDERSHIELD** .

5. Install the radiator access panel.
6. Install the front LH splash shield.

NOTE: The heatshield consists of 3 parts.

7. Install the upper suspension arm and brake line heat shields.
 - Install the bolts.
 - Install the nuts.
 - Tighten to 6 Nm (4 lb.ft).
8. Install the front wheel.
 - Tighten the wheel nuts to 140 Nm (103 lb.ft).
9. Install the engine compartment upper LH heat shield.
 - Install the screw.
10. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

ENGINE MOUNT RH

REMOVAL

1. Disconnect the battery ground cable.

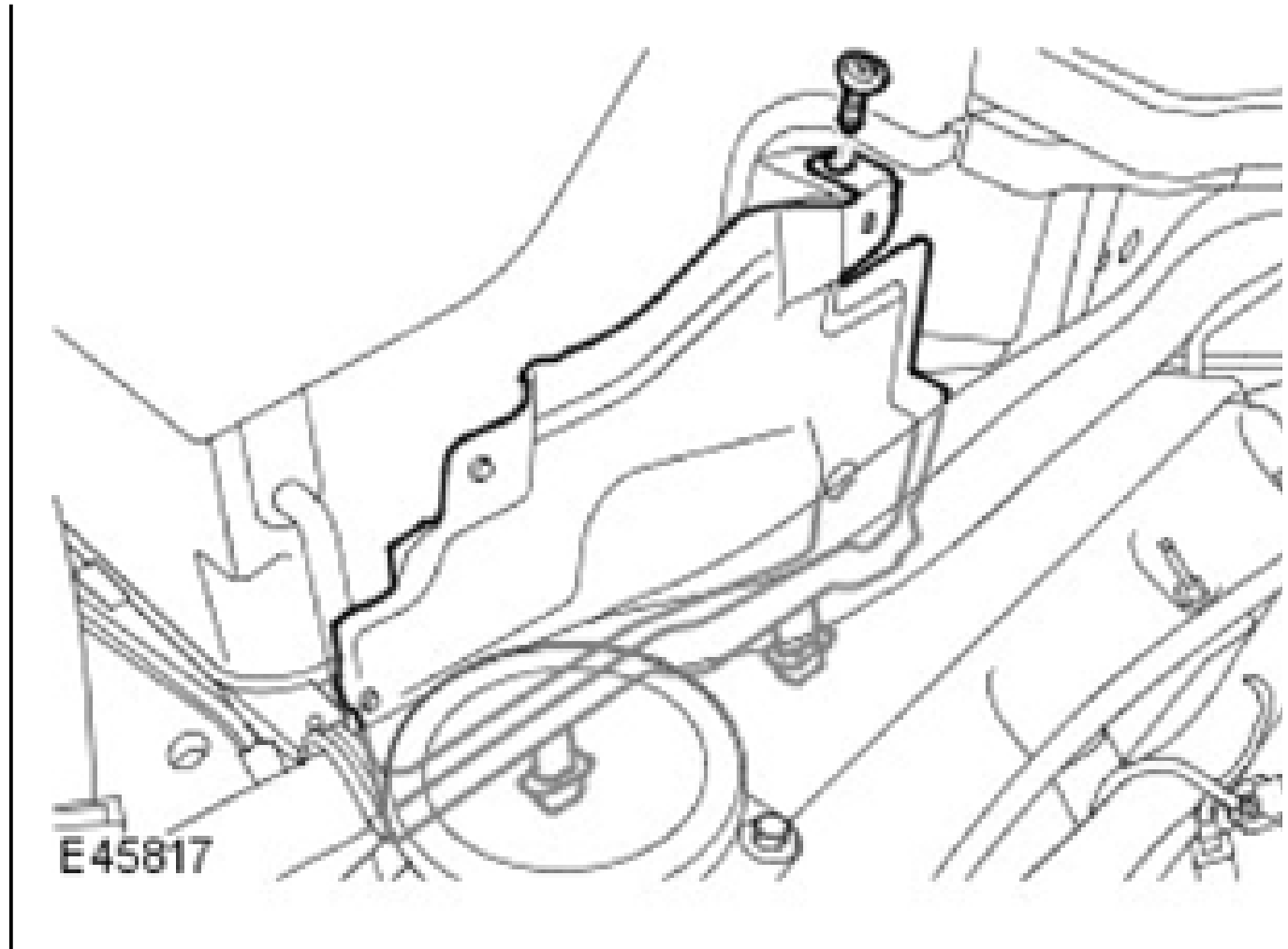
For additional information, refer to: **SPECIFICATIONS** .

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

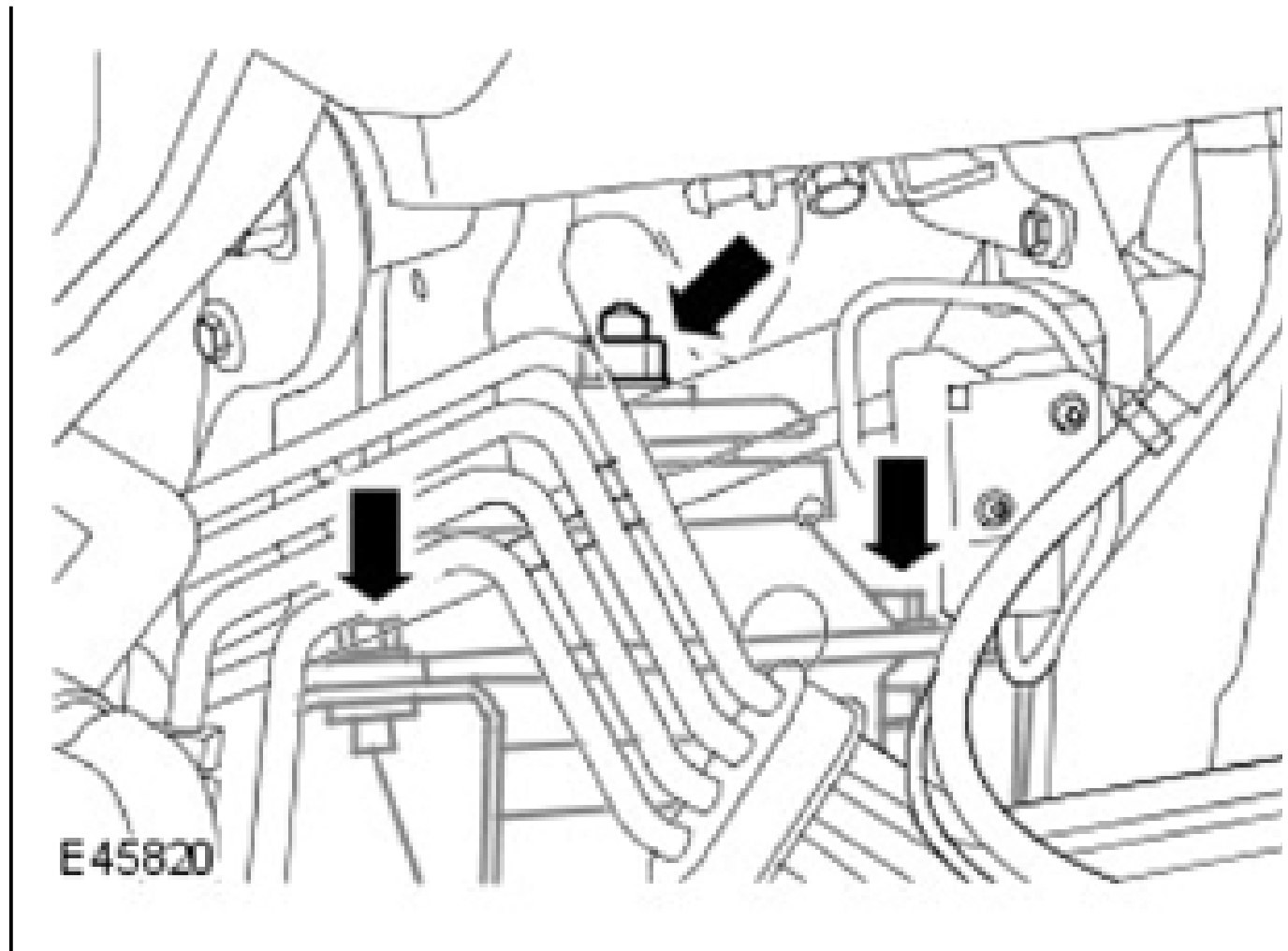
2. Raise and support the vehicle.
3. Remove the starter motor.

For additional information, refer to: **Starter Motor** .

4. Remove the engine compartment RH upper heat shield.
 - Remove the screw.
 - Release the 2 clips.



5. Support the engine.
6. Release the engine mount bracket.
 - Remove the nut.
 - Using a transmission jack, raise the engine clear of the engine mount.
7. Remove the engine mount RH.
 - Remove the 2 bolts.



INSTALLATION

1. Install the engine mount RH.
 - Clean the component mating faces.
 - Tighten the bolts to 45 Nm (33 lb.ft), then a further 60 degrees.
2. Lower the engine onto the mount.
 - Tighten the nut to 90 Nm (66 lb.ft).
3. Remove the engine support.

NOTE: The heatshield consists of 3 parts.

4. Install the upper suspension arm and brake line heat shields.
 - Install the bolts.
 - Install the nuts.
 - Tighten to 6 Nm (4 lb.ft).
5. Install the engine compartment upper RH heat shield.

- Install the screw.

6. Install the starter motor.

For additional information, refer to: **Starter Motor** .

7. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

FLEXPLATE

REMOVAL

1. Disconnect the battery ground cable.

For additional information, 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.

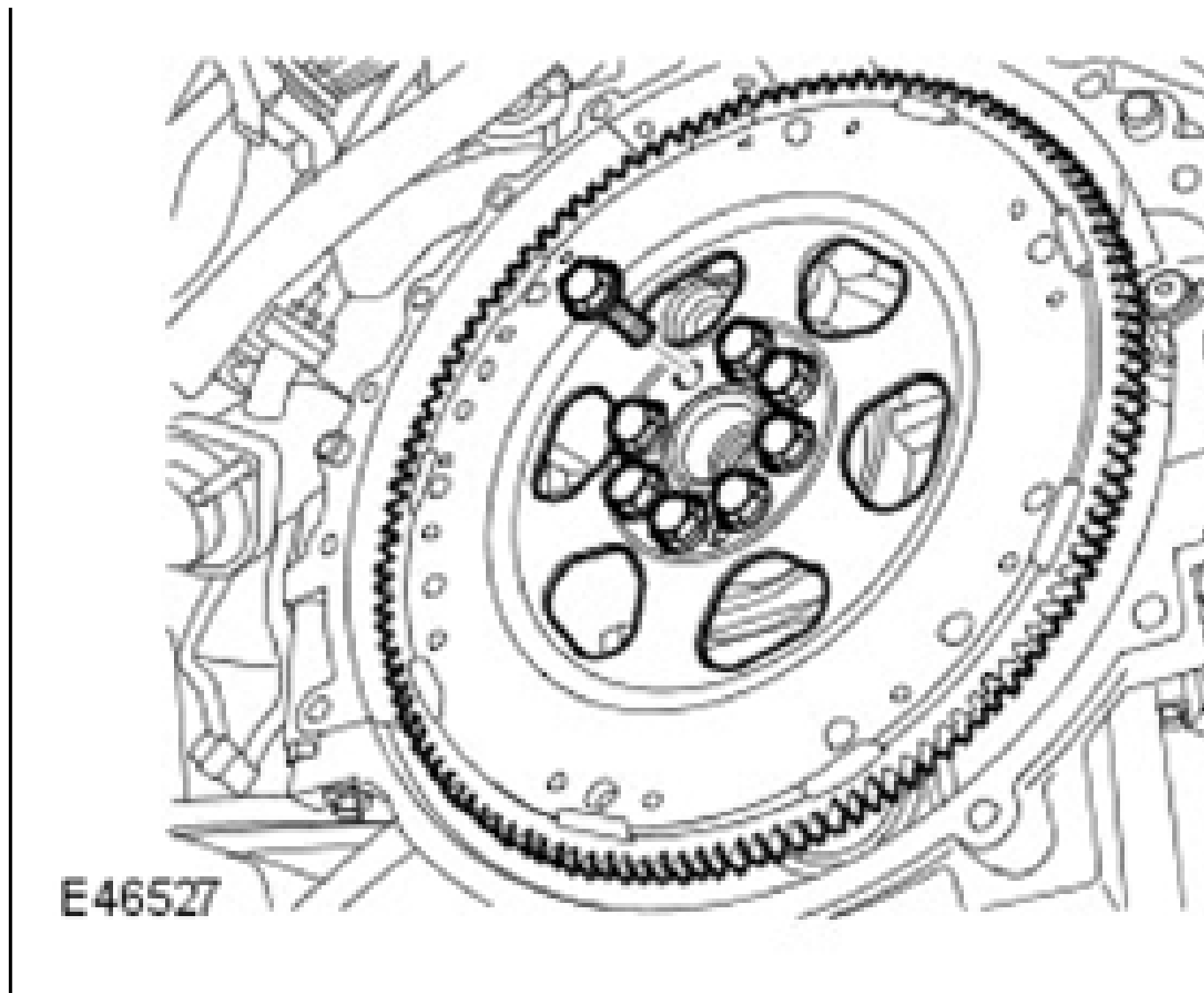
For additional information, refer to: **Transmission** .

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 and progressively in 2 stages.
 - Tighten the bolts to 15 Nm (11 lb ft).
 - Tighten the bolts to 110 Nm (81 lb.ft).
2. Install the transmission.

For additional information, refer to: **Transmission** .

3. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

OIL PUMP**REMOVAL**

1. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

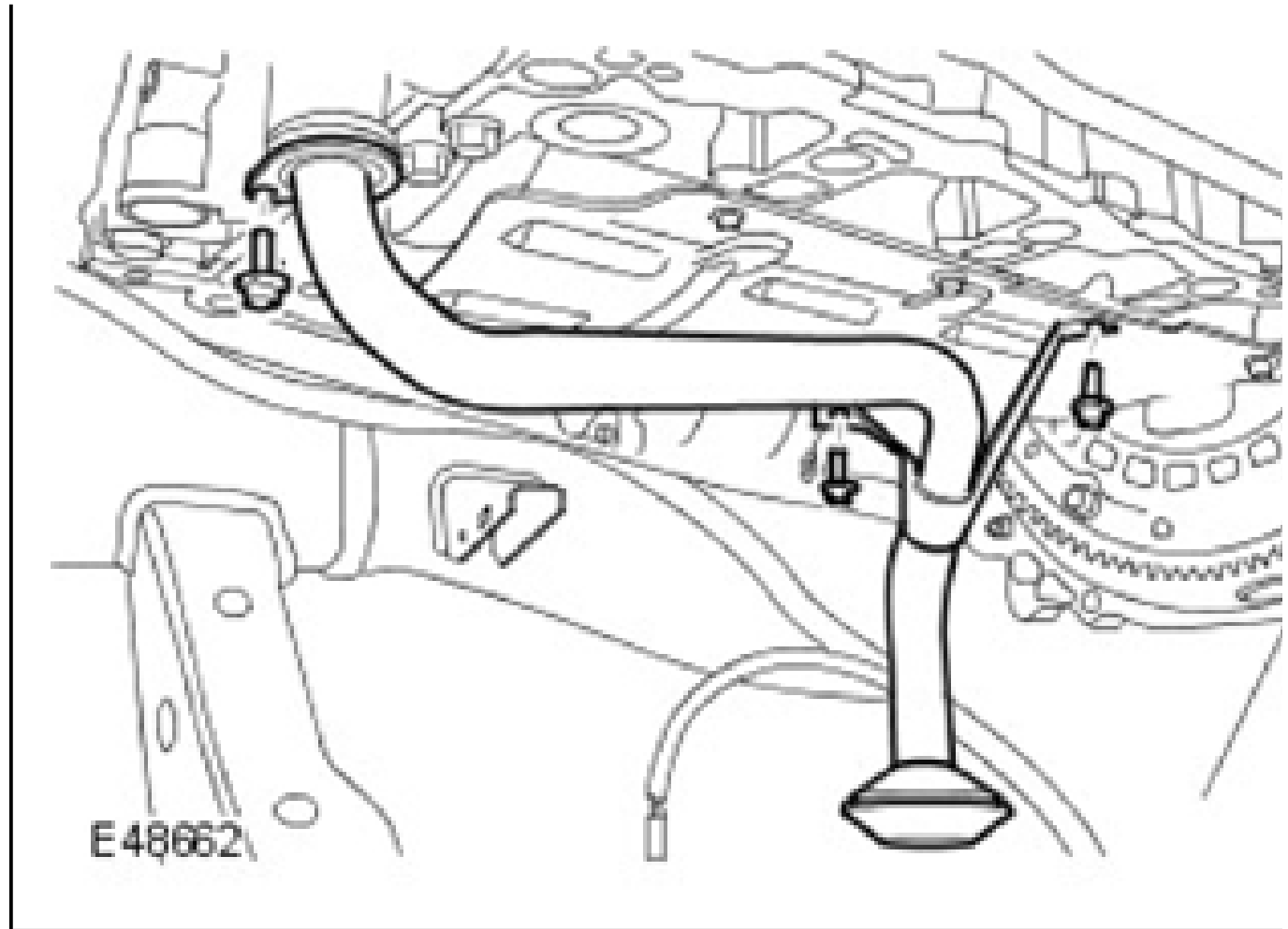
2. Remove the timing drive components.

For additional information, refer to: **TIMING DRIVE COMPONENTS**.

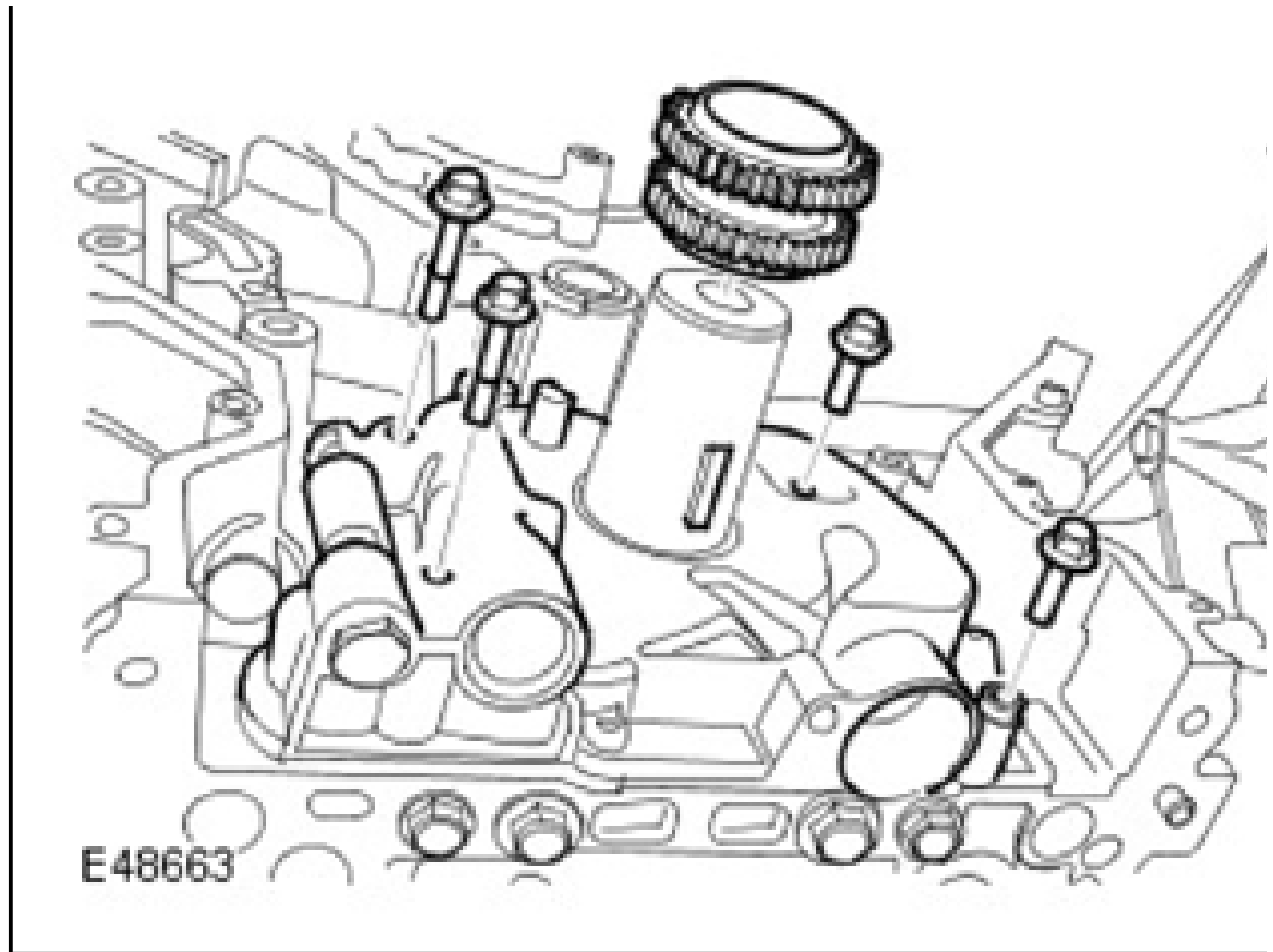
3. Remove the oil pan.

For additional information, refer to: **OIL PAN**.

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



5. Remove the oil pump assembly.
- Remove the 4 bolts.
 - Remove and discard the gasket.
 - Clean the component mating faces.



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 bolt to 10 Nm (7 lb.ft).
 - Apply sealant to the M5 bolts.
 - Tighten the bolts to 6 Nm (4 lb.ft).
3. Install the oil pan.

For additional information, refer to: **OIL PAN**.

4. Install the timing drive components.

For additional information, refer to: **TIMING DRIVE COMPONENTS**.

5. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

OIL PAN

REMOVAL

1. Disconnect the battery ground cable.

For additional information, 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 engine oil.

For additional information, refer to: **ENGINE OIL DRAINING AND FILLING** .

4. Remove the oil cooler assembly.

For additional information, refer to: **OIL COOLER**.

5. Remove the engine front cover.

For additional information, refer to: **ENGINE FRONT COVER**.

6. Remove the front differential.

For additional information, refer to: **AXLE ASSEMBLY V8 S/C 4.2L PETROL** .

7. Remove the stabilizer control arm.

For additional information, refer to: **FRONT STABILIZER BAR TDV6 2.7L DIESEL/V8 S/C 4.2L PETROL**

8. Remove the steering gear.

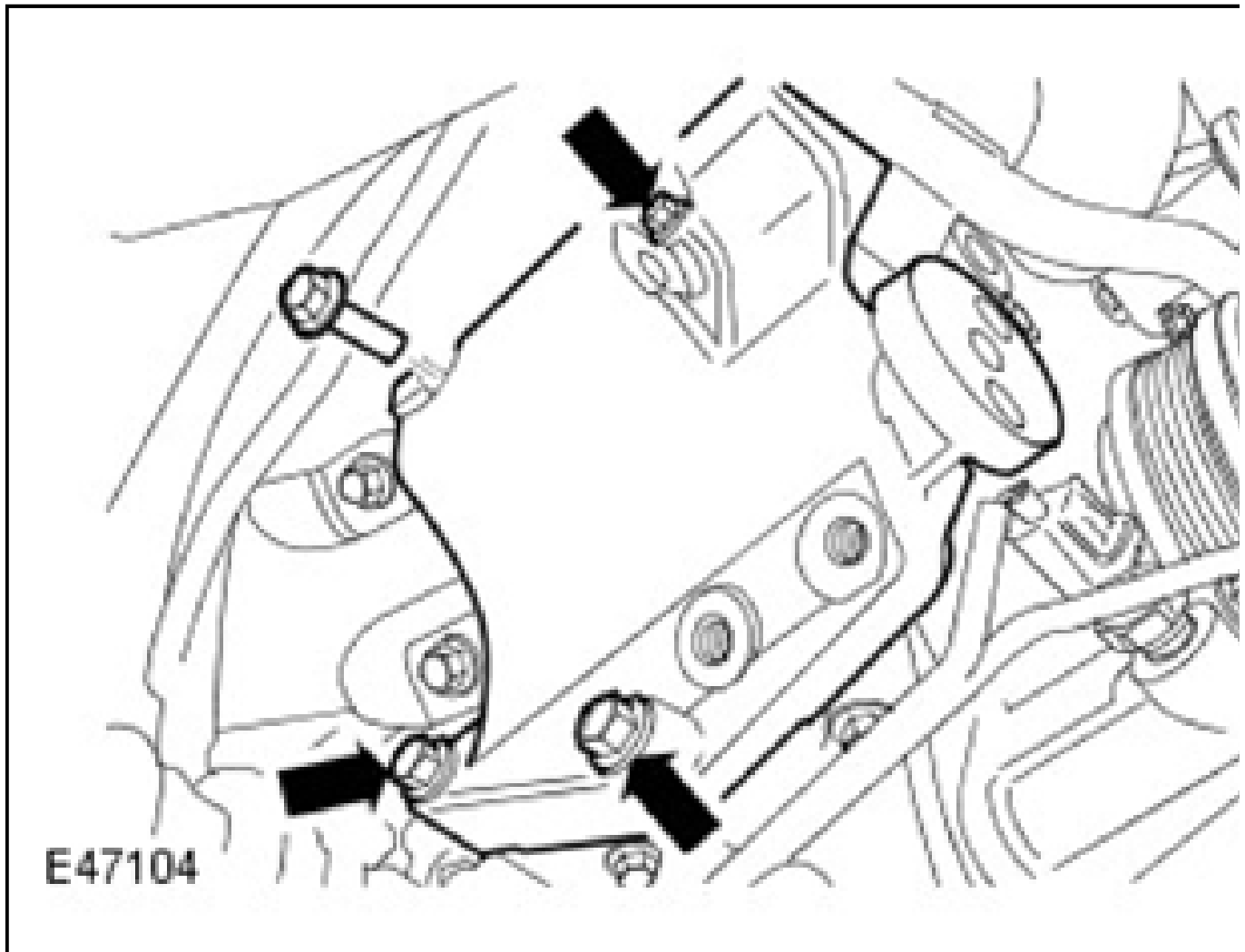
For additional information, refer to: **STEERING GEAR V8 S/C 4.2L PETROL** .

9. Remove the generator.

For additional information, refer to: **GENERATOR** .

10. Remove the generator mounting bracket.

- Remove the 4 bolts.



11. Disconnect the heated oxygen sensor (HO2S) electrical connectors.

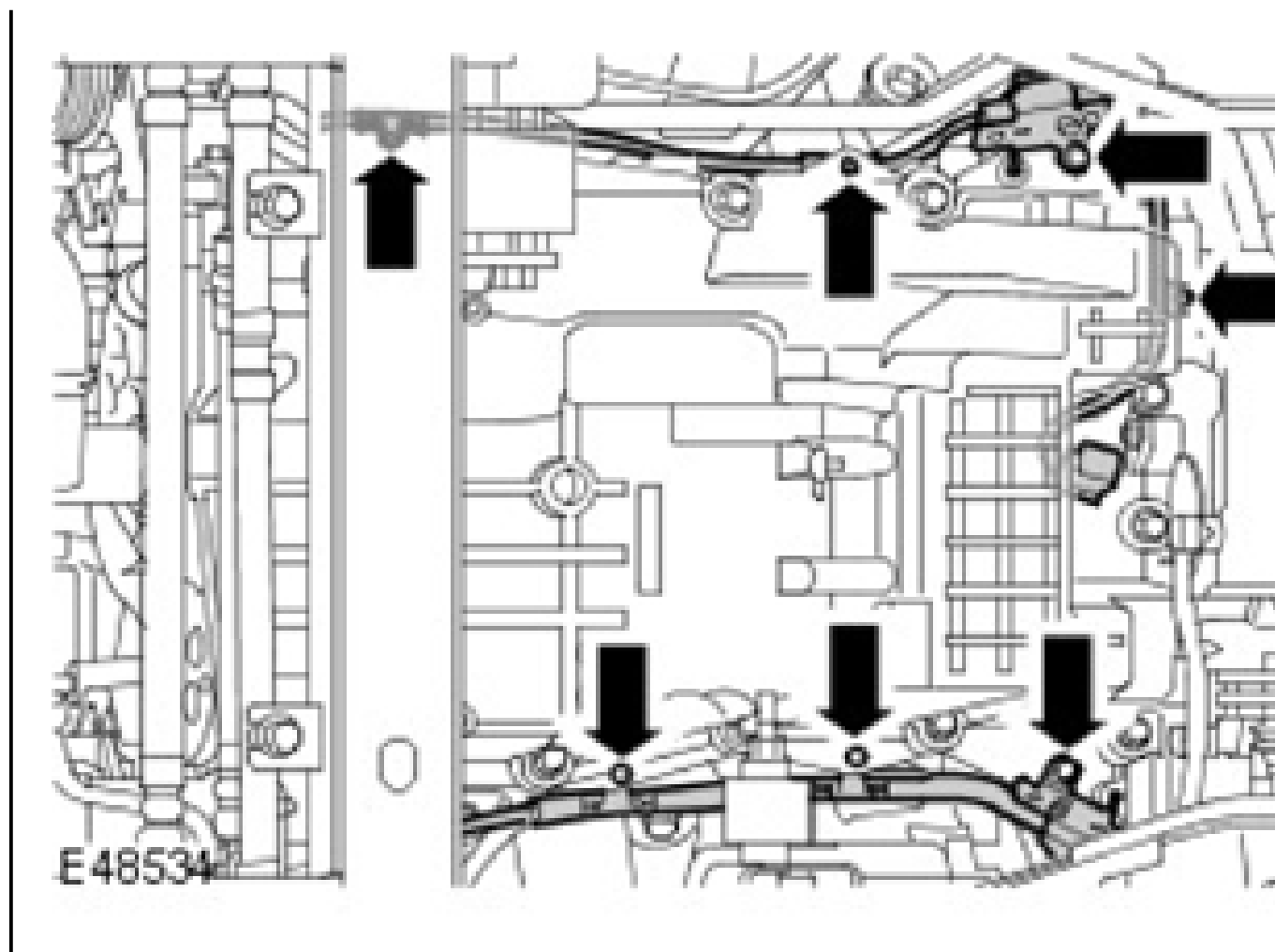
- Release the 8 wiring harness securing clips.

12. Release the HO2S mounting bracket.

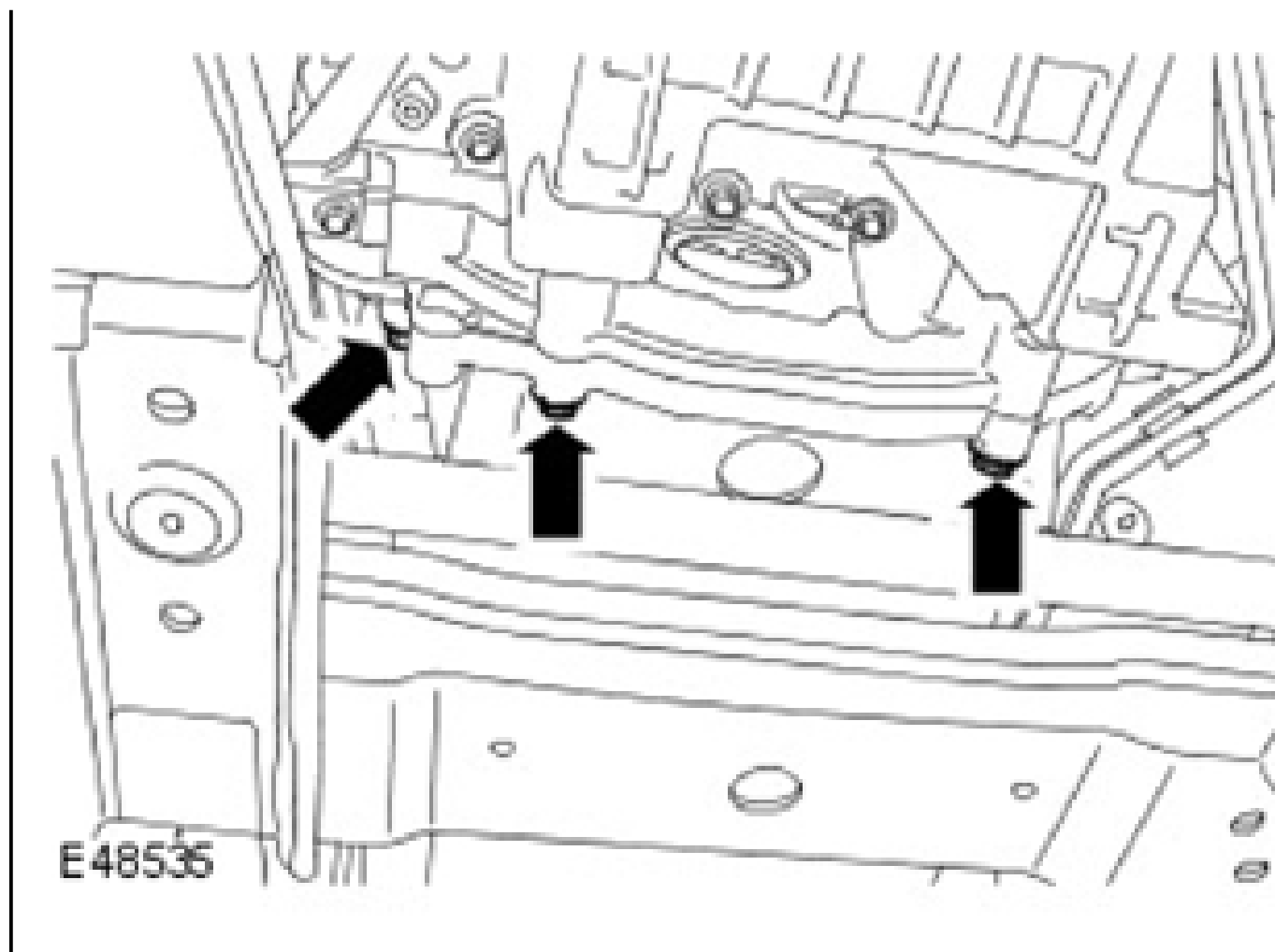
- Remove the 2 bolts.

13. Release the HO2S wiring harness from the oil pan.

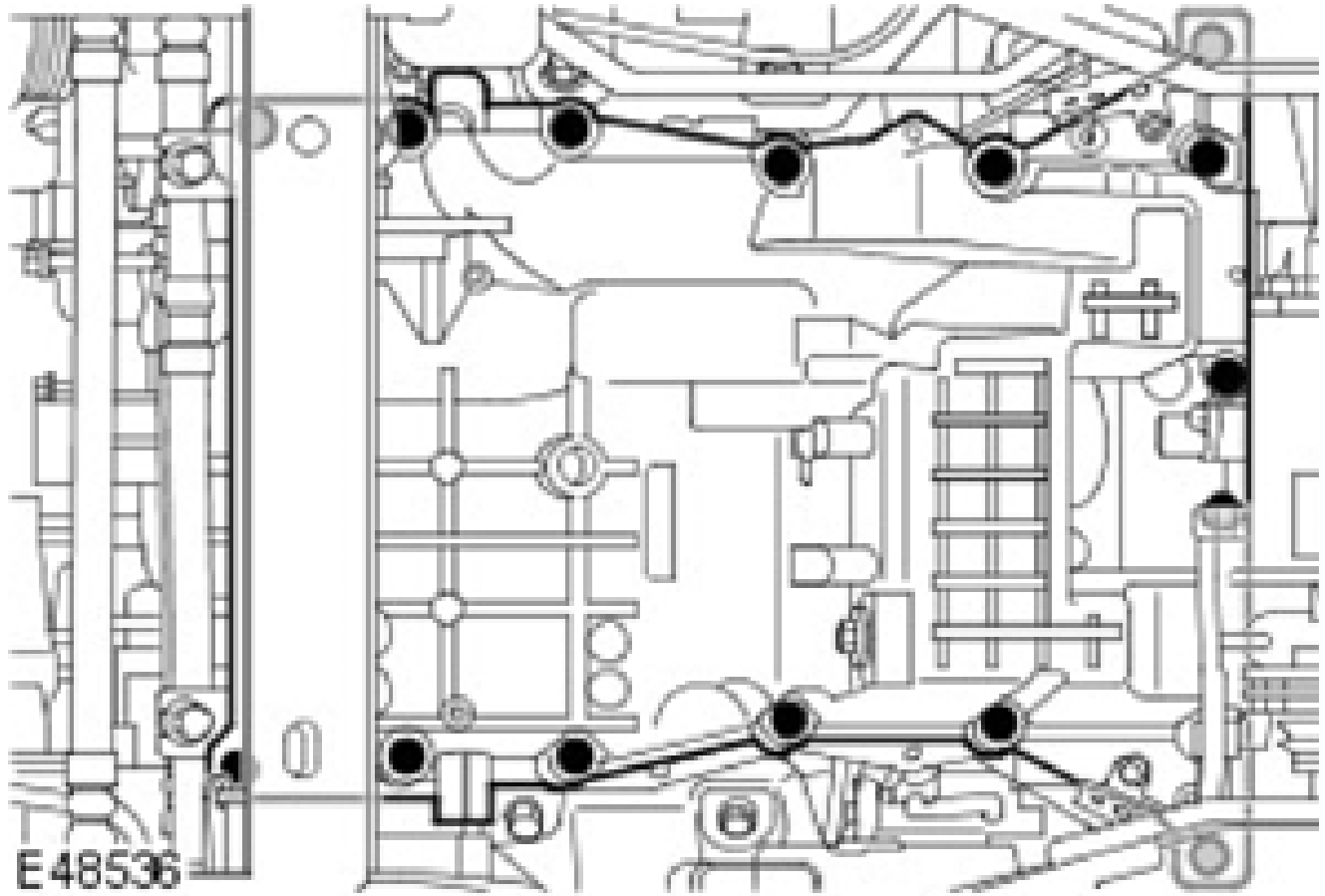
- Release the 3 clips.



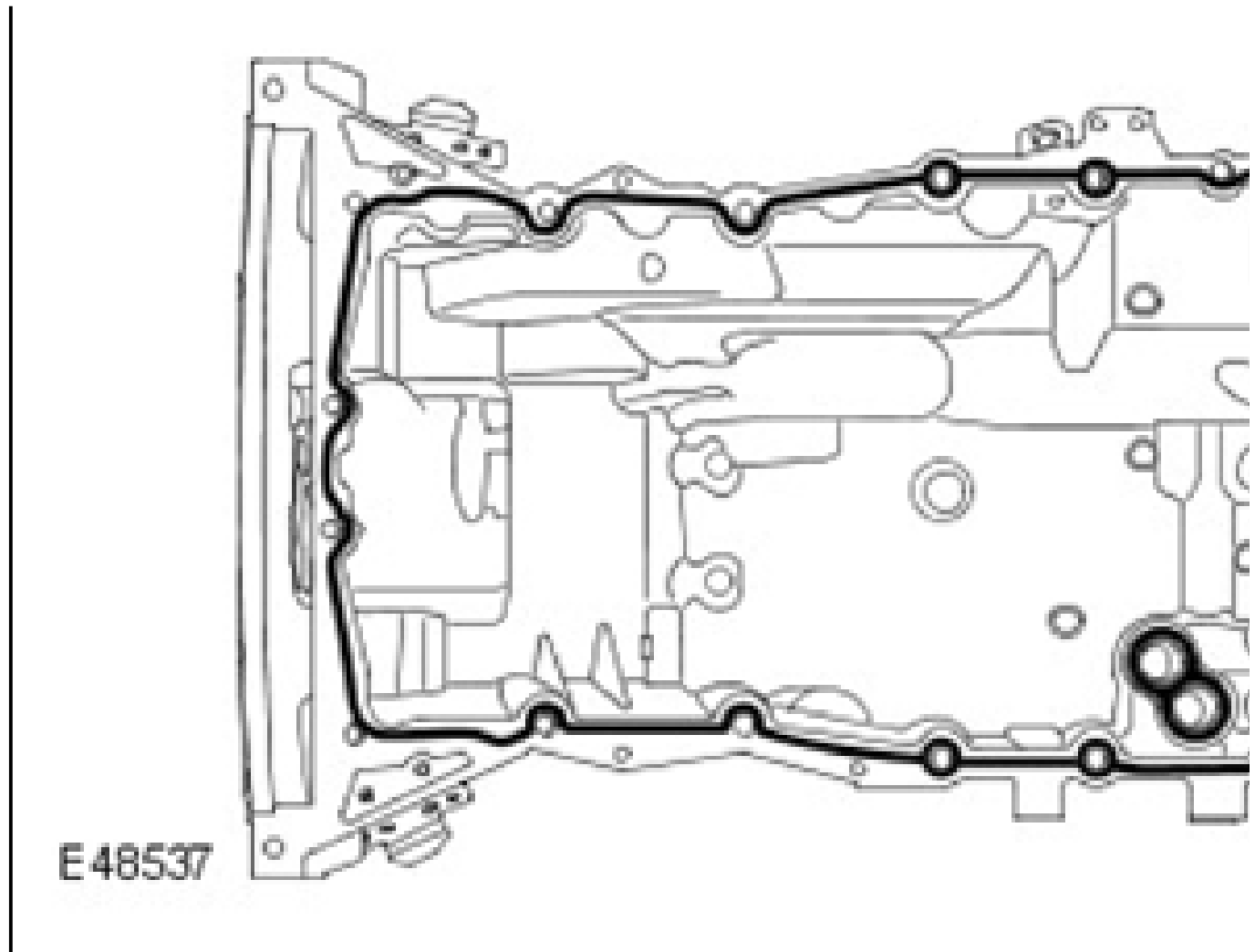
14. Remove the transmission retaining bolts.
- Remove the 3 bolts.



15. Remove the oil pan.
- Remove the 16 bolts.

**INSTALLATION**

1. Install the oil pan.
 - Clean the component mating faces.
 - Apply a bead of sealant, 3 mm diameter by 130 cm long, to the areas indicated.
 - Tighten the bolts to 20 Nm (15 lb.ft).



2. Install the transmission retaining bolts.
 - Tighten the bolts to 45 Nm (33 lb.ft).
3. Install the HO2S mounting bracket.
 - Tighten the 2 bolts to 10 Nm (7 lb.ft).
4. Connect the HO2S electrical connectors.
 - Install the wiring harness clips.
5. Install the HO2S wiring harness.
 - Secure the clips.
6. Install the generator mounting bracket.
 - Clean the component mating faces.
7. Install the generator.

For additional information, refer to: **GENERATOR** .

8. Install the steering gear.

For additional information, refer to: **STEERING GEAR V8 S/C 4.2L PETROL** .

9. Install the stabilizer control arm.

For additional information, refer to: **FRONT STABILIZER BAR TDV6 2.7L DIESEL/V8 S/C 4.2L PETROL** .

10. Install the front differential.

For additional information, refer to: **AXLE ASSEMBLY V8 S/C 4.2L PETROL** .

11. Install the oil cooler assembly.

For additional information, refer to: **OIL COOLER**.

12. Install the engine front cover.

For additional information, refer to: **ENGINE FRONT COVER**.

13. Fill the engine with oil.

For additional information, refer to: **ENGINE OIL DRAINING AND FILLING** .

14. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

OIL COOLER

REMOVAL

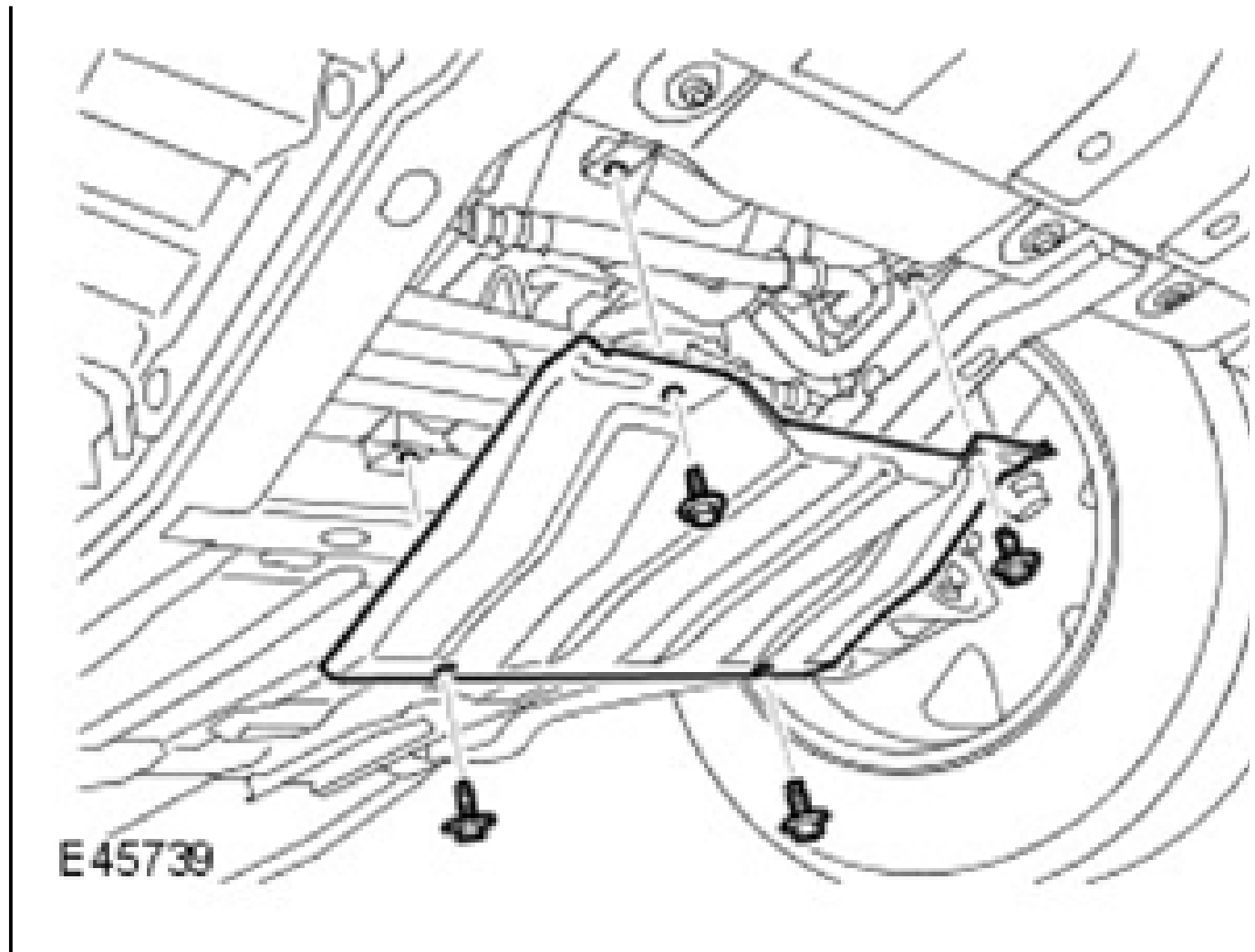
NOTE: **The special tool to disconnect the oil cooler hoses is attached to the top outlet pipe on the auxiliary oil cooler. Always replace the special tool after use.**

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

1. Raise and support the vehicle.
2. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

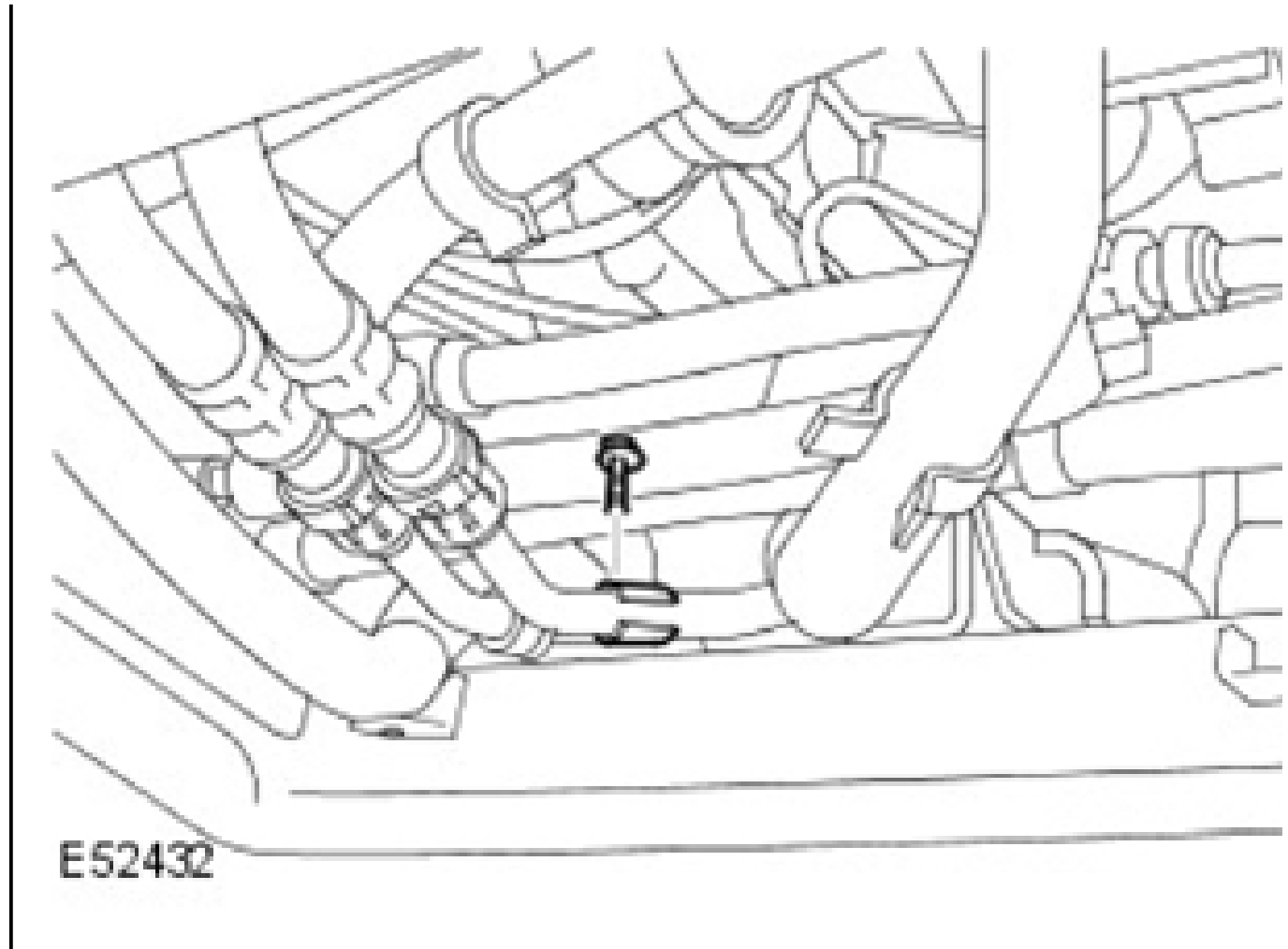
3. Remove the radiator access panel.
 - Remove the 4 bolts.



4. Remove the engine undershield.

For additional information, refer to: **ENGINE UNDERSHIELD** .

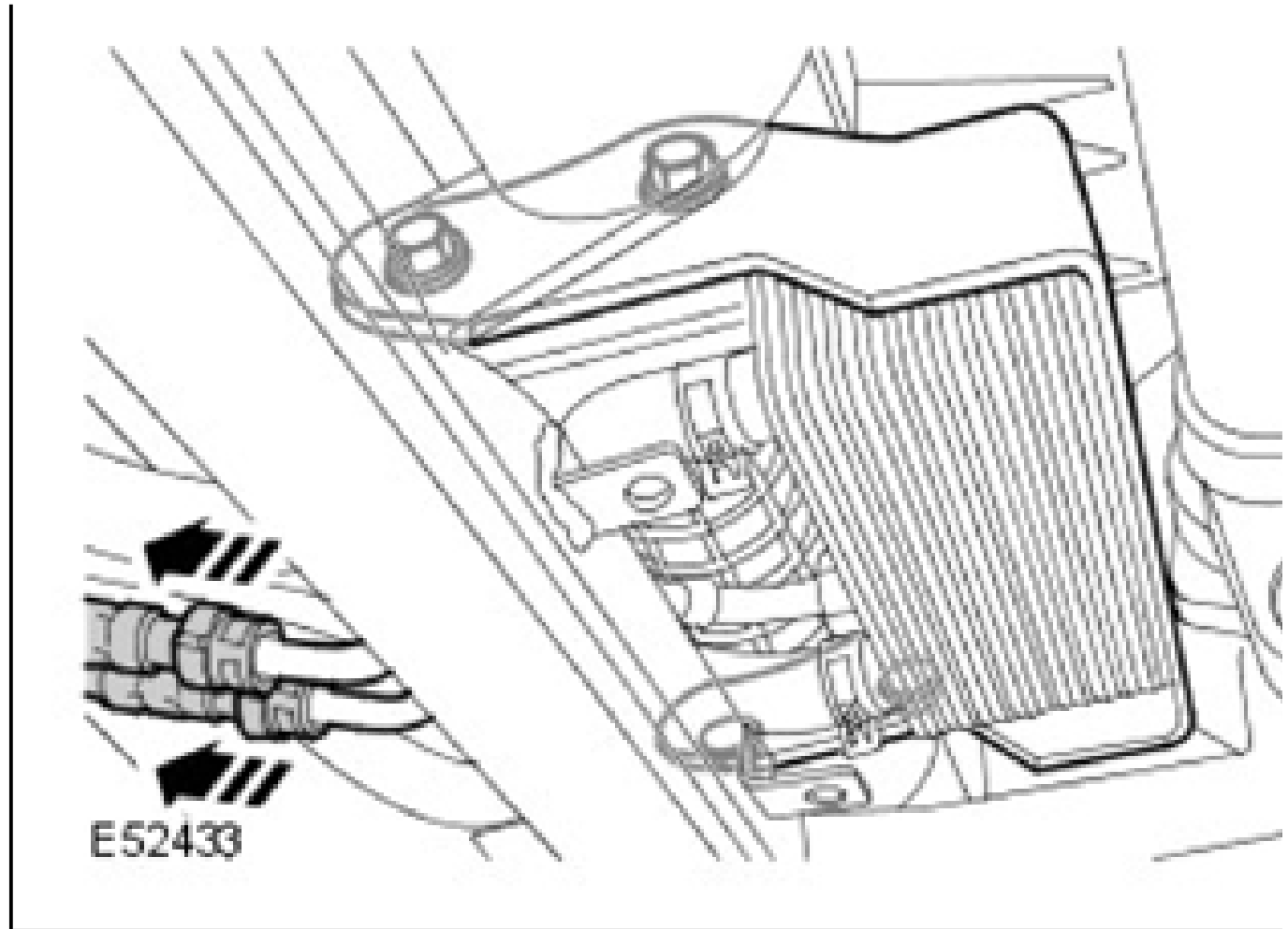
5. Remove the oil cooler pipe support bracket.
 - Remove the bolt.



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

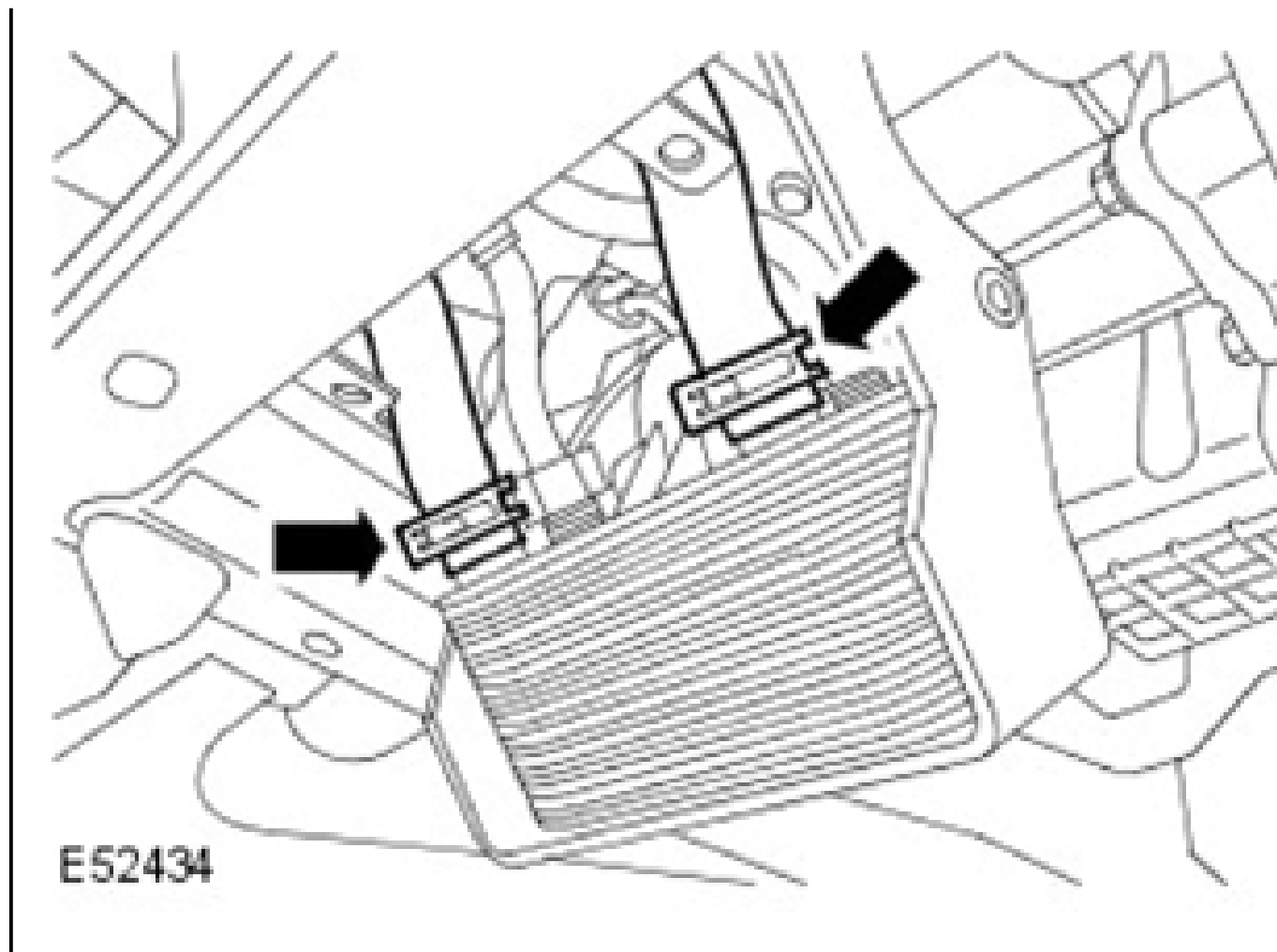
NOTE: Some fluid spillage is inevitable during this operation.

6. Release the oil cooler.
 - Using the special tool, disconnect the oil cooler hoses.
 - Remove the 4 bolts.



7. Disconnect the coolant hoses.

- Position a container to collect the fluid spillage.
- Clamp the relevant hoses, to minimize the coolant loss.
- Release the 2 clips.

**INSTALLATION**

1. Connect the coolant hoses.
 - Clean the component mating faces.
 - Secure the clips.
 - Remove the hose clamps.
2. Install the oil cooler.
 - Clean the component mating faces.
 - Install the 4 bolts and tighten to 10 Nm (7 lb.ft).
 - Connect the hoses.
3. Install the oil cooler pipe support bracket.
 - Tighten the bolt to 10 Nm (7 lb.ft).
4. Install the radiator access panel.
 - Tighten the bolts to 10 Nm (7 lb.ft).
5. Install the engine undershield.

For additional information, refer to: **ENGINE UNDERSHIELD** .

6. Check and top-up the engine oil.
7. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

8. Check and top-up the coolant.

ENGINE FRONT COVER

REMOVAL

1. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

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

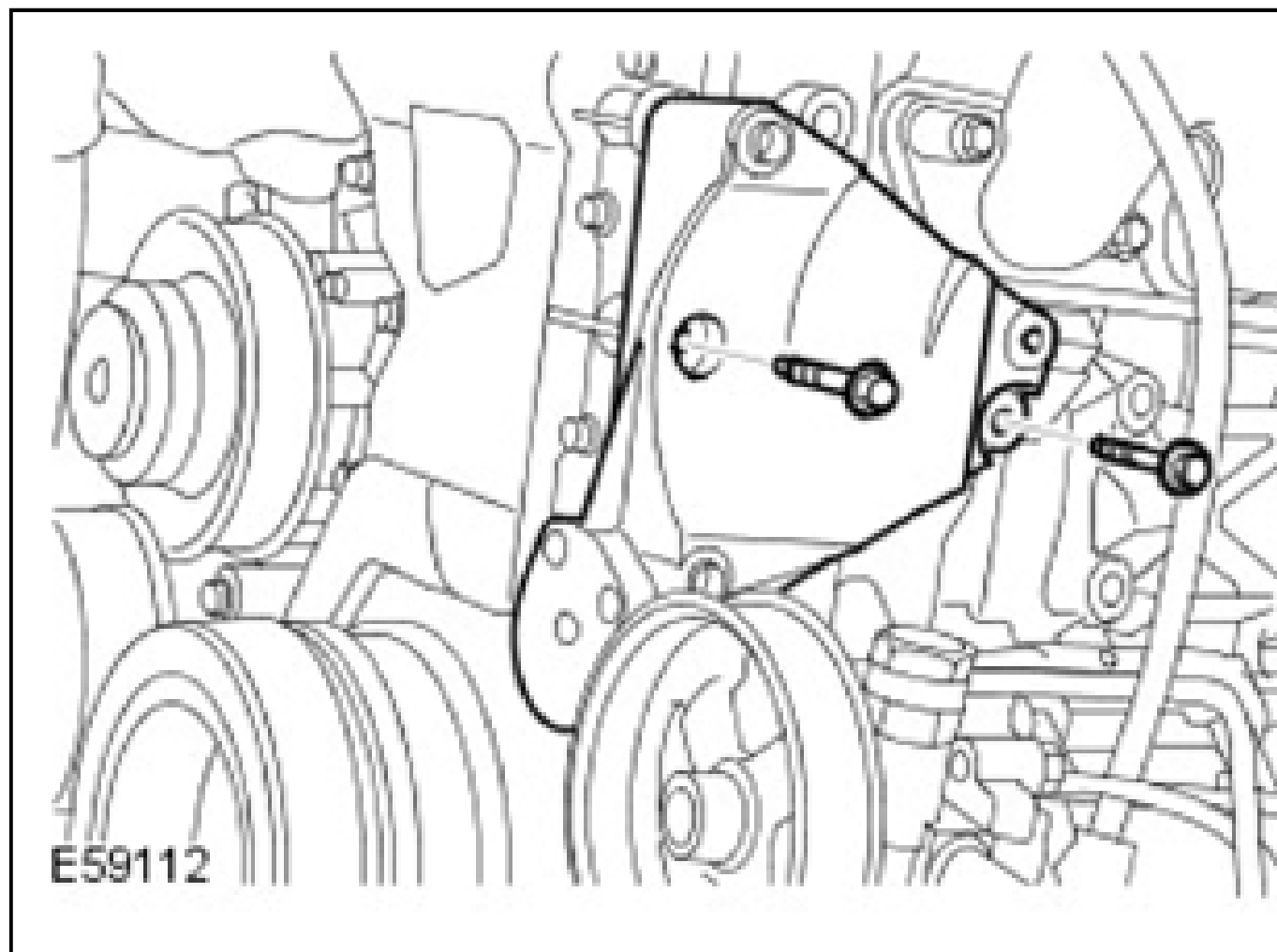
2. Raise and support the vehicle.
3. Remove the cooling fan lower shroud.
 - Release the 2 clips.



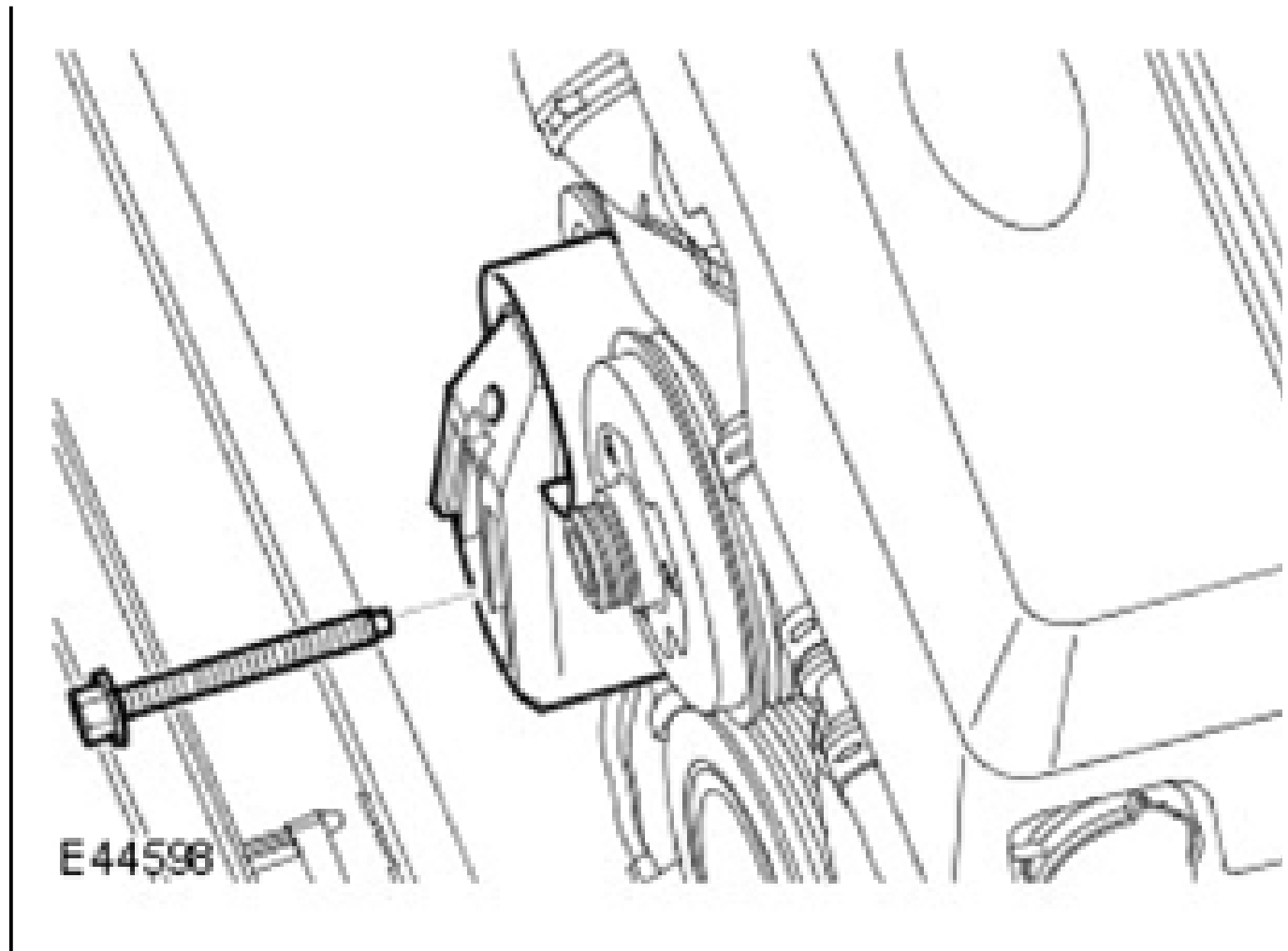
4. Remove the air conditioning (A/C) compressor.

For additional information, refer to: **AIR CONDITIONING (A/C) COMPRESSOR** .

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



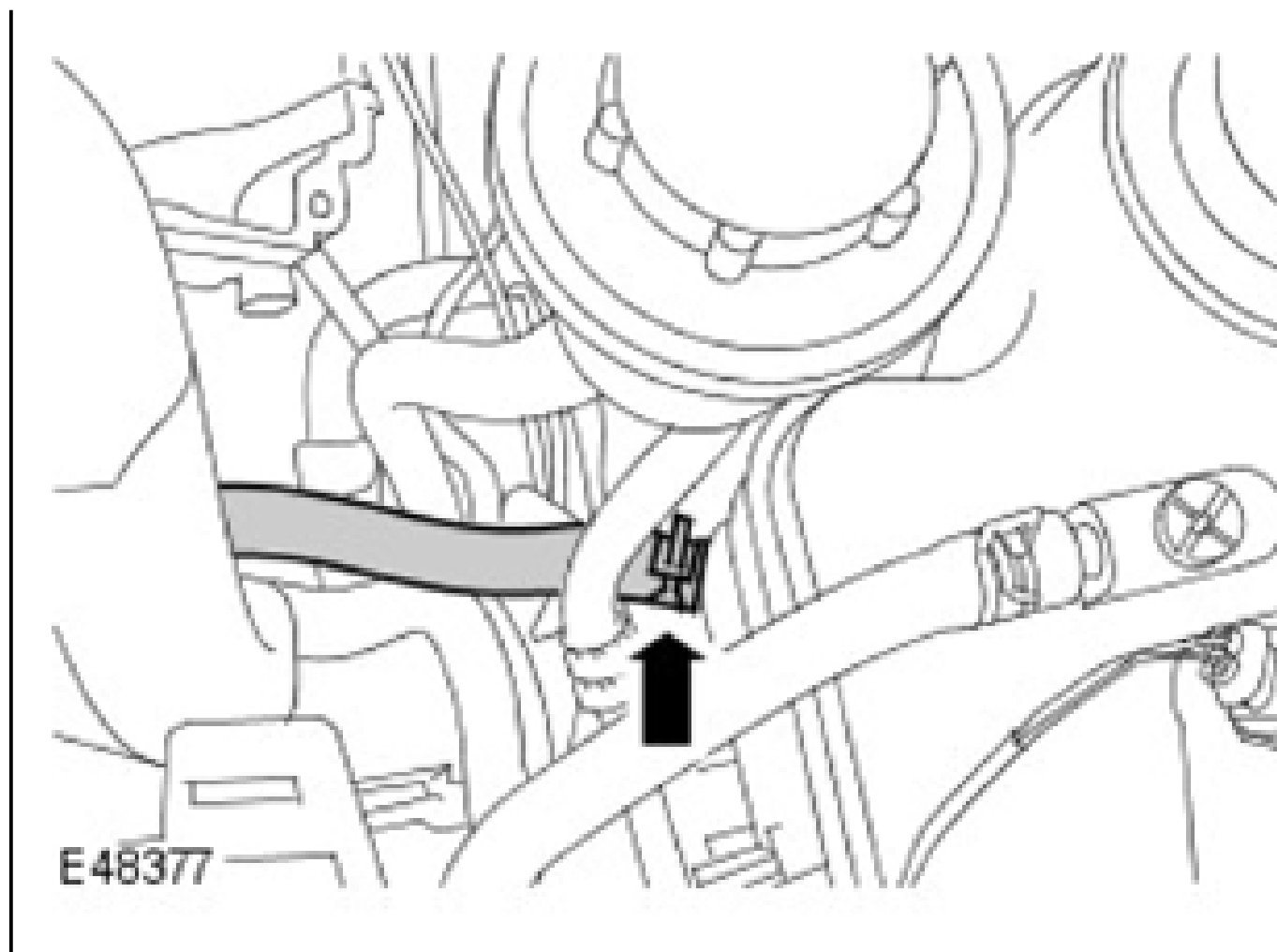
6. Remove the cooling fan drive belt tensioner.
 - Remove the bolt.



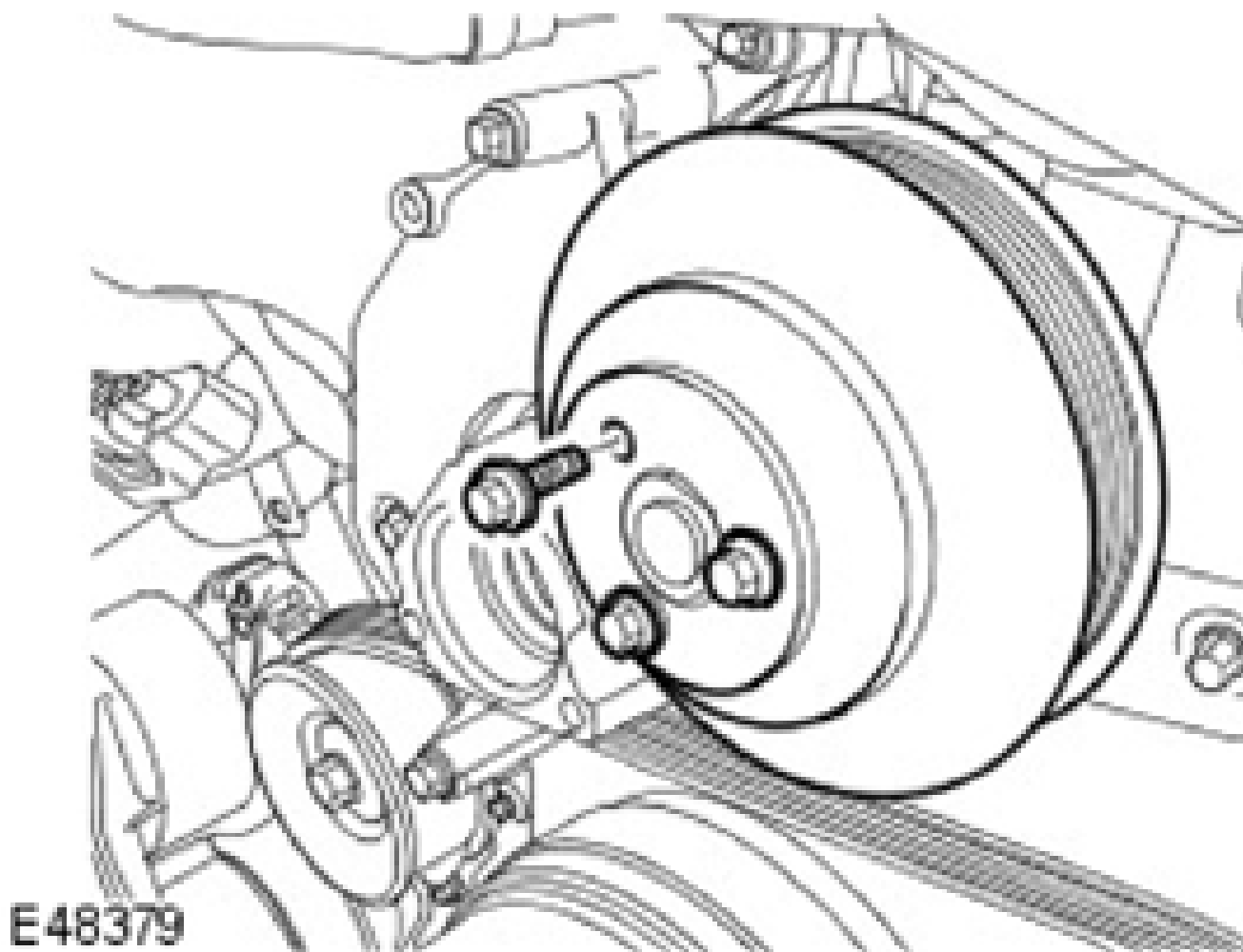
7. Remove the coolant manifold.

For additional information, refer to: **COOLANT MANIFOLD** .

8. Disconnect the coolant expansion tank hose.
 - Release the clip.

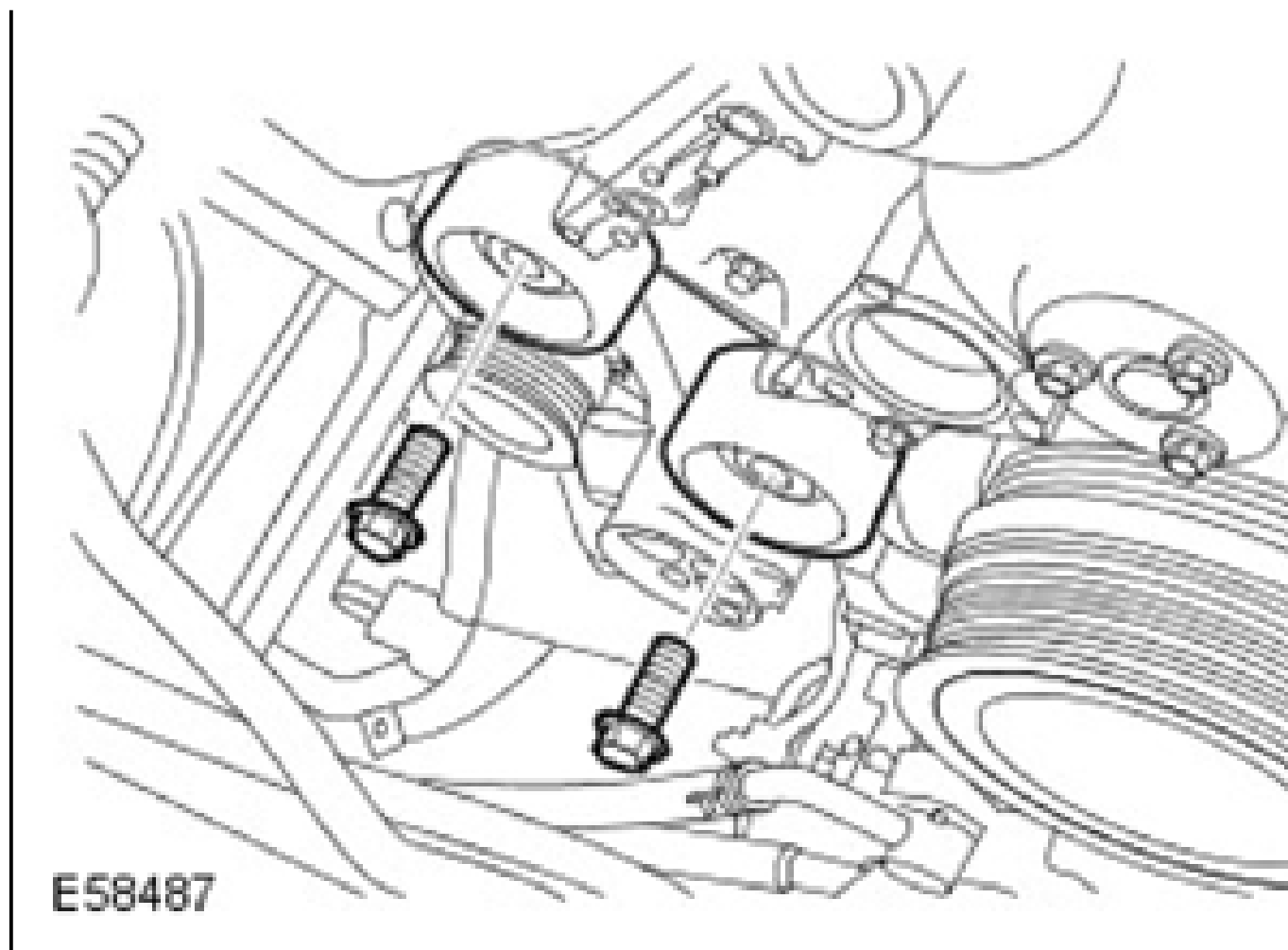


9. Remove the coolant pump pulley.
 - Remove the 3 bolts.



10. Remove the accessory drive belt idler pulley.

- Remove the bolt.
- Repeat the above procedure for the remaining idler pulley.



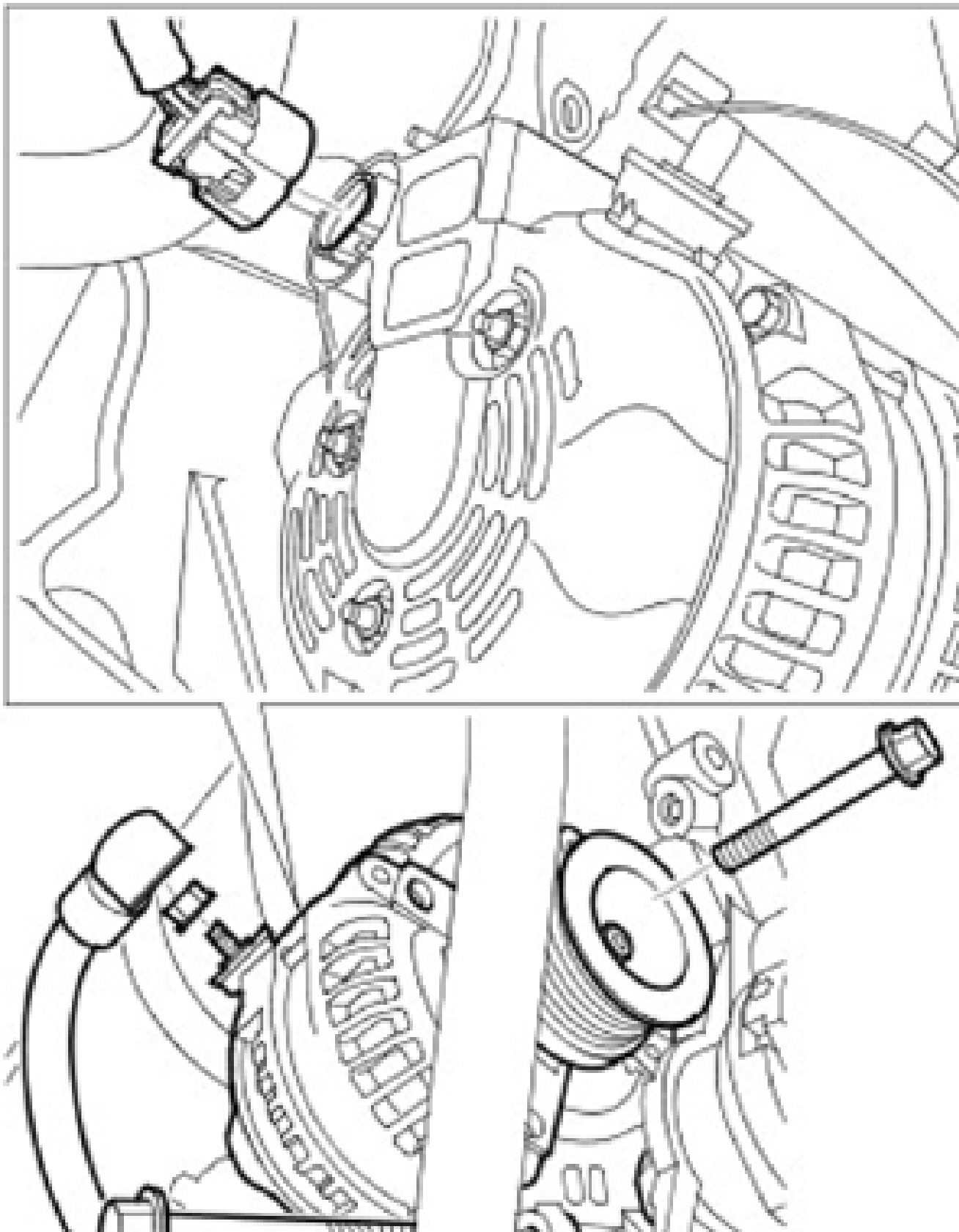
11. Remove the exhaust manifold heat shield.
 - Remove the 2 screws.



E58797

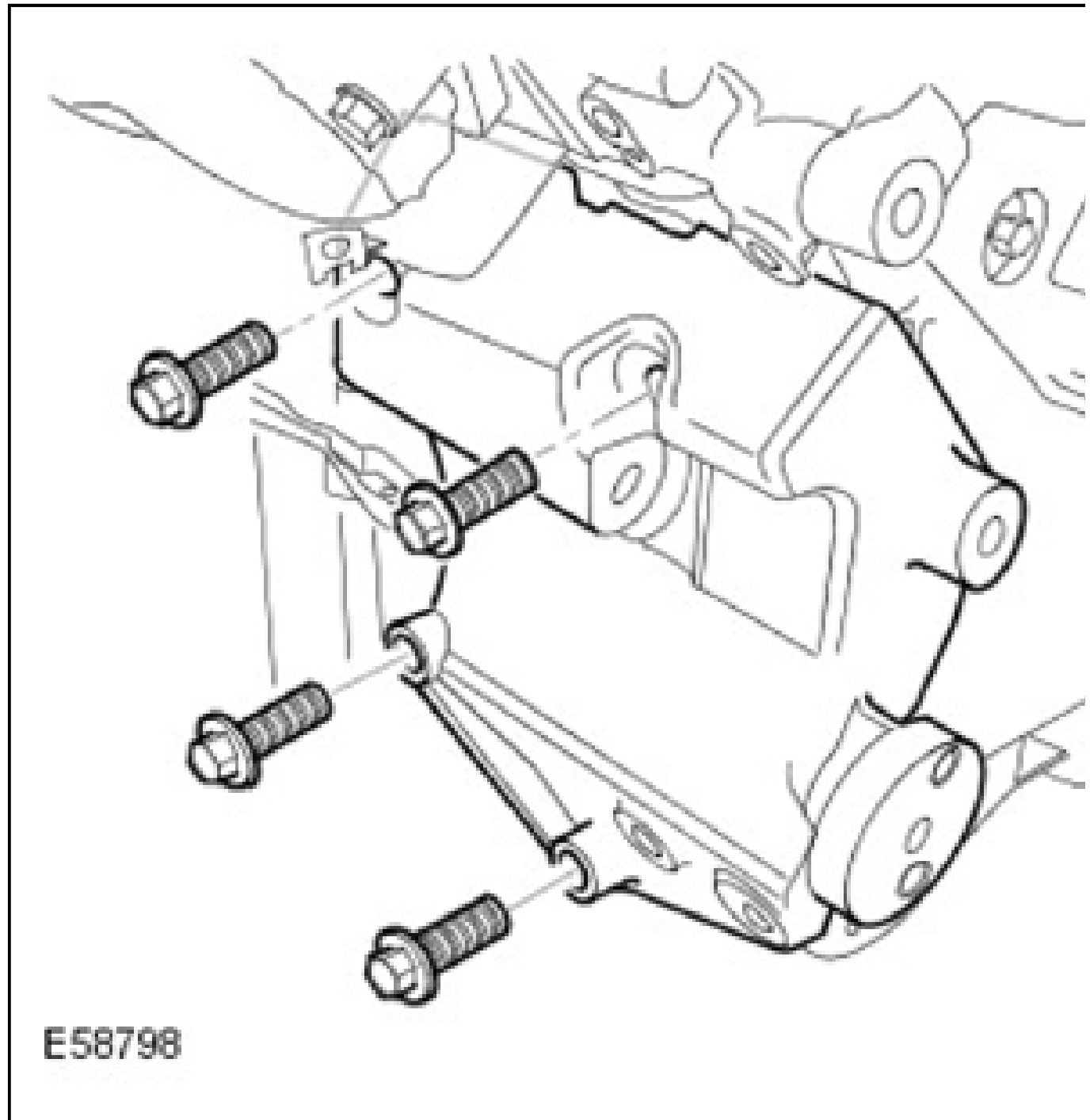
12. Disconnect the battery positive cable.
 - Release the cover.
 - Remove the nut.
13. Remove the generator.
 - Remove the 3 bolts.

- Disconnect the electrical connector.



14. Remove the generator mounting bracket.

- Remove the 4 bolts.



15. Remove the crankshaft front oil seal.

For additional information, refer to: **CRANKSHAFT FRONT SEAL**.

16. Remove the RH valve cover.

For additional information, refer to: **VALVE COVER RH.**

17. Remove the LH valve cover.

For additional information, refer to: **VALVE COVER LH.**

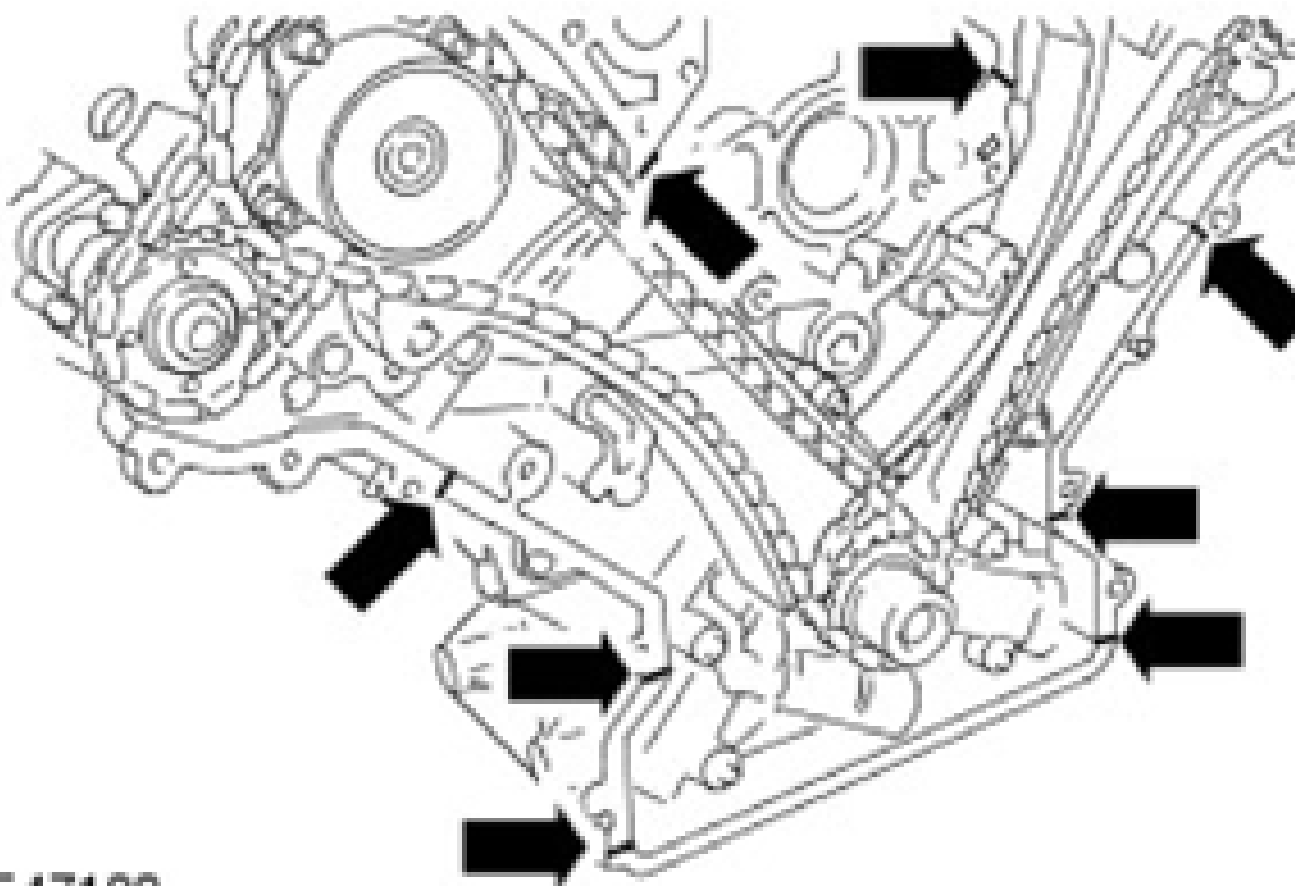
18. Remove the engine front cover.

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

INSTALLATION

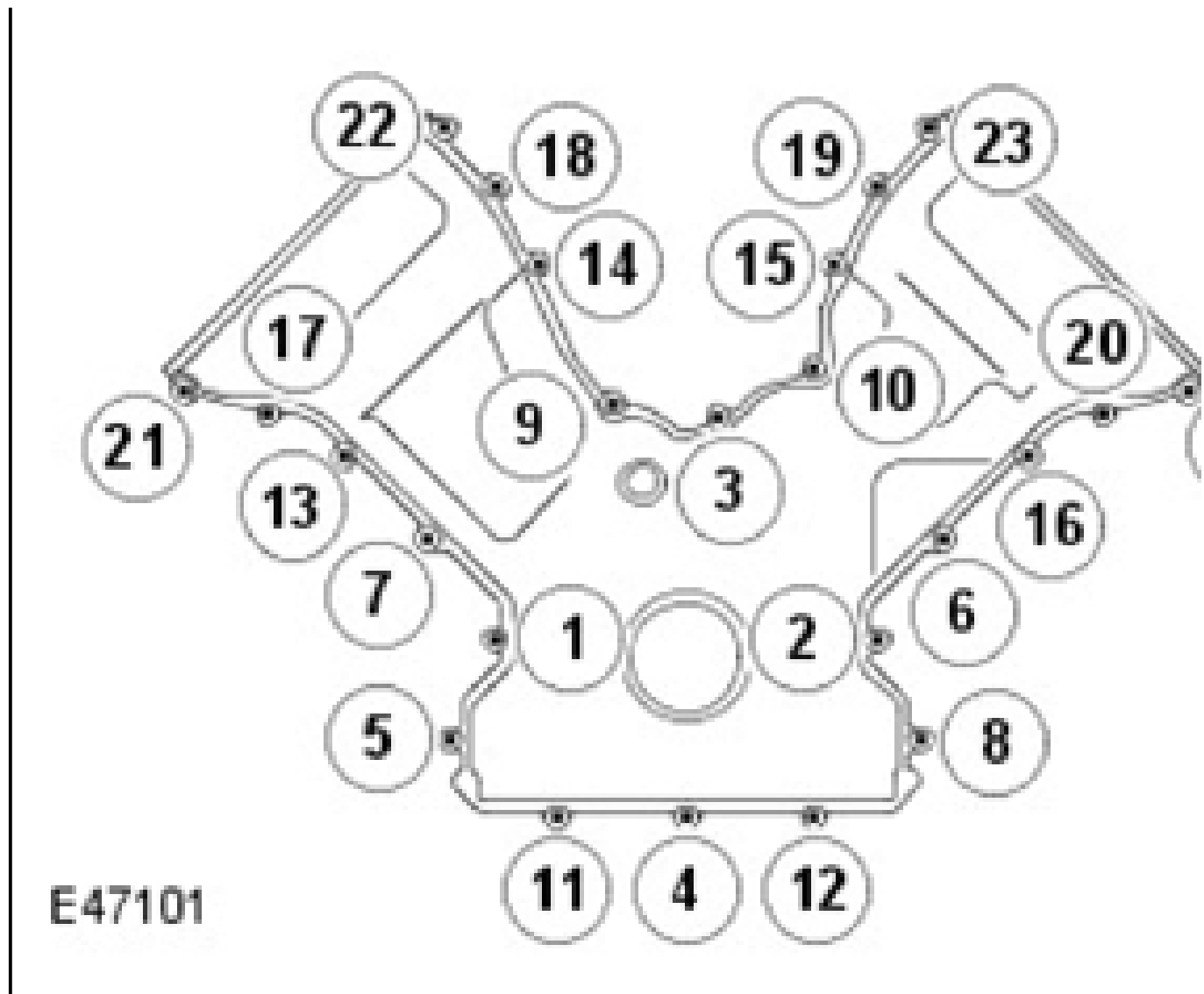
1. Install the engine front cover.

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



E47100

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



3. Install the LH valve cover.

For additional information, refer to: **VALVE COVER LH.**

4. Install the RH valve cover.

For additional information, refer to: **VALVE COVER RH.**

5. Install the crankshaft front oil seal.

For additional information, refer to: **CRANKSHAFT FRONT SEAL.**

6. Install the generator mounting bracket.

- Tighten the bolts to 45 Nm (33 lb.ft).

7. Install the generator.
 - Tighten the 3 bolts to 48 Nm (35 lb.ft).
 - Connect the electrical connector.
8. Connect the battery positive cable.
 - Tighten the nut to 10 Nm (7 lb.ft).
 - Secure the cover.
9. Install the exhaust manifold heat shield.
 - Tighten the screws.
10. Install the A/C mounting bracket.
 - Tighten the bolts to 25 Nm (18 lb.ft).
11. Install the A/C compressor.

For additional information, refer to: **AIR CONDITIONING (A/C) COMPRESSOR** .

12. Install the accessory drive belt idler pulleys.
 - Tighten the bolts to 25 Nm (18 lb.ft).
13. Install the coolant pump pulley.
 - Tighten the bolts to 10 Nm (7 lb.ft).
14. Install the coolant manifold.

For additional information, refer to: **COOLANT MANIFOLD** .

15. Install the coolant expansion tank hose.
 - Connect the clip.
16. Install the cooling fan drive belt tensioner.
 - Tighten the pulley bolt to 25 Nm (18 lb.ft).
 - Tighten the tensioner bolt to 40 Nm (30 lb.ft).
17. Install the cooling fan shroud.
18. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

19. Refill and bleed the cooling system.

For additional information, refer to: **Cooling System Draining, Filling and Bleeding** .

EXHAUST MANIFOLD LH

REMOVAL

All vehicles

1. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

2. Raise and support the vehicle.
3. Remove the exhaust system.

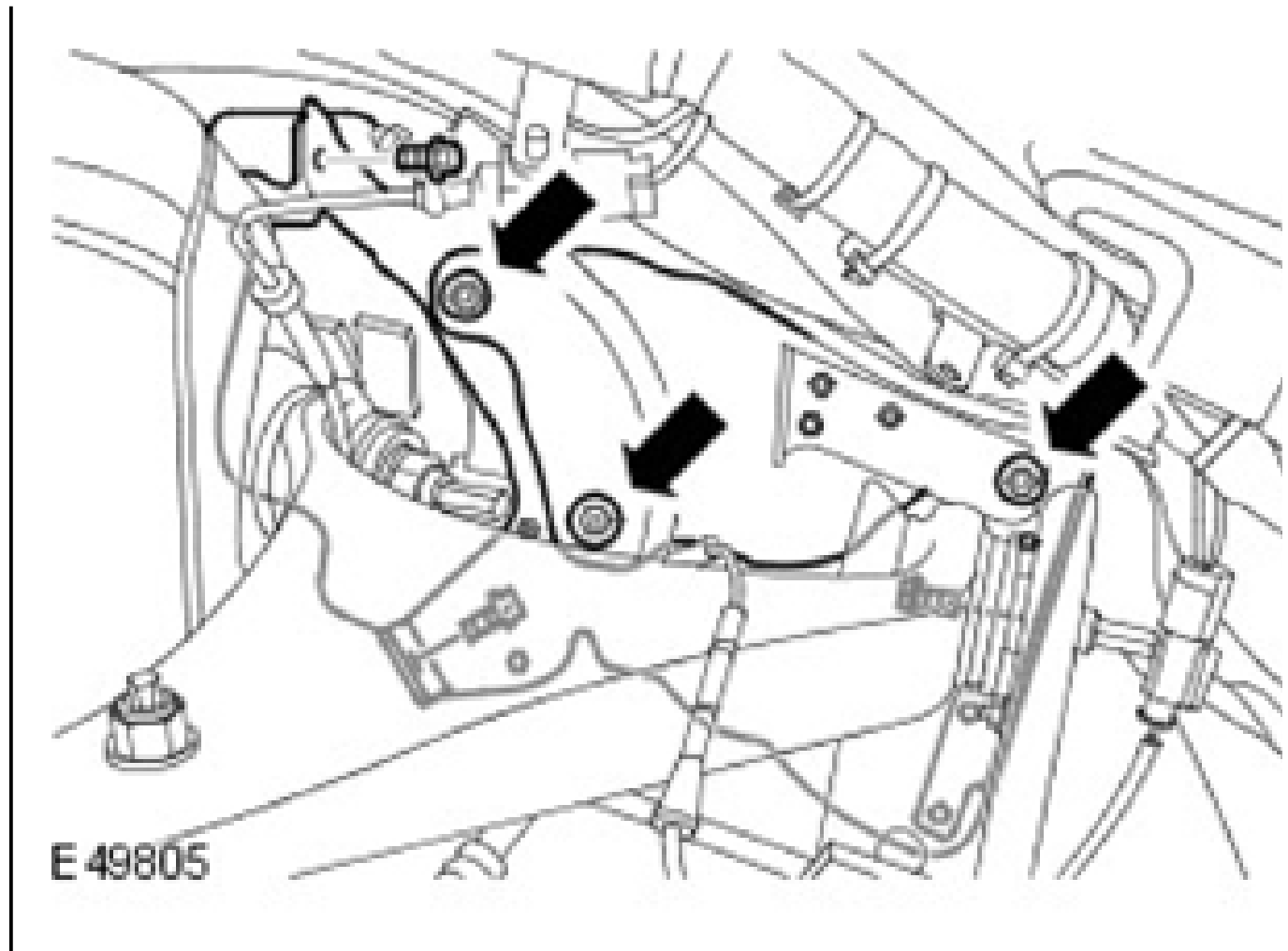
For additional information, refer to: **EXHAUST SYSTEM** .

4. Remove the fender splash shield.

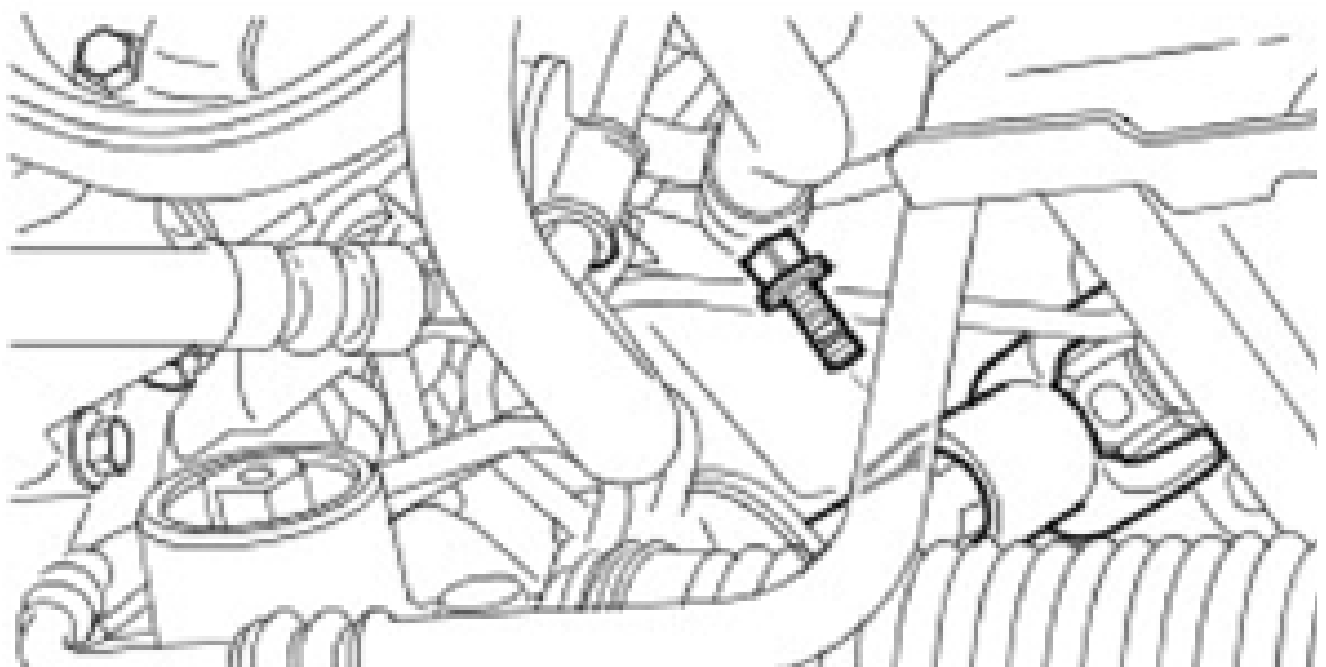
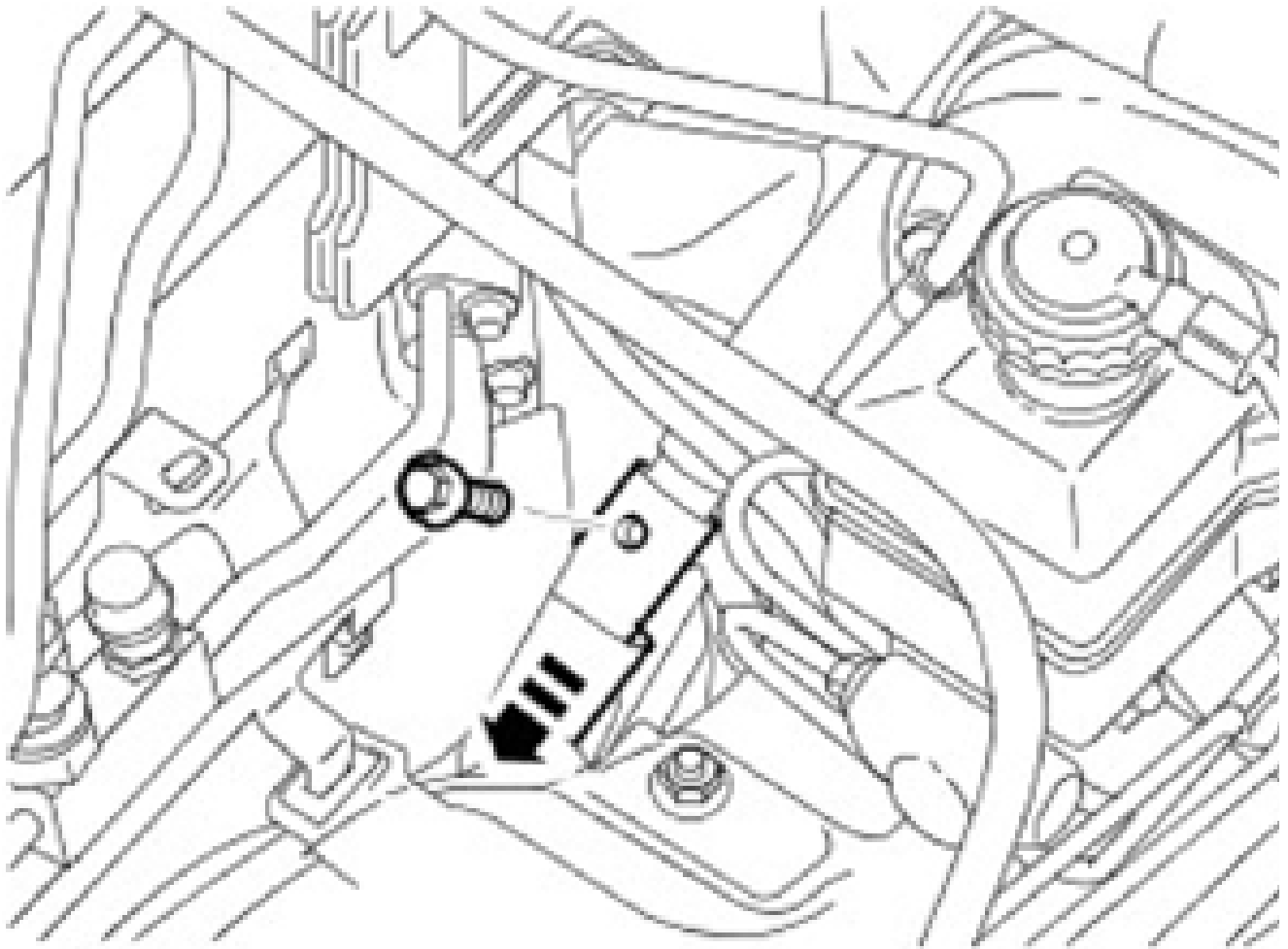
For additional information, refer to: **FENDER SPLASH SHIELD** .

NOTE: **The heatshield consists of 3 parts.**

5. Remove the upper suspension arm and brake line heat shields for access.
 - Remove the 3 nuts.
 - Remove the 3 bolts.

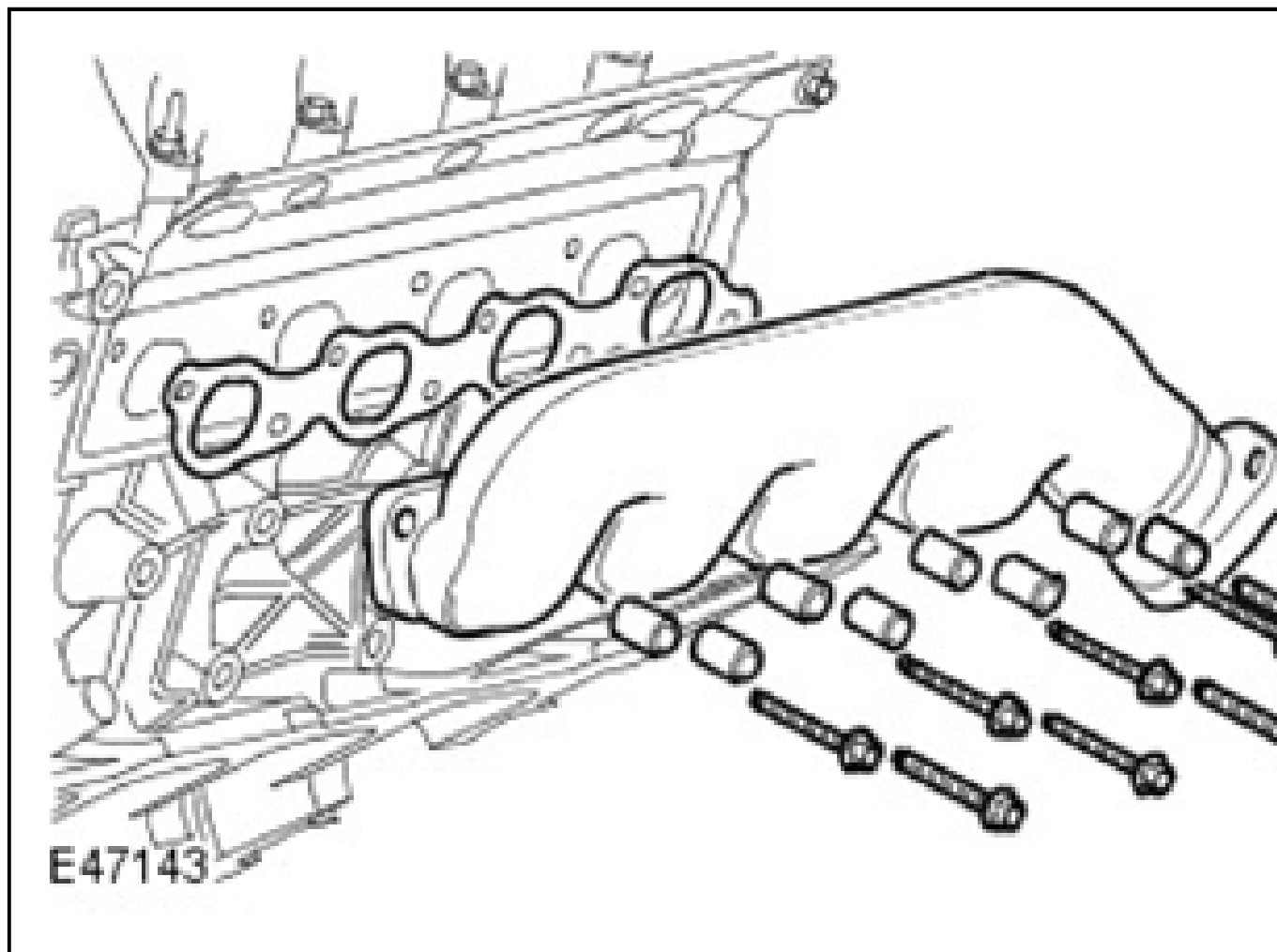
**Left-hand drive vehicles**

6. Check the road wheels are in the straight ahead position, then remove the steering column universal joint upper clamp bolt.
 - Discard the retaining bolt.
7. Release the upper steering column shaft.
8. Remove the steering gear universal joint clamp bolt.
 - Discard the retaining bolt.
9. Release and remove the shaft and joint assembly.

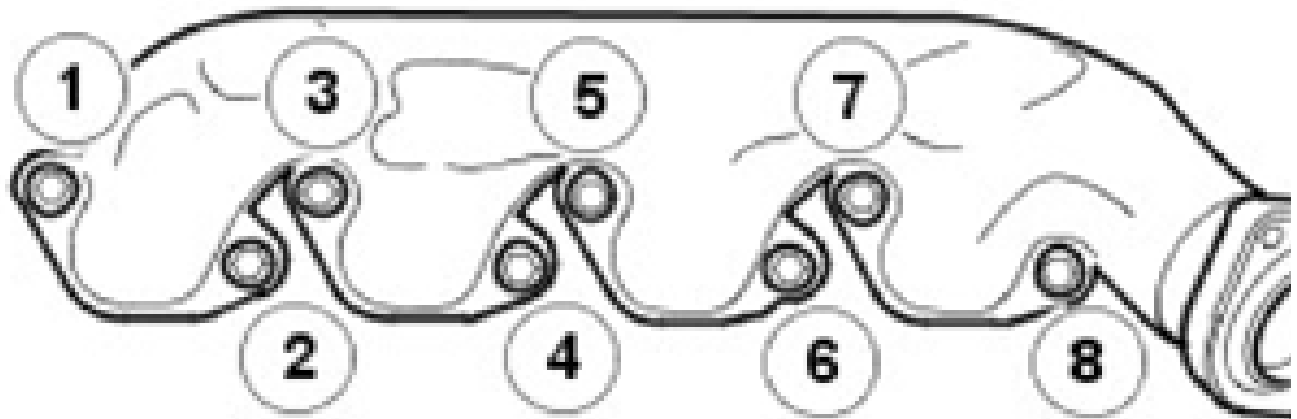


10. Remove the exhaust manifold.

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

**INSTALLATION****All vehicles**

1. Clean the component mating faces.
2. Install the exhaust manifold.
 - Install a new gasket.
 - Install, and lightly tighten the bolts.
 - Evenly and progressively, tighten the bolts in the sequence shown to 20 Nm (15 lb.ft).

**E47144****Left-hand drive vehicles**

3. Install the steering column lower universal joint assembly.
 - Clean the component mating faces.
 - Install new patchlock bolts and tighten to 25 Nm (18 lb.ft).

NOTE: **The heatshield consists of 3 parts.**

4. Install the upper suspension arm and brake line heat shields.
 - Install the bolts.
 - Install the nuts.
5. Install the fender splash shield.

For additional information, refer to: **FENDER SPLASH SHIELD** .

6. Install the exhaust system.

For additional information, refer to: **EXHAUST SYSTEM** .

7. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

EXHAUST MANIFOLD RH**REMOVAL**

1. Disconnect the battery ground cable.

For additional information, 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.

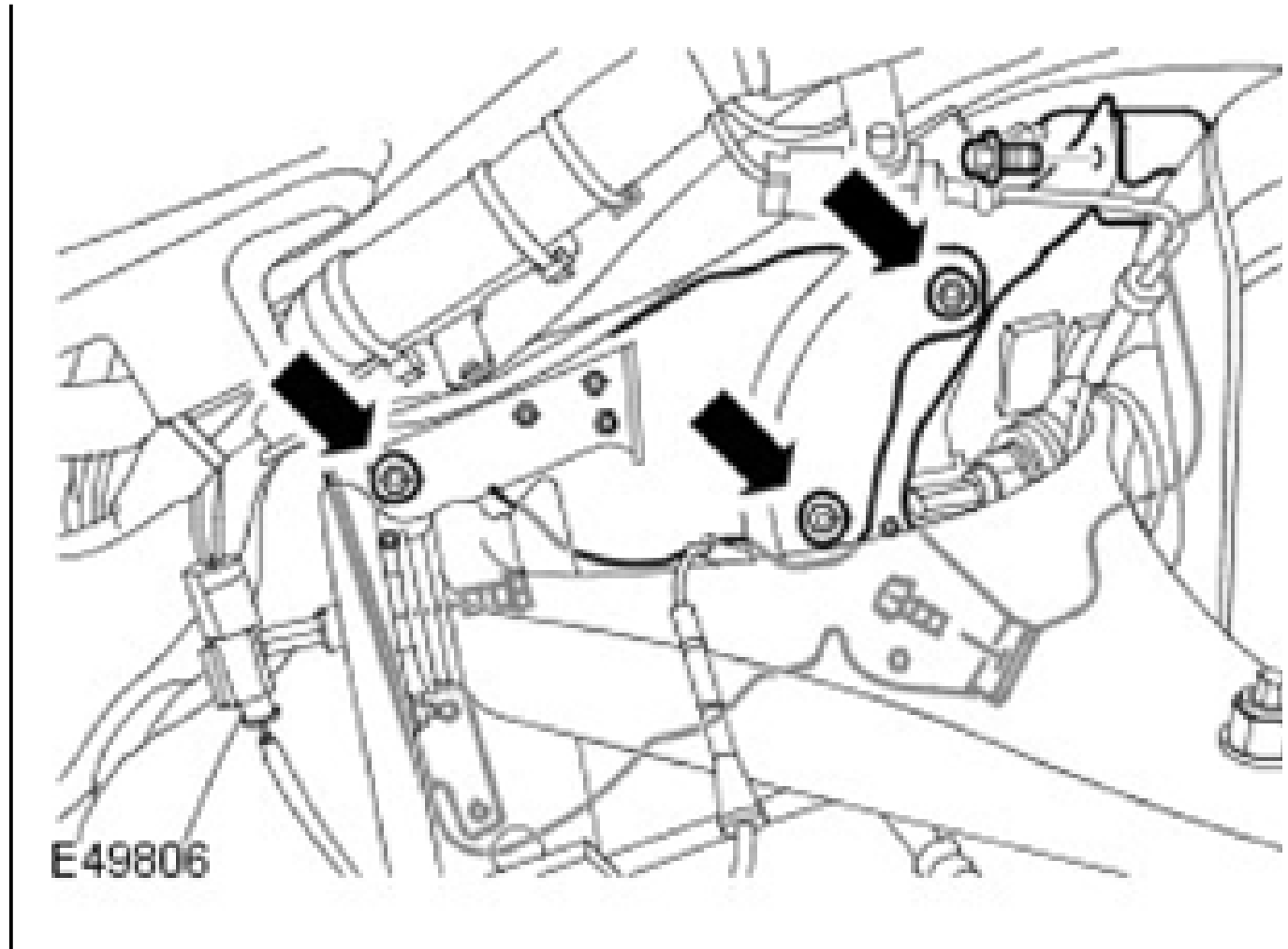
For additional information, refer to: **EXHAUST SYSTEM** .

4. Remove the fender splash shield.

For additional information, refer to: **FENDER SPLASH SHIELD** .

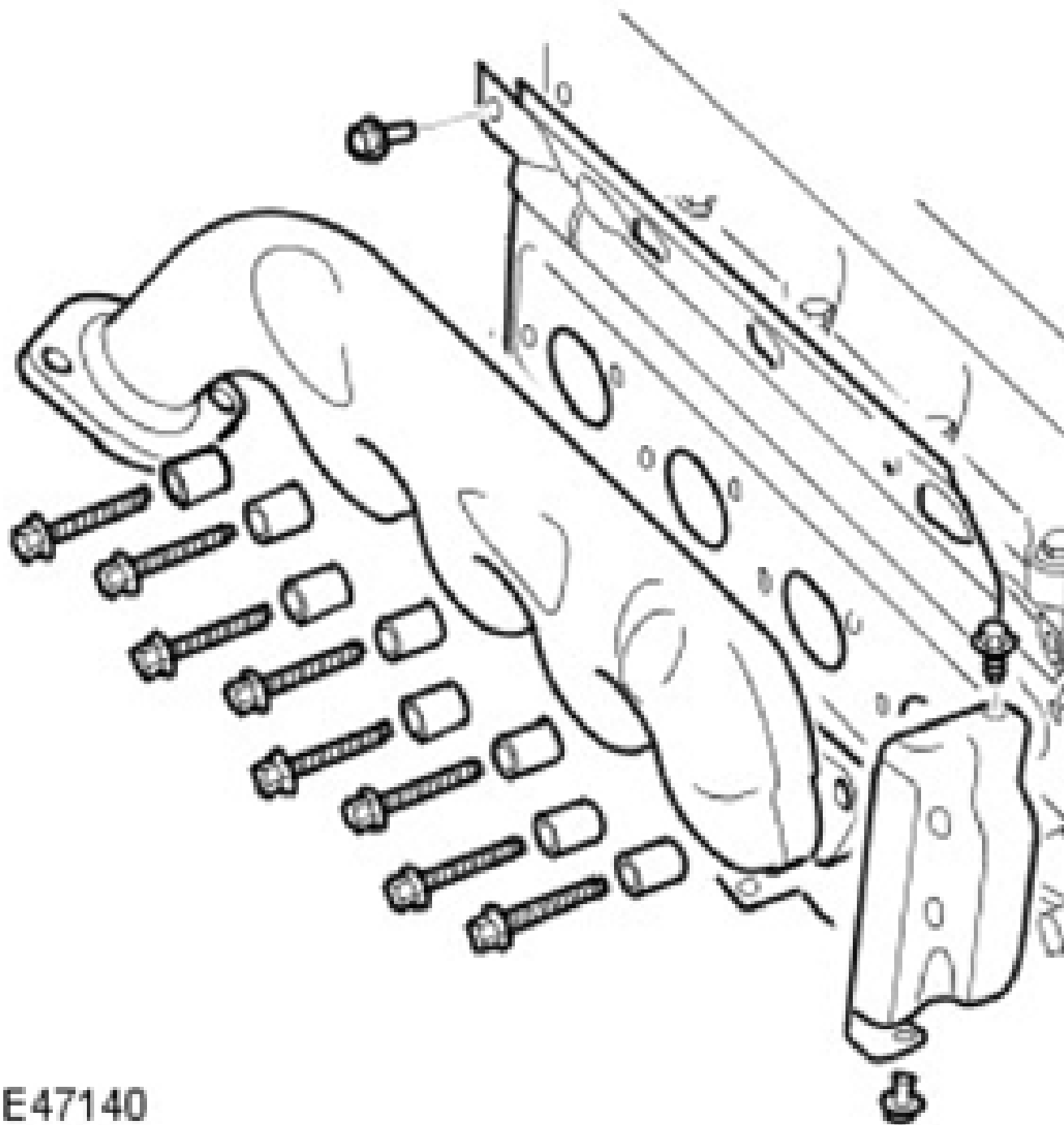
NOTE: **The heatshield consists of 3 parts.**

5. Remove the upper suspension arm and brake line heat shields for access.
 - Remove the 3 nuts.
 - Remove the 3 bolts.



6. Remove the exhaust manifold.

- Remove 2 bolts and the heat shield.
- Remove the gasket/heat shield retaining bolt.
- Remove the 8 bolts.
- Collect the spacers and discard the bolts.
- Discard the gasket/heat shield.

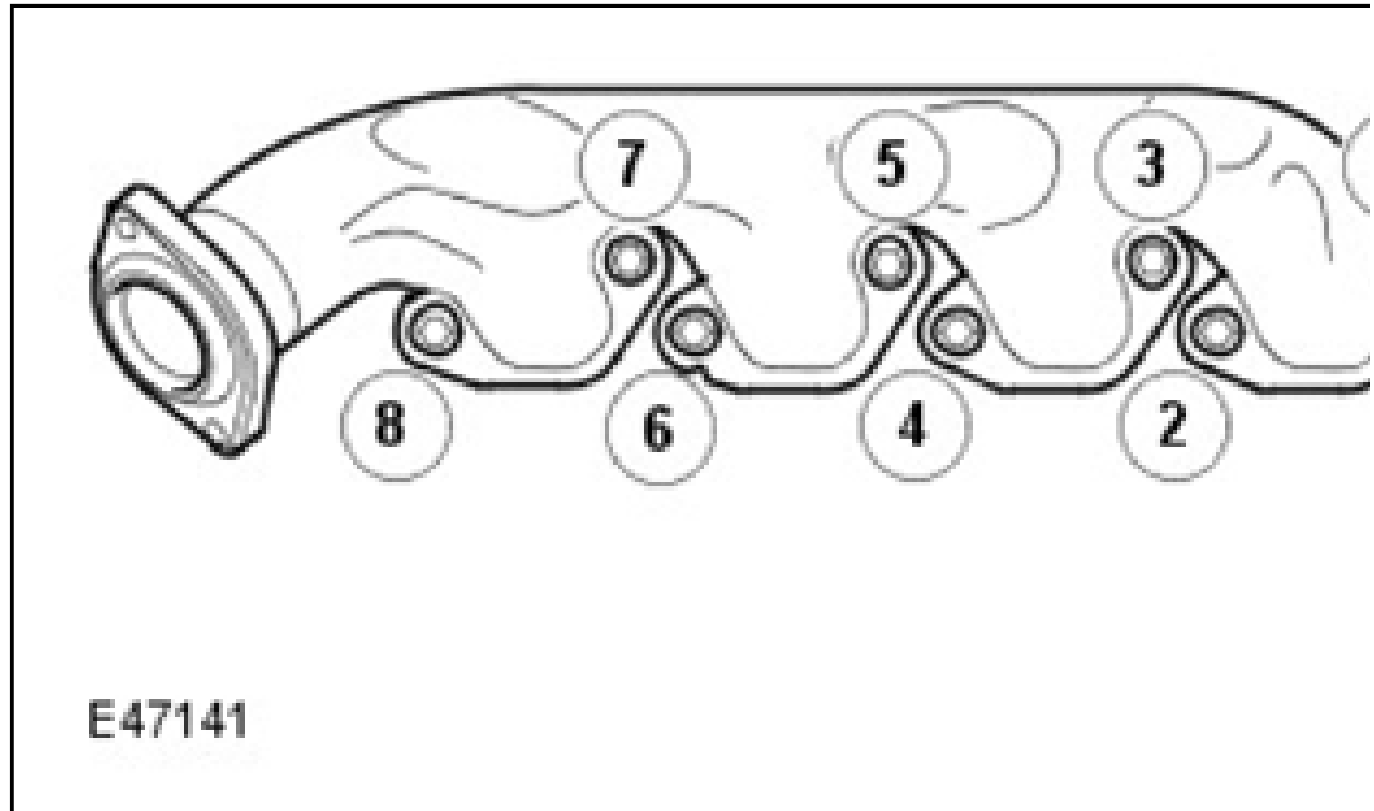


E47140

INSTALLATION

1. Clean the component mating faces.
2. Install the exhaust manifold.

- Install the gasket/heat shield.
- Install, and lightly tighten the bolts.
- Evenly and progressively, tighten the bolts in the sequence shown to 20 Nm (15 lb.ft).
- Tighten the M6 bolt to 10 Nm (7 lb.ft).
- Install the exhaust heat shield.
- Install the bolts.



NOTE: The heatshield consists of 3 parts.

3. Install the upper suspension arm and brake line heat shields.
 - Install the bolts.
 - Install the nuts.
4. Install the fender splash shield.

For additional information, refer to: **FENDER SPLASH SHIELD** .

5. Install the exhaust system.

For additional information, refer to: **EXHAUST SYSTEM** .

6. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

AUXILIARY OIL COOLER

REMOVAL

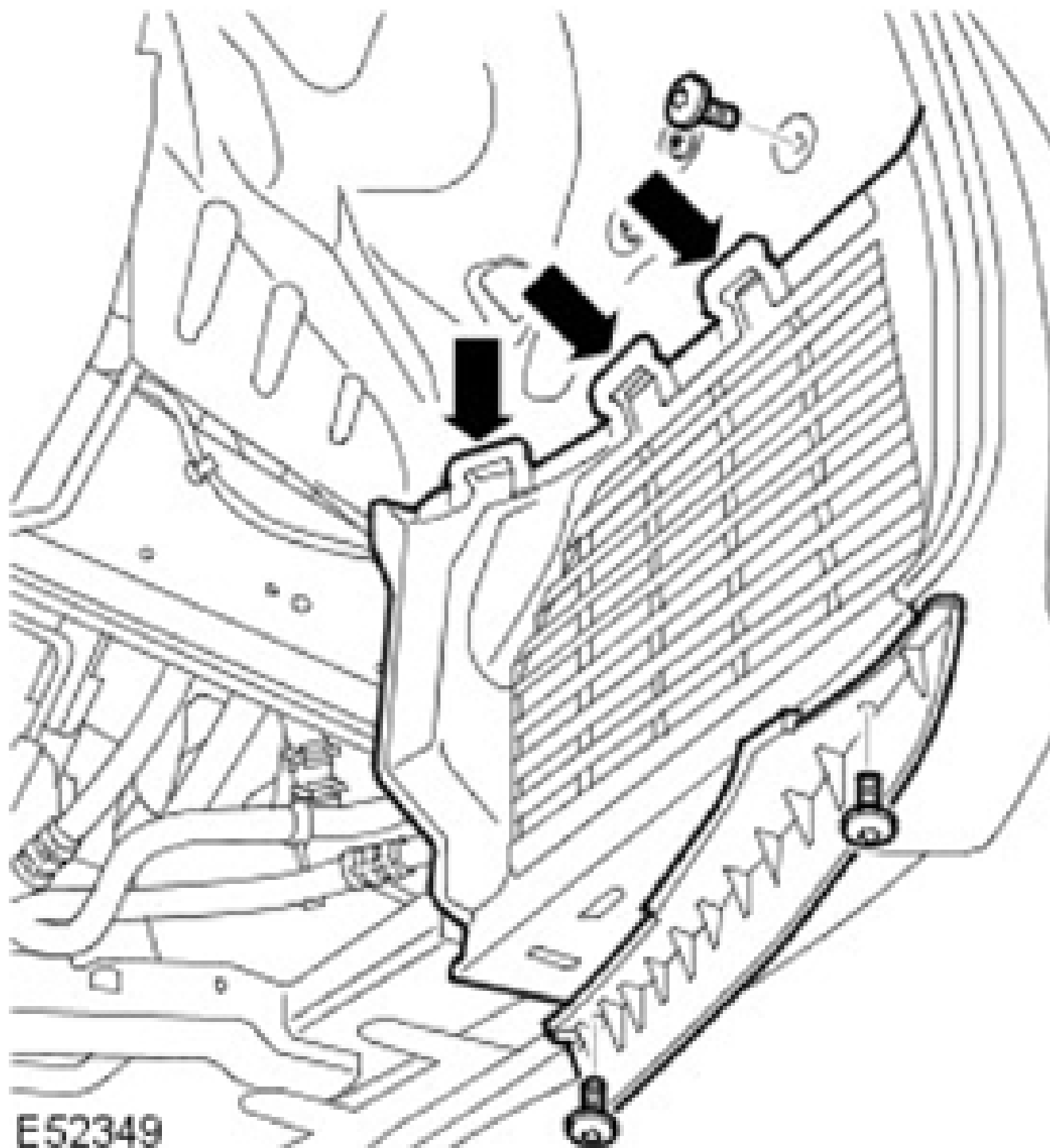
NOTE: **The special tool required to release the hoses is attached to the top outlet pipe on the cooler. Always install the special tool to the outlet pipe after use.**

1. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

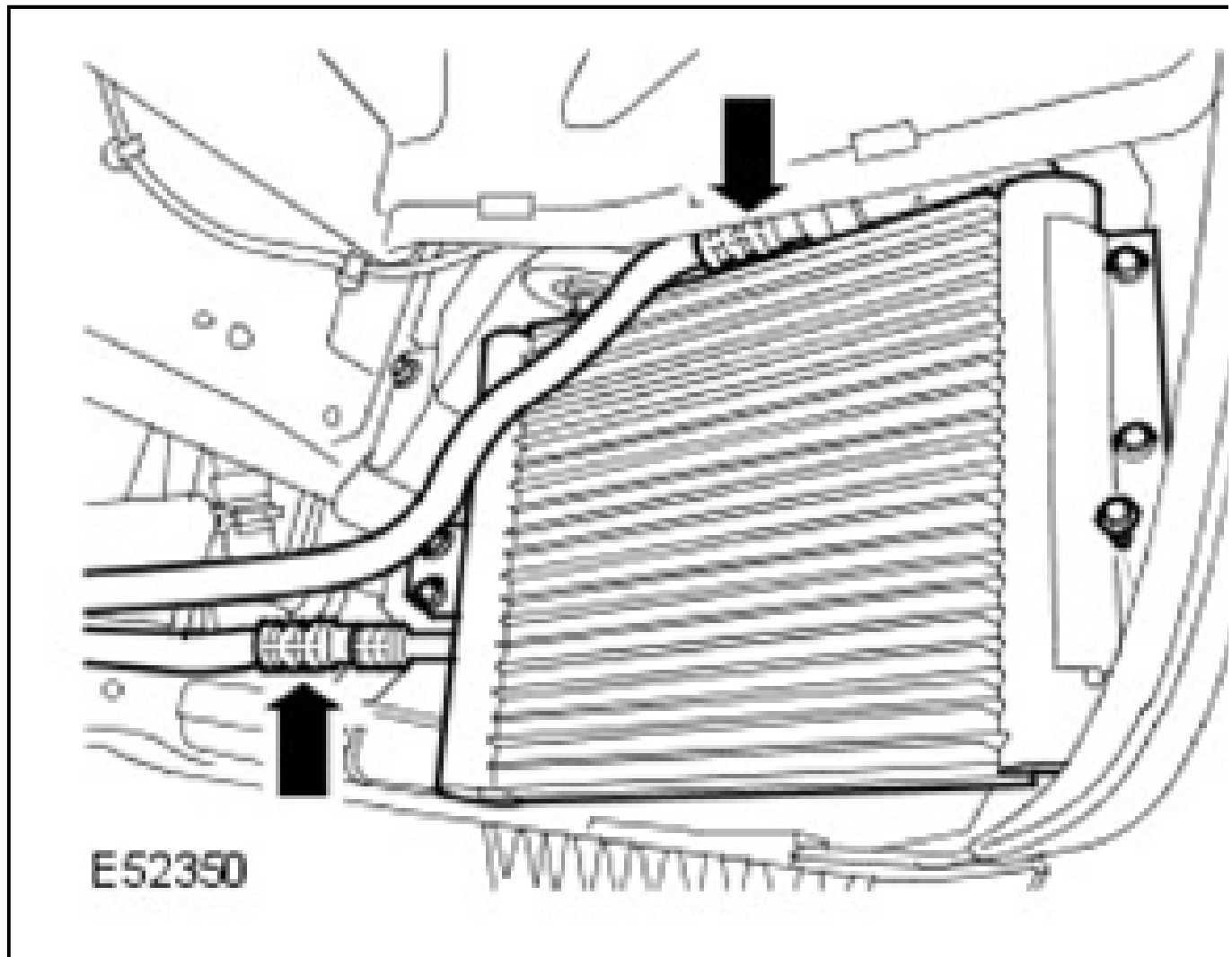
WARNING: **Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.**

2. Raise and support the vehicle.



3. Remove fender splash shield grille.
 - Remove the 3 screws.

- Release the 3 clips and remove the cover.
4. Remove the oil cooler.
- Remove the 5 bolts.
 - Position a container to collect the oil spillage.
 - Disconnect the 2 hoses.

**INSTALLATION**

1. Install the oil cooler.
 - Clean the component mating faces.
 - Connect the hoses.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Install the fender splash shield grille.
 - Clean the component mating faces.

- Secure in the 3 clips.
 - Install the screws.
3. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

4. Check and top-up the engine oil.

AUXILIARY OIL COOLER THERMOSTAT

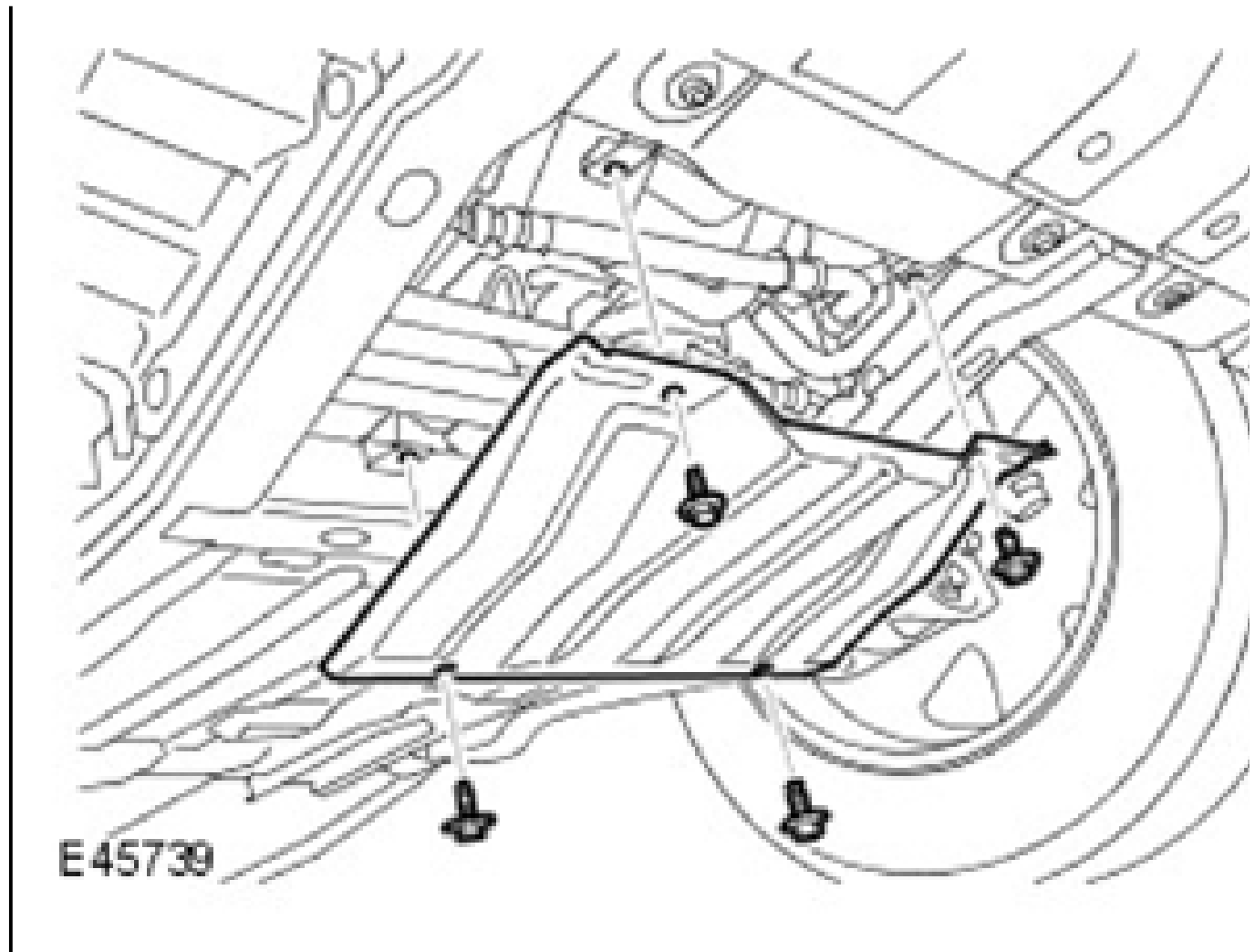
REMOVAL

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

1. Raise and support the vehicle.
2. Disconnect the battery ground cable.

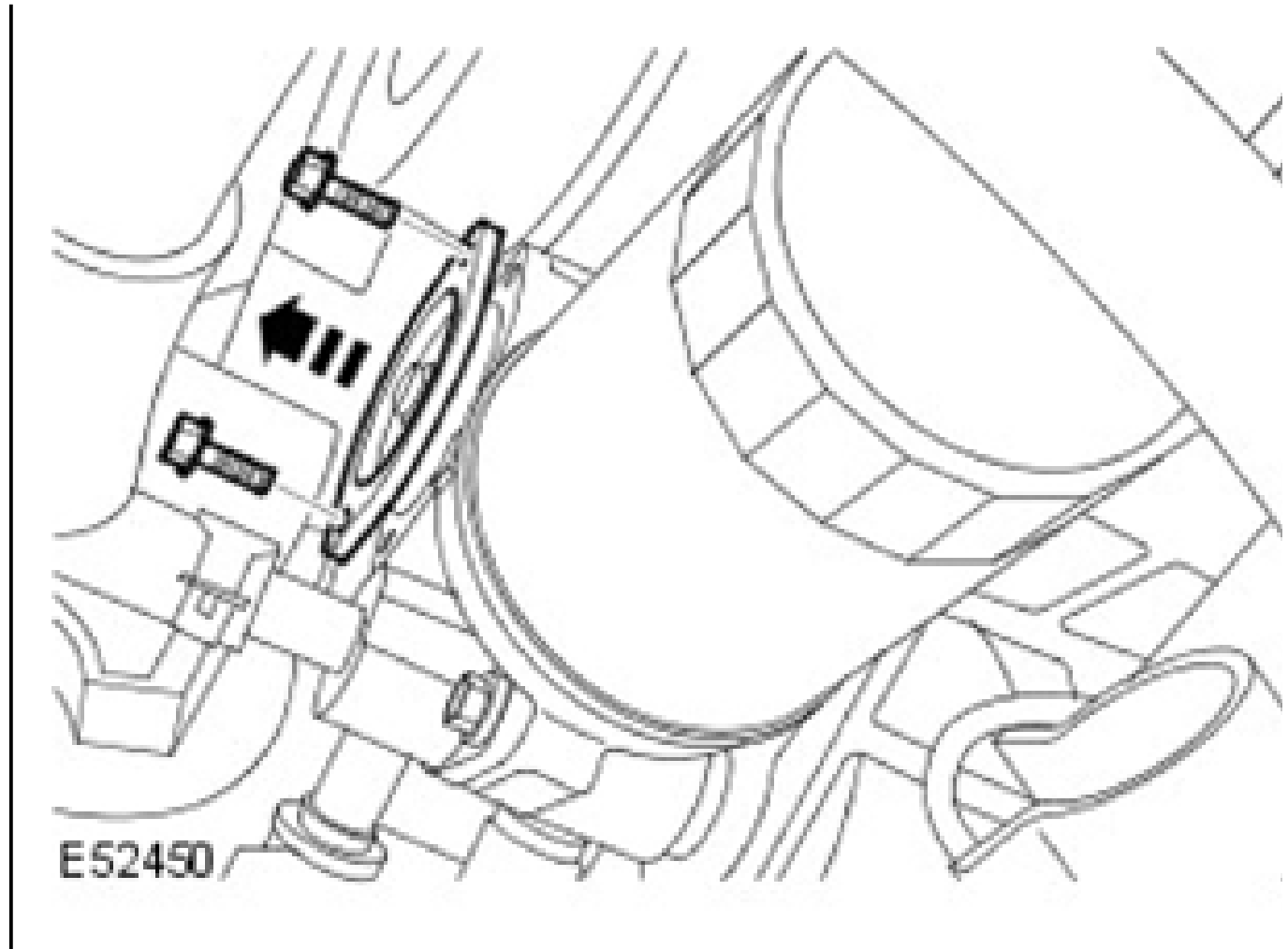
For additional information, refer to: **SPECIFICATIONS** .

3. Remove the radiator access panel.
 - Remove the 4 bolts.



NOTE: **Some fluid spillage is inevitable during this operation.**

4. Remove the thermostat.
 - Position an absorbent cloth to collect fluid spillage.
 - Remove the 2 bolts.
 - Remove and discard the O-ring seal.

**INSTALLATION**

1. Install the thermostat.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
2. Install the radiator access panel.
 - Install the 4 bolts and tighten to 10 Nm (7 lb.ft).
3. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

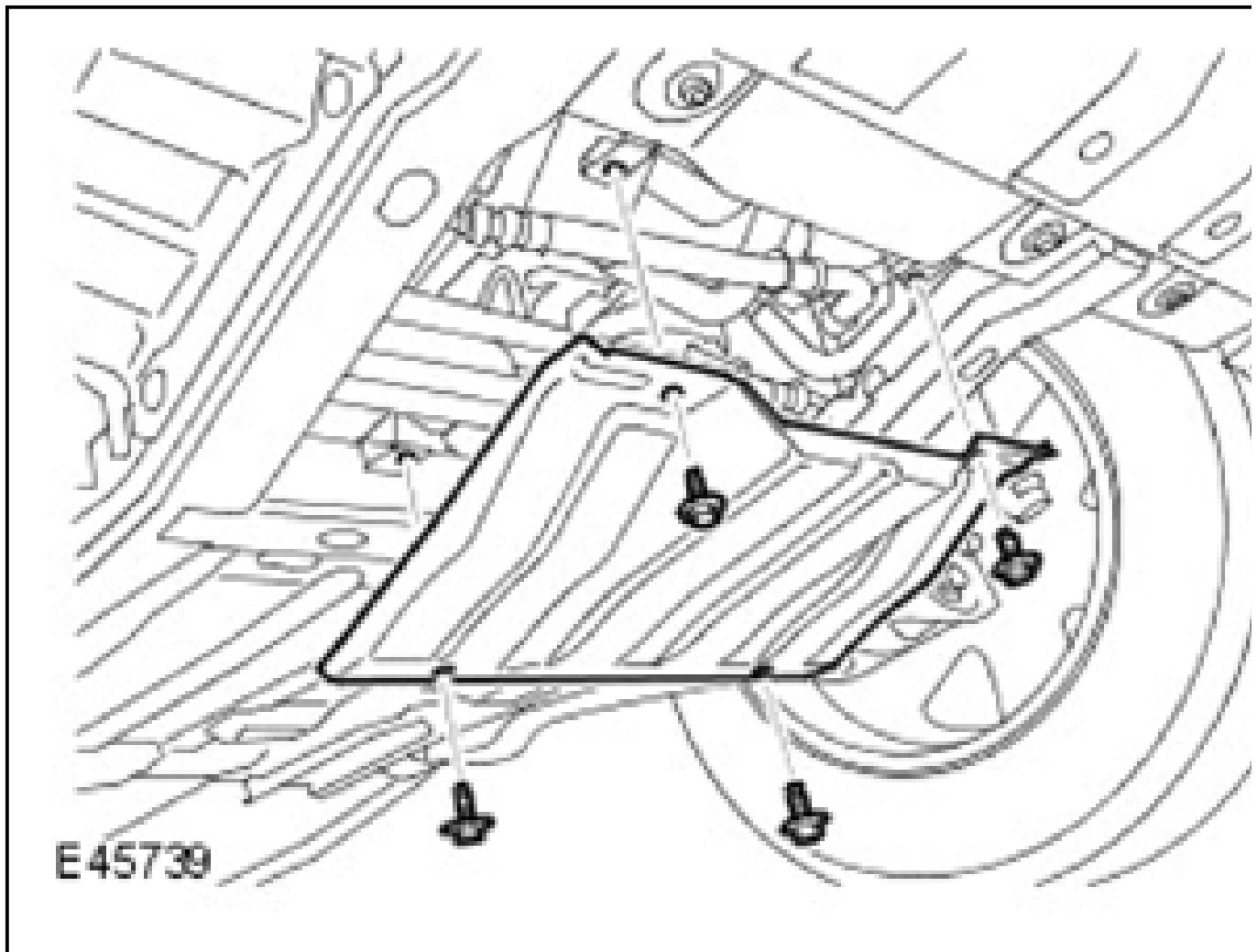
OIL FILTER HOUSING**REMOVAL**

1. Disconnect the battery ground cable.

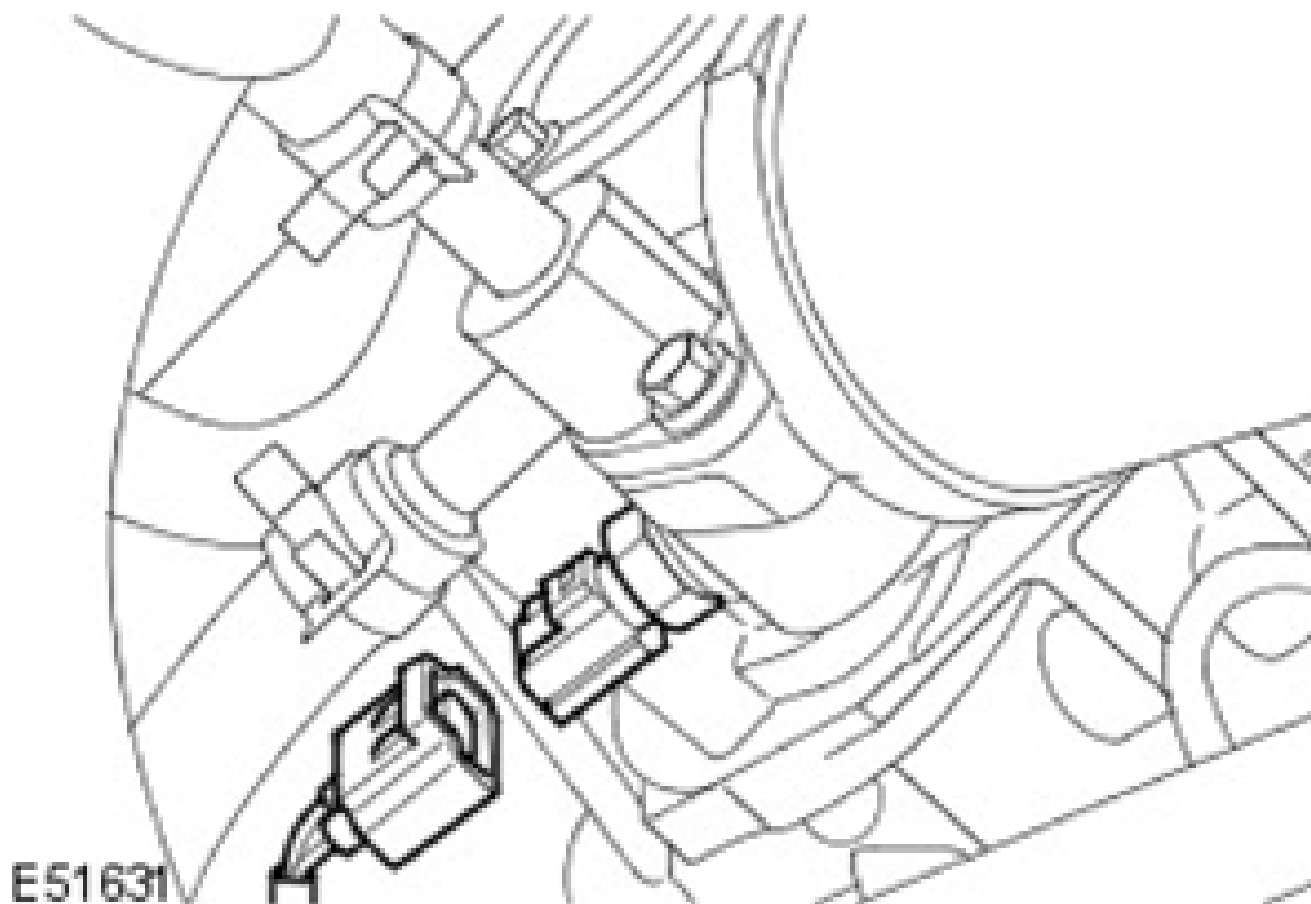
For additional information, refer to: SPECIFICATIONS .

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

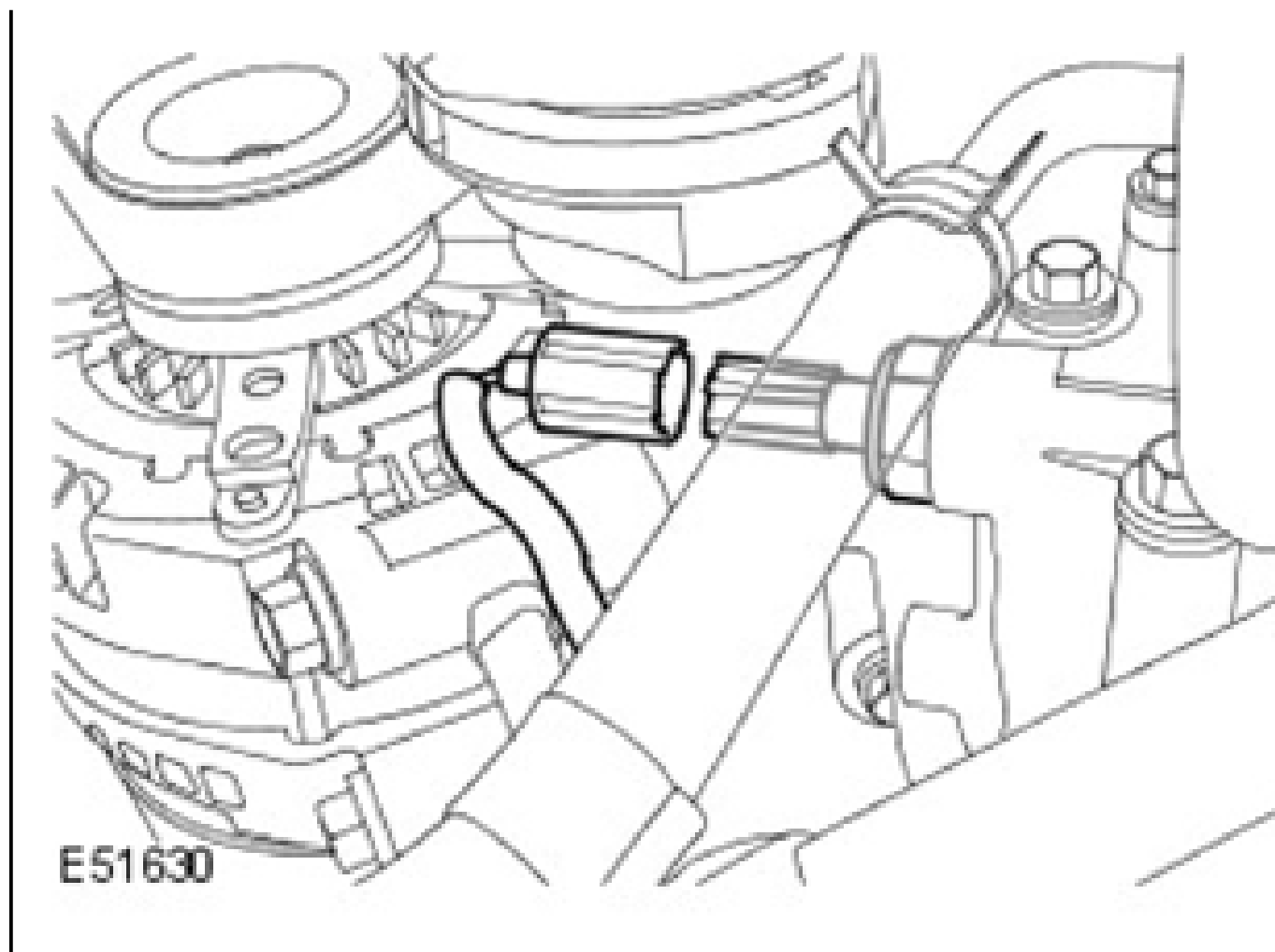
2. Raise and support the vehicle.
3. Remove the radiator access panel.
 - Remove the 4 bolts.



4. Disconnect the engine oil temperature sensor electrical connector.



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

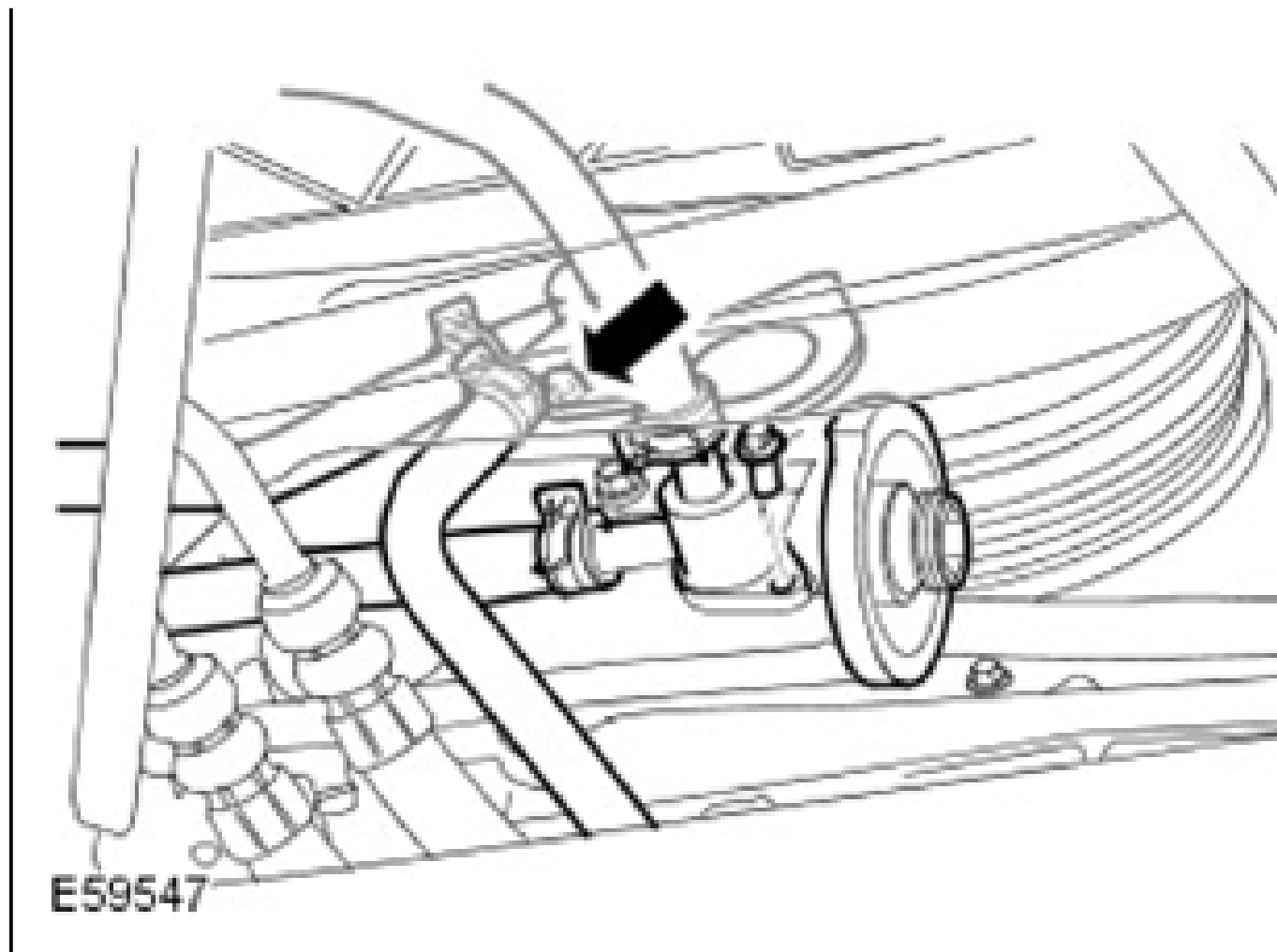


6. Remove the engine oil filter.
 - Position a container to collect the fluid spillage.

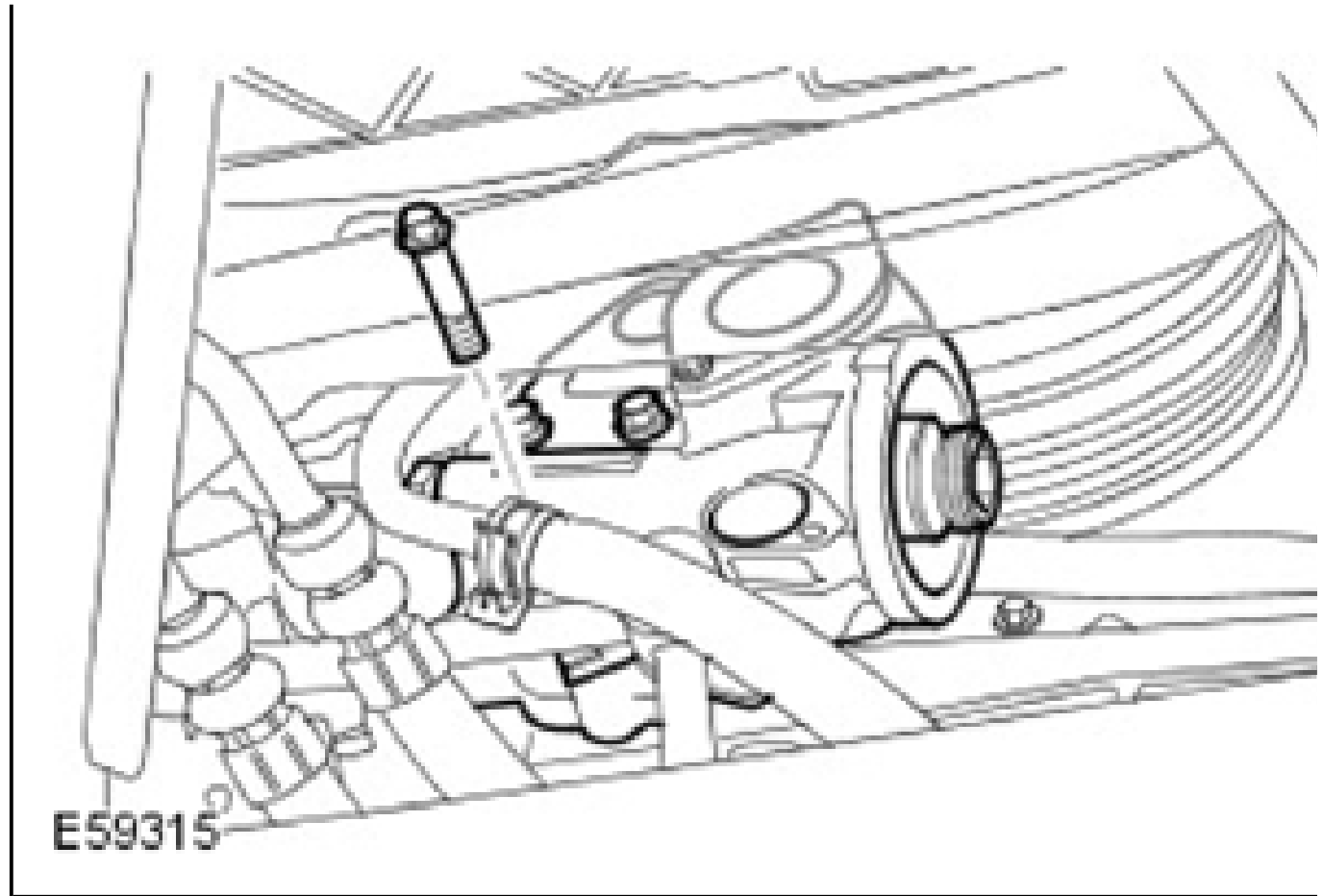


CAUTION: Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

7. Disconnect the oil cooler hose adapter.
 - Remove the bolt.
 - Remove and discard the O-ring seal.
 - Repeat the above procedure for the remaining adapter.

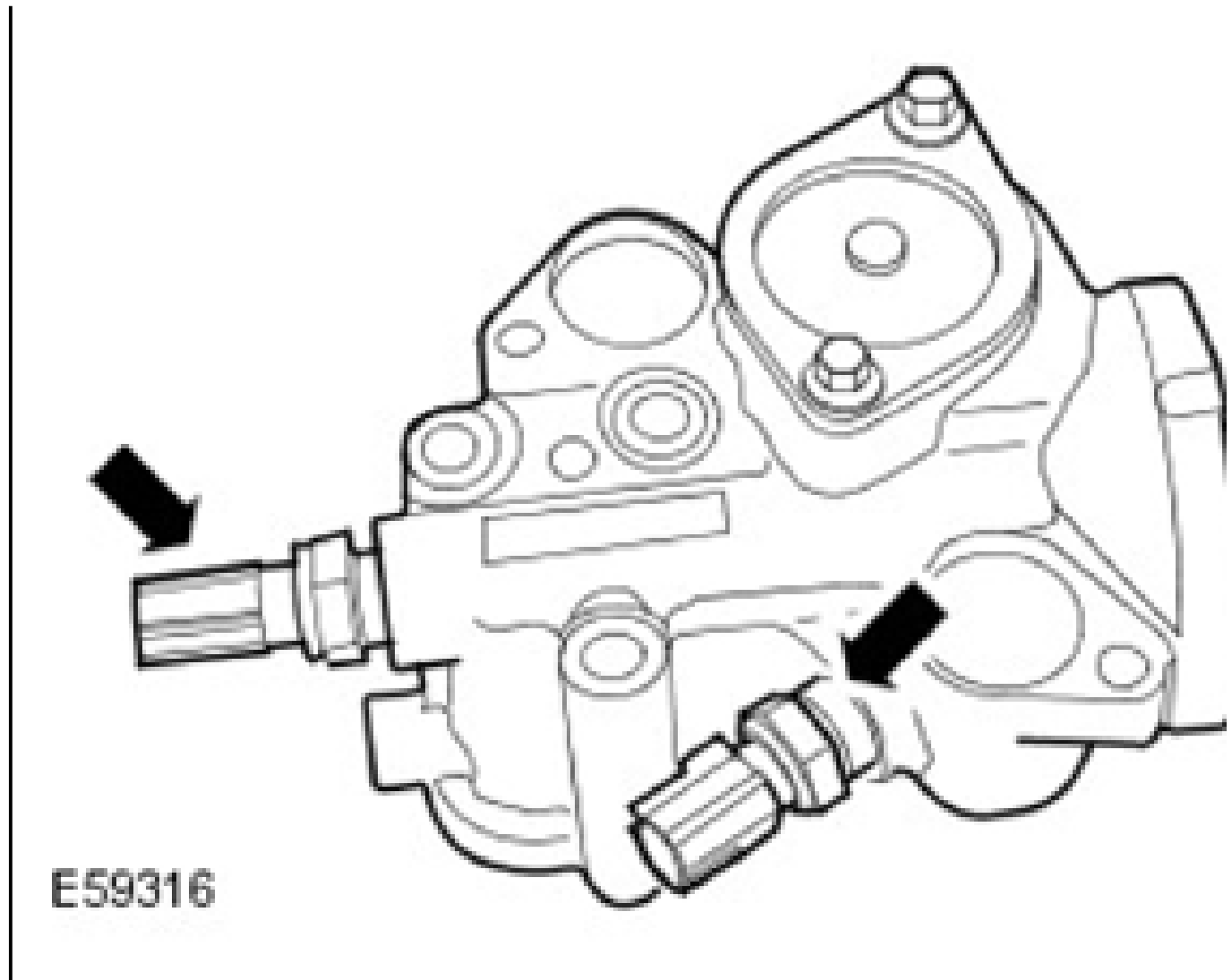


8. Remove the oil filter housing.
 - Remove the 3 bolts.
 - Remove and discard the O-ring seal.



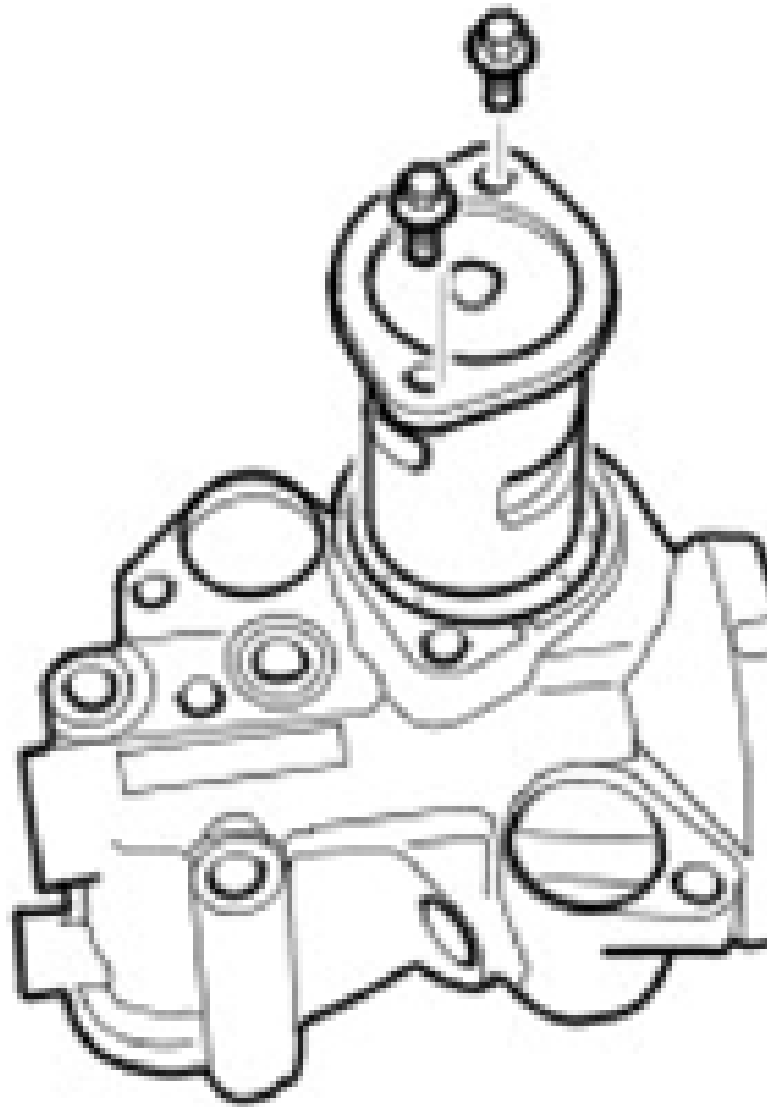
NOTE: Do not disassemble further if the component is removed for access only.

9. Remove the engine oil temperature sensor.
10. Remove the EOP sensor.



11. Remove the auxiliary oil cooler thermostat.

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



E59317

INSTALLATION

1. Install the auxiliary oil cooler thermostat.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Install the bolts and tighten to 10 Nm (7 lb.ft).
2. Install the EOP sensor.
 - Tighten the EOP sensor to 13 Nm (10 lb.ft).
3. Install the engine oil temperature sensor.
 - Tighten the engine oil temperature sensor to 20 Nm (15 lb.ft).

4. 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).
5. Connect the oil cooler hose adapters.
 - Clean the component mating faces.
 - Install new O-ring seals.
 - Tighten the bolts to 10 Nm (7 lb.ft).
6. Install the engine oil filter.
 - Lubricate the seal with clean engine oil.
7. Connect the EOP sensor electrical connector.
8. Connect the engine oil temperature sensor electrical connector.
9. Install the radiator splash shield.
10. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

11. Check and top-up the engine oil.

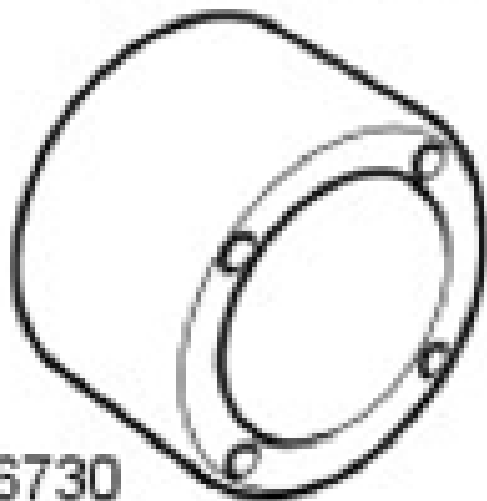
REMOVAL AND INSTALLATION

CRANKSHAFT MAIN BEARING CARRIER

SPECIAL TOOL(S)

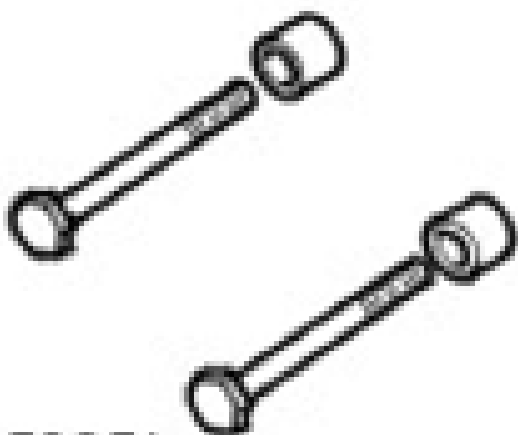
	Adapter 303-191-03
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303-191-03



E46730

303-191-04

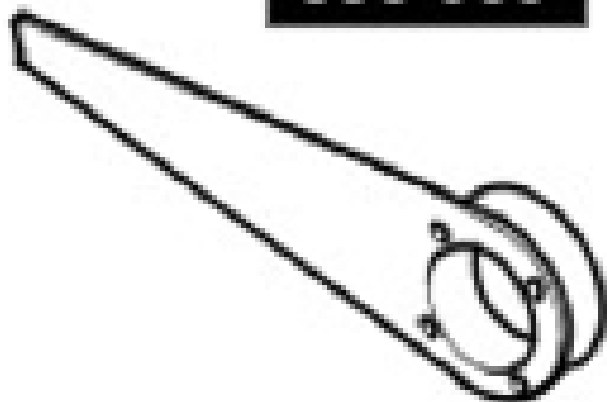


E59251

Bolts and spacers
303-191-04

Holding Tool Crankshaft Pulley
303-893 (LRT-12-080)

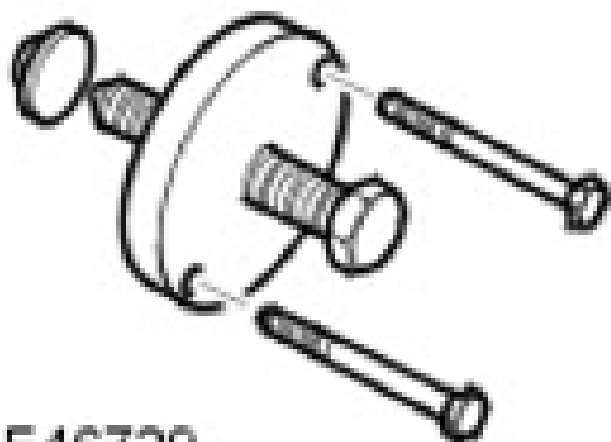
303-893



E46728

Remover, crankshaft pulley
303-588

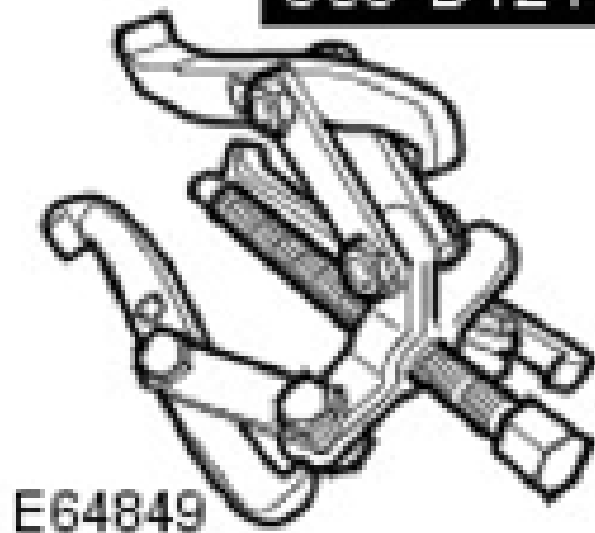
303-588



E46729

Remover, crankshaft seal
303-D121

303-D121

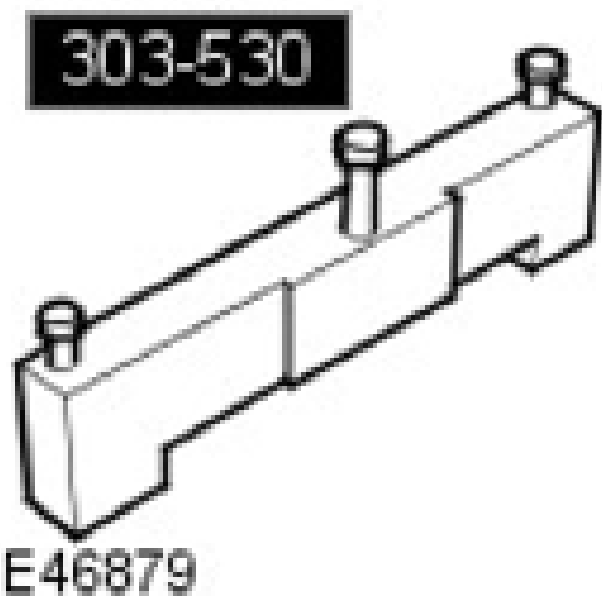


Timing Setting tool
303-645

303-645



Camshaft setting/locking tool
303-530

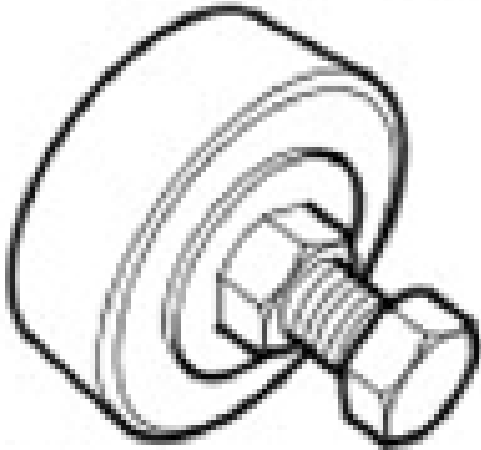


Crankshaft rear oil seal remover/installer
303-538



Installer, crankshaft seal
303-1100

303-1100



E46732

Adapter - Crankshaft seal installer
303-1100-01

303-1100-01



E67144

REMOVAL

1. Disconnect the battery ground cable.

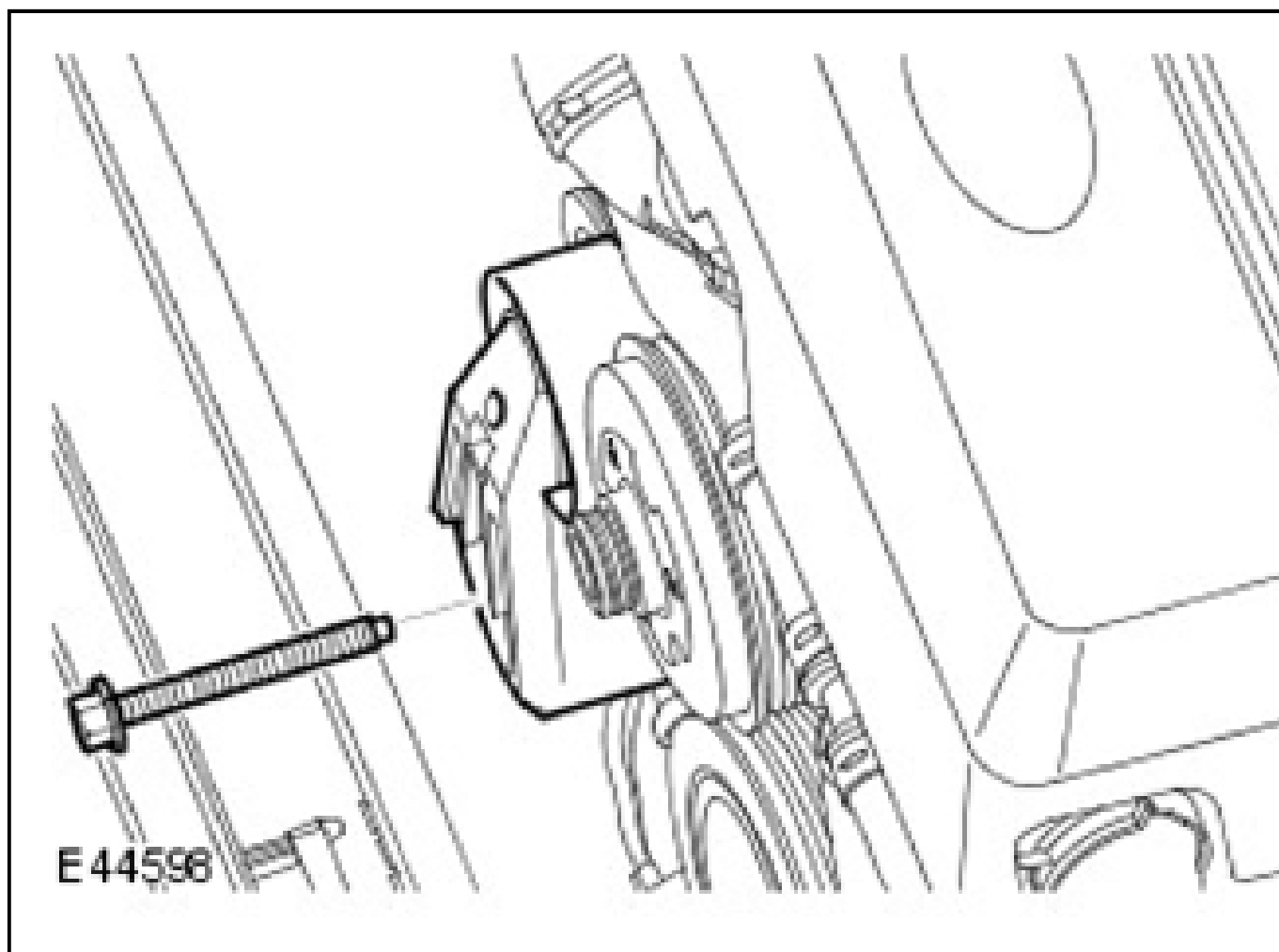
For additional information, refer to: **SPECIFICATIONS** .

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.

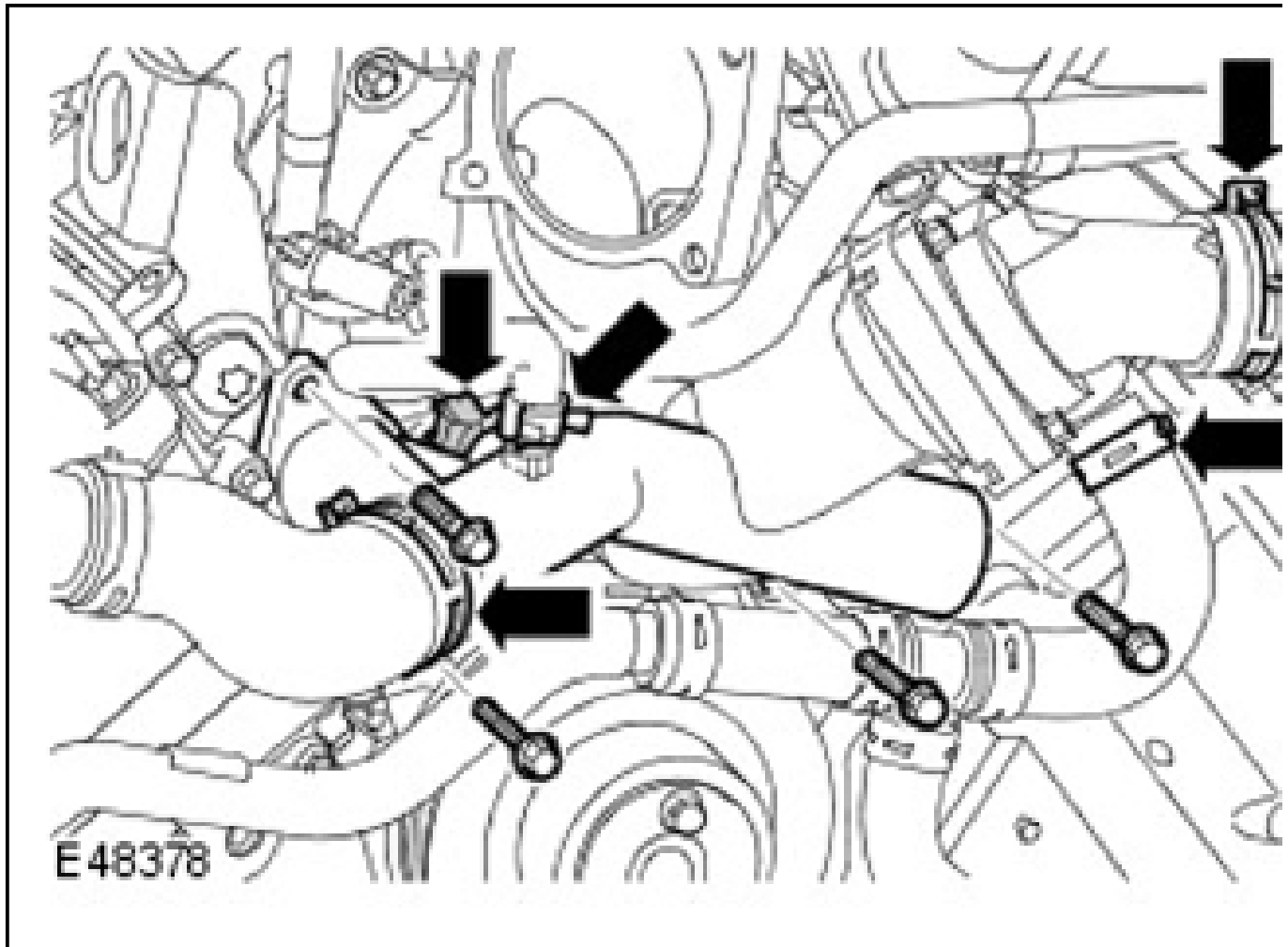
For additional information, refer to: **ENGINE**.

4. Mount the engine to an engine stand.
5. Remove the cooling fan drive belt tensioner.
 - Remove the bolt.



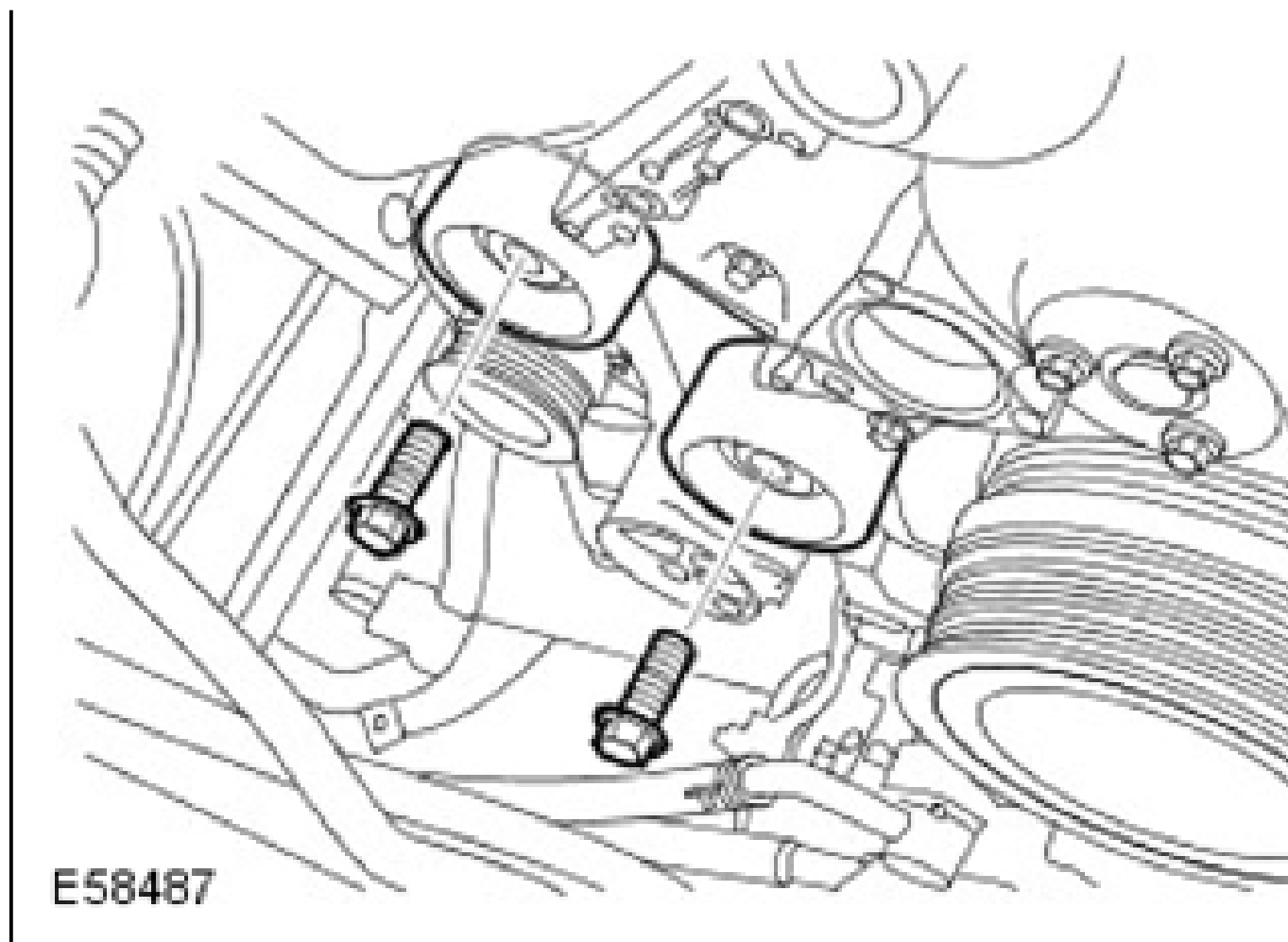
6. Remove the coolant manifold.

- Release the clips and disconnect the 4 coolant hoses.
- Remove the 4 bolts.
- Disconnect the engine coolant temperature (ECT) sensor electrical connector.



7. Remove the coolant pump and accessory drive belt idler pulleys.

- Remove the bolts.

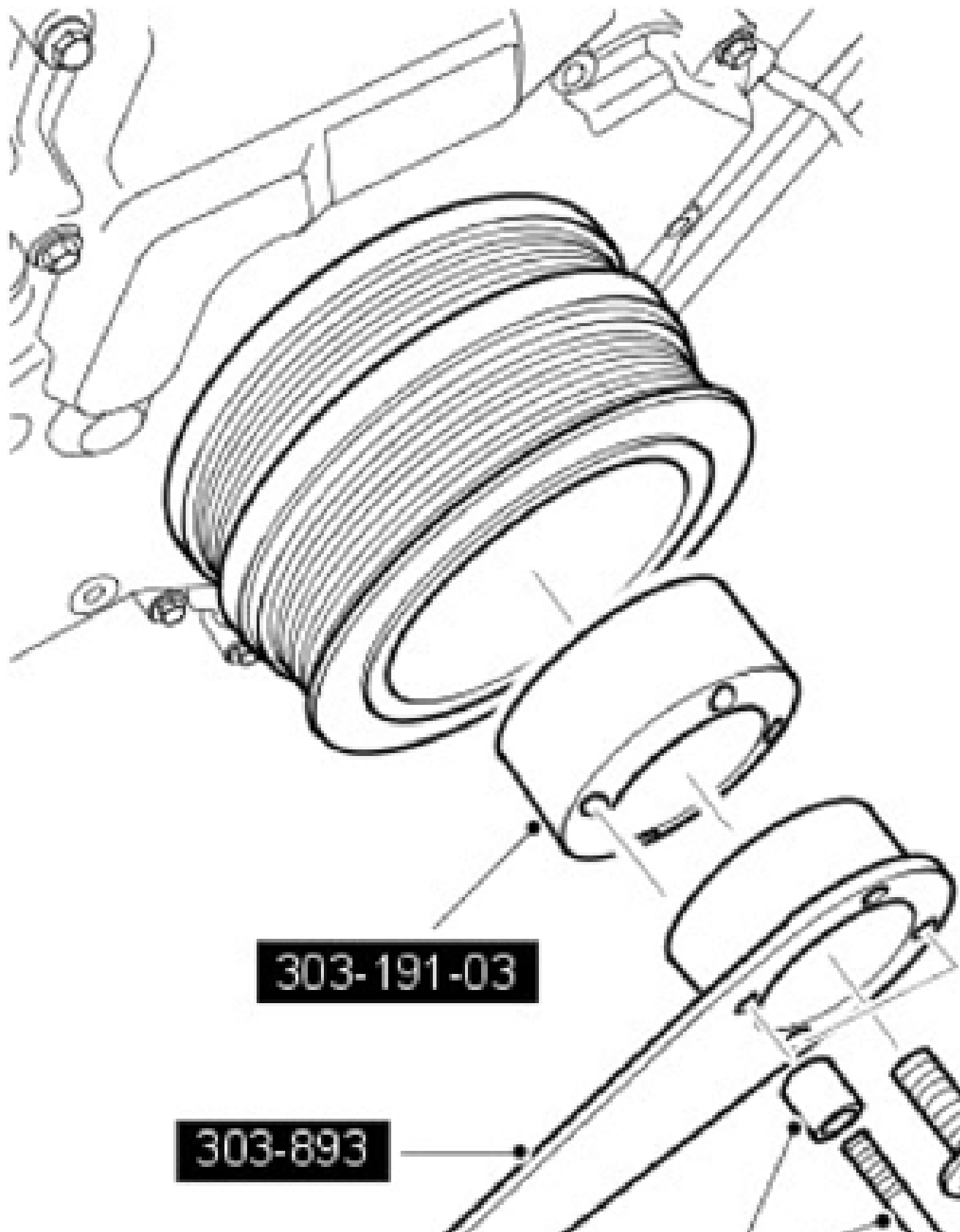


8. Remove the exhaust manifold heat shield.
 - Remove the 2 bolts.



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

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



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

10. Using the special tools, remove the crankshaft pulley bolt.

- Discard the bolt.
- Remove the special tools.

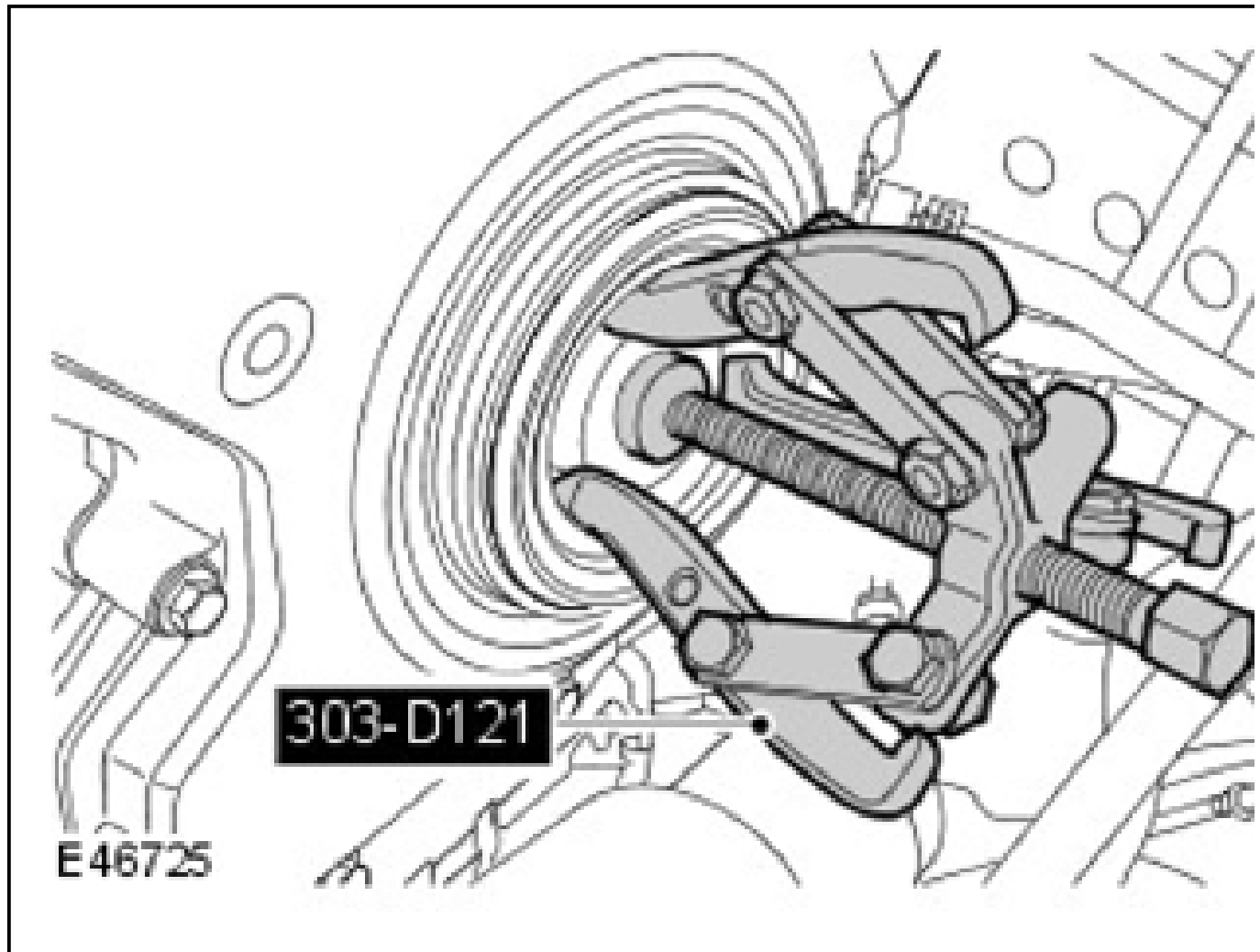
NOTE: **The crankshaft pulley will be very tight.**

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

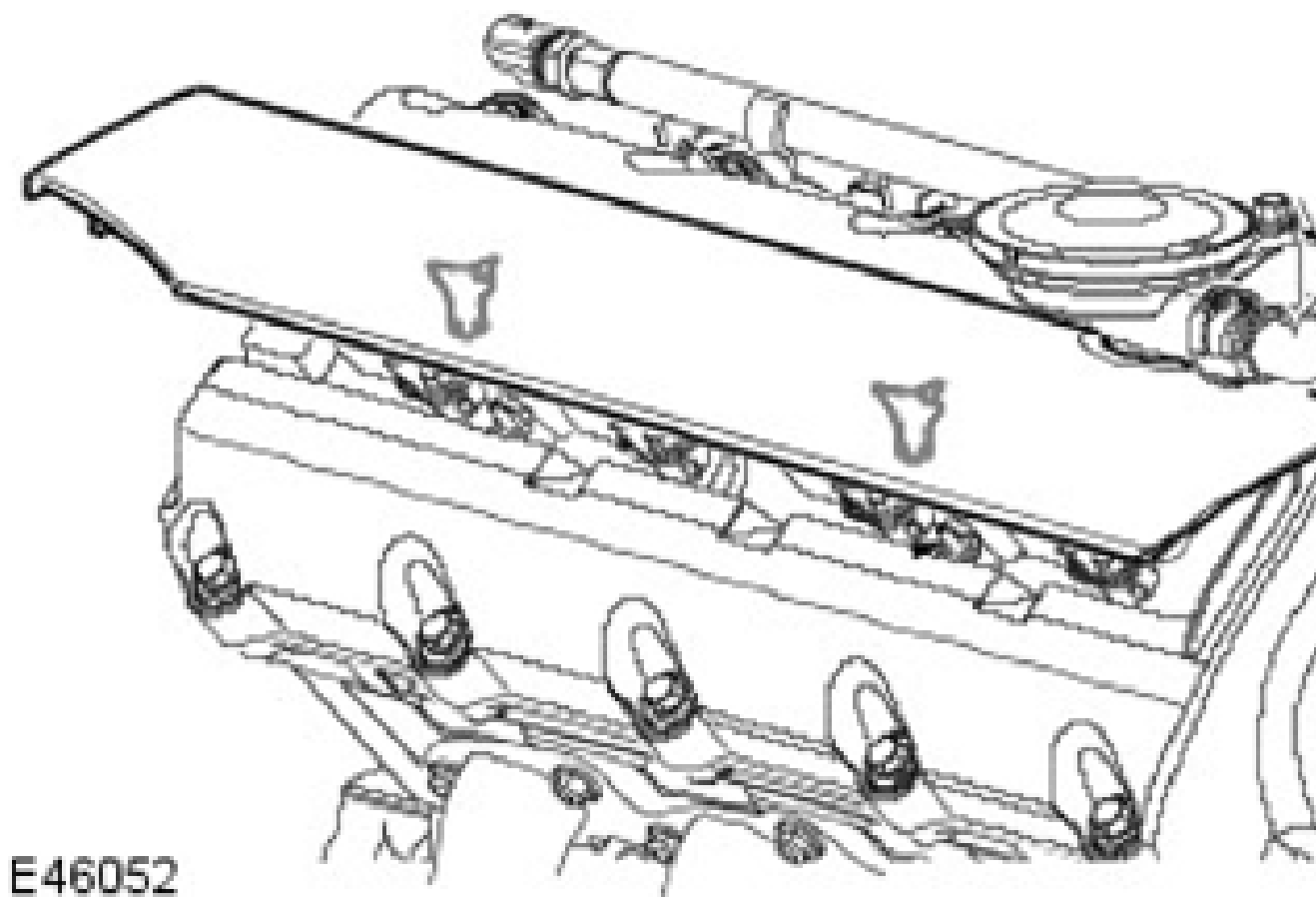
- Collect the locking ring.
- Remove the special tools.



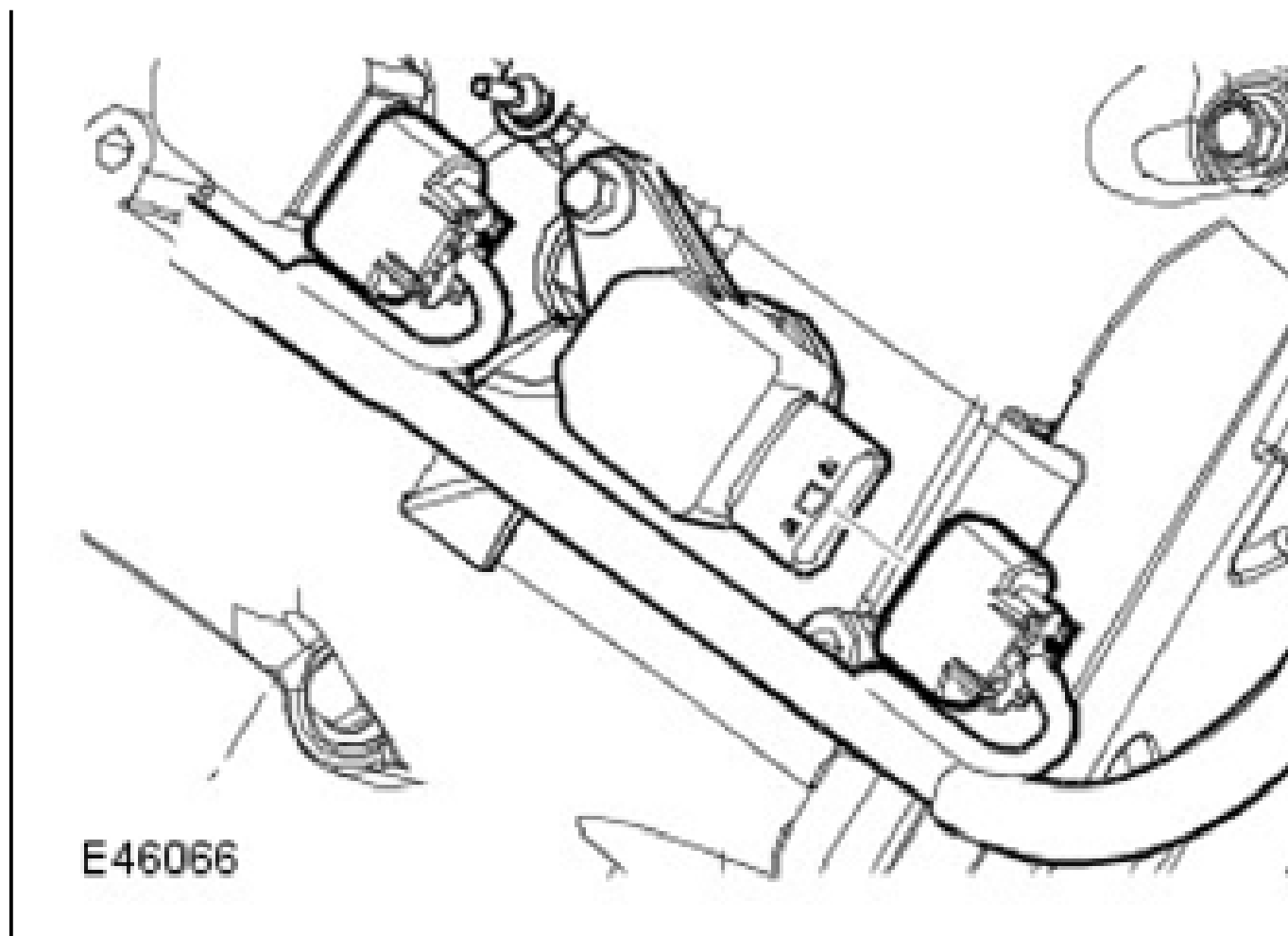
12. Using the special tool, remove and discard the crankshaft front seal.



13. Remove the RH ignition coil-on-plug cover.
- Release from the 2 clips.

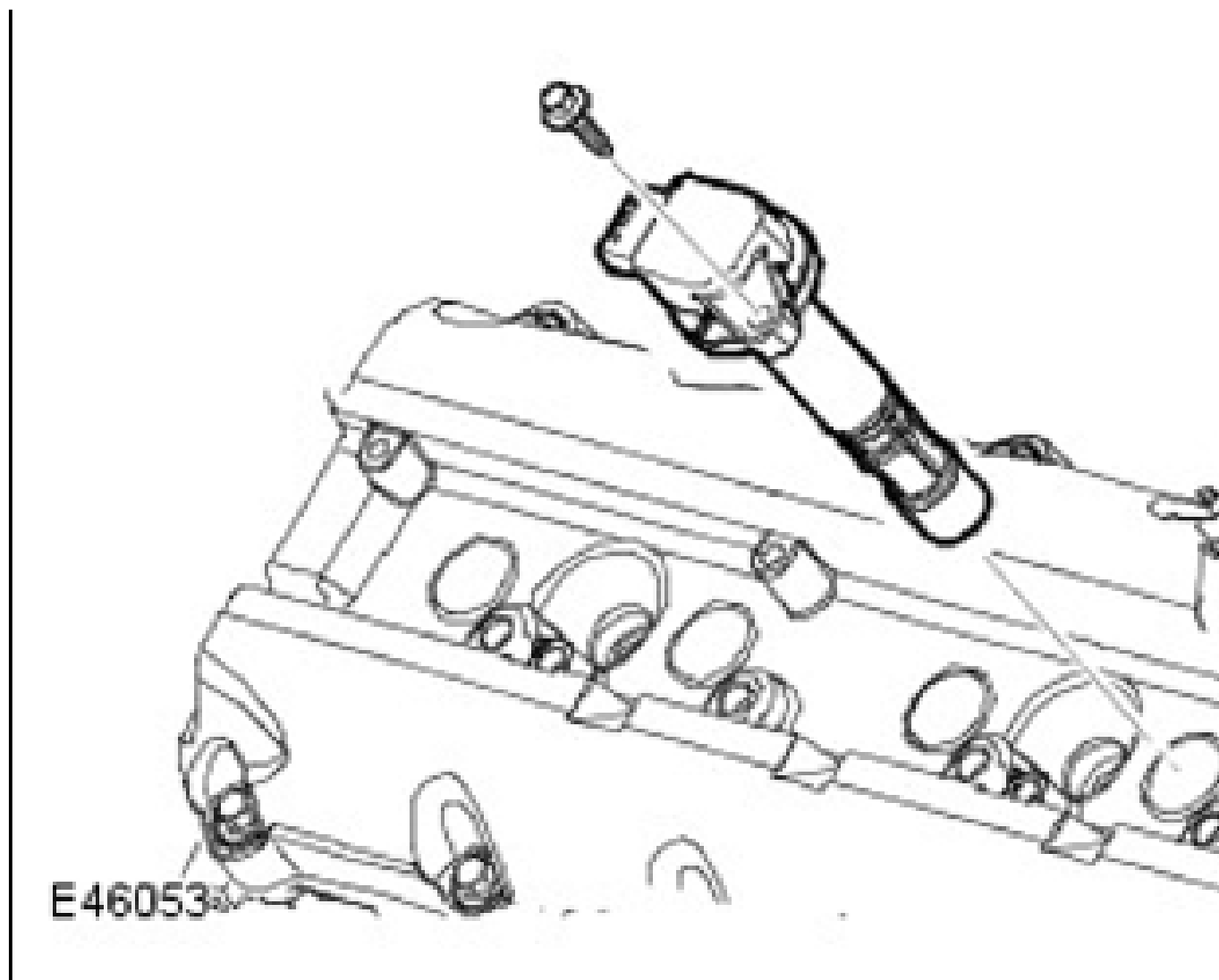


14. Disconnect the RH ignition coil-on-plug electrical connector.

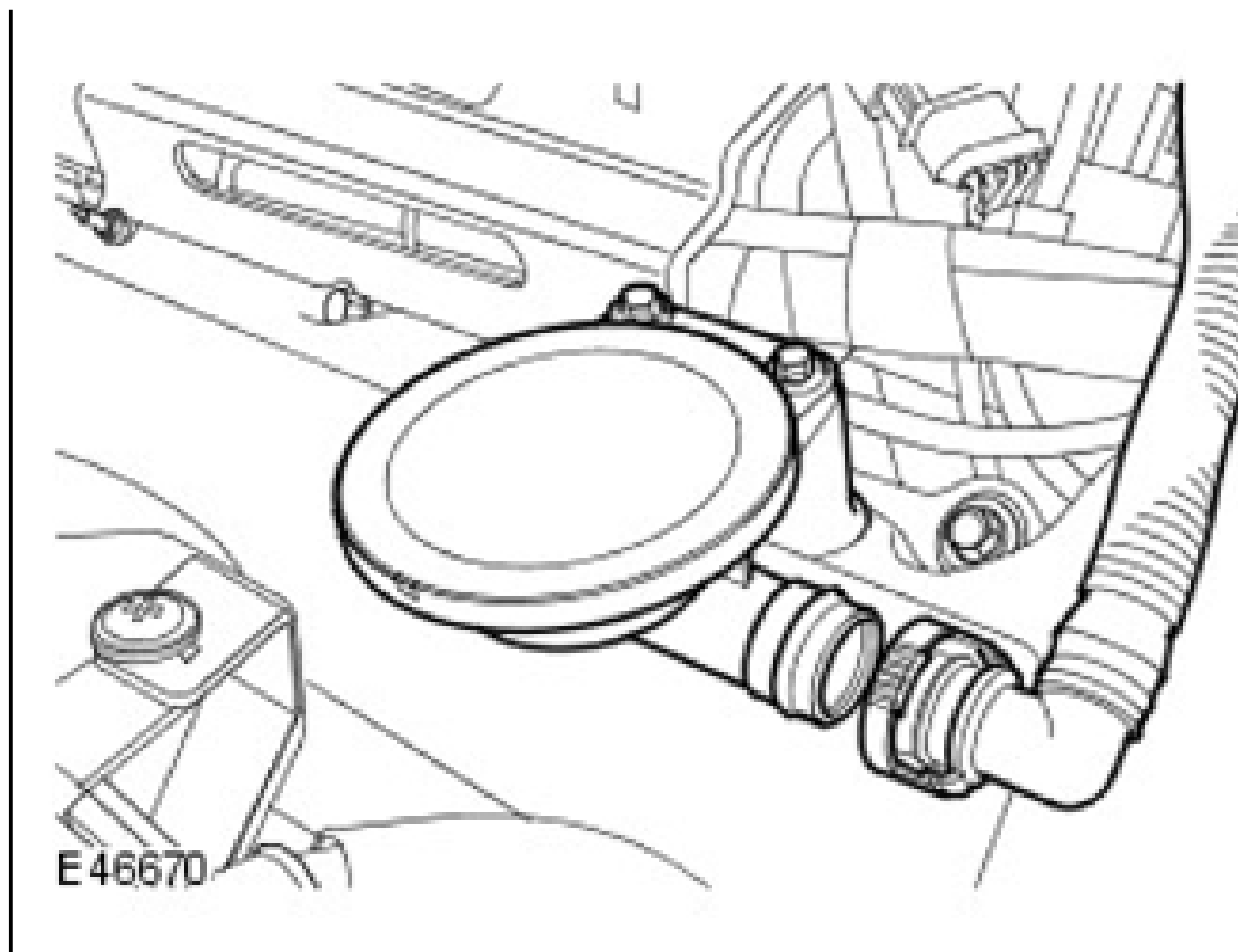


15. Remove the RH ignition coil-on-plug.

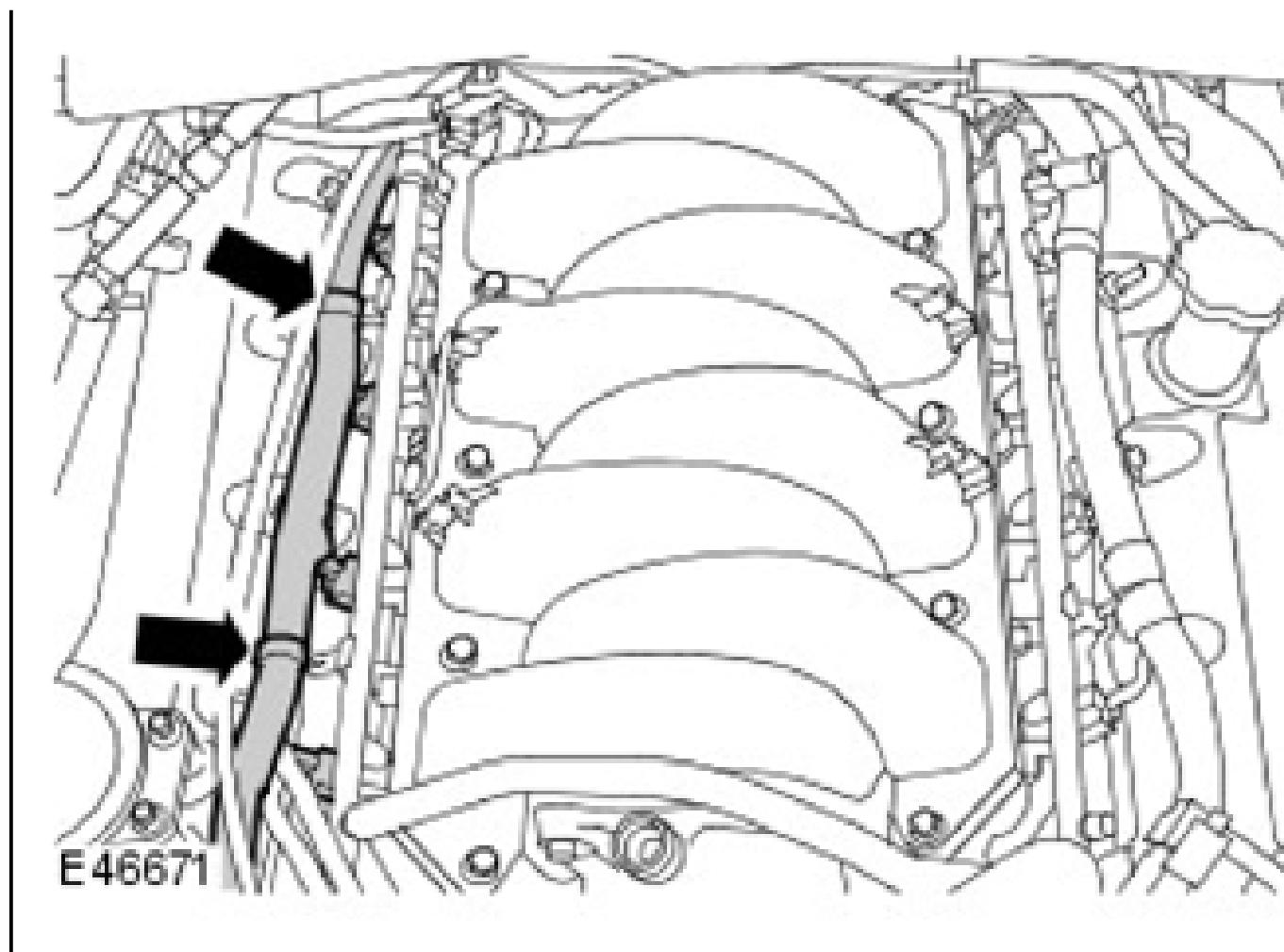
- Remove the bolt.
- Remove and discard the seal.



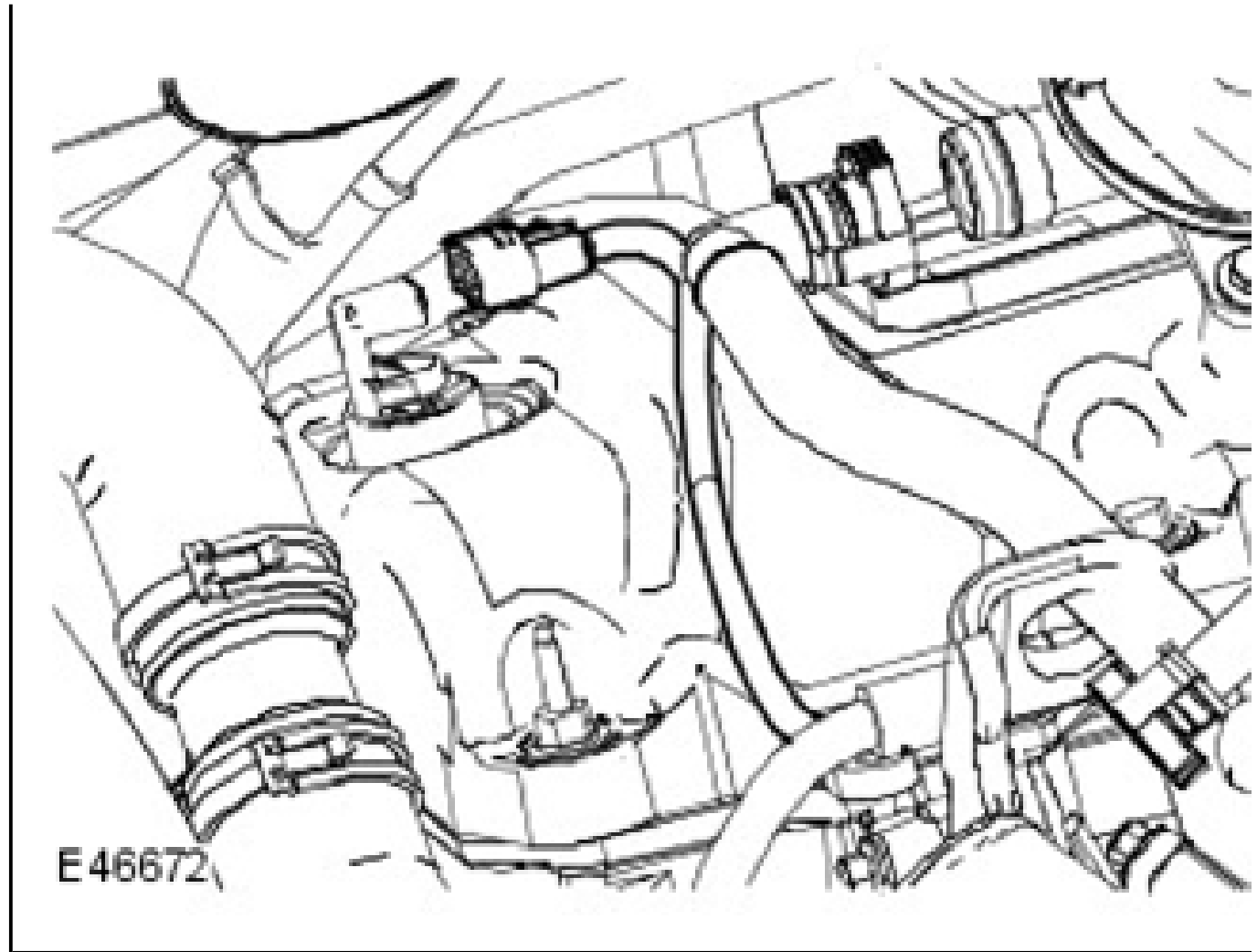
16. Remove the remaining RH ignition coil-on-plugs.
17. Disconnect the positive crankcase ventilation (PCV) line.



18. Release the engine wiring harness from the retaining bracket.



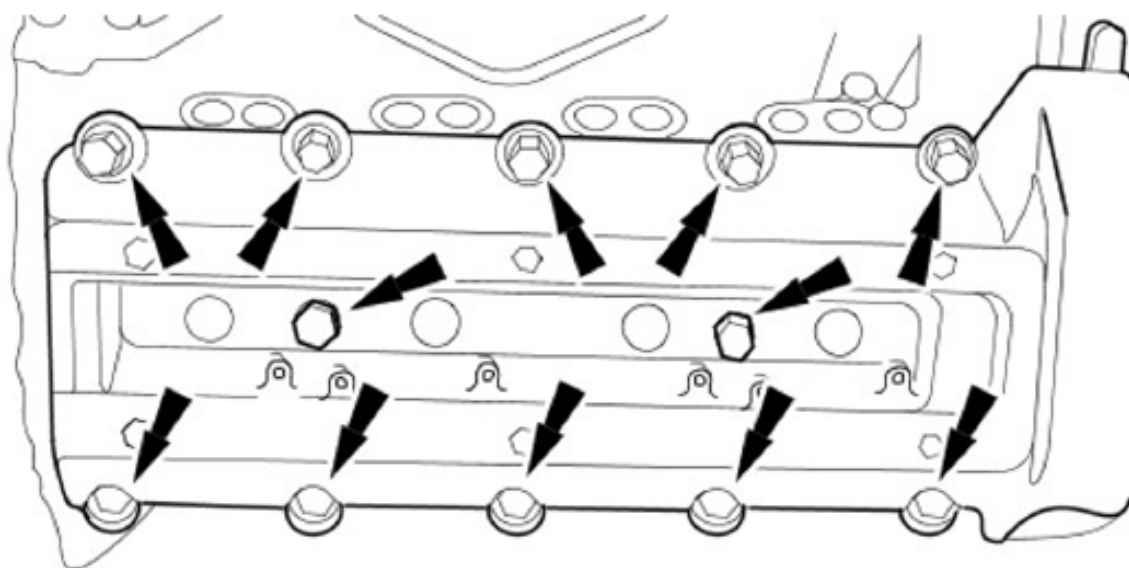
19. Disconnect the RH variable camshaft timing (VCT) oil solenoid electrical connector.



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

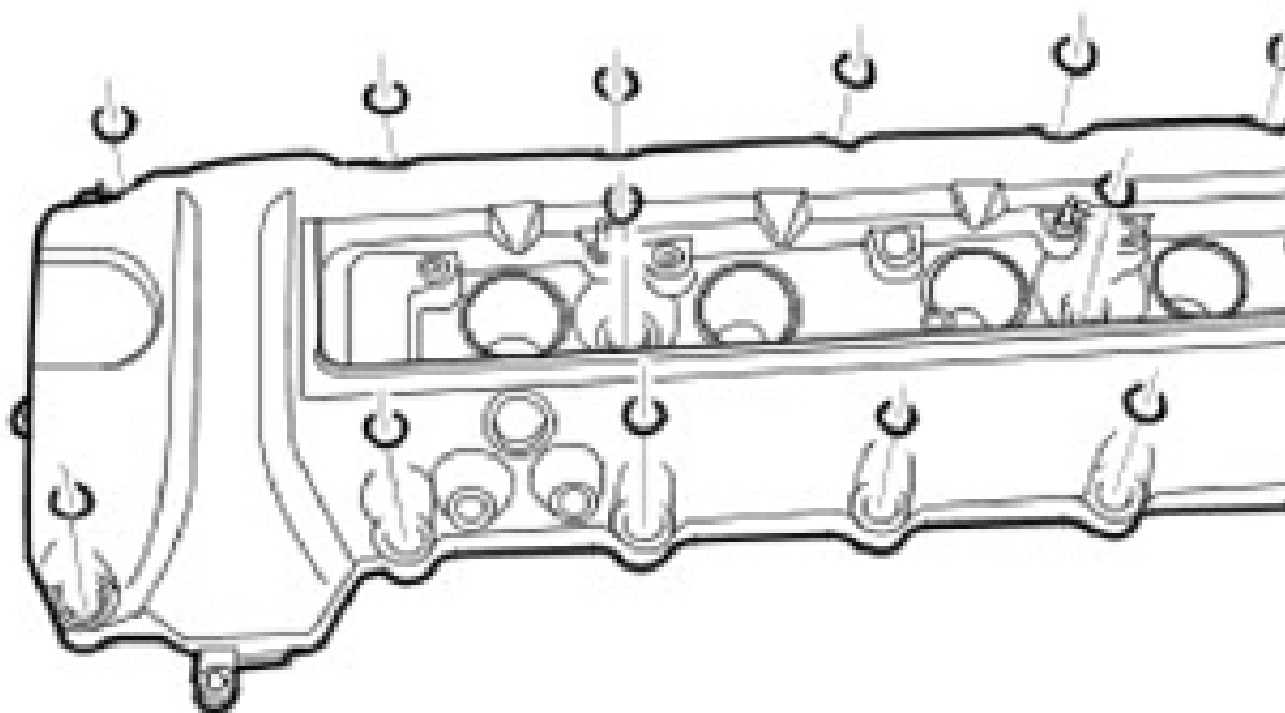
20. Remove the RH valve cover.

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



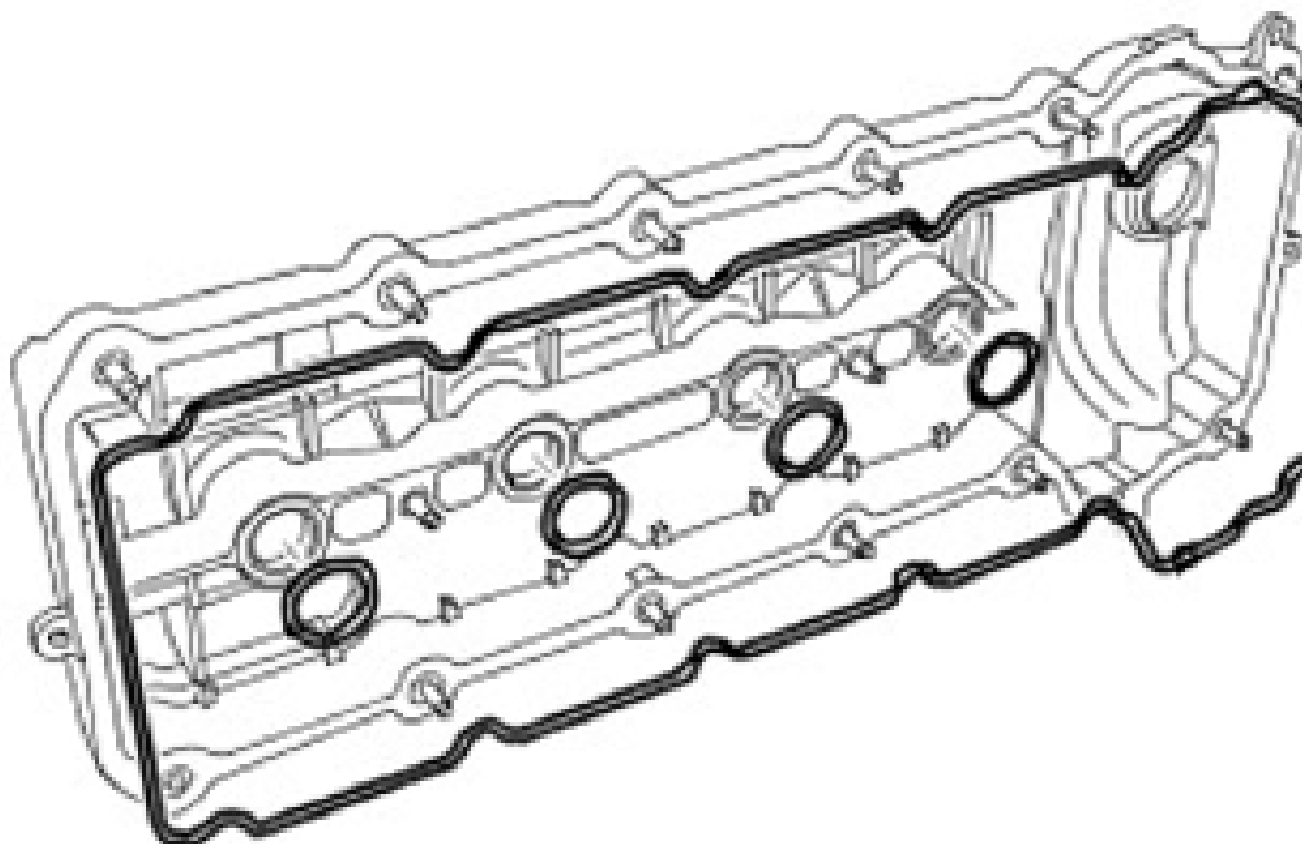
E30696

21. Remove and discard the RH valve cover bolt O-ring seals.



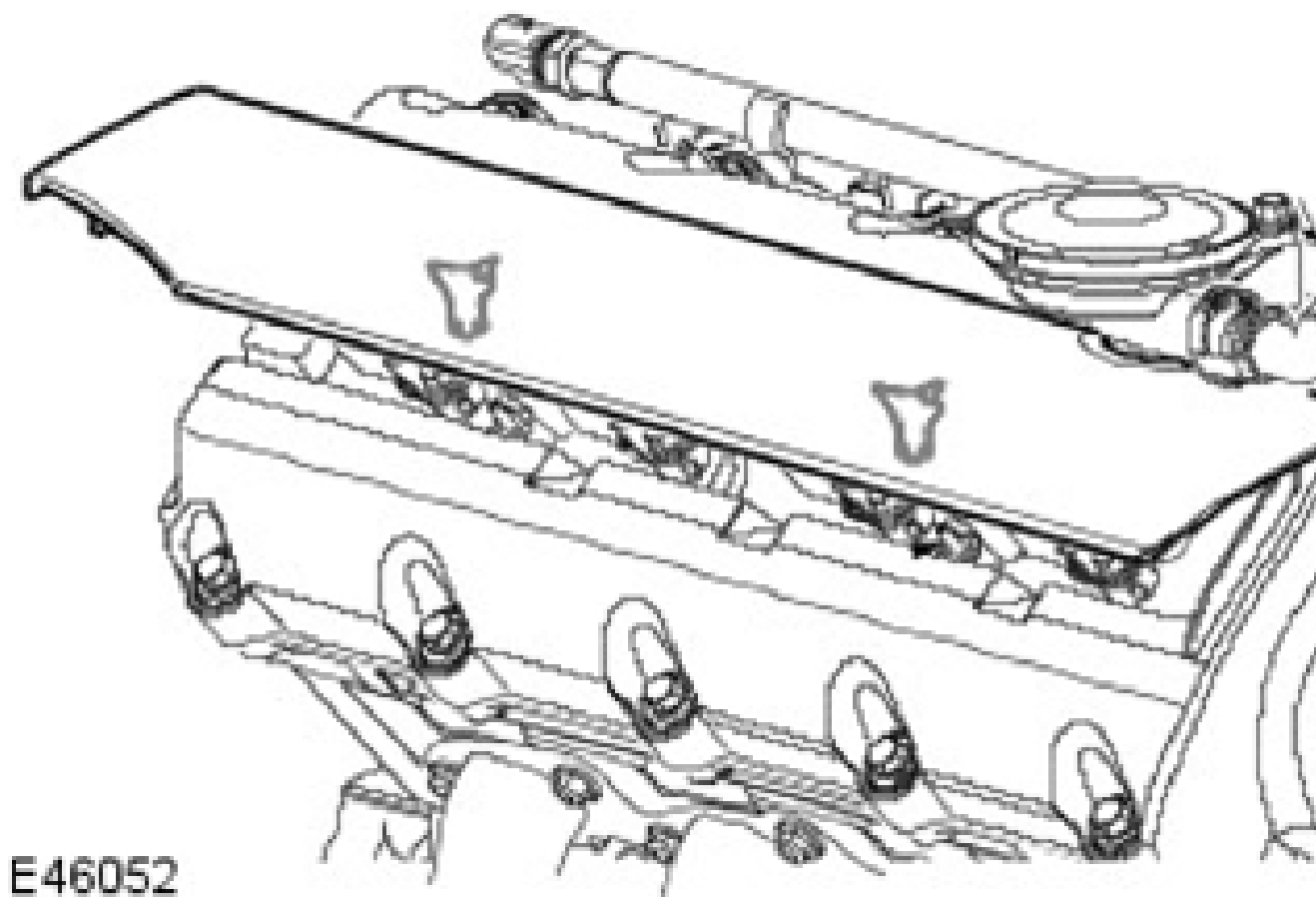
E46676

22. Remove and discard the RH valve cover gaskets.
- Remove and discard the seals.

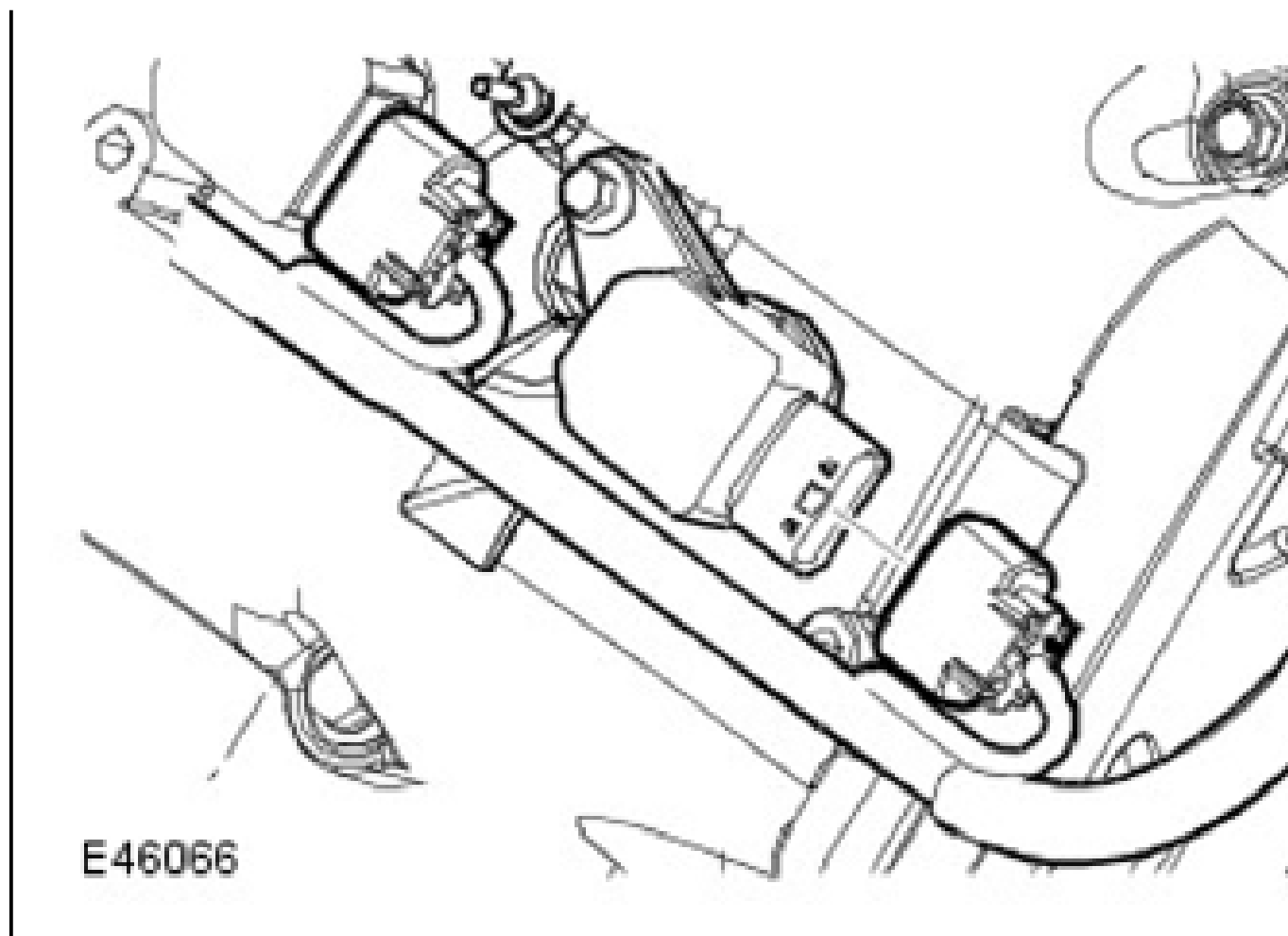


E46677

23. Remove the LH ignition coil-on-plug cover.
- Release from the 2 clips.

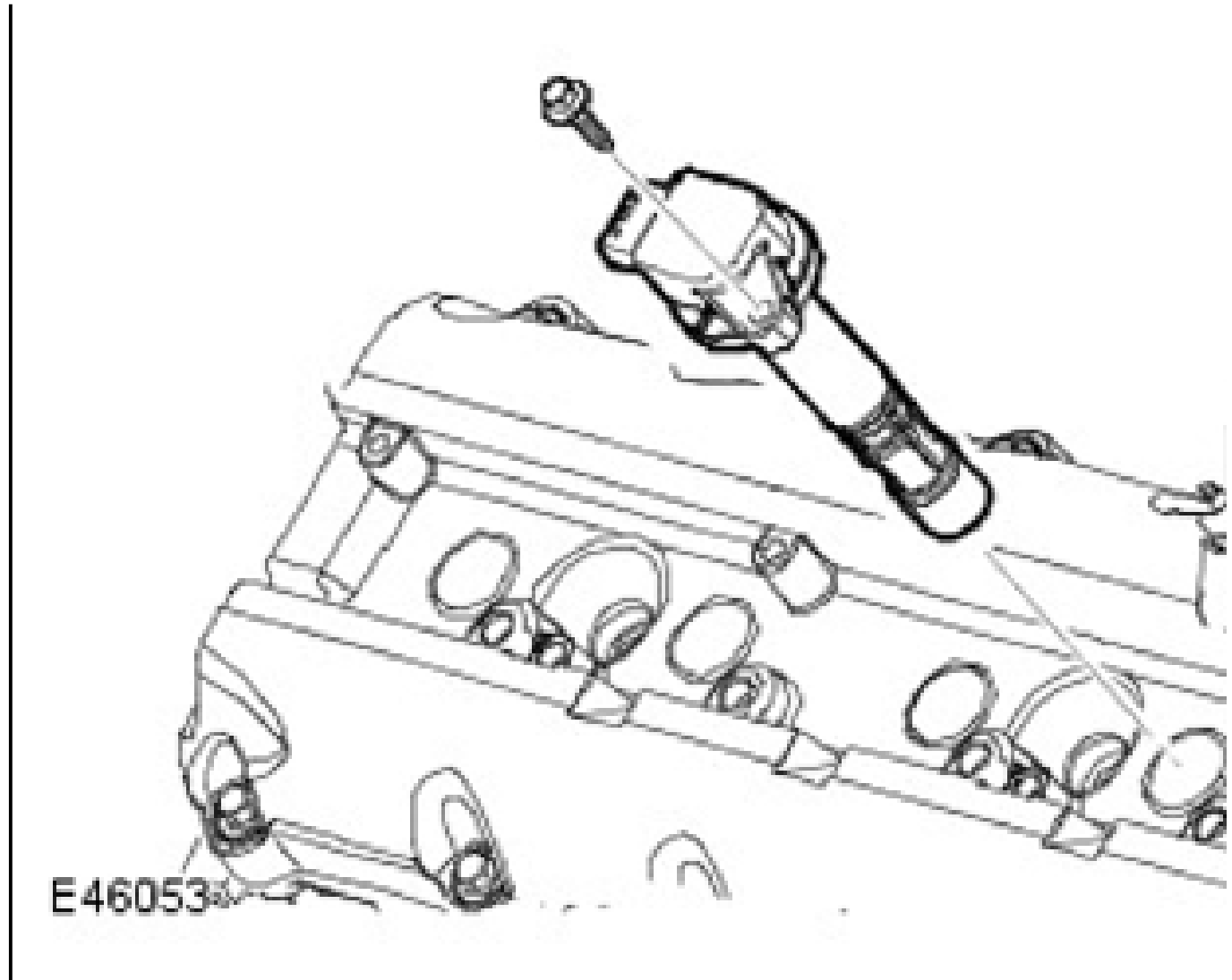


24. Disconnect the LH ignition coil-on-plug electrical connector.

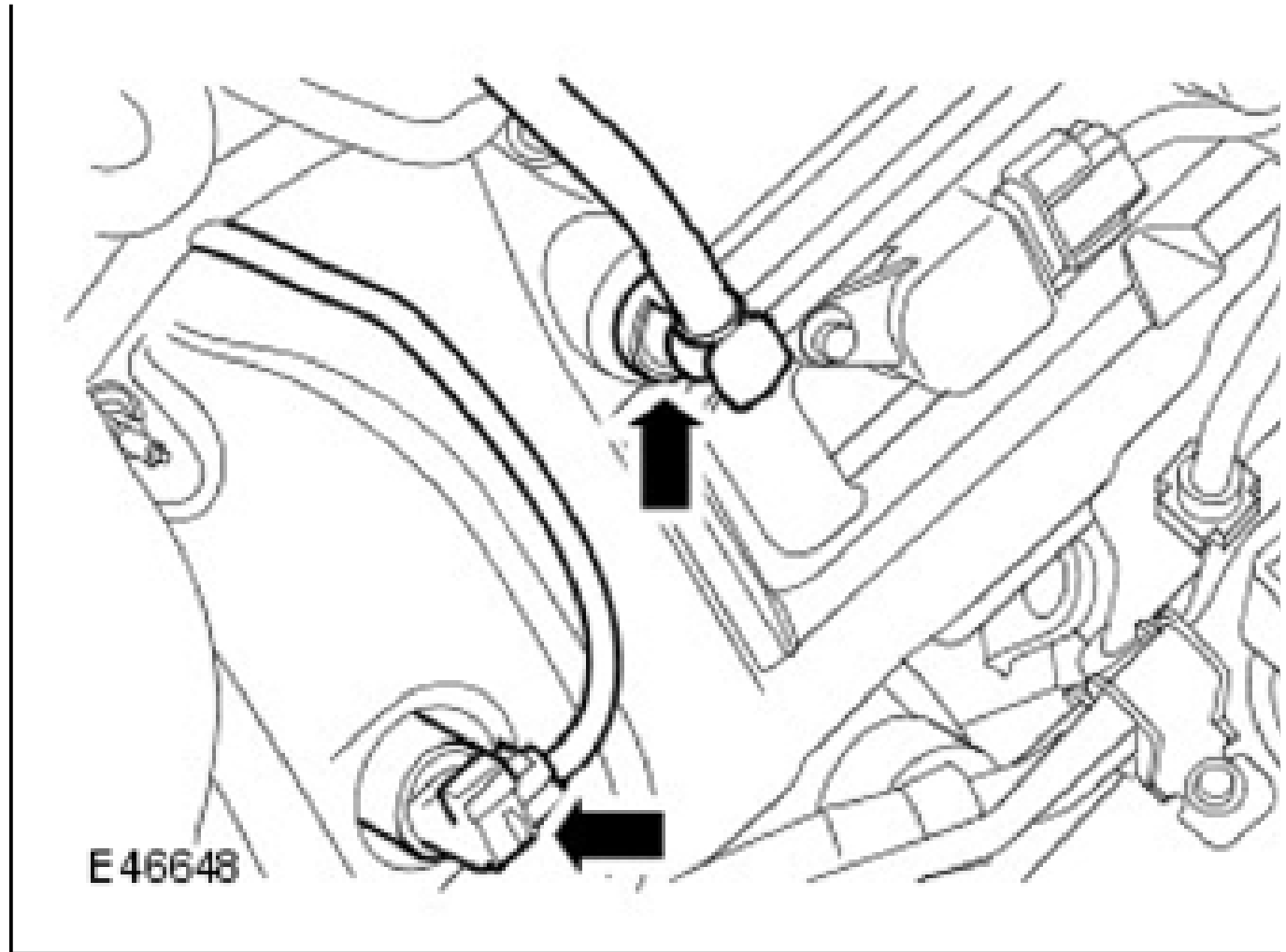


25. Remove the LH ignition coil-on-plug.

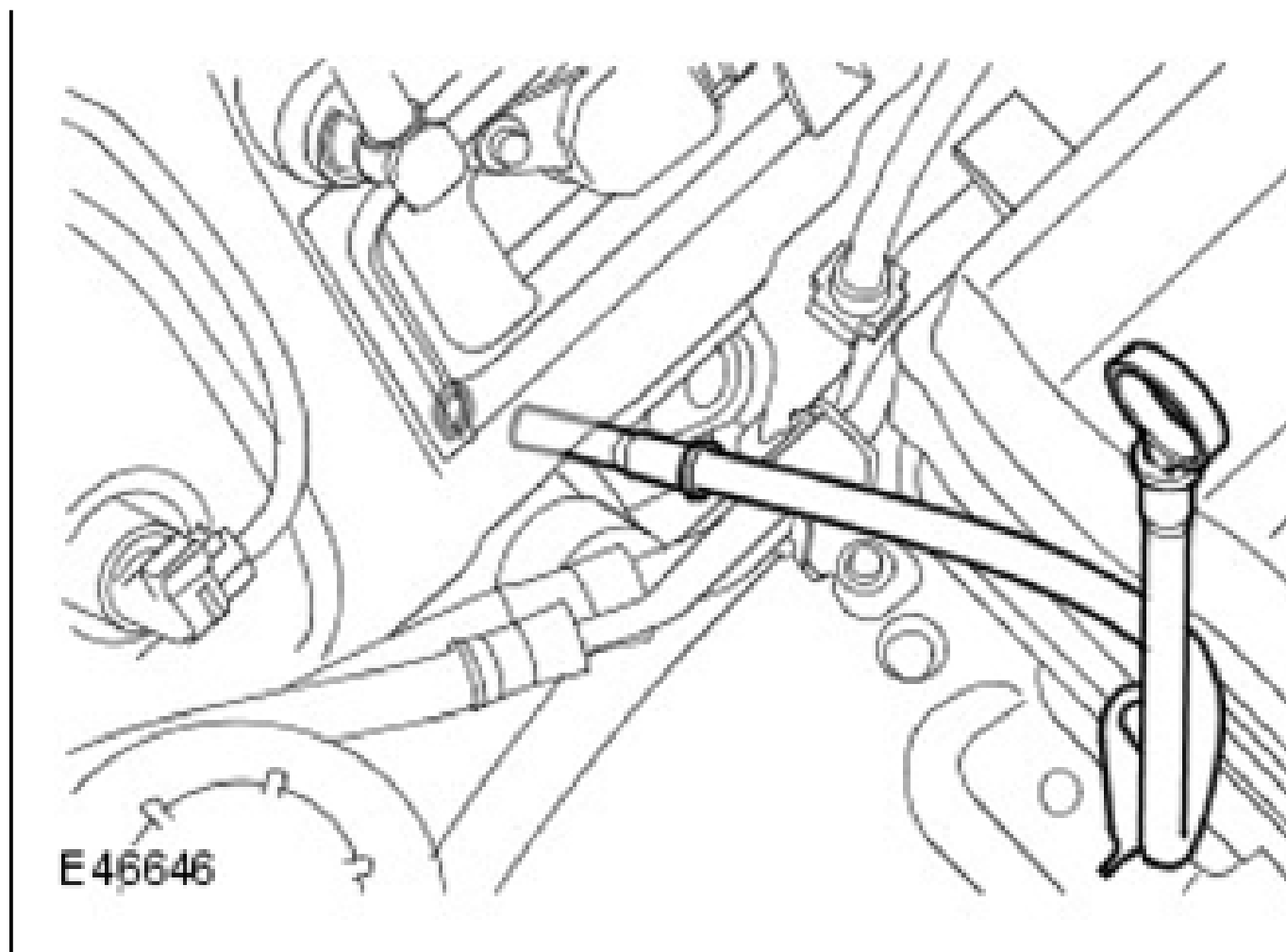
- Remove the bolt.
- Remove and discard the seal.



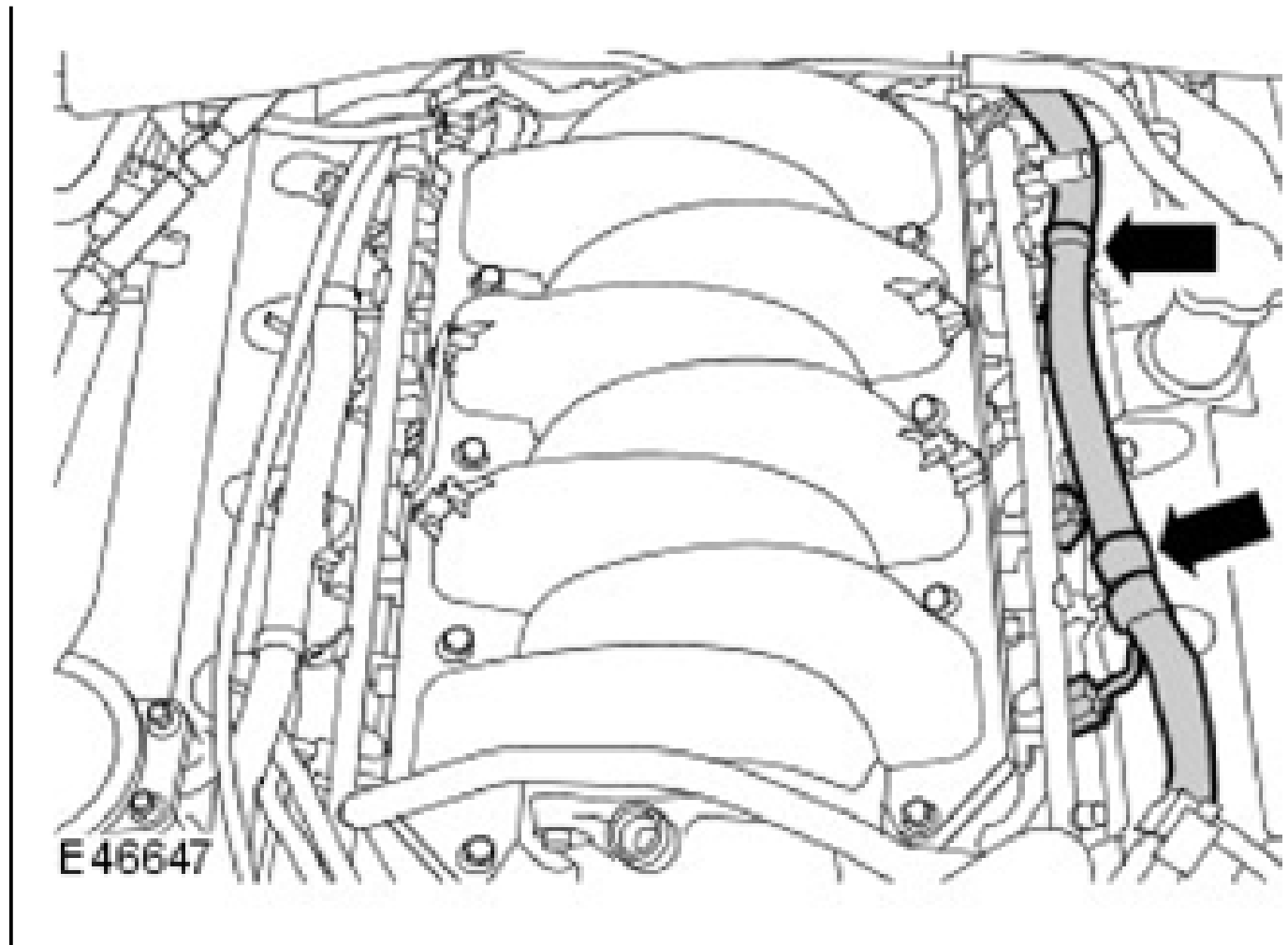
26. Remove the remaining LH ignition coil-on-plugs.
27. Disconnect the LH variable camshaft timing (VCT) oil solenoid electrical connector.
28. Disconnect the valve cover breather hose.



29. Remove the oil level indicator and tube.
- Remove the oil level indicator.
 - Remove the nut.
 - Remove the tube.
 - Remove and discard the O-ring seal.

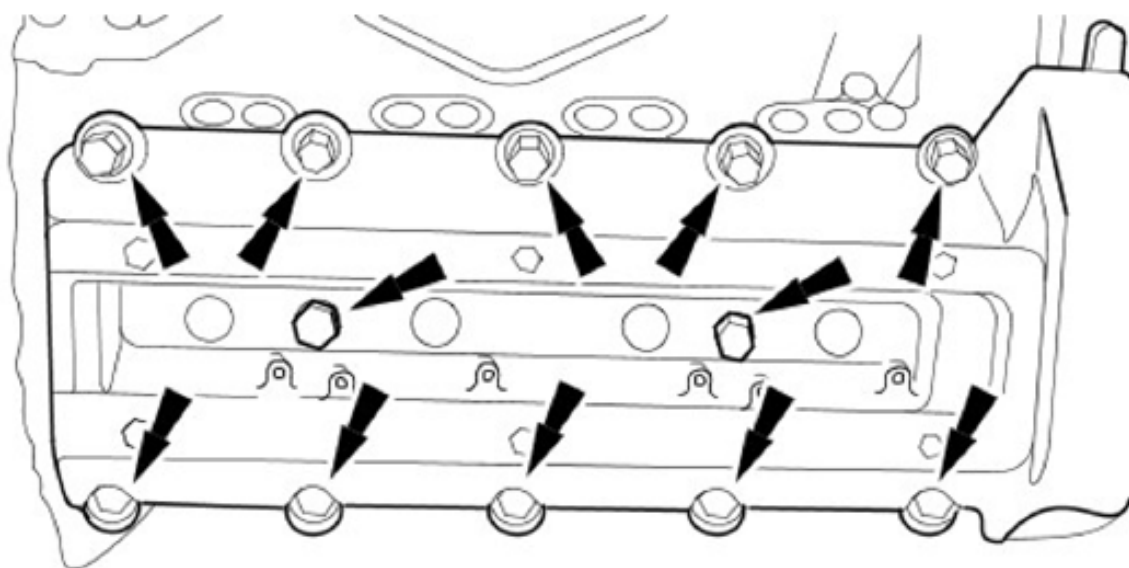


30. Release the engine wiring harness from the retaining bracket.



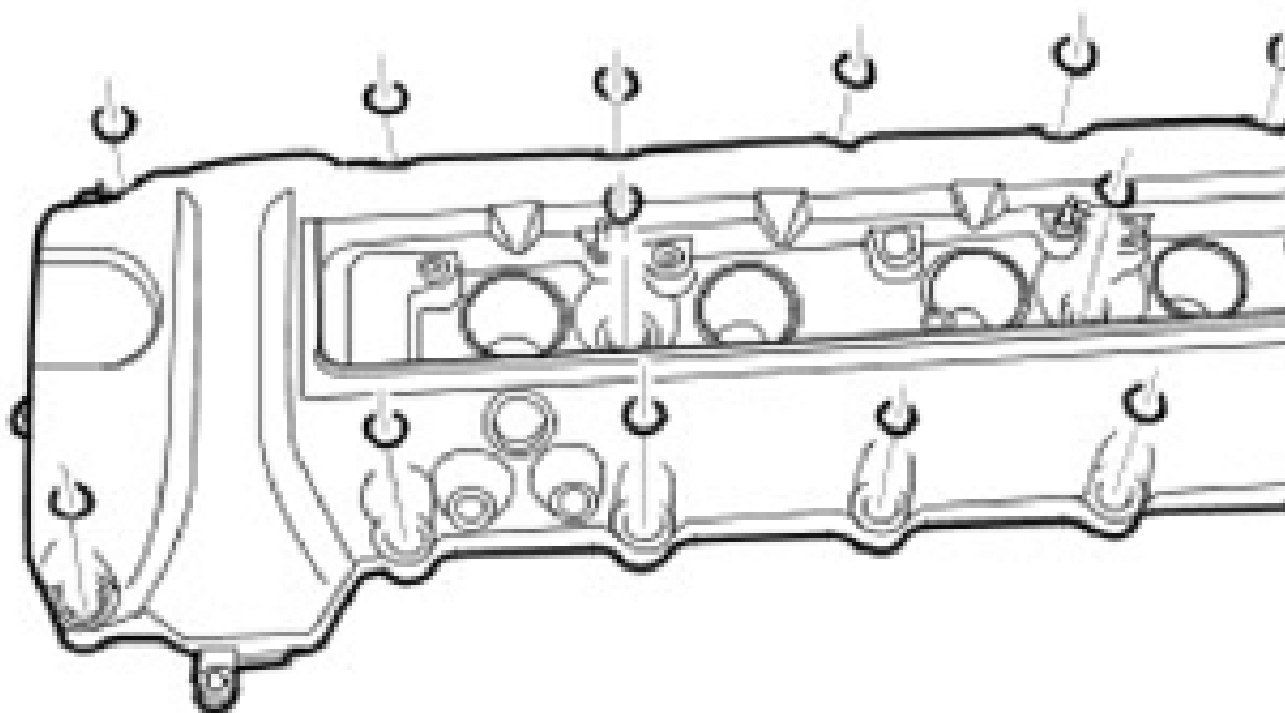
NOTE: Note the fitted position of the retaining bolts prior to removal.

31. Remove the LH valve cover.
 - Remove the 14 valve cover retaining bolts.



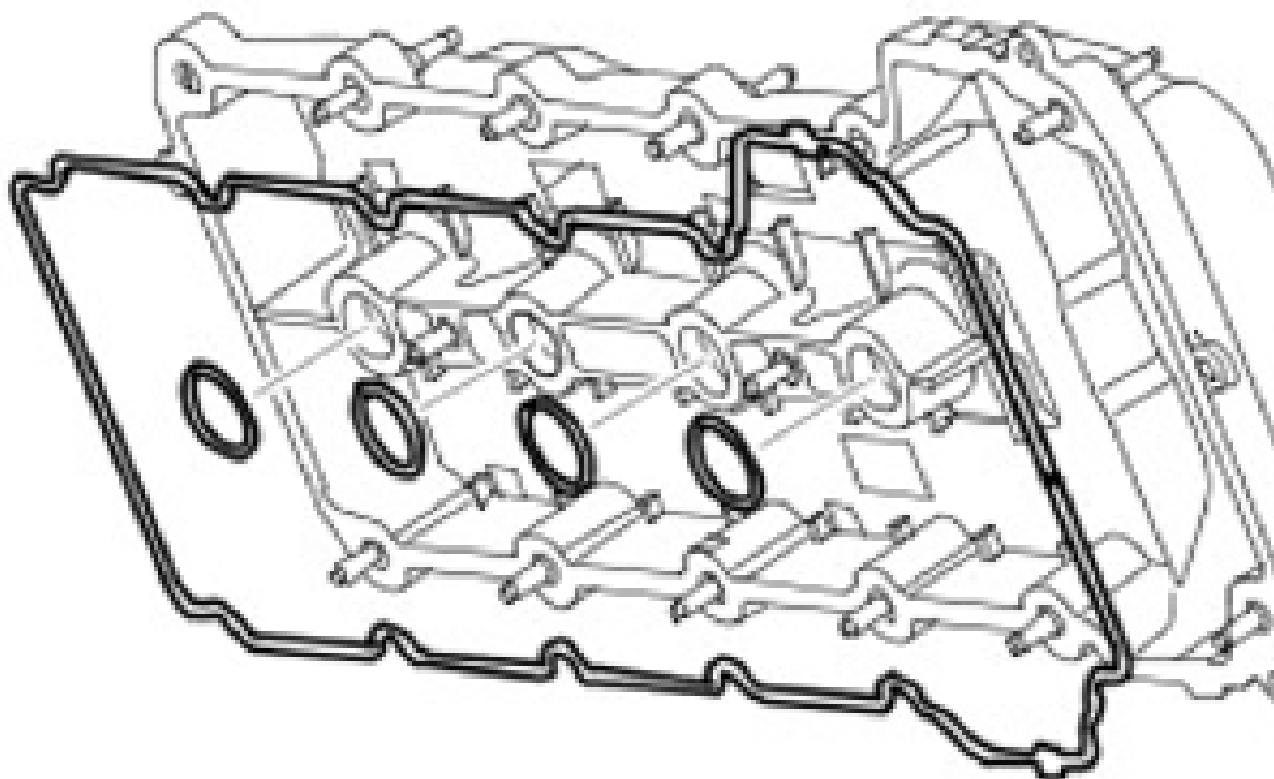
E30696

32. Remove and discard the LH valve cover bolt O-ring seals.



E46676

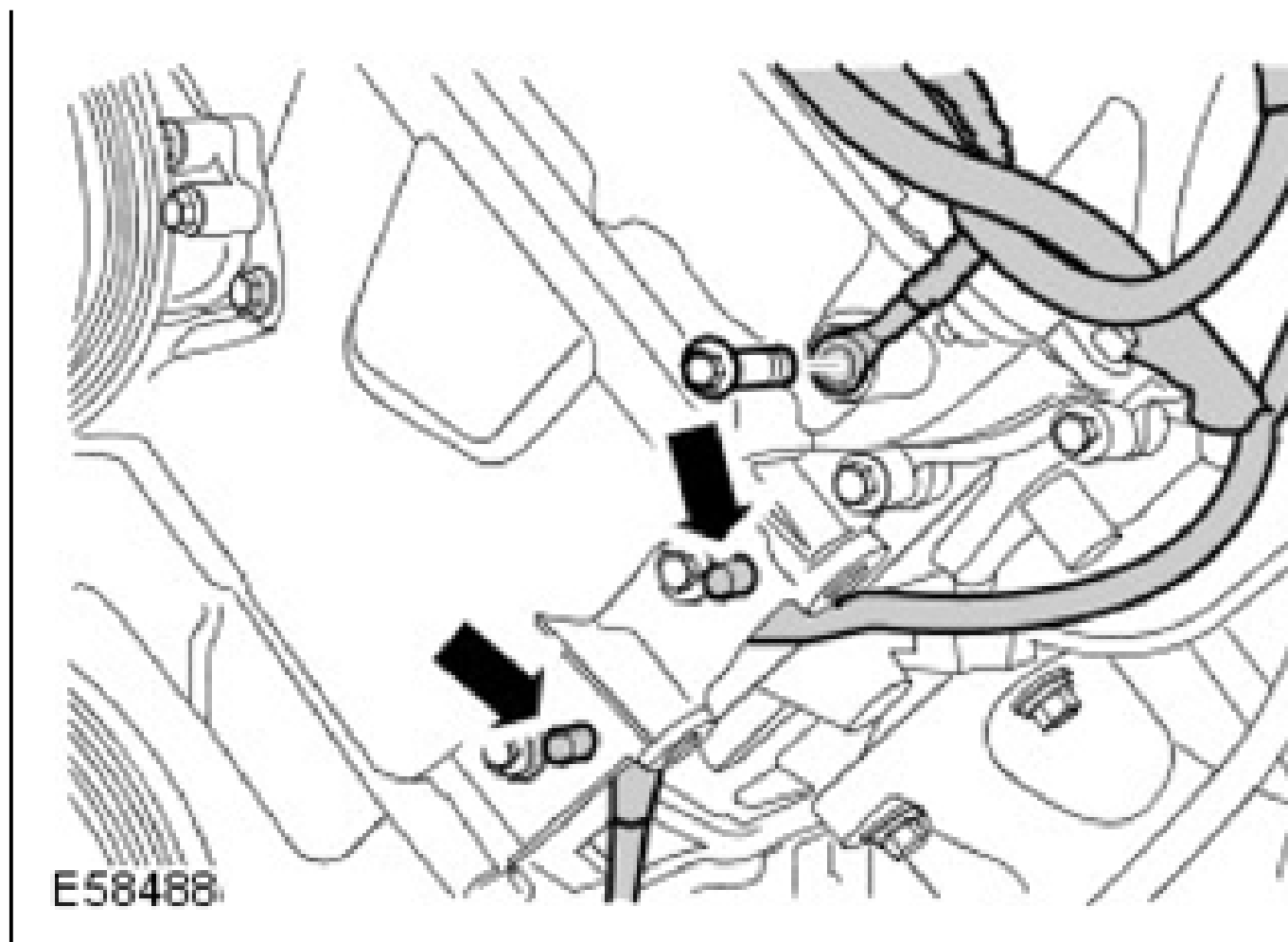
33. Remove and discard the LH valve cover gaskets.
- Remove and discard the seals.



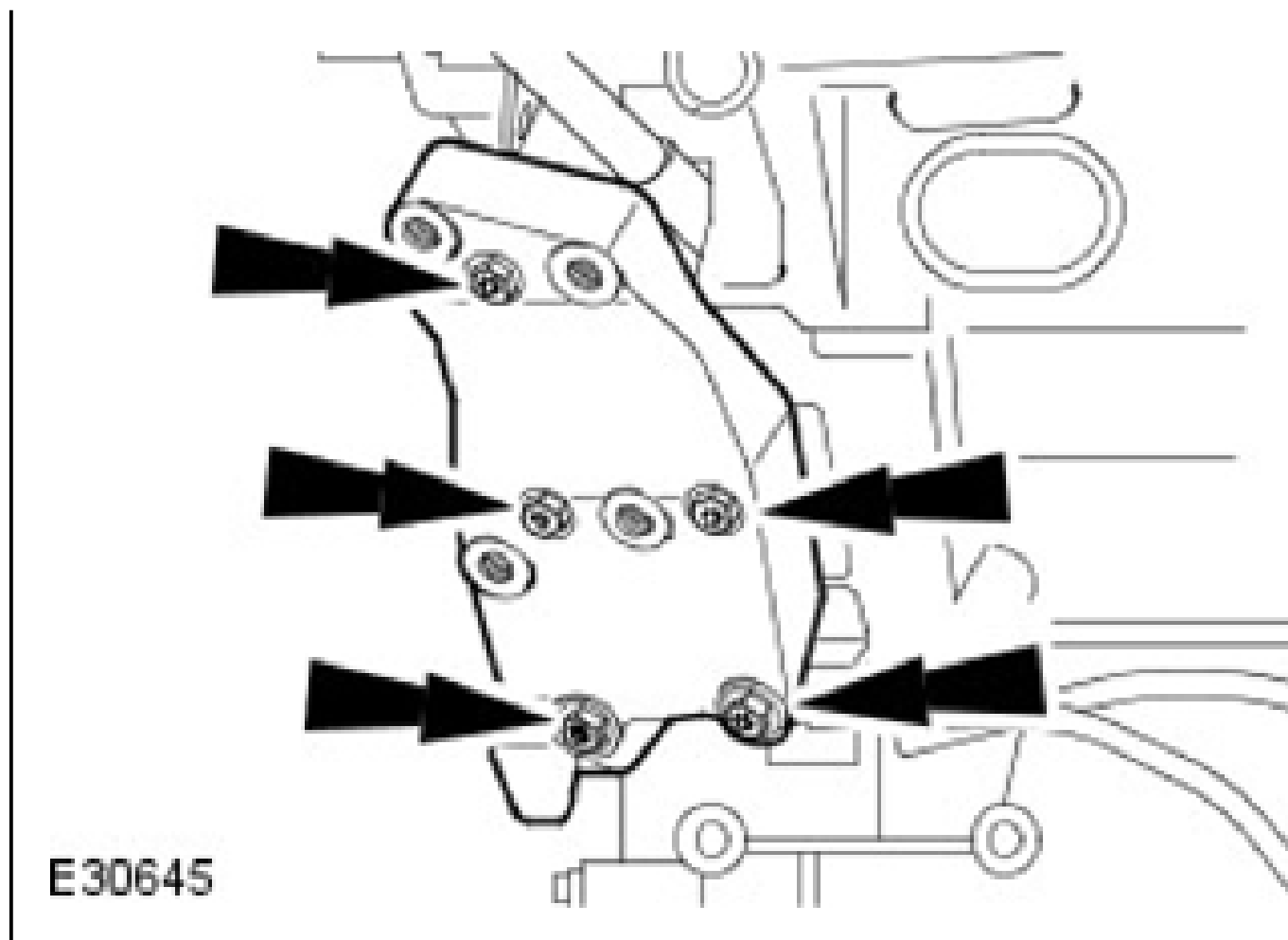
E 46652

34. Release the engine wiring harness.

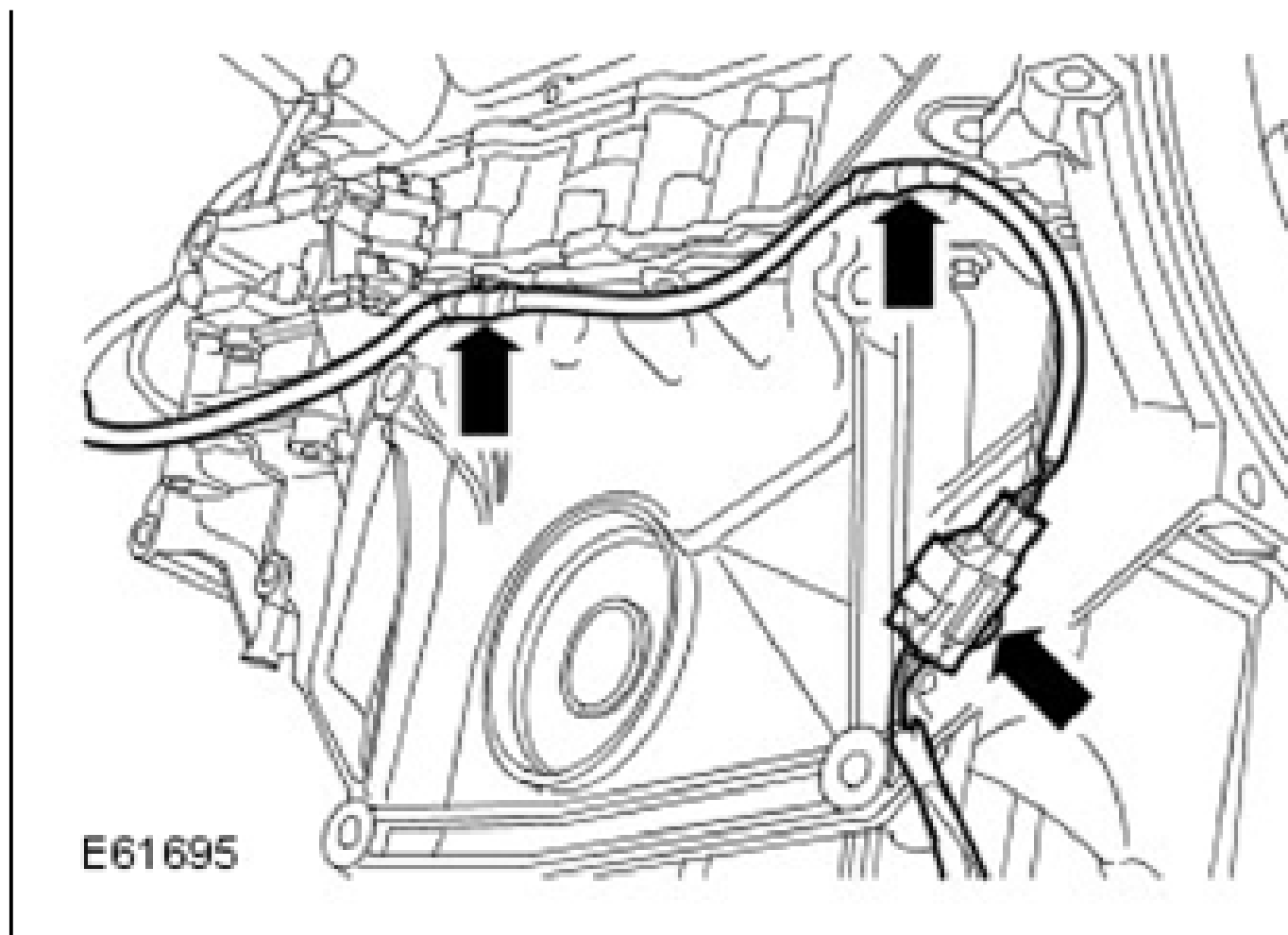
- Release the 2 clips.
- Remove the bolt.



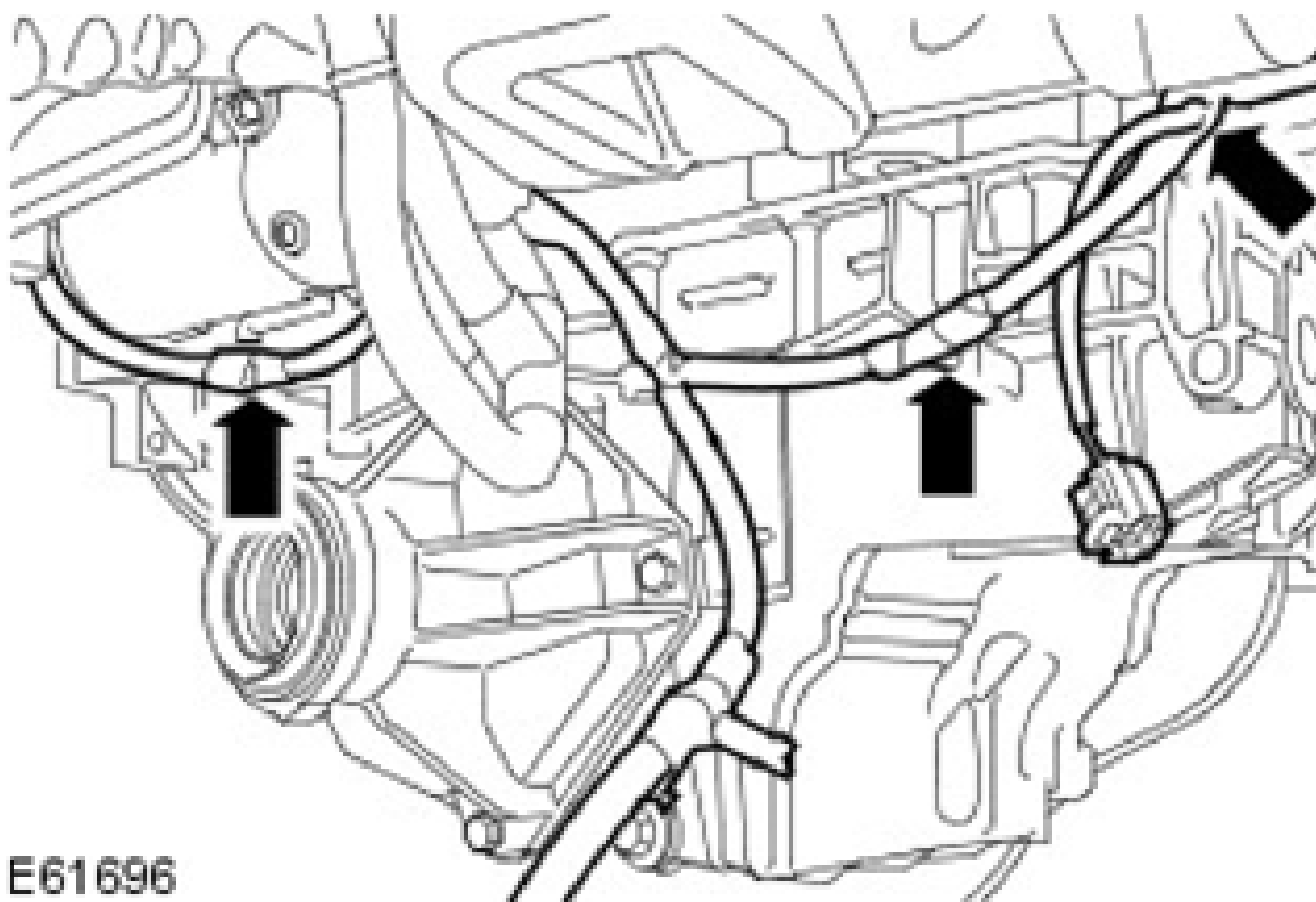
35. Remove the power steering pump mounting bracket.
- Remove the 5 bolts.



36. Release the wiring harness from the LH side of the engine.
- Release the 3 clips.

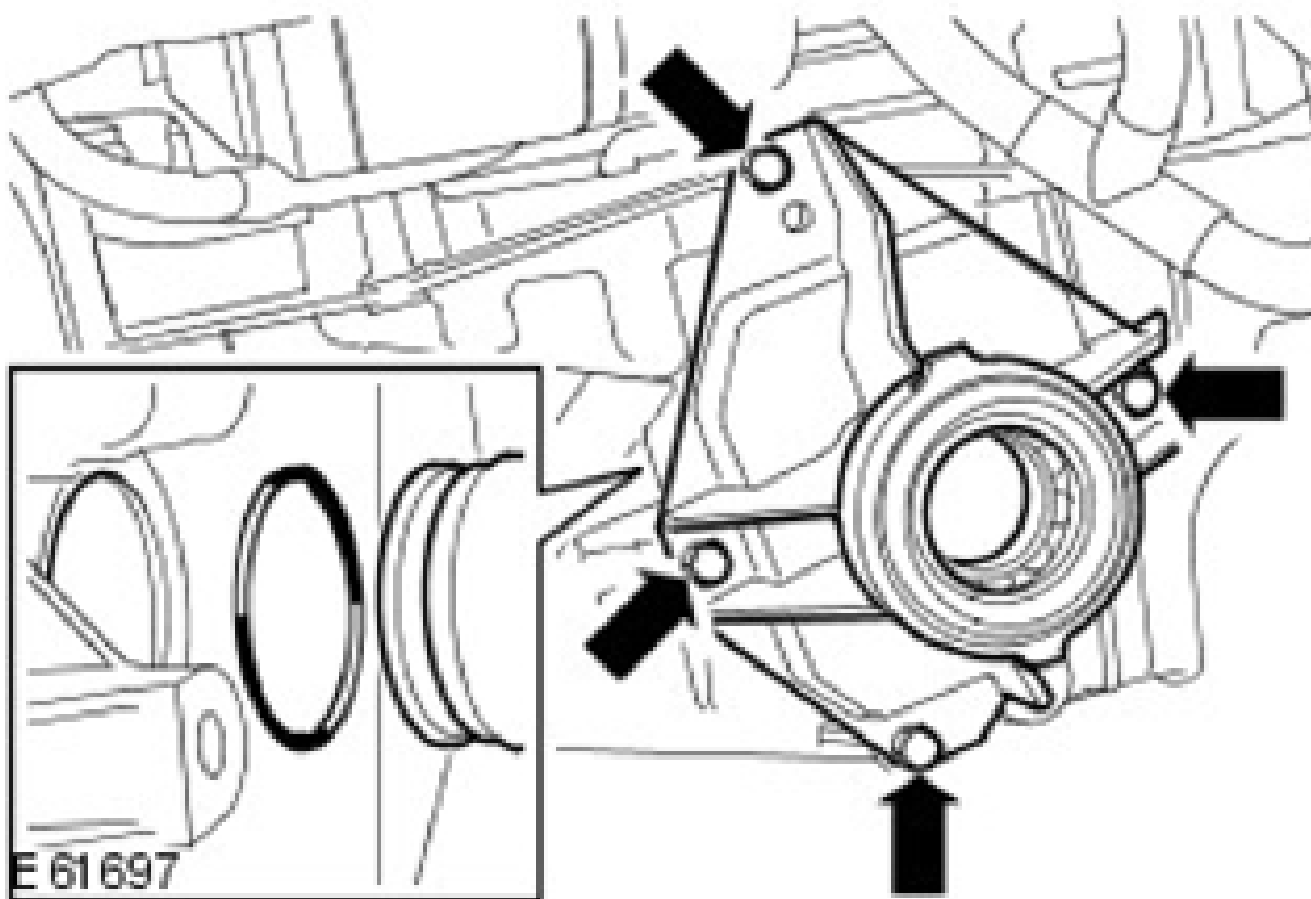


37. Release the wiring harness from the RH side of the engine.
- Release the 3 clips.

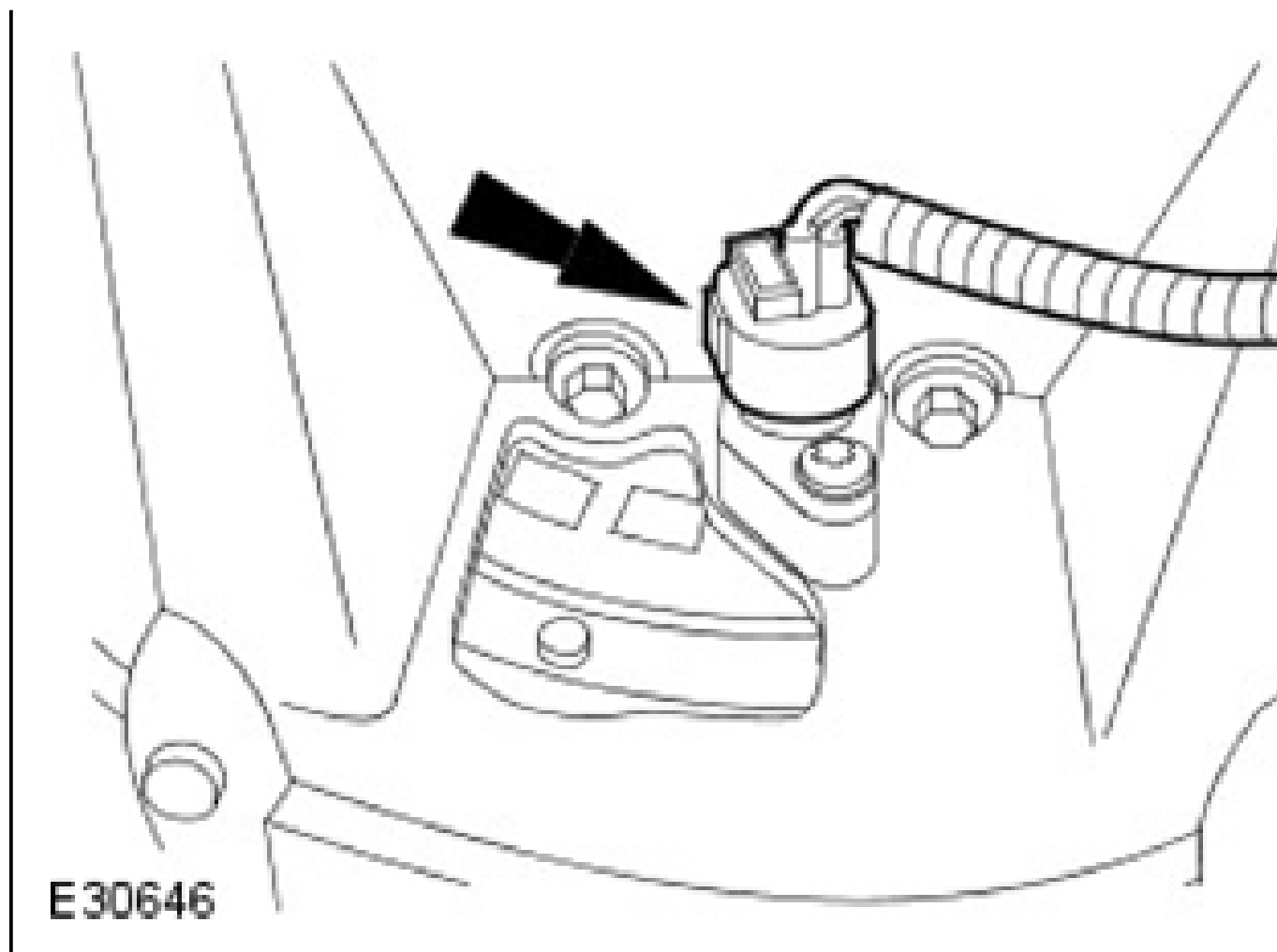


38. Remove the halfshaft support bearing housing.

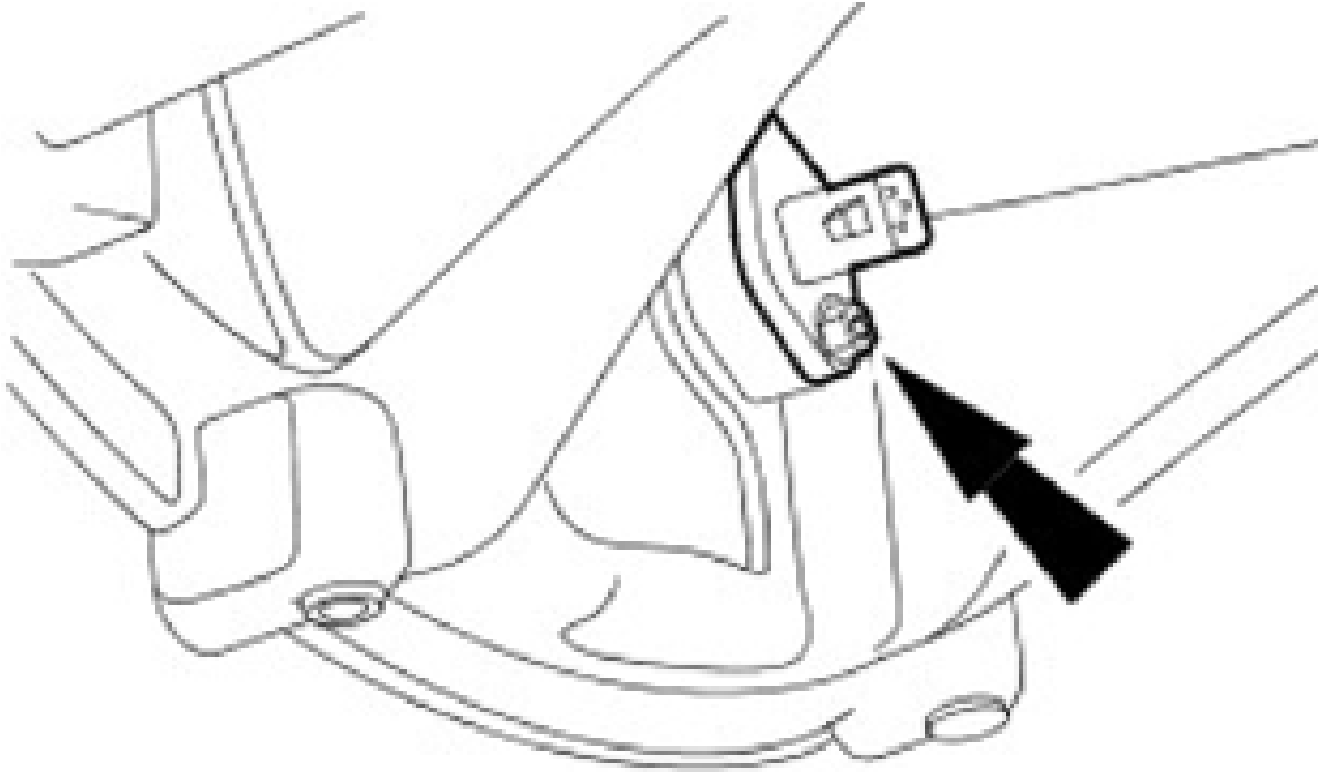
- Remove the 4 bolts.
- Remove and discard the O-ring seal.



39. Disconnect the crankshaft position (CKP) sensor electrical connector.



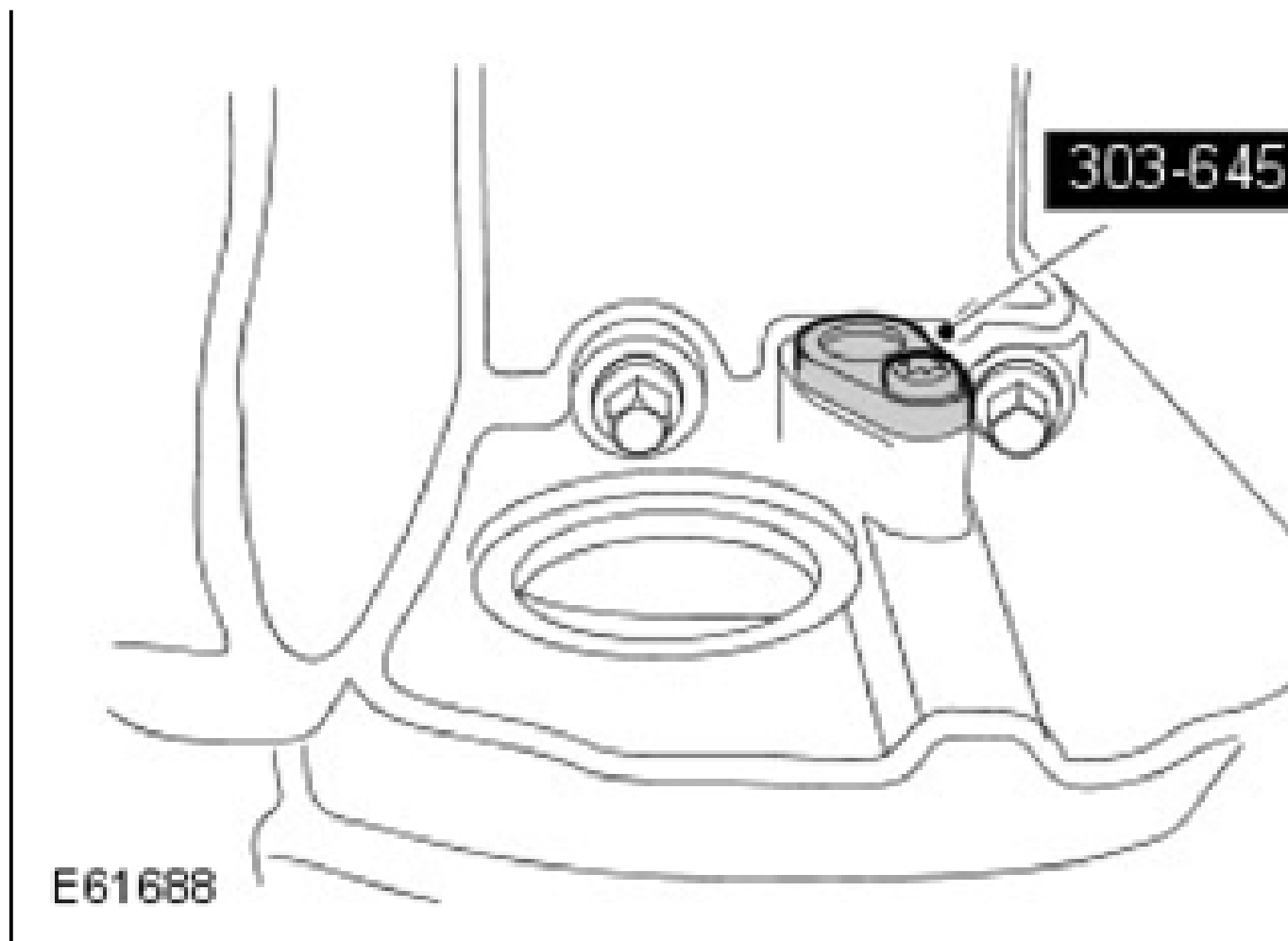
40. Remove the CKP sensor.
- Remove the bolt.



E 30694

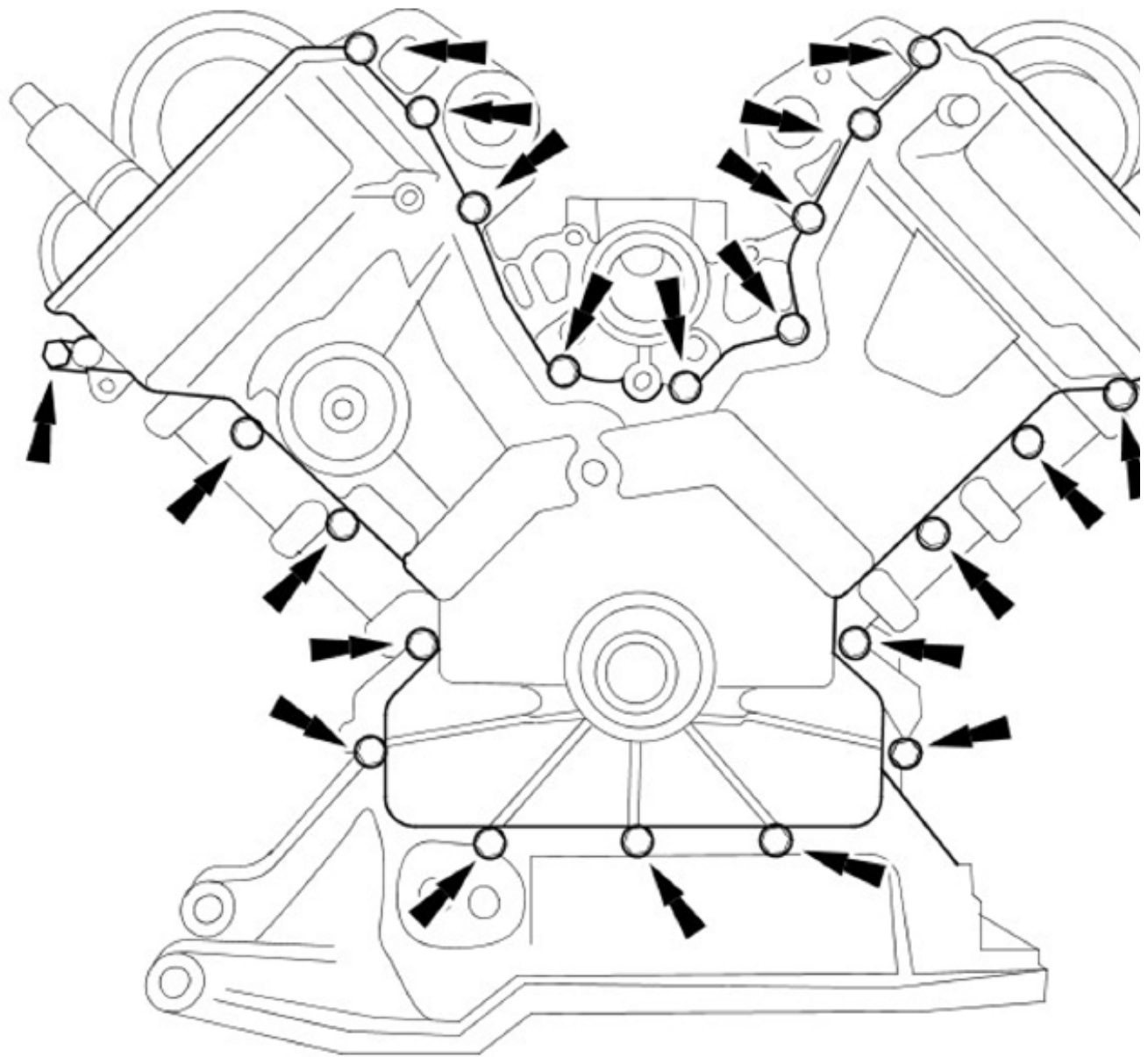
NOTE: Install the special tool to the crankshaft sensor aperture.

41. Lock the crankshaft.
 - Install the special tool.
 - Install the bolt.



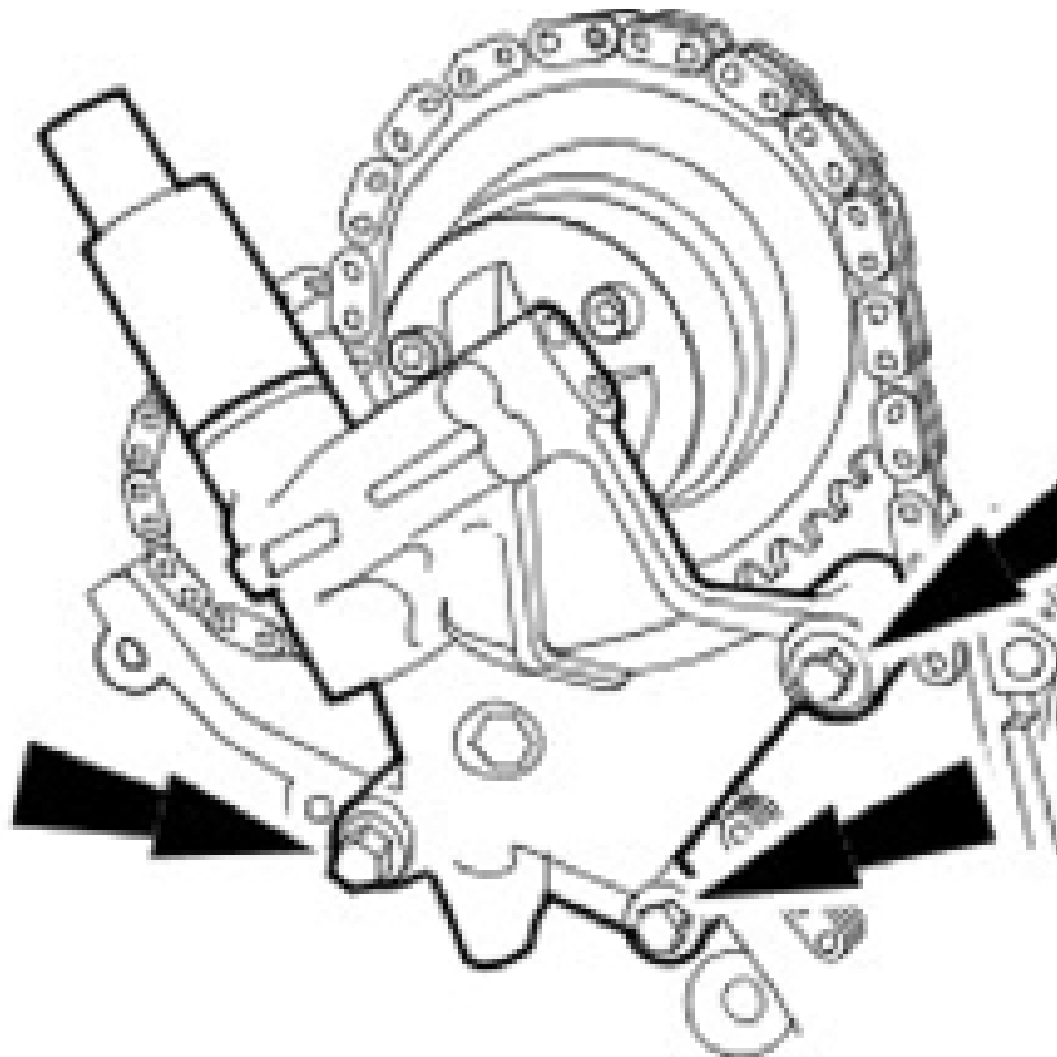
42. Remove the engine front cover.

- Remove the 24 bolts.
- Remove and discard the gasket.
- Remove and discard the 3 O-ring seals.



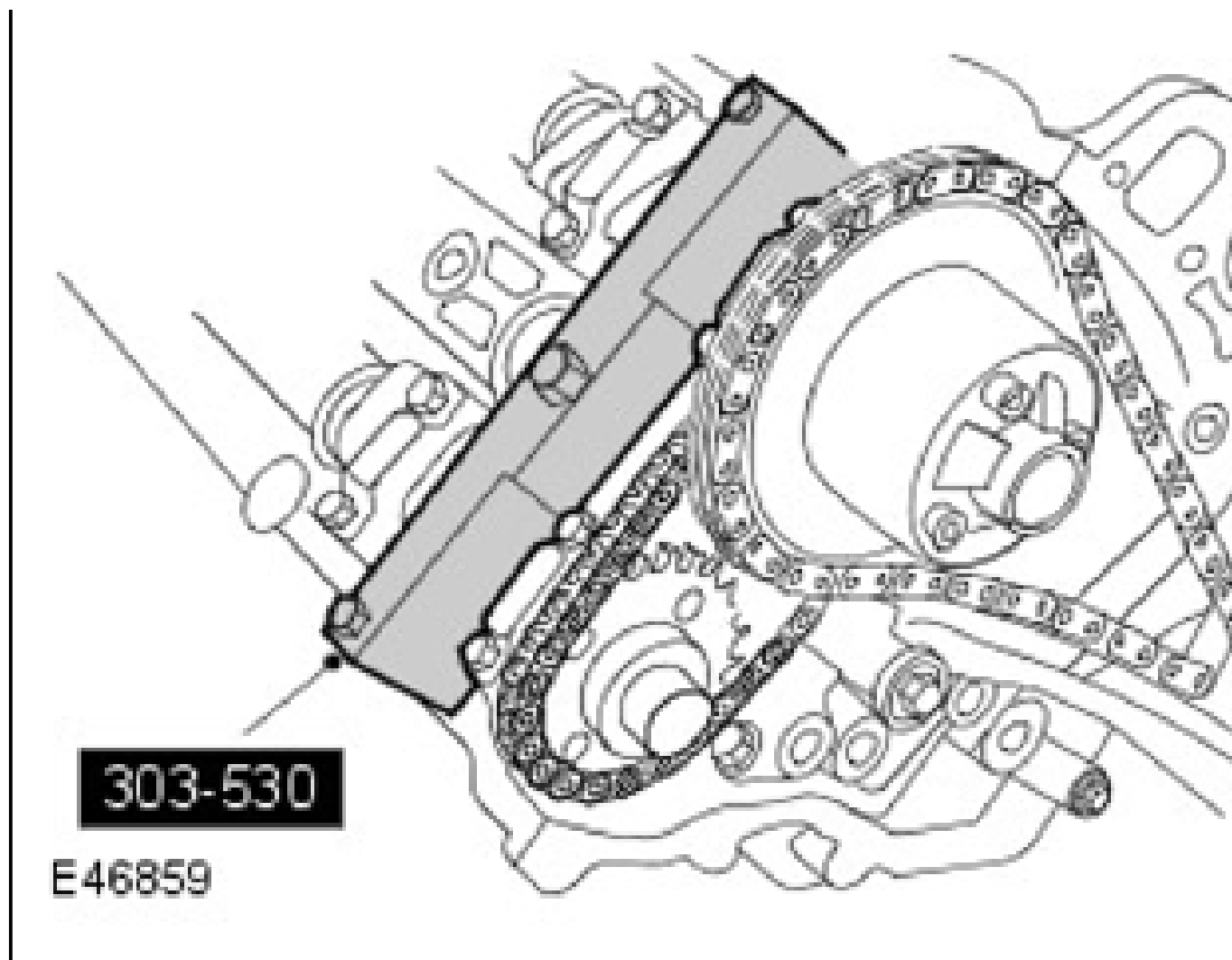
VUJ0002398

43. Remove the RH VCT housing.
- Remove the 3 bolts.
 - Remove and discard the O-ring seals.

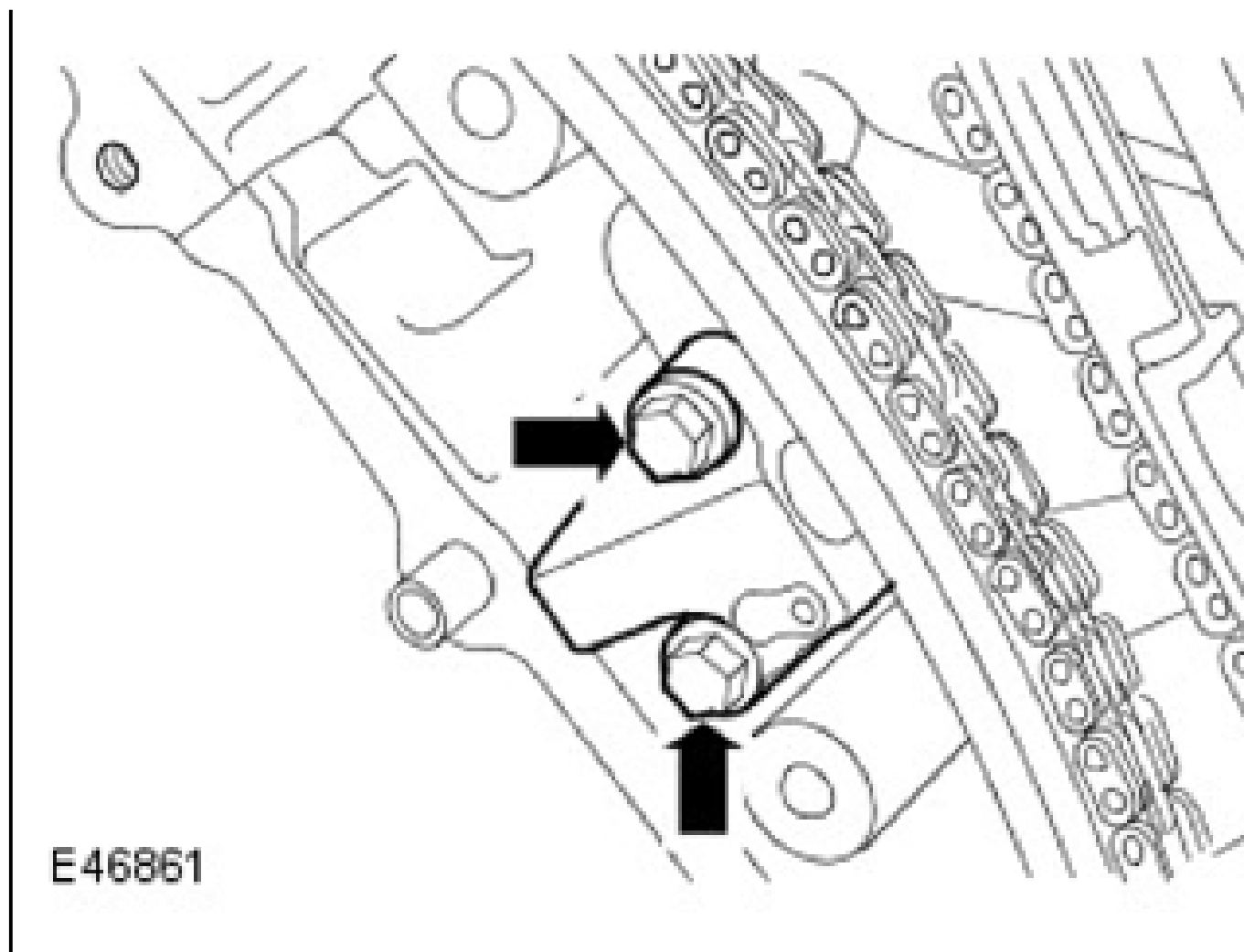


E 30699

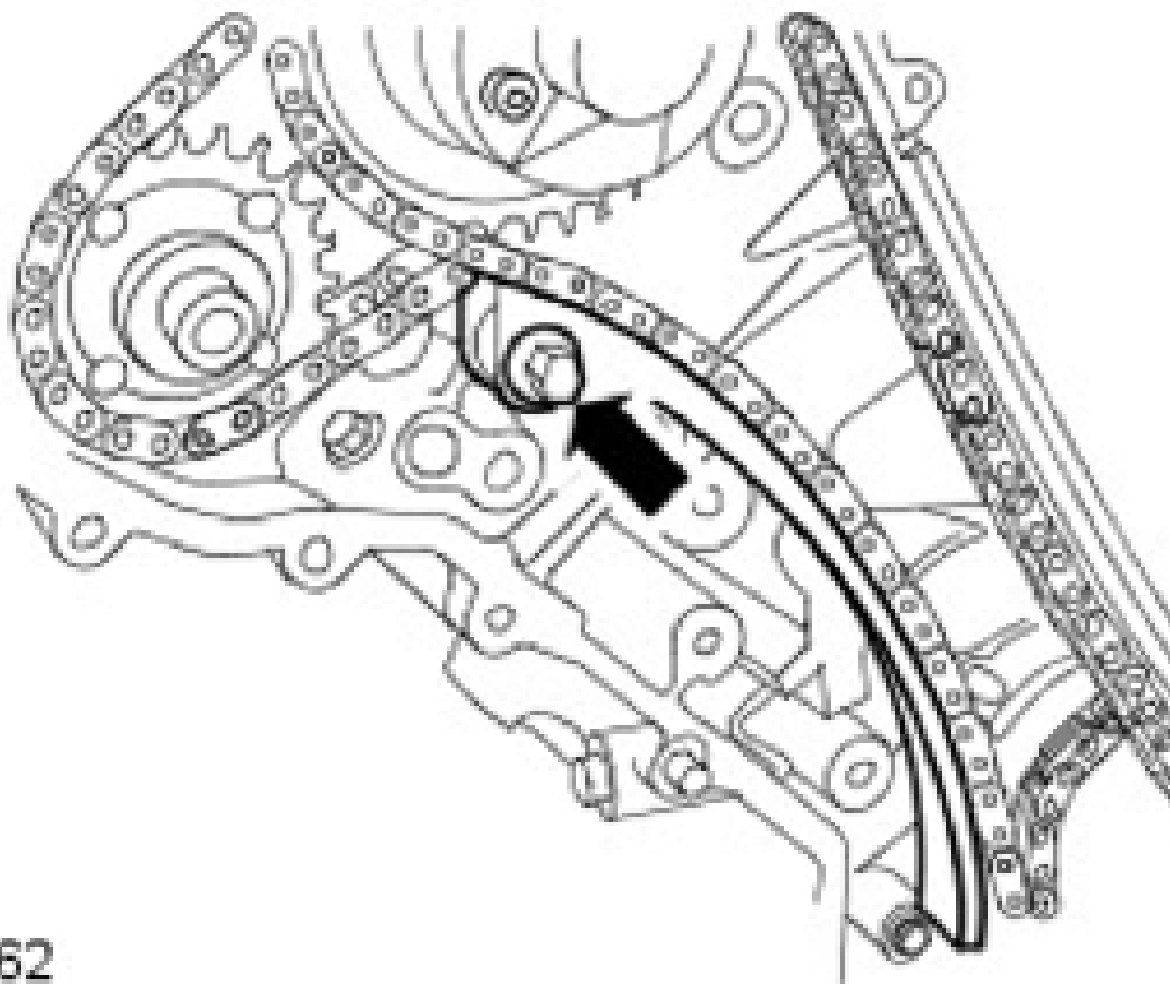
44. Install the special tool to the RH cylinder head.
- Install the 3 bolts.



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

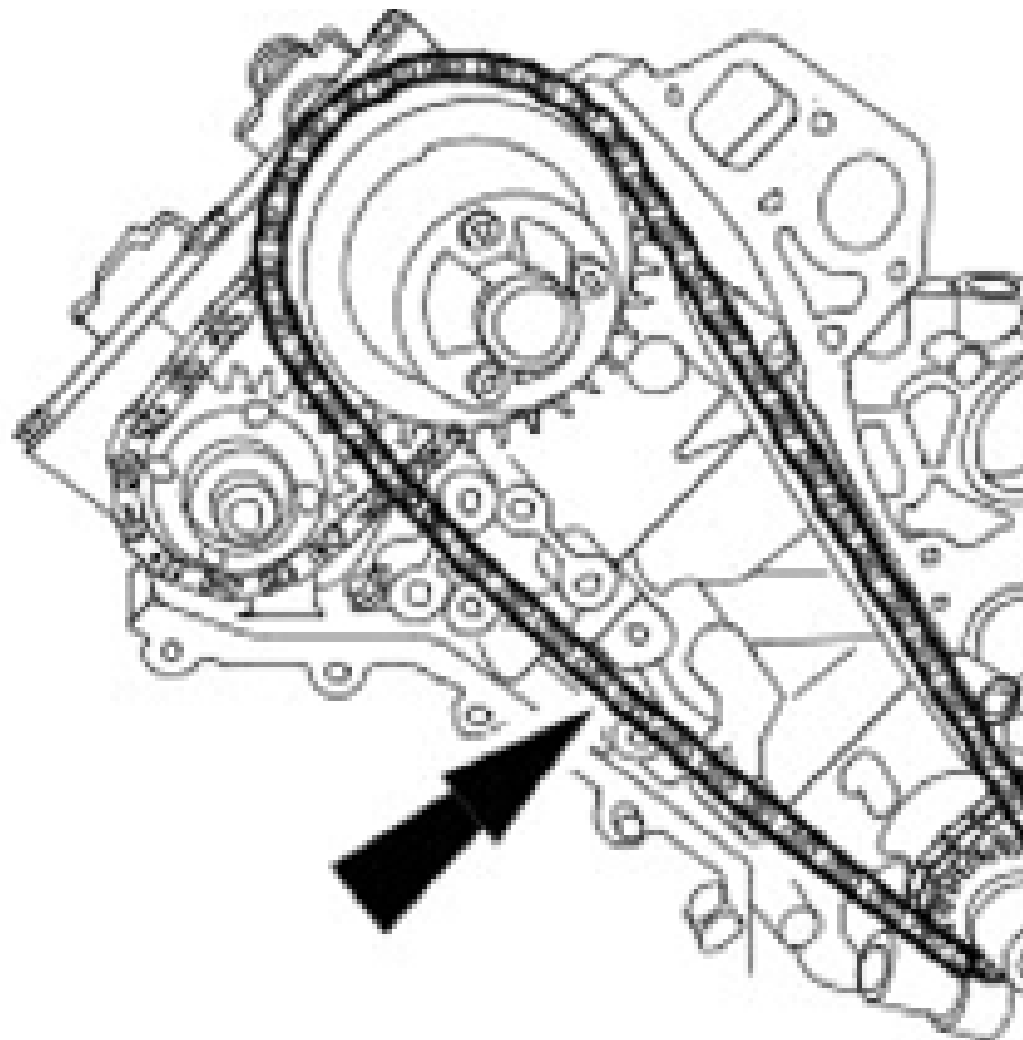


46. Remove the RH primary timing chain tensioner guide.
- Remove the bolt.



E46862

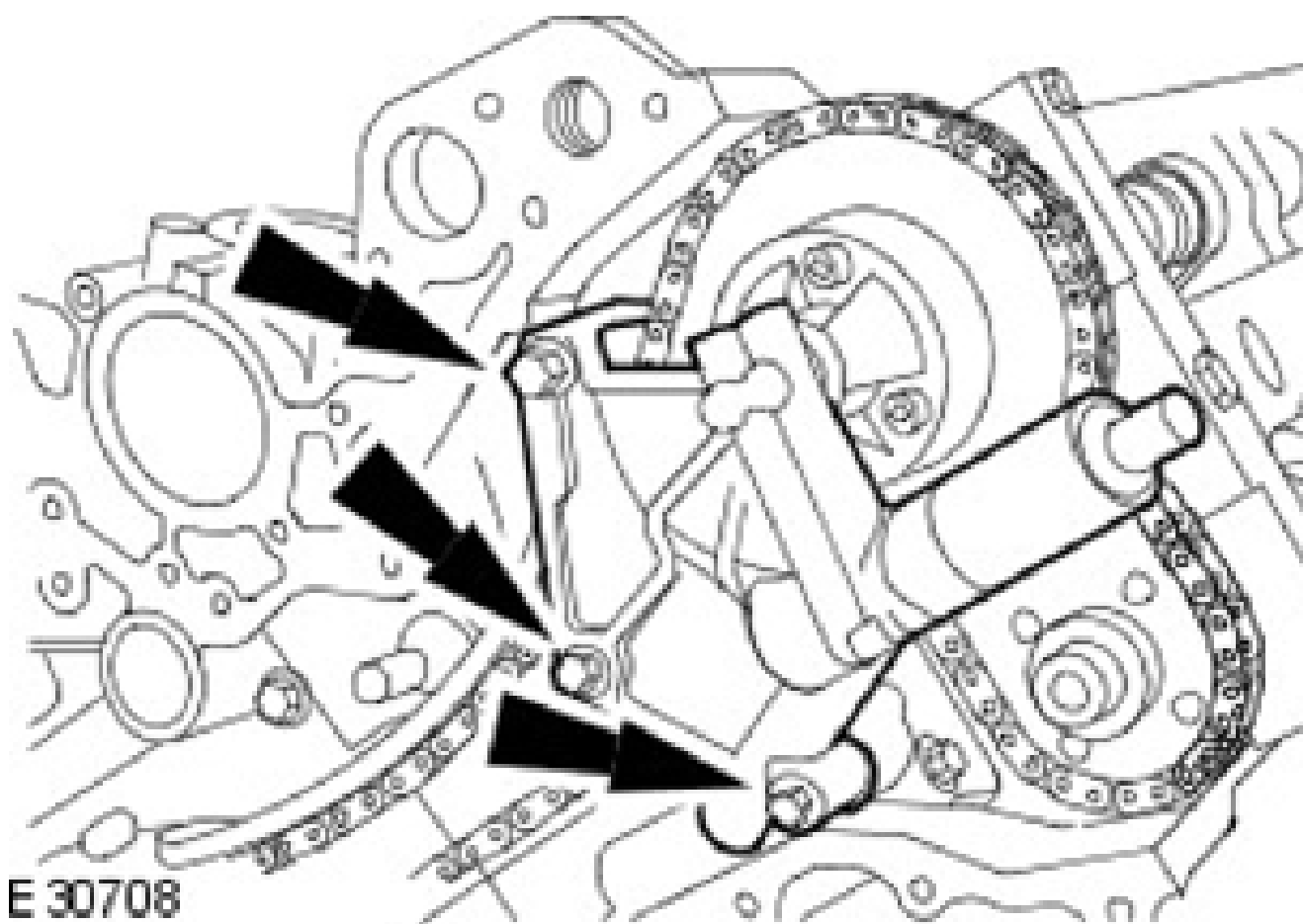
47. Remove the RH primary timing chain.



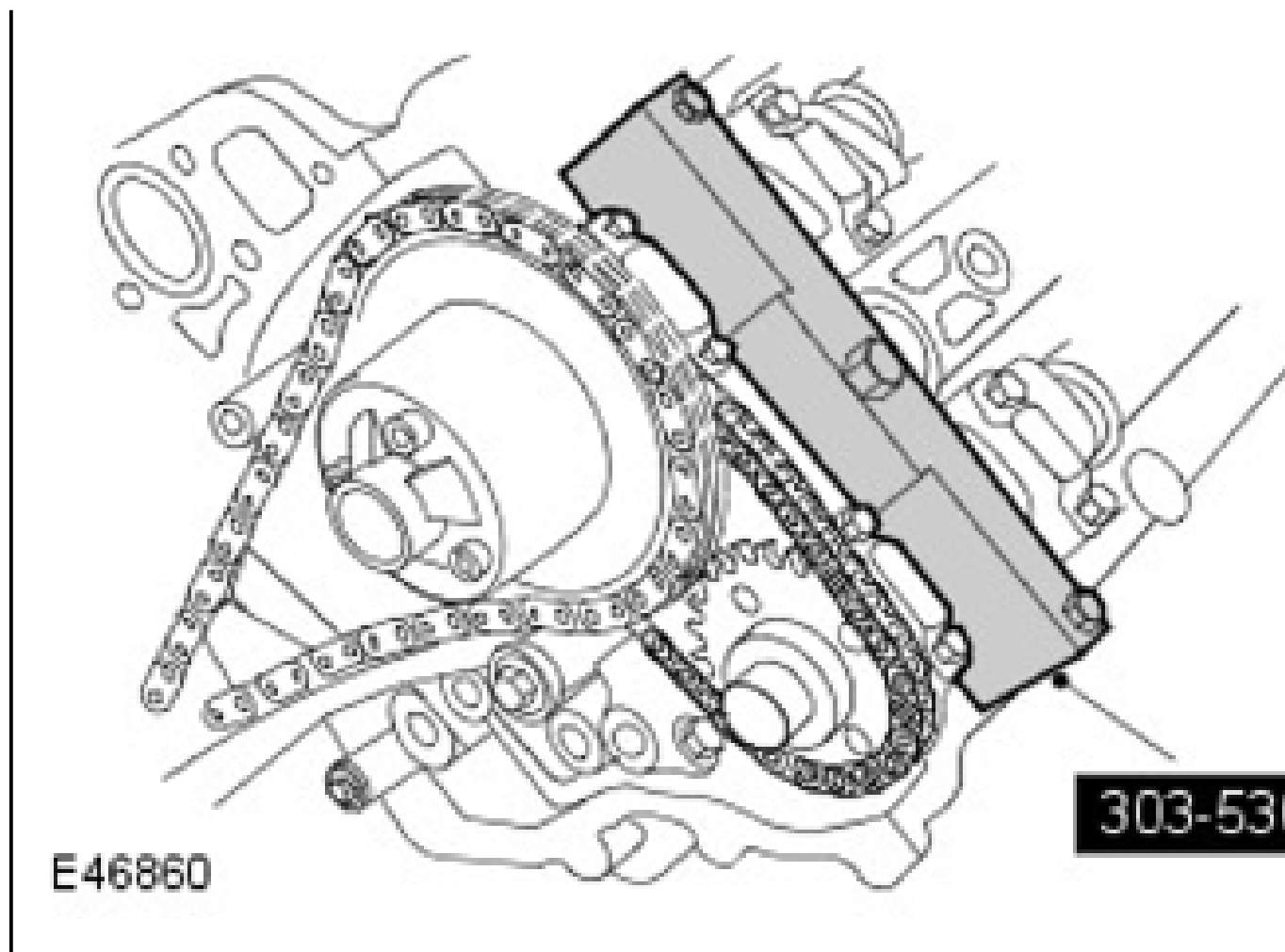
E 30703

48. Remove the LH VCT housing.

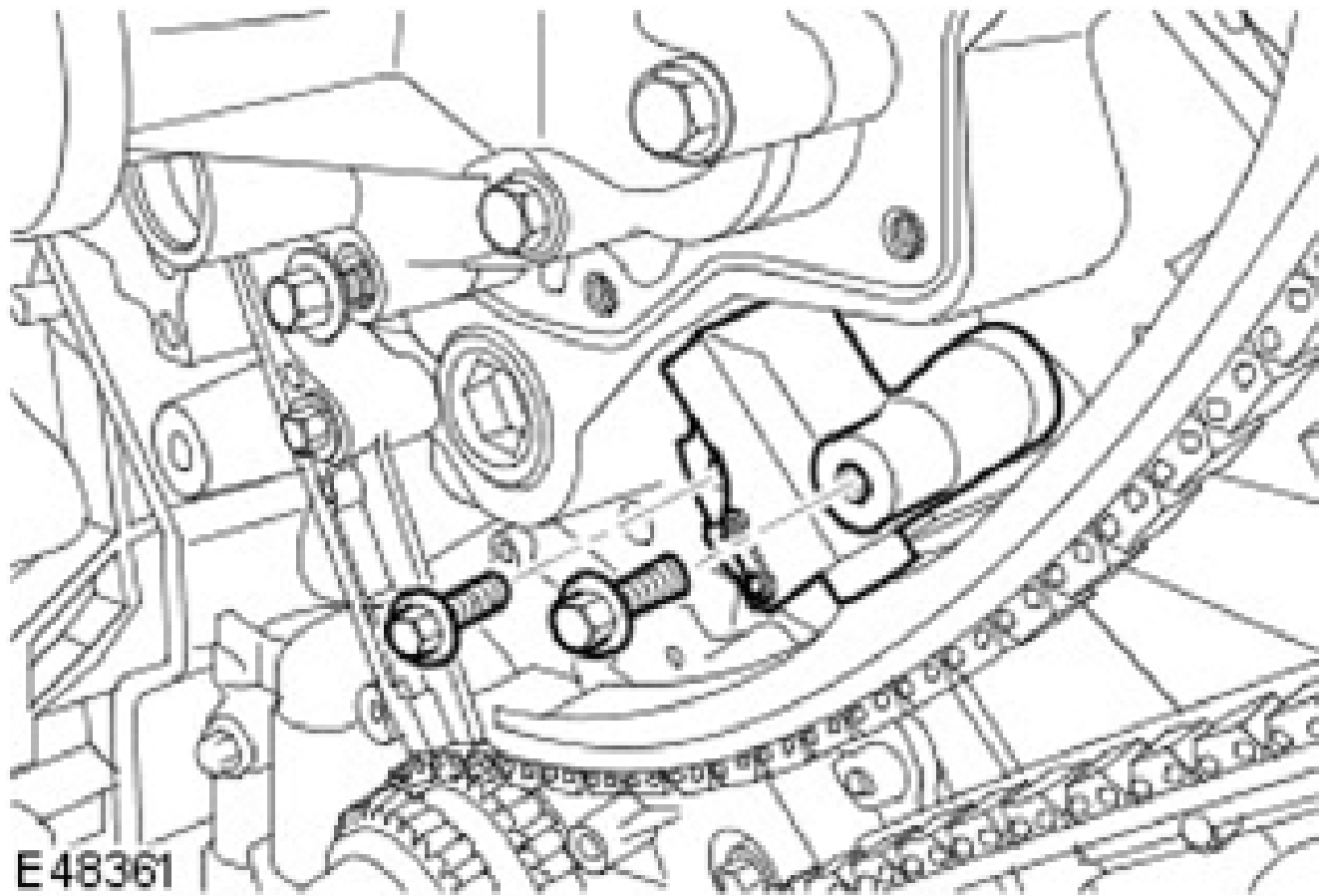
- Remove the 3 bolts.
- Remove and discard the O-ring seals.



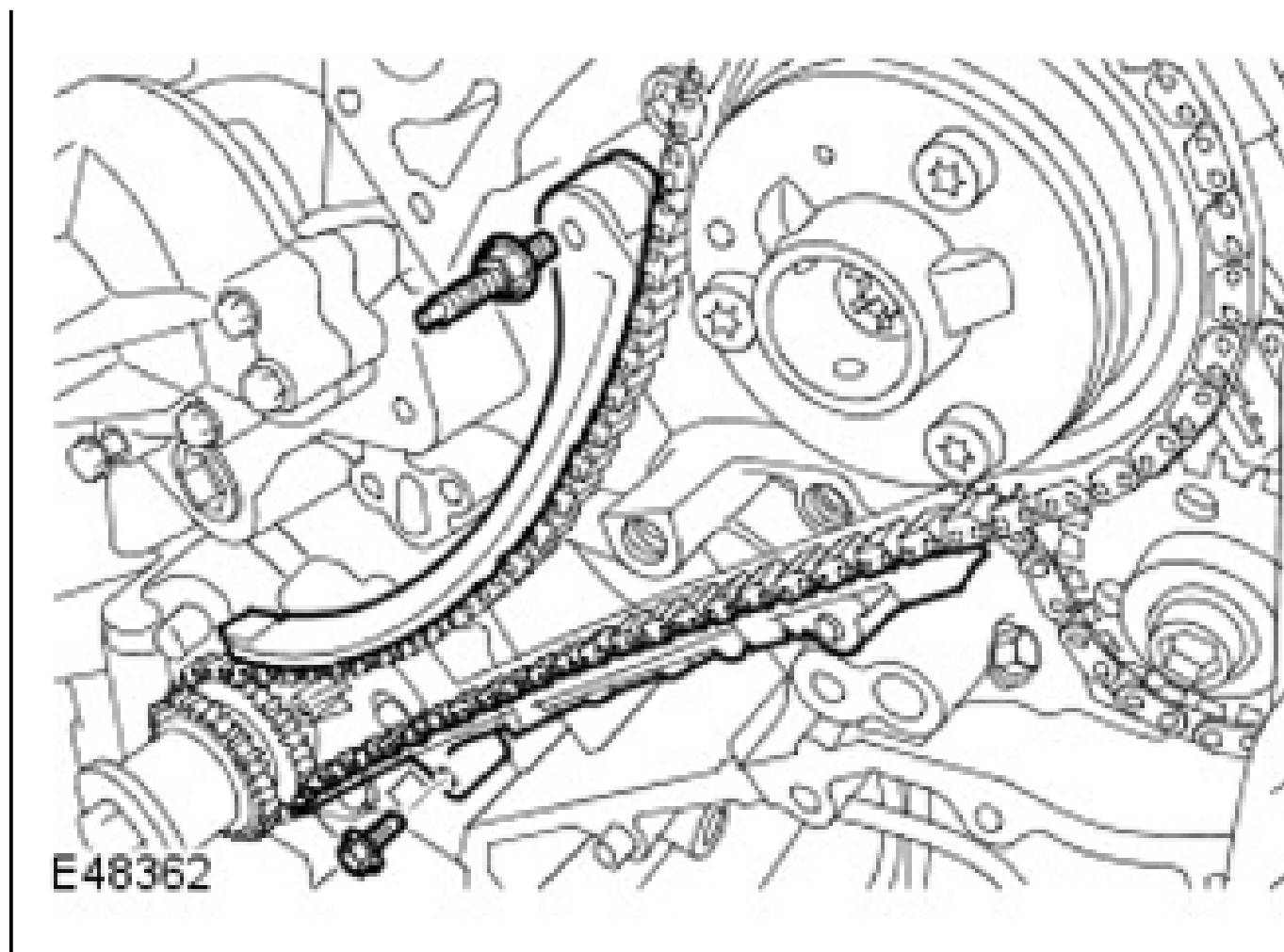
49. Install the special tool to the LH cylinder head.
- Install the 3 bolts.



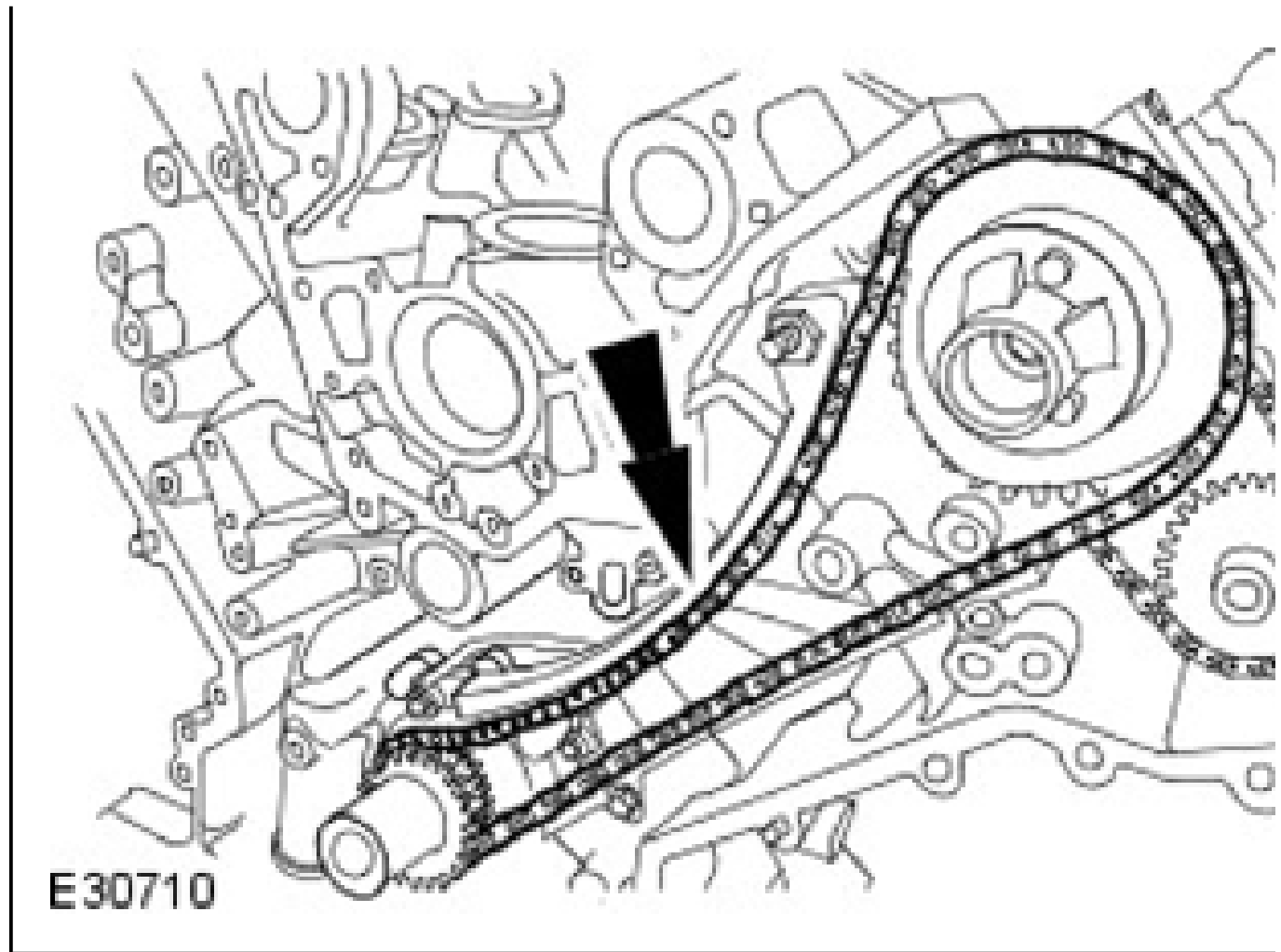
50. Remove the LH primary timing chain tensioner.
- Remove the 2 bolts.



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

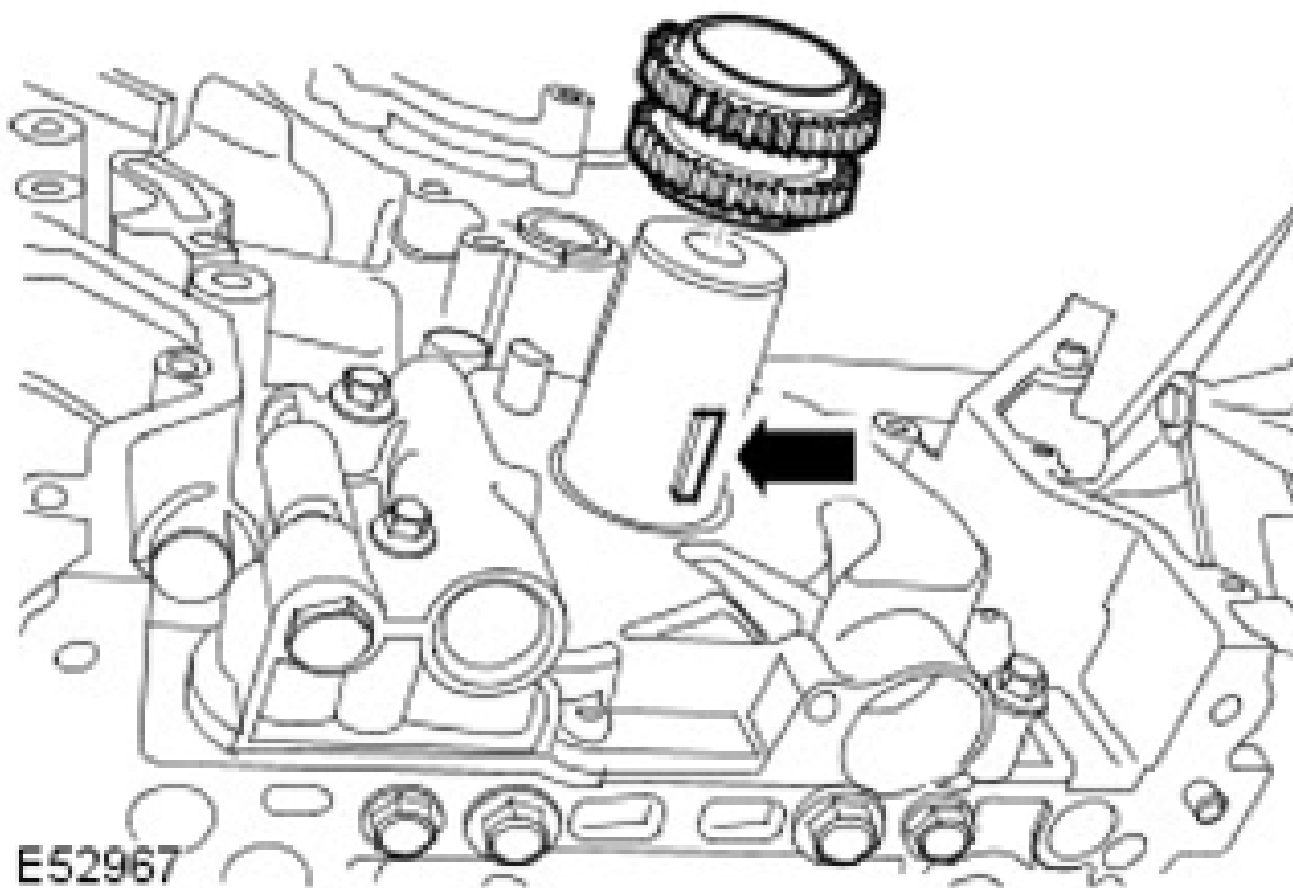


52. Remove the LH primary timing chain.

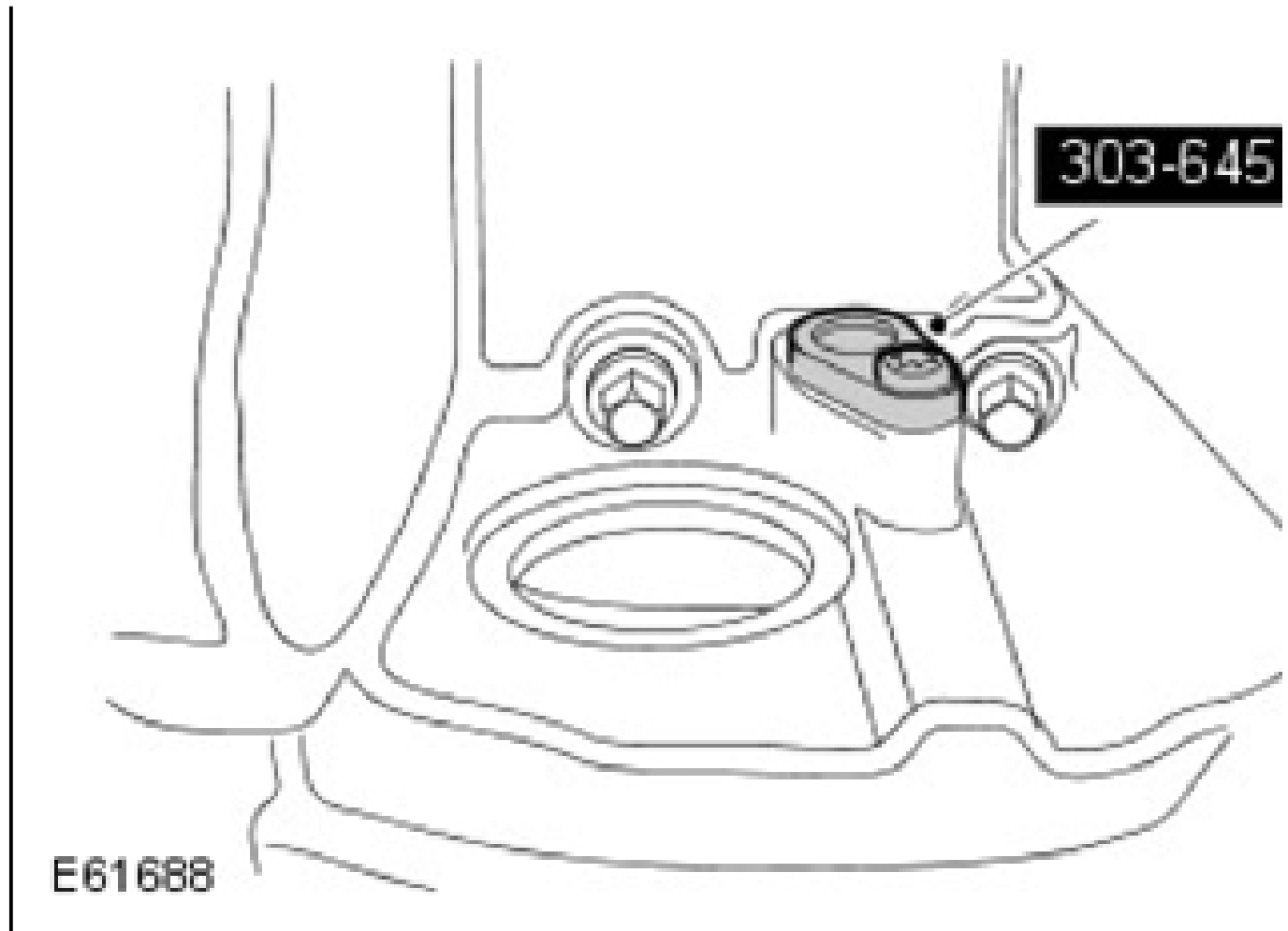


NOTE: Note the orientation of the crankshaft sprocket.

53. Remove the crankshaft sprocket.
 - Remove the crankshaft sprocket key.



54. 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.

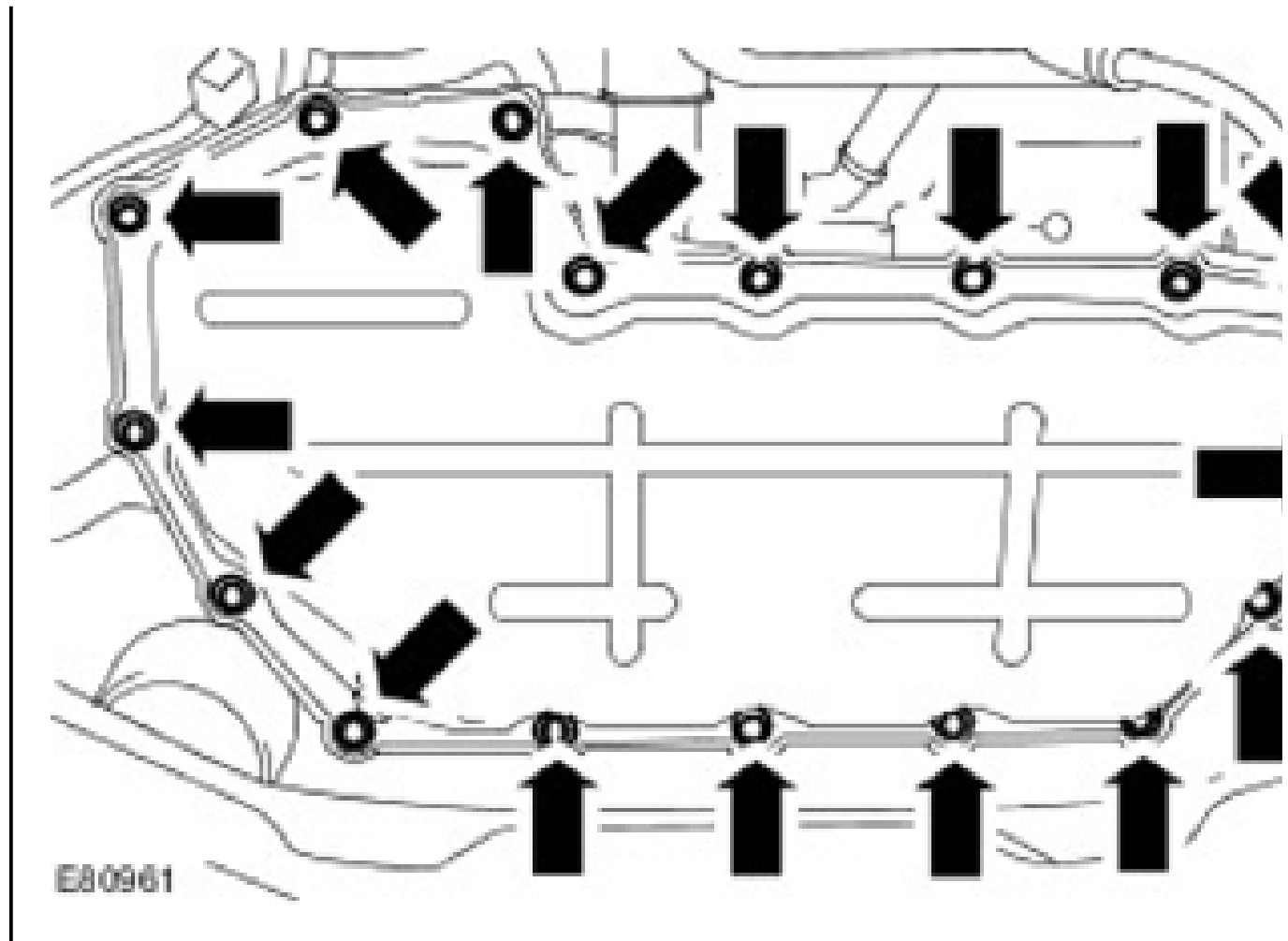
55. Remove the torque converter flexplate.
- Remove the 8 bolts.



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

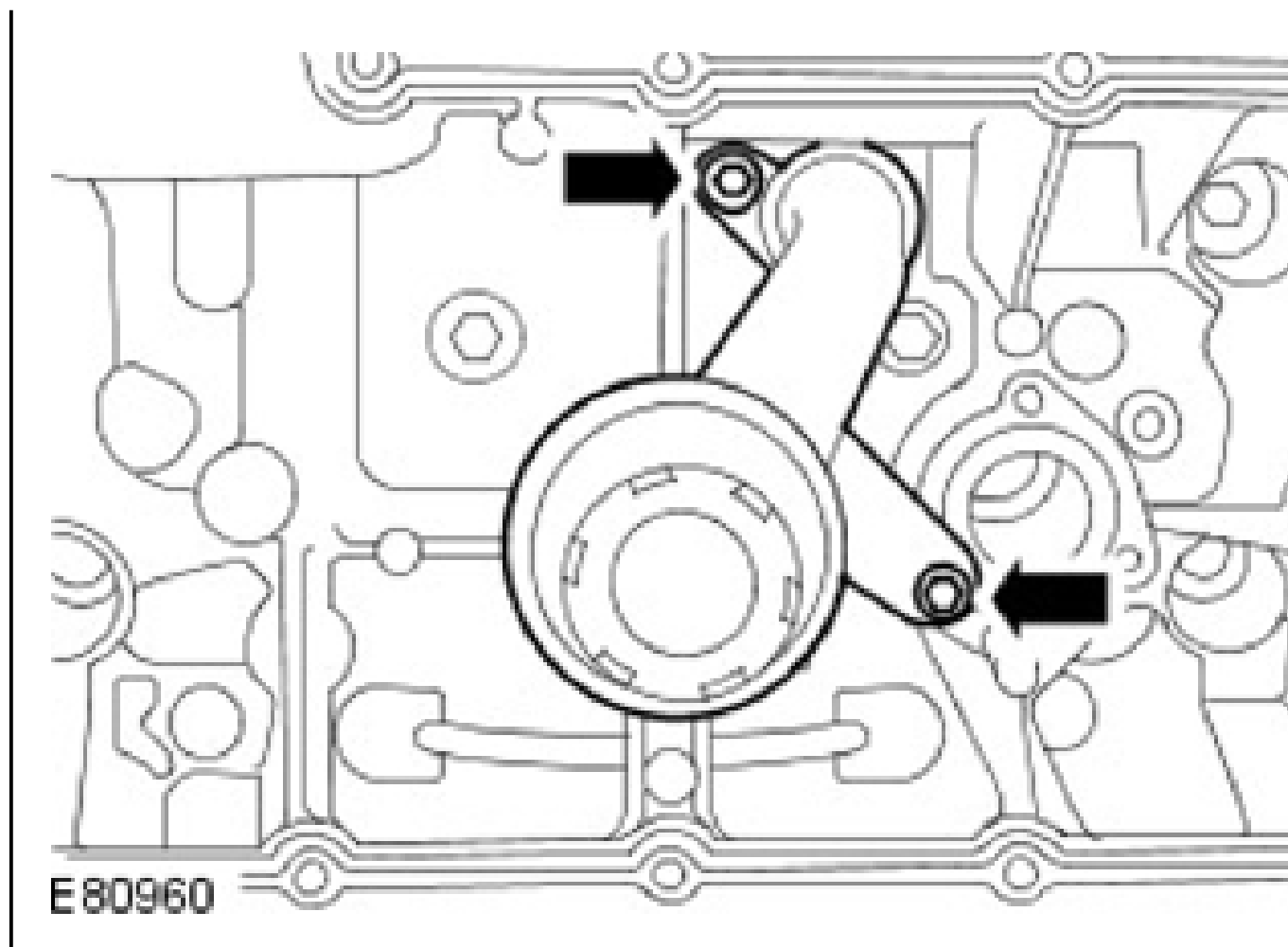
56. Remove the oil pan.

- Remove the 17 bolts.
- Remove and discard the gasket.

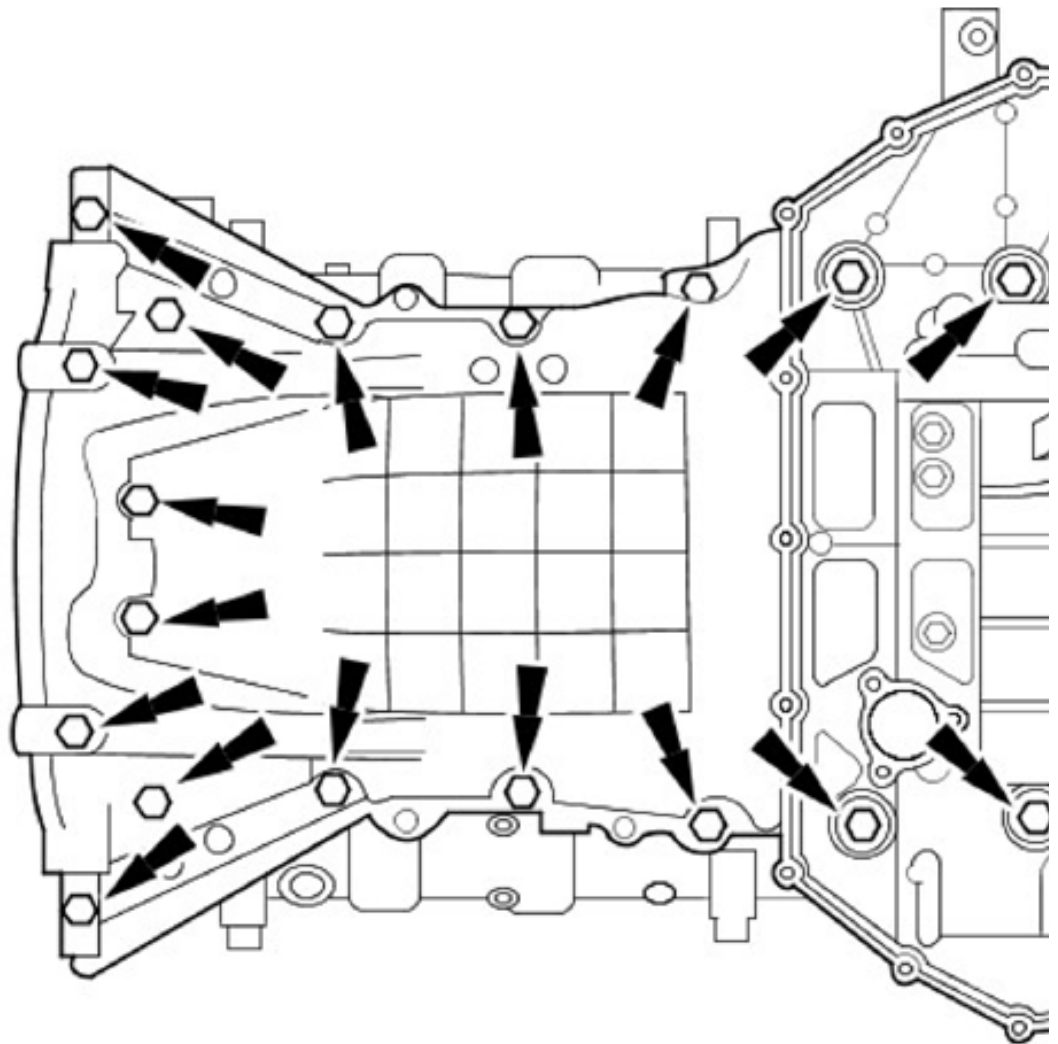


57. Remove the oil strainer pick-up assembly.

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



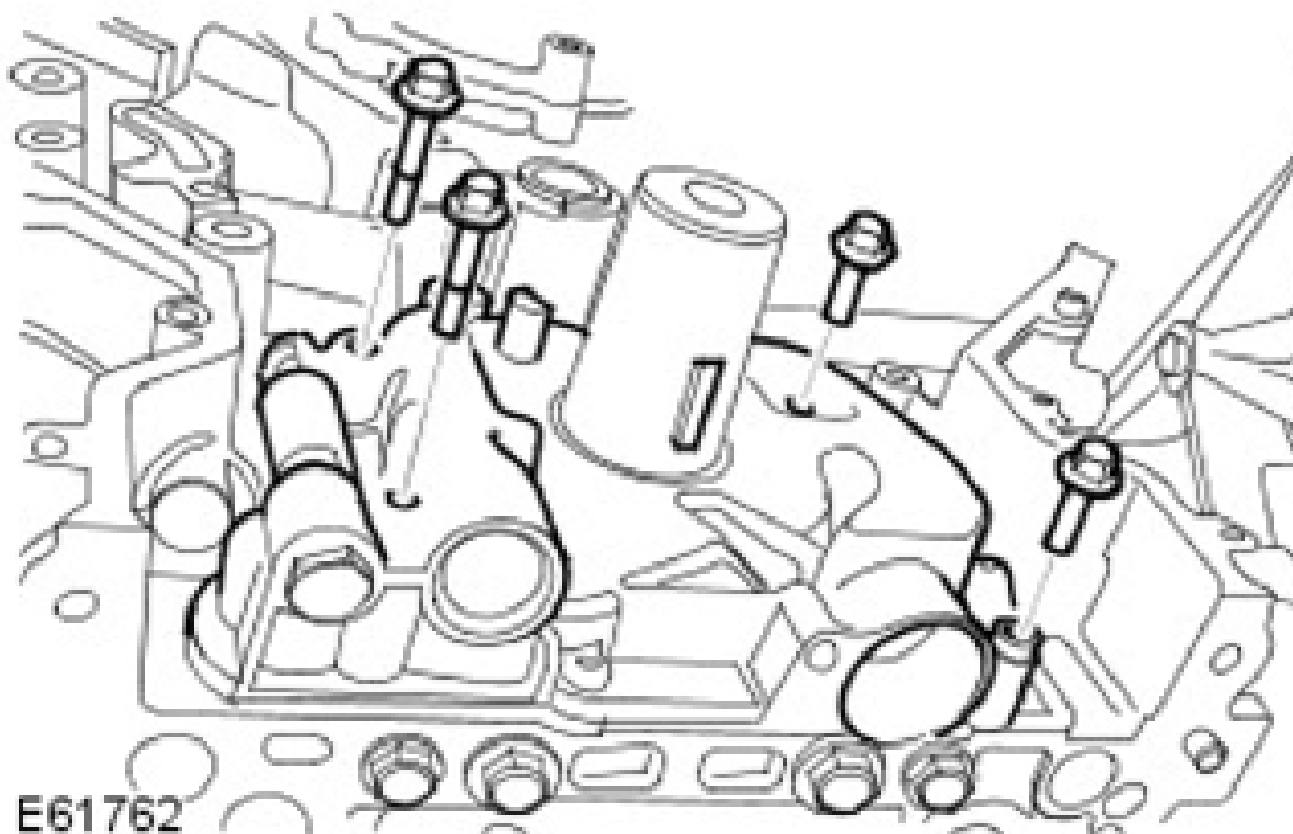
58. Remove the oil pan extension.
- Remove the 18 bolts.



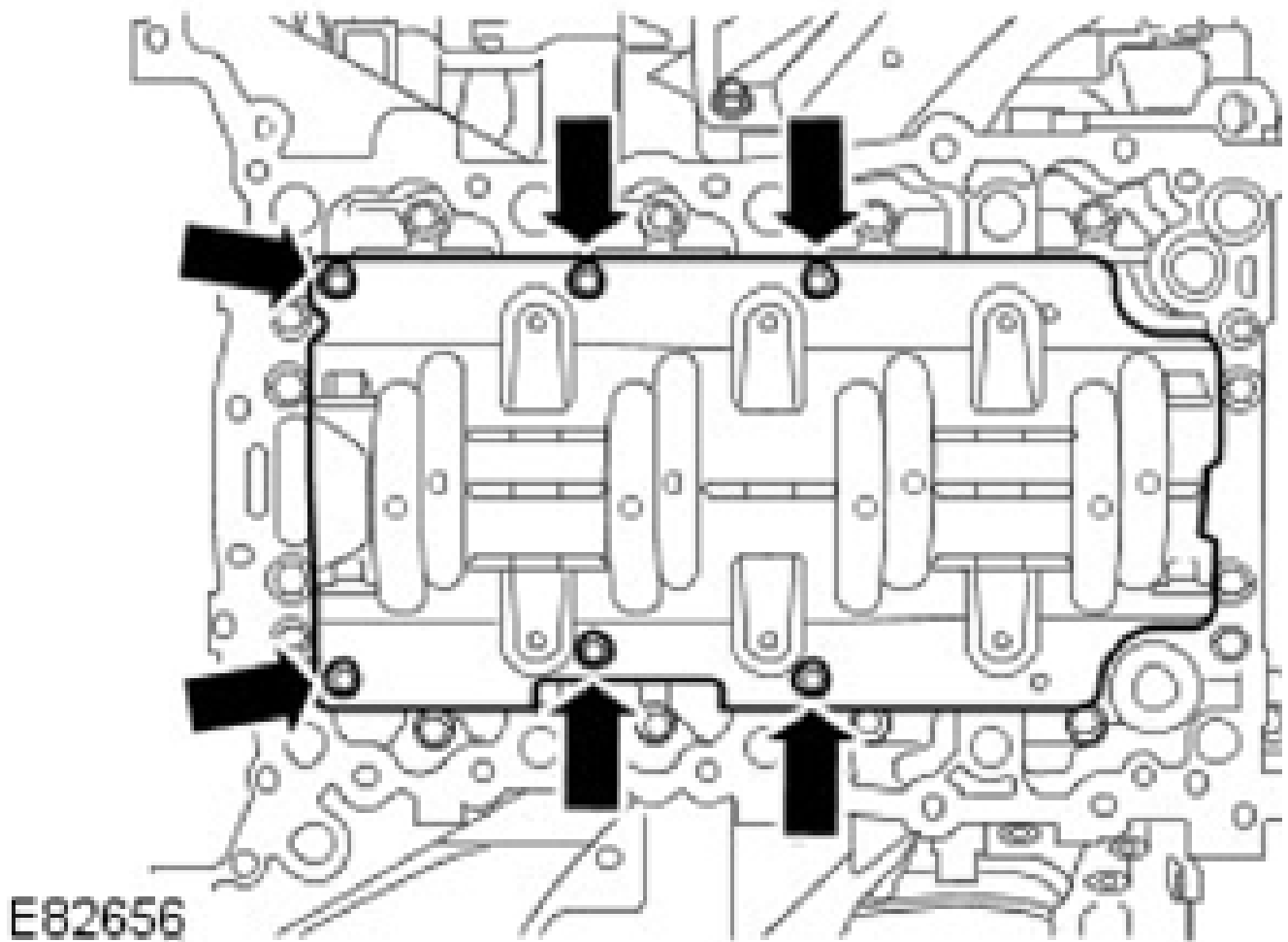
VJJ0002435

59. Remove the oil pump assembly.

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



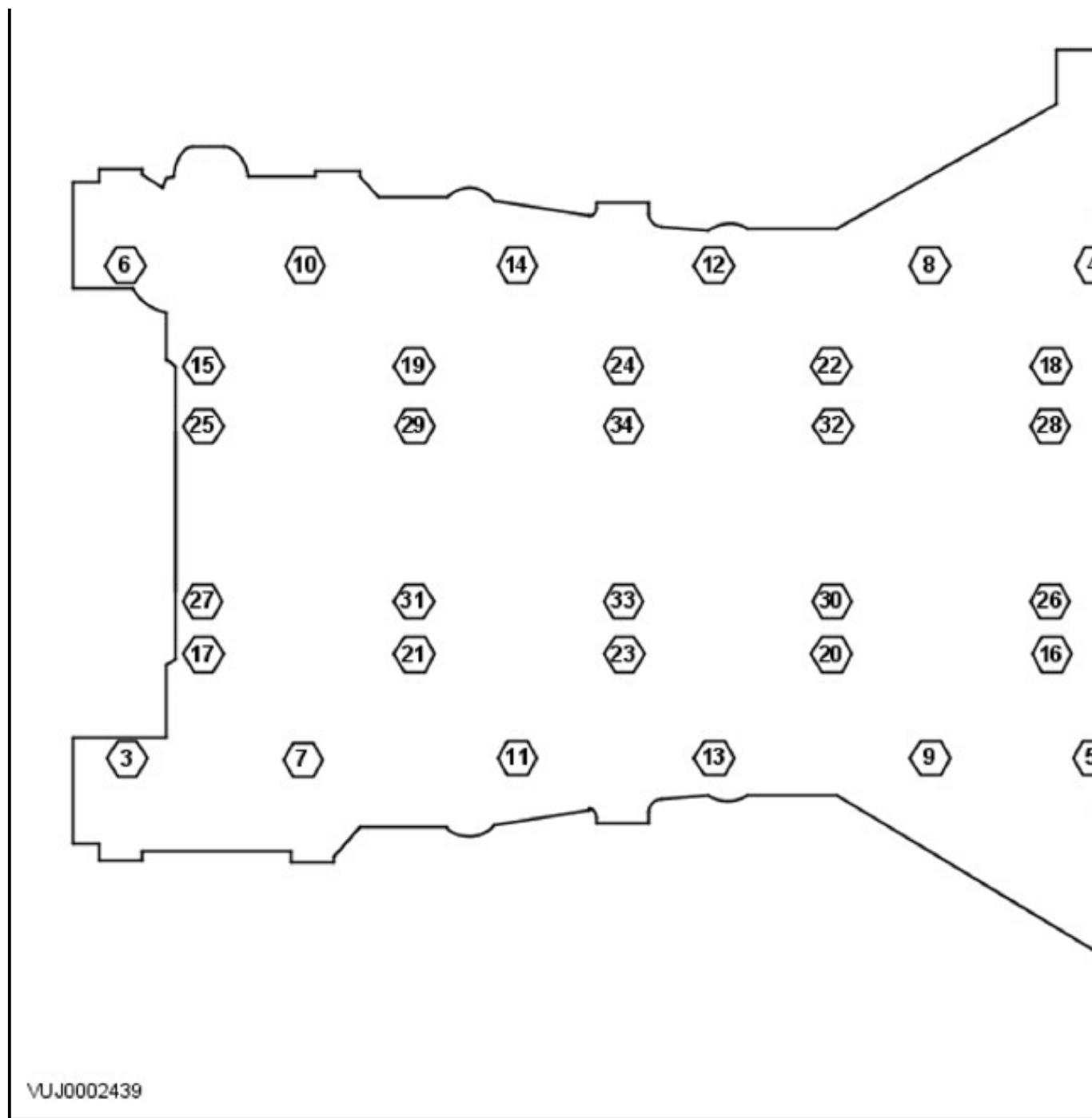
60. Remove the baffle plate.
- Remove the 6 bolts.



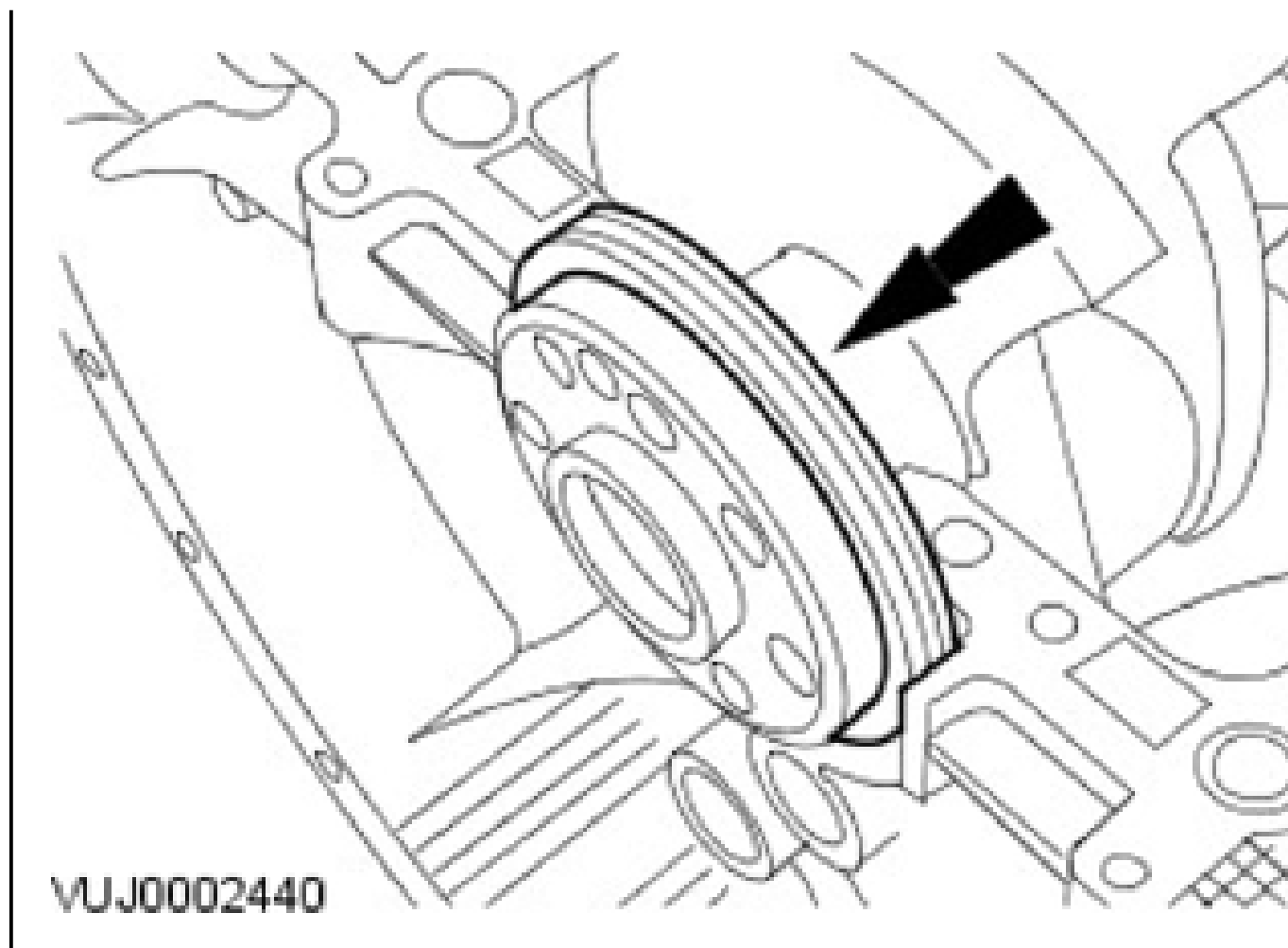
CAUTION: To make sure damage does not occur to the crankshaft and piston components, the engine must be inverted on the engine stand. Failure to follow this instruction may result in damage to the engine.

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.

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



62. Discard the crankshaft rear main oil seal.



INSTALLATION

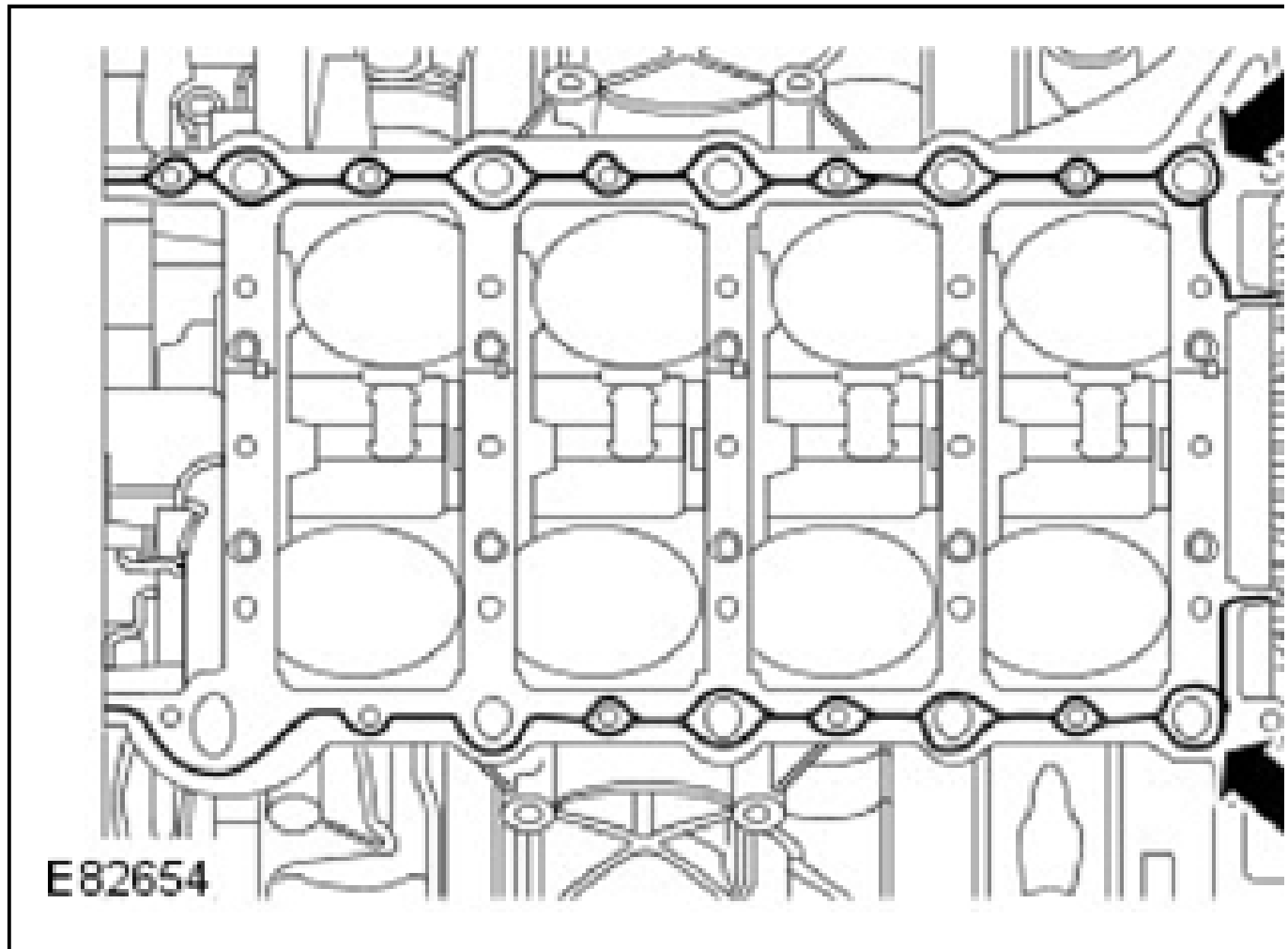
CAUTION: Use only a plastic scraper when removing the sealing material.

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.

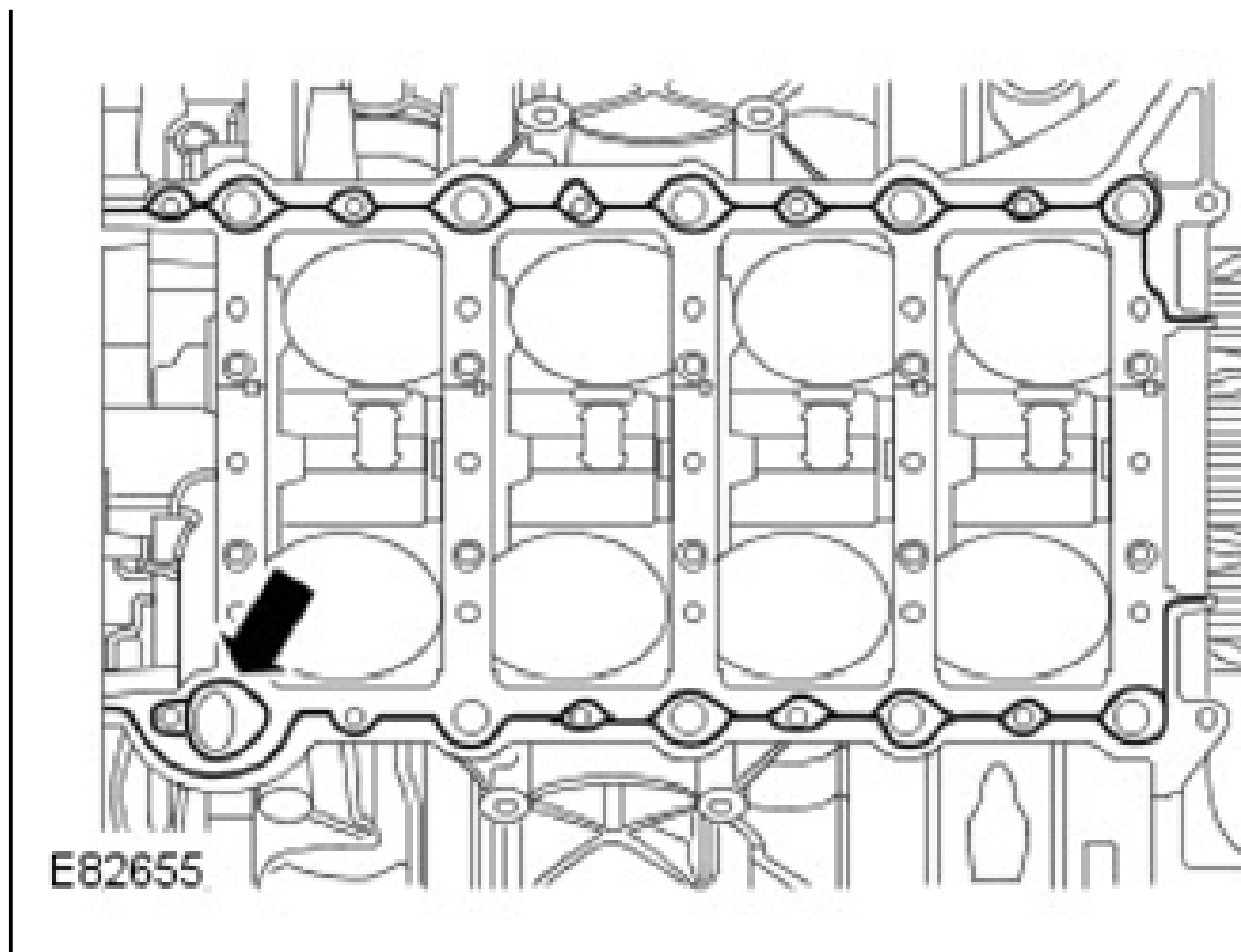
NOTE: Install the crankshaft main bearing carrier and tighten bolts to specification within twenty minutes of applying the sealant.

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.

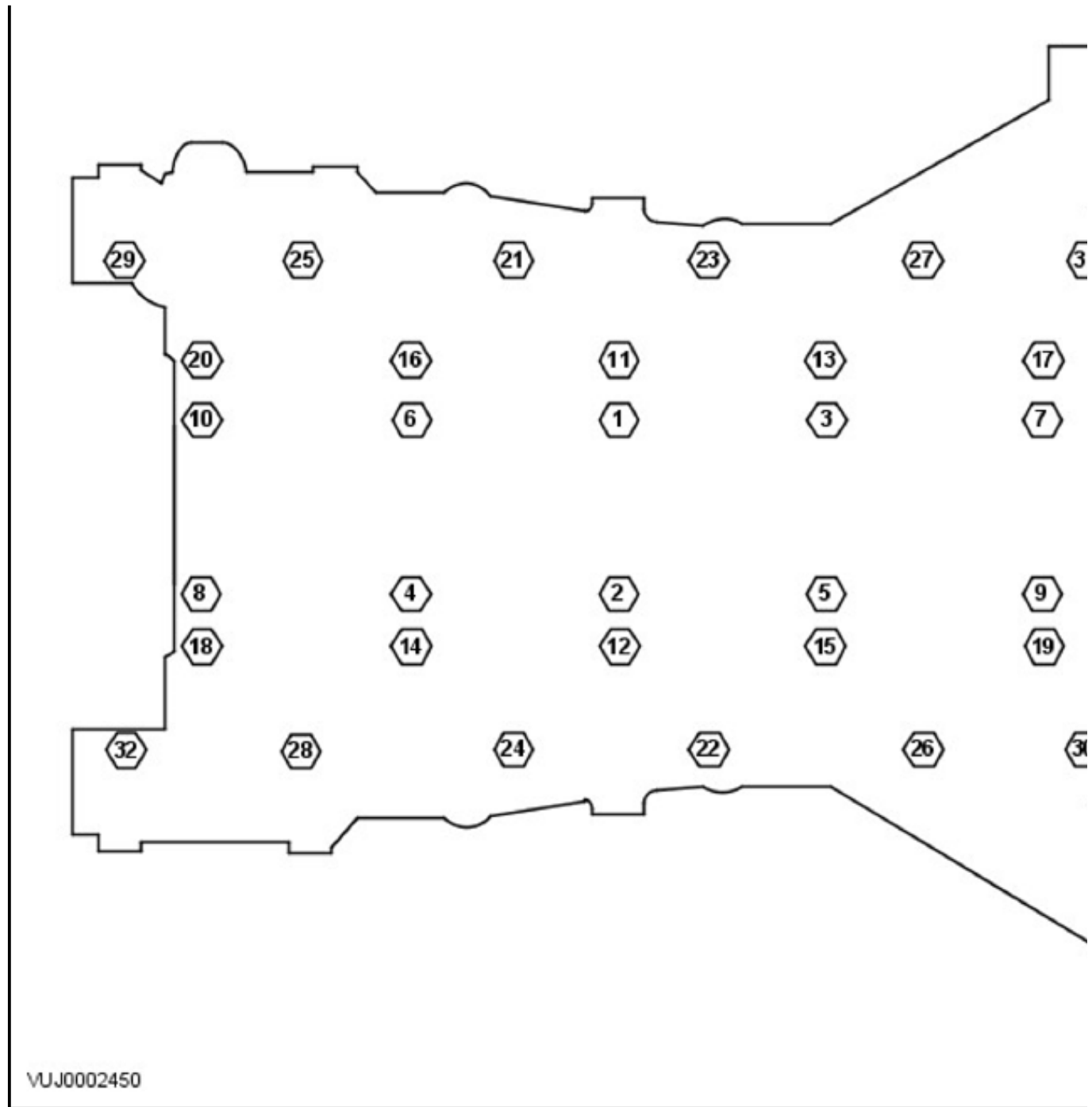
NOTE: Do not rotate the crankshaft until all the retaining bolts are tightened to specification.

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

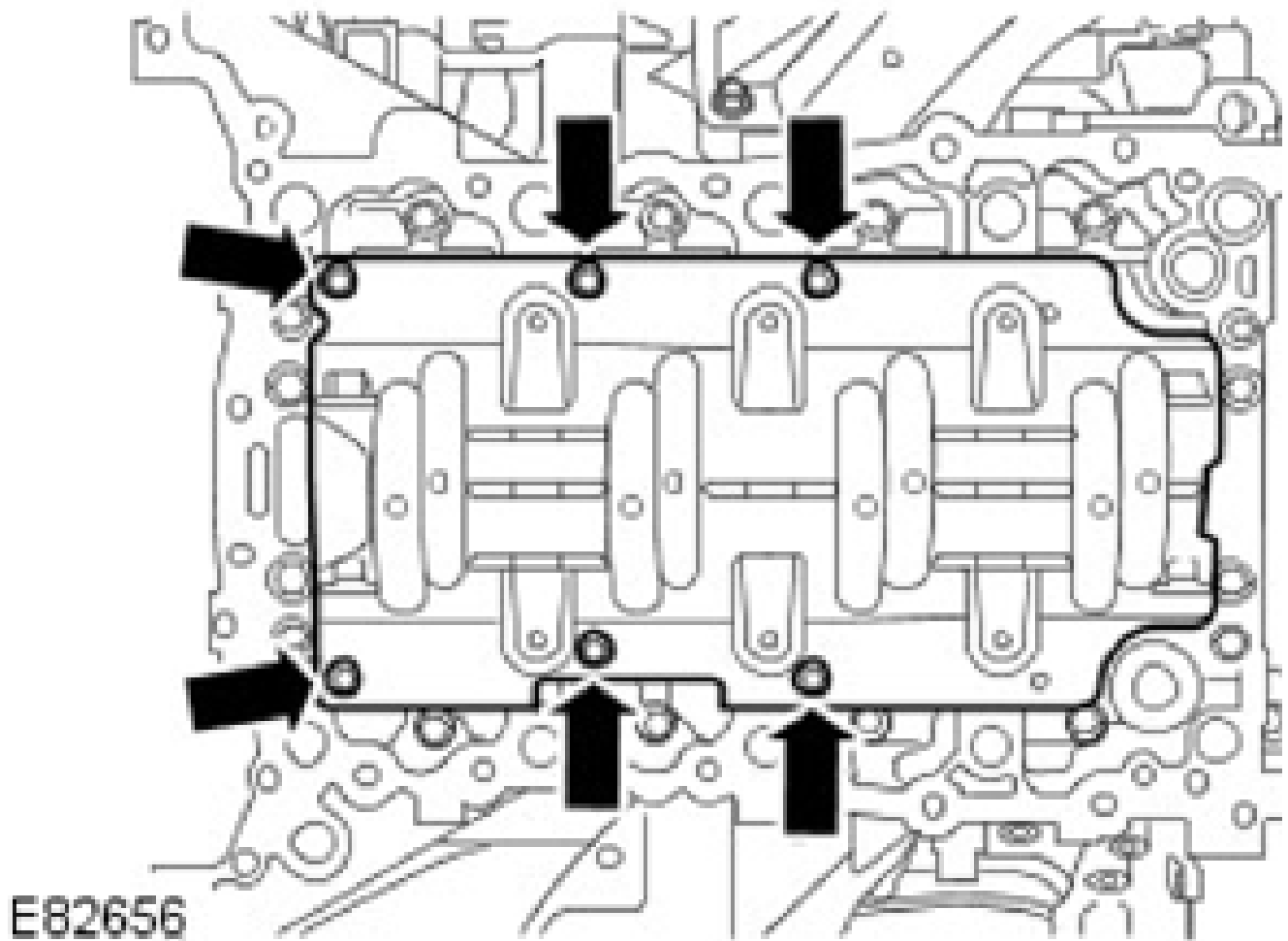
NOTE: Tighten the retaining bolts in the sequence shown.

4. Install the crankshaft main bearing carrier to the cylinder block.
 1. Stage 1: Bolts 21 to 32, tighten to 15 Nm (11 lb.ft).

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



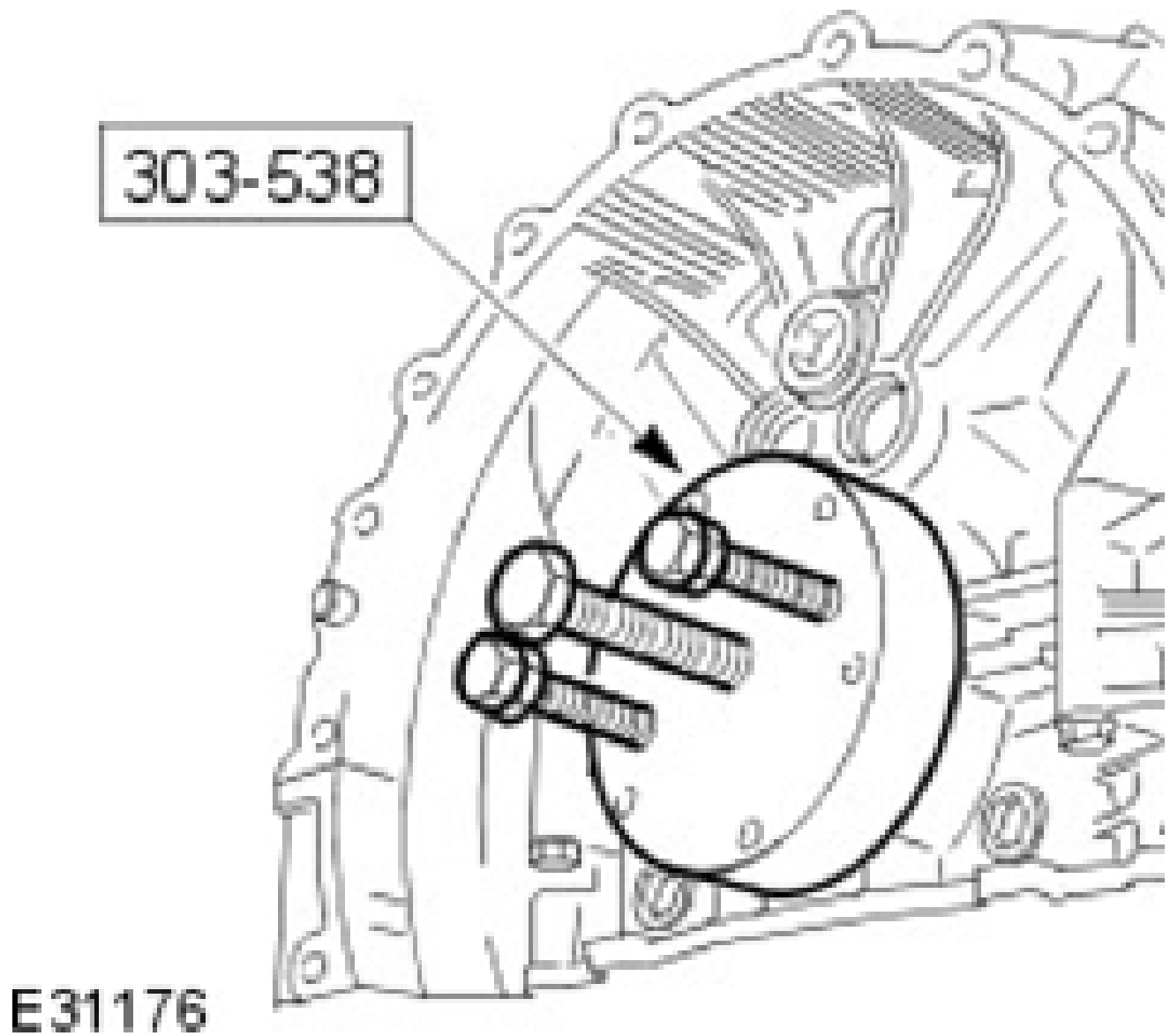
5. Rotate the crankshaft to check correct operation.
6. Remove excess sealant which may squeeze out at the front cover sealing surfaces.
7. Install the baffle plate.
 - Tighten the 6 bolts to 6 Nm (4 lb.ft).



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

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.

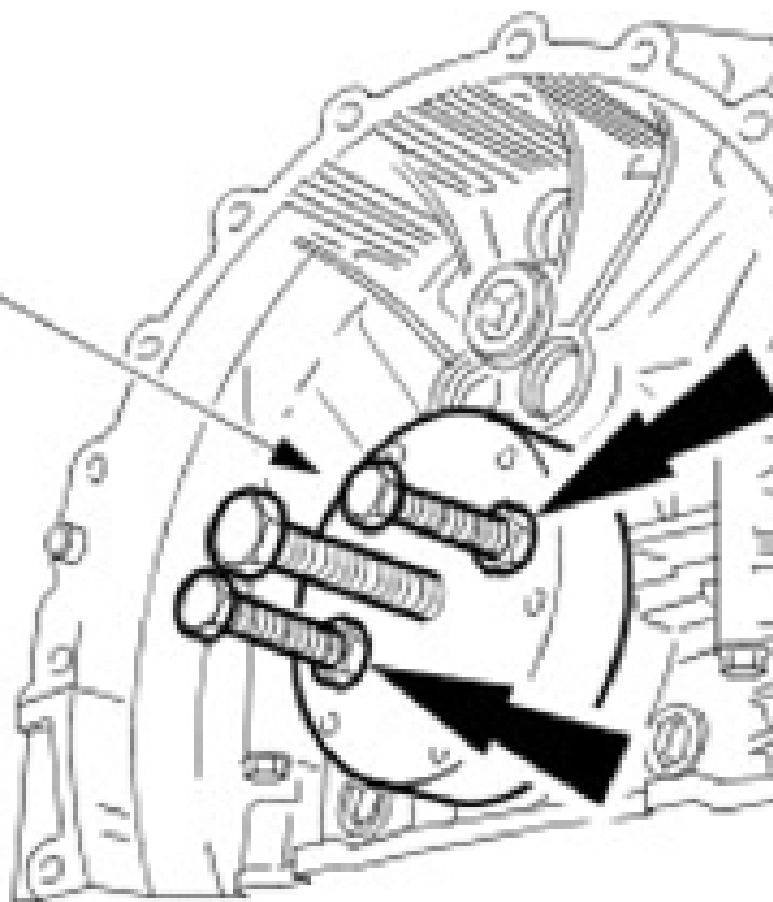
8. Using the special tool, position the crankshaft rear oil seal.
 - Install the special tool to the crankshaft.



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

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

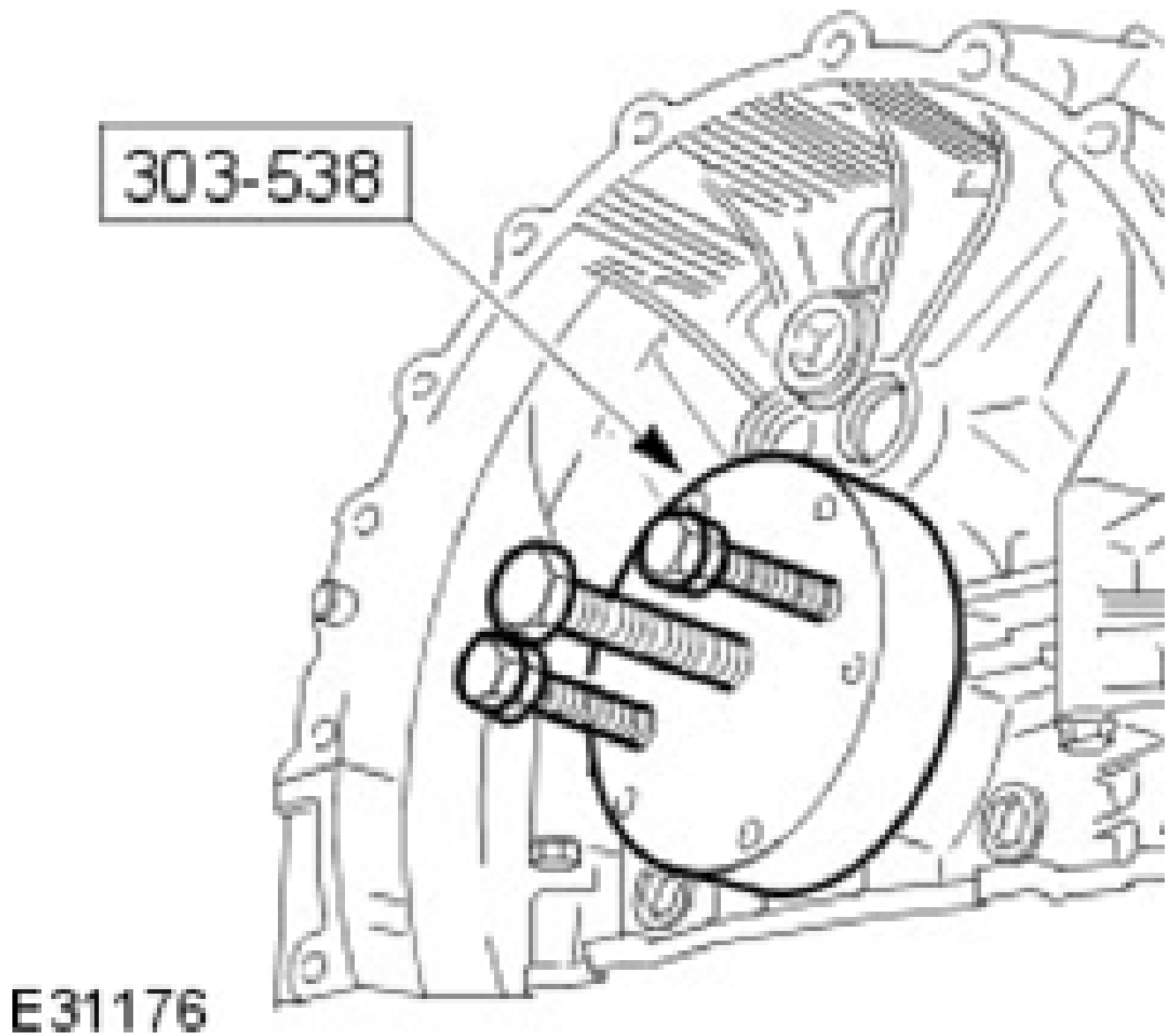
303-538



E31177

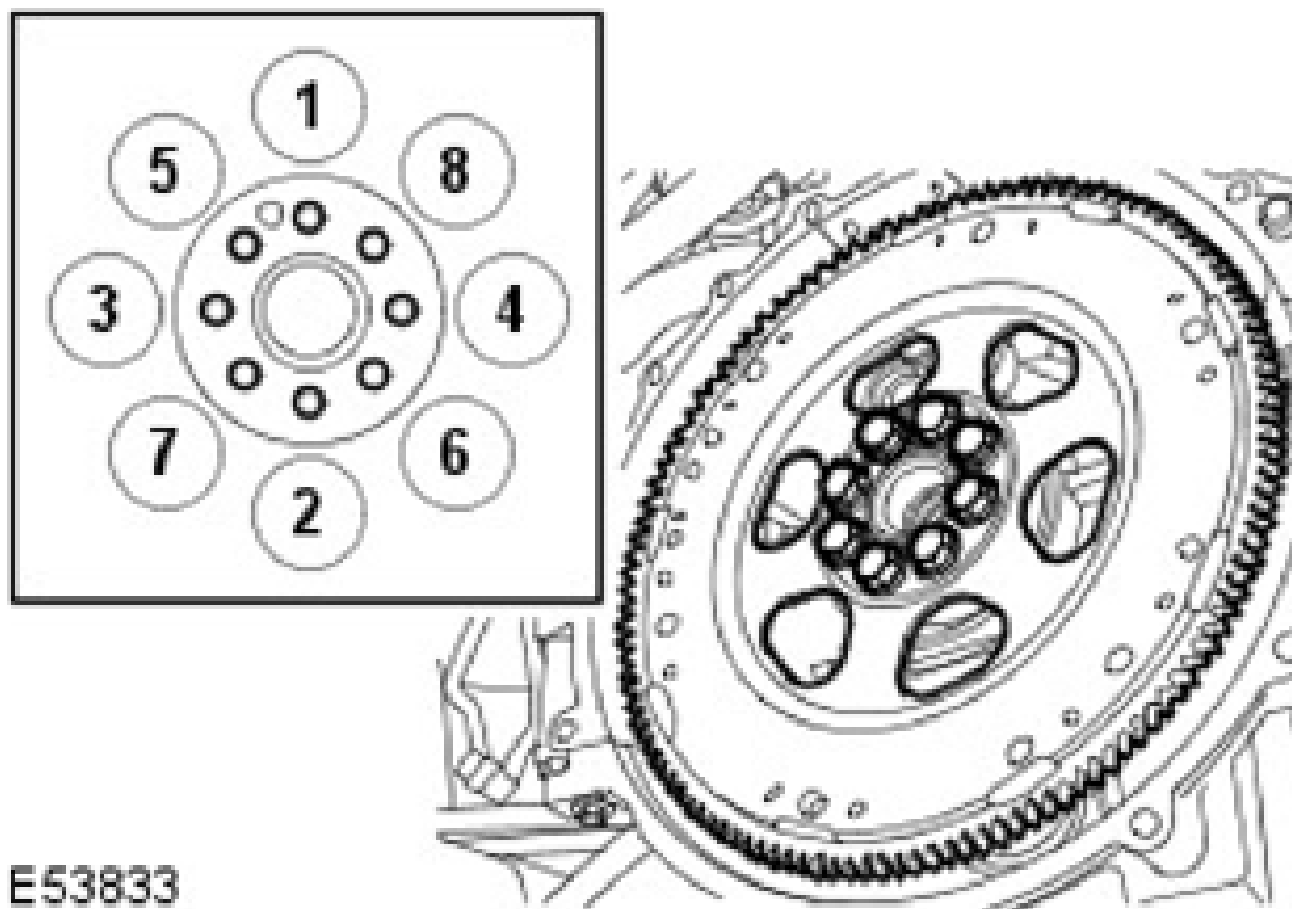
CAUTION: Make sure that the crankshaft rear oil seal is correctly located.

10. Remove the special tool.

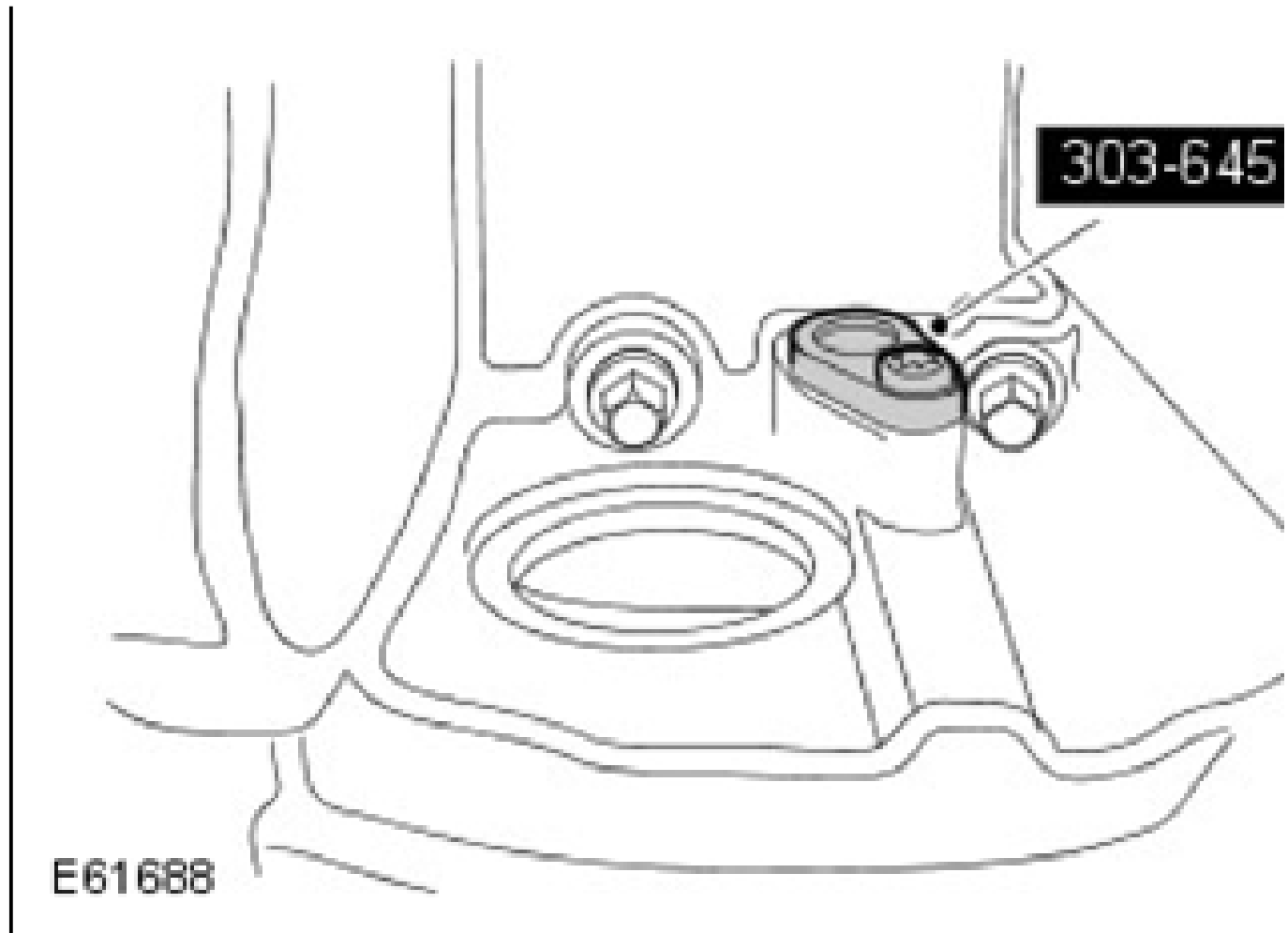


NOTE: Prevent the flexplate from rotating.

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.



NOTE: Install a new gasket.

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

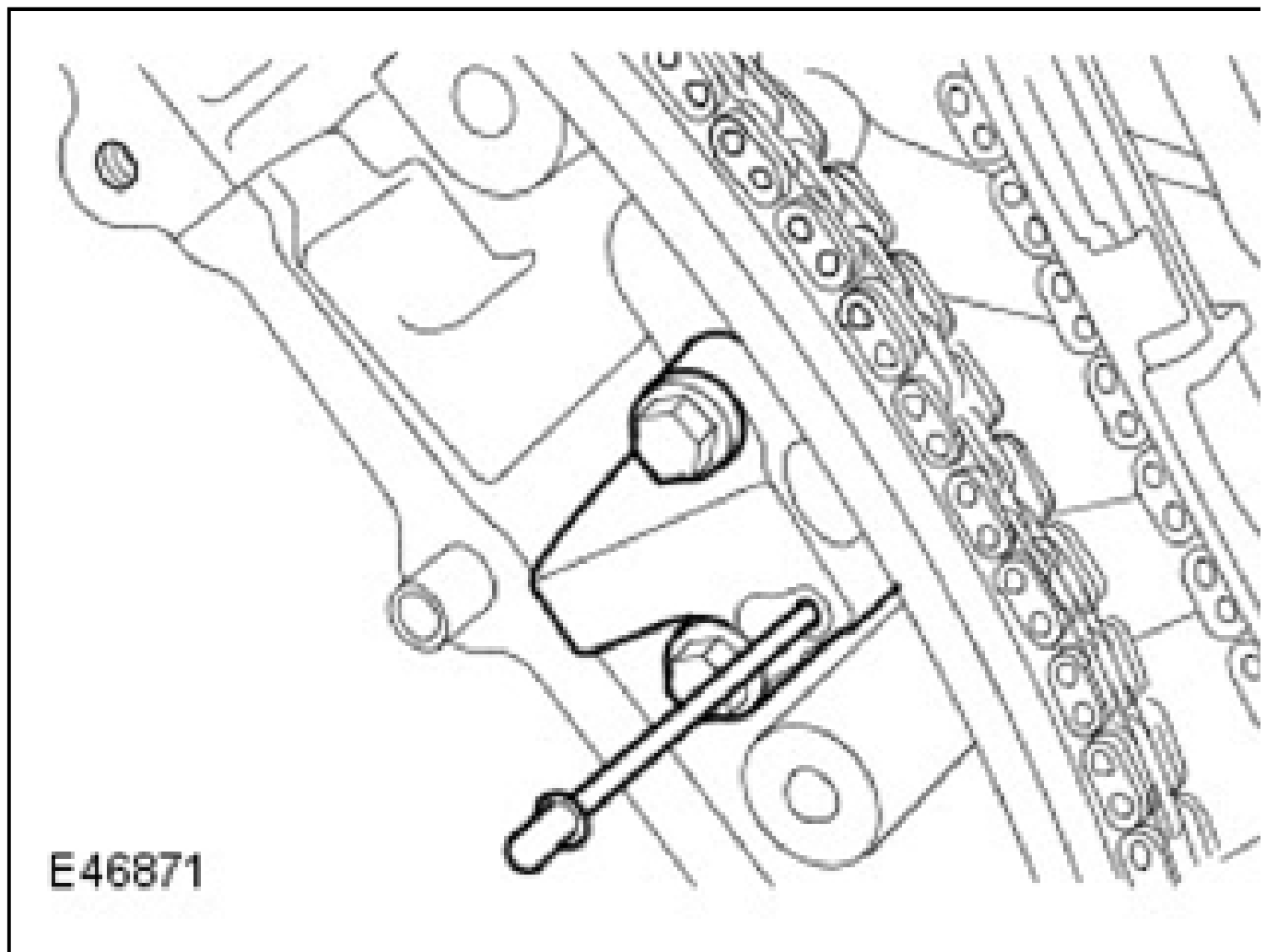
NOTE: Install a new O-ring seal.

14. 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).
15. Install the crankshaft sprocket.
 - Clean the component mating faces.

- Install the crankshaft sprocket key.
16. Install the LH primary timing chain.
- Make sure the timing chain slack is on the tensioner side of the timing chain.
17. 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.

18. Install the LH primary timing chain tensioner.
- Using a 3 mm (0.118 in) diameter rod, retain the chain tensioner piston.
 - Tighten the bolts to 12 Nm (9 lb.ft).
 - Remove the retaining rod.



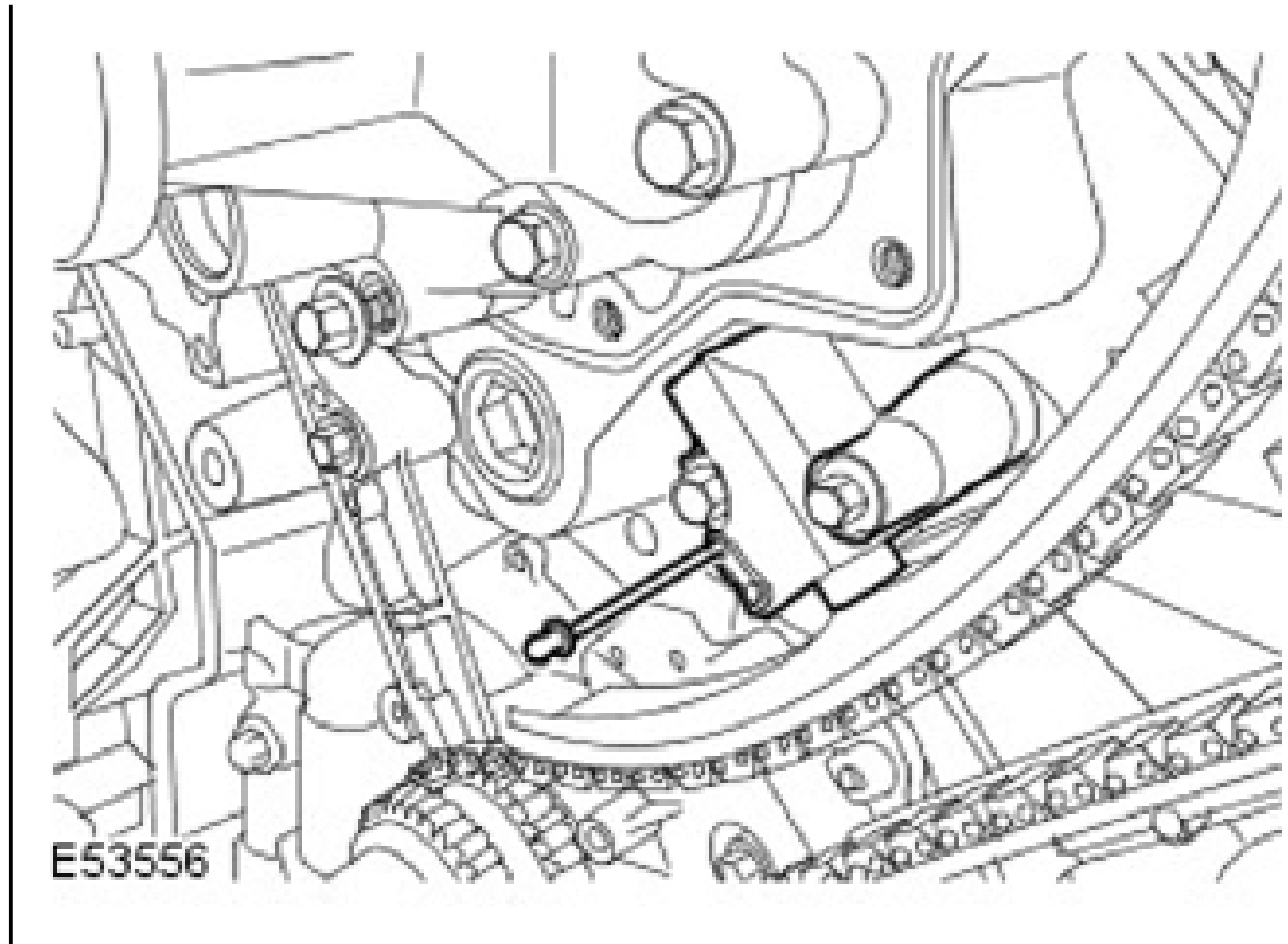
CAUTION: Make sure that new bolts are installed.

NOTE: Install new O-ring seals.

19. Install the LH VCT control solenoid housing.
 - Install the O-ring seals.
 - Tighten the bolts to 22 Nm (16 lb.ft).
 - Tighten the nut to 10 Nm (7 lb.ft).
20. Install the RH primary timing chain.
 - Make sure the timing chain slack is on the tensioner side of the timing chain.
21. 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.

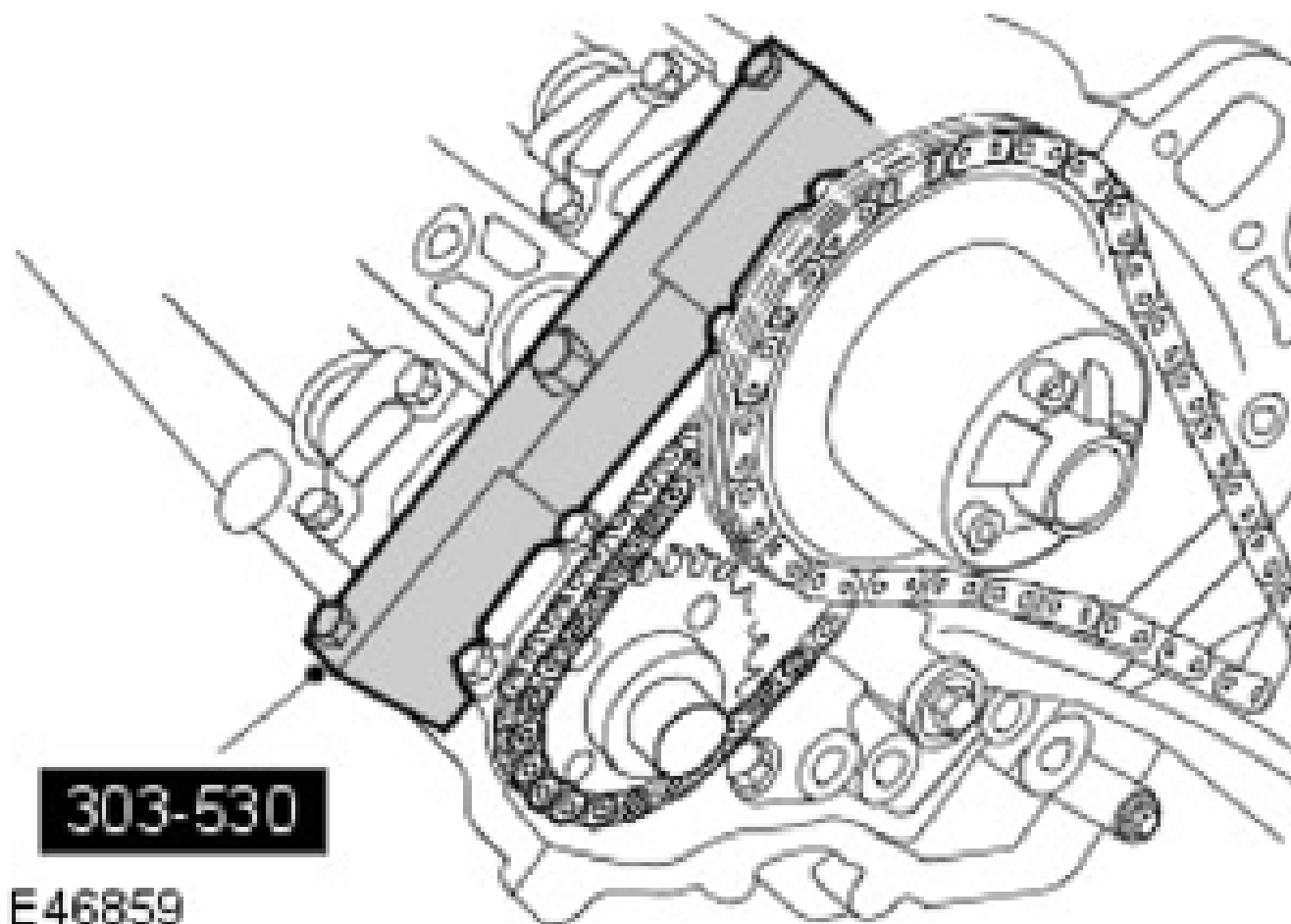
22. Install the RH primary timing chain tensioner.
 - Using a 3 mm (0.118 in) diameter rod, retain the chain tensioner piston.
 - Tighten the bolts to 12 Nm (9 lb.ft).
 - Remove the retaining rod.



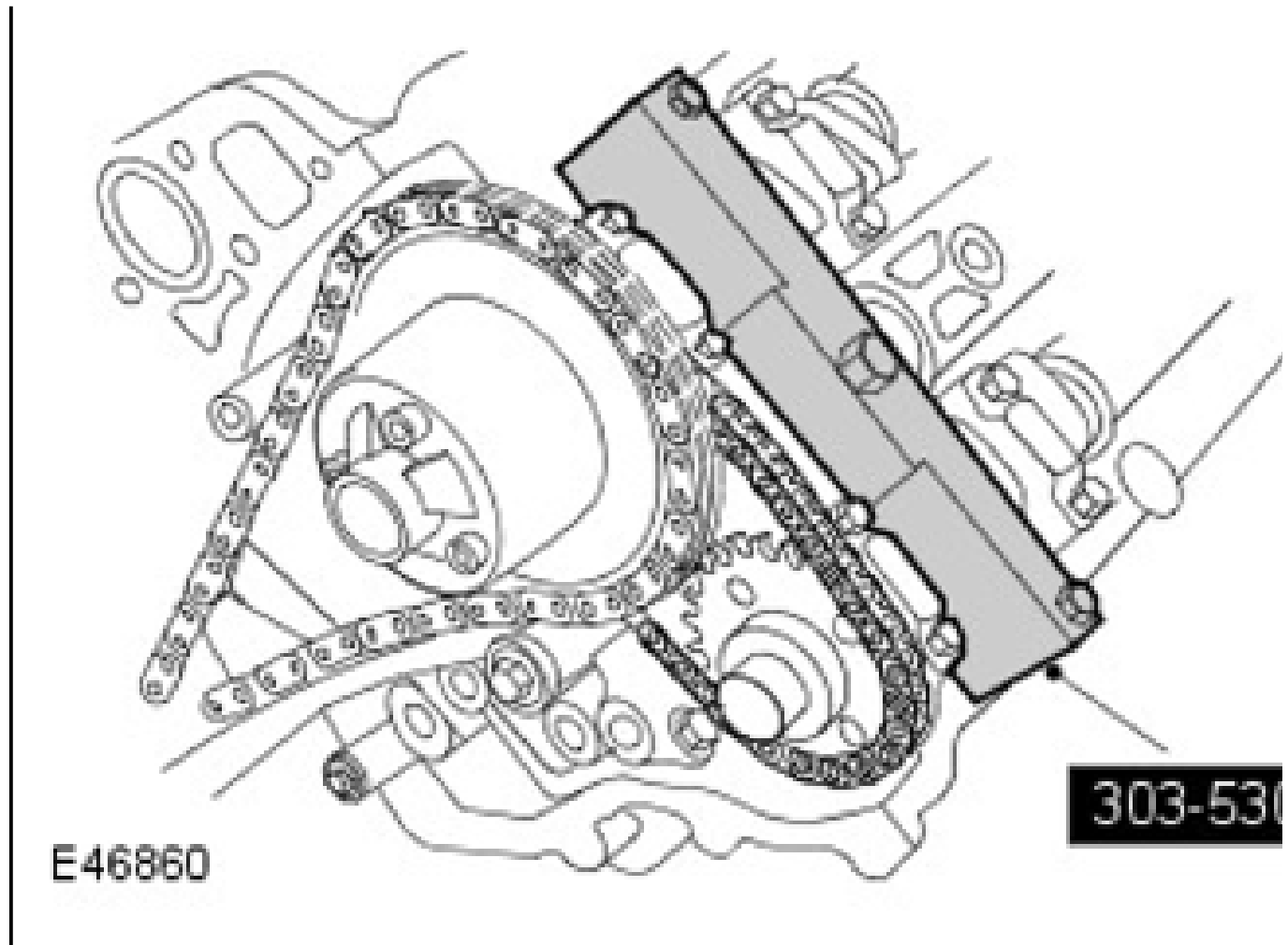
CAUTION: Make sure that new bolts are installed.

NOTE: Install new O-ring seals.

23. Install the RH VCT control solenoid housing.
 - Install the O-ring seals.
 - Tighten the bolts to 22 Nm (16 lb.ft).
 - Tighten the nut to 10 Nm (7 lb.ft).
24. Remove the special tool from the RH cylinder head.

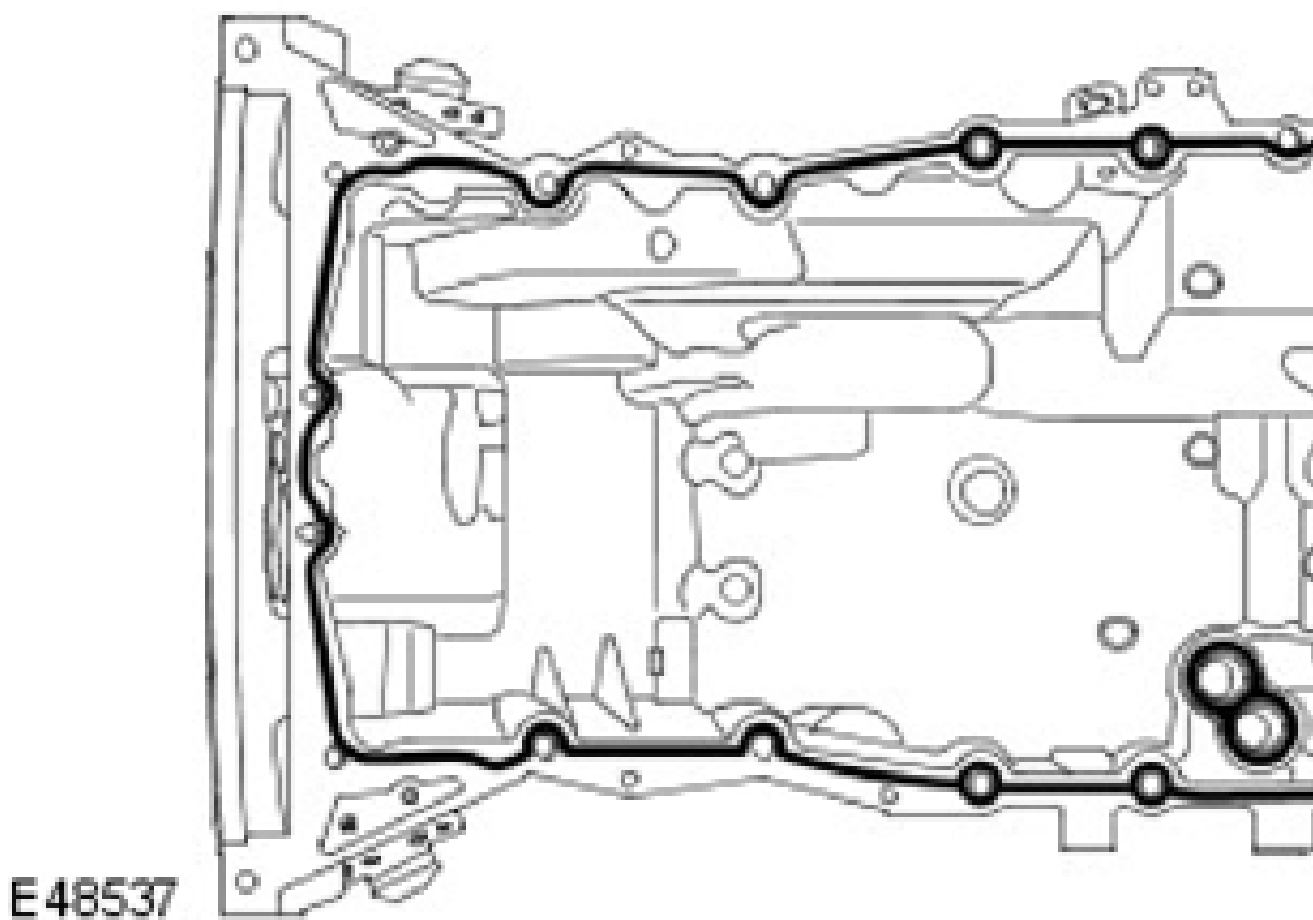


25. Remove the special tool from the LH cylinder head.

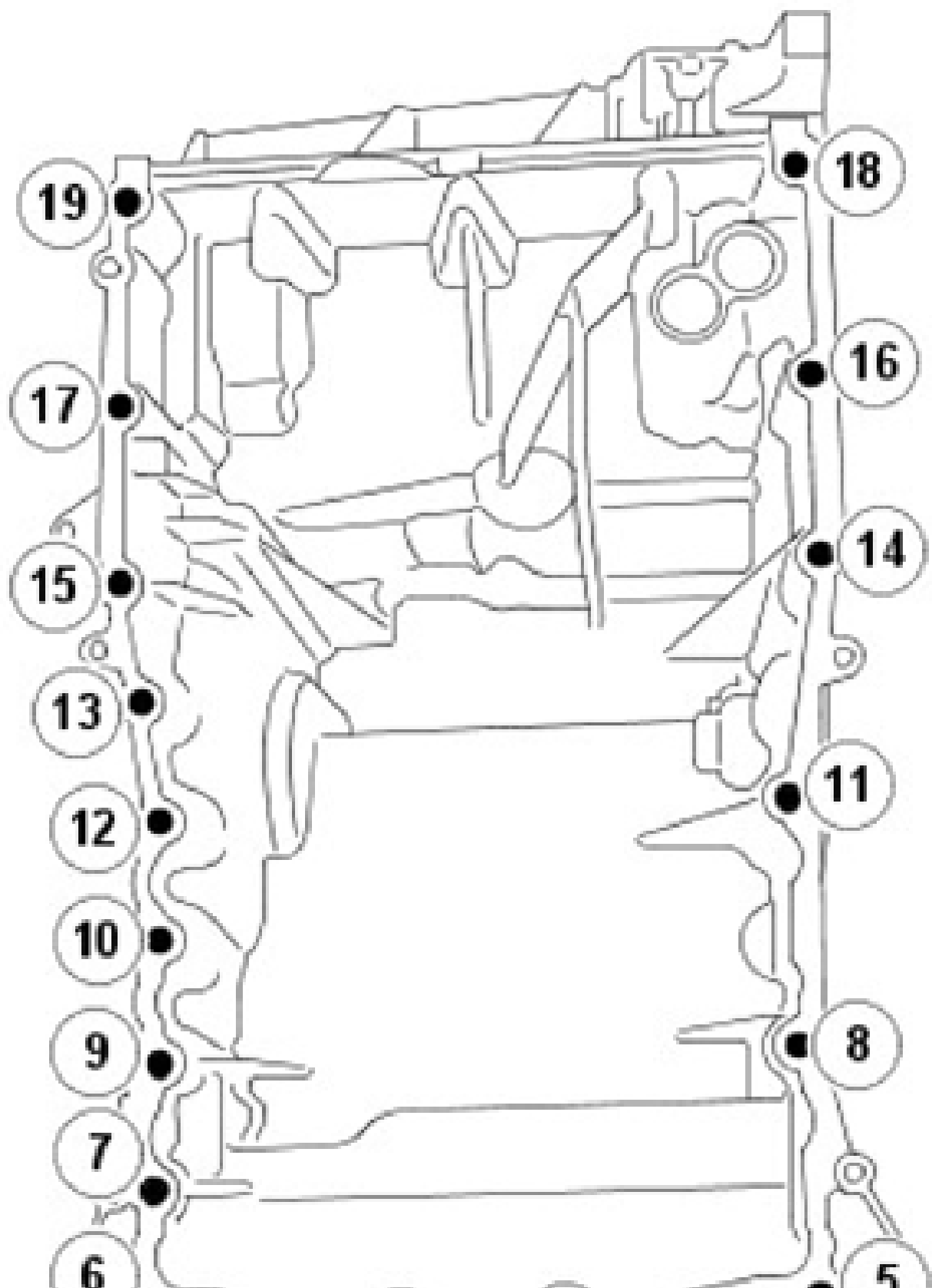


26. Install the oil pan extension.

- 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.

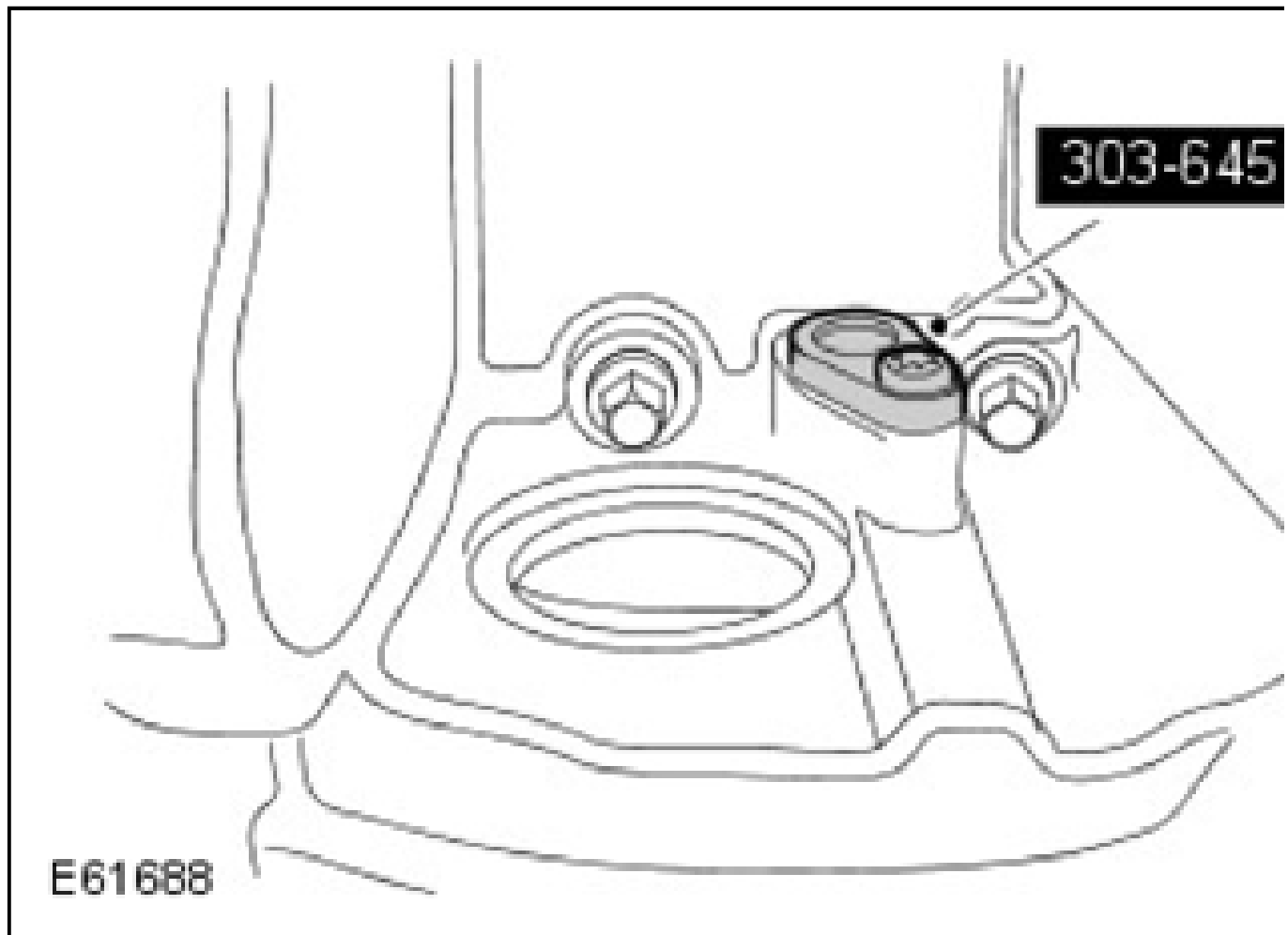


27. Tighten the oil pan bolts in the sequence shown to 20 Nm (15 lb.ft).



28. Remove the special tool.

- Remove the bolt.



29. Install the CKP sensor.

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

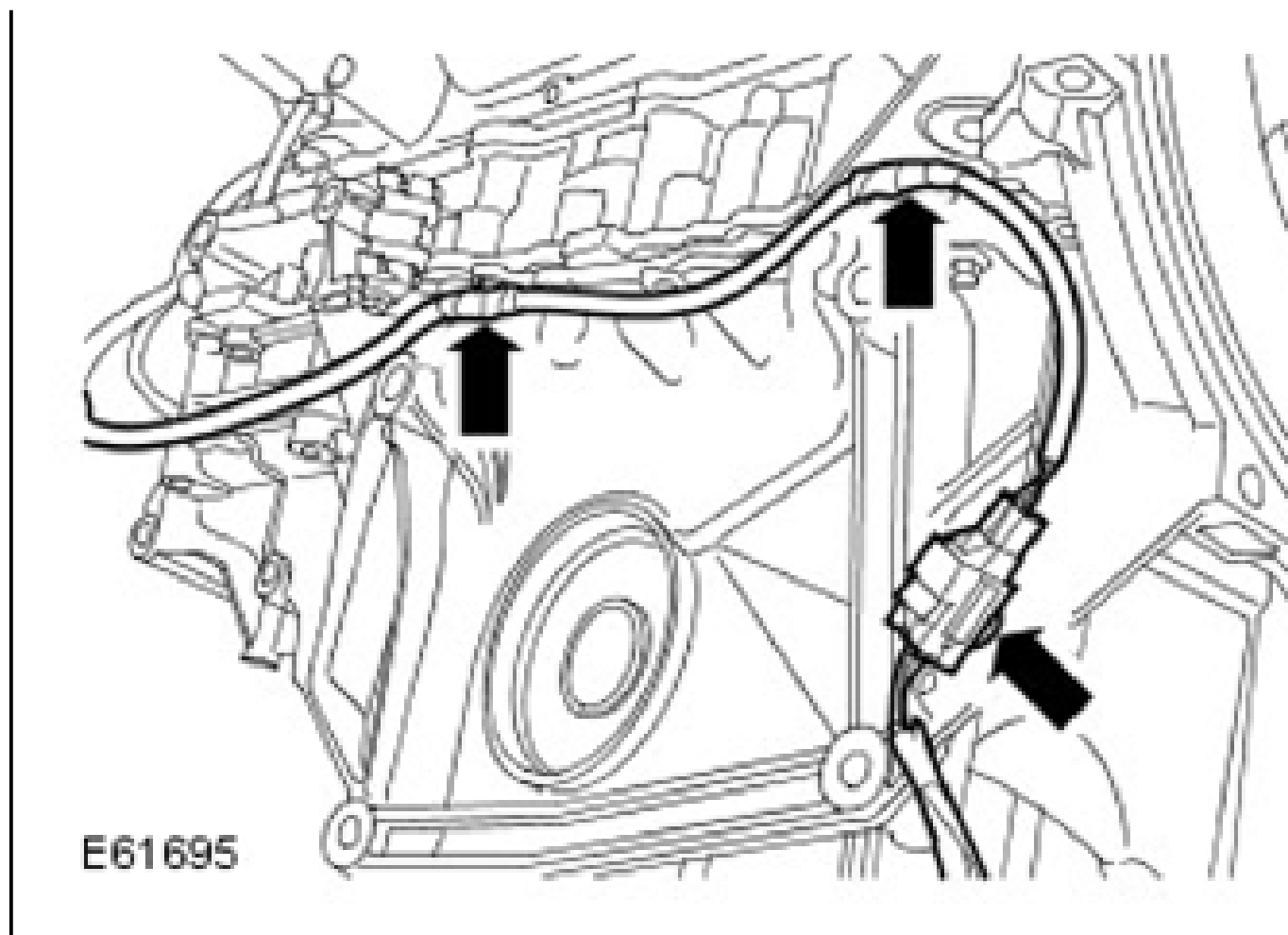
NOTE: Install a new O-ring seal.

30. Install the halfshaft support bearing housing.

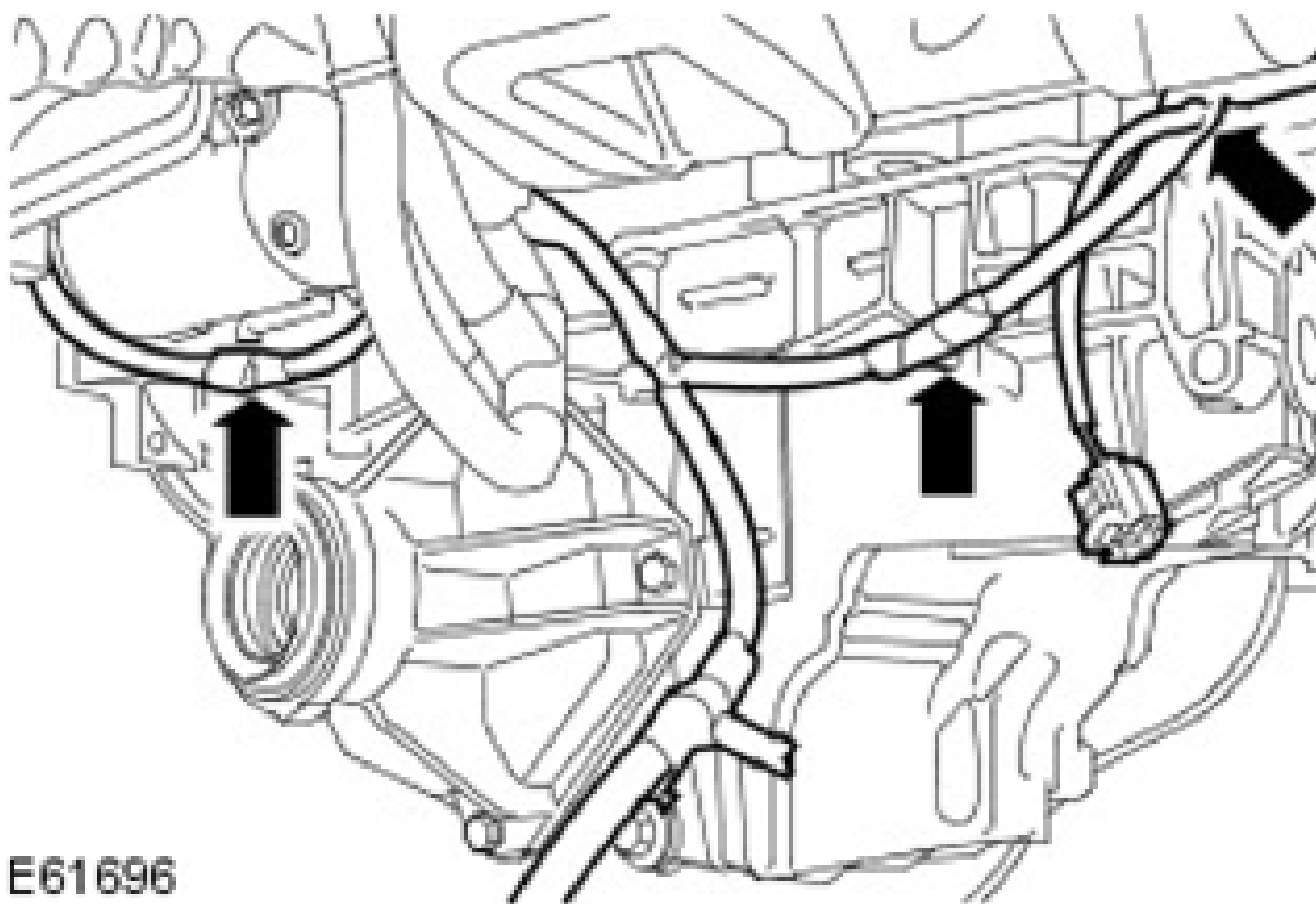
- Install the O-ring seal.
- Lubricate the O-ring seal with a suitable lubricant.
- Tighten the bolts evenly to 25 Nm (18 lb.ft).

31. Attach the wiring harness to the LH side of the engine

- Secure the clips.



32. Attach the wiring harness to the RH side of the engine.
- Secure the clips.



33. Install the power steering pump mounting bracket.

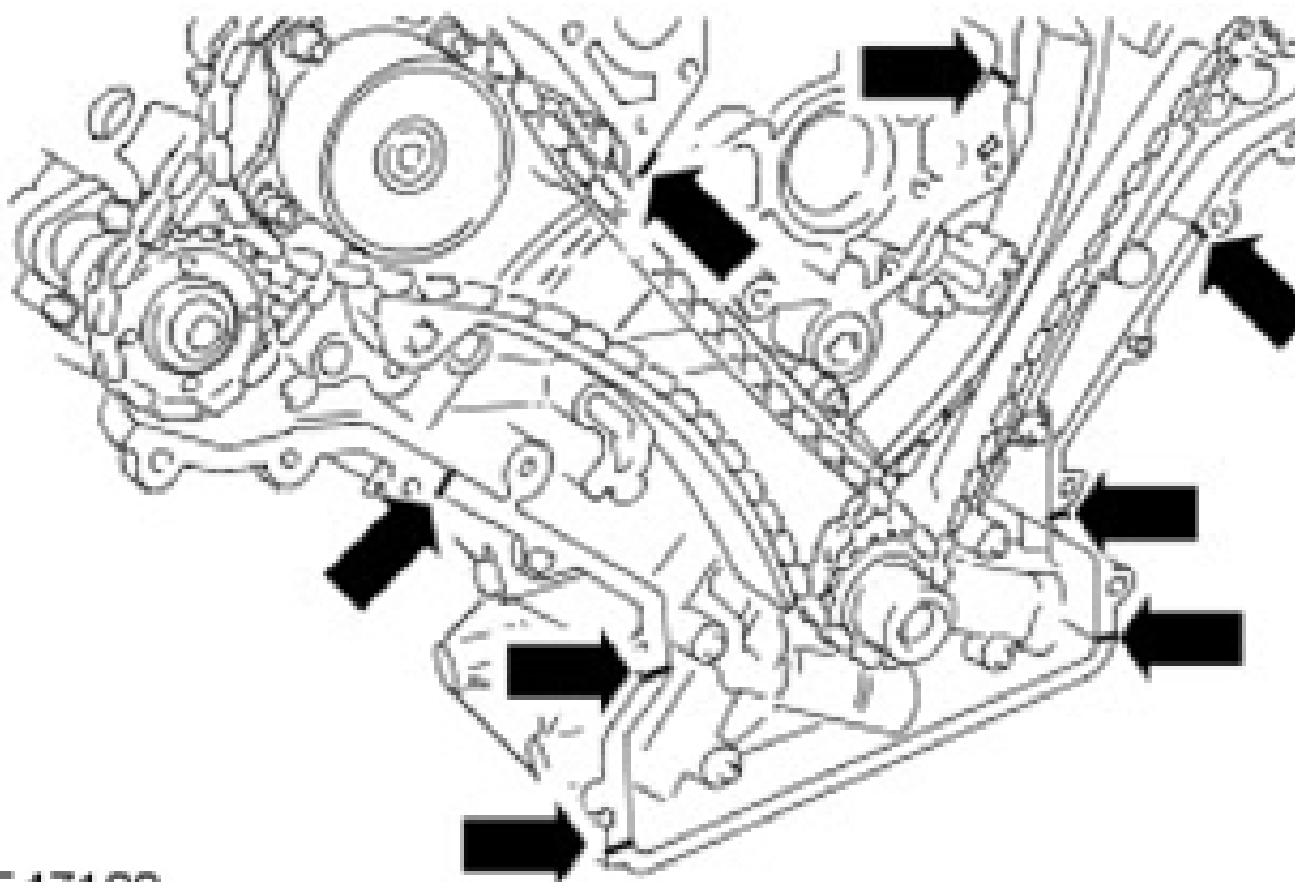
- Tighten the bolts to 25 Nm (18 lb.ft).

NOTE: Install a new gasket.

NOTE: Install a new O-ring seal.

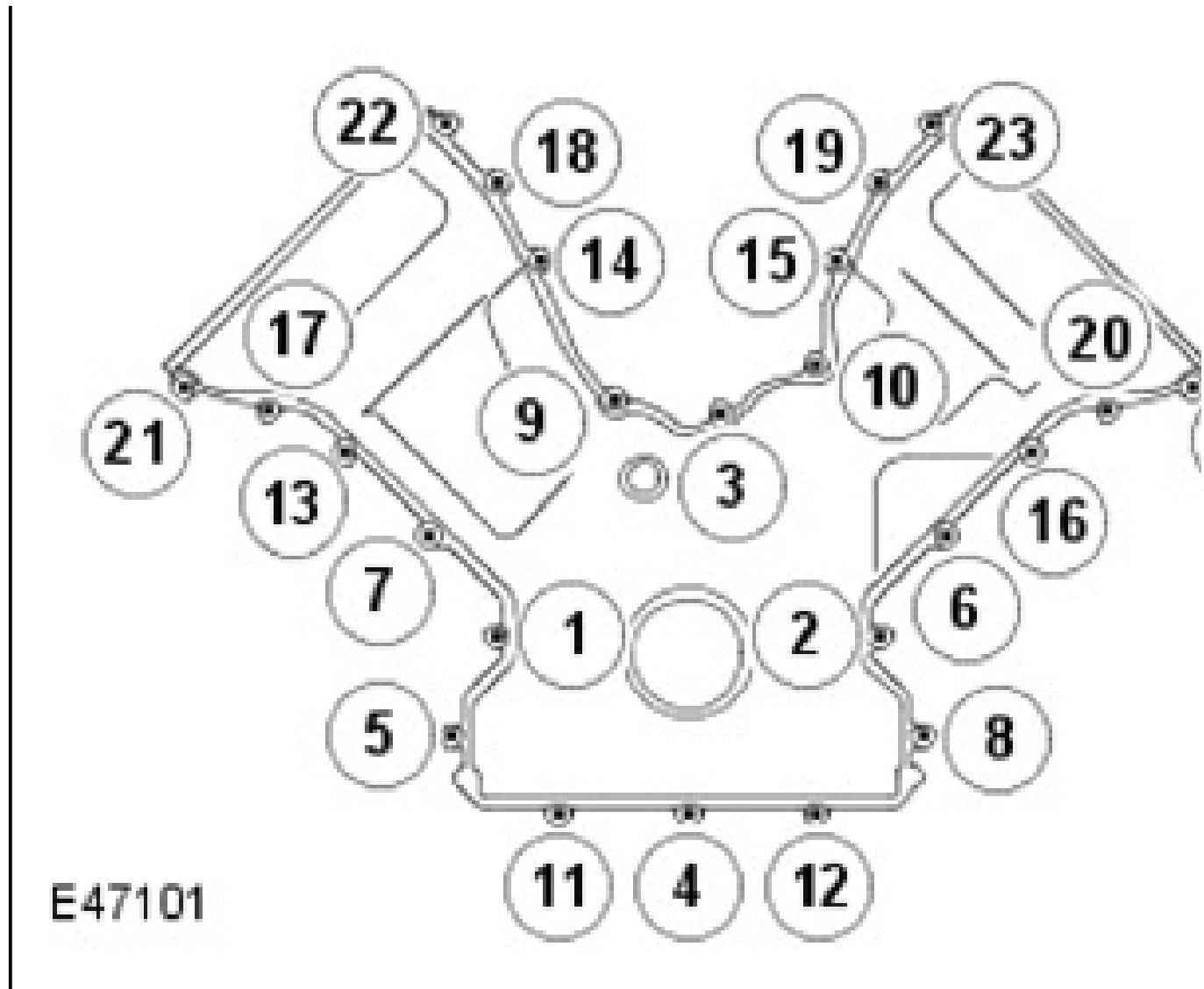
34. Install the engine front cover.

- Clean the component mating faces.
- Apply a 3 mm (0.118 in) diameter bead of sealant 12mm (0.47 in) long, to the 8 places indicated.
- Install the gasket.
- Install the O-ring seal.



E47100

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



36. Attach the engine wiring harness.
- Secure the clips.
 - Tighten the bolt to 10 Nm (7 lb.ft).

NOTE: Install new seals.

37. Install the LH valve cover plug aperture seals.
38. Install new LH valve cover bolt O-ring seals.

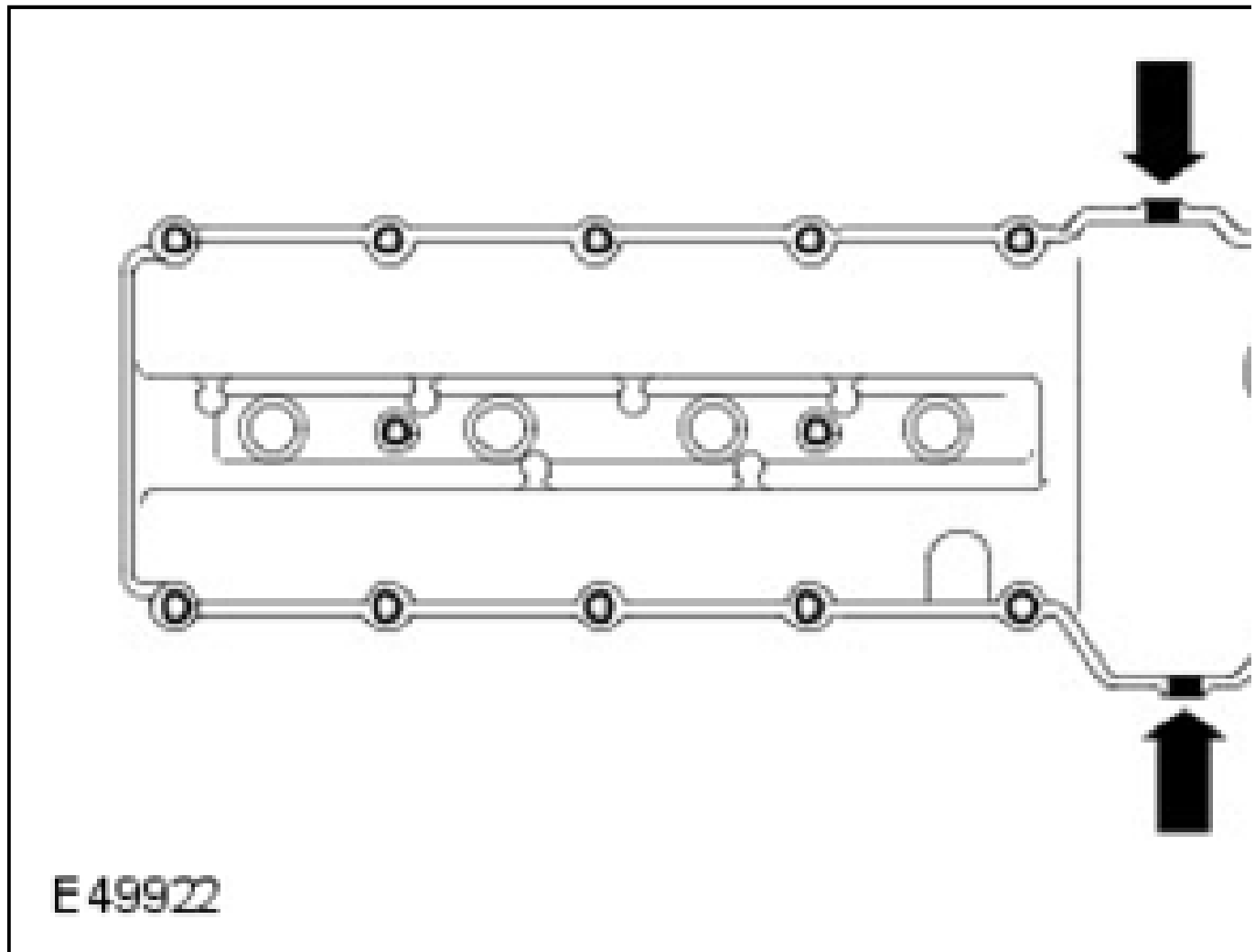
NOTE: Install a new gasket.

NOTE: Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3 mm (0.118 in) diameter 12 mm

(0.47 in) 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.

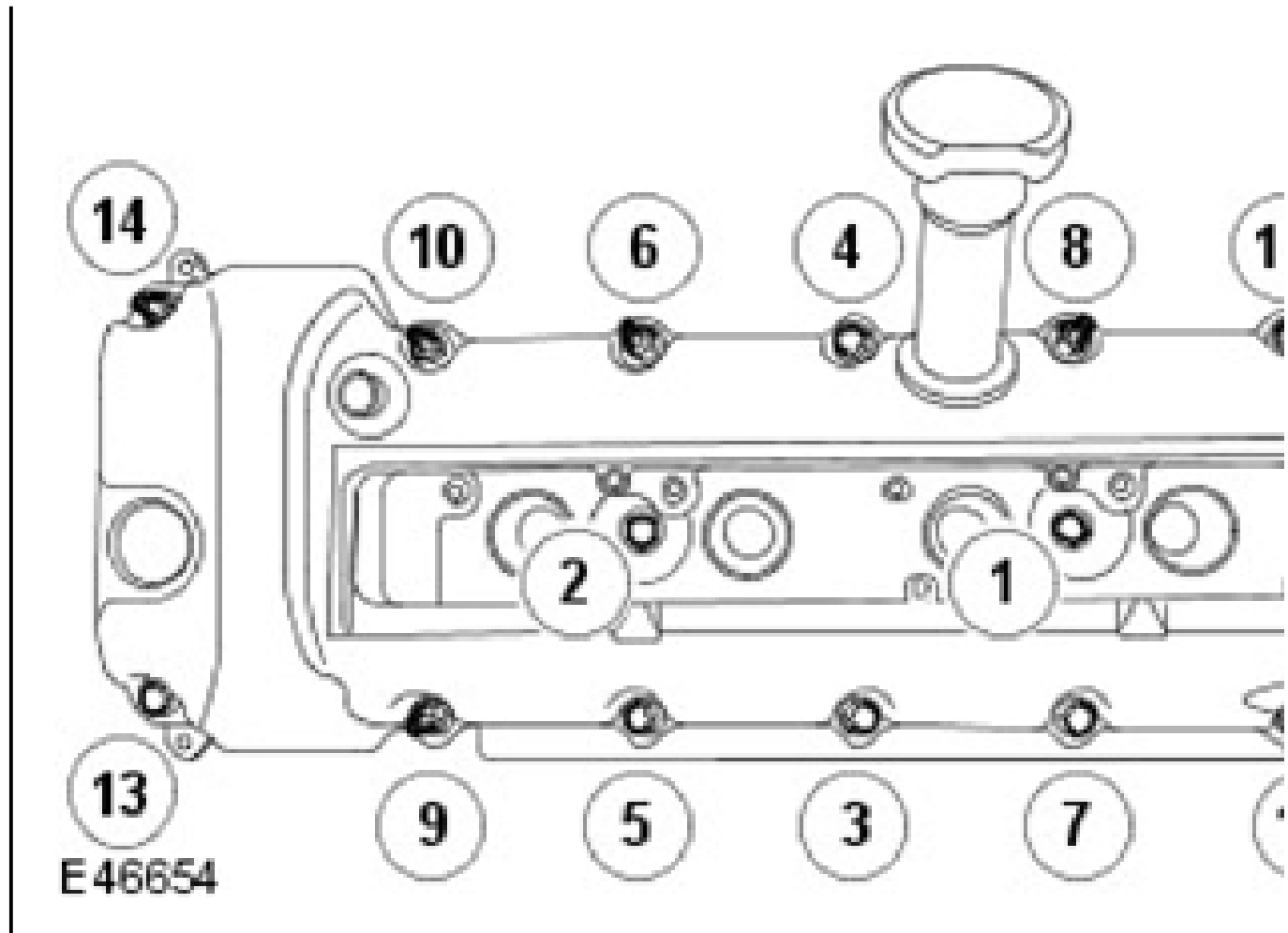
39. Install the LH valve cover.

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



40. Install the LH valve cover bolts.

- Install the LH valve cover bolts to the positions previously noted.
- Tighten the bolts in the sequence shown to 12 Nm (9 lb.ft).



41. Connect the LH VCT oil solenoid electrical connector.
42. Attach the engine wiring harness to the retaining bracket.

NOTE: Install a new O-ring seal.

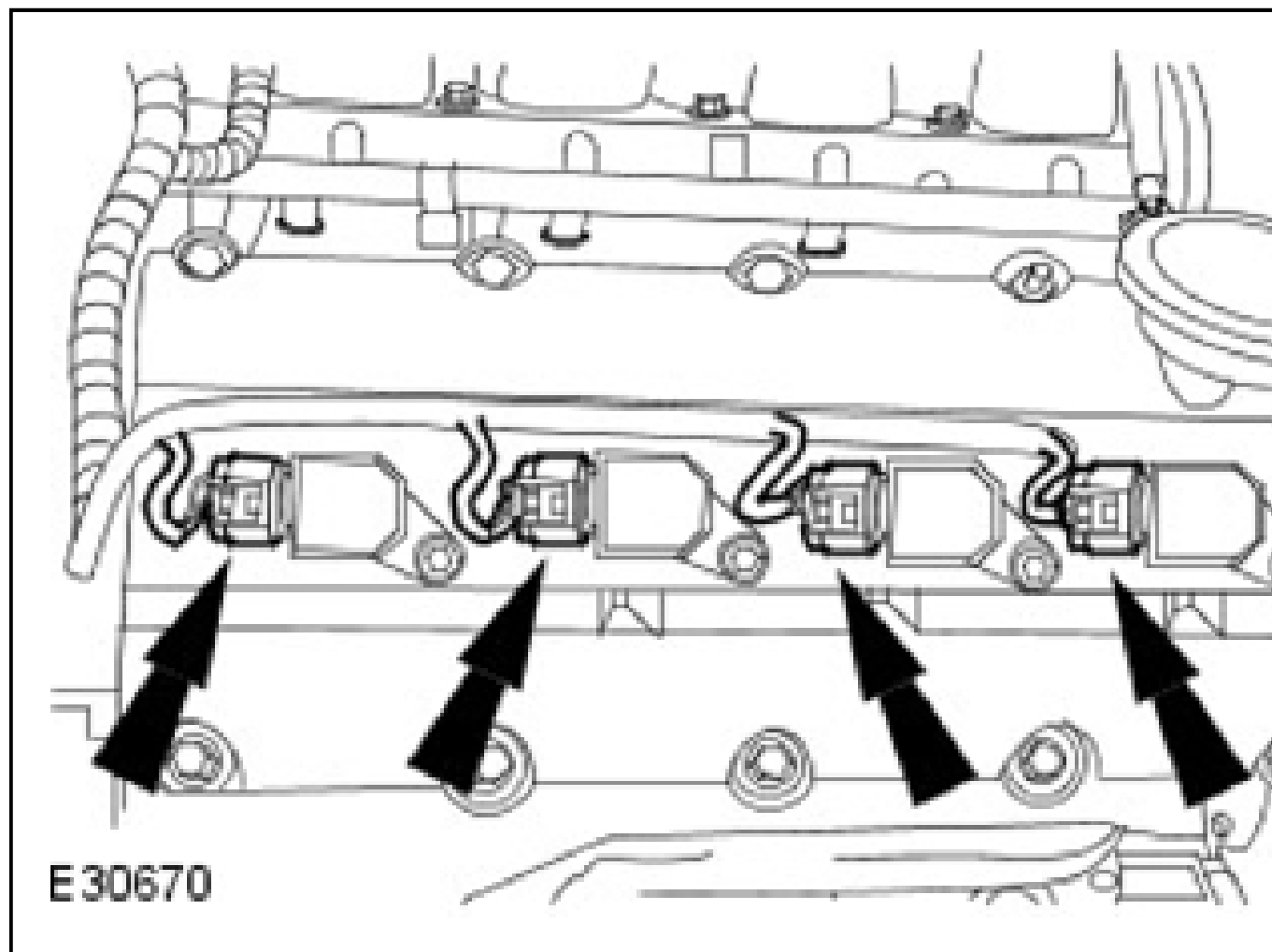
43. With assistance, install the oil level indicator and tube.
 - Clean the component mating faces.
 - Install the O-ring seal.
 - Lubricate the O-ring seal with clean engine oil.
 - Tighten the nut to 6 Nm (4 lb.ft).

NOTE: Install new O-ring seals.

44. Install the 4 LH ignition coil-on-plugs.
 - Install the O-ring seals.
 - Install the 4 ignition coil-on-plugs.

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

45. Connect the 4 electrical connectors.



46. Install the LH ignition coil-on-plug cover.

NOTE: Install new seals.

47. Install new RH valve cover plug aperture seals.

48. Install new RH valve cover bolt O-ring seals.

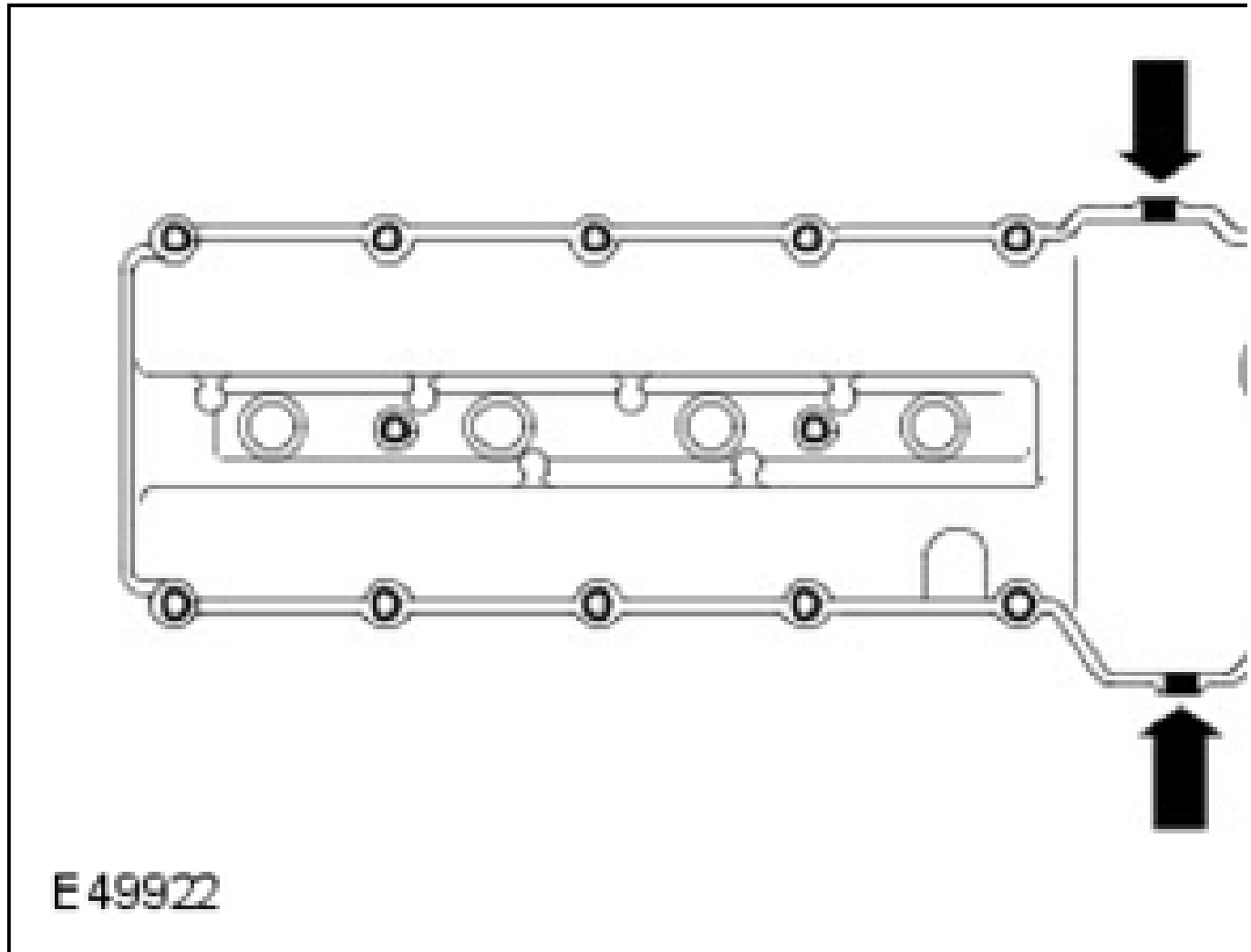
NOTE: Install a new gasket.

NOTE: Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3 mm (0.118 in) diameter 12 mm (0.47 in) 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.

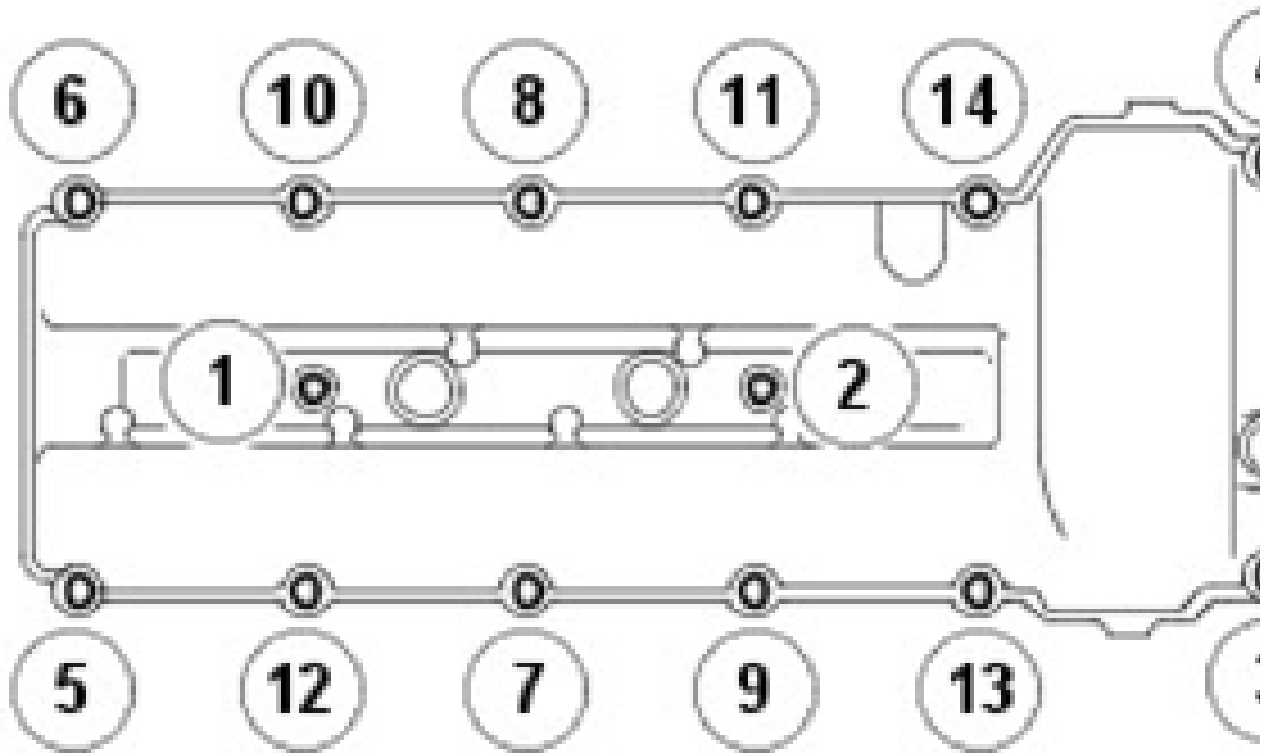
49. Install the RH valve cover.

- Clean the component mating faces.
- Install the gasket.



50. Install the RH valve cover bolts.

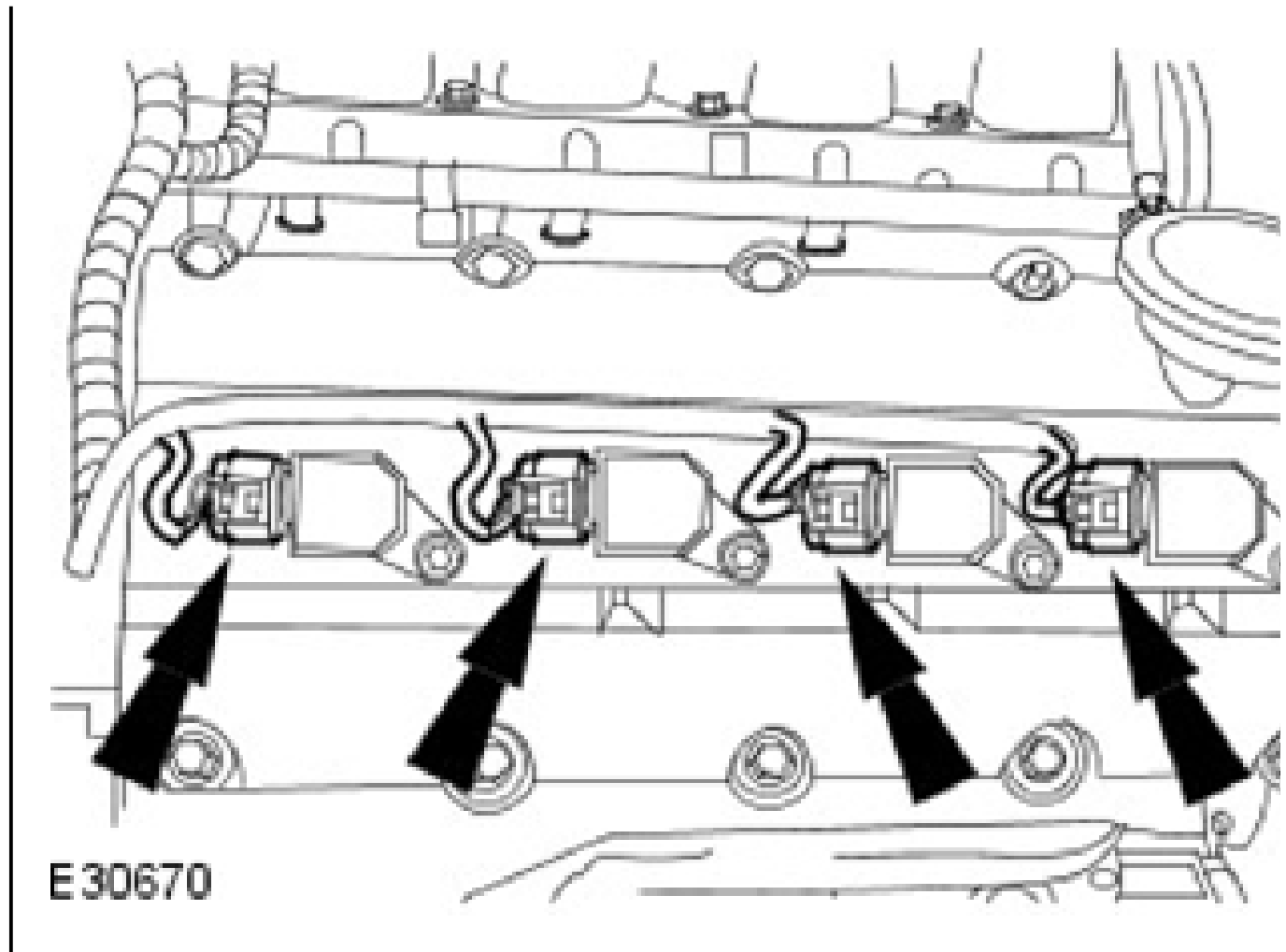
- Install the RH valve cover bolts to the positions previously noted.
- Tighten the bolts in the sequence shown to 12 Nm (9 lb.ft).



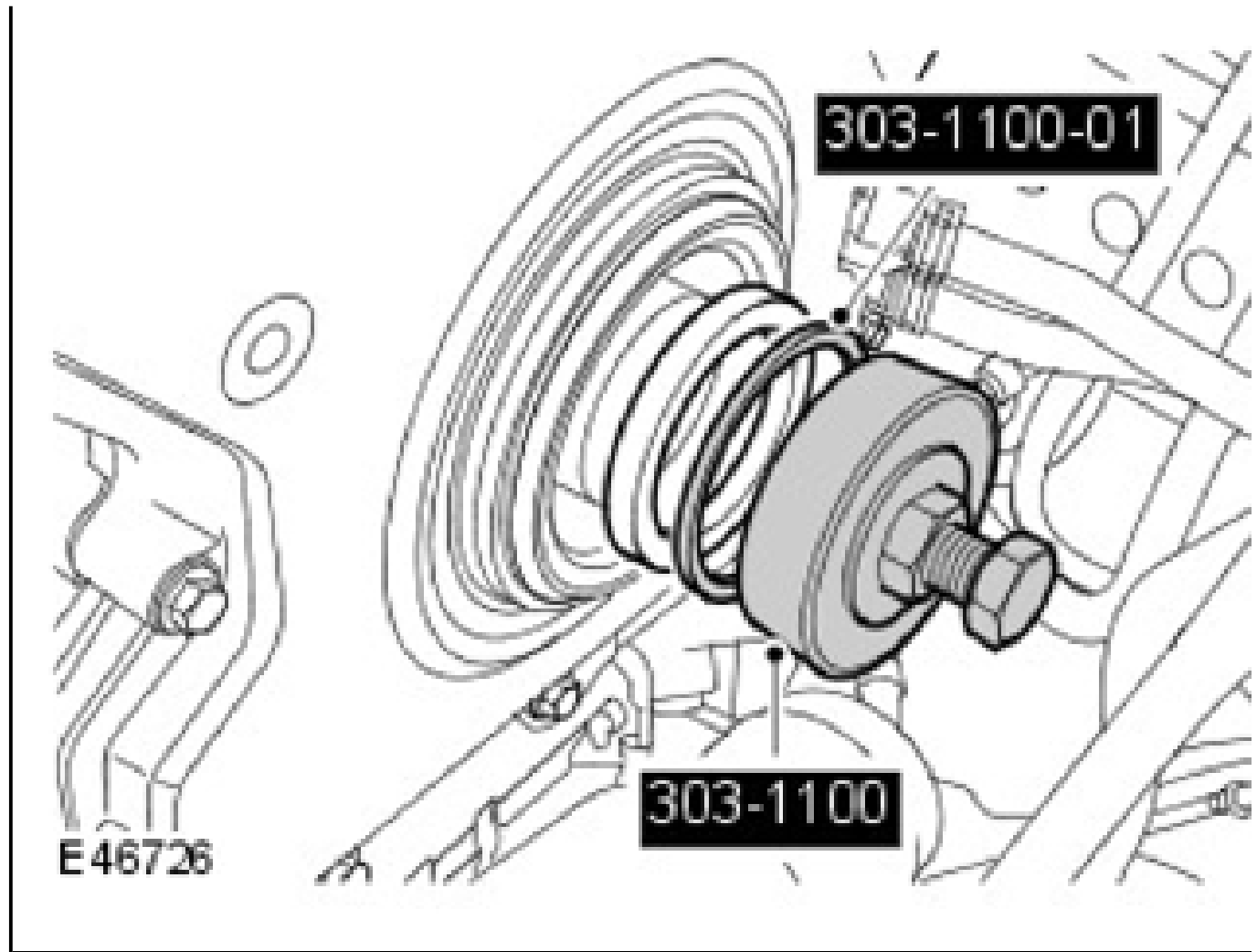
E 46679

NOTE: Install new O-ring seals.

51. Install the 4 RH ignition coil-on-plugs.
 - Install the O-ring seals.
 - Install the 4 ignition coil-on-plugs.
 - Tighten the bolts to 6 Nm (4 lb.ft).
52. Connect the 4 electrical connectors.



53. Connect the RH VCT oil solenoid electrical connector.
54. Attach the engine wiring harness to the retaining bracket.
55. Connect the PCV line to the RH valve cover.
56. Clean the crankshaft pulley mating faces.
57. Using the special tool, install the crankshaft front seal.
 - Lubricate the seal with clean engine oil.
 - Use the discarded crankshaft bolt with the special tool.
 - Remove the special tools.



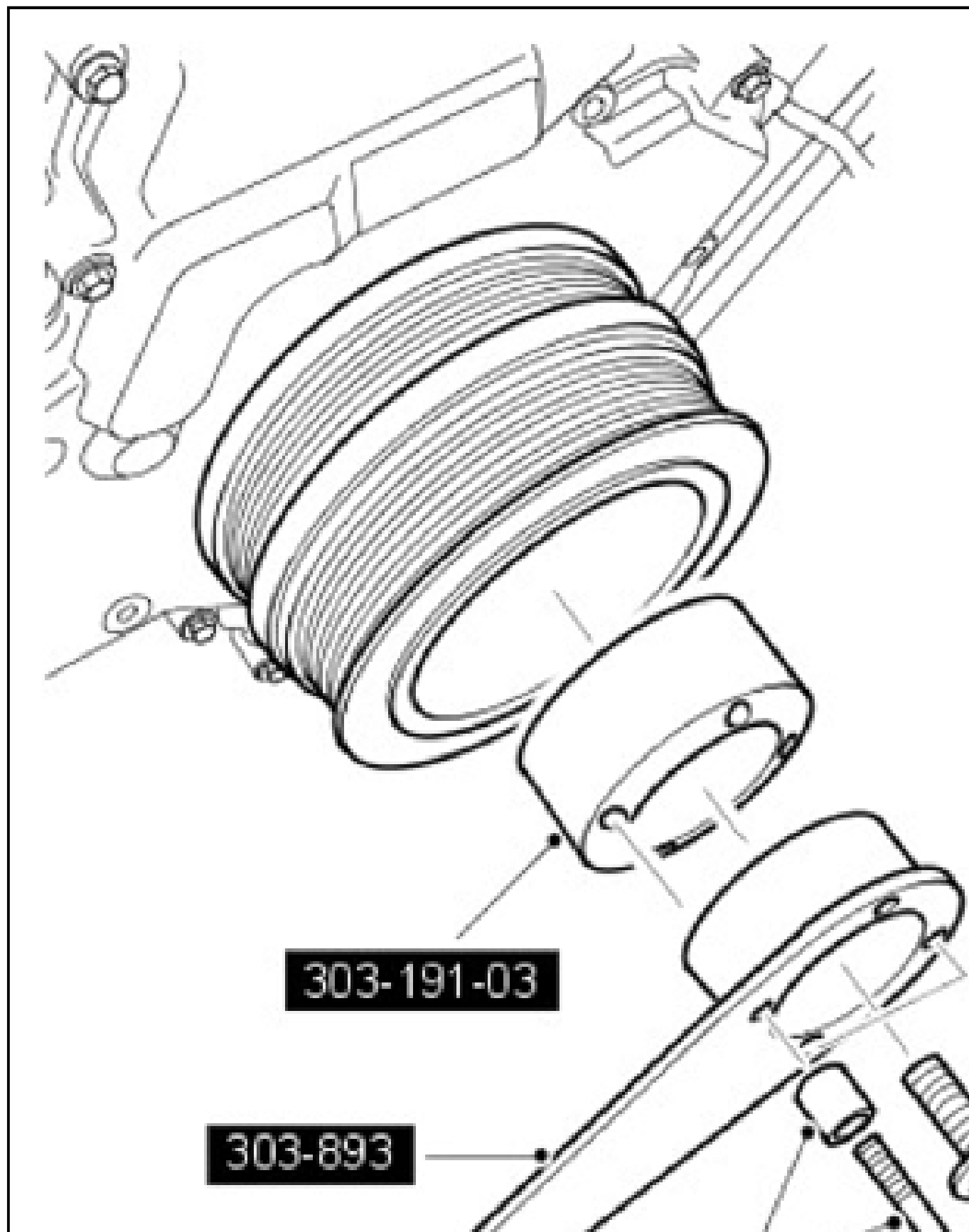
58. Install the crankshaft pulley.
 - Lubricate the seal with clean engine oil.
59. Install the crankshaft pulley locking ring.

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

60. 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.

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



62. Install the exhaust manifold heat shield.
 - Tighten the 2 bolts.
63. Install the accessory drive belt idler pulleys.
 - Tighten the bolts to 25 Nm (18 lb.ft).
64. Install the coolant pump pulley.
 - Tighten the bolts to 10 Nm (7 lb.ft).

NOTE: **Install new O-ring seals.**

65. Install the coolant manifold.
 - Clean the components.
 - Install the O-ring seals.
 - Connect the 4 coolant hoses and install the clips.
 - Attach the wiring harness bracket.
 - Tighten the 2 bolts to 10 Nm (7 lb.ft).
66. Connect the ECT sensor electrical connector.
67. Install the cooling fan drive belt tensioner.
 - Tighten the bolt to 40 Nm (30 lb.ft).
68. Remove the engine from the engine stand.
69. Install the engine.

For additional information, refer to: **ENGINE**.

70. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

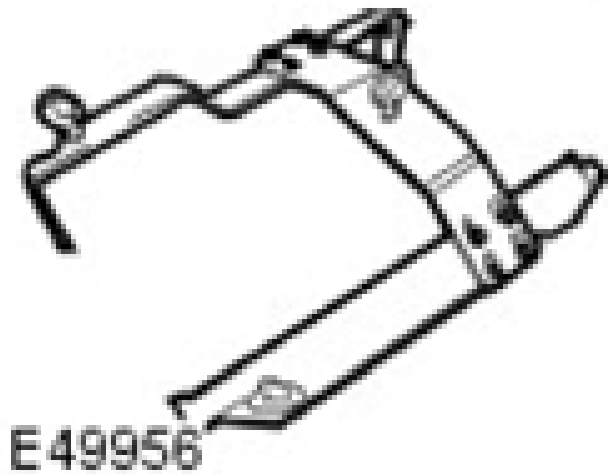
REMOVAL

ENGINE

SPECIAL TOOL(S)

	Engine lifting cradle 303-1144
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303-1144



E49956

Fuel spring lock decoupling tool
310-D005

310-D005



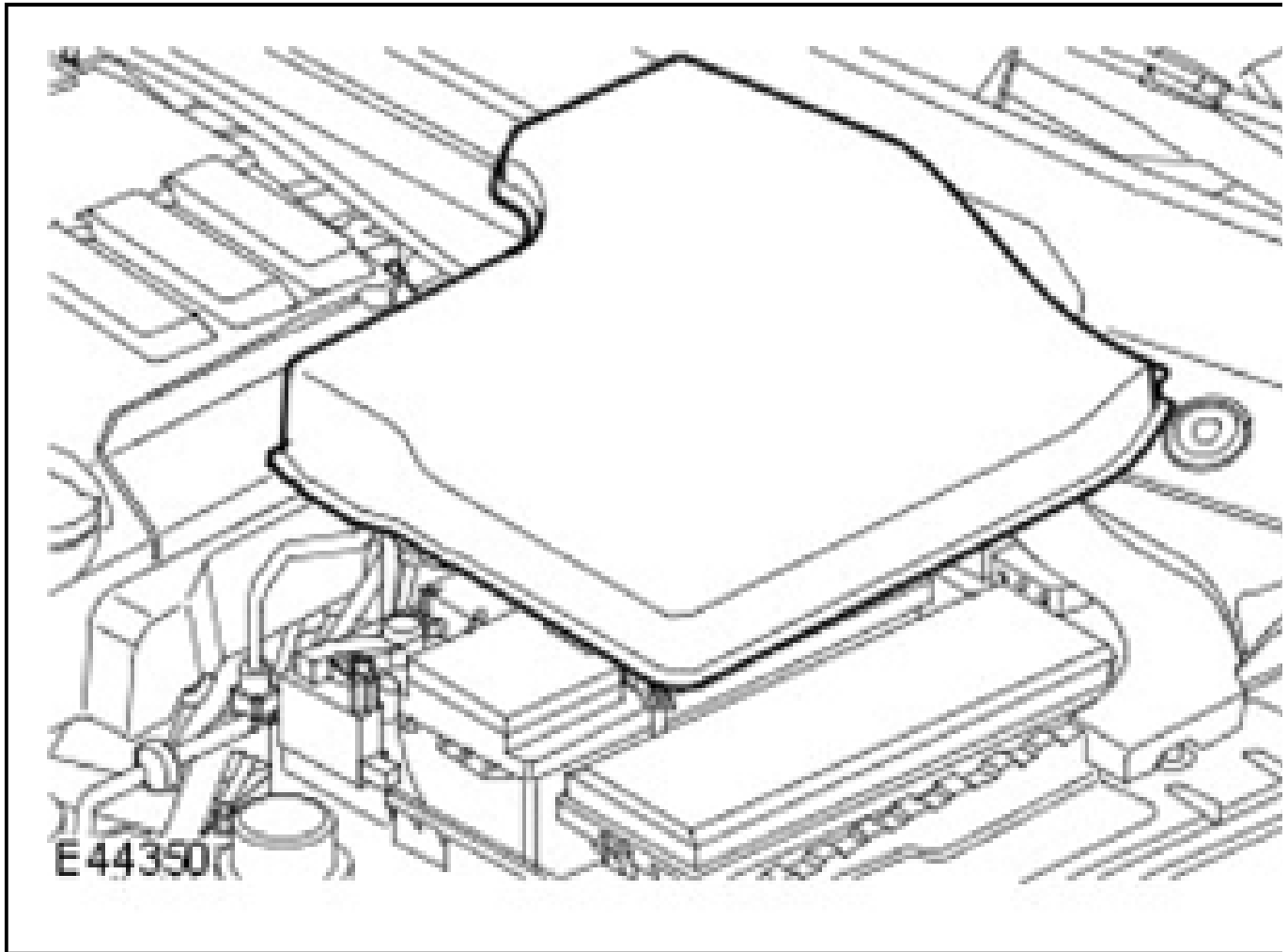
E45289

REMOVAL

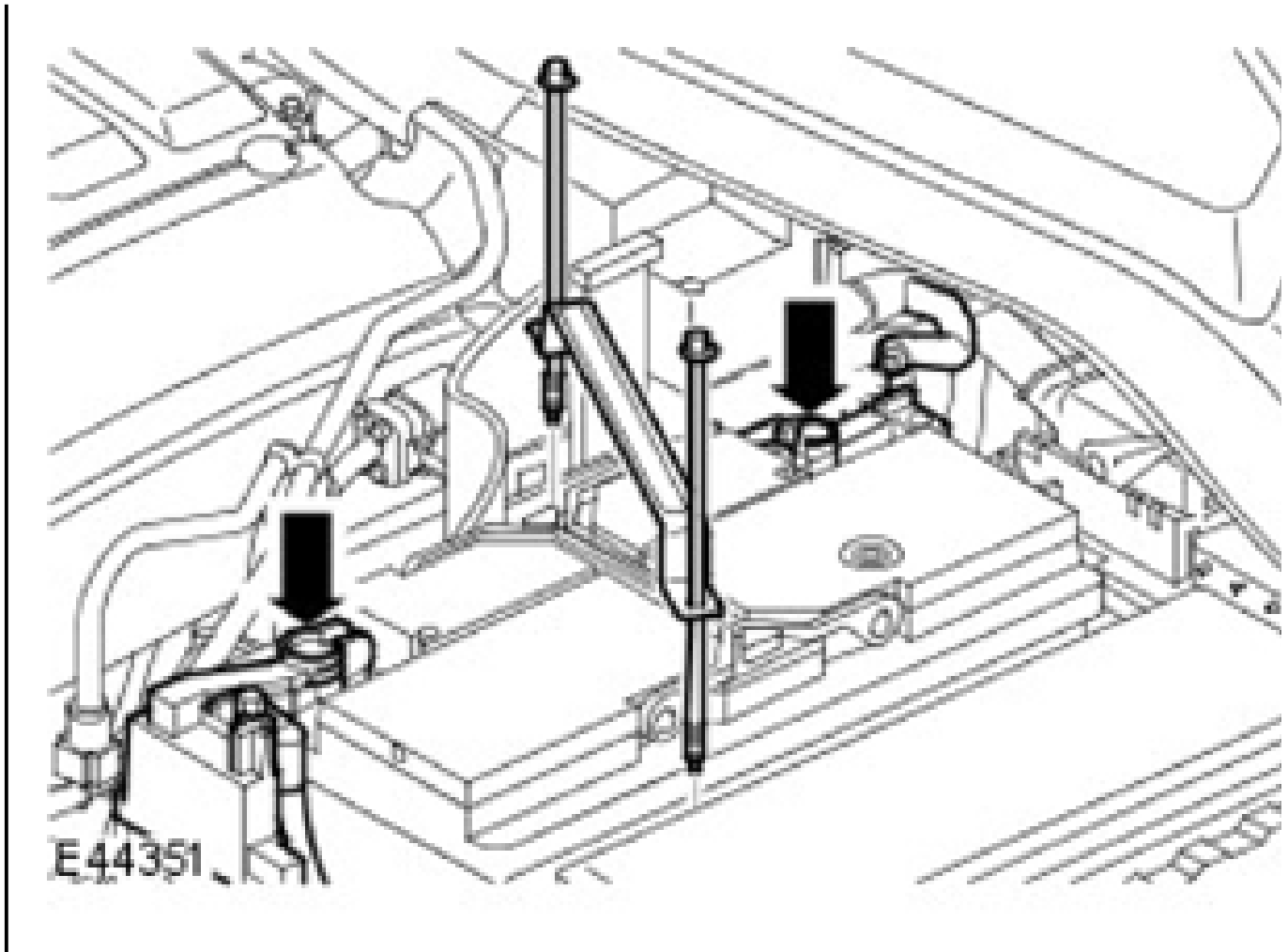
1. Secure the hood in the service position.
2. Disconnect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

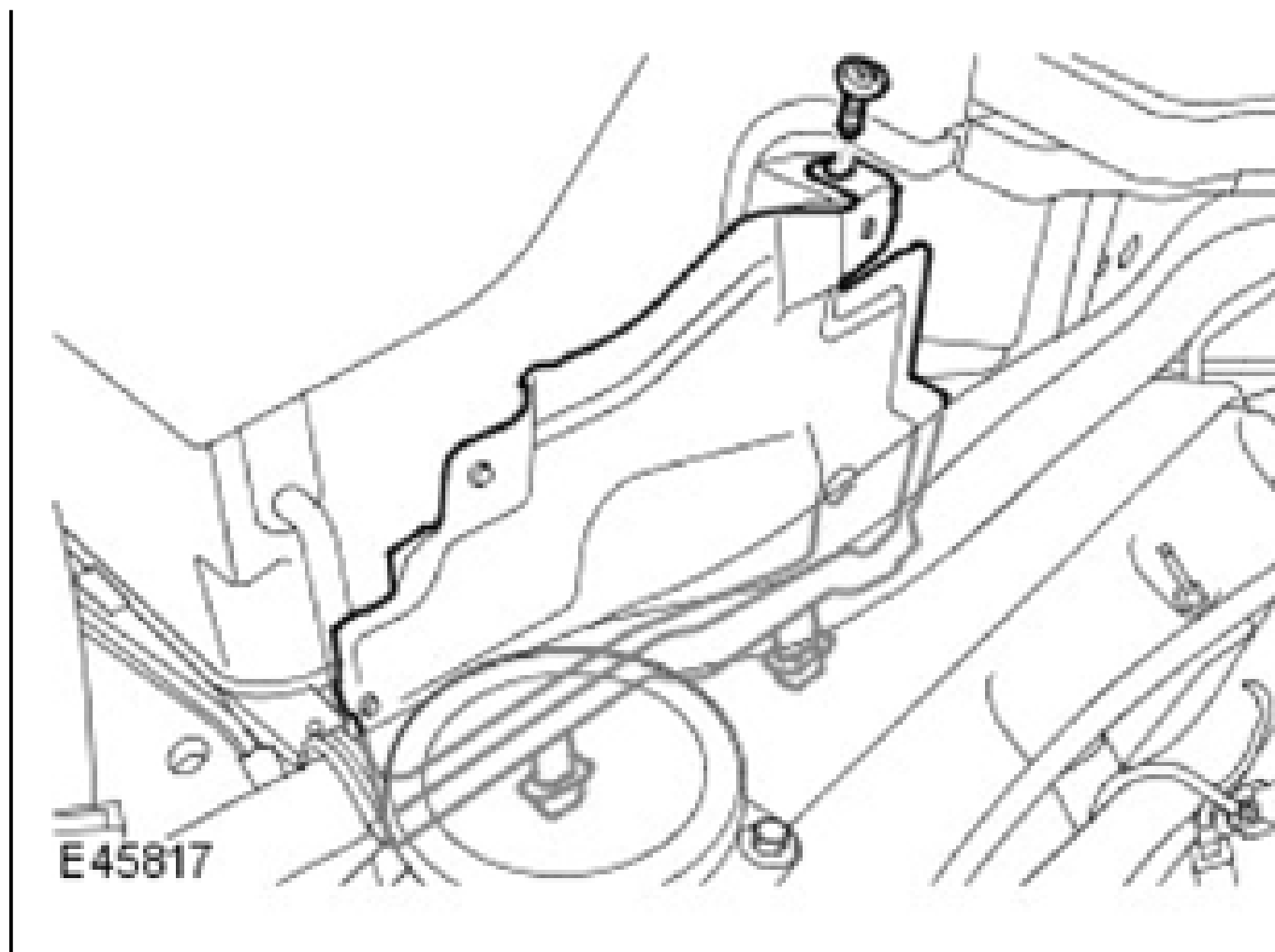
3. Remove the battery cover.
 - Release the 2 mounting clips.



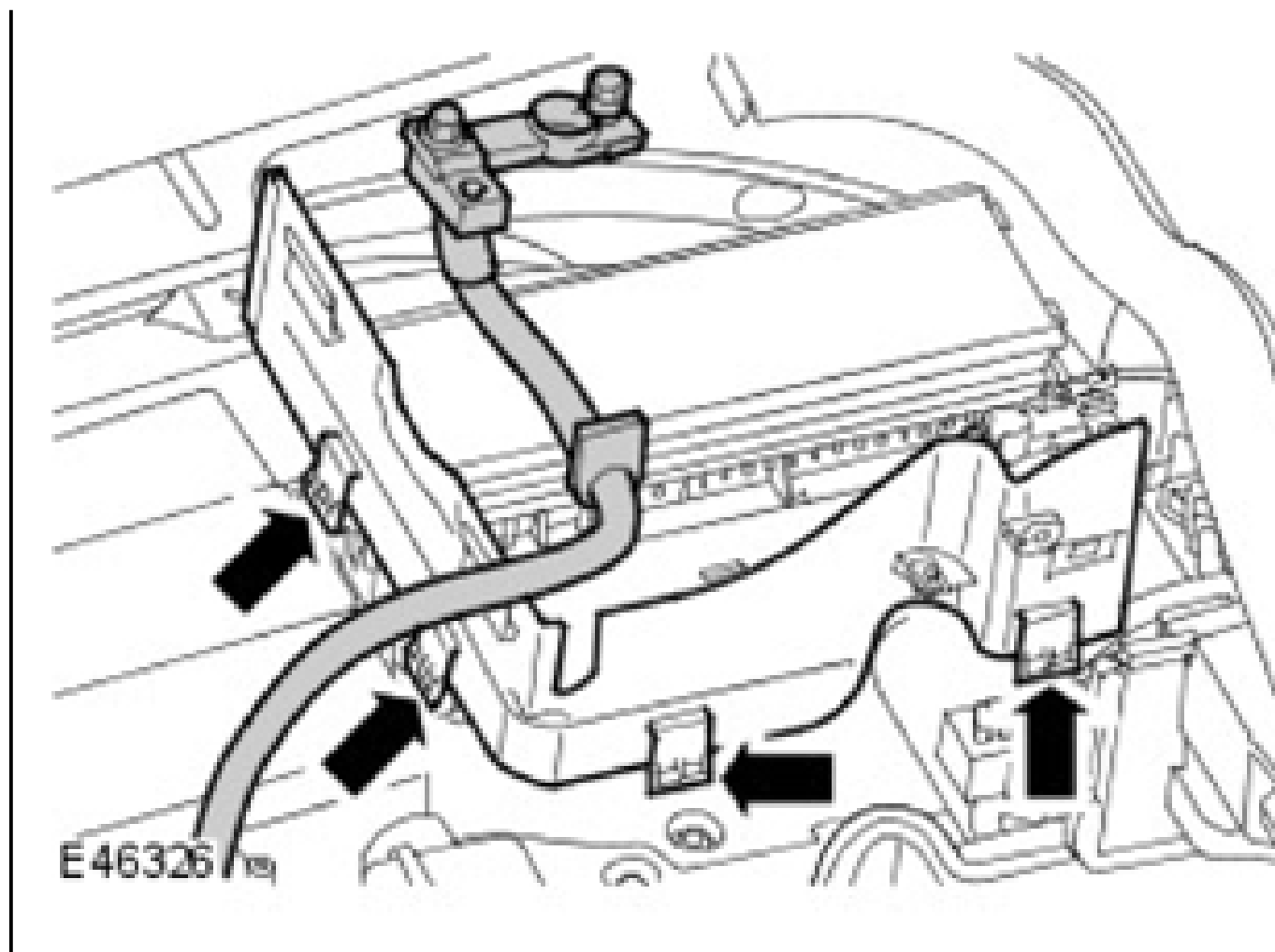
4. Disconnect the battery positive cable.
5. Remove 2 bolts securing the battery clamp and remove the clamp.



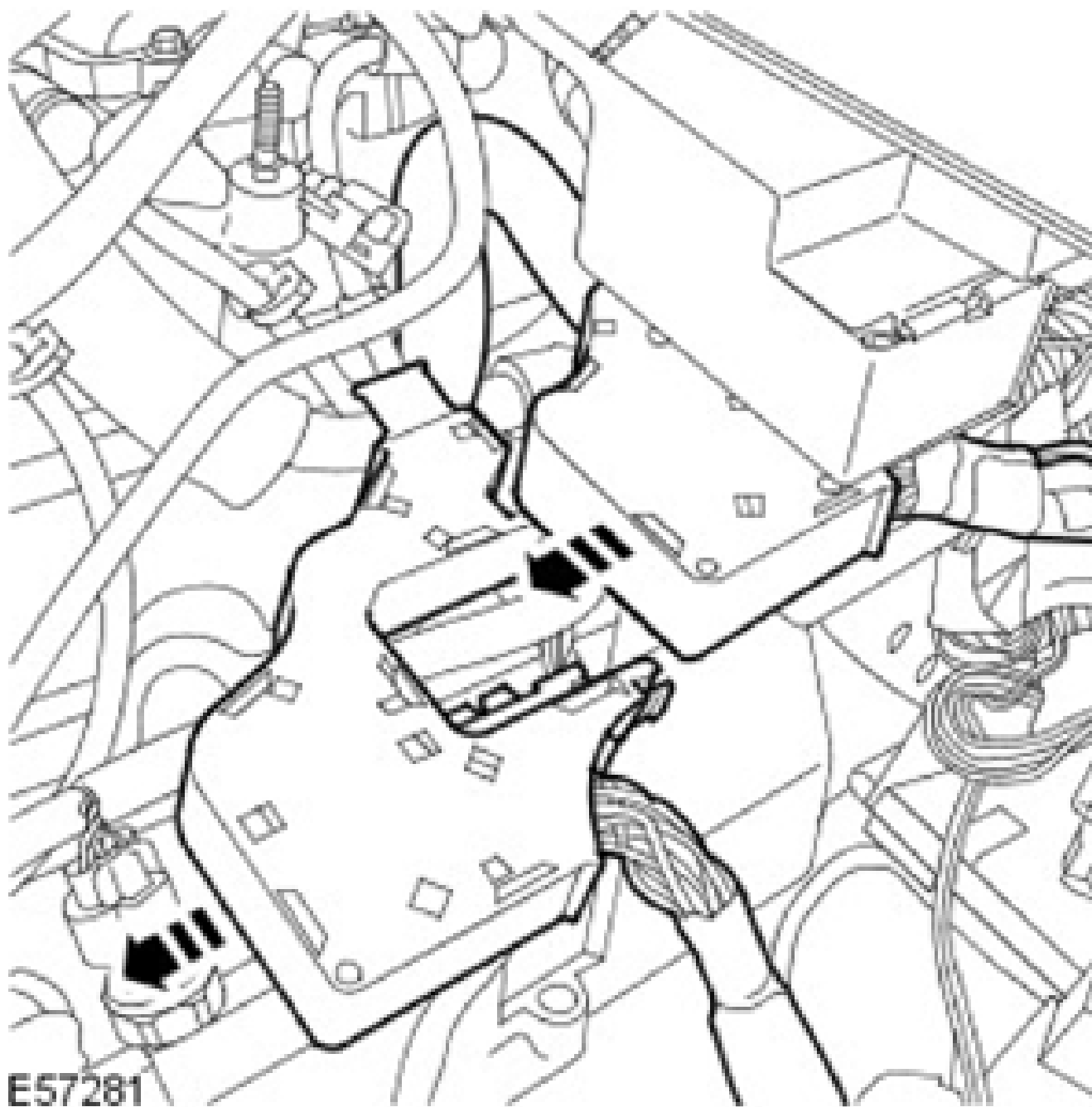
6. Remove the battery.
7. Remove the engine compartment upper heat shield.
 - Remove the 2 screws.
 - Release the 2 mounting clips.



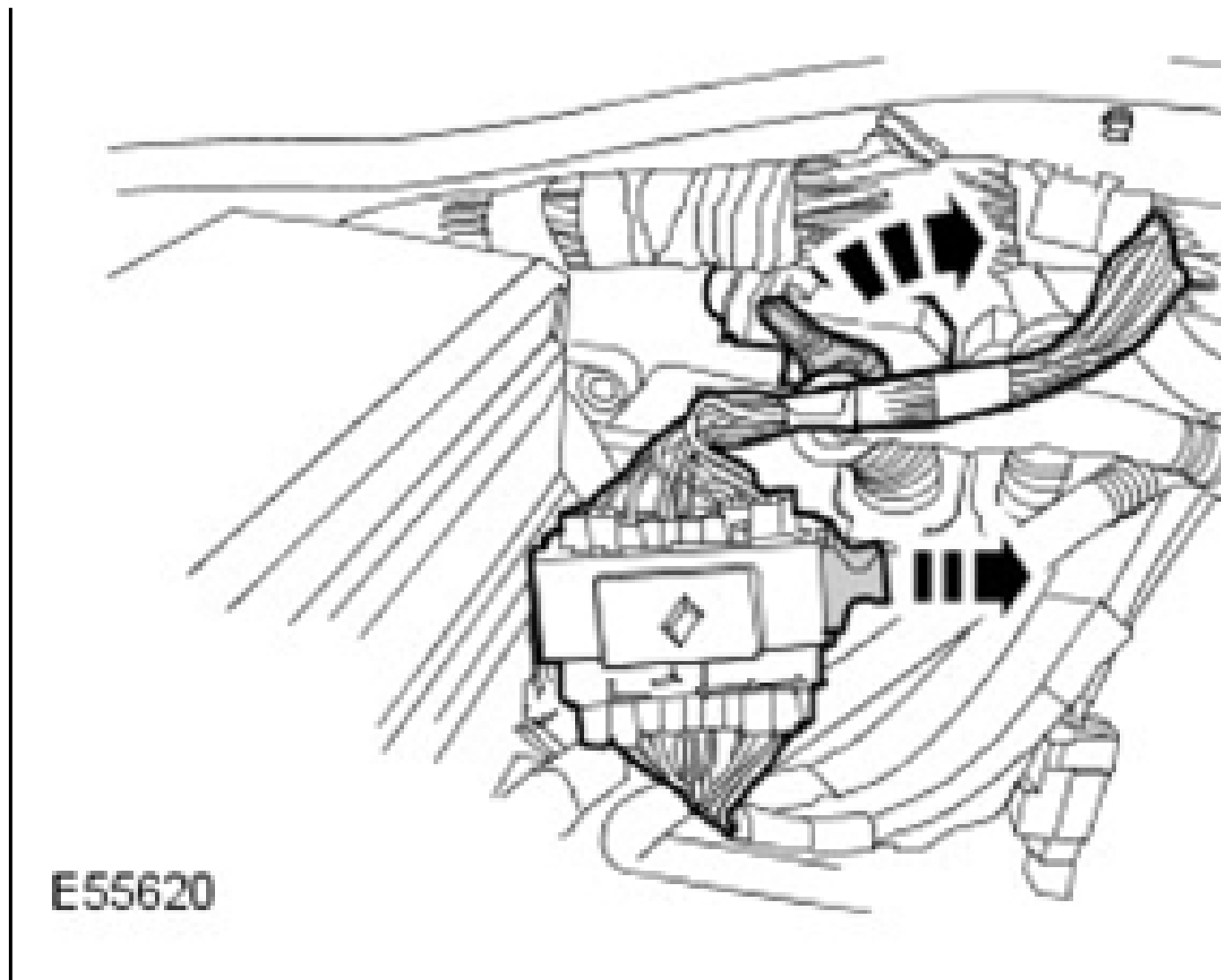
8. Remove the battery compartment side wall.
 - Release the battery positive cable and grommet.
 - Release the 4 clips.



9. Release the cassette.
 - Release the 2 clips.



10. Disconnect the engine wiring harness.
 - Release and disconnect the 2 electrical connectors.



11. Remove the RH air cleaner assembly.

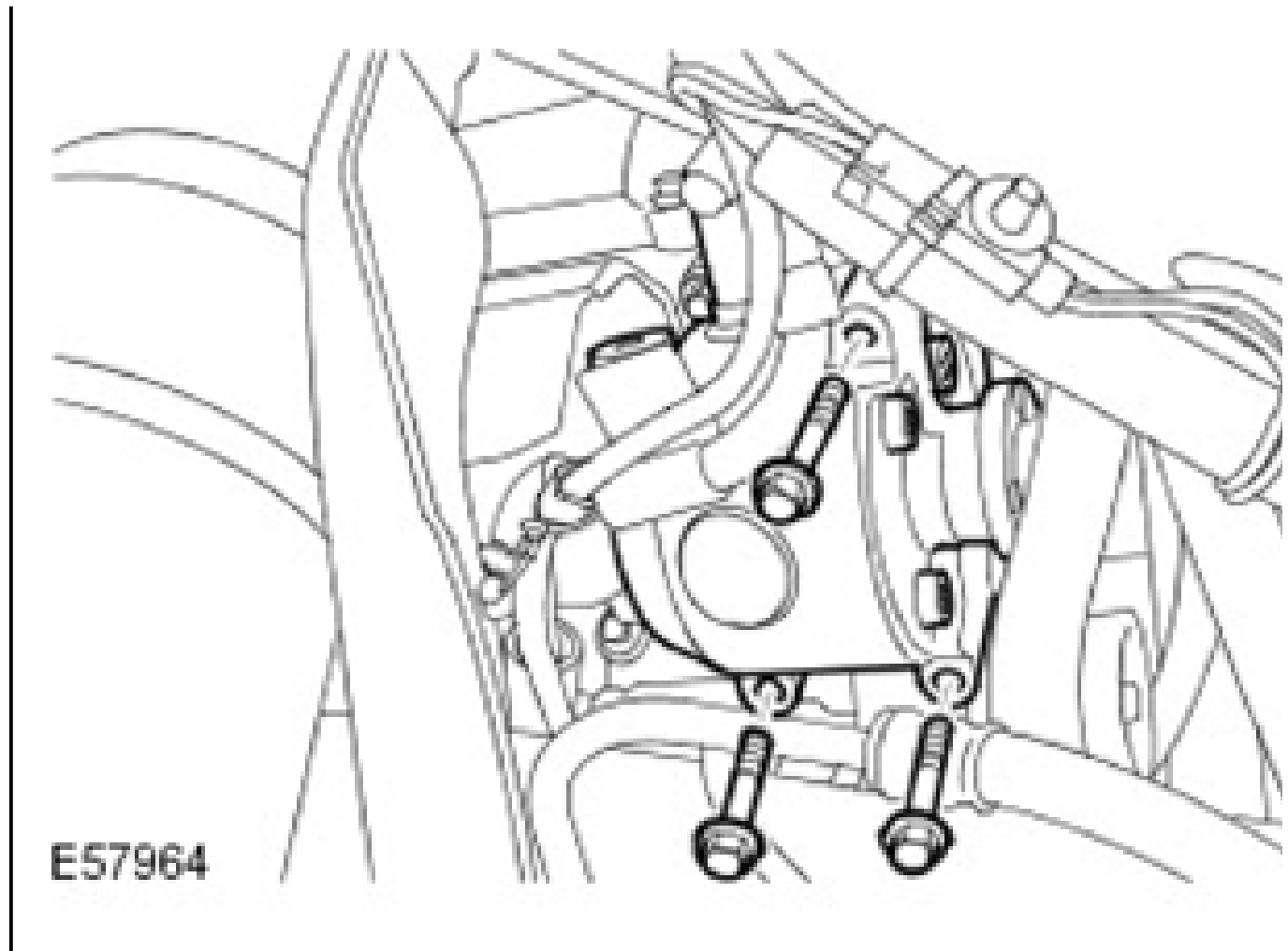
For additional information, refer to: [Air Cleaner](#) .

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

12. Raise and support the vehicle.
13. Remove the fender splash shields.

For additional information, refer to: [FENDER SPLASH SHIELD](#) .

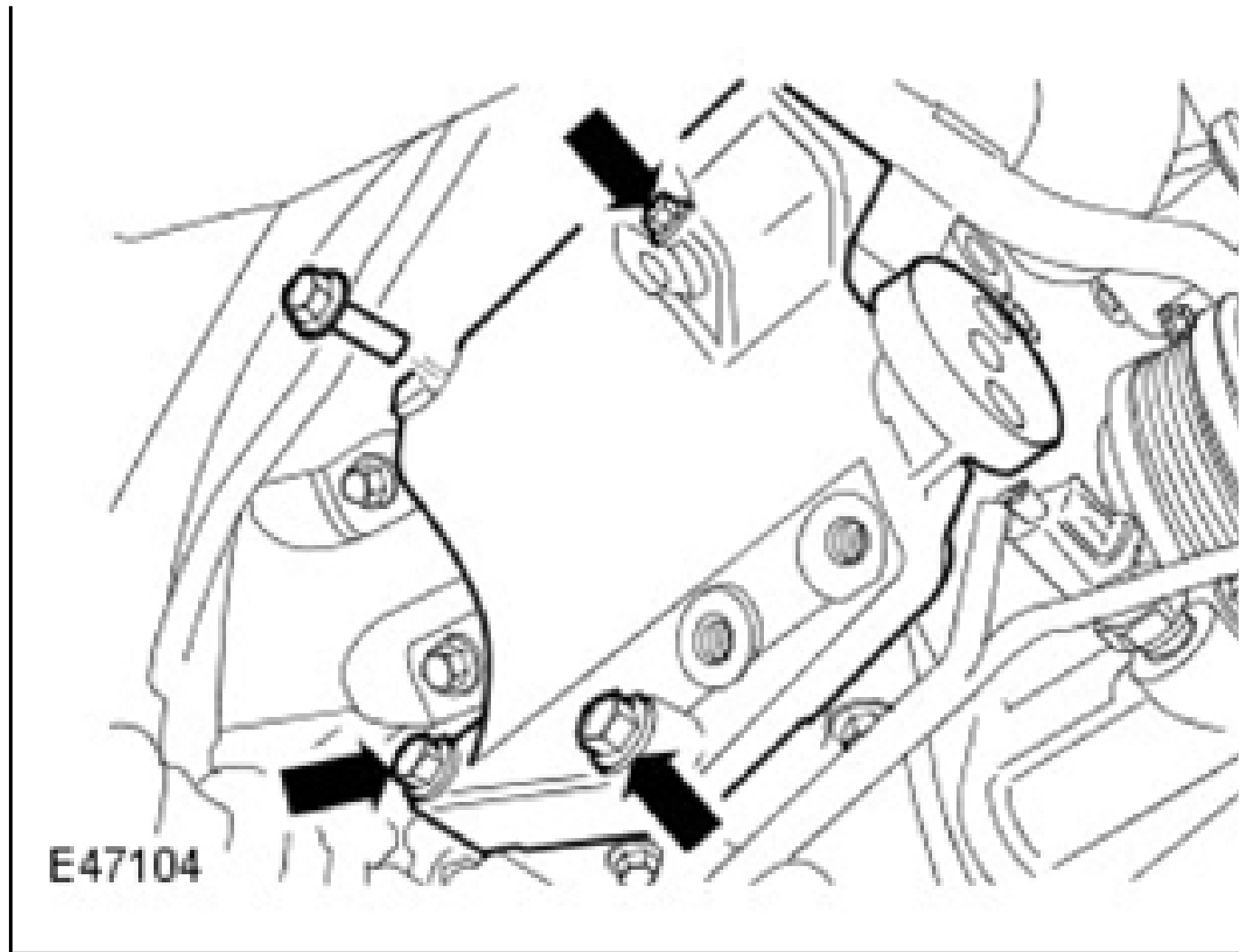
14. Release the dynamic response pump and tie aside.
 - Remove the 3 bolts.



15. Remove the generator.

For additional information, refer to: **GENERATOR** .

16. Remove the dynamic response and generator mounting brackets.
- Remove the 8 bolts.



17. Drain the cooling system.

For additional information, refer to: **Cooling System Draining, Filling and Bleeding** .

18. Drain the engine oil.

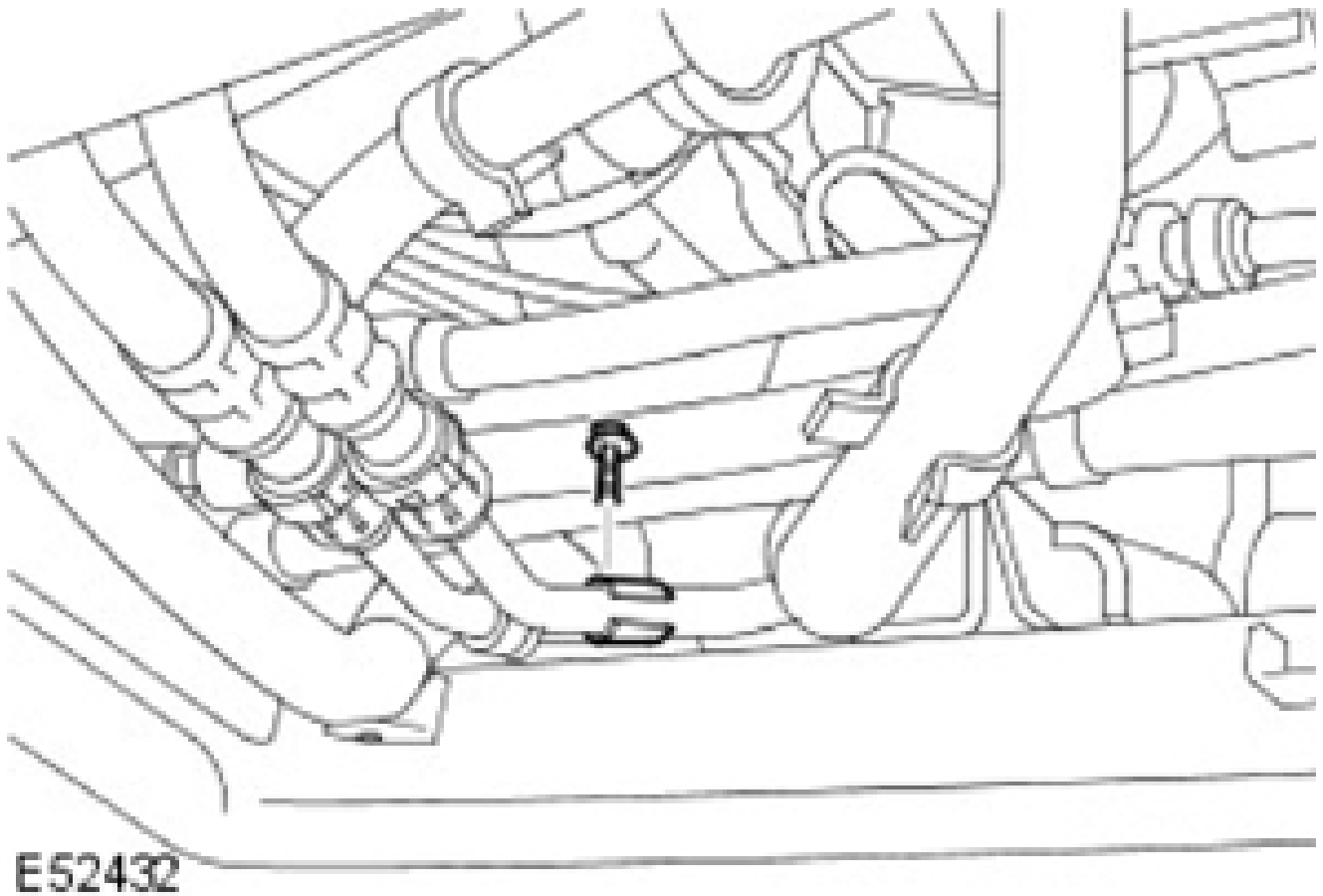
For additional information, refer to: **ENGINE OIL DRAINING AND FILLING**.

19. Remove the exhaust system.

For additional information, refer to: **EXHAUST SYSTEM** .

20. Remove the oil cooler pipe support bracket.

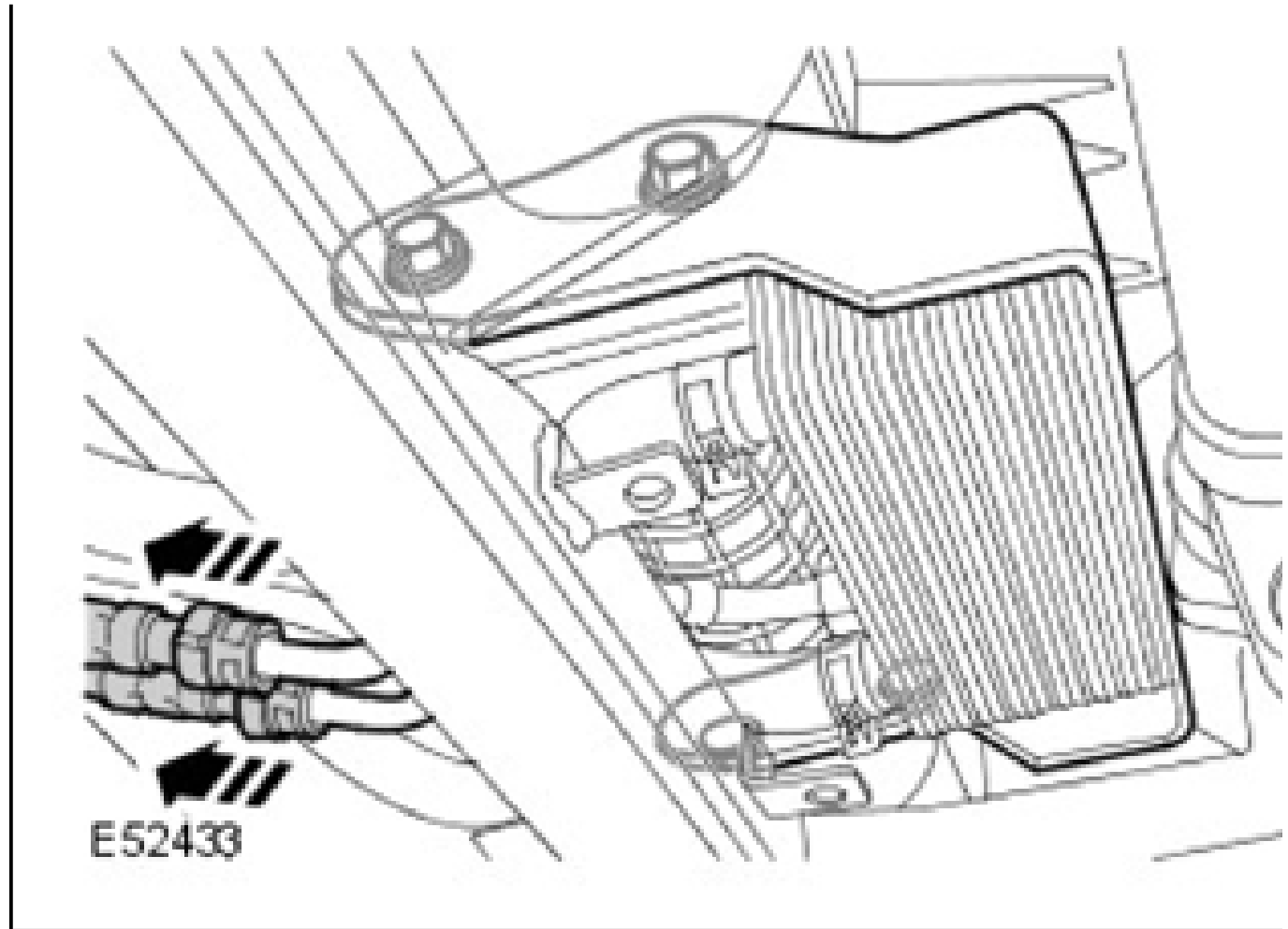
- Remove the bolt.



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

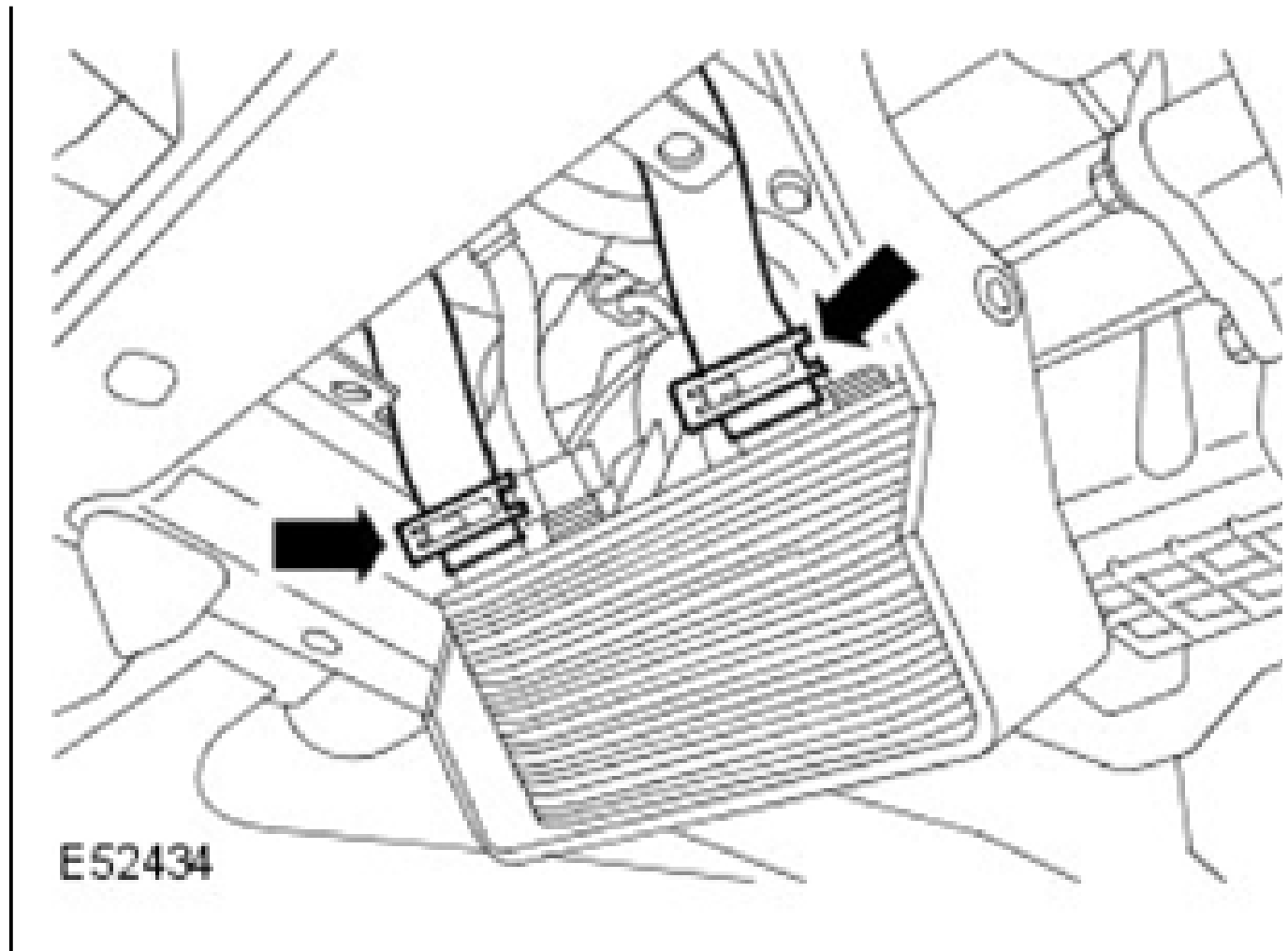
21. Release the oil cooler.

- Disconnect the oil cooler hoses.
- Remove the 4 bolts.



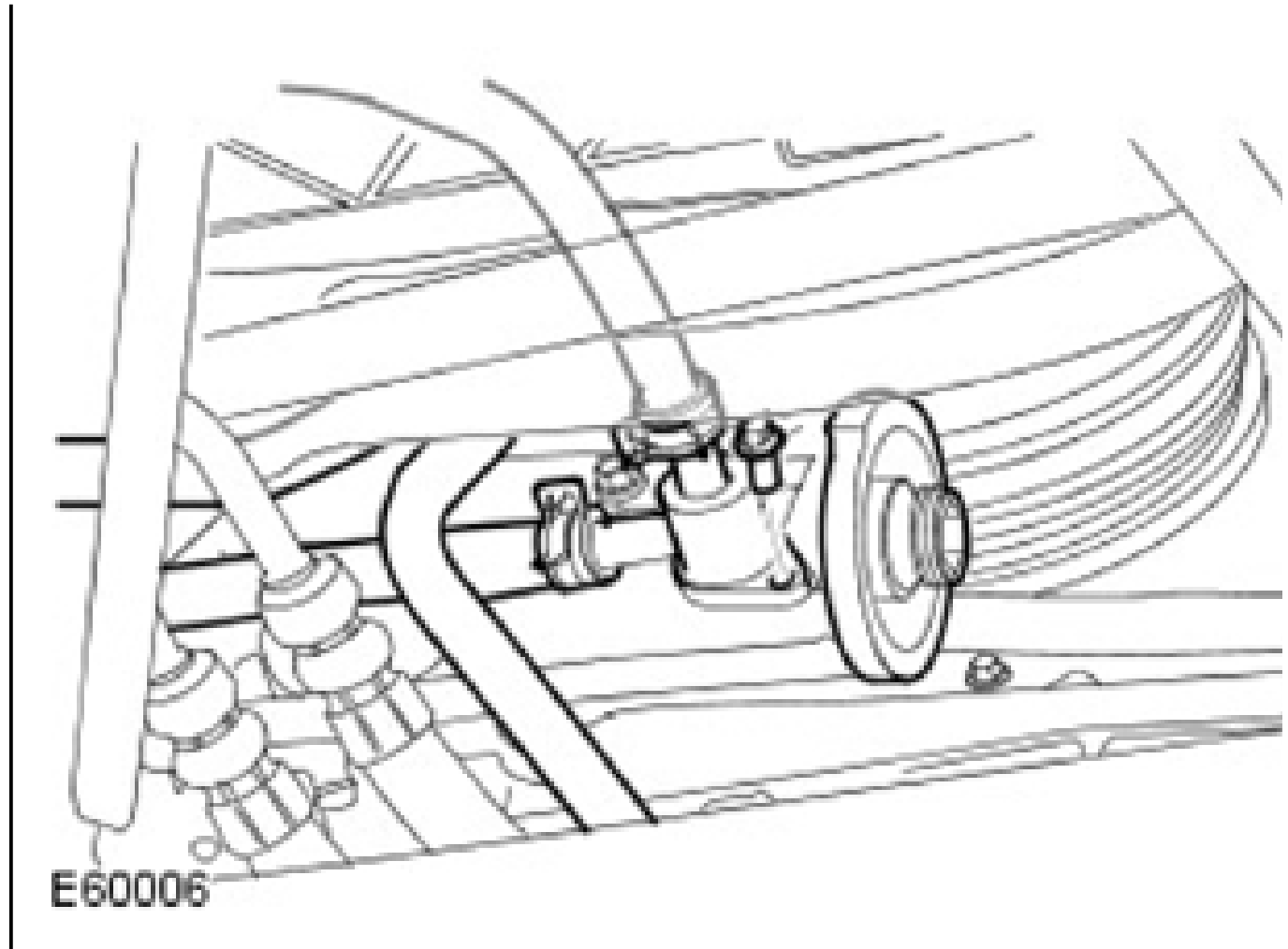
22. Disconnect the engine oil cooler coolant hoses.

- Position a container to collect the fluid spillage.
- Clamp the relevant hoses, to minimize the coolant loss.
- Release the 2 clips.



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

23. Release and tie aside the oil filter housing.
 - Remove the oil union bolt for access.
 - Remove the 3 bolts.



24. Remove the LH charge air cooler.

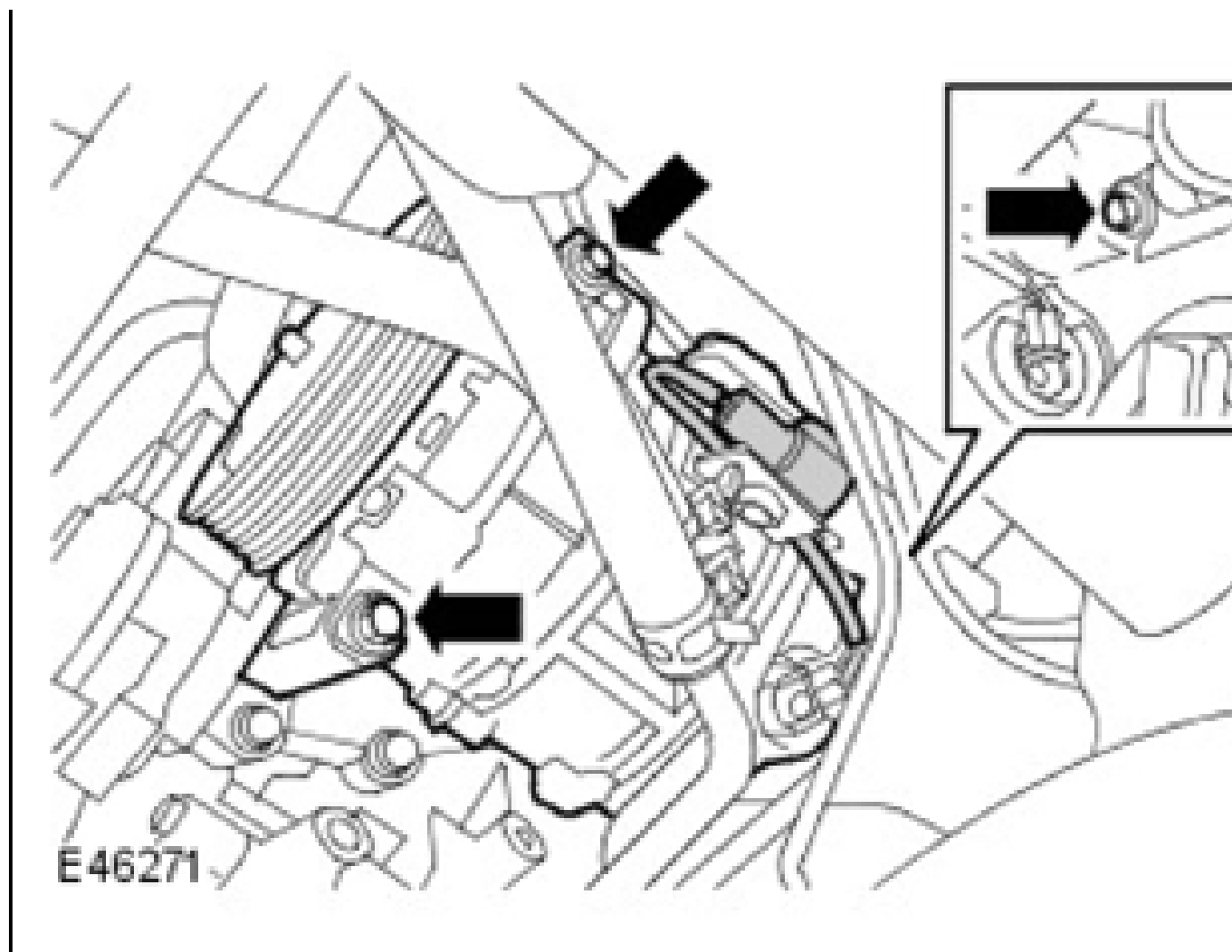
For additional information, refer to: **CHARGE AIR COOLER** .

25. Remove the RH charge air cooler.
26. Release the power steering pump and tie aside
- Remove the 3 bolts.

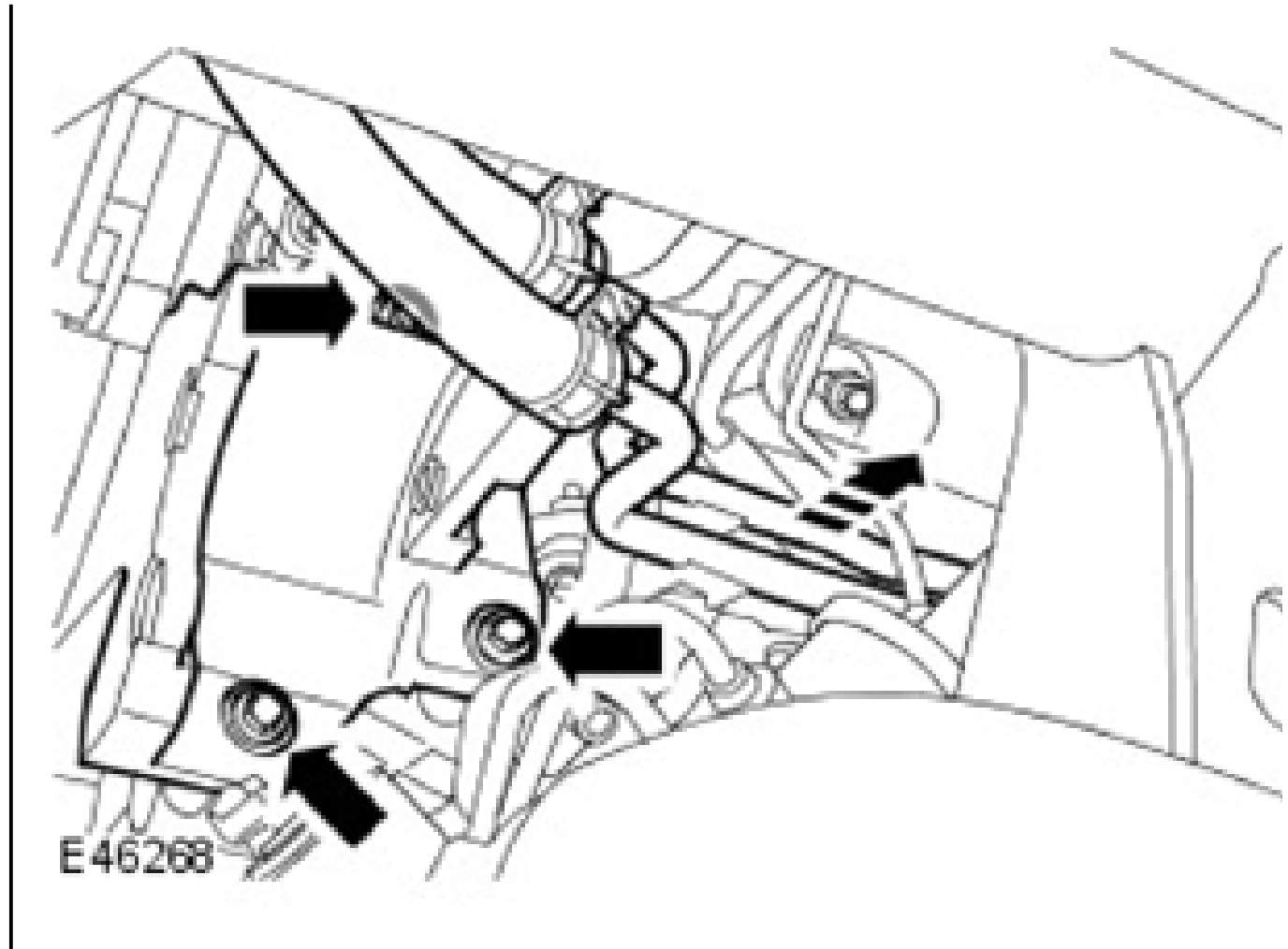


27. Release the A/C compressor and tie aside.

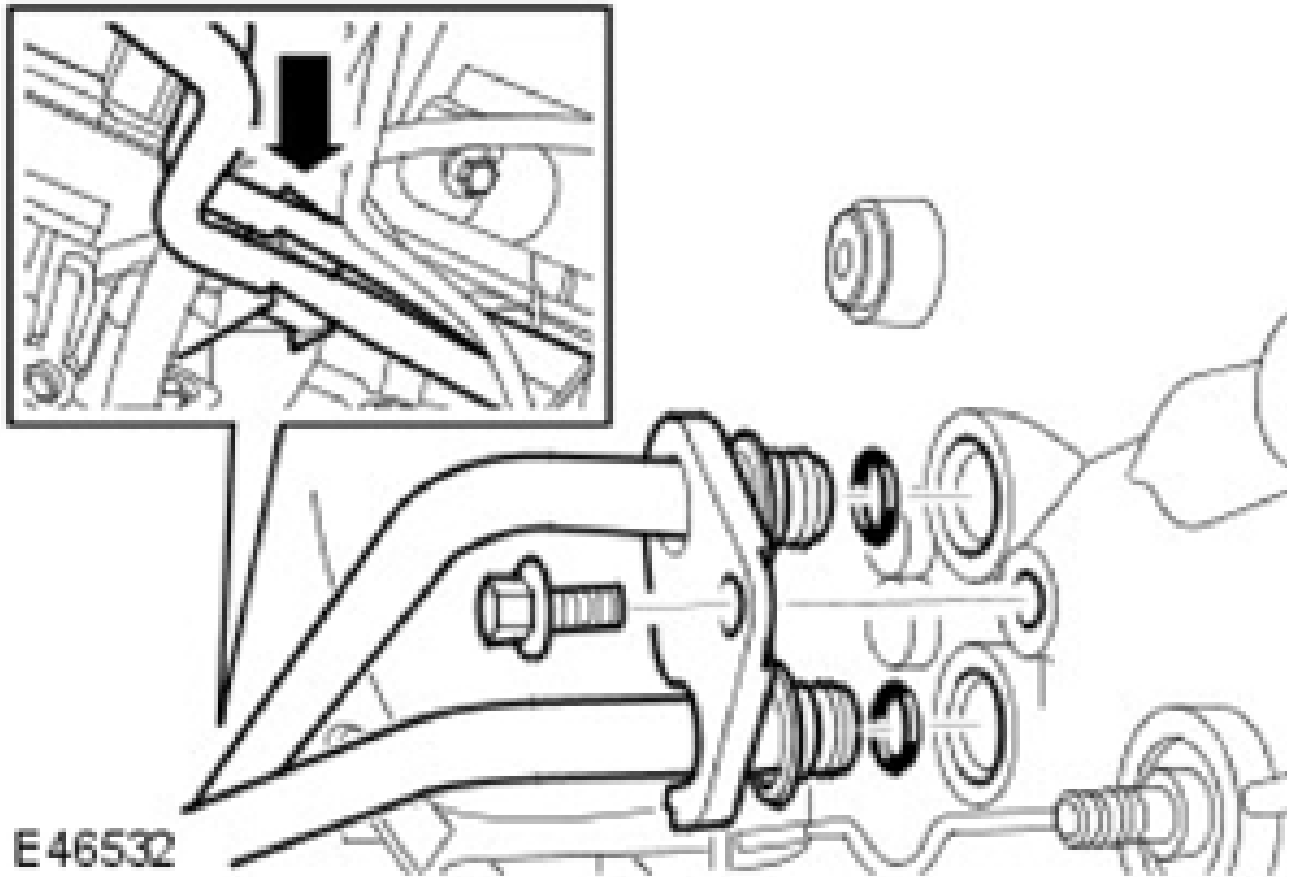
- Remove the 3 bolts.
- Disconnect the electrical connector.



28. Remove the A/C compressor mounting bracket.
- Remove the 3 bolts.

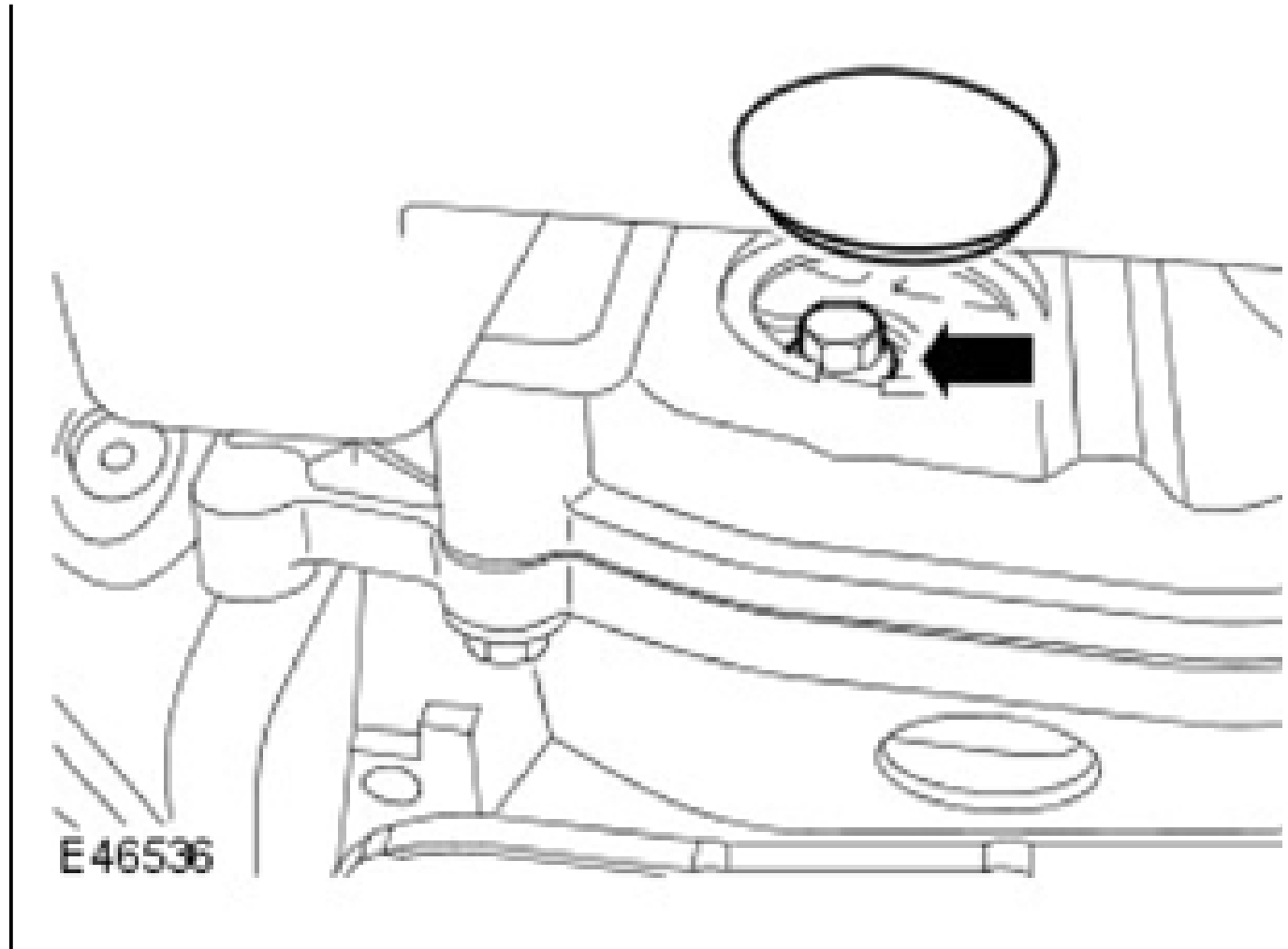


29. Release the transmission cooler pipes.
- Position a container to collect the fluid.
 - Remove the bolt.
 - Release the 2 clips.
 - Move the transmission pipes aside.



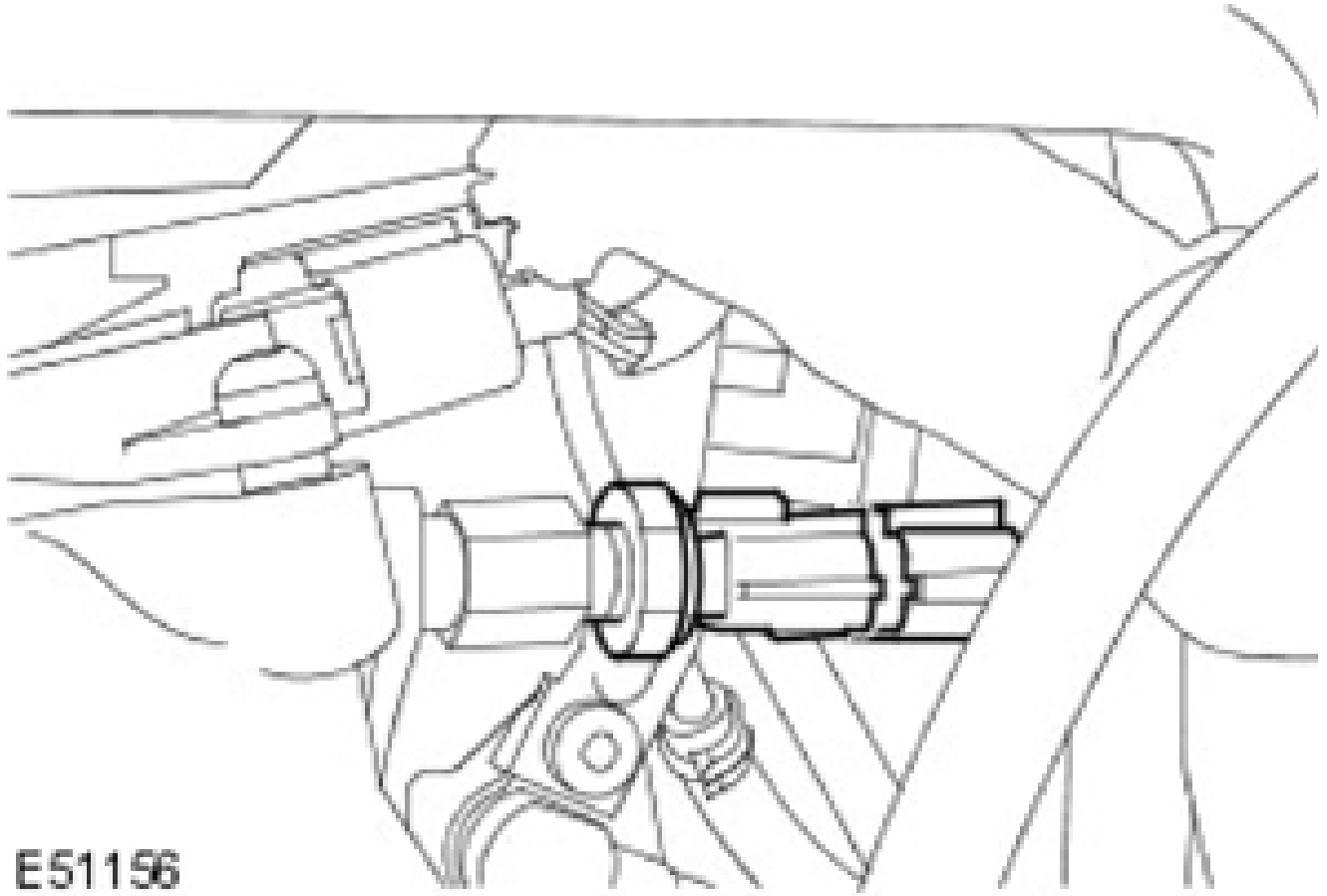
30. Release the flexplate.

- Remove the grommet.
- Rotate the crankshaft to access the retaining bolts.
- Remove the 3 bolts.



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

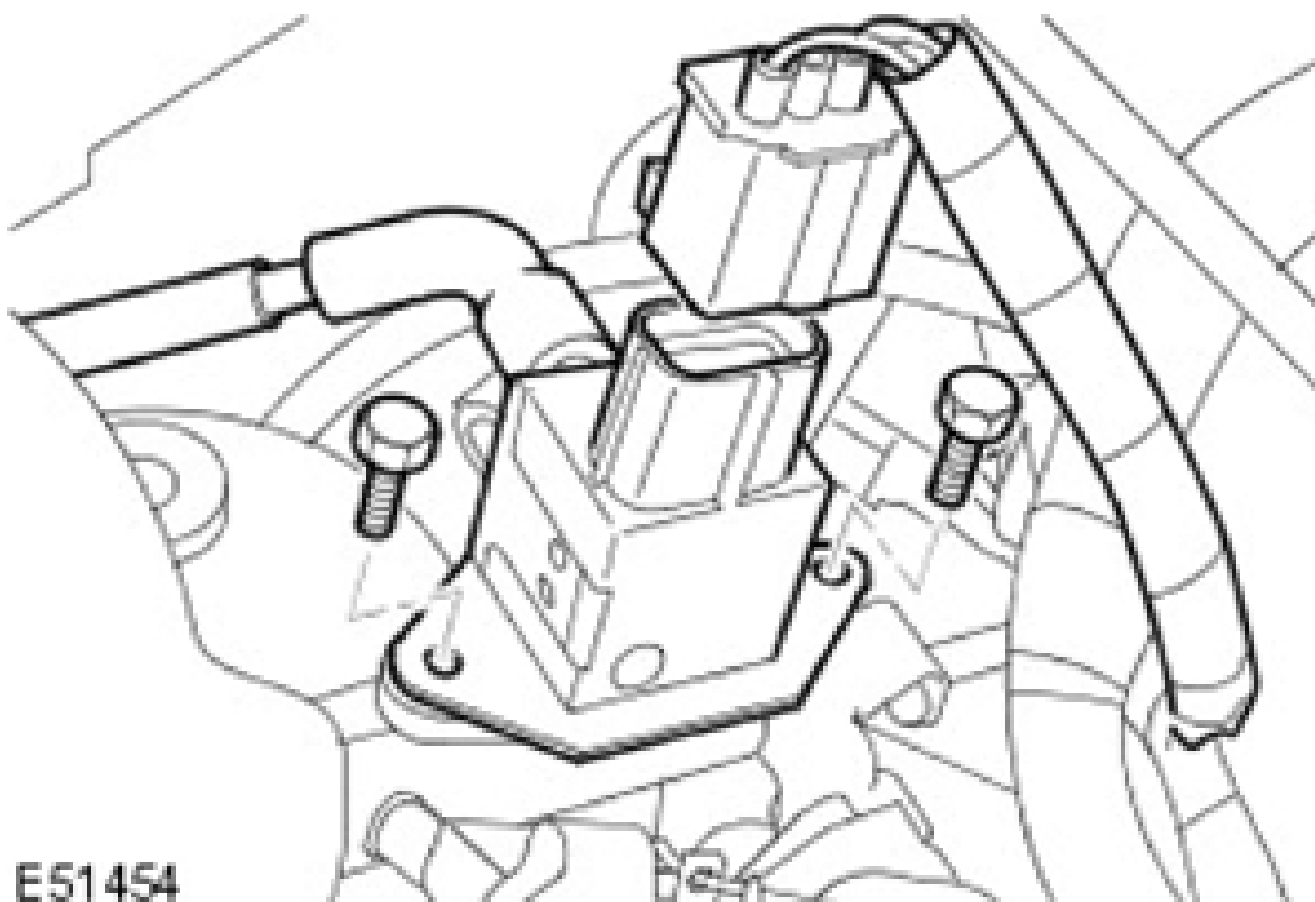
31. Remove the fuel temperature sensor.
 - Disconnect the electrical connector.
 - Position an absorbent cloth to collect fluid spillage.



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

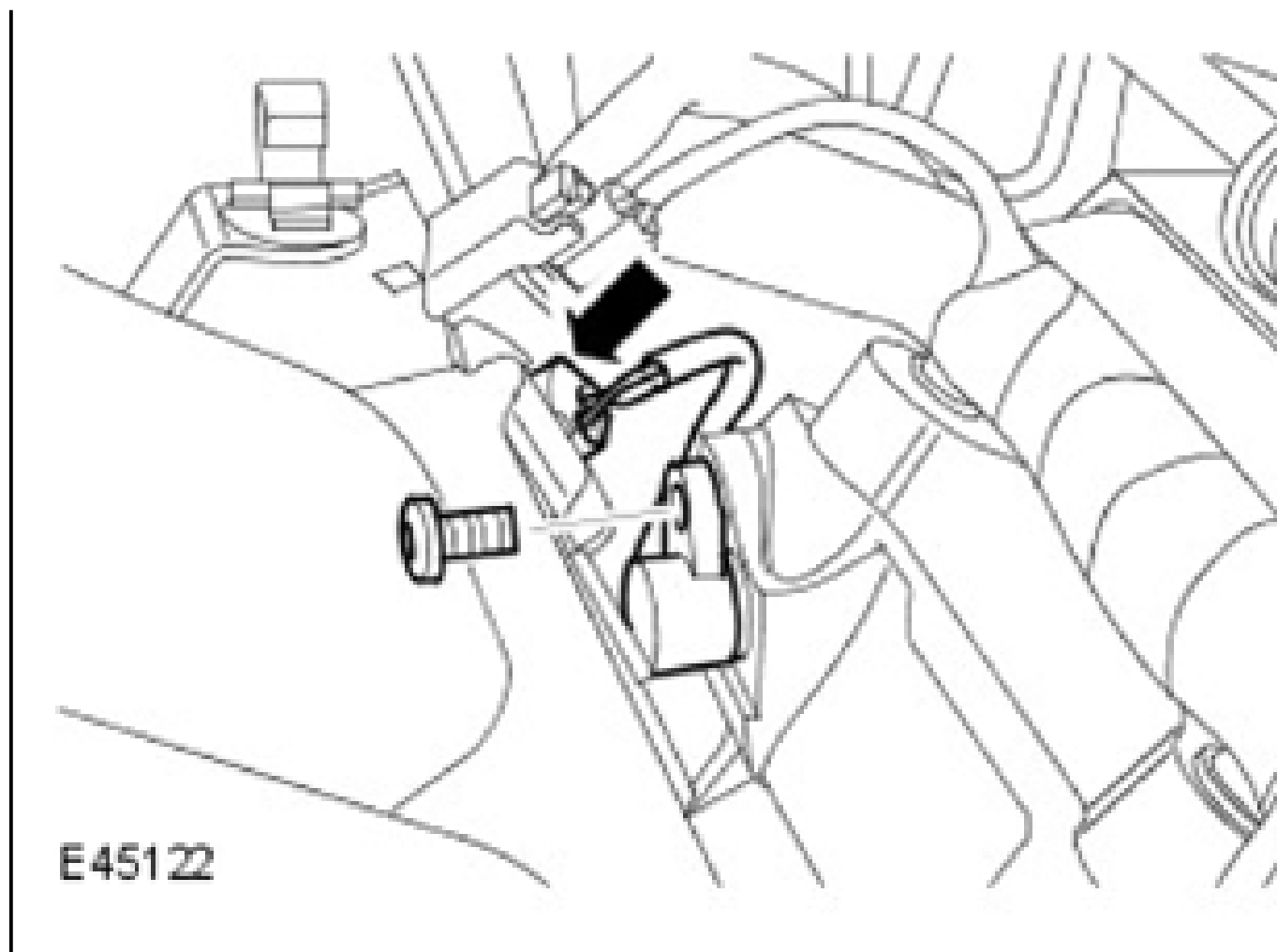
32. Remove the fuel rail pressure sensor.

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



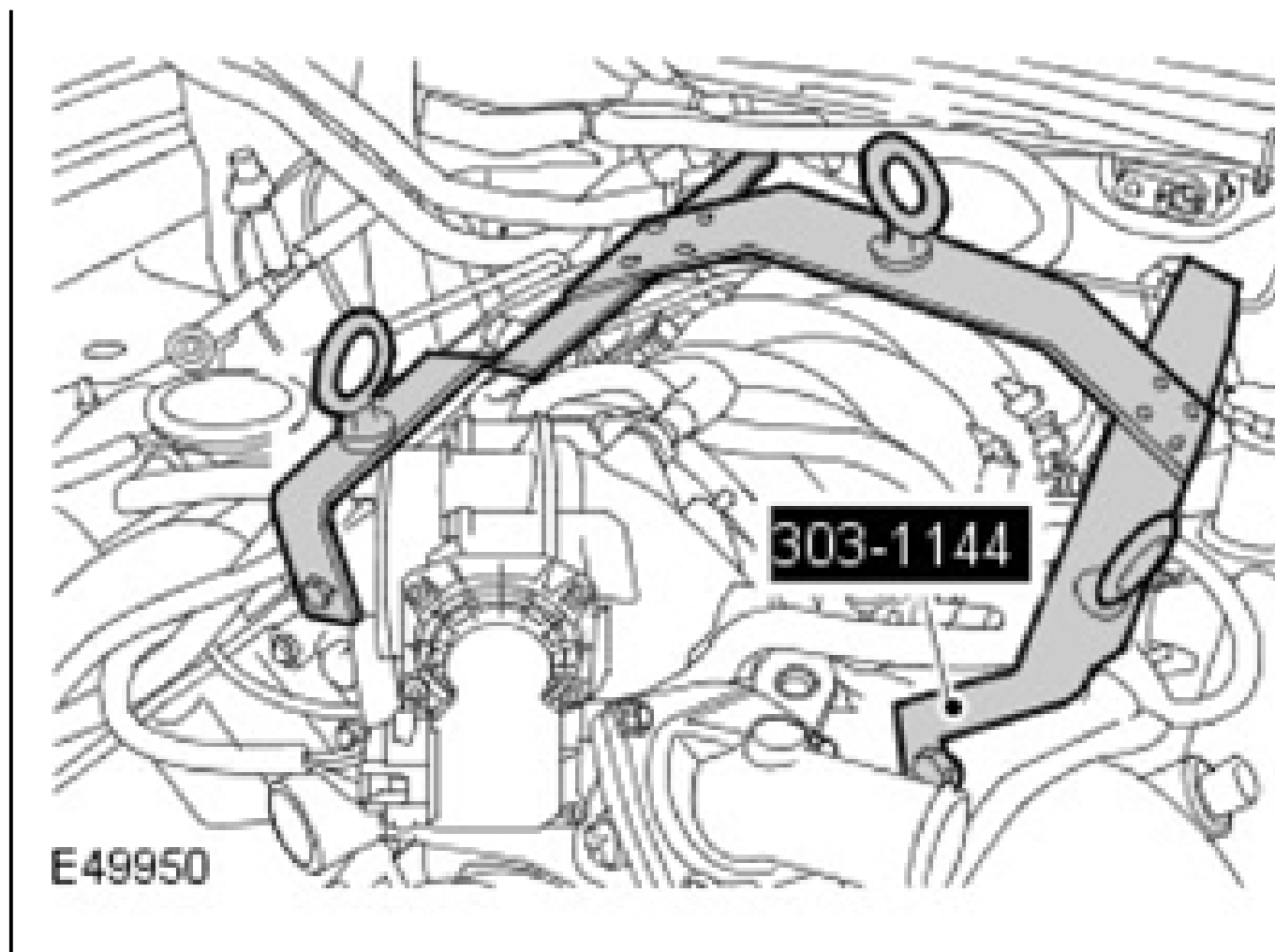
33. Remove both camshaft position (CMP) sensors and brackets for access.

- Remove the Torx screw.
- Release the harness brackets.



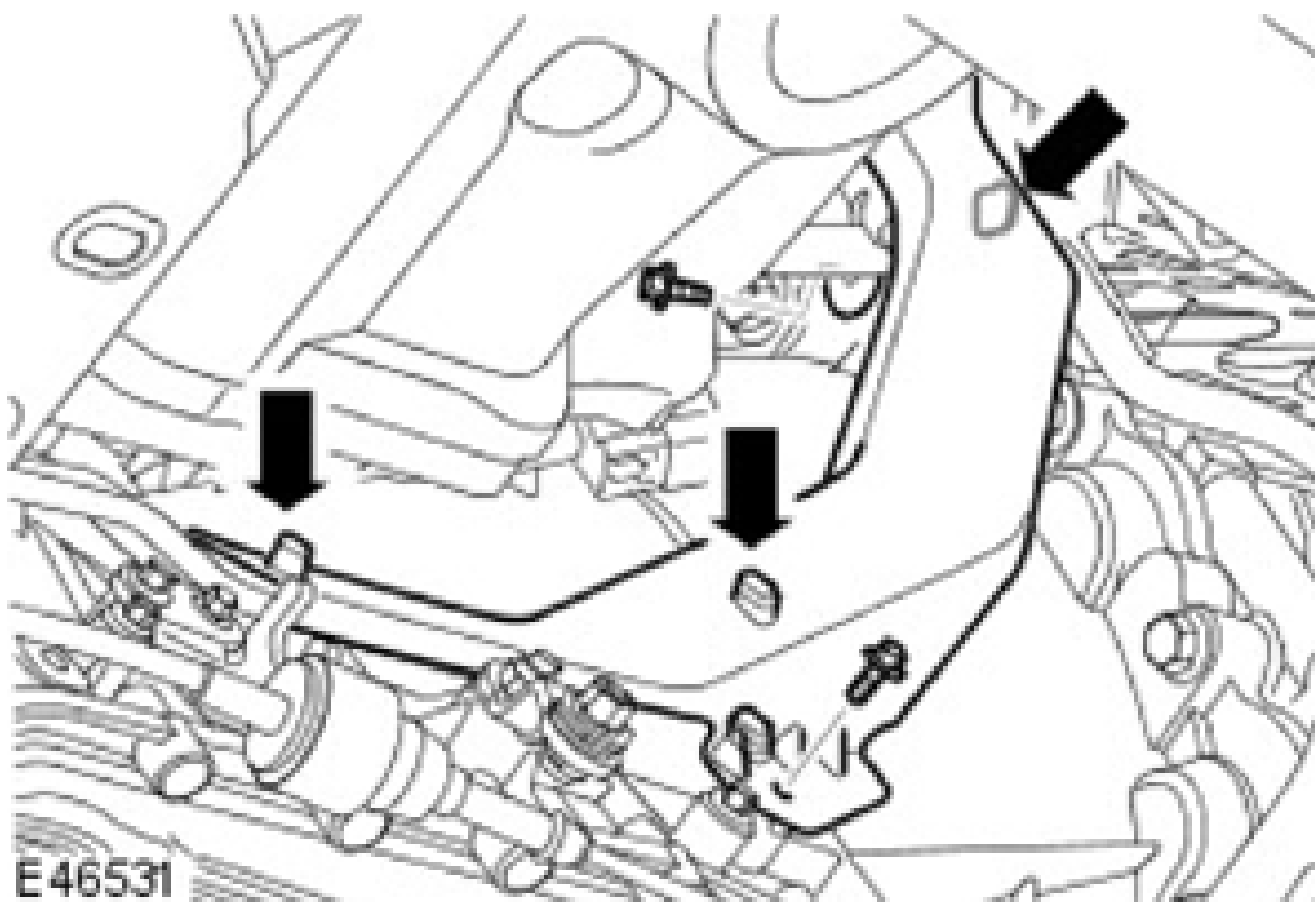
NOTE: Naturally aspirated illustrated, mounting points are identical on the supercharged engine.

34. Install the engine lifting cradle.

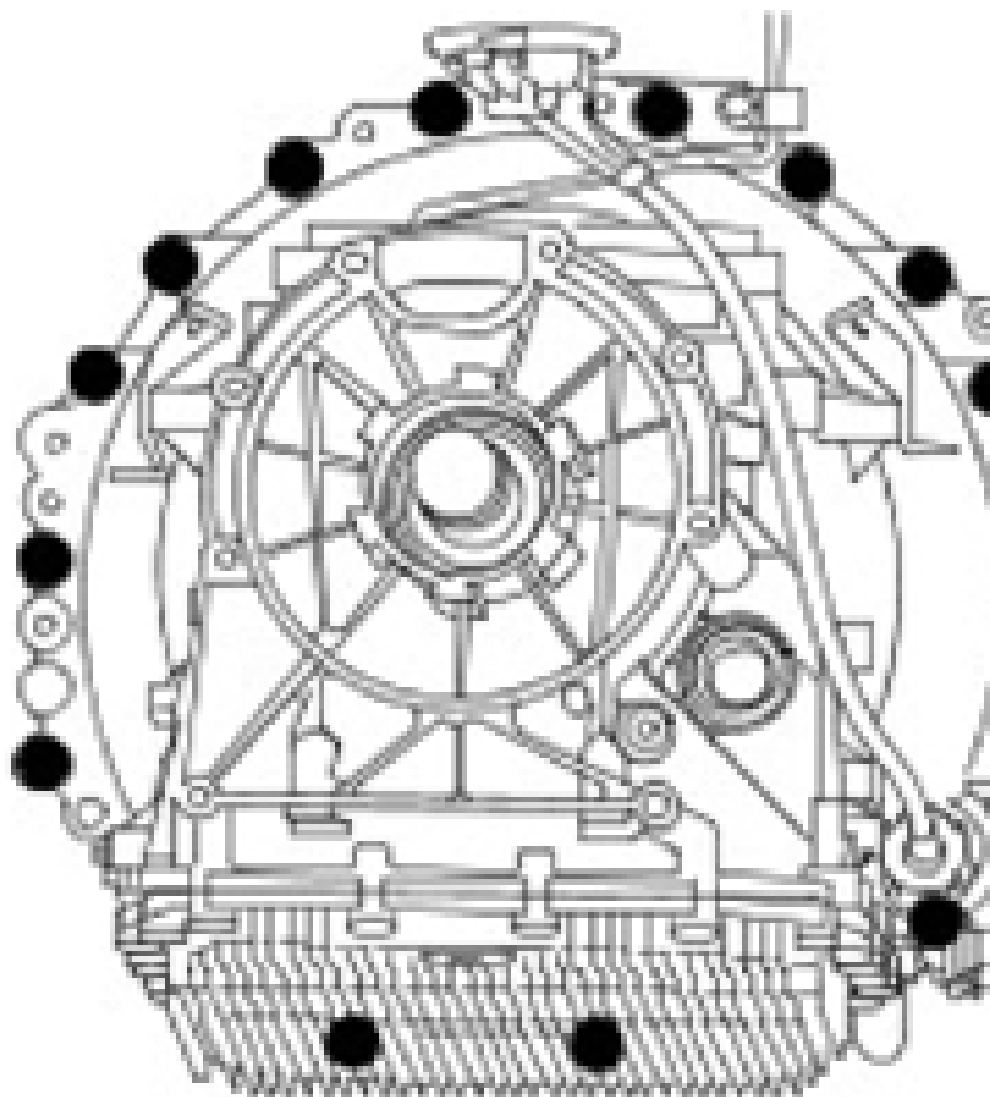


35. Release the heat shield for access to the transmission bolts.

- Remove the 2 bolts.
- Move the shield aside.

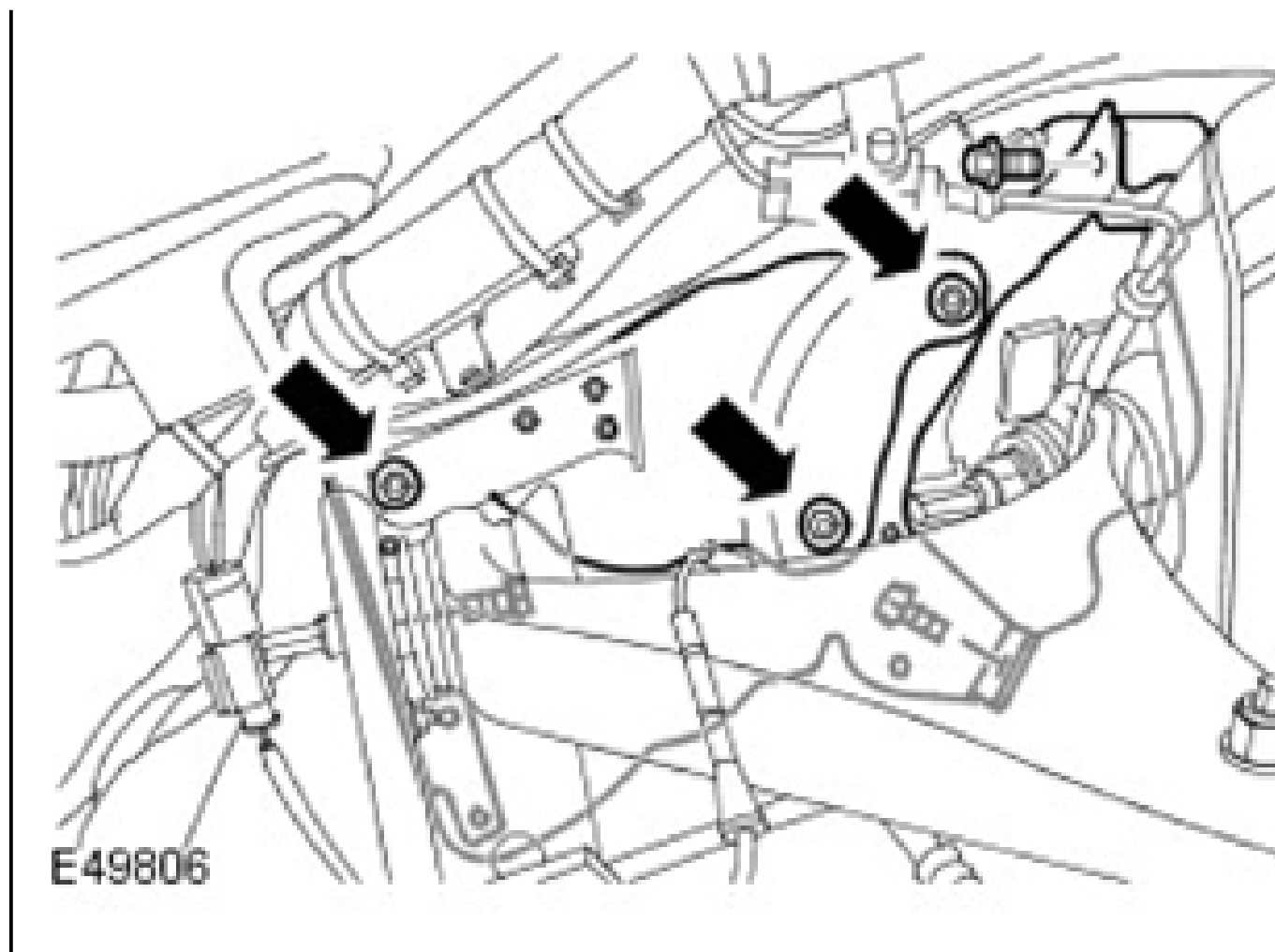


36. Remove the transmission bolts.
- Support the transmission.
 - Remove the 16 bolts.



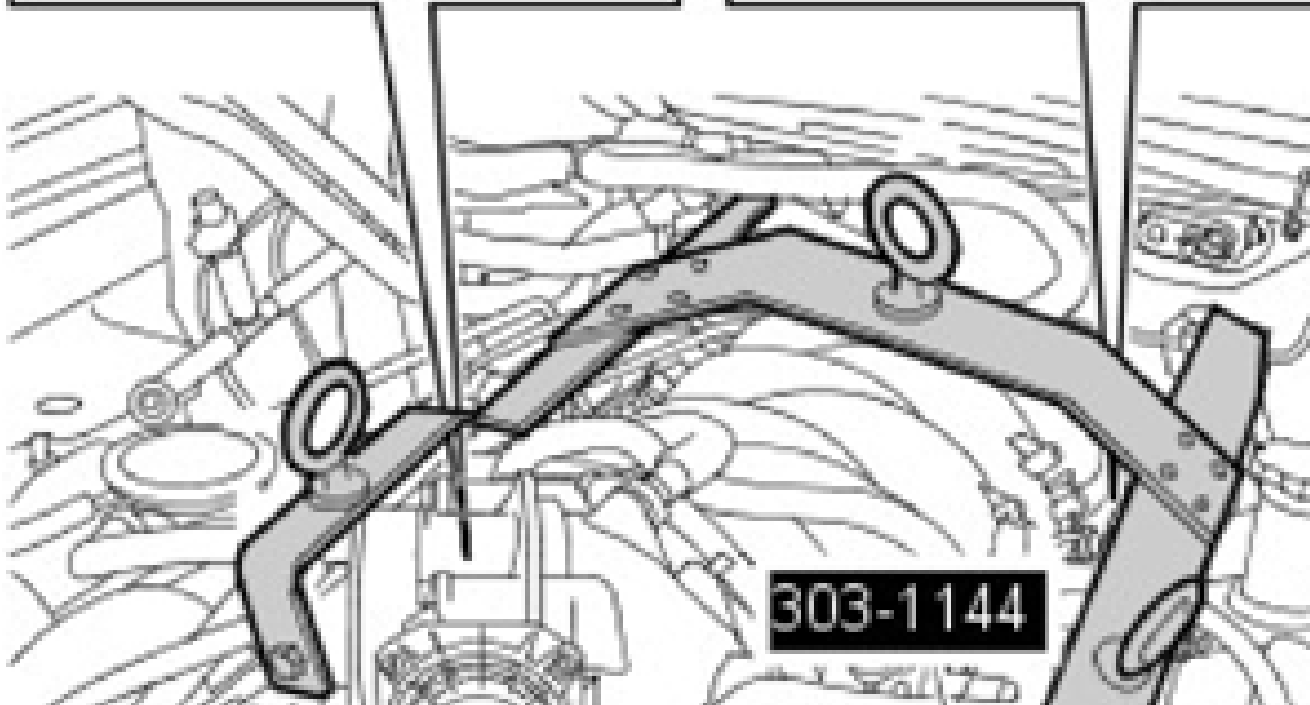
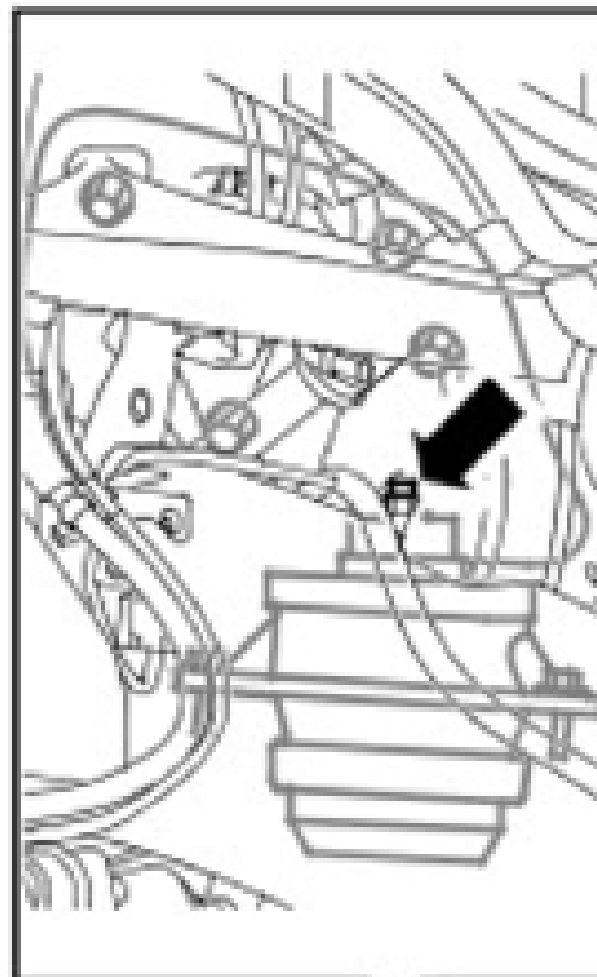
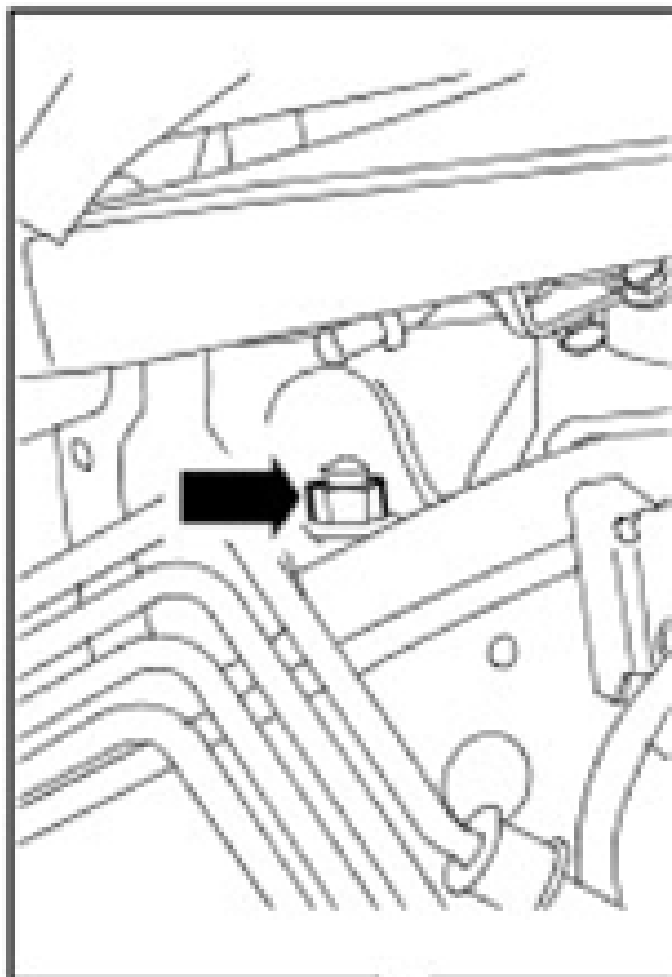
E46537

37. Remove the upper suspension arm and brake line heat shields for access.

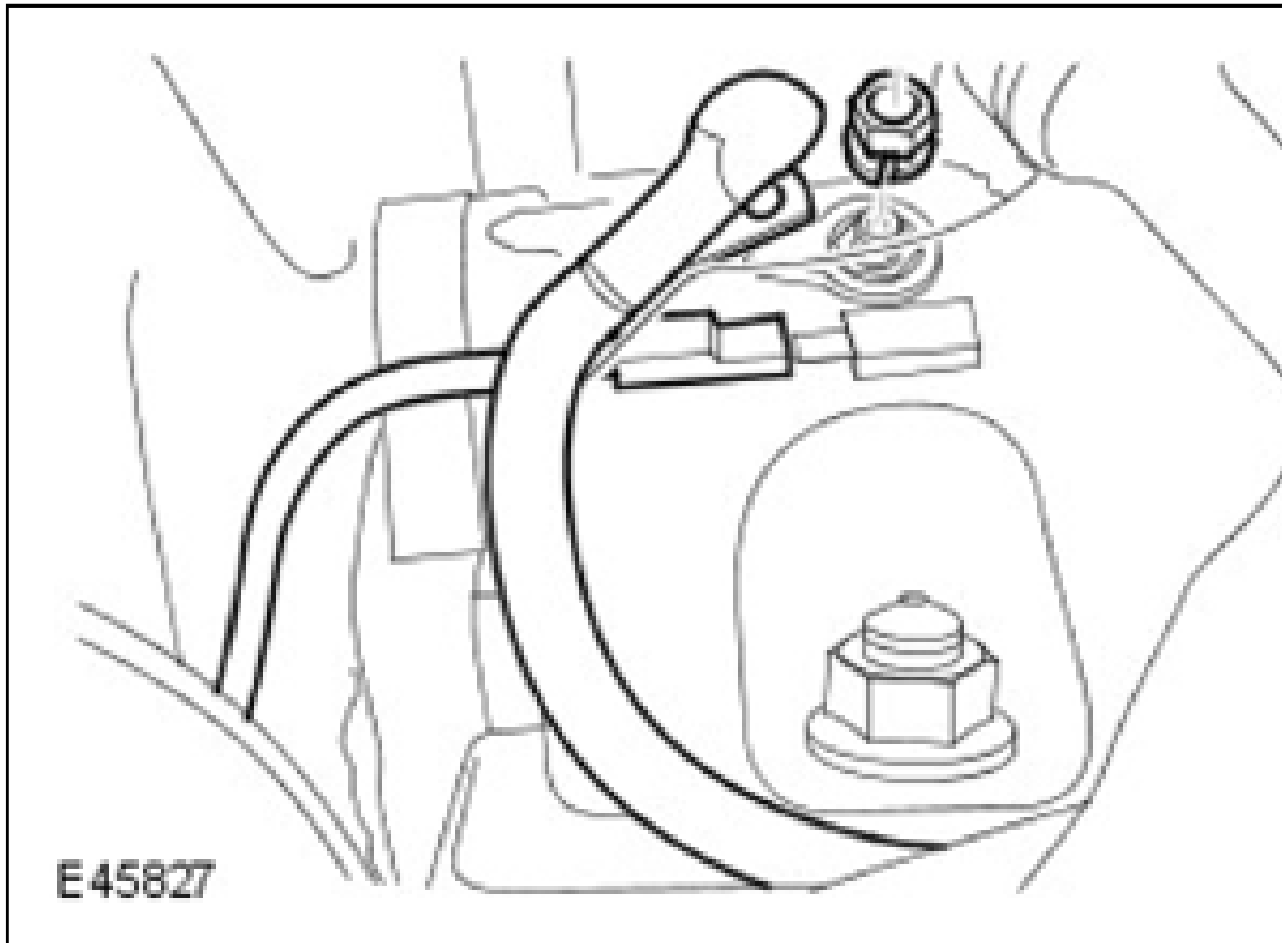


NOTE: Naturally aspirated graphic shown.

38. Remove the 2 engine mount nuts.



39. Release the engine from mounts and the transmission.
 - Install the lifting chains.
 - Raise the RH side of the engine by approximately 40 mm.
40. Disconnect the starter motor electrical connections.
 - Remove the nut.



41. Remove the starter motor.
 - Remove the starter motor retaining bolts.

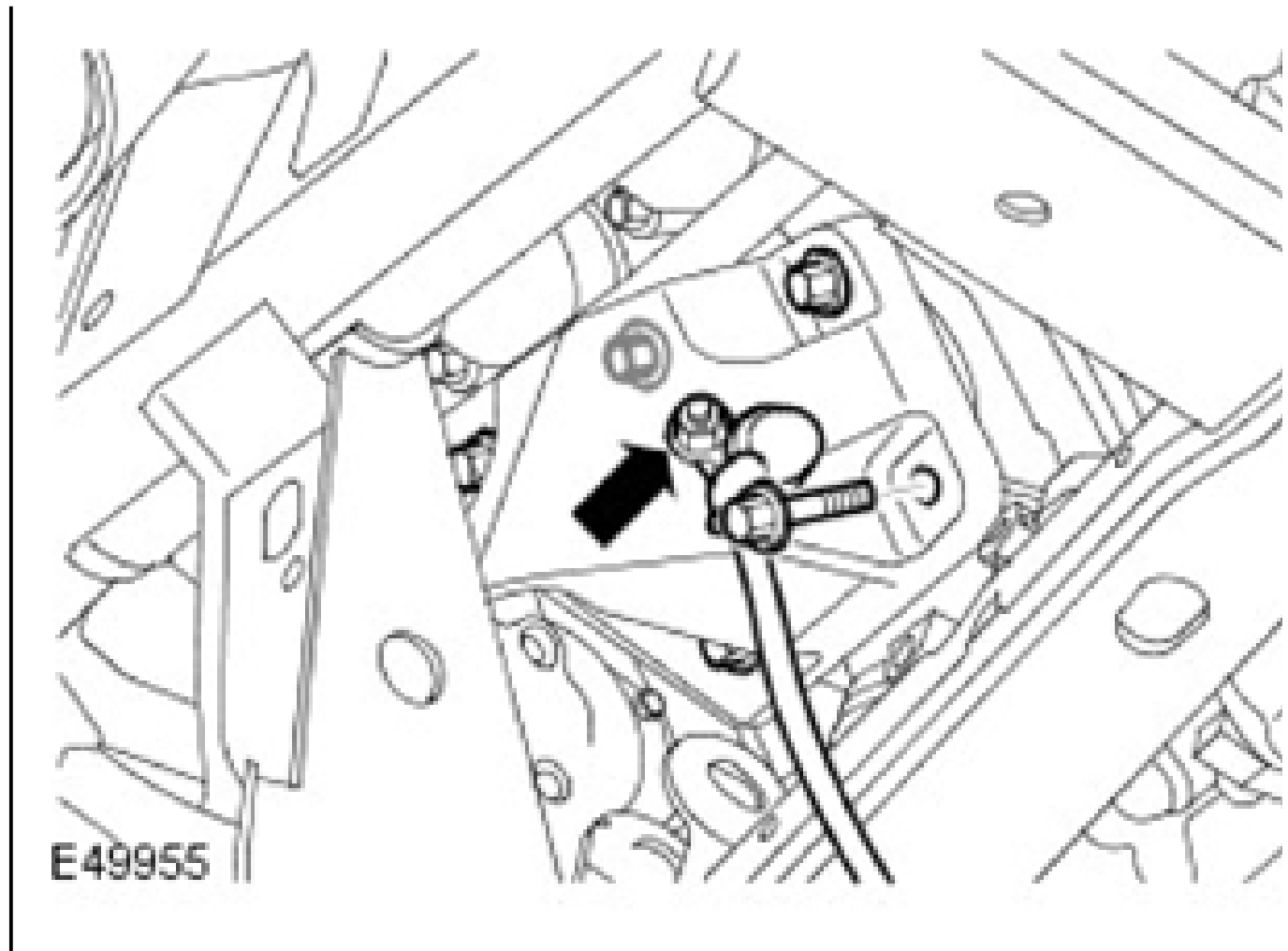


CAUTION: Make sure the torque converter remains connected to the transmission.

CAUTION: Care must be taken to avoid damaging the steering rack and differential.

42. Remove the engine front mount bracket.

- Remove 4 bolts securing the engine mount bracket to the cylinder block.
- Disconnect the engine ground cable from the RH mounting bracket.
- Carefully and progressively raise and remove the engine.



CAUTION: Make sure the torque converter remains connected to the transmission.

CAUTION: Care must be taken to avoid damaging the steering rack and differential.

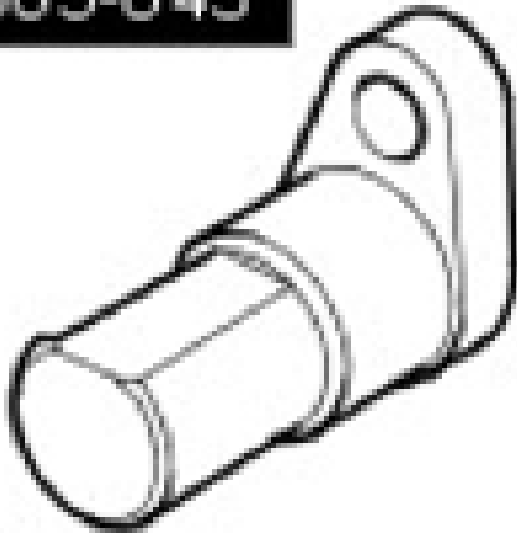
43. Carefully and progressively raise and remove the engine.
44. Disconnect the lifting chains.
 - Remove the engine lifting cradle.
45. Position the engine.
 - Install the lifting chains.
 - Raise the engine.
 - Clean the component mating faces.
 - Clean the locating dowels.

DISASSEMBLY

ENGINE

SPECIAL TOOL(S)

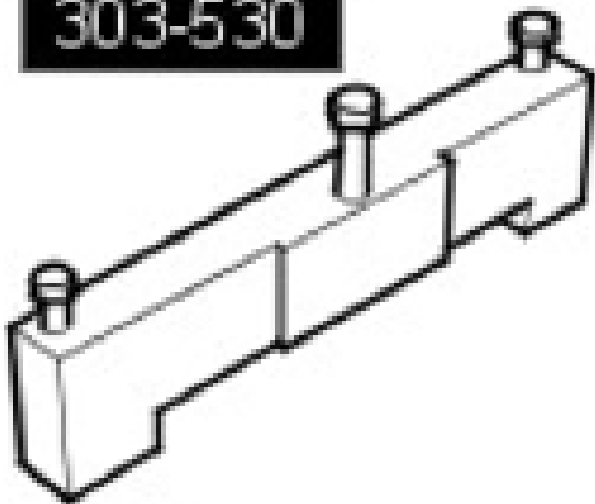
303-645



E46881

Timing Setting tool
303-645

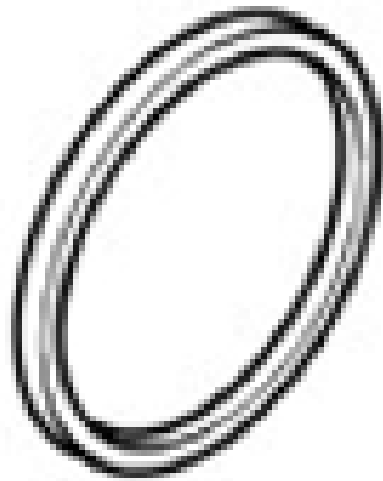
303-530



E46879

Camshaft setting/locking tool
303-530

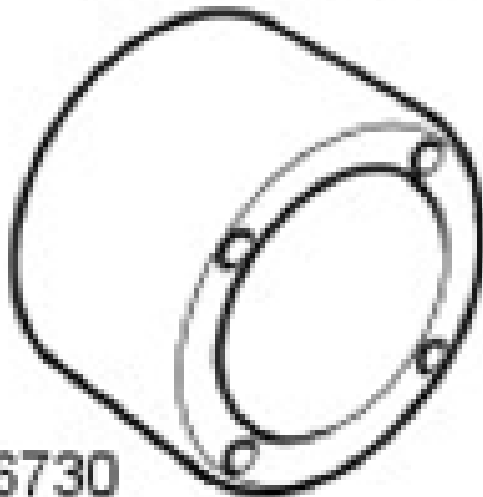
303-1100-01



E67144

Adapter - Crankshaft seal installer
303-1100-01

303-191-03

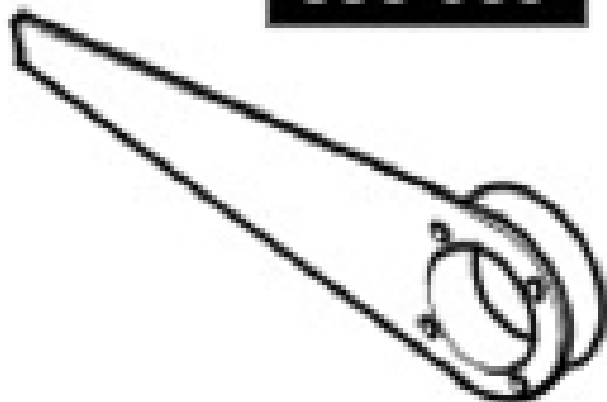


E46730

Adapter
303-191-03

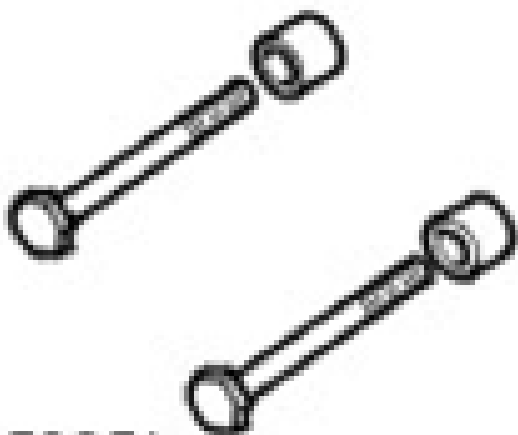
Holding Tool Crankshaft Pulley
303-893 (LRT-12-080)

303-893



E46728

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.

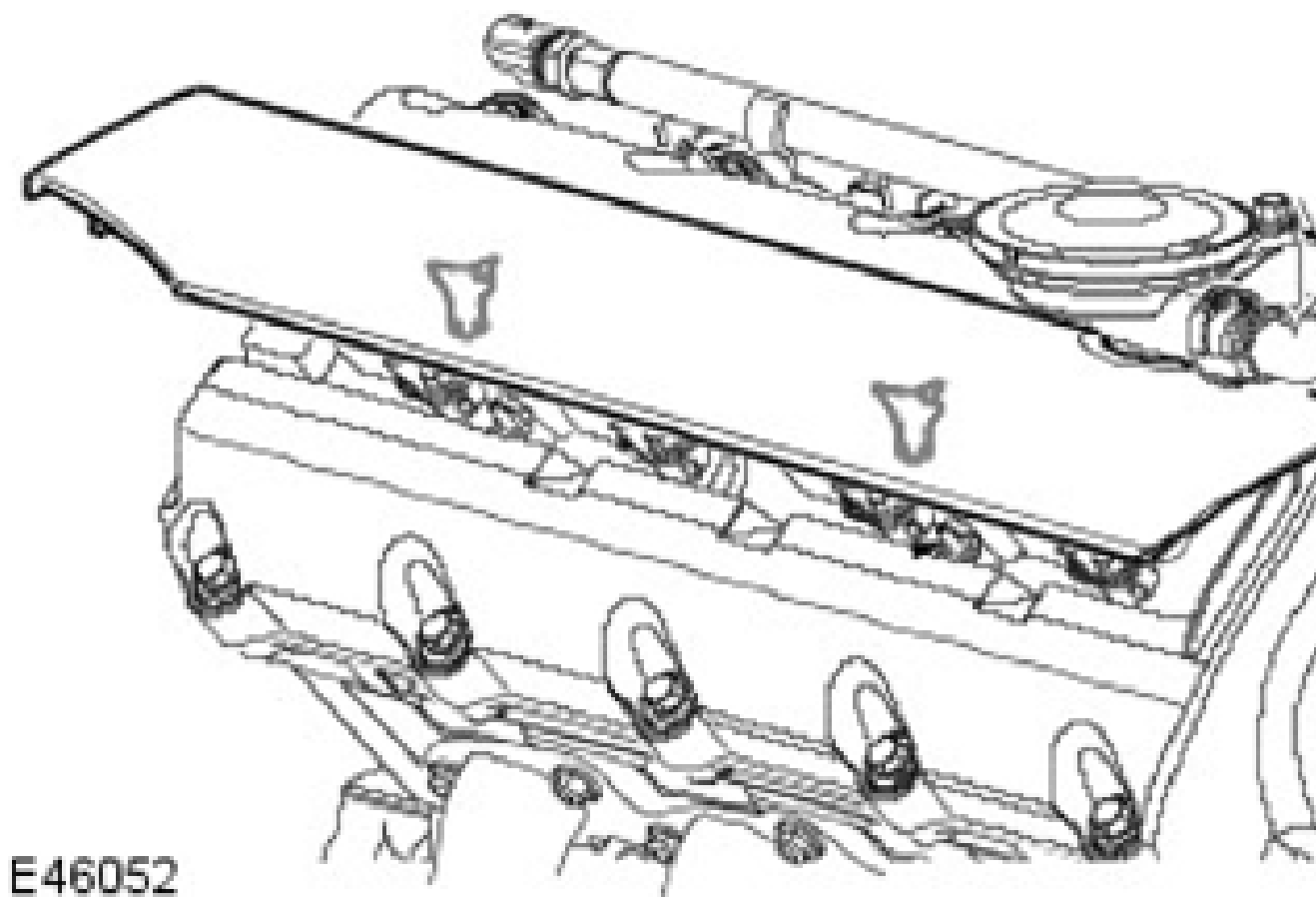
For additional information, refer to: **ENGINE**.

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 the engine stand.
 - Fully tighten the engine stand leg nuts.
3. Release the camshaft position (CMP) sensor connector block from the intake manifold assembly.



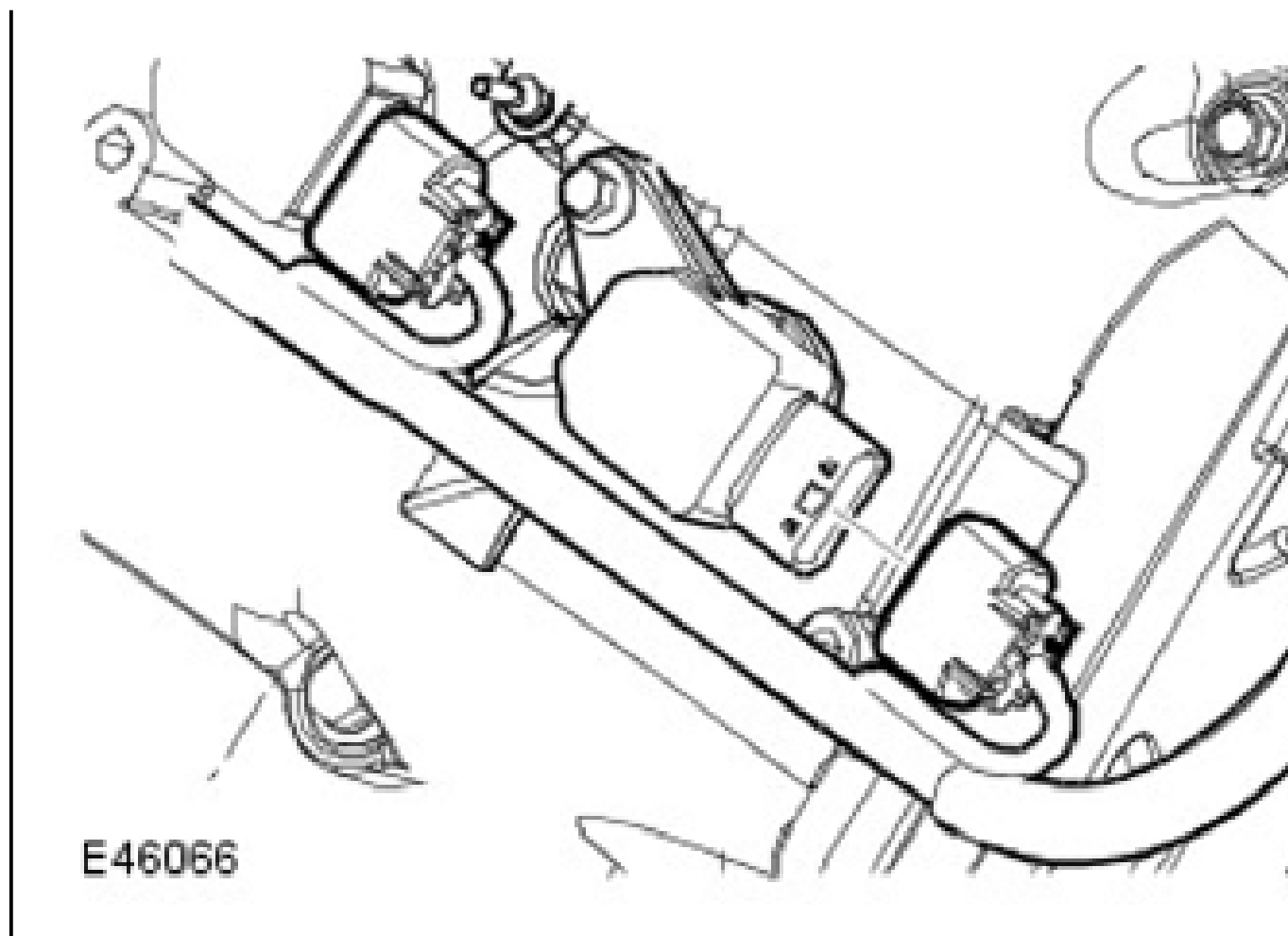
NOTE: RH illustration shown, LH is similar.

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



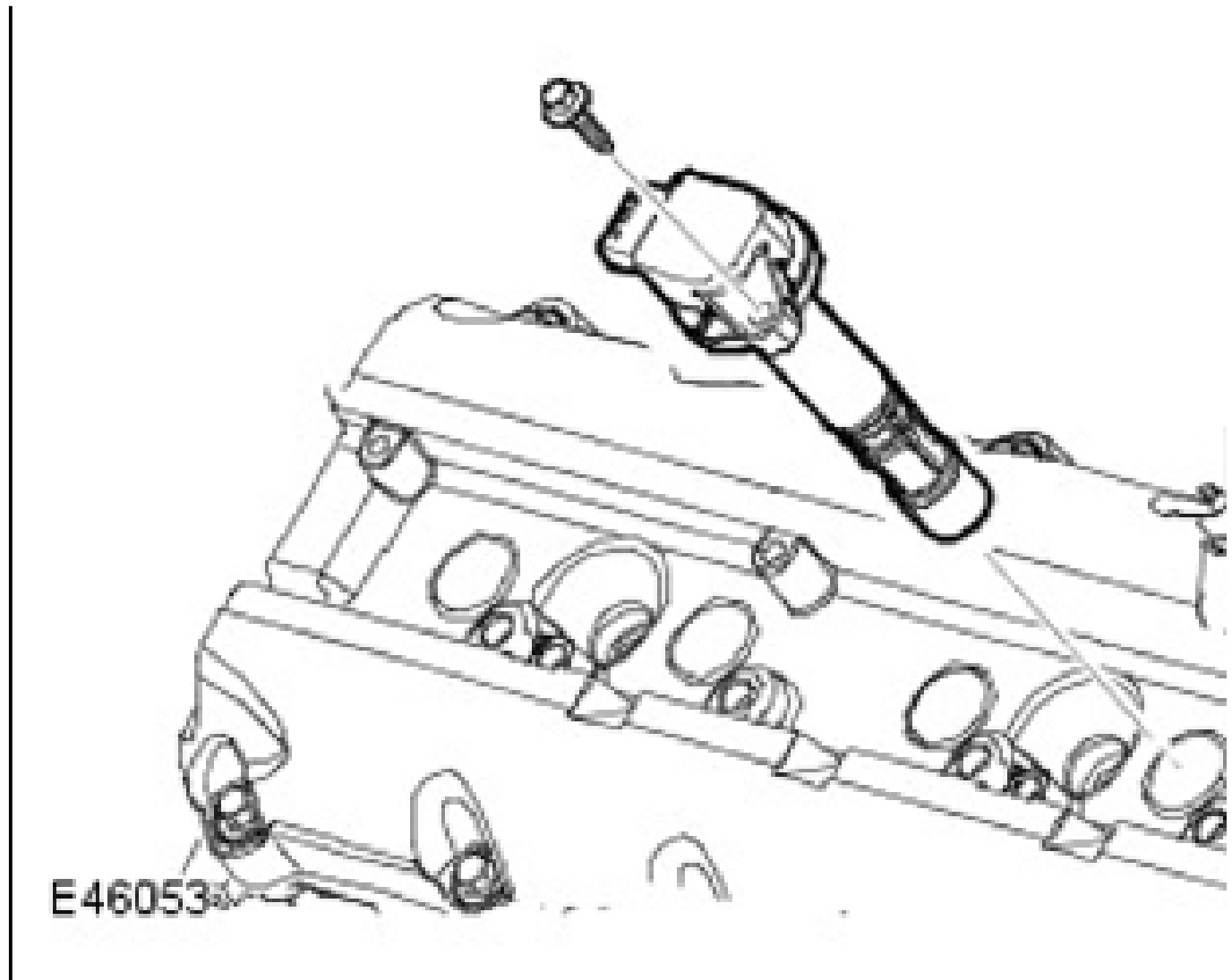
NOTE: RH illustration shown, LH is similar.

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



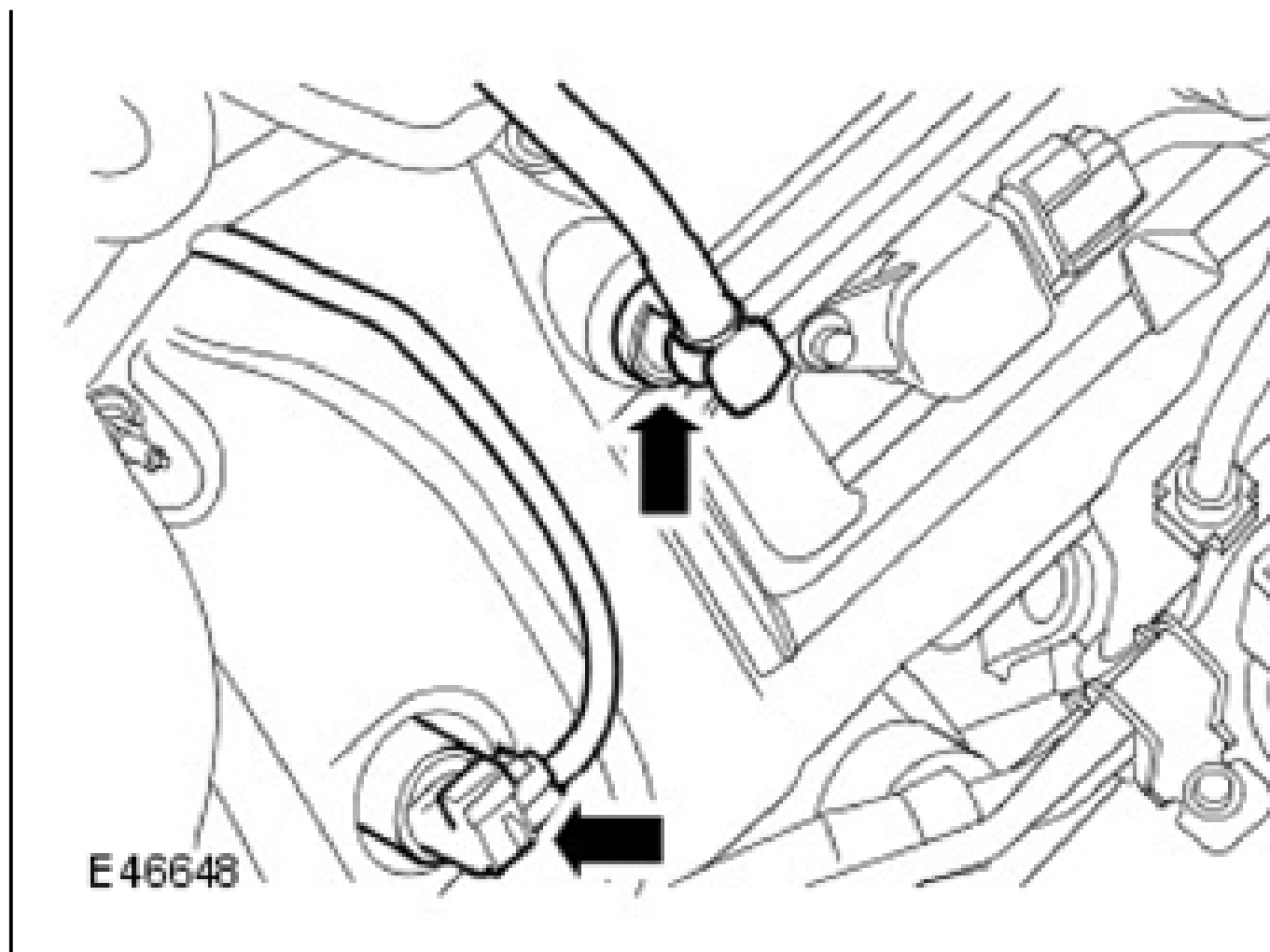
NOTE: RH illustration shown, LH is similar.

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



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

7. Disconnect the valve cover breather hose.

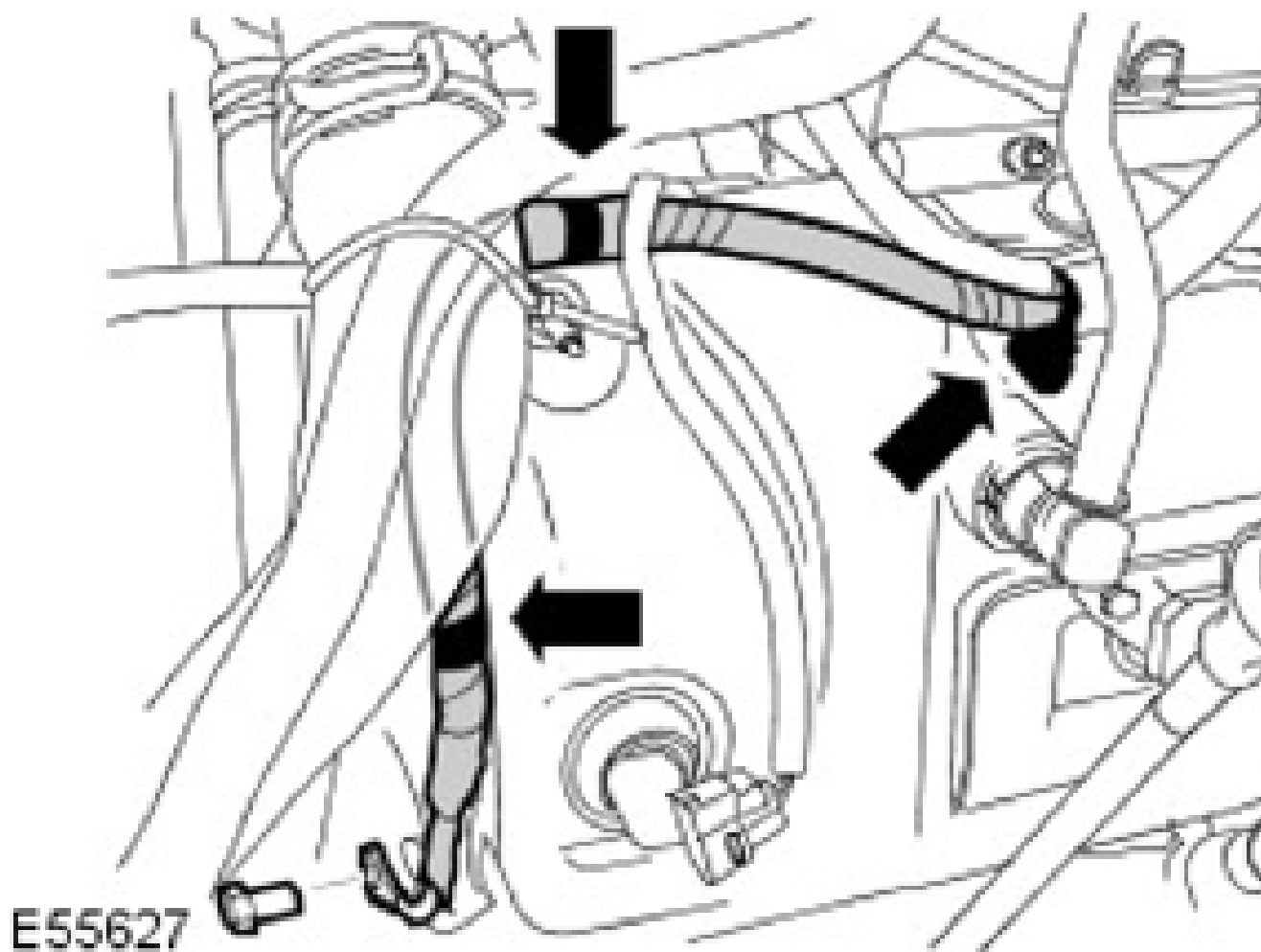


8. Disconnect the engine coolant temperature (ECT) sensor electrical connector.

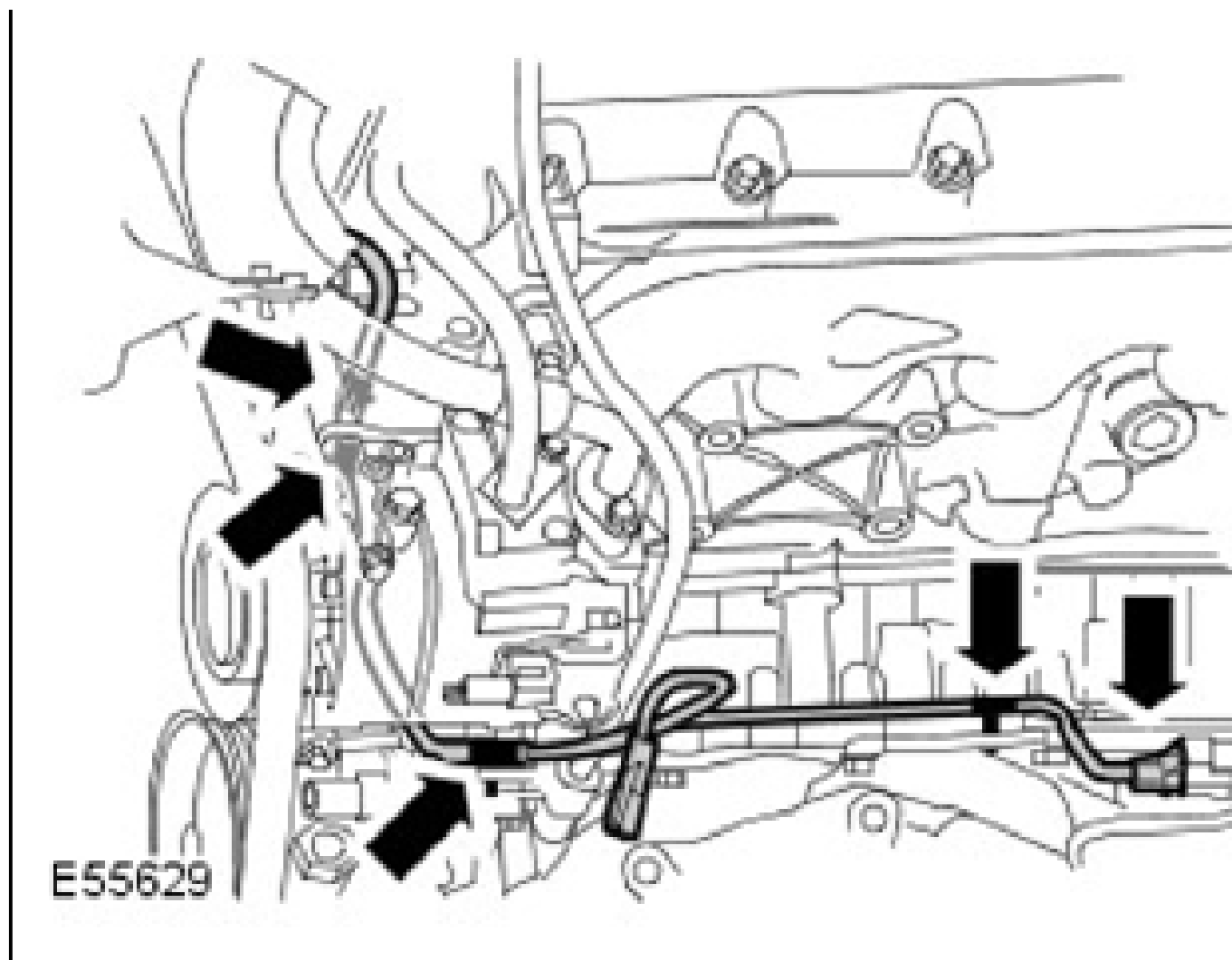


NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

9. Disconnect the cylinder head earth connector.
 - Remove the bolt.
 - Release the 3 clips.

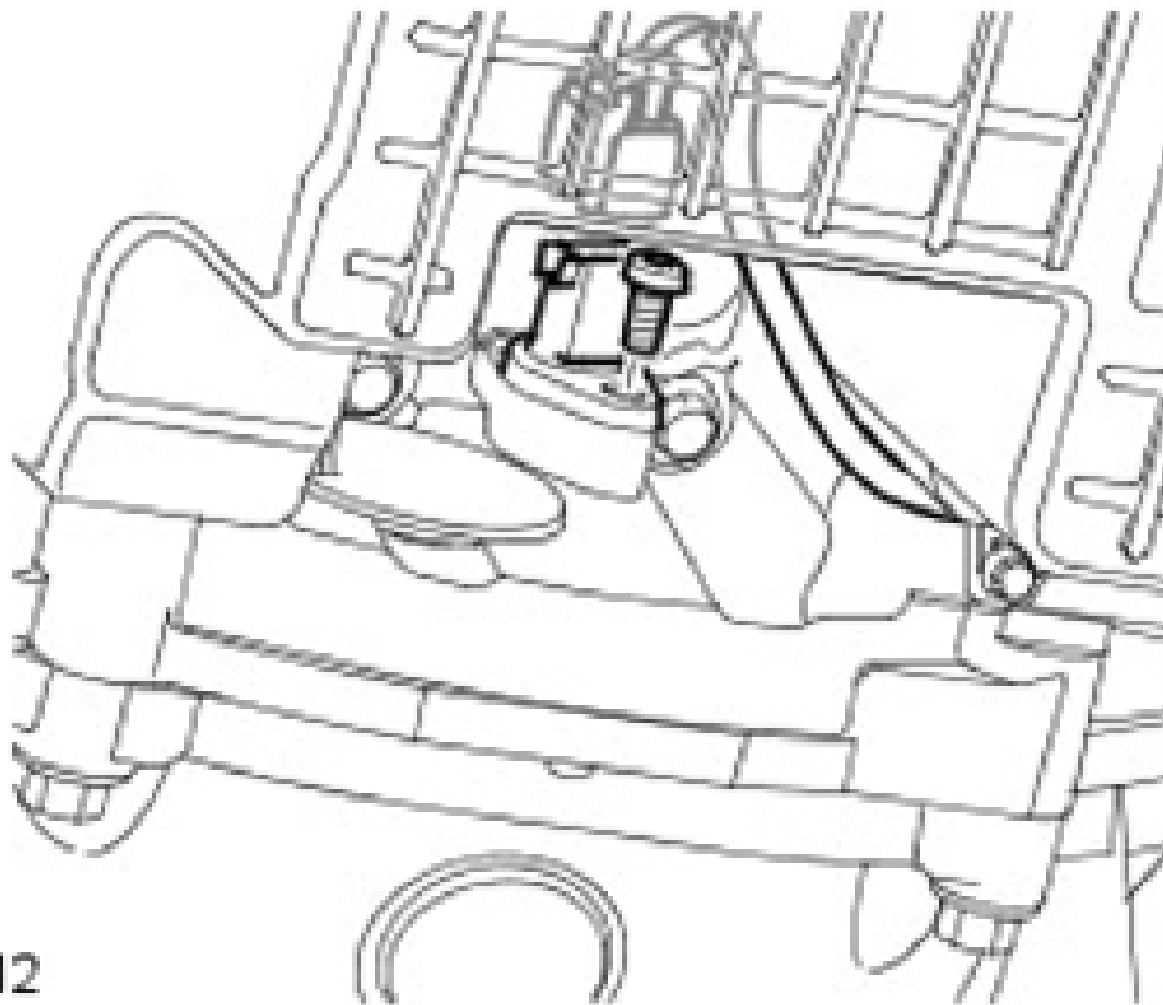


10. Disconnect the knock sensors (KS) electrical connector.
11. Release the 5 air conditioning (A/C) harness retaining clips.

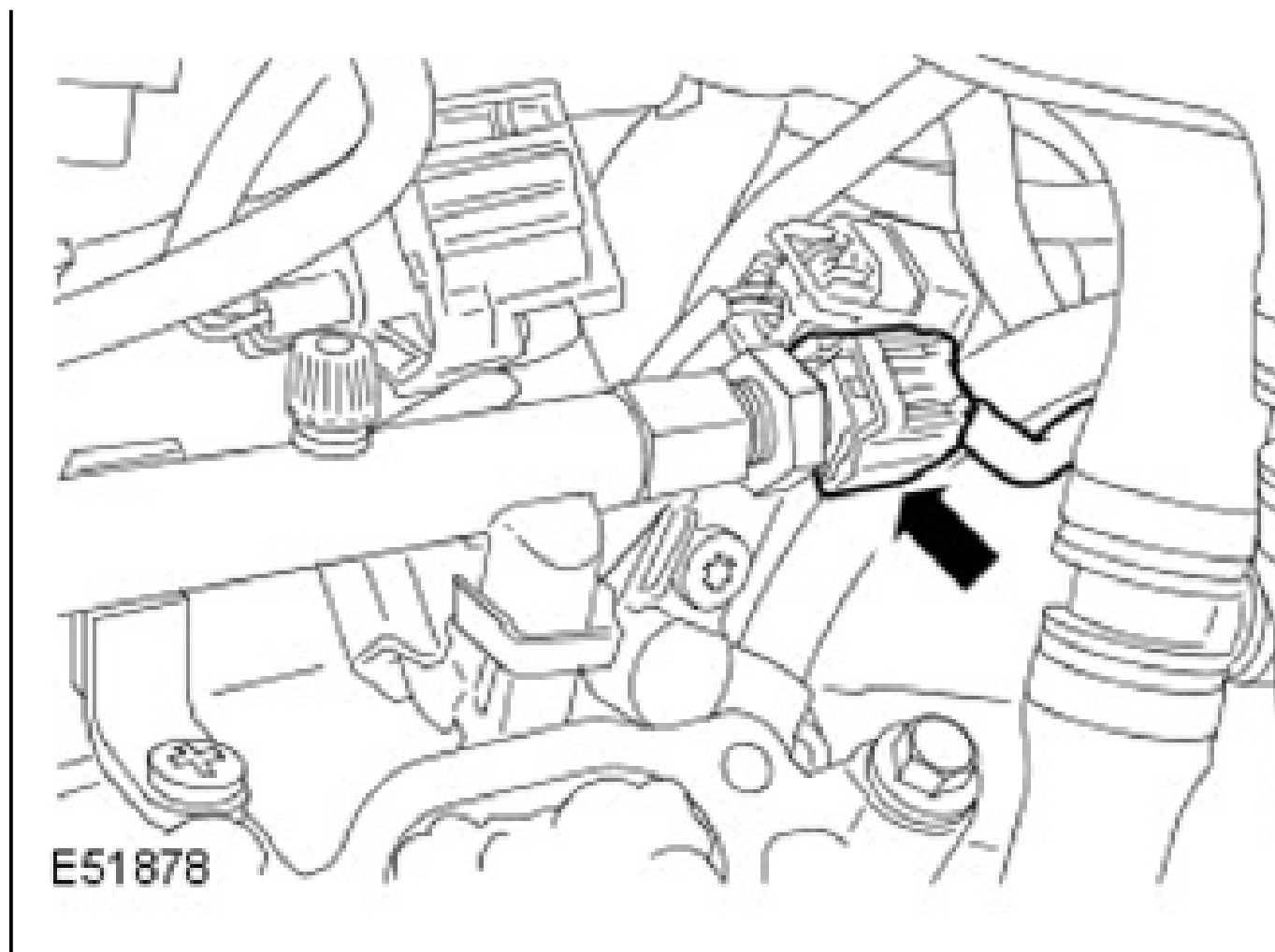


12. Remove the crankshaft position (CKP) sensor.

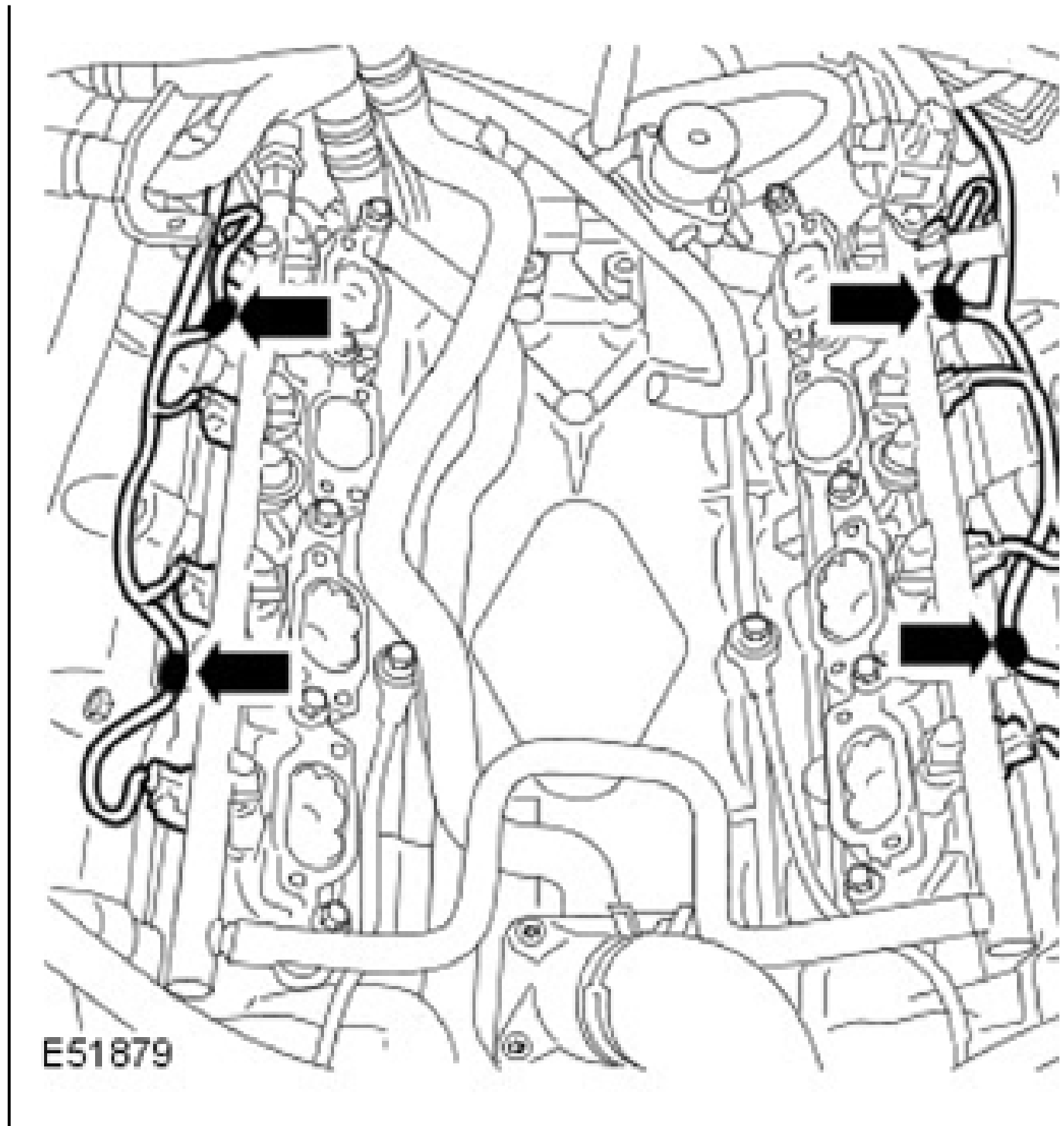
- Disconnect the electrical connector.
- Remove the Torx screw.



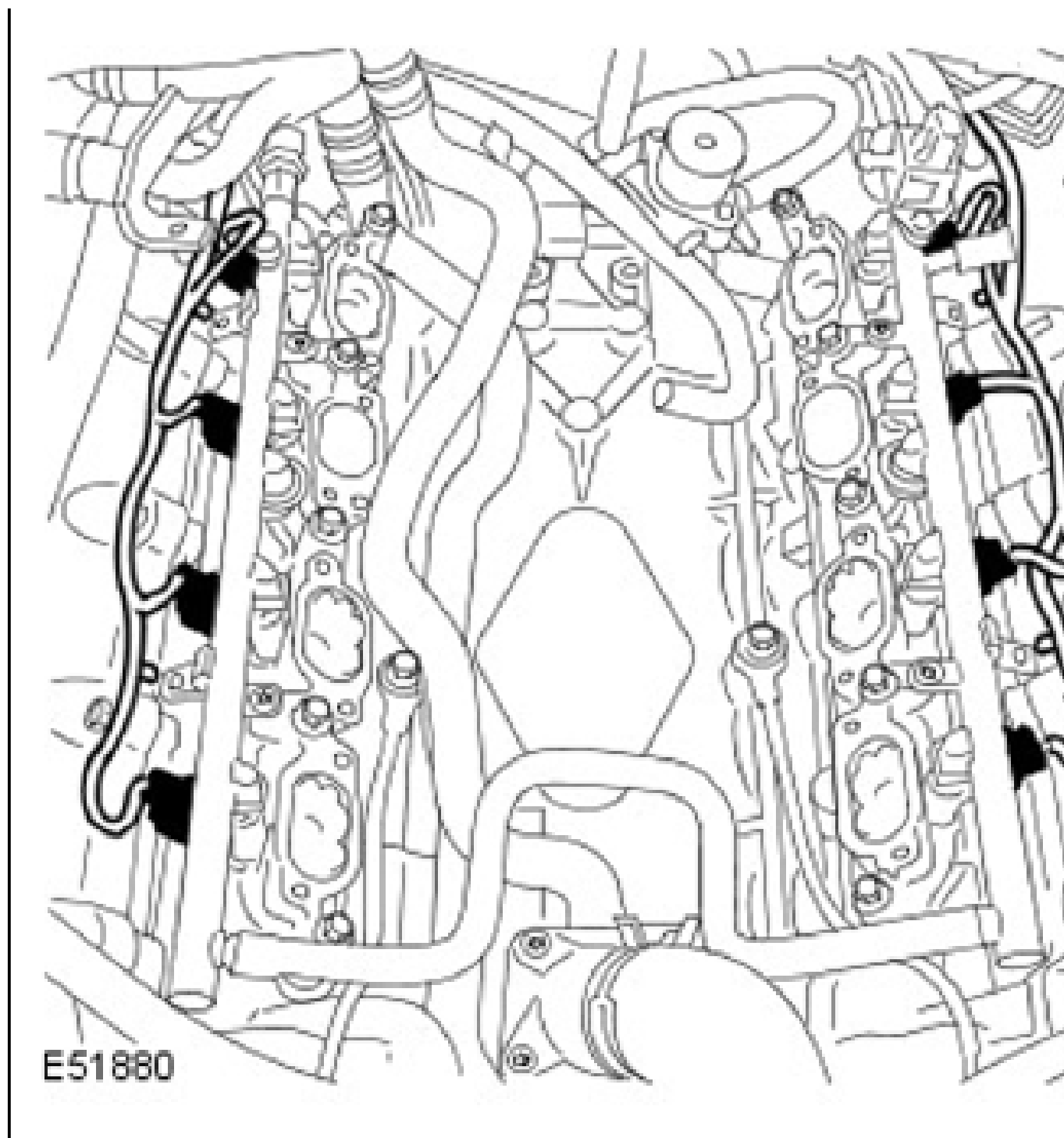
13. Disconnect the fuel temperature sensor electrical connector.



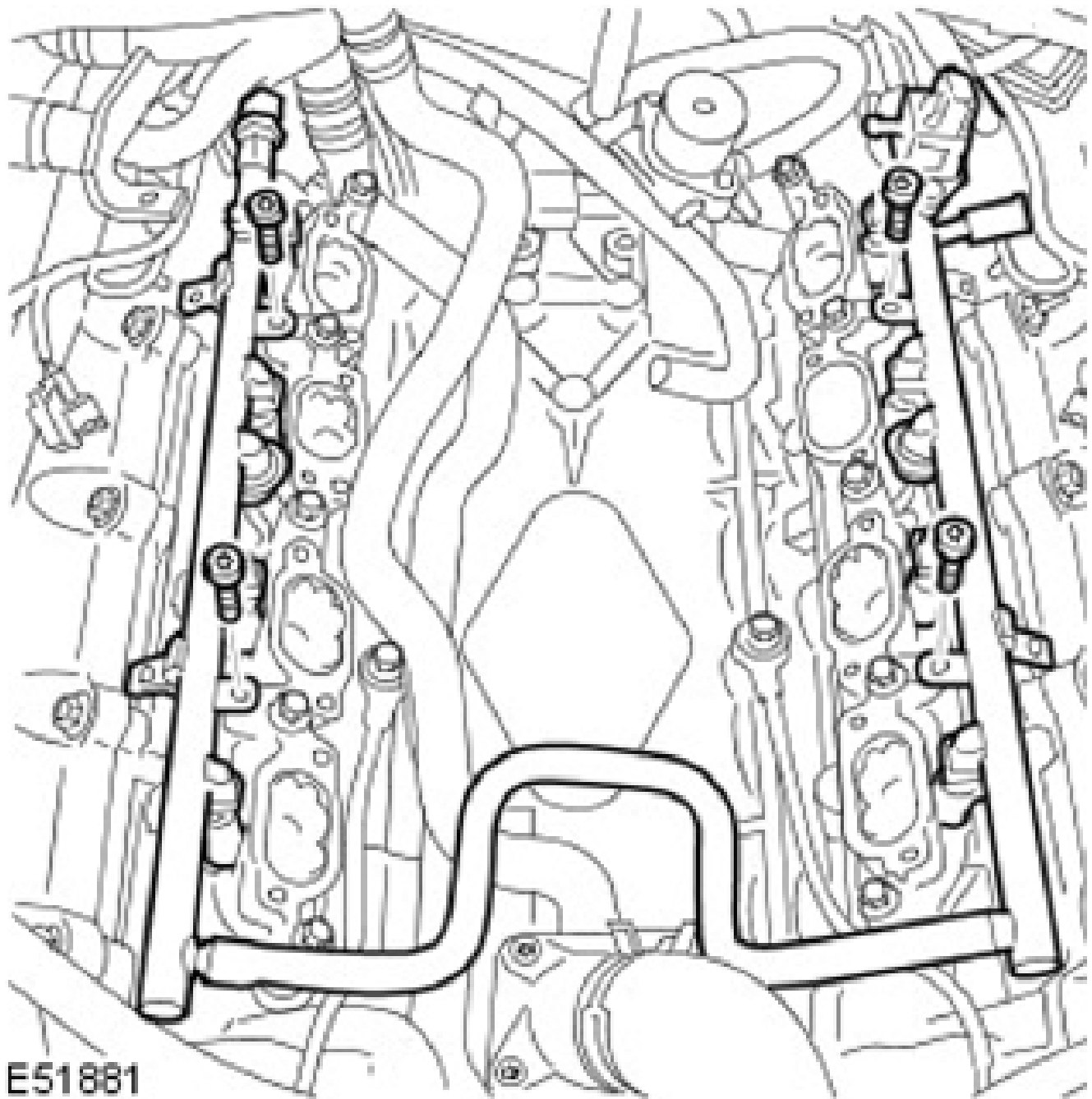
14. Release the fuel injector harness from the fuel rail.
- Release the 4 clips.



15. Disconnect the fuel injector electrical connectors.
 - Release the 8 clips.

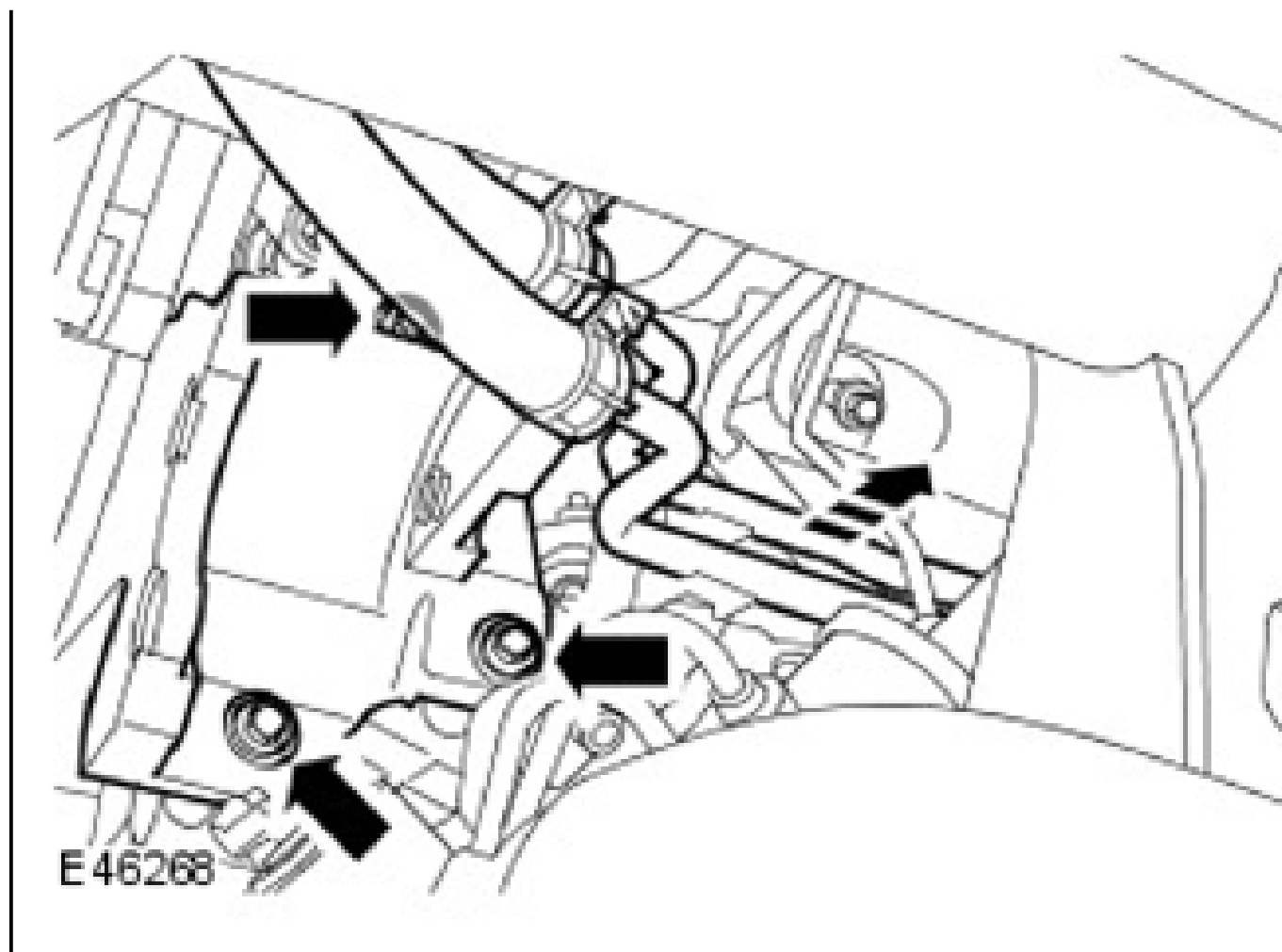


16. Remove the fuel rail.
- Remove the 4 Torx screws.
 - Remove and discard the fuel injector O-ring seals.

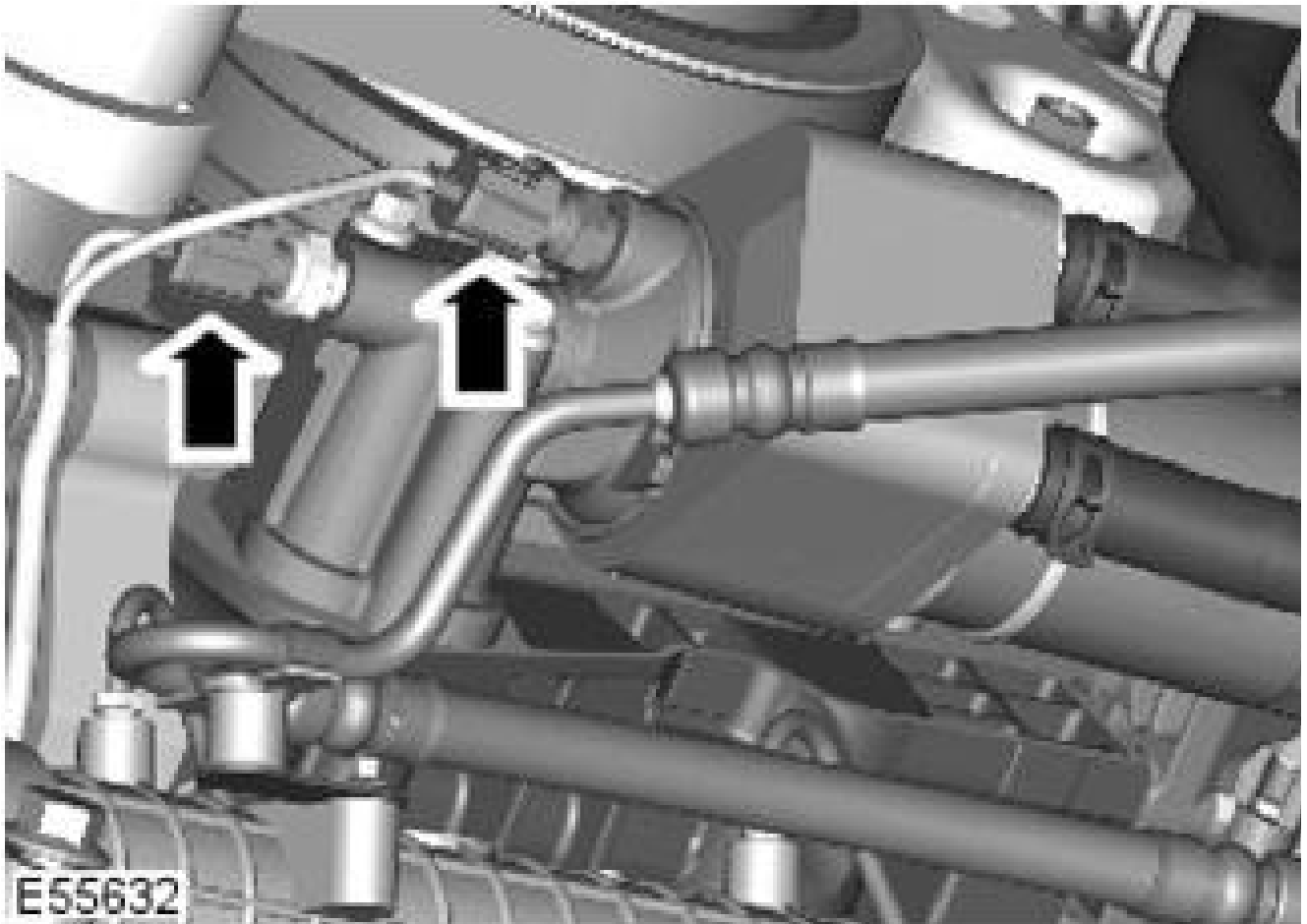


17. Remove the power steering pump mounting bracket.

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

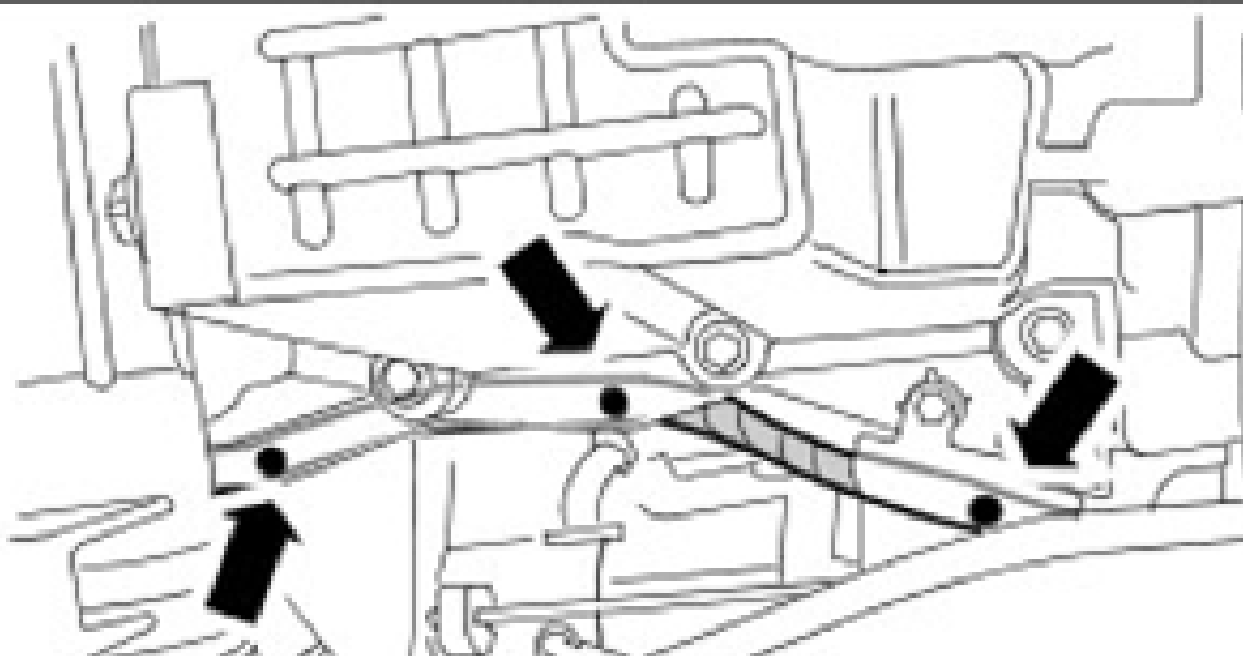
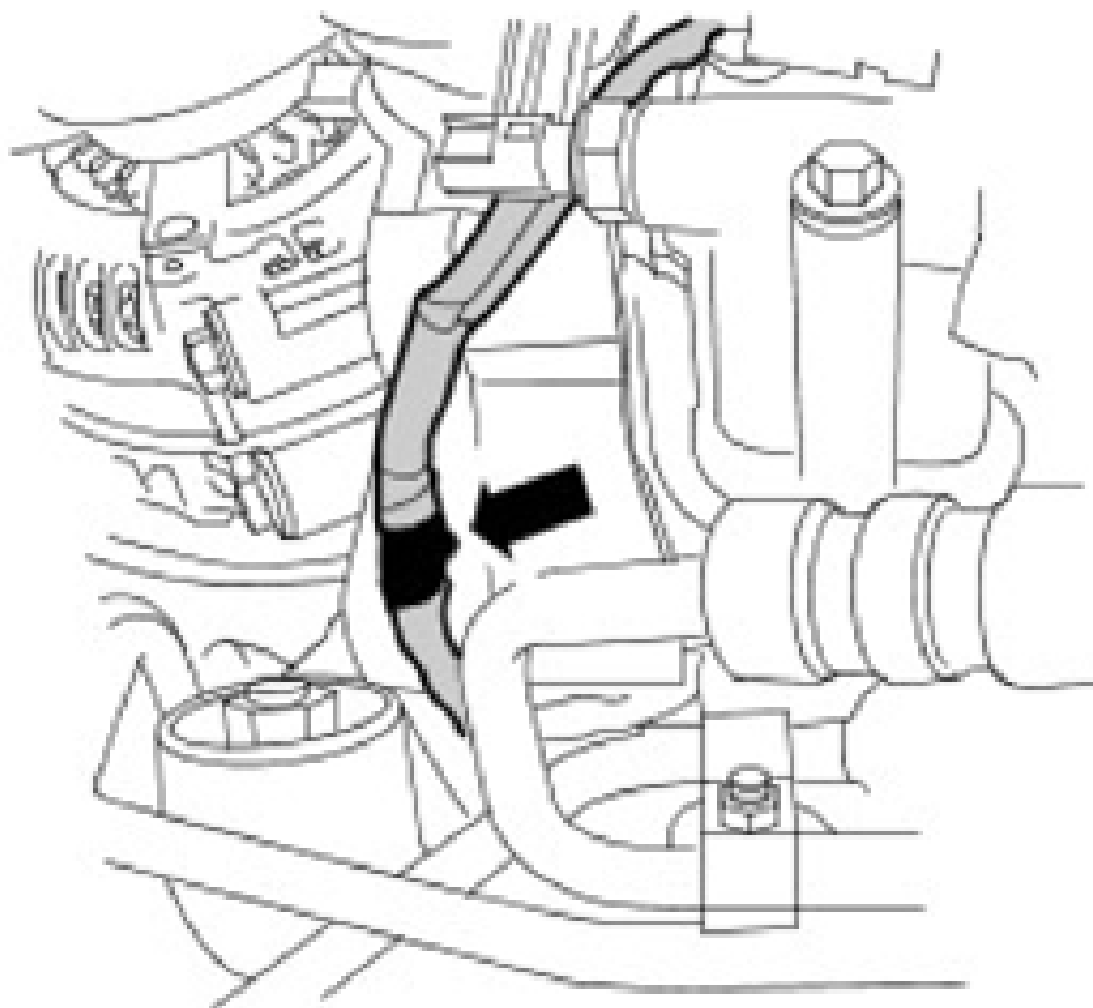


18. Disconnect the oil temperature and oil pressure sensors.



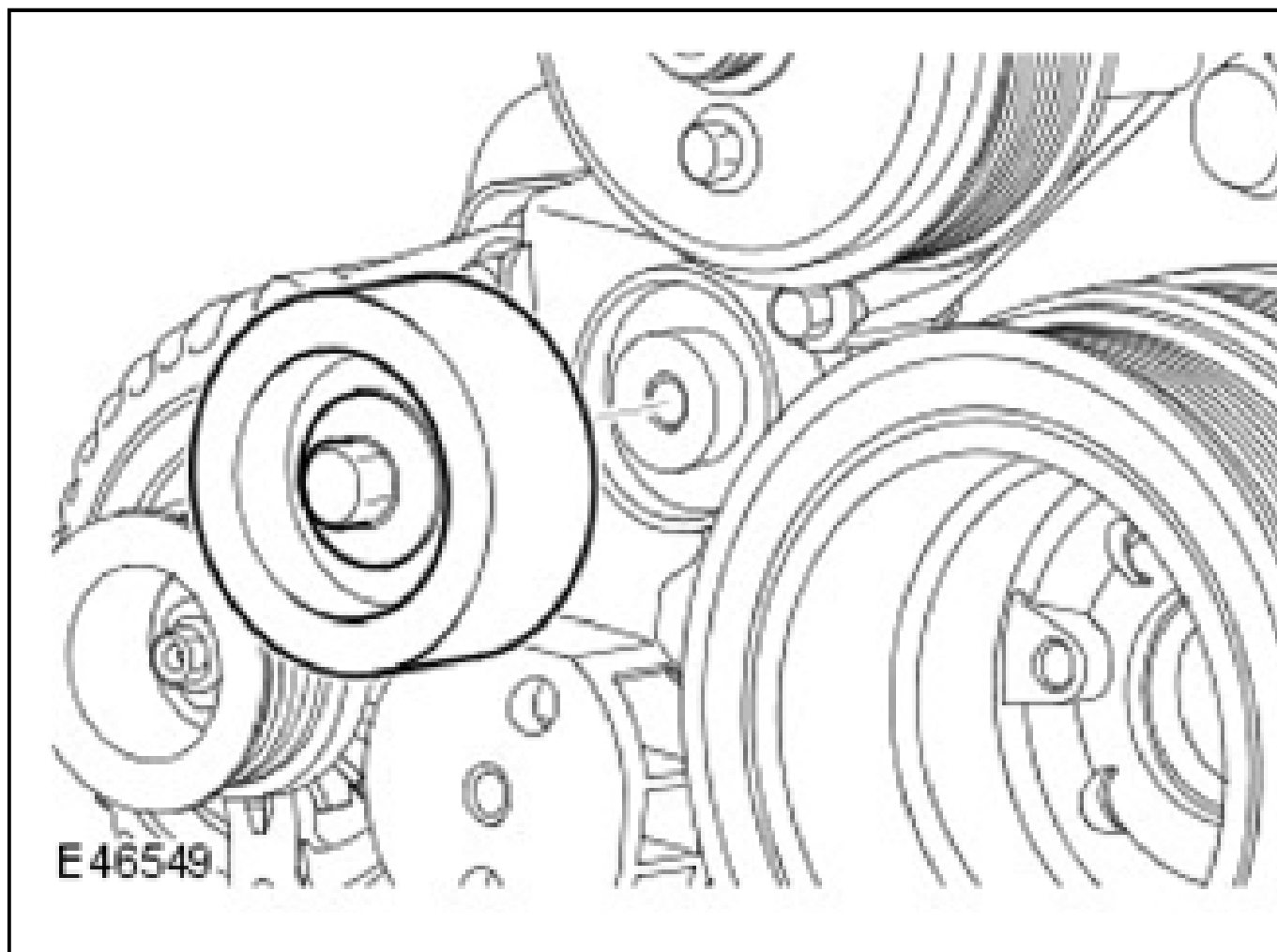
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

19. Release the 4 clips securing the generator harness.



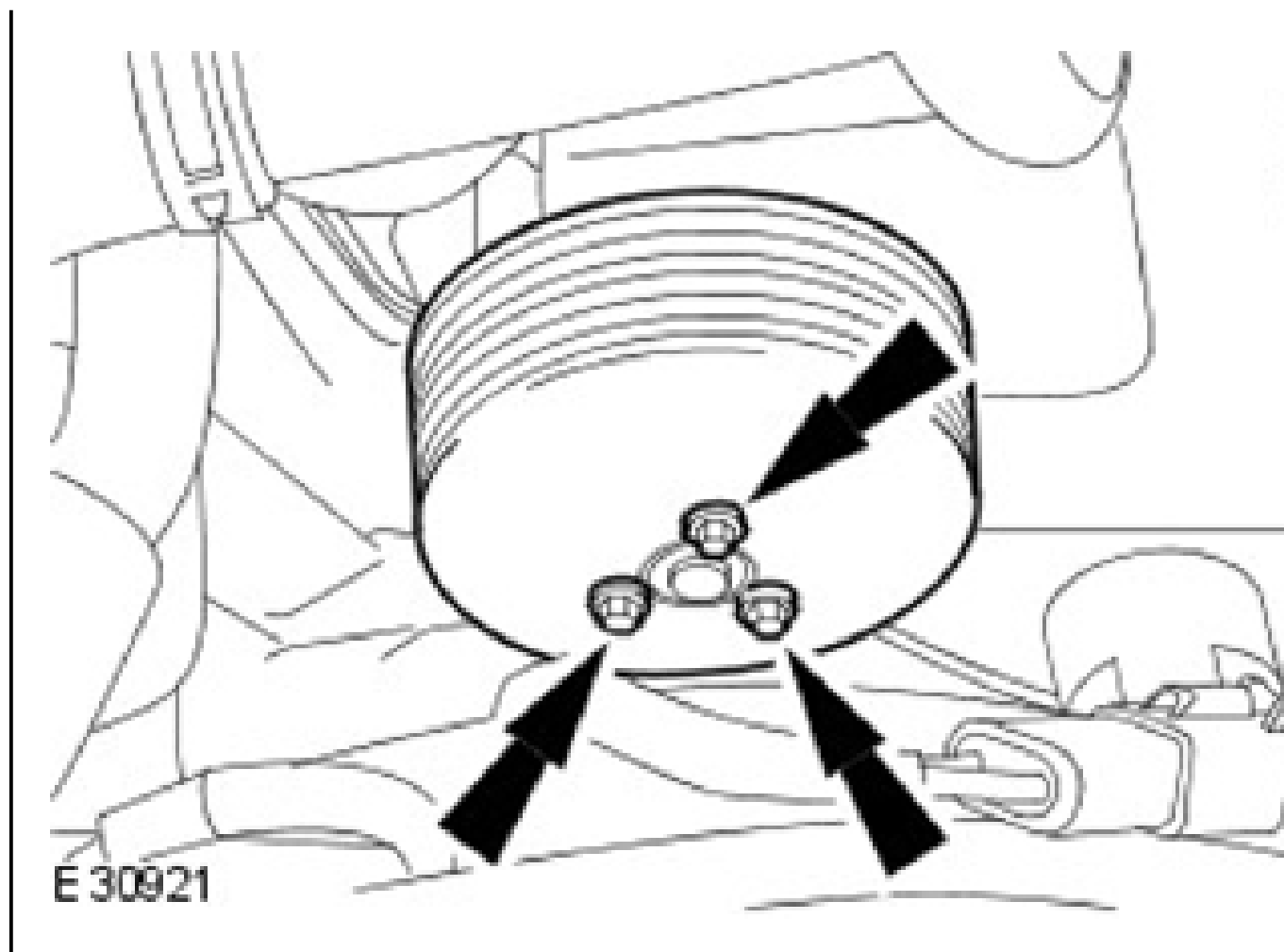
20. Remove the accessory drive belt idler pulley.

- Remove the bolt.

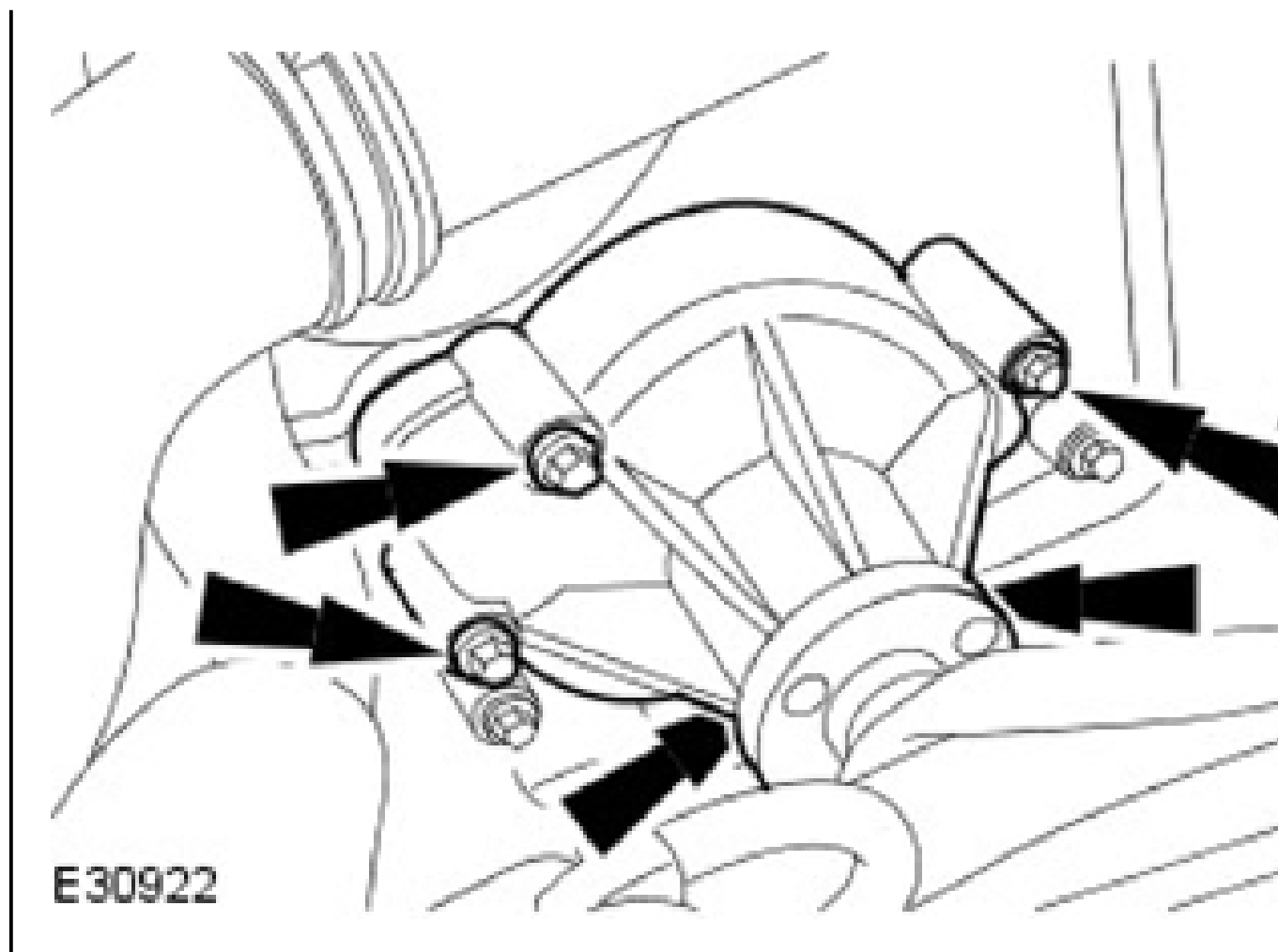


21. Remove the coolant pump pulley.

- Remove the 3 bolts.

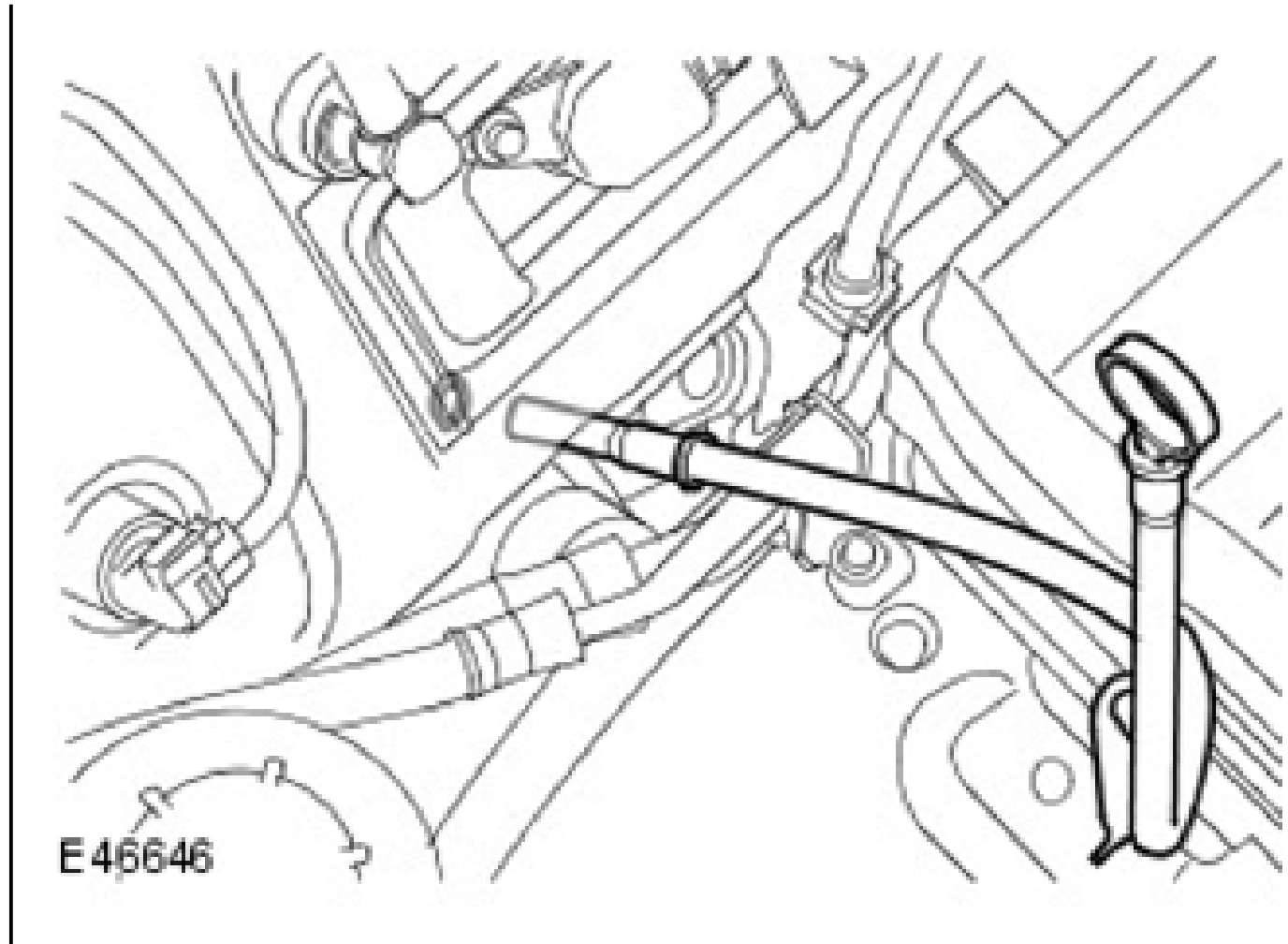


22. Remove the coolant pump.



23. Remove the oil level indicator and tube.

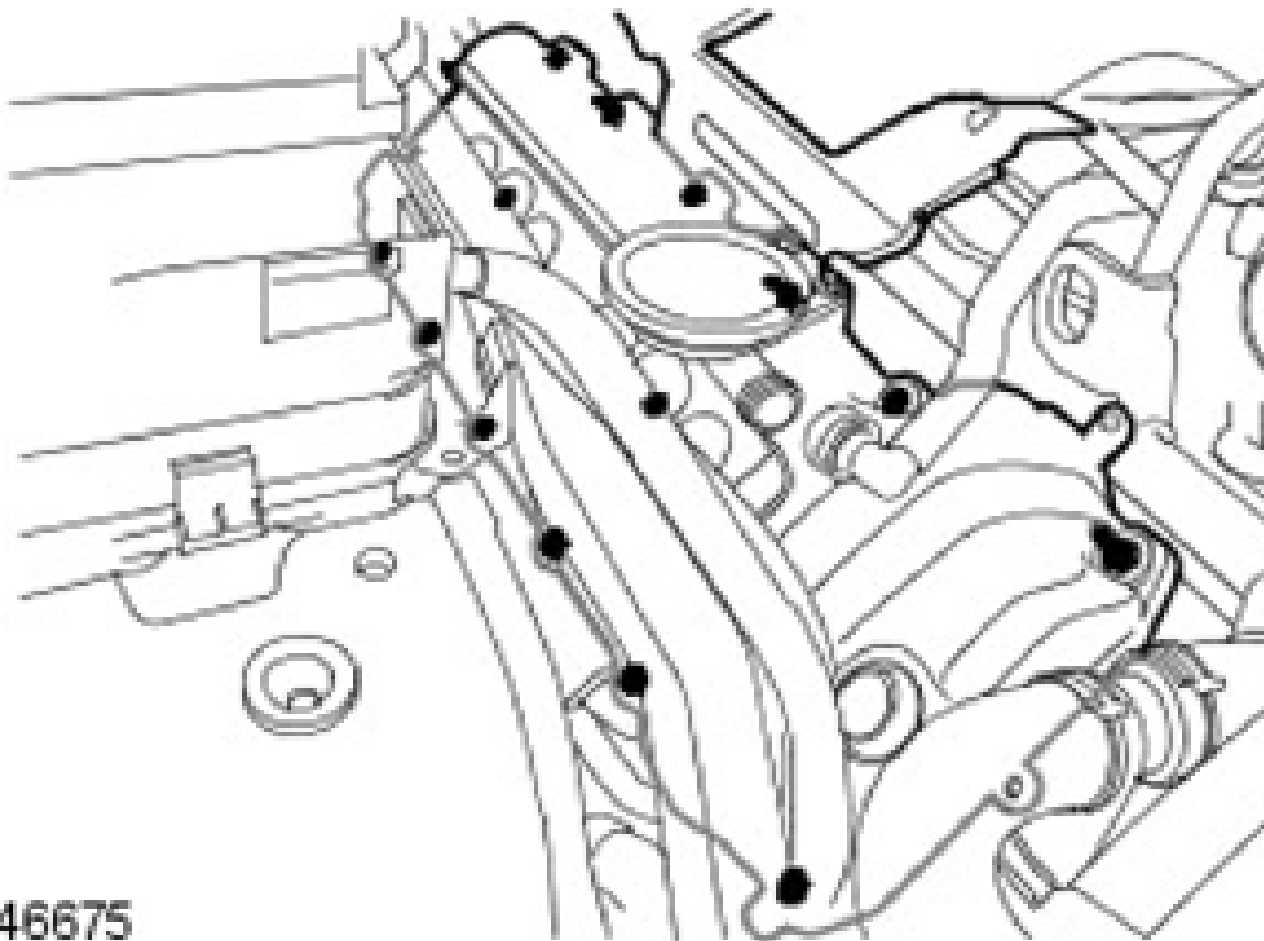
- Remove the nut.
- Discard the O-ring seal.



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

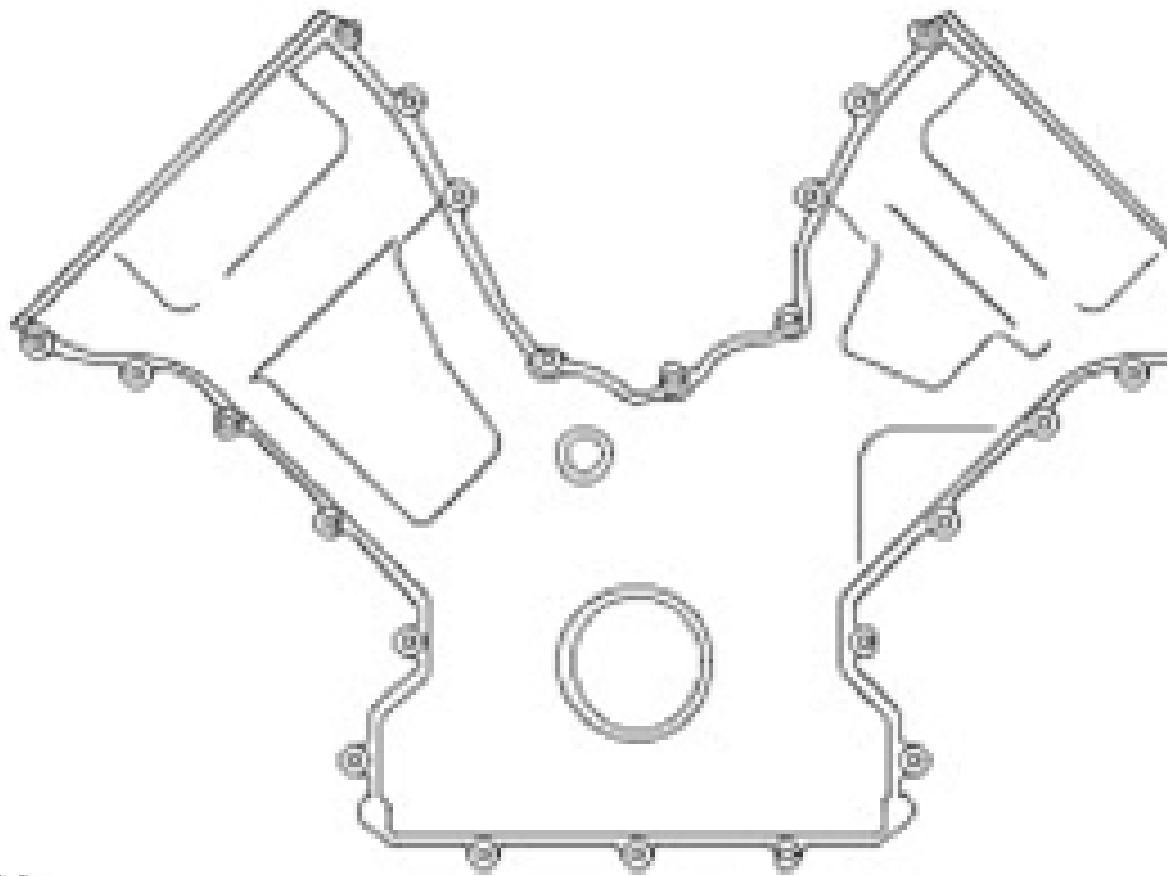
24. Remove the RH valve cover.

- 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.



E46675

25. Remove the engine front cover.
- Remove the 24 bolts.
 - Remove and discard the gasket.



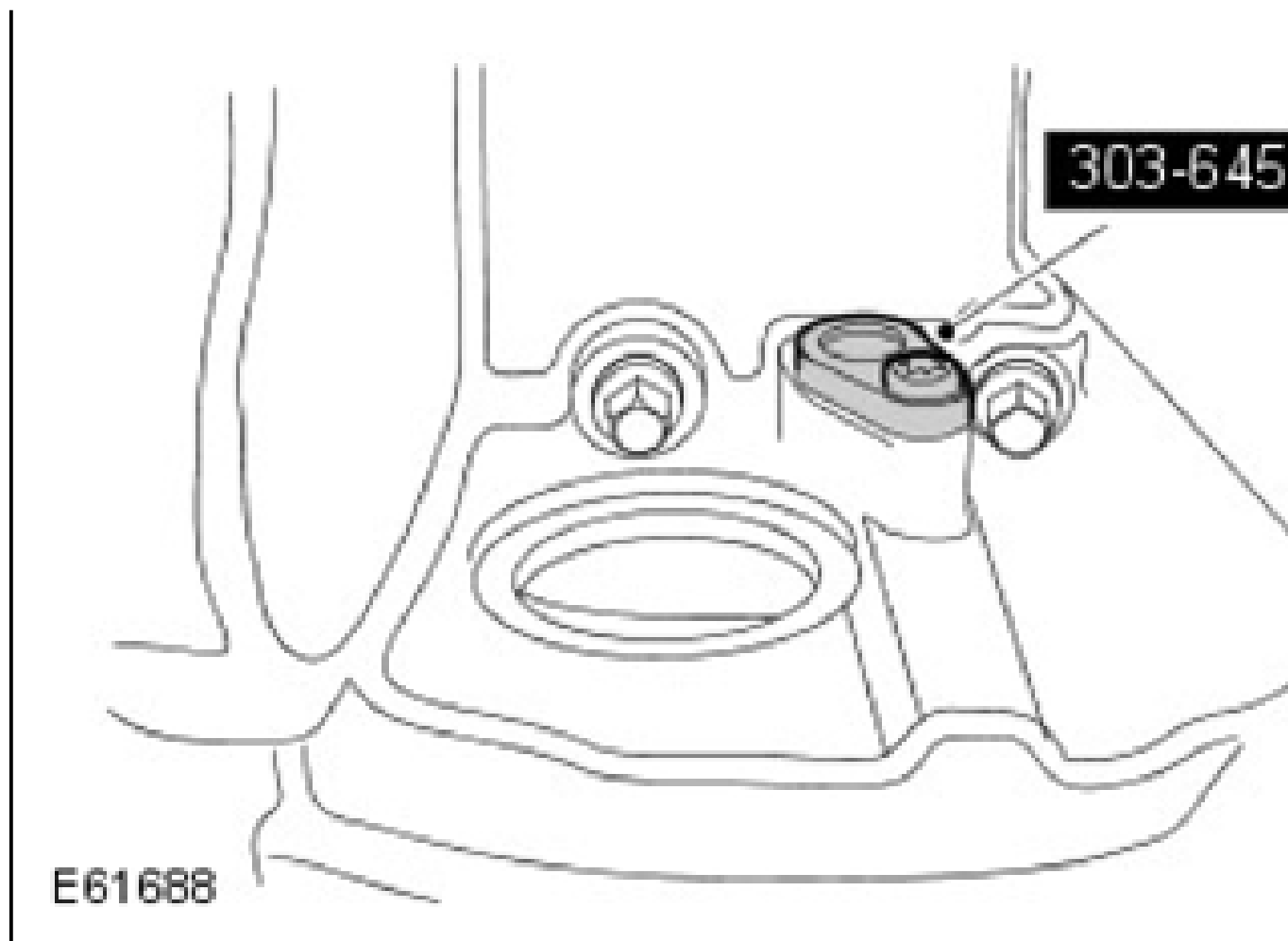
E48381

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

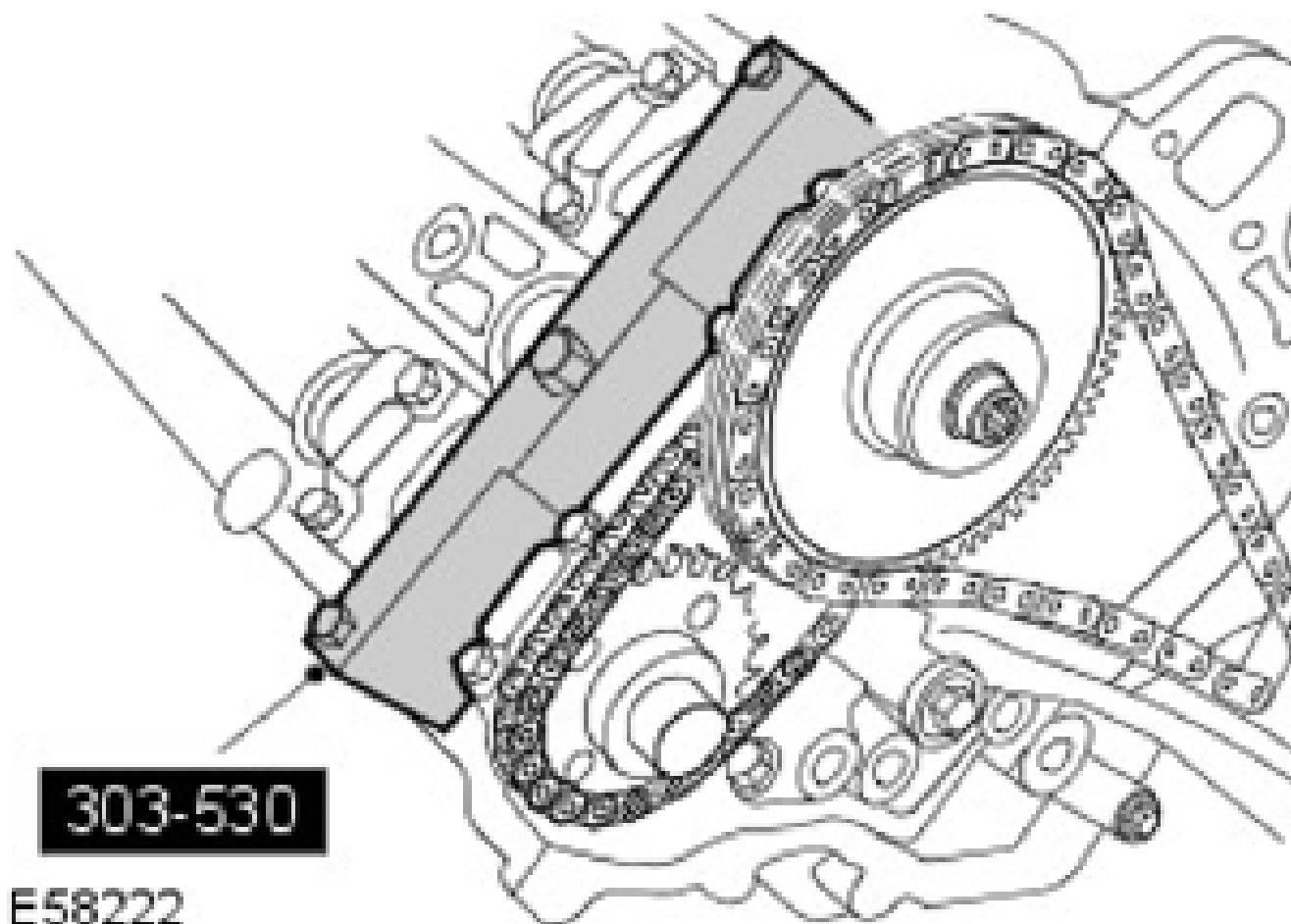
NOTE: The engine is now in the **SAFE** position.

27. Lock the crankshaft.

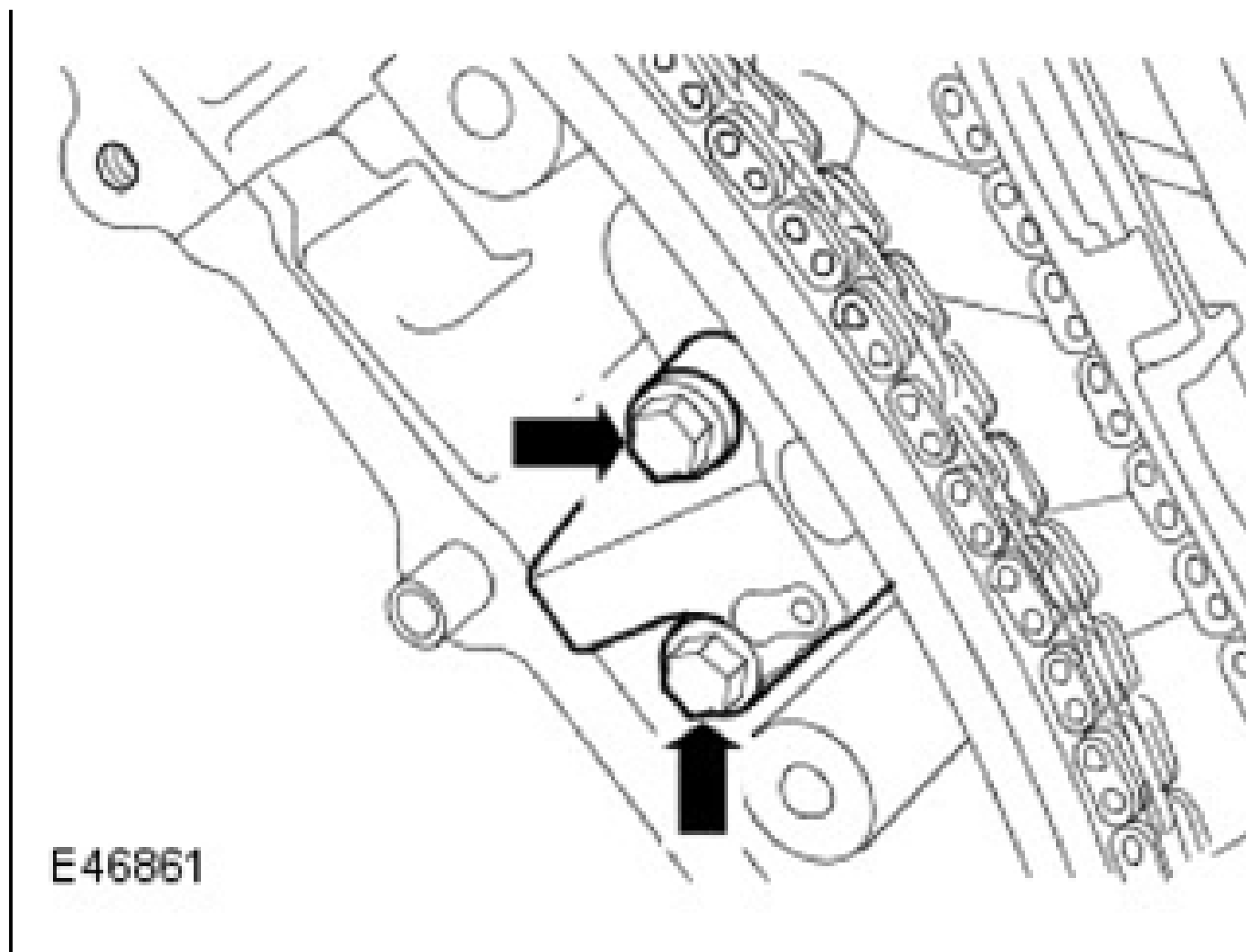
- Install the special tool.
- Install the screw.



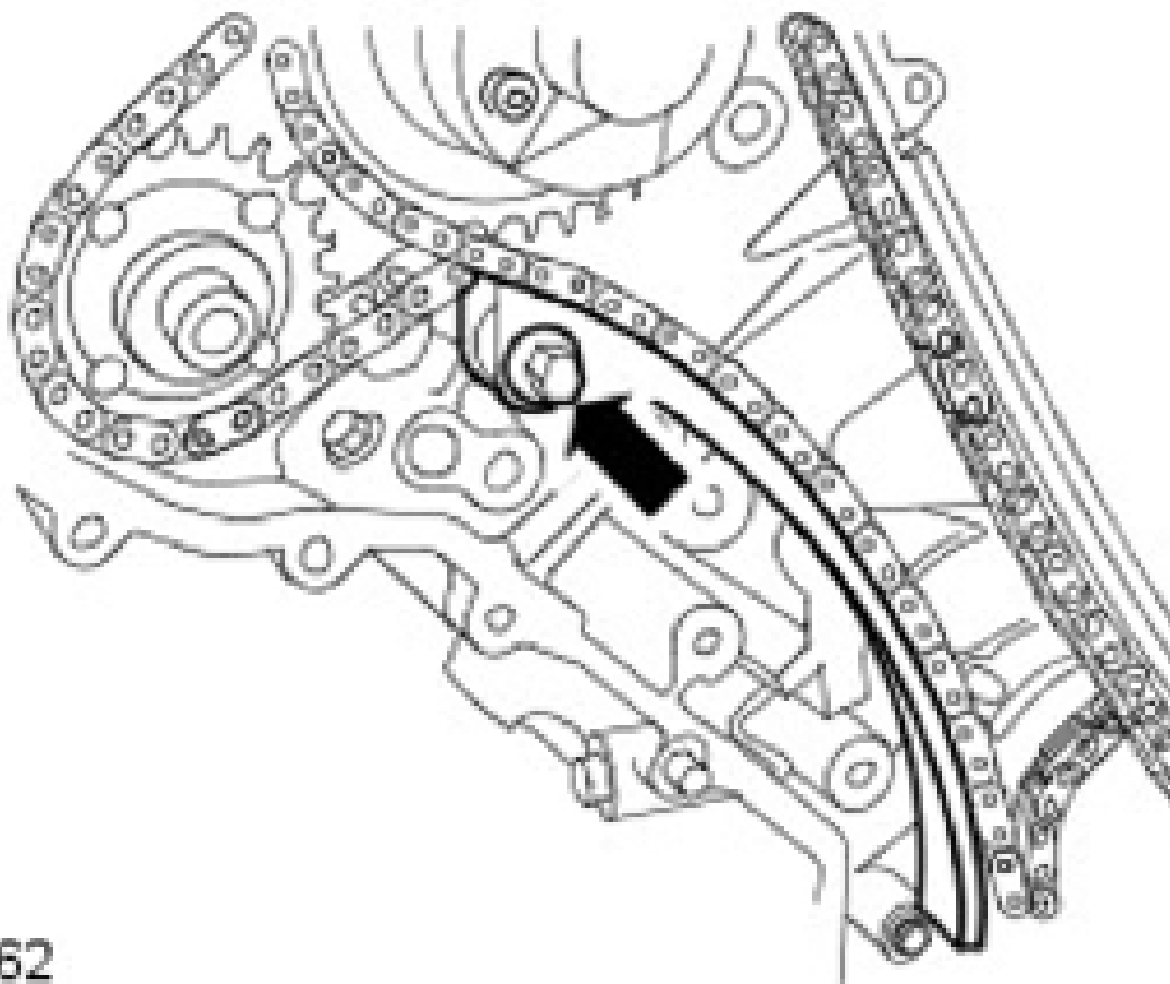
28. Install the special tool to the RH cylinder head.
- Install the 3 bolts.



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

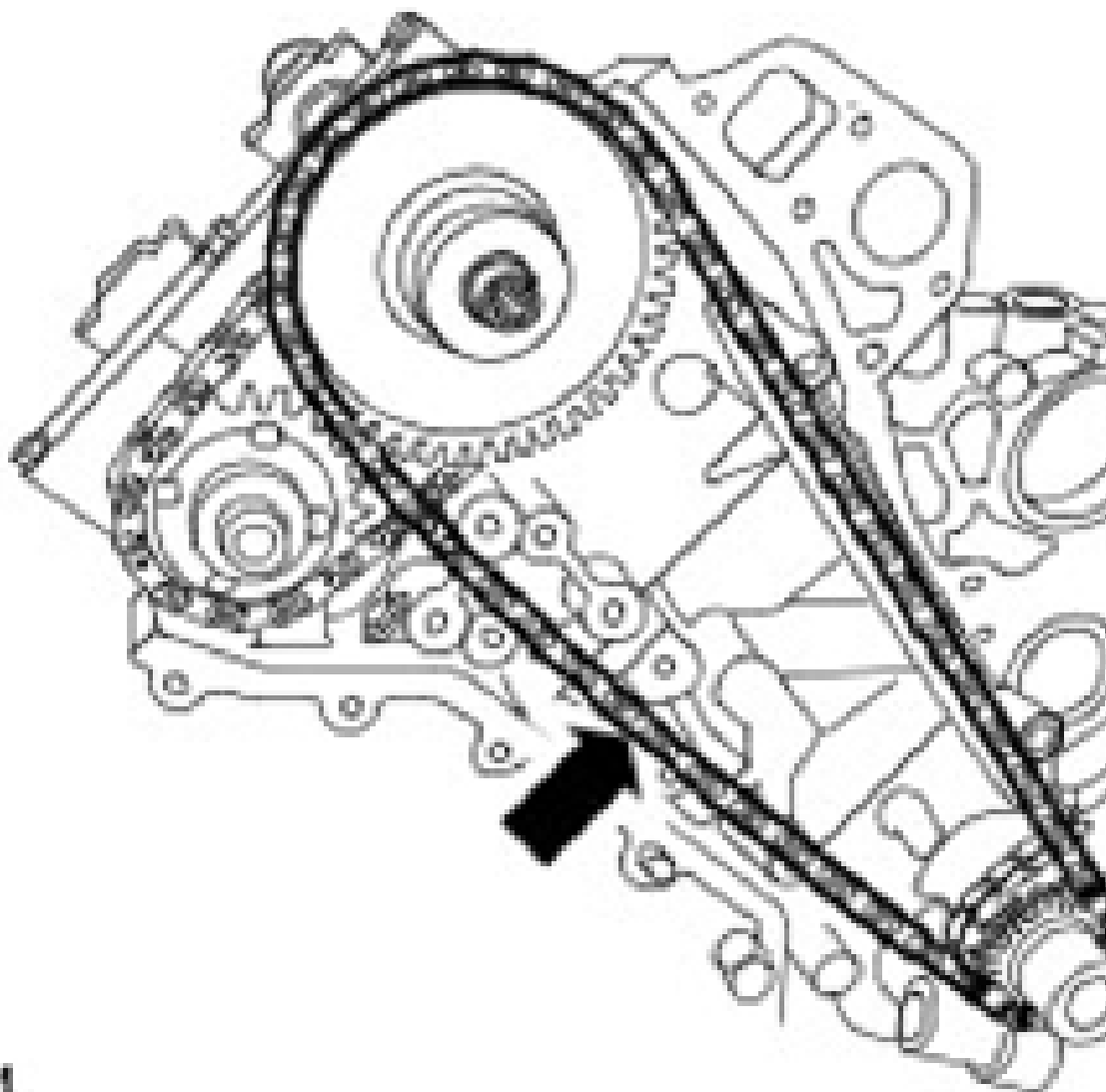


30. Remove the RH primary timing chain tensioner guide.
- Remove the bolt.



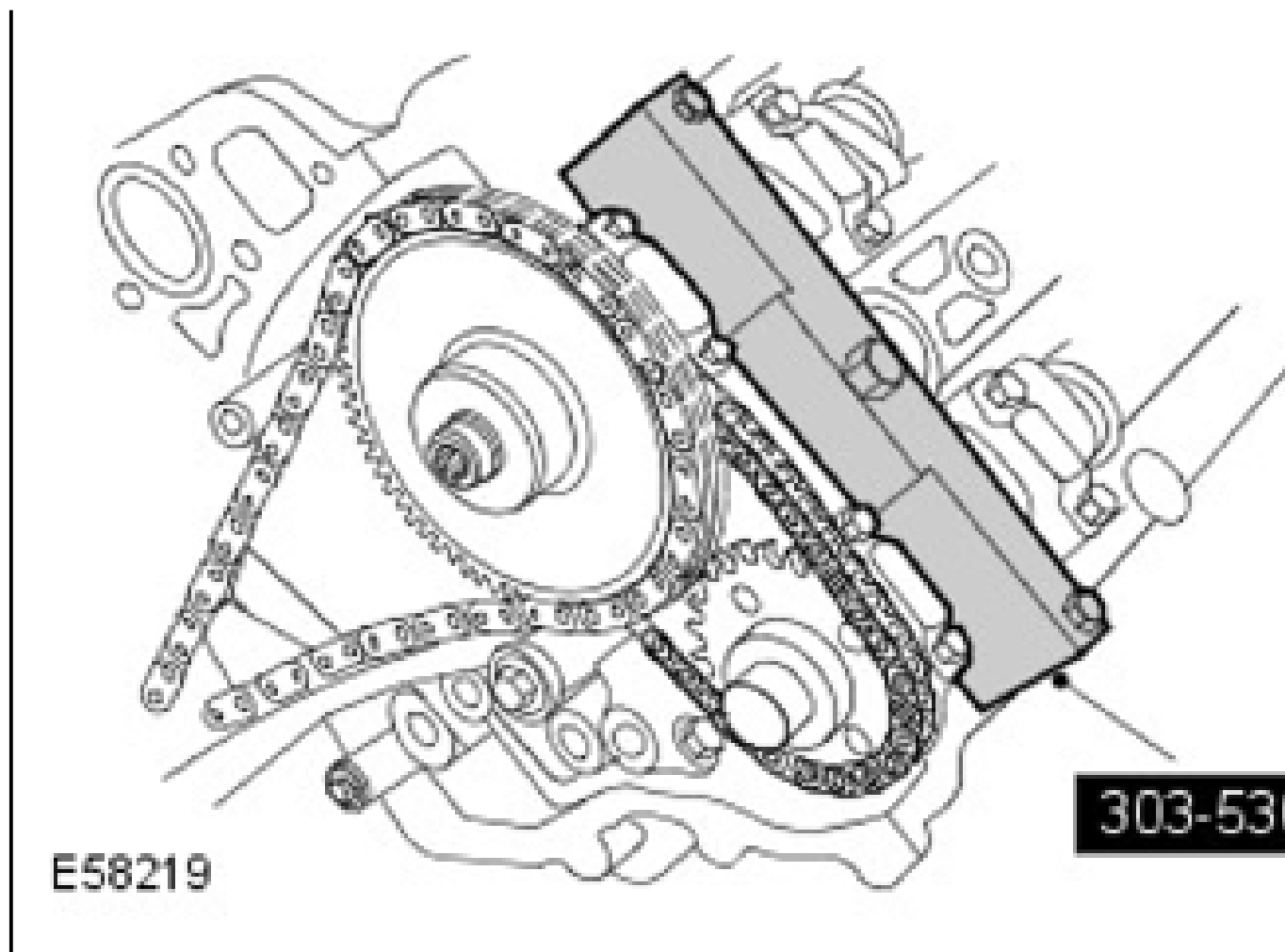
E46862

31. Remove the RH primary timing chain.

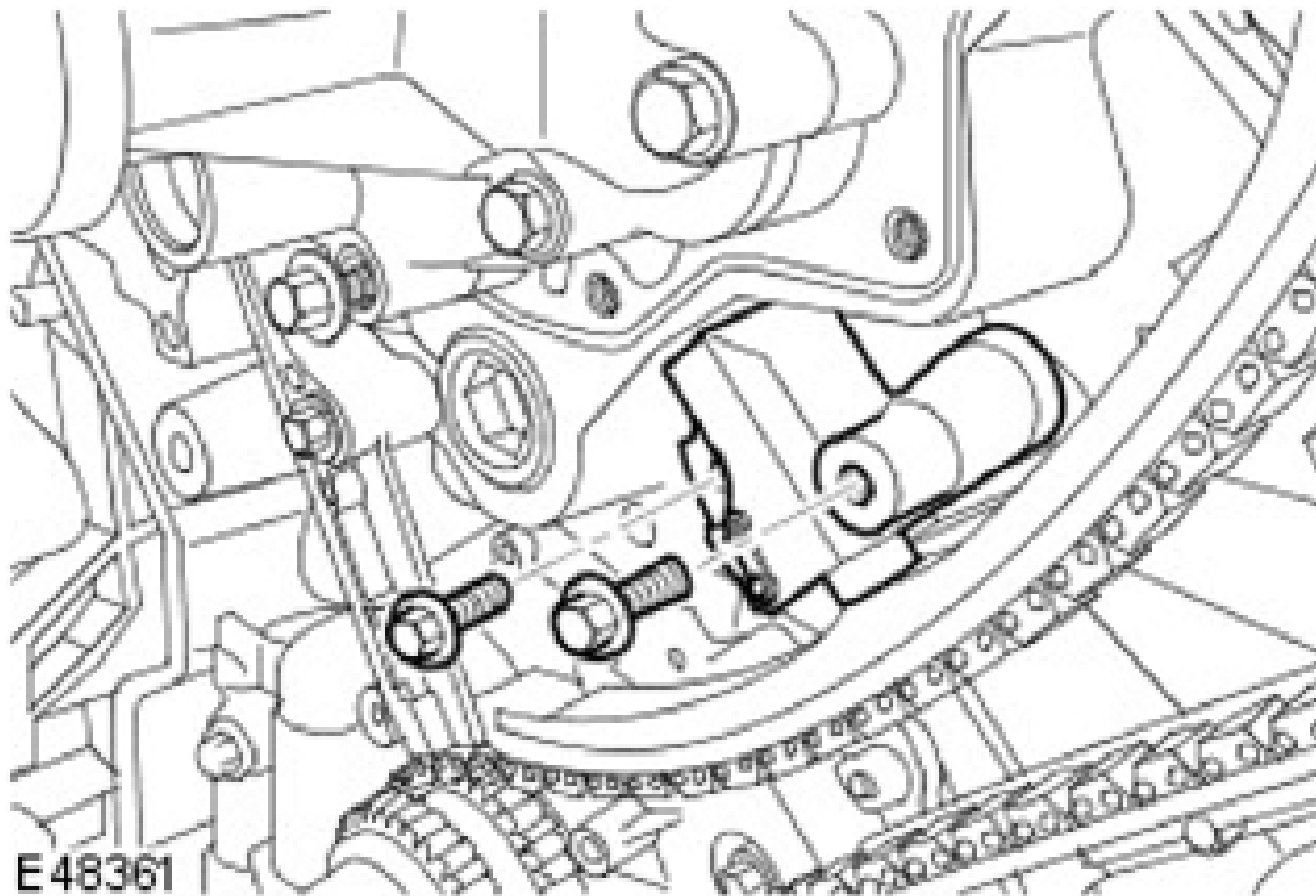


E58224

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

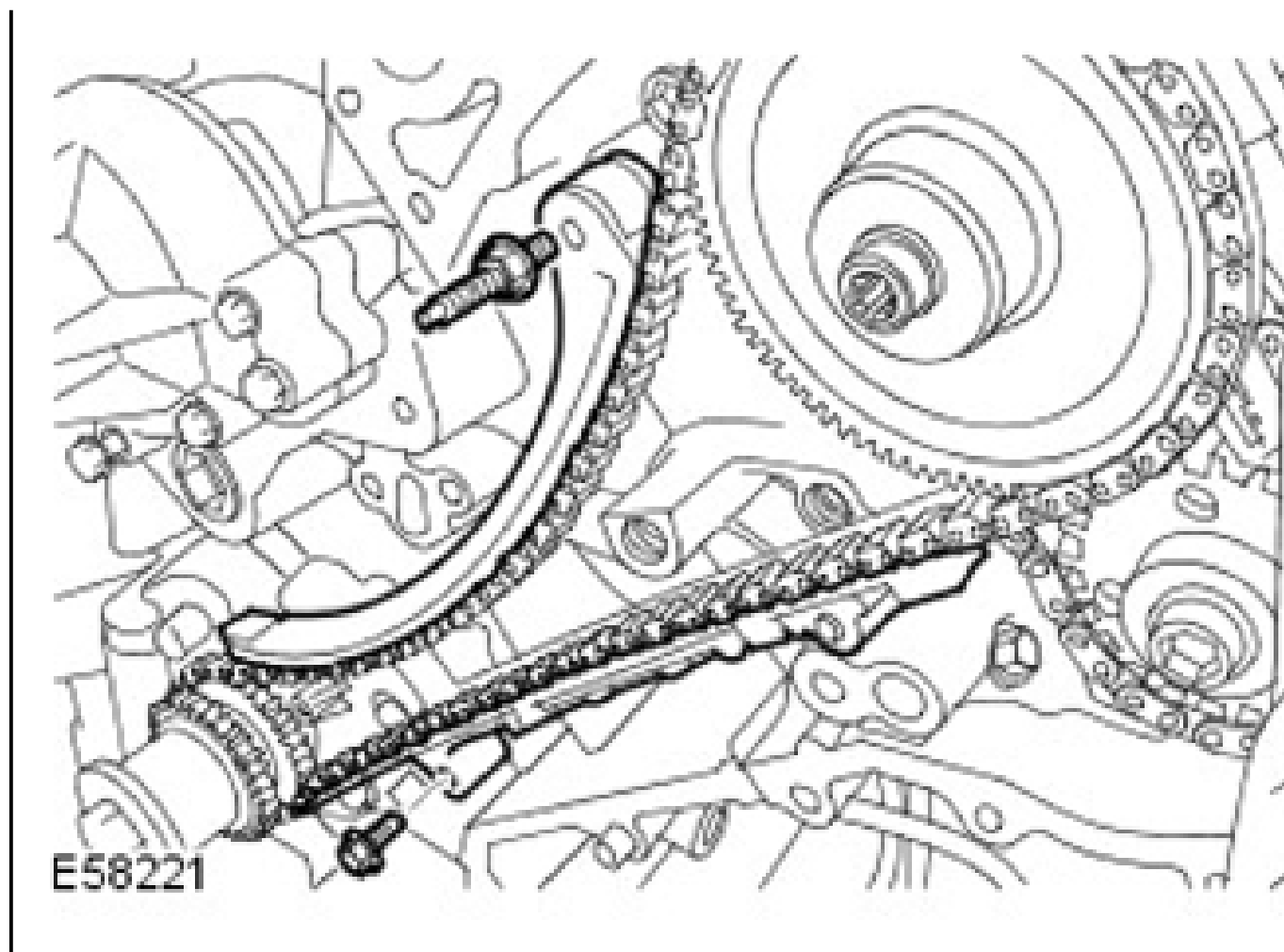


33. Remove the LH primary timing chain tensioner.
- Remove the 2 bolts.



34. Remove the LH upper and lower primary timing chain tensioner guides.

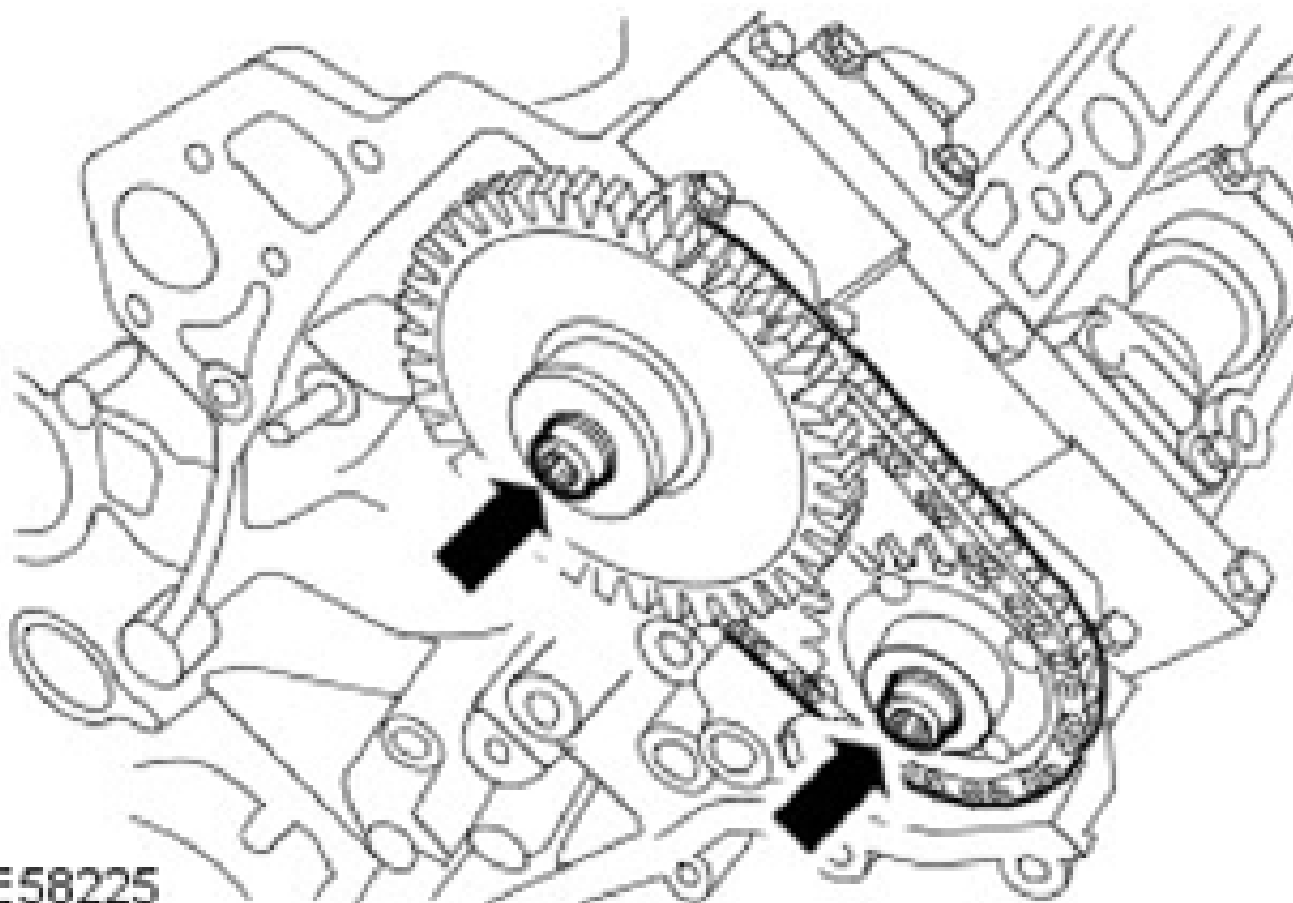
- Remove the stud.
- Remove the bolt.



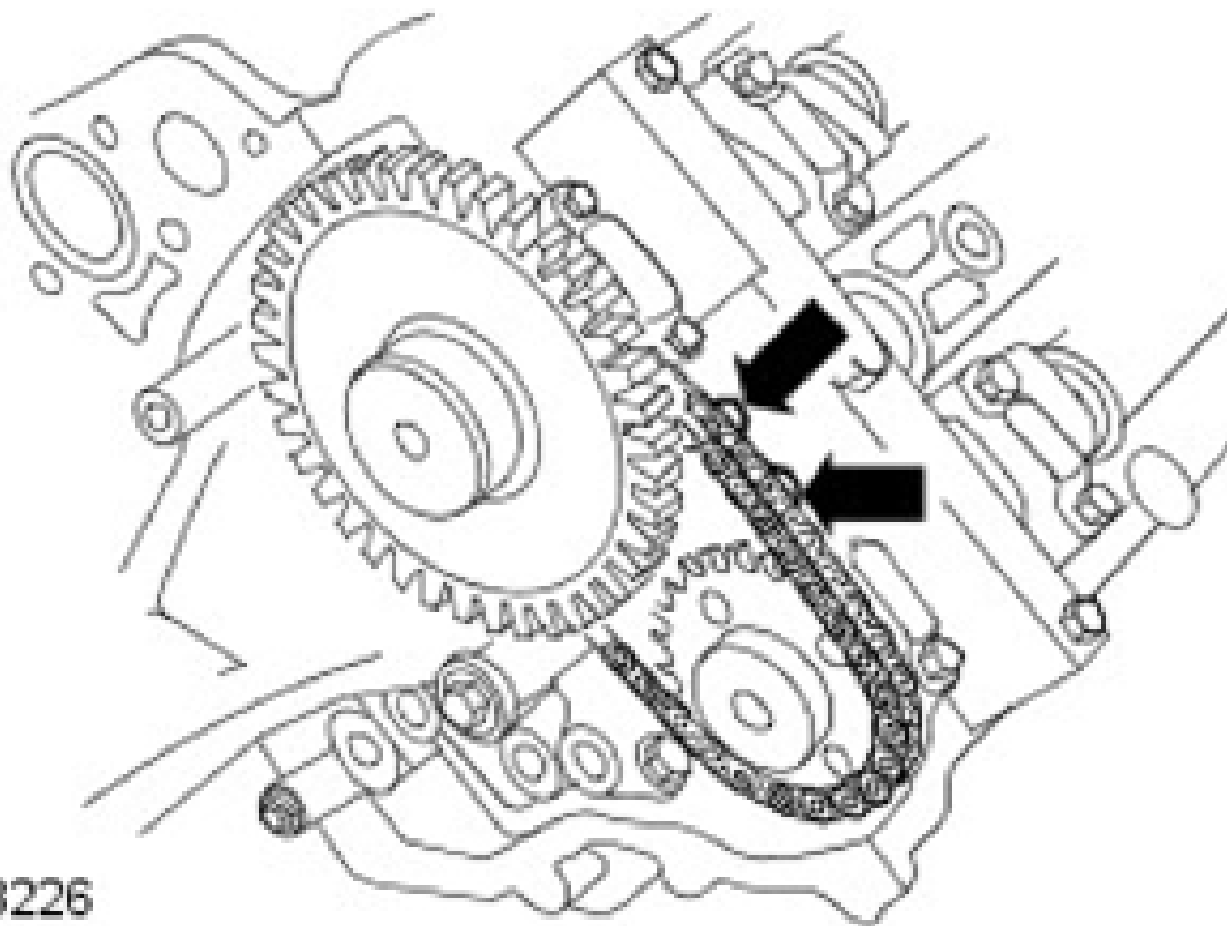
35. Remove the LH primary timing chain.

CAUTION: Discard the bolts.

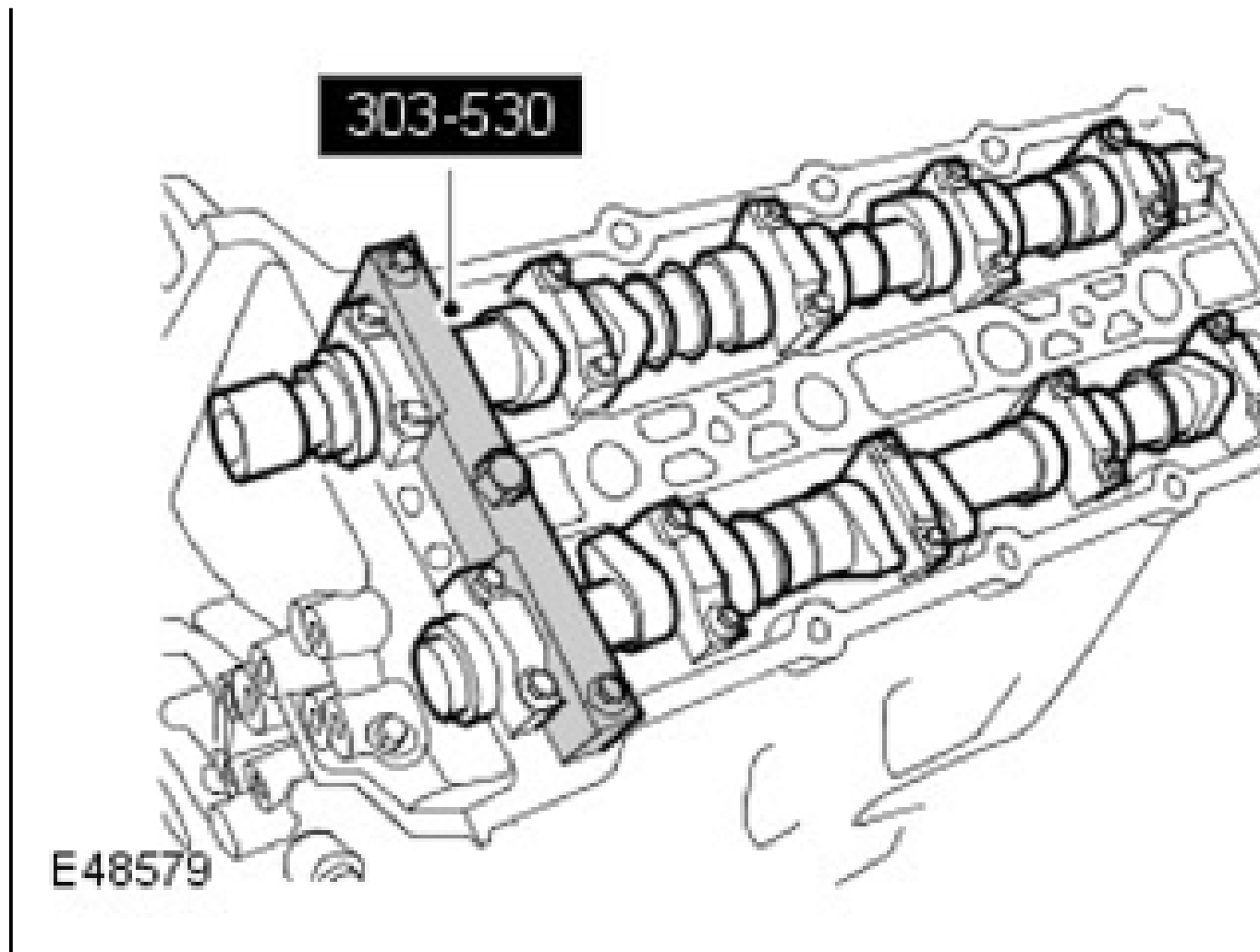
36. Remove the camshaft sprockets.
- Remove the 2 bolts.



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



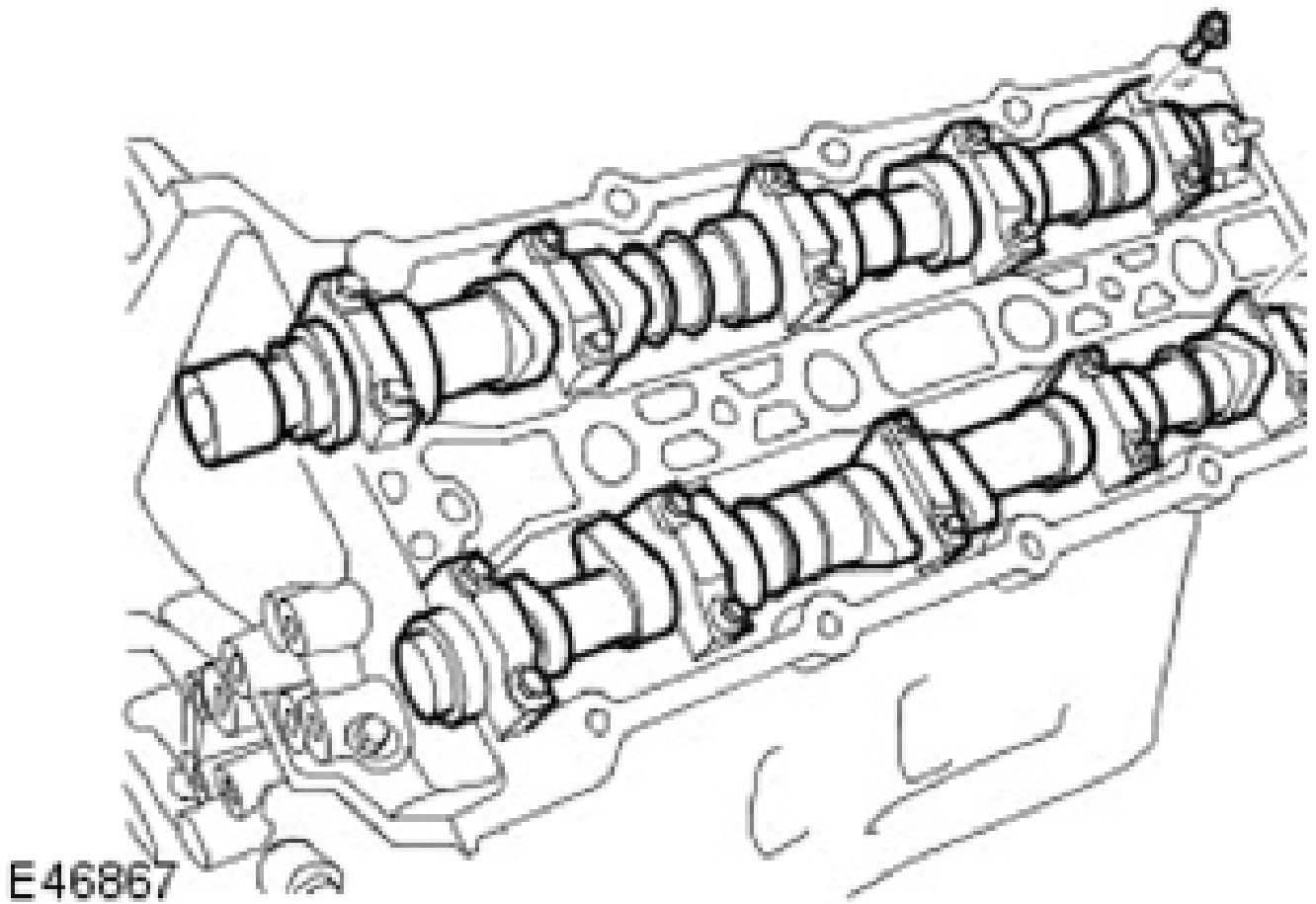
38. Remove the special tool from the LH cylinder head.
- Remove the 3 bolts.



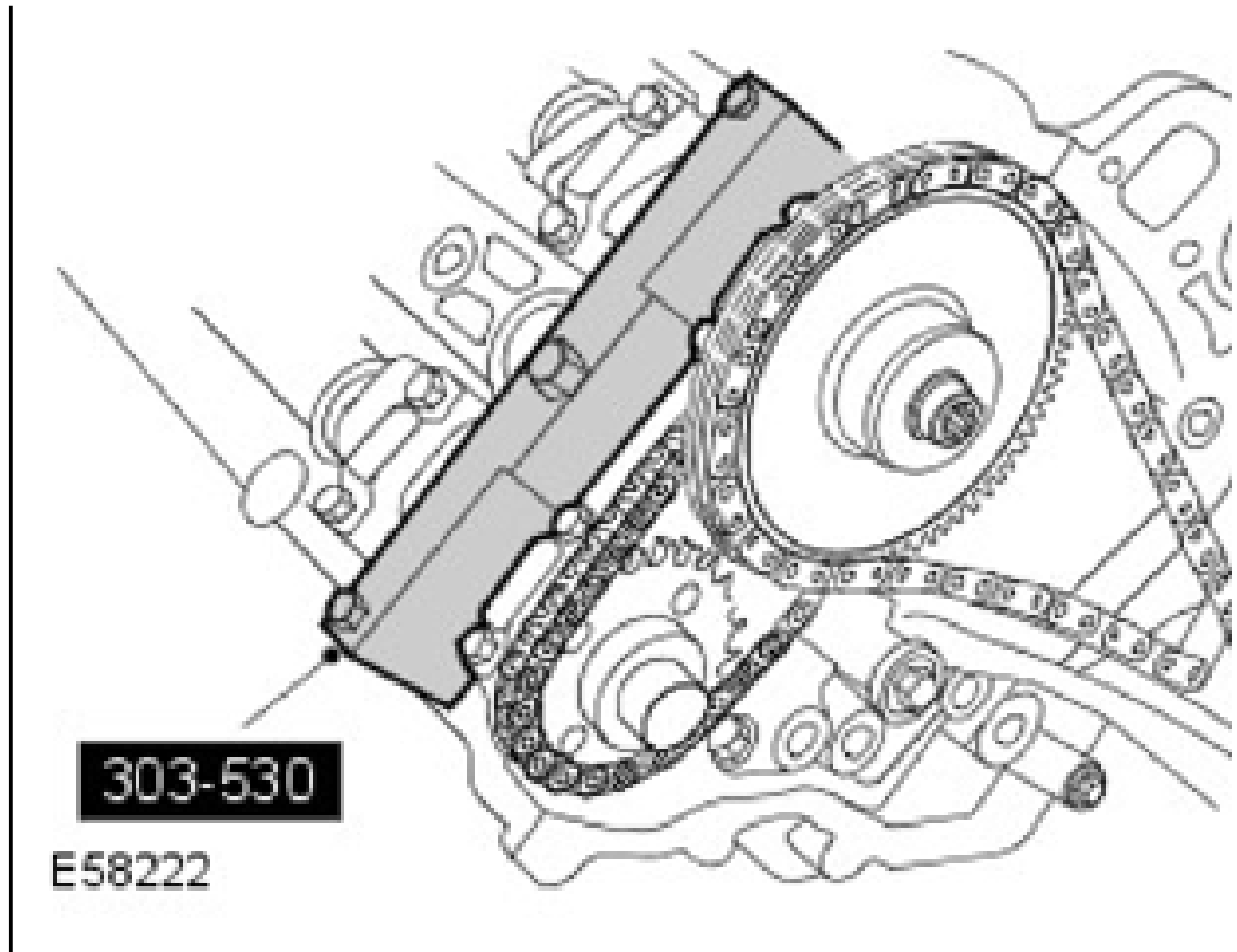
CAUTION: Evenly and progressively, release the camshaft bearing caps.

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

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



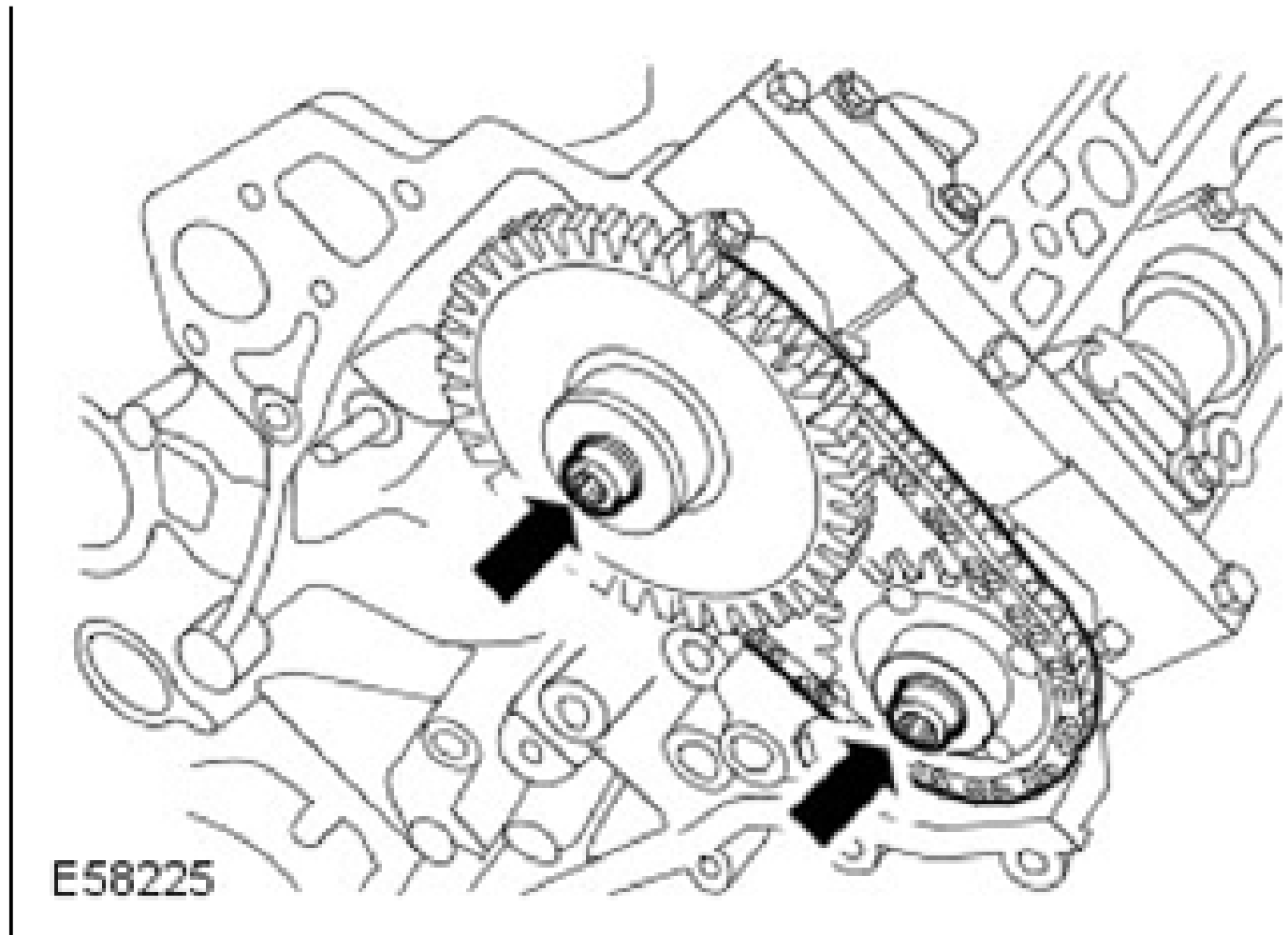
40. Remove the camshafts.
41. Install the special tool to the RH cylinder head.
 - Install the 3 bolts.



CAUTION: Discard the bolts.

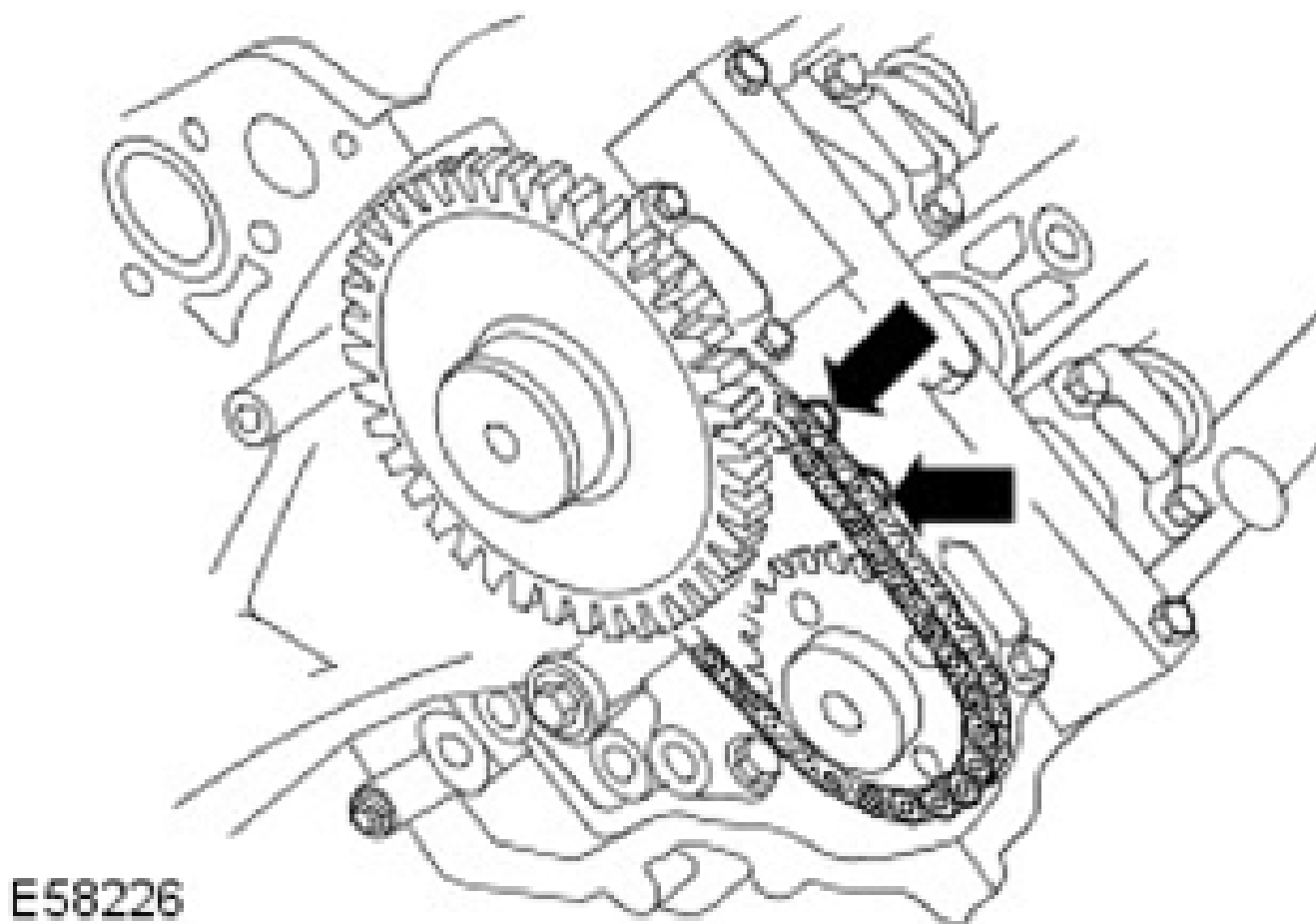
NOTE: LH illustration shown, RH is similar.

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



NOTE: LH illustration shown, RH is similar.

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

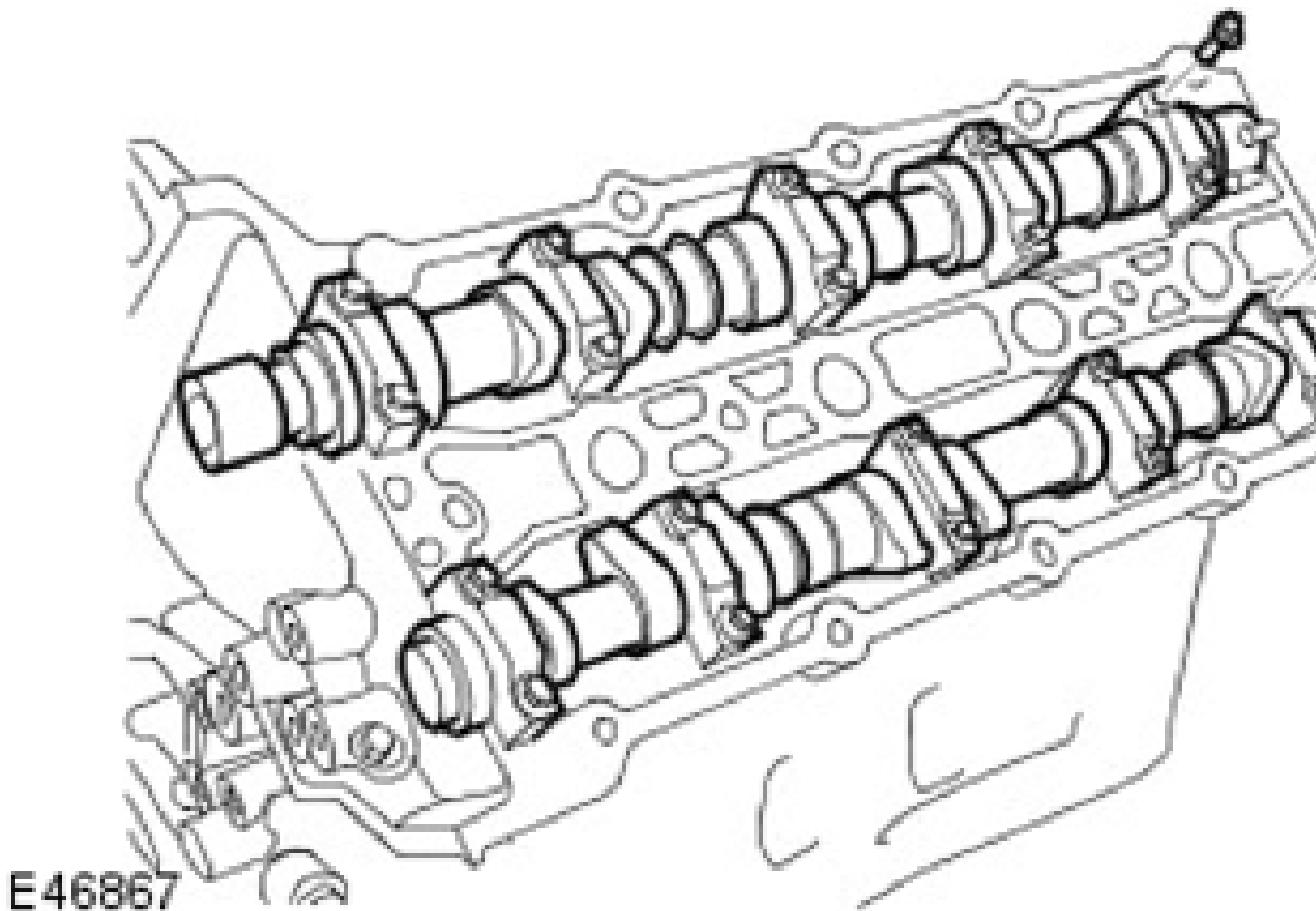


CAUTION: Evenly and progressively, release the camshaft bearing caps.

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.

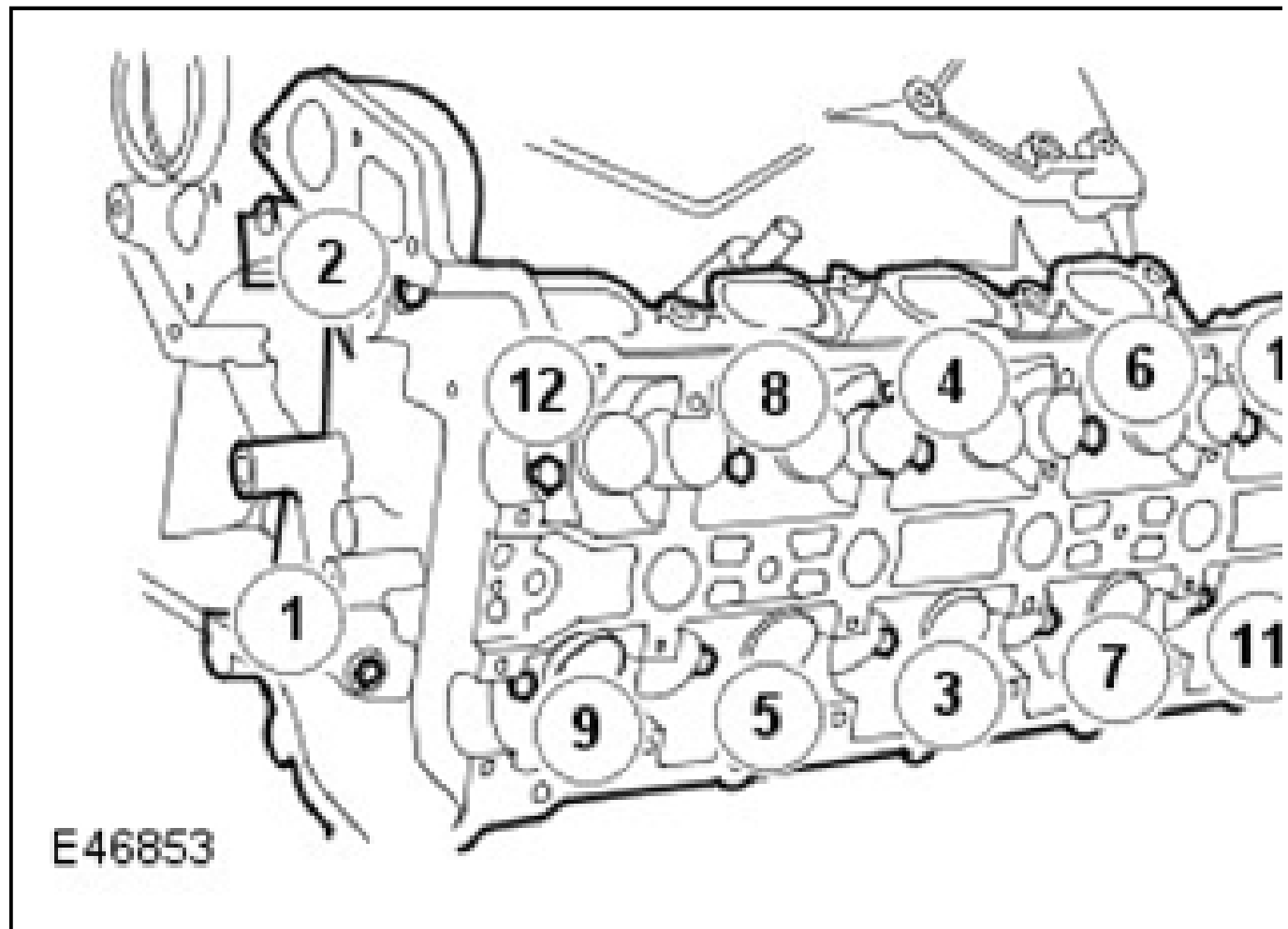
44. Remove the camshaft bearing caps.
 - Remove the 20 bolts.



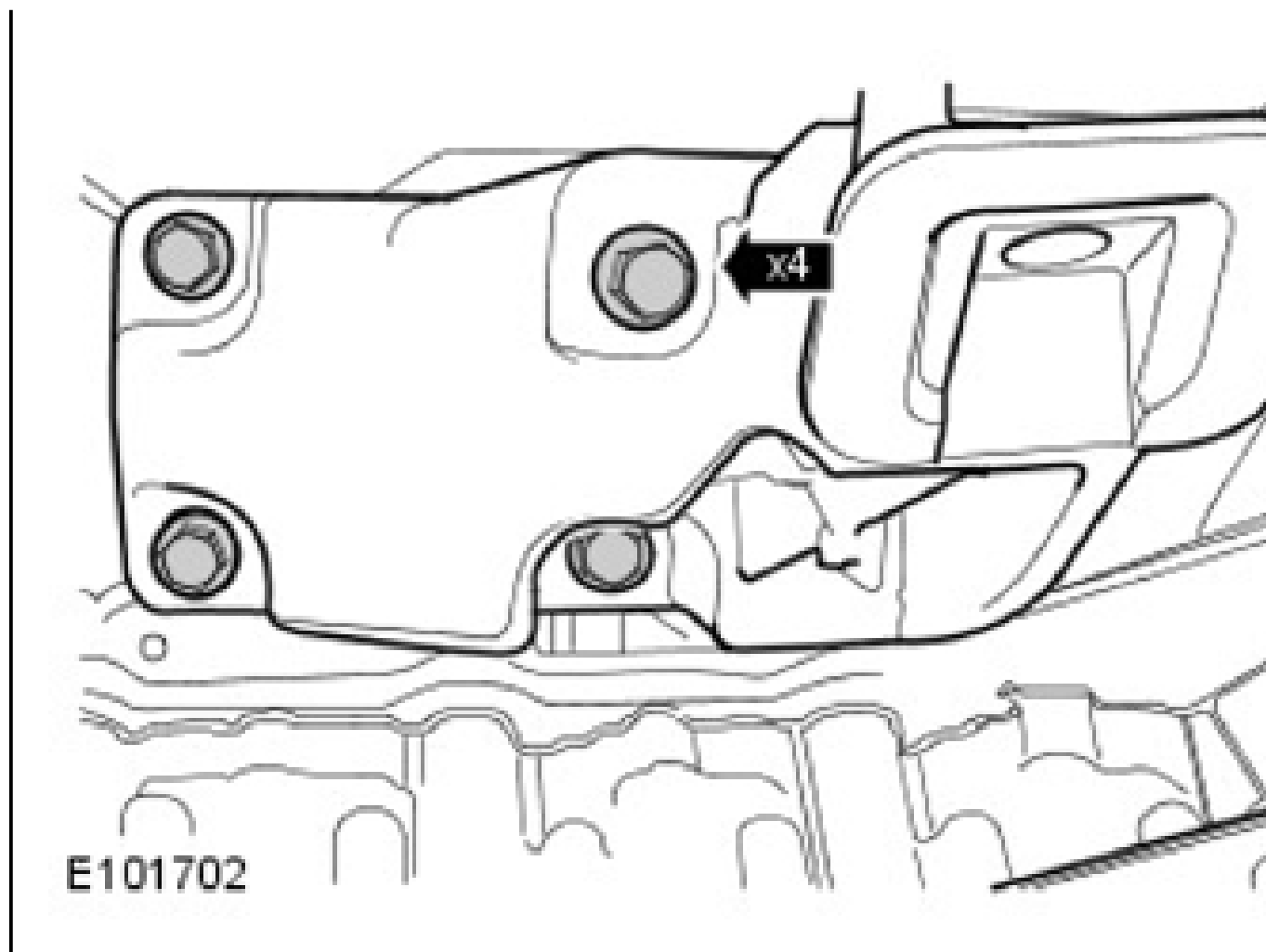
CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be removed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.

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

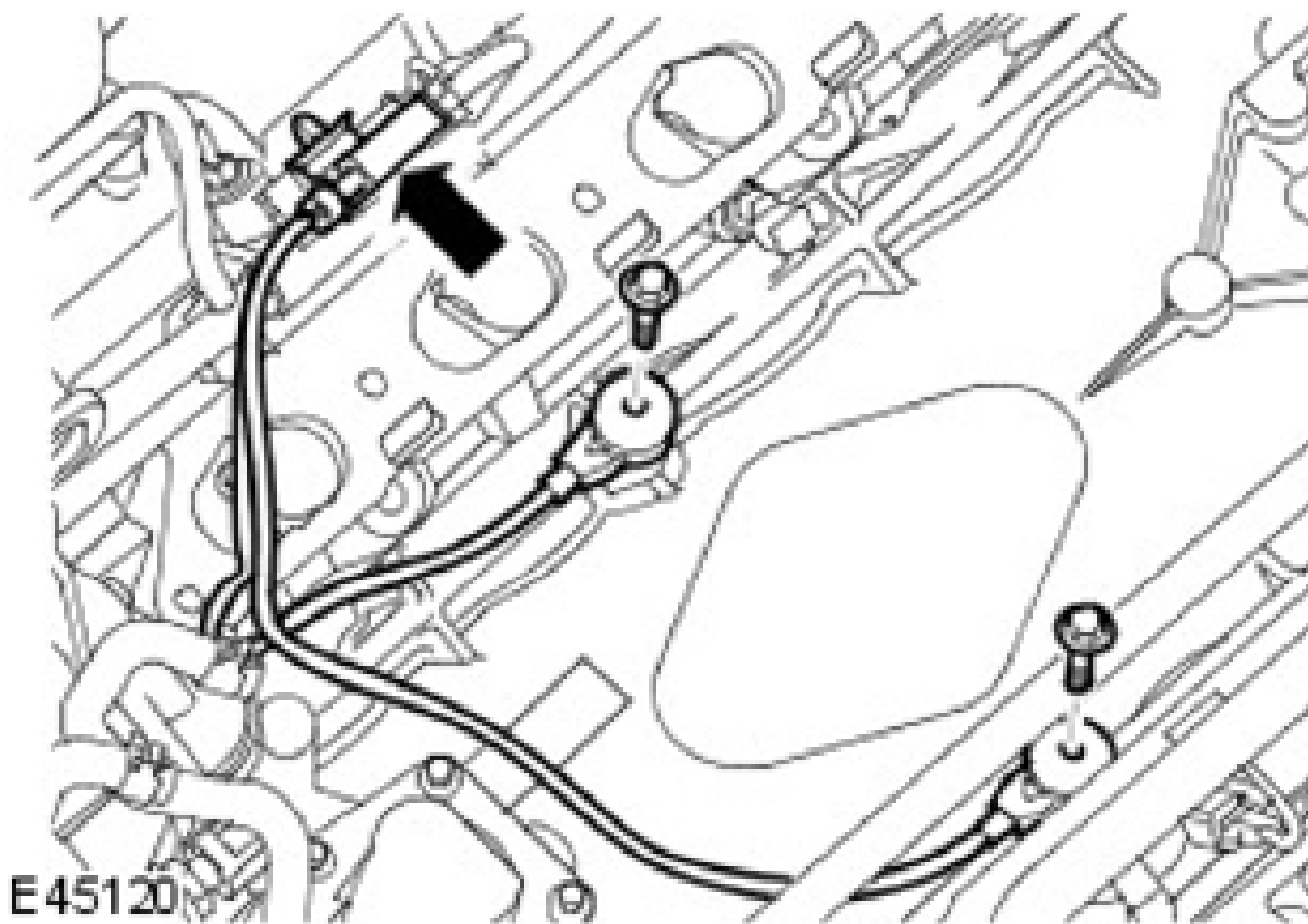
45. Remove the LH cylinder head assembly.
- Remove the 12 cylinder head bolts.
 - With assistance remove the cylinder head.
 - Remove and discard the cylinder head gasket.
 - Clean the cylinder head locating dowels.
 - Clean the component mating faces.
 - Repeat the operation for the RH side.



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



47. Remove the KS.

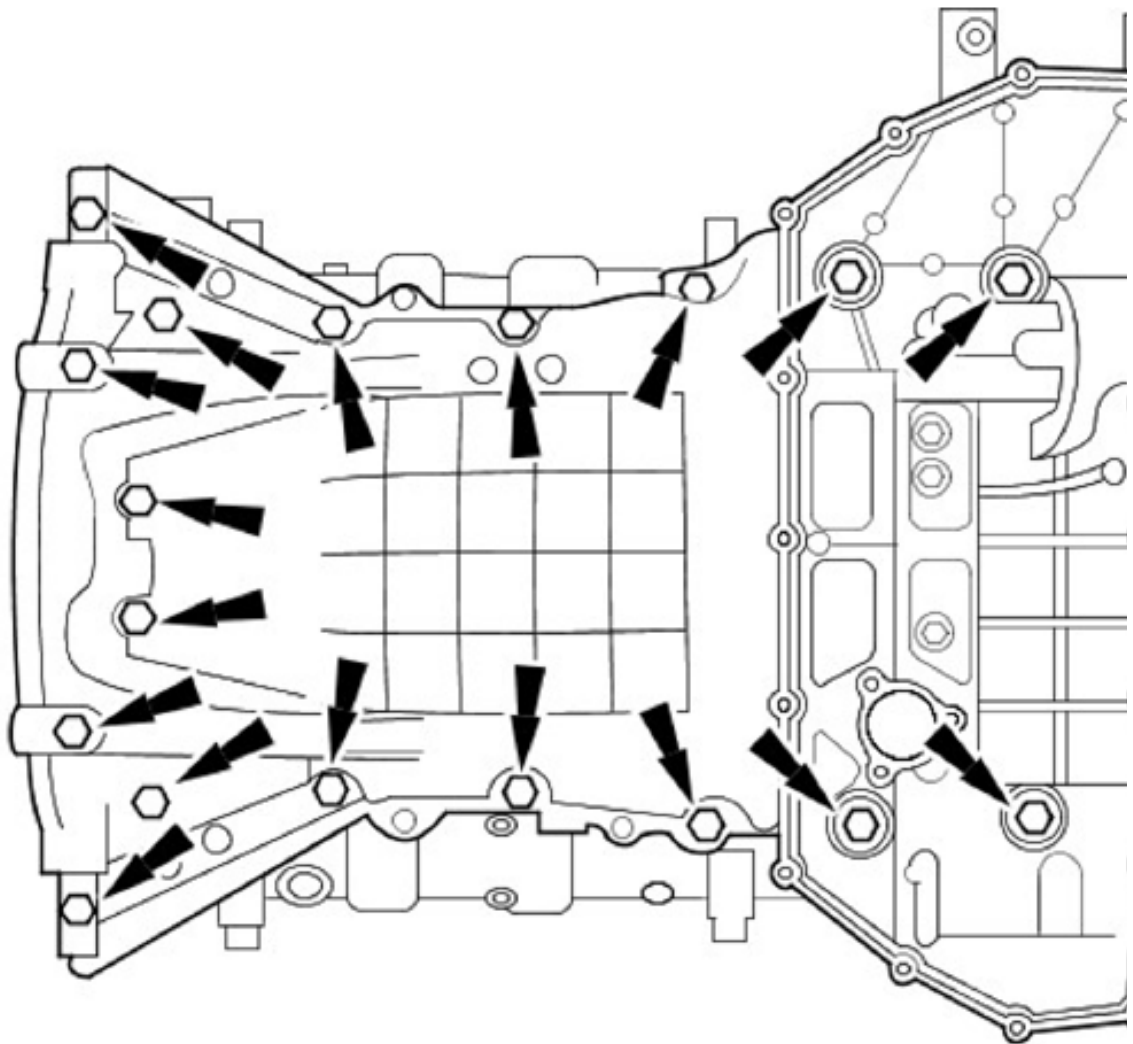


48. Remove the flexplate.
- Remove and discard the 8 bolts.



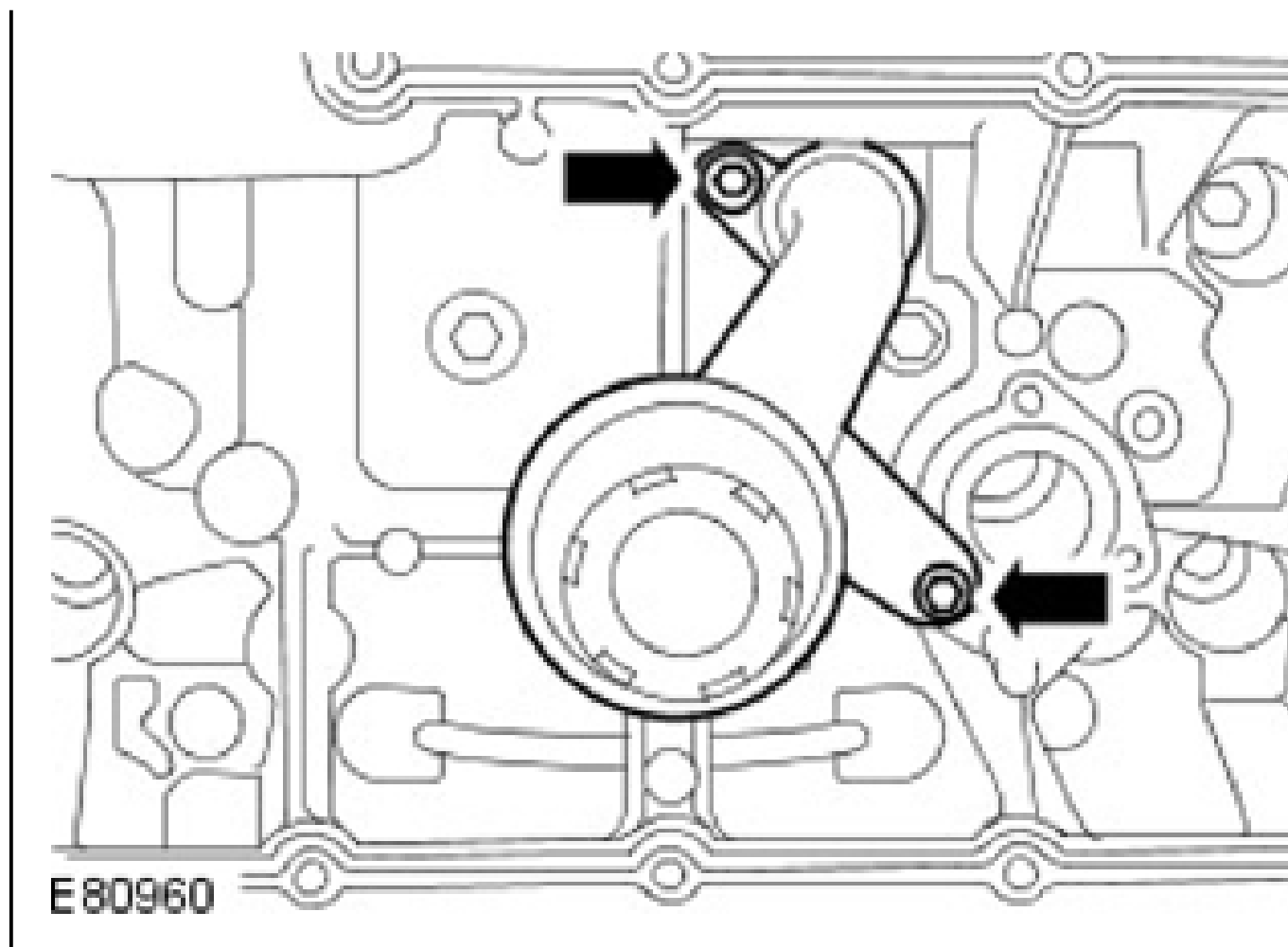
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

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

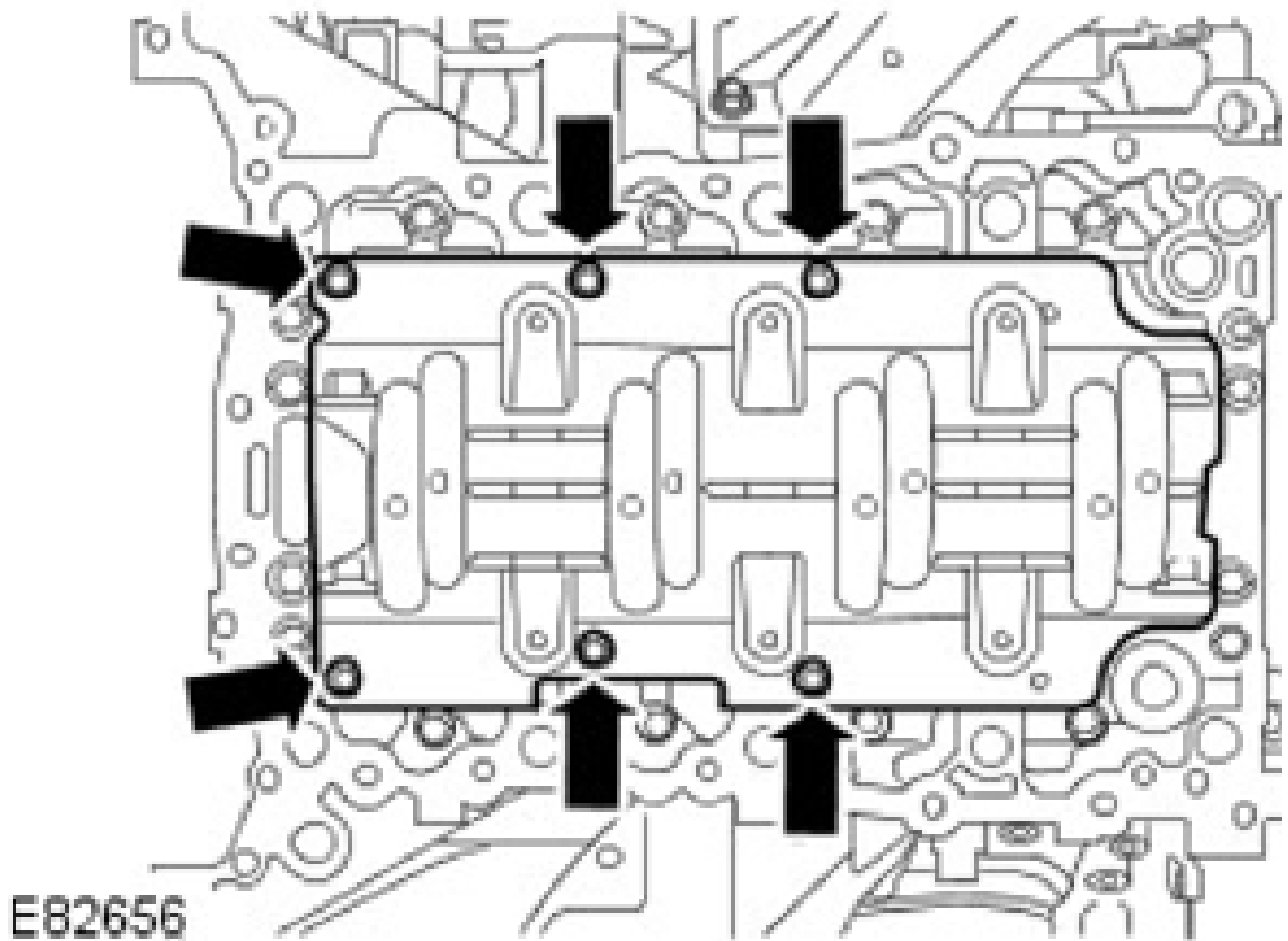


VUJ0002435

50. Remove the oil strainer pick-up assembly.
- Remove the 2 bolts.
 - Remove and discard the O-ring seal.

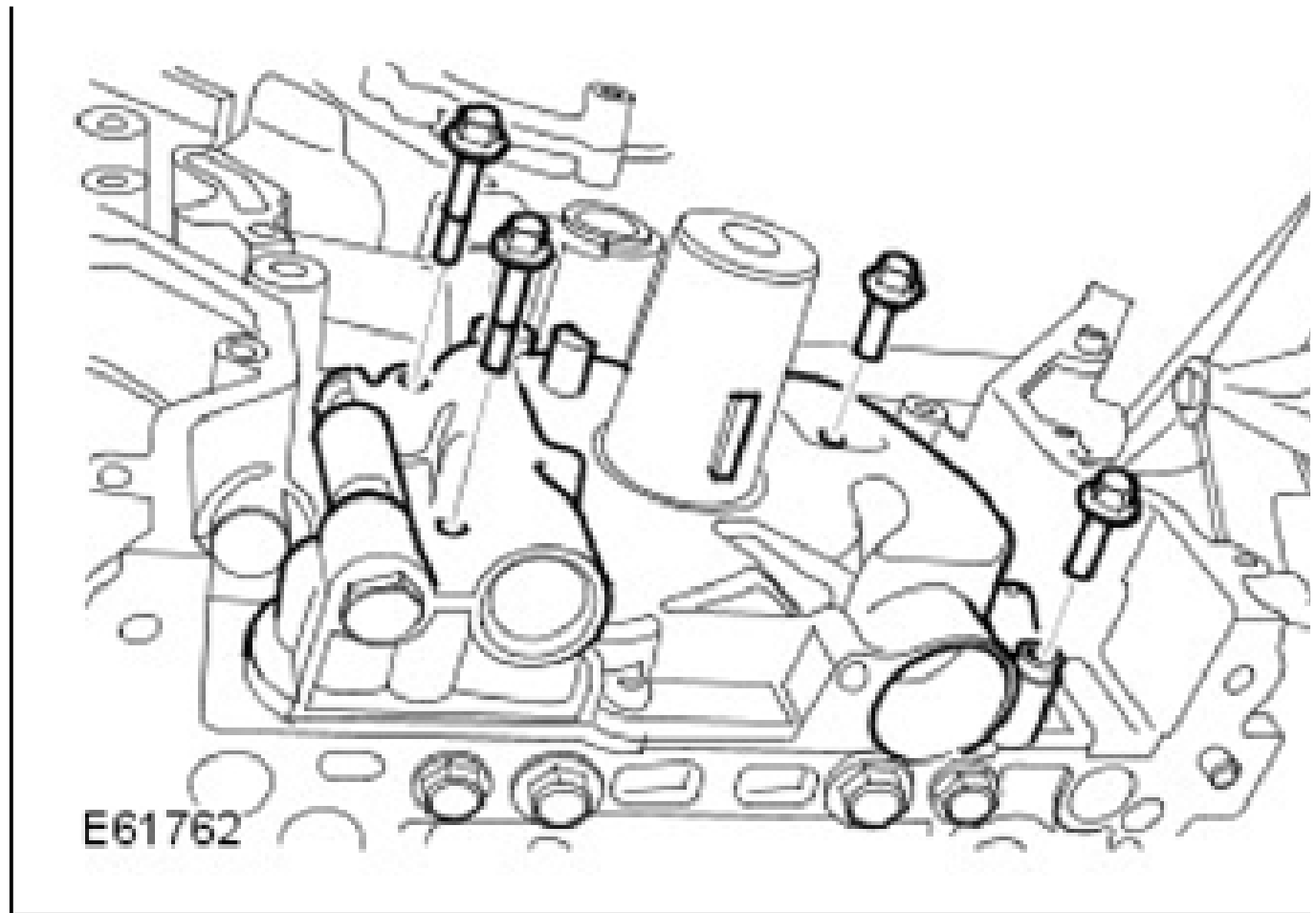


51. Remove the baffle plate.
- Remove the 6 bolts.



52. Remove the oil pump assembly.

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



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

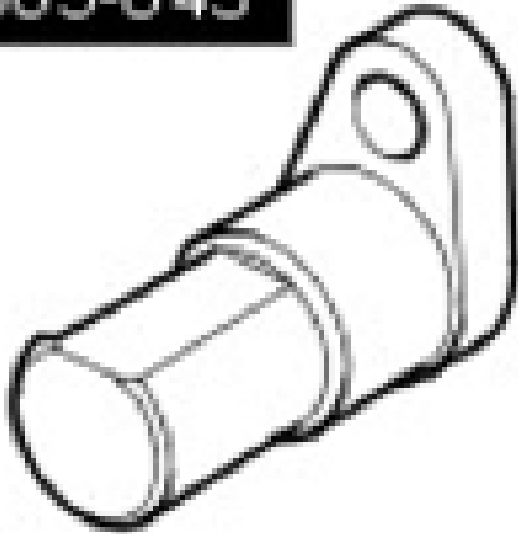
ASSEMBLY

ENGINE

SPECIAL TOOL(S)

	Timing Setting tool 303-645
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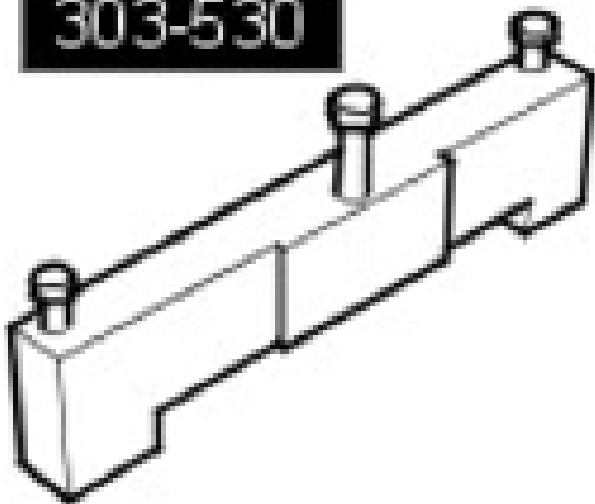
303-645



E46881

Camshaft setting/locking tool
303-530

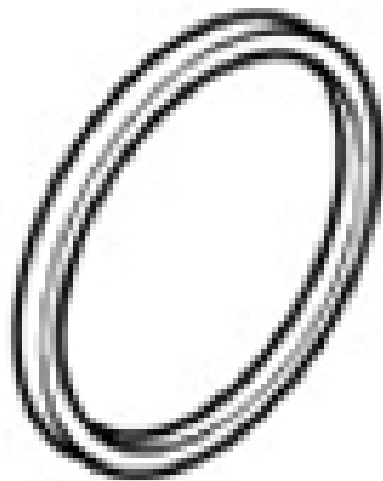
303-530



E46879

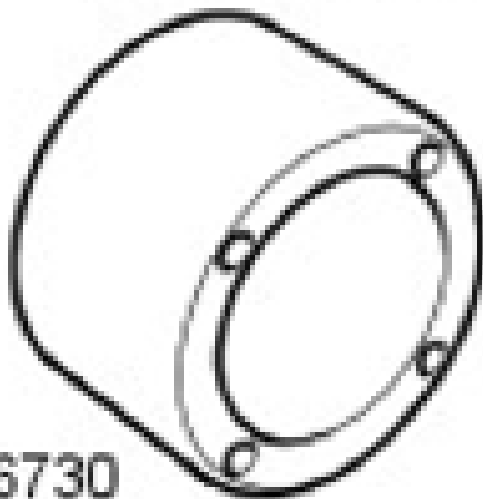
Adapter - Crankshaft seal installer
303-1100-01

303-1100-01



E67144

303-191-03

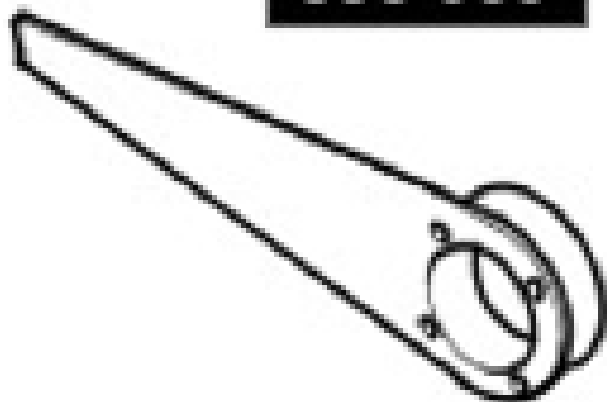


E46730

Adapter
303-191-03

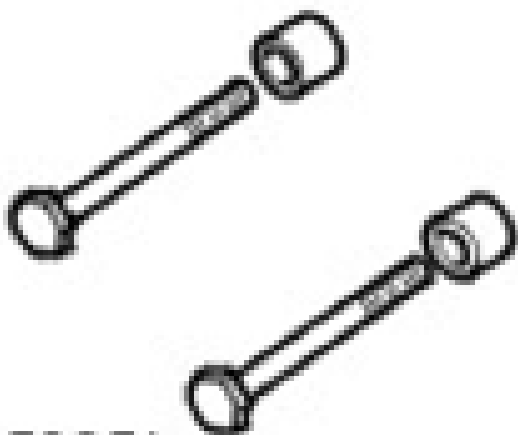
Holding Tool Crankshaft Pulley
303-893 (LRT-12-080)

303-893



E46728

303-191-04



E59251

Bolts and spacers
303-191-04

Timing chain tensioning tool
303-532

303-532



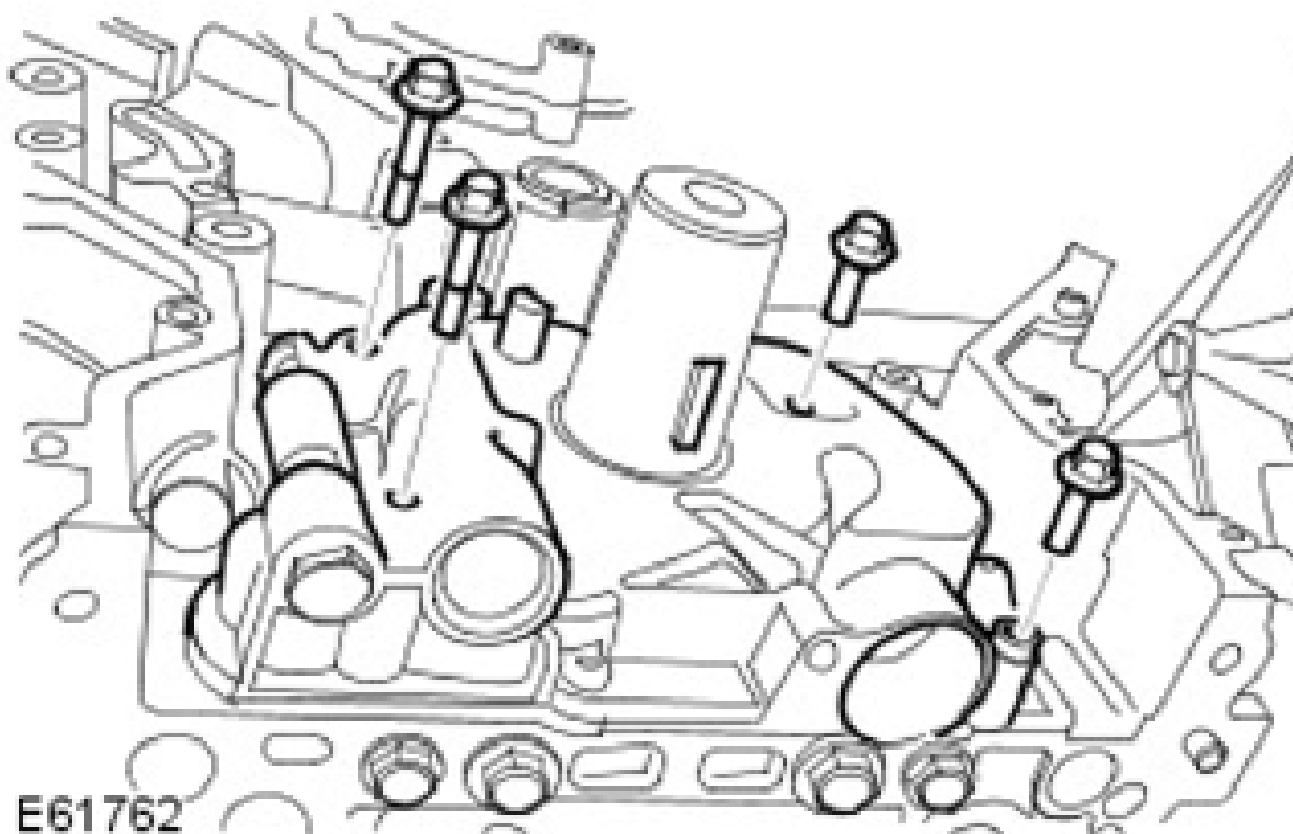
E46880

ASSEMBLY

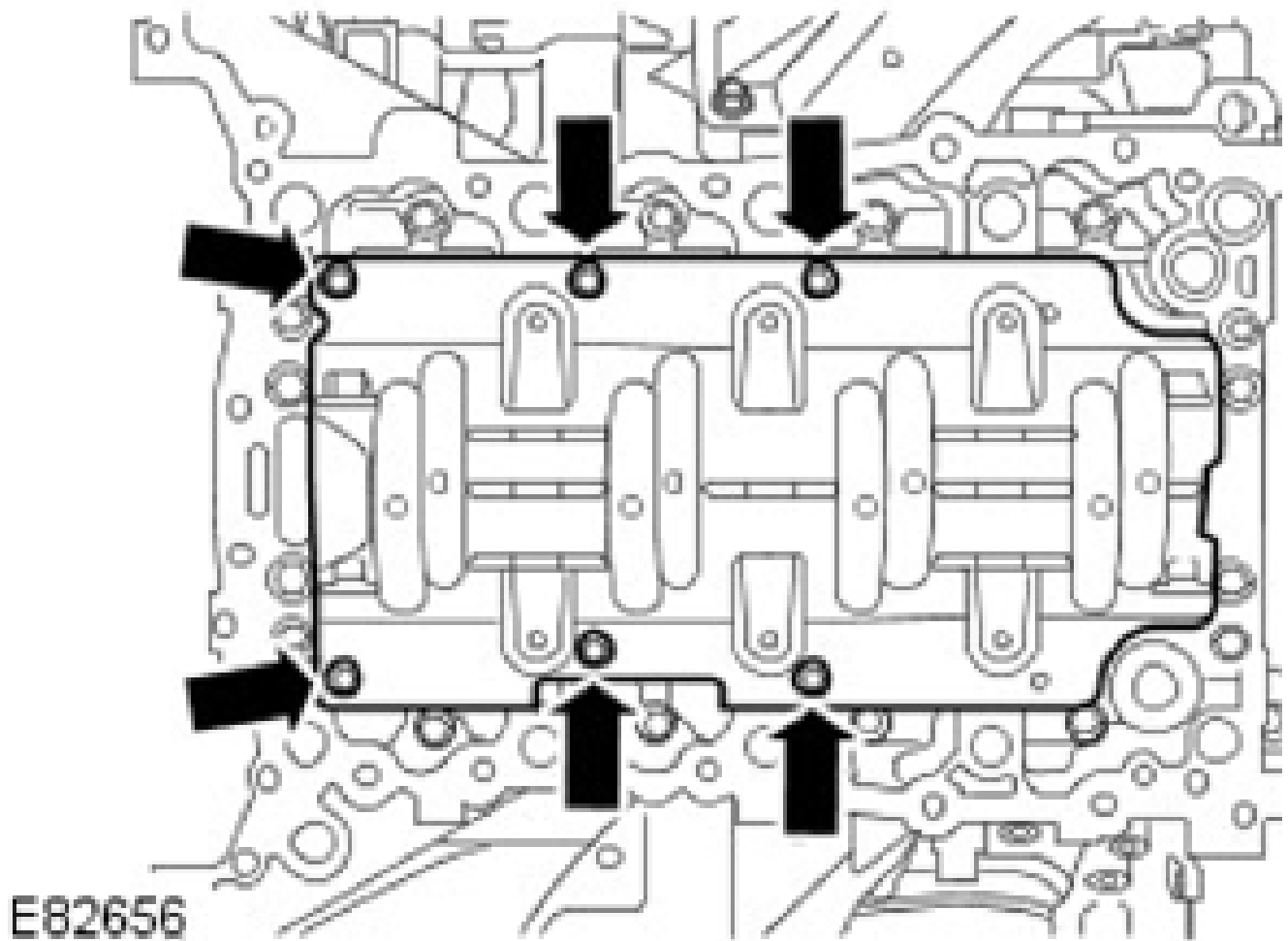
1. Secure the engine to the engine stand.
 - Align the engine to the engine stand.
 - Adjust the engine stand legs into position.
 - Mount the engine to an engine stand.
 - Fully tighten the engine stand leg nuts.

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.

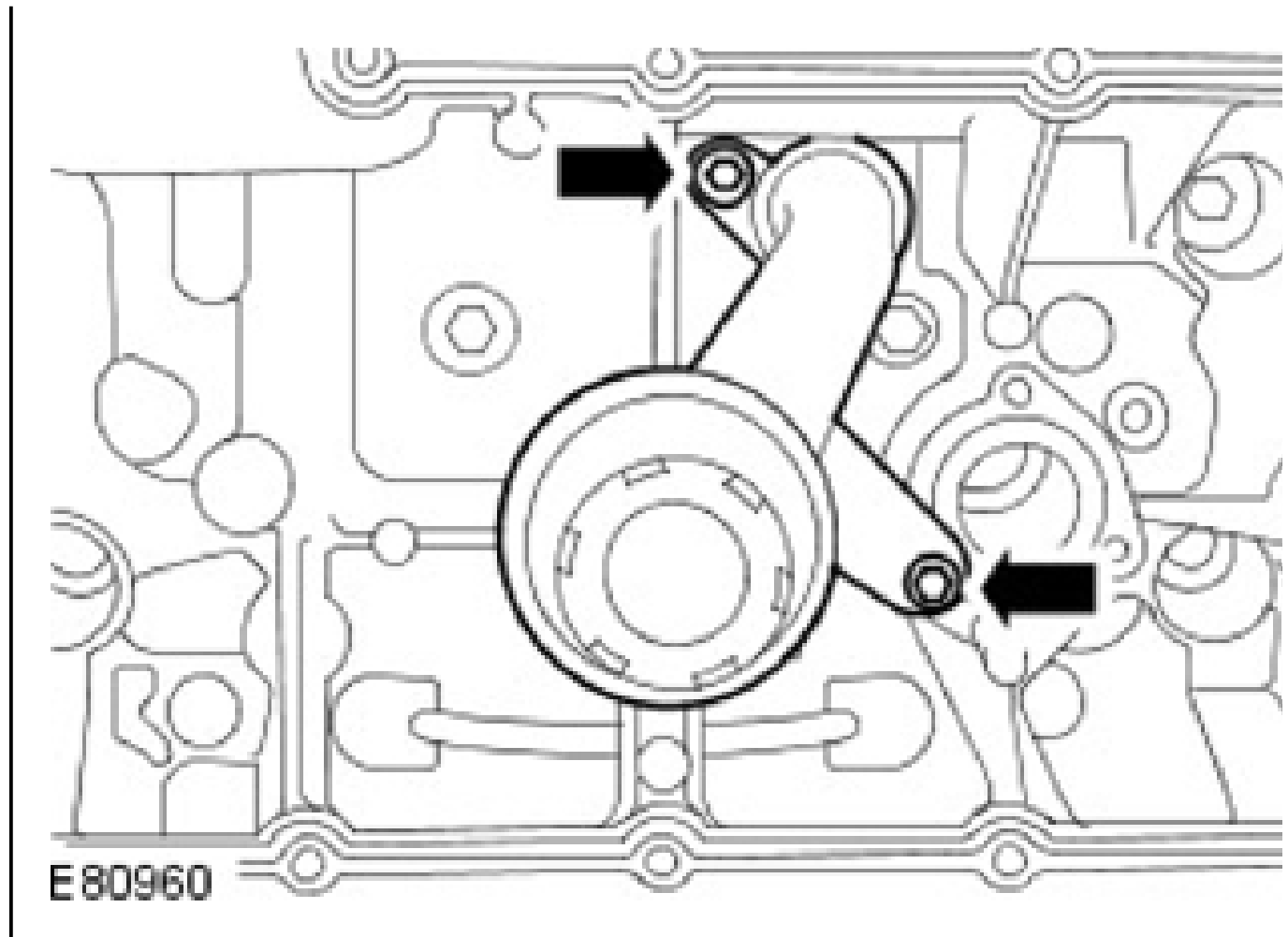


3. Install the baffle plate.
 - Tighten the 6 bolts to 6 Nm.



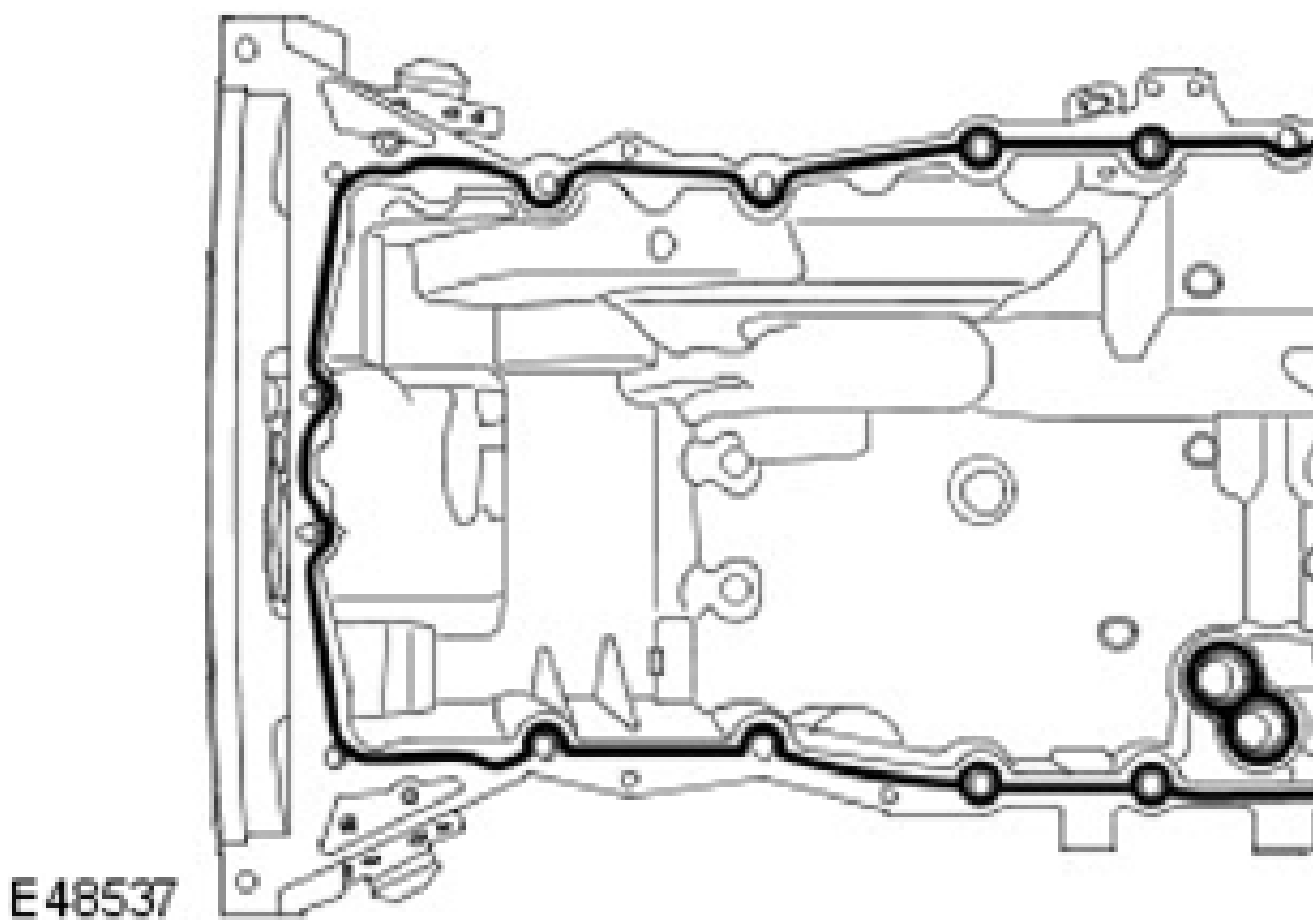
NOTE: Install a new O-ring seal.

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

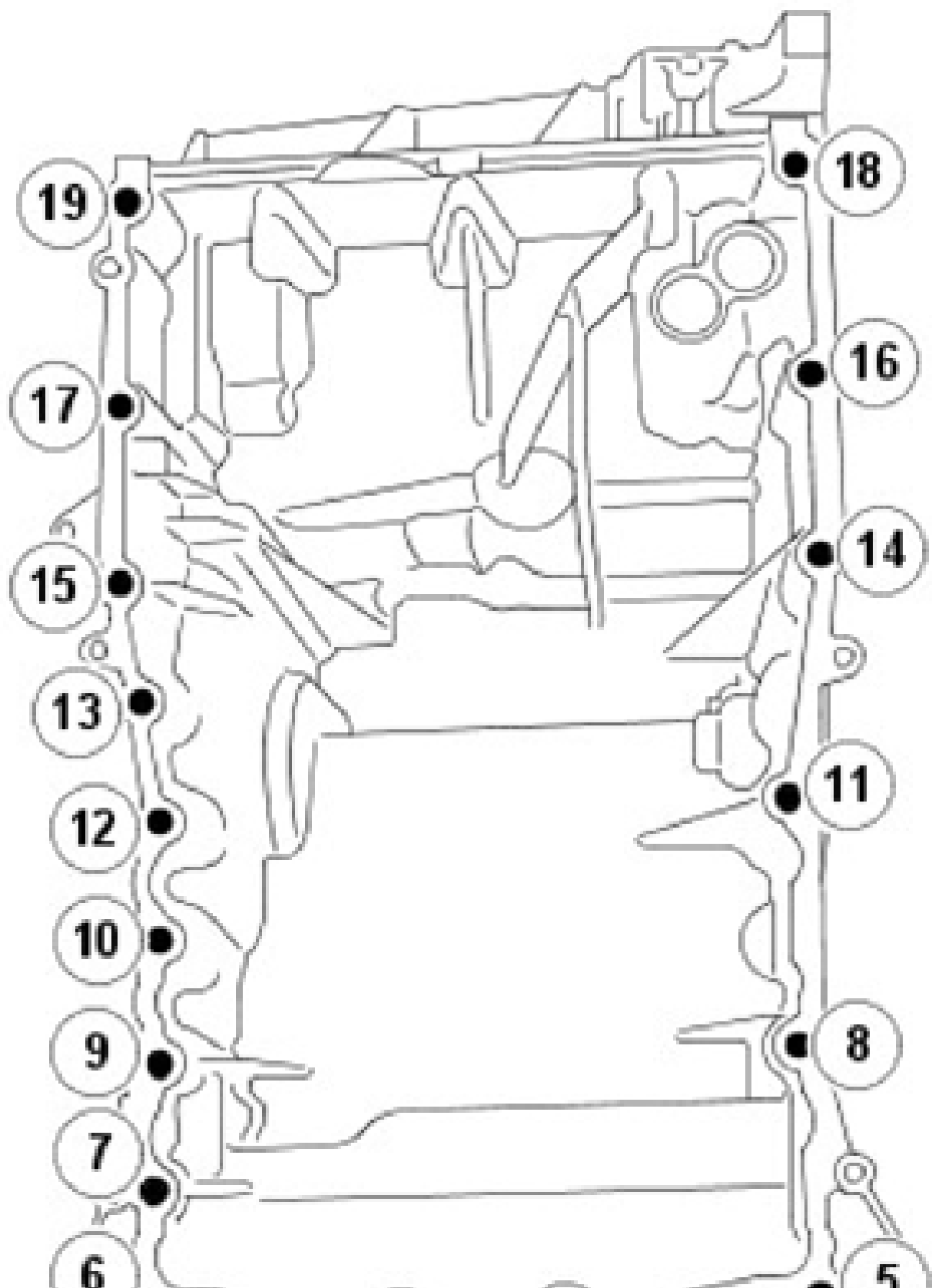


5. Install the oil pan.

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



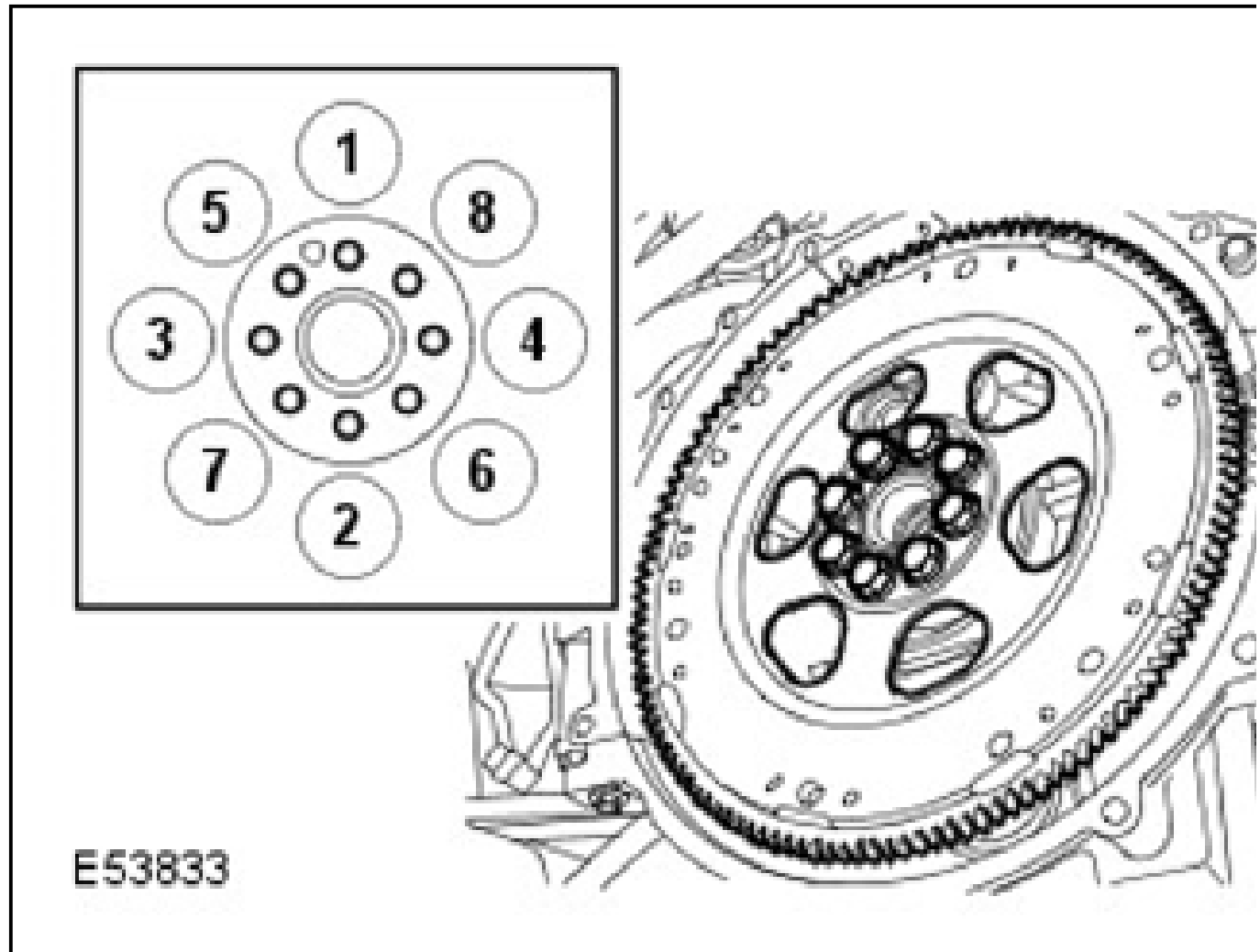
6. Tighten the oil pan bolts in the sequence shown to 20 Nm.



NOTE: Prevent the flexplate from rotating.

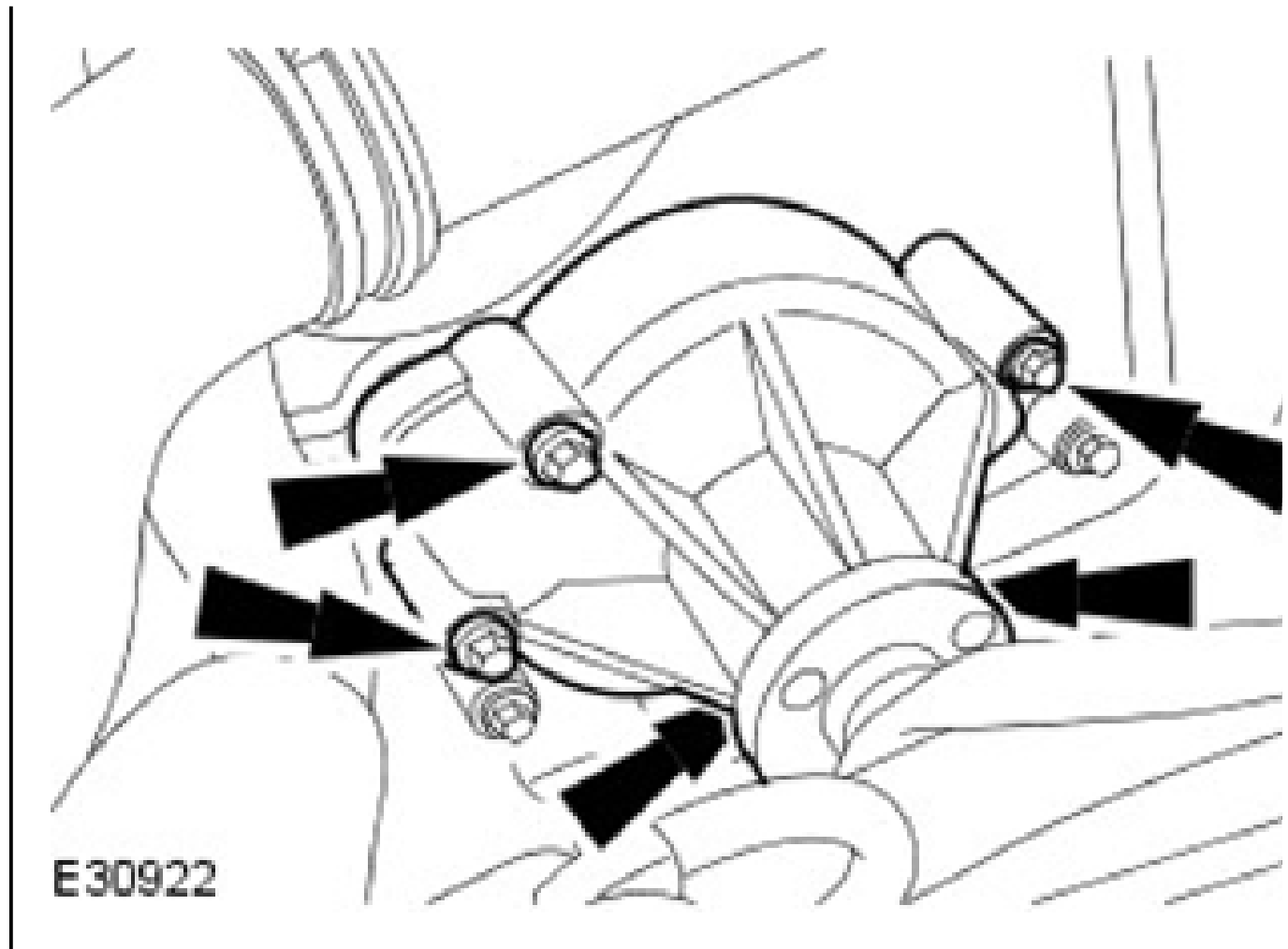
7. Install the flexplate.

- Clean the component mating faces.
- Tighten the bolts evenly in 2 stages to the sequence shown.
- Tighten the bolts to 15 Nm.
- Tighten the bolts to 110 Nm.



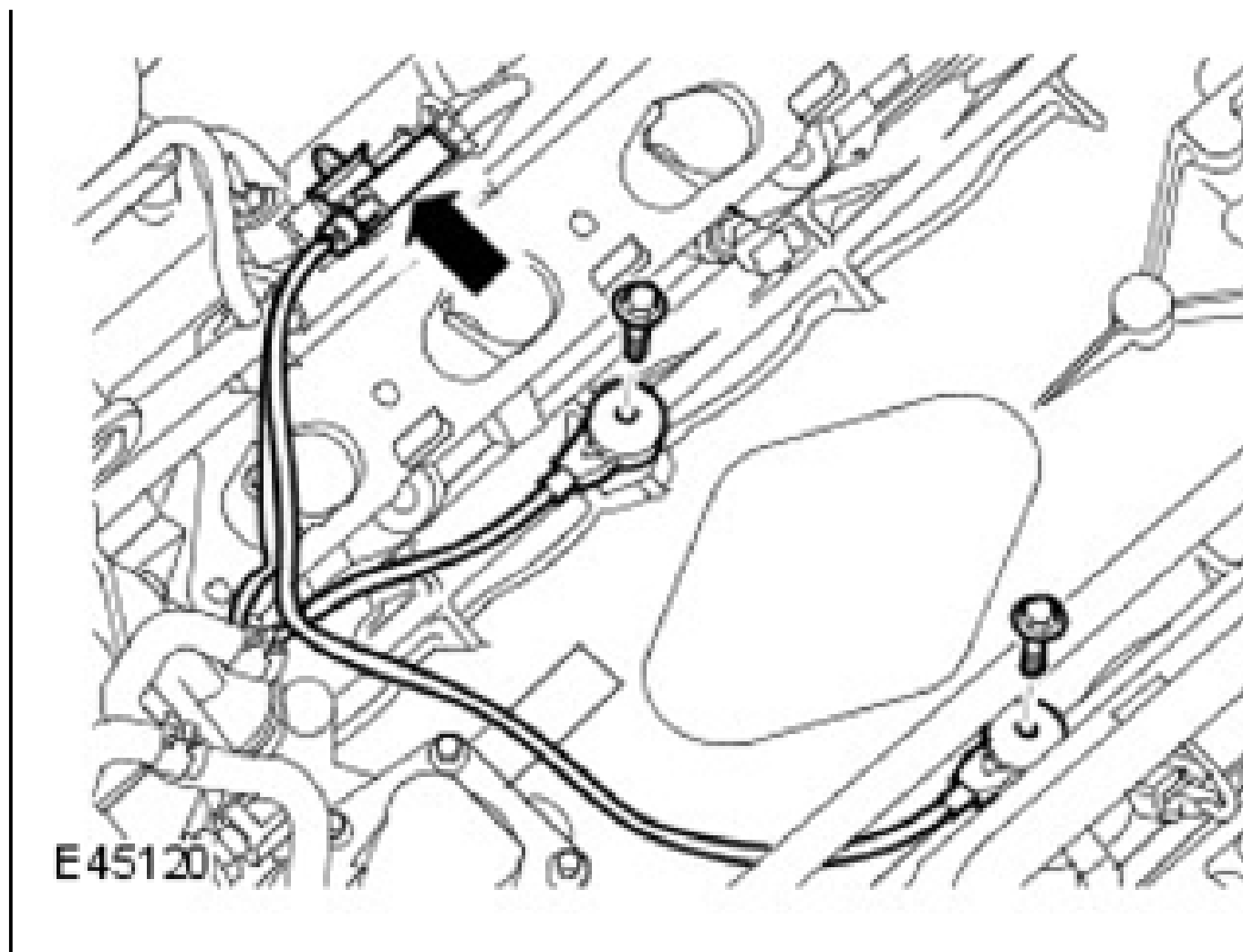
8. Install the coolant pump.

- Tighten the 5 bolts to 10 Nm.

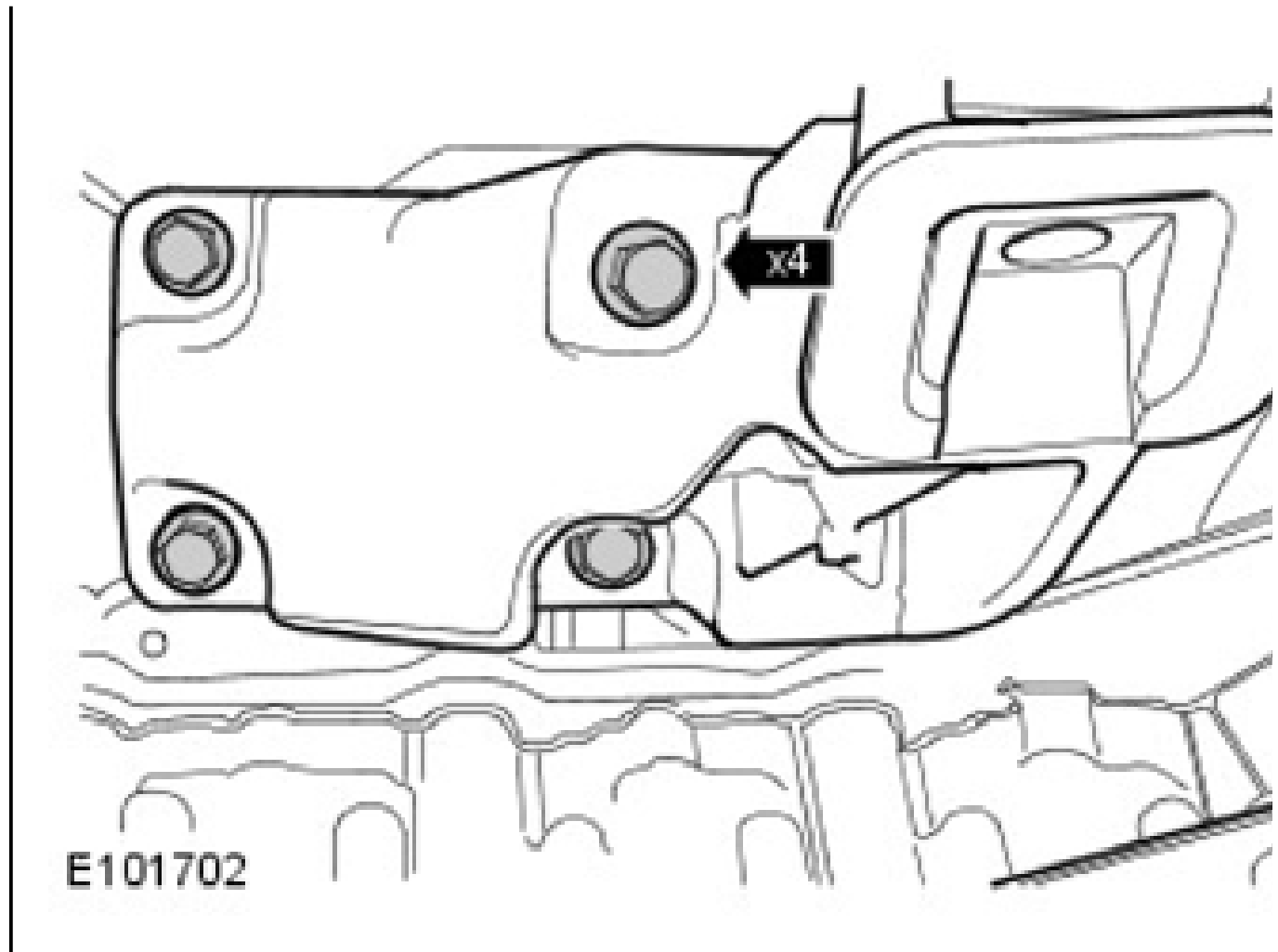


NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

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



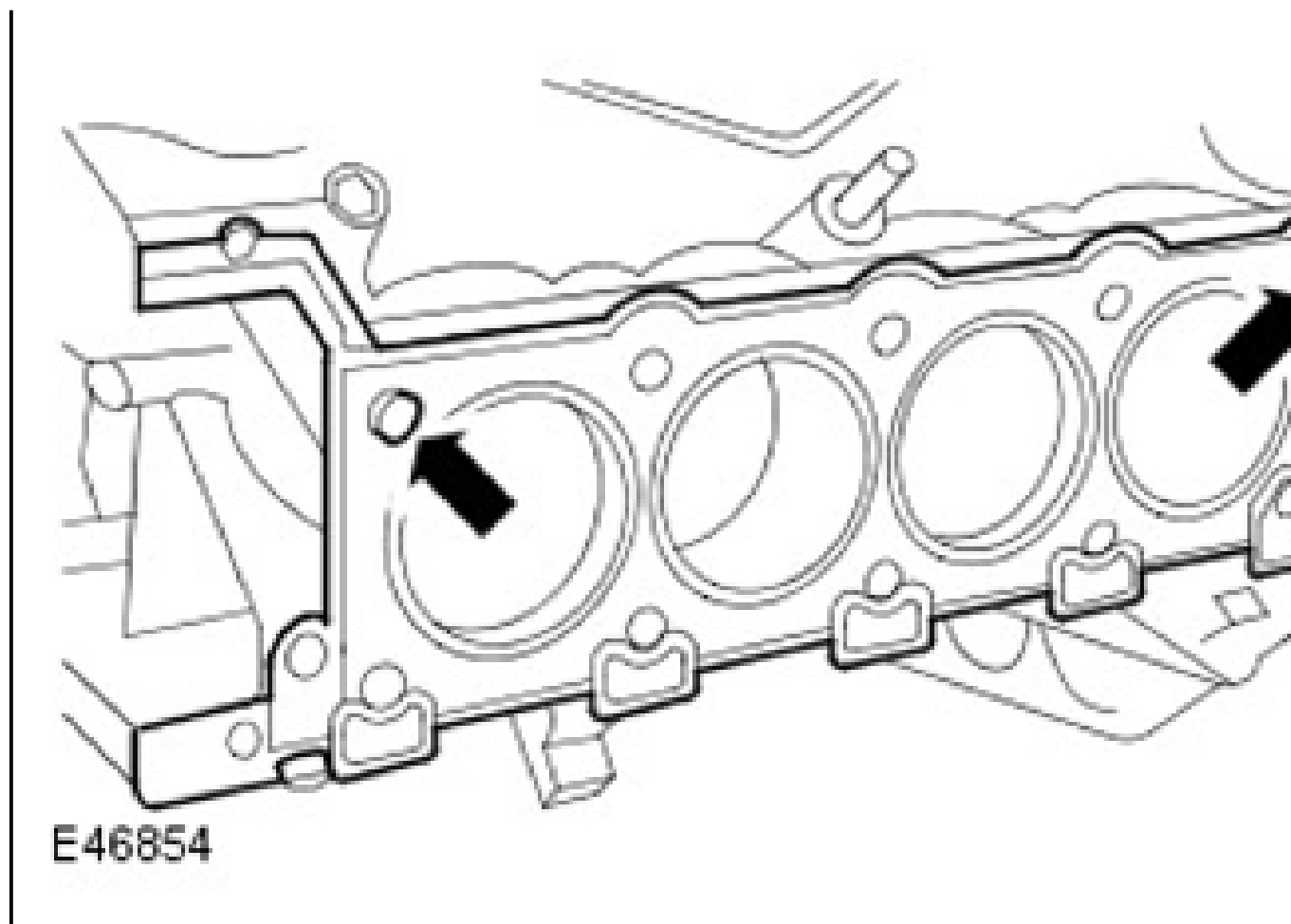
10. Attach the engine mounting bracket.



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

11. 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.



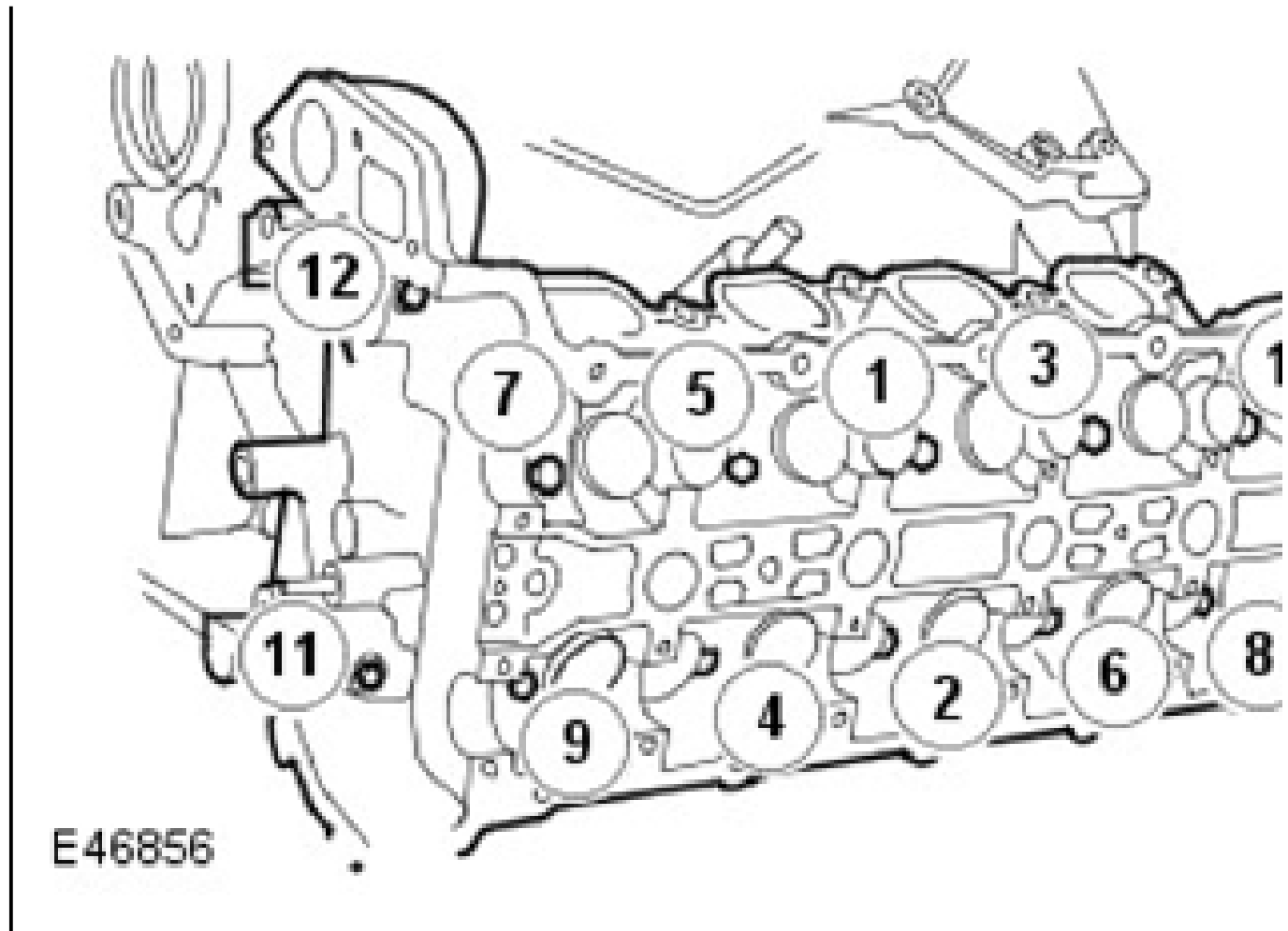
CAUTION: Vehicles fitted with Polydrive cylinder head bolts, the cylinder head bolts must be installed using a 10 mm Polydrive socket or a 10 mm Allen key. Failure to follow this instruction may result in damage to the component.

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

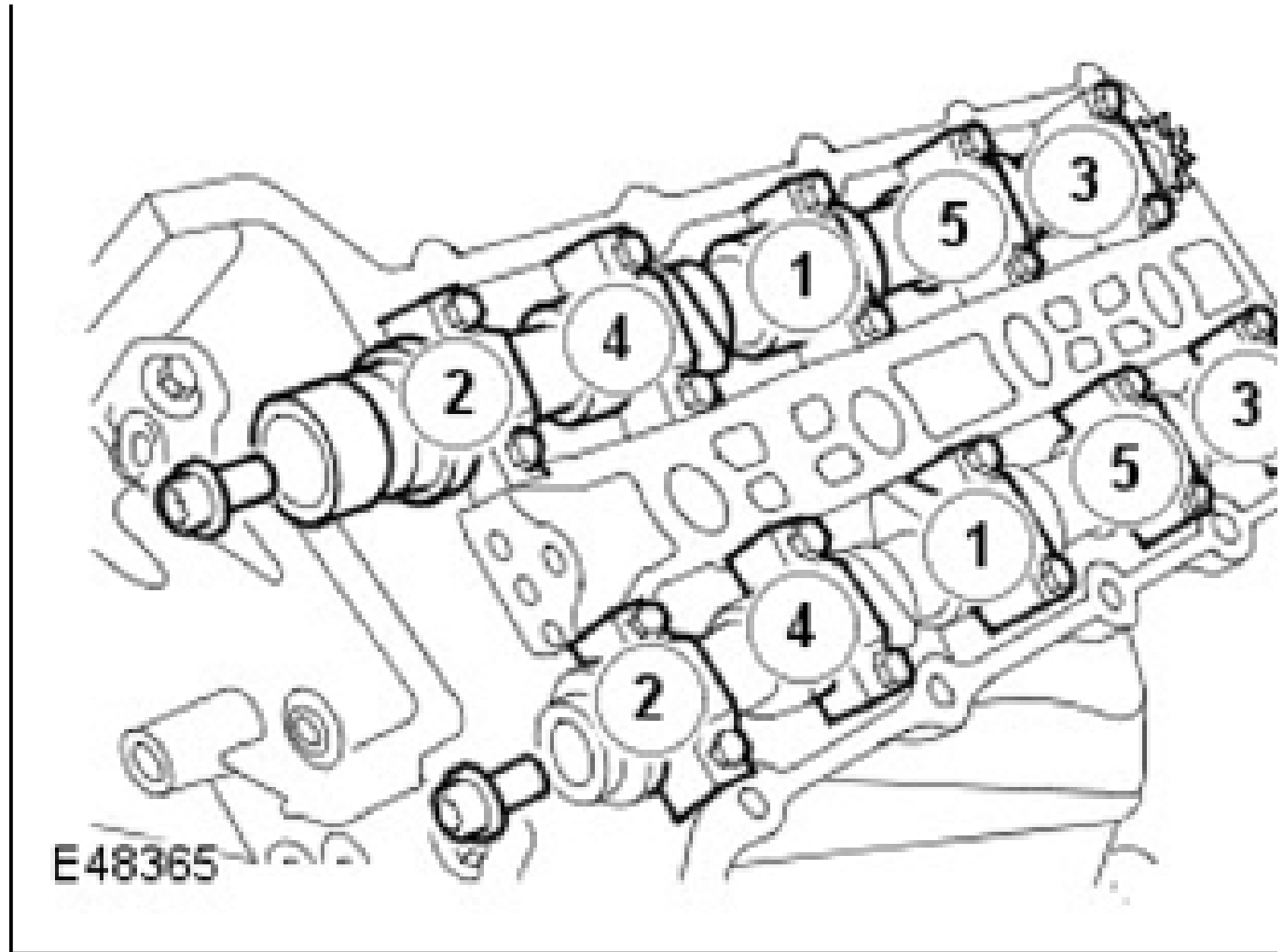
NOTE: LH illustration shown, RH is similar.

12. Install the cylinder head bolts.

- Tighten the bolts to 20 Nm.
- Tighten the bolts to 35 Nm.
- 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.
- Repeat the operation for the LH side.



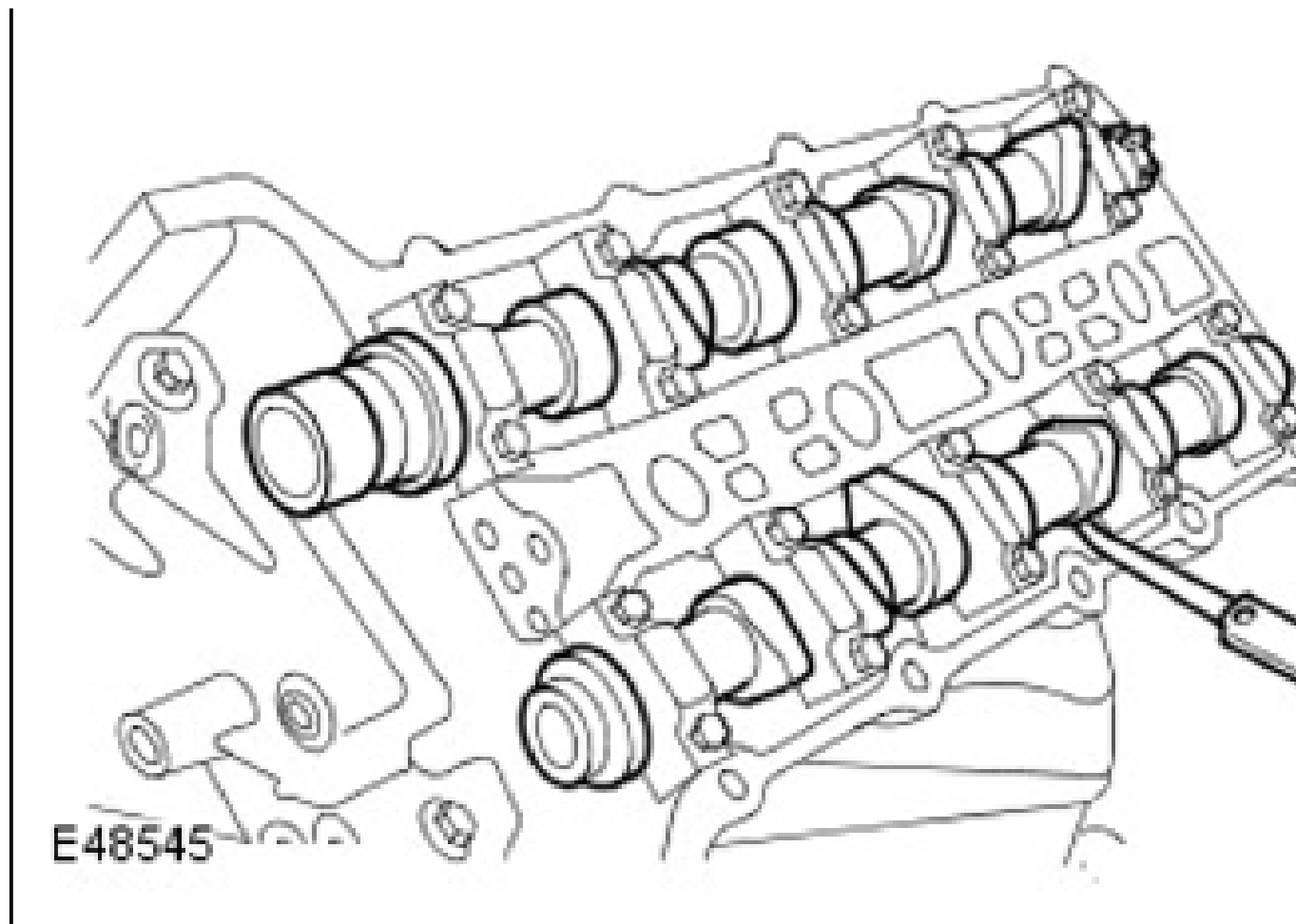
13. Install the LH camshafts.
 - Clean the component mating faces.
 - Lubricate the journals and camshaft lobes.
14. Install the camshaft bearing caps.
 - Evenly and progressively tighten the bolts in the sequence shown to 10 Nm.



15. 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.

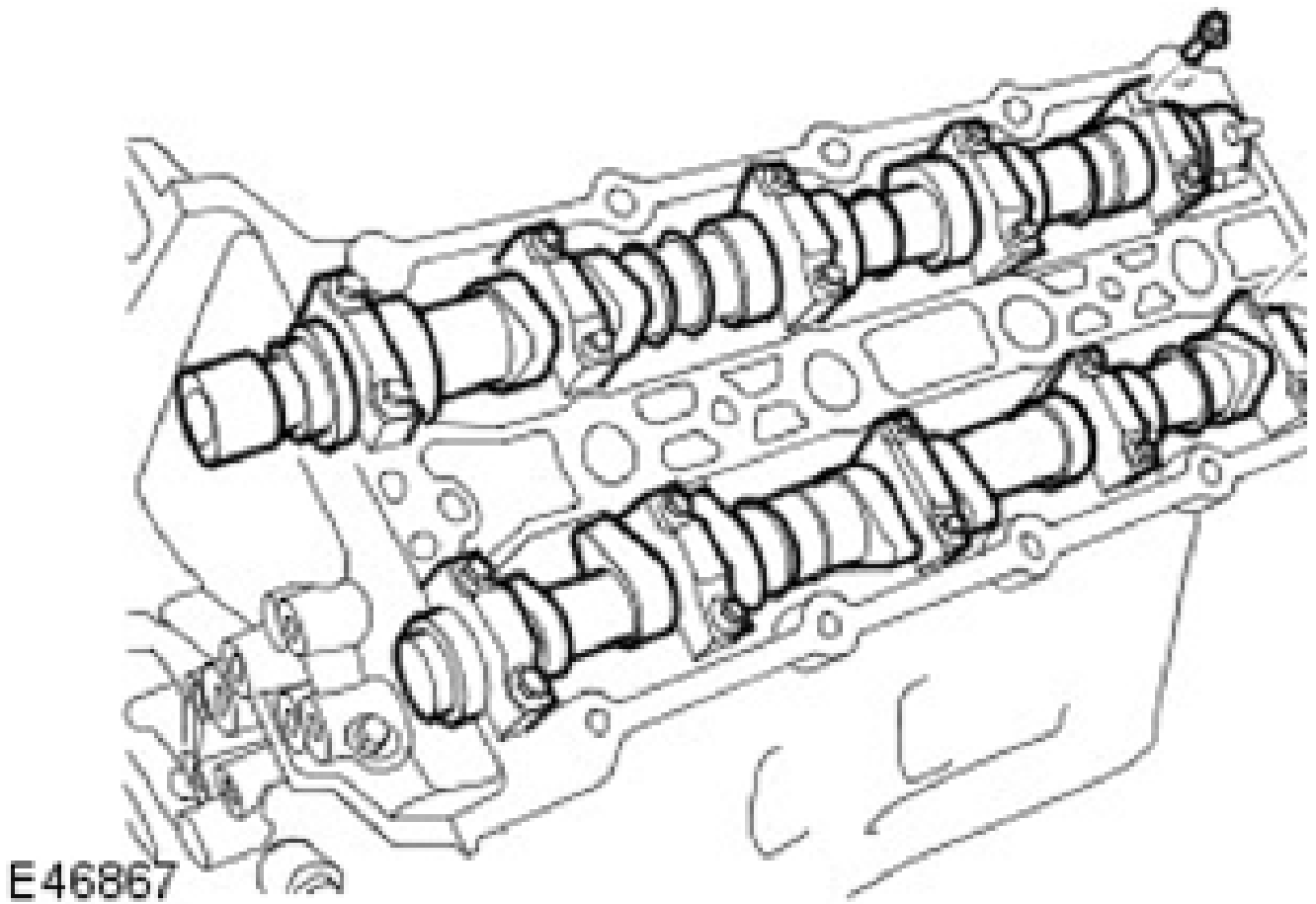
16. Measure and record the tappet clearances.
- Rotate the camshafts using the Torx bolts.



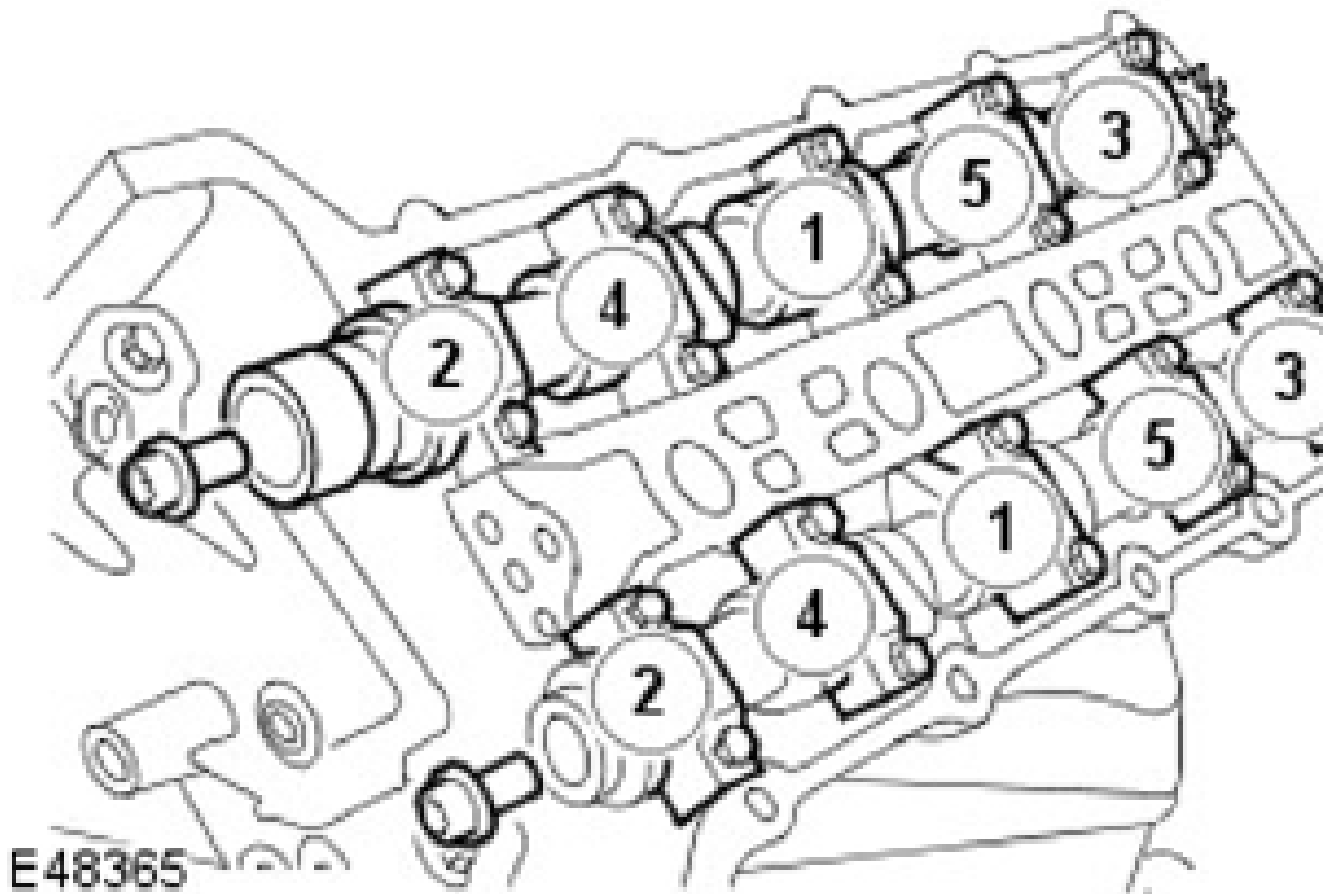
NOTE: Remove the camshaft bearing caps evenly and in stages.

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

17. Remove the camshafts.
 - Remove the 20 bolts.



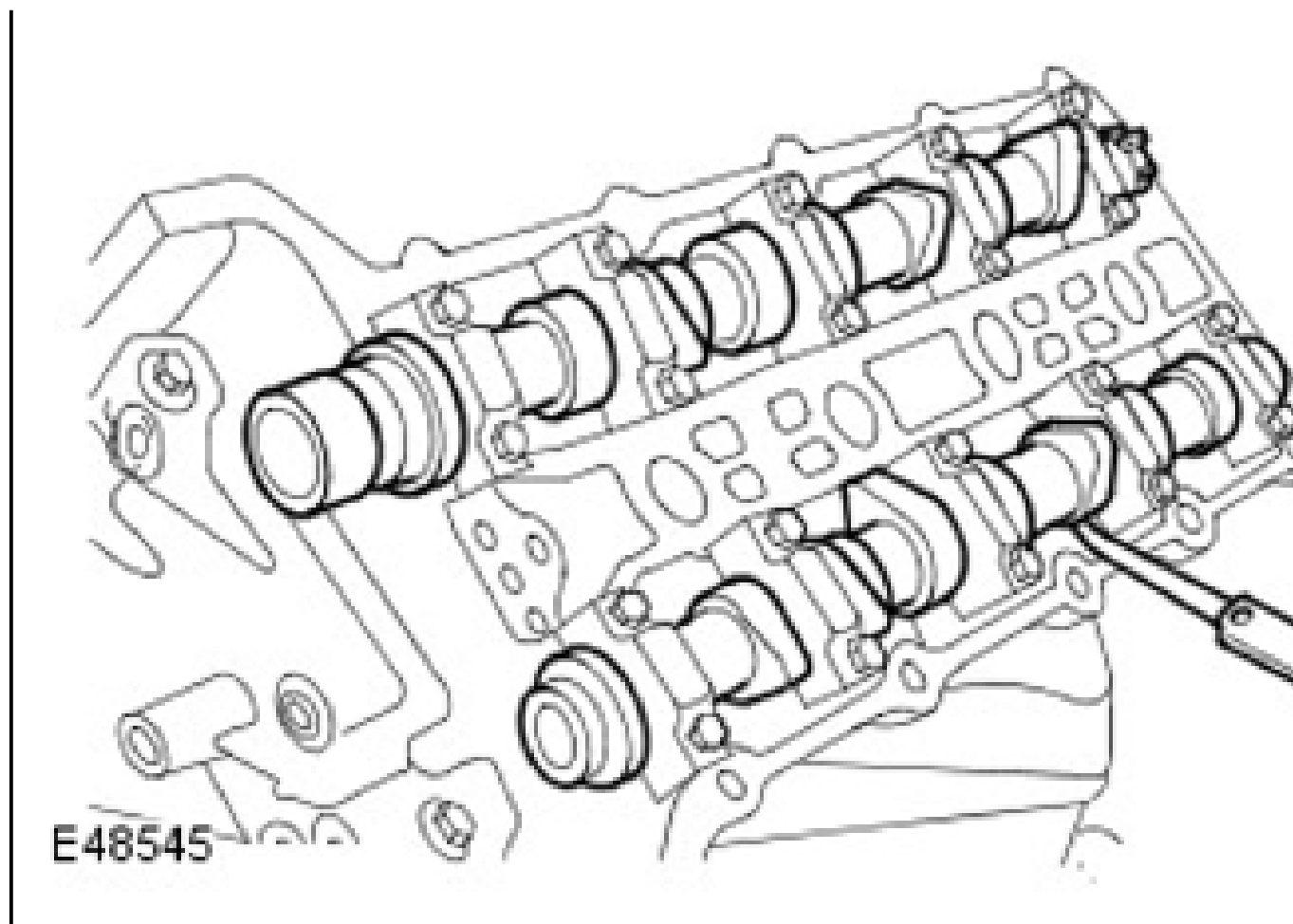
18. Remove the valve tappets, replace with selected tappets.
19. Install the camshafts.
 - Lubricate the journals and camshaft lobes.
 - Clean the component mating faces.
20. Install the camshaft bearing caps.
 - Evenly and progressively tighten the bolts in the sequence shown to 10 Nm.



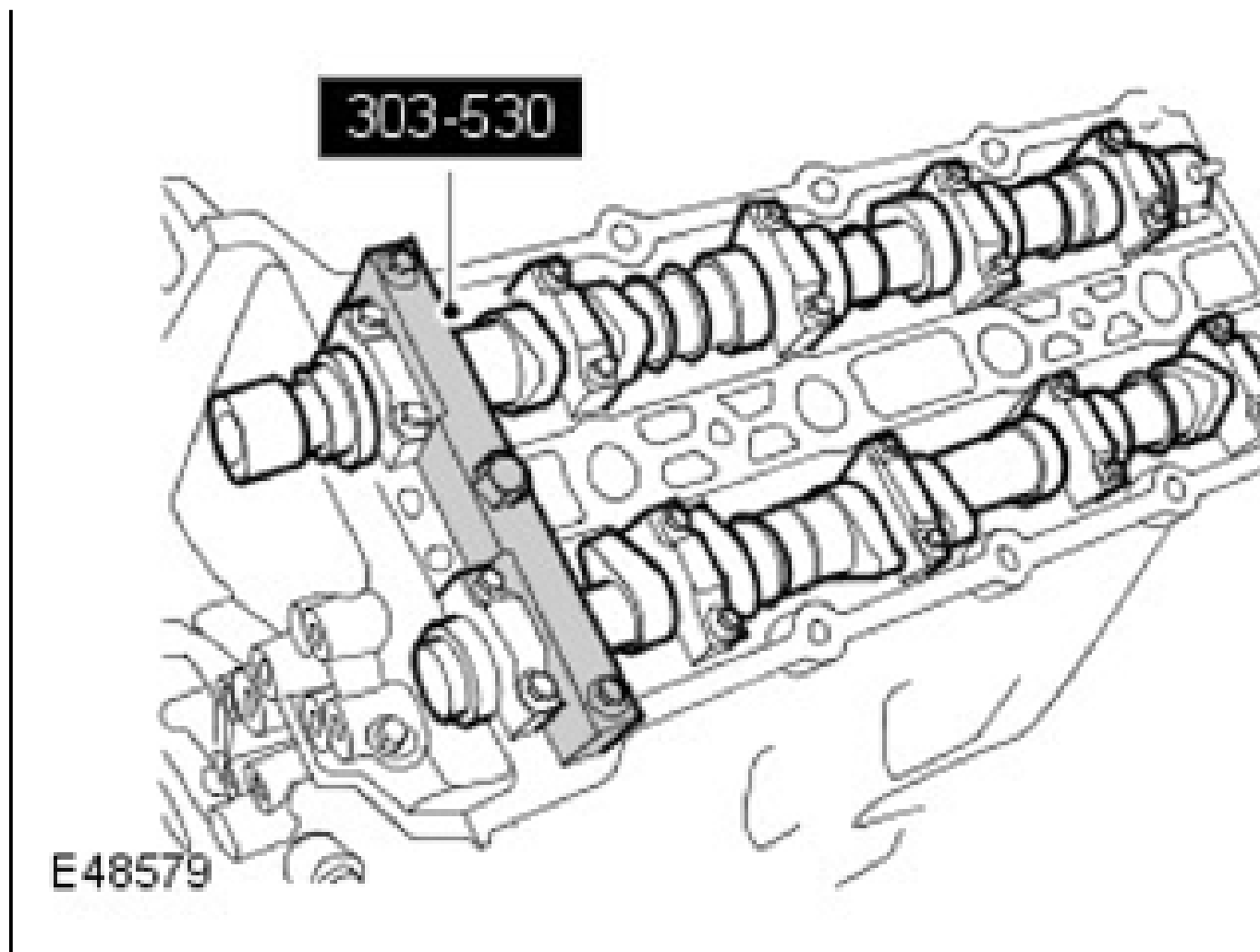
CAUTION: Camshaft lobes must be 180 degrees away from each valve tappet or valve clearance will be incorrect.

21. Check valve tappet clearances are correct.

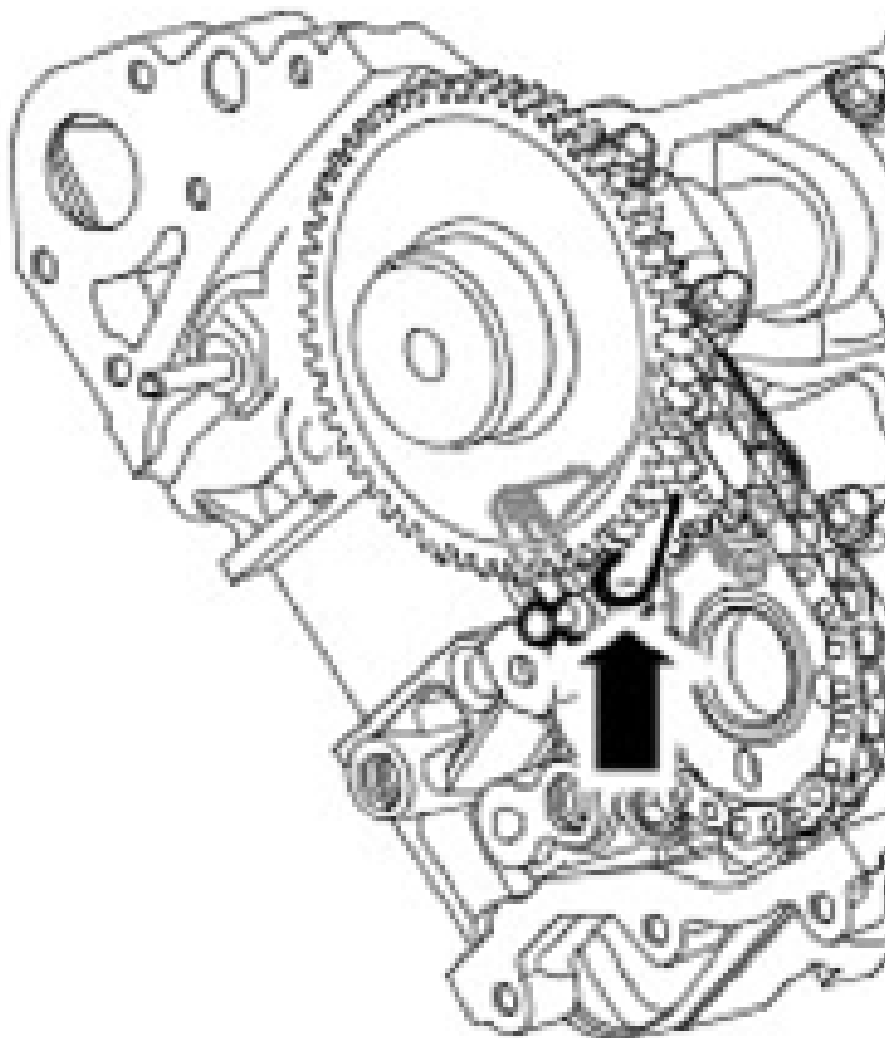
- Rotate the camshafts using the Torx bolts.
- Remove the camshaft Torx bolts after the check is complete.



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

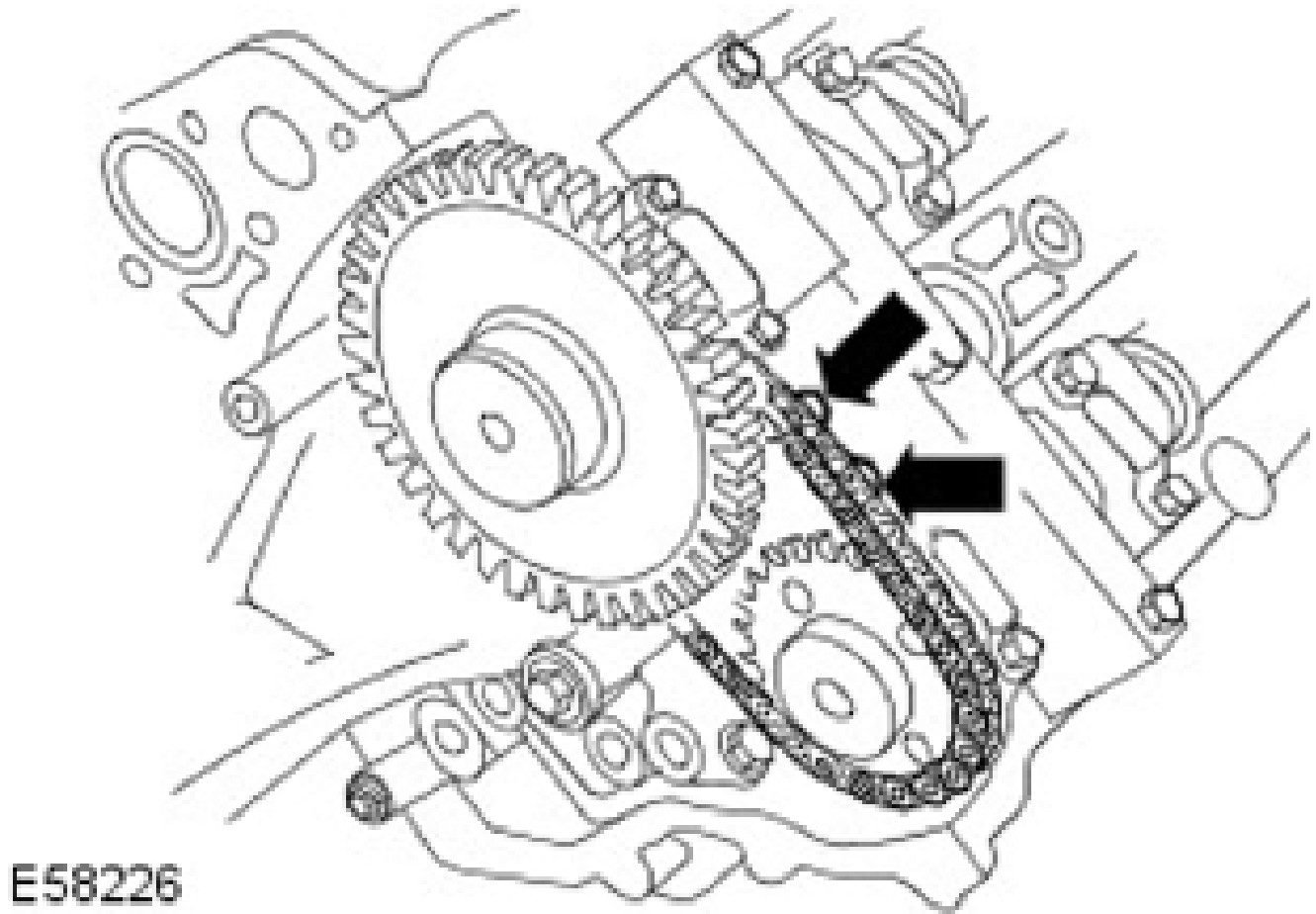


24. Depress the LH secondary timing chain tensioner piston.
- Using 1 mm diameter metal rod, retain the chain tensioner piston.



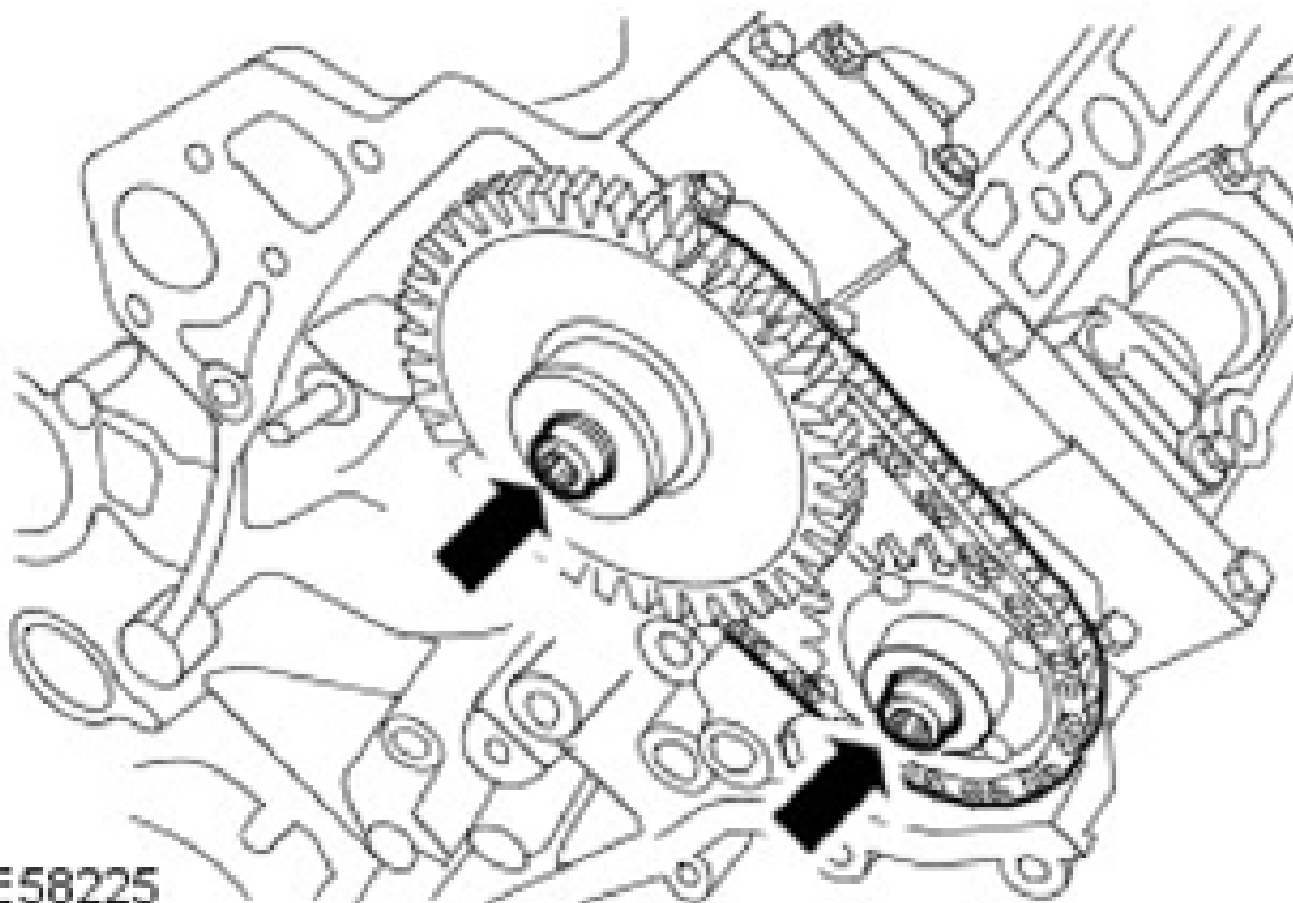
E58311

25. Install the LH secondary timing chain tensioner retaining bolts.
- Tighten the bolts to 12 Nm.



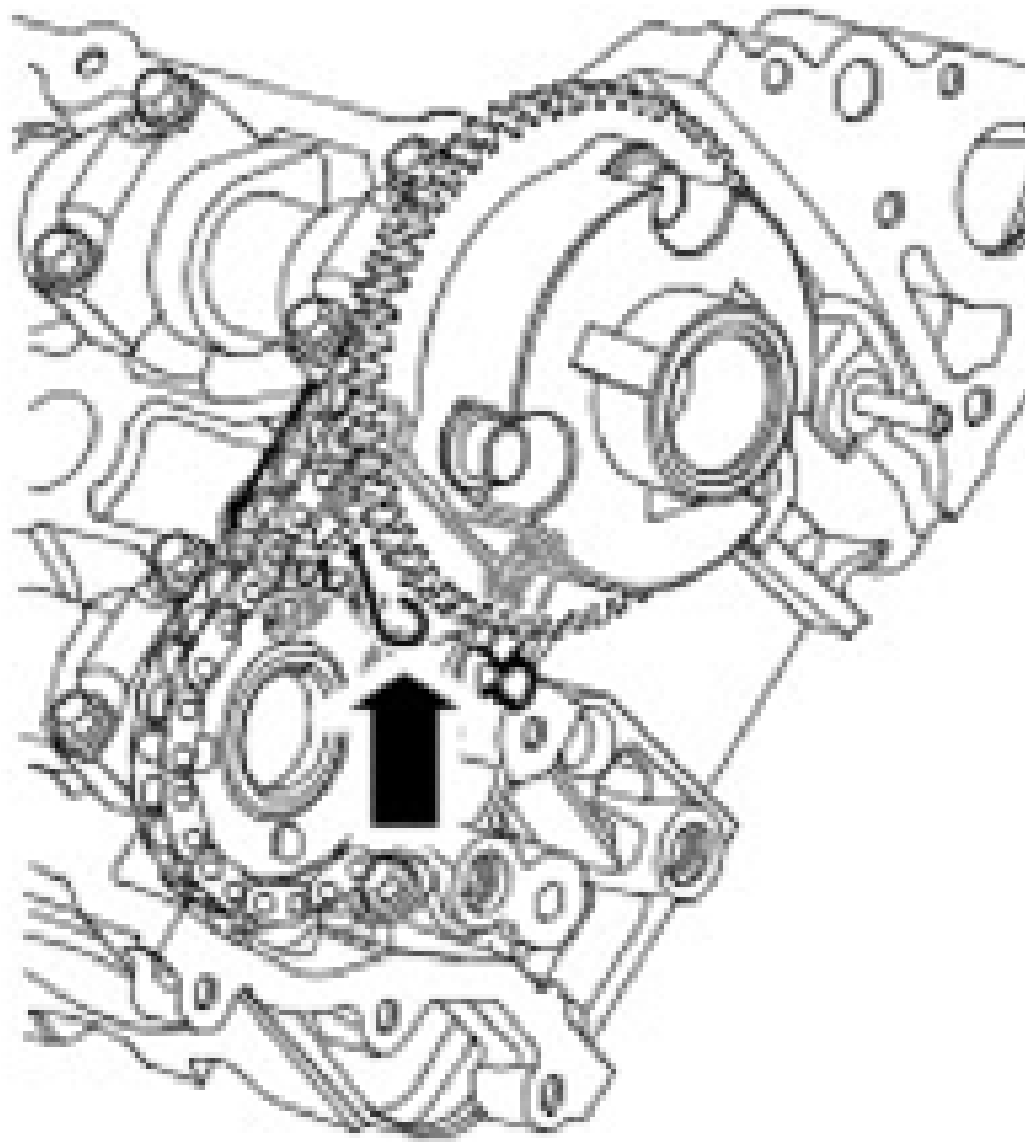
NOTE: Lightly tighten the camshaft sprocket Torx bolts, the sprockets **MUST** be free to move.

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



E58225

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



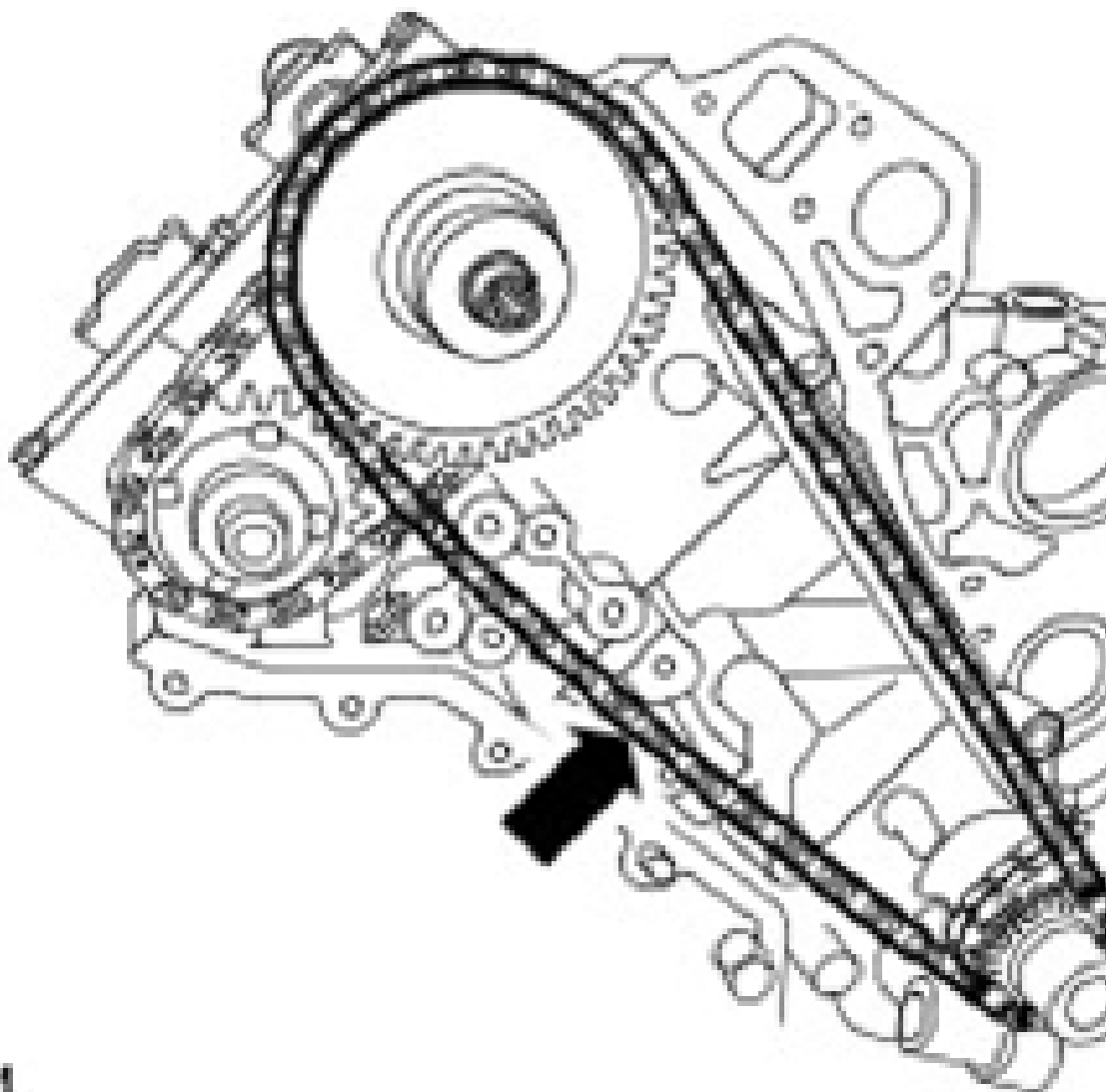
E46869

28. Repeat the operation for the RH camshafts.

NOTE: RH illustration shown, LH is similar.

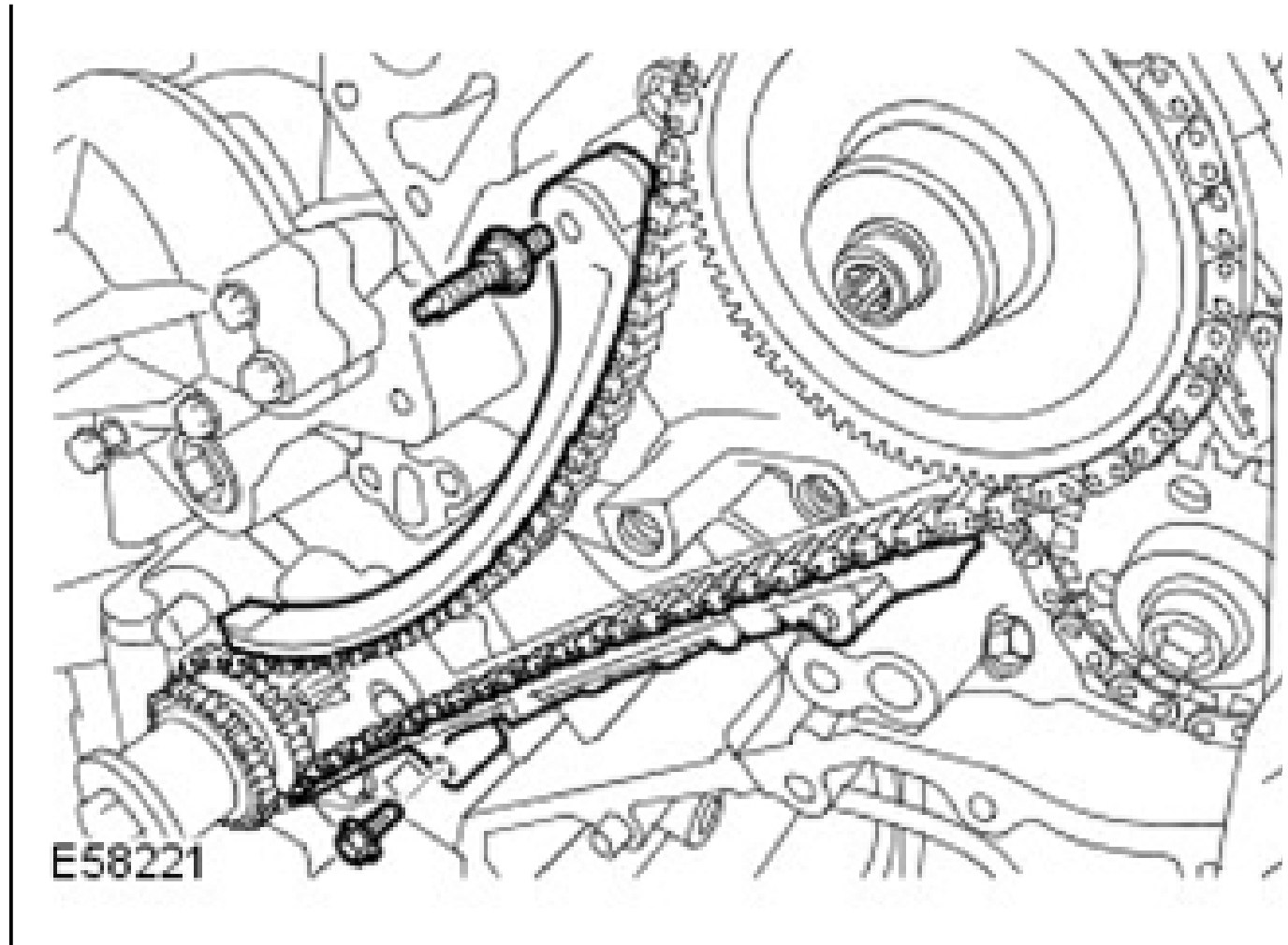
29. Install the LH primary timing chain.

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



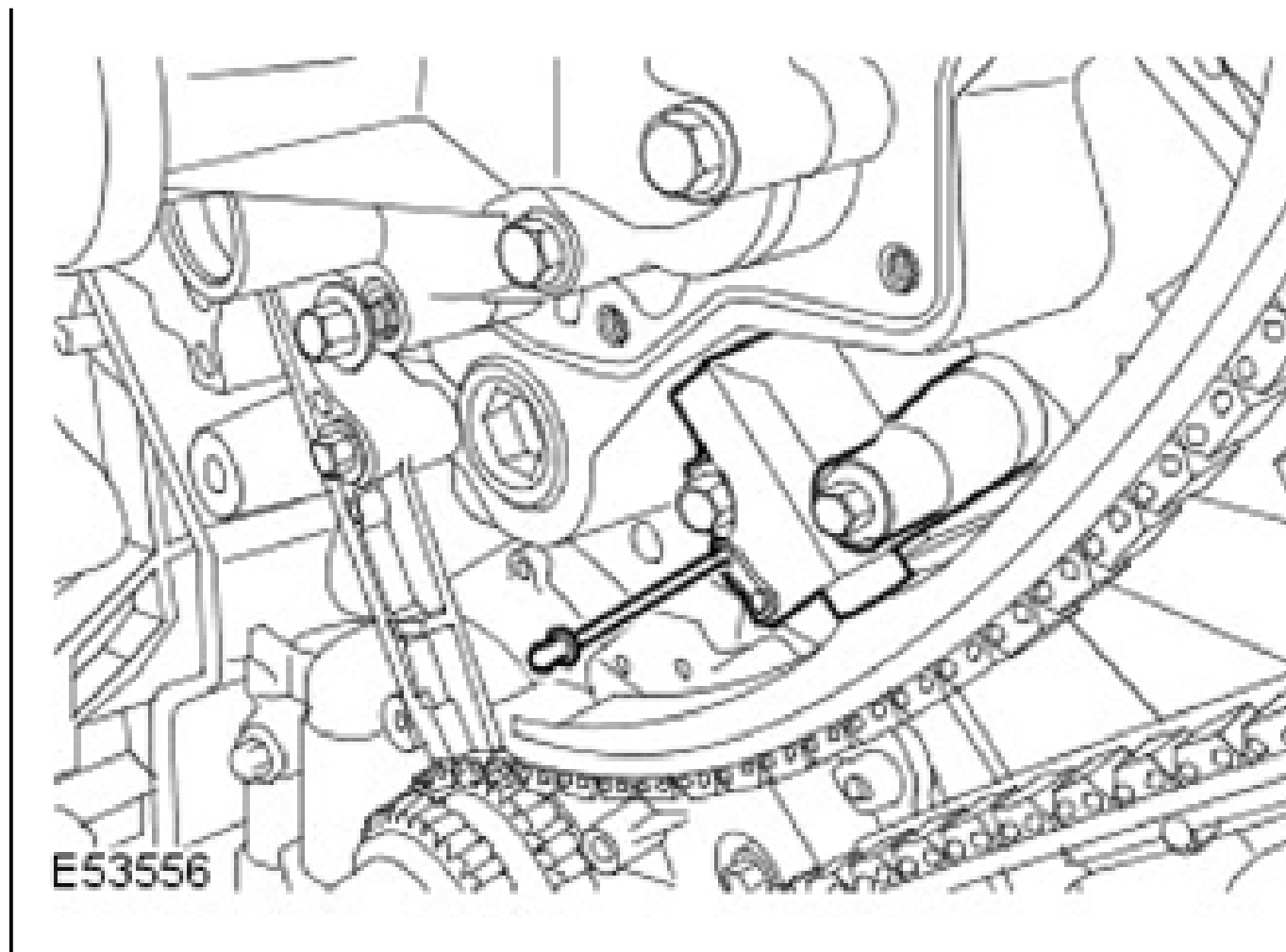
E58224

30. Install the LH primary chain tensioner guide.
- Tighten the stud 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.

31. Install the LH primary timing chain tensioner.
 - Using 3 mm diameter metal rod, retain the chain tensioner piston.
 - Tighten the bolts to 12 Nm.
 - Remove the retaining rod.



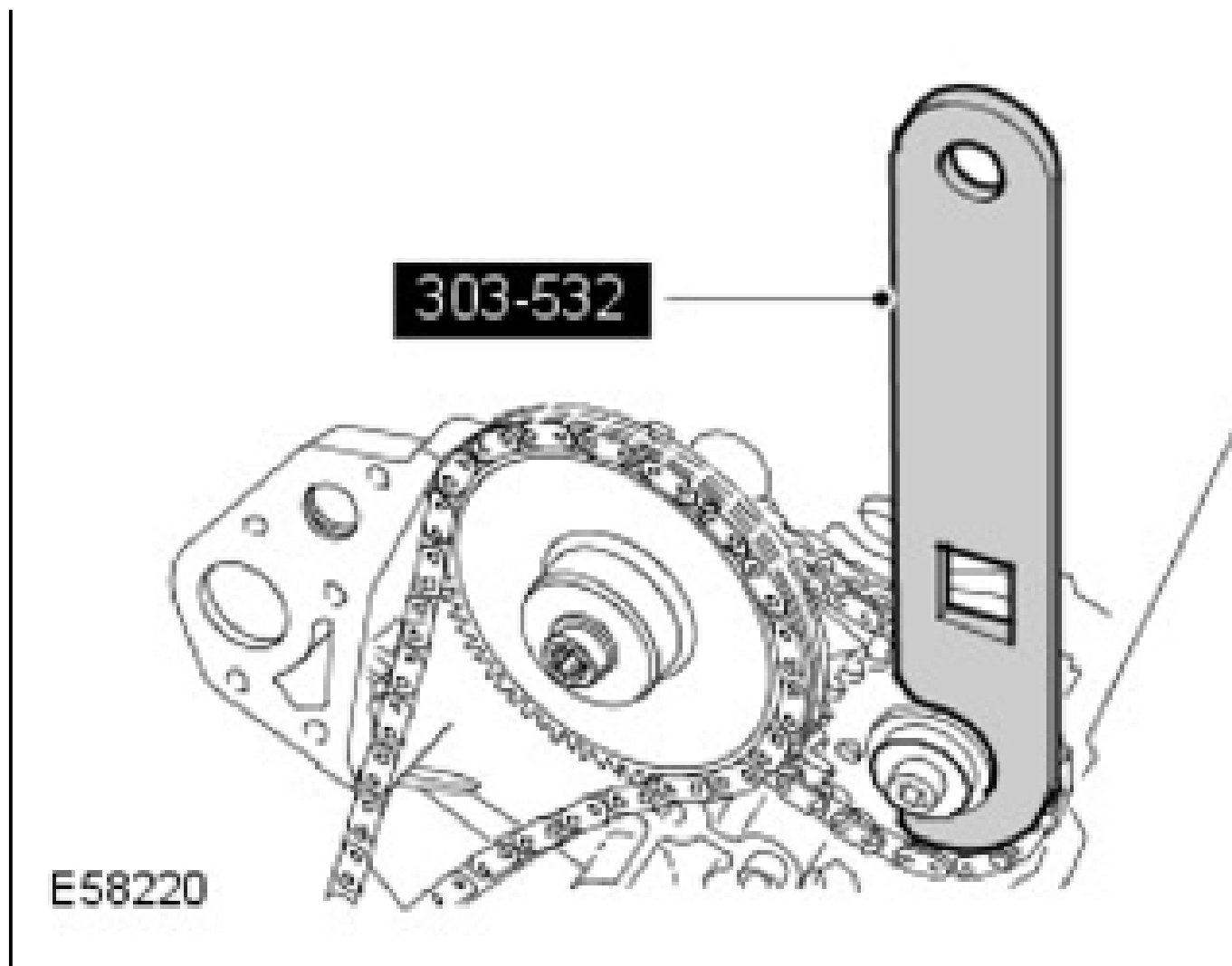
CAUTION: Make sure that new bolts are installed.

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.

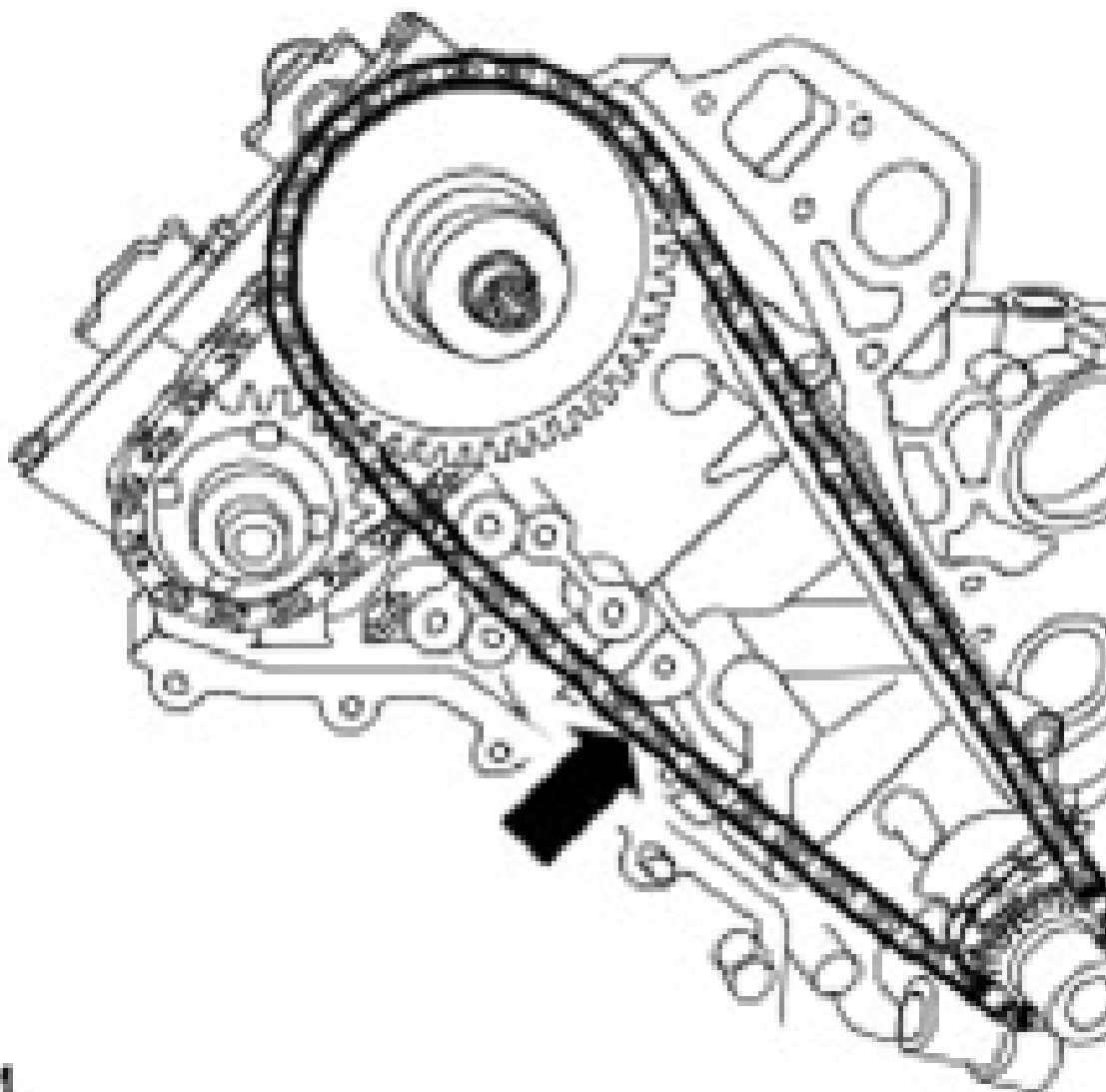
32. Install the special tool to the exhaust camshaft sprocket.

- Tighten the intake camshaft sprocket bolt to 20 Nm then a further 90 degrees.
- Tighten the exhaust camshaft sprocket bolt to 20 Nm then a further 90 degrees.



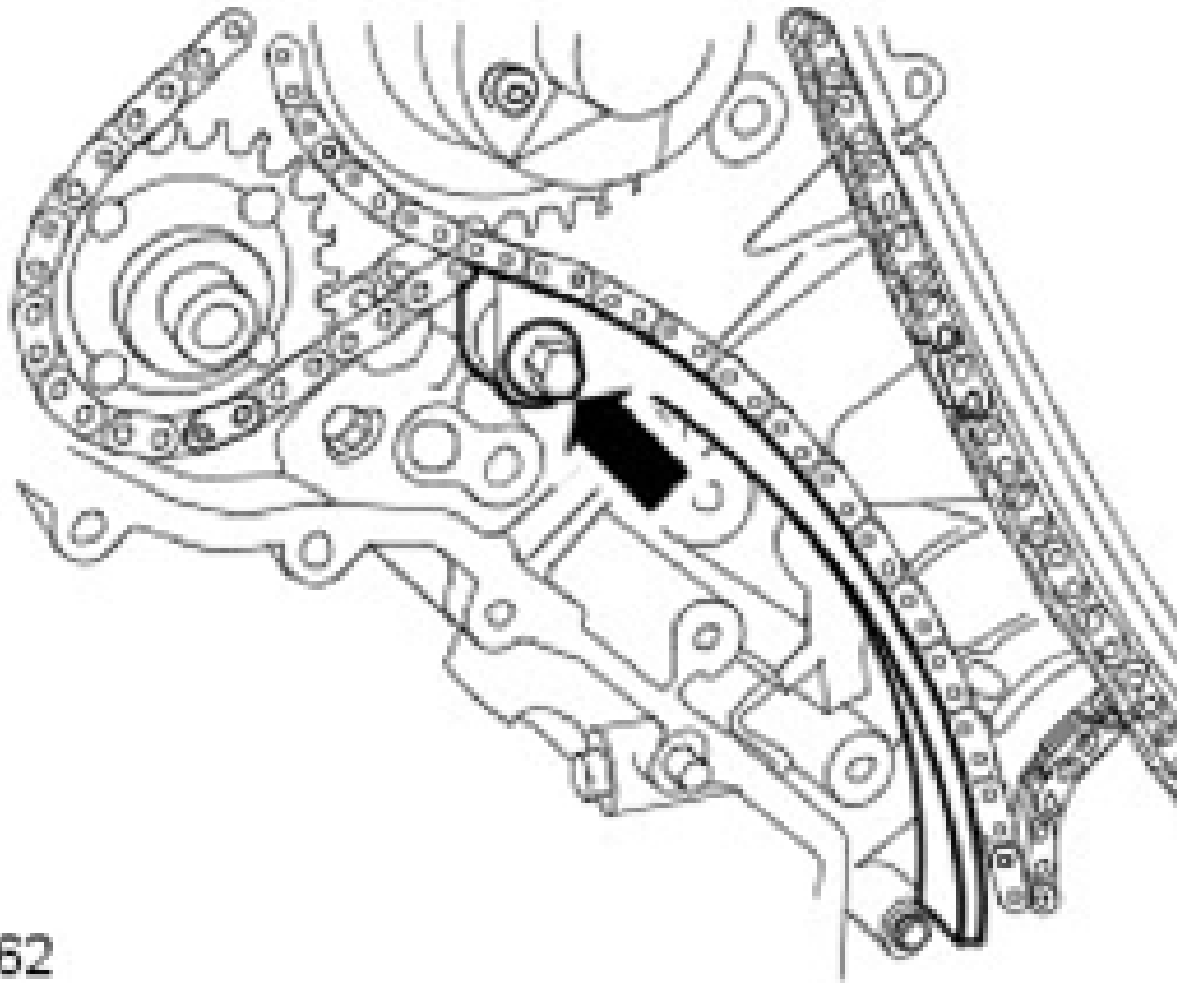
33. Install the RH primary timing chain.

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



E58224

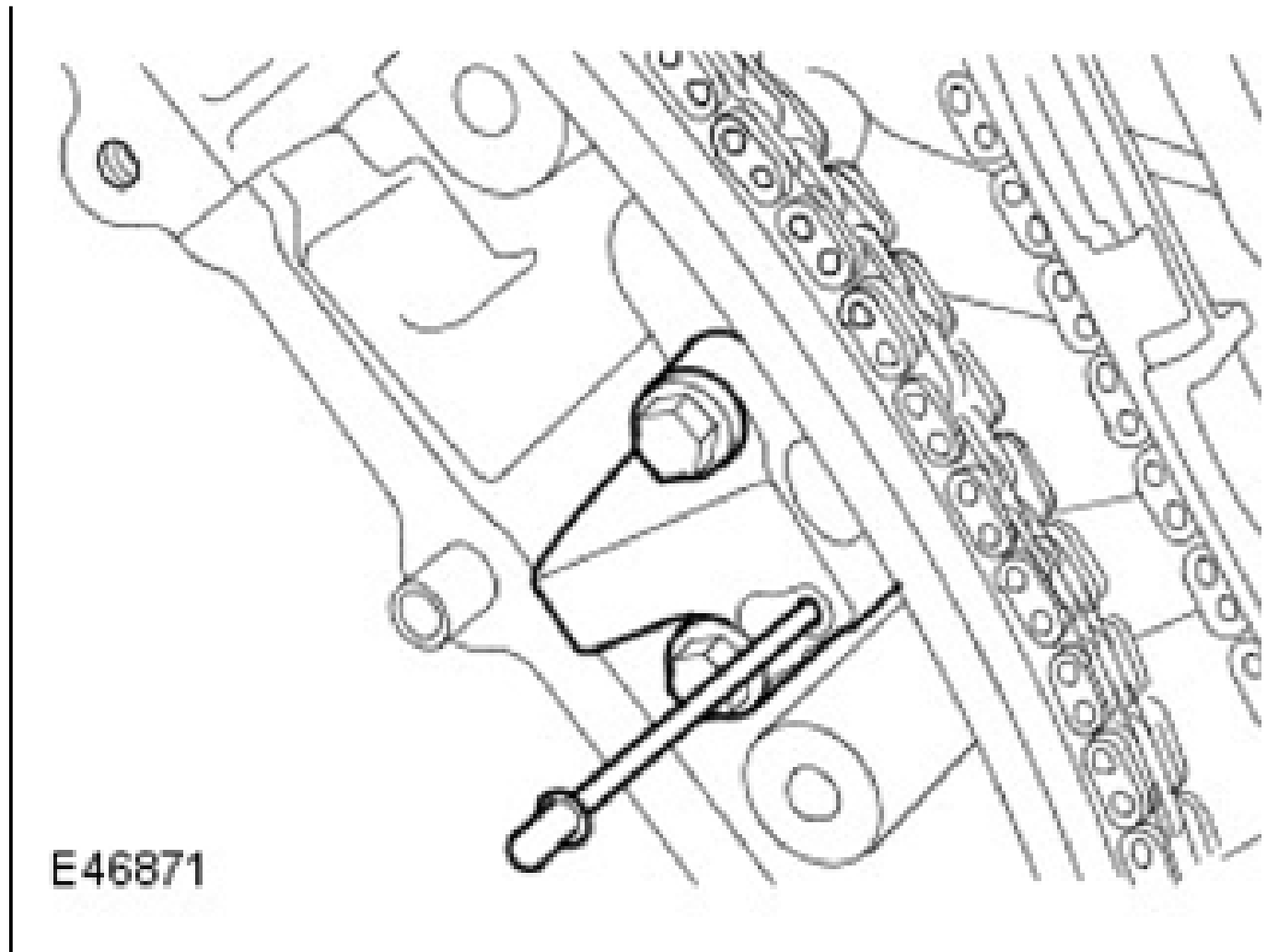
34. Install the RH primary timing chain tensioner guide.
- Tighten the bolts to 12 Nm.



E46862

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.

35. Install the RH primary timing chain tensioner.
- Using 3 mm diameter metal rod, retain the chain tensioner piston.
 - Tighten the bolts to 12 Nm.
 - Remove the retaining rod.



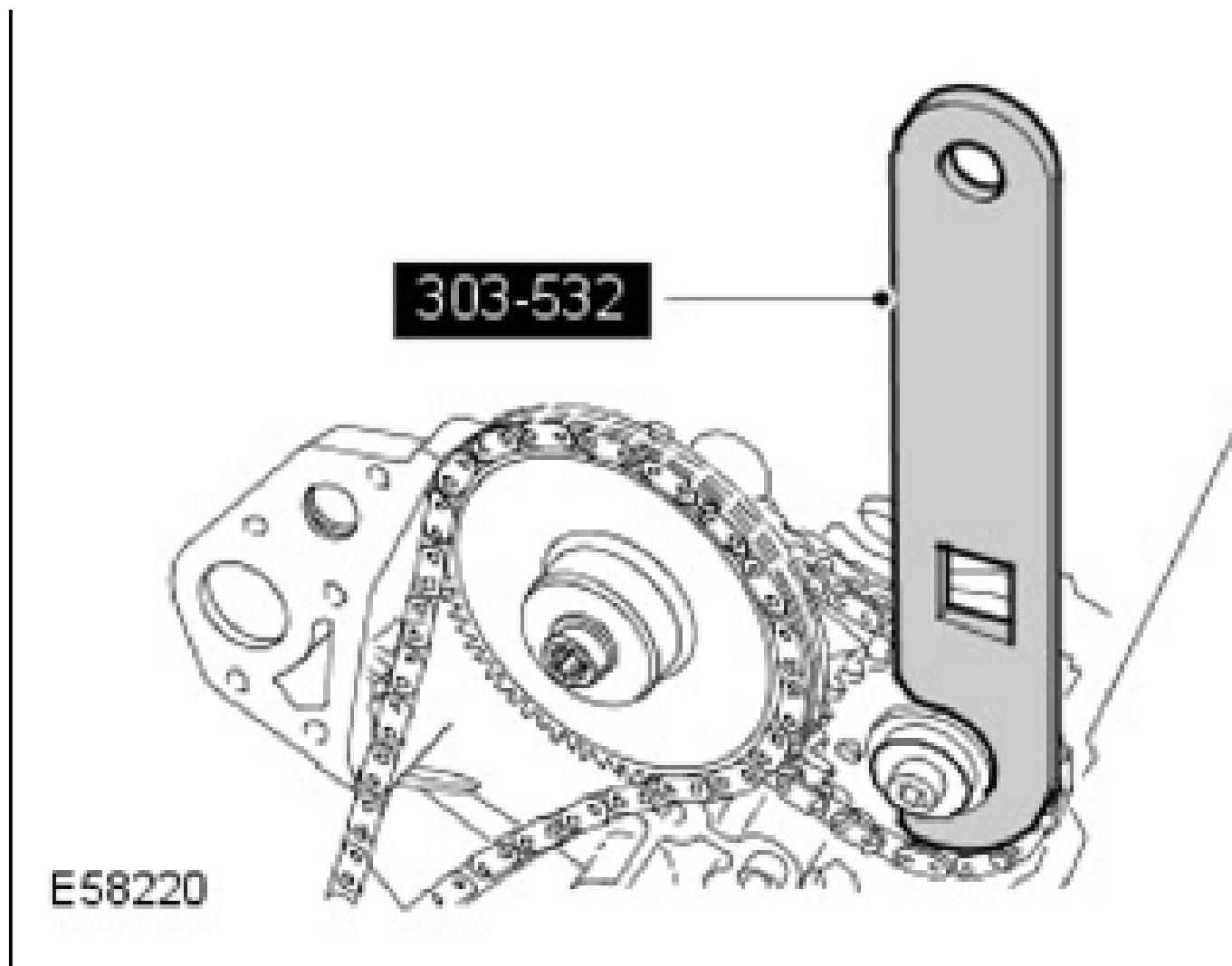
CAUTION: Using the special tool, apply force to the tool in a counter-clockwise direction, to tension the primary timing chain on its drive side.

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.

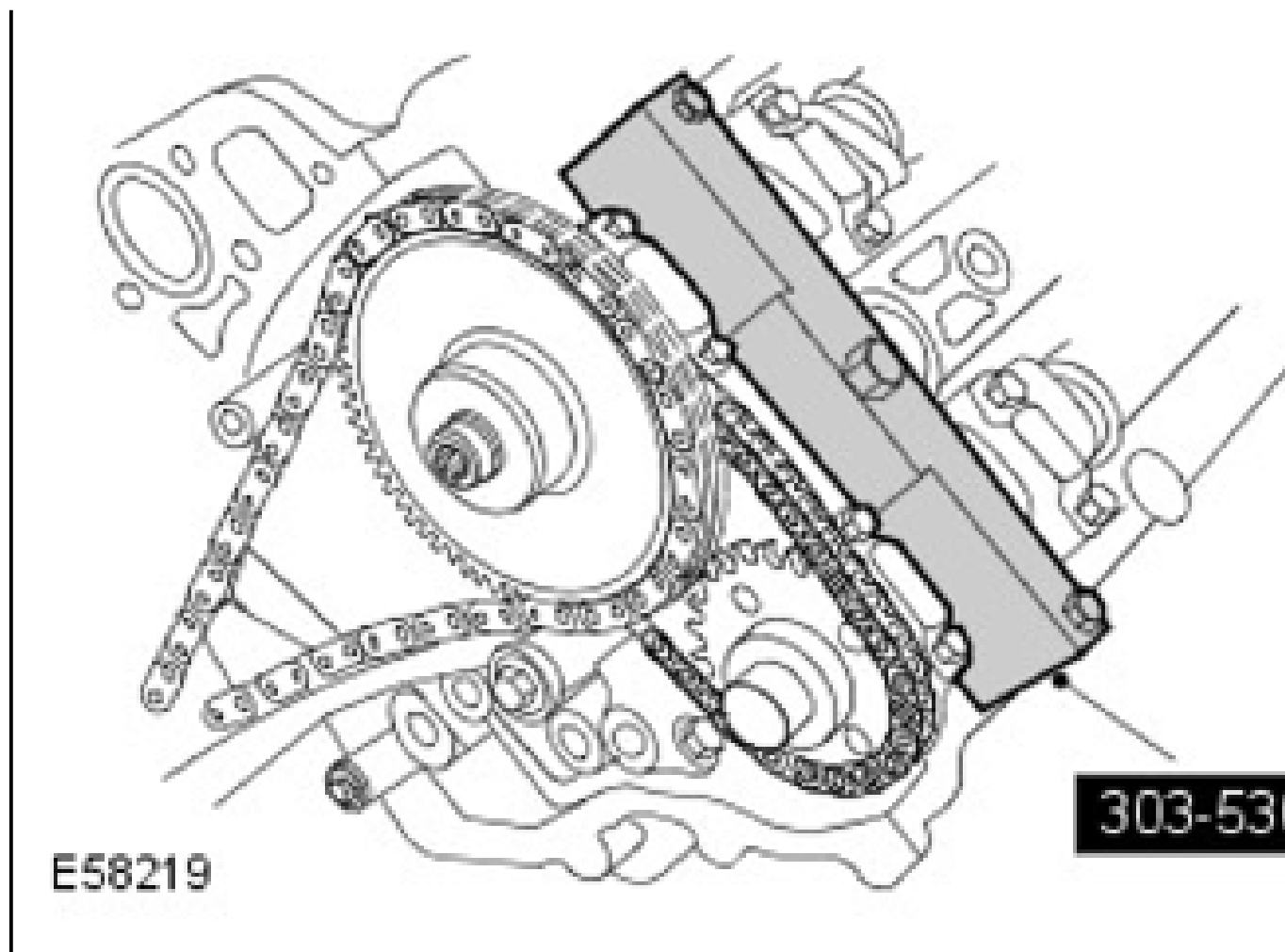
CAUTION: Make sure that new bolts are installed.

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

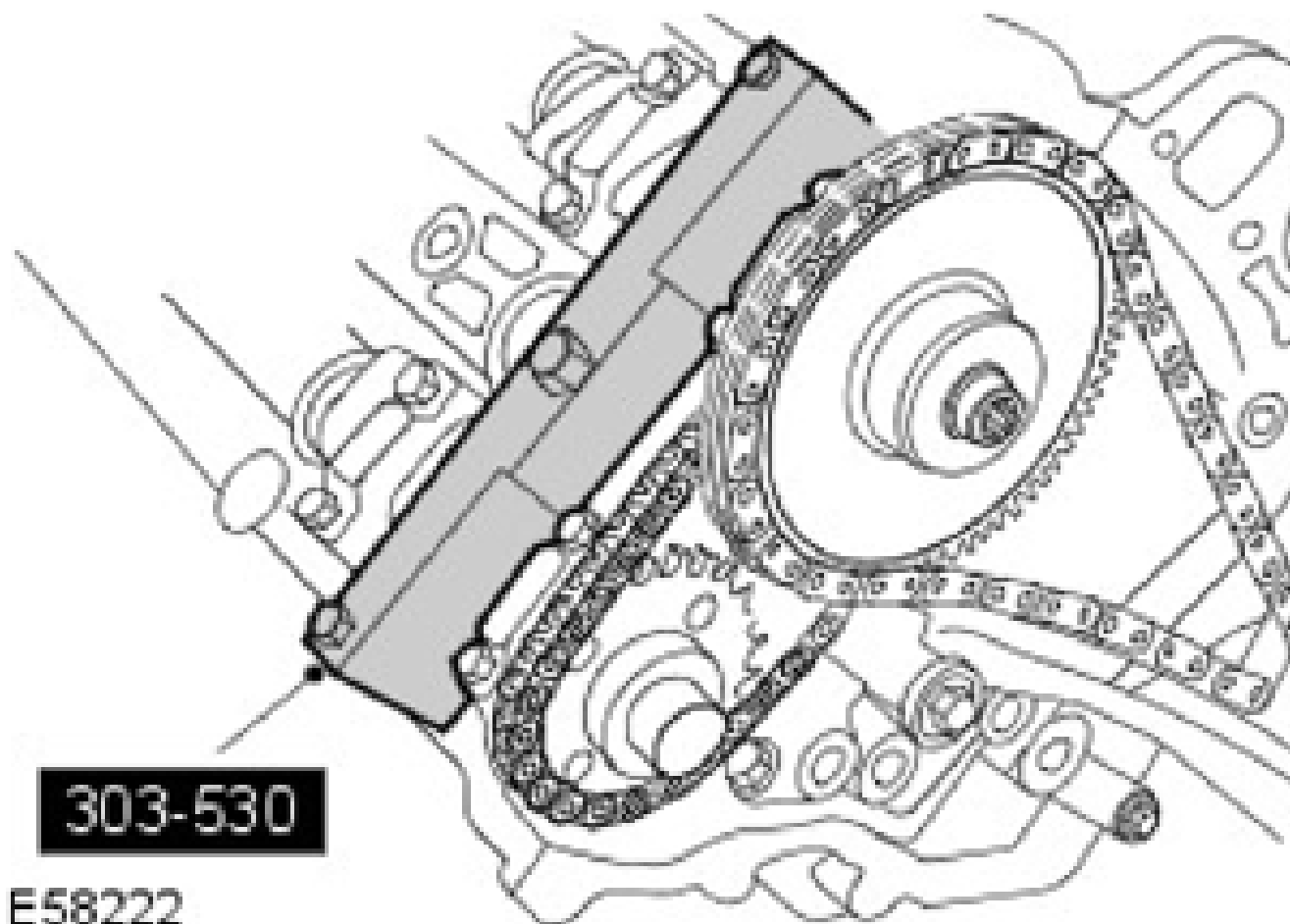
- Tighten the intake camshaft sprocket bolt to 20 Nm then a further 90 degrees.
- Tighten the exhaust camshaft sprocket bolt to 20 Nm then a further 90 degrees.



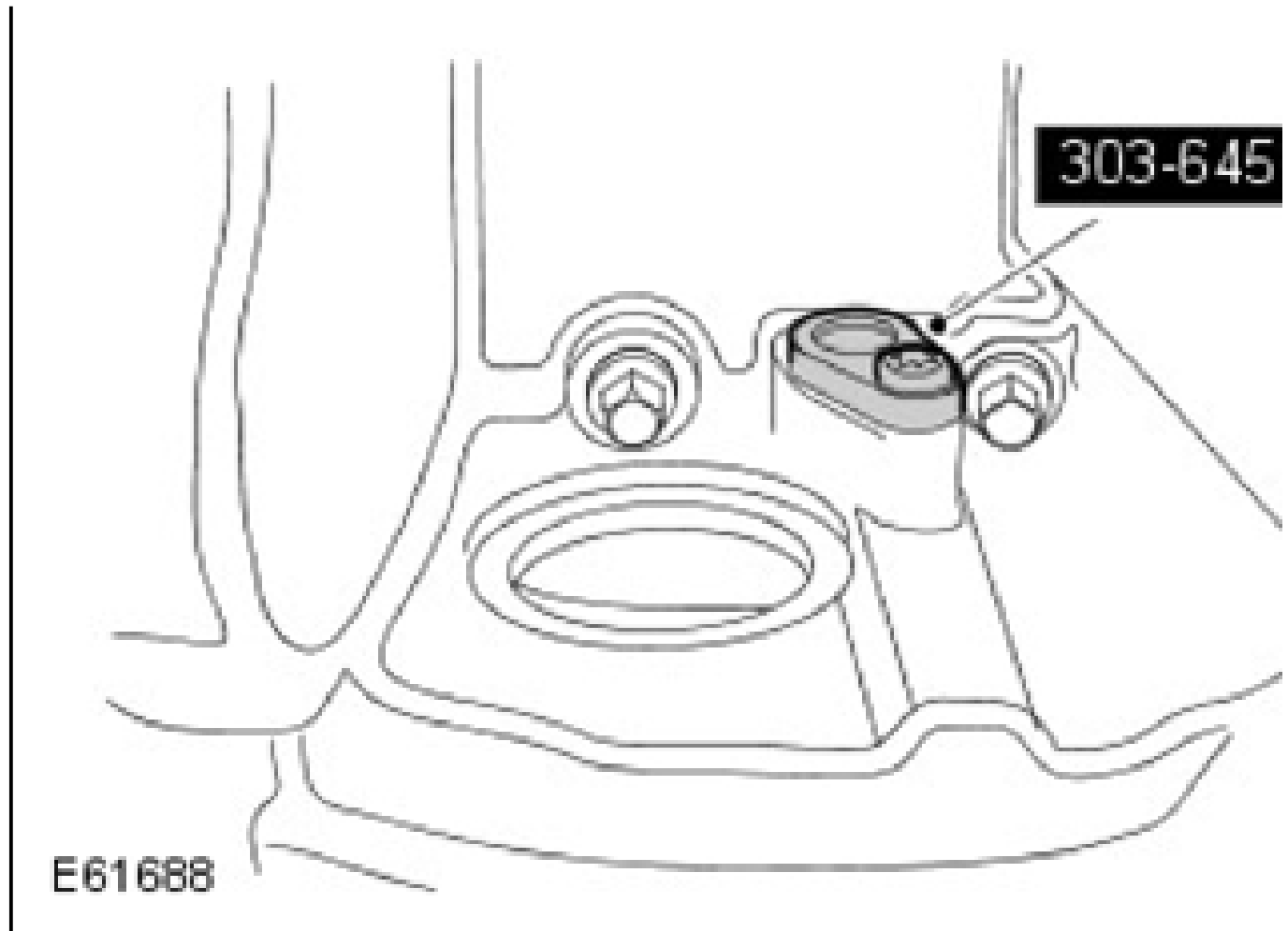
37. Remove the special tool from the LH cylinder head.



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

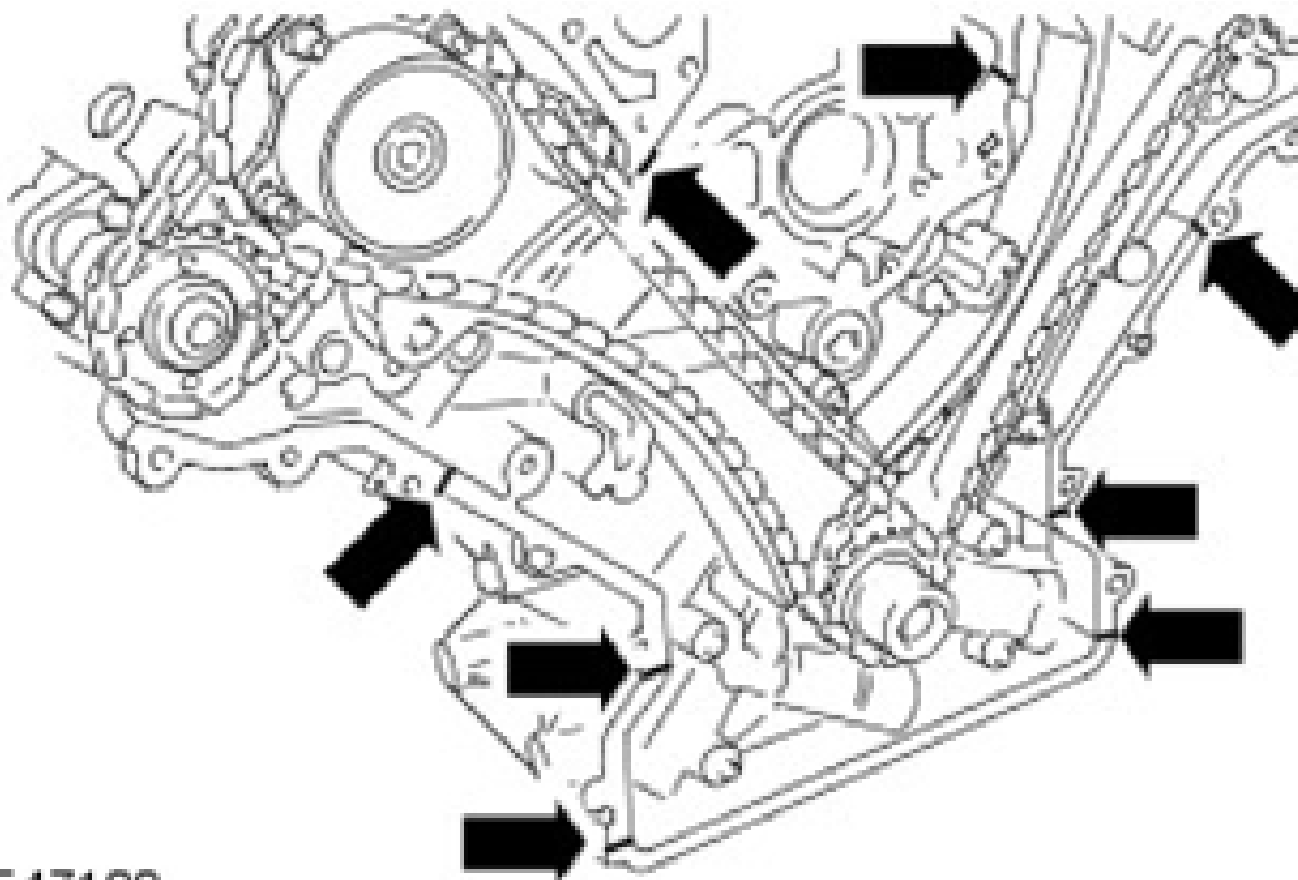


39. Remove the crankshaft locking tool.
- Remove the screw.



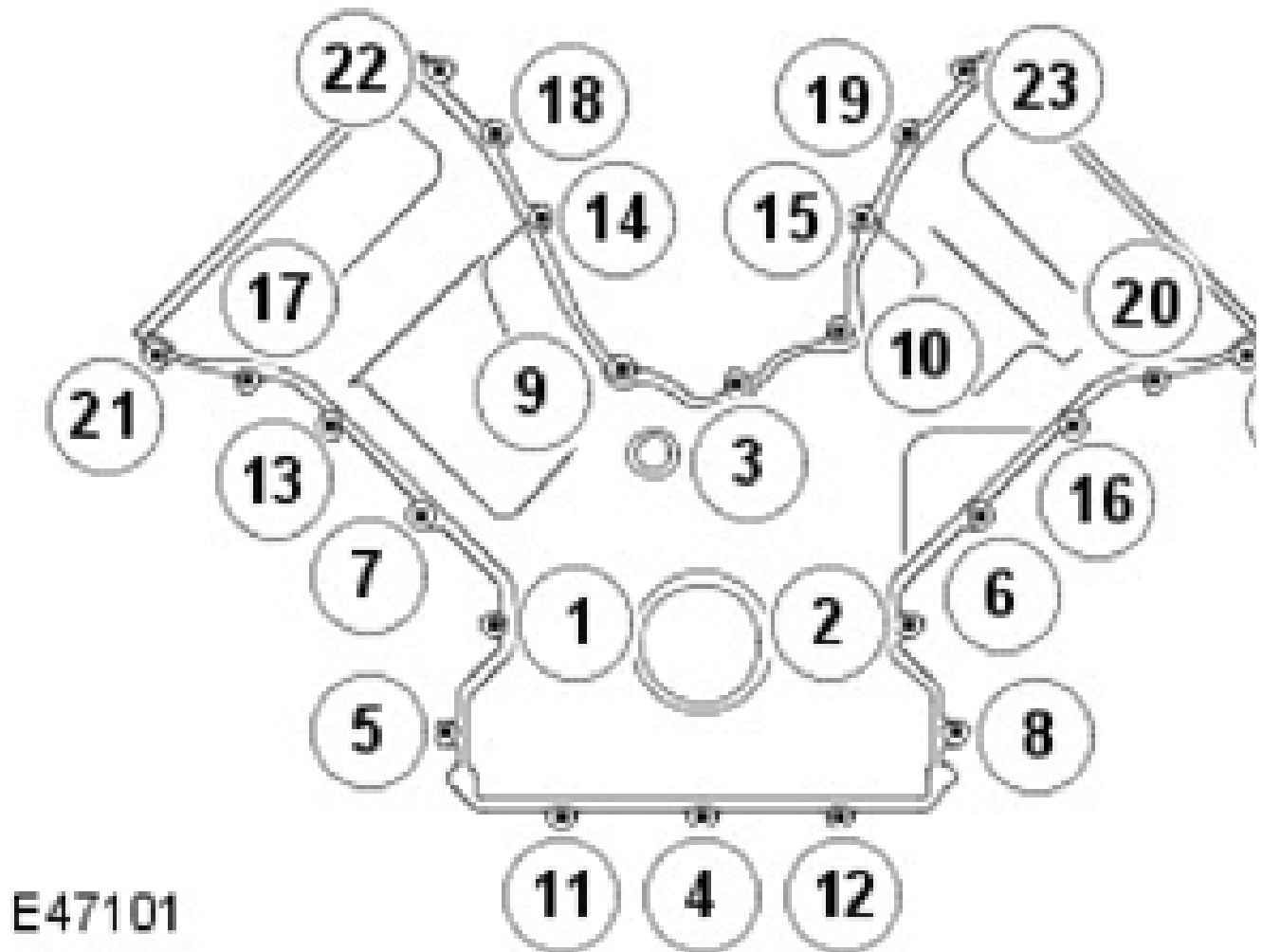
40. Install the engine front cover.

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



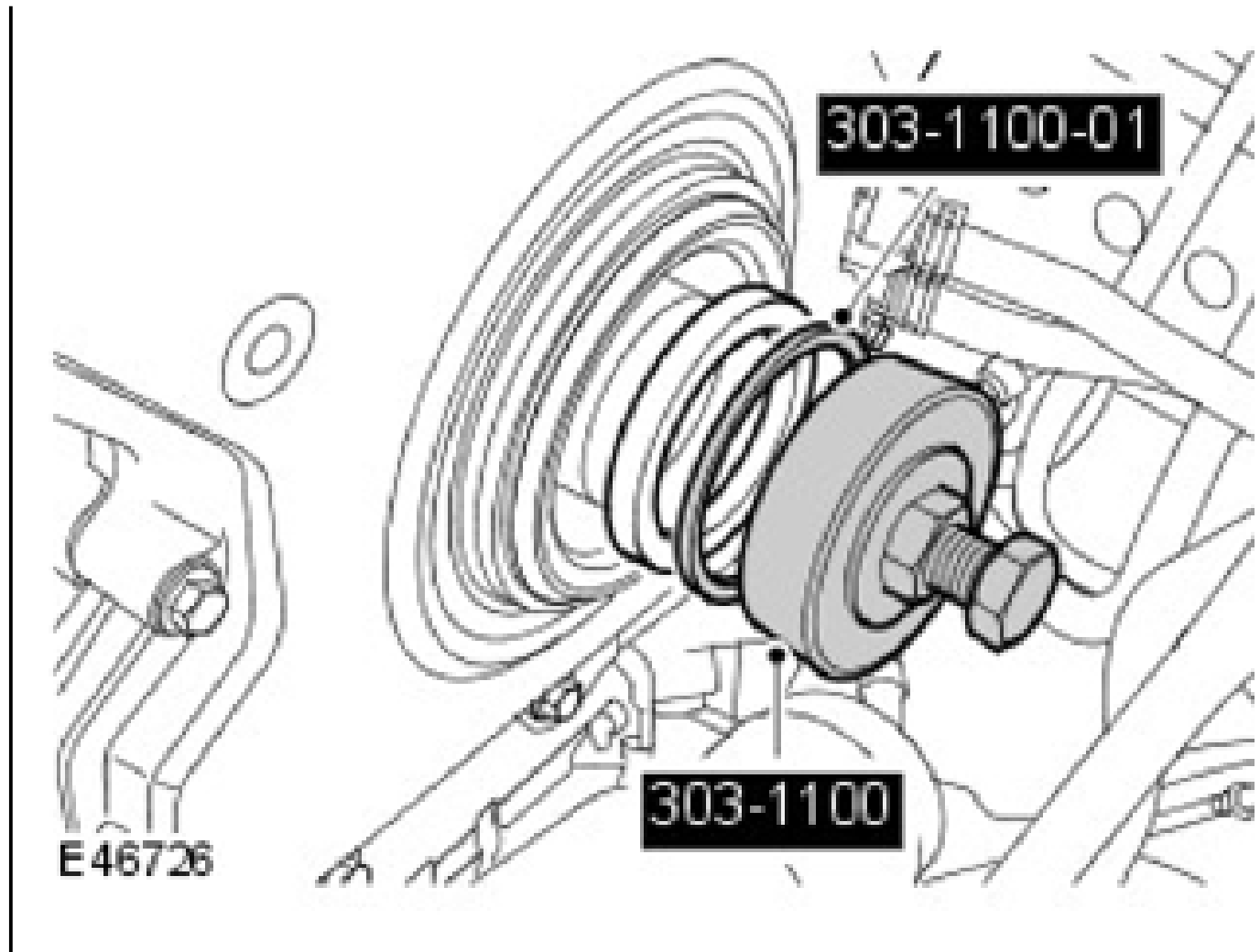
E47100

41. Evenly and progressively tighten the bolts in the sequence shown to 12 Nm.

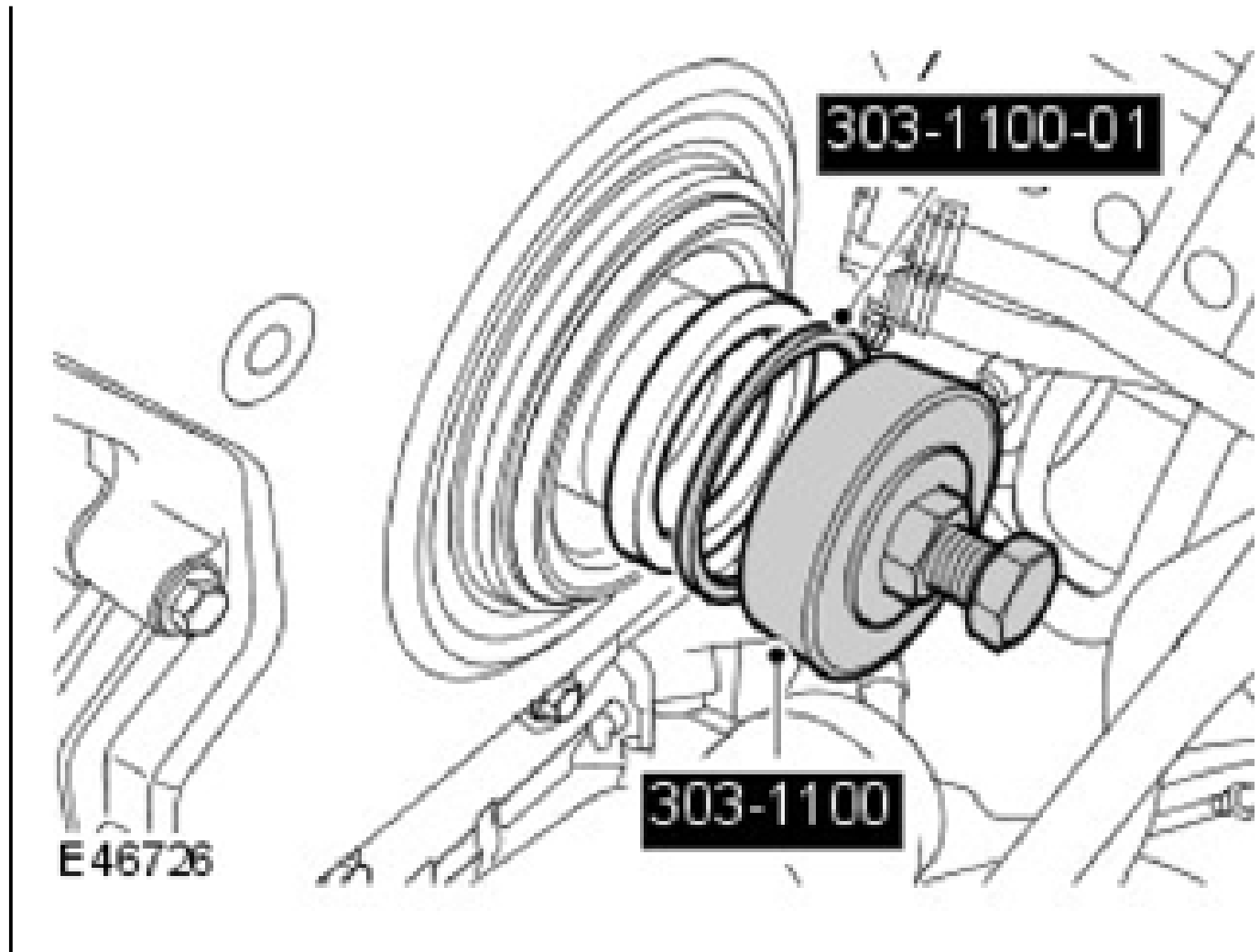


42. Using the special tools, install the crankshaft front seal.

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



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



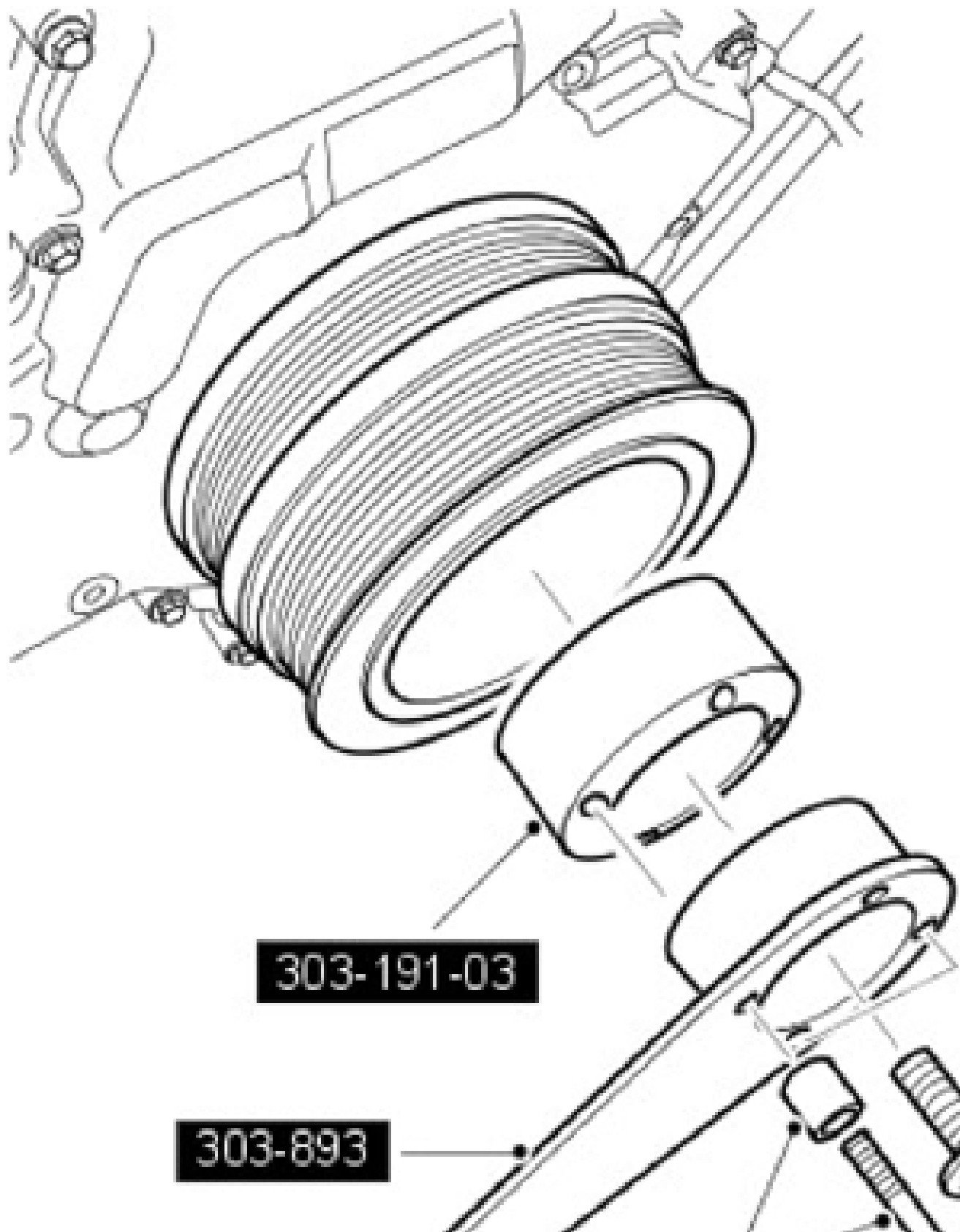
44. Install the crankshaft pulley.
 - Lubricate the seal with clean engine oil.
45. Install the crankshaft pulley locking ring.

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

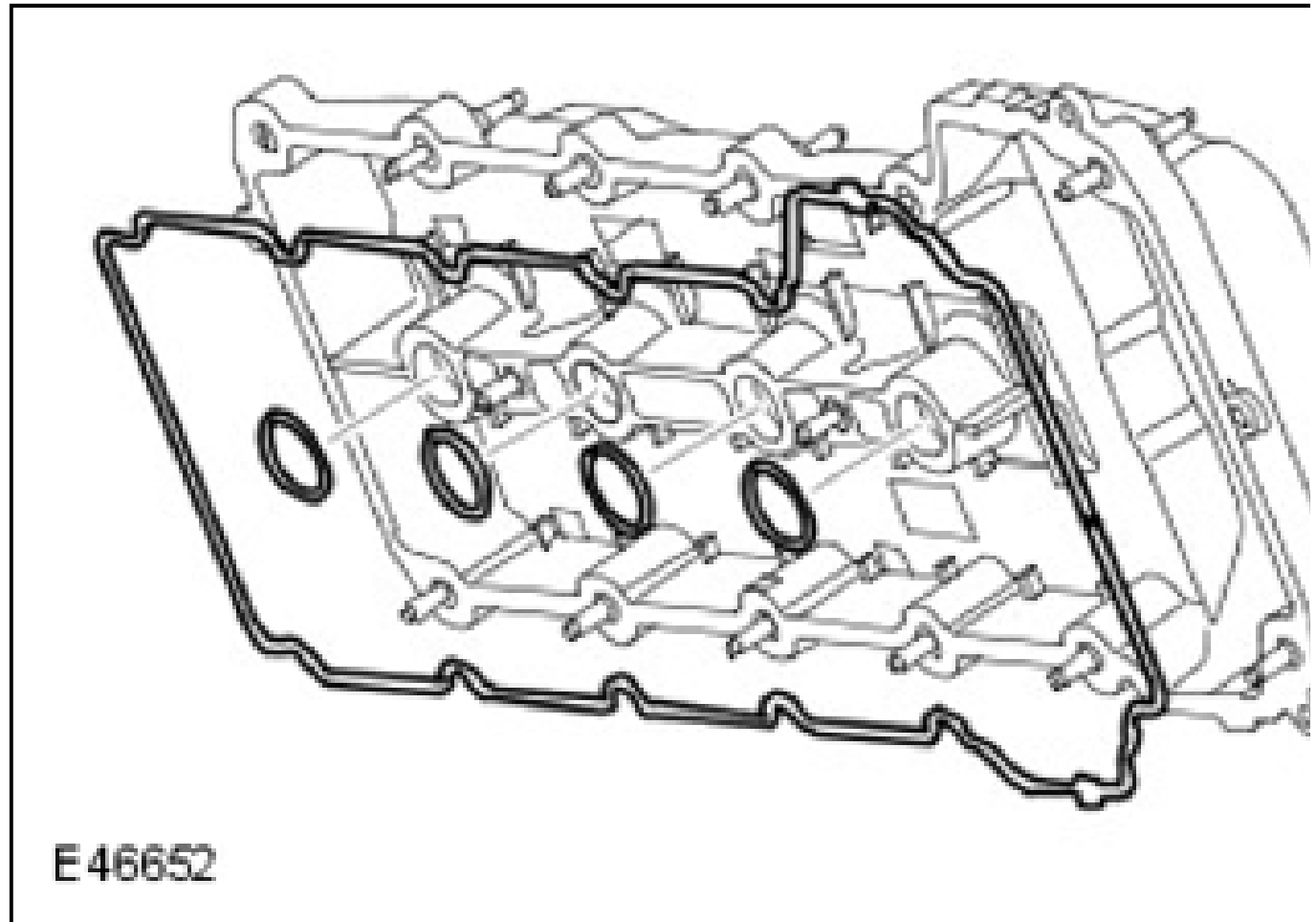
46. Install, but do not tighten, the new crankshaft pulley bolt.

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

47. Using the special tools, retain the crankshaft pulley.
 - Tighten the crankshaft pulley bolt to 380 Nm.

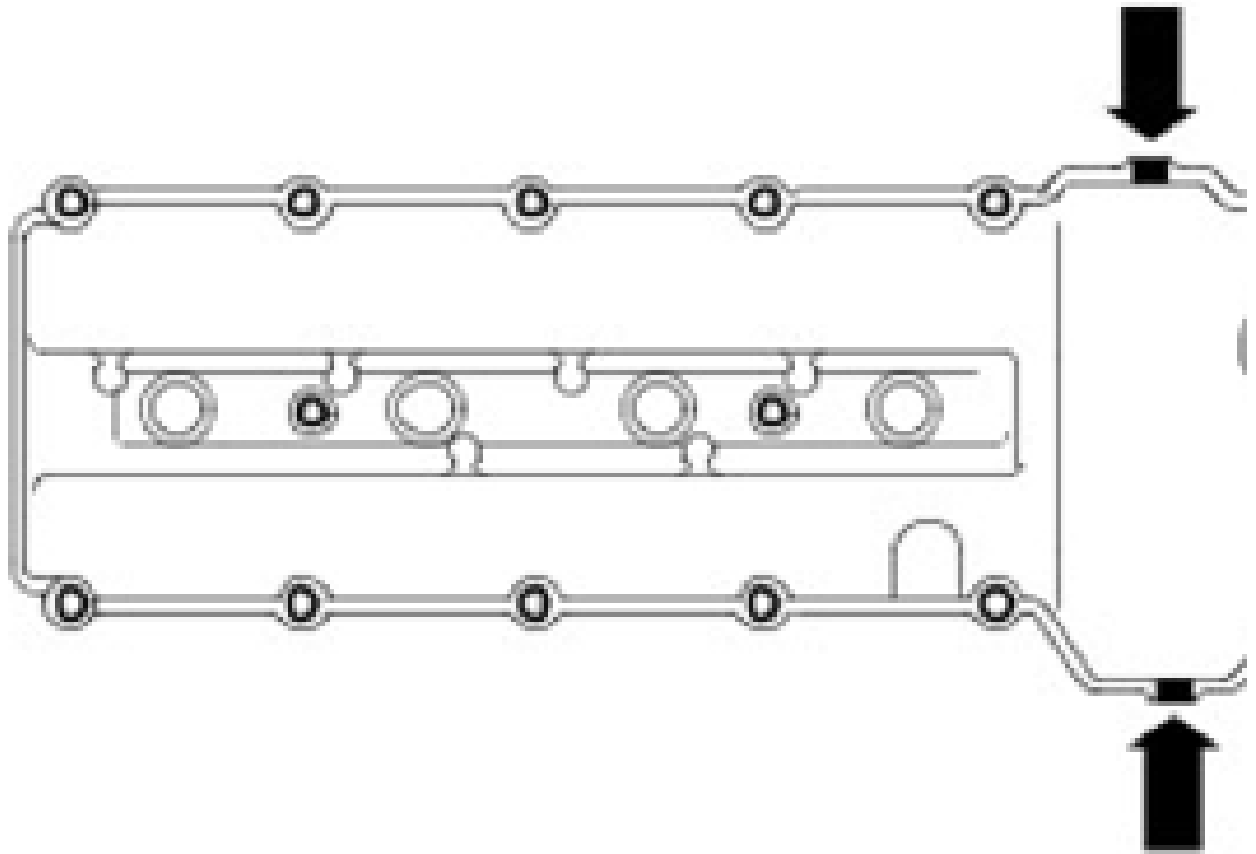


48. Remove the special tools.
49. Install new valve cover plug aperture gaskets.
 - Install a new valve cover gasket.



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.

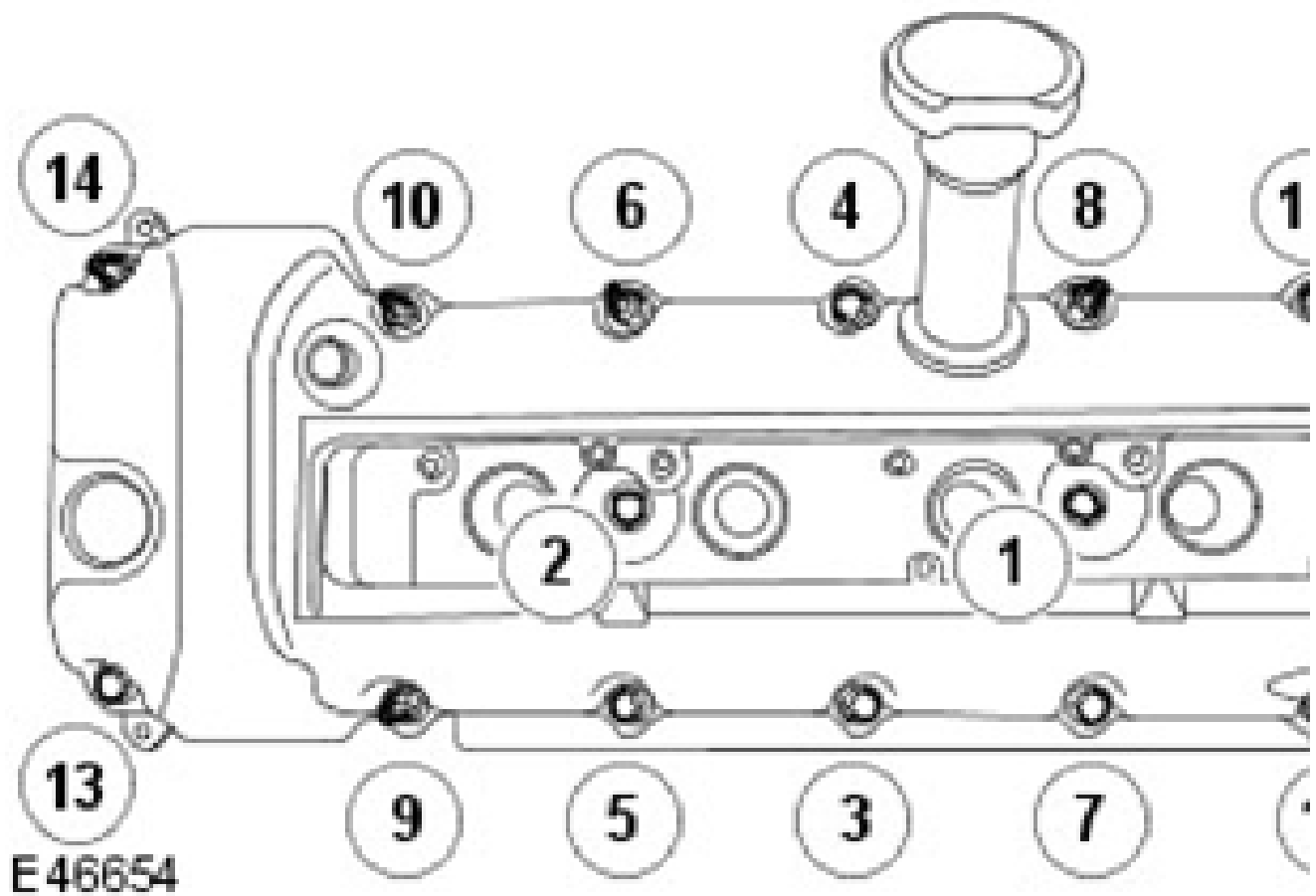
50. Install the valve cover.
 - Clean the component mating faces.



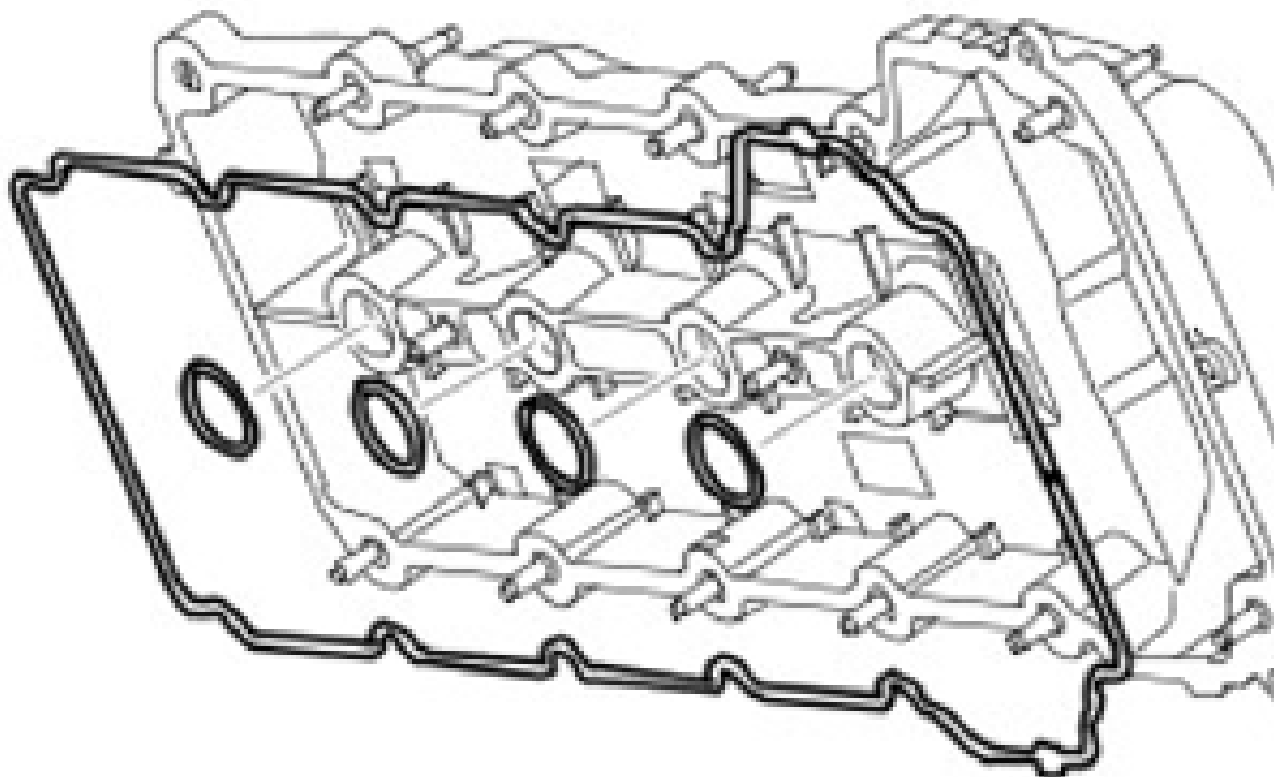
E 49922

51. 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.



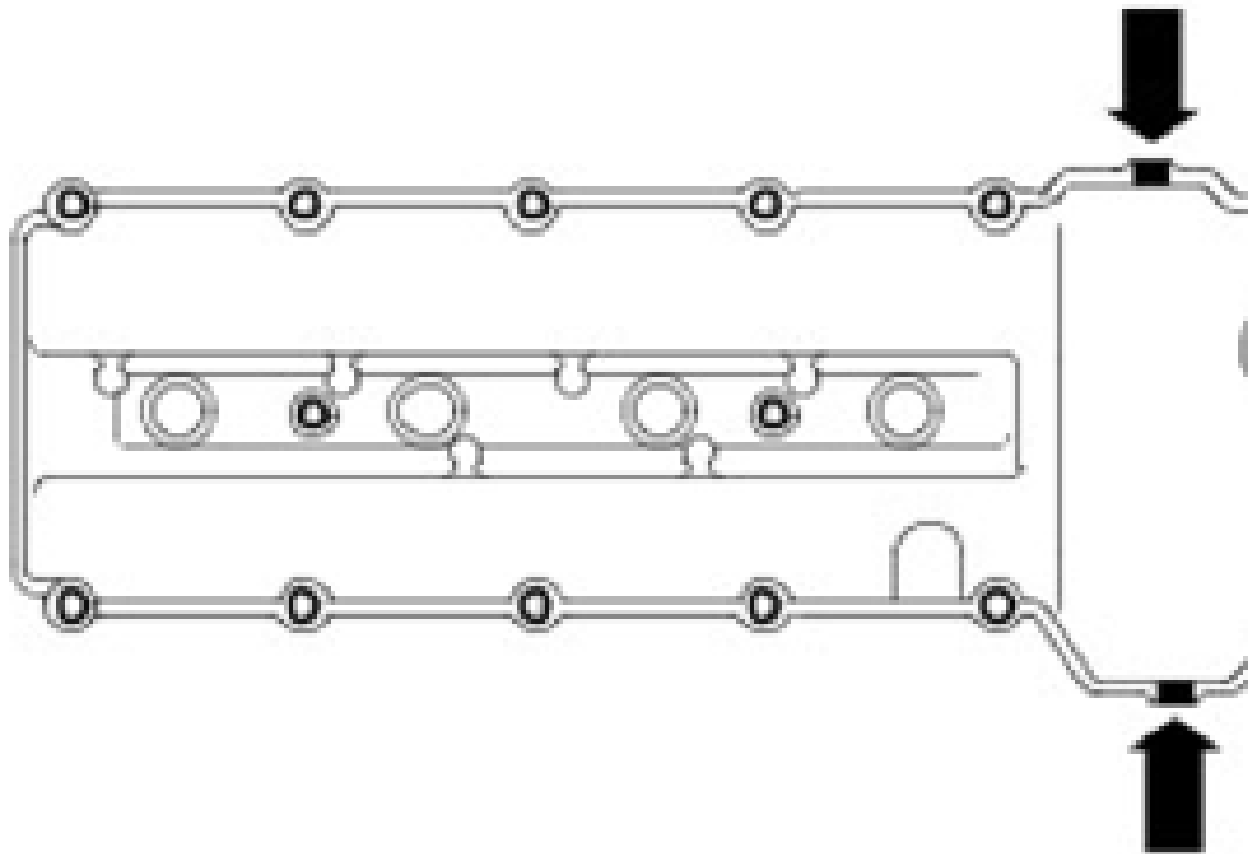
52. Install new valve cover plug aperture gaskets.
- Install a new valve cover gasket.



E 46652

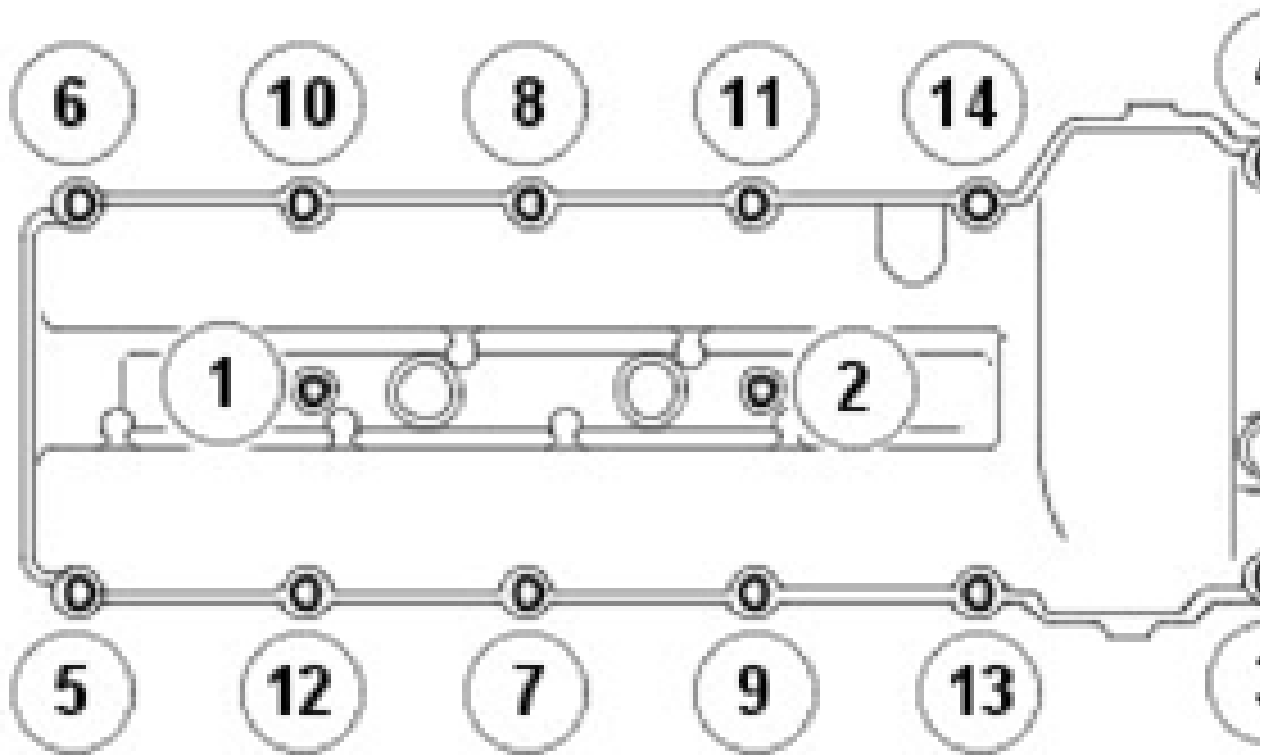
NOTE: Apply two beads of silicone gasket sealant as shown on the illustration. The application of the sealant must be 3mm diameter 12mm long. Install the valve cover immediately after applying the sealant. The cover should be fitted directly to the head without smearing the sealant or the seals.

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

**E 49922**

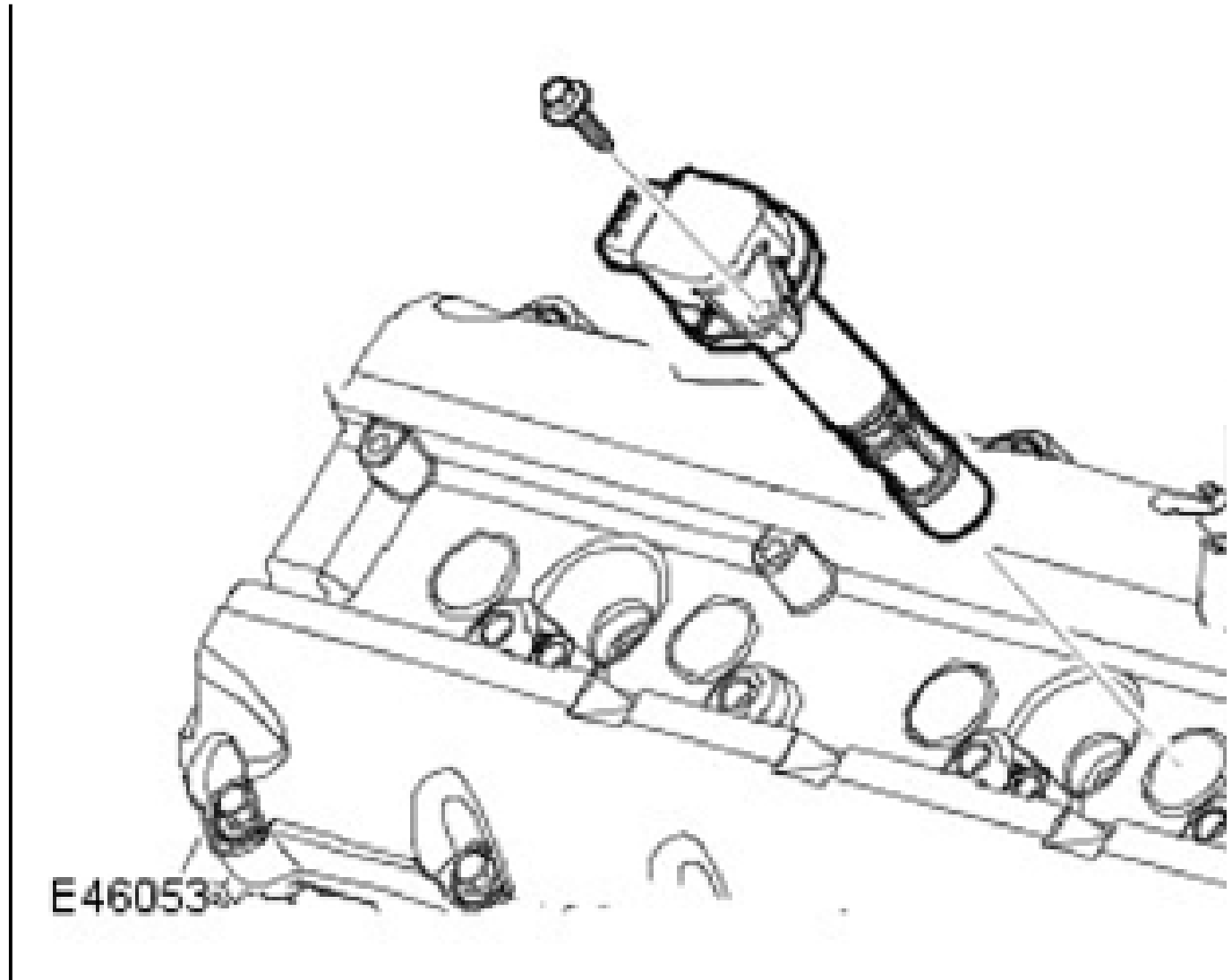
54. Install the valve cover retaining bolts.

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

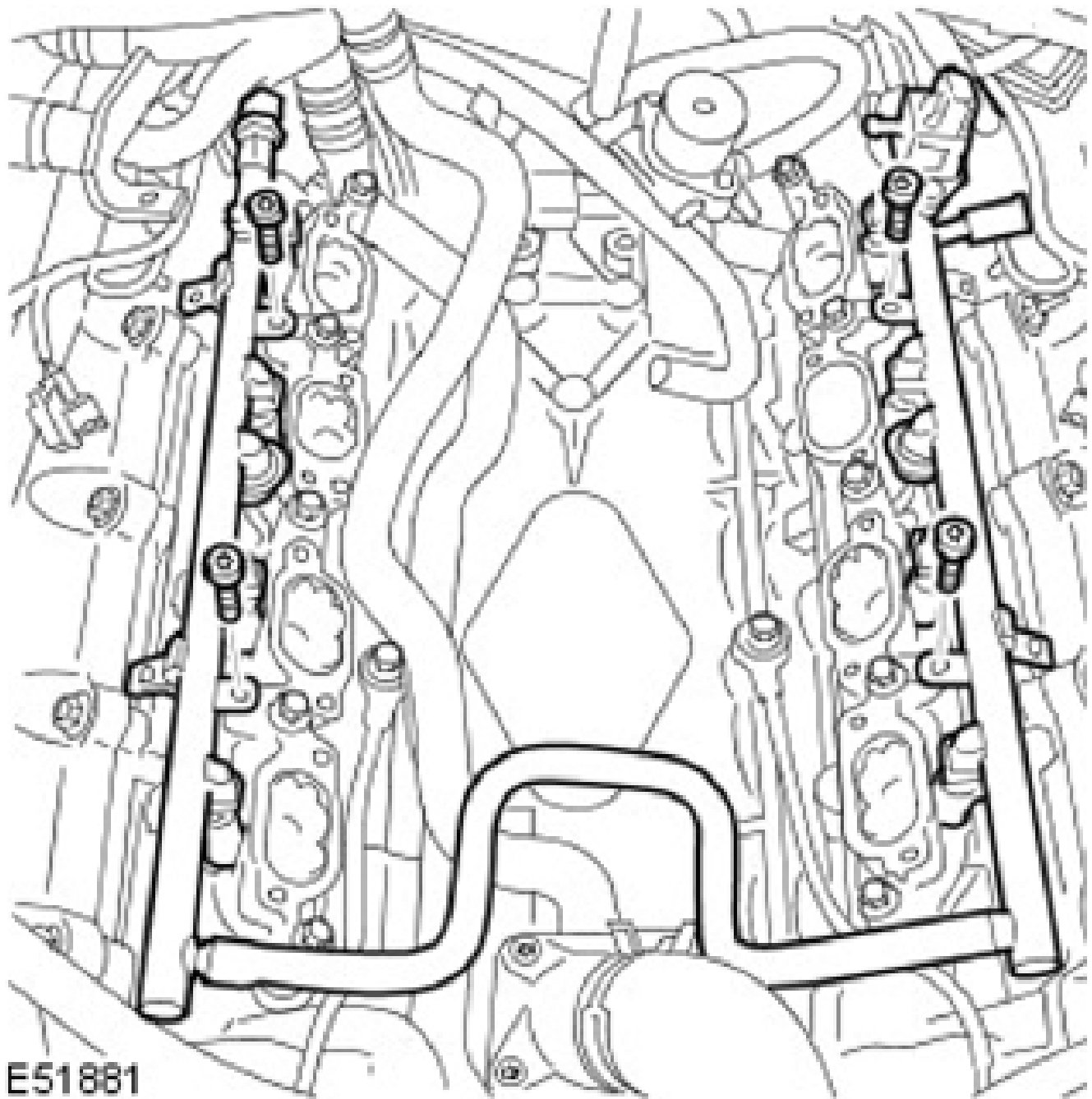


E 46679

55. Install the 8 ignition coil-on-plugs.
- Install the 8 bolts.
 - Tighten the bolts to 6 Nm.

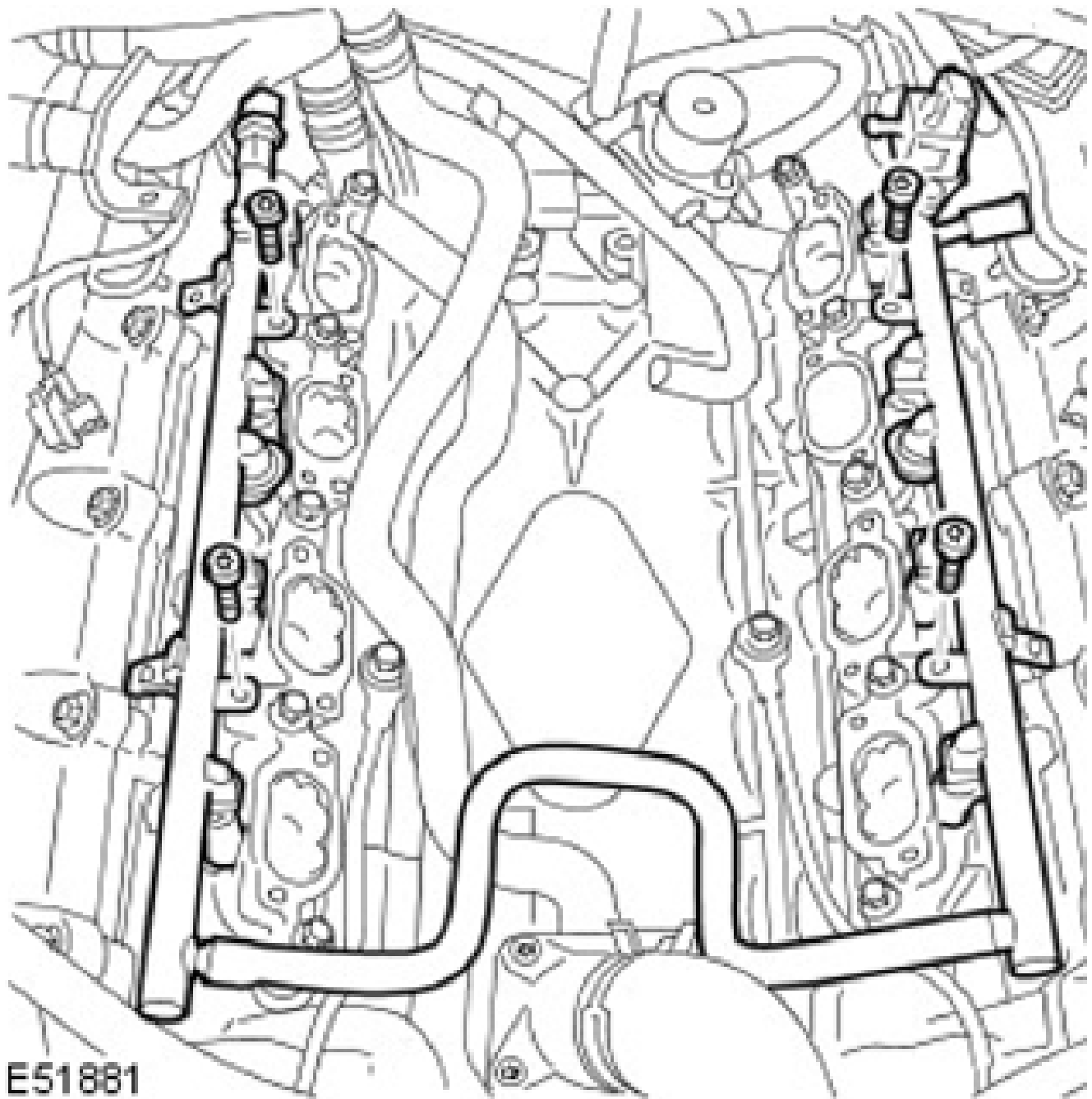


56. Install the fuel rail and injectors.
- Clean the component mating faces.
 - Install new O-ring seals.
 - Tighten the Torx screws to 10 Nm.

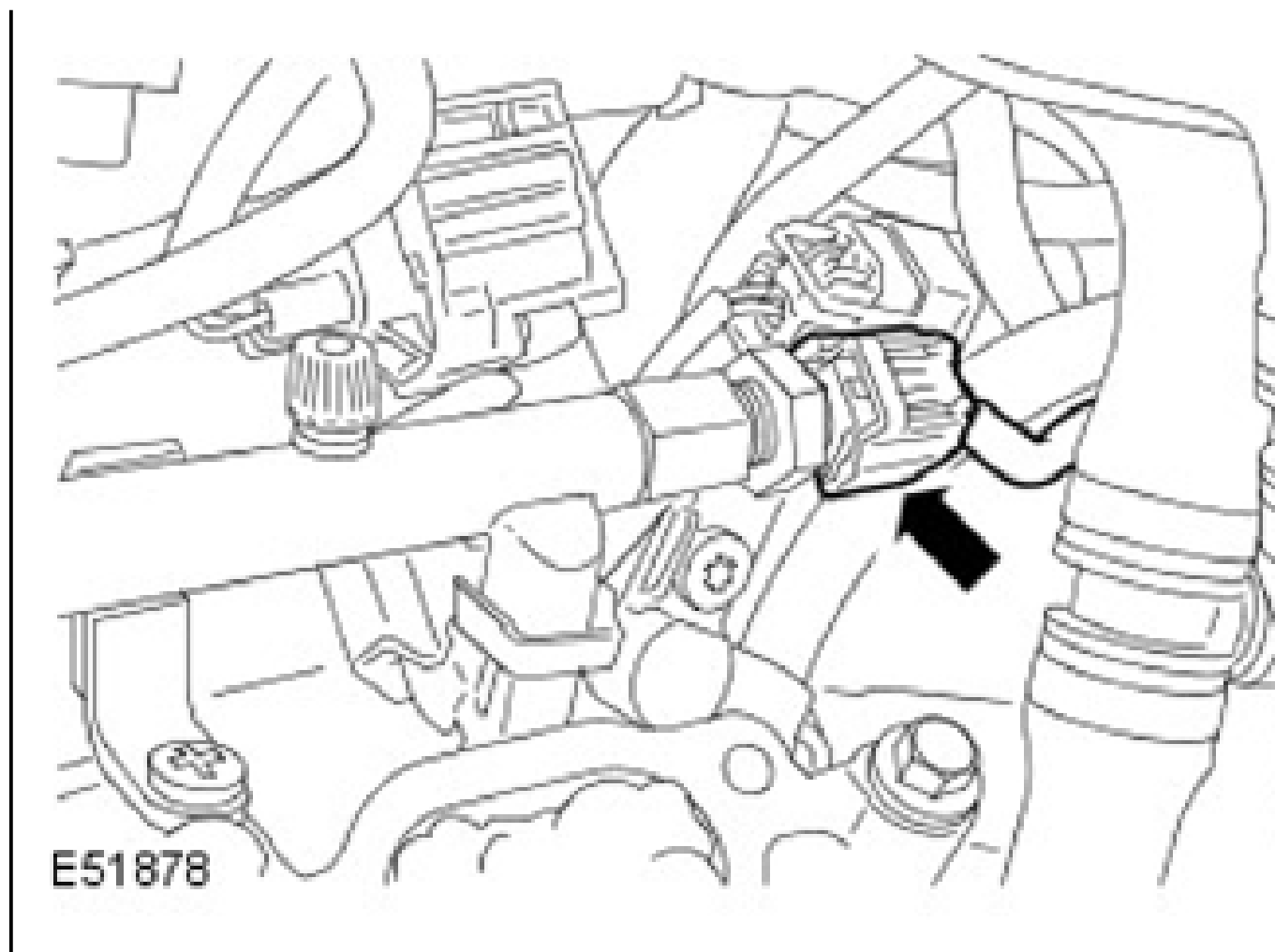


57. Install the injector harness.

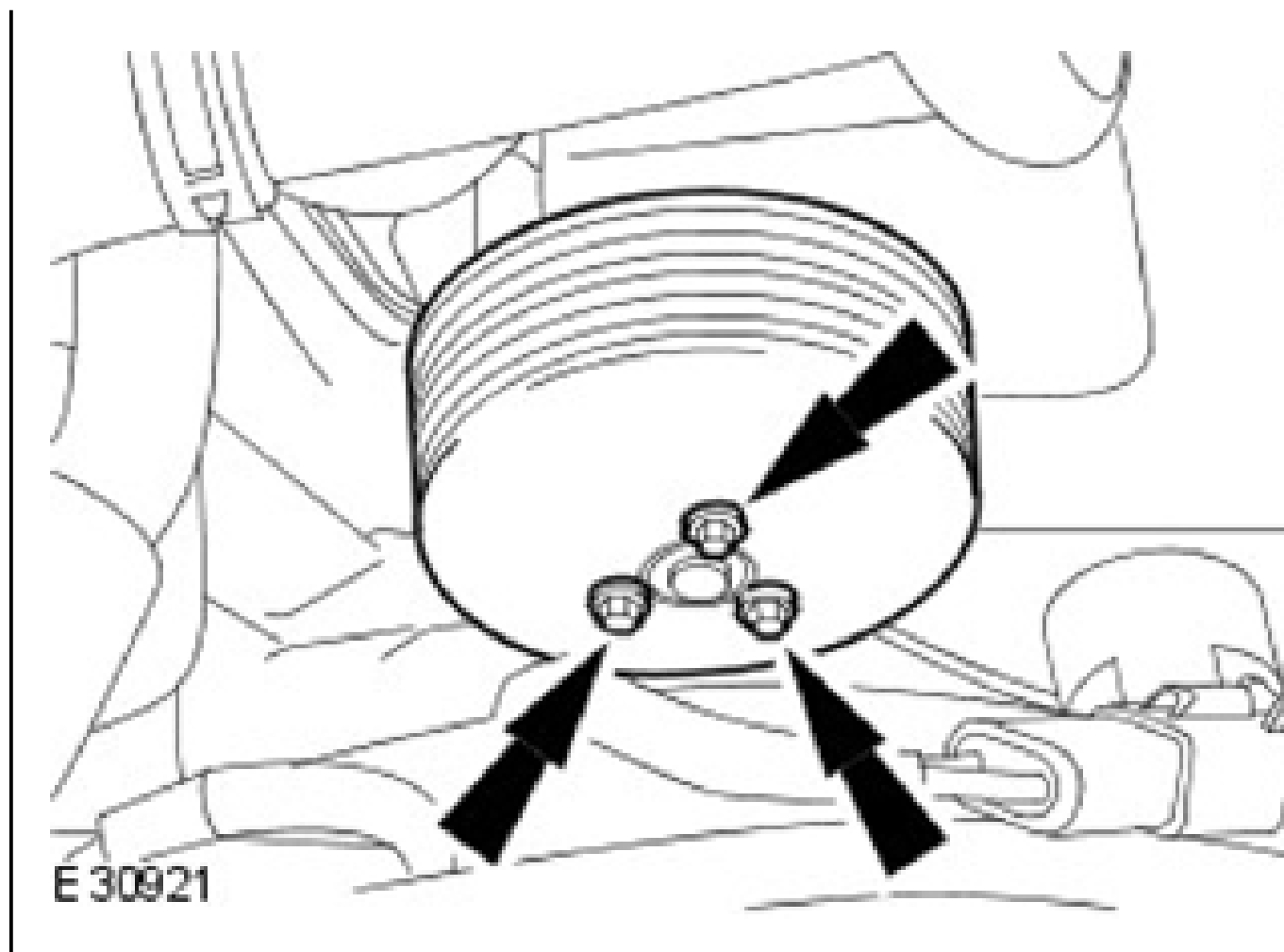
- Secure the clips.
- Connect the electrical connectors.



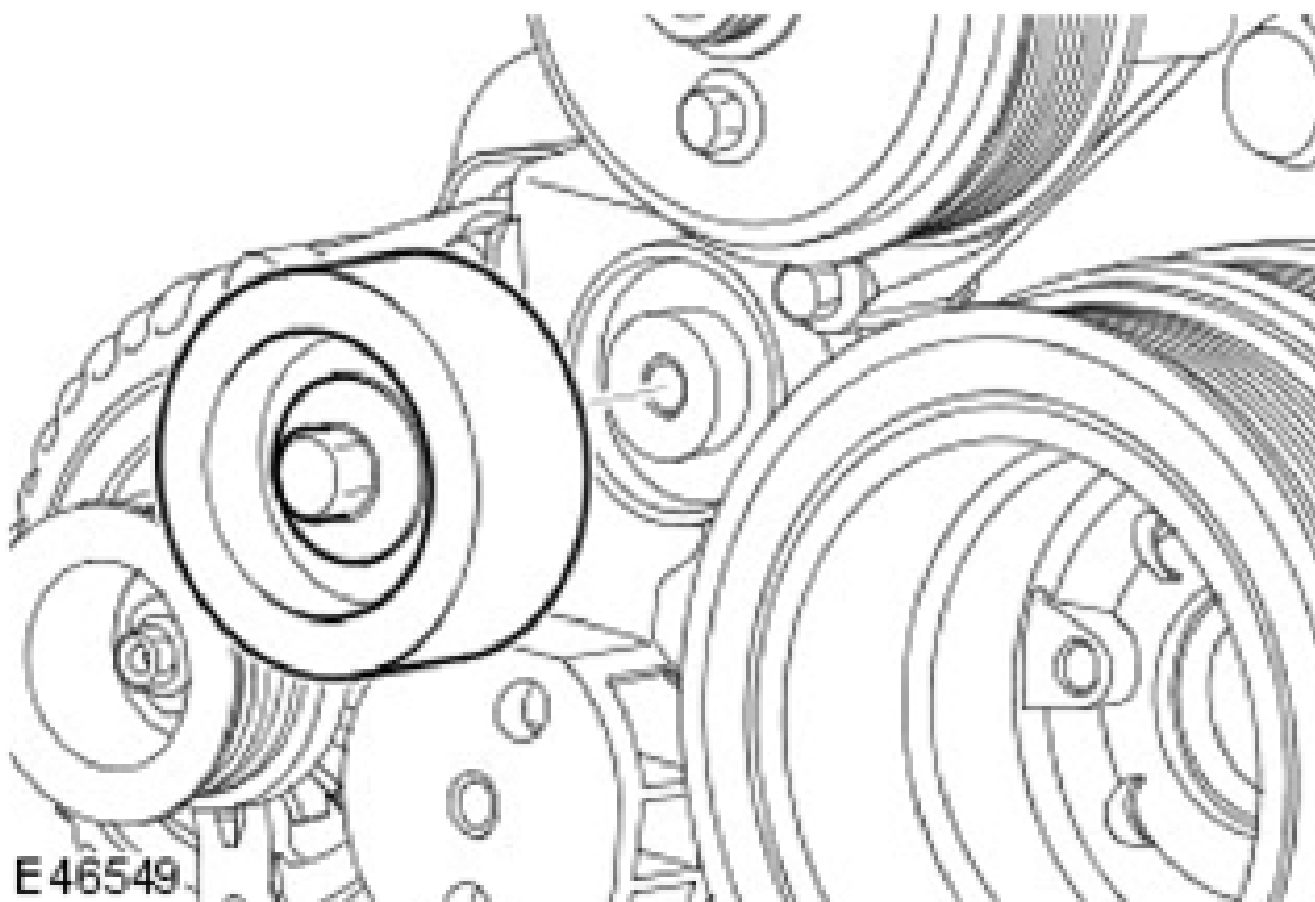
58. Connect the fuel temperature sensor electrical connector.



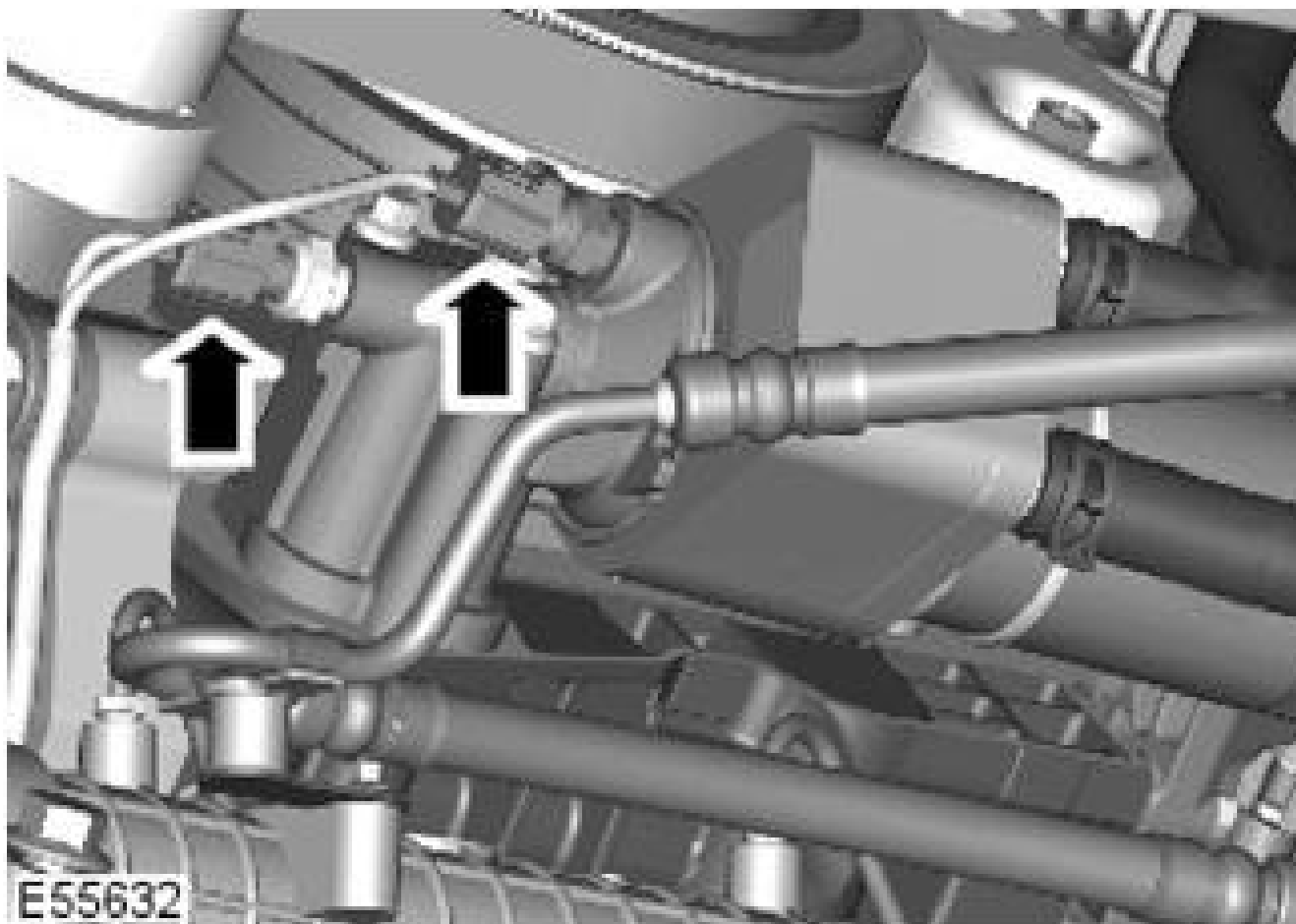
59. Install the coolant pump pulley.
- Tighten the bolts to 10 Nm.



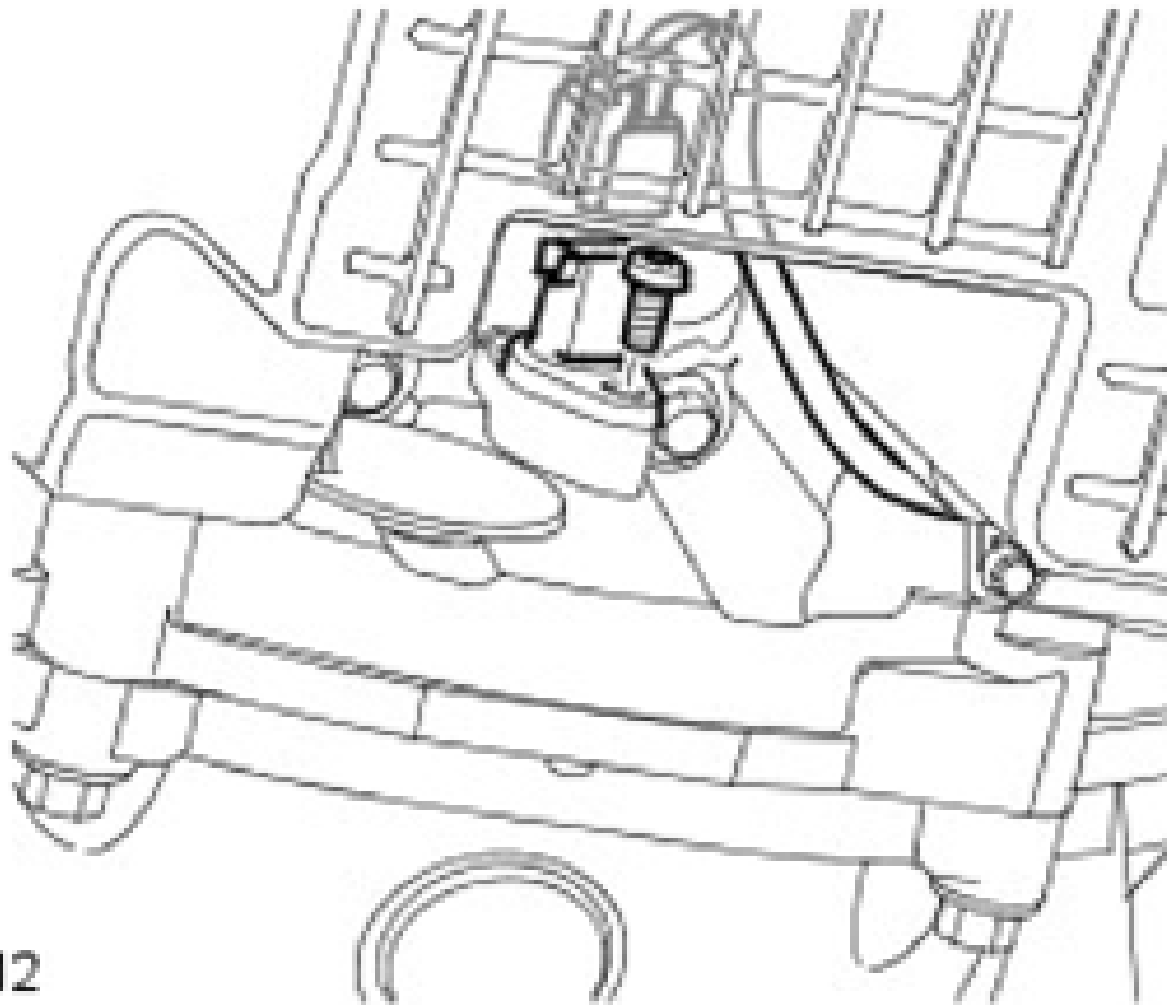
60. Install the accessory drive belt idler pulley.
- Tighten the bolt to 25 Nm.



61. Connect the oil temperature and oil pressure sensors.



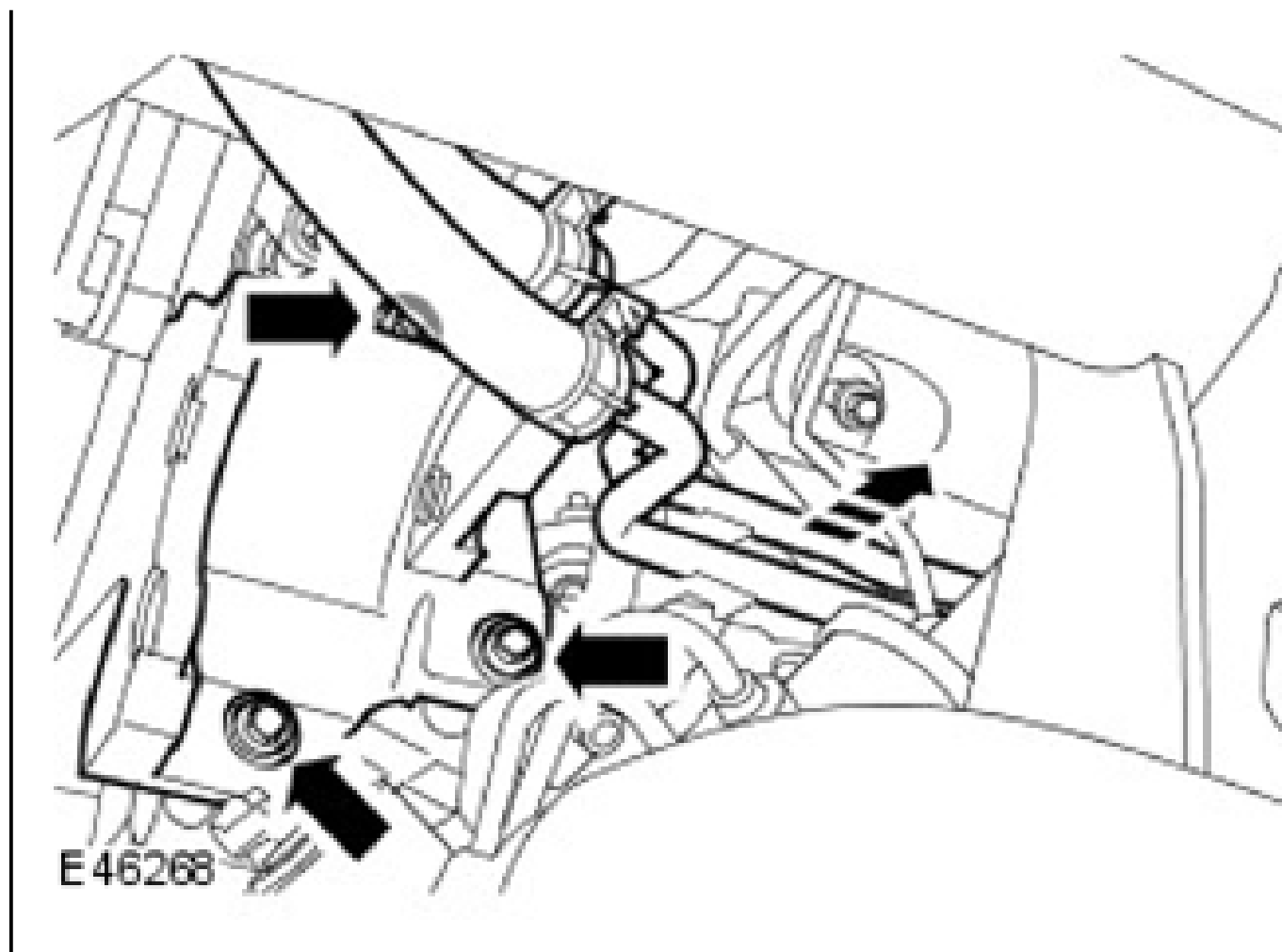
62. Install the crankshaft position (CKP) sensor electrical connector.
- Connect the CKP sensor electrical connector.



E45412

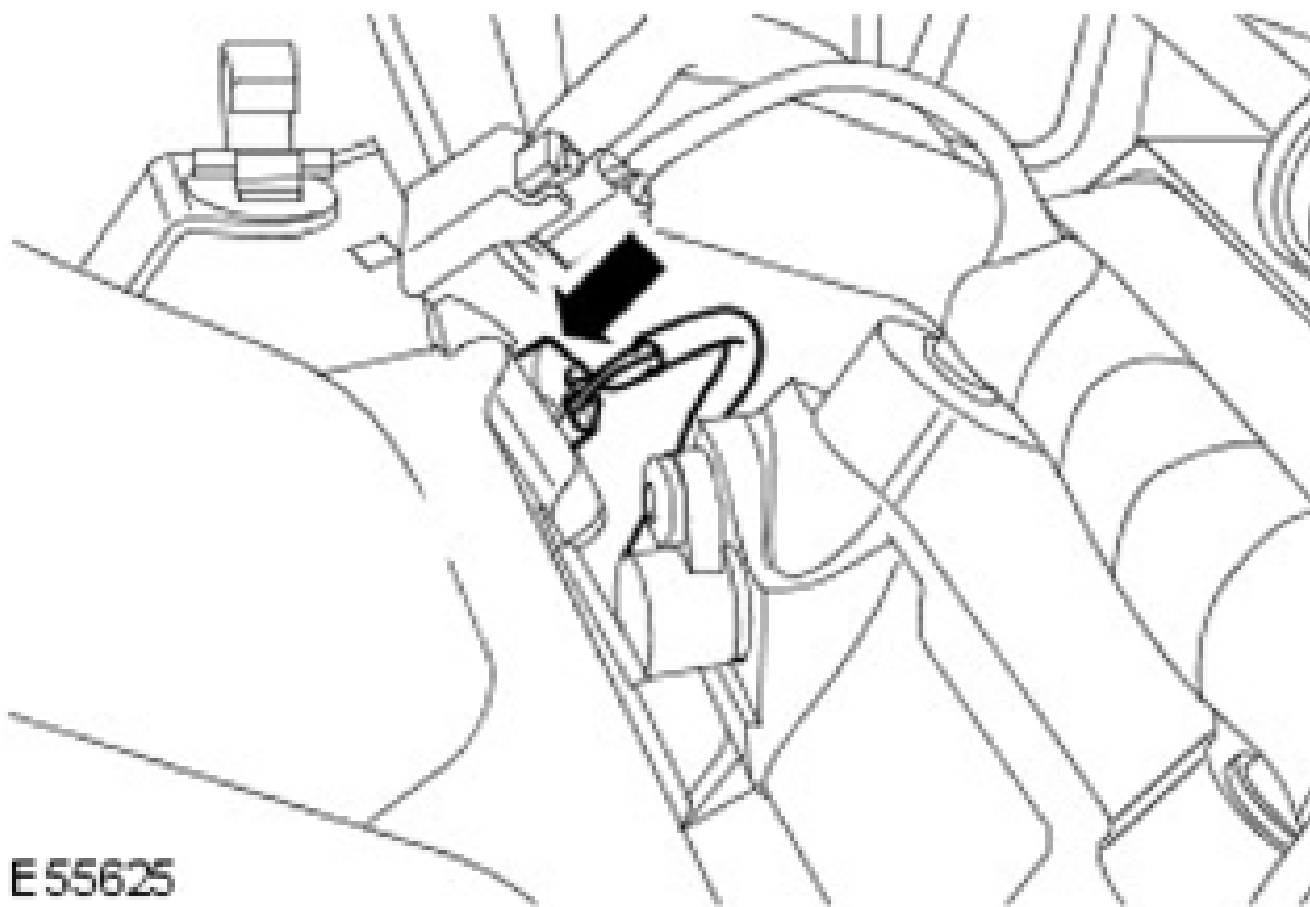
63. Install the power steering pump mounting bracket.

- Clean the component mating faces.
- Tighten the bolts to 25 Nm.
- Secure the transmission cooler pipes into clips.



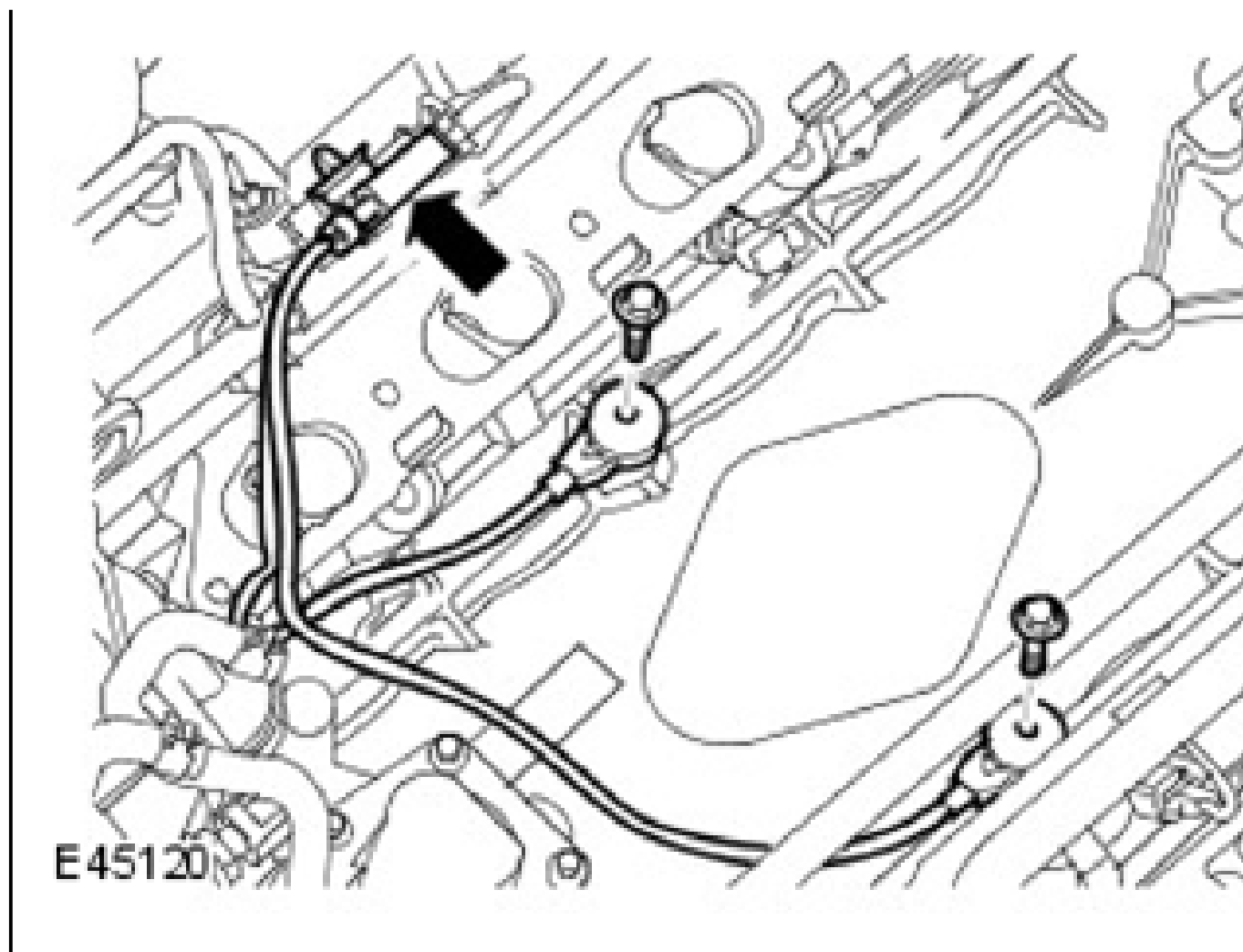
64. Connect and secure the CMP sensor electrical connectors.

- Repeat the operation for the RH side.



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

65. Connect the KS electrical connector.

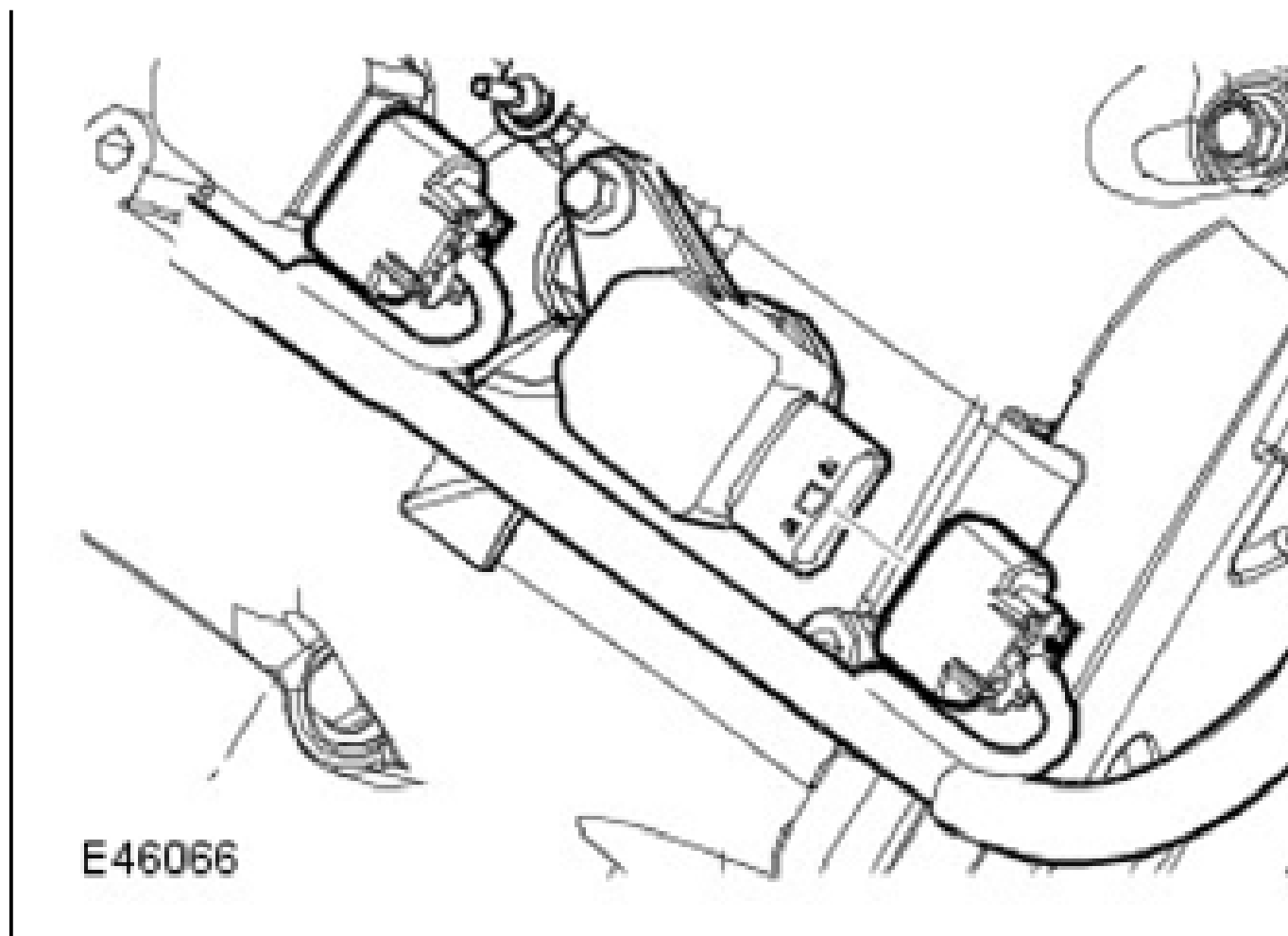


66. Connect the engine coolant temperature (ECT) sensor electrical connector.

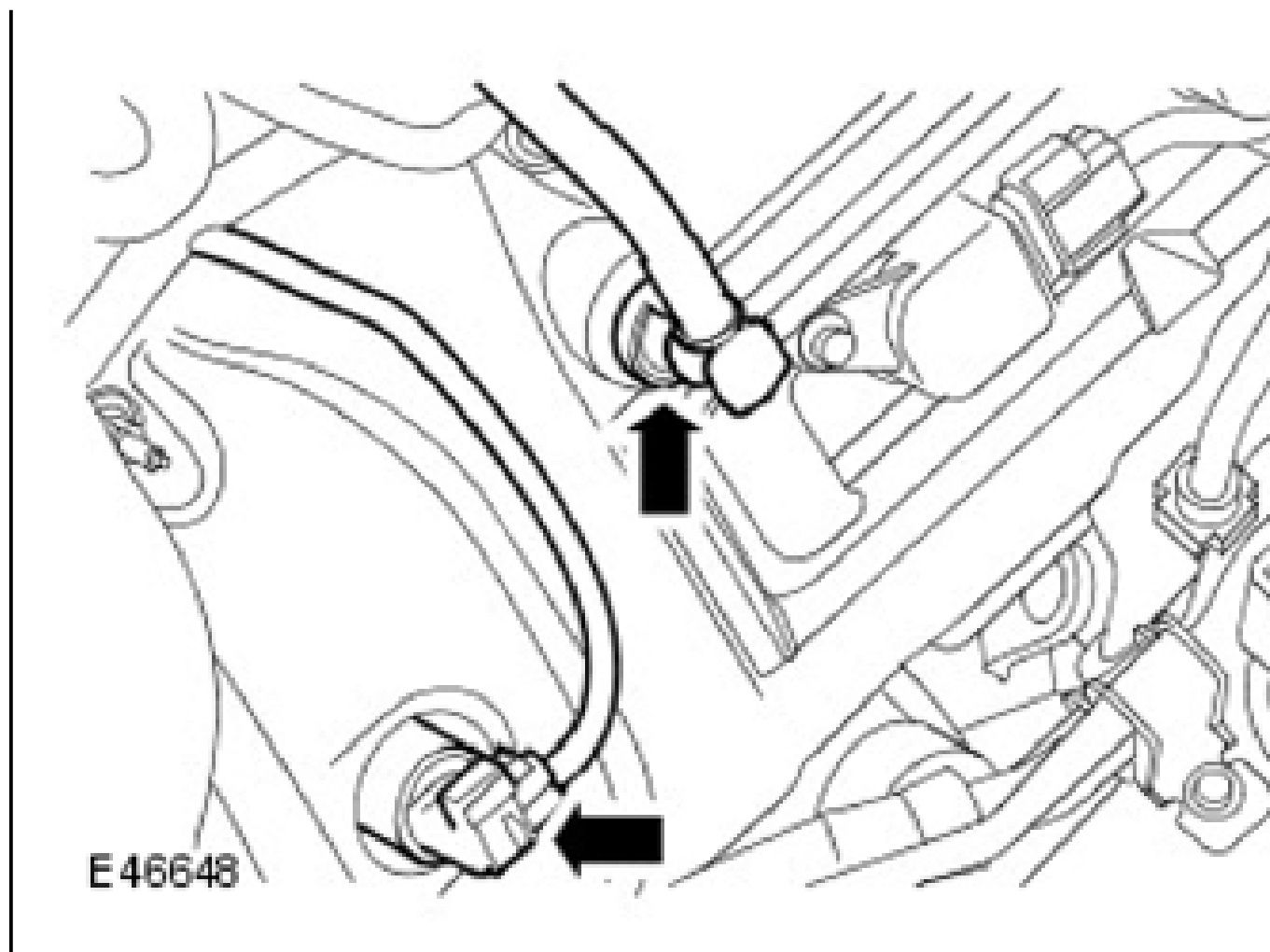


67. Connect the ignition coil-on-plug electrical connections.

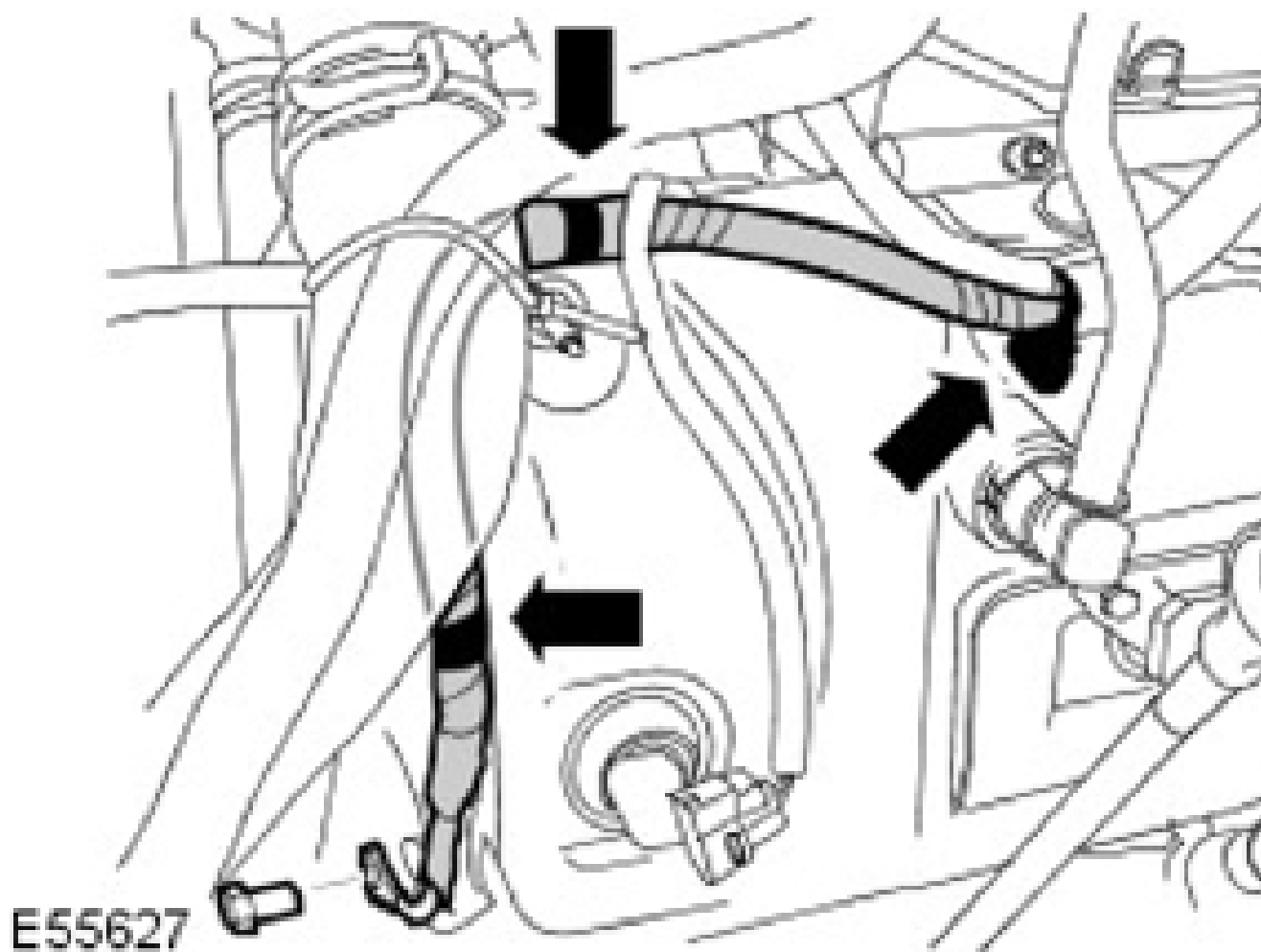
- Install the clips.
- Repeat the above procedure for the other side.



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

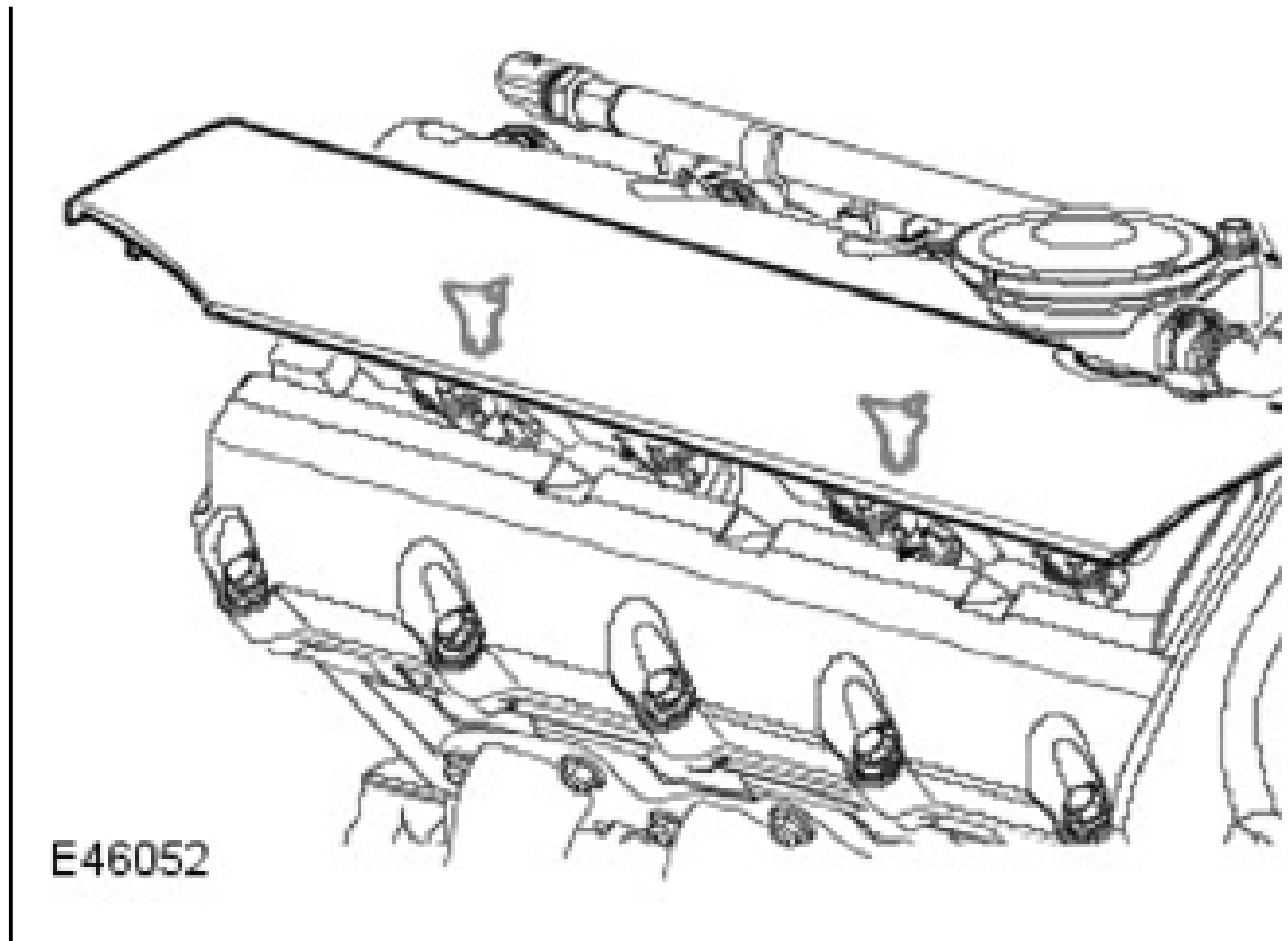


69. Connect the cylinder head earth ground connector.
- Install the bolt.
 - Secure the 3 clips.



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

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



71. Remove the engine from the engine stand.
72. Install the engine assembly.

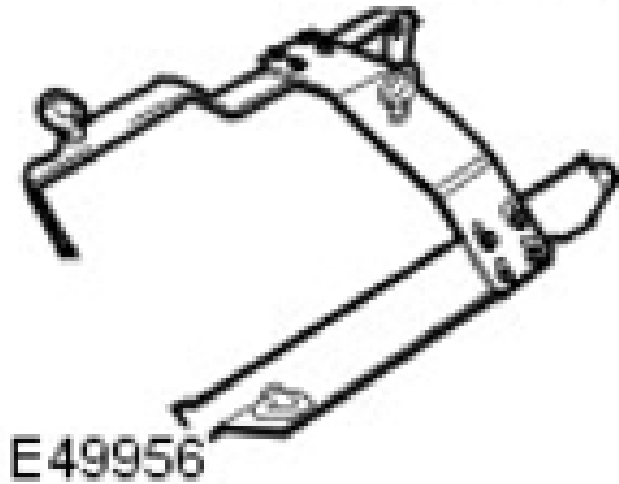
INSTALLATION

ENGINE

SPECIAL TOOL(S)

Engine lifting cradle
303-1144

303-1144



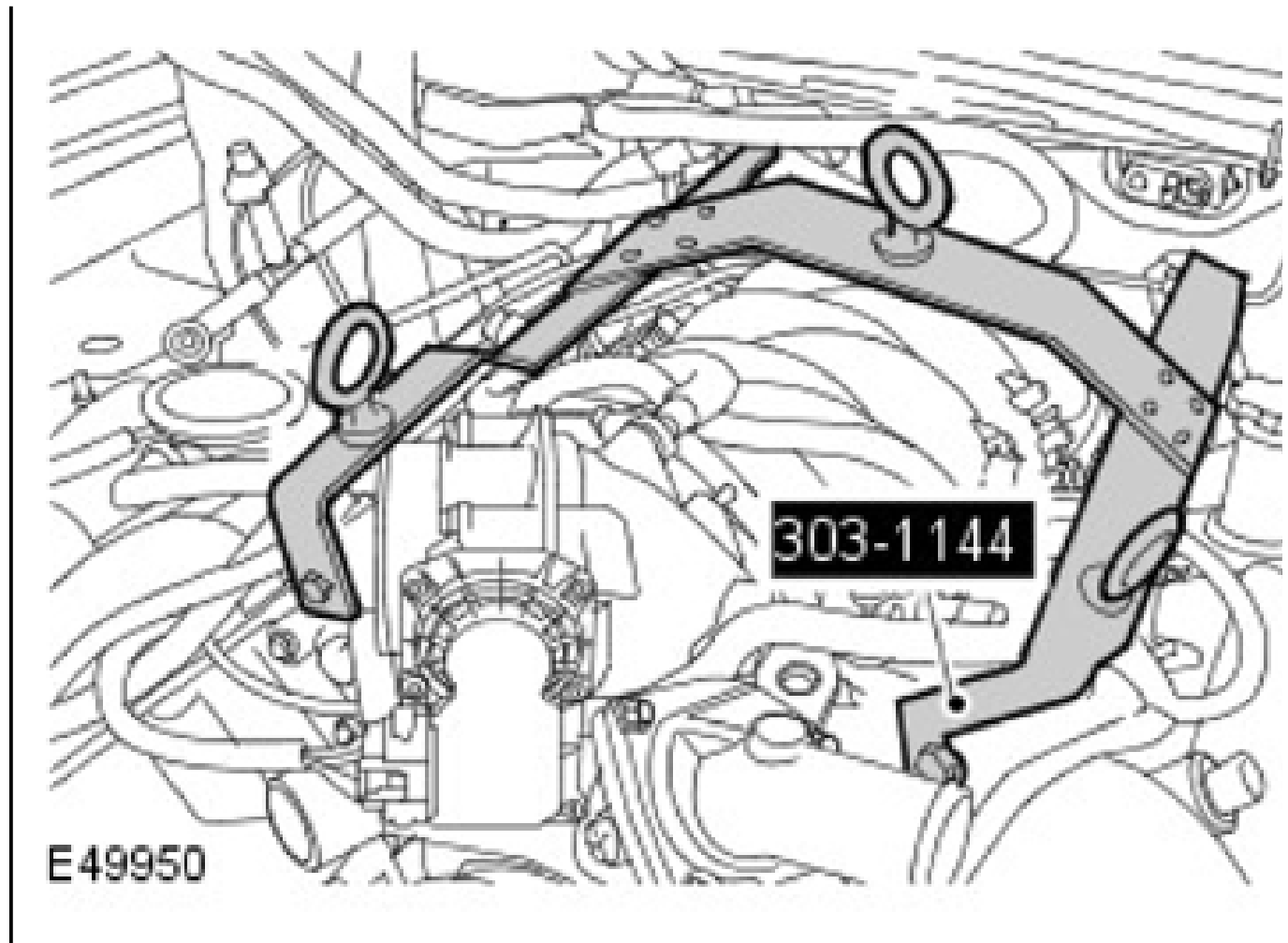
Fuel spring lock decoupling tool
310-D005

310-D005

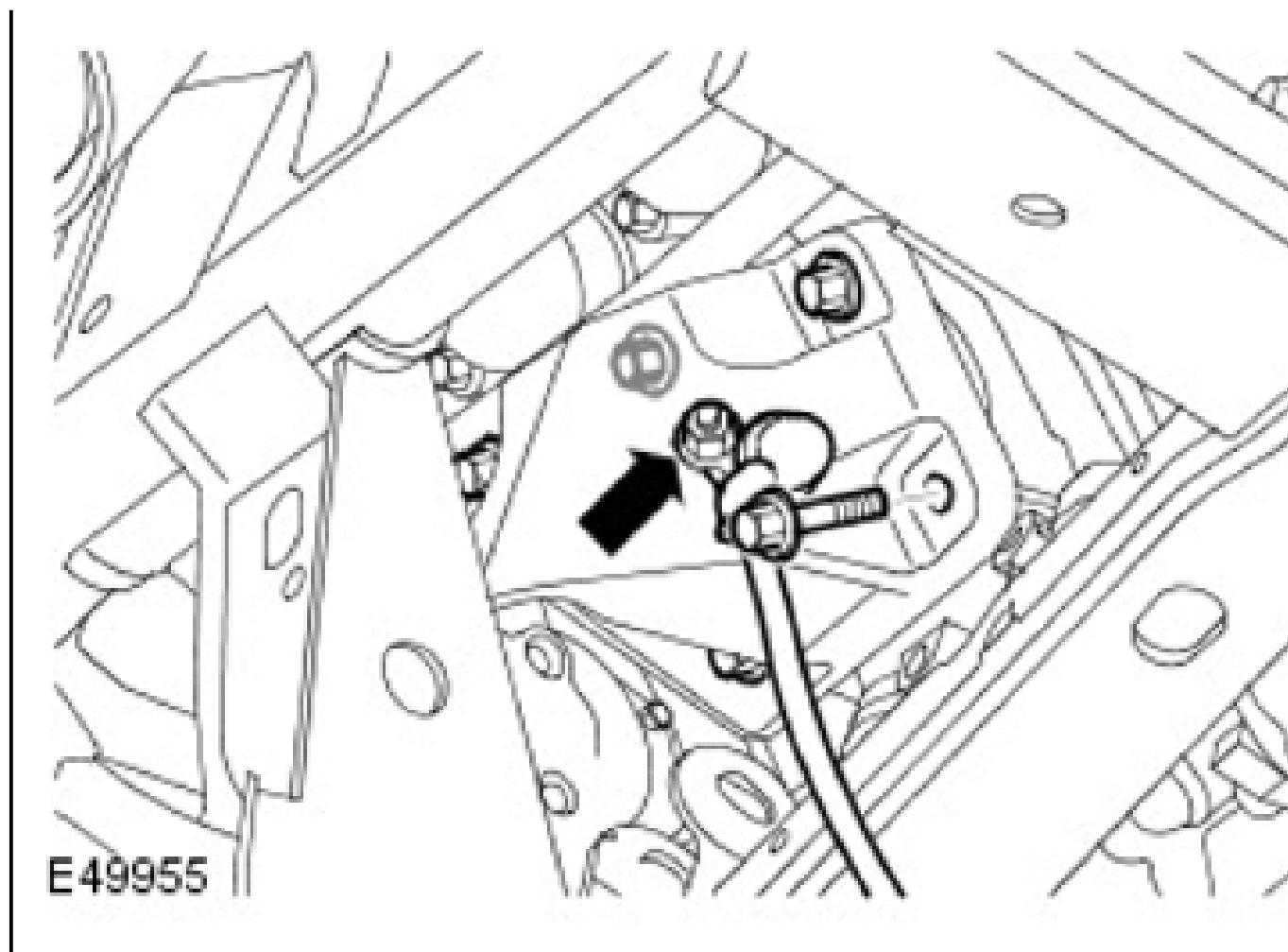


INSTALLATION

1. Install the engine lifting cradle.
 - Connect the lifting chains.



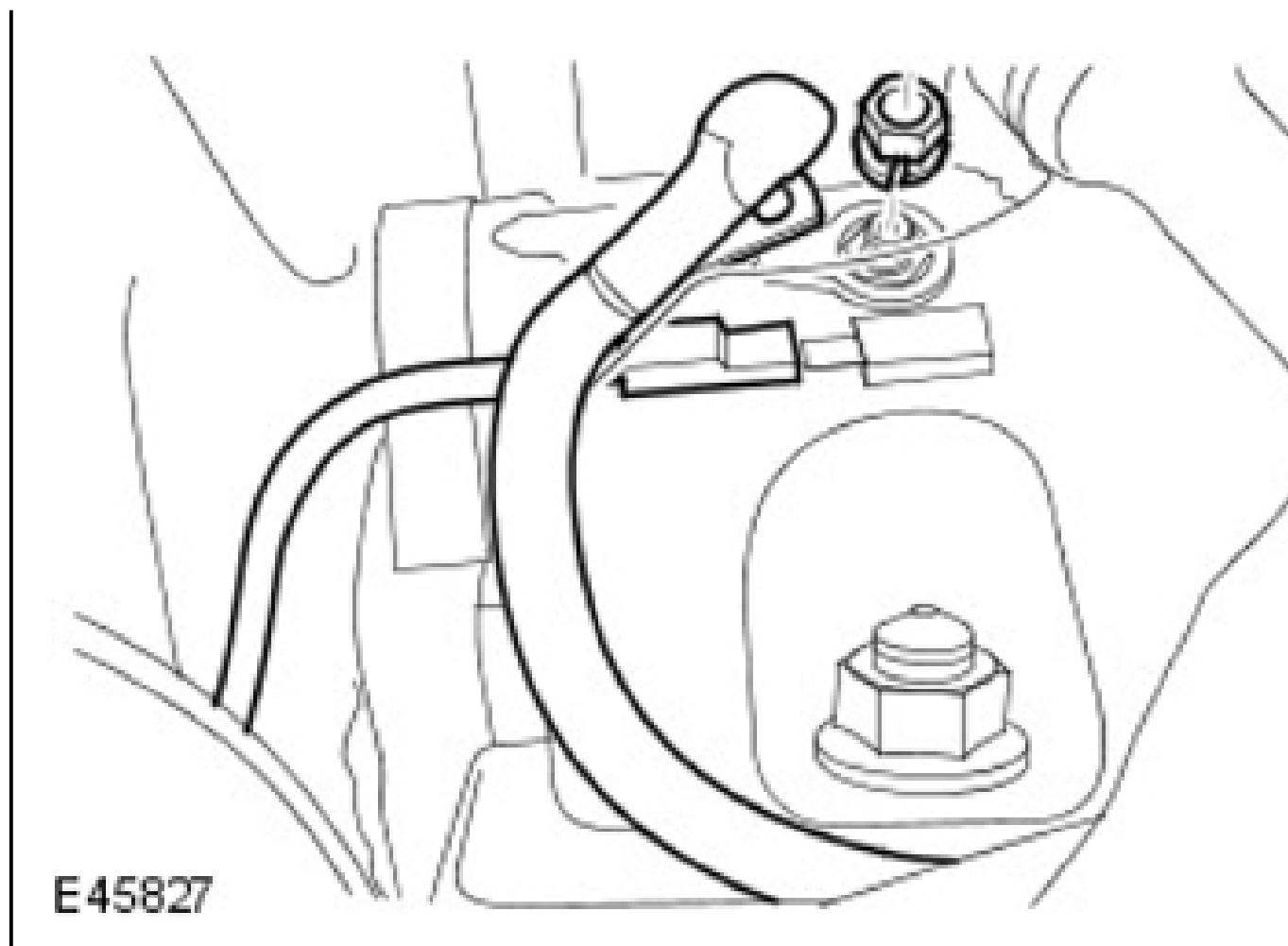
2. Carefully lower the engine until approximately 35mm above engine mounts.
3. Install the engine front mount bracket.
 - Clean the component mating faces.
 - Tighten the bolts to 45 Nm (33 lb.ft).
 - Connect the engine ground cable and tighten the bolt to 25 Nm (18 lb.ft).



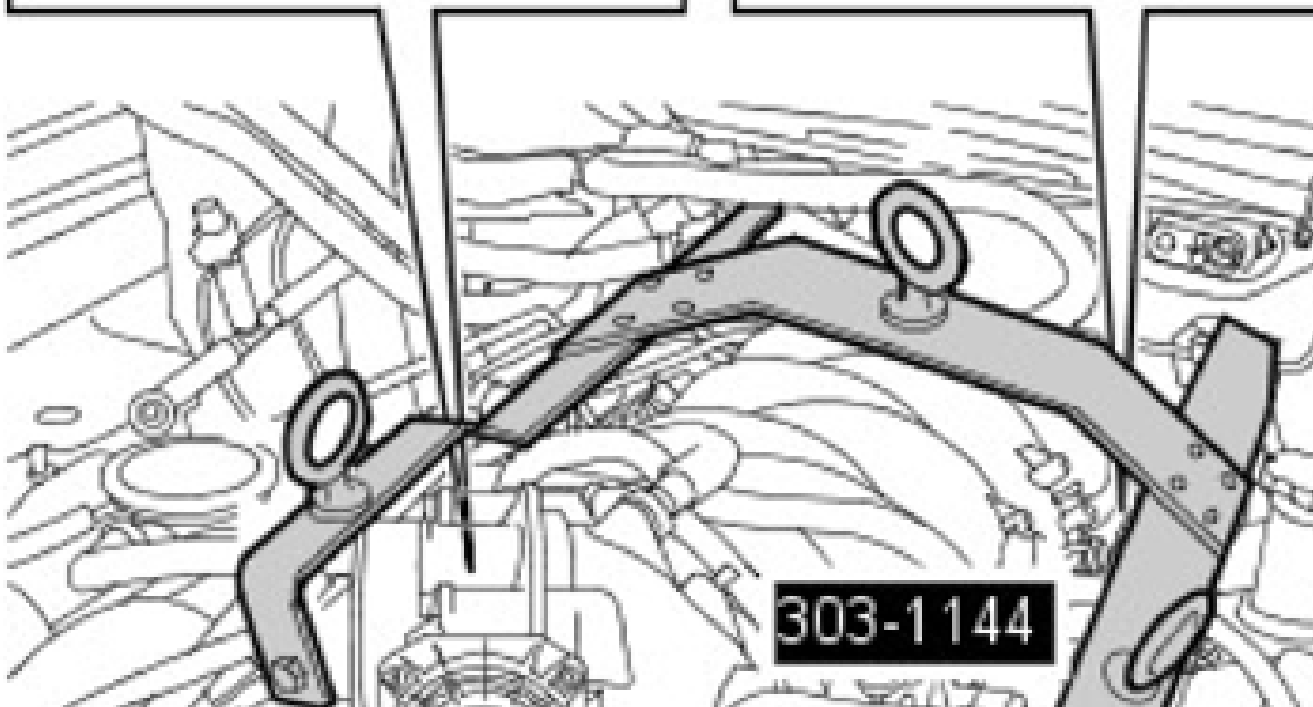
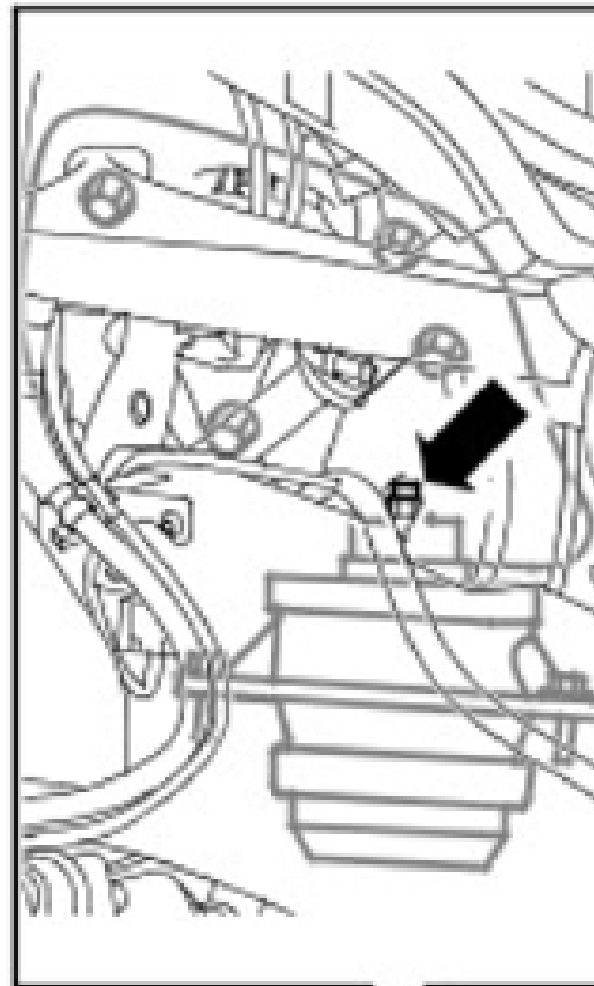
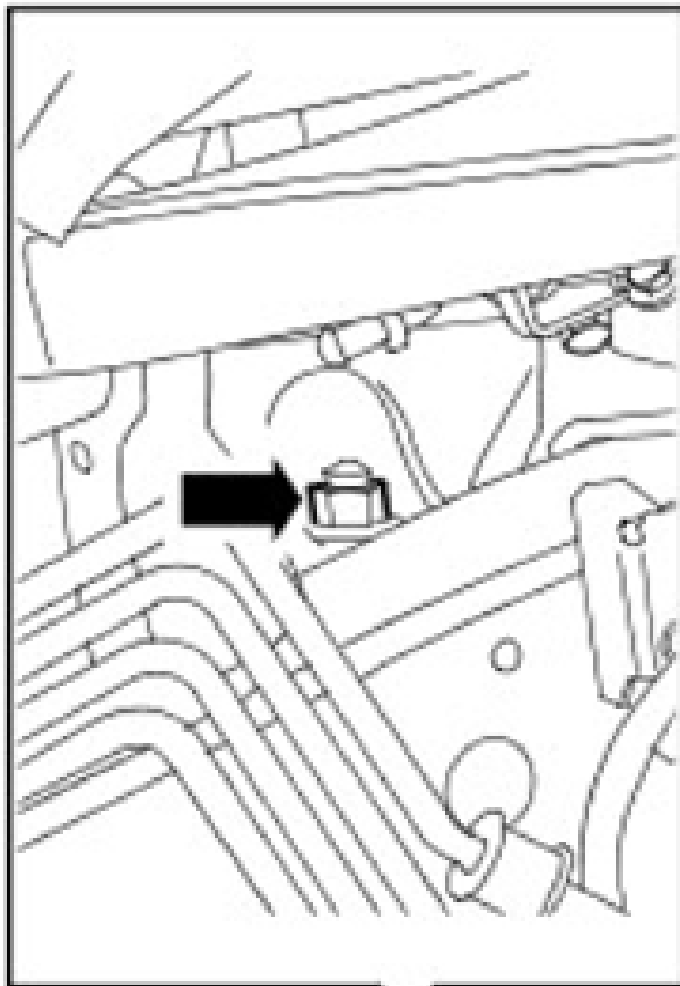
4. Install the starter motor.
 - Tighten the bolts to 45 Nm (33 lb.ft).



5. Connect the starter motor electrical connectors.
 - Connect and secure the electrical connectors.
 - Tighten the starter motor nut to 10 Nm (7 lb.ft).

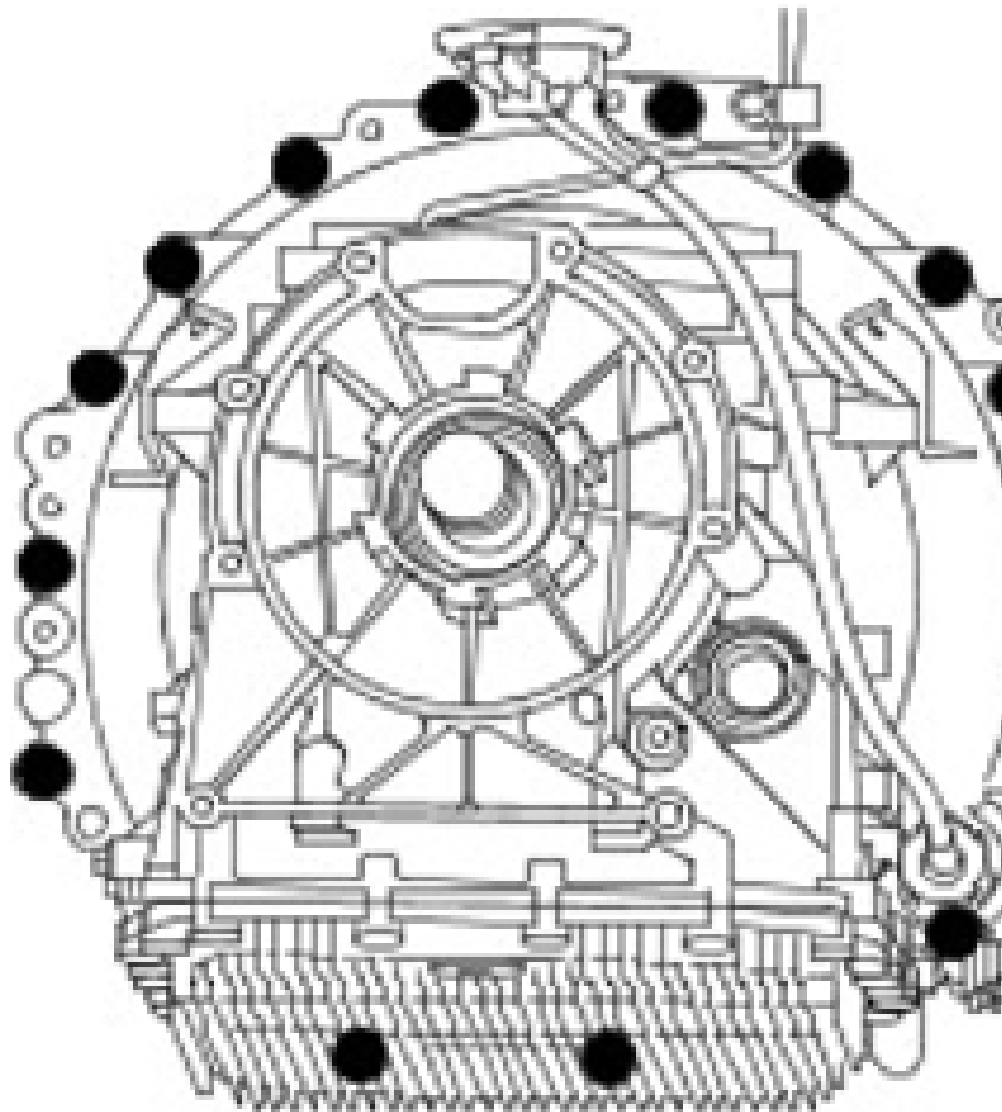


6. With assistance align the engine to the transmission and engine mounts.
 - Tighten the engine mount nuts to 90 Nm (66 lb.ft).

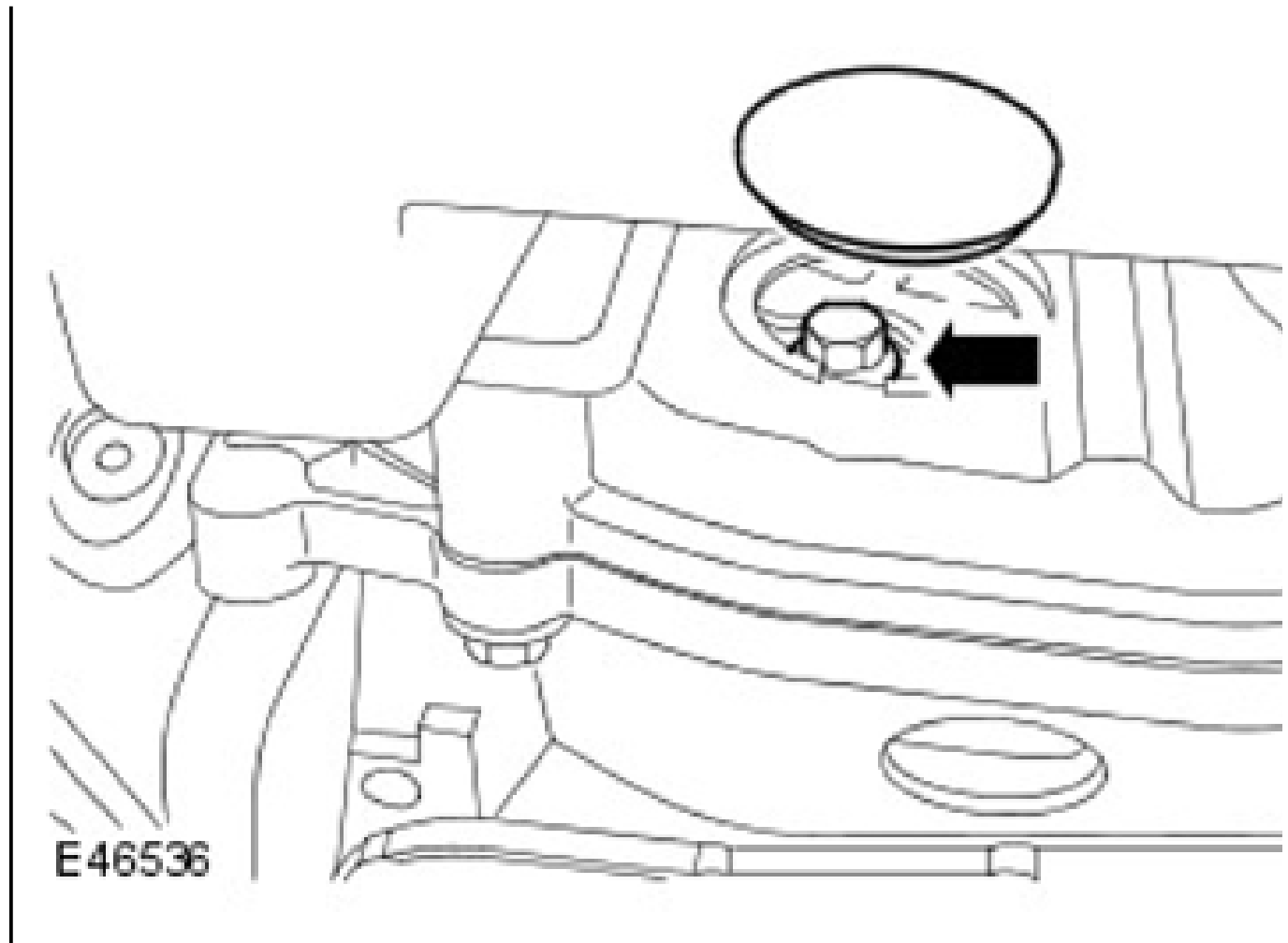


303-1144

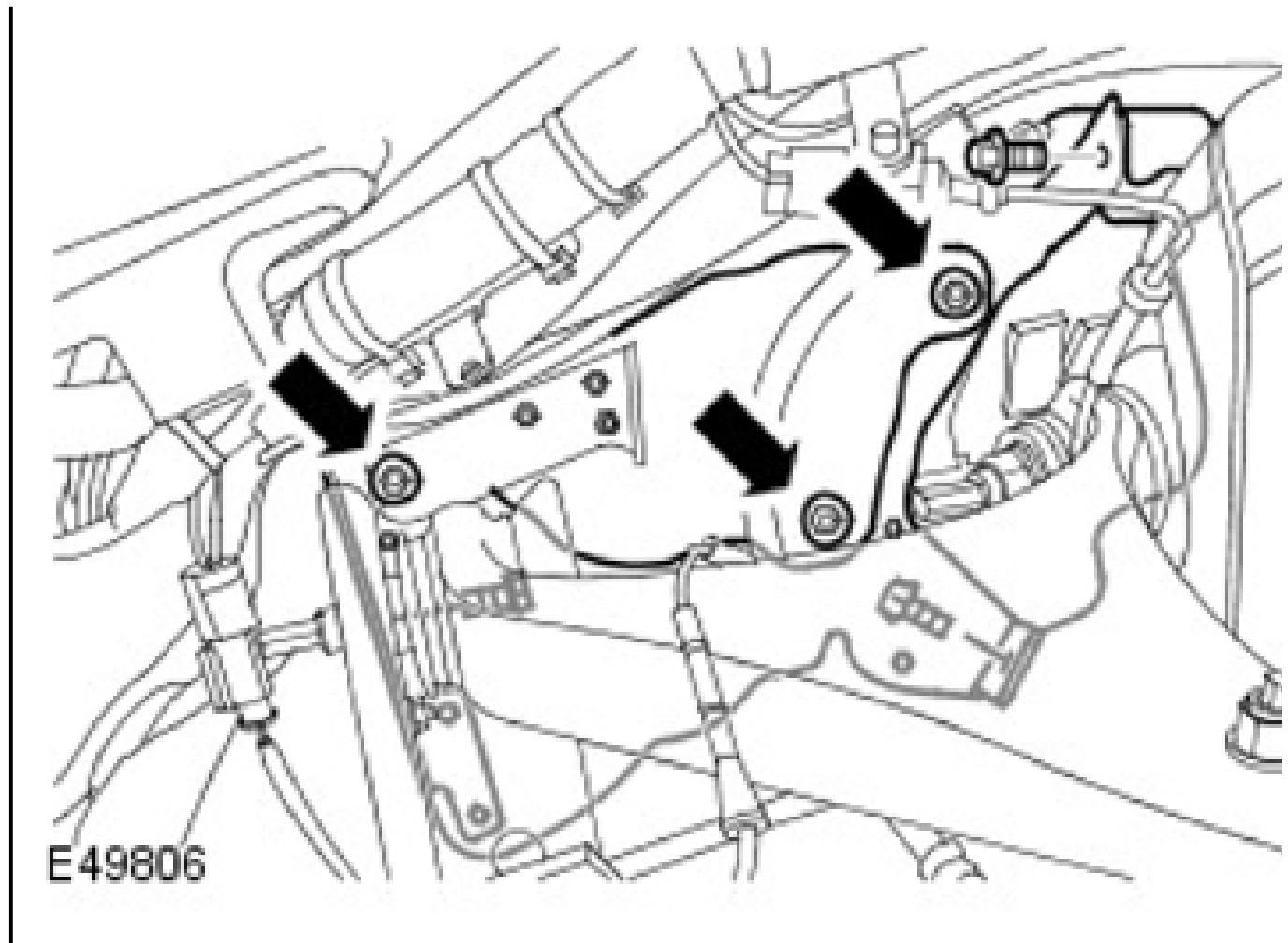
7. Install the transmission retaining bolts.
 - Tighten the bolts to 45 Nm (33 lb.ft).



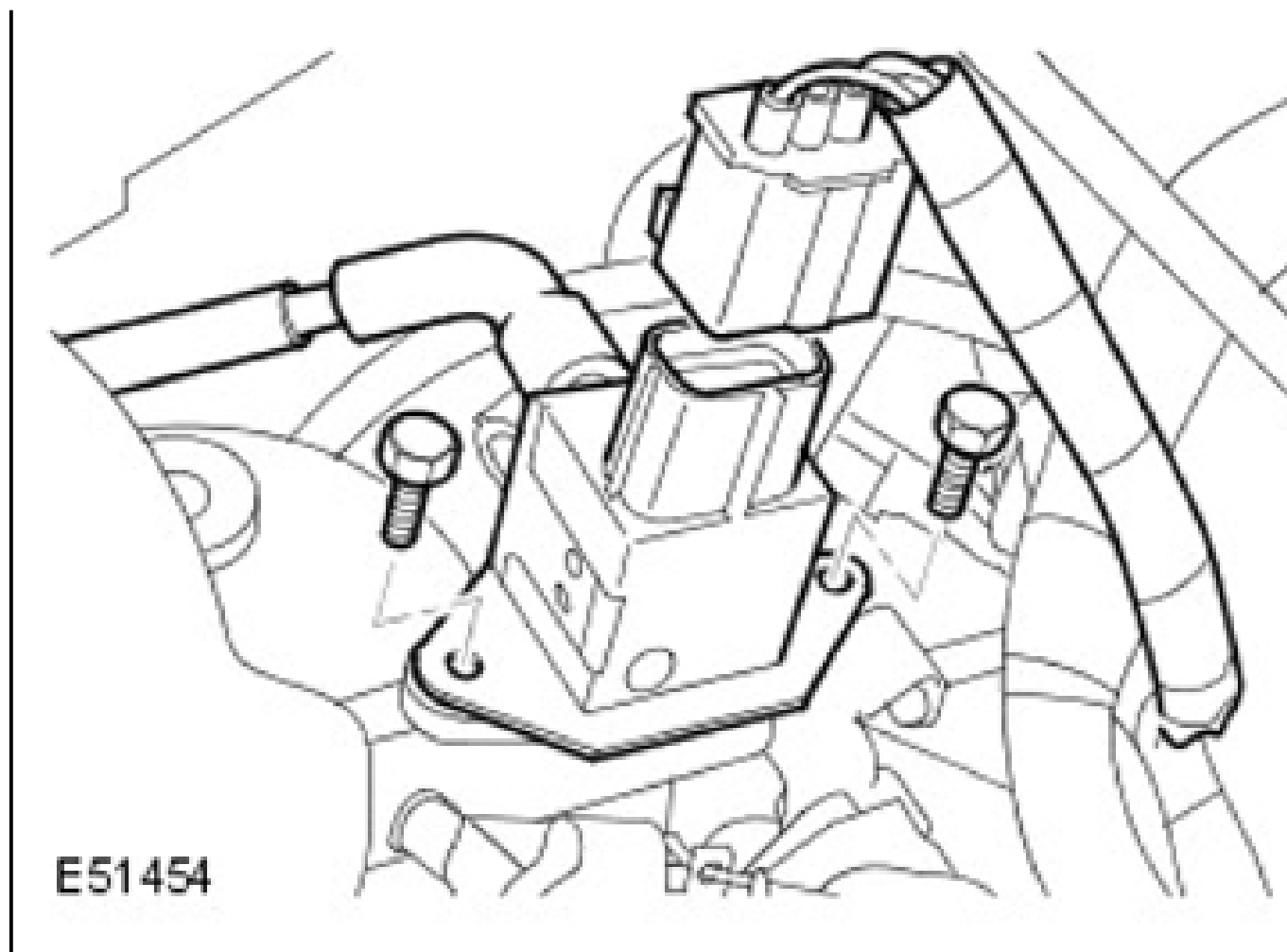
8. Attach the flexplate to the torque converter.
 - Rotate the crankshaft to access the retaining bolts.
 - Tighten the bolts evenly and progressively in 2 stages.
 - Tighten the bolts to 15 Nm (11 lb ft).
 - Tighten the bolts to 110 Nm (81 lb.ft).
 - Install the grommet.



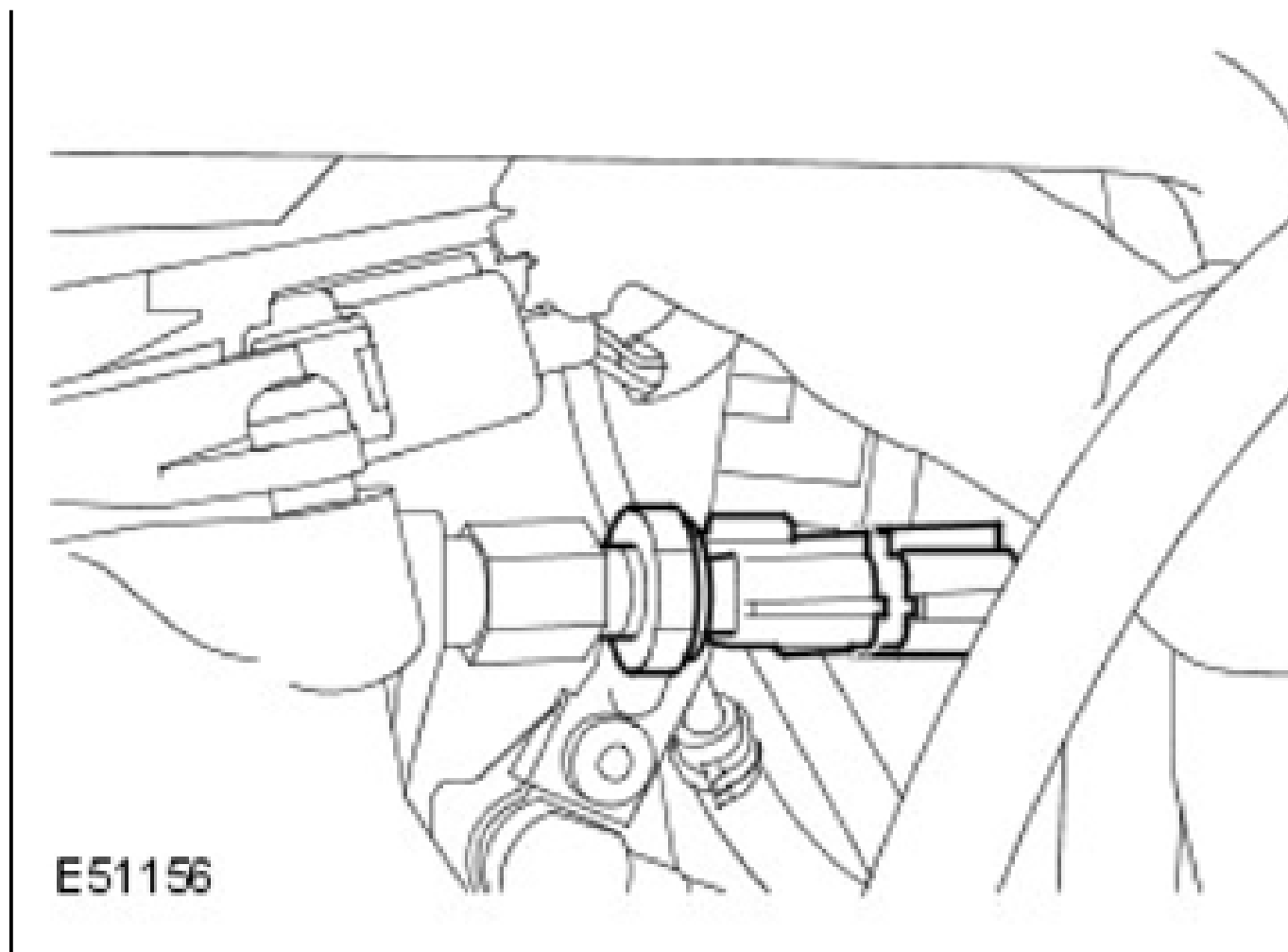
9. Remove the engine lifting cradle.
10. Install the upper suspension arm and brake line heat shields.
 - Tighten to 8 Nm (6 lb.ft)



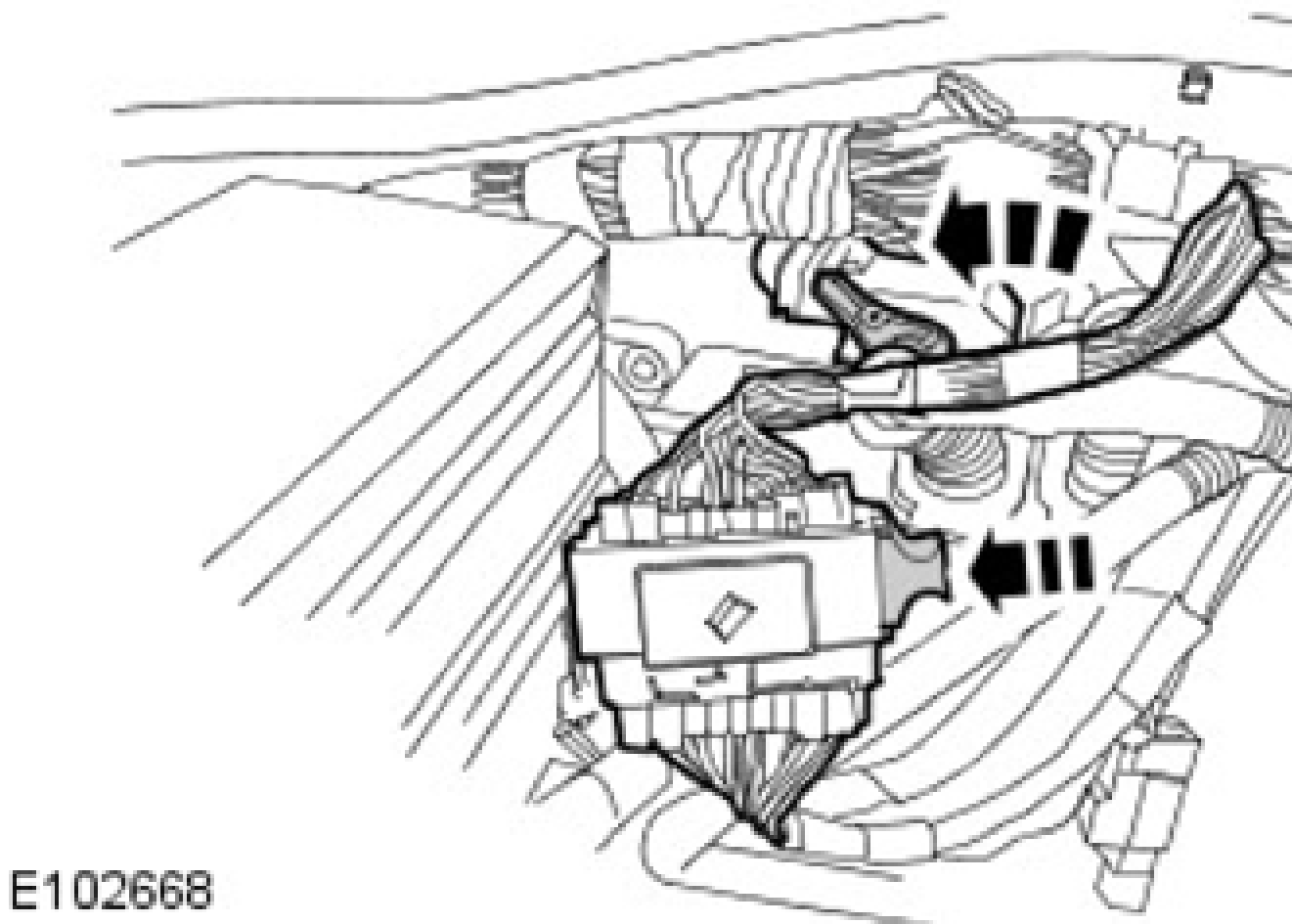
11. Install the fuel pressure sensor.
 - Install the new O-ring seals.
 - Tighten the bolts to 6 Nm (4 lb.ft).



12. Install the fuel temperature sensor.
 - Apply sealant to the sensor thread.
 - Tighten the sensor to 7 Nm (5 lb.ft).

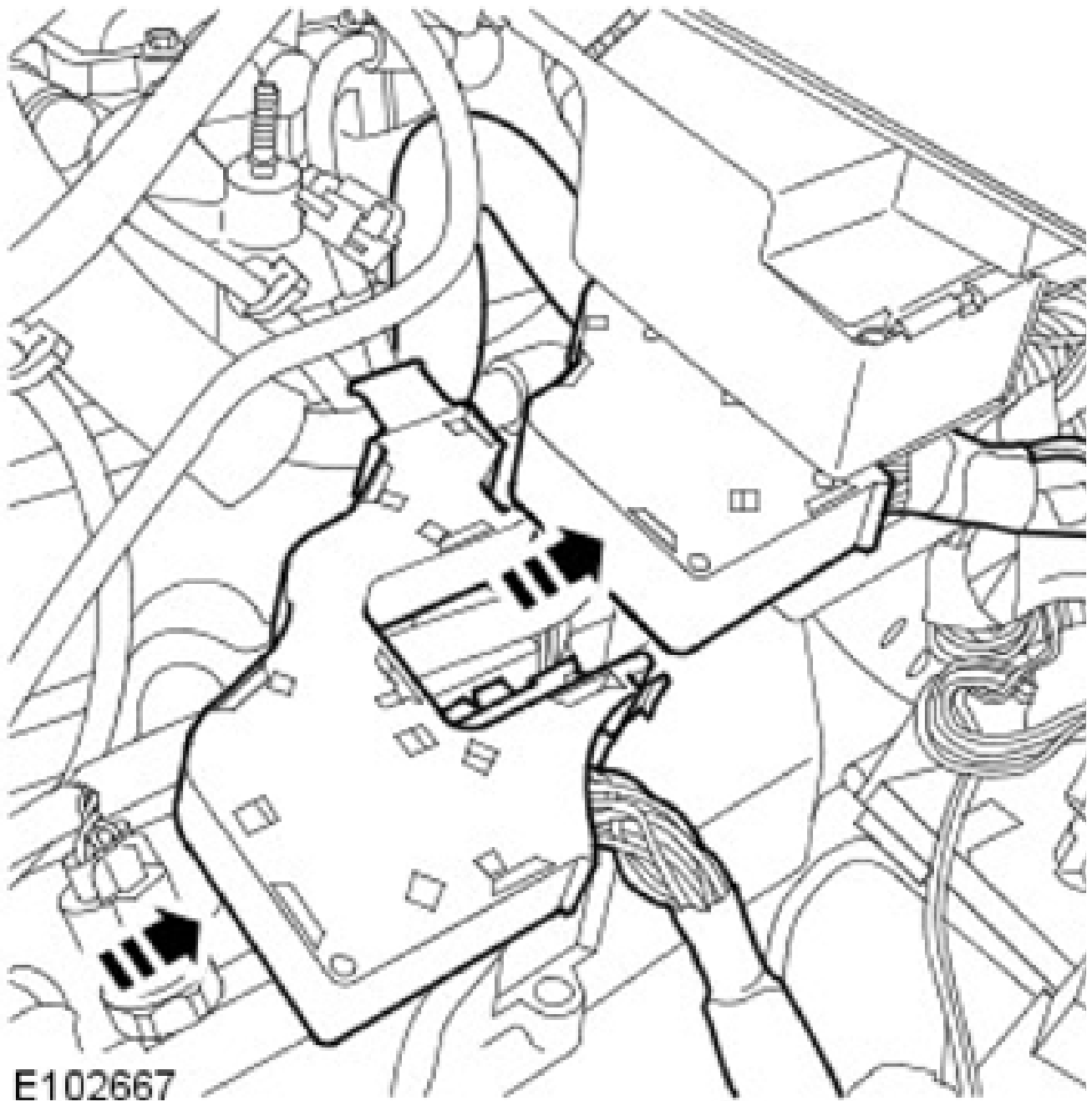


13. Connect the engine wiring harness.
 - Connect the electrical connectors.

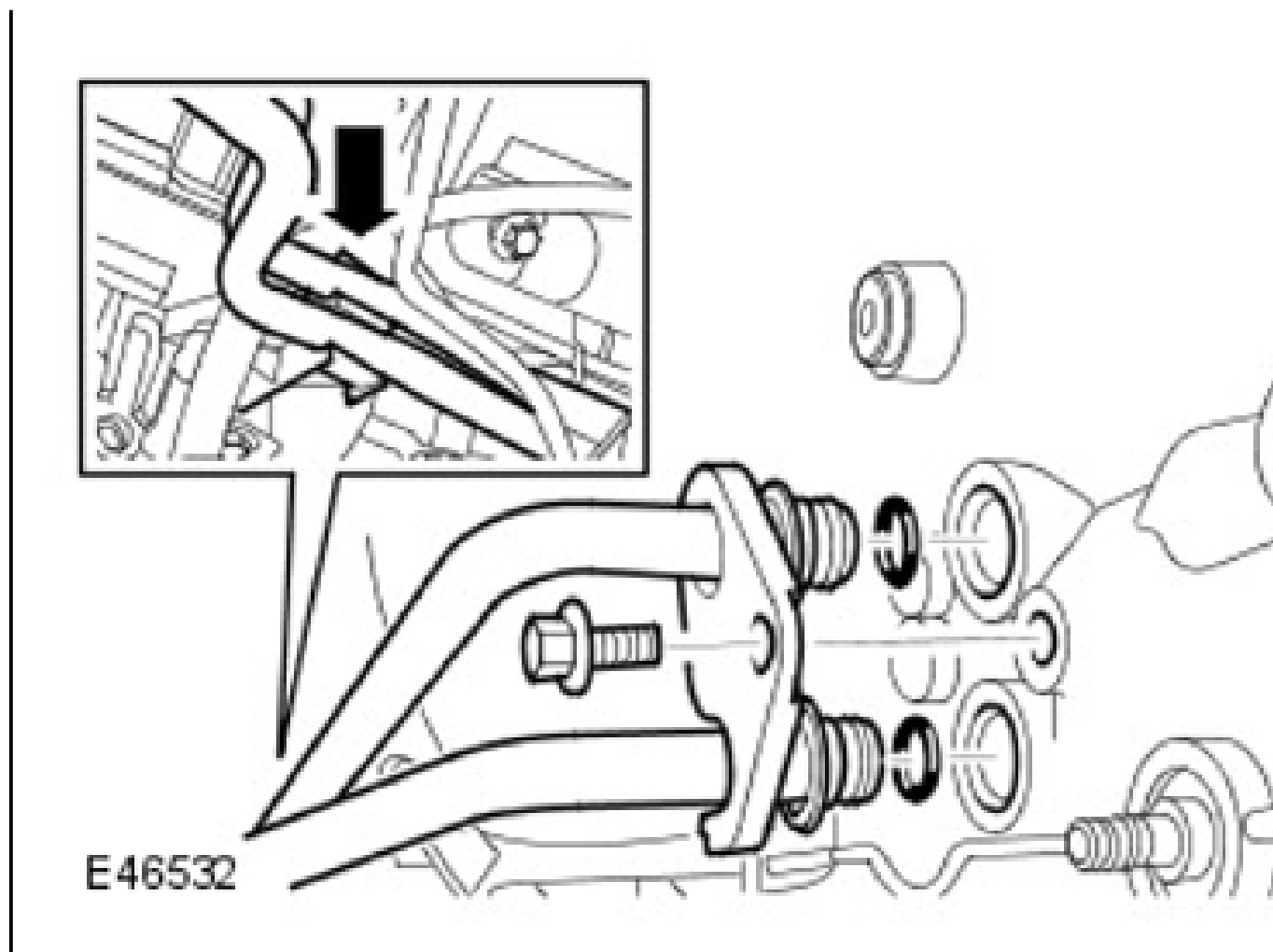


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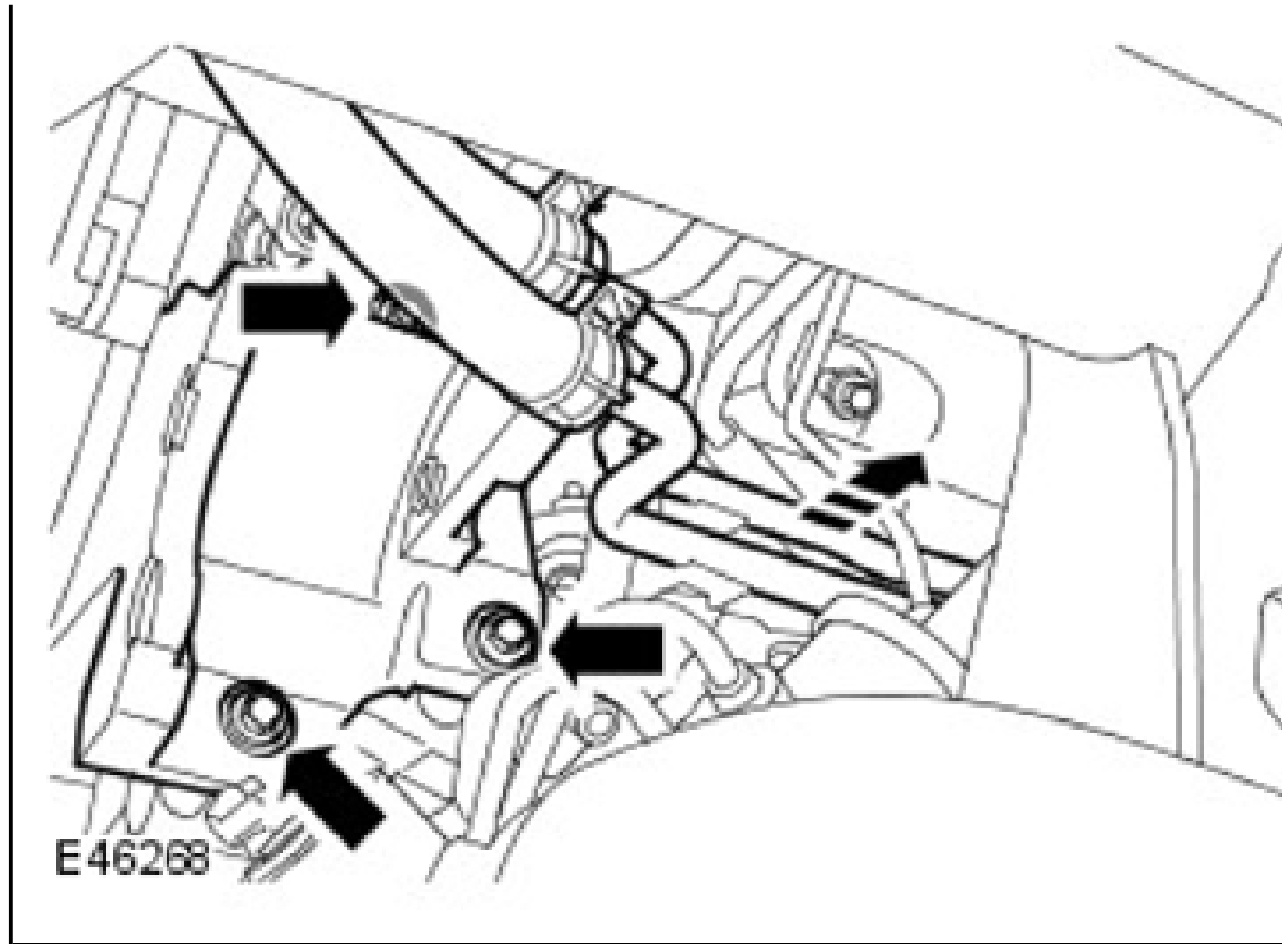
14. Install the cassette.



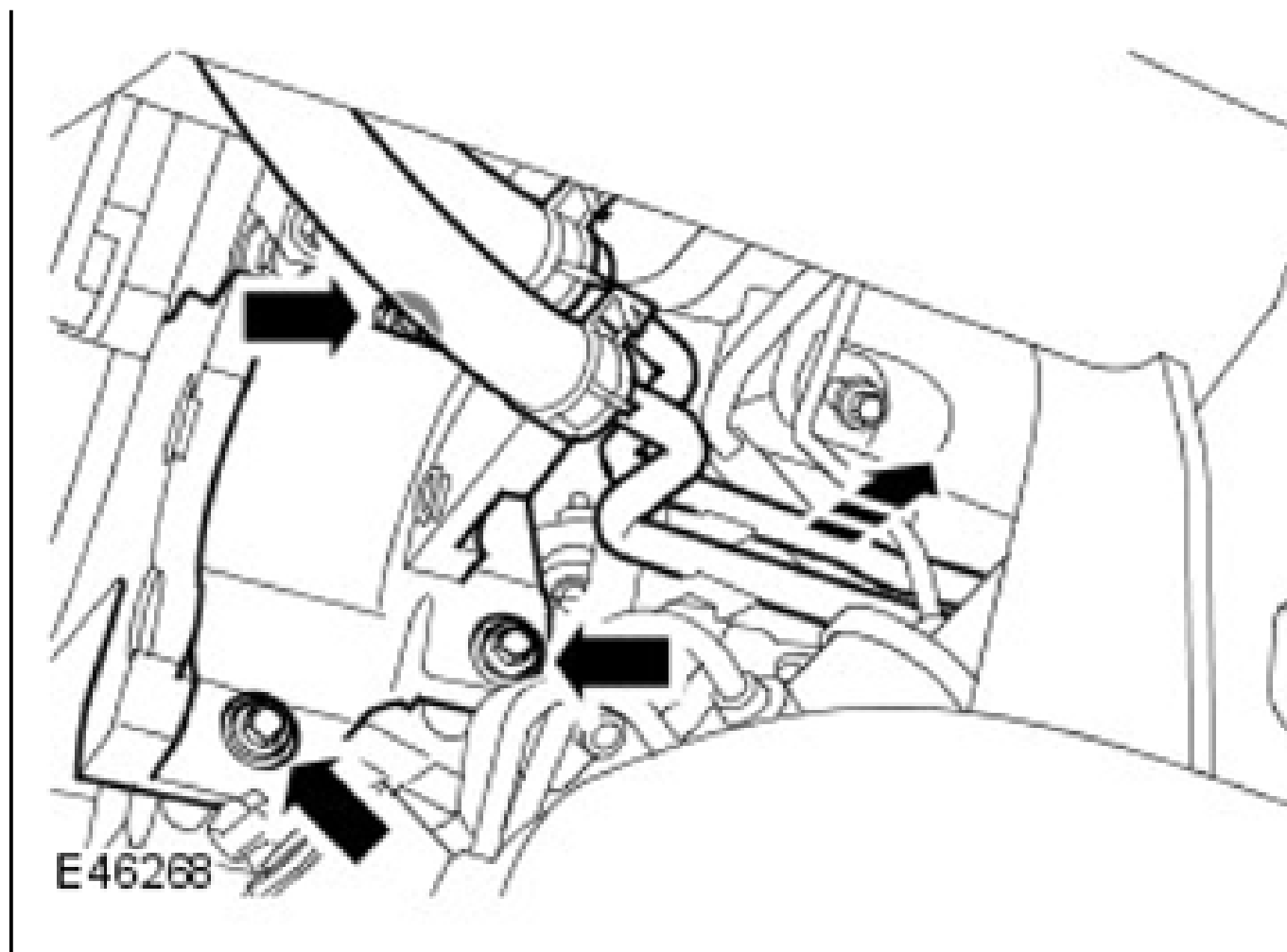
15. Install the transmission cooler pipes.
 - Clean the component mating faces.
 - Install new O-ring seals.
 - Install the clamp.
 - Tighten the bolt to 25 Nm (18 lb.ft).



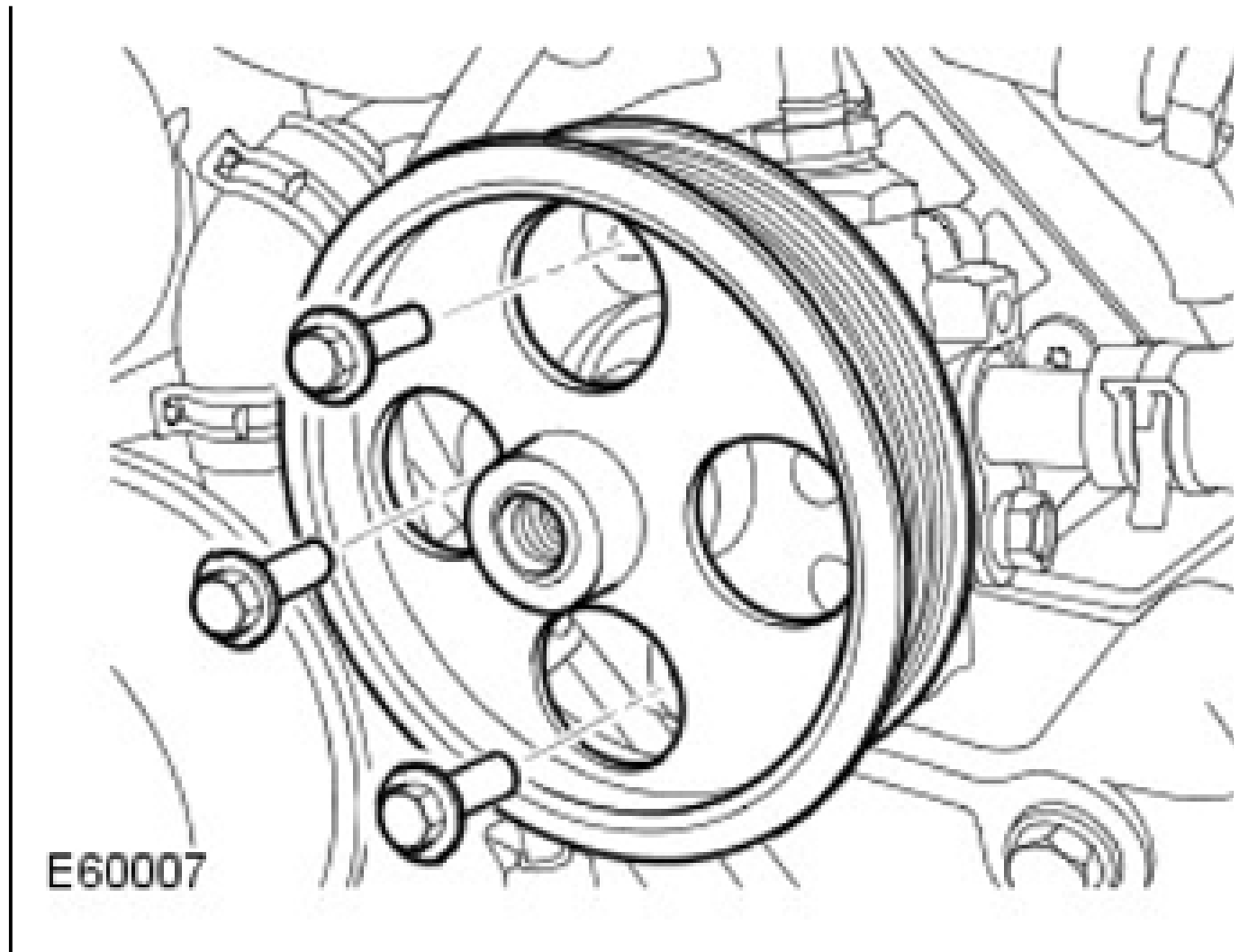
16. Install the A/C compressor mounting bracket.
 - Install the 3 bolts.



17. Install the A/C compressor assembly.
- Install the A/C mounting bracket.
 - Tighten the bolts to 25 Nm (18 lb.ft).
 - Connect and secure the electrical connector.

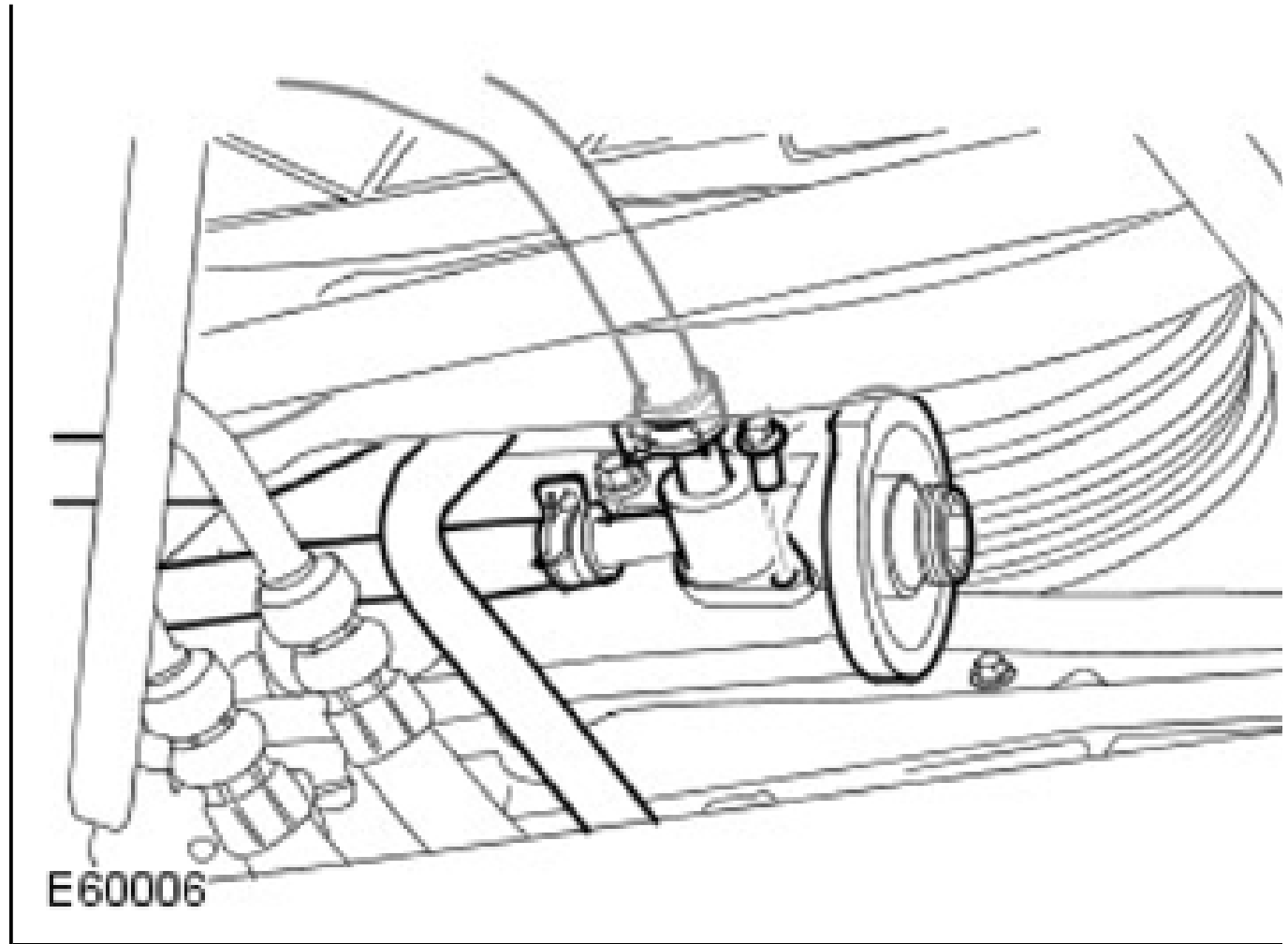


18. Install the power steering pump.
- Tighten the bolts to 25 Nm (18 lb.ft).

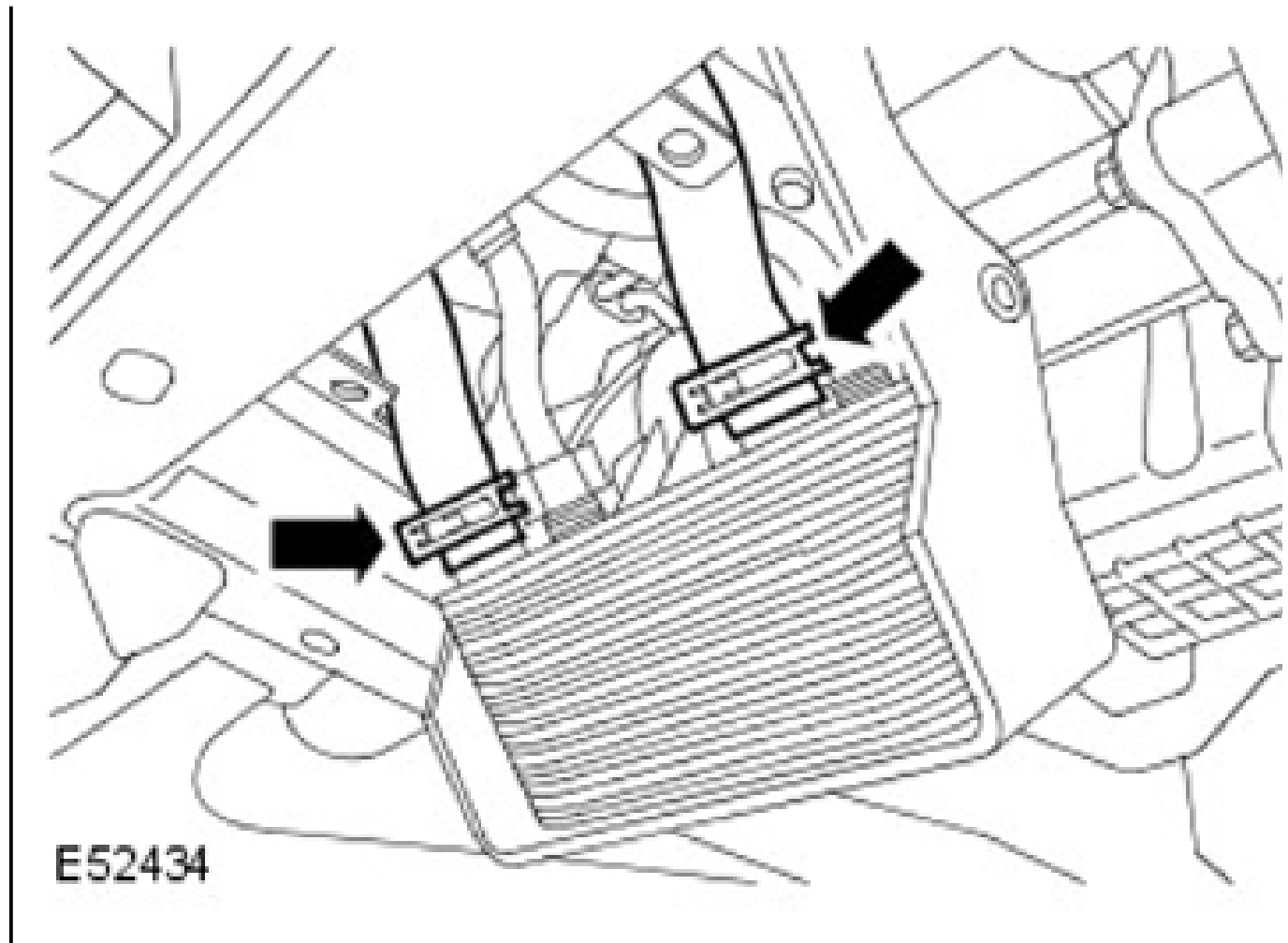


19. Install the oil filter housing.

- Clean the component mating faces.
- Tighten the M8 bolts to 25 Nm (18 lb.ft).
- Tighten the M6 bolt to 10 Nm (7 lb.ft).

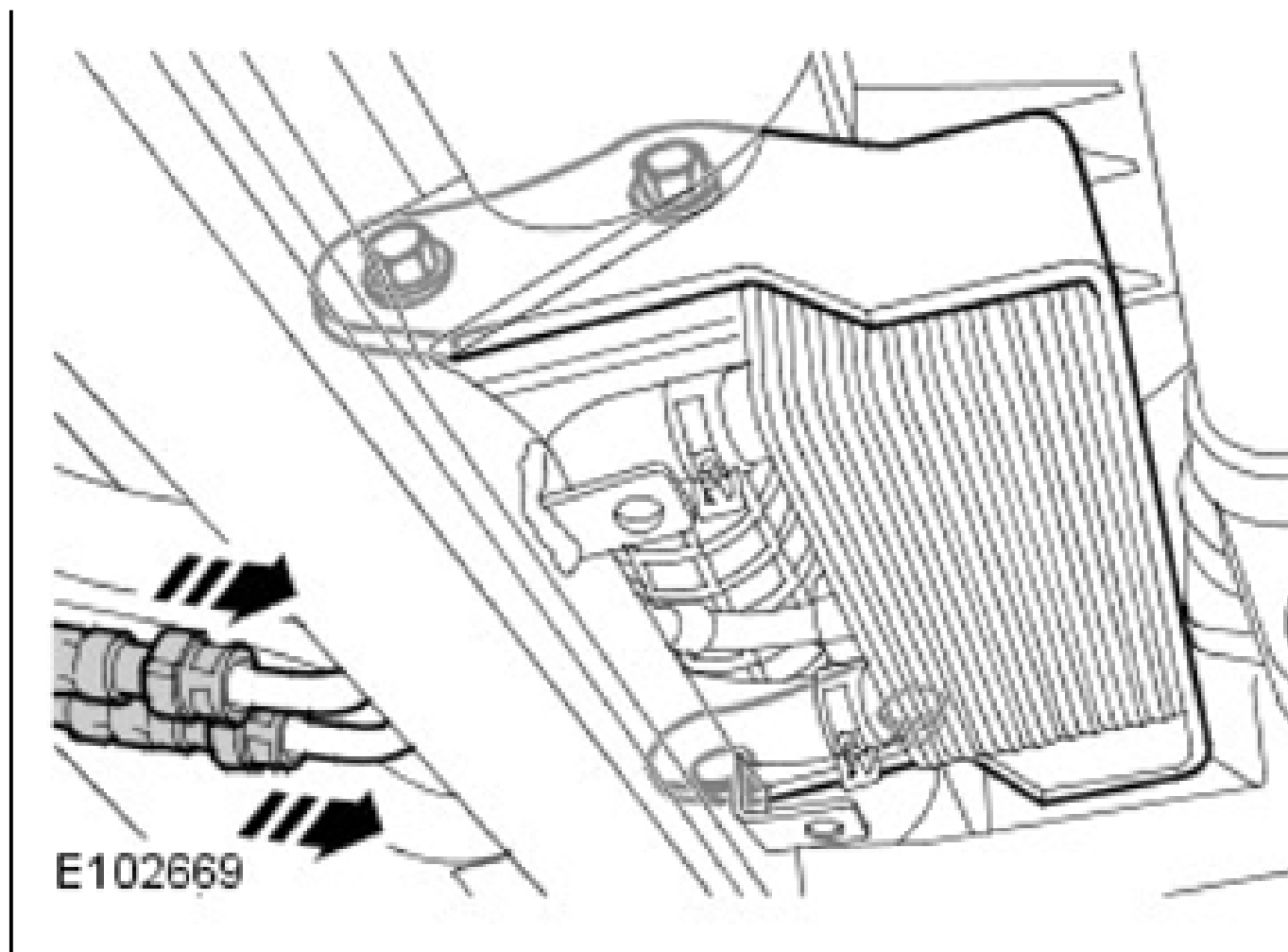


20. Connect the coolant supply hose to the new transmission cooler.
- Clean the component mating faces.
 - Secure the clips.

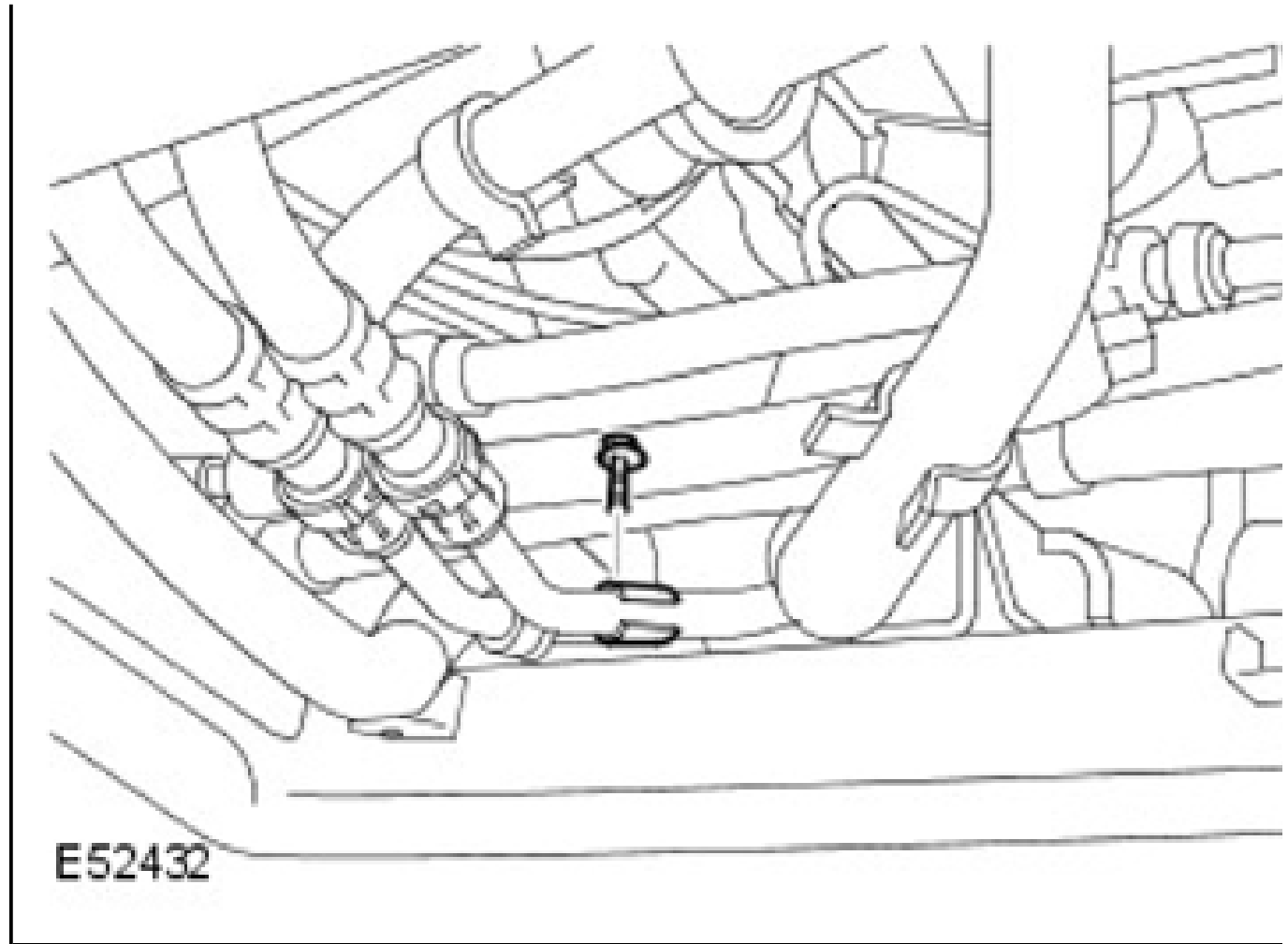


21. Install the oil cooler.

- Clean the component mating faces.
- Install the 4 bolts and tighten to 10 Nm (7 lb.ft).
- Connect the hoses.



22. Install the oil cooler pipe support bracket.
- Tighten the bolt to 10 Nm (7 lb.ft).

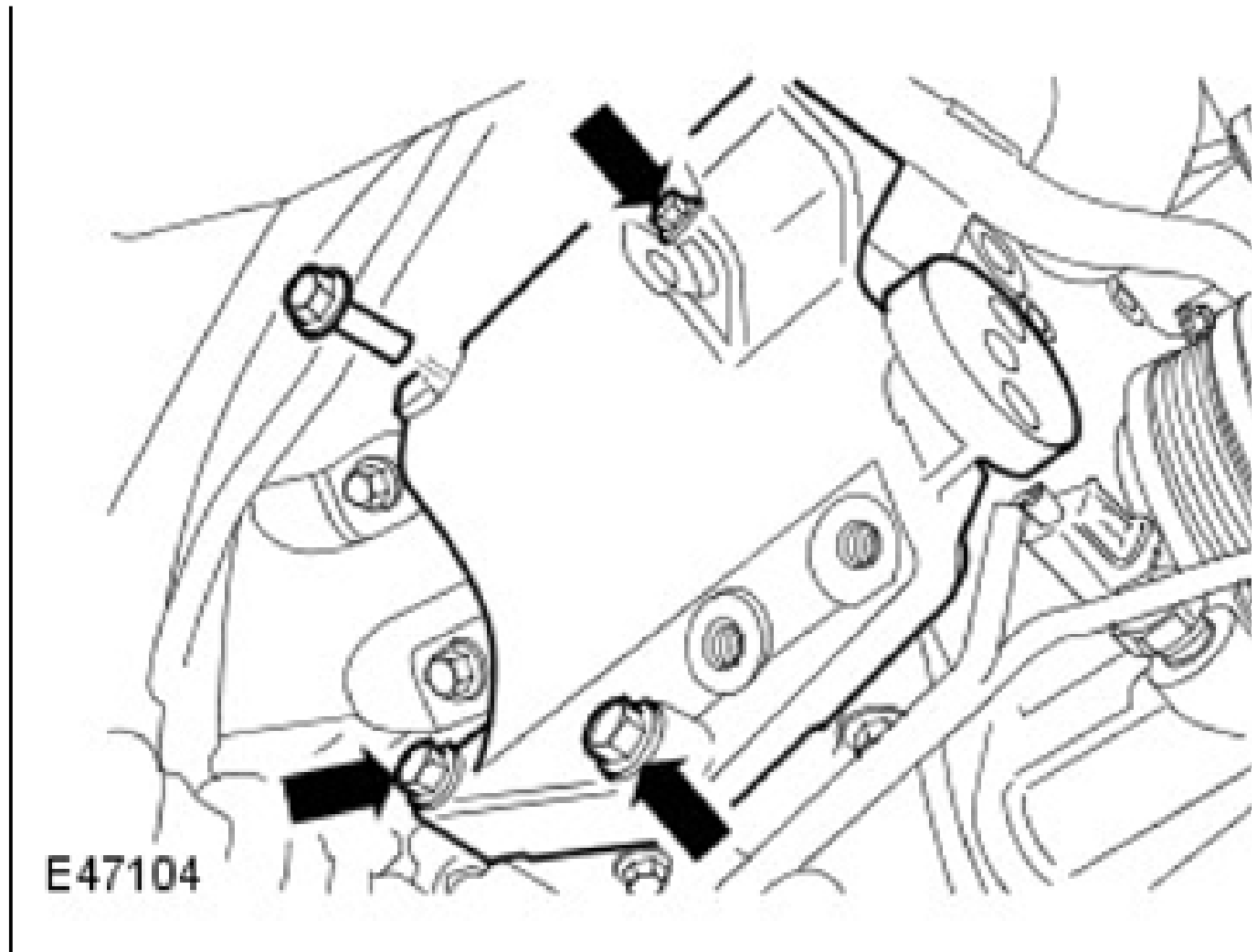


23. Install the exhaust system.

For additional information, refer to: **EXHAUST SYSTEM** .

24. Install the generator and dynamic response pump mounting brackets.

- Tighten the M10 bolts to 40 Nm (30 lb.ft).
- Tighten the M8 bolts to 25 Nm (18 lb.ft).

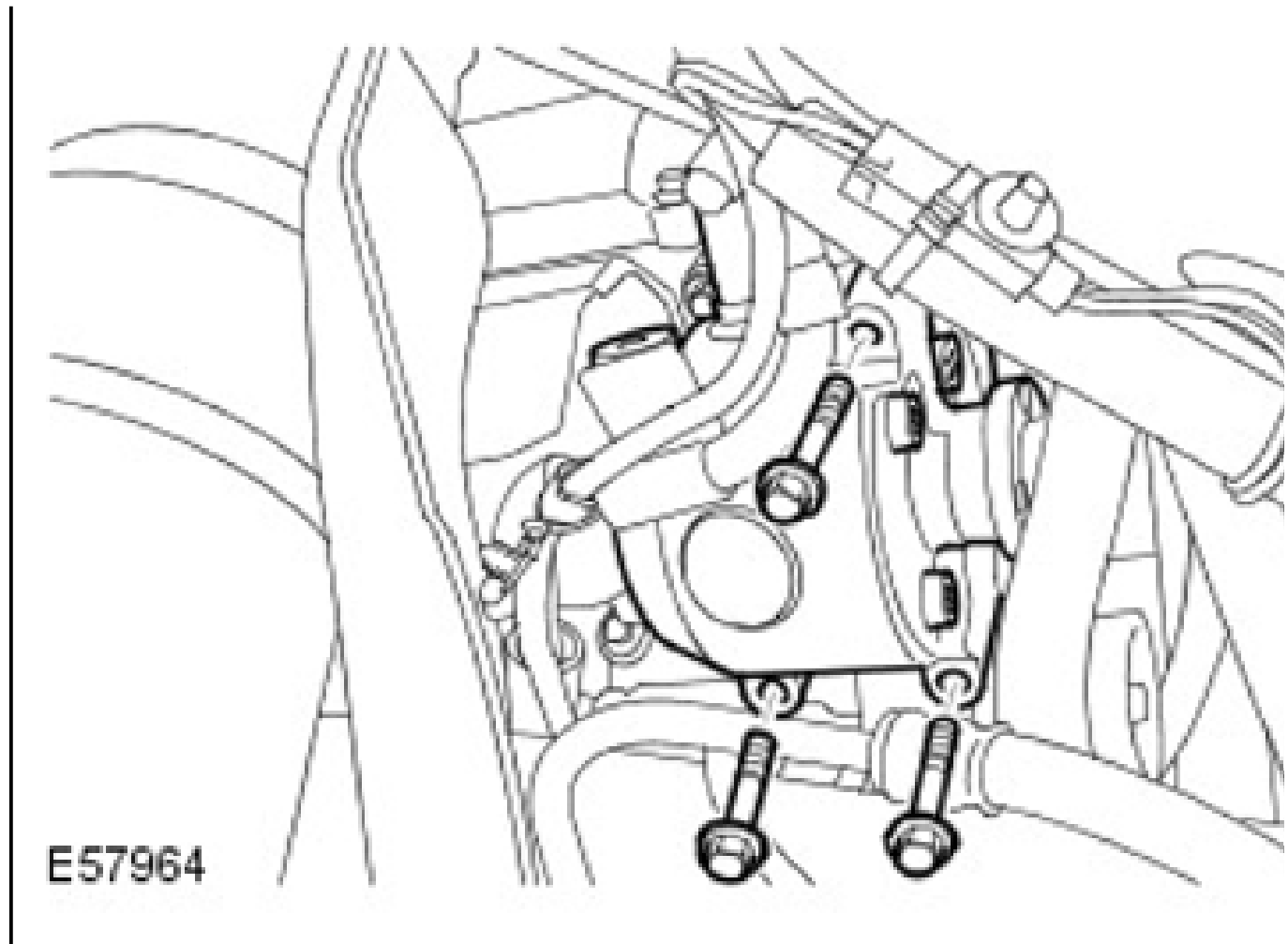


25. Install the generator.

For additional information, refer to: **GENERATOR** .

26. Install the dynamic response pump.

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



27. Install the LH charge air cooler.

For additional information, refer to: **CHARGE AIR COOLER** .

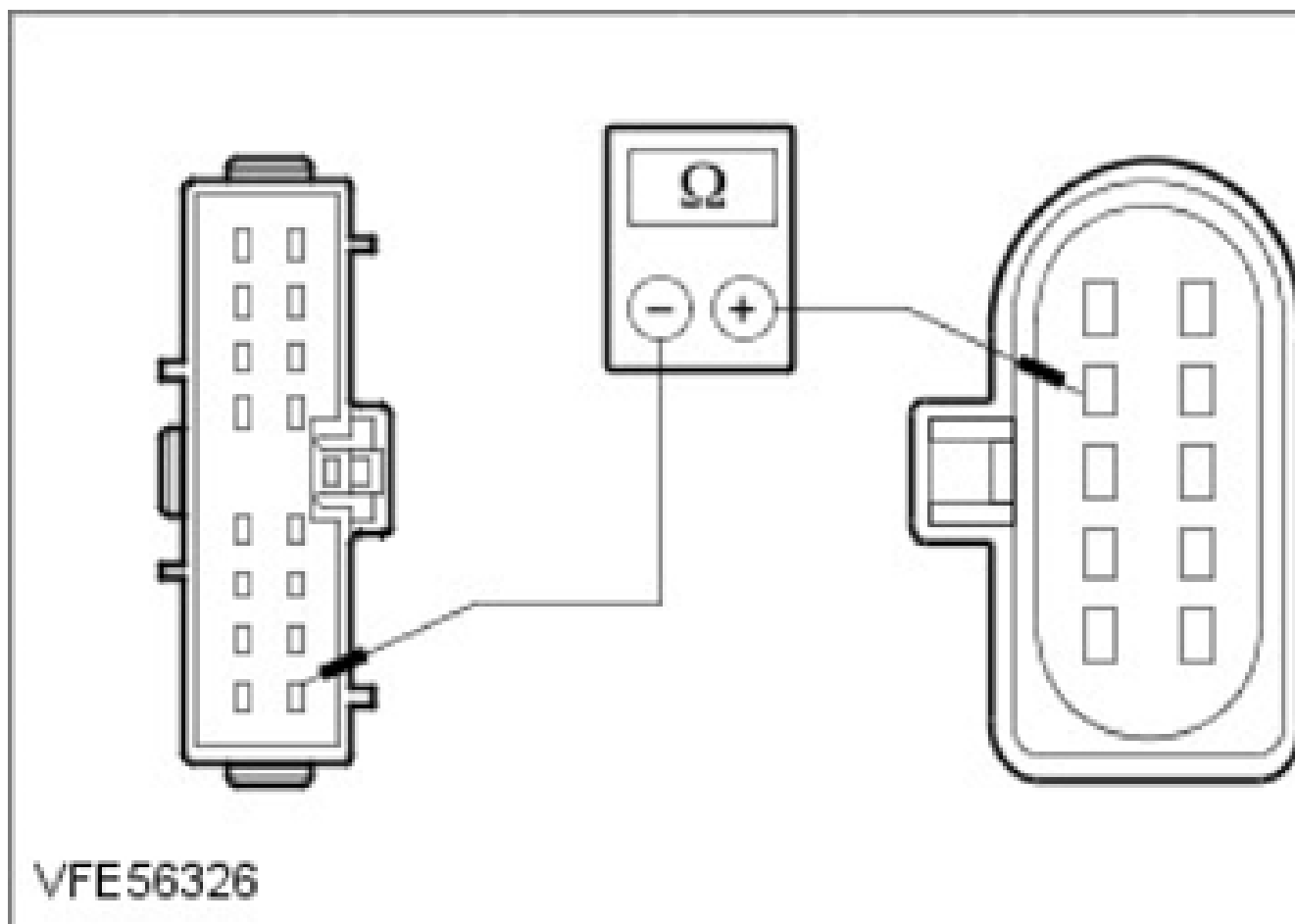
28. Install the RH charge air cooler.
29. Install the fender splash shields.

For additional information, refer to: **FENDER SPLASH SHIELD** .

30. Install the RH air cleaner assembly.

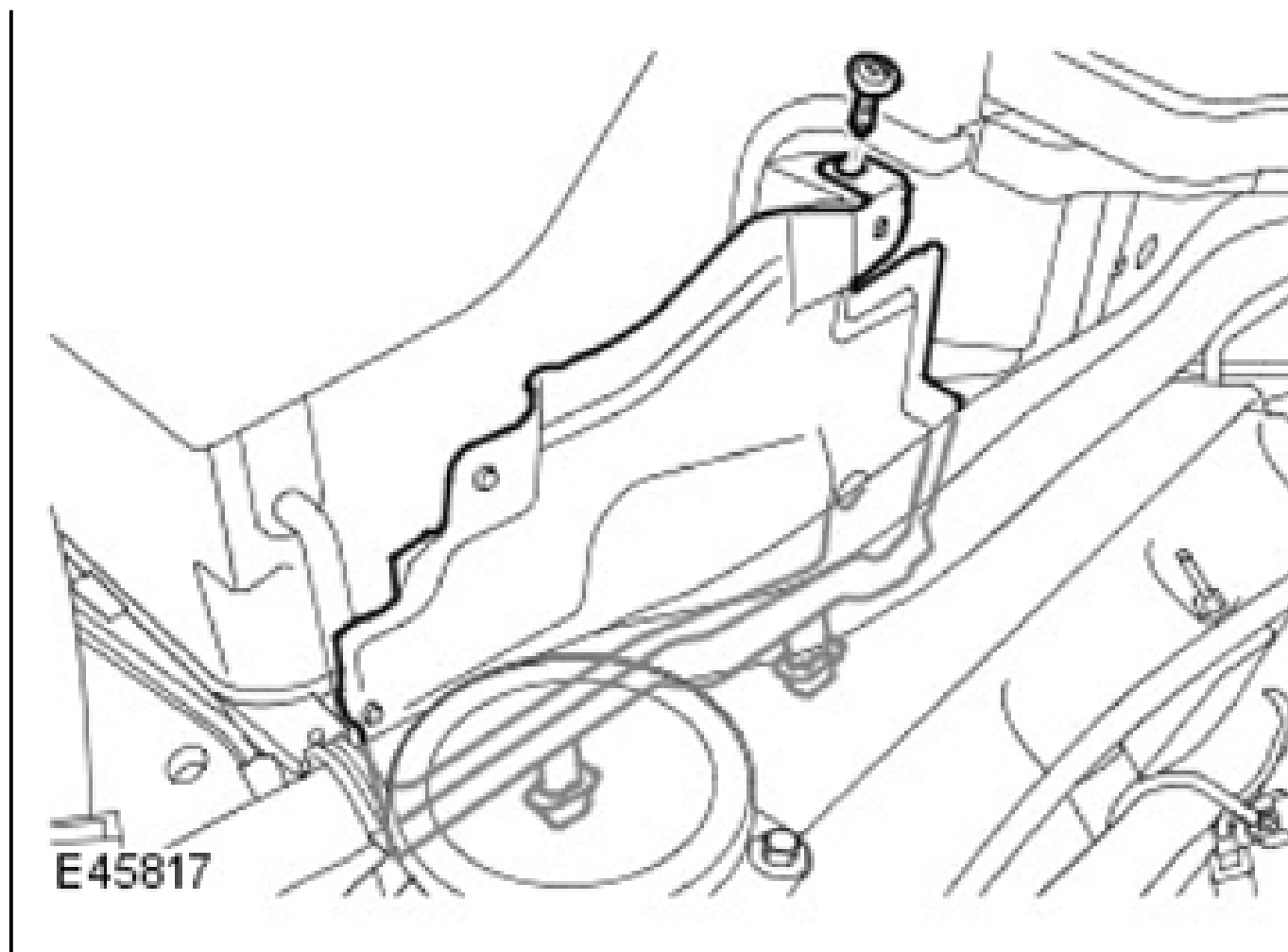
For additional information, refer to: **Air Cleaner** .

31. Install the auxiliary battery compartment side wall.
- Install the battery positive cable and grommet.
 - Secure the 4 clips.

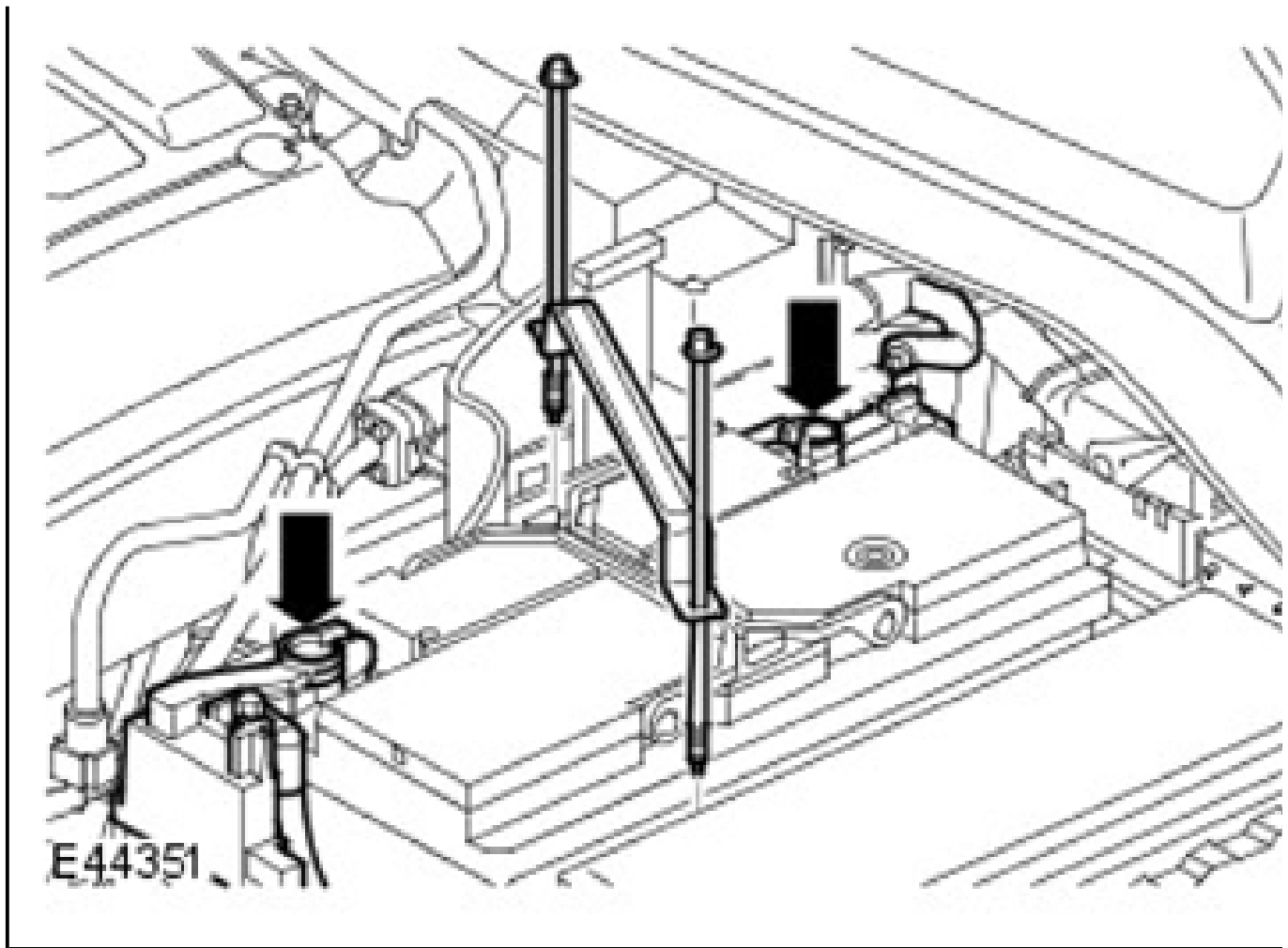


32. Install the engine compartment upper heat shield.

- Install the 2 screws.
- Secure in the 2 clips.



33. Install the battery.
34. Install the battery clamp.
 - Install the 2 bolts.



35. Install the battery positive cable.
36. Connect the battery ground cable.

For additional information, refer to: **SPECIFICATIONS** .

37. Install the battery cover.
 - Release the 2 mounting clips.
 - Secure with the 2 clips.
38. Fill the engine with oil.

For additional information, refer to: **ENGINE OIL DRAINING AND FILLING** .

39. Fill the cooling system.

For additional information, refer to: **Cooling System Draining, Filling and Bleeding** .

40. Check and top-up the transmission fluid level.

For additional information, refer to: **Transmission Fluid Level Check** .

41. Return the hood from the service position.
 - Release the 2 clips.
 - Connect the struts and secure with the clips.
42. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptations.