2014 ENGINE

Engine Mechanical - 1.0L EcoBoost - Fiesta

SPECIFICATIONS

ENGINE DATA

Description			
No. of cylinders	3		
Firing order	1-2-3		
Bore	2.831 in (71.9 mm)		
Stroke	3.228 in (82 mm)		
Engine capacity	60.96 in^3 (999 cm^3)		
Compression ratio	10:1		
Power output	74 kW (100 PS)/6000 rpm	74 kW (100 PS)/6000 rpm	92 kW (125 PS)/6000 rpm
Torque	170 Nm/1500 - 4000 rpm	170 Nm/1500 - 4000 rpm	170 Nm/1500 - 4500 rpm
Maximum permissible engine speed (continuous)	6450 rpm		
Maximum permissible engine speed (intermittent)	6675 rpm		
Idle speed	860 ± 100 rpm		
Maximum oil consumption	0.5 l/1000 km		
Spark plug	12405		
Spark plug gap	0.028 in (.7 mm)		
Engine weight	TBD		
Engine weight	TBD		

LUBRICANTS

Item	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (US); Motorcraft® SAE 5W-20 Super Premium Motor Oil (Canada)	XO-5W20-QSP (US); CXO-5W20-LSP12 (Canada)

ENGINE OIL CAPACITY

Description	liter
Initial fill including oil filter	4.60
Service fill including oil filter	4.10
Service fill without oil filter	4.00

OIL PRESSURE

Item	Specification
Oil pressure (hot @ 800 rpm)	14.5 psi (100 kPa)
Oil pressure (hot @ 2, 000 rpm)	29.0 psi (200 kPa)

VALVE CLEARANCES

Description	Specification
Valve tappet diameter	1.062 in (26.98 mm)
Valve clearance (engine cold), intake	0.0094 - 0.0118 in (0.24 - 0.30 mm)
Valve clearance (engine cold), exhaust (CM5G FC camshaft)	0.0122 - 0.0145 in (0.31 - 0.37 mm)
Valve clearance (engine cold), exhaust (CM5G FD camshaft)	0.0149 - 0.0185 in (0.38 - 0.47 mm)

CYLINDER BLOCK

Item	Specification
Cylinder bore diameter	2.831 in (71.9 mm)
Cylinder bore maximum out-of-round	TBD
Main bearing bore diameter	1.890 in (48 mm)
Head gasket surface flatness	TBD

PISTON

Item	Specification
Piston-to-bore clearance	TBD
Ring groove width - top	0.039 in (1 mm)
Ring groove width - 2nd	0.047 in (1.2 mm)
Ring groove width - oil	0.079 in (2 mm)
Piston skirt coating thickness	TBD

PISTON PIN

Item	Specification
Diameter	0.787 in (20 mm)
Length	1.850 in (47 mm)
Piston-to-pin clearance	TBD
Pin-to-rod clearance	TBD

CYLINDER HEAD

Item	Specification

Maximum distortion (mating face)	0.05
Valve lift @ zero lash (exhaust)	TBD
Valve lift @ zero lash (intake)	TBD
Valve guide diameter - bore	0.197 in (5 mm)
Valve seat width - intake/exhaust	TBD
Valve seat angle - intake	45°
Valve seat angle - exhaust	45°
Valve seat runout	TBD
Valve tappet bore diameter	1.064 in (27.02 mm)
Cam bore diameter	0.985 in (25.02 mm)

VALVE

Item	Specification
Valve head diameter - intake	1.067 in (27.1 mm)
Valve head diameter - exhaust	0.909 in (23.1 mm)
Valve stem diameter - intake	TBD
Valve stem diameter - exhaust	TBD
Valve stem-to-guide clearance - intake	TBD
Valve stem-to-guide clearance - exhaust	TBD
Valve face runout	TBD
Valve face angle - intake	45.5°
Valve face angle - exhaust	45.5°

CRANKSHAFT

Item	Specification
Main bearing journal diameter	1.732 in (44 mm)
Main bearing clearance	TBD
Connecting rod journal diameter	1.575 in (40 mm)
End play	TBD

RINGS

Item	Specification
Width - top	0.039 in (1 mm)
Width - 2nd	0.047 in (1.2 mm)
Width - oil	0.079 in (2 mm)
Ring gap (in bore) - top	0.008 in (.2 mm)
Ring gap (in bore) - 2nd	0.008 in (.2 mm)
Ring gap (in bore) - oil	0.008 in (.2 mm)

CAMSHAFT

Item	Specification
End play	TBD
Lobe lift - intake	TBD
Lobe lift - exhaust	TBD
Runout	TBD
Thrust clearance	TBD
Journal diameter	0.983 in (24.98 mm)
Journal-to-bore clearance	0.002 in (.04 mm)

CONNECTING ROD

Item	Specification
Running clearance	TBD
Bearing clearance	TBD
Bearing thickness (grade 1)	TBD (if applicable)
Bearing thickness (grade 2)	TBD (if applicable)
Bearing thickness (grade 3)	TBD (if applicable)
Bearing thickness (grade 4)	TBD (if applicable)
Crank bore diameter	1.693 in (43 mm)
Pin bore diameter	0.787 in (20 mm)
Length (center to center)	5.394 in (137 mm)

DESCRIPTION AND OPERATION

ENGINE

Overview

The following aims were at the forefront during development of the engine:

- Reduction of weight compared to the 4-cylinder engines with comparable or even lower power
- Optimization of energy efficiency through **direct injection and turbocharging** compared to the currently used 4-cylinder engines with intake manifold injection
- Reduction of inner friction compared to the engines currently used through
  - the reduction in number of cylinders from 4 to 3, thus reducing swept area and number of film lubricated bearings.
  - 8mm off set of crankshaft bore relative to cylinder bore centerline.
  - reduced friction of timing and accessory belt drives.
  - use of a variable oil pump.
  - split cooling system to improve warm-up time, and thus reduce the cold oil viscosity faster.

Since introduction of the EcoBoost® engines, the downsizing concept (reduction in cubic capacity, number of cylinders and size) has also been rigorously further implemented with this engine.

Main features:

- 3-cylinder double overhead camshaft engine with 12 valves
- Cast iron cylinder block, aluminum alloy cylinder head
- Variable camshaft timing on the intake and exhaust camshafts
- Engine oil lubricated timing belt for driving the camshafts
- Variable oil pump for delivery rate matched to meet demand
- Engine oil lubricated timing belt for driving the oil pump
- Turbocharger for increased power and reduced fuel consumption
- Additional thermostat on the short block for rapid warming up of the engine after a cold start

Engine Code Information Label

The engine code information label, located on the valve cover, contains the following:

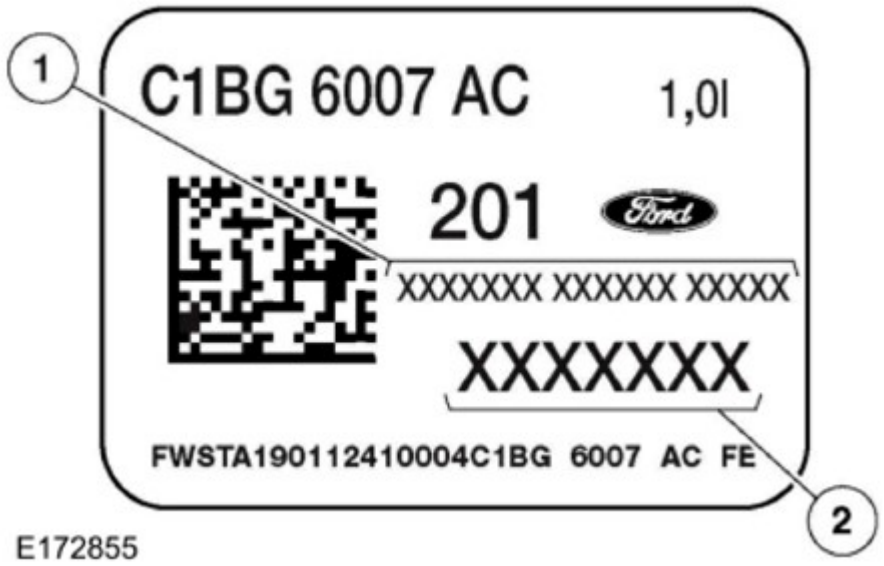
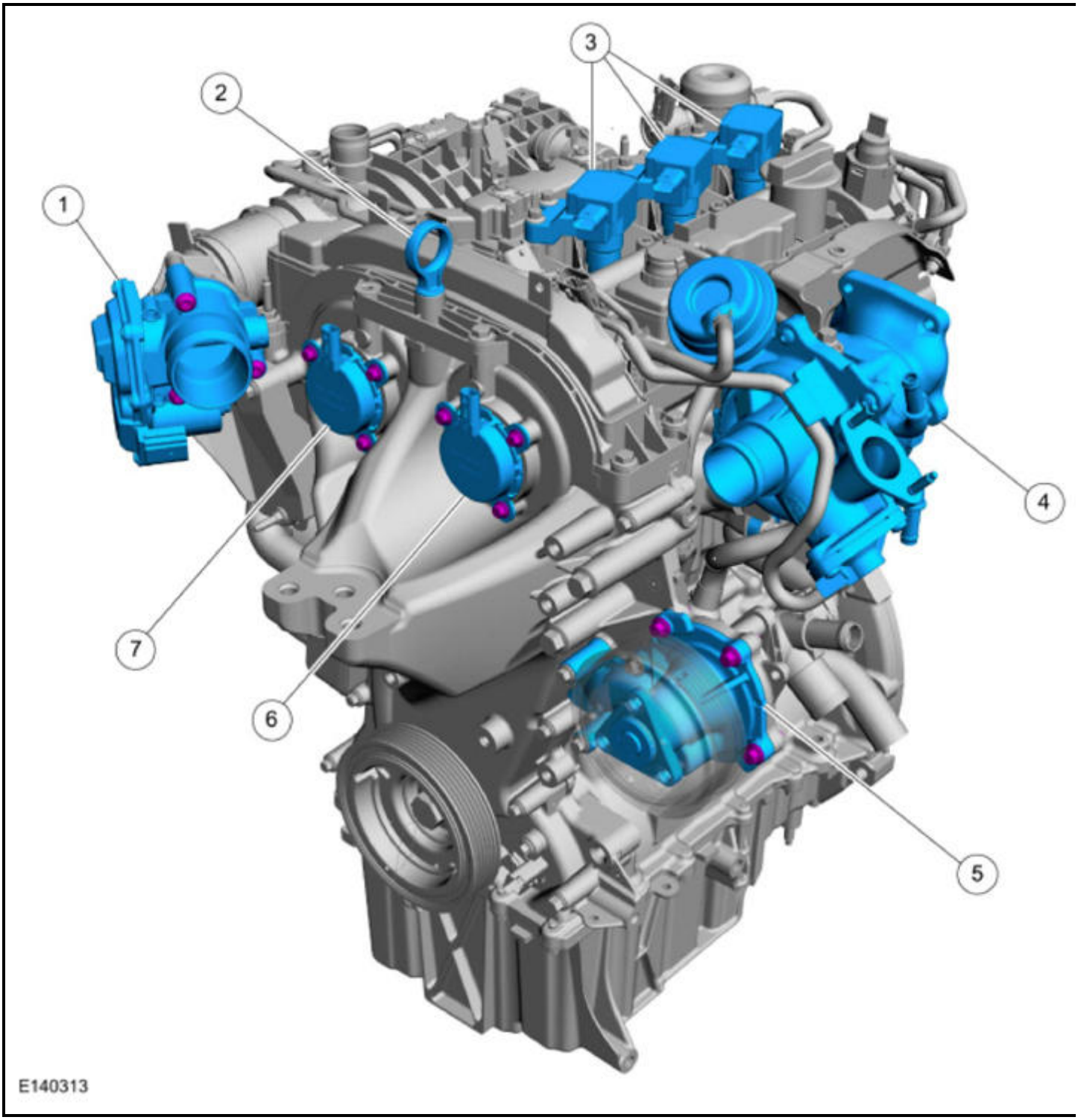


Fig. 1: Identifying Engine Code Information Label
Courtesy of FORD MOTOR CO.

Item	Description
1	Engine plant
2	Engine build date (DDMMMYY)

ENGINE COMPONENT VIEW

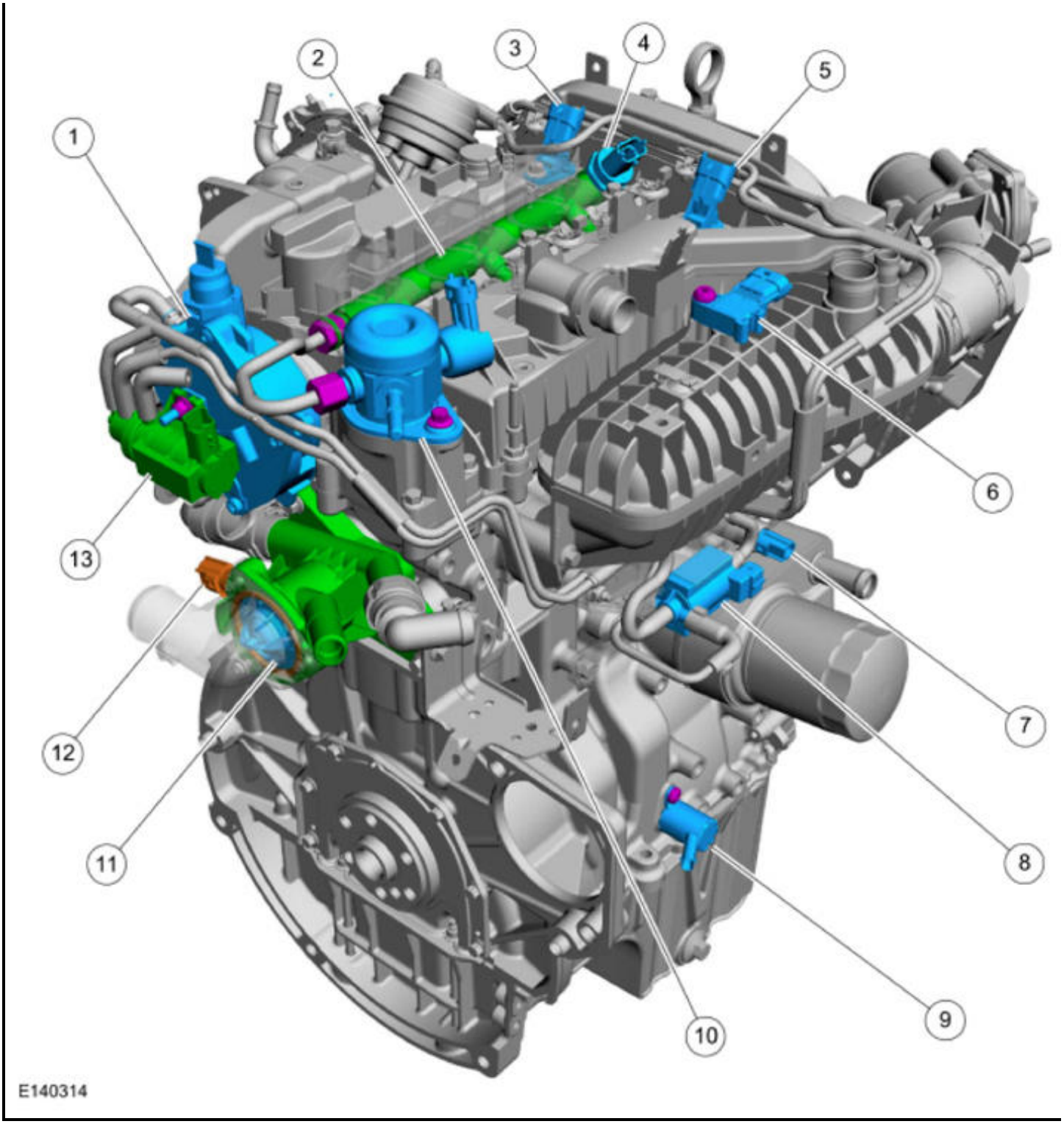
External components - Front view



Item	Part Number	Description
1	9F991	Throttle body
2	6750	Oil level indicator
3	12A366	Ignition coil-on-plugs

4	6K682	Turbocharger
5	8501	Coolant pump
6	6M280	Variable camshaft timing solenoid, exhaust camshaft
7	6M280	Variable camshaft timing solenoid, intake camshaft

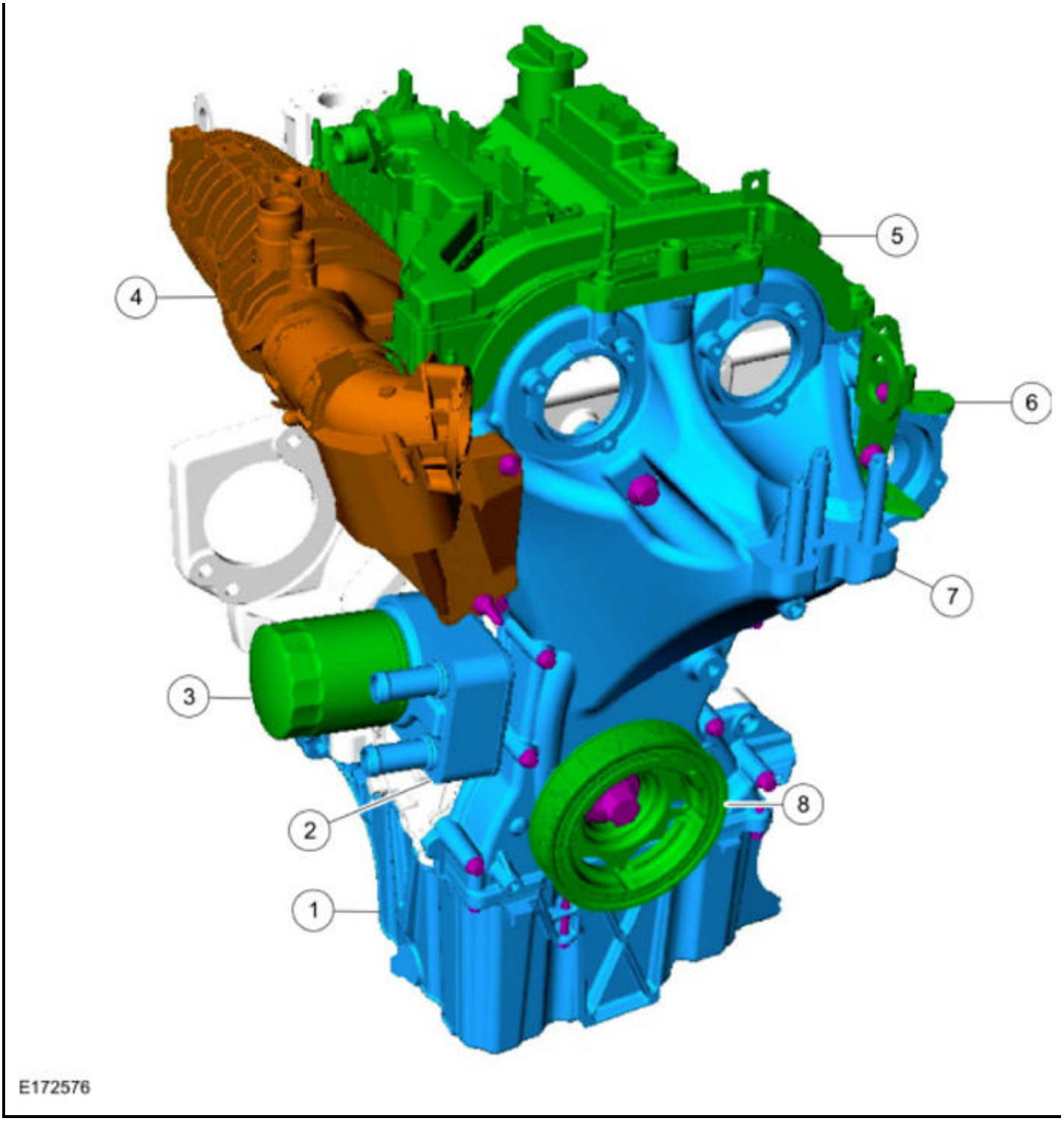
External components - Rear view



Item	Part Number	Description
1	2A451	Vacuum pump
2	9H487	High-pressure fuel rail

3	12K073	CMP (camshaft position) sensor-exhaust
4	9F972	Fuel pressure sensor
5	12K073	CMP (camshaft position) sensor-intake
6	9F479	MAP (manifold absolute pressure) sensor
7	9278	EOP (engine oil pressure) switch
8	95468	VSV (vacuum solenoid valve) - for turbo bypass control
9	6C880	Oil pump control solenoid
10	9D376	High-pressure fuel pump
11	61J20	Main outlet control thermostat
12	12A468	ECT (engine coolant temperature) sensor
13	9F490	EVRV (electronic vacuum regulating valve) - for turbo wastegate control

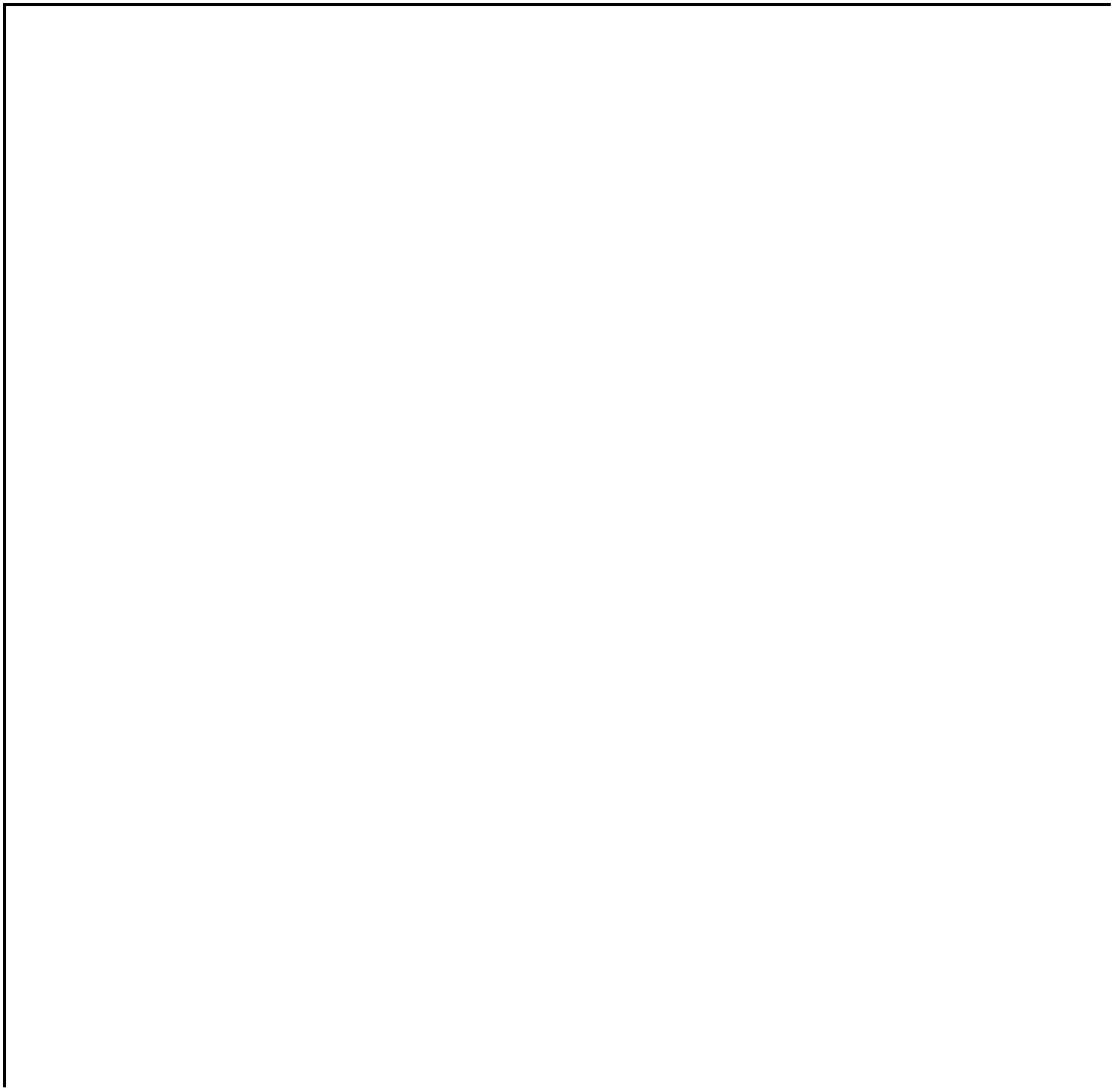
Front View

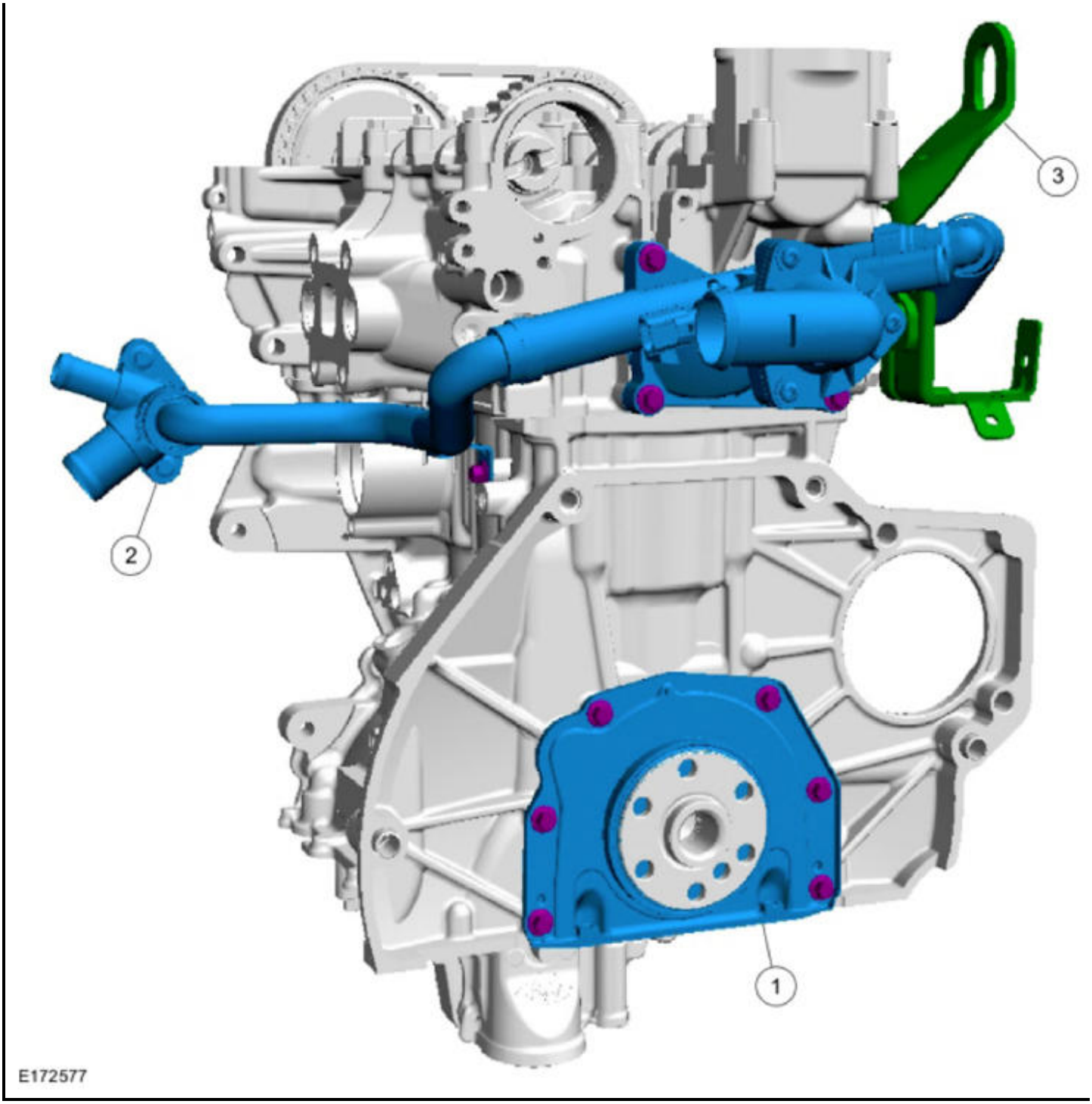


Item	Part Number	Description
1	6676	Oil pan
2	6B856	Oil cooler
3	6714	Oil filter

4	9424	Intake manifold
5	6K271	Valve cover
6	17A084	Lifting eye
7	6059	Engine front cover
8	6316	Crankshaft pulley

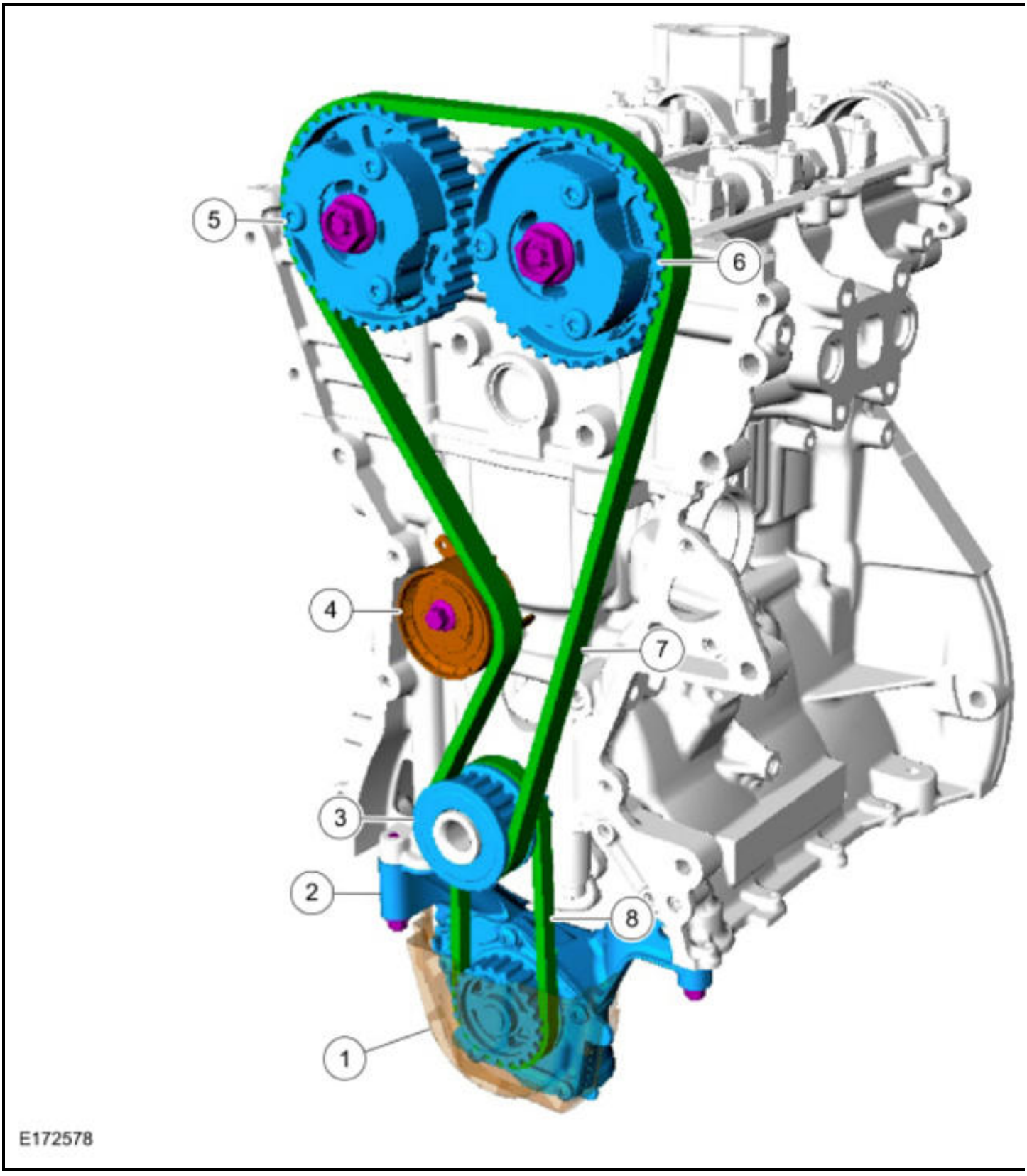
Rear View





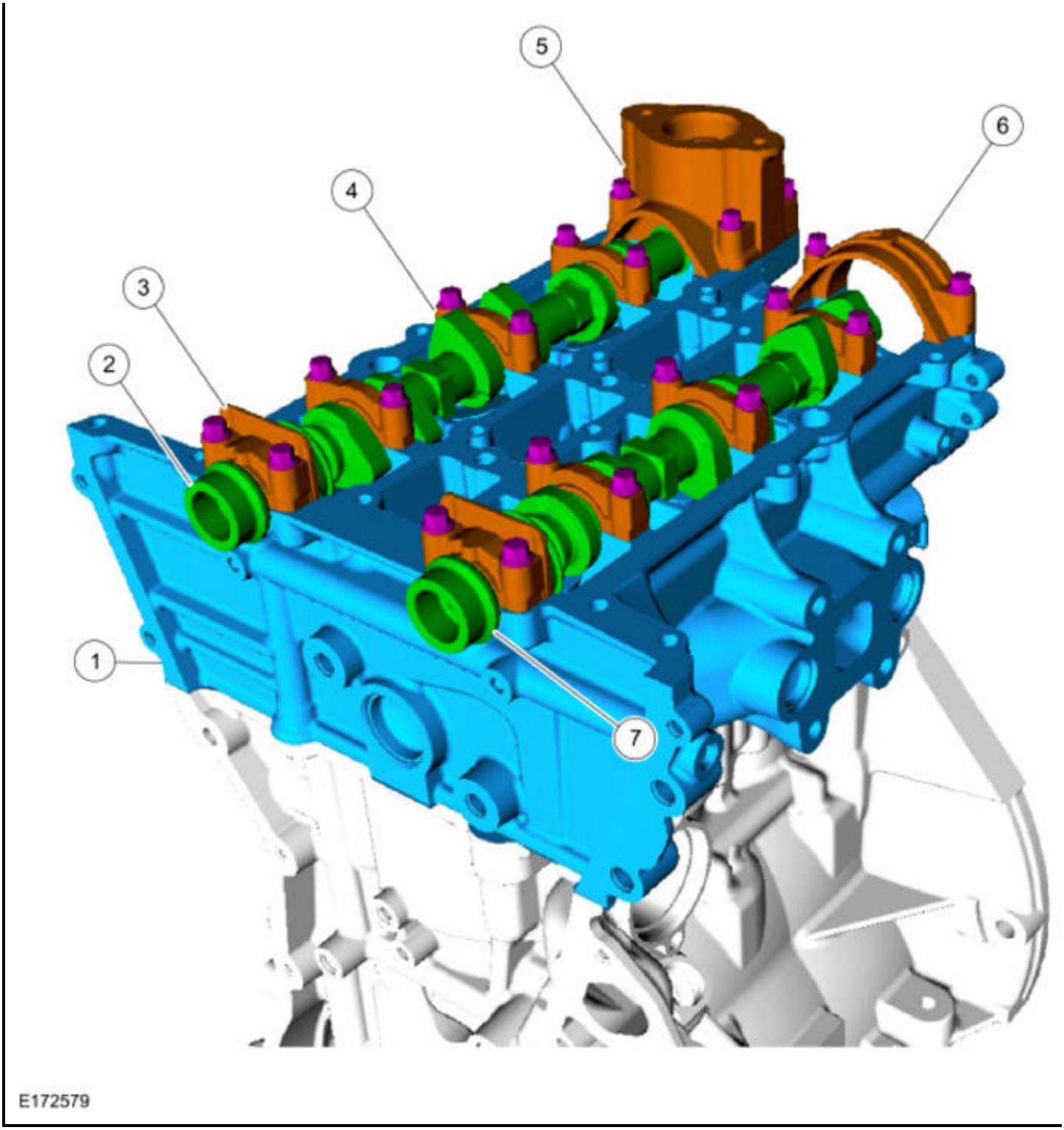
Item	Part Number	Description
1	6K301	Rear crankshaft seal
2	8D036	Coolant hose assembly
3	17K004	Lifting eye

Timing components



Item	Part Number	Description
1	6664	Oil pump cover
2	6600	Oil pump
3	6315	Timing drive pulley (outer)/Oil pump drive pulley (inner)
4	6K245	Timing belt tensioner
5	6C524	VCT (variable camshaft timing) unit-intake
6	6C525	VCT (variable camshaft timing) unit-exhaust
7	6K288	Timing belt
8	6B651	Oil pump belt

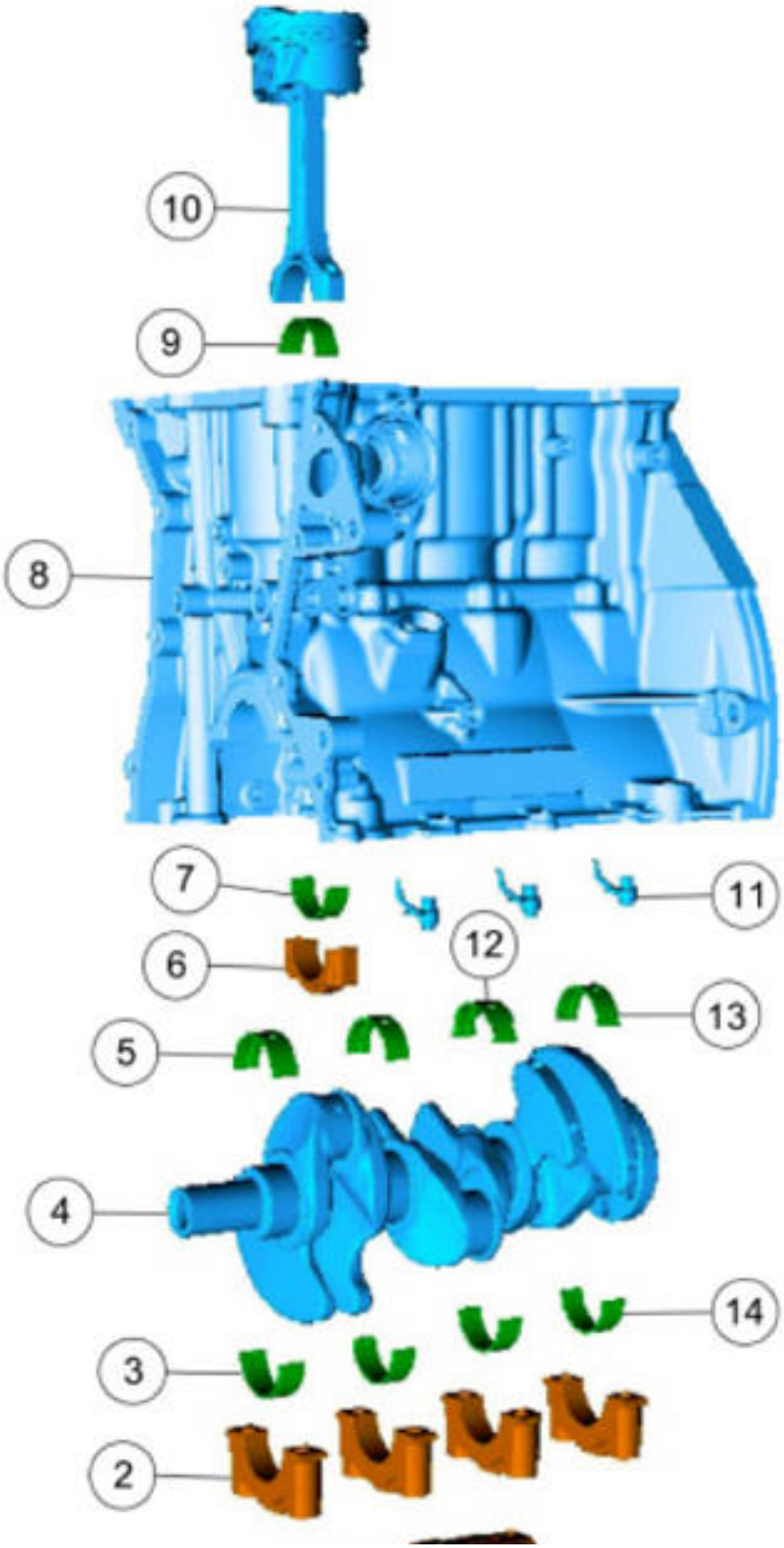
Cylinder head



Item	Part Number	Description
1	6049	Cylinder head
2	6A266	Intake camshaft

3	6B282	Camshaft bearing cap (2 required)
4	6A258	Camshaft bearing cap (6 required)
5	9P607	Camshaft bearing cap
6	6A284	Cover-vacuum pump
7	6A268	Exhaust camshaft

Cylinder block



Item	Part Number	Description
1	6687	Oil baffle
2	6325	Crankshaft bearing cap (4 required)
3	6K325	Lower crankshaft bearing - journal 1 (1 required)
4	6303	Crankshaft
5	6K324	Upper crankshaft bearing - journal 1 (1 required)
6	6200	Connecting rod cap (3 required)
7	6211	Lower connecting rod bearing (3 required)
8	6010	Cylinder block
9	6211	Upper connecting rod bearing (3 required)
10	6200/6105	Connecting rod/Piston assembly (3 required)
11	6K868	Piston cooling jet (3 required)
12	6337	Upper crankshaft thrust bearing - journal 3 (1 required)
13	6333	Upper crankshaft bearing - journals 2 and 4 (2 required)
14	6A338	Lower crankshaft bearing - journal 2, 3 and 4 (3 required)

ENGINE - SYSTEM OPERATION AND COMPONENT DESCRIPTION

System Operation

Variable Camshaft Timing

TiVCT (twin independent variable camshaft timing) is used on this engine.

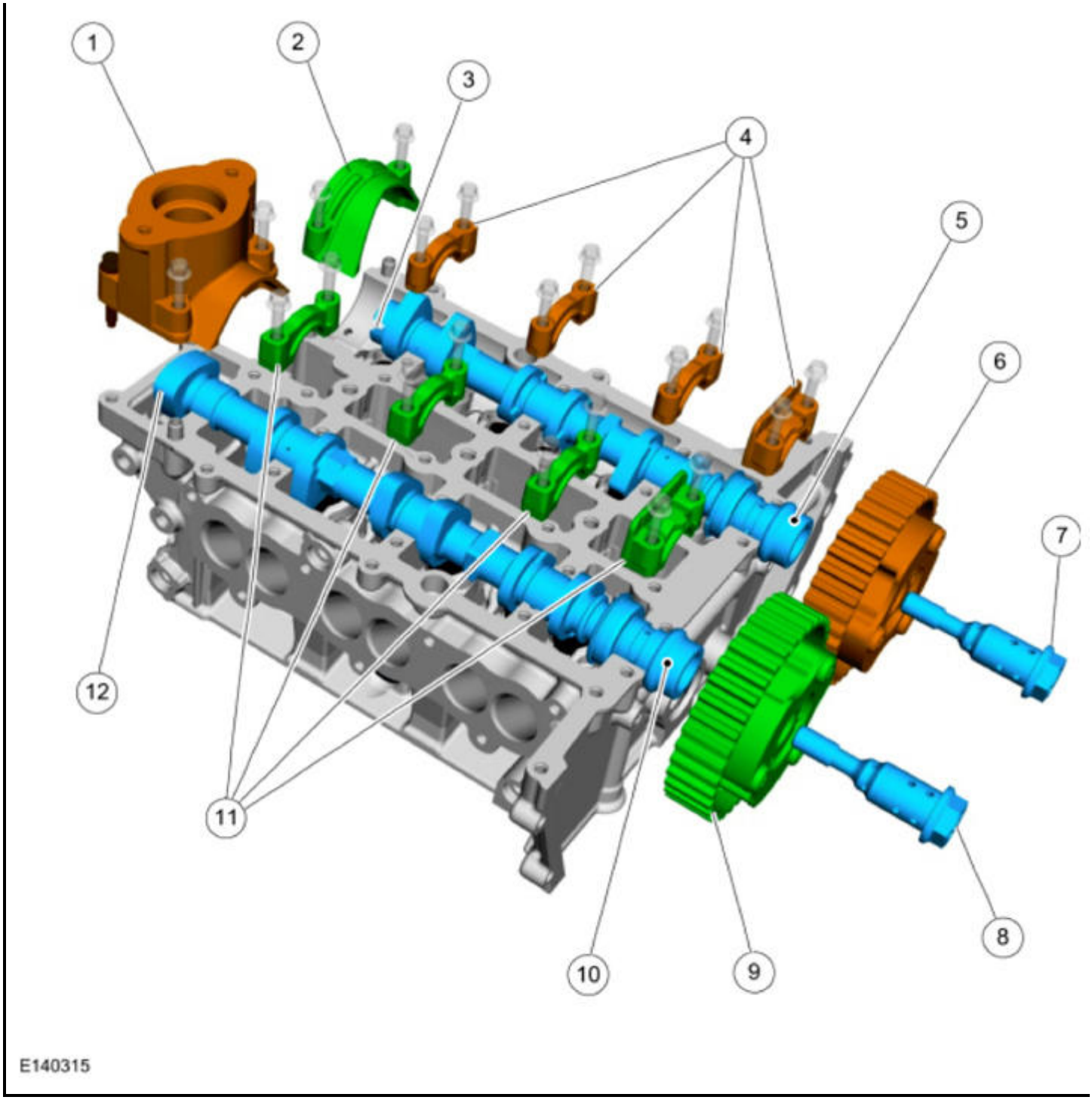
Continuous adjustment of the valve timings allows the following to be achieved:

- Smoother idling
- Increase in power and torque
- Sufficient internal exhaust gas recirculation
- Performance optimization at wide open throttle

There is a **VCT** unit on each camshaft for making the adjustment. The valve timings can be controlled by making engine speed and load dependent adjustments of the intake and exhaust camshafts.

Component Description

Cylinder Head



Item	Description
1	Camshaft bearing cap - intake camshaft with jacking point - high-pressure pump
2	Cover - vacuum pump
3	Drive - vacuum pump
	Camshaft bearing cap - exhaust camshaft

4	**Comments:** The camshaft bearing caps are identified by the numbers 1 - 4
5	Exhaust camshaft
6	**VCT** unit - exhaust camshaft
7	Exhaust camshaft VCT control valve
8	Intake camshaft VCT control valve
9	**VCT** unit - intake camshaft
10	Intake camshaft
11	Camshaft bearing cap - intake camshaft **Comments:** The camshaft bearing caps are identified by the letters A - D
12	Triple cam

NOTE: Make a note of the installed orientations and positions of the camshaft bearing caps when removing them. When installing the camshafts, care must be taken that the bearing caps are installed in the correct orientation and position and also that they are tightened in a certain order and tightened to the specified torque. The instructions in the procedure must be observed for this.

The cylinder head is made of a light metal alloy.

The exhaust manifold is part of the cylinder head and therefore cannot be replaced separately in service.

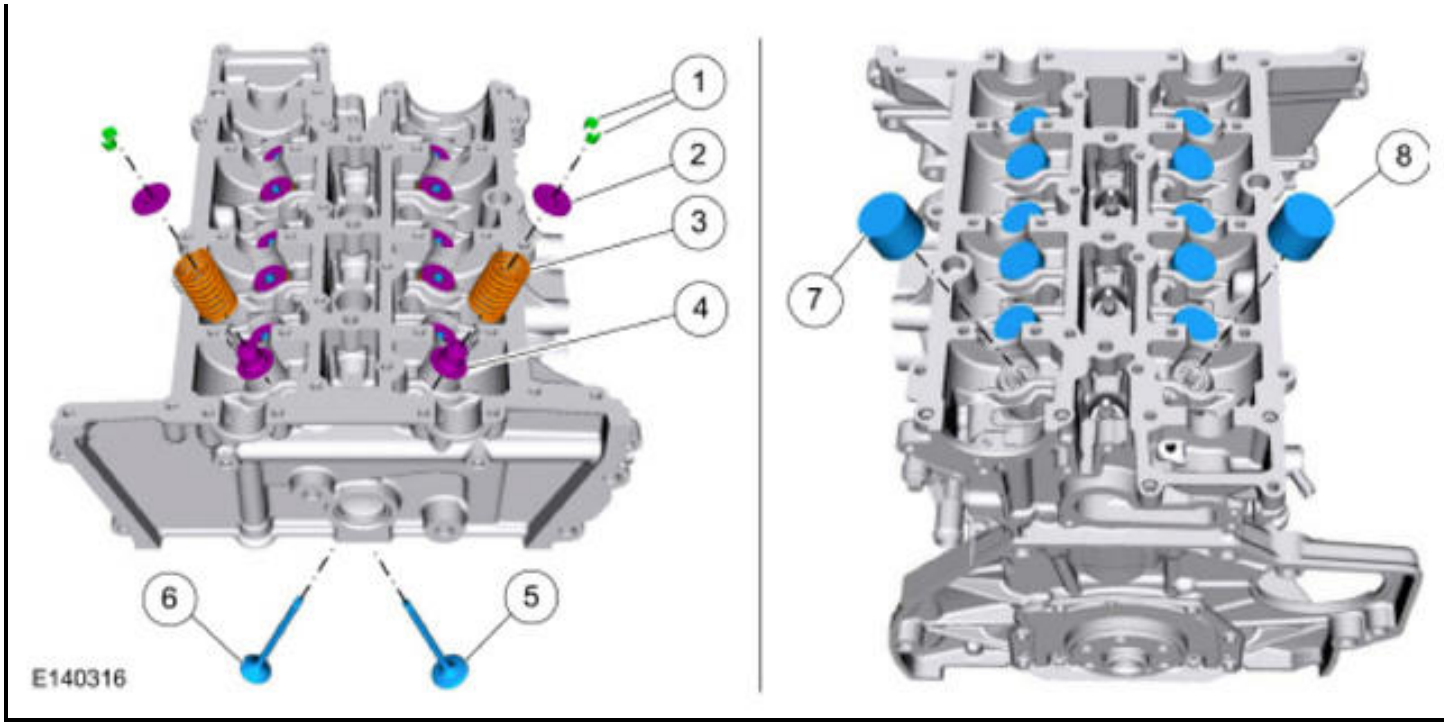
The intake camshaft is made longer by the additional triple cam for driving the high-pressure pump. It is therefore impossible to confuse it with the exhaust camshaft. It is mounted on five bearings. In addition, the intake camshaft bearing cap nearest the transmission forms the jacking point for the high-pressure pump used to create fuel at high pressure. The seal to the cylinder head is achieved using sealing compound.

The exhaust camshaft is mounted on four bearings and has an additional groove by which the vacuum pump is driven. The vacuum pump cover carries the seal for the valve cover and the vacuum pump.

The **VCT** units are bolted on the corresponding camshaft with the respective VCT control valve. The control valves are operated by a solenoid valve.

NOTE: The crankshaft and the camshafts must be brought to a defined position before the cylinder head or the camshafts are installed. The instructions in the procedure must be observed for this.

Valves



Item	Description
1	Valve collets
2	Valve spring retainer
3	Valve springs
4	Oil shield ring
5	Inlet valve
6	Outlet valve
7	Bucket tappet - exhaust valve
8	Bucket tappet - intake valve

There are four valves per cylinder in the cylinder head. Two intake and two exhaust valves, where the intake valves have a larger diameter at the valve spring retainer.

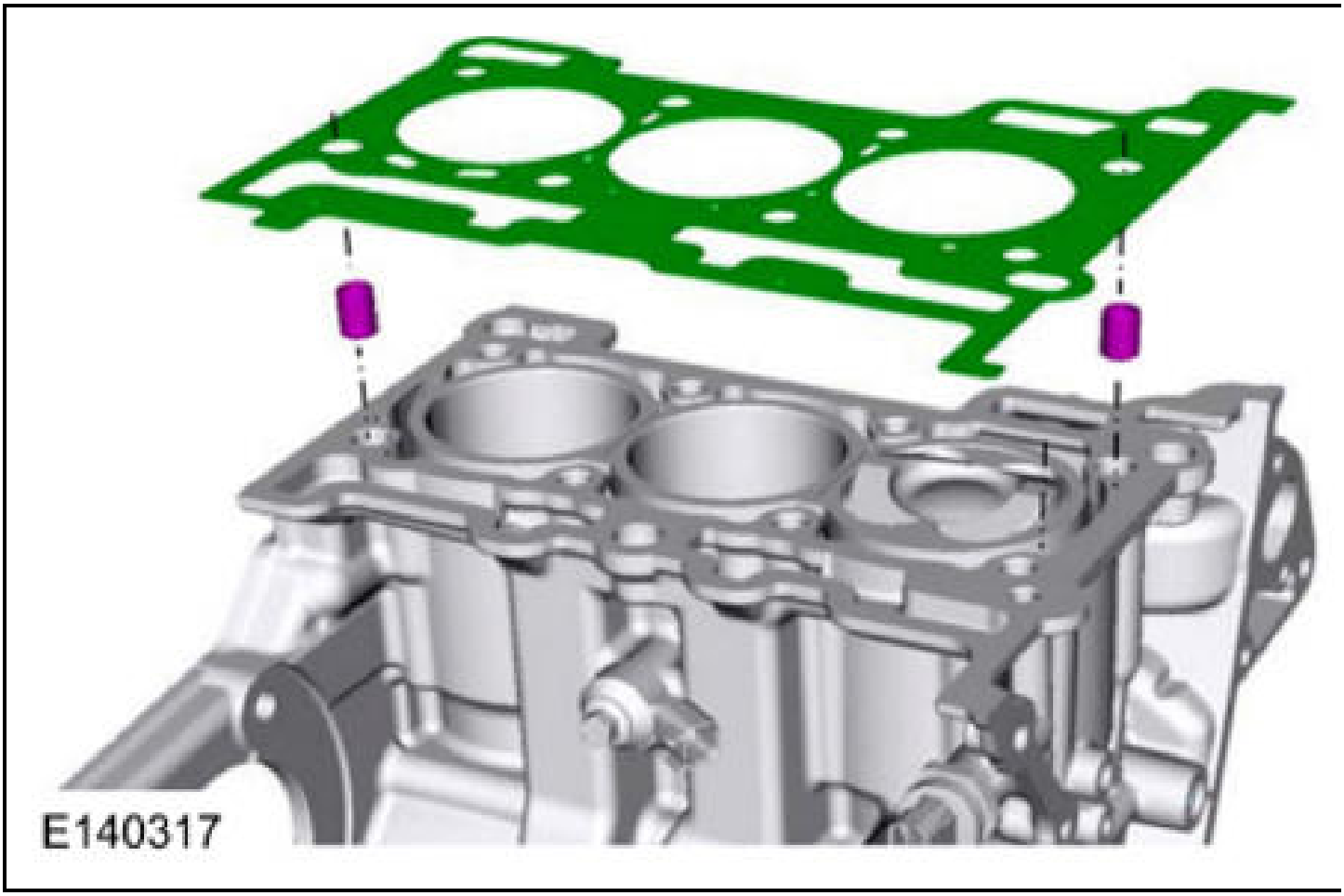
The **intake valves** are made of **one** material and are **solid** .

The **exhaust valves** are designed as **hollow valves** . The cavity is **filled with sodium** . The sodium melts at about 97°C and has good thermal conductivity. The temperature at the valve spring retainer can thus be reduced by about 100°C.

The valves are operated by mechanical bucket tappets.

NOTE: **Throughout the whole service life of the engine, during the service intervals the valve clearances do not need to be checked or even set. This is only necessary if the camshafts have been removed during repair work. The instructions in the procedure must be observed for the exact adjustment.**

Cylinder head gasket

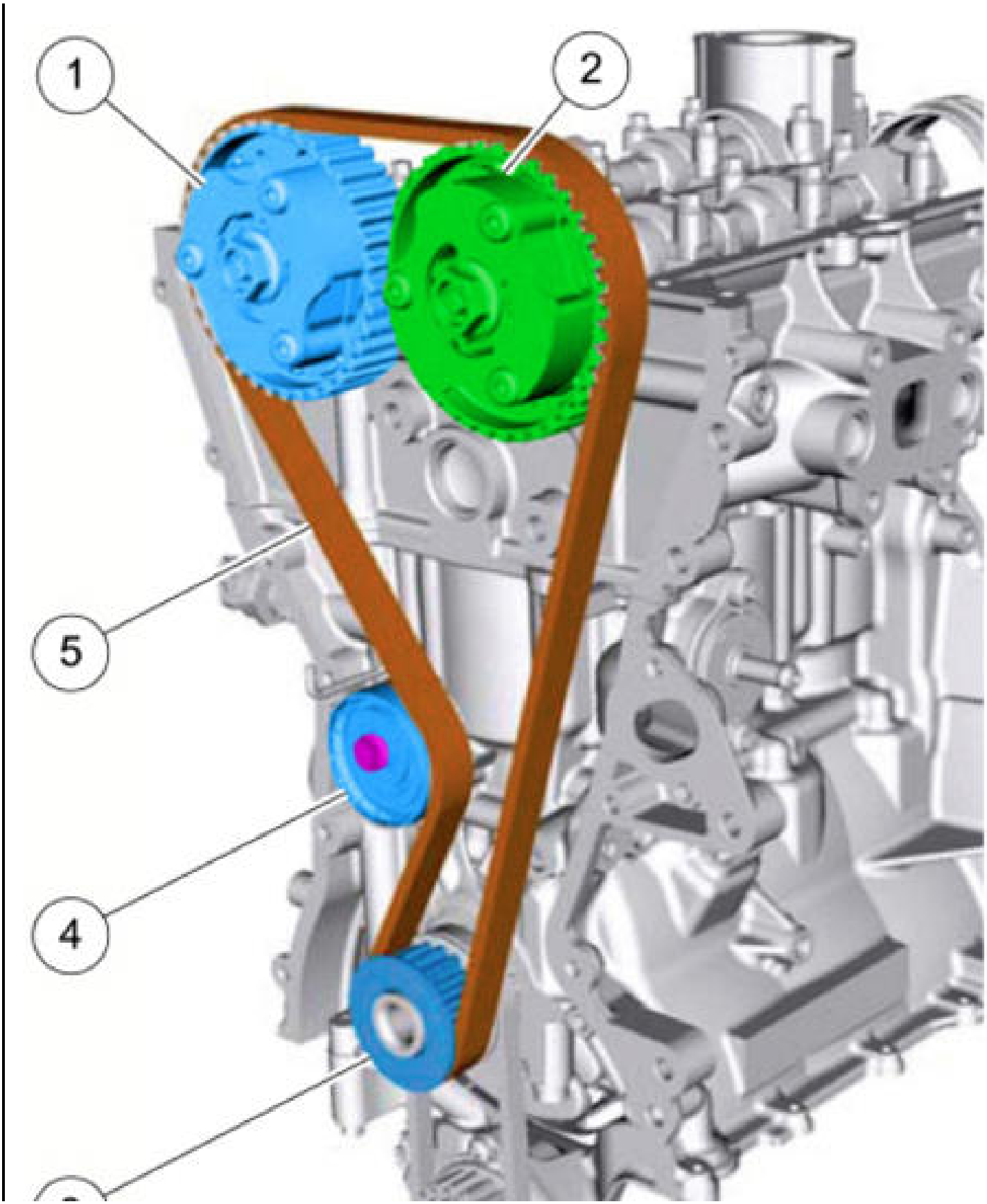


NOTE: **When the cylinder head gasket is replaced, the new gasket must have the same identification marking as the gasket which was previously installed. In addition, the instructions in the procedure must be followed for installation.**

A multi-layer steel laminate cylinder head gasket is used.

Two guide sleeves are pressed into the cylinder block to locate the cylinder head and its gasket.

Timing gear



Item	Description
1	Intake camshaft pulley with integrated **VCT**
2	Exhaust camshaft pulley with integrated **VCT**
3	Crankshaft timing gear
4	Automatic timing belt tensioner
5	Timing Belt

A newly developed **oil bath timing belt drive** is used to drive the camshafts.

Advantages of oil bath timing belt drive over an oil lubricated chain drive:

- Reduced frictional losses (about 20 per cent), thereby lower fuel consumption and thus reduced **CO2** emission
- Reduction in noise
- The guide rails usual with chain drive are eliminated

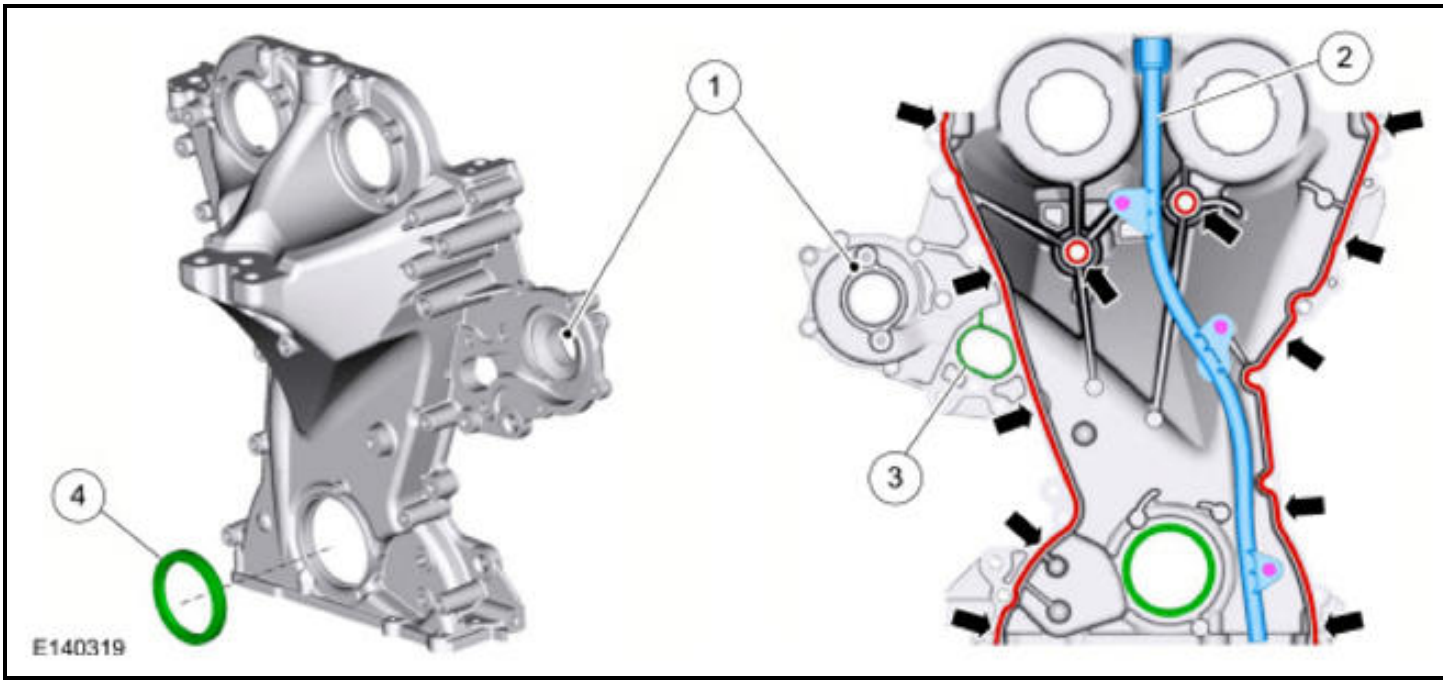
Advantages of oil bath timing belt drive over a comparable dry timing belt drive:

- The timing belt is maintenance-free

The timing belt is tensioned using an automatic timing belt tensioner.

NOTE: The instructions in the procedure must be followed for removal and installation of the timing belt.

Engine front cover



Item	Description
1	Jacking point - coolant pump
2	Guide - oil dipstick
3	Gasket - coolant inlet
4	Crankshaft front oil seal

The aluminum timing cover seals the camshaft drive to the outside. The lower area accepts the crankshaft oil seal which is installed from the outside. The special tools intended for the purpose must be used to remove and install the O-ring seal (see current appropriate service information literature).

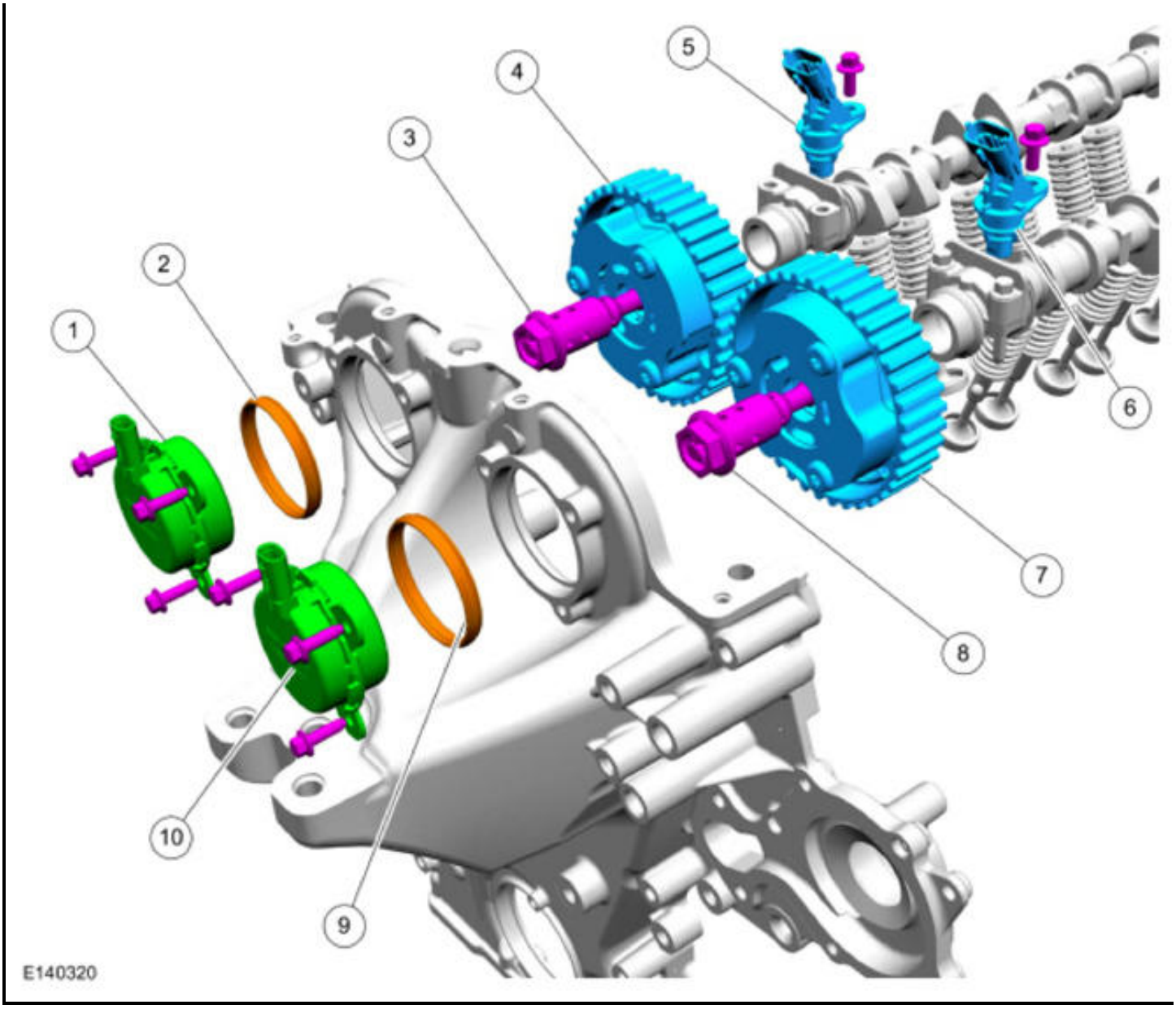
The seal to the engine is made using a sealing compound (arrows).

The oil dipstick guide is secured to the inside of the timing cover with three bolts.

In addition, the timing cover contains the jacking point for the coolant pump. To be able to remove it, the coolant pump must first be detached.

NOTE: The securing bolts of the timing cover must be tightened in a certain sequence and to a certain torque. Please refer to the instructions in the procedure for exact details of installation.

Variable Camshaft Timing

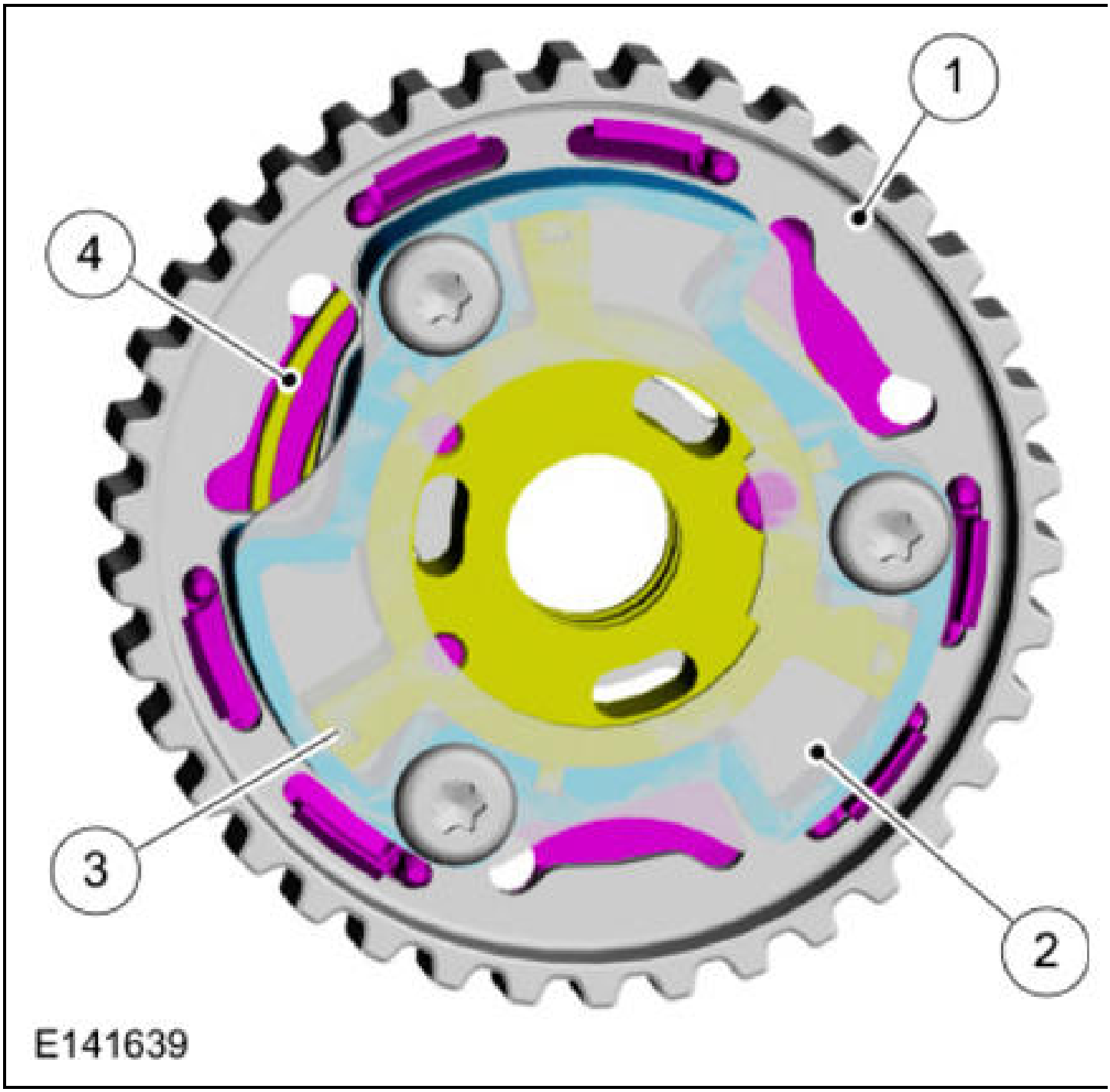


Item	Description
1	Variable camshaft timing solenoid, intake camshaft
2	Intake camshaft VCT solenoid seal
3	Intake camshaft VCT control valve
4	**VCT** unit - intake camshaft
5	**CMP** Sensor - intake camshaft
6	**CMP** Sensor - exhaust camshaft
7	**VCT** unit - exhaust camshaft
8	Exhaust camshaft VCT control valve
9	Exhaust camshaft VCT solenoid seal

10	Variable camshaft timing solenoid, exhaust camshaft

This is an electro-hydraulically controlled camshaft adjustment system that allows variable timing for the intake and exhaust camshafts independently of each other.

To do this, each camshaft is equipped with a **VCT** unit. The front closing plates of the units are marked with **I** (intake) and **e** (exhaust).



Item	Description
1	**VCT** unit (intake camshaft)
2	Front closing plate
3	Rotor
4	Return spring

The units have the same basic design. They are equipped with three oil brackets. A return spring is used to reach the closing position.

The difference between the **VCT** unit intake and exhaust camshafts is in the closing position. The unit of the intake camshaft closes in "retarded" position and the unit of the exhaust camshaft closes in the "advanced" position.

The VCT units are bolted with the associated VCT control valve on the respective camshaft. This means that:

- Securing bolt and control valve form one component.

Both **VCT** units have a maximum mechanical adjustment angle of **49** degrees crank angle. The maximum programmed adjustment angle is **45** degrees crank angle.

The particular control valve is operated by a VCT solenoid. Both solenoids are secured to the front of the timing case with three securing bolts each.

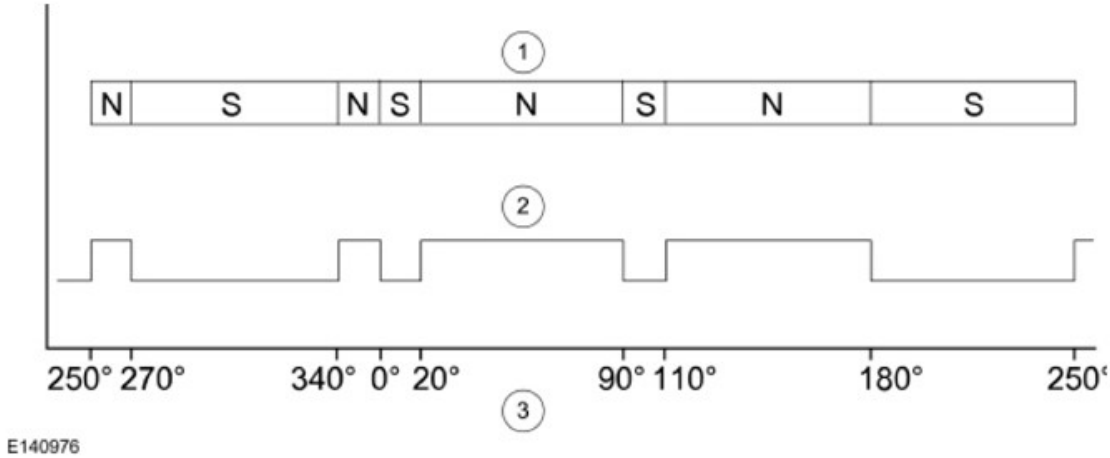


Fig. 2: CMP Sensor Signal Waveform
Courtesy of FORD MOTOR CO.

Item	Description
1	Magnetic alignment of the magnetic disk
2	Signal from **CMP** sensor
3	Setting of the camshaft **Comments:**

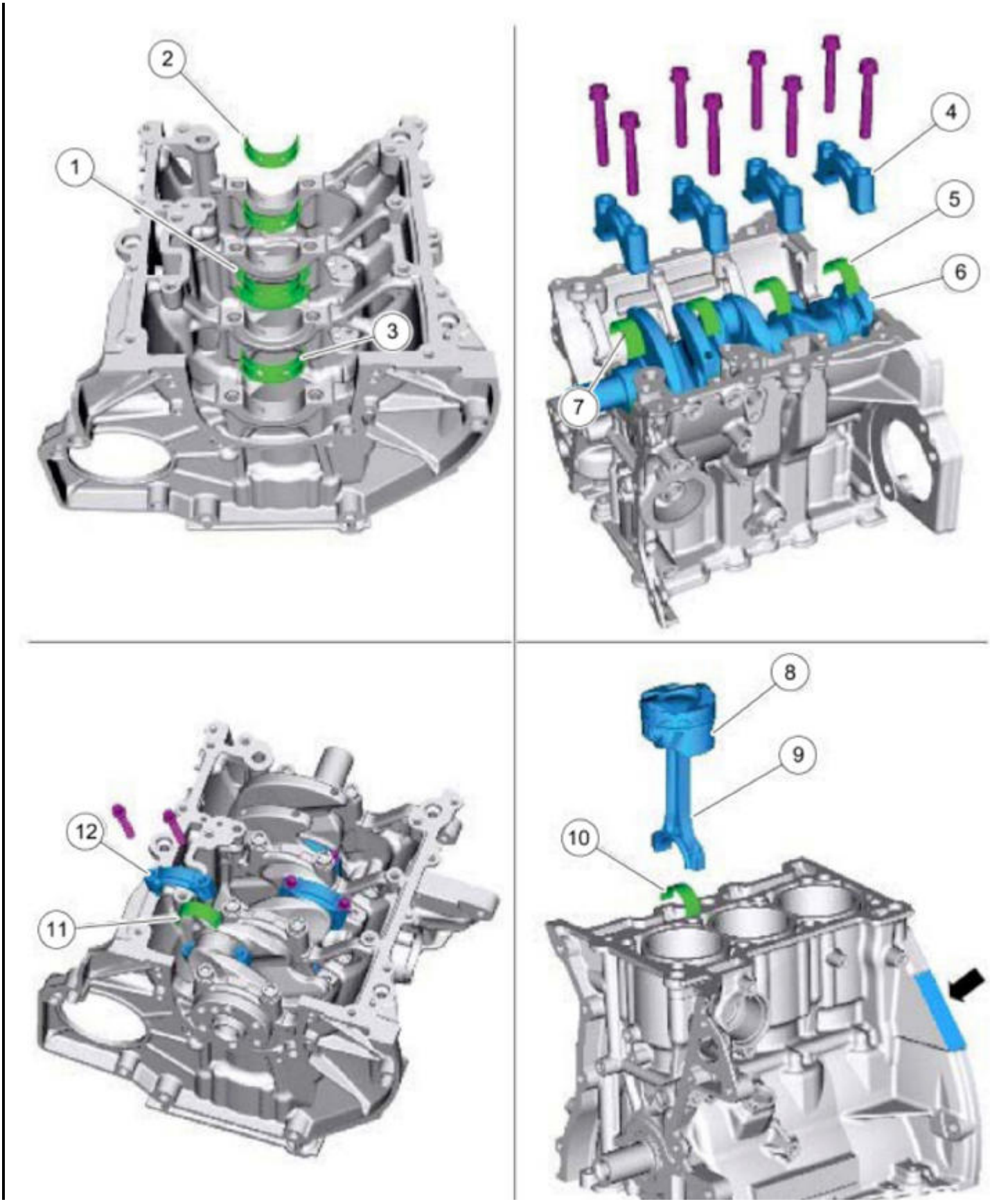
	Figures given in degrees camshaft

The exact angular position of the intake and exhaust camshaft is each detected by a **CMP** sensor. The sensor scans a magnetic disk which is shrunk onto the particular camshaft. This signal is changed into a square-wave signal by the built-in converter electronics and sent to the **PCM** .

Both sensors are mounted from above on the valve cover with one securing bolt.

NOTE: The installation position must be noted when removing the individual components. The instructions in the procedure must be followed.

Cylinder block and crankshaft assembly



Item	Description
1	Crankshaft upper bearing shell (1 required) **Comments:** Bearing shell with integral thrust washers (bearing no. 3)
2	Crankshaft upper bearing shell (1 required - bearing no. 1)
3	Crankshaft upper bearing shell (2 required - bearings no. 2 and 4)
4	Crankshaft bearing cap (quantity: 4)
5	Crankshaft lower bearing shell (1 required - bearing no. 1)
6	Crankshaft
7	Crankshaft lower bearing shell (3 required - bearings no. 2, 3 and 4)
8	Pistons (3 required)
9	Connecting rod (3 required)
10	Connecting rod upper bearing shell (3 required)
11	Connecting rod lower bearing shell (3 required)
12	Connecting rod bearing cap (3 required)

The **cylinder block** is an 'open-deck' construction made of cast iron.

The engine code is stamped on the transmission flange on the exhaust side (arrow).

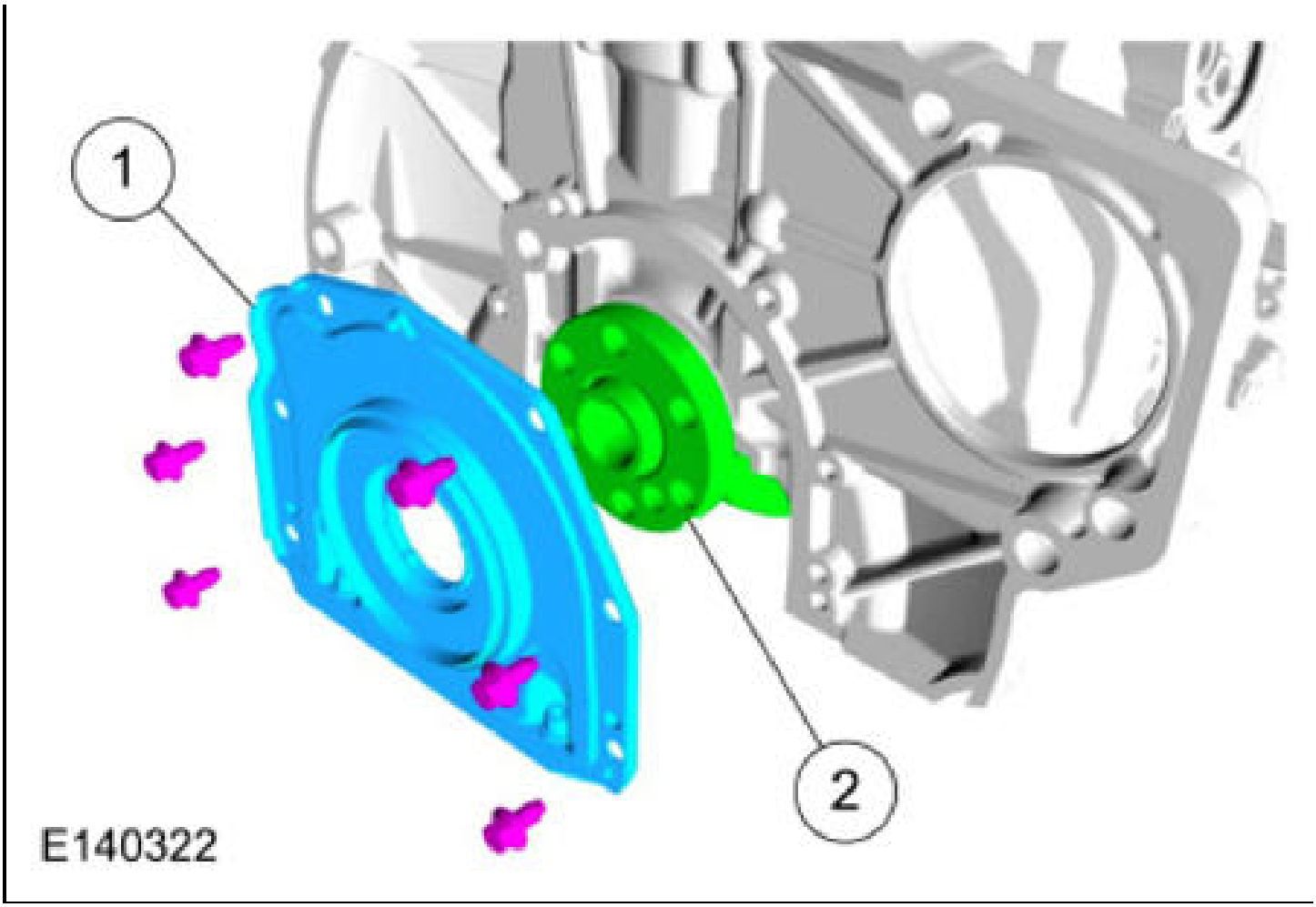
The side walls which are drawn down contribute to the rigidity of the cylinder block. These measures achieve a low weight as well as high rigidity.

The pistons are made of an aluminum-silicon alloy and are equipped with:

- an upper compression ring,
- a lower compression ring and
- a 3-part oil scraper ring (oil scraper ring as well as upper and lower tensioning spring elements).

The **crankshaft** runs in four bearings. The three crankshaft journals are at 120 degrees to one another.

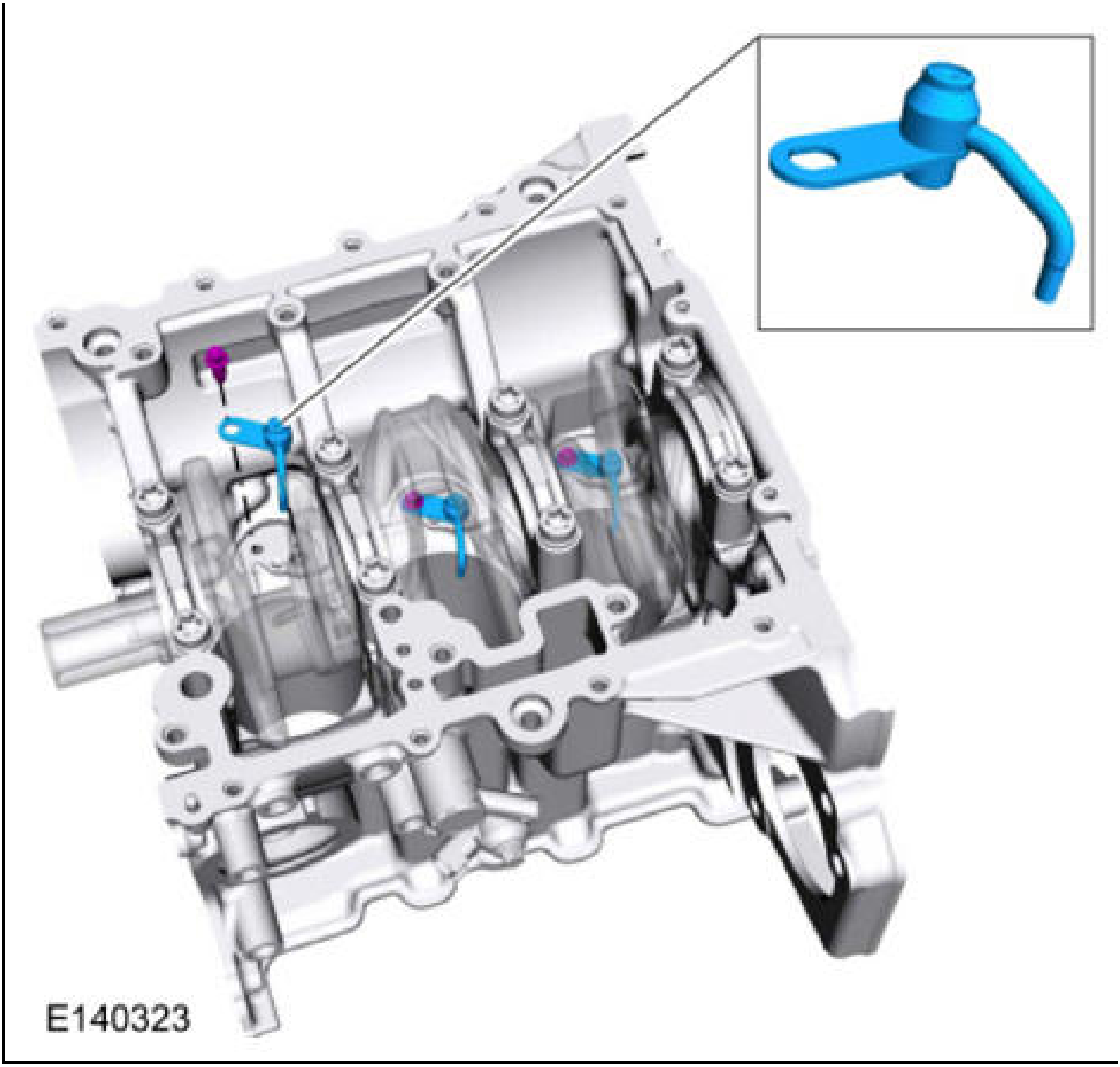
Crankshaft rear seal



Item	Description
1	Rear seal with steel carrier
2	Crankshaft

The crankshaft rear seal is vulcanized into a pressed steel carrier. The complete carrier must be replaced in the event of service work.

Oil Spray Nozzles

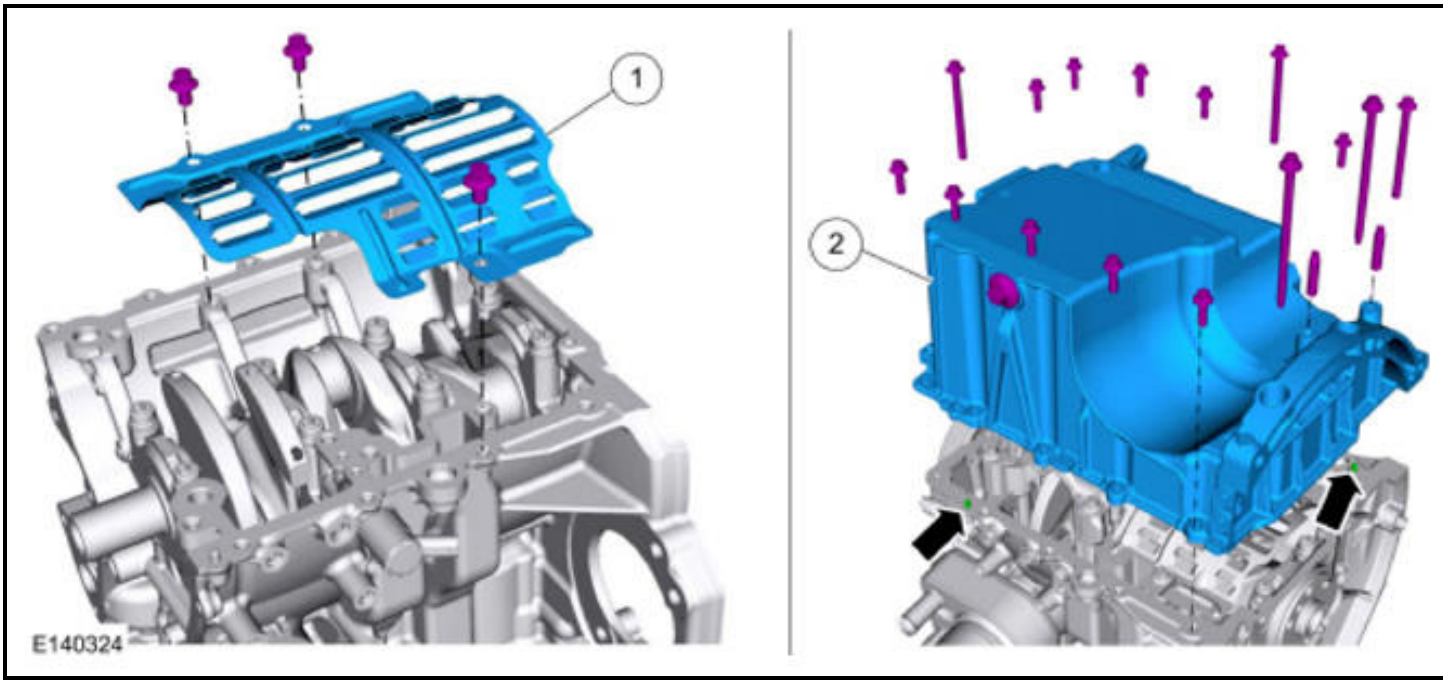


There are three oil spray nozzles for piston cooling, located at the bearing positions for the crankshaft in the cylinder block.

They are aligned so that engine oil is sprayed onto the underside of the piston.

The oil spray nozzles are equipped with a ball valve. The valve opens from an engine oil pressure of about 1.2 bar.

Oil pan baffle/oil pan



Item	Description
1	Oil baffle plate
2	Oil sump

The **oil pan baffle** is bolted to the cylinder block from underneath with three securing bolts.

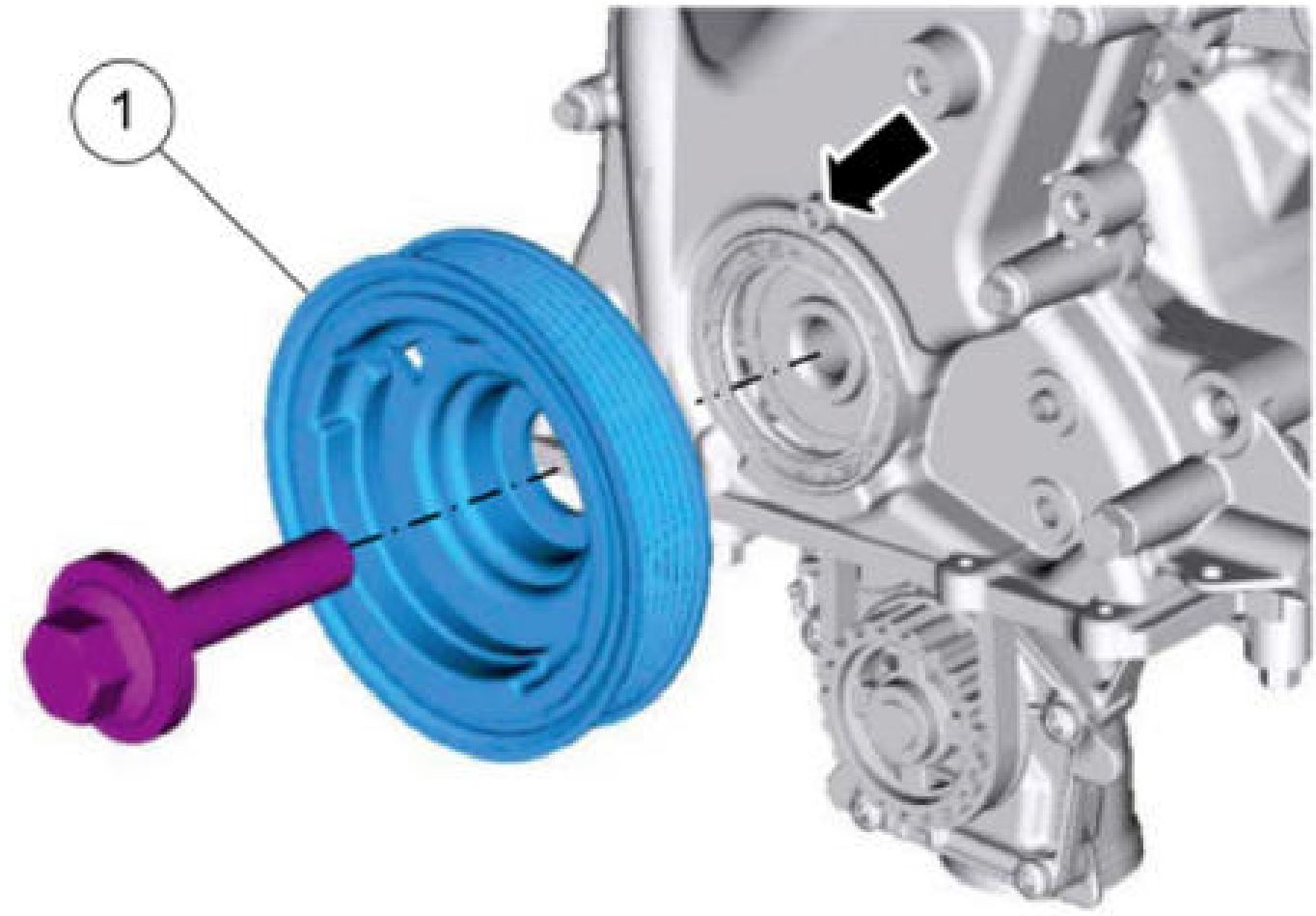
The **oil pan** is made of an aluminum alloy. It is equipped with a solid rib and at the same time forms the lower transmission flange. This achieves a rigid engine/transmission combination.

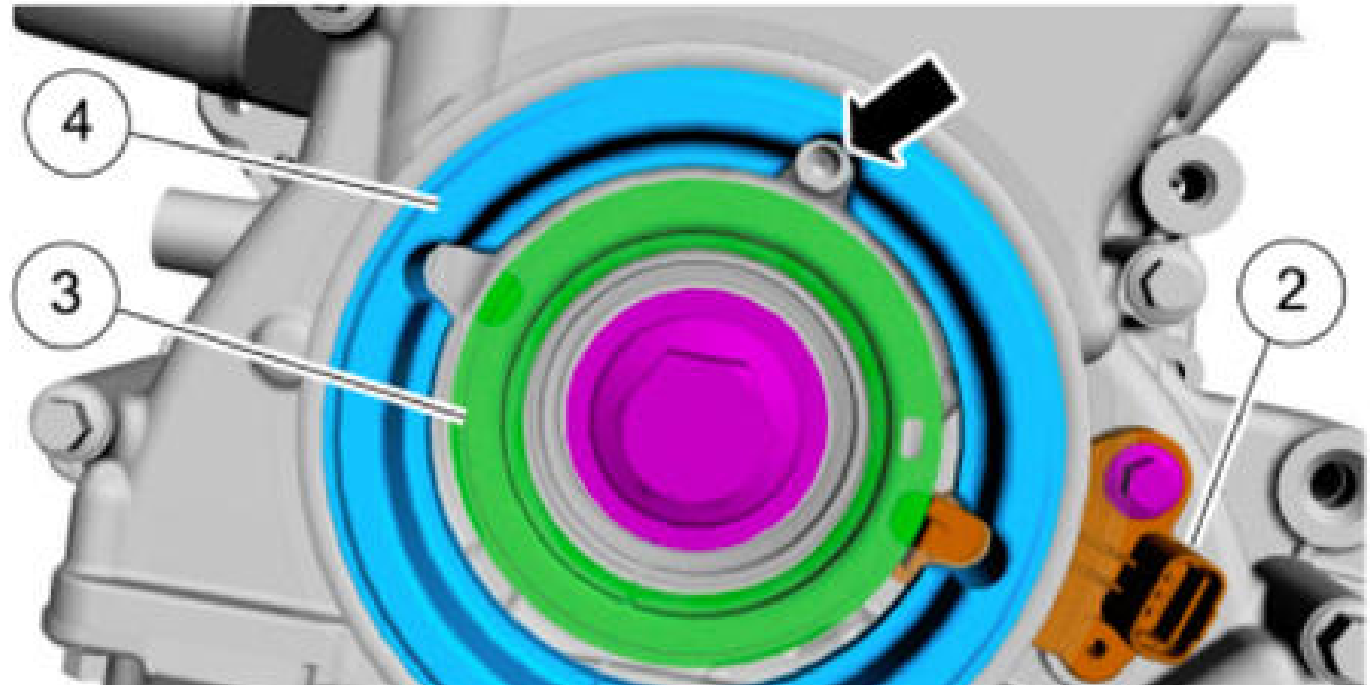
There are two guide pins (arrows) on the sealing surface of the cylinder block for exact alignment of the oil pan.

The seal of the oil pan to the cylinder block is made using sealing compound.

For installation and removal of the oil pan or the oil pan baffle, the detailed instructions in the current service information literature must be followed.

Crankshaft pulley





Item	Description
1	Crankshaft pulley
2	**CKP** sensor
3	Crankshaft position magnetic disk
4	Balance weight

The crankshaft pulley forms a single unit together with the magnetic disk for the crankshaft position.

There is an exactly positioned balance weight built into the crankshaft pulley and this reduces the vibrations of the crankshaft.

The crankshaft pulley is secured on the crankshaft only by the contact force of the securing bolt, which must be changed for a new one after removal.

NOTE: When the crankshaft pulley is installed, it must be aligned in a defined position (arrow). For this purpose, the crankshaft must be in the TDC position. The instructions in the procedure must be observed for this.

The exact position of the crankshaft is detected by the **CKP** sensor. The sensor scans the crankshaft position magnetic disk. This signal is changed into a square-wave signal by the built-in converter electronics and sent to the **PCM** . When the sensor is renewed, **no** adjustment is necessary because this is predetermined by the way in which the sensor is secured.

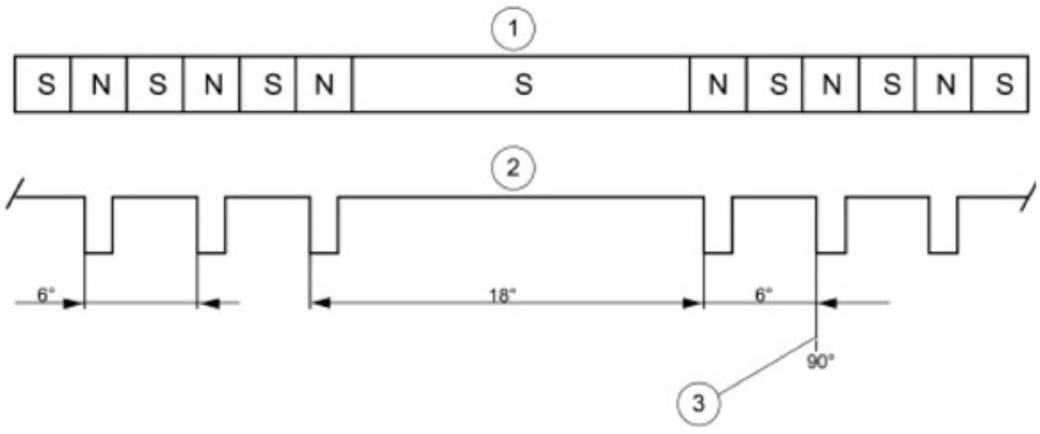
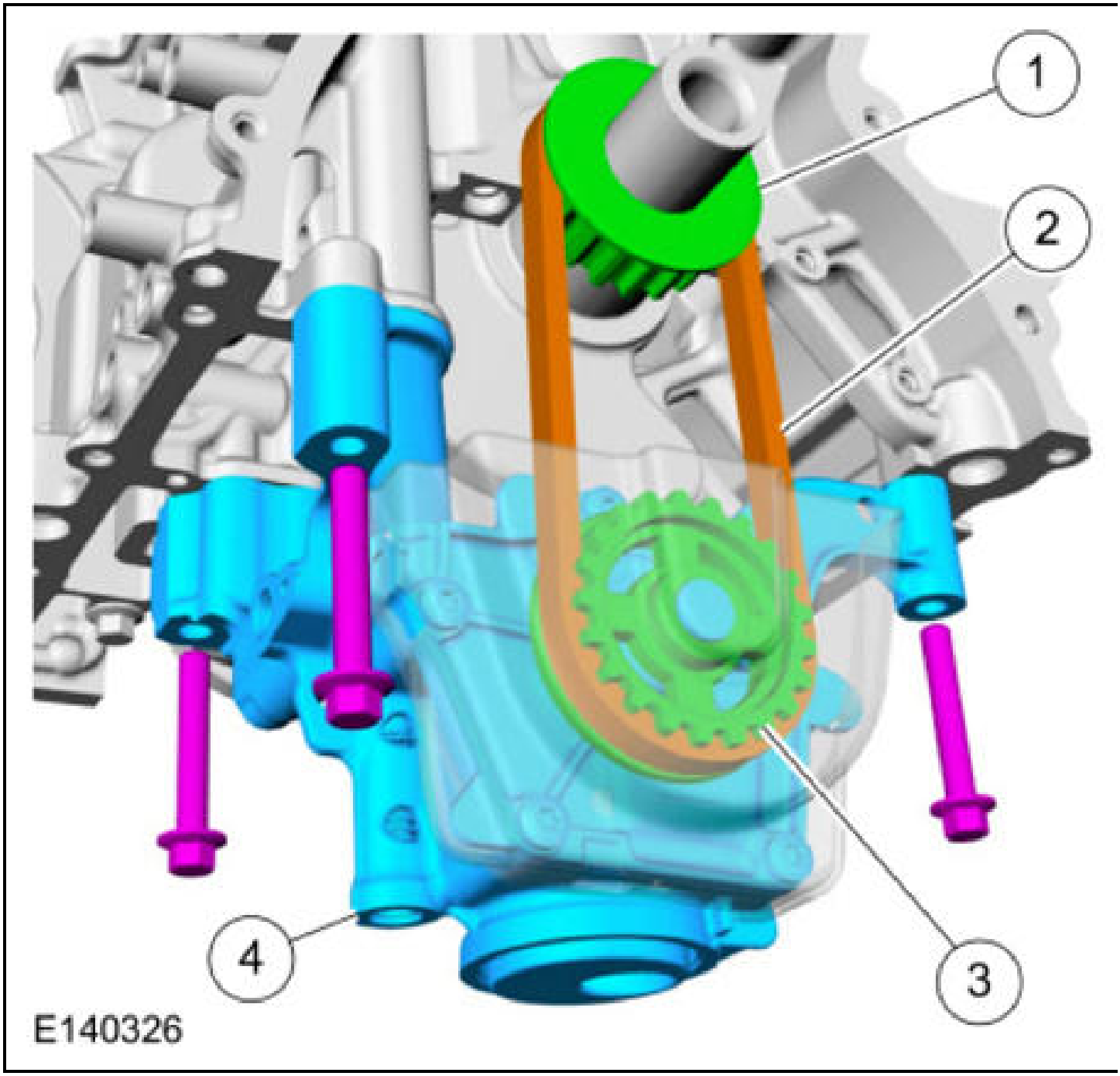


Fig. 3: CKP Sensor Signal Waveform
Courtesy of FORD MOTOR CO.

Item	Description
1	Magnetic alignment of the magnetic disk
2	Signal from **CKP** sensor
3	Reference mark 90° before **TDC** **Comments:** Figures given in degrees crankshaft

Engine Lubrication

Oil pump



Item	Description
1	Oil pump drive pulley
2	Oil pump drive belt
3	Oil pump gear

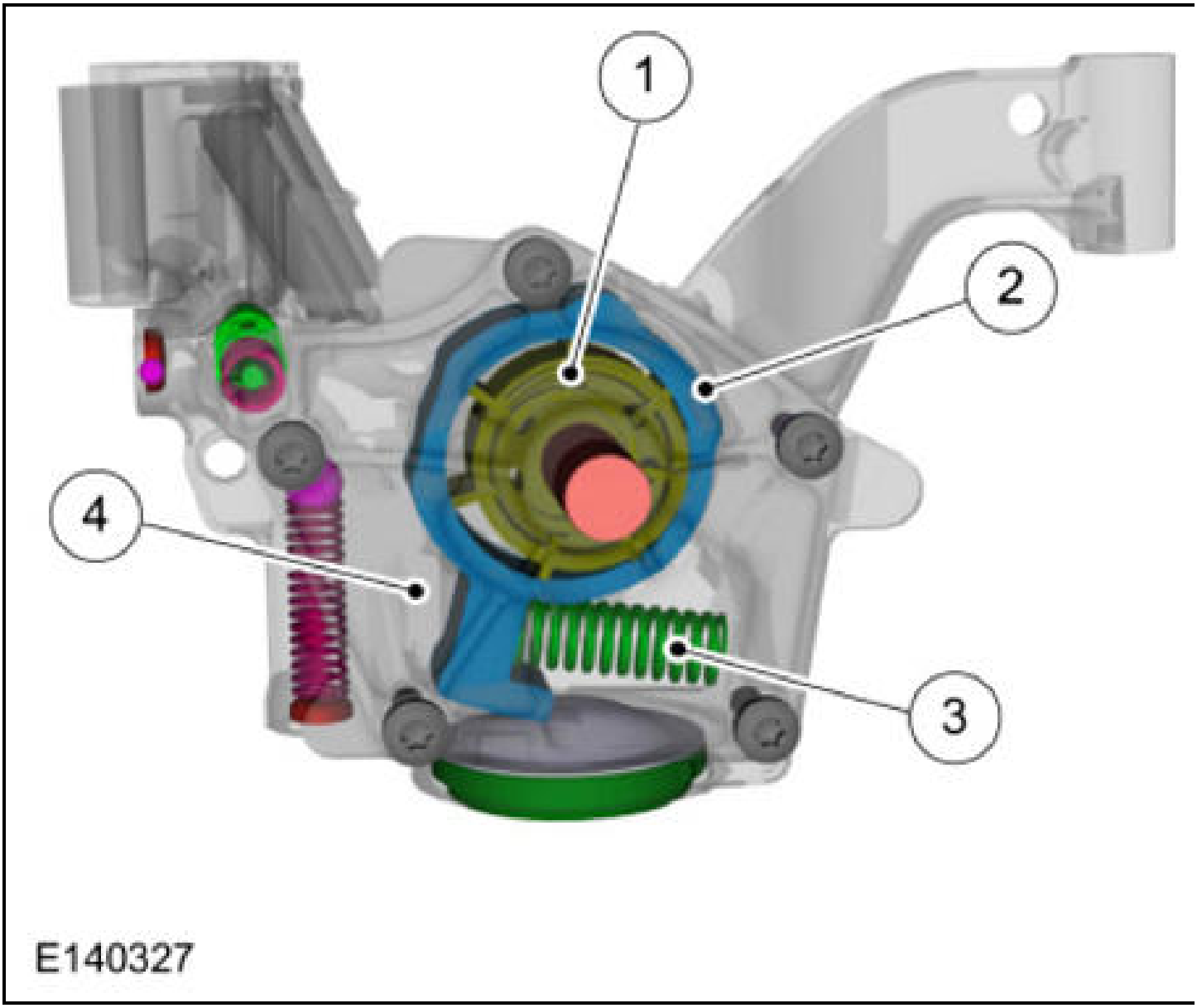
4	Oil pump

The oil pump is mounted on the cylinder block from below with three securing bolts.

Conventional oil pumps account for up to 10% of the mechanical power losses at the nominal speed of an engine, leading to increased fuel consumption. This is caused by the high output of the oil pump, especially at high engine speeds.

When a **variable oil pump** is used, the output can be matched to the required oil flow in a flexible manner, depending on the temperature and the engine speed.

Layout



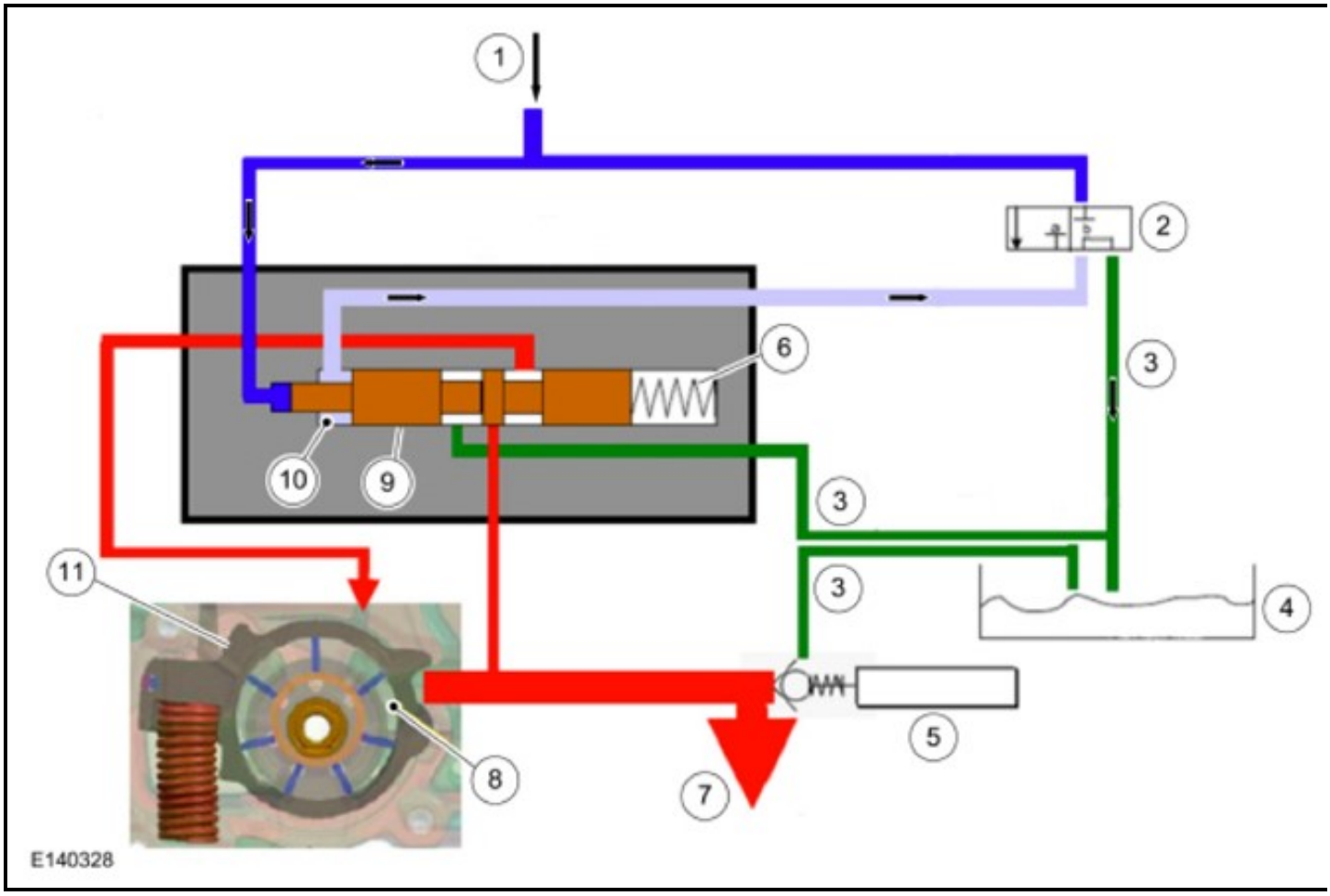
Item	Description
1	vane-type pump
2	Adjusting ring, vane pump
3	Pressure spring
4	Control pressure space

The principle component of the variable oil pump is formed by a **vane-cell pump** with an adjusting ring.

The illustration shows the adjusting ring in the **starting position** . The pressure spring pushes the adjusting ring to the left against the stop. In this position the vane-cell pump creates the maximum possible oil flow.

The oil pressure in the control pressure space can be changed depending on the oil pressure demand. If the oil pressure in the control chamber exceeds the force of the pressure spring, then the vane-cell pump adjusting ring is moved to the right. This **reduces the supply capacity** of the pump.

Operation



Item	Description

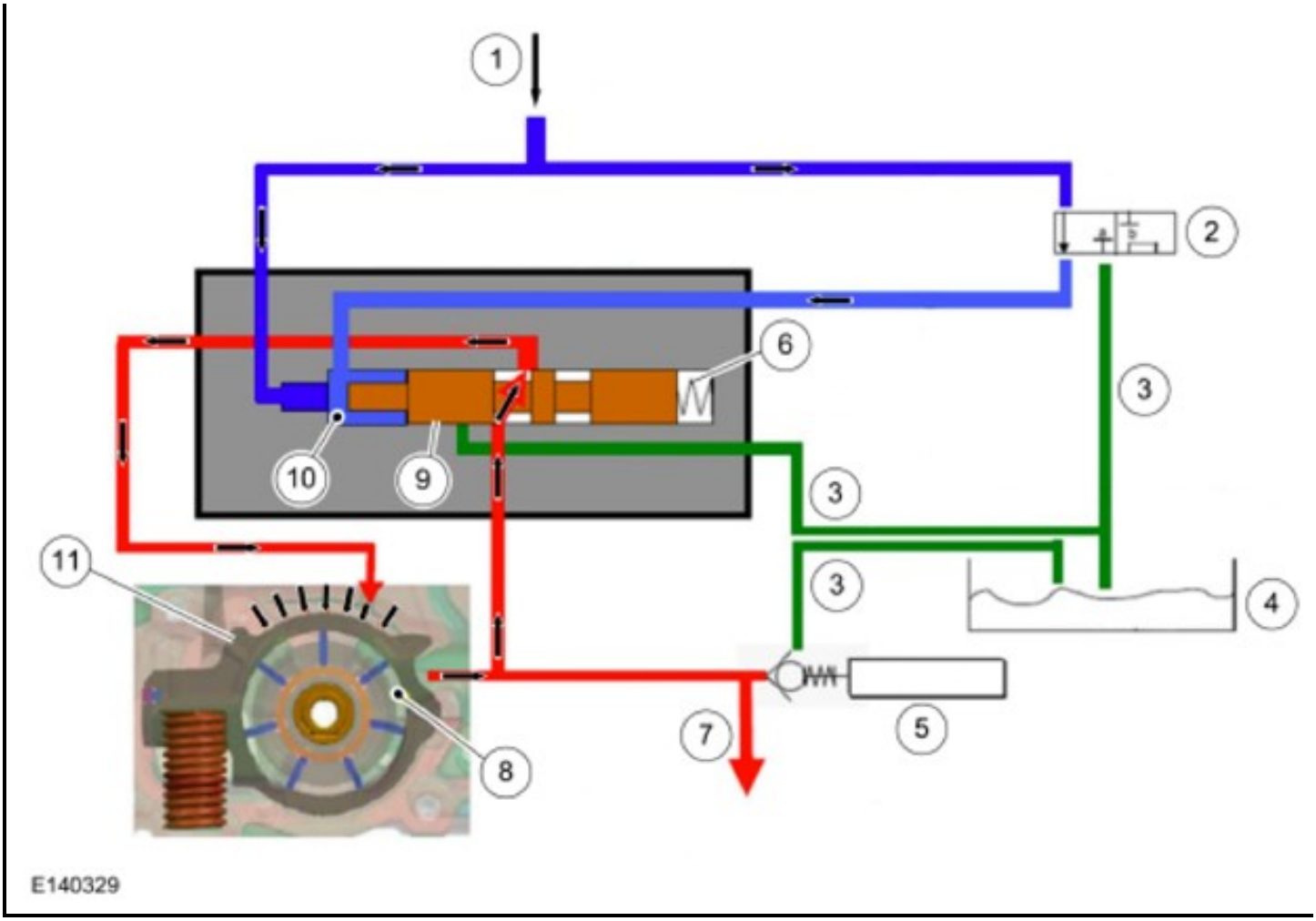
1	Oil pressure from the main oil gallery
2	Oil pump control solenoid
3	Leakage line
4	Oil sump
5	Pressure relief valve
6	Spring
7	Oil pressure to oil filter
8	Pressure port of the vane pump
9	Hydraulic control piston
10	Control chamber
11	Adjusting ring, vane pump

The oil pressure is controlled via a hydraulically operated control piston integrated into the oil pump. The pressure on the control piston is determined by a solenoid valve which is activated by the **PCM** according to the requirements.

In the rest position, the **solenoid valve is closed** (see previous illustration). The engine oil supplied by the oil pump flows to the control chamber. Because the solenoid valve is closed, the oil flows through the control chamber and drains to the oil pan via a bypass in the solenoid valve. No pressure can therefore be built up in the control chamber.

The control piston is pushed to the left by the spring force. Because of this, the control piston **closes** the **oil gallery** to the vane-cell pump adjusting ring.

In this position, the pressure gallery of the transfer pump has the **largest aperture cross-section** . The **maximum possible oil flow** is thus available for engine lubrication.



Item	Description
1	Oil pressure from the main channel
2	Oil pressure control solenoid valve
3	Leakage line
4	Oil sump
5	Pressure relief valve
6	Spring
7	Oil pressure to oil filter
8	Pressure channel of the transfer pump
9	Hydraulic control piston
10	Control chamber
11	Adjusting ring, vane pump

When operating conditions permit the vehicle to be driven with a lower oil pressure, the **PCM opens** the **solenoid valve** .

The oil pressure supplied by the oil pump now acts **directly and via the solenoid valve** on the control chamber

and with it pushes the control piston to the right against the spring force.

Because of this, the control piston opens the oil channel to the vane-cell pump adjusting ring. The pump pressure now acts on the adjusting ring and presses it towards the center of the pump.

In this position, the pressure channel of the transfer pump has only a **small aperture cross-section** . A **lower oil pressure** is thus available for engine lubrication.

DIAGNOSIS AND TESTING

ENGINE

1. For basic mechanical concerns

   REFER to: **ENGINE** .

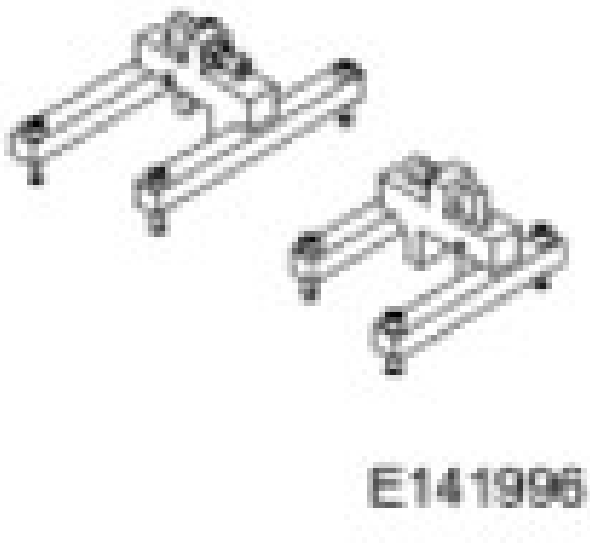
   For driveability concerns Refer to **ENGINE CONTROLS - INTRODUCTION (EXCEPT DIESEL & HYBRID) (SECTION 0)** .

GENERAL PROCEDURES

VALVE CLEARANCE ADJUSTMENT

SPECIAL TOOL DESCRIPTION

	303-1604 Timing Peg, Crankshaft TDC

	303-1605 Alignment Tool, Camshaft
Feeler Gauge	

MATERIAL SPECIFICATIONS

Name	Specification
Engine Oil - 5W20	WSS-M2C948-B
Gasket Maker TA-16	WSK-M2G348-A5

Check

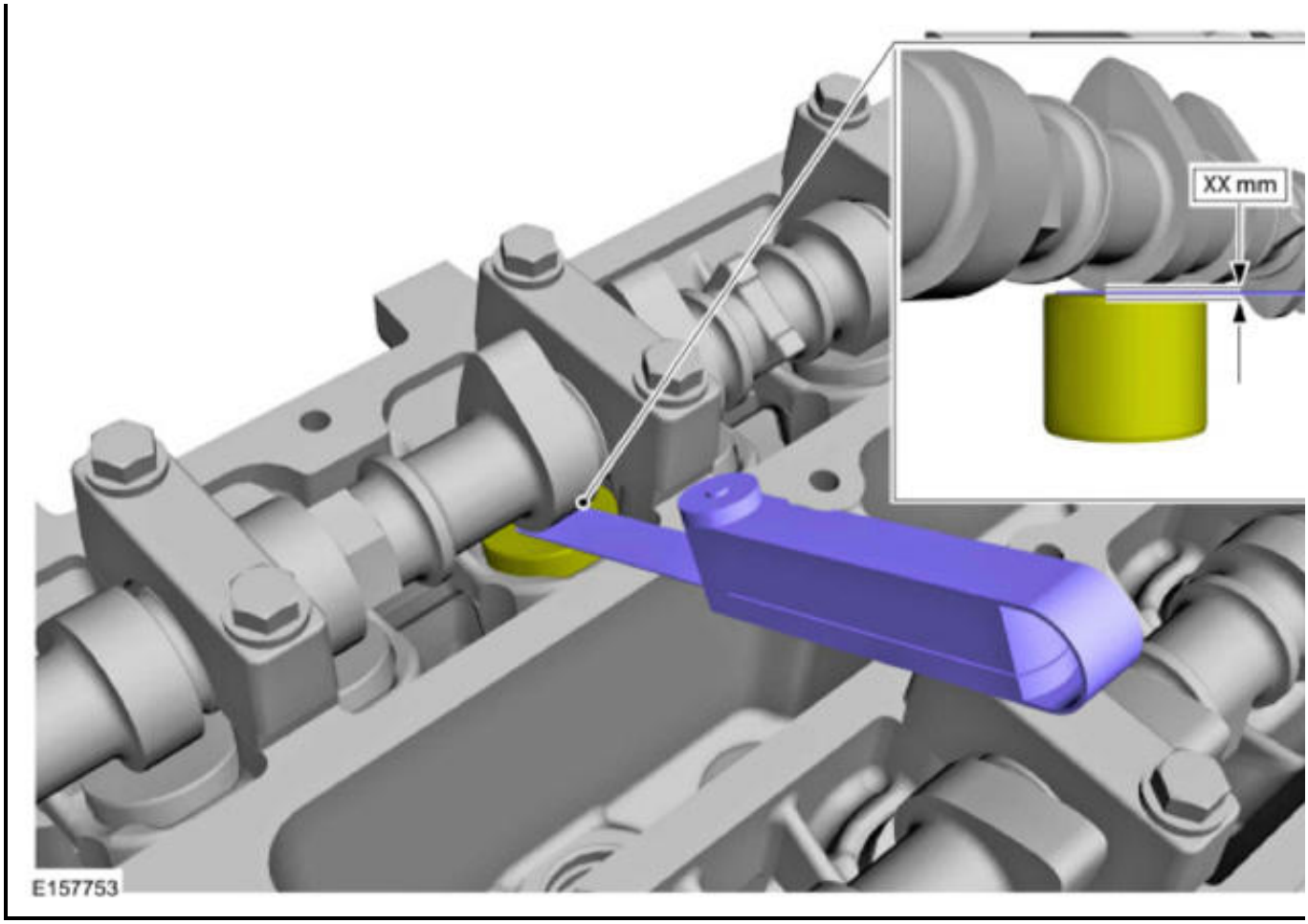
1. Refer to: **VALVE COVER** .
2. **NOTE: Only rotate the crankshaft clockwise.**

   Rotate the crankshaft until the corresponding piston is at TDC and then measure the valve clearance(s).

   Use the General Equipment: Feeler Gauge

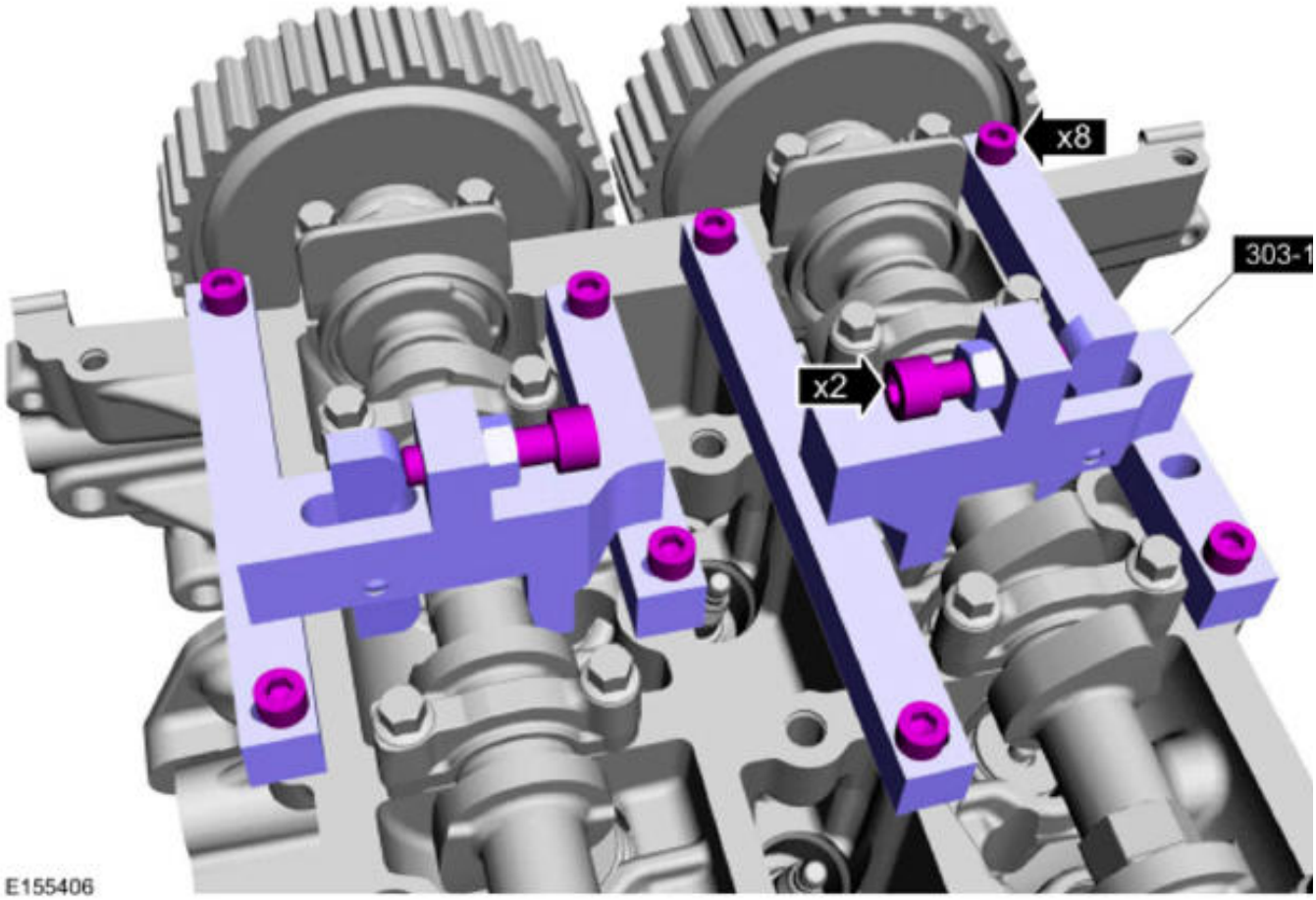
3. Note down each cylinder number and the valve clearances measured.
4. Compare the measured valve clearance(s) with the specifications.

   Refer to: **SPECIFICATIONS** .

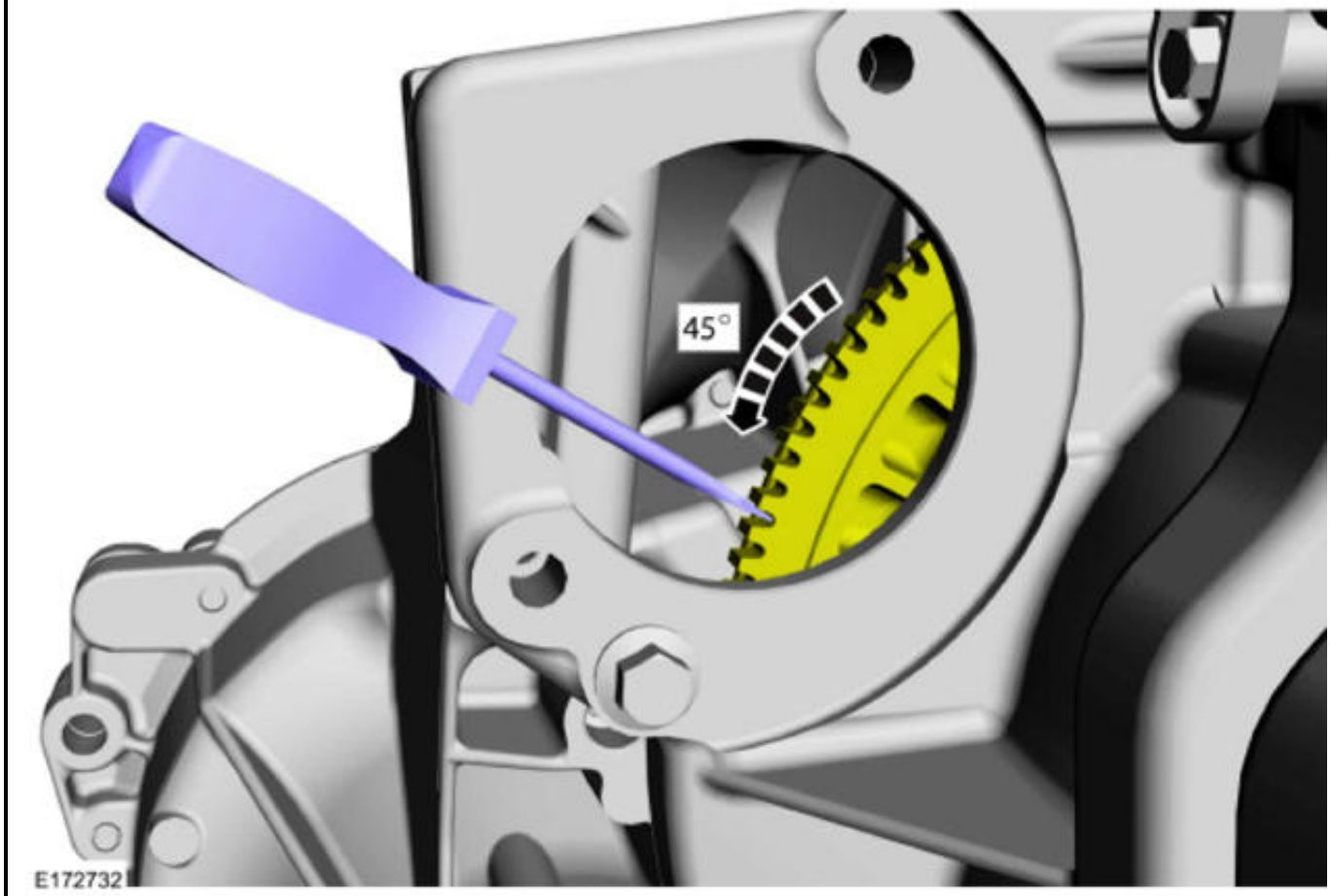


Adjustment

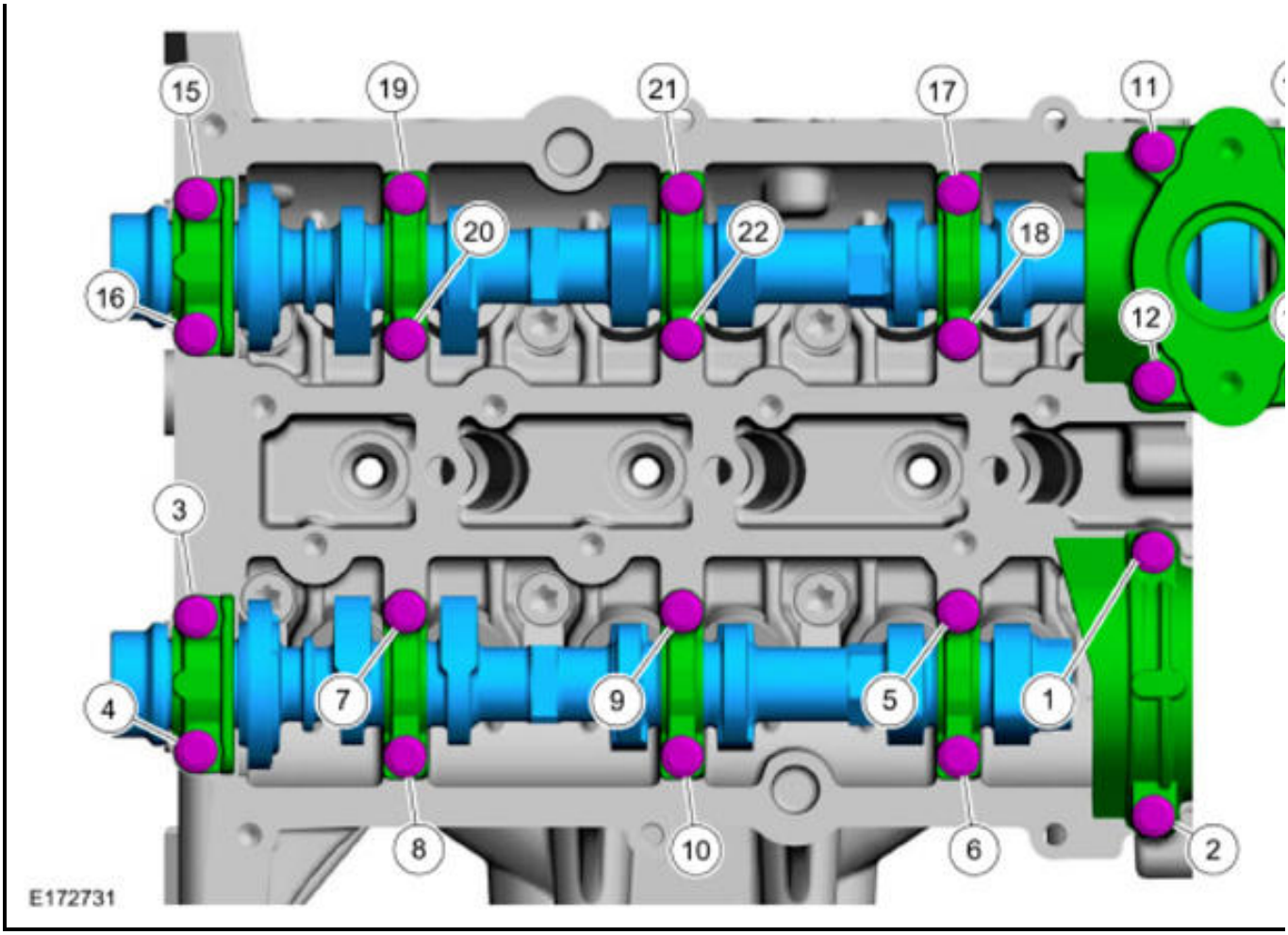
1. **NOTE: The following steps are only necessary if adjustment is required.**
2. Refer to: **VARIABLE CAMSHAFT TIMING (VCT) UNIT** .
3. Remove Special Service Tool: 303-1605 Alignment Tool, Camshaft.



4.

4. 

5. **NOTE: Note the position of the components before removal.**



6.
- Remove the valve tappet and read the thickness from the underside.
- The number on the valve tappet indicates the thickness of the bottom of the tappet. However, the number only indicates the digits after the decimal point (example: 725 = 2.725).

7.
- Calculate the required thickness of the valve tappet with the following formula: X = S + M - V
- Required thickness of tappet = X
- Thickness of currently fitted tappet = S
- Measurement of existing valve clearance (actual value) = M
- Desired valve clearance = V

8. Install the correct valve tappet.

NOTE: **Make sure that the components are installed to the position noted before removal.**

9.

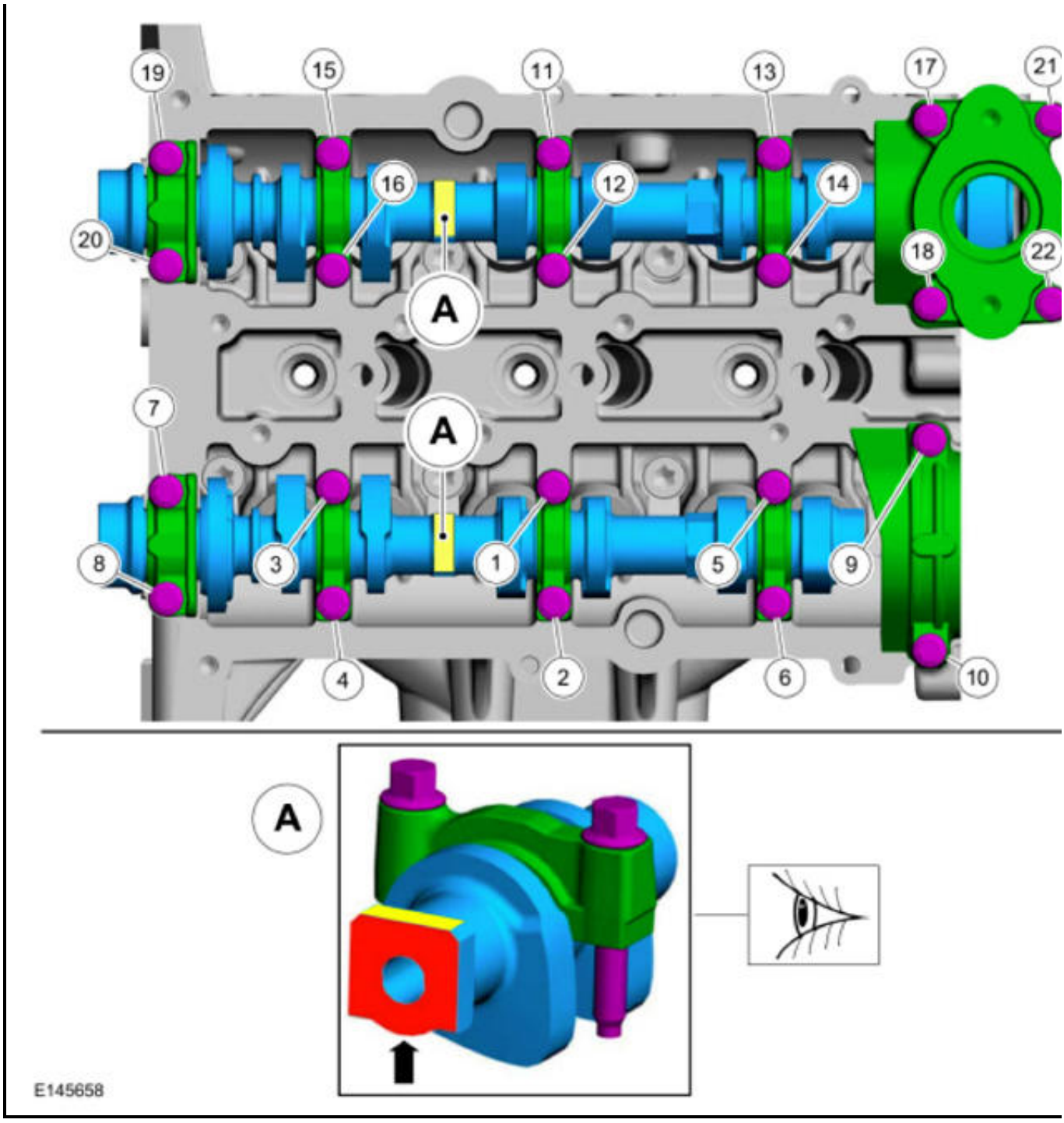
10. Install the camshafts approximately at valve overlap position cylinder No. 1.

Material : Engine Oil - 5W20 (WSS-M2C948-B)

11. **NOTE: Install all the bolts finger tight before final tightening.**

    Tighten each bolt 2 turns at a time.

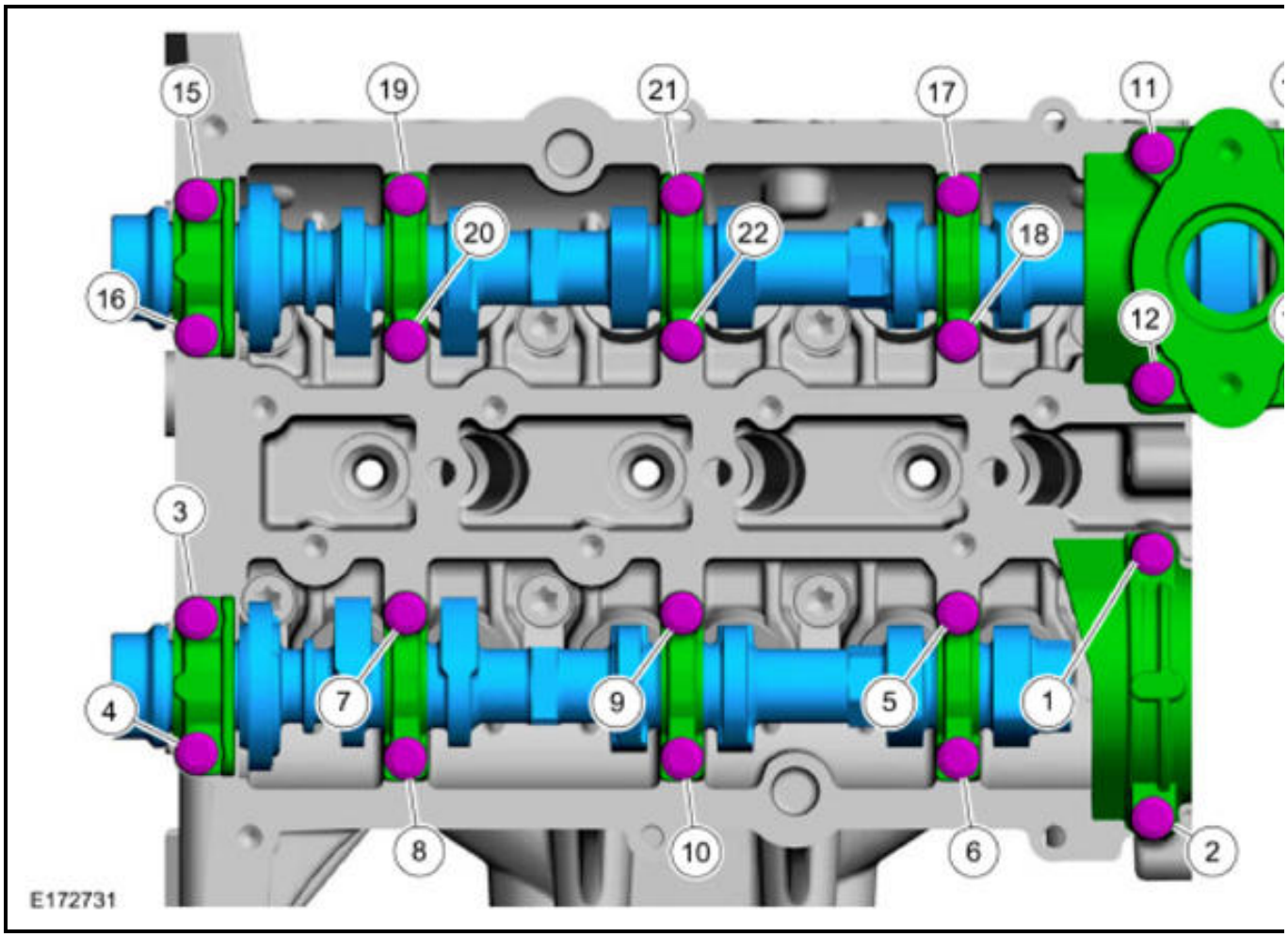
12. *Torque* : 89 lb.in (10 Nm)



13.

1. Turn the camshafts to measure the valve clearance.
2. Measure the valve clearances and repeat this procedure as necessary until all valve clearances are within the specified tolerance.

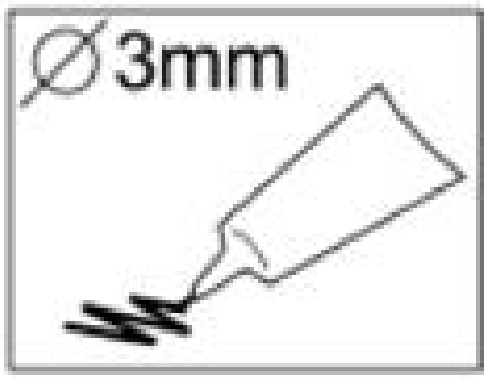
14. **NOTE: Note the position of the components before removal.**

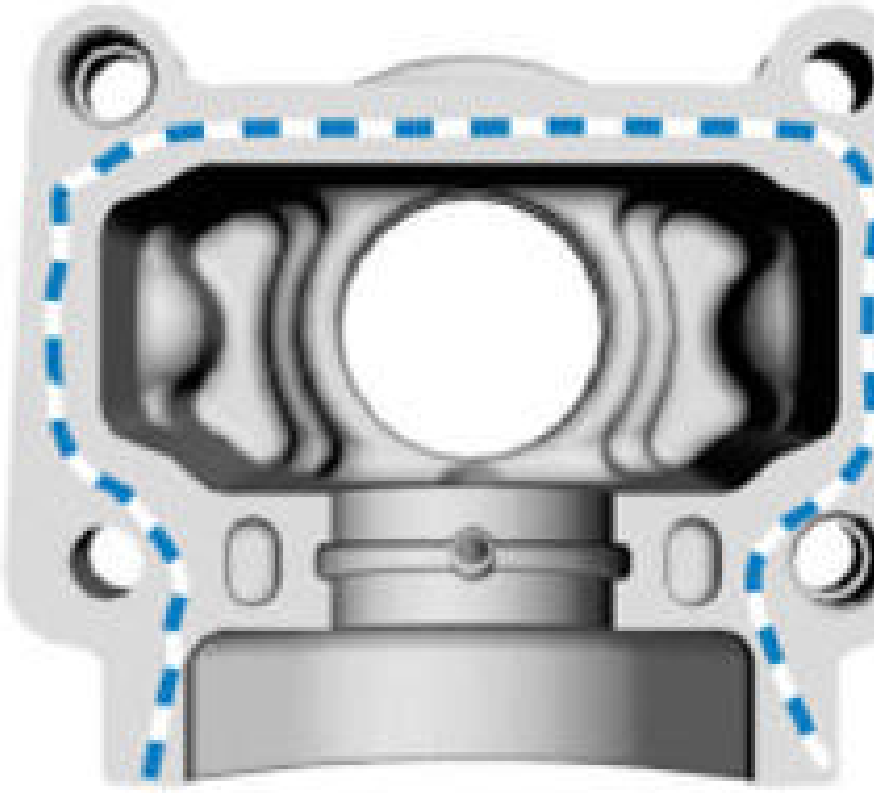


15. **NOTE:** **Make sure that the mating faces are clean and free of foreign material.**

NOTE: **The component must be installed within 5 minutes of applying the sealant.**

Material : Gasket Maker/TA-16 (WSK-M2G348-A5)

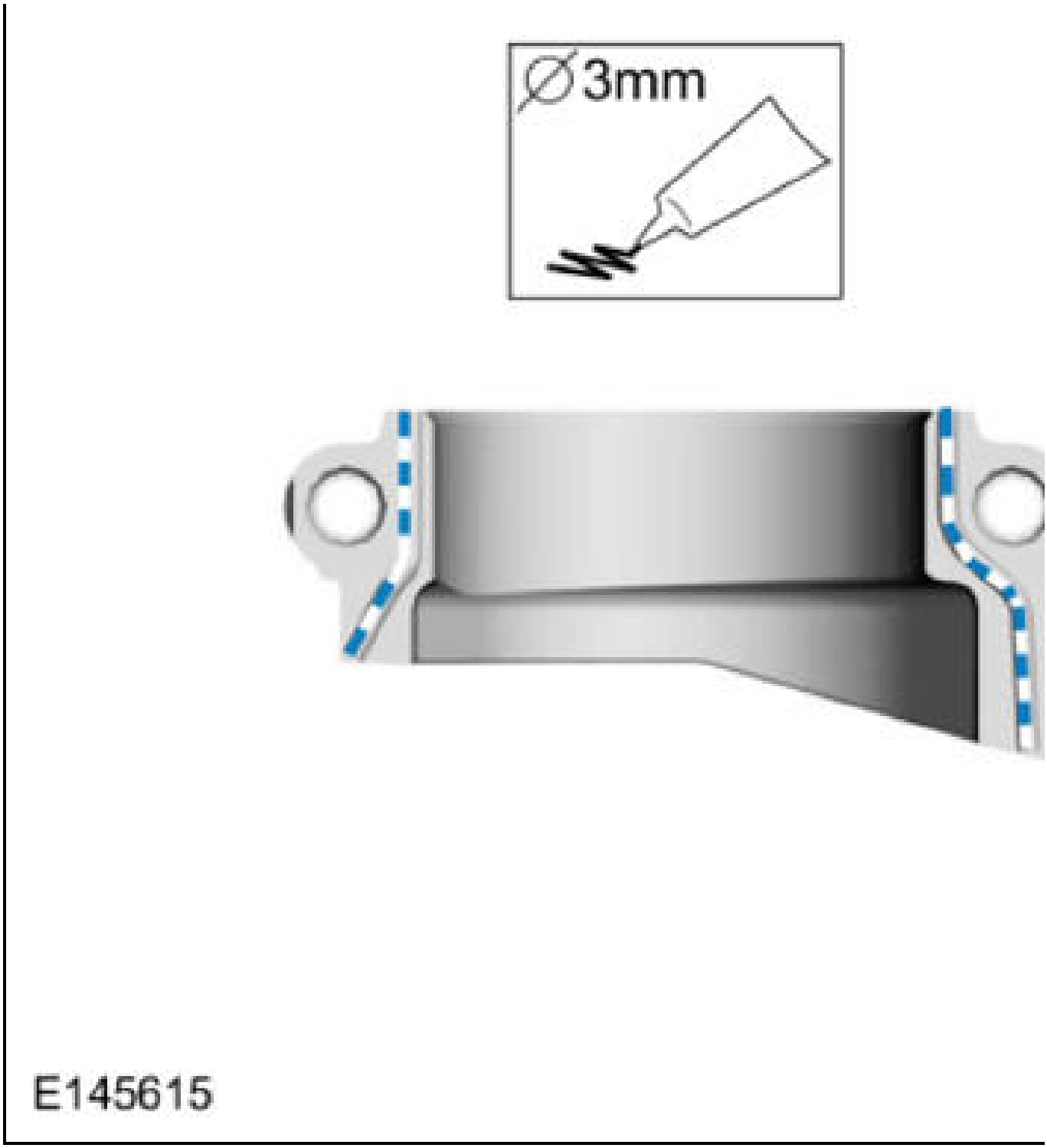




16. **NOTE: Make sure that the mating faces are clean and free of foreign material.**

NOTE: The component must be installed within 5 minutes of applying the sealant.

Material : Gasket Maker/TA-16 (WSK-M2G348-A5)



NOTE: **Make sure that the components are installed to the position noted before removal.**

17.

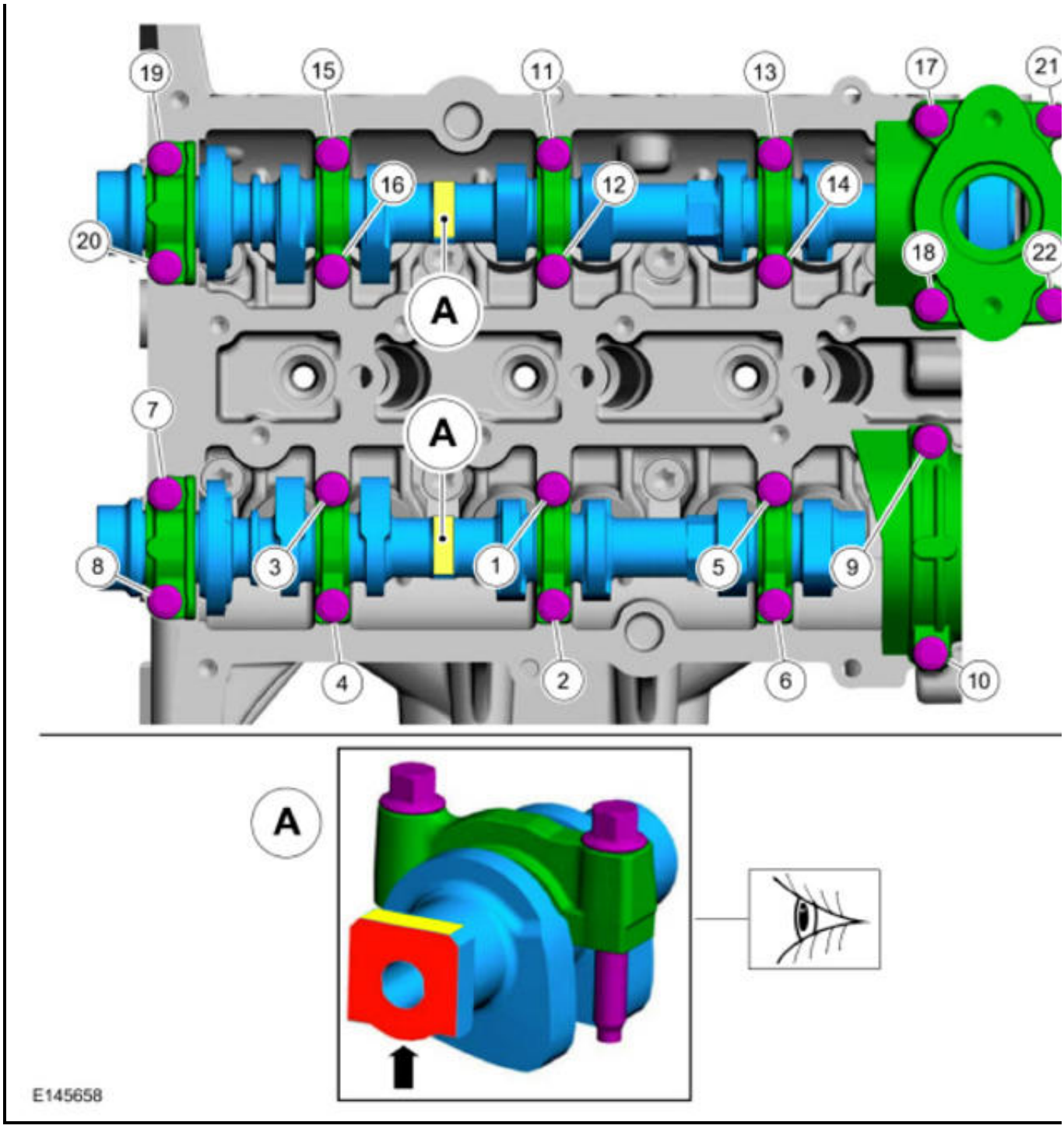
18. Install the camshafts approximately at valve overlap position cylinder No. 1.

Material : Engine Oil - 5W20 (WSS-M2C948-B)

19. **NOTE: Install all the bolts finger tight before final tightening.**

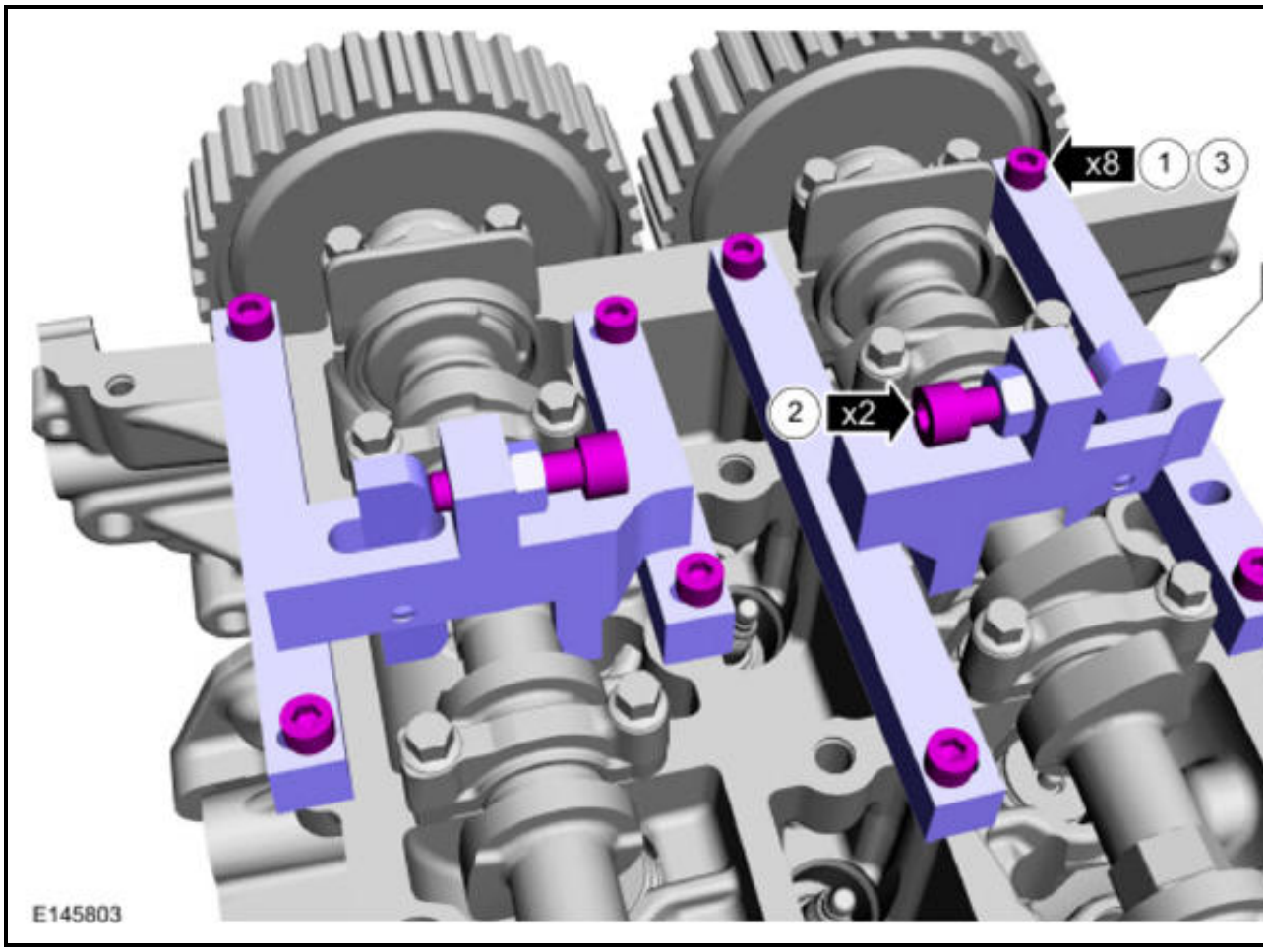
    Tighten each bolt 2 turns at a time.

20. *Torque* : 89 lb.in (10 Nm)

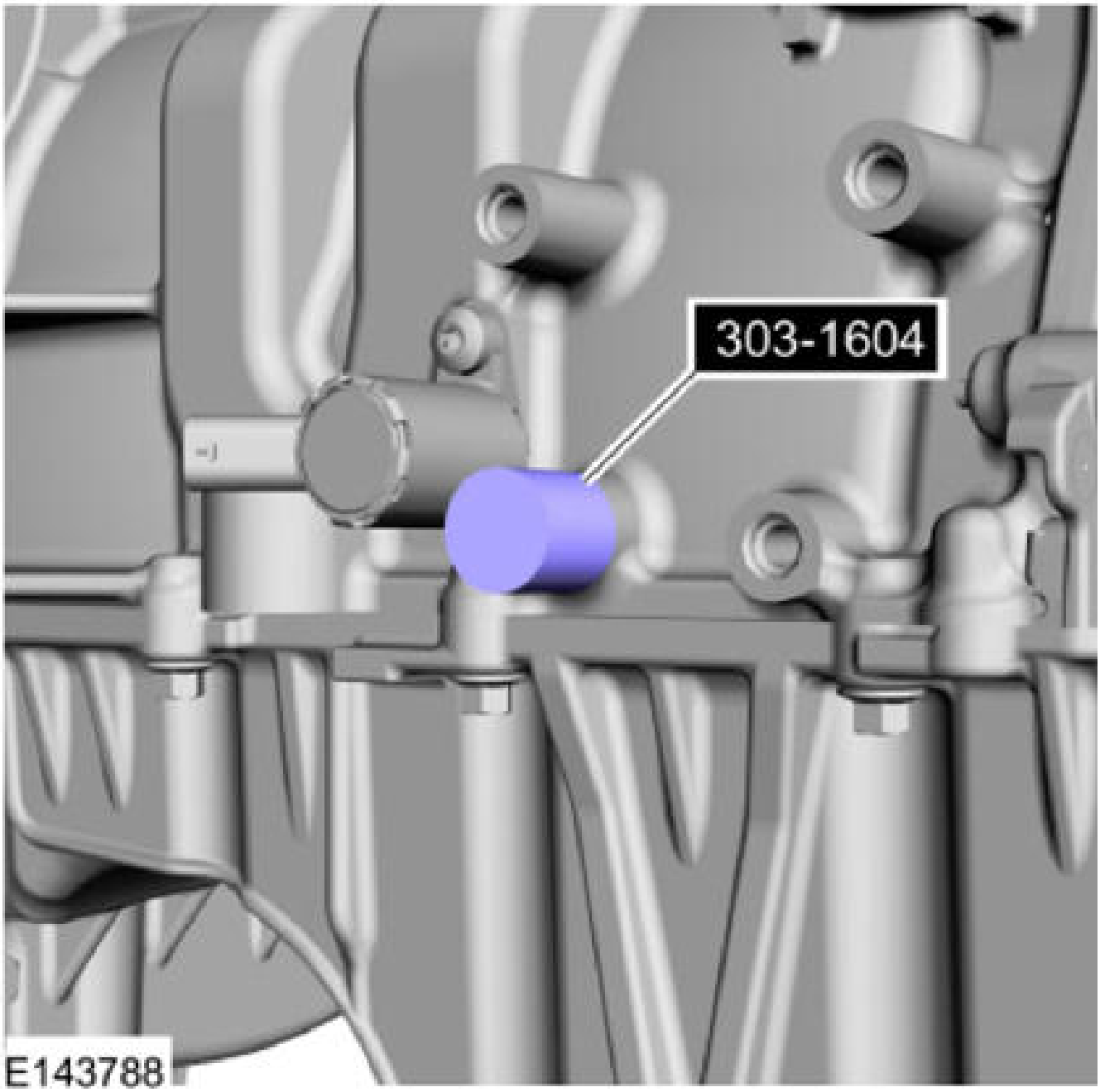


21.

1. Install Special Service Tool: 303-1605 Alignment Tool, Camshaft.
2. **NOTE: Only tighten the bolts finger tight at this stage.**
3. *Torque* : 89 lb.in (10 Nm)



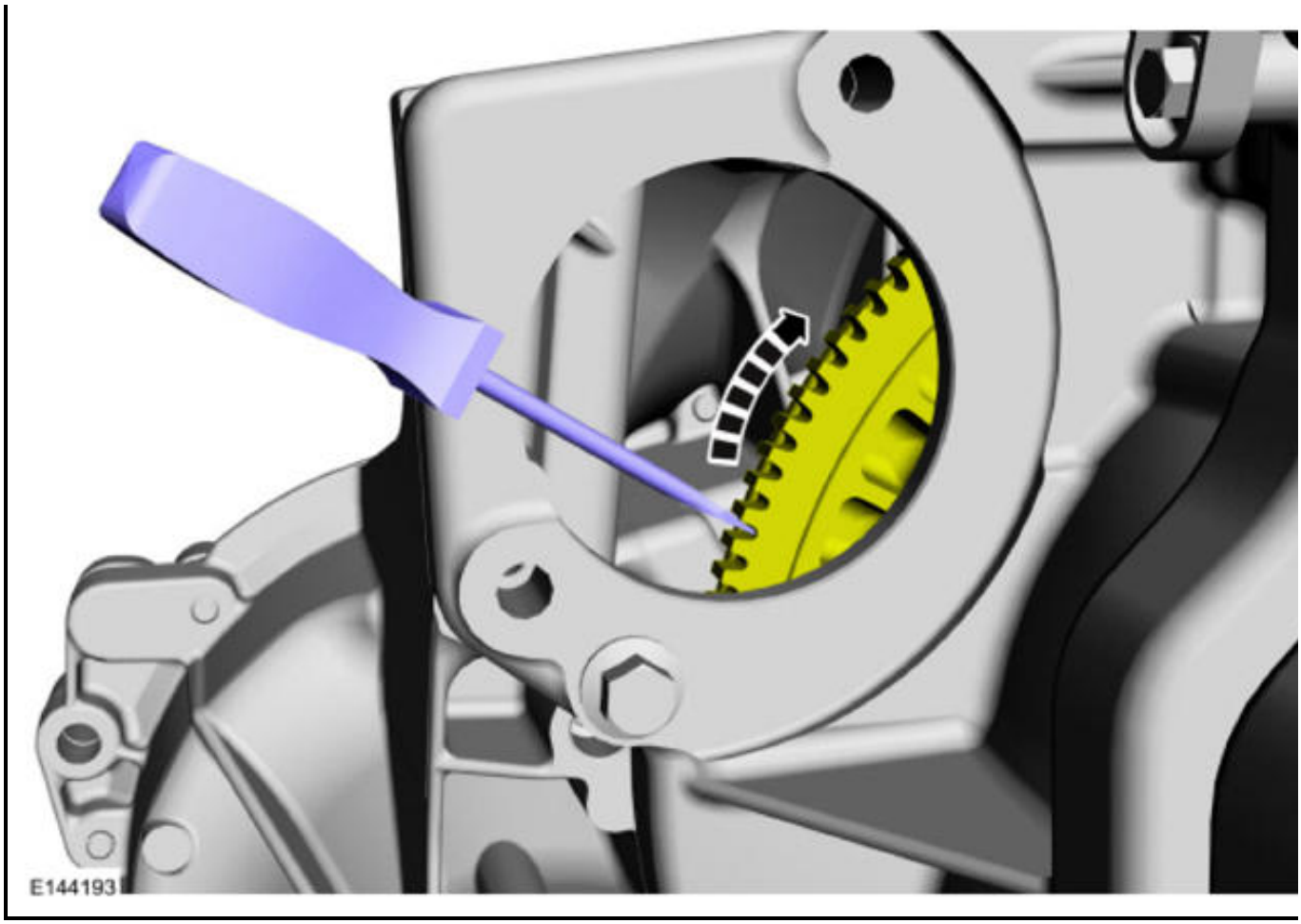
22. Install Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.



23. **NOTE: Only rotate the crankshaft clockwise.**

    Rotate the crankshaft slowly until the crankshaft stops.

24. Remove Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.



25. Refer to: **VARIABLE CAMSHAFT TIMING (VCT) UNIT** .

REMOVAL AND INSTALLATION

OIL PAN

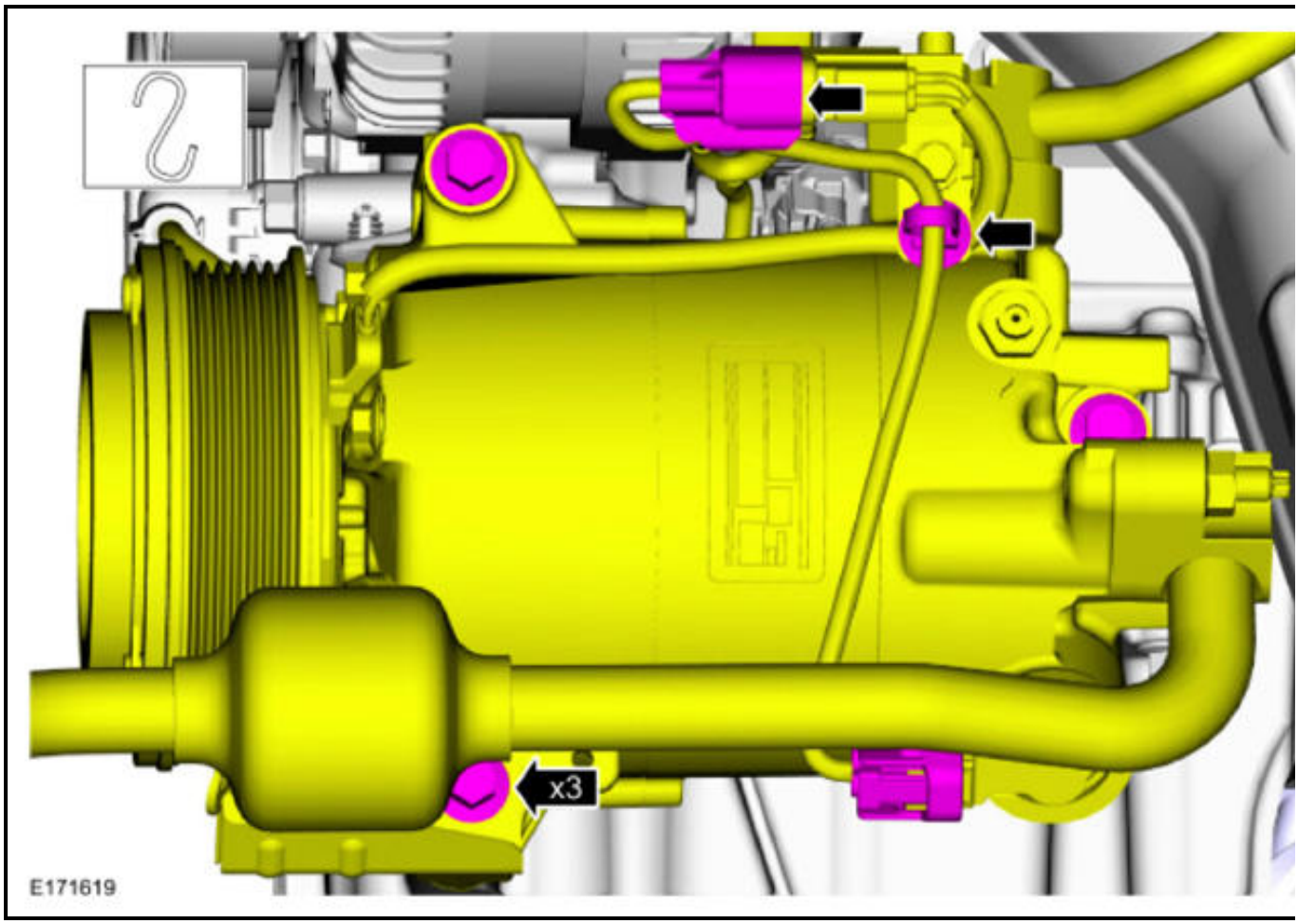
Special Tool(s)/General Equipment

Plastic Scraper

MATERIAL SPECIFICATIONS

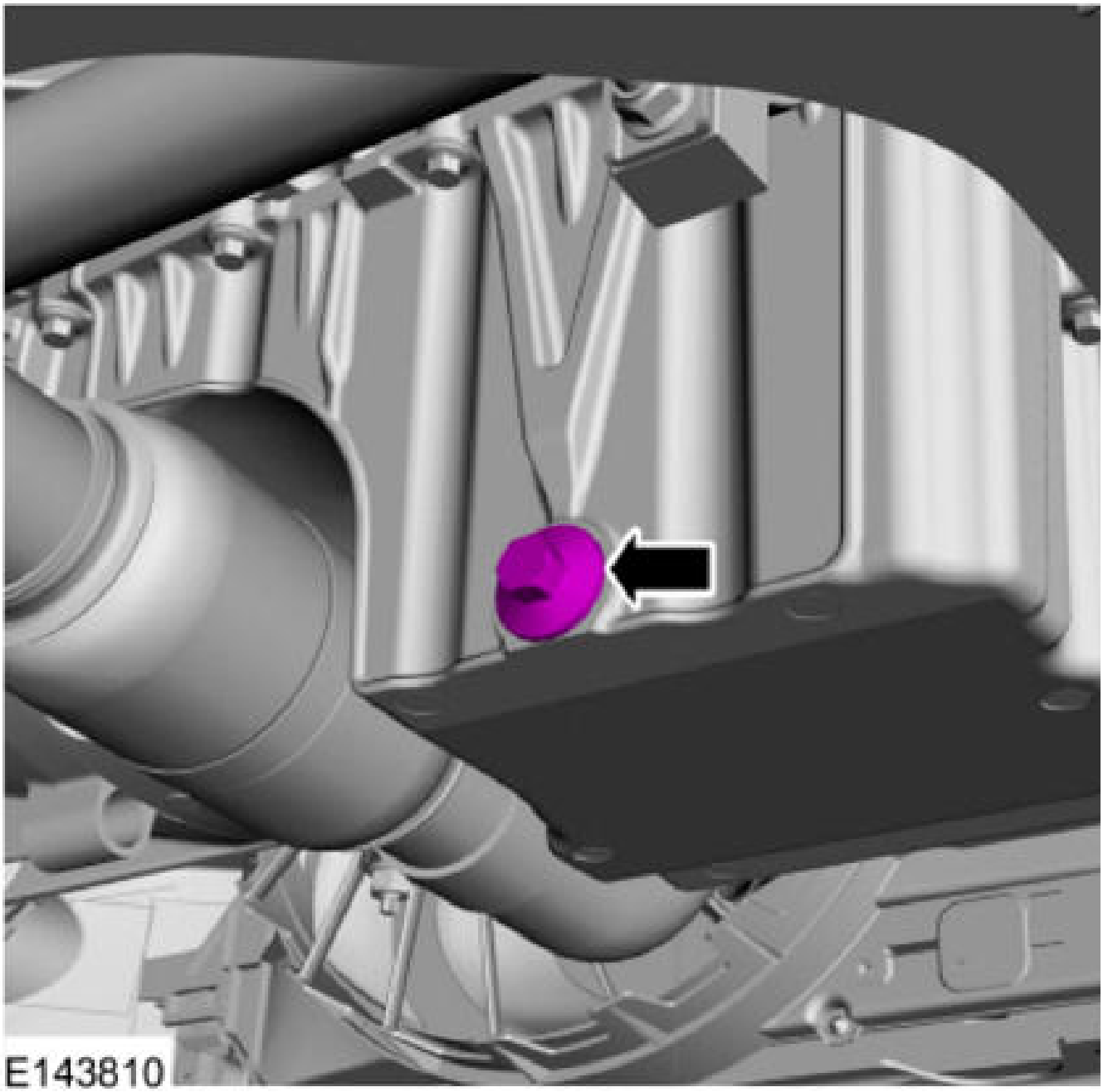
Name	Specification
Motorcraft® Metal Surface Prep ZC-31-B	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

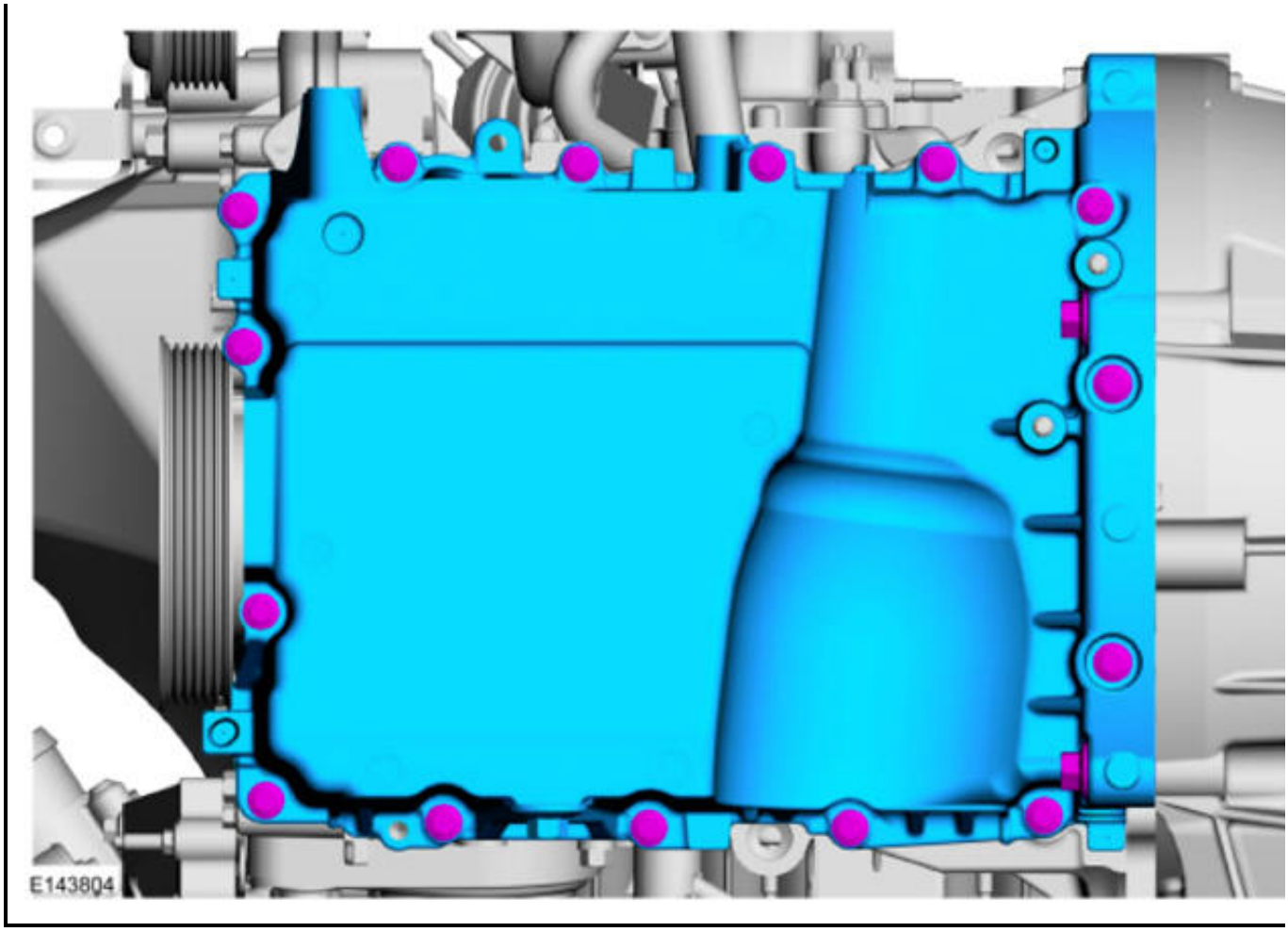
1. Refer to: **JACKING AND LIFTING - OVERVIEW** .
2. Remove the following items:
   - Refer to: **CATALYTIC CONVERTER** .
   - Refer to: **ACCESSORY DRIVE BELT** .
3. 

WARNING: **Be prepared to collect escaping fluid.**

4. *Torque* : 18 lb.ft (25 Nm)



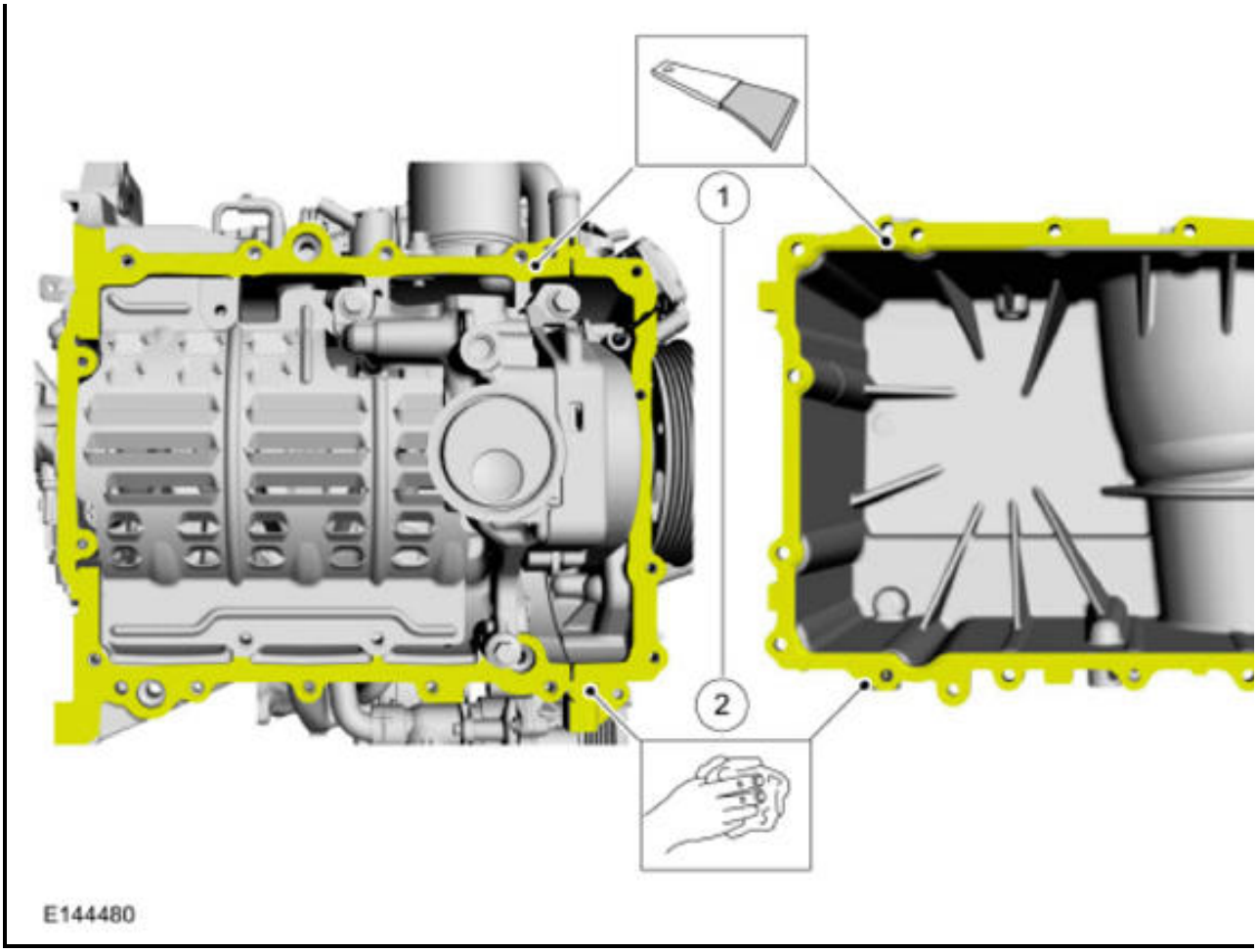
5.

5. 

Installation

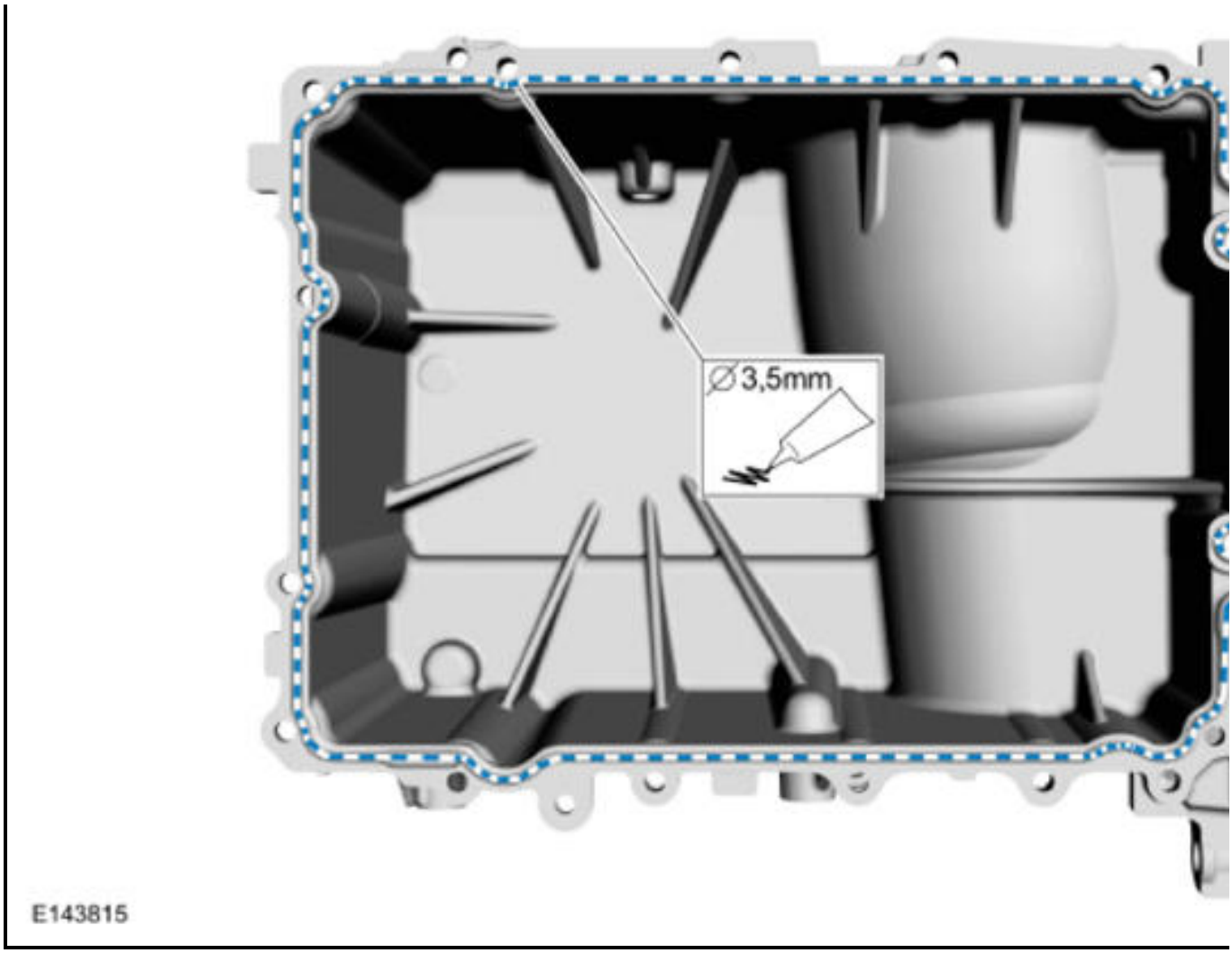
1. **NOTE: Make sure that the mating faces are clean and free of foreign material.**

    1. Use the General Equipment: Plastic Scraper
    2. *Material* : Motorcraft® Metal Surface Prep/ZC-31-B



2. **NOTE: The component must be installed within 10 minutes of applying the sealant.**

Material : Silicone Gasket and Sealant/TA-30 (WSE-M4G323-A4)



3. *Torque* :

   1-2, M6x20: 89 lb.in (10 Nm)

   3, M6x75: 89 lb.in (10 Nm)

   4-6, M6x20,: 89 lb.in (10 Nm)

   7, M6x75,: 89 lb.in (10 Nm)

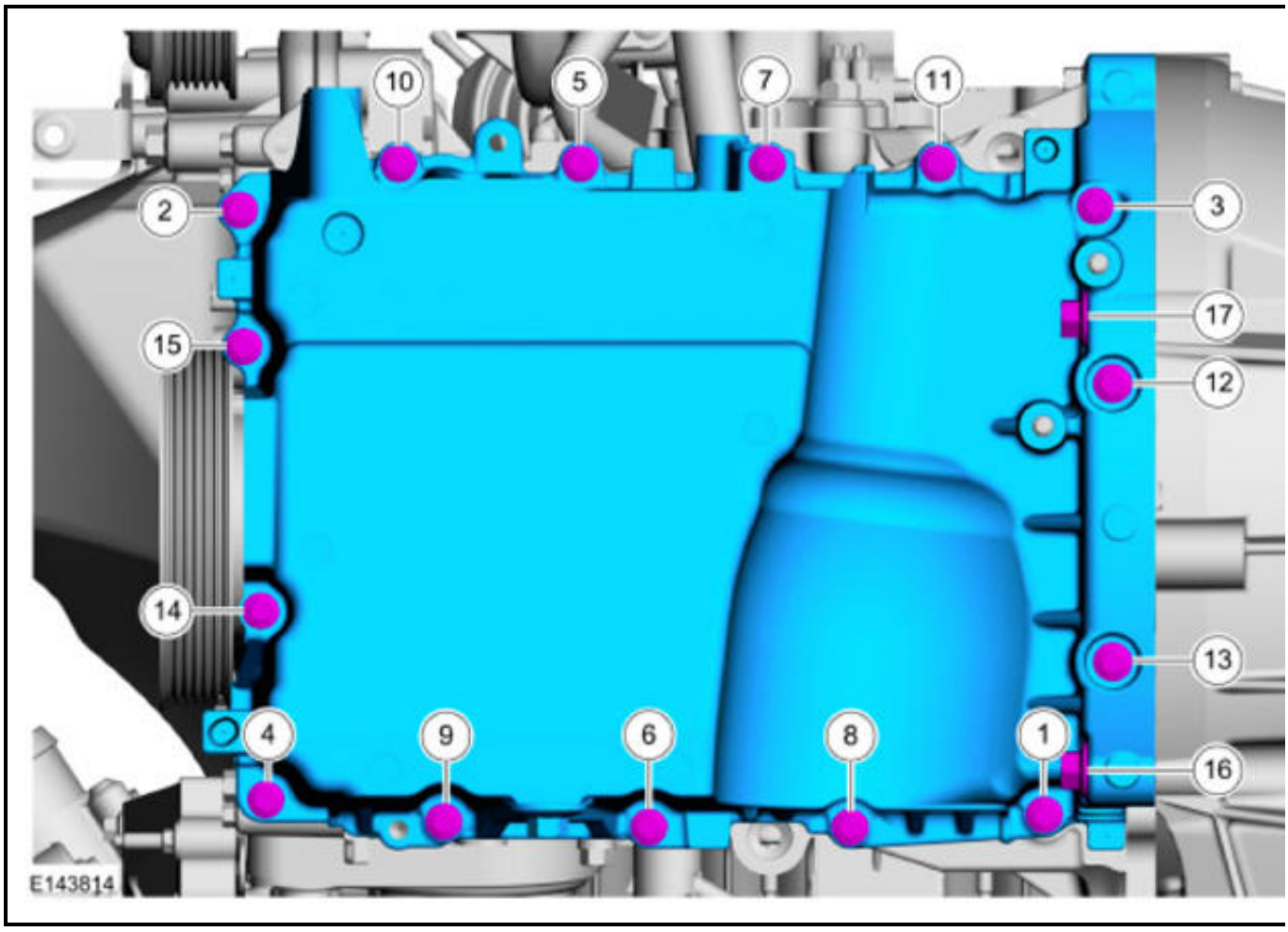
   8-11, M6x20,: 89 lb.in (10 Nm)

   12-13, M6x105,: 89 lb.in (10 Nm)

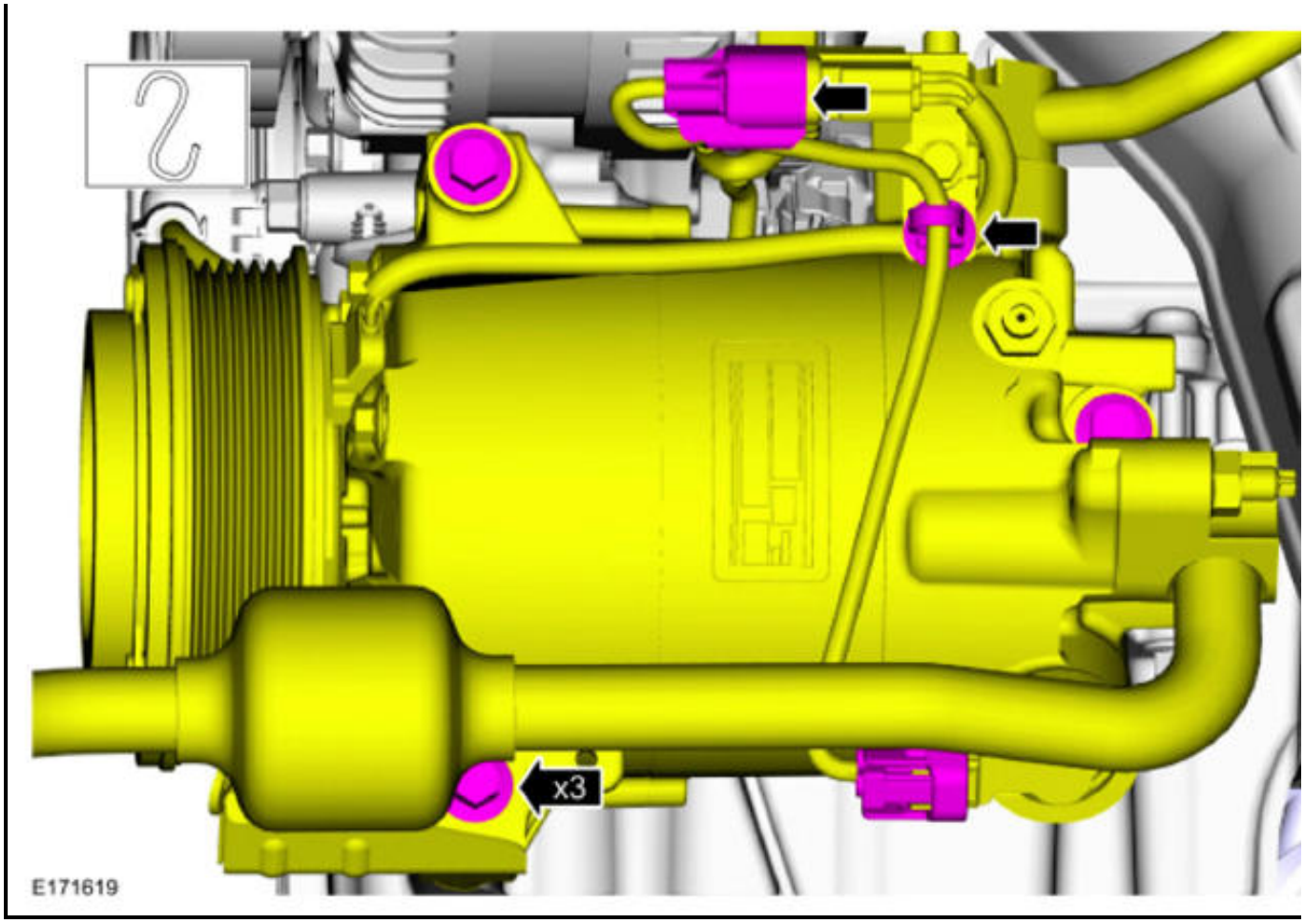
   14, M6x75,: 89 lb.in (10 Nm)

   15, M6x20,: 89 lb.in (10 Nm)

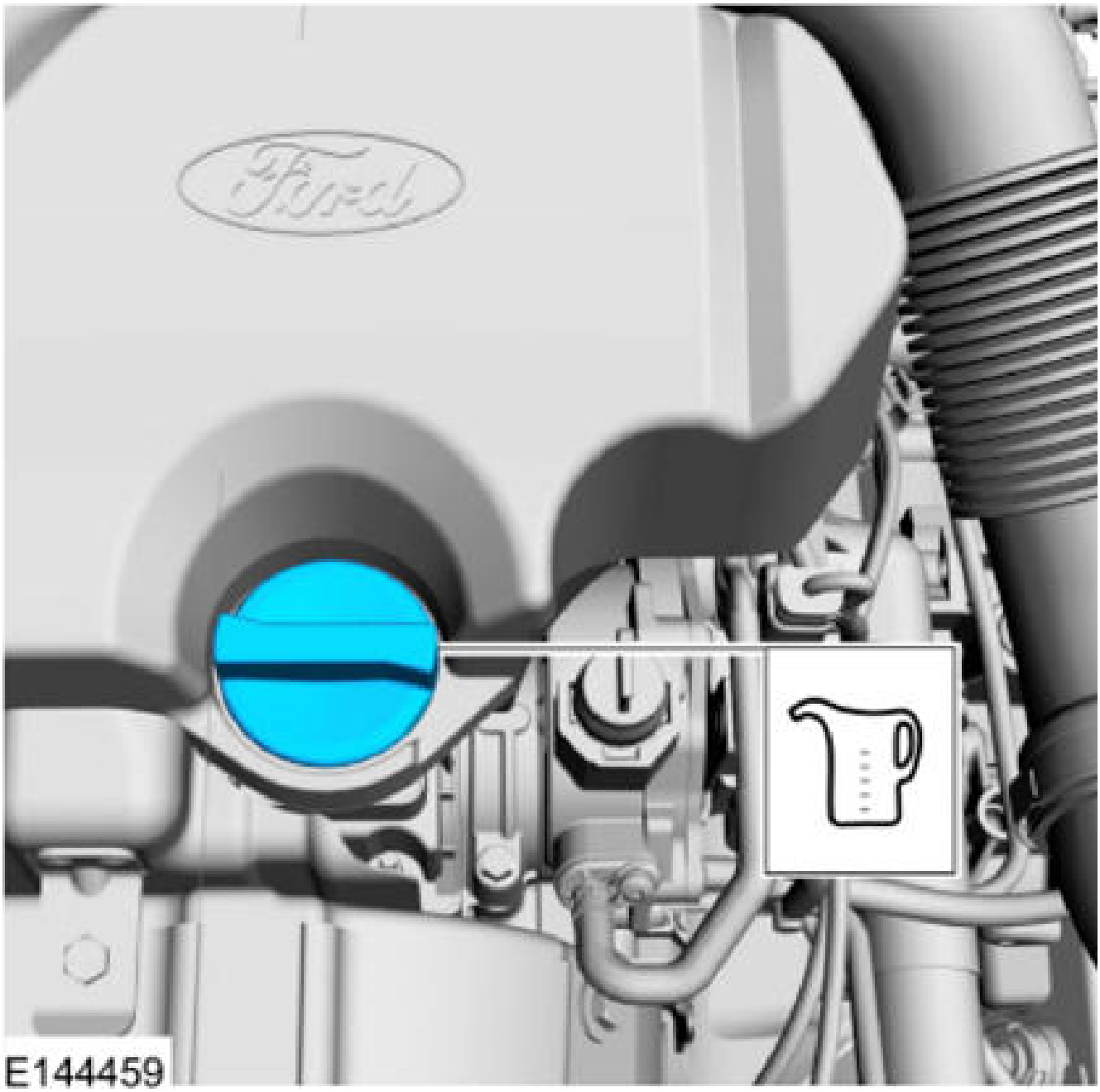
16-17, M10x45: 35 lb.ft (48 Nm)



4. *Torque* : 18 lb.ft (25 Nm)

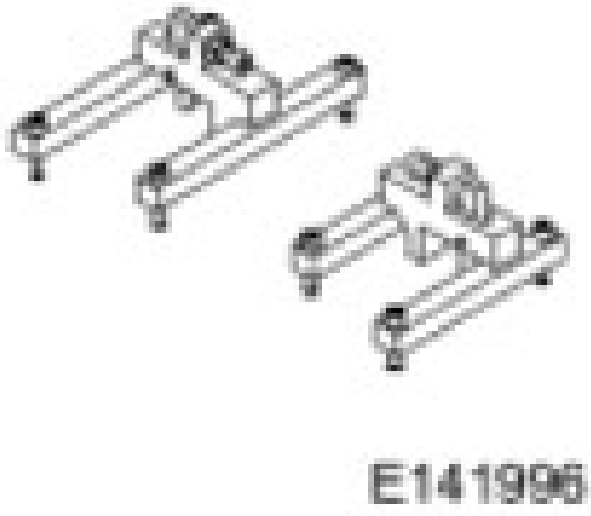


5. Install the following items:
   - Refer to: **CATALYTIC CONVERTER** .
   - Refer to: **ACCESSORY DRIVE BELT** .
6. Refer to: **SPECIFICATIONS** .



CAMSHAFTS

SPECIAL TOOL DESCRIPTION

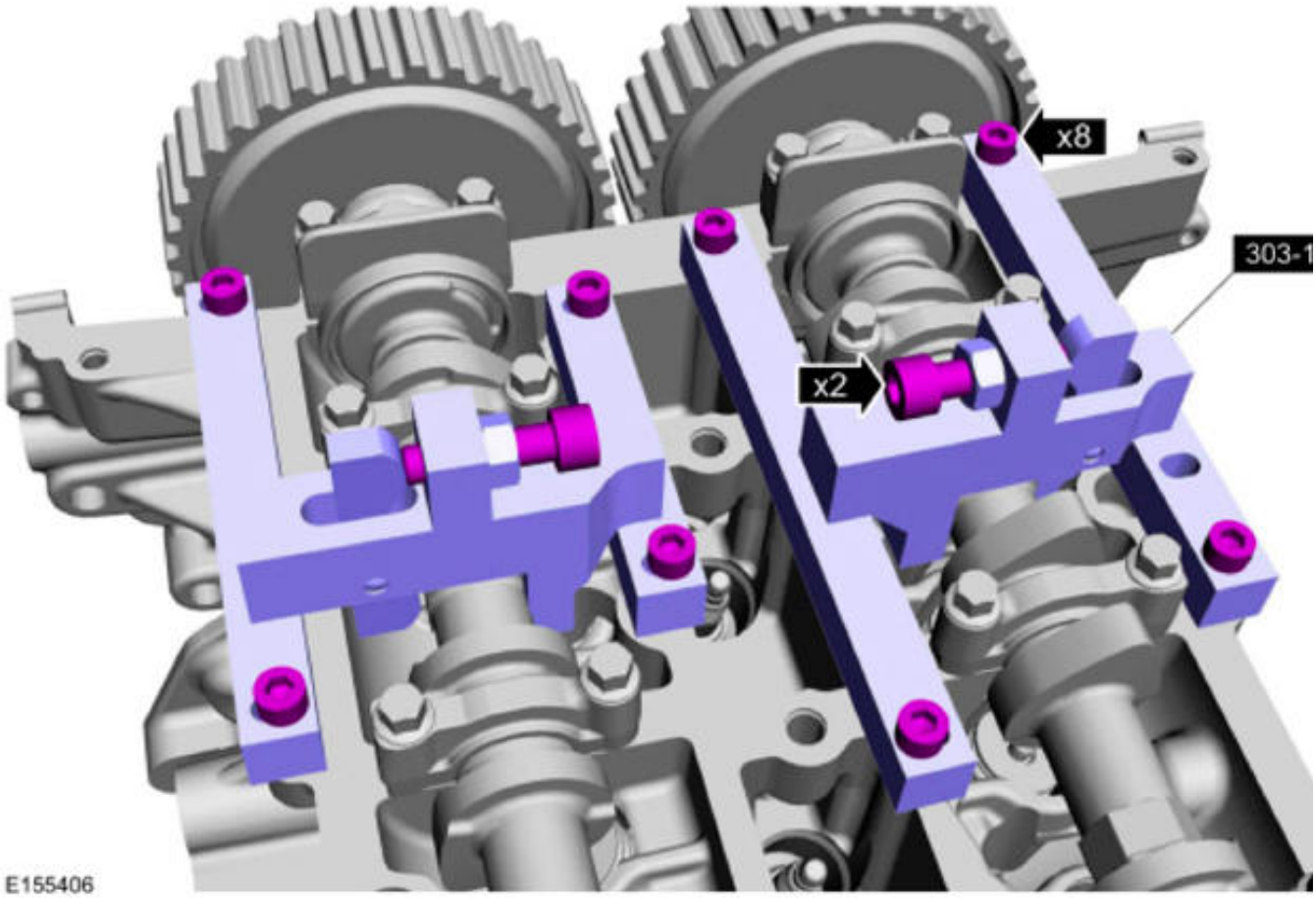
	303-1605 Alignment Tool, Camshaft

MATERIAL SPECIFICATIONS

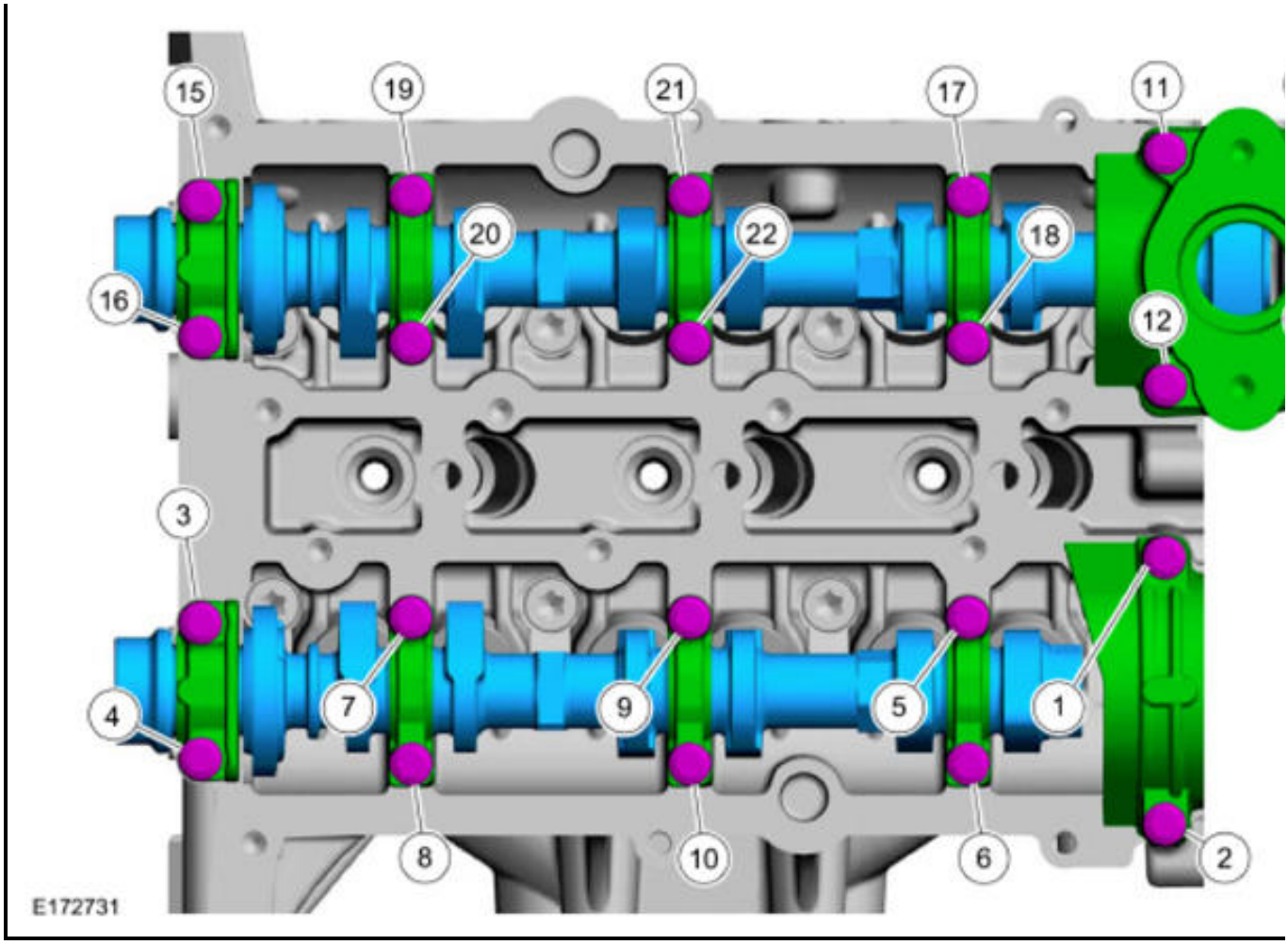
Name	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.) XO-5W20-QSP (U.S.)	WSS-M2C945-A
Gasket Maker TA-16	WSK-M2G348-A5

Removal

1. Refer to: **VARIABLE CAMSHAFT TIMING (VCT) UNIT** .
2. Remove Special Service Tool: 303-1605 Alignment Tool, Camshaft.



3. **NOTE: Note the position of the components before removal.**

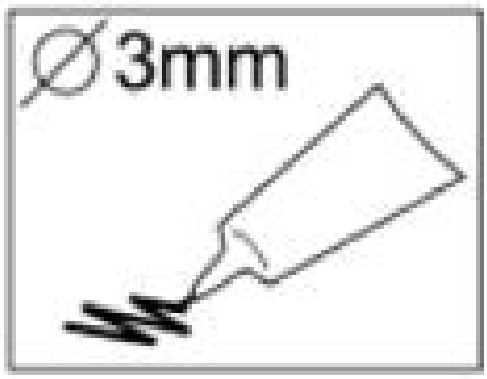


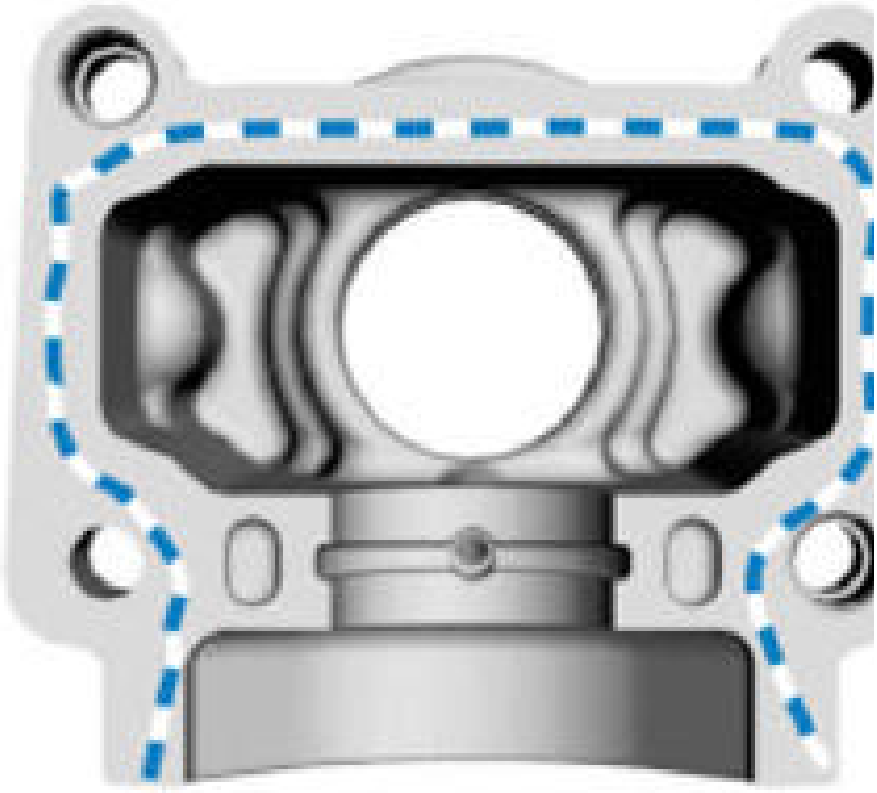
Installation

1. **NOTE: Make sure that the mating faces are clean and free of foreign material.**

   NOTE: The component must be installed within 5 minutes of applying the sealant.

   Material : Gasket Maker/TA-16 (WSK-M2G348-A5)

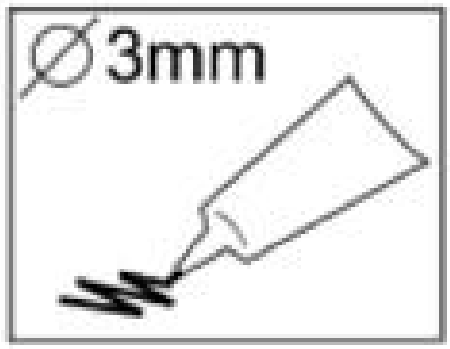


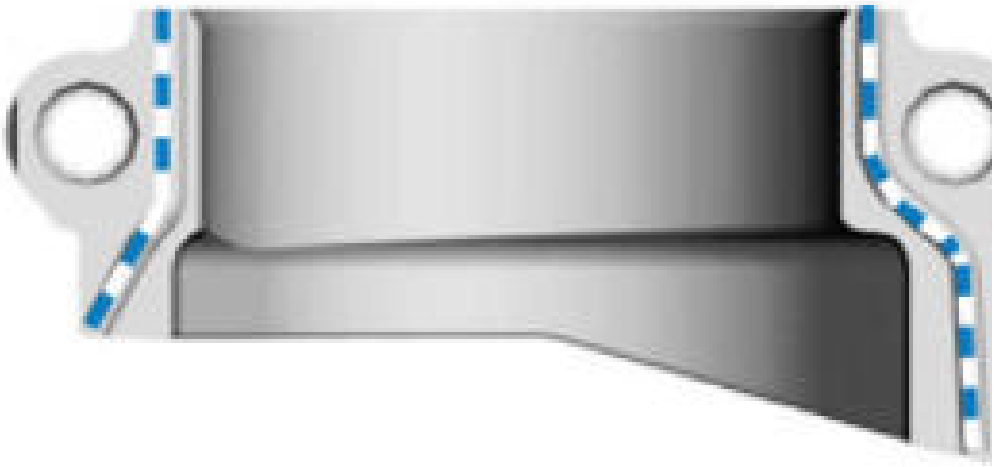


2. **NOTE: Make sure that the mating faces are clean and free of foreign material.**

   NOTE: The component must be installed within 5 minutes of applying the sealant.

   Material : Gasket Maker/TA-16 (WSK-M2G348-A5)





E145615

3. **NOTE: Make sure that the components are installed to the position noted before removal.**

NOTE: Make sure that new bolts are installed.

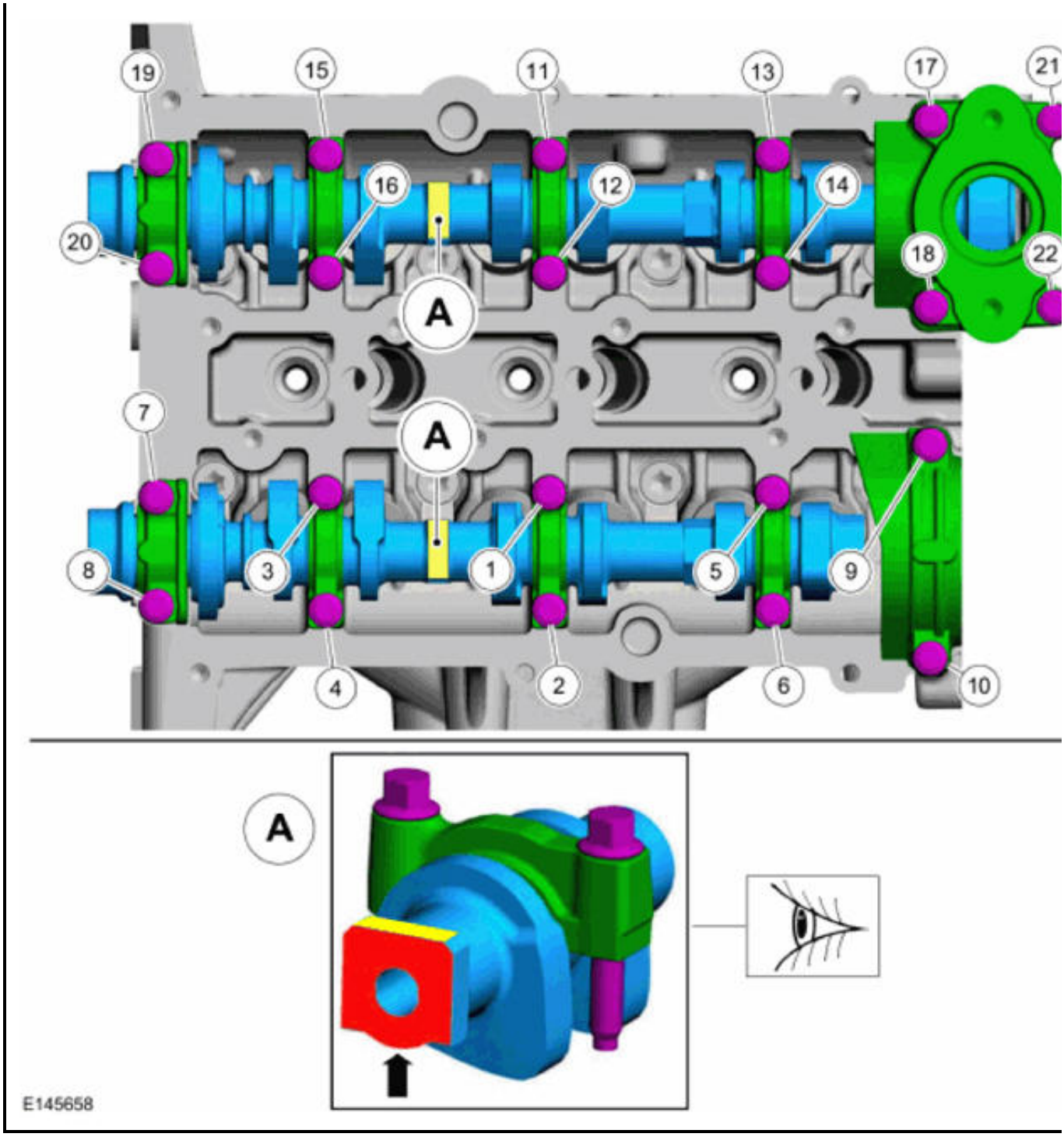
4. Install the camshafts approximately at valve overlap position cylinder No. 1.

   Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

5. **NOTE: Install all the bolts finger tight before final tightening.**

   Tighten each bolt 2 turns at a time.

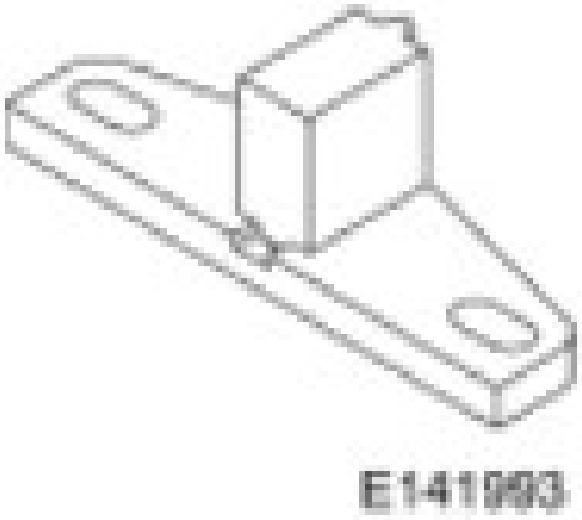
6. *Torque* : 89 lb.in (10 Nm)
7. Refer to: **VALVE CLEARANCE ADJUSTMENT** .



8. Refer to: **VARIABLE CAMSHAFT TIMING (VCT) UNIT** .

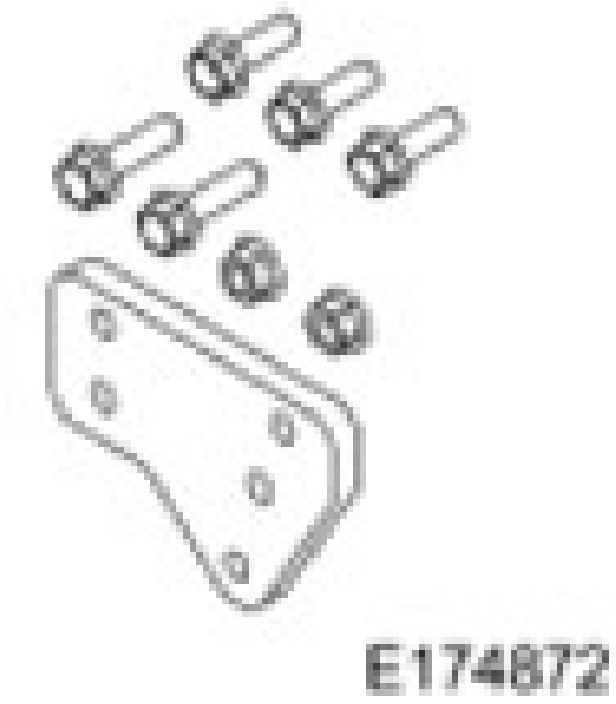
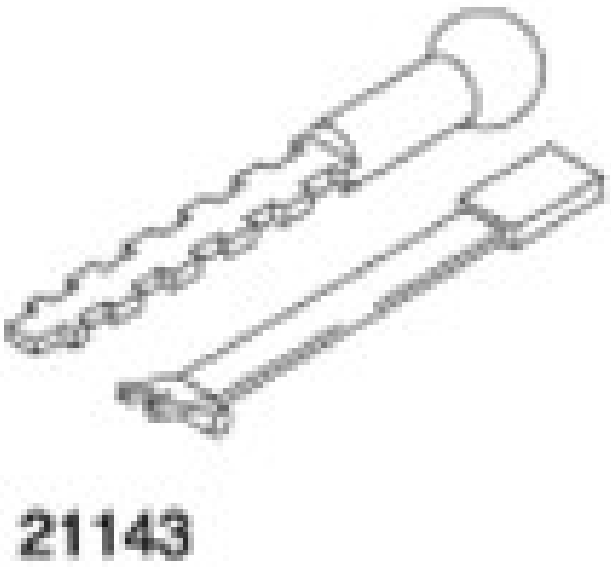
CRANKSHAFT FRONT SEAL

SPECIAL TOOL DESCRIPTION

 E141983	303-1602 Locking Tool, Crankshaft
 E141994	303-1603 Installer, Front Cover Seal
	303-1604

	Timing Peg, Crankshaft TDC
	303-1606 Locking Tool, Variable Camshaft Timing
	303-1611 Torque Multiplier

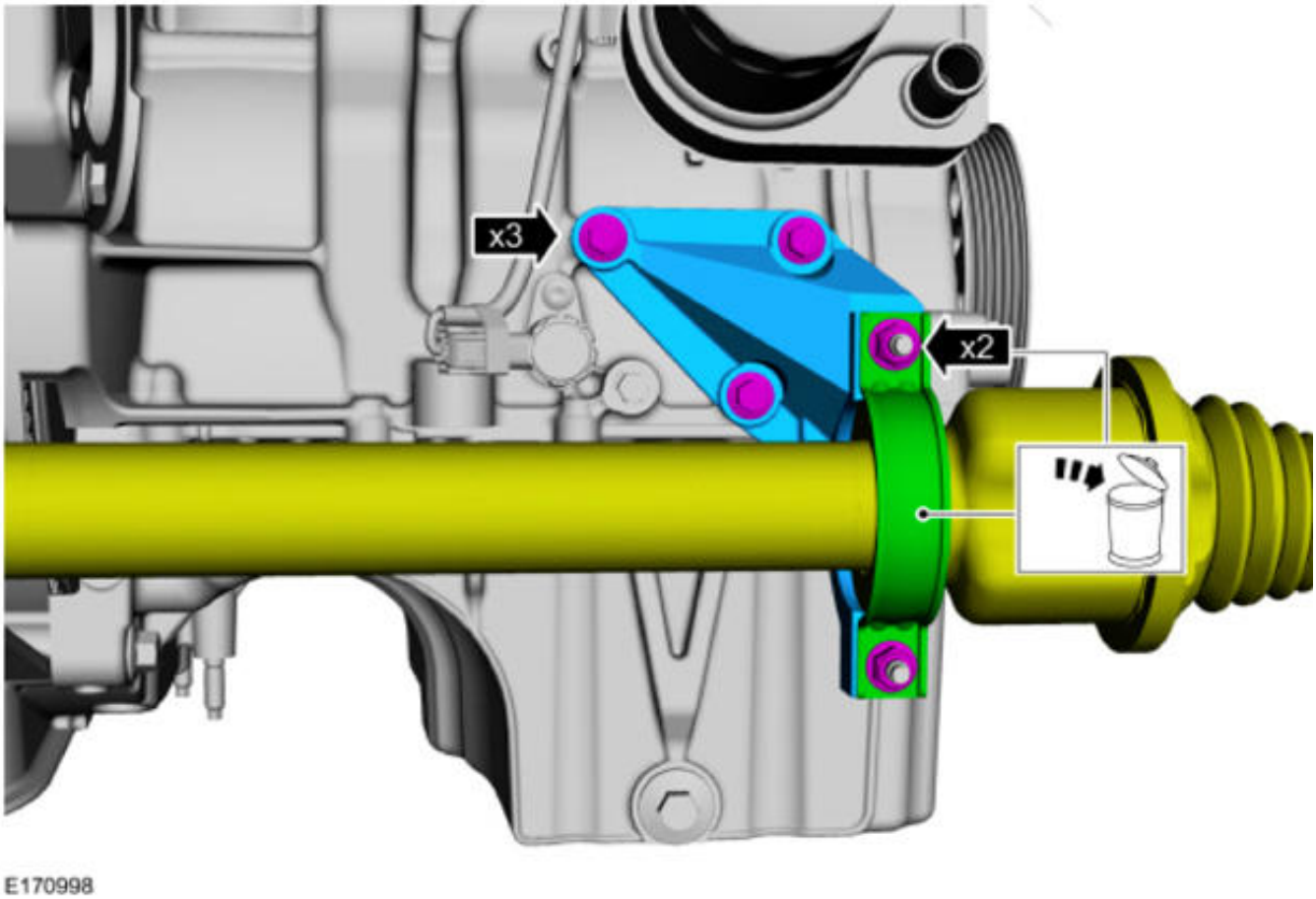
 E141998	
 E141999	303-1611-01 Adapter for 303-1611
	303-1611-02 Adapter for 303-1611, Torque Multiplier TKIT-2014A-FL TKIT-2014A-ROW

	
	**303-293** Remover, Crankshaft Seal
Hose Clamp Remover/Installer	
Punch	

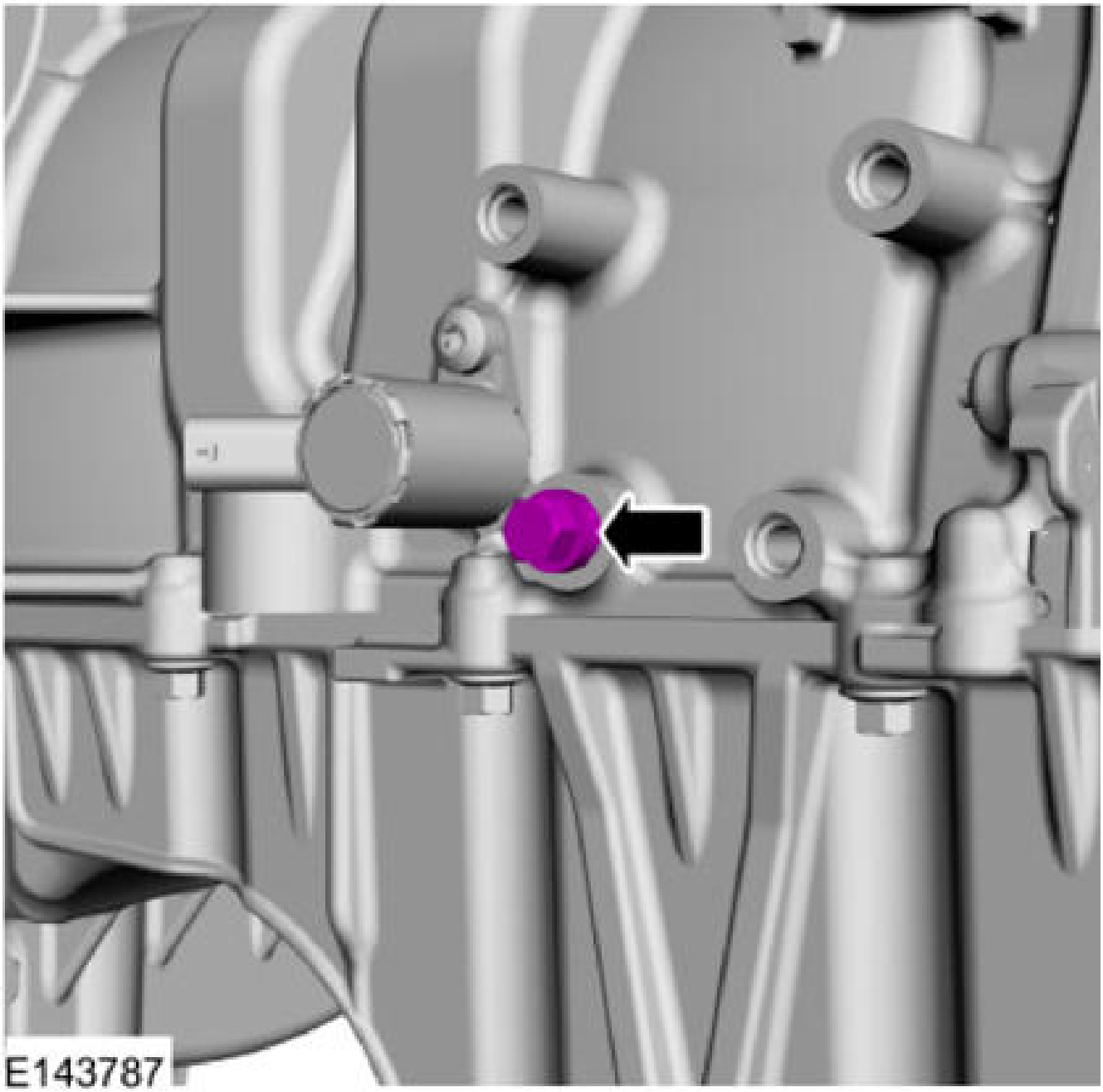
MATERIAL SPECIFICATIONS

Name	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.) XO-5W20-QSP (U.S.)	WSS-M2C945-A

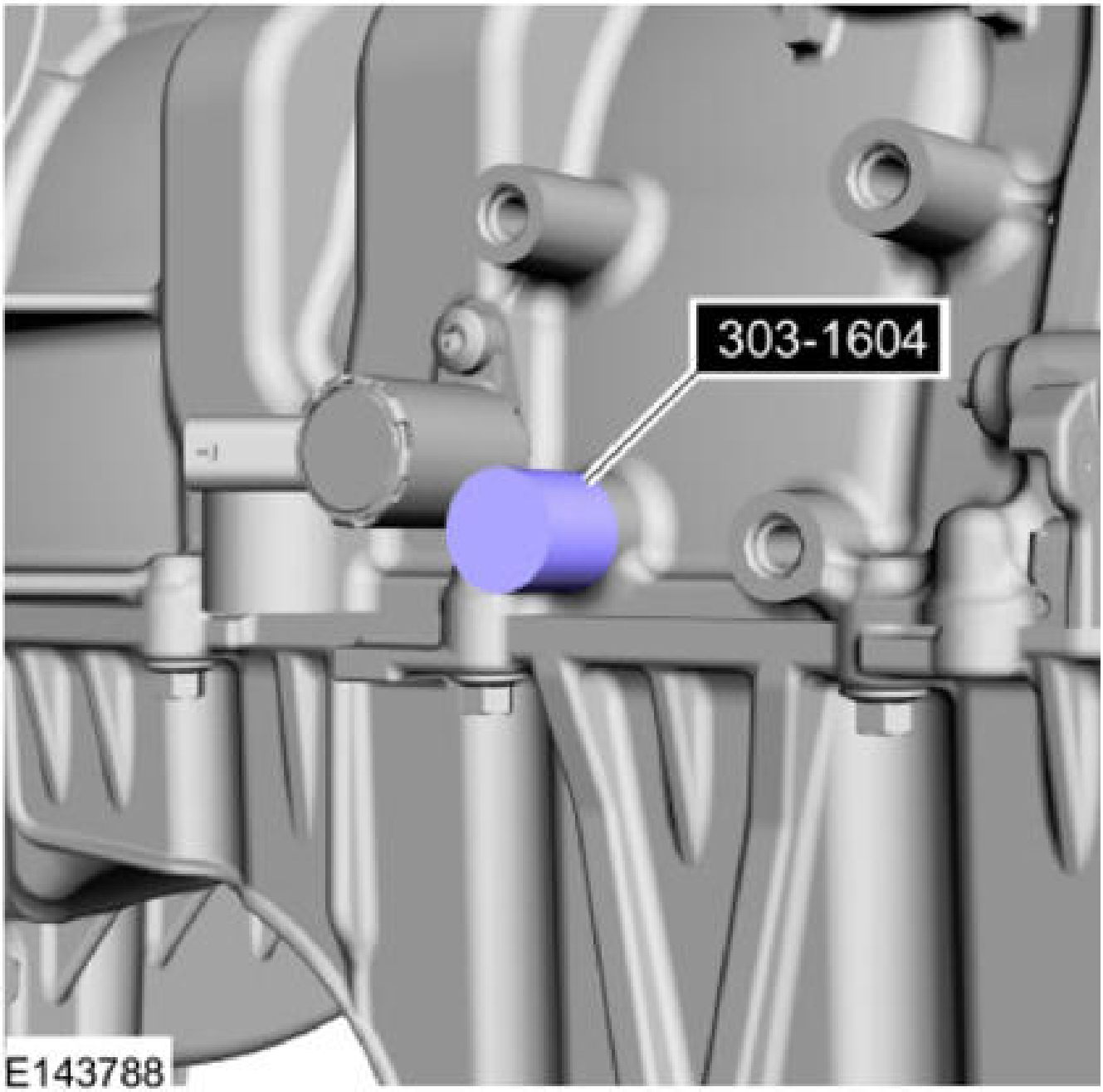
Removal

1. Refer to: **JACKING AND LIFTING - OVERVIEW** .
2. Remove the following items:
   - Refer to: **ACCESSORY DRIVE BELT** .
   - Refer to: **STARTER MOTOR** .
3. 

4.

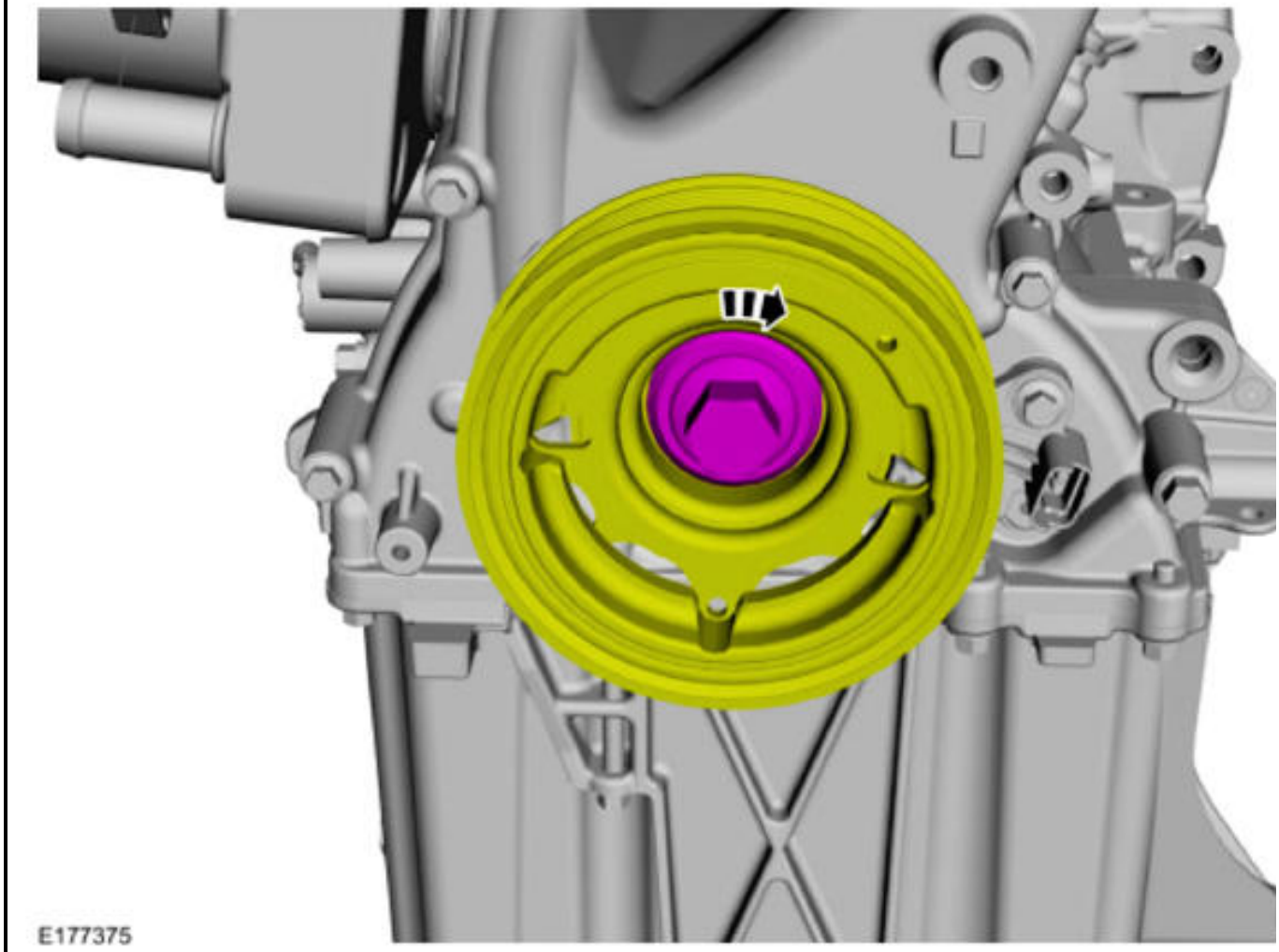
4. 

5. Install Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.

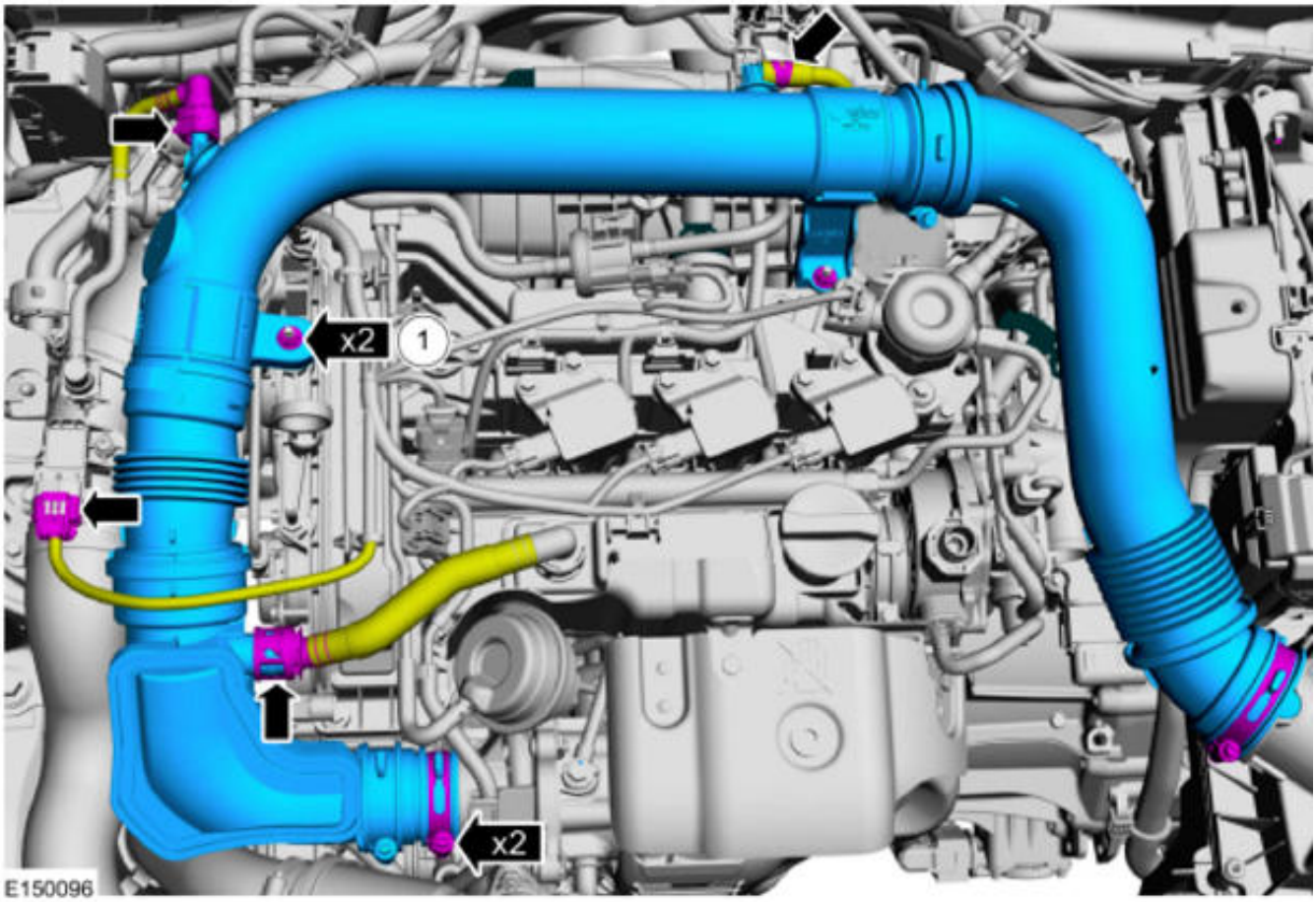


6. **NOTE: Only rotate the crankshaft clockwise.**

Rotate the crankshaft slowly until the crankshaft stops.



7. Use the General Equipment: Hose Clamp Remover/Installer



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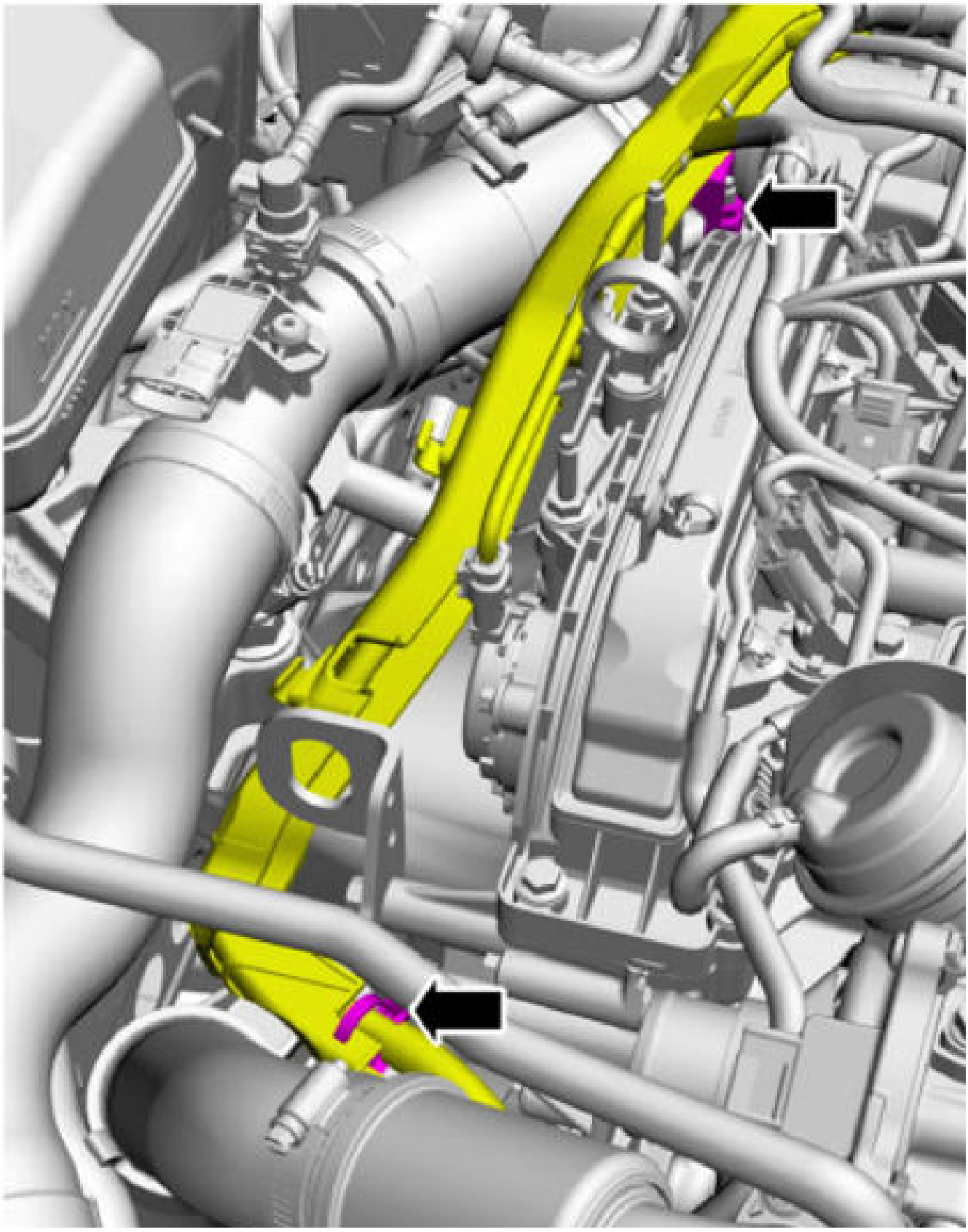
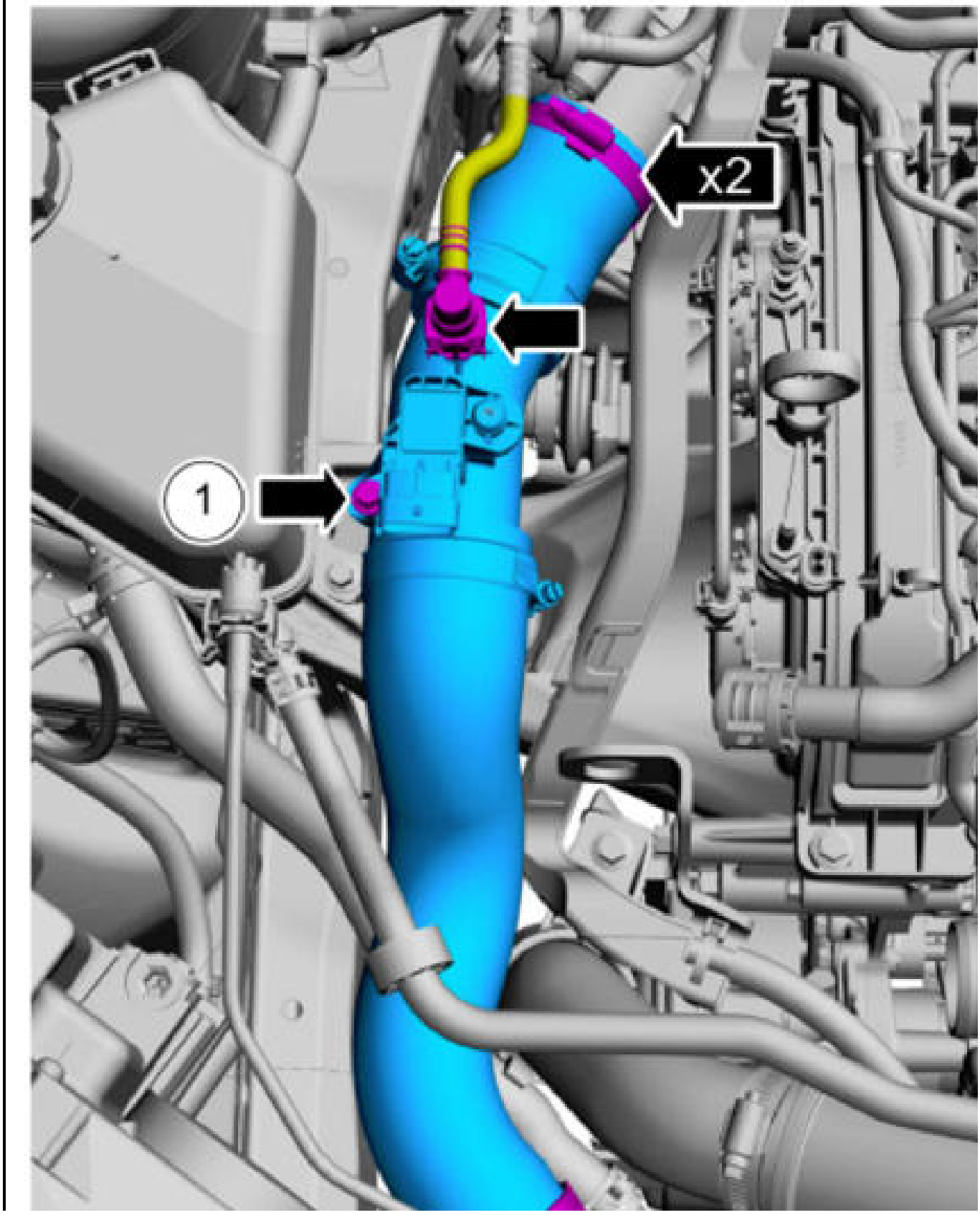
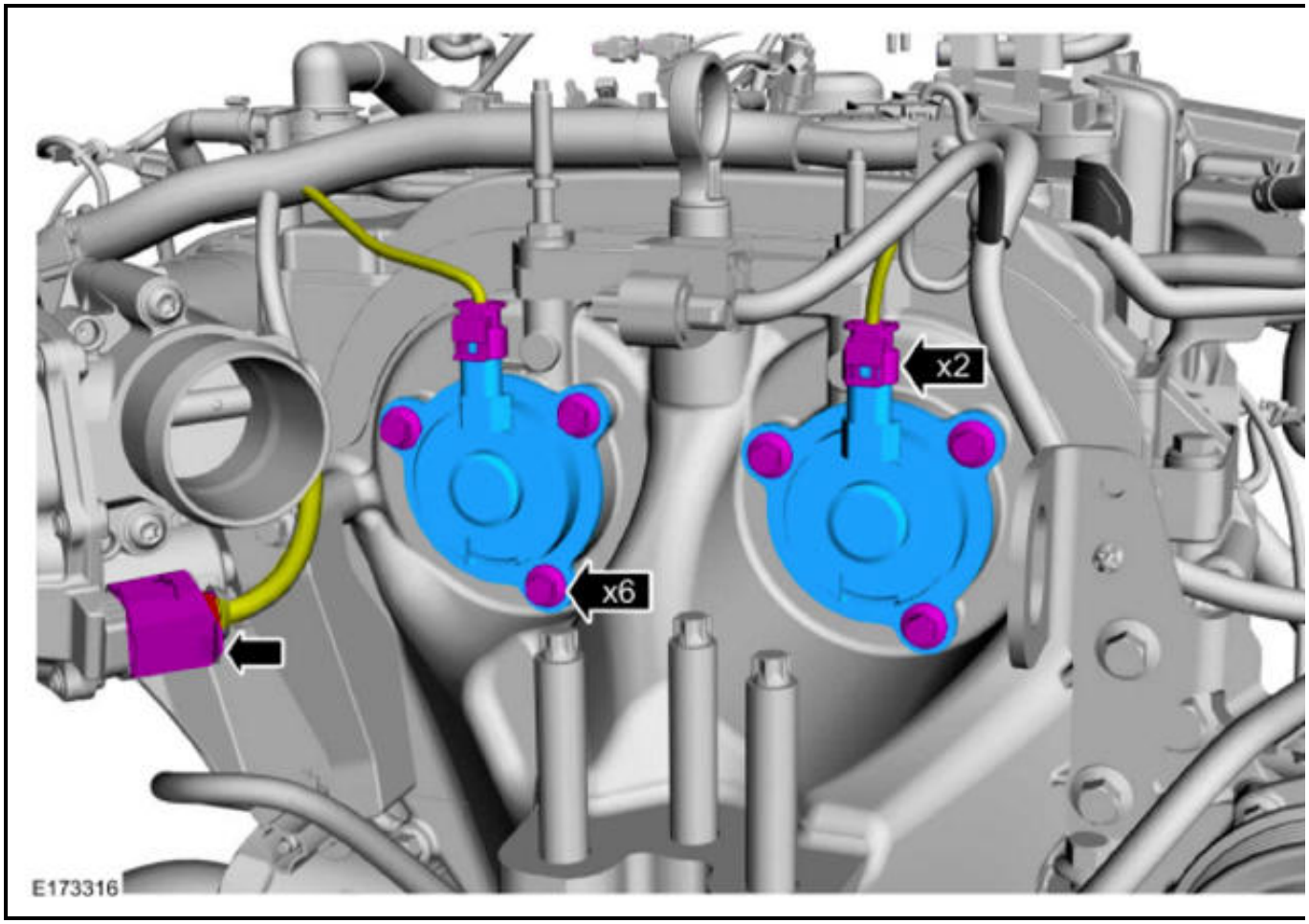


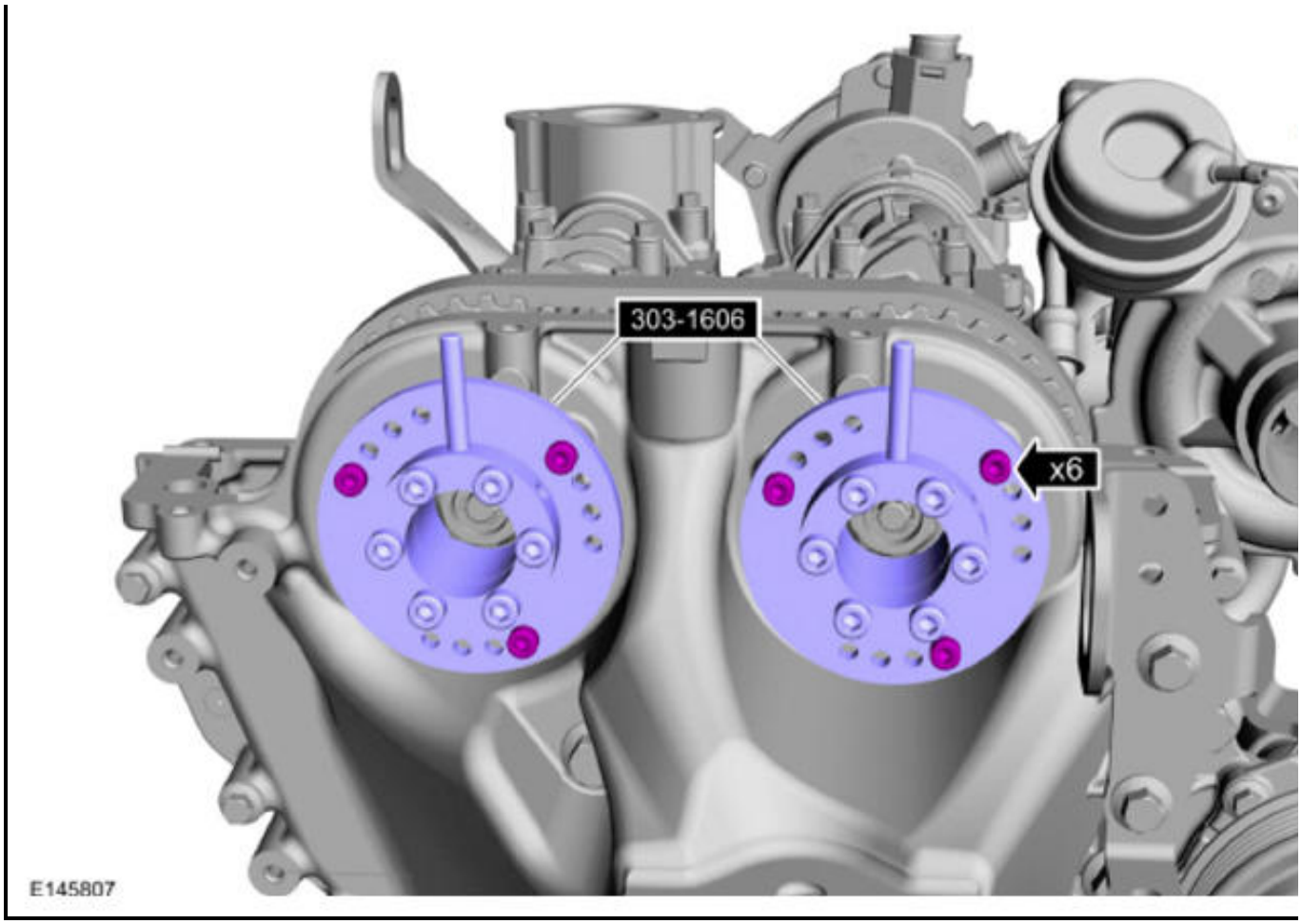


10.



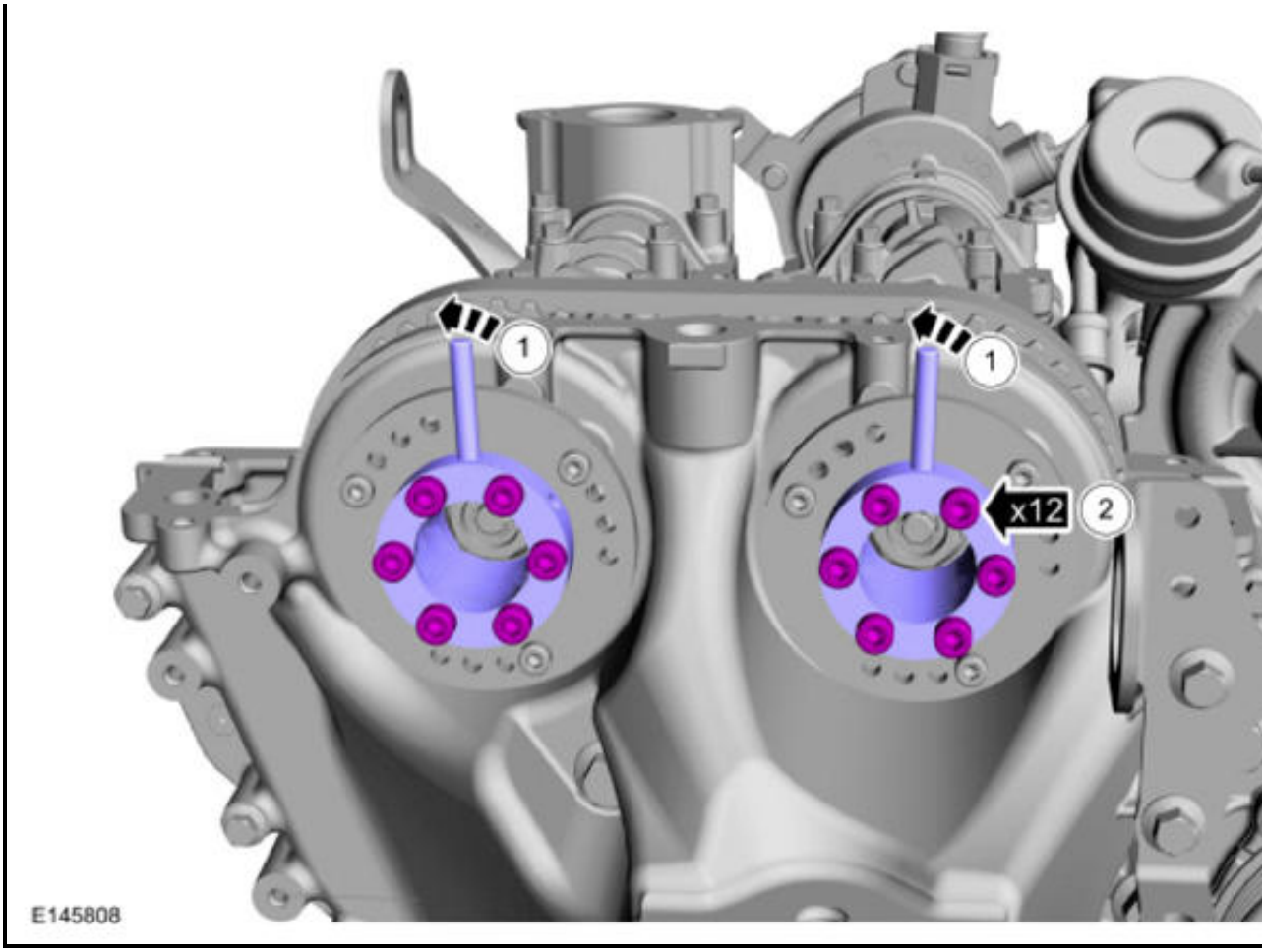
11. Install Special Service Tool: 303-1606 Locking Tool, Variable Camshaft Timing.

Torque : 89 lb.in (10 Nm)

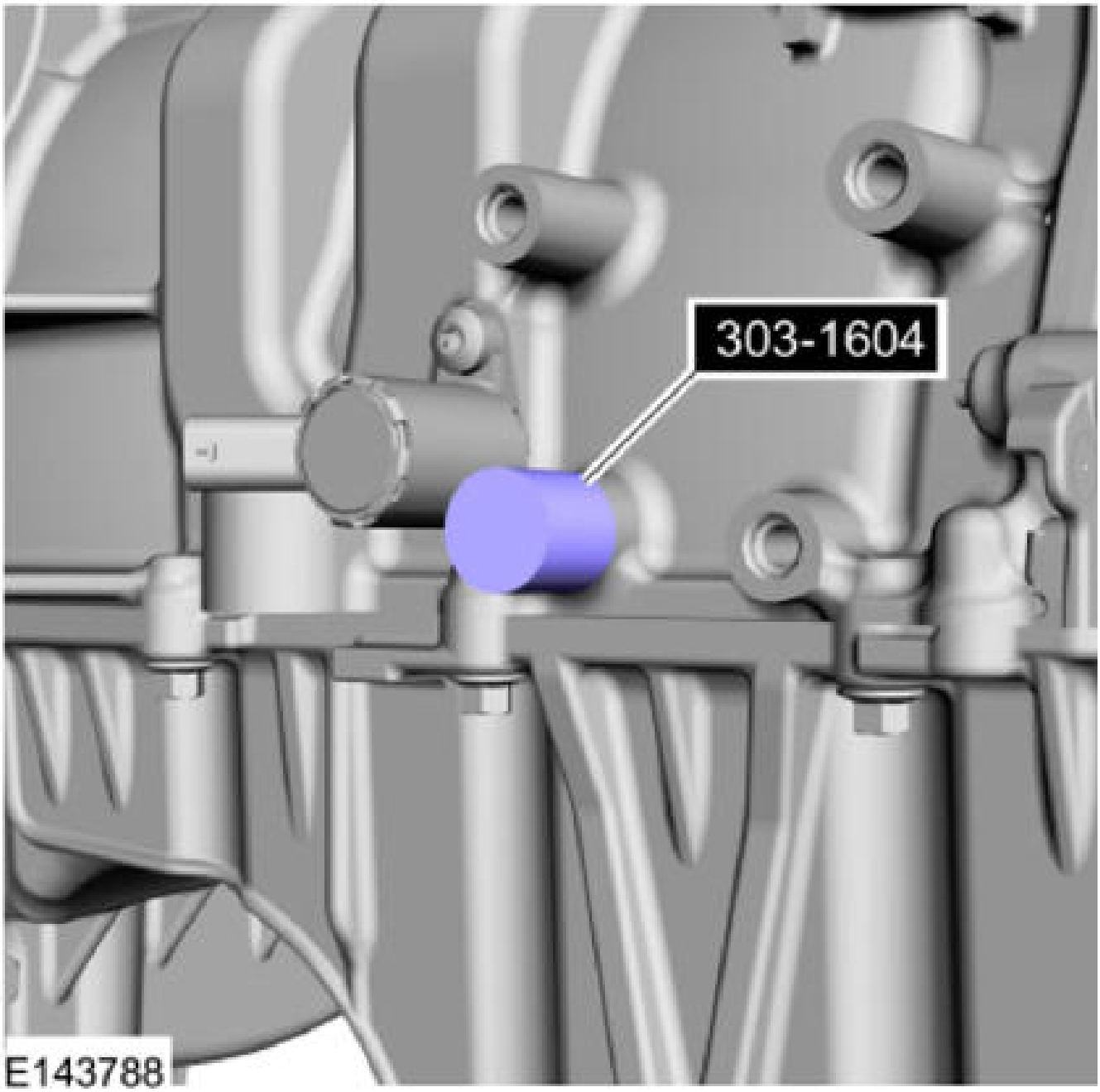


12.

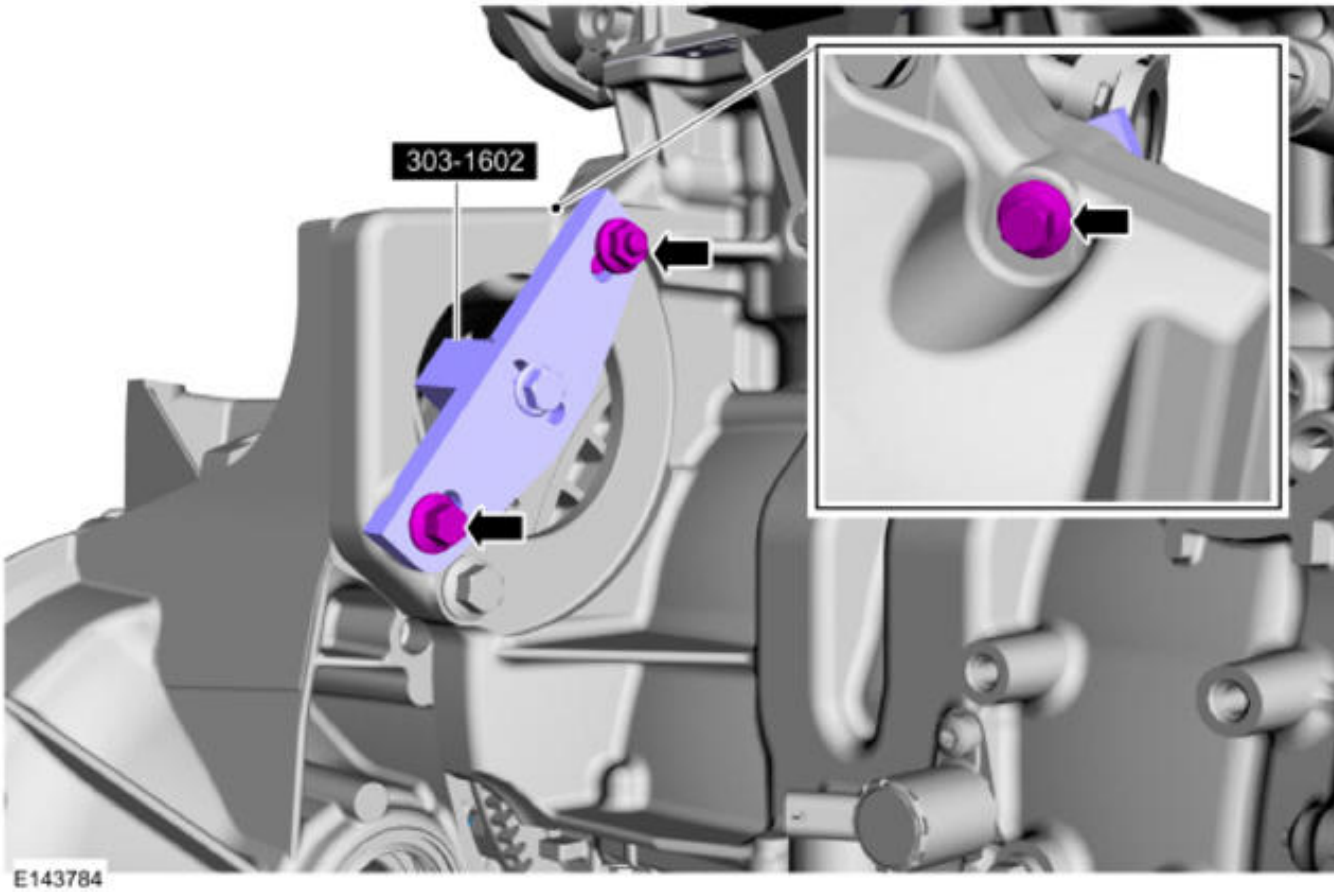
1. Turn until resistance is felt.
2. *Torque* : 133 lb.in (15 Nm)



13. Remove Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.

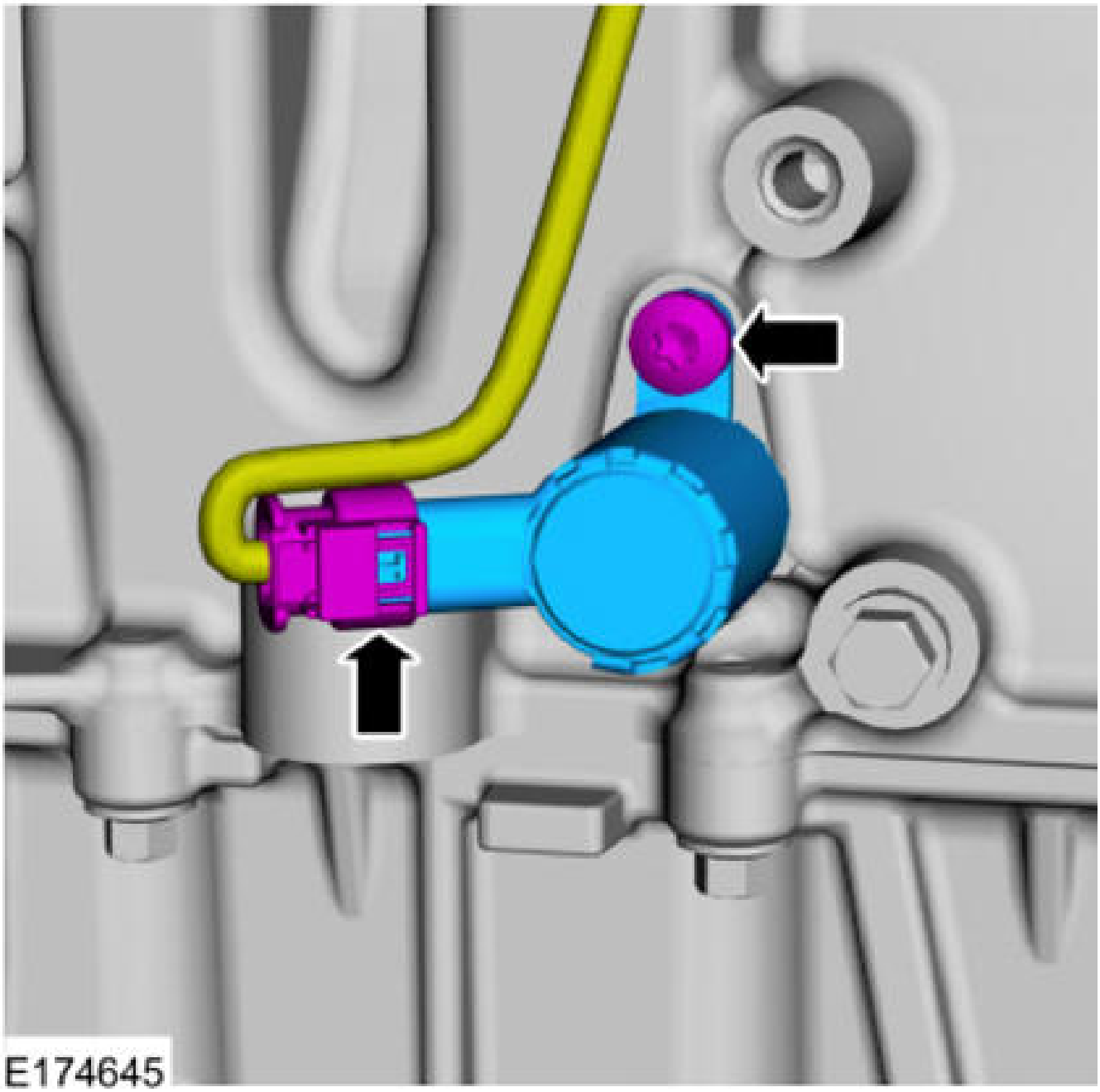


14. Install Special Service Tool: 303-1602 Locking Tool, Crankshaft.



15.

15.

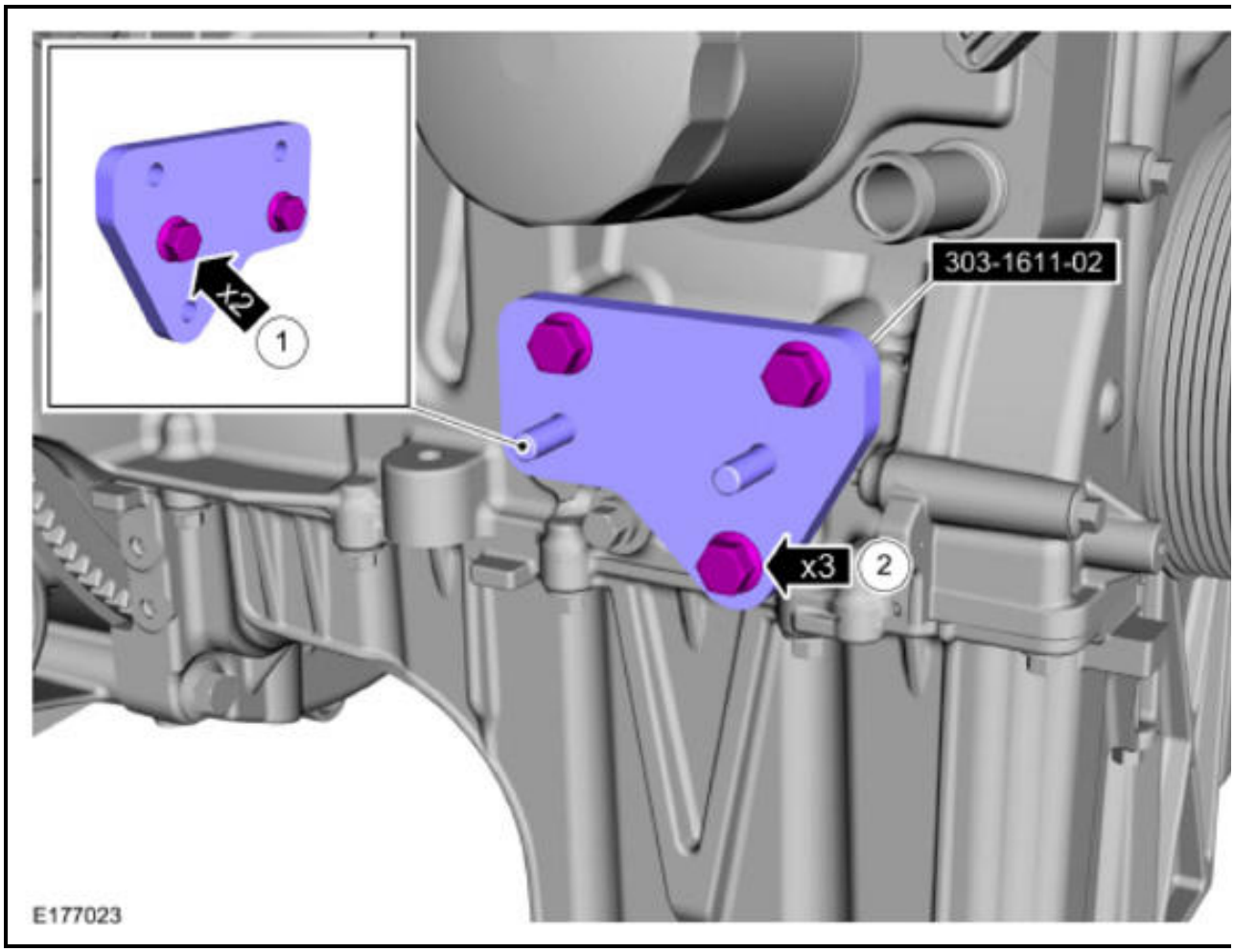


16.

1. M8x30
2. M8x25

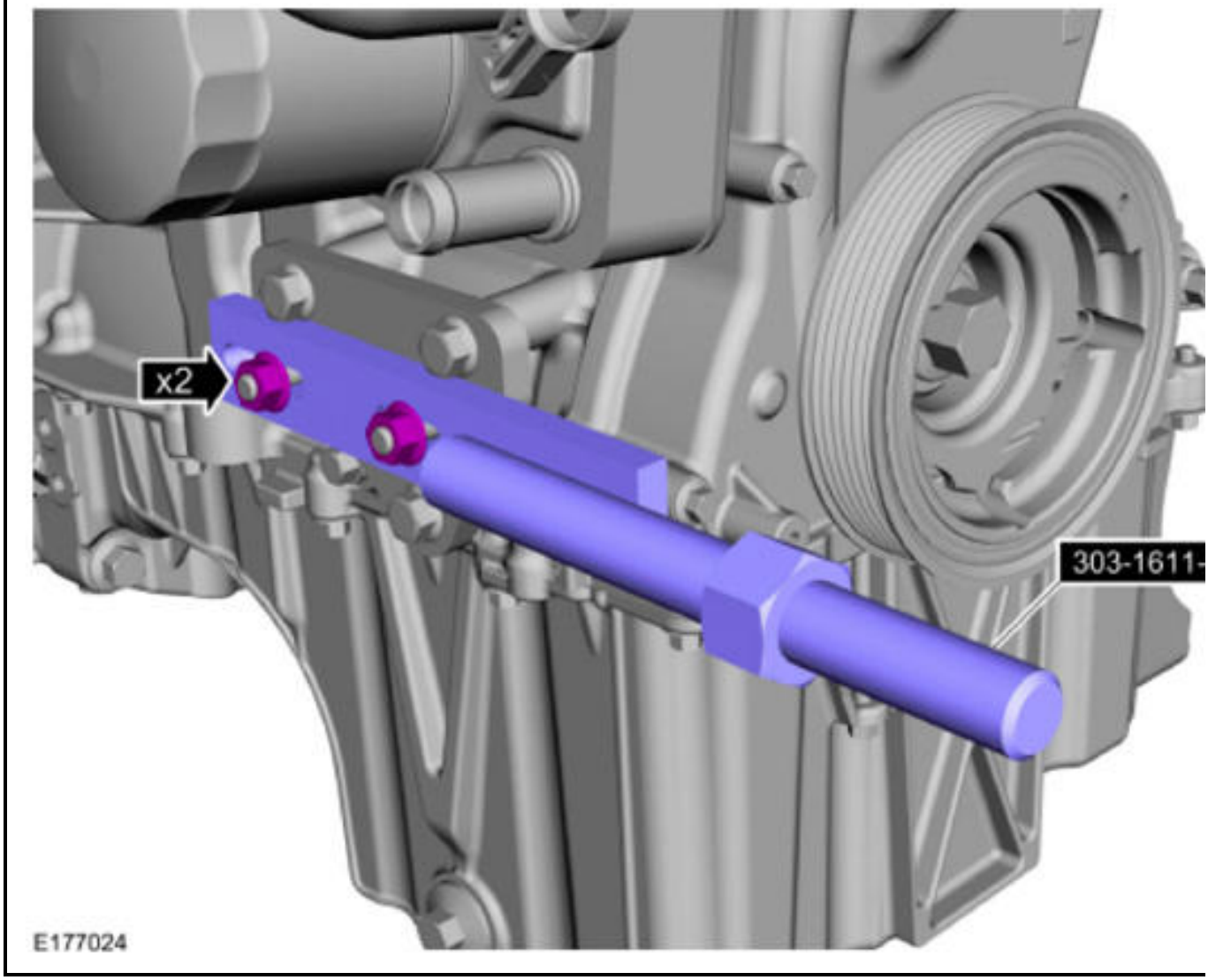
Install Special Service Tool: **303-1611-02 Adapter for 303-1611, Torque Multiplier** .

Torque : 18 lb.ft (24 Nm)



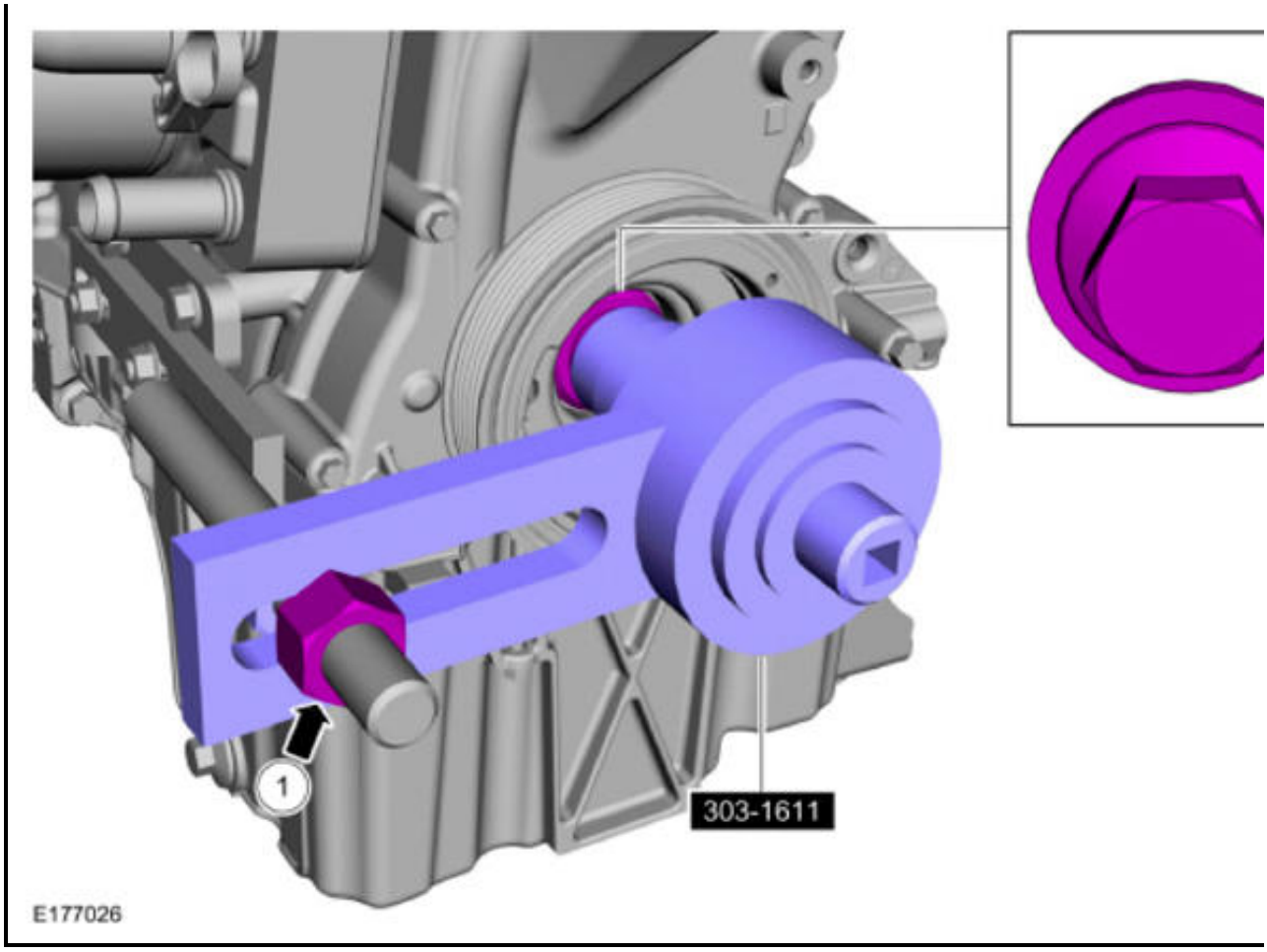
17. Install Special Service Tool: 303-1611-01 Adapter for 303-1611.

    Torque : 18 lb.ft (24 Nm)



18. Install Special Service Tool: 303-1611 Torque Multiplier.
19.
    1. Only tighten the nut finger tight at this stage.
    2. Loosen:

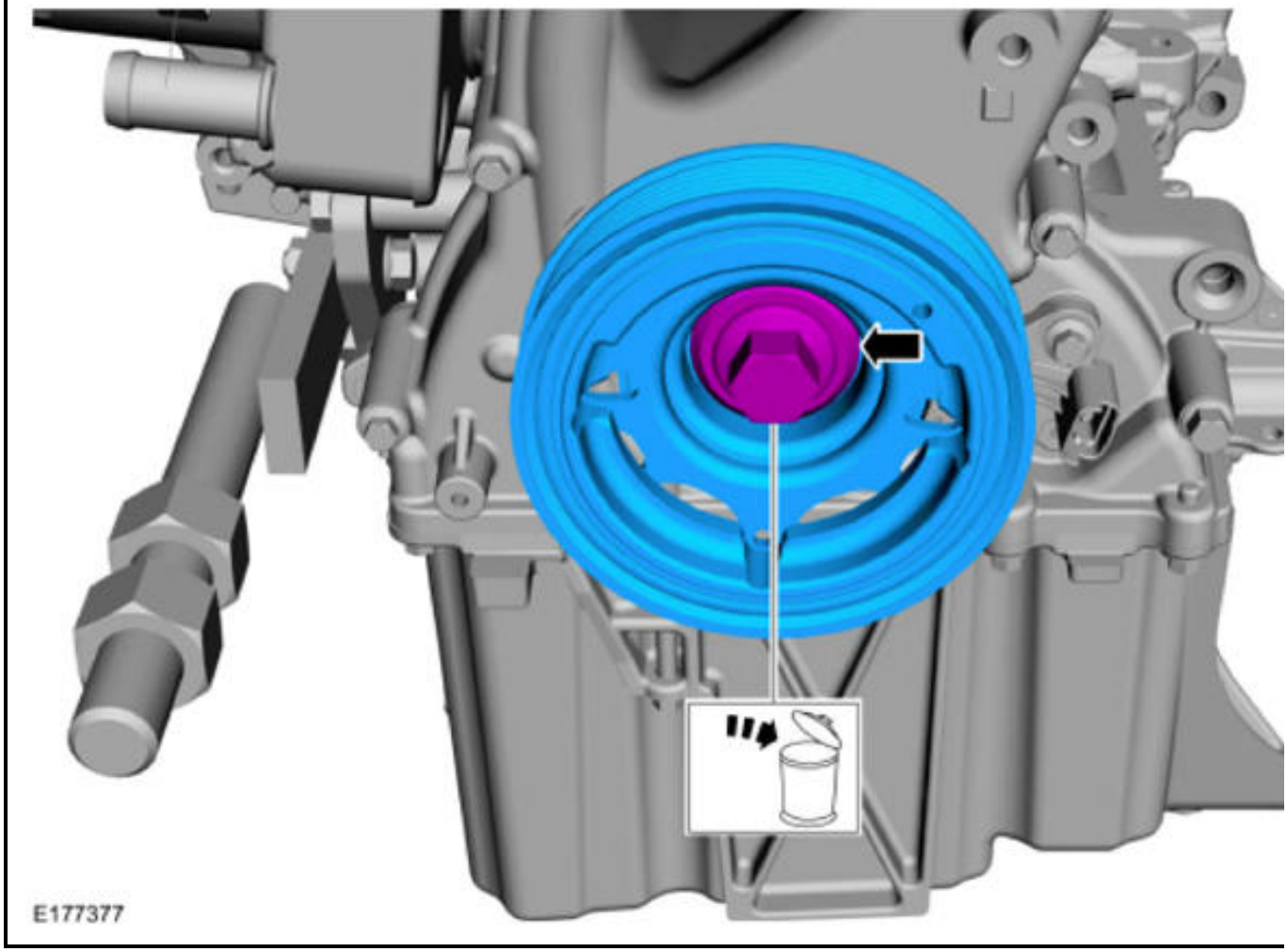
    : 5 turn(s)



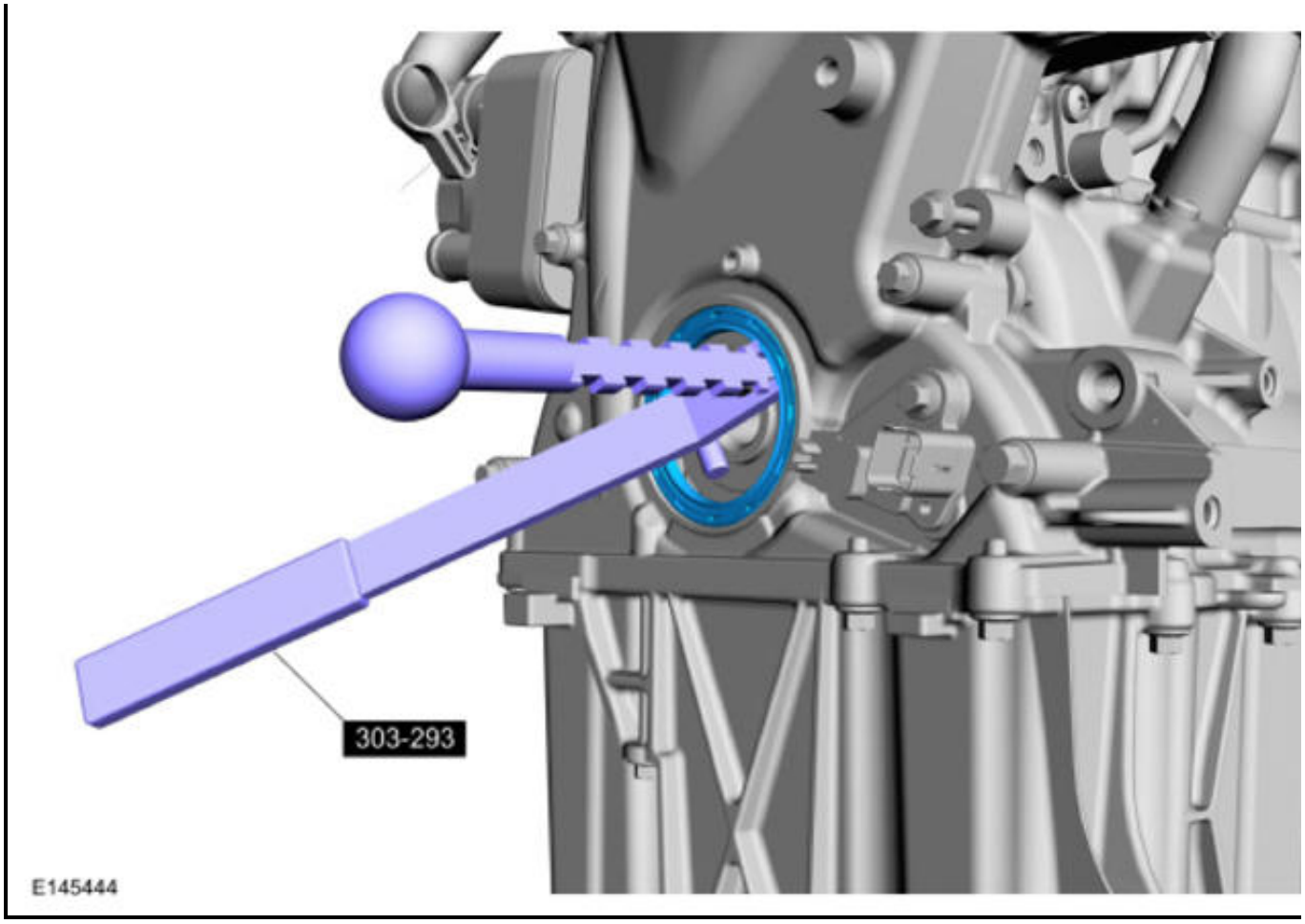
20. Remove Special Service Tool: 303-1611 Torque Multiplier.

21.

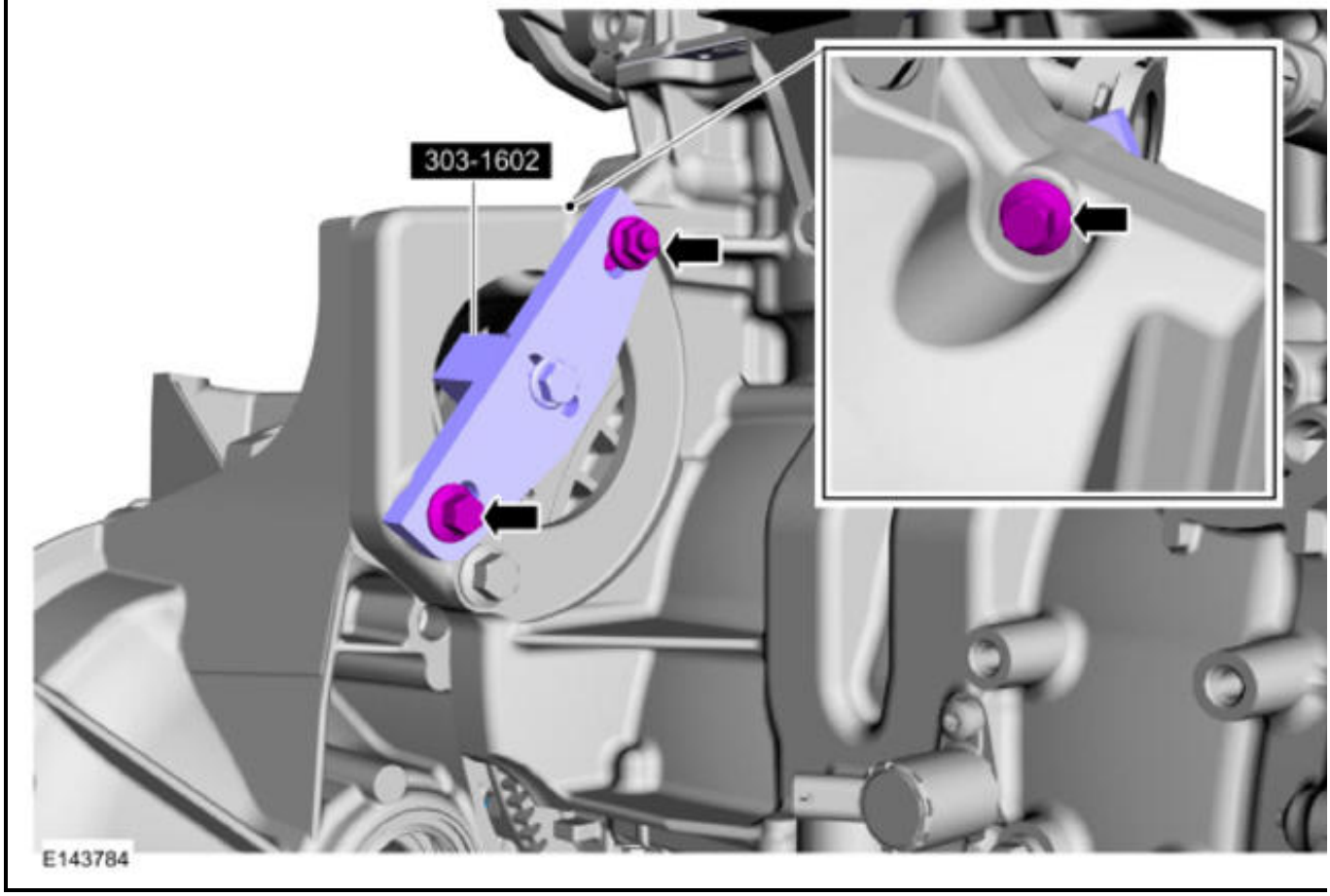
21.



22. Use Special Service Tool: **303-293 Remover, Crankshaft Seal** .



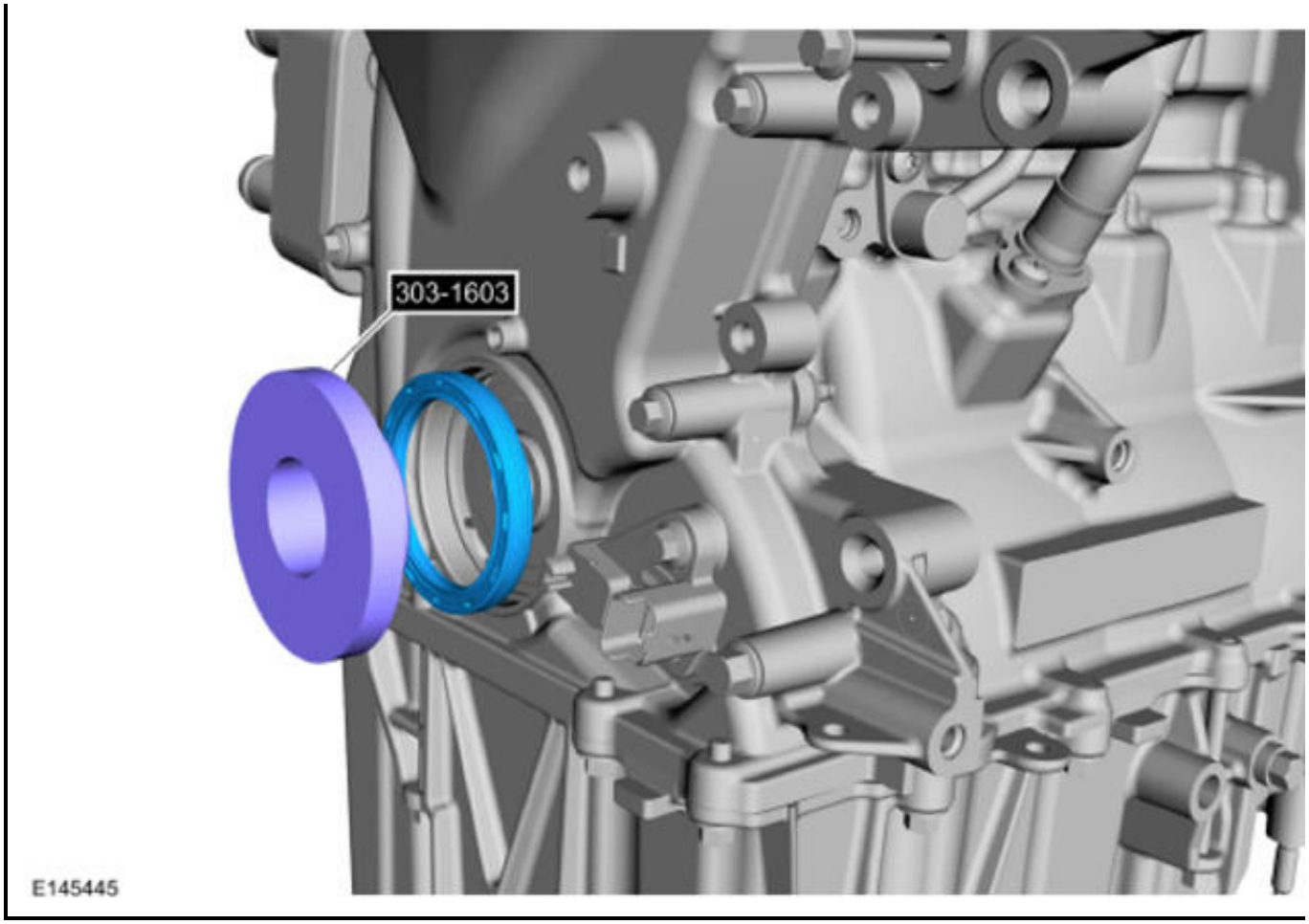
23. Remove Special Service Tool: 303-1602 Locking Tool, Crankshaft.



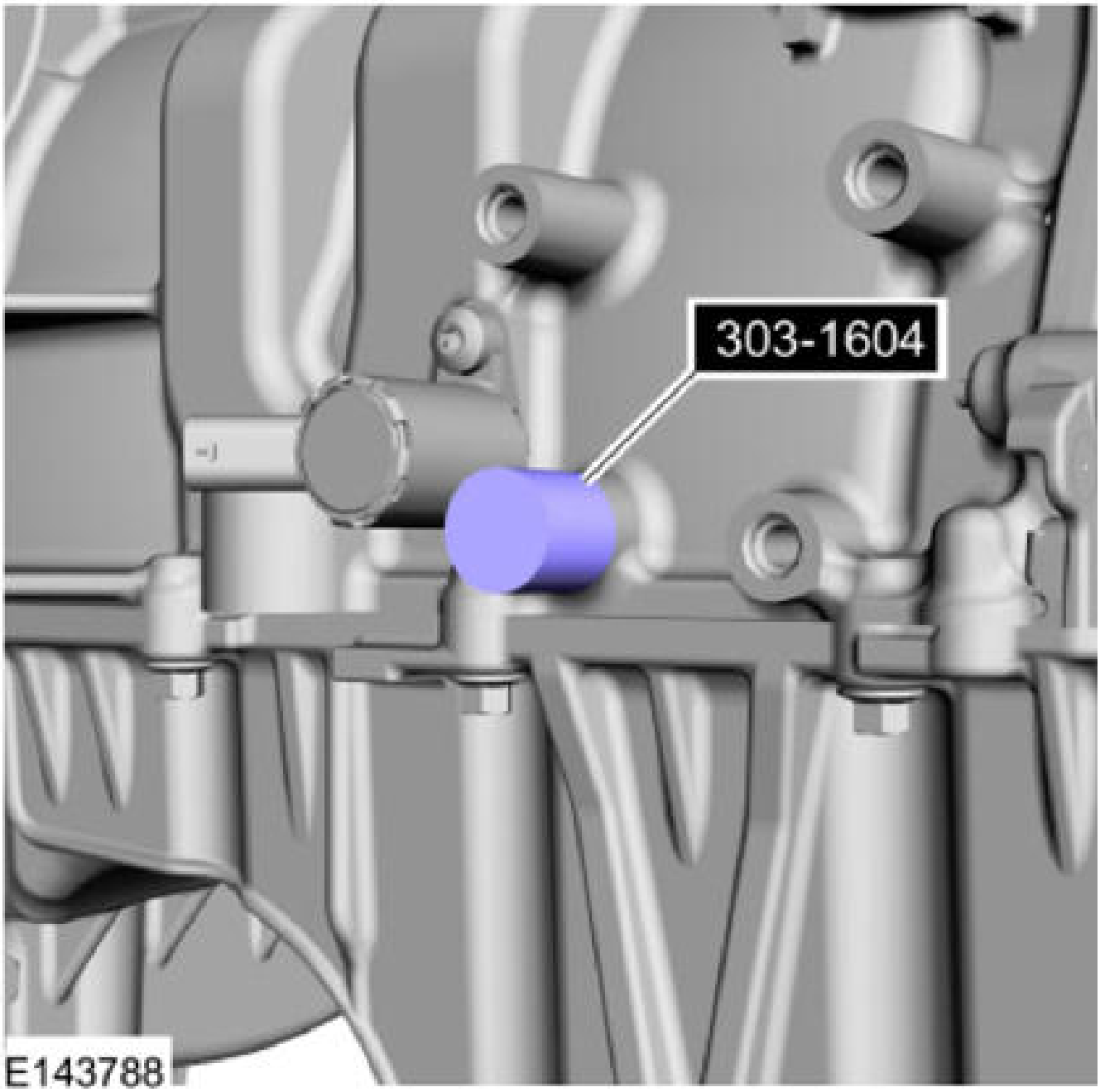
Installation

1. **NOTE: Make sure that a new component is installed.**

   Use Special Service Tool: 303-1603 Installer, Front Cover Seal.

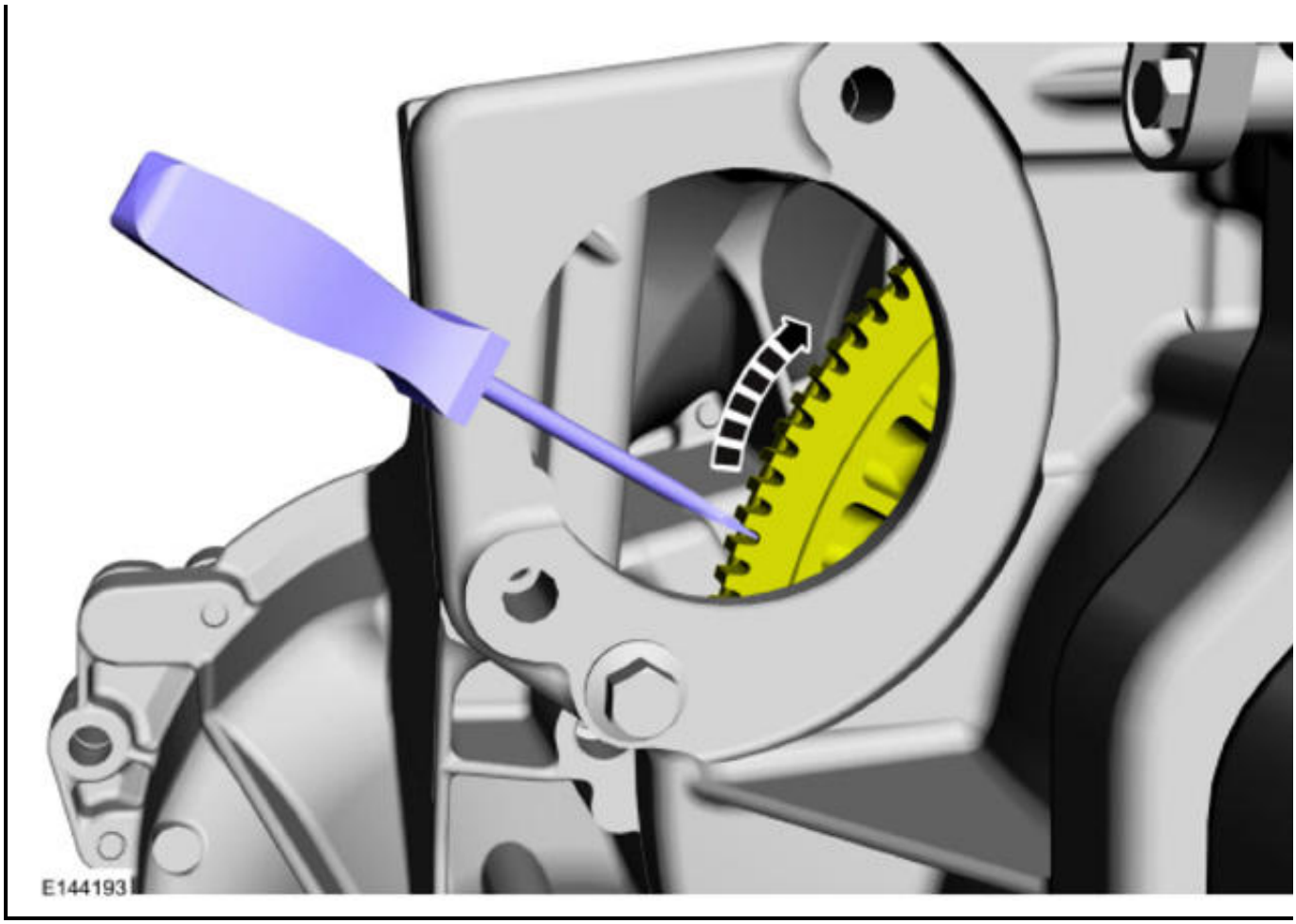


2. Install Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.



3. **NOTE: Only rotate the crankshaft clockwise.**

Rotate the crankshaft slowly until the crankshaft stops.



4.

1.

NOTE: Make sure that a new component is installed.

2. Install 3/16 inch punch.

Use the General Equipment: Punch

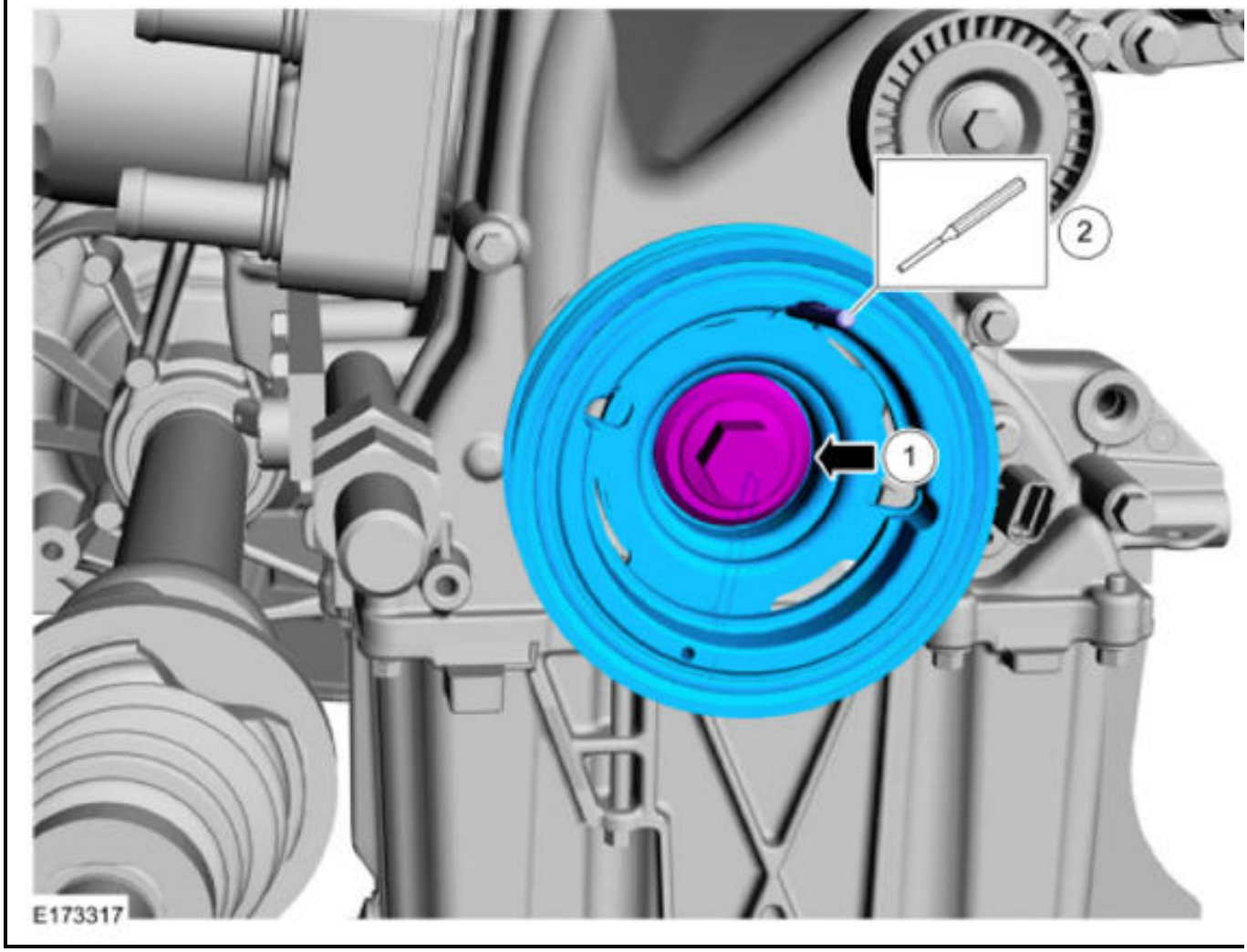
5. *Torque* :

Stage 1: 18 lb.ft (25 Nm)

Stage 2: 52 lb.ft (70 Nm)

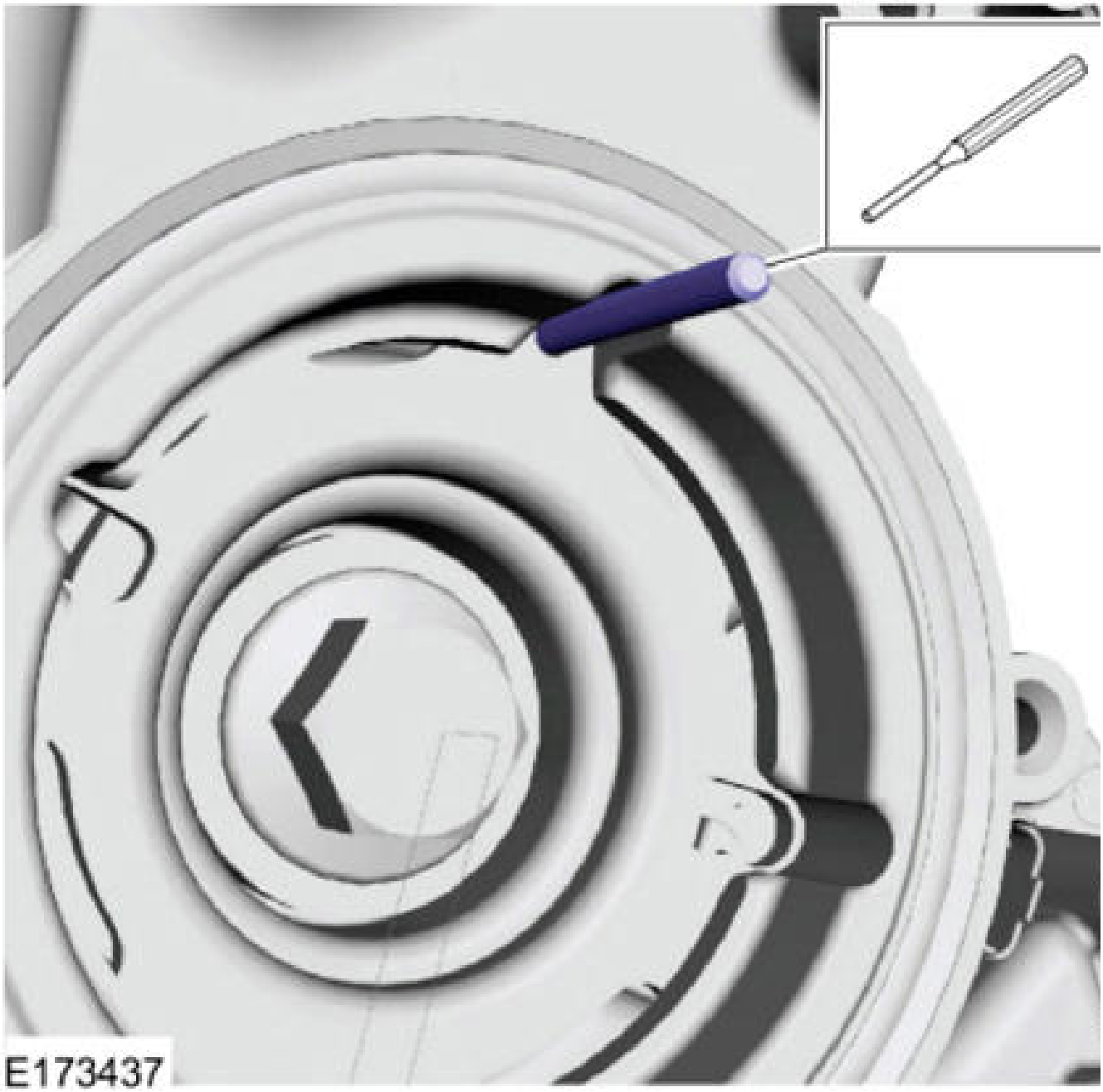
	A multimedia supplement to the instructions contained in this article is available. To view the multimedia example of the condition described go to;

YouTube	**http://www.youtube.com/user/Mitchell1Tips then type, "A00670659.vid1" into the "Search Channel" box.**



6. Remove 3/16 inch punch.

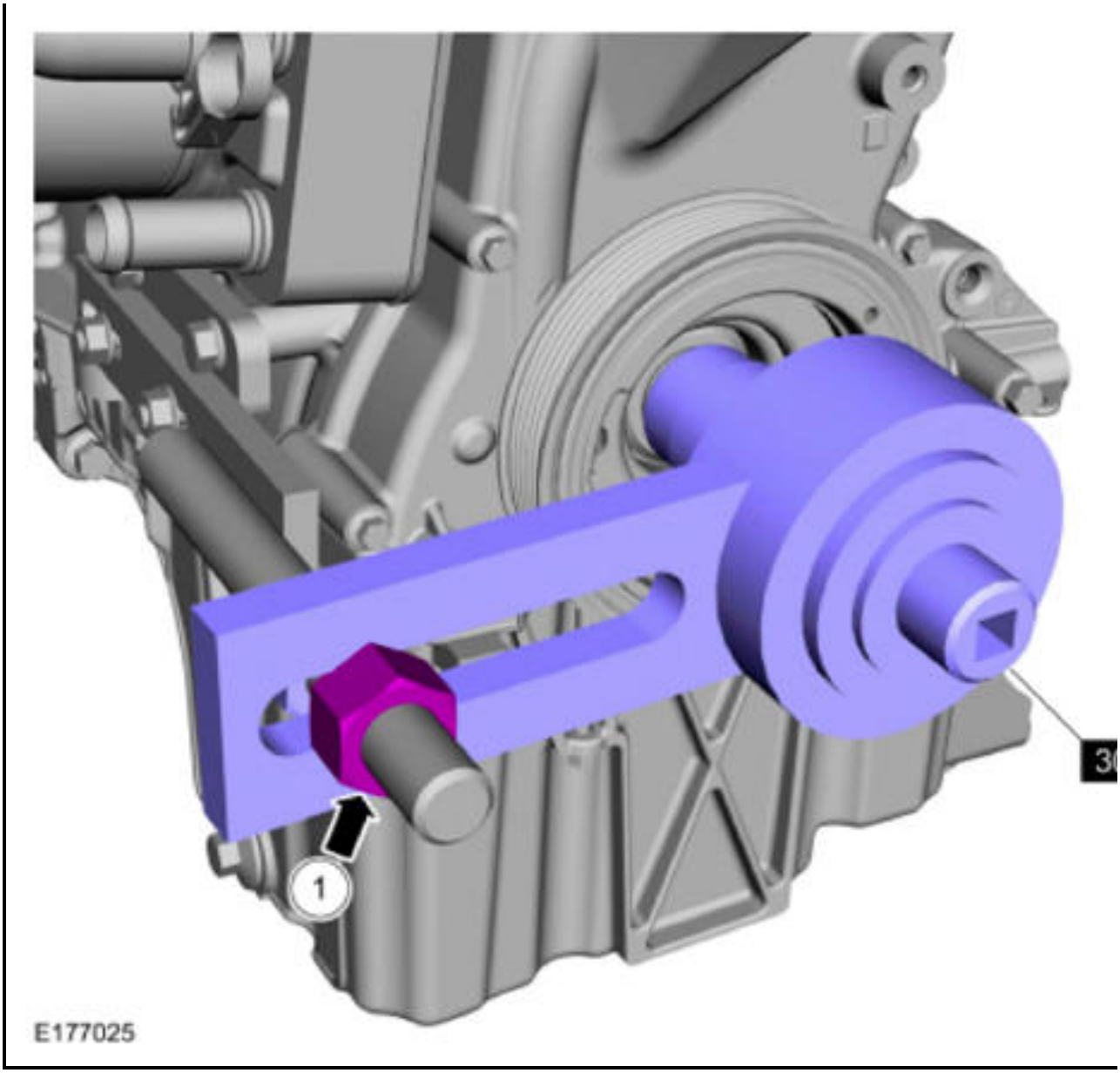
   Use the General Equipment: Punch



7.

- Only tighten the nut finger tight at this stage.

  Install Special Service Tool: 303-1611 Torque Multiplier.



8.

YouTube	A multimedia supplement to the instructions contained in this article is available. To view the multimedia example of the condition described go to; **http://www.youtube.com/user/Mitchell1Tips** **then type, "A00670659.vid2" into the "Search Channel" box.**

1. *Torque* : 44 lb.ft (60 Nm)
2. *Torque* :

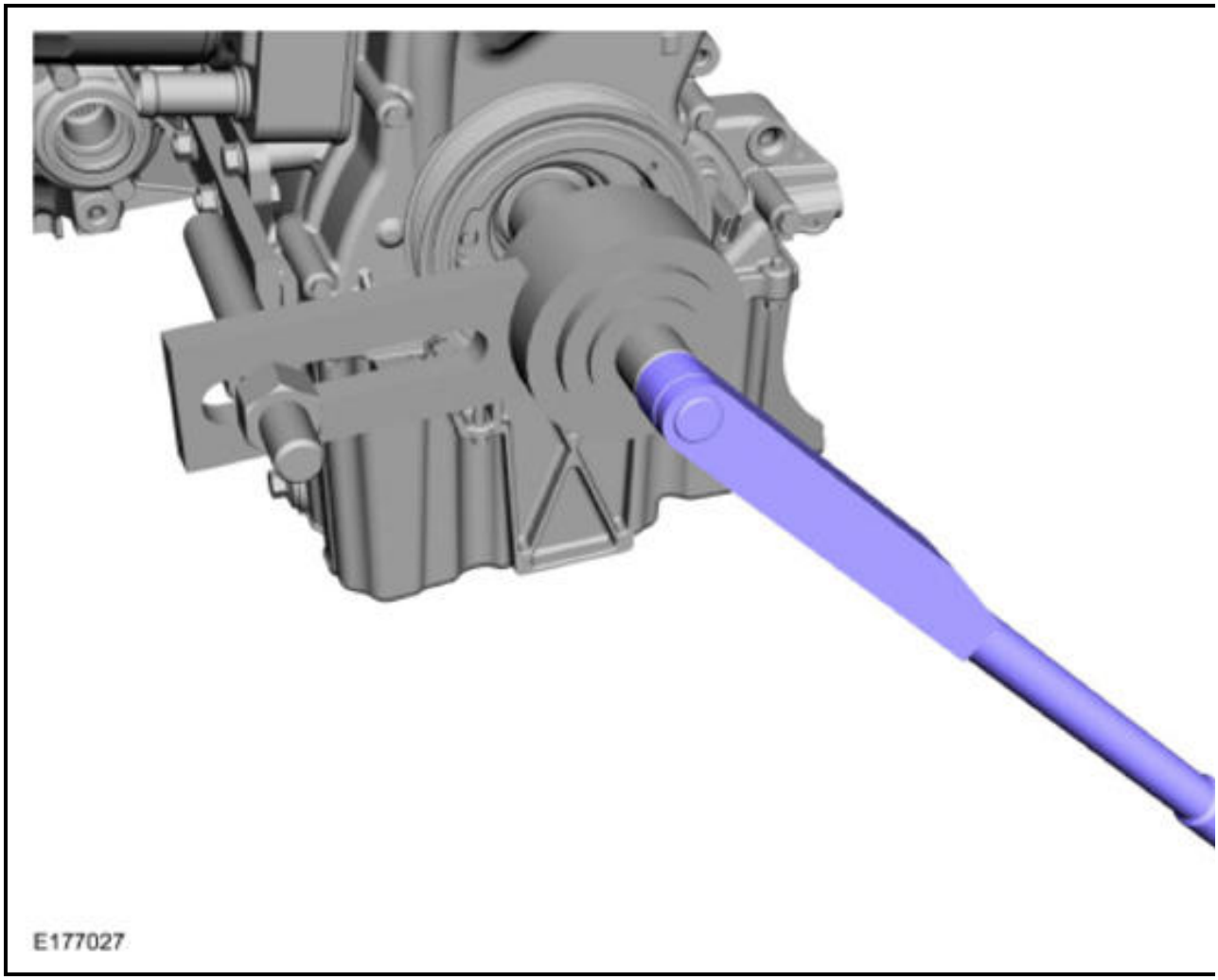
Stage 1: 90°

Stage 2: 90°

Stage 3: 90°

Stage 4: 90°

Stage 5: 90°

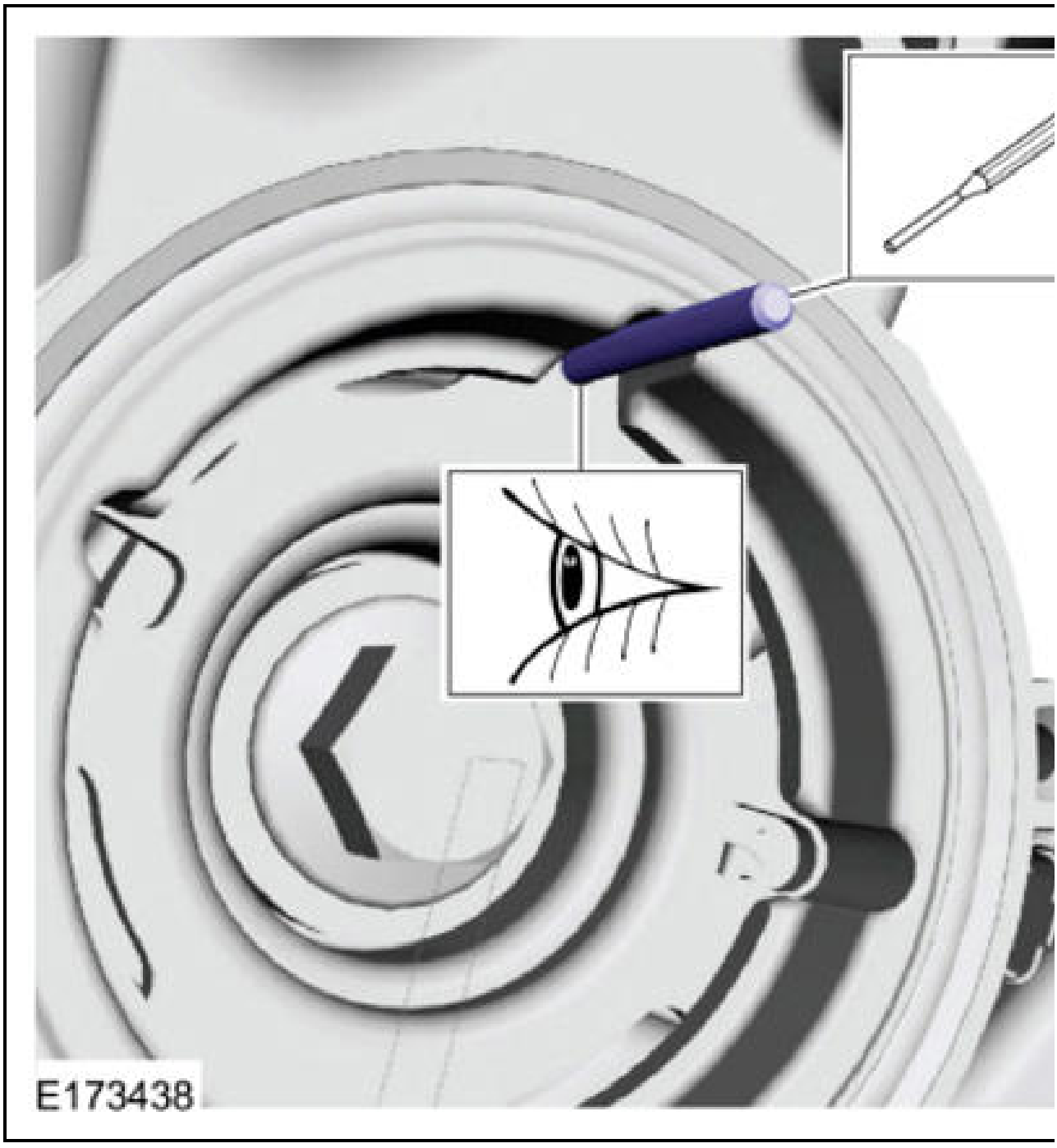


9. Remove Special Service Tool: 303-1611 Torque Multiplier.
10.
    - Install 3/16 inch punch.

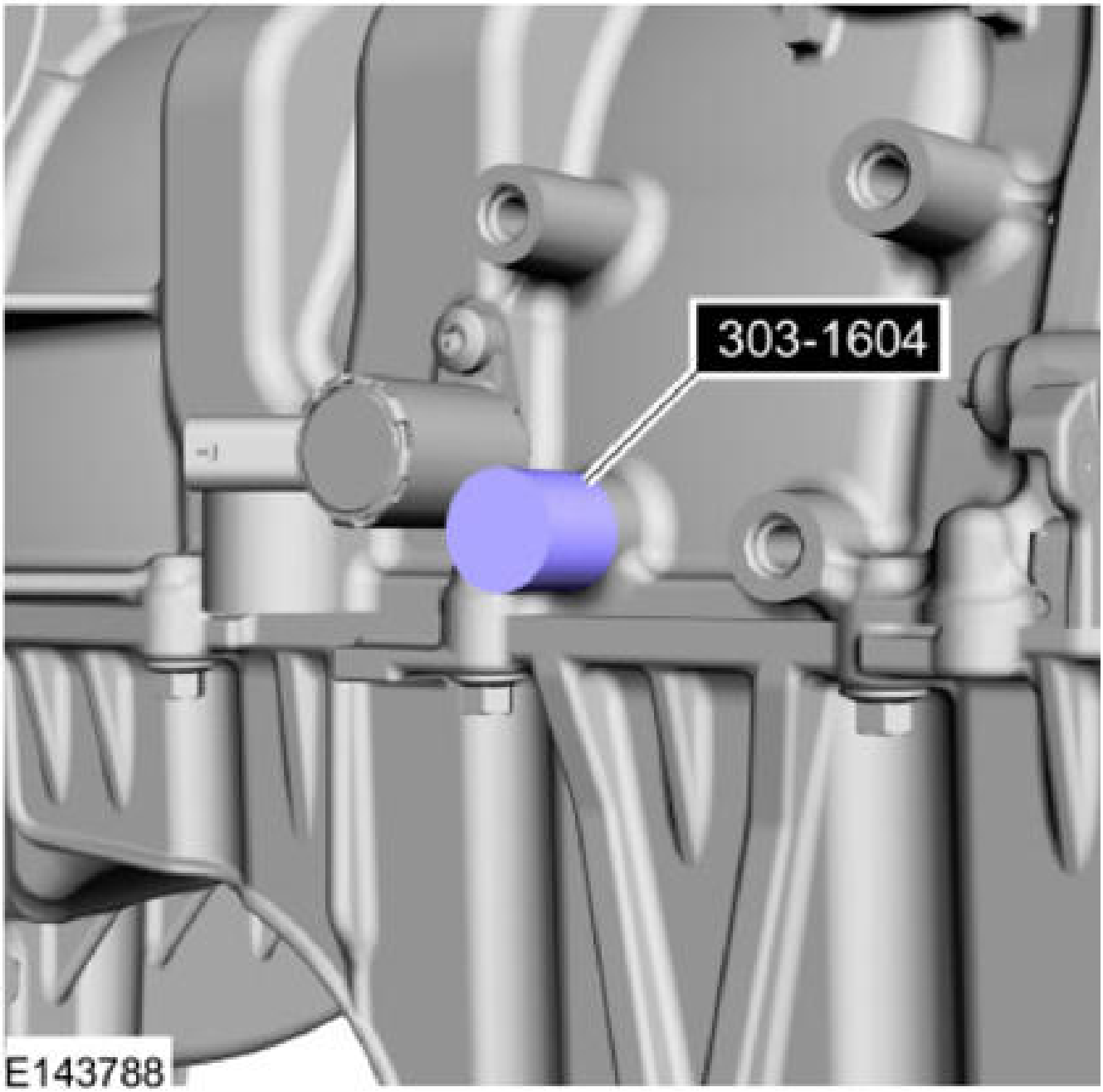
      Use the General Equipment: Punch

    - Remove 3/16 inch punch.

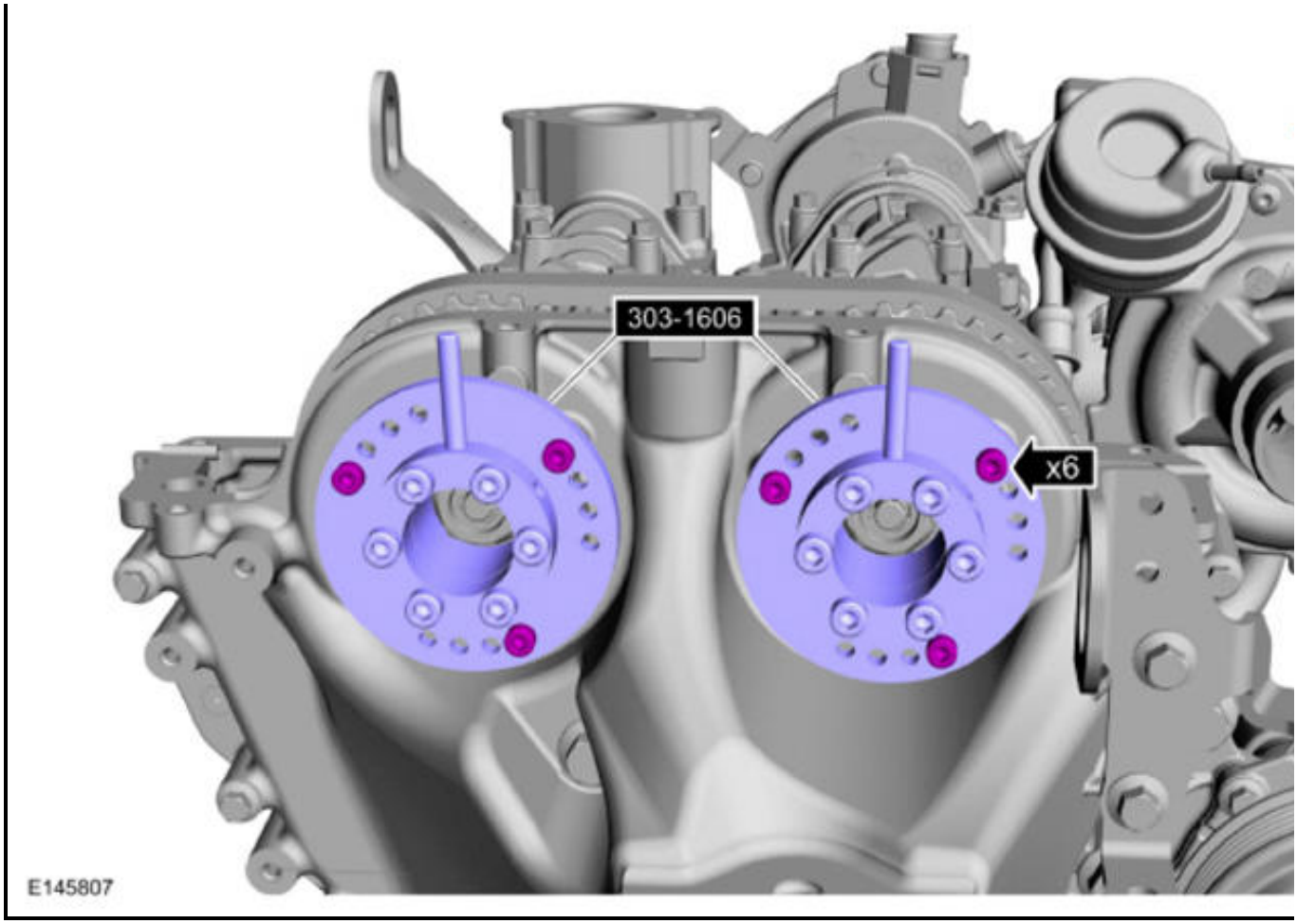
Use the General Equipment: Punch



11. Remove Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.

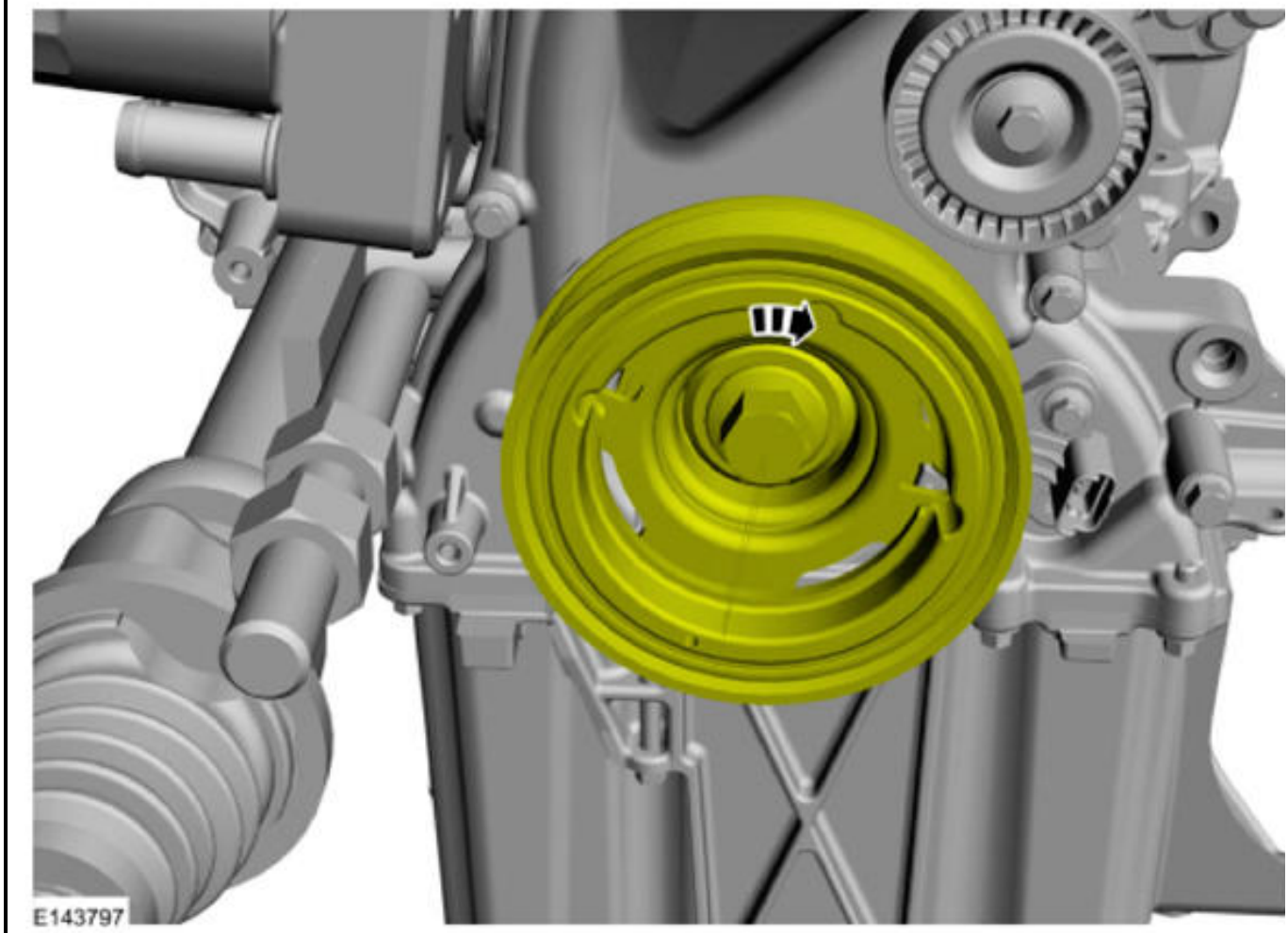


12. Remove Special Service Tool: 303-1606 Locking Tool, Variable Camshaft Timing.

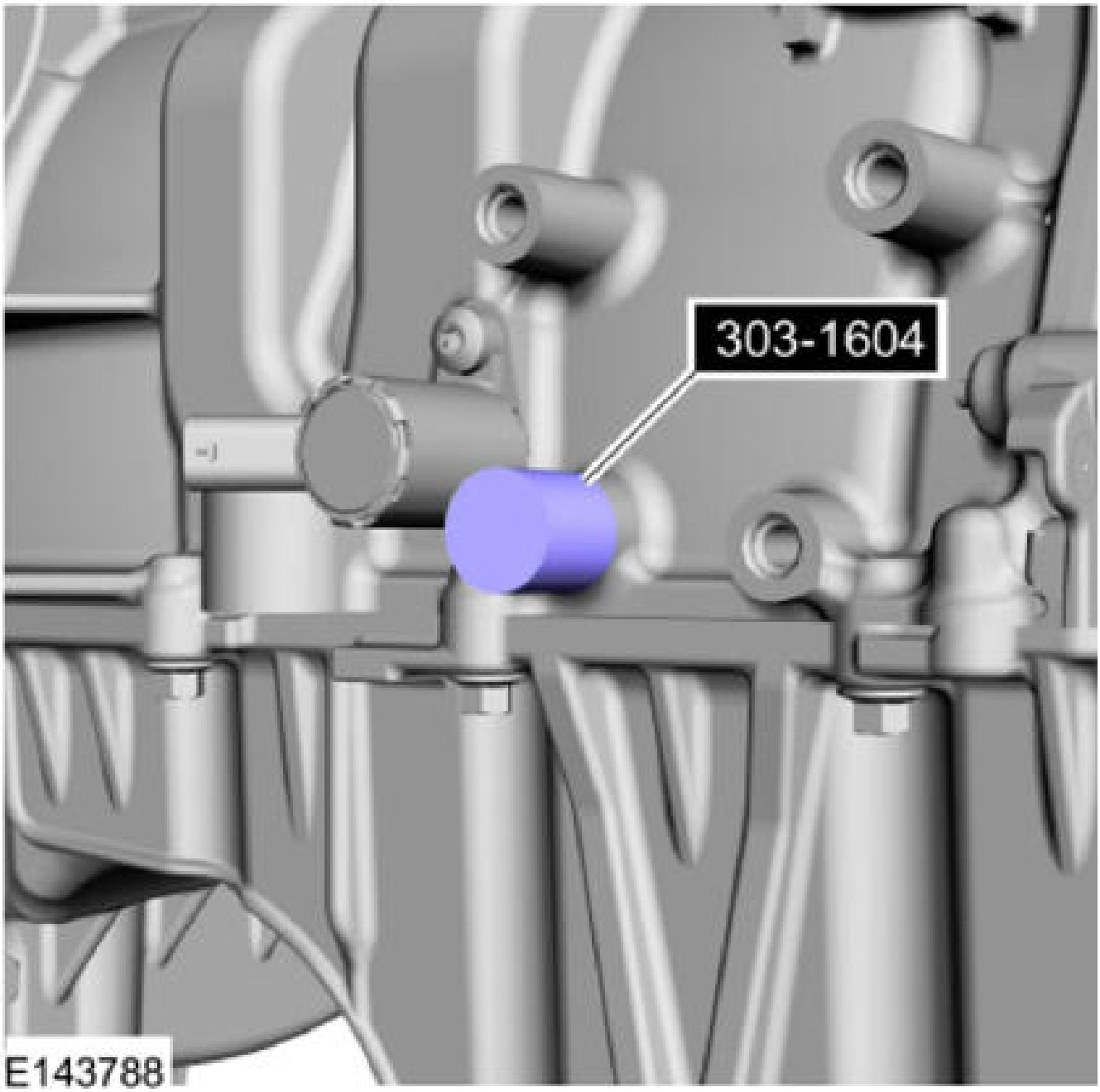


13. **NOTE: Only rotate the crankshaft clockwise.**

Rotate the crankshaft 1 and 3/4 revolutions and continue until piston No. 1 is approximately 45° before top dead center (BTDC).

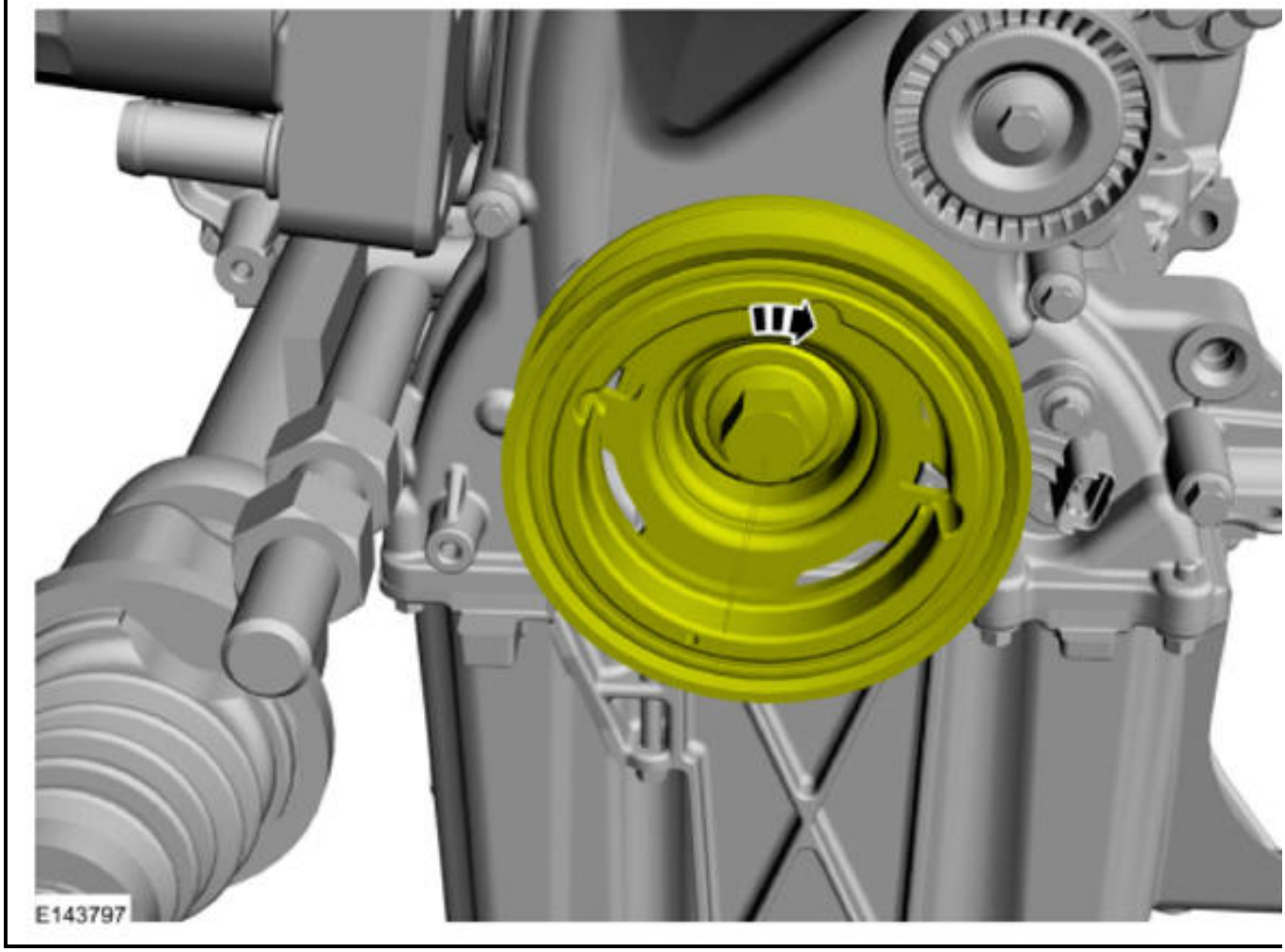


14. Install Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.



15. **NOTE: Only rotate the crankshaft clockwise.**

Rotate the crankshaft slowly until the crankshaft stops.



16.

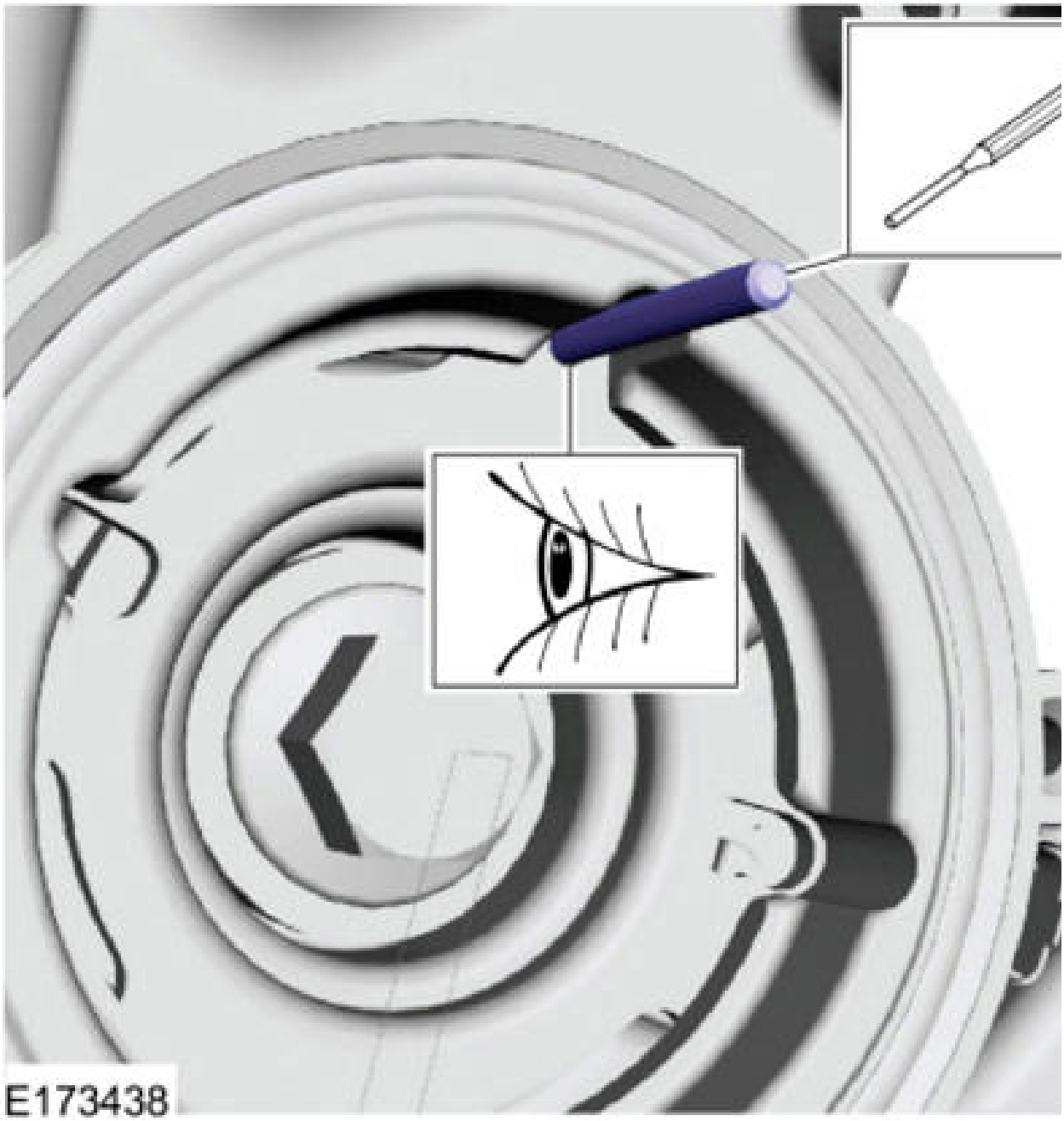
- **NOTE: The punch can only be installed if the valve timing is correct.**

  Install 3/16 inch punch.

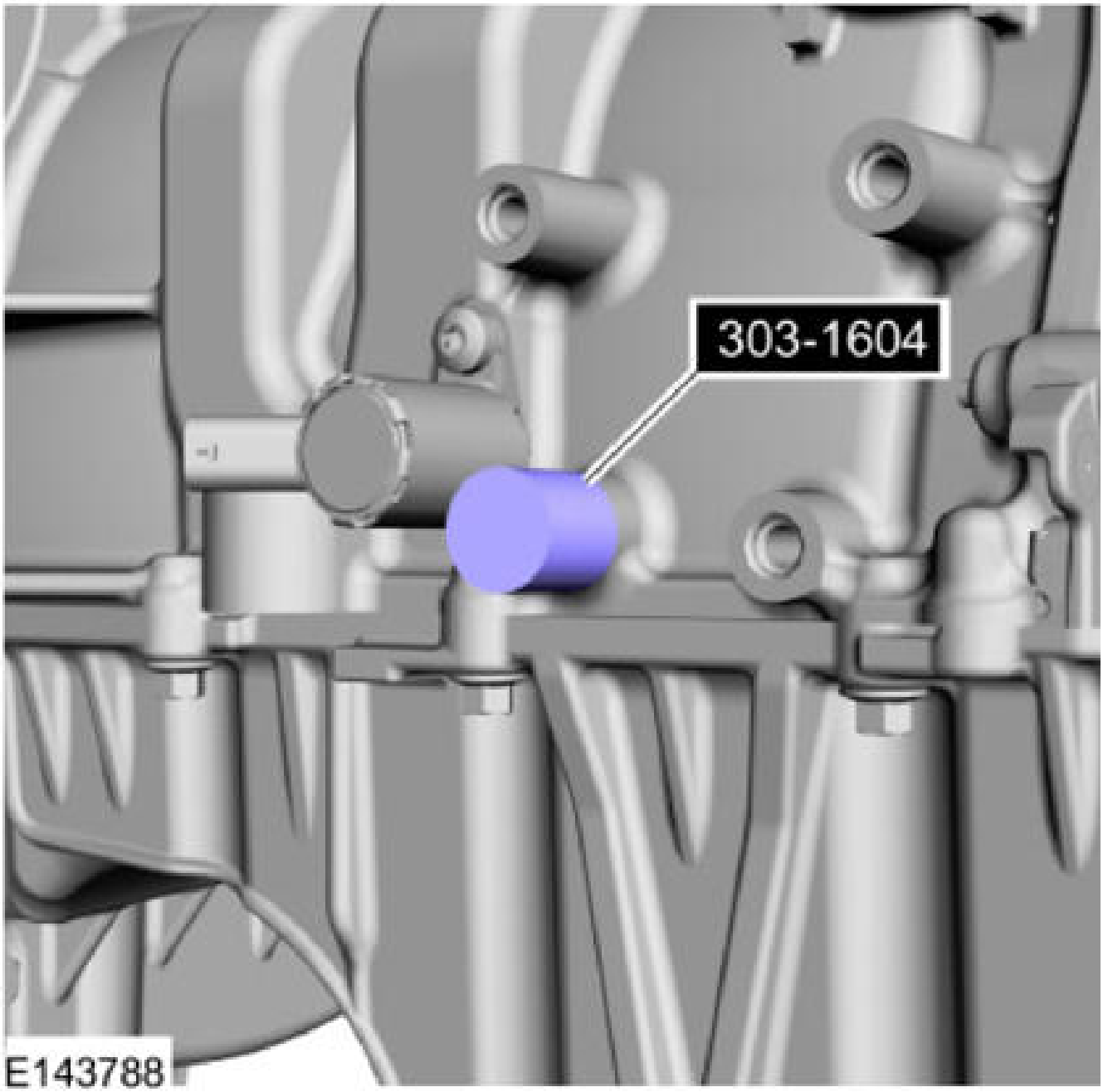
  Use the General Equipment: Punch

- Remove 3/16 inch punch.

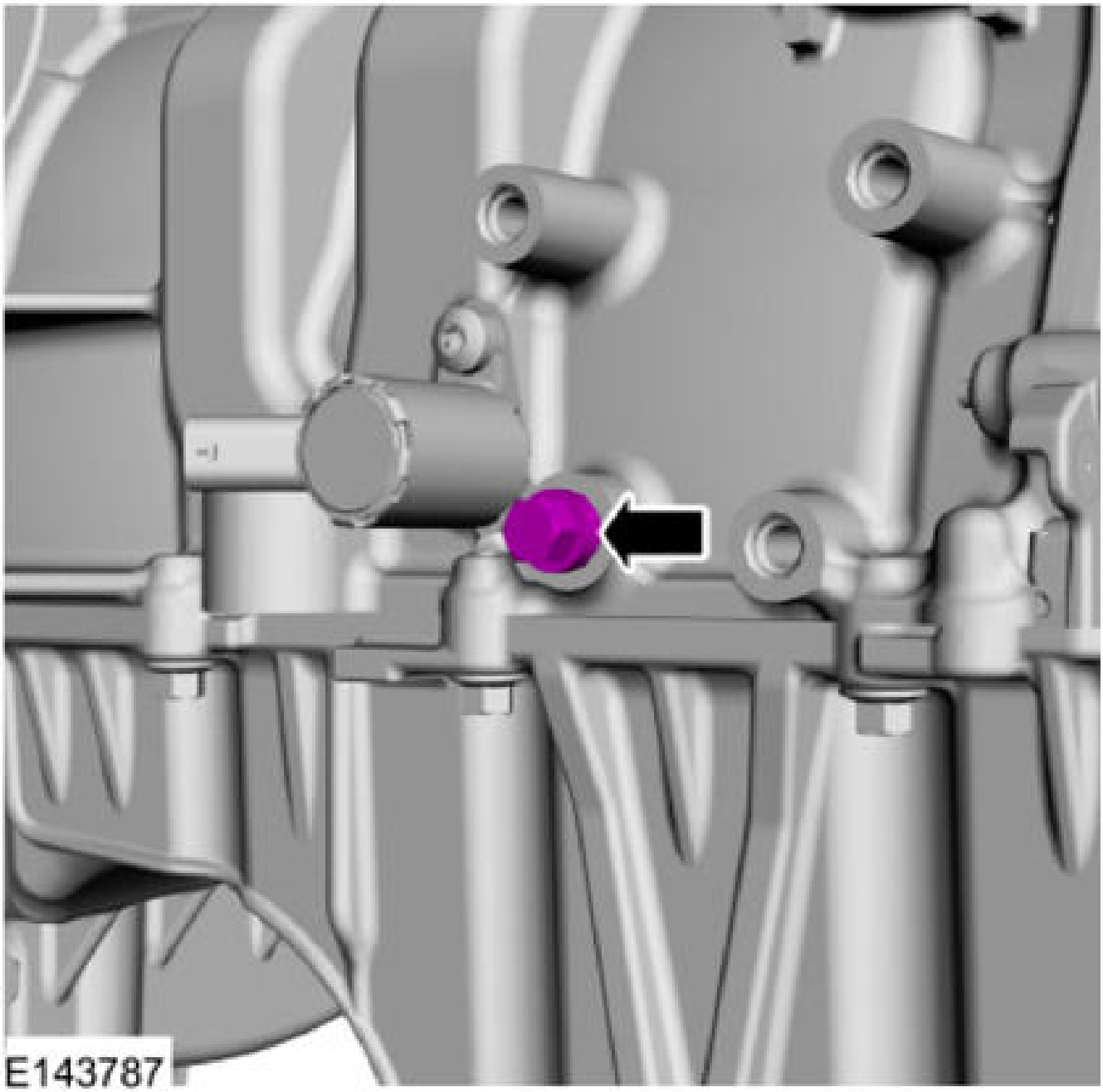
  Use the General Equipment: Punch



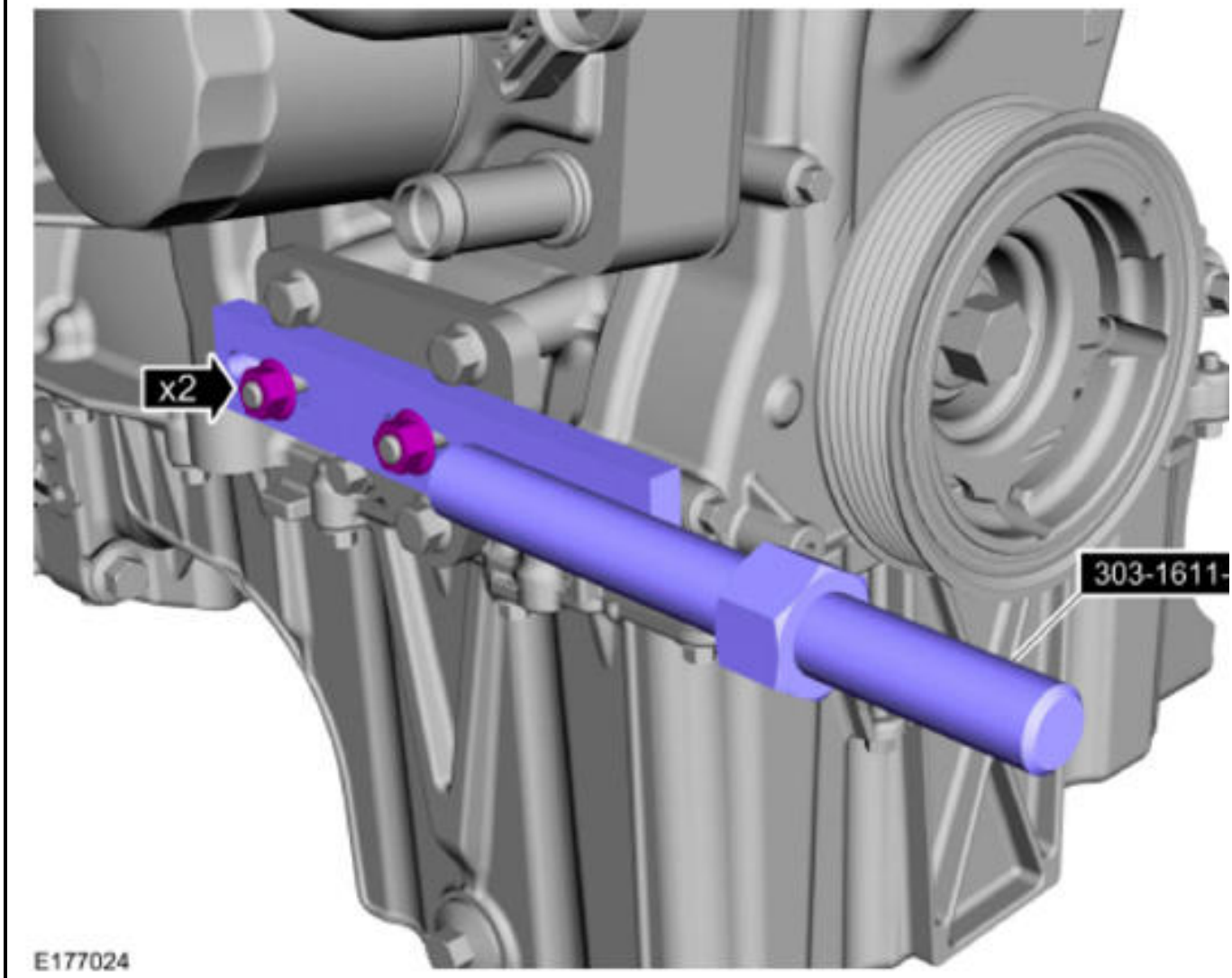
17. Remove Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.



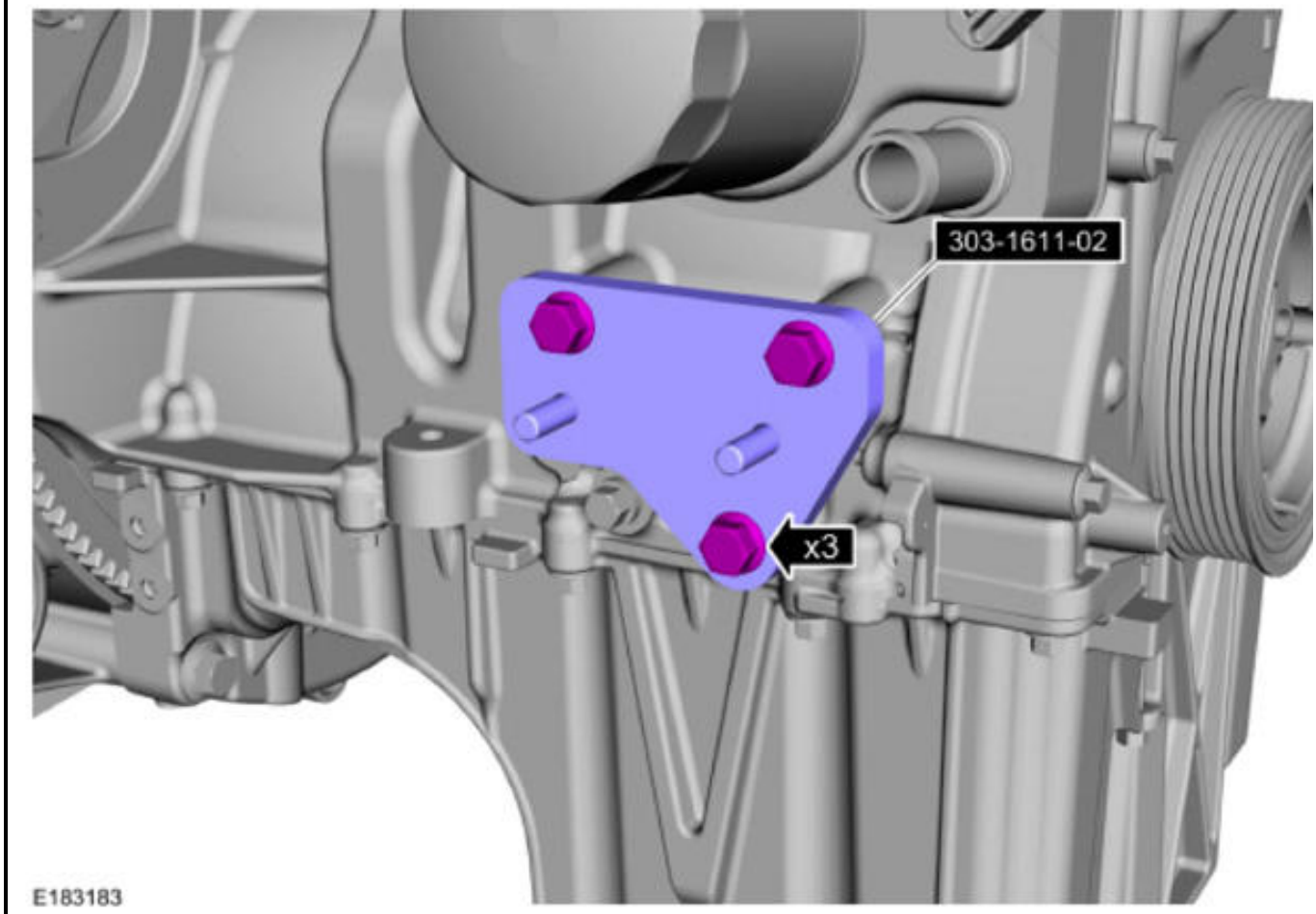
18. *Torque* : 177 lb.in (20 Nm)



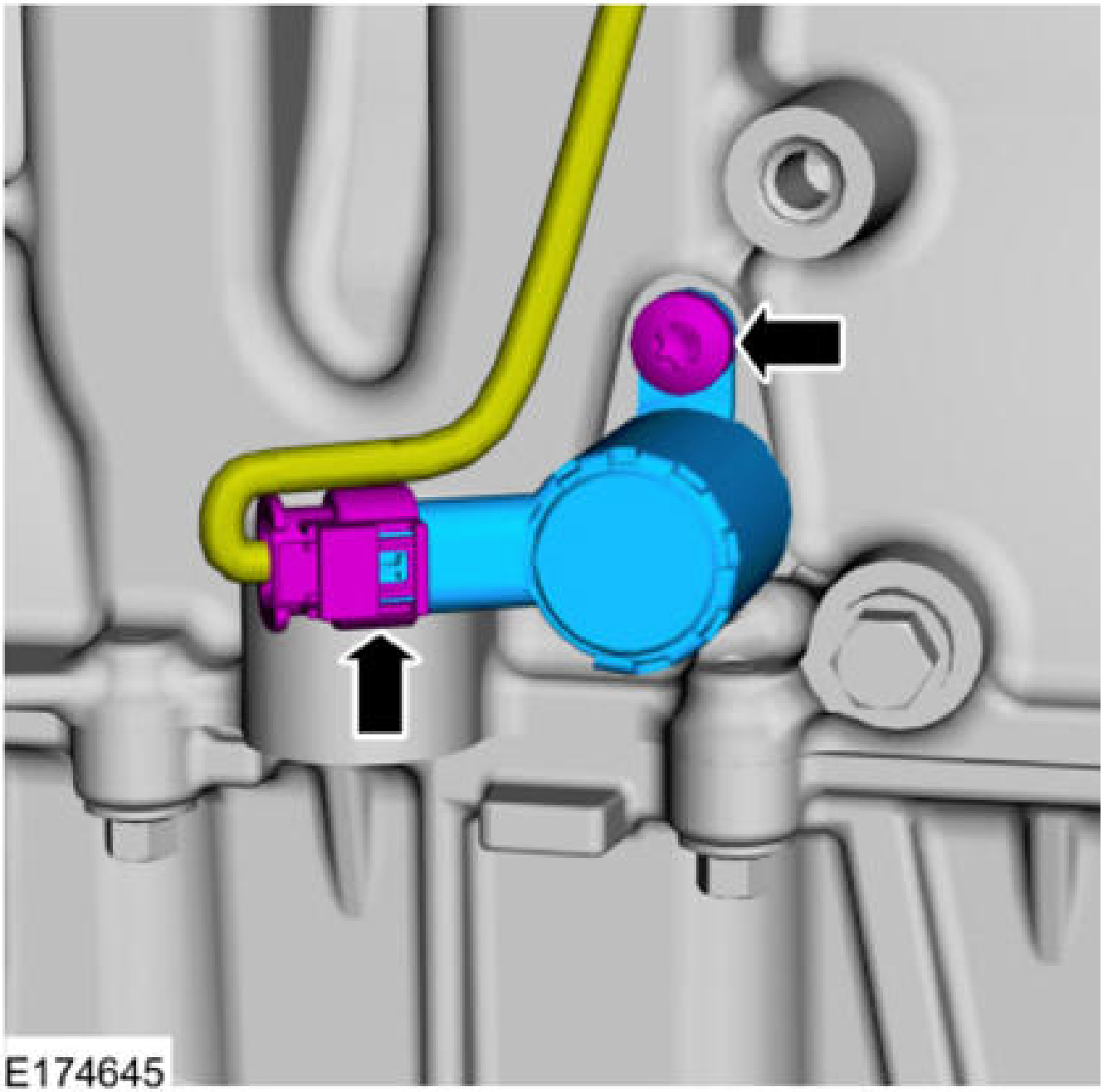
19. Remove Special Service Tool: 303-1611-01 Adapter for 303-1611.



20. Remove Special Service Tool: **303-1611-02 Adapter for 303-1611, Torque Multiplier** .



21. *Torque* : 89 lb.in (10 Nm)



22.

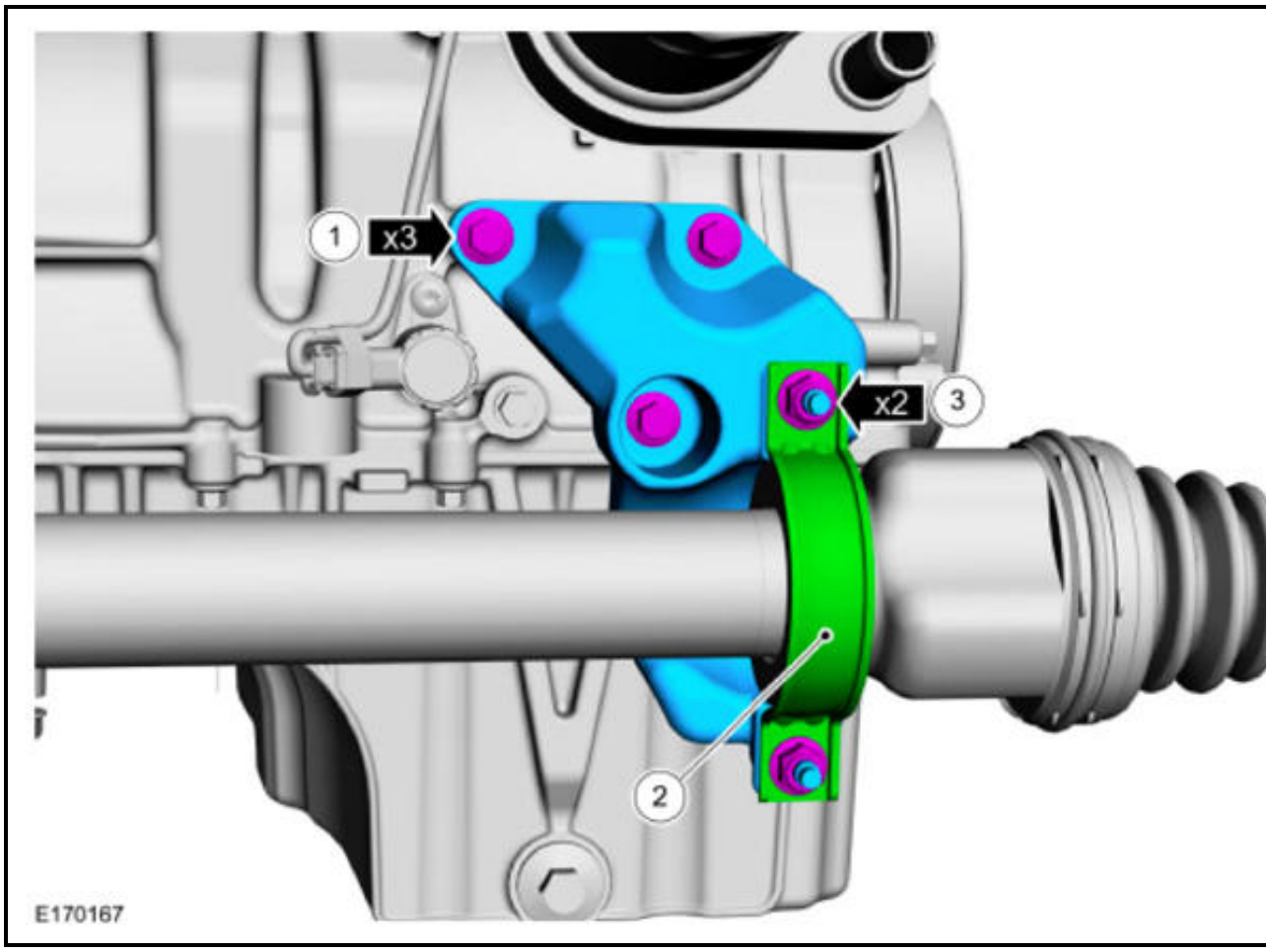
1. *Torque* : 18 lb.ft (24 Nm)
2.

NOTE: Make sure that a new component is installed.

3.

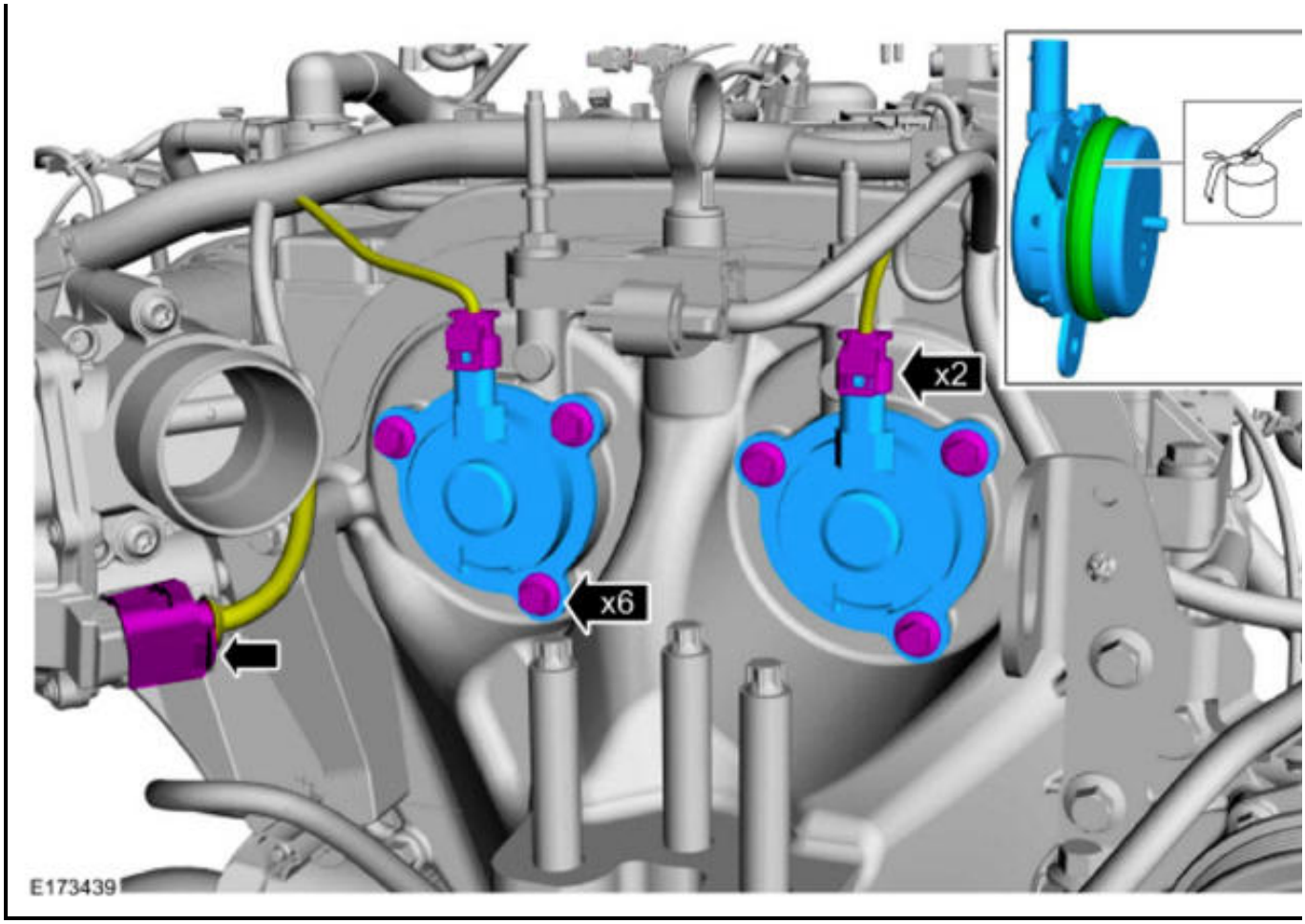
NOTE: **Make sure that new components are installed.**

Torque : 18 lb.ft (25 Nm)

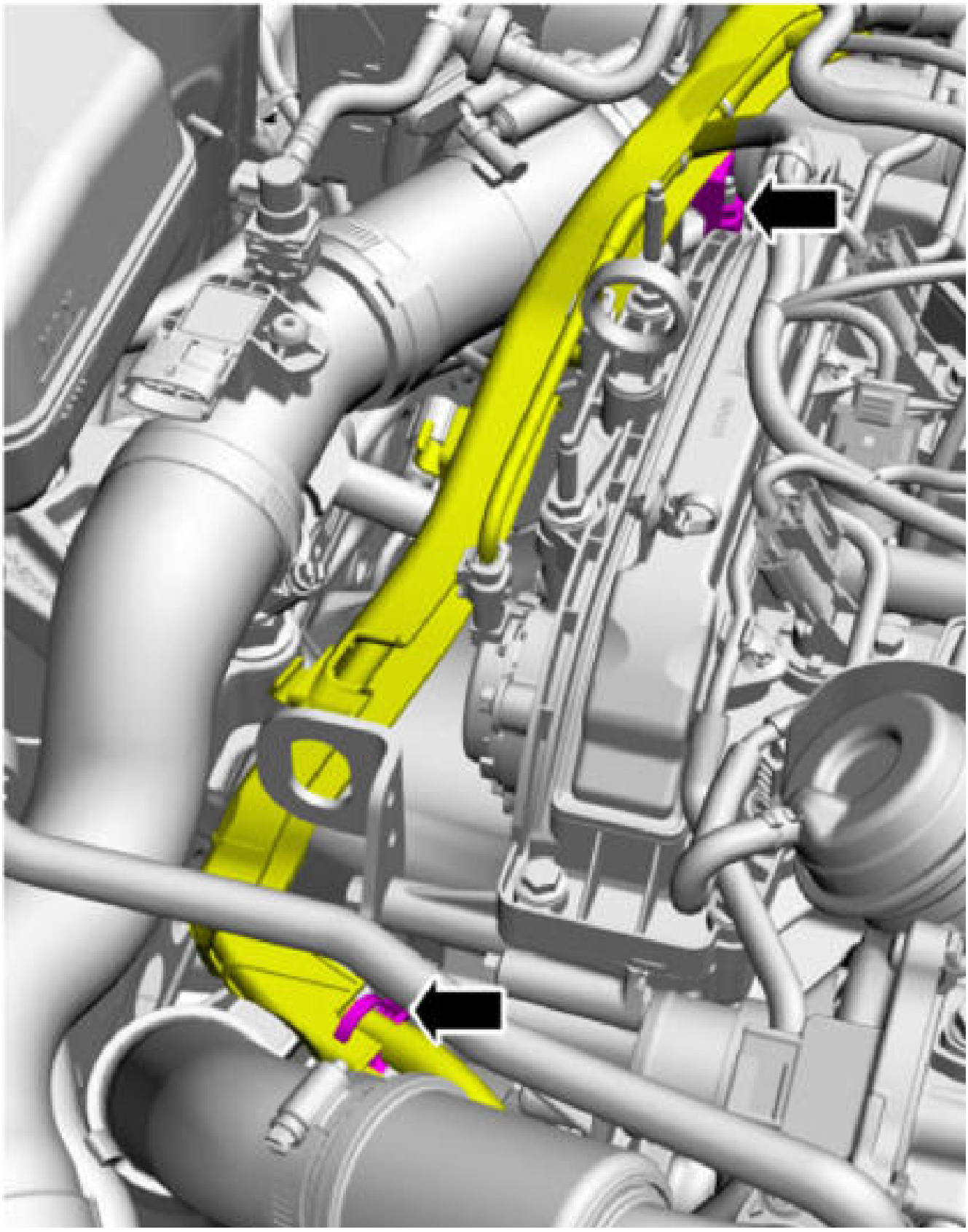


23. Install the following items:
    - Refer to: **STARTER MOTOR** .
    - Refer to: **ACCESSORY DRIVE BELT** .
24. *Material* : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

    Torque : 62 lb.in (7 Nm)

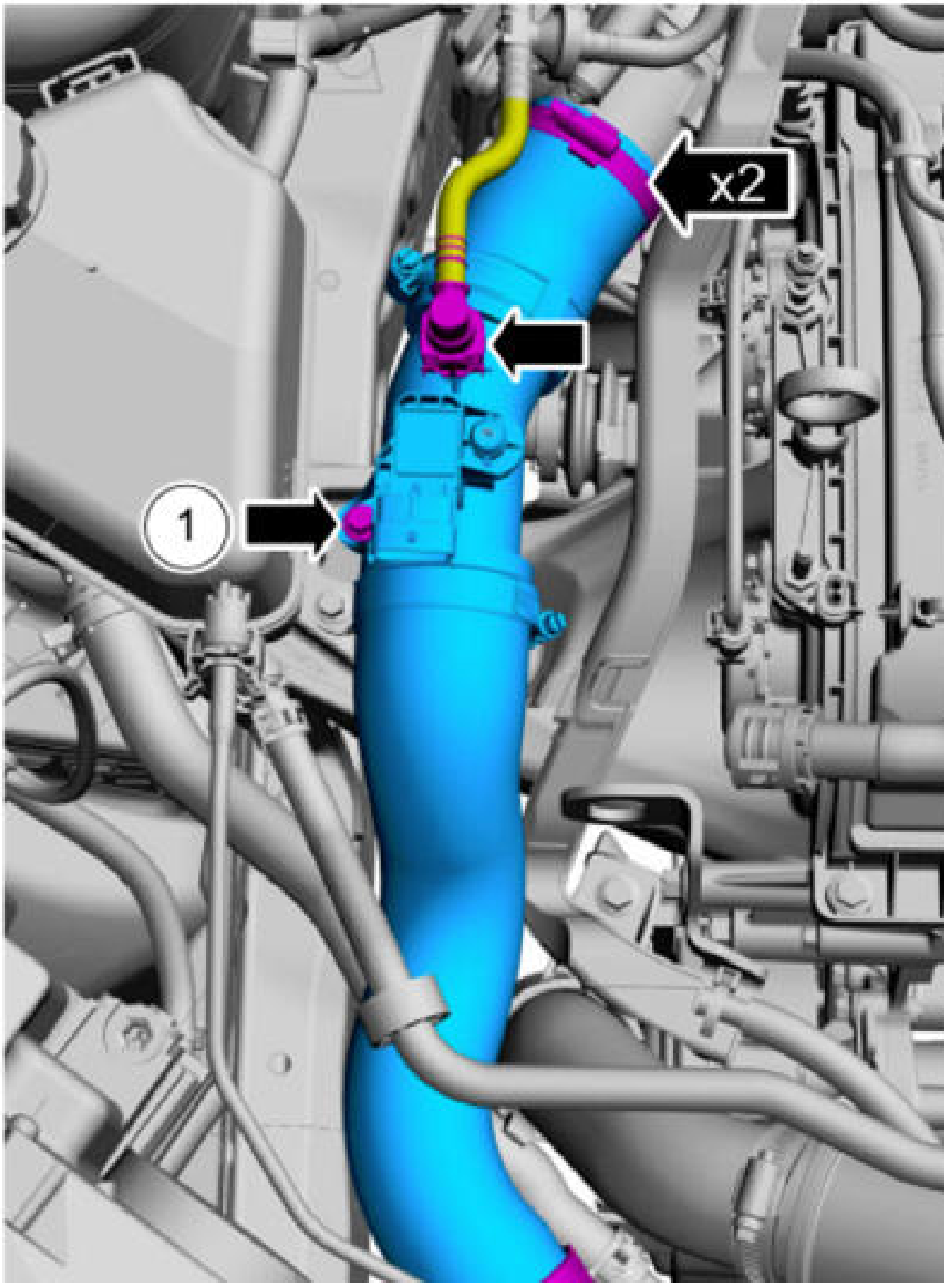


25.



26.

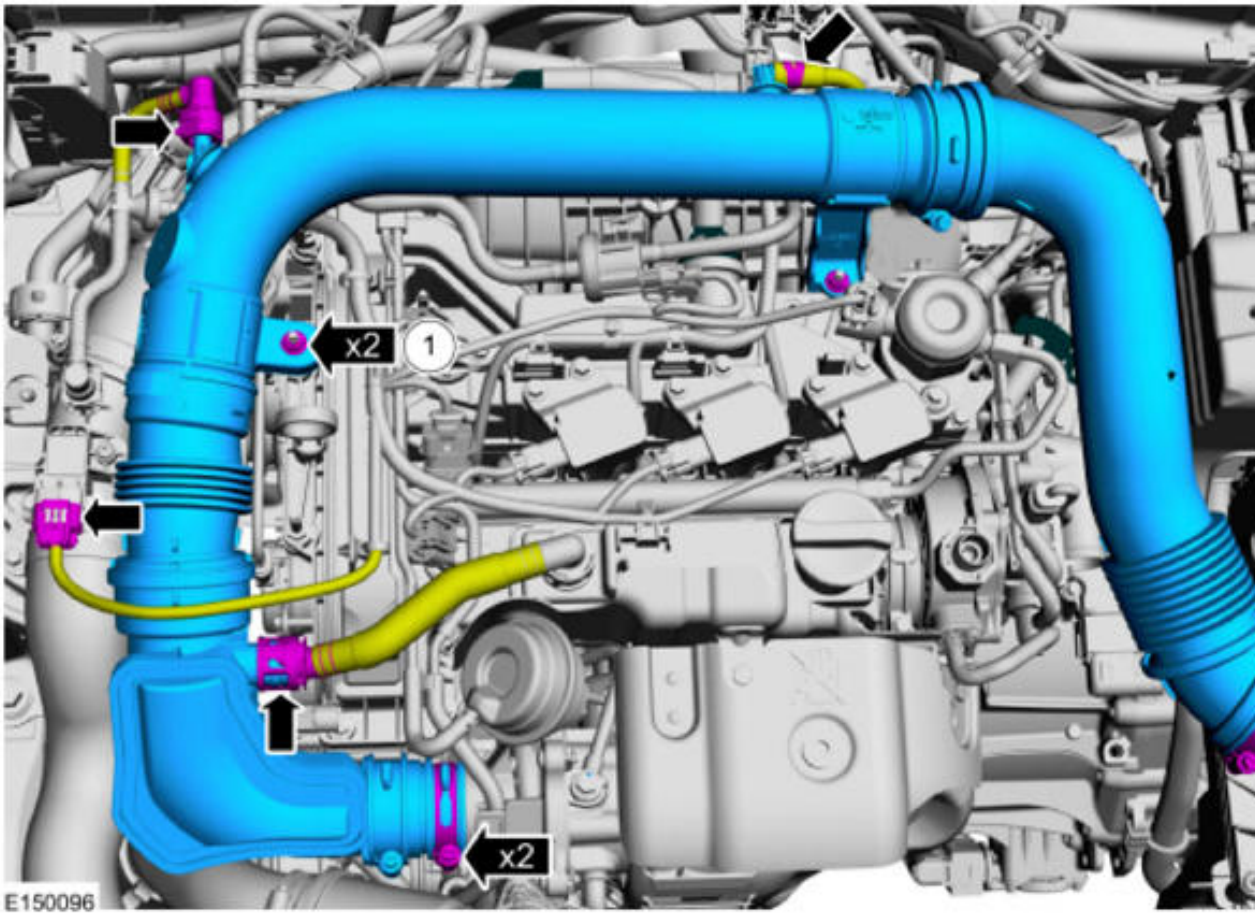
1. *Torque* : 133 lb.in (15 Nm)



27.

- Use the General Equipment: Hose Clamp Remover/Installer

  Torque : 97 lb.in (11 Nm)

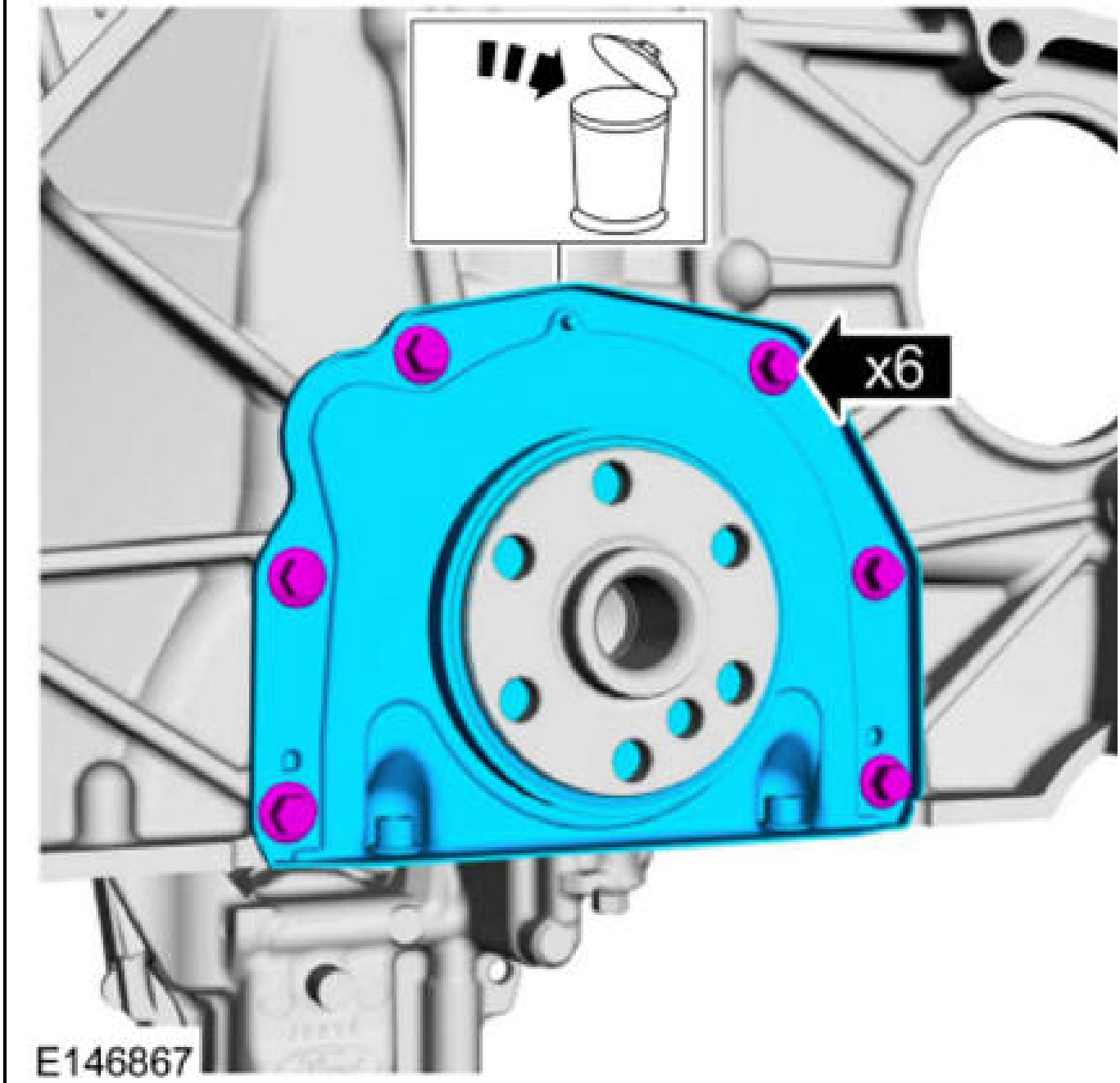


CRANKSHAFT REAR SEAL

Removal

1. Refer to: **JACKING AND LIFTING - OVERVIEW** .
2. Refer to: **OIL PAN** .
3. Refer to: **FLYWHEEL** .
4.

4.

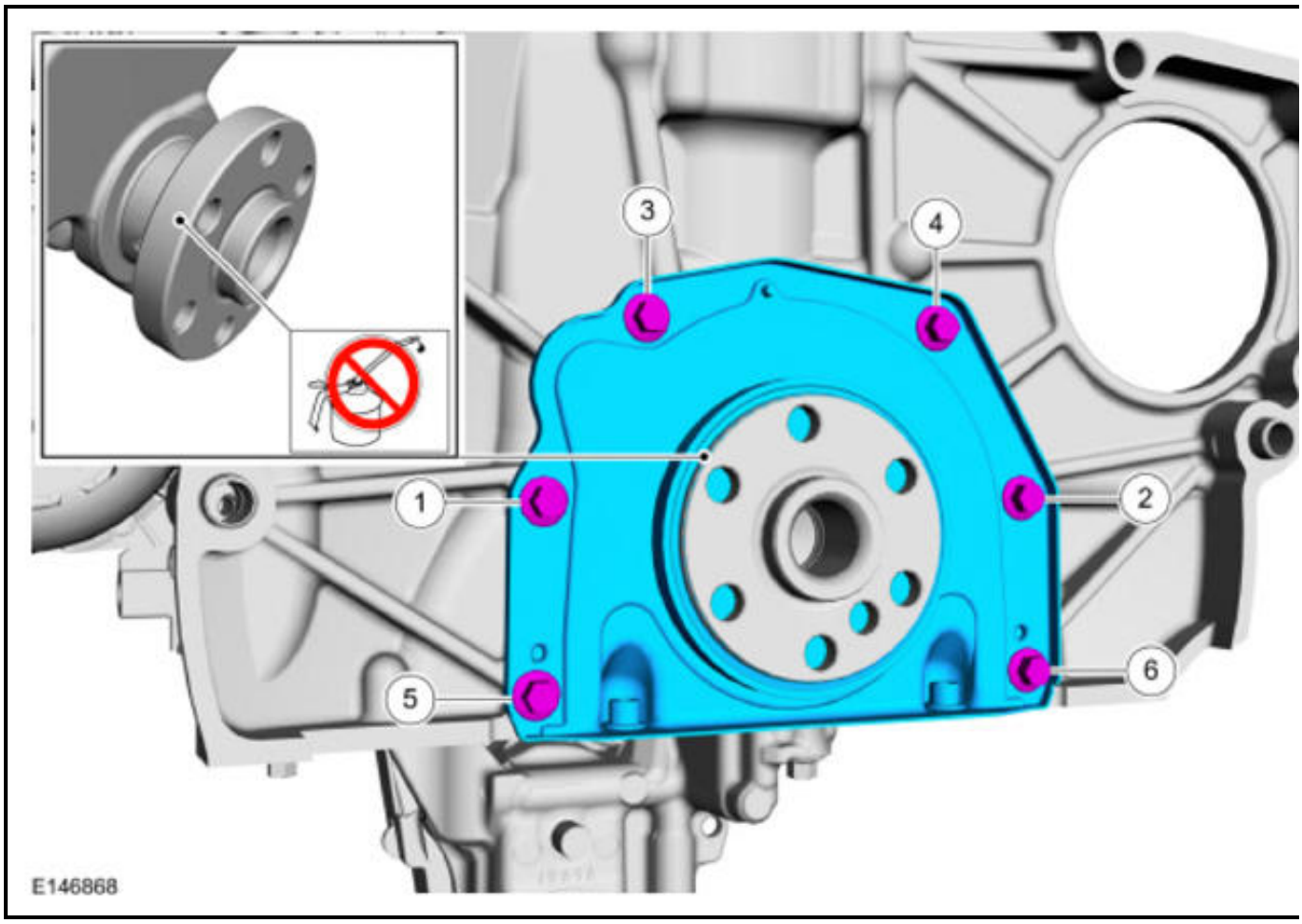


Installation

1. **NOTE:** **Make sure that the mating faces are clean and free of foreign material.**

   NOTE: **New crankshaft rear seal carriers are supplied with an alignment sleeve which must be removed after installation.**

Torque : 89 lb.in (10 Nm)



2. Refer to: **FLYWHEEL** .
3. Refer to: **OIL PAN** .

CYLINDER HEAD

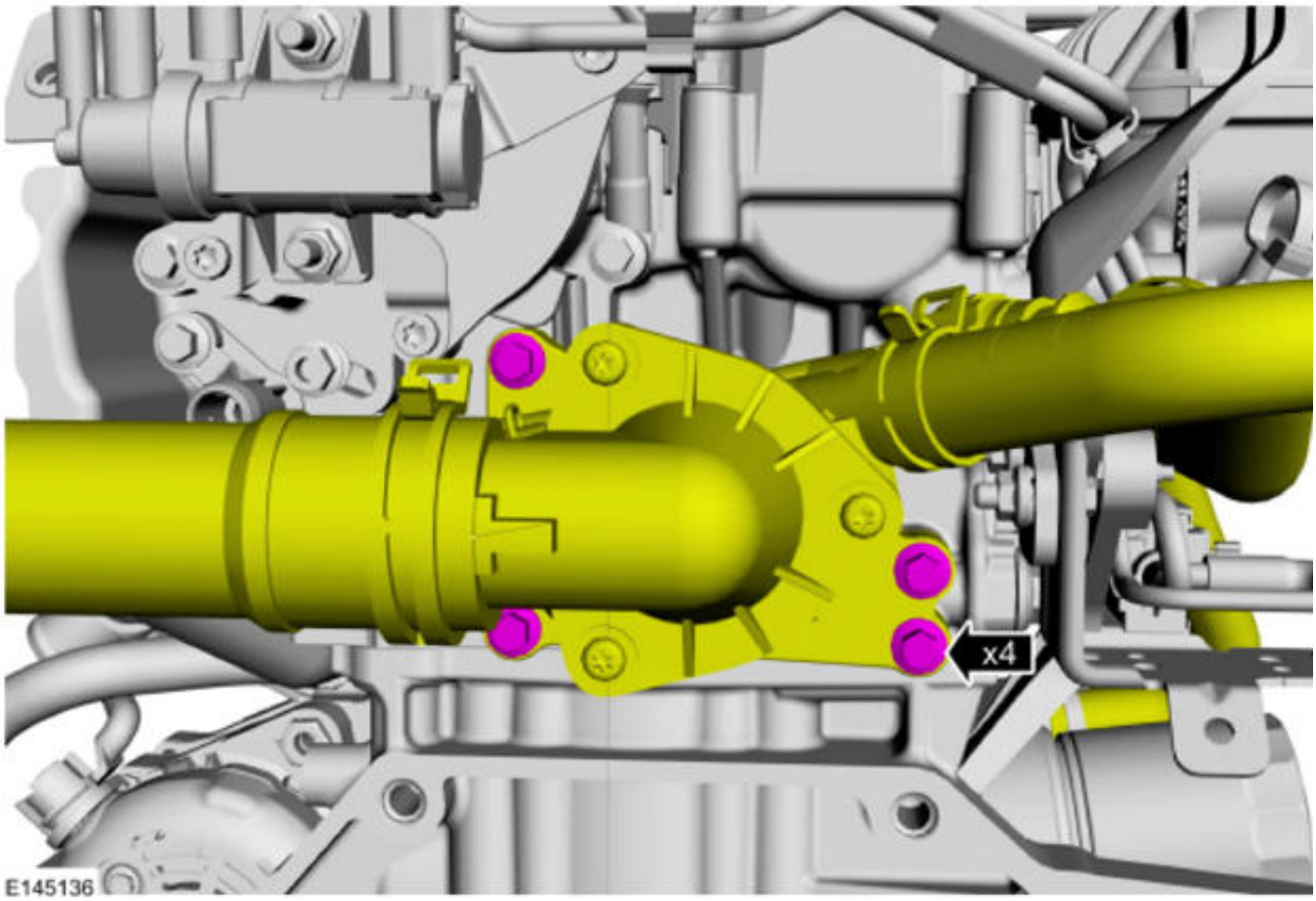
MATERIAL SPECIFICATIONS

Name	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.) XO-5W20-QSP (U.S.)	WSS-M2C945-A

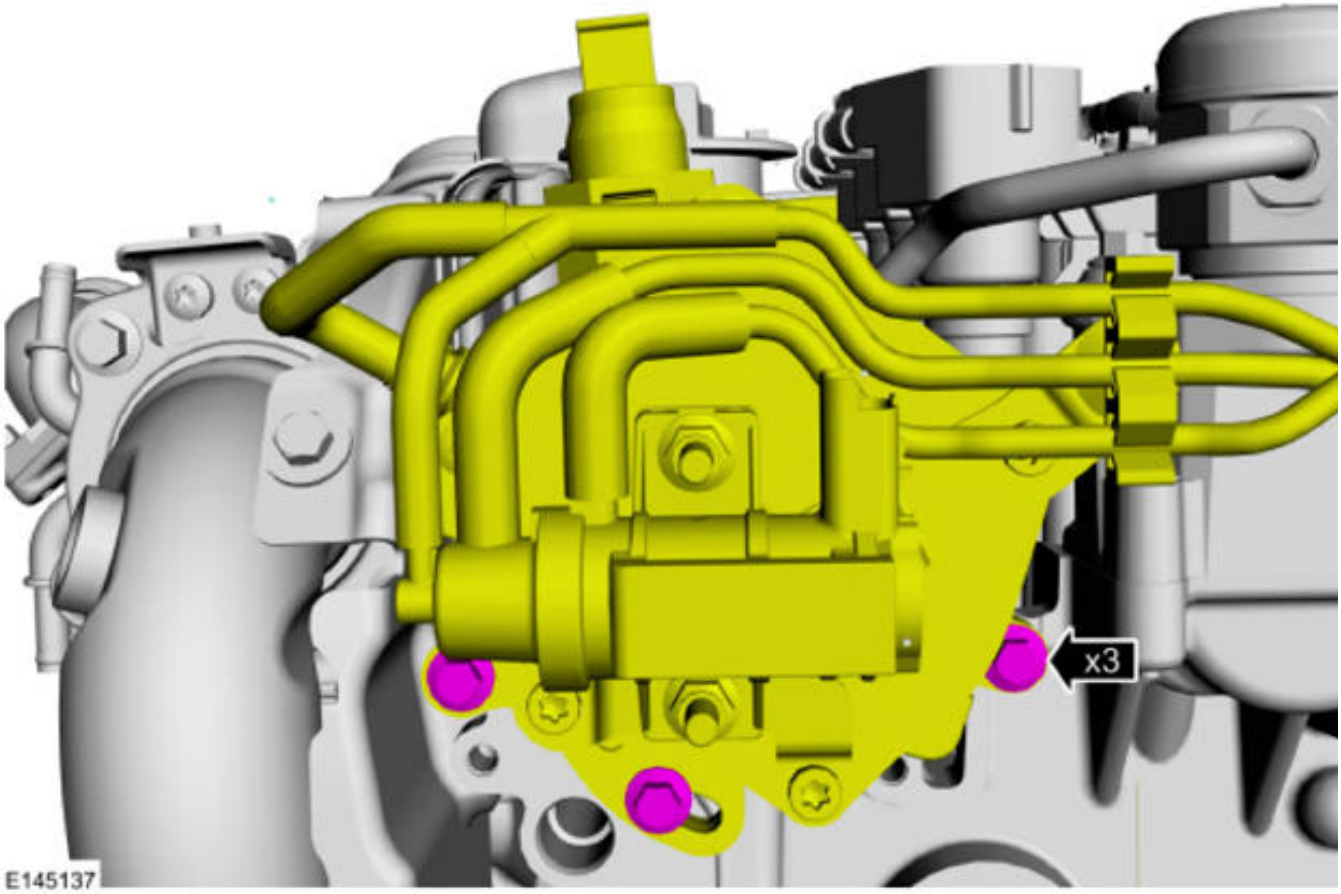
Removal

1. Remove the following items:
   - Refer to: **TURBOCHARGER** - 1.0L EcoBoost (90kW/120PS) .
   - Refer to: **CAMSHAFTS** .
2.

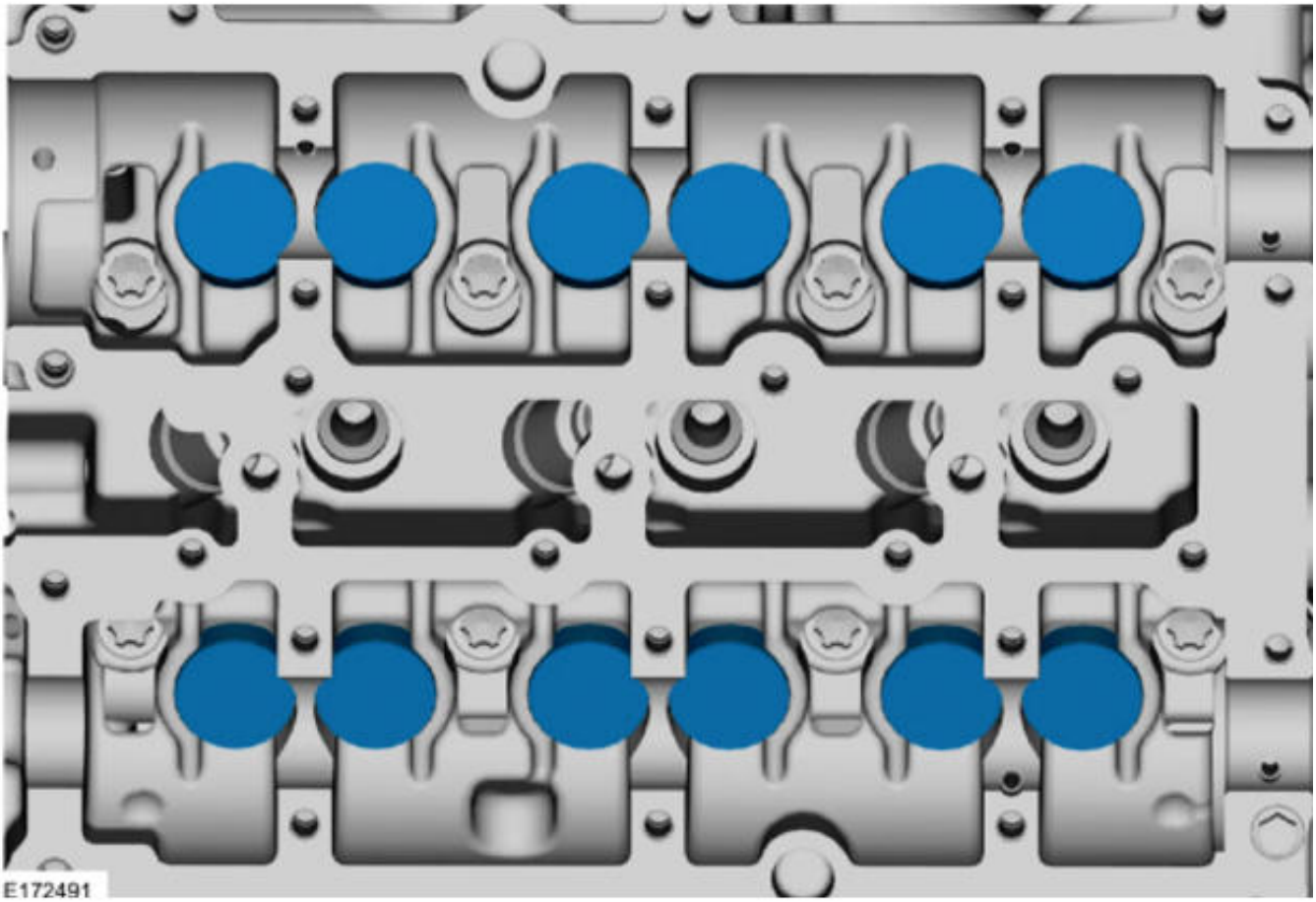
2.



3.

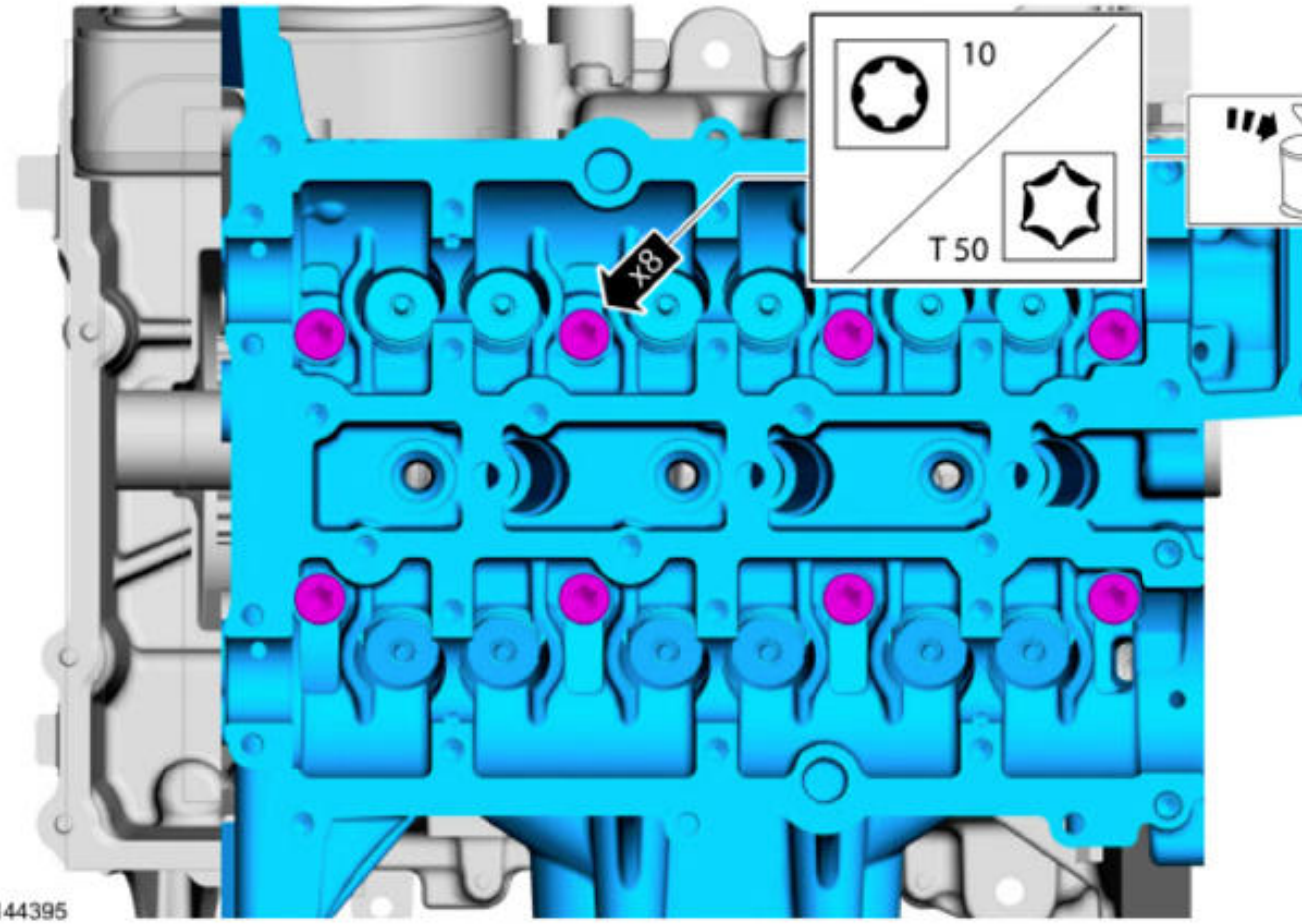
3. 

4. **NOTE: Note the position of the components before removal.**

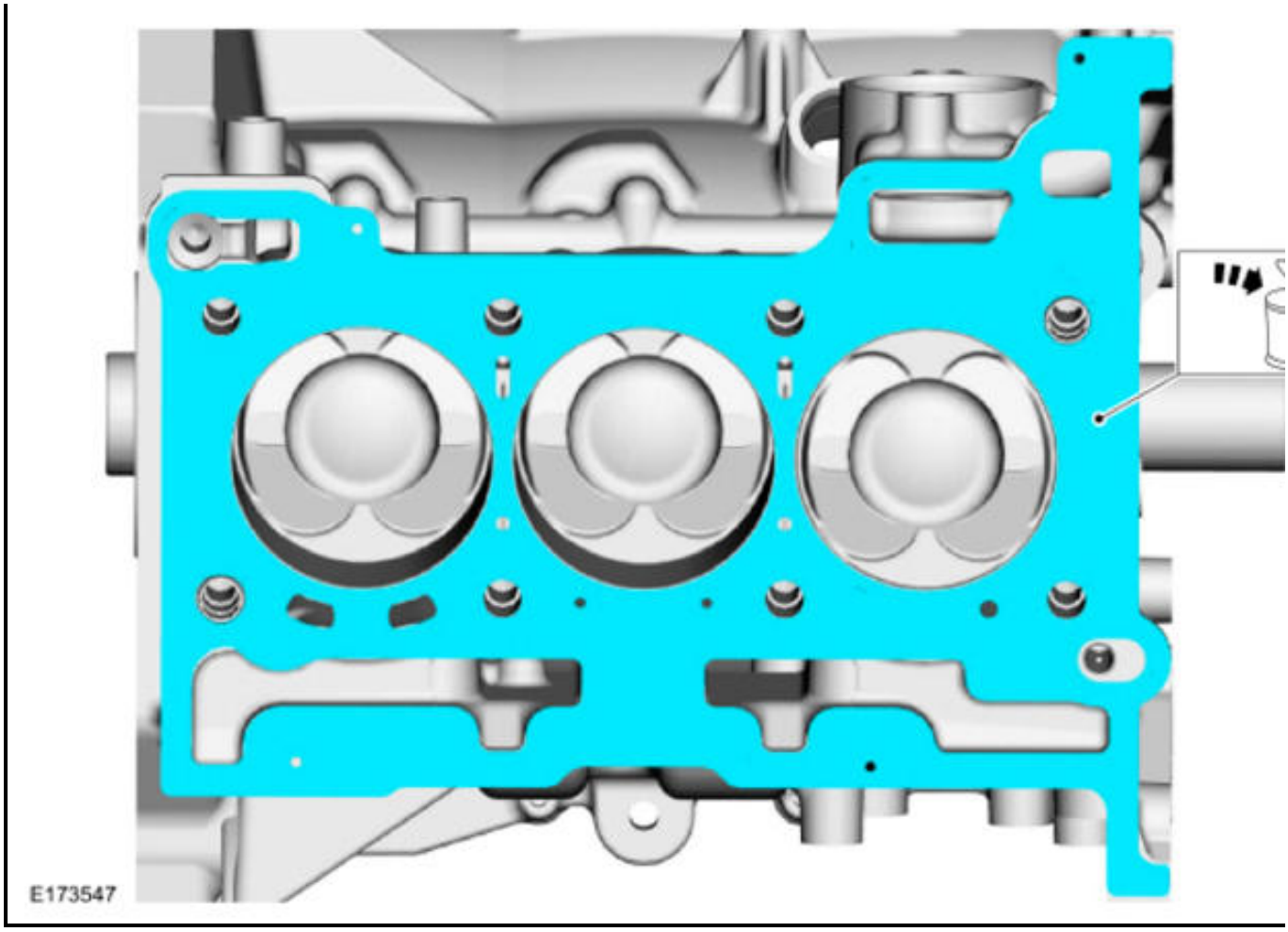


5.

5.

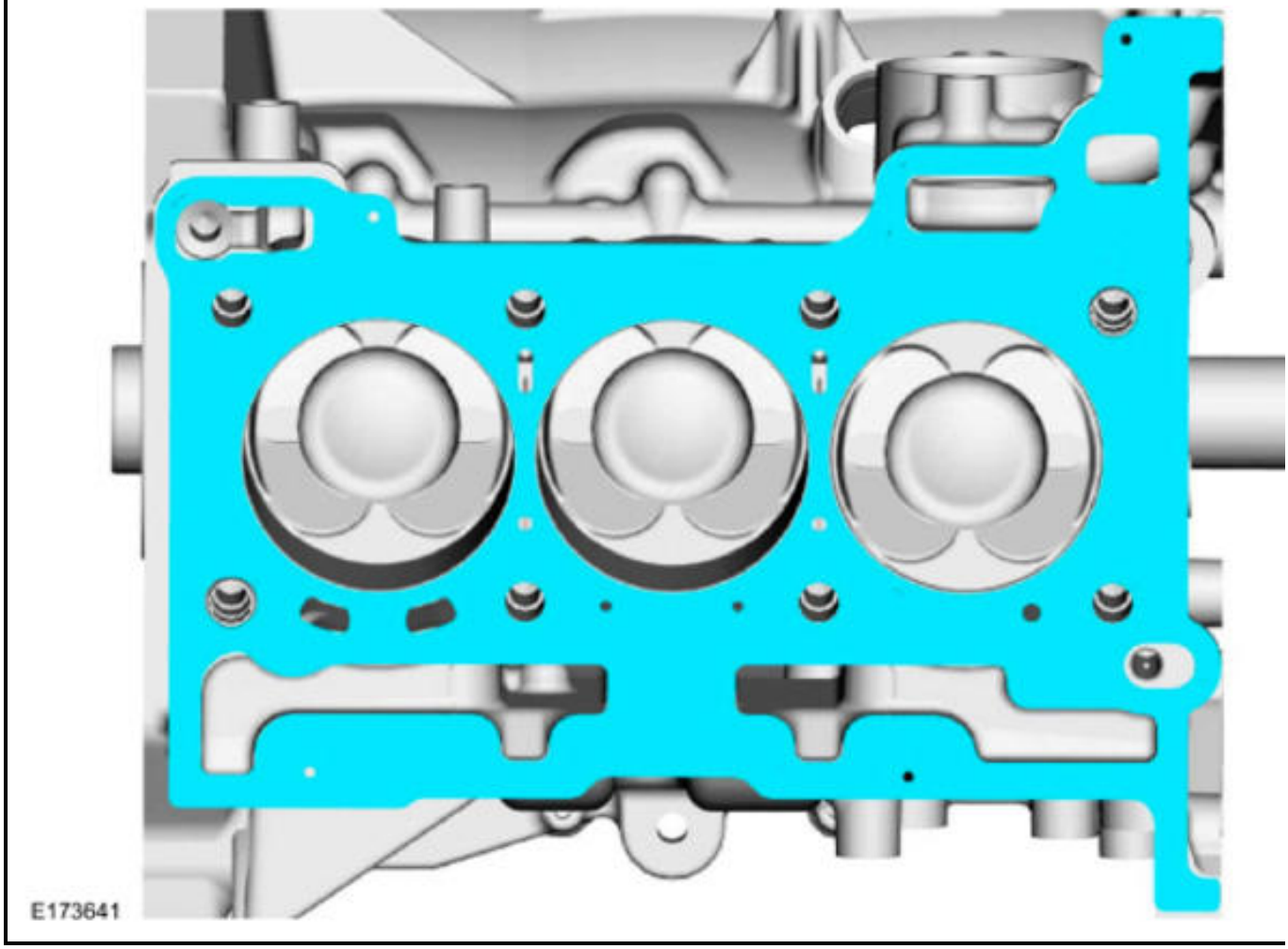


6.

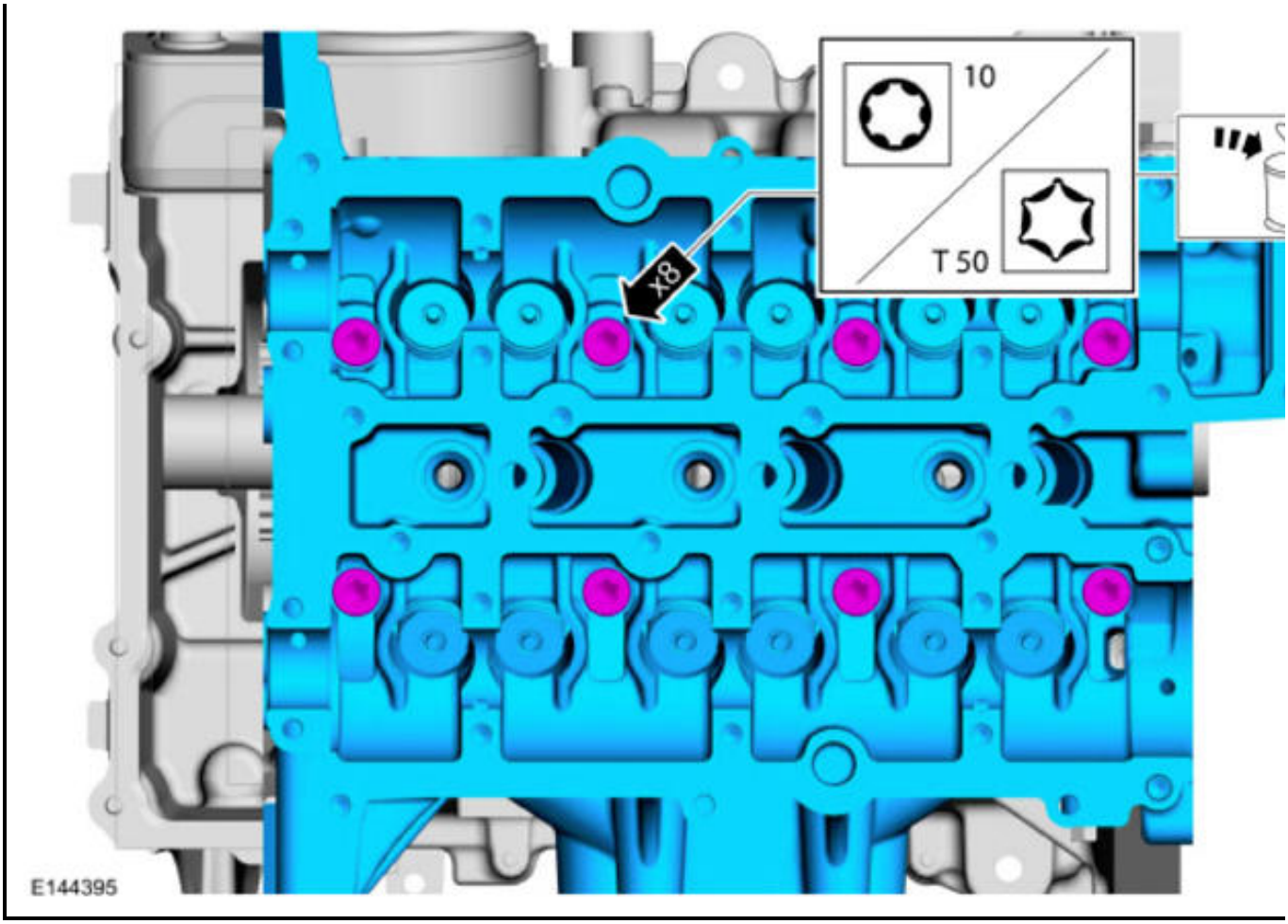
6. 

Installation

1.

1. 

2.

2. 

3. **NOTE: Make sure that new bolts are installed.**

NOTE: Only tighten the bolts finger tight at this stage.

Torque :

Stage 1: 89 lb.in (10 Nm)

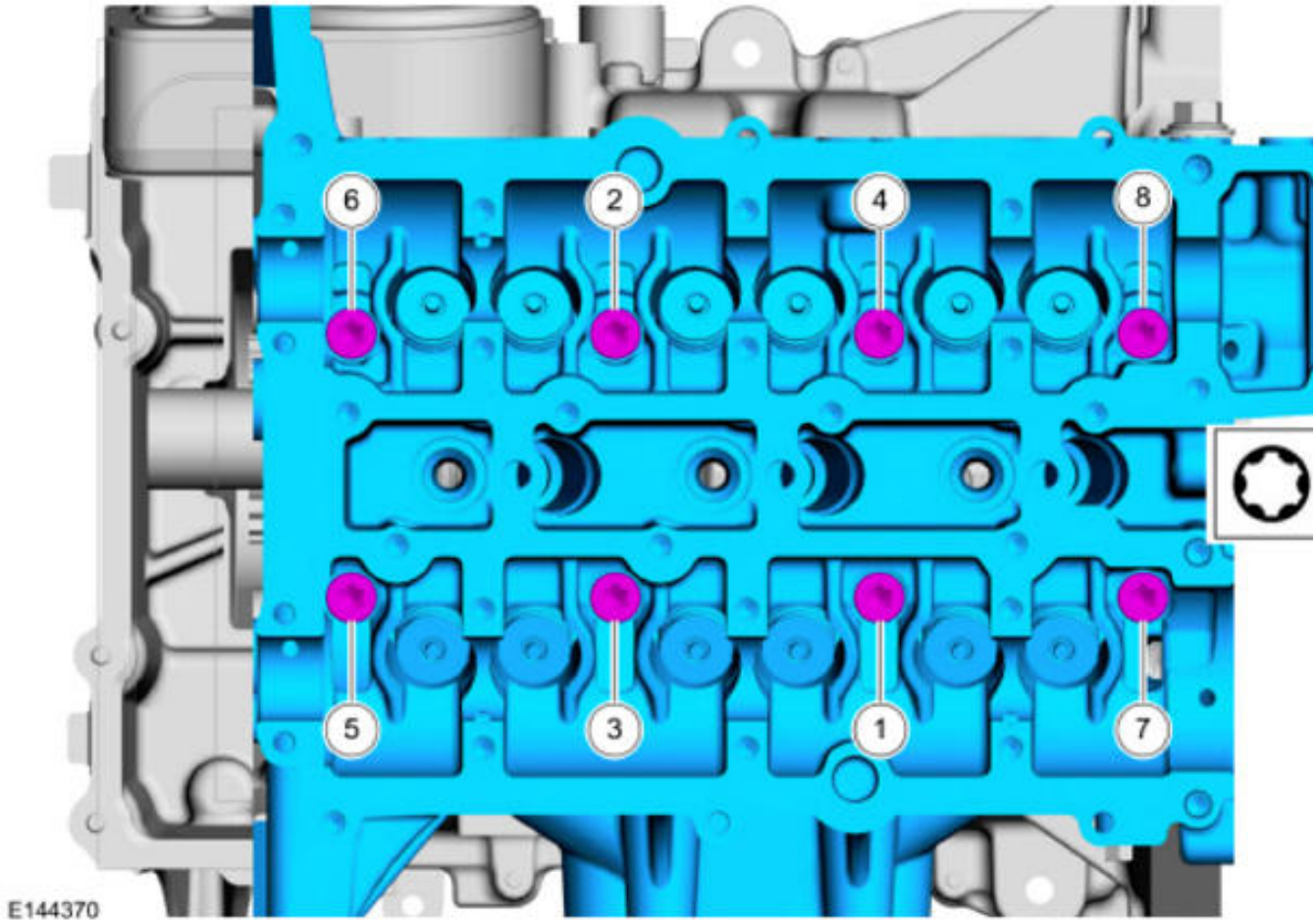
Stage 2: 30 lb.ft (40 Nm)

Stage 3: Loosen: 45°

Stage 4: 22 lb.ft (30 Nm)

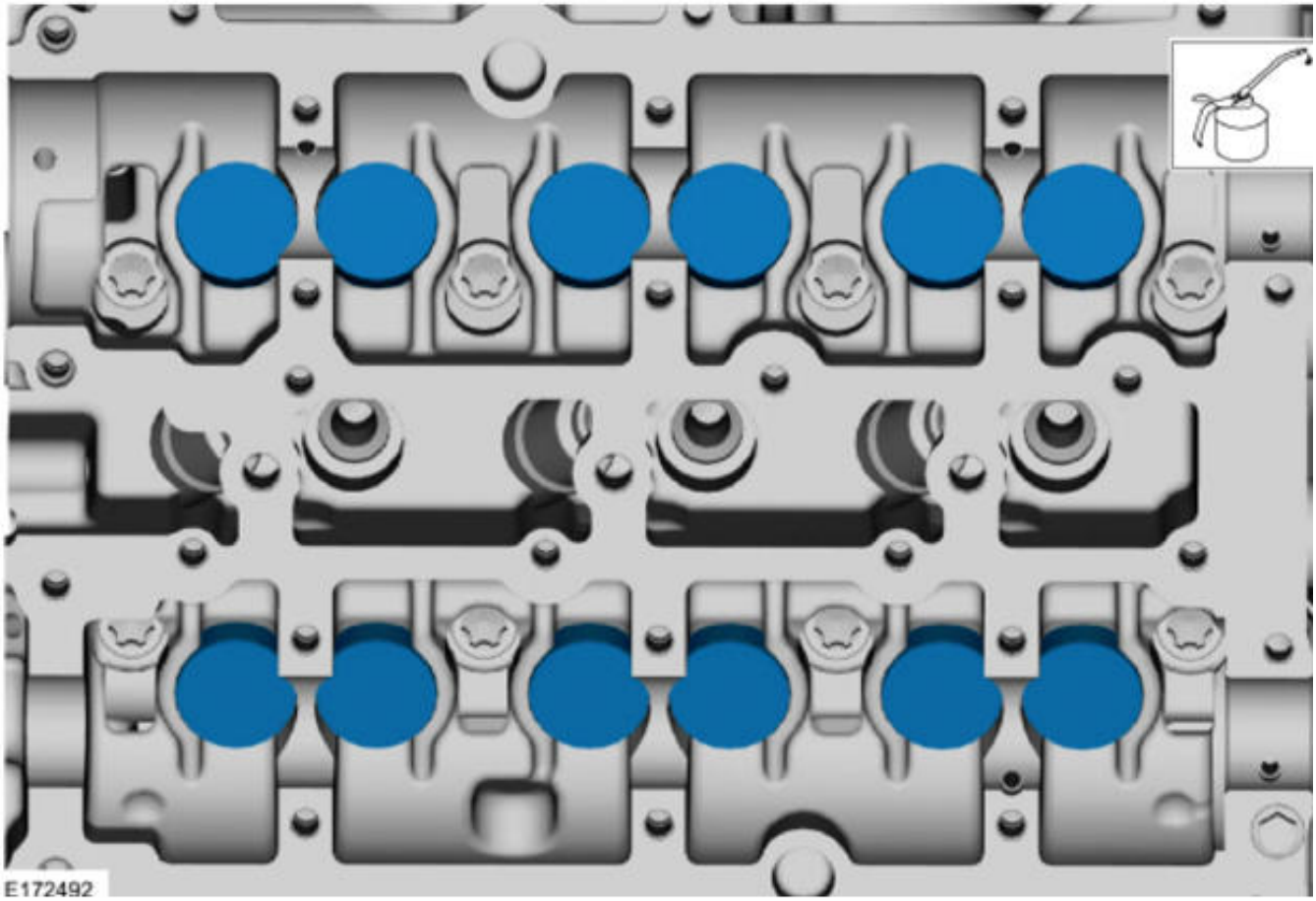
Stage 5: 90°

Stage 6: 90°

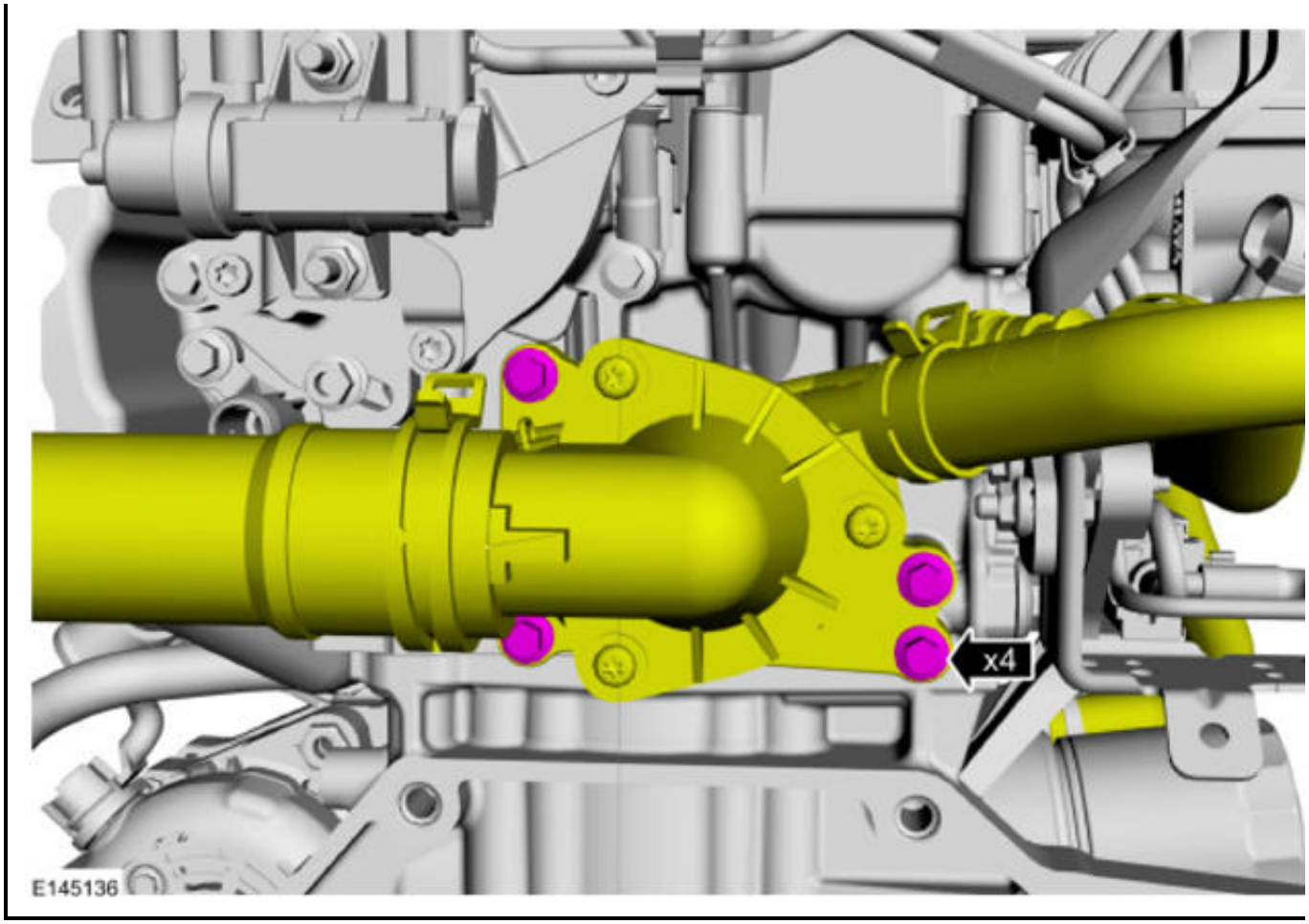


4. **NOTE: Install the components in their original position.**

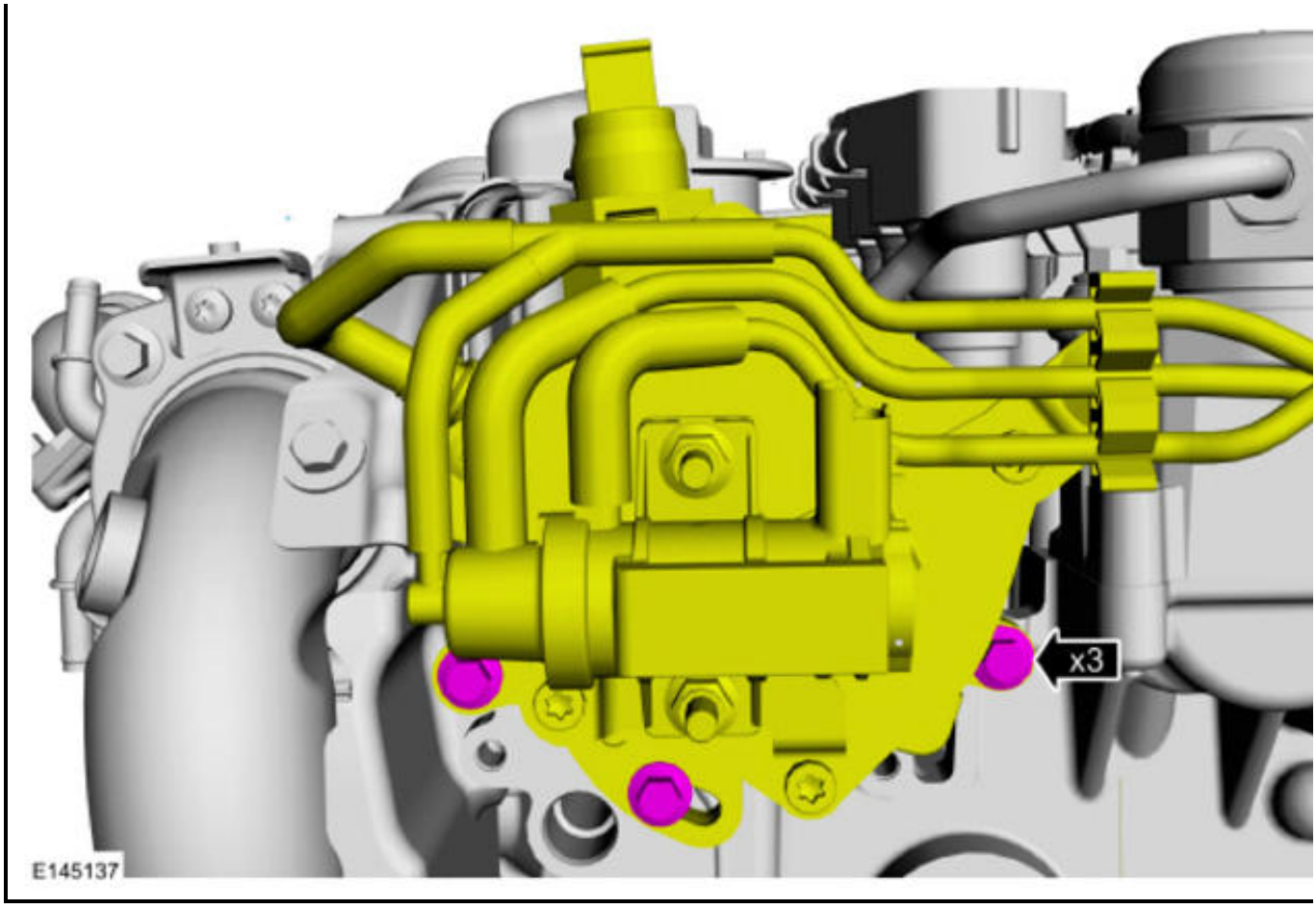
Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)



5. *Torque* : 89 lb.in (10 Nm)



6. *Torque* : 89 lb.in (10 Nm)

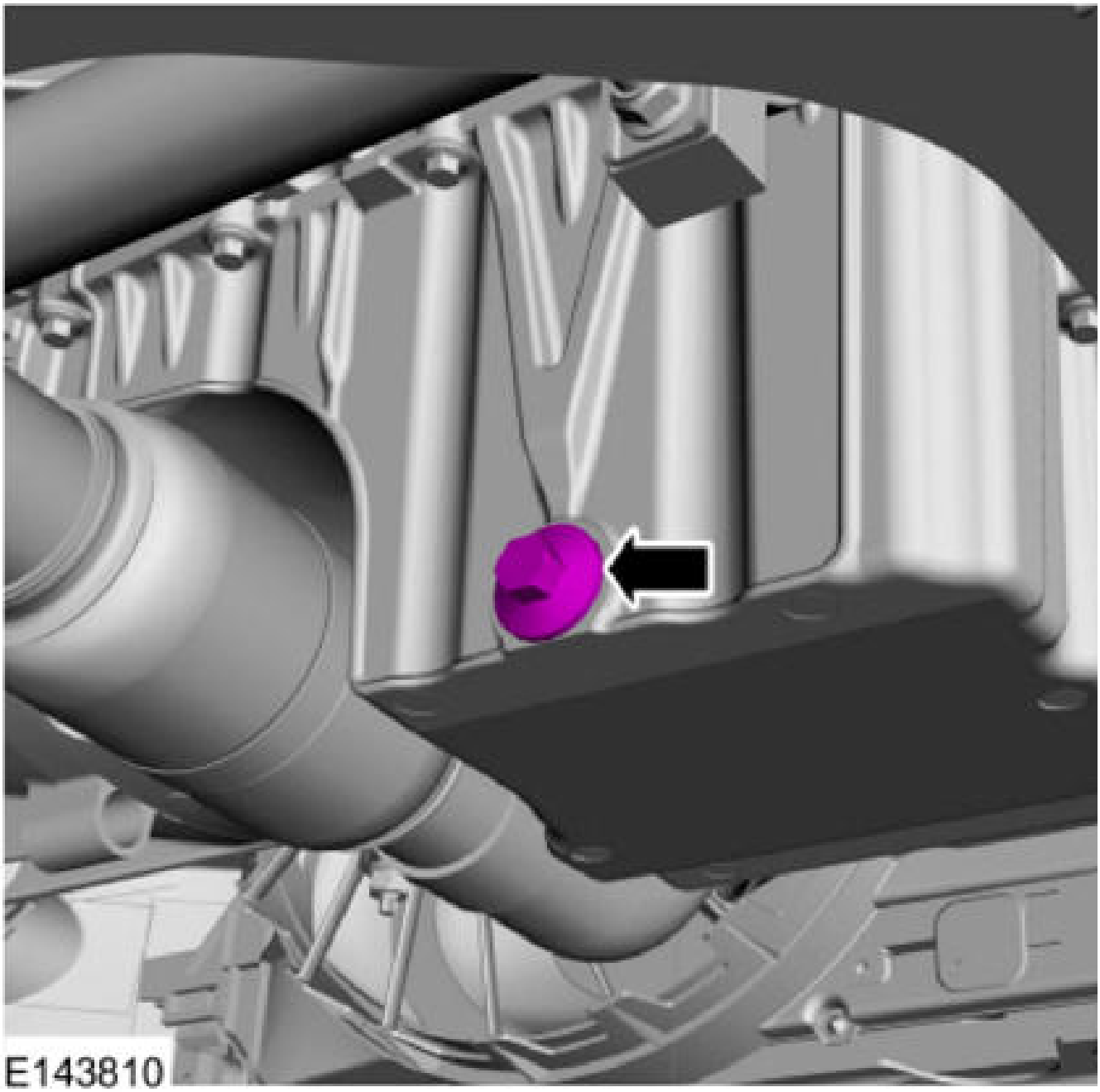


7. Install the following items:
   - Refer to: **CAMSHAFTS** .
   - Refer to: **TURBOCHARGER** .

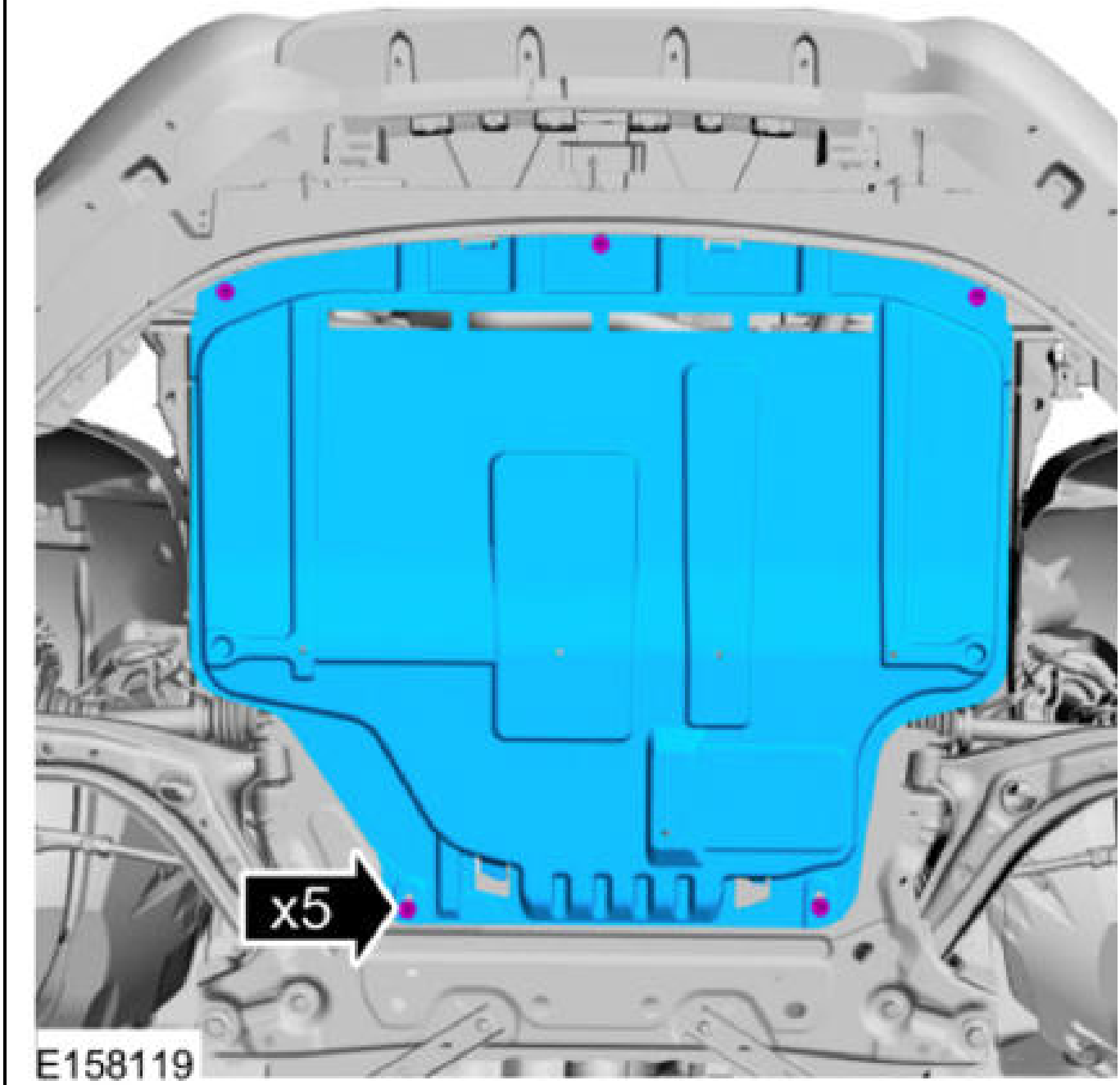
   WARNING: Be prepared to collect escaping fluid.

8.

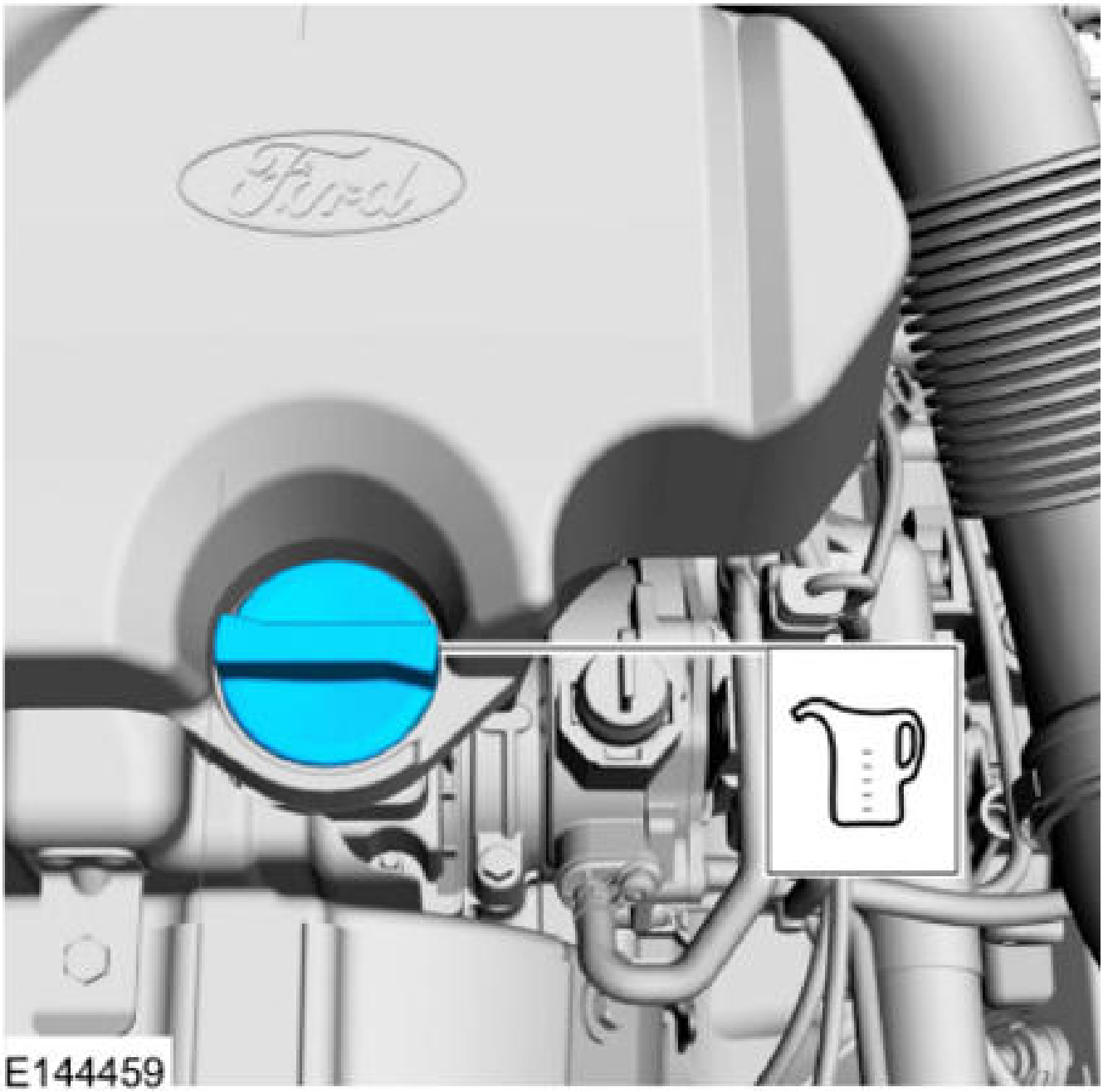
Torque : 18 lb.ft (25 Nm)



9. If equipped.



10. Refer to: **SPECIFICATIONS** .



ENGINE FRONT COVER

SPECIAL TOOL DESCRIPTION

Trolley Jack
Wooden Block

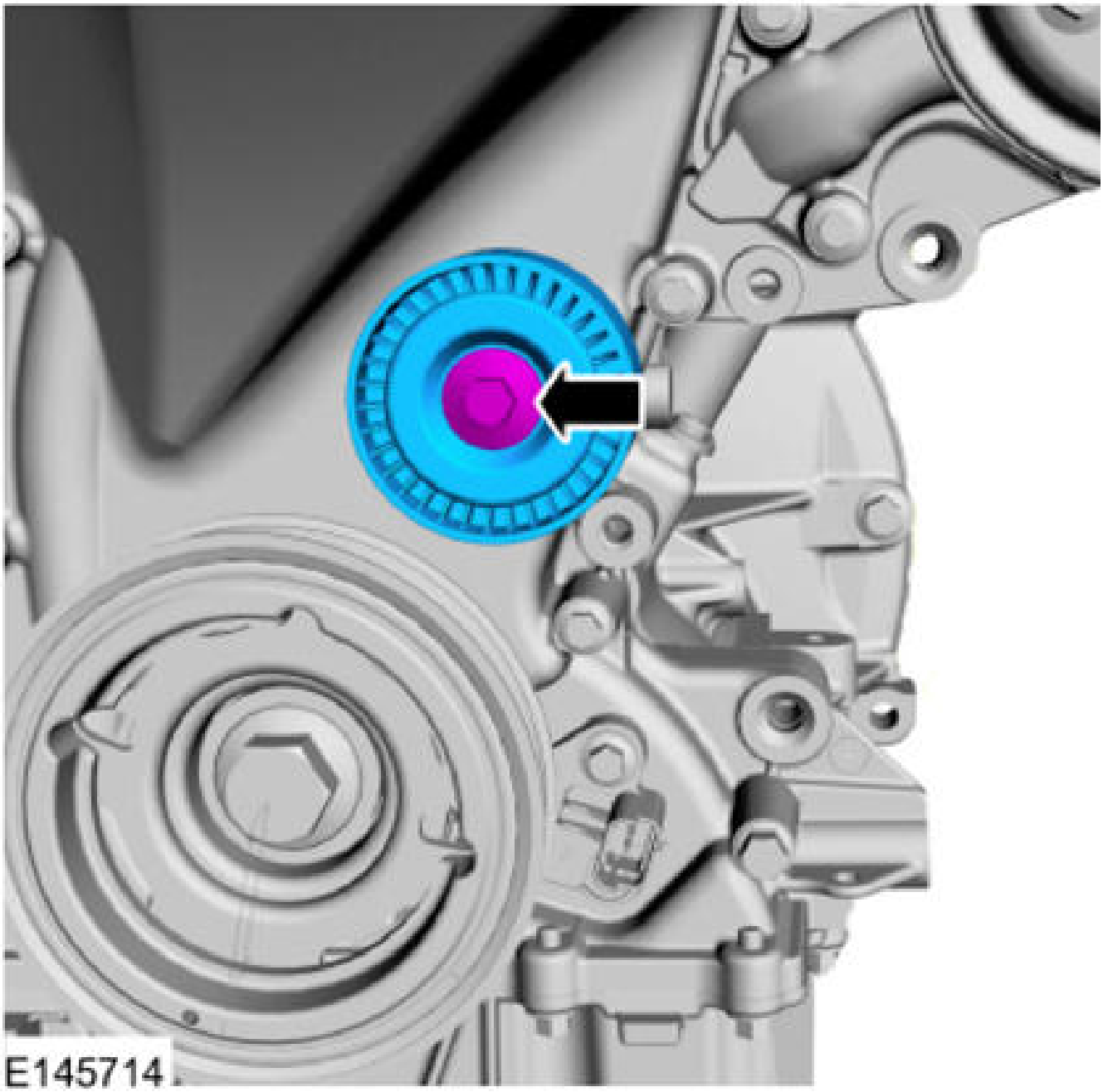
MATERIAL SPECIFICATIONS

Name	Specification
Motorcraft® Metal Surface Prep ZC-31-B	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

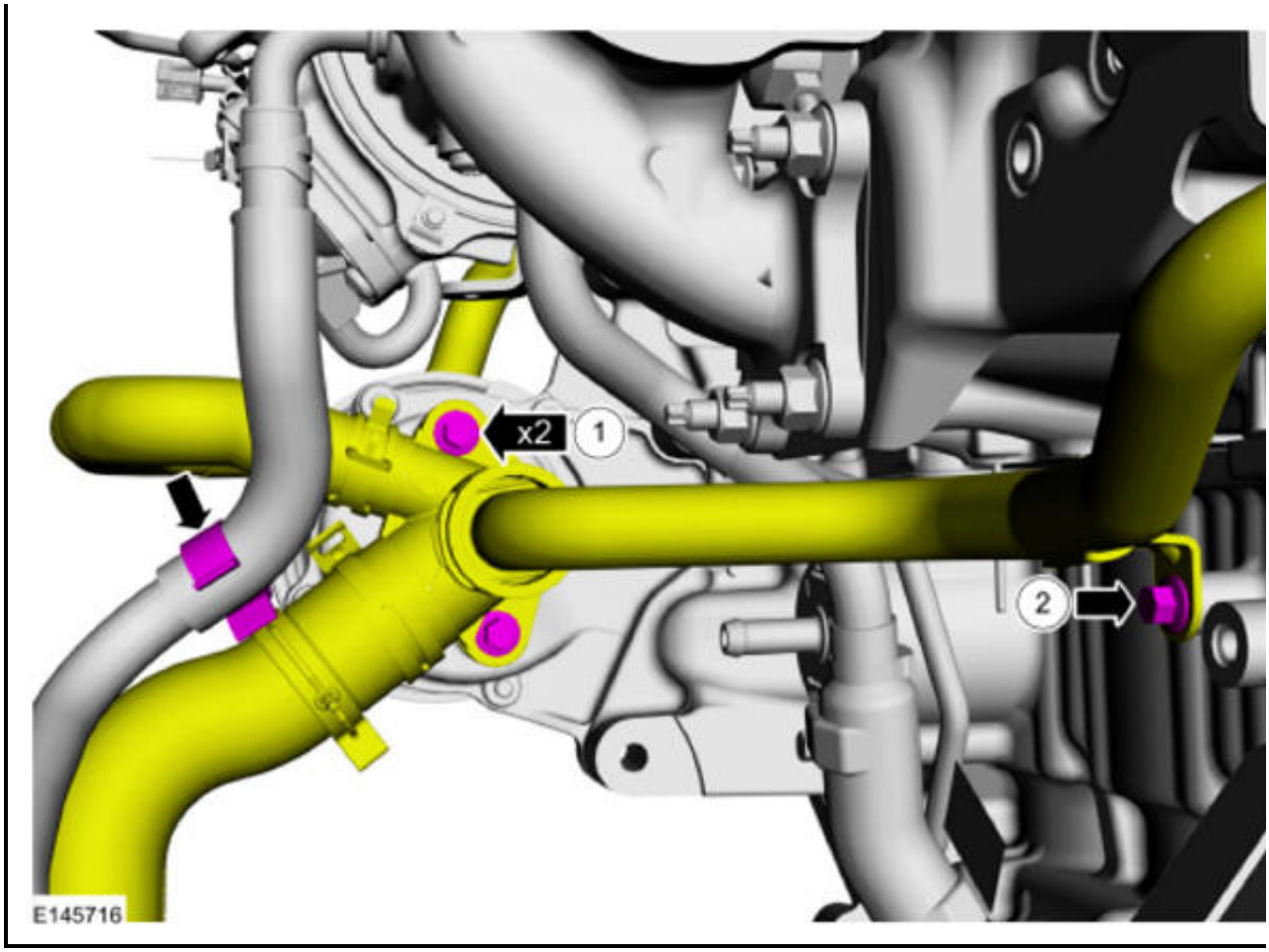
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Remove the following items:
   - Refer to: **CRANKSHAFT FRONT SEAL** .
   - Refer to: **VALVE COVER** .
   - Refer to: **INTAKE MANIFOLD** .
   - Refer to: **CATALYTIC CONVERTER** .
   - Refer to: **ACCESSORY DRIVE BELT TENSIONER** .
   - Refer to: **GENERATOR - 1.0L ECOBOOST (90KW/120PS)** .
2. *Torque* : 18 lb.ft (25 Nm)



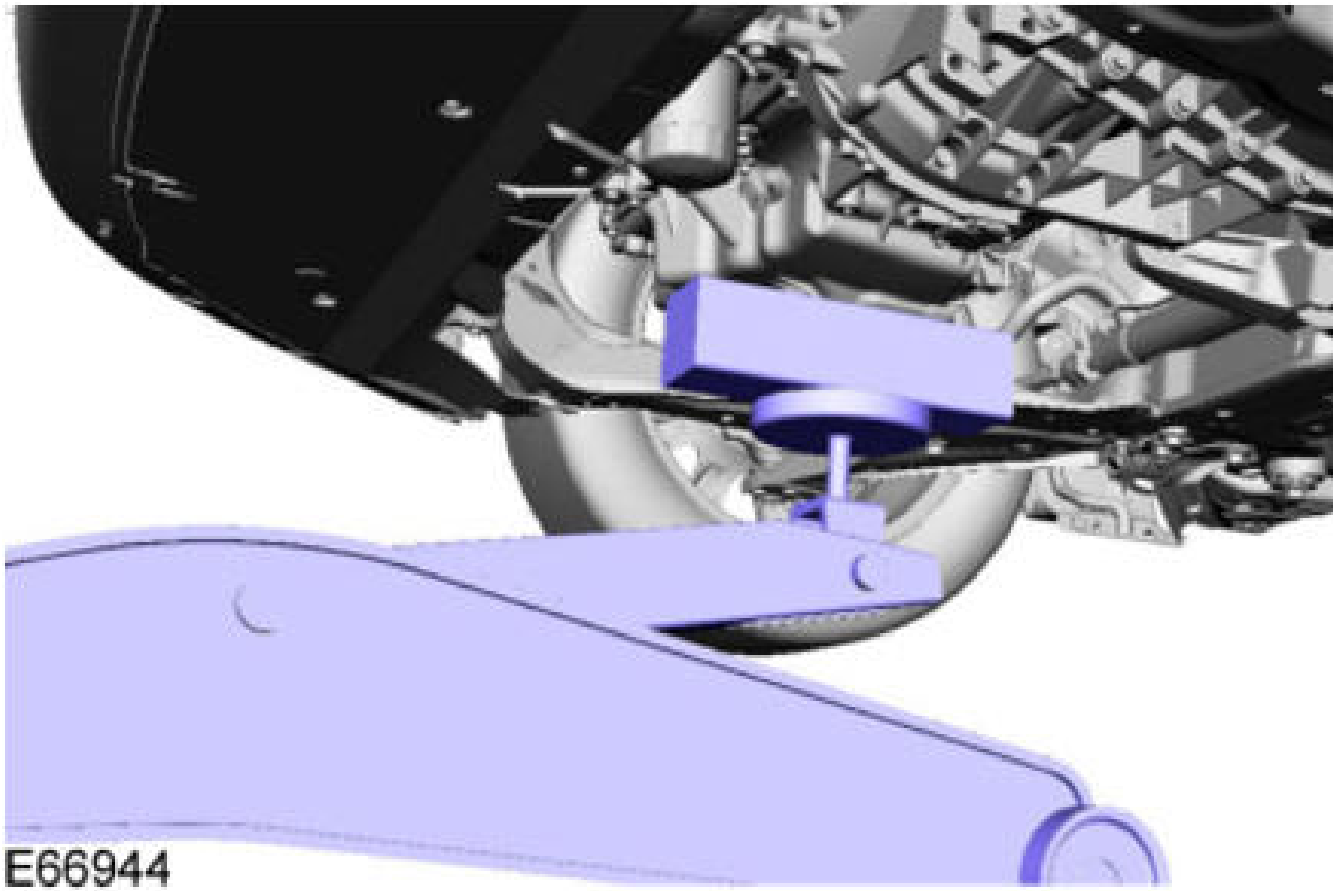
3. *Torque* :
    1. 89 lb.in (10 Nm)
    2. 89 lb.in (10 Nm)



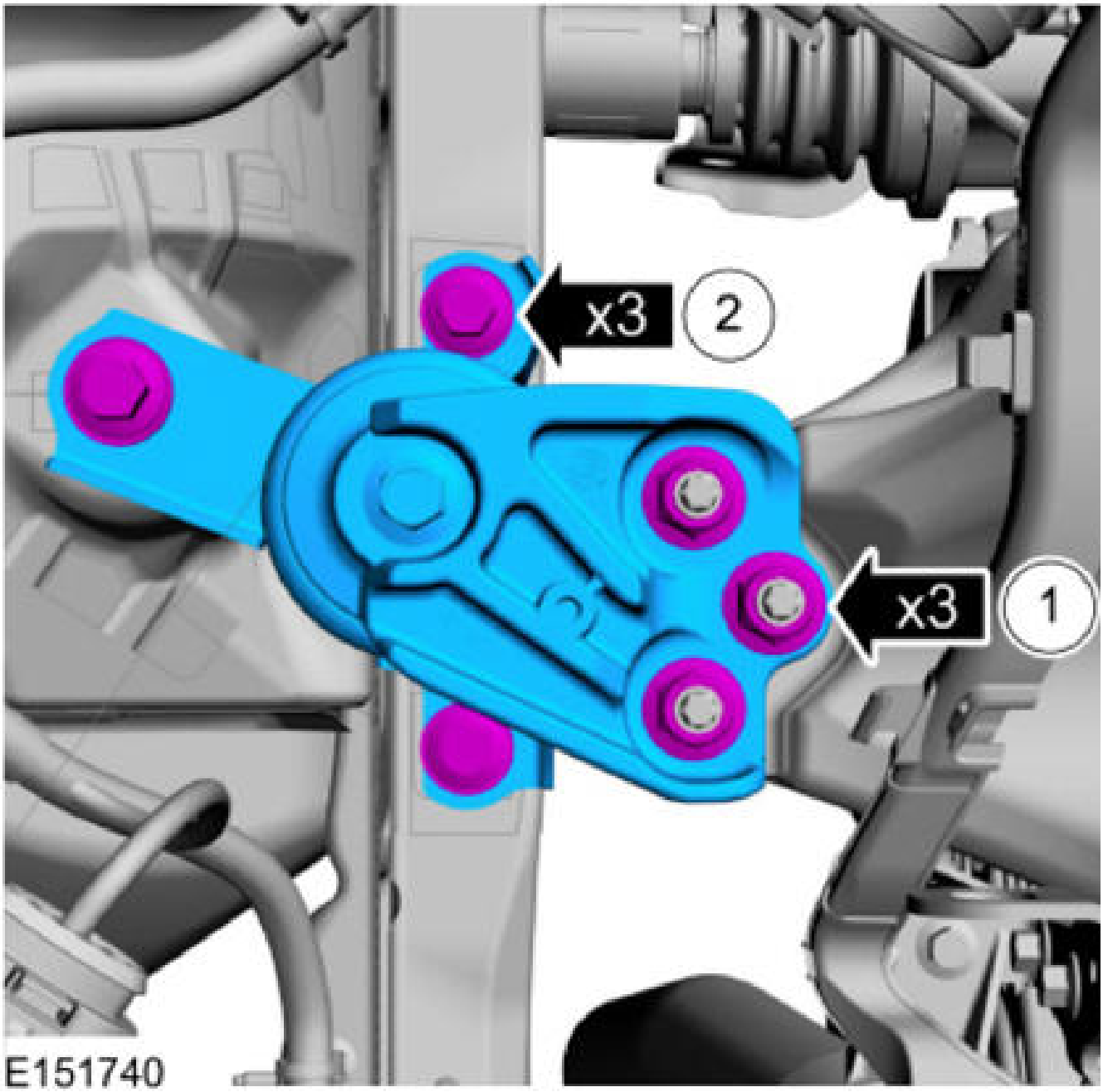
4. **NOTE: Use a wooden block to protect the oil pan when supporting the engine.**

Use the General Equipment: Trolley Jack

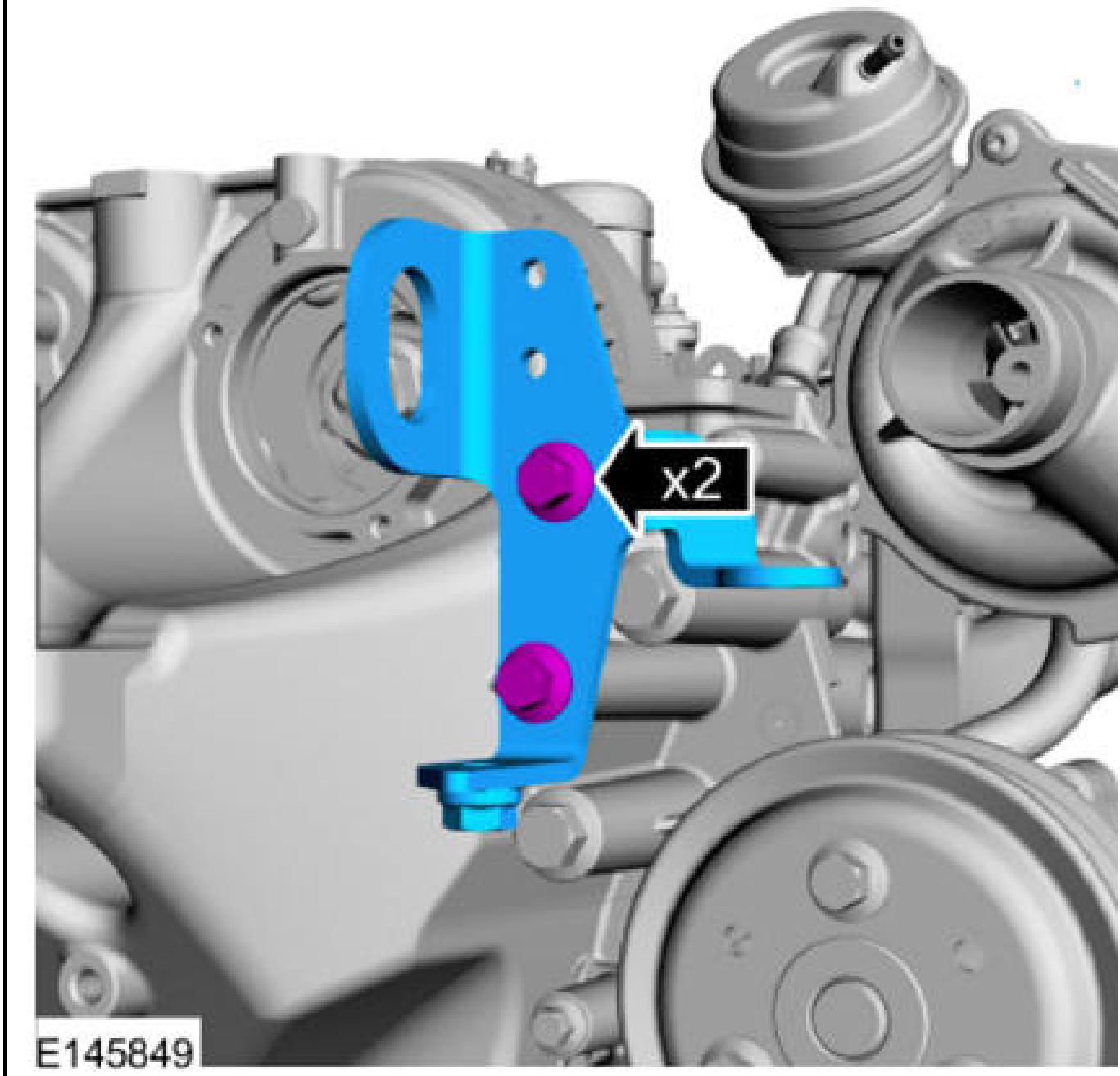
Use the General Equipment: Wooden Block



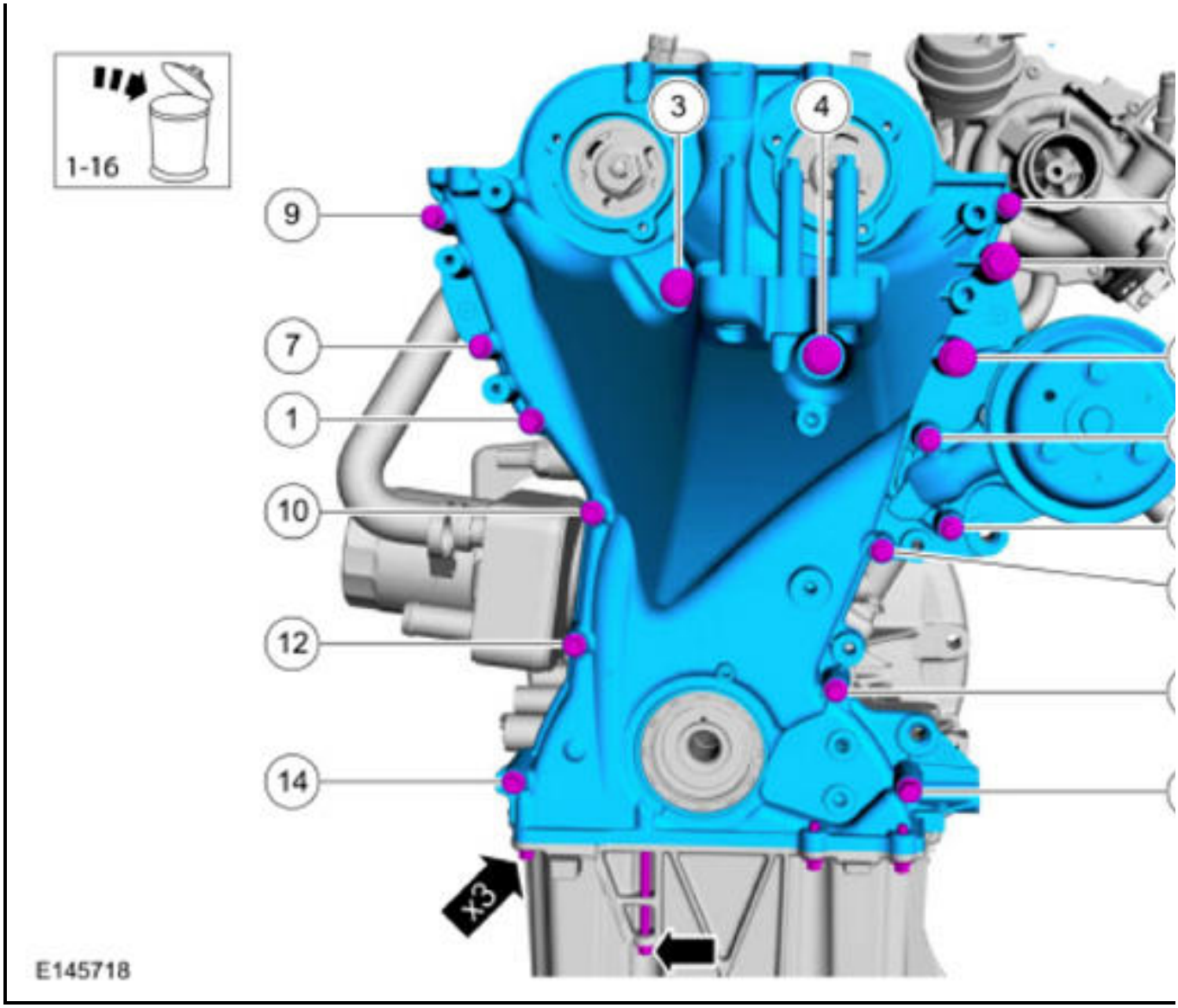
5.

5. 

6. *Torque* : 16 lb.ft (22 Nm)



7. **NOTE:** **Note the different lengths of the bolts.**

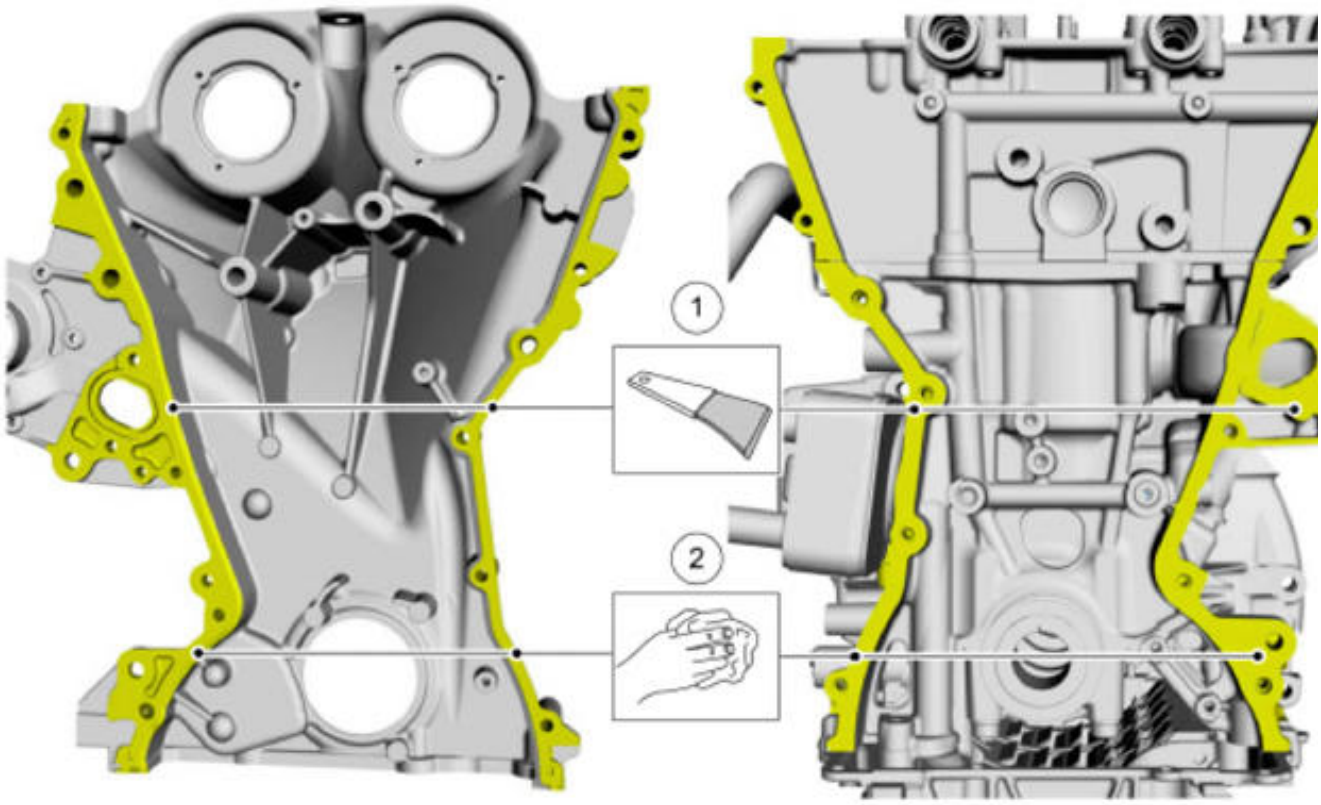


Installation

1. To install, reverse the removal procedure.

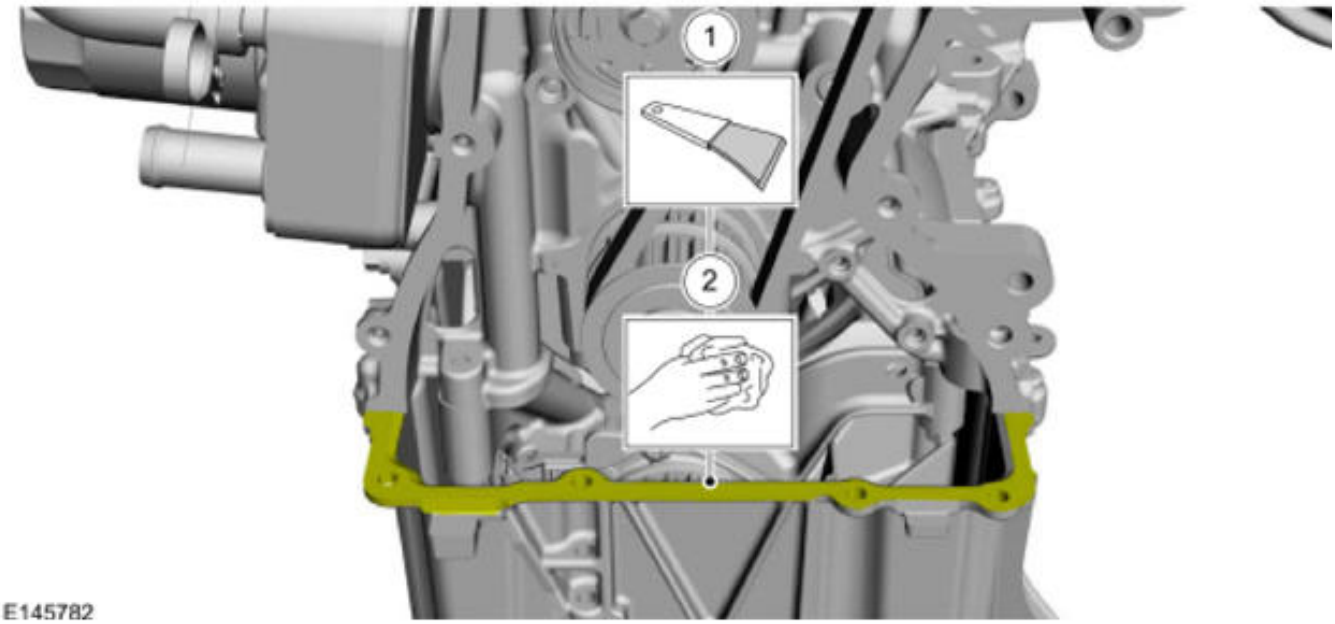
NOTE: **Make sure that the surface is clean and free of foreign material before taping around the component.**

2. *Material* : Motorcraft® Metal Surface Prep/ZC-31-B



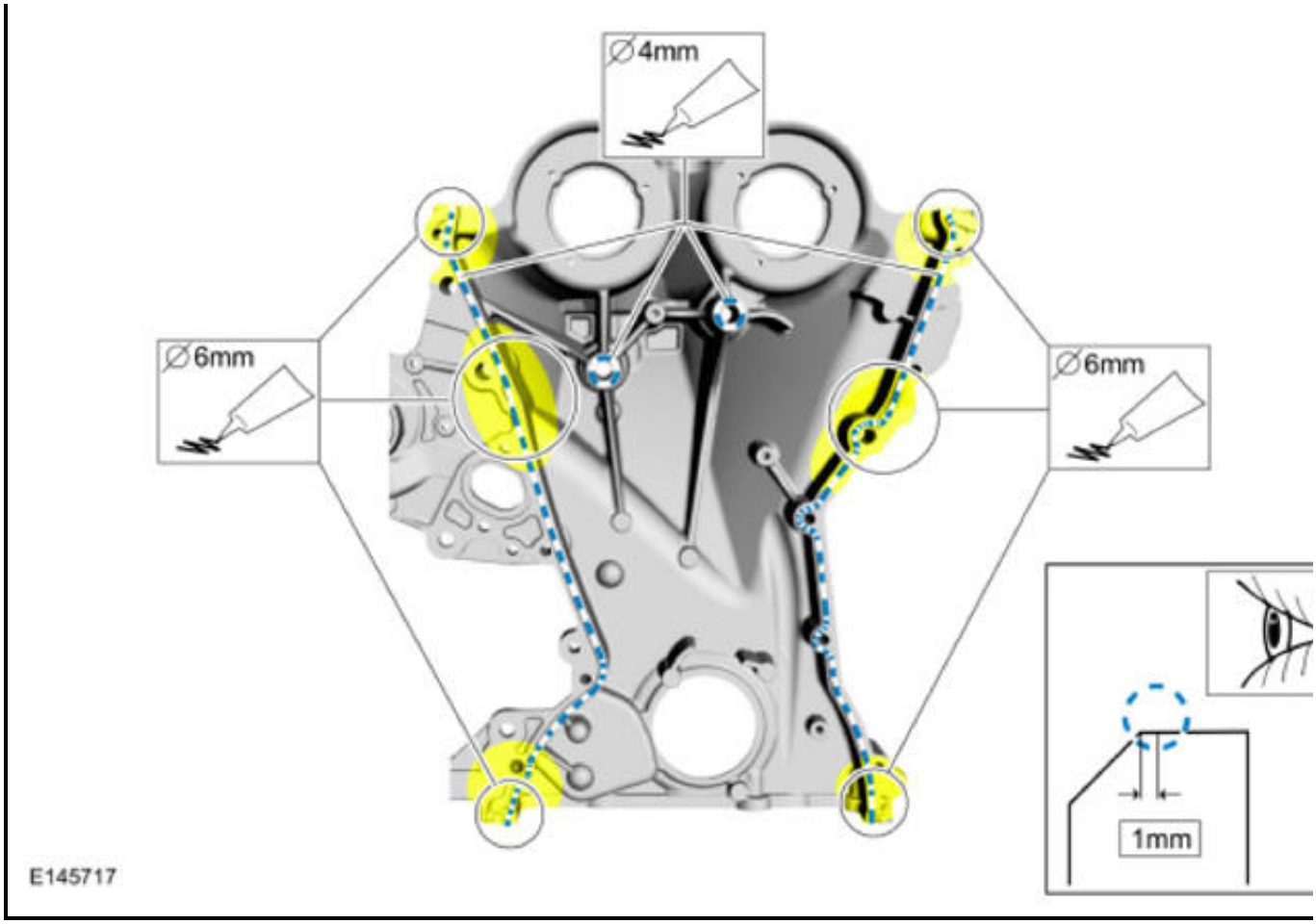
3. **NOTE: Make sure that the surface is clean and free of foreign material before taping around the component.**

Material : Motorcraft® Metal Surface Prep/ZC-31-B



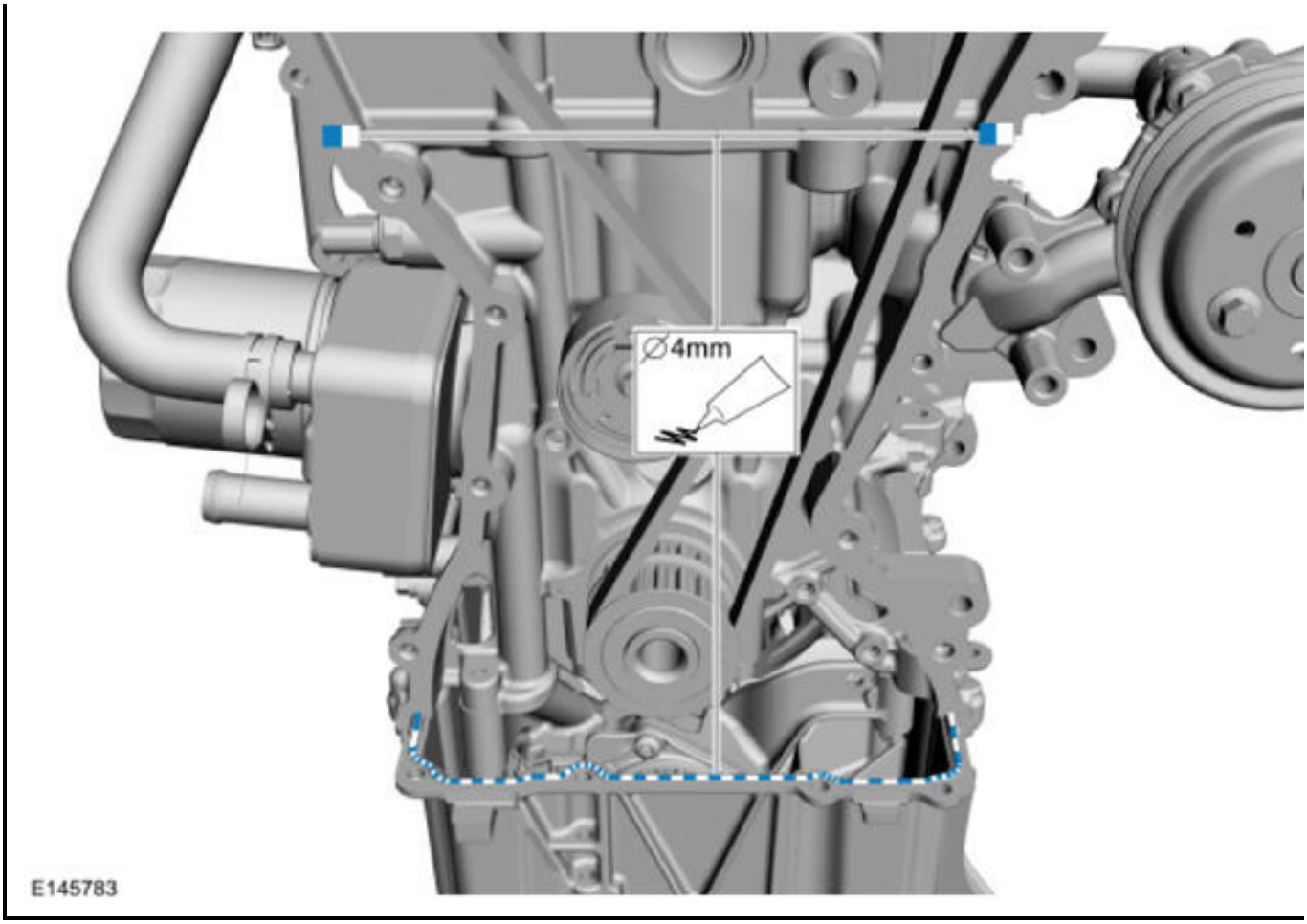
4. **NOTE: The component must be installed within 10 minutes of applying the sealant.**

Material : Silicone Gasket and Sealant/TA-30 (WSE-M4G323-A4)



5. **NOTE: The component must be installed within 10 minutes of applying the sealant.**

Material : Silicone Gasket and Sealant/TA-30 (WSE-M4G323-A4)



6.

- **NOTE: Make sure that new components are installed.**

Torque :

1-2, M6x60: 44 lb.in (5 Nm)

- **NOTE: Make sure that new components are installed.**

Torque :

3-6, M10x95: 89 lb.in (10 Nm)

- **NOTE: Make sure that new components are installed.**

Torque :

7-16 M6x60: 44 lb.in (5 Nm)

- *Torque* :

  17-19 M6x60: 44 lb.in (5 Nm)

  20 M6x75: 44 lb.in (5 Nm)

- *Torque* :

  3-6: 30 lb.ft (40 Nm)

- *Torque* :

  3-4:

  Stage 1: 52 lb.ft (70 Nm)

  Stage 2: 90°

- *Torque* :

  5-6:

  Stage 1: 52 lb.ft (70 Nm)

  Stage 2: 90°

- 1-2

  Torque :

  Stage 1: 80 lb.in (9 Nm)

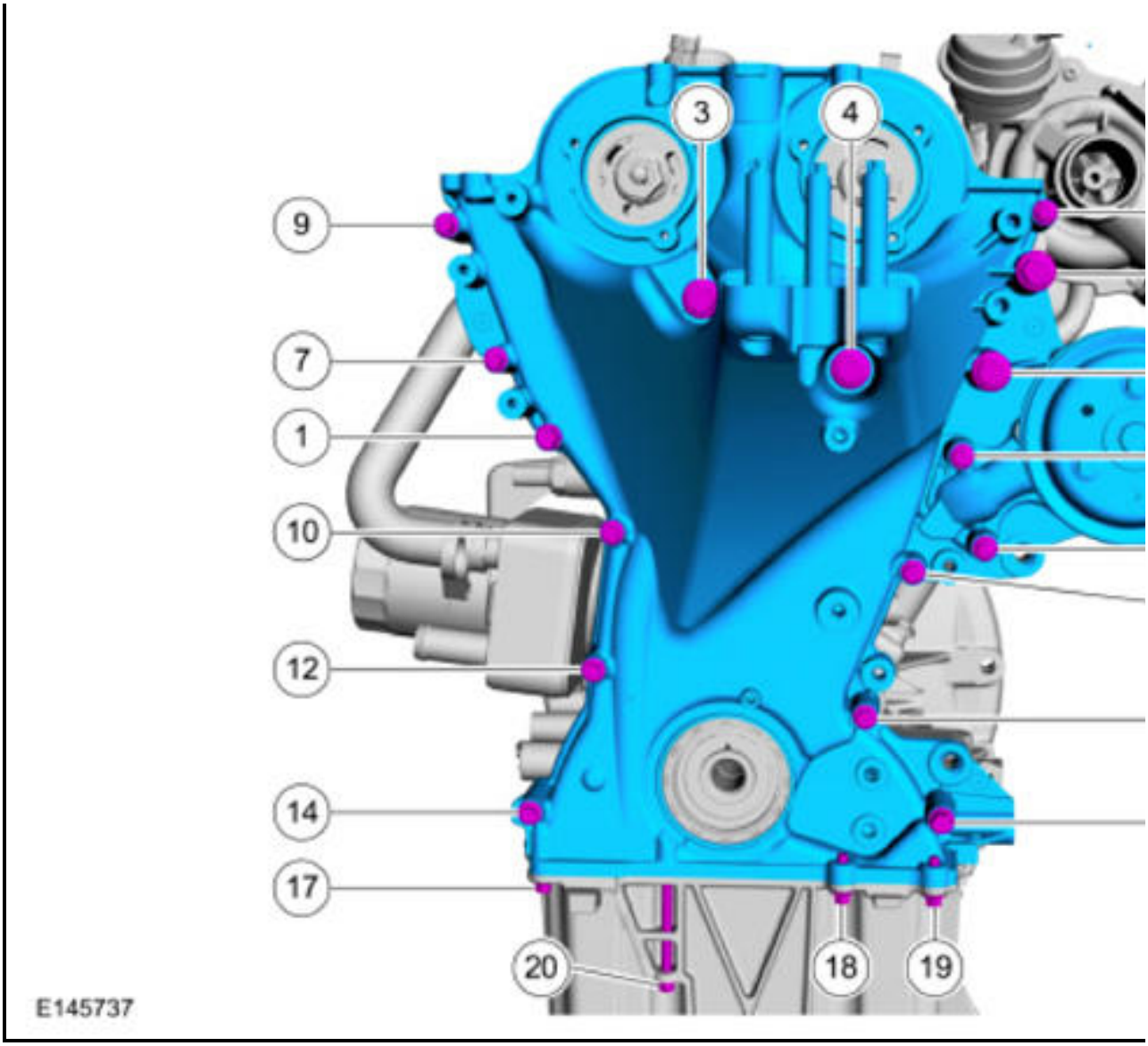
  Stage 2: 90°

- 7-20

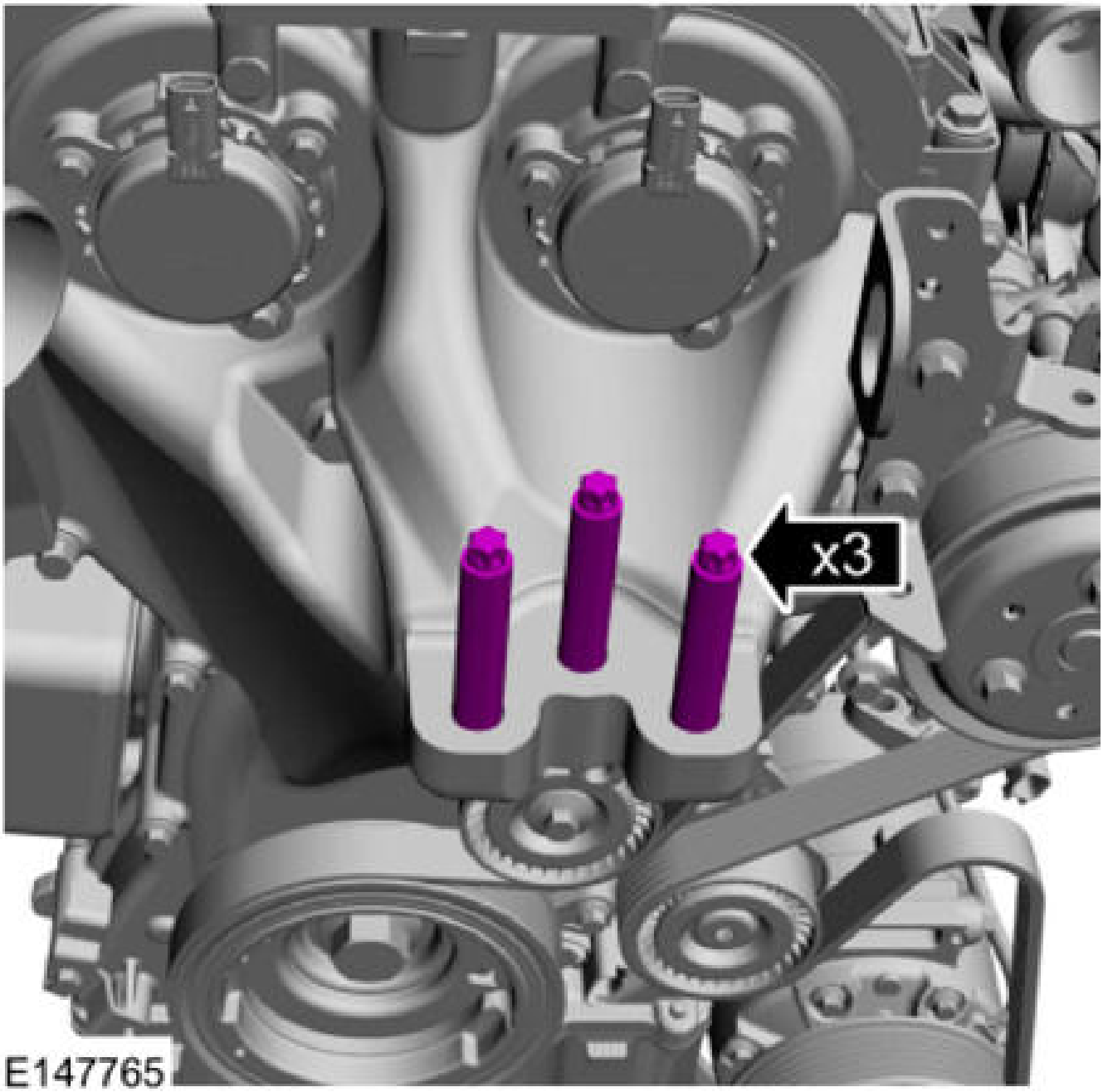
  Torque :

  Stage 1: 133 lb.in (15 Nm)

  Stage 2: 90°



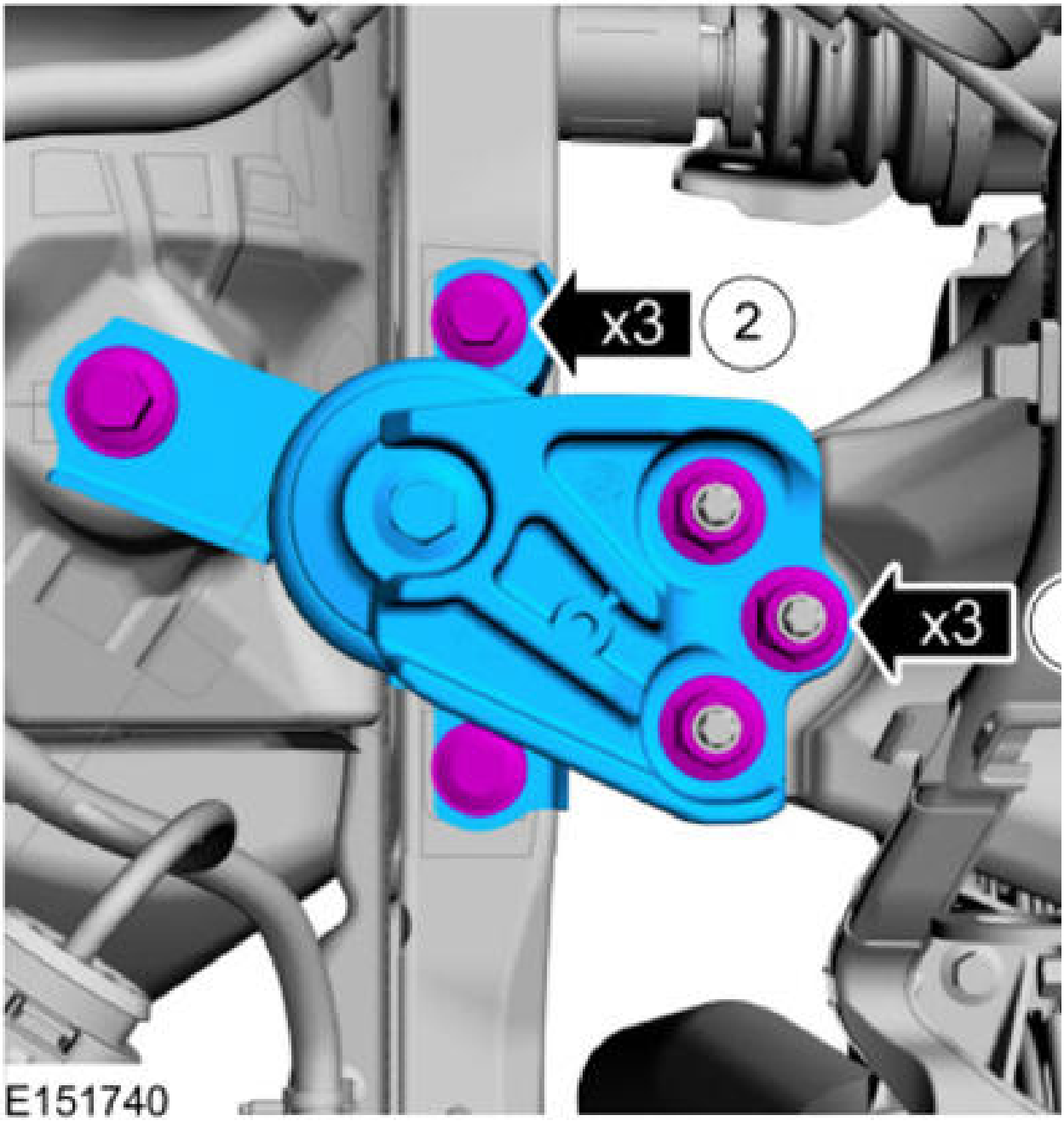
7. *Torque* : 89 lb.in (10 Nm)



8.

1. *Torque* : 59 lb.ft (80 Nm)
2.

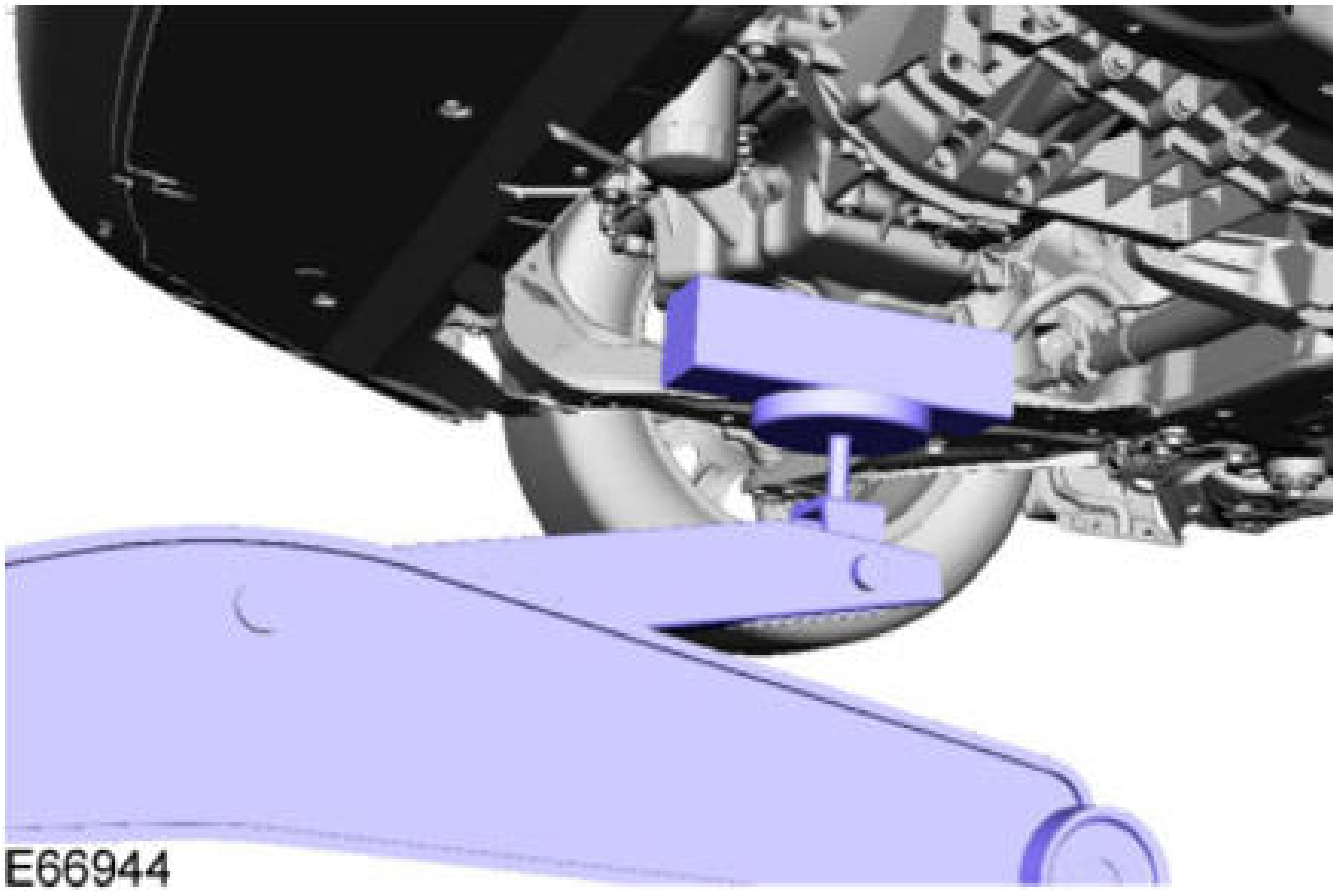
NOTE: Only tighten the bolts finger tight at this stage.



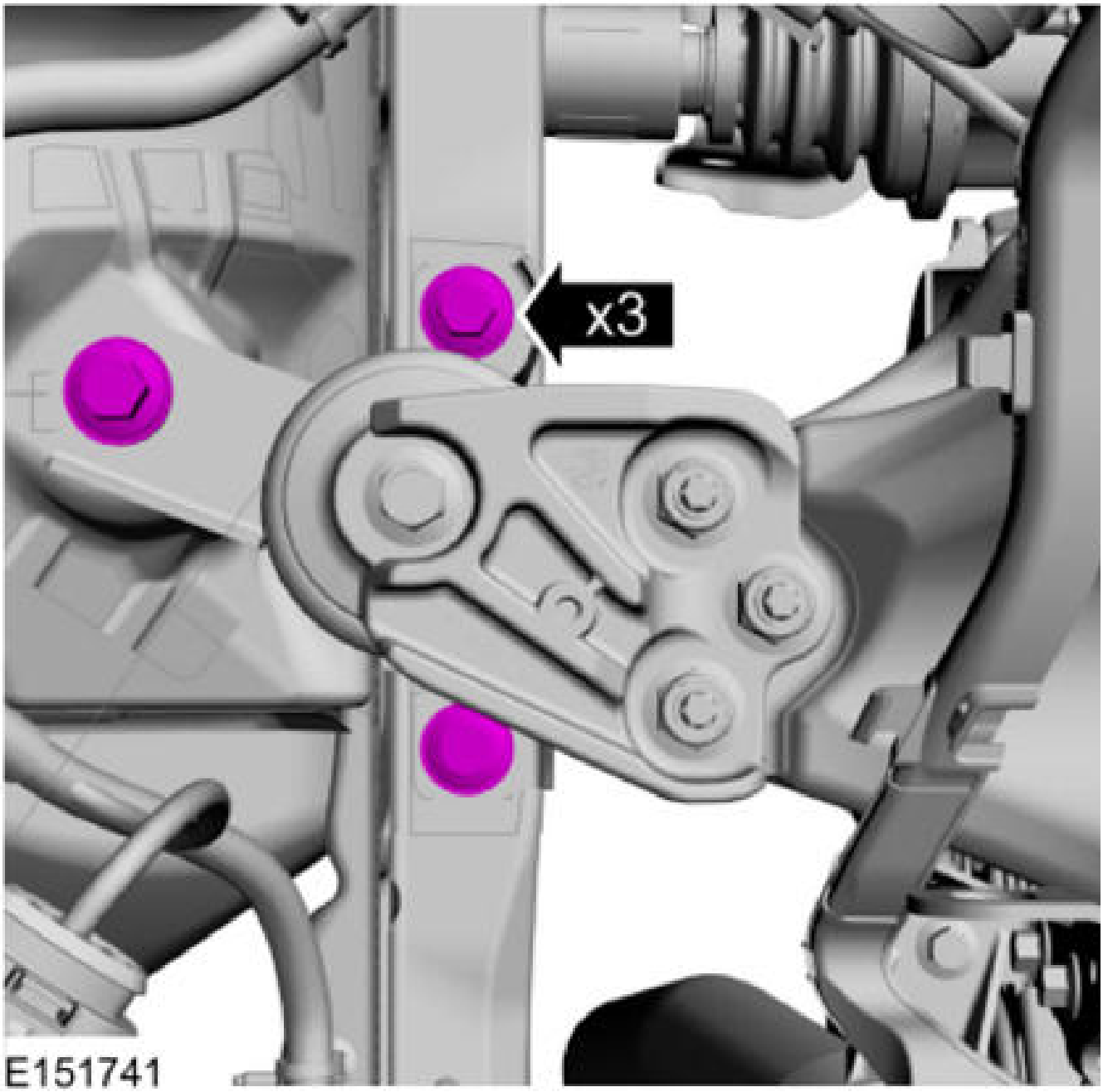
9. Remove

   Use the General Equipment: Trolley Jack

   Use the General Equipment: Wooden Block



10. *Torque* : 66 lb.ft (90 Nm)



INTAKE MANIFOLD

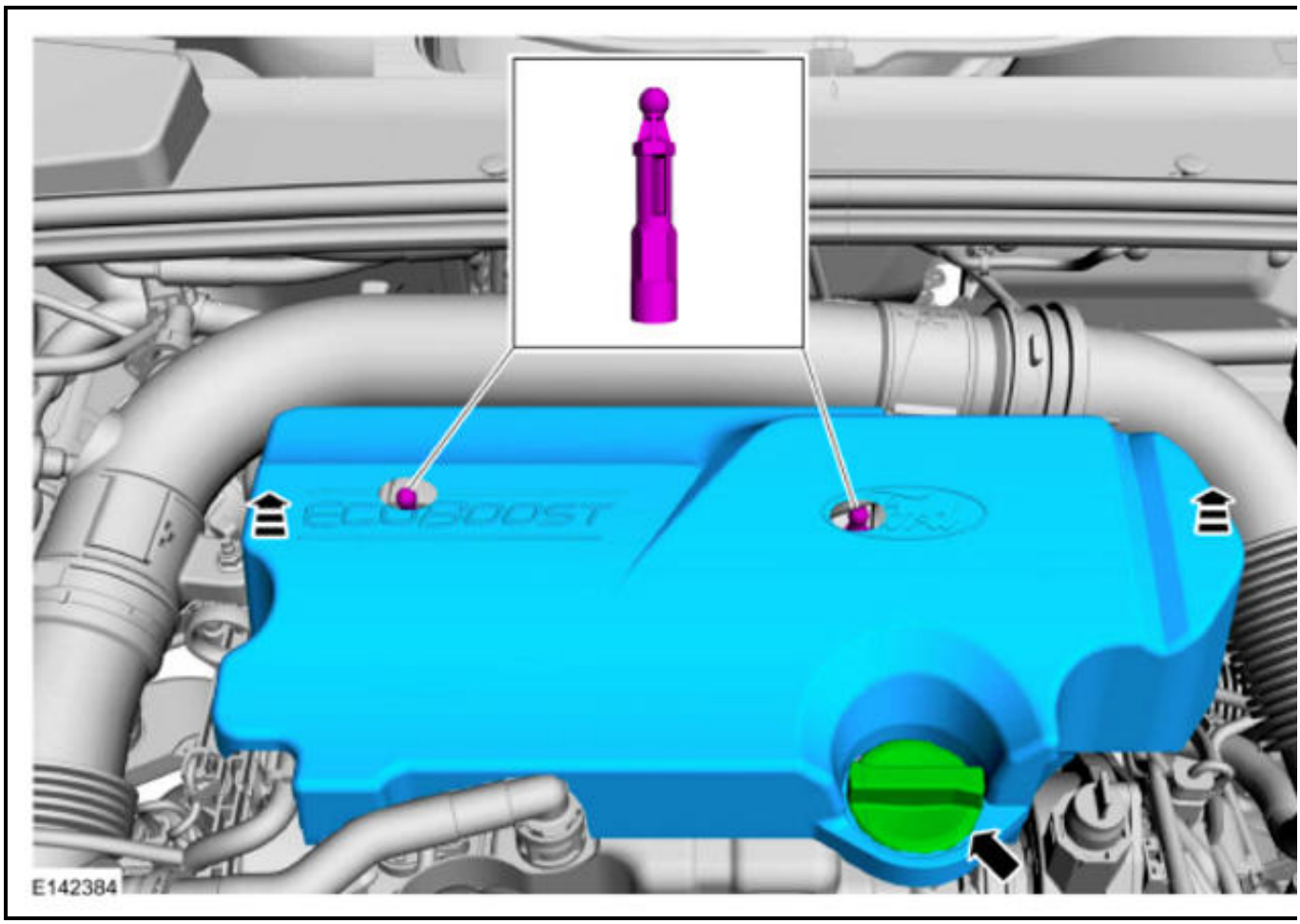
Special Tool(s)/General Equipment

Hose Clamp Remover/Installer

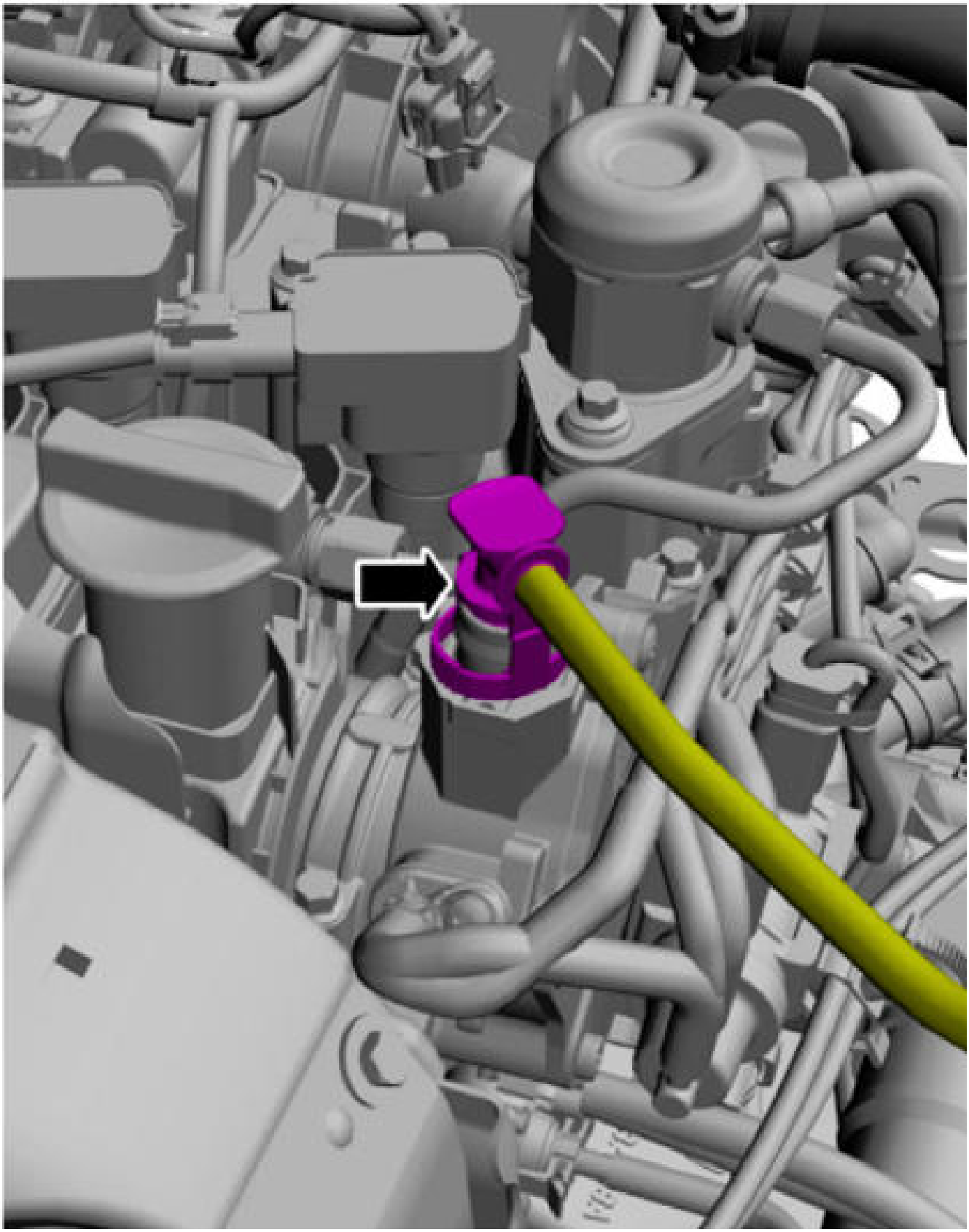
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: **JACKING AND LIFTING - OVERVIEW** .
2. Refer to: **BATTERY DISCONNECT AND CONNECT** .
3. If equipped.



4.

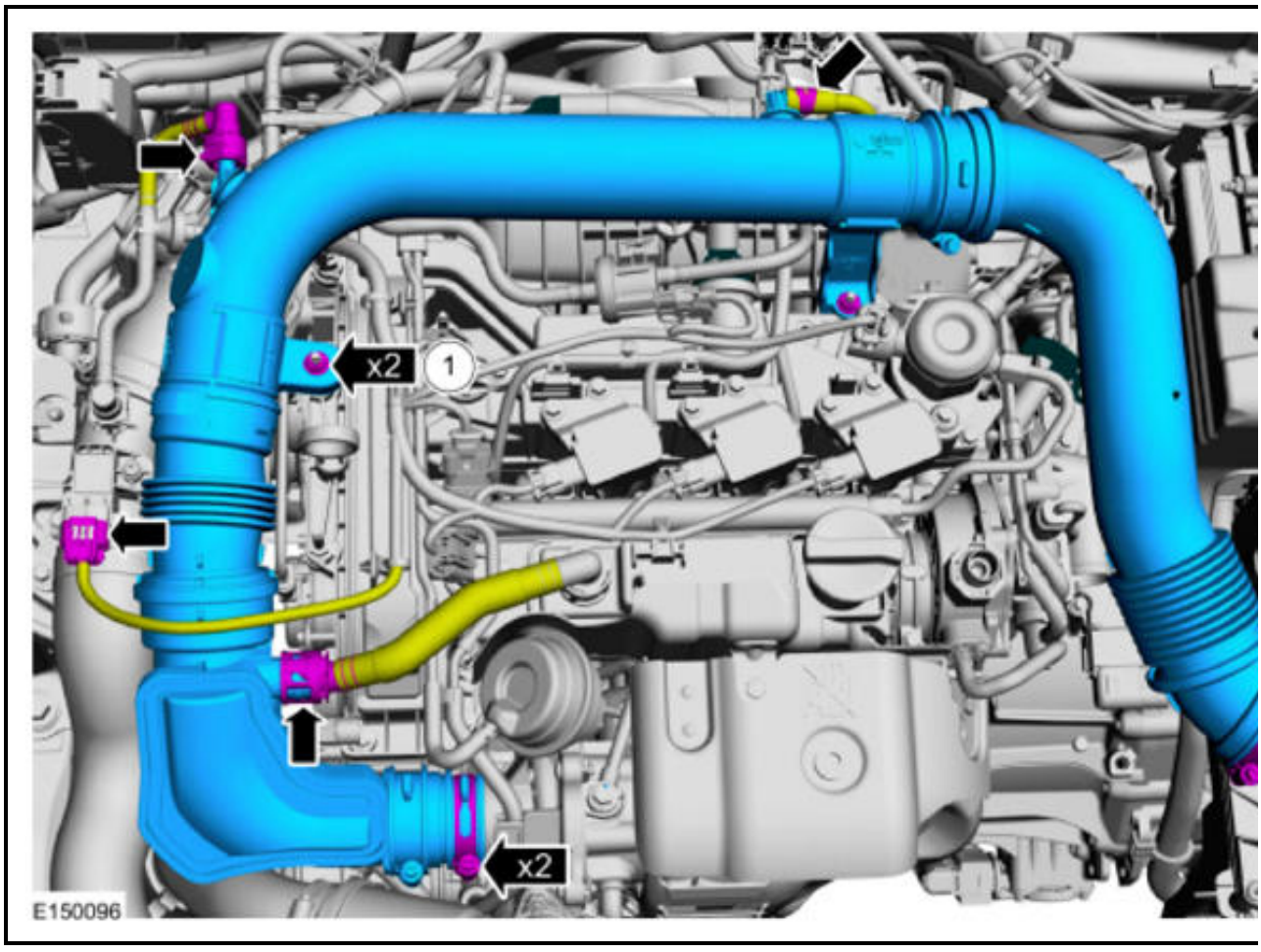


5. Refer to: **QUICK RELEASE COUPLING** .

   Use the General Equipment: Hose Clamp Remover/Installer

   Torque :

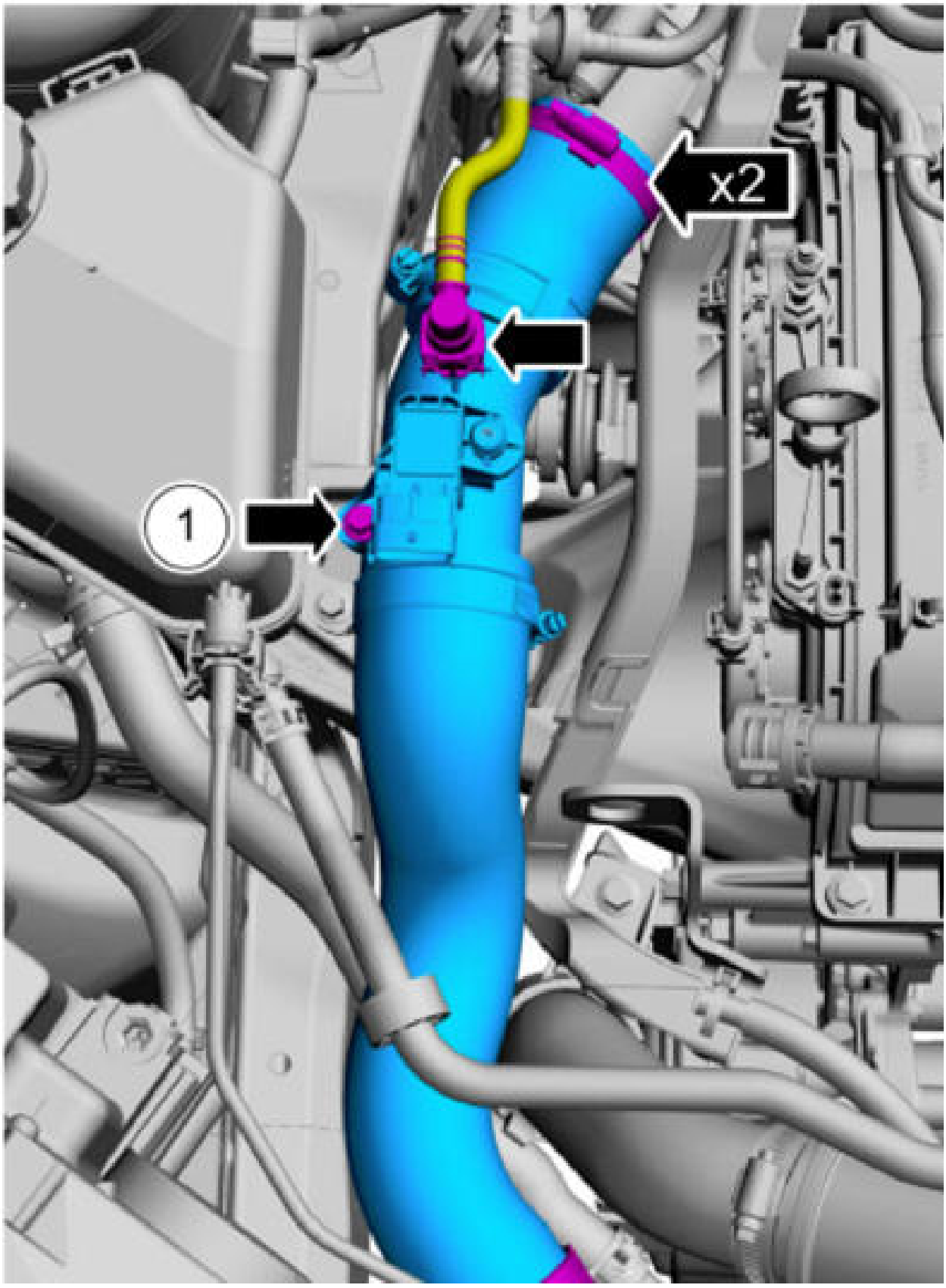
   1. 97 lb.in (11 Nm)



6. Refer to: **QUICK RELEASE COUPLING** .

   Torque :

   1. 133 lb.in (15 Nm)



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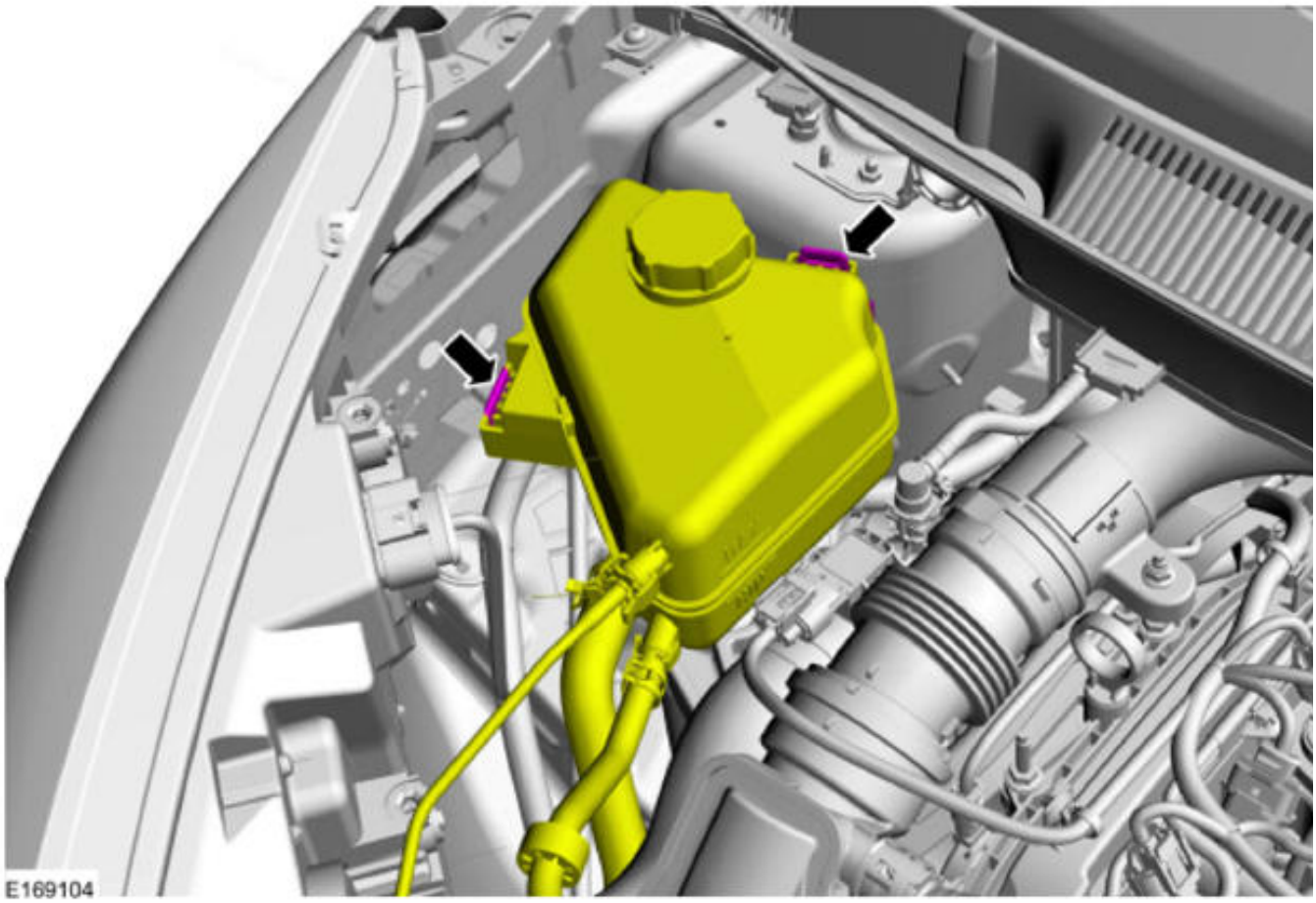
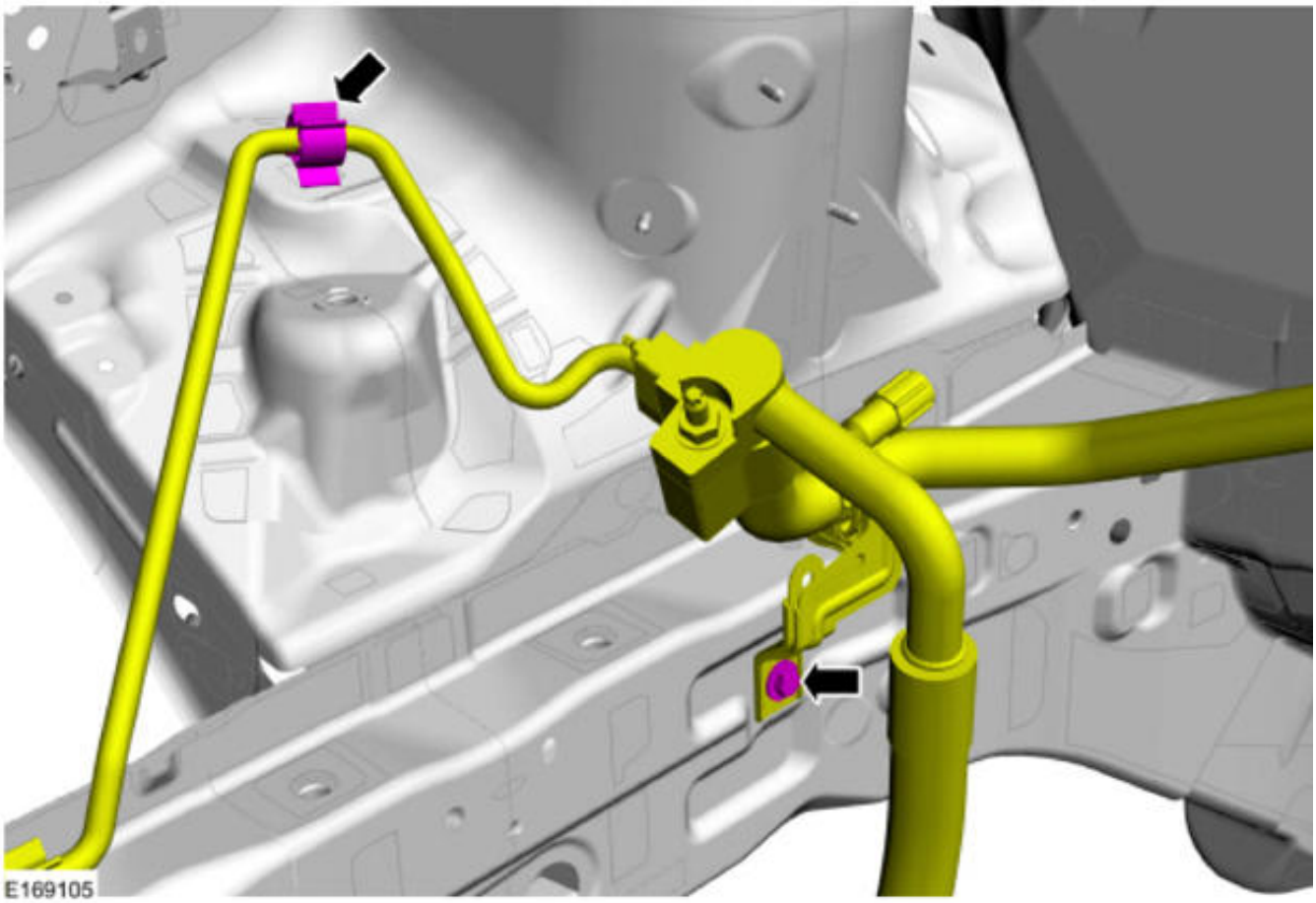
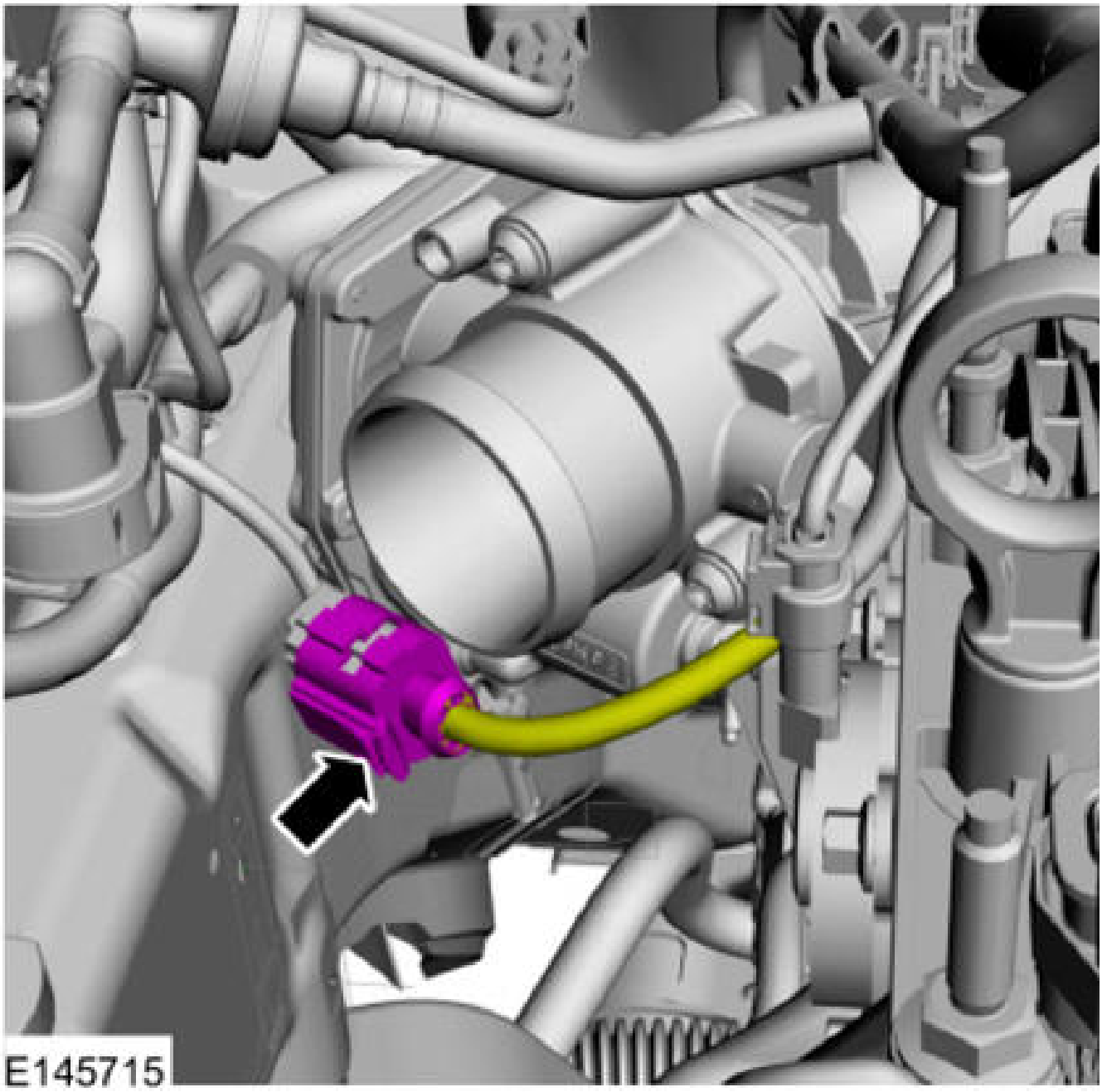


8.

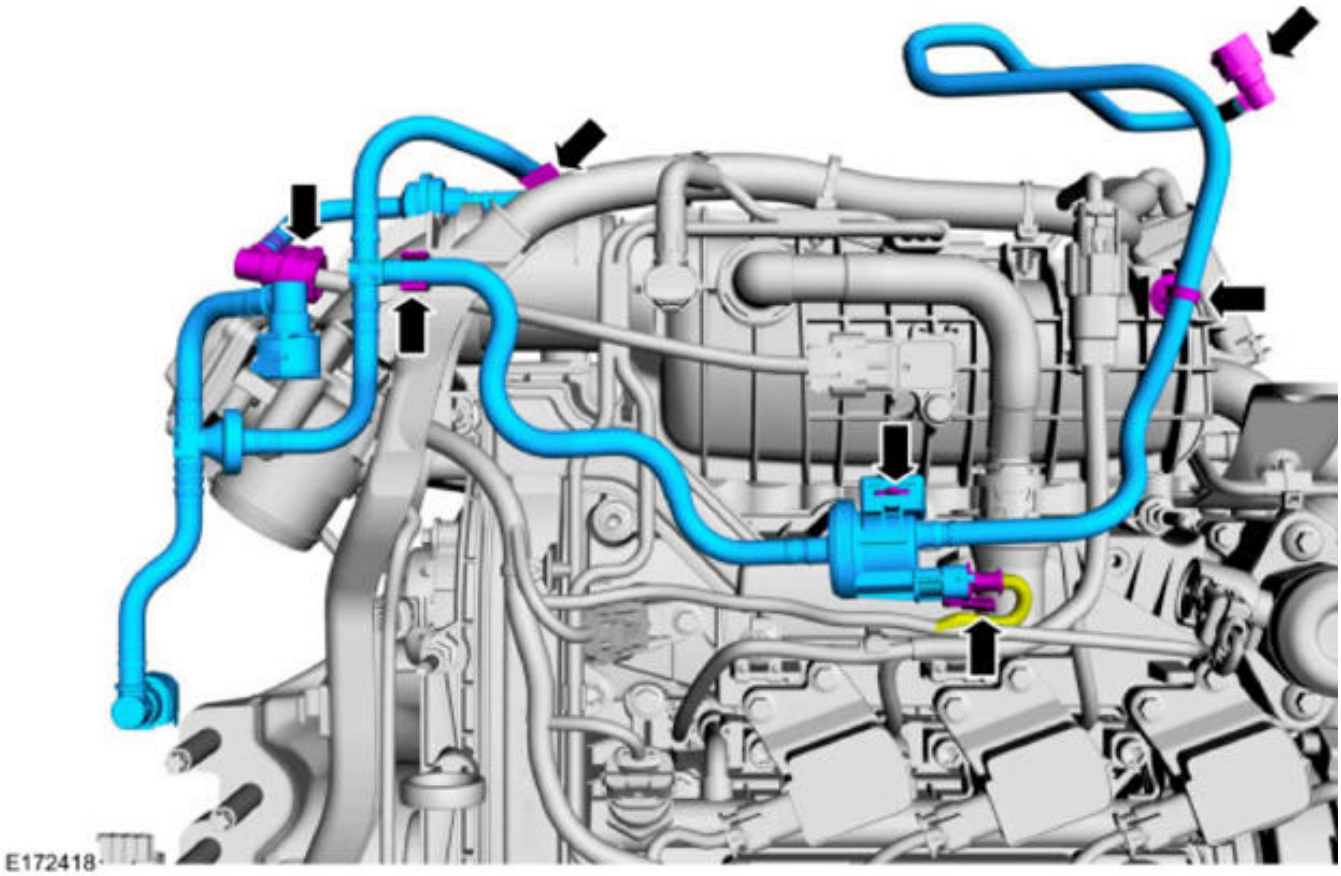
8.



9.

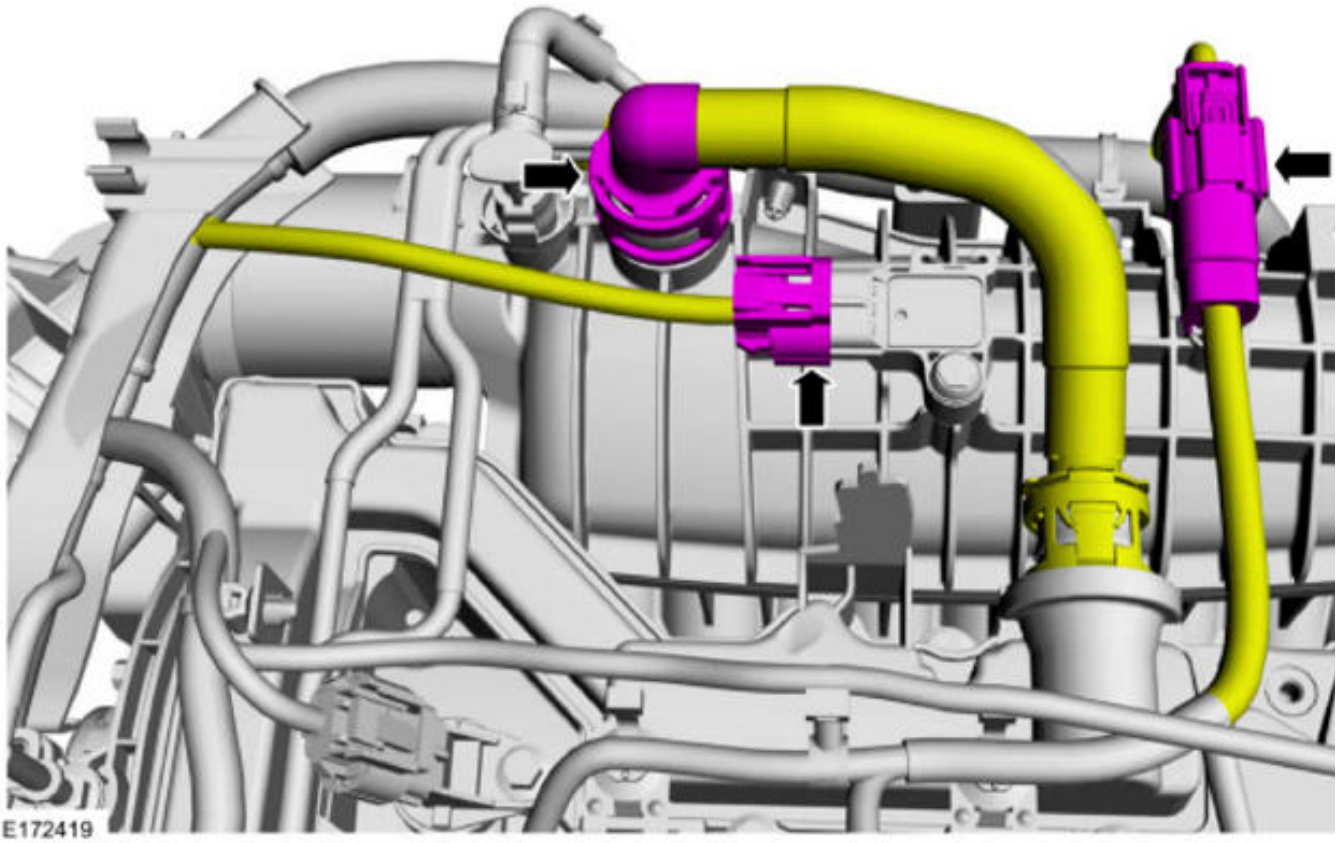
9. 

10. Refer to: **QUICK RELEASE COUPLING** .



11.

11.



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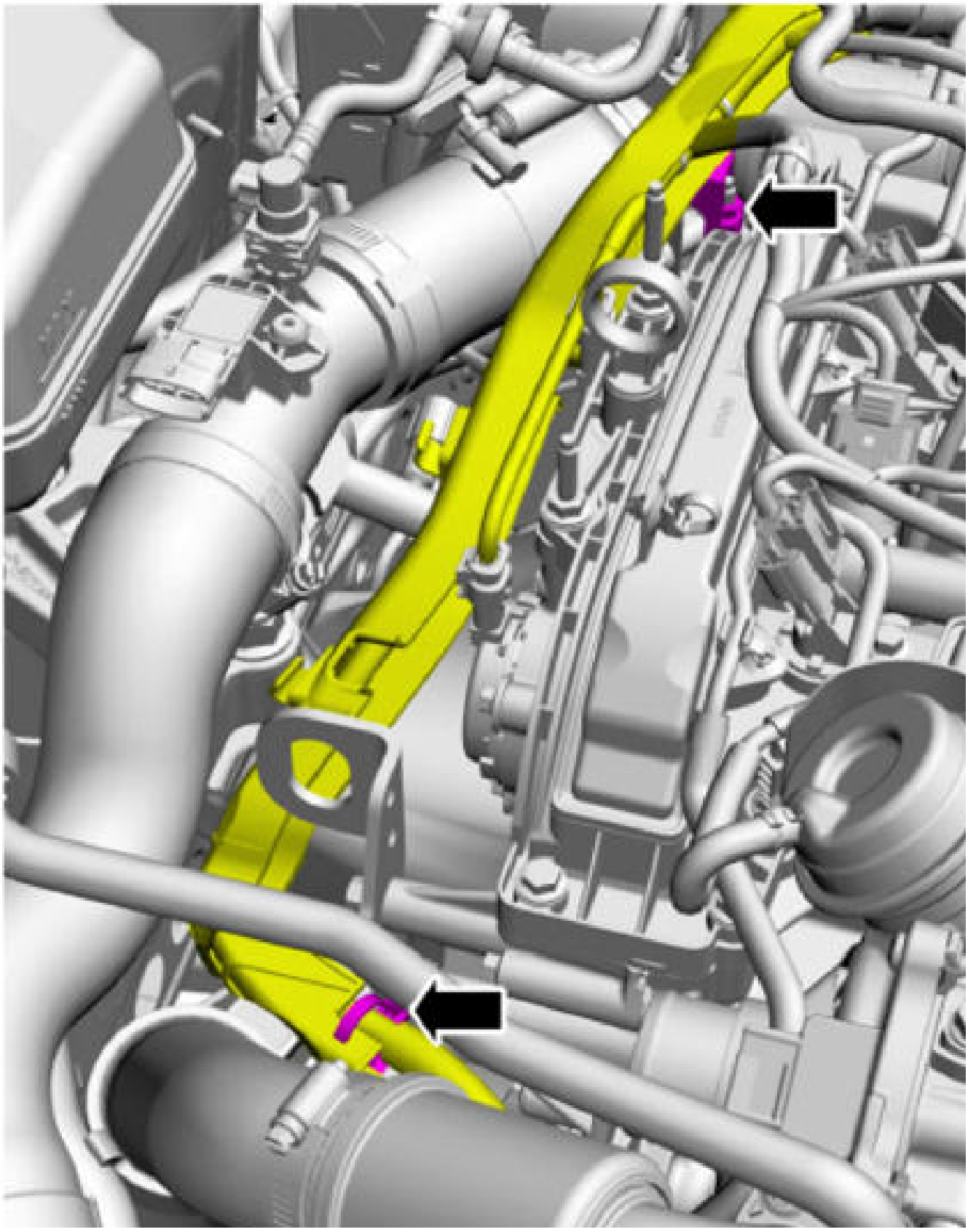

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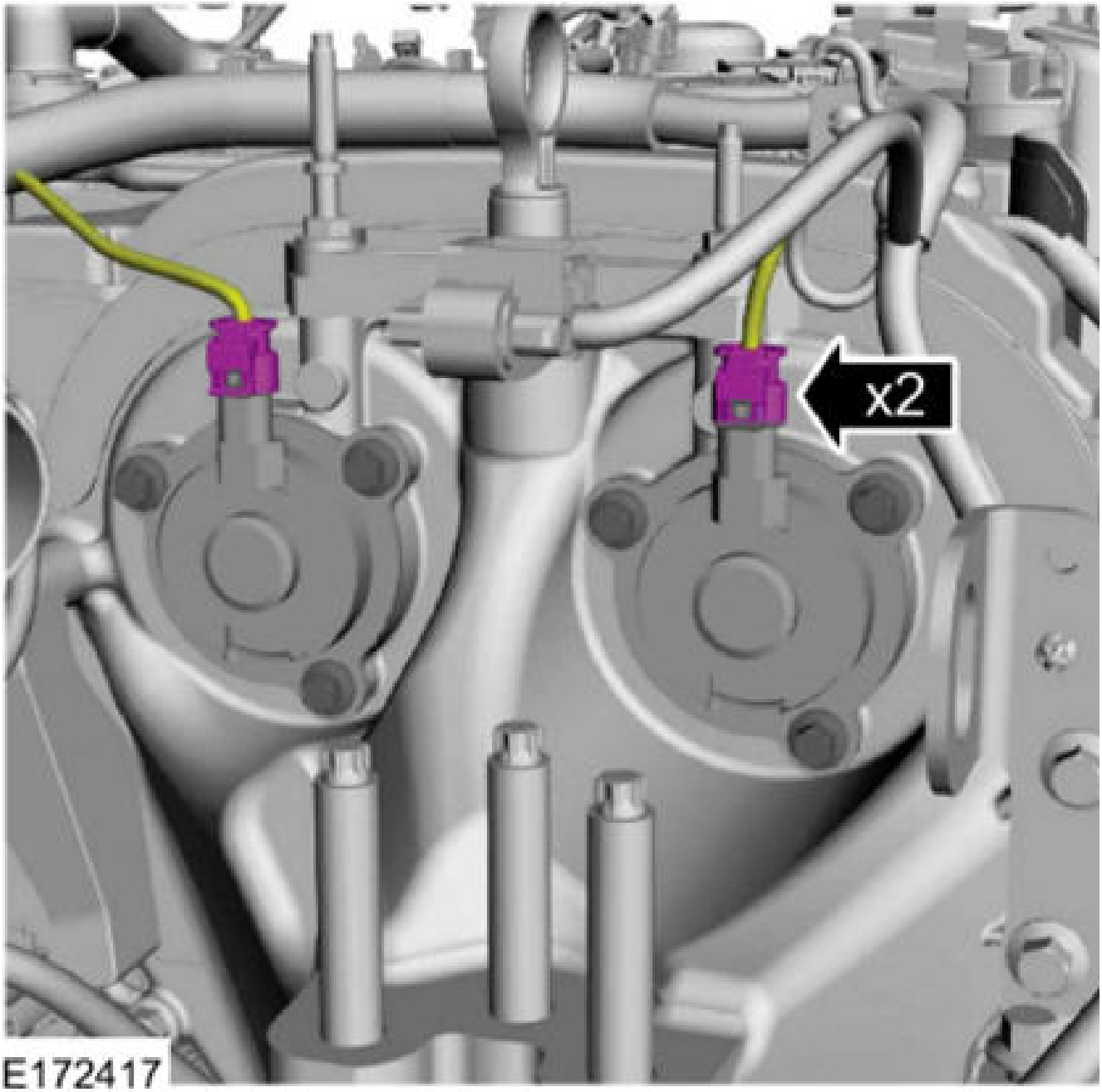
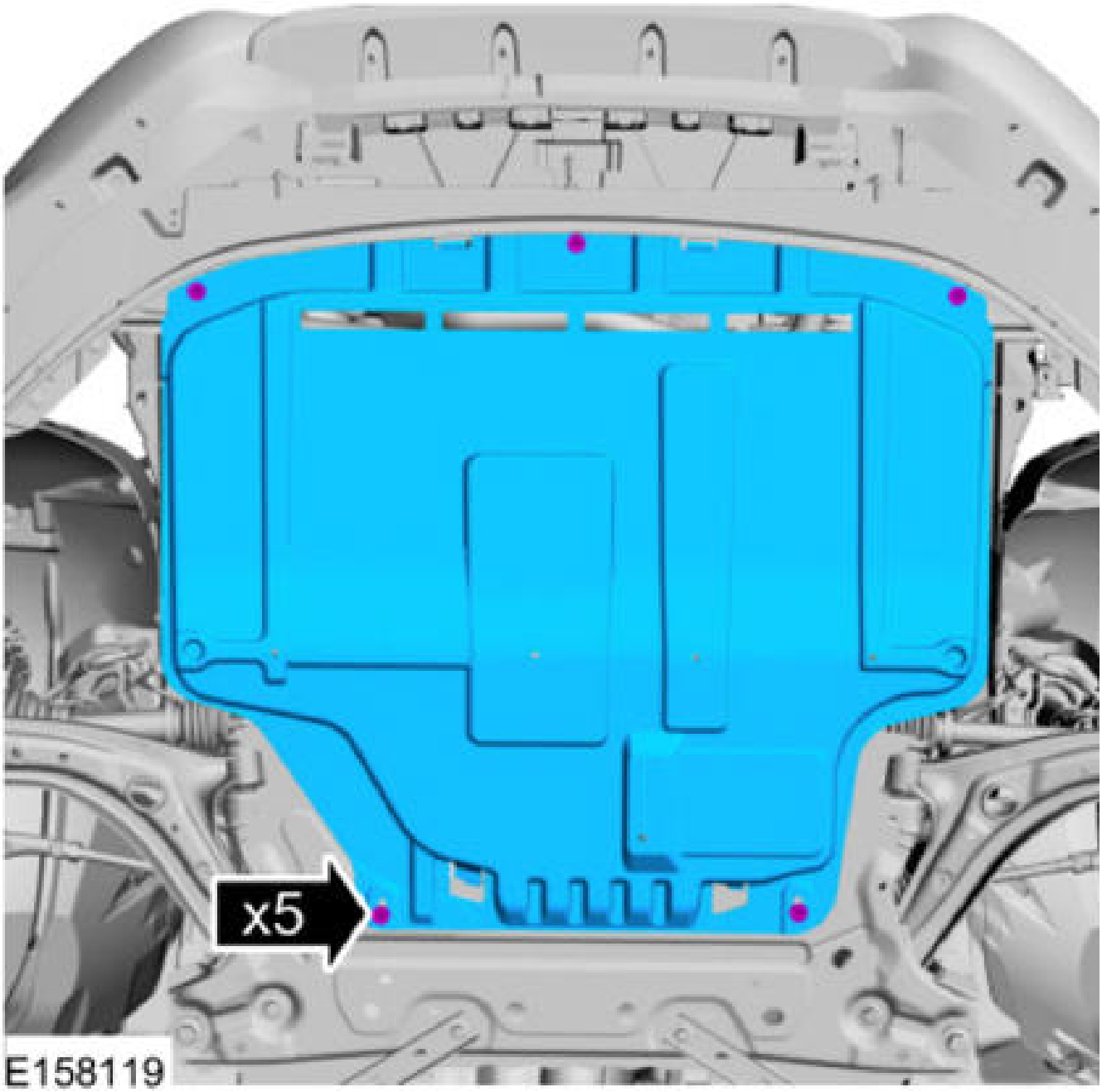
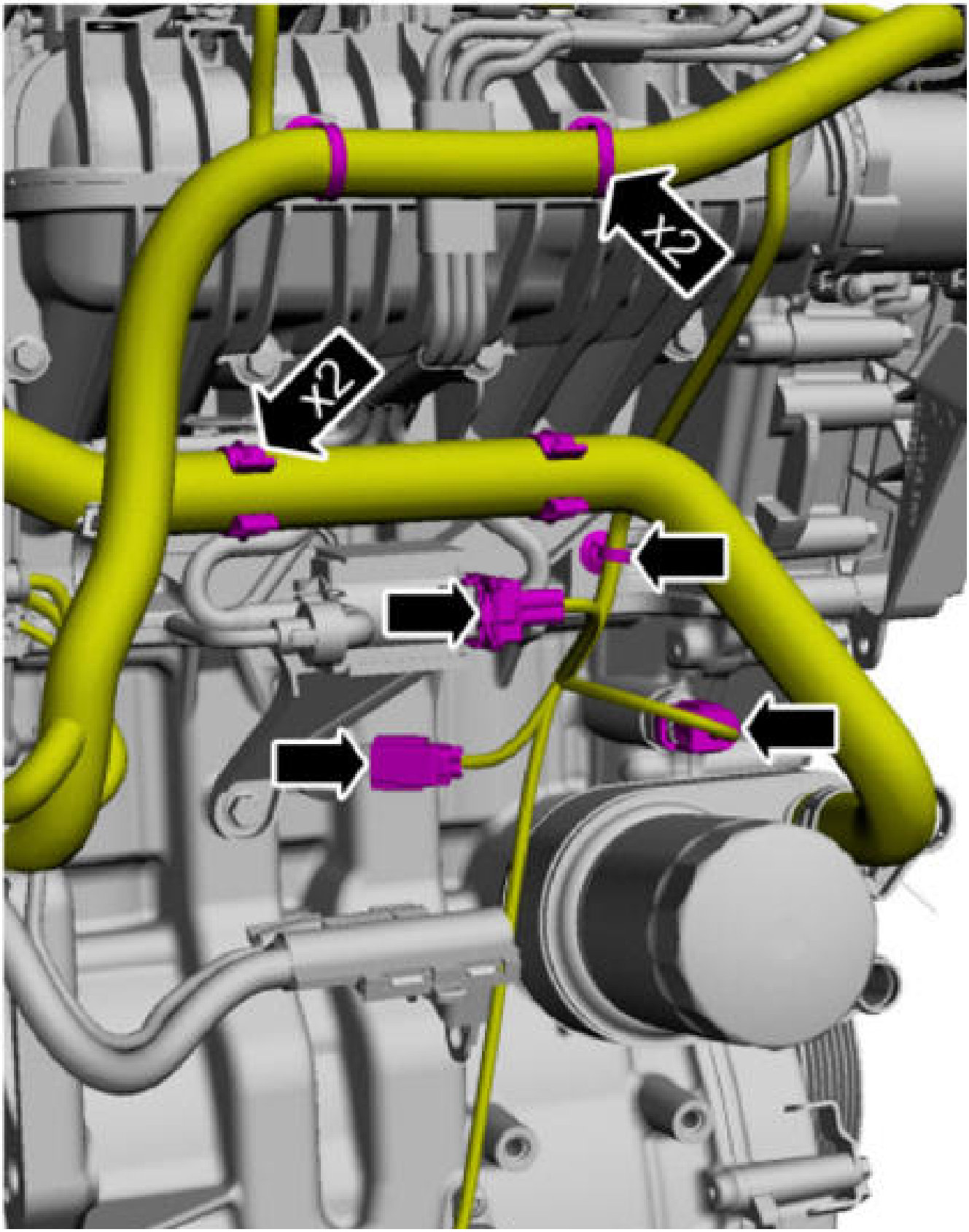


14. If equipped.

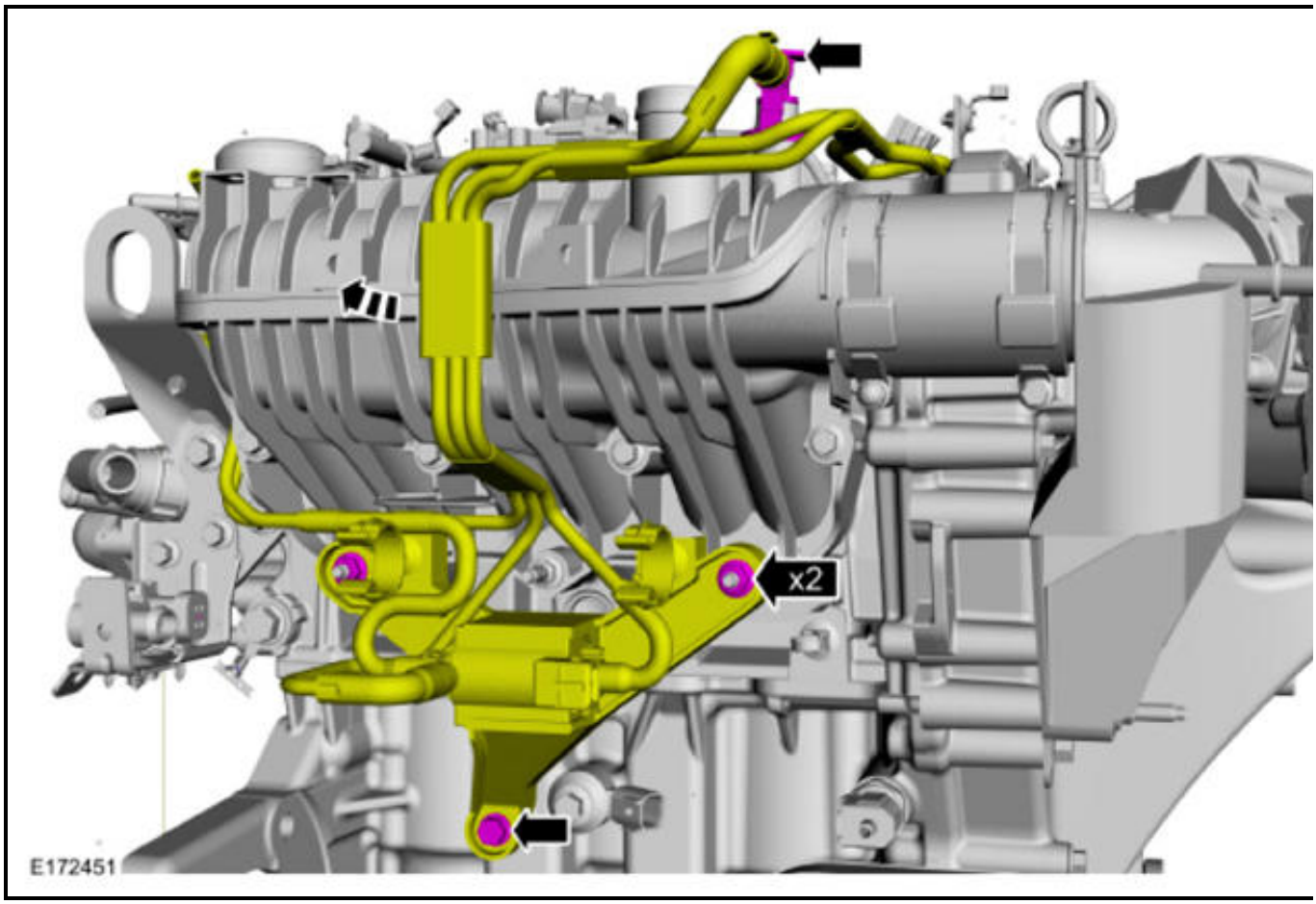


15.



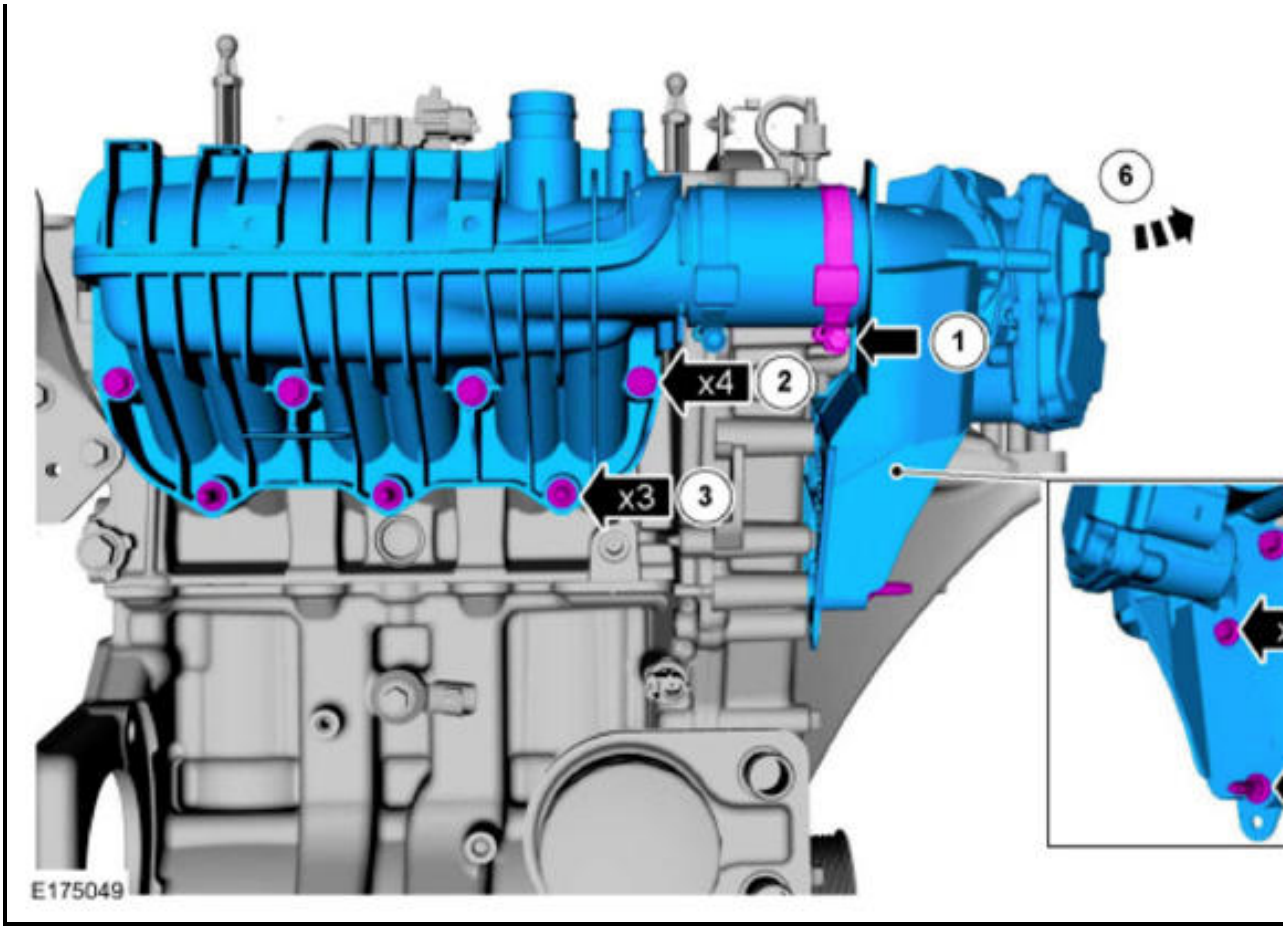
16. Position vacuum harness to rear of intake manifold.

Torque : 89 lb.in (10 Nm)



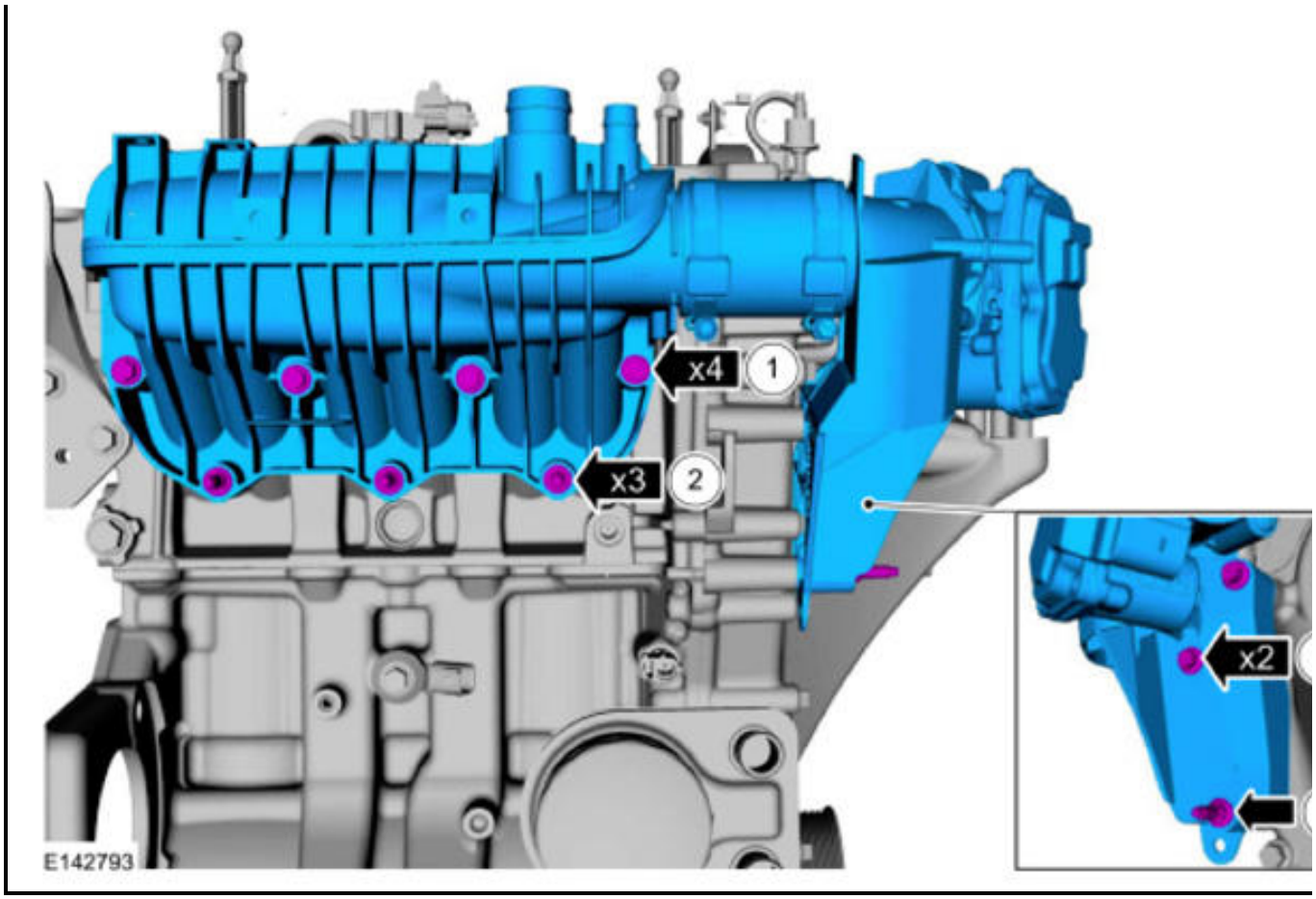
17.

1. Loosen clamp.



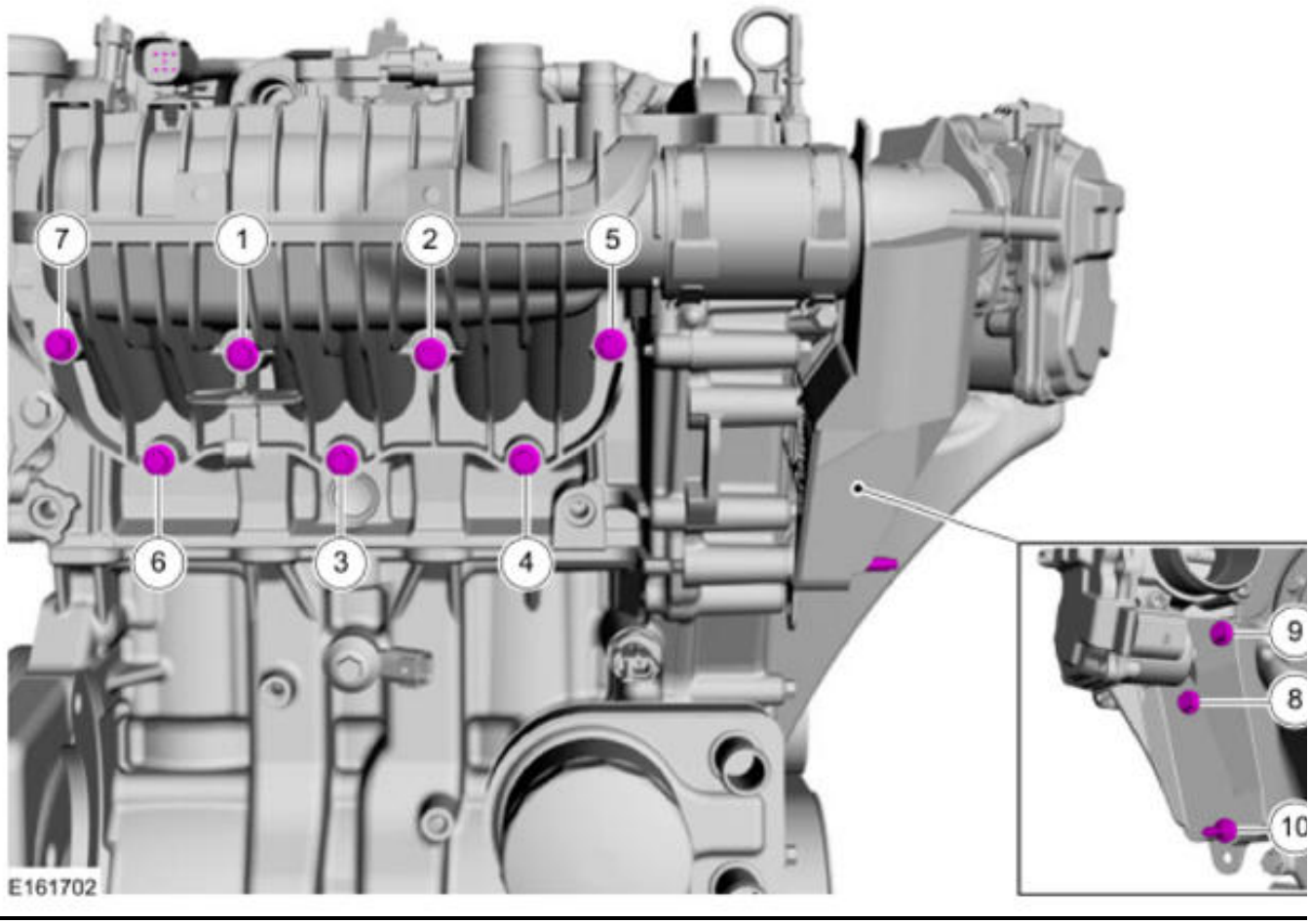
Installation

1. To install, reverse the removal procedure.
2. **NOTE: Only tighten the bolts finger tight at this stage.**

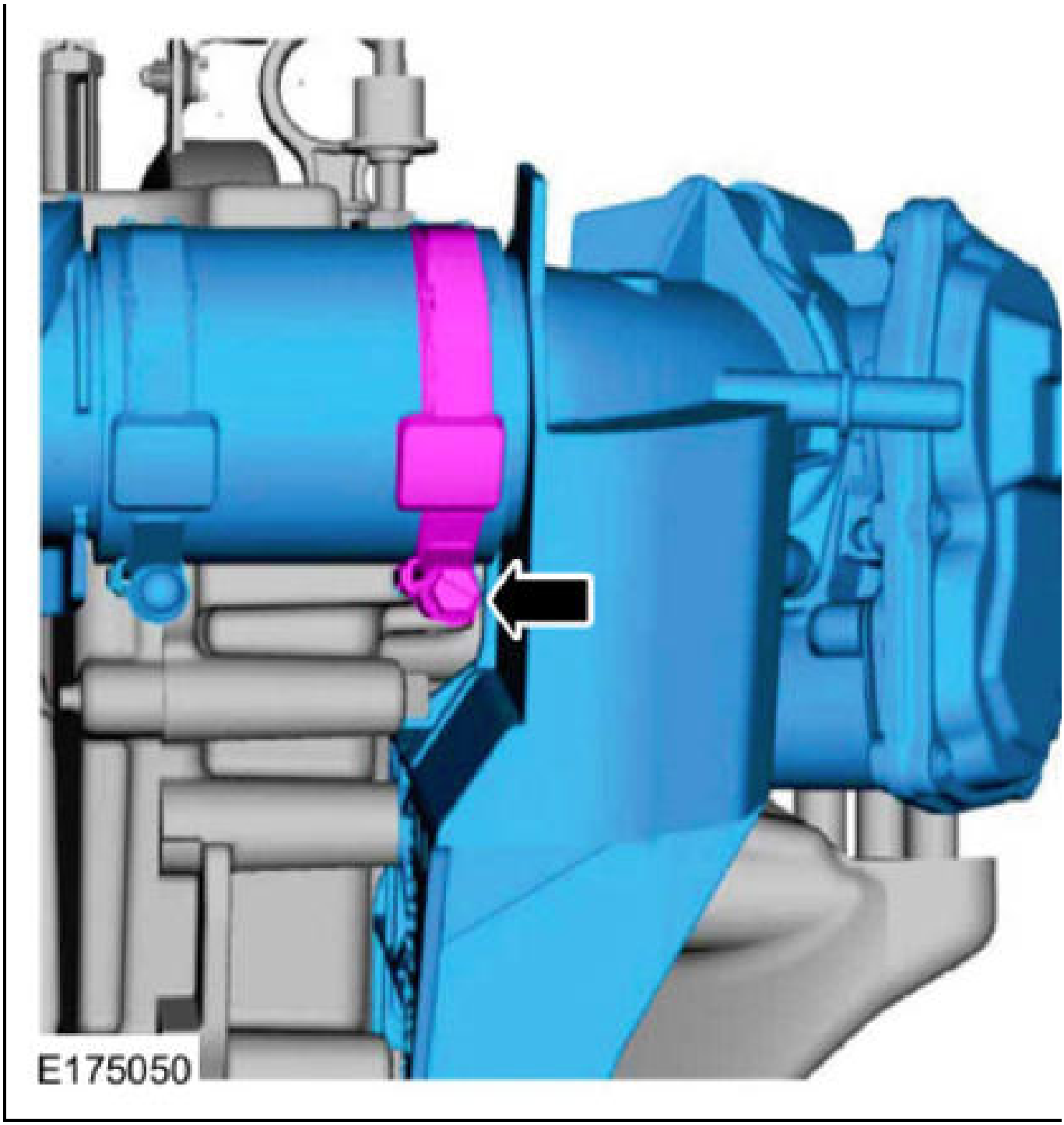


3. *Torque* :

   1-10: 89 lb.in (10 Nm)



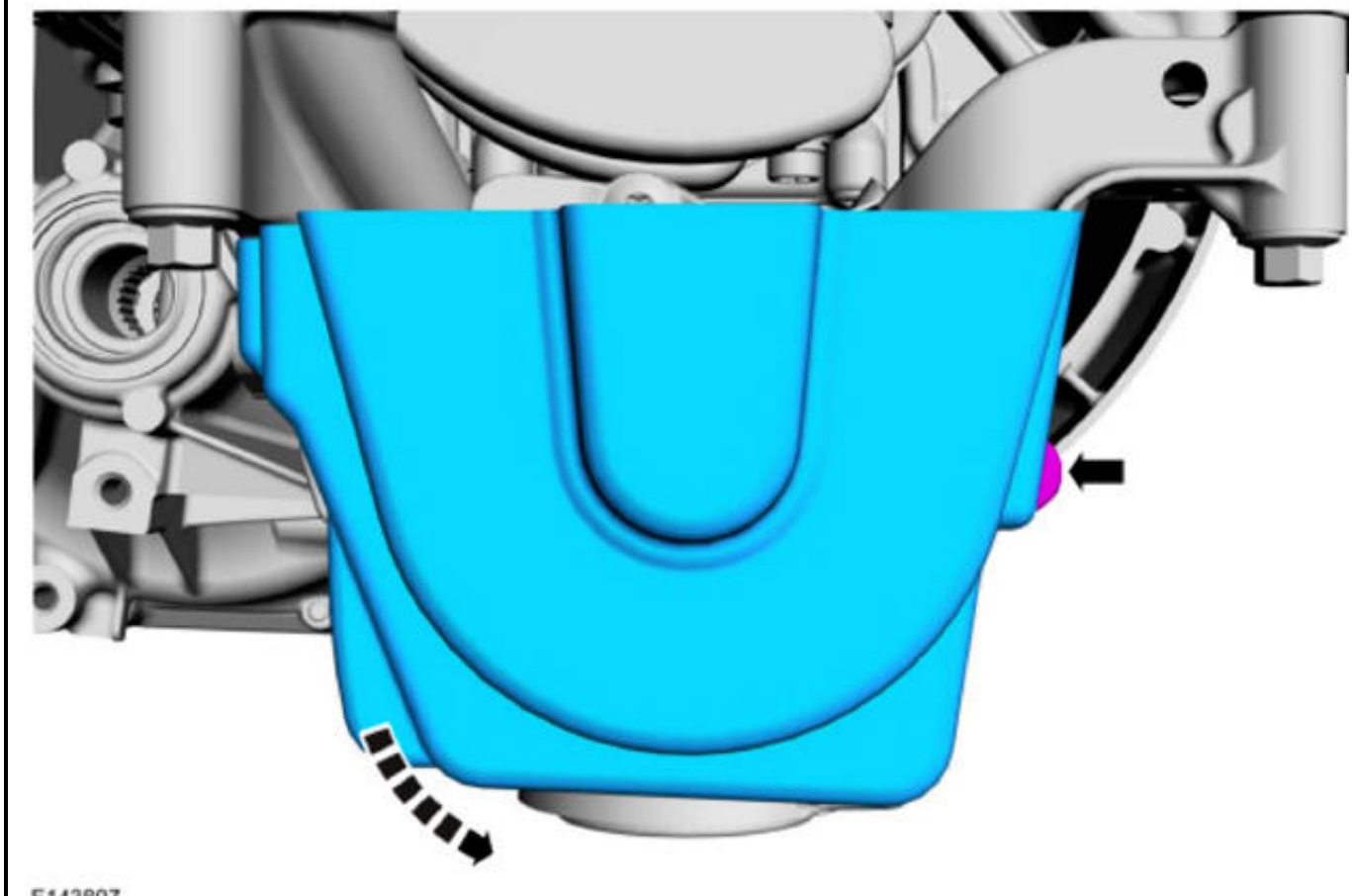
4. *Torque* : 44 lb.in (5 Nm)



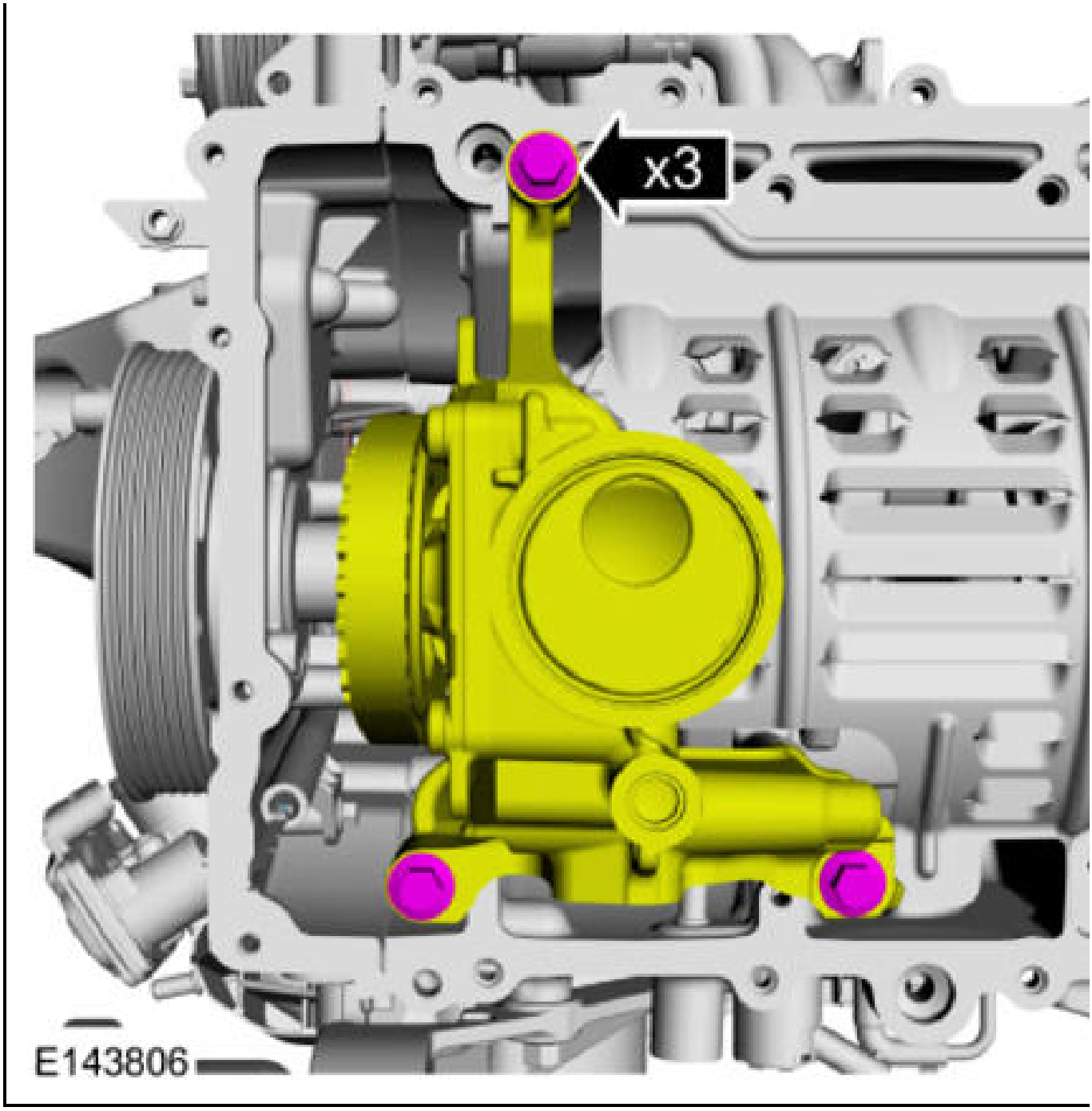
OIL PUMP

Removal

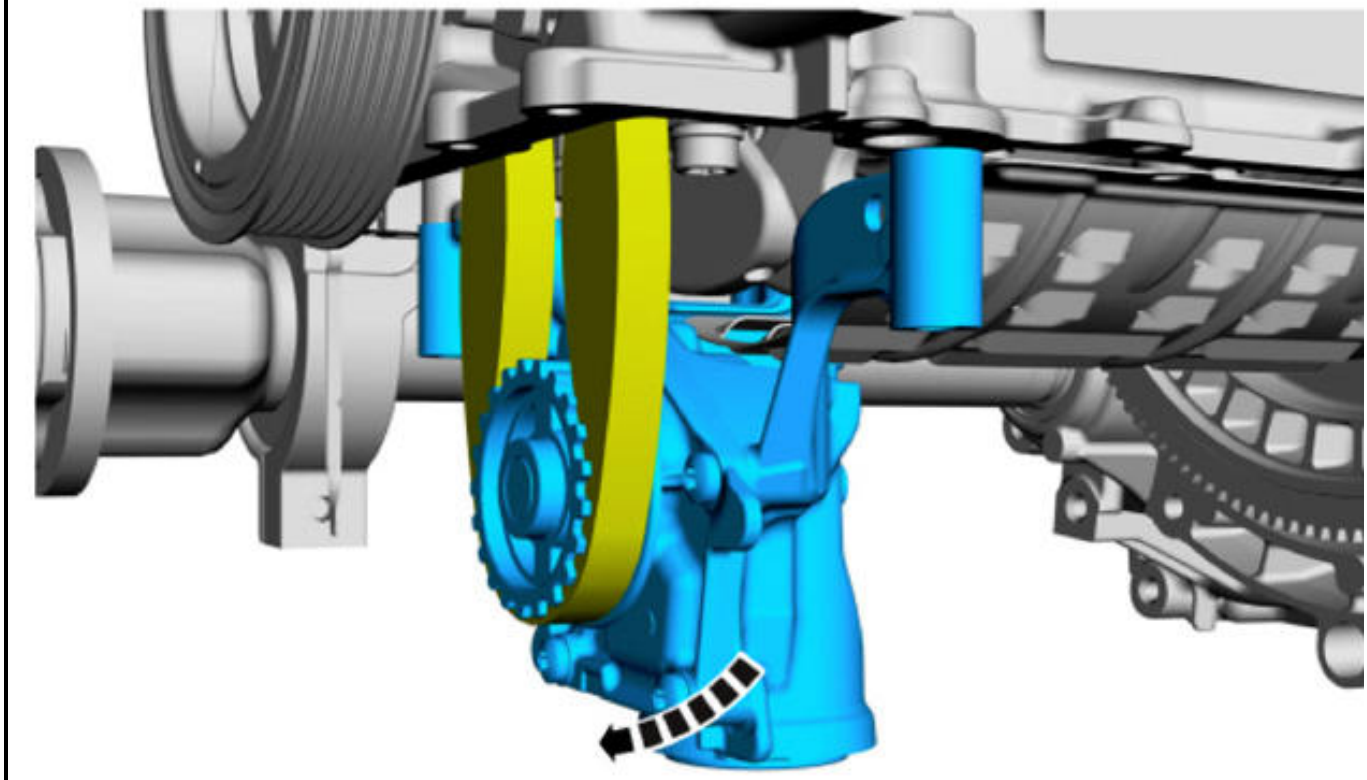
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: **JACKING AND LIFTING - OVERVIEW** .
2. Refer to: **OIL PAN** .
3. 

4. *Torque* : 18 lb.ft (25 Nm)



5.

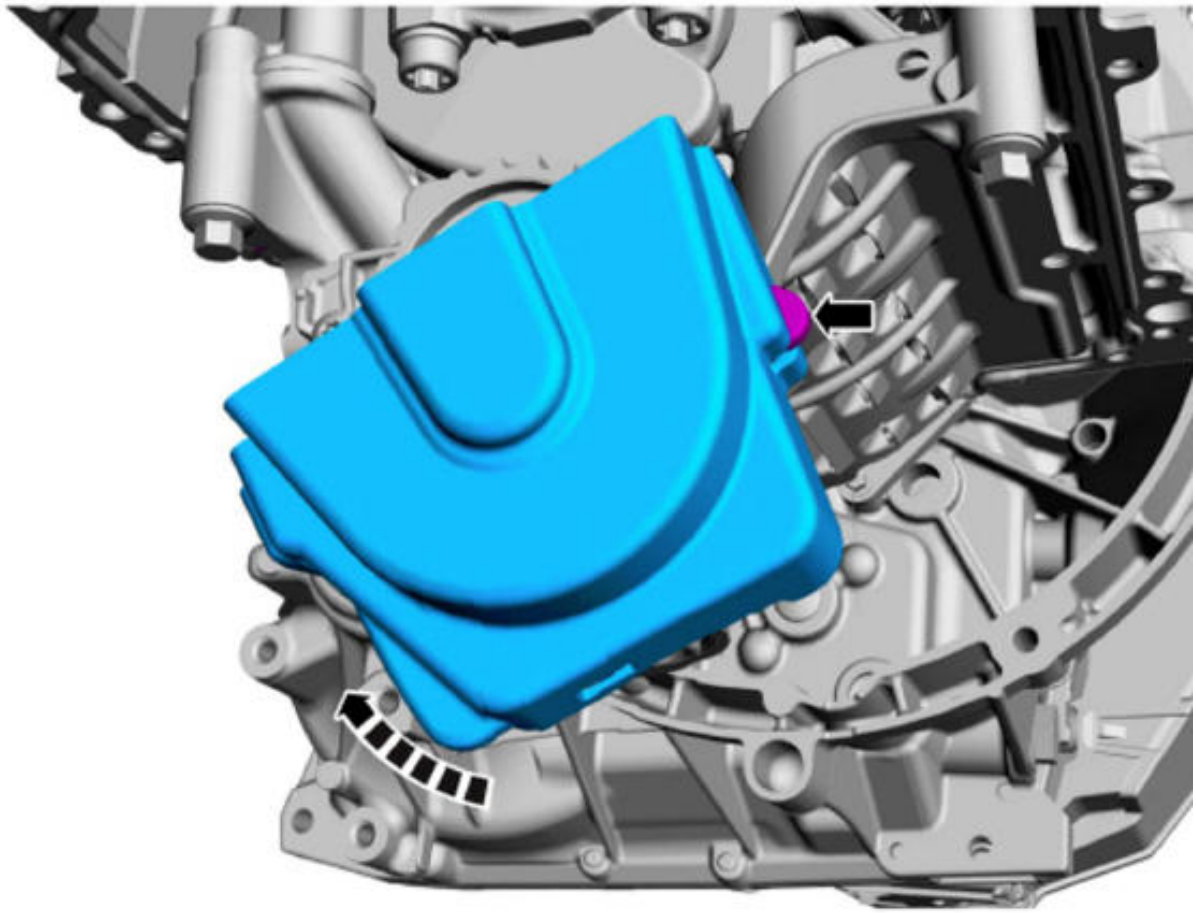
5. 

Installation

1. To install, reverse the removal procedure.

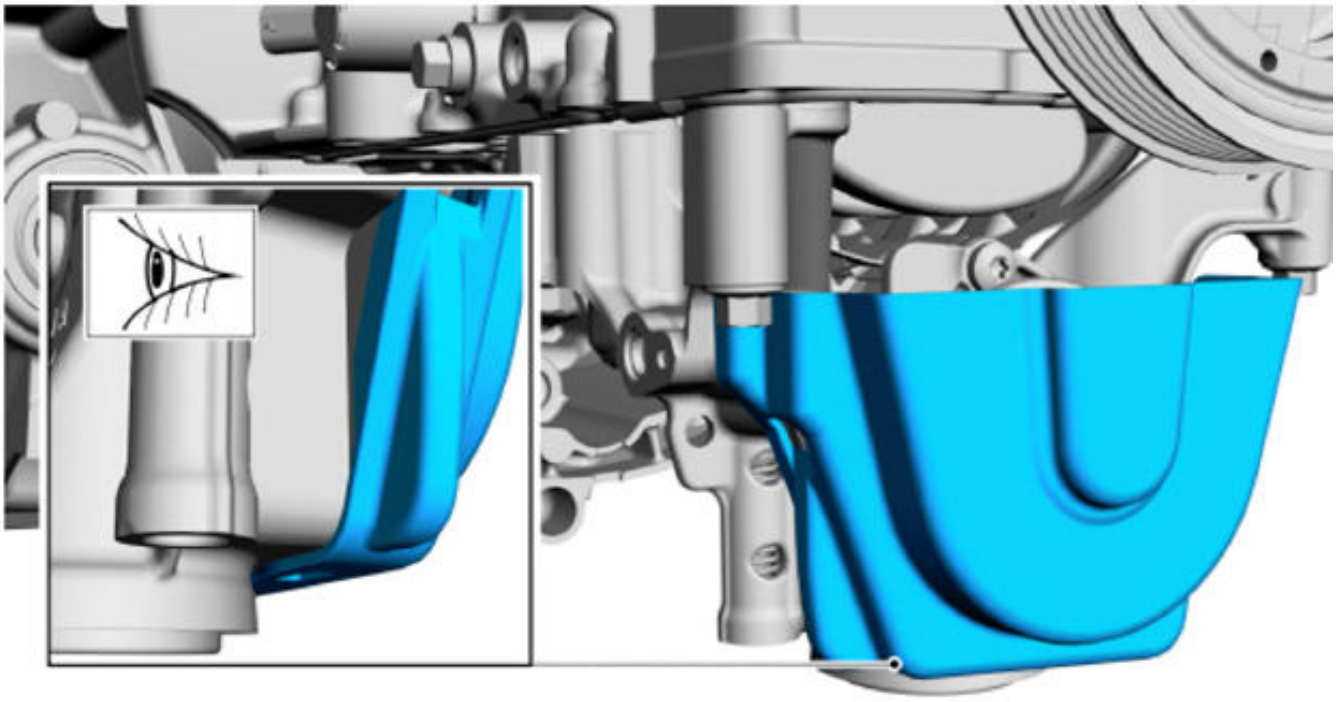
2.

2.



3.

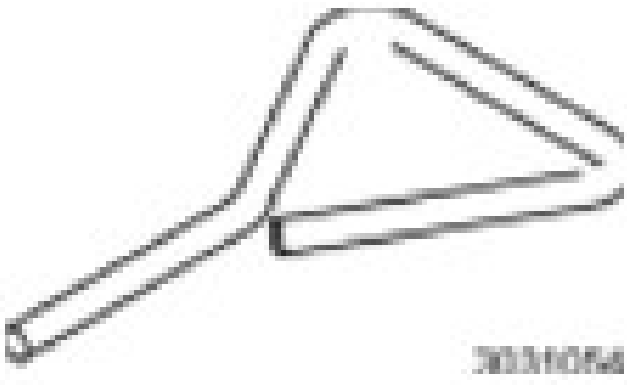
YouTube	A multimedia supplement to the instructions contained in this article is available. To view the multimedia example of the condition described go to; **http://www.youtube.com/user/Mitchell1Tips** **then type, "A00670659.vid3" into the "Search Channel" box.**

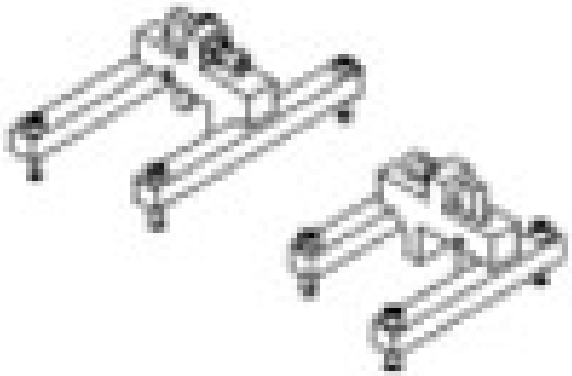


E143849

TIMING BELT

SPECIAL TOOL DESCRIPTION

	303-1054 Locking Tool, Timing Belt Tensioner

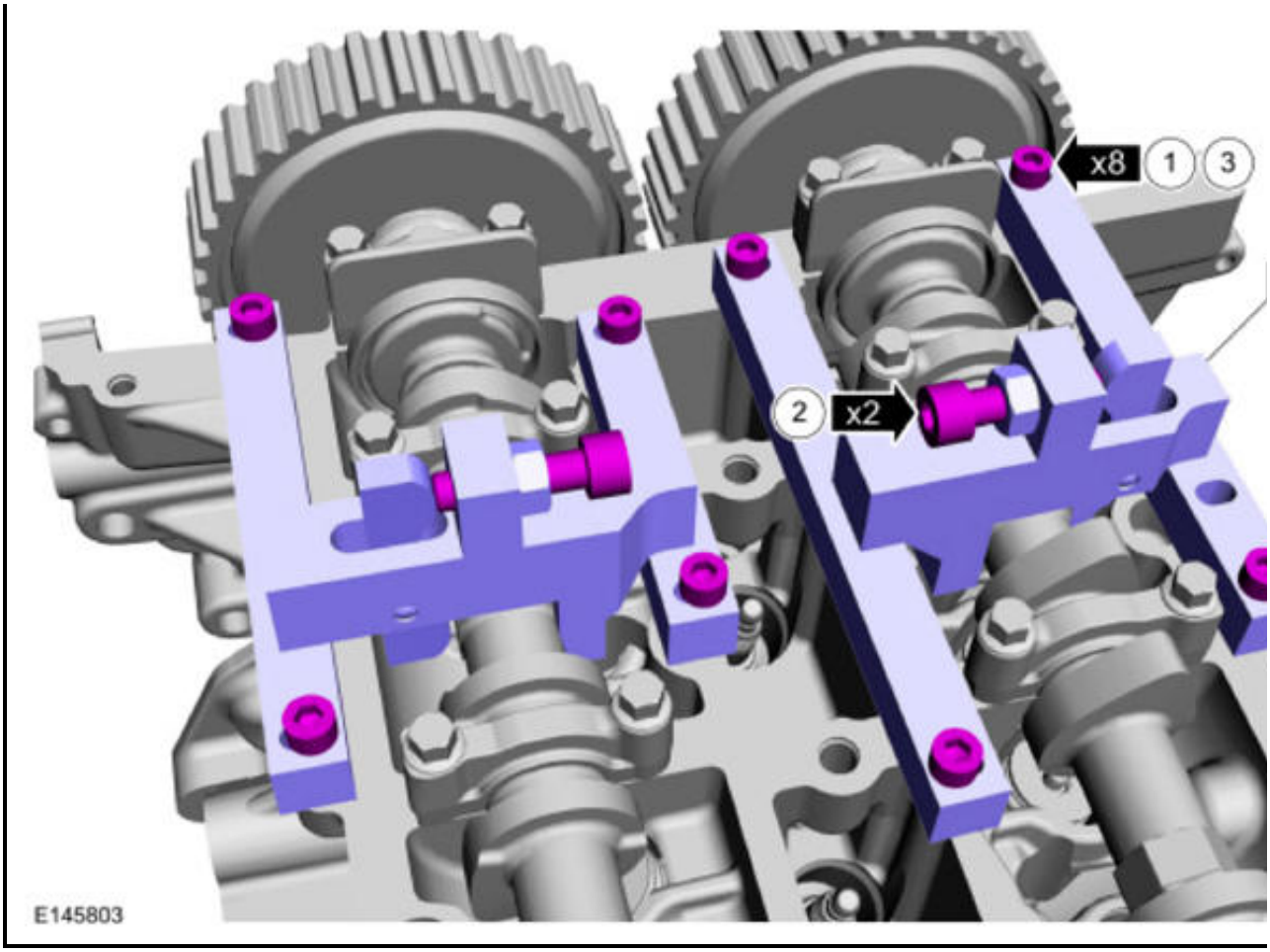
 E141996	303-1605 Alignment Tool, Camshaft

Removal

1. Refer to: **ENGINE FRONT COVER** .
2.
   1. Install Special Service Tool: 303-1605 Alignment Tool, Camshaft.
   2.

      NOTE: Only tighten the bolts finger tight at this stage.

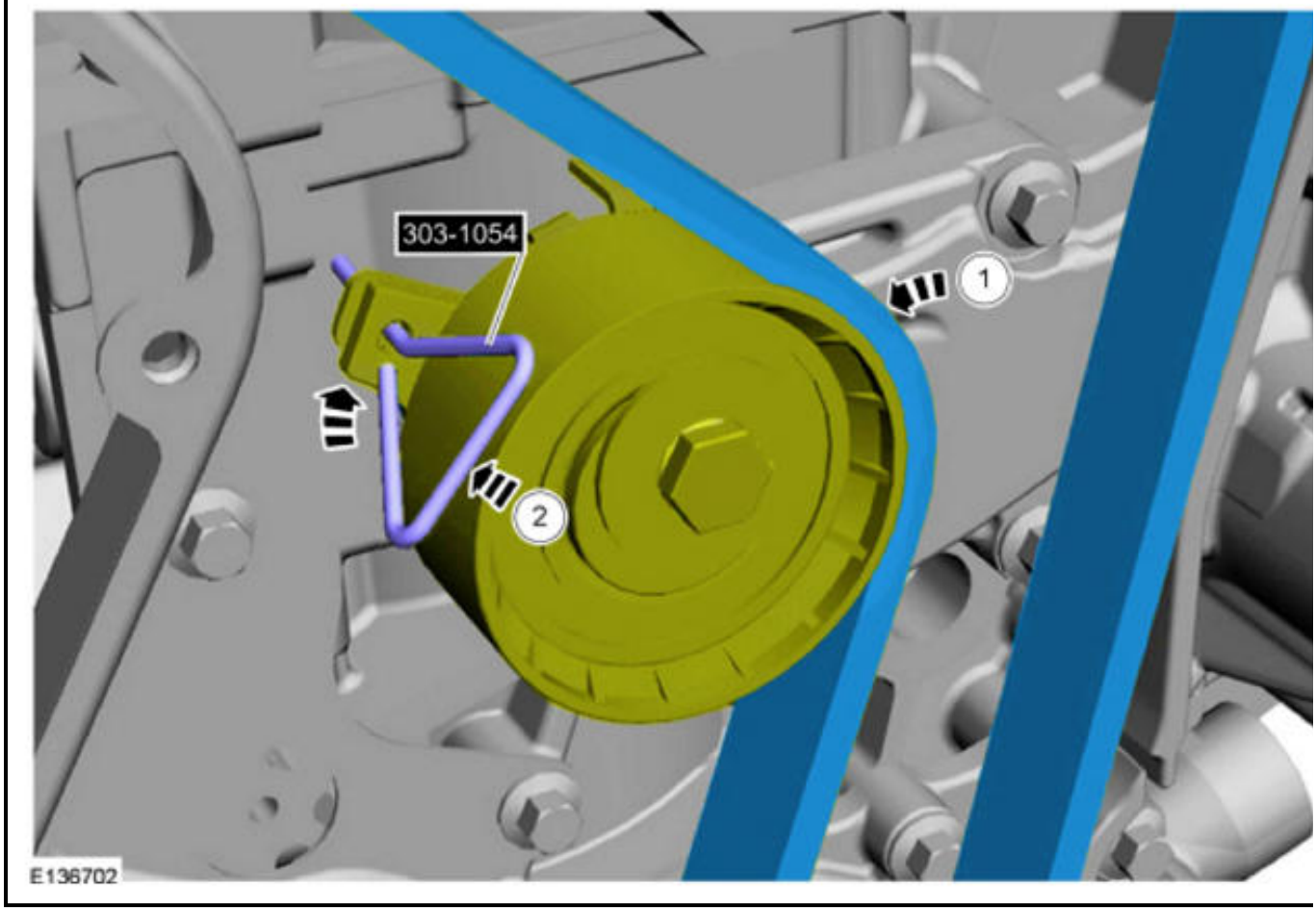
   3. *Torque* : 89 lb.in (10 Nm)



WARNING: **Take extra care when handling the compressed spring.**

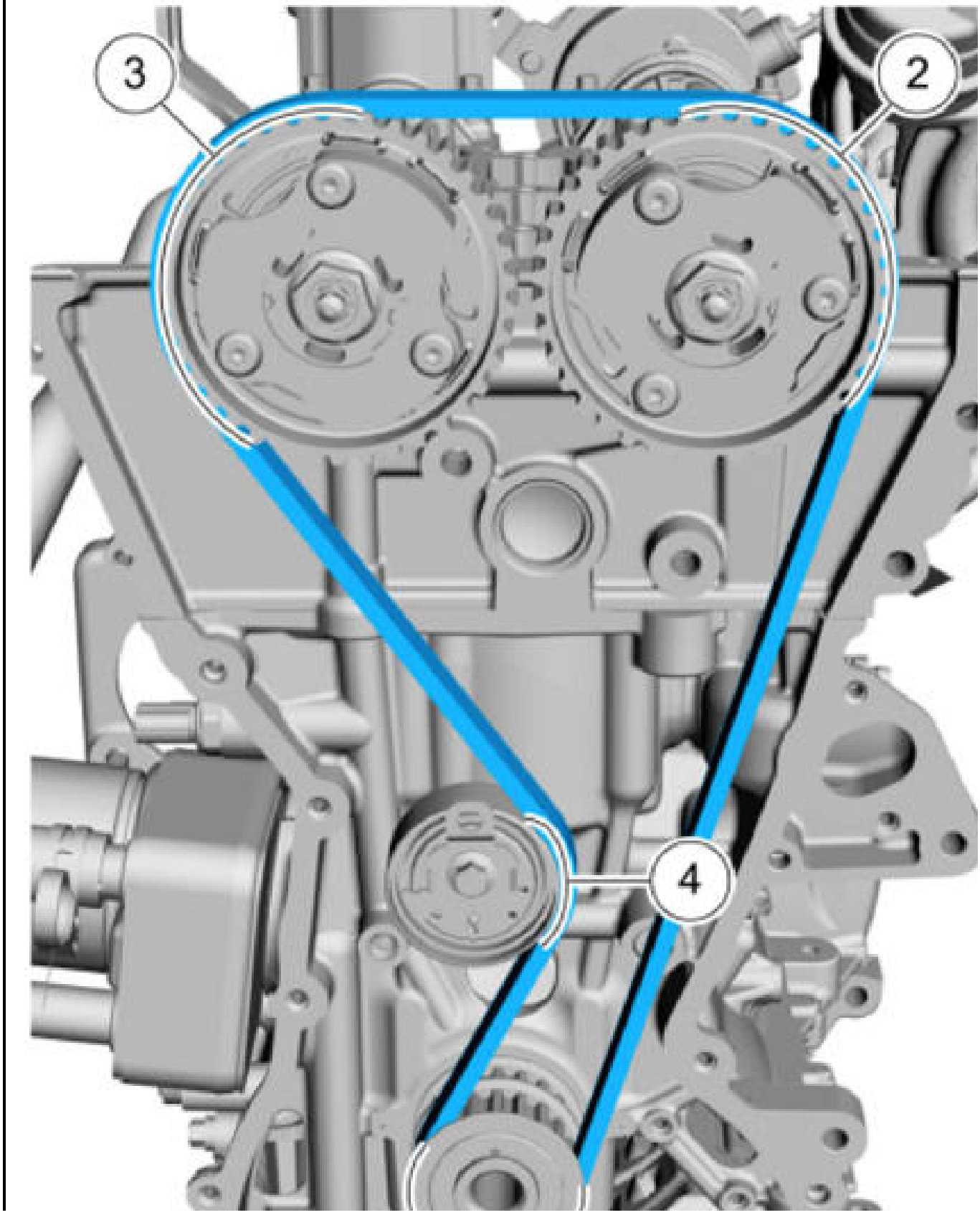
3.

Install Special Service Tool: 303-1054 Locking Tool, Timing Belt Tensioner.



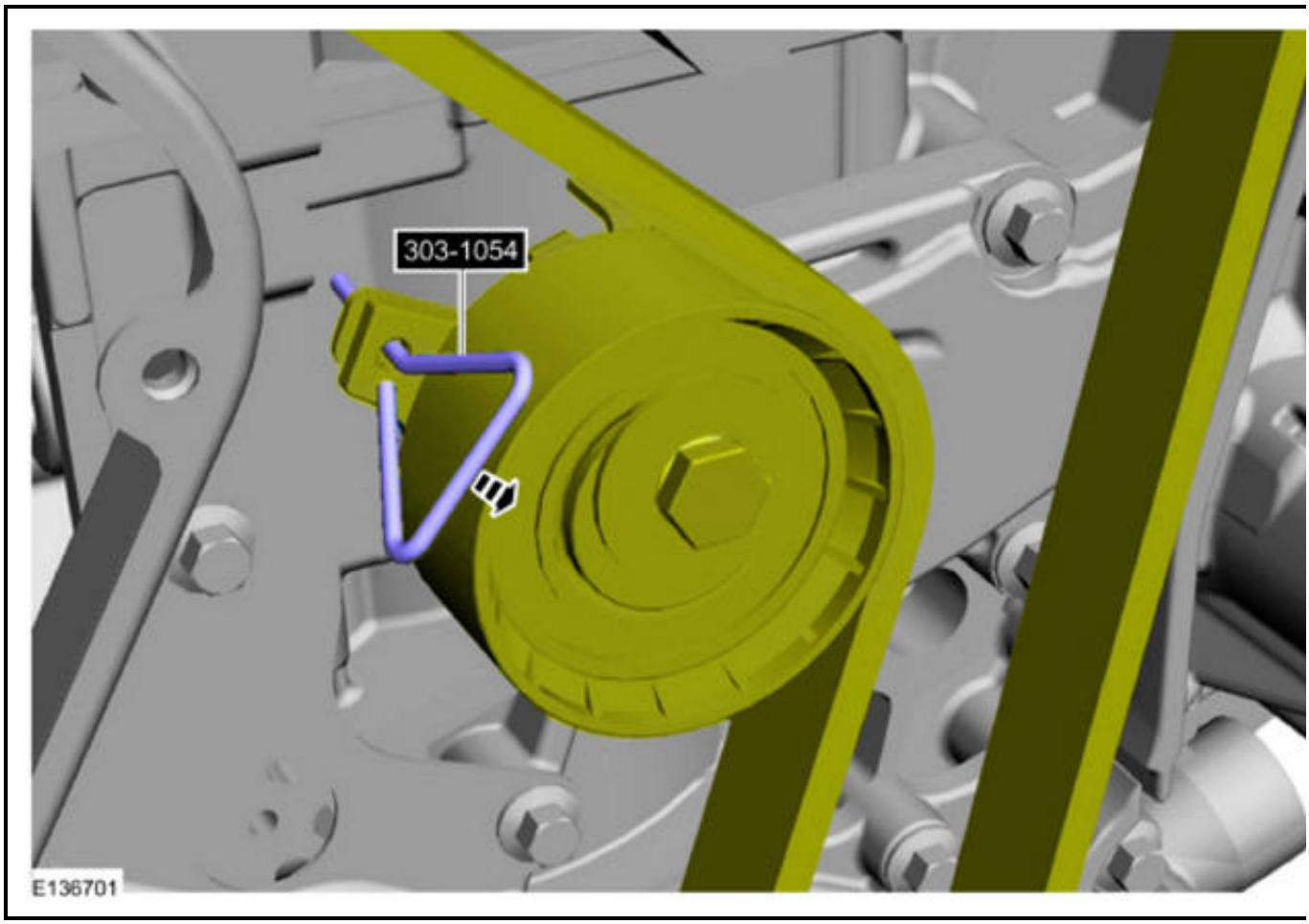
Installation

1.

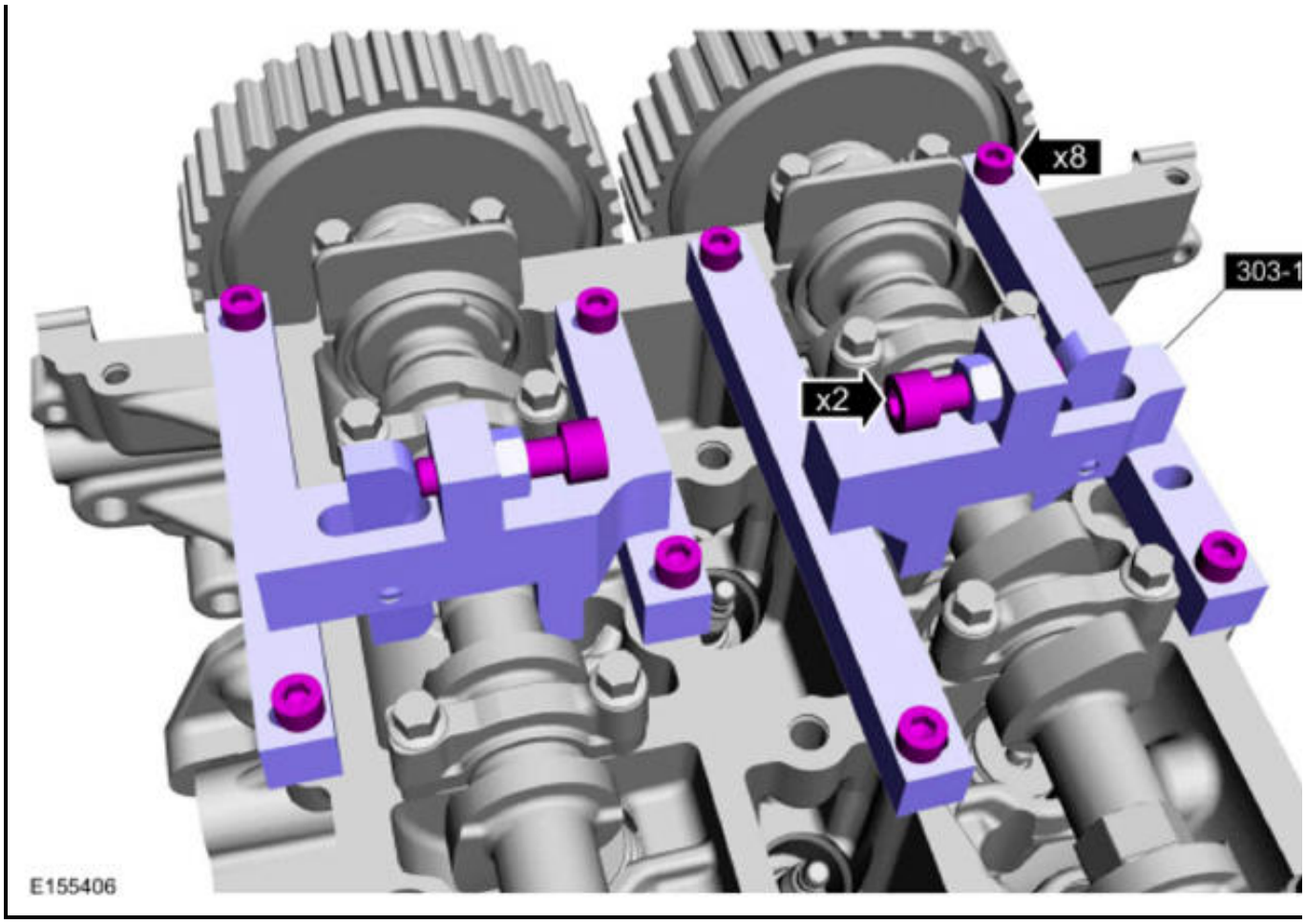


WARNING: Take extra care when handling the compressed spring.

2. Remove Special Service Tool: 303-1054 Locking Tool, Timing Belt Tensioner.



3. Remove Special Service Tool: 303-1605 Alignment Tool, Camshaft.



4. Refer to: **ENGINE FRONT COVER** .

VALVE COVER

Special Tool(s)/General Equipment

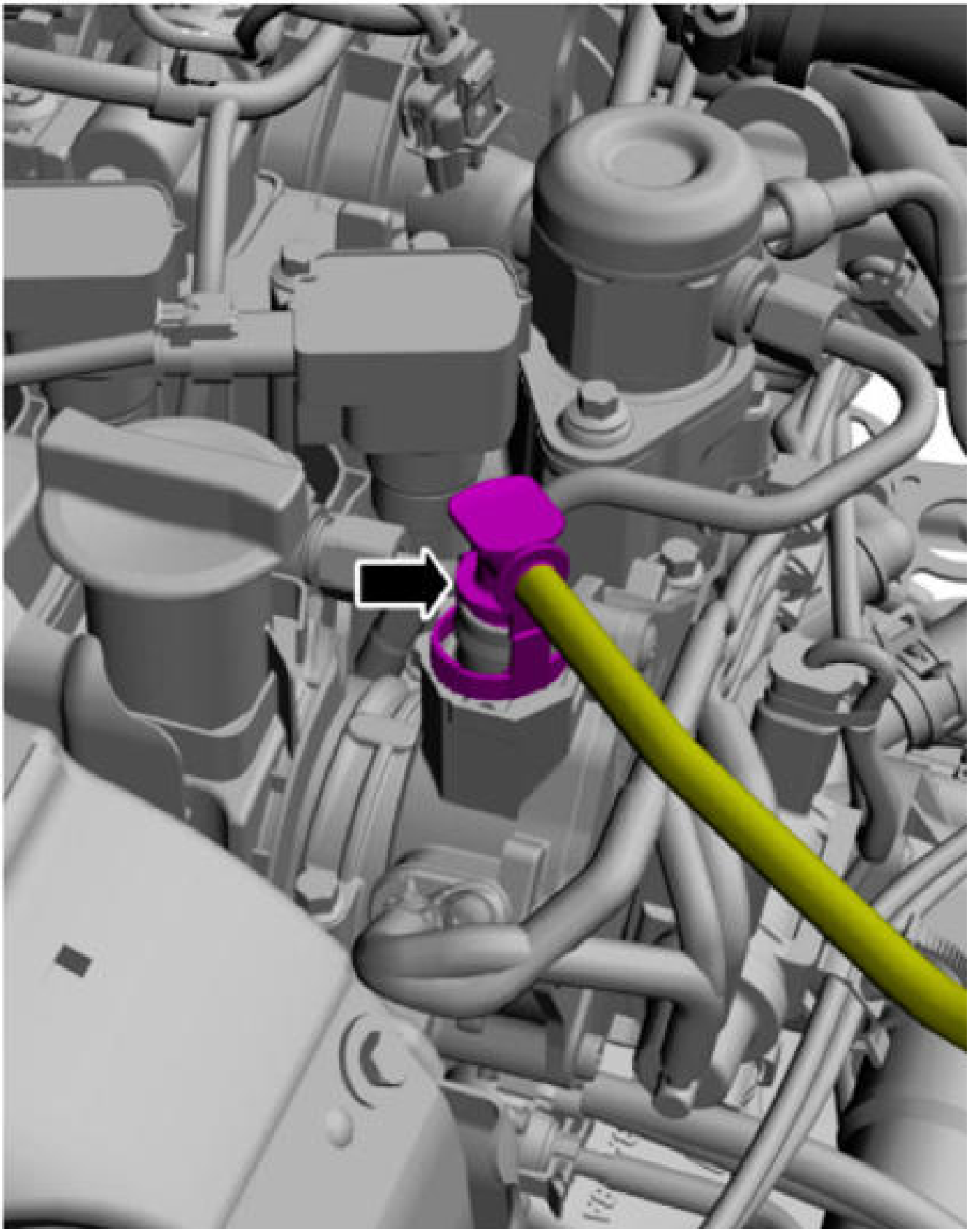
Hose Clamp Remover/Installer

MATERIAL SPECIFICATIONS

Name	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.) XO-5W20-QSP (U.S.)	WSS-M2C945-A
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Gasket Maker TA-16	WSK-M2G348-A5

Removal

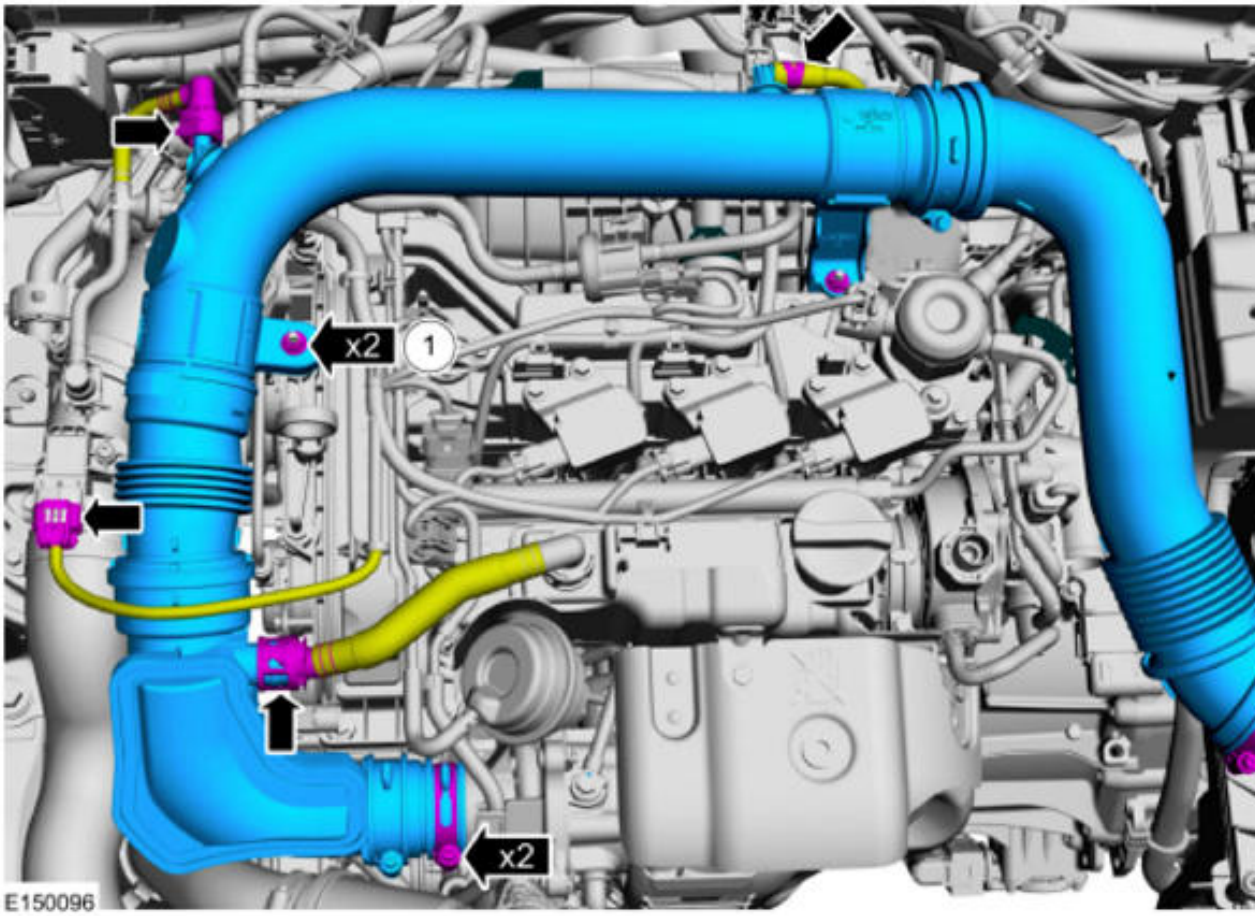
1. Refer to: **BATTERY DISCONNECT AND CONNECT** .
2. Refer to: **FUEL RAIL** .
3.



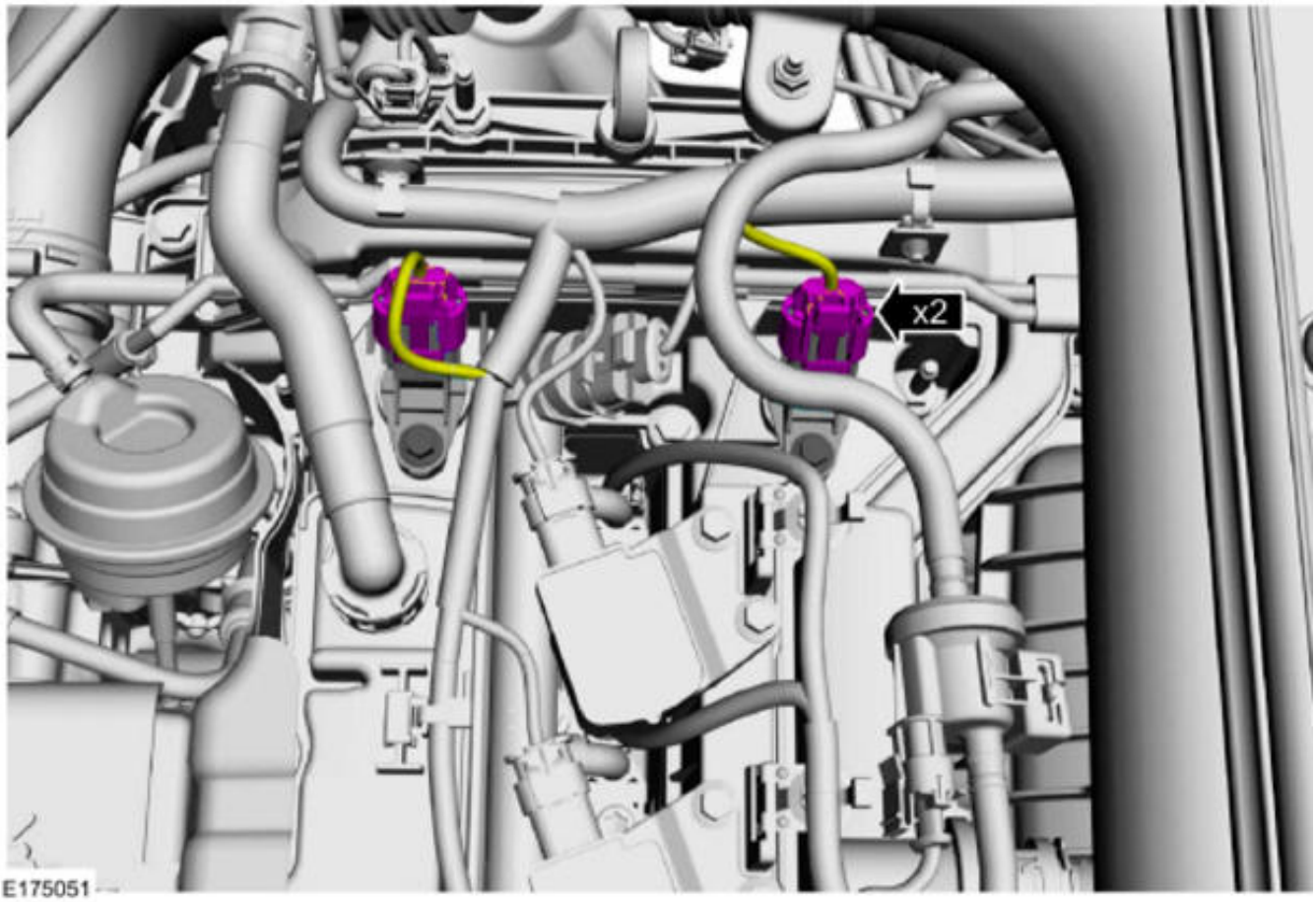
4.

1. Use the General Equipment: Hose Clamp Remover/Installer

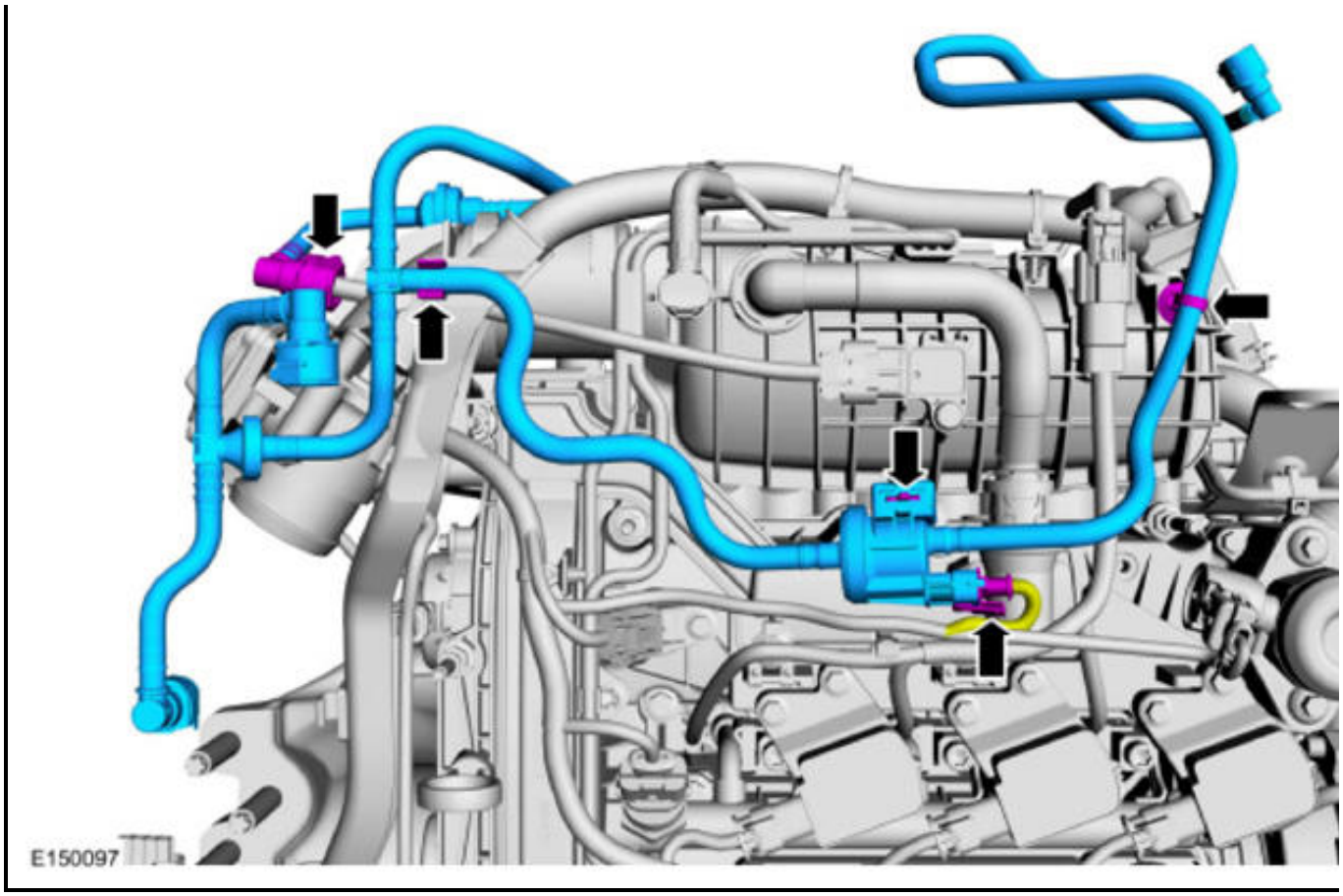
Torque : 97 lb.in (11 Nm)



5.

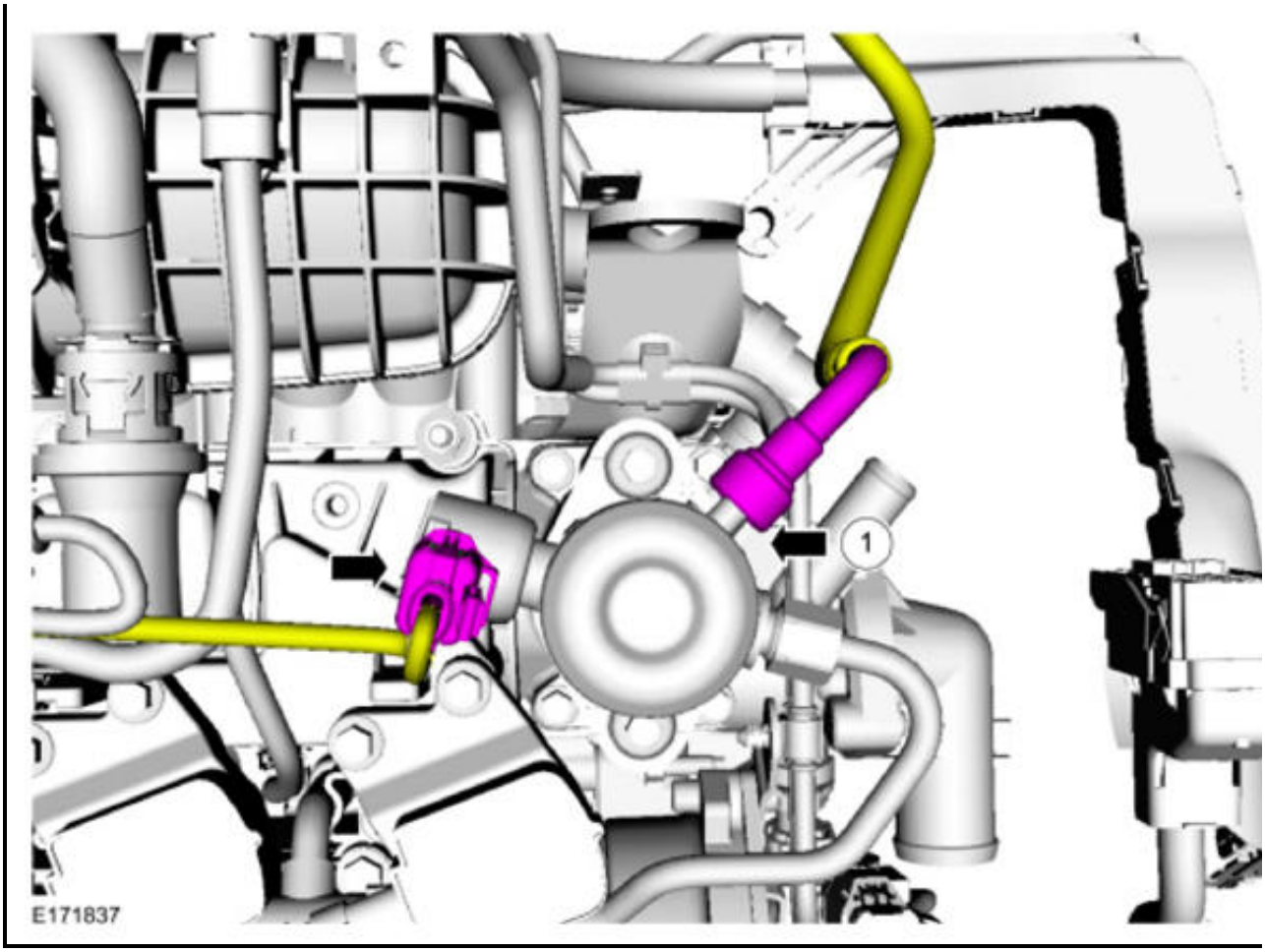
5. 

6. Refer to: **QUICK RELEASE COUPLING** .

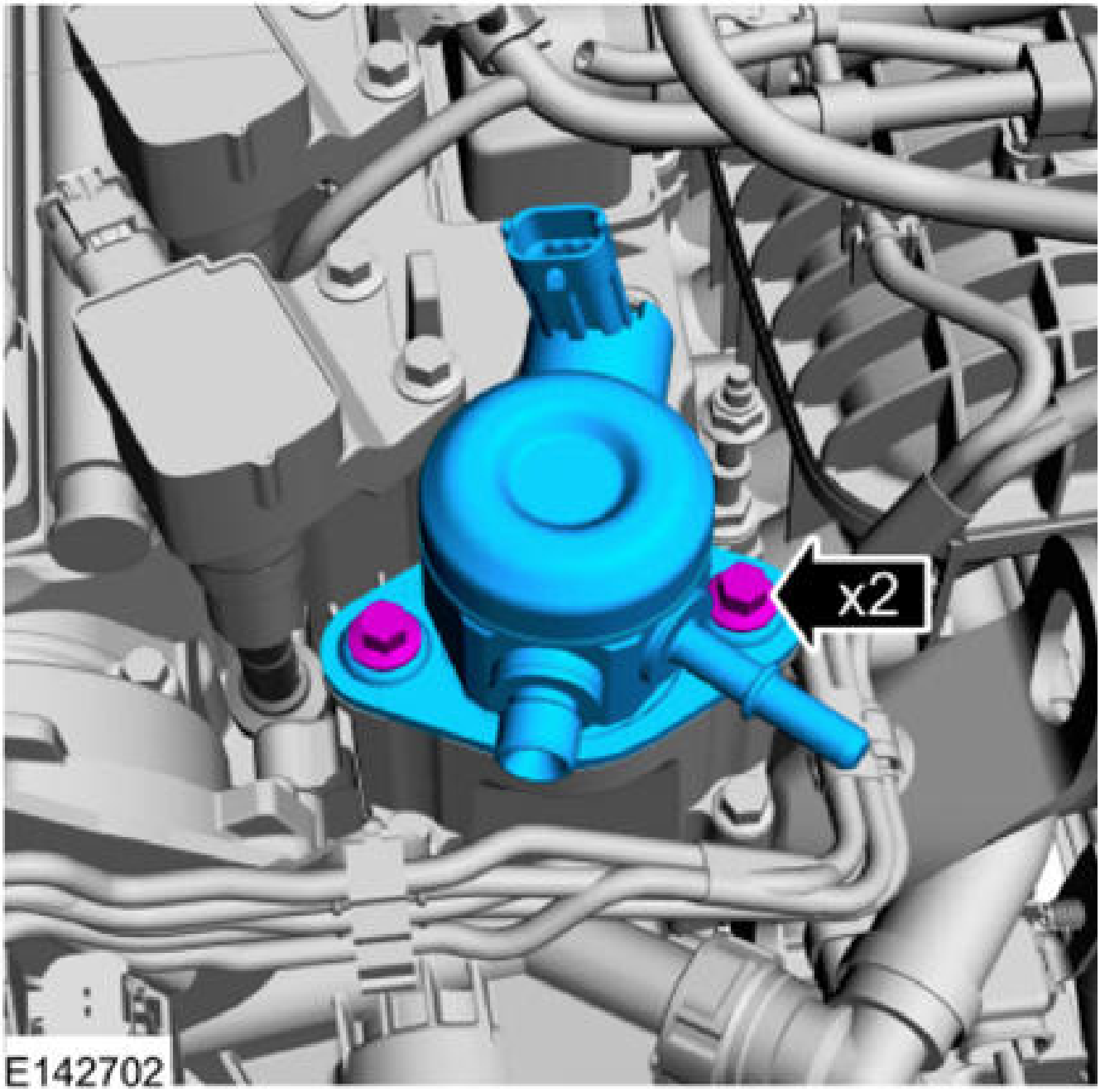


7.

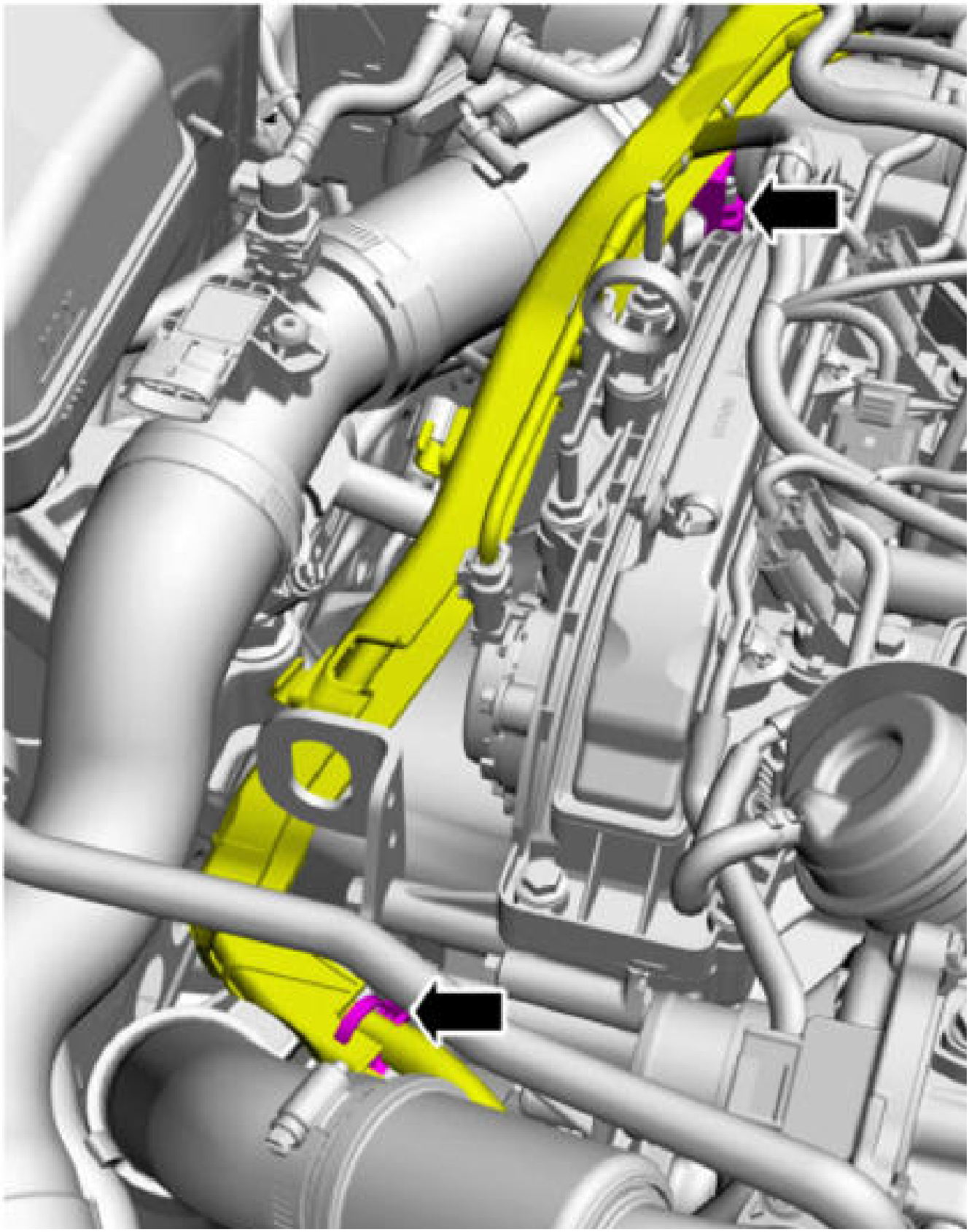
1. Refer to: **SPRING LOCK COUPLINGS** .

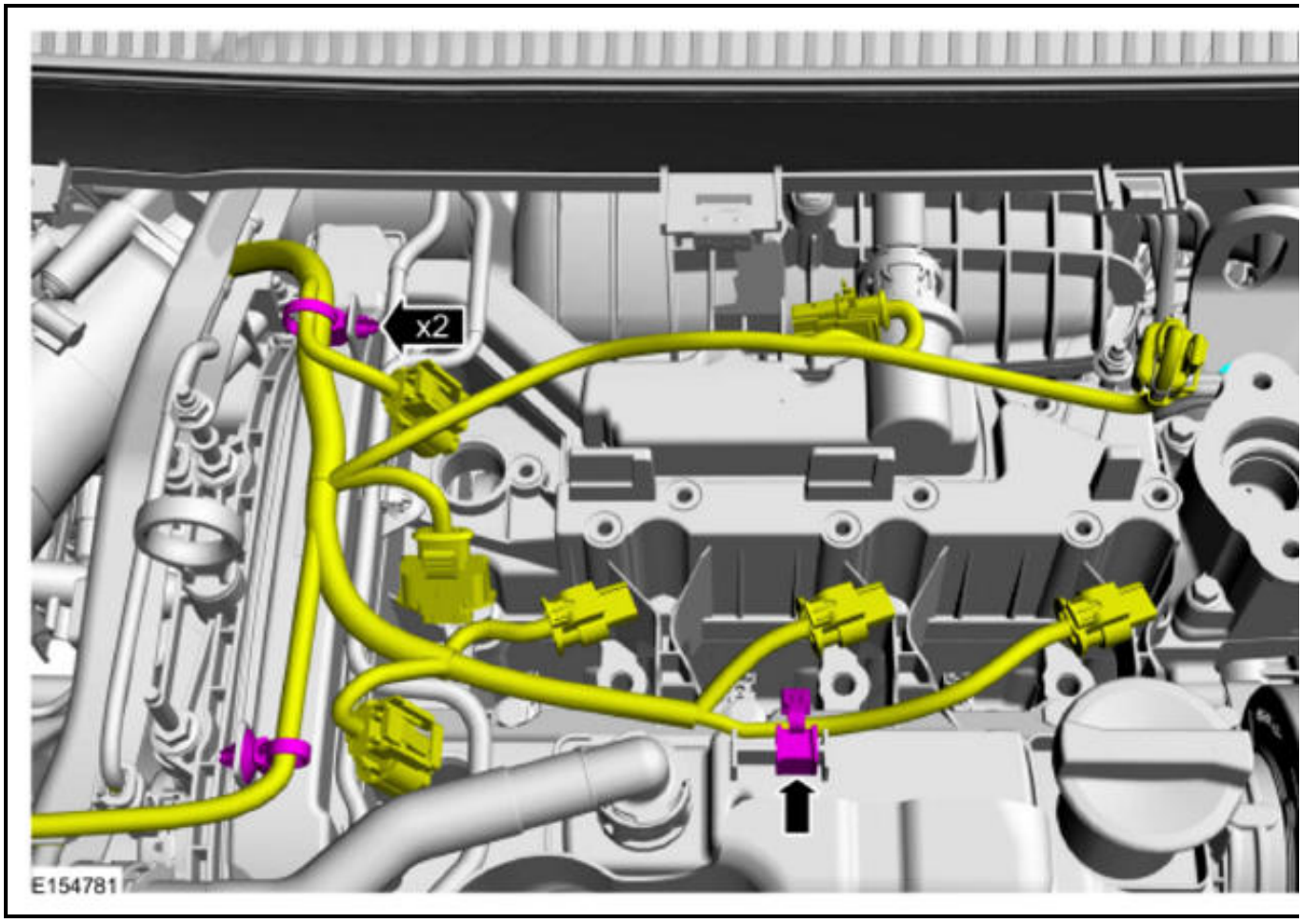


8. Loosen each bolt 1 turn at a time until all bolts are removed.

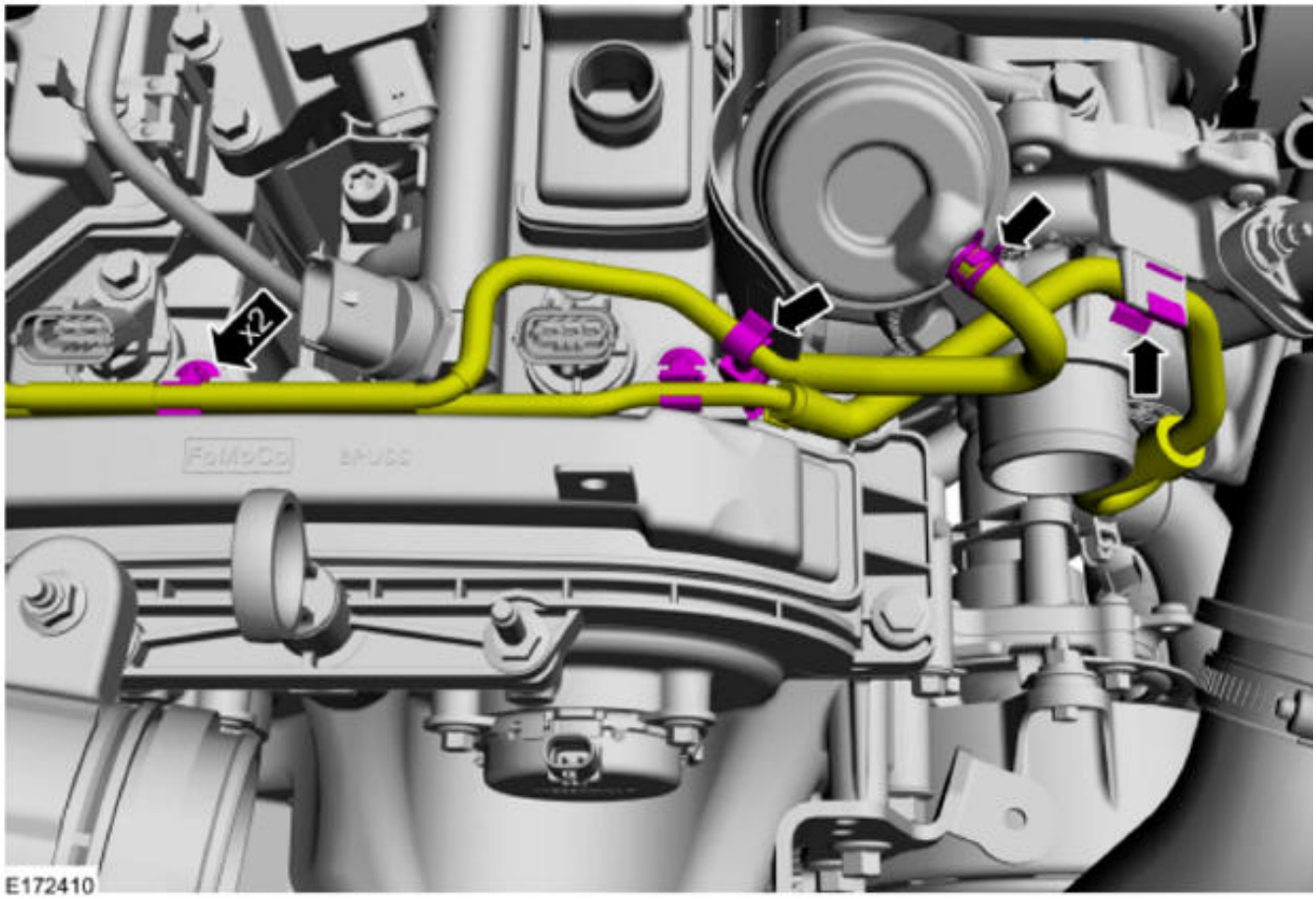


9.

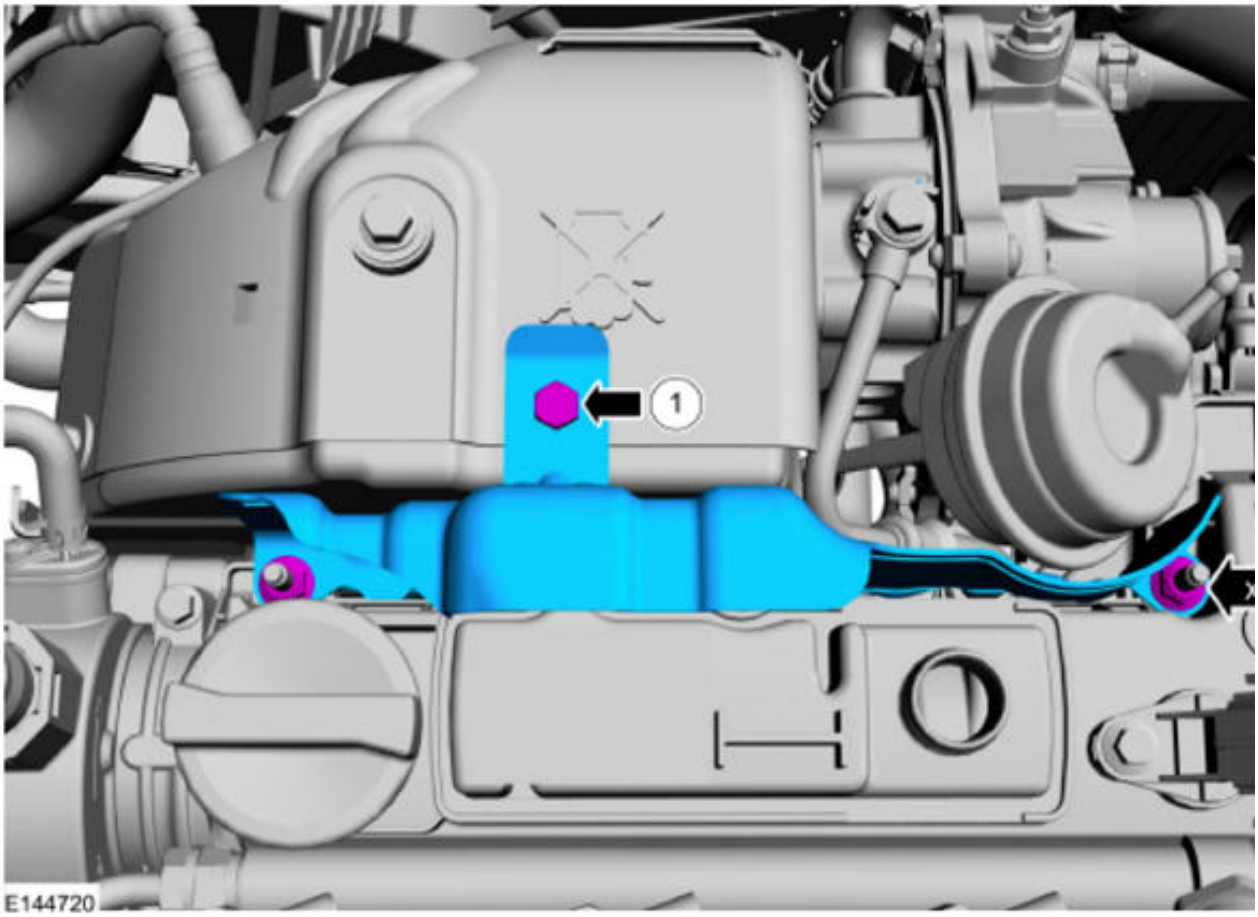


10. 

11. Use the General Equipment: Hose Clamp Remover/Installer

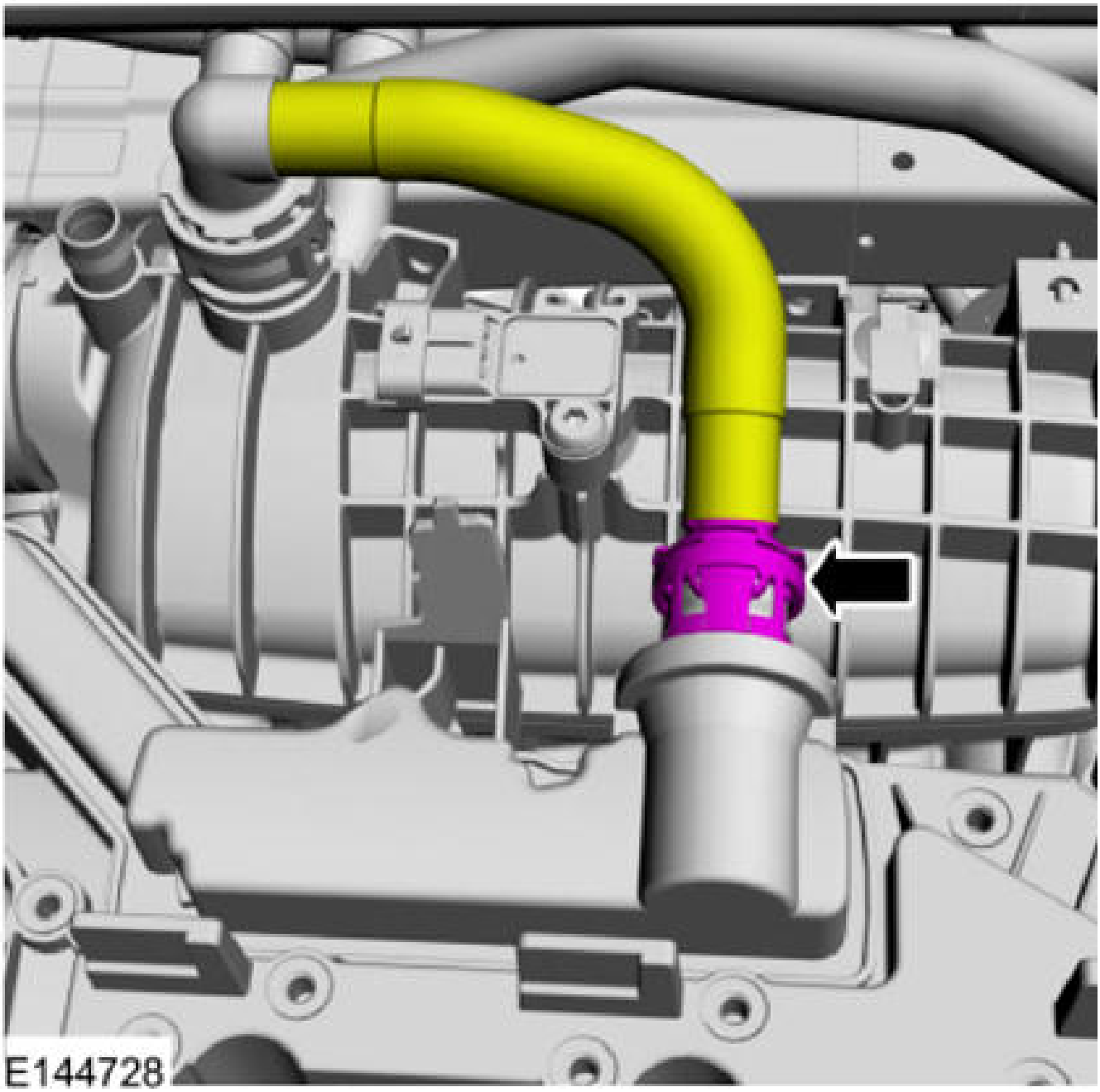


12. *Torque* :
    1. 97 lb.in (11 Nm)
    2. 53 lb.in (6 Nm)



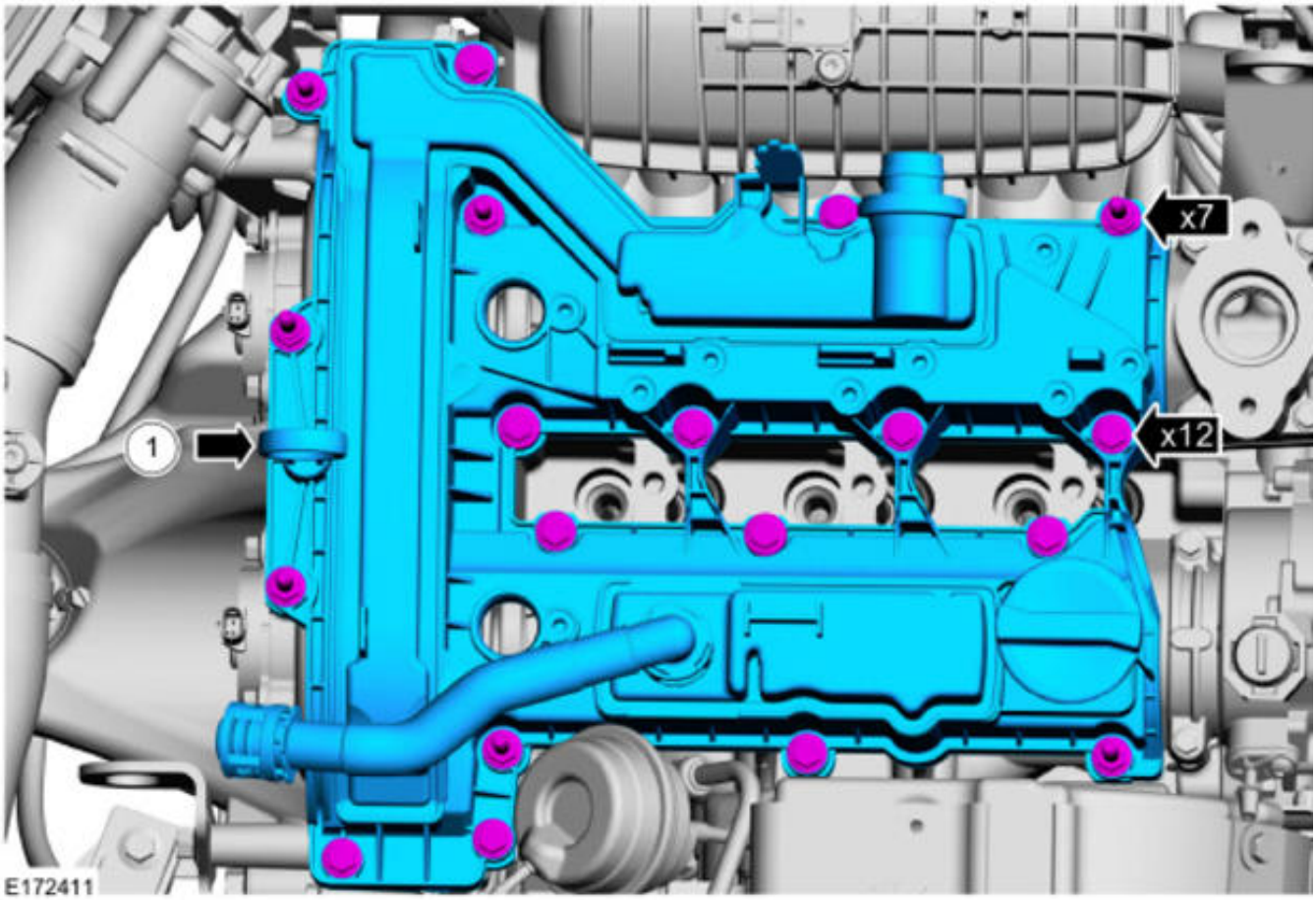
13.

13.



14.

14.



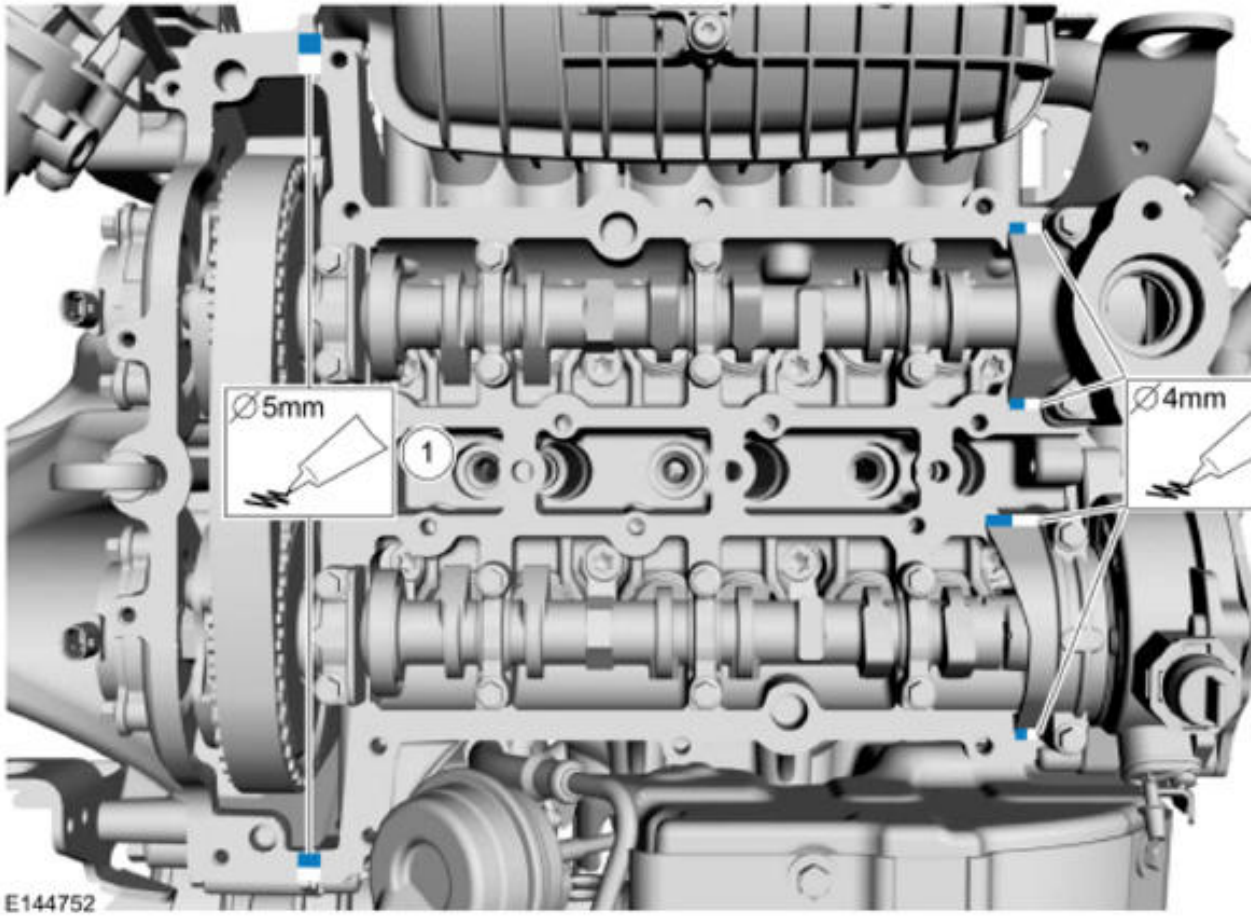
Installation

1. To install, reverse the removal procedure.

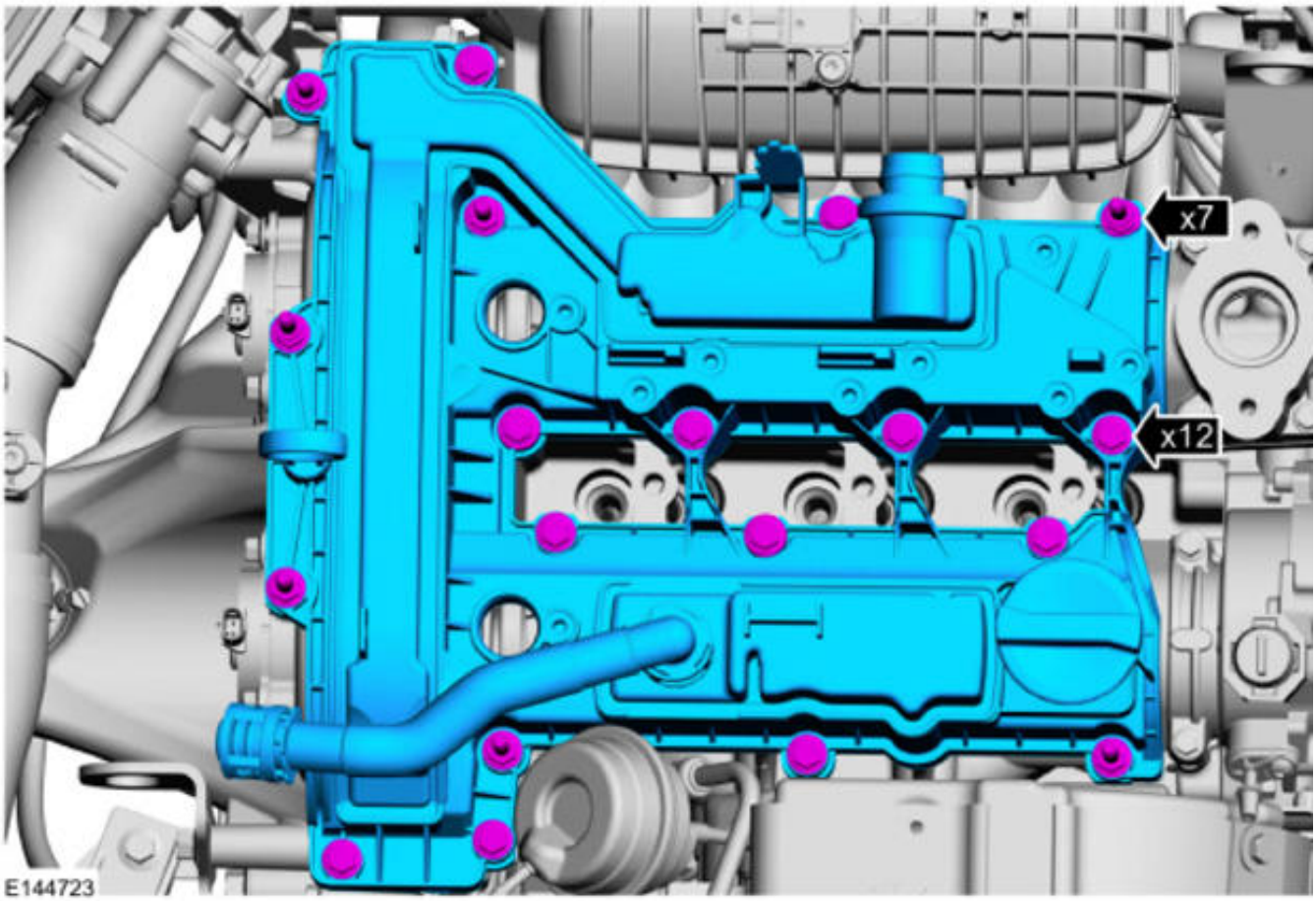
NOTE: **Make sure that the component is clean, free of foreign material and lubricant.**

2.

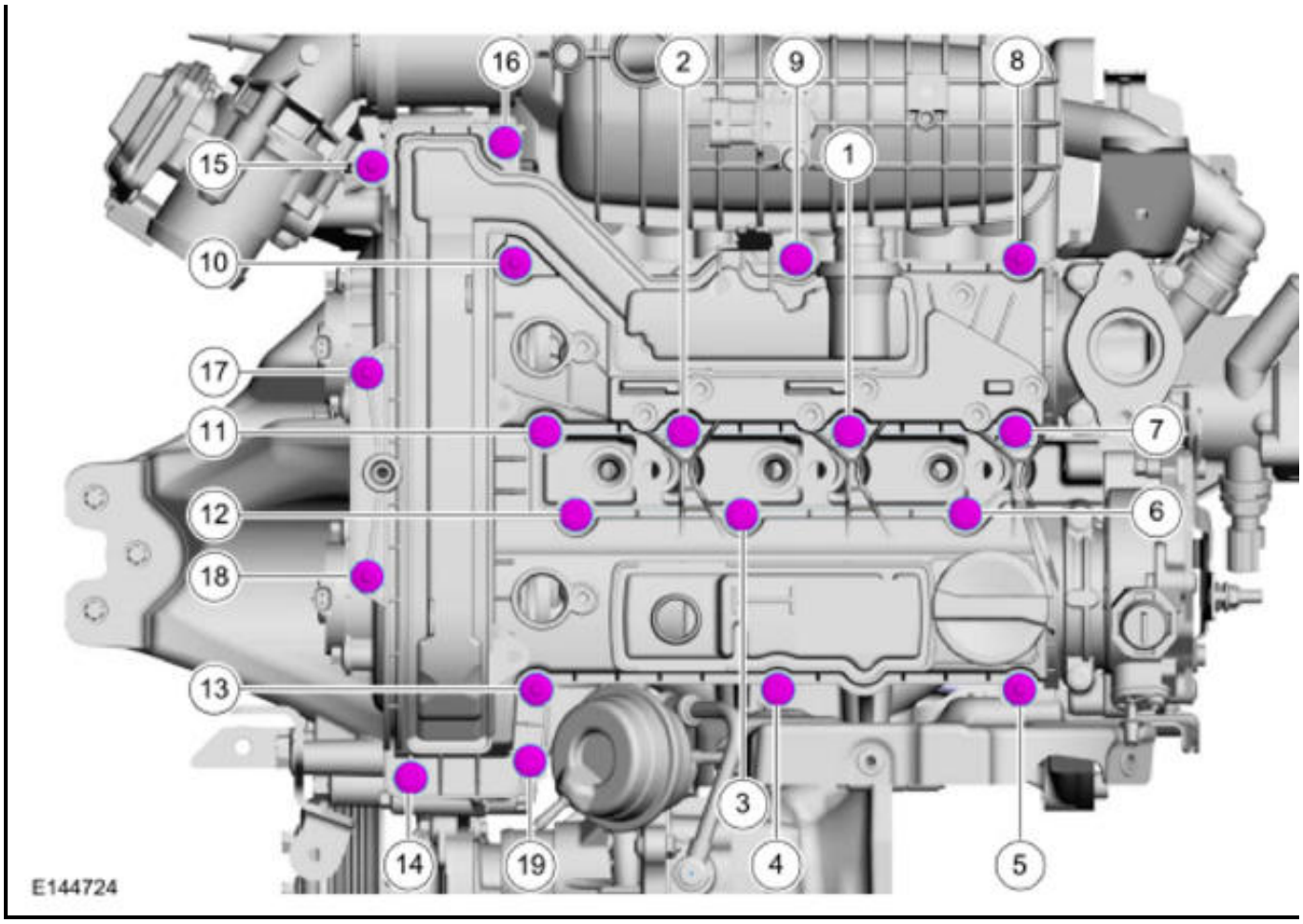
1. *Material* : Silicone Gasket and Sealant/TA-30 (WSE-M4G323-A4)
2. *Material* : Gasket Maker/TA-16 (WSK-M2G348-A5)



3. **NOTE: Only tighten the bolts finger tight at this stage.**



4. *Torque* : 89 lb.in (10 Nm)



5.

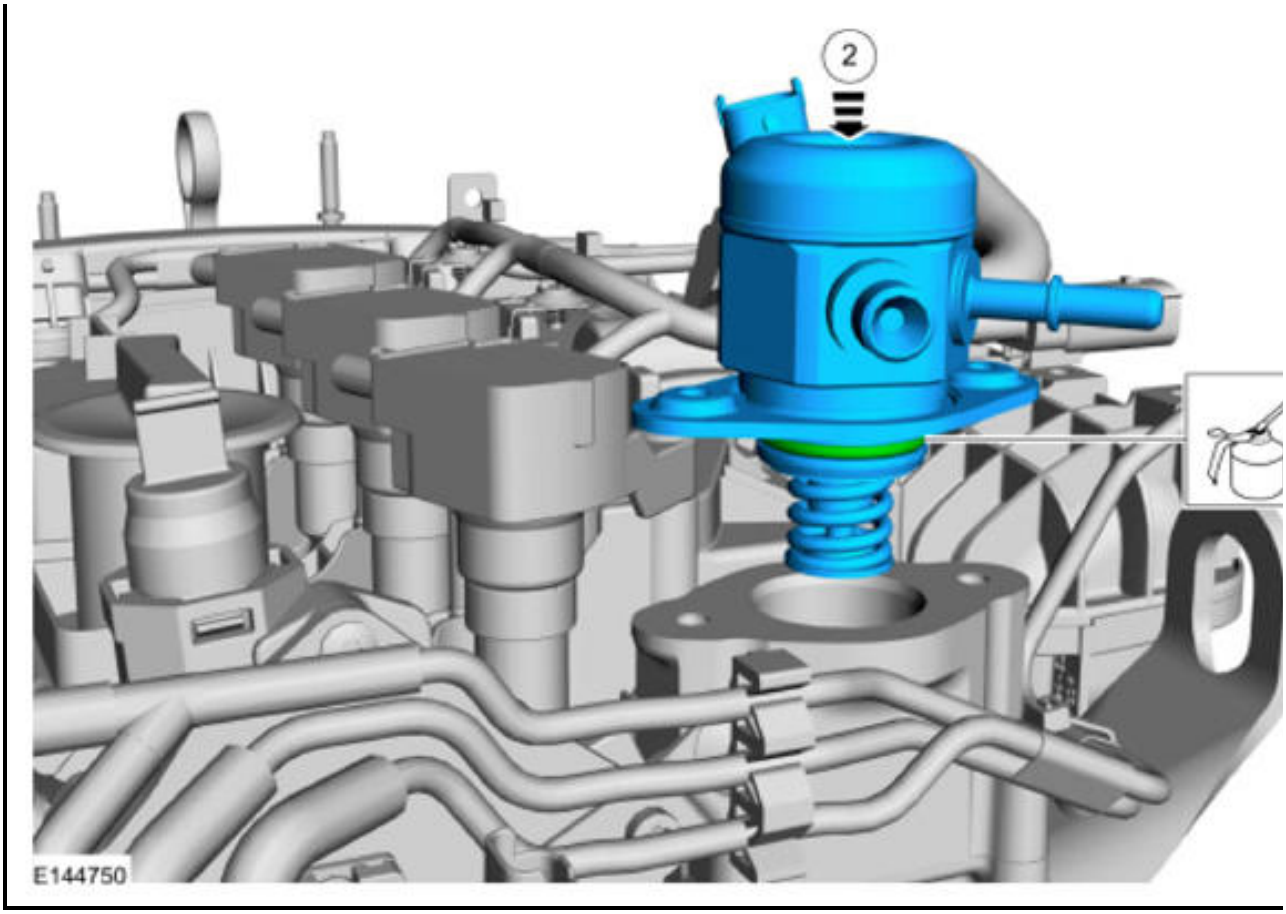
1.

NOTE: Make sure that a new component is installed.

Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

2.

NOTE: Only use moderate force.

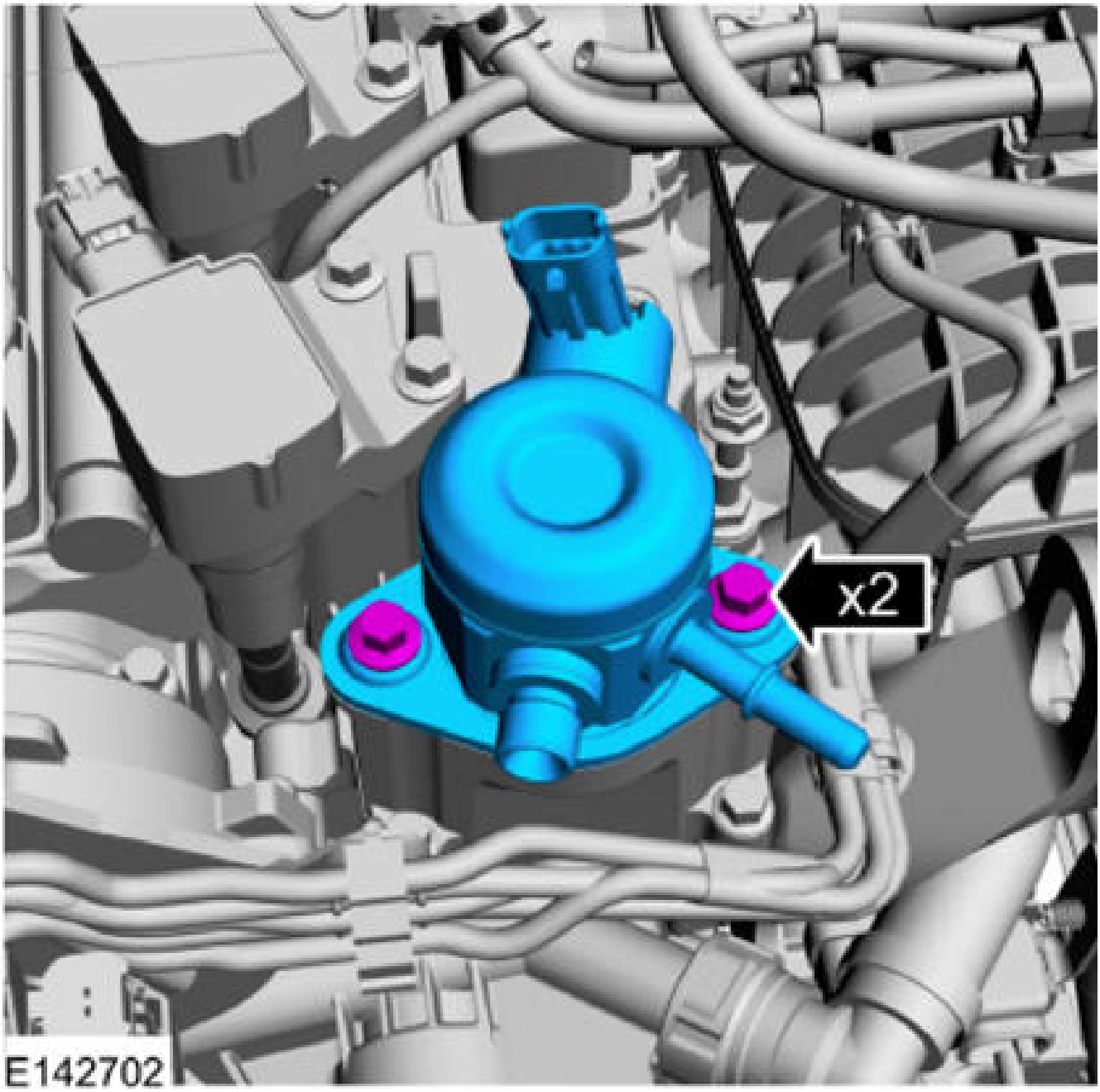


6. Tighten each bolt 0.5 turn at a time.

   Torque :

   Stage 1: 44 lb.in (5 Nm)

   Stage 2: 115 lb.in (13 Nm)



ENGINE MOUNT

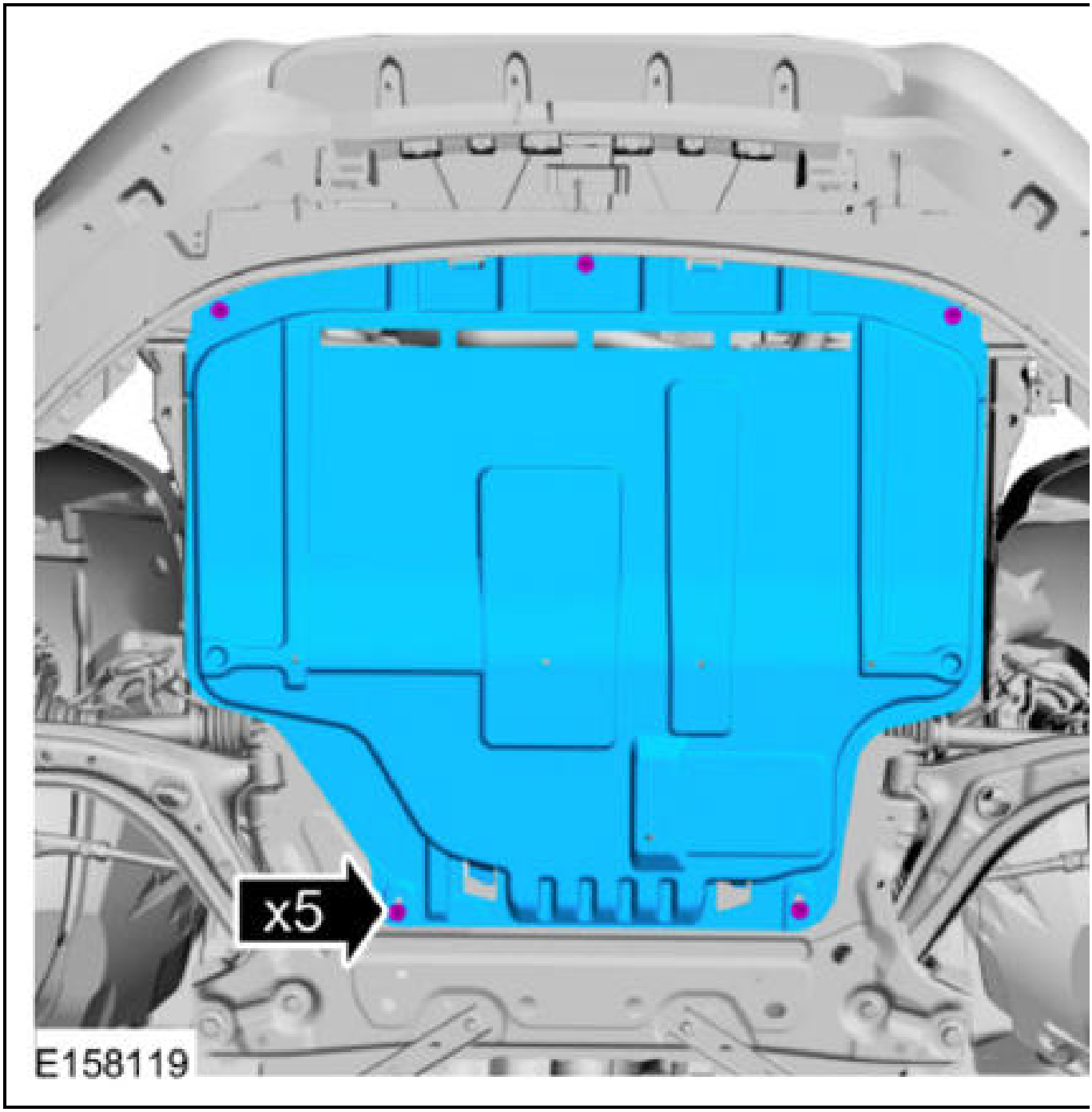
SPECIAL TOOL DESCRIPTION

Trolley Jack
Wooden Block

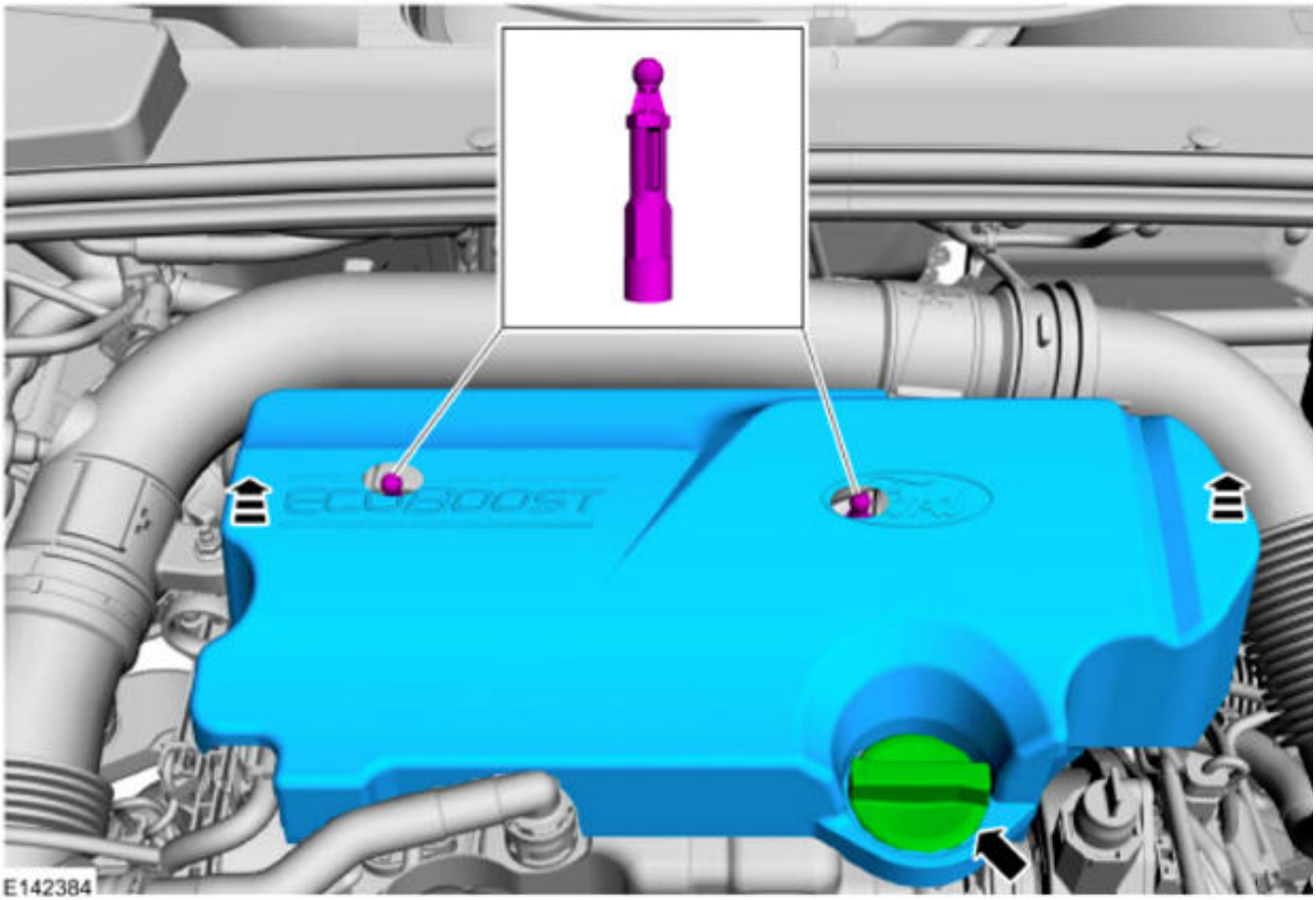
Removal

NOTE: Removal steps in this procedure may contain installation details.

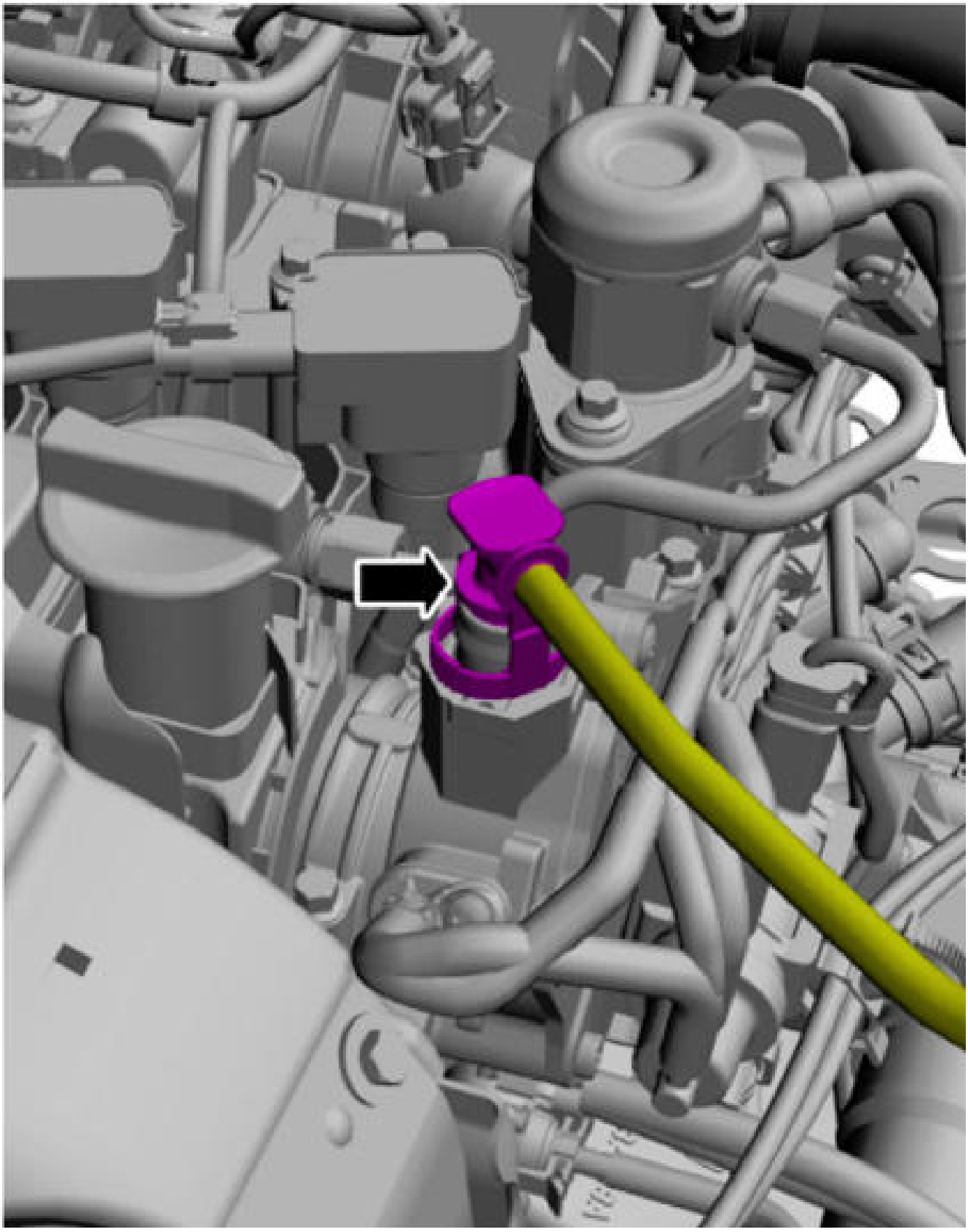
1. Refer to: **JACKING AND LIFTING - OVERVIEW** .
2. If equipped.



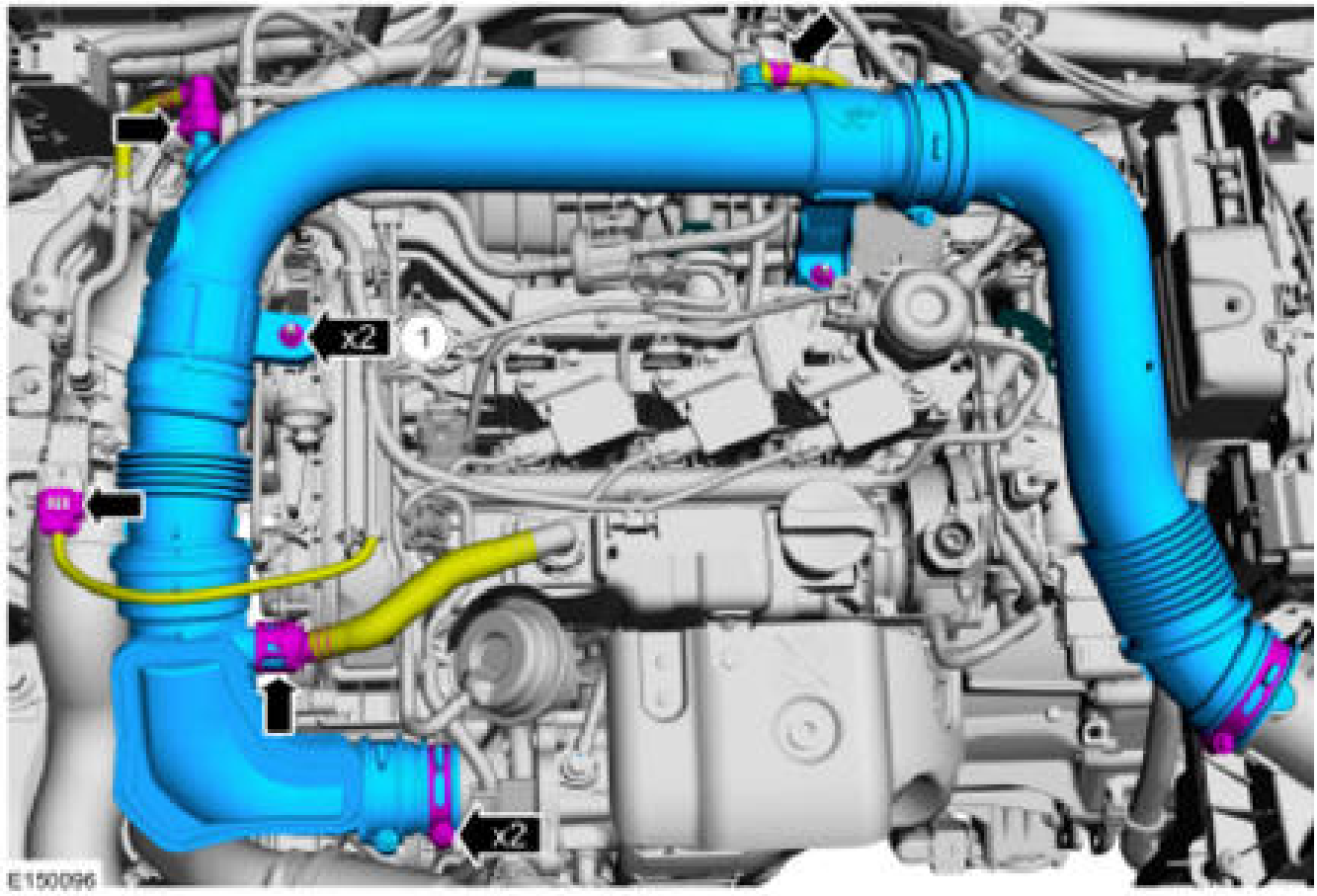
3. If equipped.



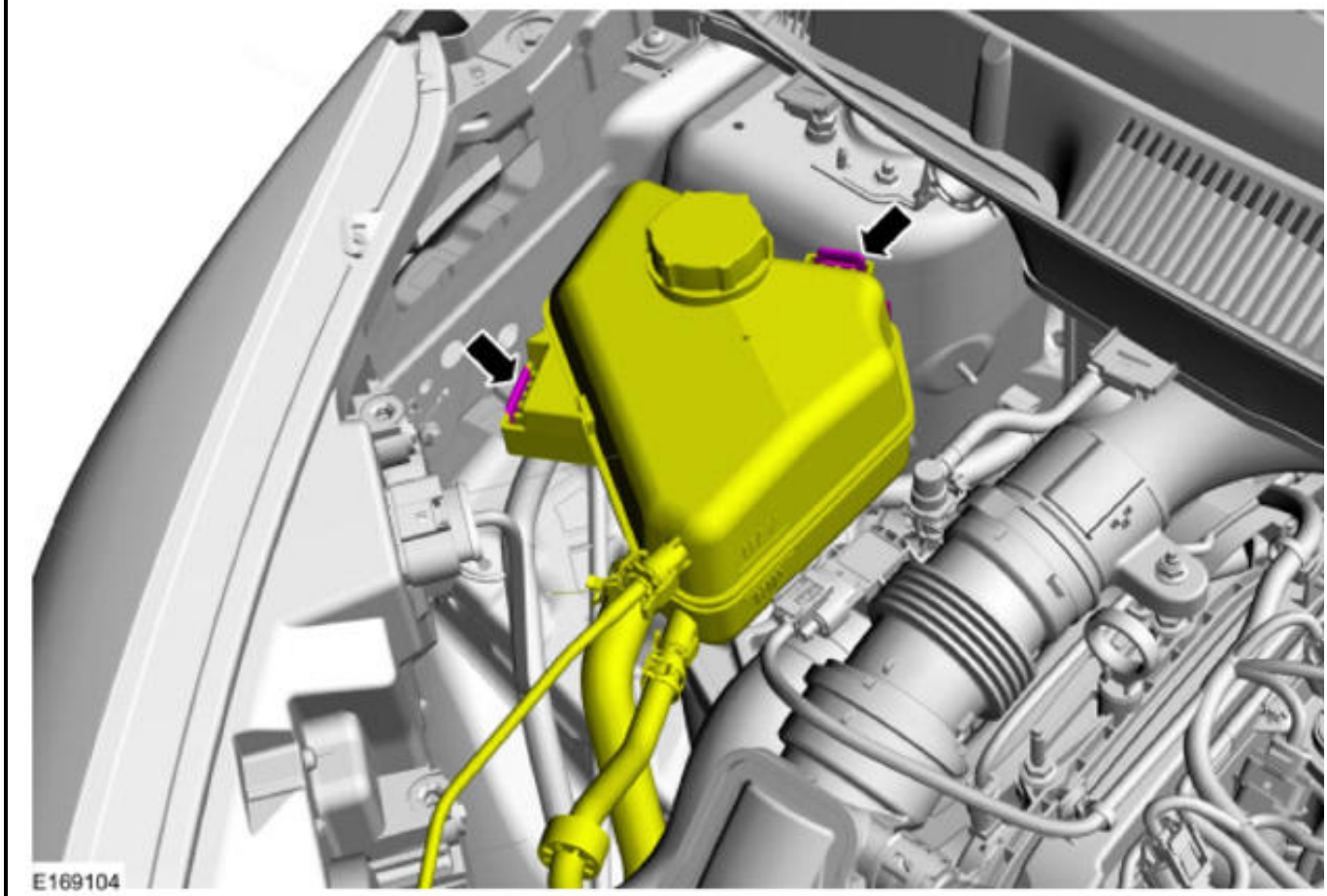
4.



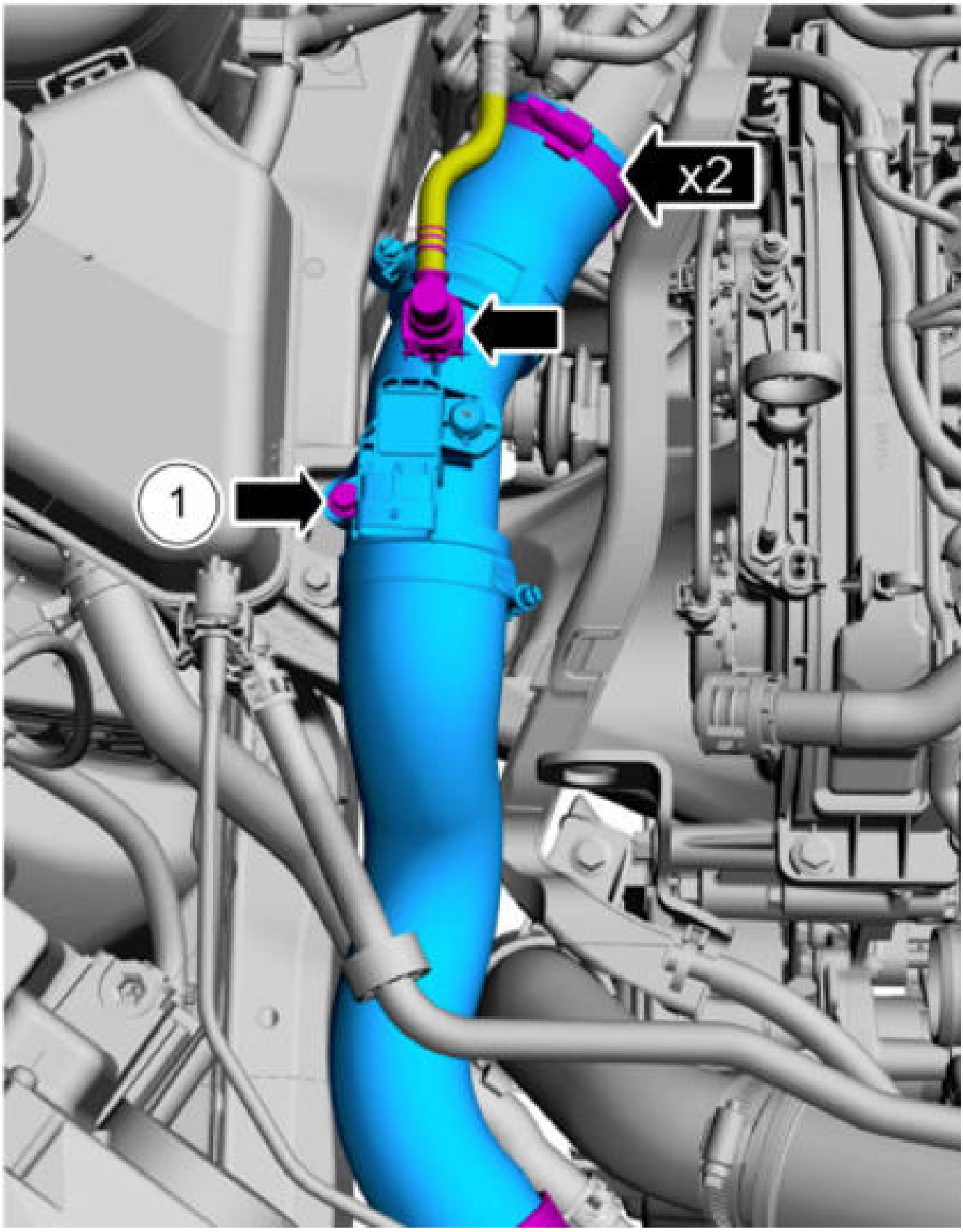
5. Refer to: **QUICK RELEASE COUPLING** .



6.

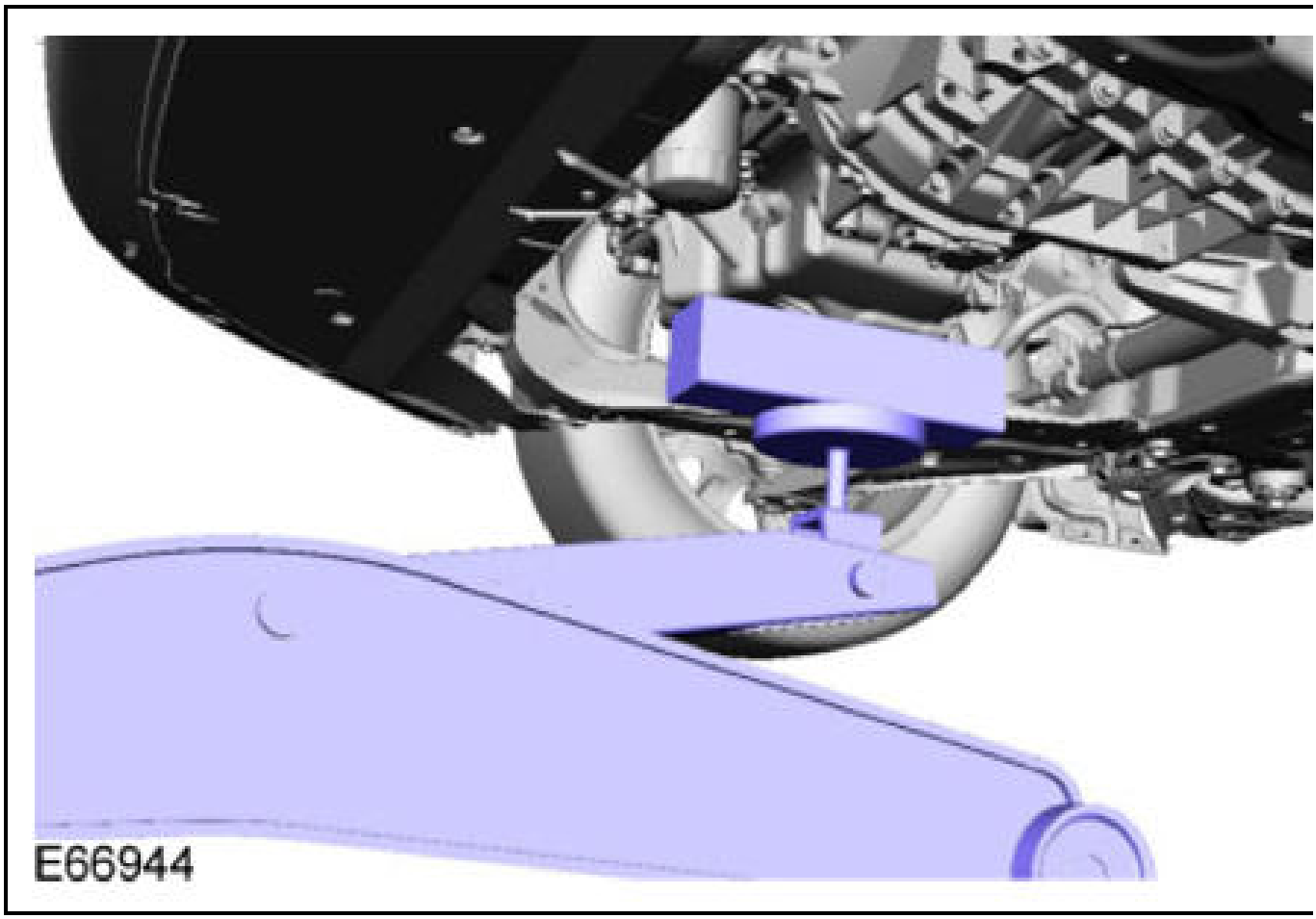
6. 

7. Refer to: **QUICK RELEASE COUPLING** .



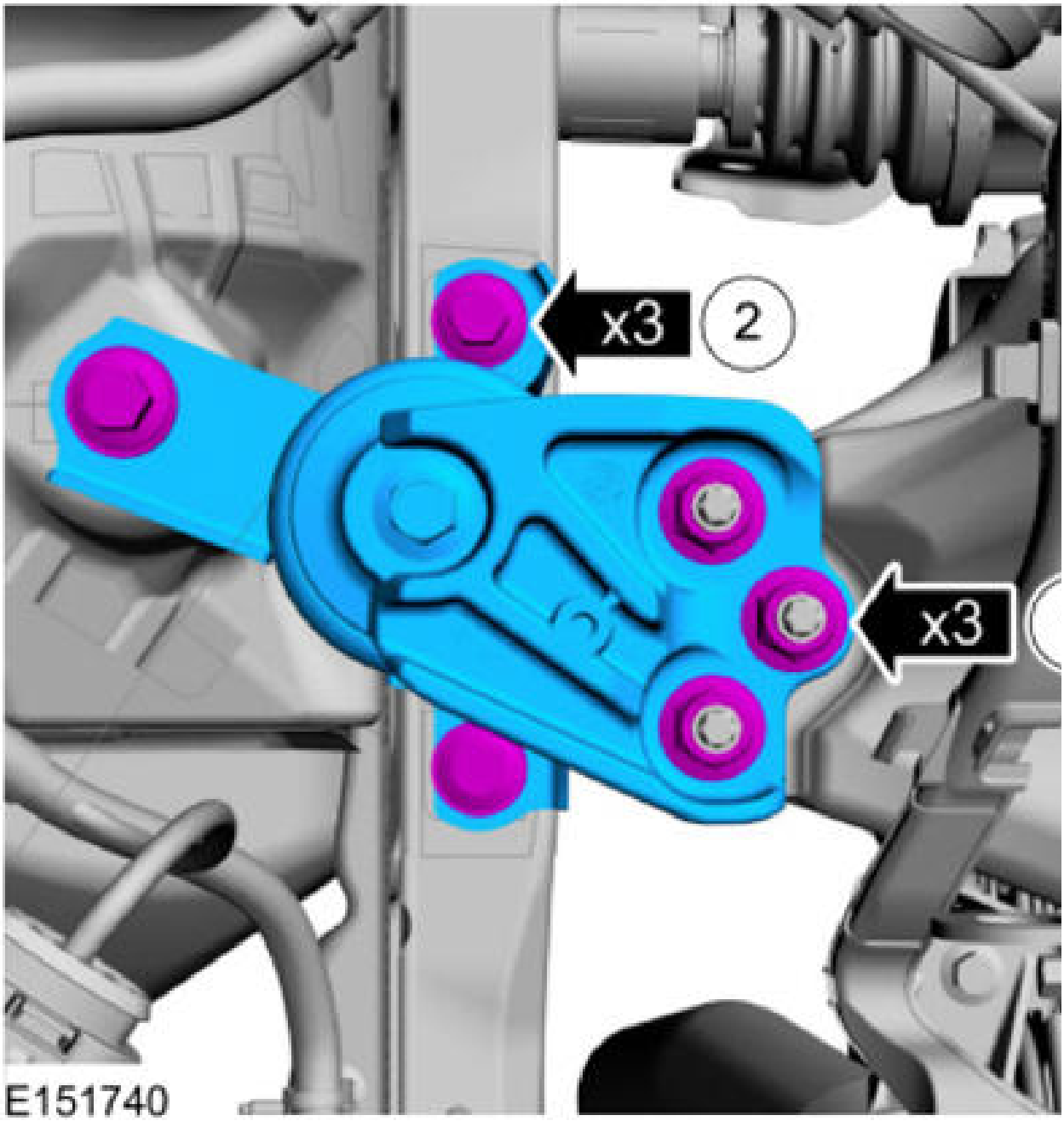
8. Use the General Equipment: Trolley Jack

   Use the General Equipment: Wooden Block



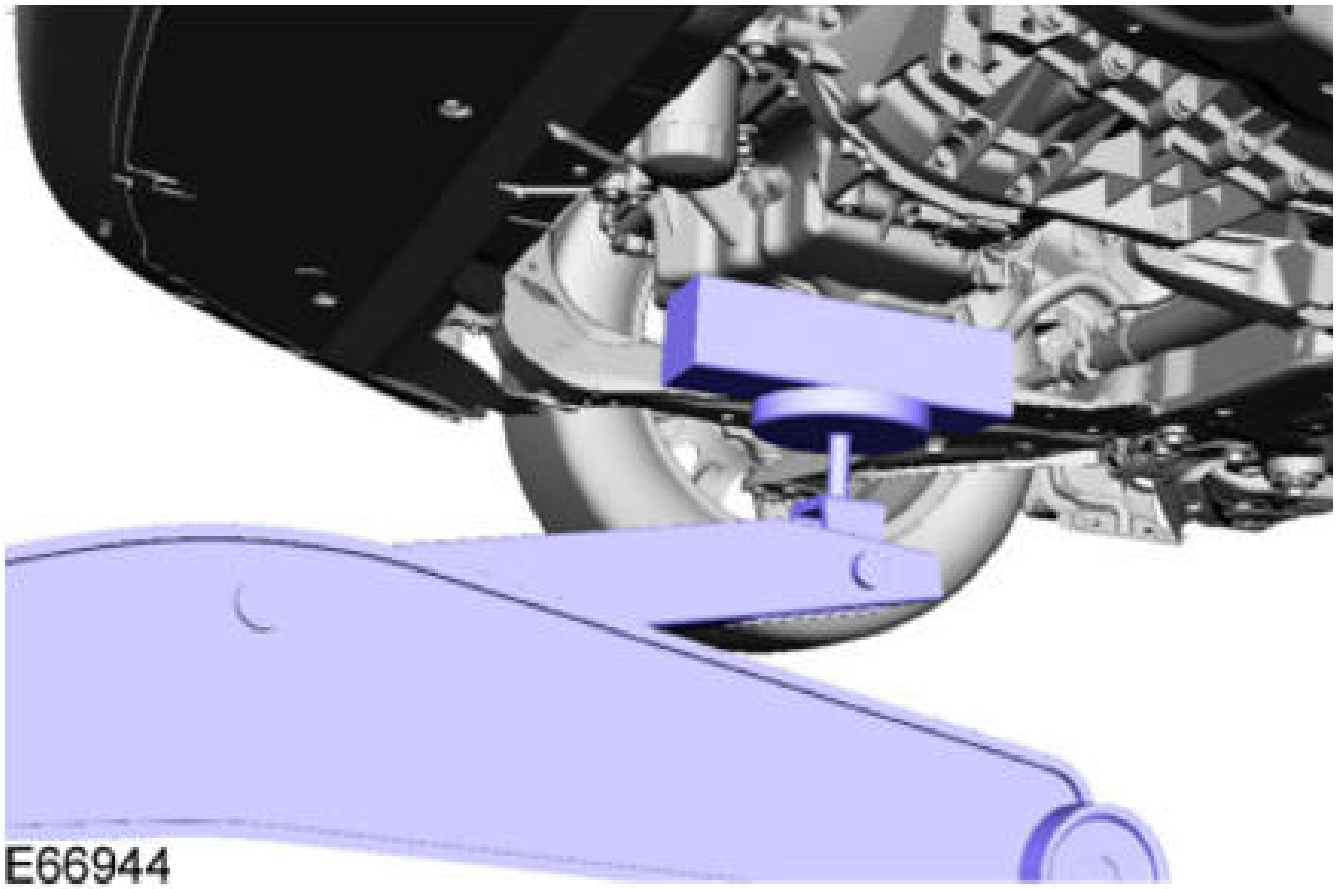
9.

   1. *Torque* : 35 lb.ft (48 Nm)
   2. Do not tighten at this time.

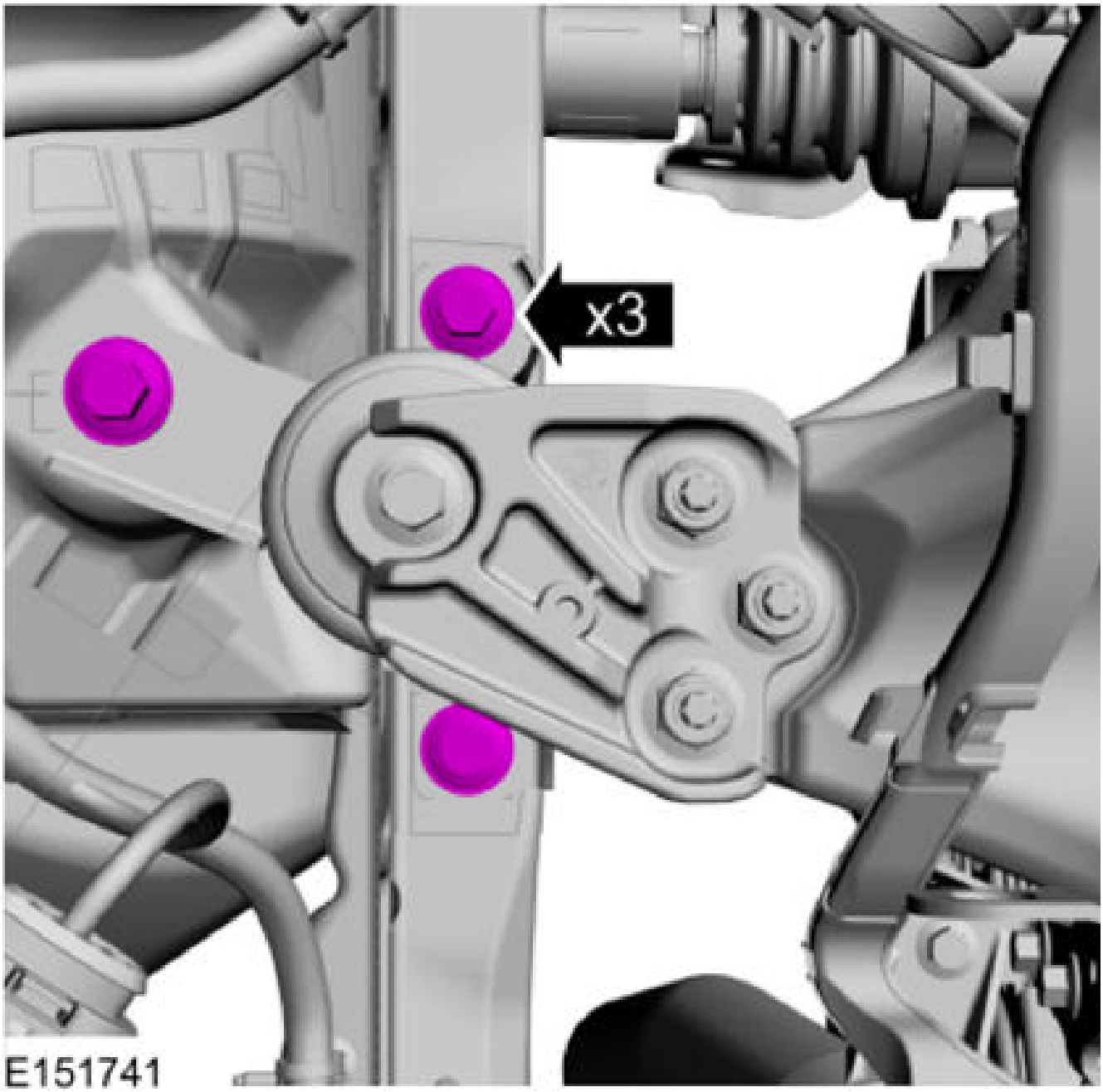


10. Use the General Equipment: Trolley Jack

    Use the General Equipment: Wooden Block

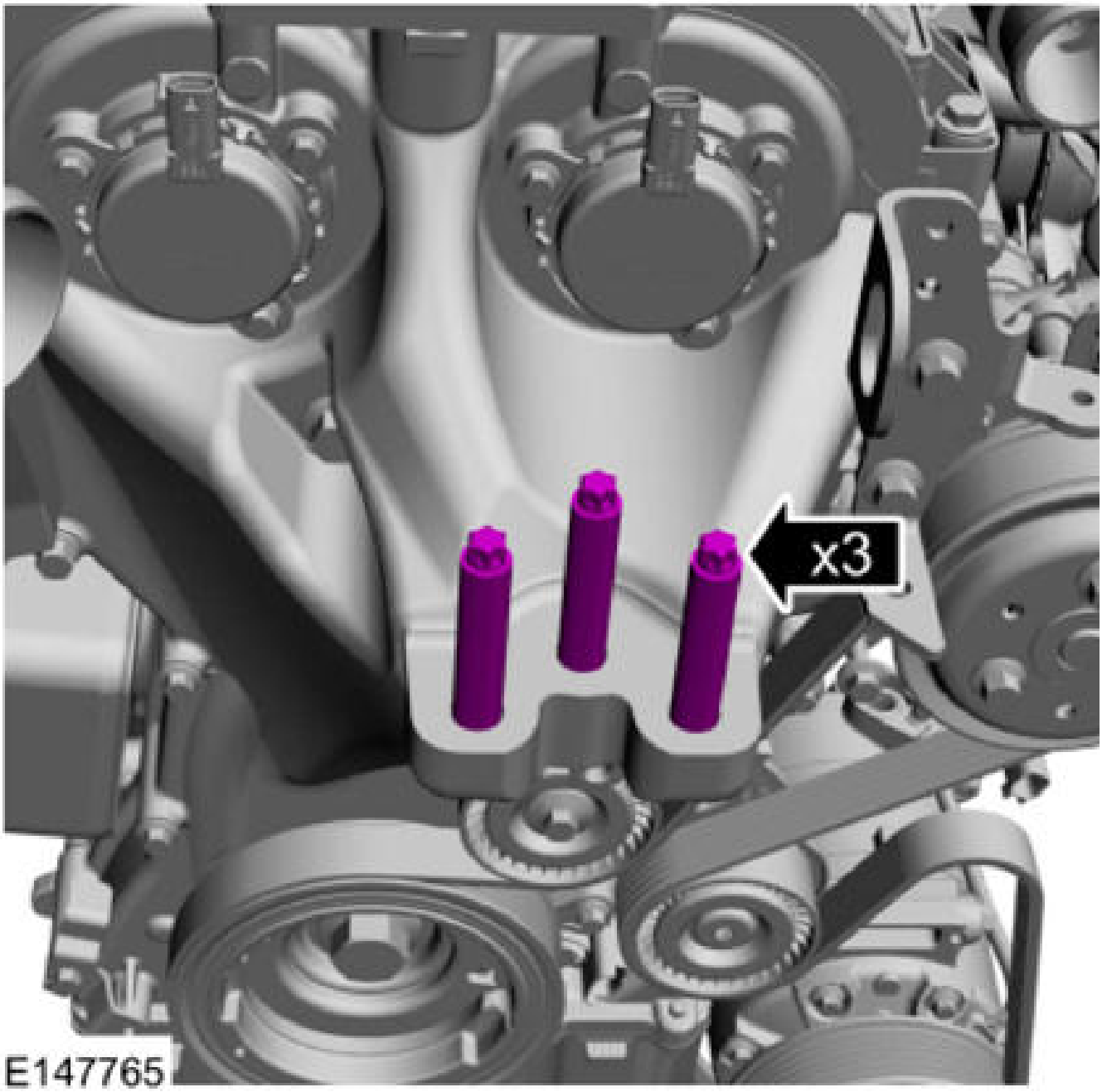


11. *Torque* : 66 lb.ft (90 Nm)



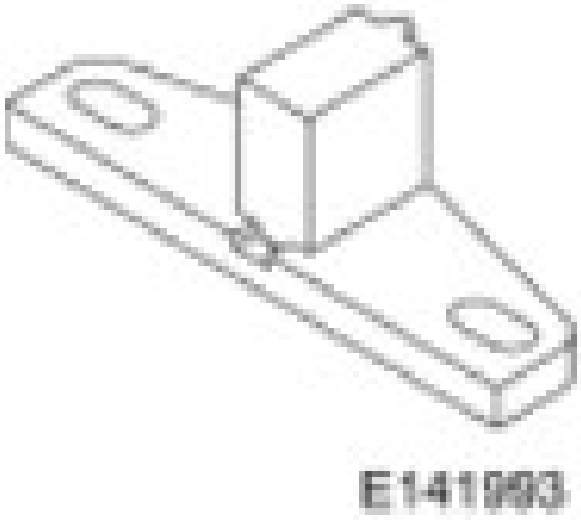
Installation

1. To install, reverse the removal procedure.
2. *Torque* : 89 lb.in (10 Nm)



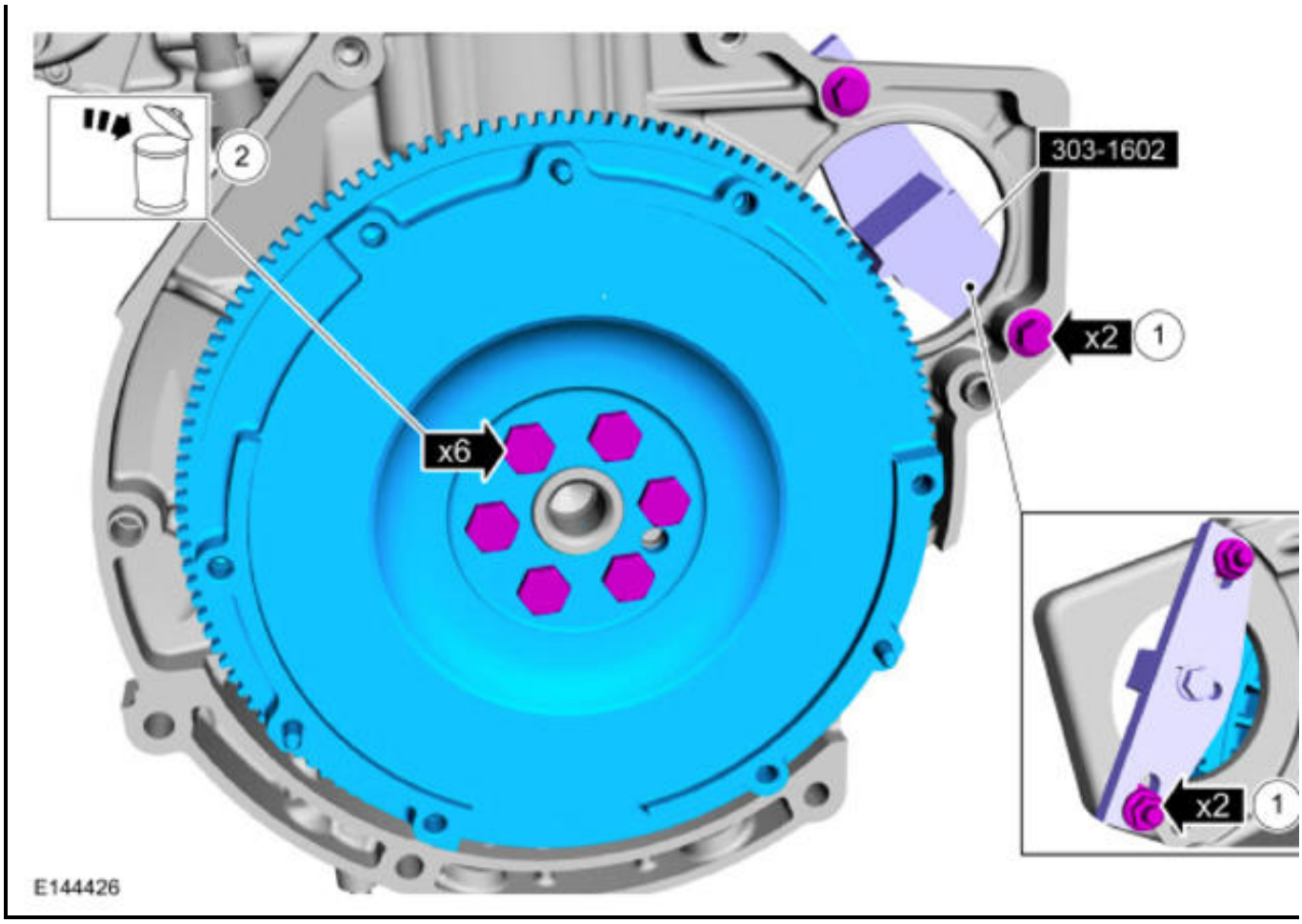
FLYWHEEL

SPECIAL TOOL DESCRIPTION

 E141983	303-1602 Locking Tool, Crankshaft

Removal

1. Refer to: **JACKING AND LIFTING - OVERVIEW** .
2. Refer to: **CLUTCH DISC AND PRESSURE PLATE - 1.0L ECOBOOST (90KW/120PS)** .
3. Use Special Service Tool: 303-1602 Locking Tool, Crankshaft.



Installation

1. **NOTE: Make sure that new bolts are installed.**

   Use Special Service Tool: 303-1602 Locking Tool, Crankshaft.

   Torque :

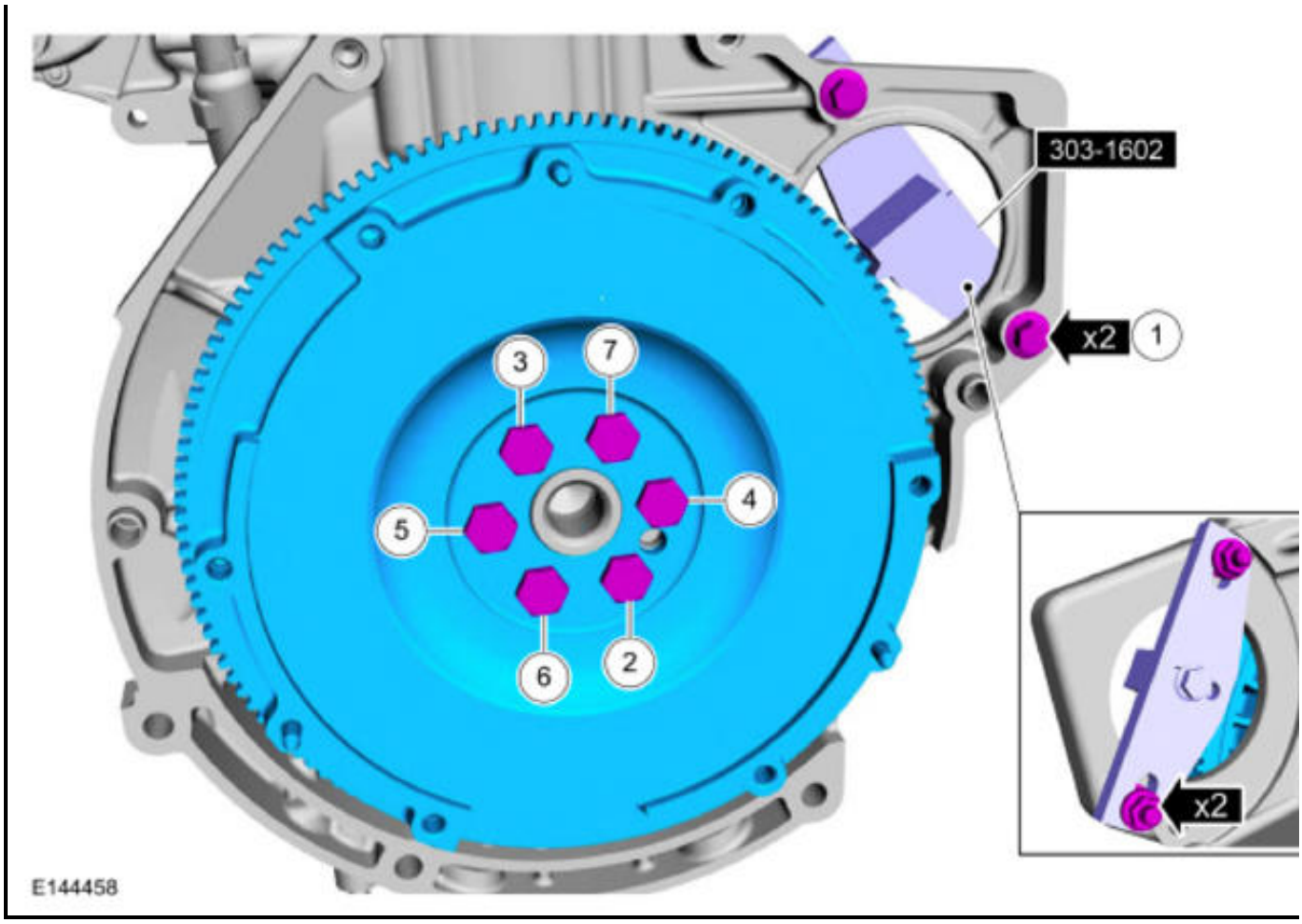
   2-7:

   Stage 1: 89 lb.in (10 Nm)

   Stage 2: 18 lb.ft (25 Nm)

   Stage 3: 37 lb.ft (50 Nm)

   Stage 4: 90°



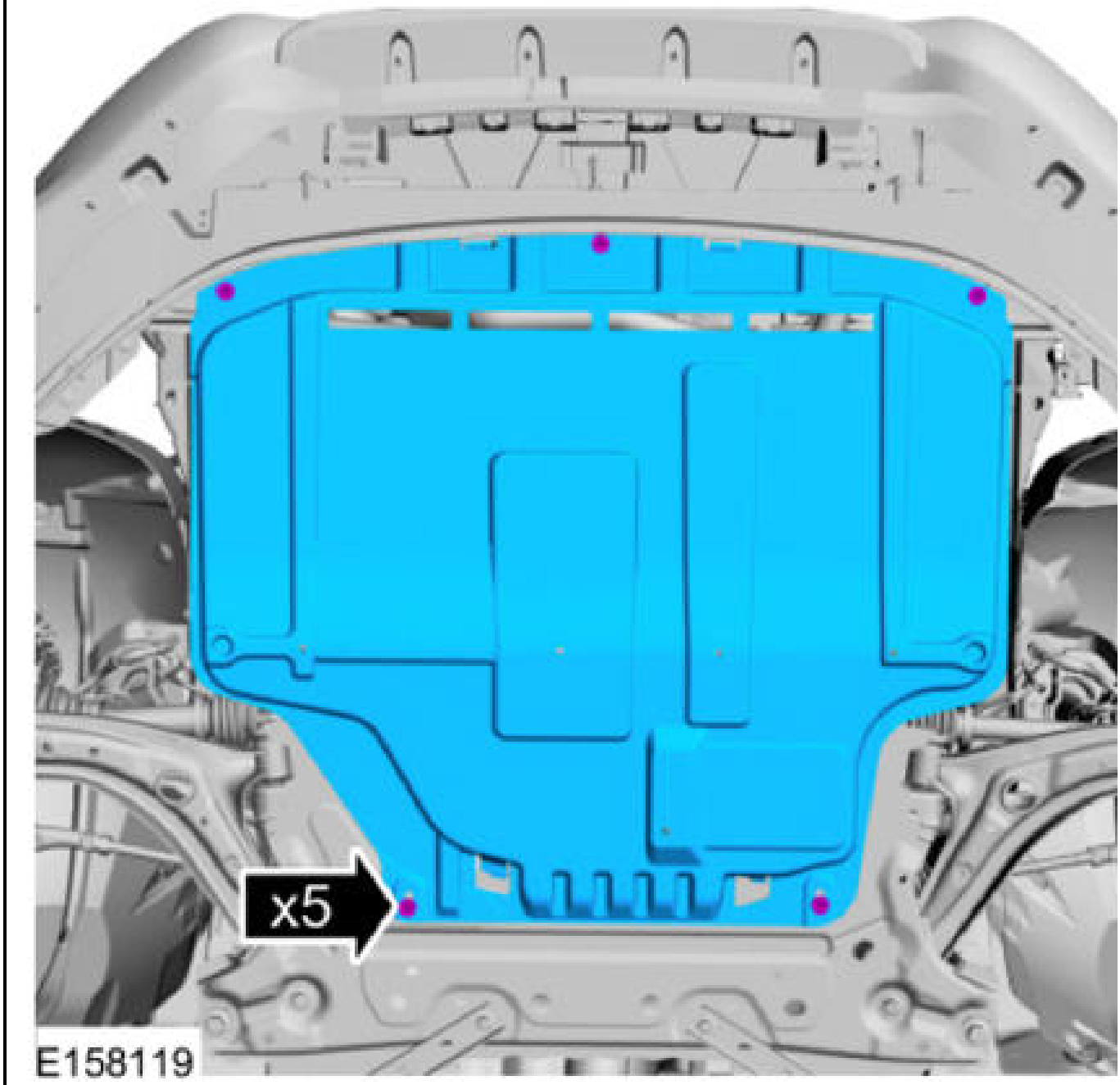
2. Refer to: **CLUTCH DISC AND PRESSURE PLATE - 1.0L ECOBOOST (90KW/120PS)** .

OIL PRESSURE SWITCH

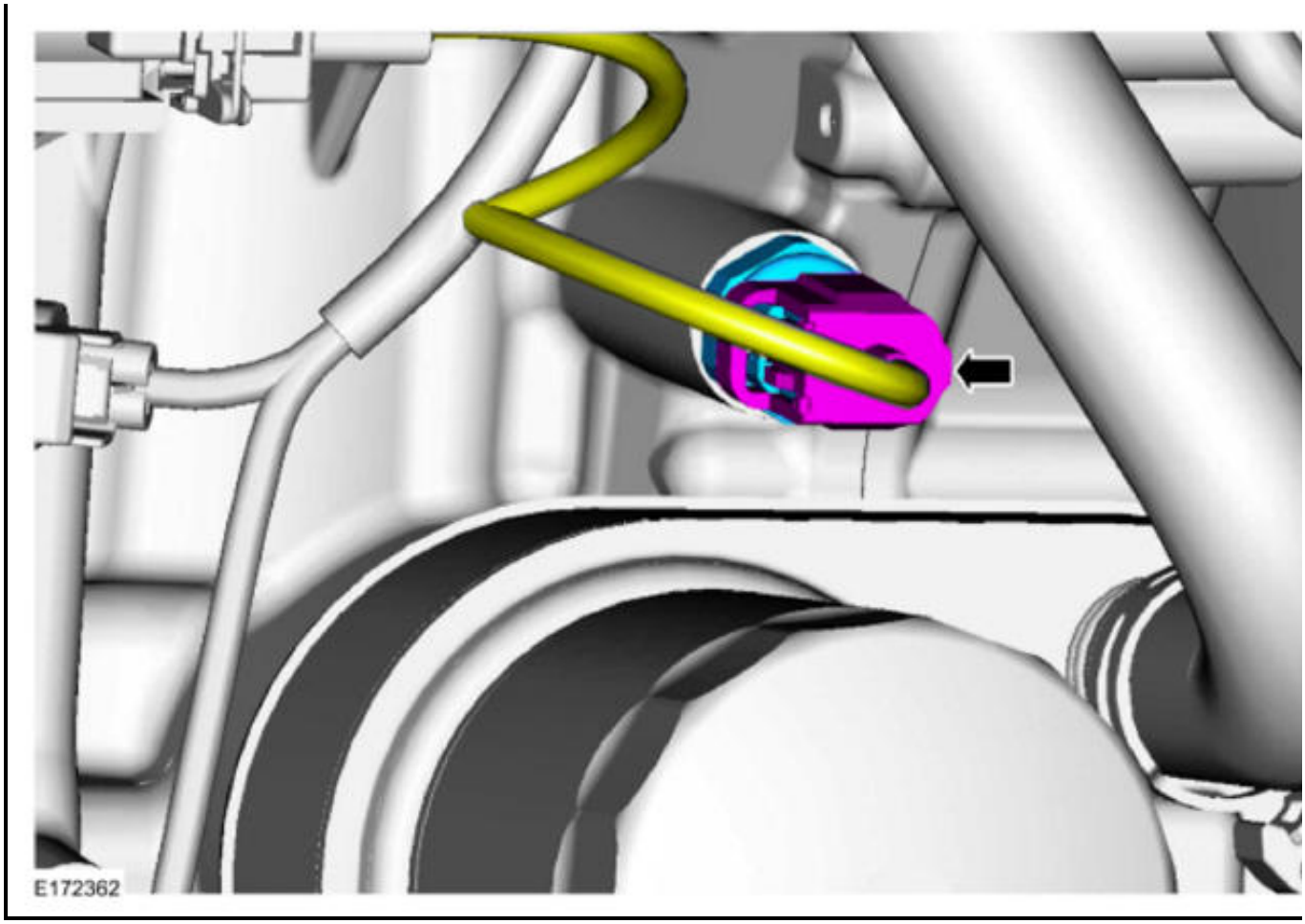
Removal

NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: **JACKING AND LIFTING - OVERVIEW** .
2. If equipped.



3. *Torque* : 142 lb.in (16 Nm)



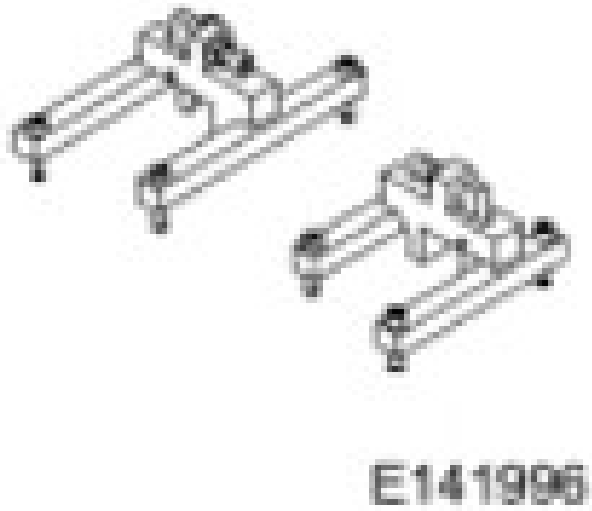
Installation

1. To install, reverse the removal procedure.

VARIABLE CAMSHAFT TIMING (VCT) UNIT

SPECIAL TOOL DESCRIPTION

	303-1054 Locking Tool, Timing Belt Tensioner

	303-1604 Timing Peg, Crankshaft TDC
	303-1605 Alignment Tool, Camshaft
	303-1606 Locking Tool, Variable Camshaft Timing

	
Plastic Scraper	
Trolley Jack	
Wooden Block	

MATERIAL SPECIFICATIONS

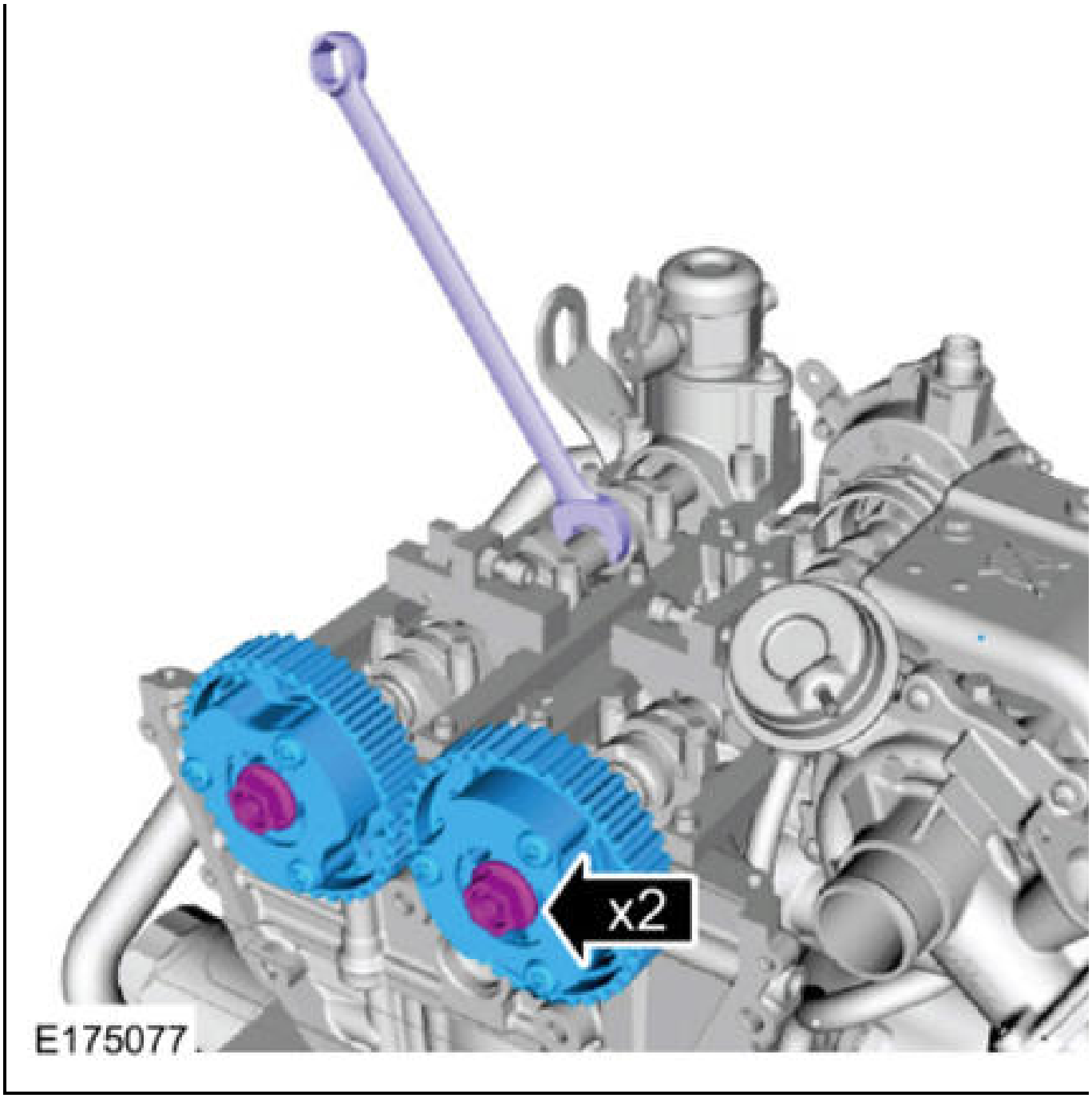
Name	Specification
Motorcraft® Metal Surface Prep ZC-31-B	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4

Removal

1. Refer to: **TIMING BELT** .

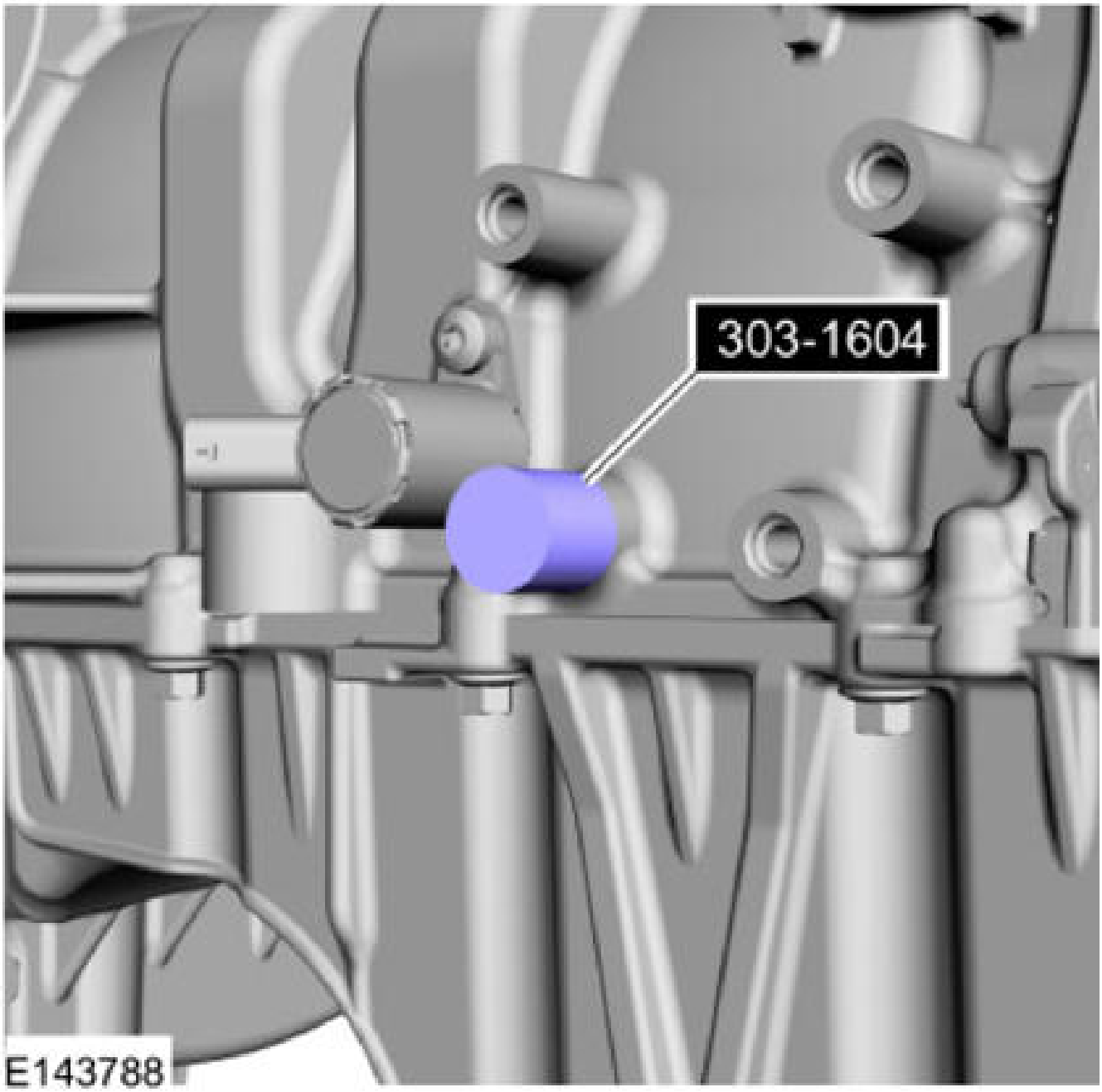
NOTE: Use an open-ended wrench to hold the camshafts by the hexagon to prevent the camshafts from turning.

2.



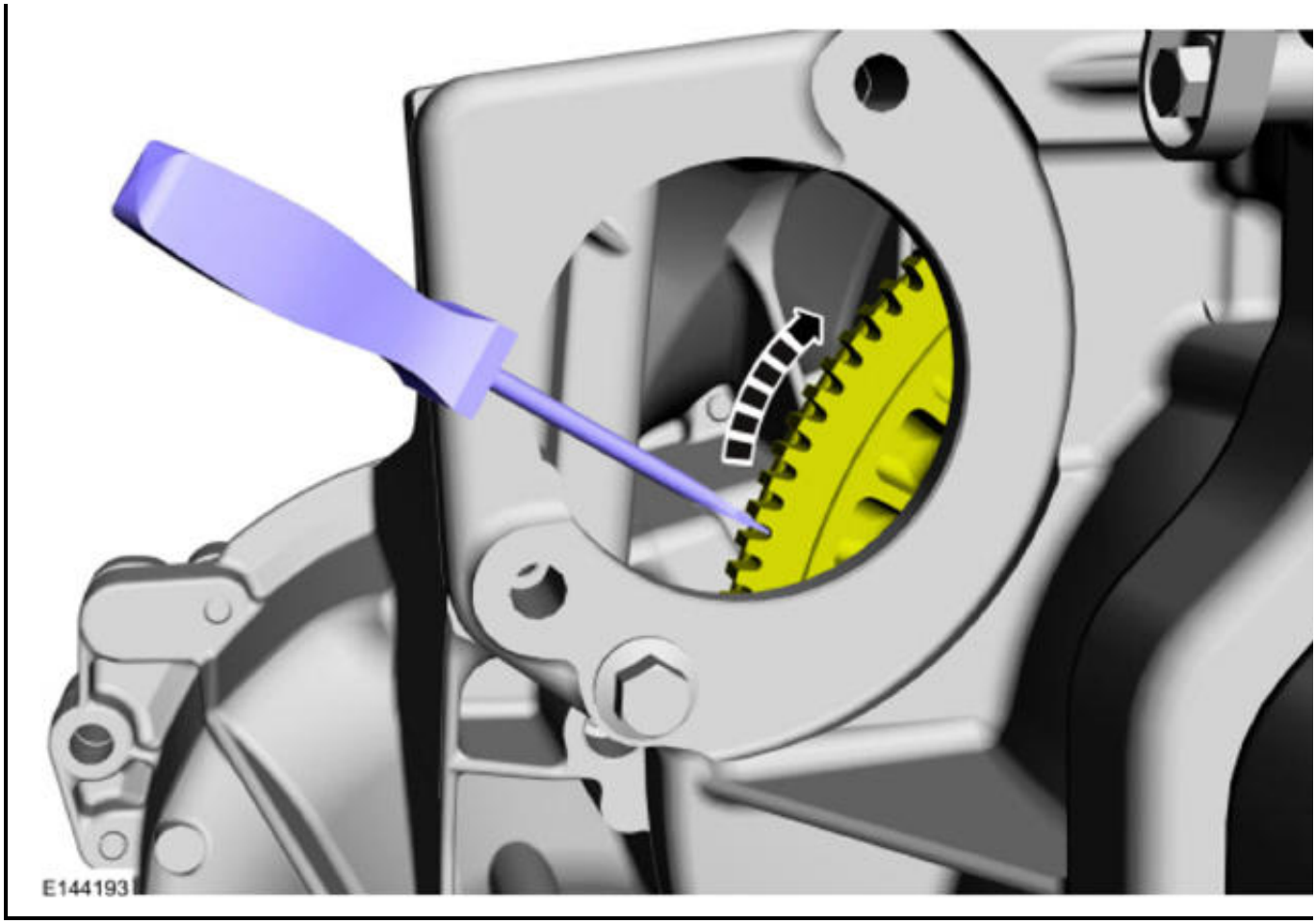
Installation

1. Install Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.

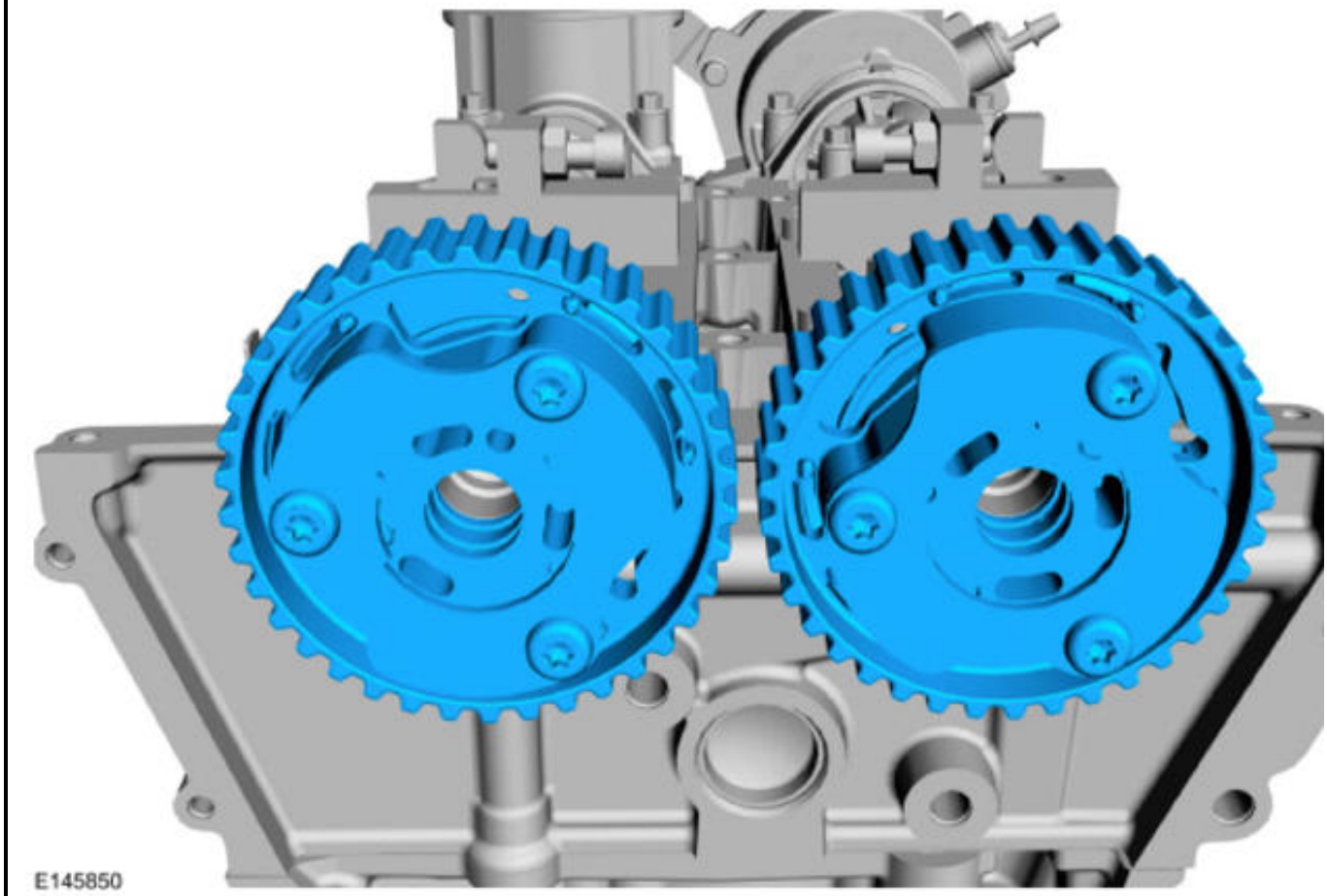


2. **NOTE: Only rotate the crankshaft clockwise.**

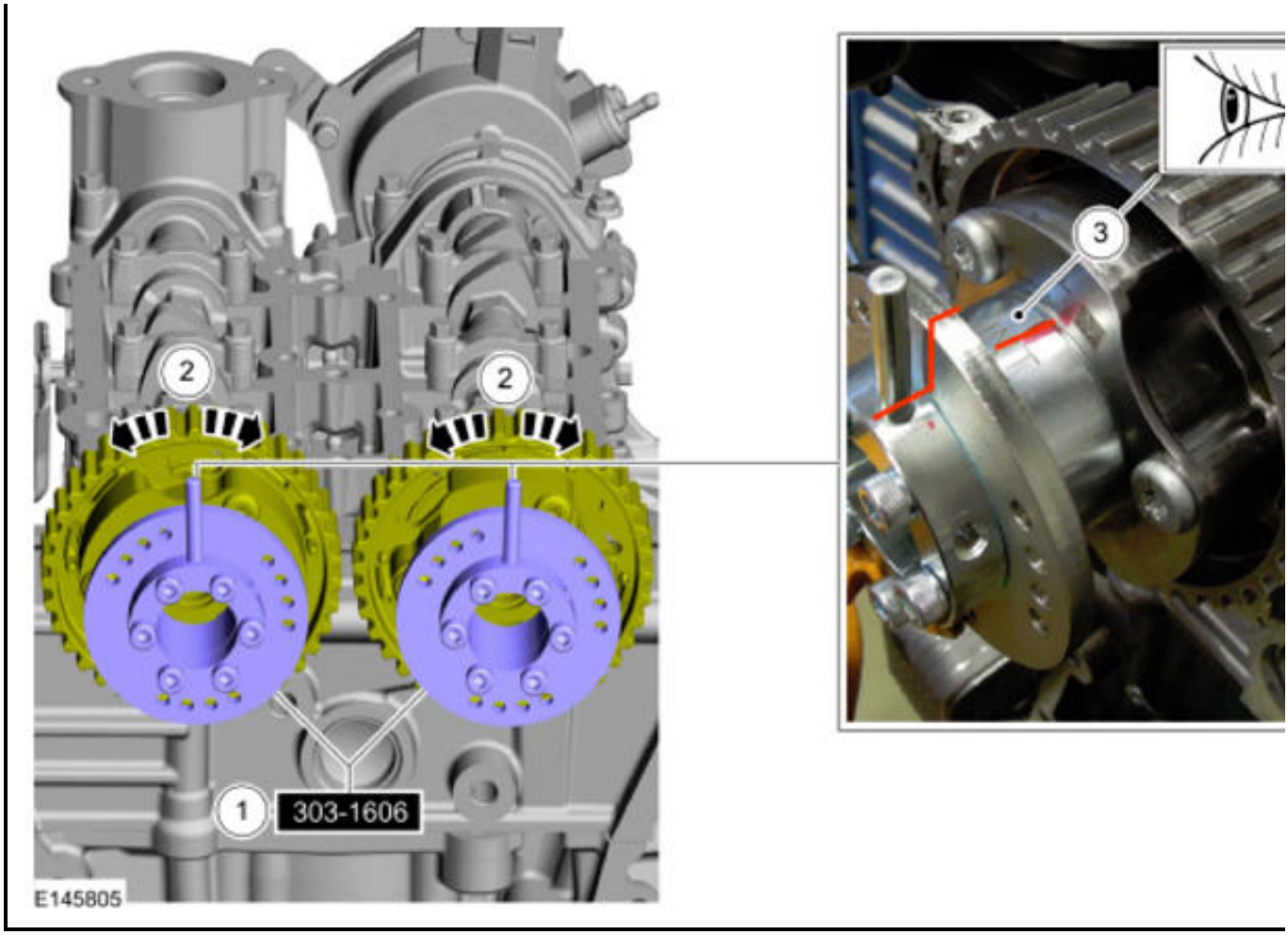
Rotate the crankshaft slowly until the crankshaft stops.



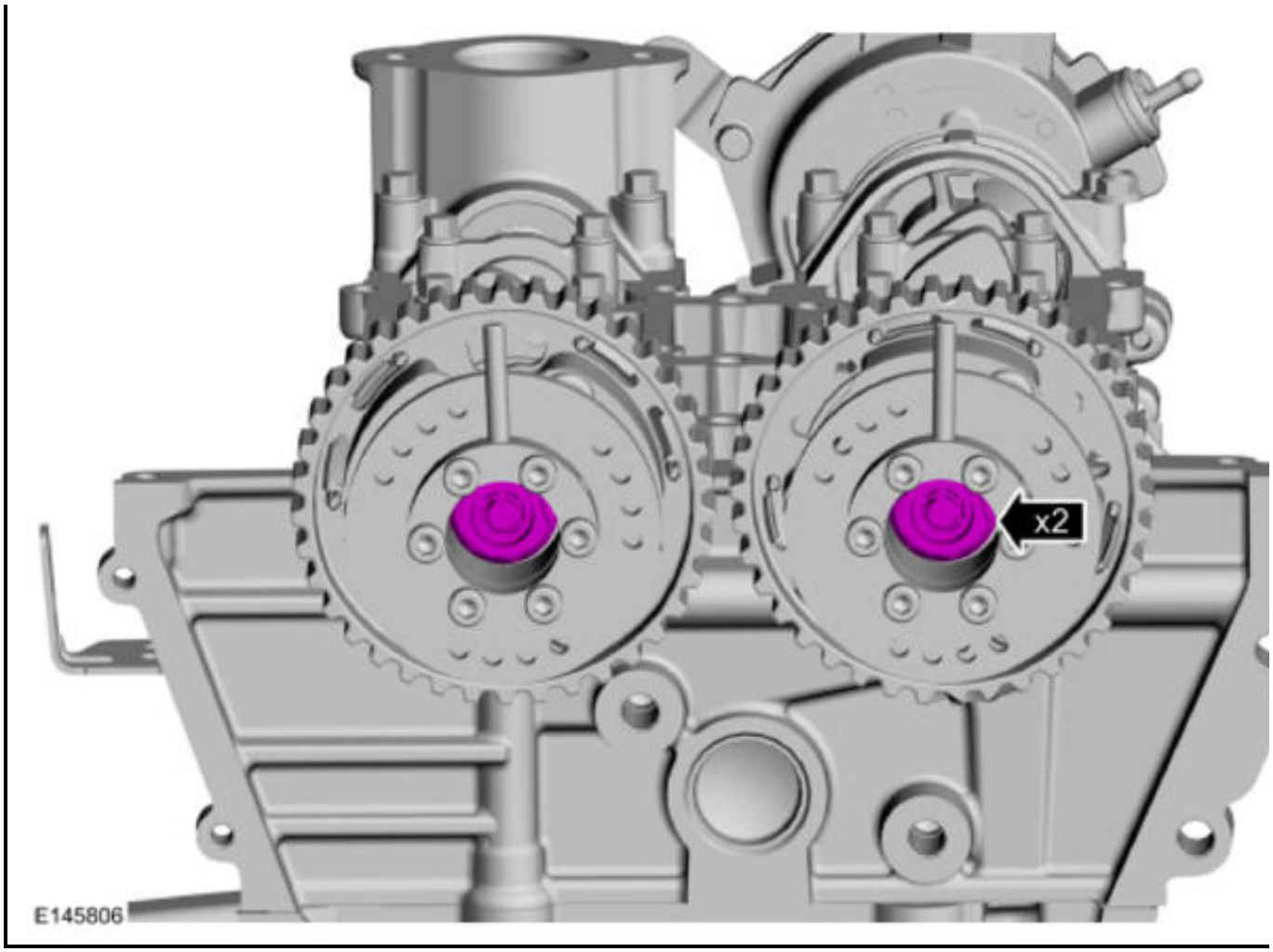
3.

3. 

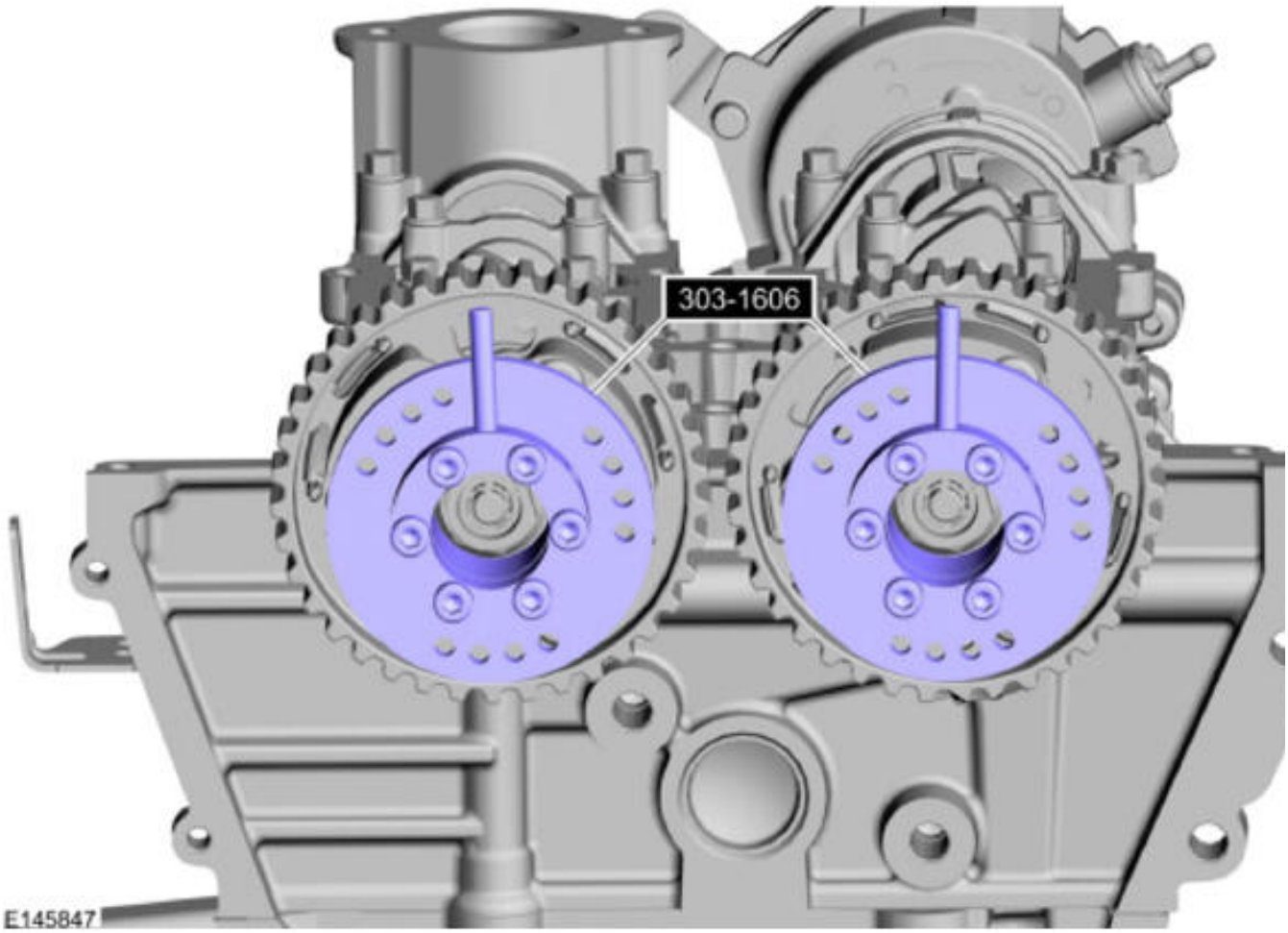
4. Install Special Service Tool: 303-1606 Locking Tool, Variable Camshaft Timing.



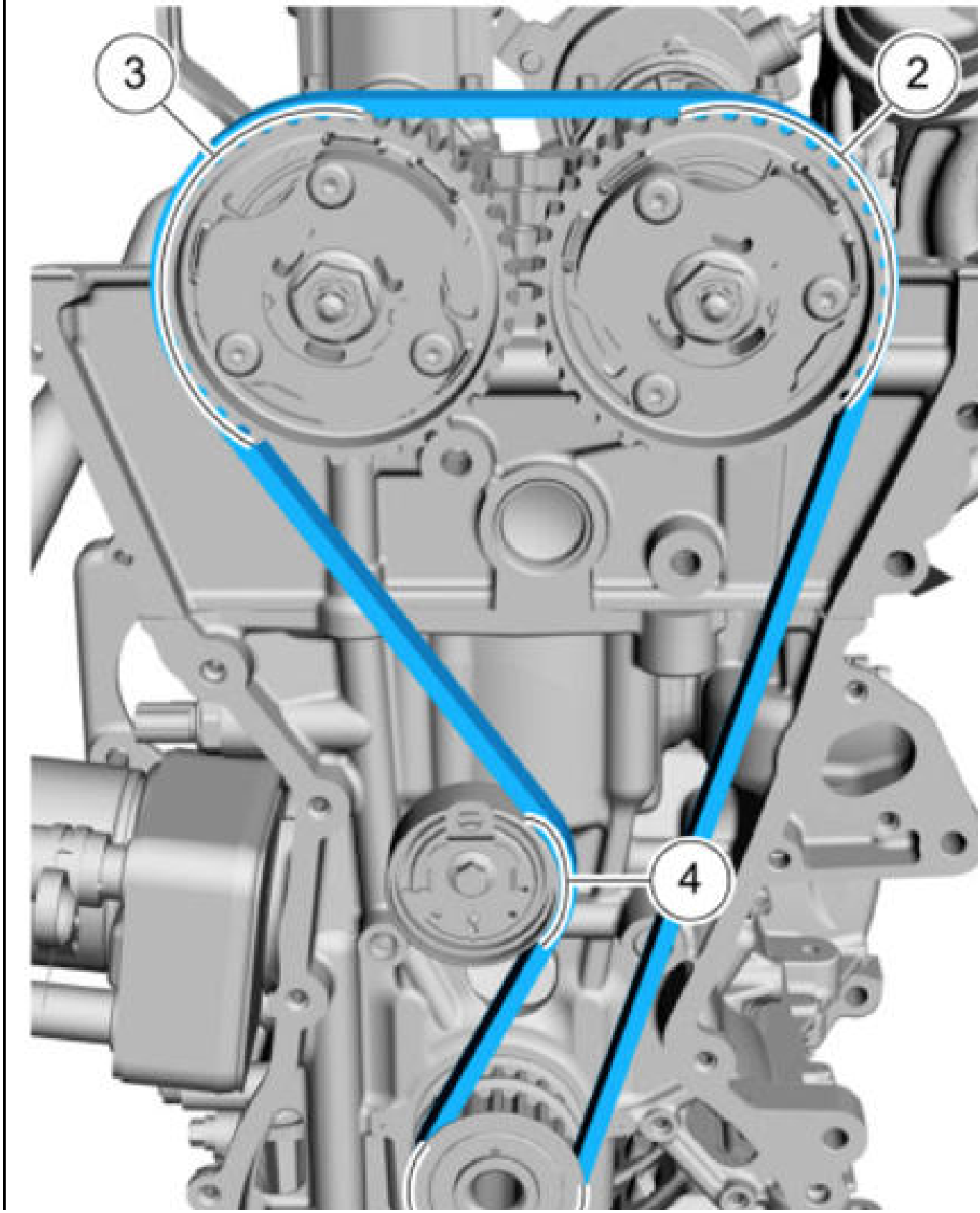
5. **NOTE: Only tighten the bolts finger tight at this stage.**



6. Remove Special Service Tool: 303-1606 Locking Tool, Variable Camshaft Timing.



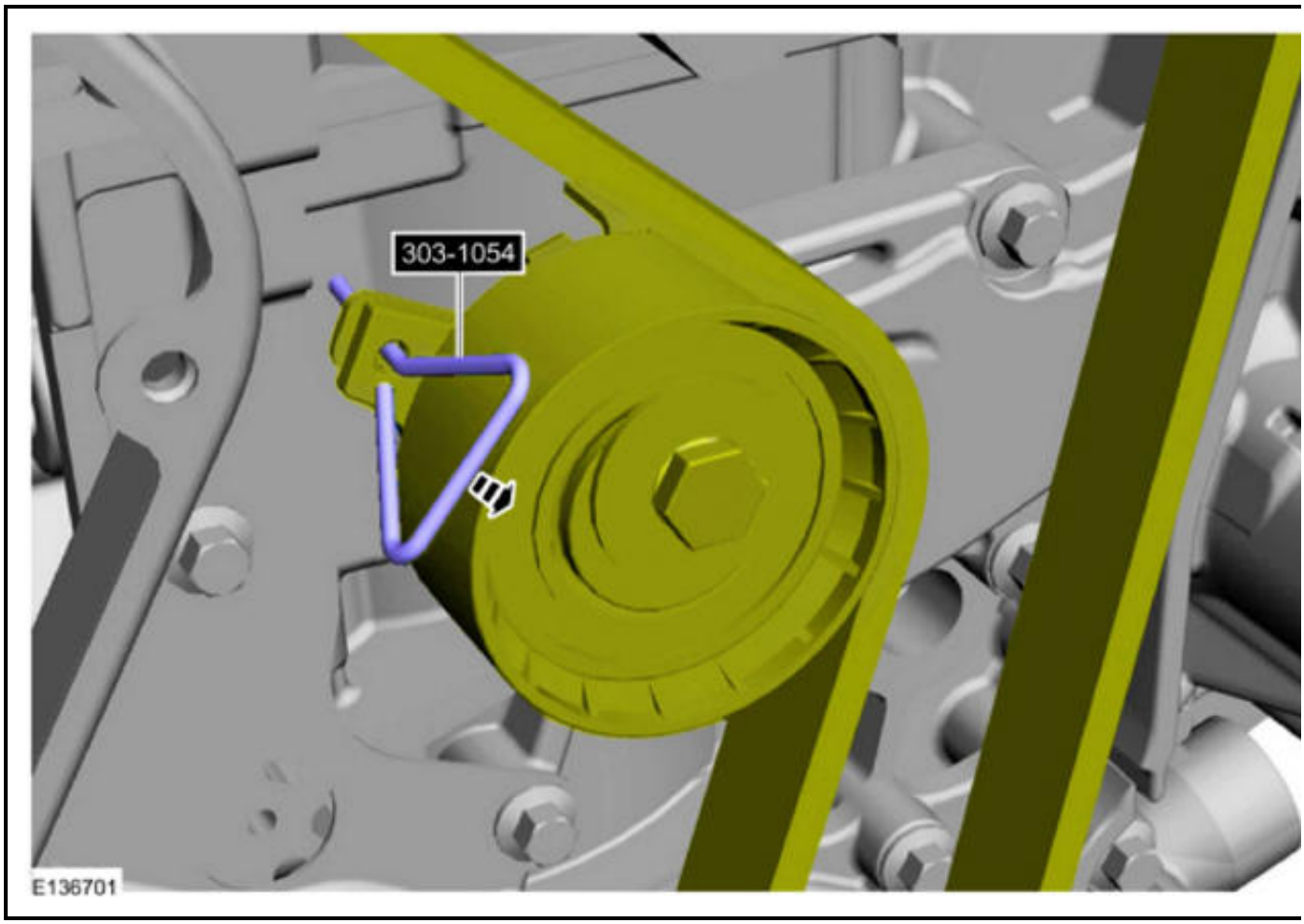
7.



WARNING: Take extra care when handling the compressed spring.

8.

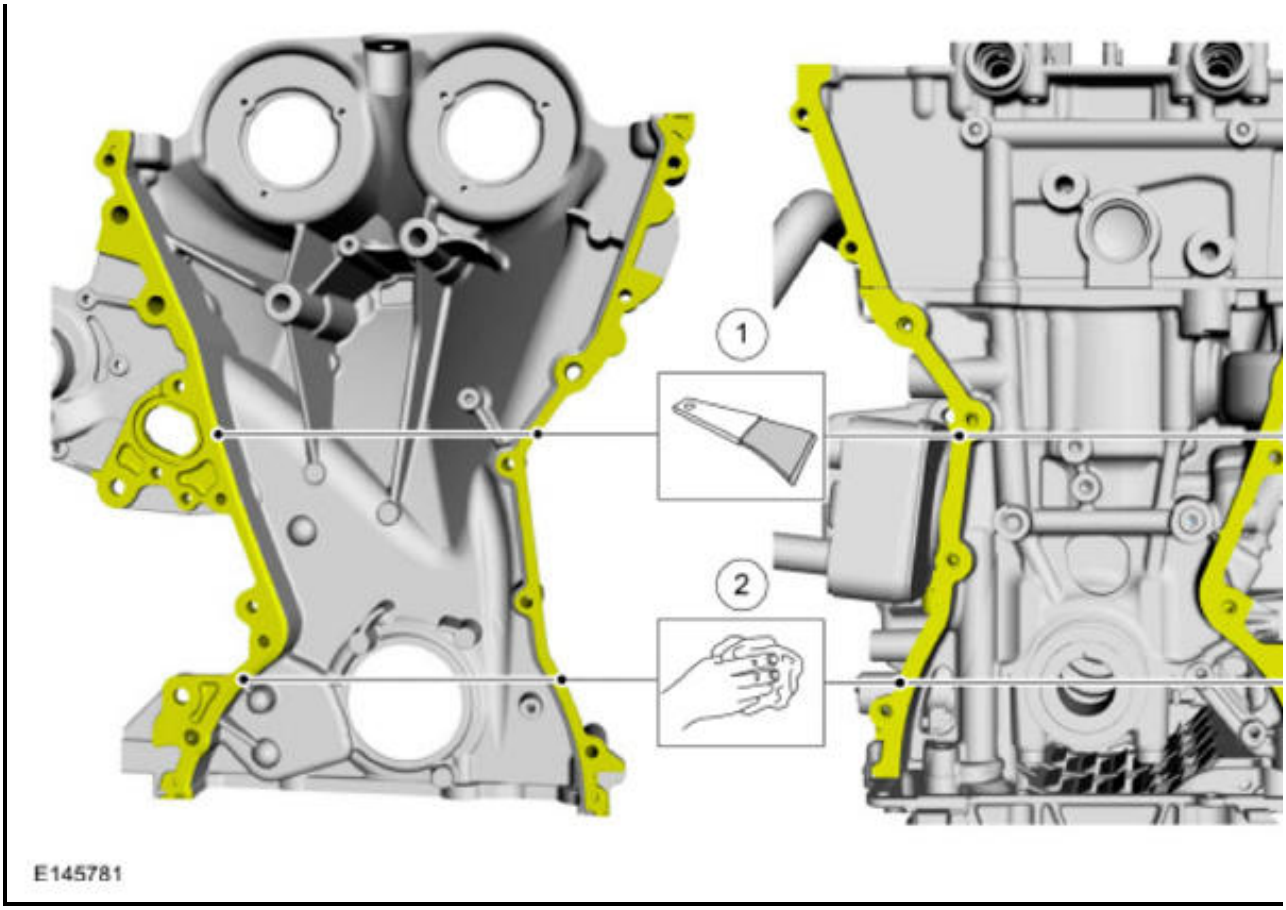
Remove Special Service Tool: 303-1054 Locking Tool, Timing Belt Tensioner.



9.

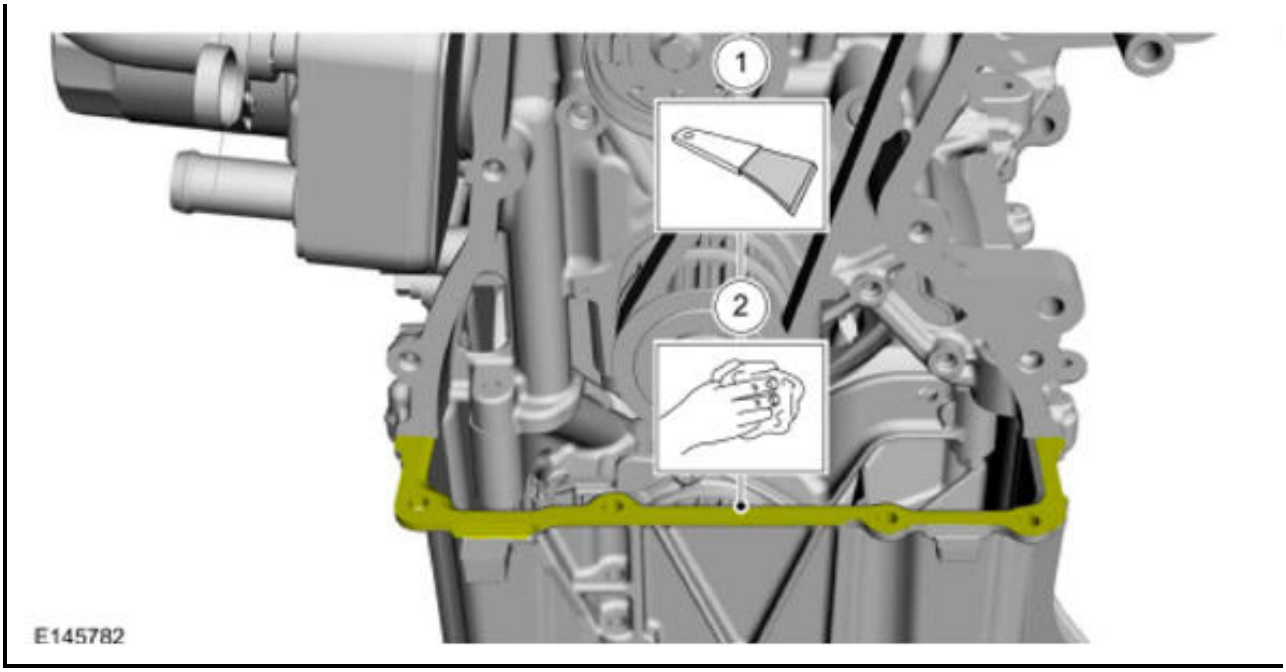
NOTE: Make sure that the surface is clean and free of foreign material before taping around the component.

1. Use the General Equipment: Plastic Scraper
2. *Material* : Motorcraft® Metal Surface Prep/ZC-31-B



10. **NOTE: Make sure that the surface is clean and free of foreign material before taping around the component.**

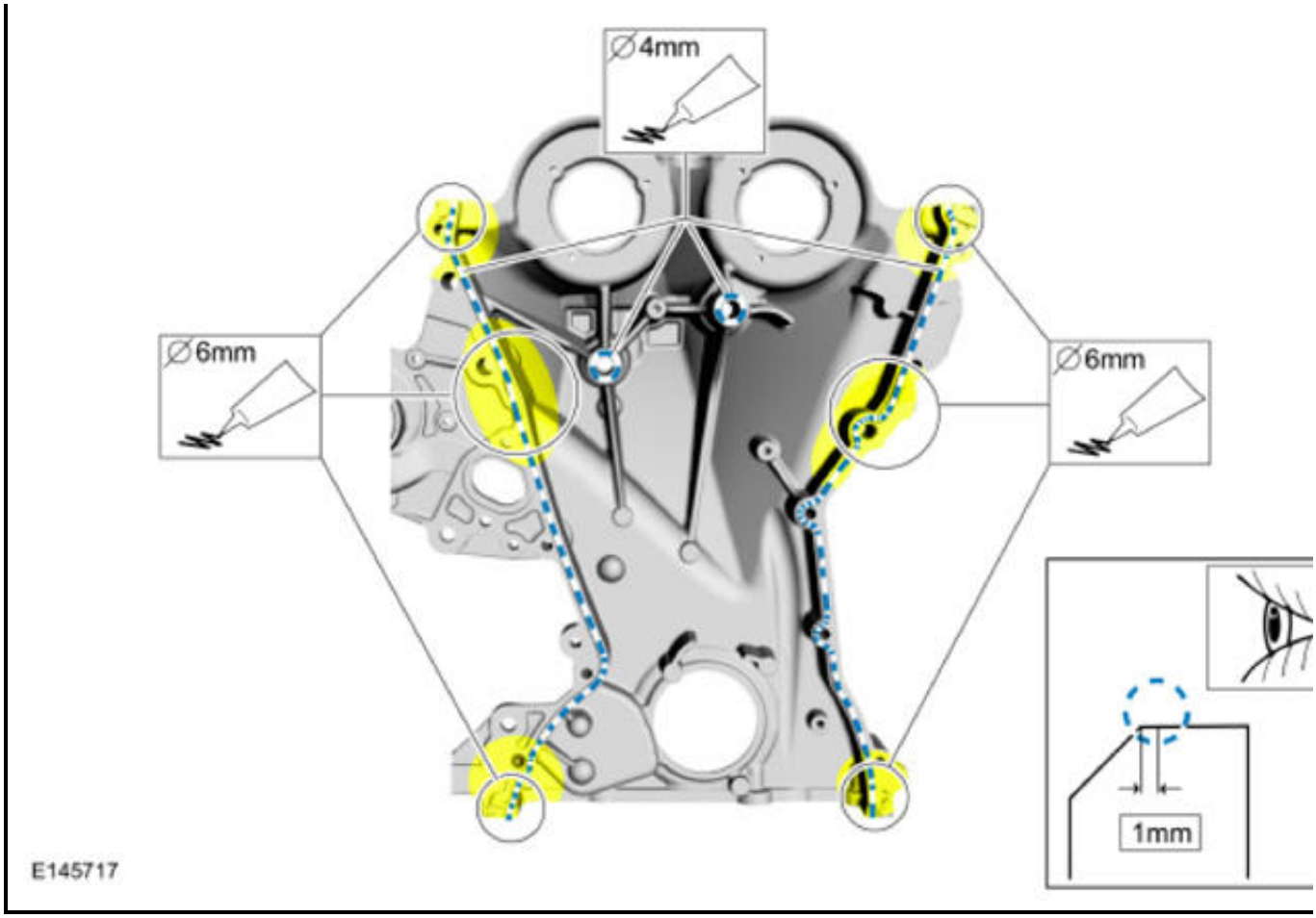
1. Use the General Equipment: Plastic Scraper
2. *Material* : Motorcraft® Metal Surface Prep/ZC-31-B



NOTE: **The component must be installed within 10 minutes of applying the sealant.**

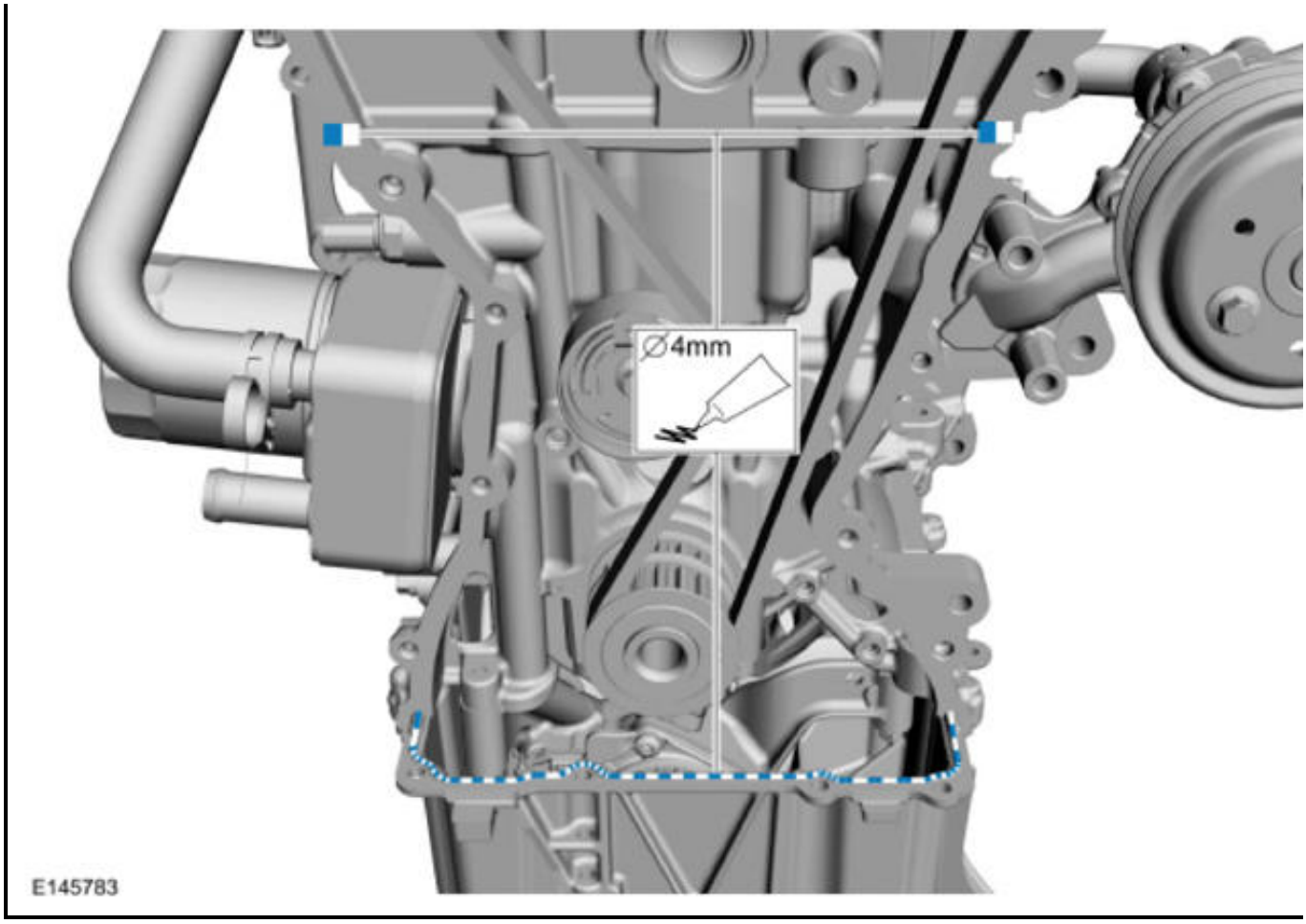
11.

Material : Silicone Gasket and Sealant/TA-30 (WSE-M4G323-A4)



12. **NOTE: The component must be installed within 10 minutes of applying the sealant.**

Material : Silicone Gasket and Sealant/TA-30 (WSE-M4G323-A4)



13.

- **NOTE: Make sure that new components are installed.**

Torque :

1-2, M6x60: 44 lb.in (5 Nm)

- **NOTE: Make sure that new components are installed.**

Torque :

3-6, M10x95: 89 lb.in (10 Nm)

- **NOTE: Make sure that new components are installed.**

Torque :

7-16 M6x60: 44 lb.in (5 Nm)

- *Torque* :

  17-19 M6x60: 44 lb.in (5 Nm)

  20 M6x75: 44 lb.in (5 Nm)

- *Torque* :

  3-6: 30 lb.ft (40 Nm)

- *Torque* :

  3-4:

  Stage 1: 52 lb.ft (70 Nm)

  Stage 2: 90°

- *Torque* :

  5-6:

  Stage 1: 52 lb.ft (70 Nm)

  Stage 2: 90°

- 1-2

  Torque :

  Stage 1: 80 lb.in (9 Nm)

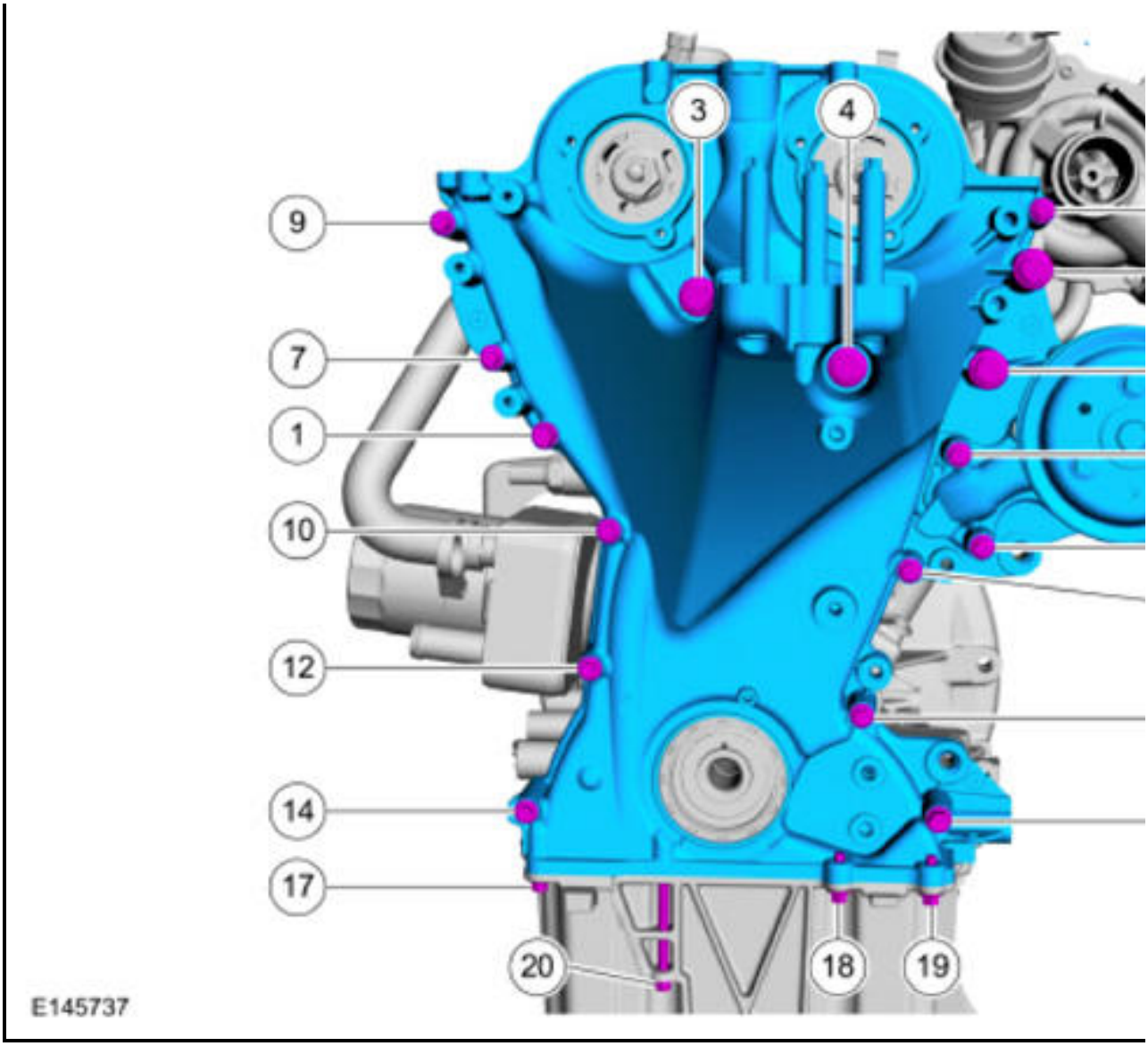
  Stage 2: 90°

- 7-20

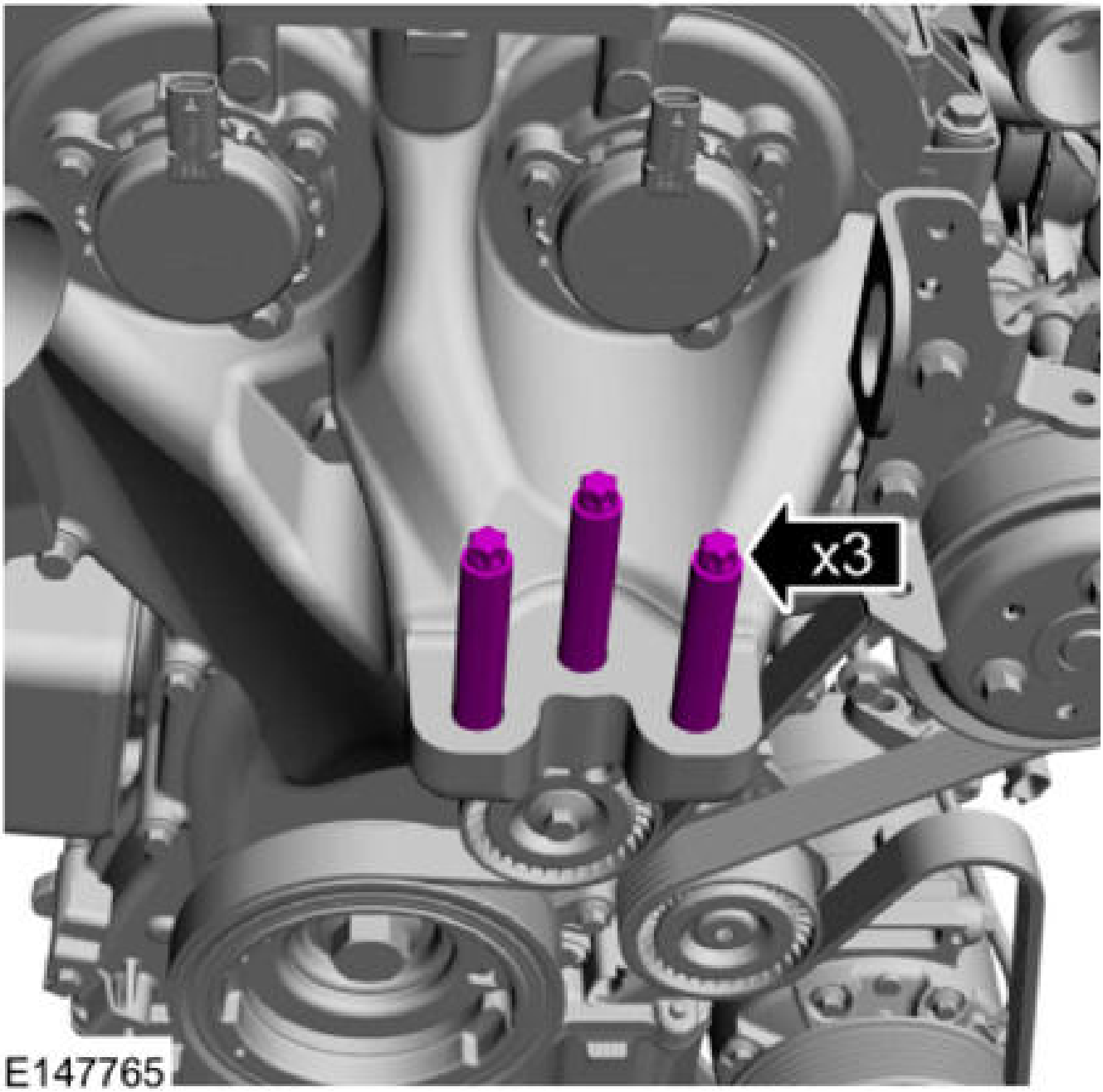
  Torque :

  Stage 1: 133 lb.in (15 Nm)

  Stage 2: 90°



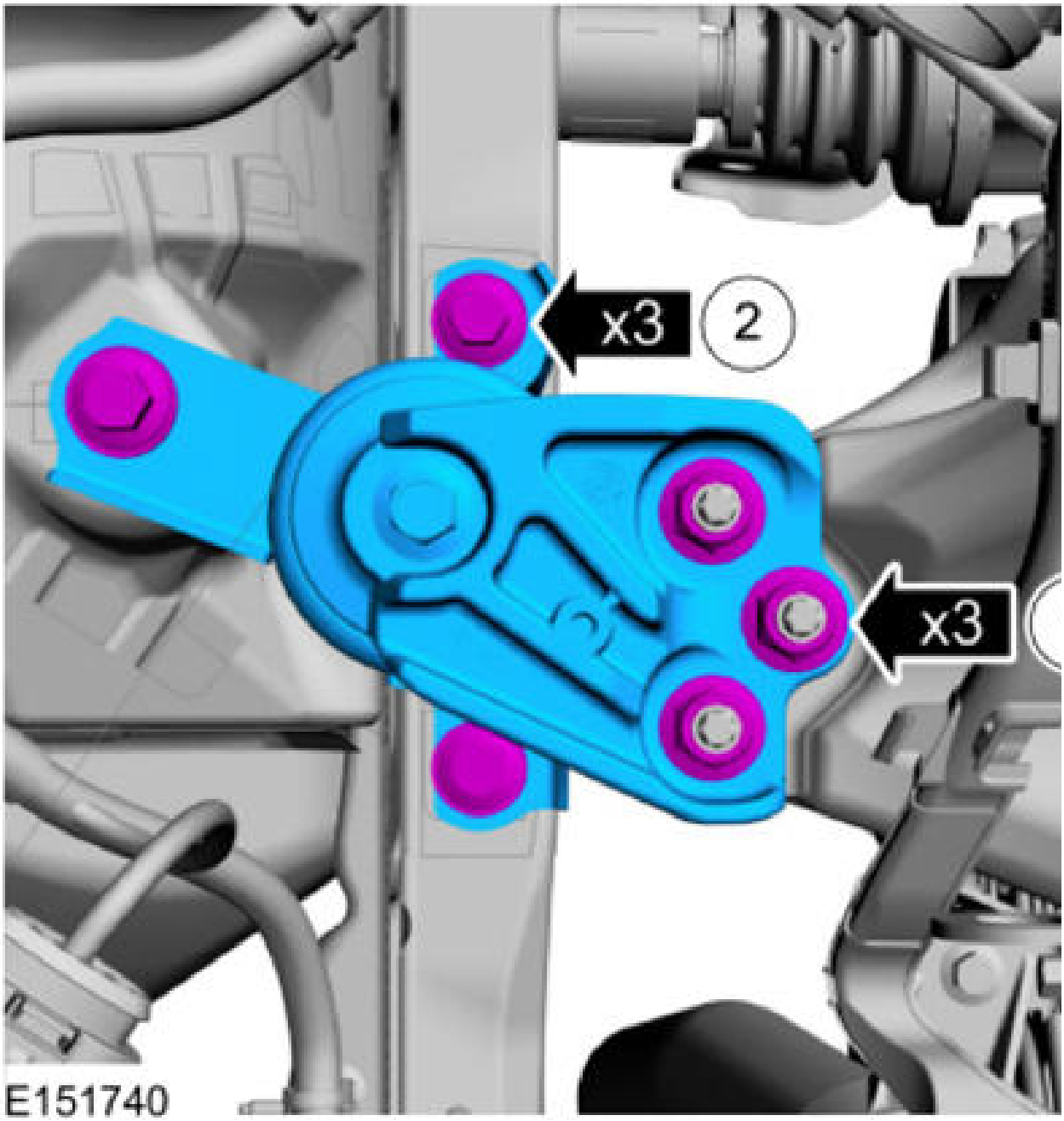
14. *Torque* : 89 lb.in (10 Nm)



15.

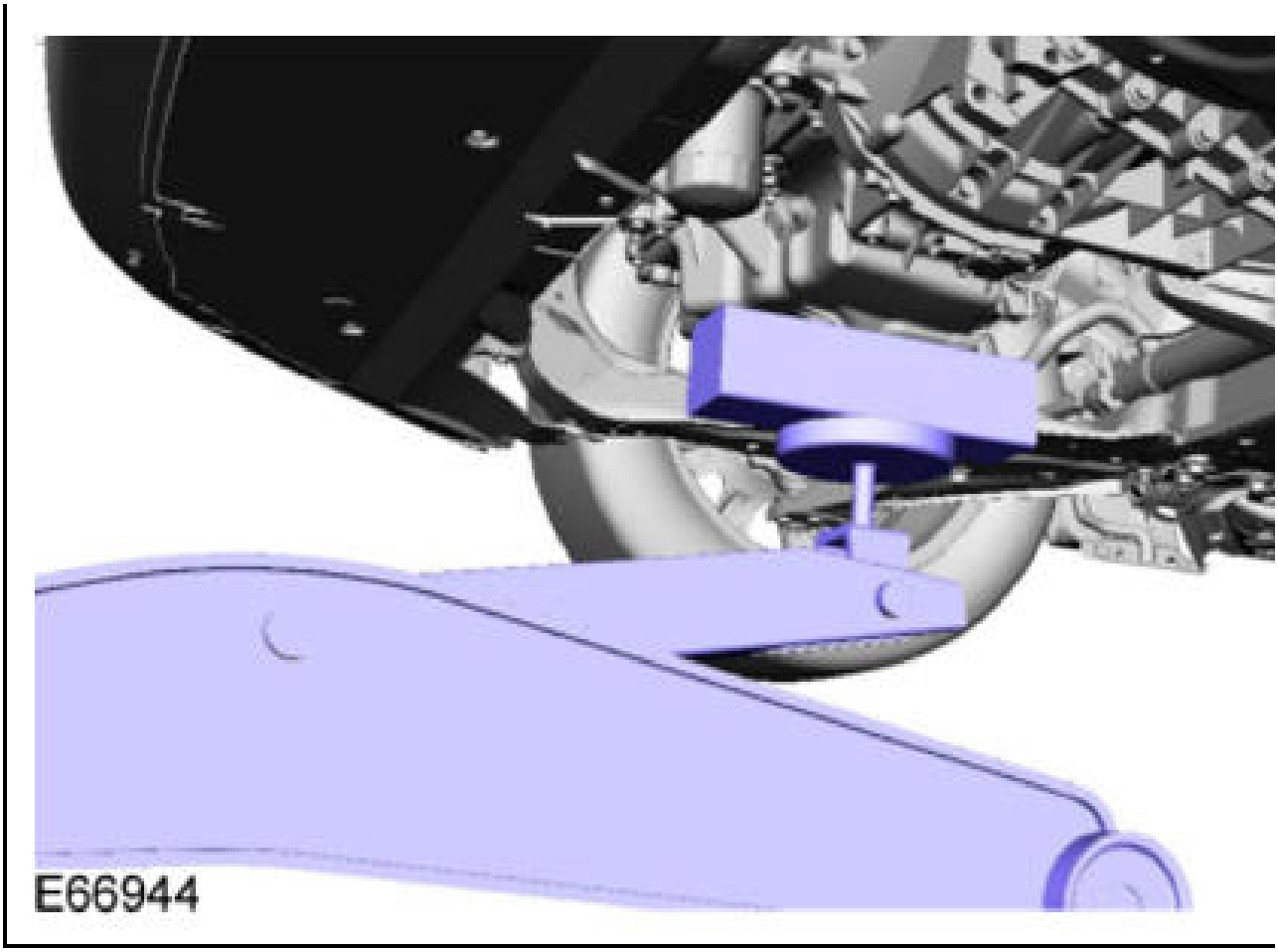
1. *Torque* : 59 lb.ft (80 Nm)
2.

NOTE: Only tighten the bolts finger tight at this stage.

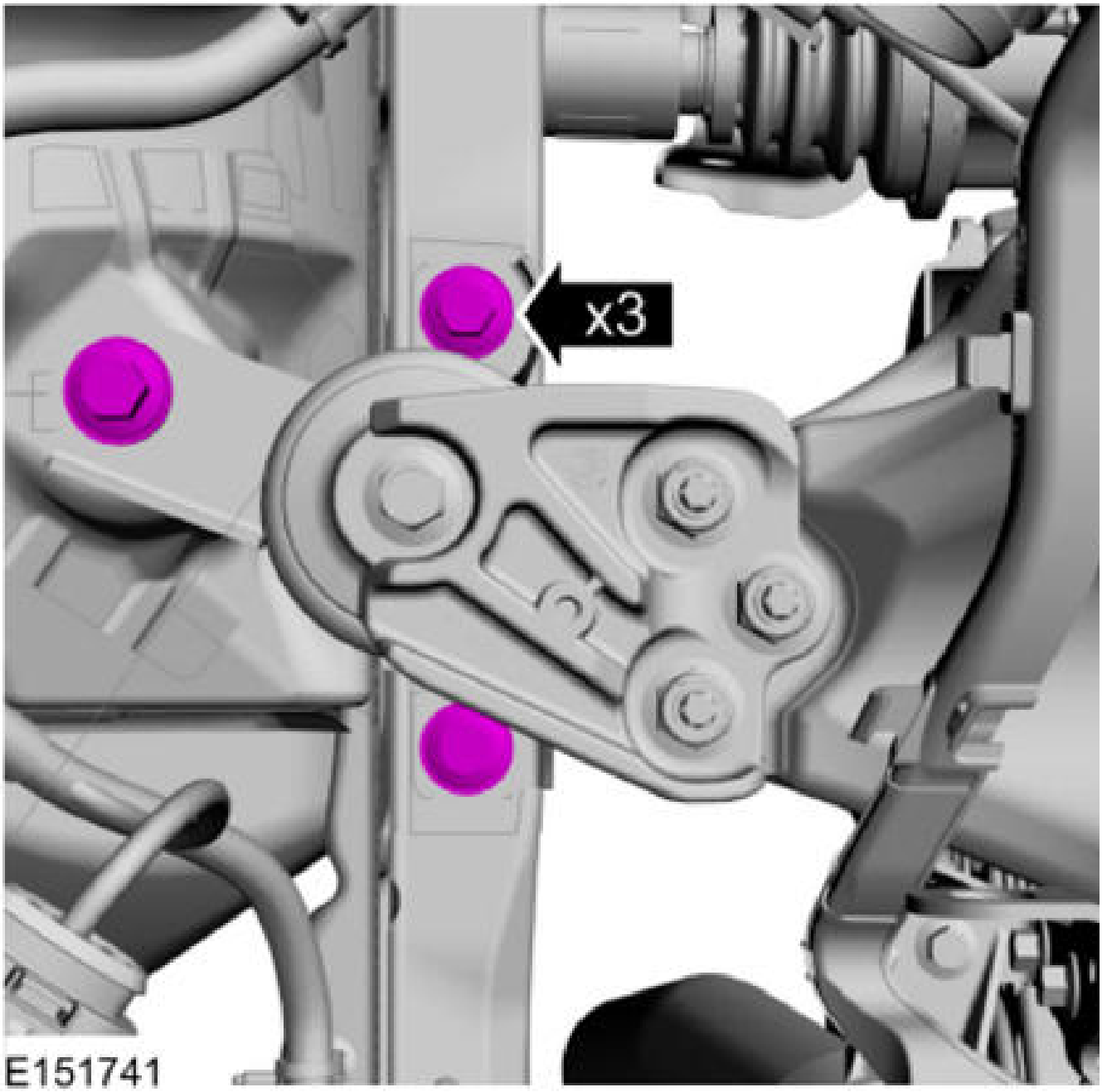


16. Remove the following items:
    - Use the General Equipment: Trolley Jack

      Use the General Equipment: Wooden Block

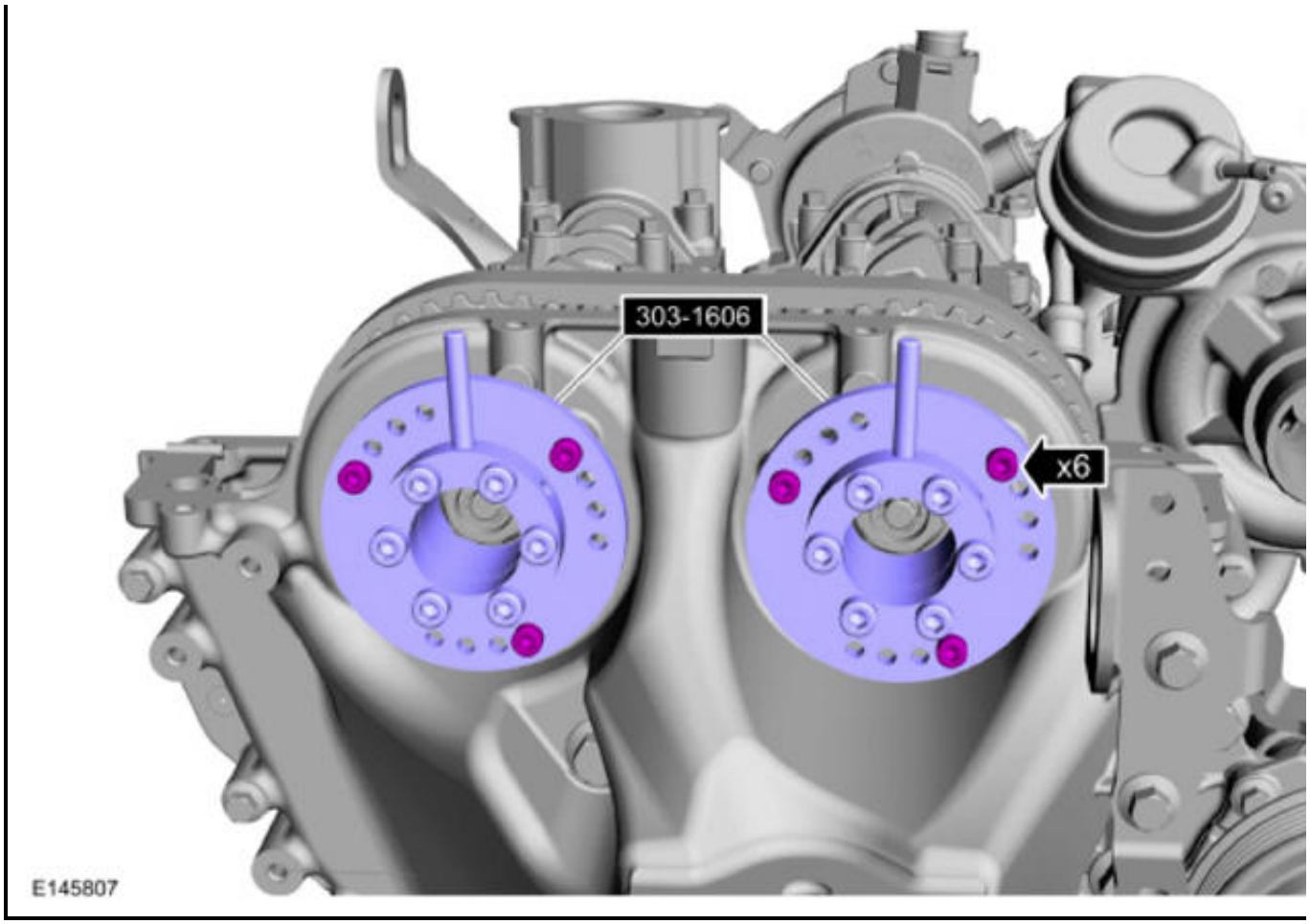


17. *Torque* : 66 lb.ft (90 Nm)



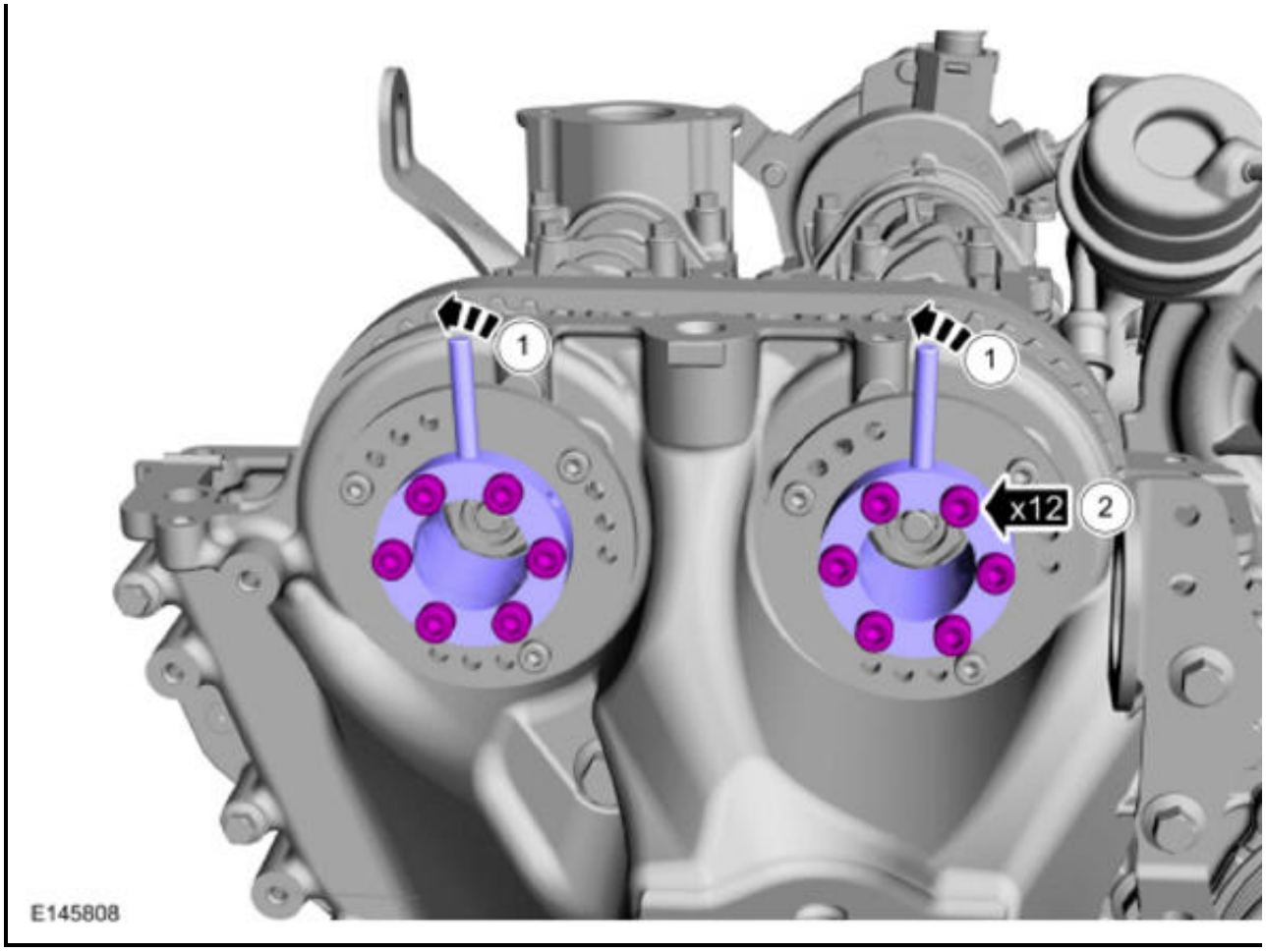
18. Install Special Service Tool: 303-1606 Locking Tool, Variable Camshaft Timing.

    Torque : 89 lb.in (10 Nm)



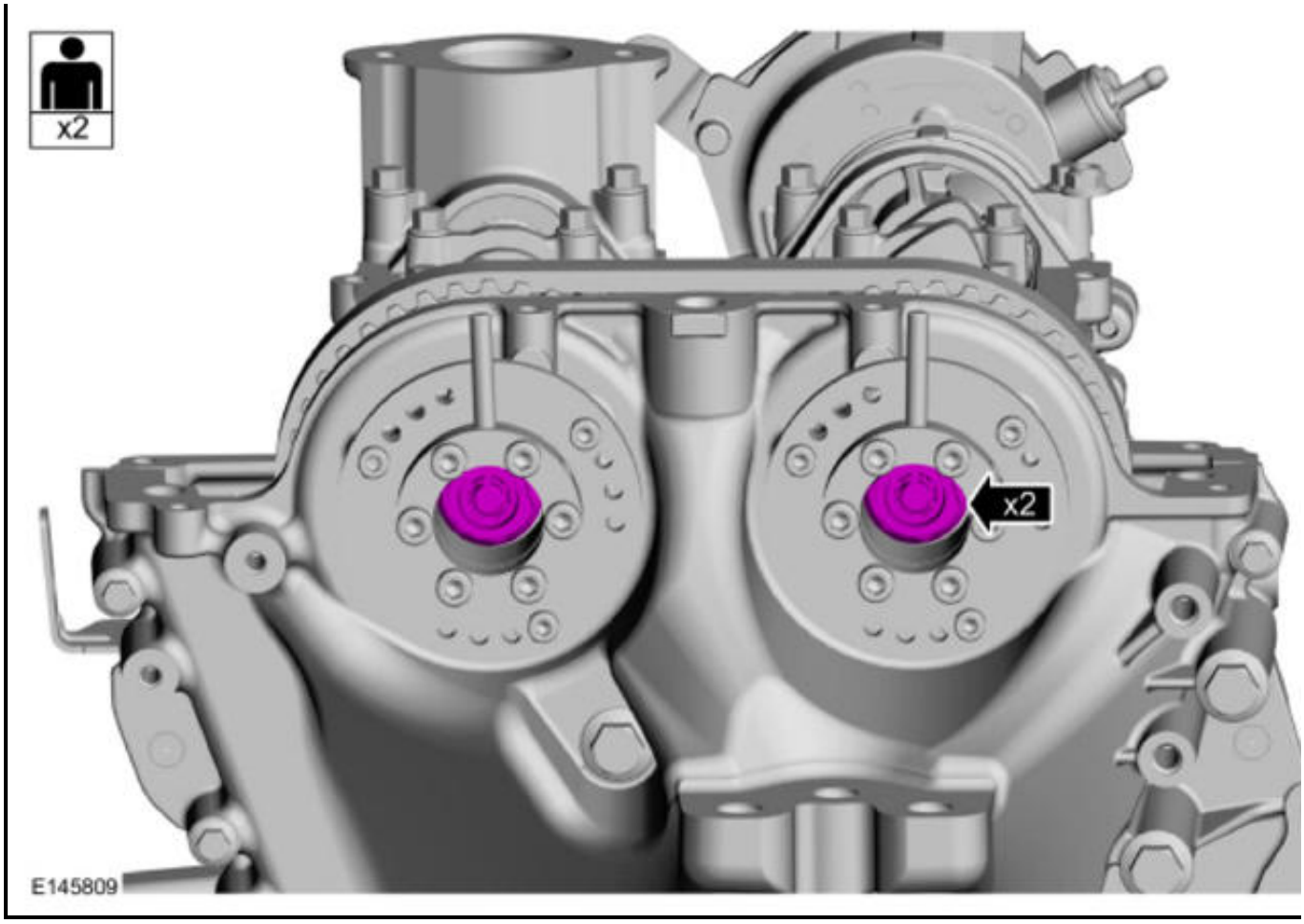
19.

1. Turn until resistance is felt.
2. *Torque* : 133 lb.in (15 Nm)

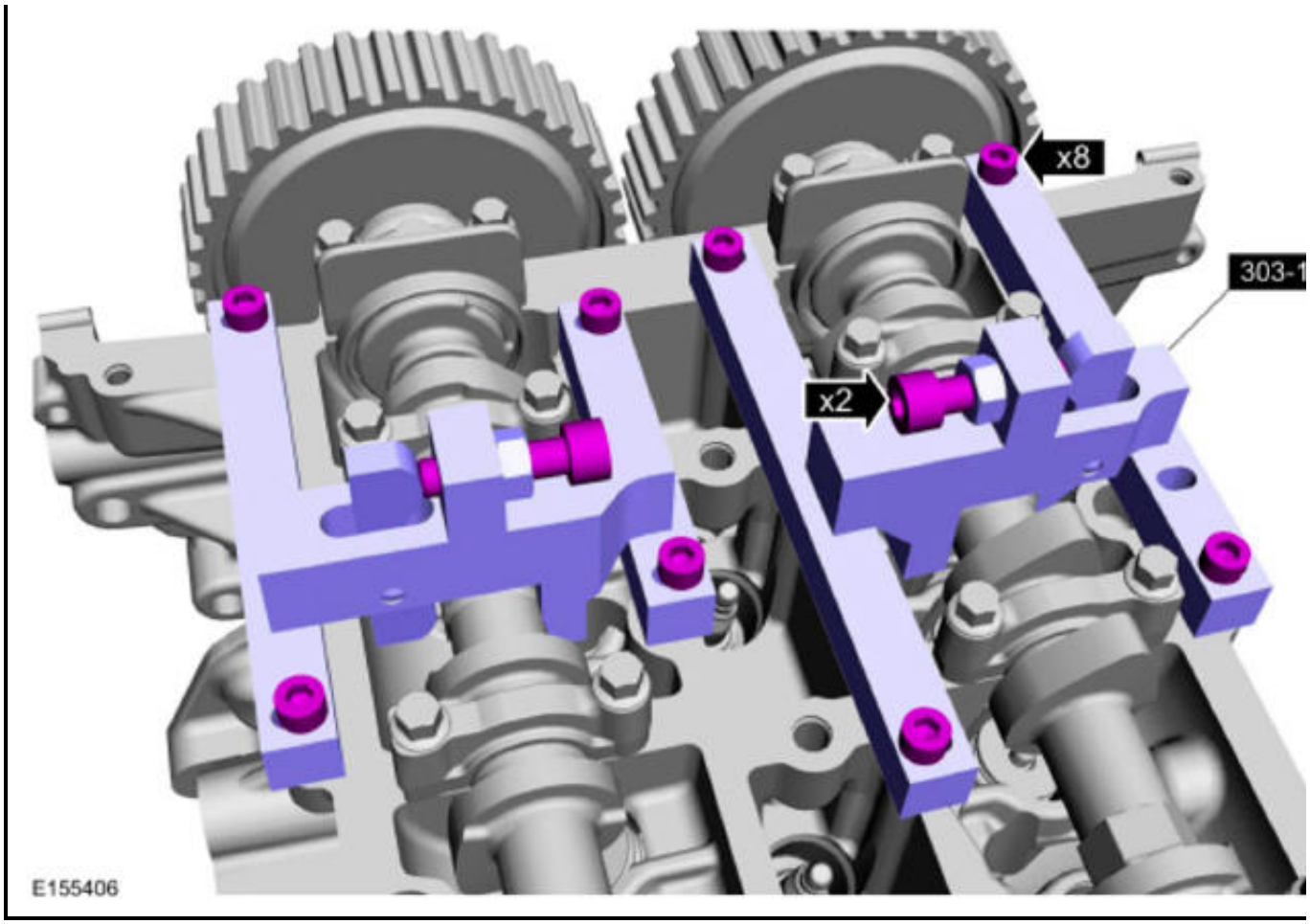


20. **NOTE: Use an open-ended wrench to hold the camshafts by the hexagon to prevent the camshafts from turning.**

Torque : 22 lb.ft (30 Nm)



21. Remove Special Service Tool: 303-1605 Alignment Tool, Camshaft.



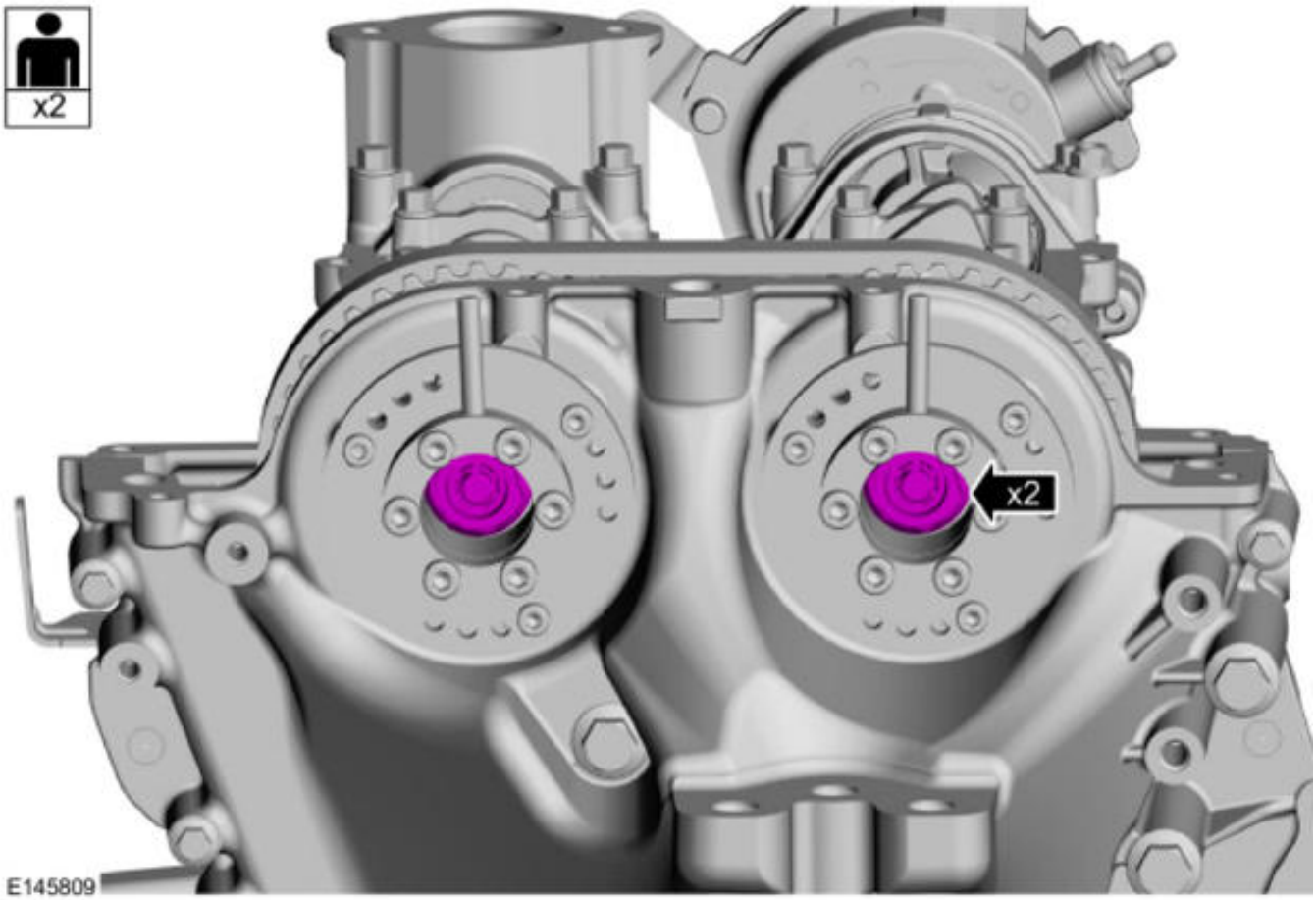
22. **NOTE: Use an open-ended wrench to hold the camshafts by the hexagon to prevent the camshafts from turning.**

Torque :

Stage 1: 37 lb.ft (50 Nm)

Stage 2: 70 lb.ft (95 Nm)

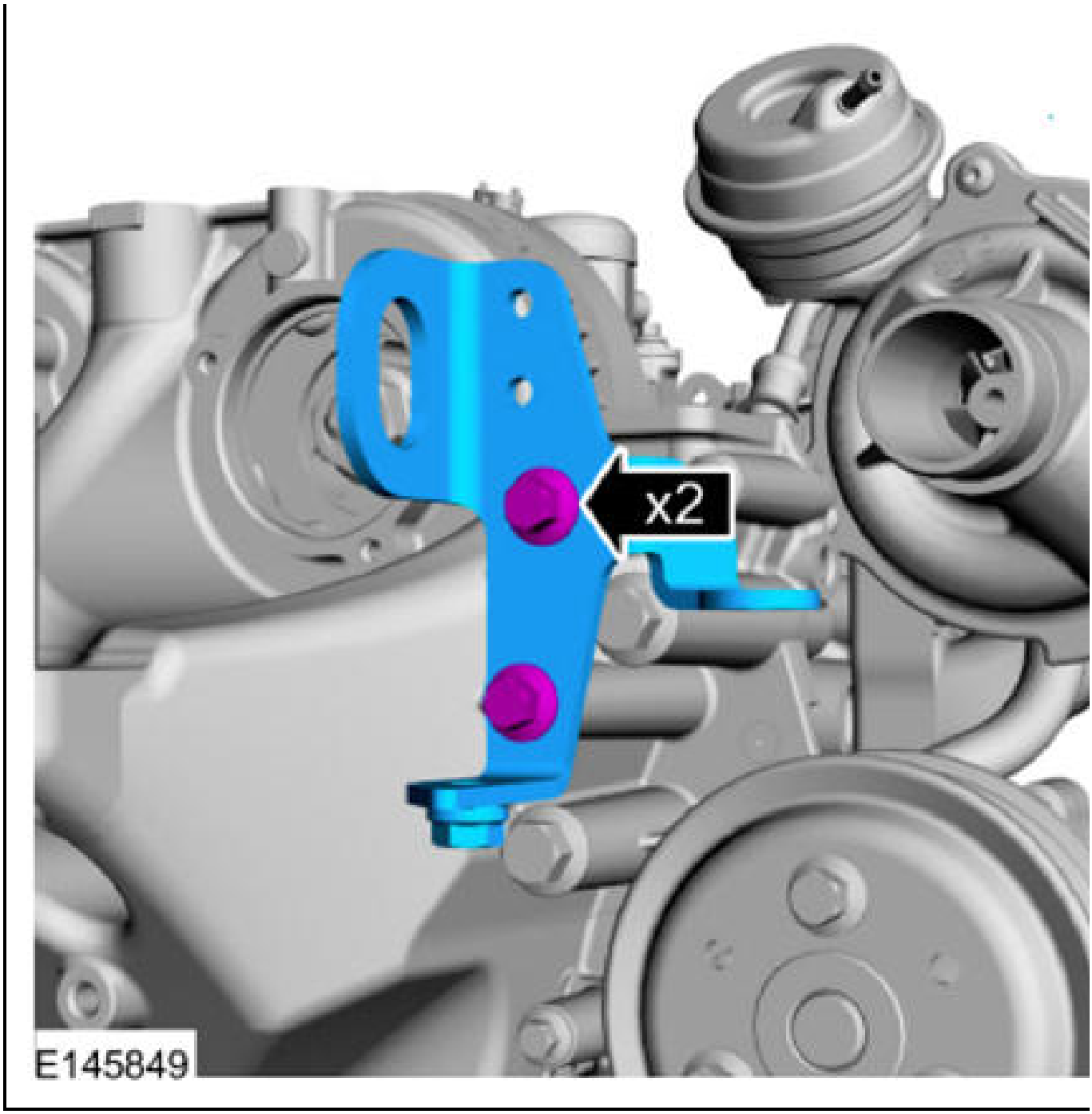
Stage 3: 45°



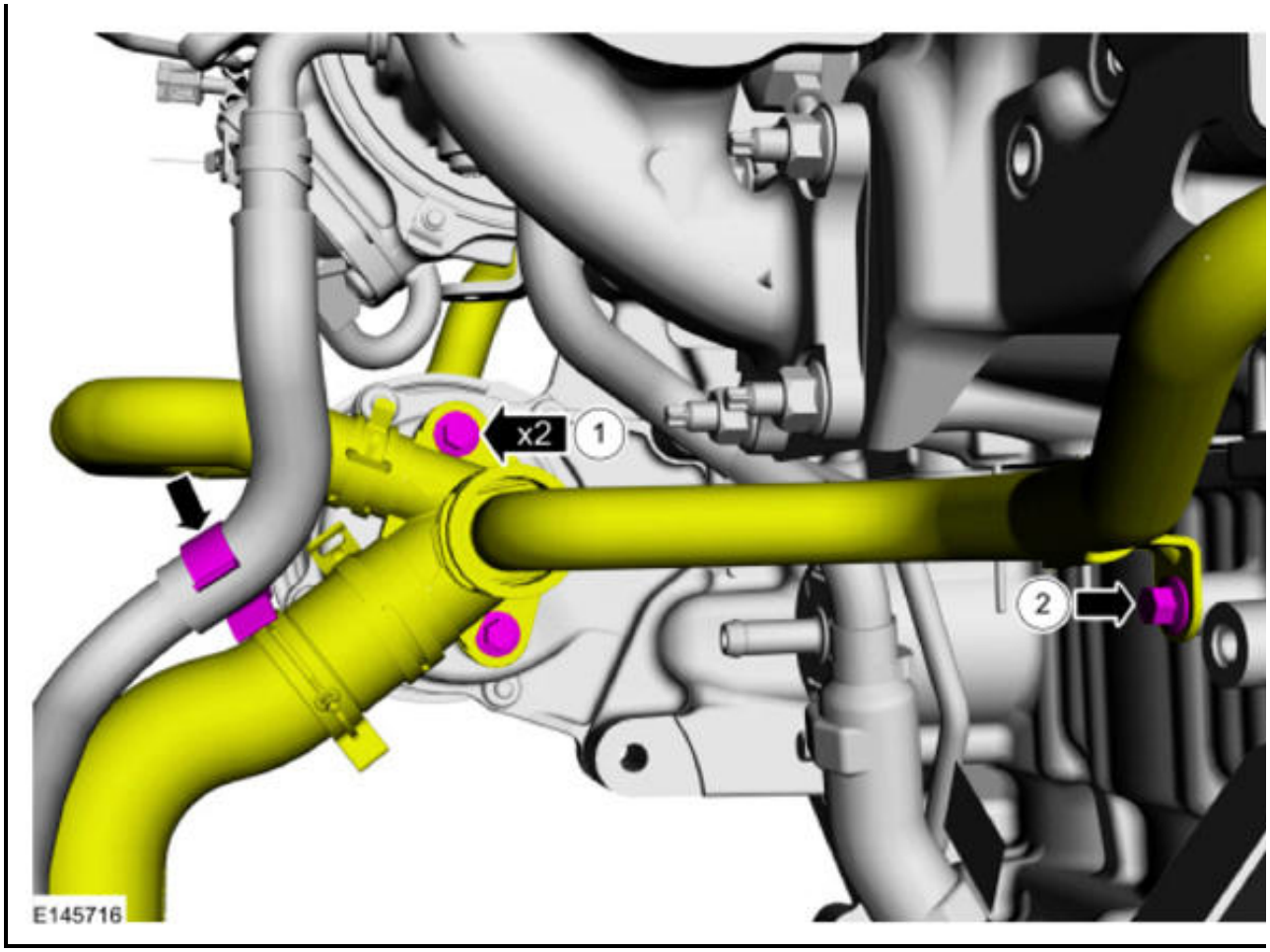
23. **NOTE: The air intake pipes and wiring harness retainers will be installed during the valve cover installation.**

Refer to: **CRANKSHAFT FRONT SEAL** .

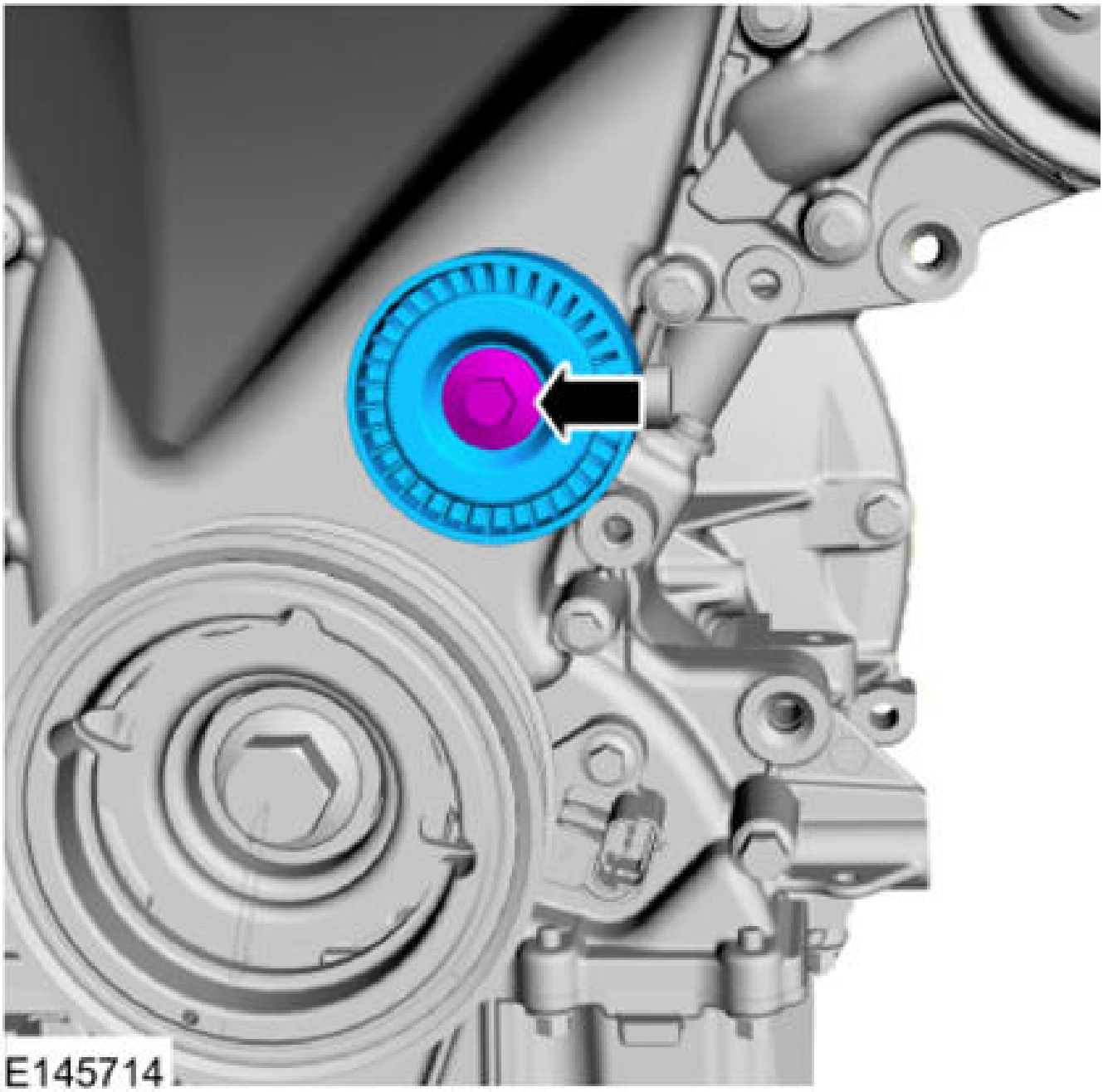
24. *Torque* : 16 lb.ft (22 Nm)



25. *Torque* :
    1. 89 lb.in (10 Nm)
    2. 89 lb.in (10 Nm)



26. *Torque* : 18 lb.ft (25 Nm)



27. Install the following items:
    - Refer to: **GENERATOR - 1.0L ECOBOOST (90KW/120PS)** .
    - Refer to: **ACCESSORY DRIVE BELT TENSIONER** .
    - Refer to: **CATALYTIC CONVERTER** .
    - Refer to: **INTAKE MANIFOLD** .
    - Refer to: **VALVE COVER** .

OIL COOLER

Special Tool(s)/General Equipment

SPECIAL TOOL(S)/GENERAL EQUIPMENT

Oil Drain Equipment
Hose Clamp Remover/Installer
Locking Pliers

Materials

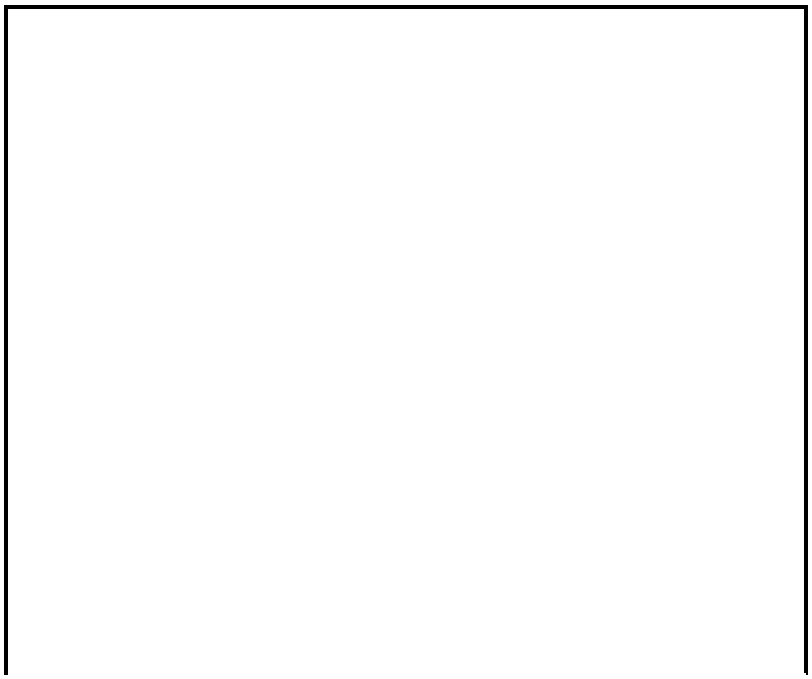
MATERIALS

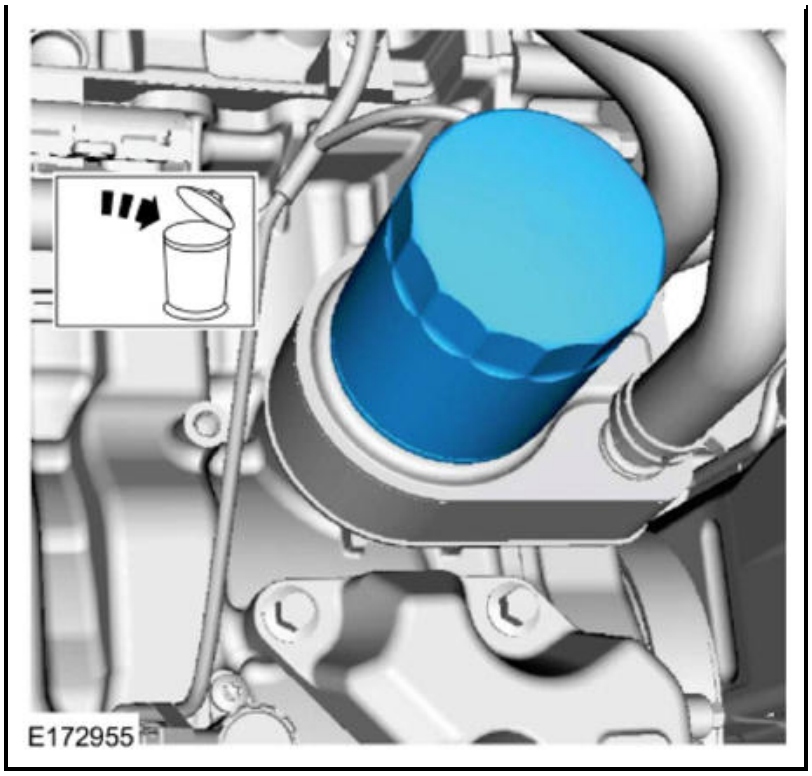
Name	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.) XO-5W20-QSP (U.S.)	WSS-M2C945-A
Motorcraft® Orange Antifreeze/Coolant Prediluted (U.S.) VC-3DIL-B (U.S.)	WSS-M97B44-D2
Motorcraft® Orange Antifreeze/Coolant Concentrated (U.S.) VC-3-B (U.S.)	WSS-M97B44-D

Removal

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to: **JACKING AND LIFTING - OVERVIEW** .
2. Remove and discard the engine oil filter.

   Use the General Equipment: Oil Drain Equipment

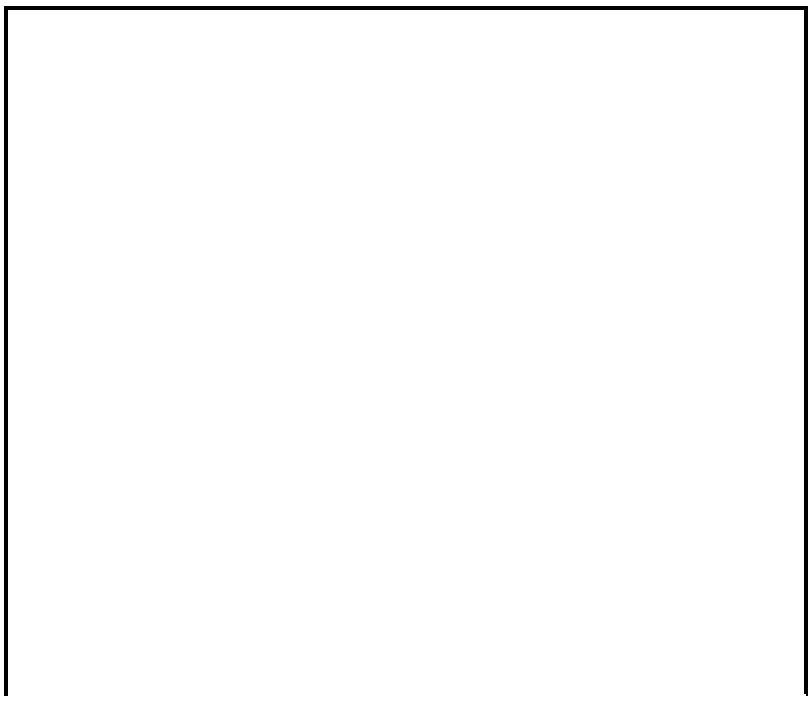


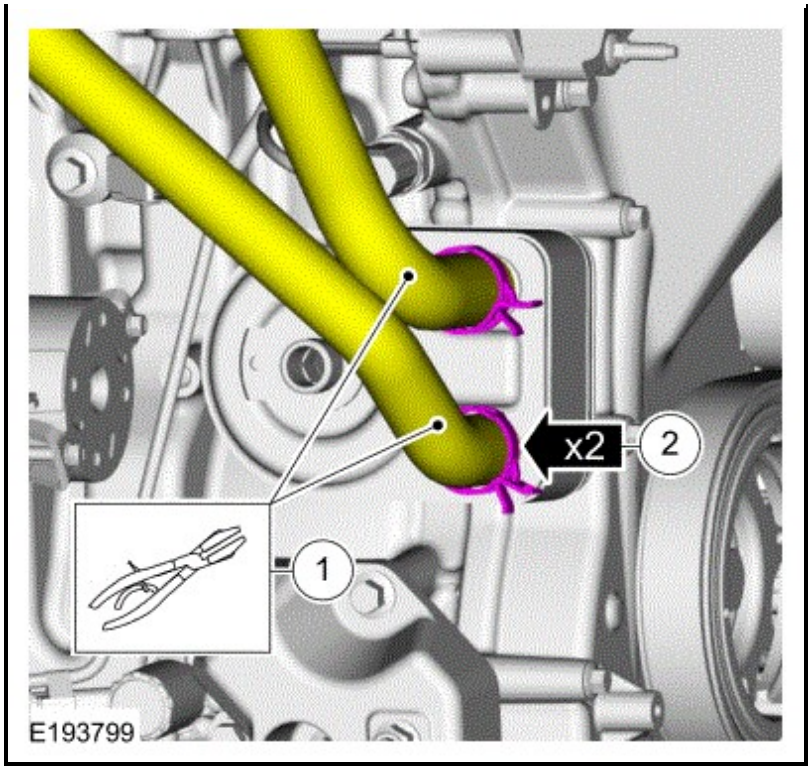


3.

1. Using hose locking pliers, clamp the oil cooler coolant hoses. Use the General Equipment: Locking Pliers

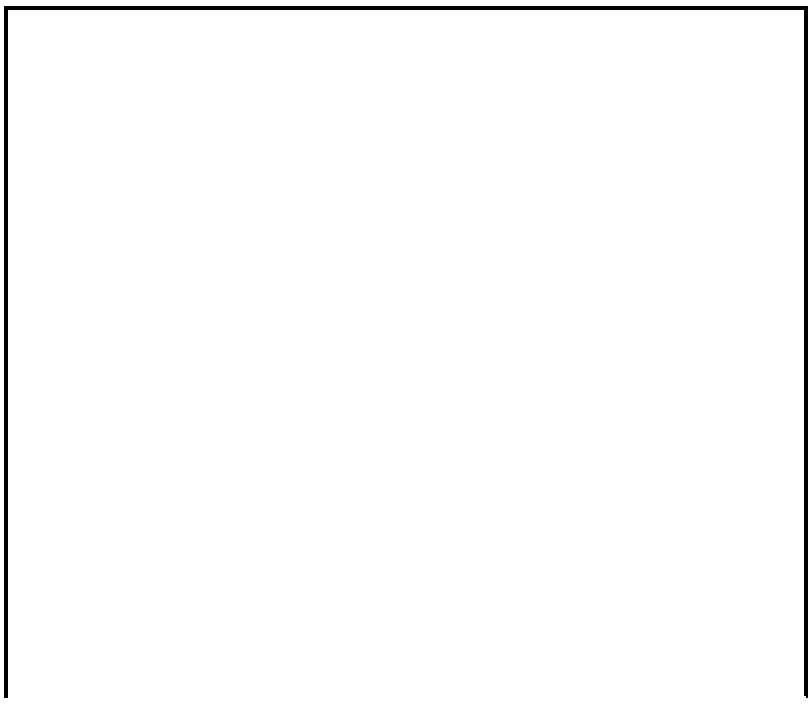
2. Using the hose clamp remover, remove the coolant hoses. Use the General Equipment: Hose Clamp Remover/Installer

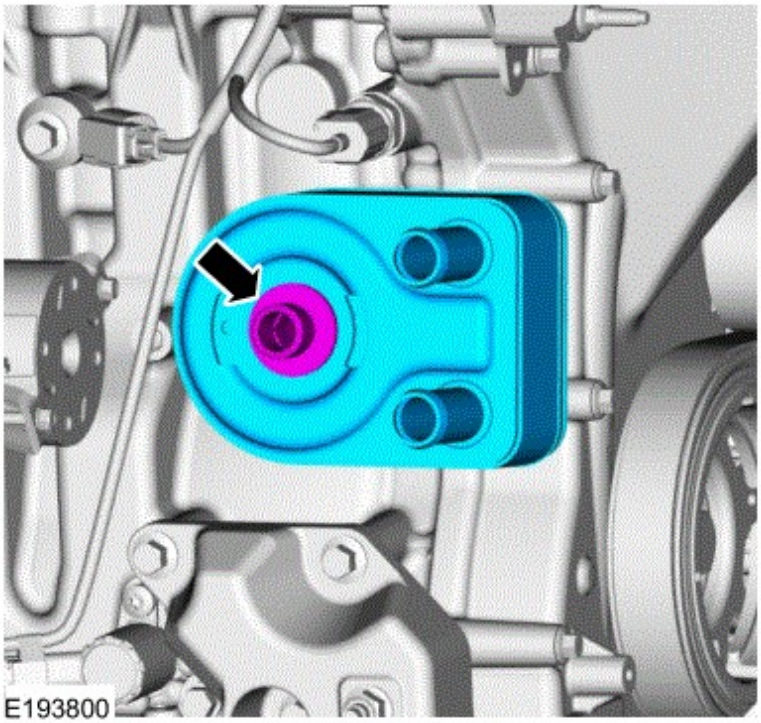




NOTE: **If metal or foreign material is present in the oil cooler, mechanical concerns exist. To diagnose the mechanical concerns refer to ENGINE SYSTEM - GENERAL INFORMATION .**

4. Remove the bolt and the oil cooler.

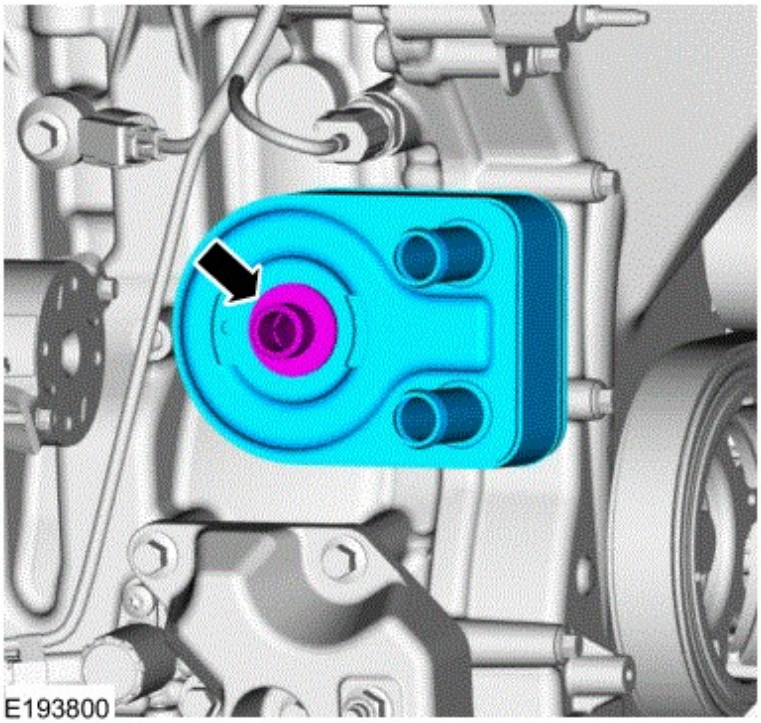




Installation

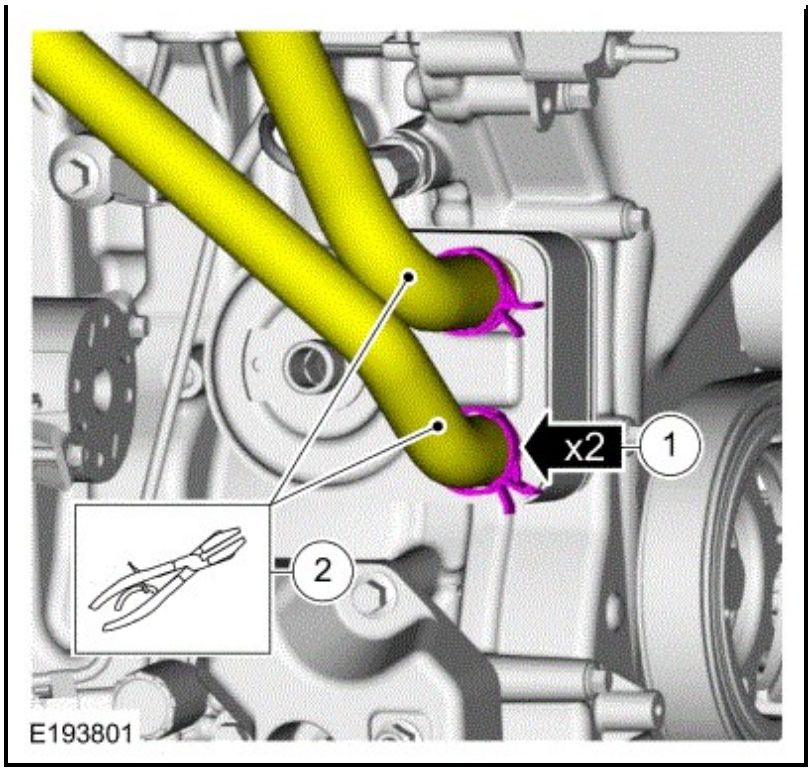
1. Install the oil cooler and the bolt.

   Torque: 41 lb.ft (55 Nm)



2.

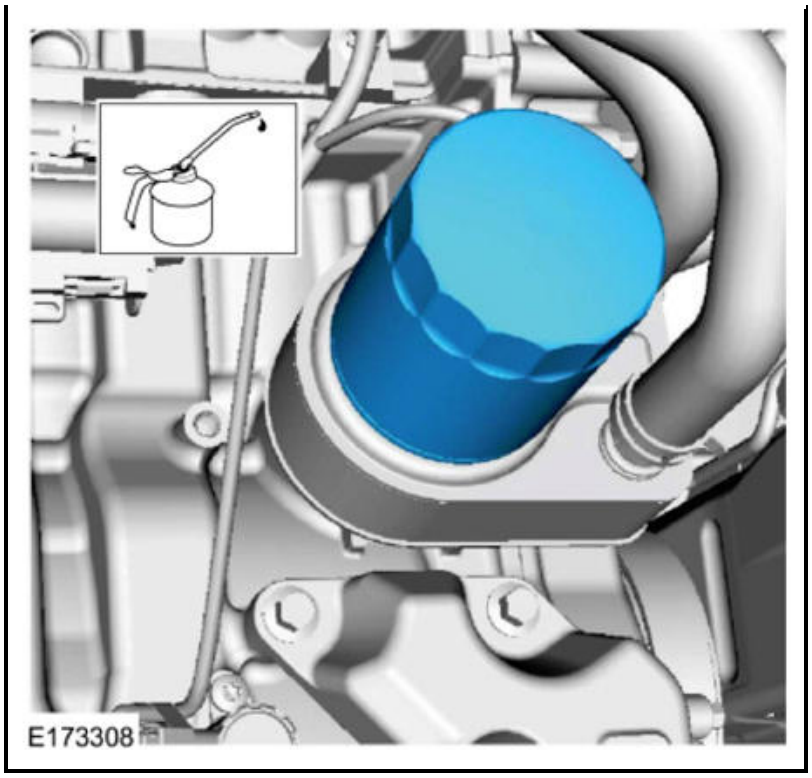
1. Using the hose clamp installer, install the coolant hoses. Use the General Equipment: Hose Clamp Remover/Installer
2. Remove the hose locking pliers.



3. **NOTE: Lubricate the engine oil filter gasket with clean engine oil.**

Install a new engine oil filter.

Torque: 128 lb.in (14.5 Nm)



4. Inspect and adjust the coolant level in the degas bottle.

   Material: Motorcraft® Orange Antifreeze/Coolant Concentrated (U.S.) / VC-3-B (U.S.) (WSS-M97B44-D)

   Material: Motorcraft® Orange Antifreeze/Coolant Prediluted (U.S.) / VC-3DIL-B (U.S.) (WSS-M97B44-D2)

5. Inspect and adjust the engine oil level.

   Material: Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.) / XO-5W20-QSP (U.S.) (WSS-M2C945-A)

REMOVAL

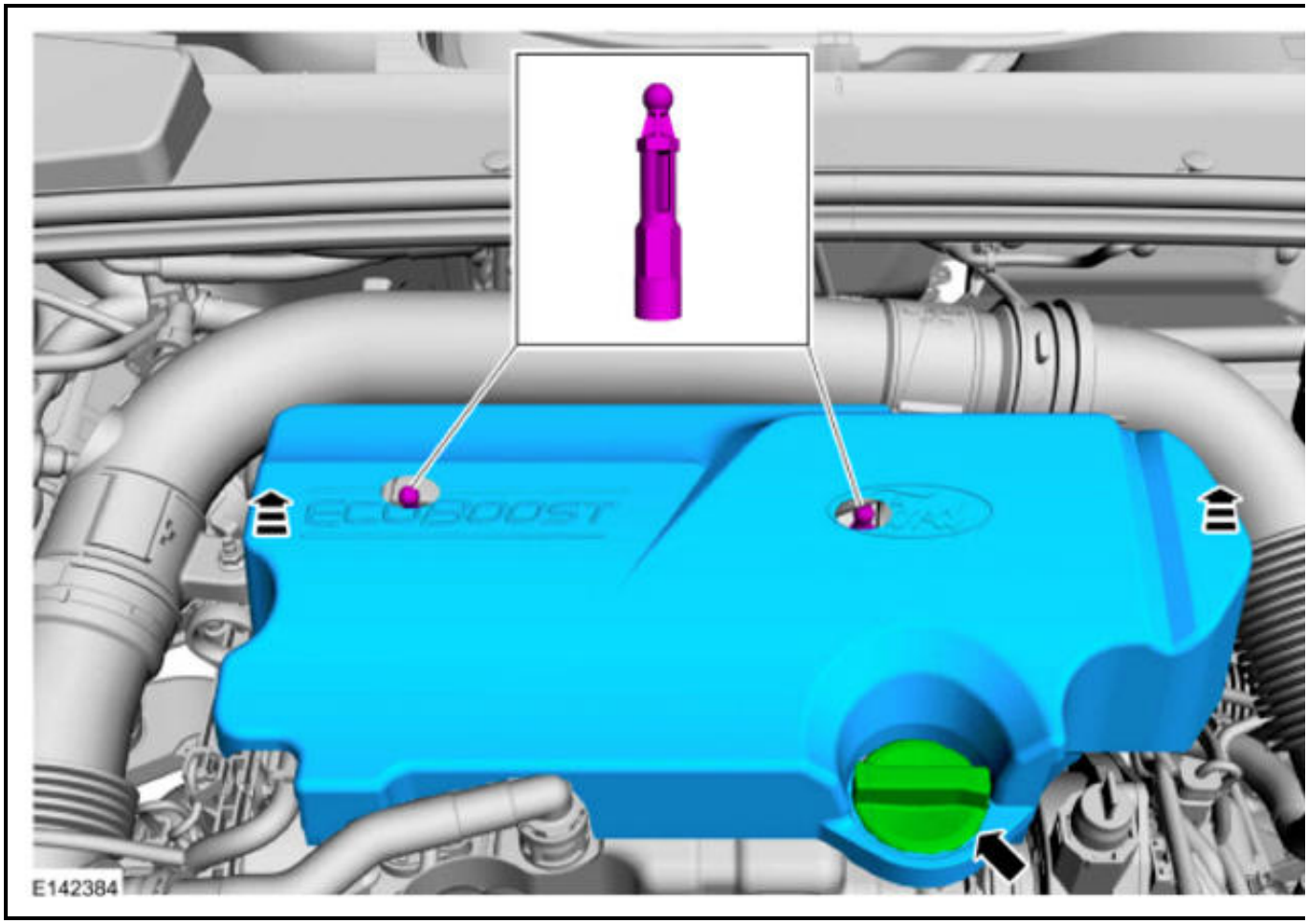
ENGINE

SPECIAL TOOL DESCRIPTION

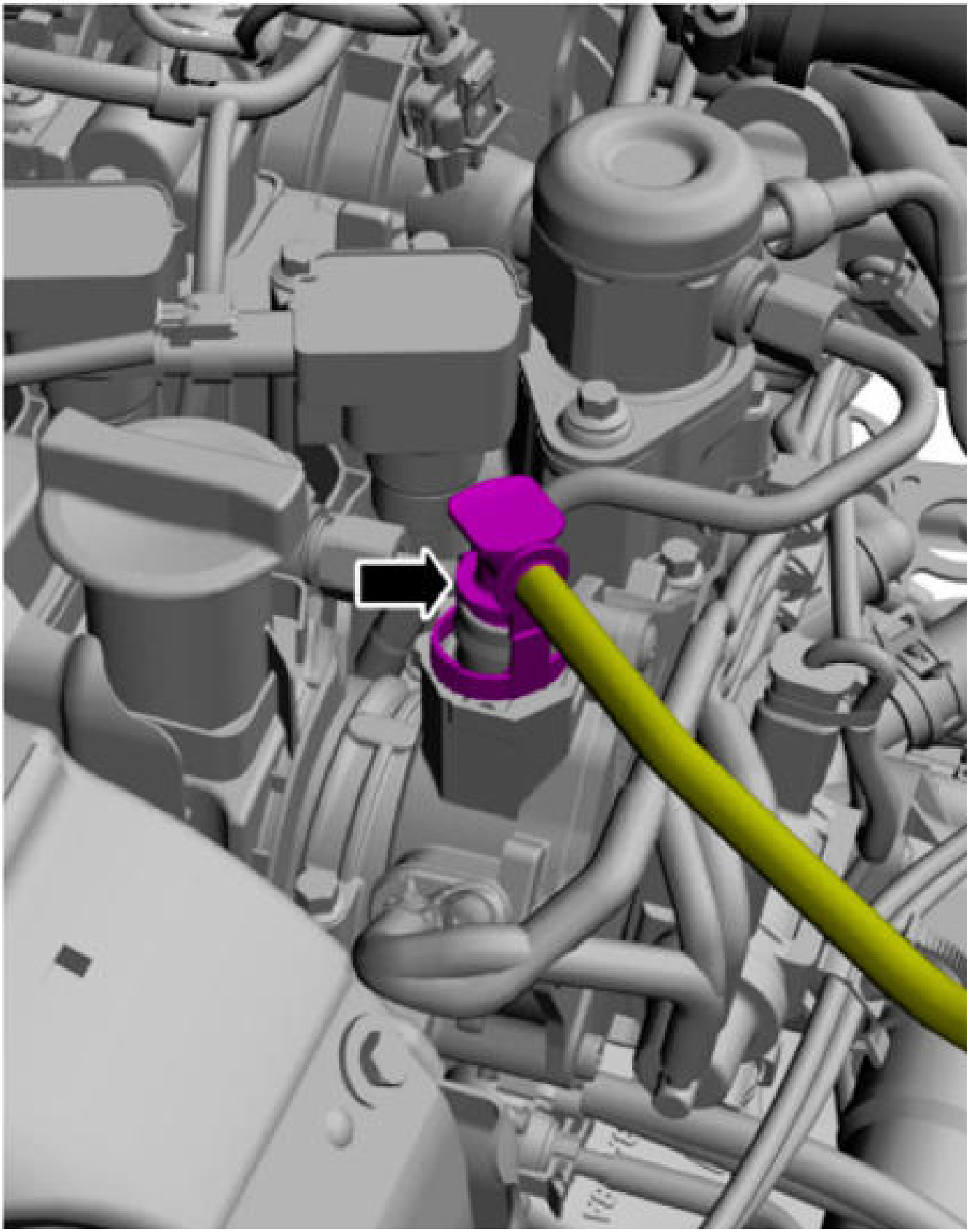
	**300-OTC1585AE** Powertrain Lift
	**300-OTC1819E** 2, 200# Floor Crane, Fold Away
Tie Rod End Remover	
Steering Wheel Holder	
Adjustable Mounting Arm	
Cable Ties	
Hose Clamp Remover/Installer	

Wooden Block

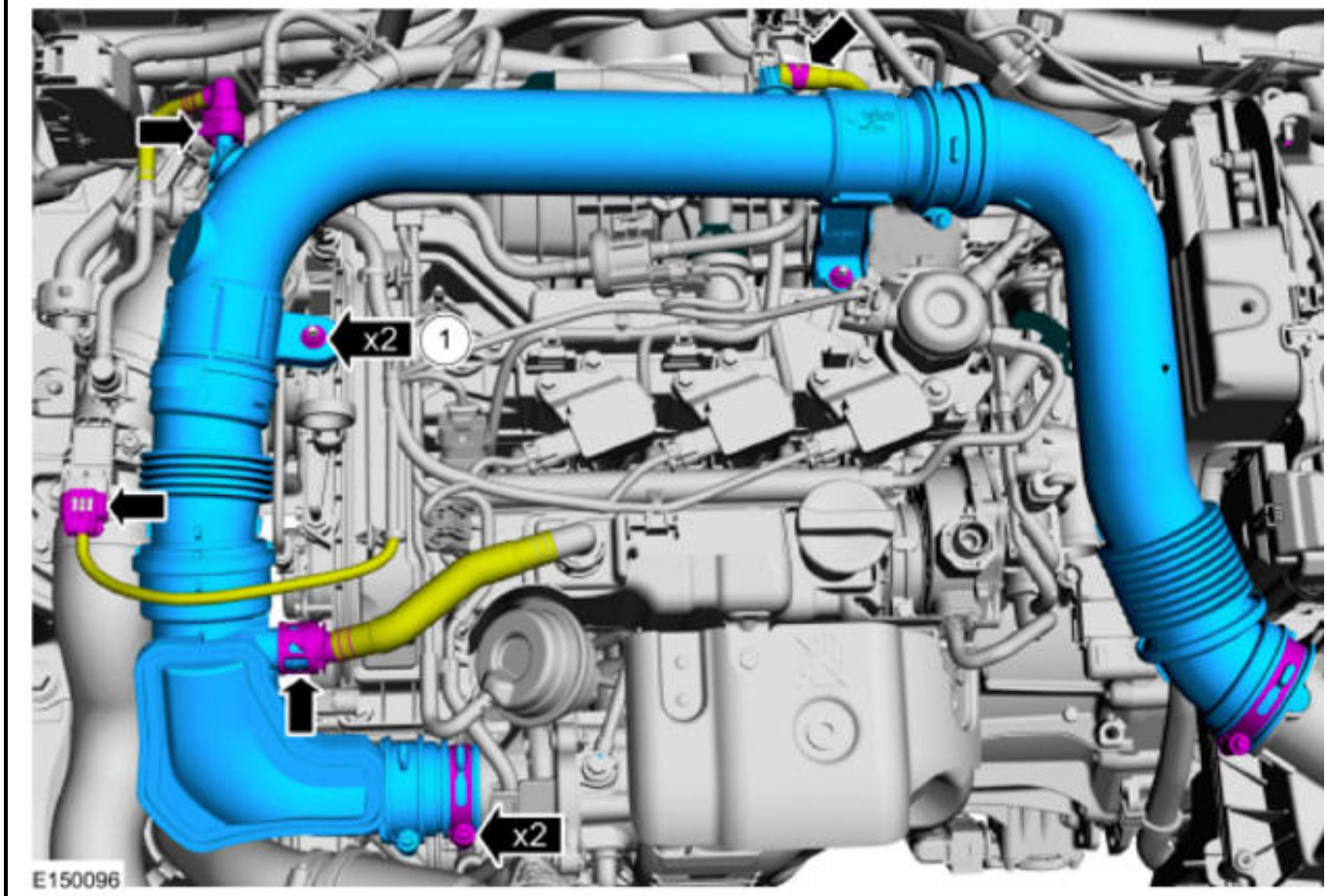
1. Refer to: **JACKING AND LIFTING - OVERVIEW** .
2. Refer to: **FUEL SYSTEM PRESSURE RELEASE** .
3. Refer to: **COOLING SYSTEM DRAINING AND VACUUM FILLING** .
4. If equipped.



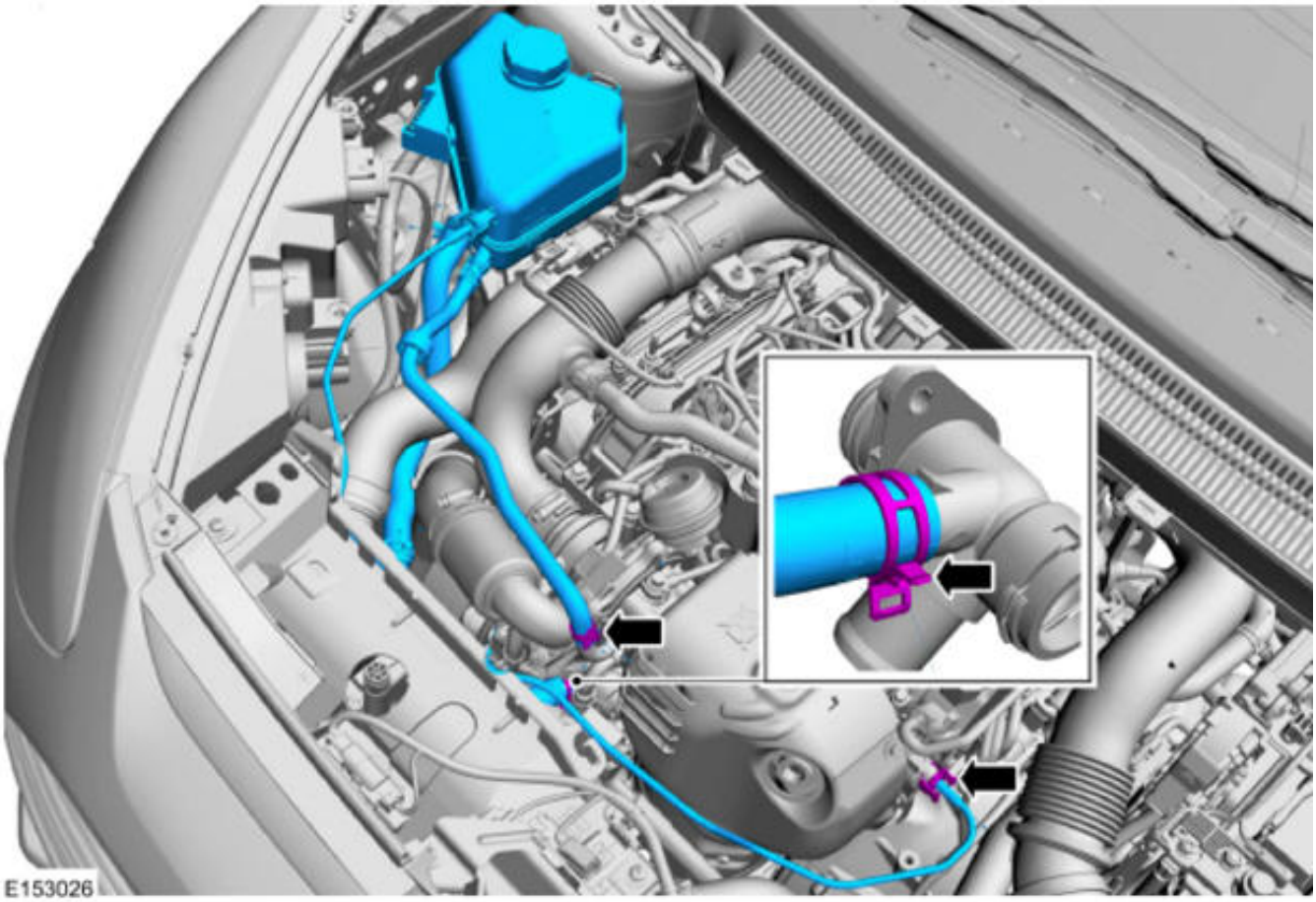
5.



6. Use the General Equipment: Hose Clamp Remover/Installer



7. Use the General Equipment: Hose Clamp Remover/Installer



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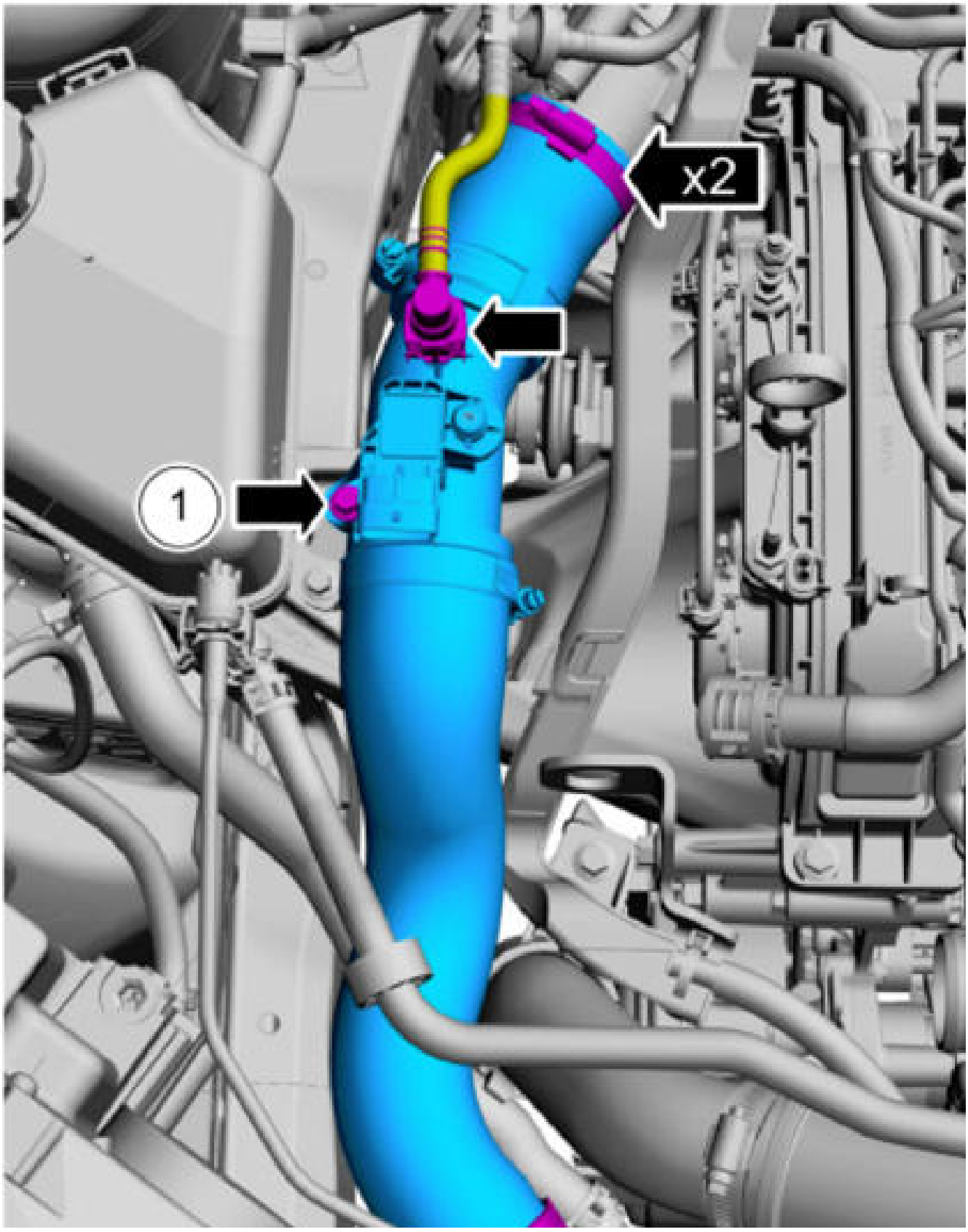
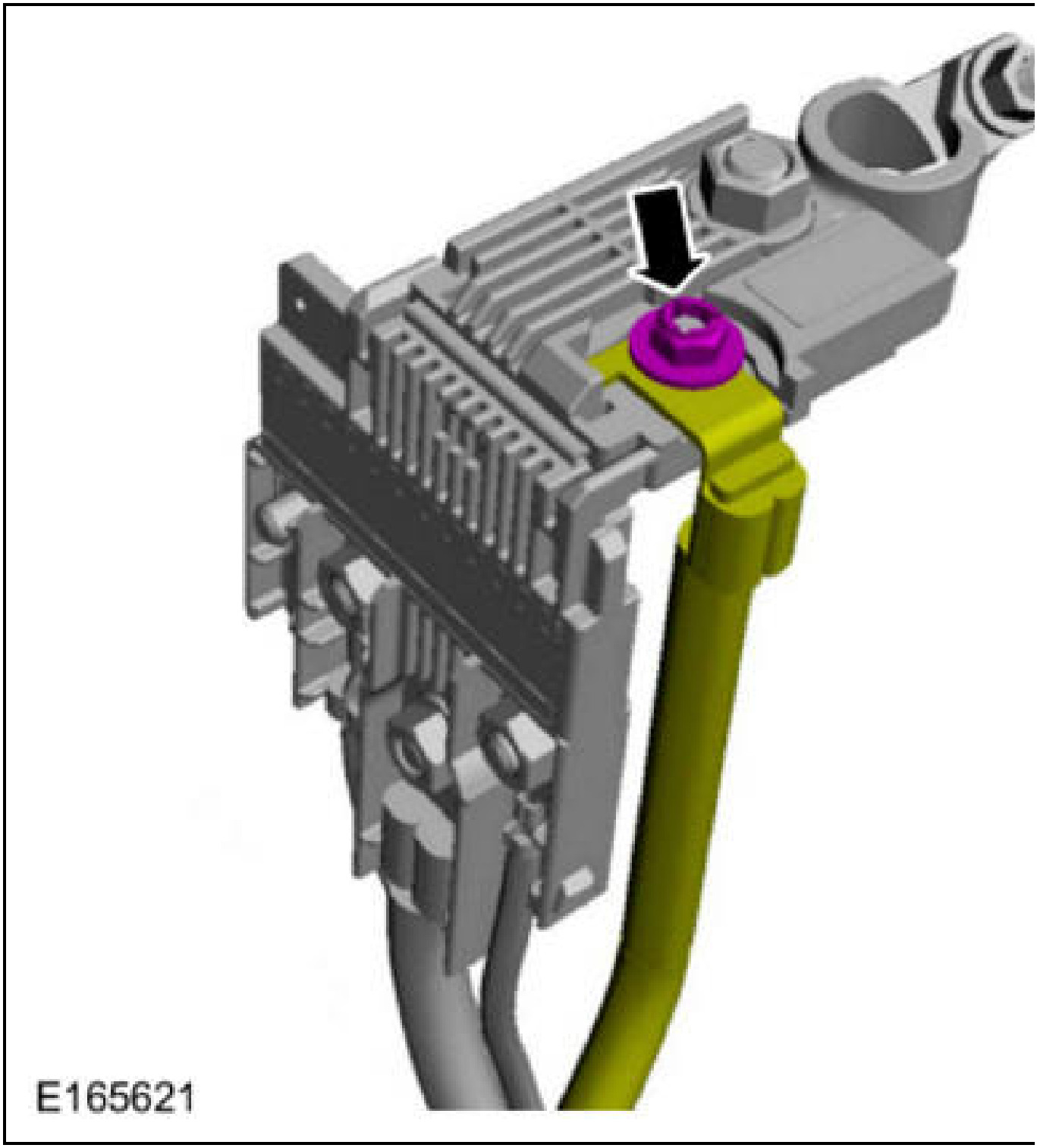


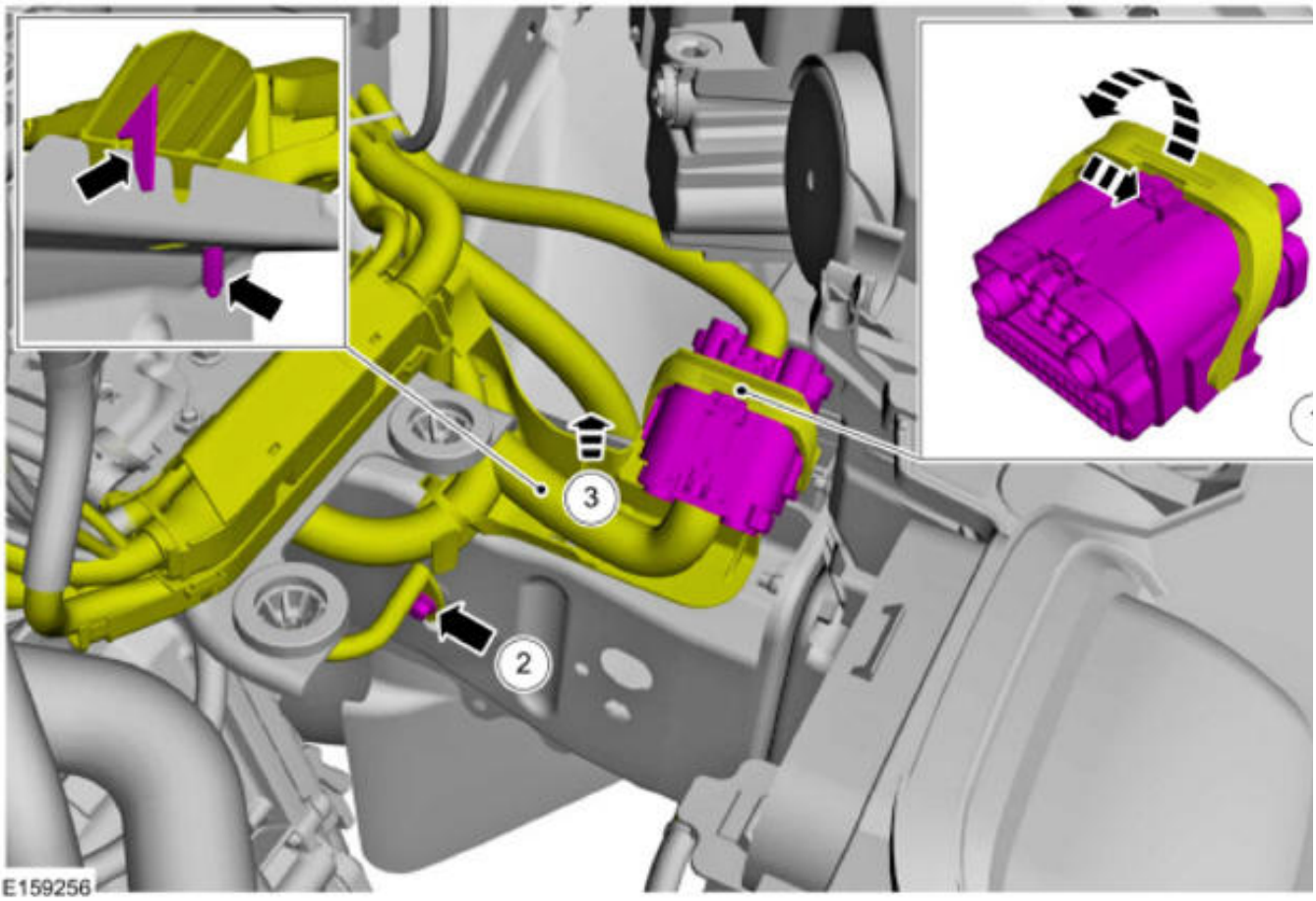
9. Refer to: **BATTERY TRAY - 1.0L ECOBOOST (90KW/120PS)/1.6L ECOBOOST (132KW/180PS) - SIGMA** .



10.

11.

11.



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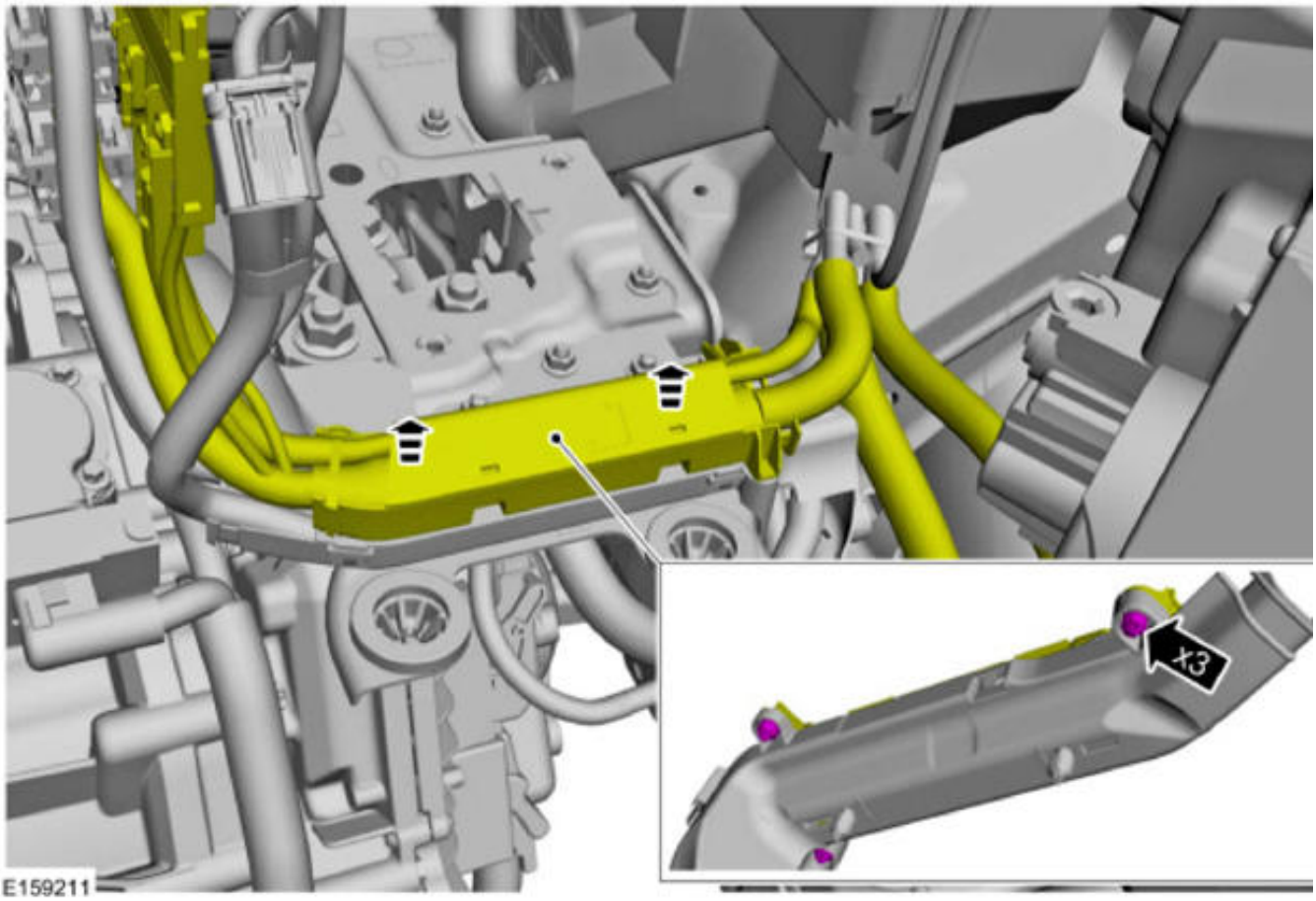
12.



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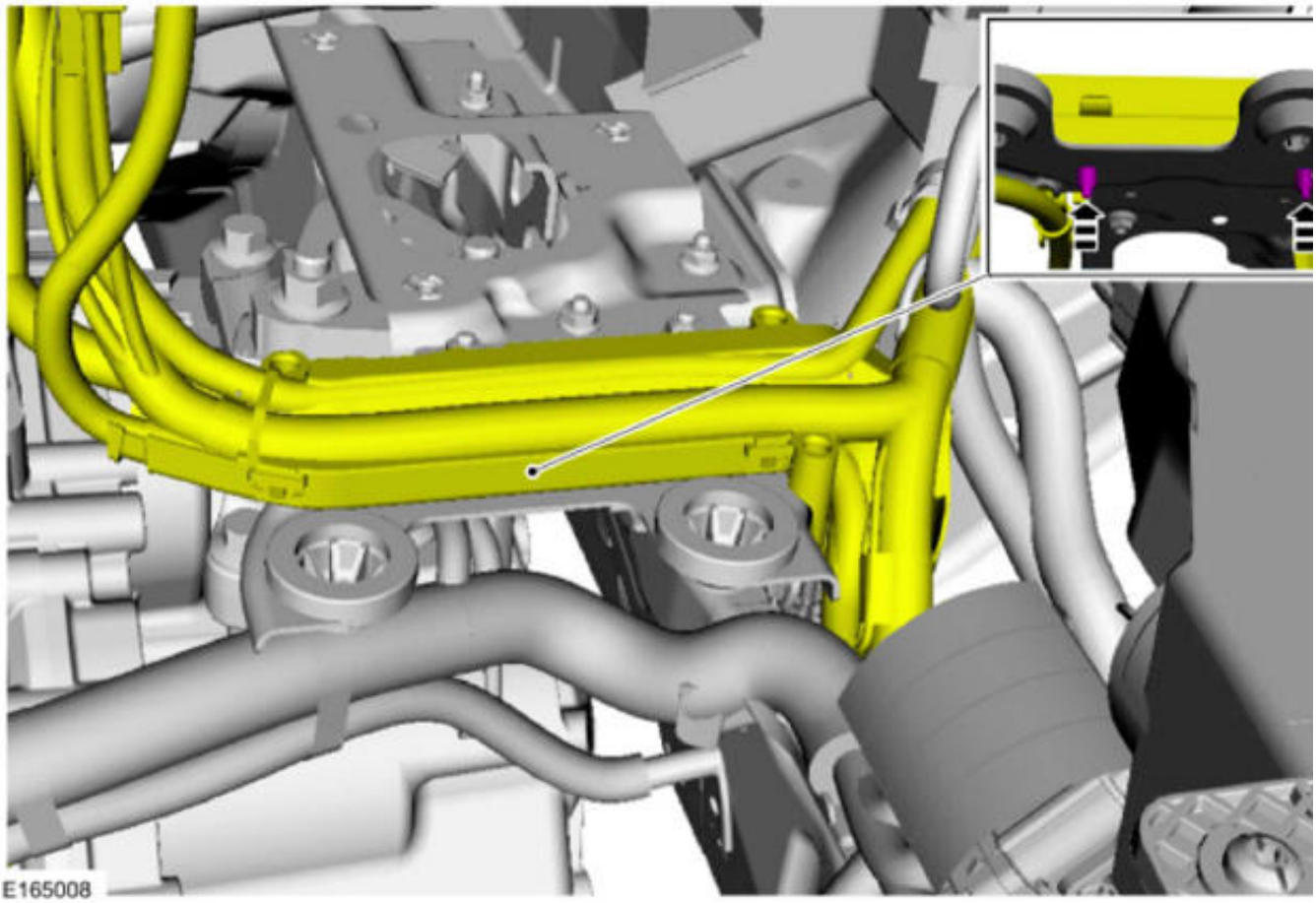
13.



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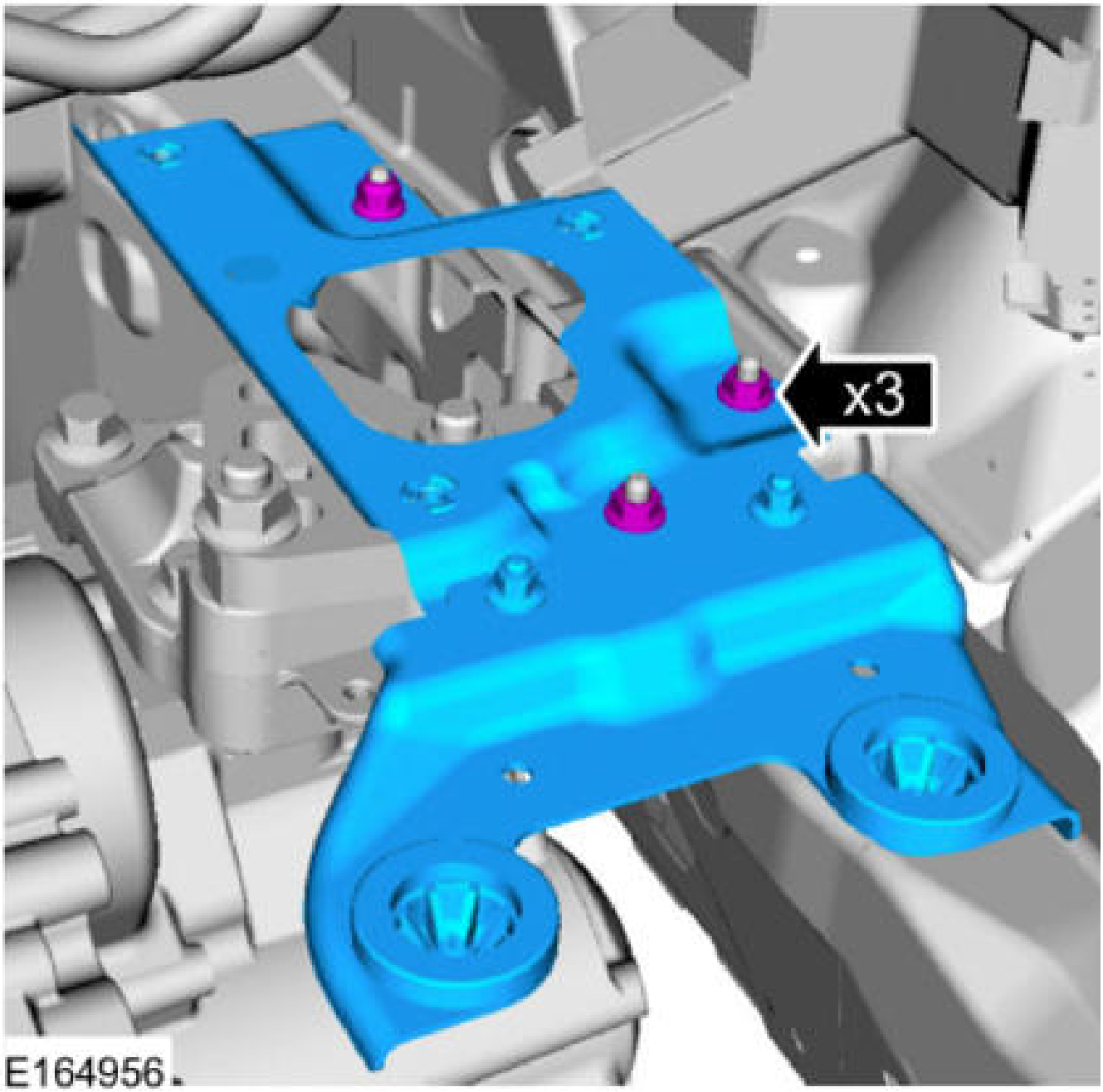
14.



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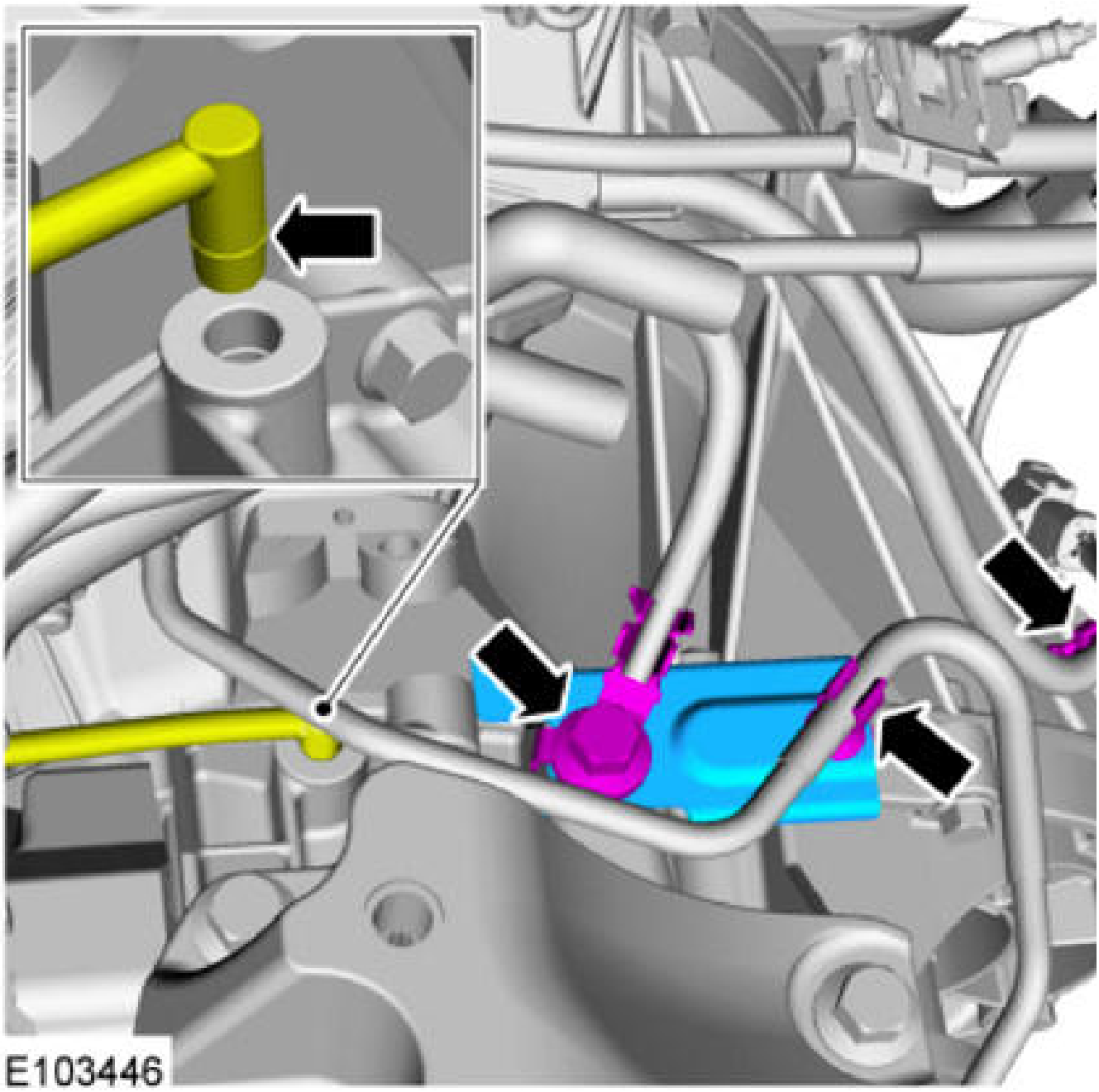
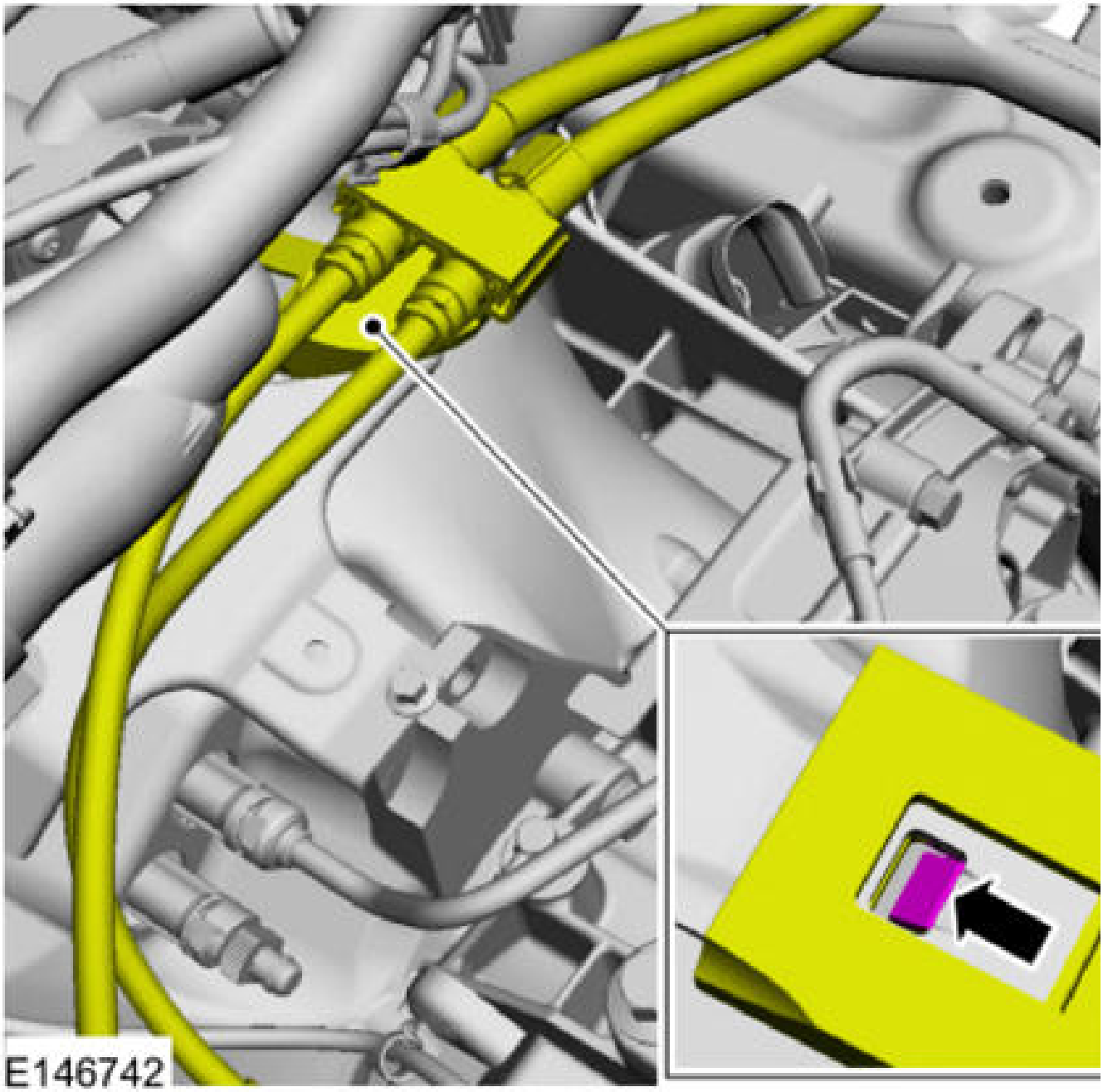
15.

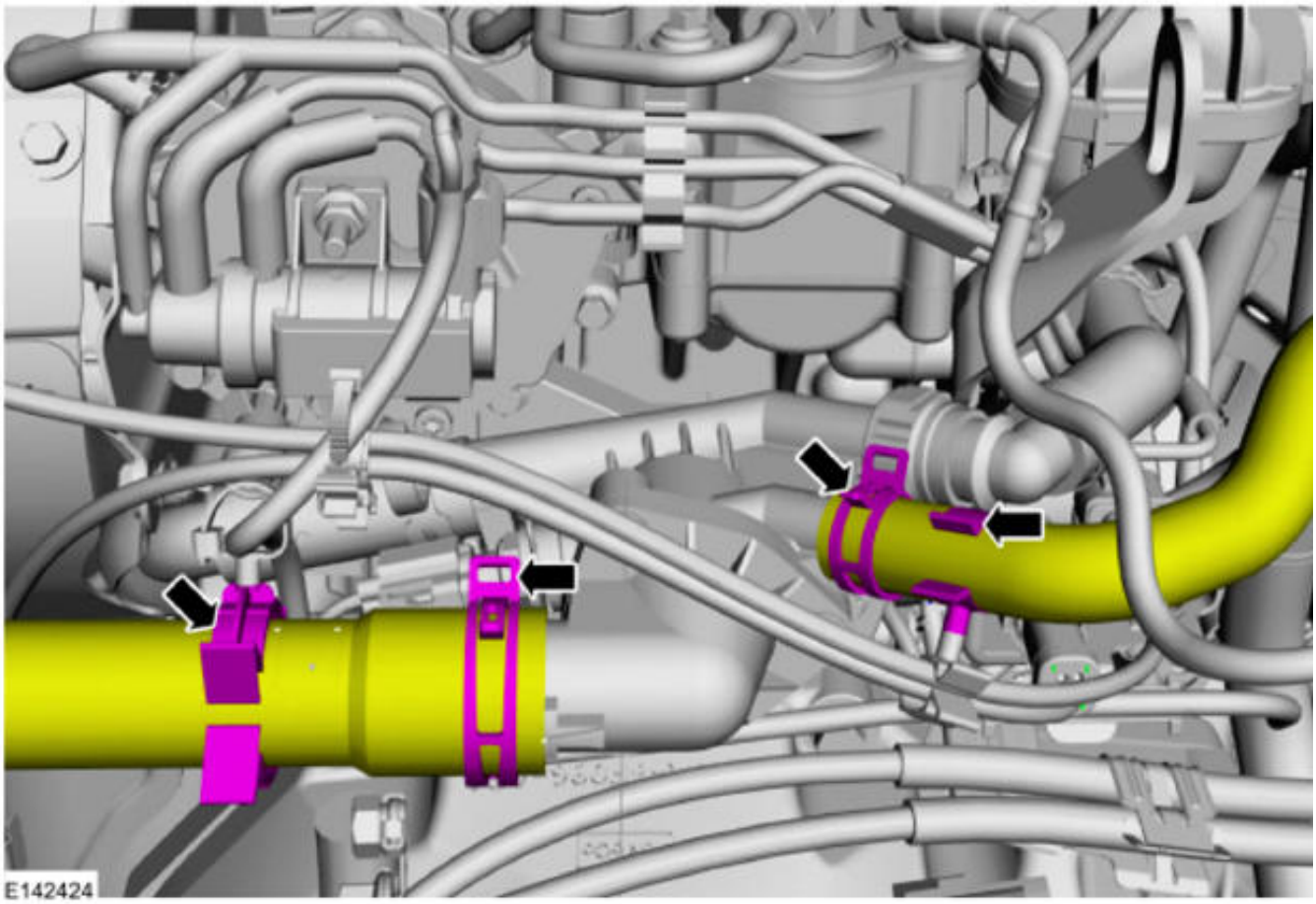


16.

16.

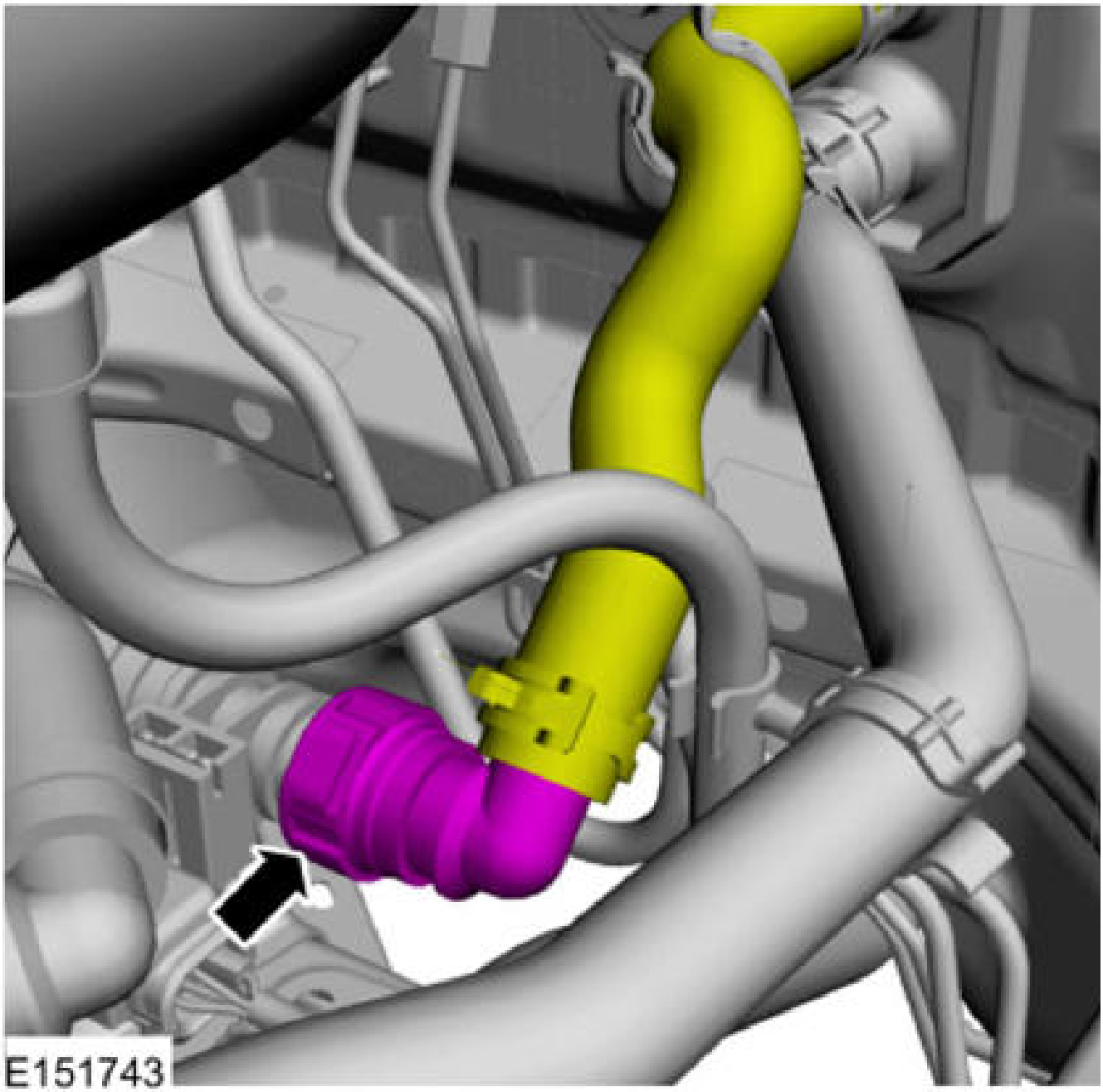


17. Use the General Equipment: Hose Clamp Remover/Installer



18.

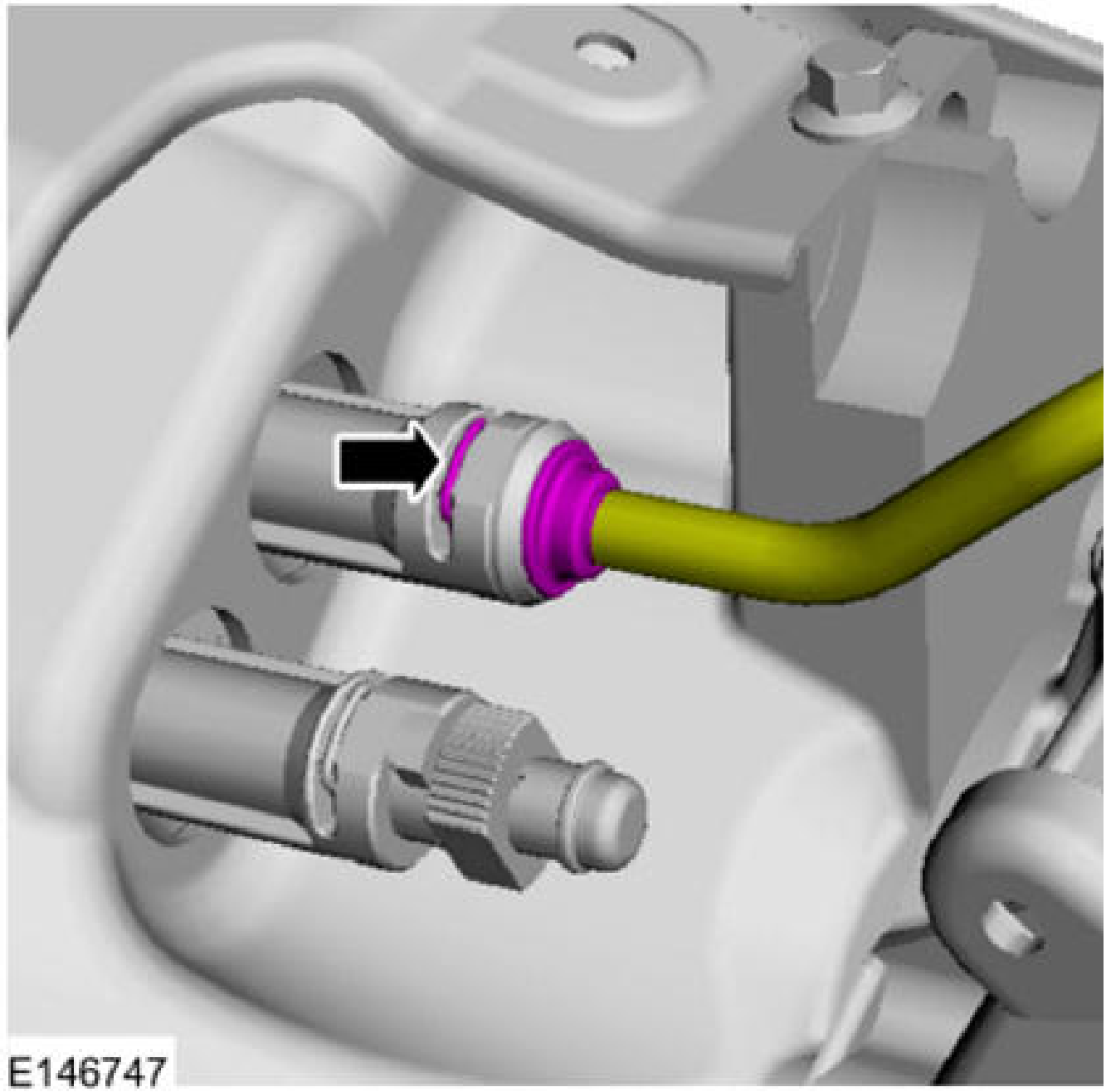
18.



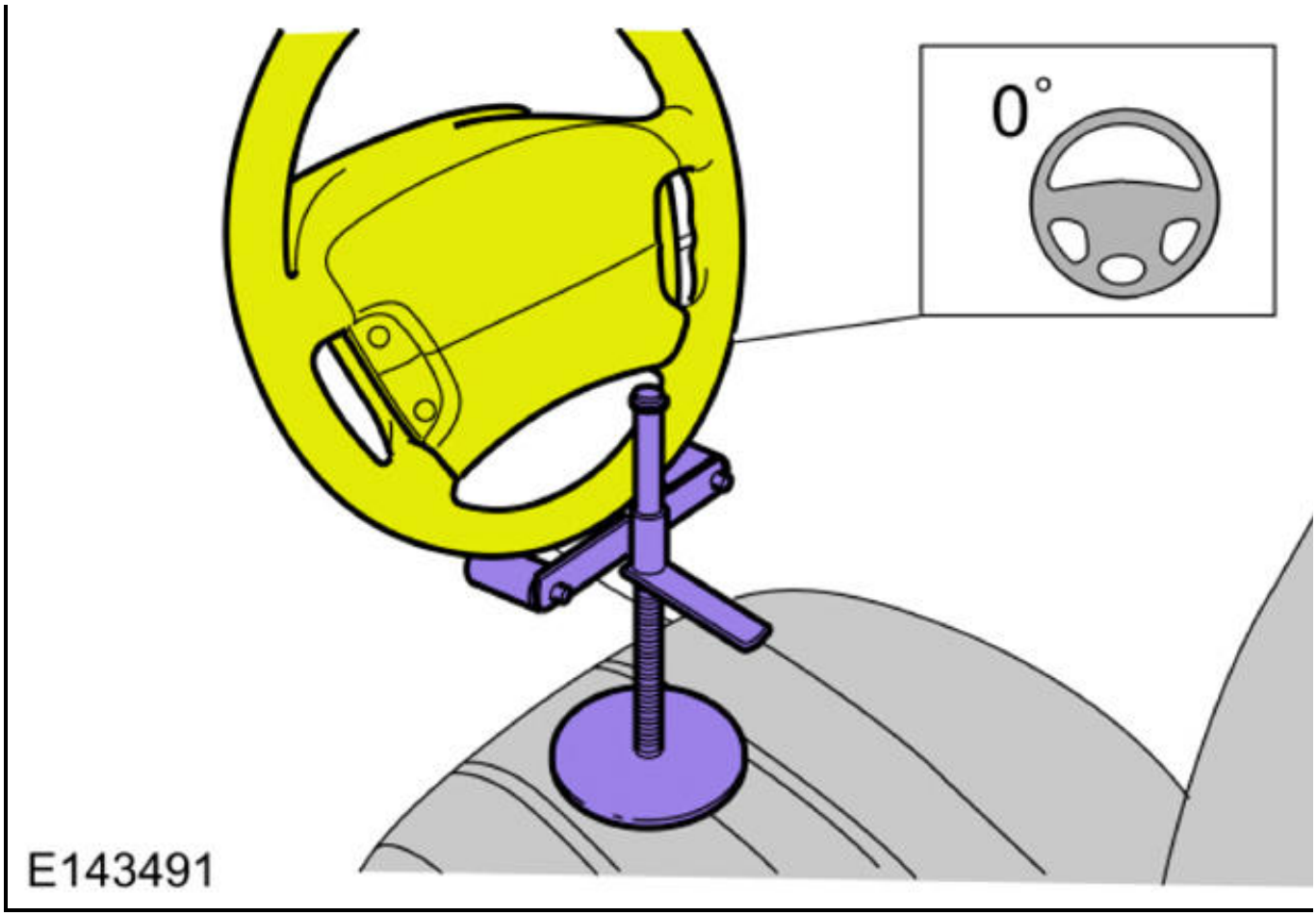
19.

NOTE: **If the fluid is spilled on the paintwork, the affected area must be immediately washed down with cold water.**

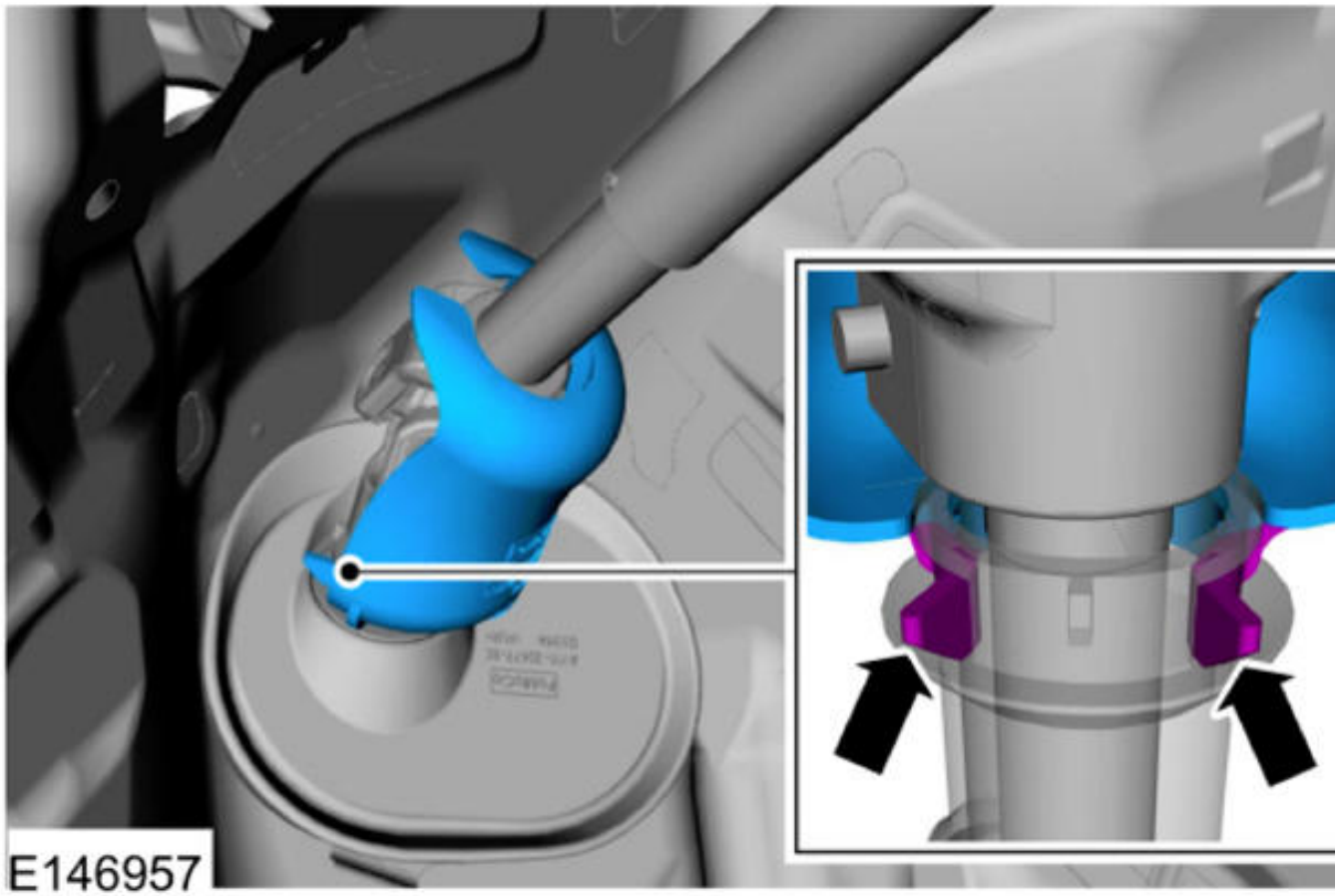
NOTE: **Make sure that all openings are sealed.**



20. Use the General Equipment: Steering Wheel Holder



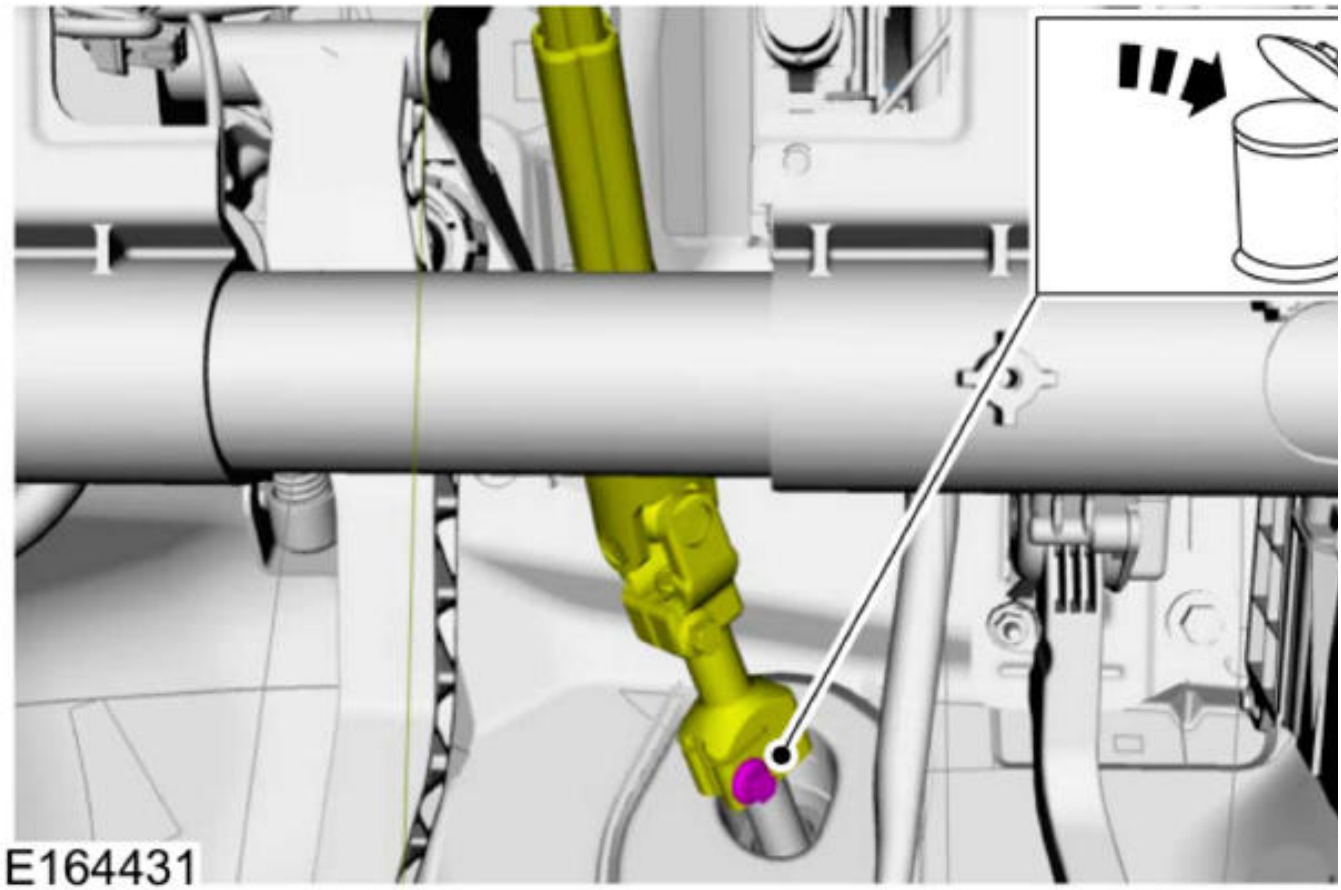
21. If equipped.



WARNING: Do not reuse steering column shaft bolts. This may result in fastener failure and steering column shaft detachment or loss of steering control. Failure to follow this instruction may result in serious injury to vehicle occupant(s).

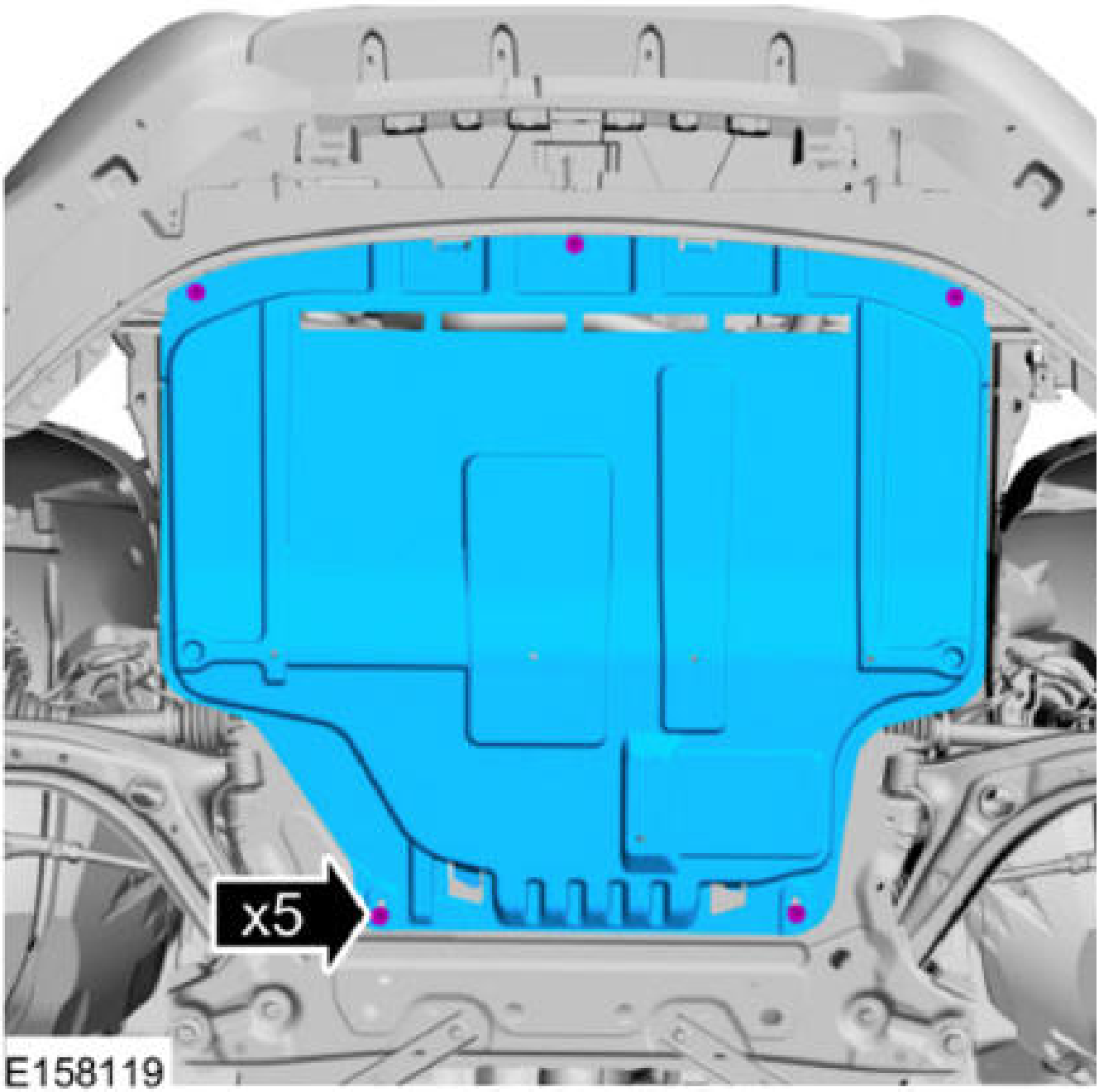
22.

NOTE: Do not allow the steering column to rotate while the steering column shaft is disconnected or damage to the clockspring may result. If there is evidence that the steering column shaft has rotated, remove and re-center the clockspring. For additional information, refer to SUPPLEMENTAL RESTRAINT SYSTEM .



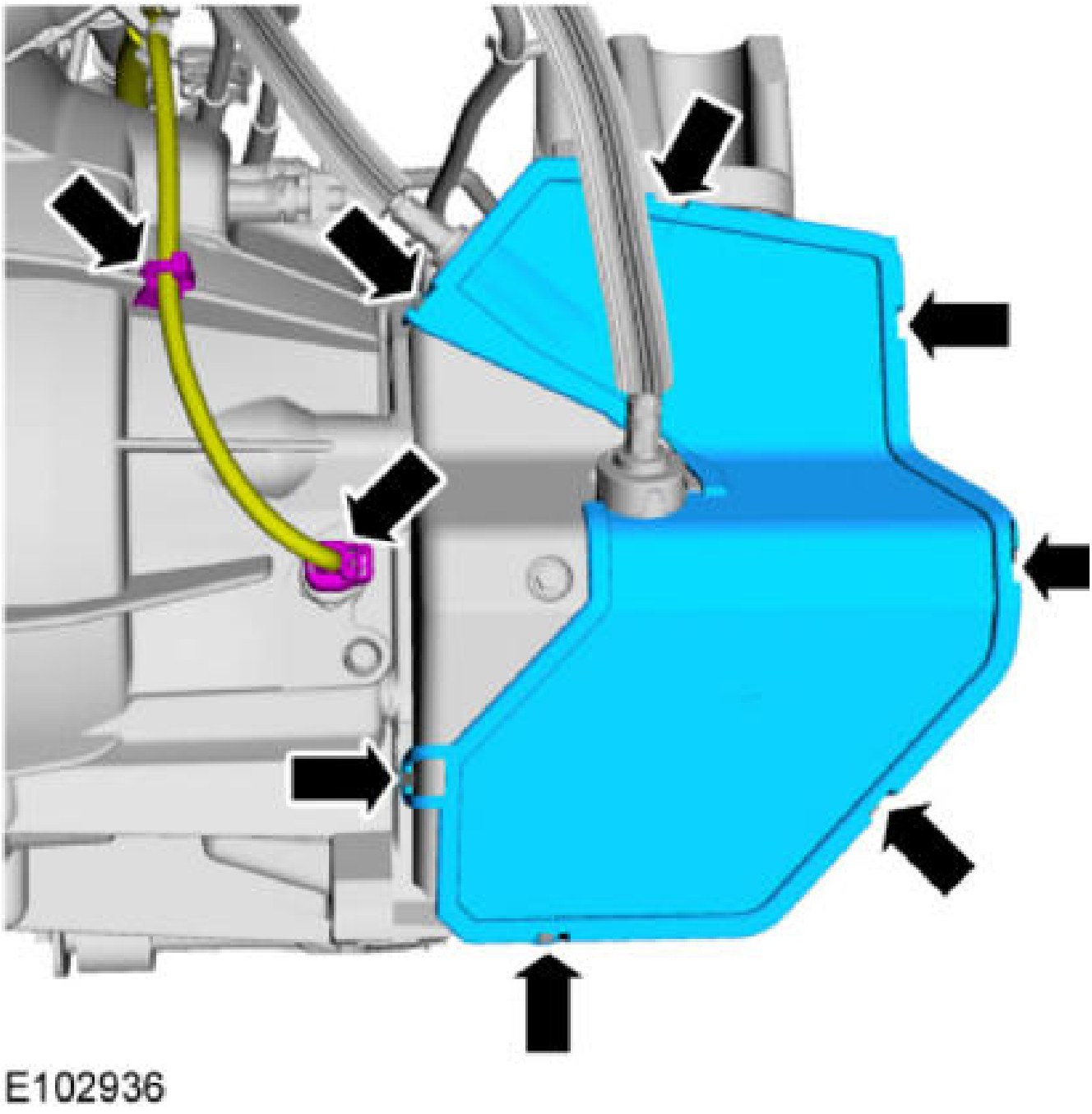
23.

23.

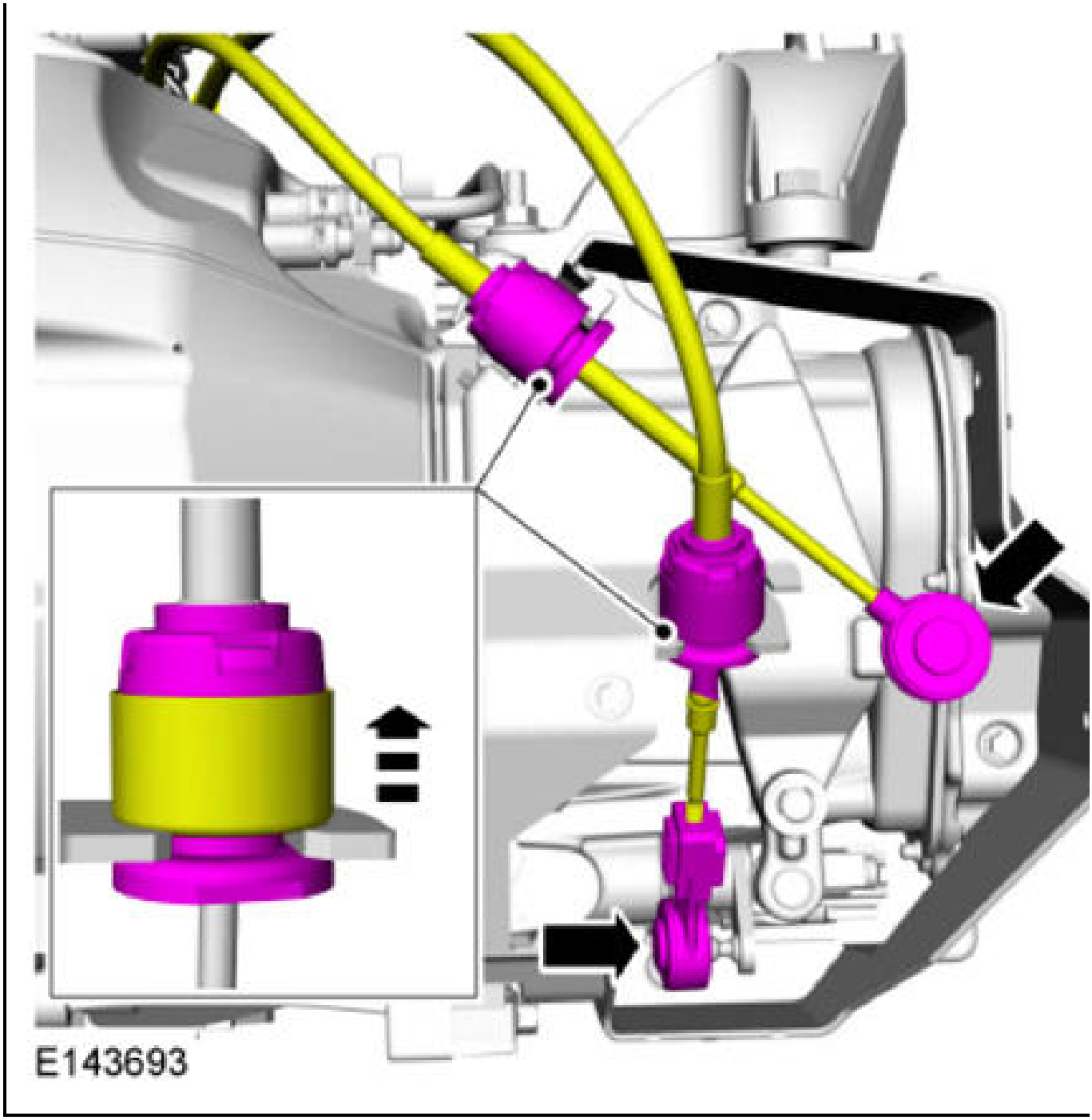


24.

24.

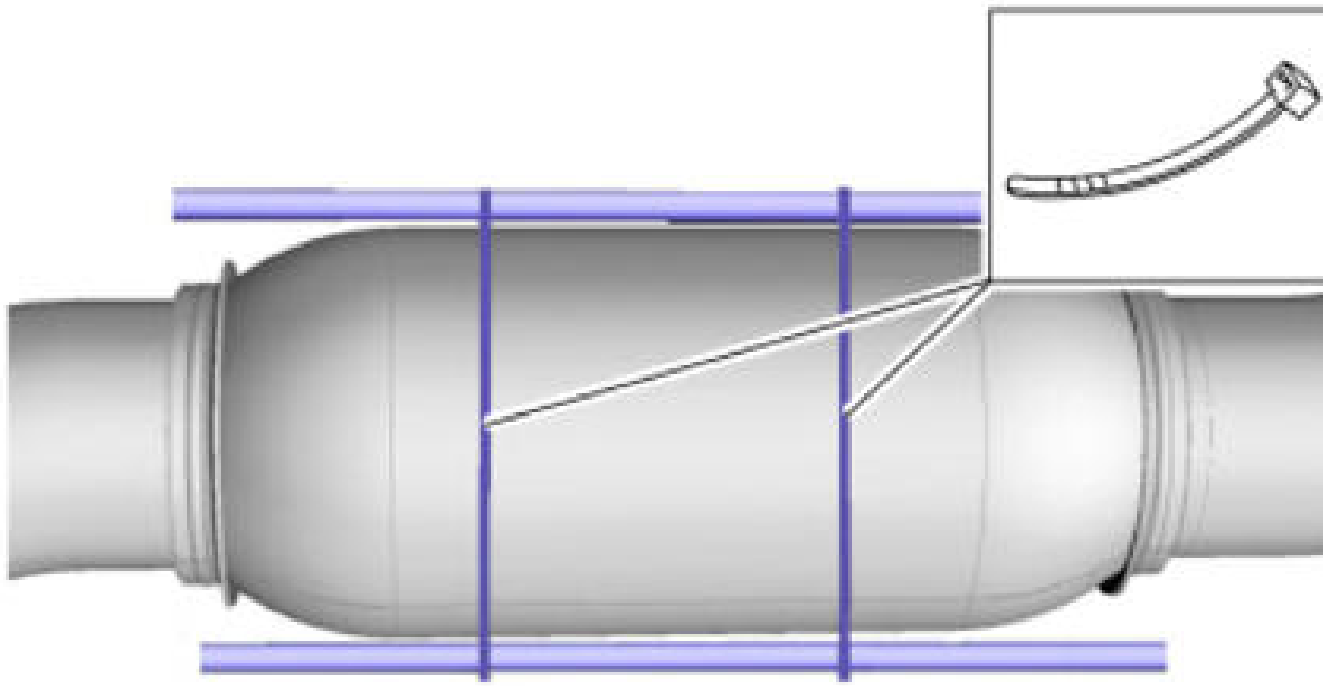


25. **NOTE: Gearshift cables must not be kinked or bent.**



26. **NOTE: Make sure that the exhaust flexible pipe is not forcibly bent or twisted.**

Use the General Equipment: Cable Ties



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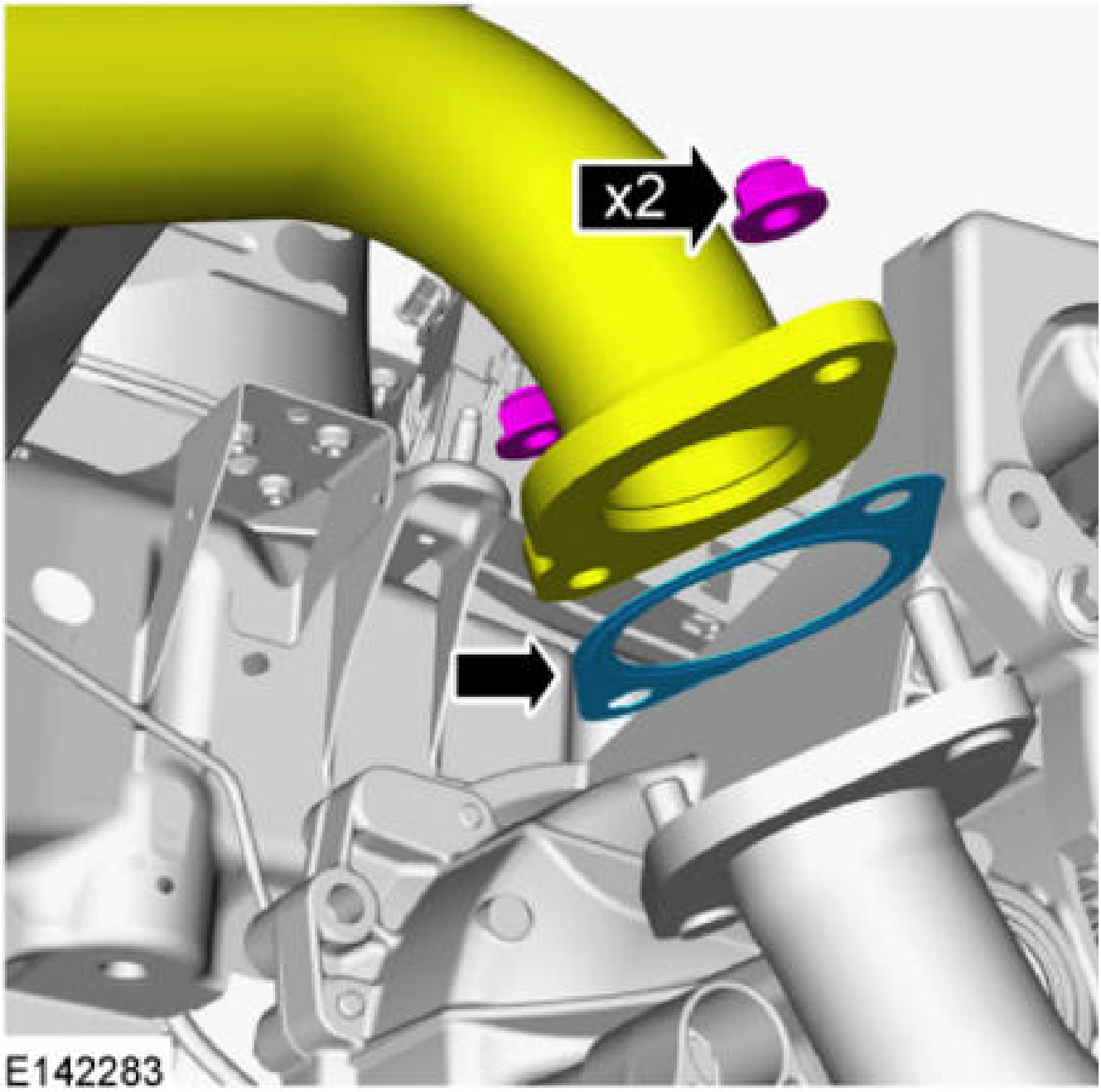
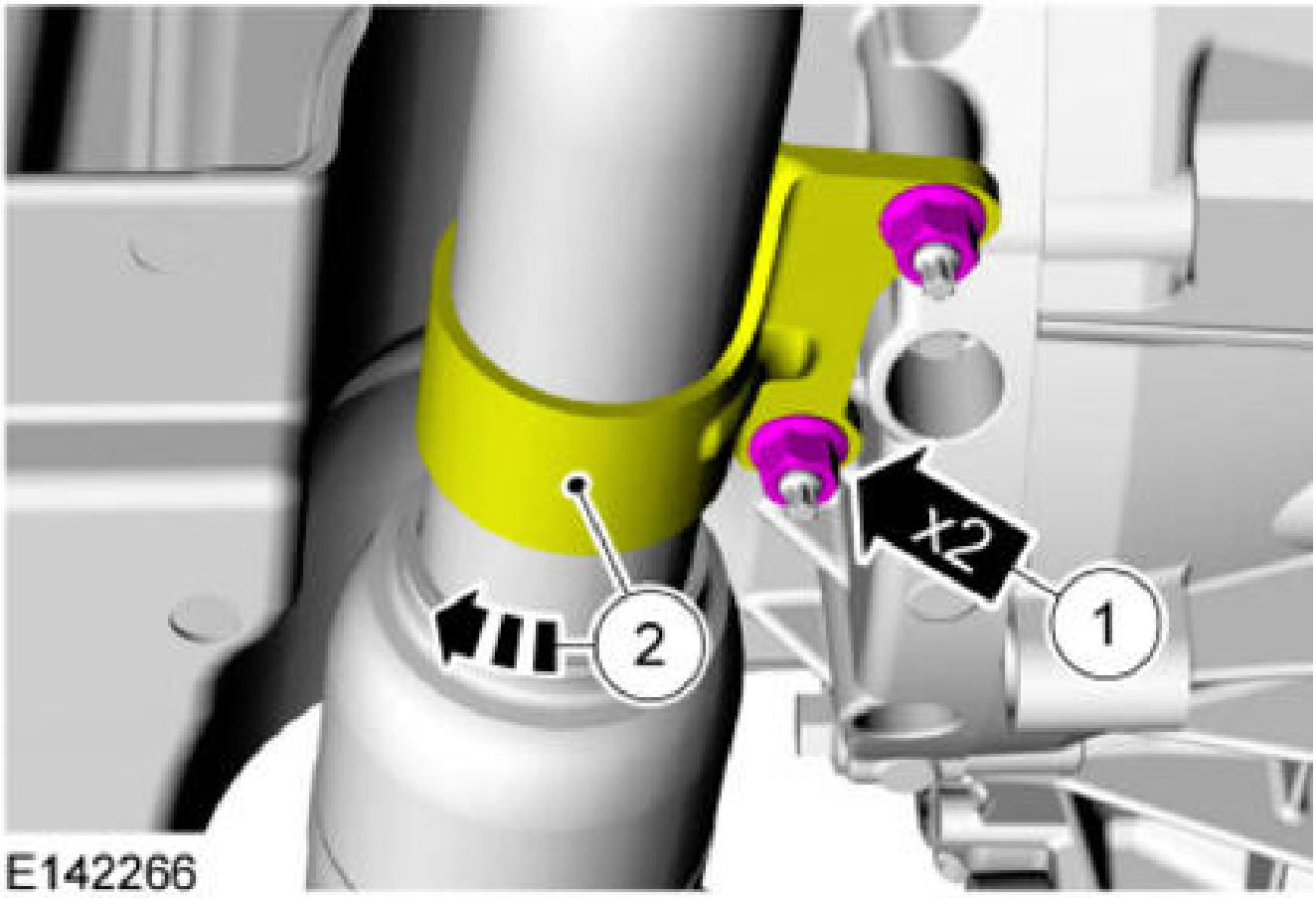
27.

27.



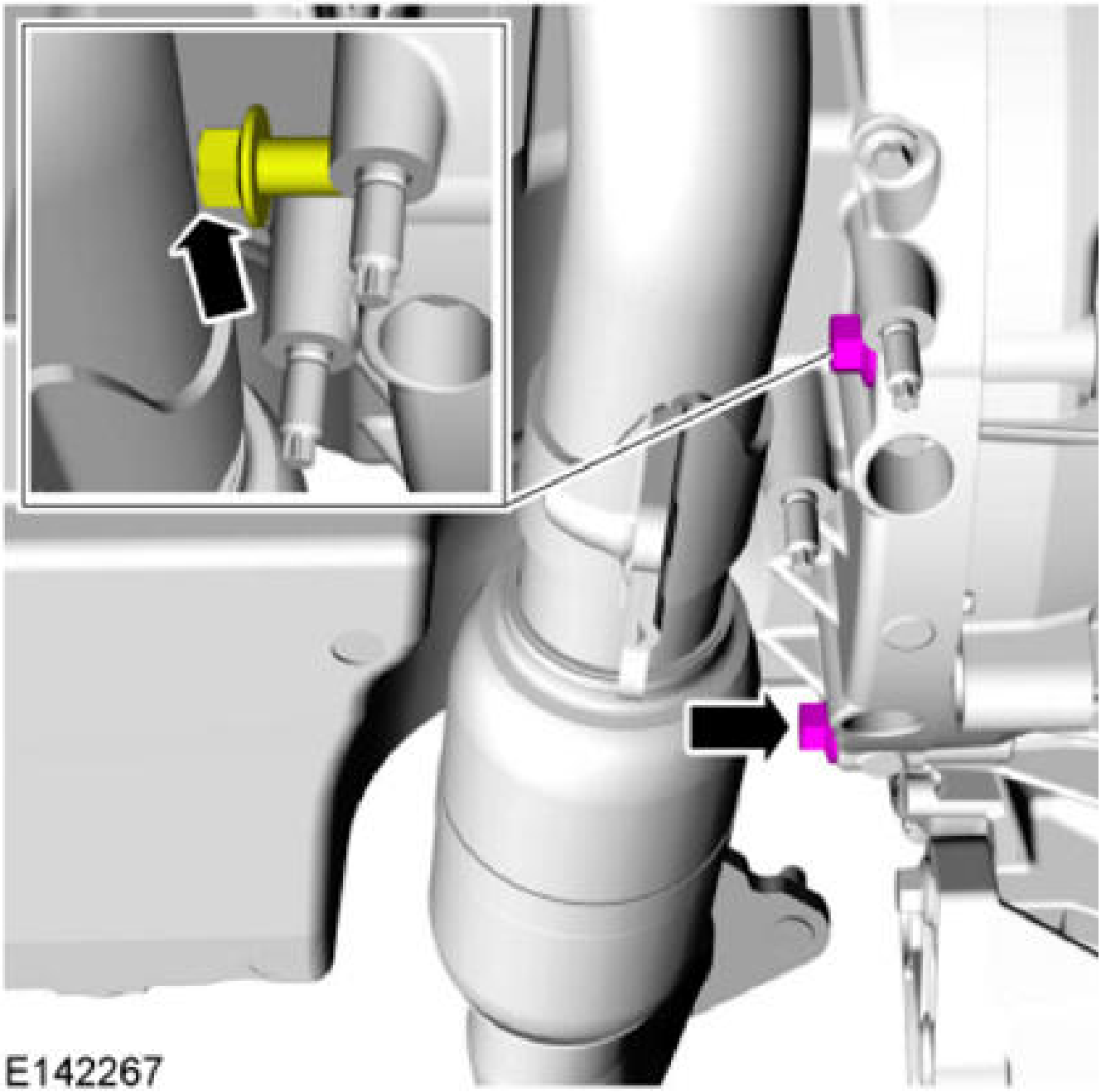
28.

28.



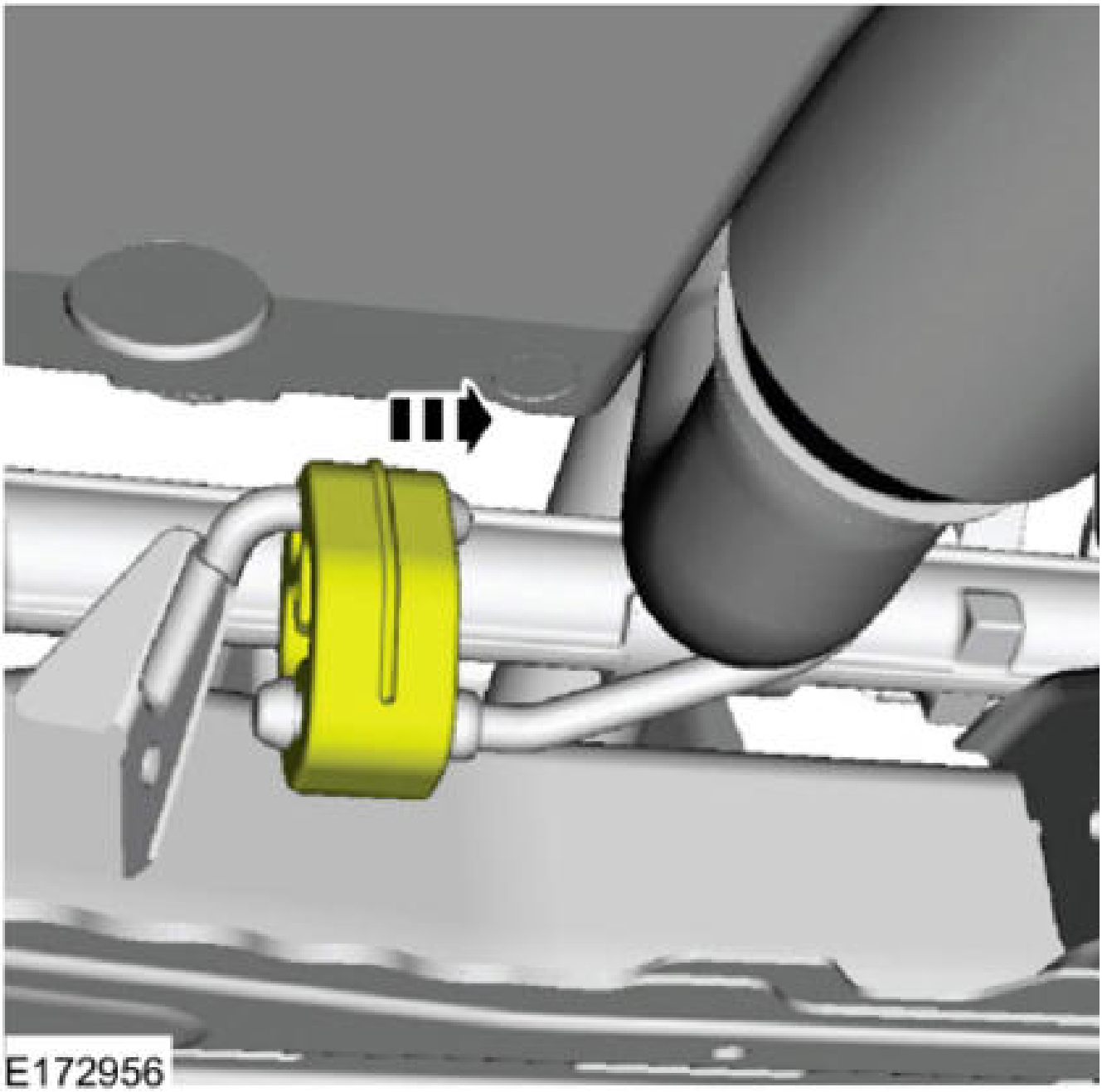
29.

29.

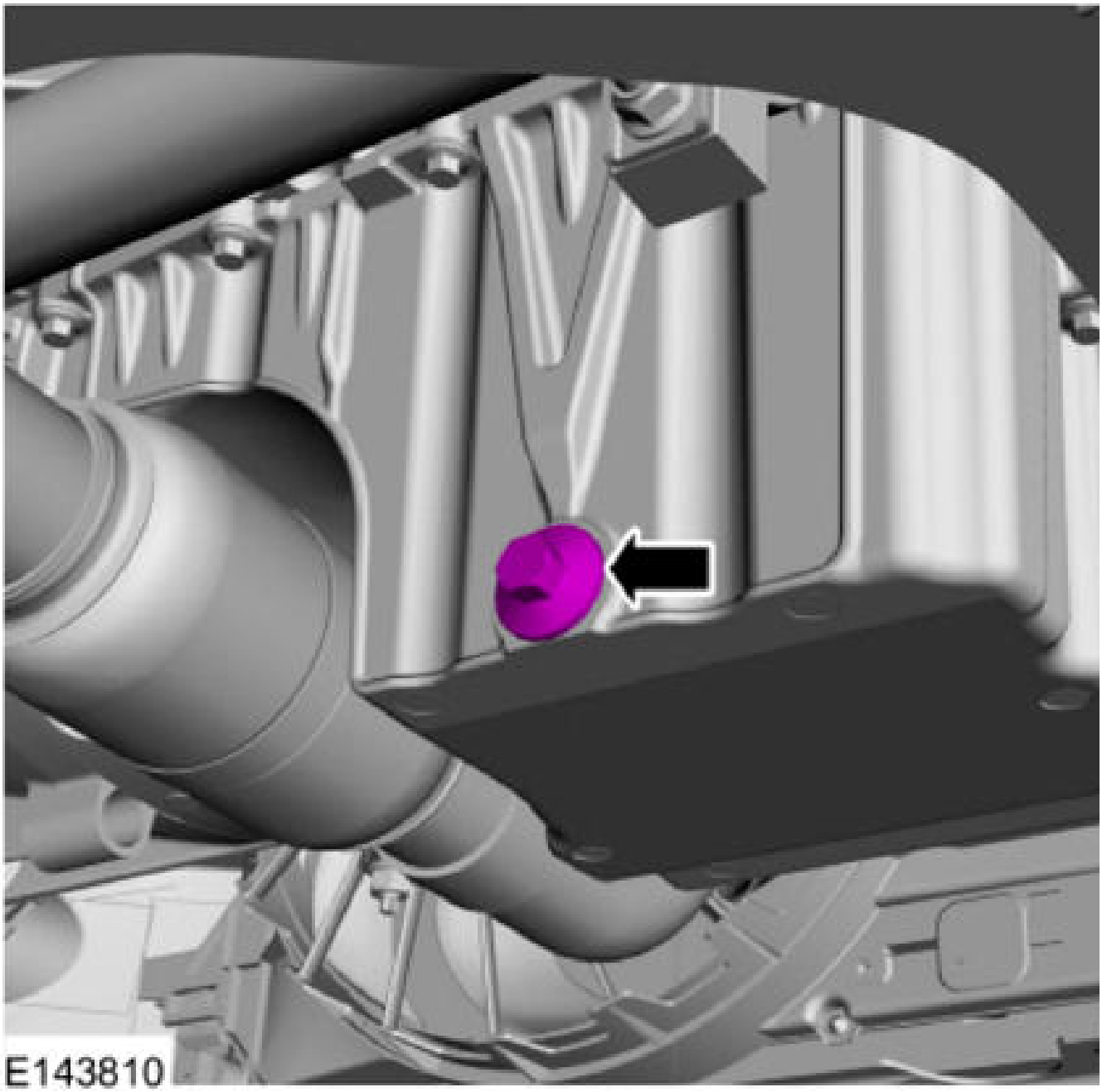


30.

30.

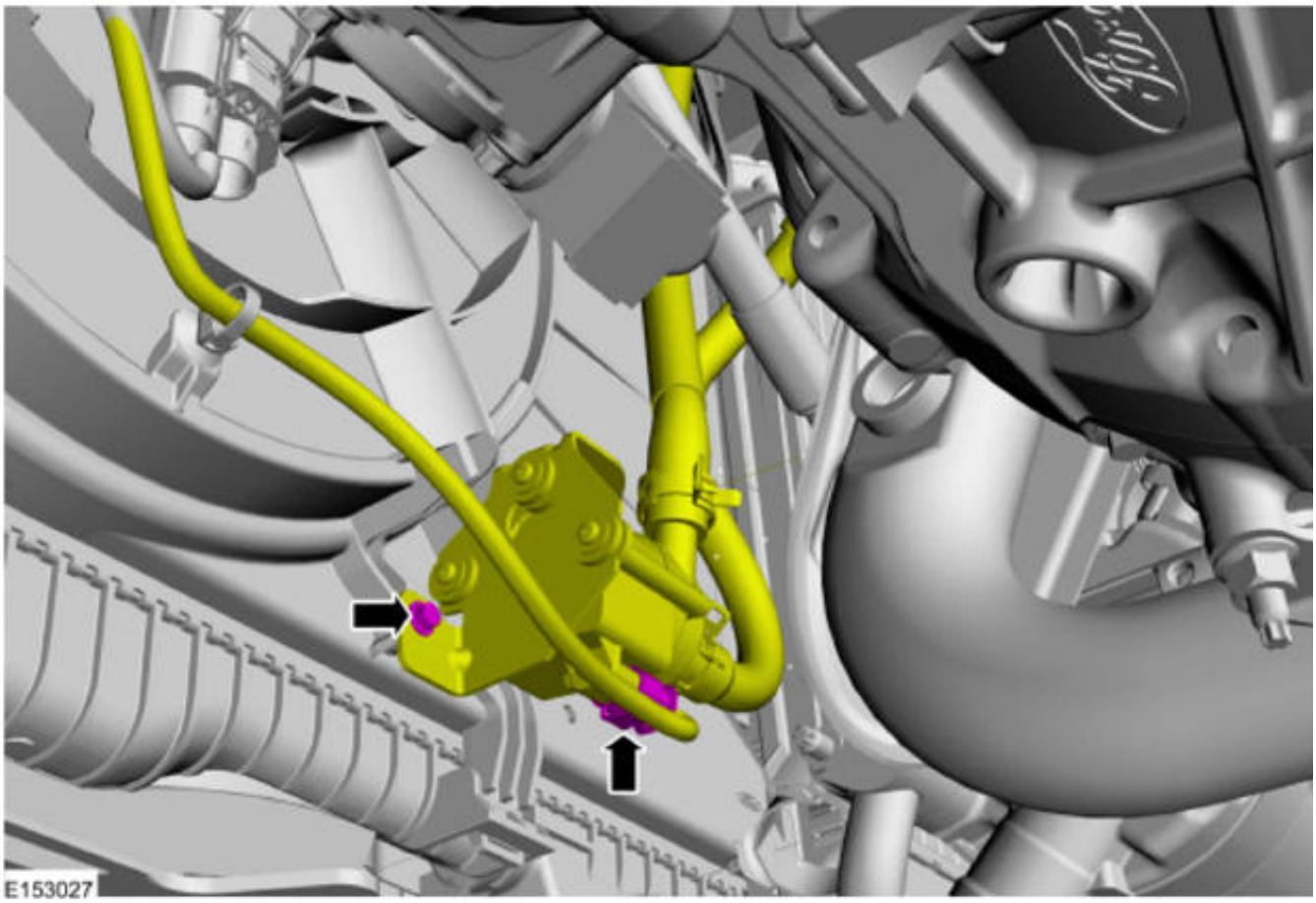


31. *Torque* : 18 lb.ft (25 Nm)

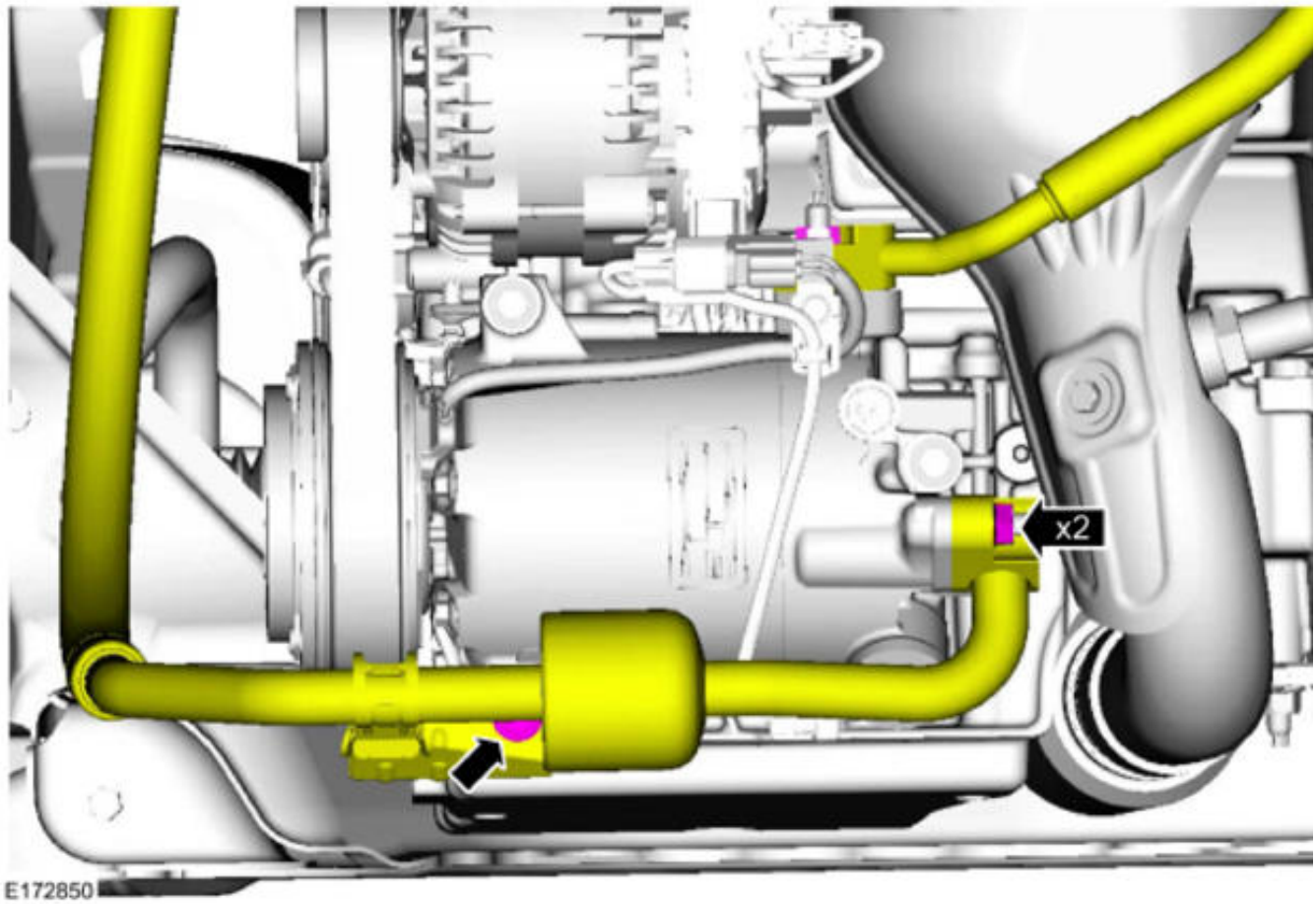


32.

32.

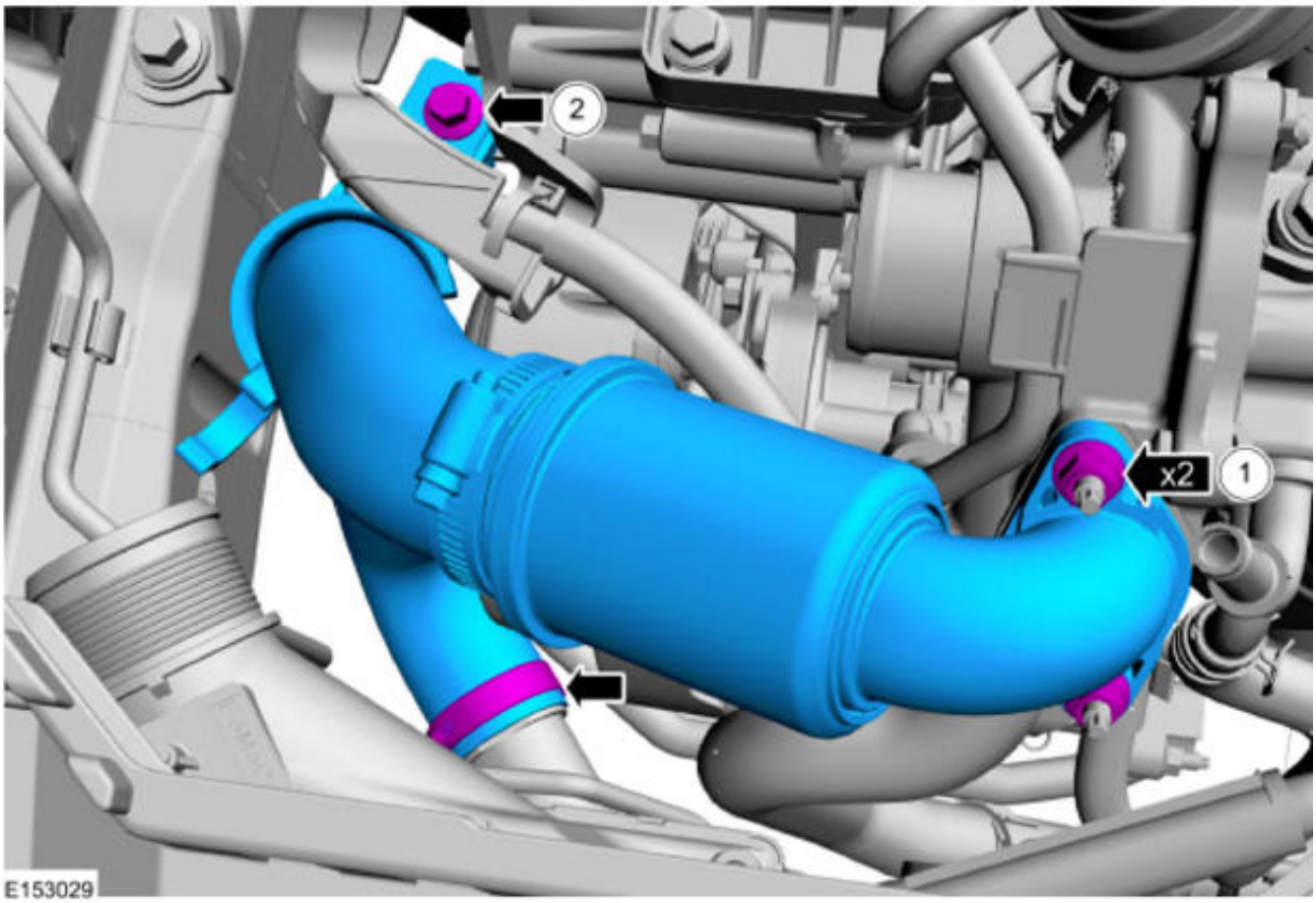


33. **NOTE: Make sure that all openings are sealed.**



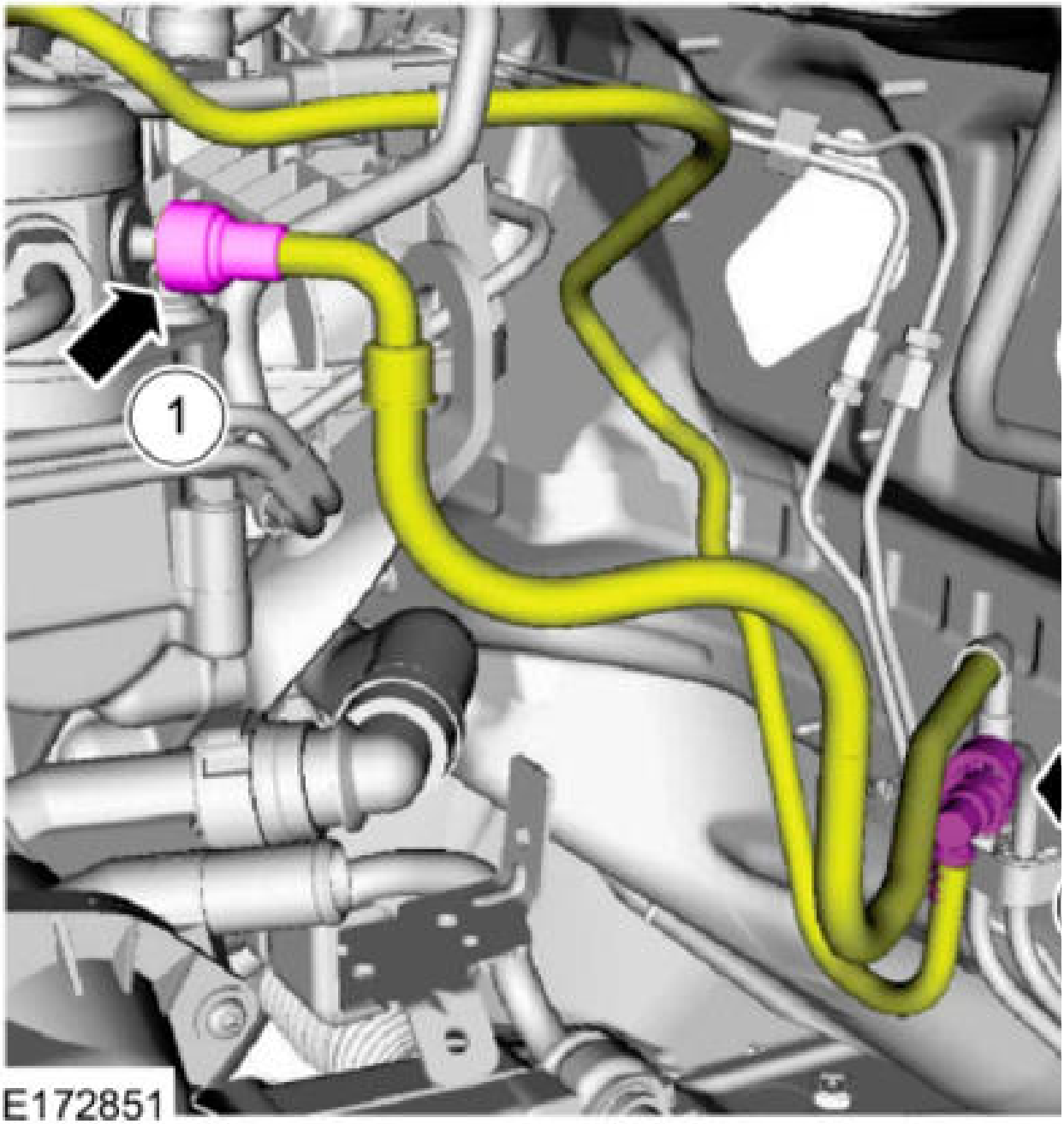
34.

34.



35.

1. Refer to: **SPRING LOCK COUPLINGS** .
2. Refer to: **QUICK RELEASE COUPLING** .

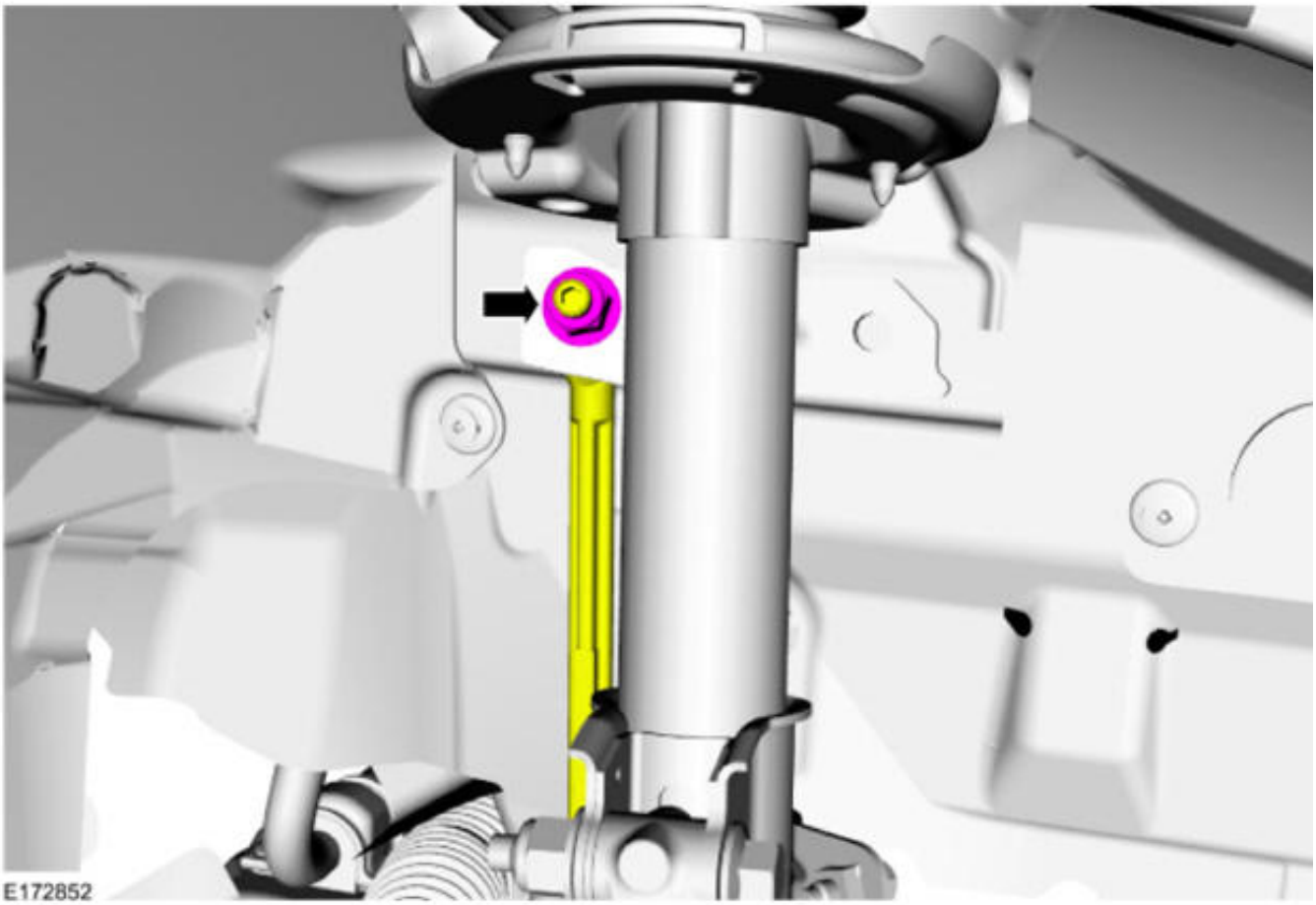


36. Front **RH** and **LH** .

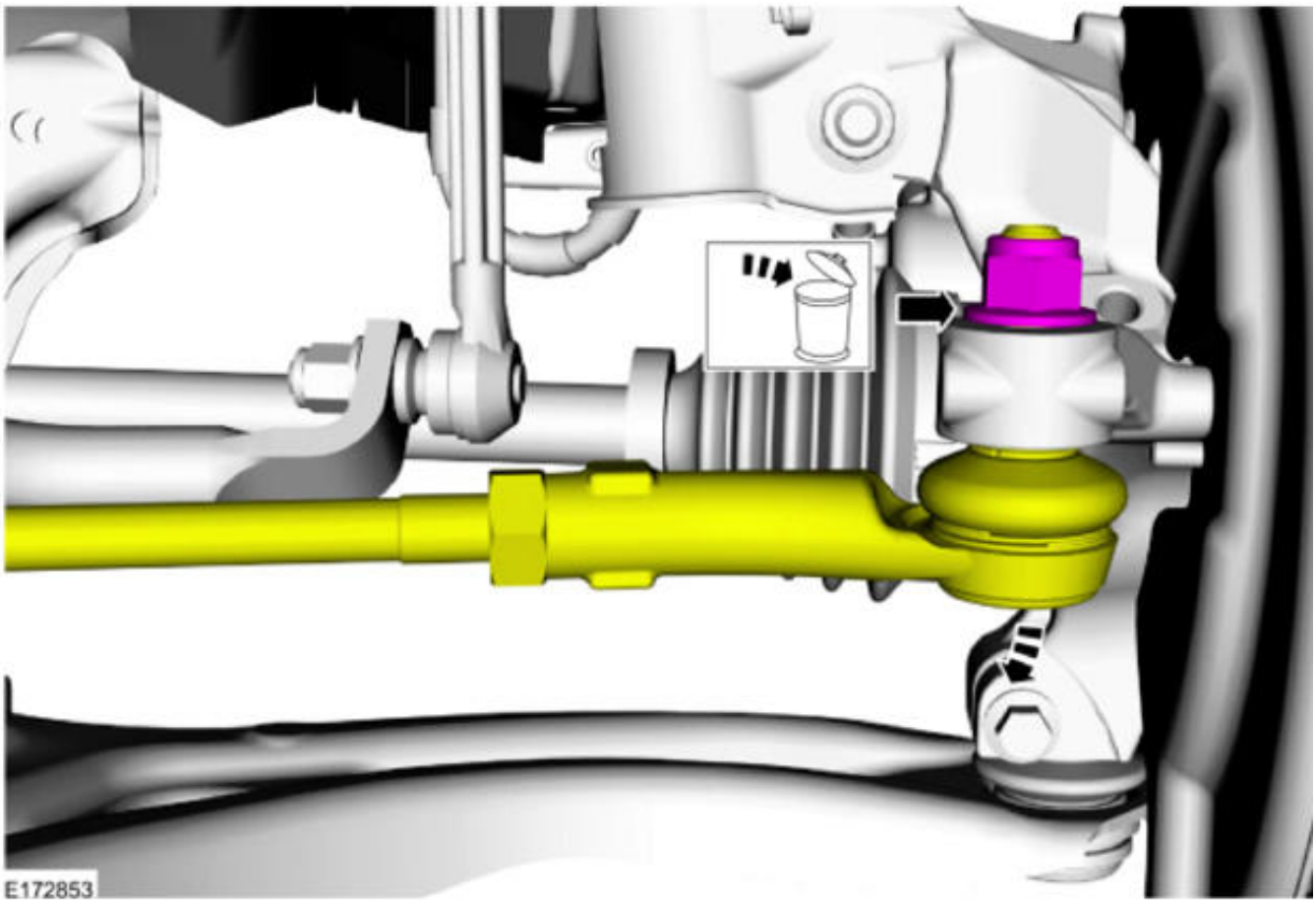
    Refer to: **WHEEL AND TIRE** .

37.

37.

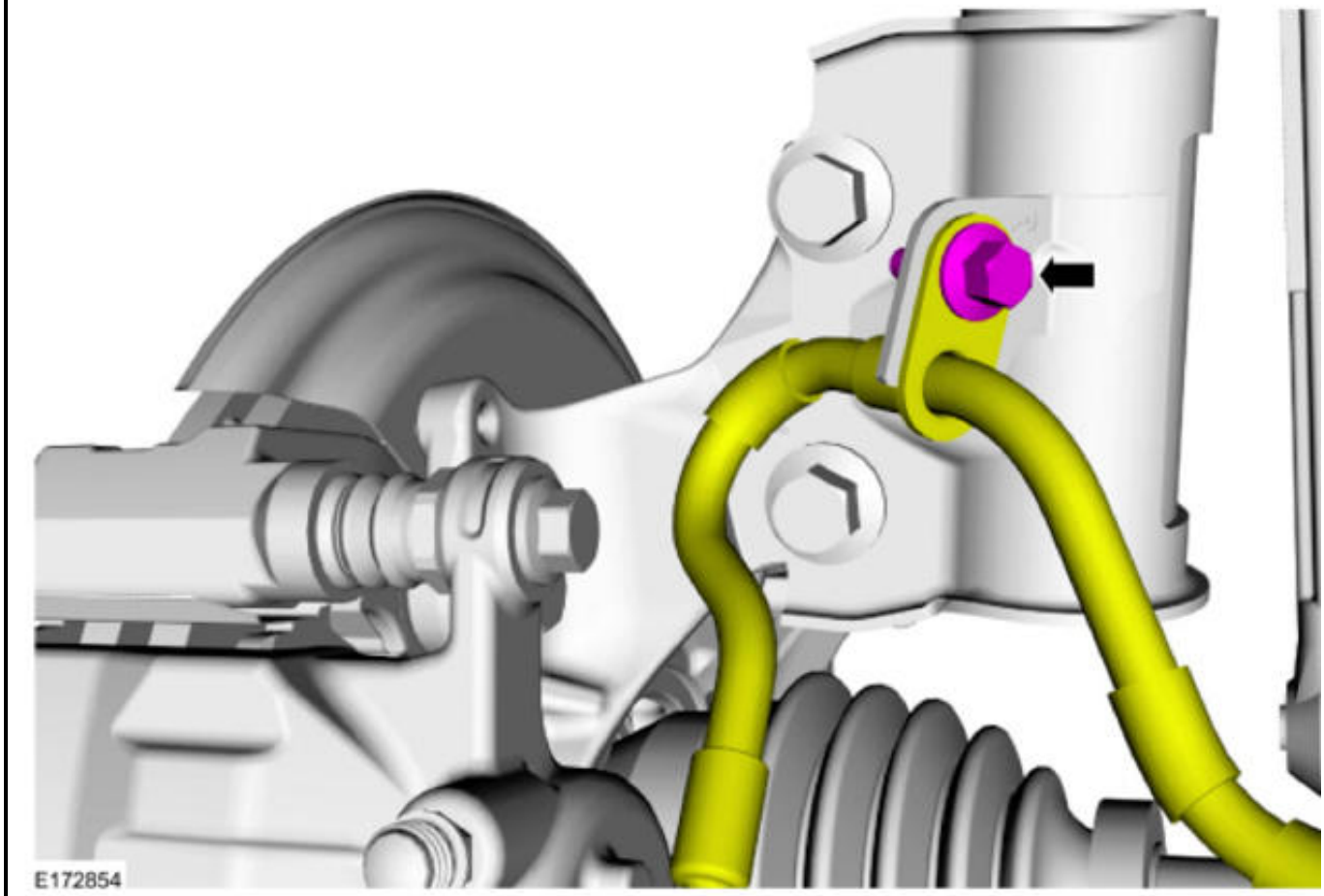


38. Use the General Equipment: Tie Rod End Remover



39.

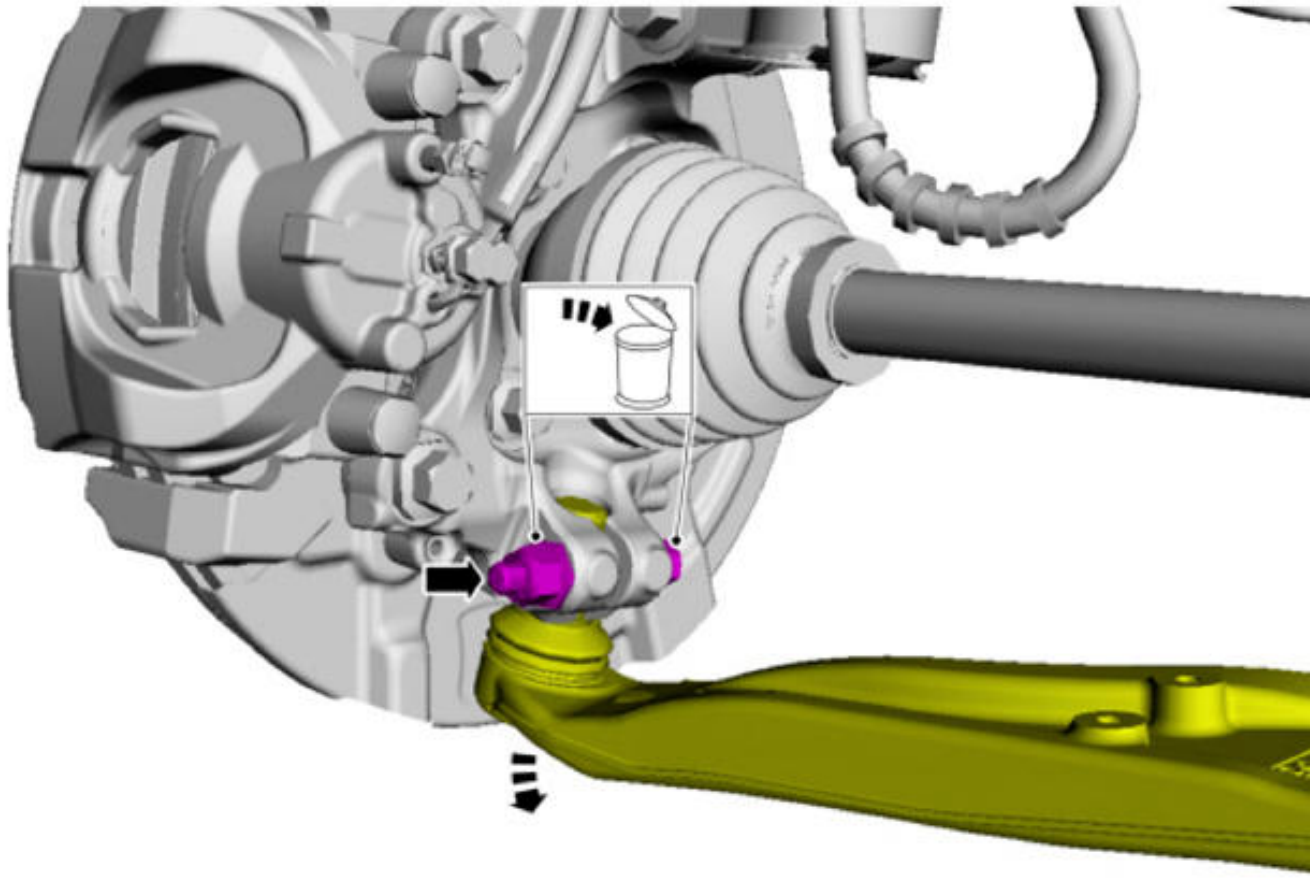
39.



40.

NOTE: **Do not use a prying device or separator fork between the ball joint and the wheel knuckle. Damage to the ball joint or ball joint seal may result. Only use the pry bar by inserting it into the lower arm body opening.**

NOTE: **Use care when releasing the lower arm and wheel knuckle into the resting position or damage to the ball joint seal may result.**



41.

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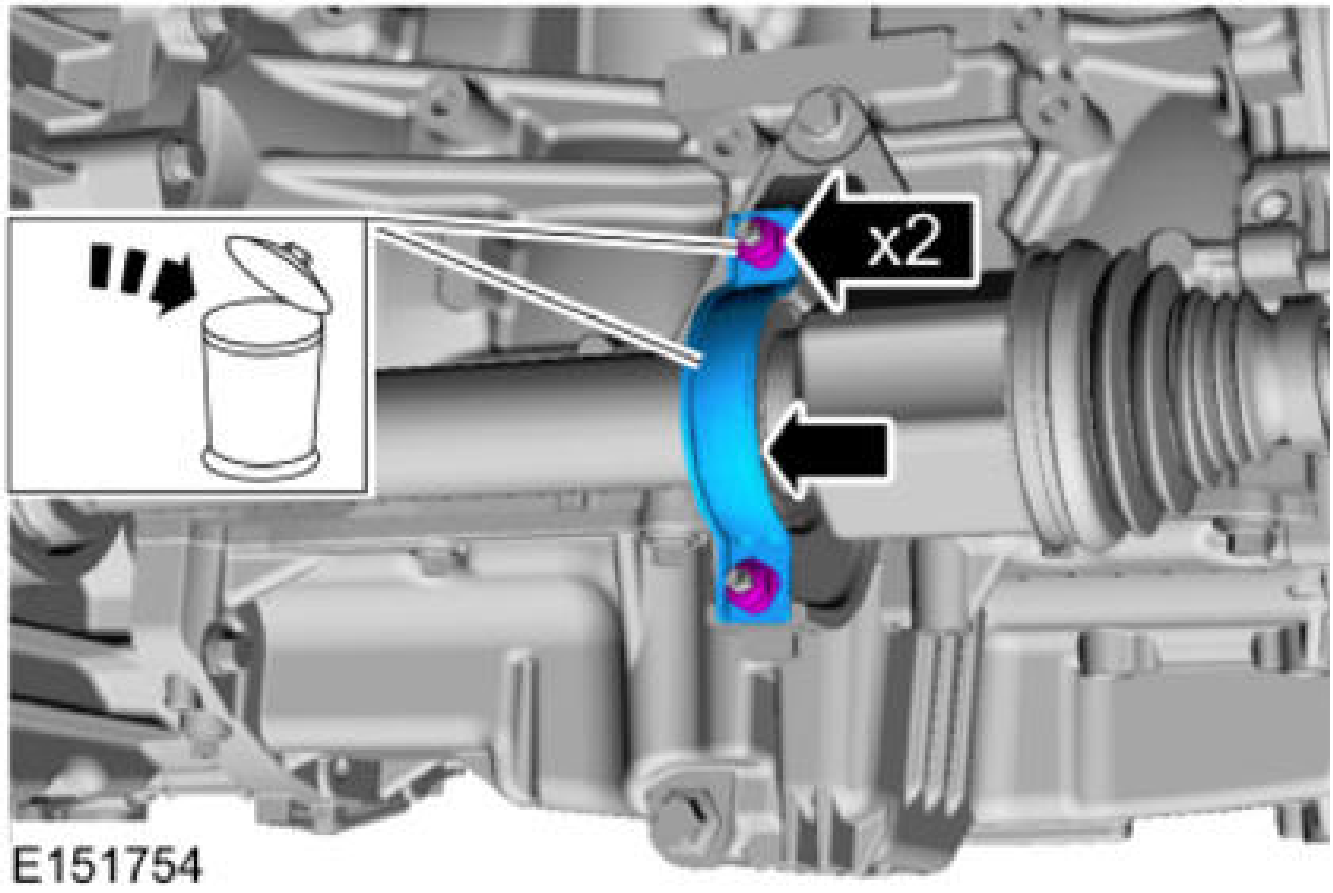
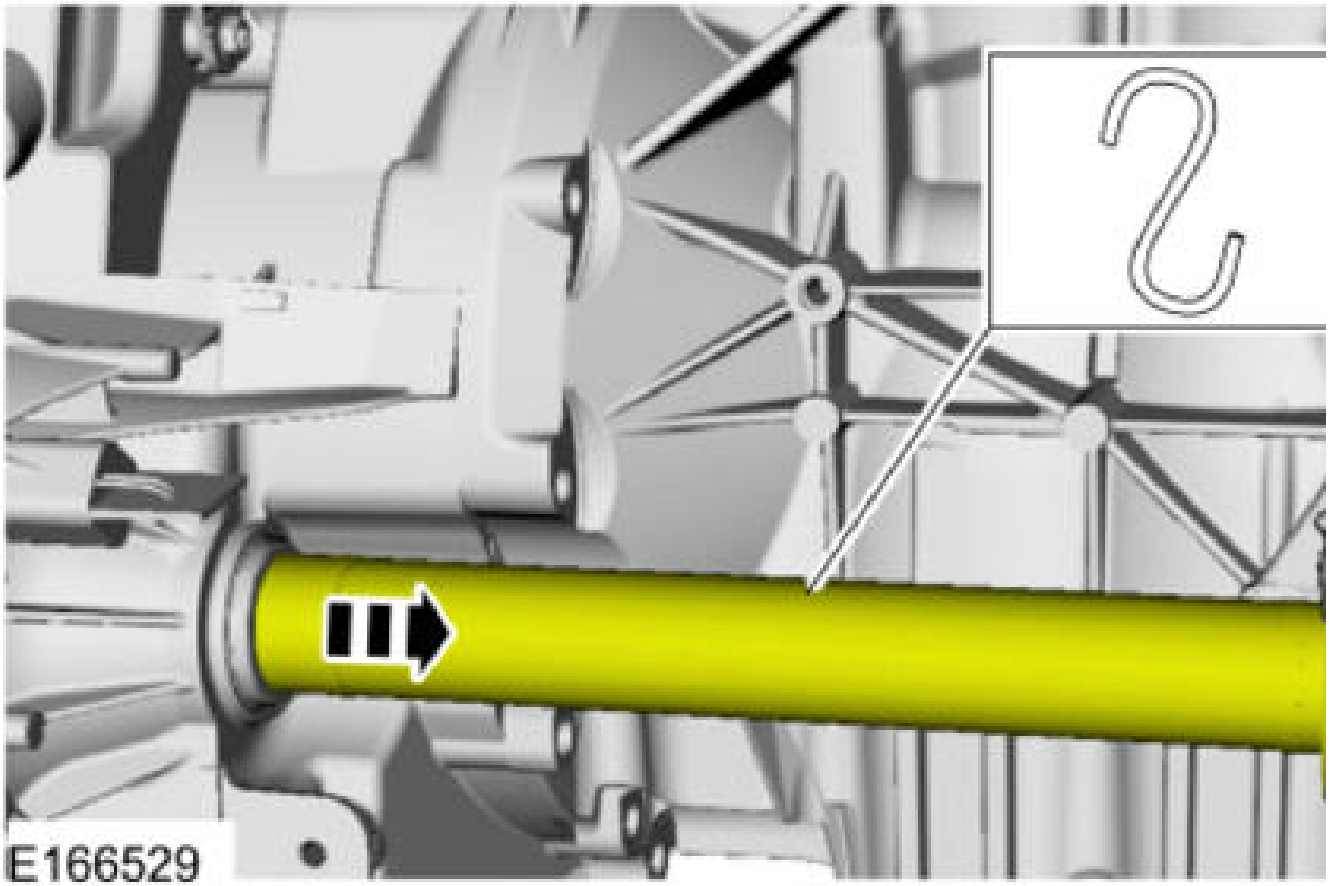


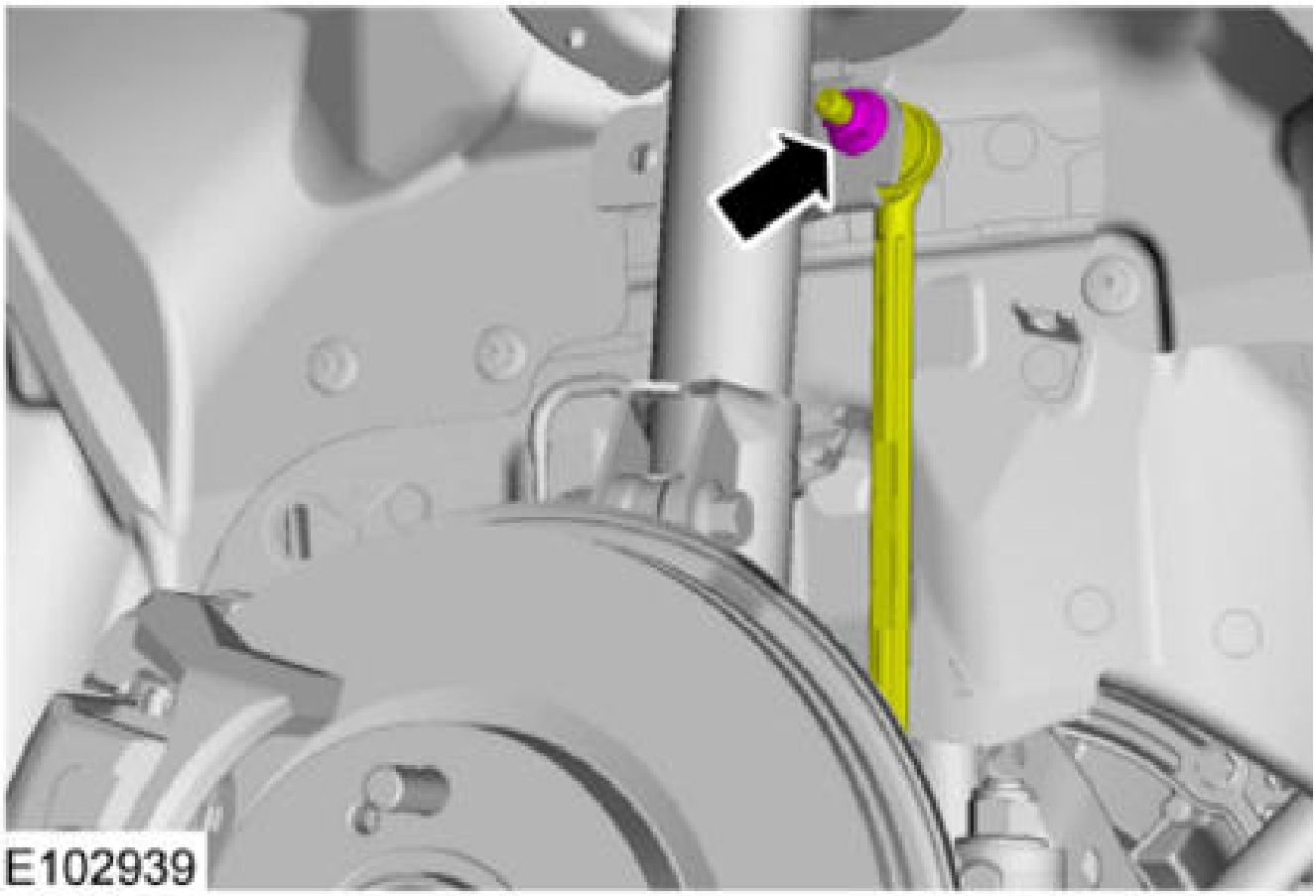
42.

42.



43.

43.

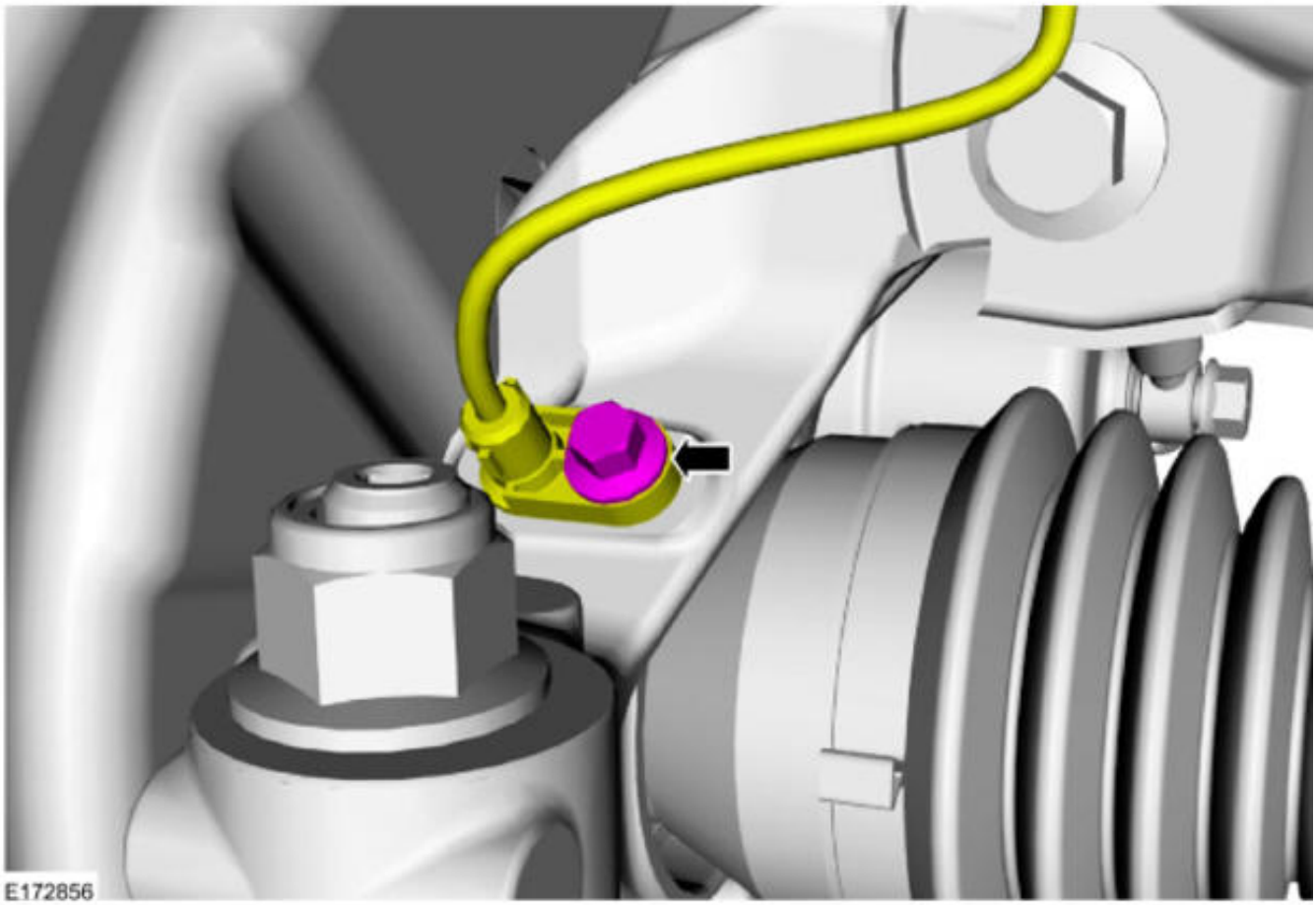


44. Remove **LH** brake disc.

    Refer to: **BRAKE DISC** .

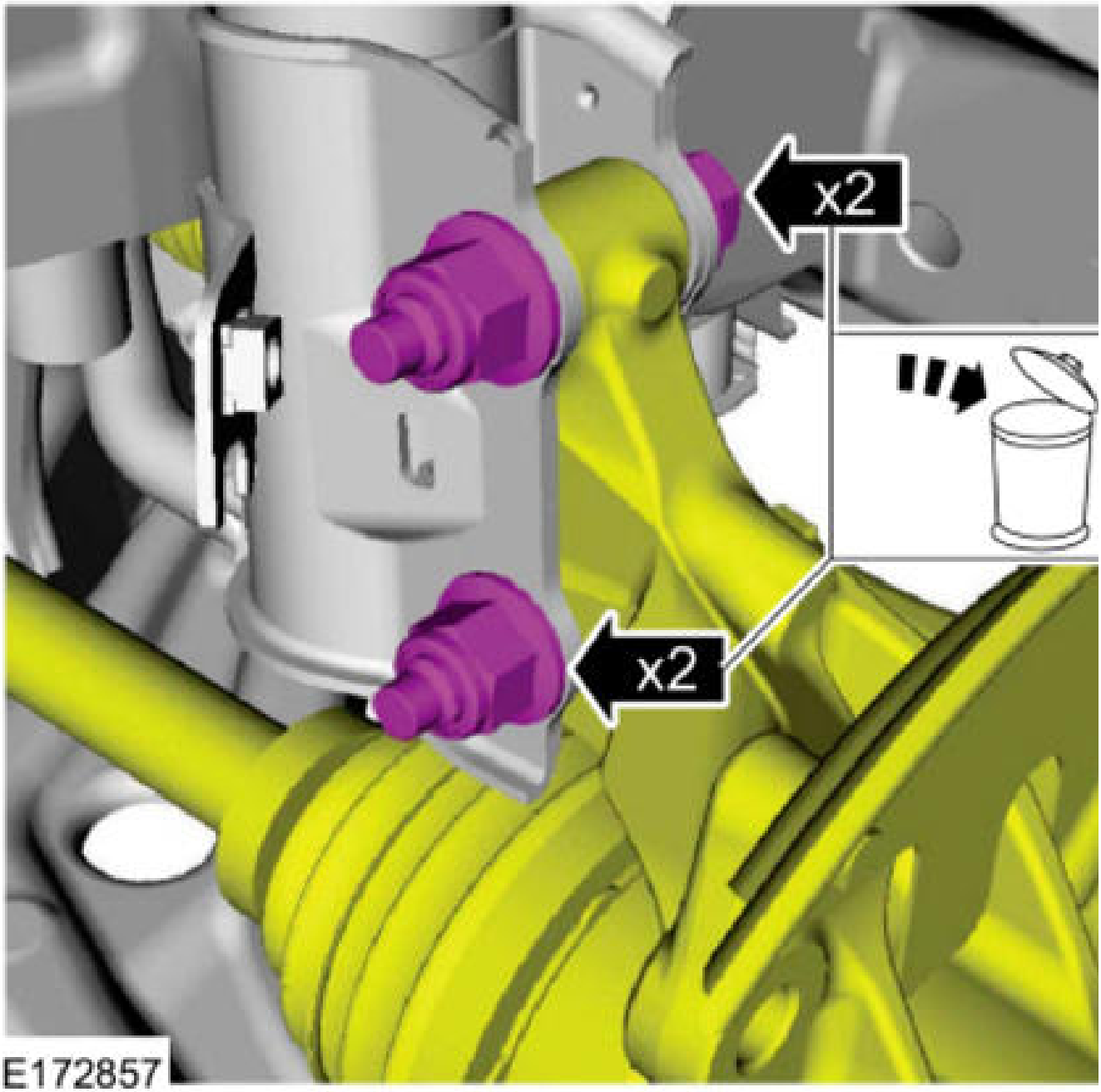
45.

45.



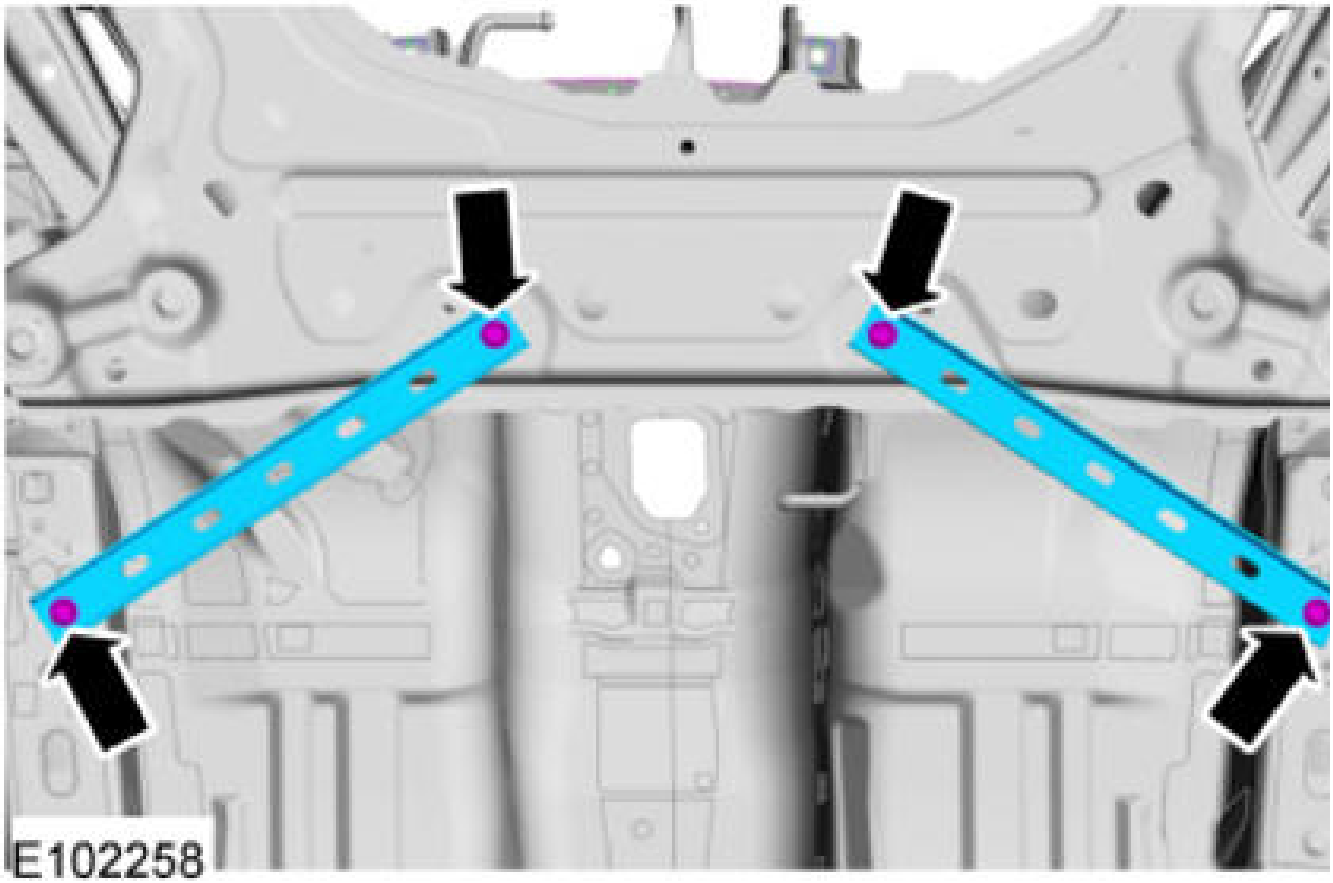
46.

46.



47.

47.



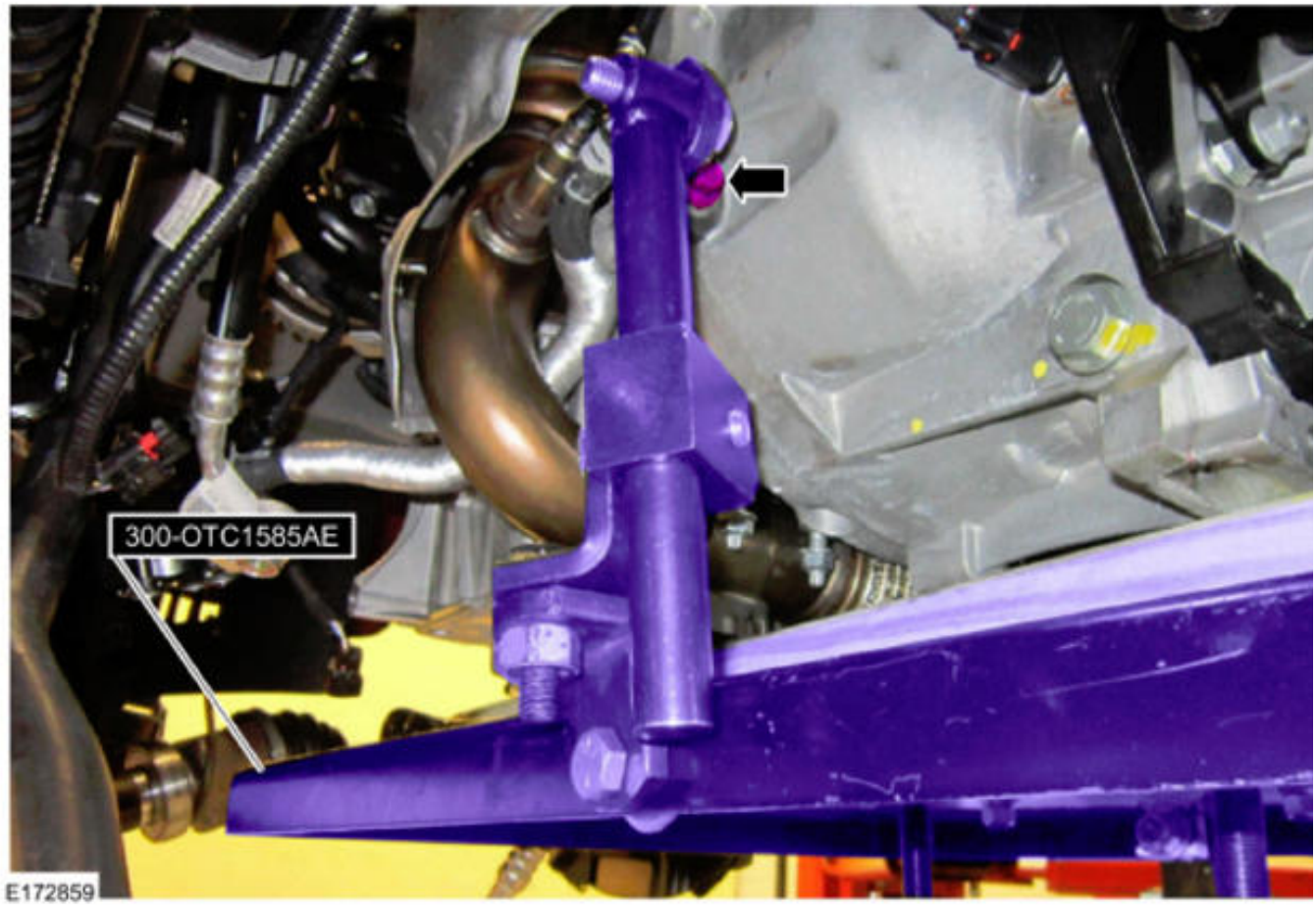
48. Use Special Service Tool: **300-OTC1585AE Powertrain Lift** .

    Use the General Equipment: Wooden Block

49. Use Special Service Tool: **300-OTC1585AE Powertrain Lift** .

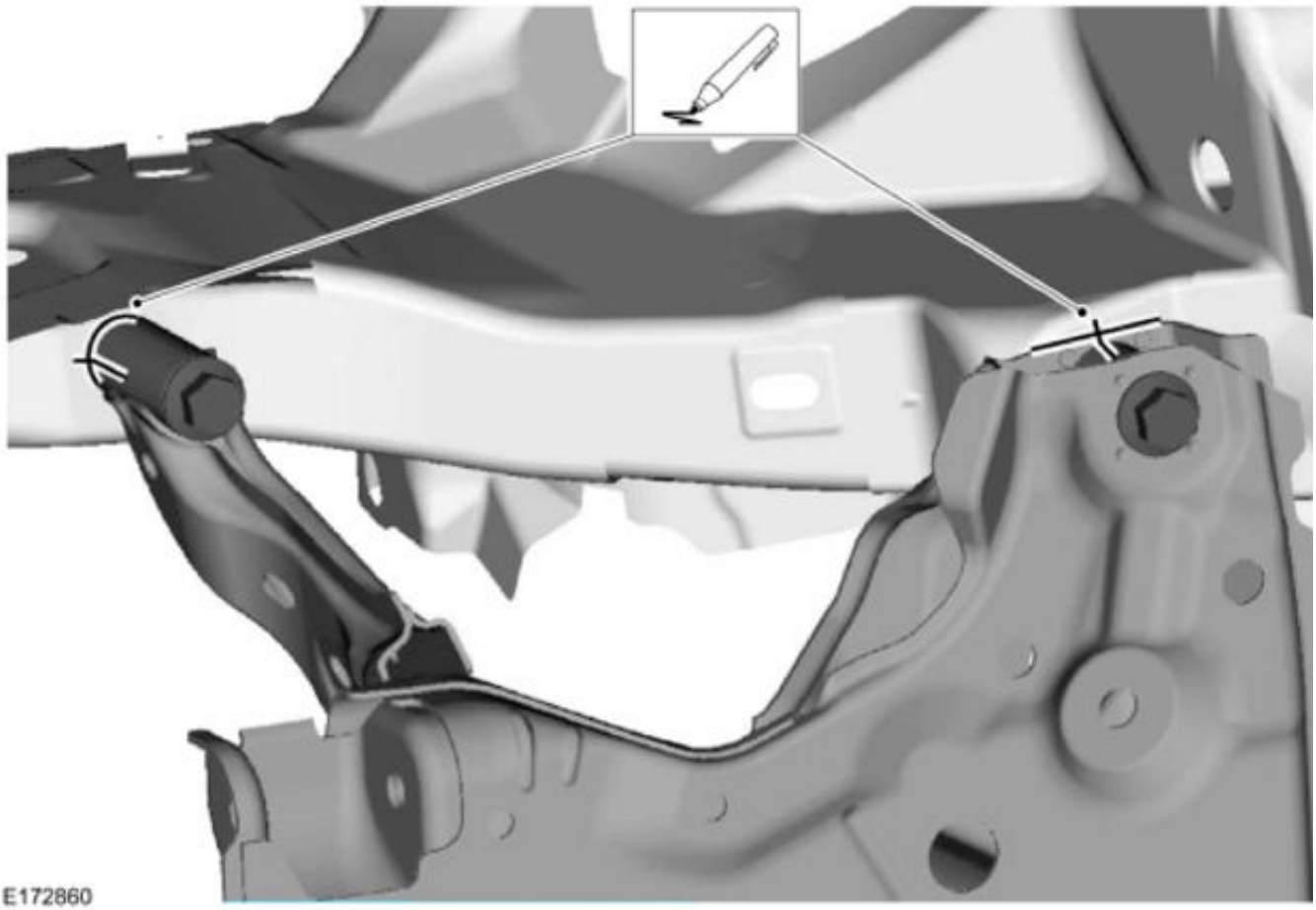
    Use the General Equipment: Wooden Block

    Use the General Equipment: Adjustable Mounting Arm



50.

50.



51.

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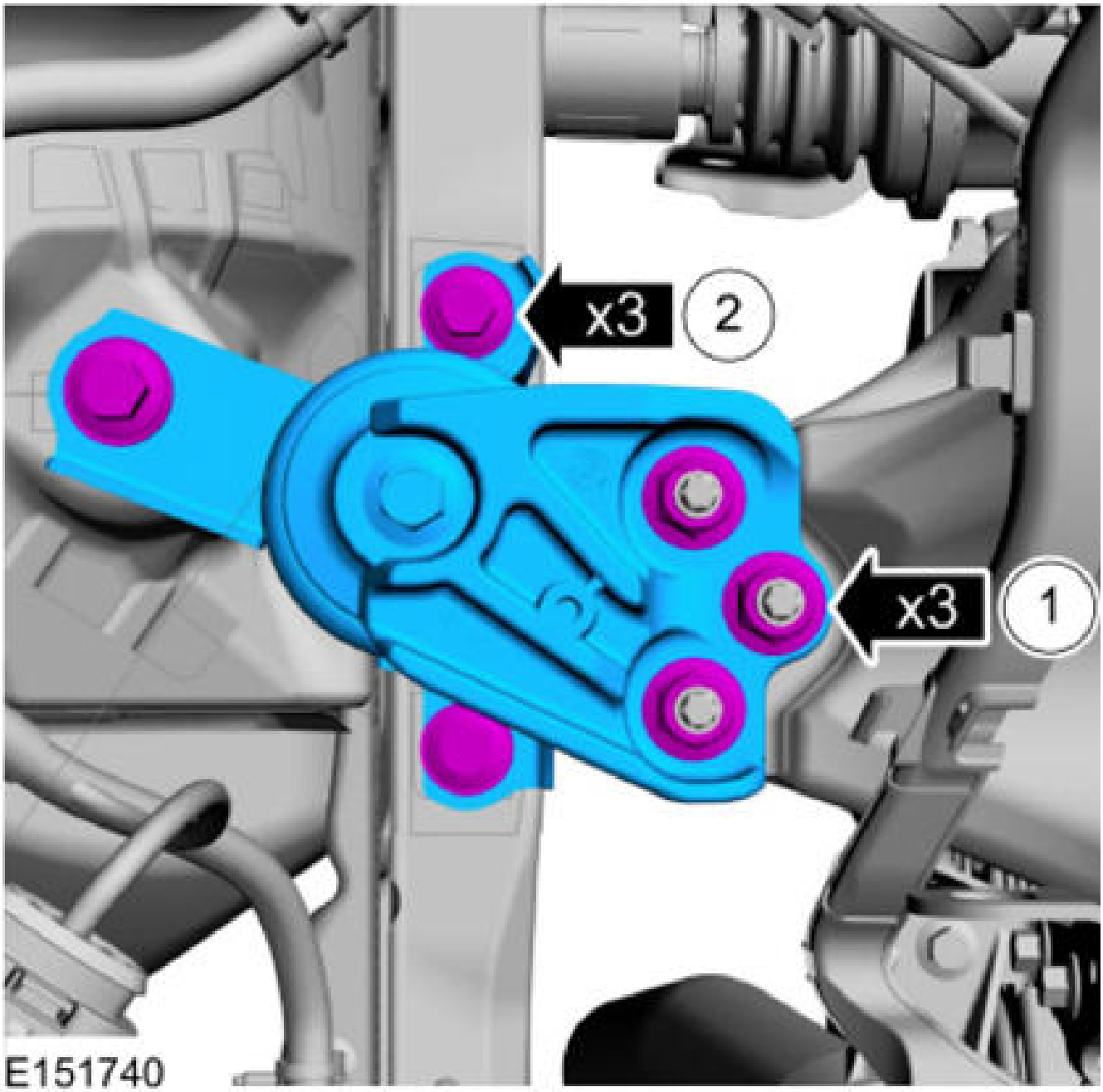

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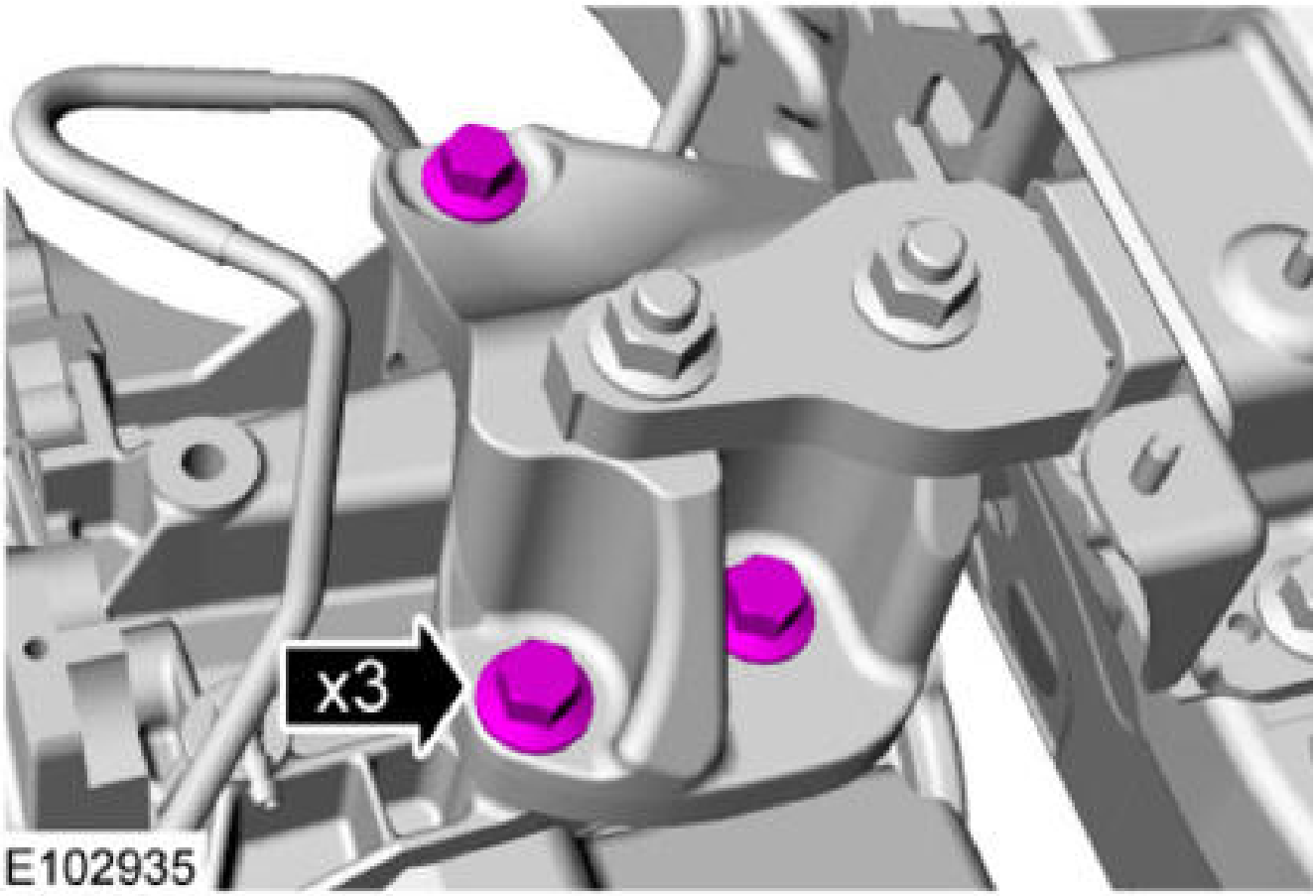
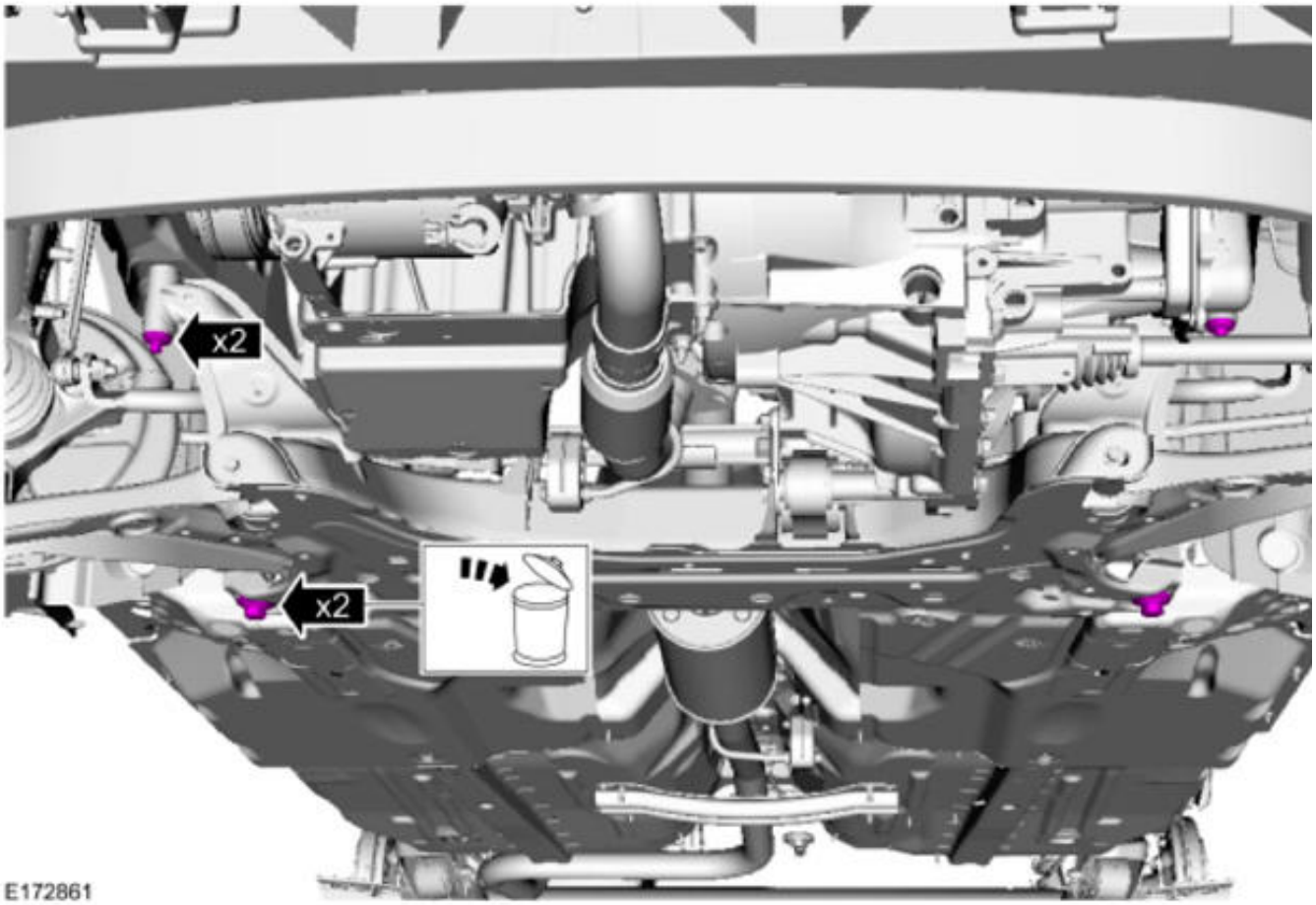
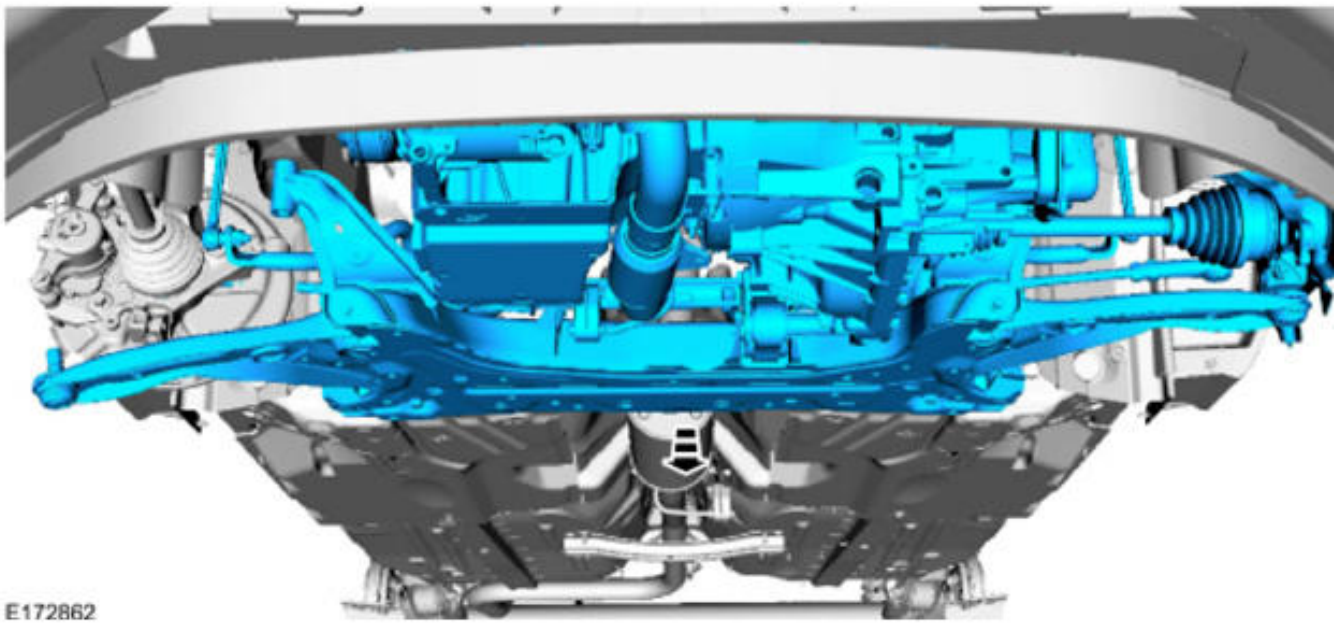


53.

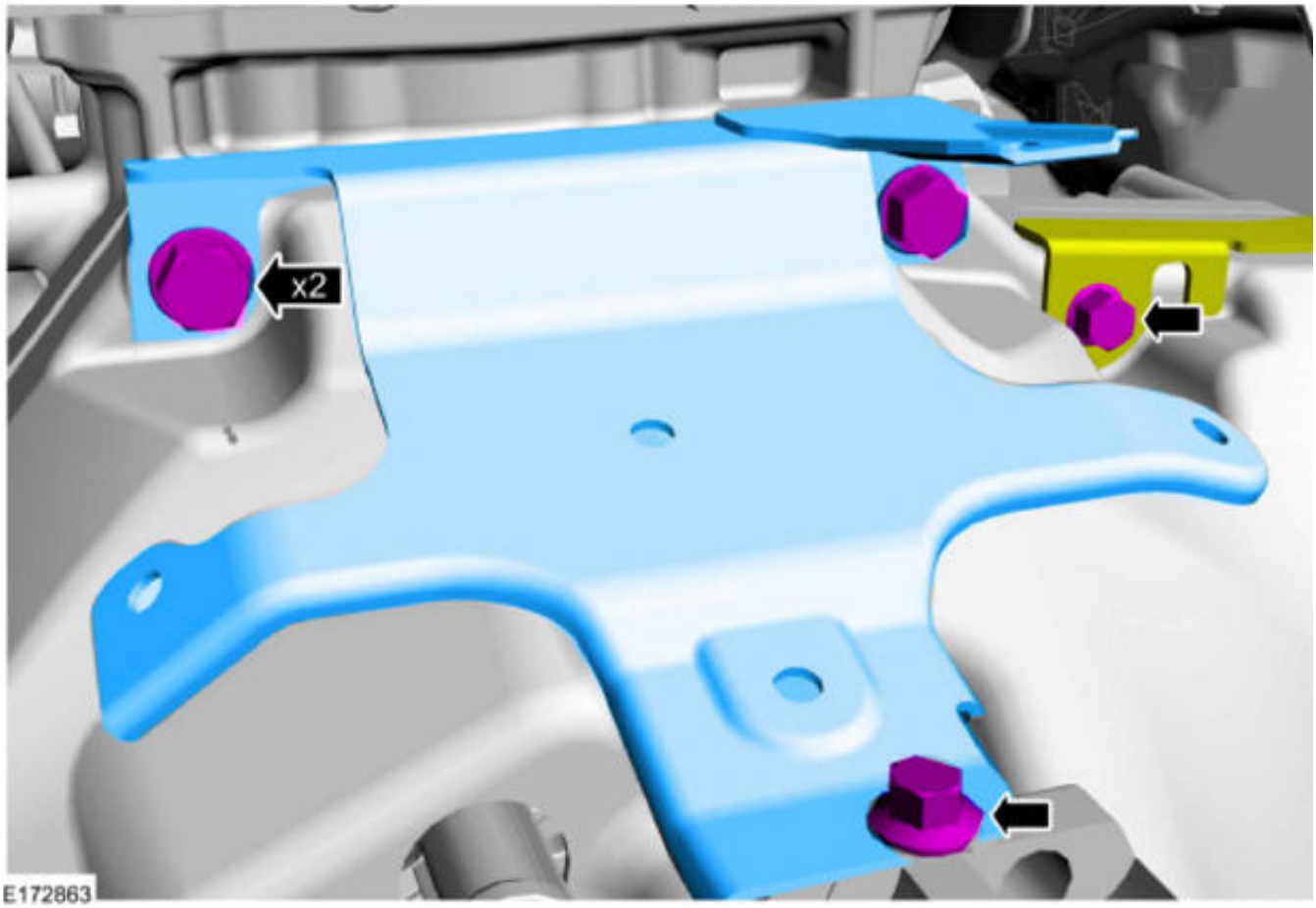
53.



54. Using the powertrain lift, lower the powertrain and subframe as an assembly.

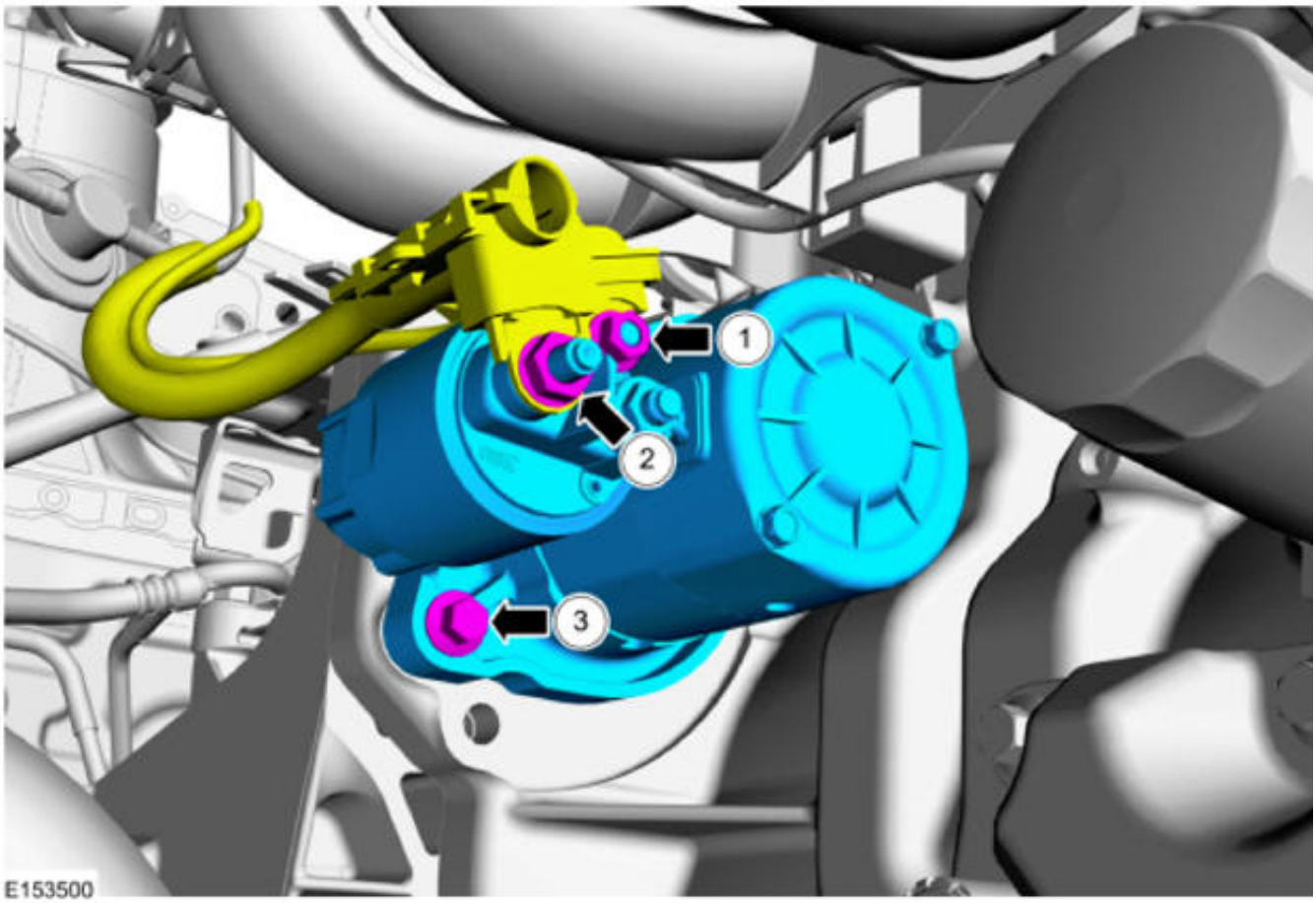


55. **NOTE: Wiring harness removed for clarity.**



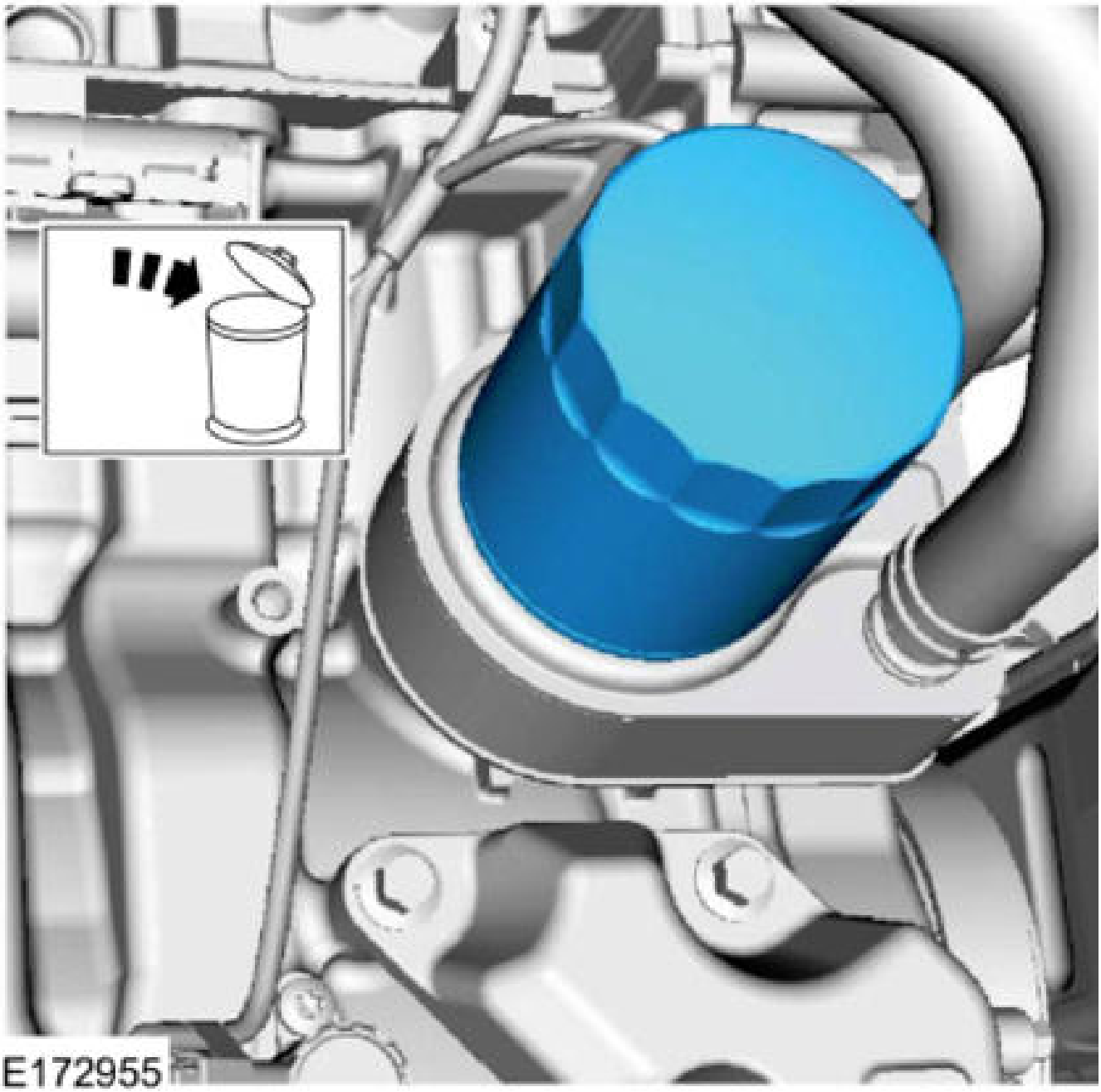
56.

56.



57.

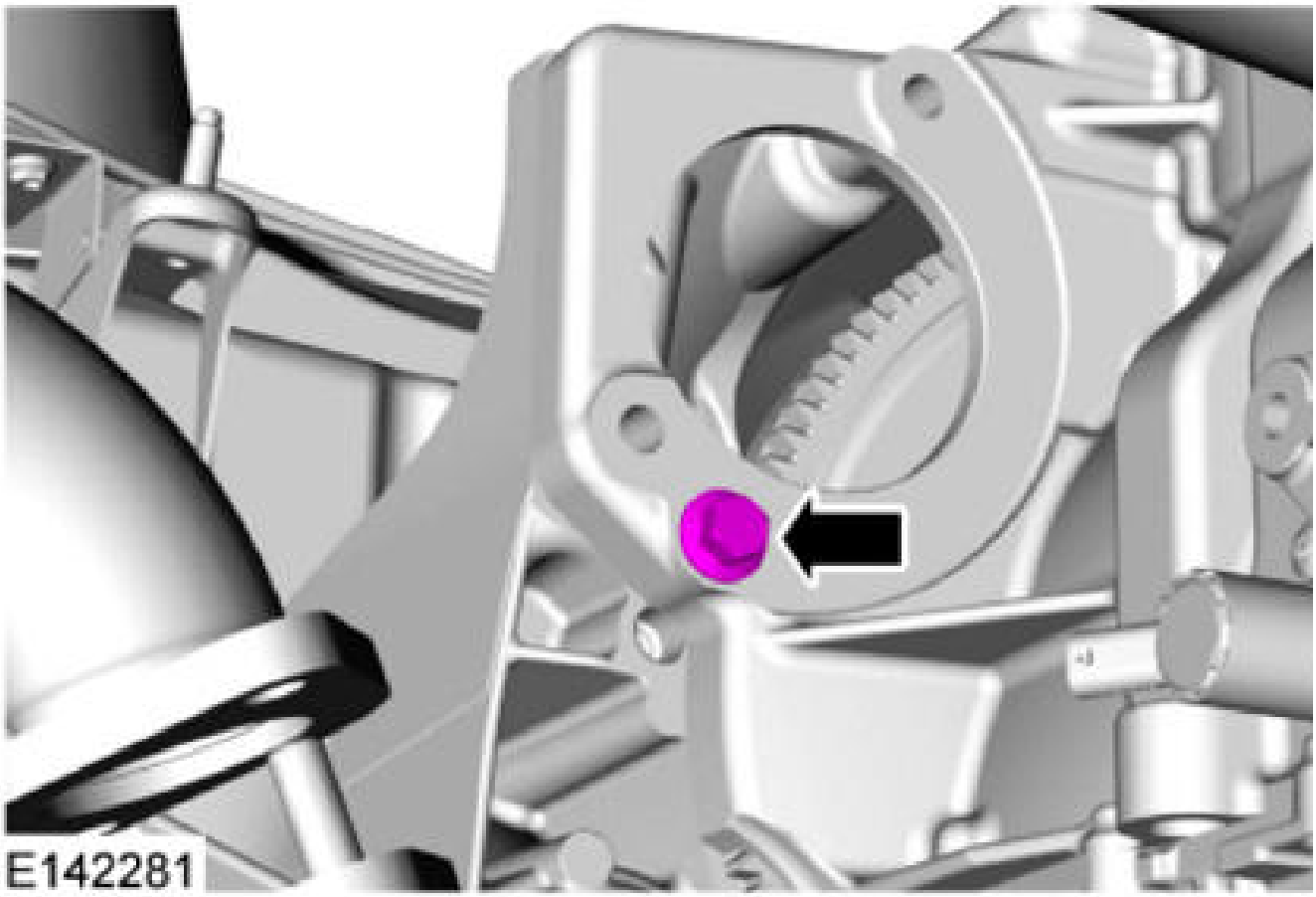
57.



58. Install Special Service Tool: **300-OTC1819E 2, 200# Floor Crane, Fold Away** .

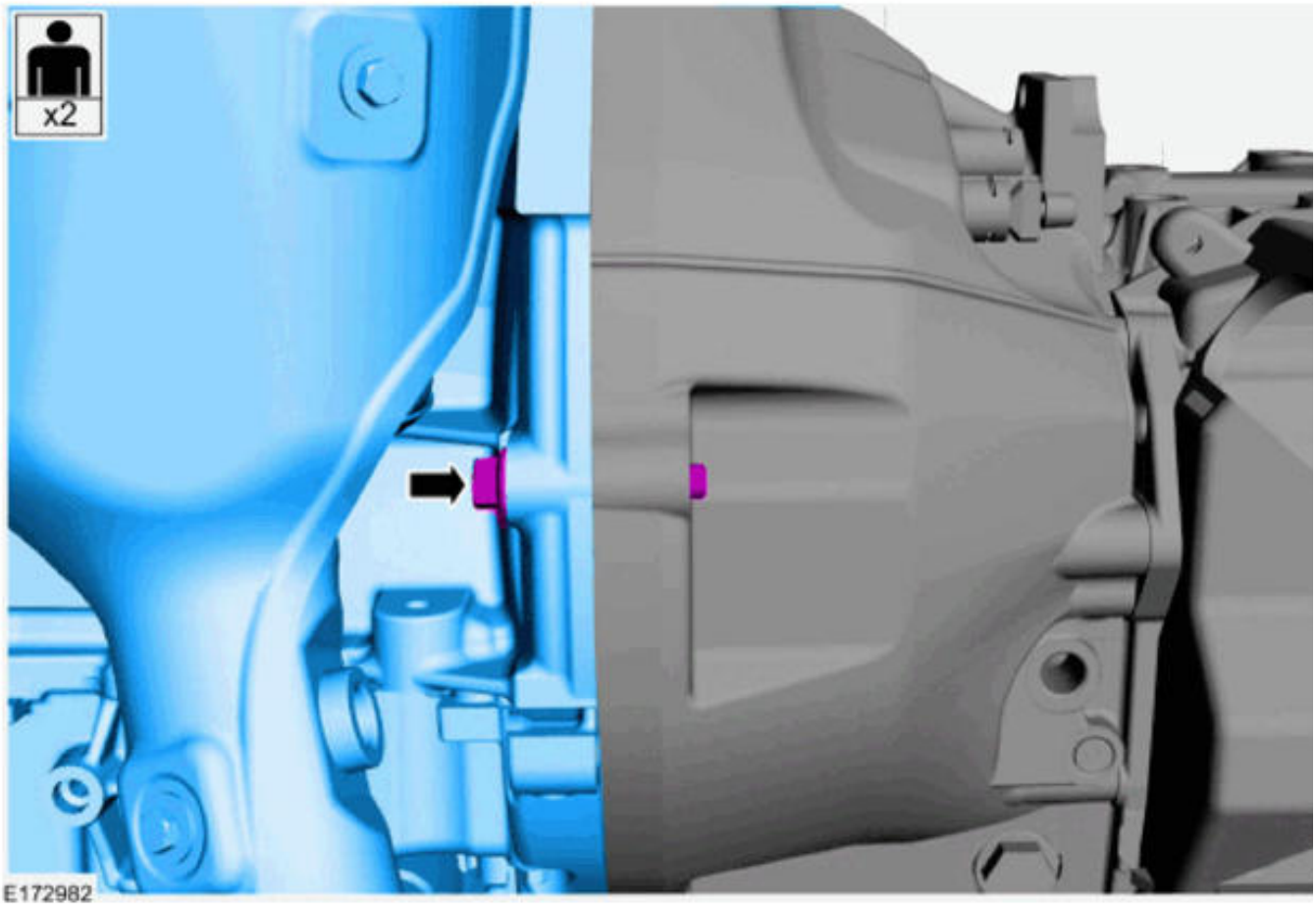
59.

59.



60.

60.

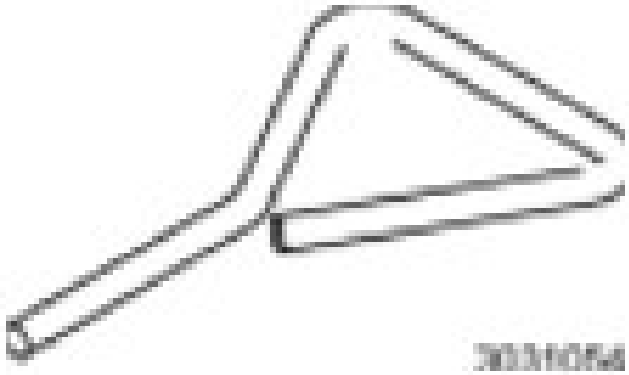


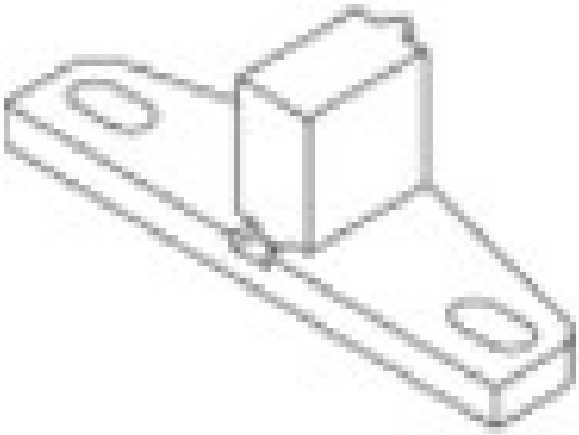
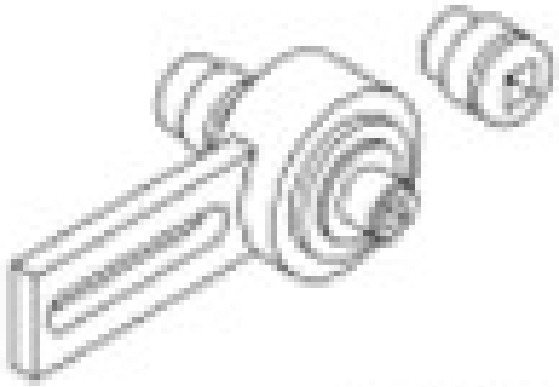
DISASSEMBLY

ENGINE

SPECIAL TOOL DESCRIPTION

	300-OTC1819E 2, 200# Floor Crane, Fold Away

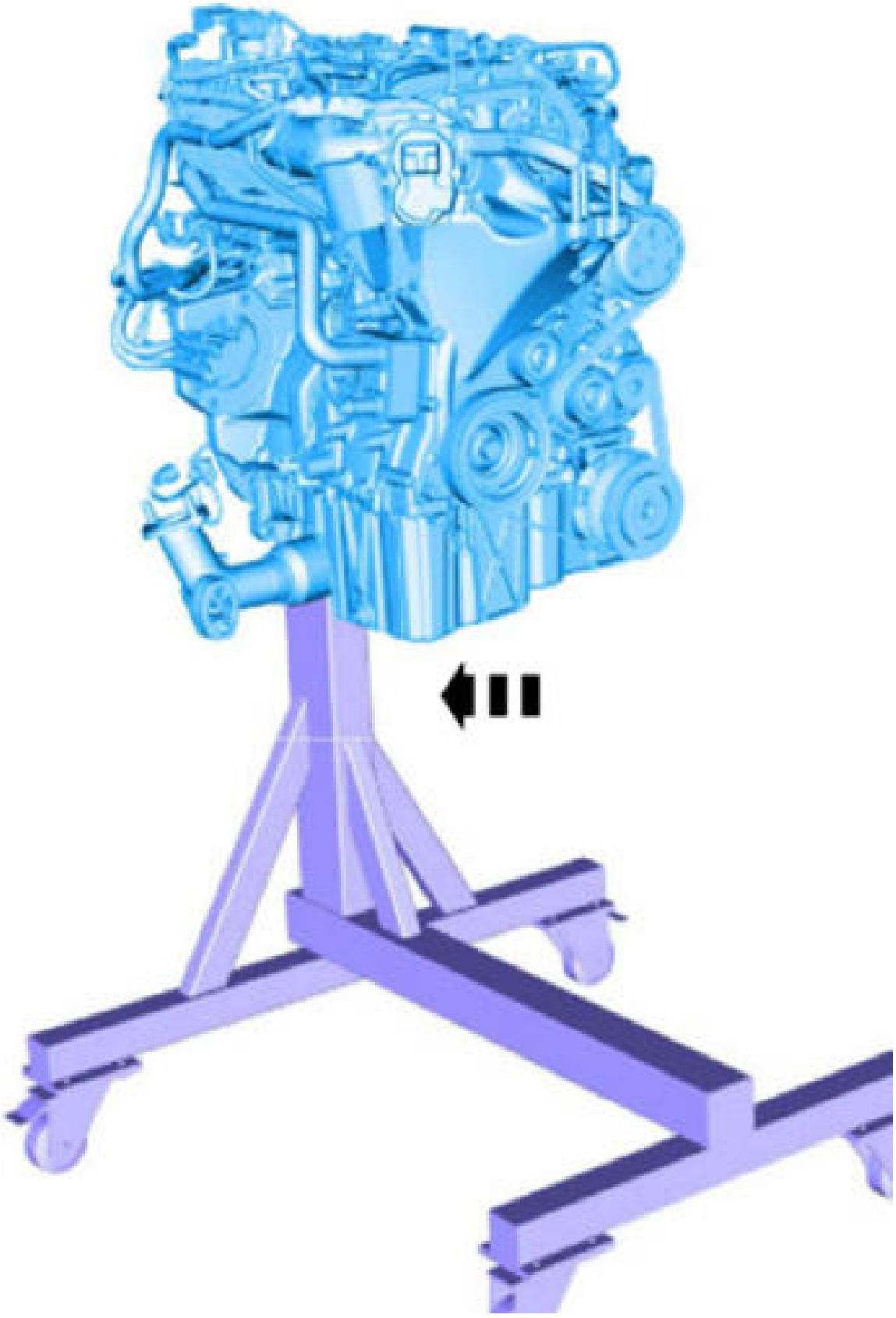
	
	303-1054 Locking Tool, Timing Belt Tensioner
	303-1602 Locking Tool, Crankshaft

 E141993	
 E141998	303-1611 Torque Multiplier
	303-1611-01 Adapter for 303-1611

 E141939	
 E174872	**303-1611-02** Adapter for 303-1611, Torque Multiplier TKIT-2014A-FL TKIT-2014A-ROW
	**307-005** (T59L-100-B) Slide Hammer

	**310-206** Remover, Fuel Injector TKIT-2009A-FLM
Hose Clamp Remover/Installer	
4 mm Drill Bit	

1.

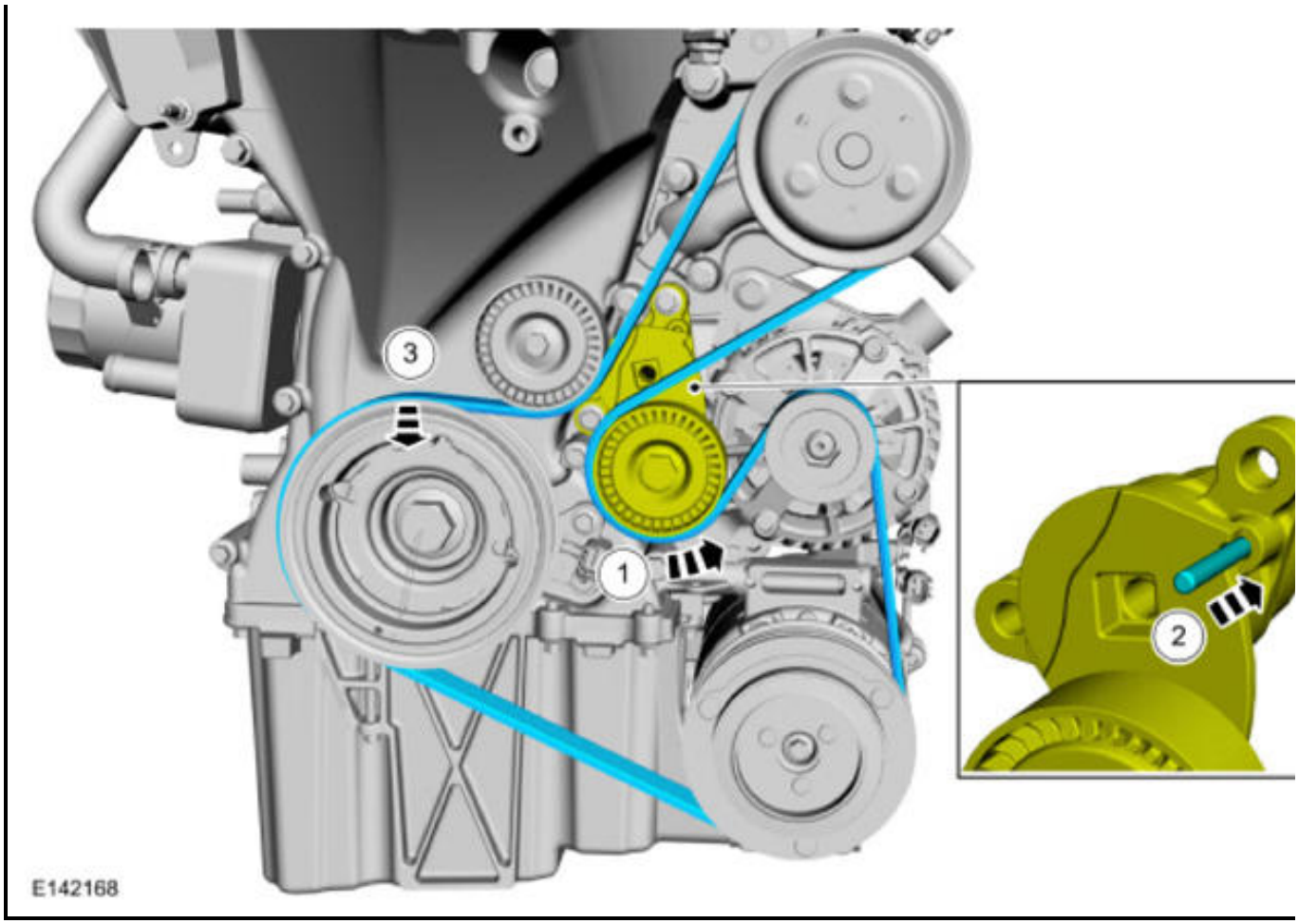


2. Remove Special Service Tool: **300-OTC1819E 2, 200# Floor Crane, Fold Away** .

WARNING: Take extra care when handling the compressed spring.

3.

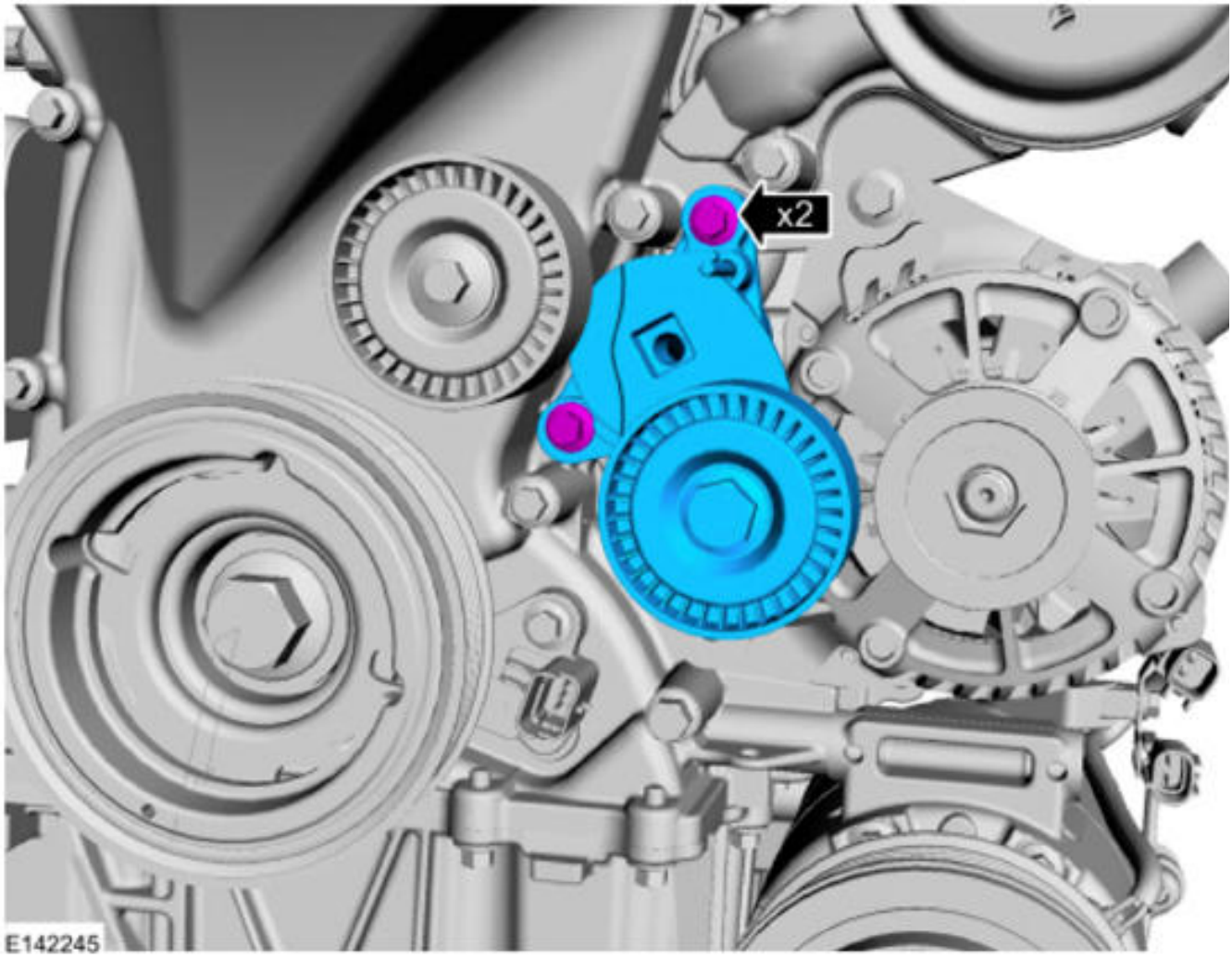
Use the General Equipment: 4 mm Drill Bit



WARNING: Take extra care when handling the compressed spring.

4.

Use the General Equipment: 4 mm Drill Bit



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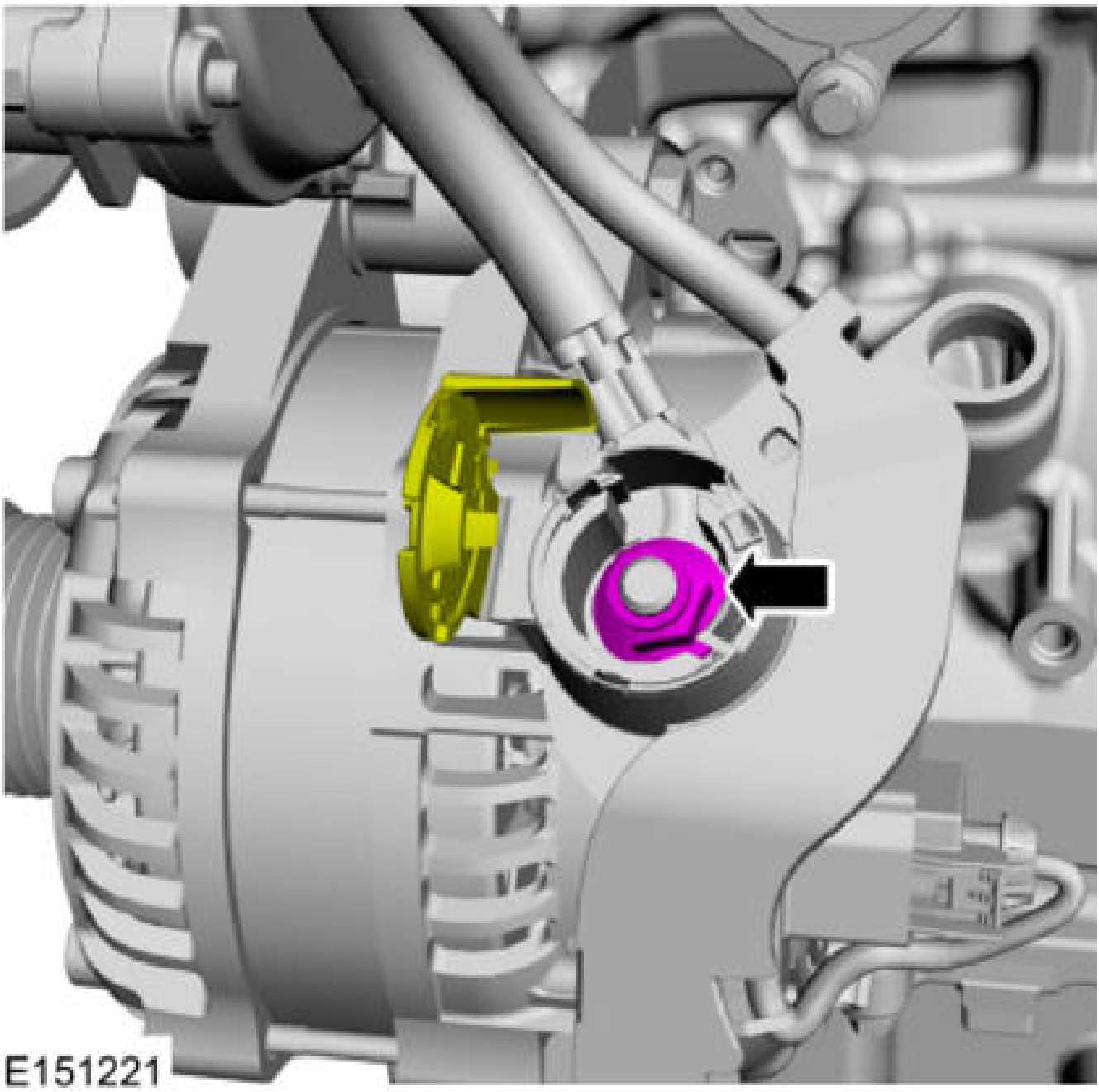
5. 

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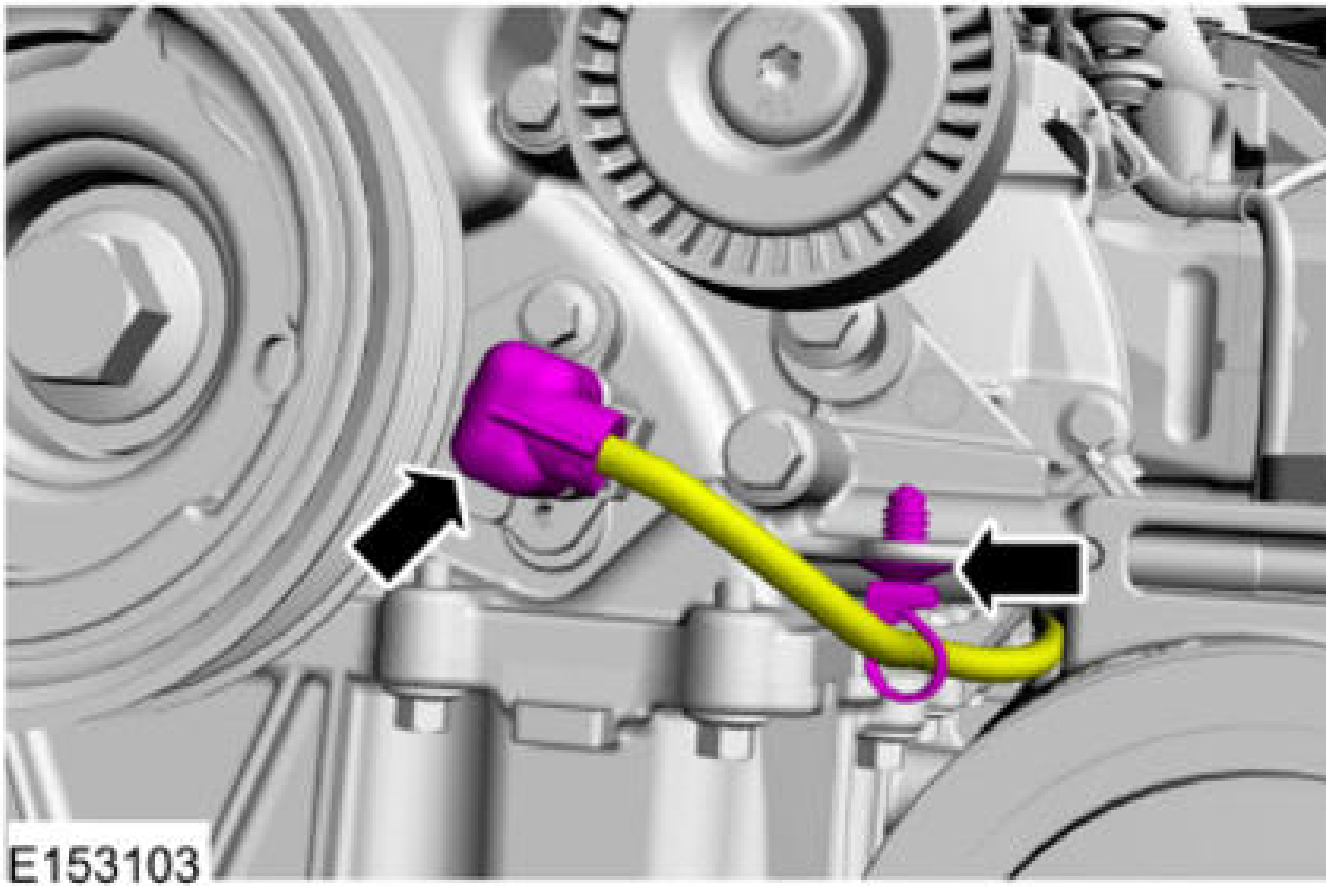
6.



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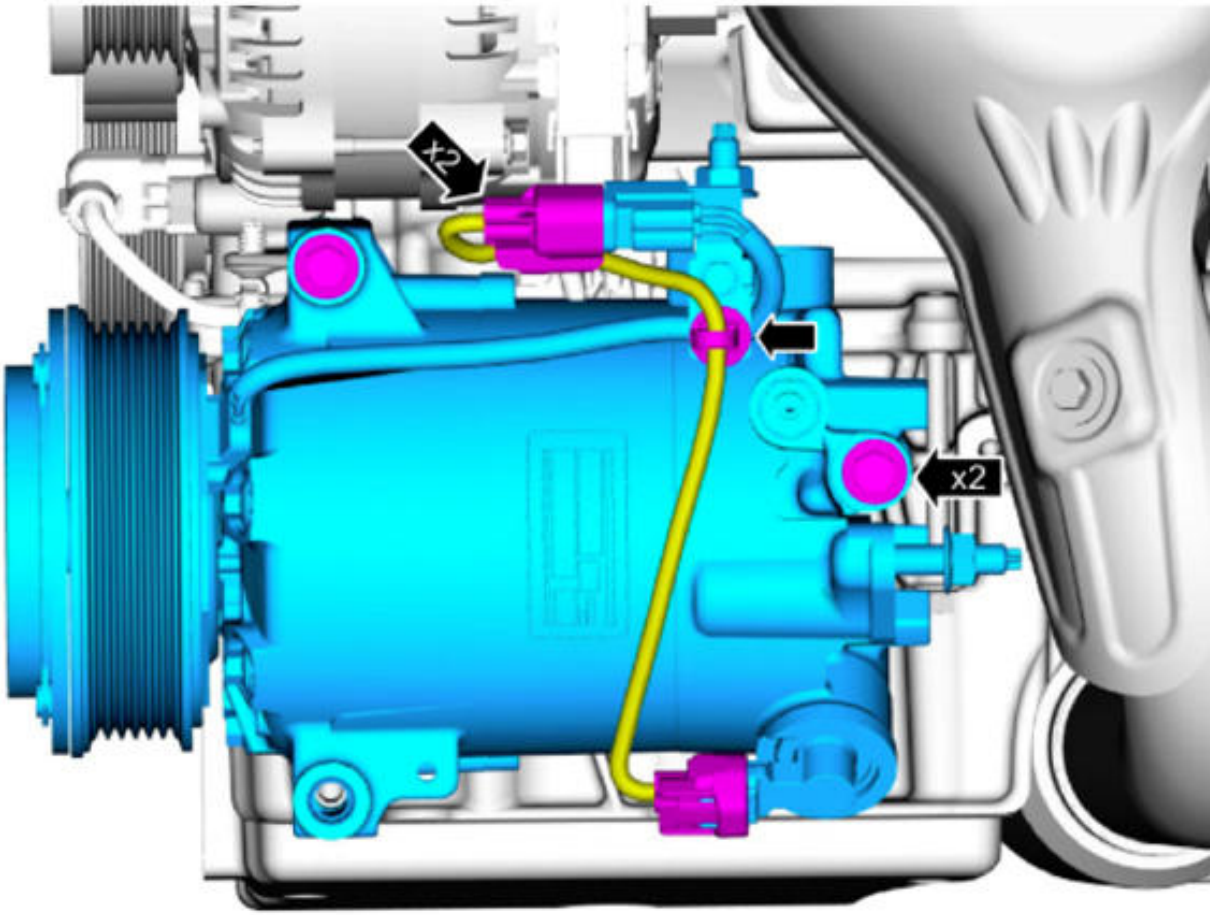

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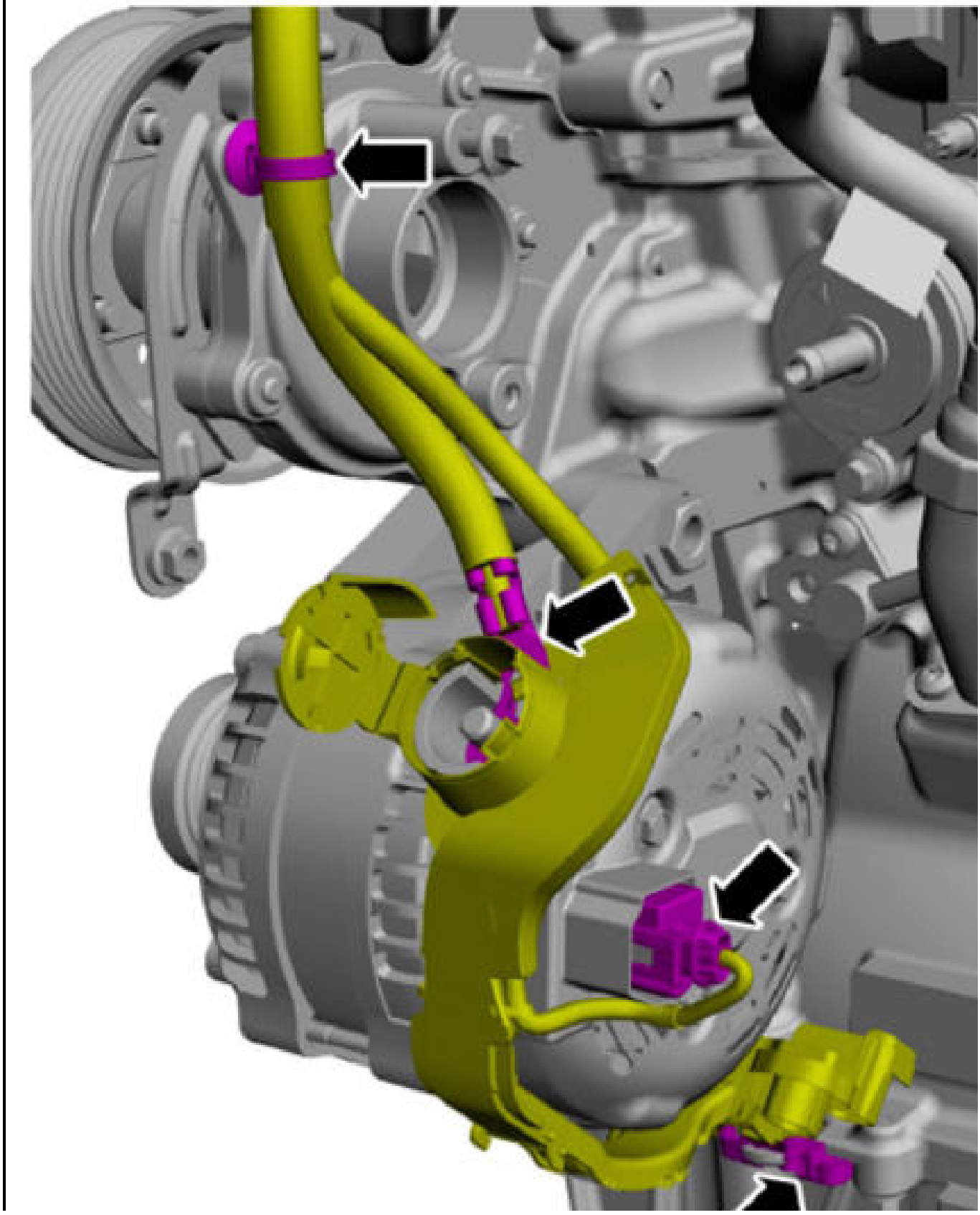

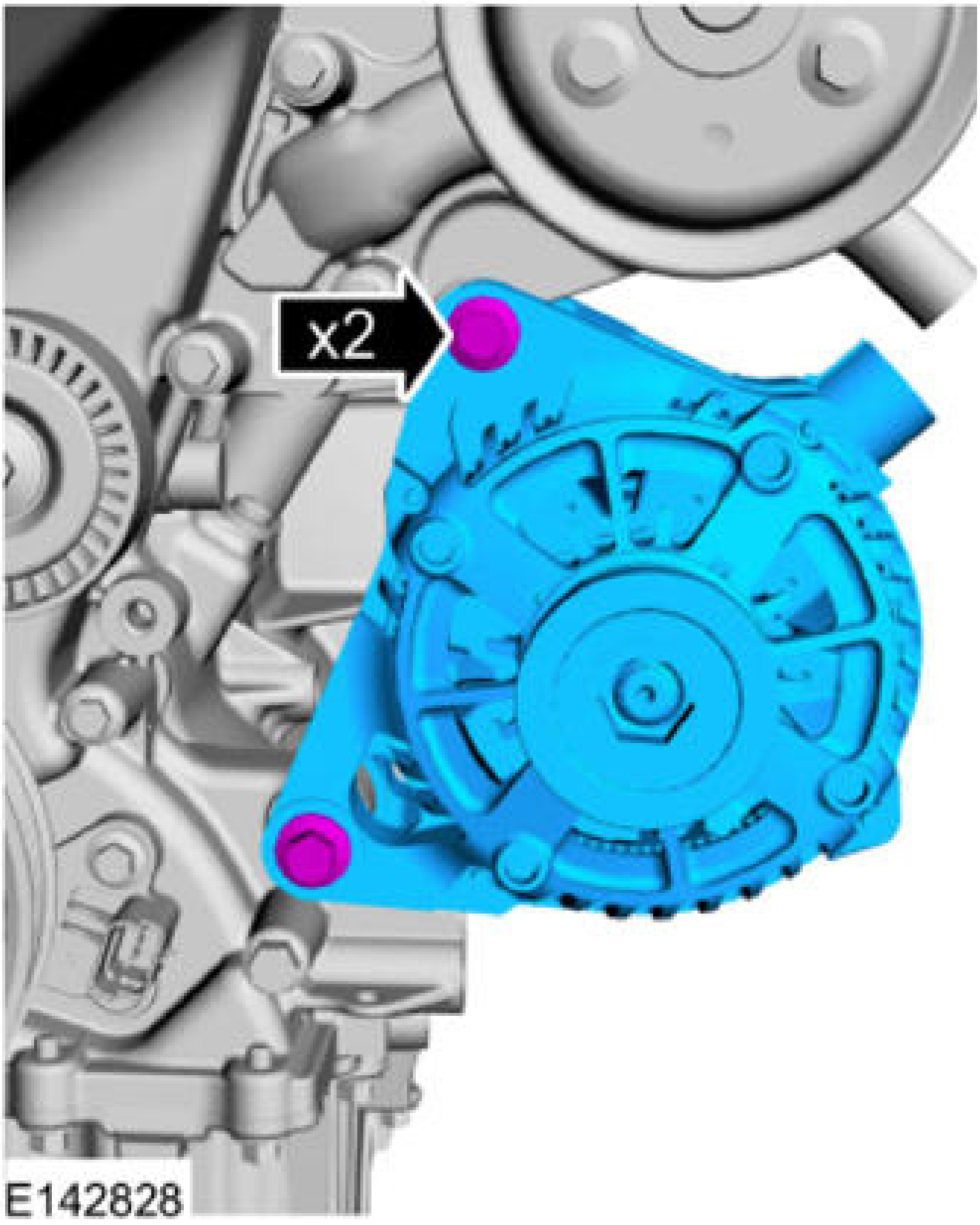

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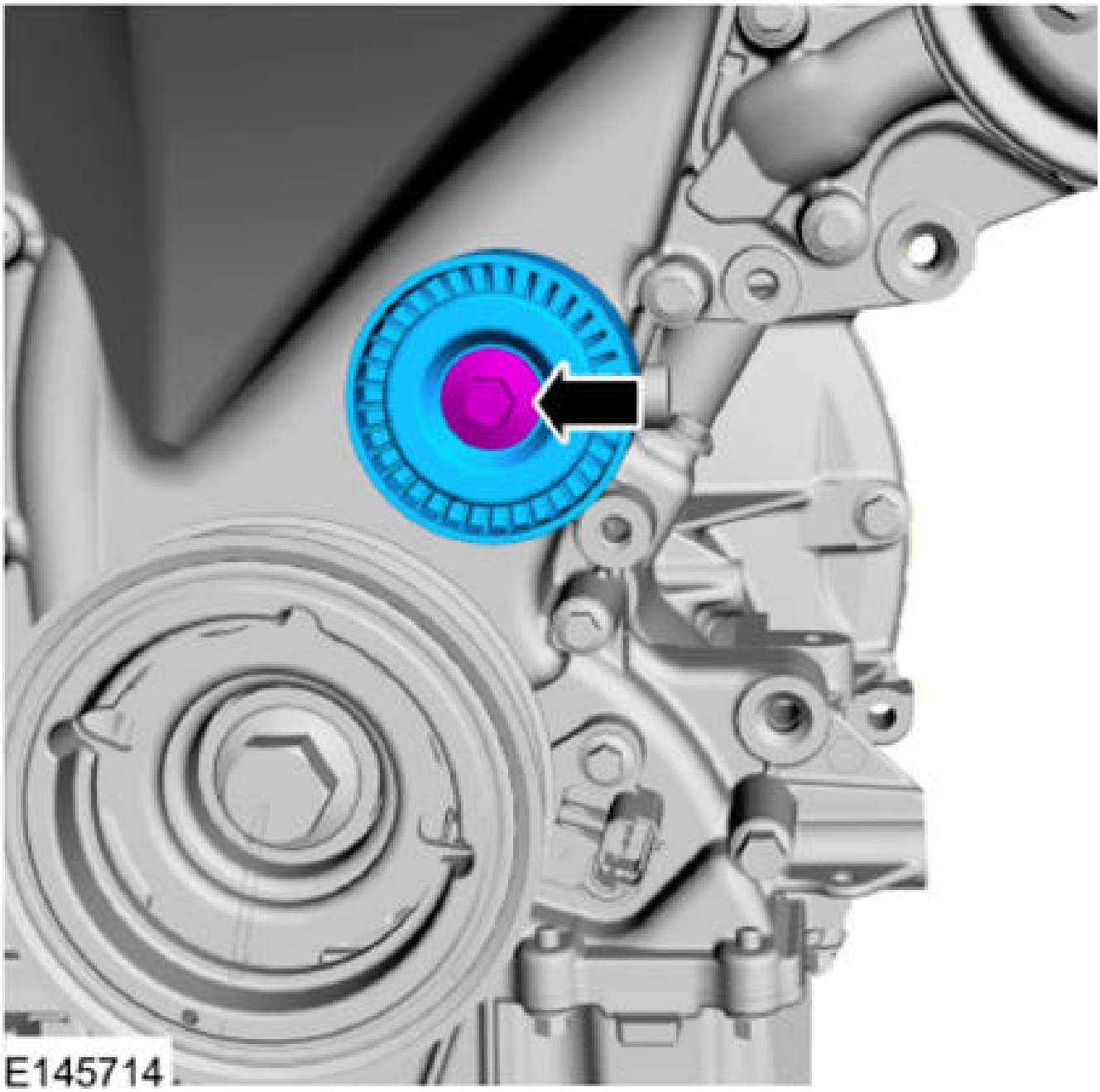

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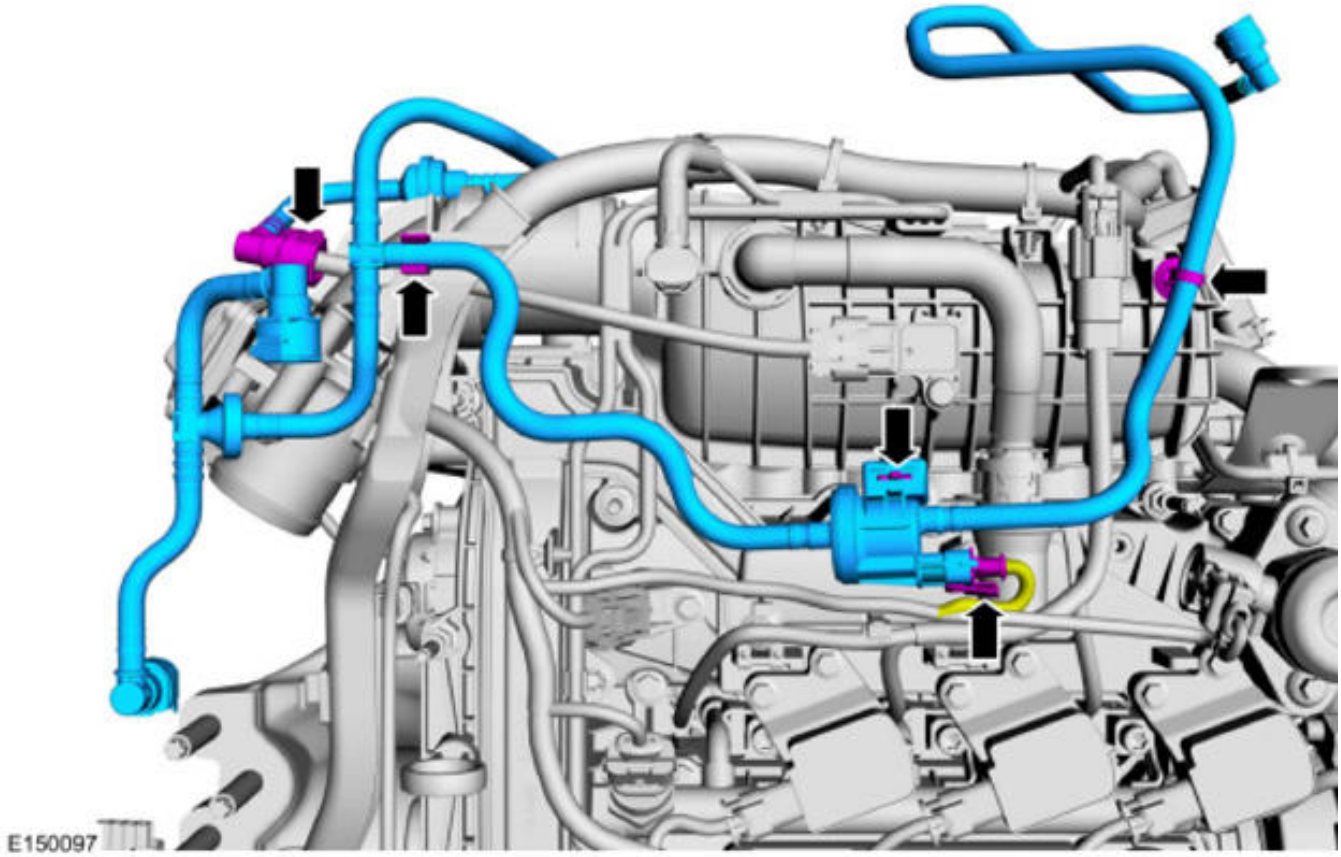

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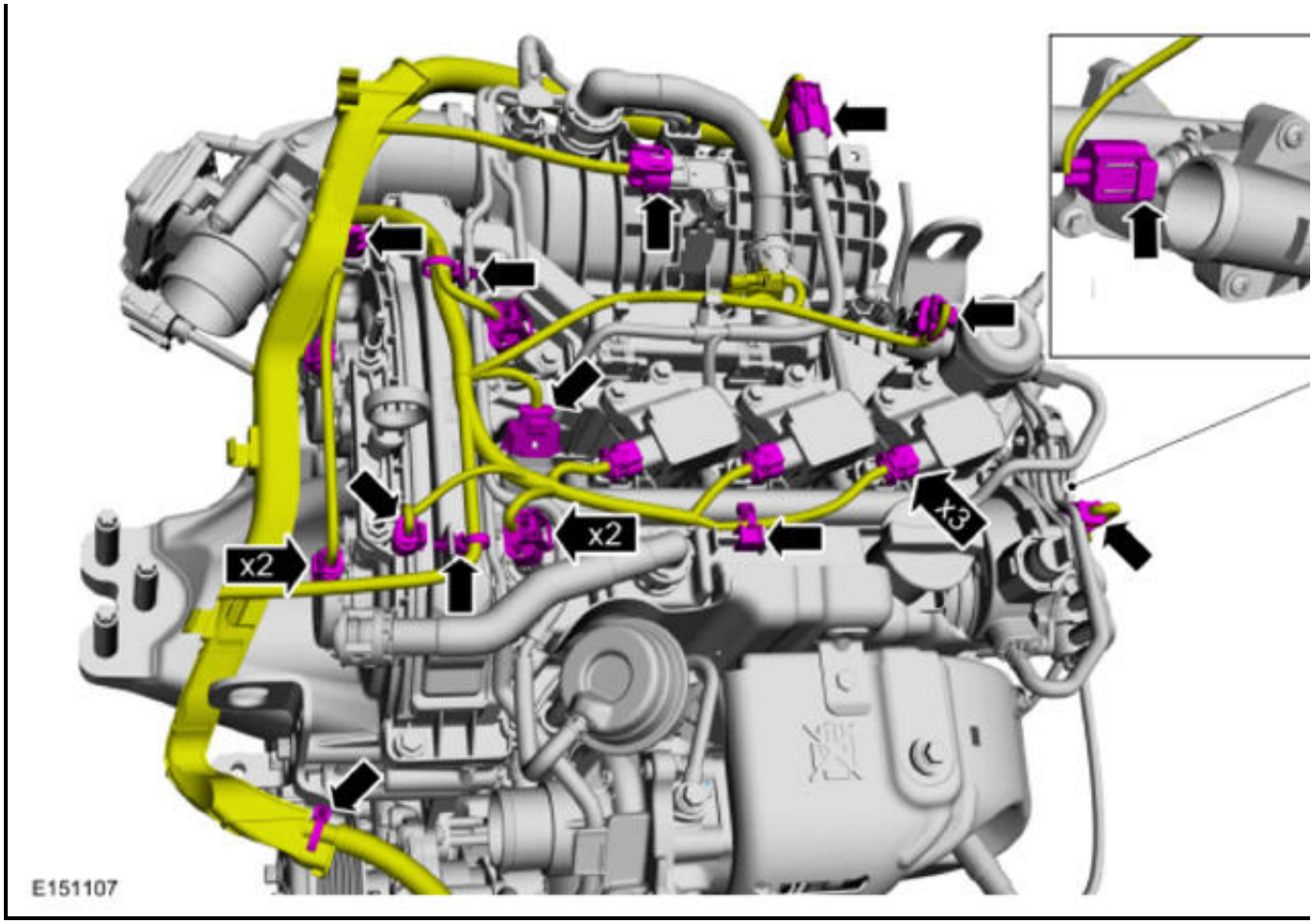
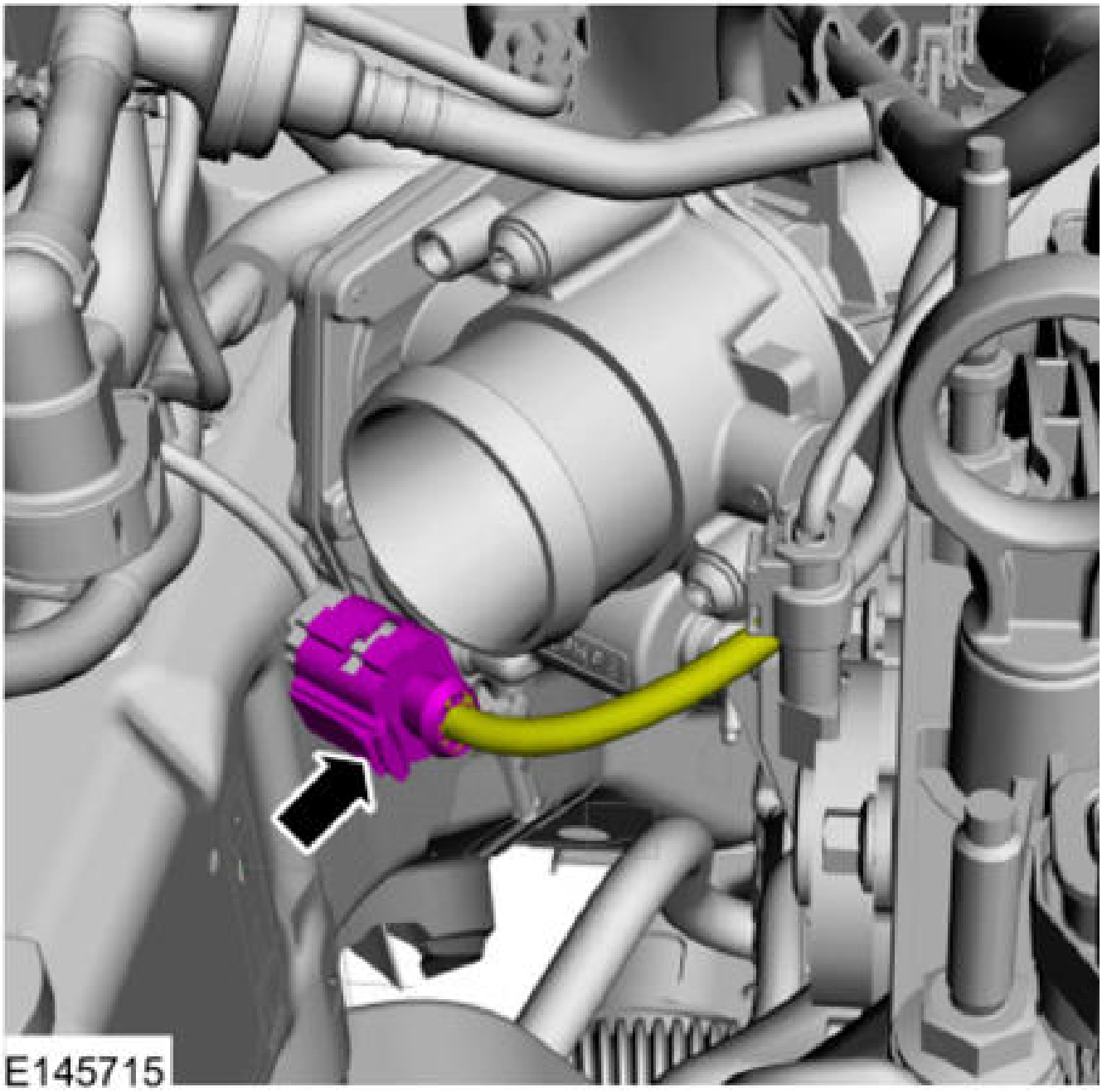
12.



13.

13.



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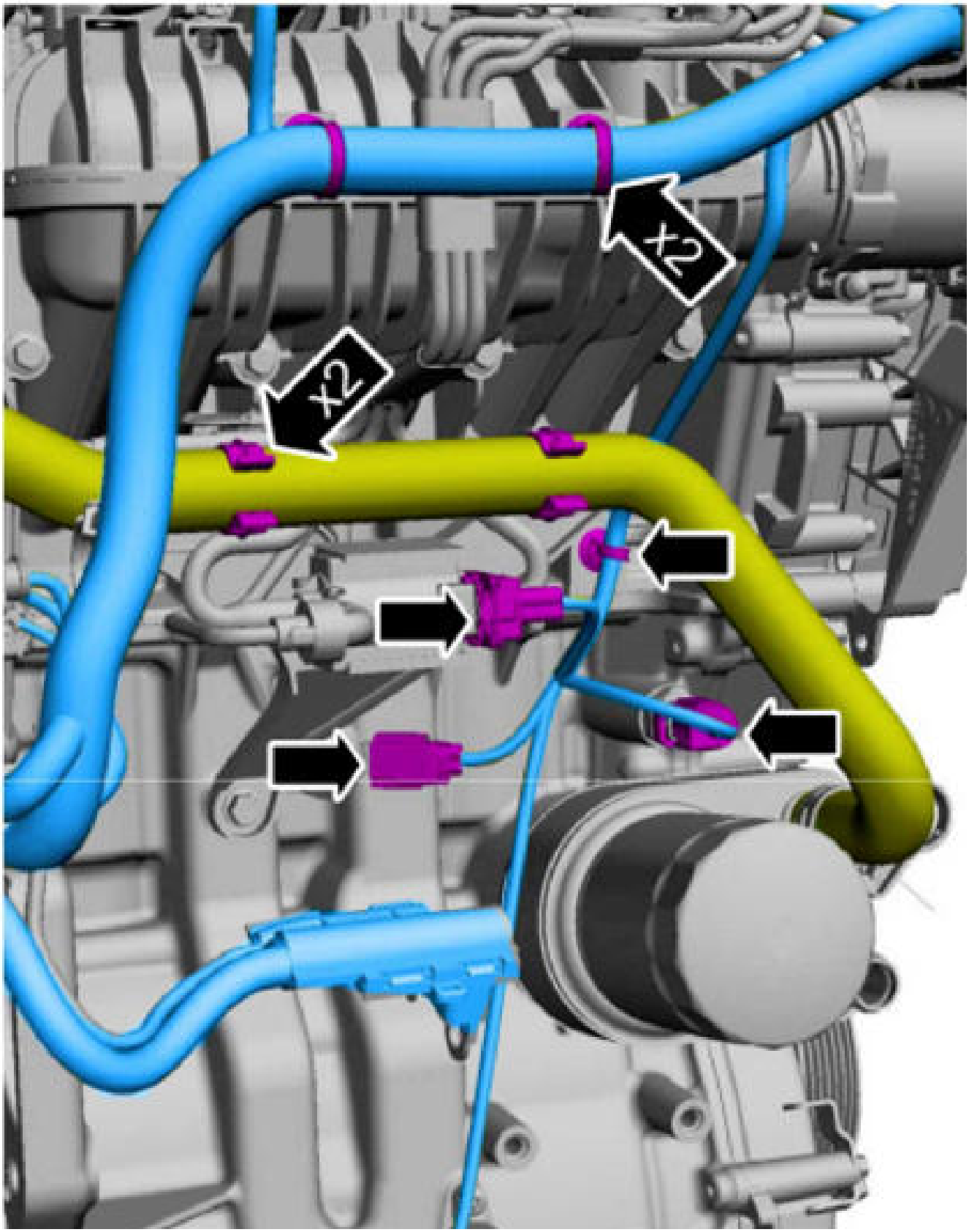
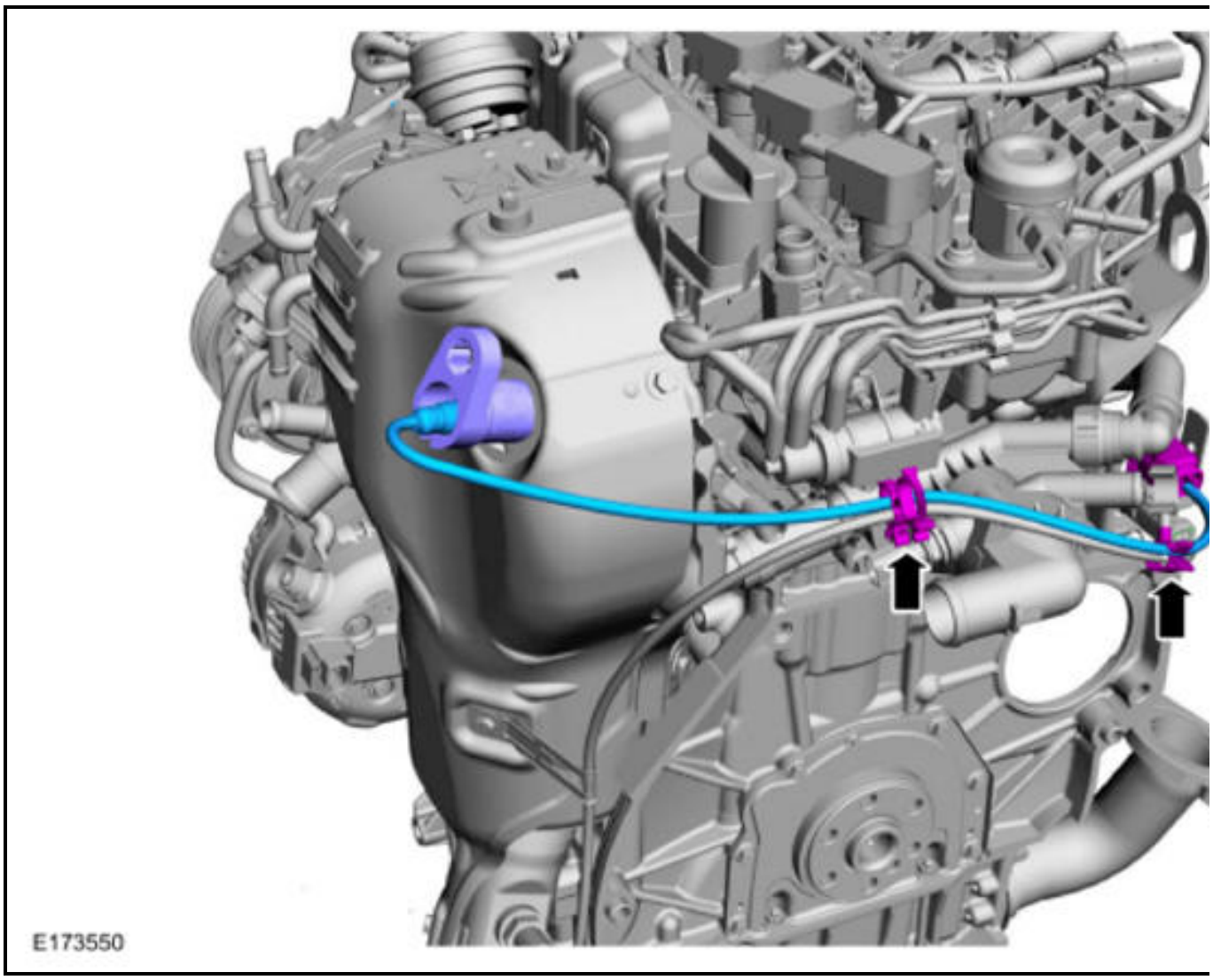
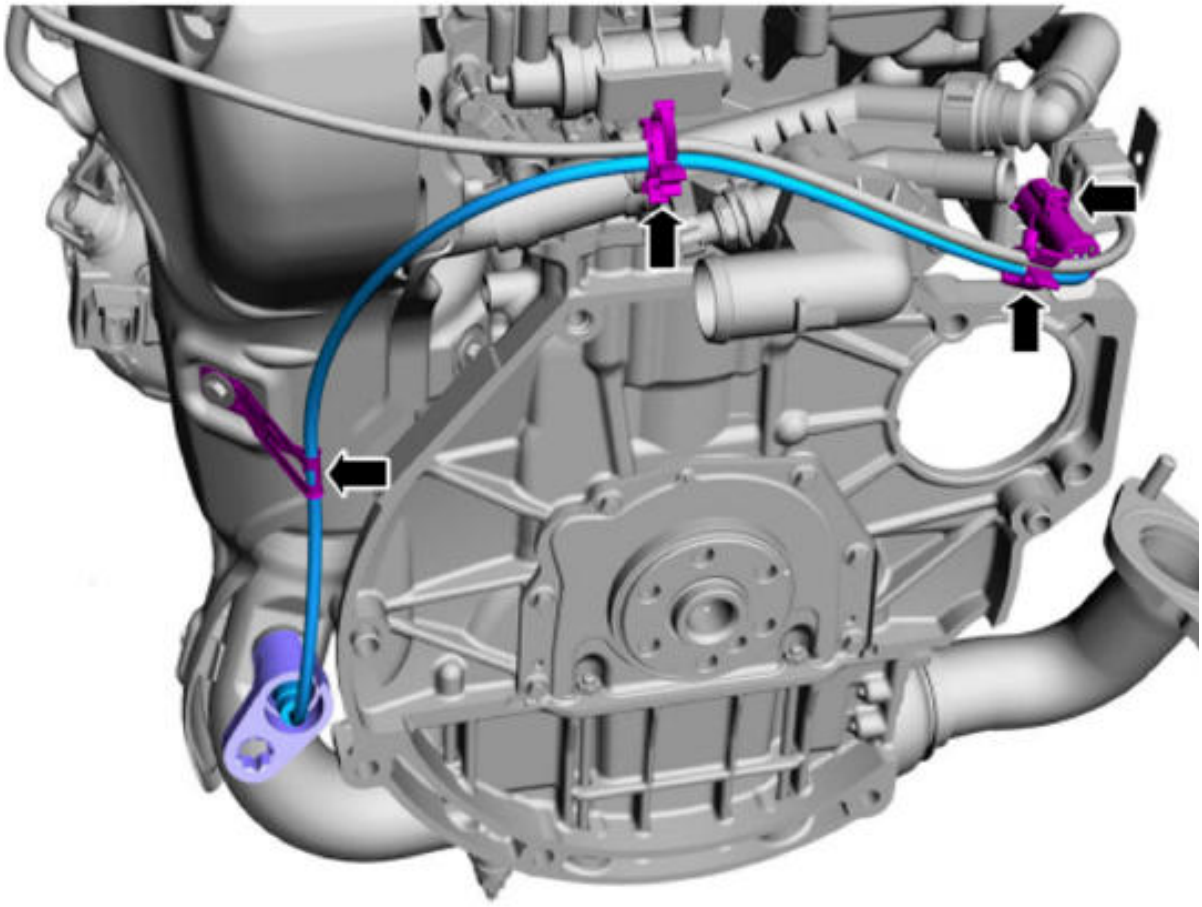


15. **NOTE: Use a commercially available socket.**



16. **NOTE: Use a commercially available socket.**



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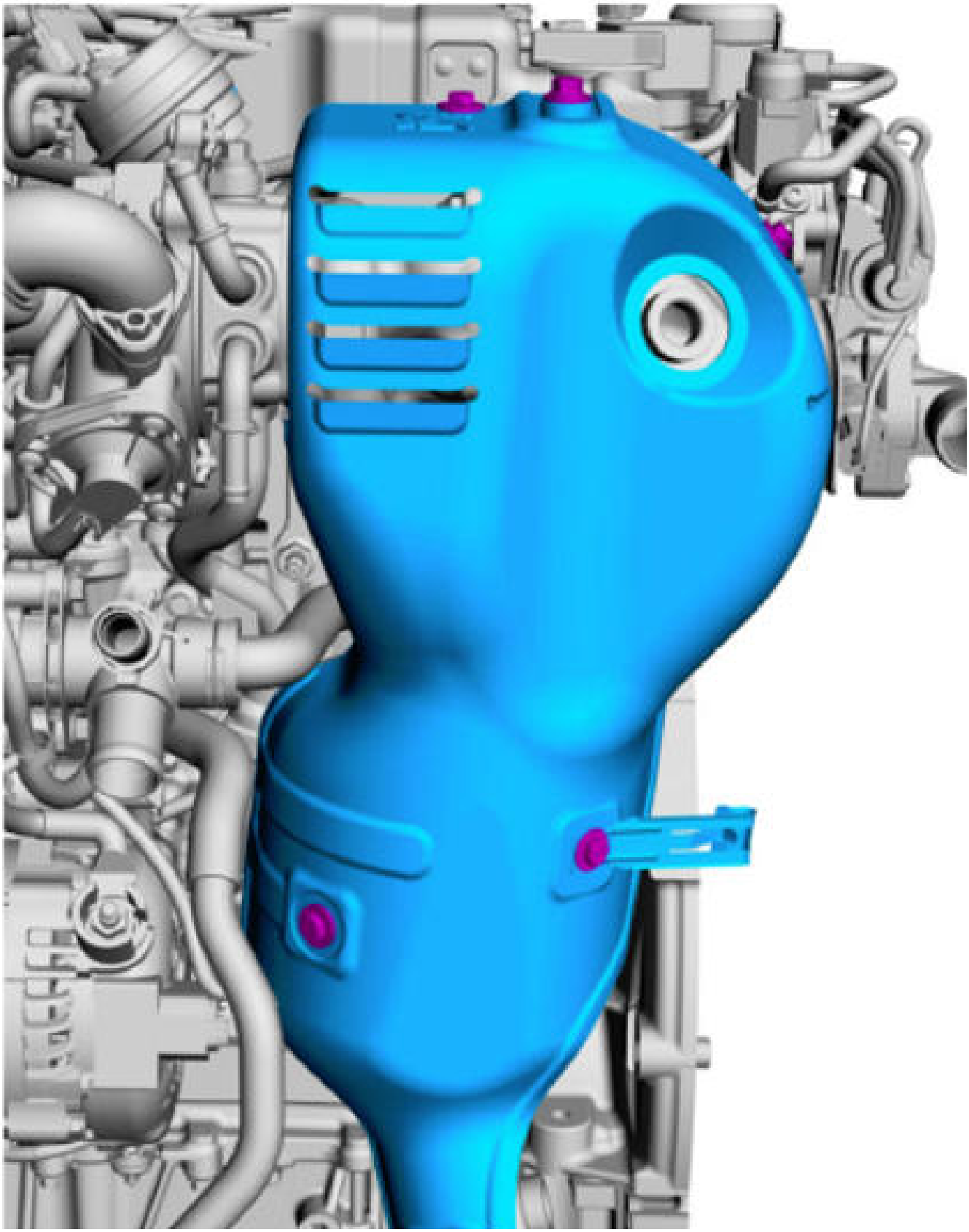

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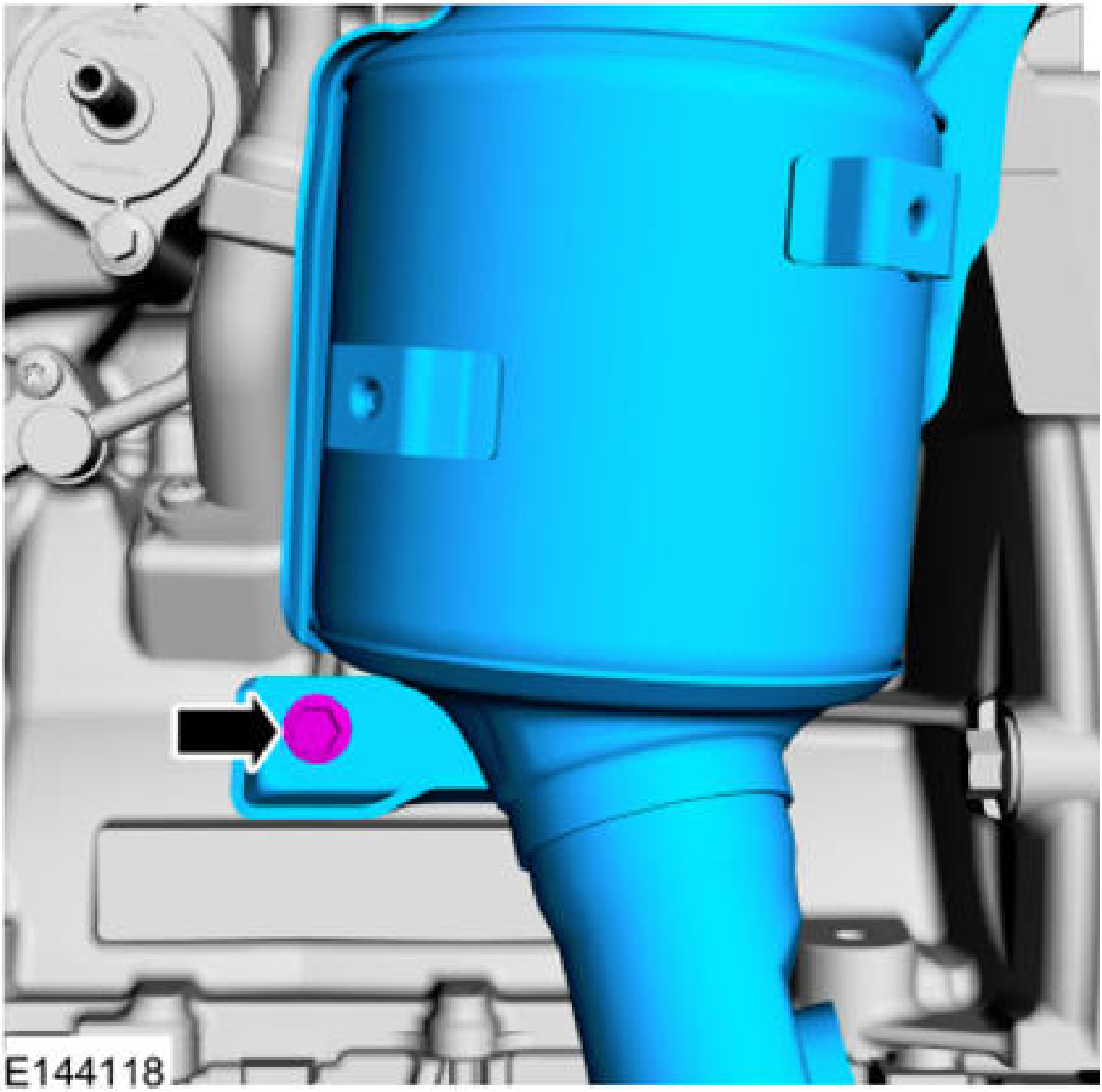

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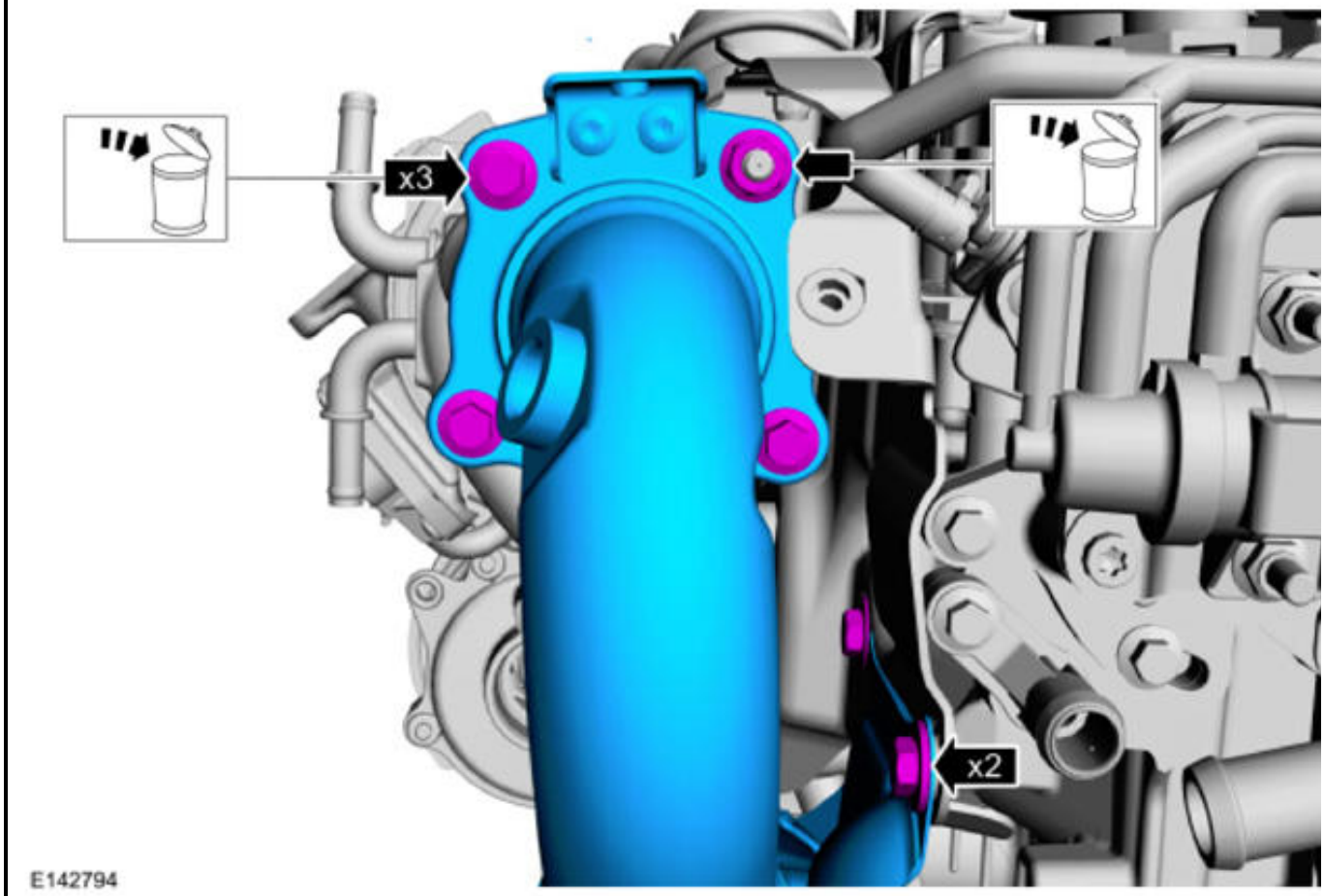

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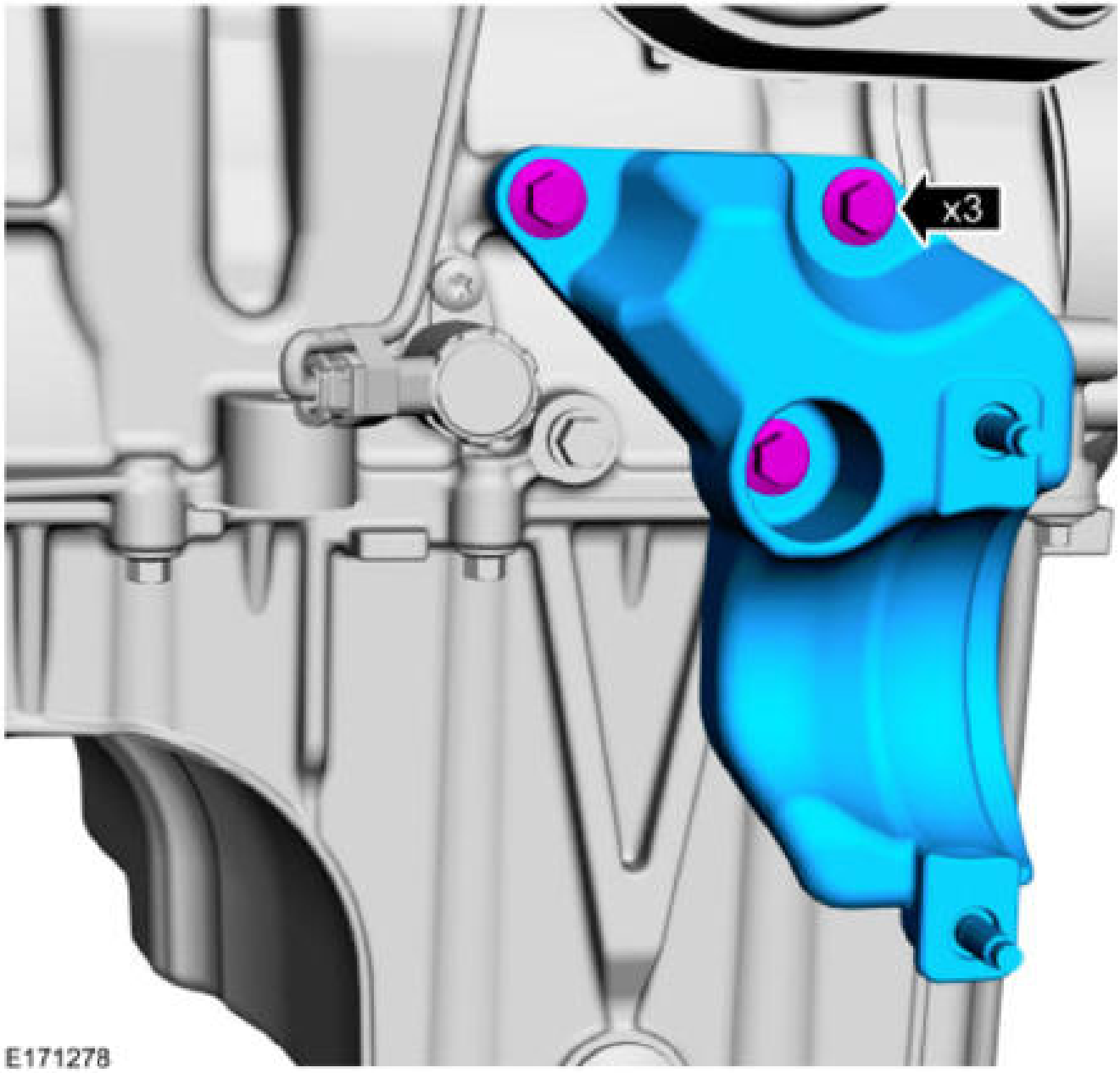
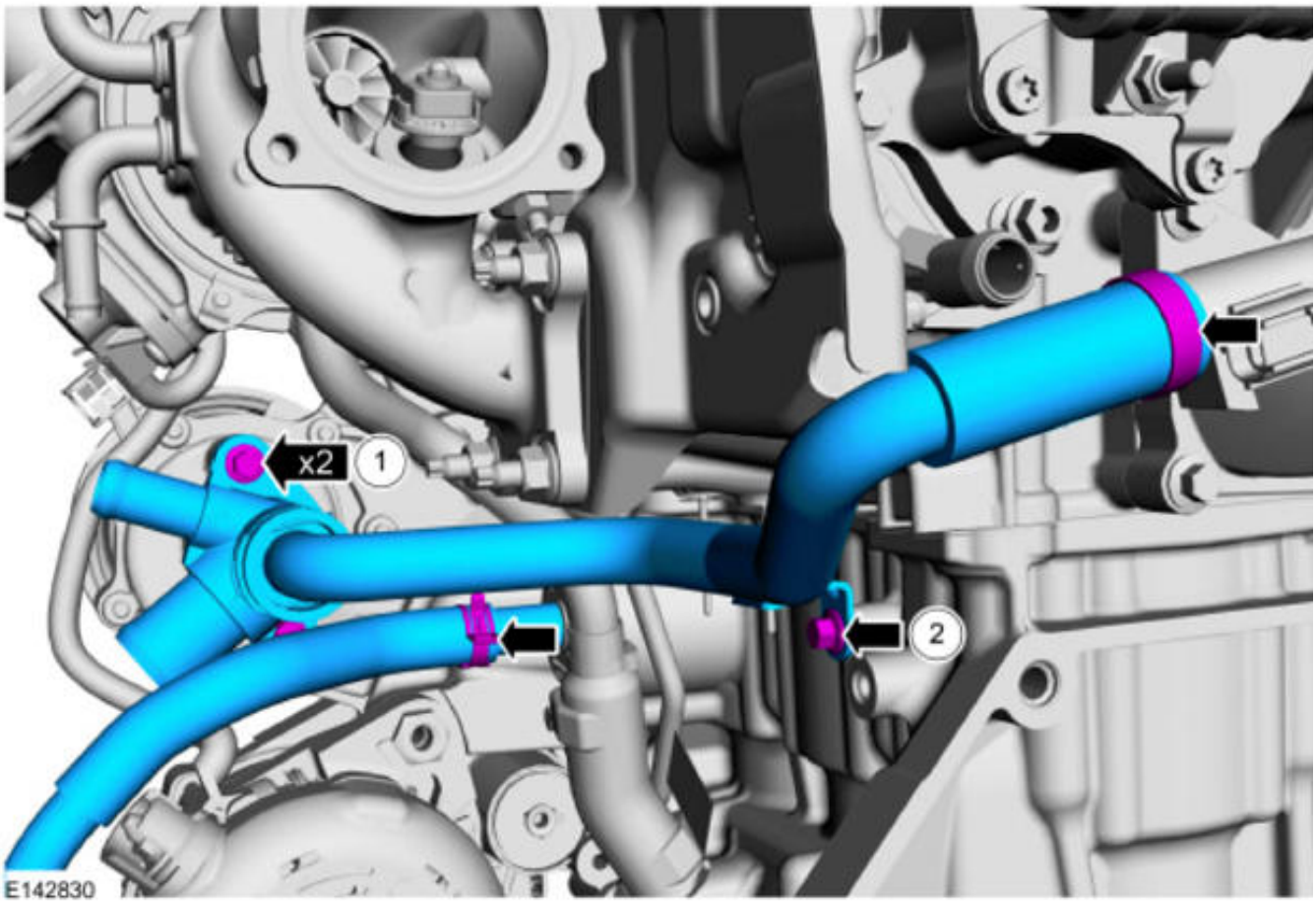
20.



21. Use the General Equipment: Hose Clamp Remover/Installer



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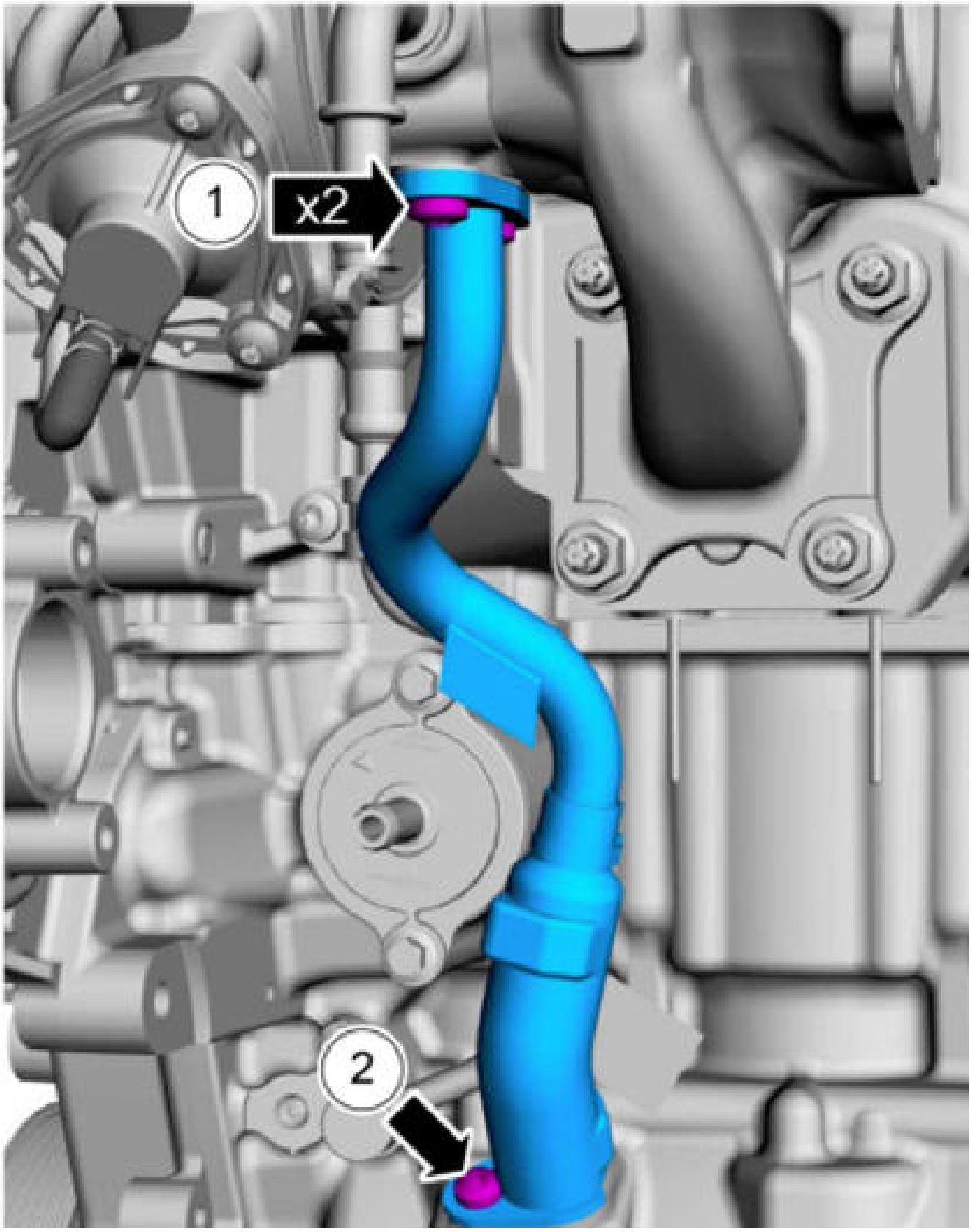
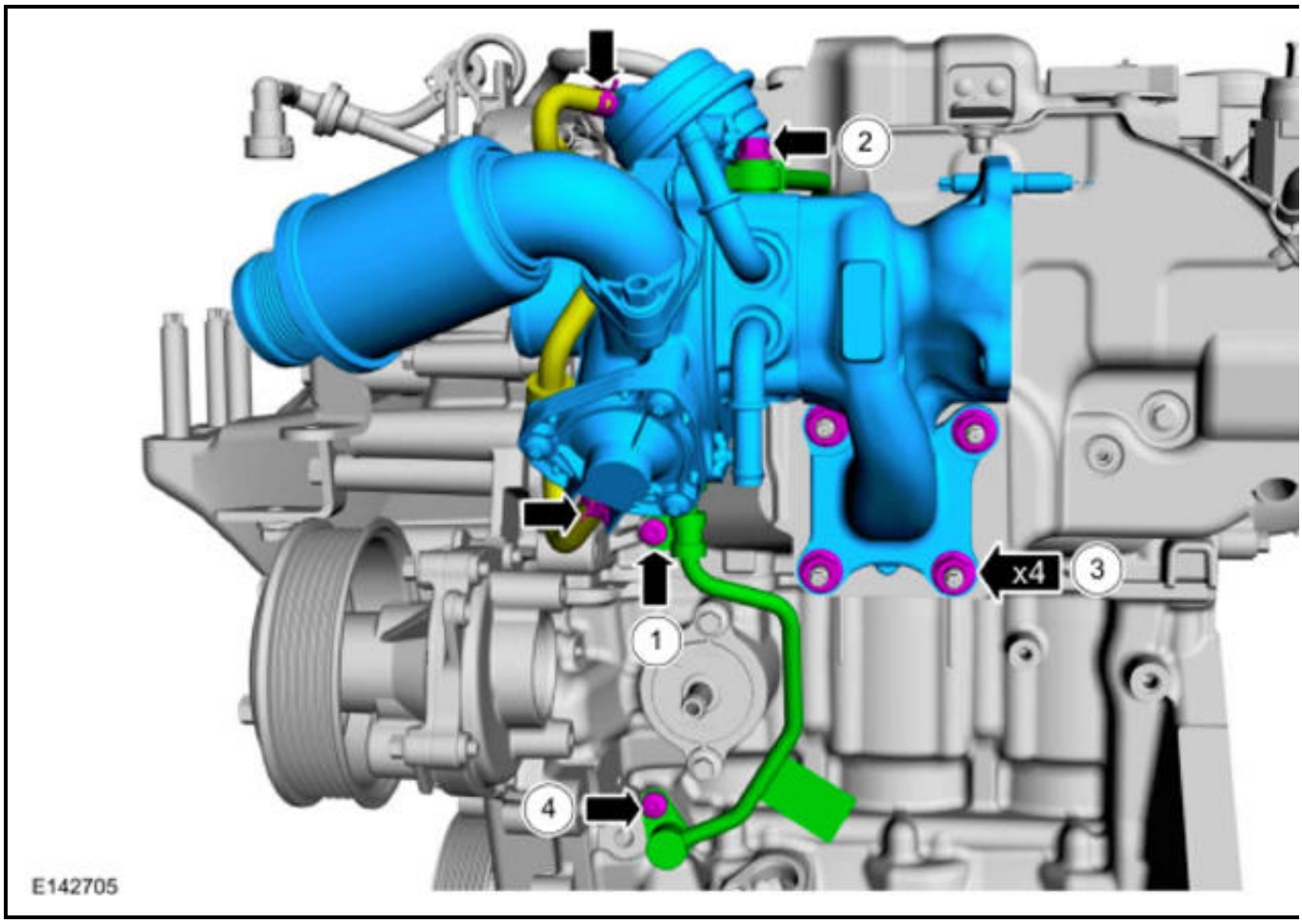


23. Use the General Equipment: Hose Clamp Remover/Installer



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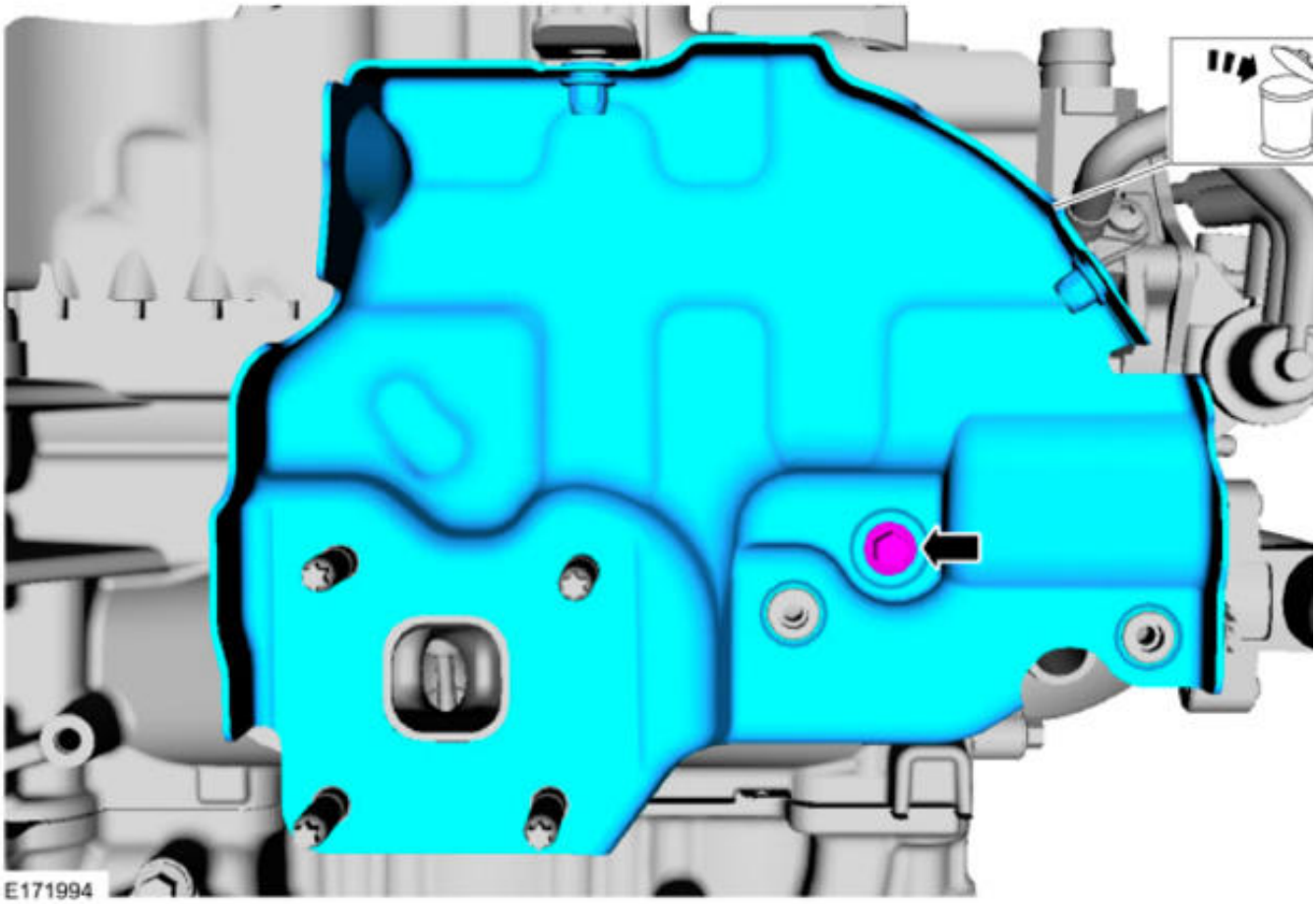
24.



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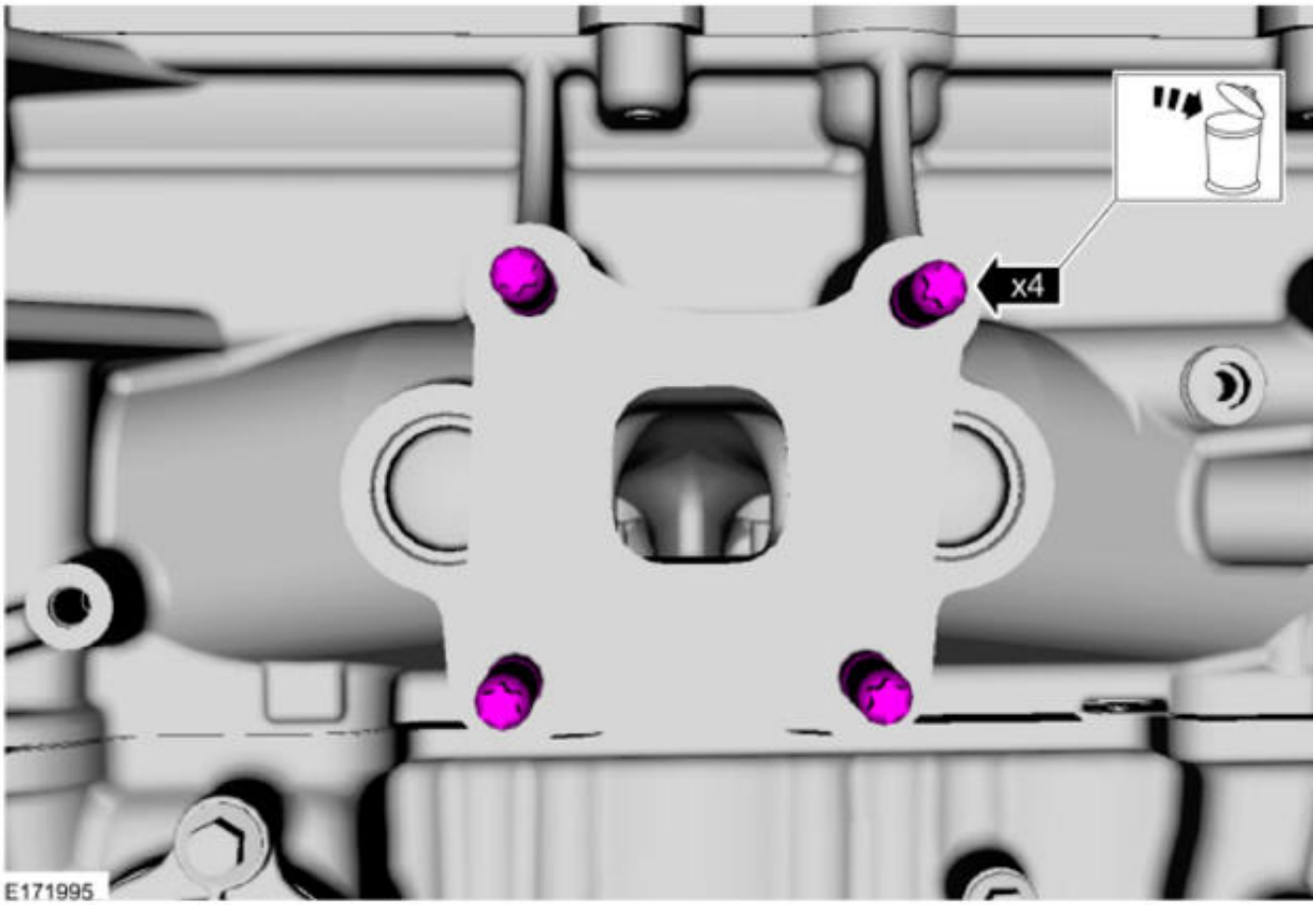
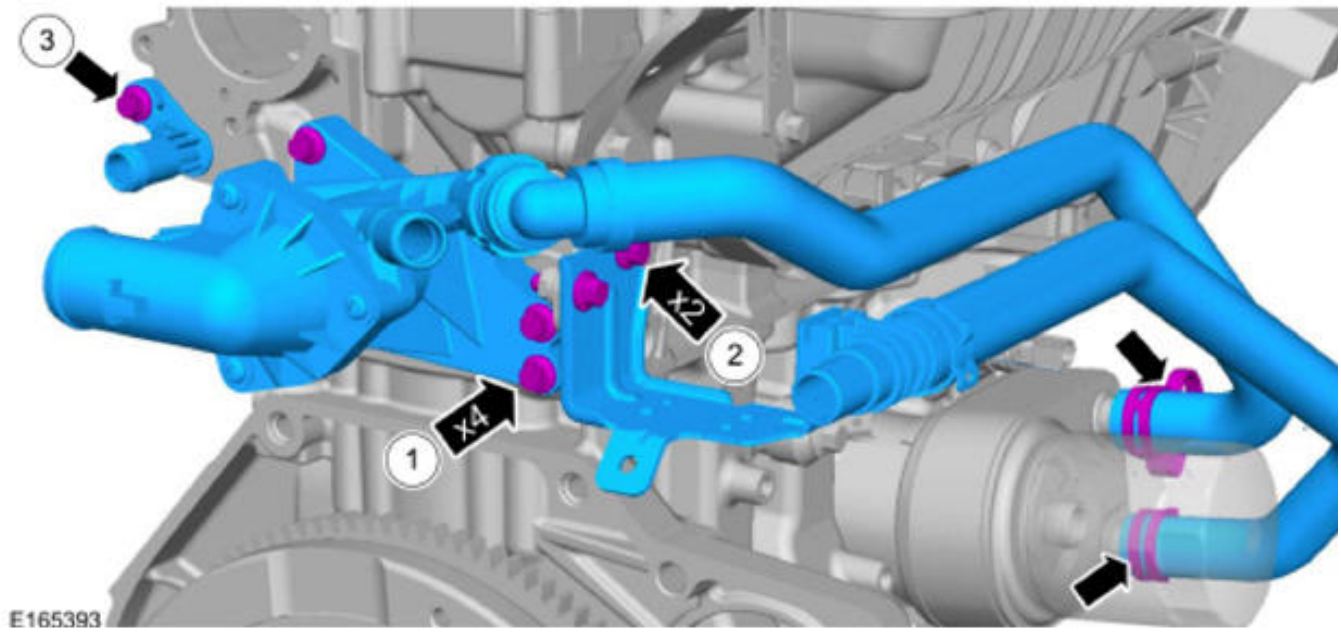
25.

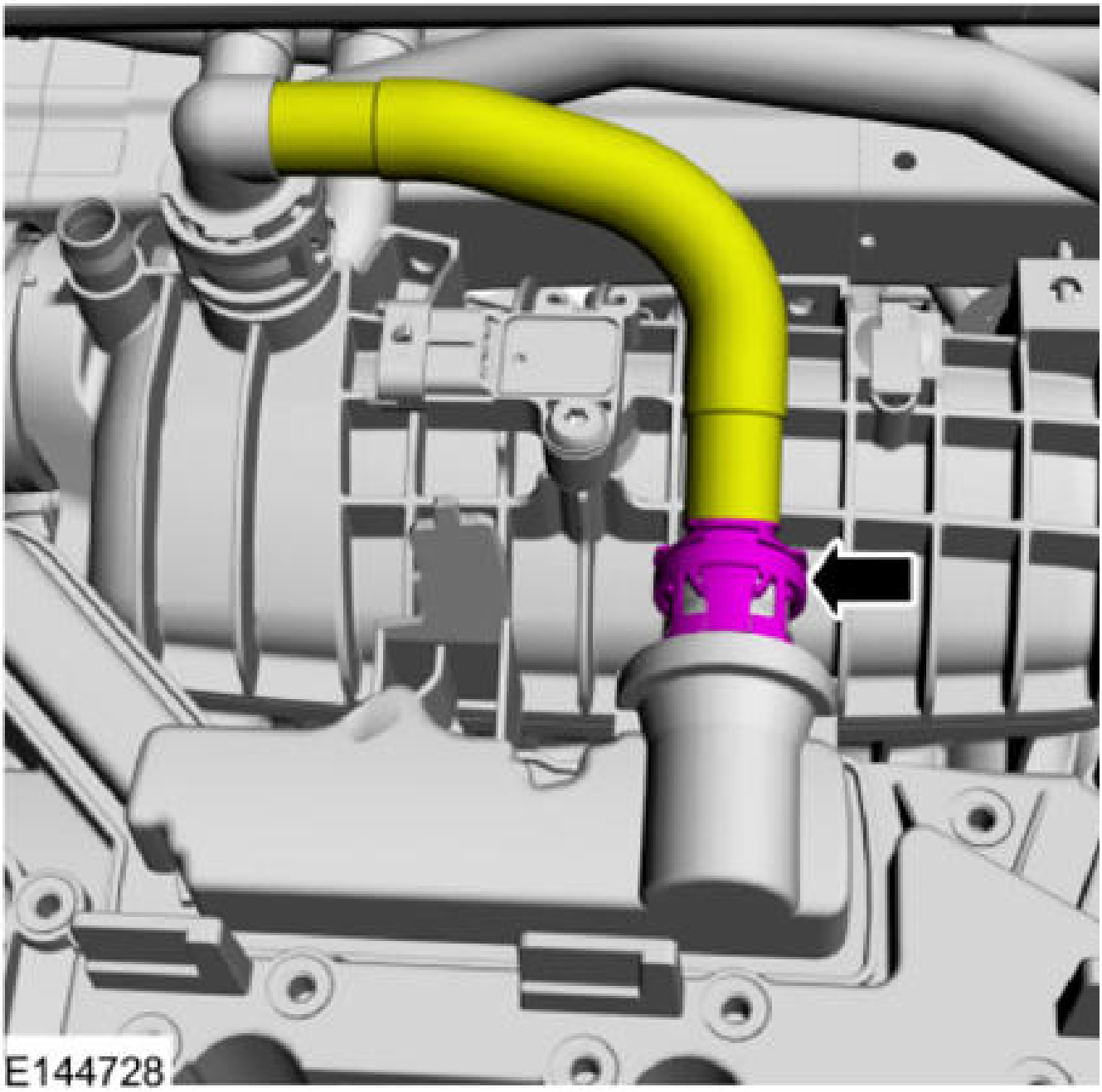


26. Use the General Equipment: Hose Clamp Remover/Installer



27.

27.



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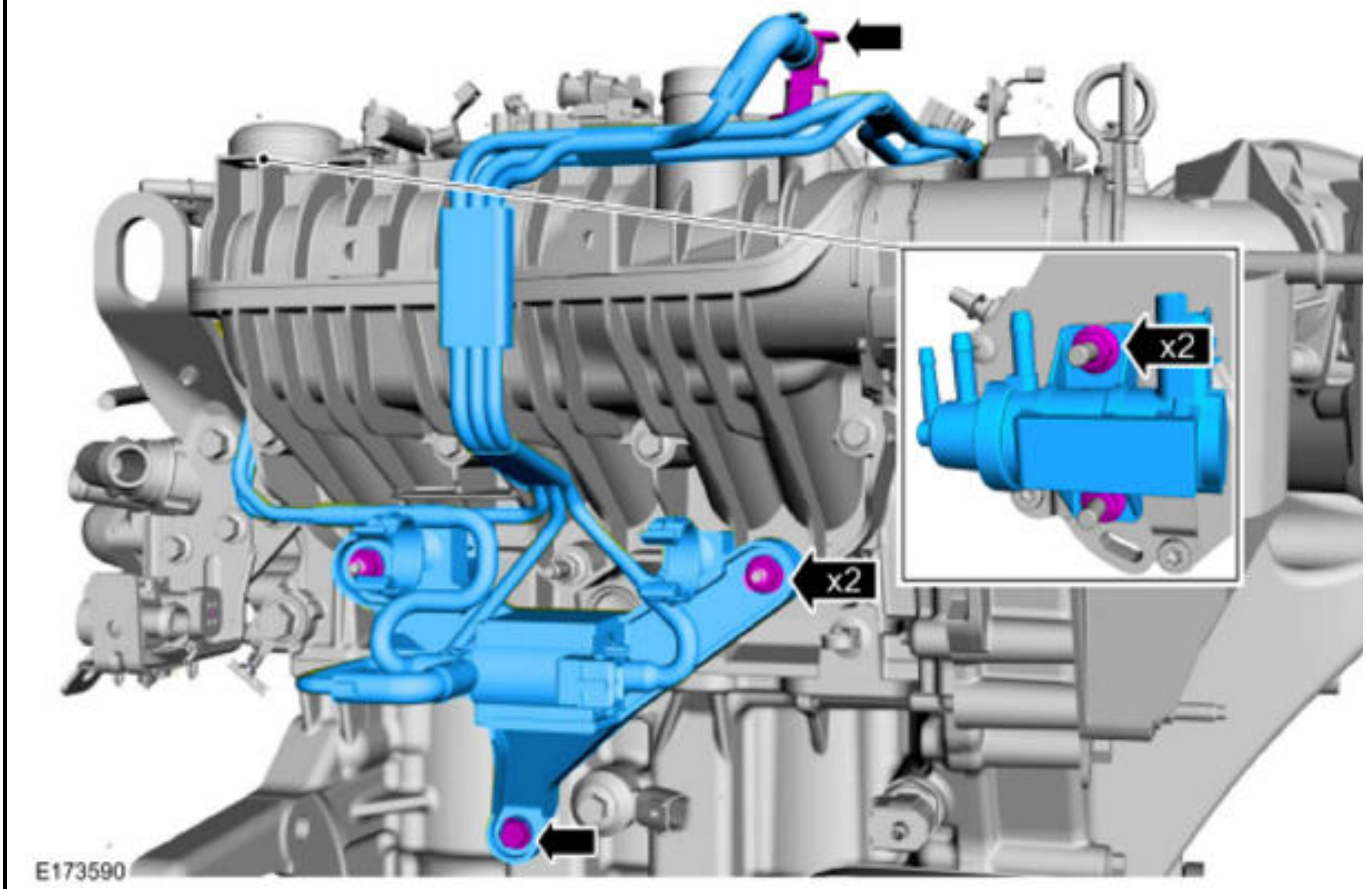

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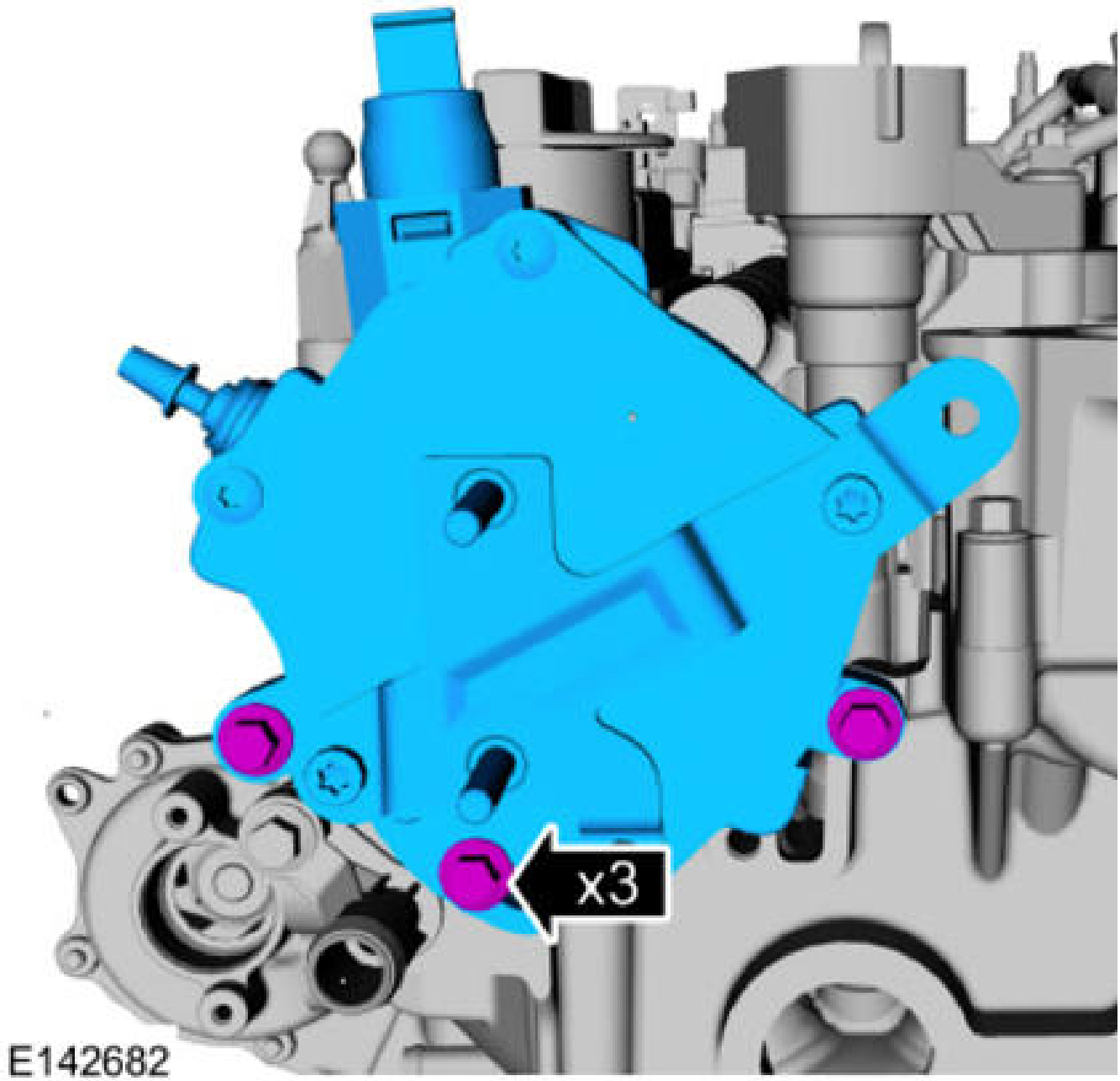

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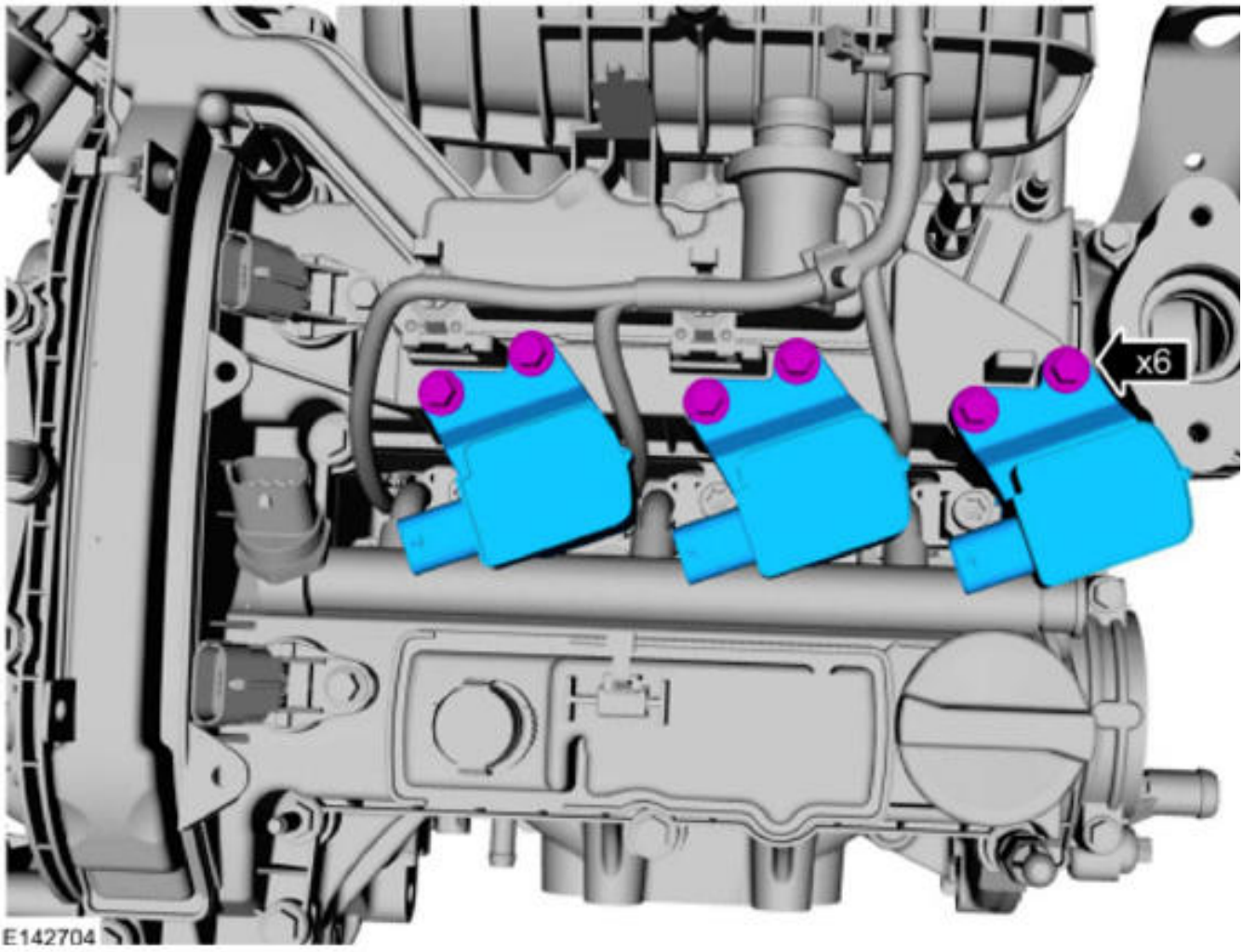
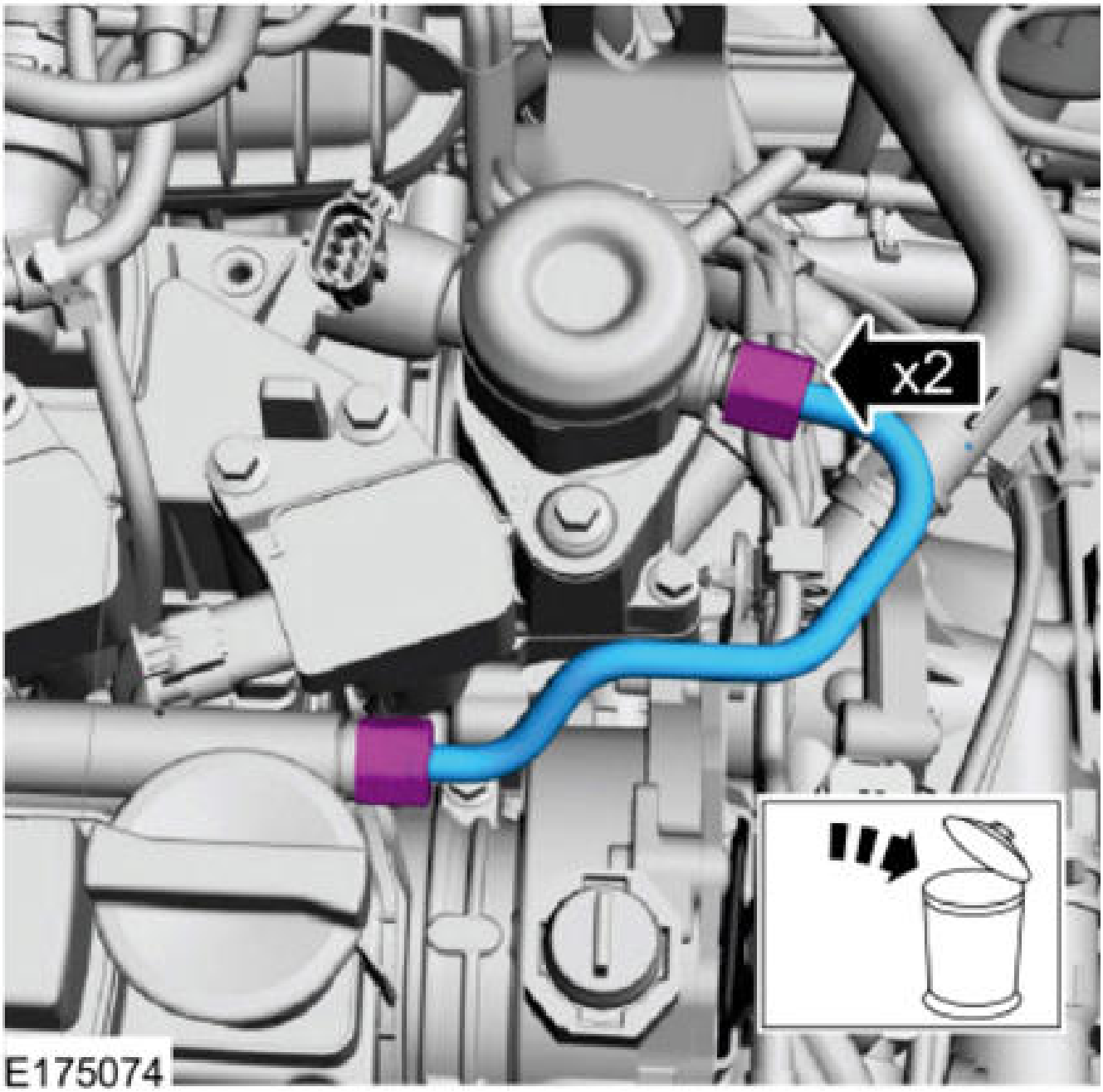
30.

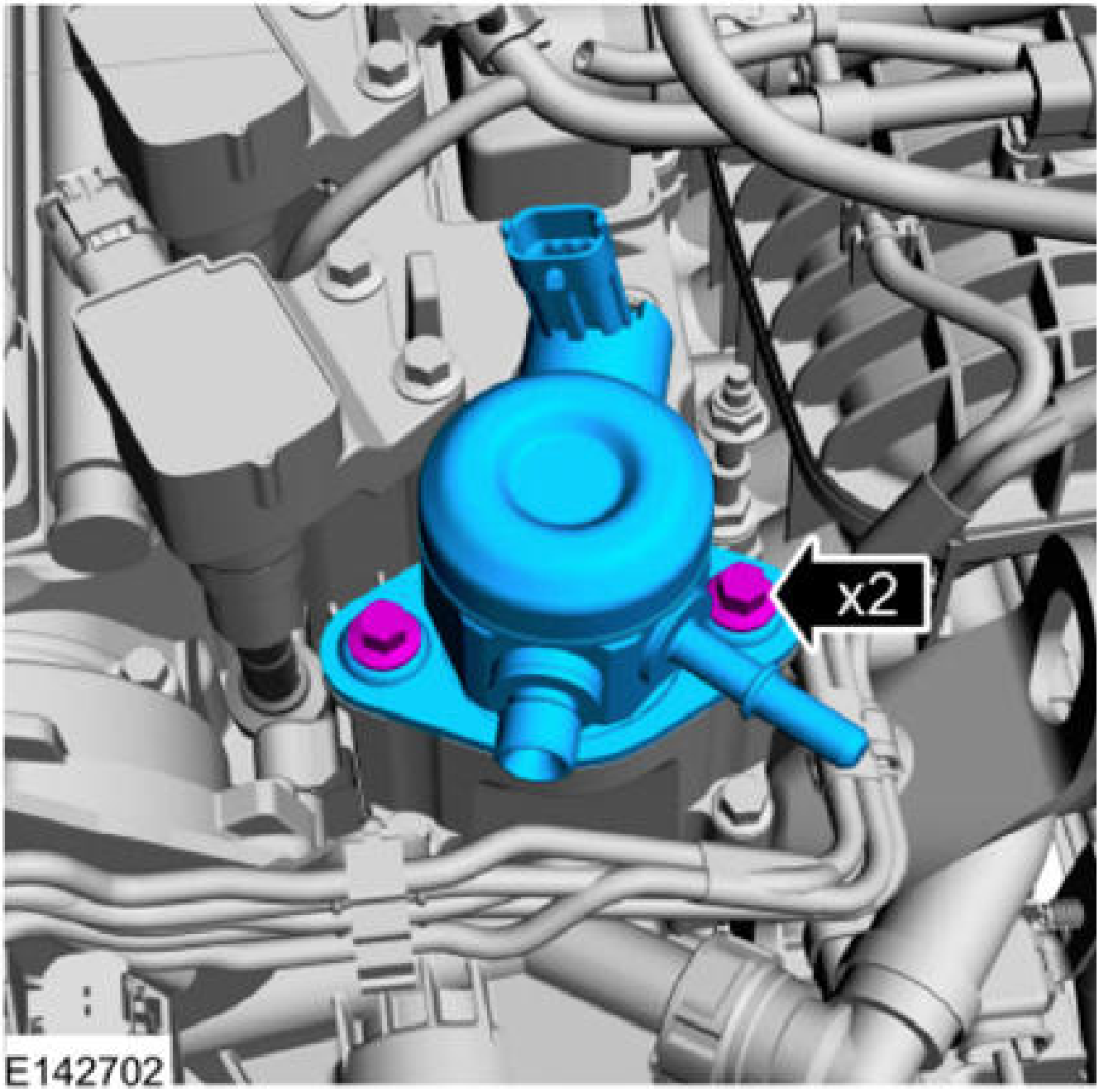


31.

31.



32. Loosen each bolt 1 turn at a time until all bolts are removed.



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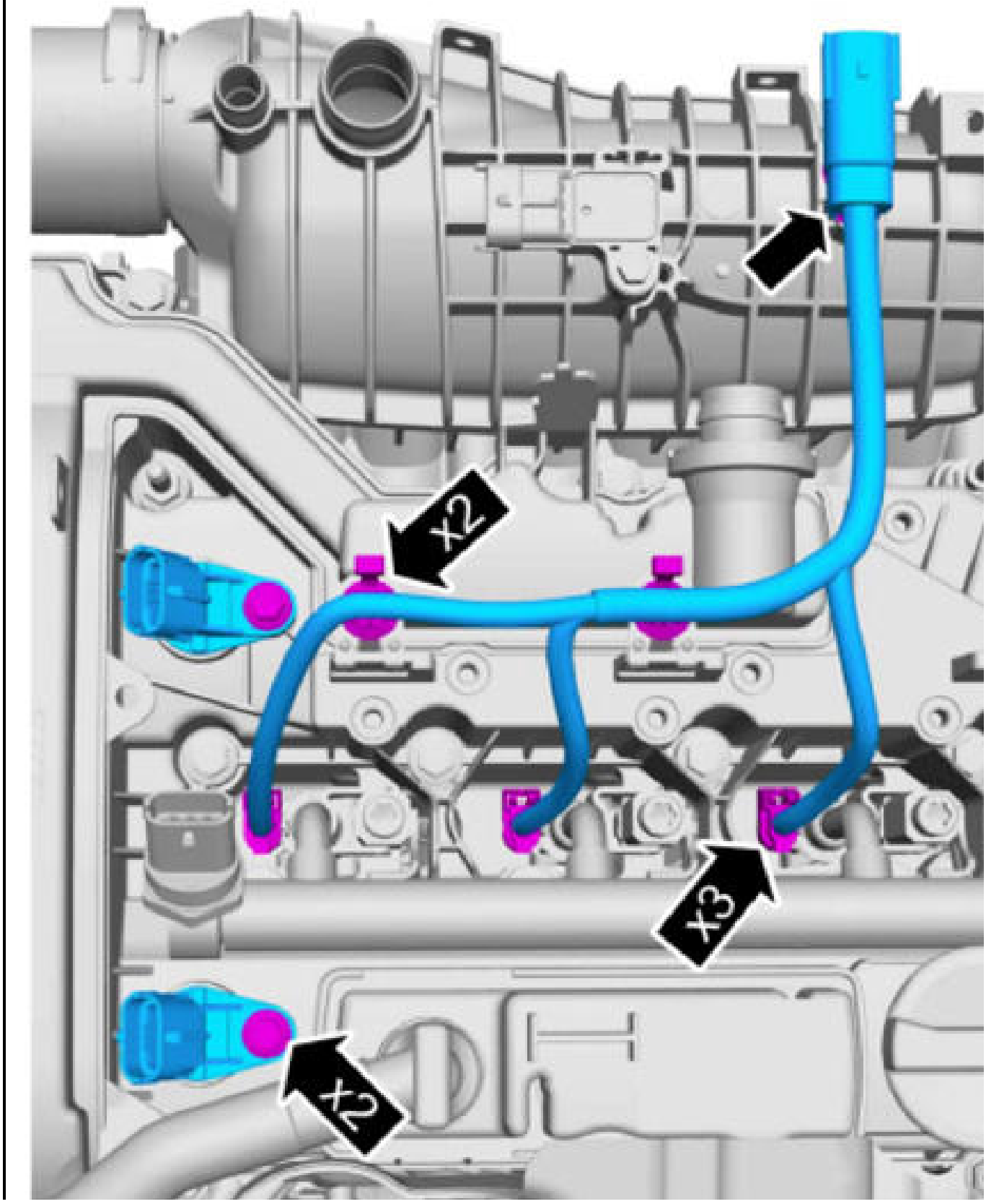
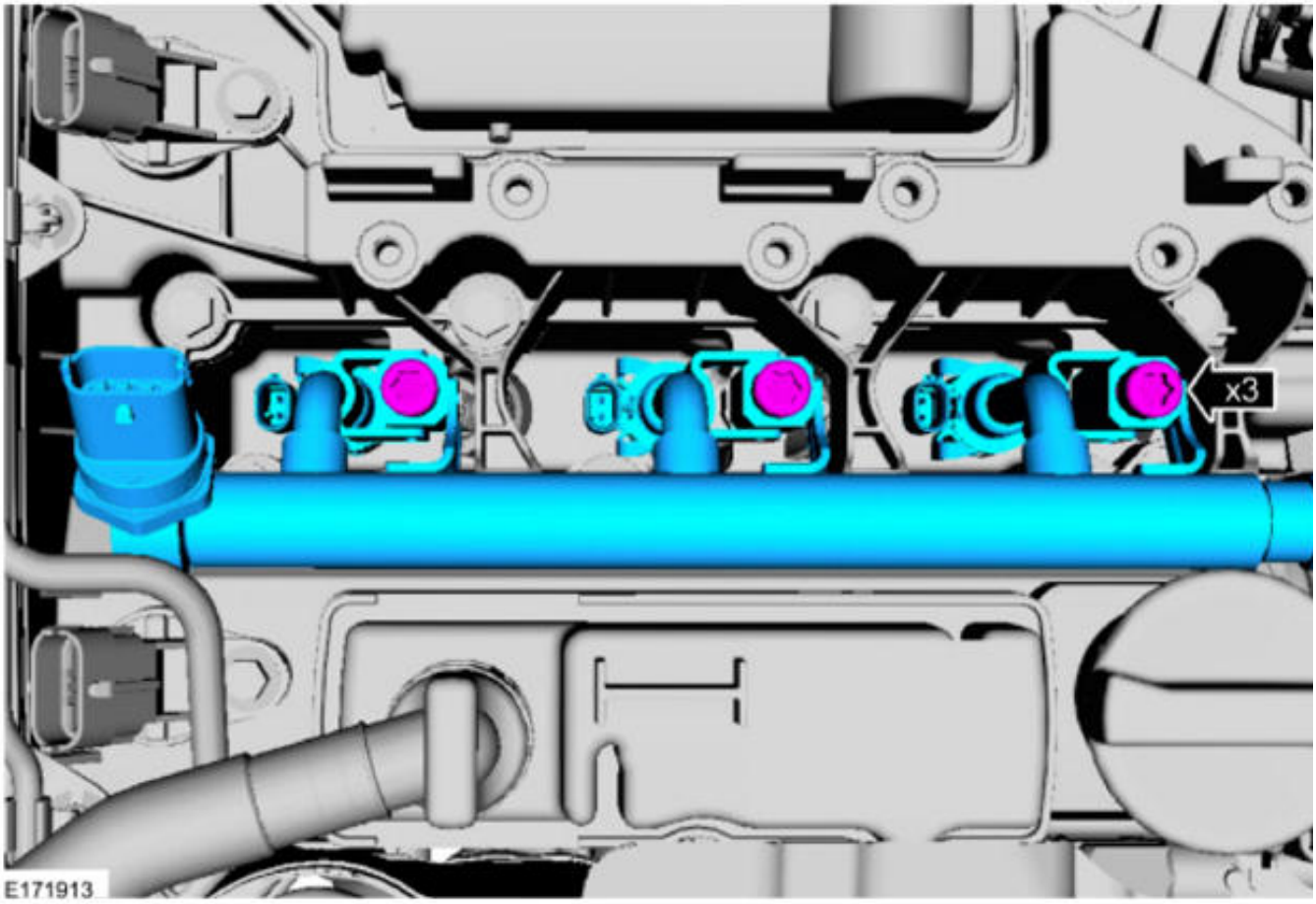


34. **NOTE: Pull out the fuel rails in the direction of the fuel injector axis or damage may occur to the fuel injectors.**

NOTE: Use regulated low pressure compressed air to remove any dirt or foreign material from the cylinder head, block and general surrounding area of the fuel rail and the fuel injectors.

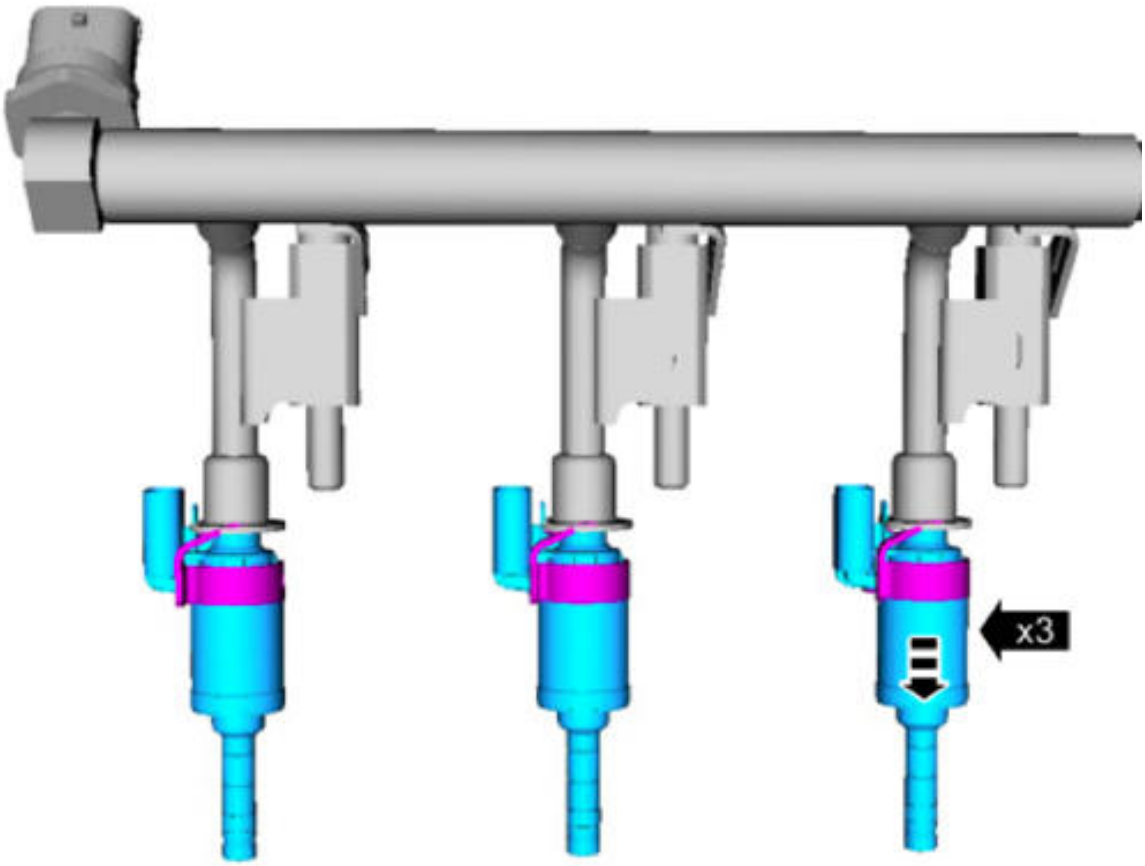
NOTE: When removing the fuel rails, the fuel injectors may remain in the cylinder head and require the use of a Fuel Injector Remover tool to extract.



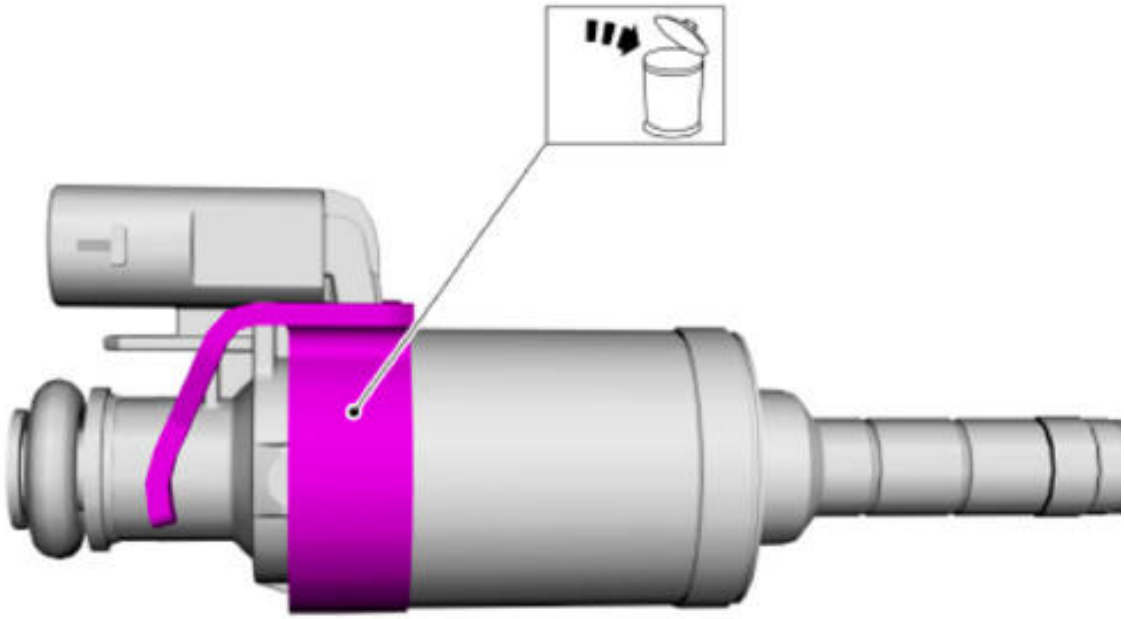
35. **NOTE: Take extra care when handling the components.**

NOTE: Make sure that the component is clean, free of foreign material and lubricant.

NOTE: Only use moderate force.

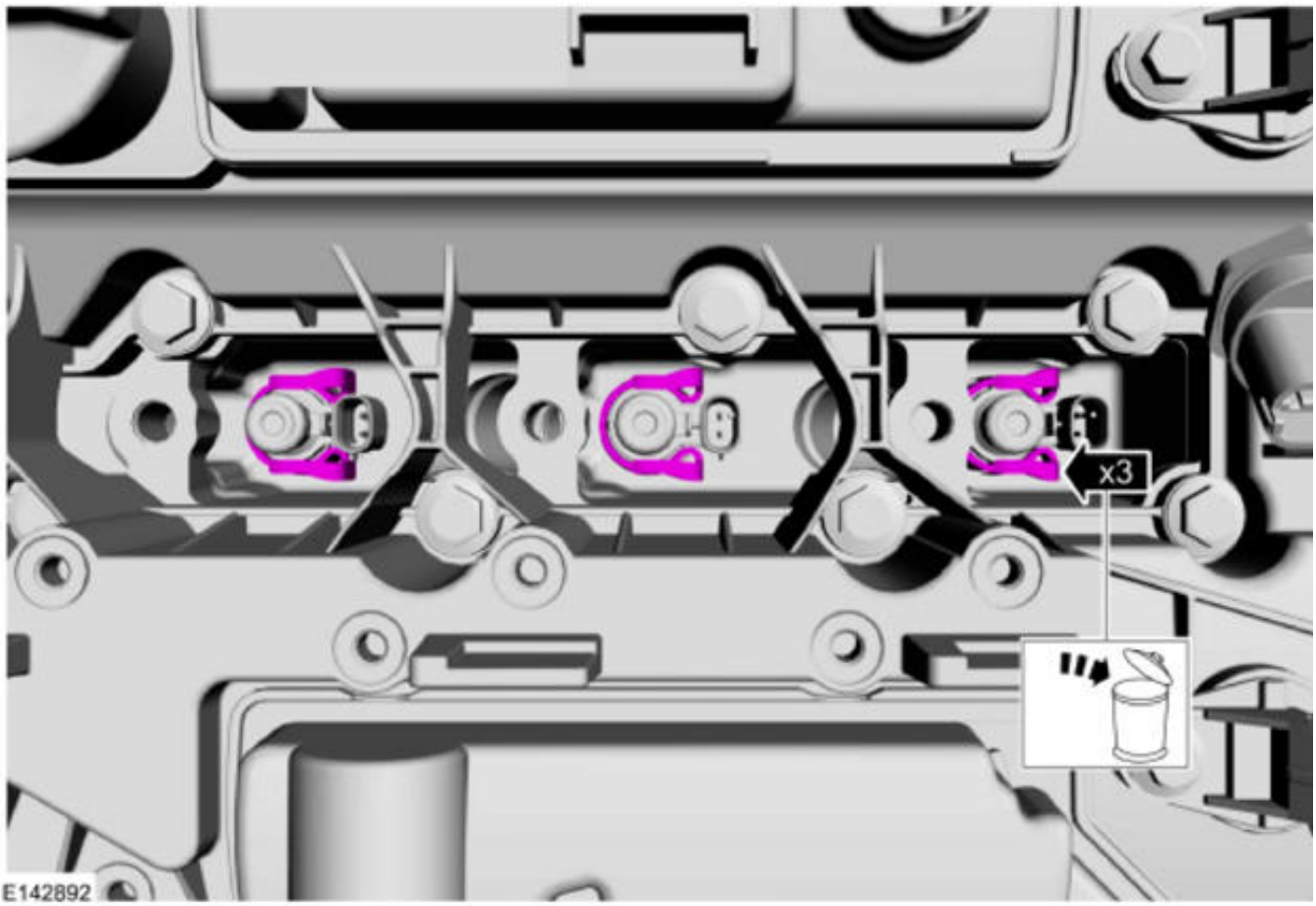


36. **NOTE: Take extra care when handling the components**



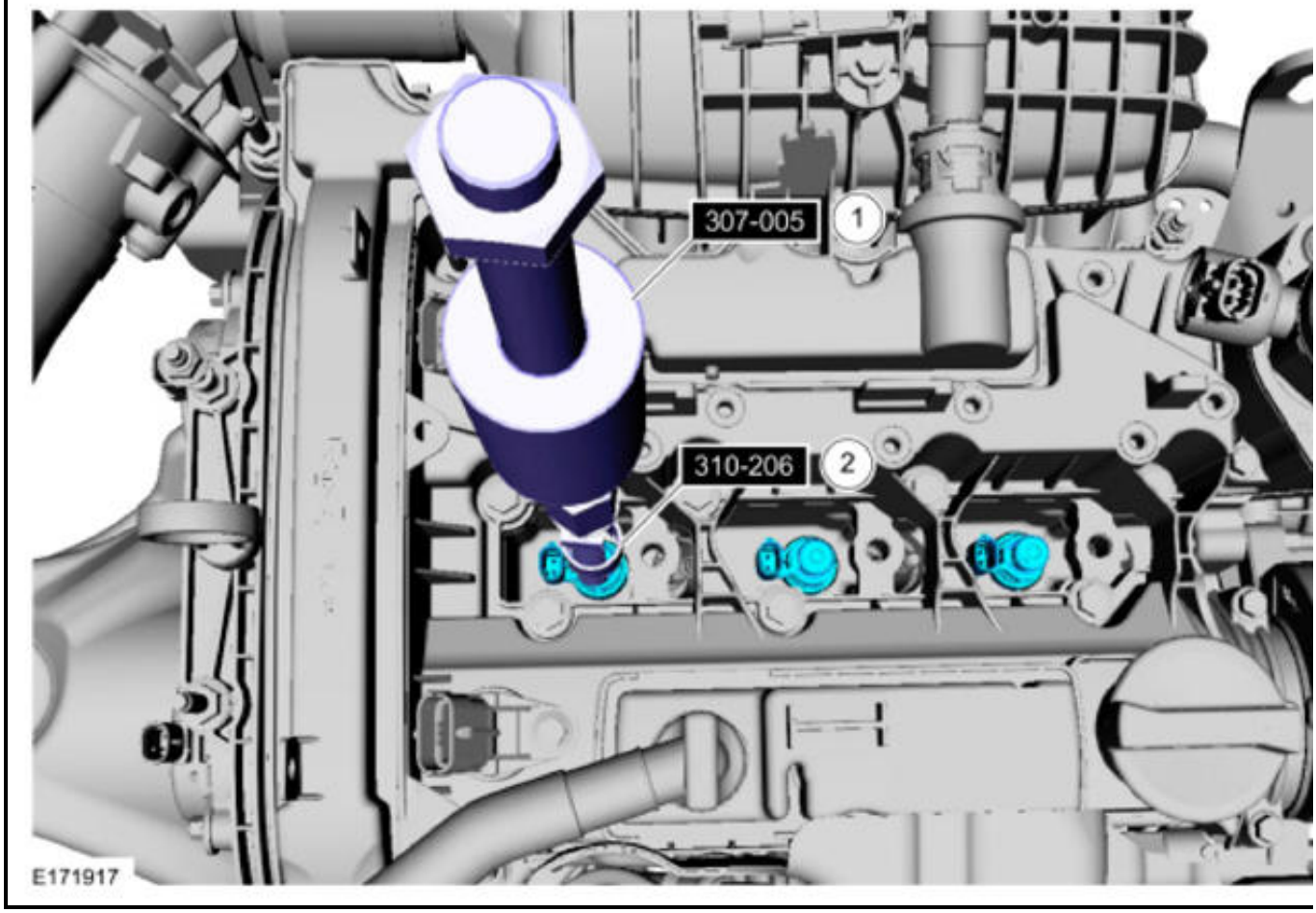
E142883

37. **NOTE: This step is only necessary if the component remains in the cylinder head.**



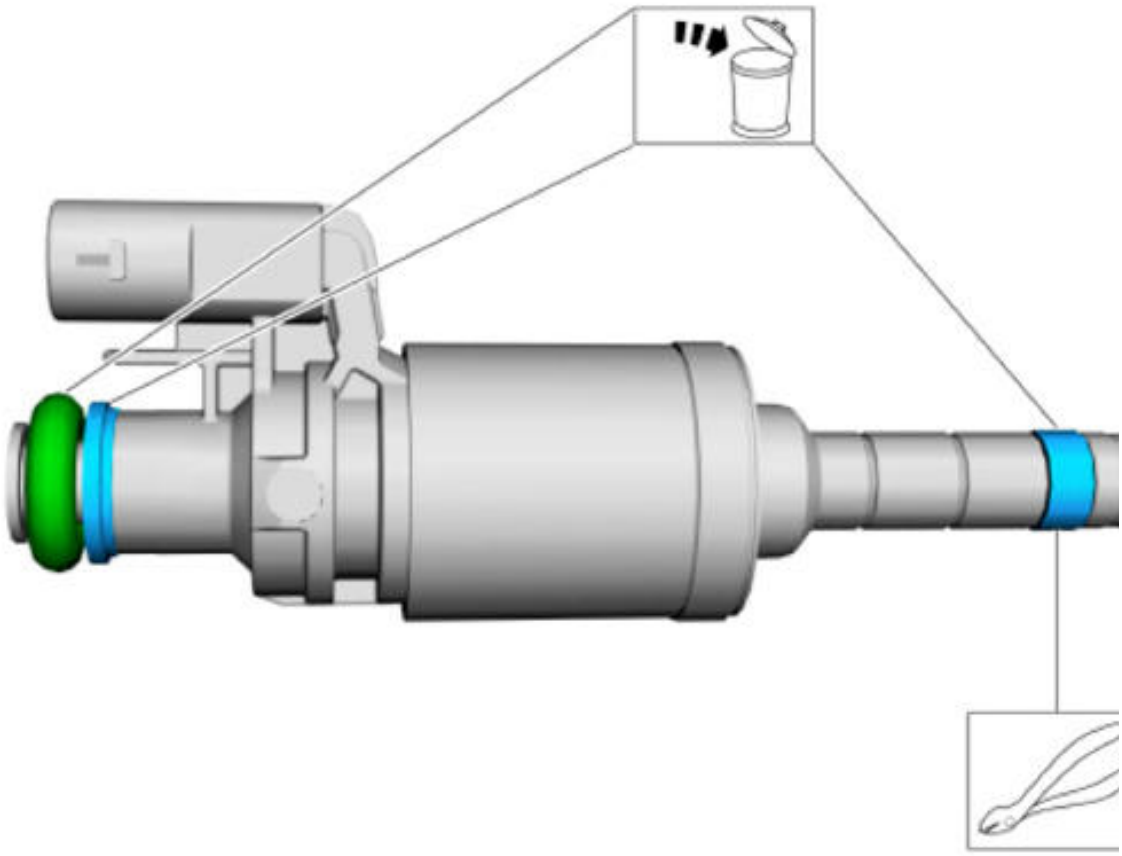
38. **NOTE: This step is only necessary if the component remains in the cylinder head.**

Use Special Service Tool: **307-005 (T59L-100-B) Slide Hammer** , **310-206 Remover, Fuel Injector** .



39. **NOTE:** **Take extra care when handling the components**

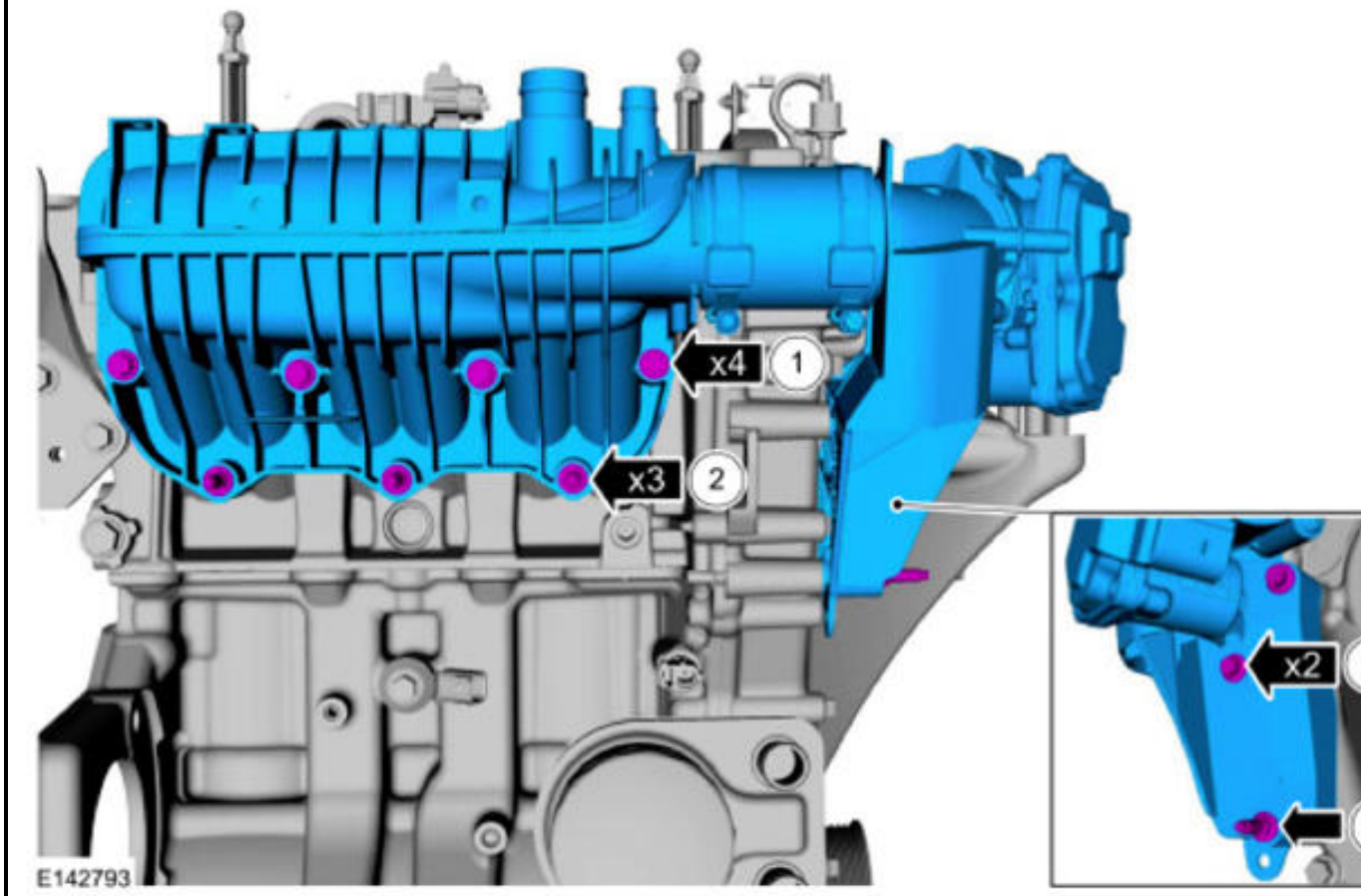
NOTE: **Make sure that the component is clean, free of foreign material and lubricant.**



E142884

40.

40.



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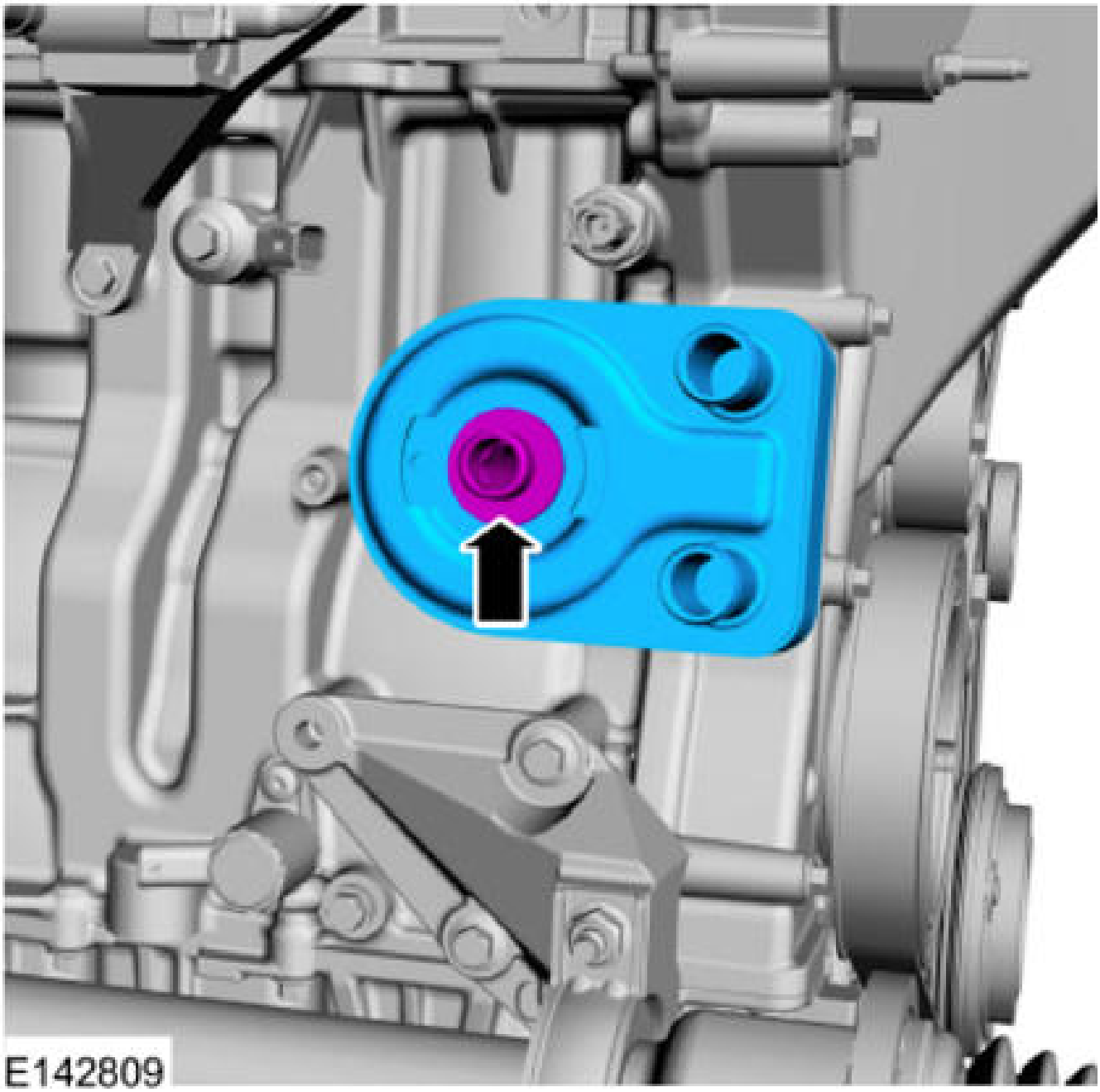
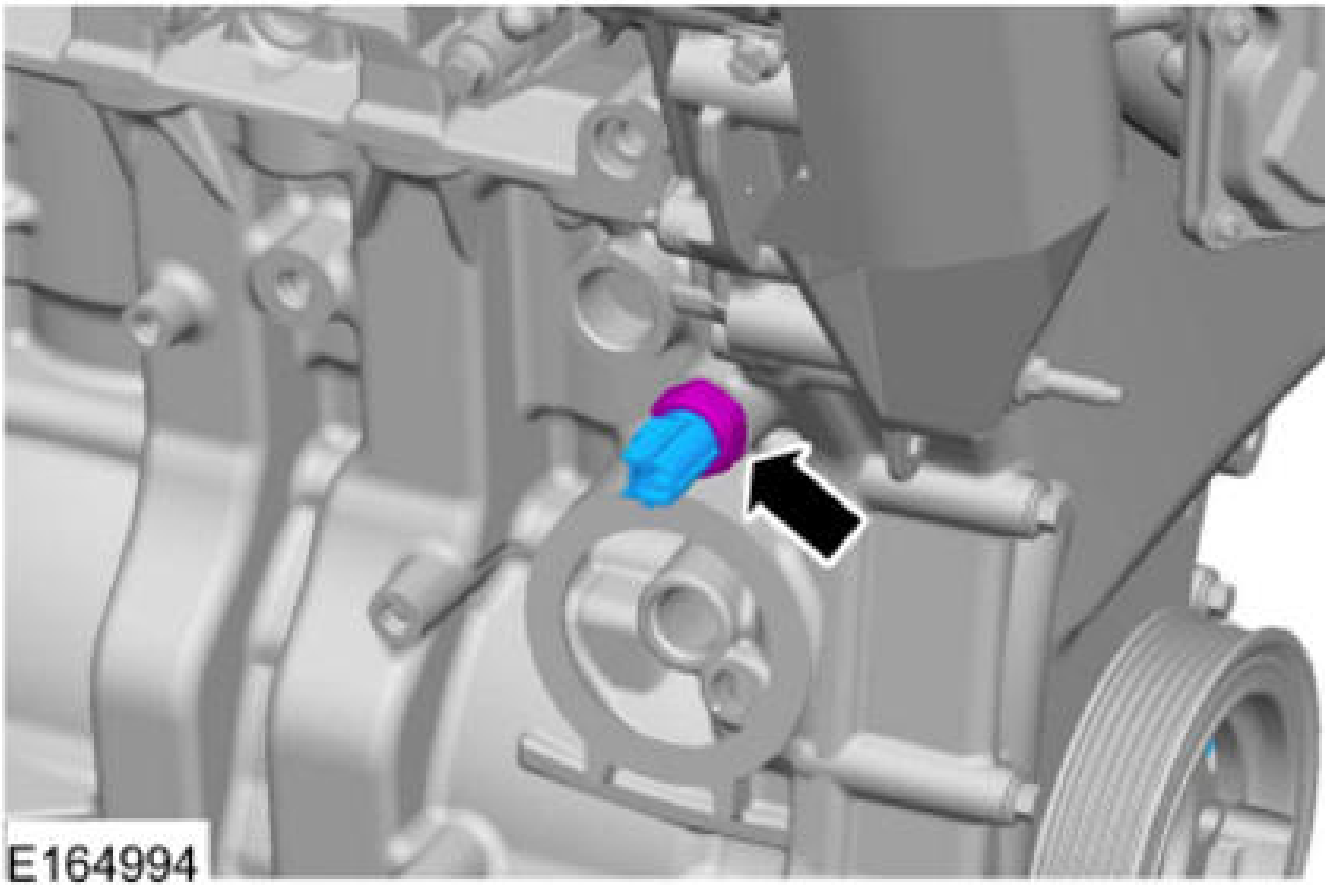
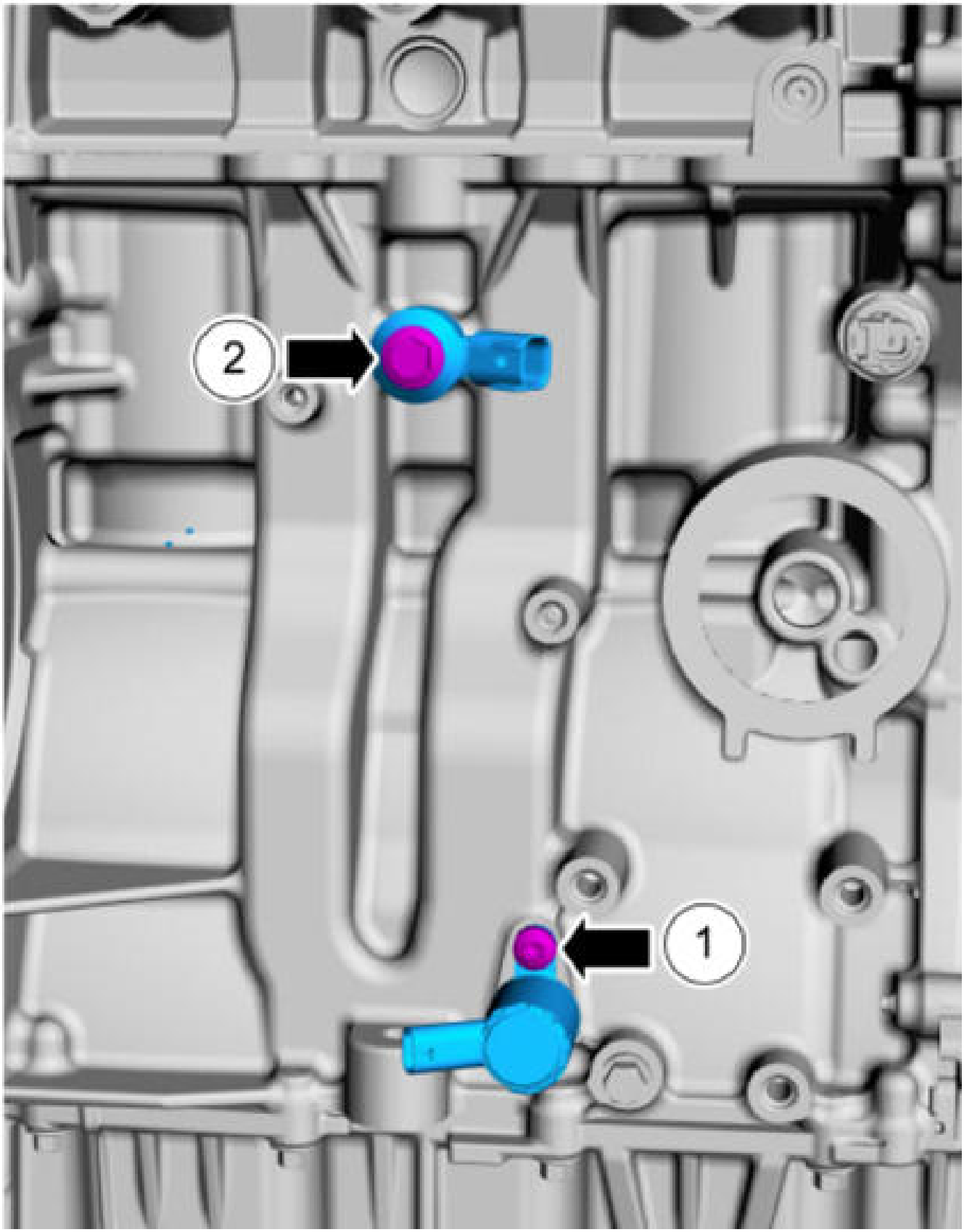
41.



42.

42. 

43. **NOTE: Note the position of the components before removal.**



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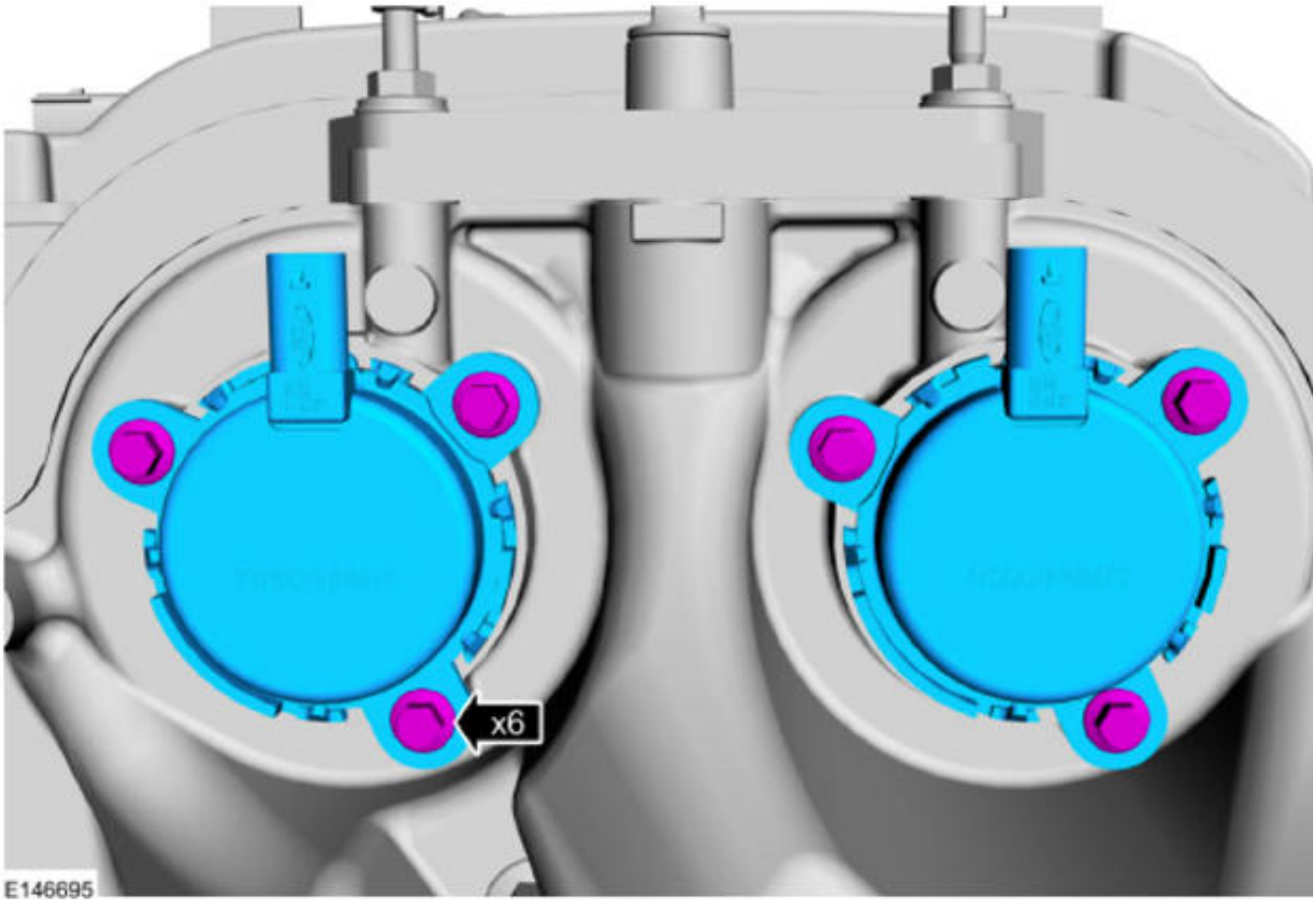
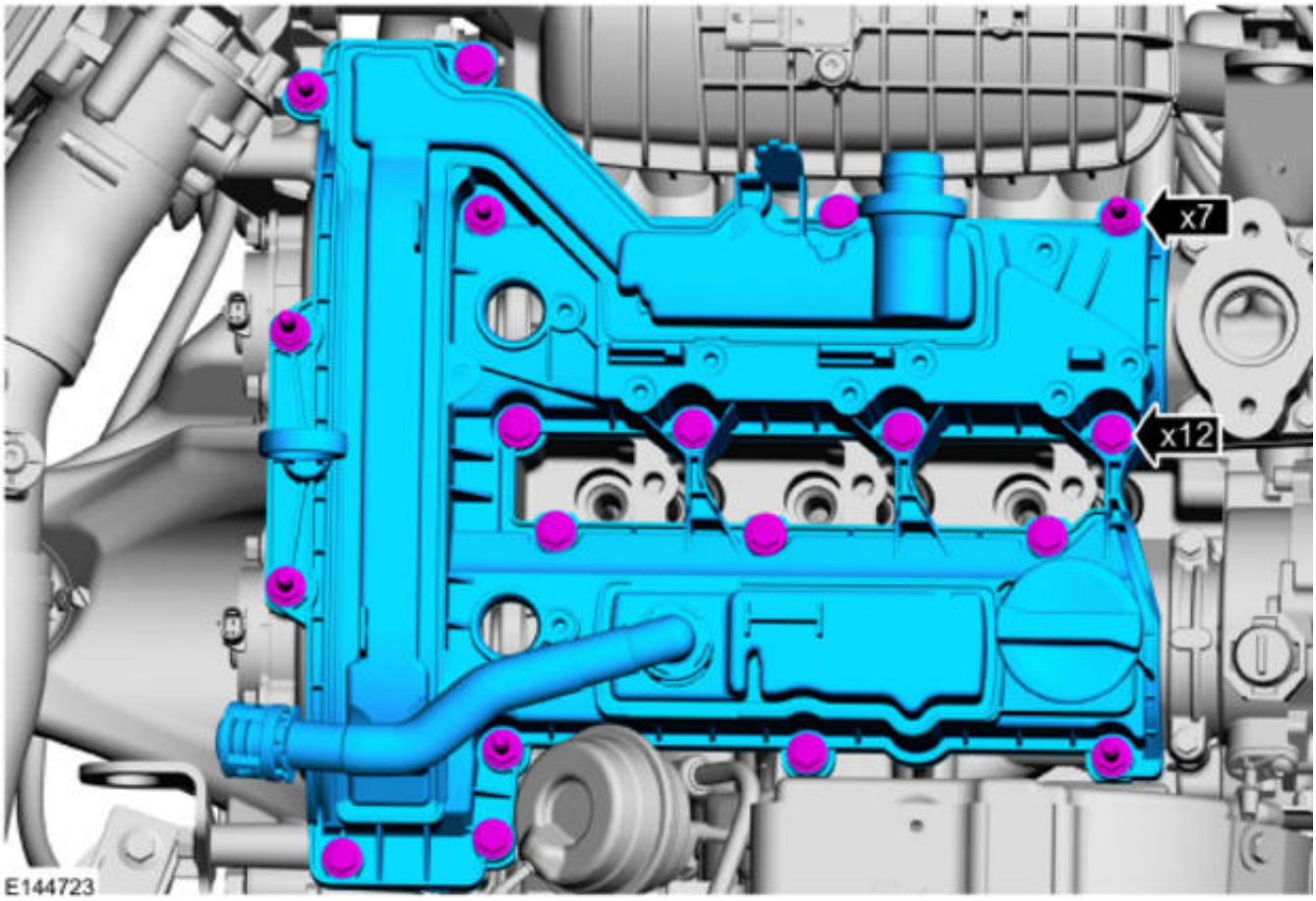
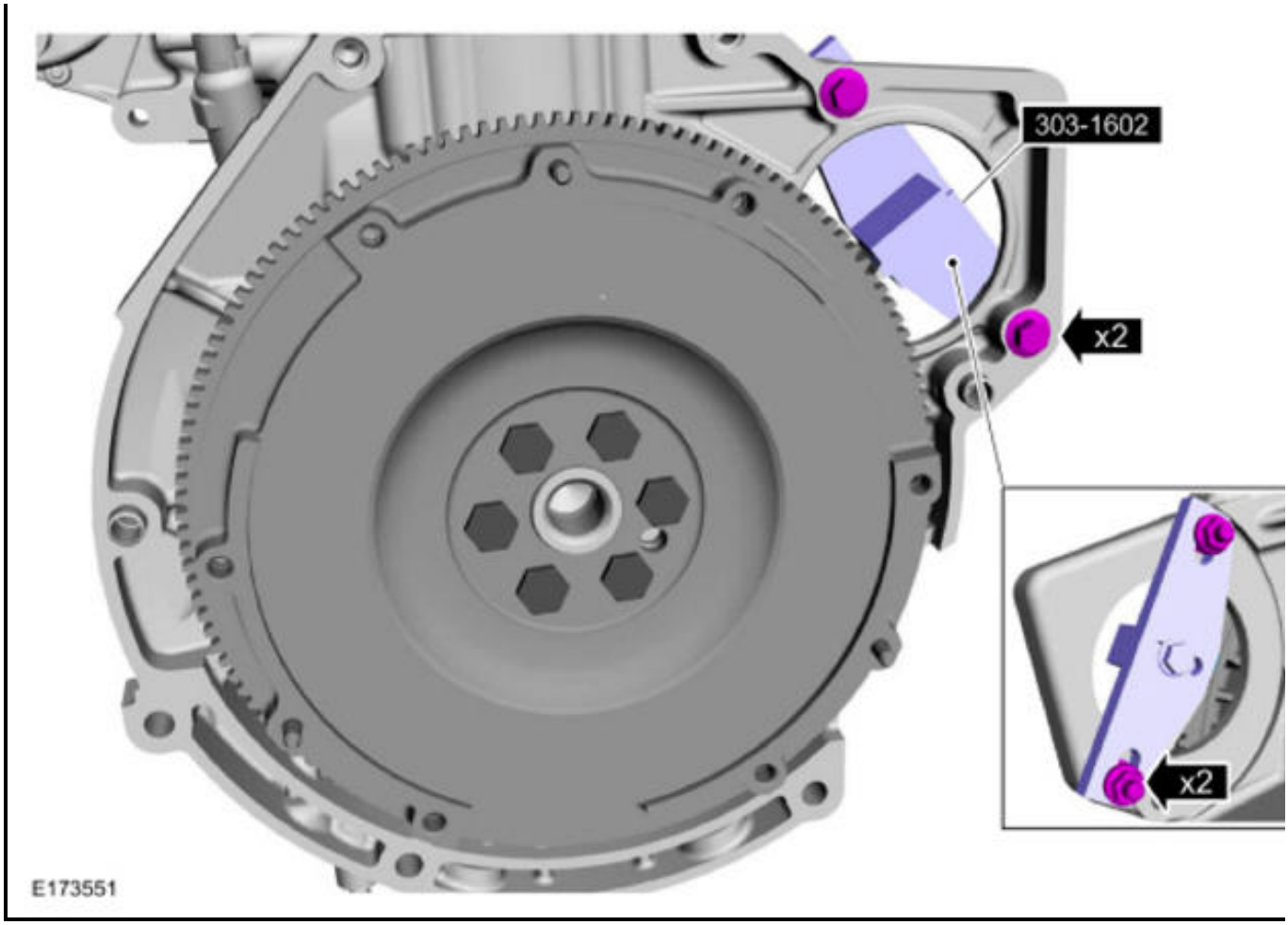


45.

45.



46. Use Special Service Tool: 303-1602 Locking Tool, Crankshaft.

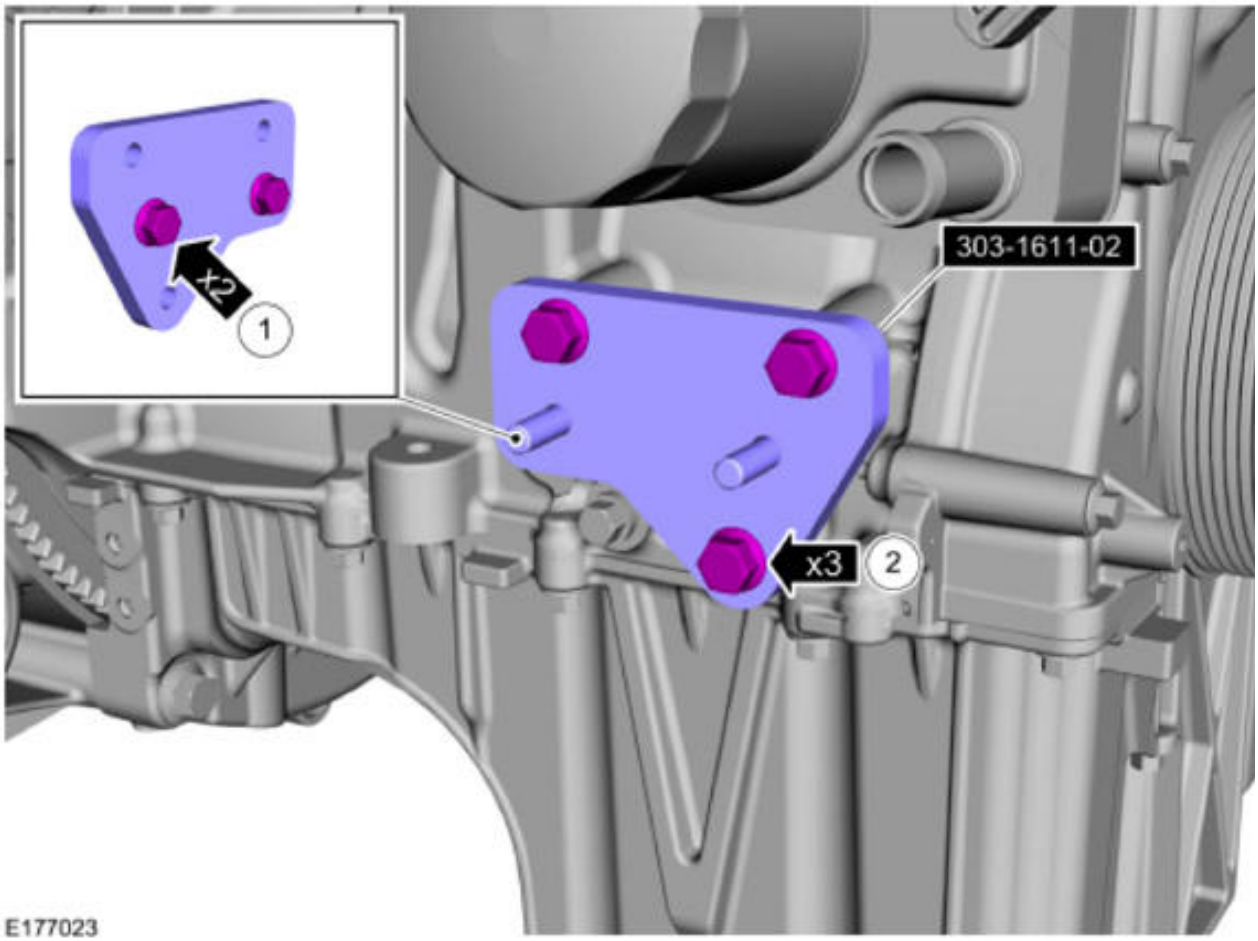


47.

1. M8x30
2. M8x25

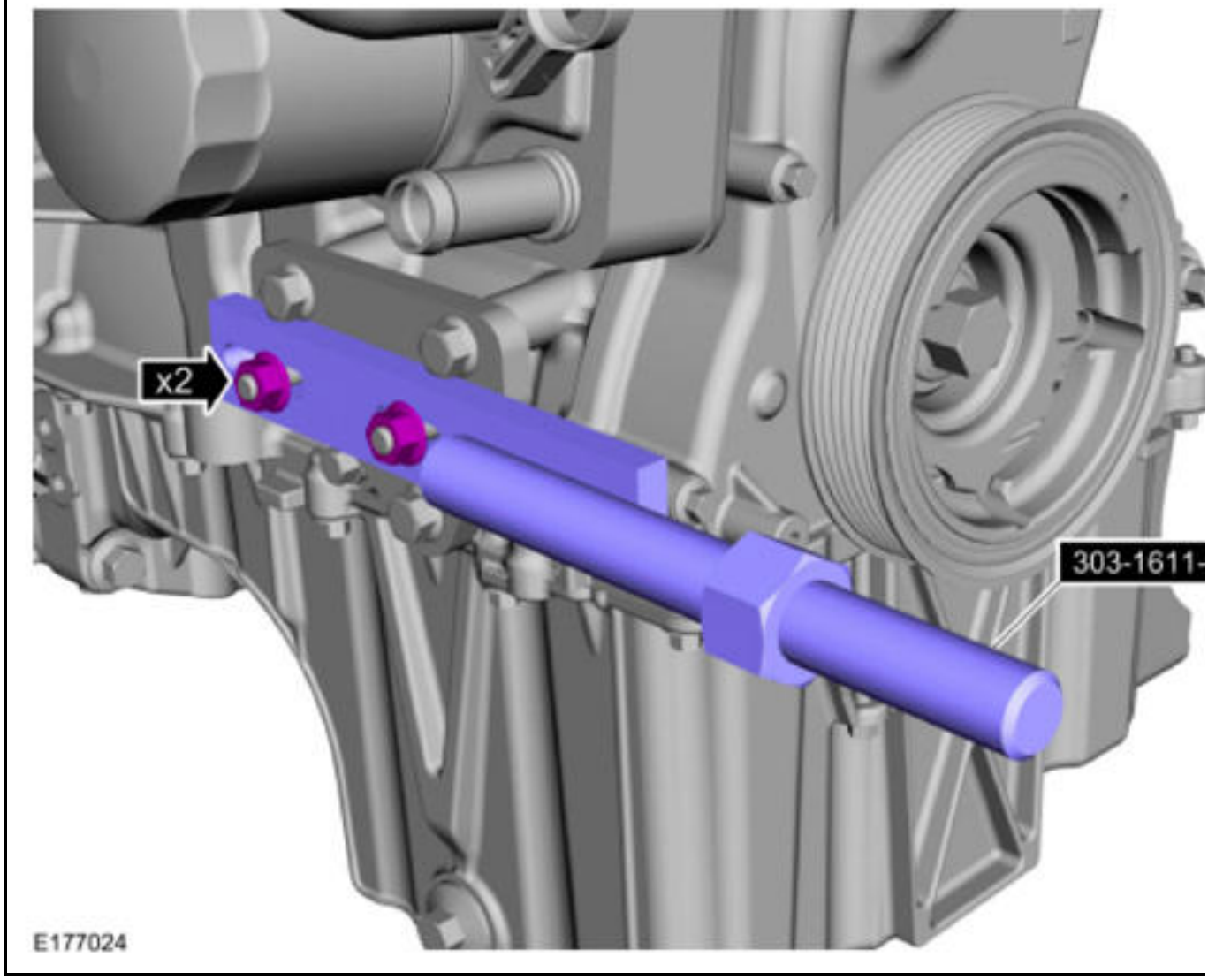
Install Special Service Tool: **303-1611-02 Adapter for 303-1611, Torque Multiplier** .

Torque : 18 lb.ft (24 Nm)



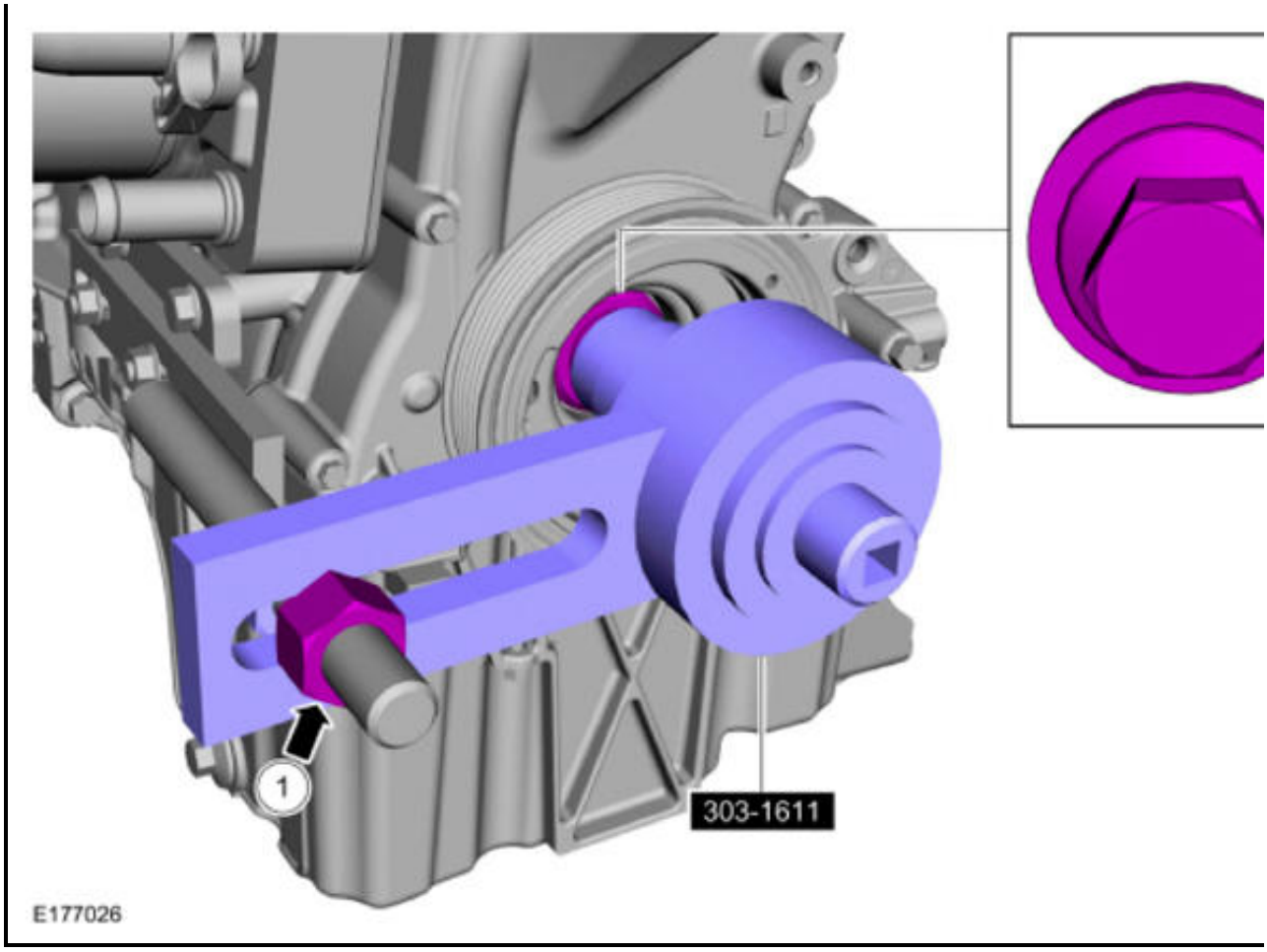
48. Install Special Service Tool: 303-1611-01 Adapter for 303-1611.

Torque : 18 lb.ft (24 Nm)



49. Install Special Service Tool: 303-1611 Torque Multiplier.
50.
    1. Only tighten the nut finger tight at this stage.
    2. Loosen:

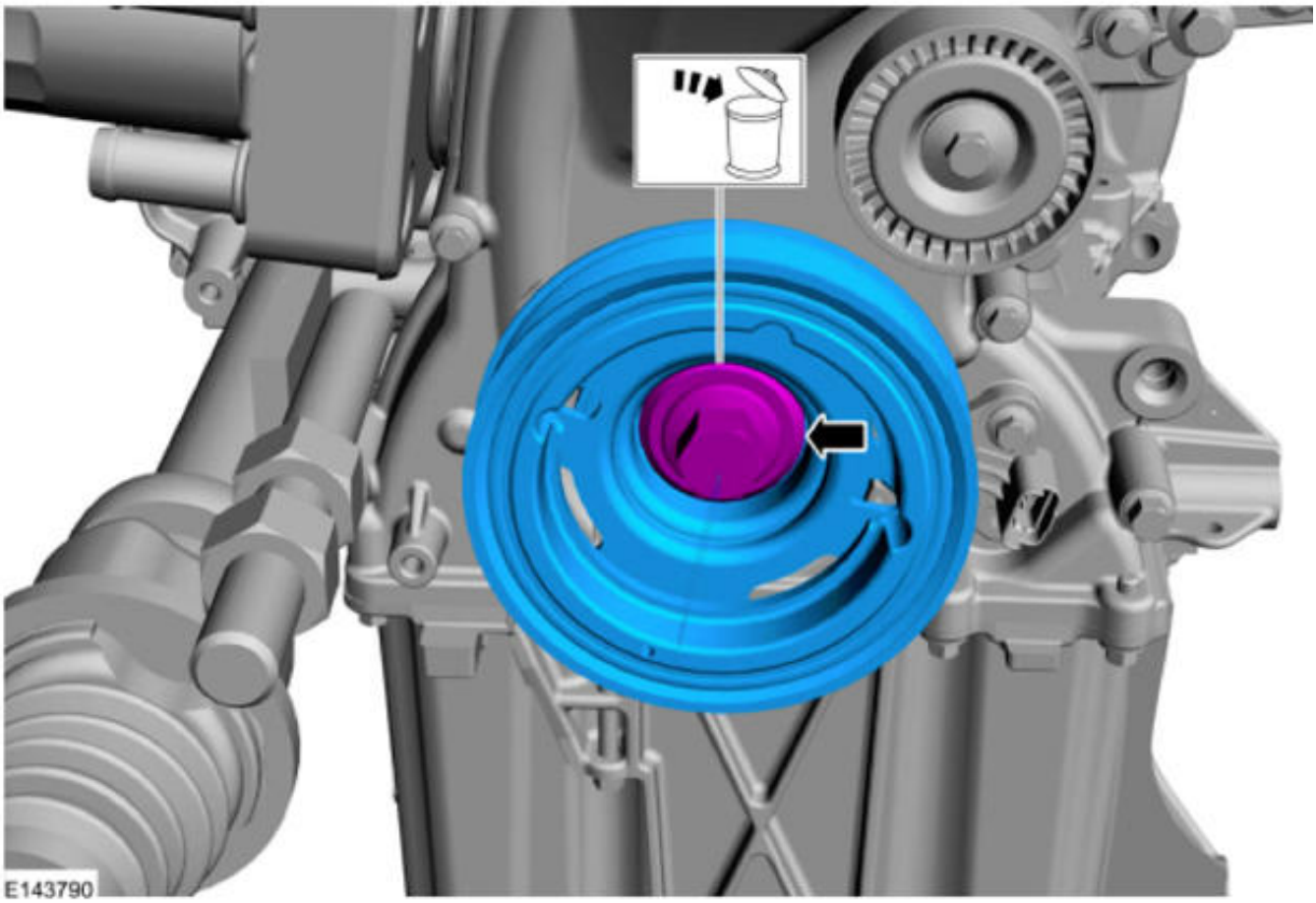
    : 5 turn(s)



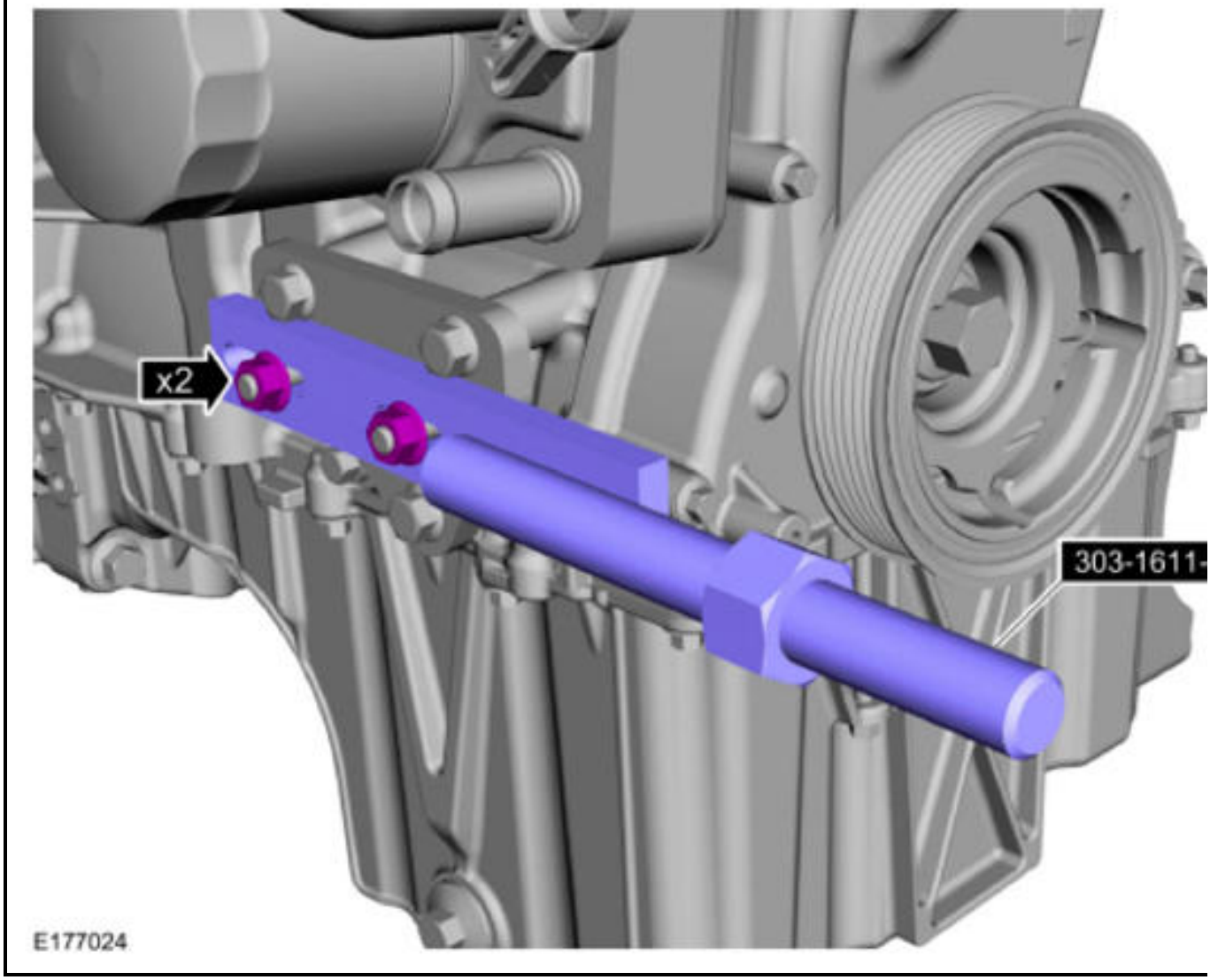
51. Remove Special Service Tool: 303-1611 Torque Multiplier.

52.

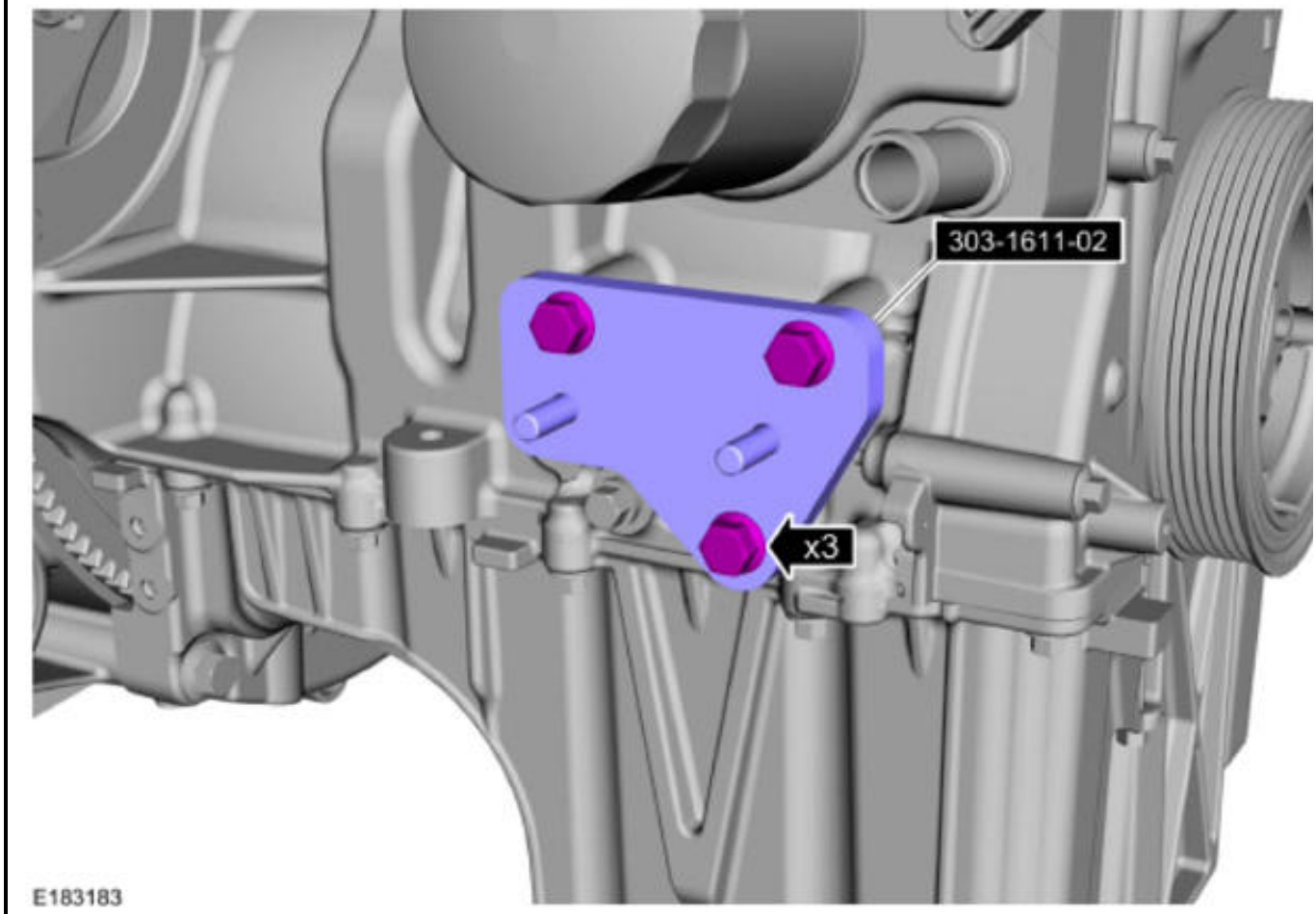
52.



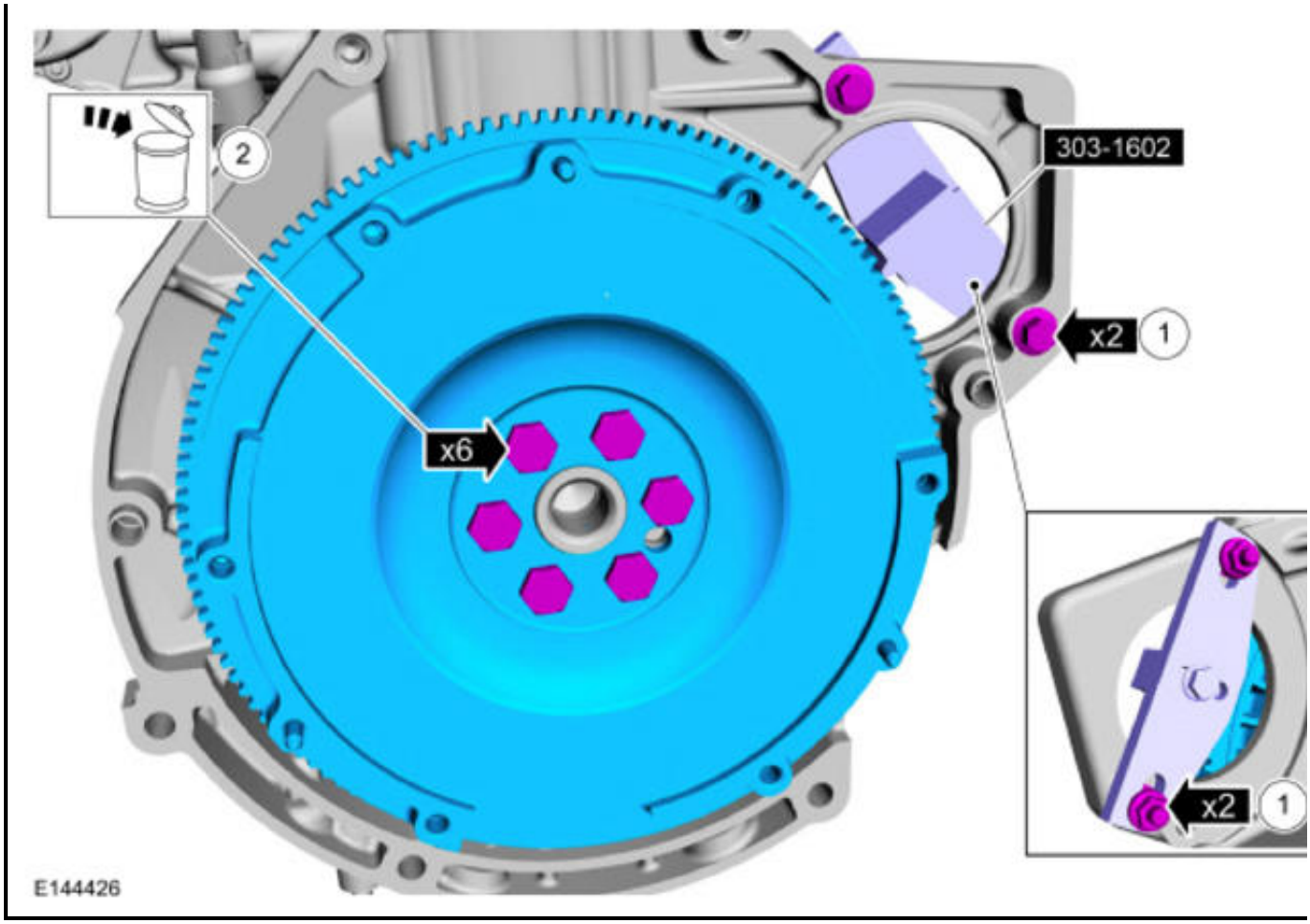
53. Remove Special Service Tool: 303-1611-01 Adapter for 303-1611.



54. Remove Special Service Tool: **303-1611-02 Adapter for 303-1611, Torque Multiplier** .

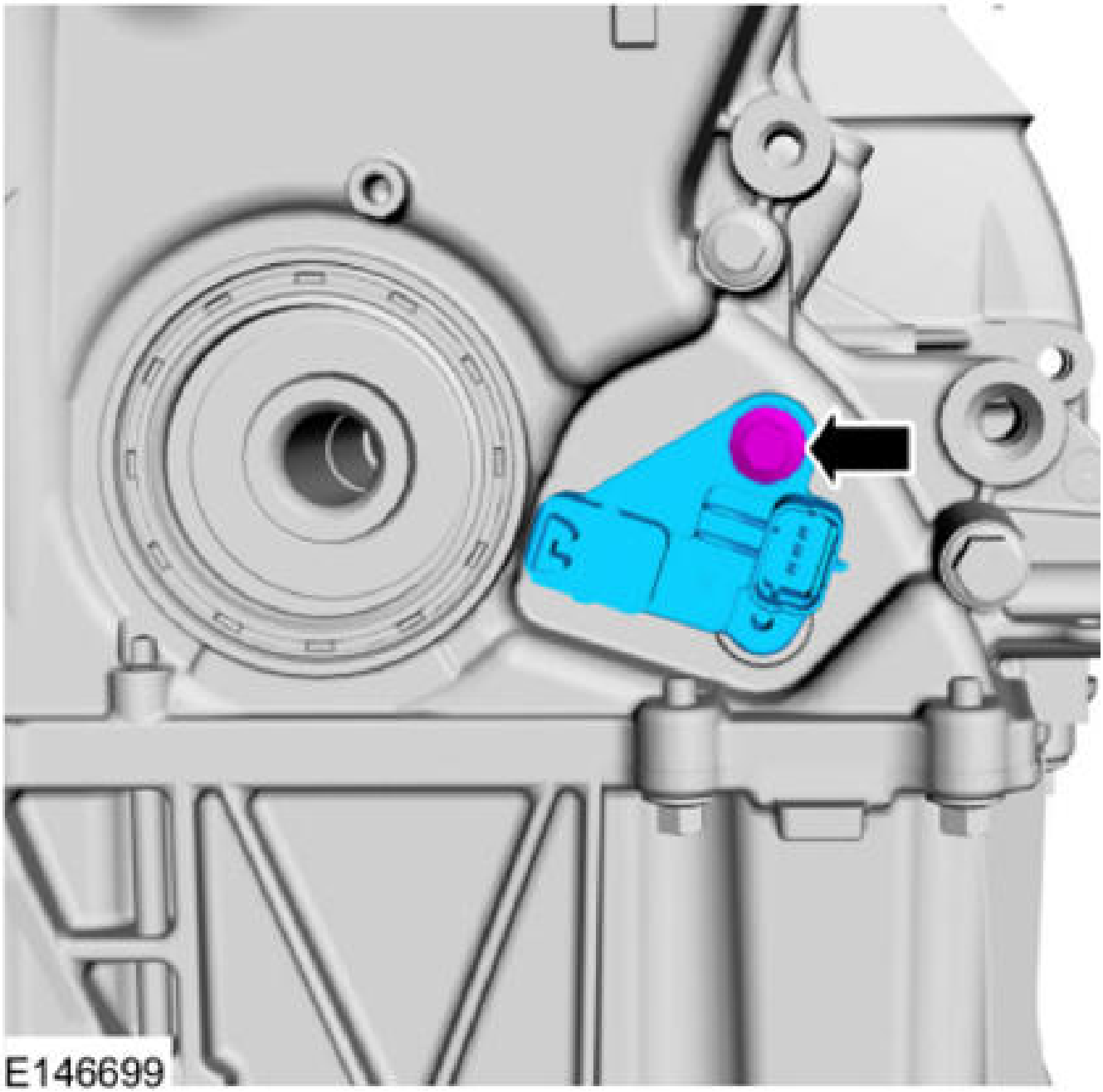


55. Use Special Service Tool: 303-1602 Locking Tool, Crankshaft.



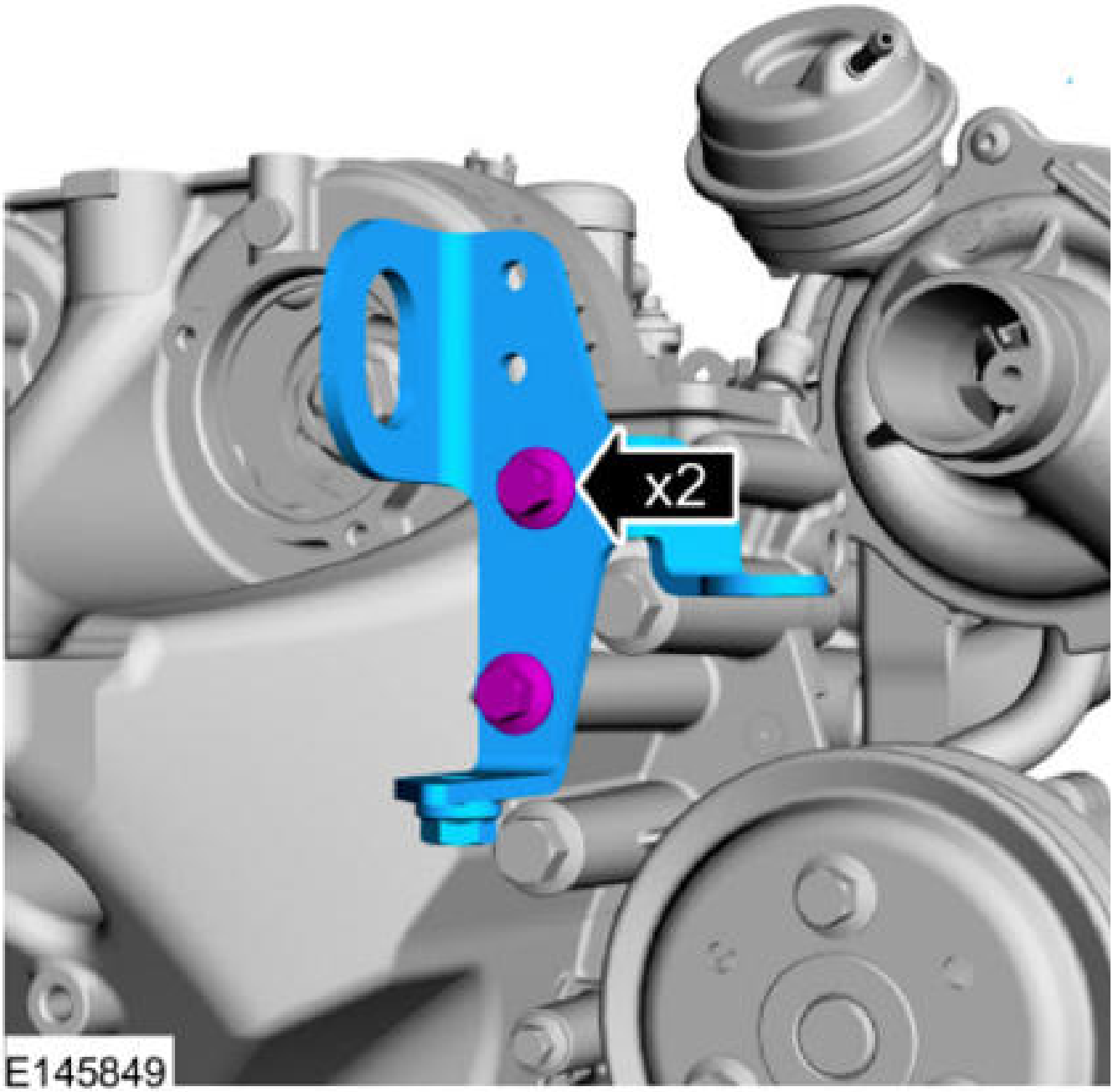
56.

56.

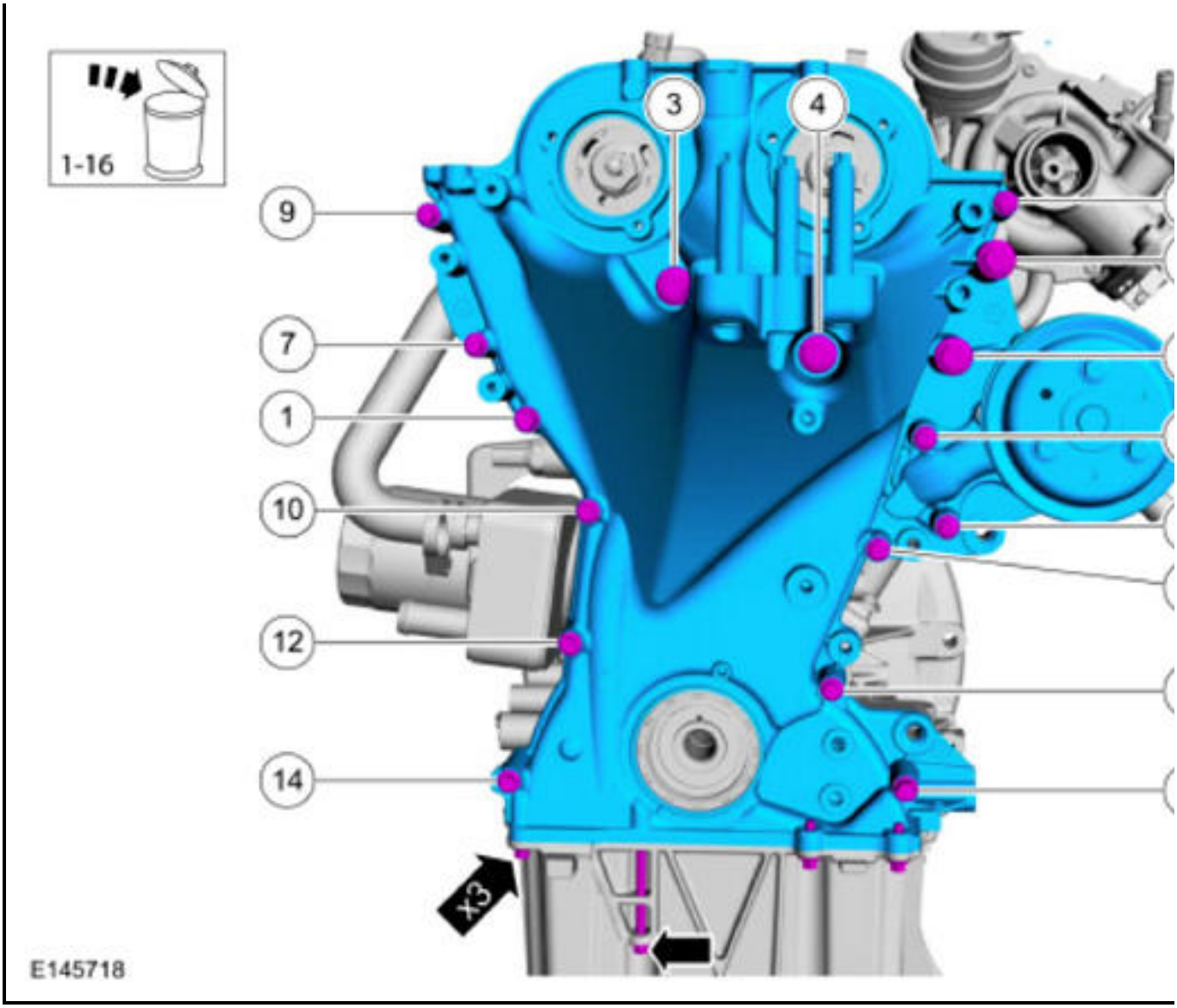


57.

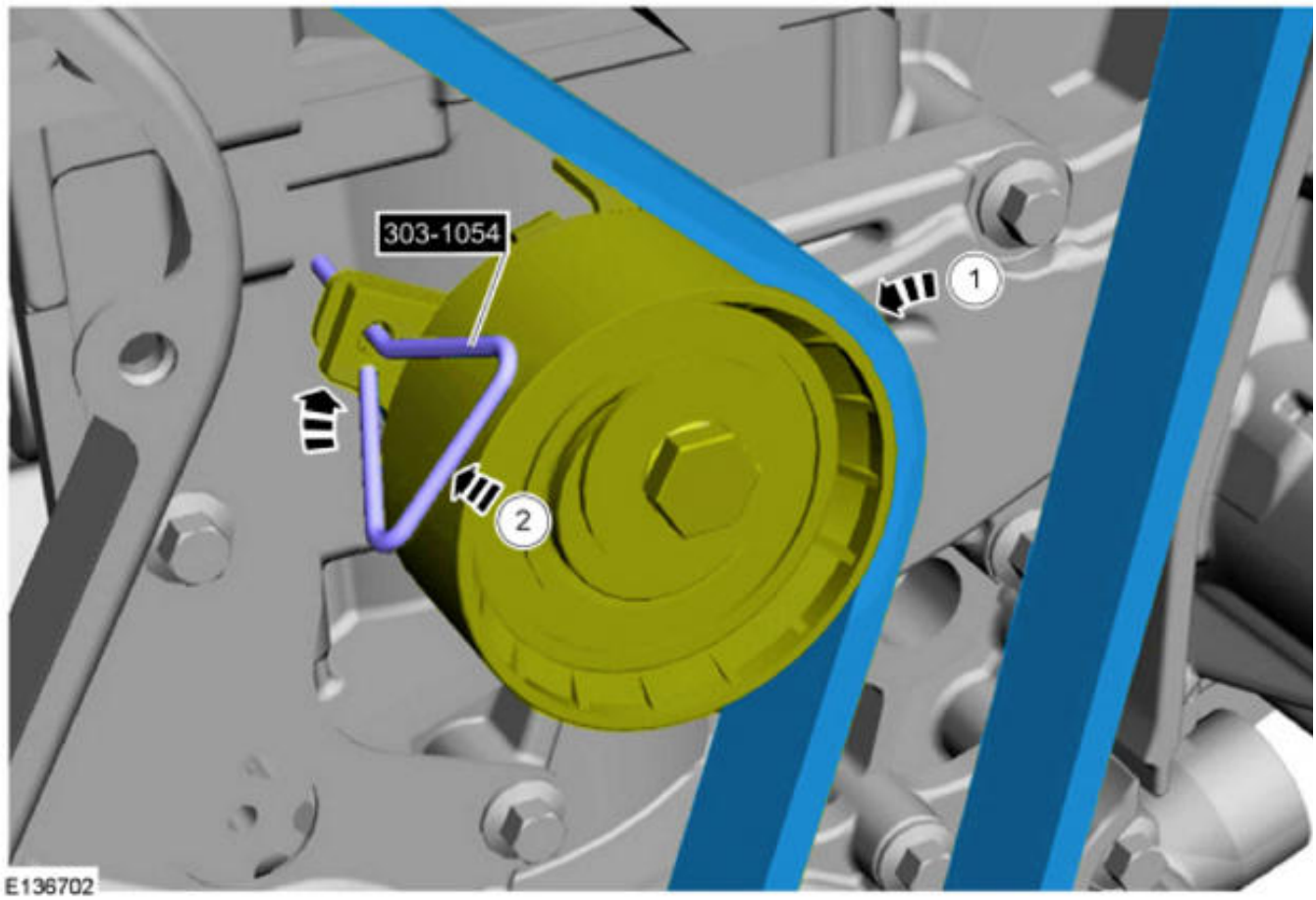
57.



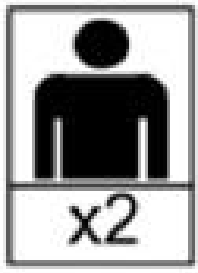
58. **NOTE:** **Note the different lengths of the bolts.**

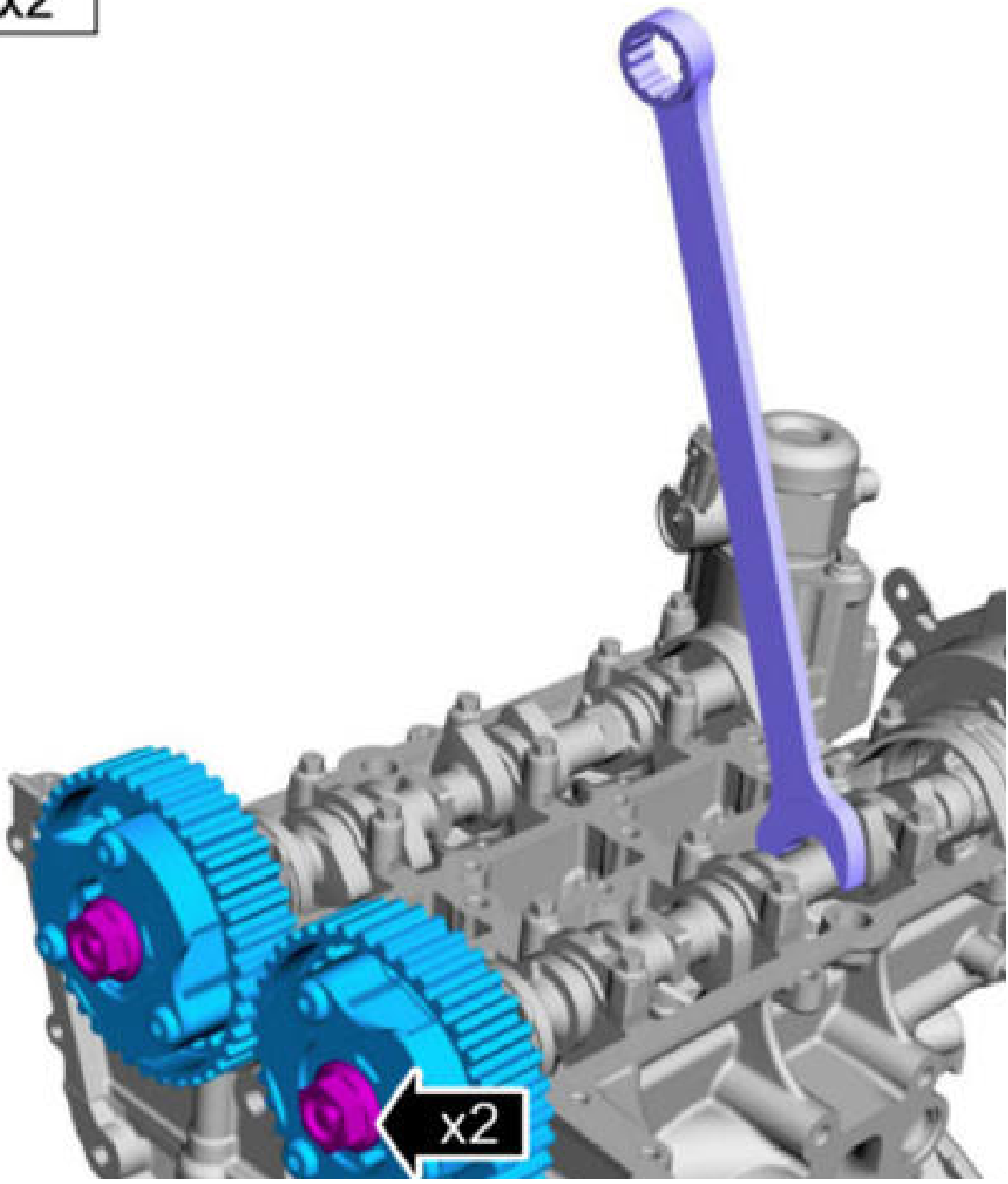


59. Install Special Service Tool: 303-1054 Locking Tool, Timing Belt Tensioner.

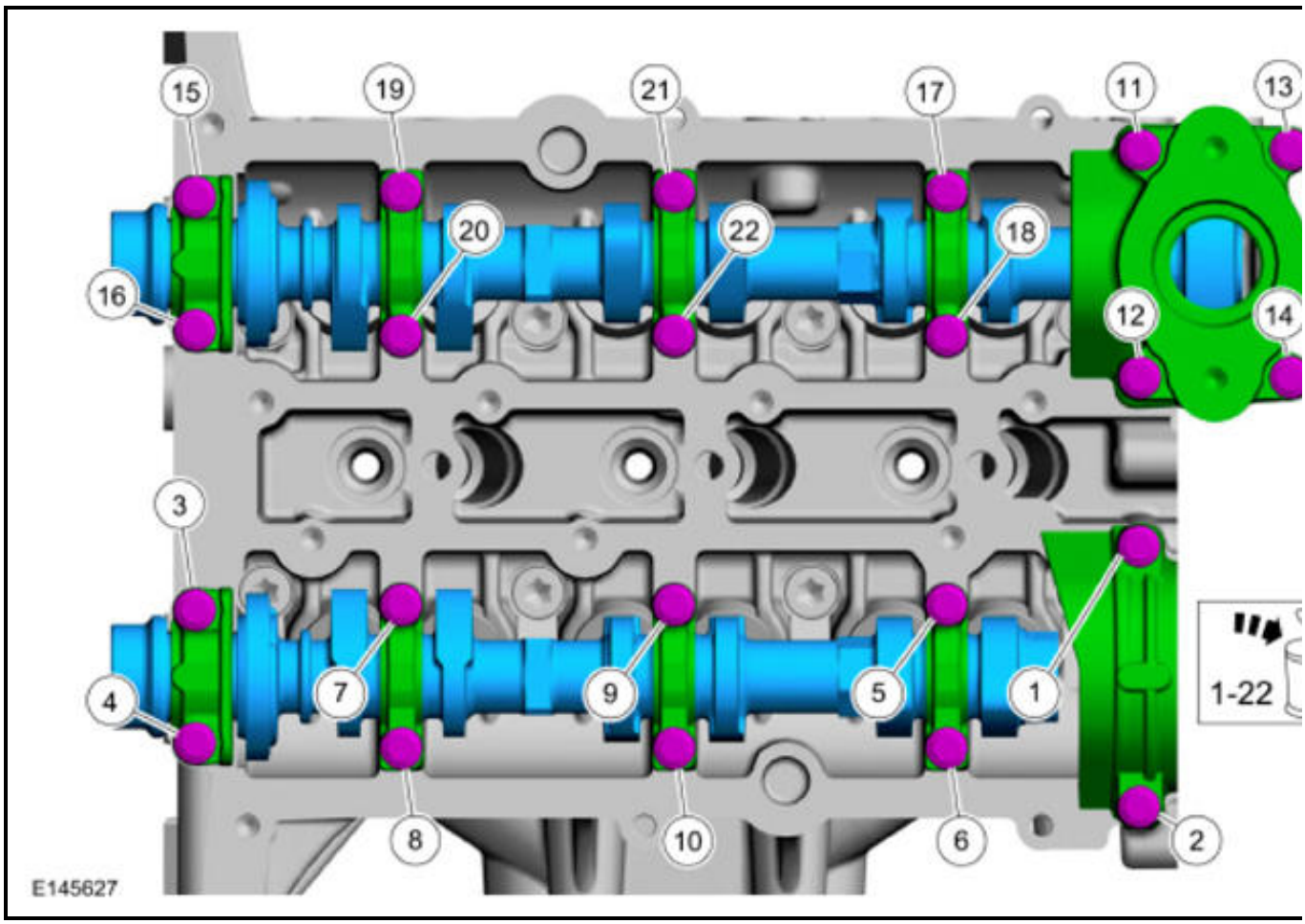


60. **NOTE: Use an open-ended wrench to prevent the component from turning.**

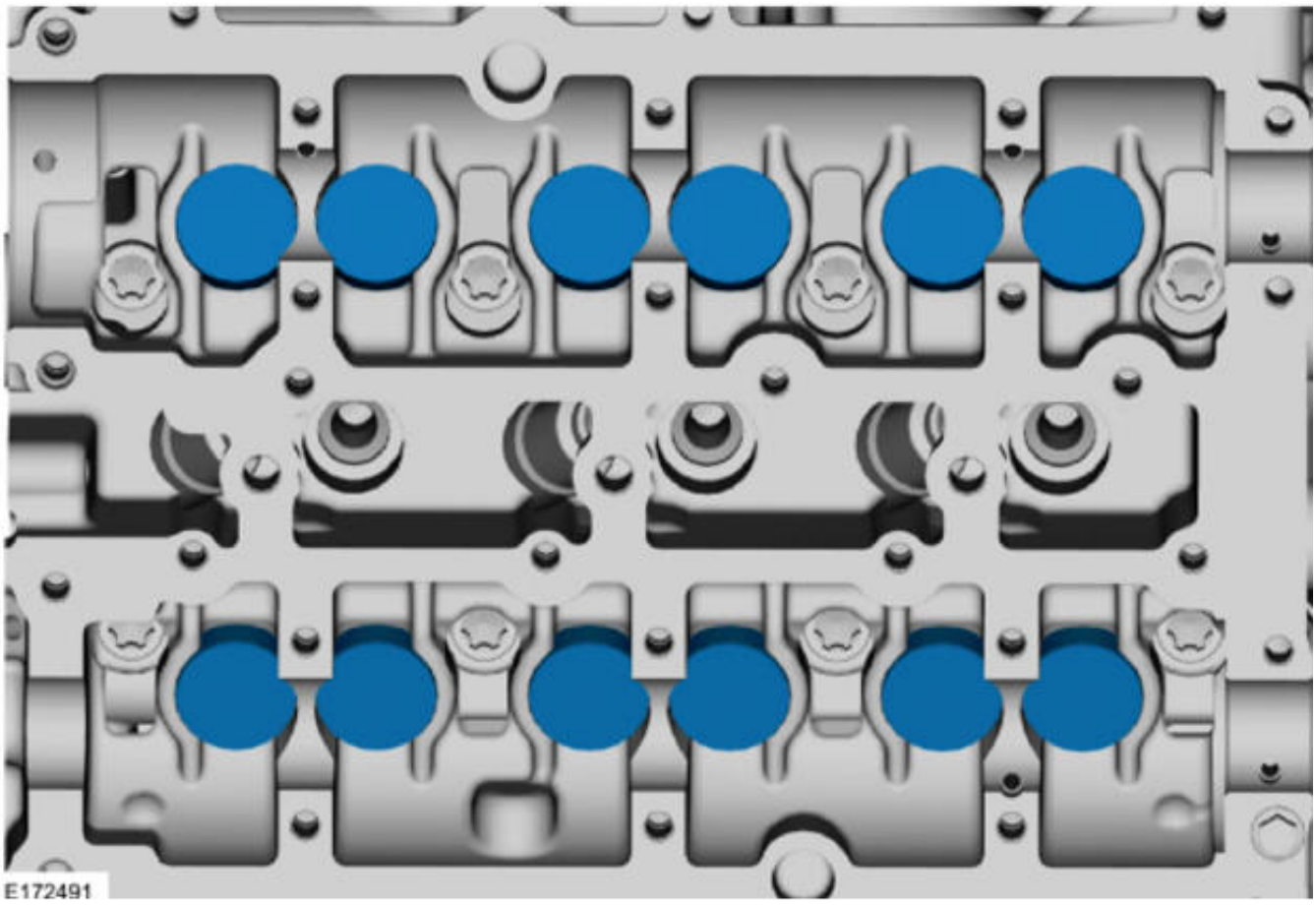




61. **NOTE: Note the position of the components before removal.**

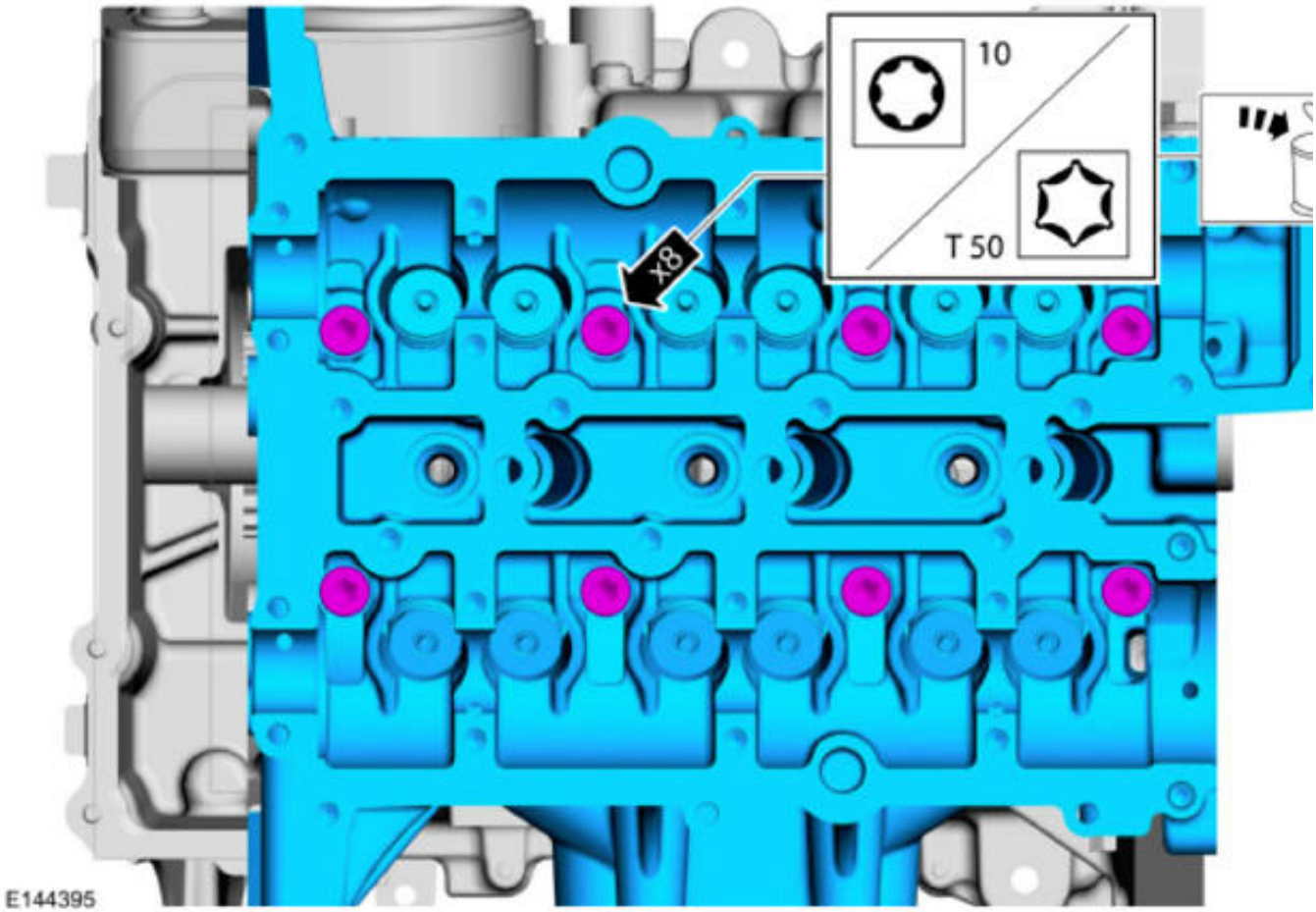


62. **NOTE: Note the position of the components before removal.**



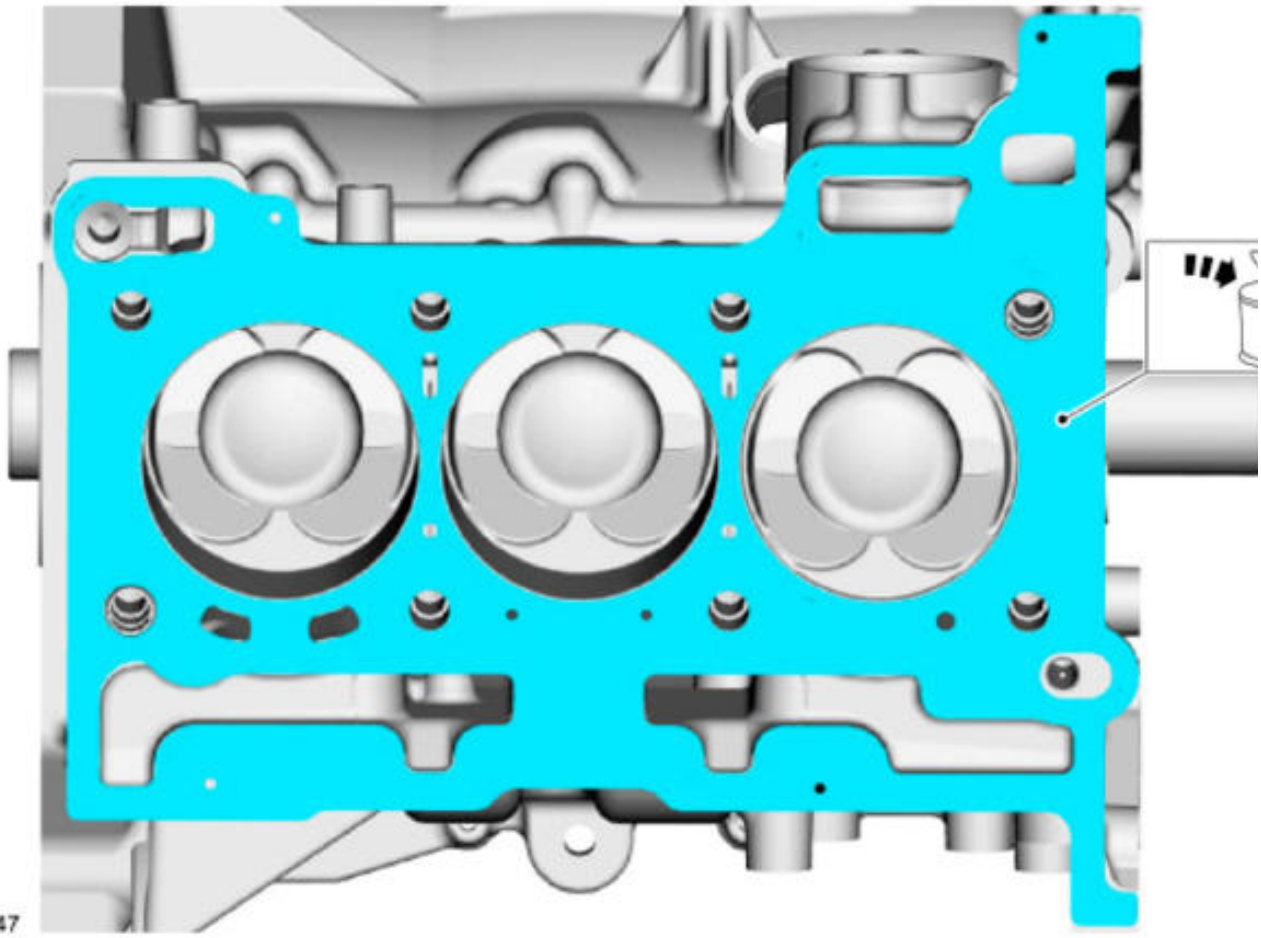
63.

63.

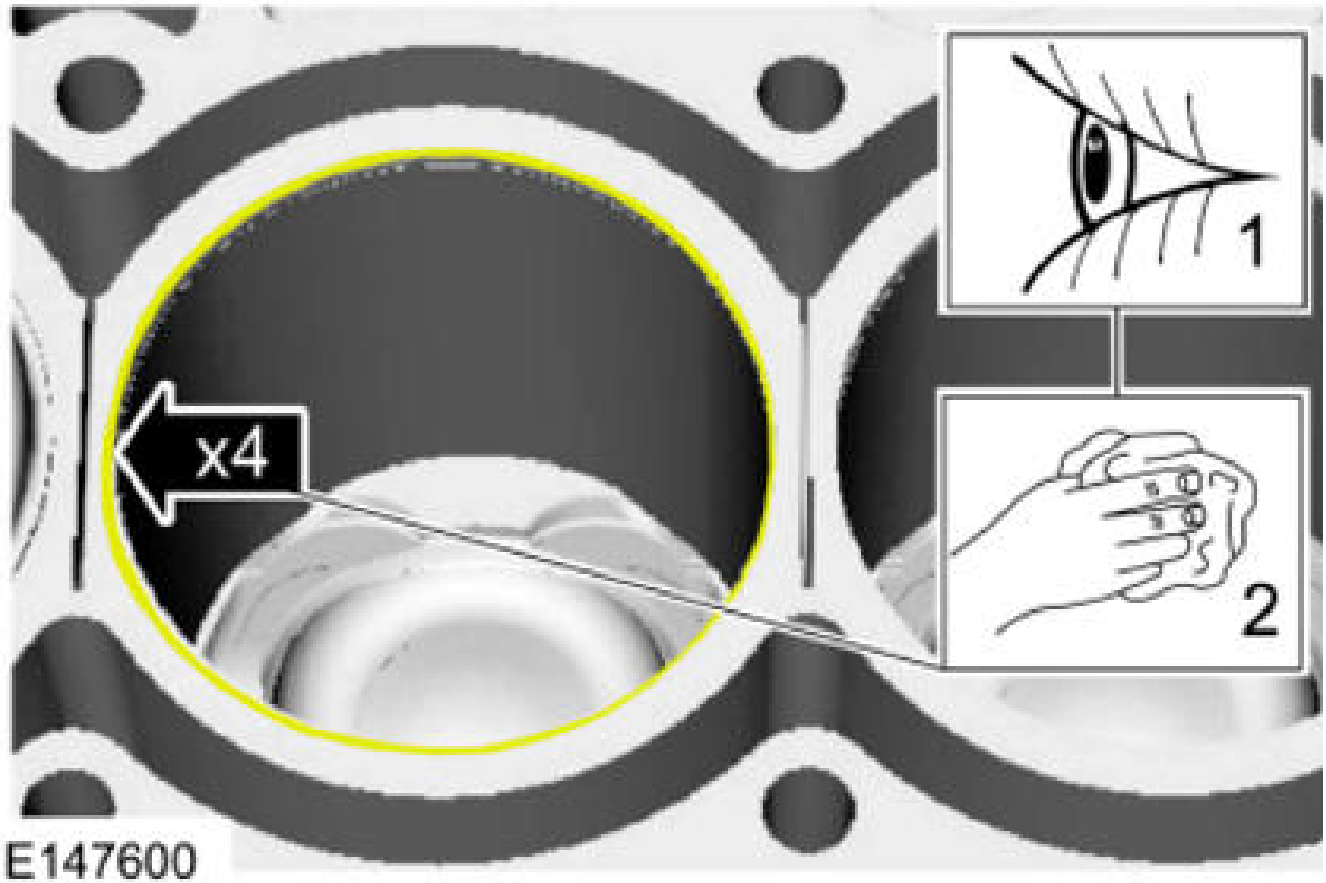


64.

64.

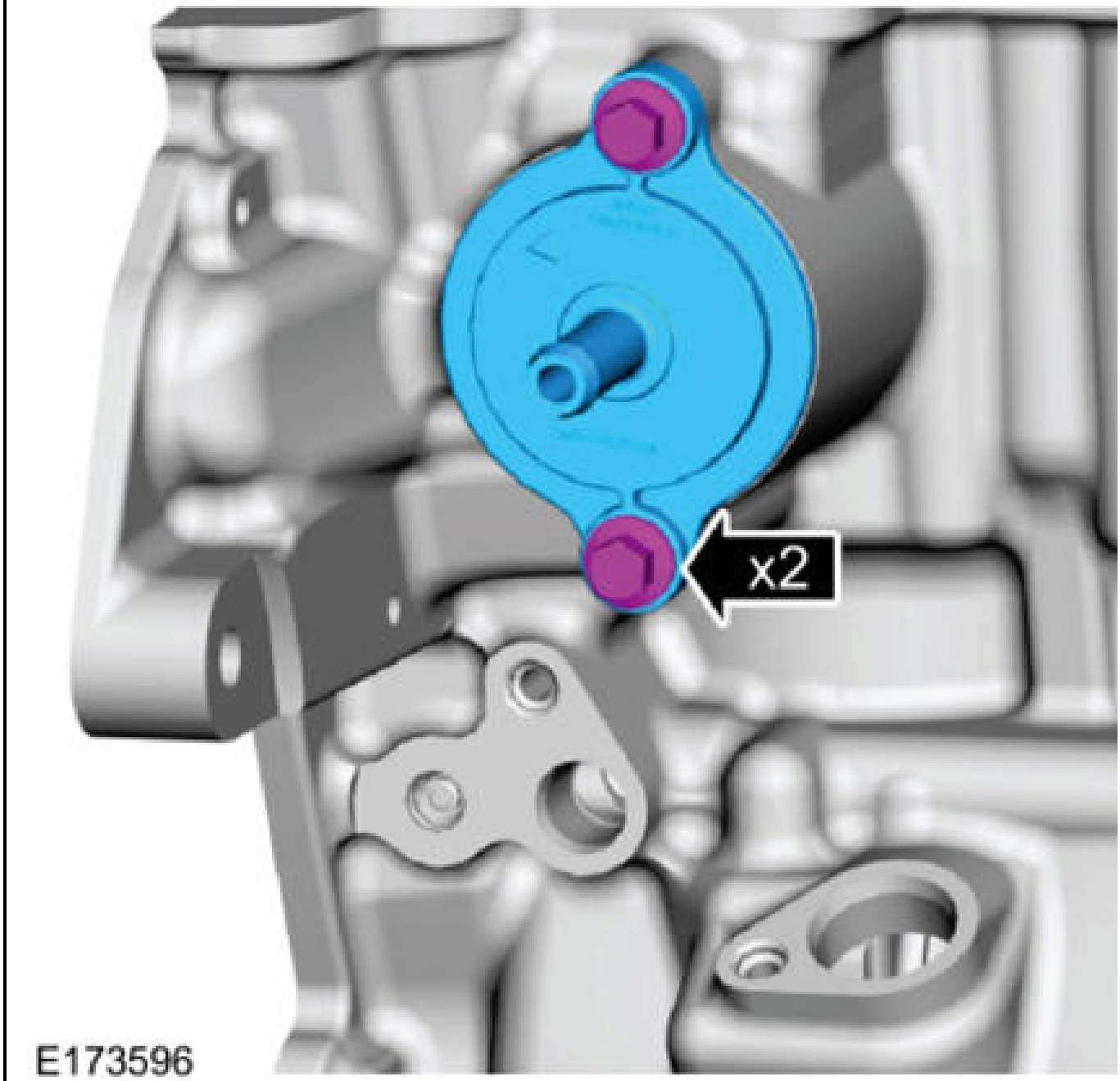


65. **NOTE:** **Clean the specified component with a abrasive pad.**

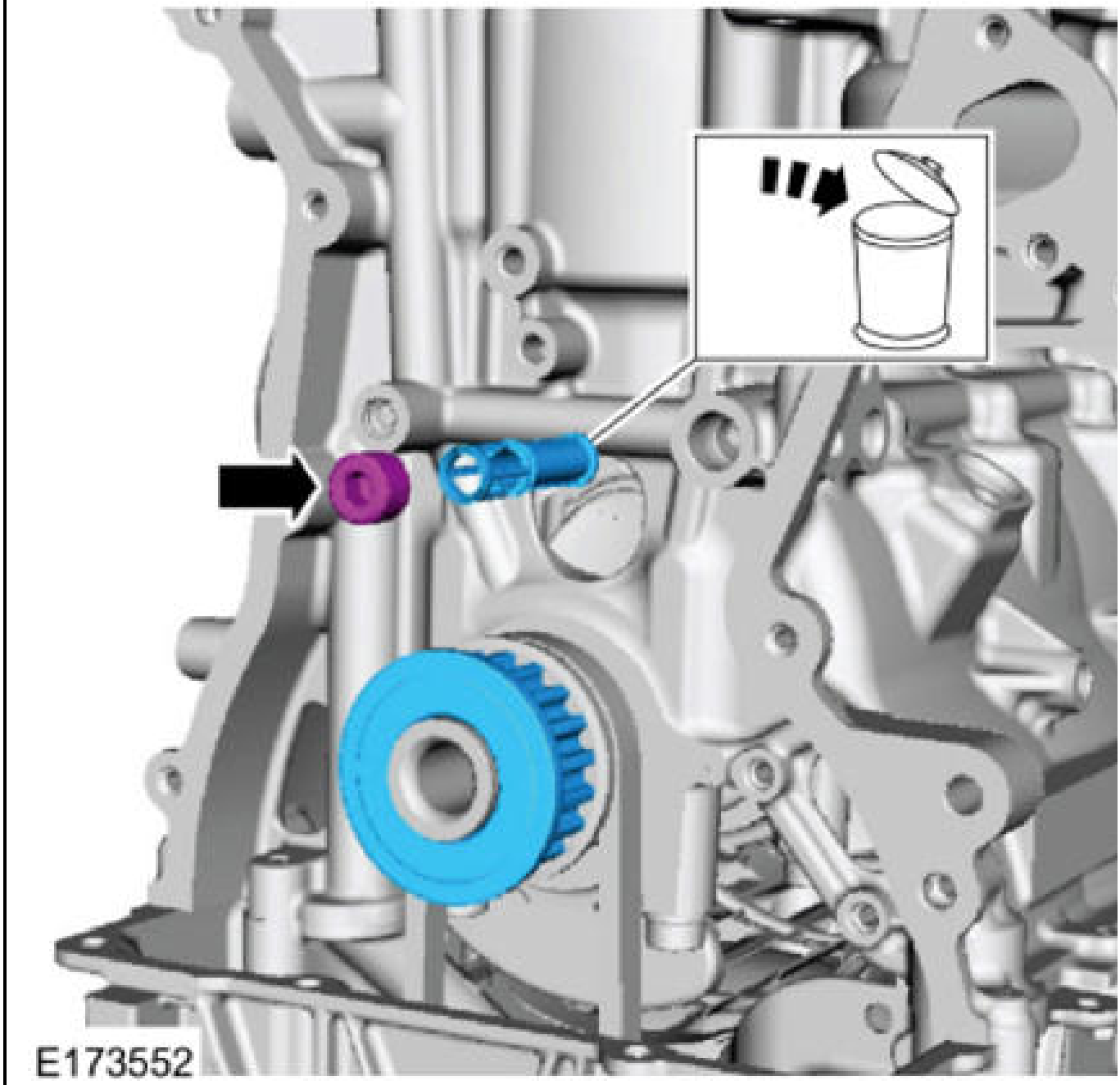


66.

66.

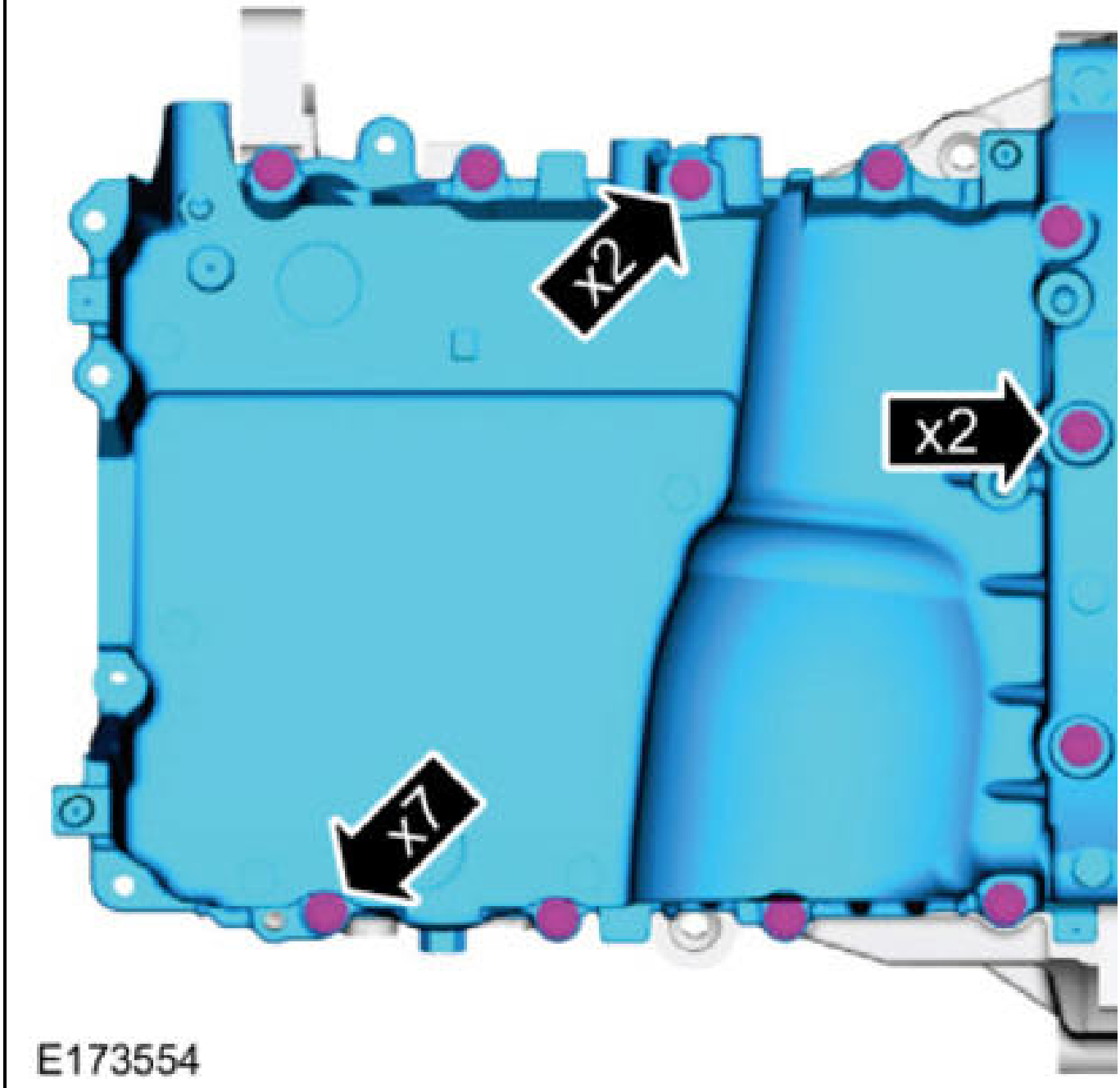


67. **NOTE: Note the position of the component before removal.**



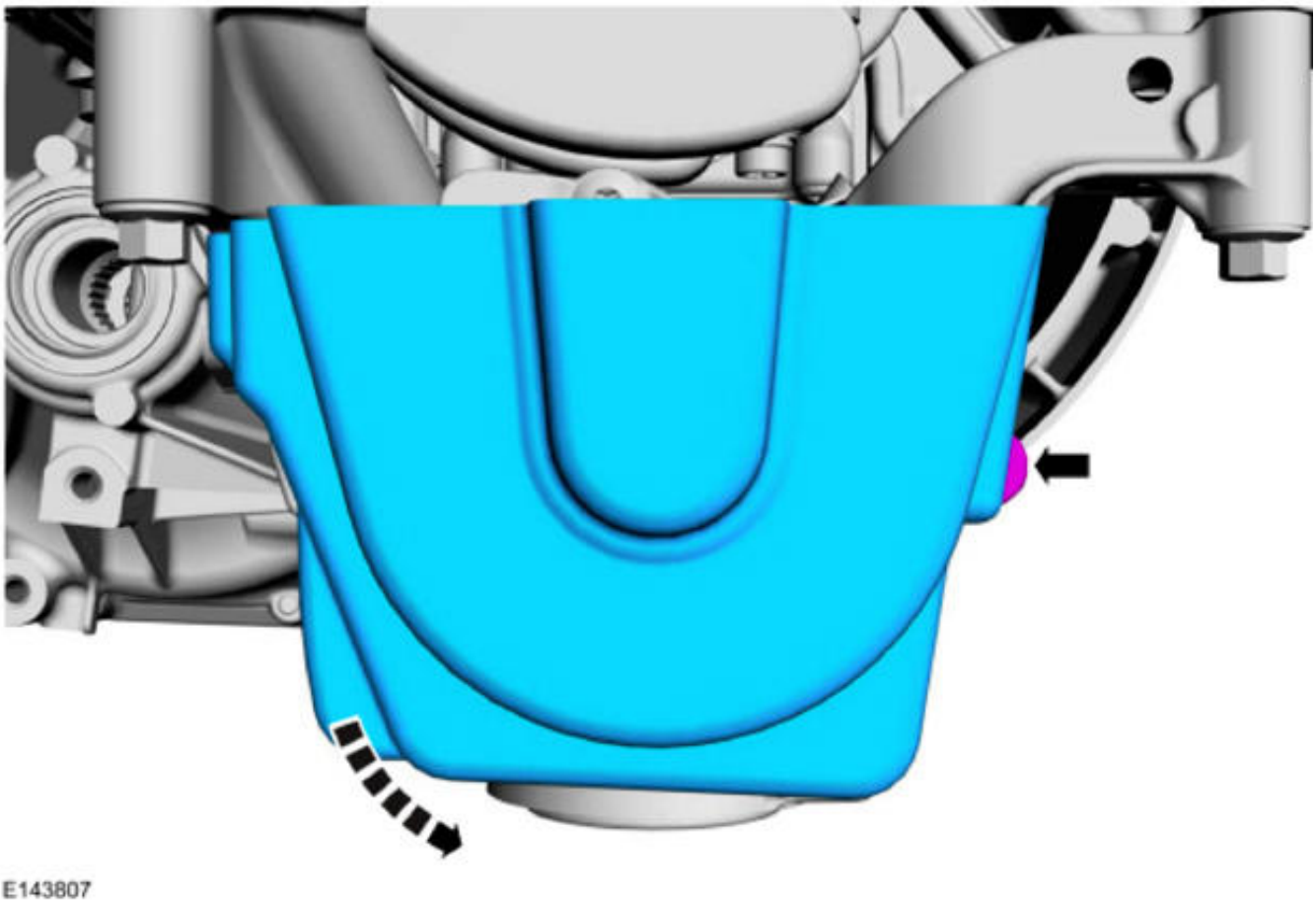
68.

68.

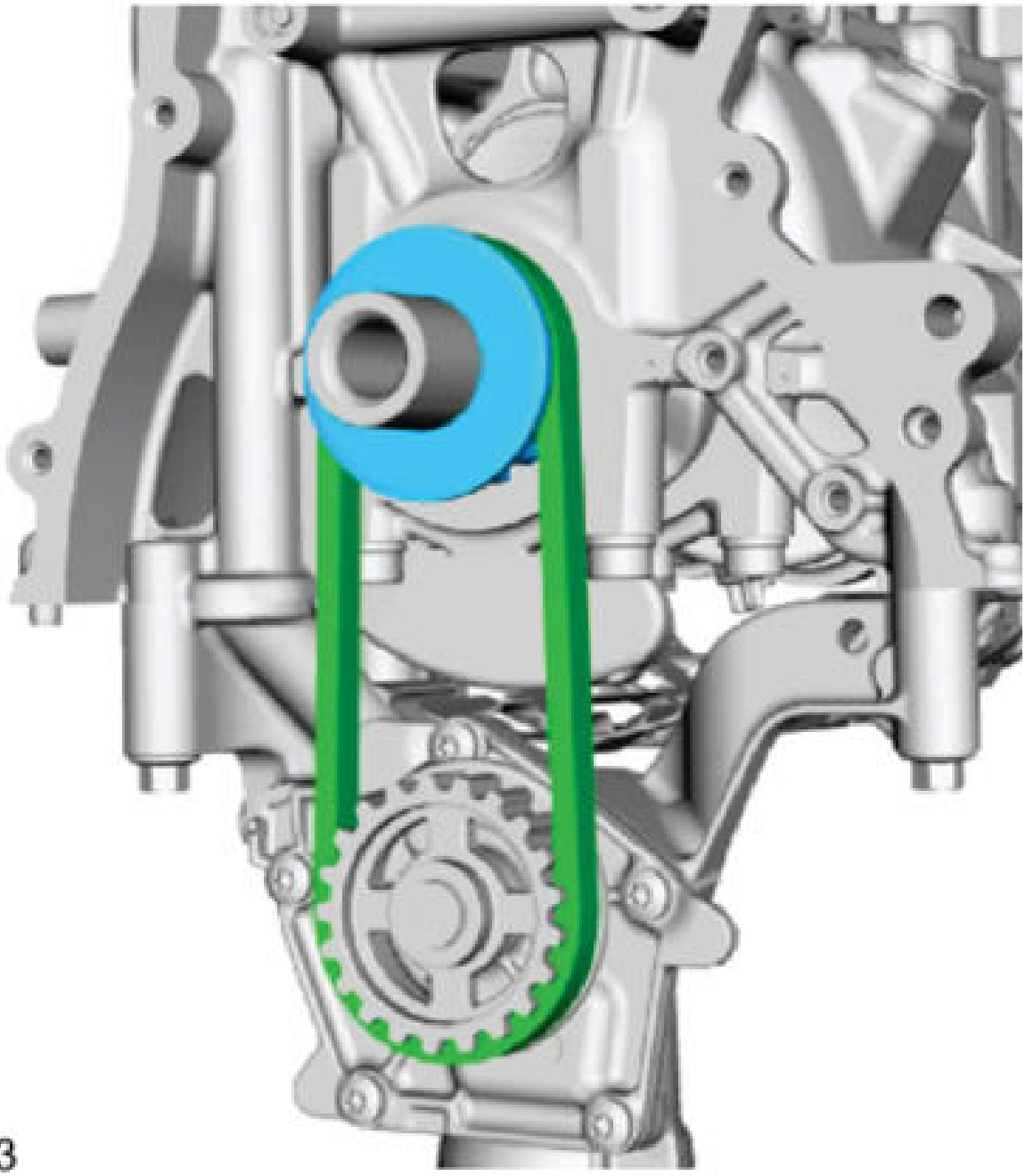


69.

69.

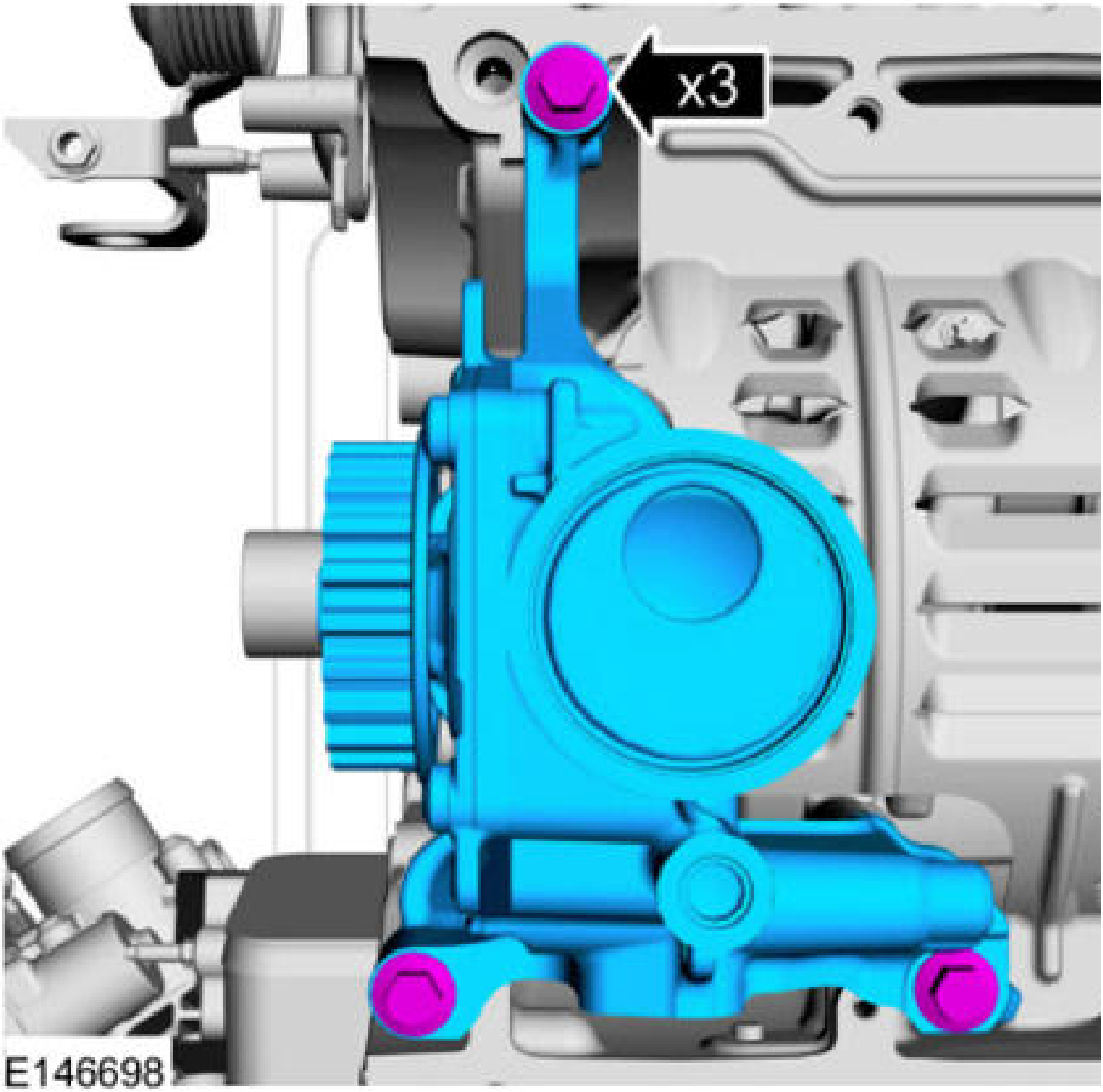


70. **NOTE: Note the position of the component before removal.**



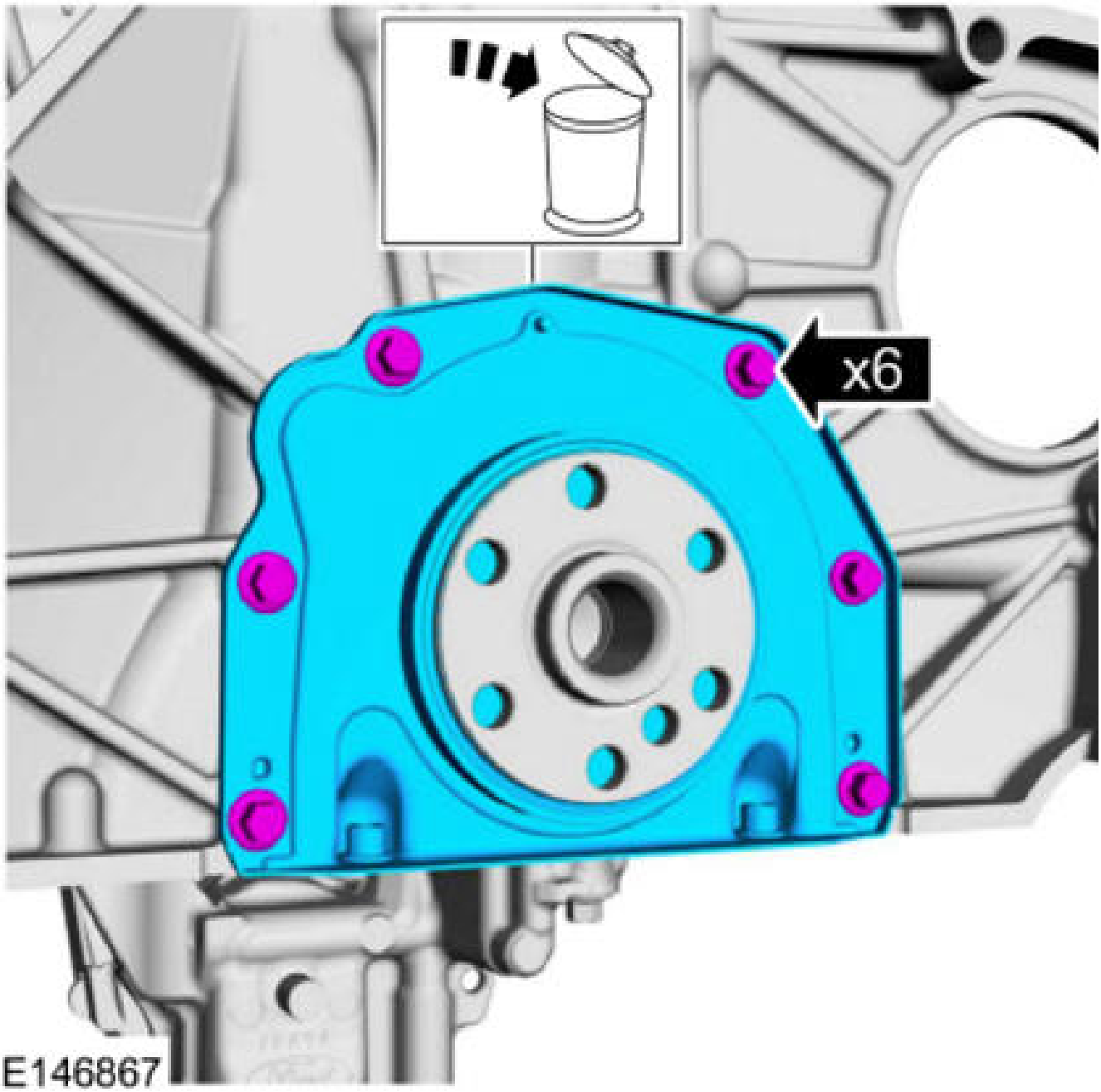
71.

71.



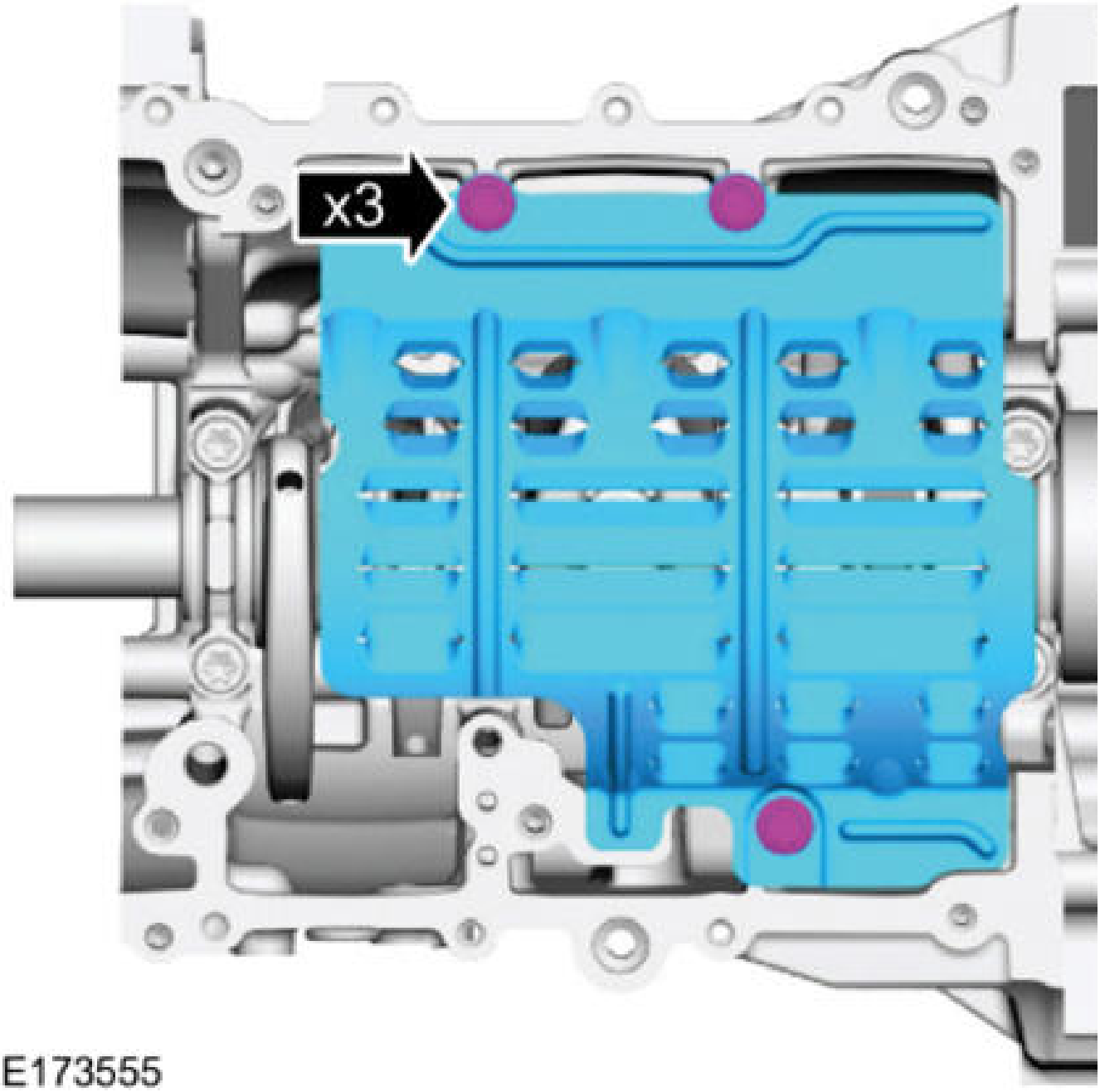
72.

72.

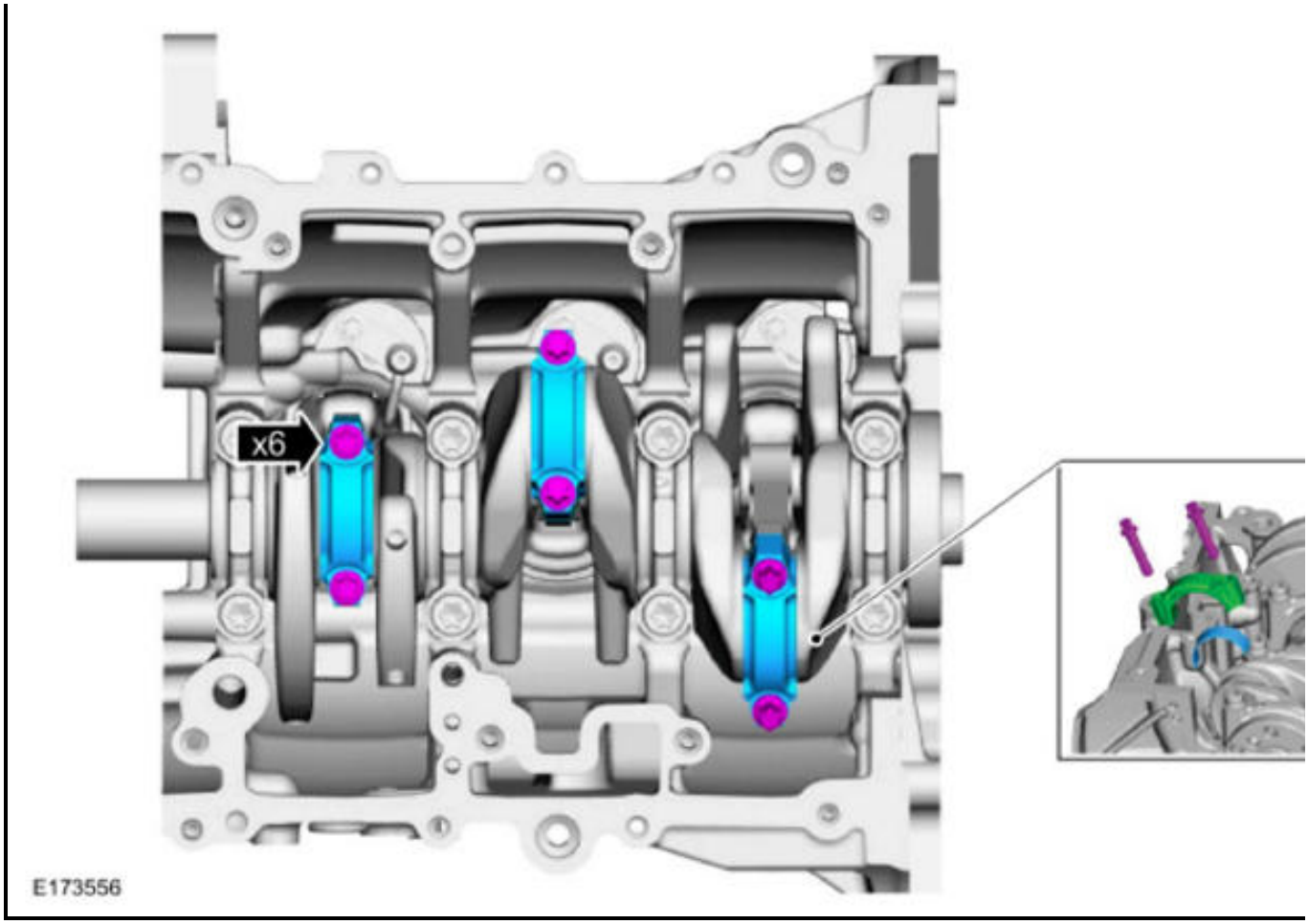


73.

73.



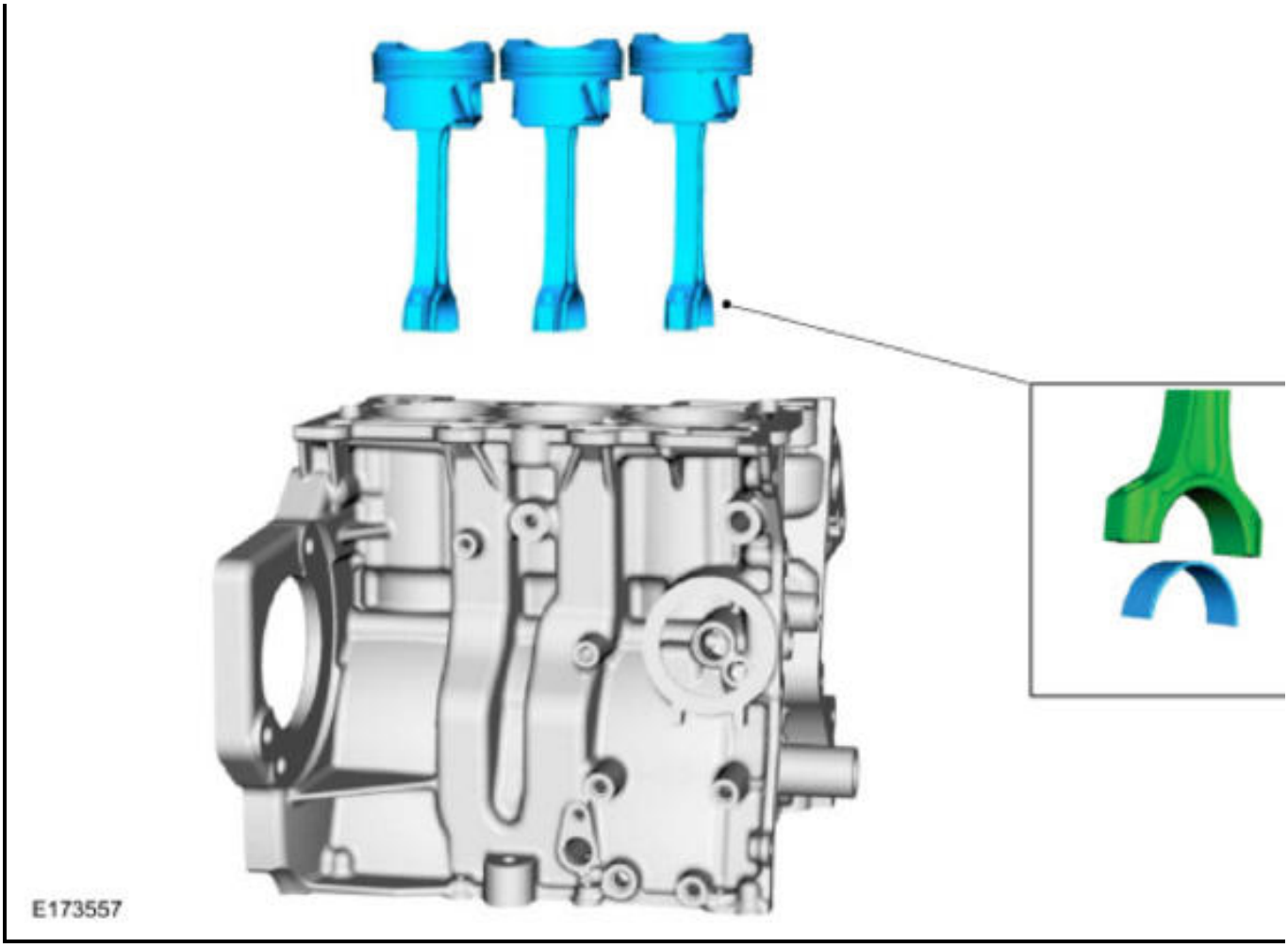
74. **NOTE:** **Mark the position of the parts, so they can be installed in their original positions.**



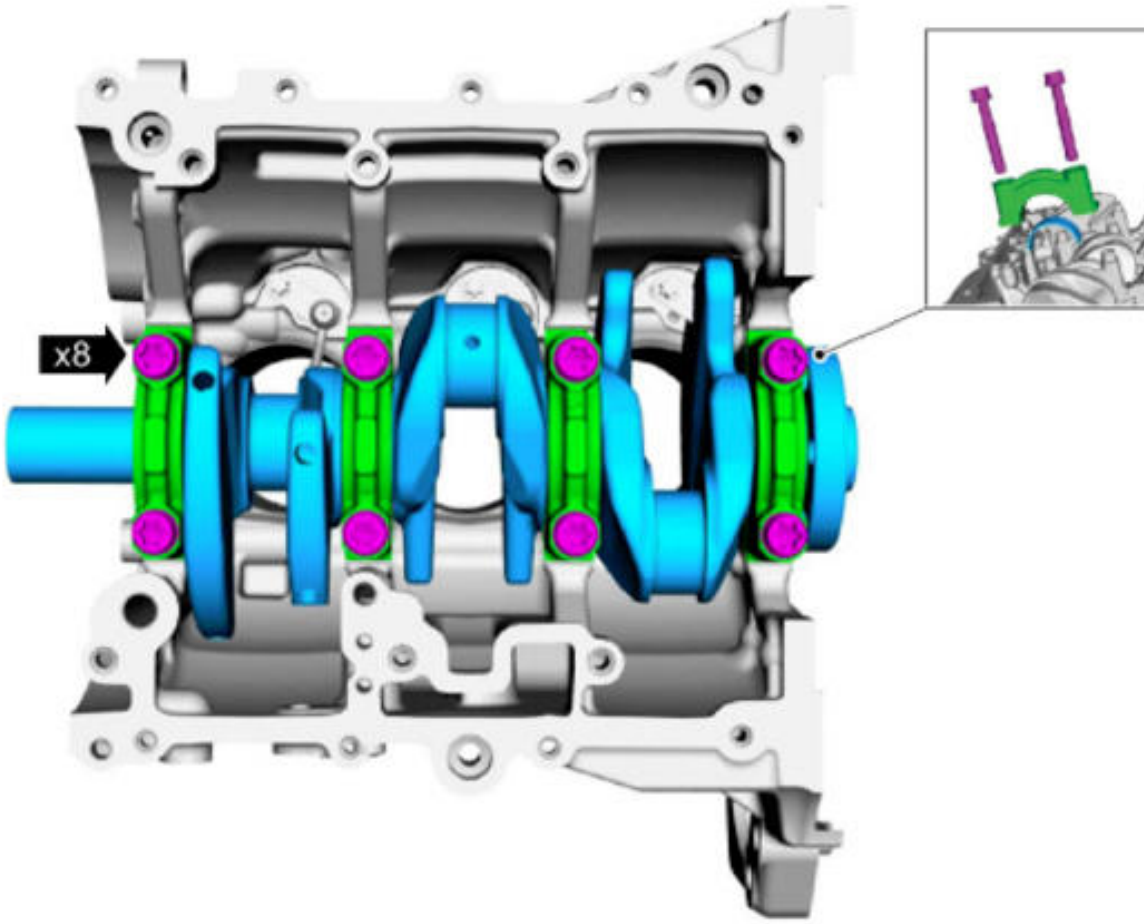
75.

NOTE: **Mark the position of the parts, so they can be installed in their original positions.**

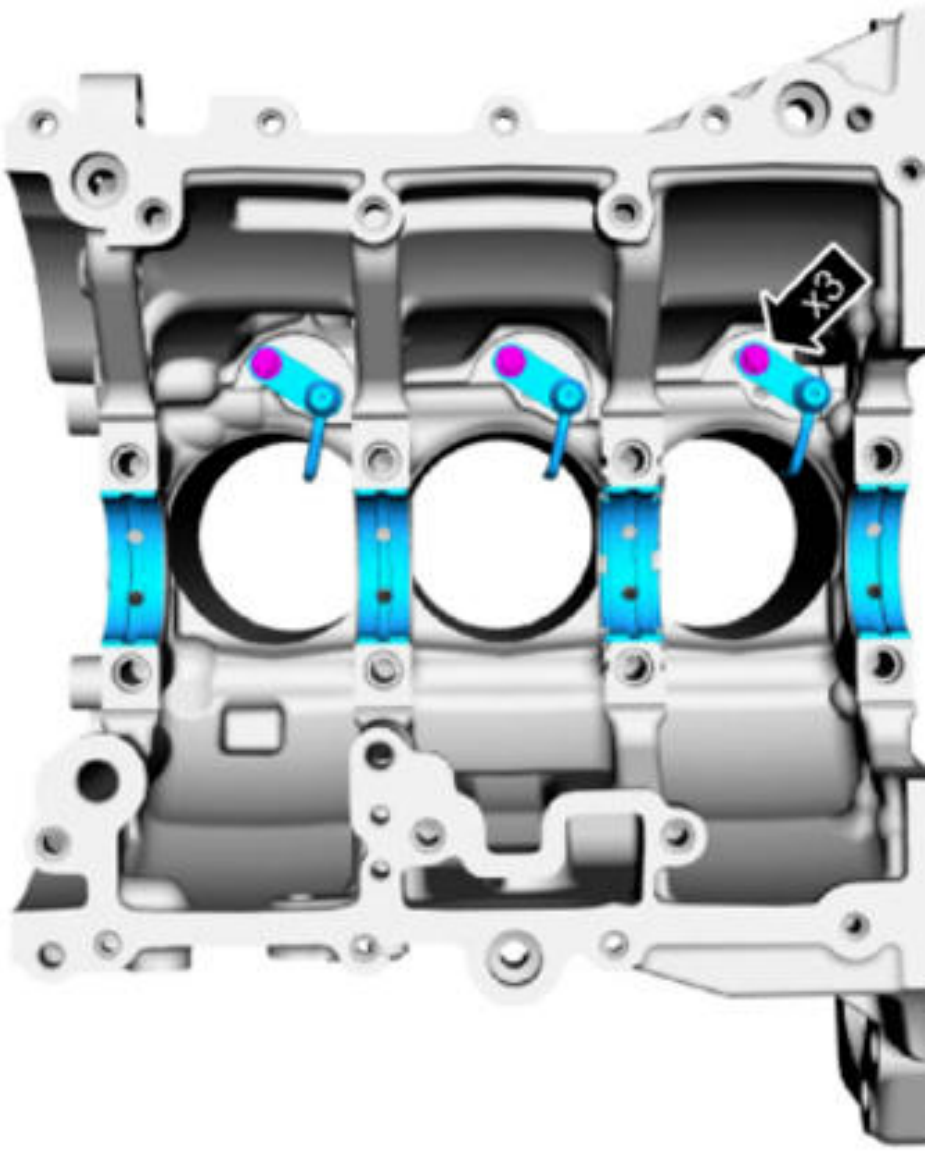
NOTE: **Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**



76. **NOTE:** **If the main bearings are being reused, mark them in order for correct orientation and reassembly.**



77. **NOTE:** **If the main bearings are being reused, mark them in order for correct orientation and reassembly.**

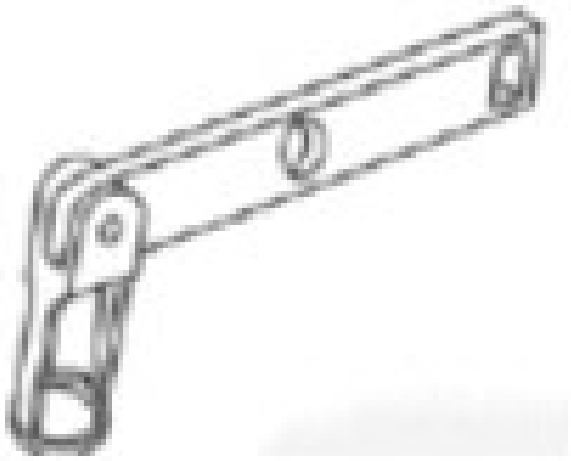
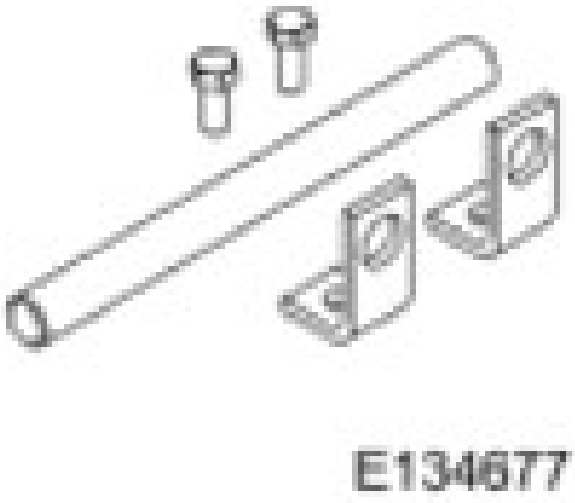


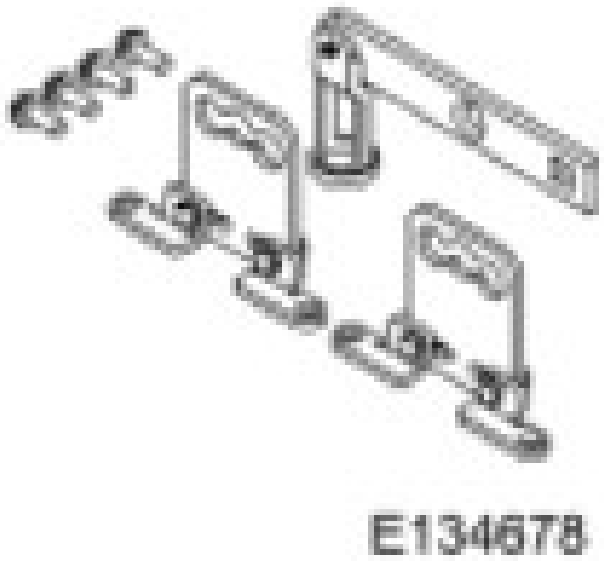
DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

CYLINDER HEAD

SPECIAL TOOL DESCRIPTION

	303-1418

	Compressor, Valve Spring TKIT-2008ET-FLM TKIT-2008ET-ROW
 E134677	**303-300** (T87C-6565-A) Set, Valve Spring Compressor TKIT-2009TC-F T88C-1000-ST TKIT-1988-FESTIVA TKIT-1988-TRACER
	303-350 (T89P-6565-A) Compressor, Valve Spring TKIT-1989-F TKIT-1989-FM TKIT-1989-FLM TKIT-1990-LMH



MATERIAL SPECIFICATIONS

Name	Specification
Motorcraft® Multi-Purpose Grease Spray XL-5	ESB-M1C93-B
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.) XO-5W20-QSP (U.S.)	WSS-M2C945-A

DISASSEMBLY

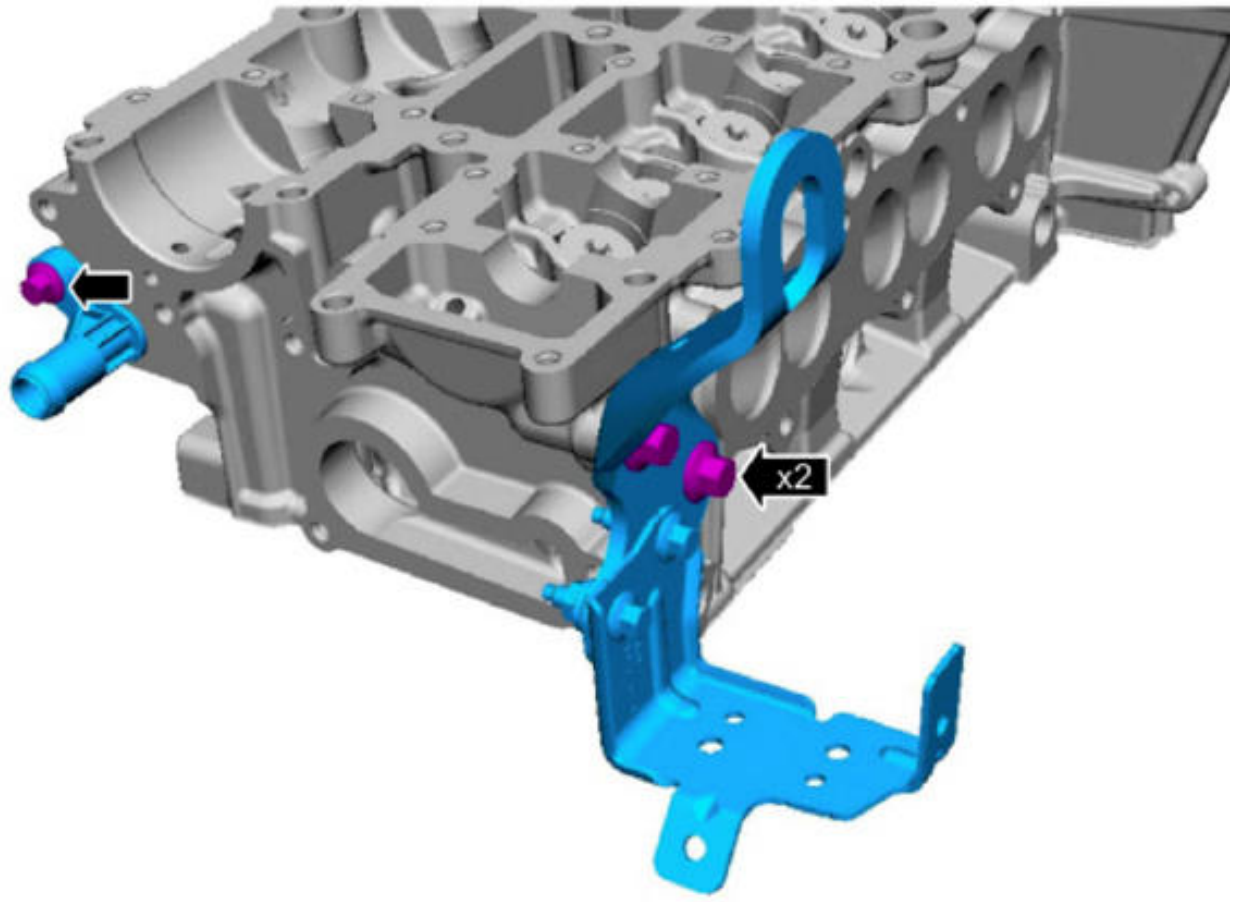
NOTE: During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.

NOTE: Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

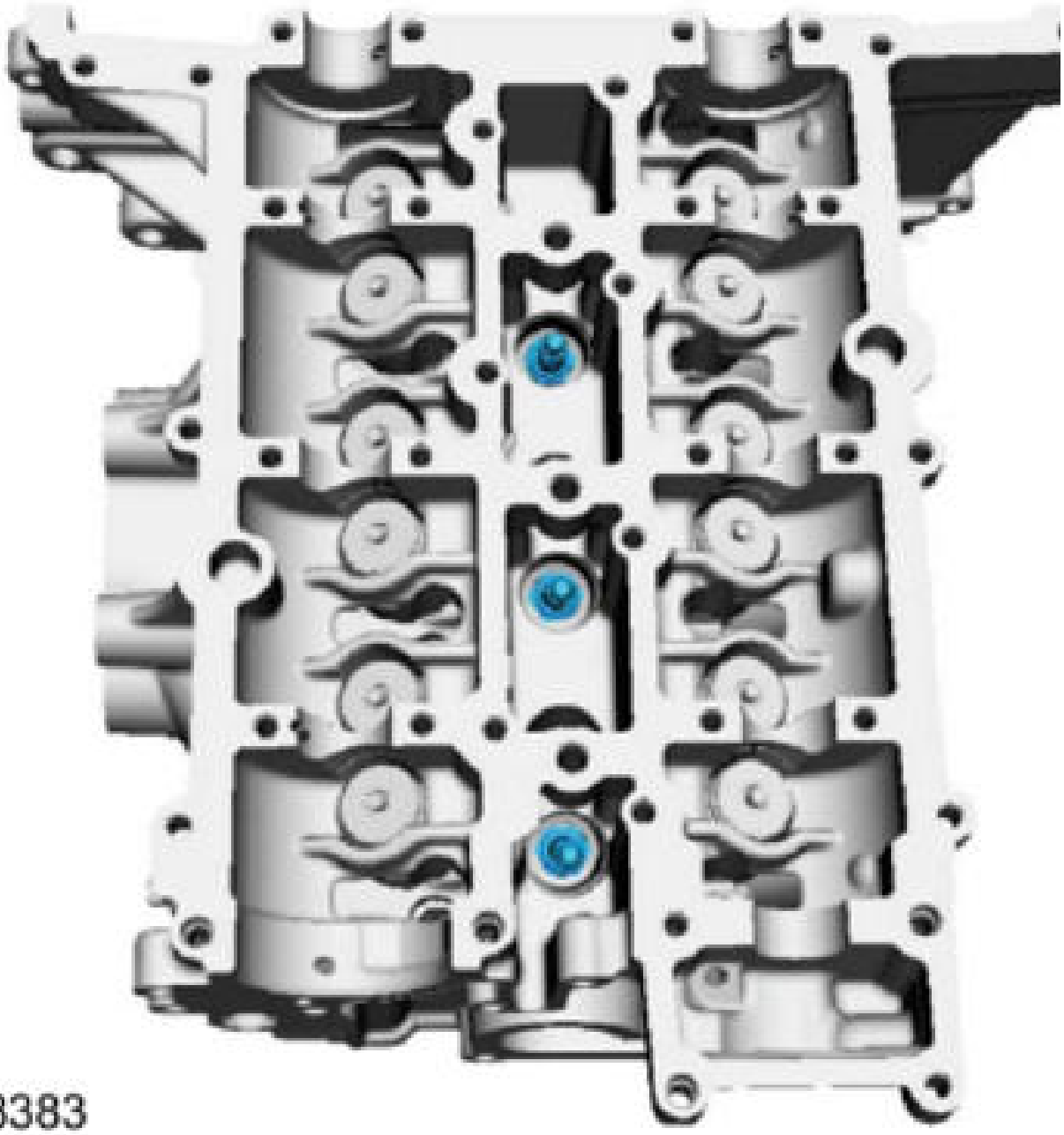
NOTE: If the components are to be reinstalled, mark the location of the components removed, they must be installed in the same location.

1.

1.



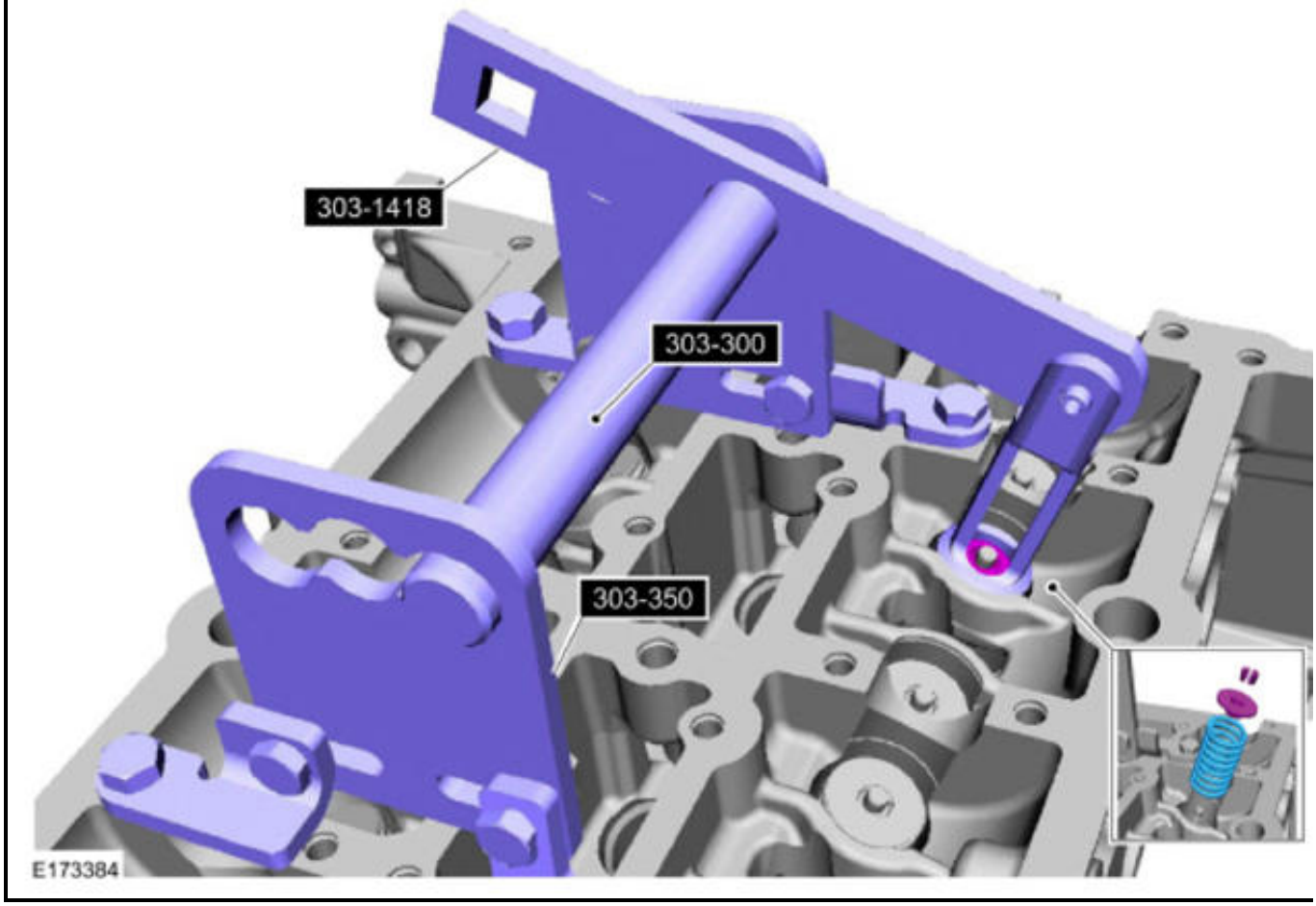
2. **NOTE:** **Only use hand tools when removing or installing spark plugs, or damage can occur to the cylinder head or spark plug.**



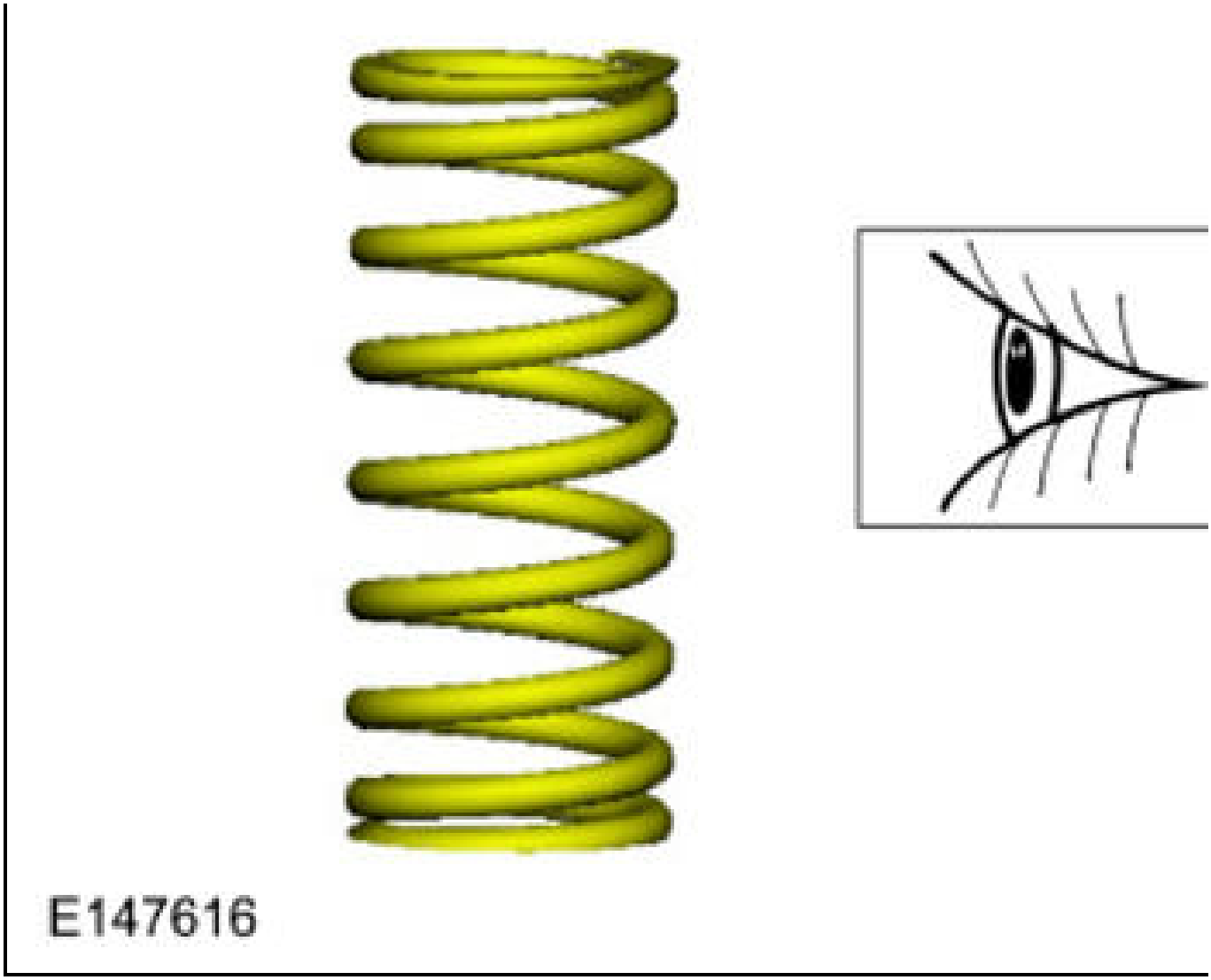
3. **NOTE: Use a small screwdriver and multi-purpose grease to remove the valve collets.**

Install Special Service Tool: **303-300 (T87C-6565-A) Set, Valve Spring Compressor** , **303-350 (T89P-6565-A) Compressor, Valve Spring** , **303-1418 Compressor, Valve Spring** .

Material : Motorcraft® Multi-Purpose Grease Spray/XL-5 (ESB-M1C93-B)

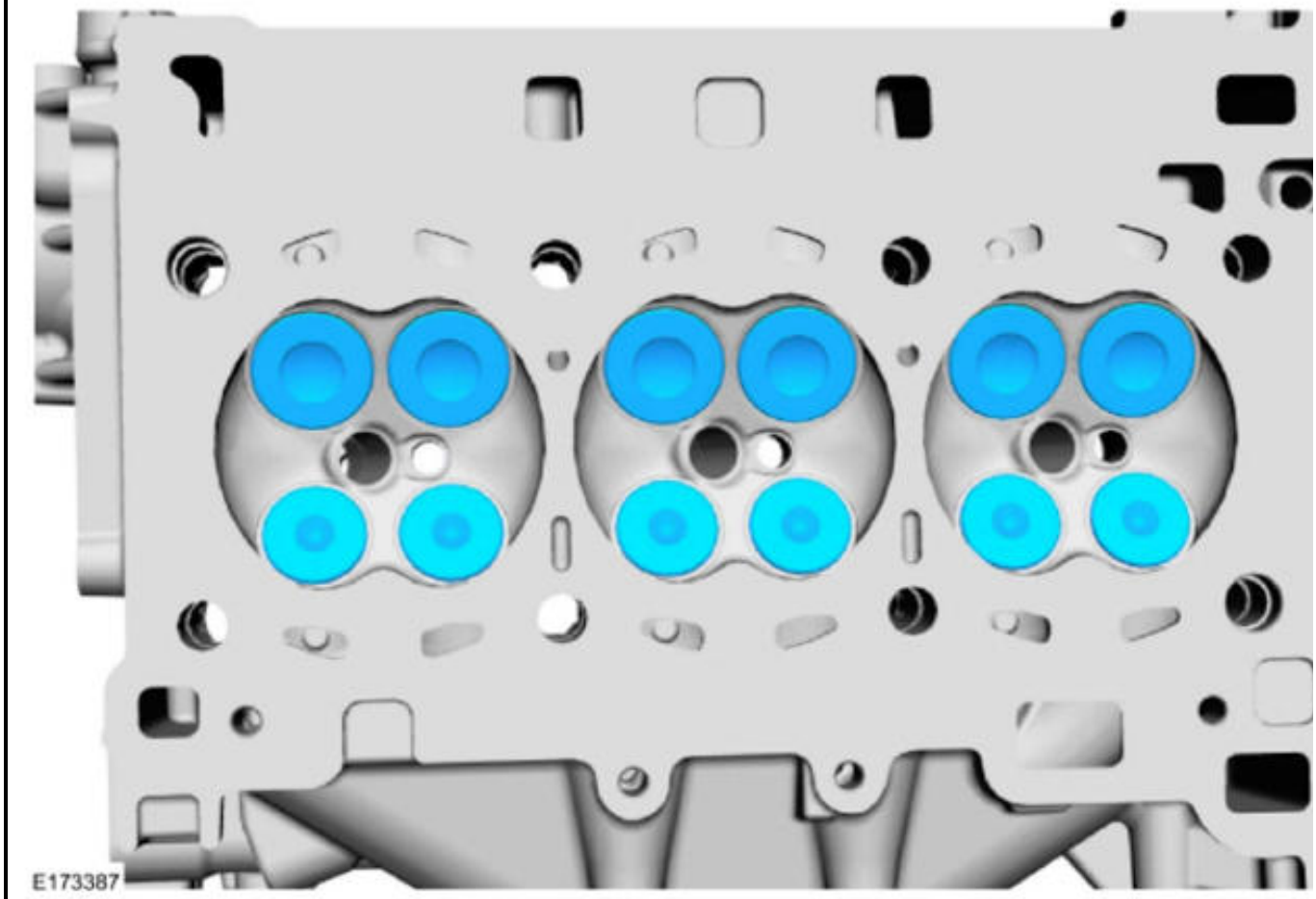


4.

4. 

5. **NOTE: Use commercially available valve stem seal pliers.**

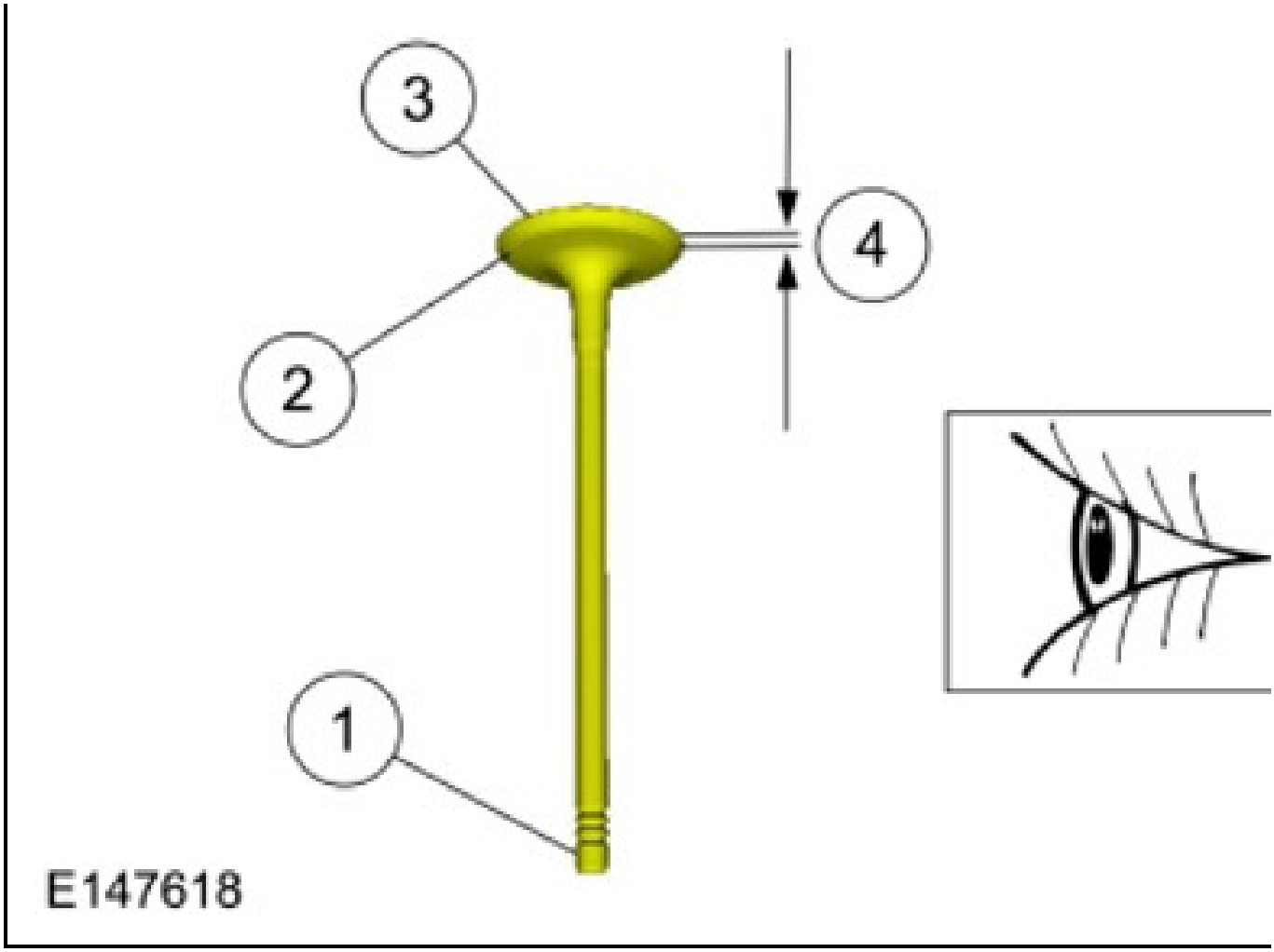
6.

6. 

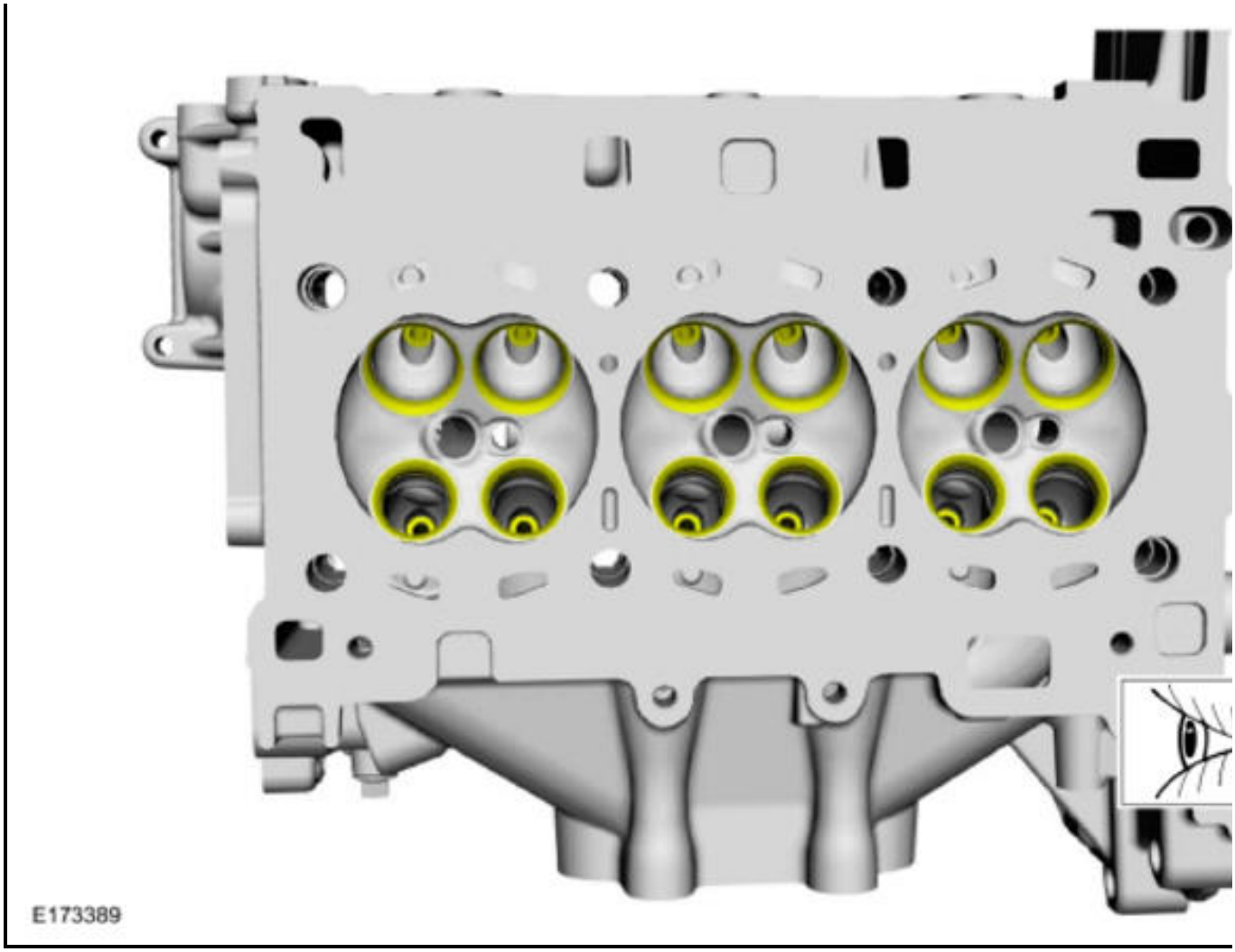
7.
1. The end of the stem for grooves or scoring.
2. The valve face and the edge for pits, grooves or scores.
3. The valve head for signs of burning, erosion, warpage and cracking.
4. The valve margin for wear.

8.

8.



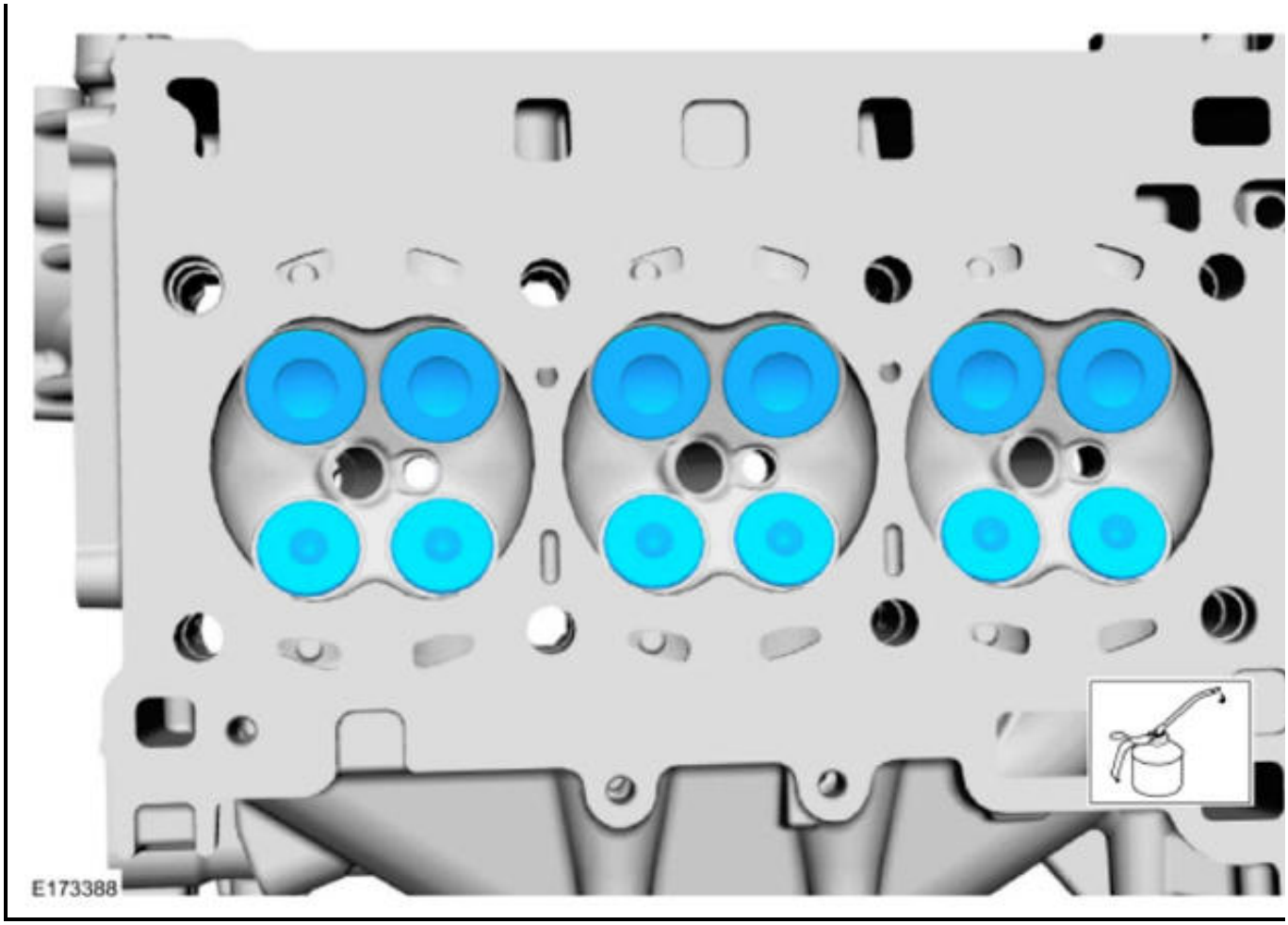
9.

9. 

ASSEMBLY

1. **NOTE: If installing the original valves, make sure the valves are installed in the same position from which they were removed. Coat the valve stems with clean engine oil.**

Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)



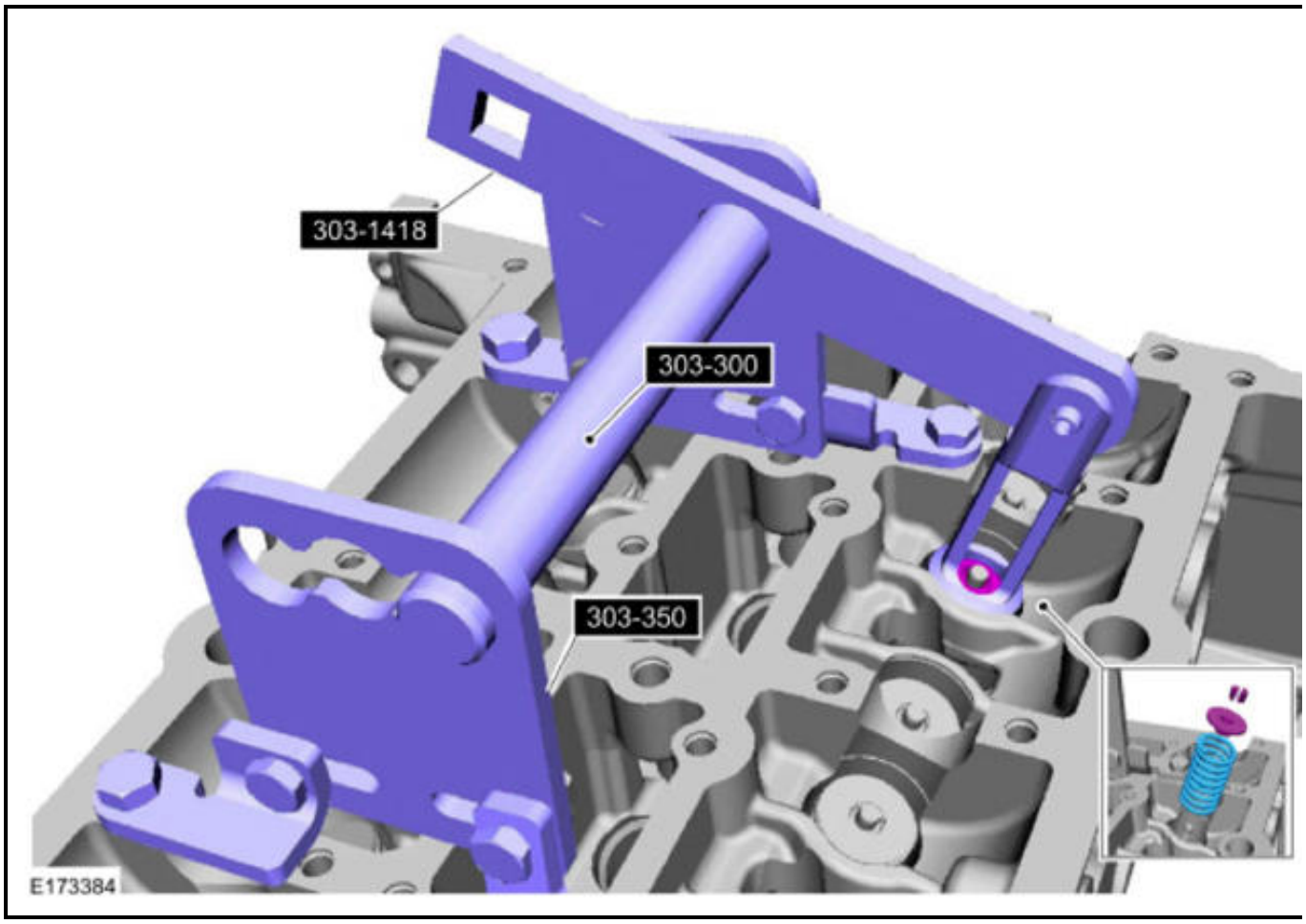
2. **NOTE: Use commercially available valve stem seal pliers.**

Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

3. **NOTE: Use a small screwdriver and multi-purpose grease to install the valve collets.**

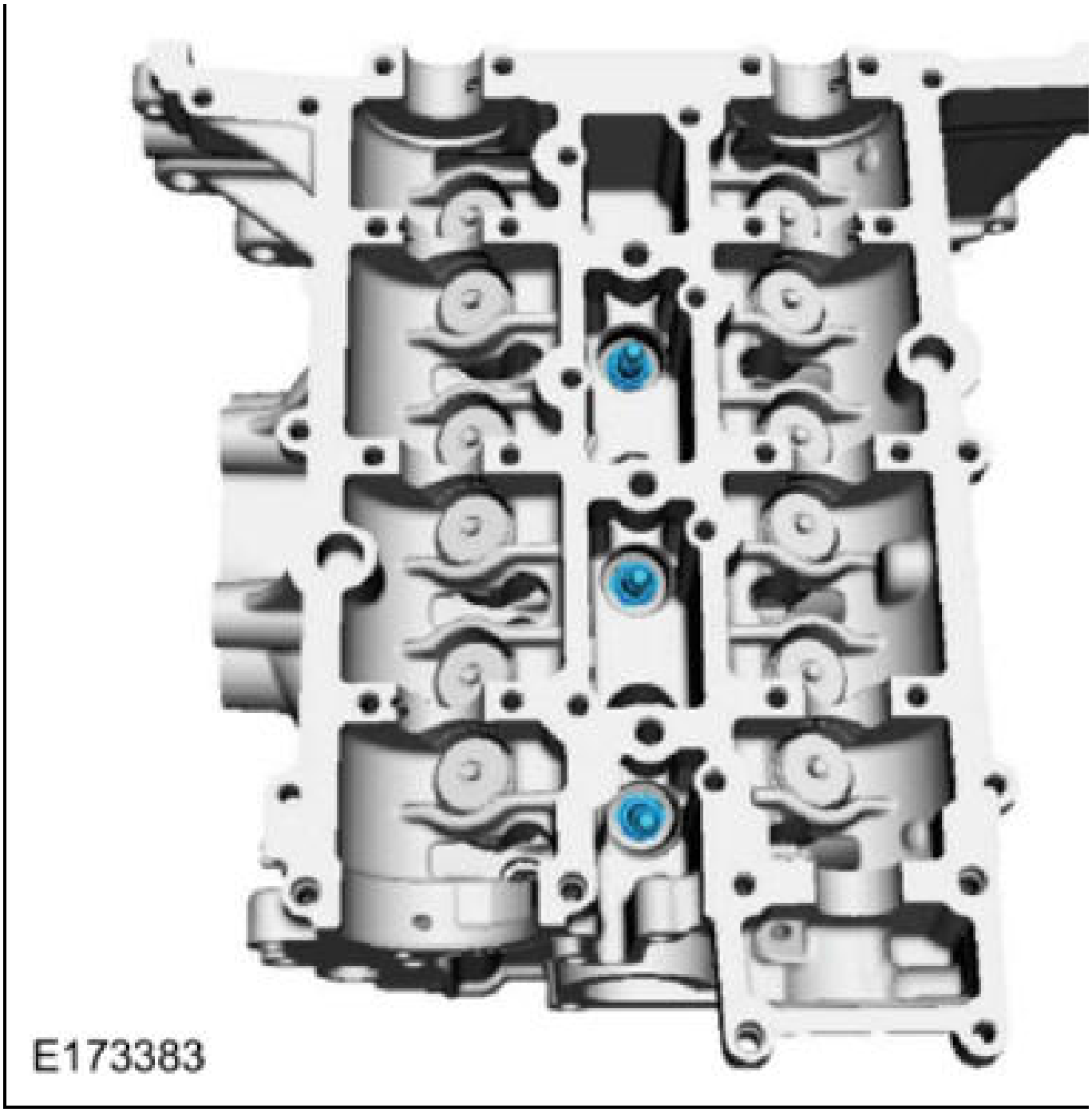
Install Special Service Tool: **303-300 (T87C-6565-A) Set, Valve Spring Compressor** , **303-350 (T89P-6565-A) Compressor, Valve Spring** , **303-1418 Compressor, Valve Spring** .

Material : Motorcraft® Multi-Purpose Grease Spray/XL-5 (ESB-M1C93-B)



4. **NOTE: Only use hand tools when removing or installing spark plugs, or damage can occur to the cylinder head or spark plug.**

Torque : 115 lb.in (13 Nm)



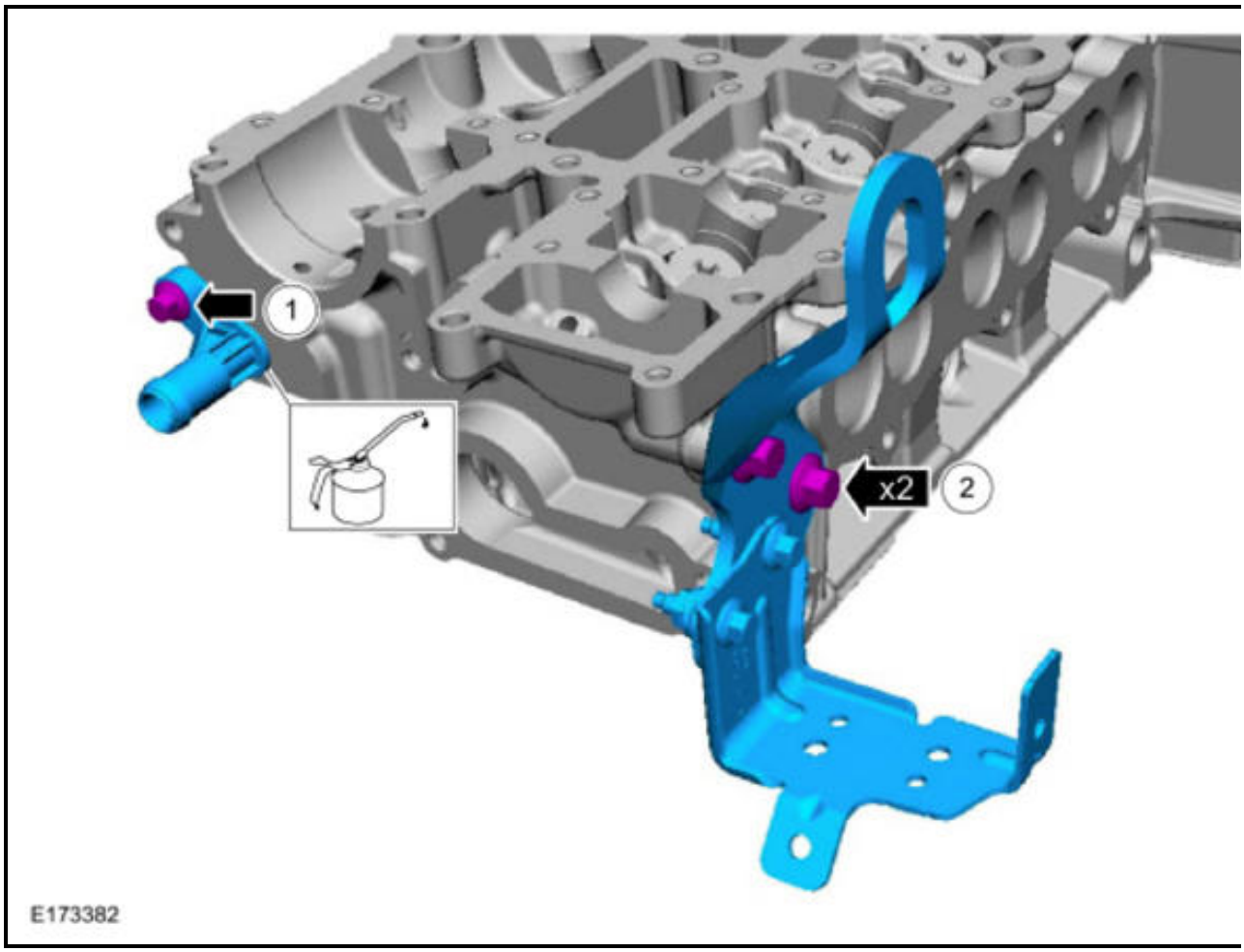
5.

1. Lubricate degas tube O-ring seal with clean engine oil.

Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

Torque : 84 lb.in (9.5 Nm)

2. *Torque* : 17 lb.ft (23 Nm)



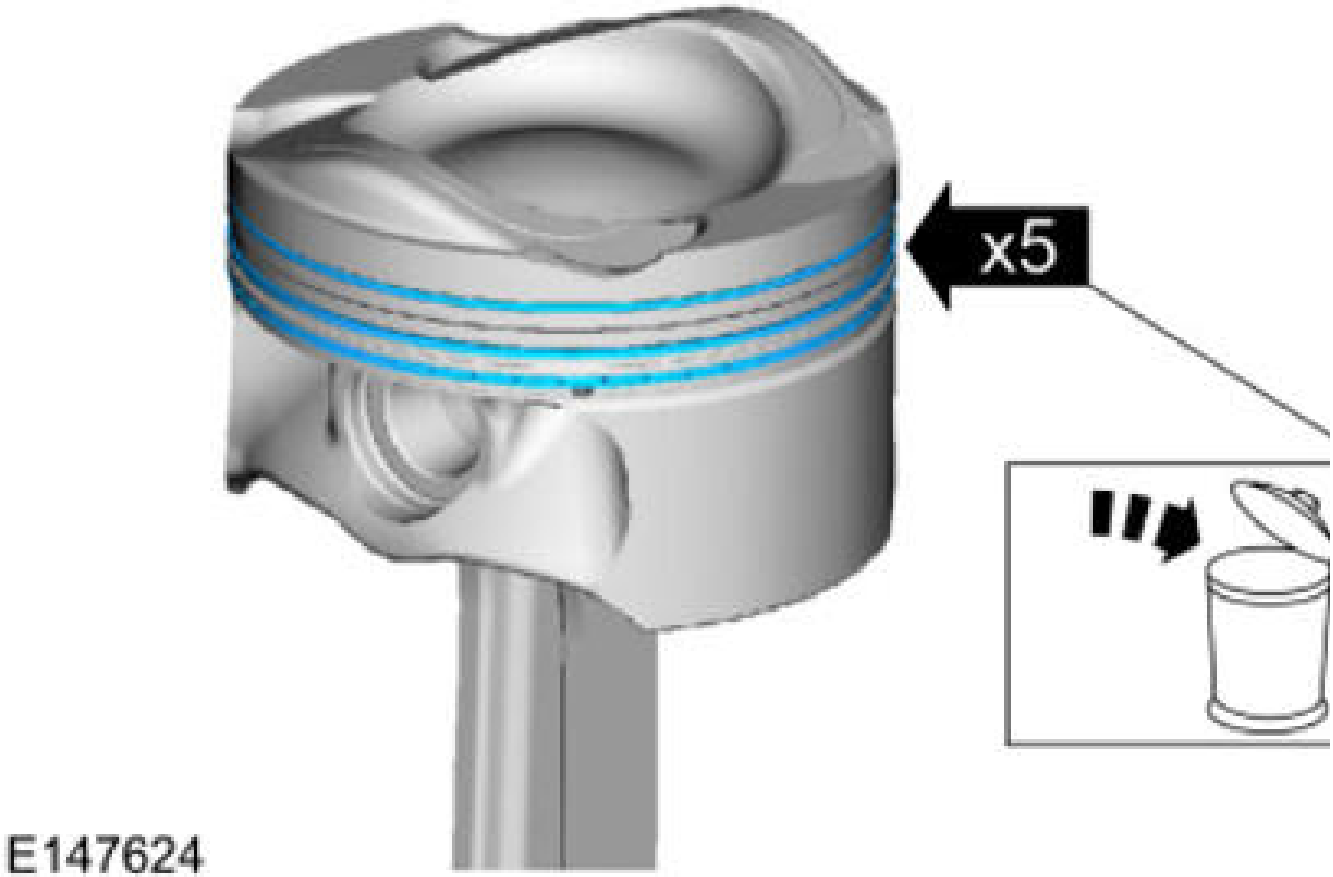
PISTON

MATERIAL SPECIFICATIONS

Name	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.) XO-5W20-QSP (U.S.)	WSS-M2C945-A

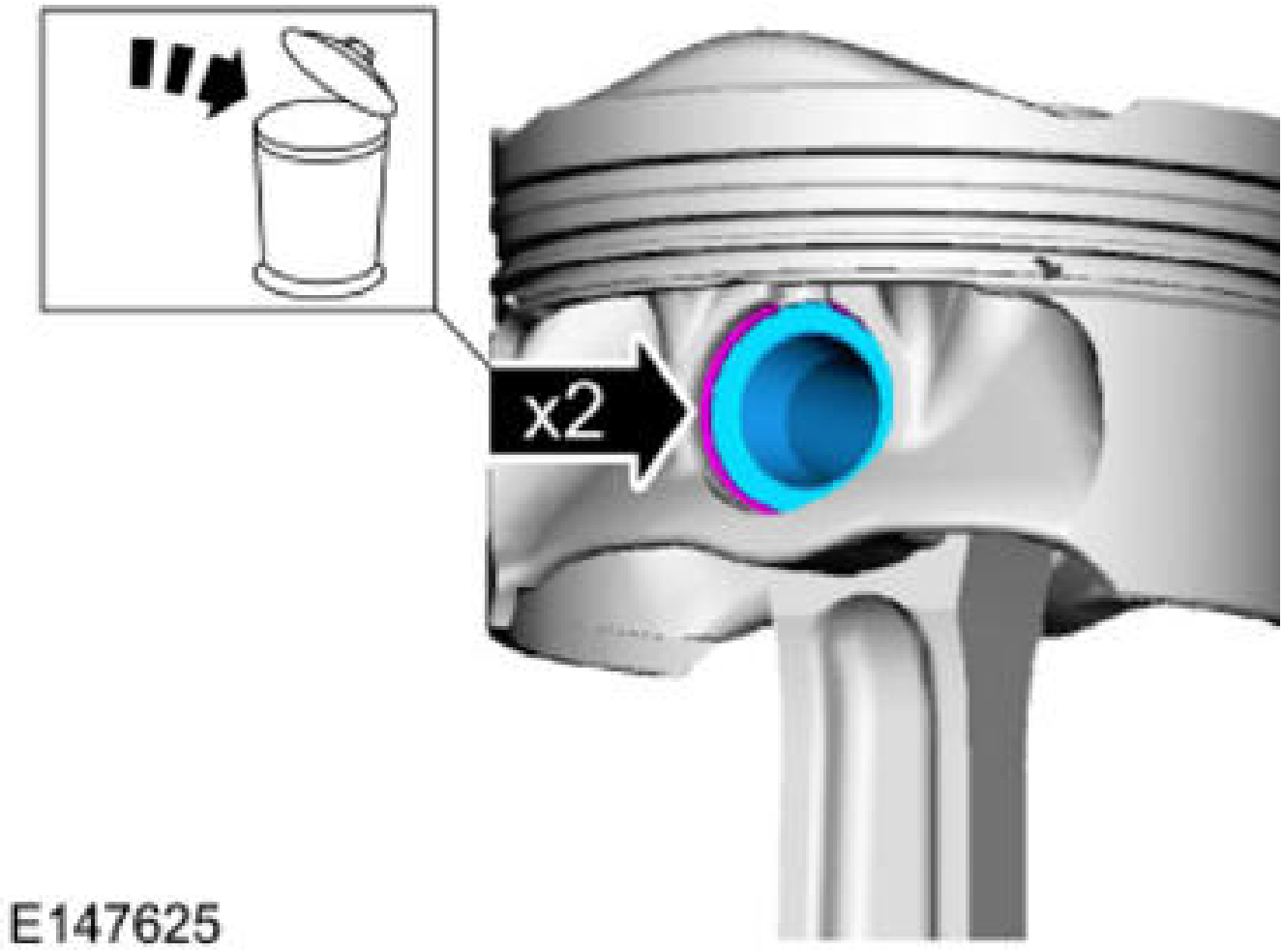
DISASSEMBLY

1.

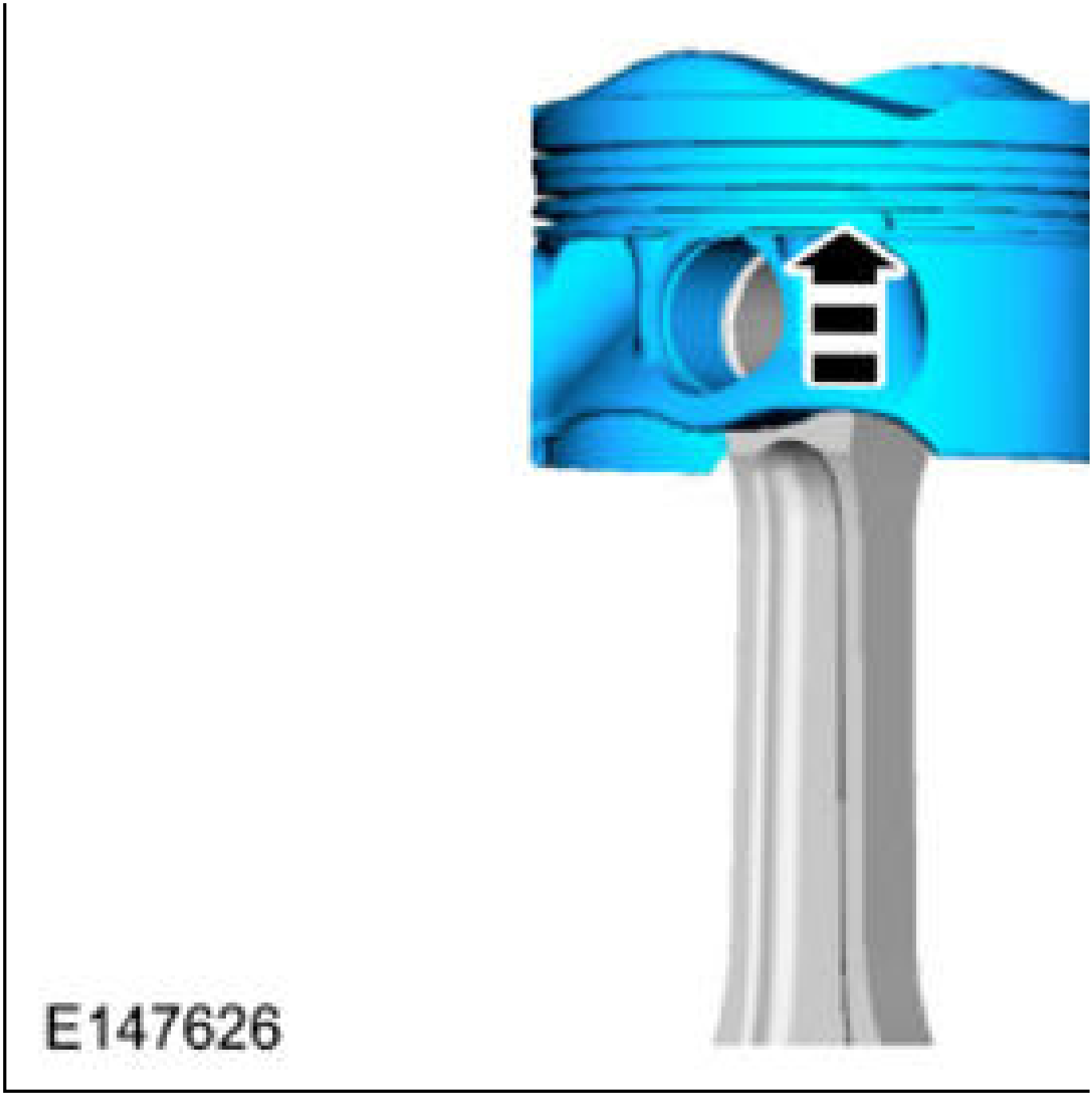
1. 

2.

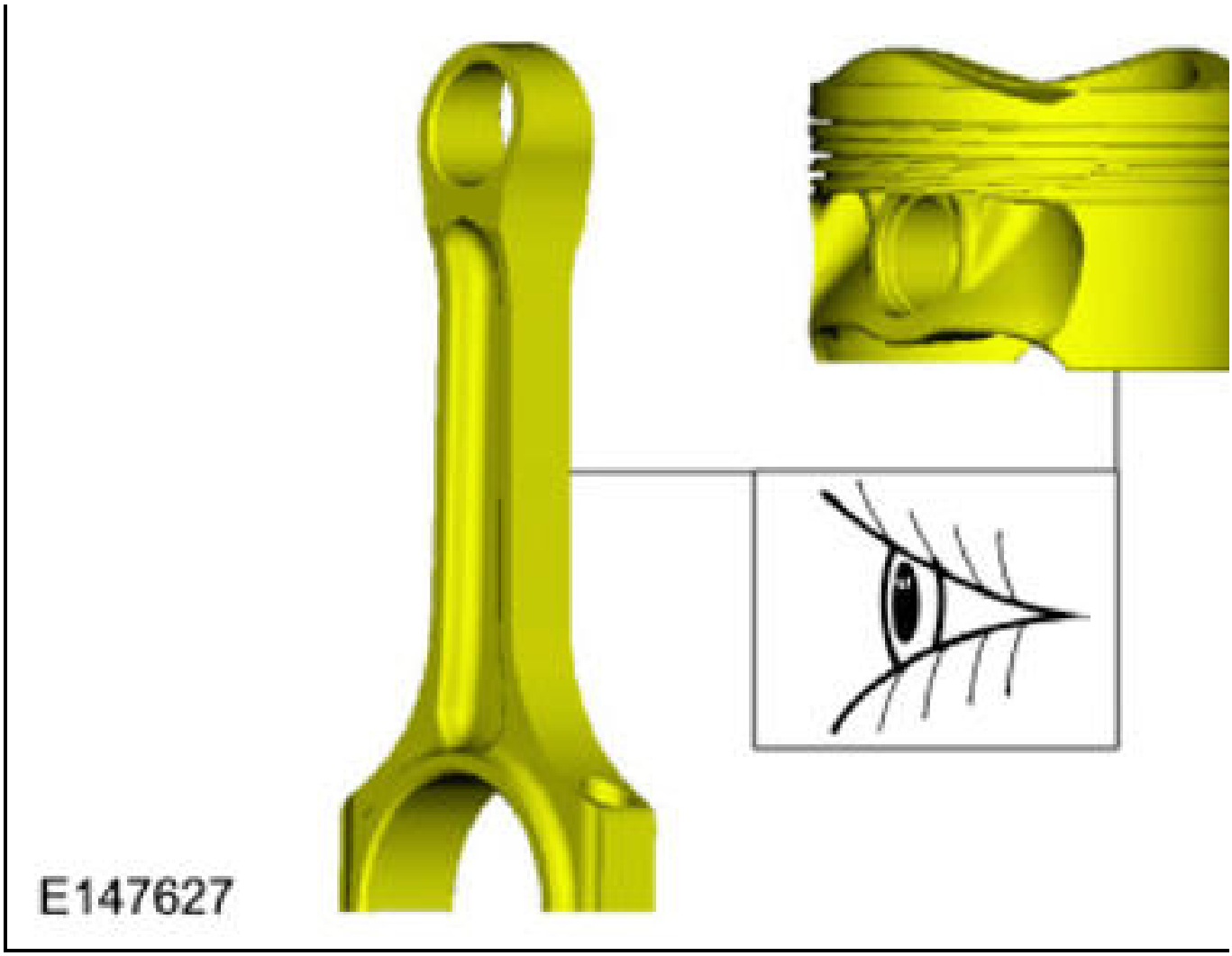
2.



3.

3. 

4. Refer to: **PISTON INSPECTION** .



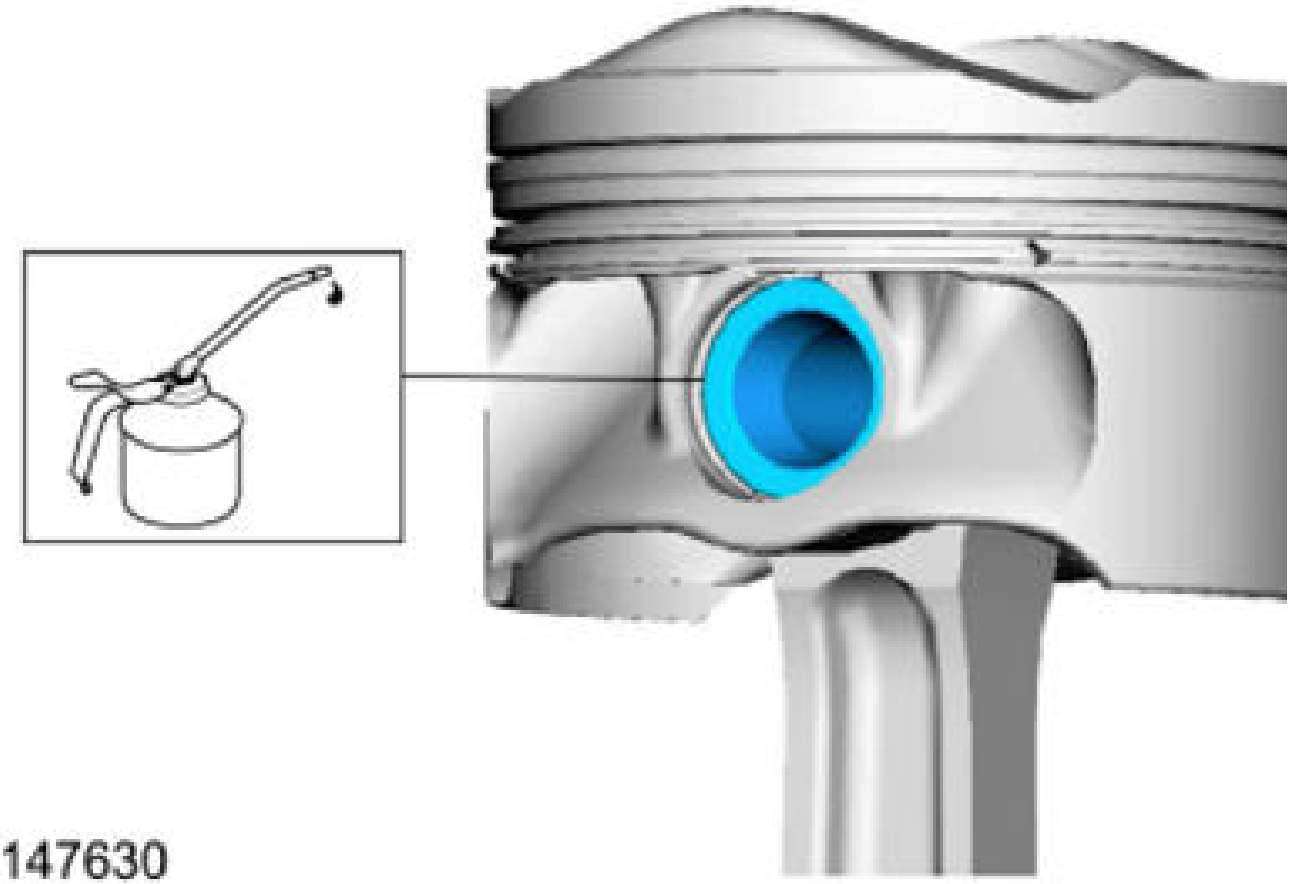
ASSEMBLY

1.

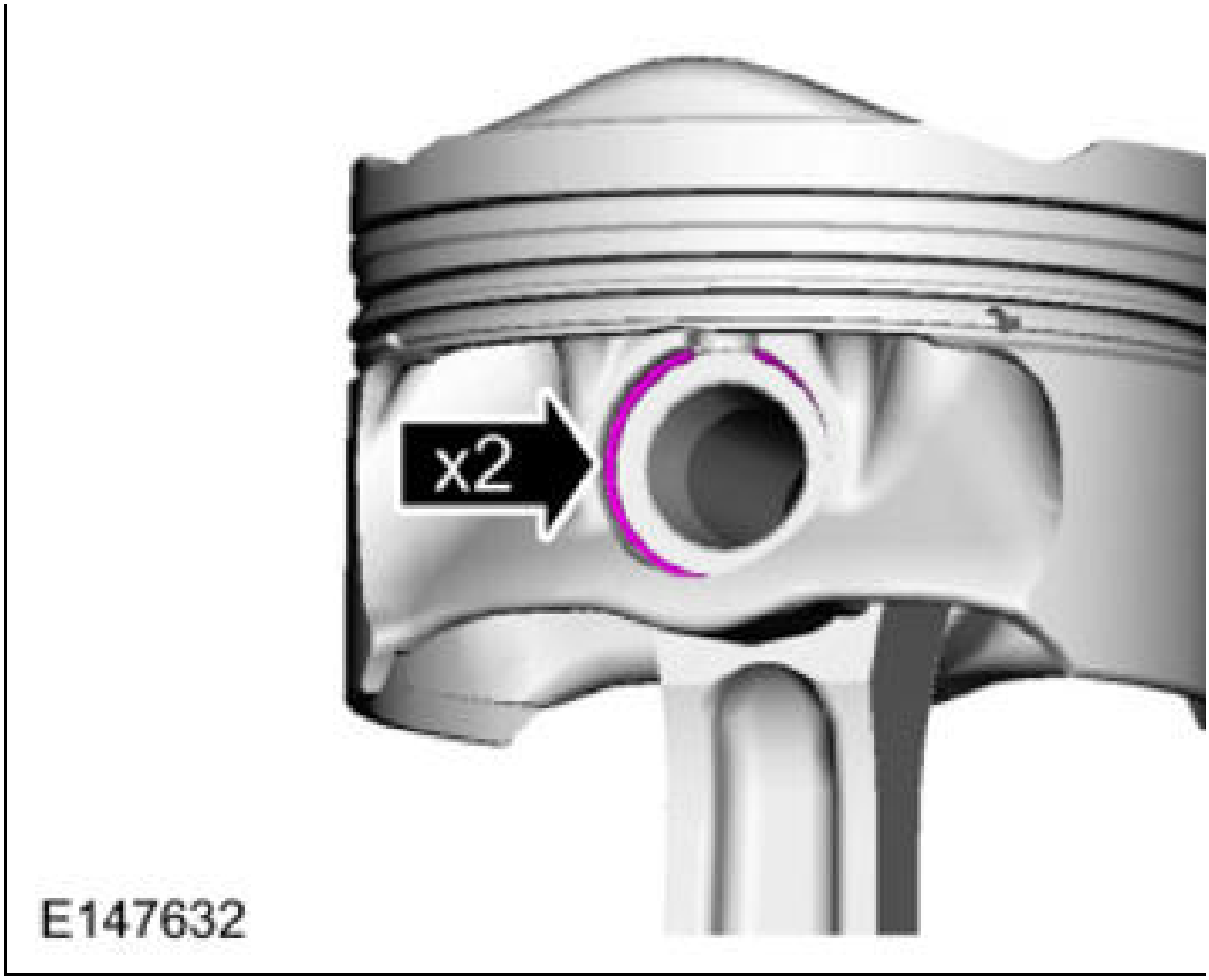
1. Indicates front of engine.

2. 

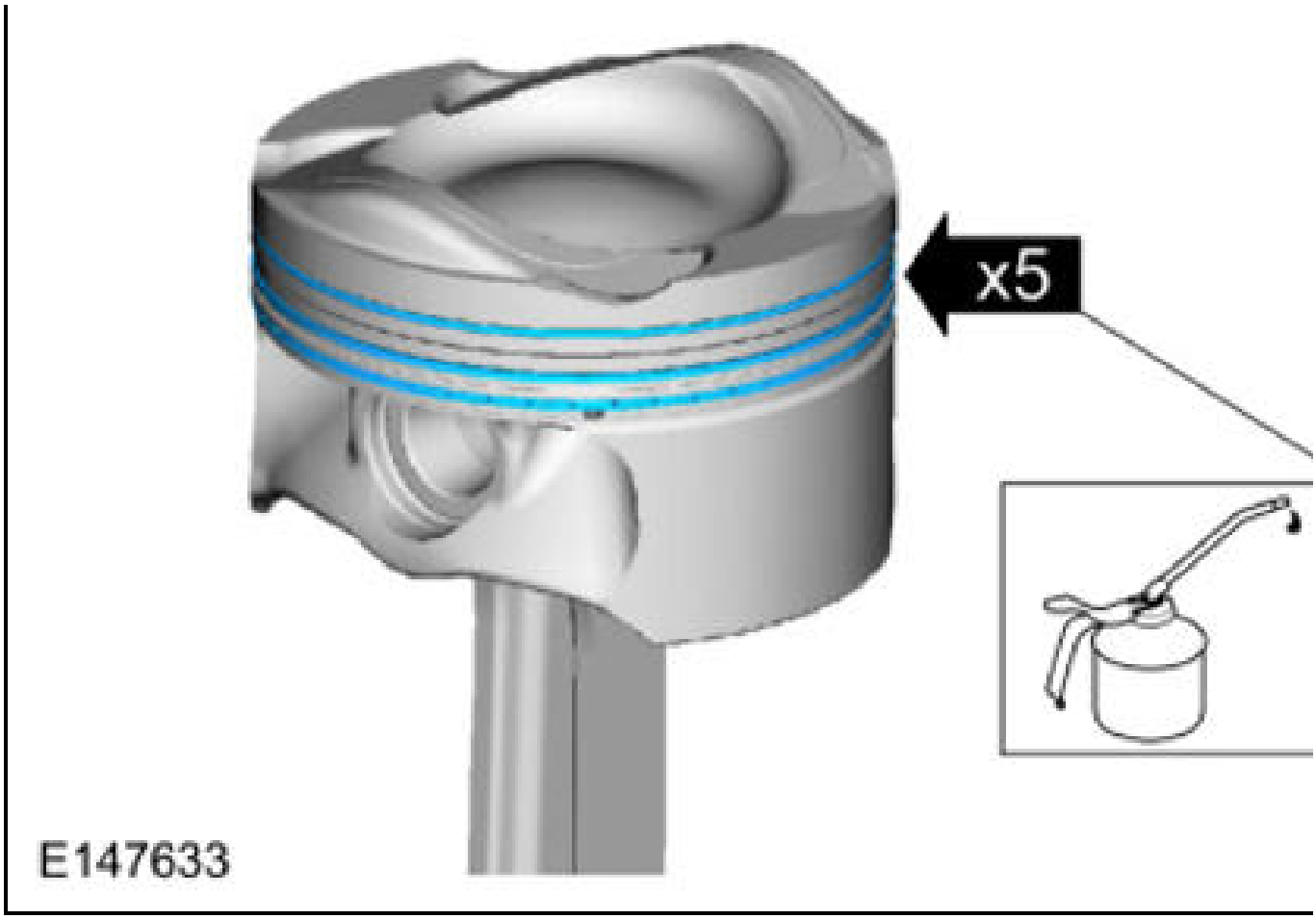
3. *Material* : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)



4.

4. 

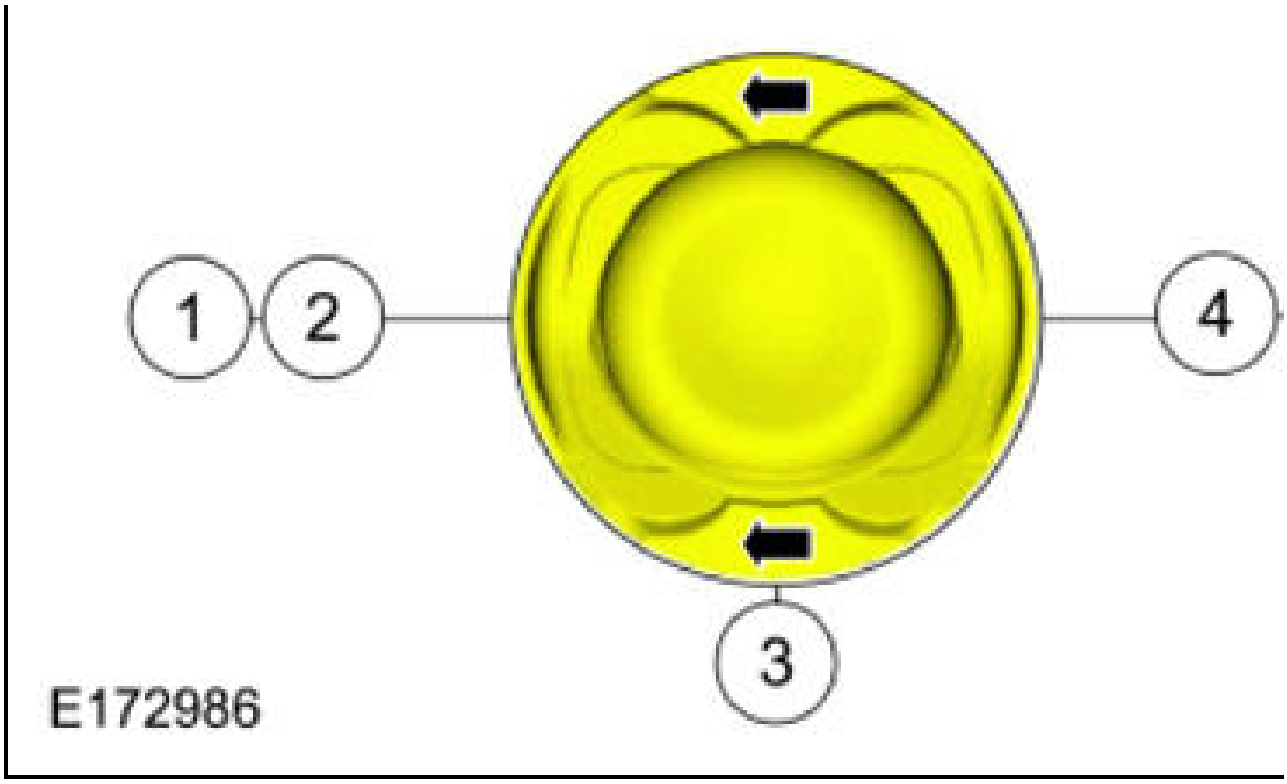
5. *Material* : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)



6. **NOTE: The upper and lower compression rings are to be fitted with the identification marks on the upper side.**

NOTE: Arrows faces the front of the engine.

1. Upper compression ring gap location.
2. Upper oil control segment ring gap location.
3. Expander ring gap location.
4. Lower oil control segment ring gap location.
5. Lower compression ring gap location.



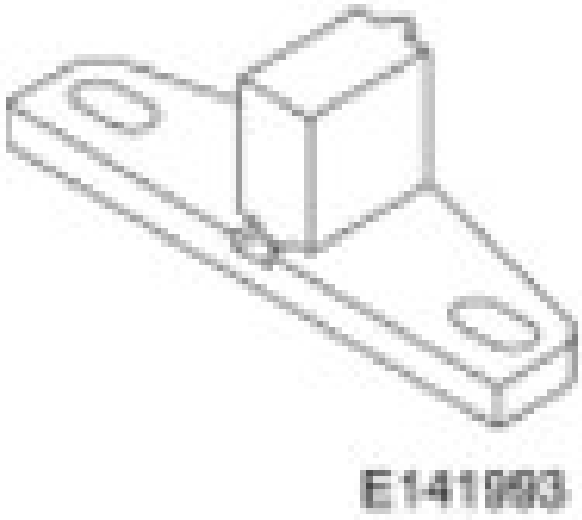
ASSEMBLY

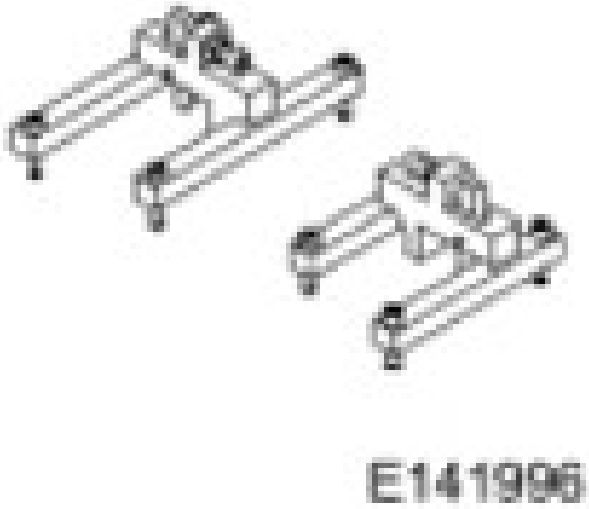
ENGINE

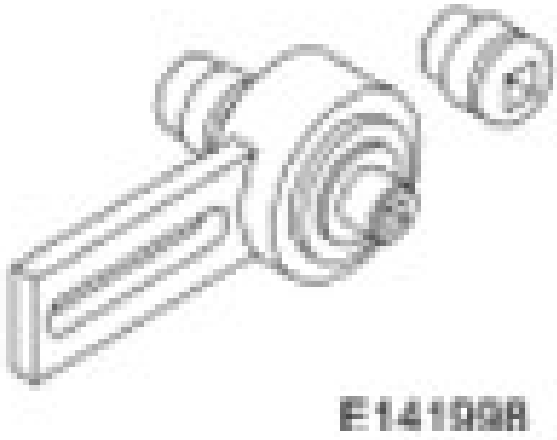
SPECIAL TOOL DESCRIPTION

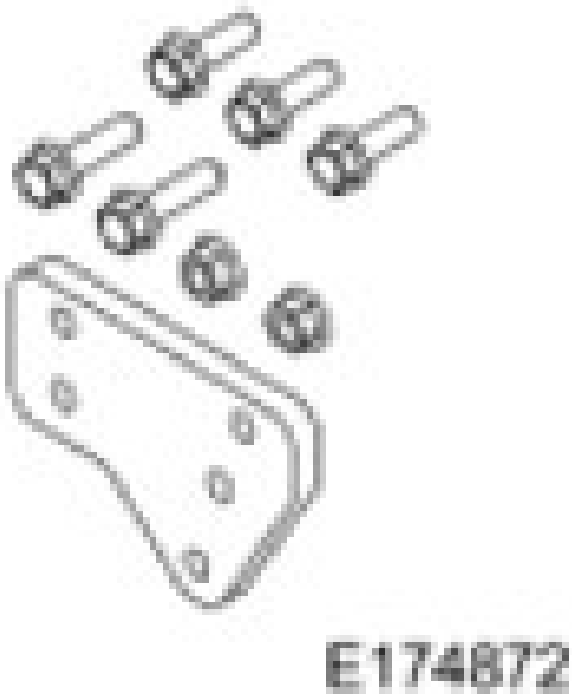
	100-002 (TOOL-4201-C) Holding Fixture with Dial Indicator Gauge

	
	**300-OTC1819E** 2, 200# Floor Crane, Fold Away

	303-1054 Locking Tool, Timing Belt Tensioner
	303-1602 Locking Tool, Crankshaft
	303-1604 Timing Peg, Crankshaft TDC

	
	303-1605 Alignment Tool, Camshaft
	303-1606 Locking Tool, Variable Camshaft Timing

 E141997	
 E141998	303-1611 Torque Multiplier
	303-1611-01 Adapter for 303-1611

 E141988	
 E174872	**303-1611-02** Adapter for 303-1611, Torque Multiplier TKIT-2014A-FL TKIT-2014A-ROW

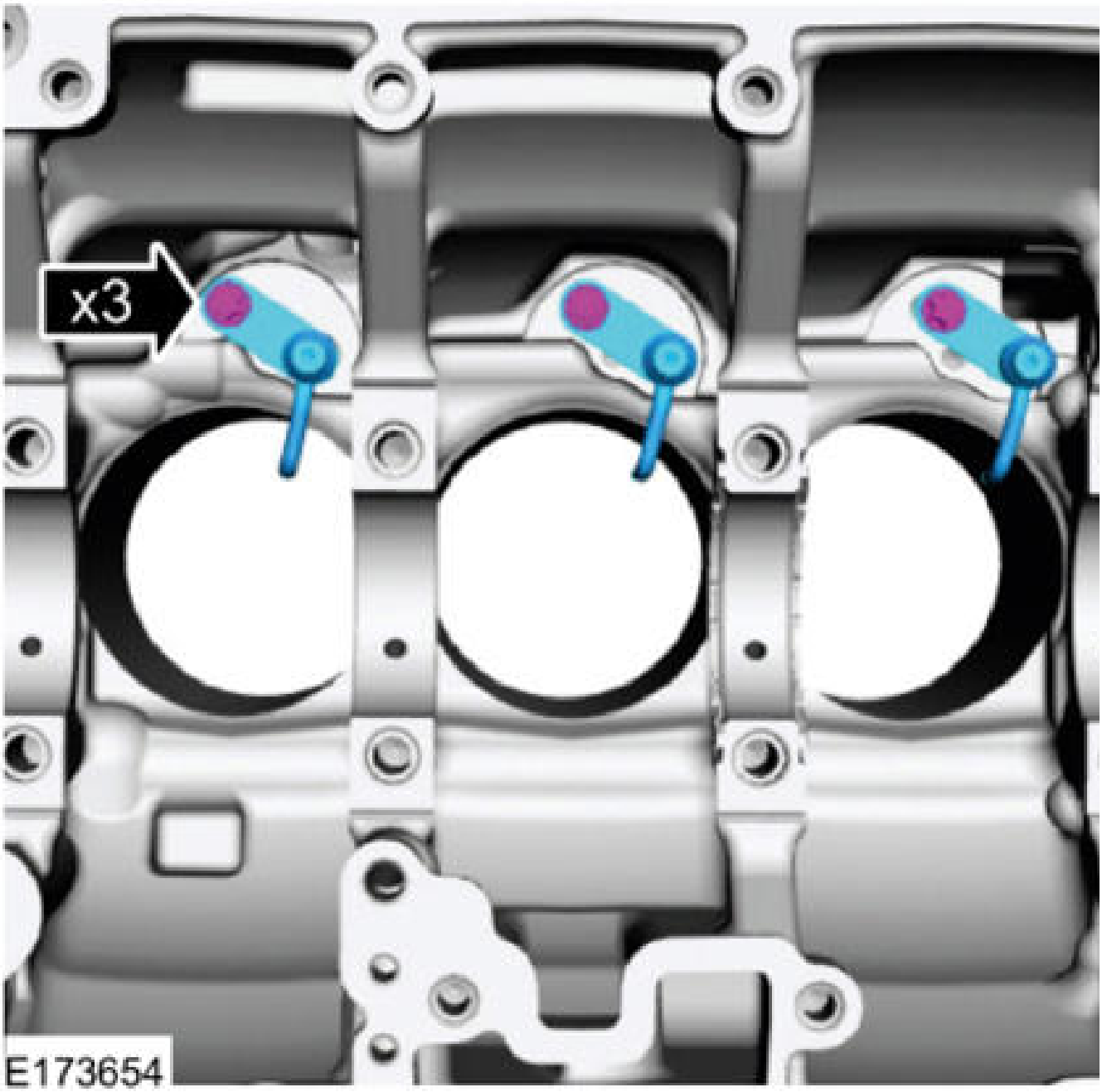
	310-128 Installer Set, Teflon Seal
Feeler Gauge	
Plastic Scraper	
Hose Clamp Remover/Installer	
Piston Ring Compressor	
Punch	
4 mm Drill Bit	

MATERIAL SPECIFICATIONS

Name	Specification
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.) XO-5W20-QSP (U.S.)	WSS-M2C945-A
Motorcraft® Metal Surface Prep ZC-31-B	-
Silicone Gasket and Sealant TA-30	WSE-M4G323-A4
Gasket Maker TA-16	WSK-M2G348-A5

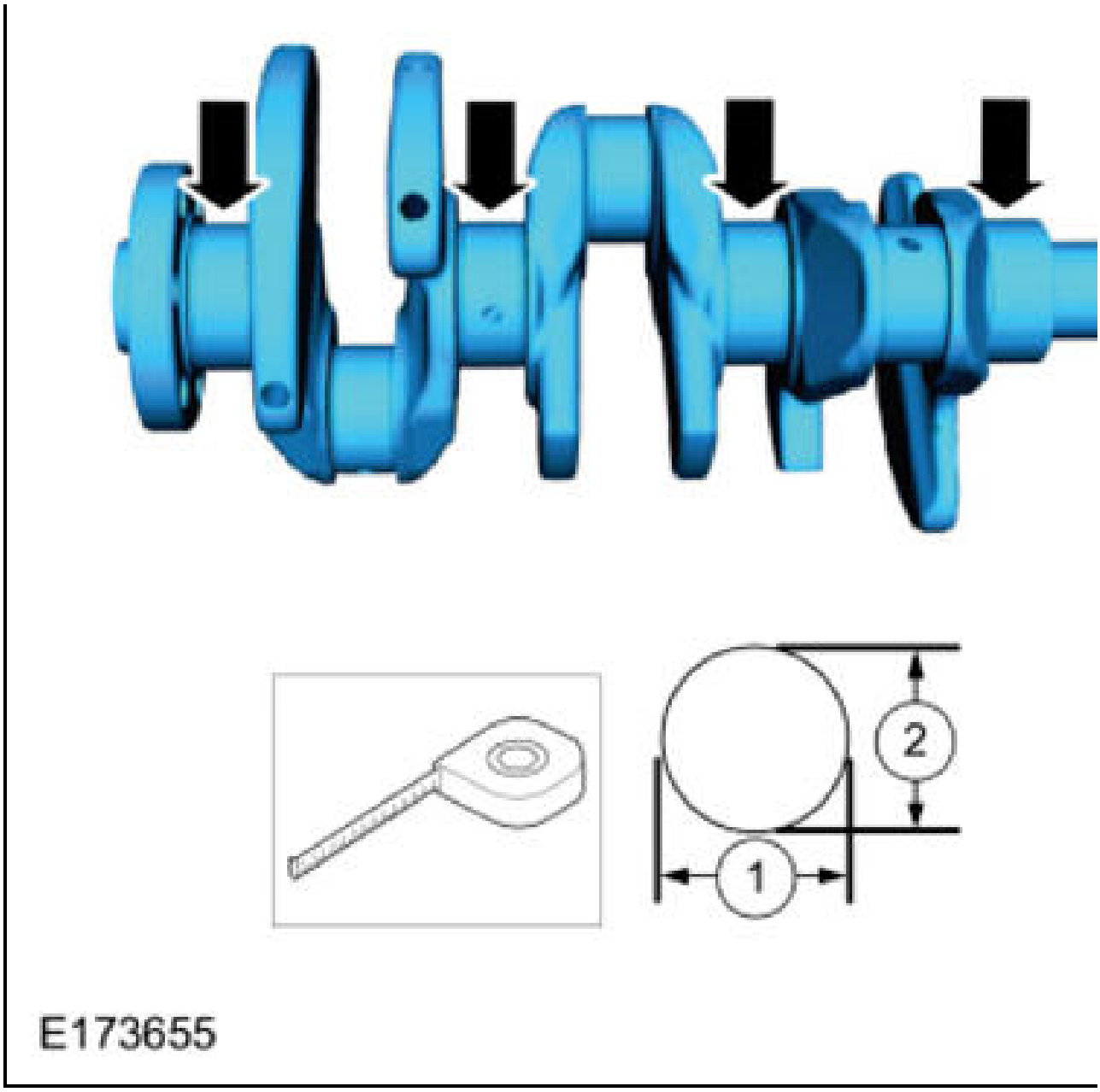
NOTE: During engine repair procedures, cleanliness is extremely important. All parts must be thoroughly cleaned and any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

1. *Torque* : 89 lb.in (10 Nm)



2.

- Measure the diameter in two directions.
- Record the smallest measurement for each crankshaft main bearing journal.



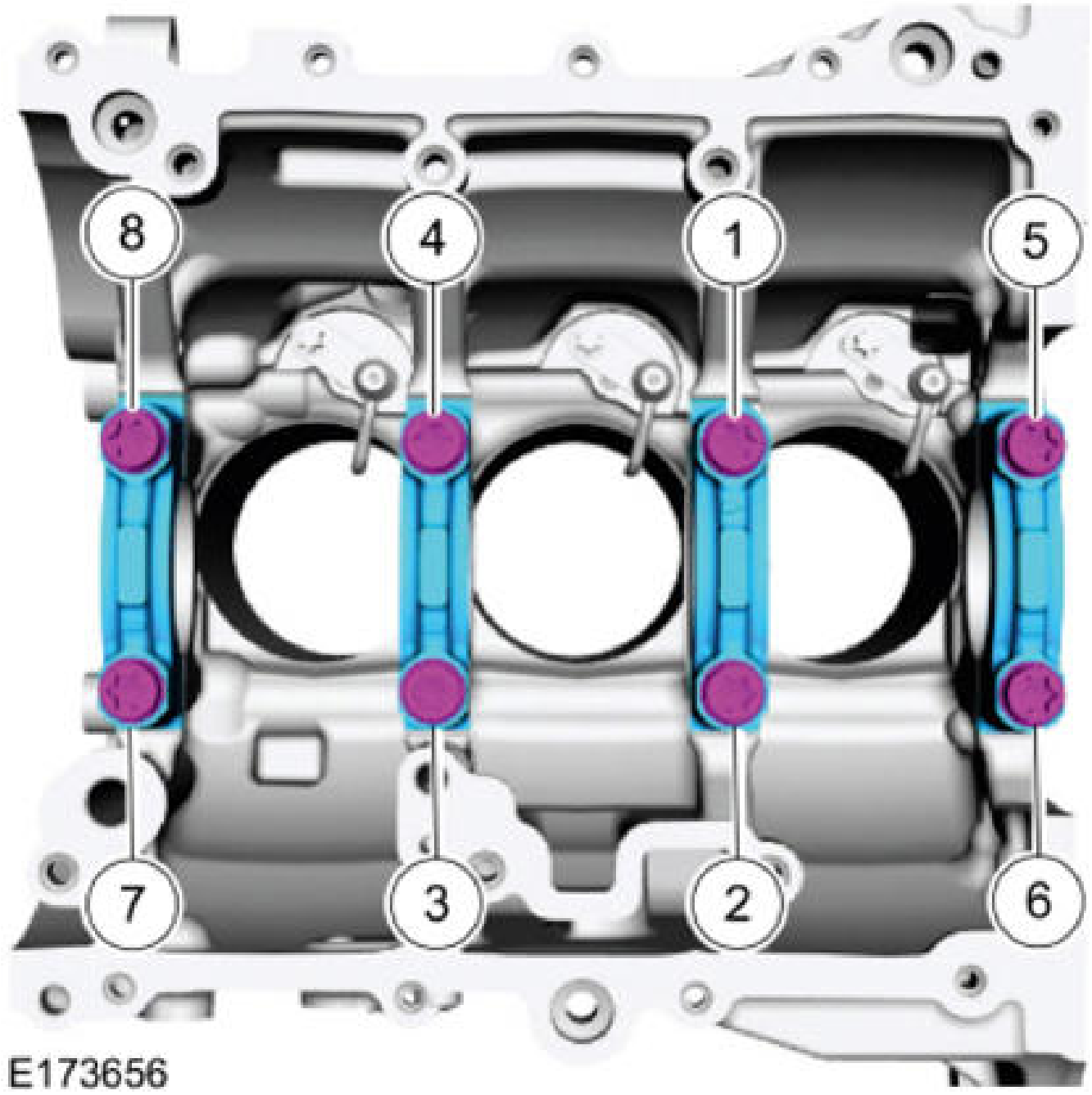
3. *Torque* :

   Stage 1: 89 lb.in (10 Nm)

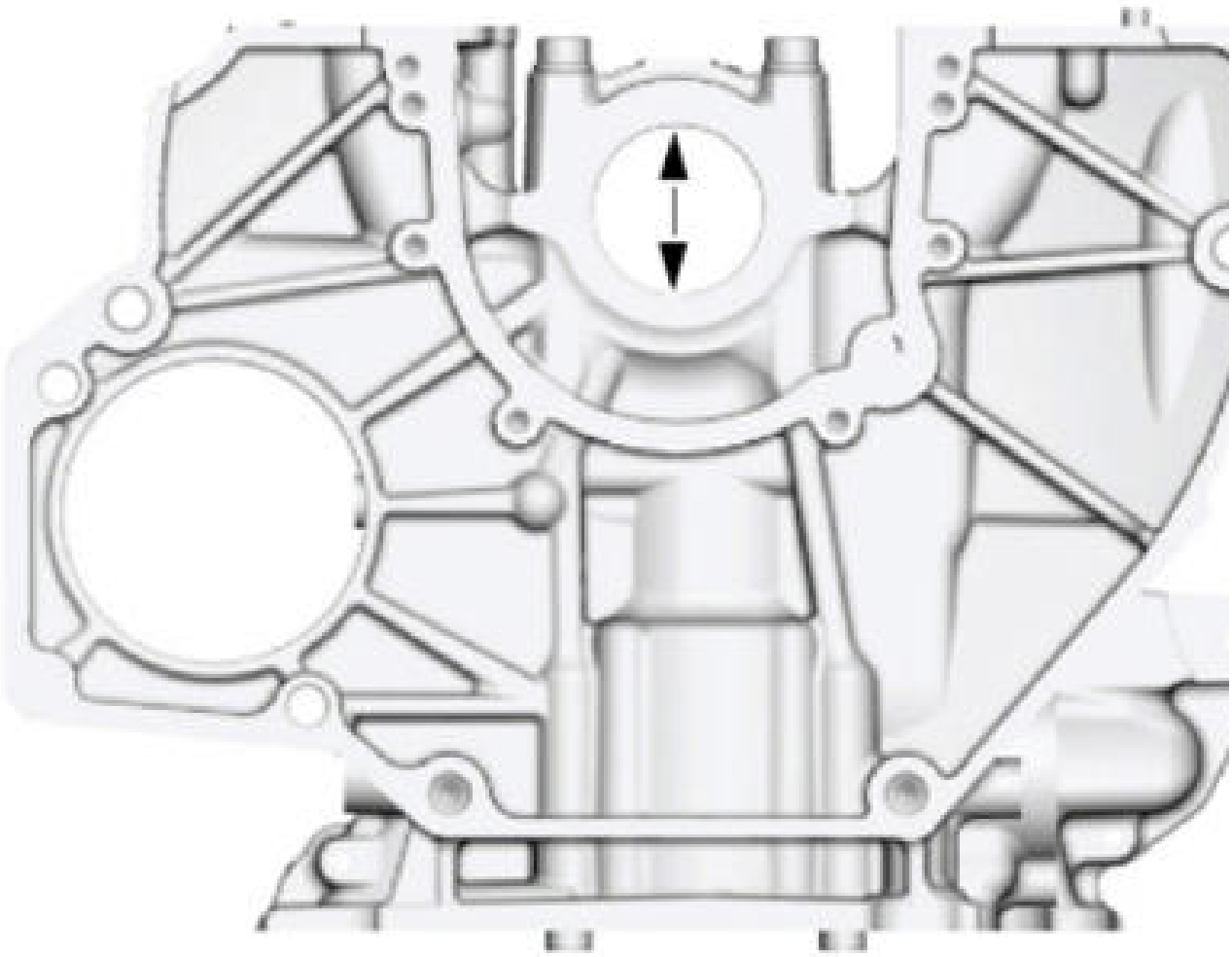
   Stage 2: 18 lb.ft (25 Nm)

   Stage 3: 22 lb.ft (30 Nm)

   Stage 4: 15°

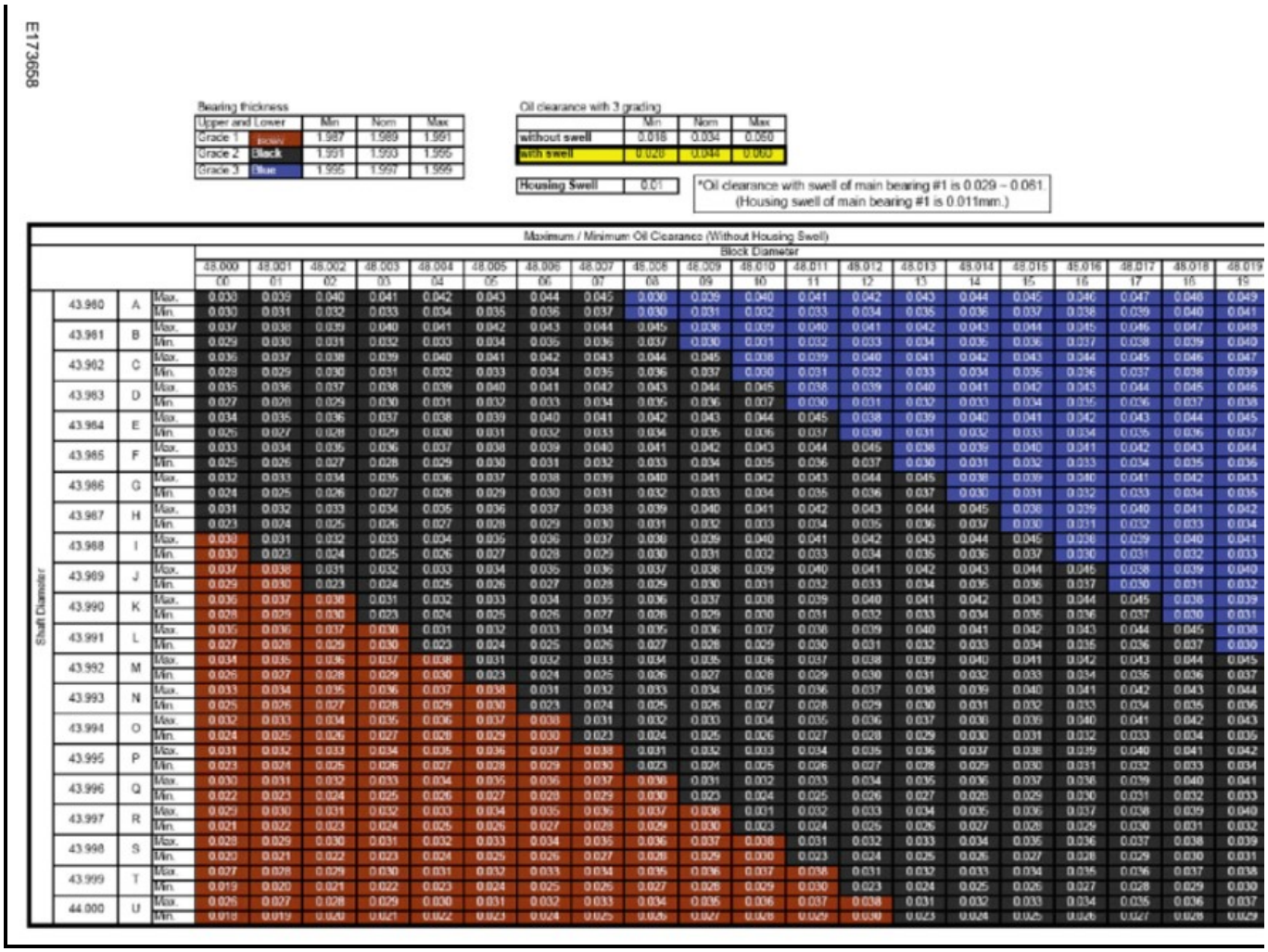


4. Measure each crankshaft block main bearing bore diameter.



E173657

5. Using the chart, select the crankshaft main bearings.



E174658

Bearing thickness

Upper and Lower		Min	Nom	Max
Grade 1	Brown	1.987	1.989	1.991
Grade 2	Black	1.991	1.993	1.995
Grade 3	Blue	1.995	1.997	1.999

Oil clearance with 3 grading

	Min	Nom	Max
without swell	0.016	0.034	0.060
with swell	0.029	0.044	0.060

Housing Swell	0.01

*Oil clearance with swell of main bearing #1 is 0.029 – 0.061. (Housing swell of main bearing #1 is 0.011mm.)

Maximum / Minimum Oil Clearance (Without Housing Swell)

Shaft Diameter				Block Diameter																		
				48.000	48.001	48.002	48.003	48.004	48.005	48.006	48.007	48.008	48.009	48.010	48.011	48.012	48.013	48.014	48.015	48.016	48.017	48.018	48.019
				00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19
43.980	A	Max.		0.030	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.030	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.046	0.047	0.048	0.049
		Min.		0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041
43.981	B	Max.		0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.046	0.047	0.048
		Min.		0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040
43.982	C	Max.		0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.046	0.047
		Min.		0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039
43.983	D	Max.		0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.046
		Min.		0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038
43.984	E	Max.		0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045
		Min.		0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037
43.985	F	Max.		0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.038	0.039	0.040	0.041	0.042	0.043	0.044
		Min.		0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030	0.031	0.032	0.033	0.034	0.035	0.036
43.986	G	Max.		0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.038	0.039	0.040	0.041	0.042	0.043
		Min.		0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030	0.031	0.032	0.033	0.034	0.035
43.987	H	Max.		0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.038	0.039	0.040	0.041	0.042
		Min.		0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030	0.031	0.032	0.033	0.034
43.988	I	Max.		0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.036	0.039	0.040	0.041
		Min.		0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030	0.031	0.032	0.033
43.989	J	Max.		0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.038	0.039	0.040
		Min.		0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030	0.031	0.032
43.990	K	Max.		0.036	0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.038	0.039
		Min.		0.028	0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030	0.031
43.991	L	Max.		0.035	0.036	0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045	0.038
		Min.		0.027	0.028	0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.030
43.992	M	Max.		0.034	0.035	0.036	0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044	0.045
		Min.		0.026	0.027	0.028	0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037
43.993	N	Max.		0.033	0.034	0.035	0.036	0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043	0.044
		Min.		0.025	0.026	0.027	0.028	0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036
43.994	O	Max.		0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042	0.043
		Min.		0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035
43.995	P	Max.		0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041	0.042
		Min.		0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034
43.996	Q	Max.		0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040	0.041
		Min.		0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033
43.997	R	Max.		0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039	0.040
		Min.		0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032
43.998	S	Max.		0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.039
		Min.		0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031
43.999	T	Max.		0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038
		Min.		0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030
44.000	U	Max.		0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037	0.038	0.031	0.032	0.033	0.034	0.035	0.036	0.037
		Min.		0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.023	0.024	0.025	0.026	0.027	0.028	0.029

6. Original connecting rod cap bolts.

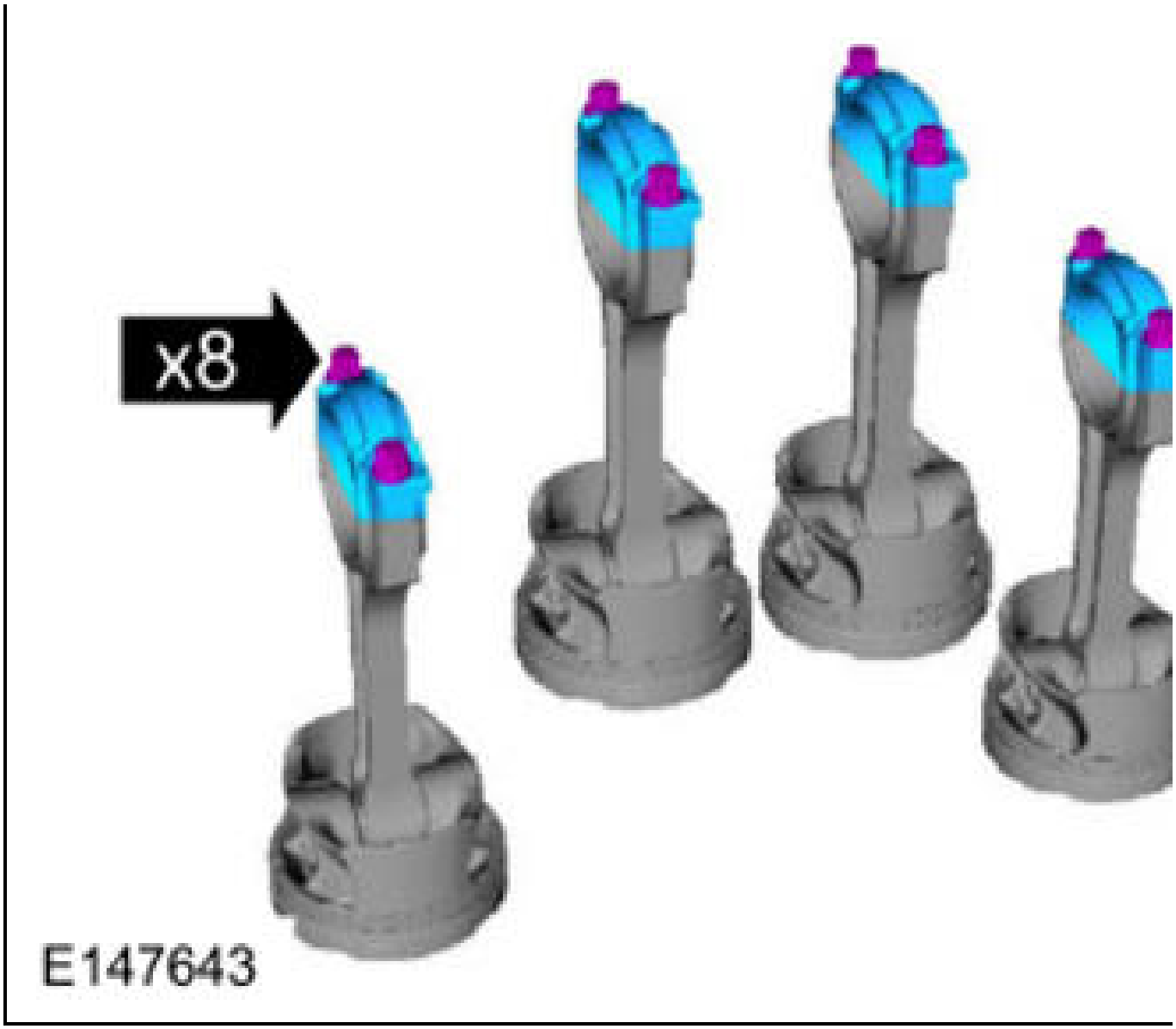
   Torque :

   Stage 1: 71 lb.in (8 Nm)

   Stage 2: 106 lb.in (12 Nm)

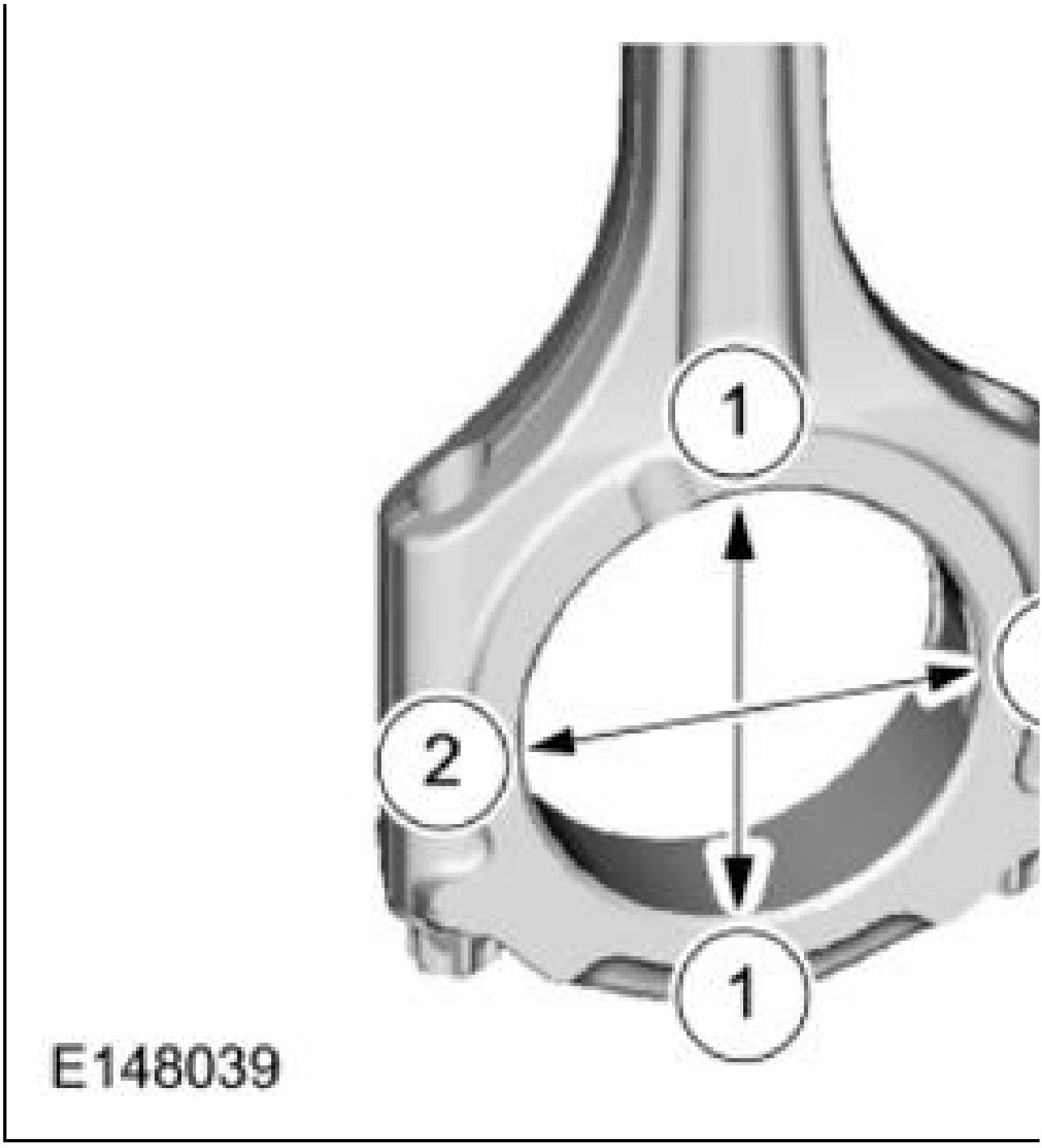
   Stage 3: 159 lb.in (18 Nm)

   Stage 4: 35°

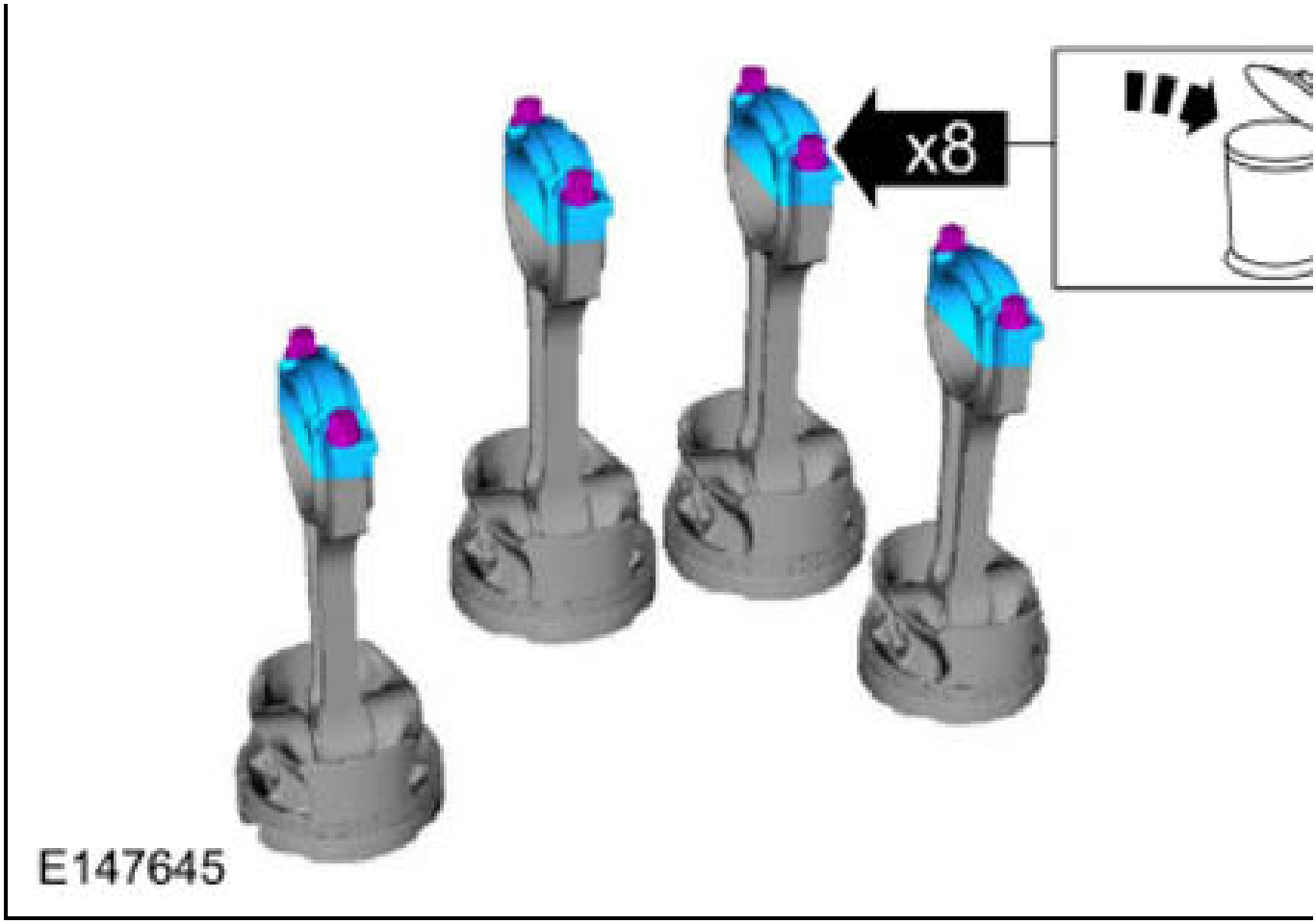


7.

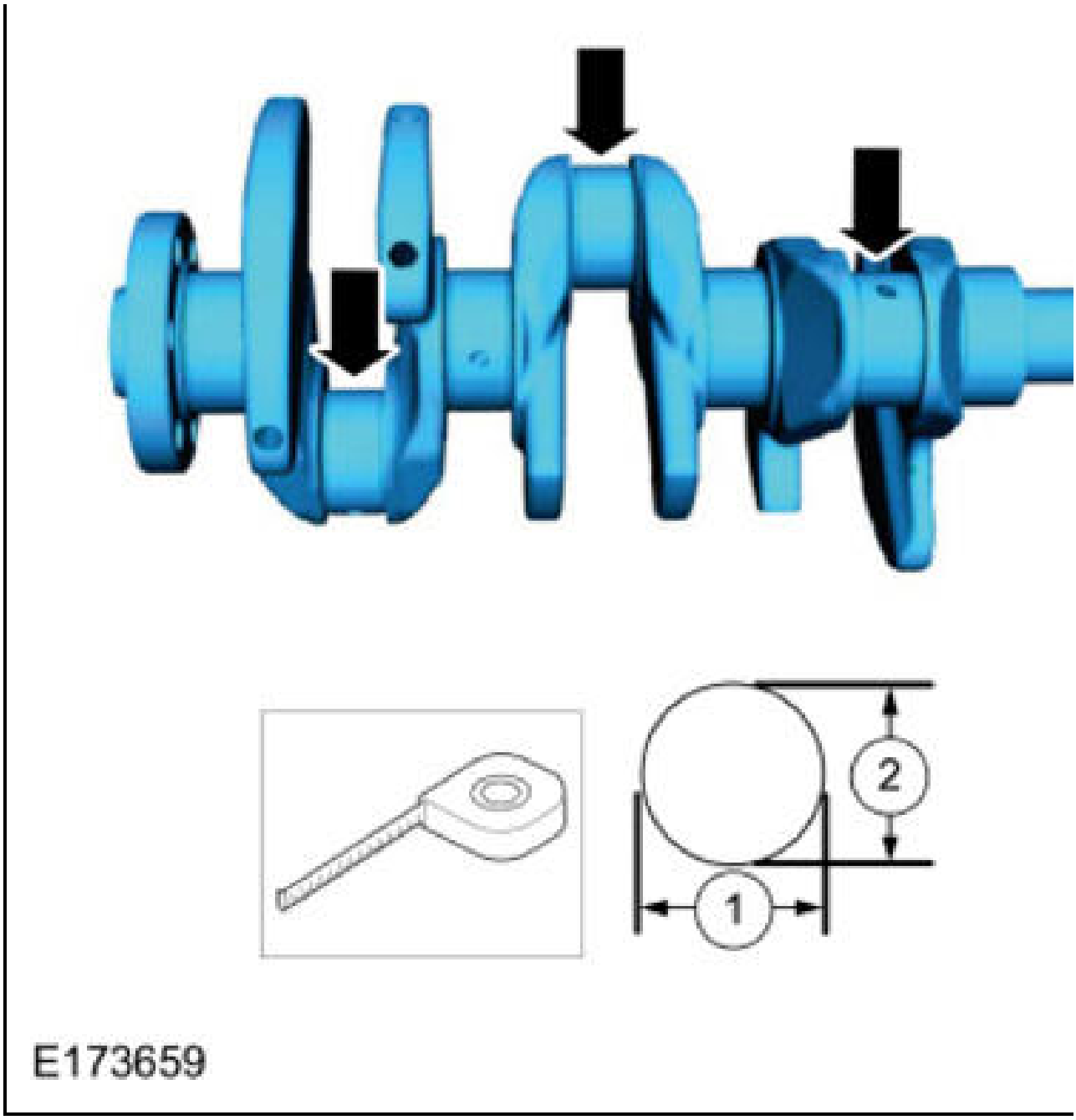
- Measure the diameter in two directions.
- Record the smallest measurement for each connecting rod.



8.

8. 

9.
- Measure the diameter in two directions.
- Record the smallest measurement for each connecting rod journal.



10. Using the chart, select the correct connecting rod bearings for each crankshaft connecting rod journal.

Bearing thickness

Upper and Lower		Min	Nom	Max
Grade 1	Brown	1.491	1.493	1.495
Grade 2	Black	1.495	1.497	1.499
Grade 3	Blue	1.499	1.501	1.503

Oil clearance with 3 grading

	Min	Nom	Max
without swell	0.010	0.024	0.038
with swell	0.020	0.034	0.048

Housing Swell	0.01

Maximum / Minimum Oil Clearance (Without Housing Swell)

Shaft Diameter				43.000 00	43.001 01	43.002 02	43.003 03	43.004 04	43.005 05	43.006 06	43.007 07	43.008 08	43.009 09	43.010 10	43.011 11	43.012 12	43.013 13	43.014 14	43.015 15
39.980	A	Max.		0.030	0.031	0.032	0.033	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036	0.037
		Min.		0.022	0.023	0.024	0.025	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029
39.981	B	Max.		0.029	0.030	0.031	0.032	0.033	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035	0.036
		Min.		0.021	0.022	0.023	0.024	0.025	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028
39.982	C	Max.		0.028	0.029	0.030	0.031	0.032	0.033	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034	0.035
		Min.		0.020	0.021	0.022	0.023	0.024	0.025	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027
39.983	D	Max.		0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.034
		Min.		0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.026
39.984	E	Max.		0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033
		Min.		0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025
39.985	F	Max.		0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.026	0.027	0.028	0.029	0.030	0.031	0.032
		Min.		0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.018	0.019	0.020	0.021	0.022	0.023	0.024
39.986	G	Max.		0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.026	0.027	0.028	0.029	0.030	0.031
		Min.		0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.018	0.019	0.020	0.021	0.022	0.023
39.987	H	Max.		0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.026	0.027	0.028	0.029	0.030
		Min.		0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.018	0.019	0.020	0.021	0.022
39.988	I	Max.		0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.026	0.027	0.028	0.029
		Min.		0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.018	0.019	0.020	0.021
39.989	J	Max.		0.029	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.026	0.027	0.028
		Min.		0.021	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.018	0.019	0.020
39.990	K	Max.		0.028	0.029	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.026	0.027
		Min.		0.020	0.021	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.018	0.019
39.991	L	Max.		0.027	0.028	0.029	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033	0.026
		Min.		0.019	0.020	0.021	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.018
39.992	M	Max.		0.026	0.027	0.028	0.029	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032	0.033
		Min.		0.018	0.019	0.020	0.021	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025
39.993	N	Max.		0.025	0.026	0.027	0.028	0.029	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031	0.032
		Min.		0.017	0.018	0.019	0.020	0.021	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023	0.024
39.994	O	Max.		0.024	0.025	0.026	0.027	0.028	0.029	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030	0.031
		Min.		0.016	0.017	0.018	0.019	0.020	0.021	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.022	0.023
39.995	P	Max.		0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.030
		Min.		0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.022
39.996	Q	Max.		0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029
		Min.		0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021
39.997	R	Max.		0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.022	0.023	0.024	0.025	0.026	0.027	0.028
		Min.		0.013	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.014	0.015	0.016	0.017	0.018	0.019	0.020
39.998	S	Max.		0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.022	0.023	0.024	0.025	0.026	0.027
		Min.		0.012	0.013	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.014	0.015	0.016	0.017	0.018	0.019
39.999	T	Max.		0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.022	0.023	0.024	0.025	0.026
		Min.		0.011	0.012	0.013	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.014	0.015	0.016	0.017	0.018
40.000	U	Max.		0.018	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.027	0.028	0.029	0.022	0.023	0.024	0.025
		Min.		0.010	0.011	0.012	0.013	0.014	0.015	0.016	0.017	0.018	0.019	0.020	0.021	0.014	0.015	0.016	0.017

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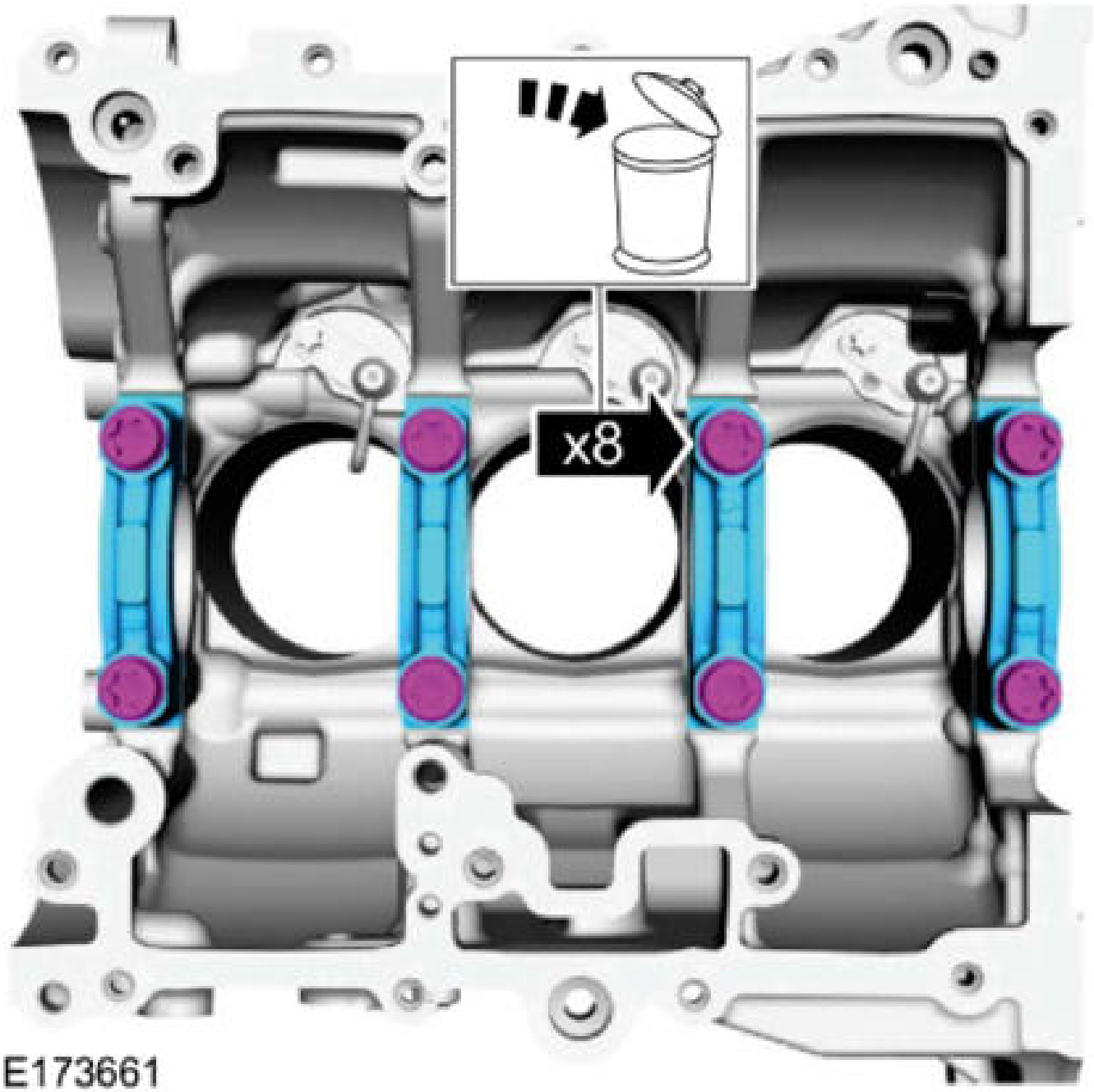
11.

11.

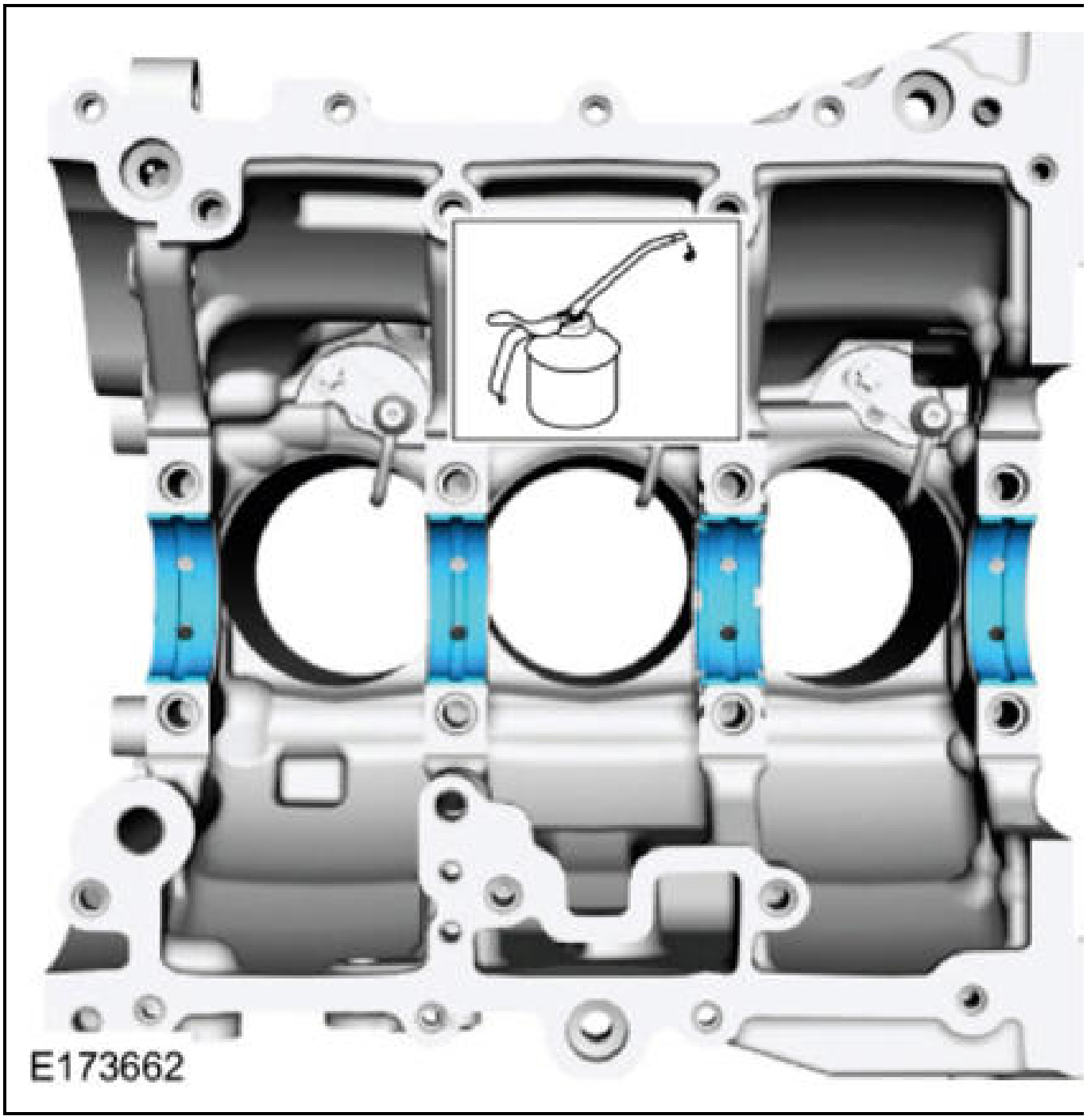


12.

NOTE: **Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.**

NOTE: **If reusing the crankshaft main bearings, install them in their original positions and orientation as noted during disassembly.**

Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

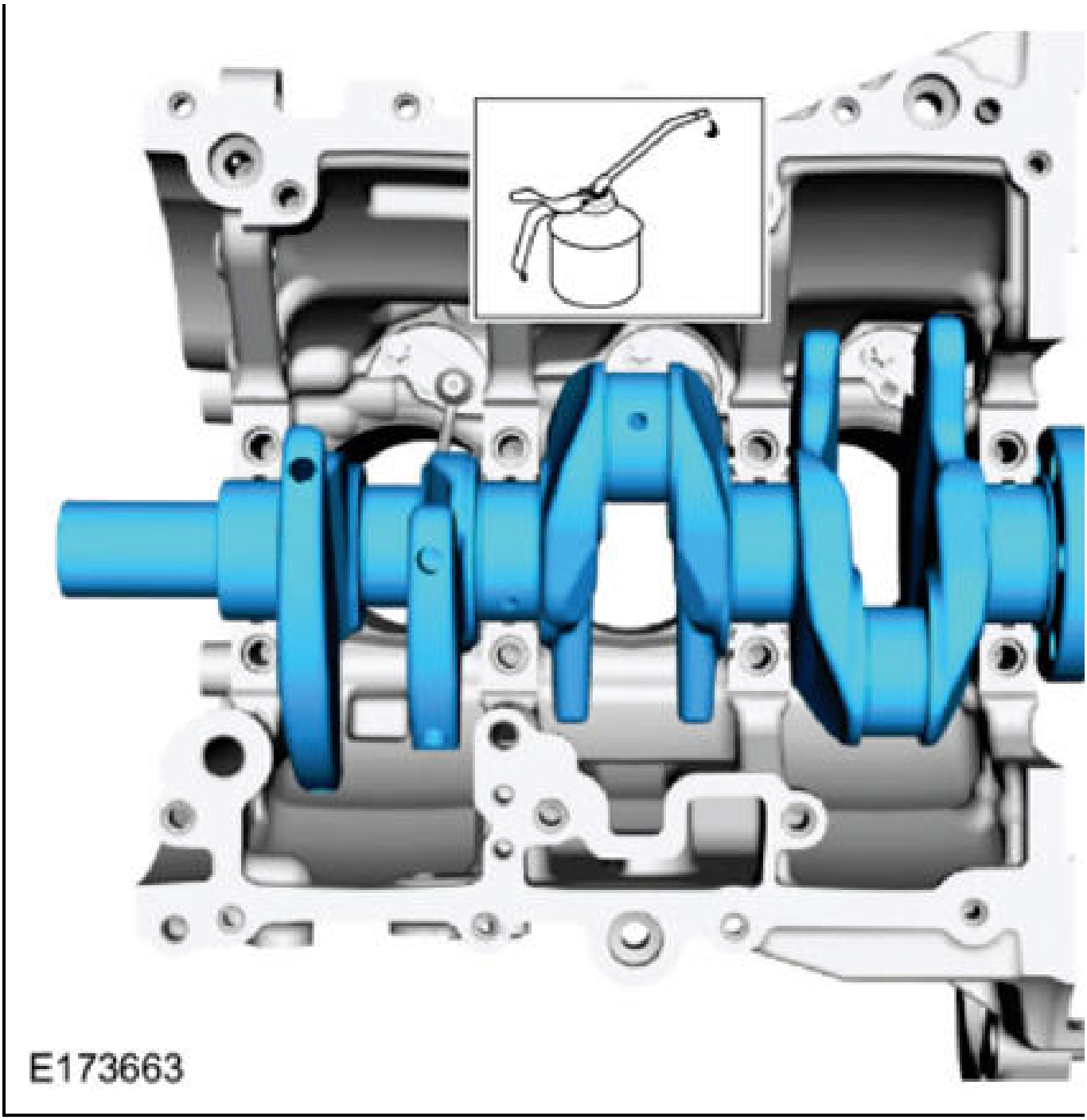


13. **NOTE: If reusing the crankshaft main bearings, install them in their original positions and orientation as noted during disassembly.**

Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.)

(WSS-M2C945-A)

14. *Material* : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)



15. *Material* : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

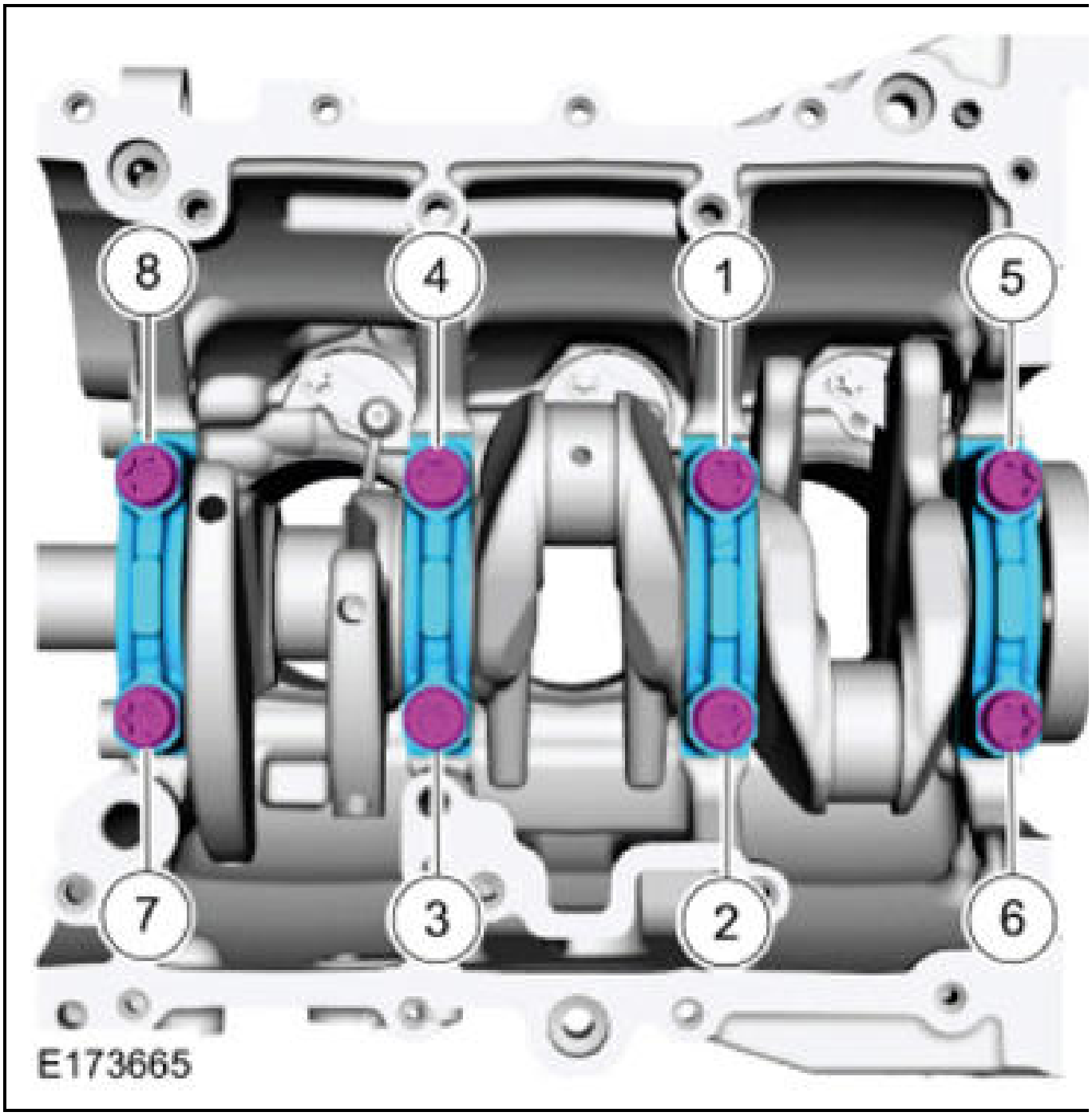
    Torque :

    Stage 1: 89 lb.in (10 Nm)

    Stage 2: 18 lb.ft (25 Nm)

Stage 3: 22 lb.ft (30 Nm)

Stage 4: 15°

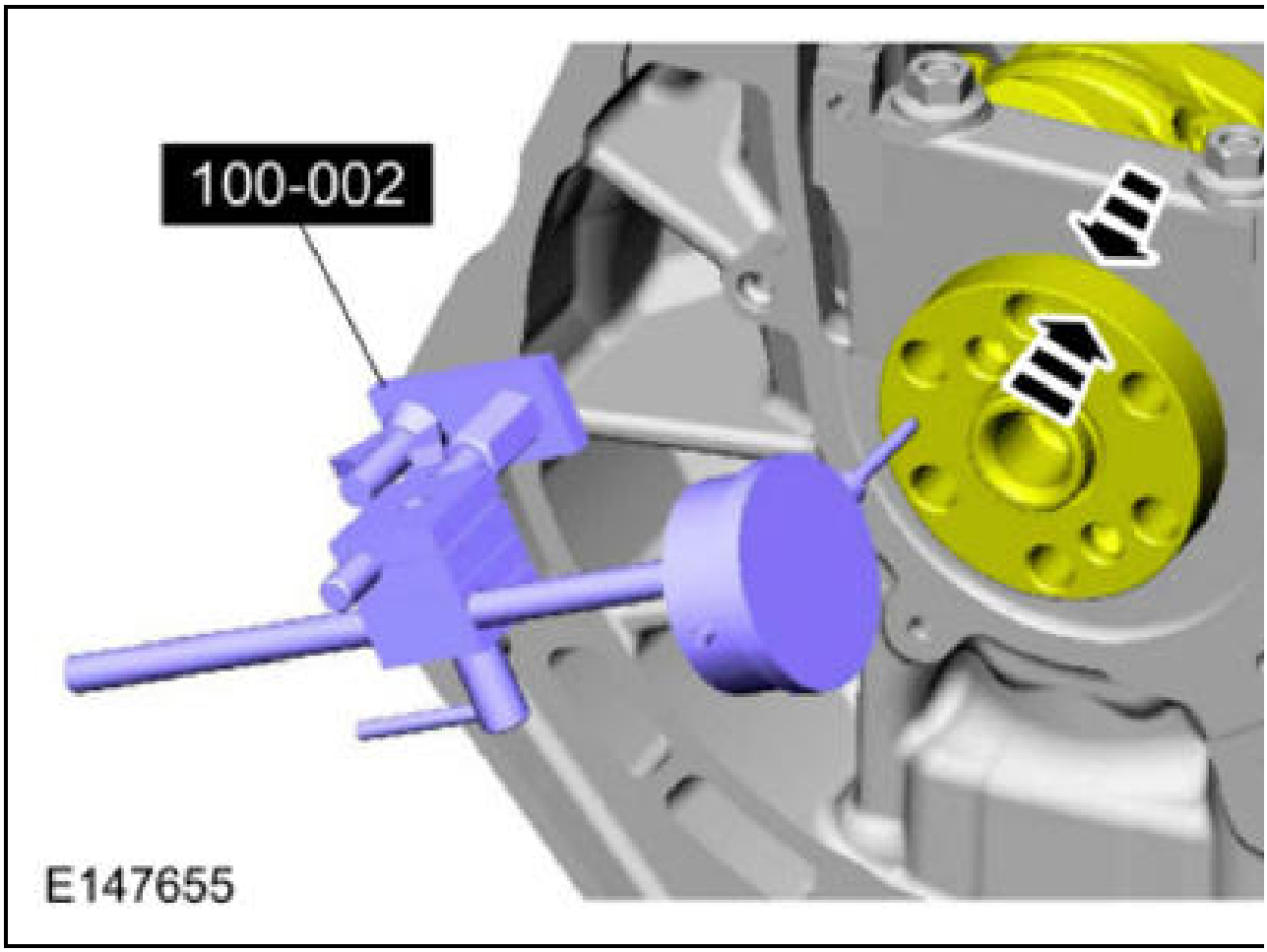


16.

- Position the crankshaft to the rear of the cylinder block.
- Zero the Dial Indicator Gauge with Holding Fixture.

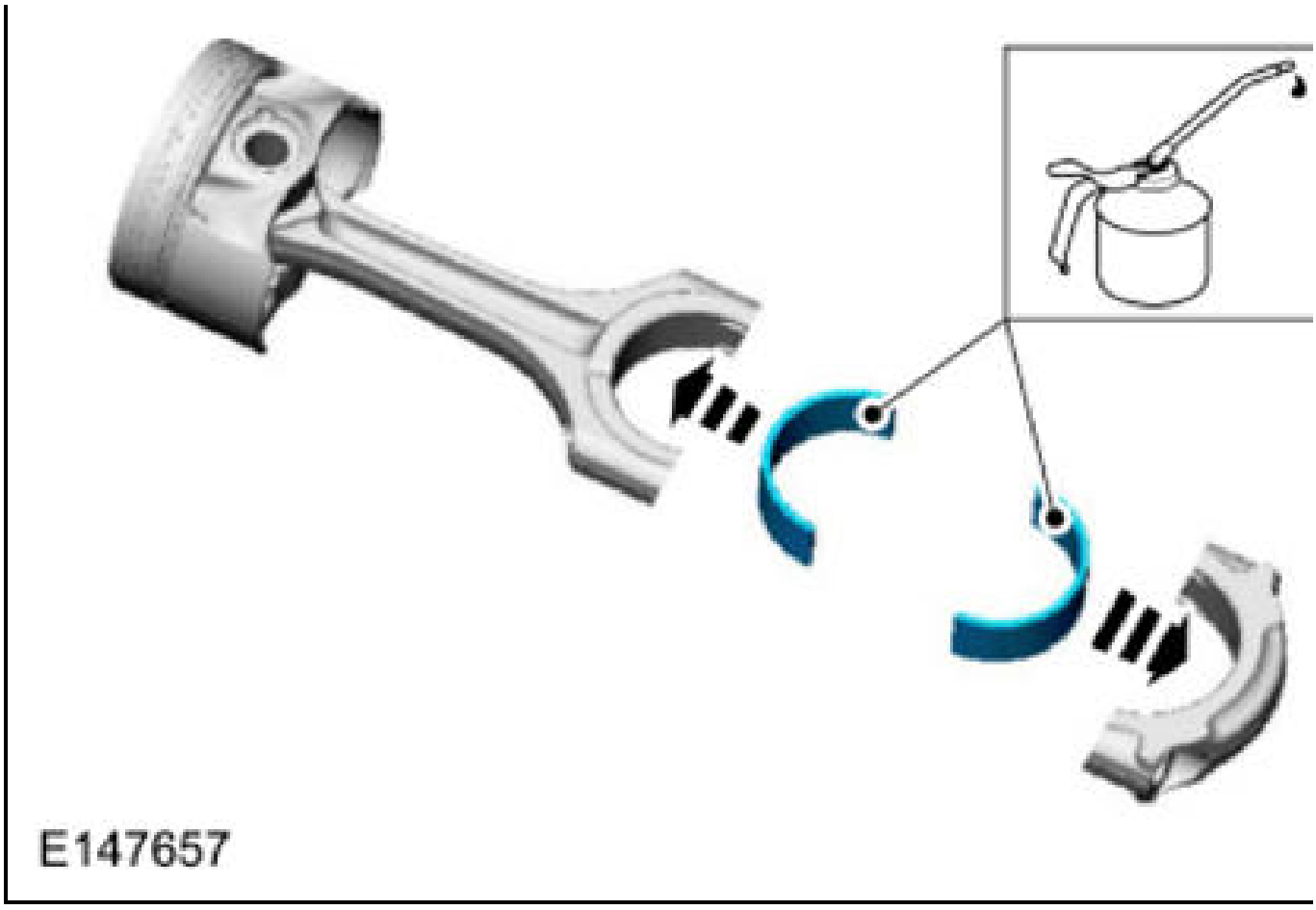
Use Special Service Tool: **100-002 (TOOL-4201-C) Holding Fixture with Dial Indicator Gauge** .

- Move the crankshaft to the front of the cylinder block. Note and record the crankshaft end play.
- Acceptable crankshaft end play is 0.220-0.450 mm (0.0087-0.0177 in). If the crankshaft end play exceeds the specified range, install new parts as necessary.



17. **NOTE: If reusing the connecting rod bearings, install them in their original positions and orientation as noted during disassembly.**

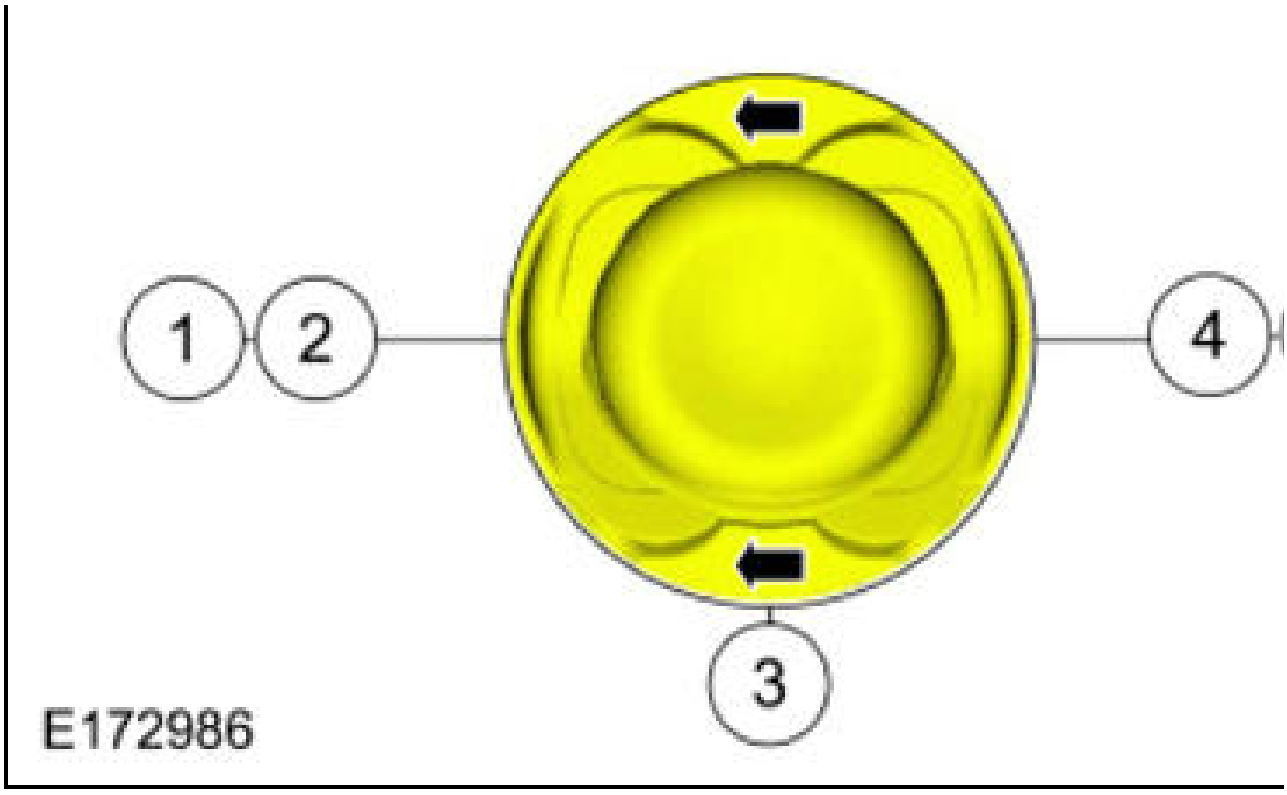
Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)



18. **NOTE: The upper and lower compression rings are to be fitted with the identification marks on the upper side.**

NOTE: Arrows face the front of the engine.

1. Upper compression ring gap location.
2. Upper oil control segment ring gap location.
3. Expander ring gap location.
4. Lower oil control segment ring gap location.
5. Lower compression ring gap location.



19.

NOTE: **Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Push the piston down until the connecting rod bearing seats on the crankshaft journal.**

NOTE: **Make sure the piston arrow on top is facing toward the front of the engine.**

Use the General Equipment: Piston Ring Compressor

Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

20. **NOTE: The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.**

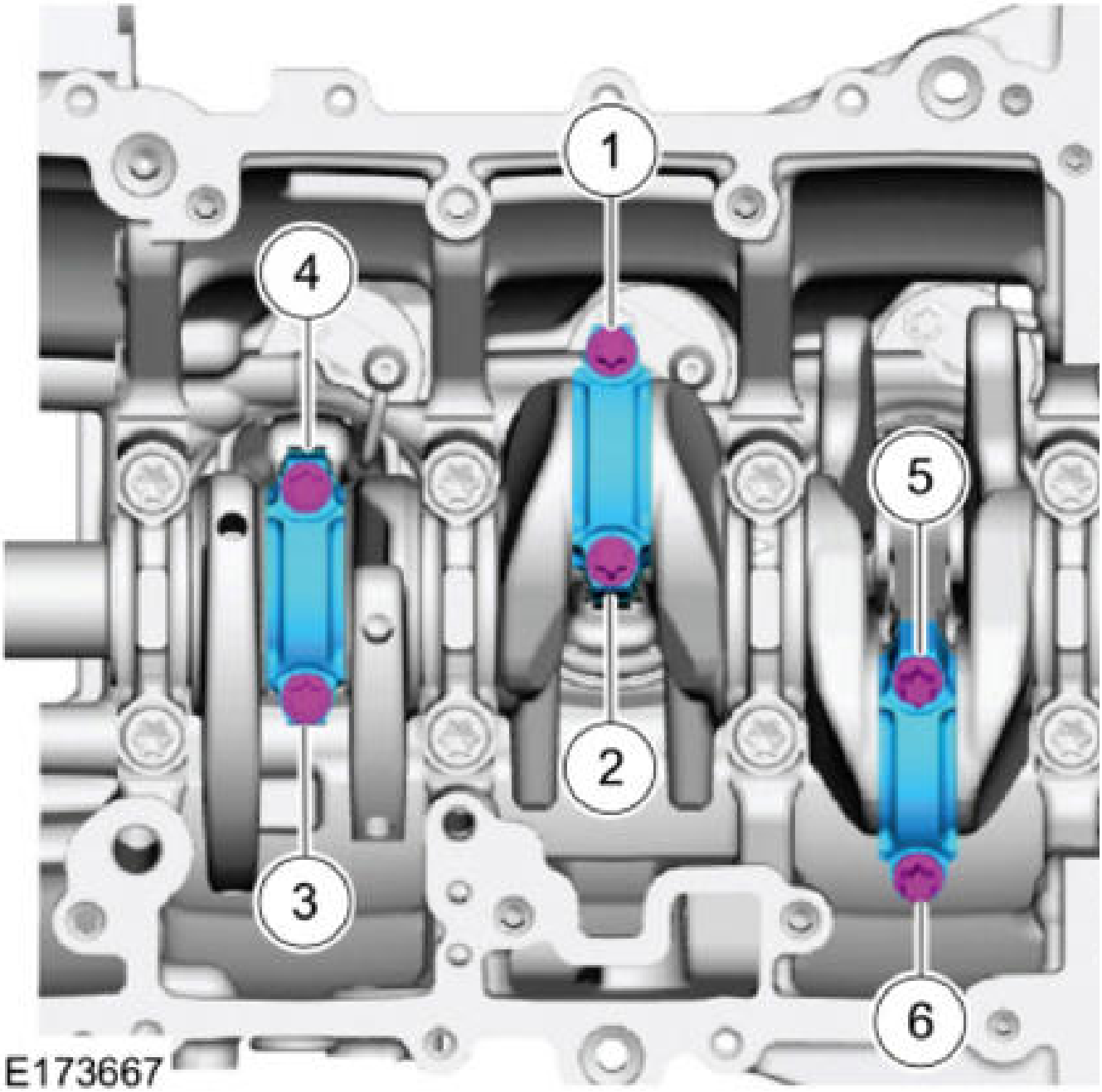
Torque :

Stage 1: 71 lb.in (8 Nm)

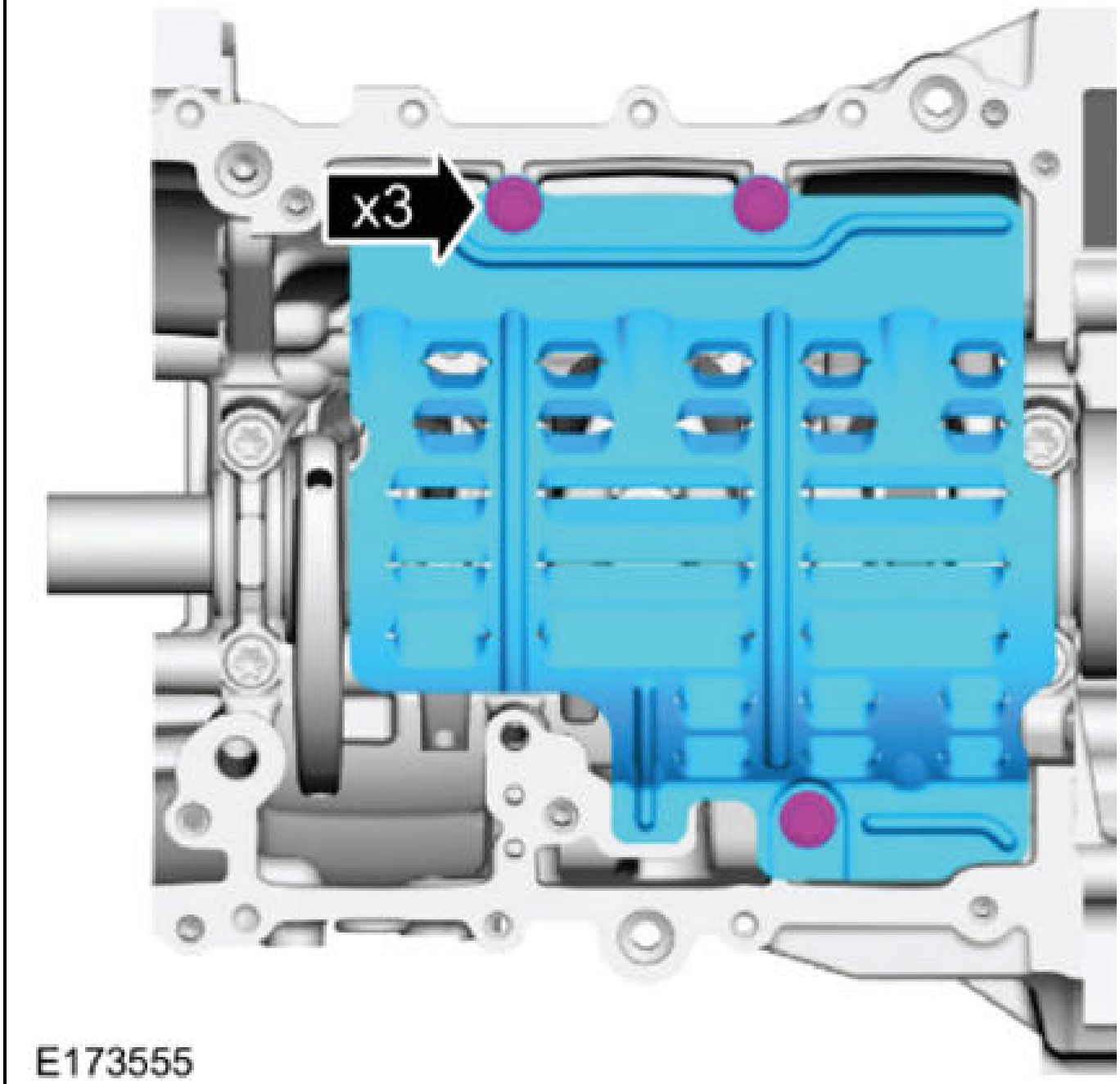
Stage 2: 106 lb.in (12 Nm)

Stage 3: 159 lb.in (18 Nm)

Stage 4: 35°



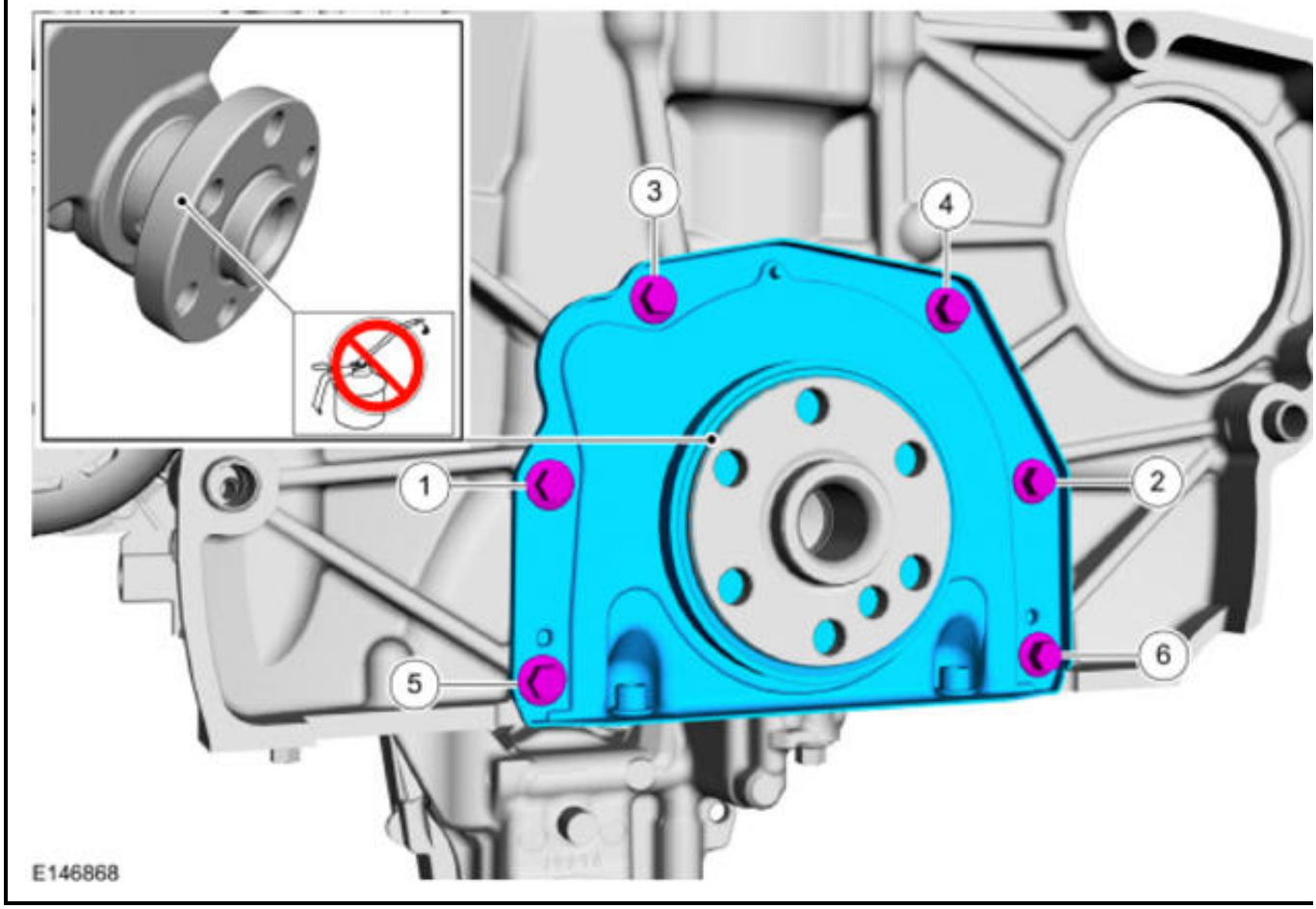
21. *Torque* : 17 lb.ft (23 Nm)



22. **NOTE:** **Make sure that the mating faces are clean and free of foreign material.**

NOTE: **New crankshaft rear seal carriers are supplied with an alignment sleeve which must be removed after installation.**

Torque : 89 lb.in (10 Nm)



23. **NOTE: Make sure that new bolts are installed.**

- Use Special Service Tool: 303-1602 Locking Tool, Crankshaft.

  Torque :

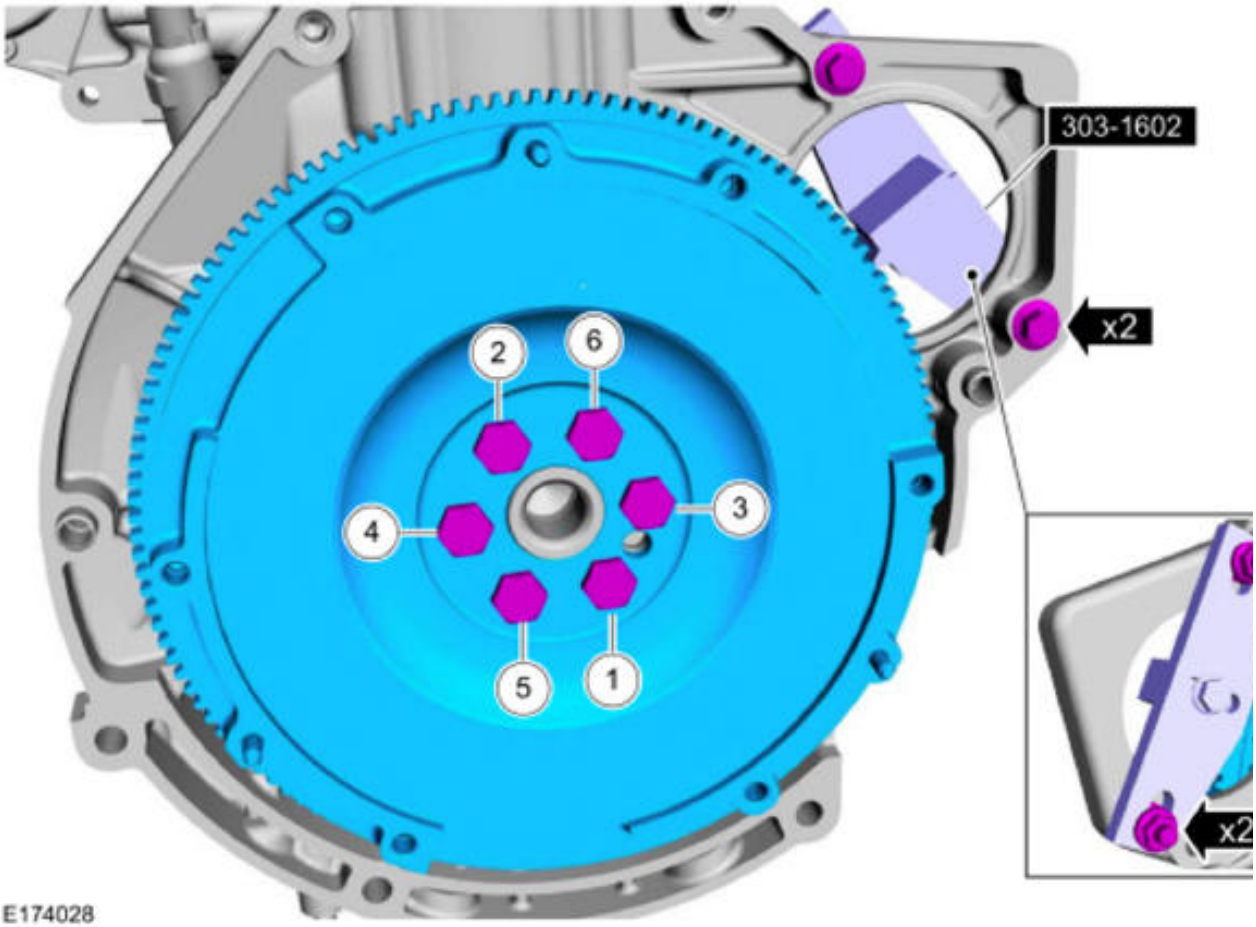
  2-7:

  Stage 1: 18 lb.ft (25 Nm)

  Stage 2: 37 lb.ft (50 Nm)

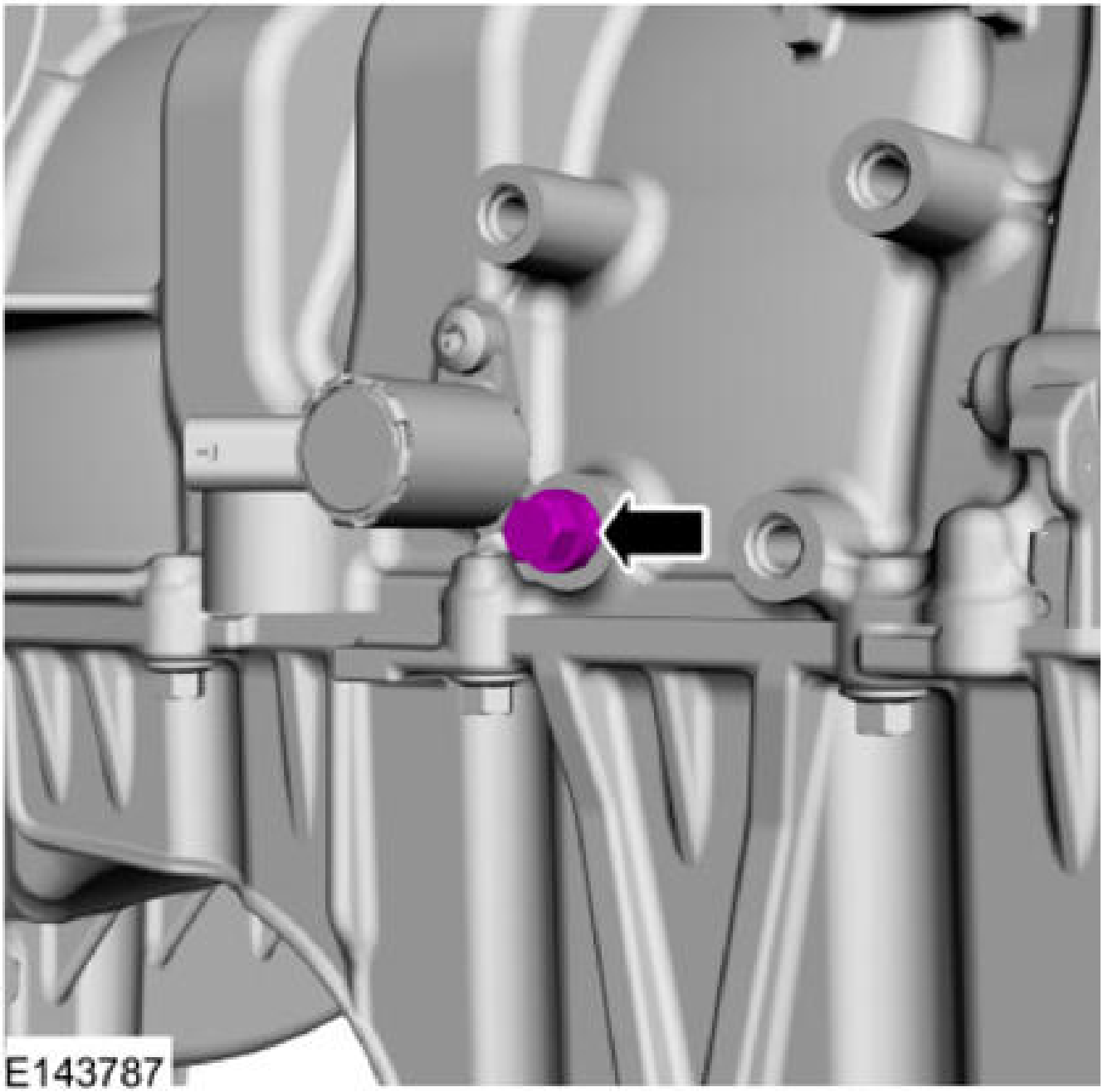
  Stage 3: 90°

- Remove Special Service Tool: 303-1602 Locking Tool, Crankshaft.

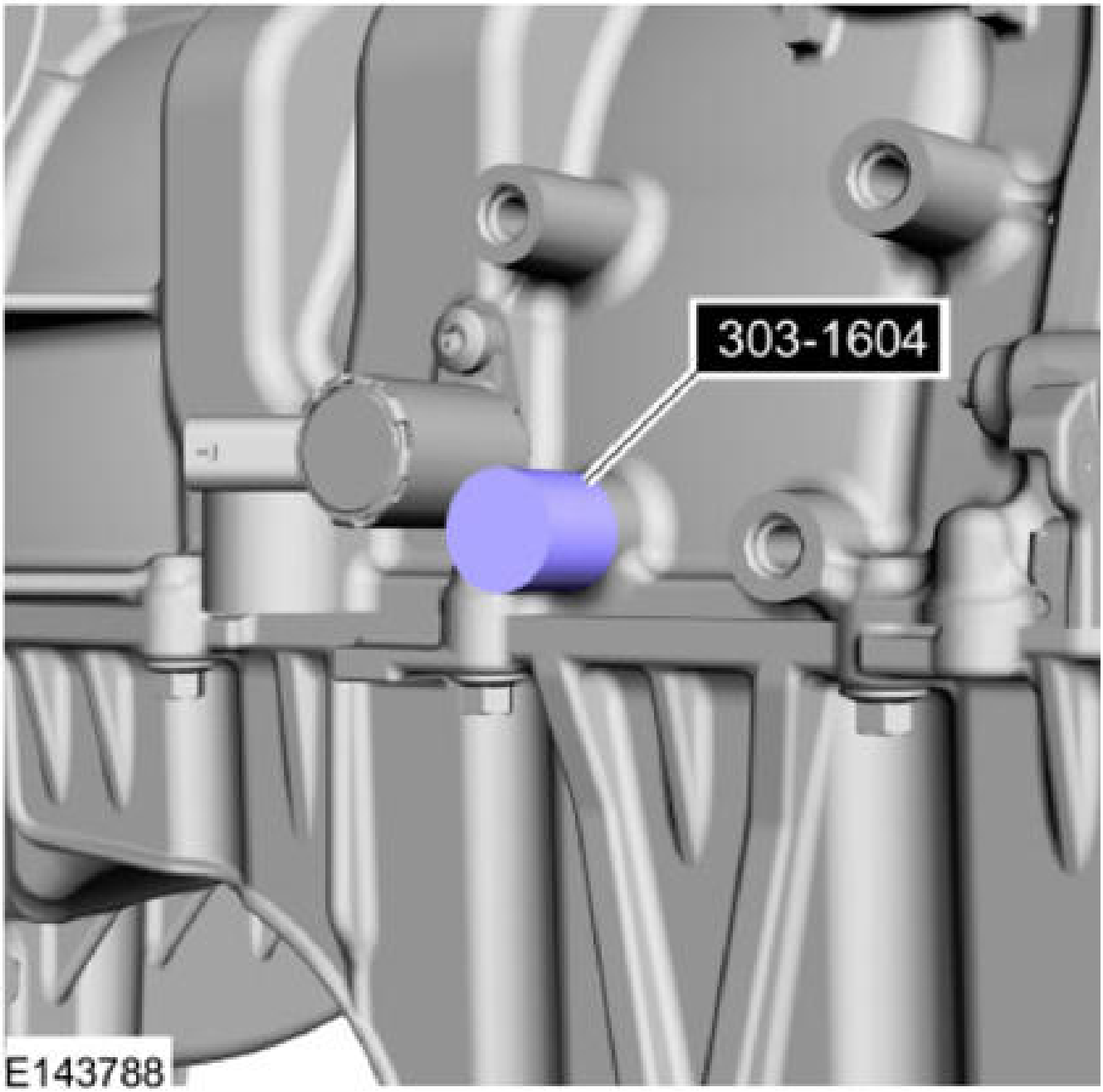


24.

24.

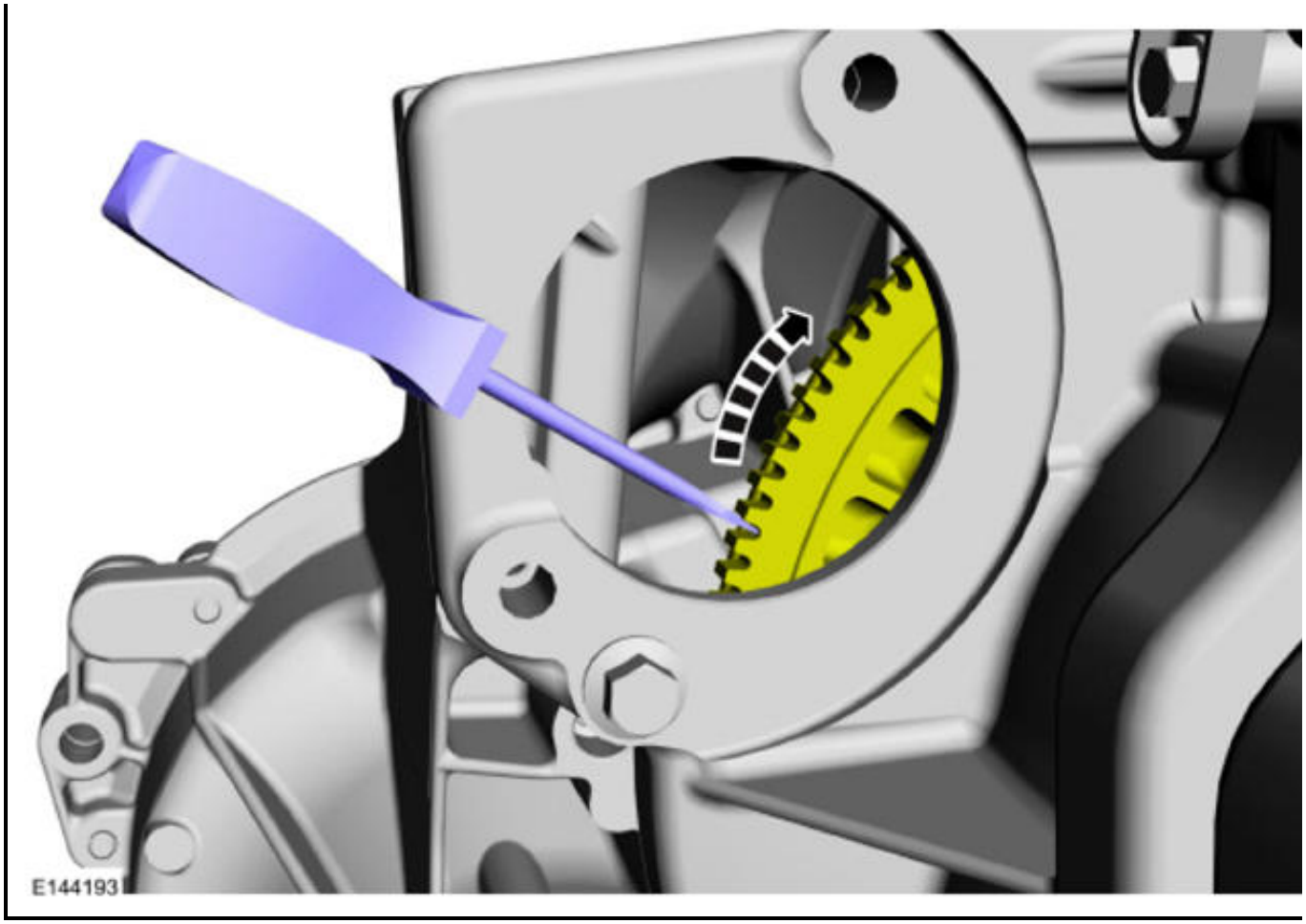


25. Install Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.

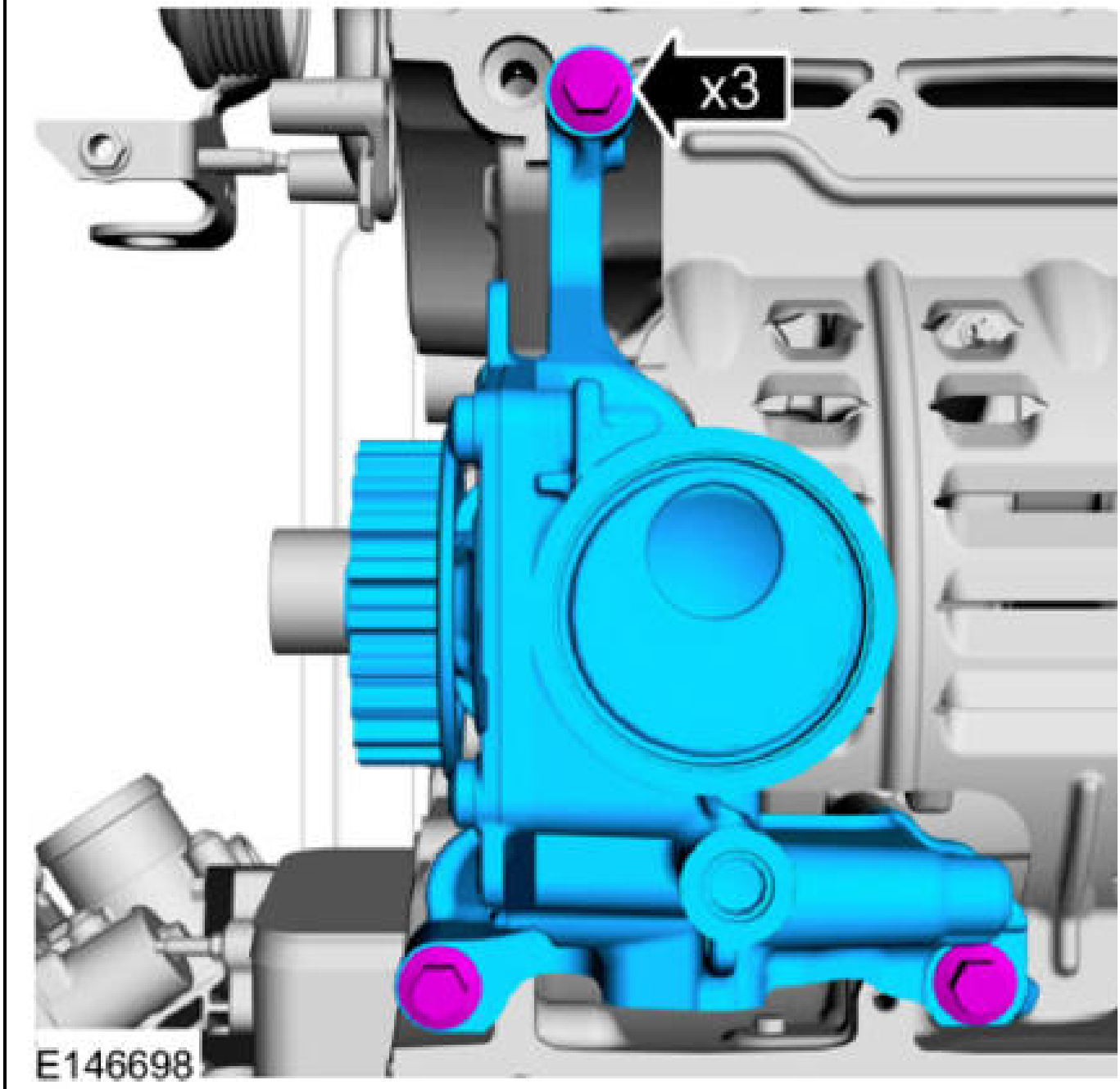


26. **NOTE: Only rotate the crankshaft clockwise.**

Rotate the crankshaft slowly until the crankshaft stops.

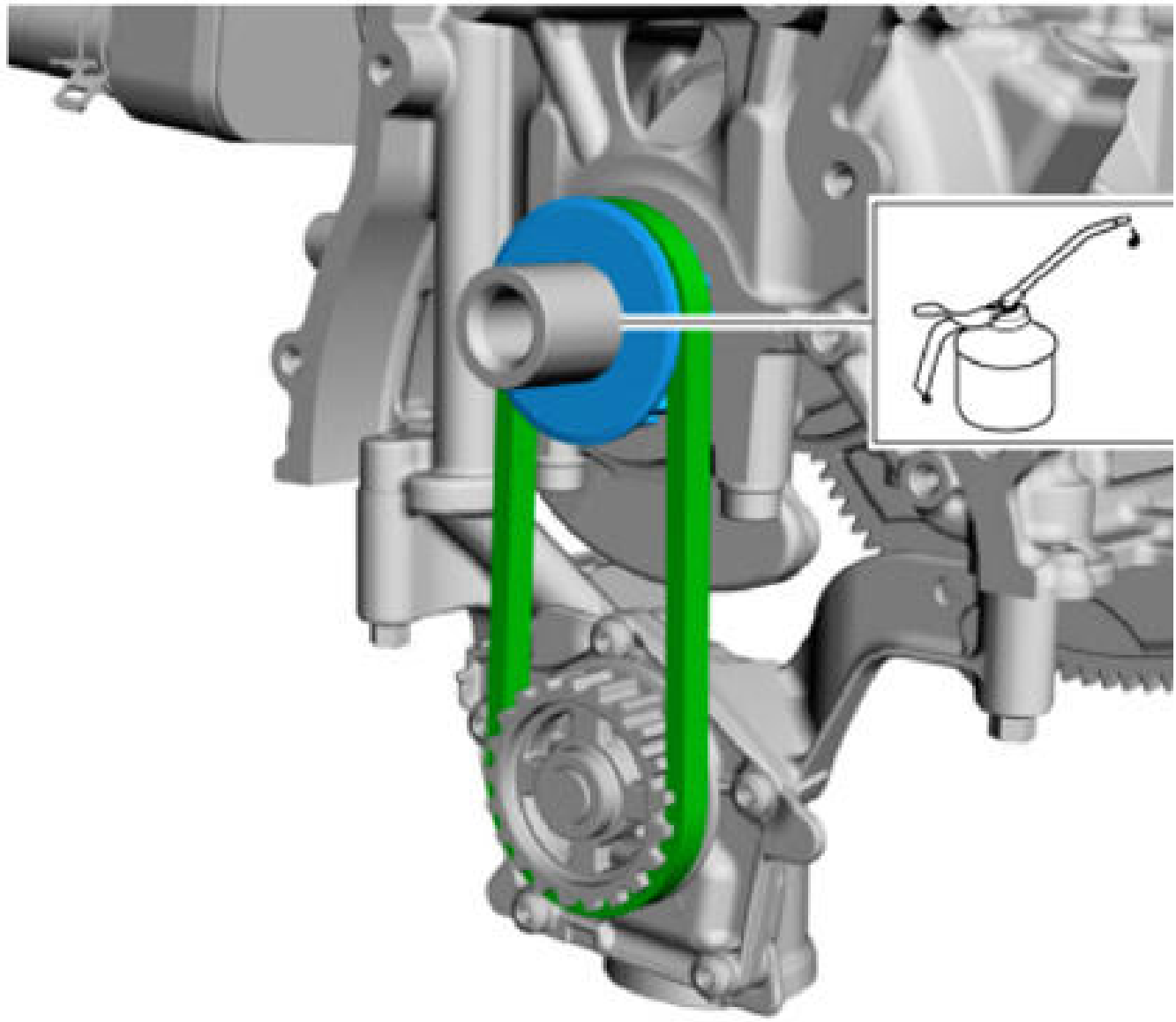


27. *Torque* : 18 lb.ft (25 Nm)



28. **NOTE: Make sure that the component is installed to the position noted before removal.**

Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)



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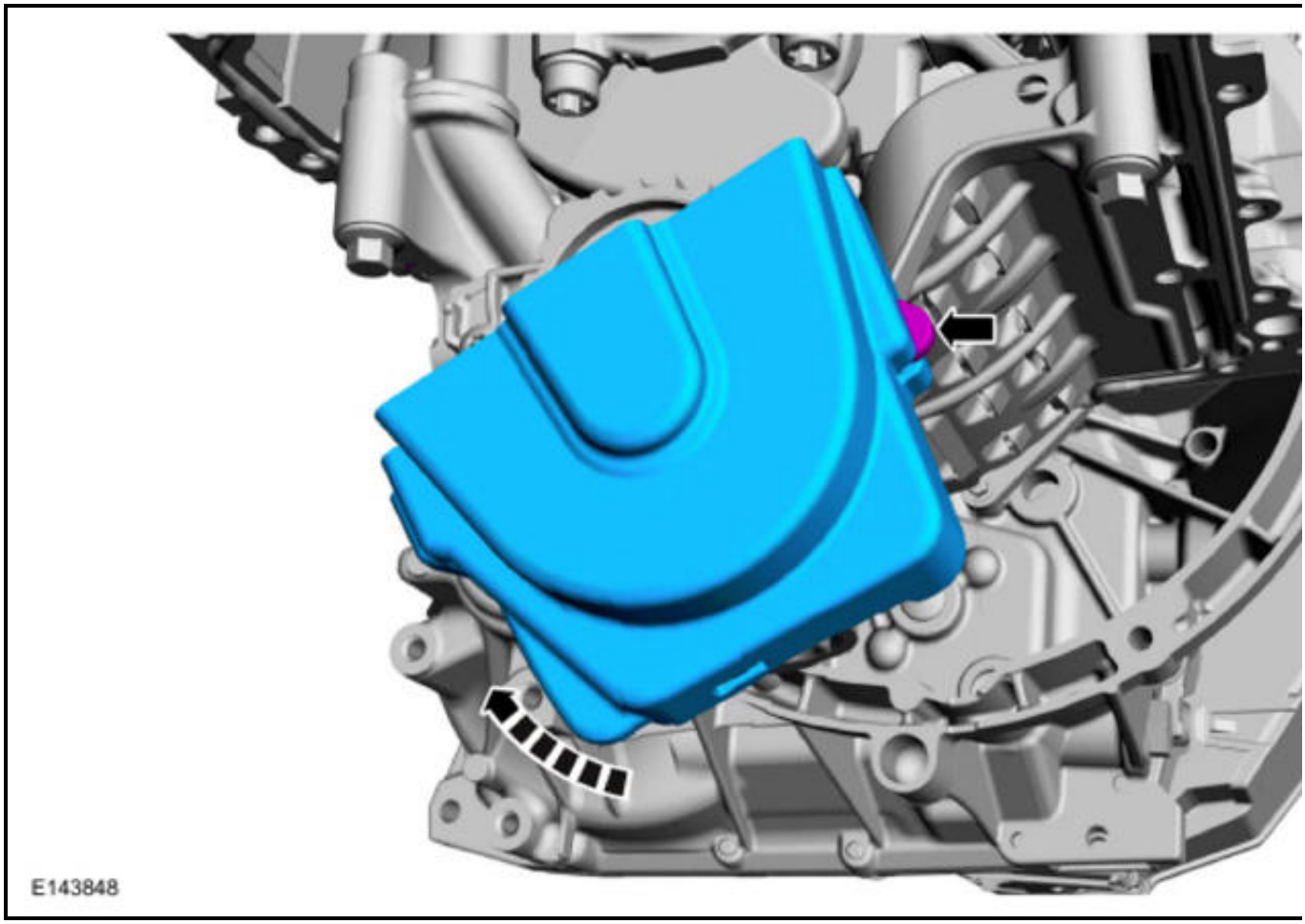
29.

YouTube	A multimedia supplement to the instructions contained in this article is available. To view the multimedia example of the condition described go to; **http://www.youtube.com/user/Mitchell1Tips** **then type, "A00670659.vid3" into the "Search Channel" box.**



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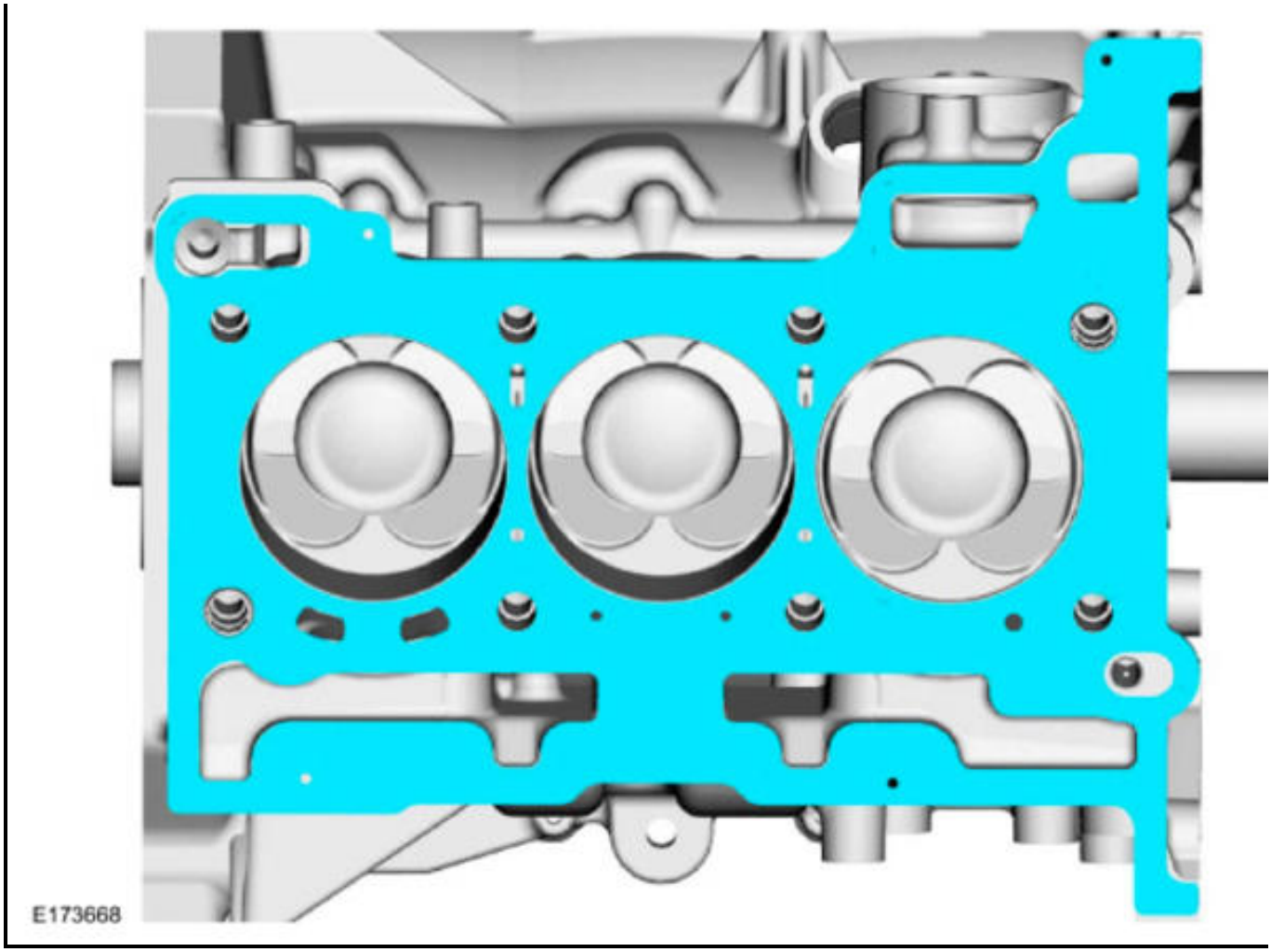


31. **NOTE: Make sure that new bolts are installed.**

NOTE: Only tighten the bolts finger tight at this stage.

Torque :

Stage 1: 89 lb.in (10 Nm)

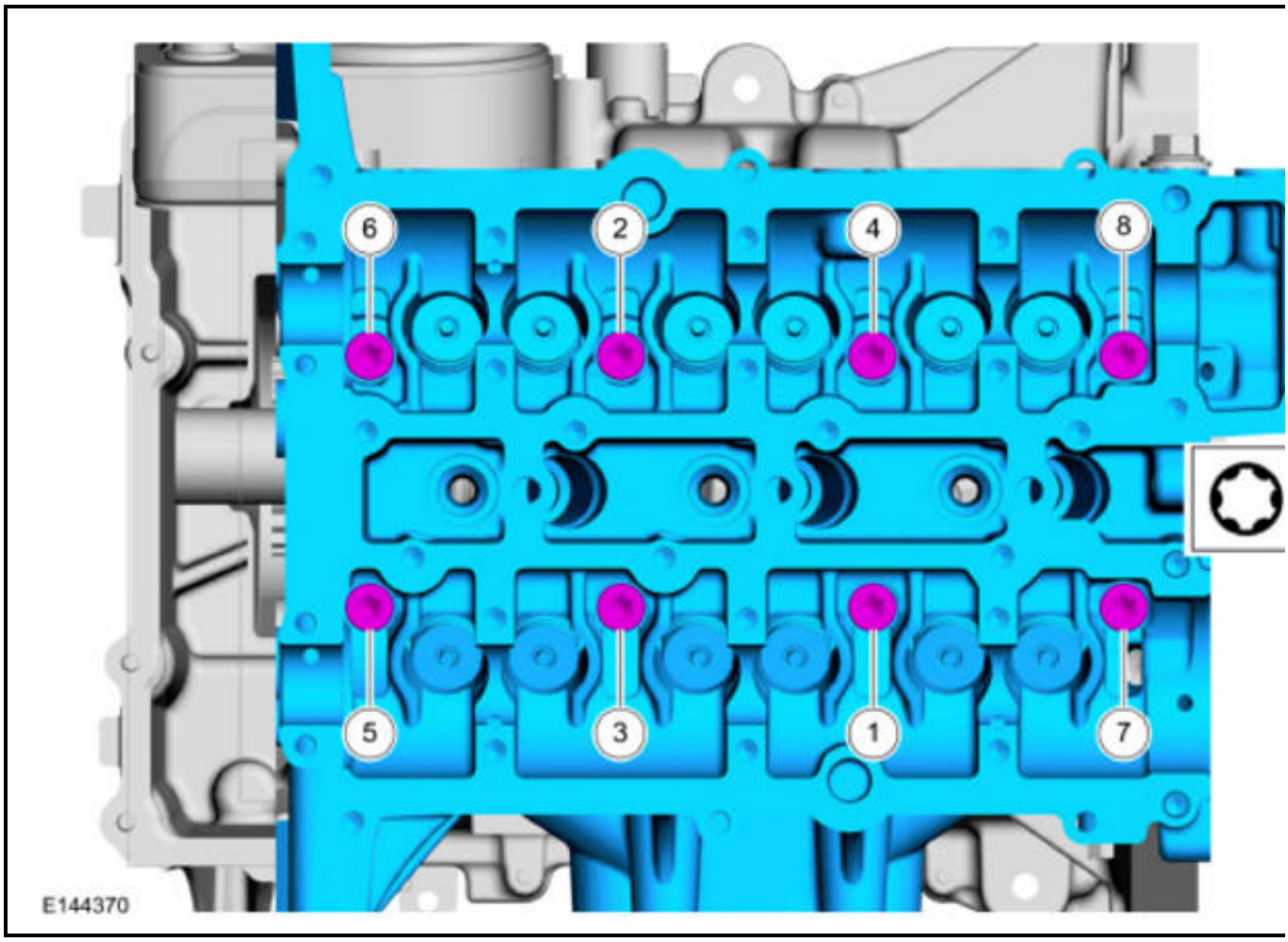
Stage 2: 30 lb.ft (40 Nm)

Stage 3: Loosen: 45°

Stage 4: 22 lb.ft (30 Nm)

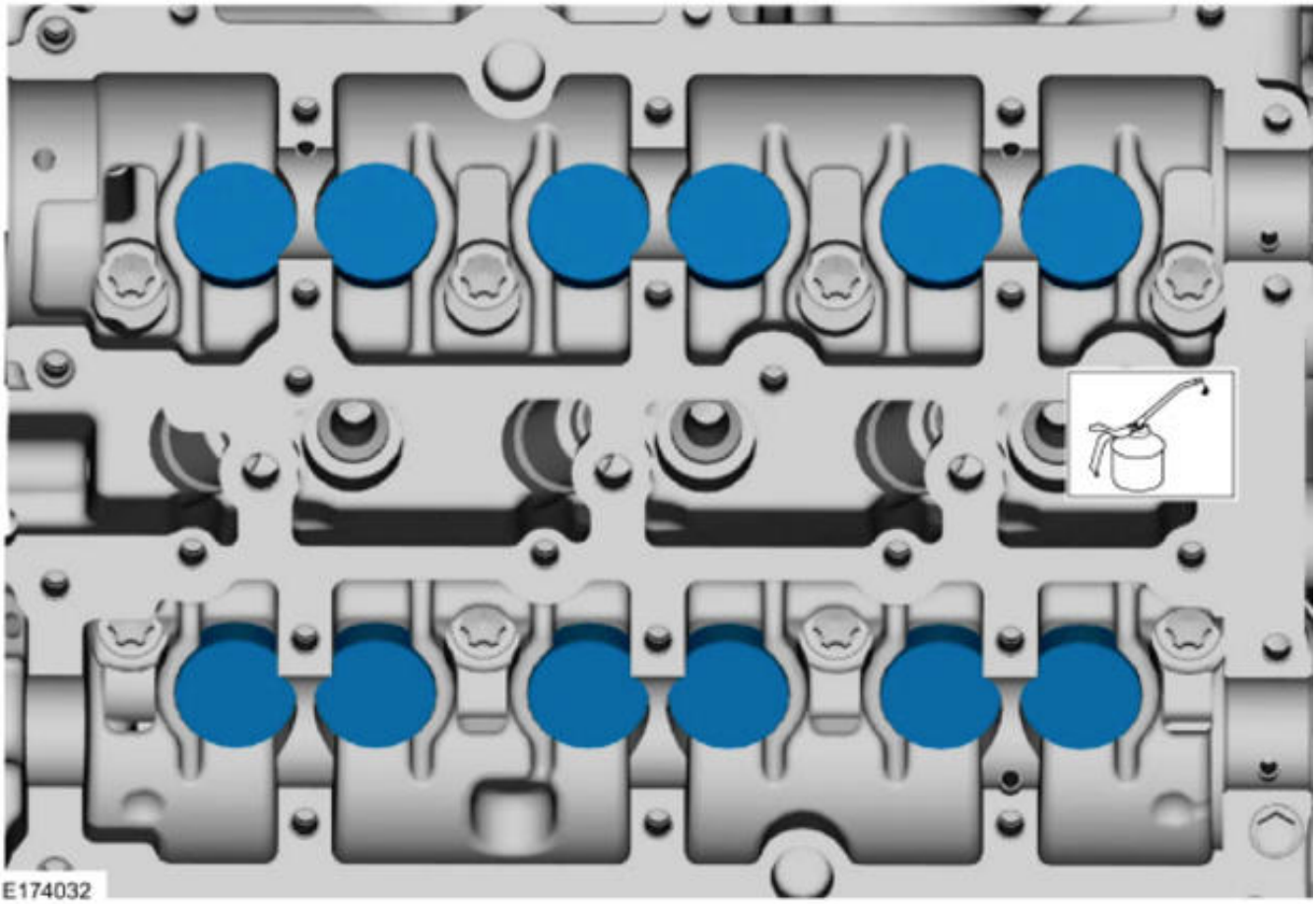
Stage 5: 90°

Stage 6: 90°



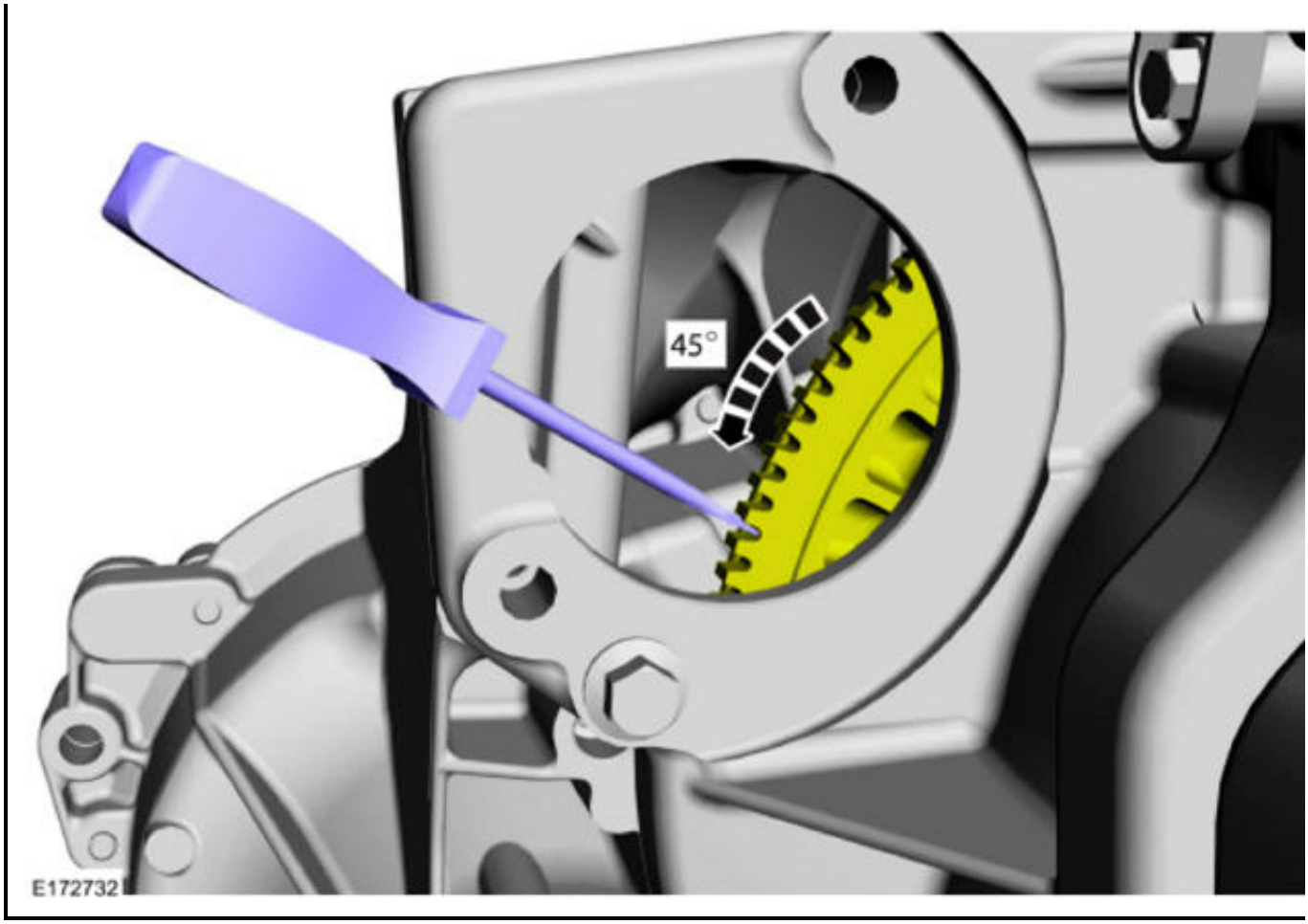
32. **NOTE: Install the components in their original position.**

Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)



33.

33.



34.

- Install the camshafts approximately at valve overlap position cylinder No. 1.

  Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

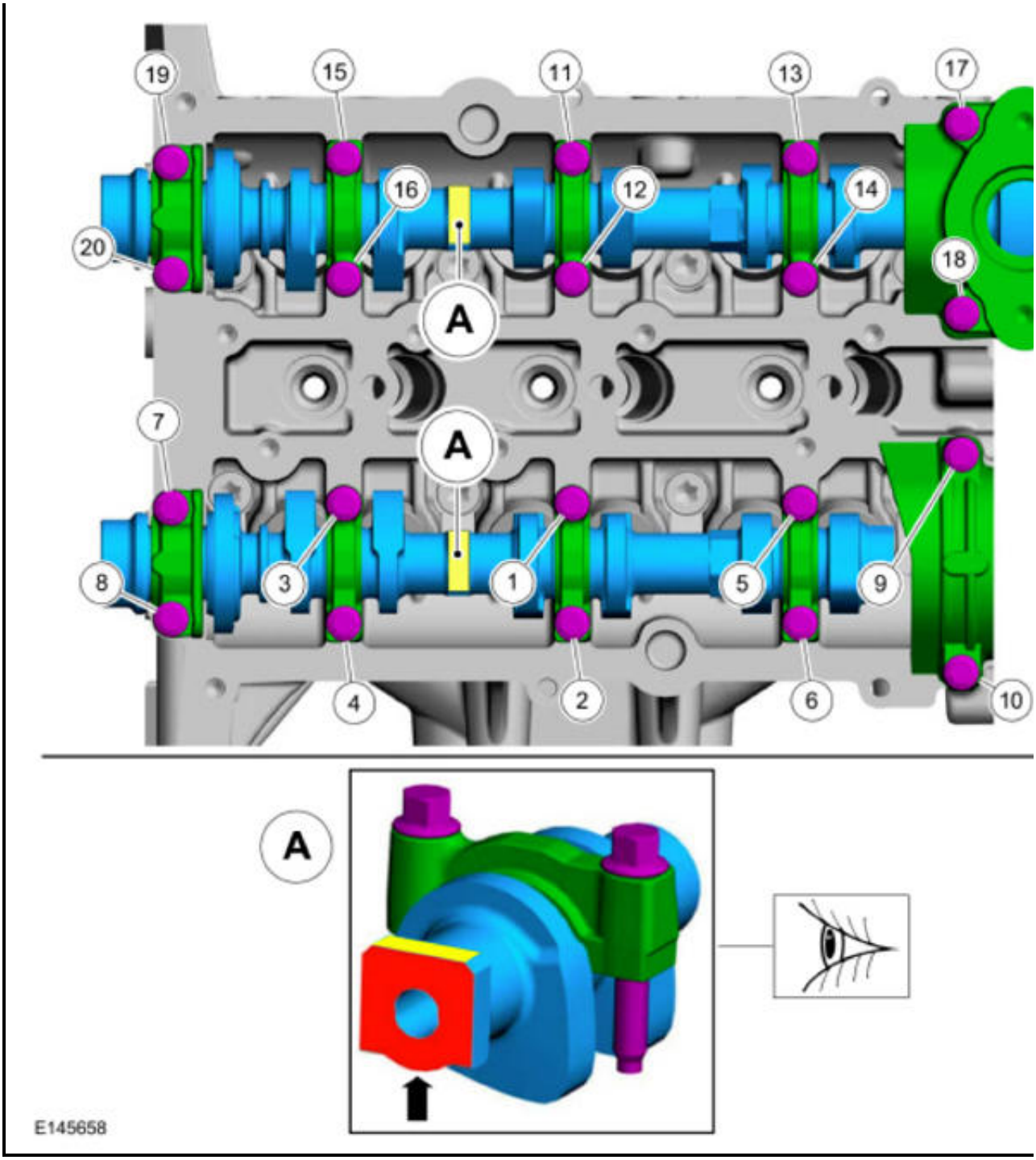
- **NOTE: Make sure that the components are installed to the position noted before removal.**

  NOTE: Make sure that new bolts are installed.

  Install all the bolts finger tight before final tightening.

- Tighten each bolt 2 turns at a time.

  Torque : 89 lb.in (10 Nm)



35.

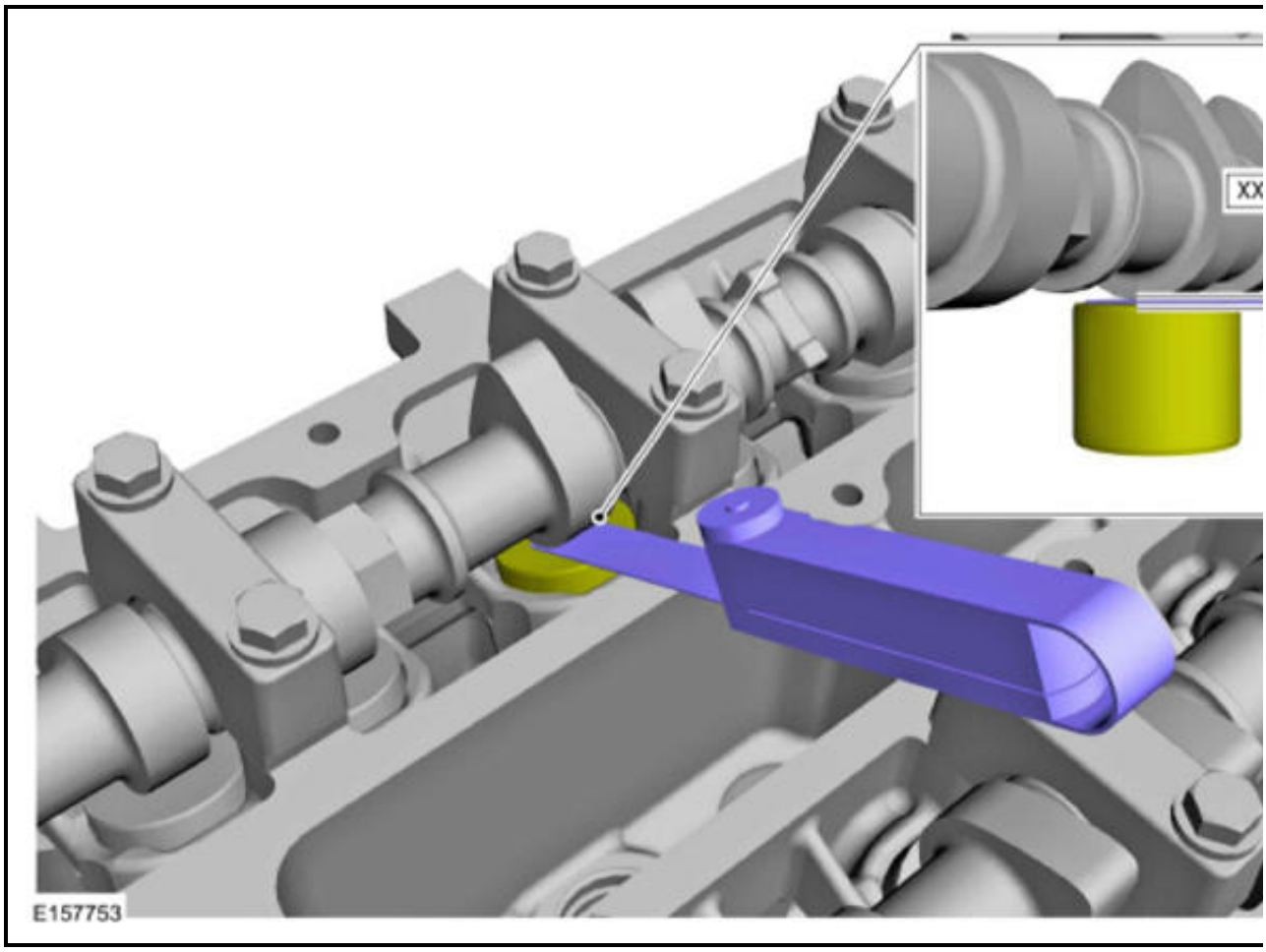
- Rotate the camshafts and measure the valve clearances.

  Use the General Equipment: Feeler Gauge

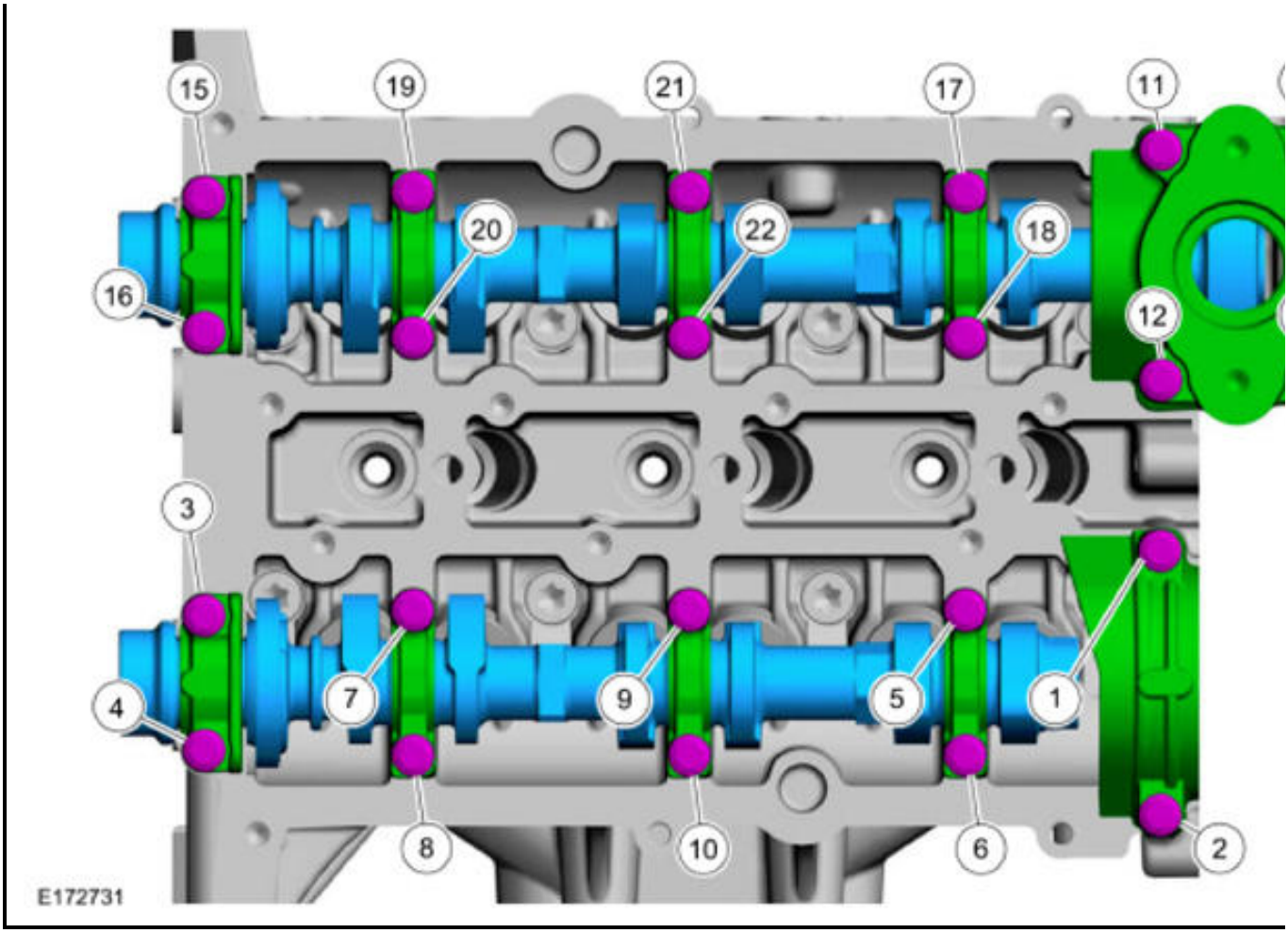
- Note down each cylinder number and the valve clearances measured.

- Compare the measured valve clearances with the specifications.

  Refer to: **SPECIFICATIONS** .



36. **NOTE: Note the position of the components before removal.**



37.

- Remove the valve tappet and read the thickness from the underside.
- The number on the valve tappet indicates the thickness of the bottom of the tappet. However, the number only indicates the digits after the decimal point (example: 725 = 2.725).

38.

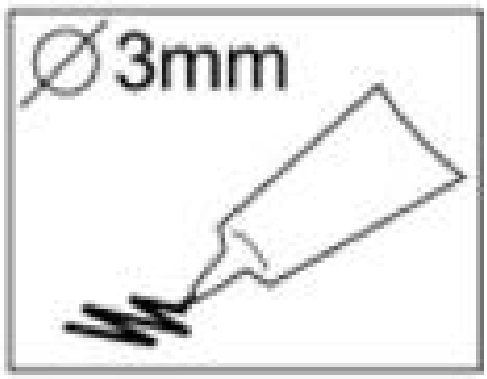
- Calculate the required thickness of the valve tappet with the following formula: X = S + M - V
- Required thickness of tappet = X
- Thickness of currently fitted tappet = S
- Measurement of existing valve clearance (actual value) = M
- Desired valve clearance = V

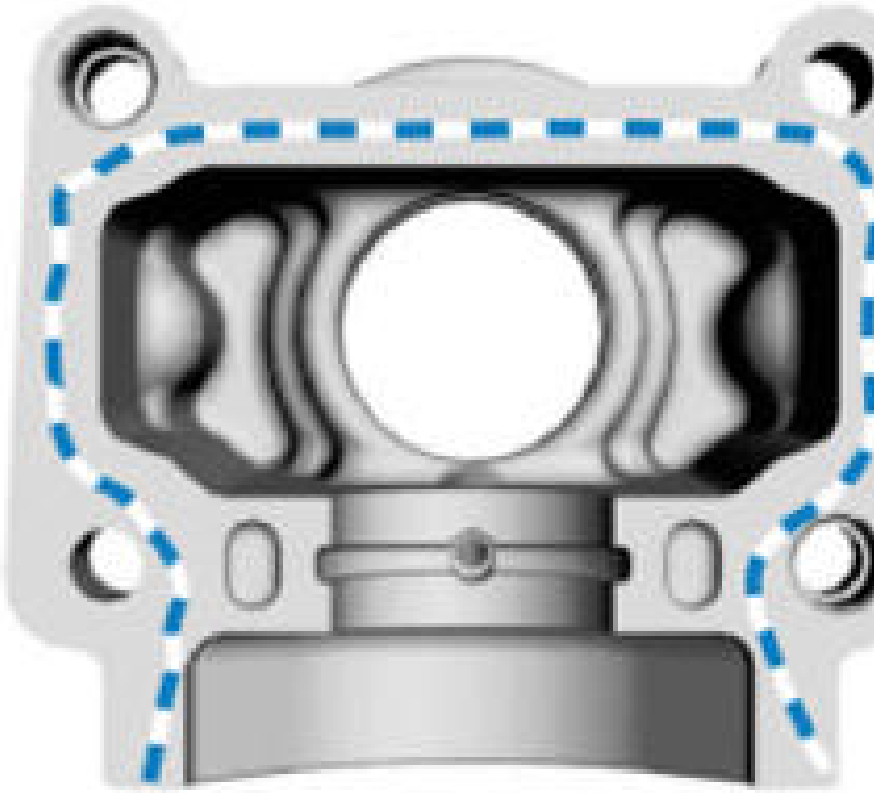
39. Install the correct valve tappet.

40. **NOTE: Make sure that the mating faces are clean and free of foreign material.**

NOTE: The component must be installed within 5 minutes of applying the sealant.

Material : Gasket Maker/TA-16 (WSK-M2G348-A5)

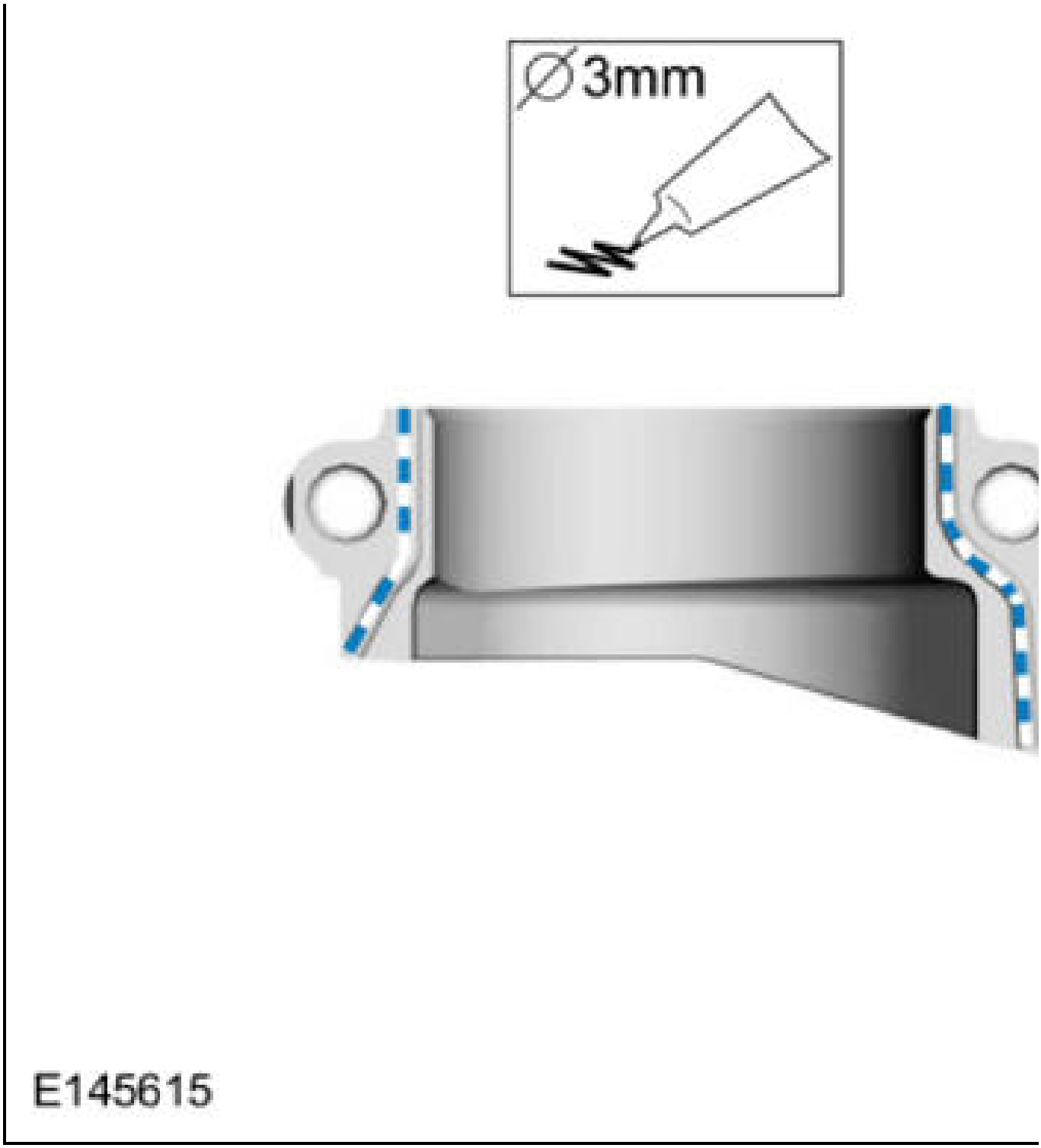




41. **NOTE: Make sure that the mating faces are clean and free of foreign material.**

NOTE: The component must be installed within 5 minutes of applying the sealant.

Material : Gasket Maker/TA-16 (WSK-M2G348-A5)



42.

- Install the camshafts approximately at valve overlap position cylinder No. 1.

  Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

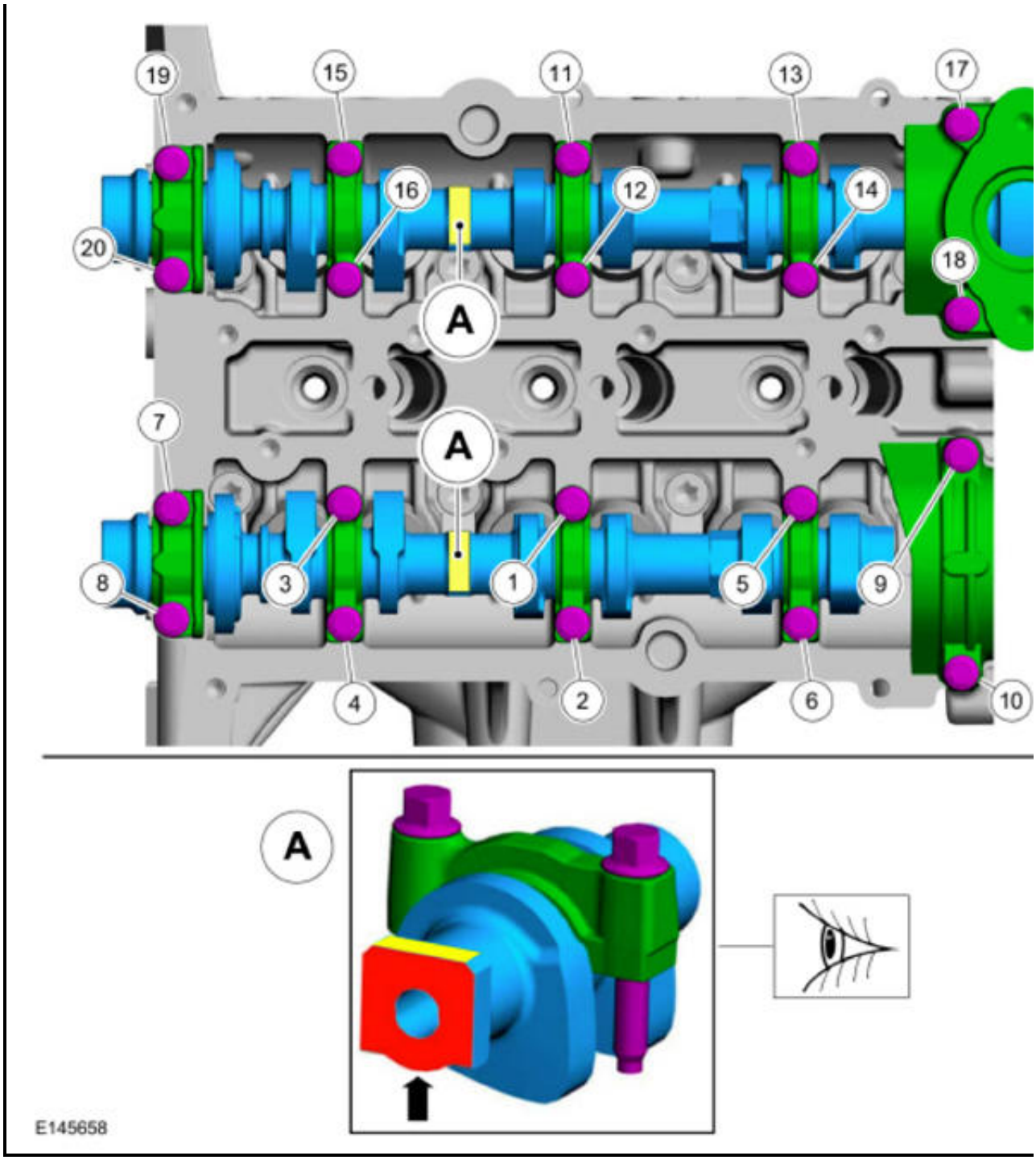
- **NOTE: Make sure that the components are installed to the position noted before removal.**

NOTE: Make sure that new bolts are installed.

Install all the bolts finger tight before final tightening.

- Tighten each bolt 2 turns at a time.

Torque : 89 lb.in (10 Nm)

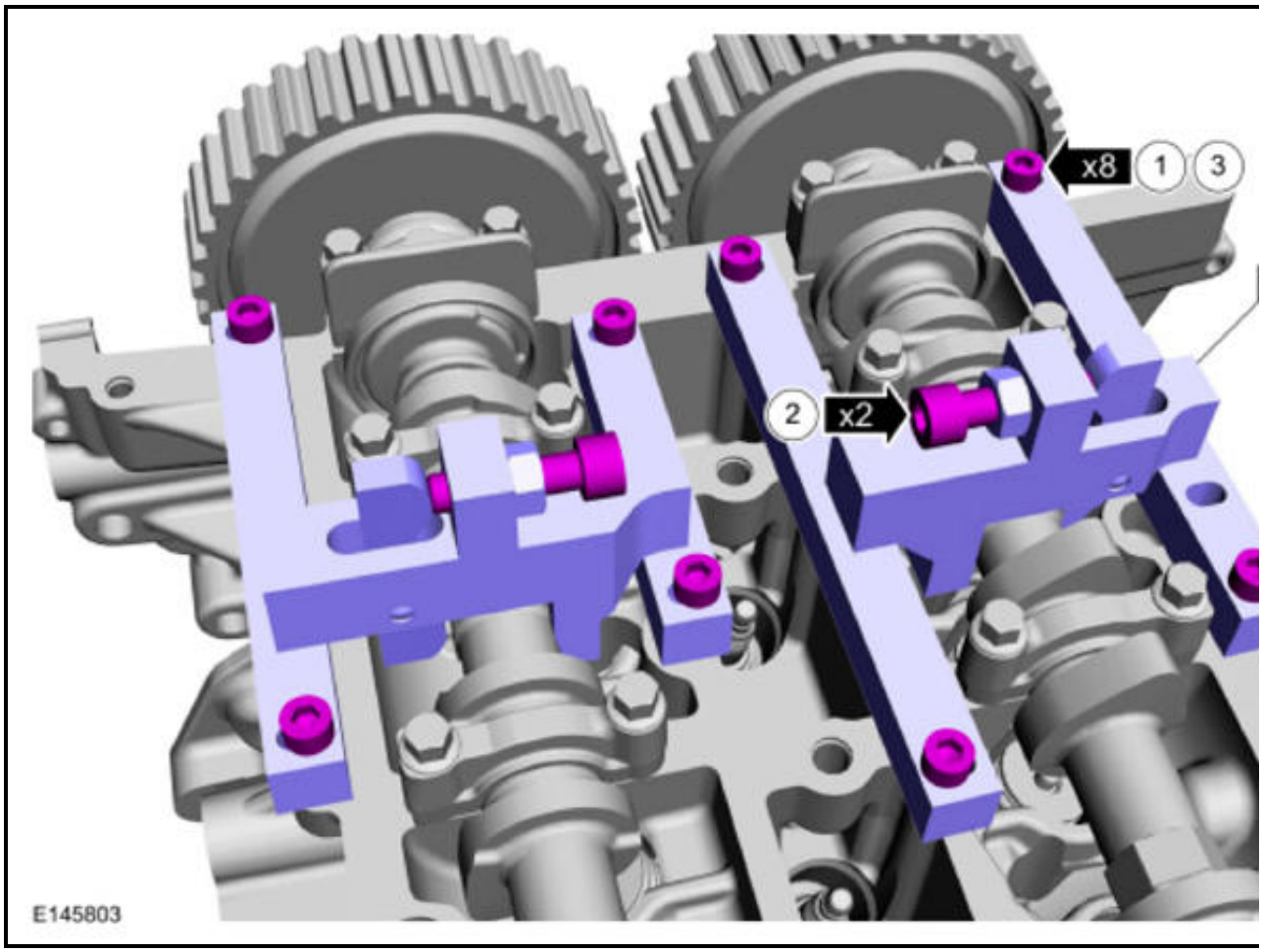


43.

1. Install Special Service Tool: 303-1605 Alignment Tool, Camshaft.
2.

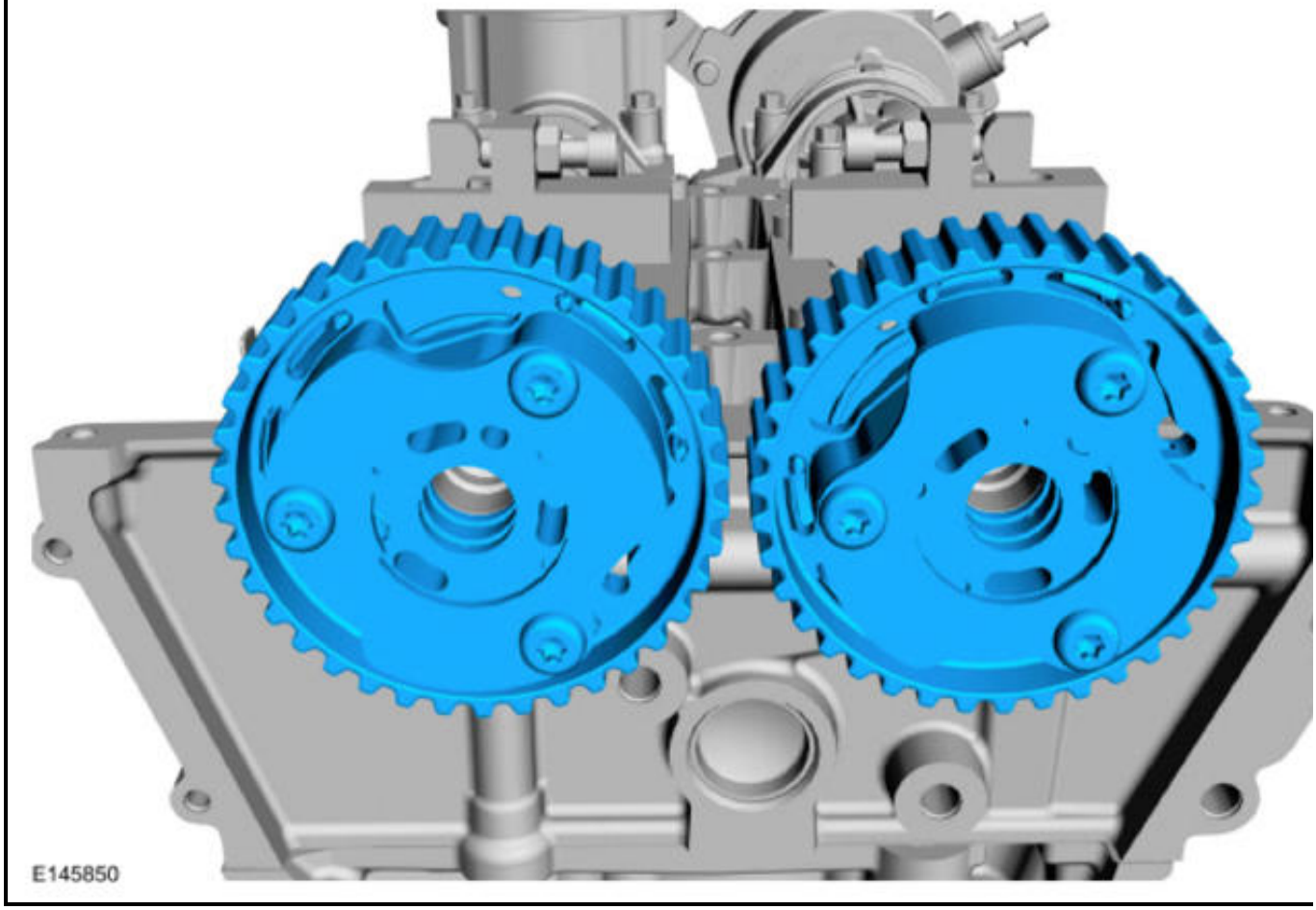
NOTE: Only tighten the bolts finger tight at this stage.

3. *Torque* : 89 lb.in (10 Nm)

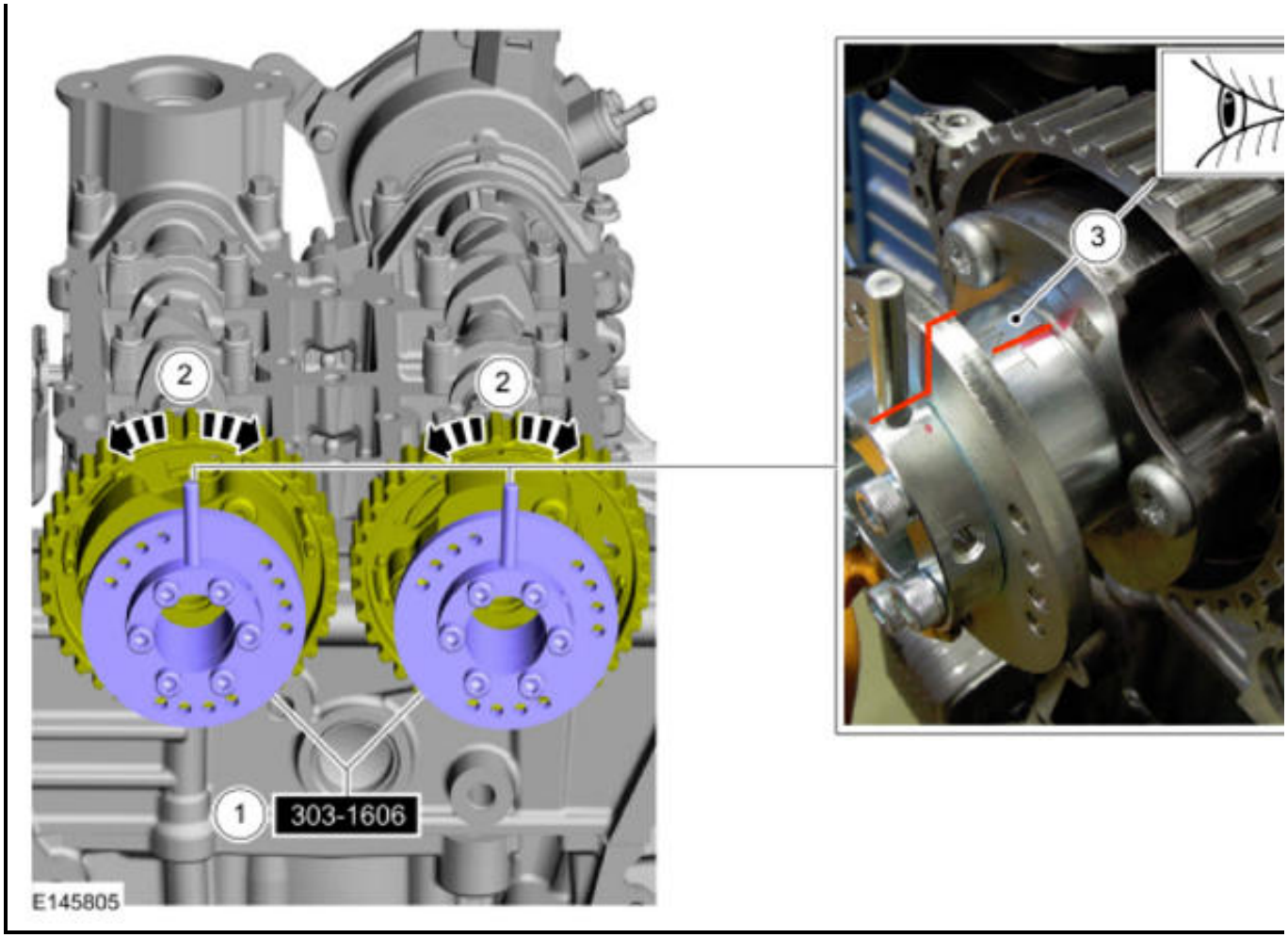


44.

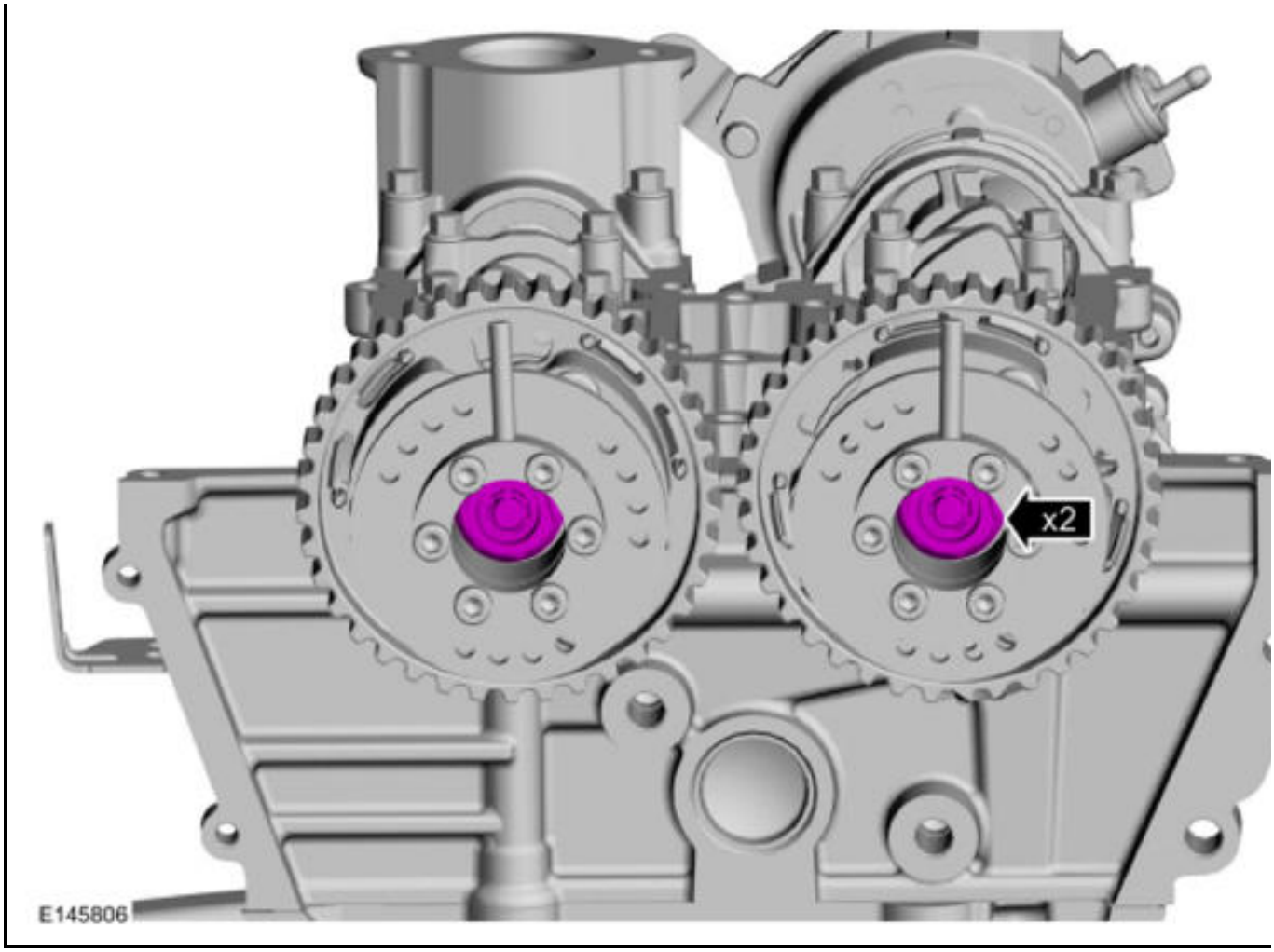
44.



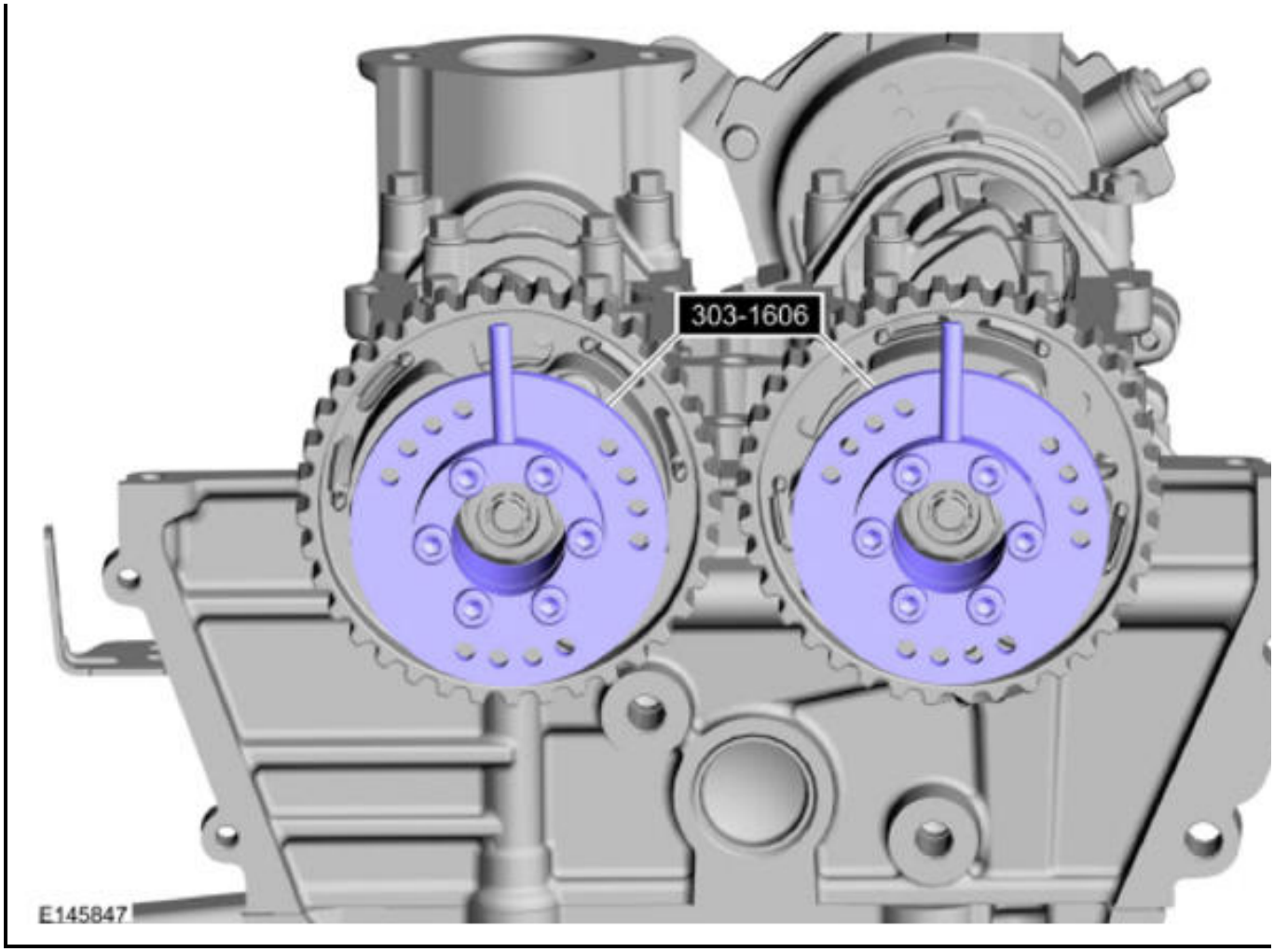
45. Install Special Service Tool: 303-1606 Locking Tool, Variable Camshaft Timing.



46. **NOTE:** **Only tighten the bolts finger tight at this stage.**



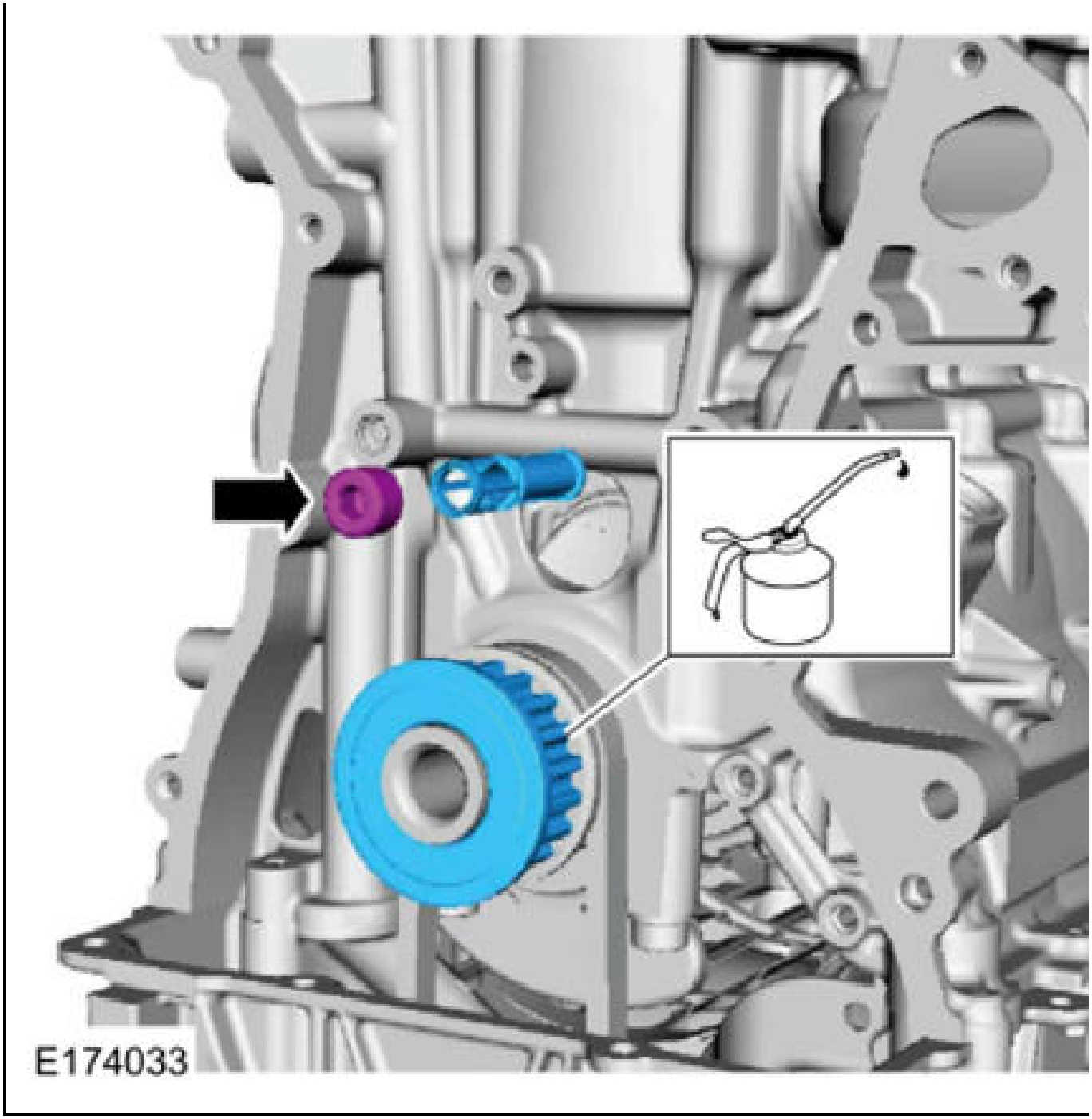
47. Remove Special Service Tool: 303-1606 Locking Tool, Variable Camshaft Timing.



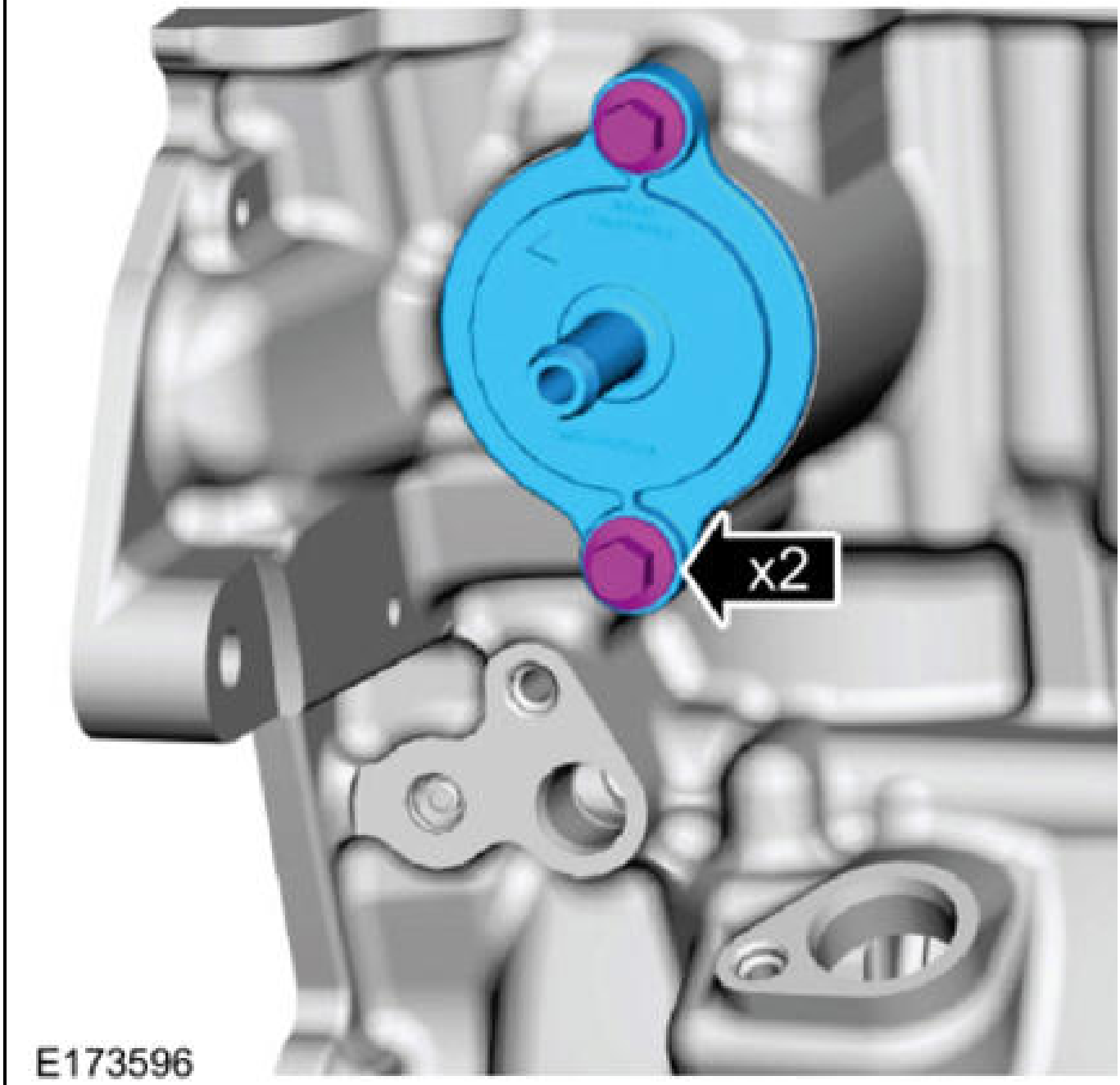
48. **NOTE: Make sure that the component is installed to the position noted before removal.**

Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

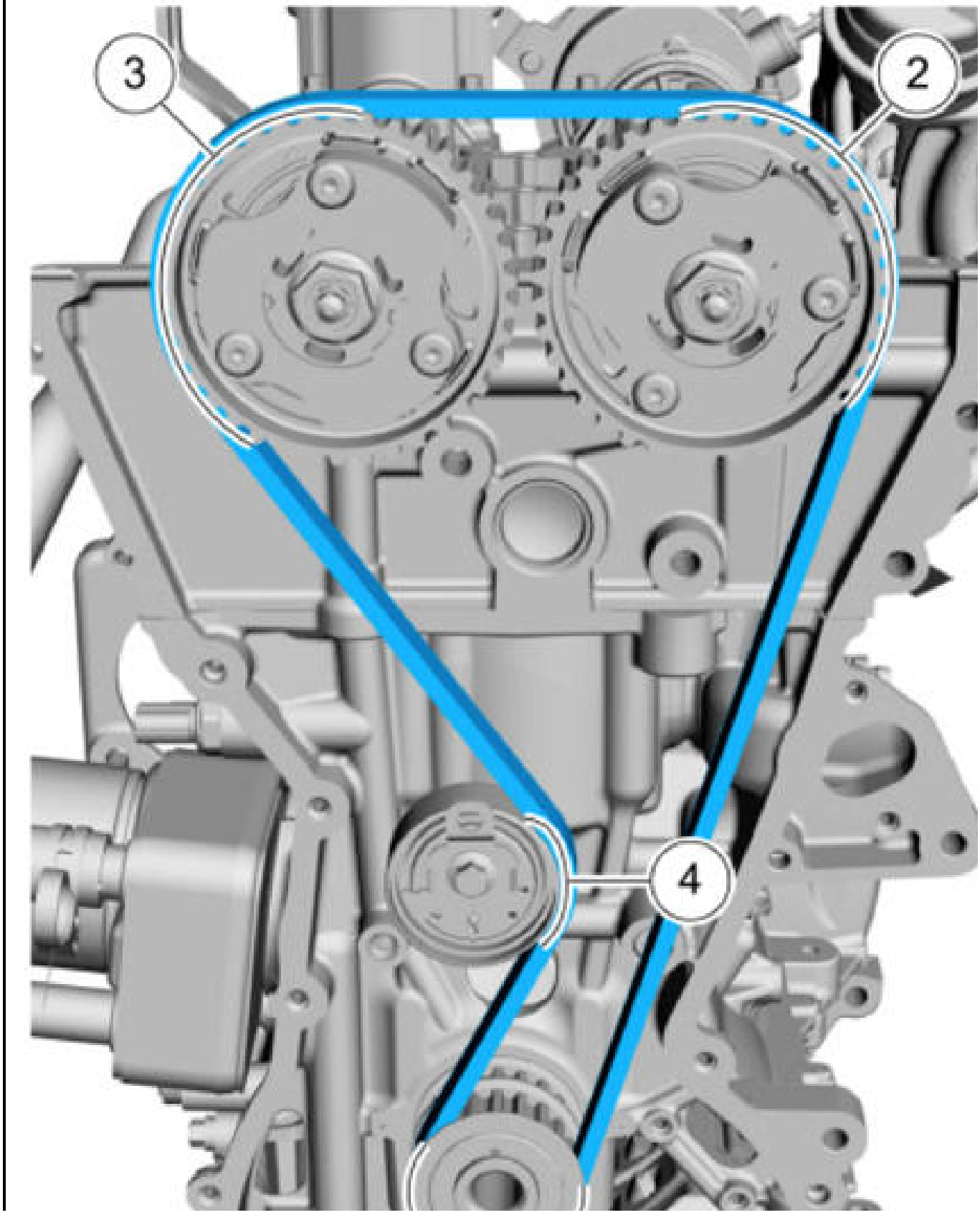
Torque : 80 lb.in (9 Nm)



49. *Torque* : 89 lb.in (10 Nm)



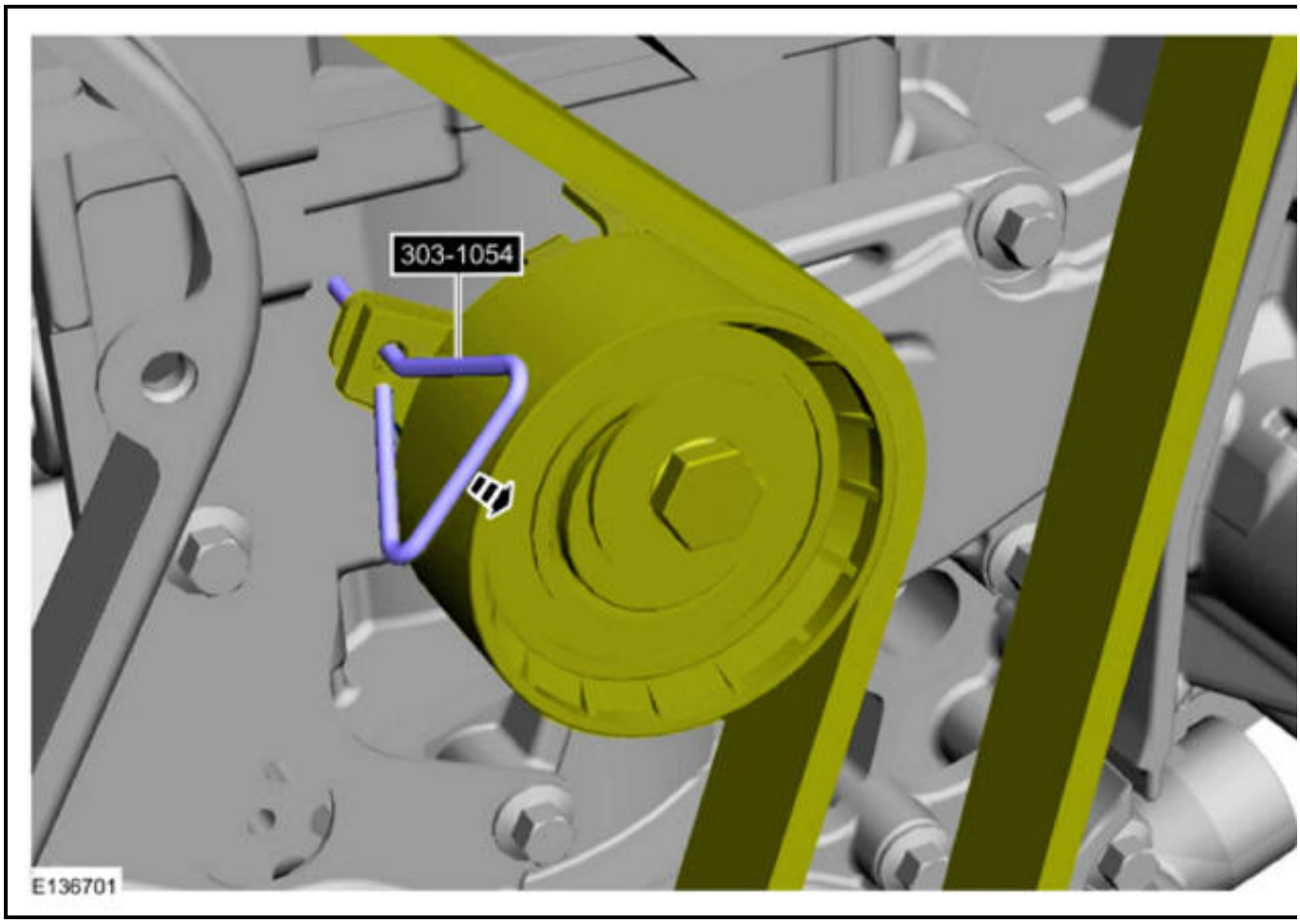
50.



WARNING: Take extra care when handling the compressed spring.

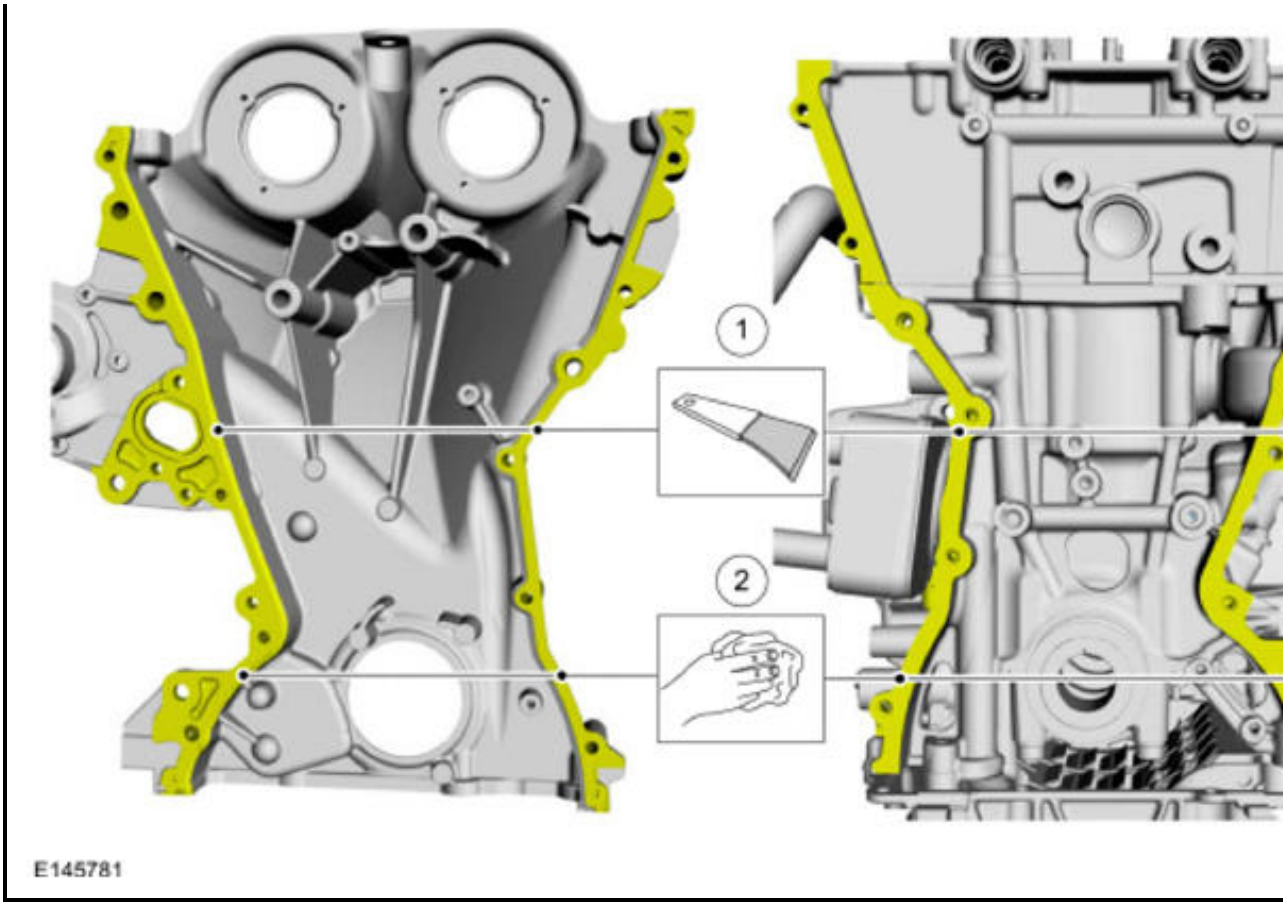
51.

Remove Special Service Tool: 303-1054 Locking Tool, Timing Belt Tensioner.



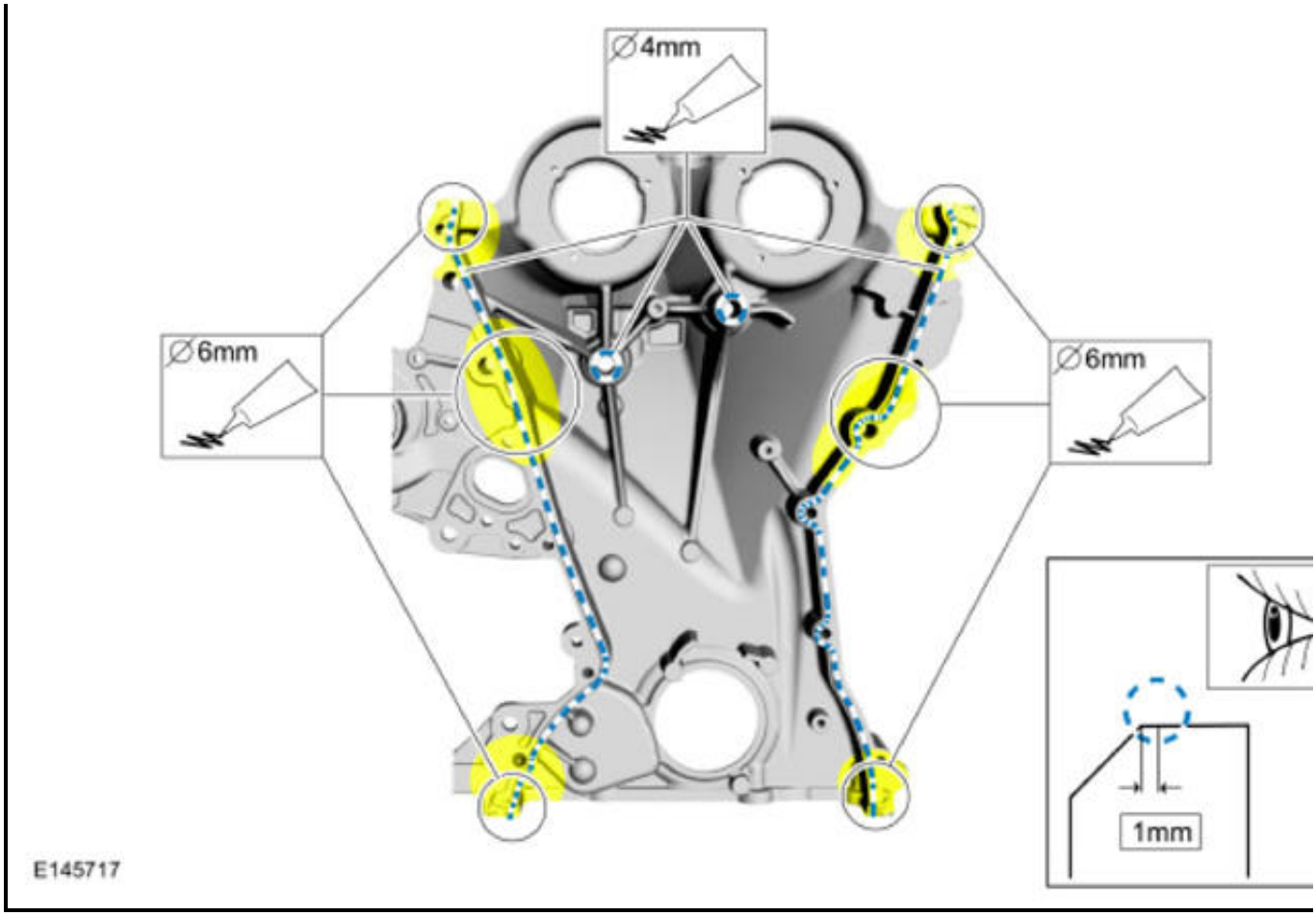
52. **NOTE: Make sure that the mating faces are clean and free of foreign material.**

1. Use the General Equipment: Plastic Scraper
2. *Material* : Motorcraft® Metal Surface Prep/ZC-31-B



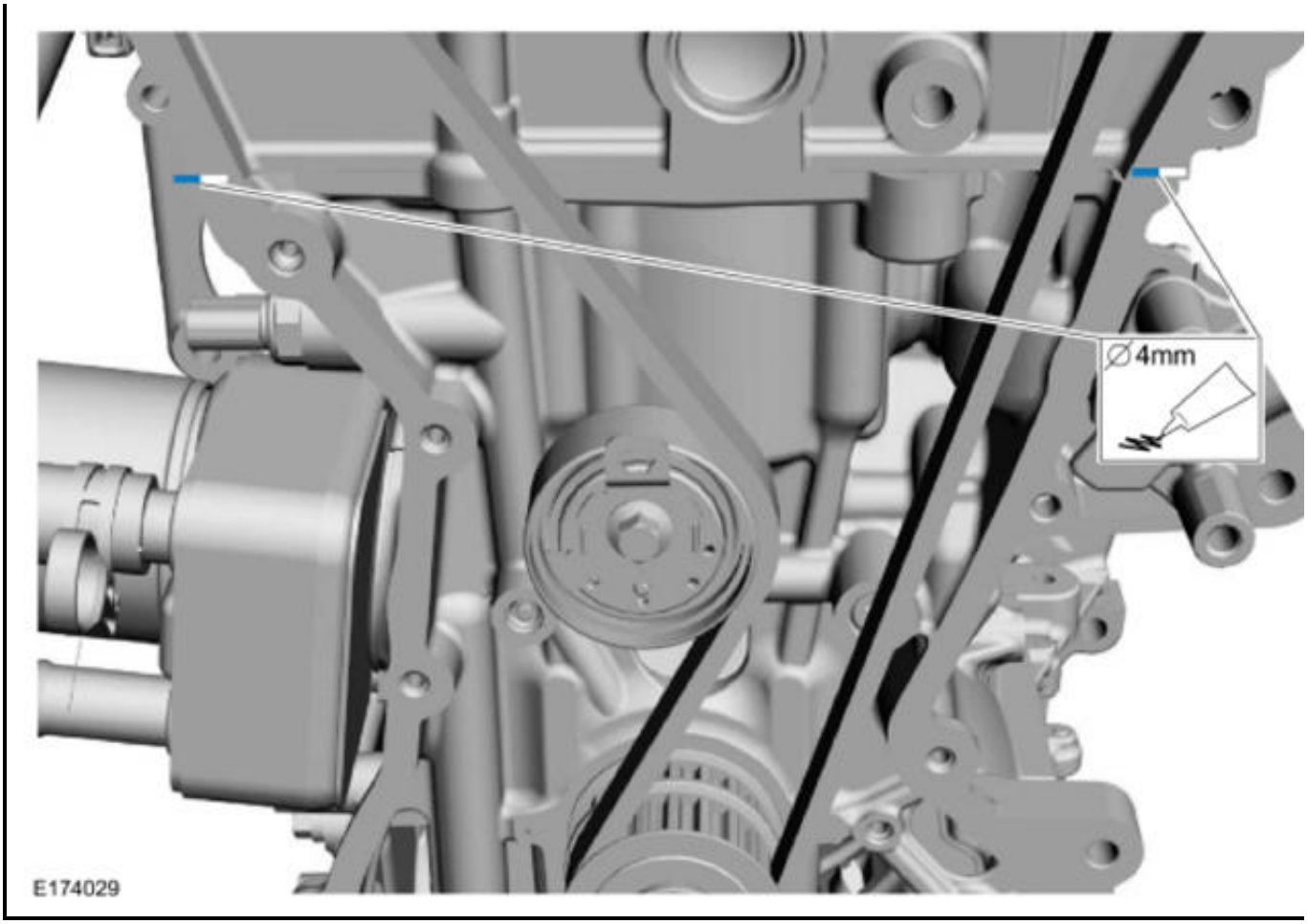
53. **NOTE: The component must be installed within 10 minutes of applying the sealant.**

Material : Silicone Gasket and Sealant/TA-30 (WSE-M4G323-A4)



54. **NOTE: The component must be installed within 10 minutes of applying the sealant.**

Material : Silicone Gasket and Sealant/TA-30 (WSE-M4G323-A4)



55.

- **NOTE: Make sure that new components are installed.**

Torque :

1-2, M6x60: 44 lb.in (5 Nm)

- **NOTE: Make sure that new components are installed.**

Torque :

3-6, M10x95: 89 lb.in (10 Nm)

- **NOTE: Make sure that new components are installed.**

Torque :

7-16 M6x60: 44 lb.in (5 Nm)

- *Torque* :

  3-6: 30 lb.ft (40 Nm)

- *Torque* :

  3-4:

  Stage 1: 52 lb.ft (70 Nm)

  Stage 2: 90°

- *Torque* :

  5-6:

  Stage 1: 52 lb.ft (70 Nm)

  Stage 2: 90°

- 1-2

  Torque :

  Stage 1: 80 lb.in (9 Nm)

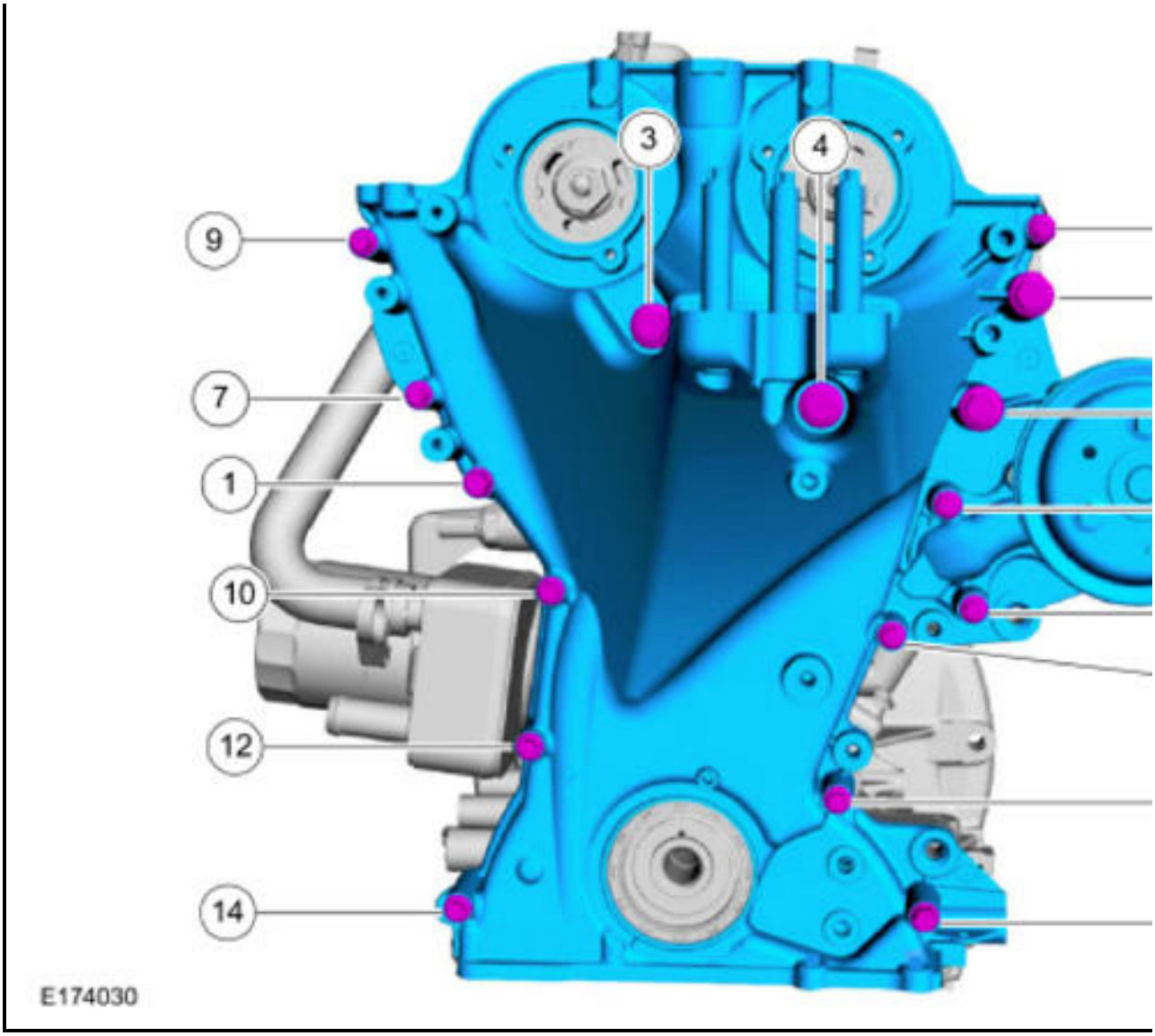
  Stage 2: 90°

- 7-16

  Torque :

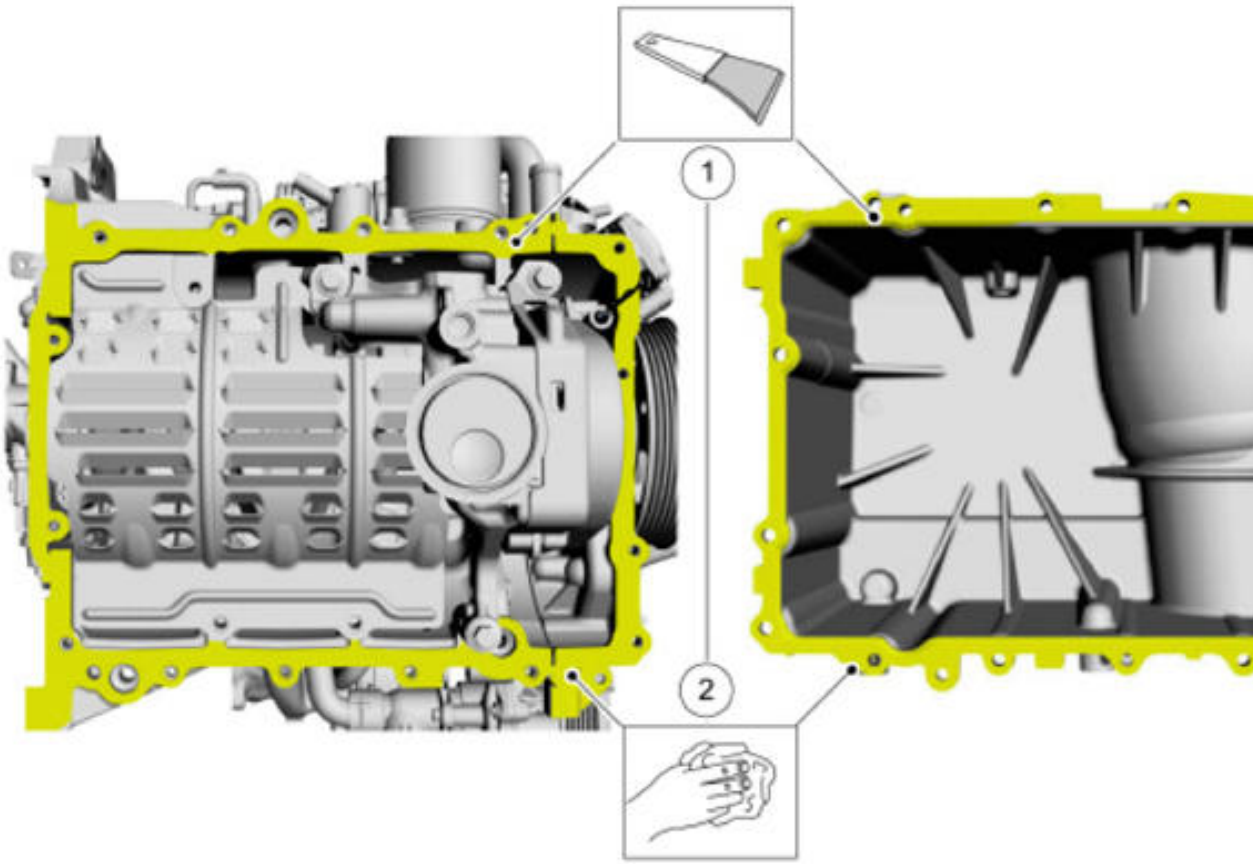
  Stage 1: 133 lb.in (15 Nm)

  Stage 2: 90°



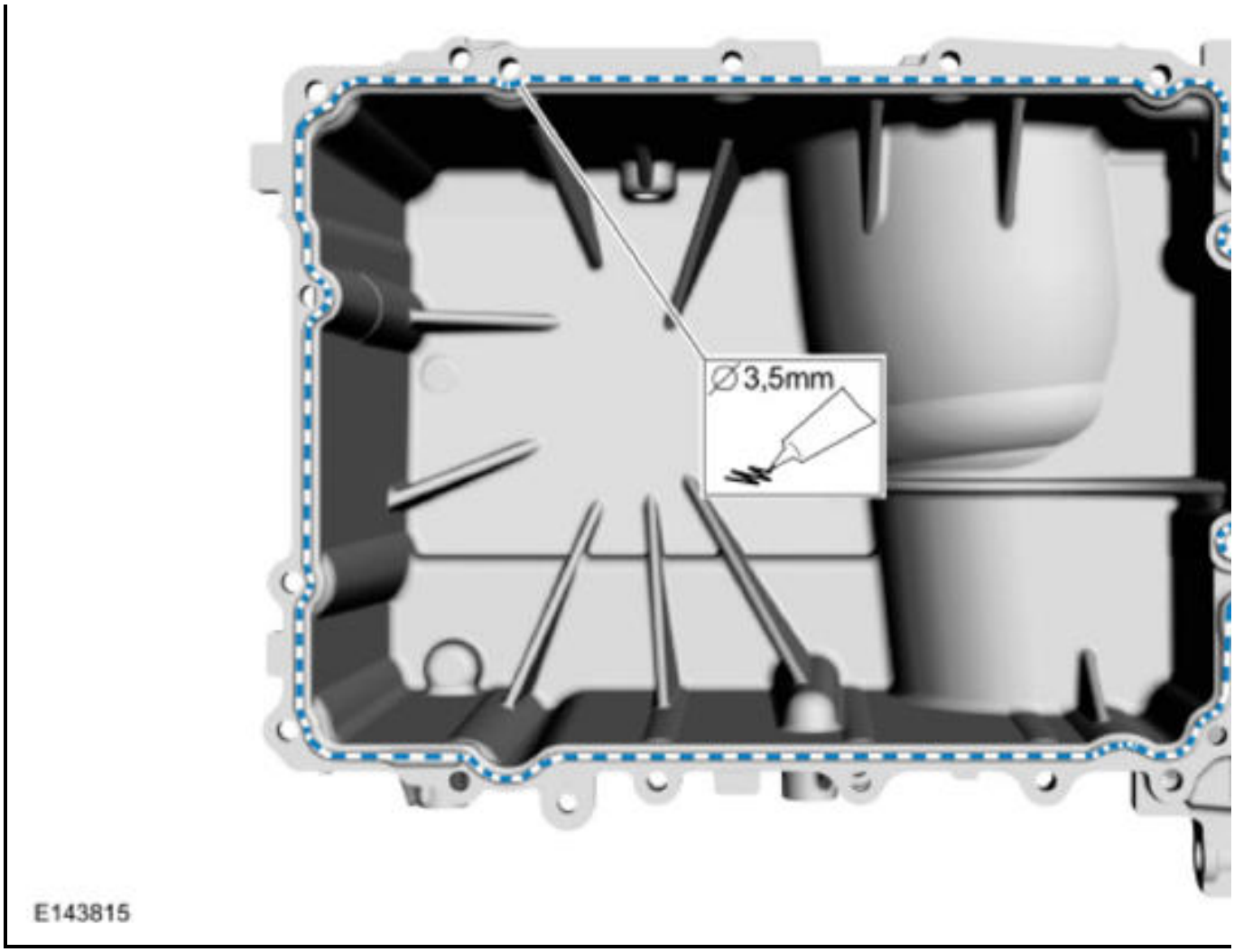
56. **NOTE: Make sure that the mating faces are clean and free of foreign material.**

1. Use the General Equipment: Plastic Scraper
2. *Material* : Motorcraft® Metal Surface Prep/ZC-31-B



57. **NOTE: The component must be installed within 5 minutes of applying the sealant.**

Material : Silicone Gasket and Sealant/TA-30 (WSE-M4G323-A4)



58. *Torque* :

    1-2, M6x20: 89 lb.in (10 Nm)

    3, M6x75: 89 lb.in (10 Nm)

    4-6, M6x20,: 89 lb.in (10 Nm)

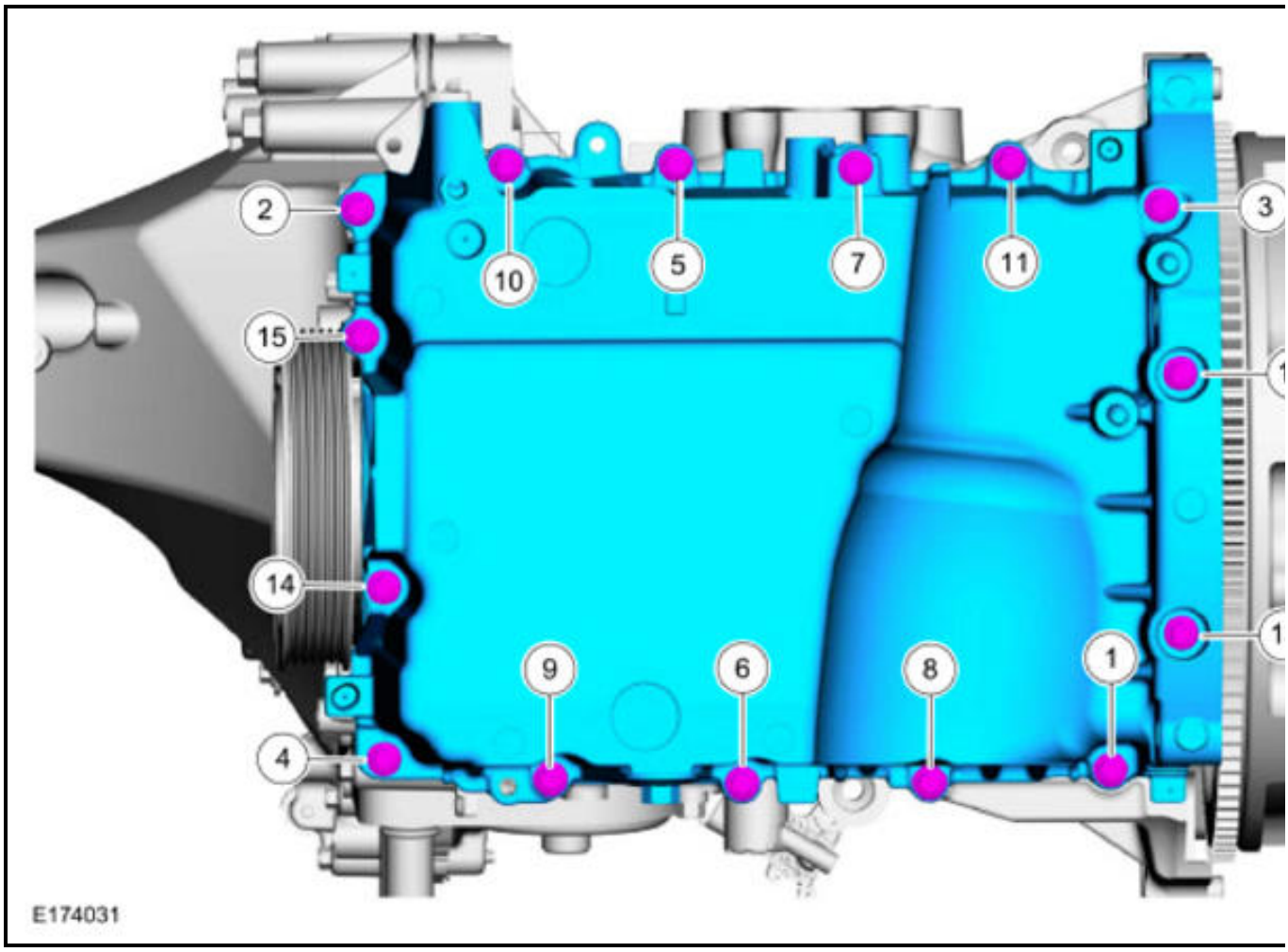
    7, M6x75,: 89 lb.in (10 Nm)

    8-11, M6x20,: 89 lb.in (10 Nm)

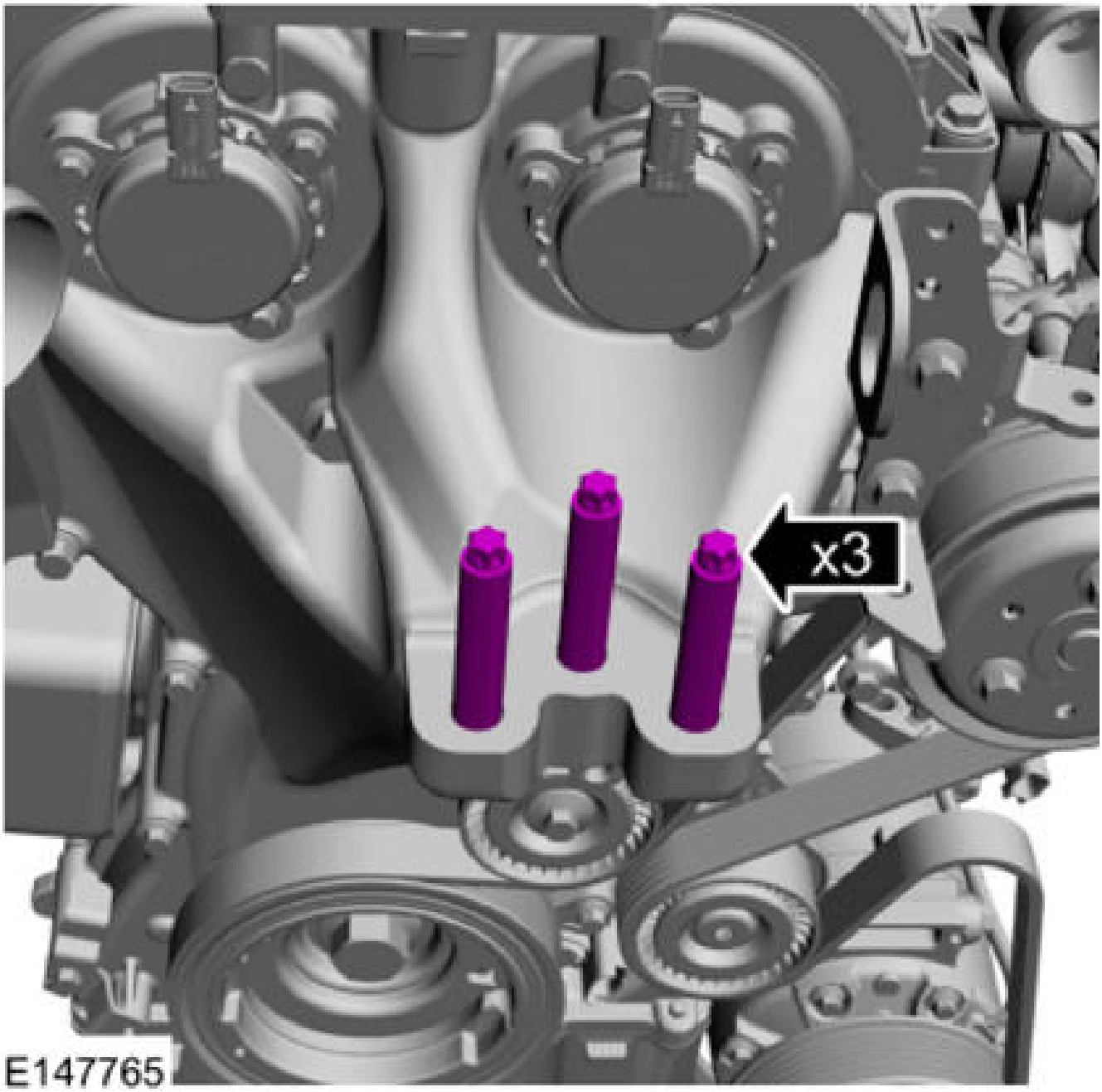
    12-13, M6x105,: 89 lb.in (10 Nm)

    14, M6x75,: 89 lb.in (10 Nm)

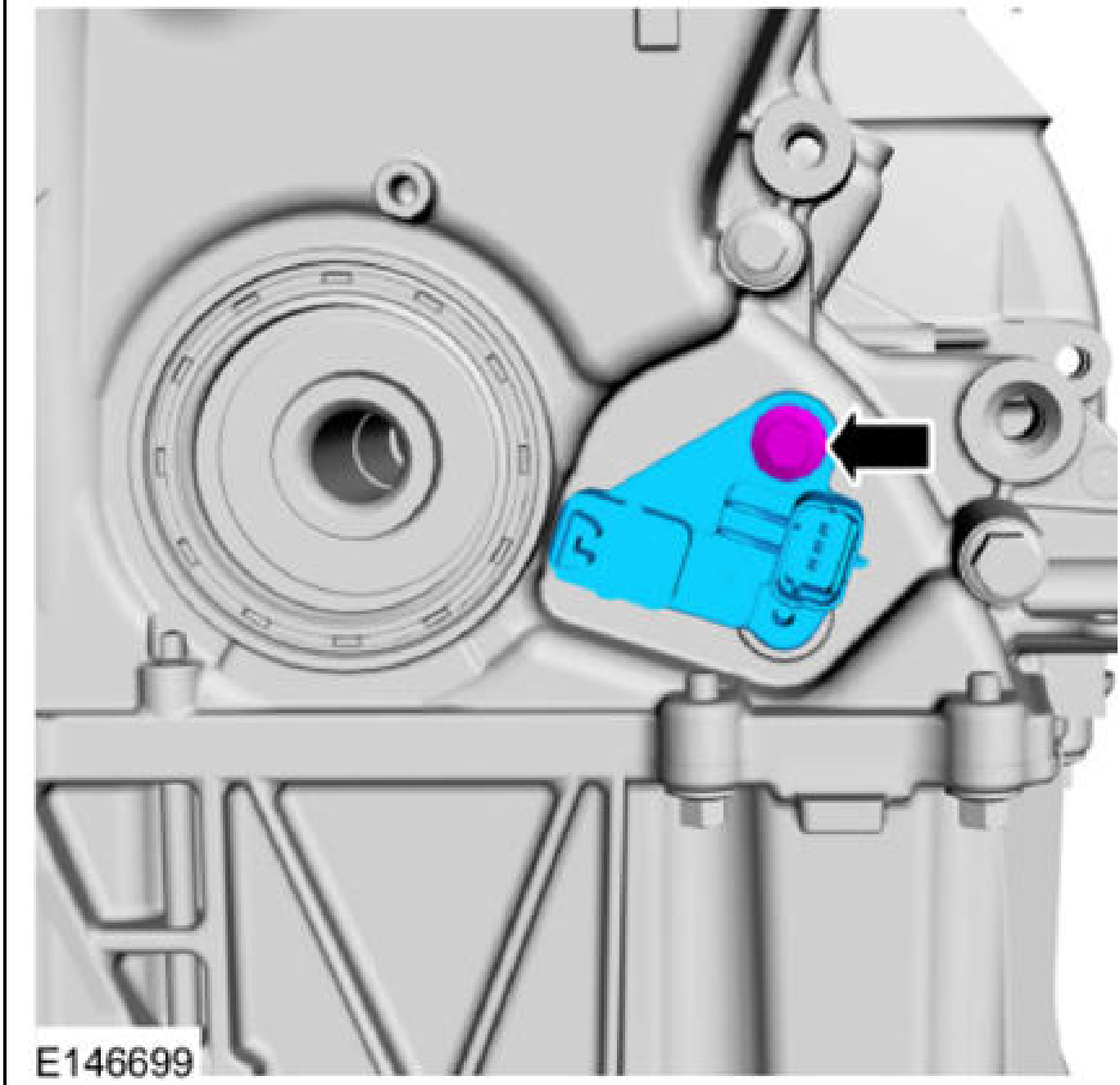
    15, M6x20,: 89 lb.in (10 Nm)



59. *Torque* : 89 lb.in (10 Nm)

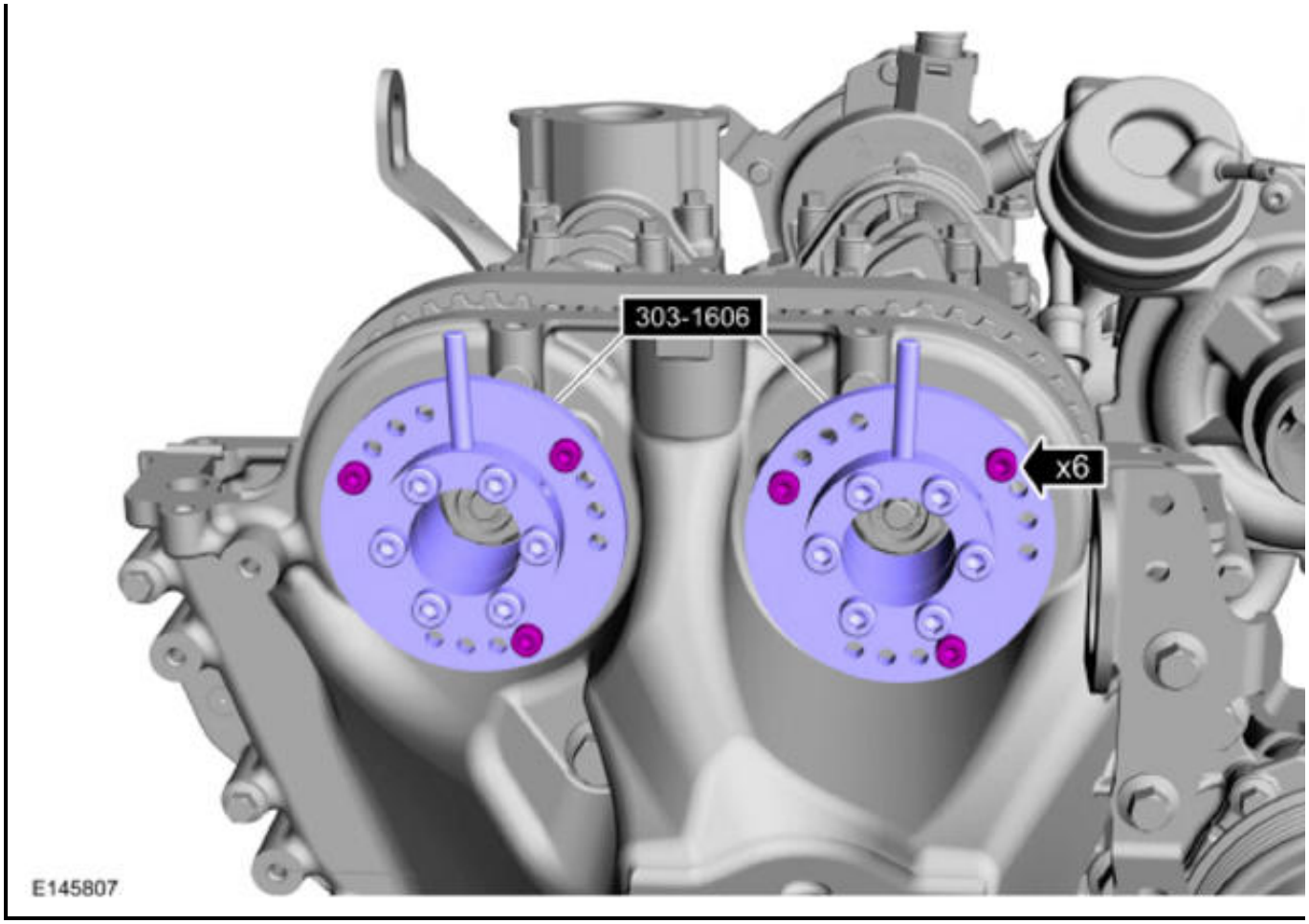


60. *Torque* : 89 lb.in (10 Nm)



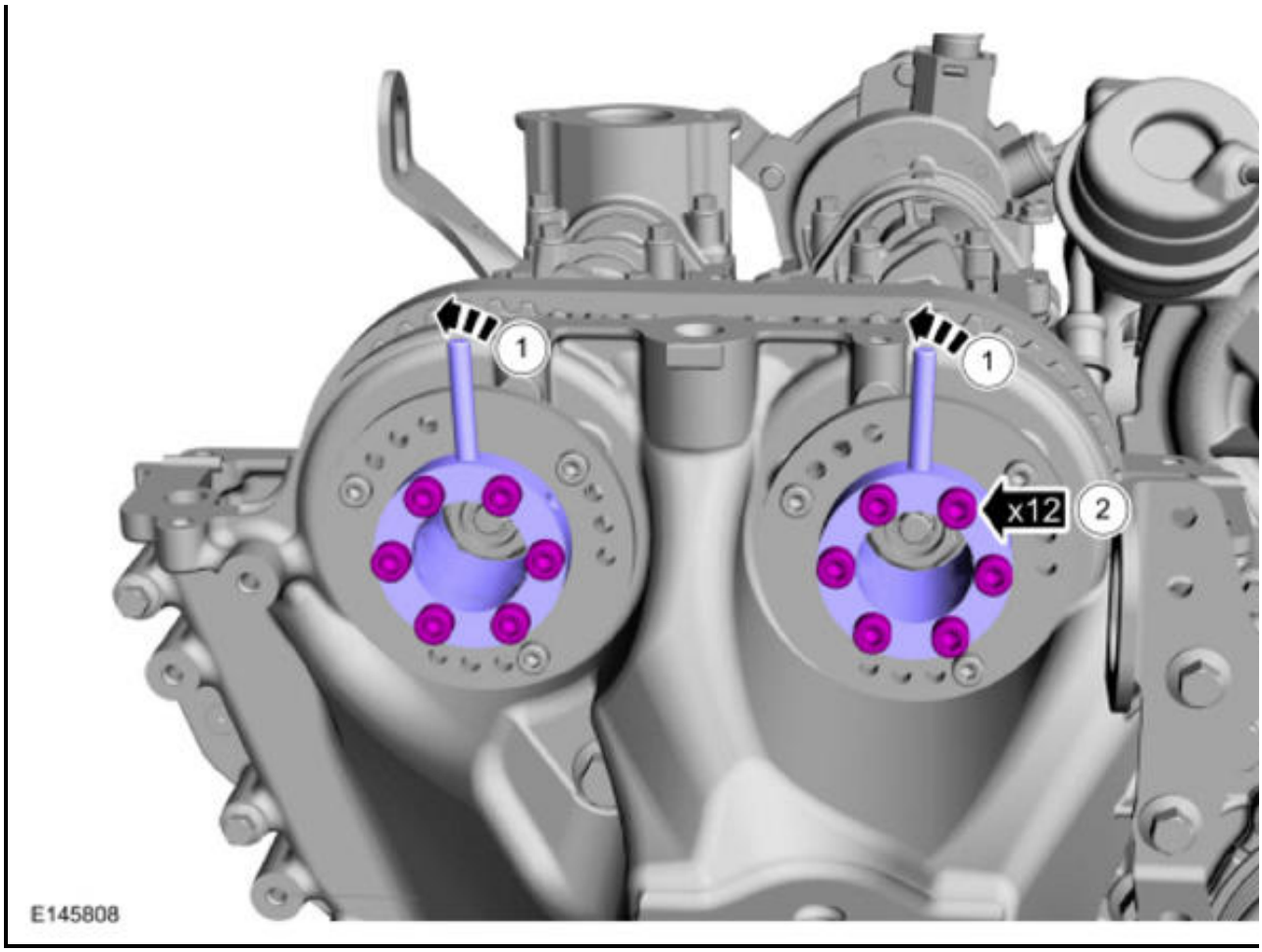
61. Install Special Service Tool: 303-1606 Locking Tool, Variable Camshaft Timing.

Torque : 89 lb.in (10 Nm)

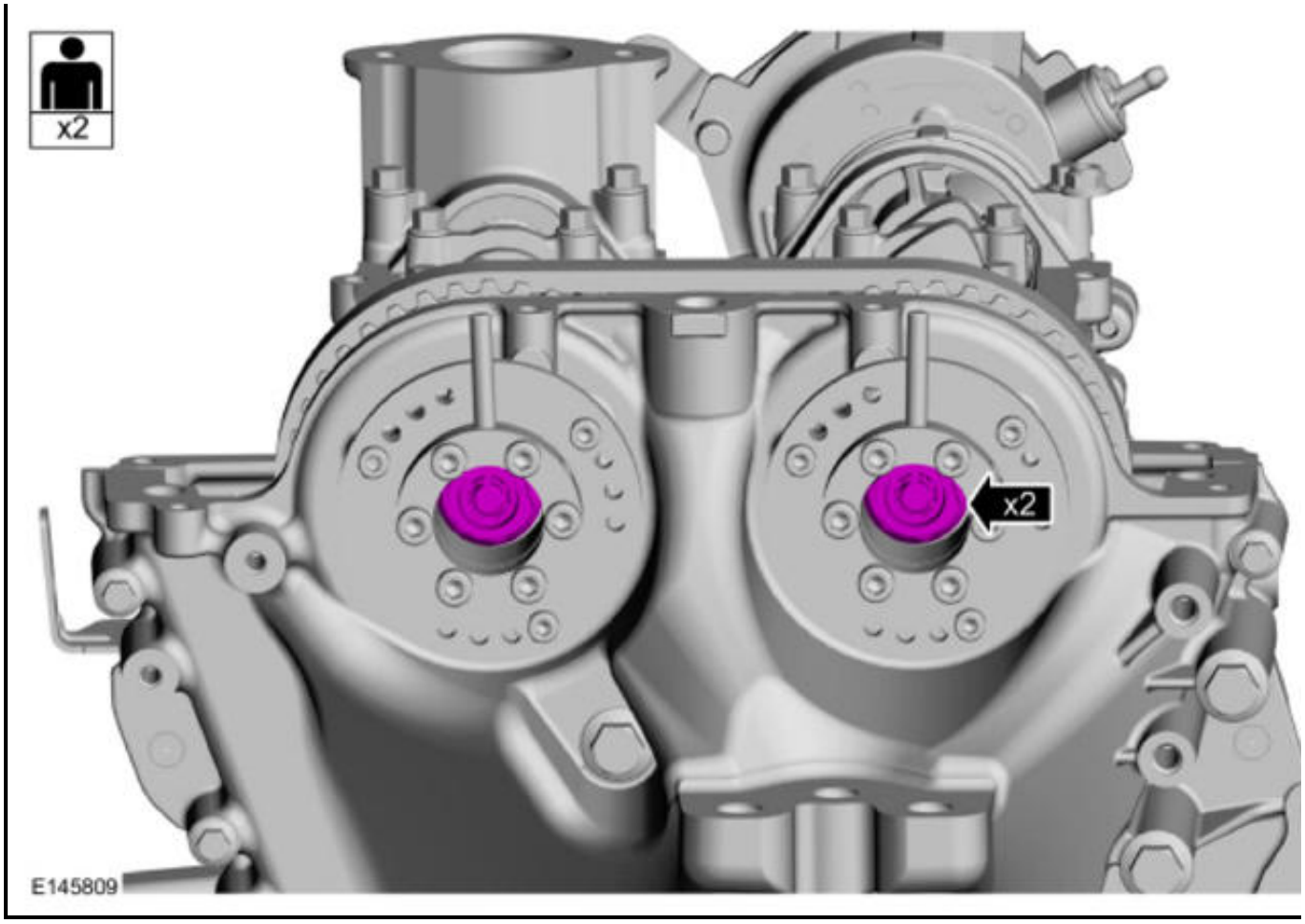


62.

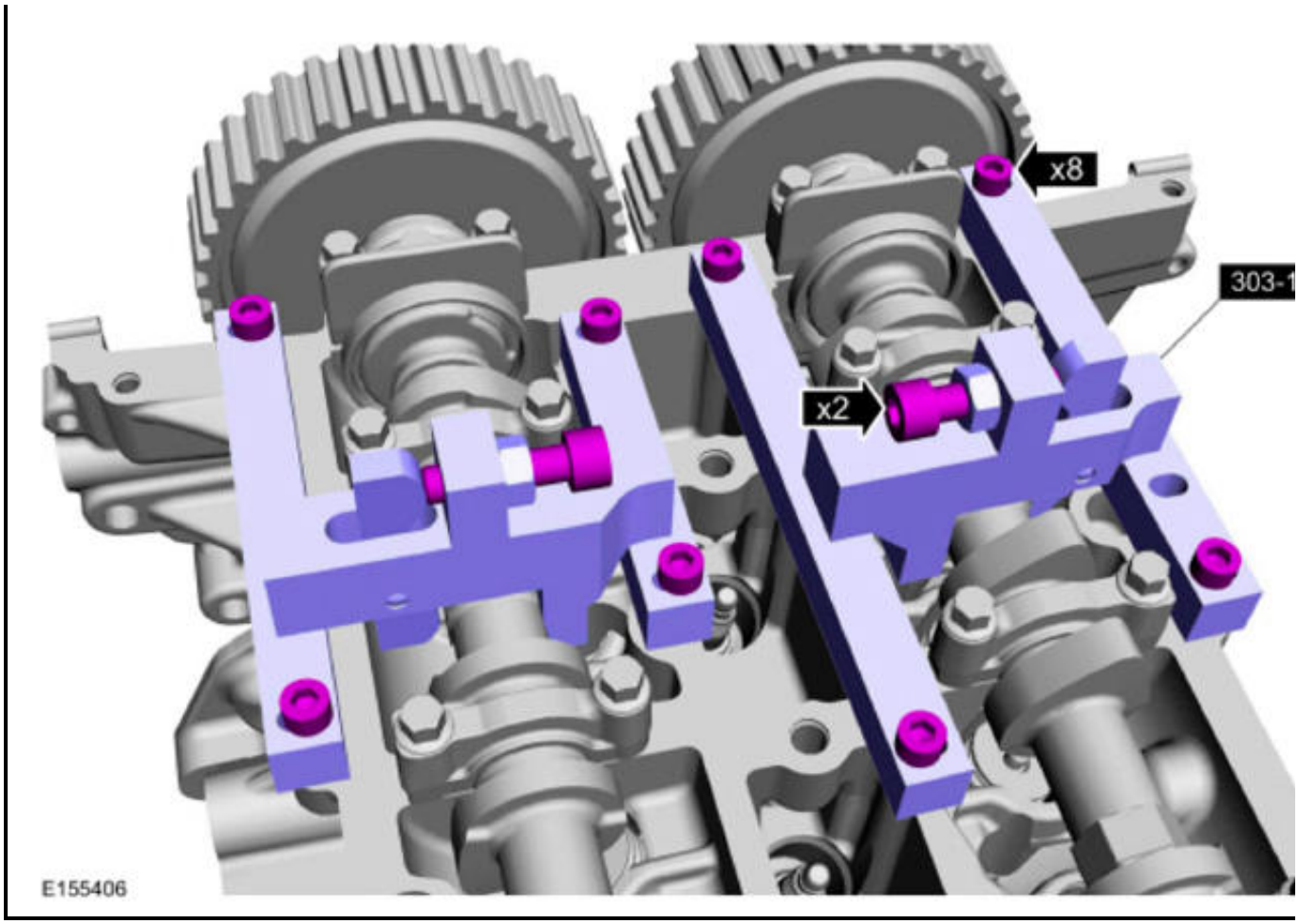
1. Turn until resistance is felt.
2. *Torque* : 133 lb.in (15 Nm)



63. *Torque* : 22 lb.ft (30 Nm)



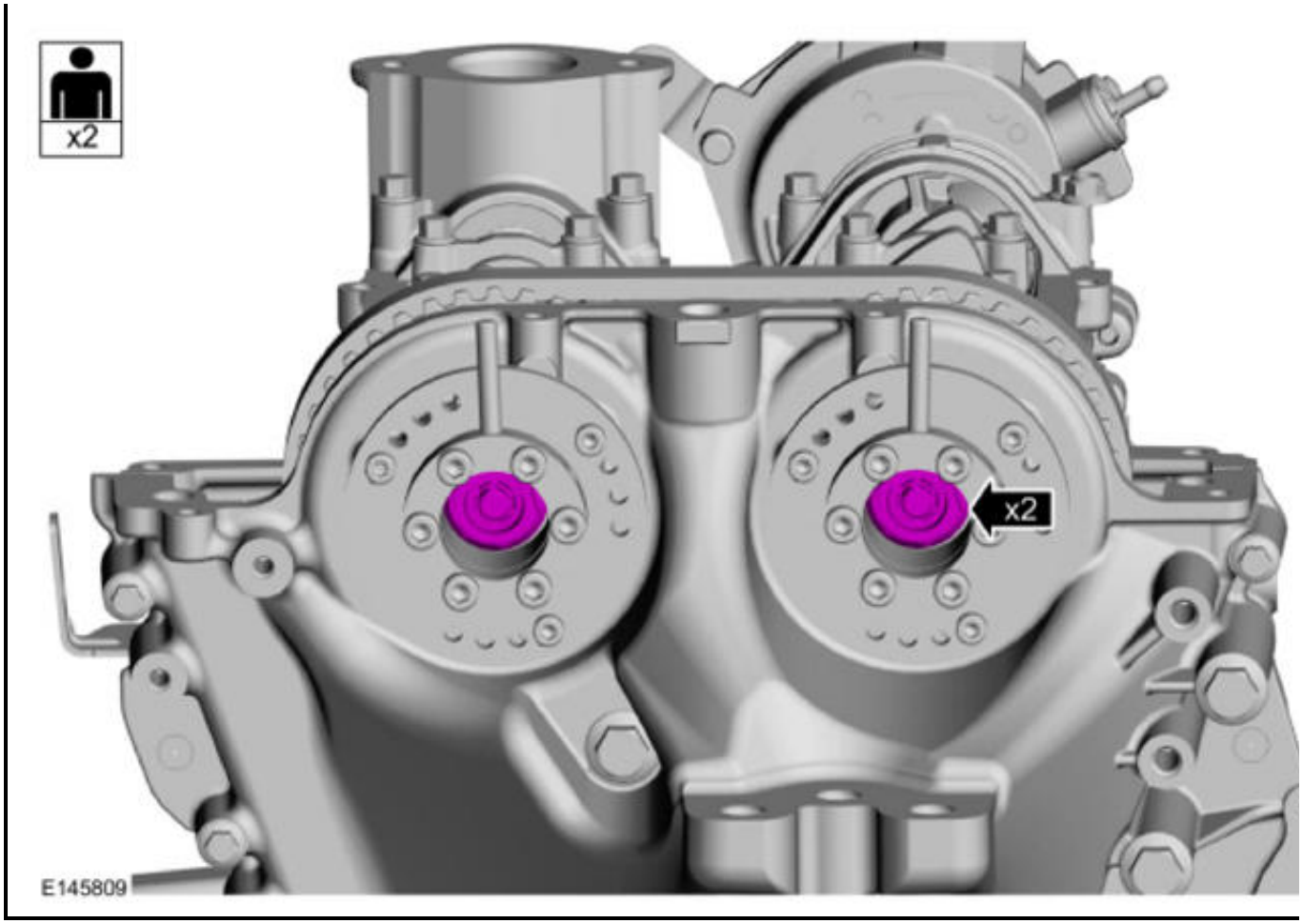
64. Remove Special Service Tool: 303-1605 Alignment Tool, Camshaft.



65. *Torque* :

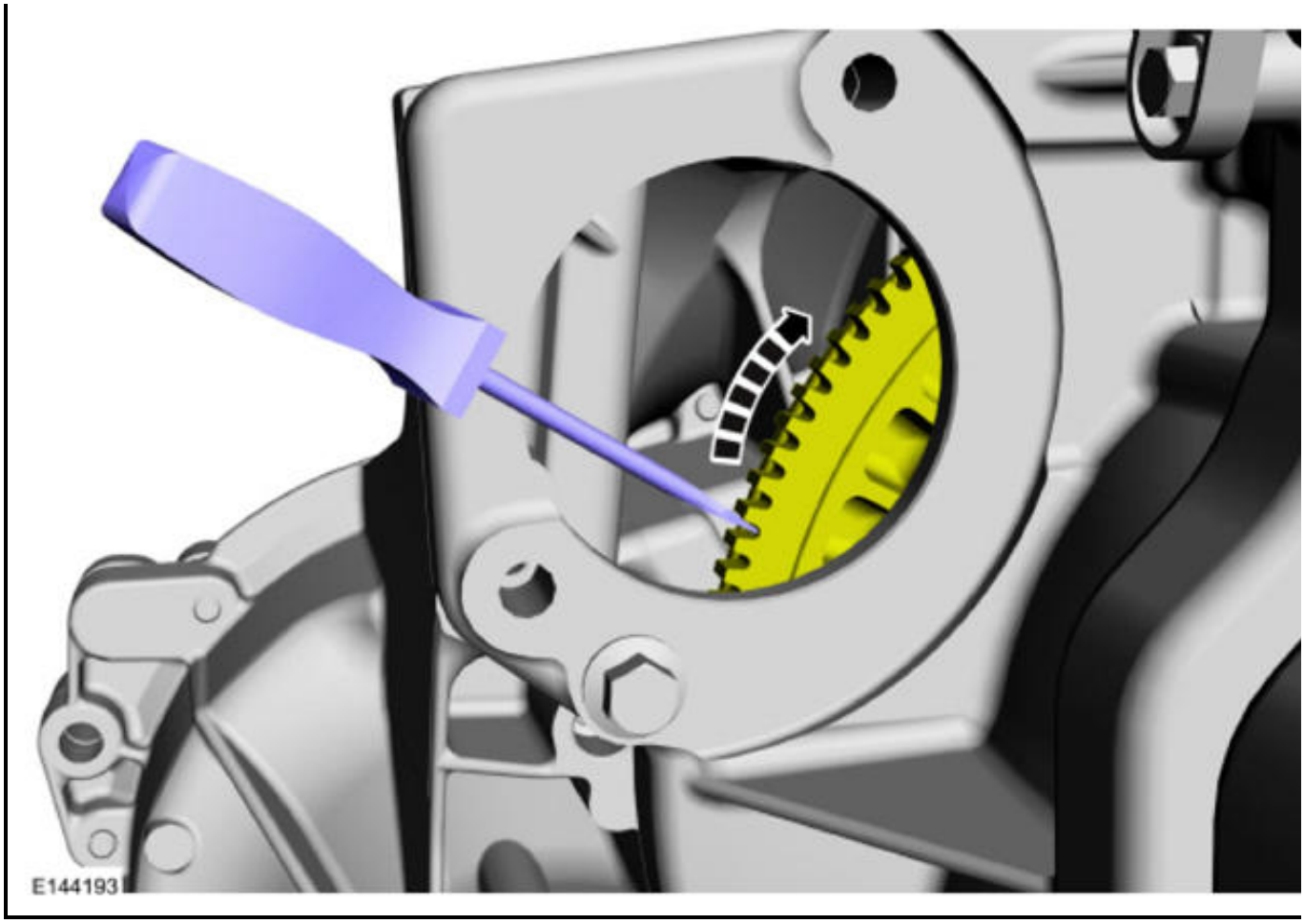
Stage 1: 37 lb.ft (50 Nm)

Stage 2: 70°



66. **NOTE: Only rotate the crankshaft clockwise.**

Rotate the crankshaft slowly until the crankshaft stops.



YouTube	A multimedia supplement to the instructions contained in this article is available. To view the multimedia example of the condition described go to; **http://www.youtube.com/user/Mitchell1Tips** **then type, "A0067059.vid1" into the "Search Channel" box.**

67.

1.

NOTE: Make sure that a new component is installed.

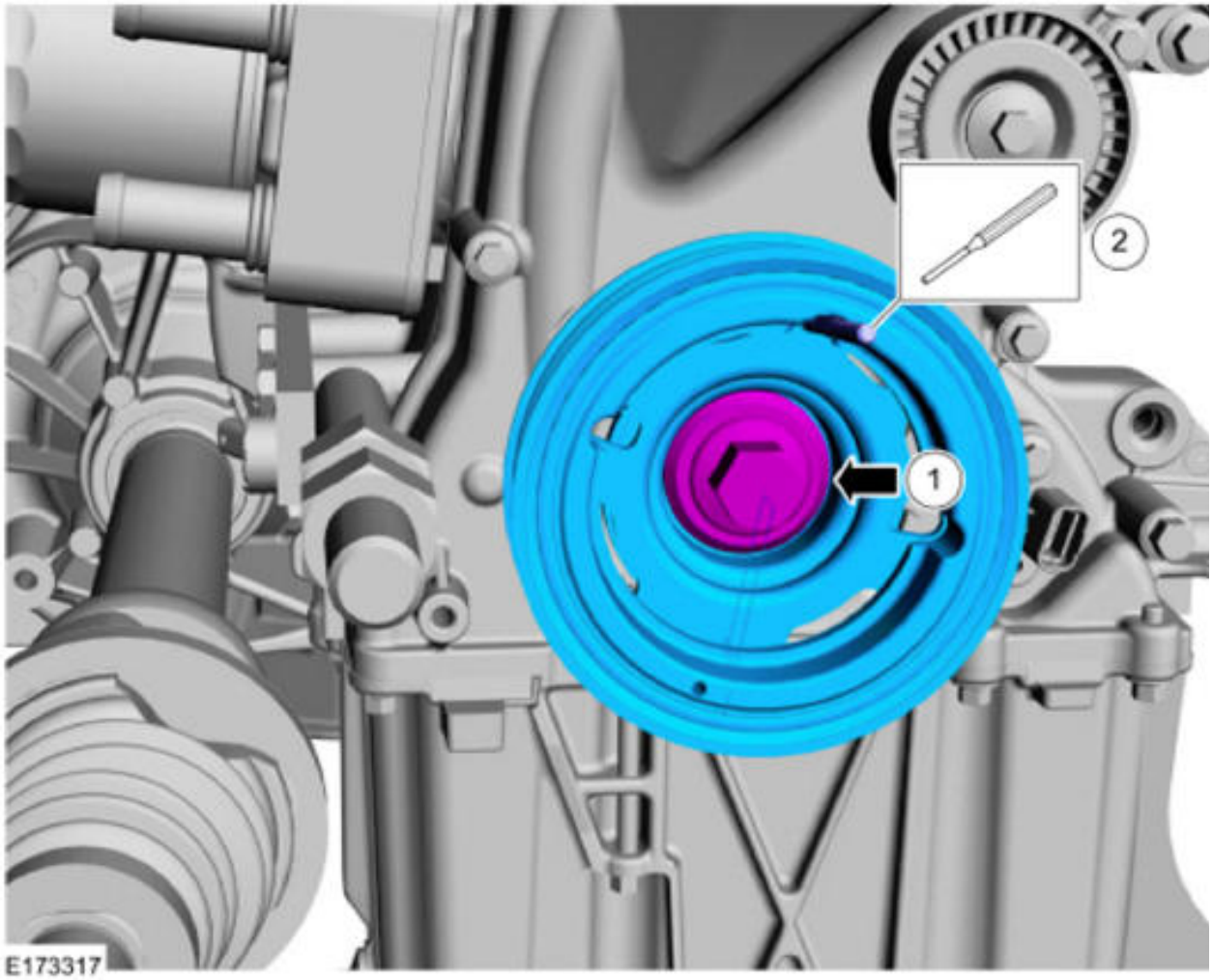
2. Install 3/16 inch punch.

Use the General Equipment: Punch

Torque :

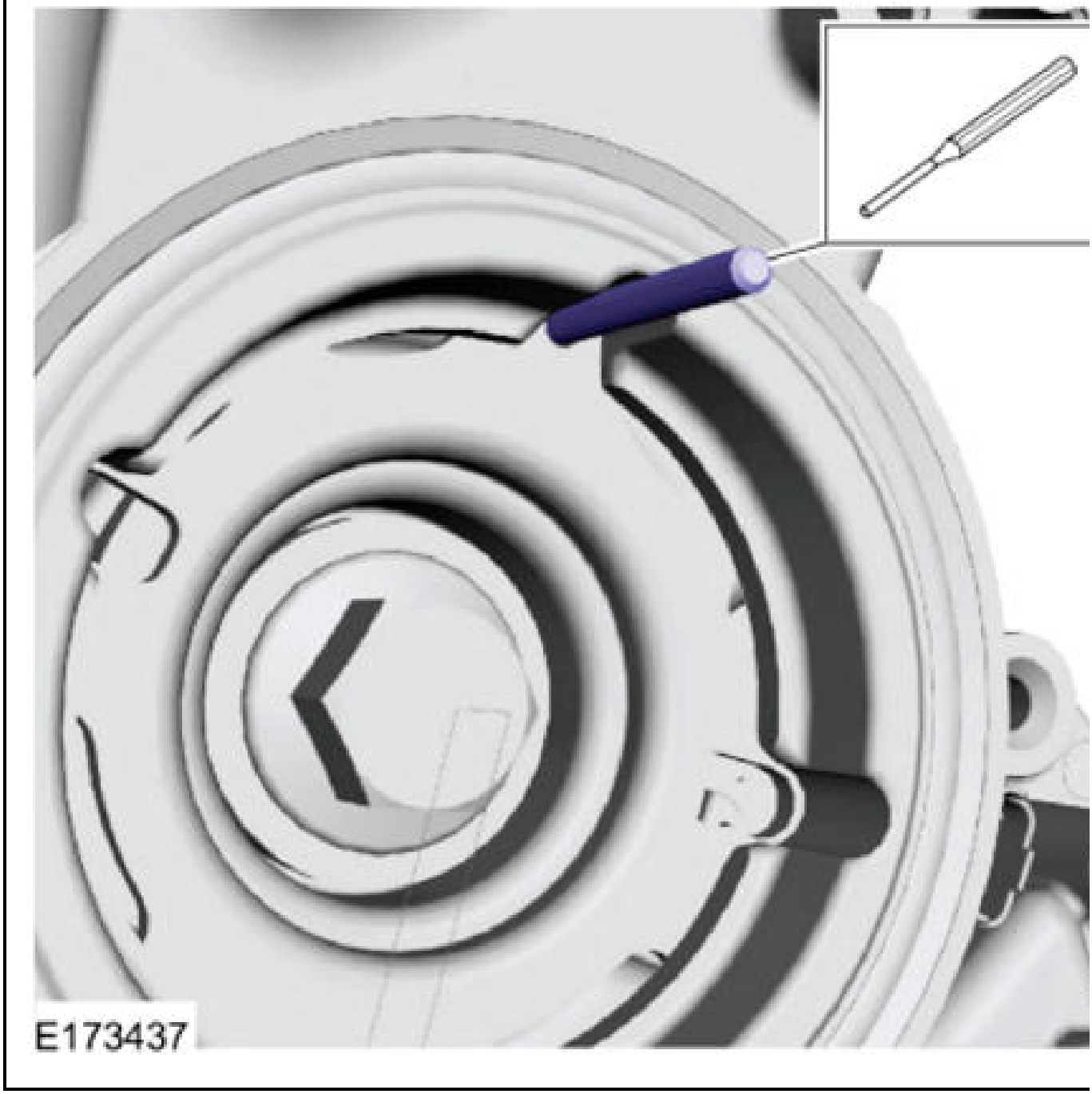
Stage 1: 18 lb.ft (25 Nm)

Stage 2: 52 lb.ft (70 Nm)



68. Remove 3/16 inch punch.

Use the General Equipment: Punch

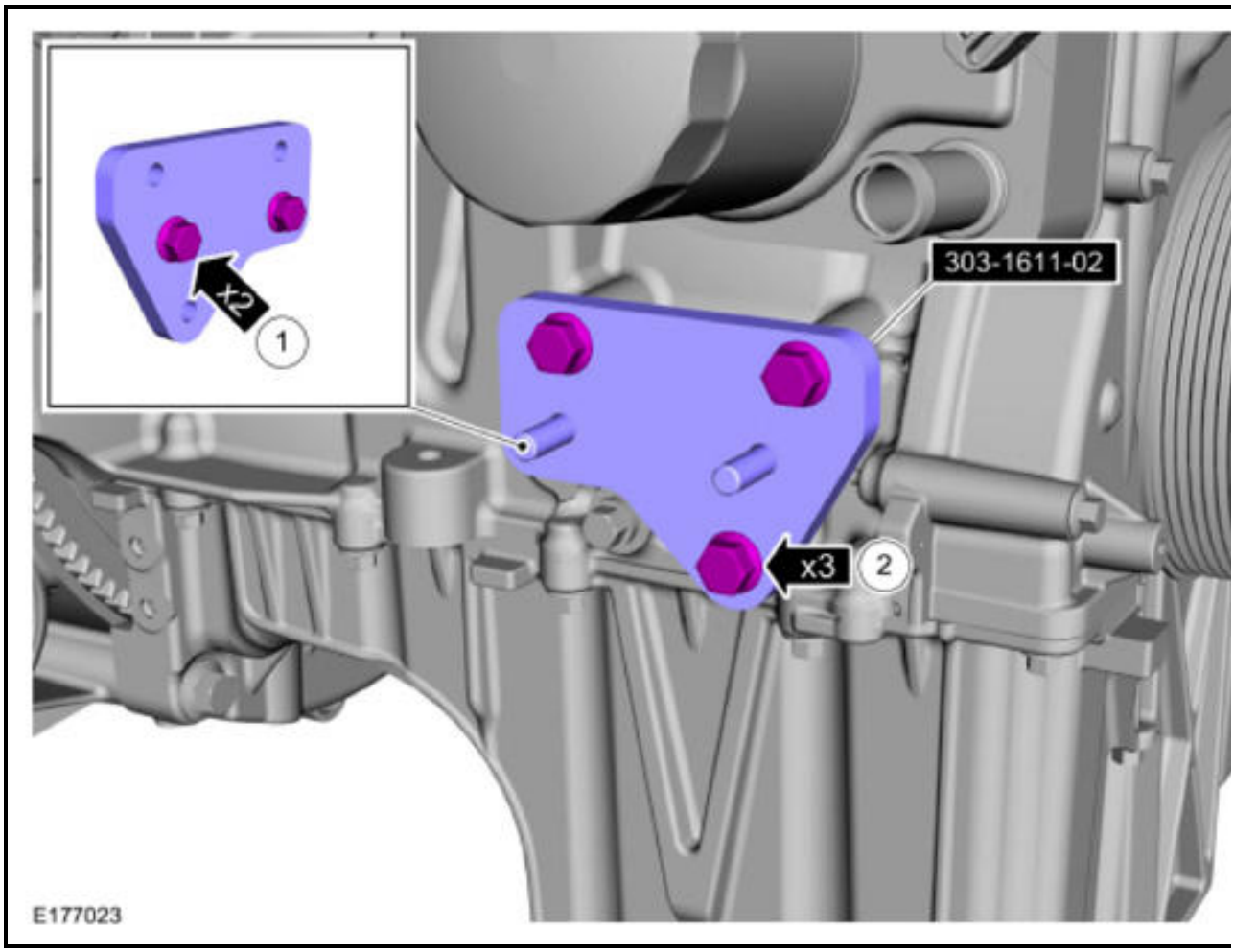


69.

1. M8x30
2. M8x25

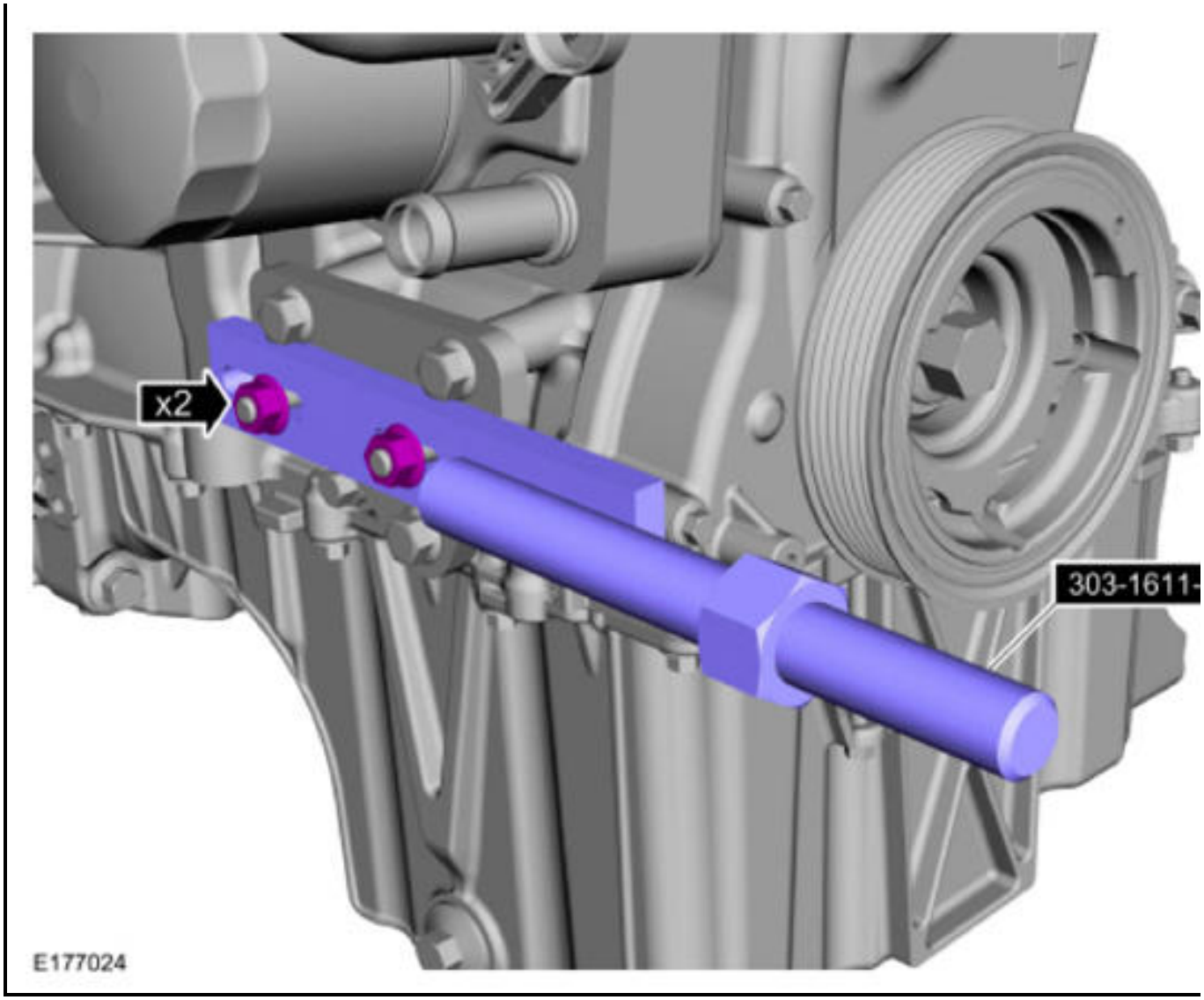
Install Special Service Tool: **303-1611-02 Adapter for 303-1611, Torque Multiplier** .

Torque : 18 lb.ft (24 Nm)



70. Install Special Service Tool: 303-1611-01 Adapter for 303-1611.

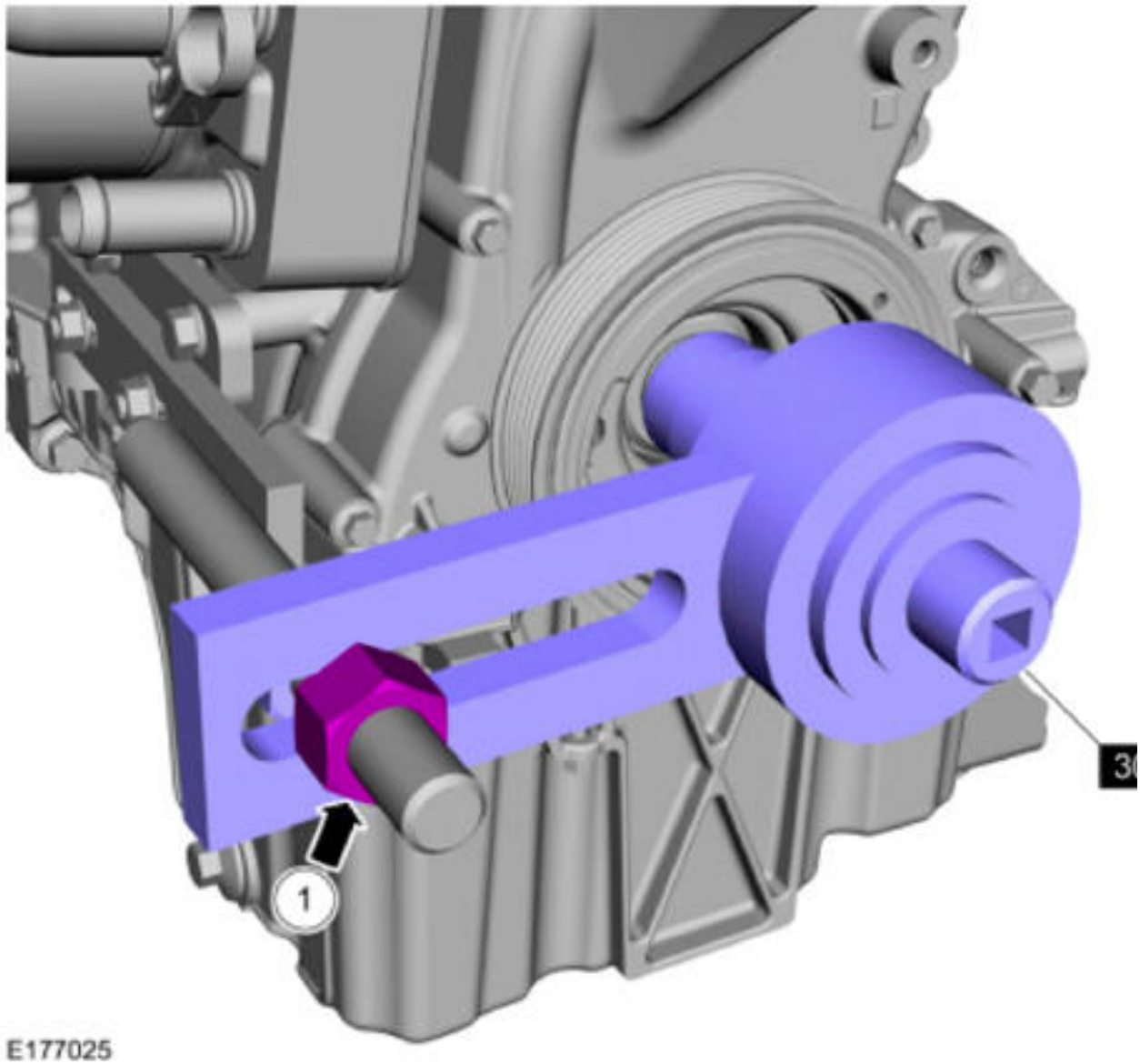
Torque : 18 lb.ft (24 Nm)



71.

- Only tighten the nut finger tight at this stage.

  Install Special Service Tool: 303-1611 Torque Multiplier.



72.

YouTube	A multimedia supplement to the instructions contained in this article is available. To view the multimedia example of the condition described go to; **http://www.youtube.com/user/Mitchell1Tips** **then type, "A00670659.vid2" into the "Search Channel" box.**

1. *Torque* : 44 lb.ft (60 Nm)
2. *Torque* :

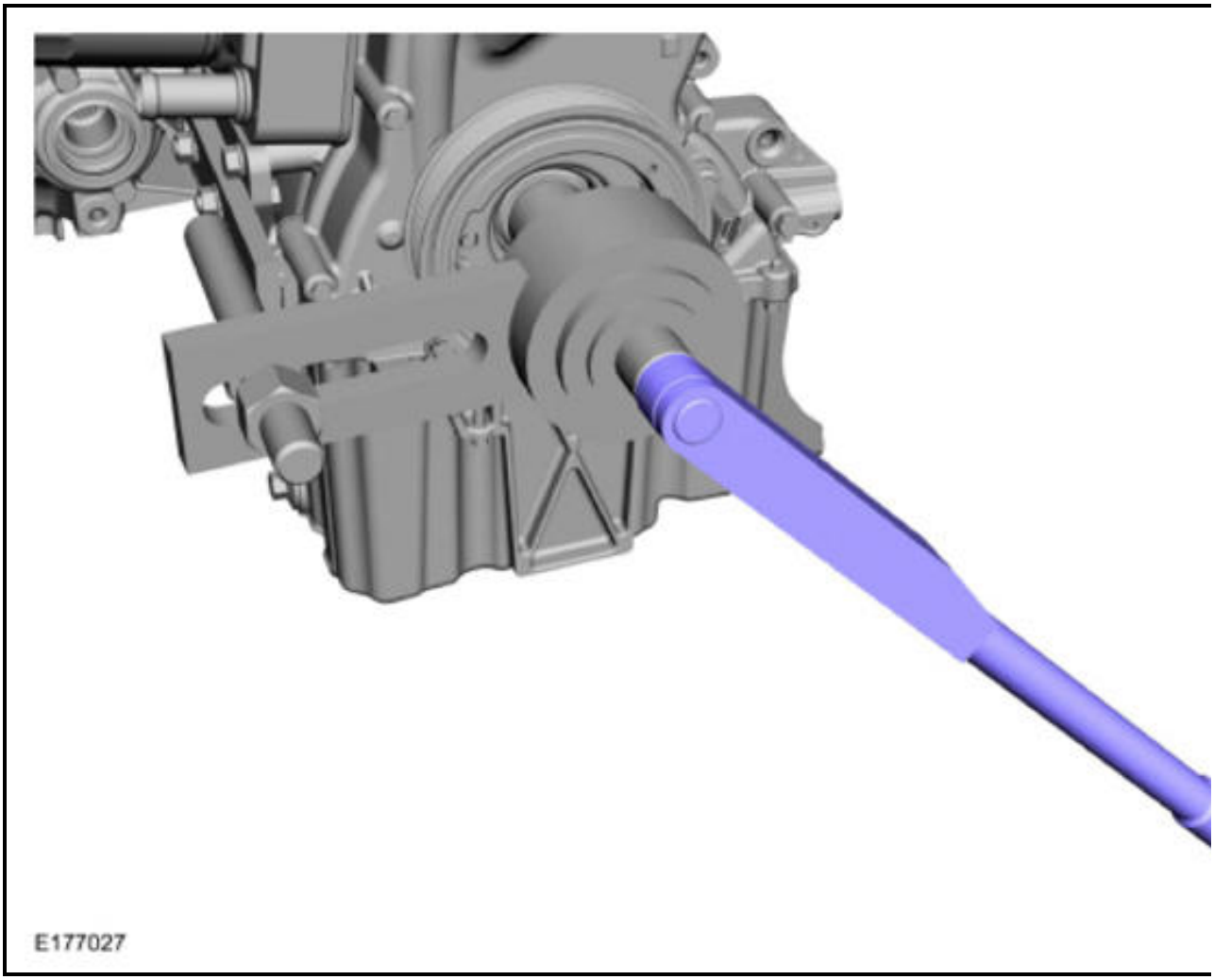
Stage 1: 90°

Stage 2: 90°

Stage 3: 90°

Stage 4: 90°

Stage 5: 90°

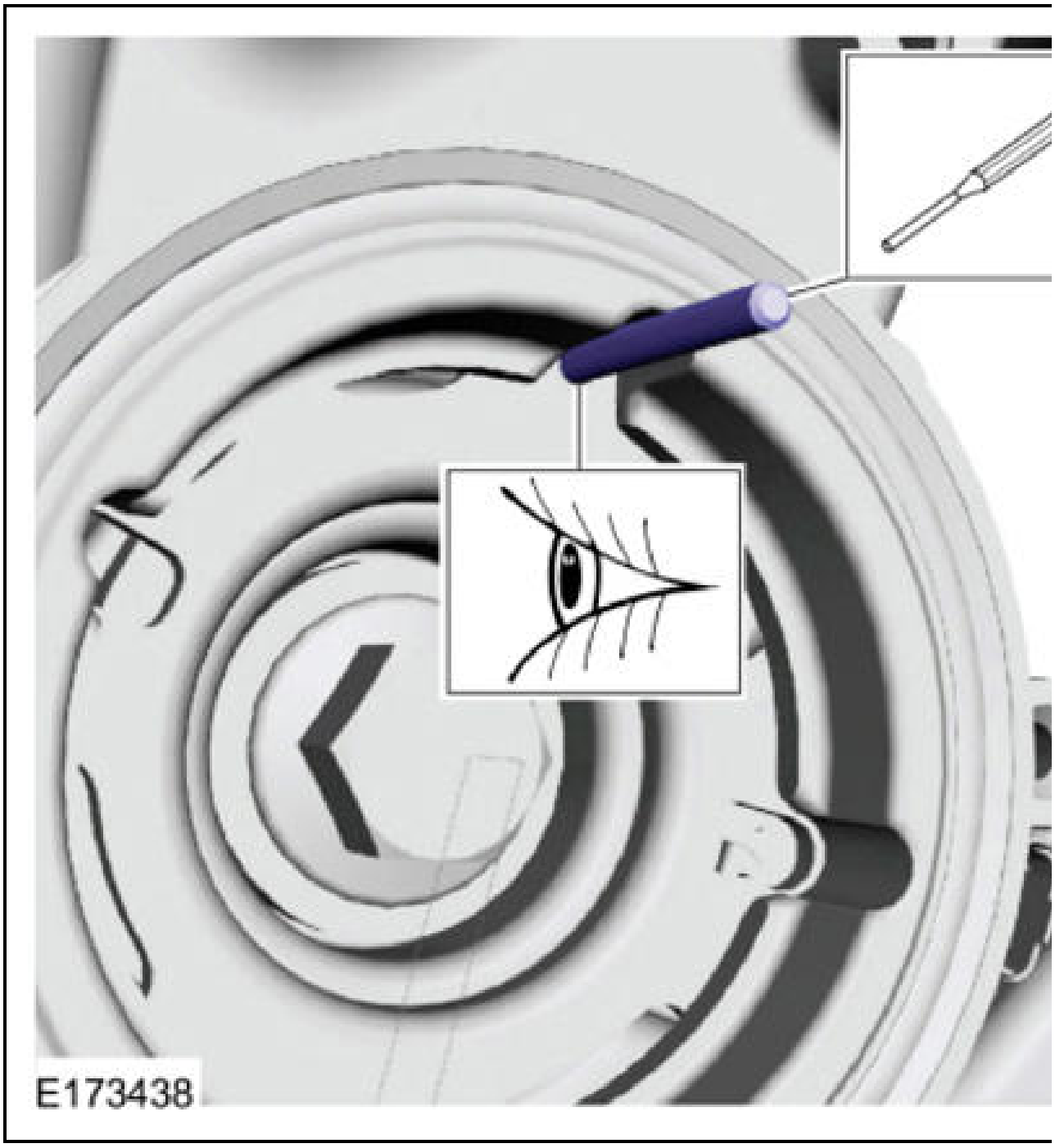


73. Remove Special Service Tool: 303-1611 Torque Multiplier.
74.
    - Install 3/16 inch punch.

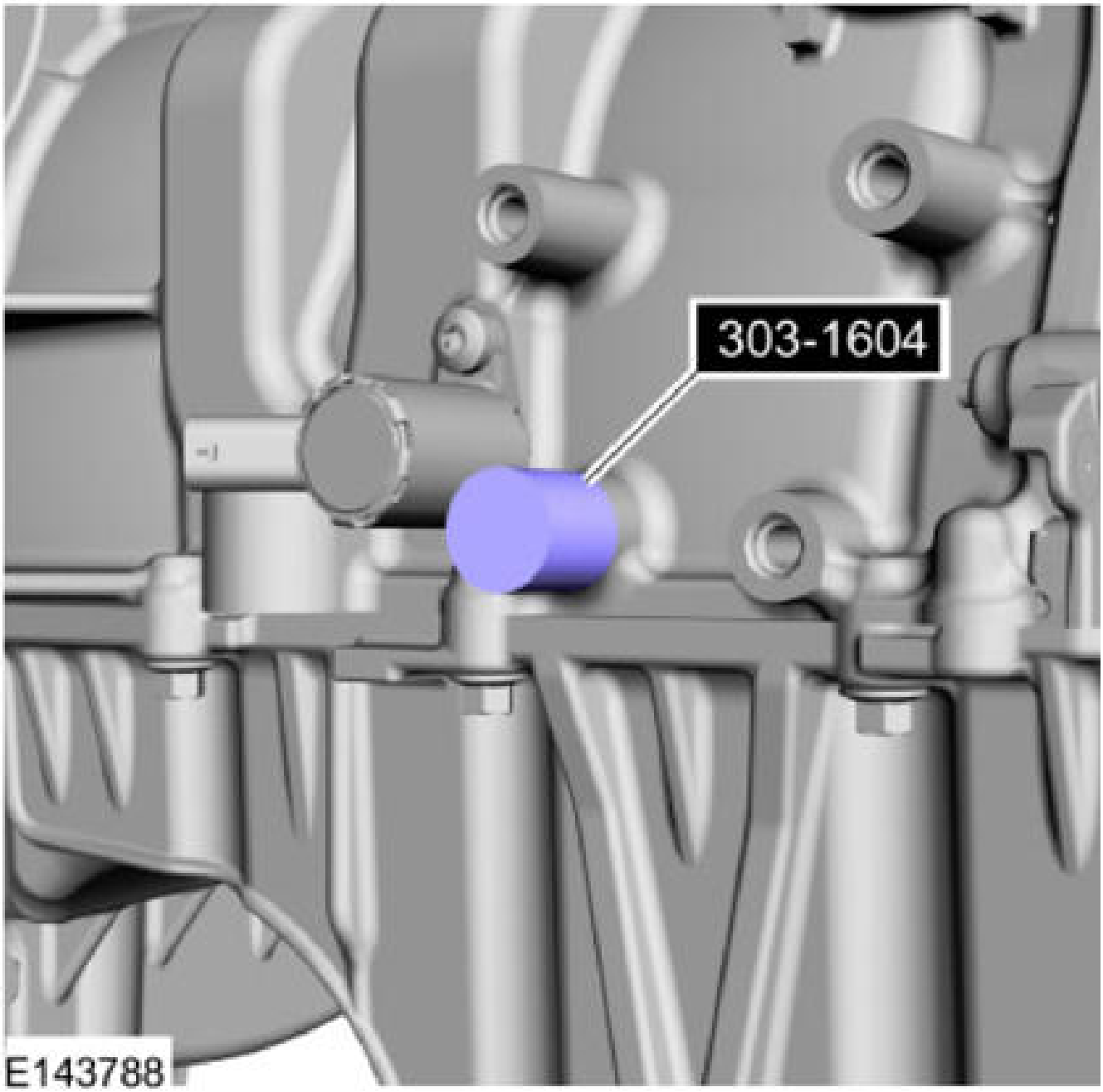
      Use the General Equipment: Punch

    - Remove 3/16 inch punch.

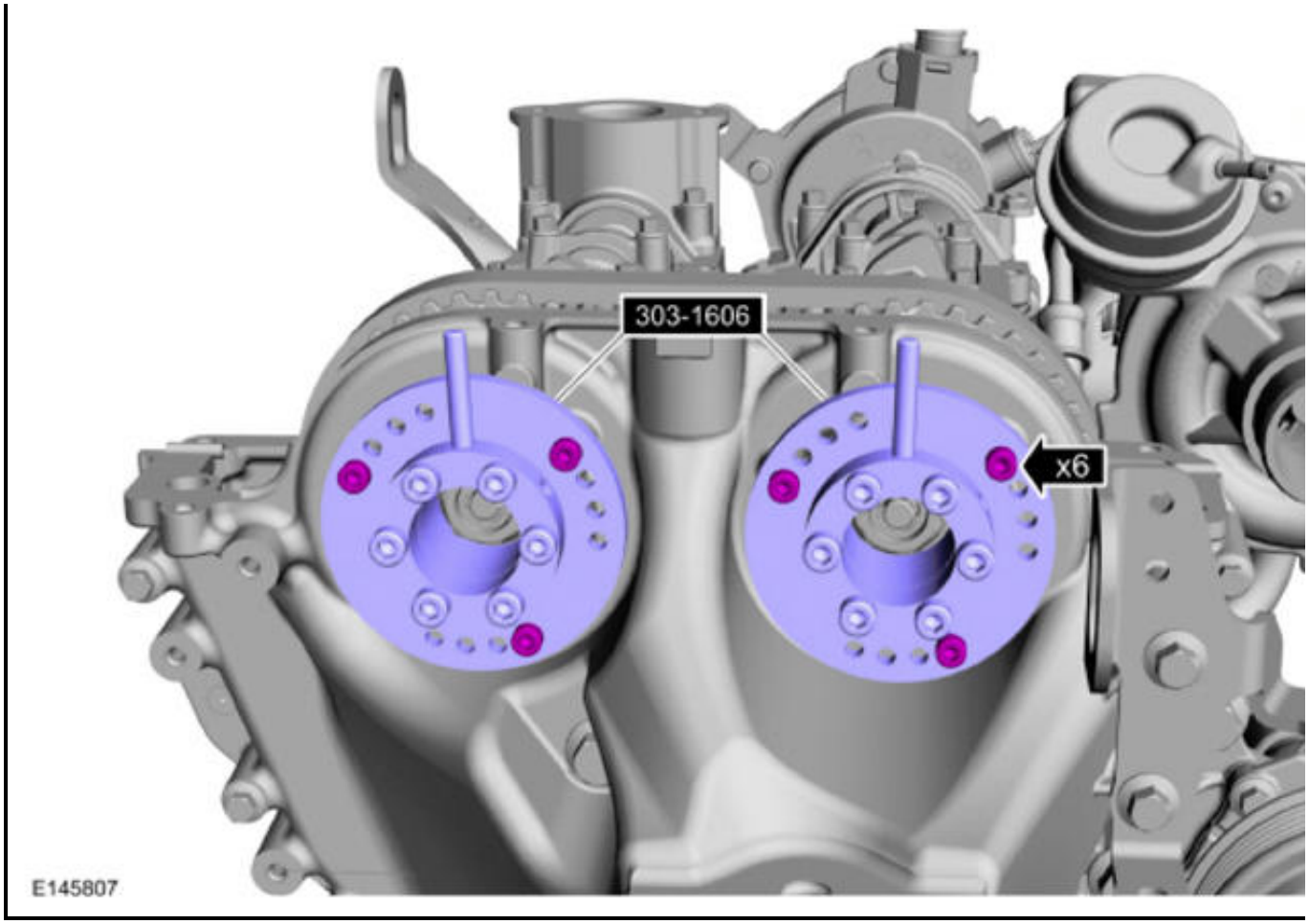
Use the General Equipment: Punch



75. Remove Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.

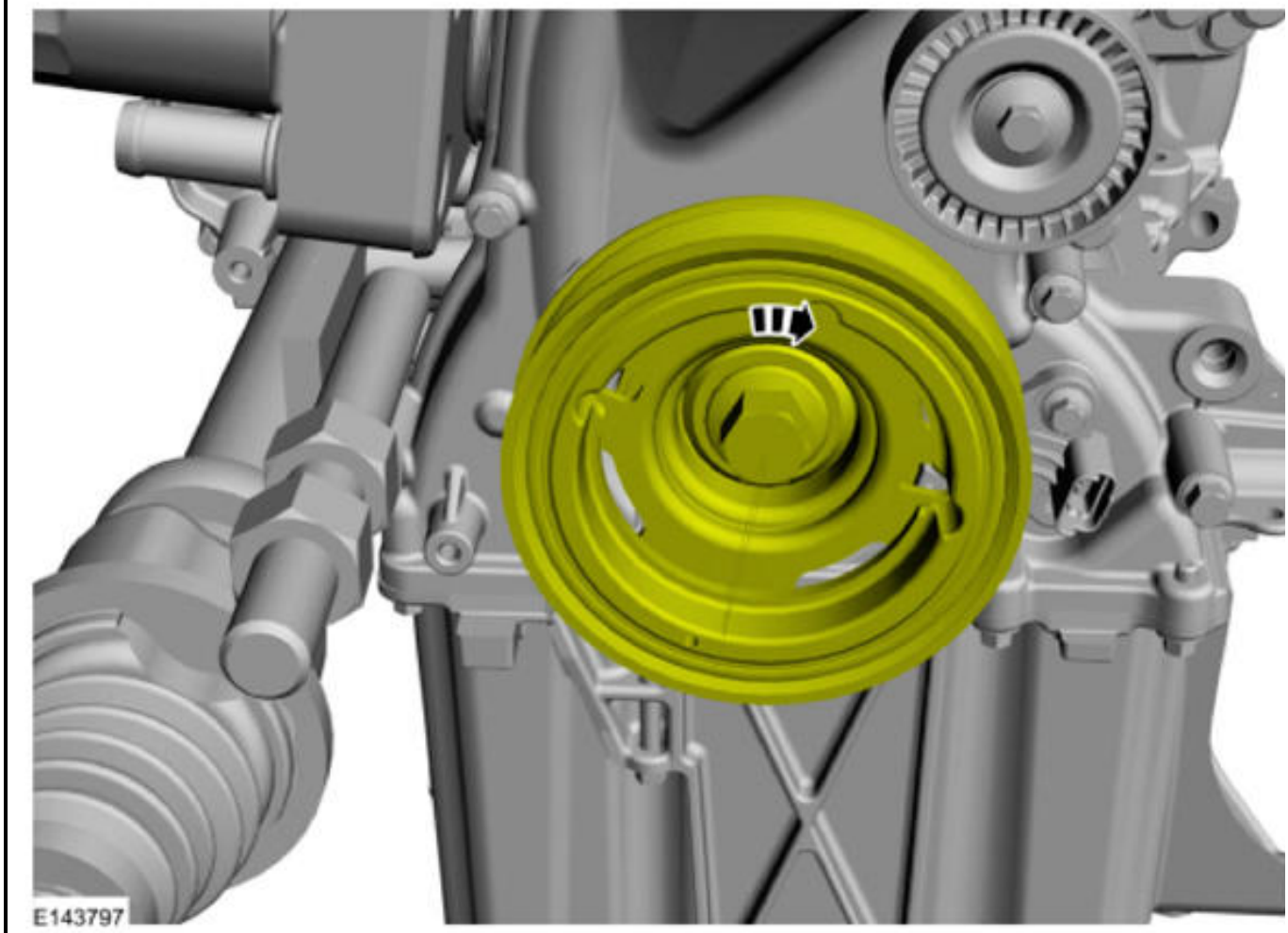


76. Remove Special Service Tool: 303-1606 Locking Tool, Variable Camshaft Timing.

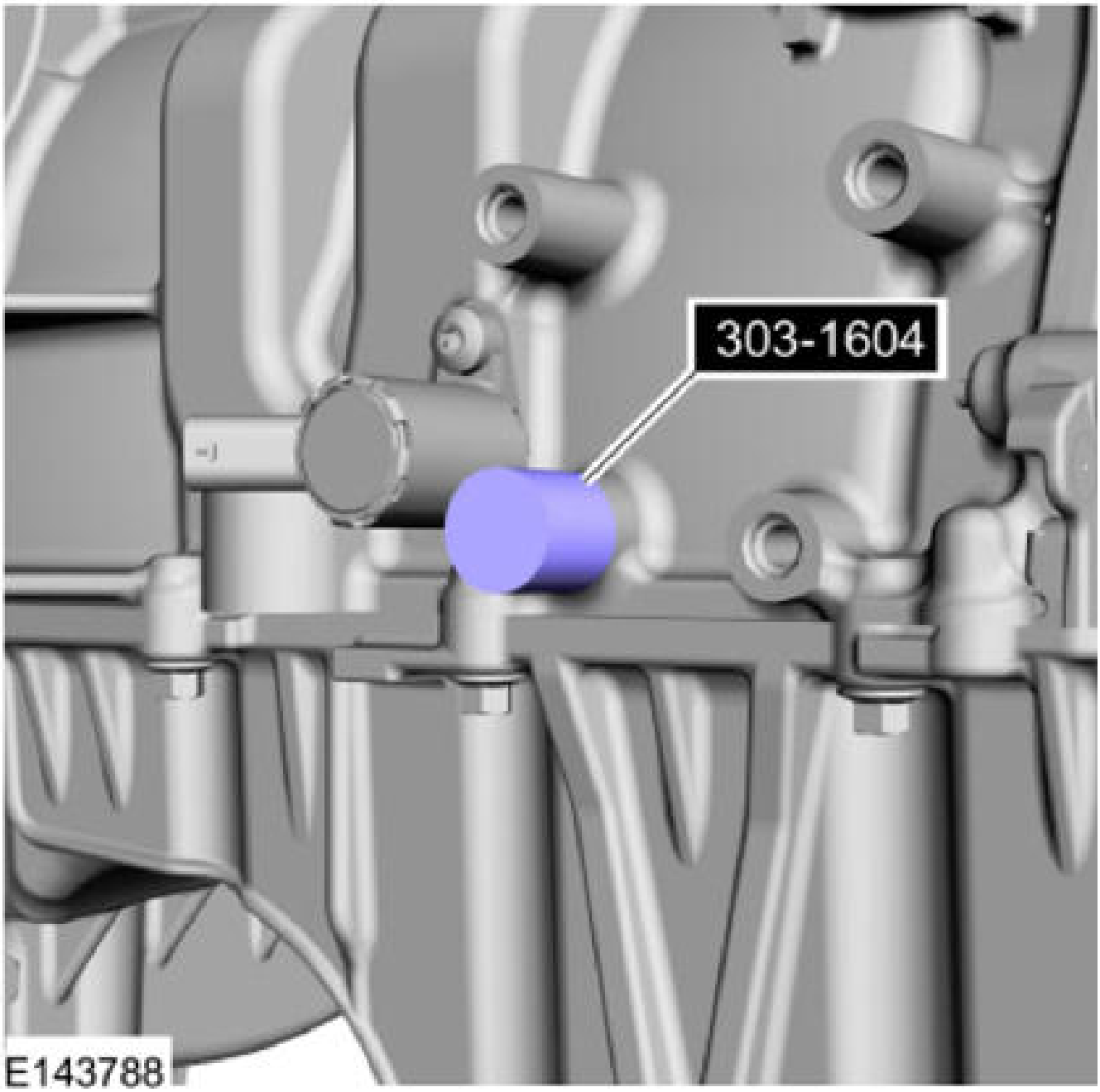


77. **NOTE: Only rotate the crankshaft clockwise.**

Rotate the crankshaft 1 and 3/4 revolutions and continue until piston No. 1 is approximately 45° before top dead center (BTDC).

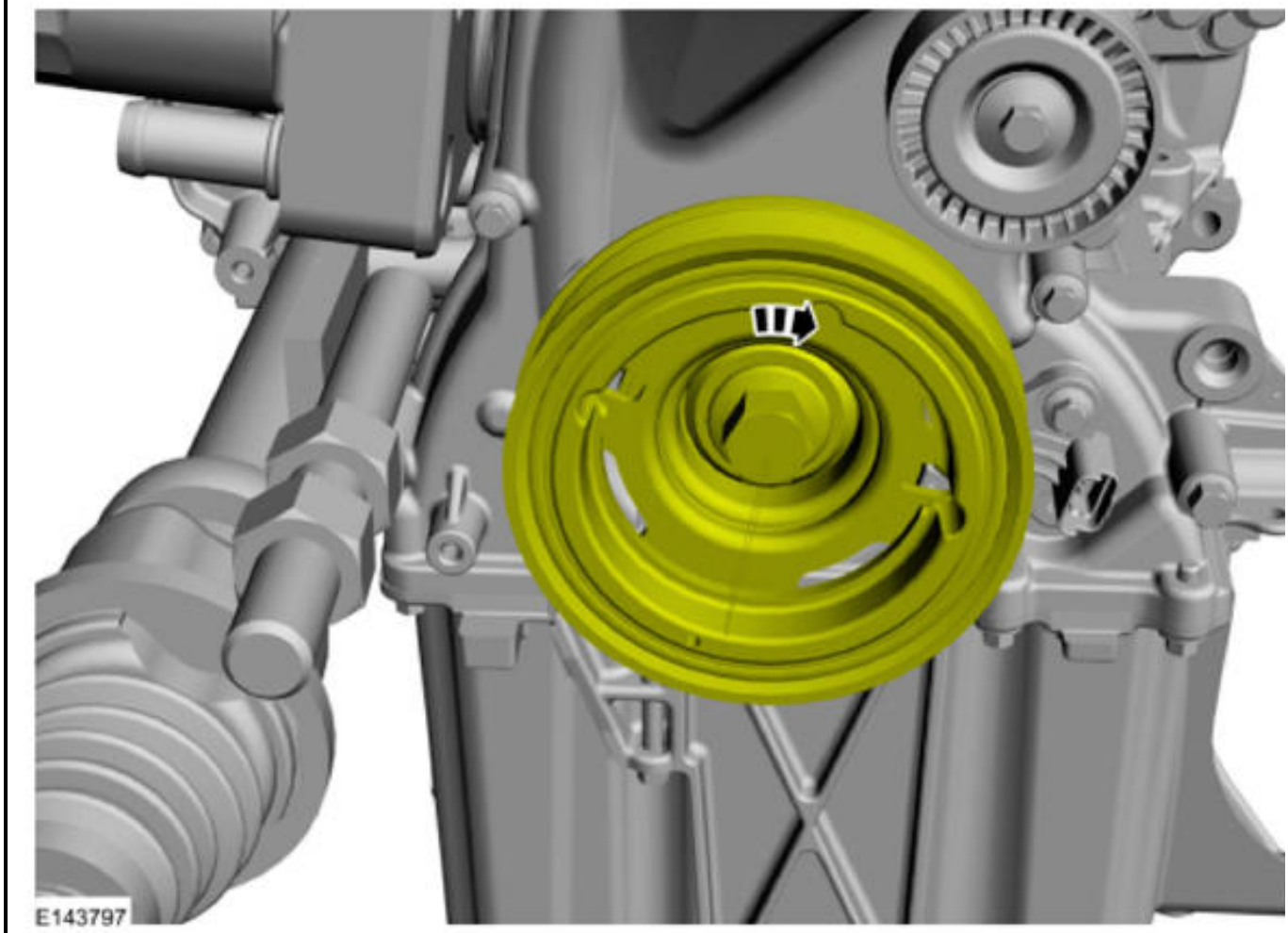


78. Install Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.



79. **NOTE: Only rotate the crankshaft clockwise.**

Rotate the crankshaft slowly until the crankshaft stops.



80.

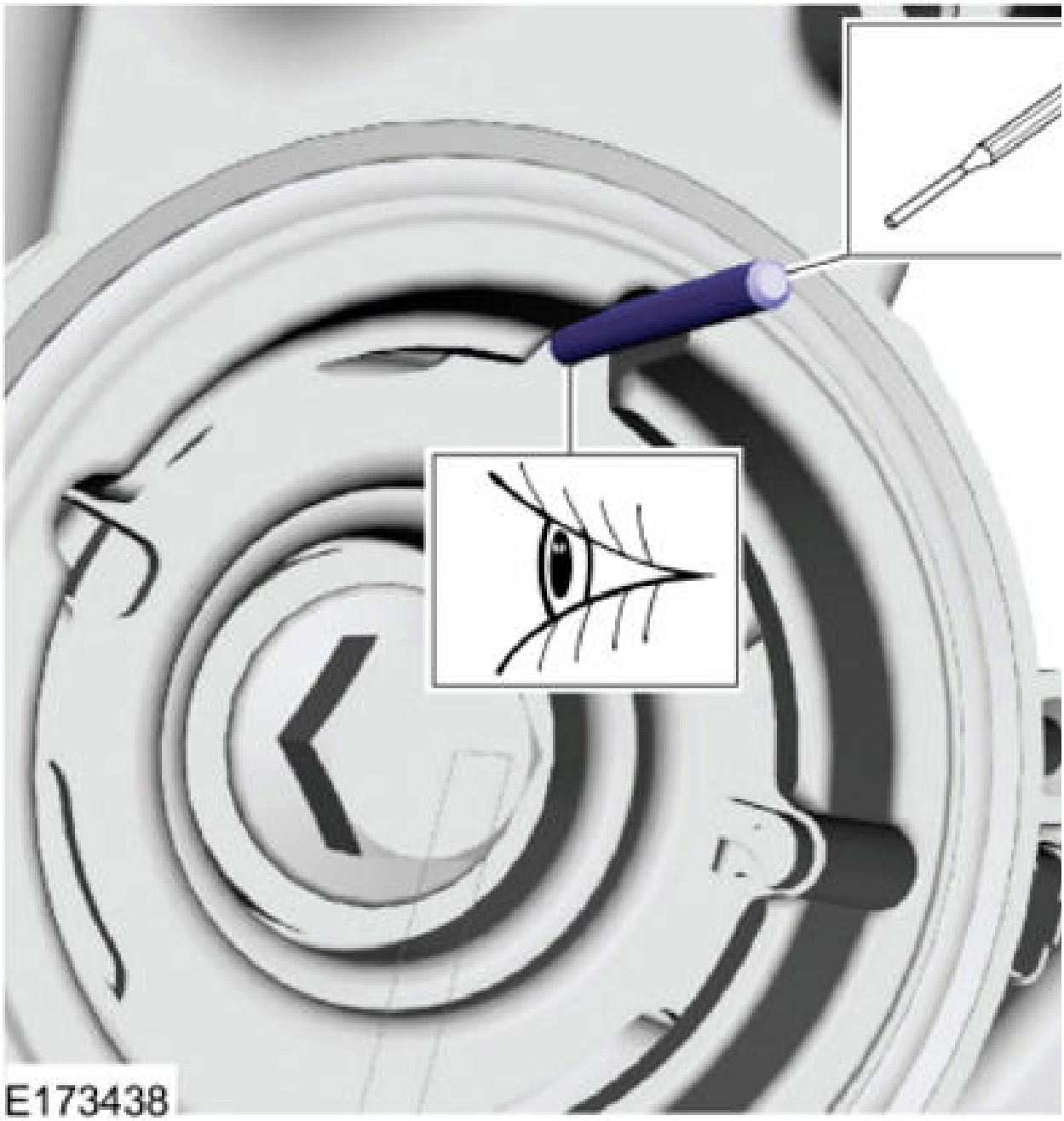
- **NOTE: The punch can only be installed if the valve timing is correct.**

  Install 3/16 inch punch.

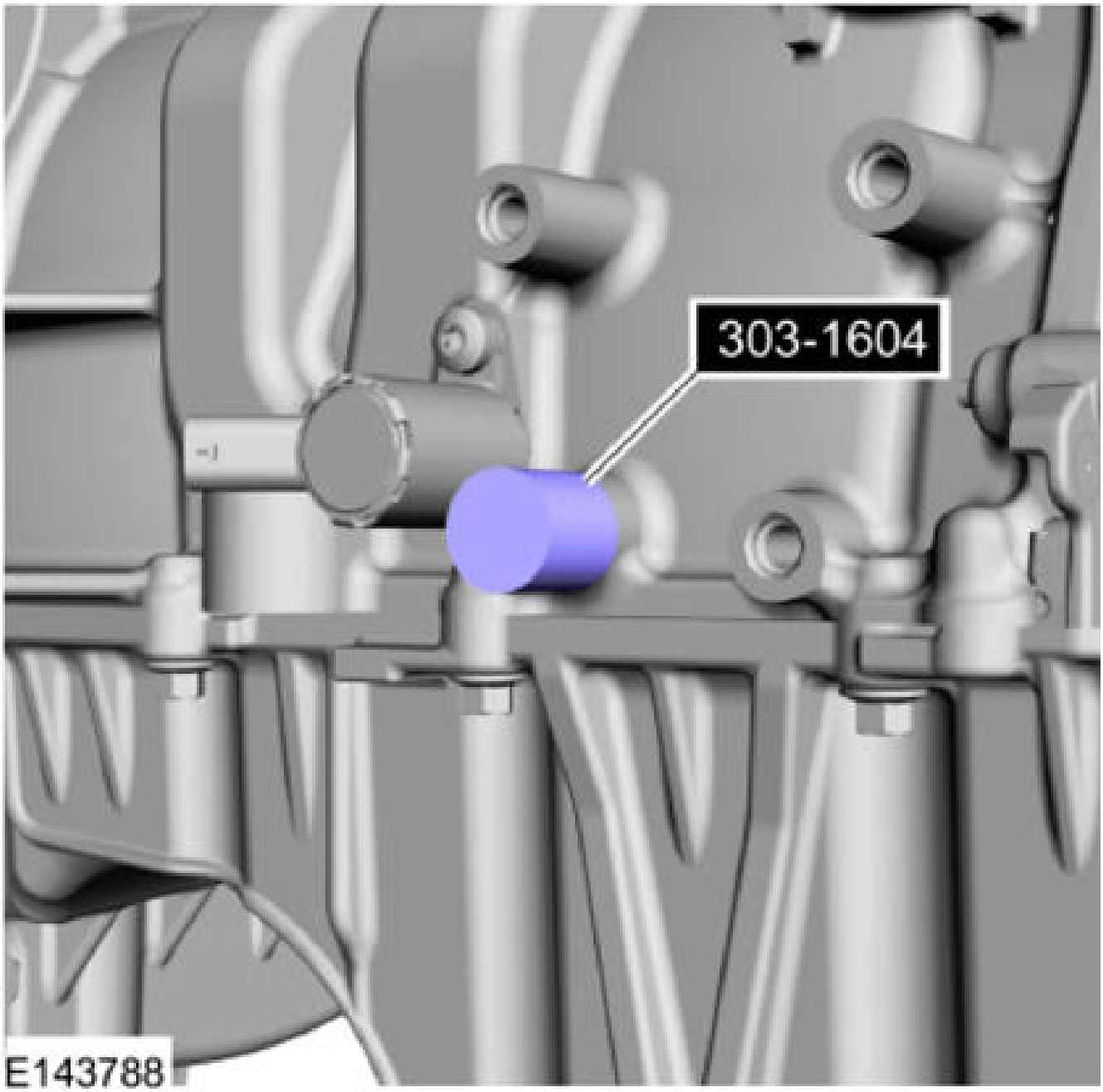
  Use the General Equipment: Punch

- Remove 3/16 inch punch.

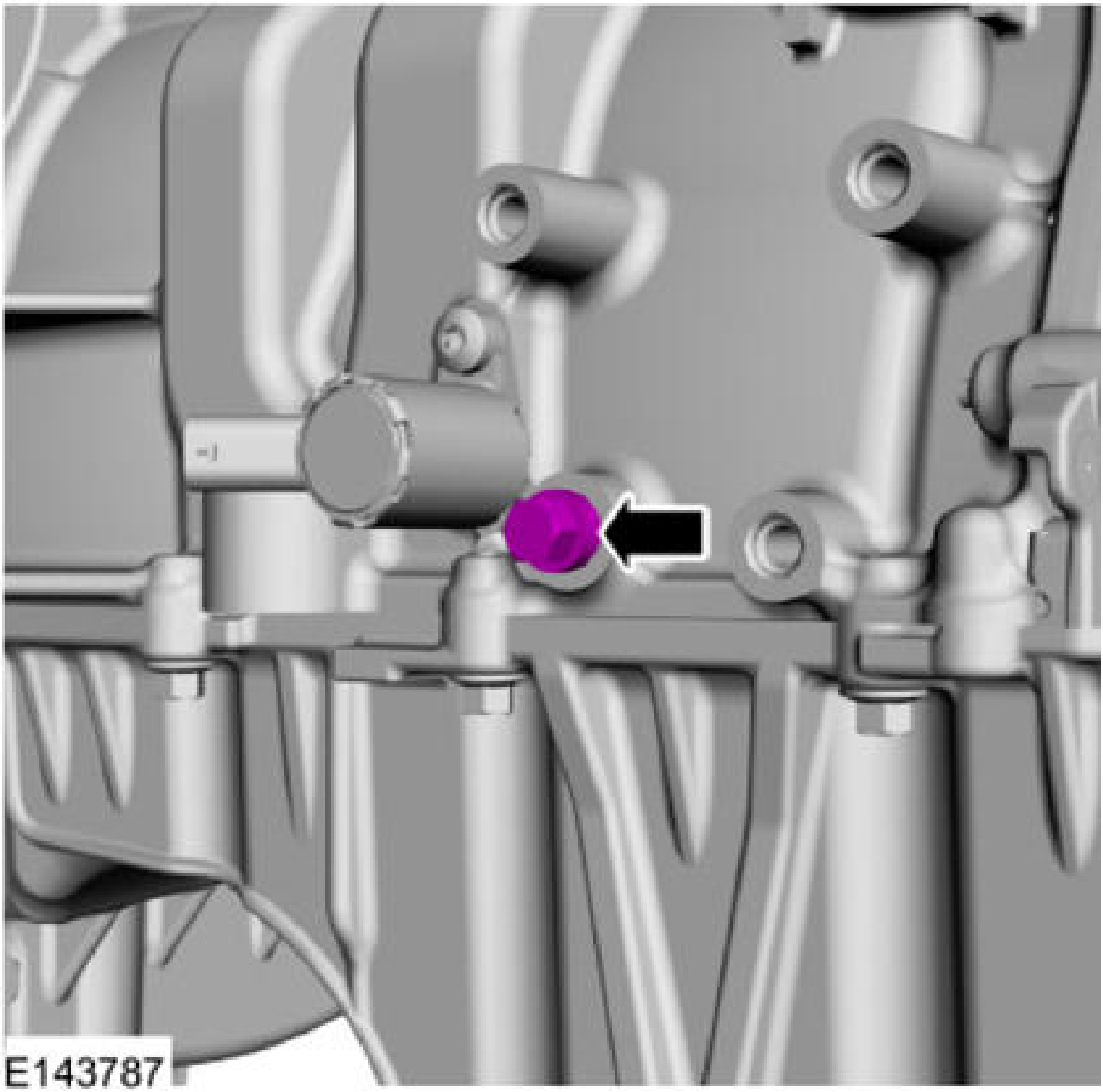
  Use the General Equipment: Punch



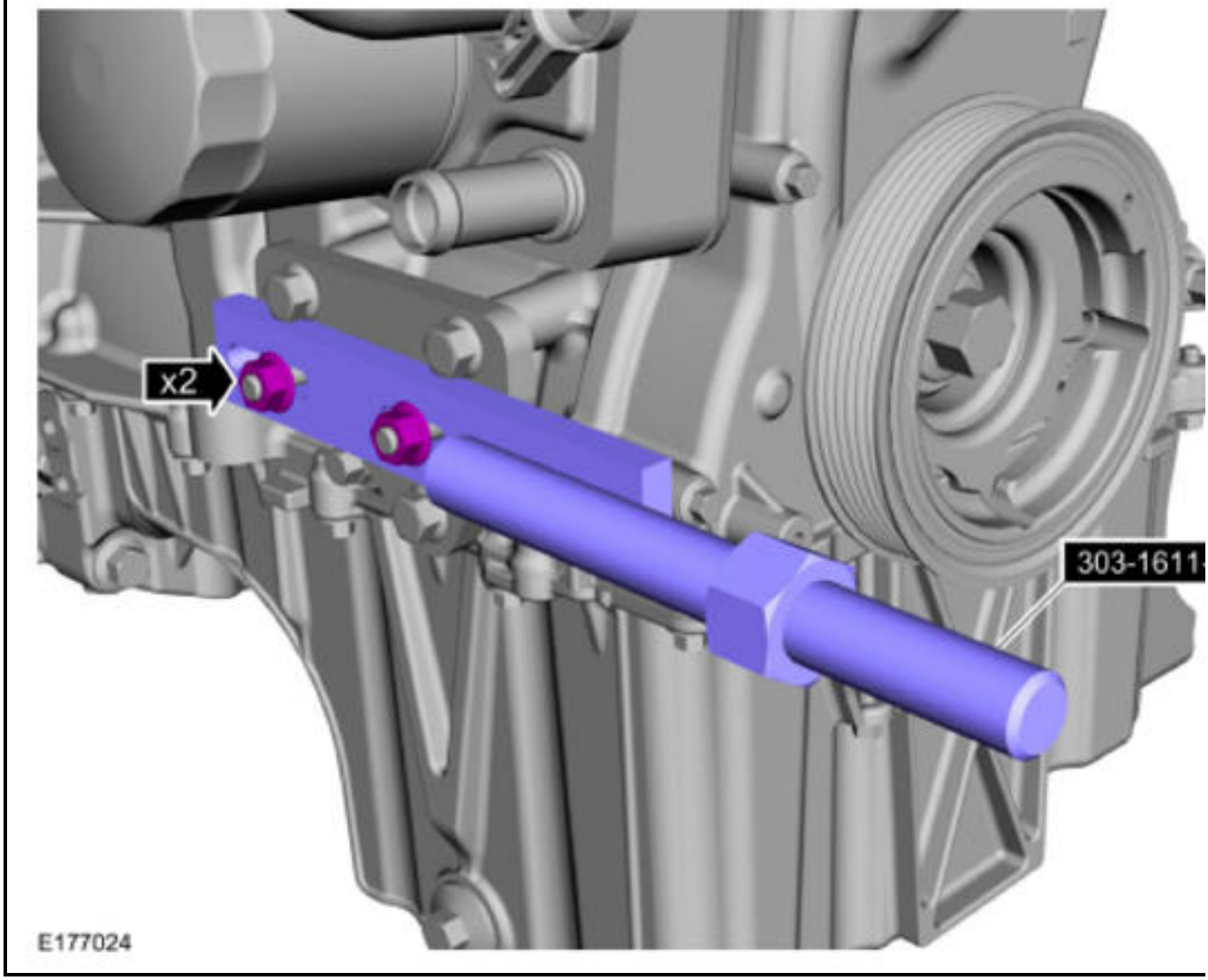
81. Remove Special Service Tool: 303-1604 Timing Peg, Crankshaft TDC.



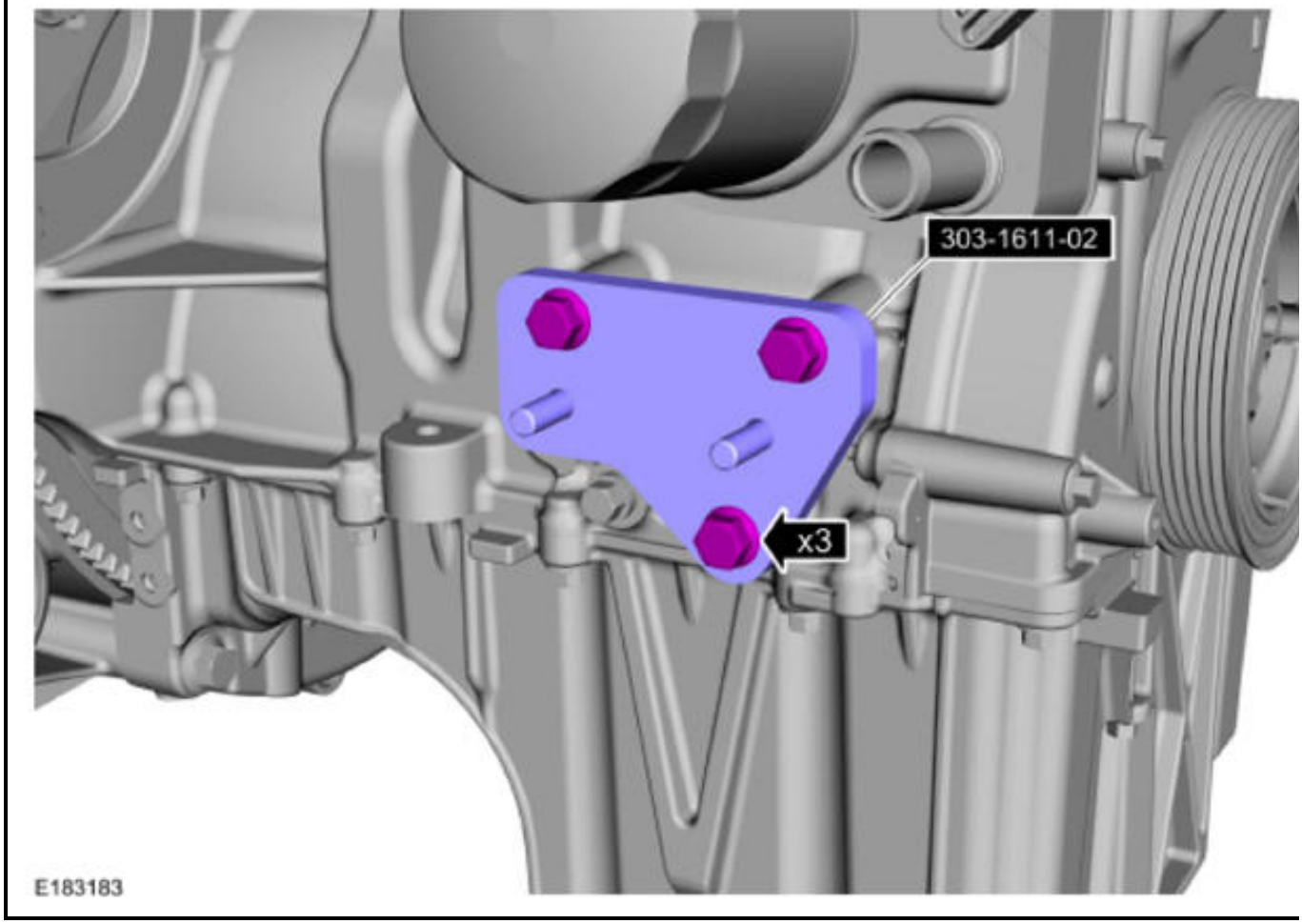
82. *Torque* : 177 lb.in (20 Nm)



83. Remove Special Service Tool: 303-1611-01 Adapter for 303-1611.

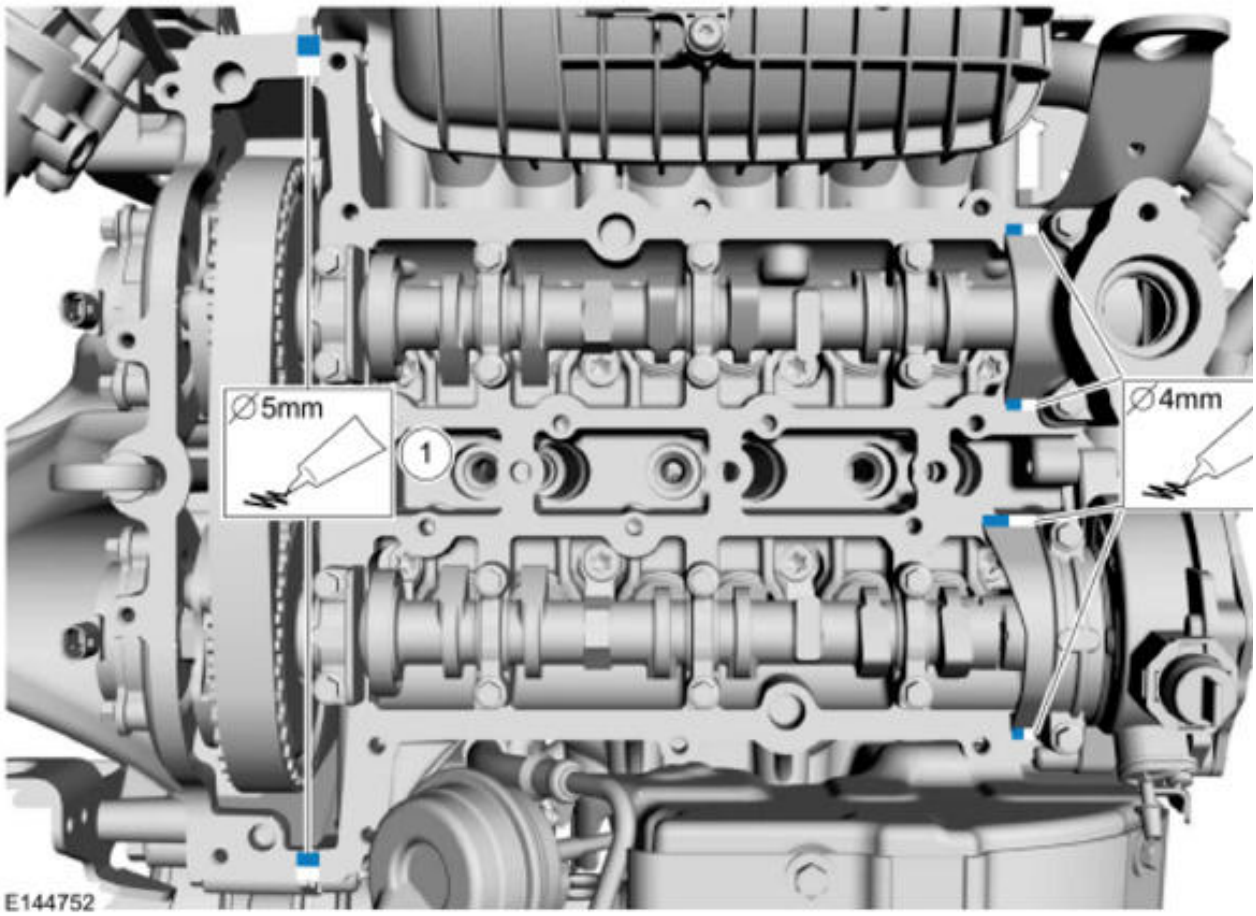


84. Remove Special Service Tool: **303-1611-02 Adapter for 303-1611, Torque Multiplier** .

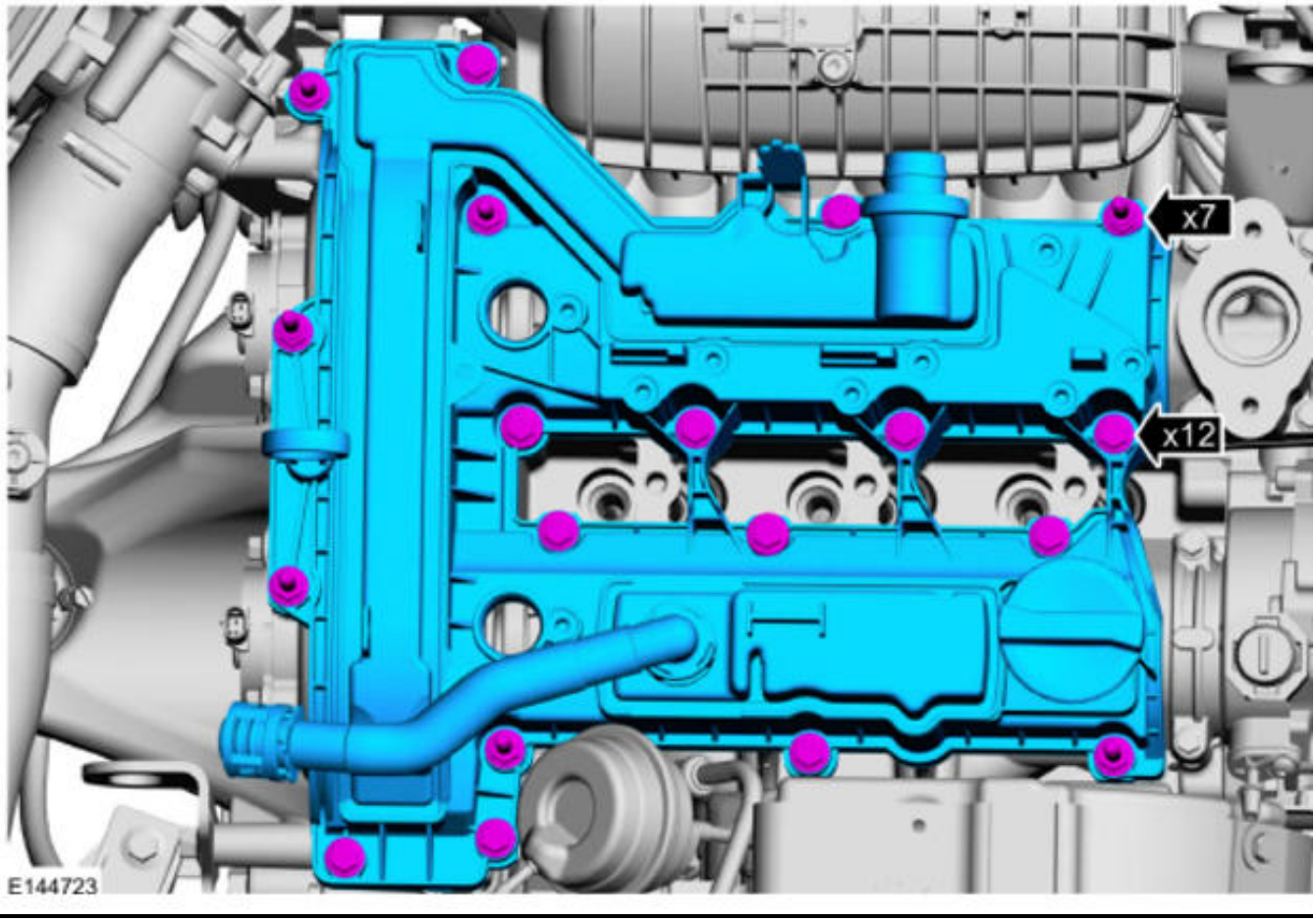


85. **NOTE: Make sure that the component is clean, free of foreign material and lubricant.**

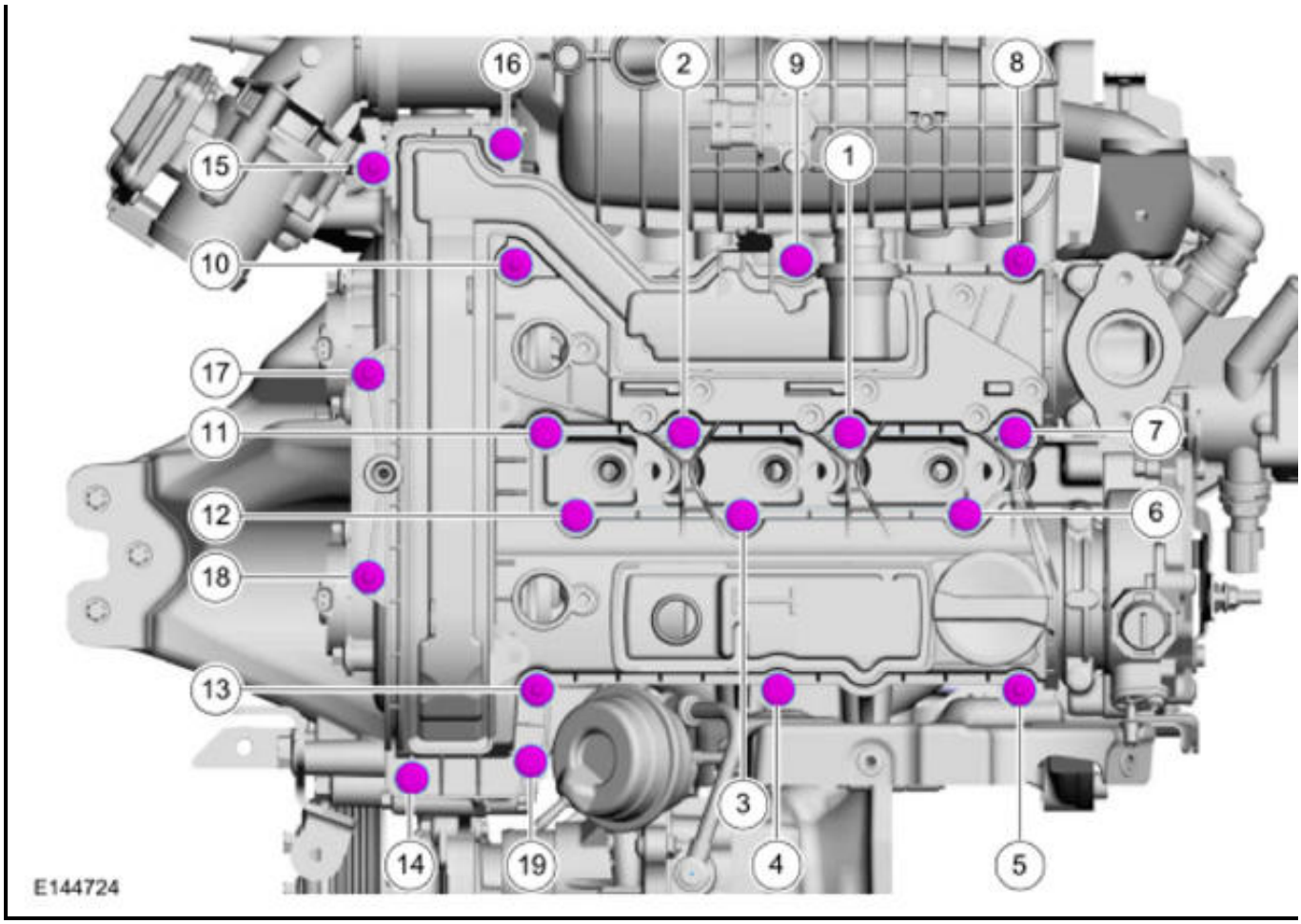
1. *Material* : Silicone Gasket and Sealant/TA-30 (WSE-M4G323-A4)
2. *Material* : Gasket Maker/TA-16 (WSK-M2G348-A5)



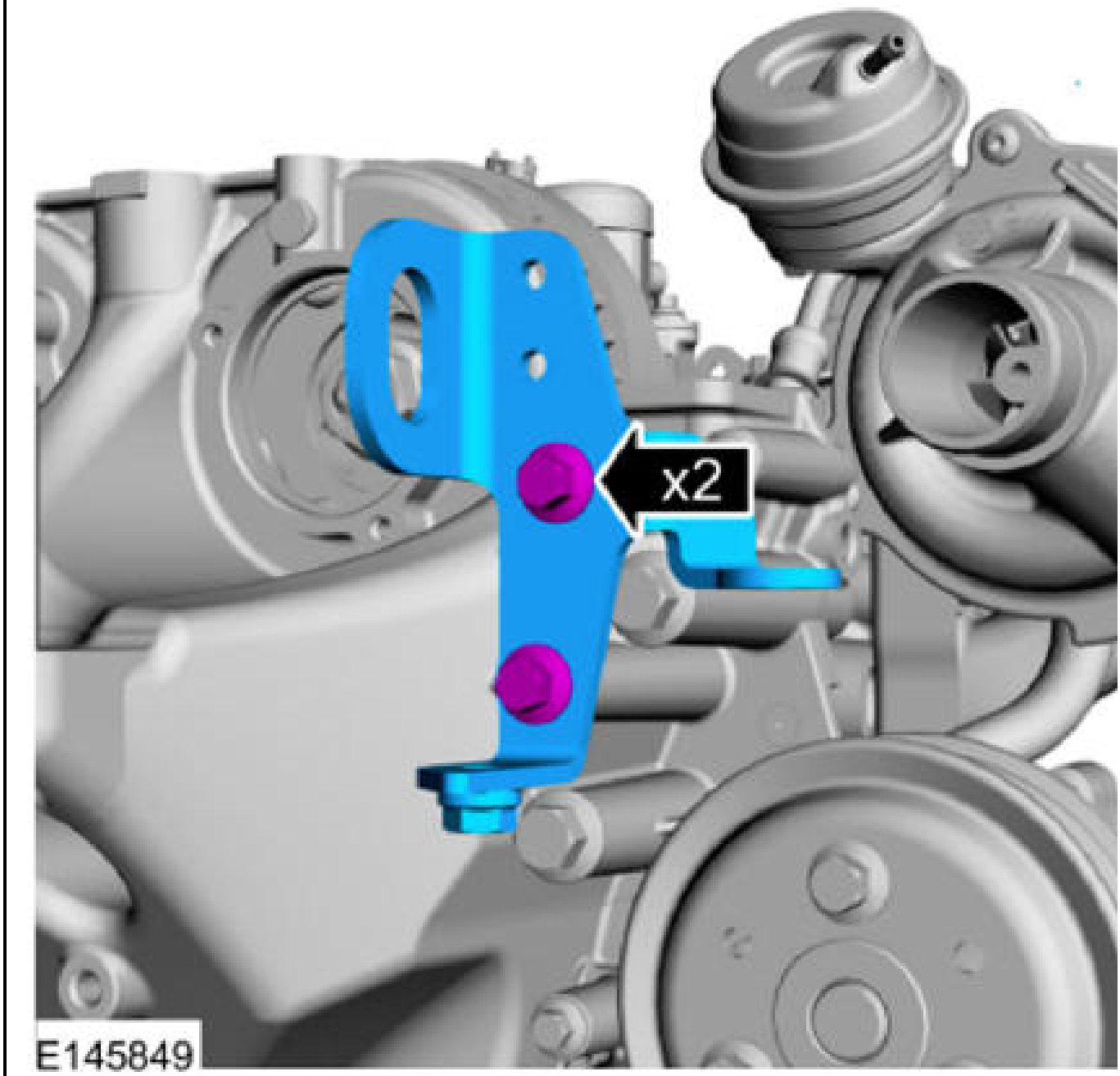
86. **NOTE:** **Only tighten the bolts finger tight at this stage.**



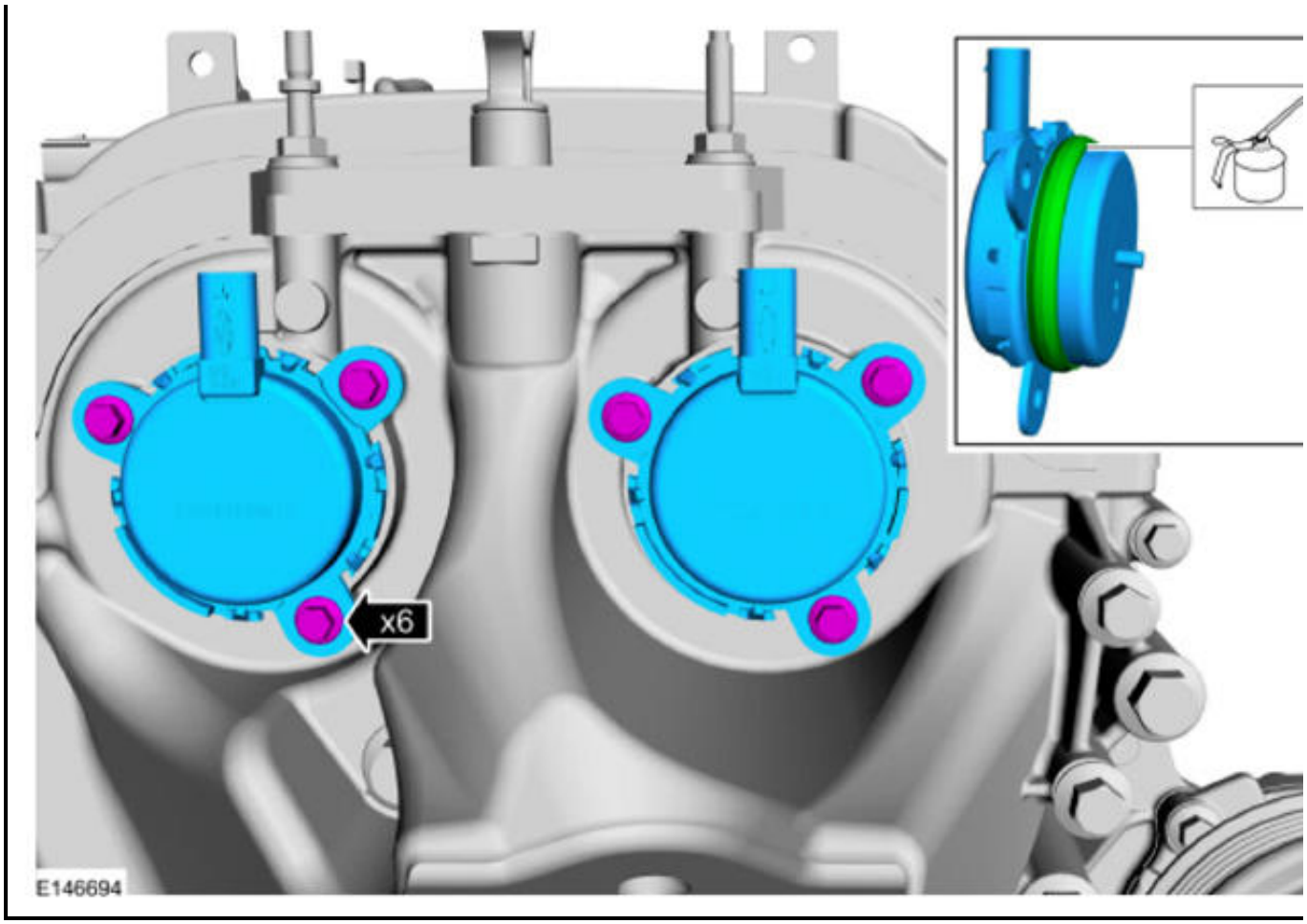
87. *Torque* : 89 lb.in (10 Nm)



88. *Torque* : 17 lb.ft (23 Nm)



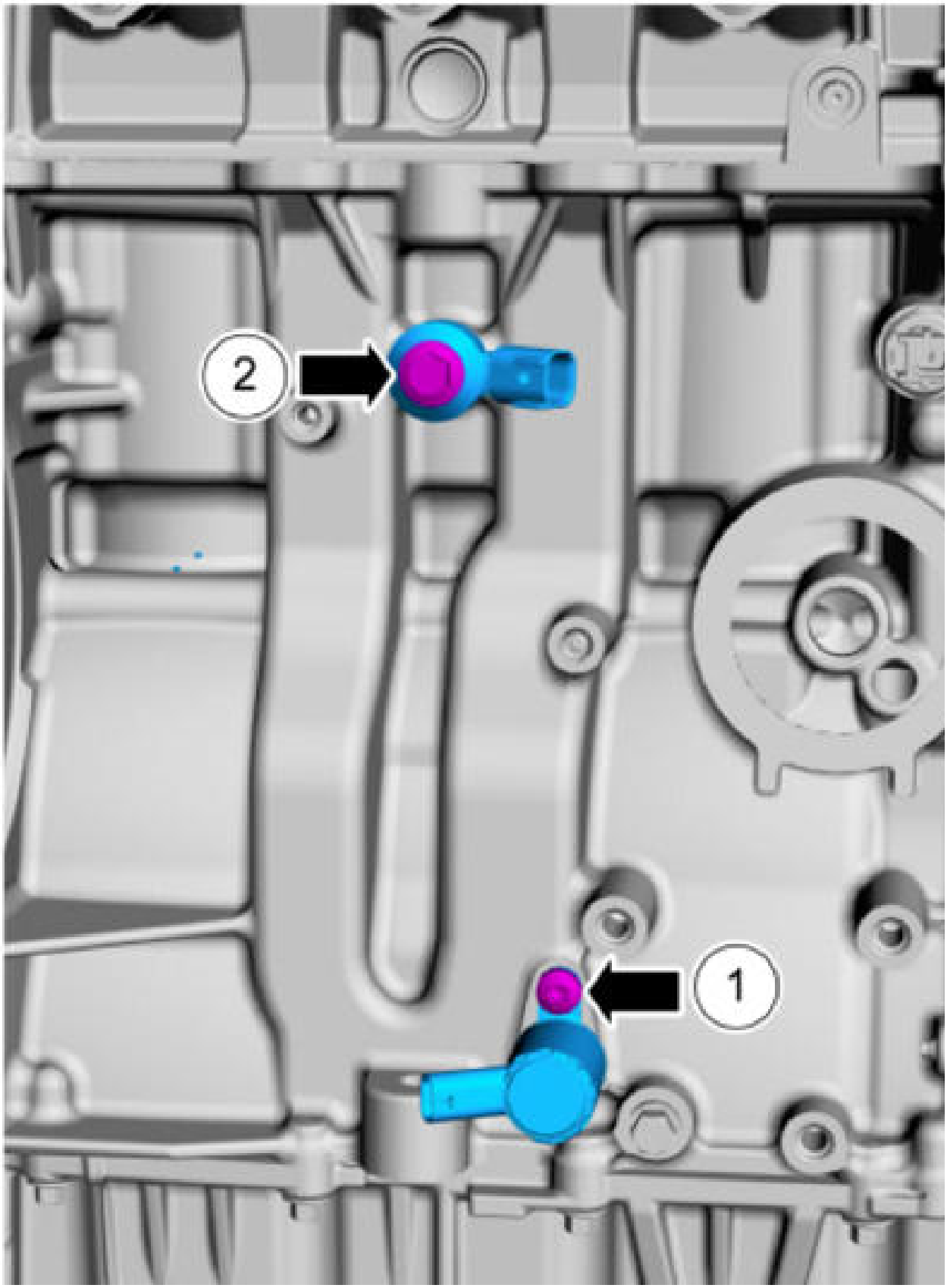
89. *Material* : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)



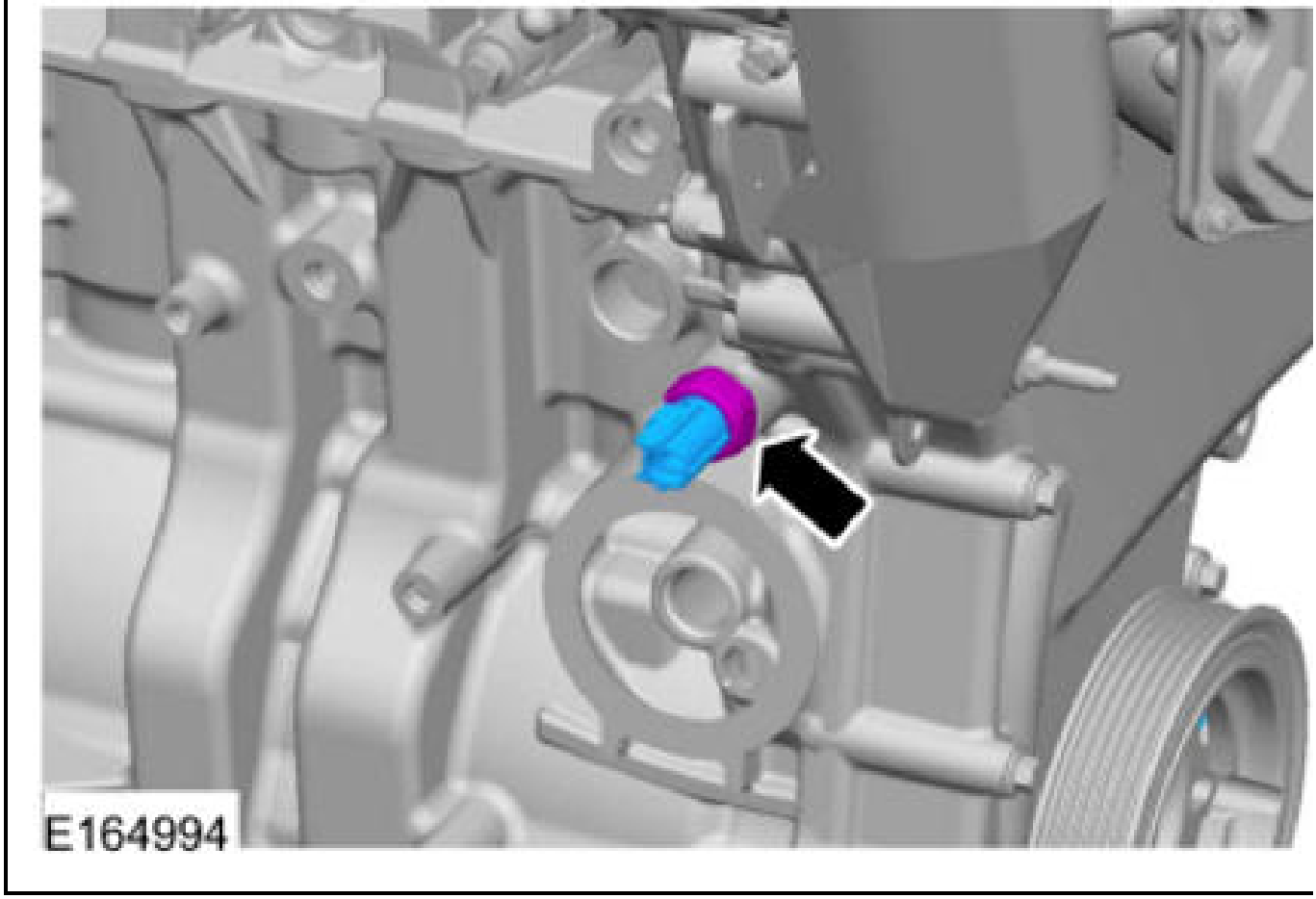
90. **NOTE: Make sure that the components are installed to the position noted before removal.**

Torque :

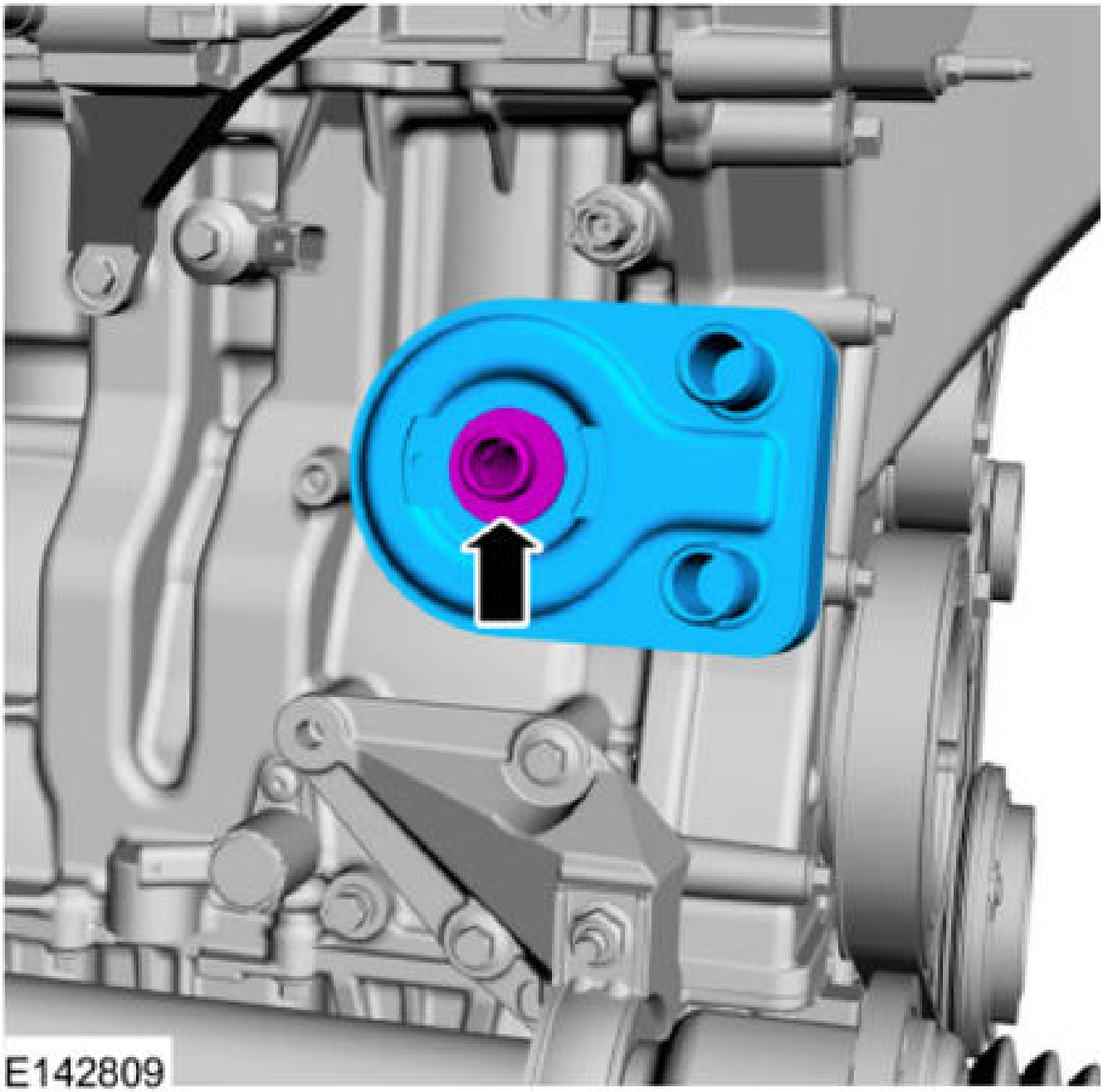
1. 89 lb.in (10 Nm)
2. 177 lb.in (20 Nm)



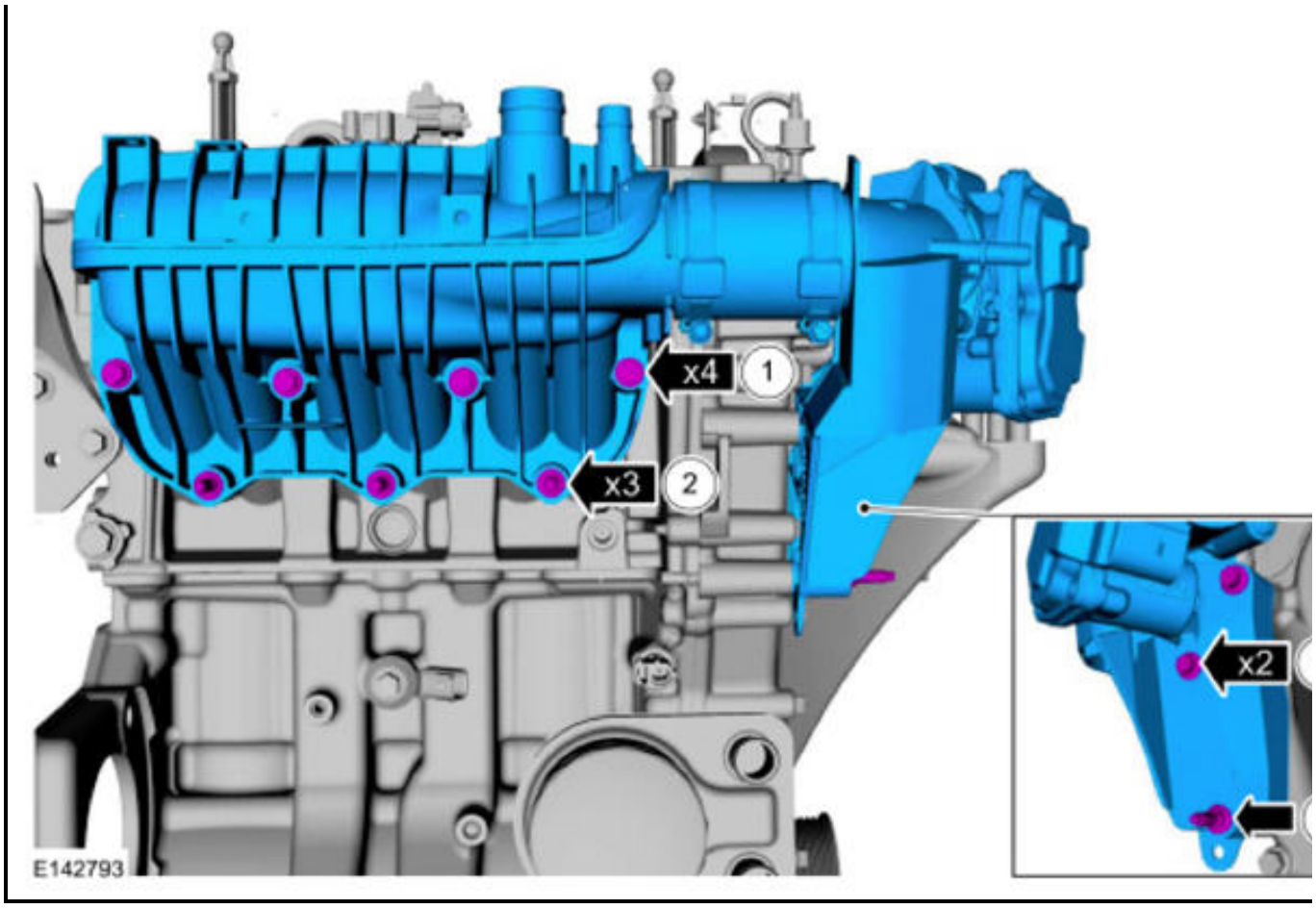
91. *Torque* : 142 lb.in (16 Nm)



92. *Torque* : 41 lb.ft (55 Nm)

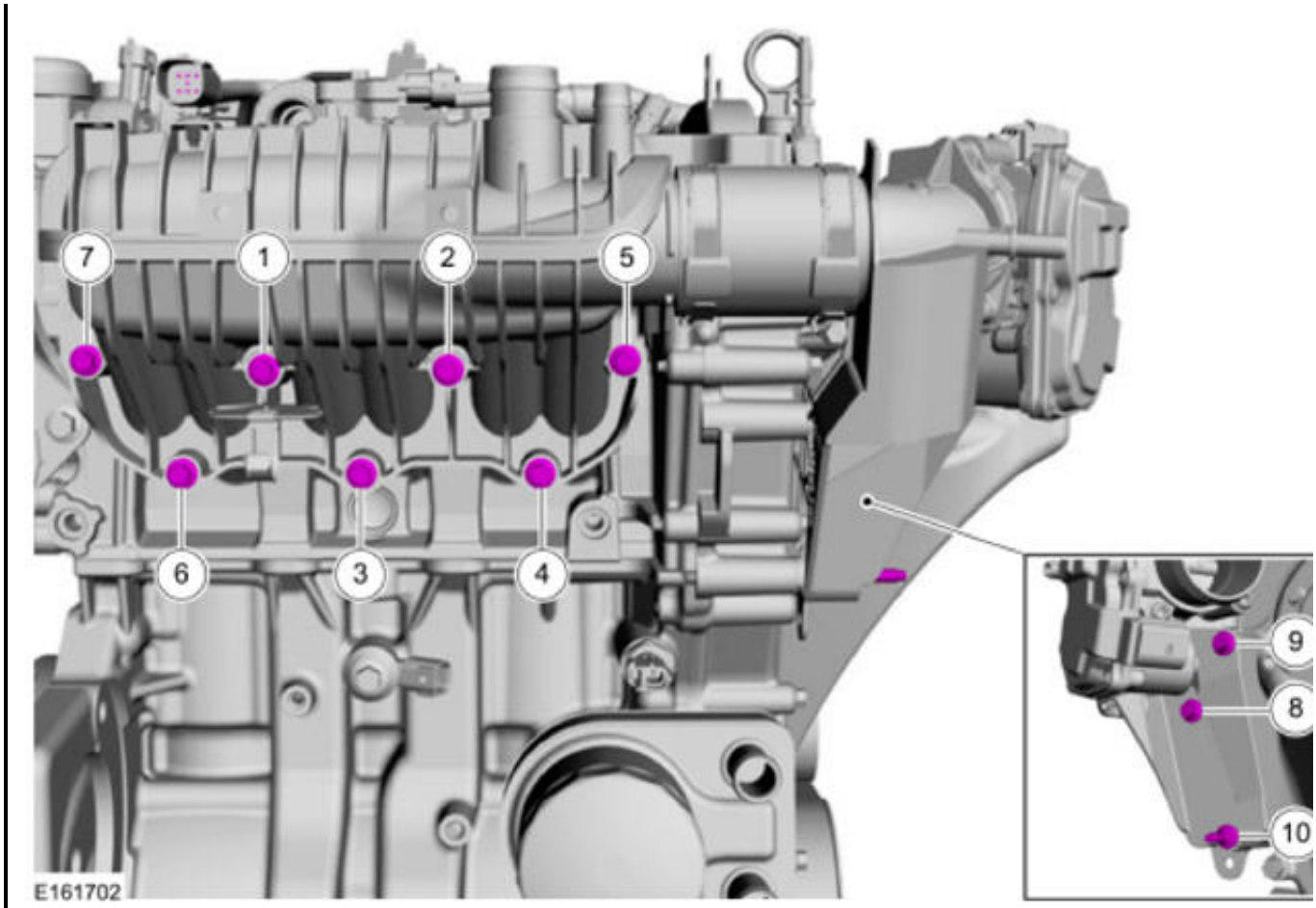


93. **NOTE: Only tighten the bolts finger tight at this stage.**



94. *Torque* :

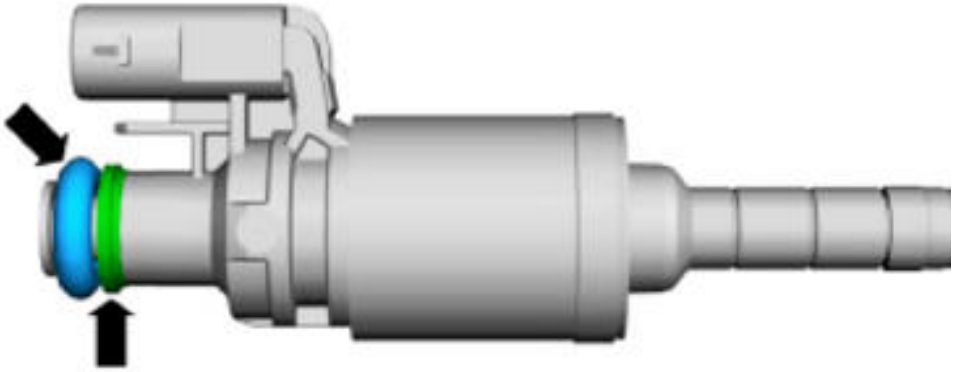
    1-10: 89 lb.in (10 Nm)



95.

NOTE: **Make sure that the component is clean, free of foreign material and lubricant.**

NOTE: **Make sure that new components are installed.**



E144661

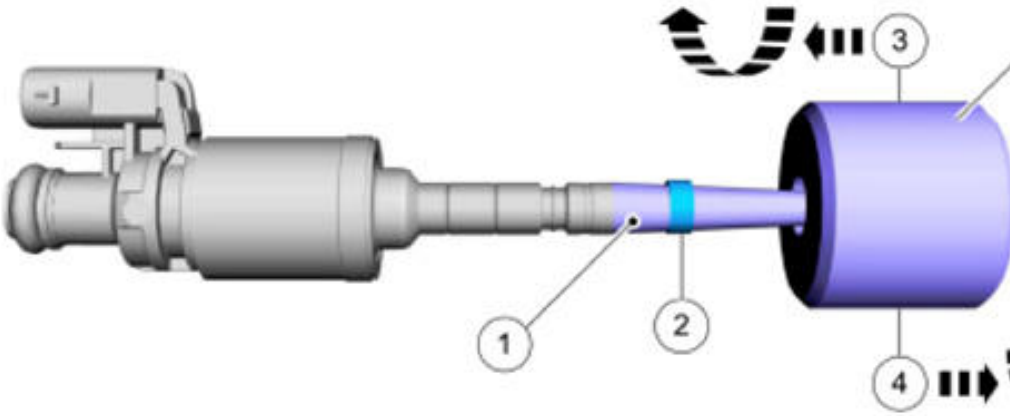
96. **NOTE: Take extra care when handling the components.**

NOTE: Make sure that the area around the component is clean and free of foreign material.

1. Use Special Service Tool: 310-128 Installer Set, Teflon Seal.
2.

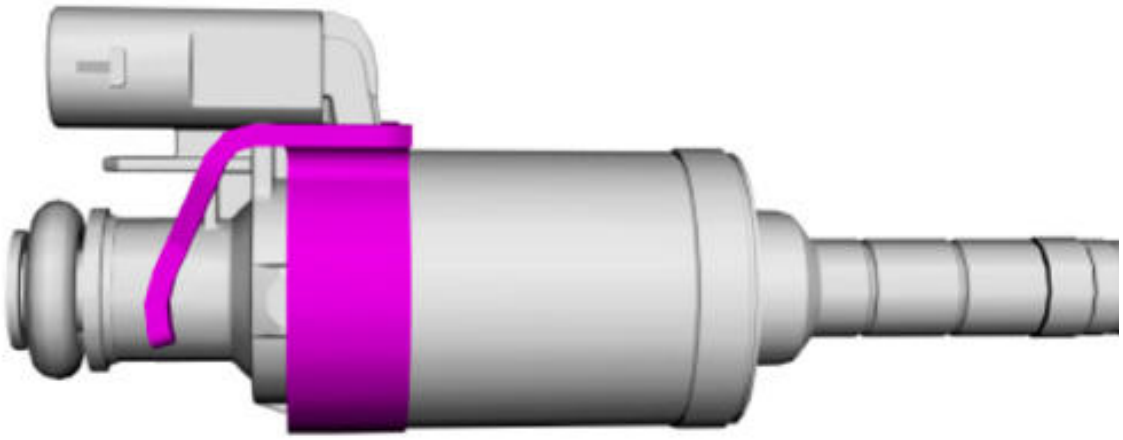
NOTE: Make sure that a new component is installed.

3. Use Special Service Tool: 310-128 Installer Set, Teflon Seal.
4. Use Special Service Tool: 310-128 Installer Set, Teflon Seal.



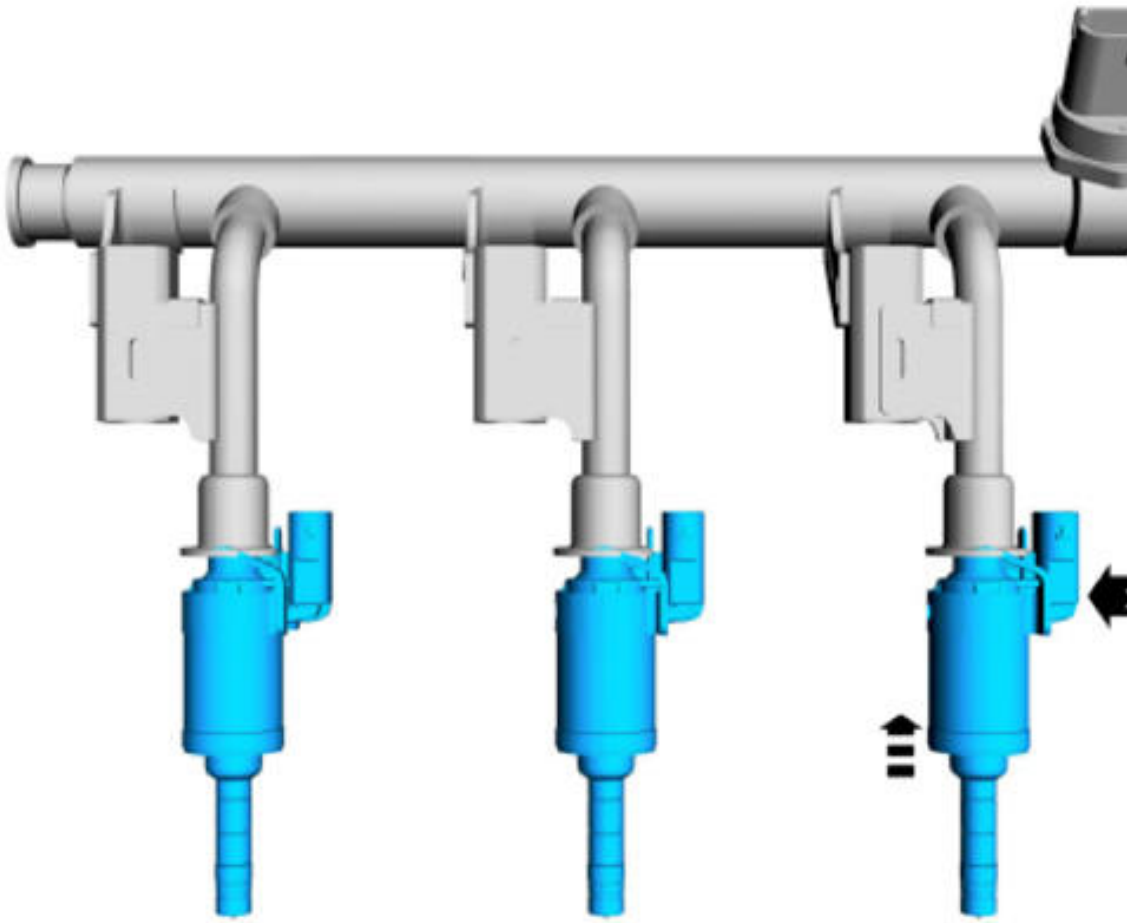
E144660

97. **NOTE: Make sure that new components are installed.**


E145187

98.

98.

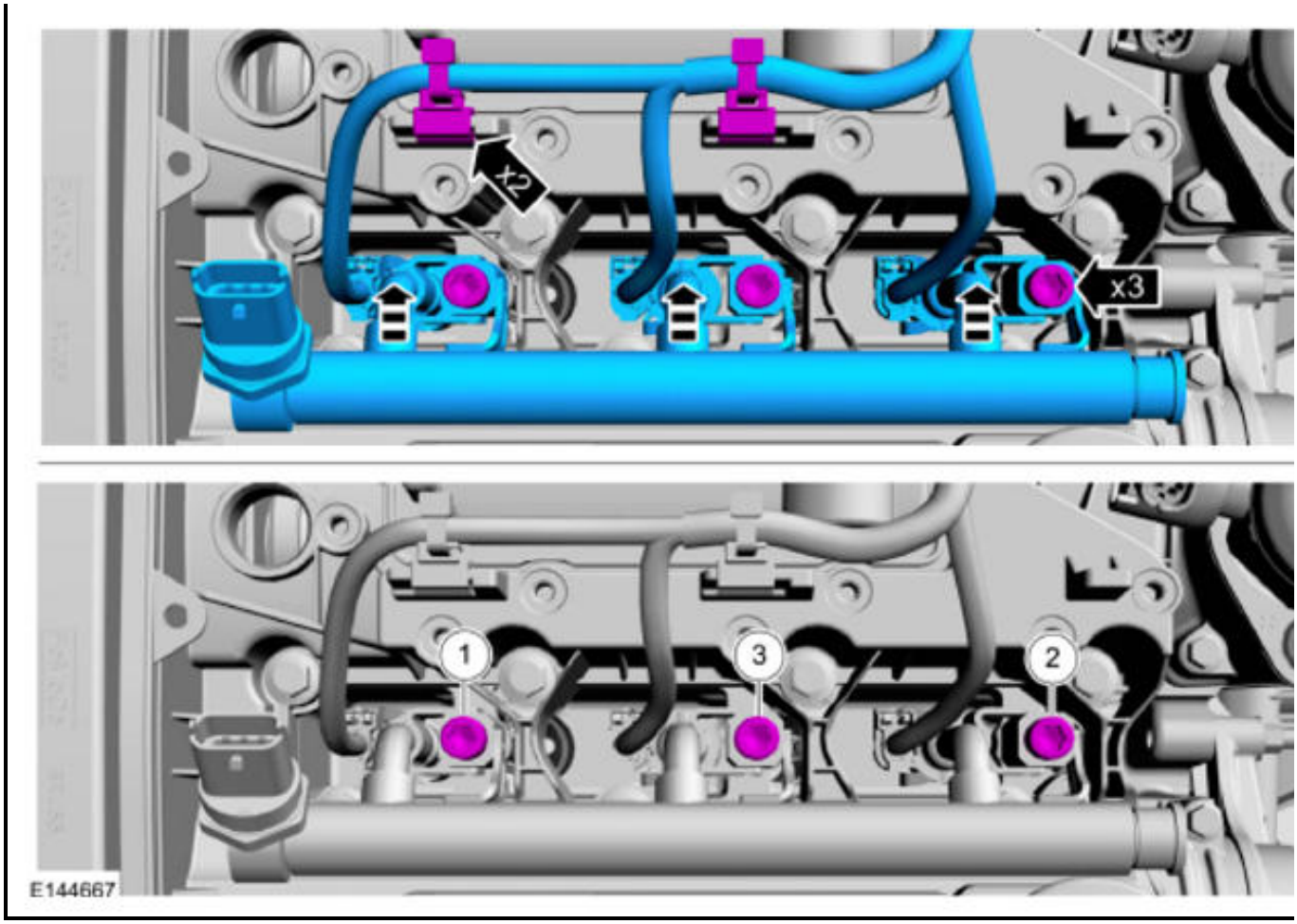


99. **NOTE: Only use moderate force.**

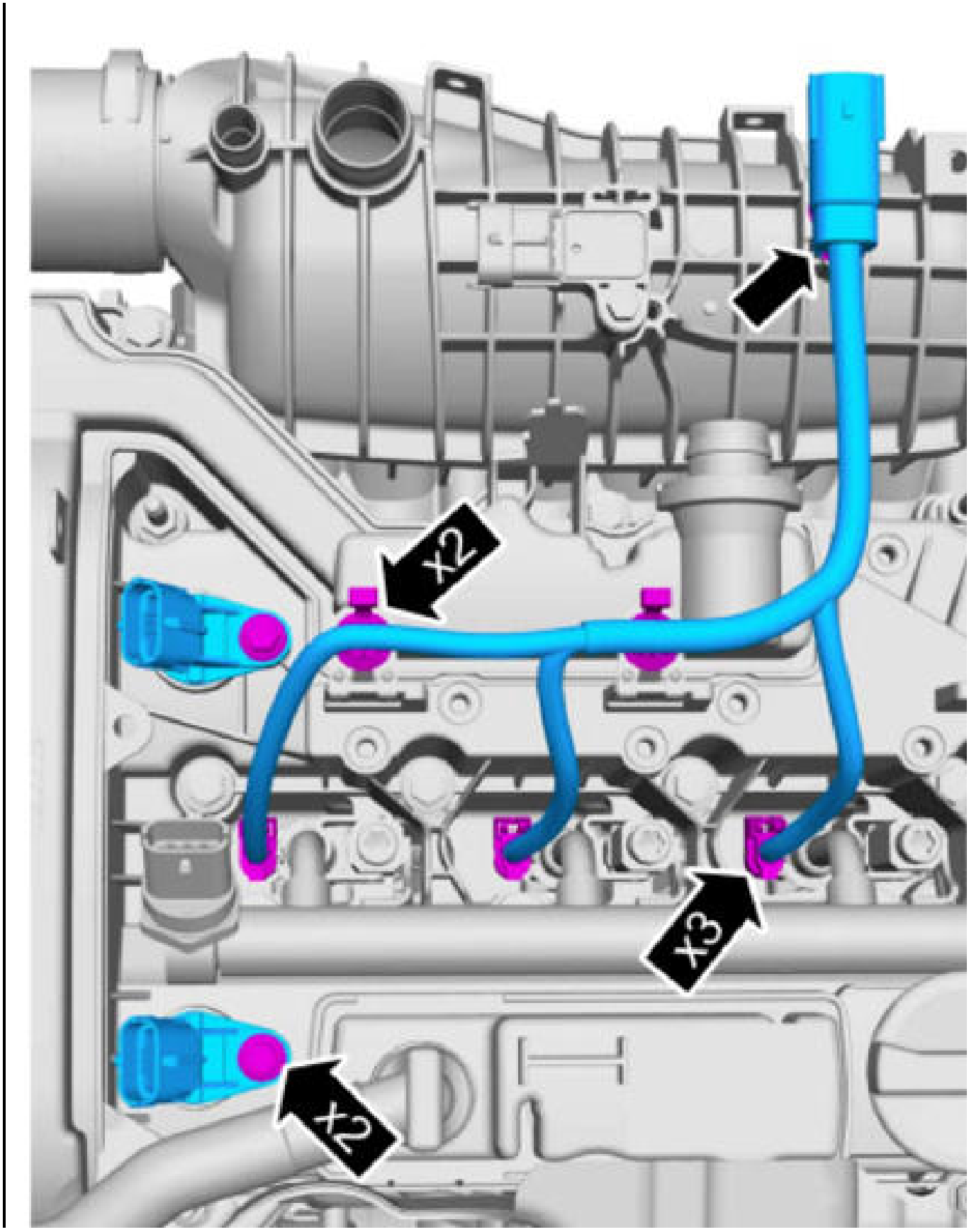
NOTE: Install all the bolts finger tight before final tightening.

Tighten each bolt 1 turn at a time.

Torque : 17 lb.ft (23 Nm)



100. *Torque* : 89 lb.in (10 Nm)

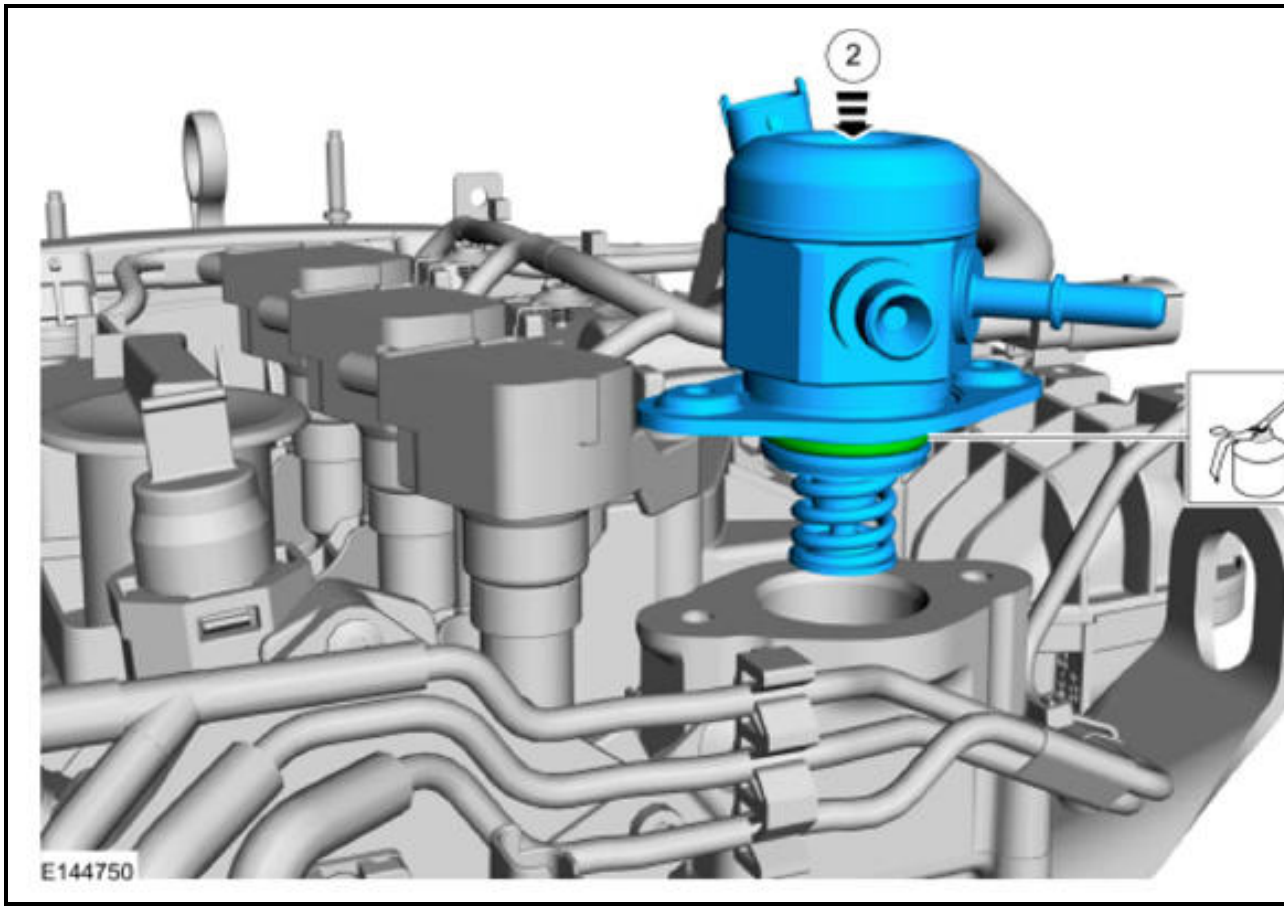


101.

1.

NOTE: Make sure that a new component is installed.

Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

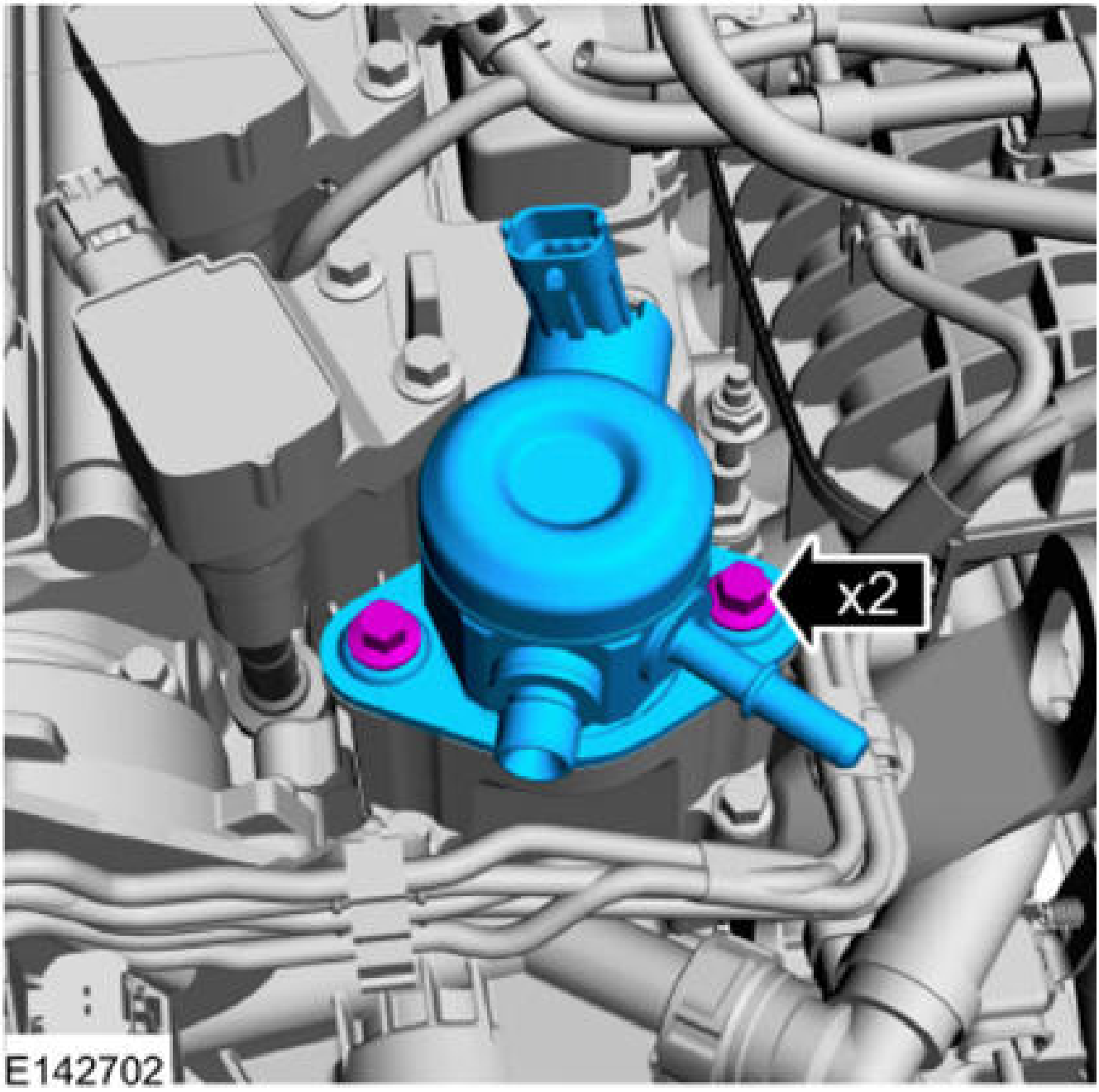


102. Tighten each bolt 0.5 turn at a time.

Torque :

Stage 1: 44 lb.in (5 Nm)

Stage 2: 115 lb.in (13 Nm)



103.

1.

NOTE: Make sure that a new component is installed.

2.

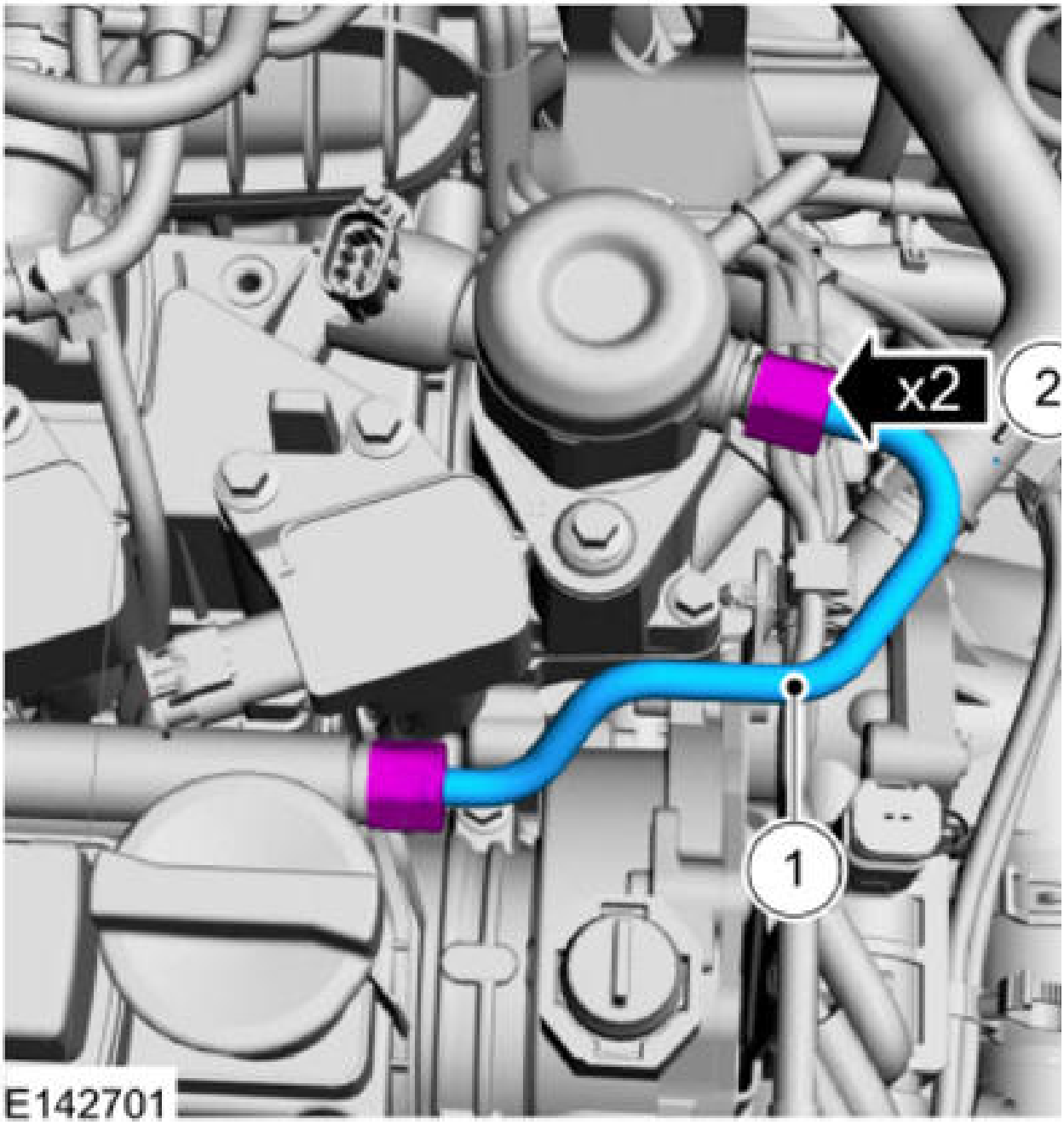
NOTE: Tighten both fittings finger tight prior to final tightening.

Torque :

Stage 1: 124 lb.in (14 Nm)

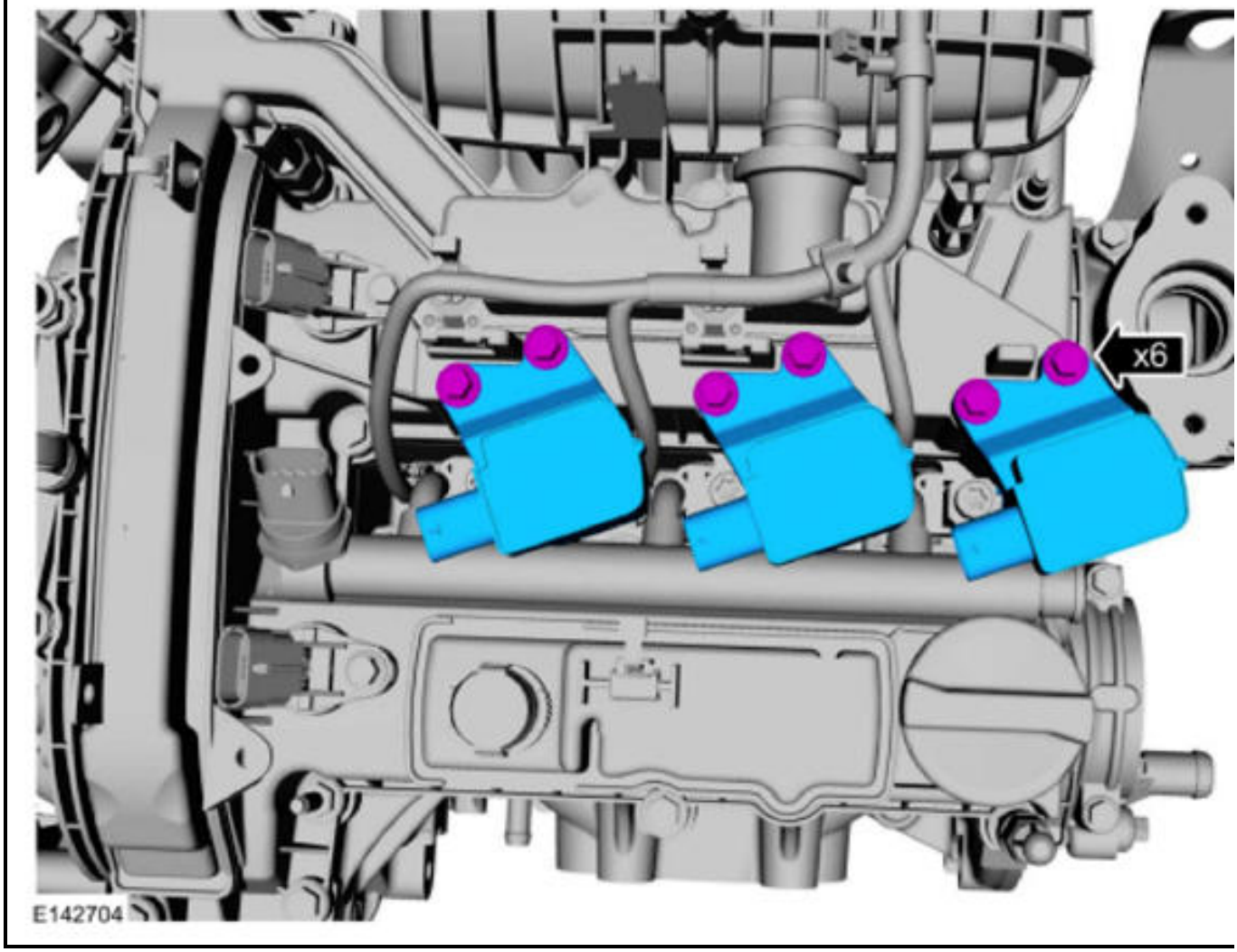
Stage 2: 177 lb.in (20 Nm)

Stage 3: 20°

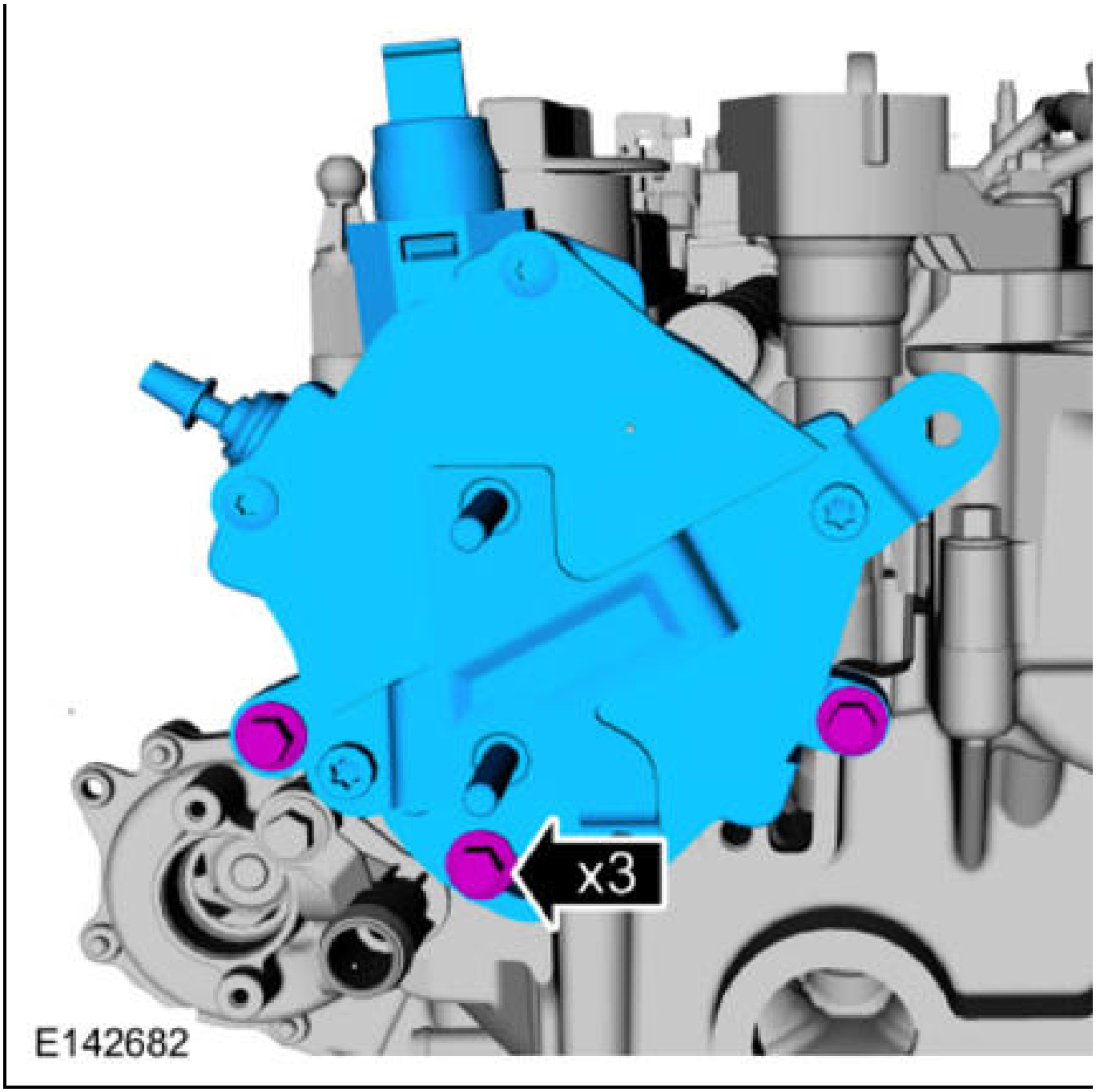


104. **NOTE:** **Install all the bolts finger tight before final tightening.**

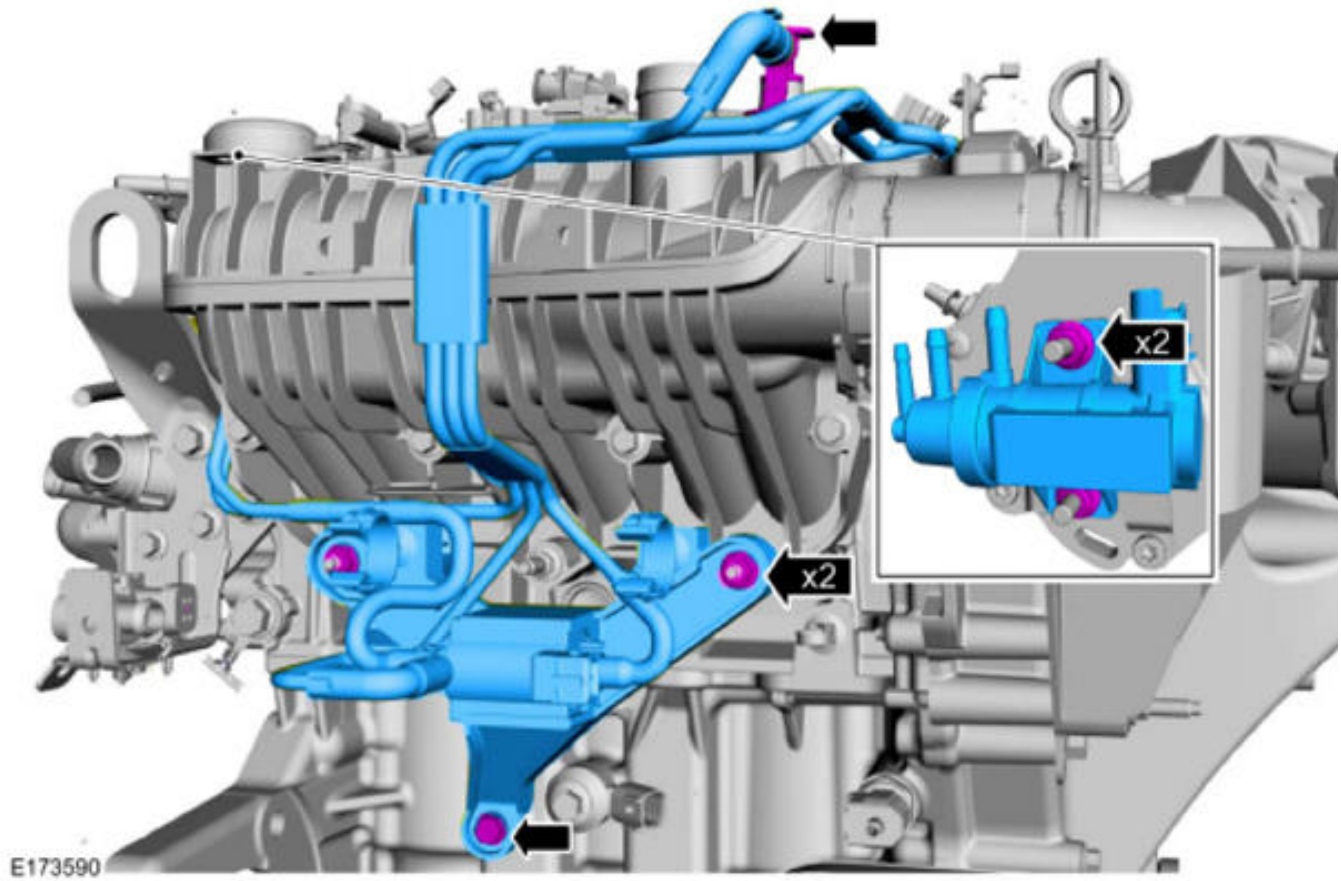
Torque : 89 lb.in (10 Nm)



105. *Torque* : 89 lb.in (10 Nm)

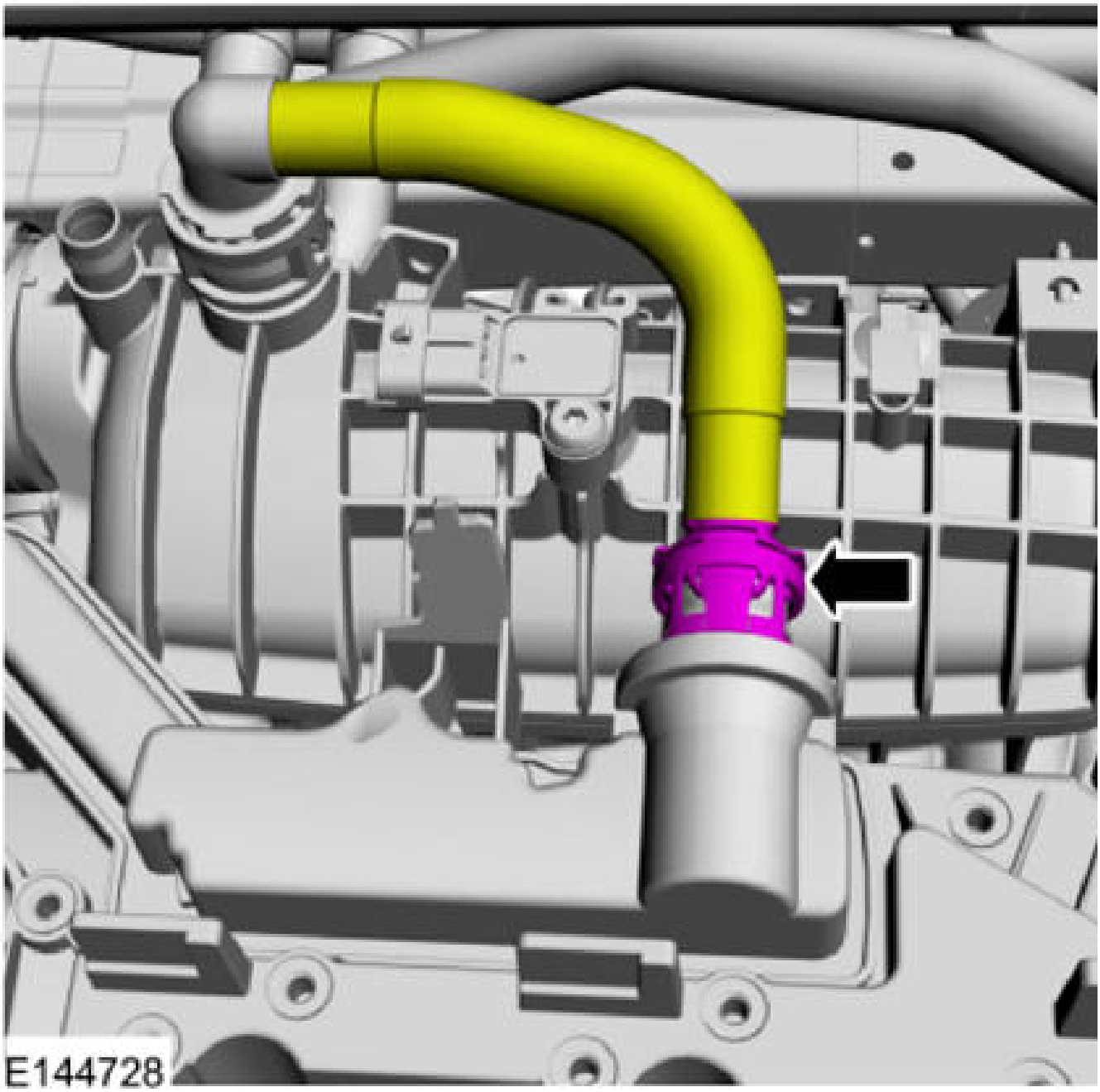


106. *Torque* : 80 lb.in (9 Nm)



107.

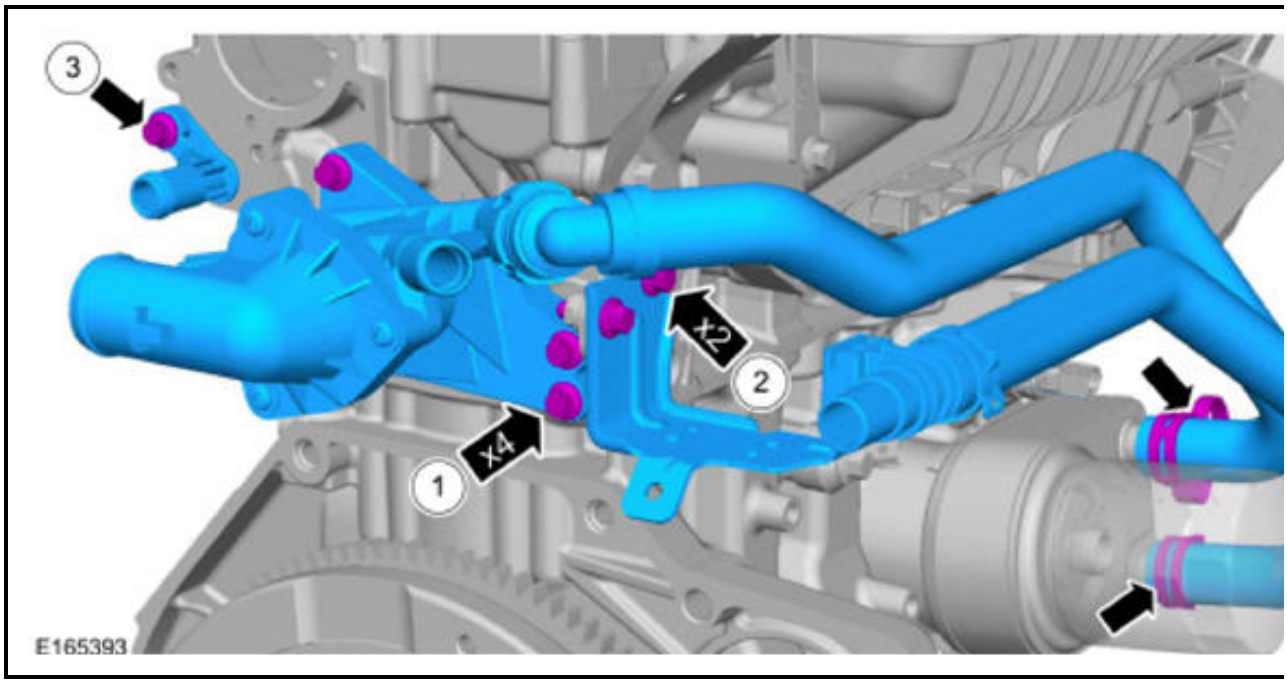
107.



108. Use the General Equipment: Hose Clamp Remover/Installer

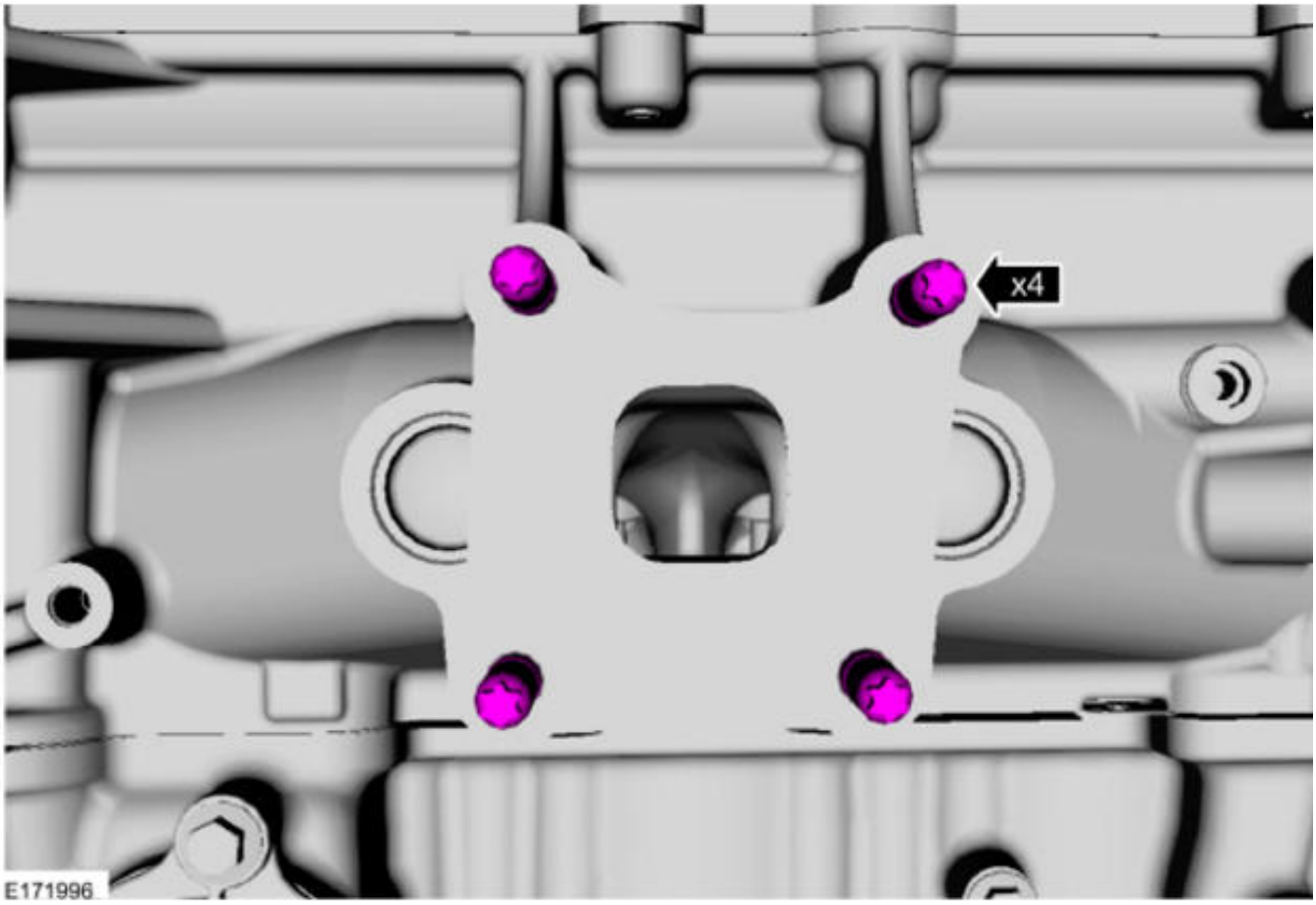
Torque :

1. 89 lb.in (10 Nm)
2. 89 lb.in (10 Nm)
3. 89 lb.in (10 Nm)



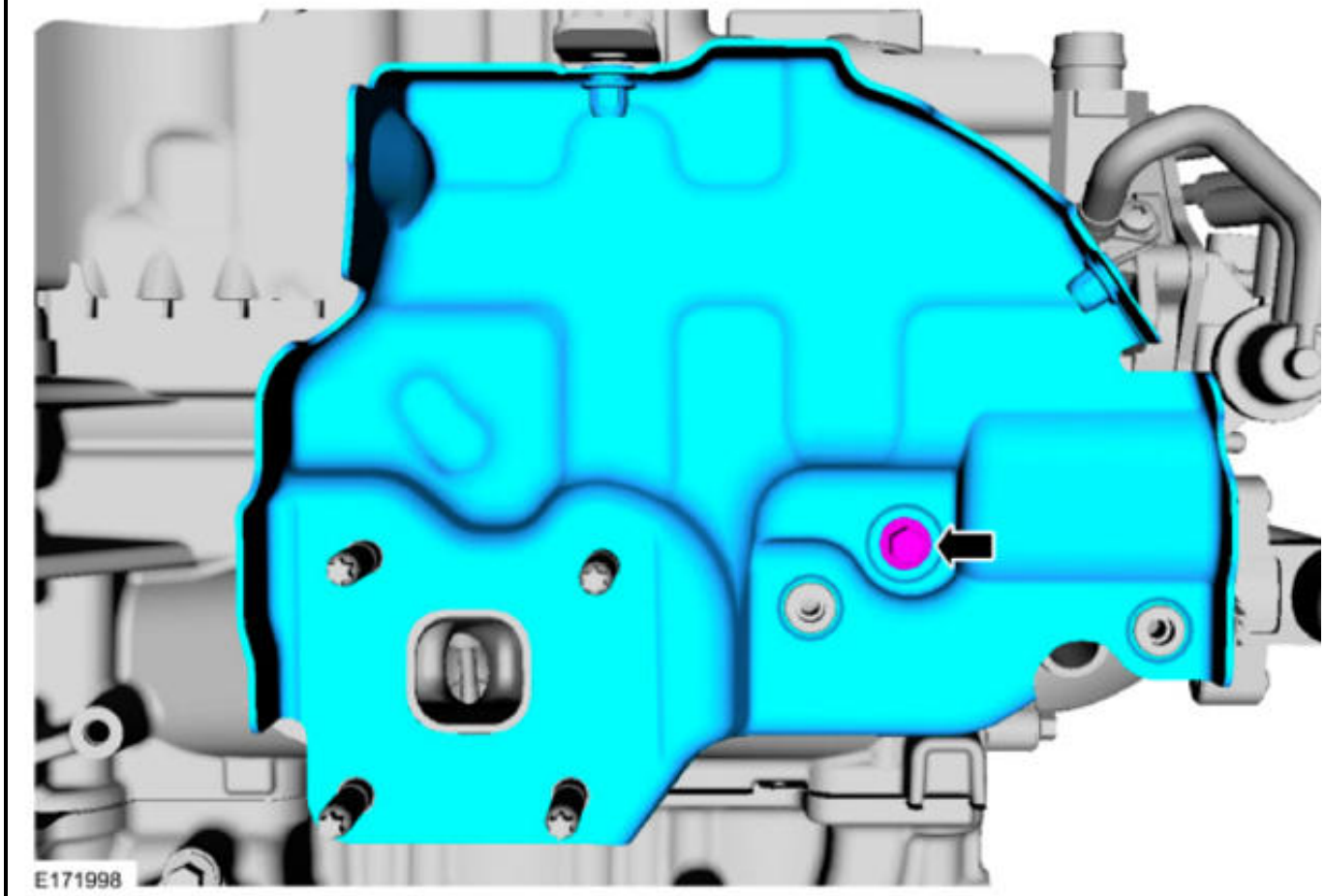
109. Make sure that 4 new turbocharger mounting studs and that a new turbocharger gasket is installed.

Torque : 89 lb.in (10 Nm)



110. Make sure that a new heat shield and turbocharger gasket are installed.

Torque : 89 lb.in (10 Nm)



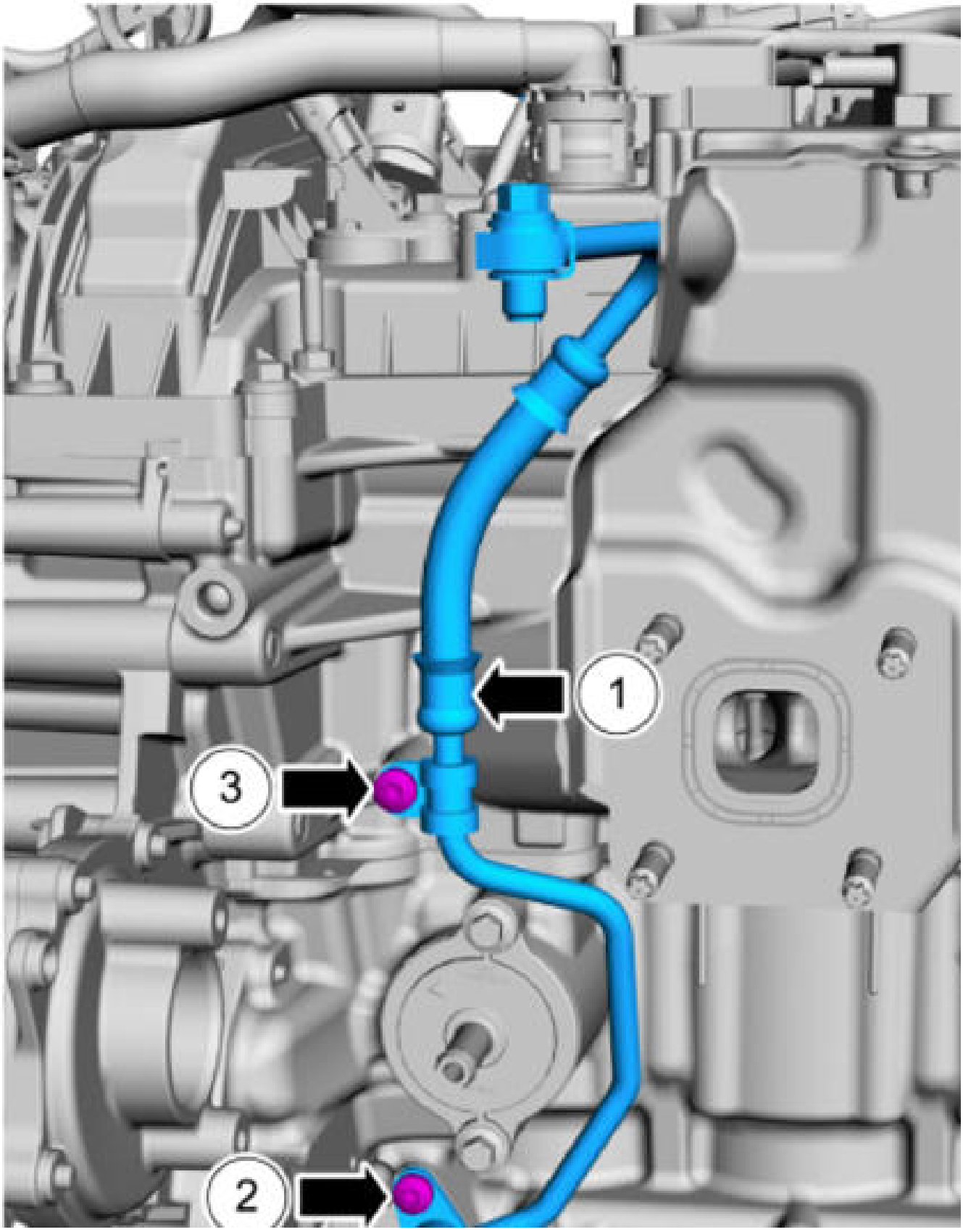
111.

- **NOTE: Make sure that a new component is installed.**

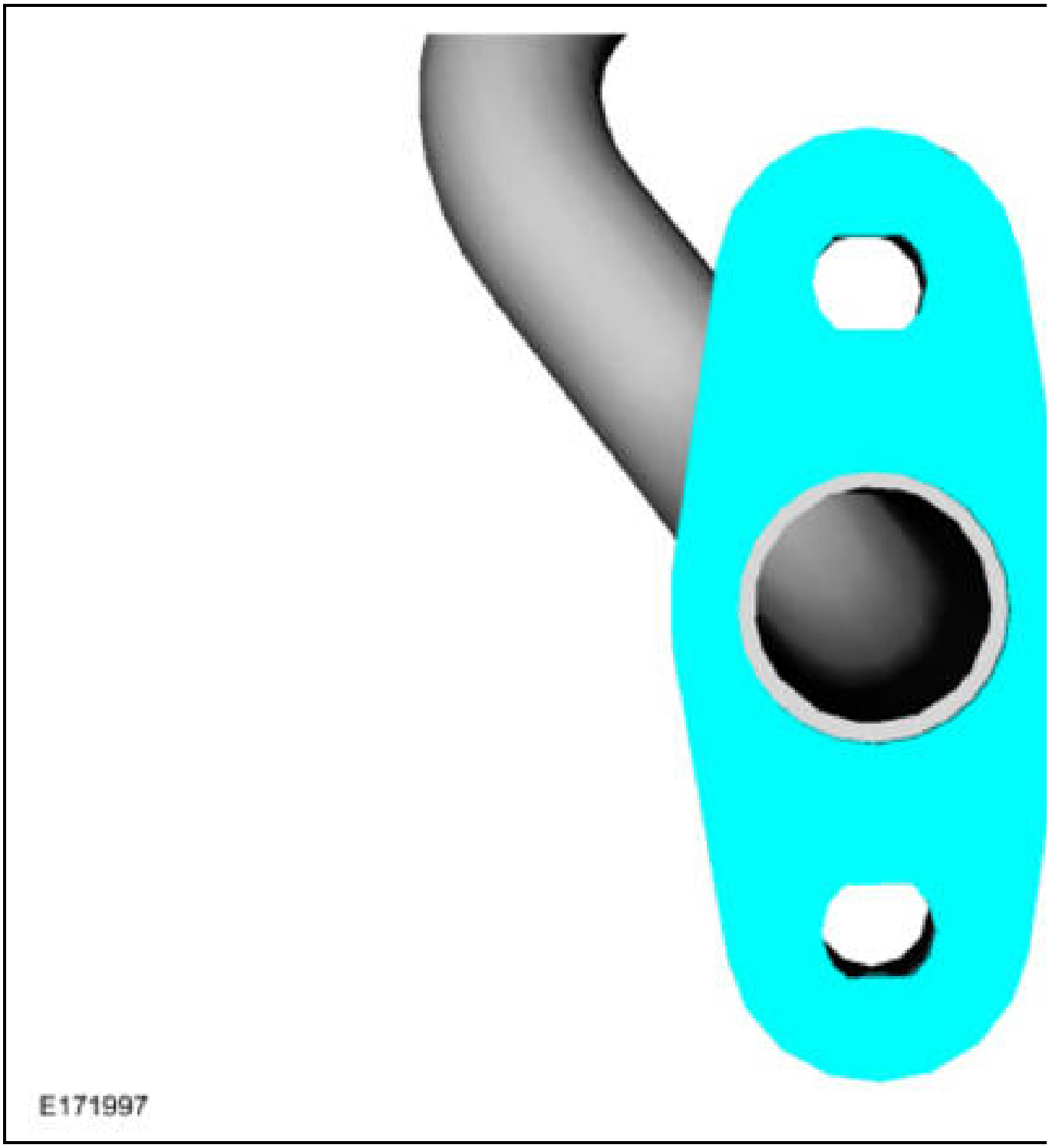
112. **NOTE: Install all the bolts finger tight before final tightening.**

Torque :

2-3: 89 lb.in (10 Nm)



113. Make sure that a new turbocharger oil return hose gasket is installed.

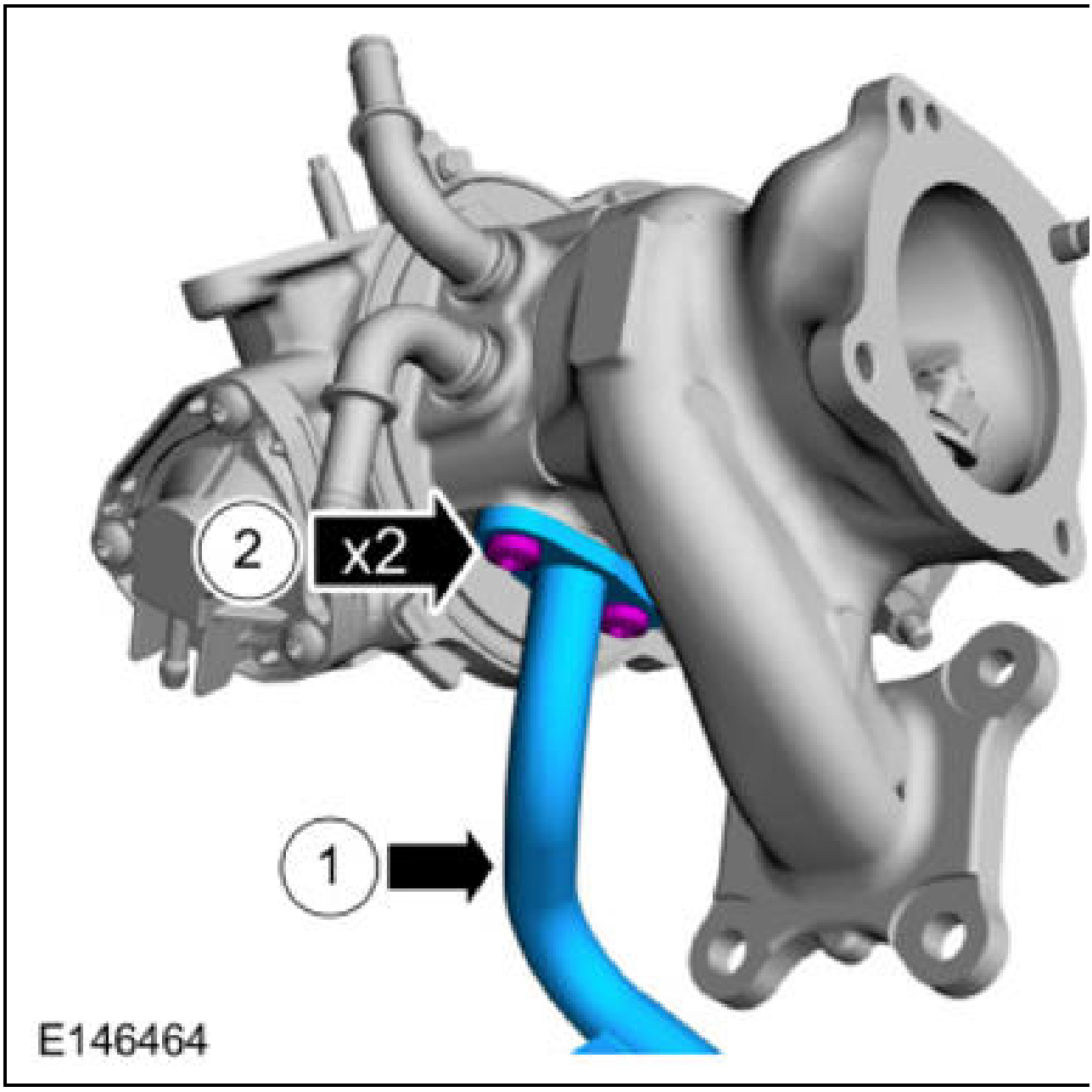


114.

1.

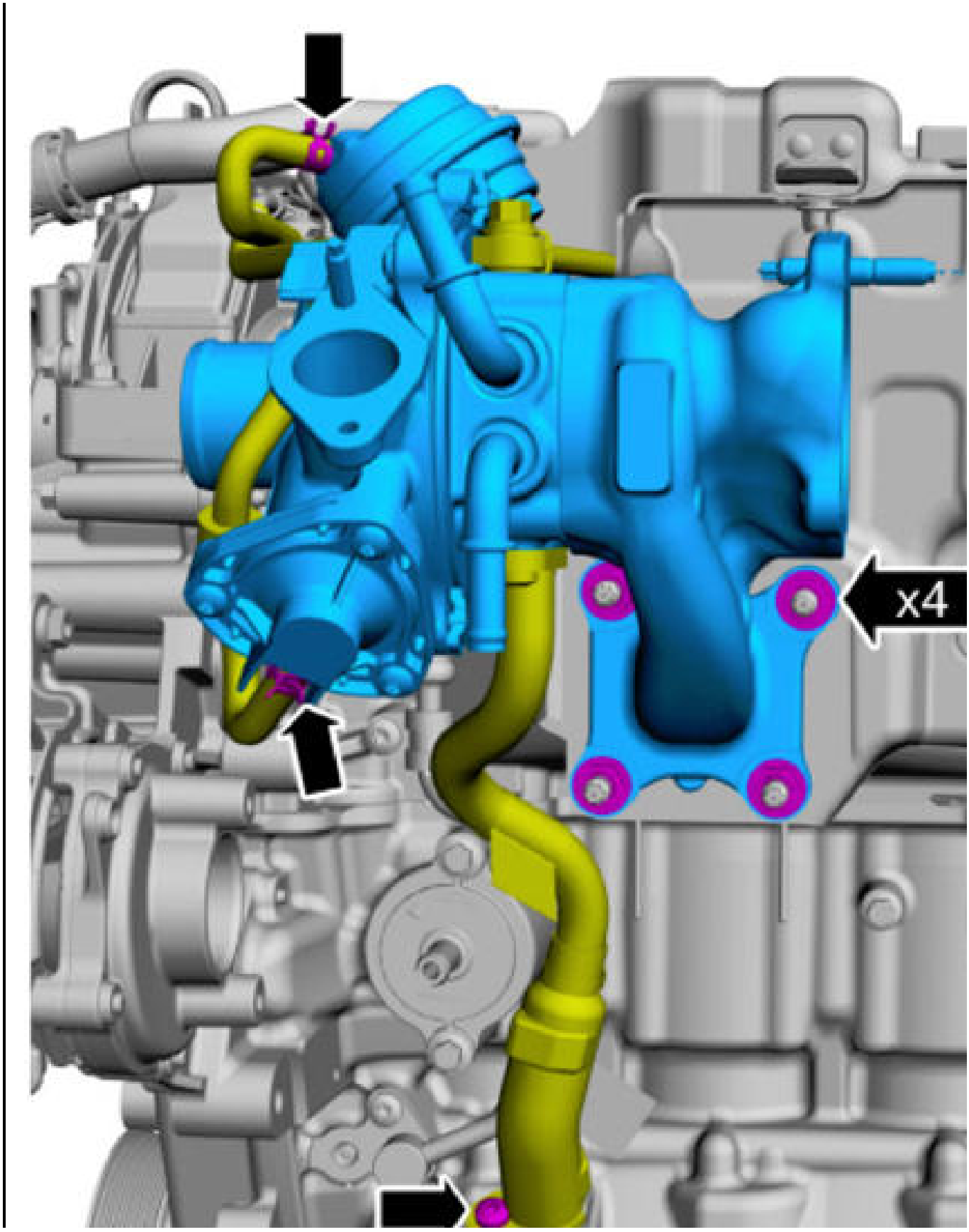
NOTE: Make sure that a new component is installed.

2. *Torque* : 89 lb.in (10 Nm)



115. **NOTE: Only tighten the nuts and bolts finger tight at this stage.**

Use the General Equipment: Hose Clamp Remover/Installer



116. *Torque* :

1-4:

Stage 1: 168 lb.in (19 Nm)

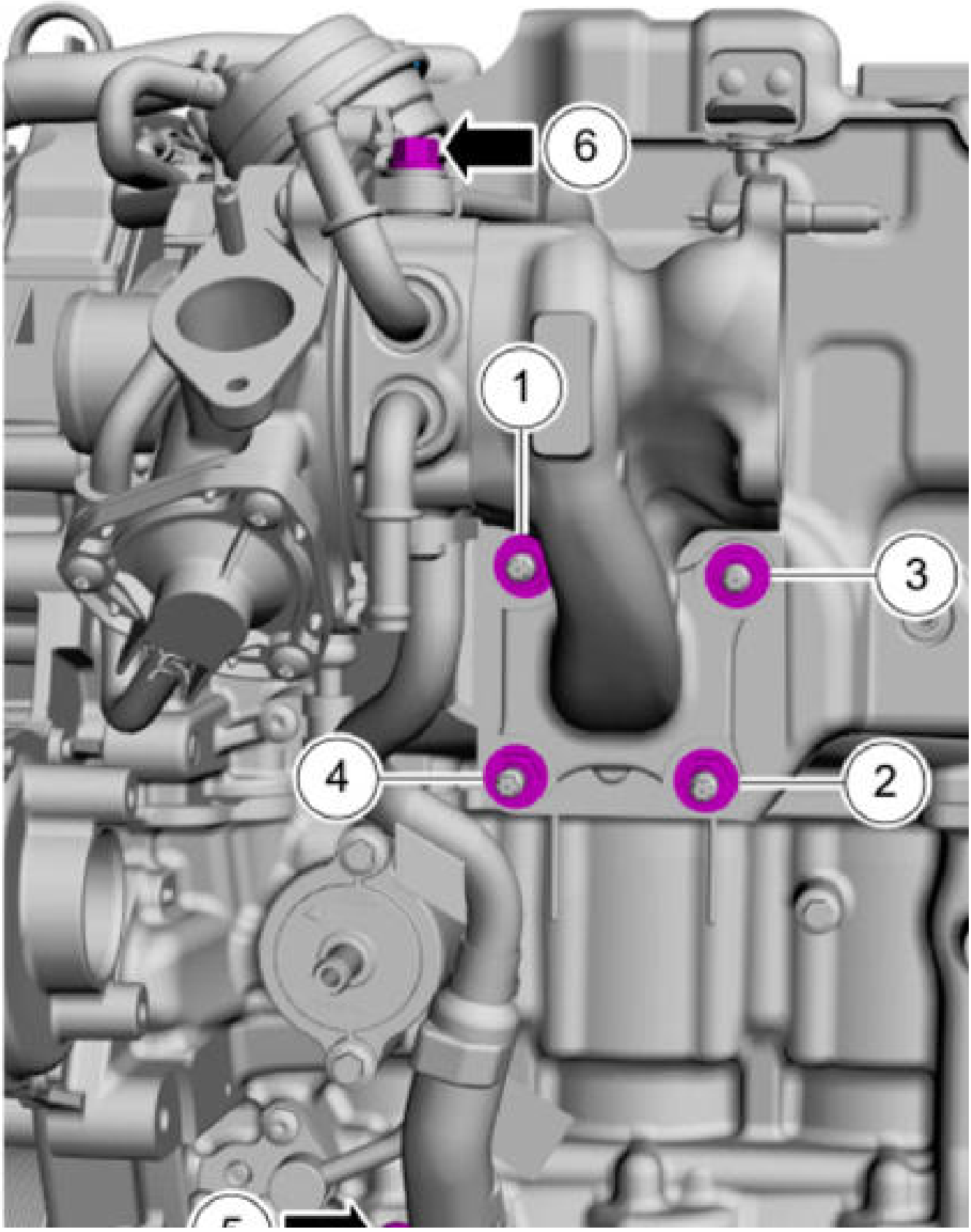
Stage 2: 18 lb.ft (24 Nm)

Stage 3: Wait 30 s

Stage 4: 18 lb.ft (24 Nm)

5: 89 lb.in (10 Nm)

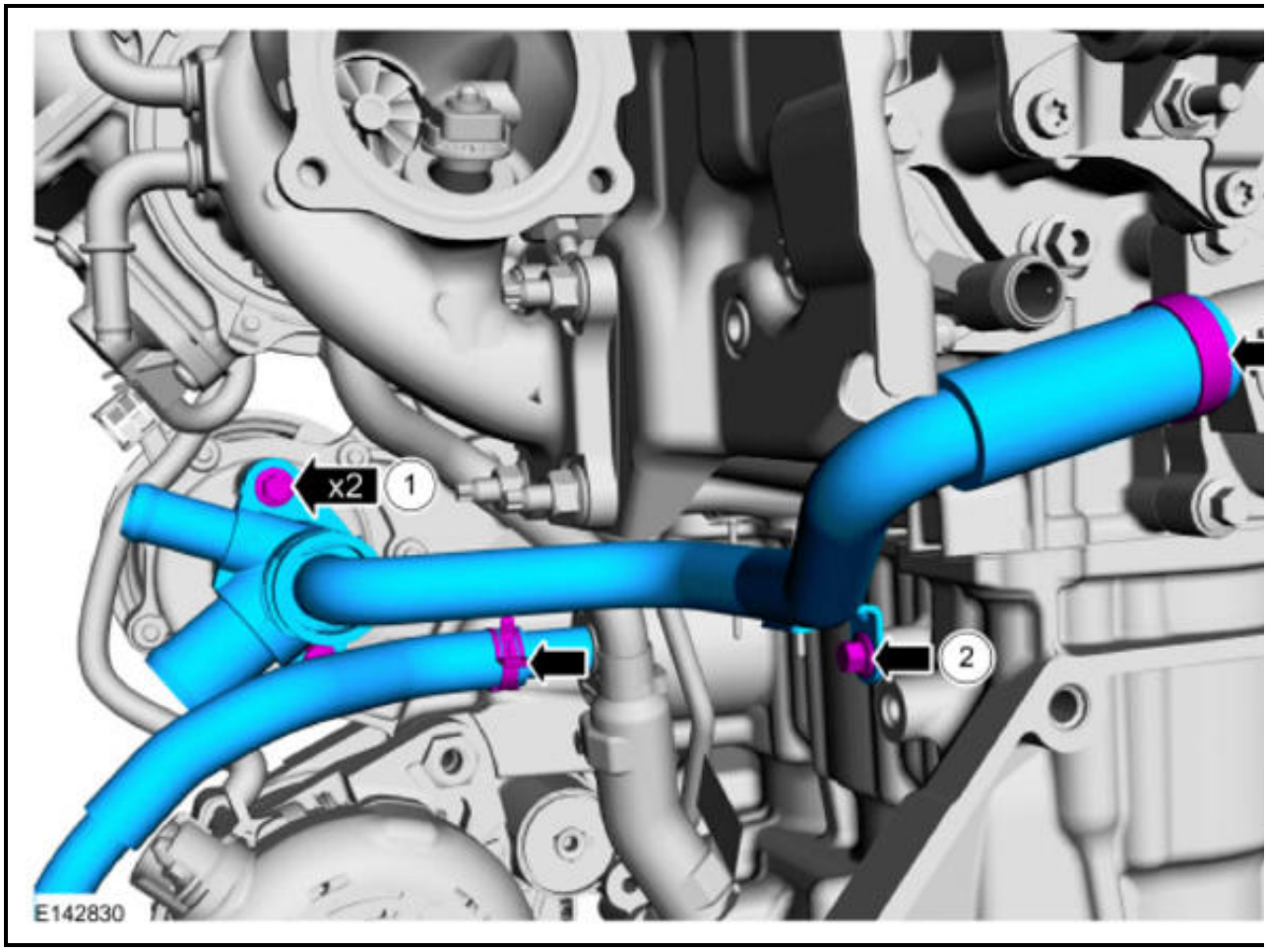
6: 22 lb.ft (30 Nm)



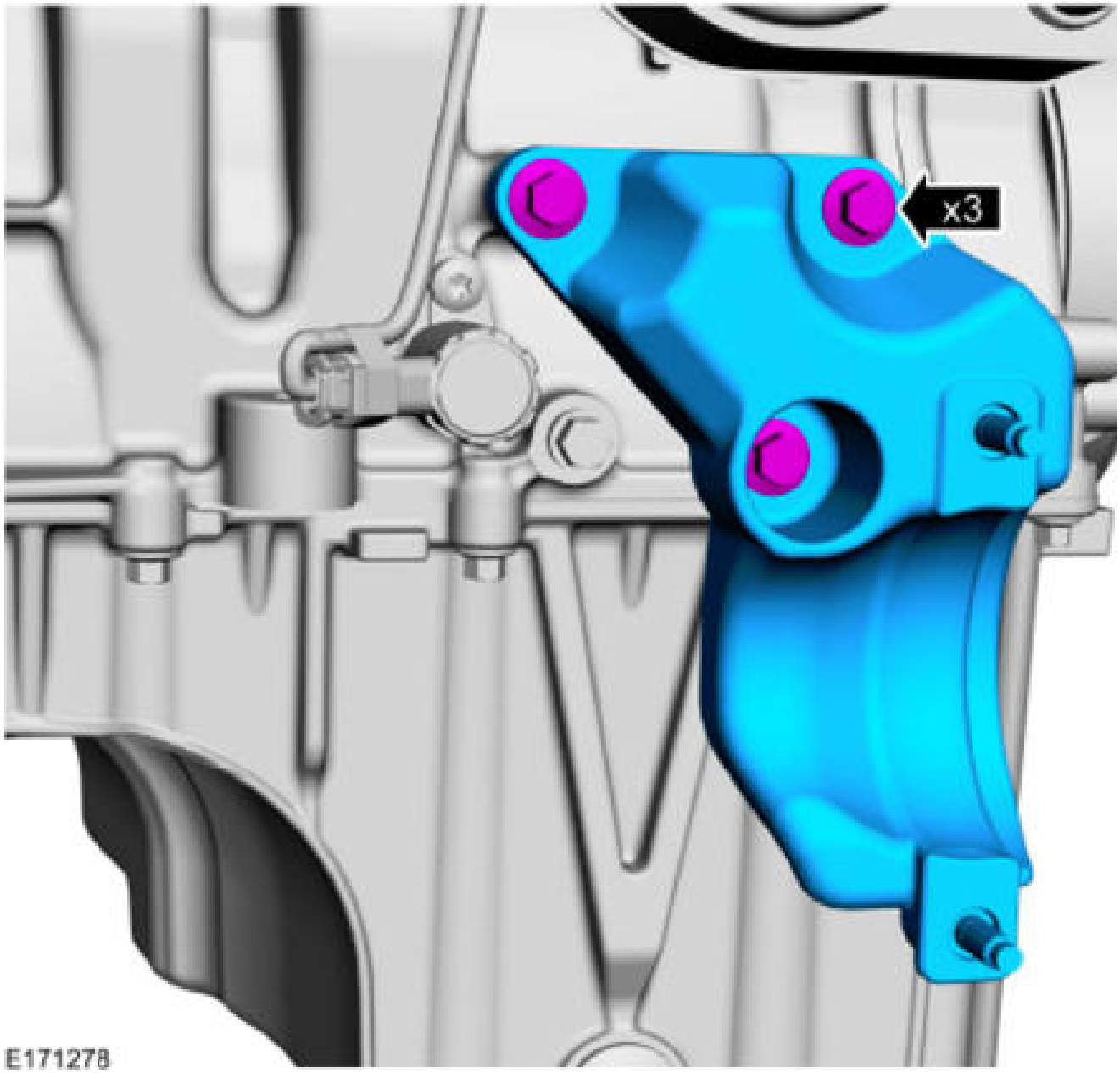
117. Use the General Equipment: Hose Clamp Remover/Installer

Torque :

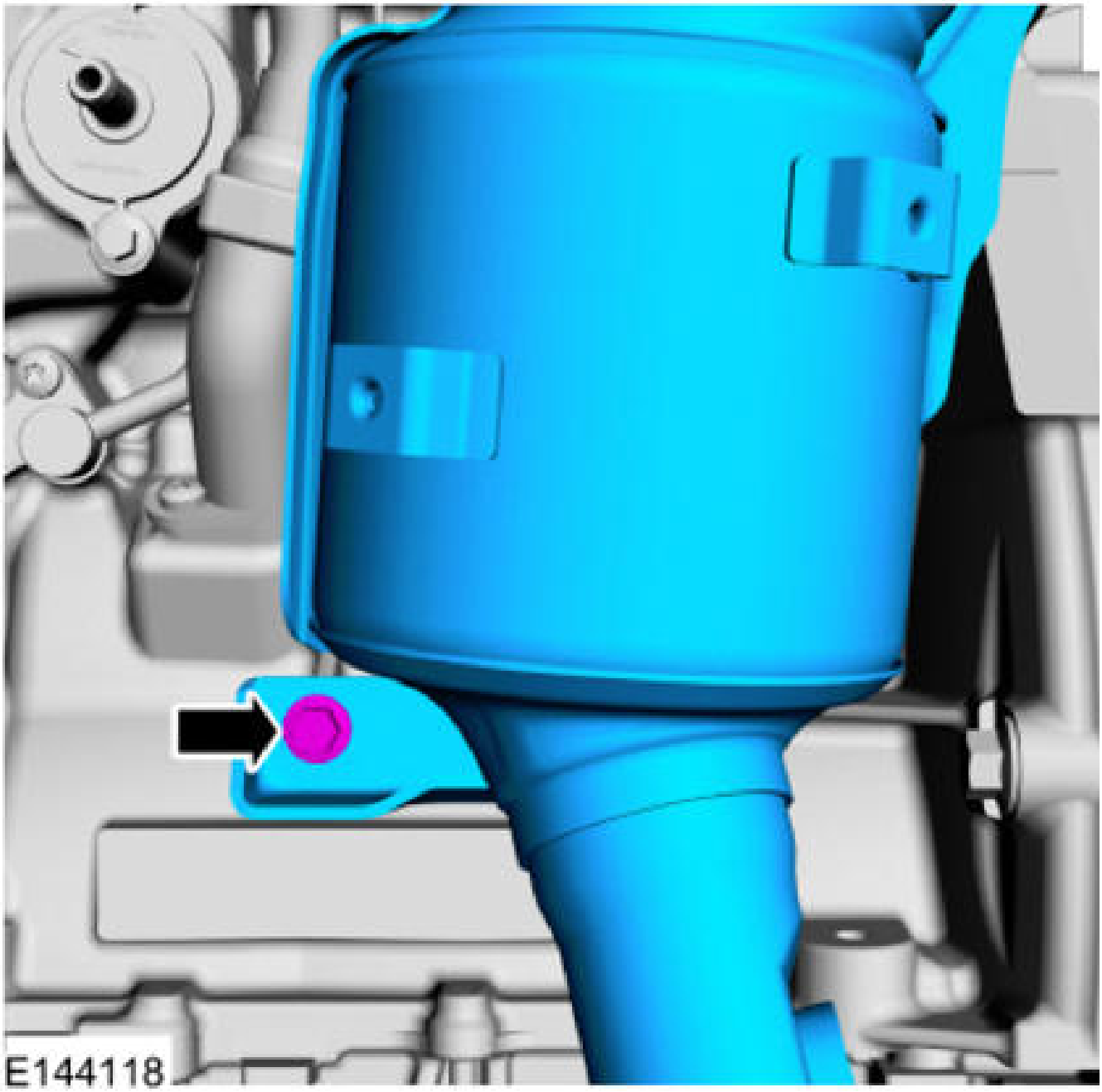
1. 89 lb.in (10 Nm)
2. 89 lb.in (10 Nm)



118. *Torque* : 18 lb.ft (24 Nm)



119. **NOTE:** **Only tighten the bolt finger tight at this stage.**



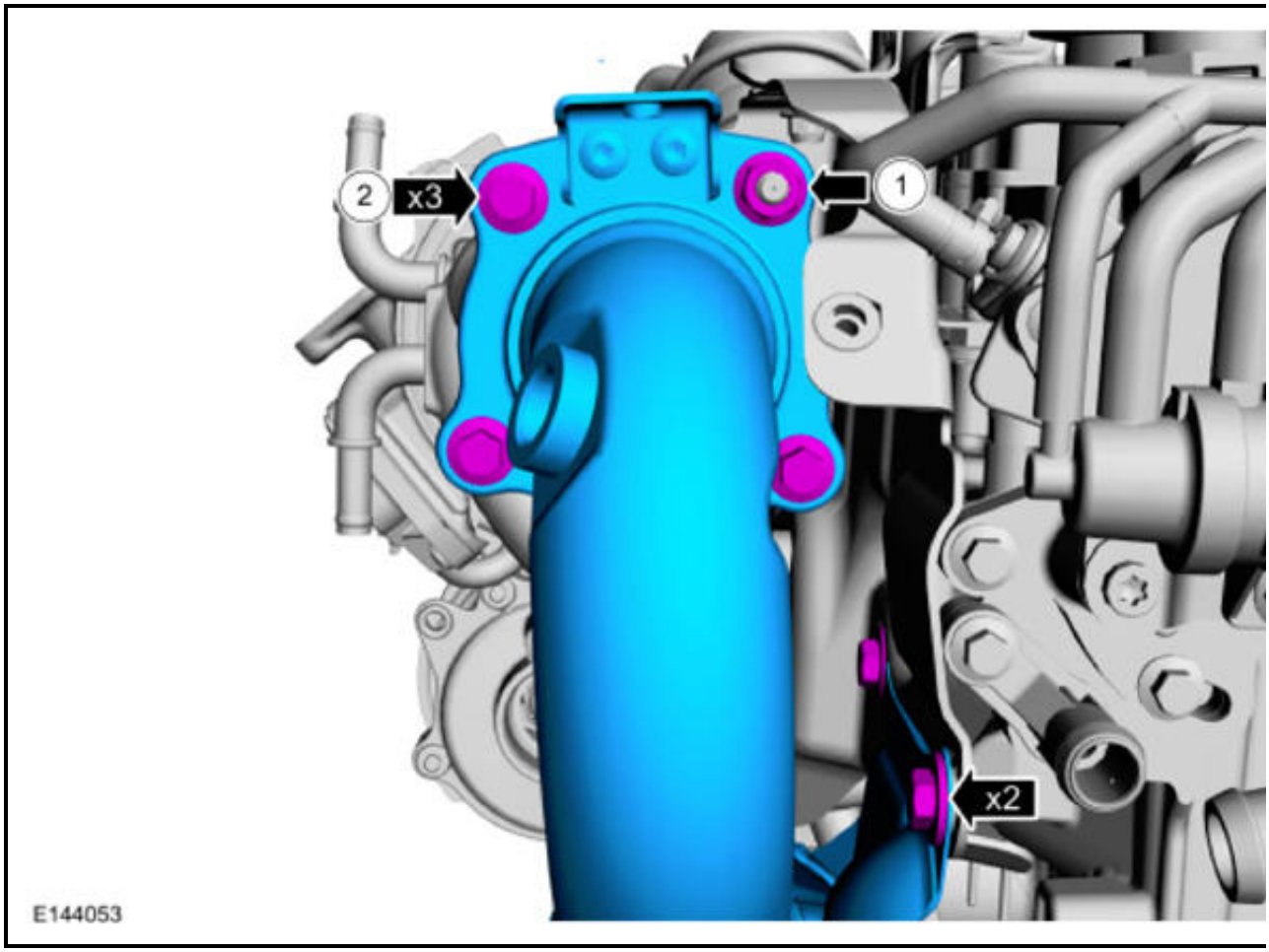
120. **NOTE:** **Only tighten the nut and bolts finger tight at this stage.**

1.

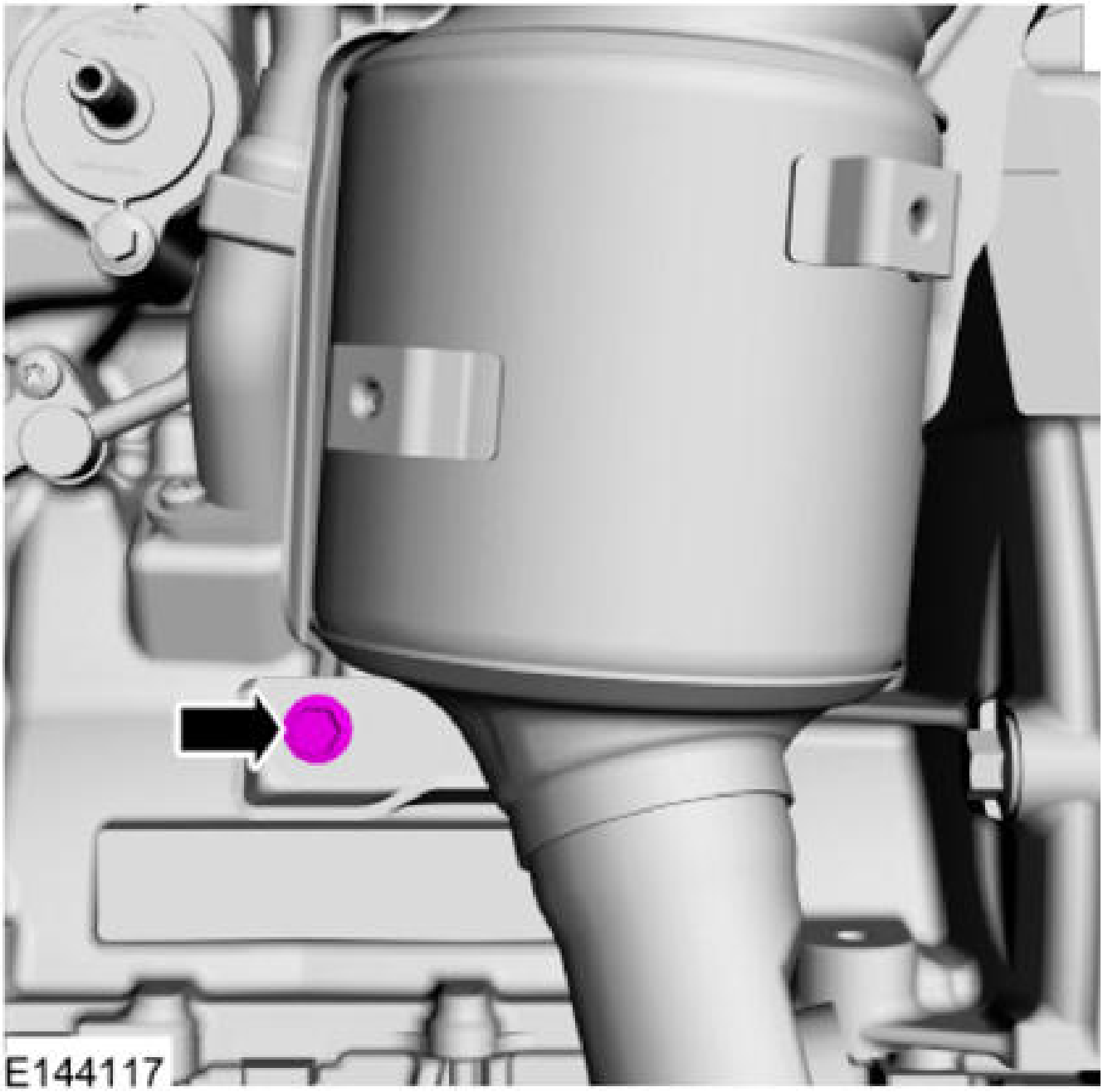
NOTE: **Make sure that a new component is installed.**

2.

NOTE: **Make sure that new components are installed.**



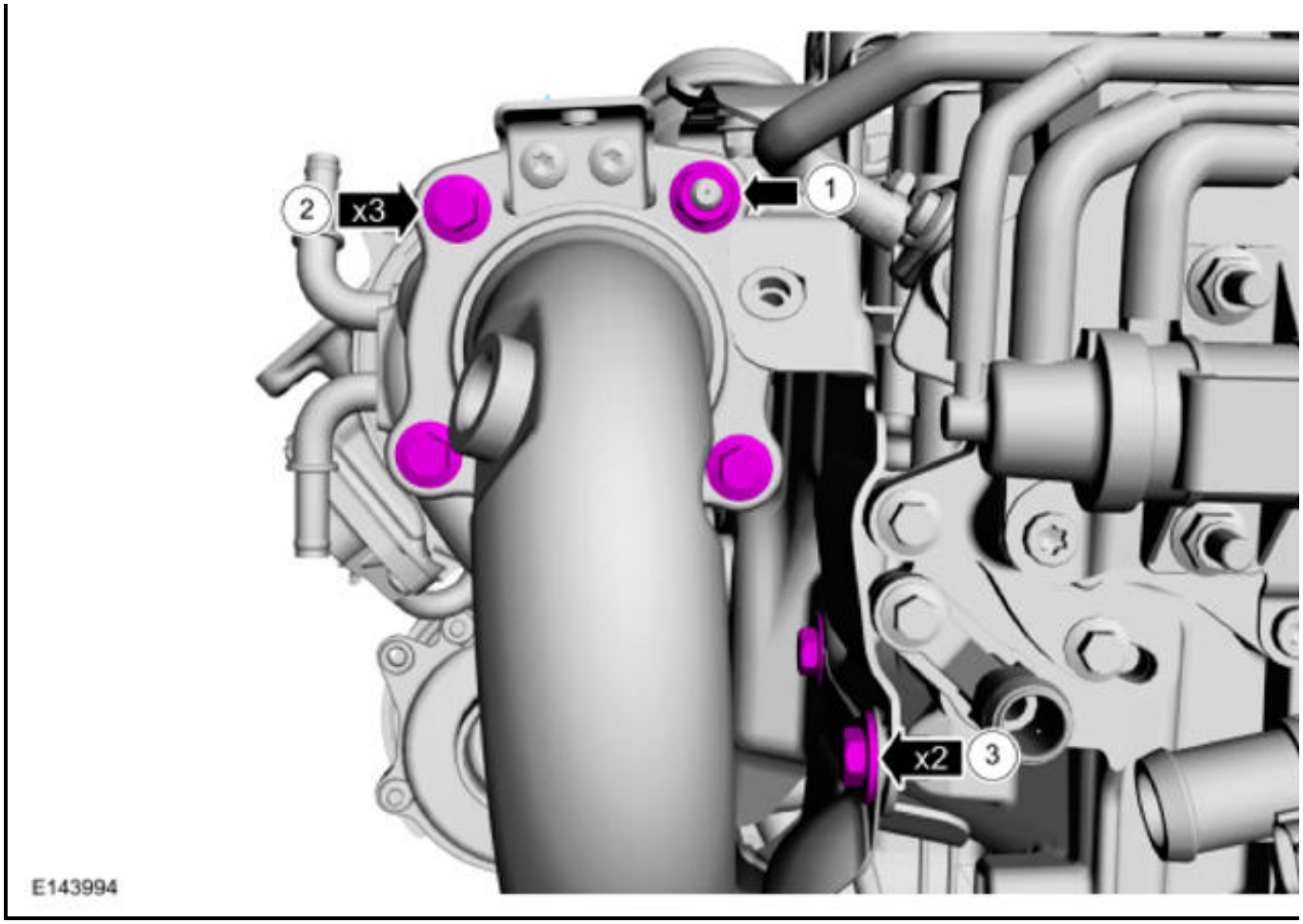
121. *Torque* : 18 lb.ft (25 Nm)



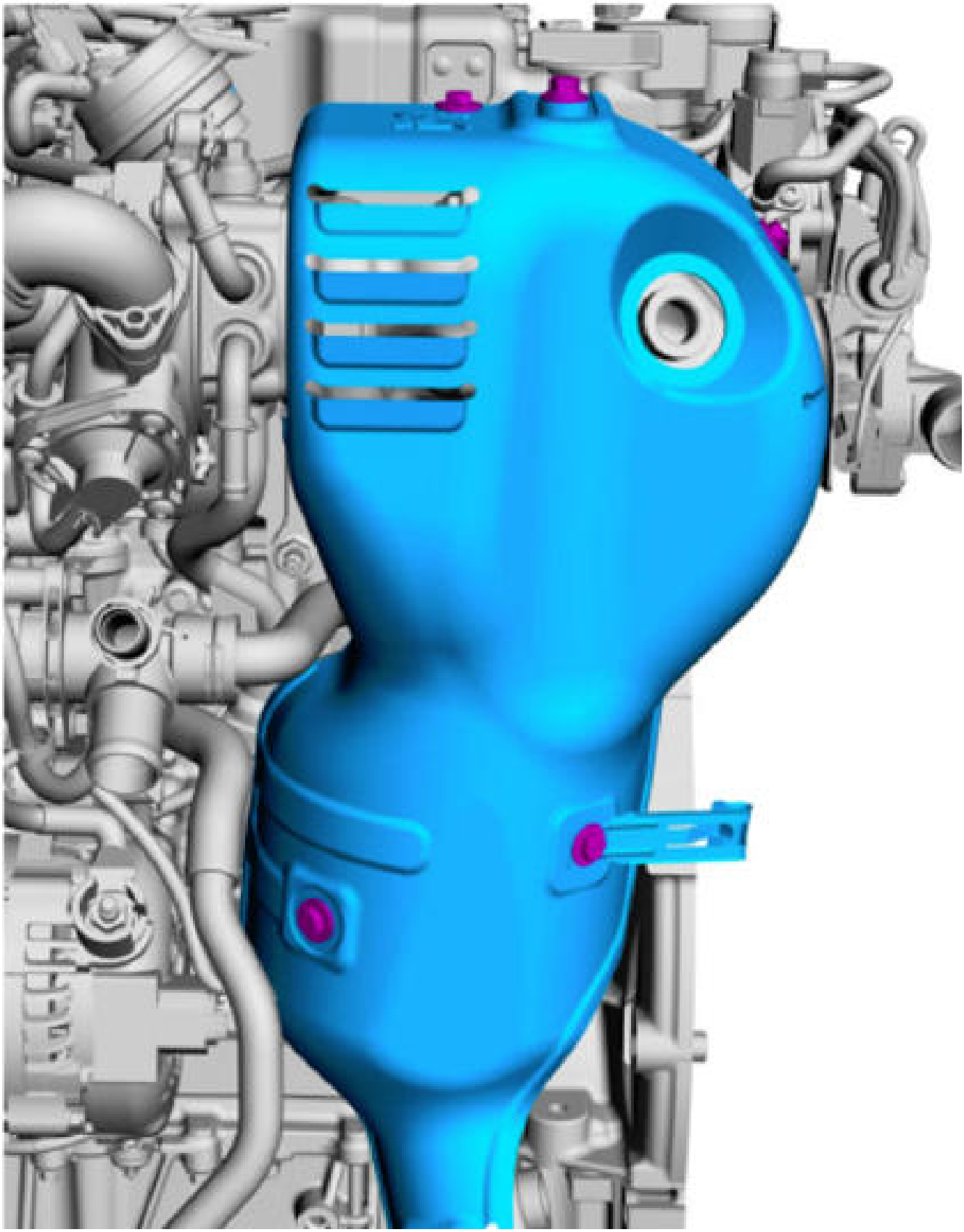
122. *Torque* :

1-2: 18 lb.ft (25 Nm)

3: 97 lb.in (11 Nm)

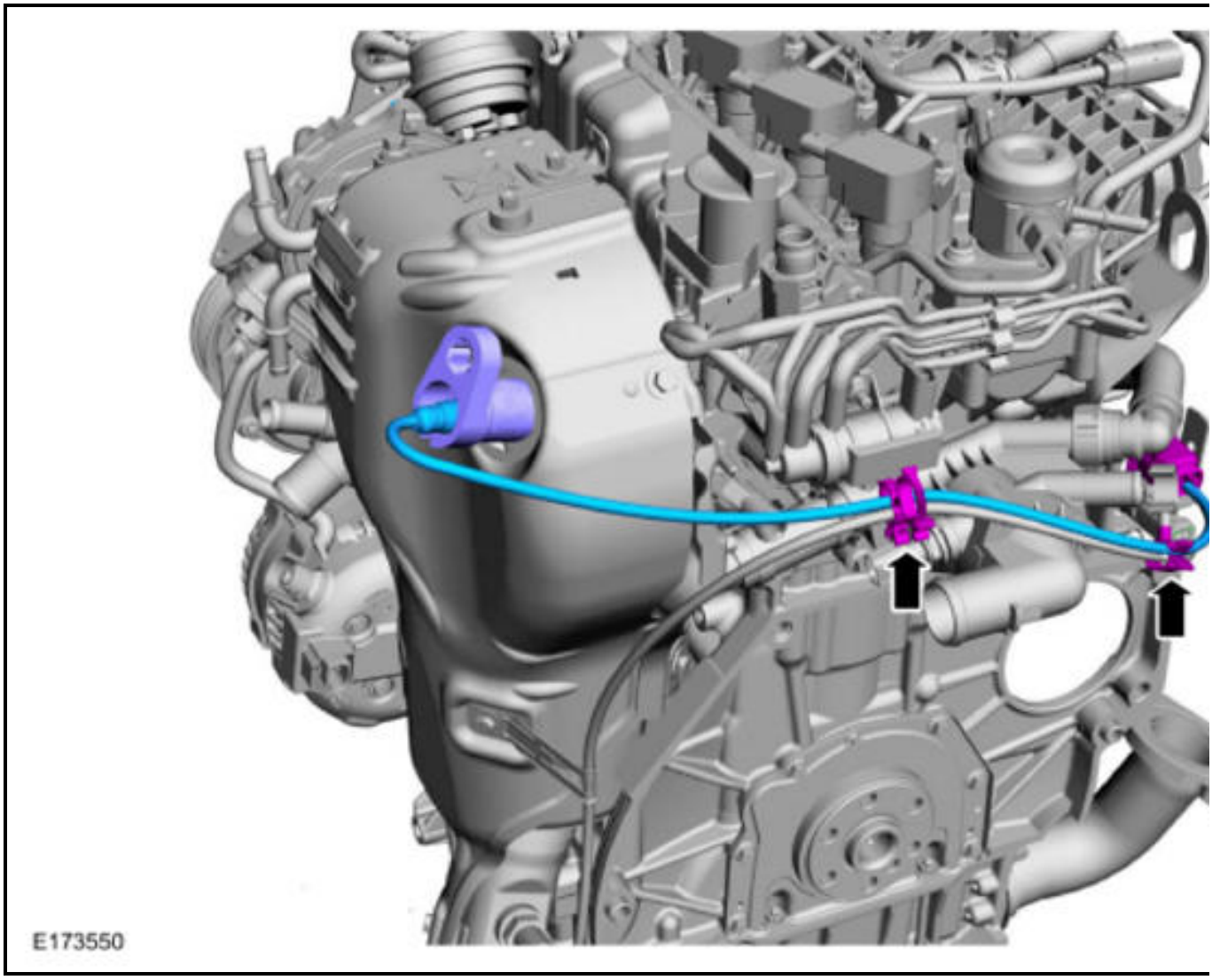


123. *Torque* : 97 lb.in (11 Nm)



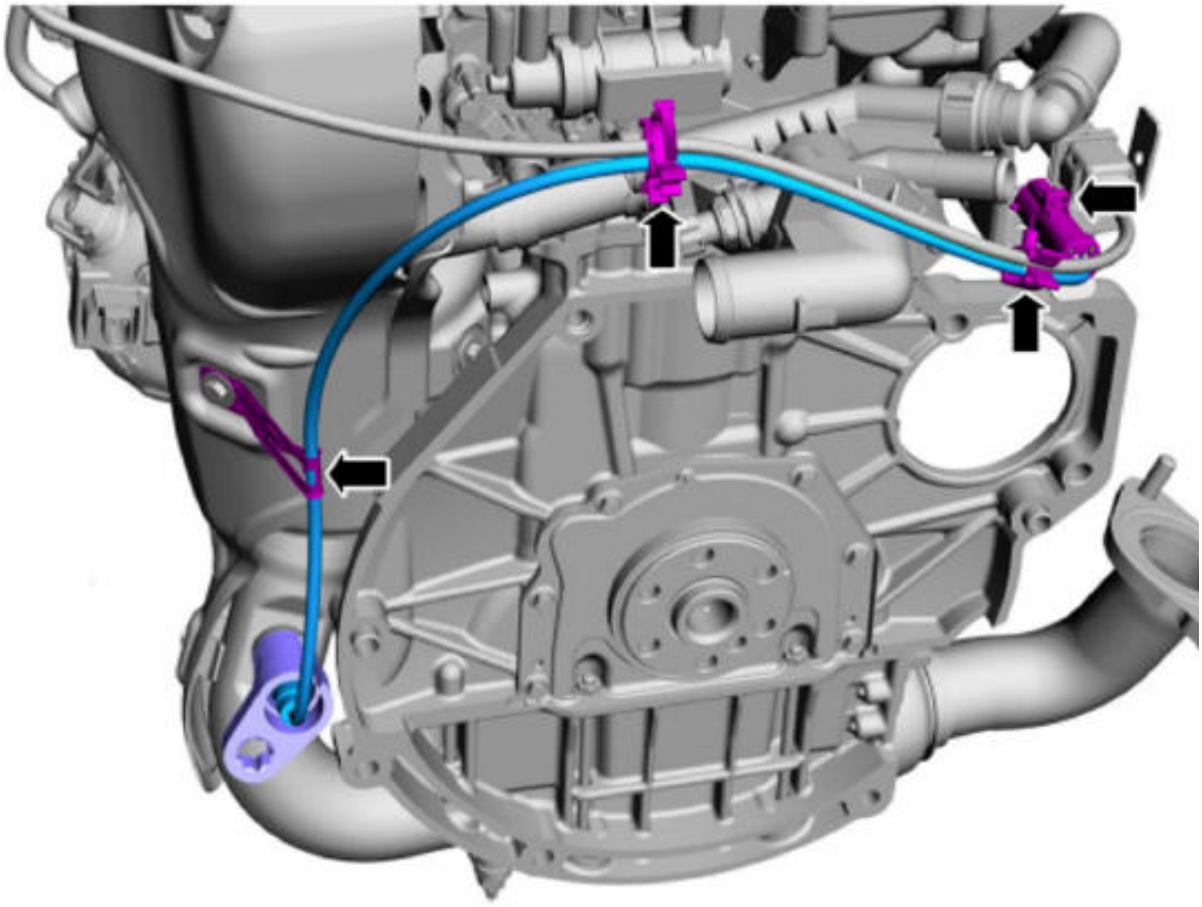
124. **NOTE: Use a commercially available socket.**

Torque : 35 lb.ft (48 Nm)

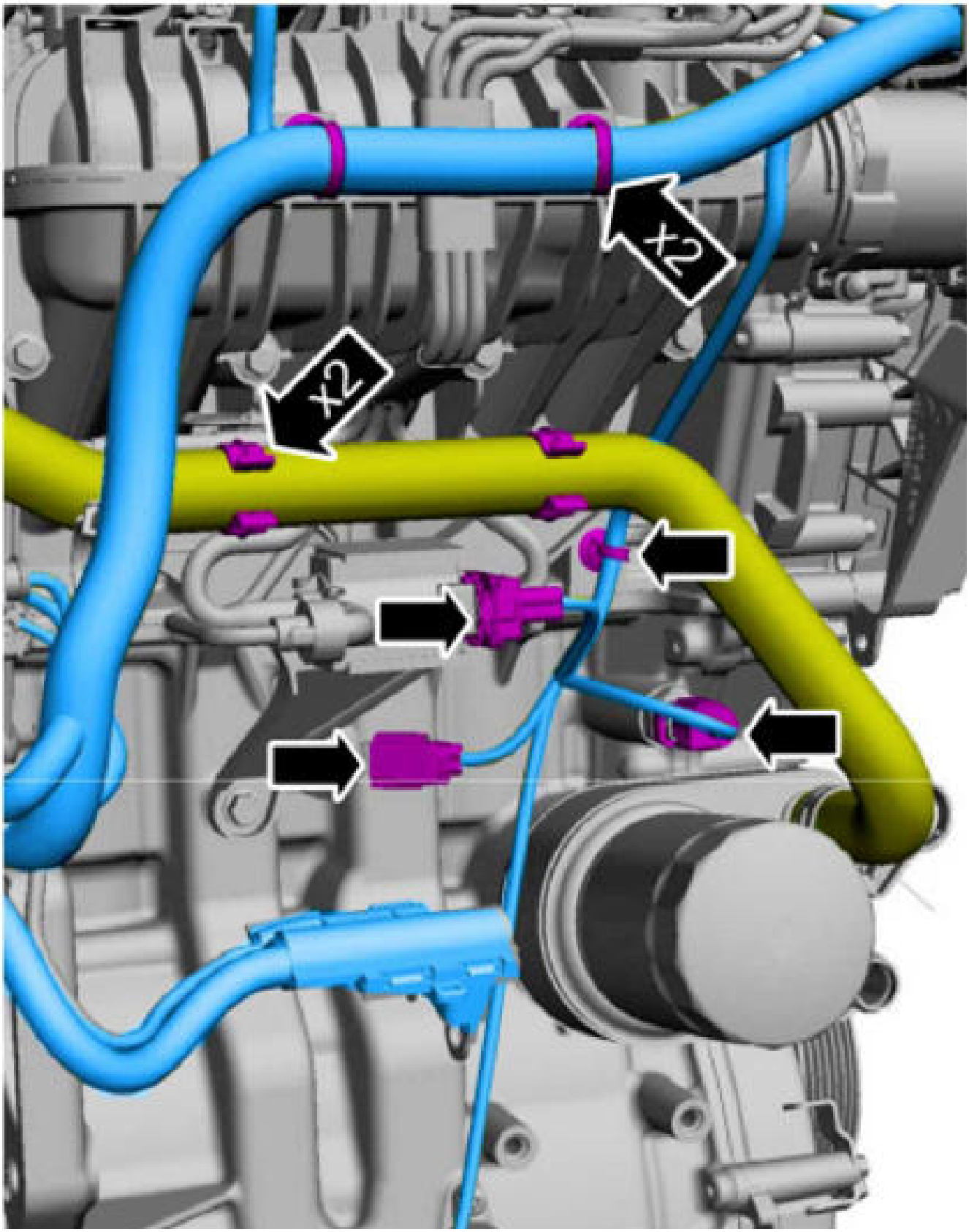


125. **NOTE: Use a commercially available socket.**

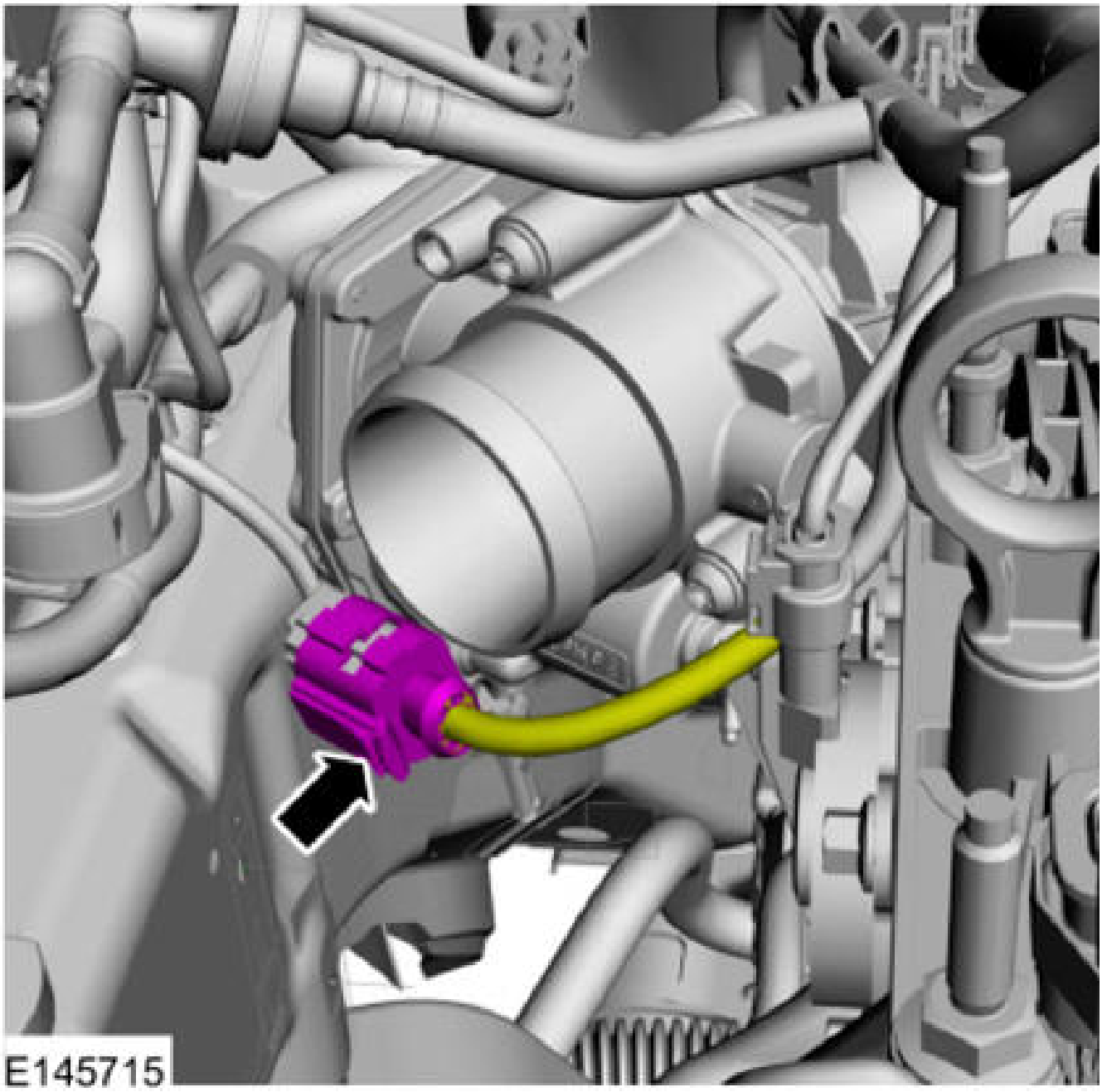
Torque : 35 lb.ft (48 Nm)



126.

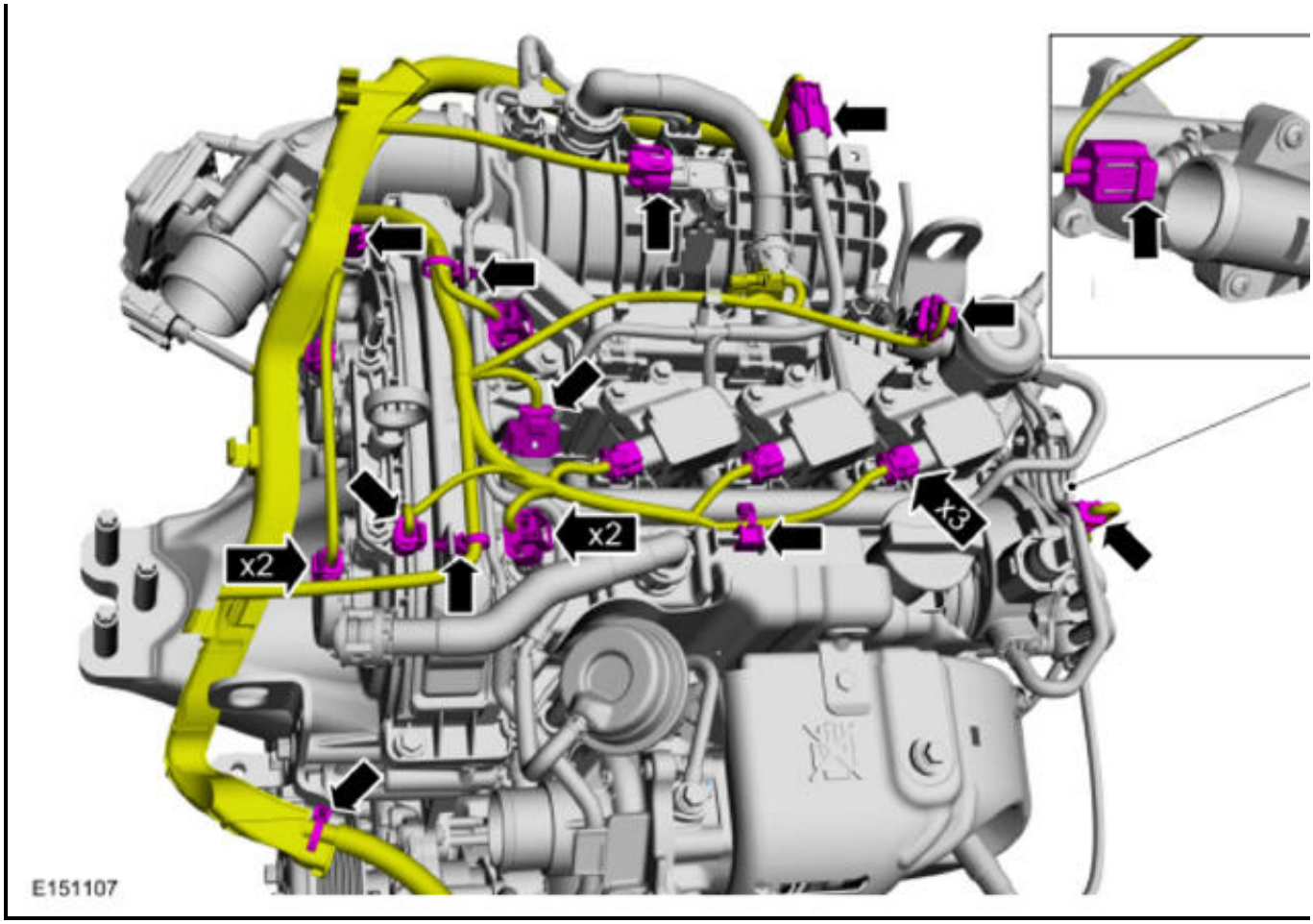


127.



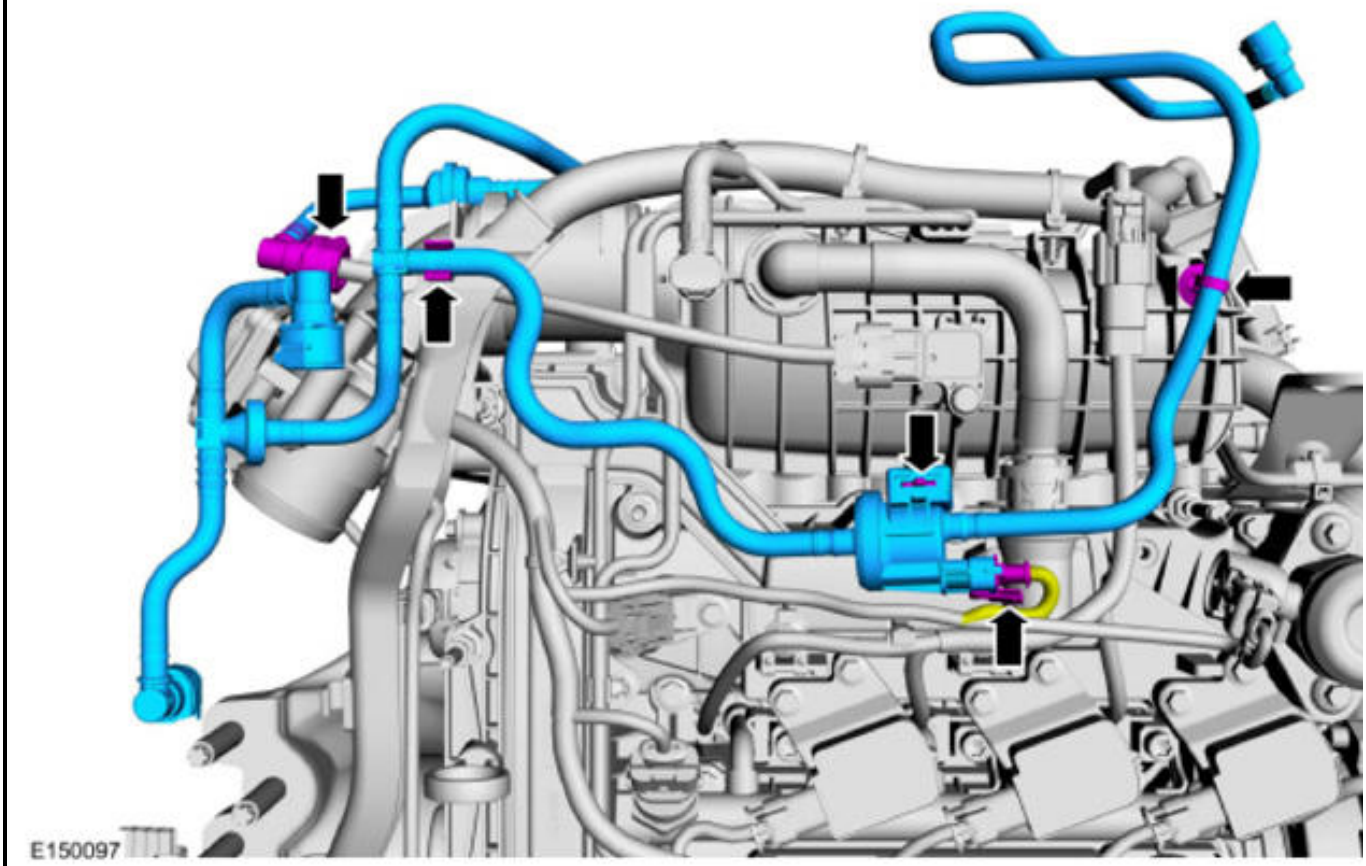
128.

128.

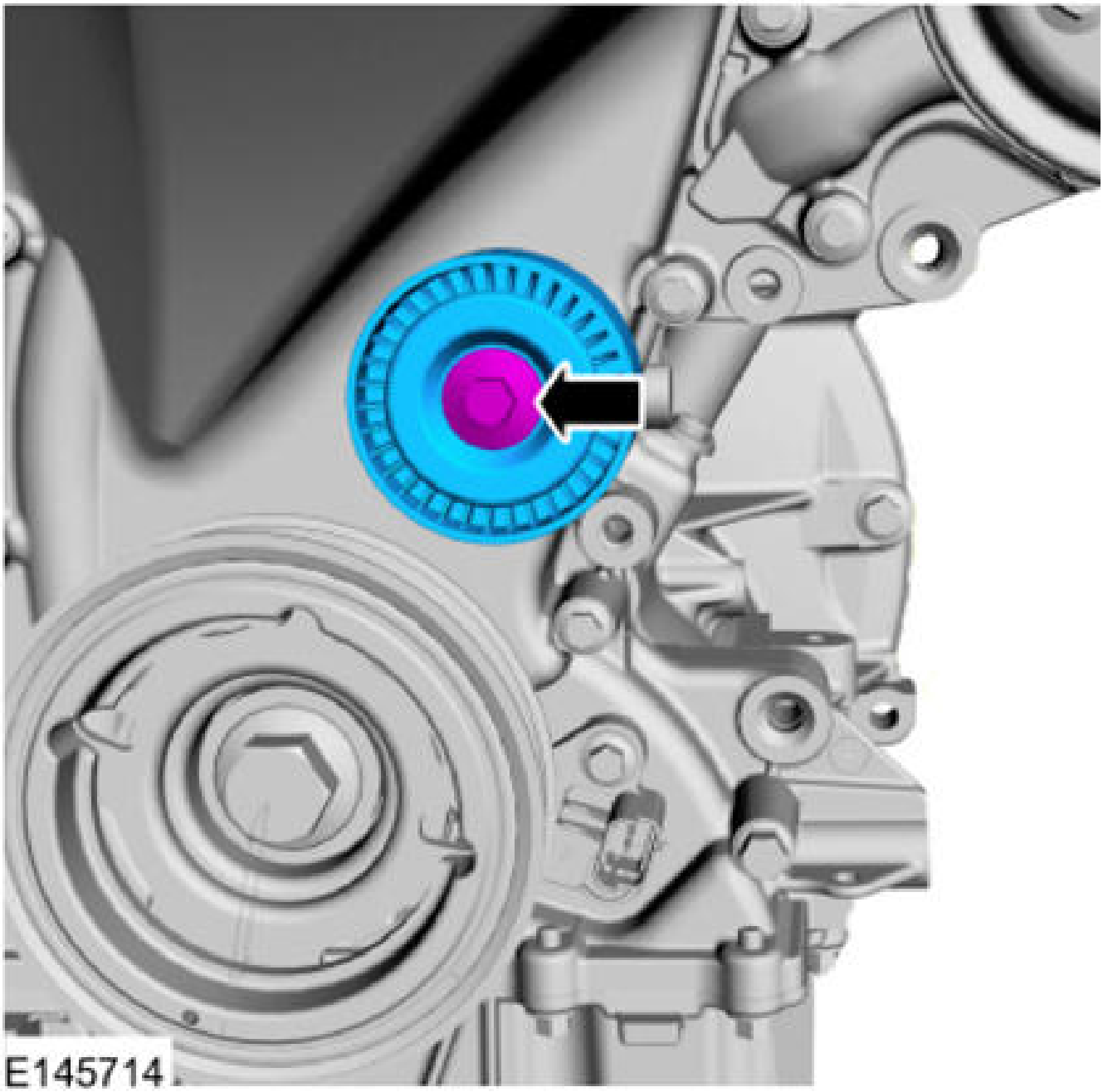


129.

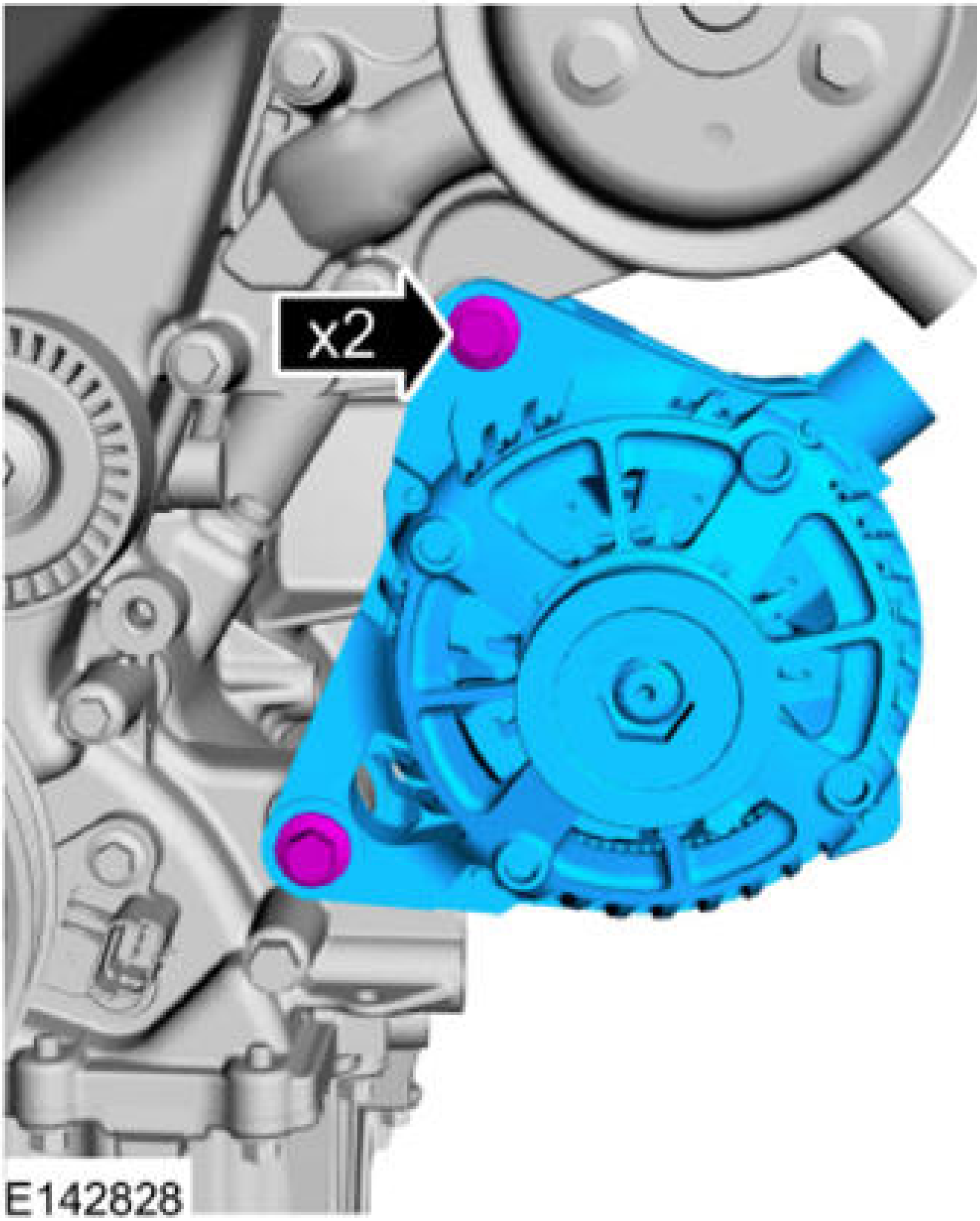
129.

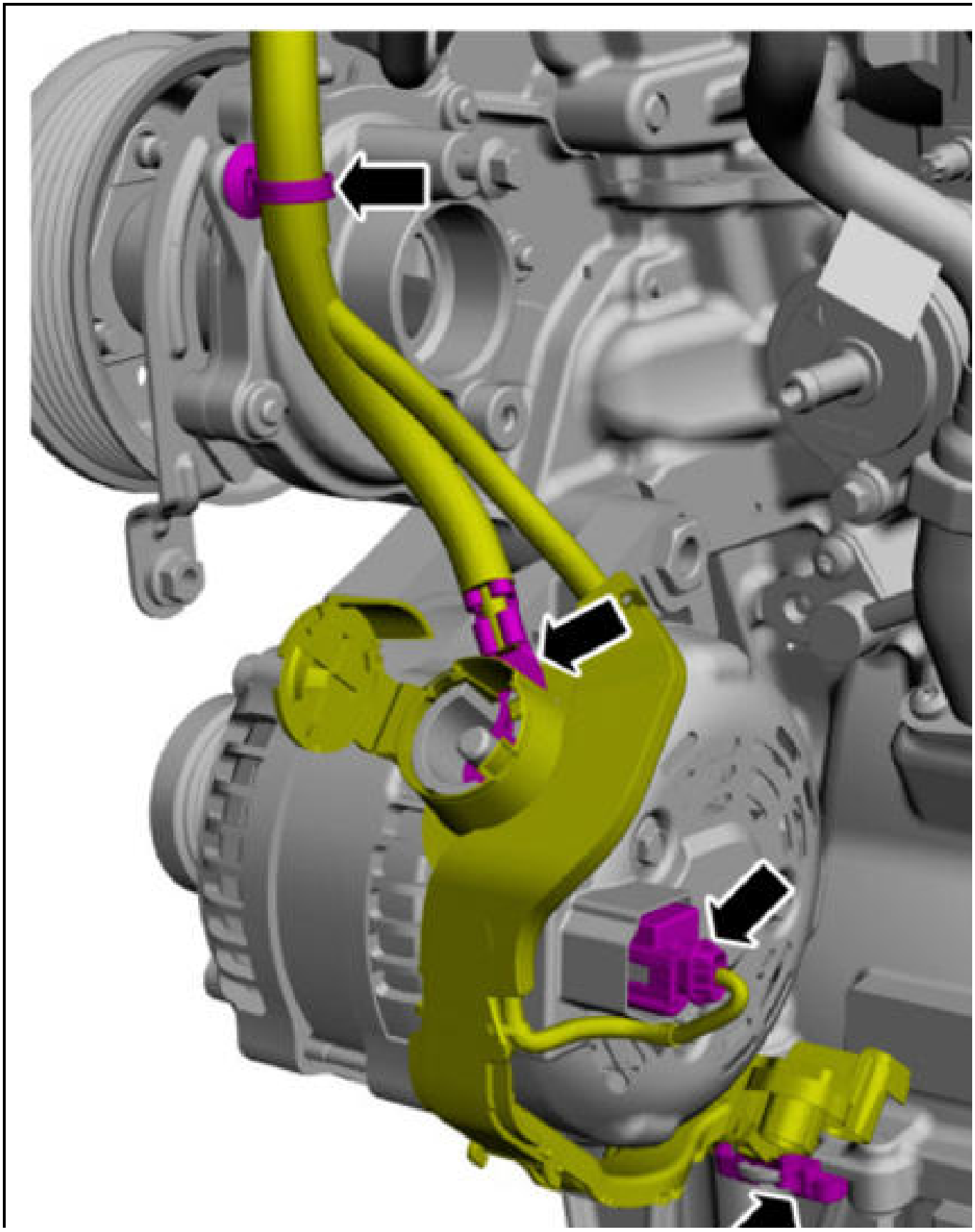


130. *Torque* : 18 lb.ft (25 Nm)

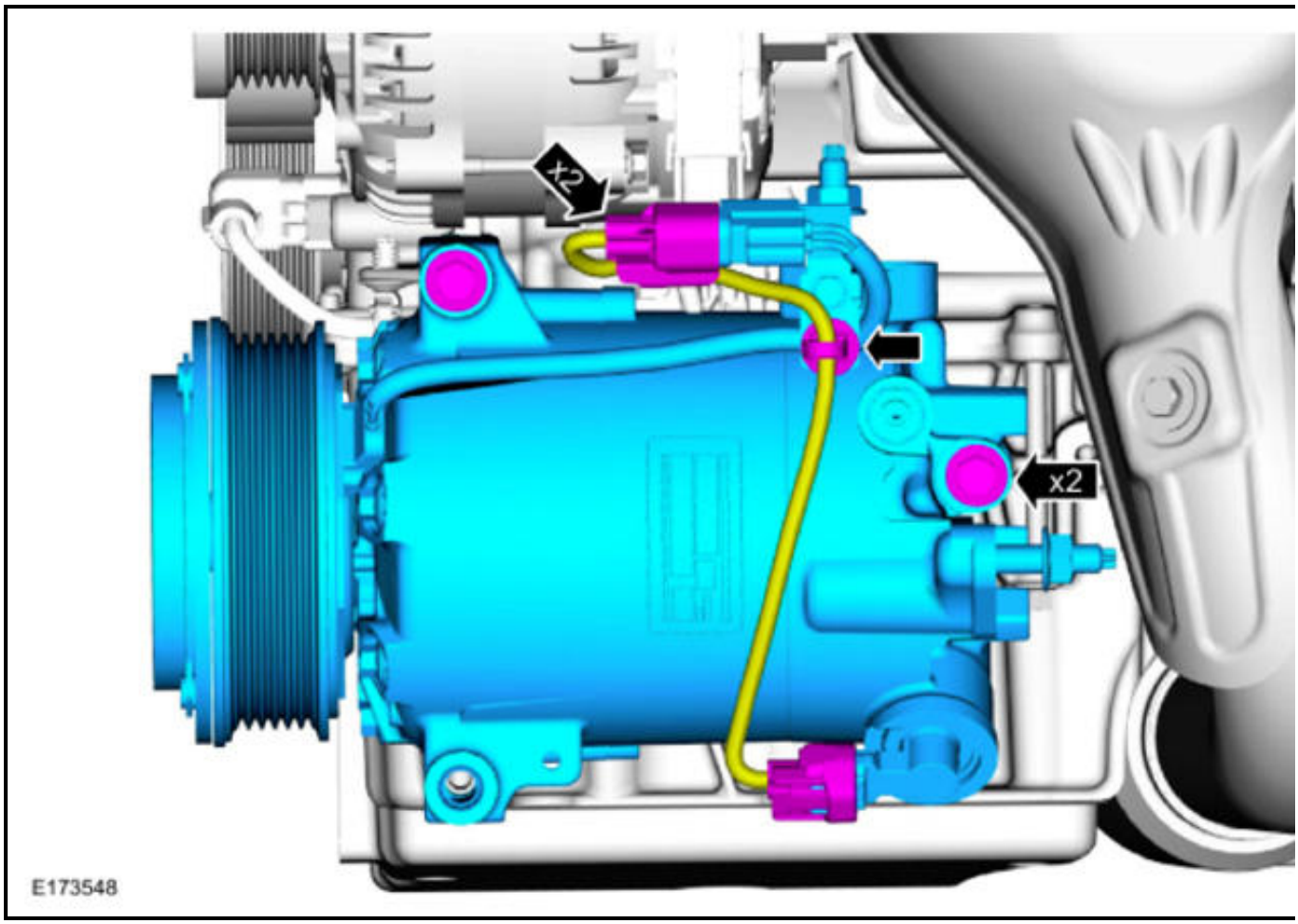


131. *Torque* : 35 lb.ft (48 Nm)



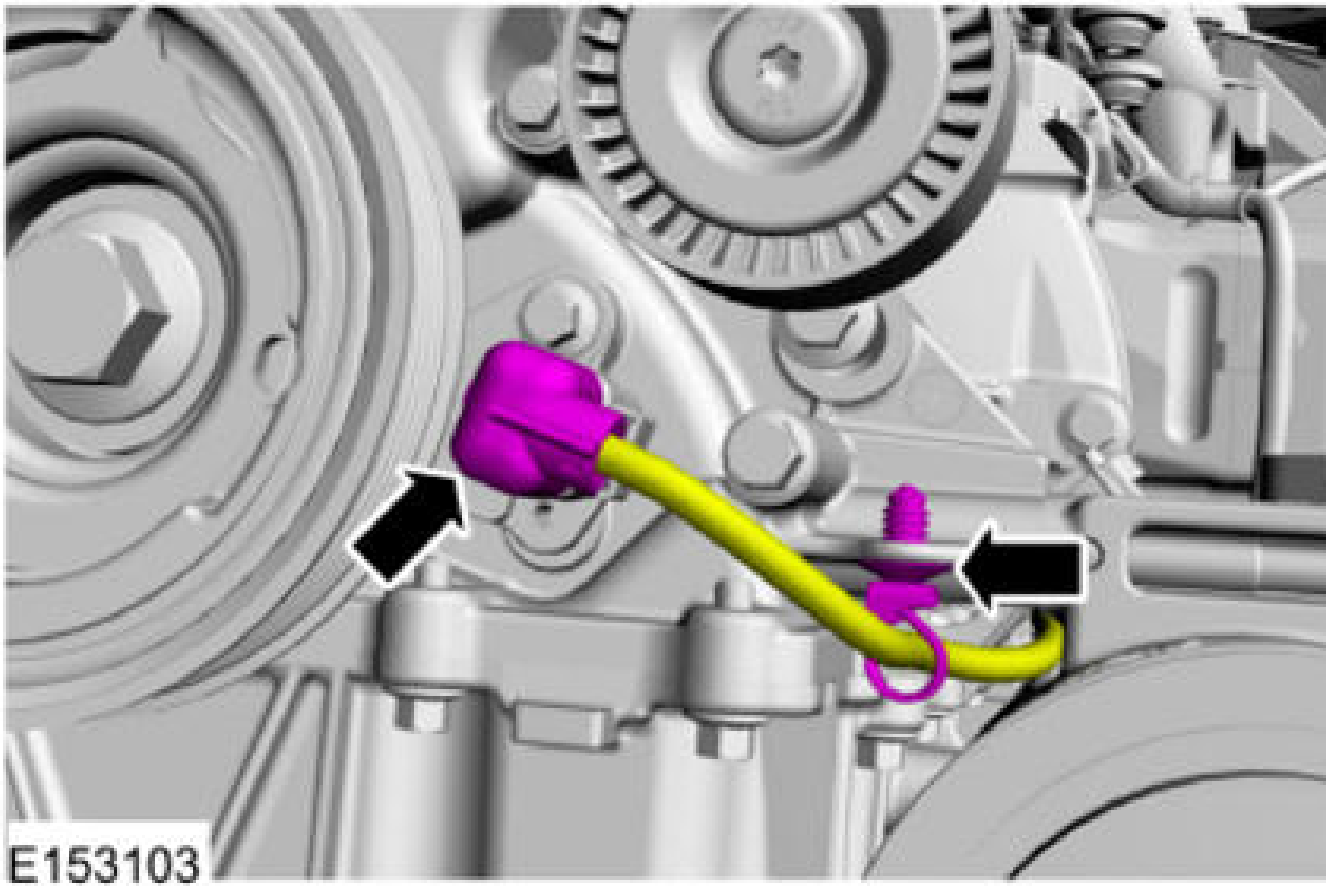


133. *Torque* : 18 lb.ft (25 Nm)

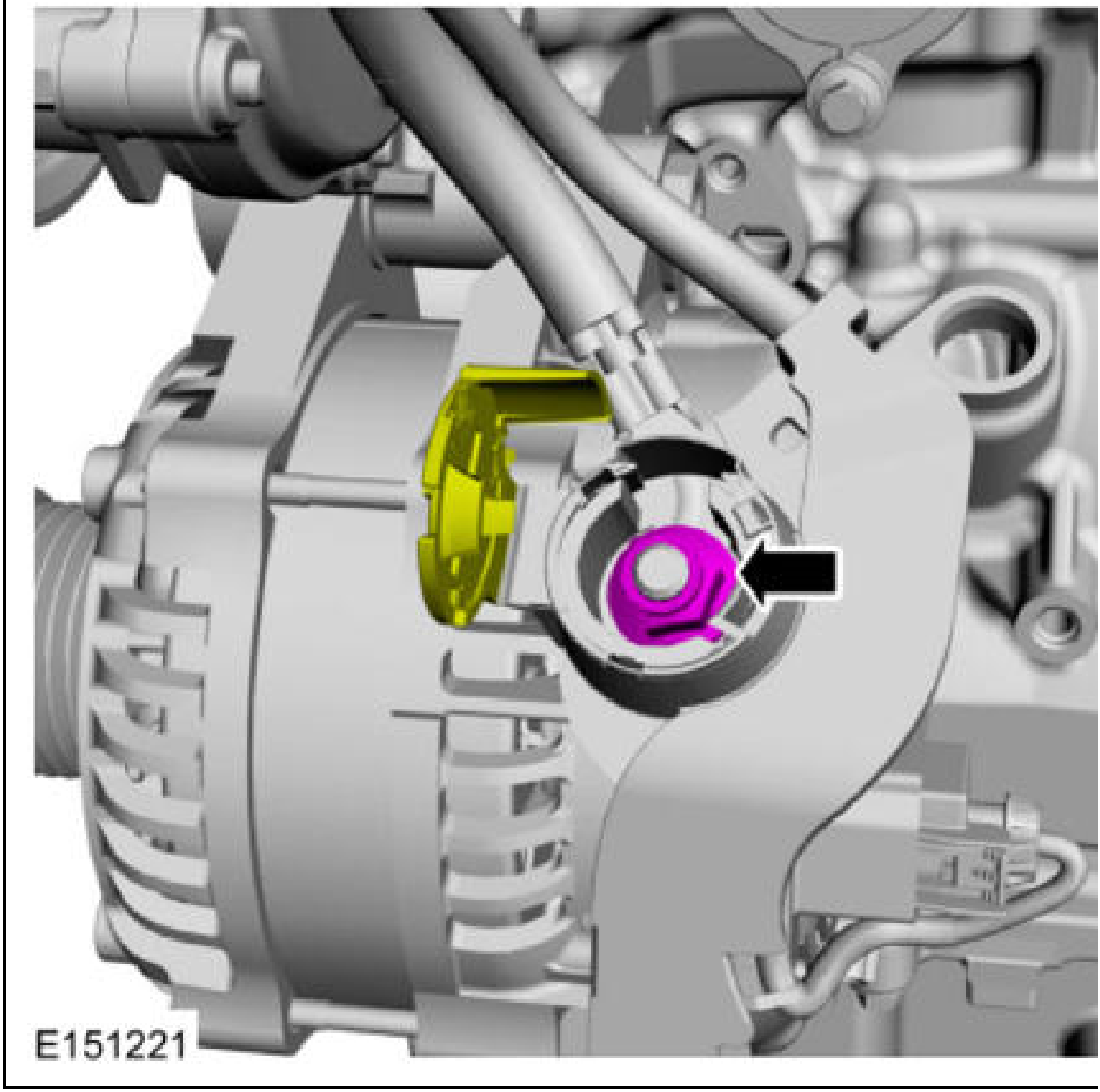


134.

134.



135. *Torque* : 18 lb.ft (25 Nm)

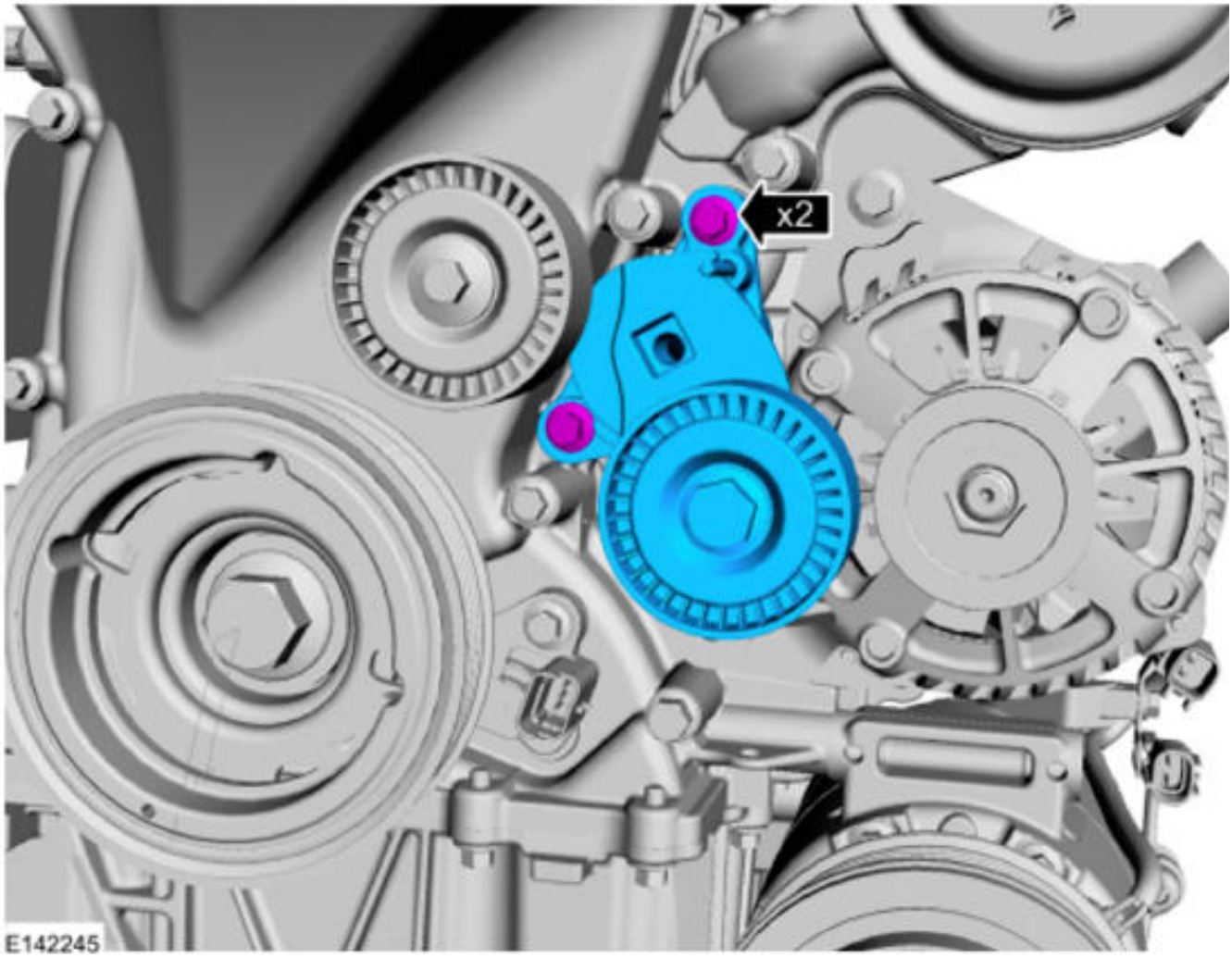


WARNING: **Take extra care when handling the compressed spring.**

136.

Use the General Equipment: 4 mm Drill Bit

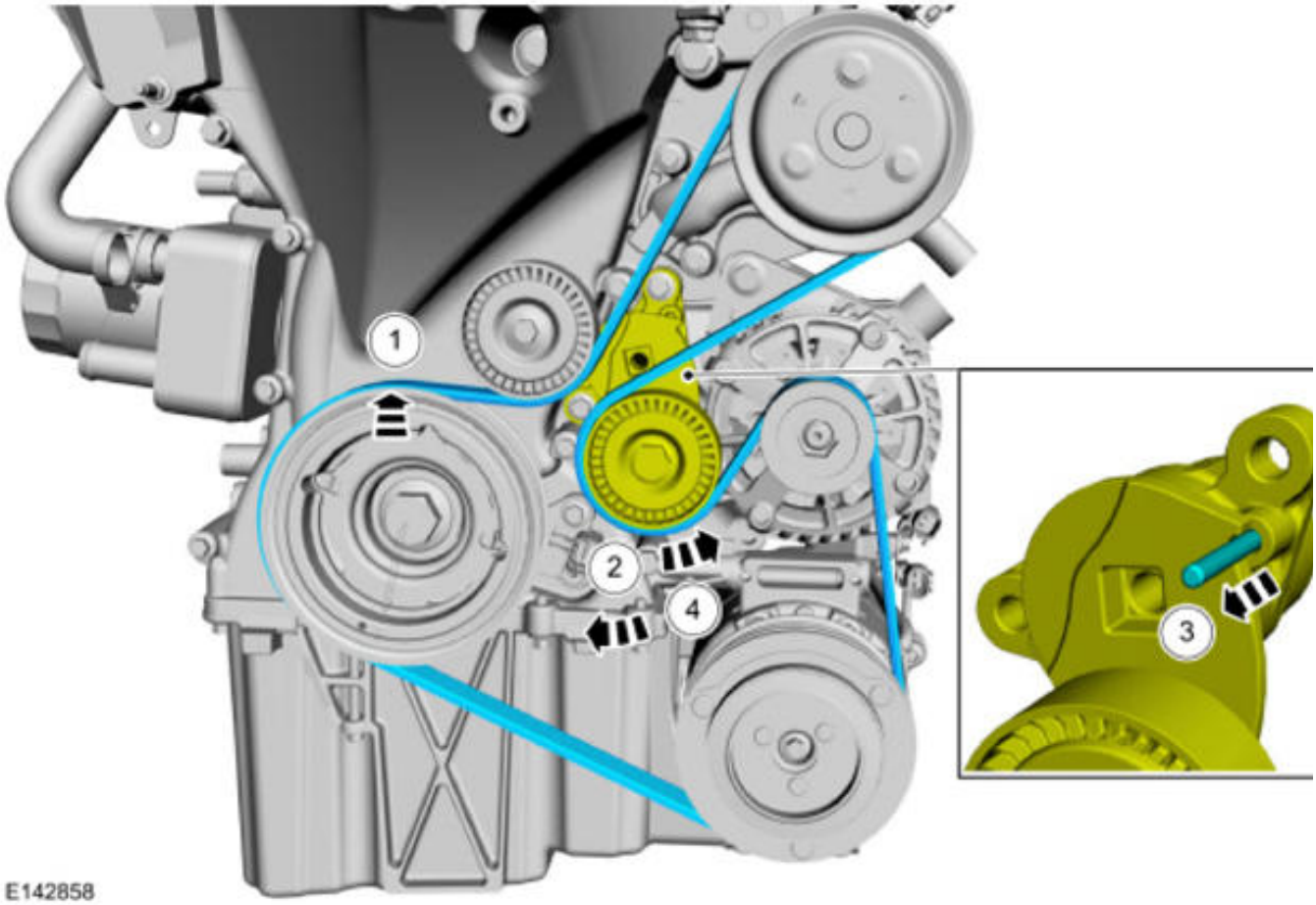
Torque : 18 lb.ft (25 Nm)



WARNING: **Take extra care when handling the compressed spring.**

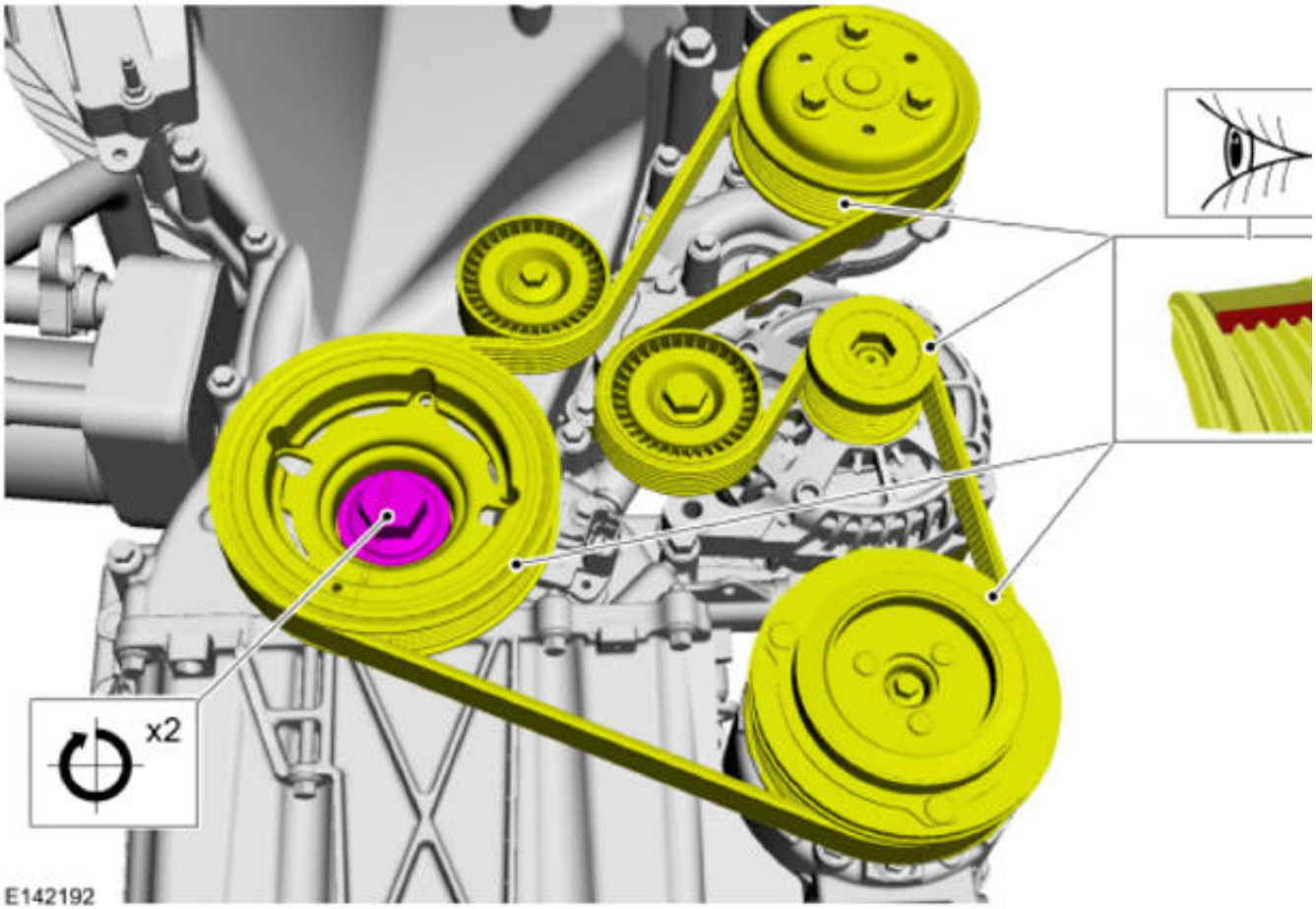
137.

Use the General Equipment: 4 mm Drill Bit



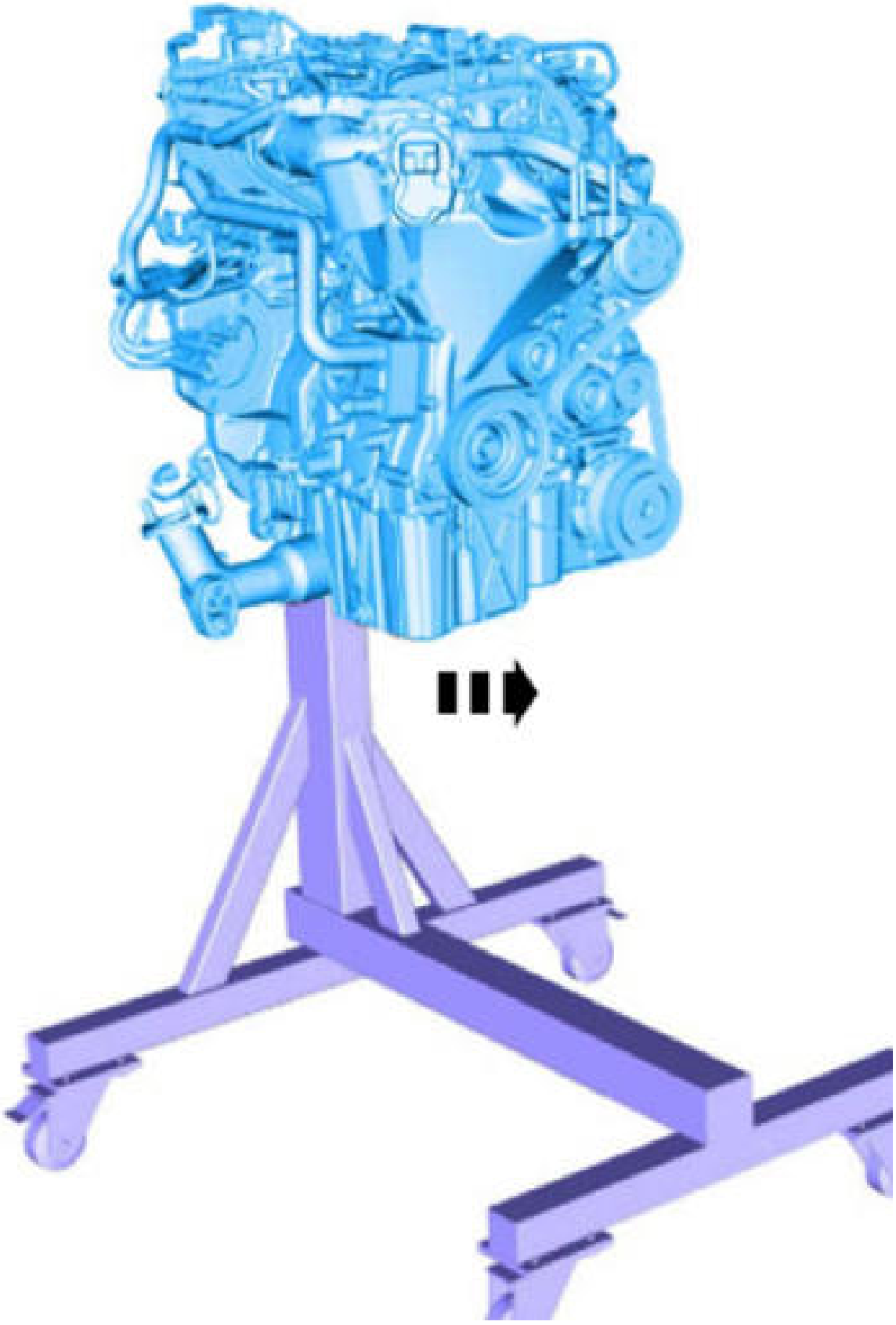
138. **NOTE:** **Only rotate the crankshaft clockwise.**

NOTE: **Make sure that the accessory drive belt is correctly located on each pulley.**



139. Remove Special Service Tool: **300-OTC1819E 2, 200# Floor Crane, Fold Away** .

140.



INSTALLATION

ENGINE

SPECIAL TOOL DESCRIPTION

	**300-OTC1585AE** Powertrain Lift
	**300-OTC1819E** 2, 200# Floor Crane, Fold Away

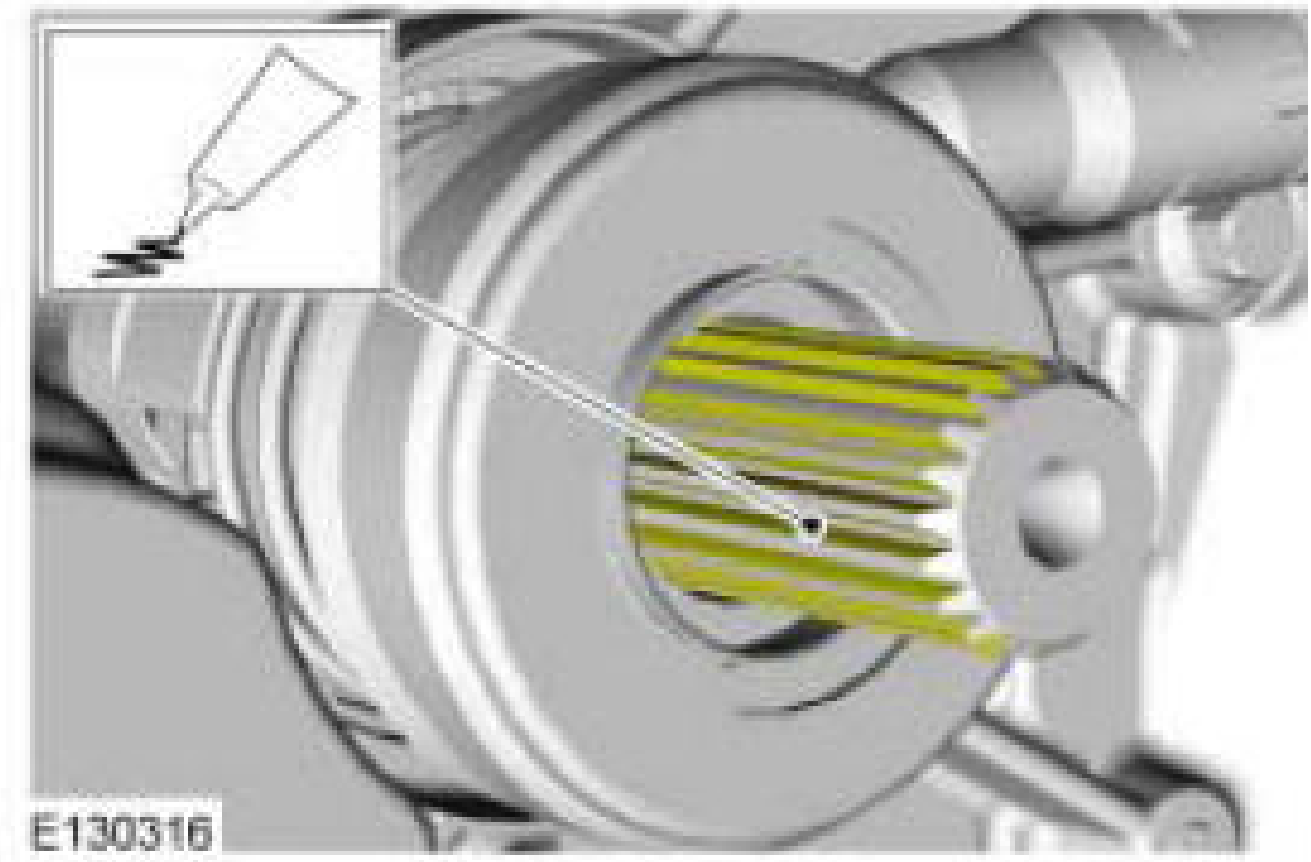
	308-848 Installer, Driveshaft Seal
Steering Wheel Holder	
Cable Ties	
Hose Clamp Remover/Installer	
Wooden Block	

MATERIAL SPECIFICATIONS

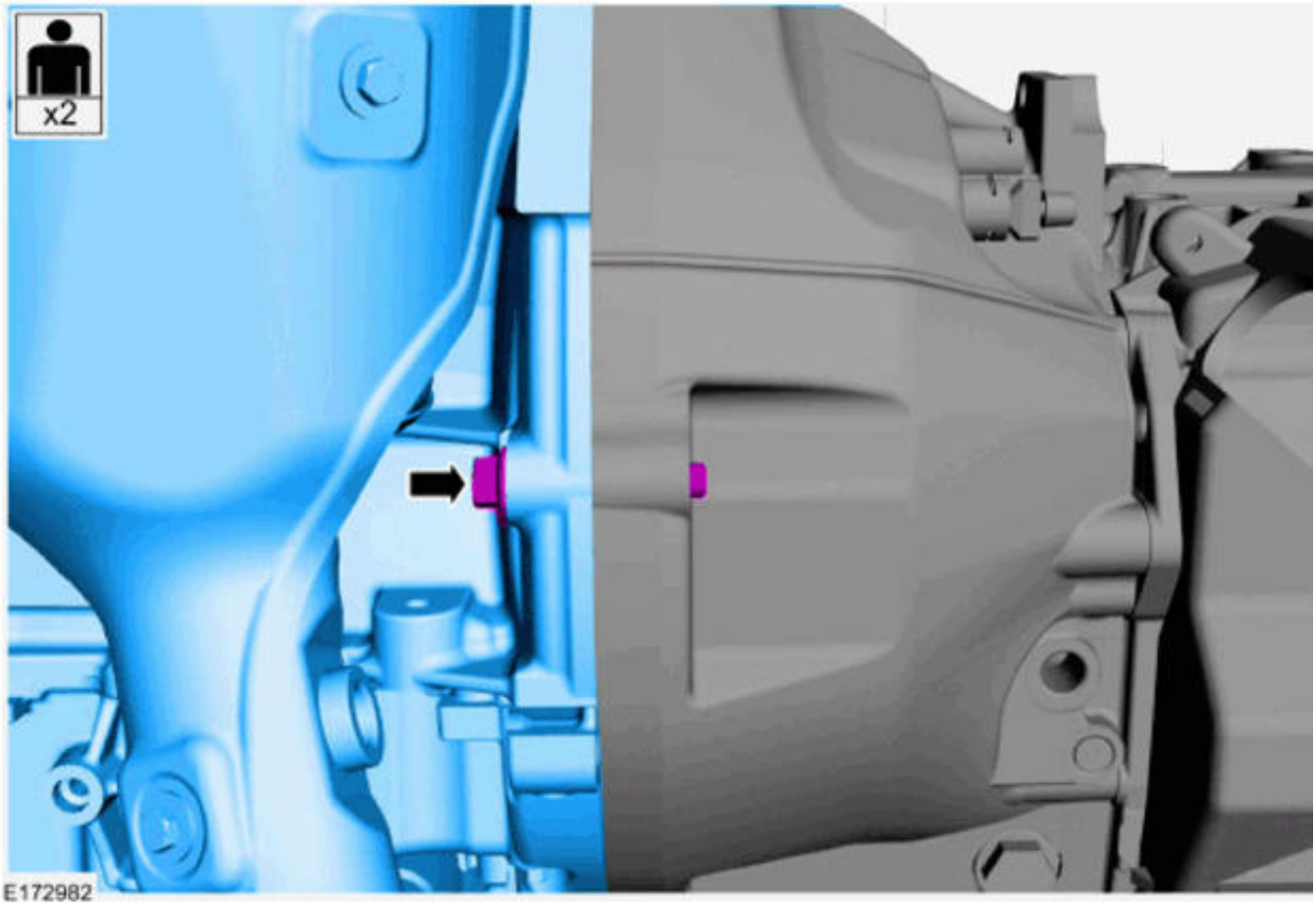
Name	Specification
High Temperature 4x4 Front Axle and Wheel Bearing Grease XG-11	WSS-M1C267-A1
Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.) XO-5W20-QSP (U.S.)	WSS-M2C945-A

1. Apply a thin coating.

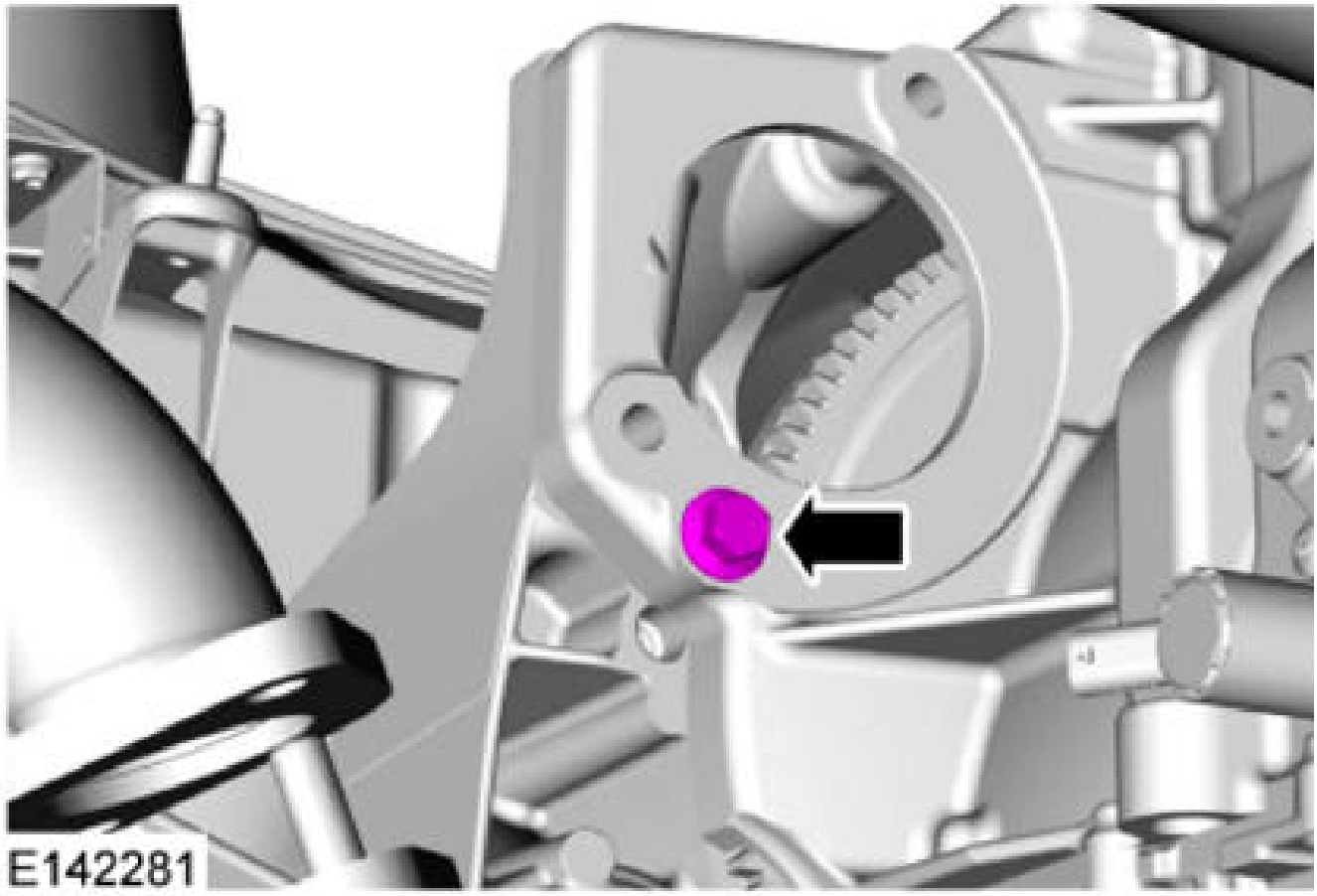
   Material : High Temperature 4x4 Front Axle and Wheel Bearing Grease/XG-11 (WSS-M1C267-A1)



2. *Torque* : 35 lb.ft (48 Nm)



3. *Torque* : 35 lb.ft (48 Nm)

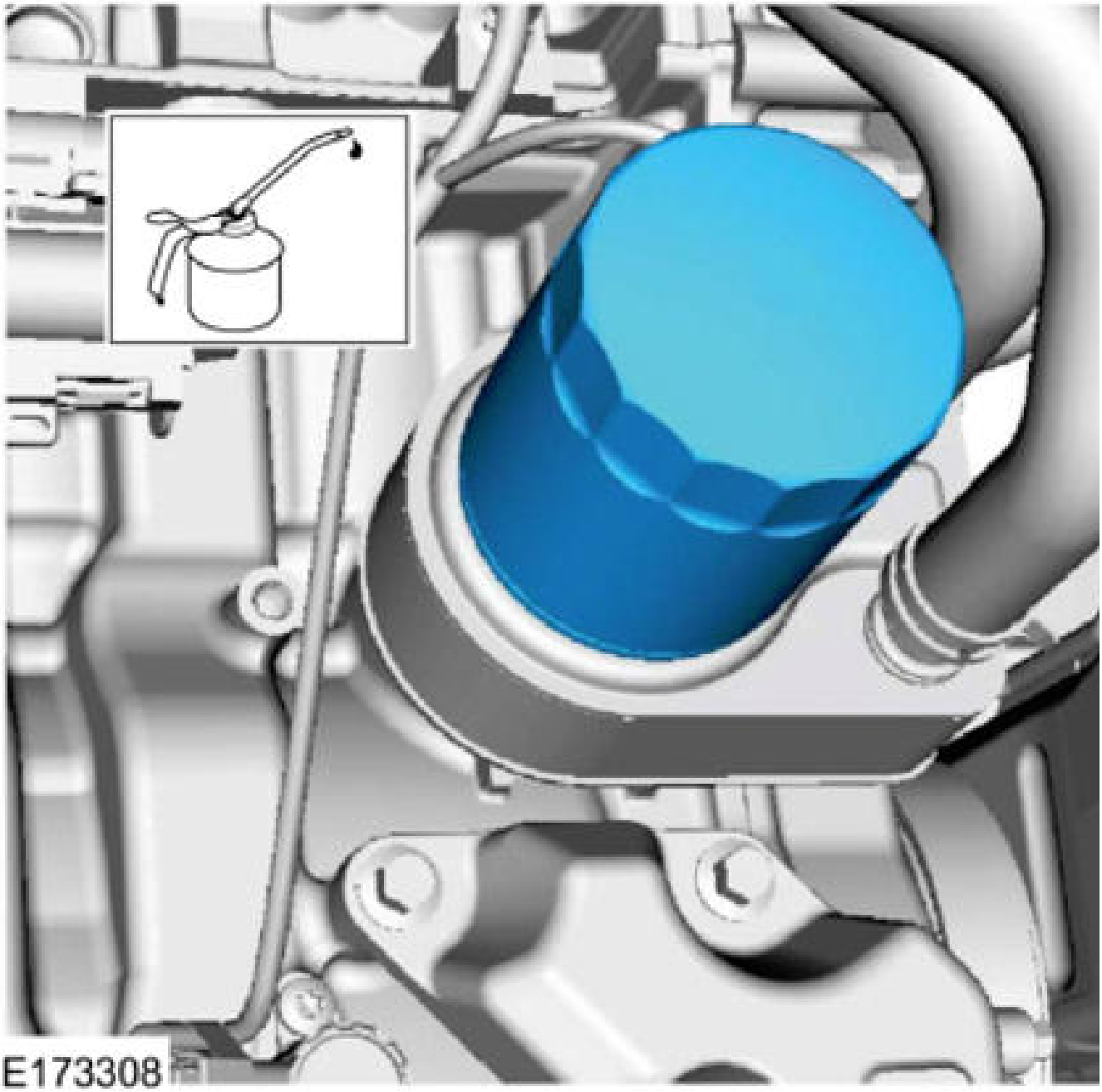


4. Remove Special Service Tool: **300-OTC1819E 2, 200# Floor Crane, Fold Away** .

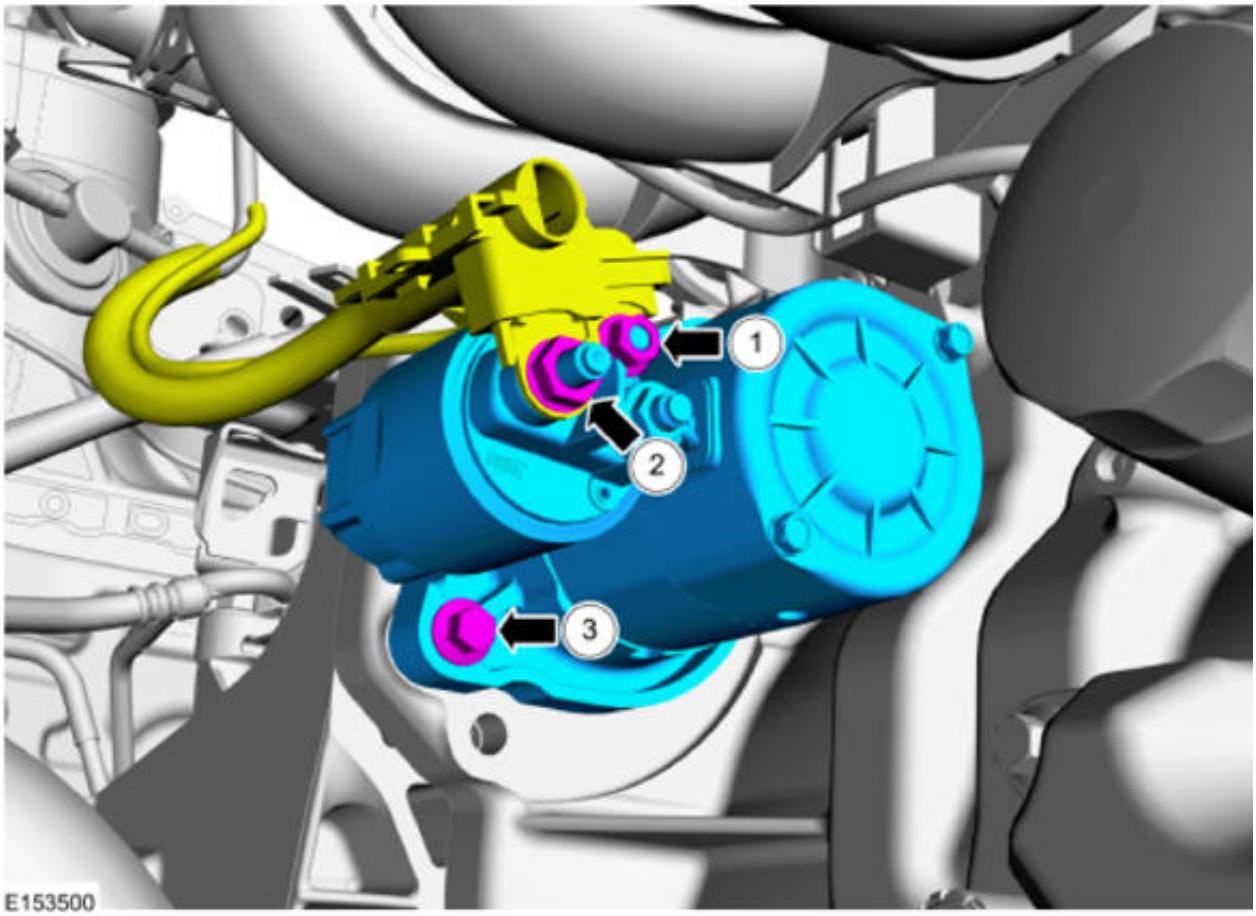
5. Lubricate seal.

   Material : Motorcraft® SAE 5W-20 Premium Synthetic Blend Motor Oil (U.S.)/XO-5W20-QSP (U.S.) (WSS-M2C945-A)

   Torque : 128 lb.in (14.5 Nm)

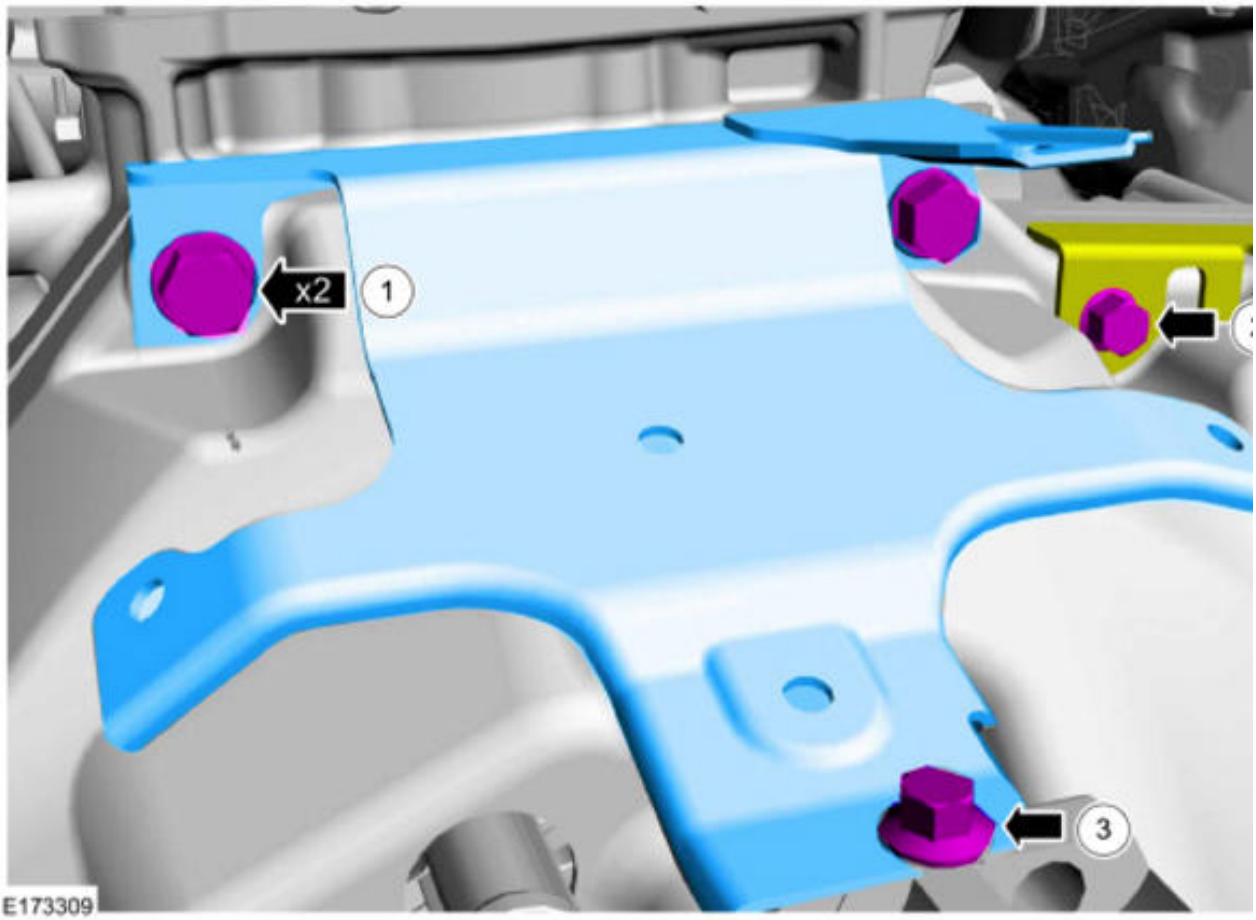


6. *Torque* :
    1. 53 lb.in (6 Nm)
    2. 106 lb.in (12 Nm)
    3. 26 lb.ft (35 Nm)

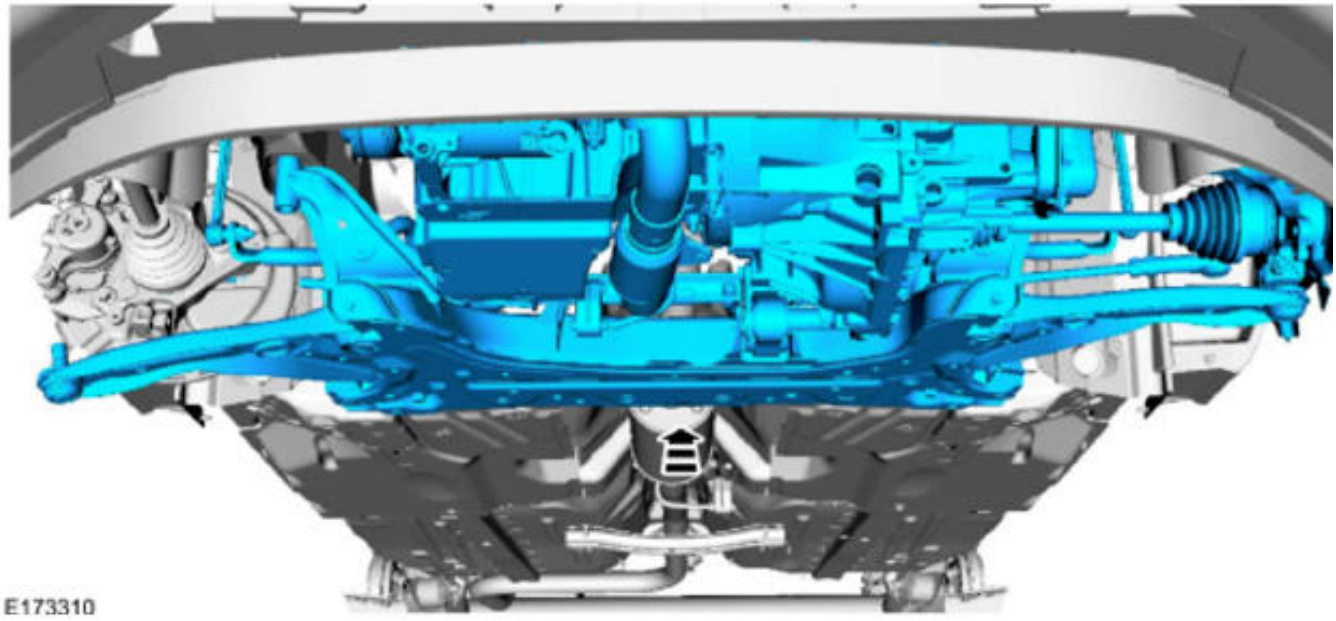


7. **NOTE: Wiring harness removed for clarity.**

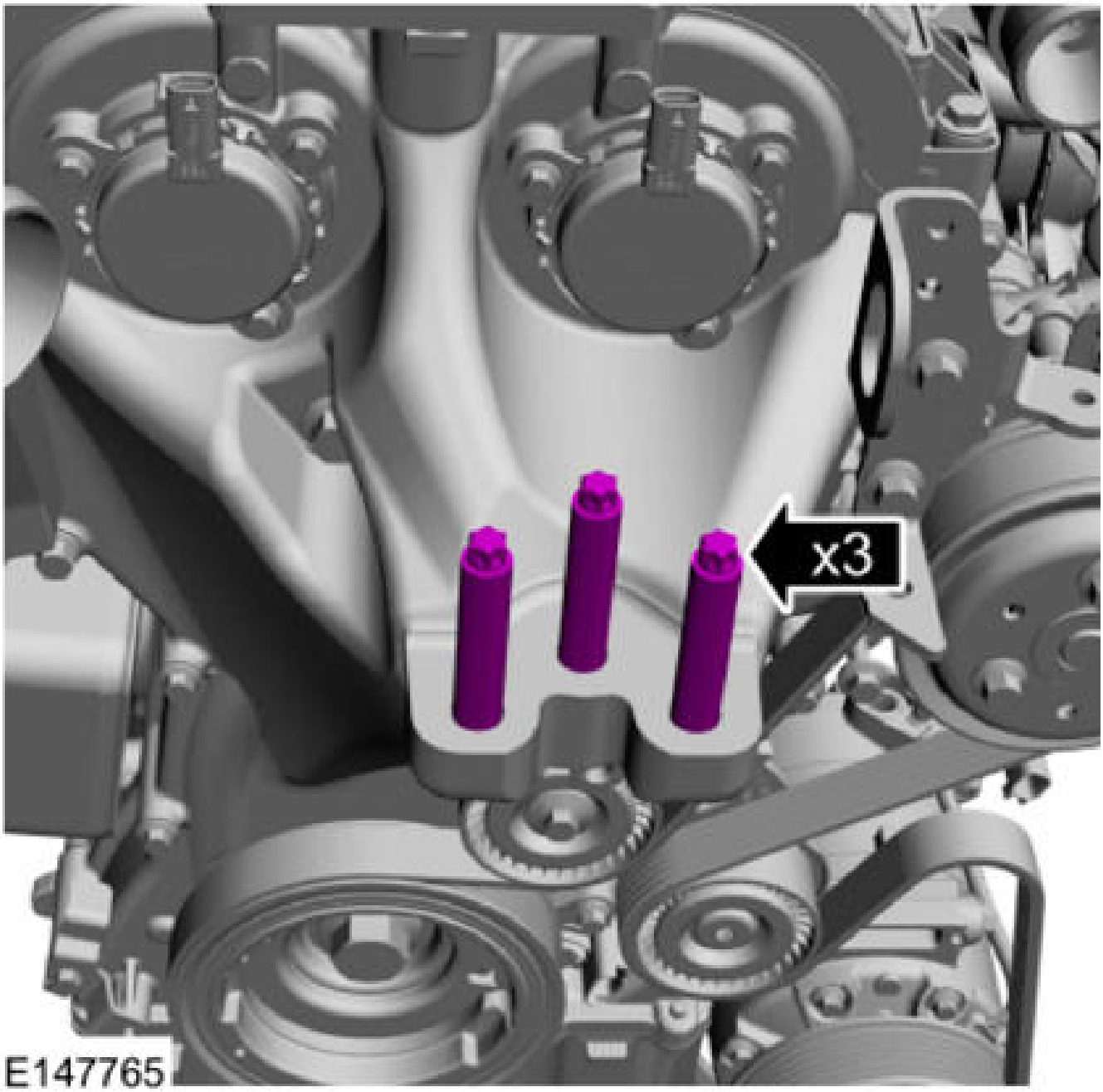
1. *Torque* : 35 lb.ft (48 Nm)
2. *Torque* : 26 lb.ft (35 Nm)
3. *Torque* : 106 lb.in (12 Nm)



8. Using the powertrain lift, raise the powertrain and subframe as an assembly into the vehicle.



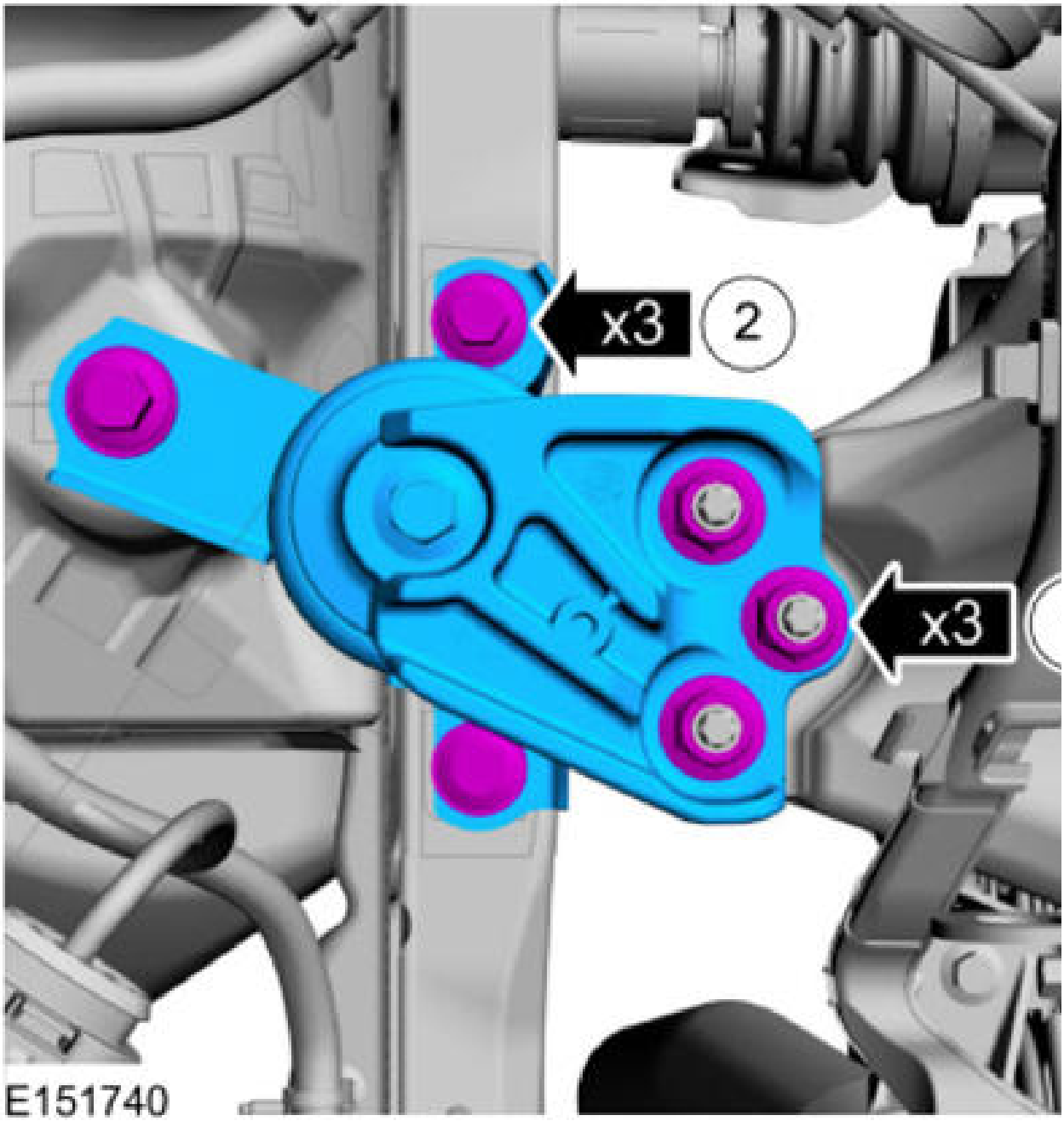
9. *Torque* : 89 lb.in (10 Nm)



10.

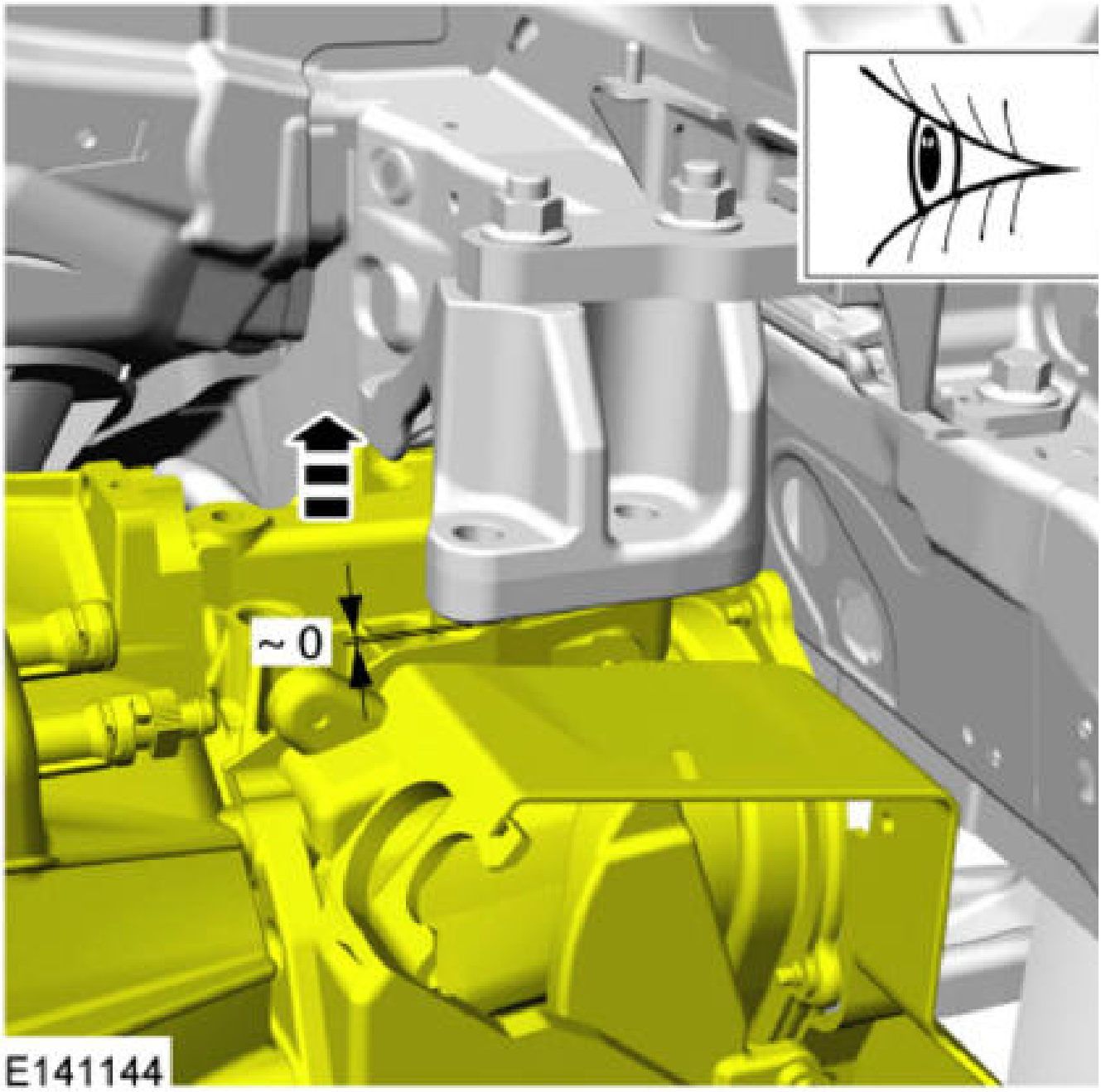
1. *Torque* : 59 lb.ft (80 Nm)
2.

NOTE: Only tighten the bolts finger tight at this stage.

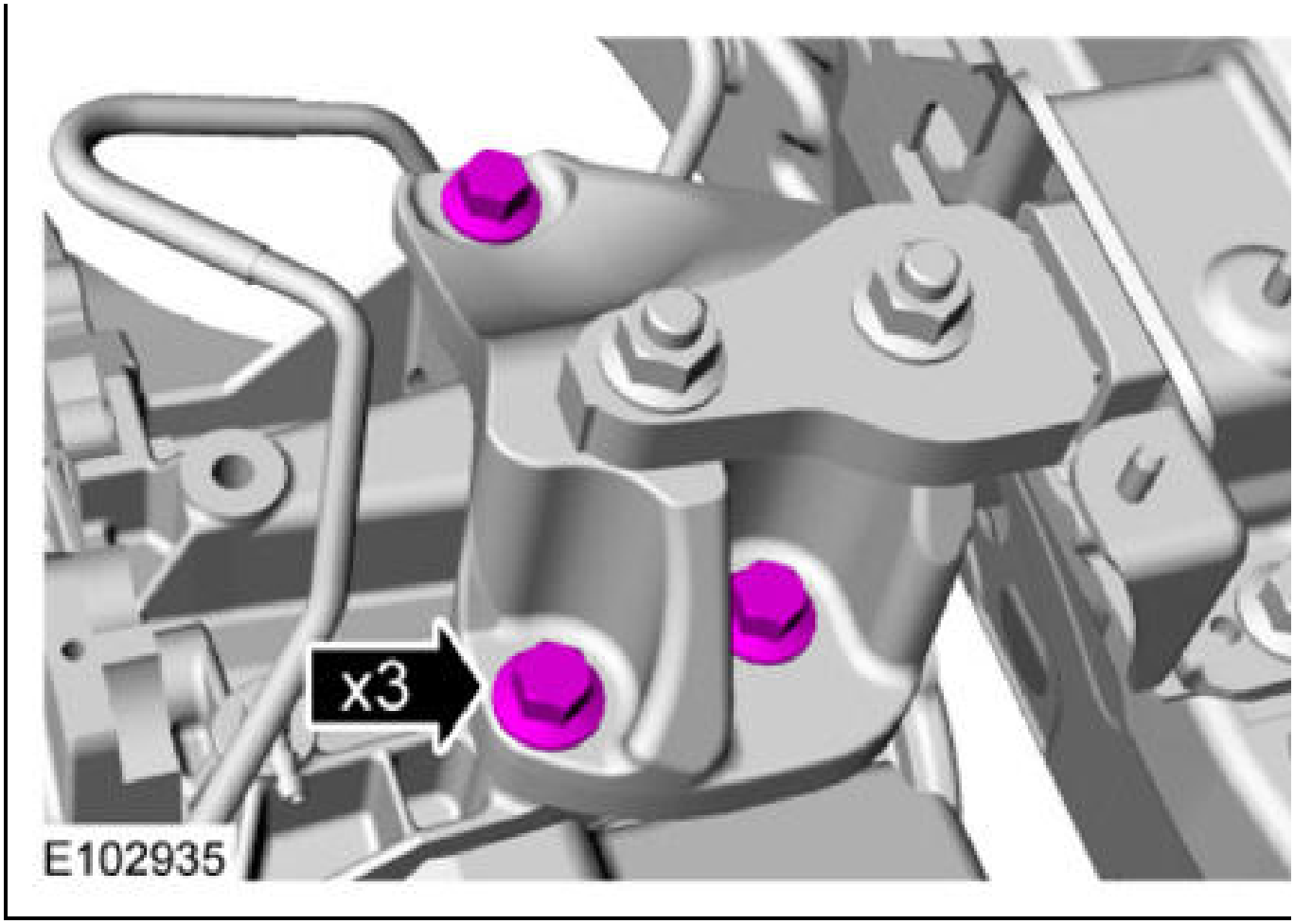


11.

11.



12. *Torque* : 59 lb.ft (80 Nm)

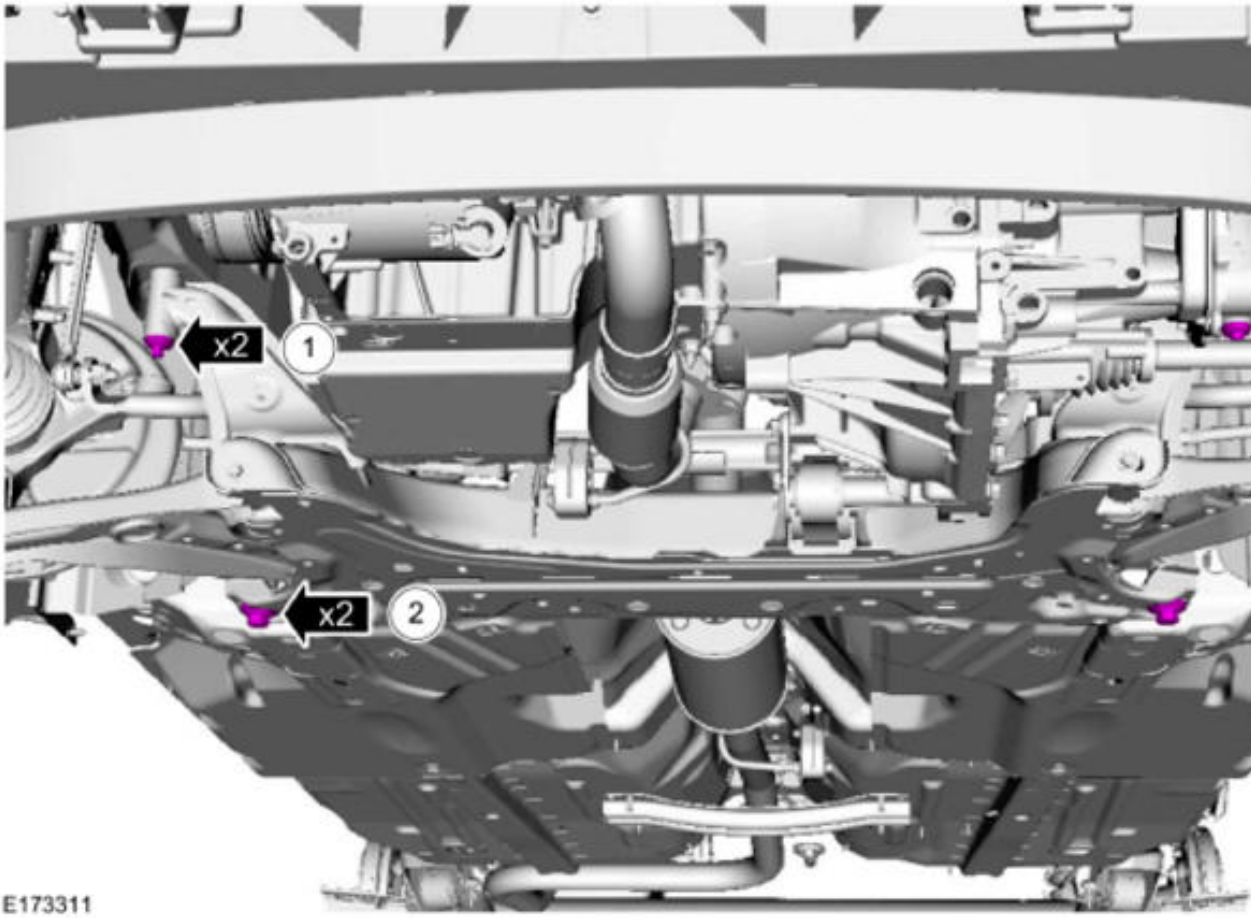


13. **NOTE: Align subframe to marks made during removal.**

1. *Torque* : 59 lb.ft (80 Nm)
2. *Torque* :

Stage 1: 74 lb.ft (100 Nm)

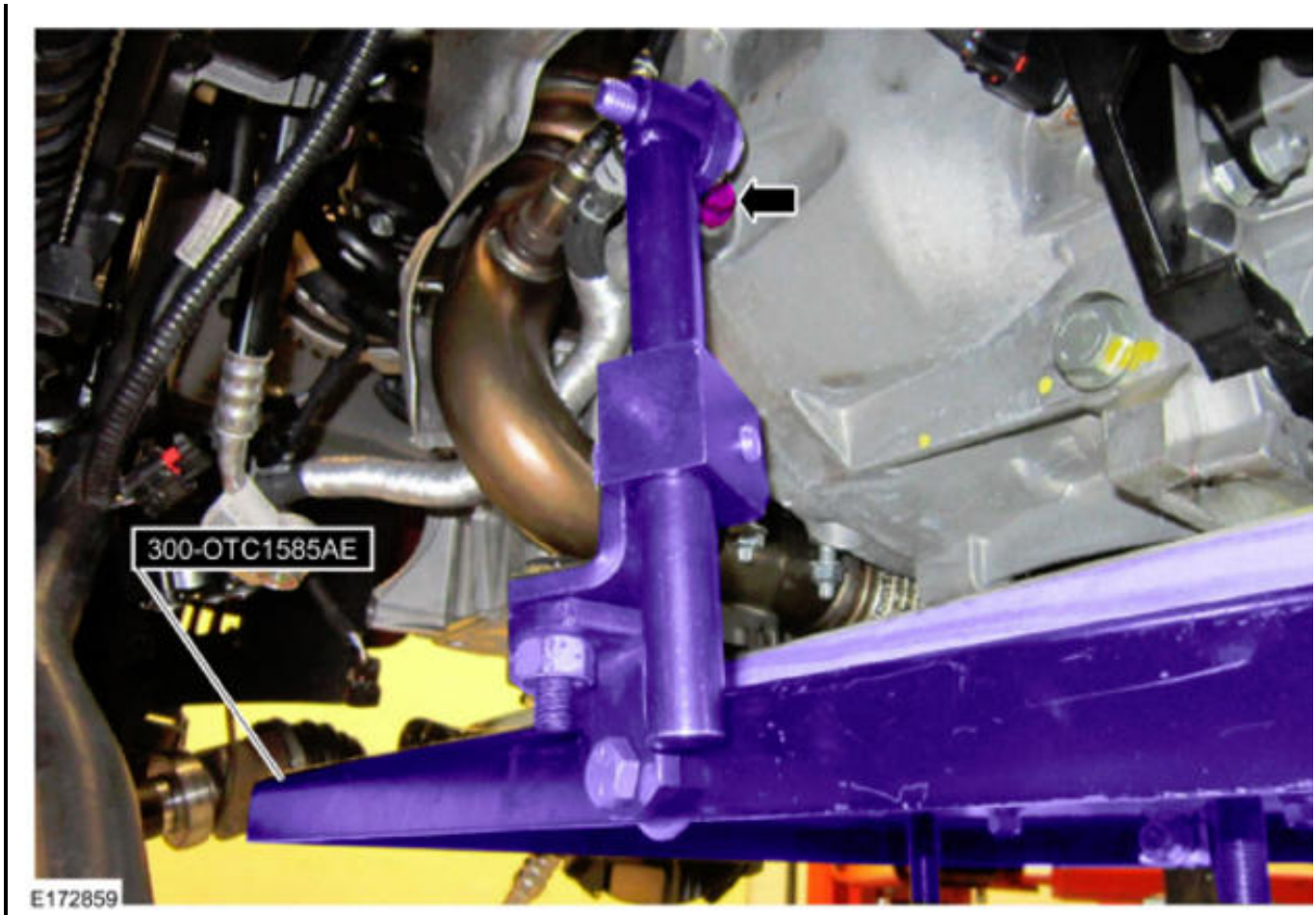
Stage 2: 240°



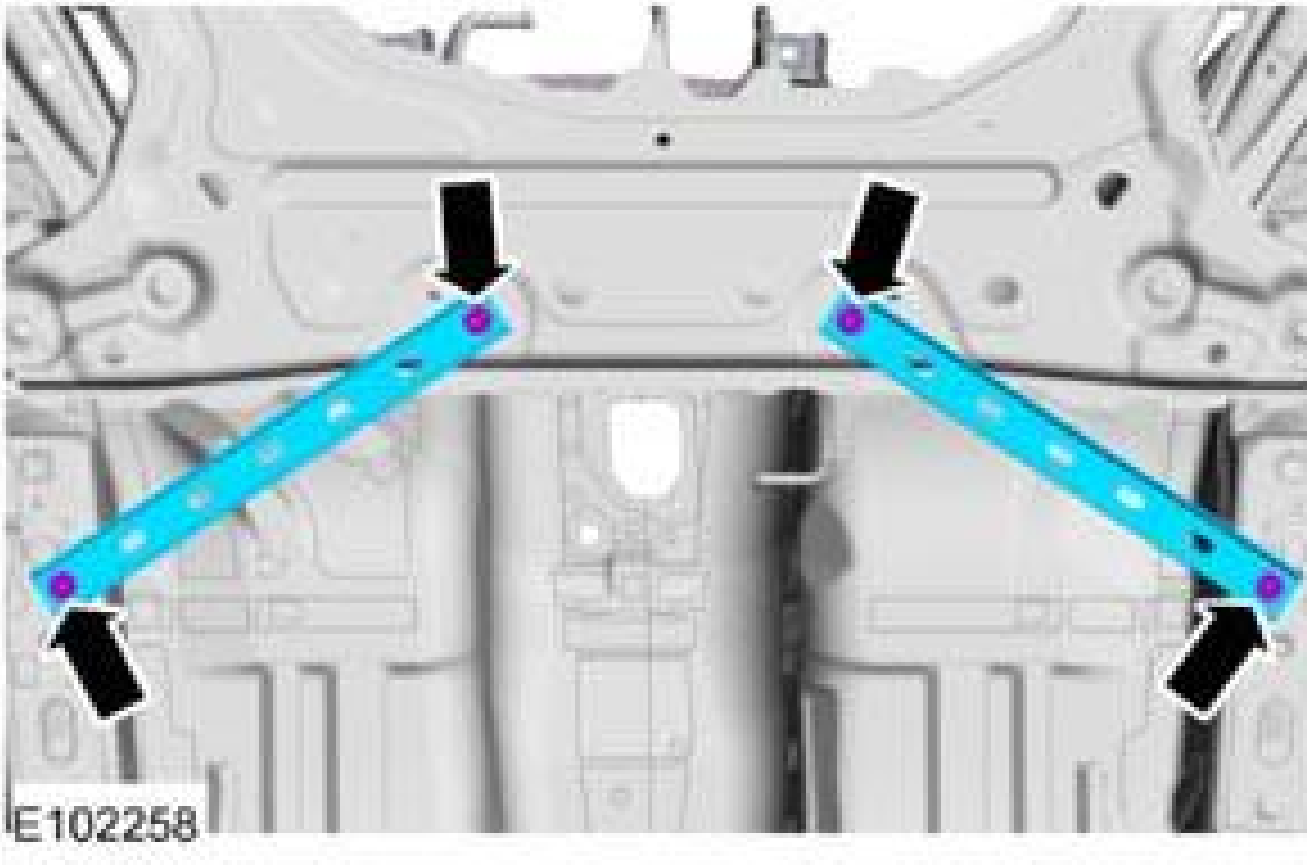
14. Remove Special Service Tool: **300-OTC1585AE Powertrain Lift** .

    Remove the General Equipment:

    Remove the General Equipment: Wooden Block



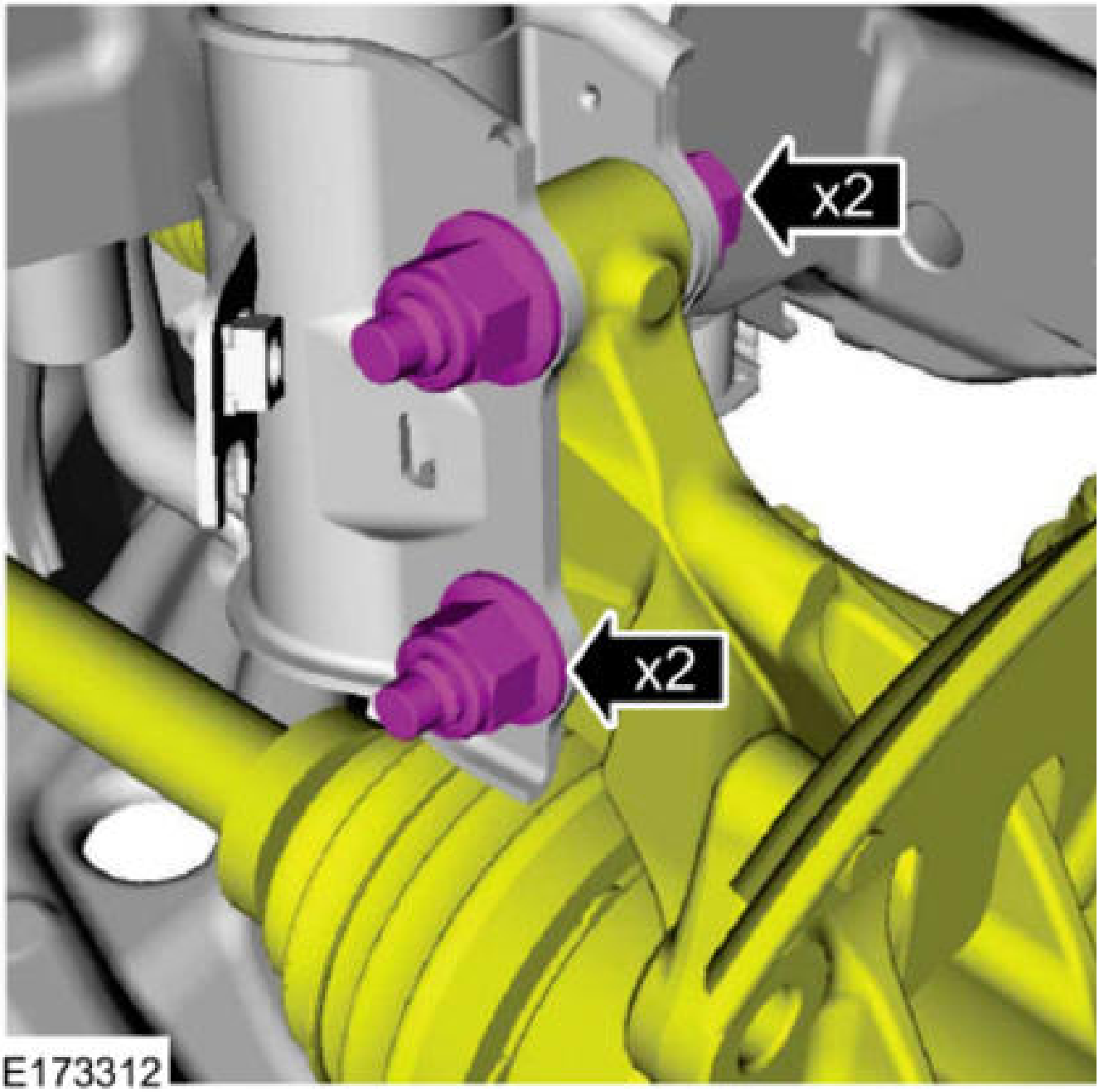
15. *Torque* : 35 lb.ft (48 Nm)



16. *Torque* :

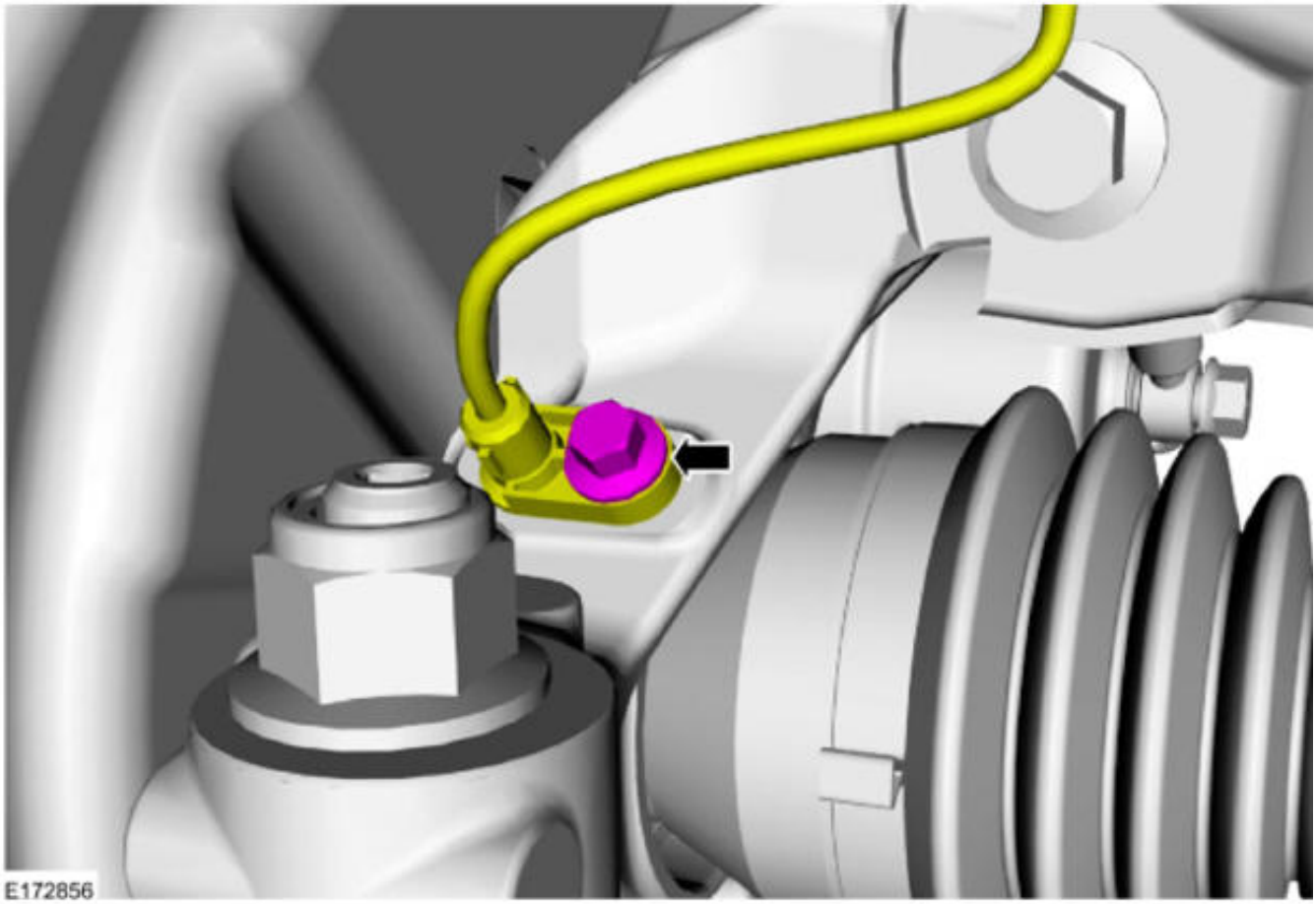
    Stage 1: 60 lb.ft (82 Nm)

    Stage 2: 90°



17. **NOTE: Make sure that the sensor housing is clean and free of foreign material.**

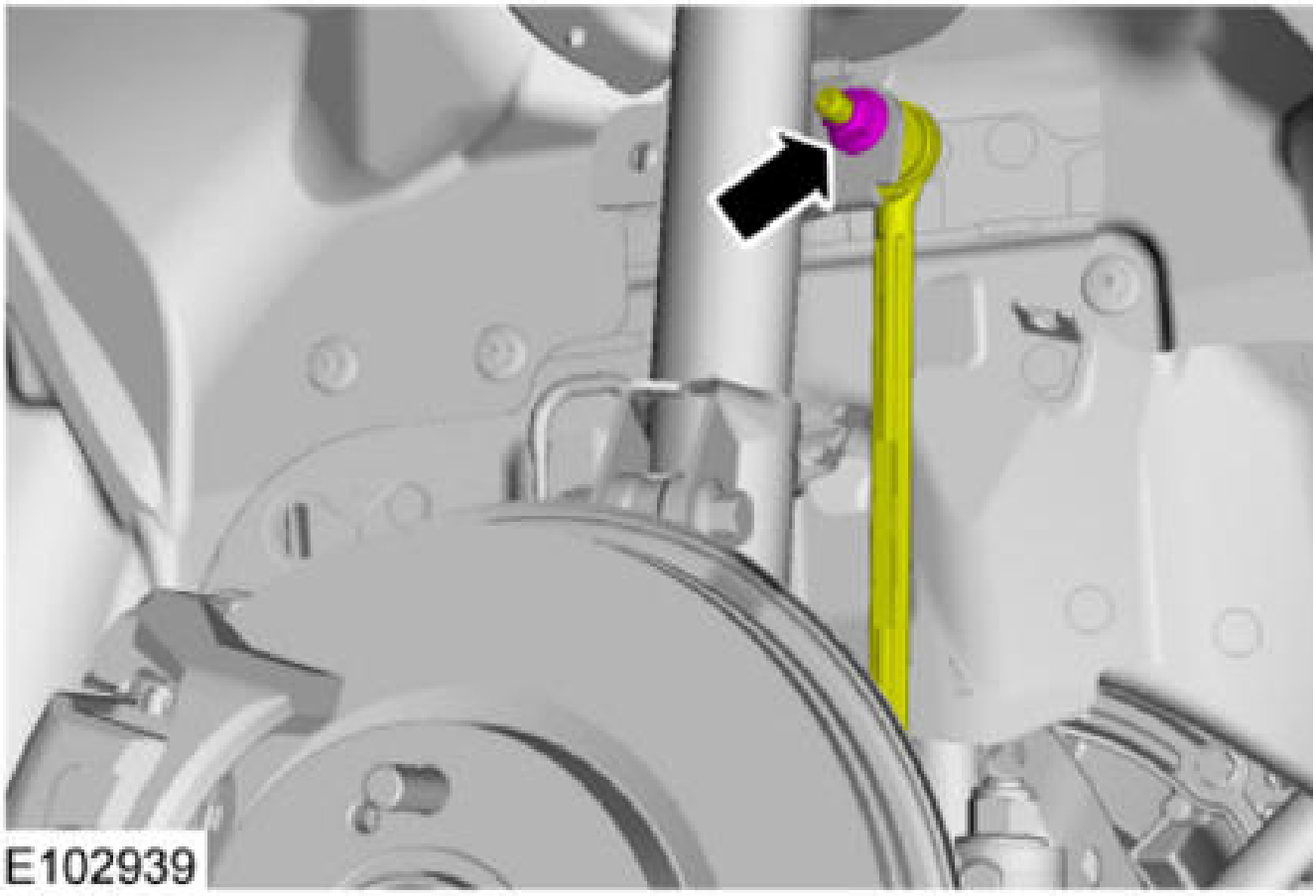
Torque : 80 lb.in (9 Nm)



18. Install **LH** brake disc.

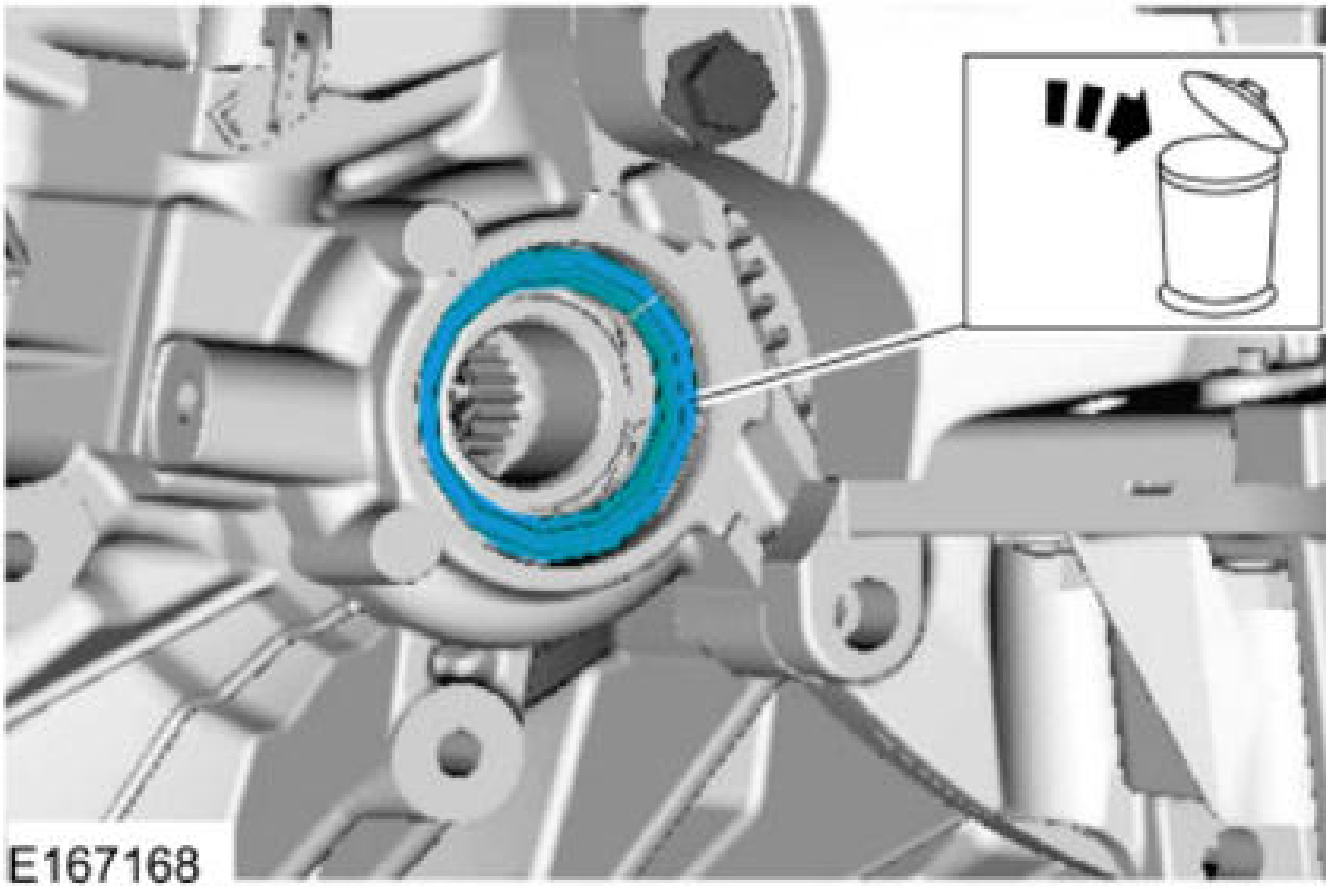
    Refer to: **BRAKE DISC** .

19. *Torque* : 35 lb.ft (48 Nm)

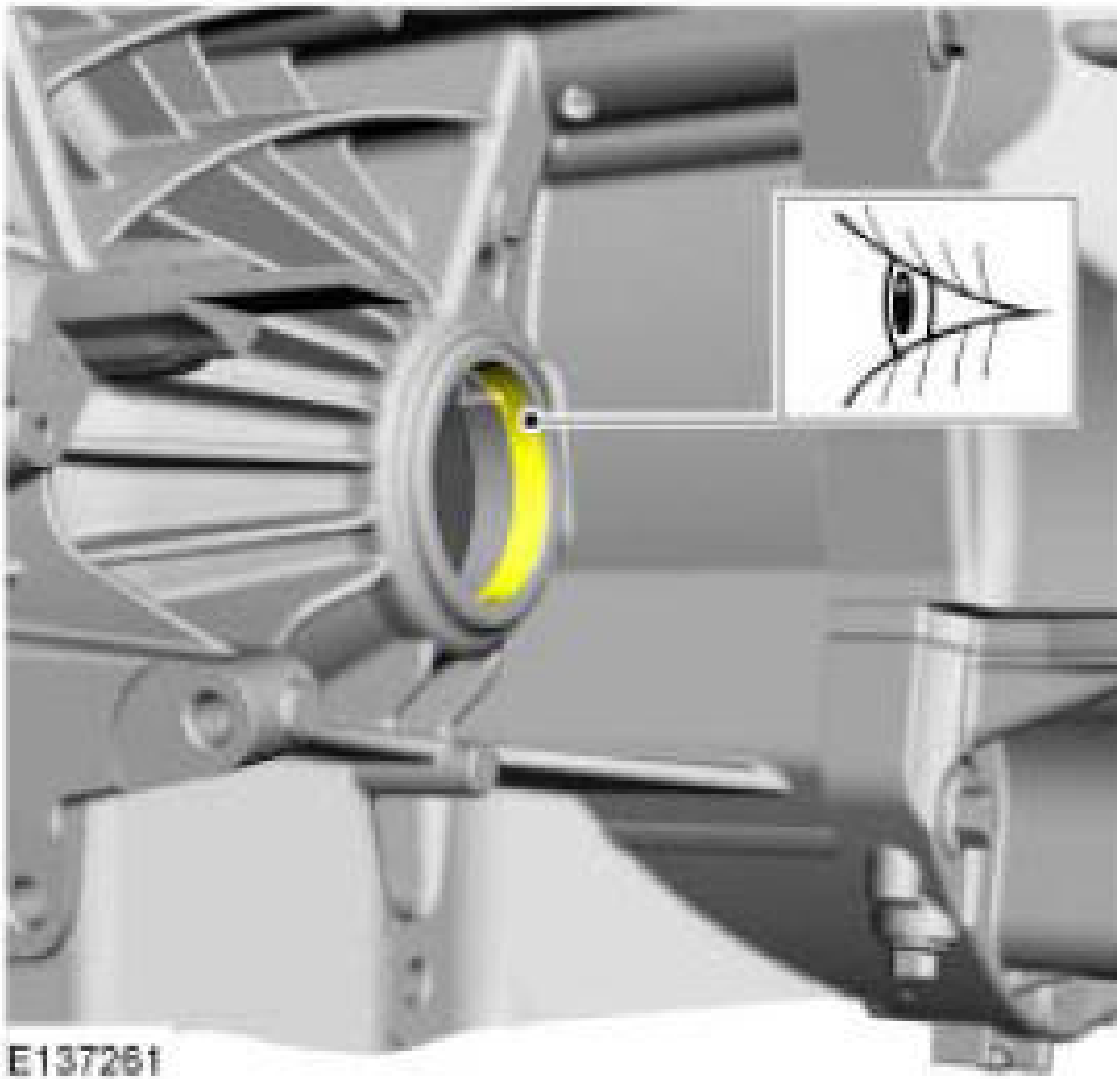


20.

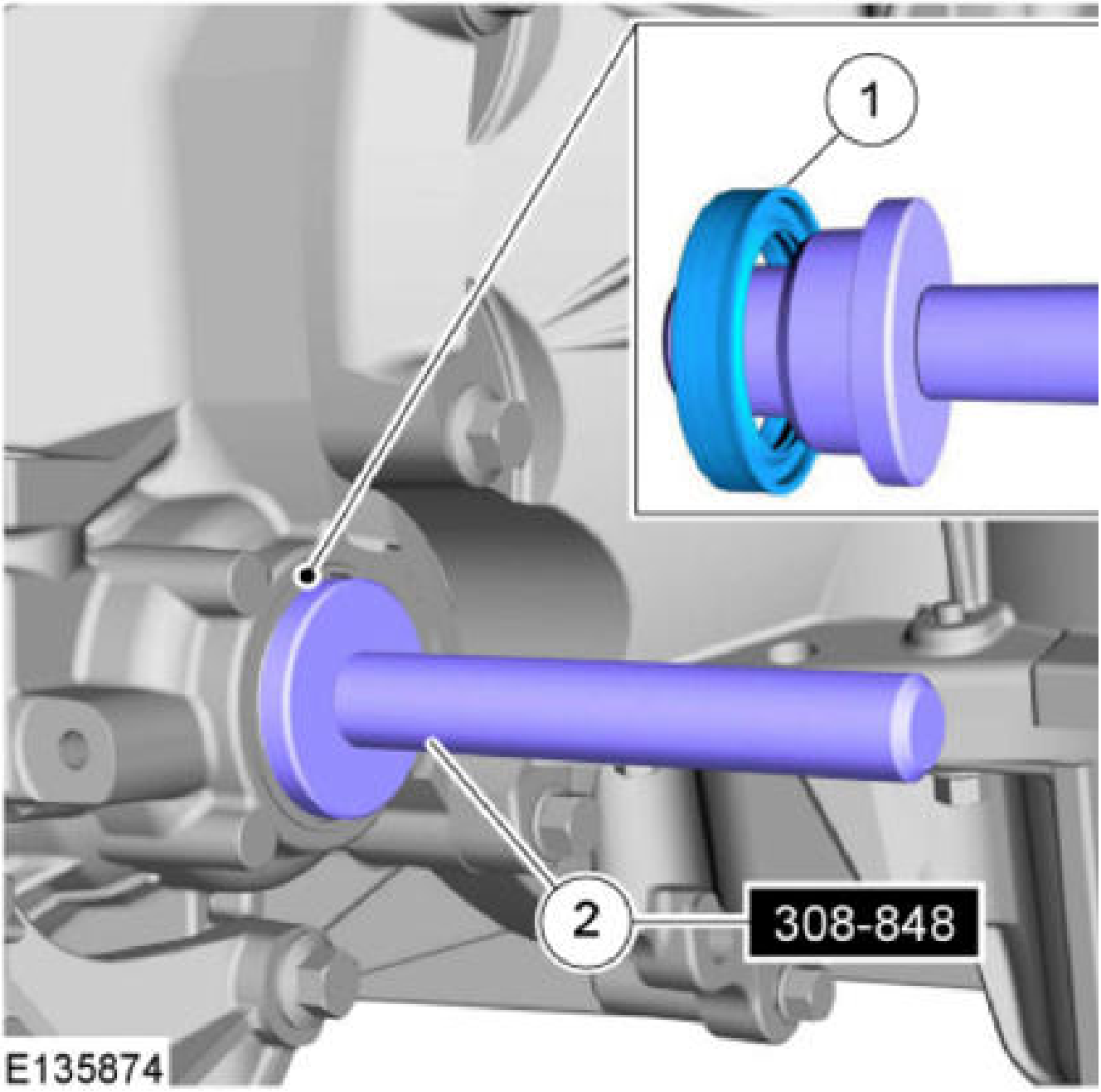
20.



21. **NOTE: Make sure that the mating faces are clean and free of corrosion and foreign material.**

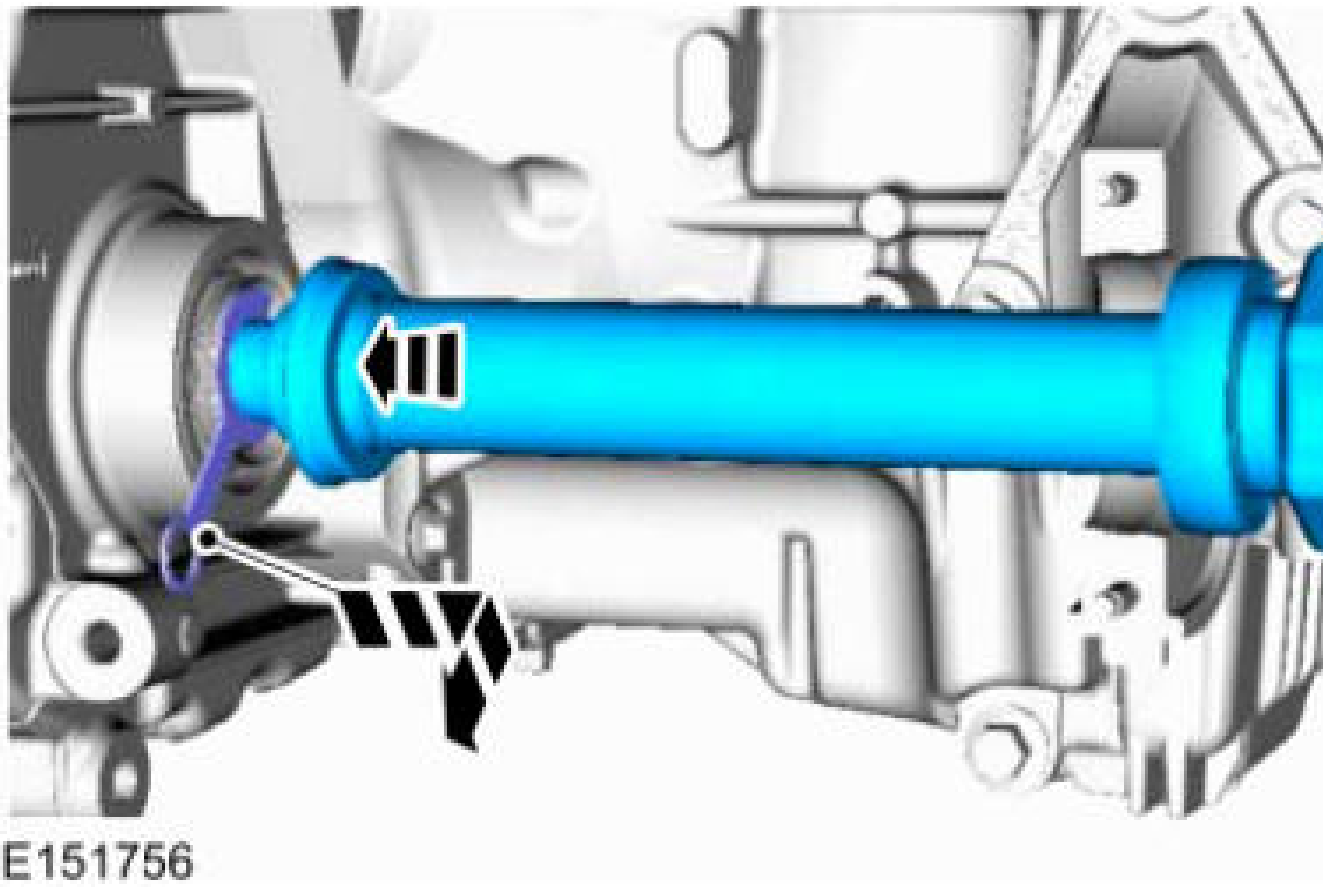


22. Use Special Service Tool: 308-848 Installer, Driveshaft Seal.



23. **NOTE: Do not fully install the shaft at this time.**

Using part: 97ZT-7M181-A.



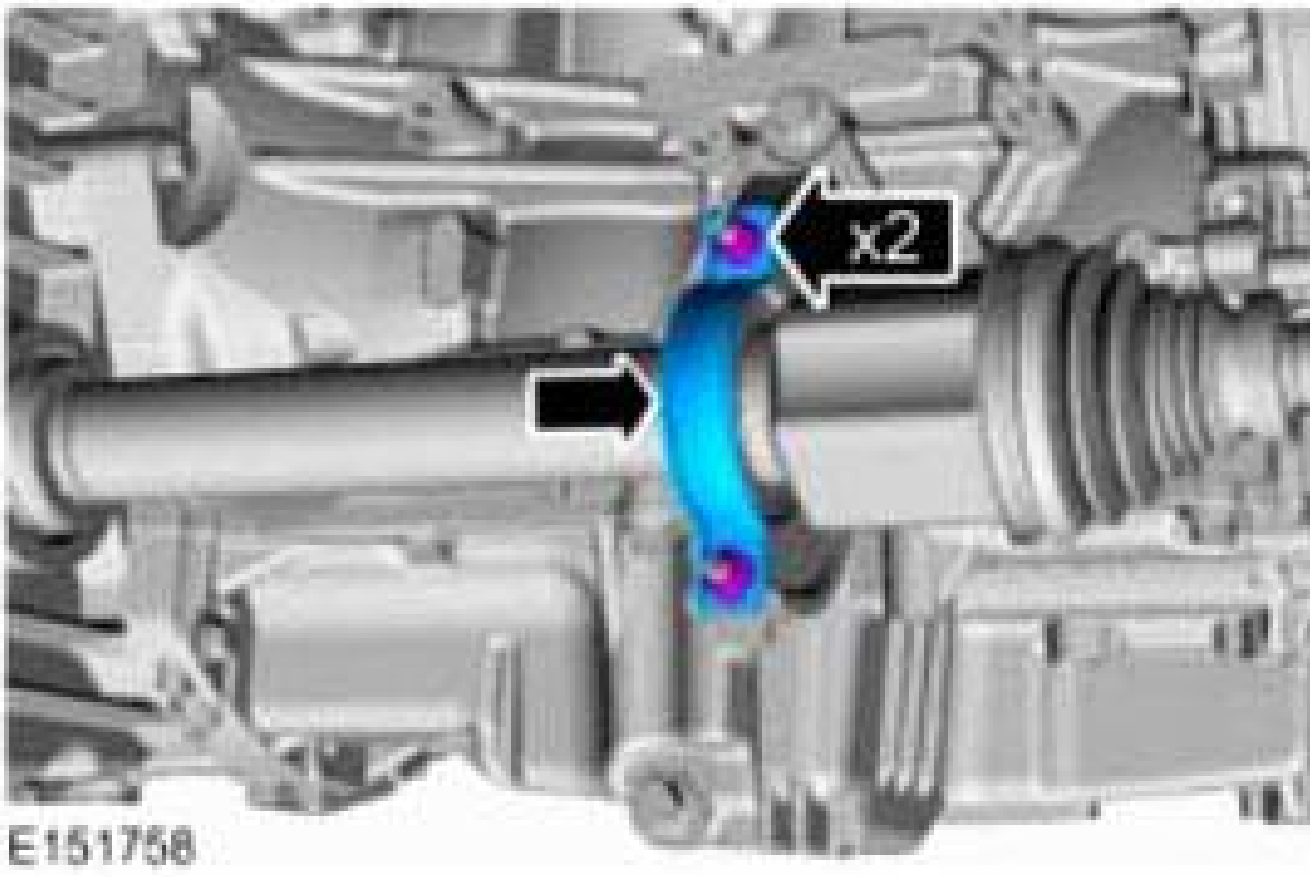
24. **NOTE: Insert the intermediate shaft until the intermediate shaft bearing is centered in the concave groove of the intermediate shaft bearing bracket.**

25. *Torque* :

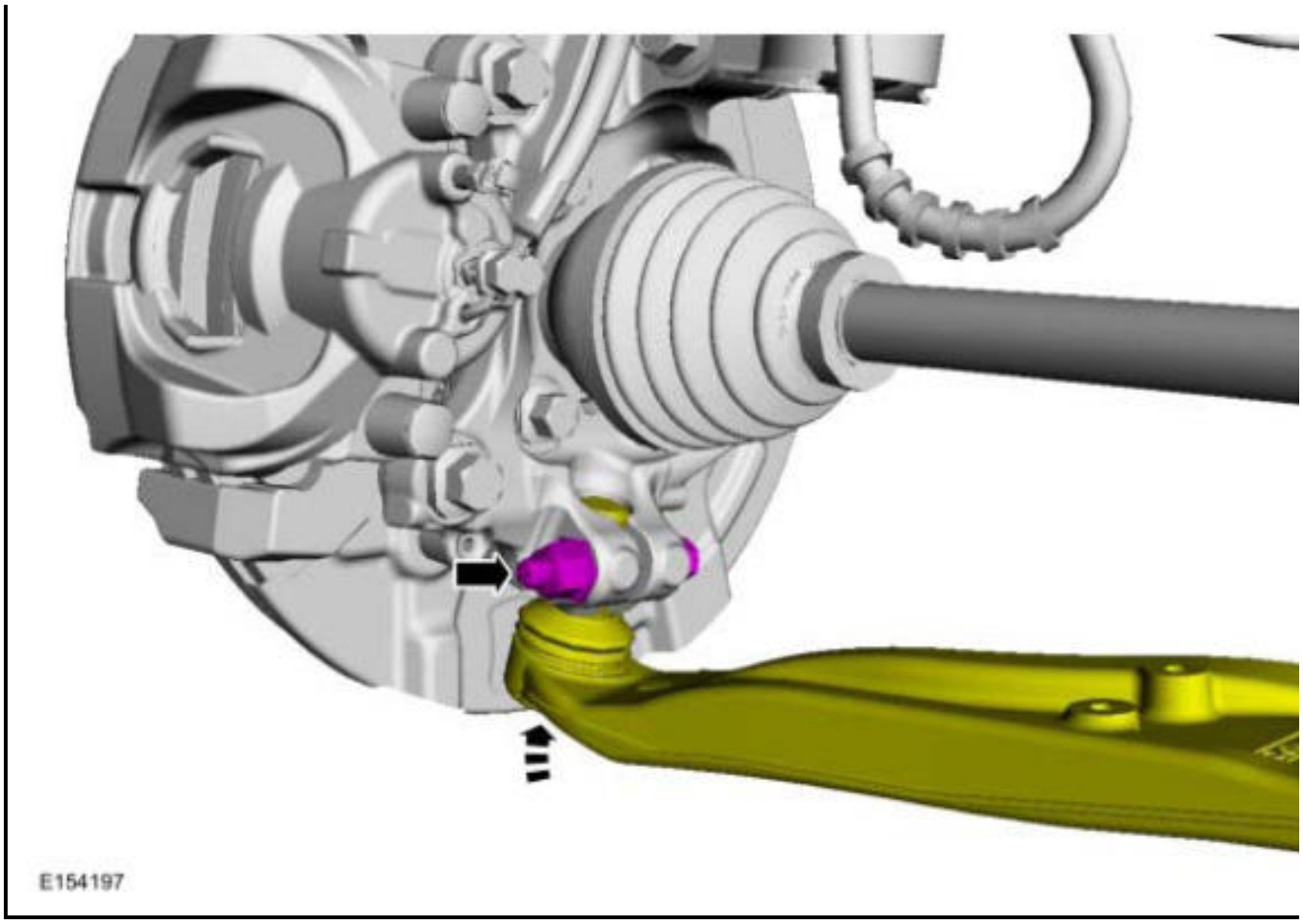
    Stage 1: 44 lb.in (5 Nm)

    Stage 2: 18 lb.ft (24 Nm)

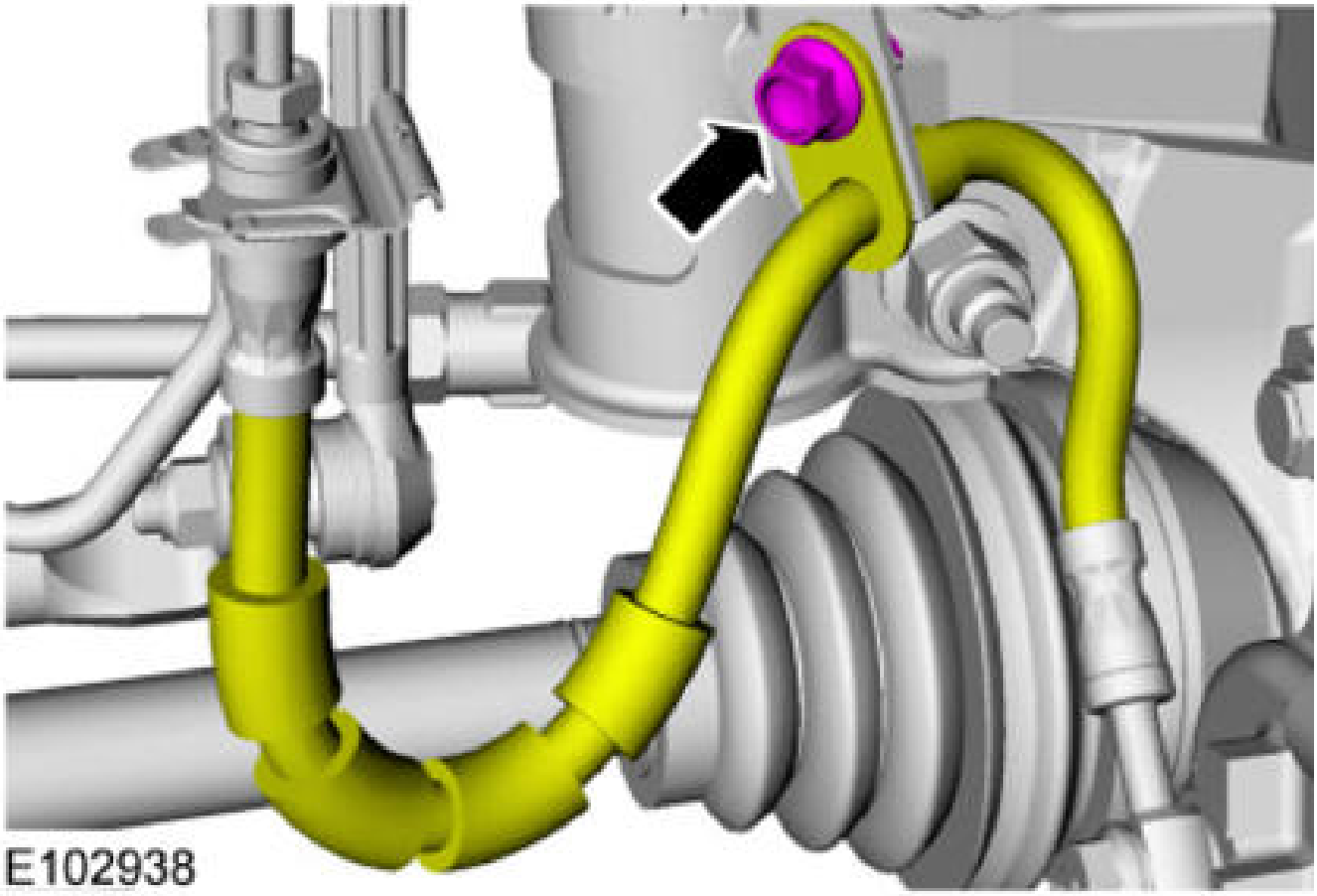
    Stage 3: 18 lb.ft (24 Nm)



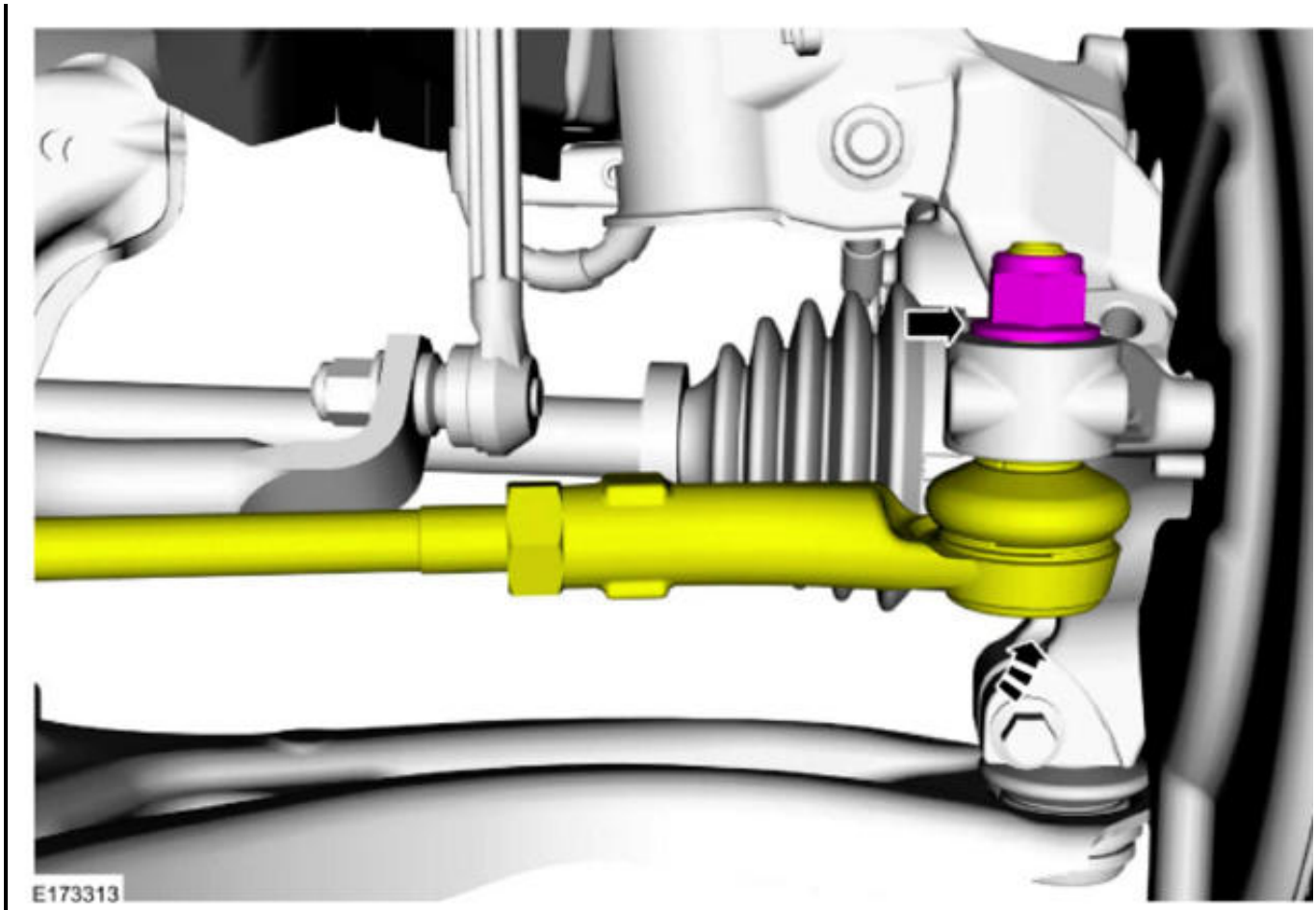
26. *Torque* : 38 lb.ft (52 Nm)



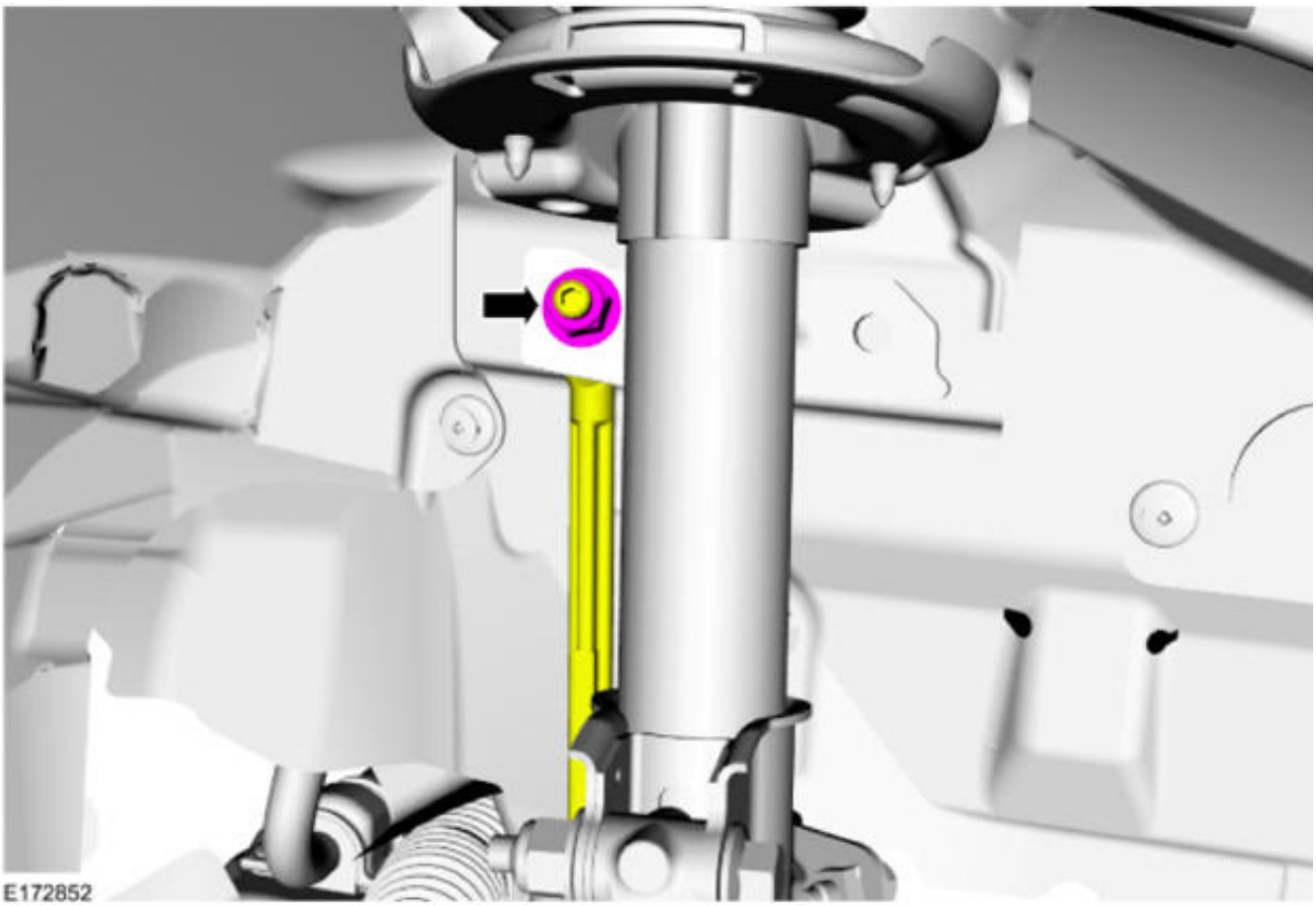
27. *Torque* : 19 lb.ft (26 Nm)



28. *Torque* : 39 lb.ft (53 Nm)



29. *Torque* : 35 lb.ft (48 Nm)

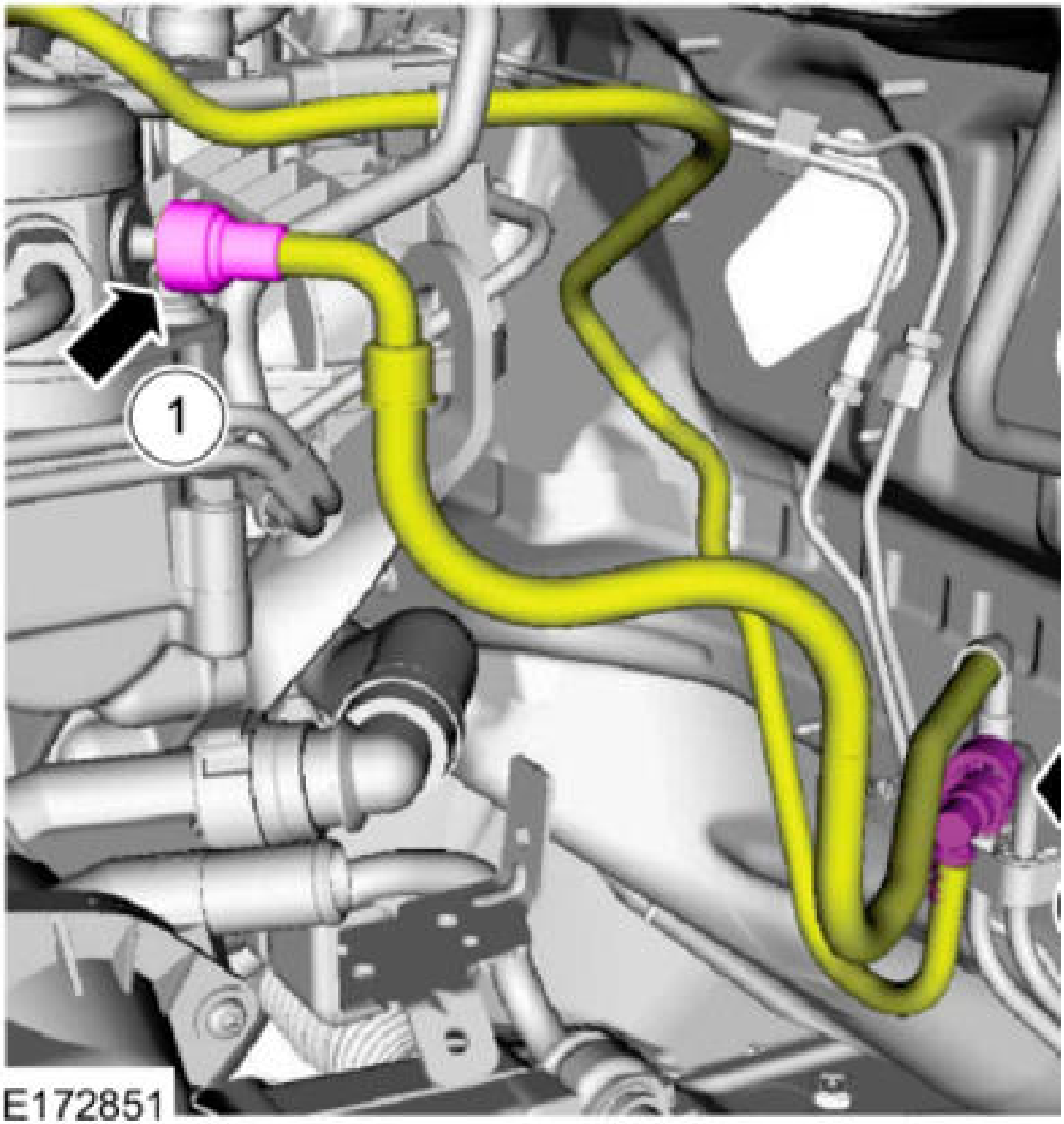


30. Front **RH** and **LH** .

    Refer to: **WHEEL AND TIRE** .

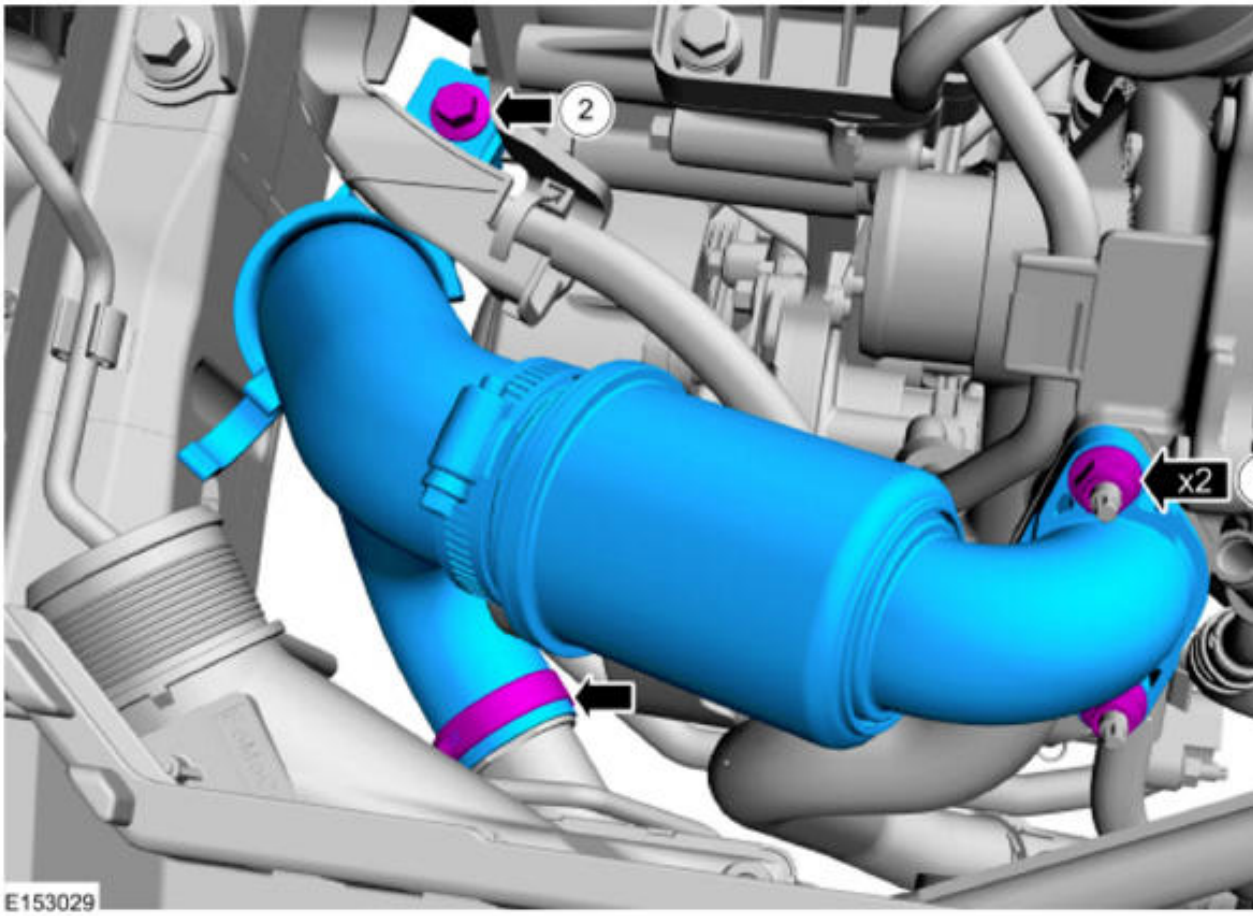
31.

    1. Refer to: **SPRING LOCK COUPLINGS** .
    2. Refer to: **QUICK RELEASE COUPLING** .



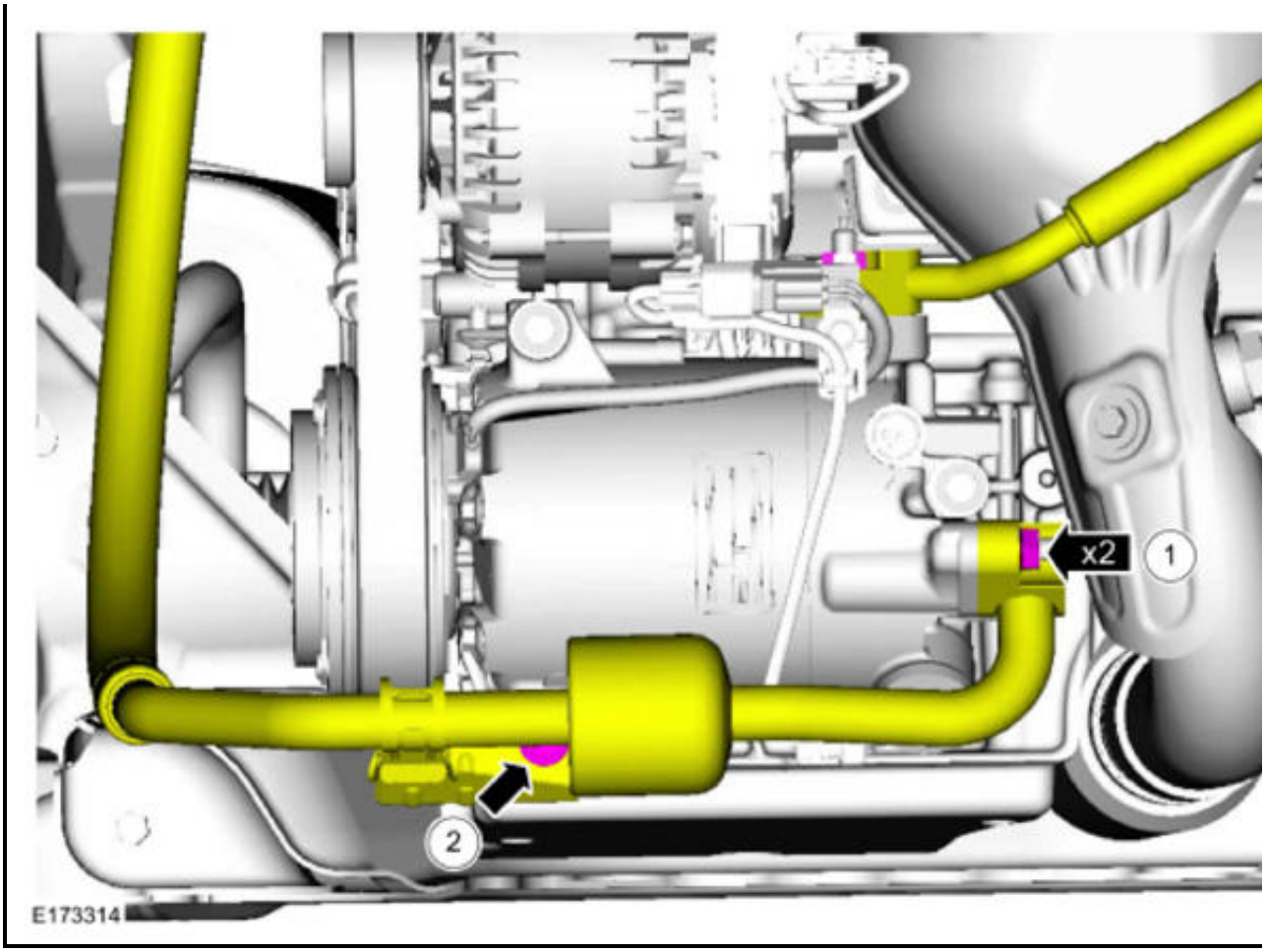
32.

1. *Torque* : 89 lb.in (10 Nm)
2. *Torque* : 106 lb.in (12 Nm)

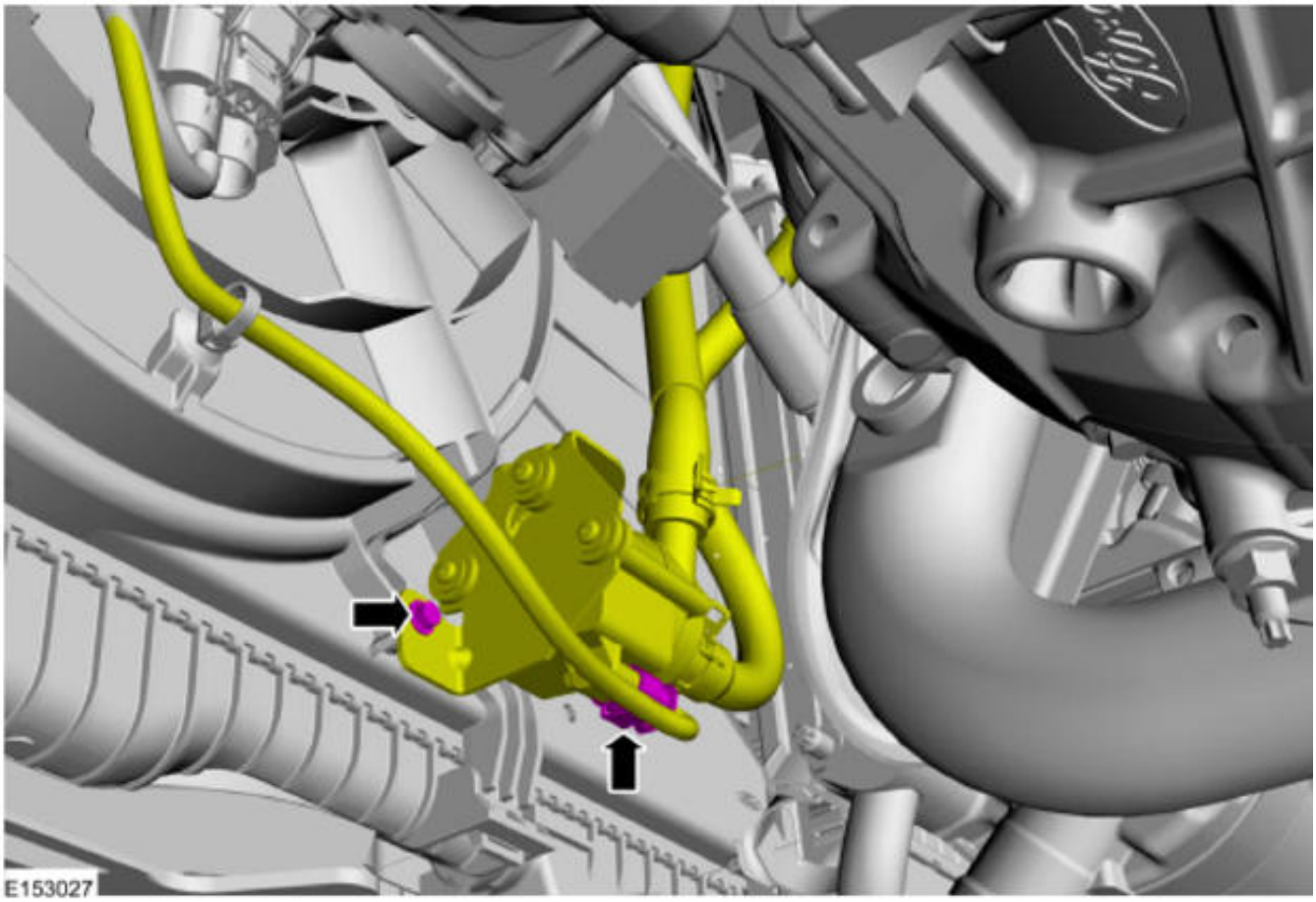


33.

1. *Torque* : 133 lb.in (15 Nm)
2. *Torque* : 18 lb.ft (25 Nm)

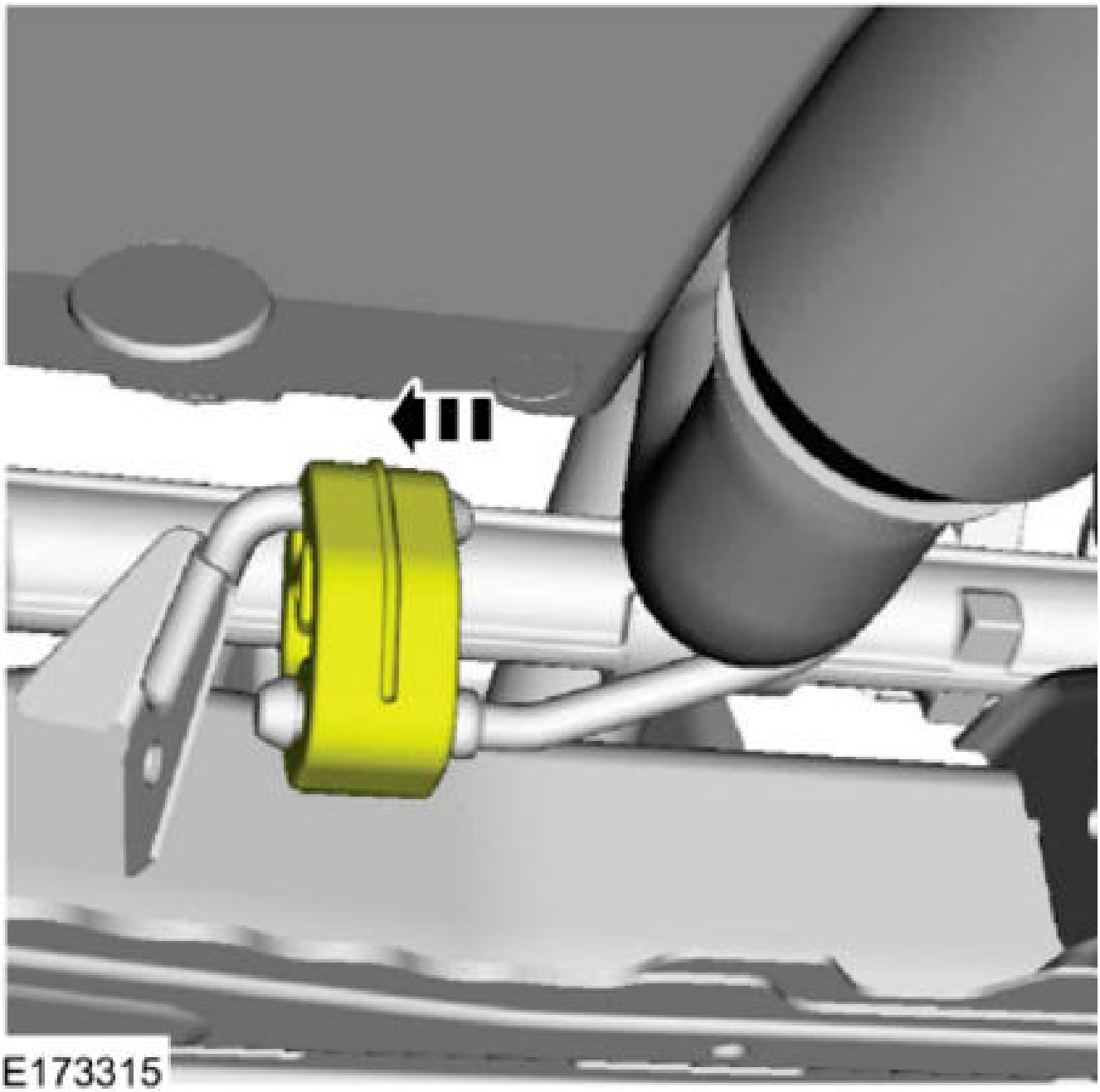


34. *Torque* : 89 lb.in (10 Nm)

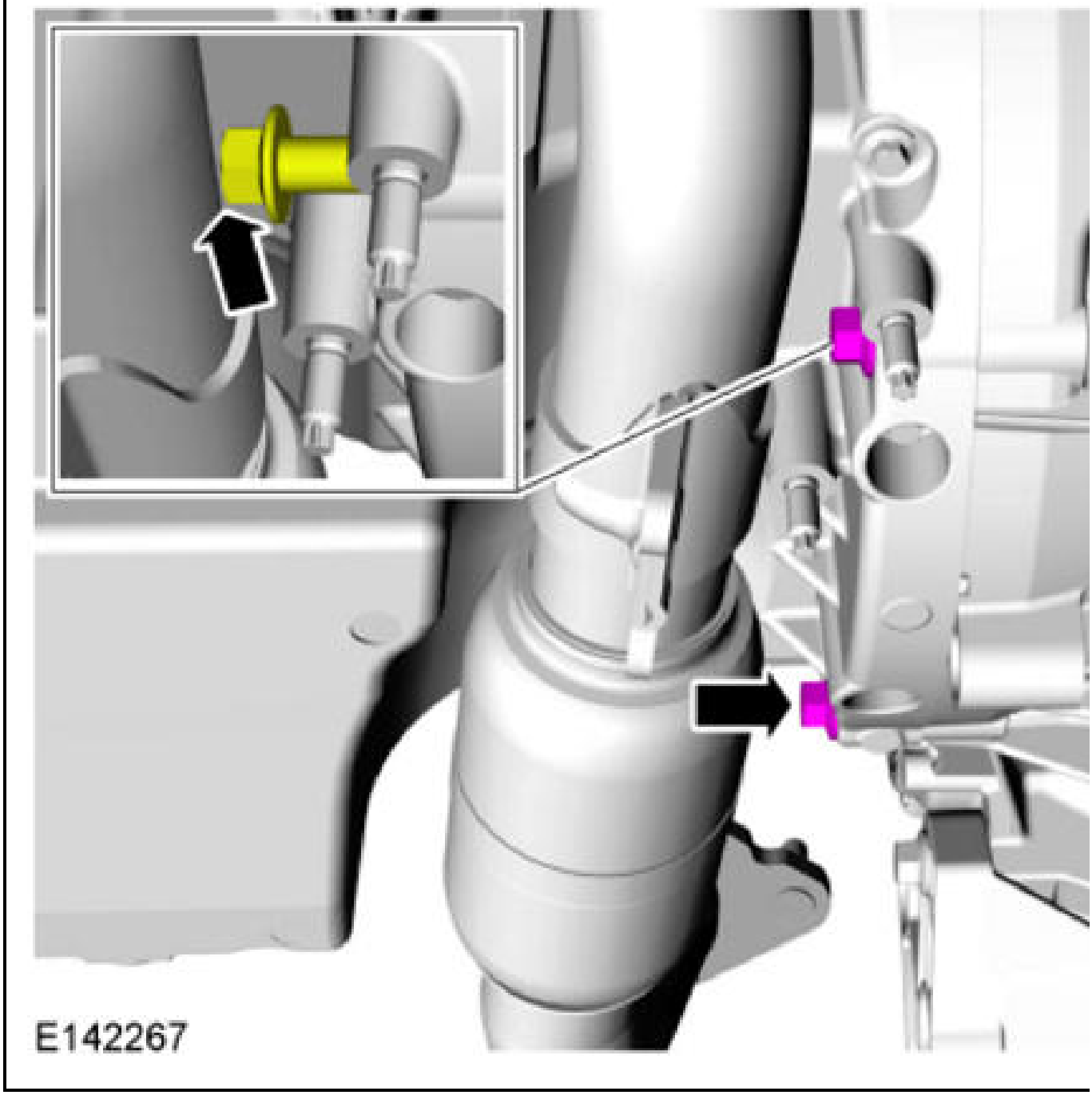


35.

35.

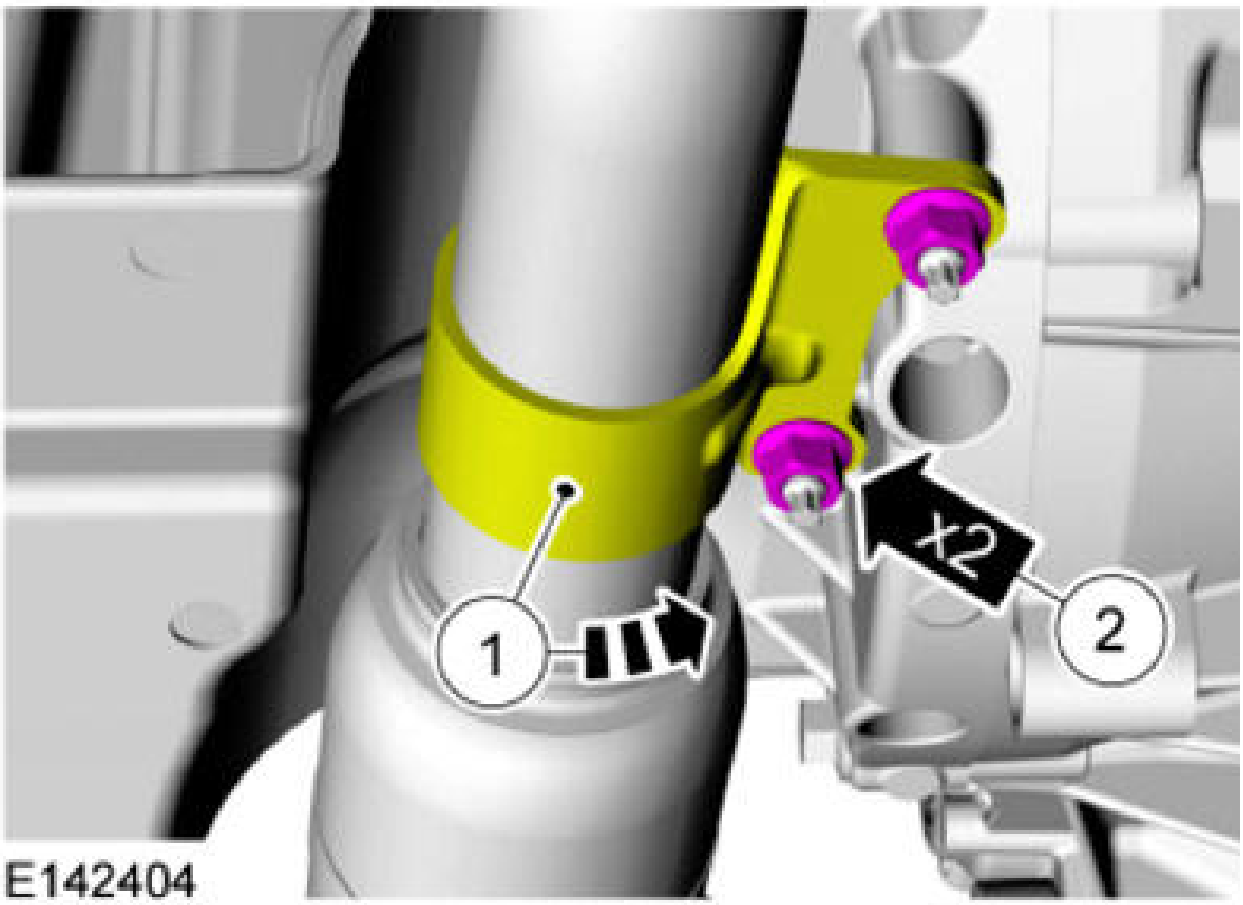


36. *Torque* : 35 lb.ft (48 Nm)

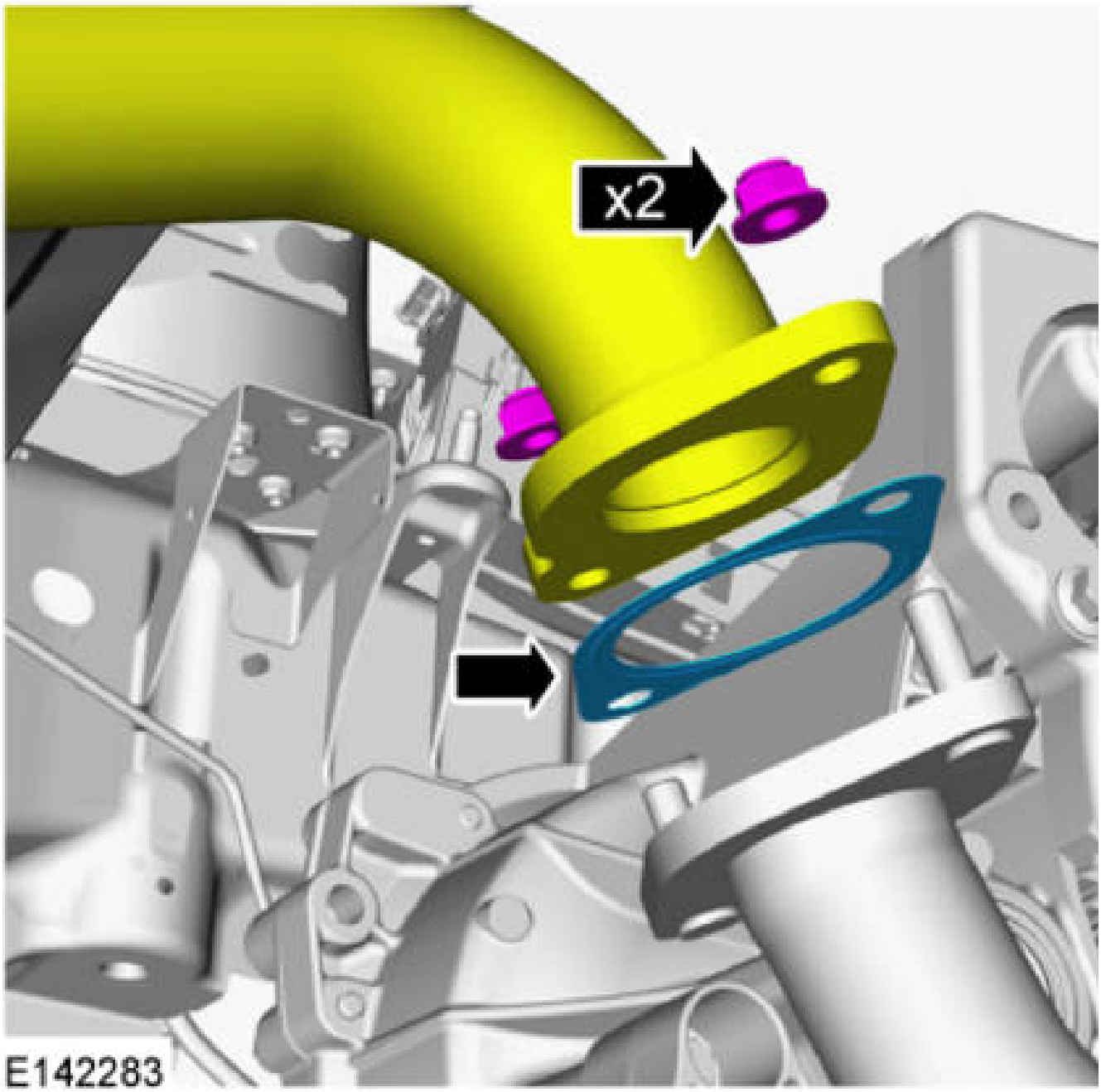


37.

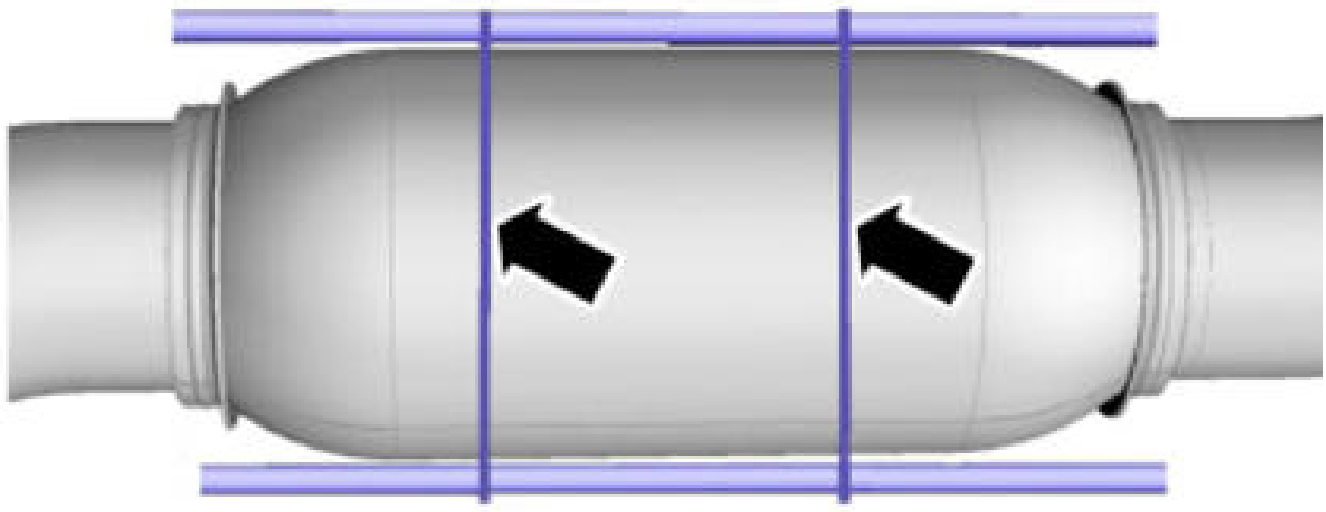
2. *Torque* : 18 lb.ft (25 Nm)



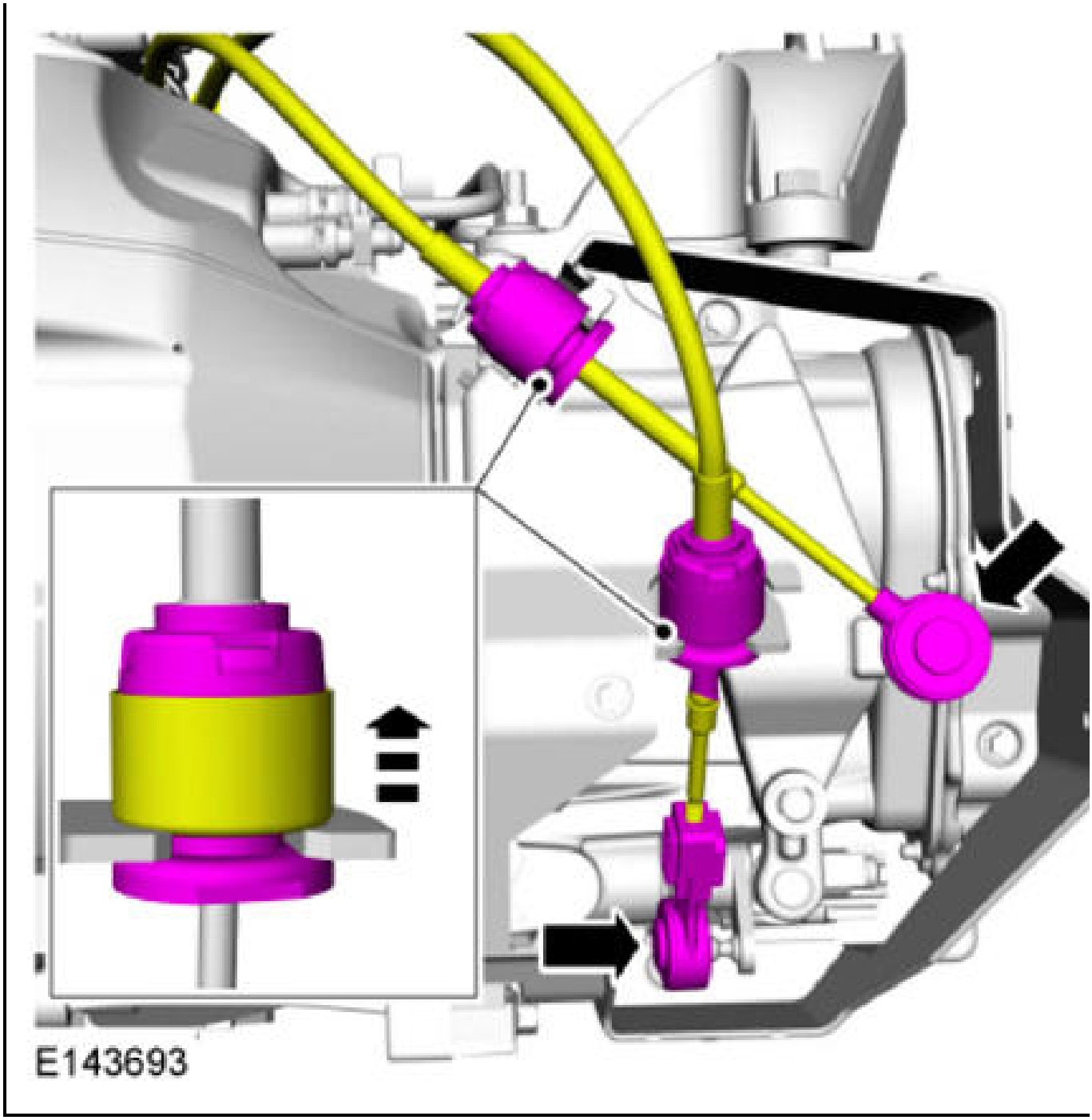
38. Refer to: **TRANSMISSION FLUID LEVEL CHECK** .
39. *Torque* : 35 lb.ft (48 Nm)



40. Remove the General Equipment: Cable Ties



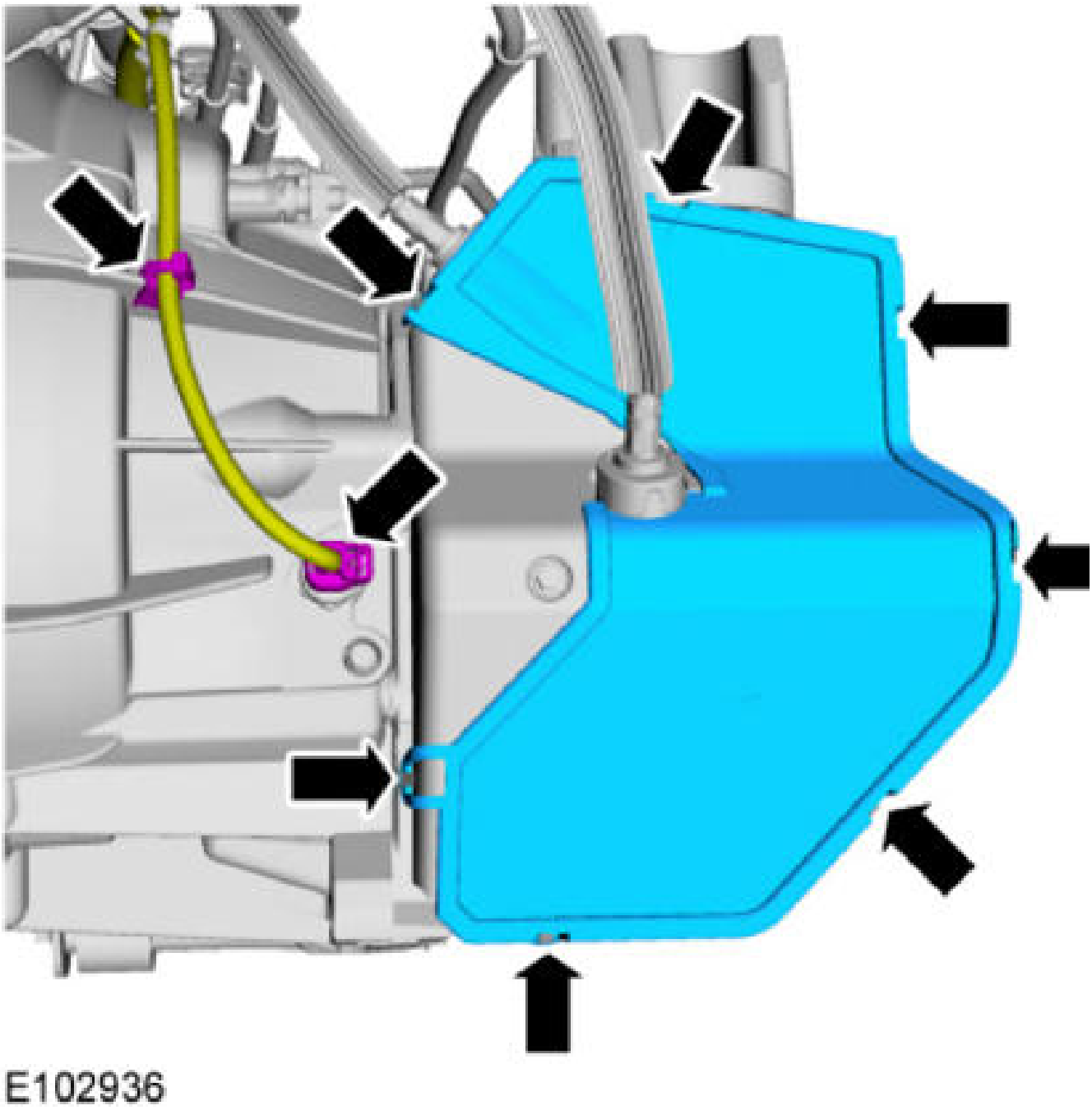
41. **NOTE: Gearshift cables must not be kinked or bent.**



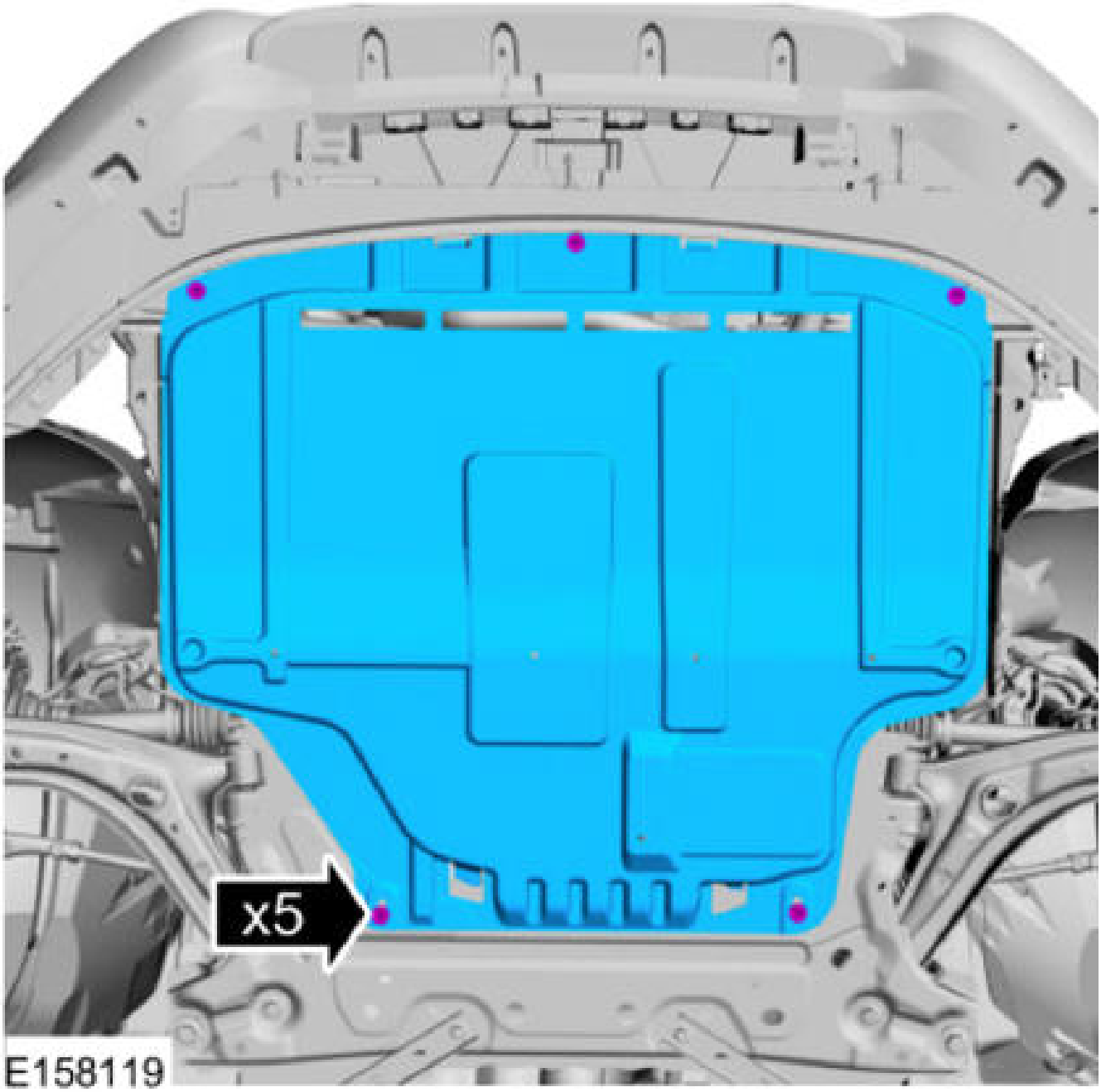
42. Refer to: **GEARSHIFT CABLE ADJUSTMENT - 5-SPEED MANUAL TRANSMISSION - B5/IB5** .

43.

43.



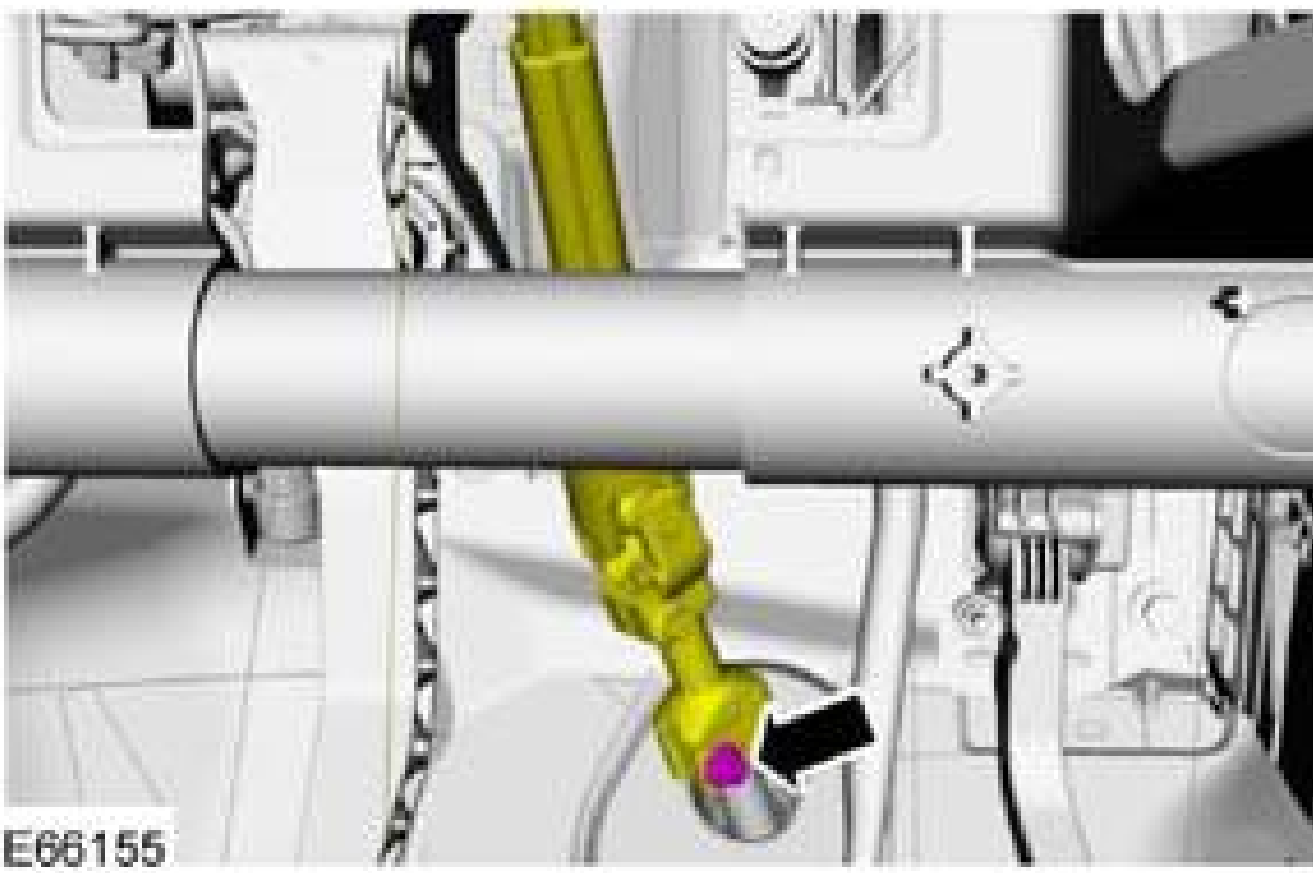
44.



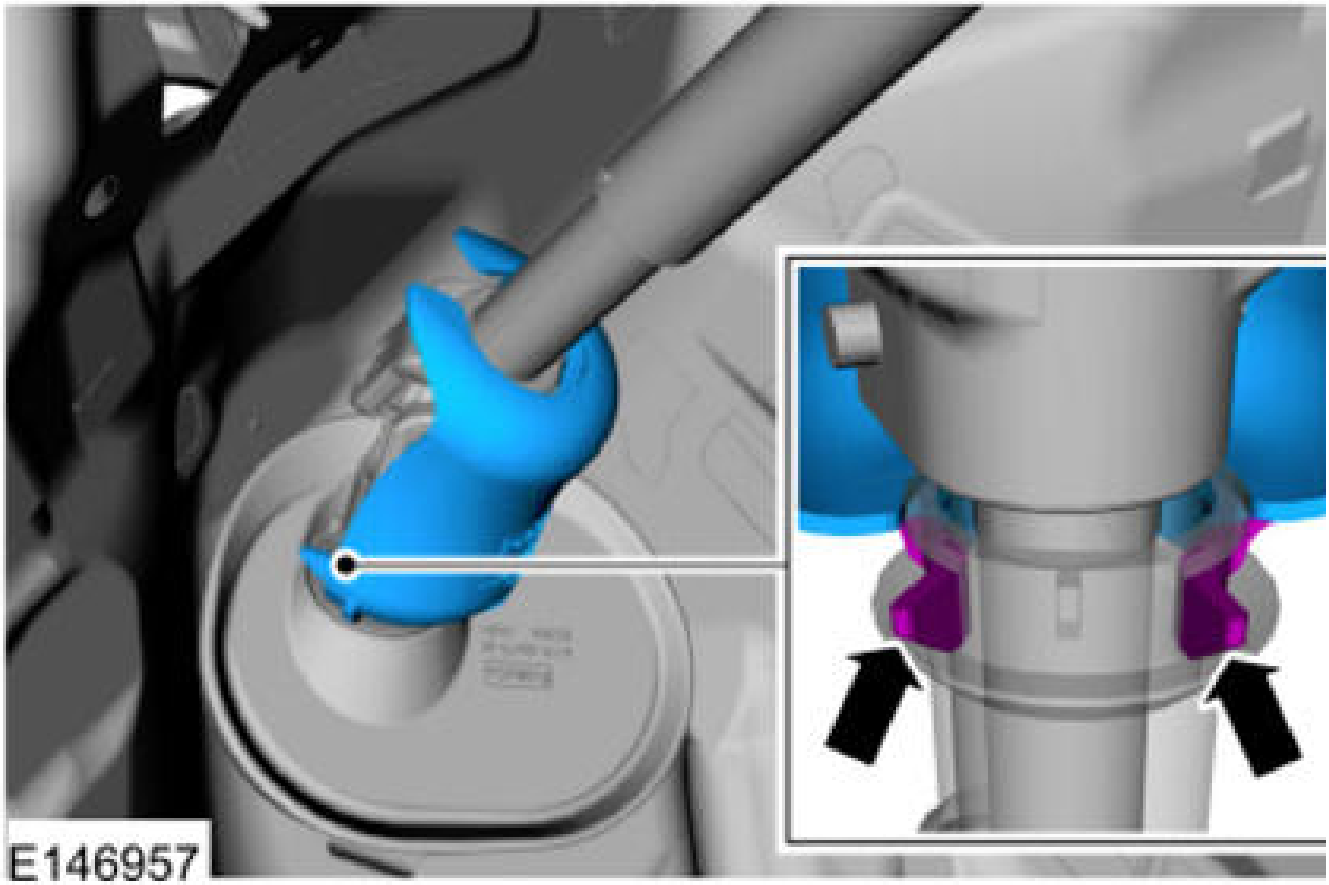
44.

WARNING: **Do not reuse steering column shaft bolts. This may result in fastener failure and steering column shaft detachment or loss of steering control. Failure to follow this instruction may result in serious injury to vehicle occupant(s).**

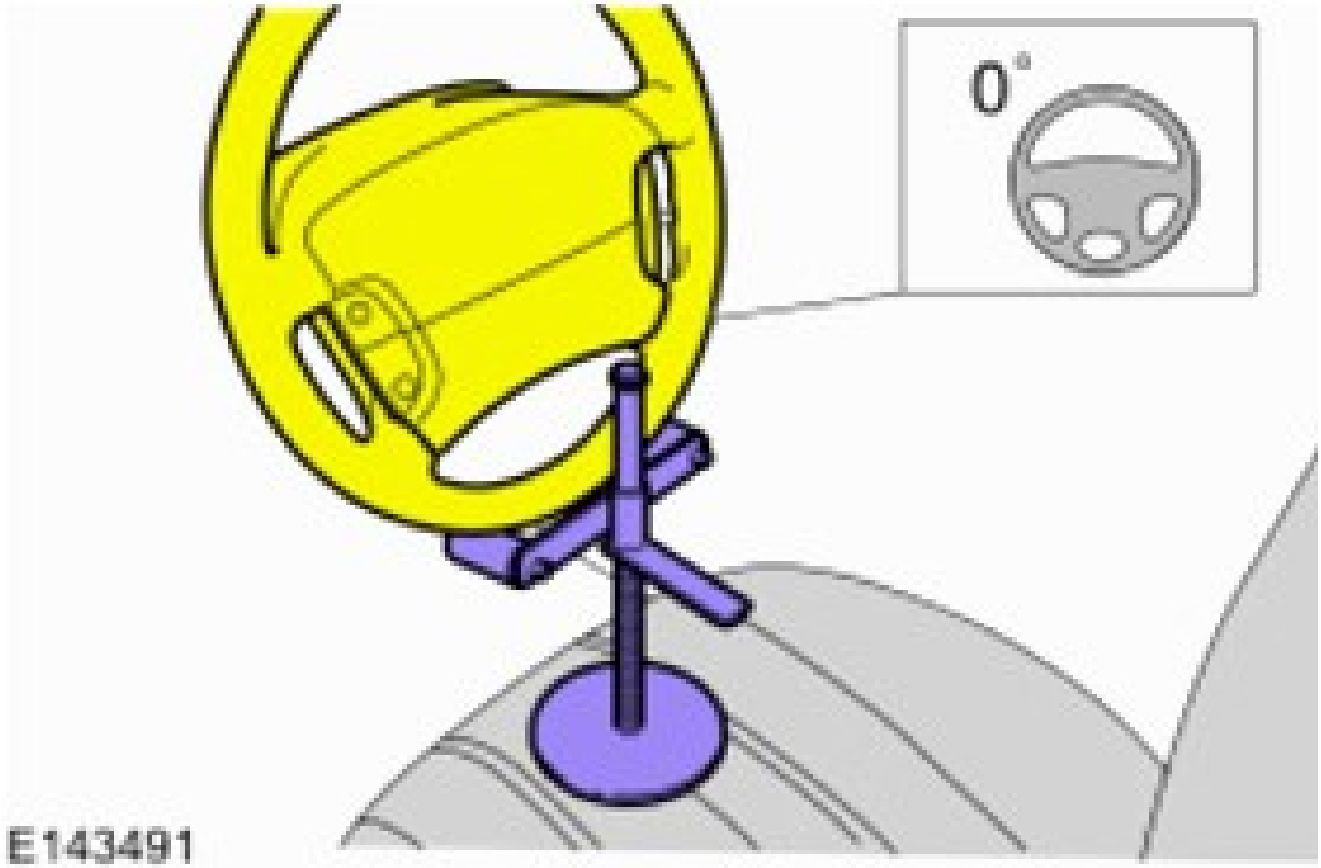
45.



46. If equipped

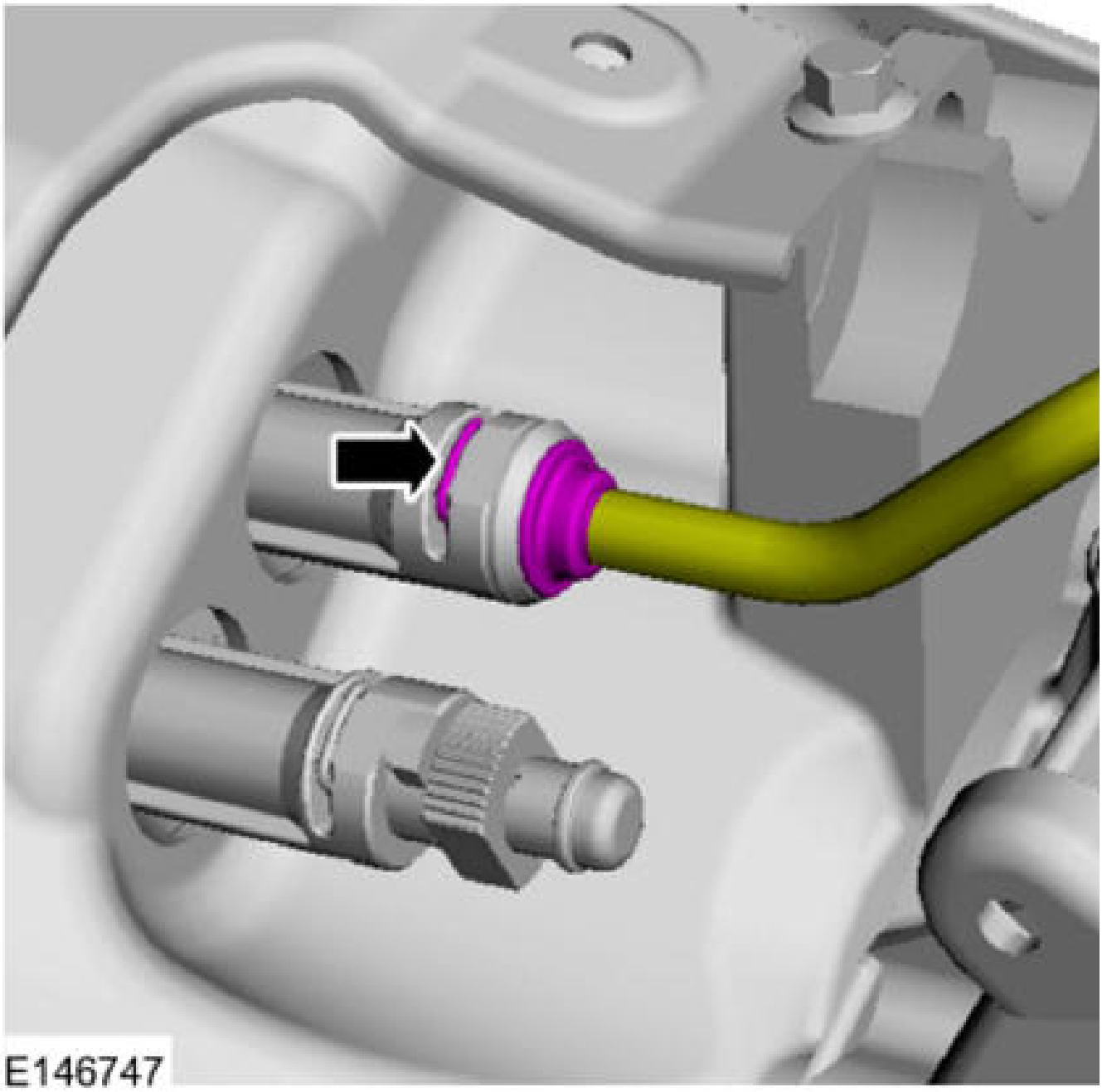


47. Remove the General Equipment: Steering Wheel Holder



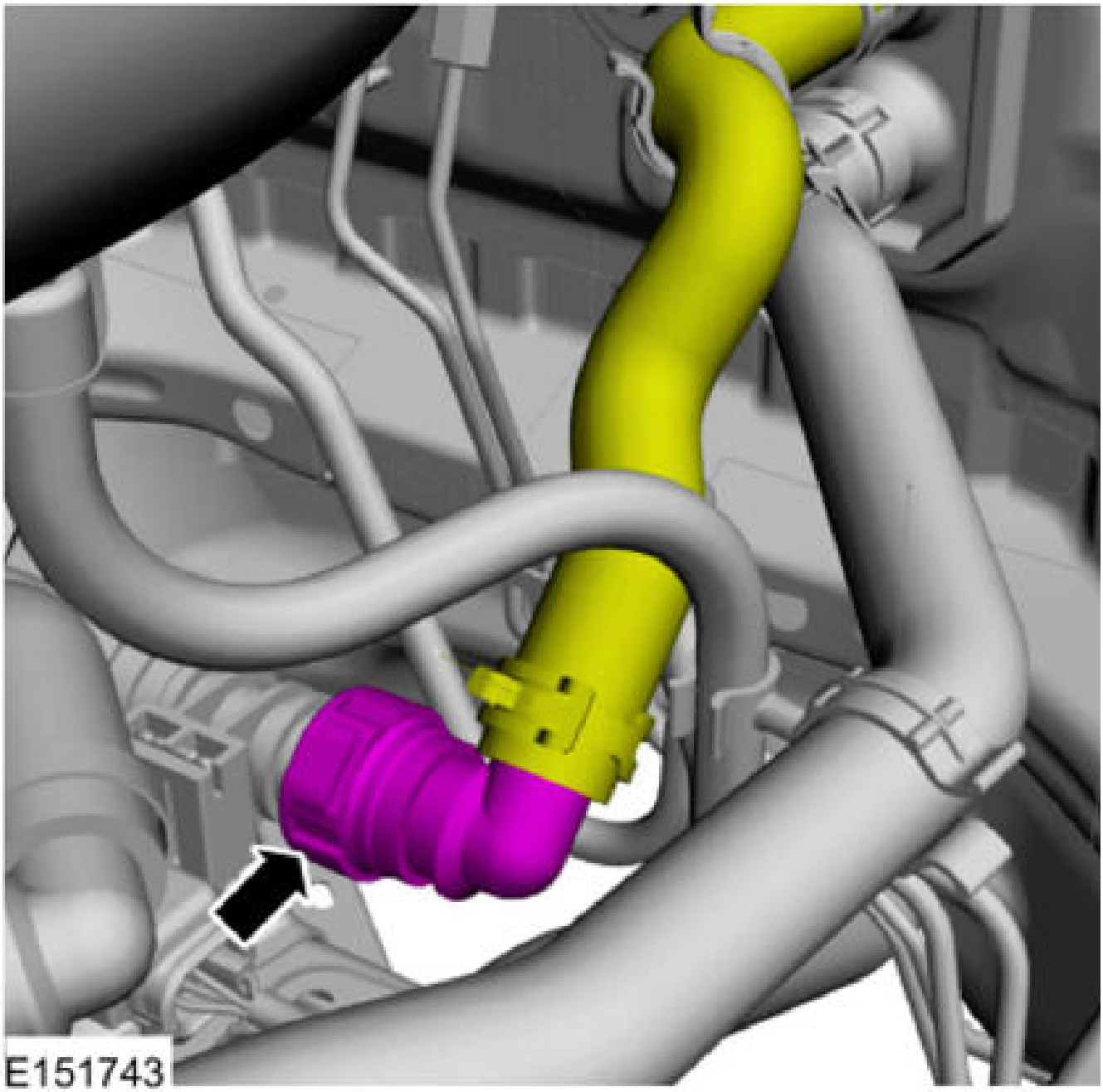
48.

48.

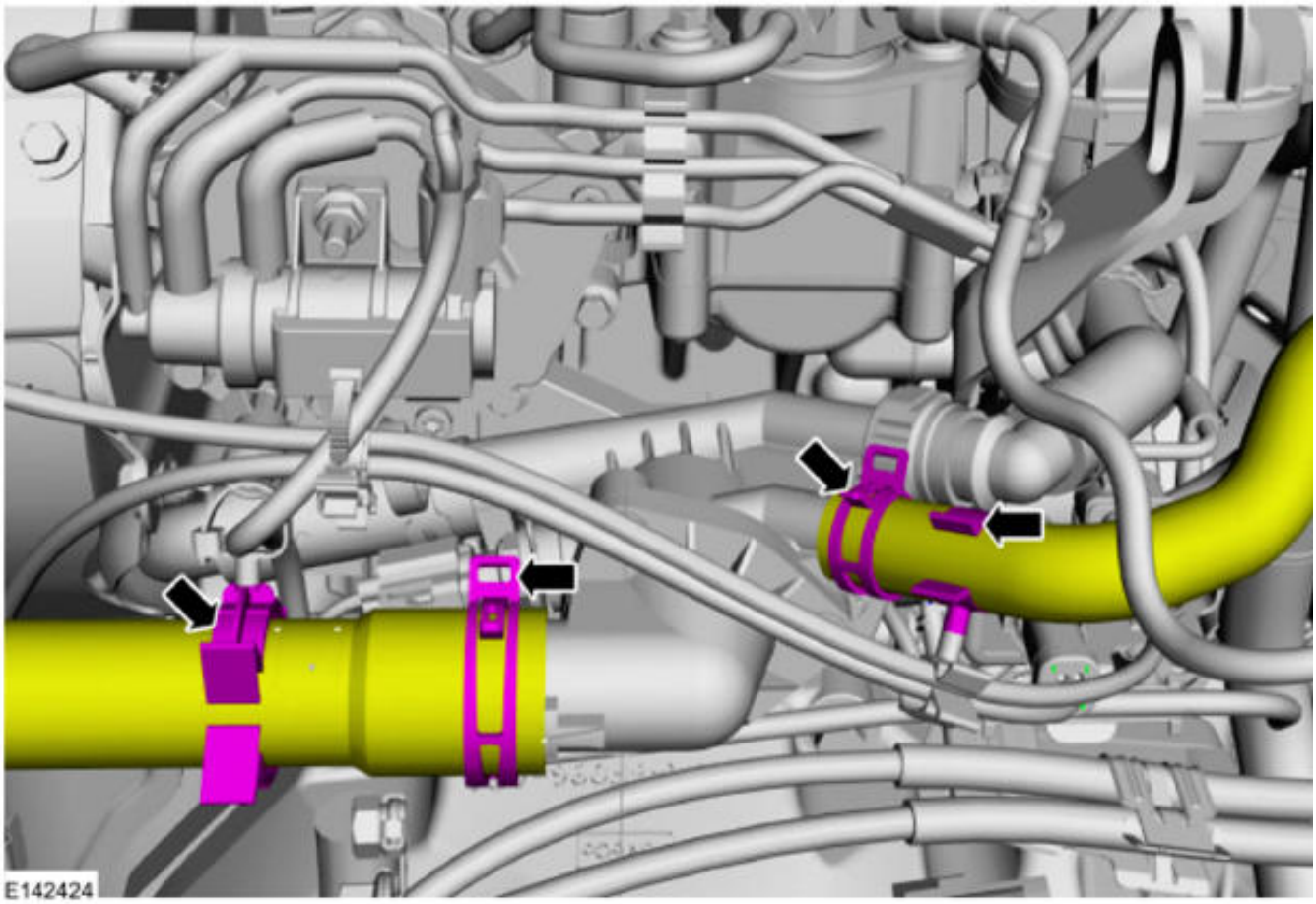


49.

49.

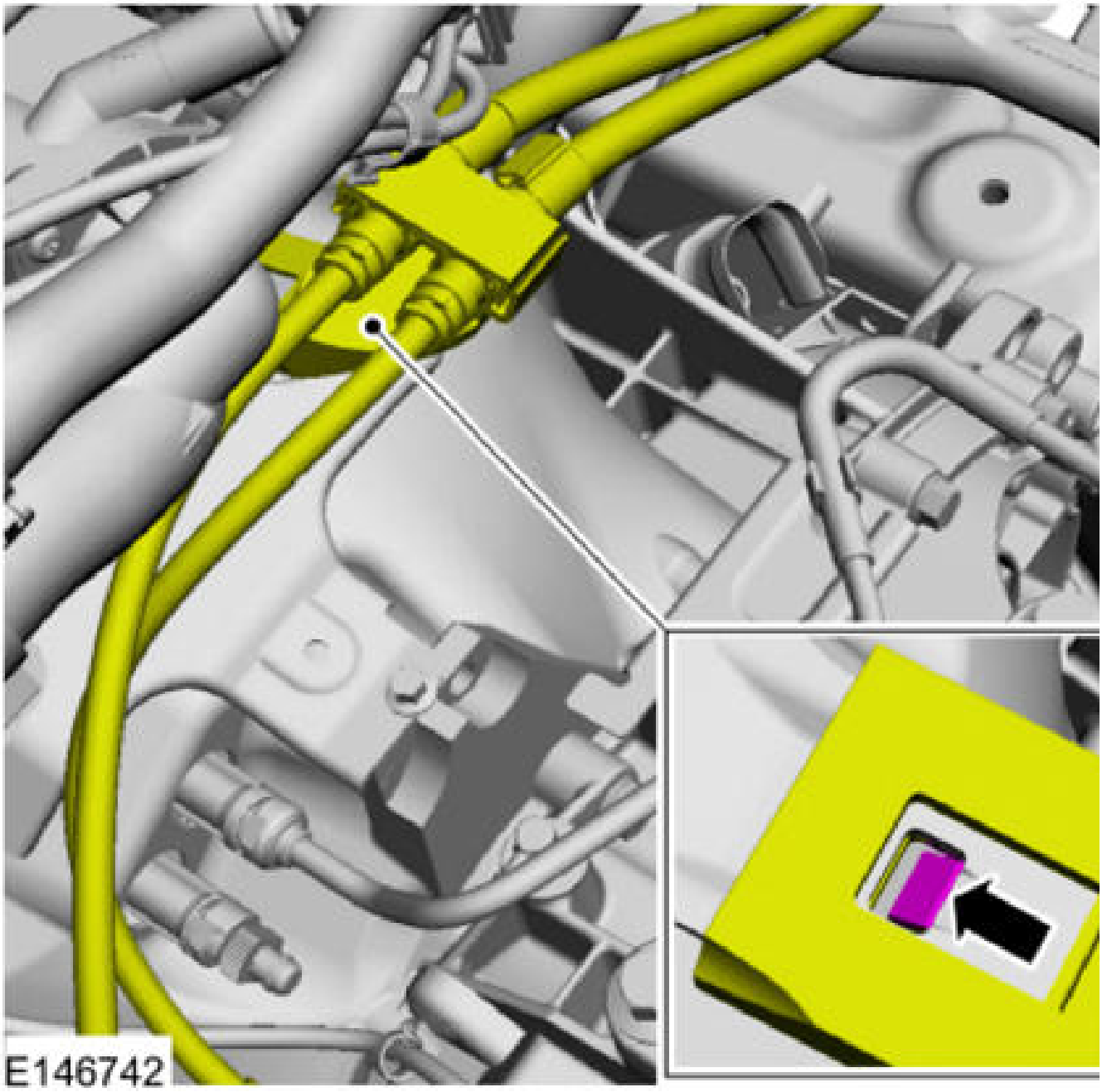


50. Use the General Equipment: Hose Clamp Remover/Installer

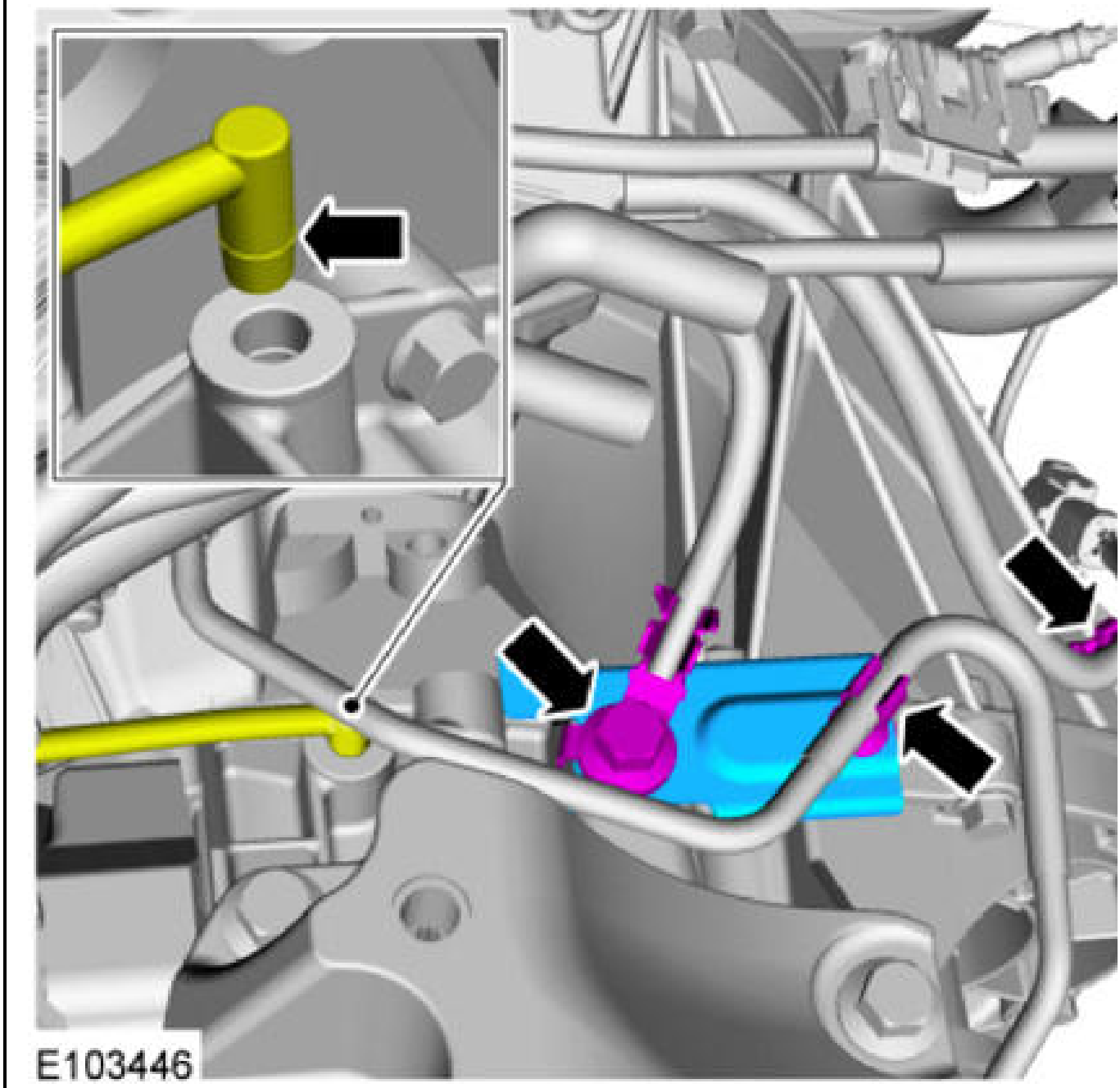


51.

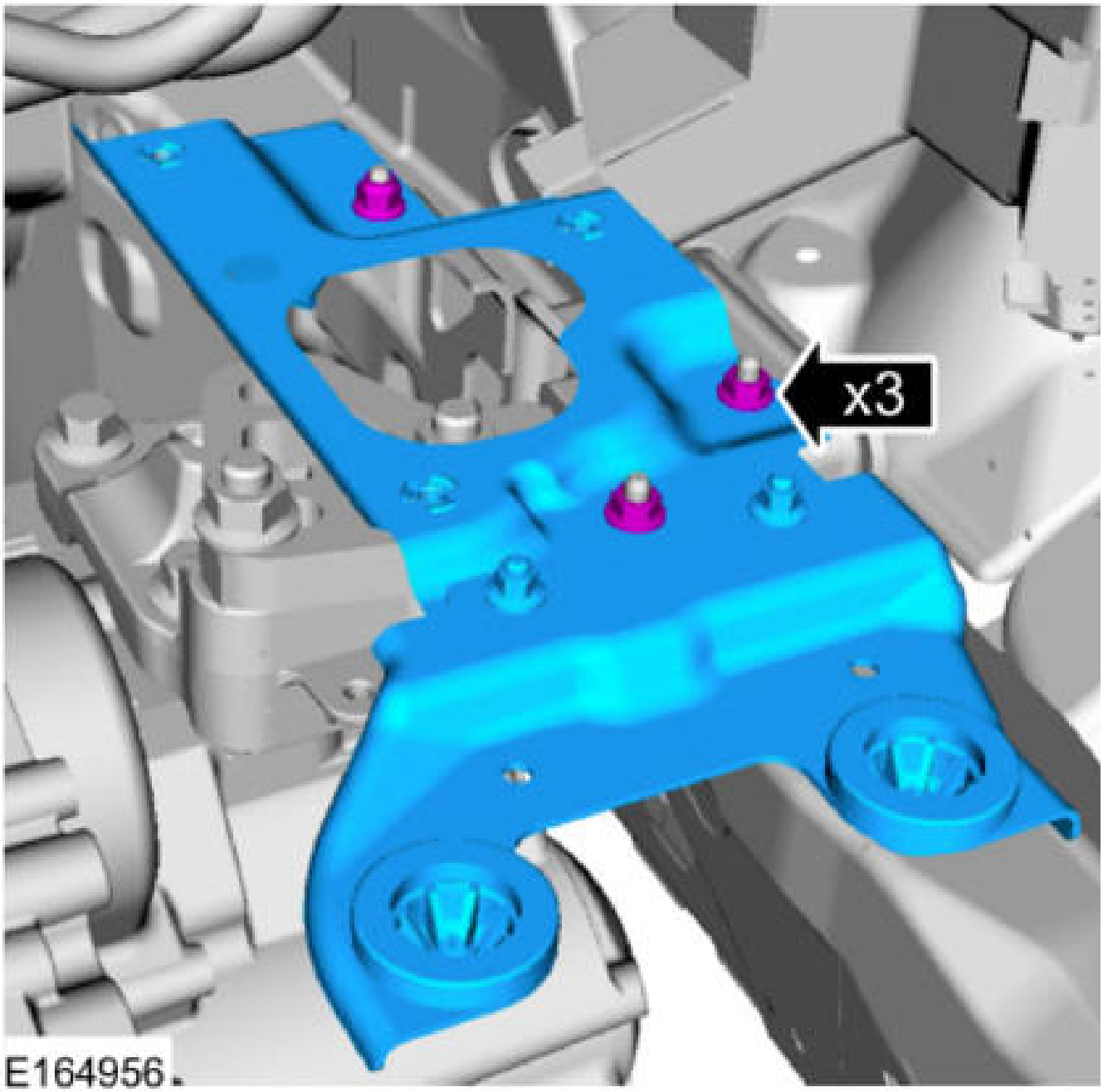
51.



52. *Torque* : 18 lb.ft (25 Nm)

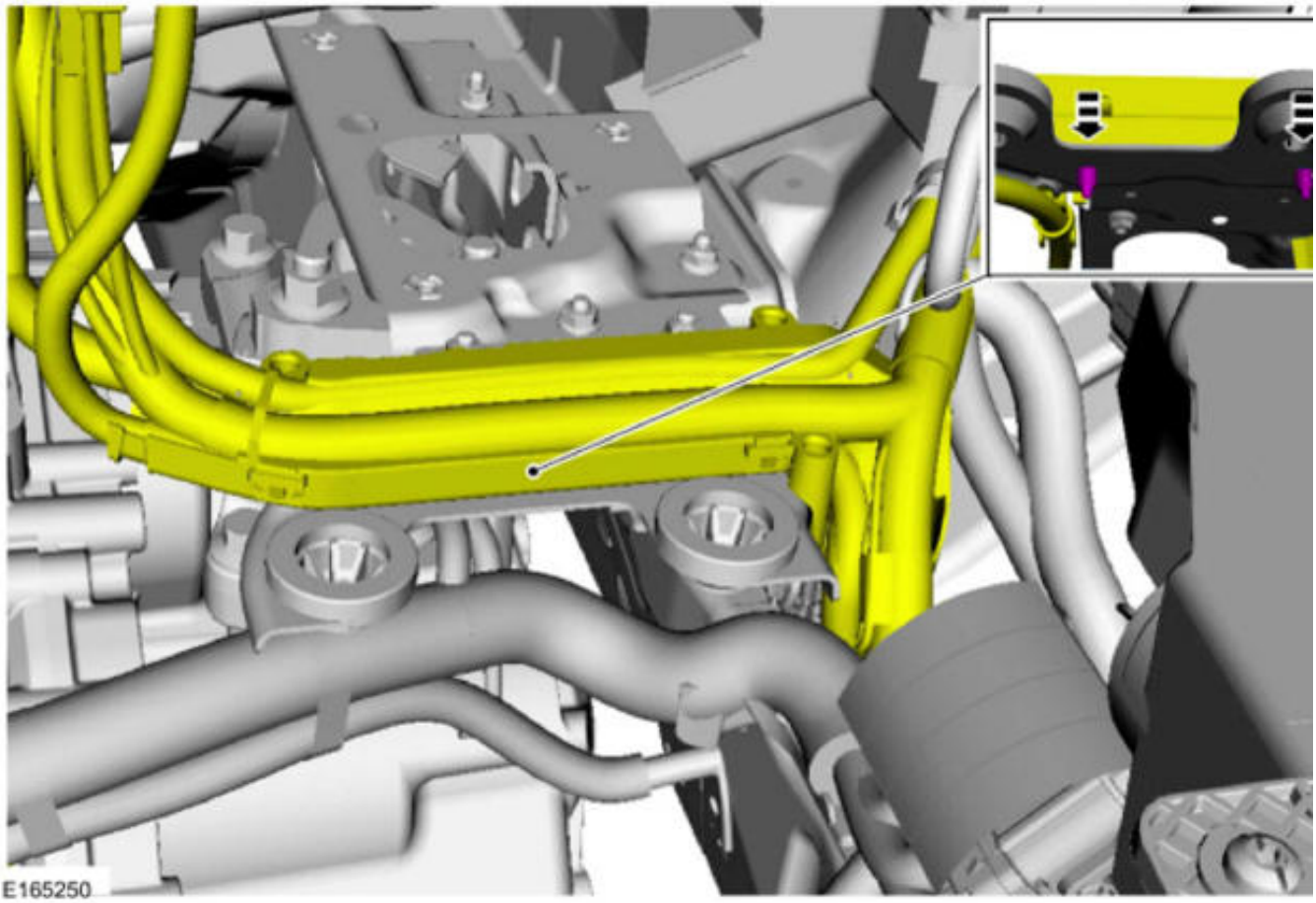


53. *Torque* : 89 lb.in (10 Nm)



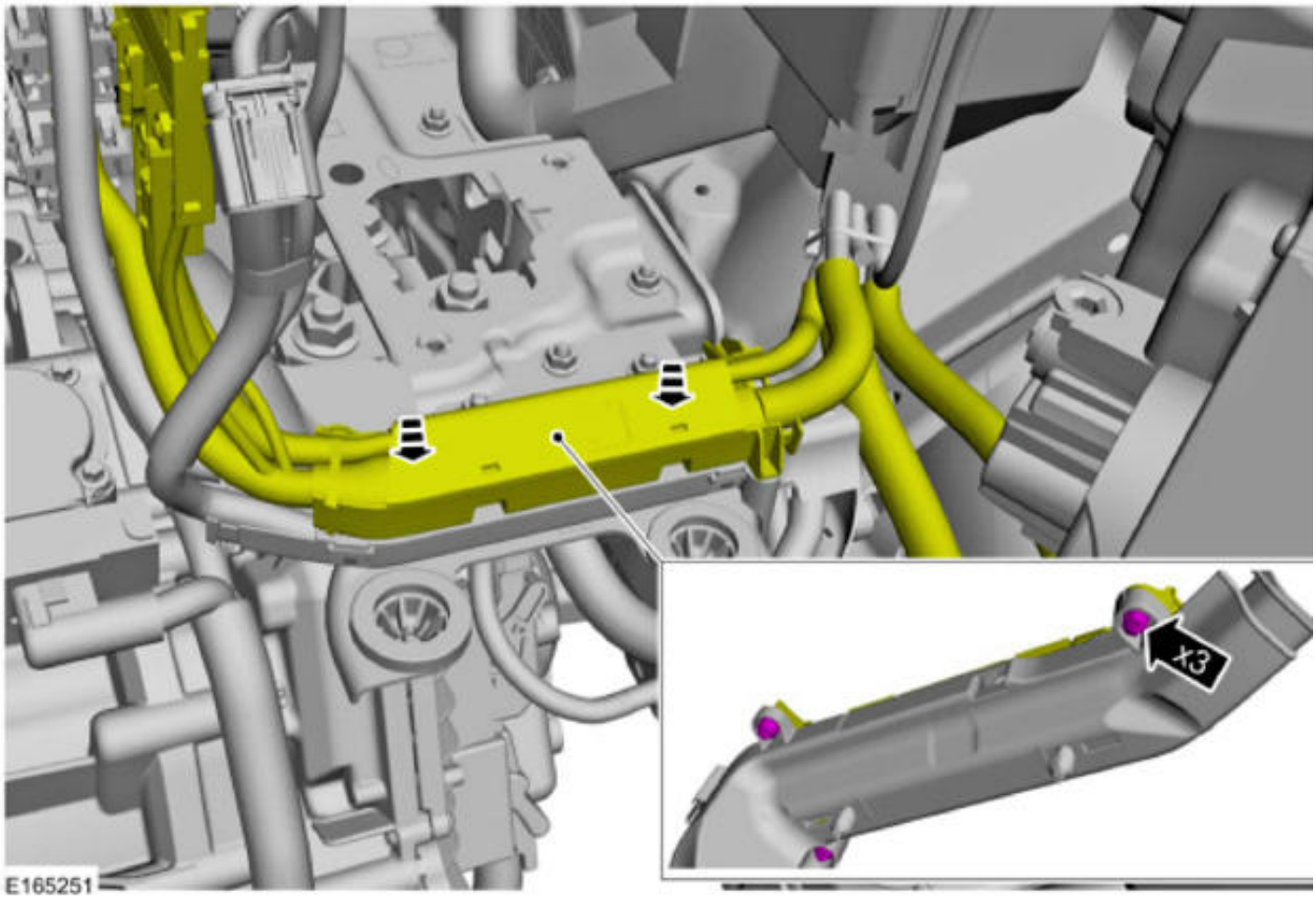
54.

54.

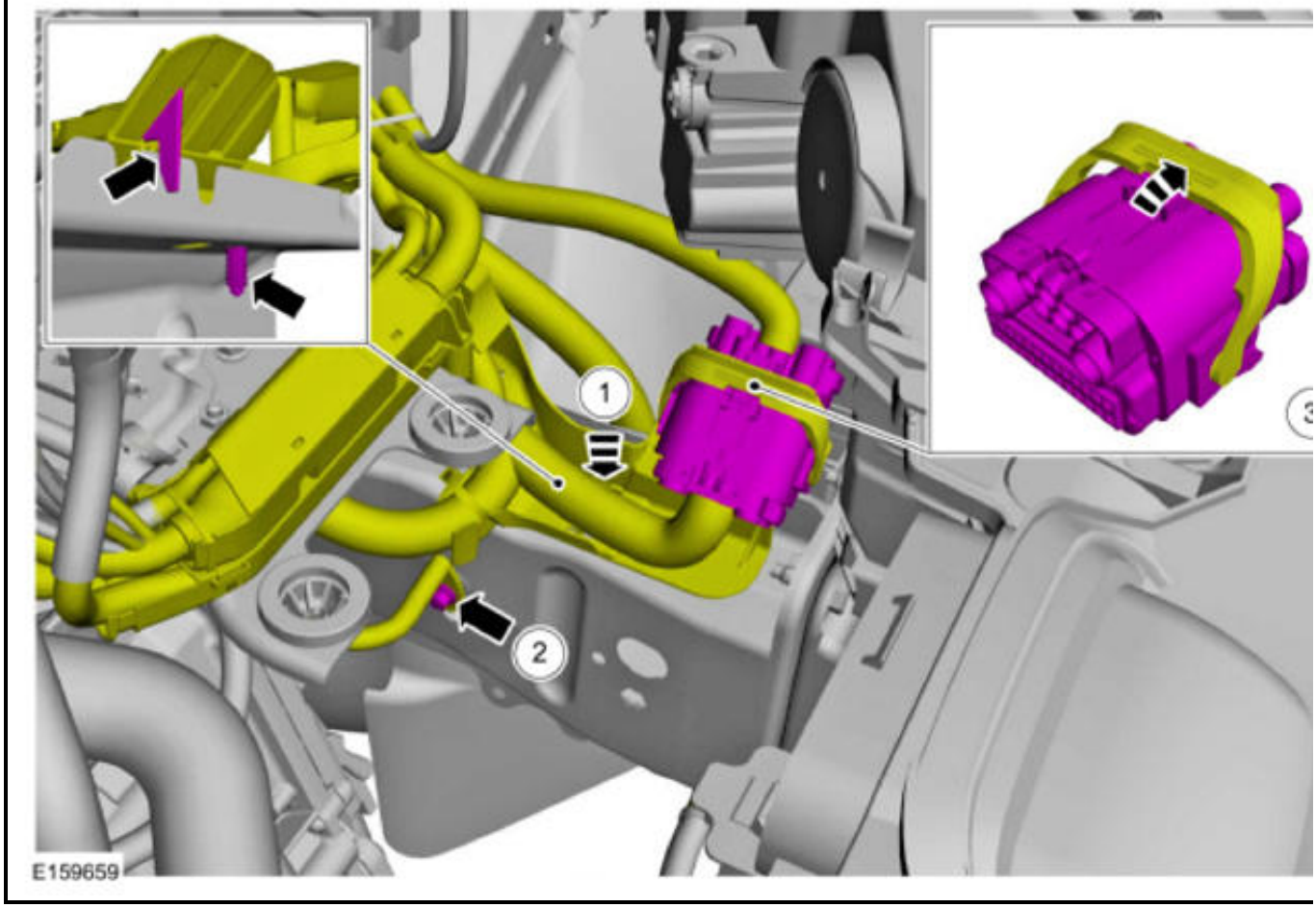


55.

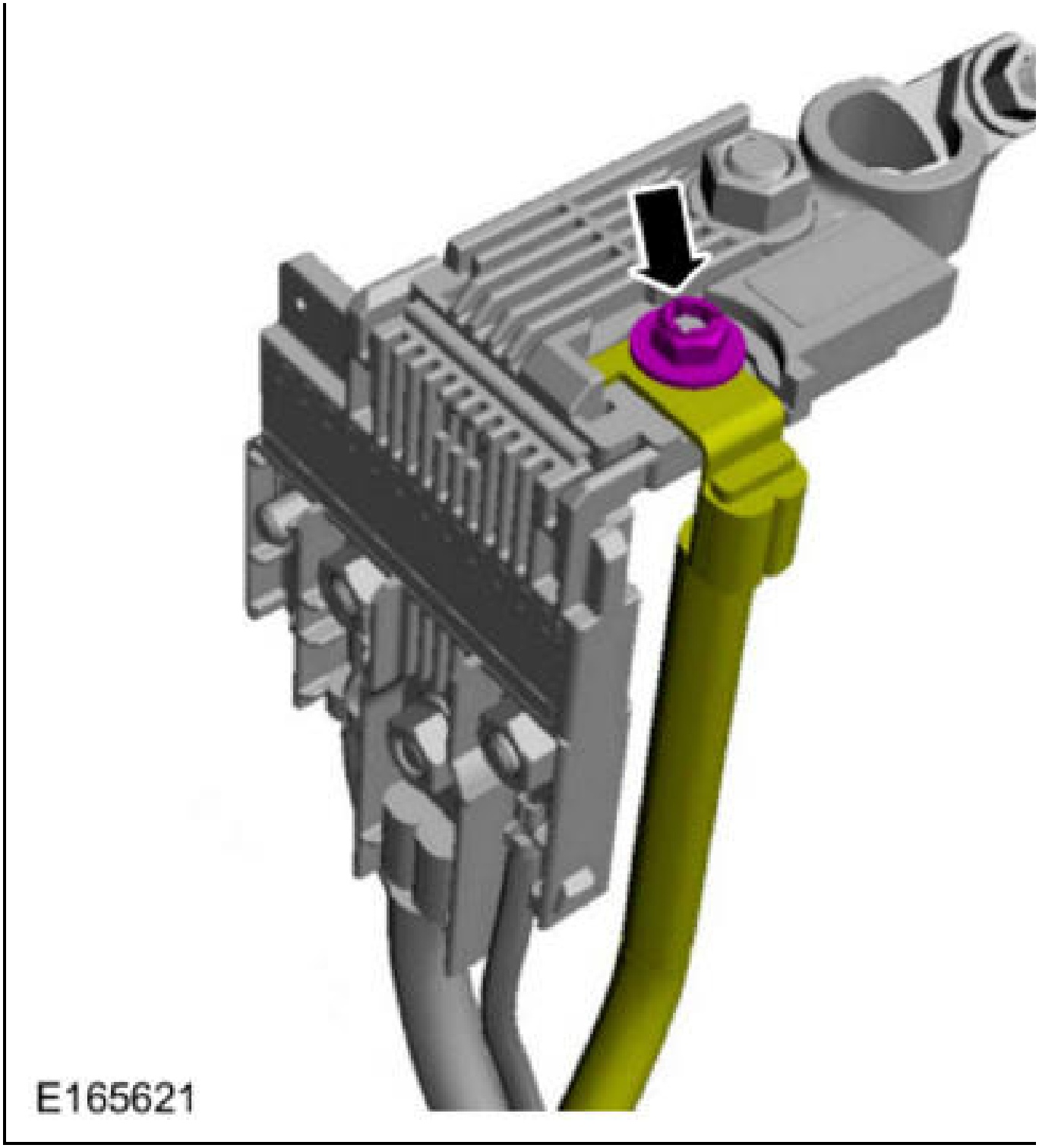
55.



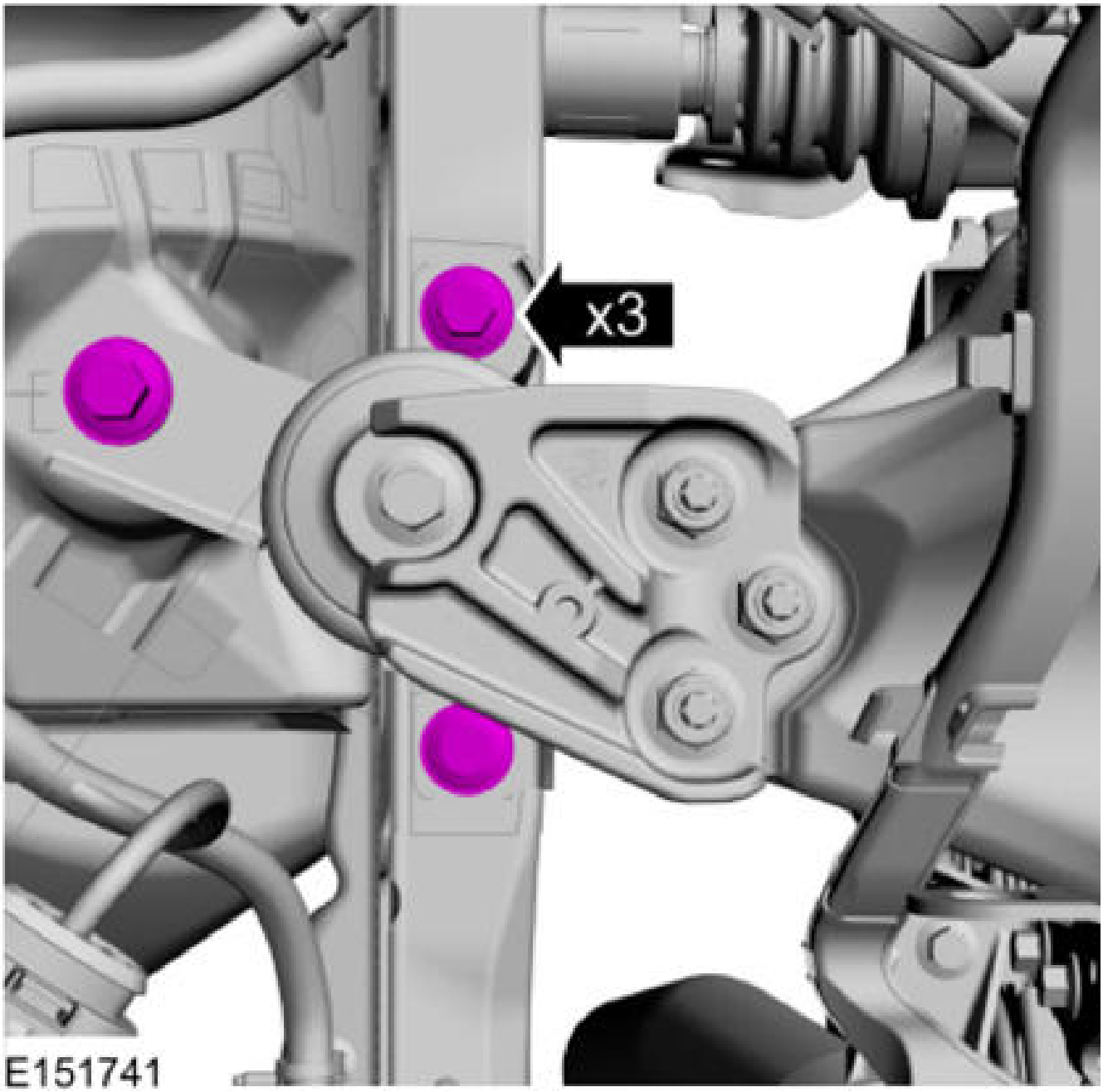
56. *Torque* : 115 lb.in (13 Nm)



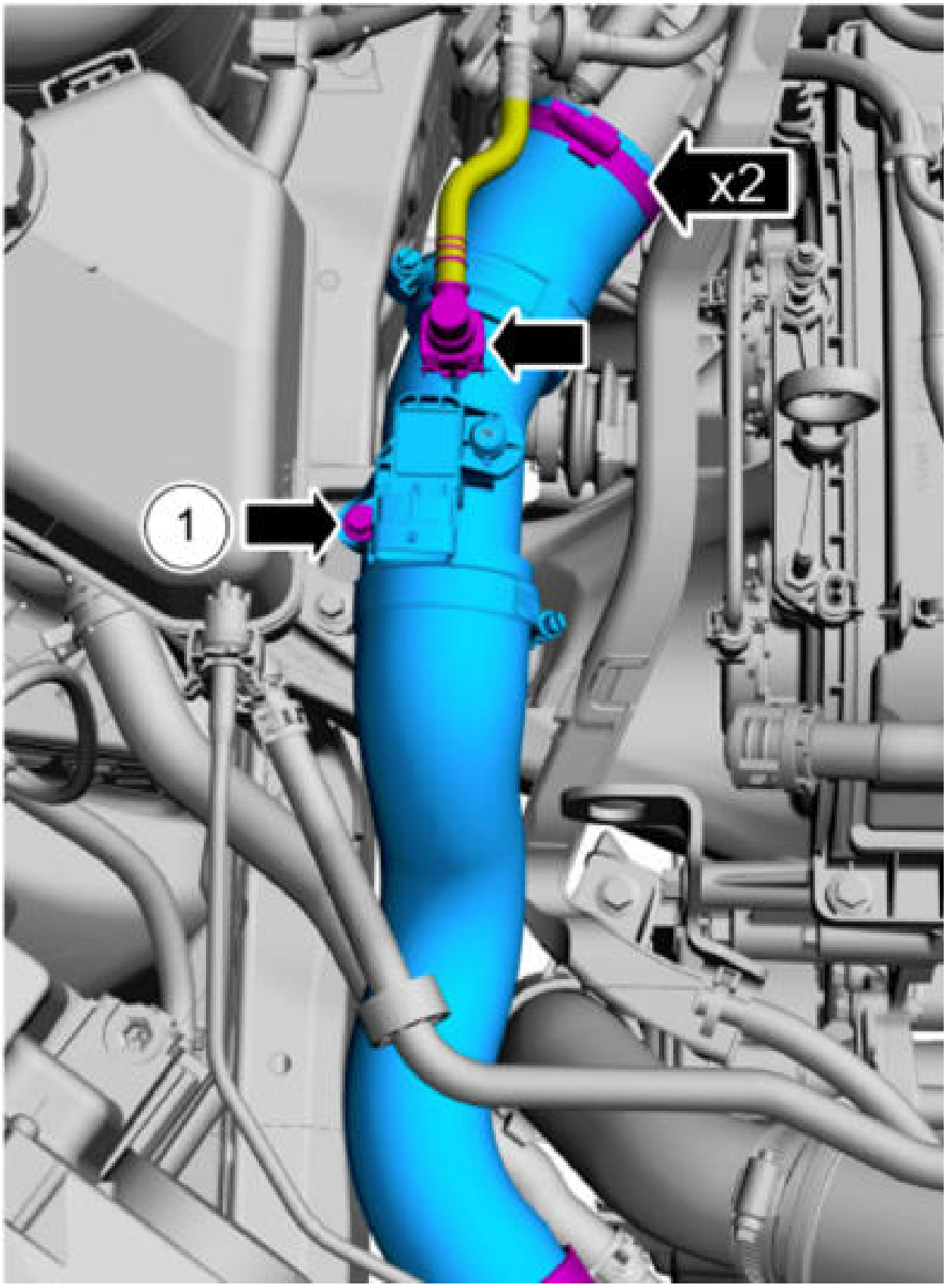
57. *Torque* : 44 lb.in (5 Nm)



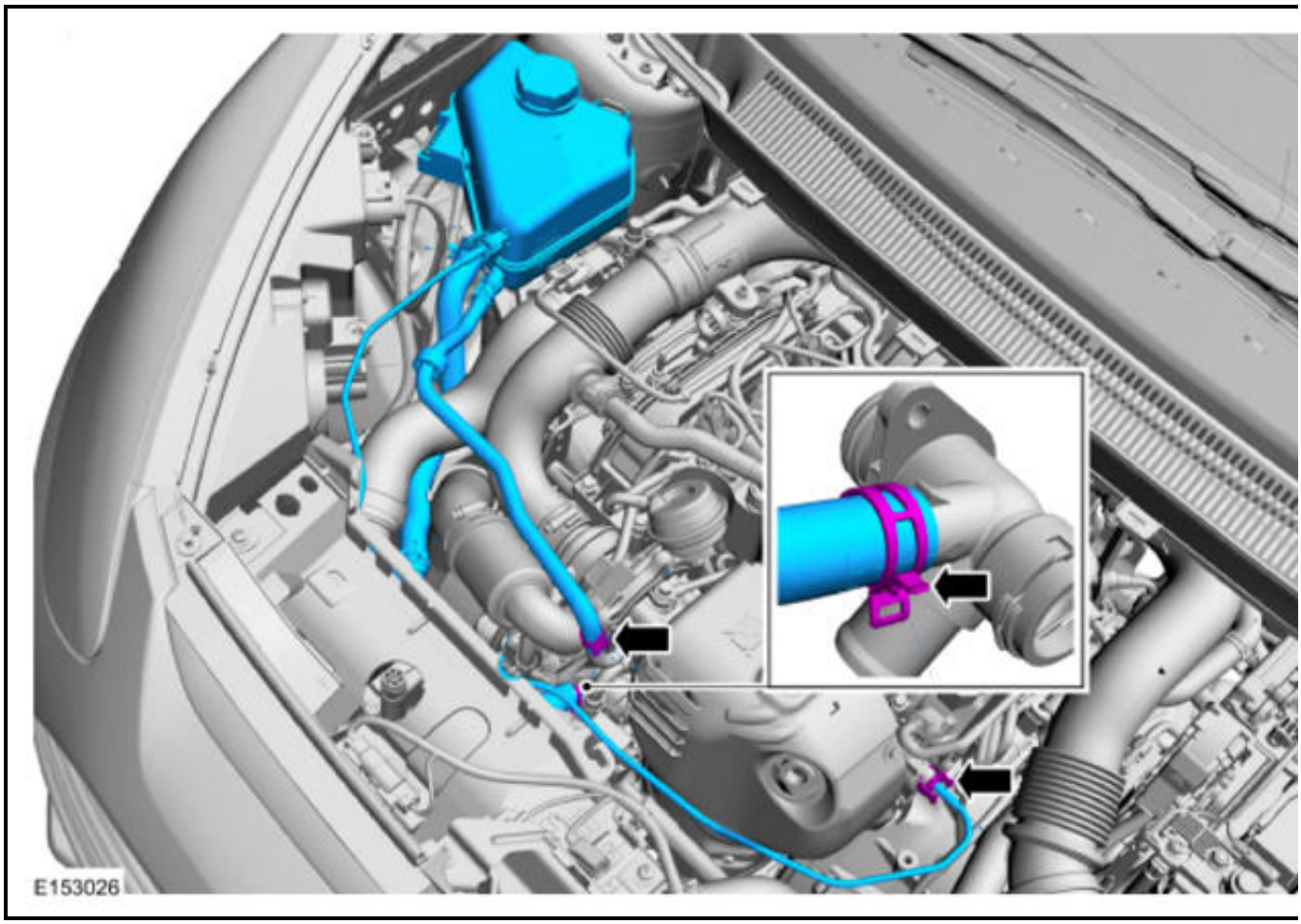
58. Refer to: **BATTERY TRAY - 1.0L ECOBOOST (90KW/120PS)/1.6L ECOBOOST (132KW/180PS) - SIGMA** .
59. *Torque* : 35 lb.ft (48 Nm)



60. *Torque* :
    1. 133 lb.in (15 Nm)



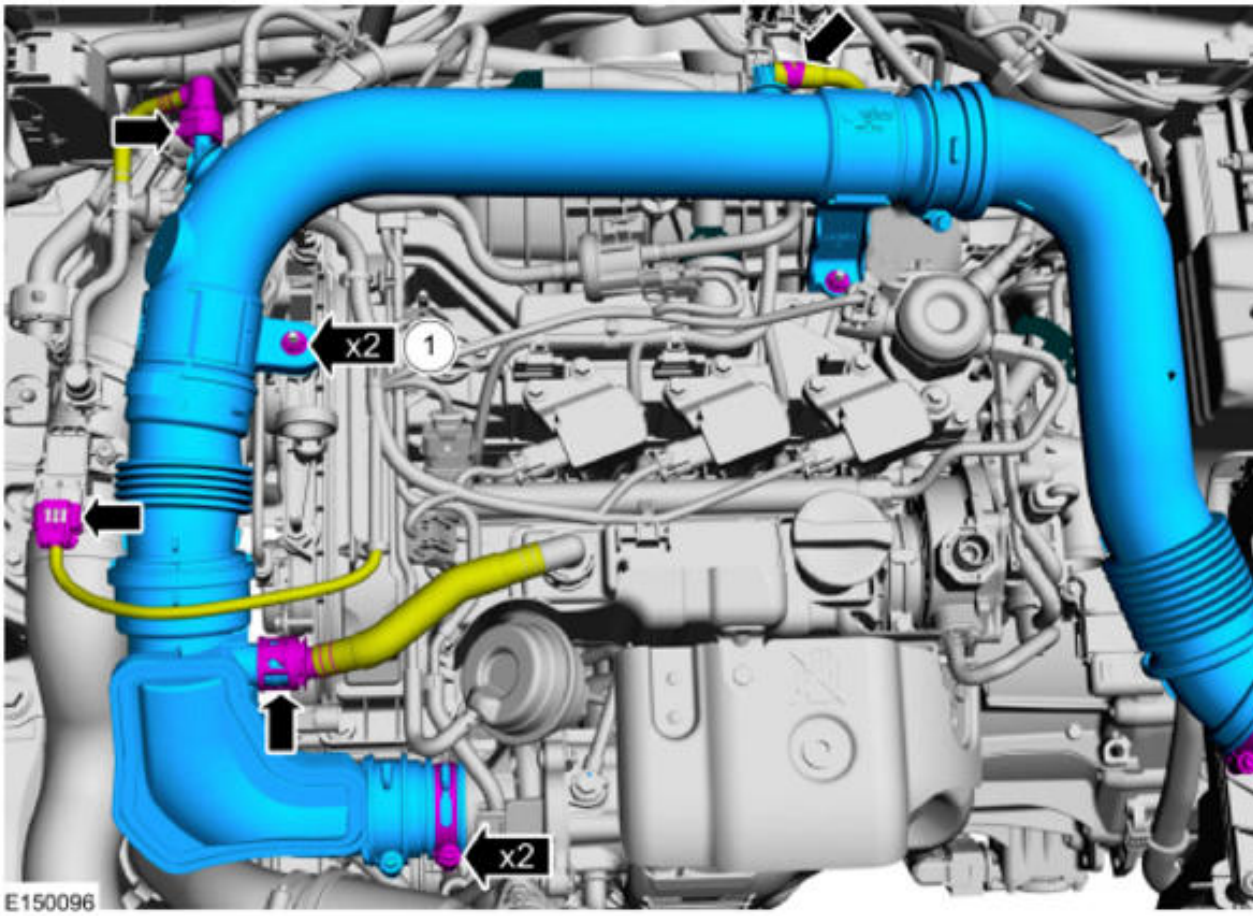
61. Use the General Equipment: Hose Clamp Remover/Installer



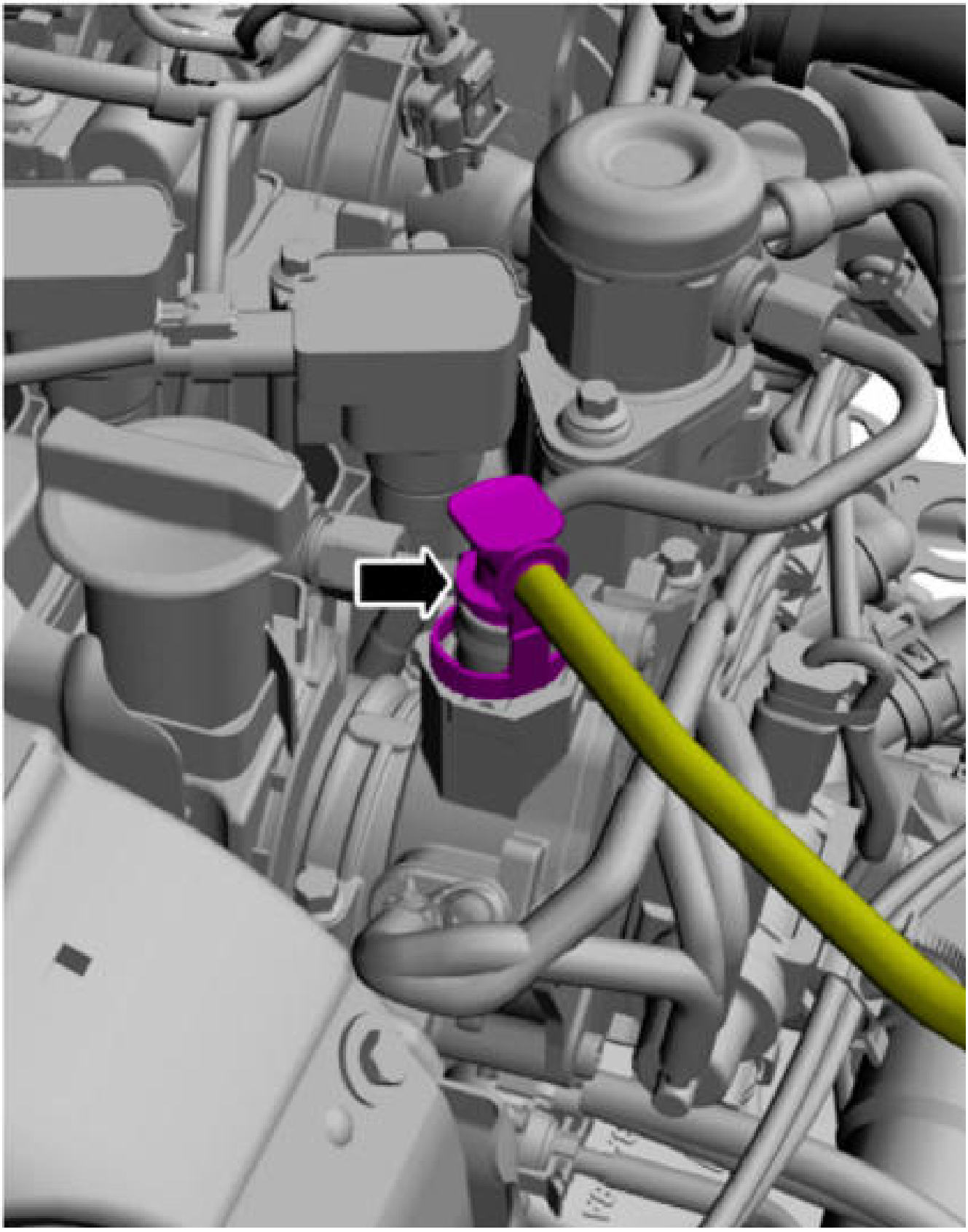
62. Use the General Equipment: Hose Clamp Remover/Installer

Torque :

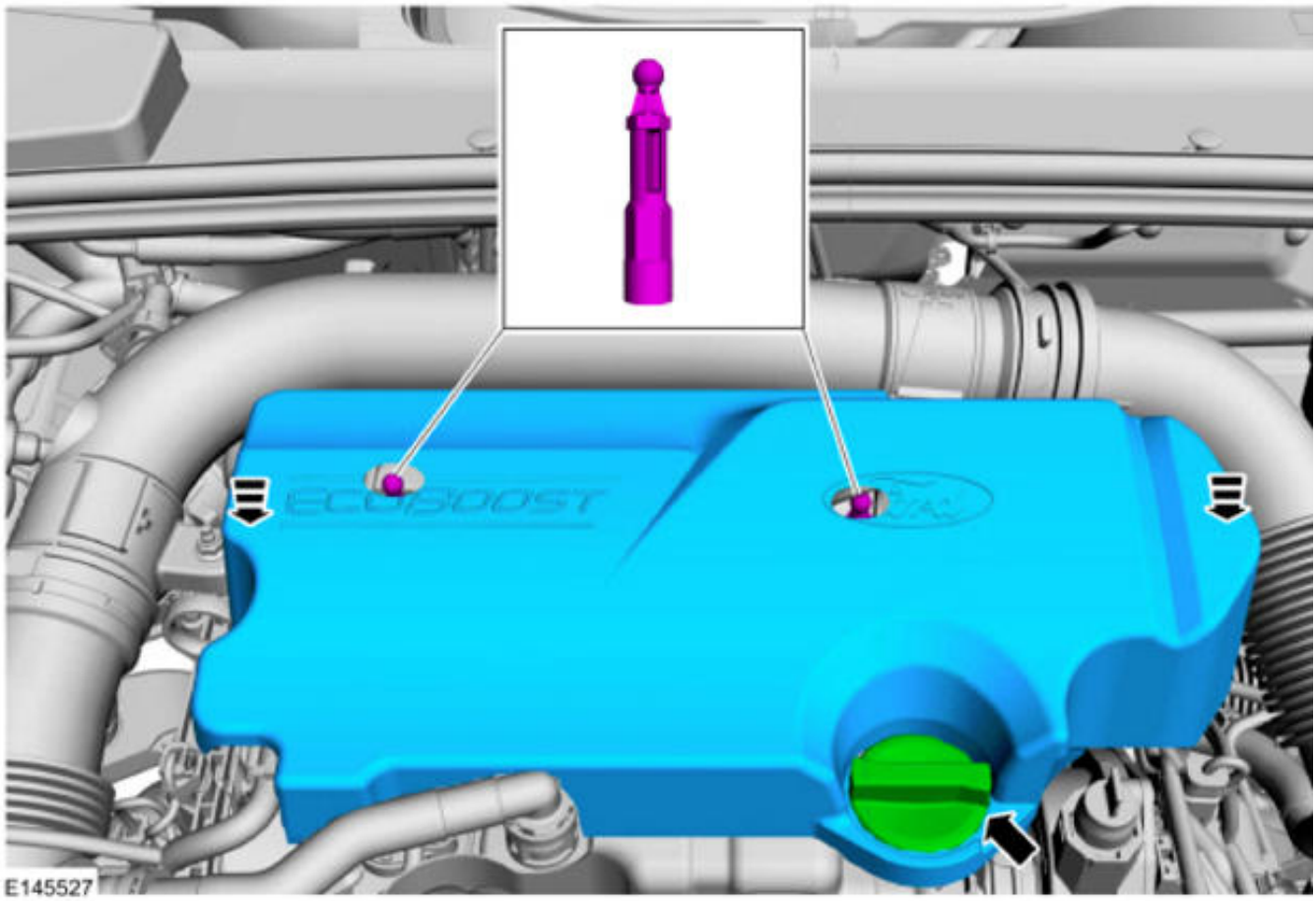
1. 97 lb.in (11 Nm)



63.

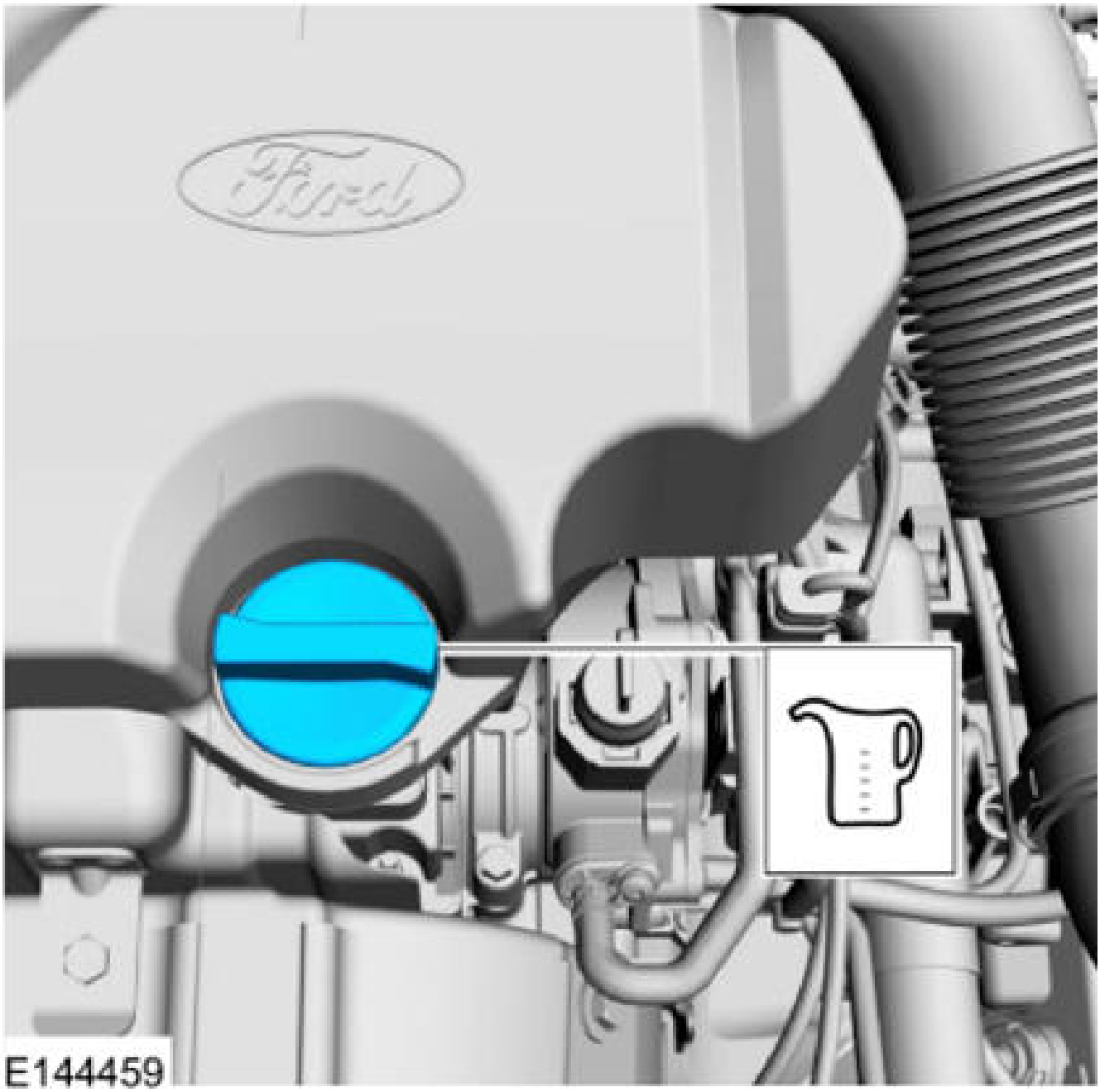


64.



65. Fill the engine with clean engine oil

Refer to: **SPECIFICATIONS** .



66. Refer to: **COOLING SYSTEM DRAINING AND VACUUM FILLING** .
67. Refer to: **CLUTCH SYSTEM BLEEDING** .
68. Refer to: **AIR CONDITIONING (A/C) SYSTEM RECOVERY, EVACUATION AND CHARGING** .
69. After completing the repairs, perform the Misfire Monitor Neutral Profile Correction procedure.

