

**2018 ENGINE****Engine - 3.0L Power Stroke Diesel - F150****SPECIFICATIONS****SPECIFICATIONS****Engine**

| Item              | Specification         |
|-------------------|-----------------------|
| Displacement      | 3.0L Diesel (183 CID) |
| No. of cylinders  | 6                     |
| Bore              | 84.0 mm (3.31 in)     |
| Stroke            | 90.0 mm (3.54 in)     |
| Firing order      | 1-4-2-5-3-6           |
| Compression ratio | 16.0:1                |

**Lubricants**

| Item  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> SAE 5W-30 F150 Diesel Motor Oil (XO-5W30-QFA) | WSS-M2C214-B1 |

**Engine Oil Capacity**

| Item                              | Specification |
|-----------------------------------|---------------|
| Service fill including oil filter | 6.5qt (6.15L) |
| Service fill without oil filter   | 6.0qt (5.68L) |

**Oil Pressure**

| Item   | Specification     |
|--|-------------------|
| Oil pressure @ idle with engine at normal operating temperature      | 10.0psi (68.9kPa) |
| Oil pressure @ 3,500 rpm with engine at normal operating temperature | 28.0psi (193kPa)  |

**Cylinder Block**

| Item  | Specification  |
|---|--|
| Cylinder bore diameter at 60 mm (2.36 in) depth | 3.307-3.308in (83.994-84.024mm)  |
| Block bore maximum out-of-round                 | 0.0003in (.0075mm)   |
| Cylinder bore taper                             | 0.0005in (.012mm)  |
| Main bearing bore diameter                      | 2.953-2.954in (75-75.02mm)   |
| Head gasket surface flatness                    | Flat within 0.10 mm (0.004 in) overall. Flat within 0.150 mm (0.005 in) overall 0.050 mm (0.001 in) per 150 mm (5.905 in) x 150 mm (5.905 in) 0.025 mm (0.0009 in) per 25 mm (0.98 in) x 25 mm (0.98 in) |

**Piston**

| Item | Specification |
|------|---------------|
|------|---------------|

| Item                     | Specification                     |
|--------------------------|-----------------------------------|
| Piston diameter          | 3.3044-3.3050in (83.932-83.948mm) |
| Piston pin bore diameter | 1.1813-1.1815in (30.006-30.011mm) |

### Piston Pin

| Item                      | Specification                     |
|---------------------------|-----------------------------------|
| Piston pin diameter       | 1.1809-1.1810in (29.994-29.998mm) |
| Piston pin side clearance | 0.0003-0.0007in (.008-.017mm)     |

### Cylinder Head

| Item   | Specification   |
|--|---|
| Cylinder head gasket surface flatness                      | Flat within 0.08 mm (0.003 in) length end to end, area 150 mm (5.9 in) x 150 mm (5.9 in) (or full width) should be less than 0.05 mm (0.002 in) |
| For piston protrusion of 0.552-0.603 mm (0.0217-0.0237 in) | Use a grade 2 cylinder head gasket with a thickness of 1.17 mm (0.0460 in)  |
| For piston protrusion of 0.604-0.655 mm (0.0237-0.0257 in) | Use a grade 3 cylinder head gasket with a thickness of 1.22 mm (0.0480 in)  |
| For piston protrusion of 0.656-0.707 mm (0.0258-0.0278 in) | Use a grade 4 cylinder head gasket with a thickness of 1.27 mm (0.0500 in)  |
| For piston protrusion of 0.708-0.760 mm (0.0278-0.0299 in) | Use a grade 5 cylinder head gasket with a thickness of 1.32 mm (0.0519 in)  |
| Valve guide inner diameter                                 | 0.235-0.236in (5.97-5.99mm)   |
| Valve stem diameter - intake                               | 0.2333-0.2340in (5.927-5.943mm)   |
| Valve stem diameter - exhaust                              | 0.2330-0.2336in (5.917-5.933mm)   |
| Valve stem-to-guide clearance - intake                     | 0.0011-0.0025in (.027-.063mm)   |
| Valve stem-to-guide clearance - exhaust                    | 0.0015-0.0029in (.037-.073mm)   |

### Camshaft

| Item                                  | Specification                 |
|---------------------------------------|-------------------------------|
| Camshaft journal bore inside diameter | 1.024-1.025in (26-26.03mm)    |
| Camshaft bearing outside diameter     | 1.021-1.022in (25.94-25.96mm) |
| Camshaft journal-to-bearing clearance | 0.0016-0.0035in (.04-.09mm)   |
| End play                              | 0.0020-0.0059in (.05-.15mm)   |

### Crankshaft

| Item   | Specification                   |
|--|---------------------------------|
| Main bearing journal diameter                  | 2.755-2.756in (69.97-69.99mm)   |
| Main bearing journal-to-main bearing clearance | 0.0011-0.0025in (.027-.063mm)   |
| Connecting rod journal diameter                | 2.479-2.479in (62.958-62.978mm) |
| Crankshaft end play                            | 0.0083-0.0169in (.21-.43mm)     |

### Connecting Rod

| Item   | Specification                    |
|--|----------------------------------|
| Connecting rod-to-pin clearance                | 0.0005-0.0009in (.012-.024mm)    |
| Connecting rod pin bore diameter               | 1.1815-1.1818in (30.01-30.018mm) |
| Connecting rod bearing bore diameter           | 2.5984-2.5989in (66-66.013mm)    |
| Connecting rod bearing-to-crankshaft clearance | 0.0019-0.0030in (.047-.076mm)    |

## DESCRIPTION AND OPERATION

### ENGINE - OVERVIEW

## Overview

The 3.0L Duratorq (4V) is a V-6 engine with the following features:

- Interference design engine
- Dual overhead camshafts
- Four valves per cylinder
- Aluminum cylinder heads
- An single cast CGI (compacted graphite iron) V-cylinder block
- Common rail fuel system
- Timing belt
- Turbocharger

## Engine Identification

Always refer to these labels when installation of new parts is necessary or when checking engine calibrations. The engine parts often differ within a CID (cubic inch displacement) family. Verification of the identification codes will make sure the correct parts are obtained. These codes contain all the pertinent information relating to the dates, optional equipment and revisions.

## Engine Code Information Label

The engine code information is marked at two locations on the engine.

The engine code information is located on the metal tag located on the LH valve cover.

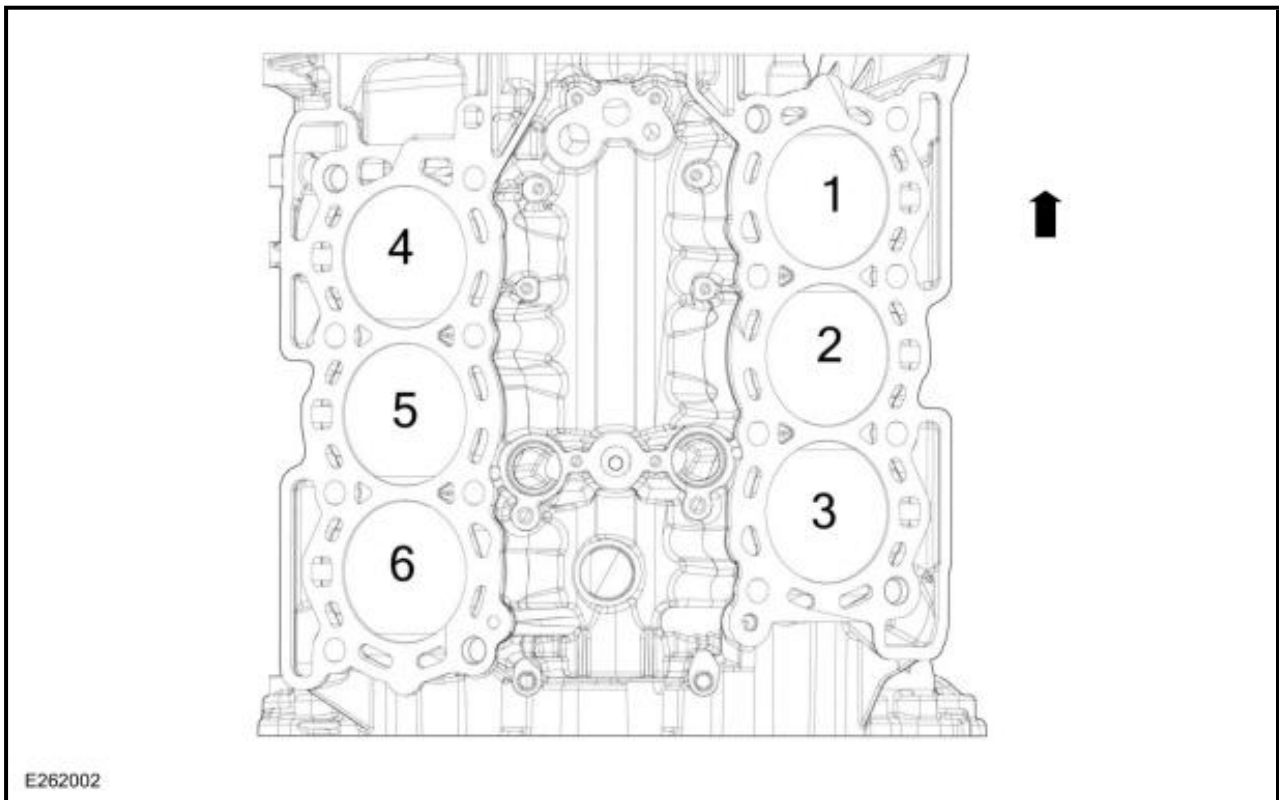


The engine code information is also located on the READ cover at the left rear of the engine.





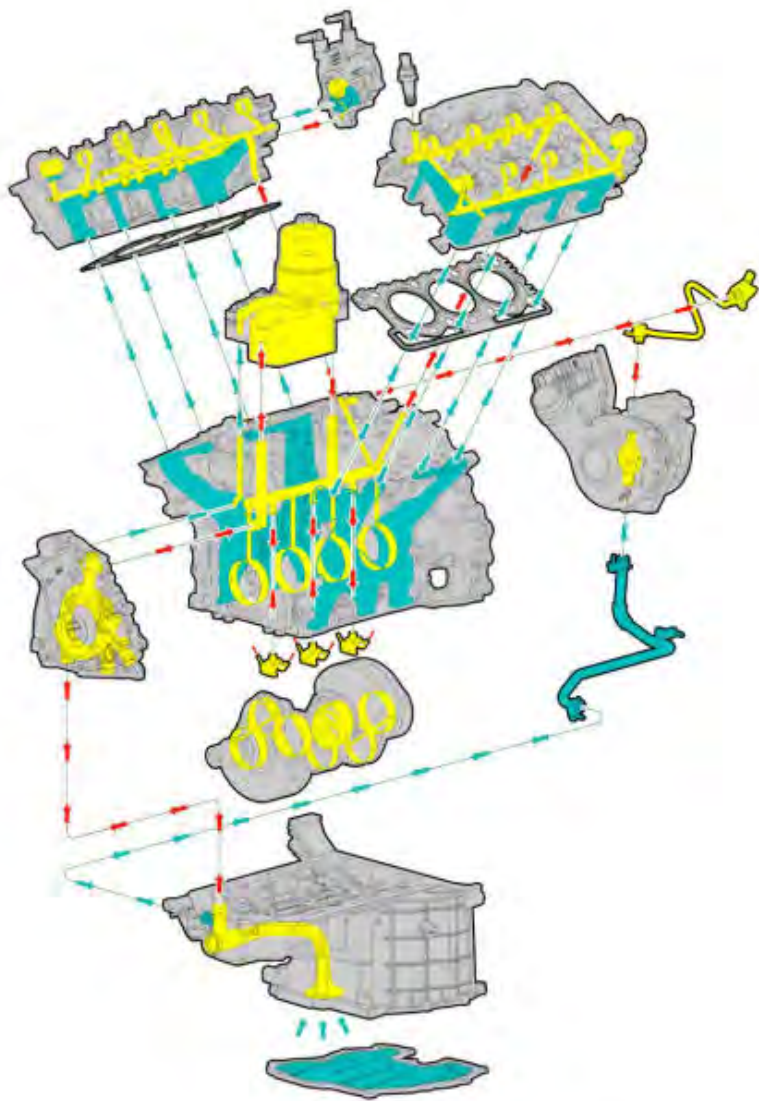
### Engine Cylinder Identification



### System Operation

### Lubrication System



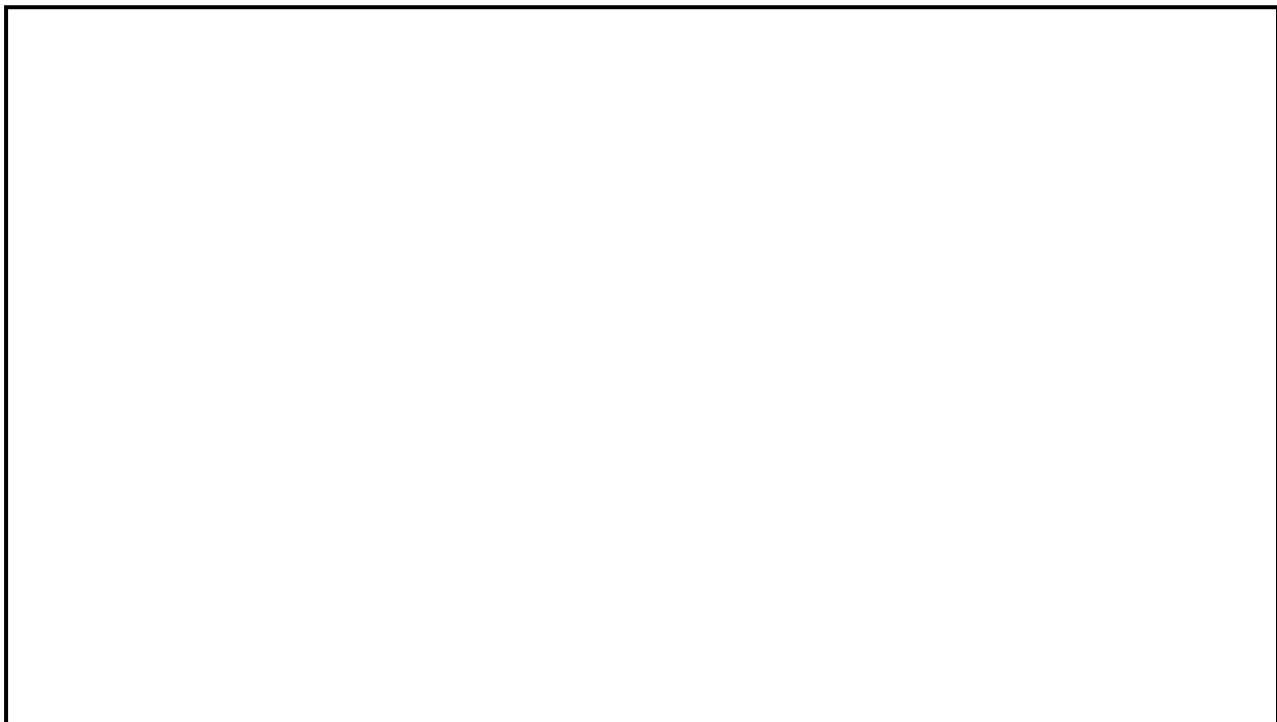


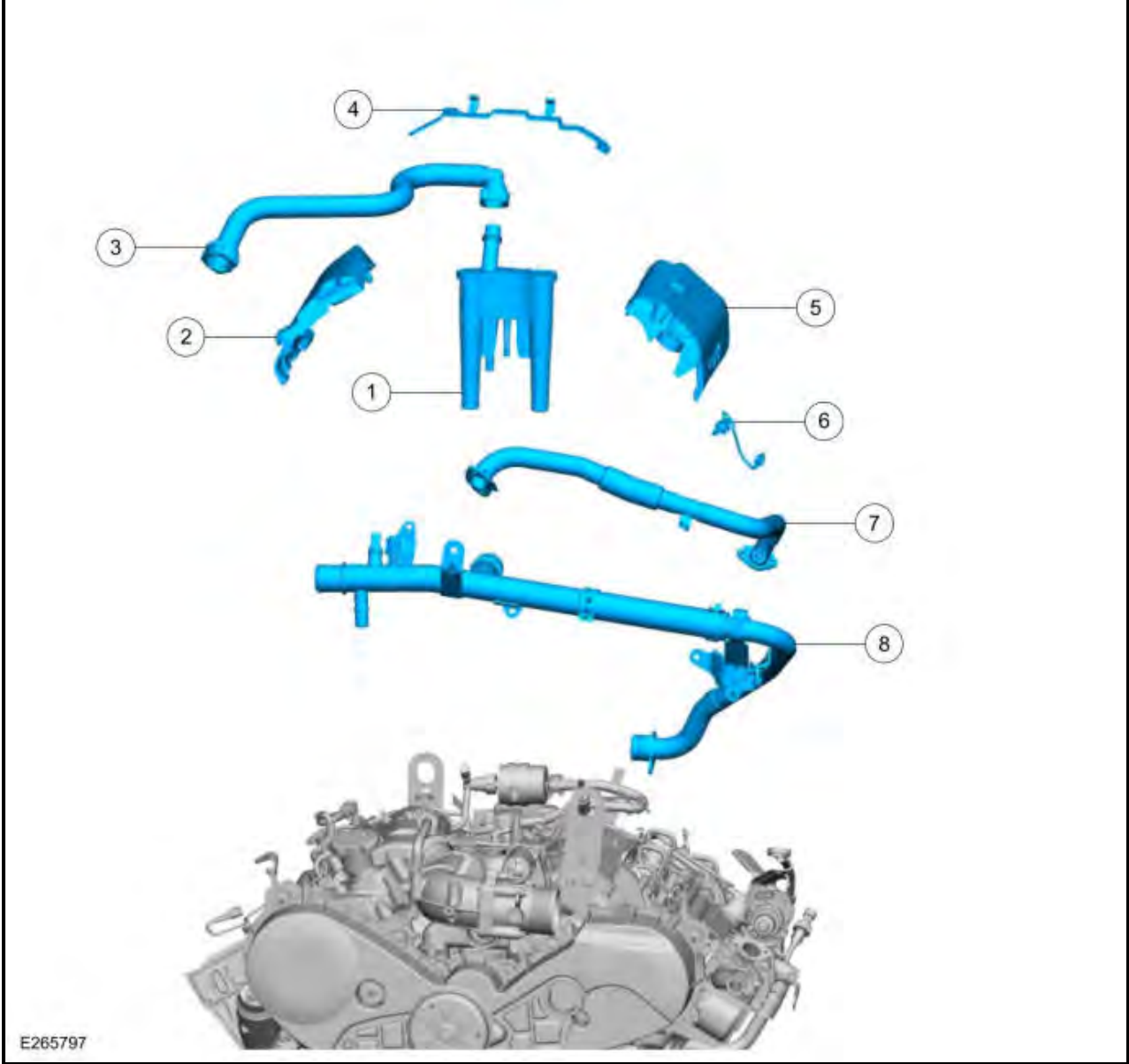
E262003

| Item   | Description                      |
|--------|----------------------------------|
| Yellow | High pressure oil flow           |
| Blue   | Oil return/low pressure oil flow |

**ENGINE COMPONENT VIEW**

**Engine Upper View 1 Exploded View**



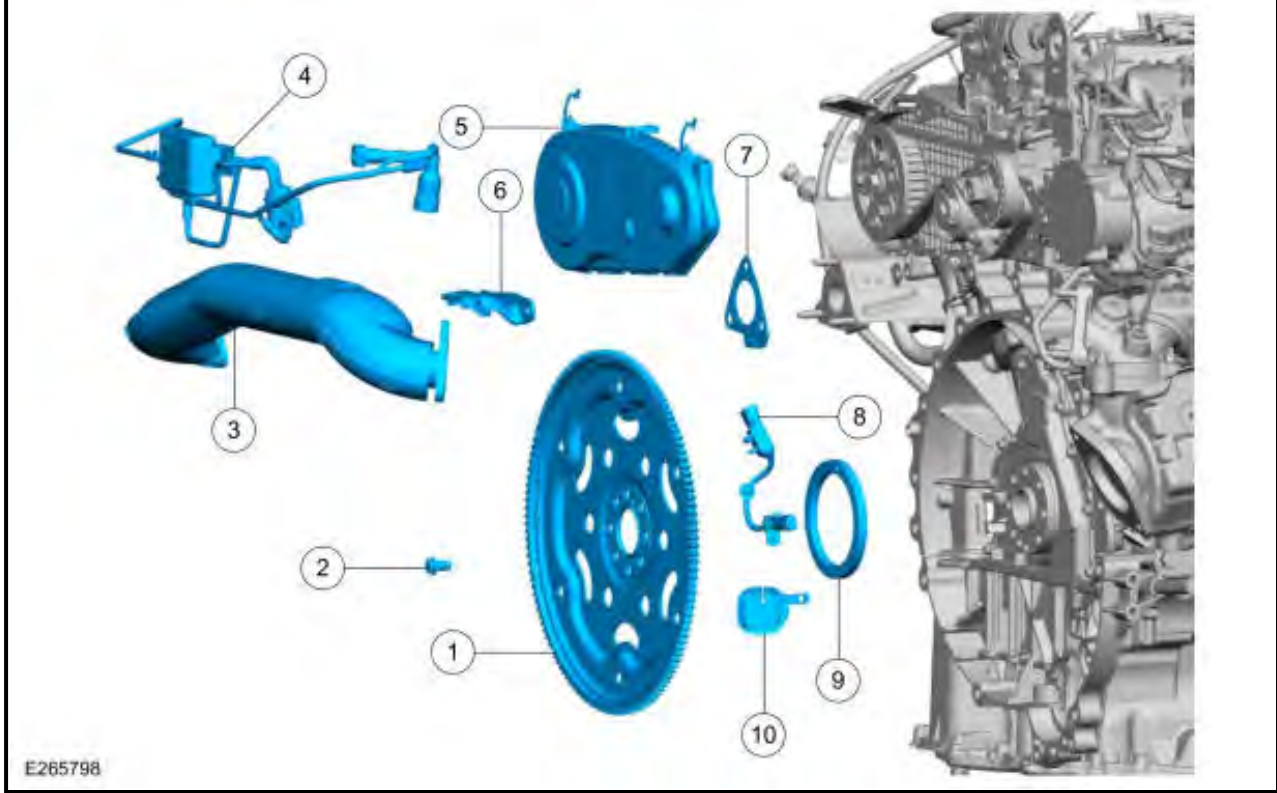


E265797

| Item | Part Number | Description   |
|------|-------------|---|
| 1    | 6A785       | Crankcase vent oil separator                            |
| 2    | 9U550       | RH (right hand) fuel injector noise insulator           |
| 3    | 6A886       | Crankcase vent oil separator hose                       |
| 4    | 6N081       | Engine cover bracket                                    |
| 5    | 9U550       | LH (left hand) fuel injector noise insulator            |
| 6    | 12B591      | EGRT (exhaust gas recirculation temperature) sensor     |
| 7    | 9H449       | EGR (exhaust gas recirculation) outlet tube             |
| 8    | 8555        | Coolant bypass tube and EGR cooler outlet hose assembly |

**Engine Rear View Exploded View**

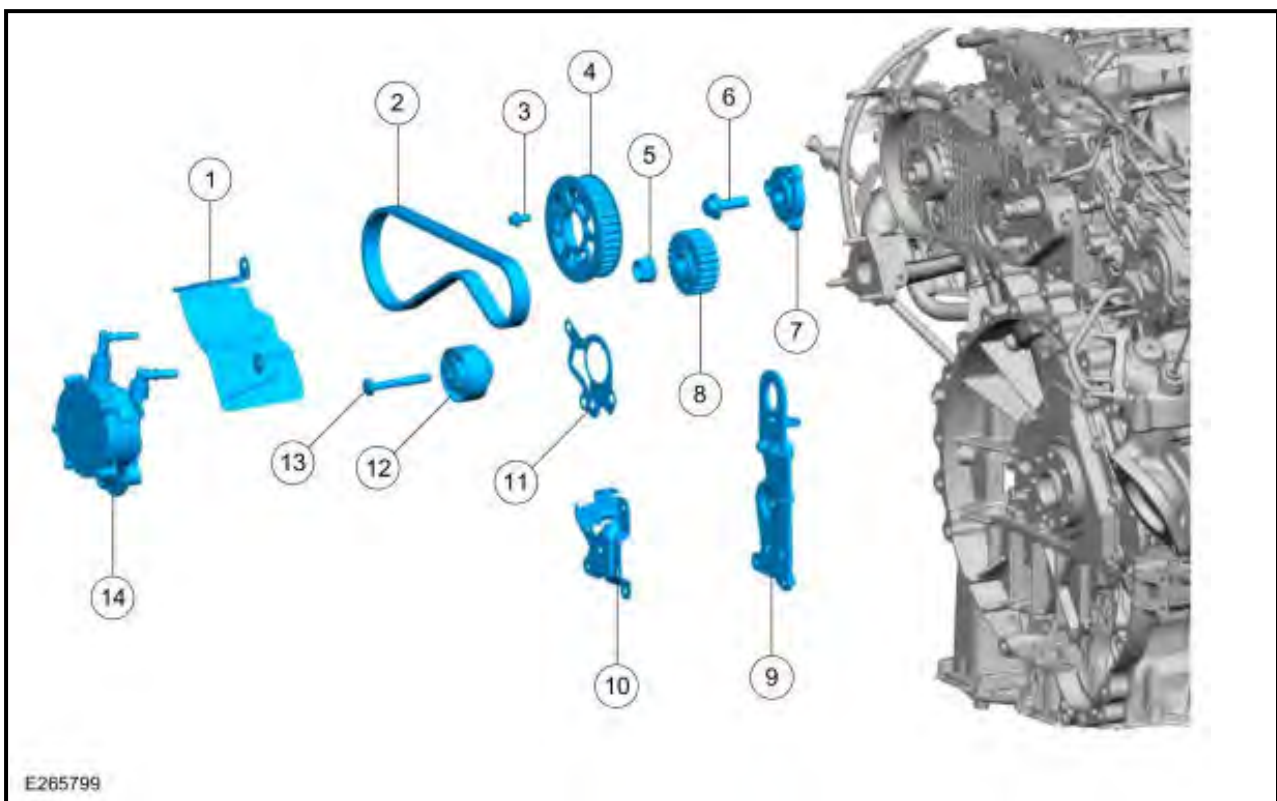




E265798

| Item | Part Number | Description   |
|------|-------------|---|
| 1    | 6375        | Flexplate   |
| 2    | 6379        | Flexplate bolt (8 required)                         |
| 3    | 6P647       | Engine exhaust crossover pipe                       |
| 4    | 9S468       | Emission system control hose and bracket assembly   |
| 5    | 6A247       | Accessory drive cover                               |
| 6    | 9L456       | Exhaust manifold crossover bracket                  |
| 7    | 9450        | Exhaust manifold crossover pipe gasket (2 required) |
| 8    | 6C315       | CKP (crankshaft position) sensor                    |
| 9    | 6M265       | Crankshaft timing trigger wheel                     |
| 10   | 6G055       | Block tool accessory hole cover                     |

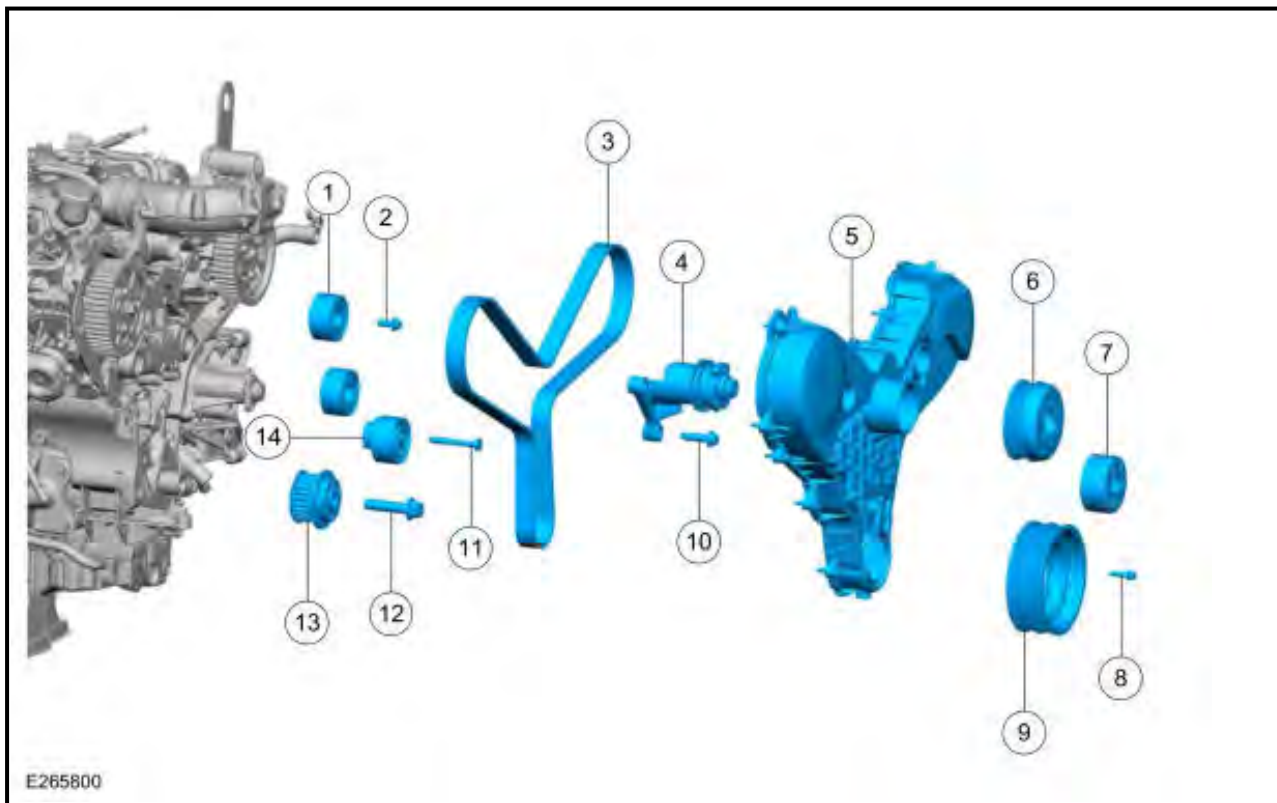
**READ and Vacuum Pump Exploded View**



E265799

| Item | Part Number | Description                       |
|------|-------------|-----------------------------------|
| 1    | 9N454       | Exhaust manifold heat shield      |
| 2    | 6K288       | Camshaft drive belt               |
| 3    | W500022     | Camshaft pulley bolt (3 required) |
| 4    | 6K286       | Camshaft pulley assembly          |
| 5    | 9D390       | Fuel injection pump nut           |
| 6    | 6279        | Camshaft gear hub bolt            |
| 7    | 6257        | Camshaft gear hub                 |
| 8    | 6A256       | Fuel injection pump pulley        |
| 9    | 17K078      | Rear engine lifting eye assembly  |
| 10   | 2A062       | Vacuum gauge bracket assembly     |
| 11   | 2D224       | Vacuum pump gasket                |
| 12   | 6K254       | Timing belt tensioner assembly    |
| 13   | W500315     | Timing belt tensioner bolt        |
| 14   | 2A451       | Vacuum pump assembly              |

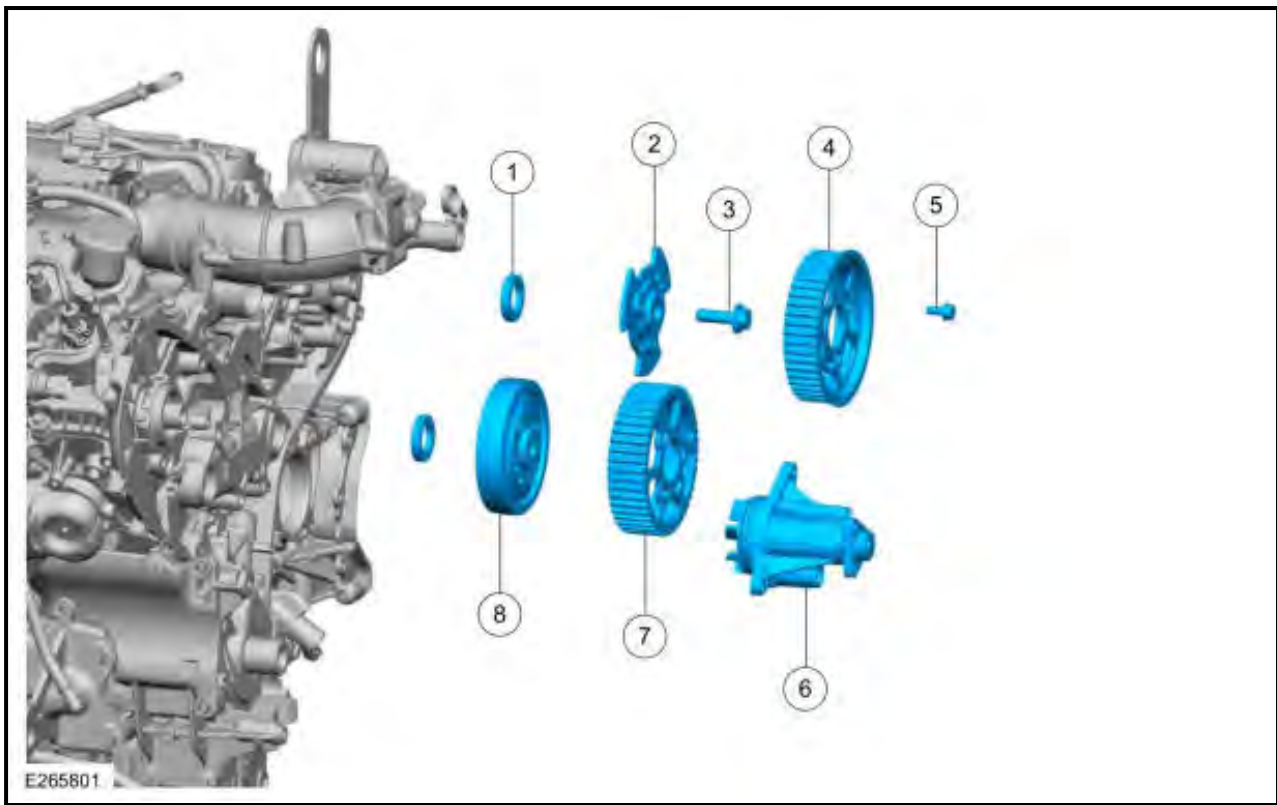
### Timing Belt Cover and Timing Belt Exploded View



| Item | Part Number | Description   |
|------|-------------|---|
| 1    | 6C348       | Timing belt routing pulley assembly (2 required)            |
| 2    | W500433     | Timing belt routing pulley bolt (2 required)                |
| 3    | 6K288       | Camshaft drive belt   |
| 4    | 8609        | Fan mounting bracket and bearing assembly                   |
| 5    | 6019        | Cylinder front cover assembly                               |
| 6    | 8610        | Fan pulley  |
| 7    | 8509        | Coolant pump pulley   |
| 8    | 6A345       | Crankshaft vibration damper bolt (6 required)               |
| 9    | 6316        | Crankshaft vibration damper assembly                        |
| 10   | W500244     | Fan mounting bracket and bearing assembly bolt (3 required) |
| 11   | 6D339       | Timing belt tensioner bolt                                  |
| 12   | 6A345       | Crankshaft pulley bolt                                      |
| 13   | 6306        | Crankshaft sprocket   |
| 14   | 6K254       | Timing belt tensioner assembly                              |

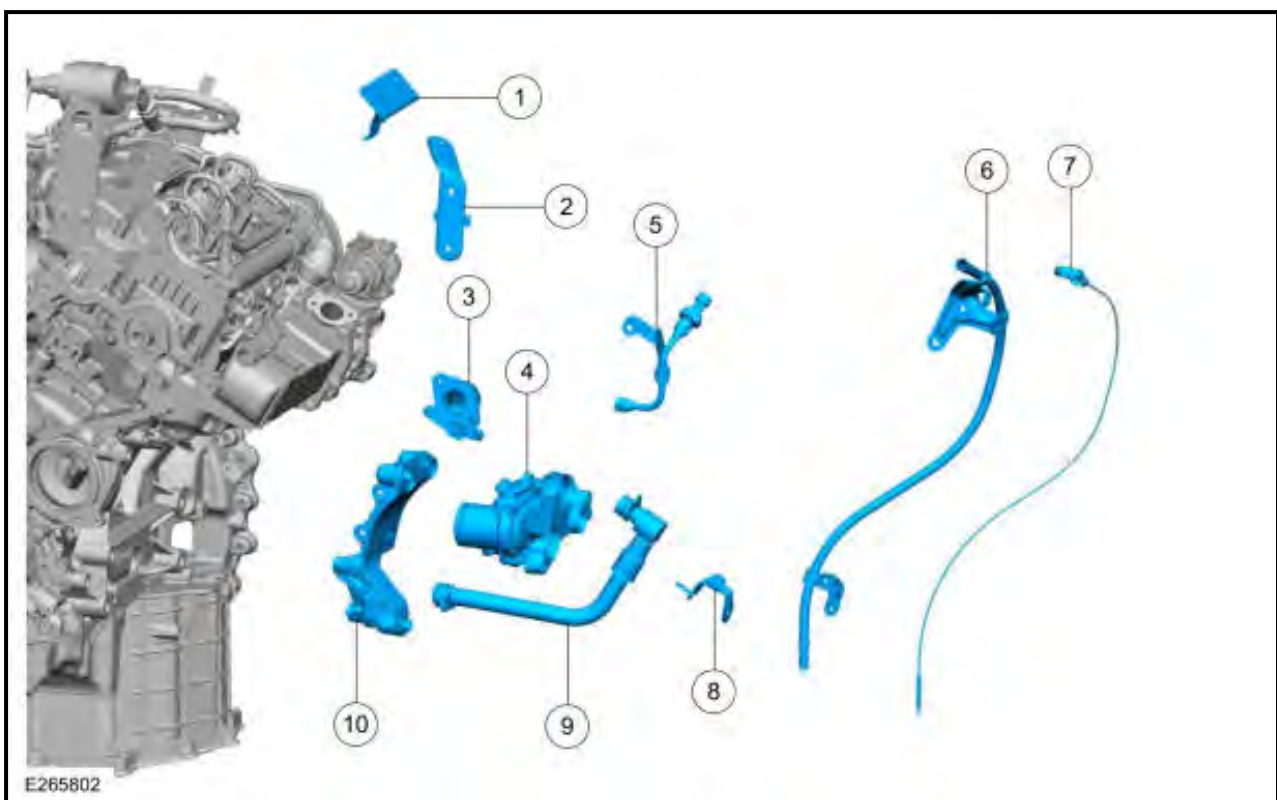


## Camshaft Drives and Coolant Pump Exploded View



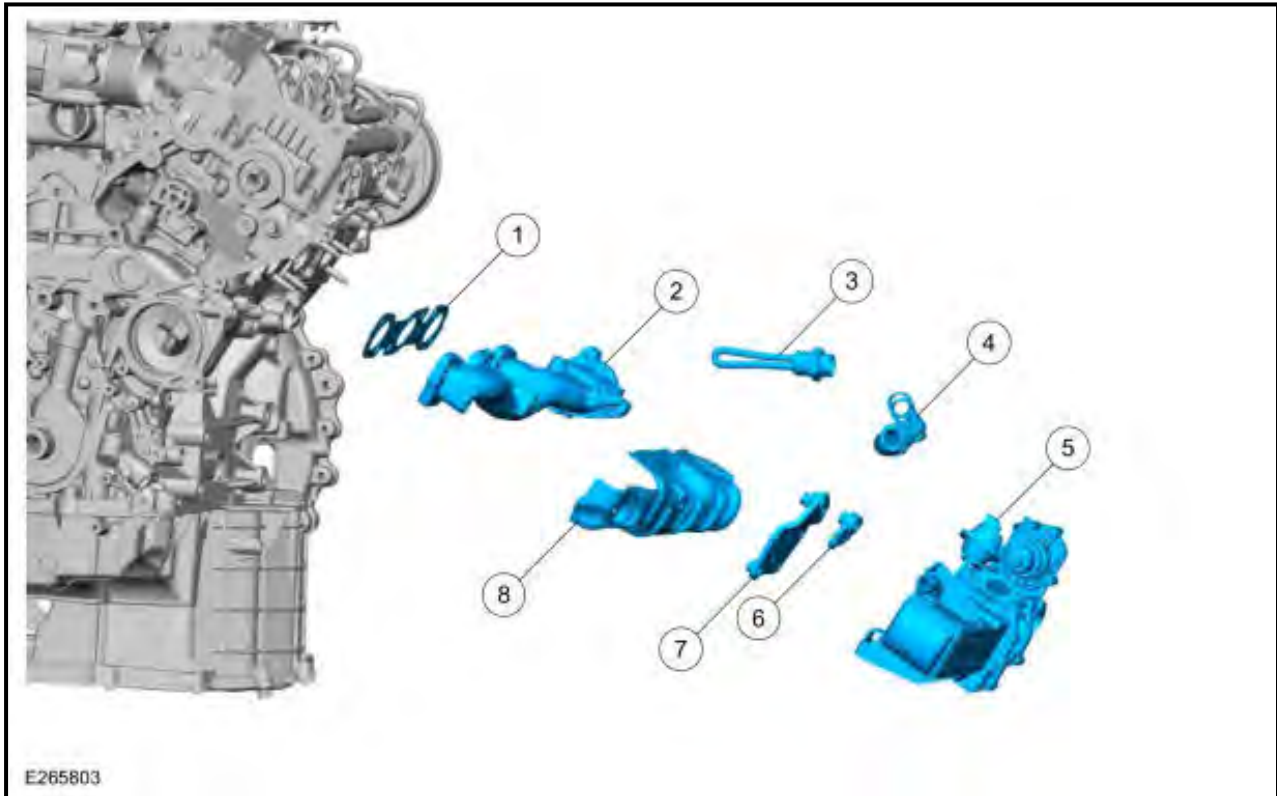
| Item | Part Number | Description                                |
|------|-------------|--|
| 1    | 6K292       | Camshaft seal (2 required)                 |
| 2    | 6257        | LH camshaft gear hub                       |
| 3    | 6279        | Camshaft gear hub bolt (2 required)        |
| 4    | 6K286       | LH camshaft pulley assembly                |
| 5    | E801031     | Camshaft pulley assembly bolt (6 required) |
| 6    | 8501        | Coolant pump assembly                      |
| 7    | 6K286       | RH camshaft pulley assembly                |
| 8    | 6257        | RH camshaft gear hub                       |

## LH View 1 Exploded View



| Item | Part Number | Description                                   |
|------|-------------|---|
| 1    | 14C508      | Wiring harness-to-engine bracket              |
| 2    | 9P995       | Fuel tube front support bracket               |
| 3    | 9D477       | EGR valve-to-exhaust manifold tube assembly   |
| 4    | 8A544       | Coolant inlet connector assembly              |
| 5    | 9F459       | EGR EP (exhaust pressure) valve tube assembly |
| 6    | 6B667       | Oil level tube and indicator assembly         |
| 7    | 6750        | Oil level indicator                           |
| 8    | 9P995       | Fuel tube front support bracket               |
| 9    | 9Y438       | EGR coolant inlet tube assembly               |
| 10   | 8D611       | LH FEAD (front end accessory drive) bracket   |

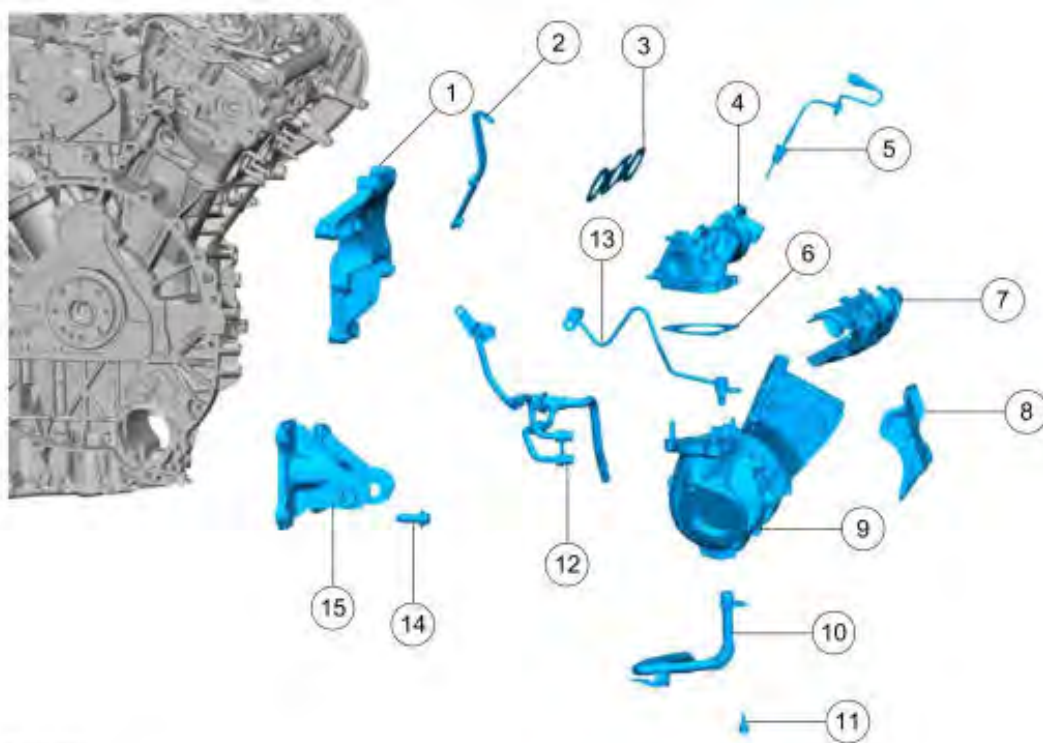
### LH View 2 Exploded View



| Item | Part Number | Description                     |
|------|-------------|---------------------------------|
| 1    | 9448        | LH exhaust manifold gasket      |
| 2    | 9431        | LH exhaust manifold             |
| 3    | 6A051       | Engine block heater assembly    |
| 4    | 9Y439       | EGR cooler outlet hose assembly |
| 5    | 9U438       | EGR cooler assembly             |
| 6    | 9F465       | EGR cooler mounting bracket     |
| 7    | 9F465       | EGR cooler mounting bracket     |
| 8    | 9N454       | LH exhaust manifold heat shield |

### RH View Exploded View

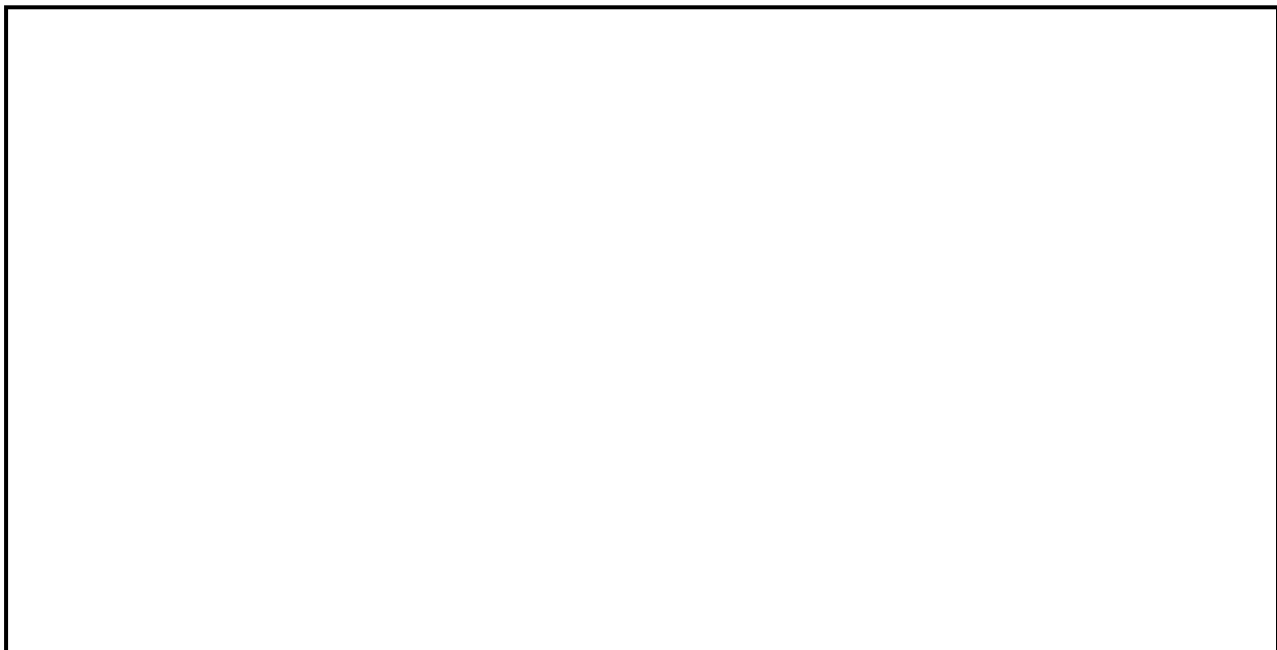


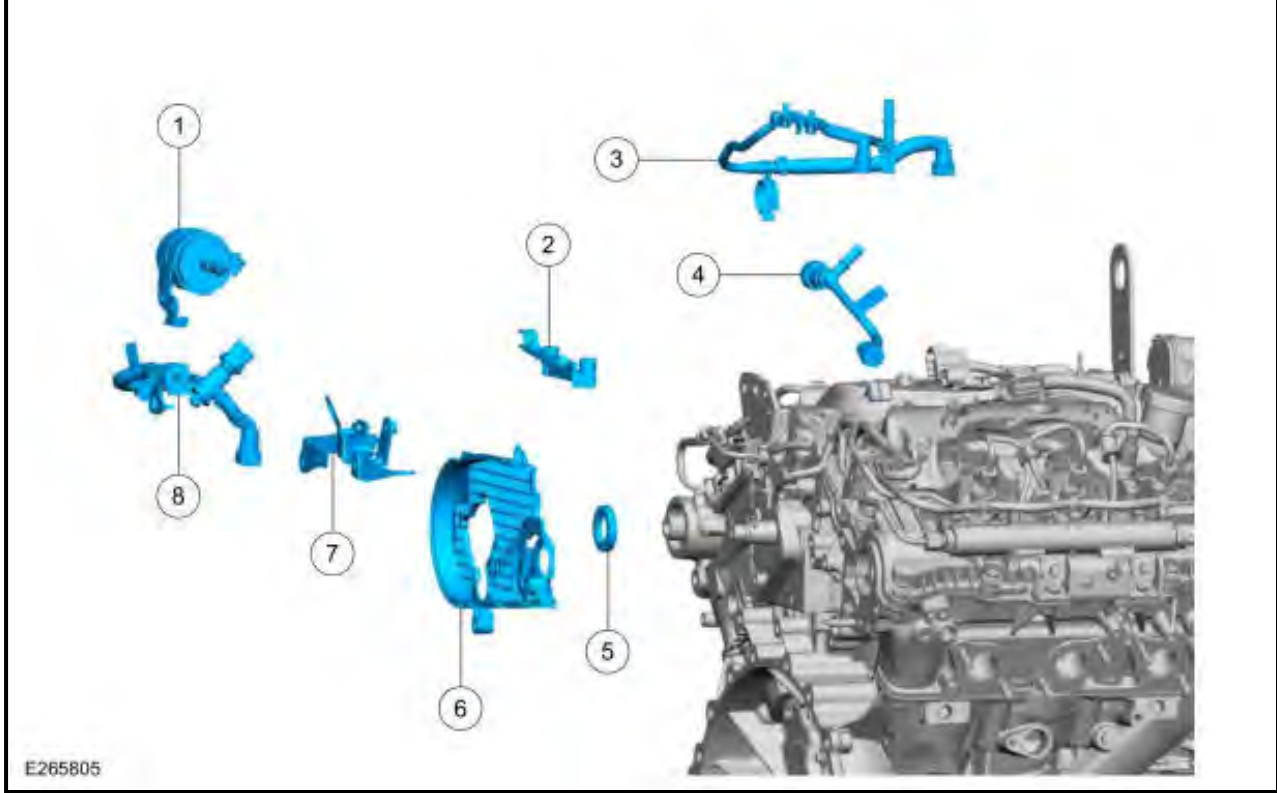


E265804

| Item | Part Number | Description   |
|------|-------------|---|
| 1    | 8D611       | RH FEAD bracket                                     |
| 2    | 18481       | Heater hose support bracket                         |
| 3    | 9448        | RH exhaust manifold gasket                          |
| 4    | 9430        | RH exhaust manifold                                 |
| 5    | 12B591      | EGRT (exhaust gas recirculation temperature) sensor |
| 6    | 9450        | Exhaust manifold-to-turbocharger gasket             |
| 7    | 9N454       | RH exhaust manifold heat shield                     |
| 8    | 6K733       | Turbocharger heat shield                            |
| 9    | 6K682       | Turbocharger assembly                               |
| 10   | 6K673       | Turbocharger oil drain tube                         |
| 11   | W716088     | Turbocharger oil drain tube bolt                    |
| 12   | 8A506       | Coolant tube assembly                               |
| 13   | 6K679       | Turbocharger oil supply tube                        |
| 14   | W718444     | Engine mounting bracket bolt (4 required)           |
| 15   | 6046        | Engine mounting bracket assembly                    |

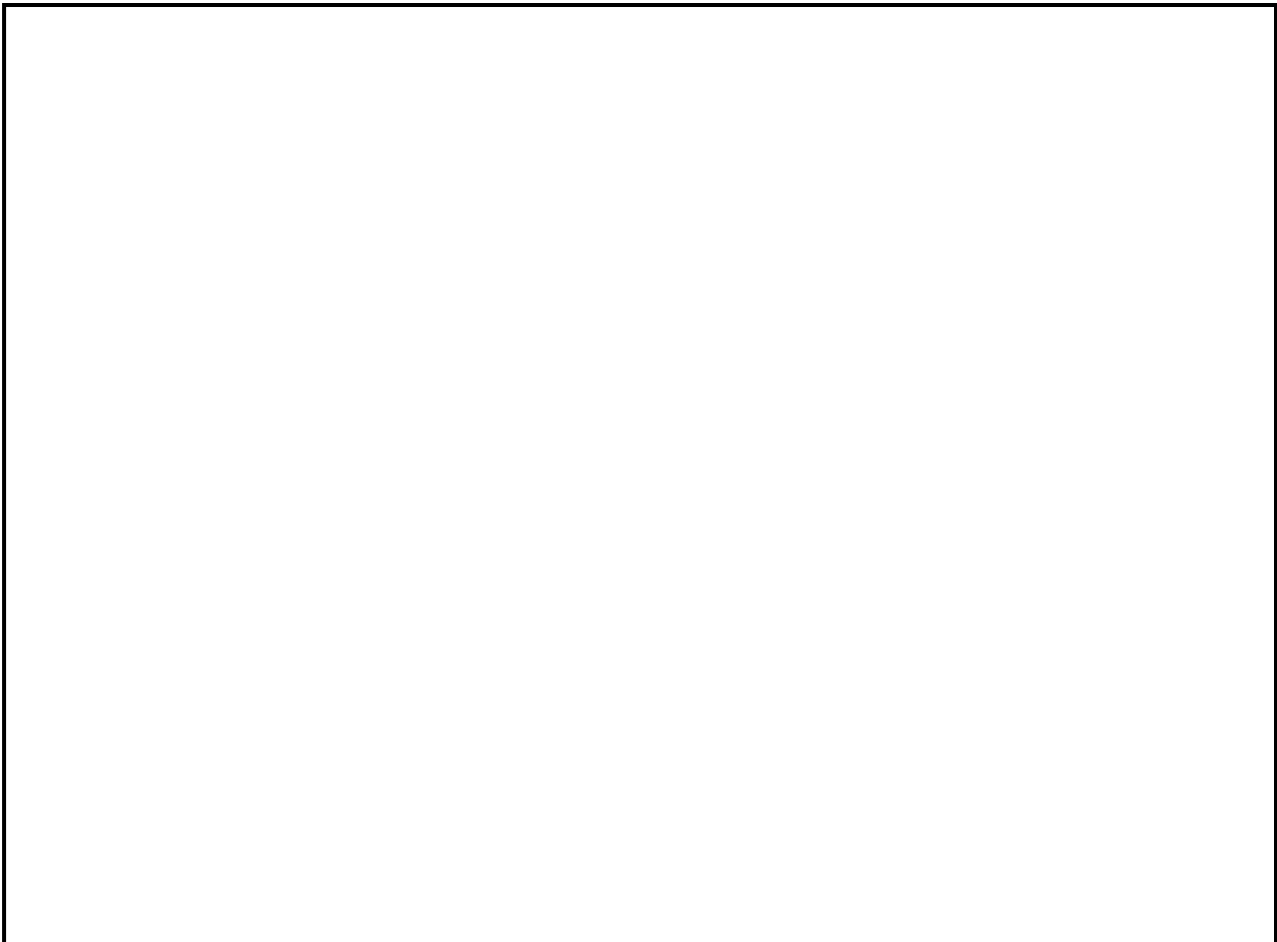
### Fuel Tubes and READ Cover Exploded View

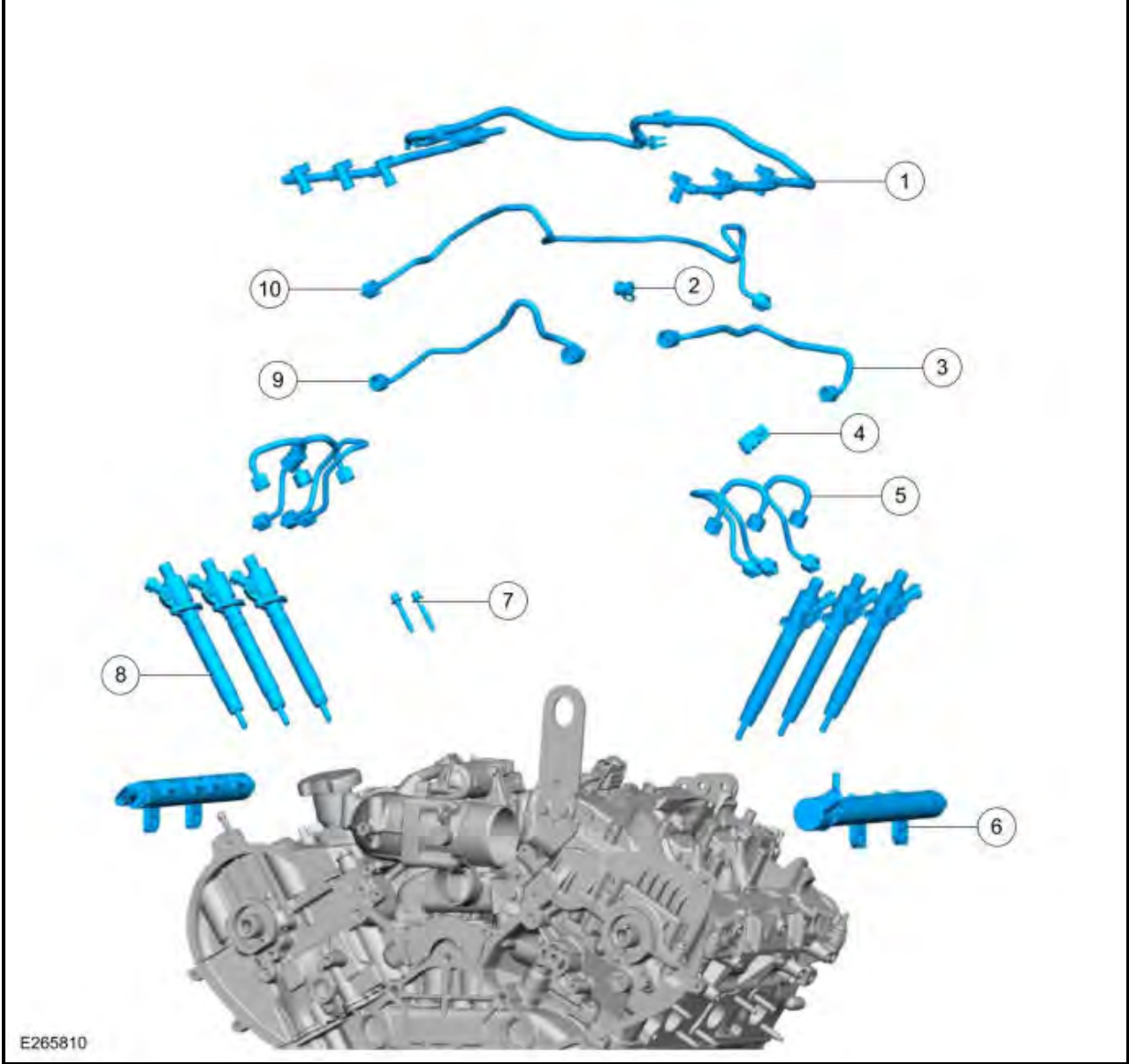




| Item | Part Number | Description                                |
|------|-------------|--|
| 1    | 9T329       | Fuel secondary filter and bracket assembly |
| 2    | 6A247       | Accessory drive belt cover                 |
| 3    | 9K151       | Fuel return tube assembly                  |
| 4    | 9J280       | Fuel supply tube assembly                  |
| 5    | 6K292       | Camshaft seal                              |
| 6    | 6A247       | Accessory drive belt cover                 |
| 7    | 14C508      | Wire harness-to-engine bracket             |
| 8    | 9J280       | Fuel supply tube assembly                  |

### Fuel Injectors and Tubes Exploded View

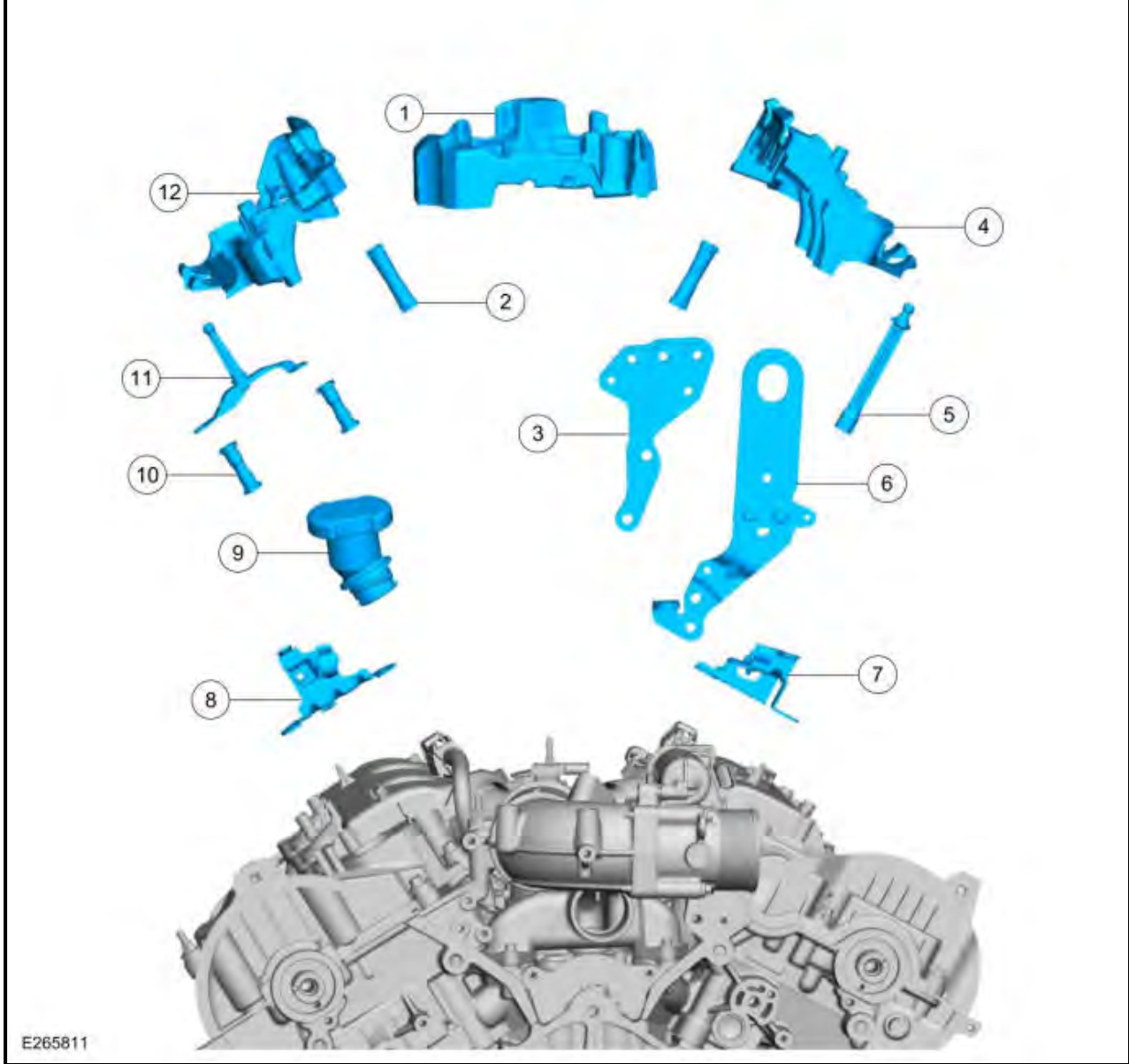




| Item | Part Number | Description  |
|------|-------------|--|
| 1    | 9K022       | Fuel leak back tube assembly                           |
| 2    | 9A317       | Fuel hose clips (2 required)                           |
| 3    | 9F911       | LH fuel manifold supply tube                           |
| 4    | 9A317       | Fuel line clip (3 required)                            |
| 5    | 9C993       | Fuel injector inlet tube assembly (6 required)         |
| 6    | 9D280       | Fuel manifold assembly (2 required)                    |
| 7    | 9L535       | Fuel injector clamp bolt (12 required)                 |
| 8    | 9K546       | Fuel injector and holder assembly (6 required)         |
| 9    | 9F911       | RH fuel manifold supply tube                           |
| 10   | 9E920       | Fuel injection pump distribution balance tube assembly |

**Engine Upper View 2 Exploded View**



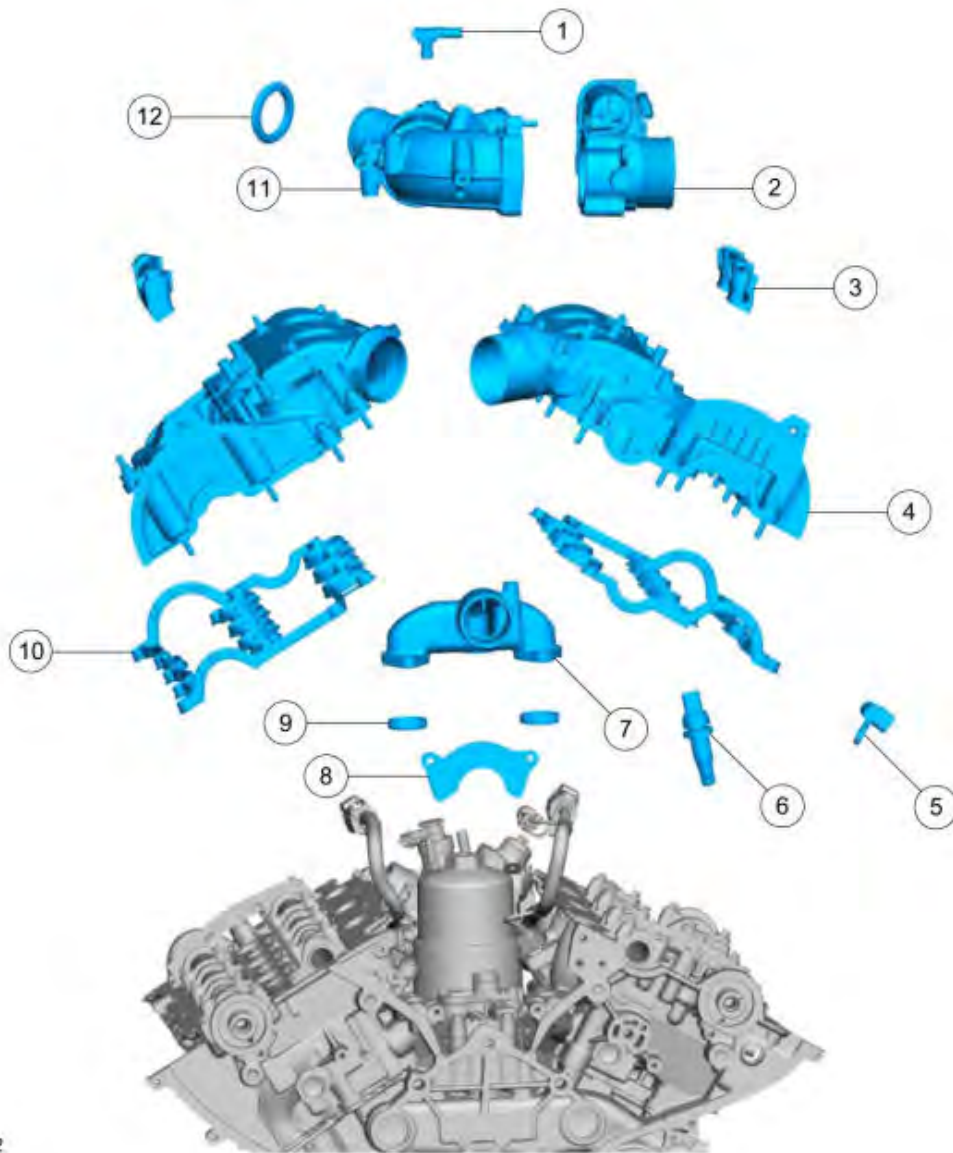


E265811

| Item | Part Number | Description                                |
|------|-------------|--|
| 1    | 9U550       | Fuel injection pump noise insulator        |
| 2    | 6A970       | Engine cover stud (2 required)             |
| 3    | 10356       | Engine cover rear bracket                  |
| 4    | 9U550       | LH fuel injector noise insulator           |
| 5    | 6A962       | Engine cover stud assembly                 |
| 6    | 17K077      | Engine lifting front eye assembly          |
| 7    | 9B394       | Fuel valve mounting bracket                |
| 8    | 9C244       | Fuel tube return bracket                   |
| 9    | 6B612       | Oil fill pipe and cap assembly             |
| 10   | 6A970       | Engine cover stud (2 required)             |
| 11   | 6L010       | Engine side cover support bracket assembly |
| 12   | 9U550       | RH fuel injector noise insulator           |

### Valve Covers and Intake Manifold Exploded View



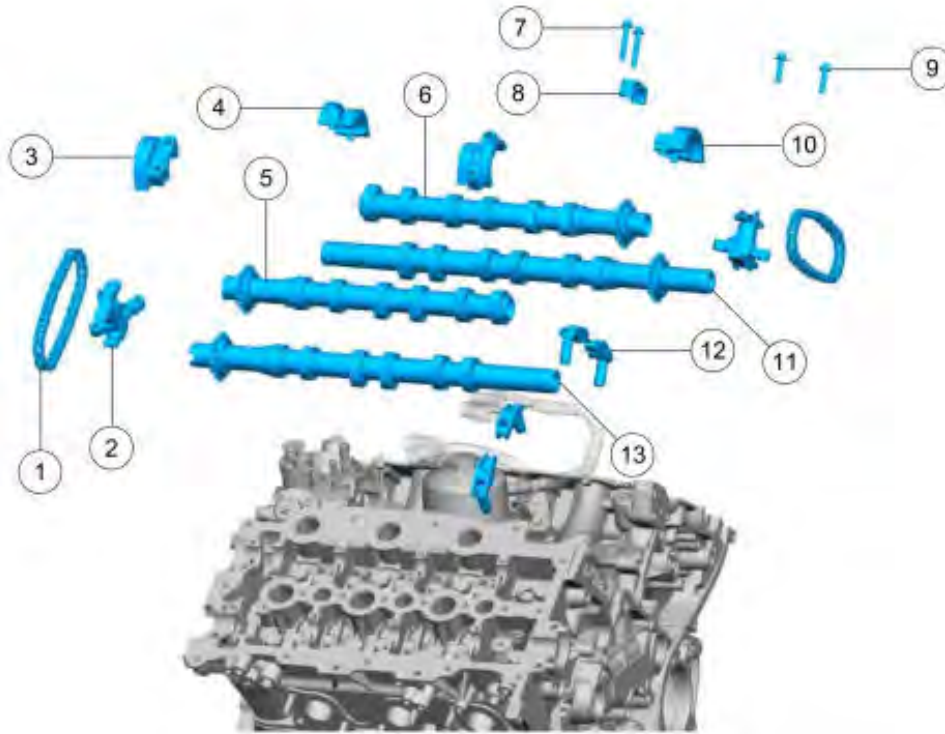


E265812

| Item | Part Number | Description                                  |
|------|-------------|--|
| 1    | 9F479       | MAP (manifold absolute pressure) sensor      |
| 2    | 9F991       | TB (throttle body) assembly                  |
| 3    | 9W276       | Fuel line support bracket (2 required)       |
| 4    | 9424        | Intake manifold assembly (2 required)        |
| 5    | 12K073      | CMP (camshaft position) sensor               |
| 6    | 9D290       | Oil pressure sensor assembly                 |
| 7    | 8592        | Coolant outlet connector assembly            |
| 8    | 6019        | Cylinder front cover assembly                |
| 9    | 9K462       | Coolant outlet connector gasket (2 required) |
| 10   | 6584        | Intake manifold gasket (2 required)          |
| 11   | 9S455       | Intake manifold assembly                     |
| 12   | 9E936       | Intake manifold gasket (2 required)          |

### Camshafts Exploded View





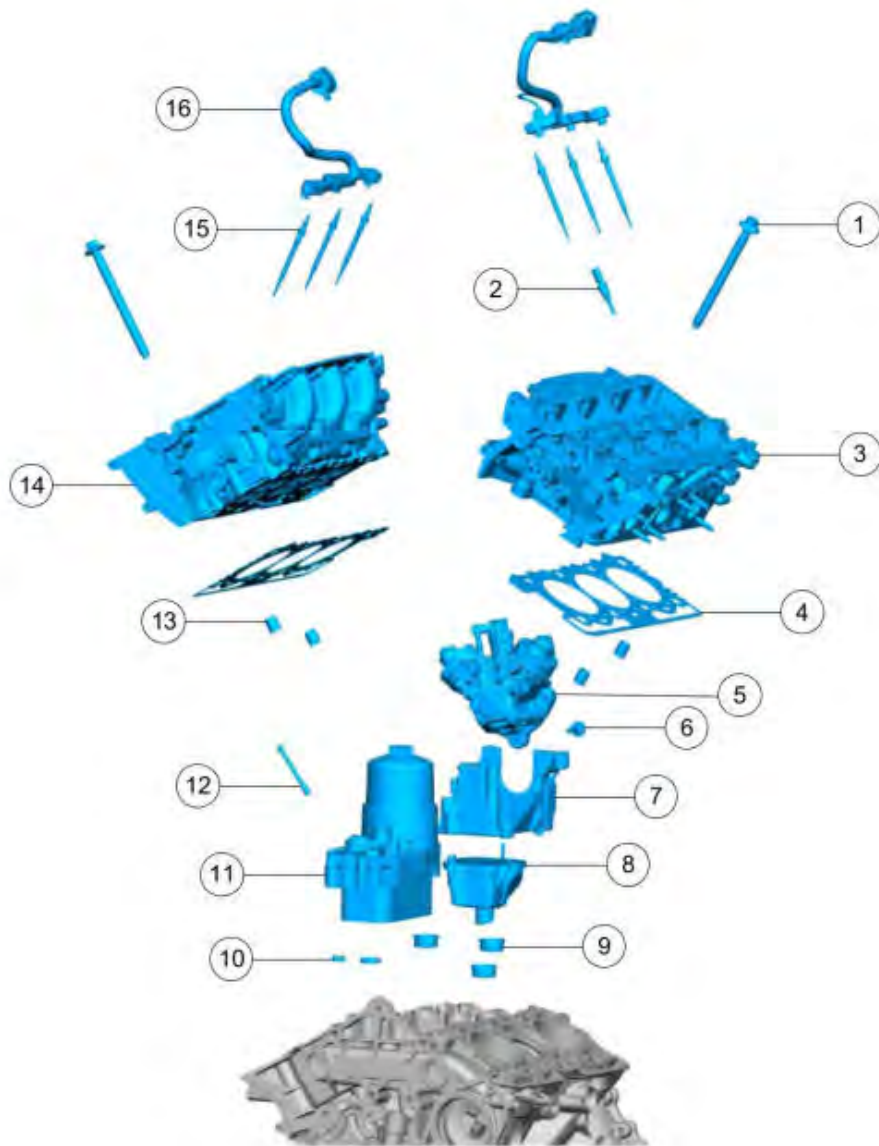
E265813

| Item | Part Number | Description   |
|------|-------------|---|
| 1    | 6268        | Timing chain (2 required)                                 |
| 2    | 6L266       | Timing chain tensioner (2 required)                       |
| 3    | 6B284       | Camshaft bearing cap (part of cylinder head)              |
| 4    | 6B280       | Camshaft bearing cap (2 required/ part of cylinder head)  |
| 5    | 6A270       | RH intake camshaft  |
| 6    | 6A271       | LH intake camshaft  |
| 7    | W710256     | Camshaft bearing cap bolt (36 required)                   |
| 8    | 6A258       | Camshaft bearing cap (14 required/ part of cylinder head) |
| 9    | W500015     | Timing chain tensioner bolt (4 required)                  |
| 10   | 6B281       | Camshaft bearing cap (part of cylinder head))             |
| 11   | 6A273       | LH exhaust camshaft                                       |
| 12   | 6G093       | Rocker arm and adjuster assembly (24 required)            |
| 13   | 6A272       | RH exhaust camshaft                                       |

### Cylinder Heads, Oil Cooler and Fuel Injection Pump Exploded View





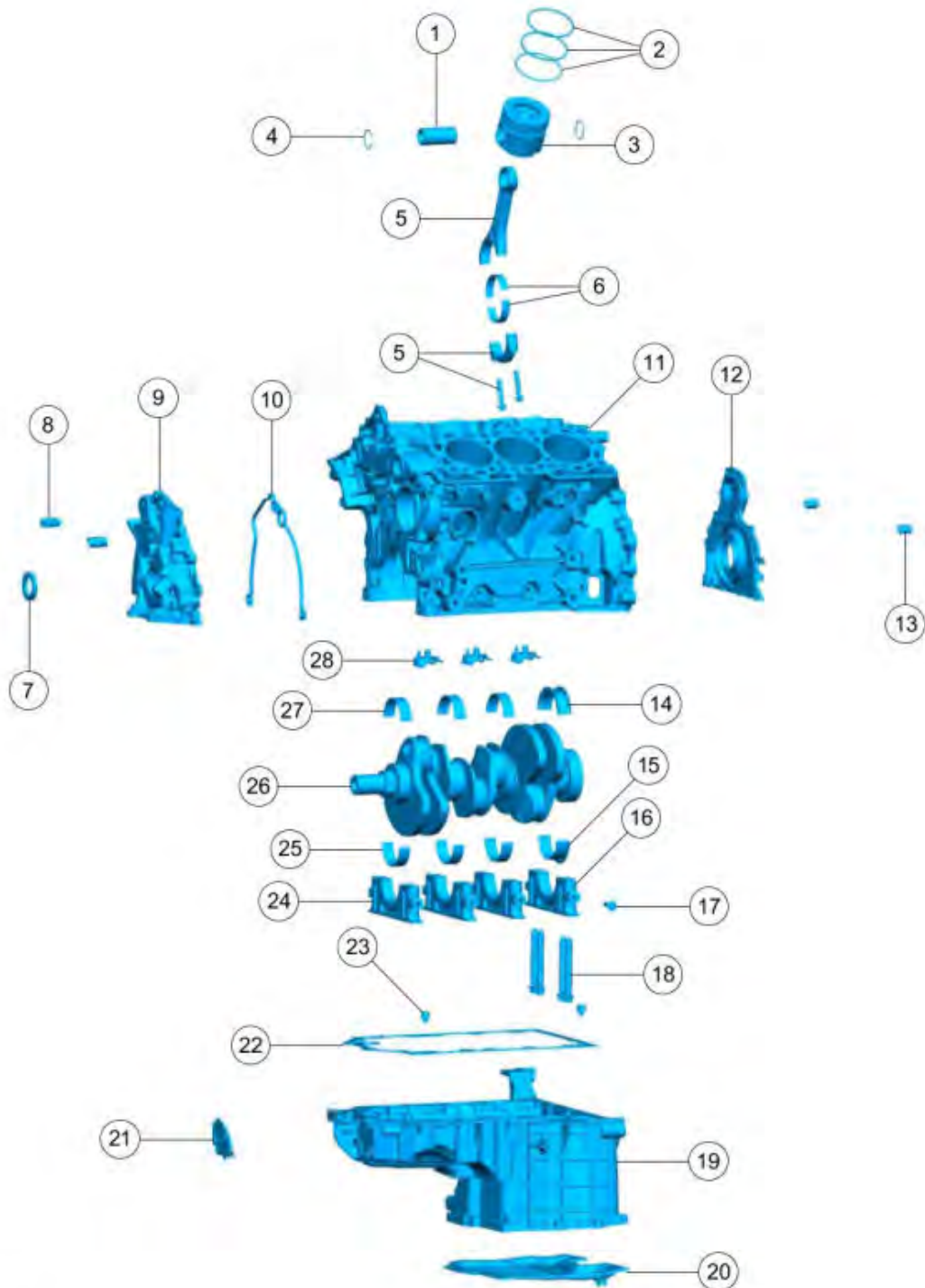


E265814

| Item | Part Number | Description                                       |
|------|-------------|---|
| 1    | 6065        | Cylinder head bolt (16 required)                  |
| 2    | 6G004       | CHT (cylinder head temperature) sensor            |
| 3    | 6050        | LH cylinder head                                  |
| 4    | 6051        | Cylinder head gasket (2 required)                 |
| 5    | 9B395       | Fuel injection pump                               |
| 6    | 9D404       | Fuel injection pump bolt (3 required)             |
| 7    | 9D355       | Fuel injection pump mounting bracket              |
| 8    | 6C714       | CCV (crankcase ventilation) reservoir assembly    |
| 9    | 6870        | Crankcase vent tube gasket (3 required)           |
| 10   | 6L709       | Oil filter adapter and cooler O-ring (4 required) |
| 11   | 6B624       | Oil filter adapter and cooler assembly            |
| 12   | 6C683       | Engine oil filter                                 |
| 13   | W713977     | Cylinder head dowel (4 required)                  |
| 14   | 6049        | RH cylinder head                                  |
| 15   | 6M090       | Glow plug (6 required)                            |
| 16   | 12A378      | Glow plug wiring (2 required)                     |

### Lower Engine Block Exploded View





E265815

| Item | Part Number | Description                                       |
|------|-------------|---|
| 1    | 6135        | Piston pin (6 required)                           |
| 2    | 6148        | Piston ring set (6 required)                      |
| 3    | 6108        | Piston (6 required)                               |
| 4    | 6140        | Piston pin retaining ring (12 required)           |
| 5    | 6200        | Connecting rod assembly (6 required)              |
| 6    | 6211        | Connecting rod bearing (6 required)               |
| 7    | 6700        | Front crankshaft seal                             |
| 8    | 6643        | Oil pump body-to-cylinder block seal (2 required) |
| 9    | 6600        | Oil pump assembly                                 |
| 10   | 6626        | Oil pump gasket                                   |
| 11   | 6010        | Cylinder block                                    |
| 12   | 6K301       | Rear crankshaft seal with retainer plate          |
| 13   | 6397        | Cylinder block dowels (2 required)                |
| 14   | 6337        | Upper main thrust bearing                         |
| 15   | 6A339       | Lower main thrust bearing                         |

| Item | Part Number | Description  |
|------|-------------|--|
| 16   | 6325        | Crankshaft main bearing cap (part of 6010)             |
| 17   | 6C357       | Crankshaft main bearing side bolt (8 required)         |
| 18   | 6345        | Crankshaft main bearing bolt (16 required)             |
| 19   | 6U004       | Engine block skirt stiffener assembly                  |
| 20   | 6675        | Oil pan assembly                                       |
| 21   | 7A828       | Converter housing lower access cover                   |
| 22   | 6G046       | Engine block skirt stiffener gasket                    |
| 23   | 6G090       | Cylinder block-to-stiffener dowel (2 required)         |
| 24   | 6330        | Crankshaft main bearing cap (3 required/ part of 6010) |
| 25   | 6331        | Lower crankshaft main bearing (3 required)             |
| 26   | 6303        | Crankshaft   |
| 27   | 6338        | Upper crankshaft main bearing (3 required)             |
| 28   | 6K858       | Piston cooling nozzles                                 |

## DIAGNOSIS AND TESTING

### ENGINE

#### Inspection and Verification - Engine Performance

**NOTE:** There are 2 diagnostic paths that can be followed depending on the type of engine concern. Carry out Inspection and Verification - Engine Performance or Inspection and Verification - NVH.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.
3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

4. **NOTE:** Make sure to use the latest scan tool software release.

If the cause is not visually evident, connect the scan tool to the DLC.

5. **NOTE:** The VCM LED prove out confirms power and ground from the DLC are provided to the VCM.

If the scan tool does not communicate with the VCM:

- check the VCM connection to the vehicle.
- check the scan tool connection to the VCM.
- check for No Power To The Scan Tool, to diagnose no power to the scan tool, REFER to: [Communications Network](#).

6. If the scan tool does not communicate with the vehicle:

- verify the ignition key is in the ON position.
- verify the scan tool operation with a known good vehicle.
- to diagnose no response from the PCM, REFER to: [Communications Network](#).

7. Carry out the network test.

- If the scan tool responds with no communication for one or more modules, REFER to: [Communications Network](#).
- If the network test passes, retrieve and record continuous memory DTCs.

8. Clear the continuous DTCs and carry out the self-test diagnostics for the PCM.
9. If the DTCs retrieved are related to the concern, REFER to: [Electronic Engine Controls](#) .
10. If no DTCs related to the concern are retrieved, GO to [Symptom Chart - Engine Performance](#).

### Inspection and Verification - NVH

1. NVH symptoms should be identified using the diagnostic tools and techniques that are available. For a list of these techniques, tools, an explanation of their uses and a glossary of common terms, REFER to: [Noise, Vibration and Harshness \(NVH\)](#) . Since it is possible that any one of multiple systems may be the cause of the symptom, it may be necessary to use a process of elimination type of diagnostic approach to pinpoint the responsible system.
2. Verify the customer concern by operating the engine to duplicate the condition.
3. Check the engine oil level and check the oil for contamination. Low engine oil level or contaminated oil are a common cause of engine noise. If the oil is contaminated, the source of the contamination must be identified and repaired as necessary.
4. Visually inspect for obvious signs of mechanical damage.
5. If the inspection reveals obvious concerns that can be readily identified, repair as necessary.

6. **NOTE:**           **Make sure to use the latest scan tool software release.**

If the cause is not visually evident, connect the scan tool to the DLC.

7. **NOTE:**           **The VCM LED prove out confirms power and ground from the DLC are provided to the VCM.**

If the scan tool does not communicate with the VCM:

- check the VCM connection to the vehicle.
- check the scan tool connection to the VCM.
- check for No Power To The Scan Tool, to diagnose no power to the scan tool, REFER to: [Communications Network](#) .

8. If the scan tool does not communicate with the vehicle:

- verify the ignition key is in the ON position.
- verify the scan tool operation with a known good vehicle.
- to diagnose no response from the PCM, REFER to: [Communications Network](#) .

9. Carry out the network test.

- If the scan tool responds with no communication for one or more modules, REFER to: [Communications Network](#) .
- If the network test passes, retrieve and record continuous memory DTCs.

10. Clear the continuous DTCs and carry out the self-test diagnostics for the PCM.

11. If the DTCs retrieved are related to the concern, REFER to: [Electronic Engine Controls](#) .

12. If no DTCs related to the concern are retrieved, continue the inspection and verification if a noise concern is related to the engine. For vibration concerns and noise concerns such as powertrain mounts, air intake system and starter GO to [Symptom Chart - NVH](#).

In some cases, a noise may be a normal characteristic of that engine type. In other cases the noise may require further investigation. Comparing the noise to a similar year/model vehicle equipped with the same engine will aid in determining if the noise is normal or abnormal.

Once a customer concern has been identified as an abnormal engine noise, it is critical to determine the location of the specific noise. Use the EngineEAR/ChassisEAR or stethoscope (the

noise will always be louder closer to the noise source) to isolate the location of the noise to one of the following areas.

- Fuel system
- Upper end of engine
- Lower end of engine
- Front of engine
- Rear of engine

### **Fuel system noise**

A common source of an engine ticking noise can be related to the fuel injection pump or fuel injector(s). This is normal engine noise that can be verified by listening to another vehicle. If the injector noise is excessive or irregular, use the EngineEAR/ChassisEAR or stethoscope to isolate the noise to a specific fuel injector.

### **Upper end engine noise**

A common source of upper end engine noise (ticking, knocking or rattle) include the camshaft(s) and valve train. Upper end engine noise can be determined using the EngineEAR/ChassisEAR or stethoscope on the valve cover bolts. If the noise is loudest from the valve cover bolts, then the noise is upper end. The EngineEAR/ChassisEAR or stethoscope can be used to further isolate the noise to the specific cylinder bank and cylinder. Removal of the valve covers will be required to pinpoint the source of the noise.

### **Lower end engine noise**

A common source of lower end engine noise (ticking or knocking) include the crankshaft, connecting rod(s) and bearings. Lower end noises can be determined by using the oil pan or lower cylinder block. If the noise is loudest from these areas, then the noise is lower end. If an engine noise is isolated to the lower end, some disassembly of the engine may be required to inspect for damage or wear.

### **Front of engine noise**

A common source of noise from the front of the engine (squeal, chirp, whine or hoot) is the FEAD components. To isolate FEAD noise, carry out the Engine Accessory Test, REFER to: [Noise, Vibration and Harshness \(NVH\)](#).

Some other noises from the front of the engine (ticking, tapping or rattle) may be internal to the engine. Use the EngineEAR/ChassisEAR or stethoscope on the timing belt cover to determine if the noise is internal to the engine. Removal of the timing belt cover may be necessary to inspect internal engine components.

### **Rear of engine noise**

A common source of noise from the rear of the engine (knocking) is the flexplate. Inspection of the flexplate will be necessary.

### **Turbocharger noise**

A common source of noise is the turbocharger. Some whine or air rush noise is an acceptable condition.

13. After the noise is localized, note the characteristics of the noise, including type of noise, frequency and conditions when the noise occurs and GO to [Symptom Chart - NVH](#).

### **Symptom Chart(s)**

#### **Symptom Chart - Engine Performance**

| Symptom | Possible Sources | Action |
|---------|------------------|--------|
|         |                  |        |

| Symptom   | Possible Sources   | Action   |
|---|--|--|
| Difficult starting  | Inoperative or damaged glow plug system<br>Inoperative or damaged fuel system<br>Inoperative or damaged starting system  | Refer to the appropriate Engine article for the procedure. Refer to <a href="#">Engine Controls - Introduction (Diesel)</a> .    |
| Damaged charging system/ battery  |  | REFER to: <a href="#">Charging System - 3.0L Power Stroke Diesel</a> .<br>TEST the system for normal operation after the repair. |
| Burnt valve   |  | INSTALL a new cylinder head.<br>TEST the system for normal operation after the repair.   |
| Worn piston   |  | INSTALL a new piston. TEST the system for normal operation after the repair.   |
| Worn piston rings   |  | INSTALL new piston rings.<br>TEST the system for normal operation after the repair.  |
| Worn cylinder   |  | INSTALL a new cylinder block. TEST the system for normal operation after the repair.   |
| Damaged head gasket   |  | INSTALL a new cylinder head gasket. TEST the system for normal operation after the repair.                                       |
| Poor idling   | Inoperative or damaged EGR system  | Refer to the appropriate Engine article for the procedure. Refer to <a href="#">Engine Controls - Introduction (Diesel)</a> .    |
| Inoperative or damaged cooling system<br>Inoperative or damaged fuel system |  | Refer to the appropriate Engine article for the procedure.   |
| Incorrect valve-to-valve seat contact                                       |  | INSTALL a new cylinder head.<br>TEST the system for normal operation after the repair.   |
| Damaged head gasket   |  | INSTALL a new cylinder head gasket. TEST the system for normal operation after the repair.                                       |
| Engine runs rough   | Inoperative or damaged fuel system<br>Leaking or damaged CAC, intake manifold or gaskets<br>EGR system fault<br>Inoperative or damaged cooling system<br>Malfunctioning or damaged air intake system | Refer to the appropriate Engine article for the procedure.   |
| Burnt or sticking valve   |  | INSTALL a new valve. TEST the system for normal operation after the repair.  |
| Weak or broken valve spring   |  | INSTALL a new valve spring.<br>TEST the system for normal operation after the repair.  |
| Worn valve guides, valves and seals   |  | INSTALL a new cylinder head.<br>TEST the system for normal operation after the repair.   |

| Symptom   | Possible Sources   | Action   |
|---|--|--|
| Excessive oil consumption                         | Leaking oil  | REPAIR oil leakage. TEST the system for normal operation after the repair.   |
| Blocked or restricted turbocharger oil drain pipe |  | INSPECT the turbocharger drain pipe. REPAIR as necessary. TEST the system for normal operation after the repair.   |
| Turbocharger oil seals leaking                    |  | REFER to Turbocharger Internal Oil Leak Test. REFER to: <b>Turbocharger</b> . TEST the system for normal operation after the repair.   |
| Malfunctioning crankcase vent oil separator       |  | REPAIR or INSTALL new components as necessary. TEST the system for normal operation after the repair.  |
| Oil dilution (fuel)                               |  | CHANGE oil to correct specification. TEST the system for normal operation after the repair.  |
| Worn valve stem seal                              |  | INSTALL a new valve stem seal. TEST the system for normal operation after the repair.  |
| Worn valve stem or valve guide                    |  | INSTALL a new cylinder head. TEST the system for normal operation after the repair.  |
| Sticking piston rings                             |  | INSTALL new piston rings. TEST the system for normal operation after the repair.   |
| Worn piston ring groove                           |  | INSTALL a new piston and piston pin. TEST the system for normal operation after the repair.  |
| Worn piston or cylinder                           |  | INSTALL a new piston or cylinder block. TEST the system for normal operation after the repair.   |
| Oil in coolant                                    | Leaking head gasket<br>Damaged cylinder block<br>Damaged cylinder head | INSPECT the engine components. INSTALL new engine components as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair. |
| Leaking oil cooler                                |  | INSPECT the oil cooler and seal for damage. INSTALL new components as necessary. Refer to the appropriate Engine article for the procedure.  |
| Coolant in oil                                    | Leaking head gasket<br>Damaged cylinder block<br>Damaged cylinder head | INSPECT the engine components. INSTALL new engine components as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair. |

| Symptom   | Possible Sources  | Action  |
|---|---|---|
| Leaking oil cooler  |   | INSPECT the oil cooler and seal for damage. INSTALL new components as necessary. Refer to the appropriate Engine article for the procedure.   |
| Insufficient power  | Air intake system blockage<br>Boost leaks or blockage<br>Inoperative or damaged fuel system | Refer to the appropriate Engine article for the procedure. Refer to <a href="#">Engine Controls - Introduction (Diesel)</a> .   |
| Turbocharger damage   |   | INSPECT the turbocharger. REFER to the Check for Free Rotation- Off Vehicle. REFER to: <a href="#">Turbocharger</a> . TEST the system for normal operation after the repair.                          |
| Damaged exhaust or exhaust leaks at turbocharger housing or exhaust manifold    |   | INSPECT for leaks. Leaks can be detected audibility or visually, by a discoloration caused by escaping hot exhaust gases. REPAIR as necessary. TEST the system for normal operation after the repair. |
| Oil level too high  |   | DRAIN oil to correct level.   |
| Incorrect engine oil  |   | INSTALL correct specification engine oil. TEST the system for normal operation after the repair.  |
| Low oil pressure  |   | CARRY OUT the Oil Pressure Test in this article. Compare to specifications, repair as necessary. TEST the system for normal operation after the repair.   |
| Excessive accessory drive belt loading<br>Inoperative or damaged cooling system |   | Refer to the appropriate Engine article for the procedure.  |
| Damaged or plugged exhaust system   |   | INSPECT exhaust system. TEST the system for normal operation after the repair.  |
| Incorrect tire size   |   | REFER to: <a href="#">Suspension System</a> . TEST the system for normal operation after the repair.  |
| Dragging brakes   |   | REFER to: <a href="#">Brake System</a> . TEST the system for normal operation after the repair.   |
| Slipping transmission   |   | Refer to the appropriate Automatic Transmission article for the procedure.  |
| Compression leakage at valve seat<br>Seized valve stem                          |   | INSTALL a new cylinder head. TEST the system for normal operation after the repair.   |
| Weak or broken valve spring   |   | INSTALL a new valve spring. TEST the system for normal operation after the repair.  |
| Worn or damaged camshaft  |   | INSTALL a new camshaft. TEST the system for normal operation after the repair.  |
|   |   |   |



| Symptom   | Possible Sources                  | Action  |
|---|-----------------------------------|---|
| Damaged head gasket   |                                   | INSTALL a new head gasket. TEST the system for normal operation after the repair.   |
| Cracked or distorted cylinder head                              |                                   | INSTALL a new cylinder head. TEST the system for normal operation after the repair.   |
| Damaged, worn or sticking piston ring(s)                        |                                   | INSTALL a new piston ring(s). TEST the system for normal operation after the repair.  |
| Worn or damaged piston  |                                   | INSTALL a new piston and piston pin. TEST the system for normal operation after the repair.   |
| Worn or damaged cylinder  |                                   | INSPECT the cylinder for wear or damage. Repair as necessary. TEST the system for normal operation after the repair.                          |
| Engine emits excessive black smoke (black/blue)                 | Clogged ACL (air cleaner) element | INSTALL a new ACL element. TEST the system for normal operation after the repair.   |
| Incorrect type or grade of oil                                  |                                   | DRAIN and FILL with specified oil.  |
| Blocked or restricted turbocharger oil drain pipe               |                                   | INSPECT the turbocharger oil drain pipe. REPAIR as necessary. TEST the system for normal operation after the repair.                          |
| Damaged/restricted or leaking turbocharger intake tube assembly |                                   | REPAIR or INSTALL a new tube as necessary. TEST the system for normal operation after the repair.   |
| Engine wear (piston rings, valve guides)                        |                                   | REPAIR as necessary. TEST the system for normal operation after the repair.   |
| Plugged crankcase ventilation system                            |                                   | Visually INSPECT the crankcase ventilation system.  |
| Turbocharger oil seals leaking                                  |                                   | REFER to Turbocharger Internal Oil Leak Test. REFER to: <a href="#">Turbocharger</a> . TEST the system for normal operation after the repair. |

#### Symptom Chart - NVH

| Symptom   | Possible Sources   | Action  |
|---|--|---|
| Drone type noise  | Powertrain mount(s)  | CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure. REFER to: <a href="#">Powertrain/Drivetrain Mount Neutralizing</a> . TEST the system for normal operation after the repair. |
| Drumming noise - occurs inside the vehicle during idle or high idle, hot or cold. Very low-frequency drumming is very rpm dependent | Engine vibration excites the body resonances inducing interior noise | CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure. REFER to: <a href="#">Powertrain/Drivetrain Mount Neutralizing</a> . TEST the system for normal operation after the repair. |

| Symptom   | Possible Sources  | Action   |
|---|---|--|
| Engine drumming noise - accompanied by vibration  | Powertrain mount(s)   | CARRY OUT the Powertrain/Drivetrain Mount Neutralizing procedure. REFER to: <a href="#">Powertrain/Drivetrain Mount Neutralizing</a> . TEST the system for normal operation after the repair.  |
| Rattle - occurs at idle or at light acceleration from a stop  | Powertrain mount(s)   | CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. For engine, Refer to the appropriate Engine article for the procedure. For transmission, Refer to the appropriate Engine Ignition article for the procedure. TEST the system for normal operation after the repair.   |
| Whine/moan type noise - pitch increases or changes with vehicle speed   | Powertrain mount(s)   | CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. For engine, Refer to the appropriate Engine article for the procedure. For transmission, Refer to the appropriate Engine Ignition article for the procedure. TEST the system for normal operation after the repair.   |
| Clunk - occurs when shifting from PARK or between REVERSE and DRIVE   | Powertrain mounts   | CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. For engine, Refer to the appropriate Engine article for the procedure. For transmission, Refer to the appropriate Engine Ignition article for the procedure. TEST the system for normal operation after the repair.   |
| Driveshaft universal joint  |   | INSPECT the driveshaft universal joints. REFER to: <a href="#">Driveshaft Universal Joint</a> . REPAIR as necessary. TEST the system for normal operation after the repair.  |
| Accessory drive bearing hoot - occurs at idle or high idle in cold temperatures of approximately 4 Â°C (40 Â°F) or colder at the first start of the day | Accessory drive idler or tensioner pulley bearing is experiencing stick/slip between ball bearings and the bearing race | CARRY OUT the Engine Cold Soak procedure. REFER to: <a href="#">Noise, Vibration and Harshness (NVH)</a> . PLACE the EngineEAR probe directly on the idler/ tensioner center post or bolt to verify which bearing is making the noise. INSTALL new parts as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair. |

| Symptom   | Possible Sources  | Action  |
|---|---|---|
| Accessory drive belt noise, squeal or chirping                  | Defective/worn or incorrect accessory drive belt<br>Misaligned pulley(s)<br>Pulley runout<br>Damaged or worn accessory drive component or idler<br>Fluid contamination of the accessory drive belt or pulleys<br>Damaged or worn accessory drive belt tensioner<br>Damaged pulley grooves | CARRY OUT the Engine Accessory Test. REFER to: <b>Noise, Vibration and Harshness (NVH)</b> . INSPECT components and INSTALL new parts as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.     |
| Clunking noise  | Coolant pump has excessive end play or imbalance  | CHECK the coolant pump for excessive end play. INSPECT the coolant pump for imbalance with the drive belt off. INSTALL a new coolant pump as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair. |
| Whine or moaning noise  | Air intake system   | CHECK the air cleaner and ducts for correct fit. INSPECT the air intake system for leaks or damage. REPAIR as necessary. TEST the system for normal operation after the repair.   |
| Whistling noise - normally accompanied with poor idle condition | Air intake system   | CHECK the air intake ducts, air cleaner, throttle body and vacuum hoses for leaks and correct fit. REPAIR or ADJUST as necessary. TEST the system for normal operation after the repair.  |
| Turbocharger intake tube assembly leaking                       |   | REPAIR or INSTALL a new tube as necessary. TEST the system for normal operation after the repair.   |
| Loose connections or damage to air intake hoses and tubes       |   | TIGHTEN hose clamps. INSPECT for damage and REPAIR as necessary. TEST the system for normal operation after the repair.   |
| Air leaks at turbine housing, blown joints or damaged exhaust   |   | INSPECT for leaks. Leaks can usually be detected audibility or visually, by a discoloration caused by escaping hot exhaust gases. REPAIR as necessary. TEST the system for normal operation after the repair.   |
| Carbon build up in the turbine housing                          |   | INSPECT the turbocharger. REFER to the Check for Free Rotation - Off Vehicle. REFER to: <b>Turbocharger</b> . TEST the system for normal operation after the repair.  |
| Turbocharger imbalance due to foreign object/damage             |   | REPAIR as necessary. TEST the system for normal operation after the repair.   |

| Symptom   | Possible Sources                              | Action   |
|---|---|--|
| Turbine bearing failure   |   | INSPECT the turbocharger. REFER to the Check for Free Rotation - Off Vehicle. REFER to: <b>Turbocharger</b> . TEST the system for normal operation after the repair.   |
| Whine or air rush type noise  | Turbocharger                                  | Acceptable condition. Some whine or air noise is common.   |
| Hissing noise - occurs during idle or high idle that is apparent with the hood open | Boost leak noise                              | Use the Ultrasonic Leak Detector/EngineEAR to locate the source. Scan the air intake system from the inlet to each cylinder intake port. DISCARD the leaking parts, and INSTALL a new component. TEST the system for normal operation after the repair.  |
| Composite intake manifold   |   | Acceptable condition. Some composite manifolds exhibit this noise, which is the effect of the composite manifold.  |
| Grinding noise - occurs during engine cranking                                      | Incorrect starter motor mounting              | INSPECT the starter motor for correct mounting. REPAIR as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.   |
| Starter motor   |   | CHECK the starter motor. INSTALL a new starter motor as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.   |
| Incorrect starter motor drive engagement<br>Damage flexplate                        |   | INSPECT the starter motor drive for wear or damage. INSTALL a new starter motor as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.<br>INSPECT the flexplate for wear or damage. INSTALL a new flexplate as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair. |
| Engine noise, front of engine - knocking noise from lower front of engine           | Damaged or separated crankshaft pulley/damper | CHECK for obvious signs of damage or wobble during operation. INSTALL new as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.  |

| Symptom   | Possible Sources                            | Action   |
|---|---|--|
| Engine noise, front of engine - ticking, tapping or rattling noise from the front of the engine   | Timing drive components<br>Damaged oil pump | REMOVE the accessory drive belt. Refer to the appropriate Engine article for the procedure. USE the EngineEAR to isolate the noise to the timing belt cover. REMOVE the timing belt cover and INSPECT the timing drive components. INSTALL new parts as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair. |
| Engine noise, upper end - ticking noise near the valve cover  | Fuel injector                               | USE the EngineEAR to isolate the noisy injector(s). INSTALL a new injector(s) as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.  |
| Engine noise, upper end - ticking, knocking or rattle noise that occurs during idle or high idle during the first cold start of the day and may disappear as the engine warms | Valve train noise                           | CARRY OUT the Valve Train Analysis in this article. INSTALL new parts as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.  |
| Engine noise, upper end - rattling noise from the valve train. Worse when the engine is cold  | Low oil level                               | CHECK the oil level. FILL as necessary.  |
| Thin or diluted oil   |   | INSPECT the oil for contamination. If the oil is contaminated, CHECK for the source. REPAIR as necessary. CHANGE the oil and filter. TEST the system for normal operation after the repair.  |
| Low oil pressure  |   | CARRY OUT the Oil Pressure Test in this article. If not within specifications, REMOVE the engine oil pan. Refer to the appropriate Engine article for the procedure. INSPECT for a blocked oil pickup tube. TEST the system for normal operation after the repair.   |
| Worn valve train components   |   | CARRY OUT the Valve Train Analysis in this article. INSTALL new parts as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.  |
| Worn valve guides   |   | CARRY OUT the Valve Guide Inner Diameter procedure. REFER to: <a href="#">Valve Guide Inner Diameter</a> .   |

| Symptom  | Possible Sources   | Action   |
|--|--|--|
| Excessive runout of the valve seats on the valve face  |  | INSPECT for abnormalities on the valve face and valve seat. INSTALL a new cylinder head assembly if abnormalities are found.   |
| Engine noise, lower end - ticking or knocking noise near the engine front cover  | Oil pump   | USE the EngineEAR to verify the oil pump as the source of the noise at low rpm. REPAIR as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.   |
| Engine noise, lower end - light knocking noise, also described as piston slap. Noise is most noticeable when the engine is cold with light to medium acceleration. The noise disappears as the engine warms        | Excessive clearance between the piston and the cylinder wall               | CARRY OUT the Piston Diameter procedure. REFER to: <a href="#">Piston Diameter</a> . Measure the cylinder bore diameter. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance. REFER to the appropriate Engine article for specifications. |
| Engine noise, lower end - light double knock or sharp rap sound. Occurs mostly with a warm engine at idle or low speeds in drive. Increases in relation to engine load. Associated with a poor lubrication history | Excessive clearance between the piston and the piston pin                  | MEASURE the piston pin bore and the piston pin in 2 directions on each side. REFER to the appropriate Engine article for specifications.   |
| Engine noise, lower end - light knocking noise. The noise is most noticeable when the engine is warm. The noise tends to decrease when the vehicle is coasting or in neutral                                       | Excessive clearance between the connecting rod bearings and the crankshaft | CARRY OUT the Connecting Rod Bearing Journal Clearance procedure. REFER to: <a href="#">Connecting Rod Bearing Journal Clearance</a> .   |
| Engine noise, lower end - deep knocking noise. The noise is most noticeable when the engine is warm, at lower rpm and under a light load and then at float   | Worn or damaged crankshaft main bearings                                   | CARRY OUT the Crankshaft Main Bearing Journal Clearance procedure. REFER to: <a href="#">Crankshaft Main Bearing Journal Clearance</a> .   |
| Engine noise, rear of engine - knocking noise at rear of engine  | Damaged flexplate  | INSPECT the flexplate for wear or damage. INSTALL a new flexplate as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.  |
| Engine vibration - vibration felt at all times   | Excessive engine pulley runout   | CARRY OUT the Engine Accessory Test. REFER to: <a href="#">Noise, Vibration and Harshness (NVH)</a> . INSTALL a new engine pulley as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.                                |

| Symptom  | Possible Sources      | Action  |
|--|-----------------------|---|
| Damaged or worn accessory component  |                       | CARRY OUT the Engine Accessory Test. REFER to: <a href="#">Noise, Vibration and Harshness (NVH)</a> . REPAIR or INSTALL a new component as necessary. TEST the system for normal operation after the repair.  |
| Engine vibration - at idle, a low-frequency vibration (5-20 Hz) or mild shake that is felt through the seat/floorpan | Cylinder misfire      | Using the scan tool, CARRY OUT the cylinder power balance and the relative compression test. REPAIR as necessary. Refer to the appropriate Engine article for the procedure. TEST the system for normal operation after the repair.   |
| Engine or torque converter out of balance  |                       | VERIFY the torque converter to crankshaft pilot clearance is correct. REPAIR as necessary. RE-INDEX the torque converter on the flex plate by 180 degrees. Refer to the appropriate Automatic Transmission article for the procedure. TEST the system for normal operation after the repair.  |
| Engine vibration - is felt with increases and decreases in engine rpm  | Powertrain mount(s)   | CHECK the powertrain mounts for damage. INSTALL new mounts as necessary. For engine, Refer to the appropriate Engine article for the procedure. For transmission, Refer to the appropriate Automatic Transmission article or Manual Transmission, Clutch and Transfer Case article for the procedure. TEST the system for normal operation after the repair.                    |
| Engine or transmission grounded to chassis   |                       | INSPECT the powertrain/ drivetrain for correct clearances. REPAIR as necessary. TEST the system for normal operation after the repair.  |
| Engine vibration - increases intensity as the engine rpm is increased  | Engine out-of-balance | CARRY OUT the NERU Test. REFER to: <a href="#">Noise, Vibration and Harshness (NVH)</a> . ROTATE the torque converter 180 degrees. INSPECT the torque converter pilot outer diameter-to-crankshaft pilot inner diameter. REPAIR as necessary. Refer to the appropriate Automatic Transmission article for the procedure. TEST the system for normal operation after the repair. |

### Component Tests

The following component tests are used to diagnose engine concerns.

#### Engine Oil Leaks

**NOTE:** If an overnight drive is done, the fan air or road air blast can cause erroneous readings.

**NOTE:** When diagnosing engine oil leaks, the source and location of the leak must be positively identified prior to repair.

Prior to carrying out this procedure, clean the cylinder block, cylinder heads, valve covers, oil pan and flexplate with a suitable solvent to remove all traces of oil.

#### Engine Oil Leaks - Fluorescent Oil Additive Method

**NOTE:** If the factory fill engine oil with dye is present, change the engine oil and the oil filter prior to using the Dye-Lite <sup>®</sup> Oil-Based Fluid Dye (164-TP33200008).

Use the UV Long-Wave W/12-foot Cord & Alligator Clips (164-R3748) or Leak Tracker UV-LED Leak Detection Flashlight (164-TP8695) to carry out the following procedure for oil leak diagnosis.

1. Add 237 ml (8 Fl Oz) of Dye-Lite <sup>®</sup> Oil-Based Fluid Dye (164-TP33200008) to a minimum of 0.47L (1/2 qt) and a maximum of 0.95L (1 qt) engine oil. Thoroughly premix the oil based fluid dye or it will not have enough time to reach the crankcase, oil galleries and seal surfaces during this particular 15 minute test. The additive must be added through the oil fill. Check the level on the oil level indicator to determine what amount of oil to premix. If it is in the middle of the crosshatch area or below the full mark, use 0.95L (1 qt). If it is at the full mark, use 0.47L (1/2 qt).

2. **NOTE:** For best results allow the customer to drive the vehicle for a day.

Run the engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using the UV Leak Detector Kit. A fluoresces white area will identify the leak. For extremely small leaks, several hours may be required for the leak to appear.

3. At the end of test, make sure the oil level is within the upper and lower oil indicator marks. Remove oil as necessary if it registers above the full mark.

#### Leakage Points - Underhood

Examine the following areas for oil leakage:

- Oil cooler
- Oil filter
- Engine oil pressure sensor
- CCV (crankcase vent) hose
- Oil separator

#### Leakage Points - Under Engine, With Vehicle on Hoist

Examine the following areas for oil leakage:

- Oil pan gasket
- Oil pan sealer
- Crankshaft front seal
- Crankshaft rear seal
- Turbocharger compressor outlet
- Vacuum pump gasket
- Camshaft seals
- Oil level indicator tube connection
- Turbocharger oil supply tube
- Turbocharger oil return tube
- Valve cover gaskets
- Cylinder head gaskets

#### Leakage Points - With Transmission and Flywheel/Flexplate Removed



Examine the following areas for oil leakage:

- Crankshaft rear oil seal
- Flexplate mounting bolt holes (with flexplate installed)
- Pipe plugs at the end of oil passages

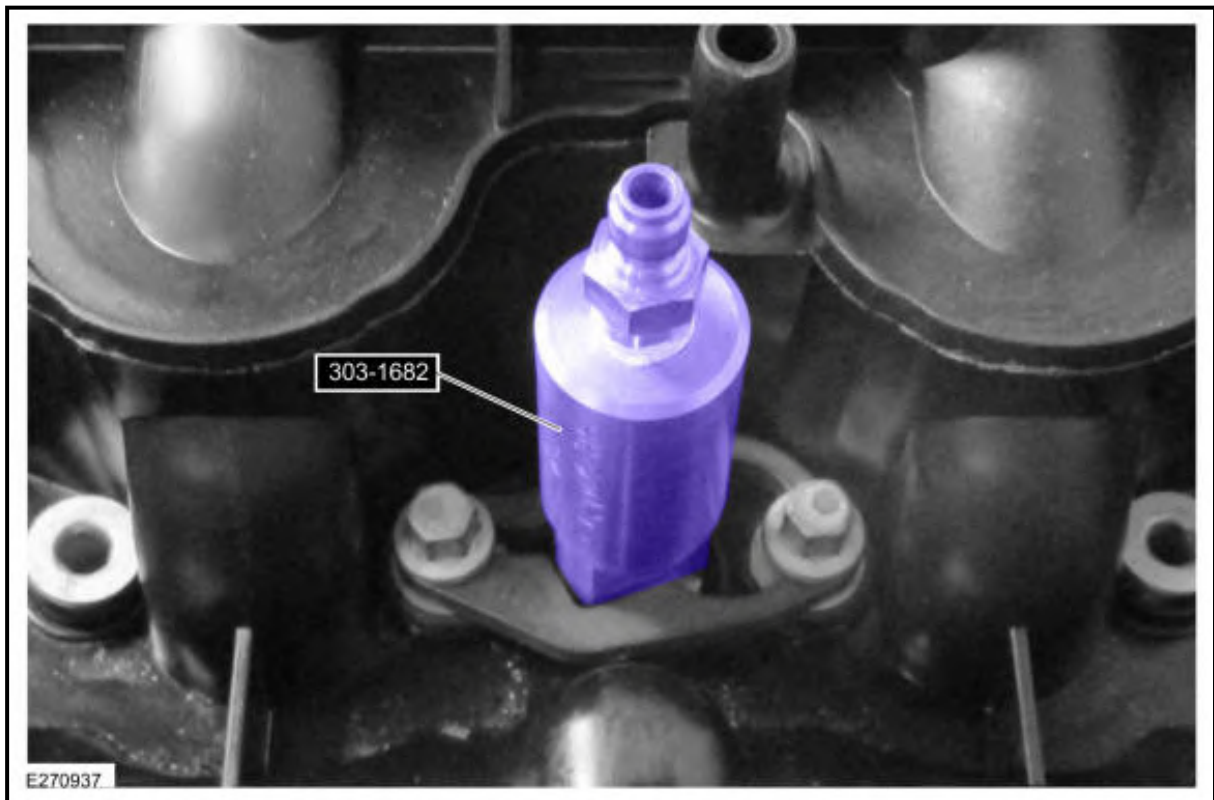
### Compression Test

1. Make sure the oil in the crankcase is of the correct viscosity and at the correct level.
2. **NOTE:**       **Failure to remove all fuel injectors may result in inconsistent test results.**

Remove the fuel injectors. REFER to: [Fuel Injectors LH](#) . and the REFER to: [Fuel Injectors RH](#)

**NOTE:**       **The battery charger must be left connected during the compression test and disconnected when the test is complete.**

3. Connect a battery charger to the battery.



**NOTE:**       **Use a fuel injector hold down from a fuel injector that has been removed for the Compression Test Adapter.**

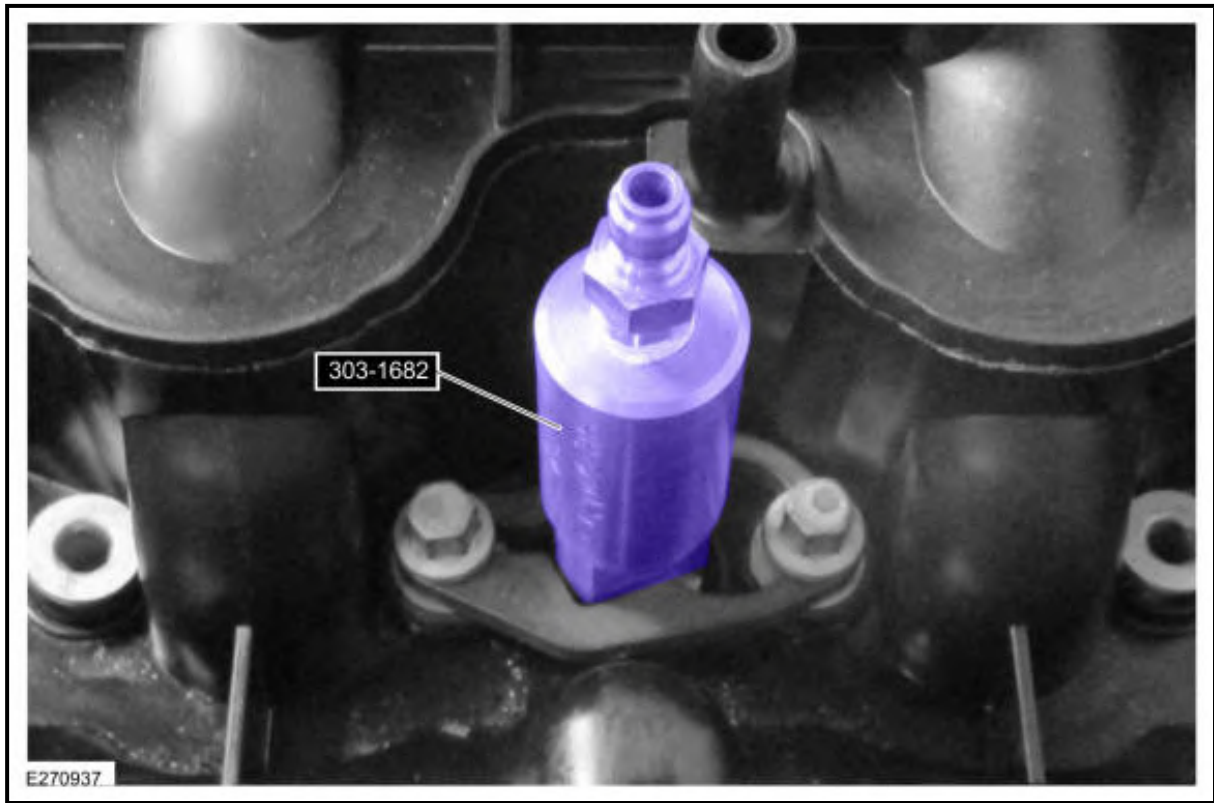
4. Install the Compression Tester Adapter (303-1682) and a commercially available diesel compression tester.

**NOTE:**       **Note the approximate number of compression strokes necessary to obtain the highest reading.**

5. Install an auxiliary starter switch in the starting circuit. With the ignition switch in the OFF position, and using the auxiliary starter switch, crank the engine a minimum of 5 compression strokes and record the highest reading.
6. Repeat the test on each cylinder, cranking the engine approximately the same number of compression strokes.

- There must not have no more than a 20% difference from the average on any given cylinder.

7. Investigate and repair any cylinder(s) that are outside the 20% range.



8. Remove the Compression Tester Adapter (303-1682) and the commercially available diesel compression tester.

9. Disconnect the battery charger from the battery.

10. Install the fuel injectors. REFER to: [Fuel Injectors LH](#) . and the REFER to: [Fuel Injectors RH](#) .

### Cylinder Leakage Detection

When a cylinder produces a low reading, use of a cylinder leakage tester will be helpful in pinpointing the exact cause.

The leakage tester is inserted in the glow plug hole, the piston is brought up to TDC on the compression stroke, and compressed air is admitted.

Once the combustion chamber is pressurized, the leakage tester gauge will read the percentage of leakage. Leakage exceeding 20% is excessive.

While the air pressure is retained in the cylinder, listen for the hiss of escaping air. A leak at the intake valve will be heard in the Throttle Body (TB). A leak at the exhaust valve can be heard at the tailpipe. Leakage past the piston rings will be audible at the crankcase vent oil separator connection. If air is passing through a blown head gasket to an adjacent cylinder, the noise will be evident at the glow plug hole of the cylinder into which the air is leaking. Cracks in the cylinder block or gasket leakage into the cooling system may be detected by a stream of bubbles in the radiator.

### Excessive Engine Oil Consumption

Nearly all engines consume oil, which is essential for normal lubrication of the cylinder bore walls and pistons and rings. Determining the level of oil consumption may require testing by recording how much oil is being added over a given set of miles.

Customer driving habits greatly influence oil consumption. Mileage accumulated during towing or heavy loading generates extra heat. Frequent short trips, stop-and-go type traffic or extensive idling, prevent the engine from reaching normal operating temperature. This prevents component clearances from reaching specified operating ranges.

The following diagnostic procedure may be utilized to determine internal oil consumption. Make sure that the concern is related to internal oil consumption, and not external leakage, which also consumes oil. Verify there are no leaks before carrying out the test. Once verified, the rate of internal oil consumption can be tested.

A new engine may require extra oil in the early stages of operation. Internal piston-to-bore clearances and sealing characteristics improve as the engine breaks in. Engines are designed for close tolerances and do not require break-in oils or additives. Use the oil specified in the Owner's Literature. Ambient temperatures may determine the oil viscosity specification. Verify that the correct oil is being used for the vehicle in the geographic region in which it is driven.

## Basic Pre-checks

1. For persistent complaints of oil consumption, interview the customer to determine the oil consumption characteristics. If possible, determine the brand and grade of oil currently in the oil pan. Look at the oil filter or oil-change station tags to determine if Ford-recommended maintenance schedules have been followed. Make sure that the oil has been changed at the specified mileage intervals. If vehicle mileage is past the first recommended drain interval, the OEM (original equipment manufacturer) production filter should have been changed.
2. Ask how the most current mileage was accumulated. That is, determine whether the vehicle was driven under the following conditions:
  - Extended idling or curbside engine operation
  - Stop-and-go traffic or taxi operation
  - Towing a trailer or vehicle loaded heavily
  - Frequent short trips (engine not up to normal operating temperature)
  - Excessive throttling or high engine-rpm driving
3. Verify that there are no external leaks. If necessary, review the diagnostic procedure under Engine Oil Leaks in the Diagnosis and Testing portion of this article.
4. Inspect the crankcase ventilation system for:
  - disconnected hoses at the valve cover or ACL (air cleaner).
  - loose or missing valve cover fill cap.
  - missing or incorrectly seated engine oil level indicator.
  - incorrect or damaged crankcase vent oil separator.
5. Inspect for signs of sludge. Sludge affects crankcase vent oil separator performance and can plug or restrict cylinder head drainback wells. It can also increase oil pressure by restricting passages and reducing the drainback capability of piston oil control rings.
6. Inspect the air filter for dirt, sludge or damage. A hole in the filter element will allow unfiltered air to bypass into the air induction system. This can cause premature internal wear (engine dusting), allowing oil to escape past rings, pistons, valves and guides.
7. If the engine is hot or was recently shut down, wait at least 10-minutes to allow the oil to drain back. Ask the customer if this requirement has been followed. Adding oil without this wait period can cause an overfill condition, leading to excessive oil consumption and foaming which may cause engine damage.
8. Make sure the oil level indicator (dipstick) is correctly and fully seated in the indicator tube. Remove the oil level indicator and record the oil level.

## Detailed Pre-checks

1. Check the thermostat opening temperature to make sure that the cooling system is operating at the specified temperature. If it is low, internal engine parts are not running at specified internal operating clearances.

## Oil Consumption Test

1. **NOTE:** Once all of the previous conditions are met, carry out an oil consumption test.

Drain the engine oil and remove the oil filter. Install a new manufacturer-specified oil filter. Make sure the vehicle is positioned on a level surface. Refill the oil pan to a level one liter (quart) less than the specified fill level, using manufacturer-specified oil.

2. Run the engine for 3 minutes (if hot) or 10 minutes (if cold). Allow for a minimum 10-minute drainback period and then record the oil level shown on the oil level indicator. Place a mark on the backside of the oil level indicator noting the oil level location.
3. Add the final one liter (quart) to complete the normal oil fill. Restart the engine and allow it to idle for 2 minutes. Shut the engine down.
4. After a 10-minute drainback period, record the location of the oil level again. Mark the oil level indicator with the new oil level location. (Note: Both marks should be very close to the MIN-MAX upper and lower limits or the upper and lower holes on the oil level indicator. These marks will exactly measure the engine's use of oil, with a one quart differential between the new marks.) Demonstrate to the customer that the factory-calibrated marks on the oil level indicator are where the oil should fall after an oil change with the specified fill amount. Explain however, that this may vary slightly between MIN-MAX or the upper and lower holes on the oil level indicator.
5. Record the vehicle mileage.
6. Advise the customer that oil level indicator readings must be taken every 320 km (200 mi) or weekly, using the revised marks as drawn. Remind the customer that the engine needs a minimum 10-minute drainback for an accurate reading and that the oil level indicator must be firmly seated in the tube prior to taking the reading.
7. When the subsequent indicator readings demonstrate a full liter (quart) has been used, record the vehicle mileage. The mileage driven should not be less than 4,800 km (3,000 mi). The drive cycle the vehicle has been operated under must be considered when making this calculation. It may be necessary to have the customer bring the vehicle in for a periodic oil level indicator reading to closely monitor oil usage.

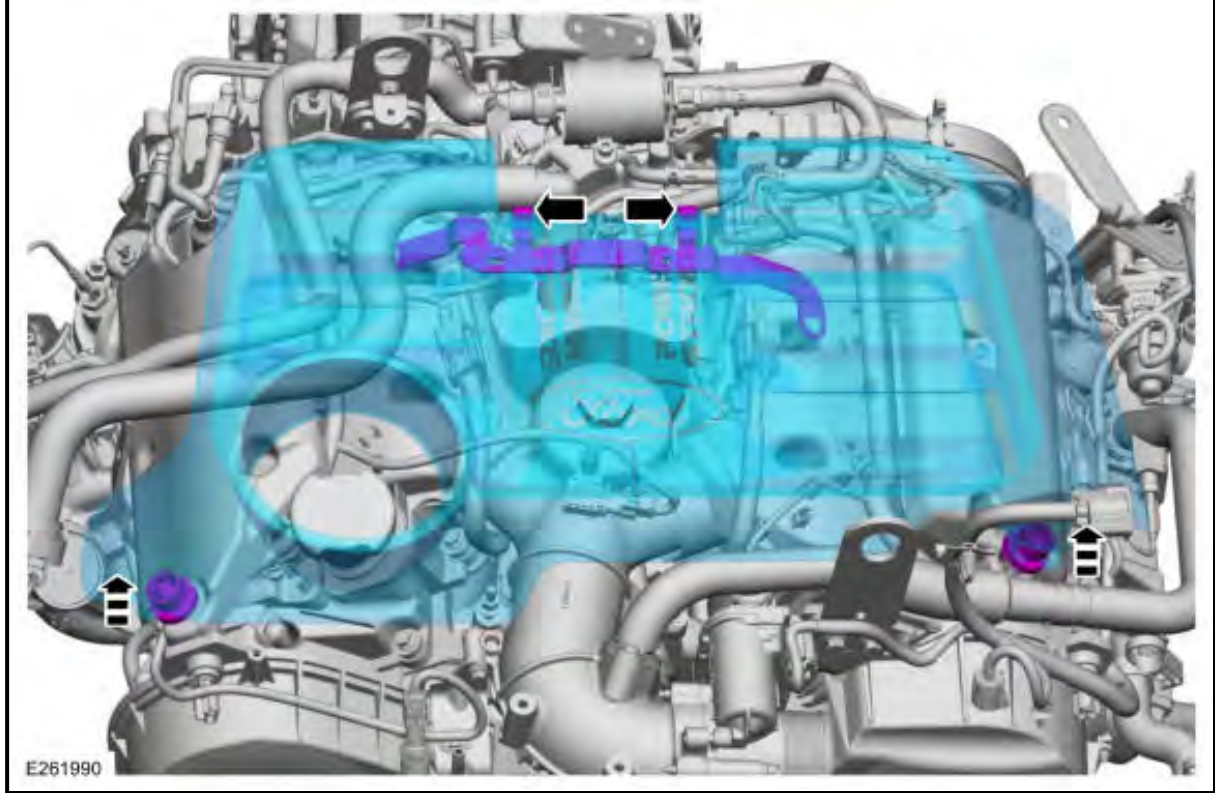
### **Post Checks, Evaluation and Corrective Action**

1. If test results indicate excessive oil consumption, carry out a cylinder compression test. The cylinder compression test should be carried out with a fully charged battery and all glow plugs removed.
2. Compression should be consistent across all cylinders. If compression tested within the specifications found in this article, the excessive oil consumption may be due to wear on the valve guides, valves or valve seals.
3. A cylinder leak detection test can be carried out using a cylinder leakage detector. This can help identify valves, piston rings, or worn valve guides/valve stems, inoperative valve stem seals or other related areas as the source of oil consumption.
4. If an internal engine part is isolated as the root cause, determine if the repair will exceed cost limits and proceed with a repair strategy as required.
5. Once corrective action to engine is complete and verifying that all pre-check items were eliminated in the original diagnosis, repeat the Oil Consumption Test as described above and verify consumption results.

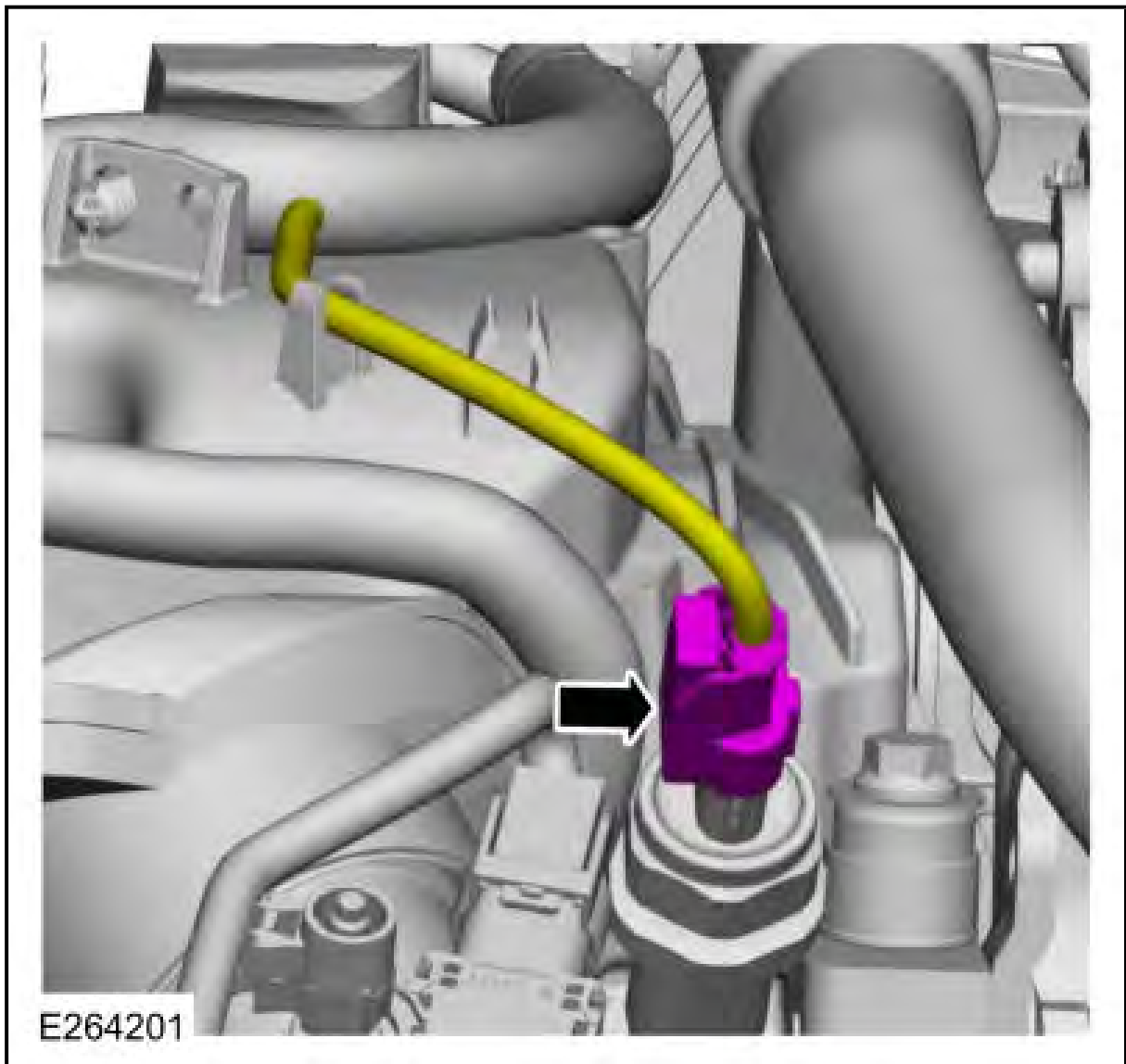
### **Oil Pressure Test**

1. Run the engine until normal operating temperature is reached.

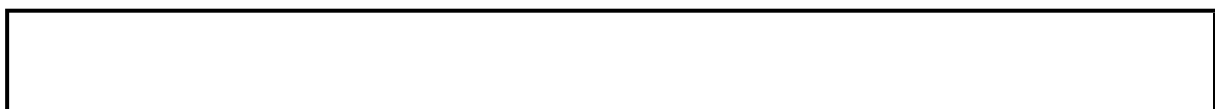


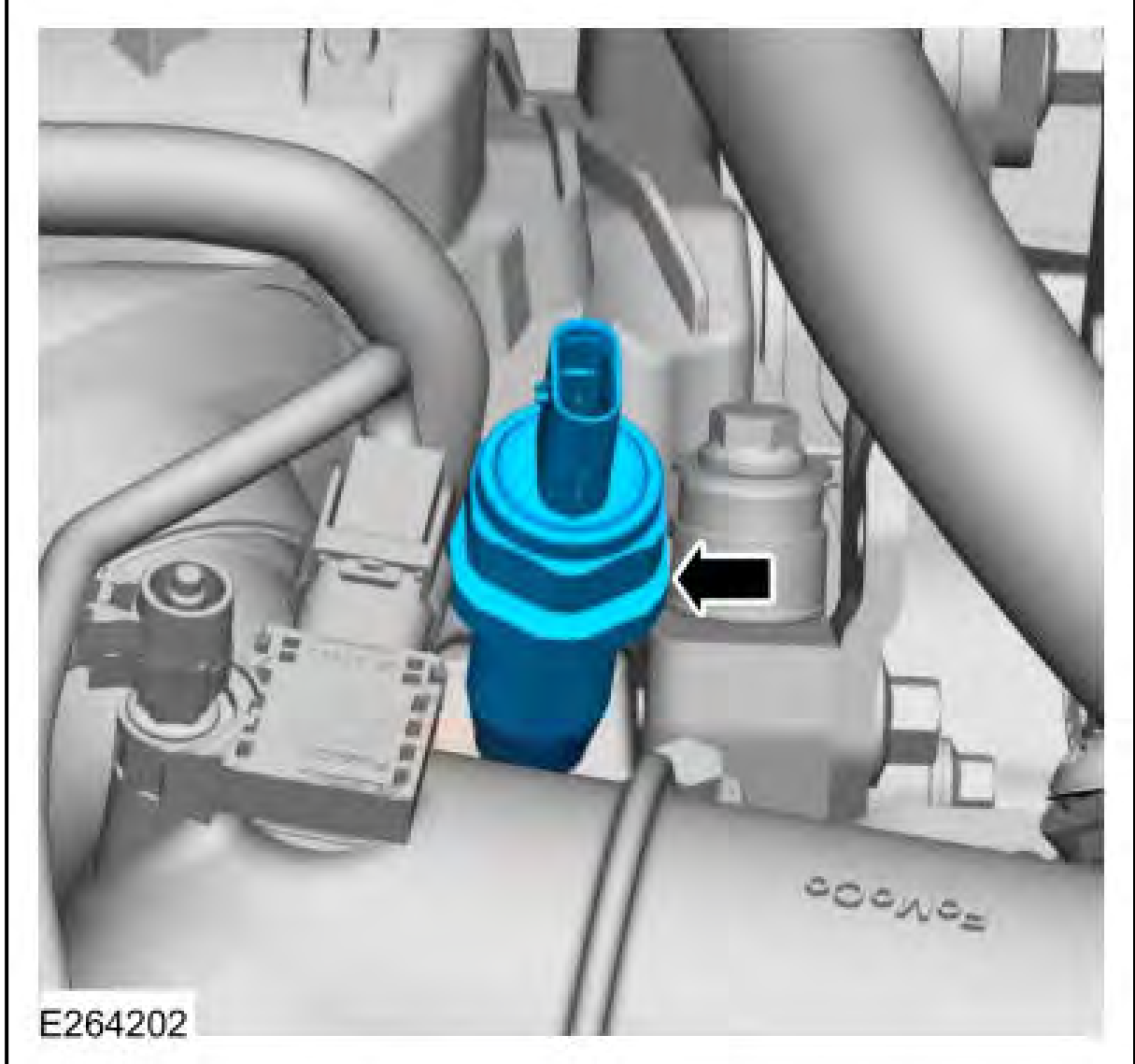


2. Remove the engine appearance cover.



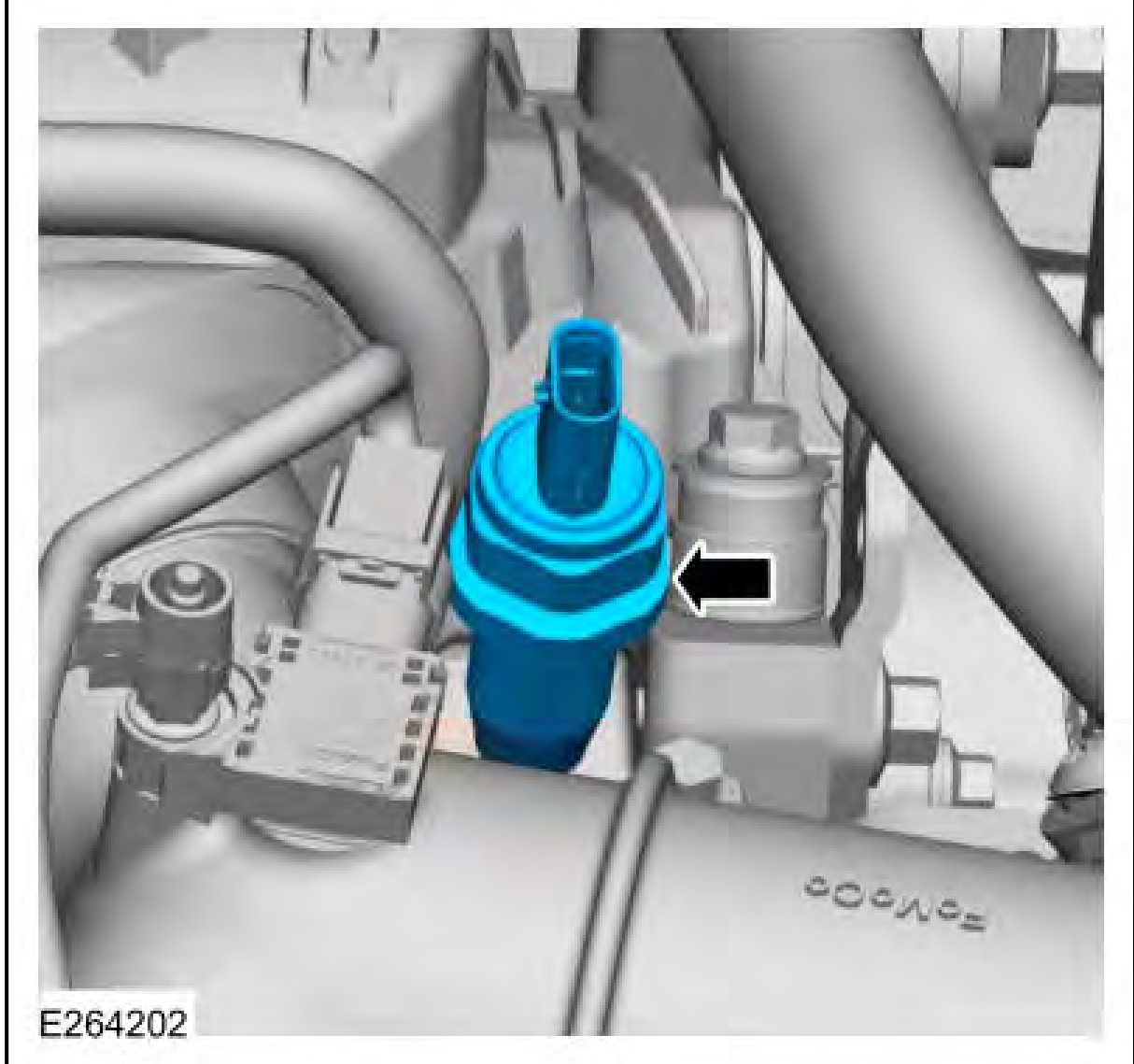
3. Disconnect the engine oil pressure sensor electrical connector.





4. Remove the oil pressure sensor.
5. Connect an commercially available Oil Pressure Gauge to the oil pressure sender port.
6. Record the oil pressure gauge reading at idle. Then run the engine at 3500 rpm and record the oil pressure gauge reading.
7. The oil pressure should be within specifications, REFER to: [Specifications](#) .
8. If the pressure is not within specification, check the following possible sources:
  - Insufficient oil
  - Oil leakage
  - Worn or damaged oil pump
  - Oil pickup tube
  - Excessive main bearing clearance
  - Excessive connecting rod bearing clearance
9. Remove the commercially available Oil Pressure Gauge from the oil pressure sender port.

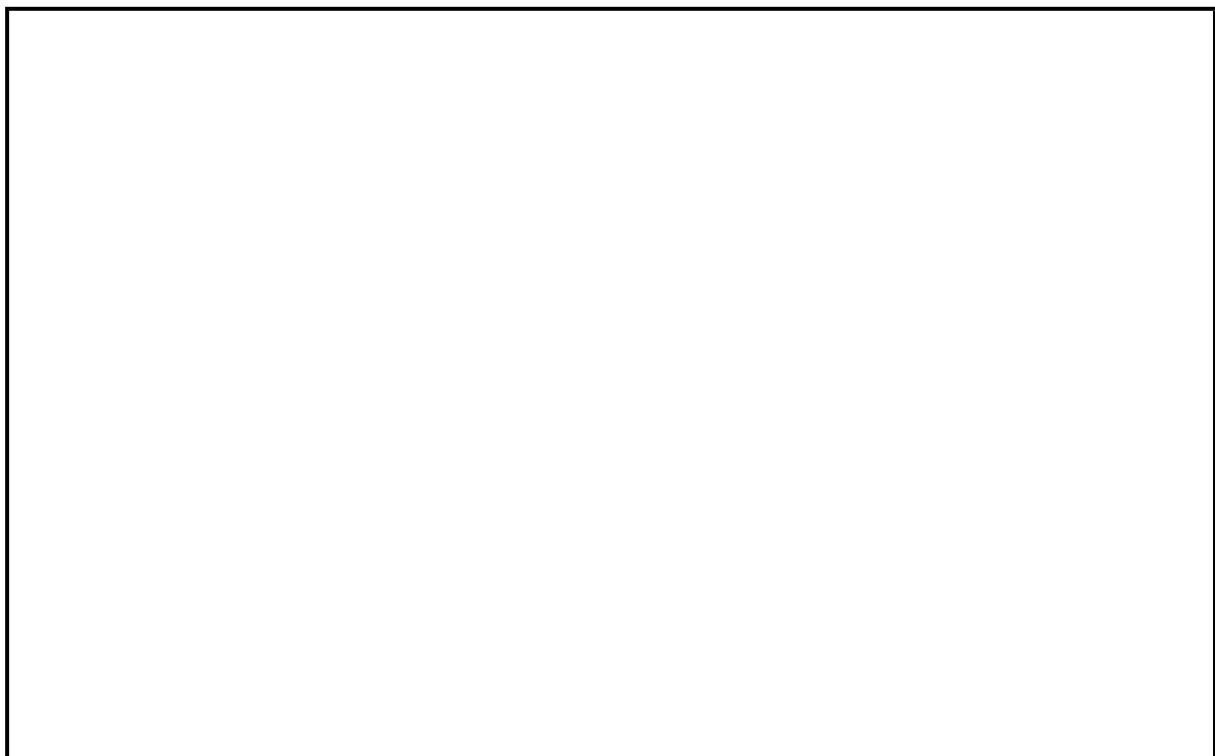


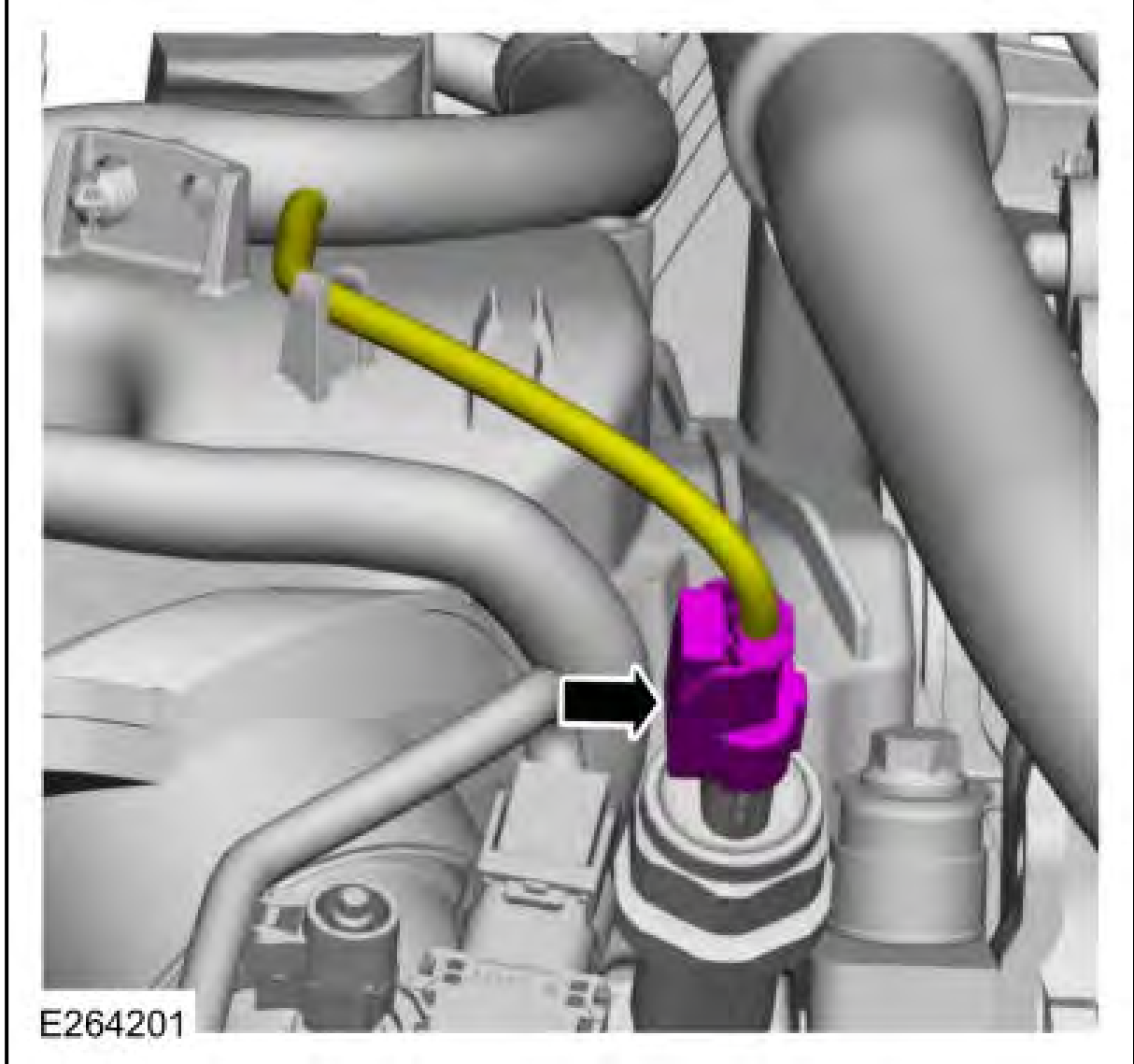


10. **NOTE:**      **If the engine oil pressure sensor is to be reused, apply thread sealant.**

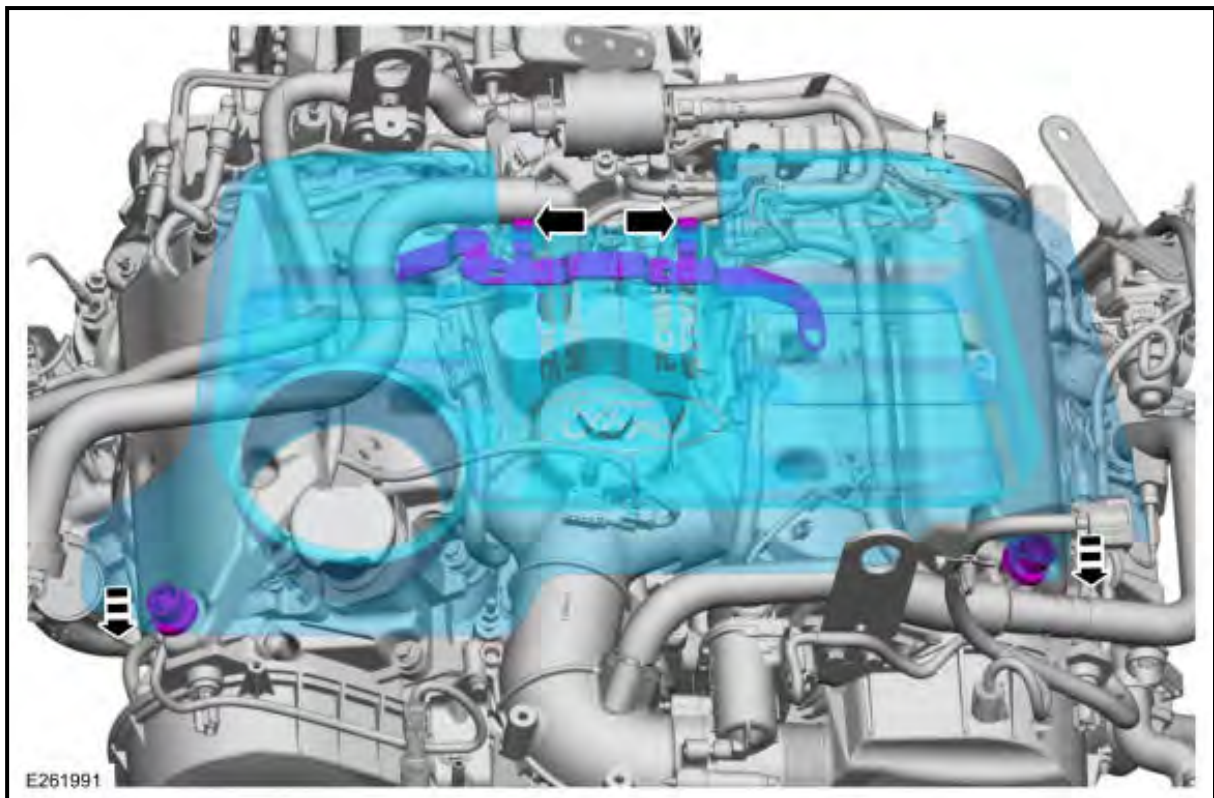
Install the oil pressure sensor.

- Material: WSK-M2G350-A2 (Thread Sealant with PTFE / TA-24)
- Torque: 159 lb.in (18 Nm)





11. Connect the engine oil pressure sensor electrical connector.



12. Install the engine appearance cover.

### Valve Train Analysis

The following inspection is used to diagnose valve train concerns.








1. Remove the valve covers. REFER to: [Valve Cover LH](#) . and the REFER to: [Valve Cover RH](#) .
2. Check for damaged or severely worn parts and correct assembly. Make sure correct parts are used with the static engine analysis as follows.
  - Check for plugged oil drain back holes.
  - Check for worn or damaged valve tips.
  - Check for damaged rocker arm assemblies.
  - Check for worn or damaged camshafts.
3. Install the valve covers. REFER to: [Valve Cover LH](#) . and the REFER to: [Valve Cover RH](#) .

## REMOVAL AND INSTALLATION

### CAMSHAFT FRONT SEAL

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

#### Special Tool(s) / General Equipment

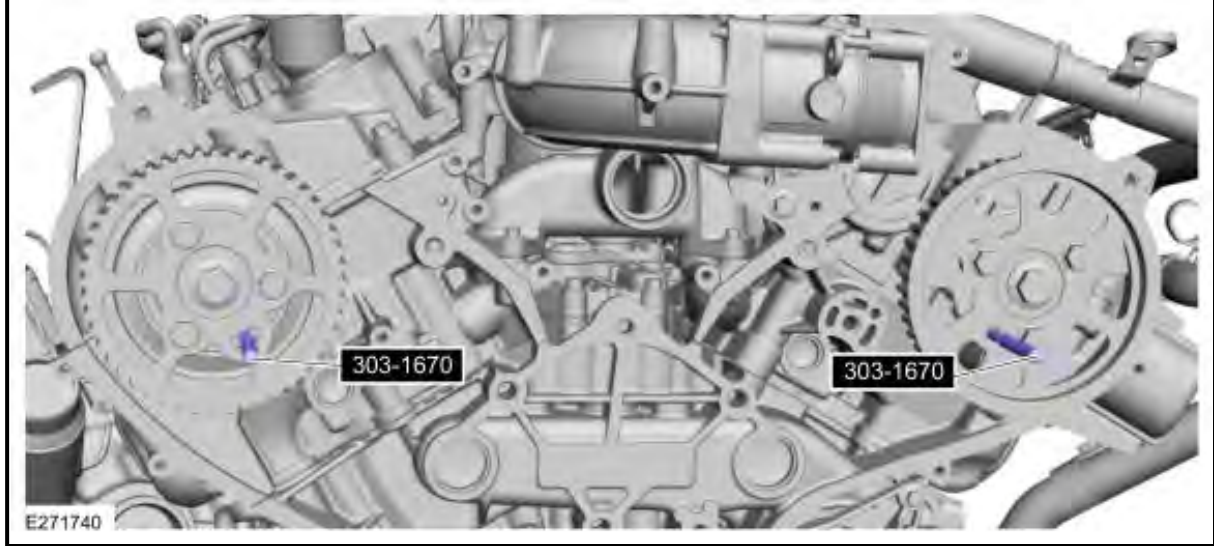
|  |  |
|--|--|
|  <p>E274086</p>   | <p><b>303-1670 Pins, Camshaft Locking</b></p>                            |
|  <p>E274089</p>  | <p>303-1673 Installer, Camshaft Seal</p>                                 |
|  <p>E274090</p> | <p>303-1674 Tool, Holding Camshaft Sprocket</p>                          |
|  <p>E274091</p> | <p>303-1675 Adapter, Seal Remover</p>                                    |
|  <p>308-375</p> | <p>308-375 Remover, Input Shaft Seal TKIT-2005U-M TKIT-1999-F/FLM/LT</p> |

### REMOVAL

#### All vehicles

1. Remove the timing belt. REFER to: [Timing Belt](#) .
2. Remove Special Service Tool: 303-1670 Pins, Camshaft Locking.

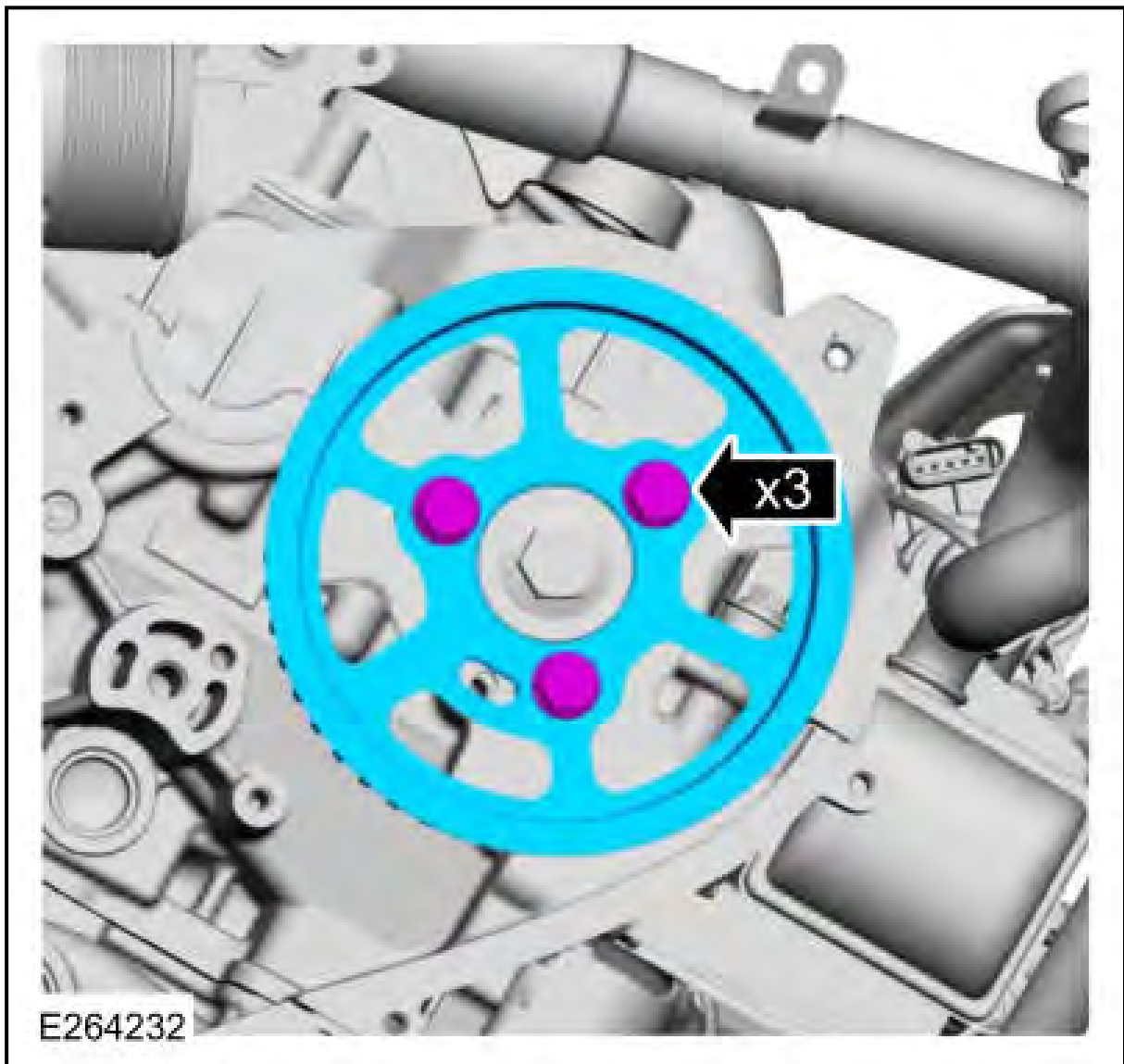




### LH camshaft seal

3. **NOTE:** Note the position of the camshaft pulley prior to removal.

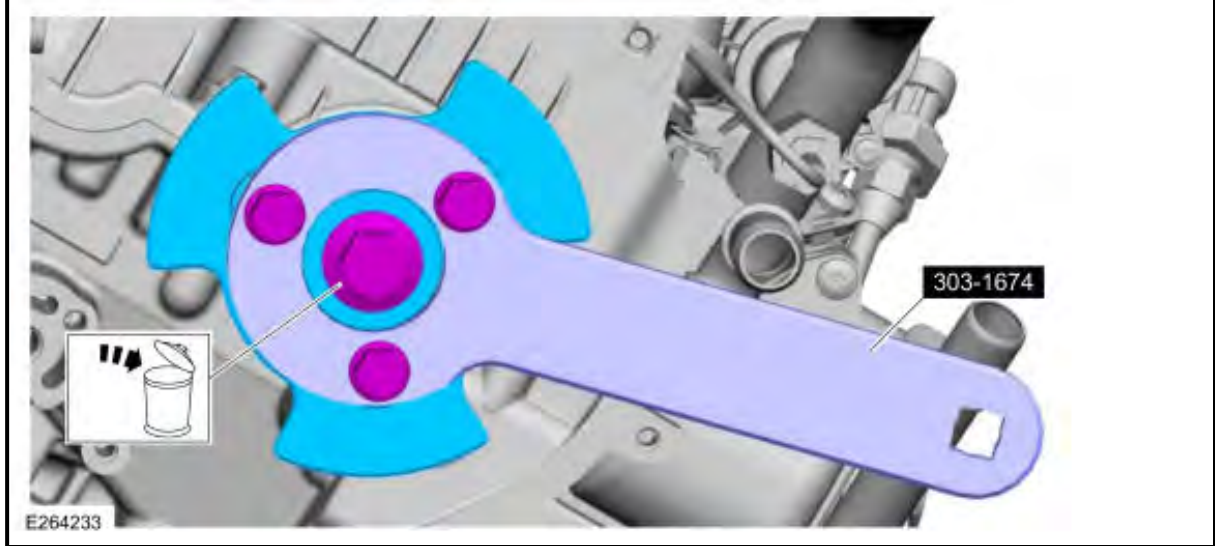
Remove the bolts and the camshaft pulley.



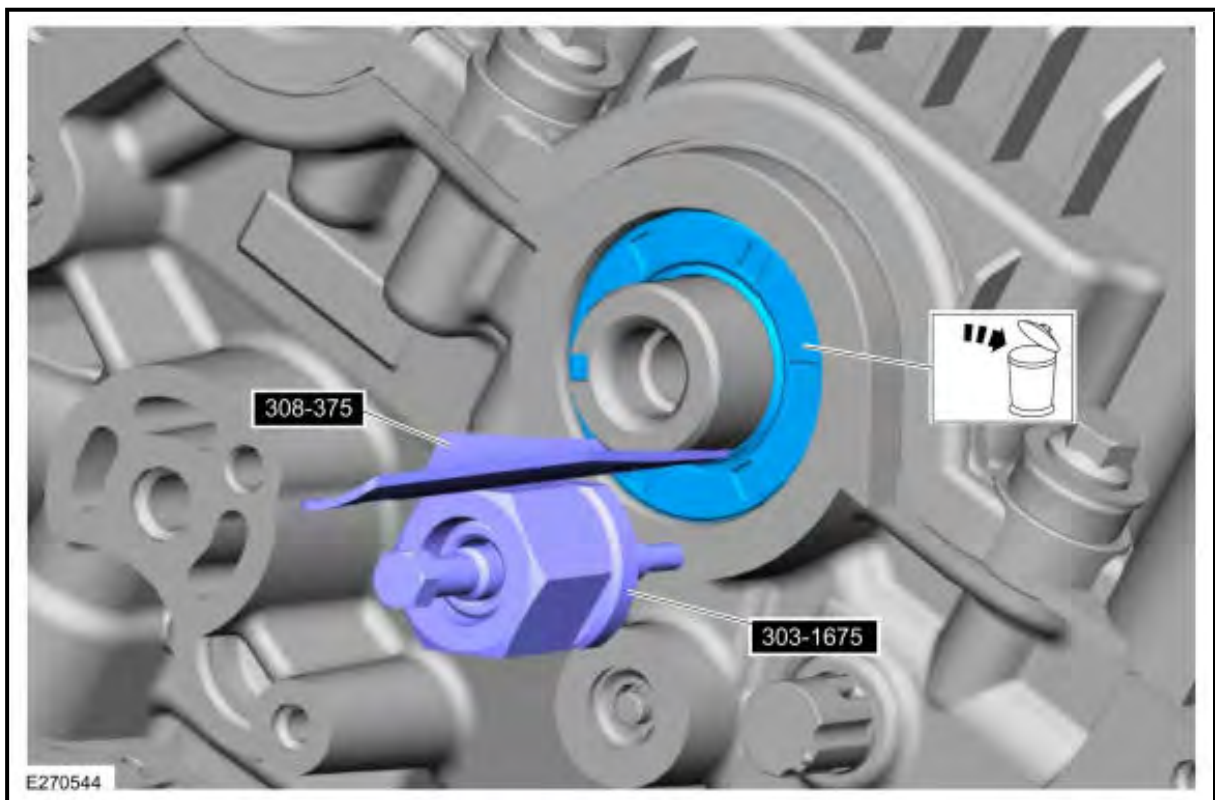
4. **NOTE:** Use the original bolts for the special tool.

Using the special tool, remove the bolt and the camshaft gear hub. Discard the bolt. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.





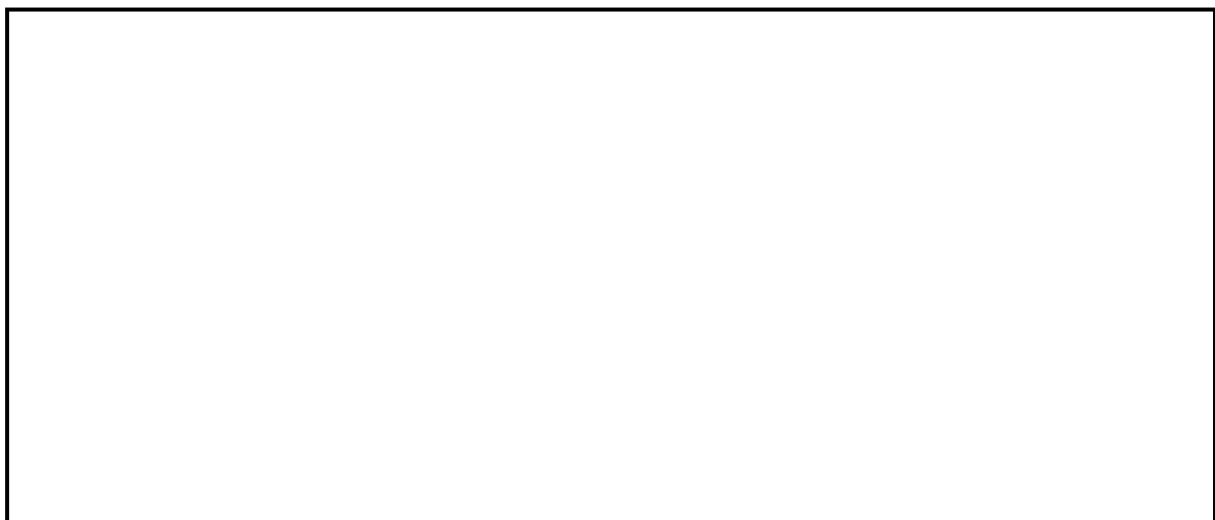
- Using the special tools, remove and discard the camshaft front seal. Use Special Service Tool: 303-1675 Adapter, Seal Remover. , 308-375 Remover, Input Shaft Seal.

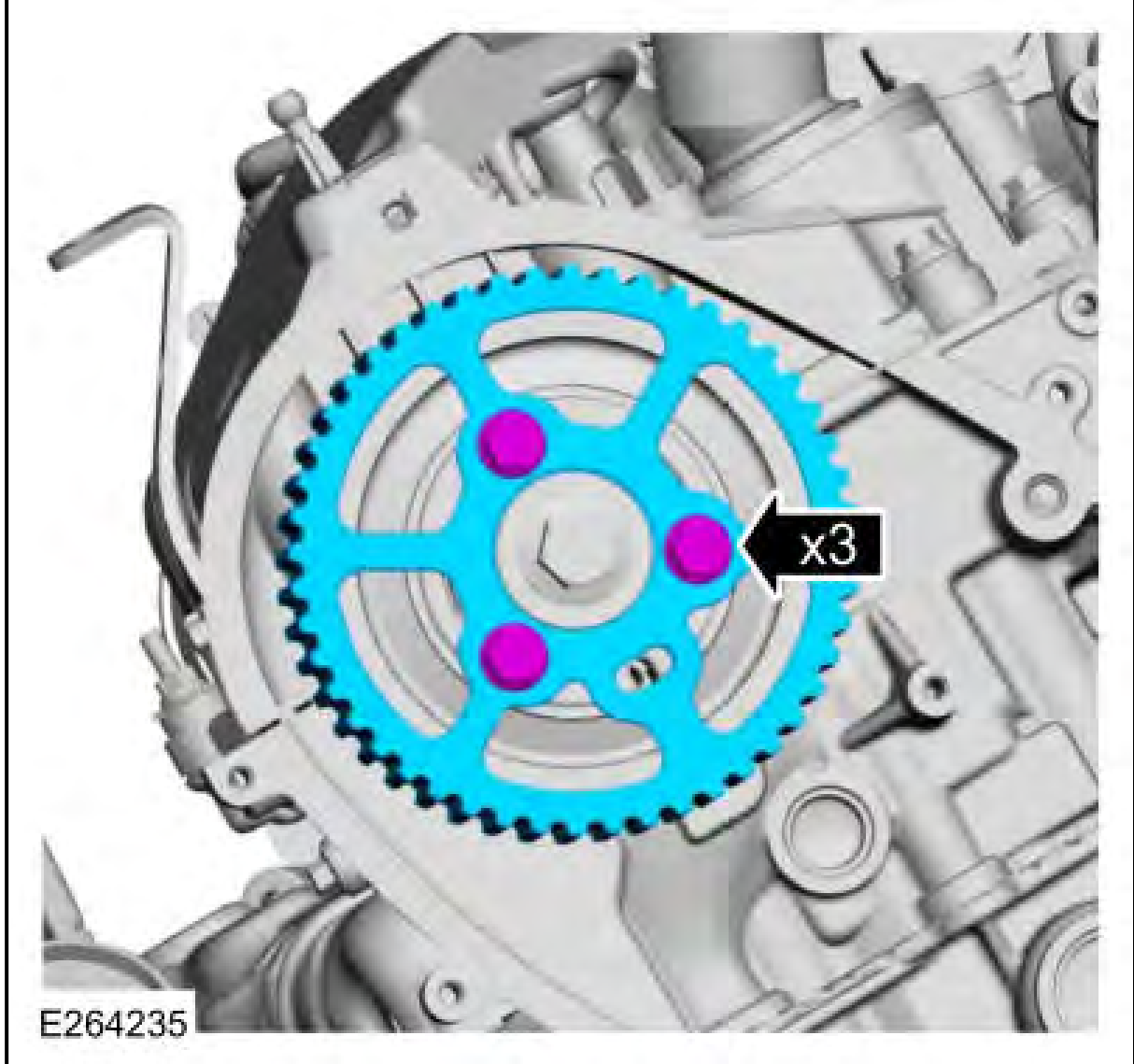


### RH camshaft seal

- NOTE:** Note the position of the camshaft pulley prior to removal.

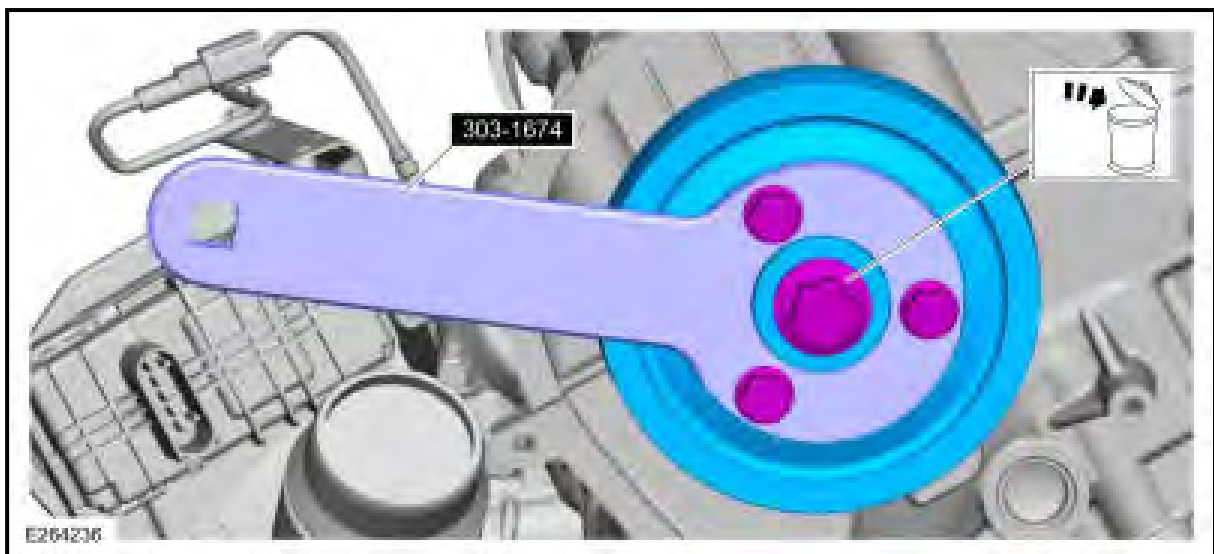
Remove the bolts and the camshaft pulley.



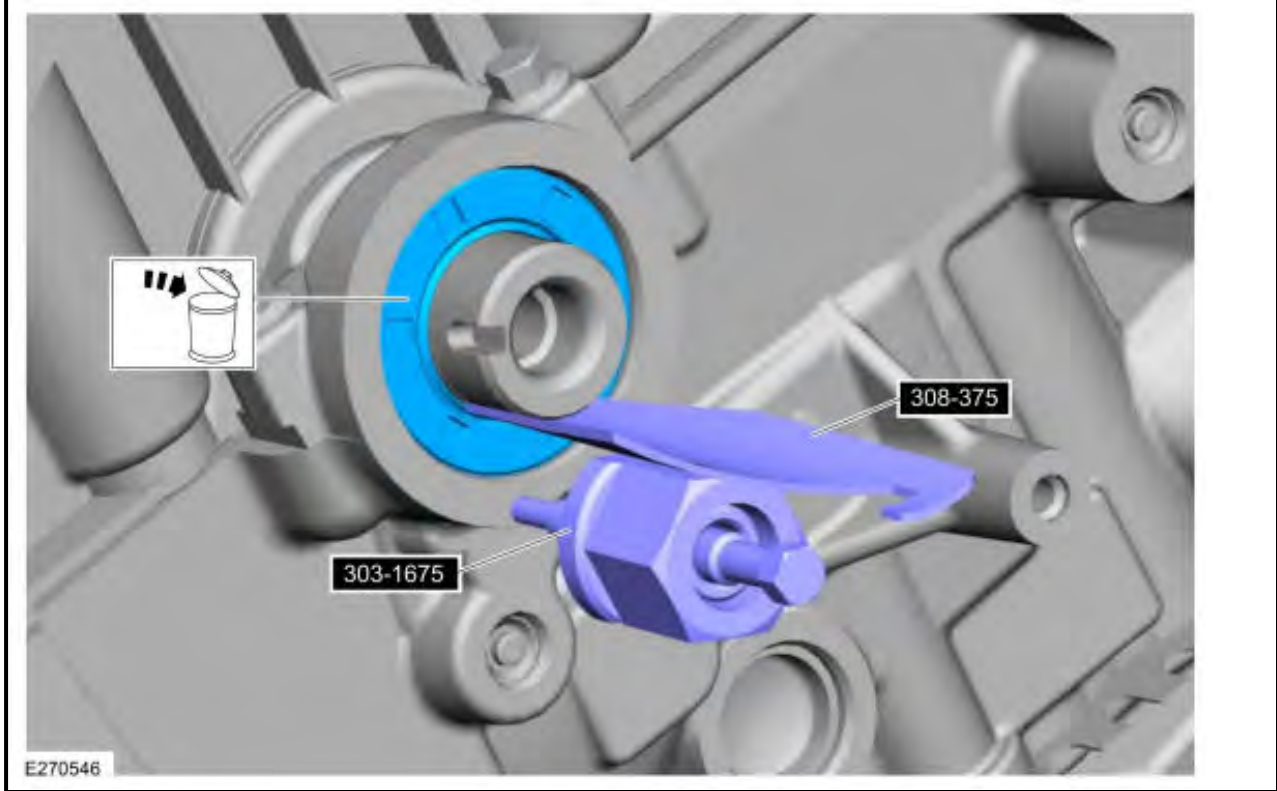


7. **NOTE:** Use the original bolts for the special tool.

Using the special tool, remove the bolt and the camshaft gear hub. Discard the bolt. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.



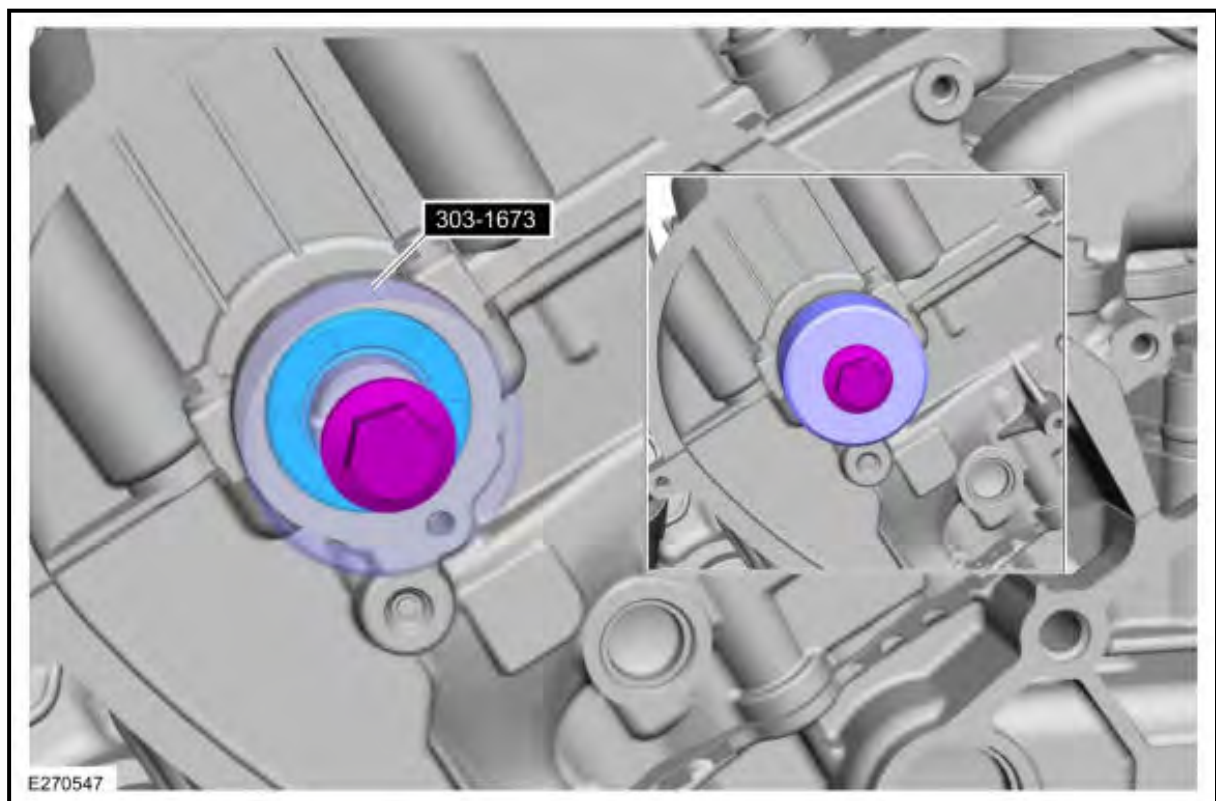
8. Using the special tools, remove and discard the camshaft front seal. Use Special Service Tool: 303-1675 Adapter, Seal Remover. , 308-375 Remover, Input Shaft Seal.



## INSTALLATION

### RH camshaft seal

1. Using the special tool, install the front camshaft seal. Use Special Service Tool: 303-1673 Installer, Camshaft Seal.

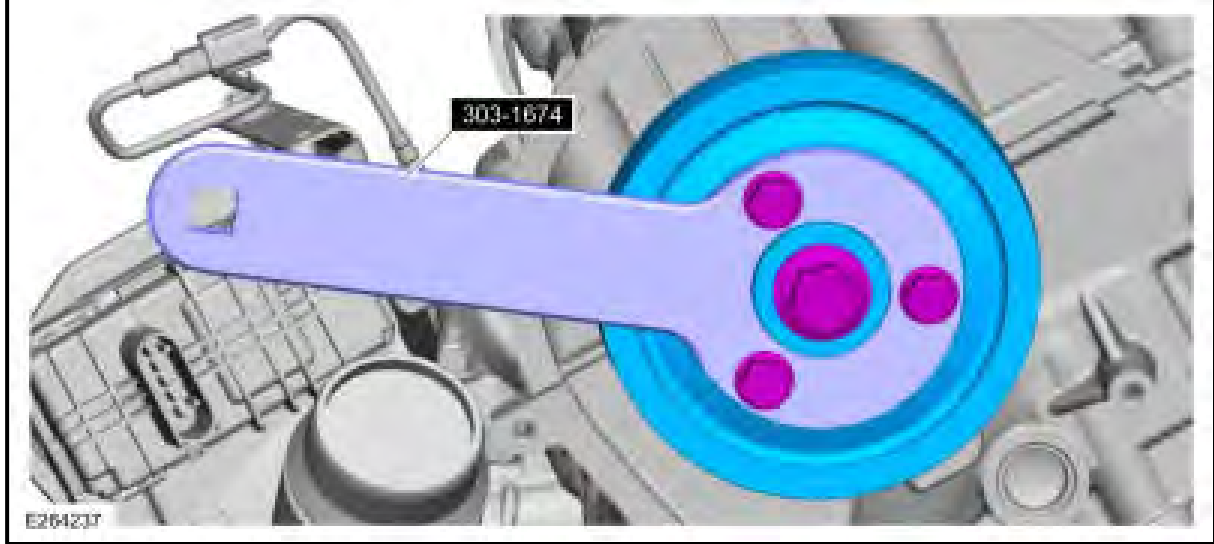


2. Using the special tool, install the RH camshaft gear hub and the bolts. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.

Torque:

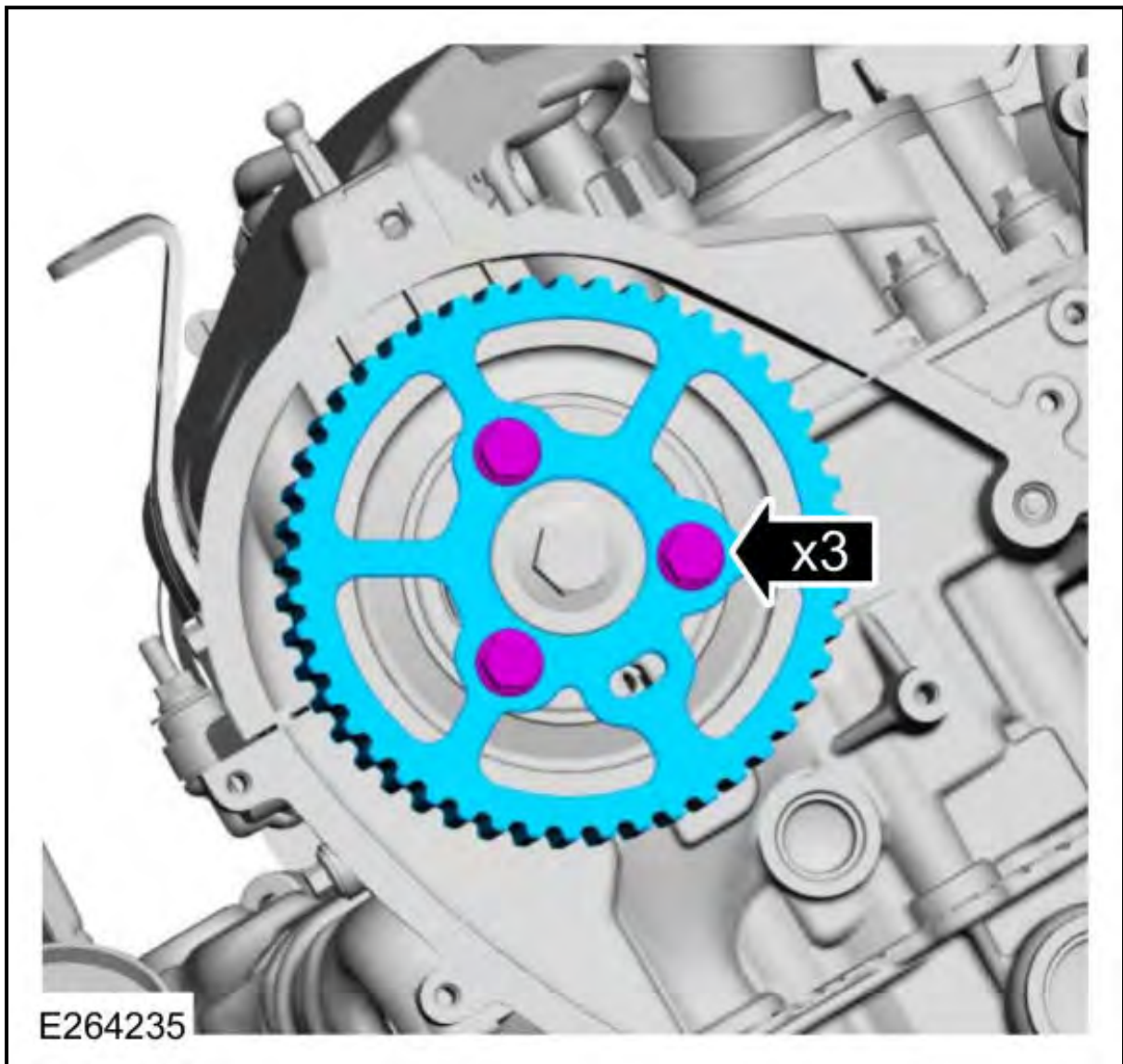
Stage 1: 59 lb.ft (80 Nm)

Stage 2: 80 Å°



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

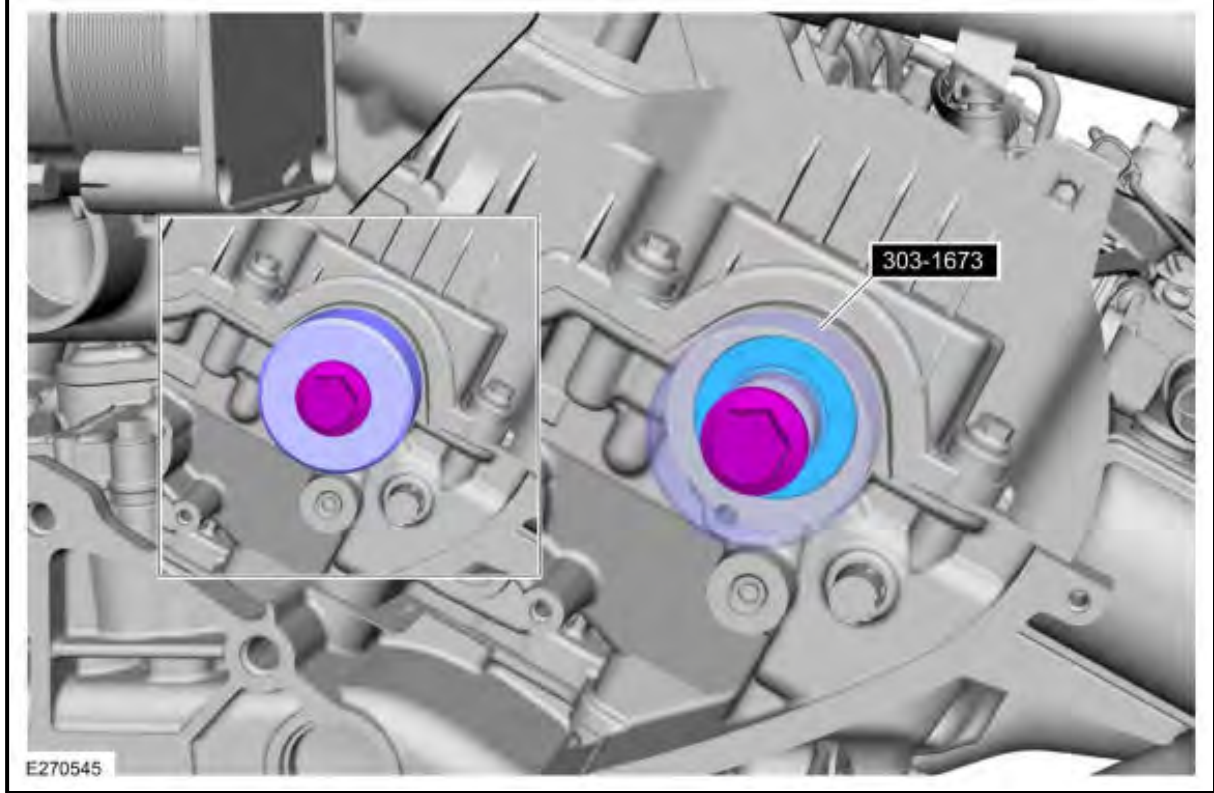
Install the camshaft pulley and the bolts.



#### LH camshaft seal

4. Using the special tool, install the front camshaft seal. Use Special Service Tool: 303-1673 Installer, Camshaft Seal.



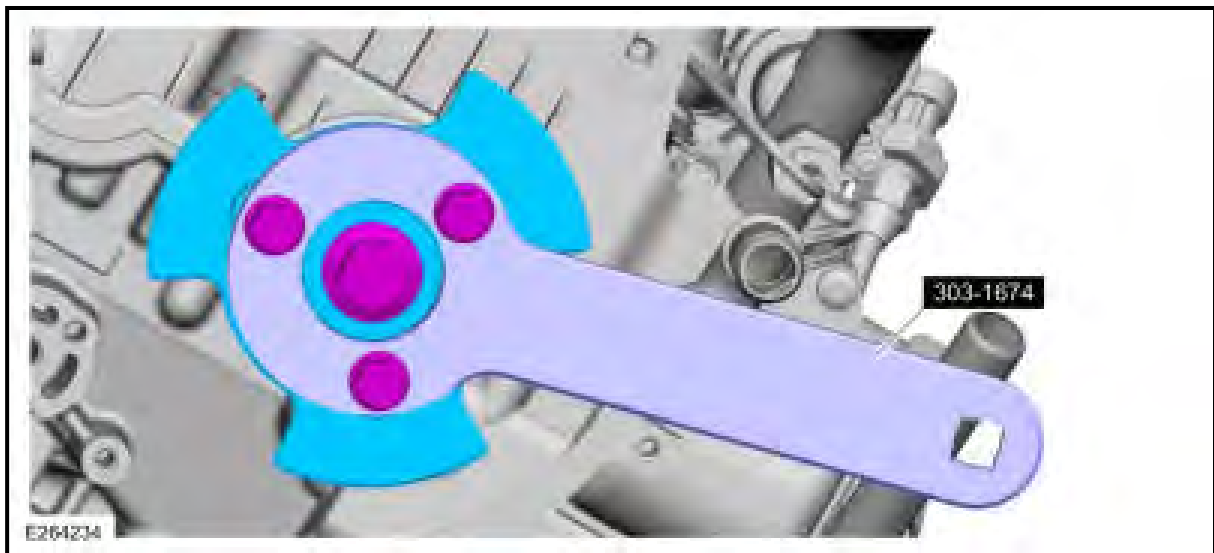


5. Using the special tool, install the LH camshaft gear hub and the bolts. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.

Torque:

Stage 1: 59 lb.ft (80 Nm)

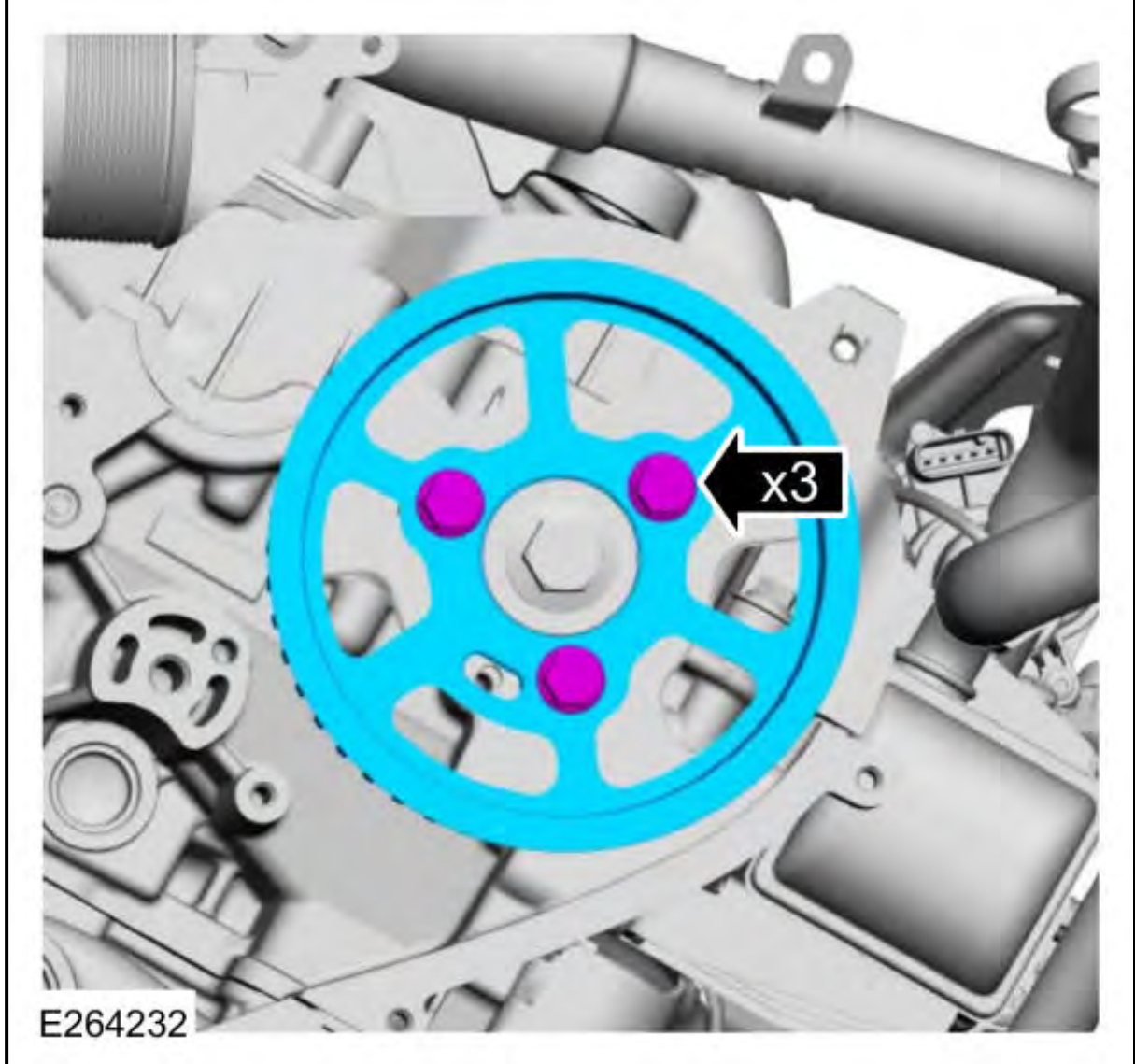
Stage 2: 80 Â°



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

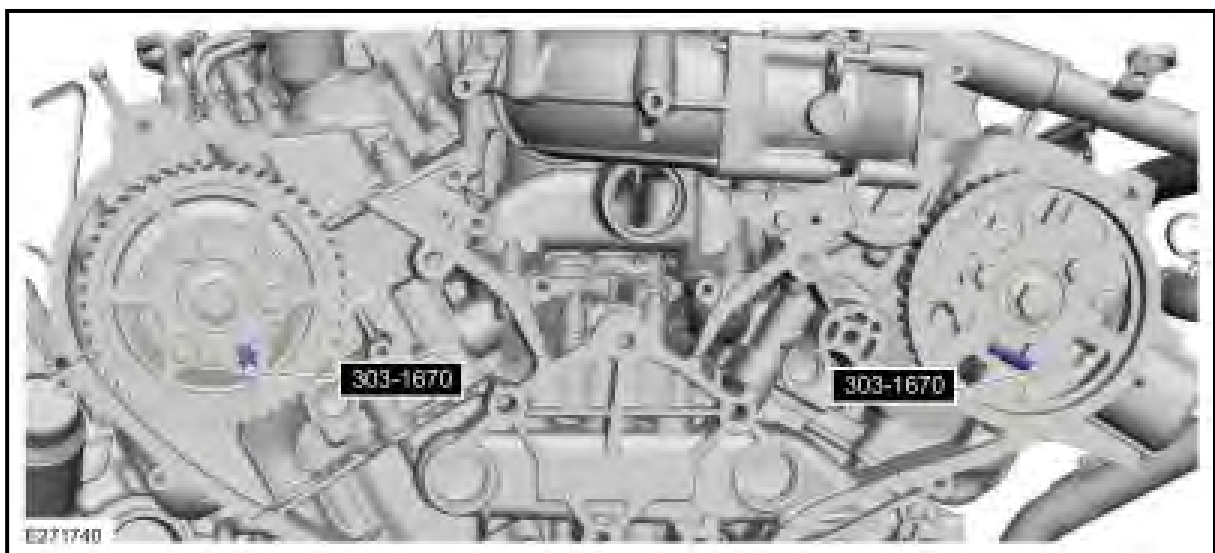
Install the camshaft pulley and the bolts.





**All vehicles**

7. Install Special Service Tool: 303-1670 Pins, Camshaft Locking.



8. Install the timing belt. REFER to: [Timing Belt](#) .





### **CAMSHAFT REAR SEAL**

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

**Special Tool(s) / General Equipment**





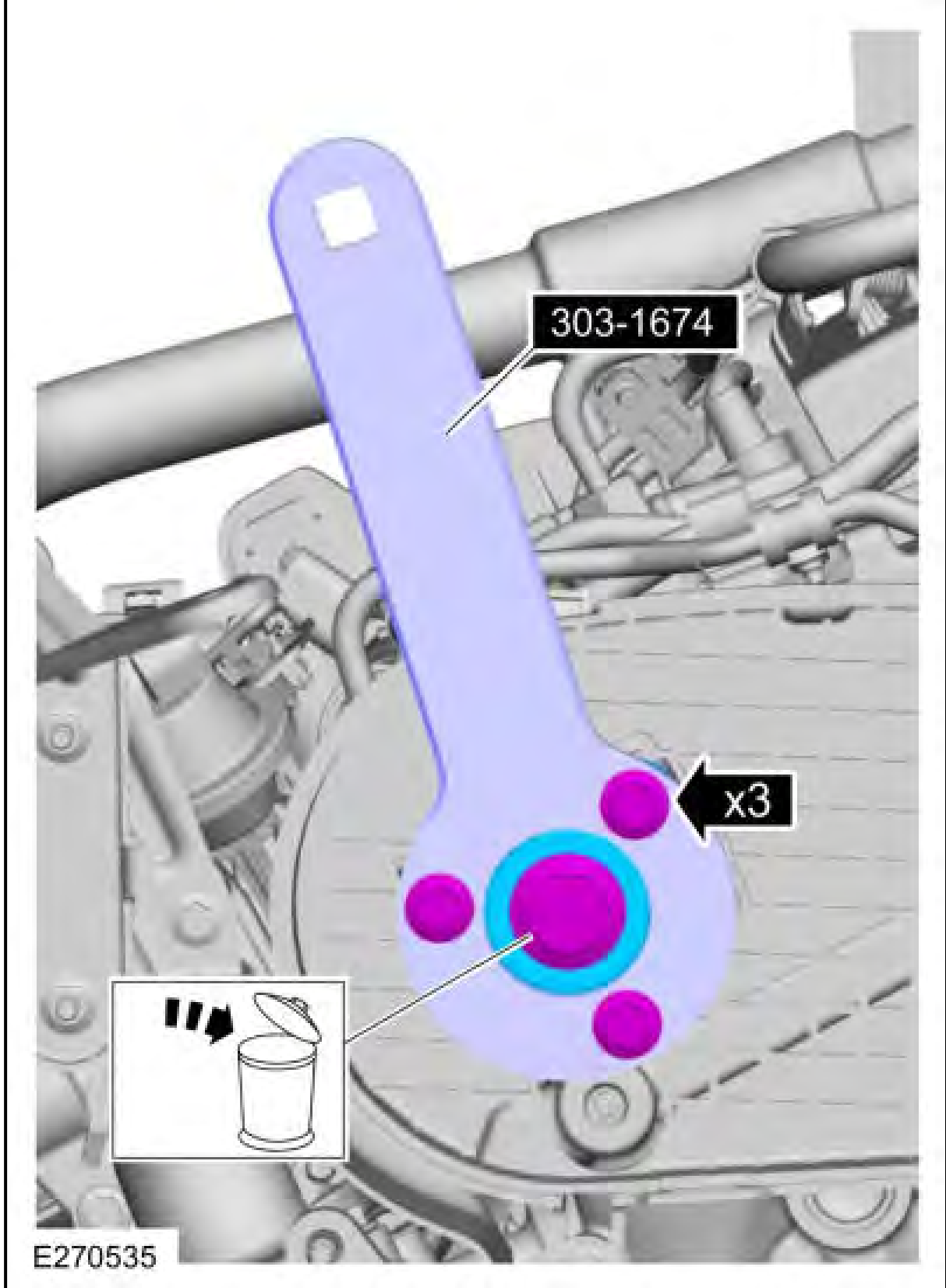
|  |  |
|--|--|
|  <p>E274089</p>  | <p><b>303-1673 Installer, Camshaft Seal</b></p>                          |
|  <p>E274090</p> | <p>303-1674 Tool, Holding Camshaft Sprocket</p>                          |
|  <p>E274091</p> | <p>303-1675 Adapter, Seal Remover</p>                                    |
|  <p>308-375</p> | <p>308-375 Remover, Input Shaft Seal TKIT-2005U-M TKIT-1999-F/FLM/LT</p> |

## REMOVAL

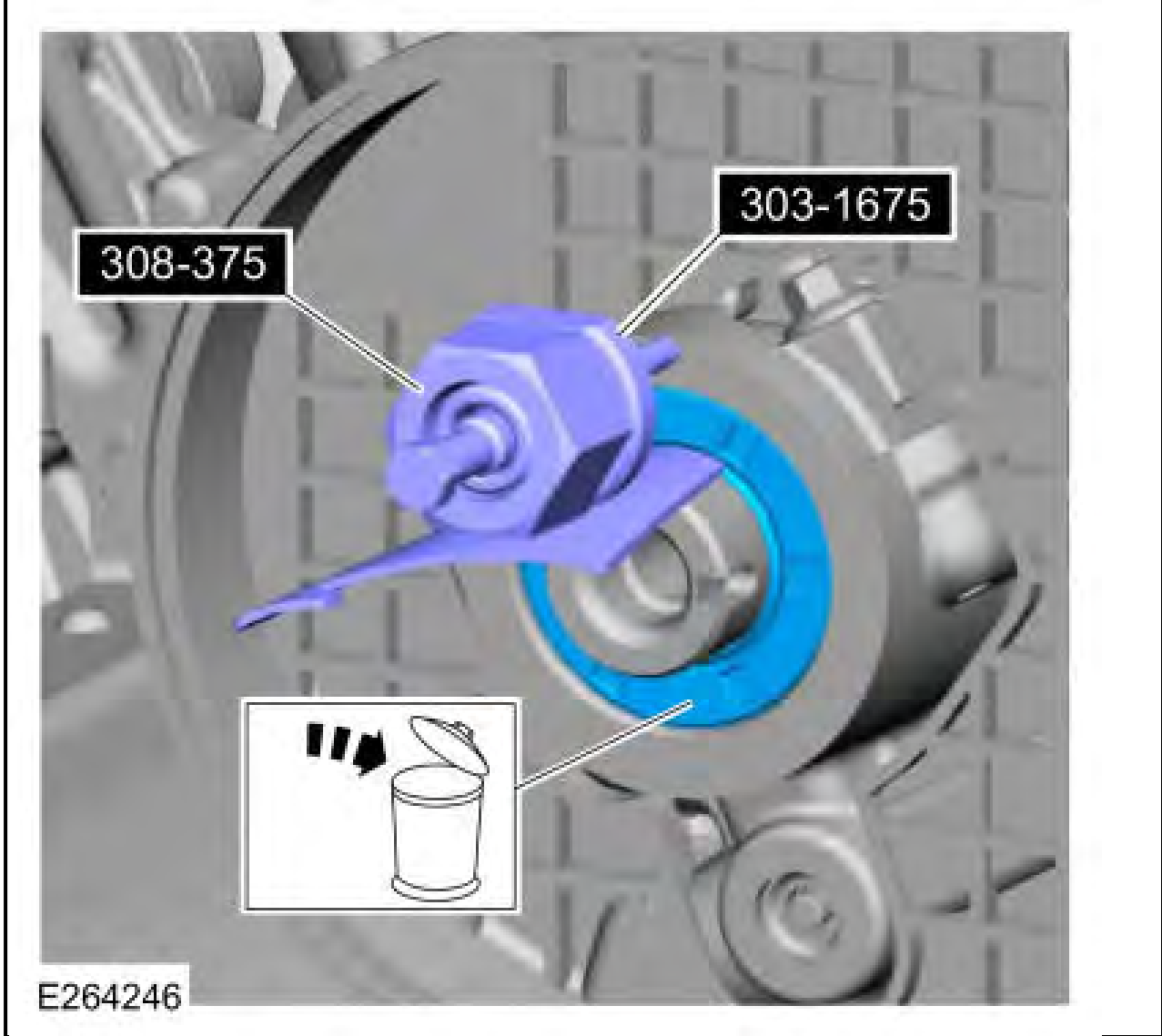
1. Remove the READ belt. REFER to: [Rear End Accessory Drive \(READ\)](#).
2. **NOTE:** Use the original bolts for the special tool.

Using the special tool, remove the bolt and the camshaft gear hub. Discard the bolt. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.



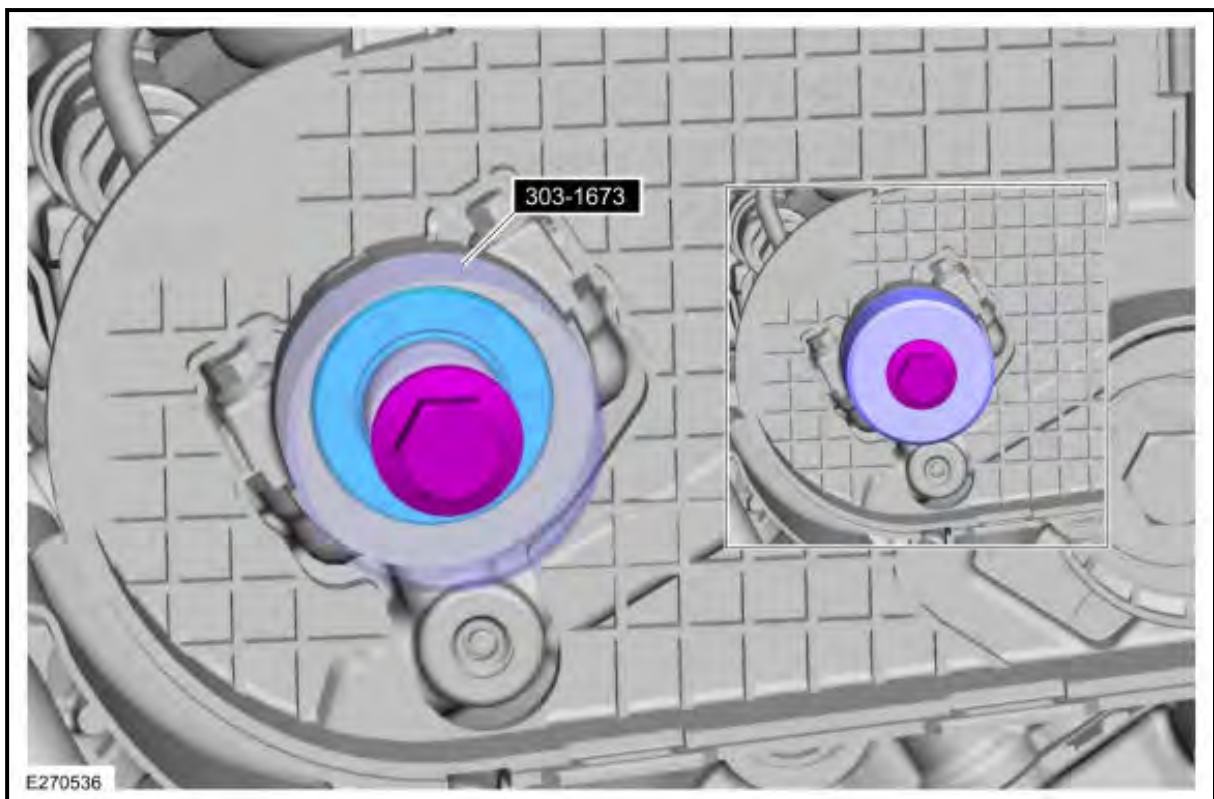


3. Using the special tools, remove and discard the camshaft rear seal. Use Special Service Tool: 303-1675 Adapter, Seal Remover. , 308-375 Remover, Input Shaft Seal.



## INSTALLATION

1. Using the special tool, install the camshaft rear seal. Use Special Service Tool: 303-1673 Installer, Camshaft Seal.

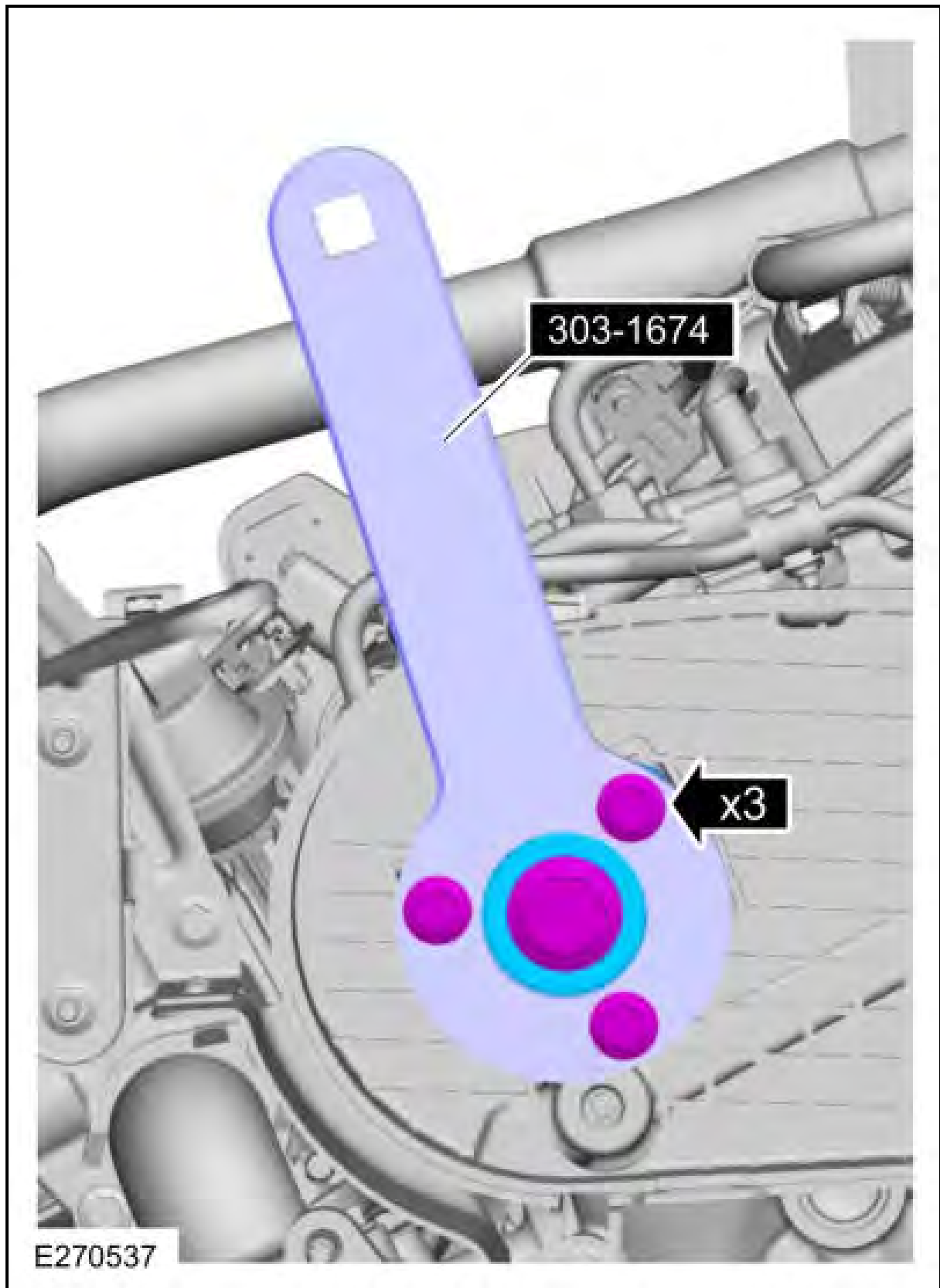


2. Using the special tool, install the camshaft gear hub and the bolt. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.

Torque:

Stage 1: 59 lb.ft (80 Nm)

Stage 2: 80 Å°



3. Install the READ belt. REFER to: [Rear End Accessory Drive \(READ\)](#) .

### **CAMSHAFT LH**

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

## Materials

| Name   | Specification  |
|--|----------------|
| Flange Sealant CU7Z-19B508-A   | WSS-M2G348-A11 |
| Motorcraft <sup>®</sup> Metal Surface Prep Wipes ZC-31-B             | -              |
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA | WSS-M2C214-B1  |

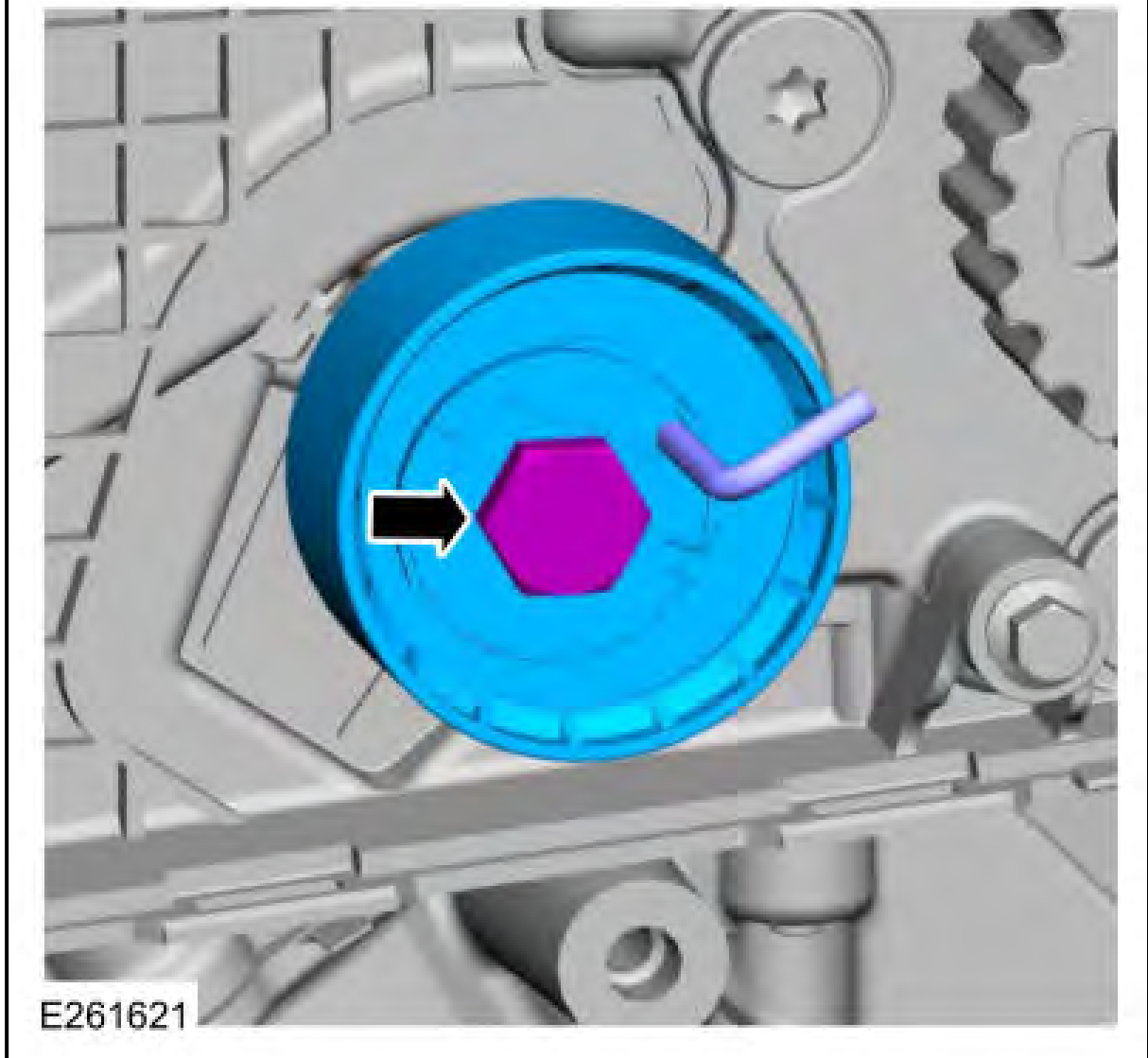
## REMOVAL

**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.

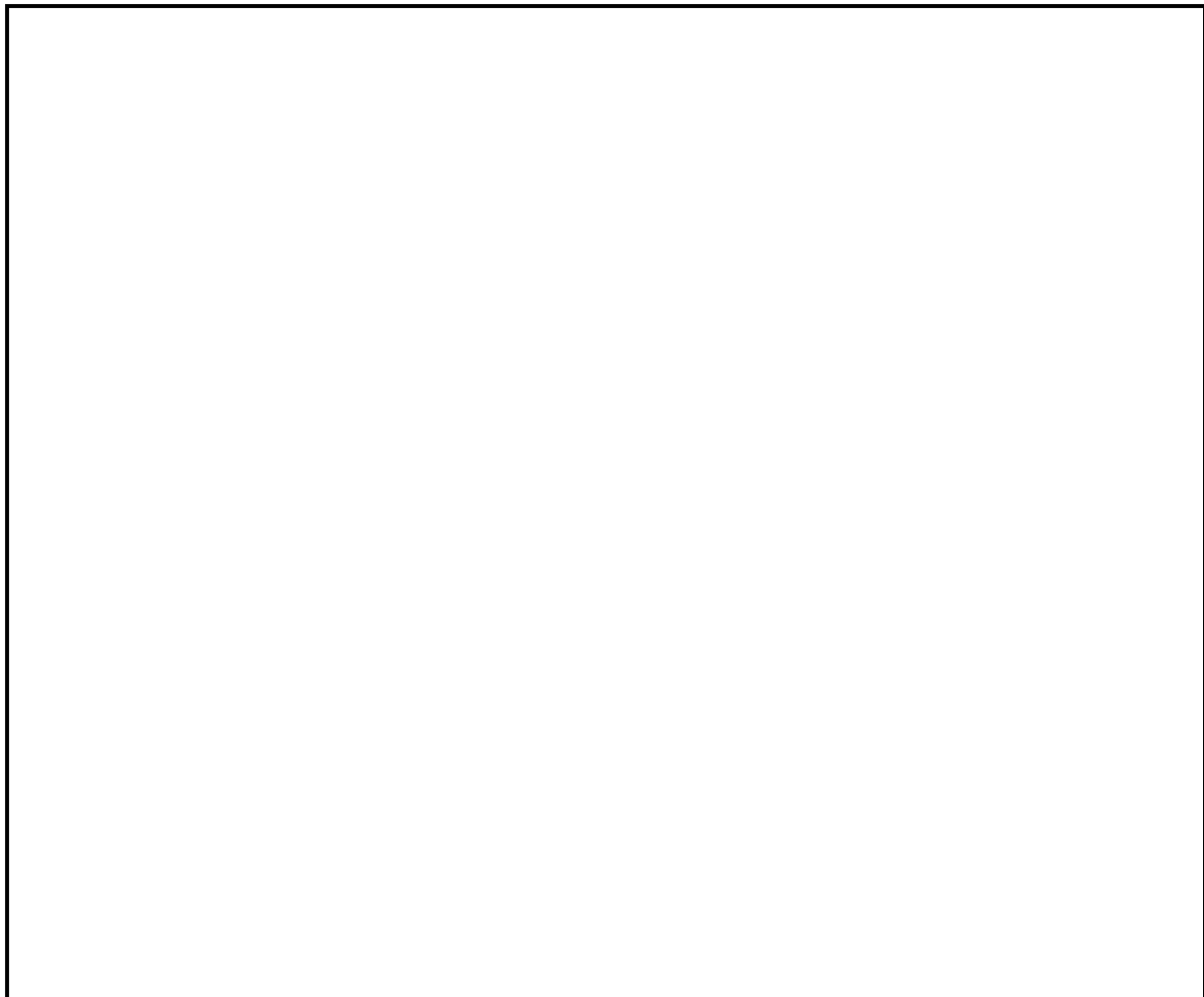
**NOTE:** If the components are to be reinstalled, they must be installed in their original locations.

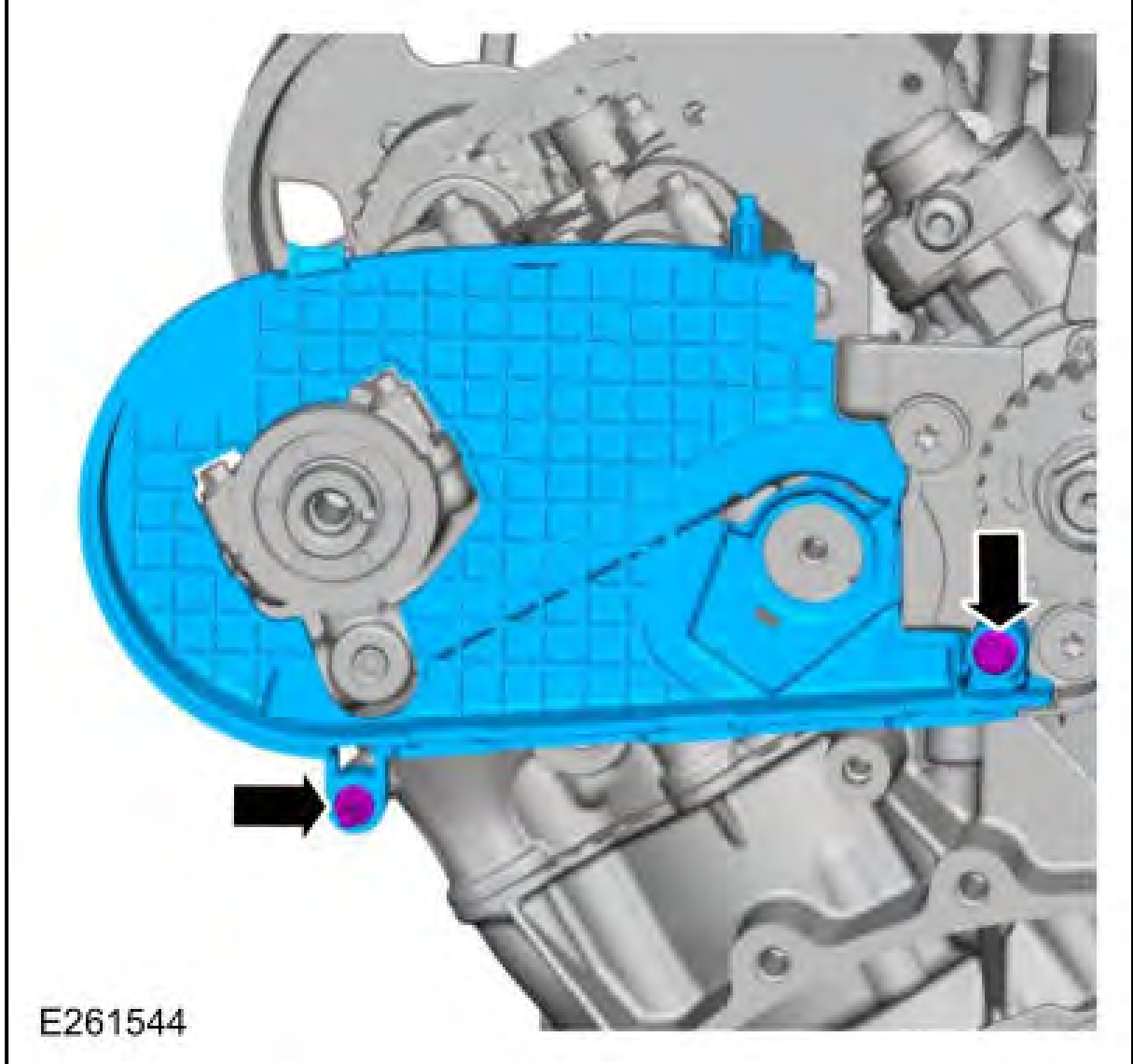
1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Release the fuel system pressure. REFER to: [Fuel System Pressure Release](#) .
3. Disconnect the battery ground cable. REFER to: [Battery Disconnect and Connect](#) .
4. Remove the following items:
  1. Remove the timing belt. REFER to: [Timing Belt](#) .
  2. Remove the LH camshaft front seal. REFER to: [Camshaft Front Seal](#) .
  3. Remove the camshaft rear seal. REFER to: [Camshaft Rear Seal](#) .
  4. Remove the LH valve cover. REFER to: [Valve Cover LH](#) .
5. Remove the bolt and the READ belt tensioner.



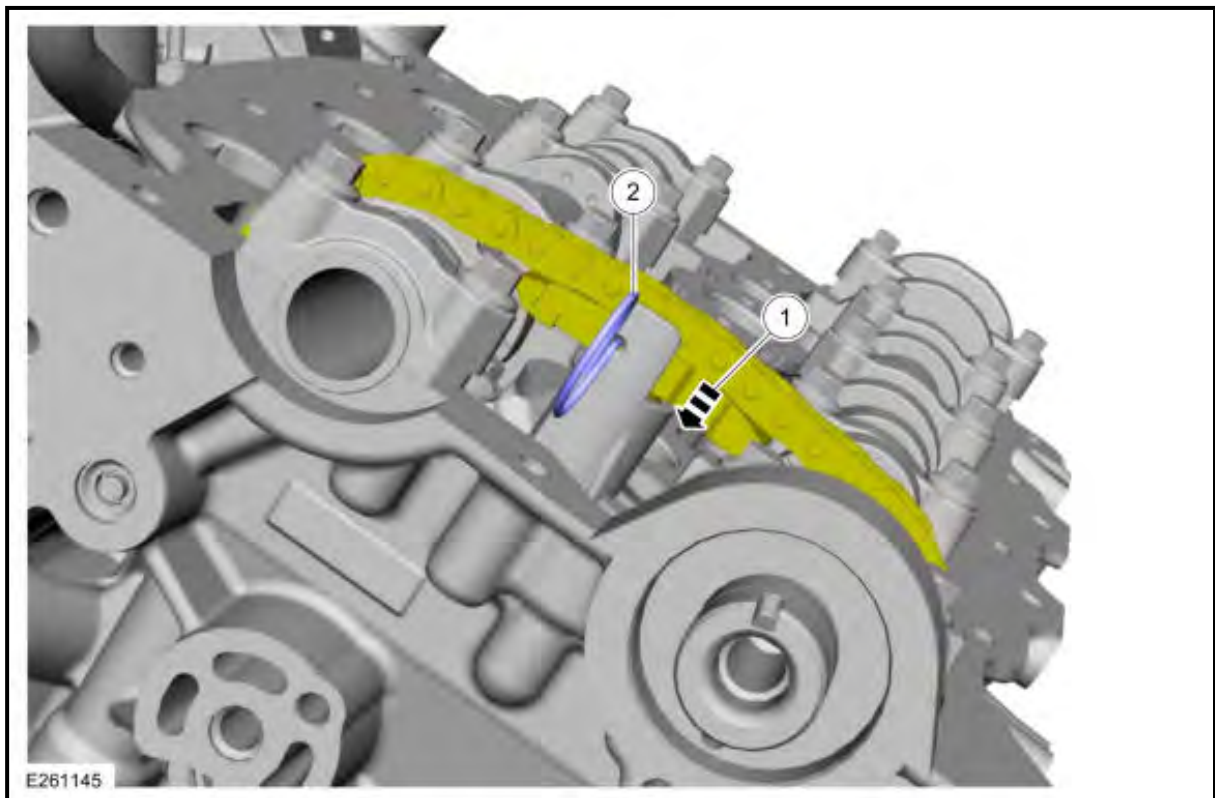


6. Remove the bolt, the stud bolt and the accessory drive cover.





7. Compress the secondary timing chain tensioner and install the retaining pin.

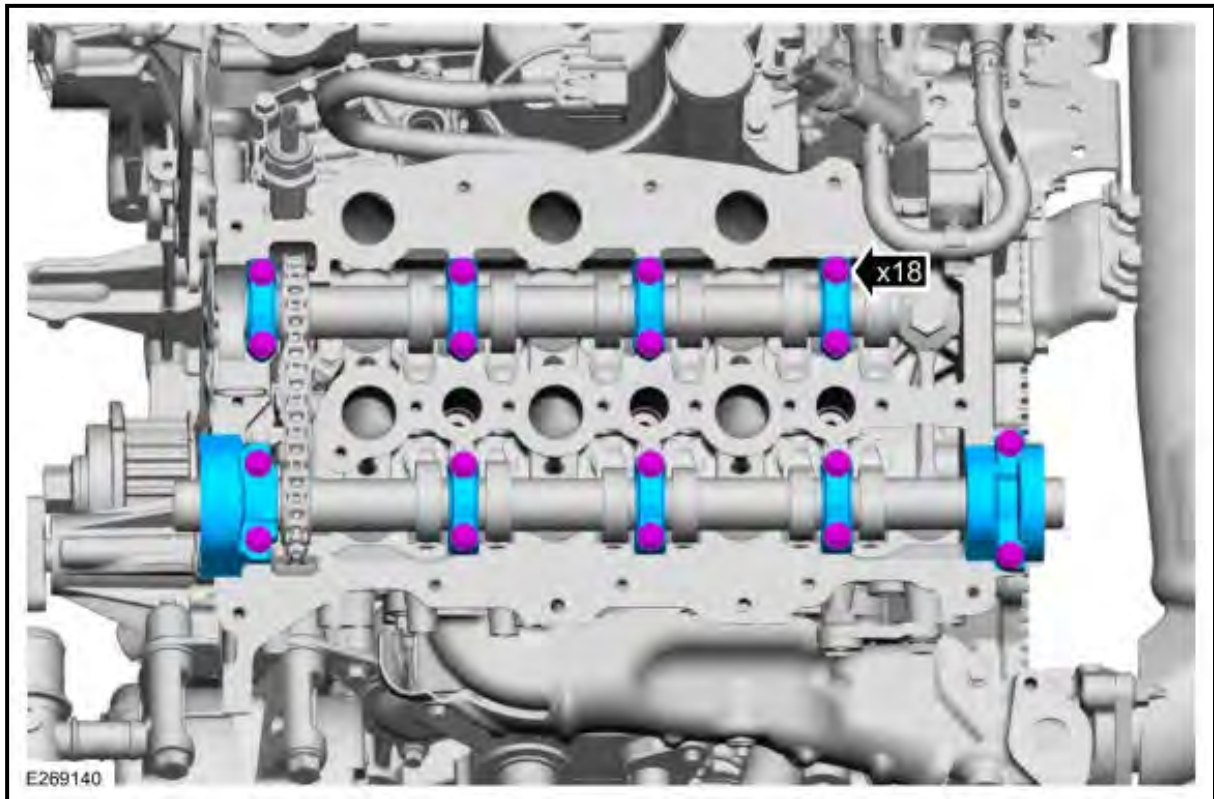


8. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in the original positions.

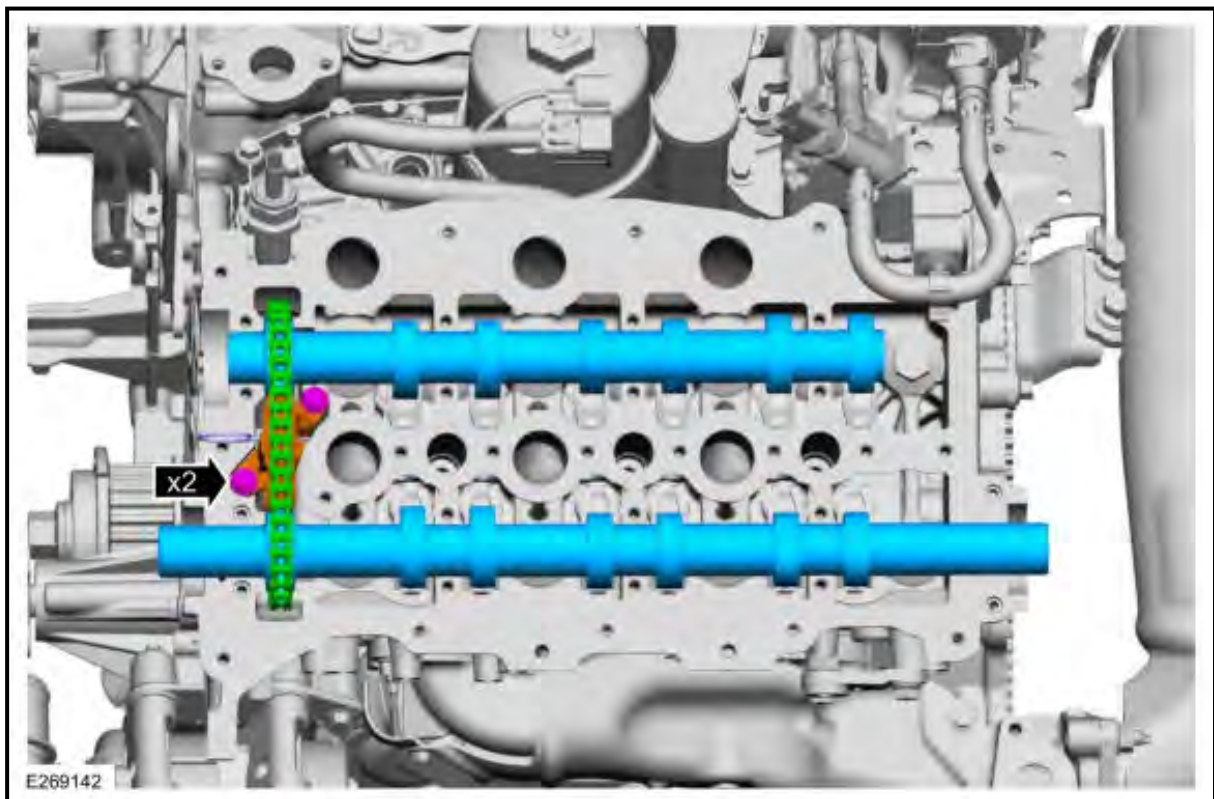
**NOTE:** Loosen the camshaft bearing cap bolts one turn at a time until all

tension is released from the camshaft bearing caps.

Remove the bolts and the camshaft bearing caps.



9. Remove the bolts and the LH camshafts, camshaft chain, secondary timing chain tensioner.



10. **NOTE:** Mark the location of the roller follower and the hydraulic lash adjuster assembly before removal.

Remove the camshaft roller follower and hydraulic lash adjuster assemblies.







11. Inspect the hydraulic lash adjuster and roller follower for damage. If any damage is found, inspect the camshaft lobes and valves for damage. Replace damaged components as necessary.



12. Clean and inspect the sealing surfaces.

Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

### INSTALLATION

1. **NOTE:** If the original hydraulic lash adjusters and roller followers are to be reinstalled, they must be installed in their original locations.

1. Lubricate the hydraulic lash adjusters and roller followers with clean engine oil.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

2. Install the hydraulic lash adjusters and roller followers.



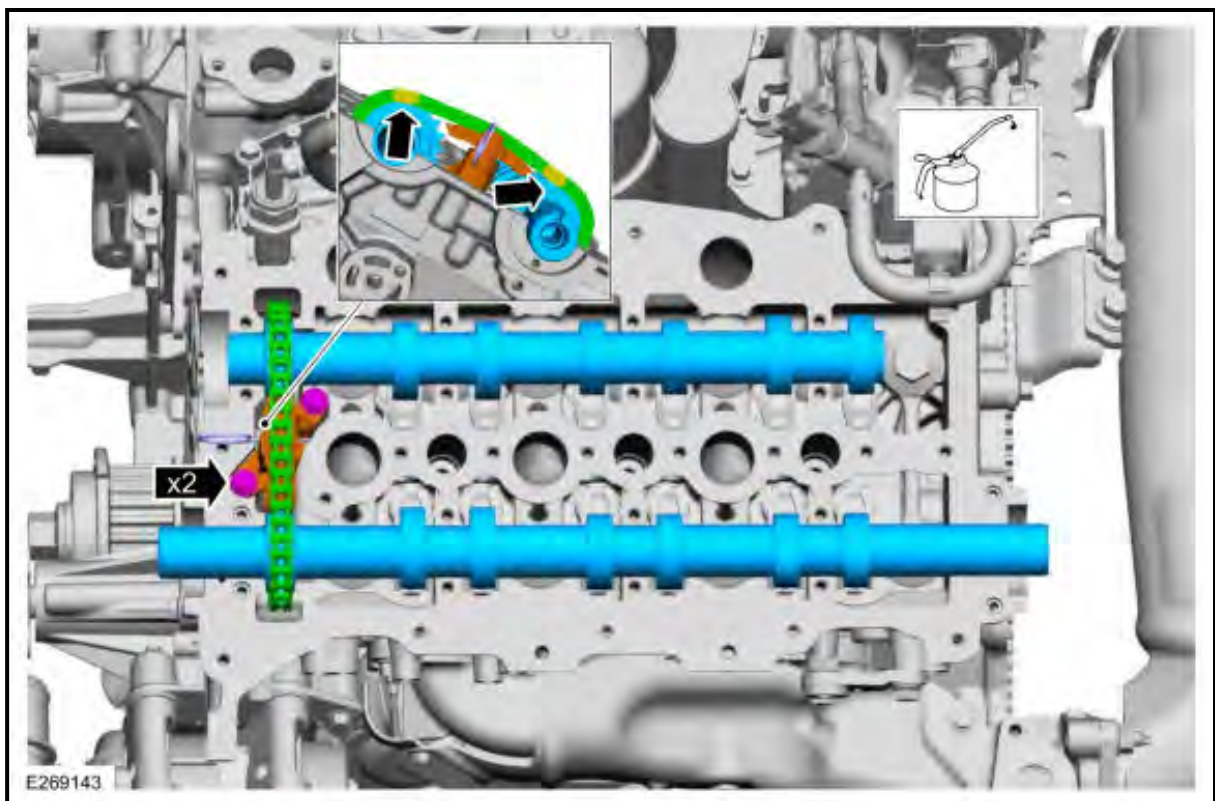
2. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

**NOTE:** Align the timing marks on the camshafts with the timing marks on the secondary timing chain.

Install the LH camshafts, camshaft chain, secondary timing chain tensioner and the bolts.

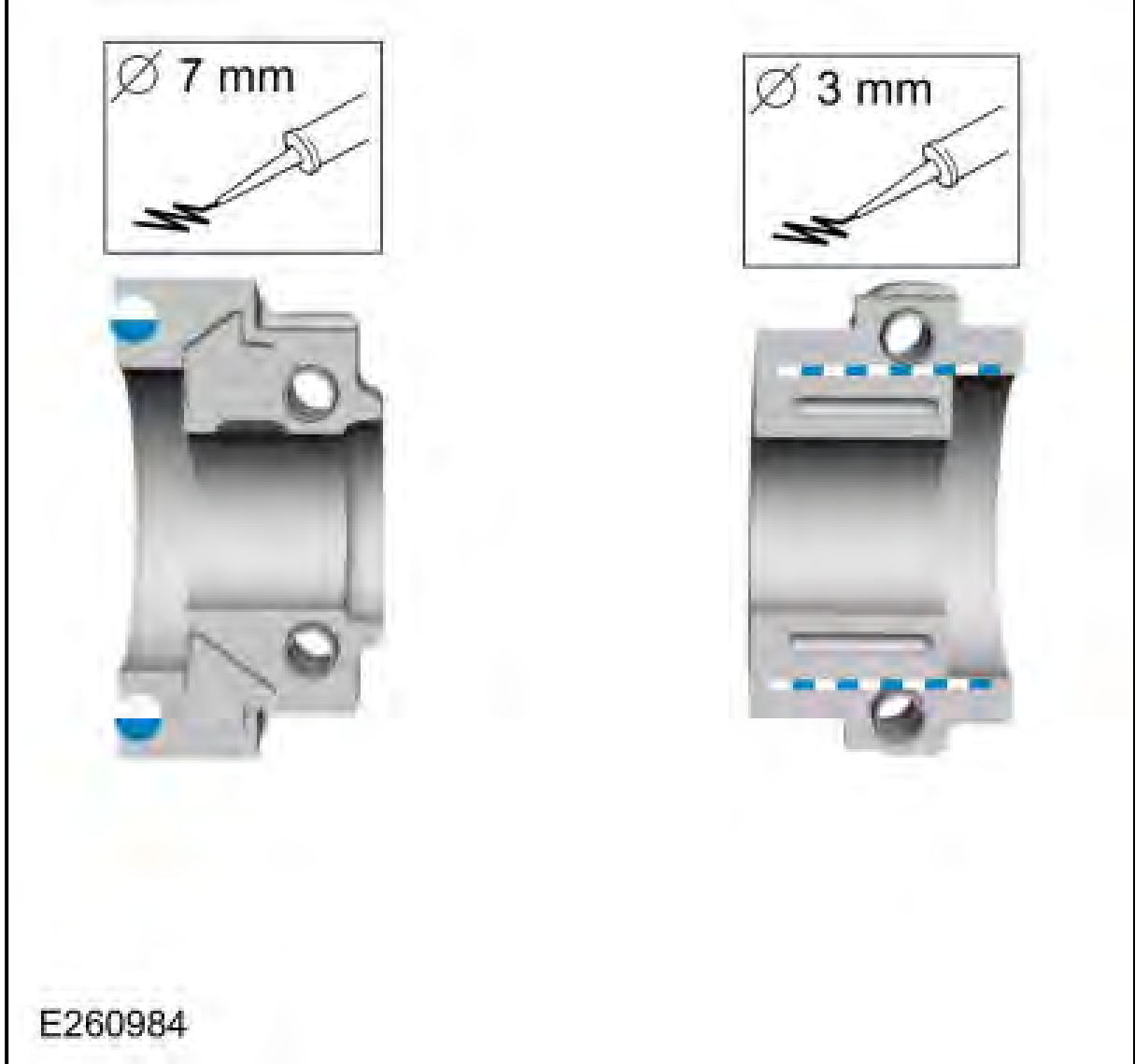
Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque: 89 lb.in (10 Nm)



3. Apply sealer to the LH camshaft bearing caps.

Material: Flange Sealant / CU7Z-19B508-A (WSS-M2G348-A11)



4. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

**NOTE:** Tighten the camshaft bearing cap bolts one turn at a time.

Apply clean engine oil to the camshaft bearing caps. Install the camshaft bearing caps and the bolts.

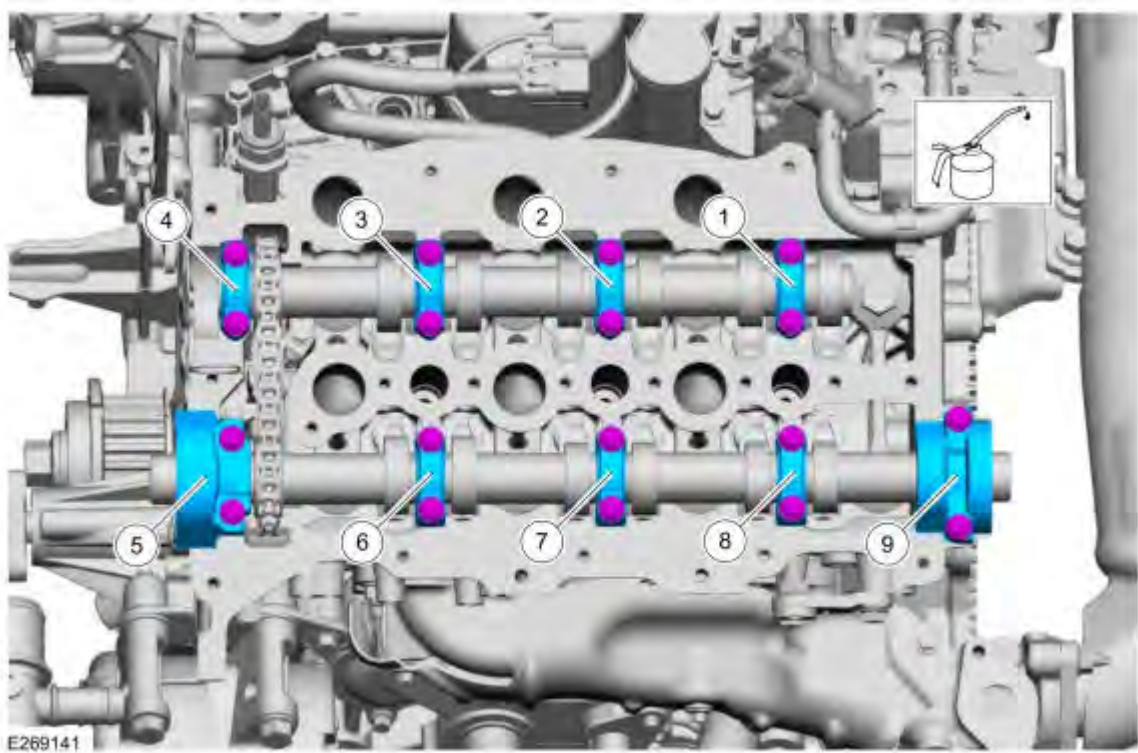
Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque:

Stage 1: 9 lb.in (1 Nm)

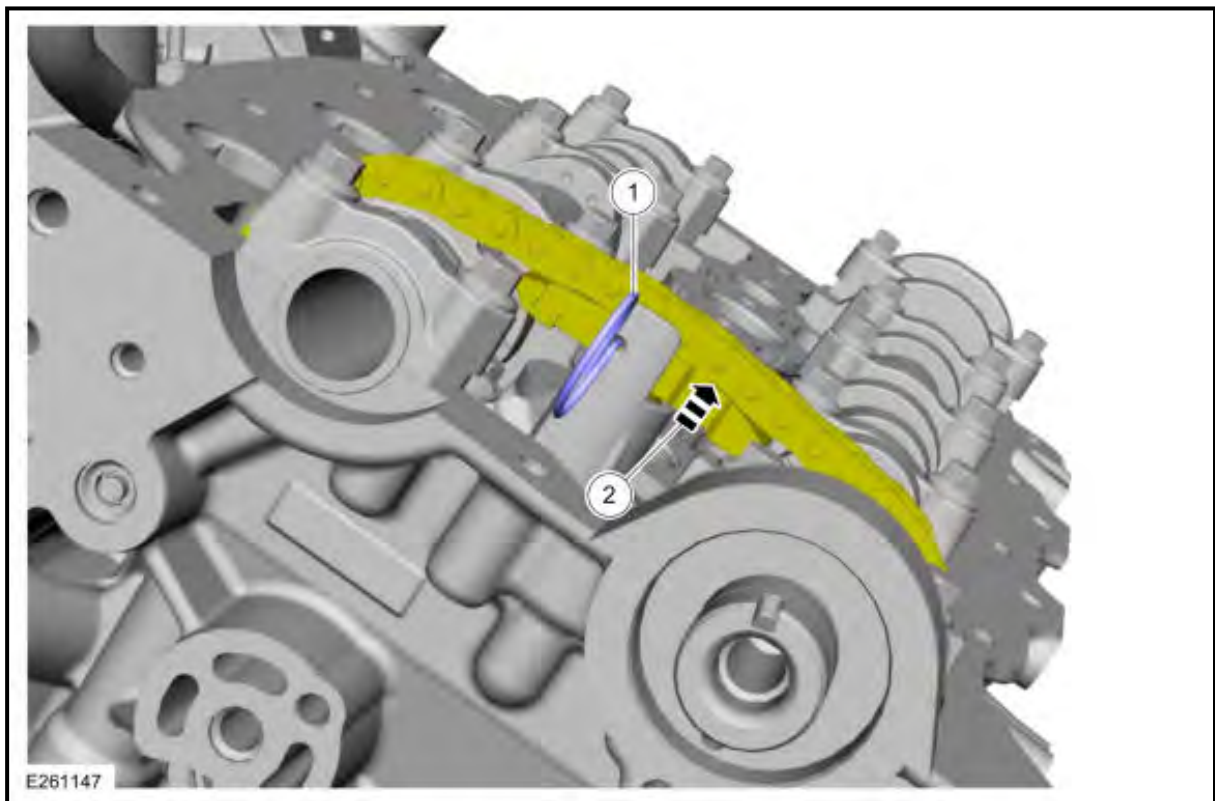
Stage 2: 44 lb.in (5 Nm)

Stage 3: 89 lb.in (10 Nm)



**Fig. 1: Camshaft Bearing Cap Tightening Sequence LH**  
 Courtesy of FORD MOTOR COMPANY

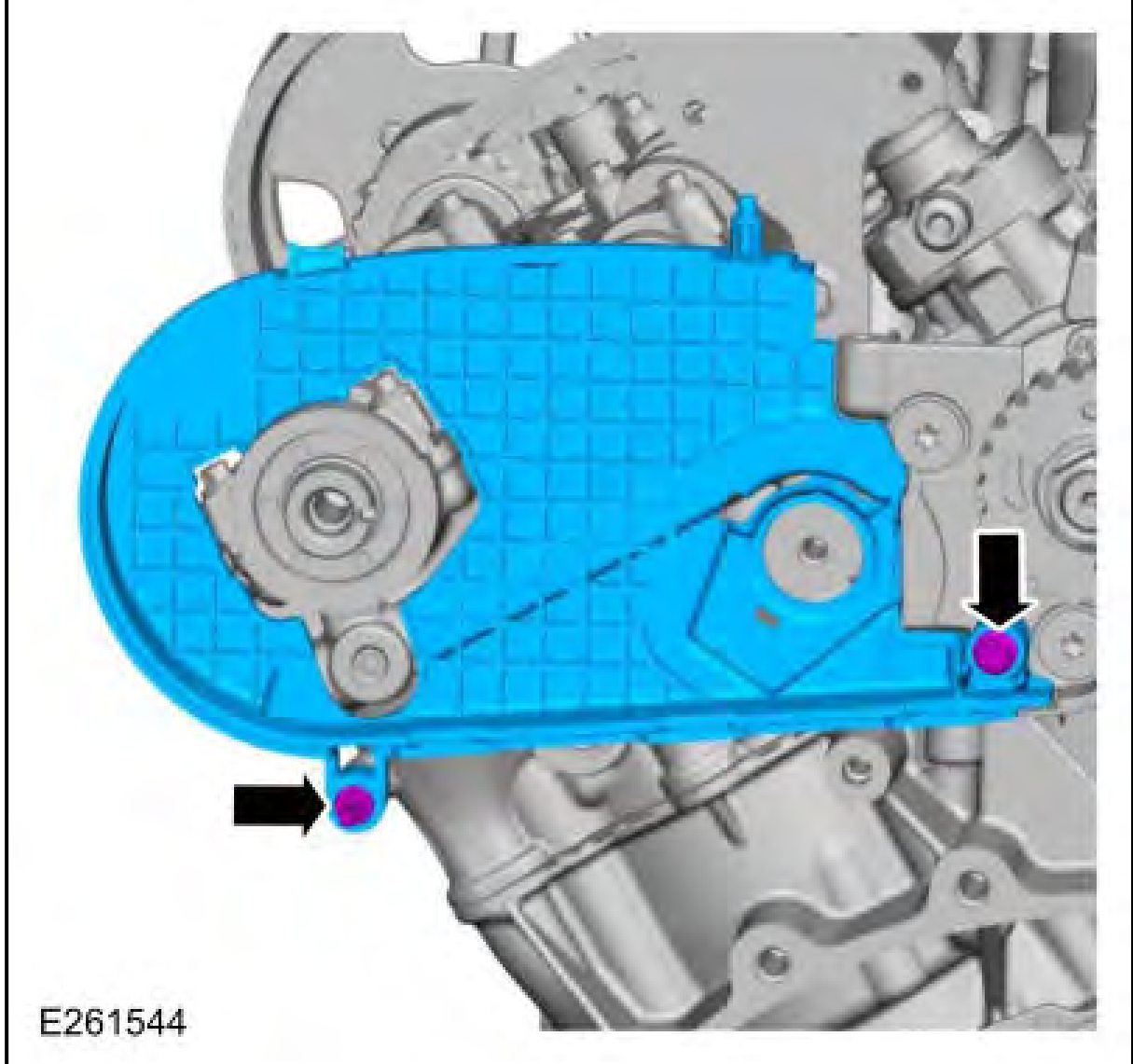
- Remove the retaining pin and release the secondary timing chain tensioner.



- Install the accessory drive cover, the bolt, and the stud bolt.

Torque: 89 lb.in (10 Nm)

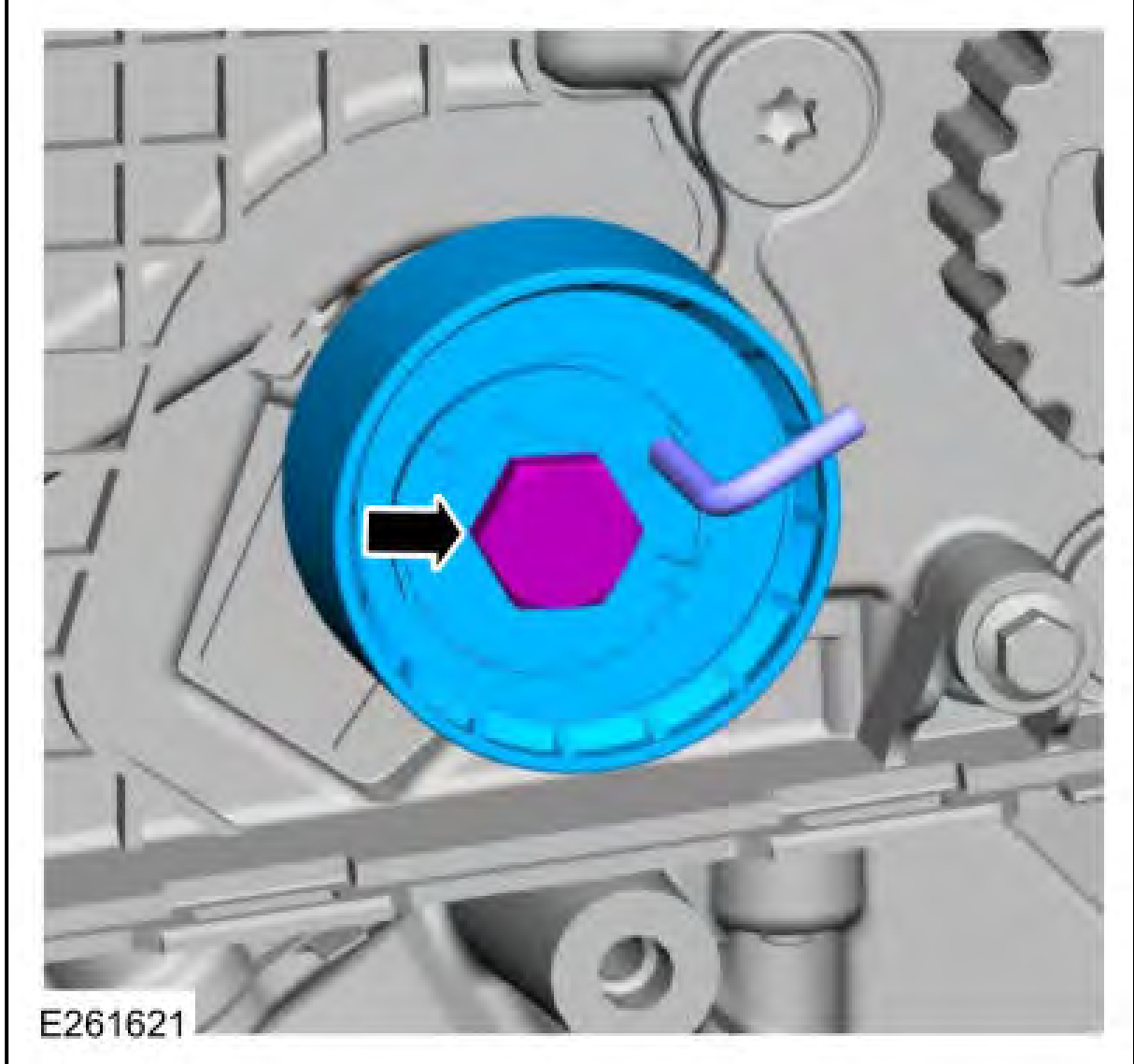




7. Install the READ belt tensioner and the bolt.

Torque: 17 lb.ft (23 Nm)





8. Install the following items:

1. Install the LH valve cover. REFER to: [Valve Cover LH](#) .
2. Install the camshaft rear seal. REFER to: [Camshaft Rear Seal](#) .
3. Install the LH camshaft front seal. REFER to: [Camshaft Front Seal](#) .
4. Install the timing belt. REFER to: [Timing Belt](#) .

9. Connect the battery ground cable. REFER to: [Battery Disconnect and Connect](#) .

## CAMSHAFT RH

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

### Materials

| Name   | Specification  |
|--|----------------|
| Motorcraft <sup>®</sup> Metal Surface Prep ZC-31-A                   | -              |
| Flange Sealant CU7Z-19B508-A   | WSS-M2G348-A11 |
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA | WSS-M2C214-B1  |

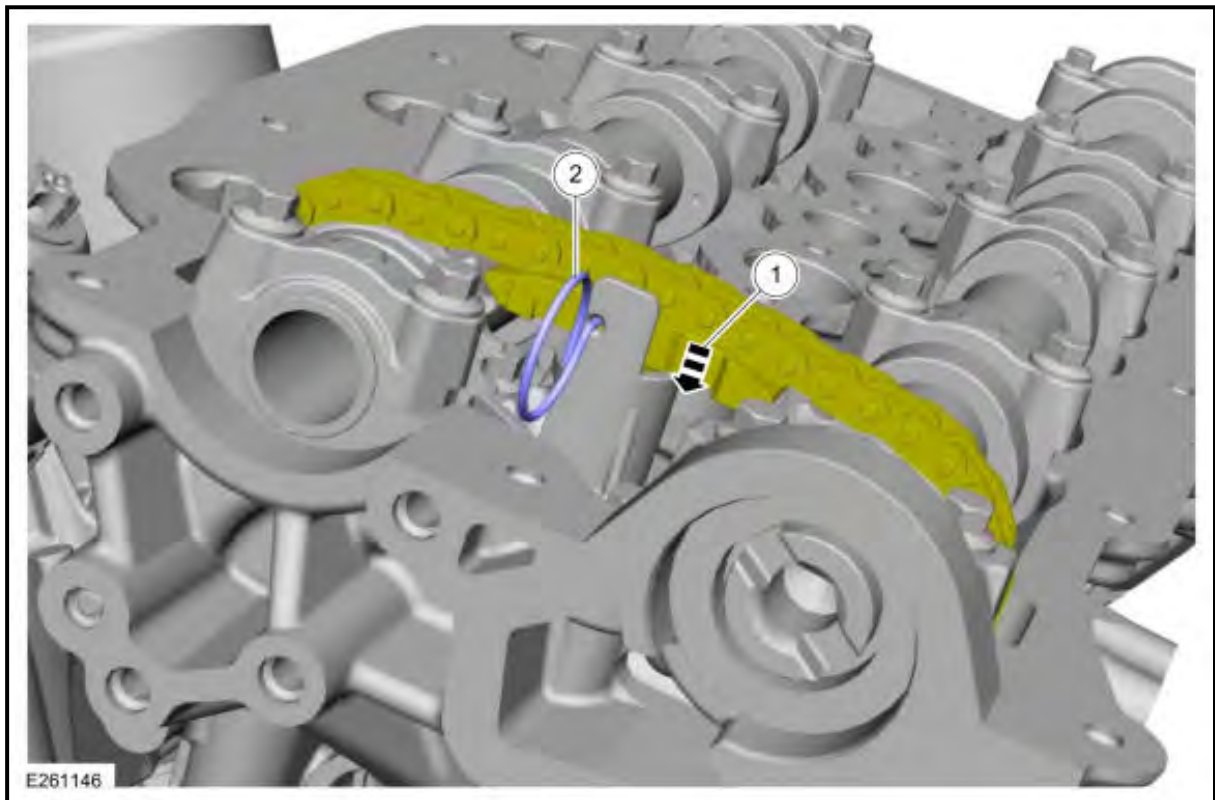
### REMOVAL

**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:** If the components are to be reinstalled, they must be installed in their

**original locations.**

1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Release the fuel system pressure. REFER to: [Fuel System Pressure Release](#) .
3. Disconnect the battery ground cable. REFER to: [Battery Disconnect and Connect](#) .
4. Remove the following items:
  1. Remove the timing belt. REFER to: [Timing Belt](#) .
  2. Remove the RH camshaft front seal. REFER to: [Camshaft Front Seal](#) .
  3. Remove the vacuum pump. REFER to: [Brake Vacuum Pump - 3.0L Power Stroke Diesel](#) .
  4. Remove the RH valve cover. REFER to: [Valve Cover RH](#) .
5. Compress the secondary timing chain tensioner and install the retaining pin.

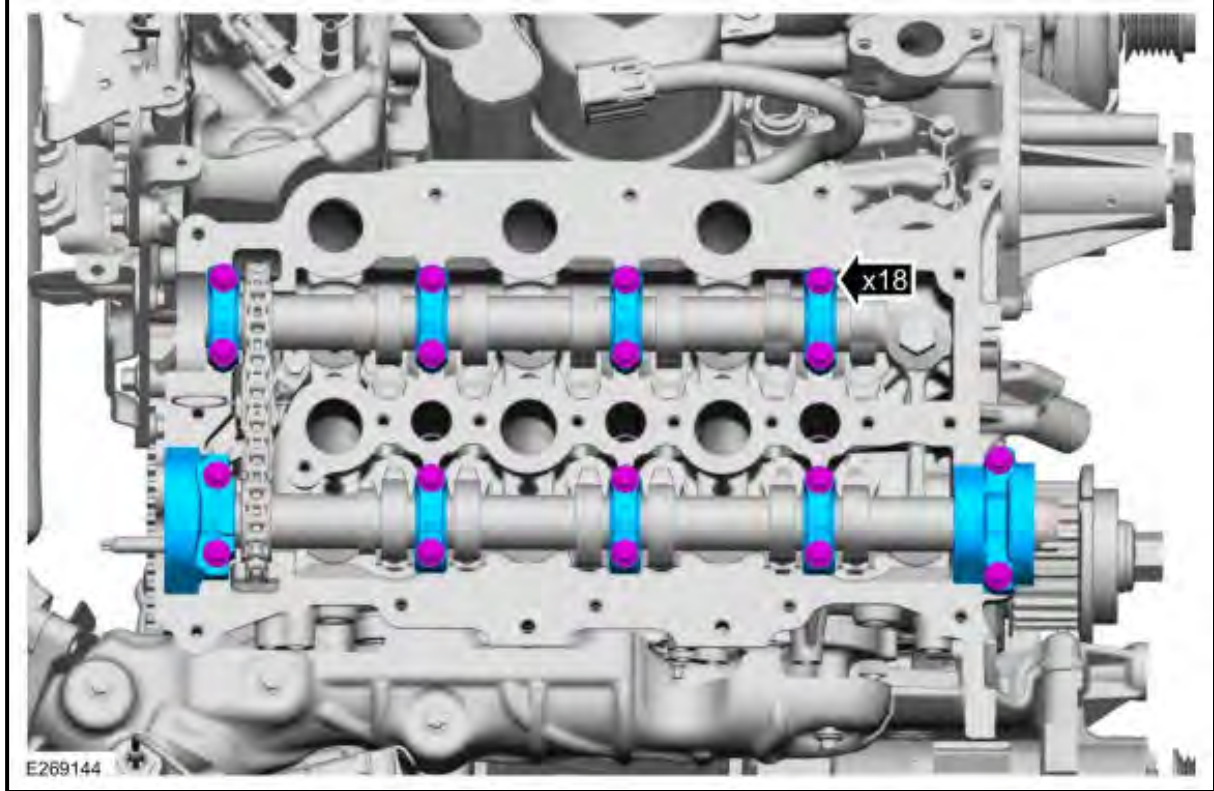


6. **NOTE:**      **Cylinder head camshaft bearing caps are numbered to verify that they are assembled in the original positions.**

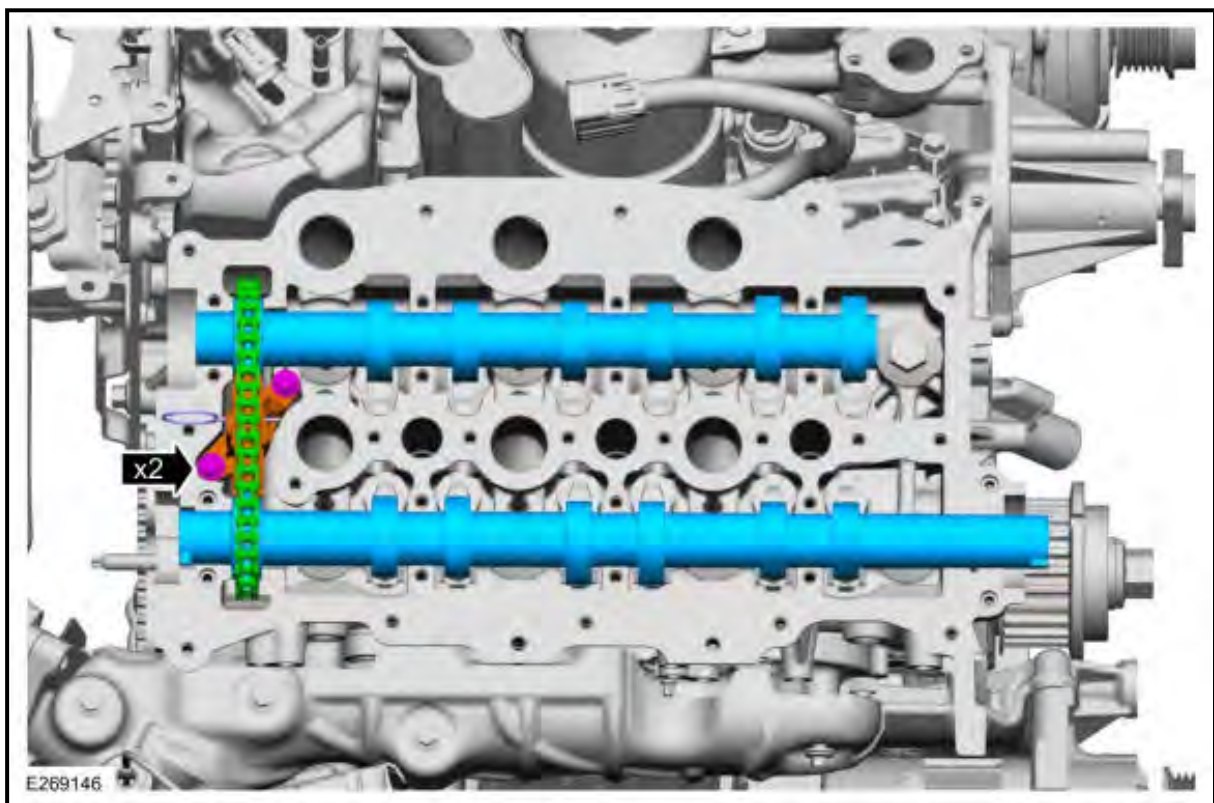
**NOTE:**      **Loosen the camshaft bearing cap bolts one turn at a time until all tension is released from the camshaft bearing caps.**

Remove the bolts and the camshaft bearing caps.



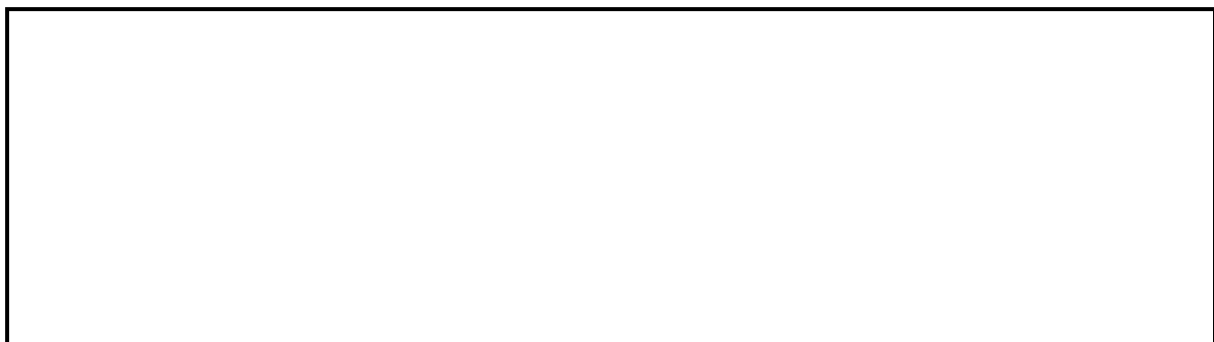


7. Remove the bolts and the RH camshafts, camshaft chain, secondary timing chain tensioner.

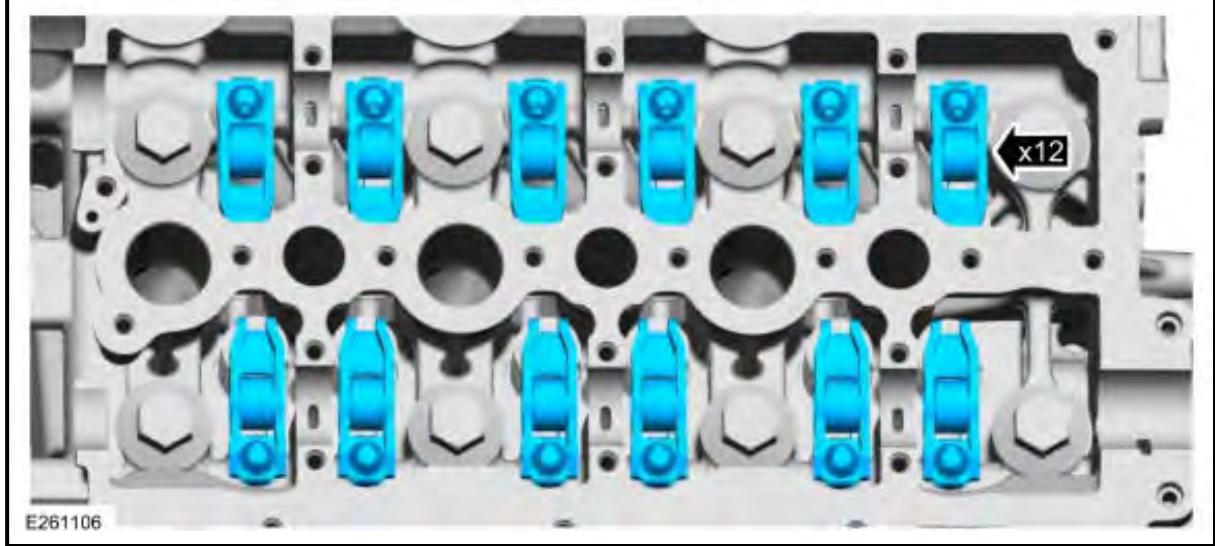


8. **NOTE:** Mark the location of the roller follower and the hydraulic lash adjuster assembly before removal.

Remove the camshaft roller follower and hydraulic lash adjuster assemblies.







9. Inspect the hydraulic lash adjuster and roller follower for damage. If any damage is found, inspect the camshaft lobes and valves for damage. Replace damaged components as necessary.



10. Clean and inspect the sealing surfaces.

Material: Motorcraft <sup>®</sup> Metal Surface Prep / ZC-31-A

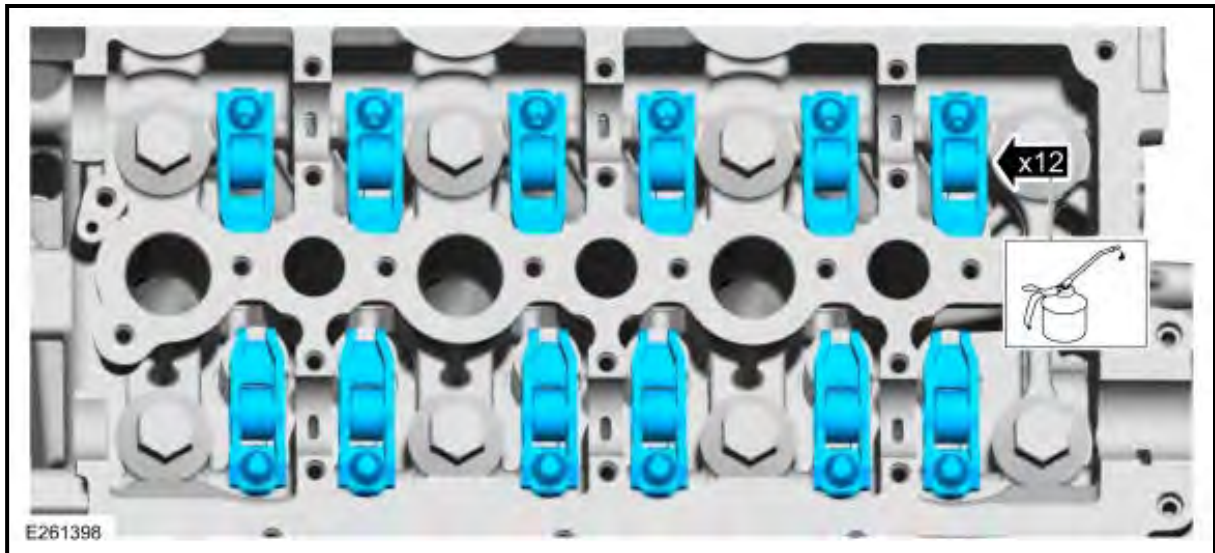
### INSTALLATION

1. **NOTE:** If the original hydraulic lash adjusters and roller followers are to be reinstalled, they must be installed in their original locations.

1. Lubricate the hydraulic lash adjusters and roller followers with clean engine oil.

Material: Motorcraft A® SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

2. Install the hydraulic lash adjusters and roller followers.



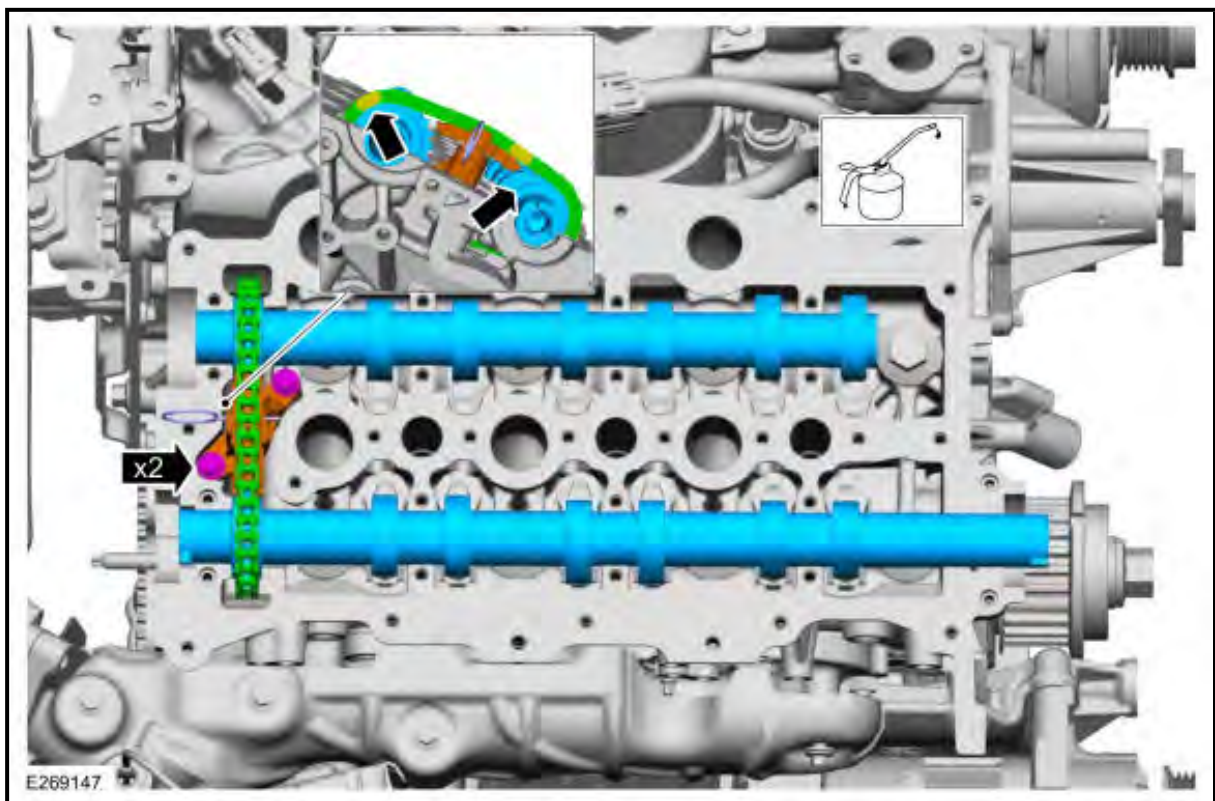
2. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

**NOTE:** Align the timing marks on the camshafts with the timing marks on the secondary timing chain.

Install the RH camshafts, camshaft chain, secondary timing chain tensioner and the bolts.

Material: Motorcraft A® SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

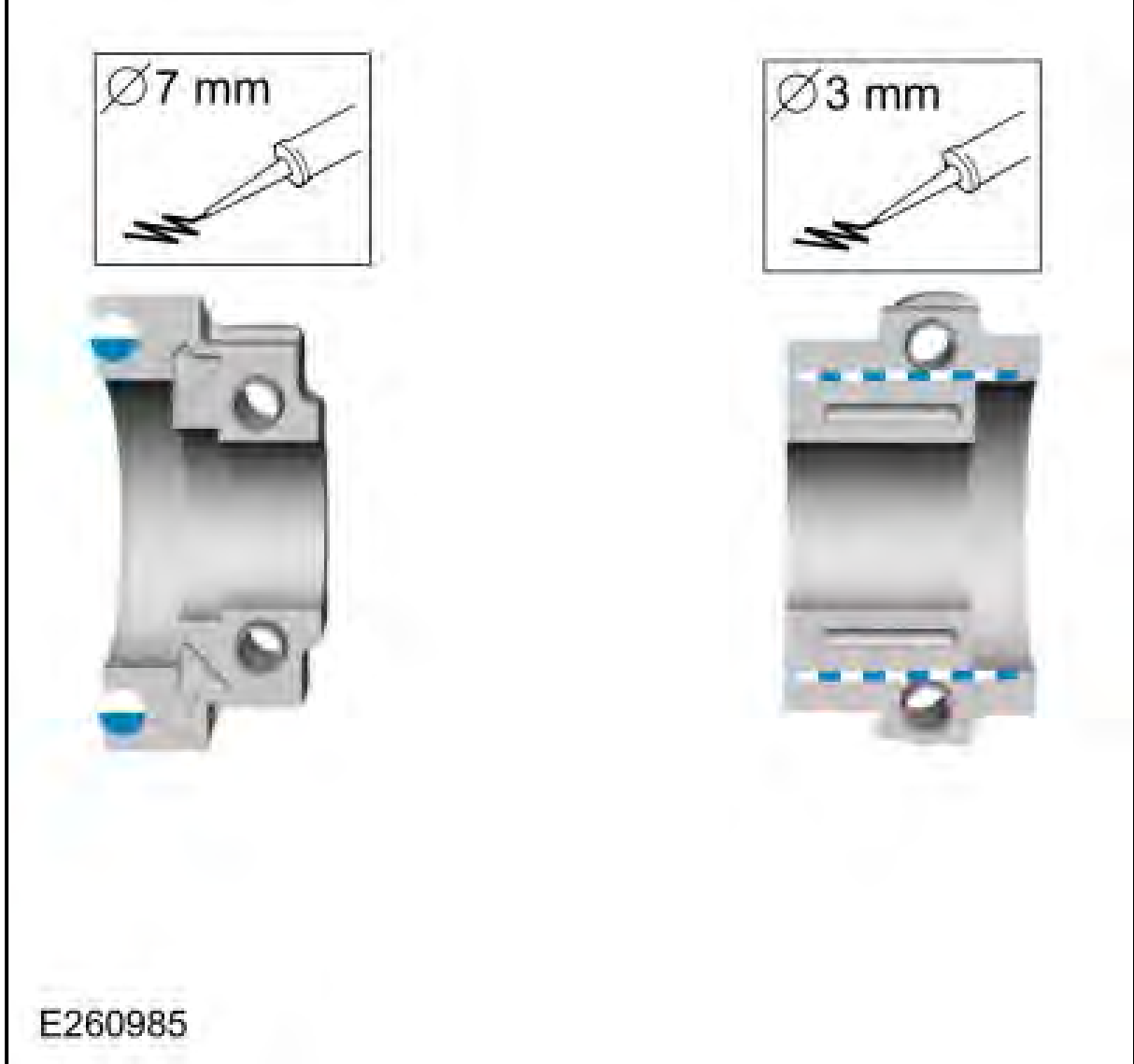
Torque: 89 lb.in (10 Nm)



3. Apply sealer to the RH camshaft bearing caps.

Material: Flange Sealant / CU7Z-19B508-A (WSS-M2G348-A11)





4. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

**NOTE:** Tighten the camshaft bearing cap bolts one turn at a time.

Apply clean engine oil to the camshaft bearing caps. Install the camshaft bearing caps and the bolts.

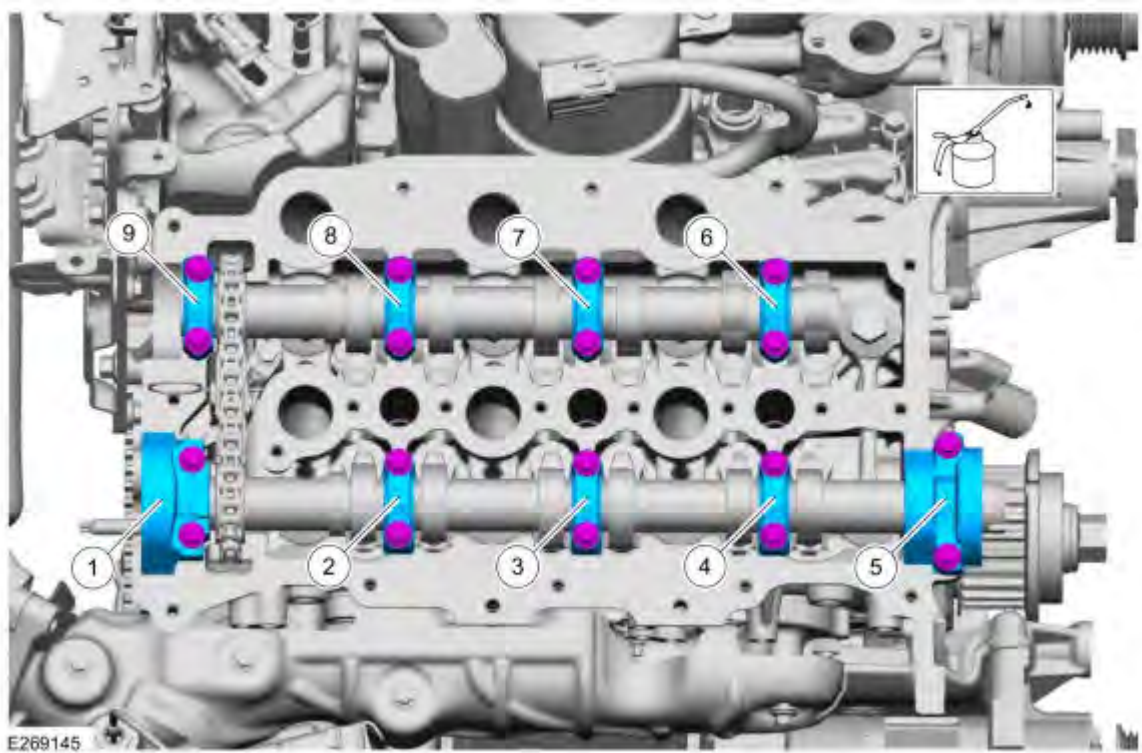
Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque:

Stage 1: 9 lb.in (1 Nm)

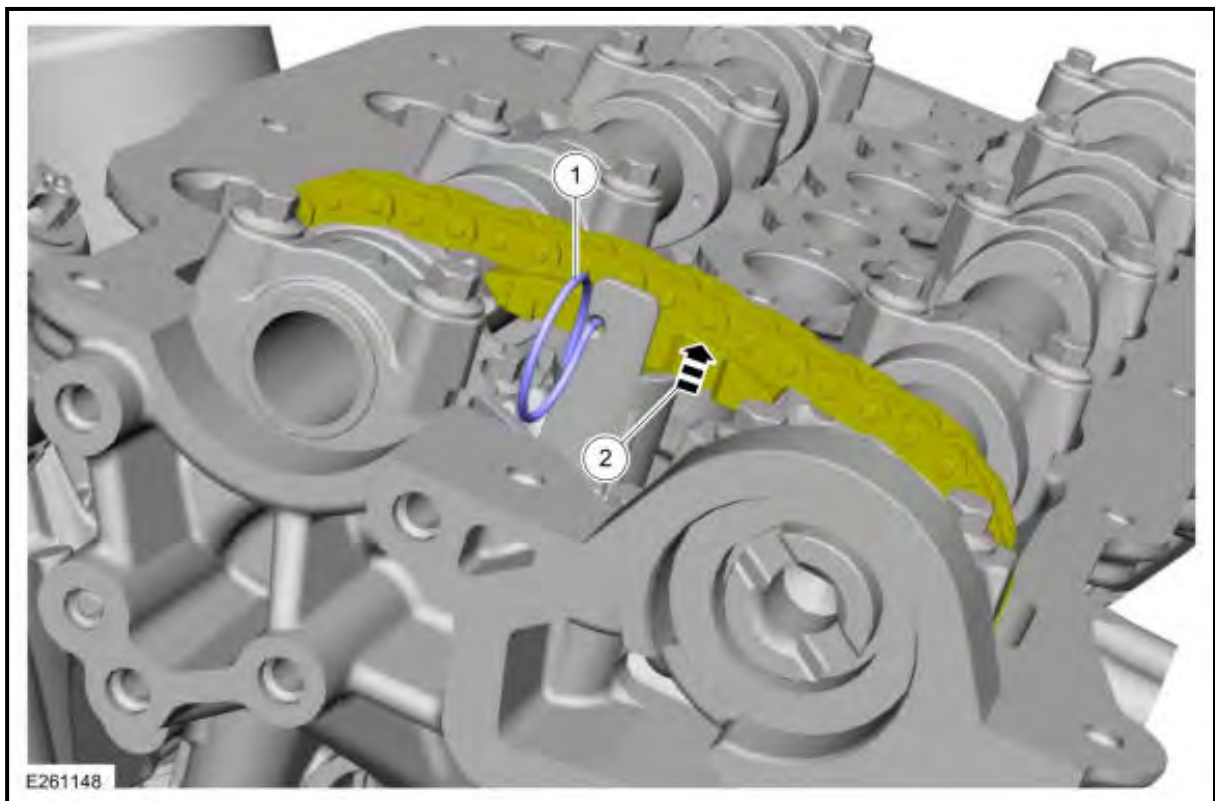
Stage 2: 44 lb.in (5 Nm)

Stage 3: 89 lb.in (10 Nm)



**Fig. 2: Camshaft bearing Cap Tightening Sequence RH**  
 Courtesy of FORD MOTOR COMPANY

5. Remove the retaining pin and release the secondary timing chain tensioner.



6. Install the following items:



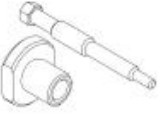


1. Install the RH valve cover. REFER to: [Valve Cover RH](#) .
2. Install the vacuum pump. REFER to: [Brake Vacuum Pump - 3.0L Power Stroke Diesel](#) .
3. Install the RH camshaft front seal. REFER to: [Camshaft Front Seal](#) .
4. Install the timing belt. REFER to: [Timing Belt](#) .

7. Connect the battery ground cable. REFER to: [Battery Disconnect and Connect](#) .

### **CRANKSHAFT FRONT SEAL**

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

## Special Tool(s) / General Equipment

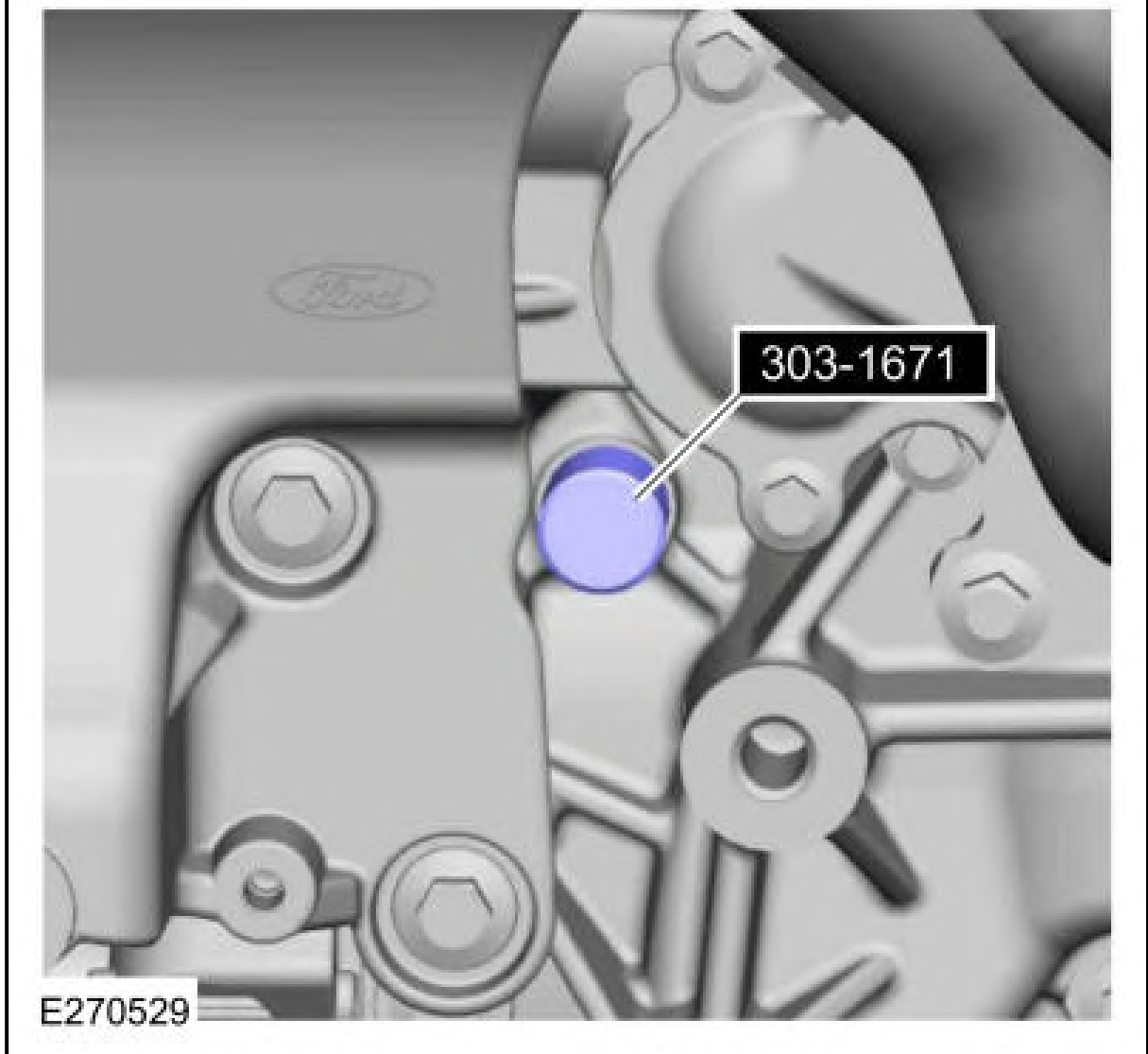
|  |   |
|--|---|
| <br>E274087 | <b>303-1671 Pin, Locking Crankshaft</b>                           |
| <br>E274088 | 303-1672 Installer, Crankshaft Seal                               |
| <br>E274091 | 303-1675 Adapter, Seal Remover                                    |
| <br>E274093 | 303-1677 Locking Tool, Flywheel                                   |
| <br>308-375 | 308-375 Remover, Input Shaft Seal TKIT-2005U-M TKIT-1999-F/FLM/LT |

### REMOVAL

**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 may cause engine failure.

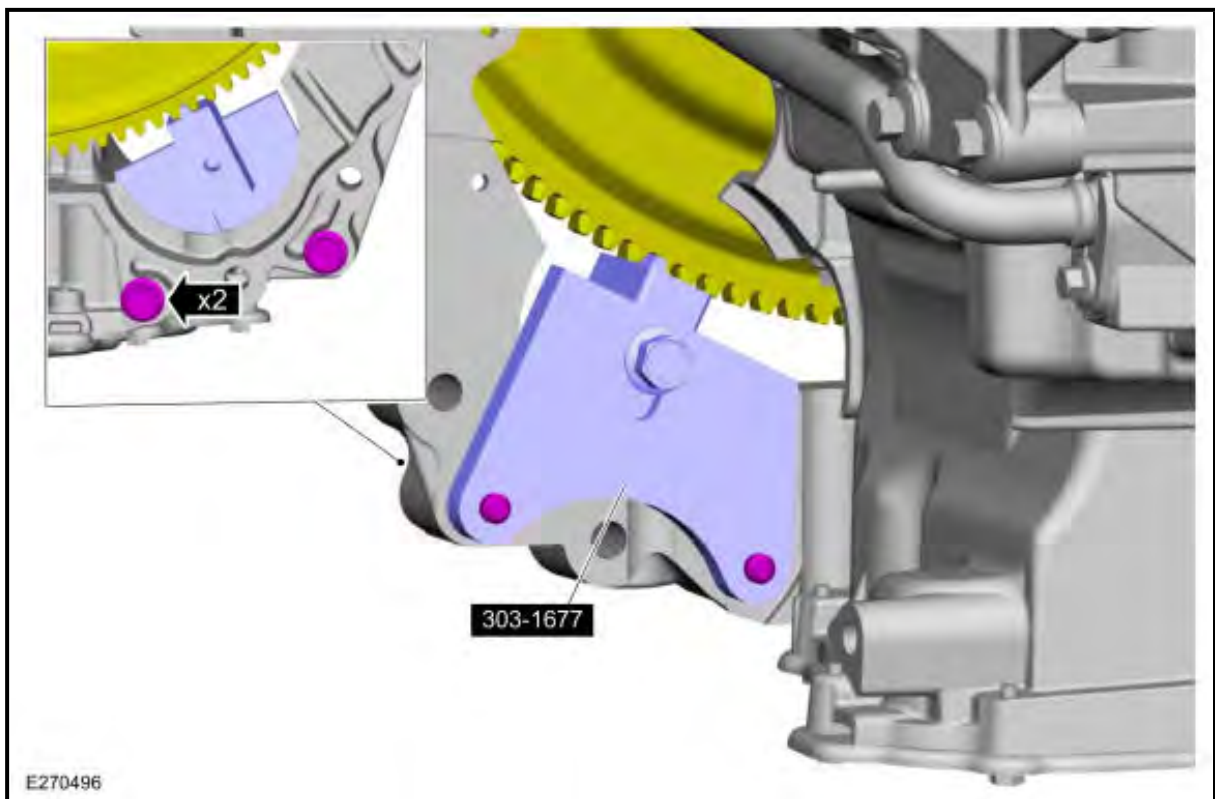
1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Remove the following items:
  1. Remove the timing belt. REFER to: [Timing Belt](#) .
  2. Remove the starter motor. REFER to: [Starter Motor](#) .
3. Remove Special Service Tool: 303-1671 Pin, Locking Crankshaft.





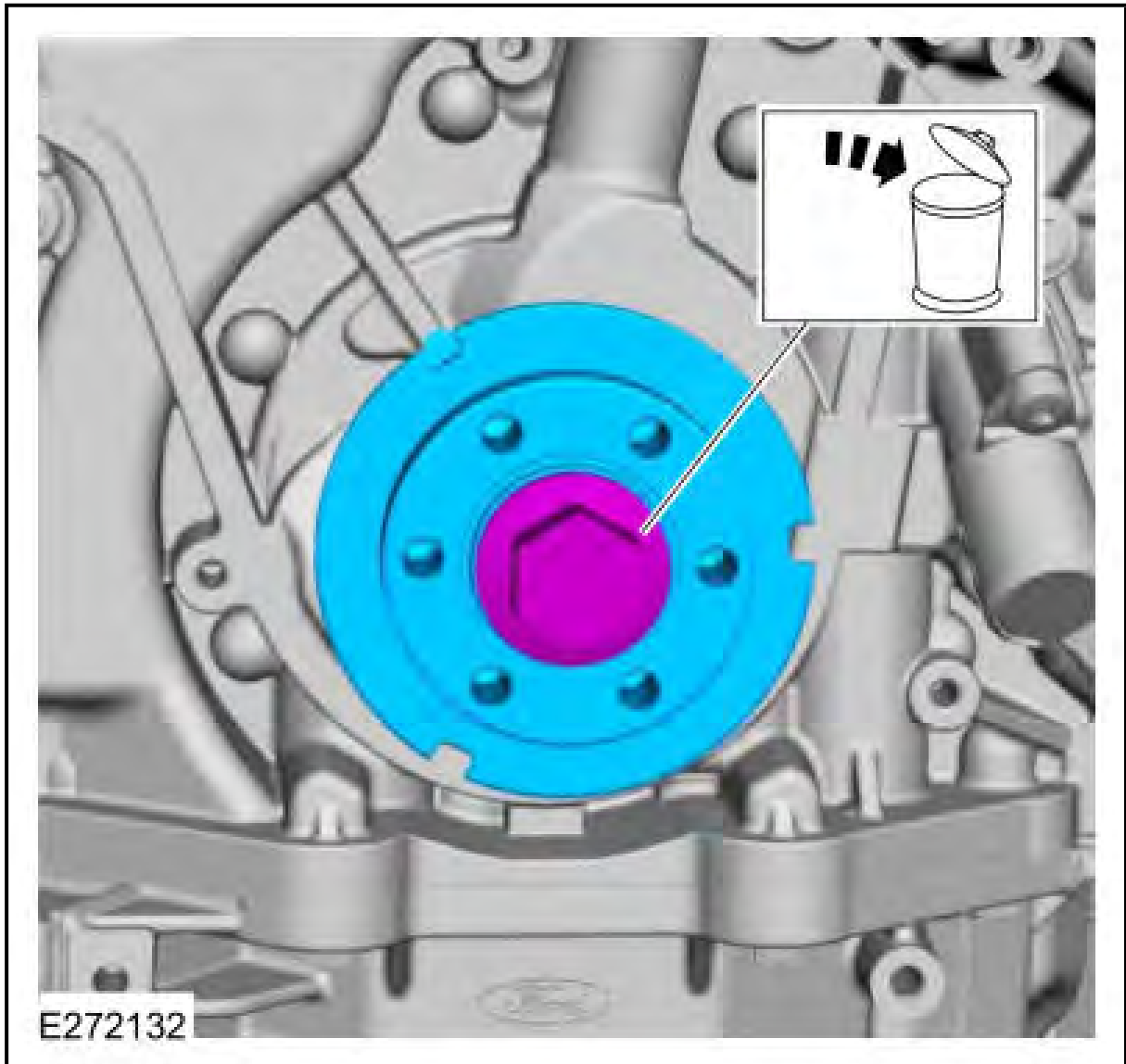
4. **NOTE:** Only rotate the crankshaft clockwise.

Install Special Service Tool: 303-1677 Locking Tool, Flywheel.

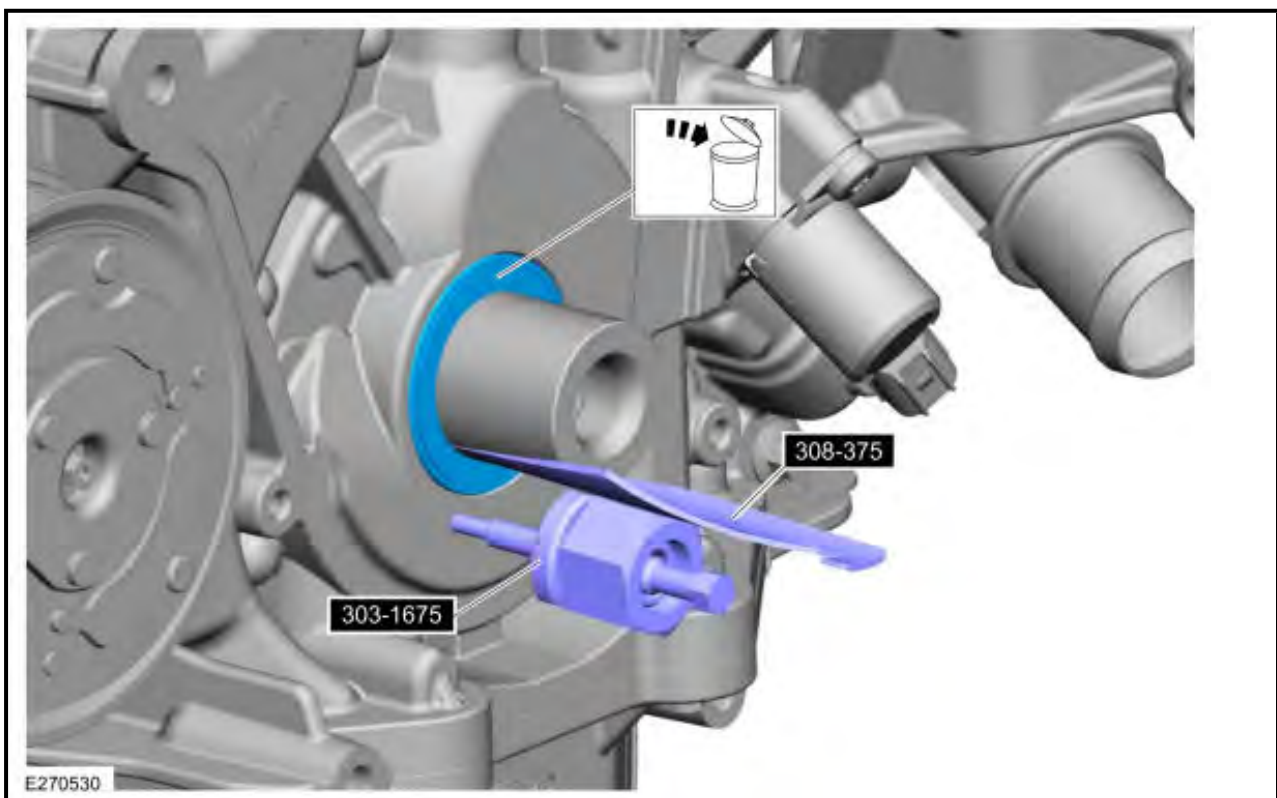


5. **NOTE:** Mark the location of the crankshaft sprocket location before removal.

- Remove the bolt and the crankshaft sprocket.
- Discard the bolt.



6. Using the special tools, remove and discard the crankshaft front seal. Use Special Service Tool: 303-1675 Adapter, Seal Remover. , 308-375 Remover, Input Shaft Seal.

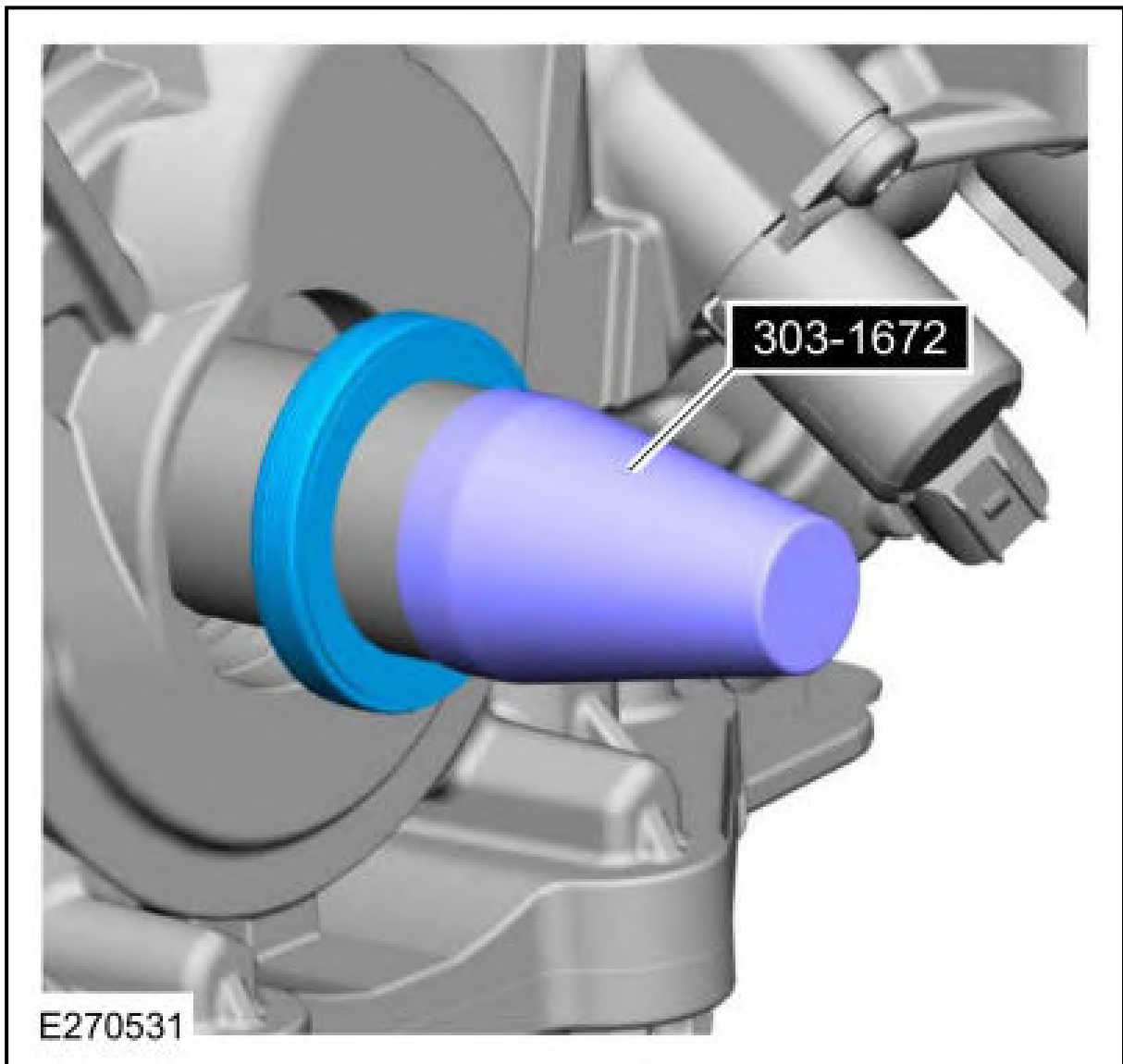


## INSTALLATION

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

**NOTE:** Rotate the seal as the seal is being installed on the crankshaft.

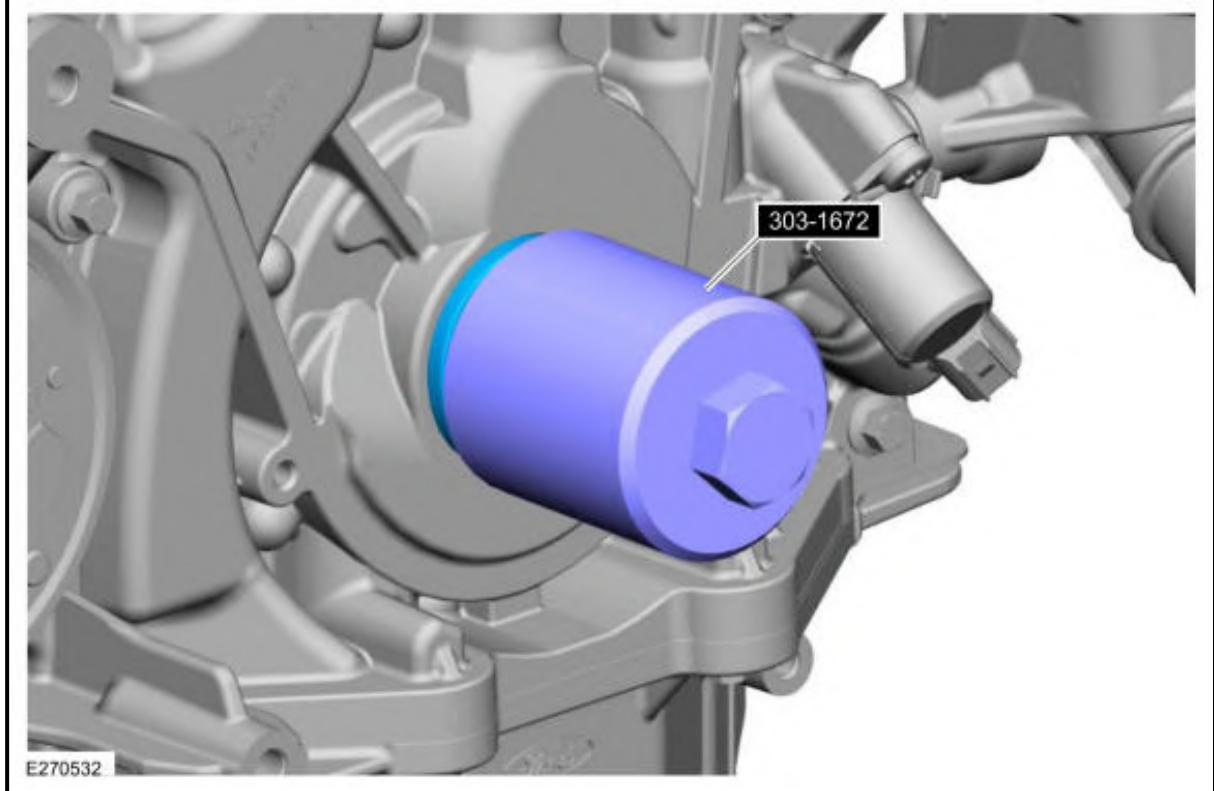
Using the special tool, position the crankshaft front seal on the crankshaft. Use Special Service Tool: 303-1672 Installer, Crankshaft Seal.



2. Using the special tool, install the crankshaft front seal. Use Special Service Tool: 303-1672 Installer, Crankshaft Seal.







3. **NOTE:**      **Align the crankshaft sprocket with the mark made during removal.**

Install the crankshaft sprocket and the bolt.

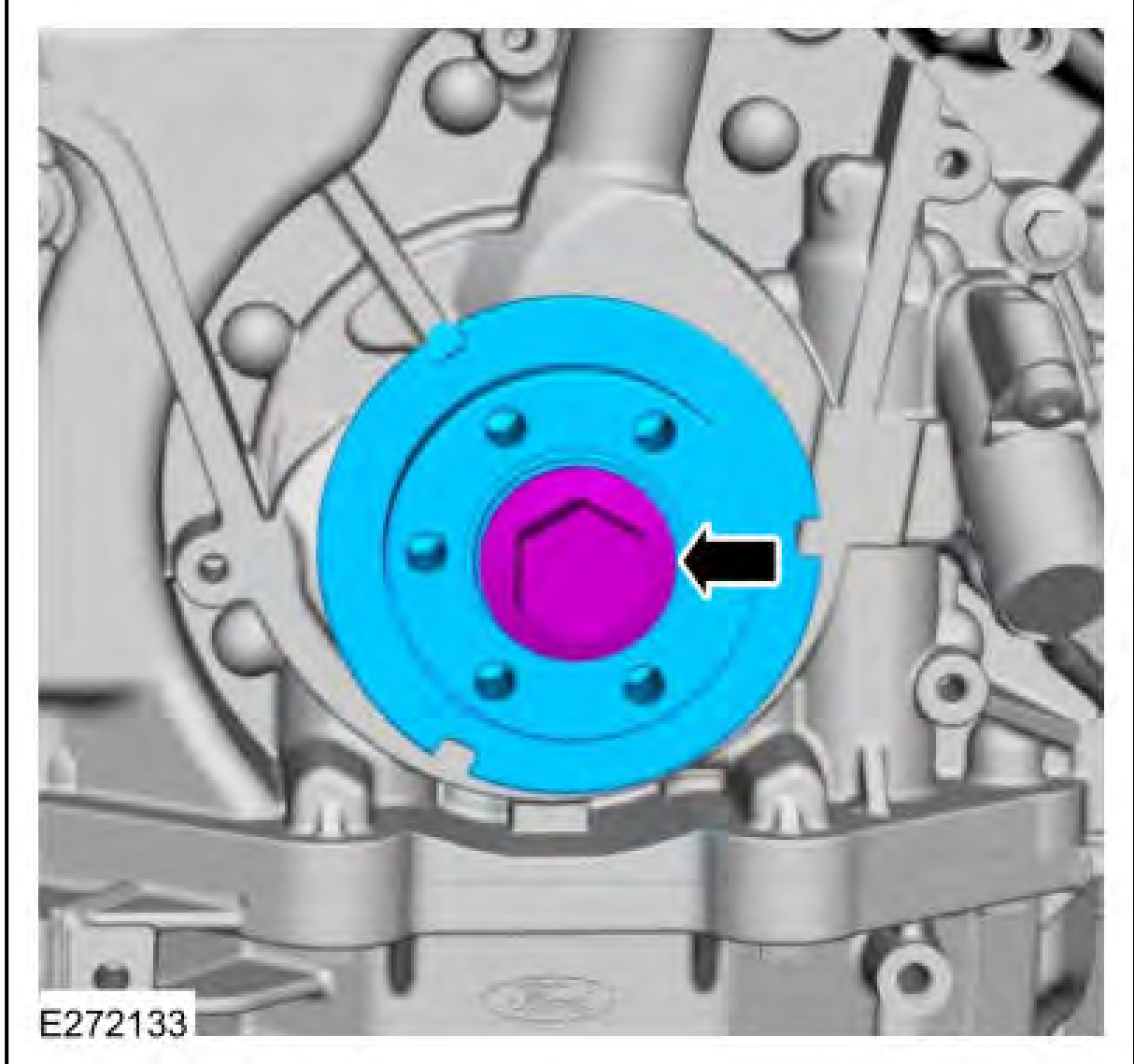
Torque:

Stage 1: 74 lb.ft (100 Nm)

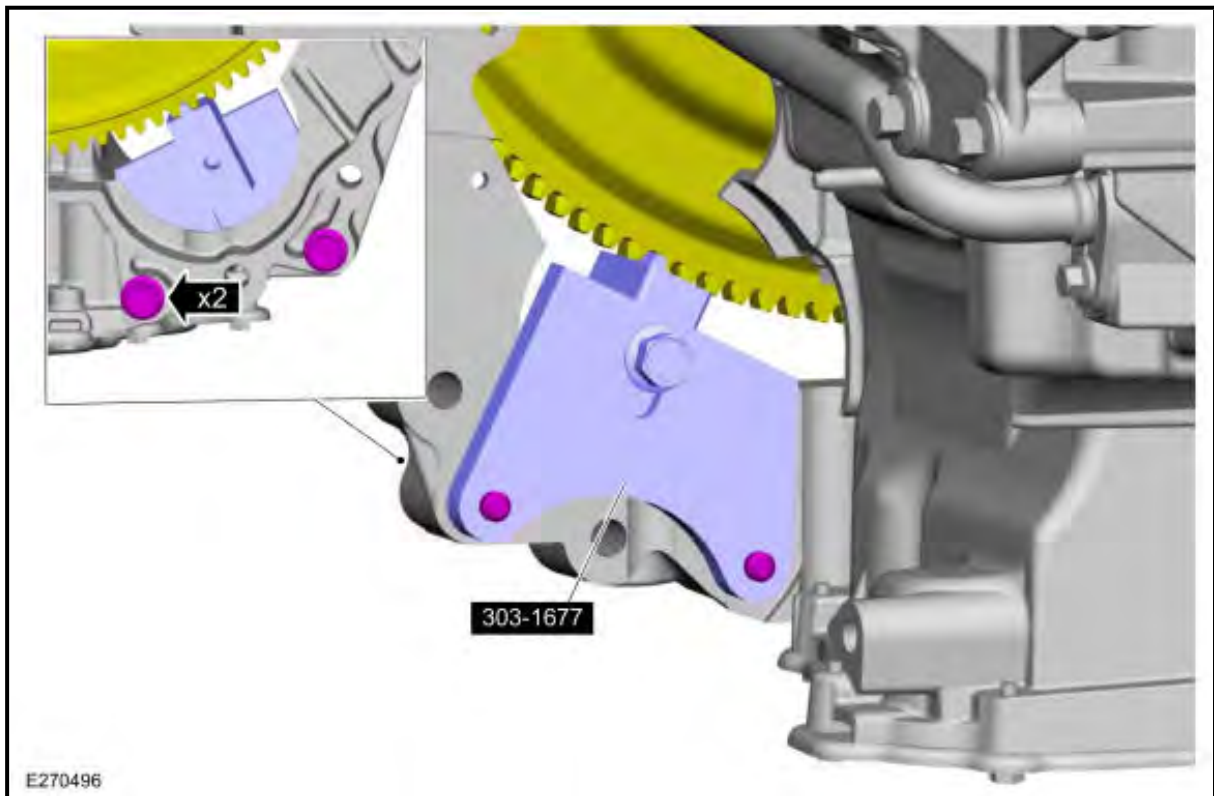
Stage 2: 221 lb.ft (300 Nm)

Stage 3: 90 Â°





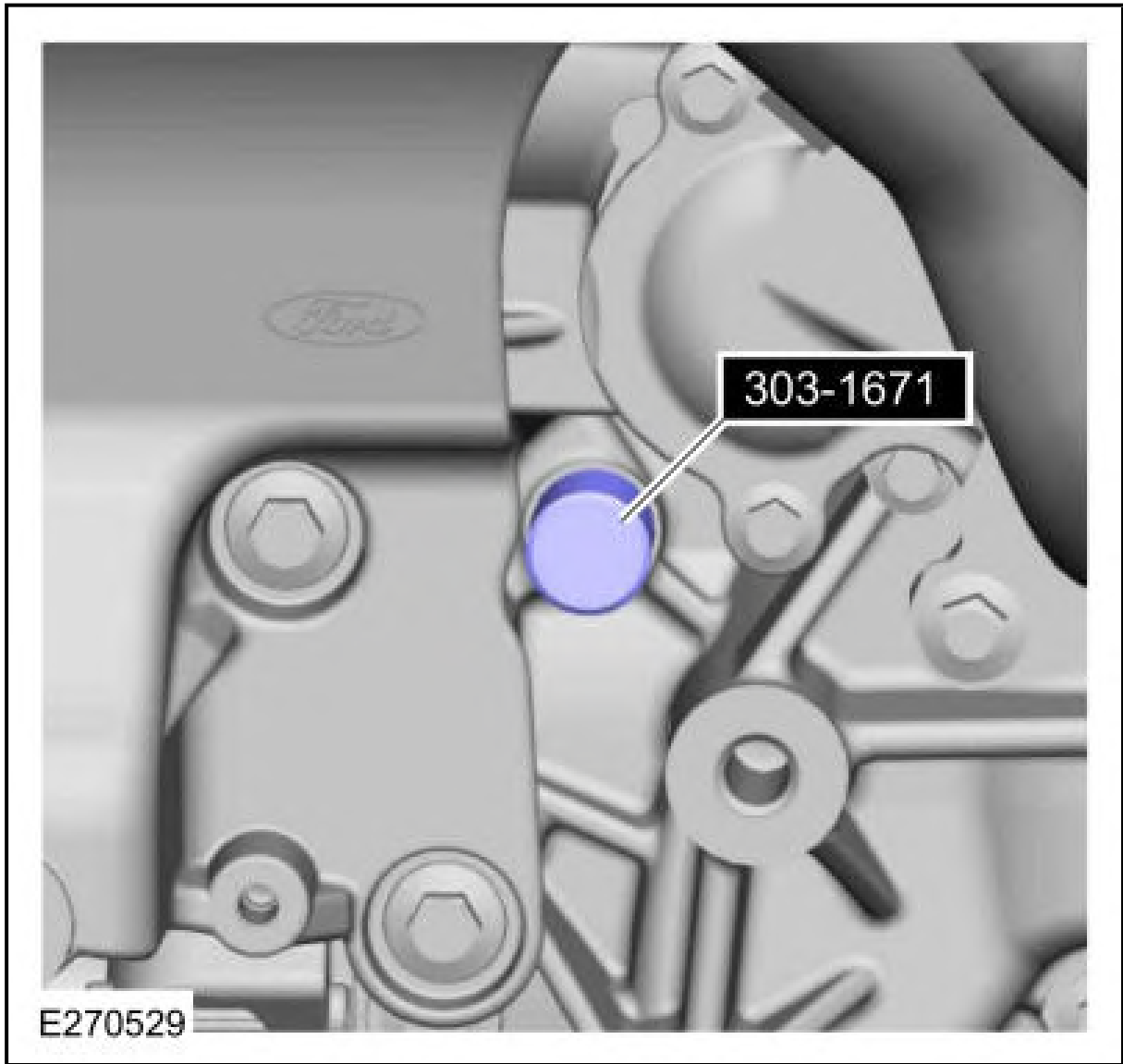
4. Remove Special Service Tool: 303-1677 Locking Tool, Flywheel.



5. Install the special tool.

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

Rotate the crankshaft clockwise so the crankshaft contacts the locking crankshaft pin. Use Special Service Tool: 303-1671 Pin, Locking Crankshaft.




6. Install the following items:

1. Install the starter motor. REFER to: [Starter Motor](#) .
2. Install the timing belt. REFER to: [Timing Belt](#) .

### **CRANKSHAFT REAR SEAL WITH RETAINER PLATE**

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

### **Special Tool(s) / General Equipment**

|  |   |
|--|---|
|  <p>E274092</p> | <p><b>303-1676 Installer, Crankshaft Position Sensor Ring</b></p> |
| <p>Plastic Scraper</p>   |   |

### **Materials**

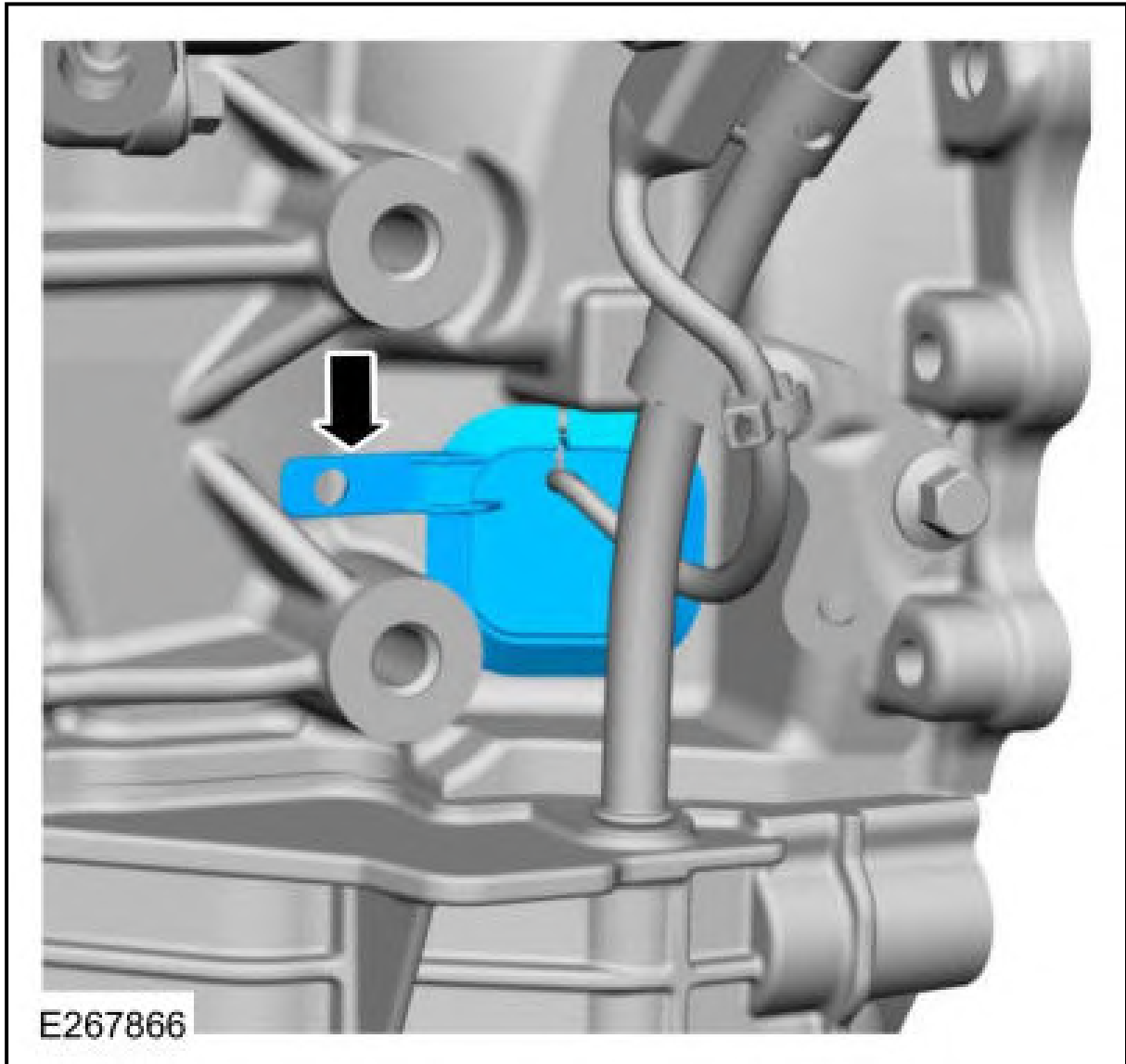
| Name  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> High Performance Engine RTV Silicone TA-357 | WSE-M4G323-A6 |
| Motorcraft <sup>®</sup> Silicone Gasket Remover ZC-30-A             | -             |
| Motorcraft <sup>®</sup> Metal Surface Prep Wipes ZC-31-B            | -             |

| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> Metal Brake Parts Cleaner PM-4-A, PM-4-B | -             |

## REMOVAL

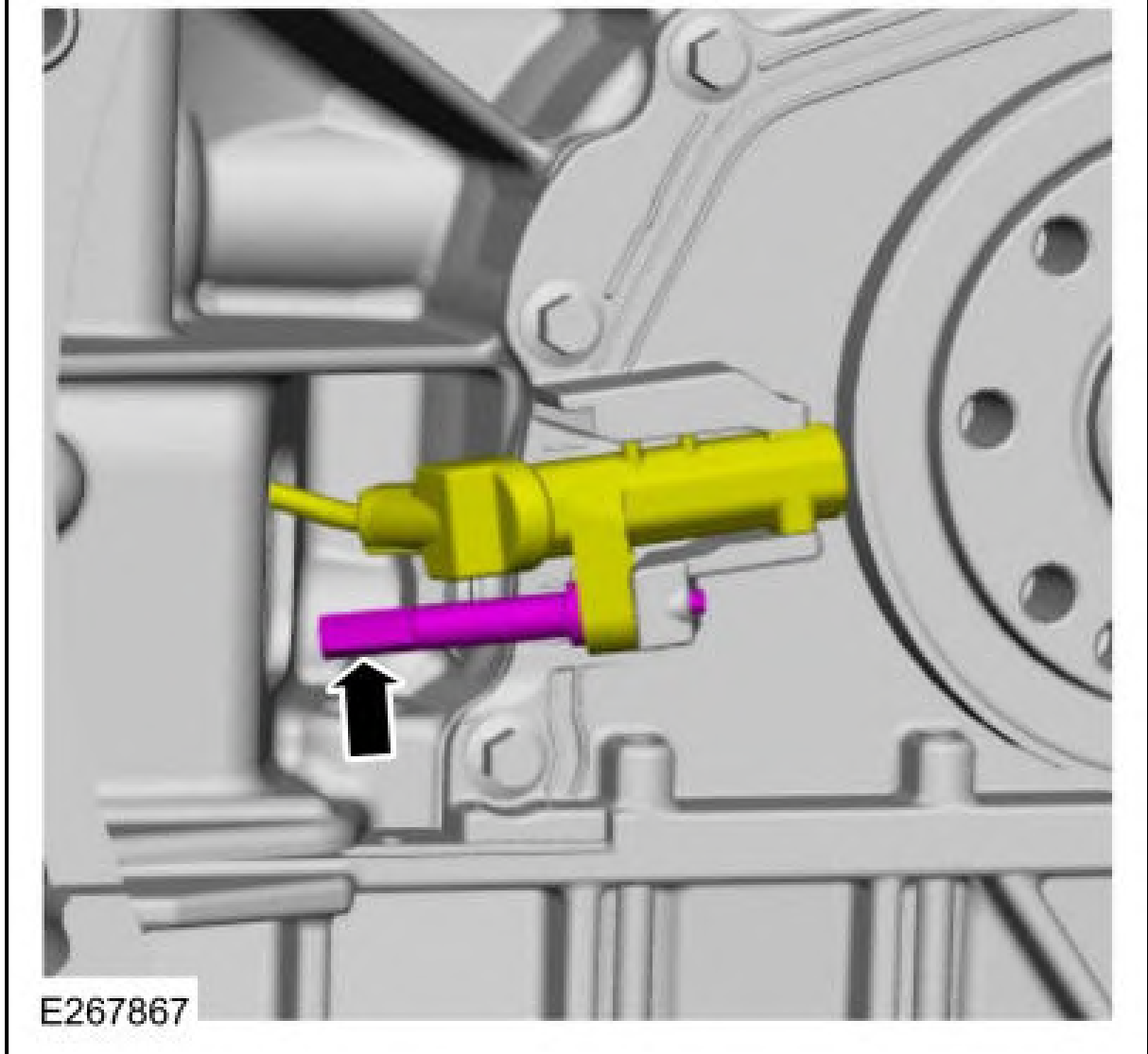
**NOTE:** During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

1. Remove the flexplate. REFER to: [Flexplate](#) .
2. Remove the CKP sensor cover.



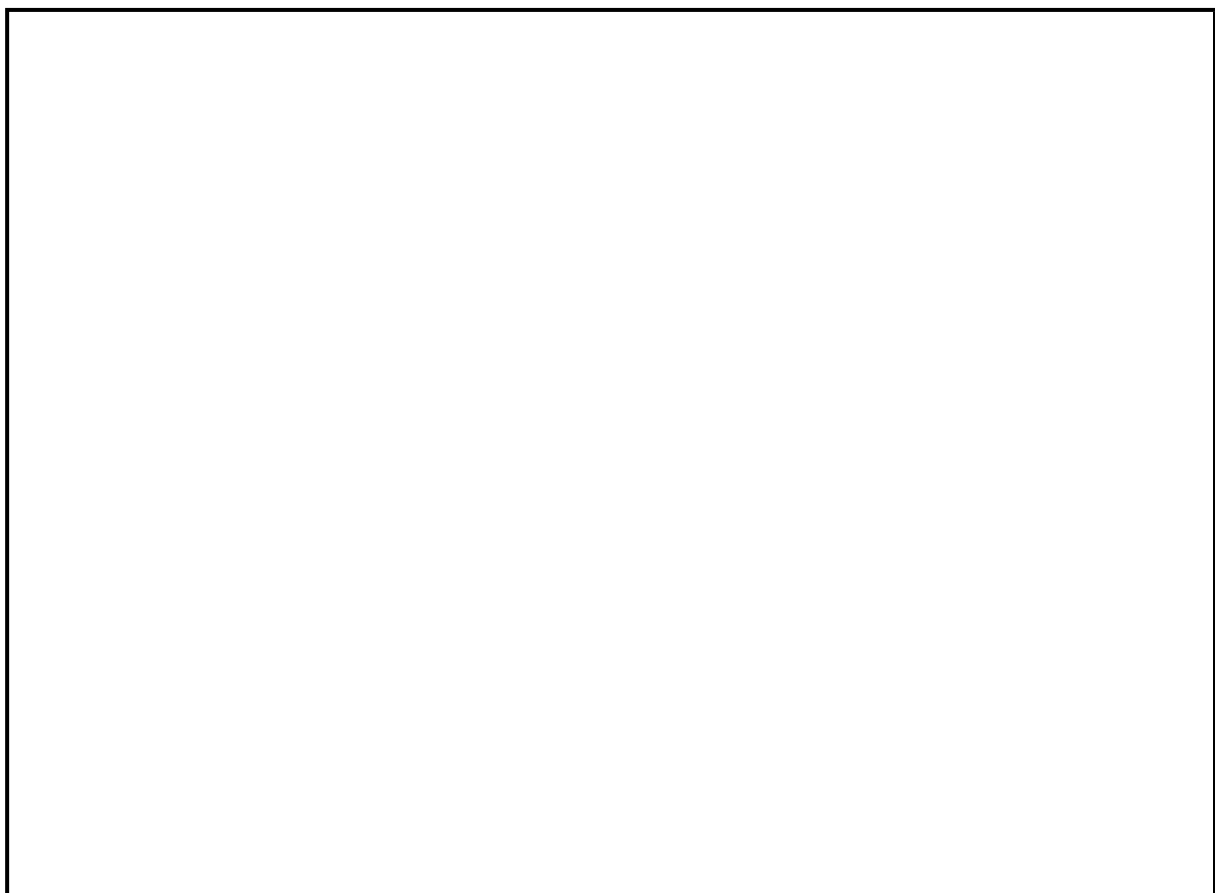
3. Remove the bolt and position aside the CKP sensor.

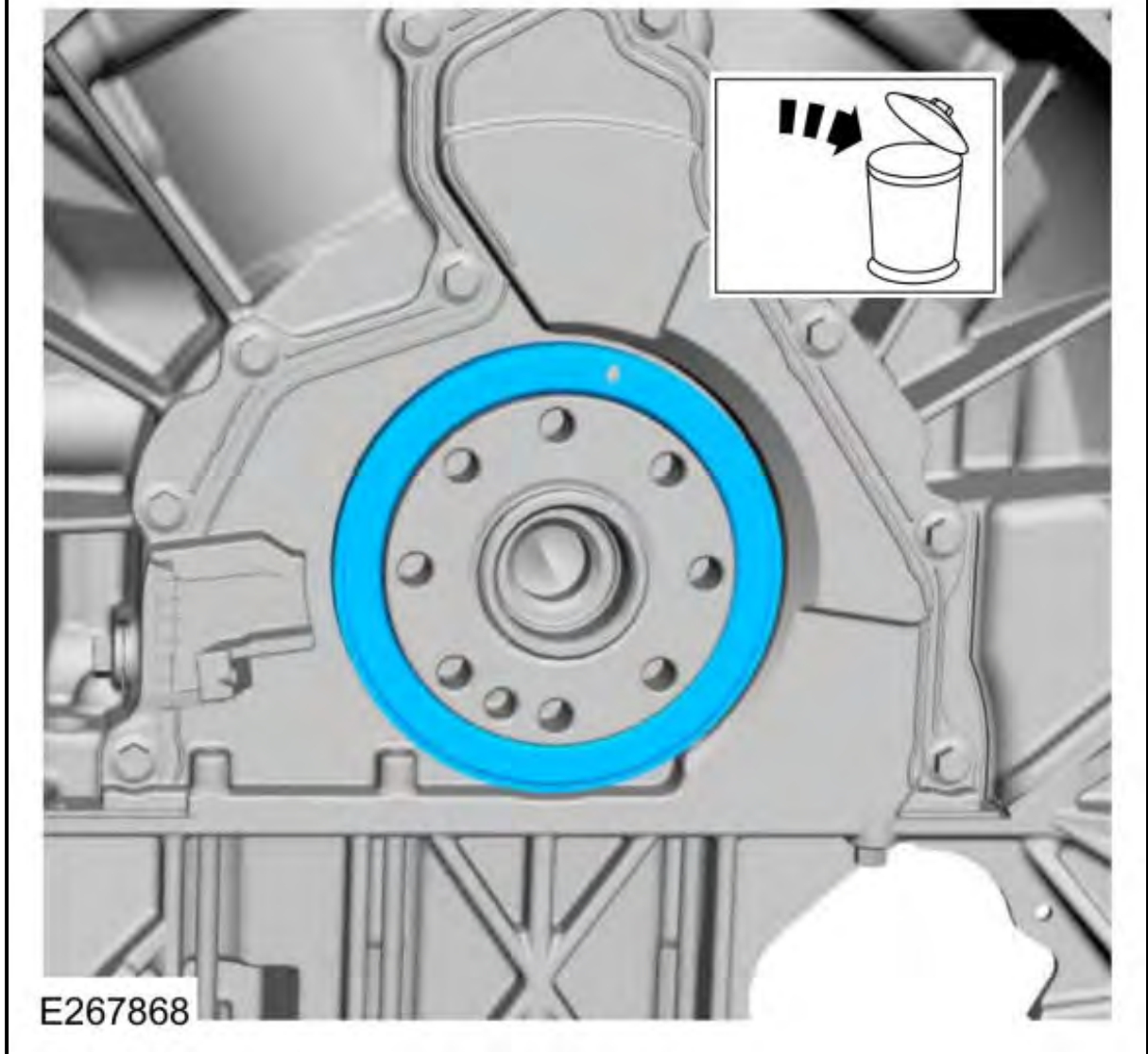




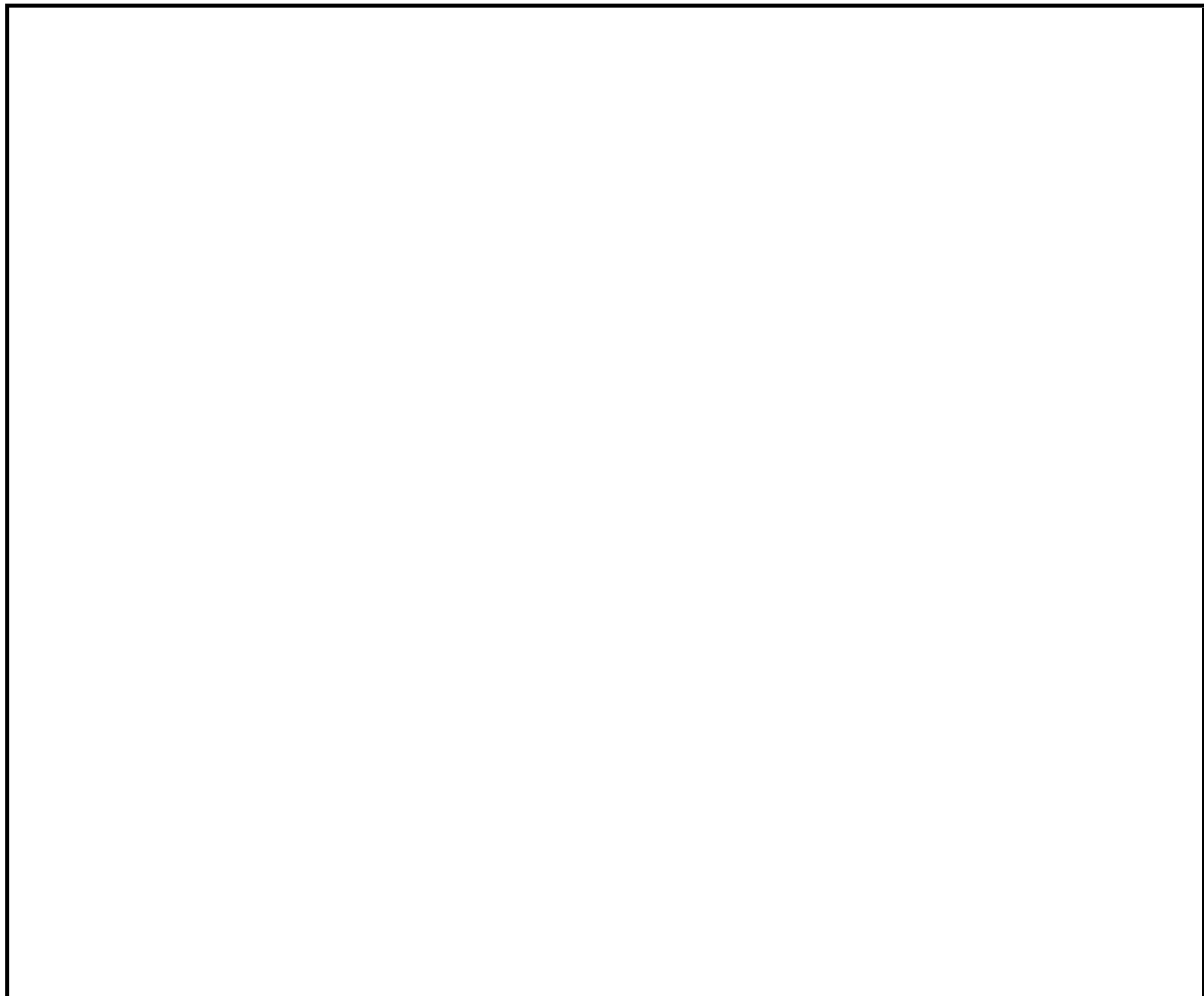
4. **NOTE:** Care must be taken not to damage the crankshaft sealing surface when removing the crankshaft timing trigger wheel.

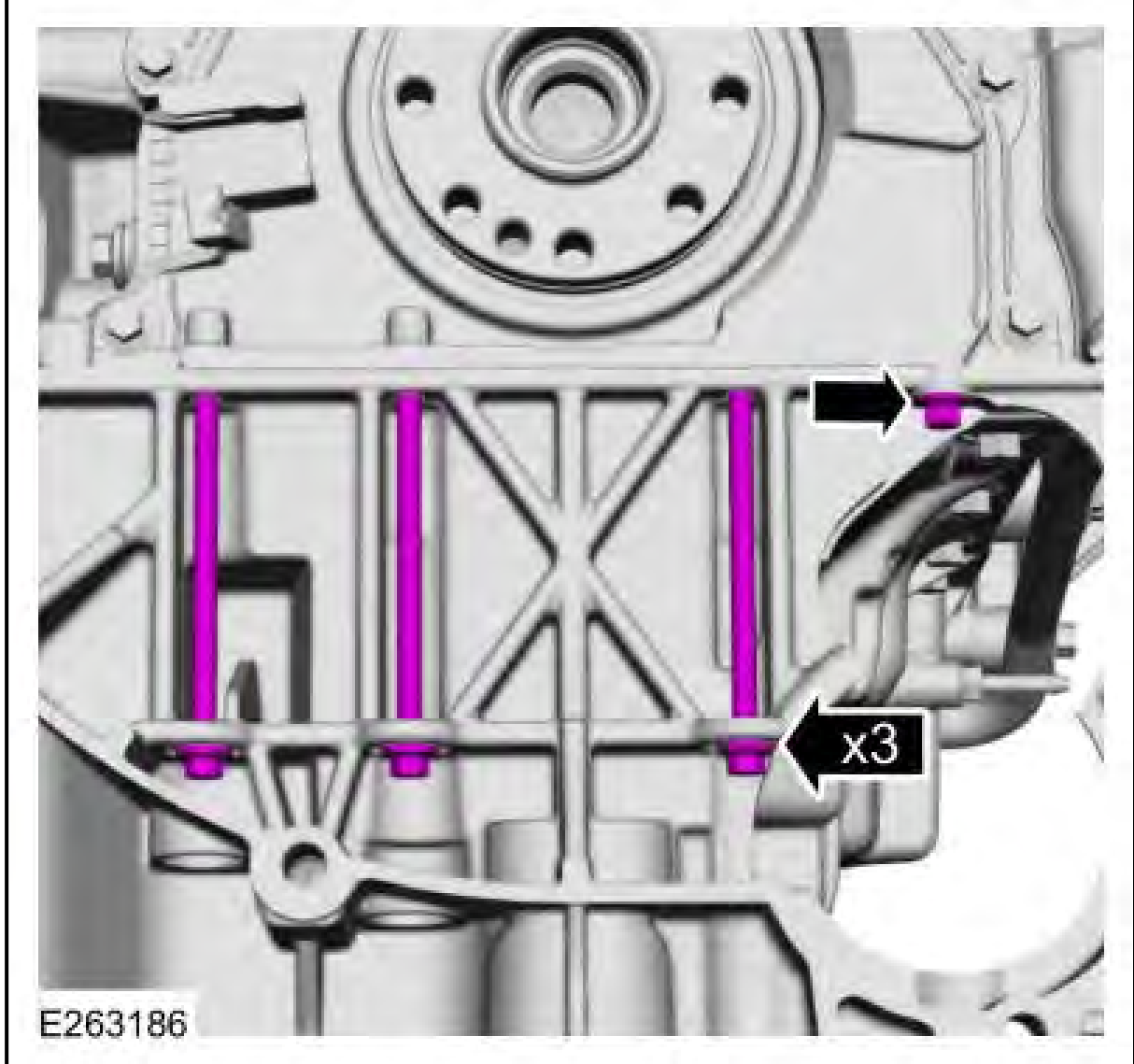
Remove and discard the CKP timing trigger wheel.





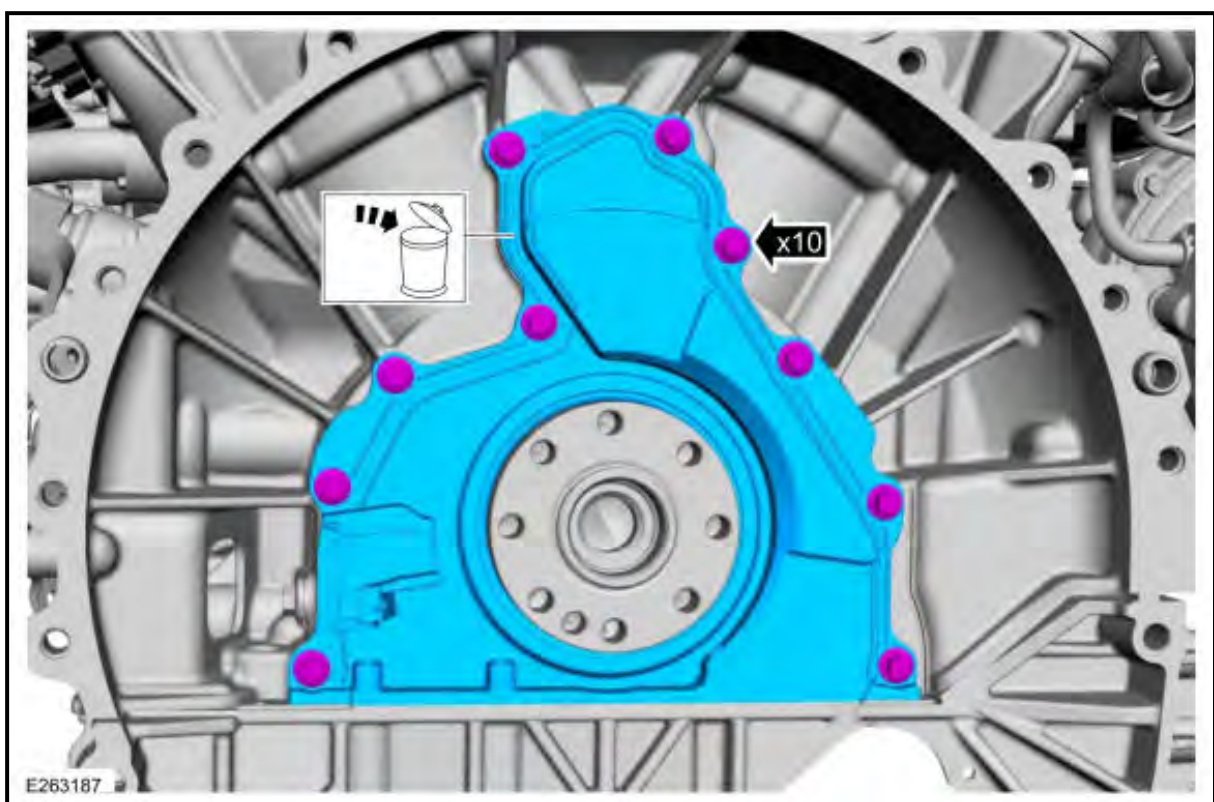
5. Remove the engine block skirt stiffener bolts.





6. Remove the bolts and the crankshaft rear seal with retainer plate.

- Discard the crankshaft rear seal with retainer plate.



7. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools

cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

**NOTE:** Use care when cleaning around the engine block skirt stiffener gasket.

Clean and inspect the mating surface. REFER to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

Material: Motorcraft <sup>®</sup> Silicone Gasket Remover / ZC-30-A

Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B

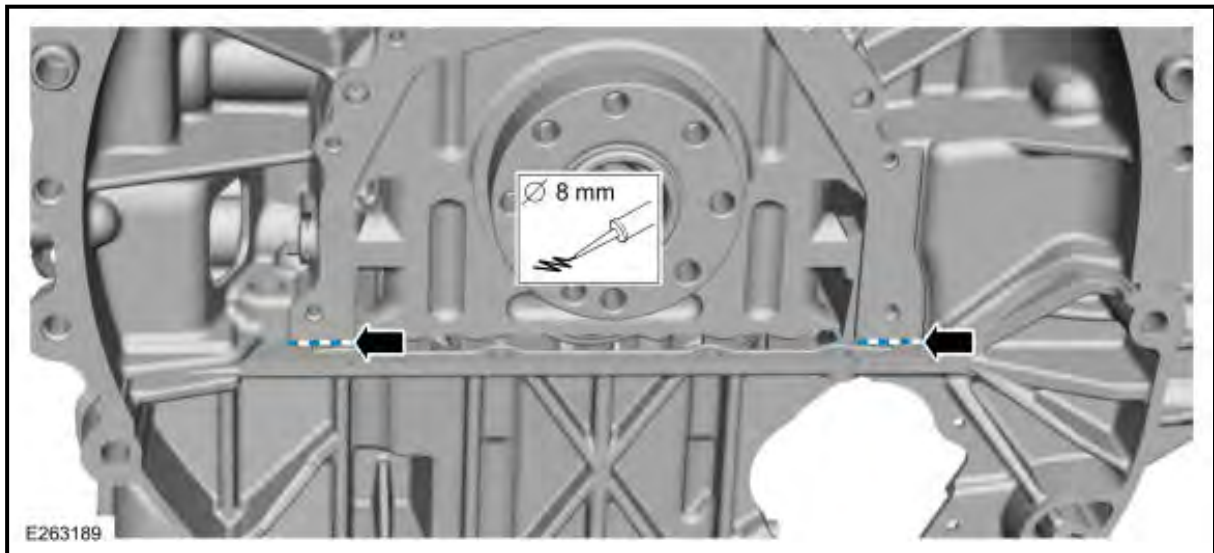
Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-

## INSTALLATION

- NOTE:** The crankshaft rear seal with retainer plate must be installed within 10 minutes of applying the sealer. Final tightening of the bolts must be completed within 60 minutes of applying the sealer. Failure to follow this procedure can cause future oil leakage.

Apply a bead of Motorcraft <sup>®</sup> High Performance Engine RTV Silicone to the cylinder block.

Material: Motorcraft <sup>®</sup> High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)

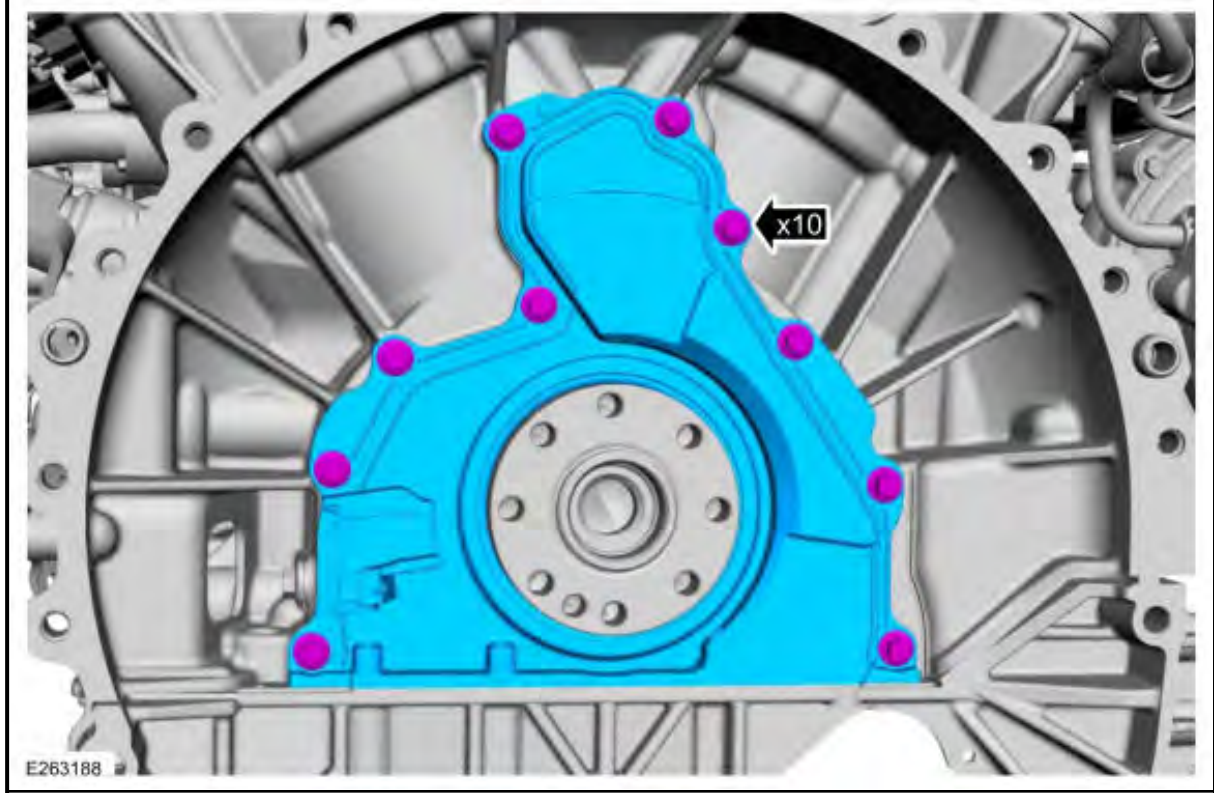


- Install the crankshaft rear seal with retainer plate and the bolts.

Torque: 89 lb.in (10 Nm)

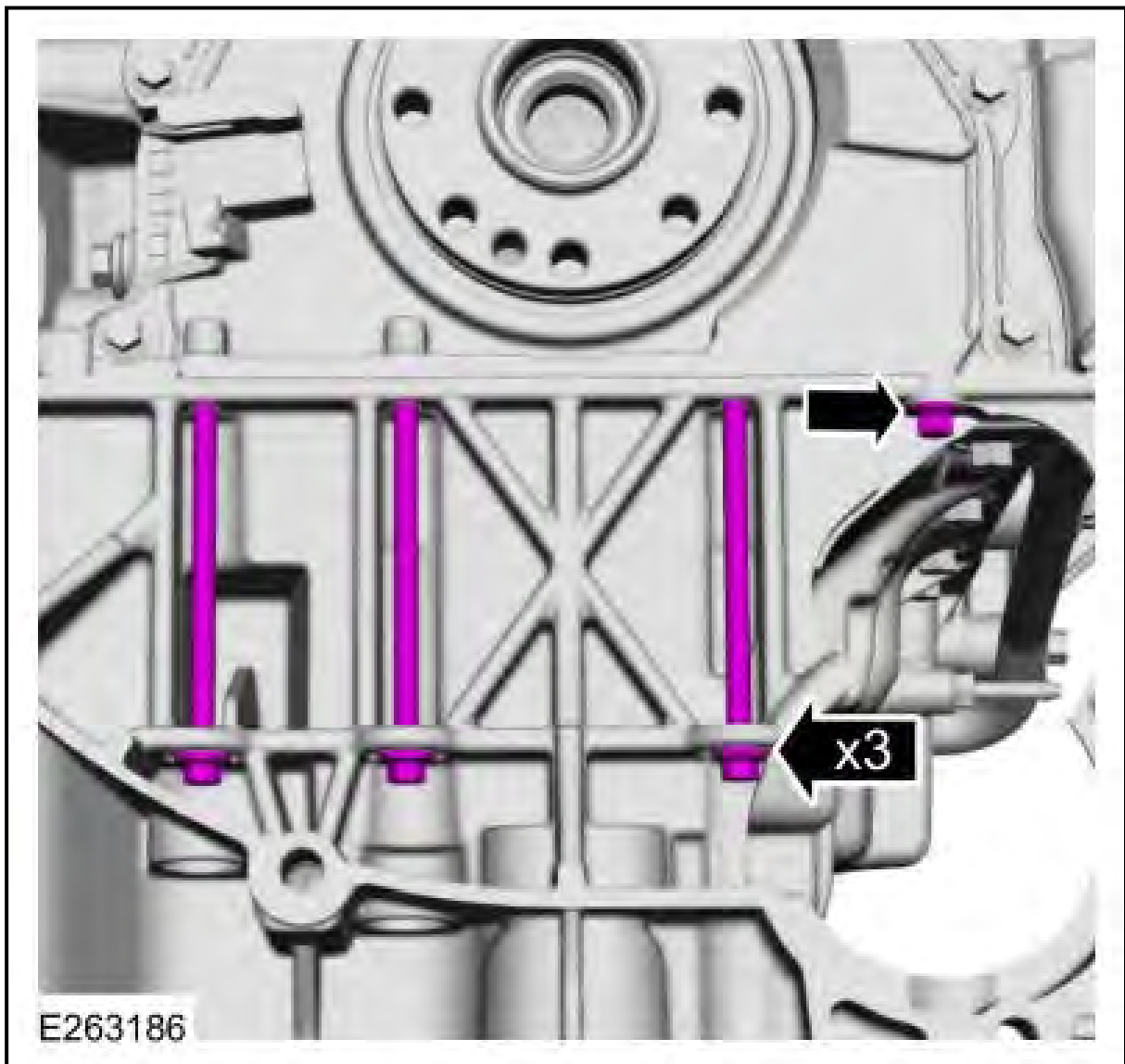






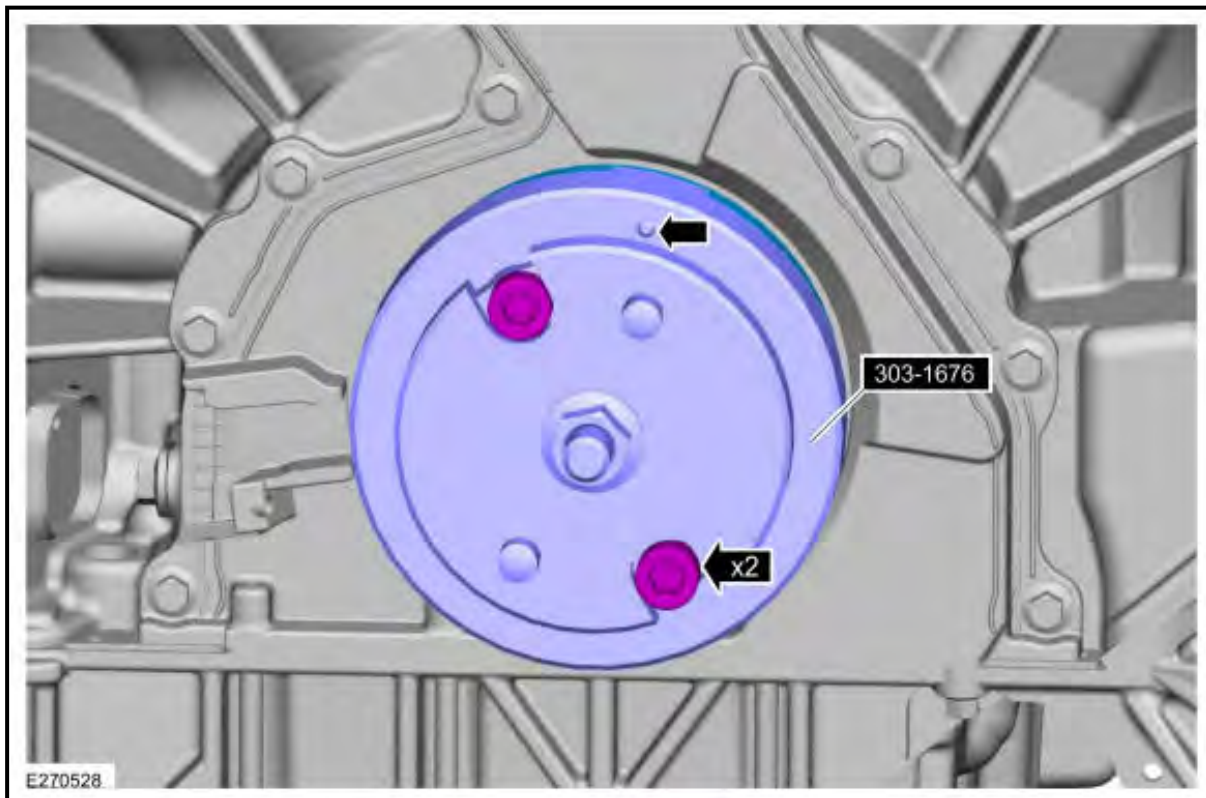
3. Install the engine block skirt stiffener bolts.

Torque: 89 lb.in (10 Nm)



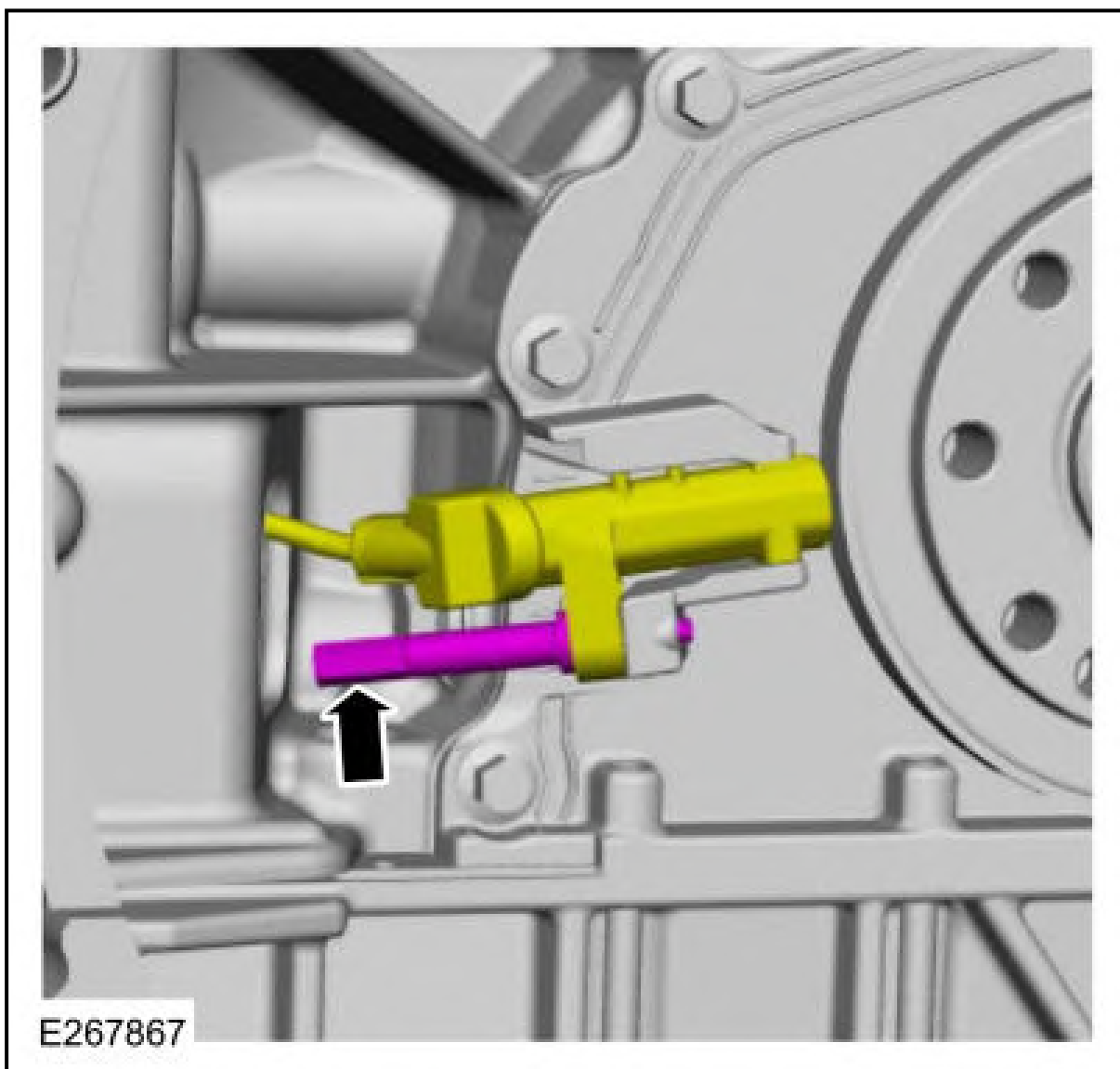
4. **NOTE:** Make sure that the locating pin on the special tool is align with the crankshaft timing trigger wheel hole.

Using the special tool, install the CKP timing trigger wheel. Use Special Service Tool: 303-1676  
Installer, Crankshaft Position Sensor Ring.

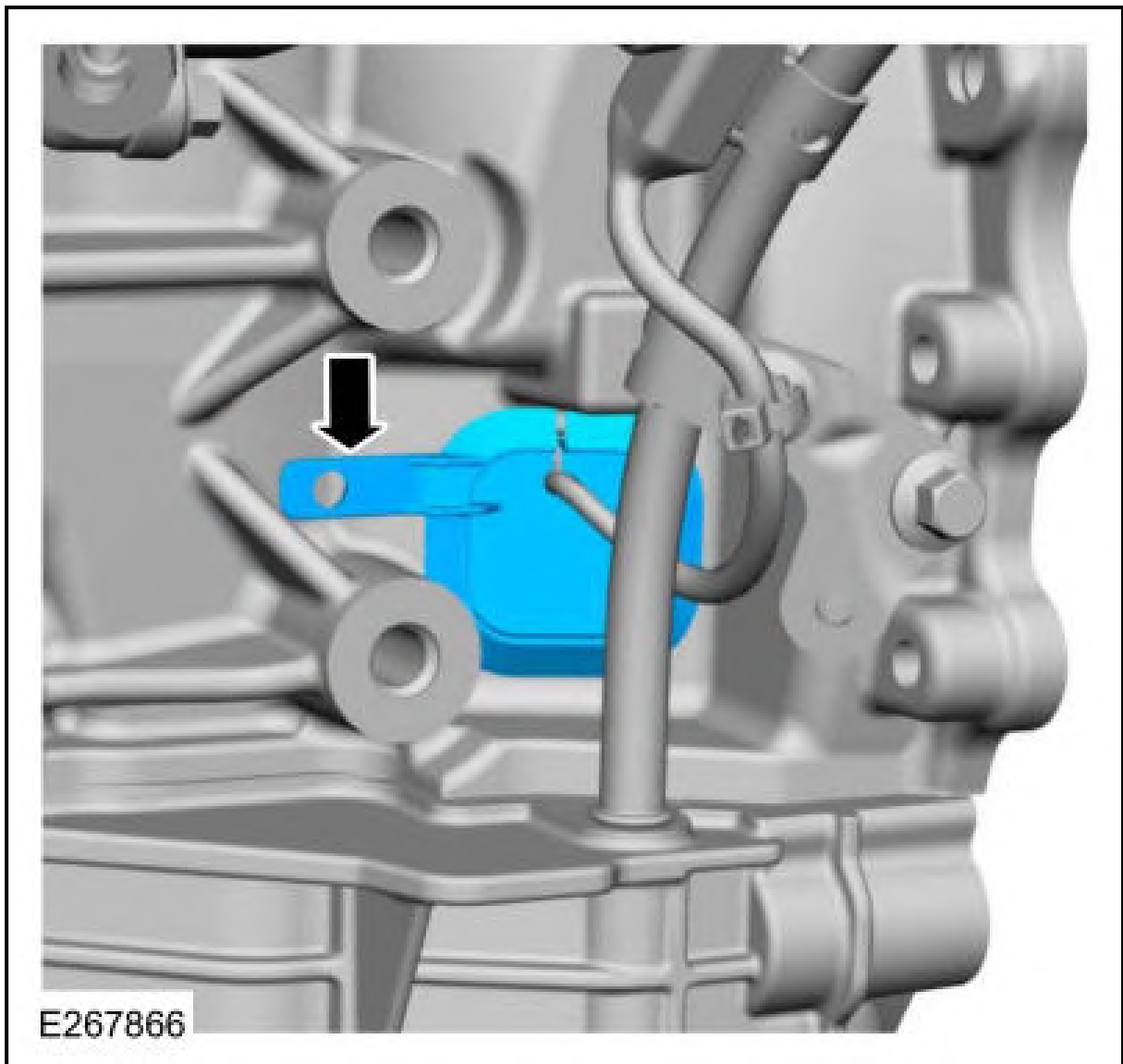


5. Position back the CKP sensor and install the bolt.

Torque: 44 lb.in (5 Nm)



6. Install the CKP sensor cover.



7. Install the flexplate. REFER to: [Flexplate](#) .

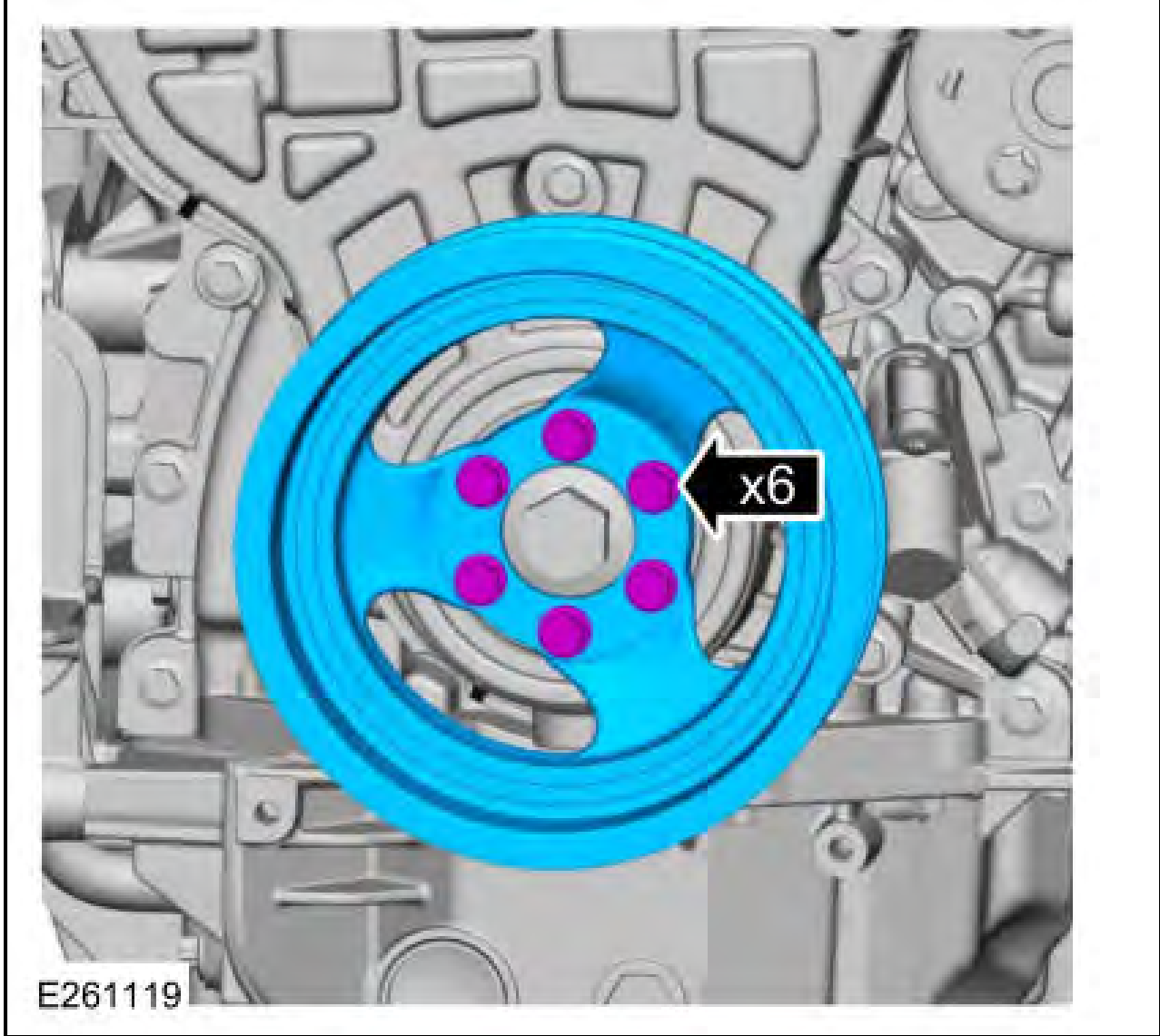
### **CRANKSHAFT VIBRATION DAMPER**

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

#### **REMOVAL**

1. Remove the accessory drive belt. REFER to: [Accessory Drive Belt](#) .
2. Remove the bolts and the crankshaft vibration damper.

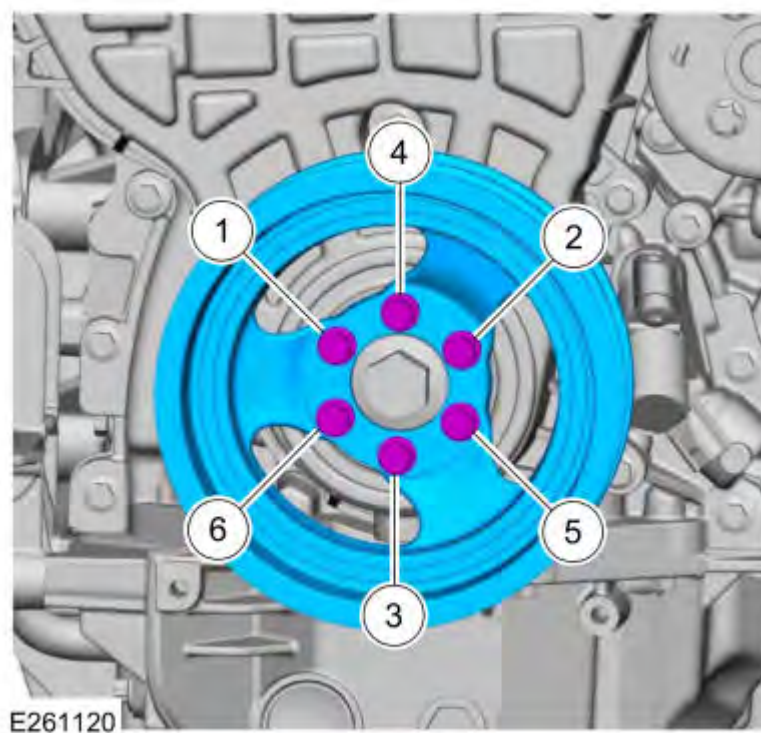




### INSTALLATION

1. Install the crankshaft vibration damper and the bolts.

Torque: 18 lb.ft (25 Nm)





**Fig. 3: Crankshaft Vibration Damper Tightening Sequence**  
Courtesy of FORD MOTOR COMPANY

2. Install the accessory drive belt. REFER to: [Accessory Drive Belt](#) .

## ENGINE MOUNT LH

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

### Special Tool(s) / General Equipment

|  |  |
|--|--|
| <br>E274098 | <b>303-1681 Spreader Bar</b>                                   |
|             | 303-F070 Support Bar, Engine TKIT-1999A-F/L TTKIT-1999A-FM/FLM |
| Vehicle/Axle Stands  |  |

### Materials

| Name  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant VC-3-B | WSS-M97B44-D  |

### REMOVAL

**NOTE:** Use care when positioning the front axle housing or the vacuum lines to the axle solenoid may become disconnected or damaged.

**NOTE:** Discard all engine mount fasteners and install new fasteners.

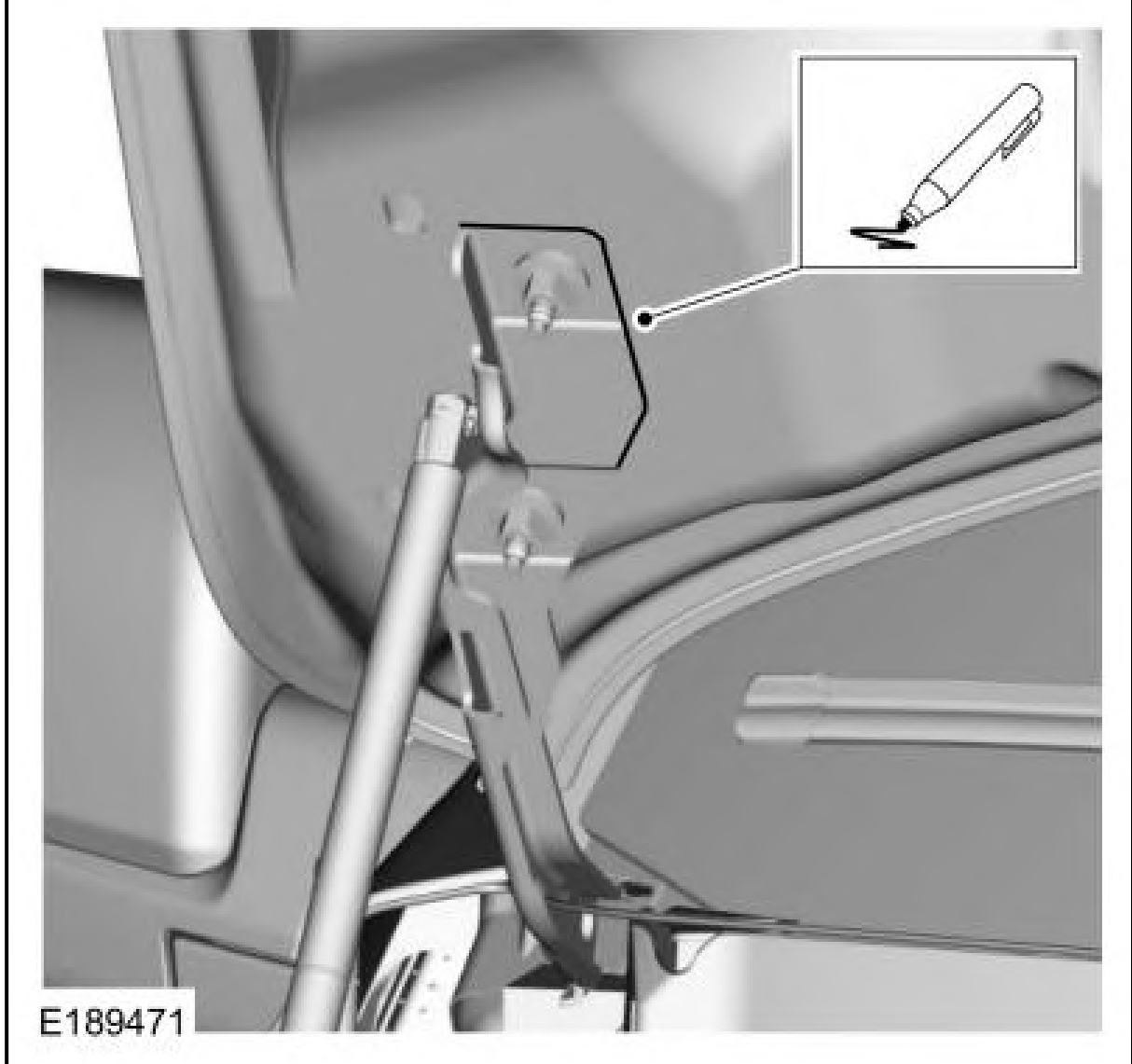
4x2/4x4

1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .

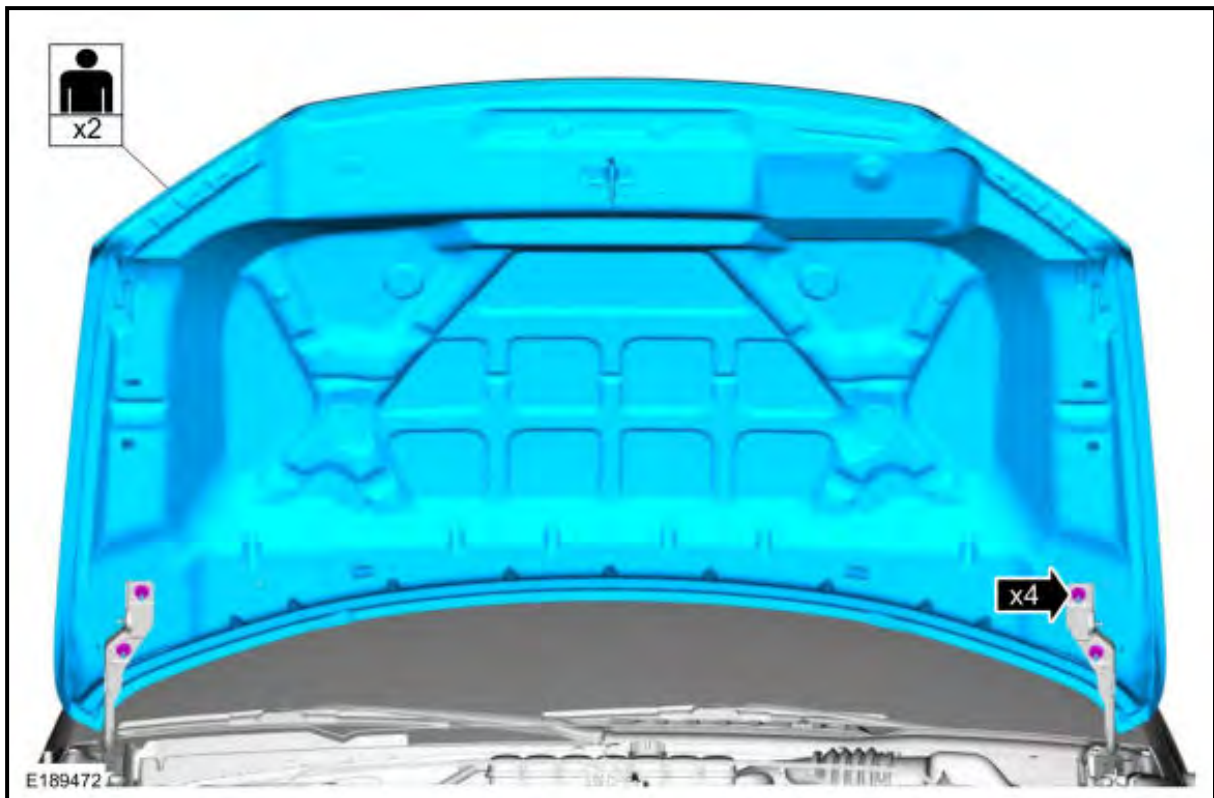
2. **NOTE:** RH shown, LH similar.

Index-mark the hood hinge location.



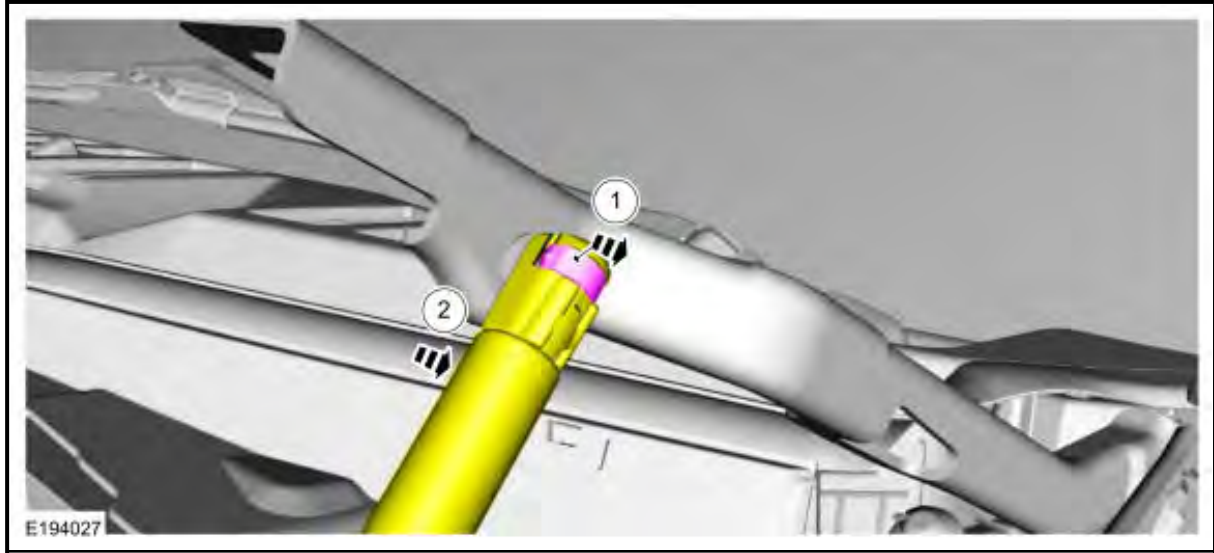


3. Remove the nuts and the hood.

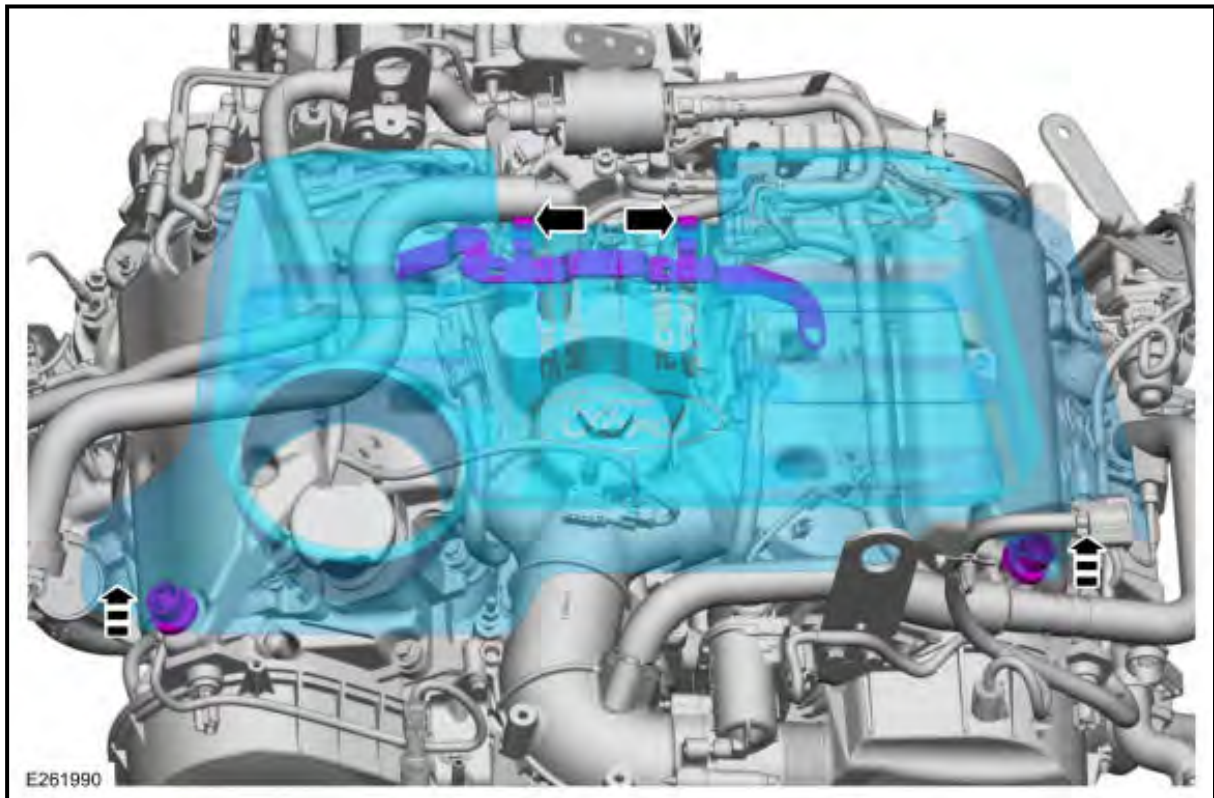


4. **NOTE:** LH shown, RH similar.

1. Release the clip.
2. Detach and position the hood shock aside.



5. Remove the engine appearance cover.



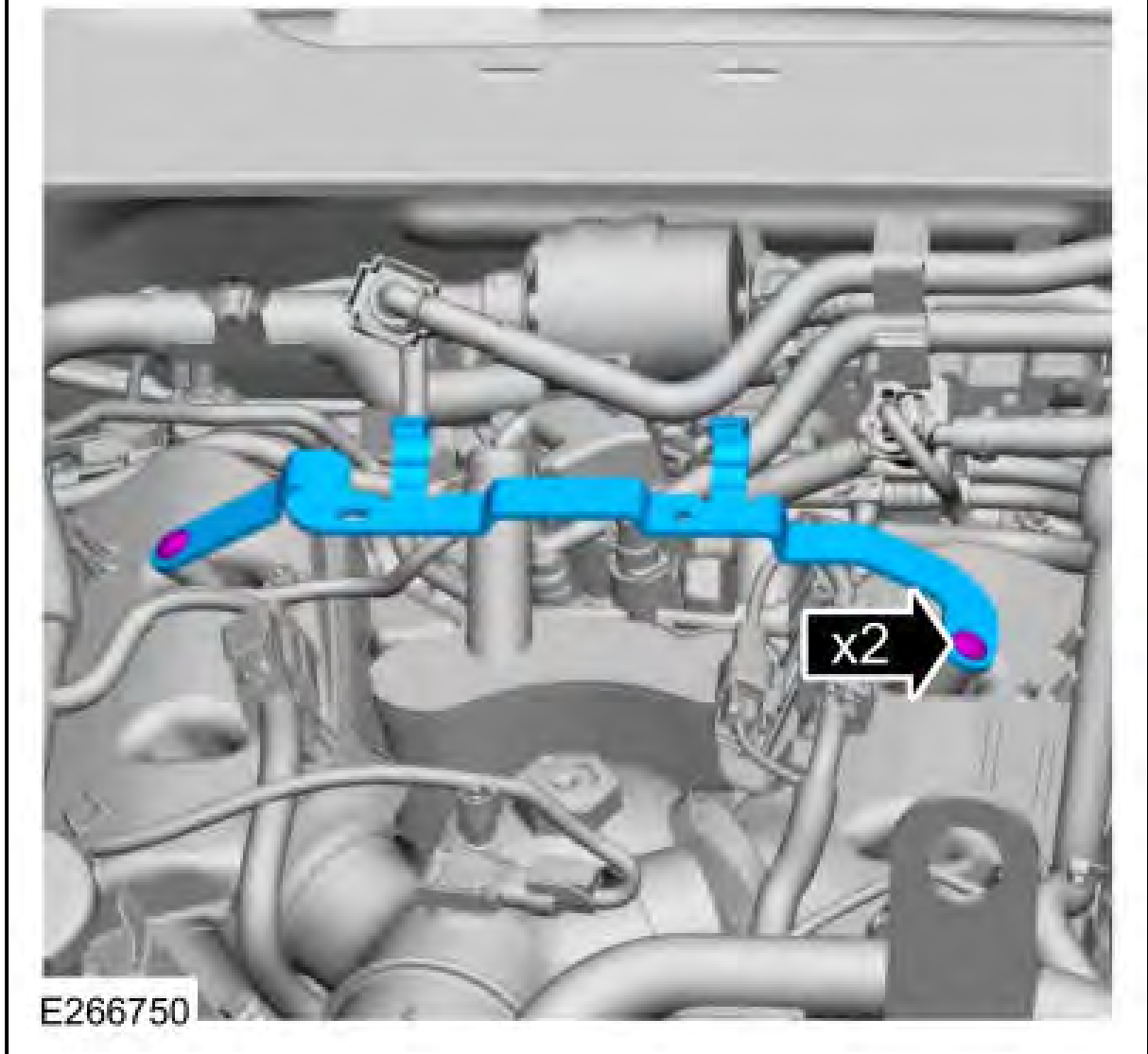
6. Drain the cooling system. REFER to: [Cooling System Draining, Vacuum Filling and Bleeding](#) .

7. Remove the following items:

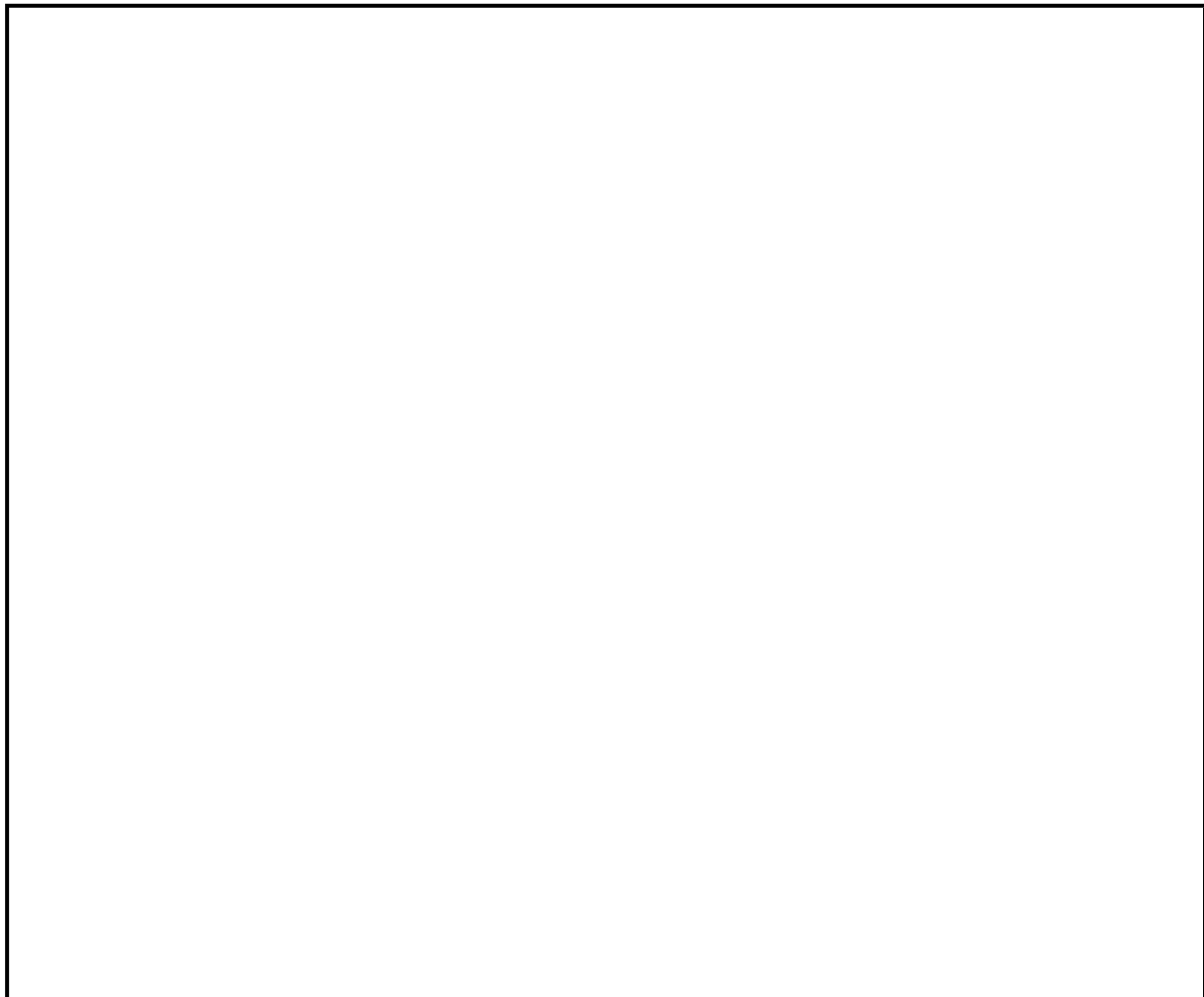
1. Remove the cowl panel. REFER to: [Cowl Panel](#) .
2. Remove the RH and the LH front fender splash shields. REFER to: [Fender Splash Shield](#) .
3. Remove the air cleaner. REFER to: [Air Cleaner](#) .
4. Remove the air cleaner outlet tube. REFER to: [Air Cleaner Outlet Pipe](#) .
5. Remove the CAC intake pipe. REFER to: [Charge Air Cooler \(CAC\) Intake Pipe](#) .
6. Remove the CAC outlet pipe. REFER to: [Charge Air Cooler \(CAC\) Outlet Pipe](#) .
7. Remove the generator. REFER to: [Generator - 3.0L Power Stroke Diesel](#) .
8. Remove the cooling fan upper shroud. REFER to: [Cooling Fan Upper Shroud](#) .

8. Remove the engine appearance cover bracket.

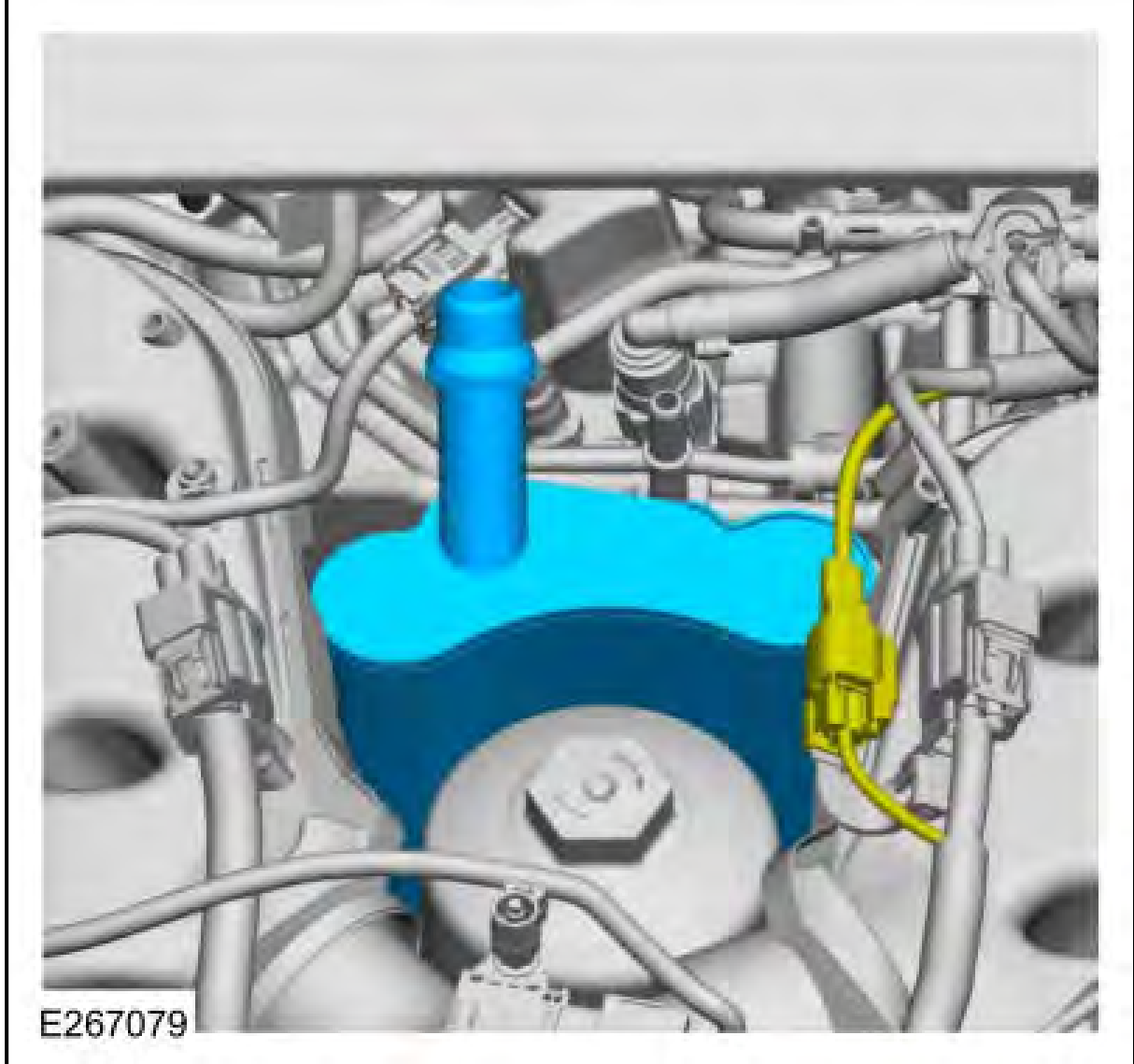




9. Position aside the wiring and remove the crankcase vent oil separator.

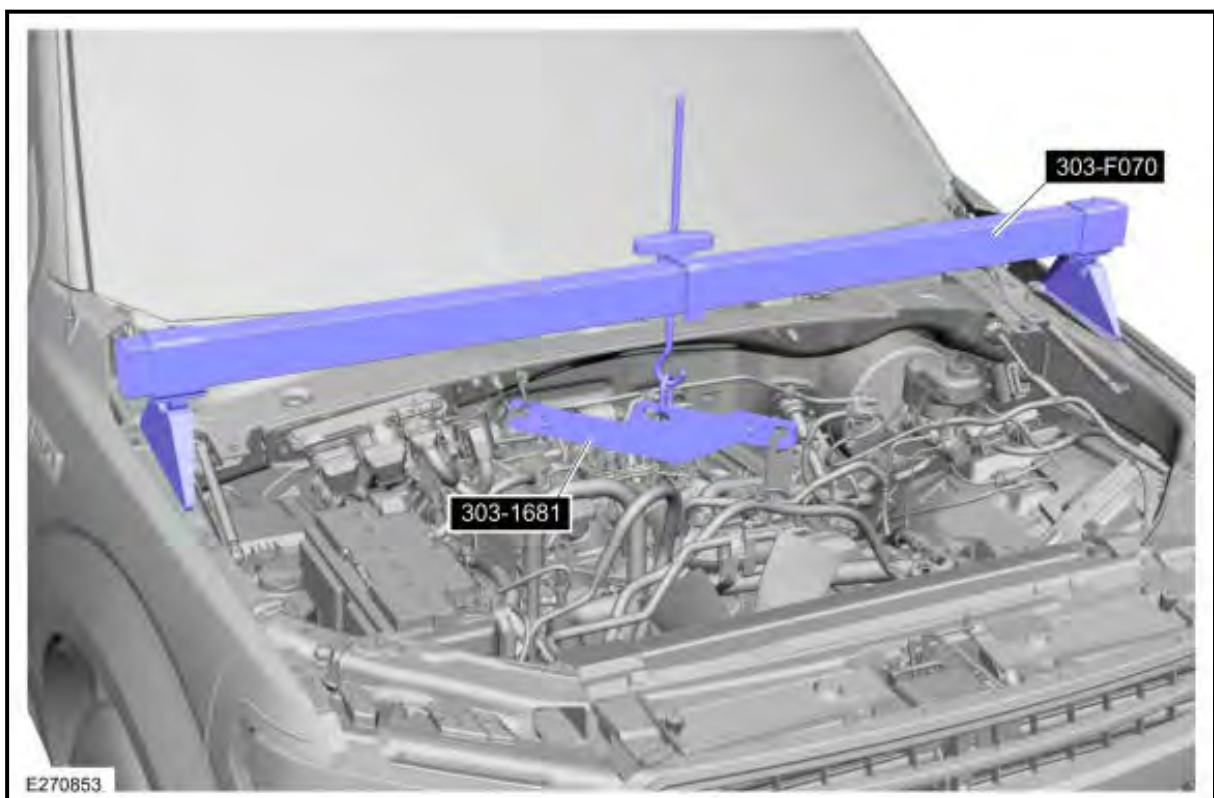




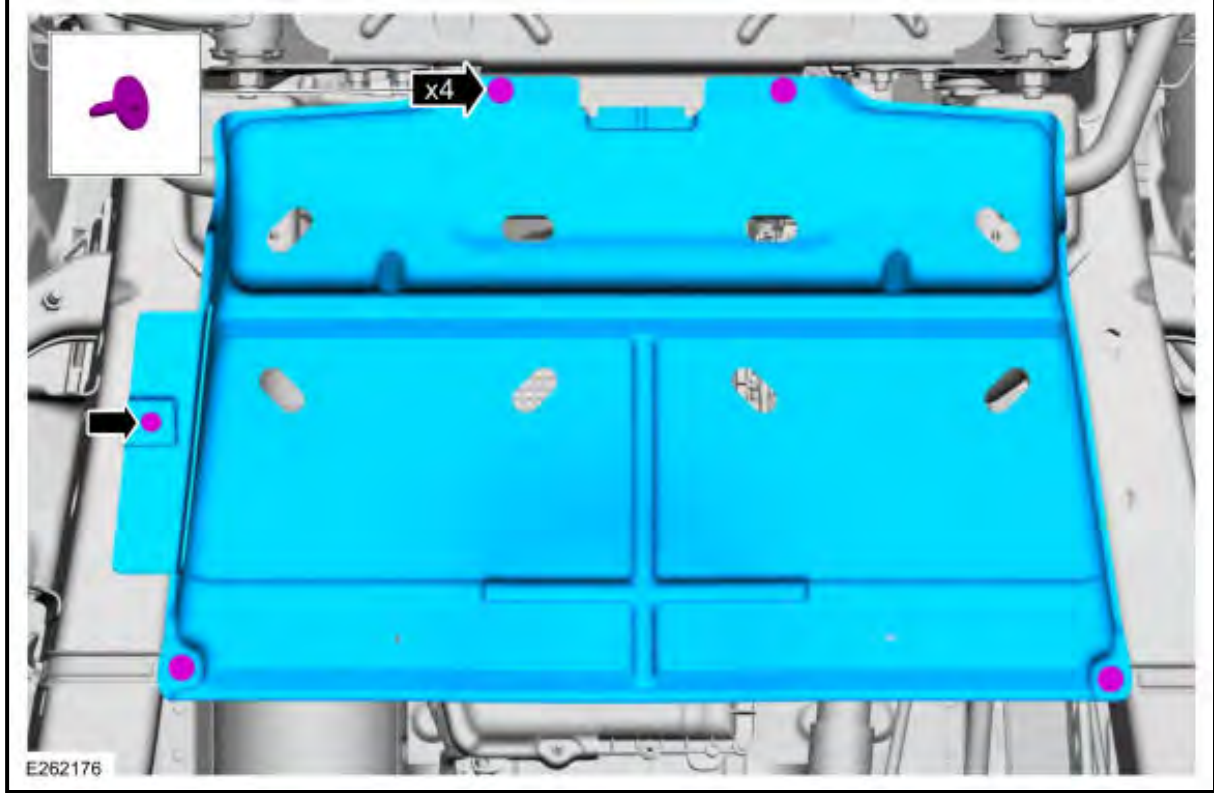


10. **NOTE:** Use a commercially available quick link.

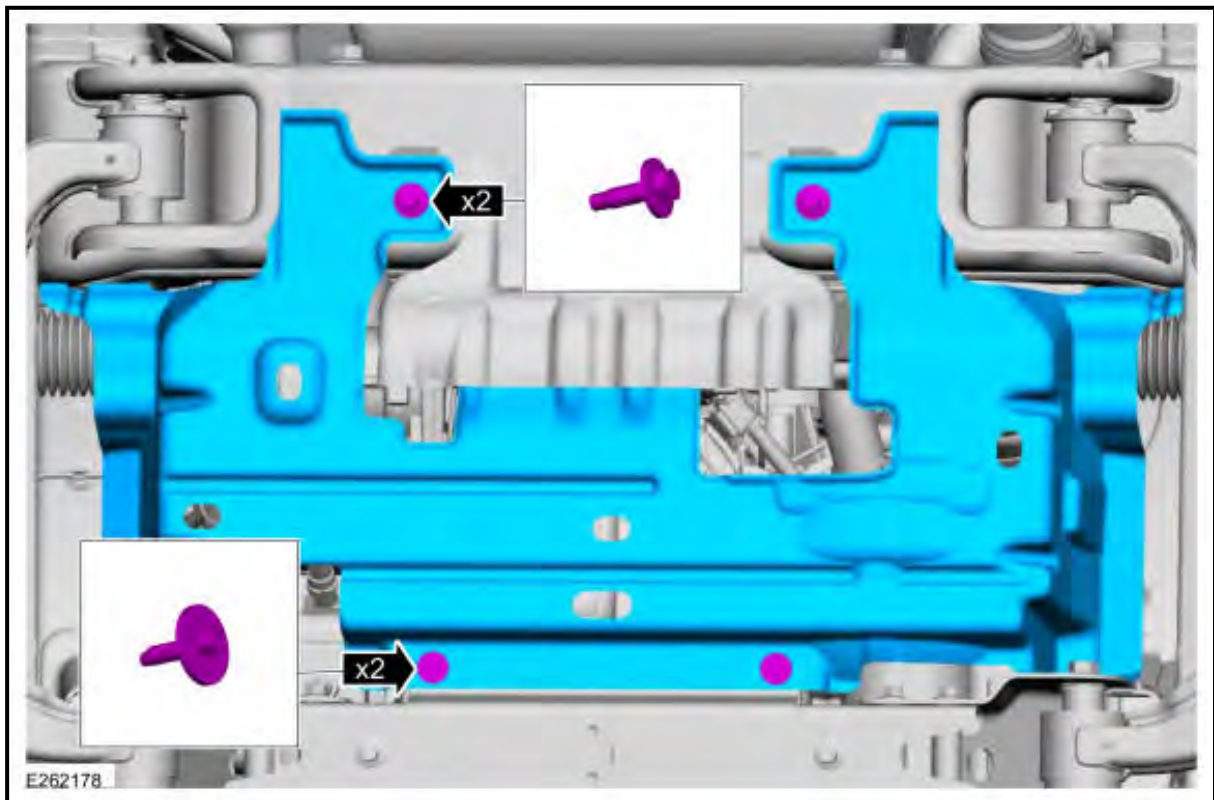
Install Special Service Tool: 303-F070 Support Bar, Engine. , 303-F070 Support Bar, Engine.



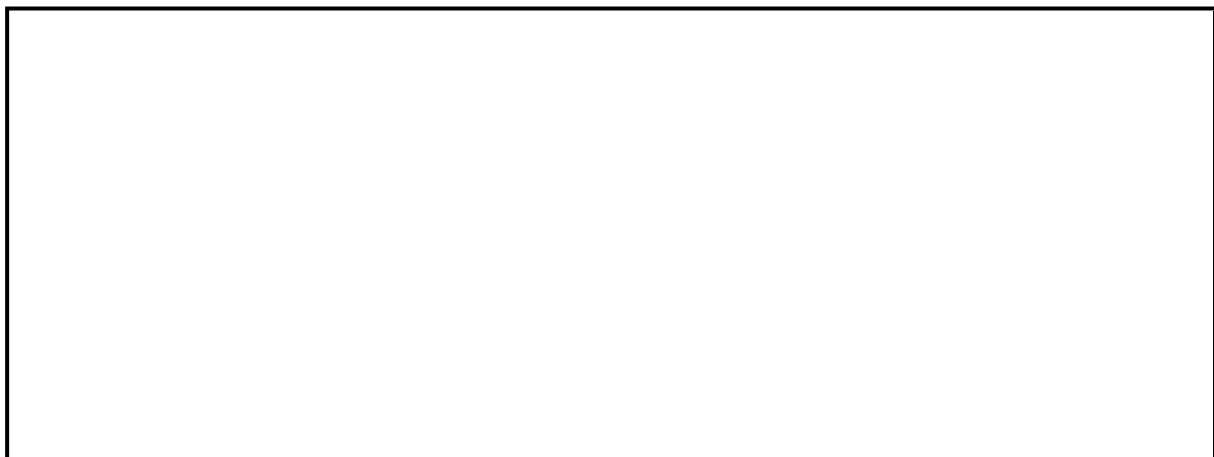
11. Remove the retainer. Remove the bolts and the transmission housing cover.

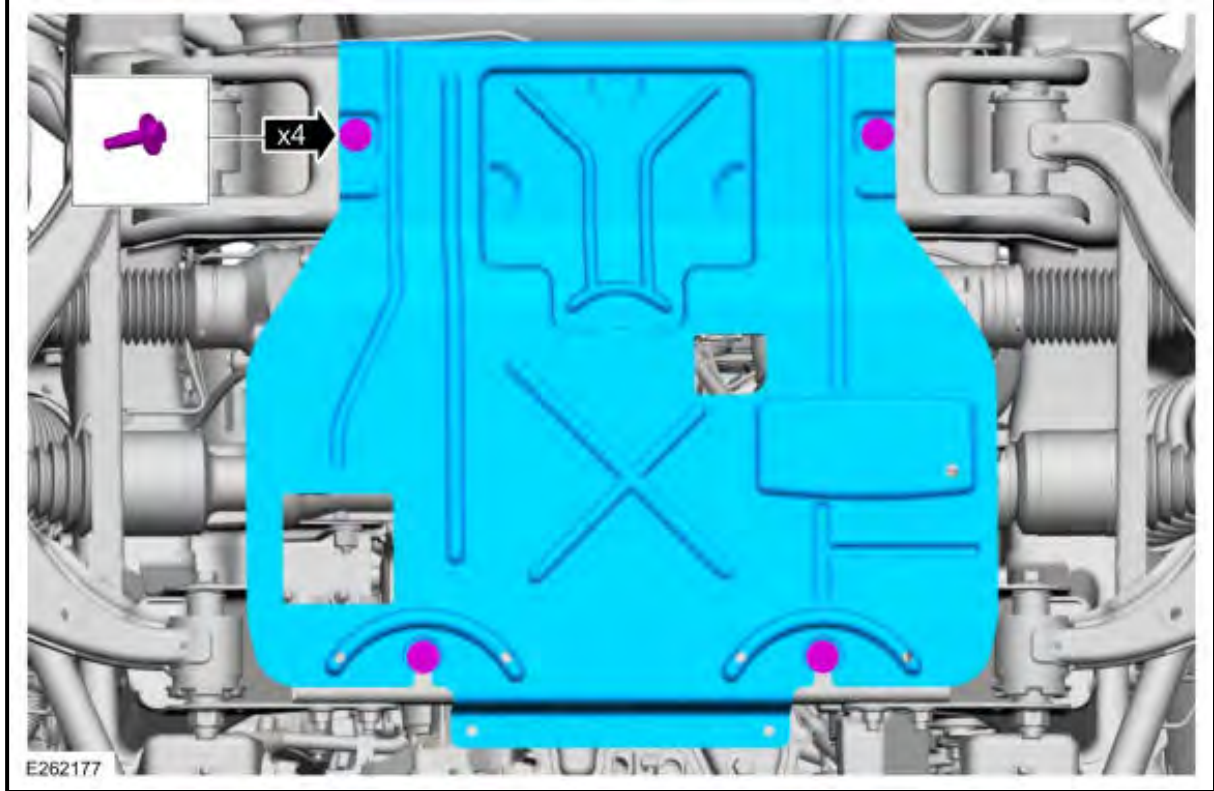


12. If equipped, remove the bolts and the underbody shield.

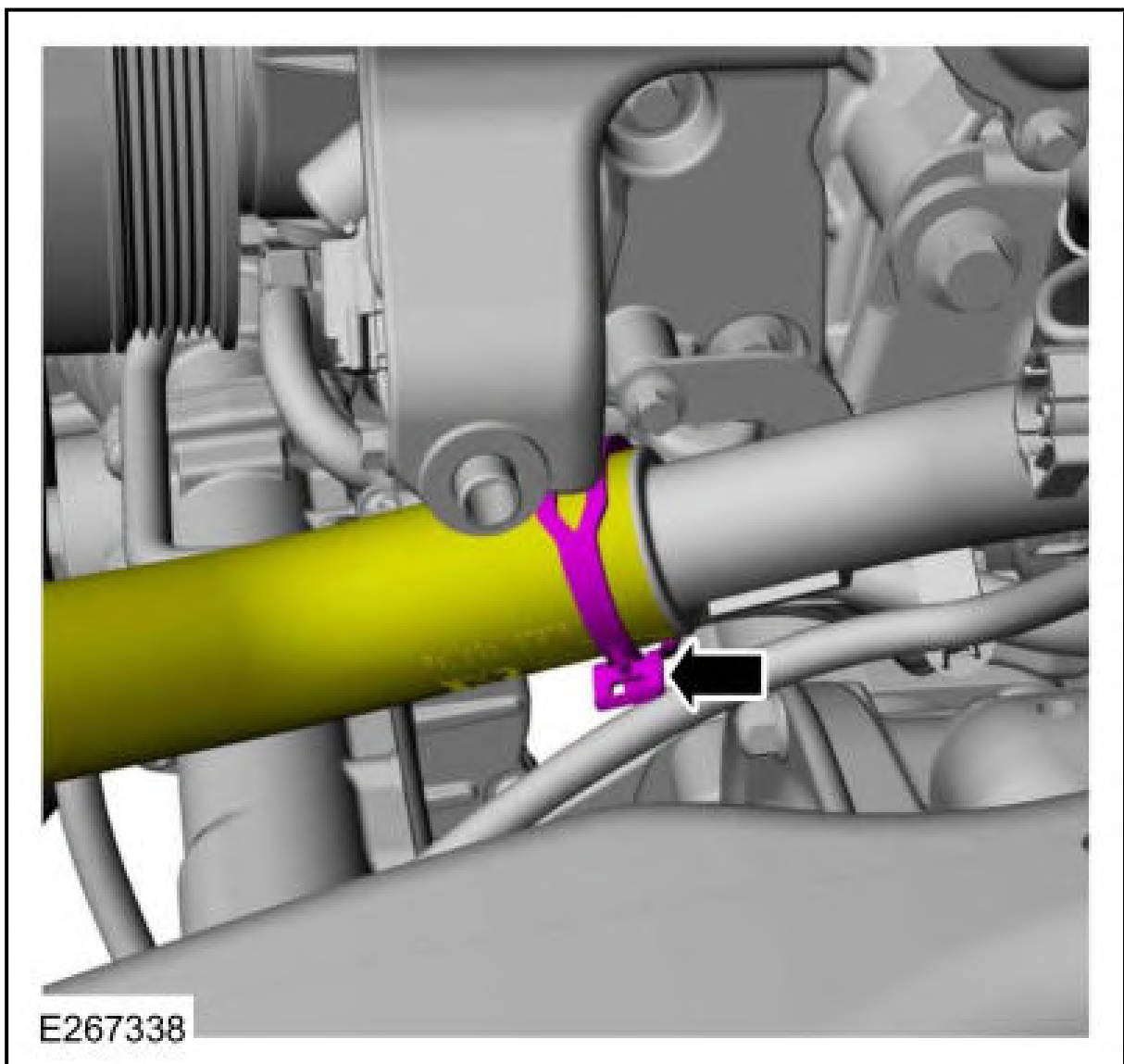


13. If equipped, remove the bolts and the skid plate.

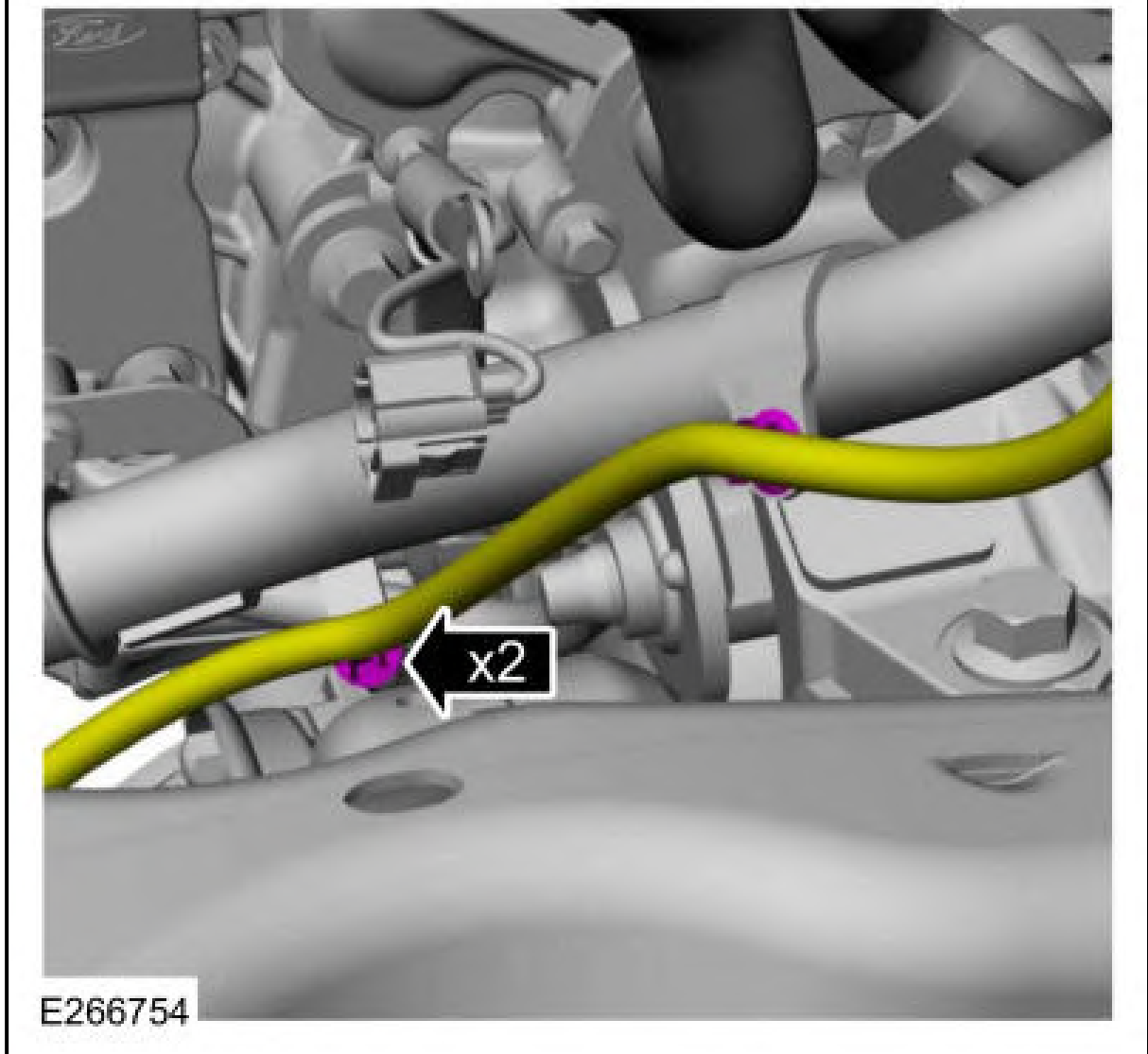




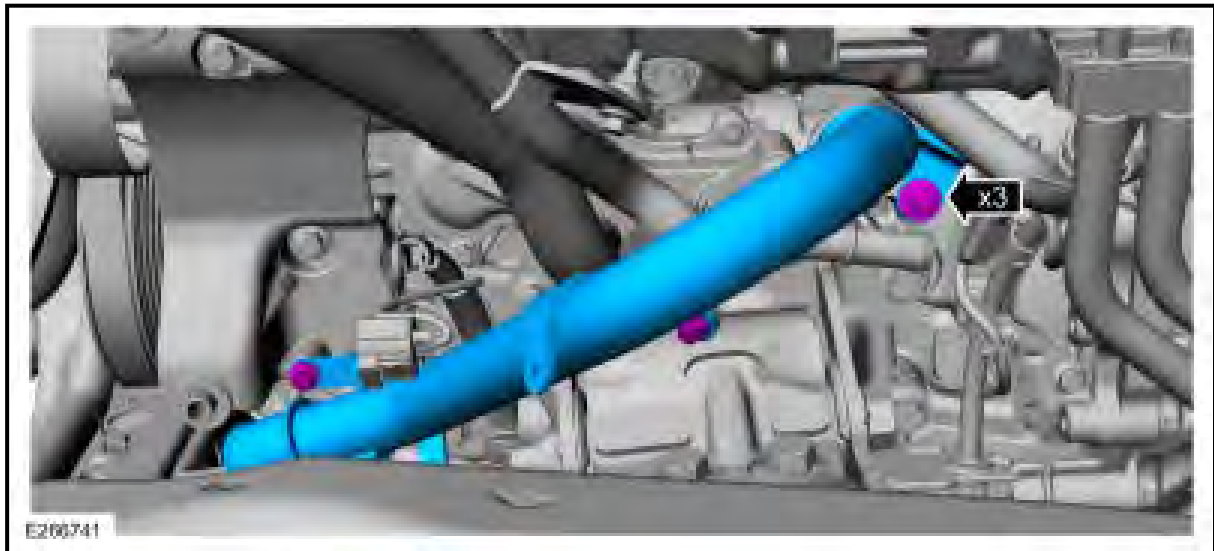
14. Disconnect the lower radiator hose from the lower radiator coolant tube.



15. If equipped, disconnect the block heater cord retainers.

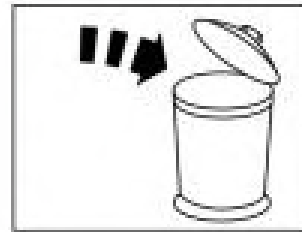


16. Remove the bolts and the lower radiator coolant tube.



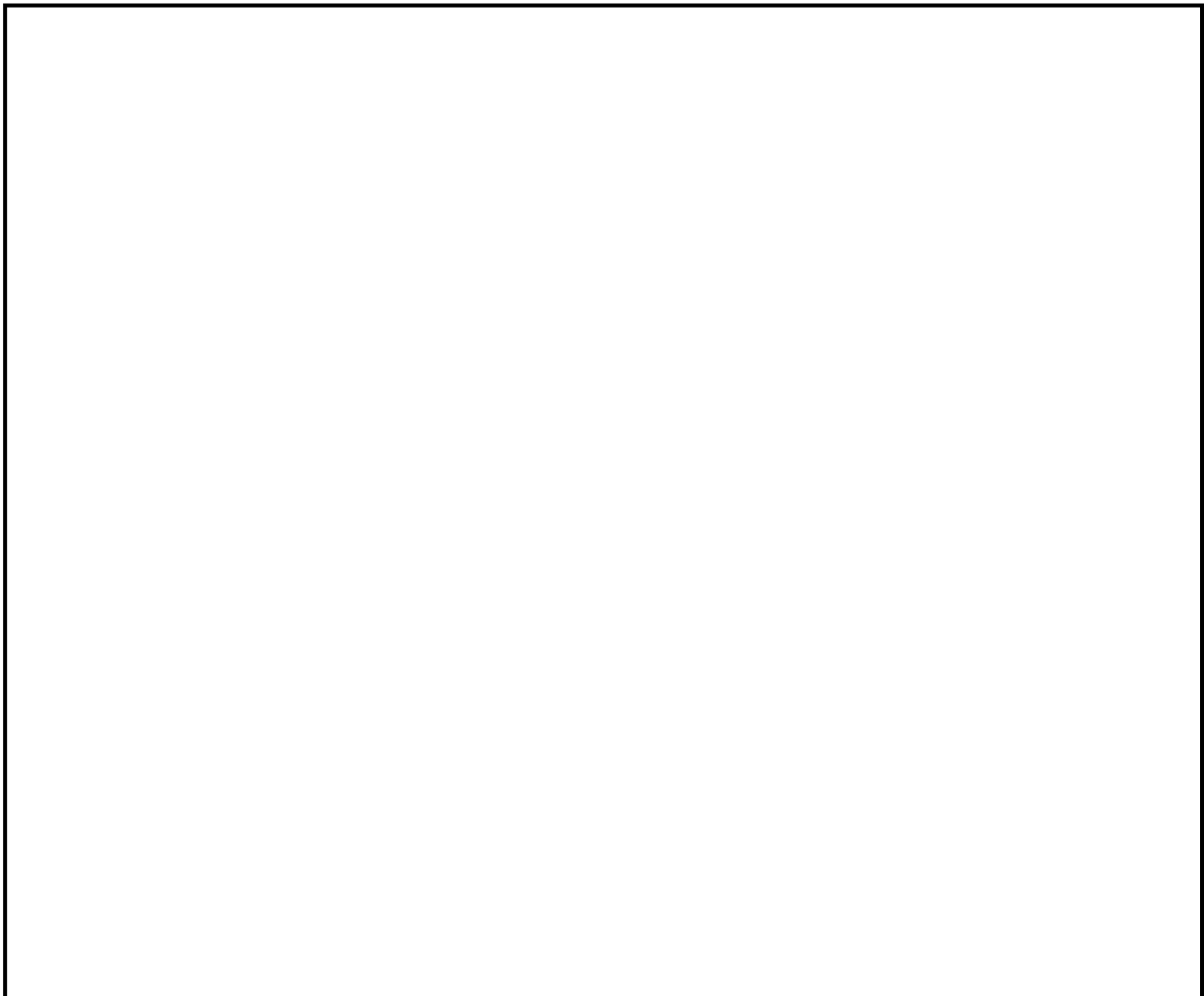
17. Remove and discard the O-ring seal from the lower radiator coolant tube.

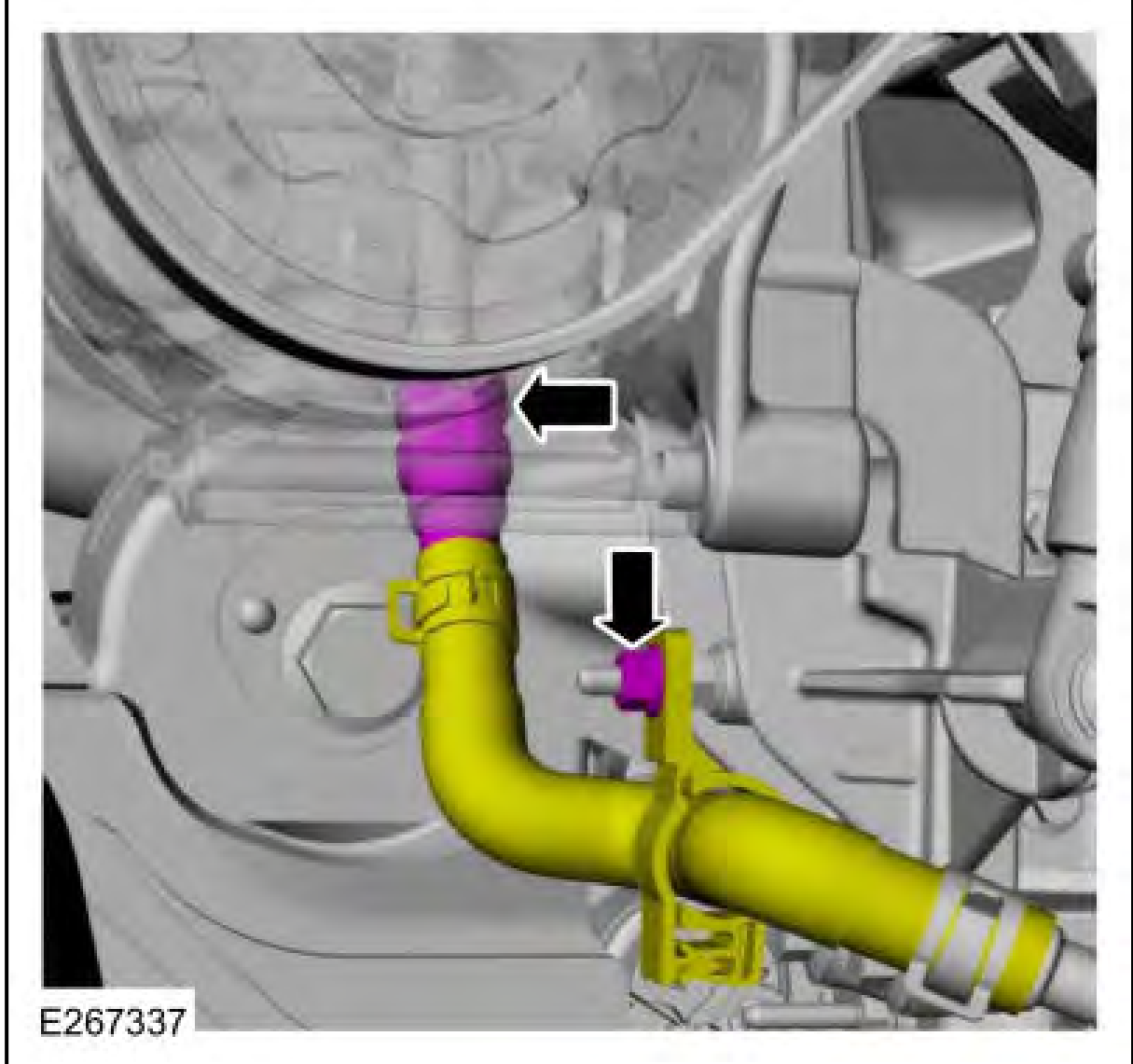




E267081

18. Disconnect the RH side coolant hose. Remove the nut and position aside the coolant hose.



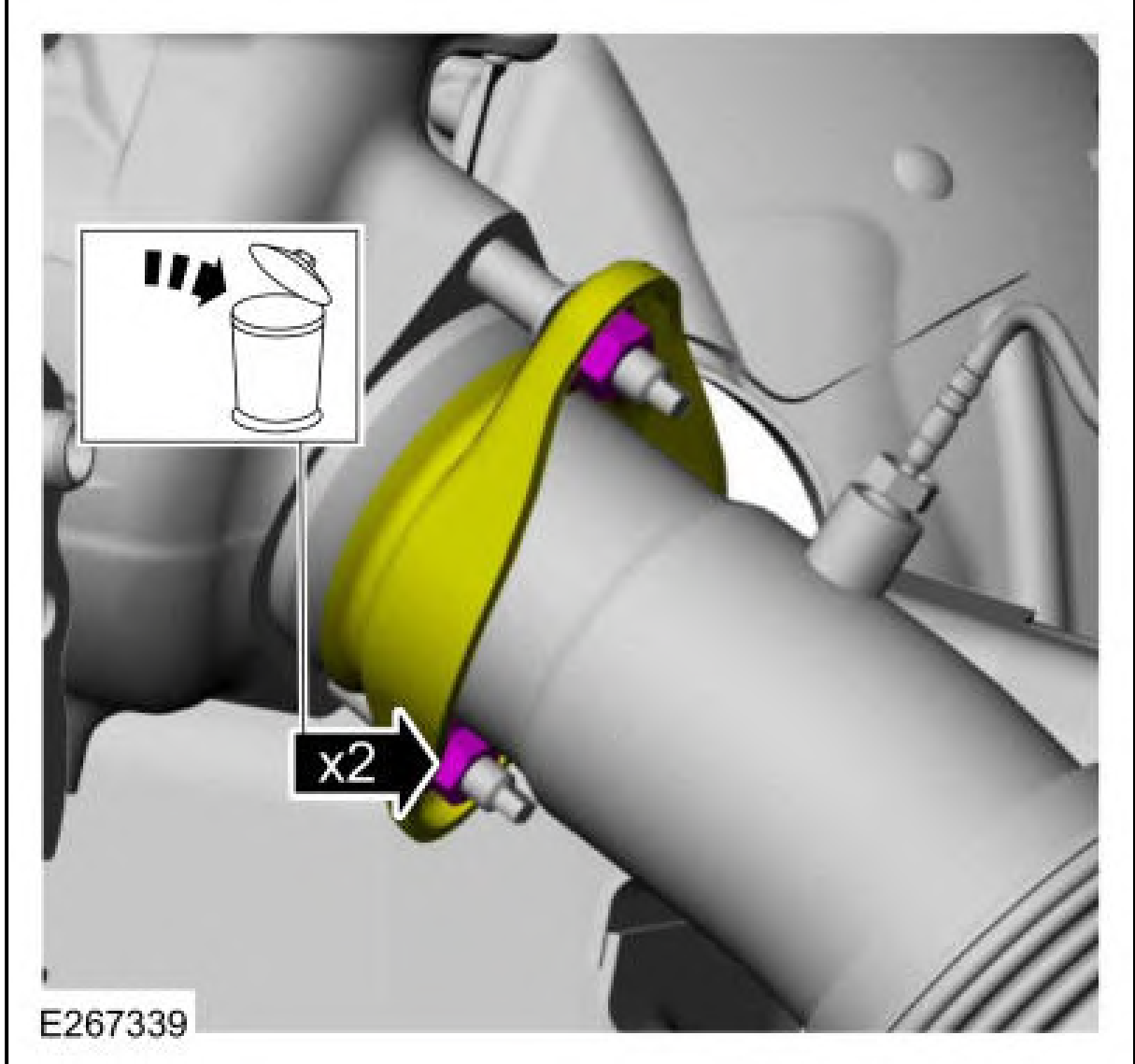


19. If equipped, remove the front driveshaft. REFER to: [Front Driveshaft](#) .

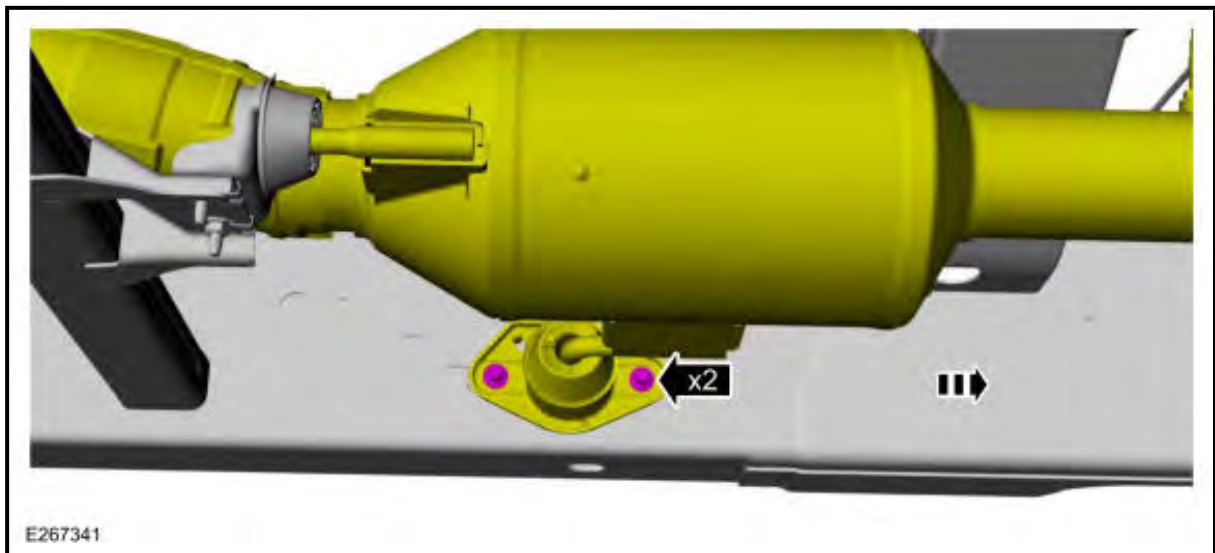
20. **NOTE:**       **Make sure that the mating faces are clean and free of foreign material.**

Remove the nuts and position the flange off the turbocharger studs.



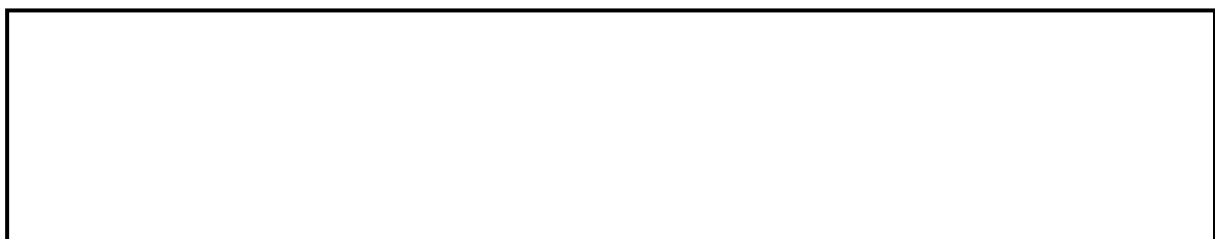


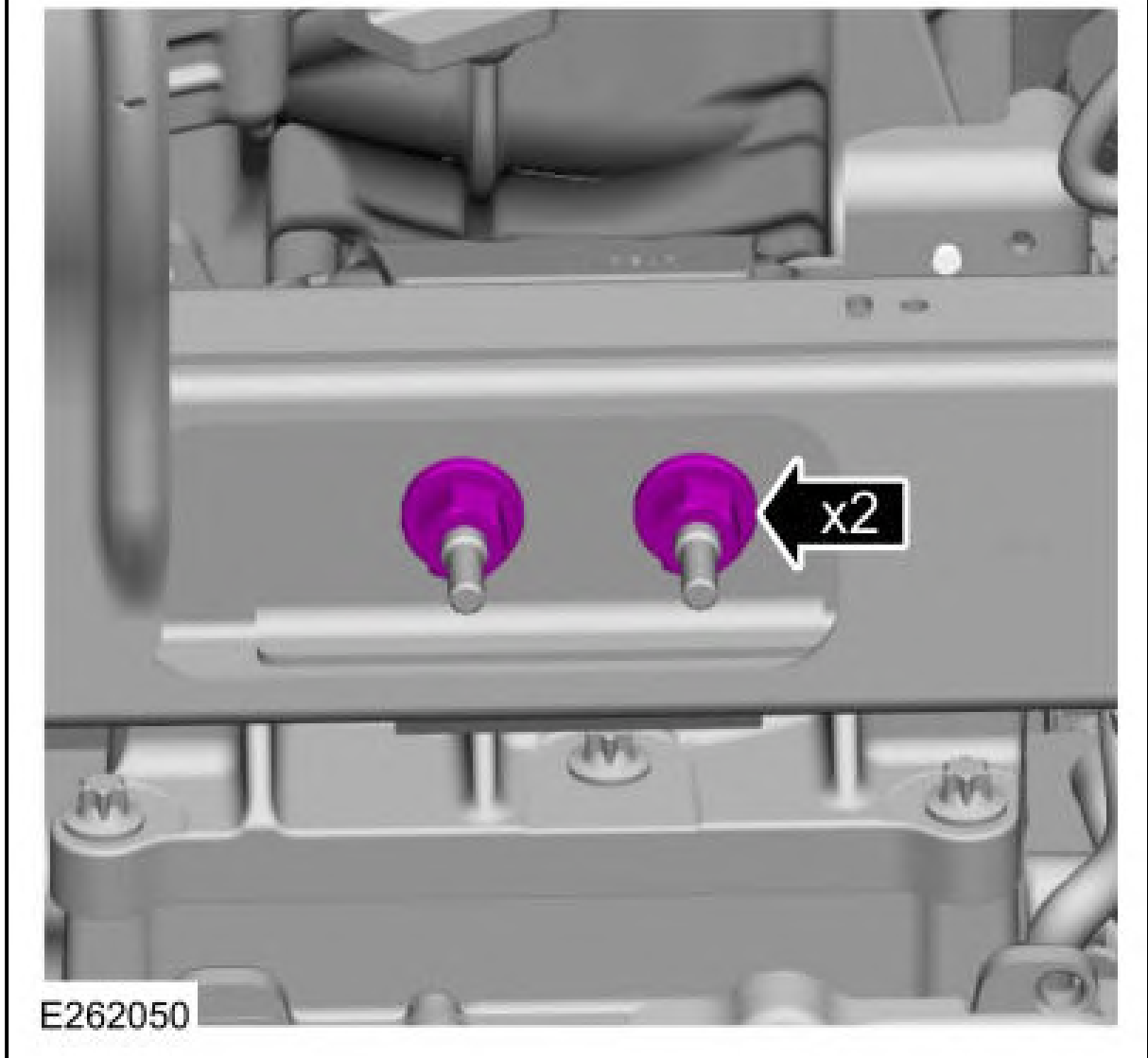
21. Remove the bolts and position back the exhaust system.



22. **NOTE:** Only use hand tools when removing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.

Loosen the transmission mount-to-crossmember nuts.



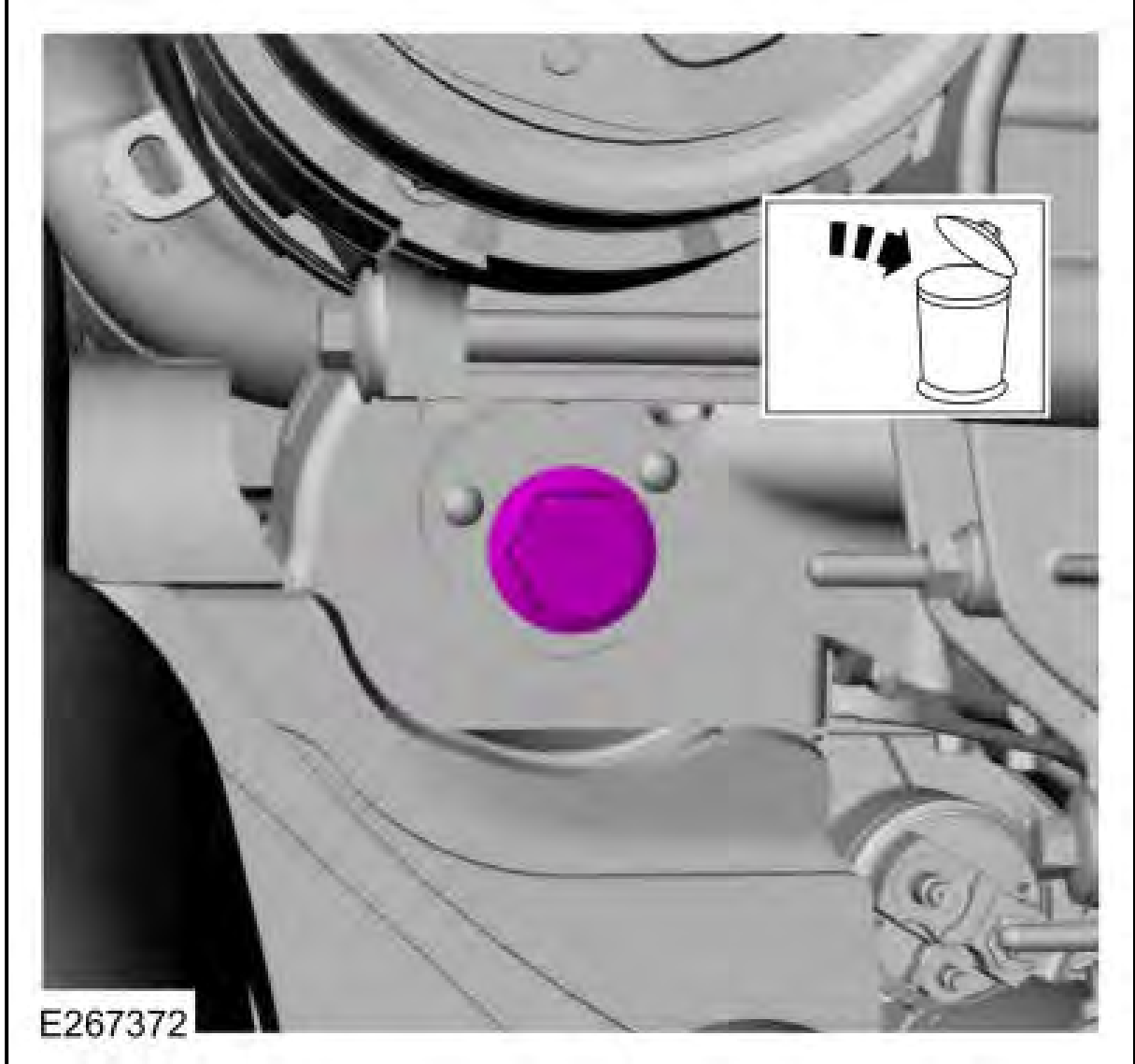


23. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

Remove and discard the RH engine mount through bolt.

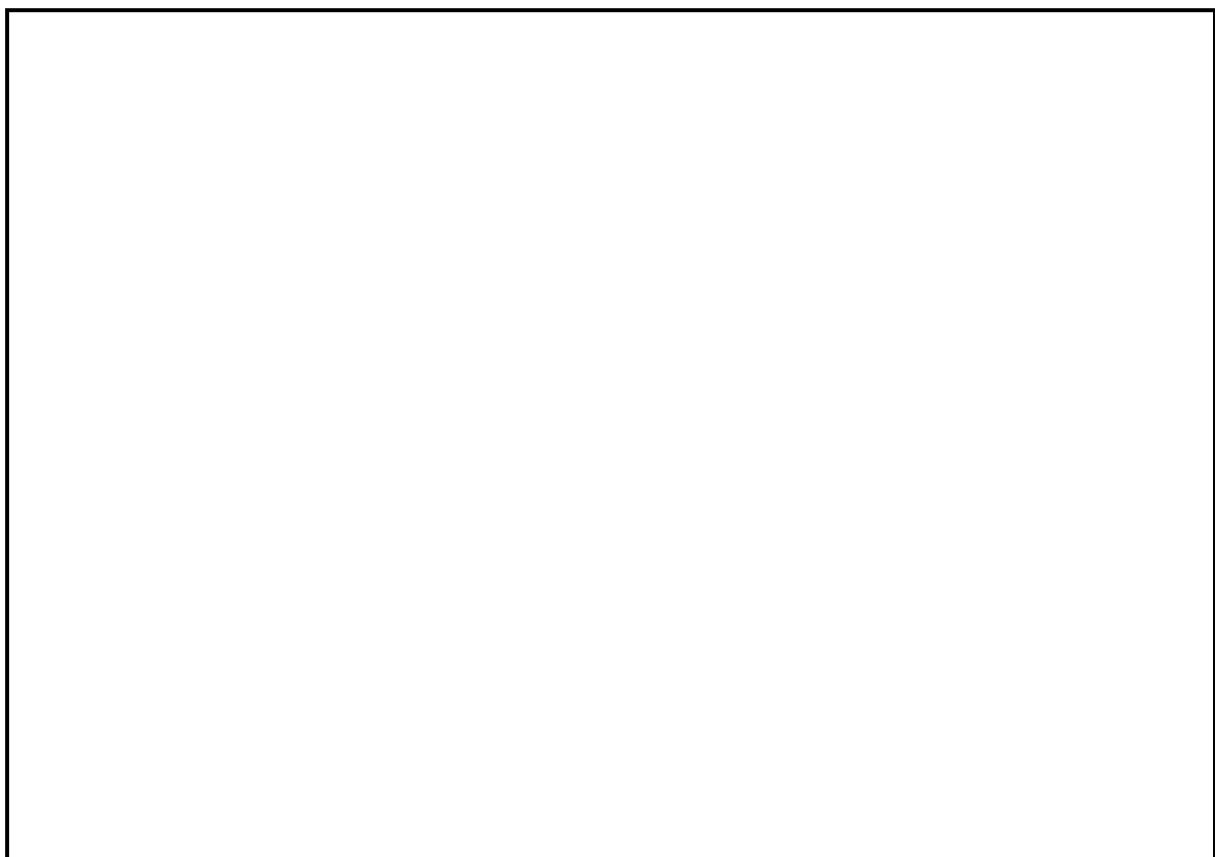


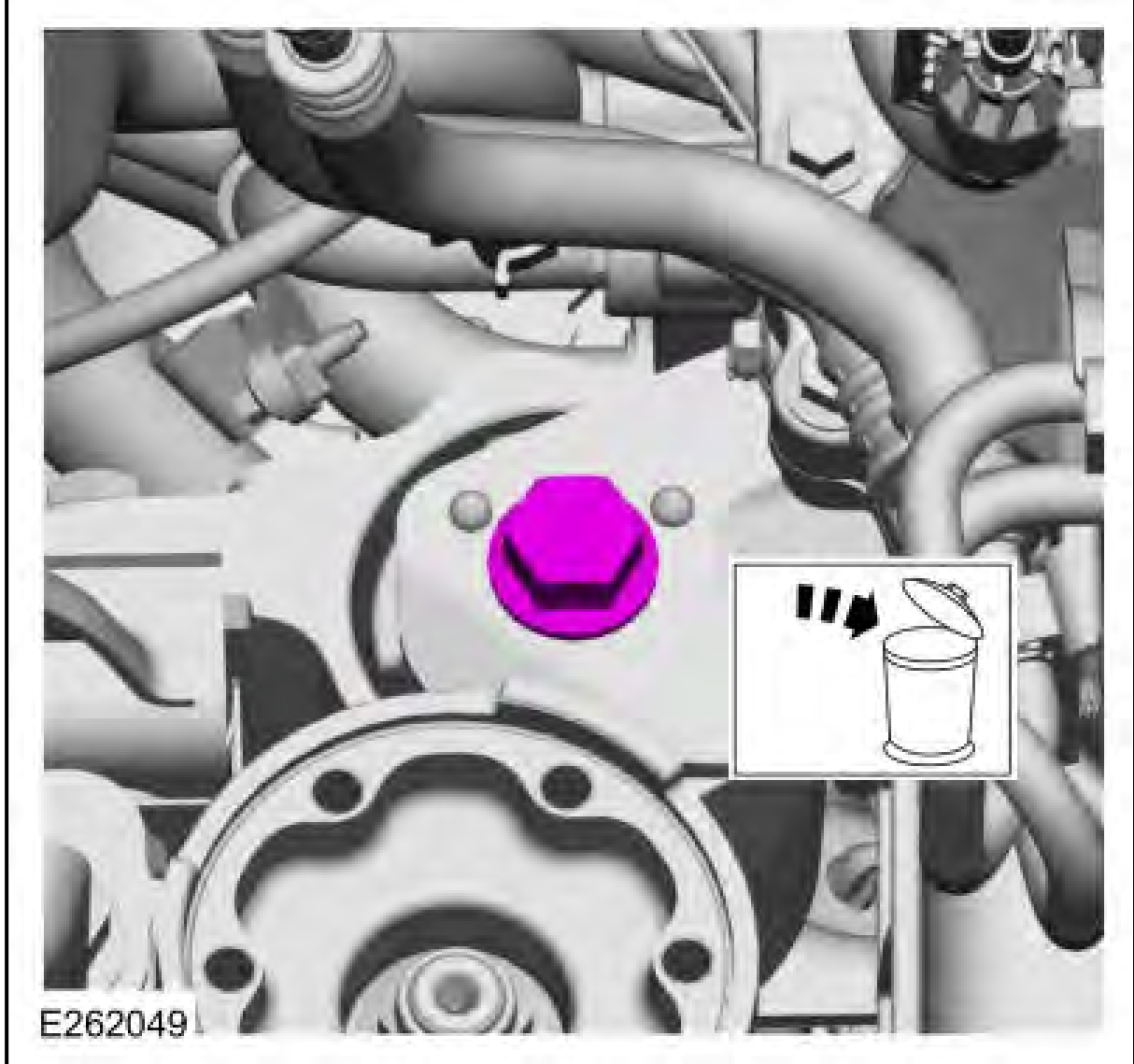




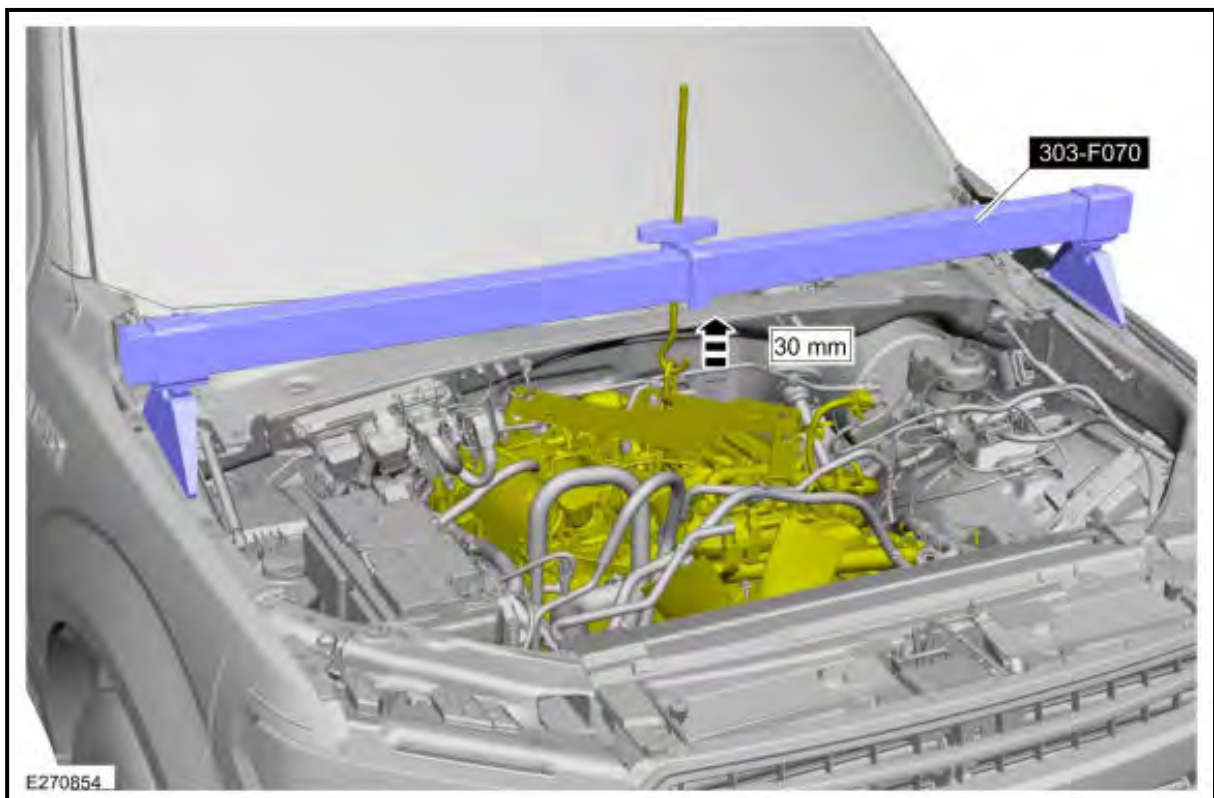
24. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

Remove and discard the LH engine mount through bolt.



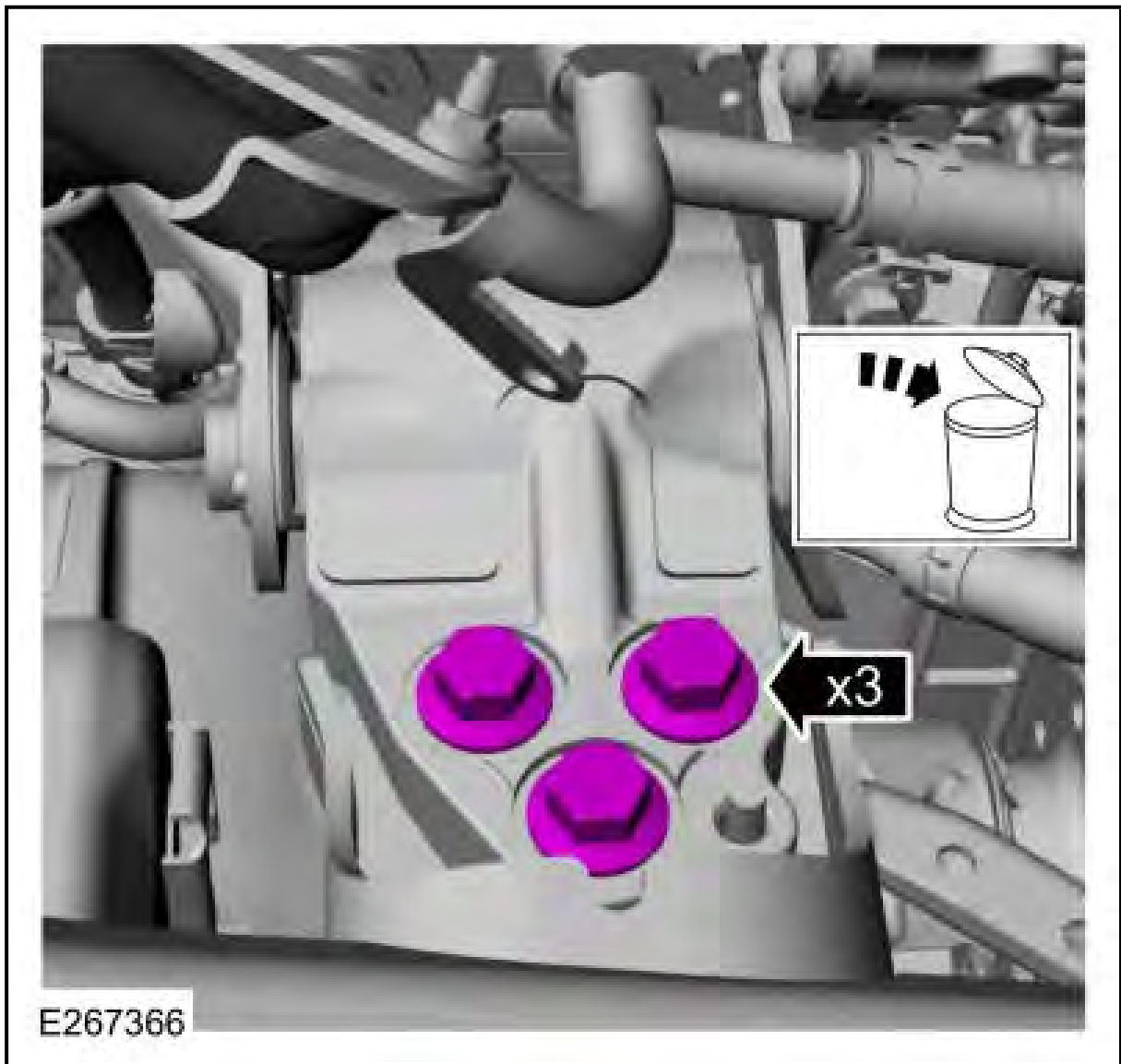


25. Raise the engine approximately 30 mm (1.18 in). Use Special Service Tool: 303-F070 Support Bar, Engine.



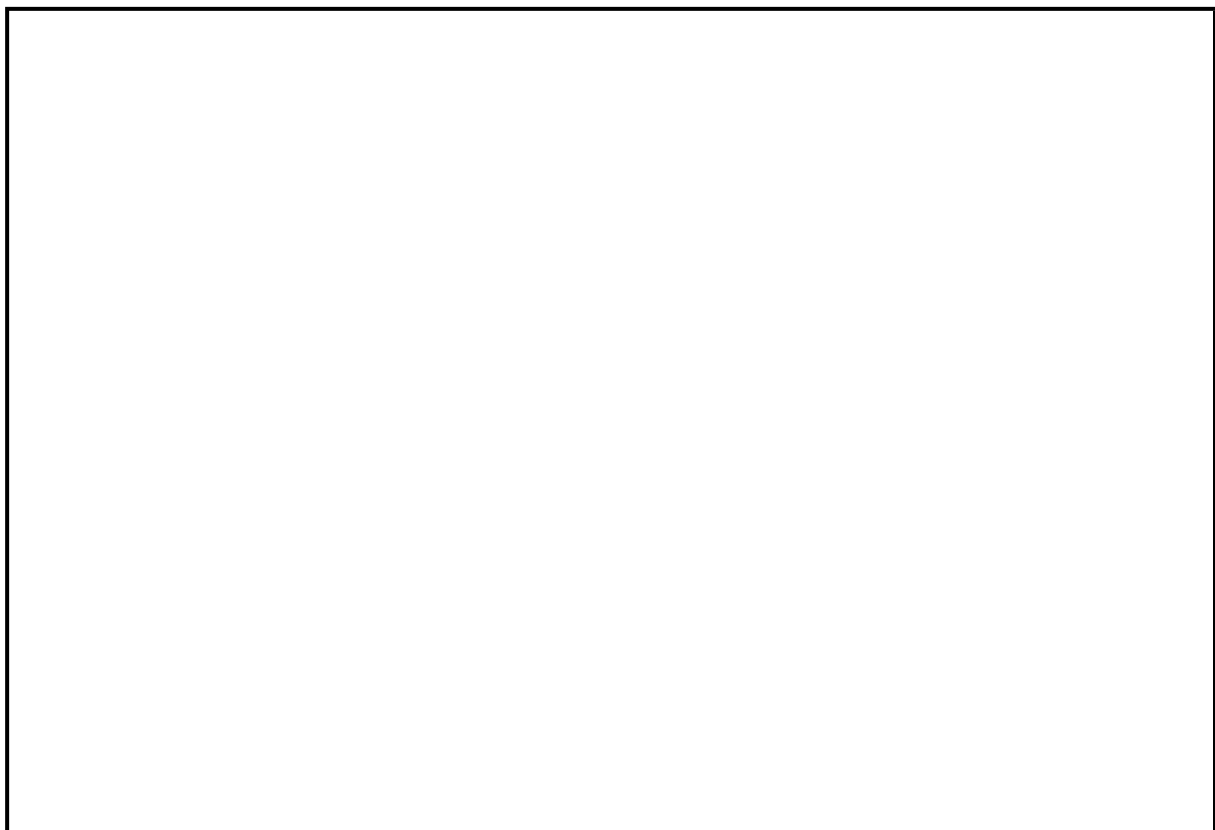
26. **NOTE:** Only use hand tools when removing or installing the engine mount-to-frame bolts or damage to the engine mount-to-frame nut plate can occur.

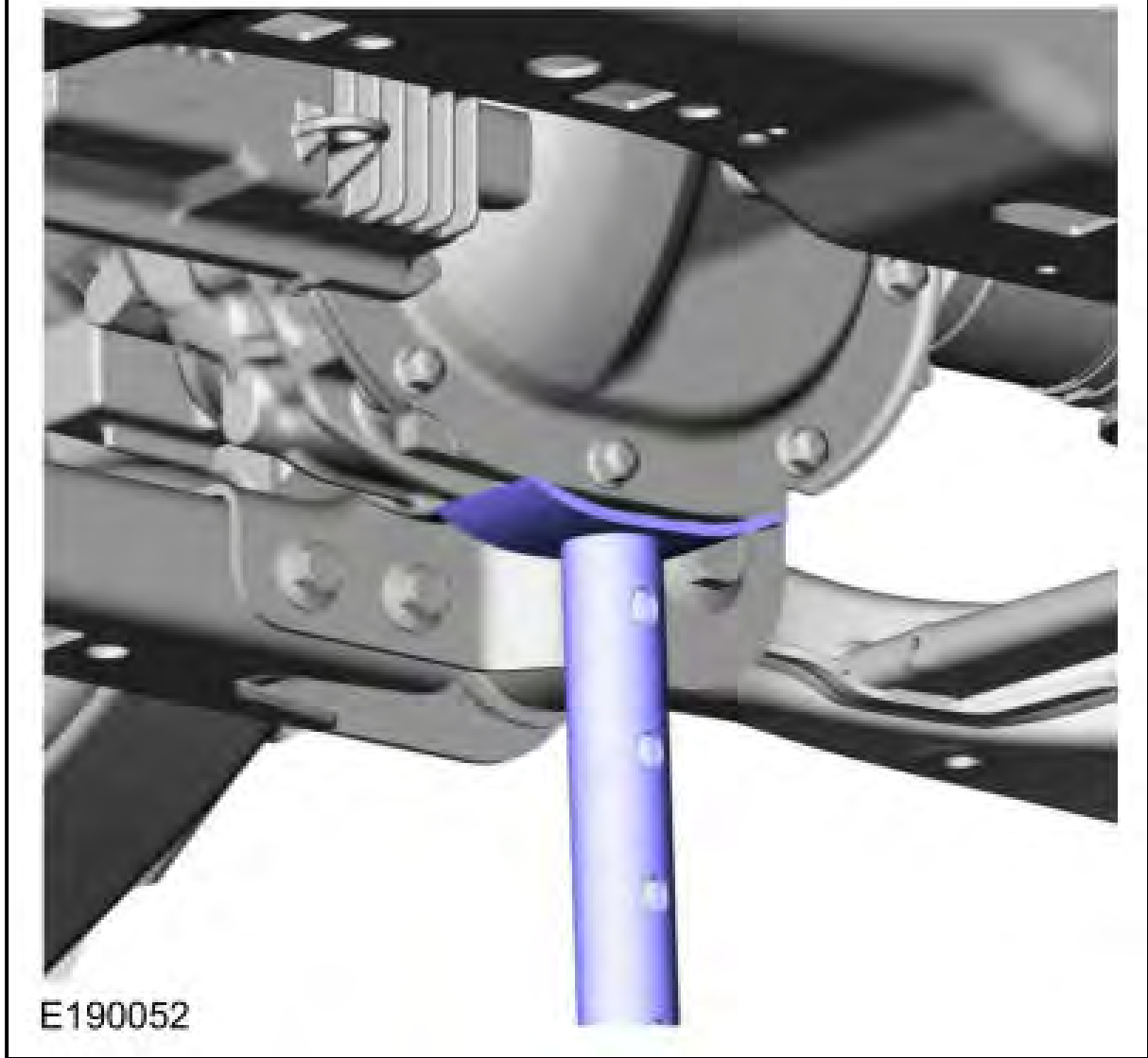
Remove and discard the LH engine mount-to-frame bolt.



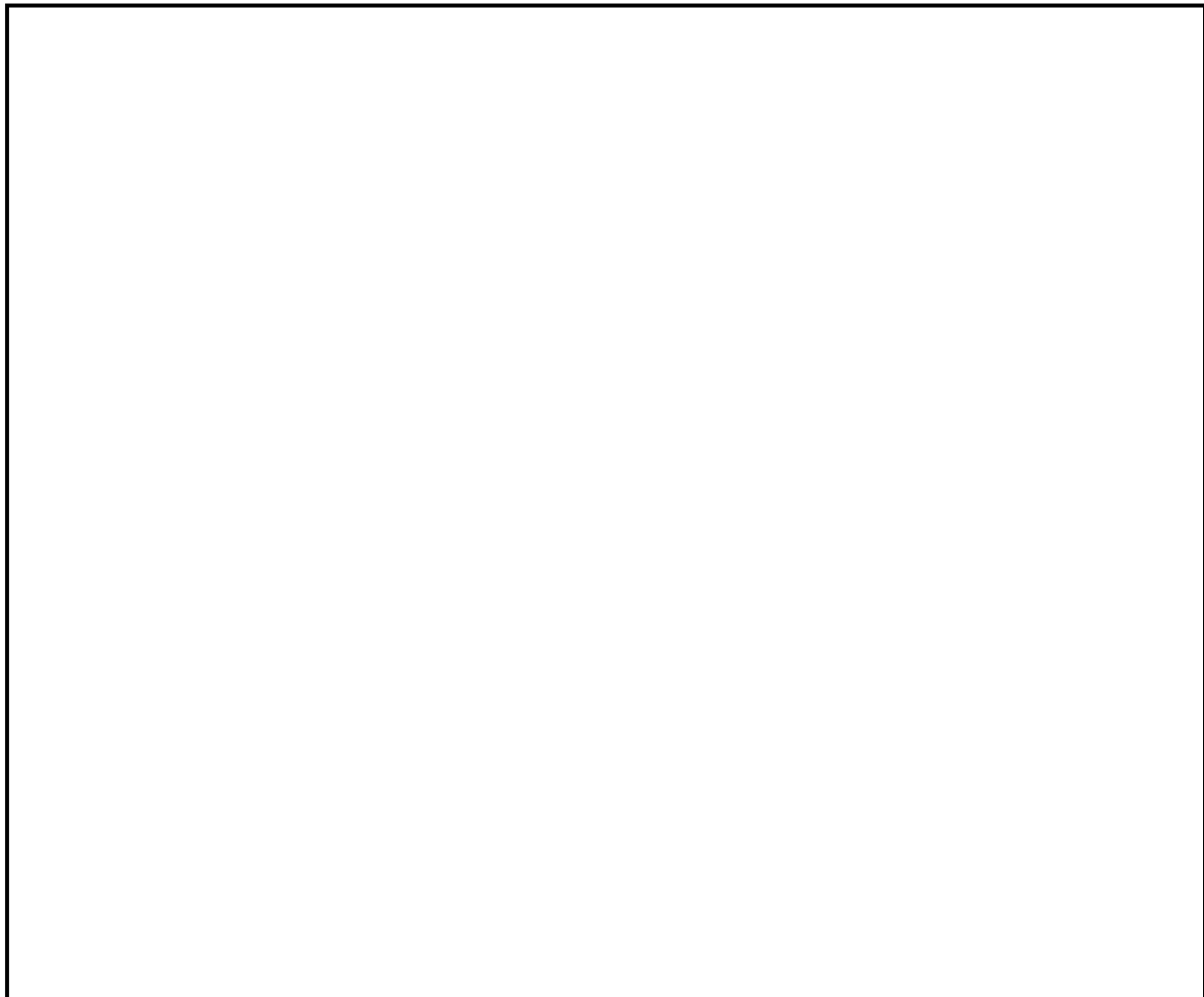
4x4

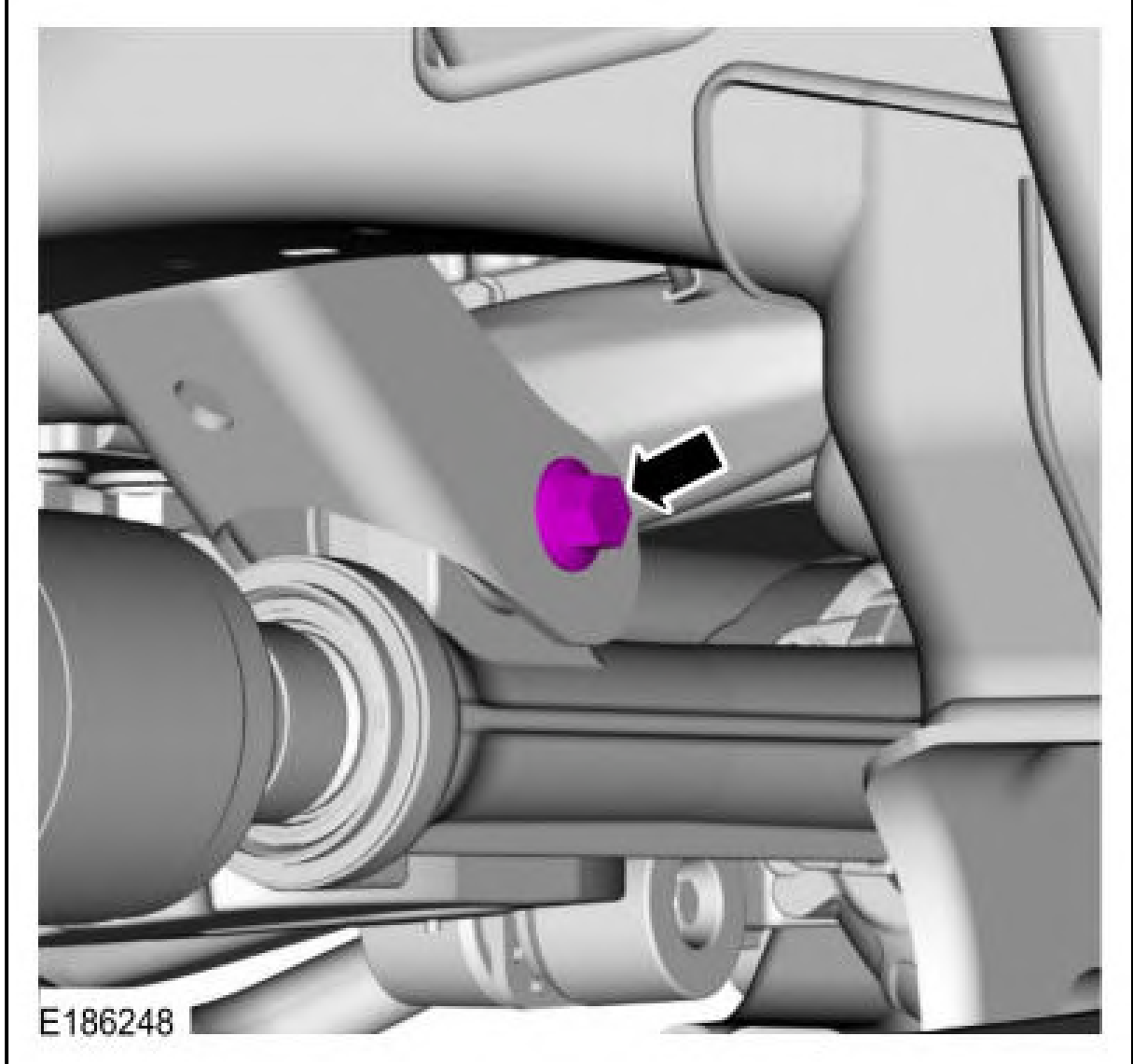
27. Using an adjustable stand, support the front axle. Use the General Equipment: Vehicle/Axle Stands



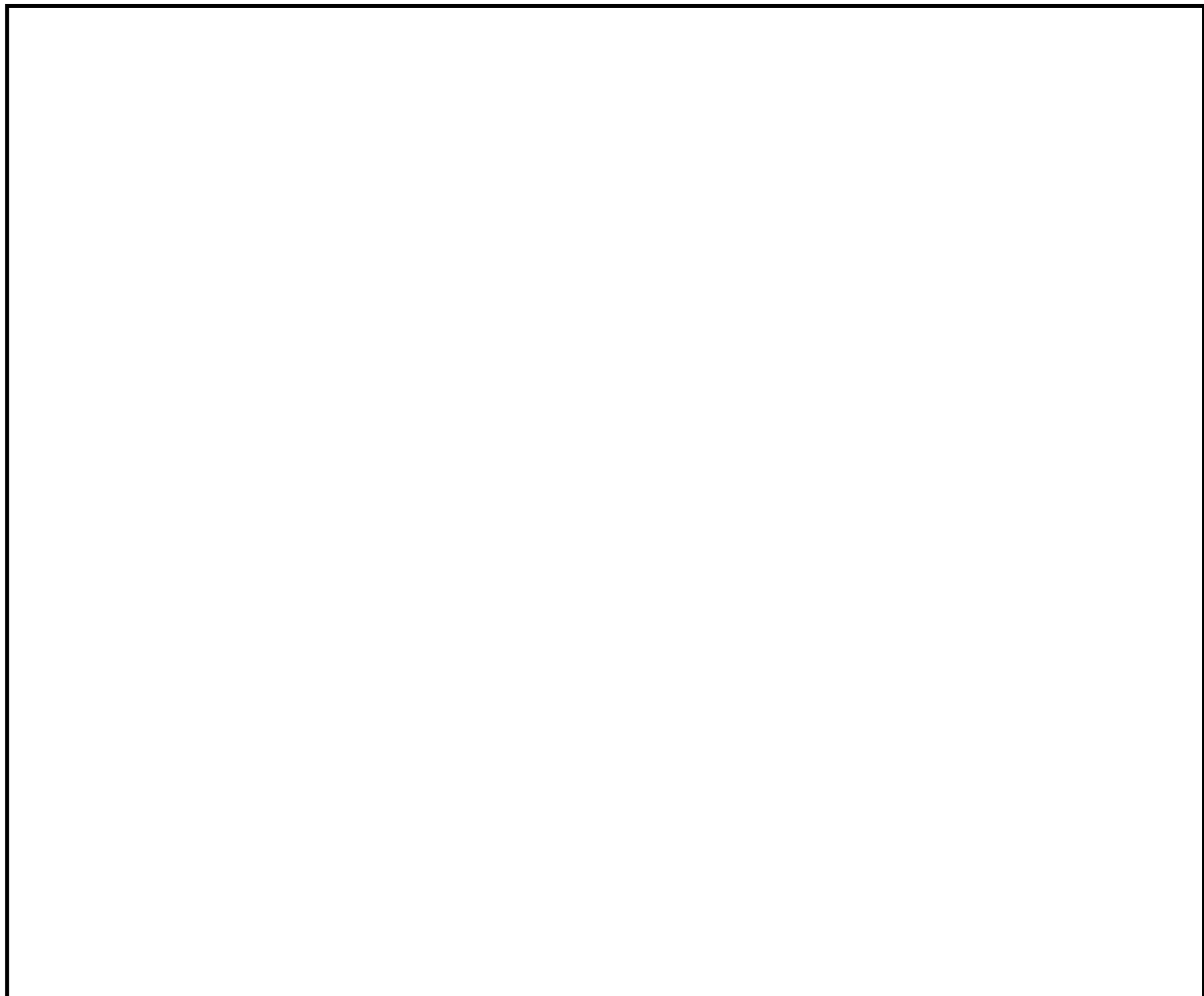


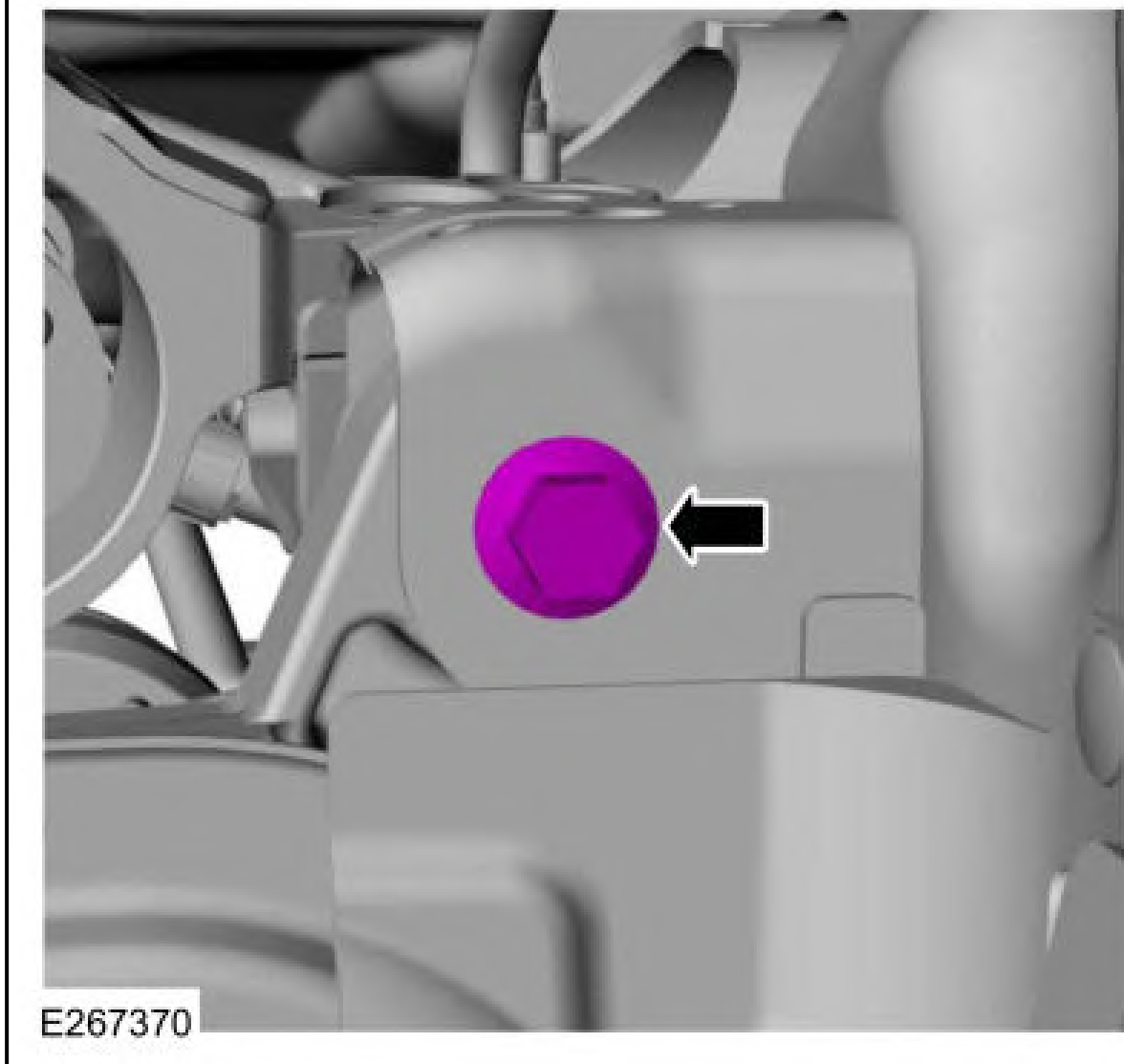
28. Remove the axle shaft housing carrier bushing bolt.





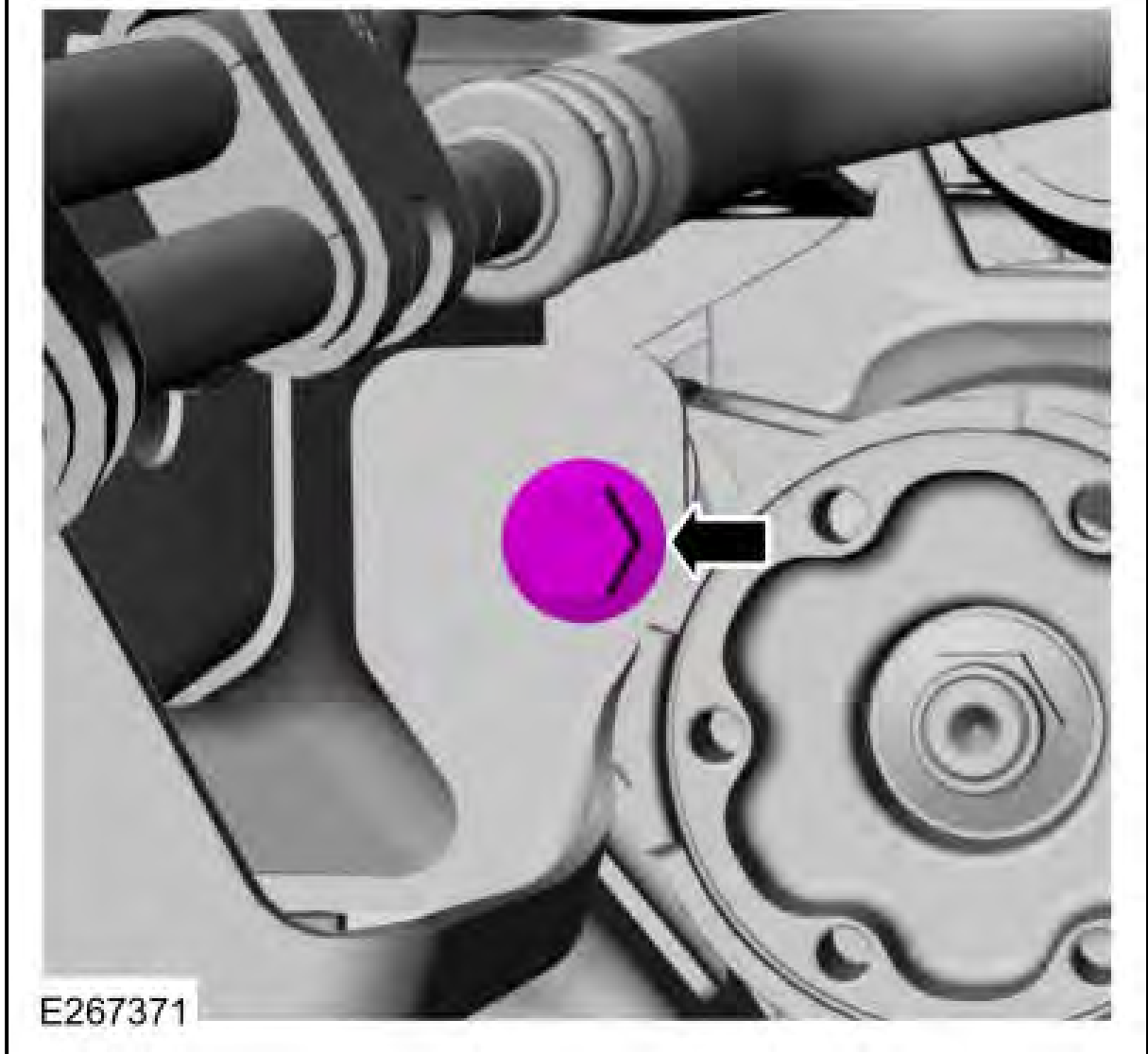
29. Remove the upper front axle carrier mounting bushing bolt.





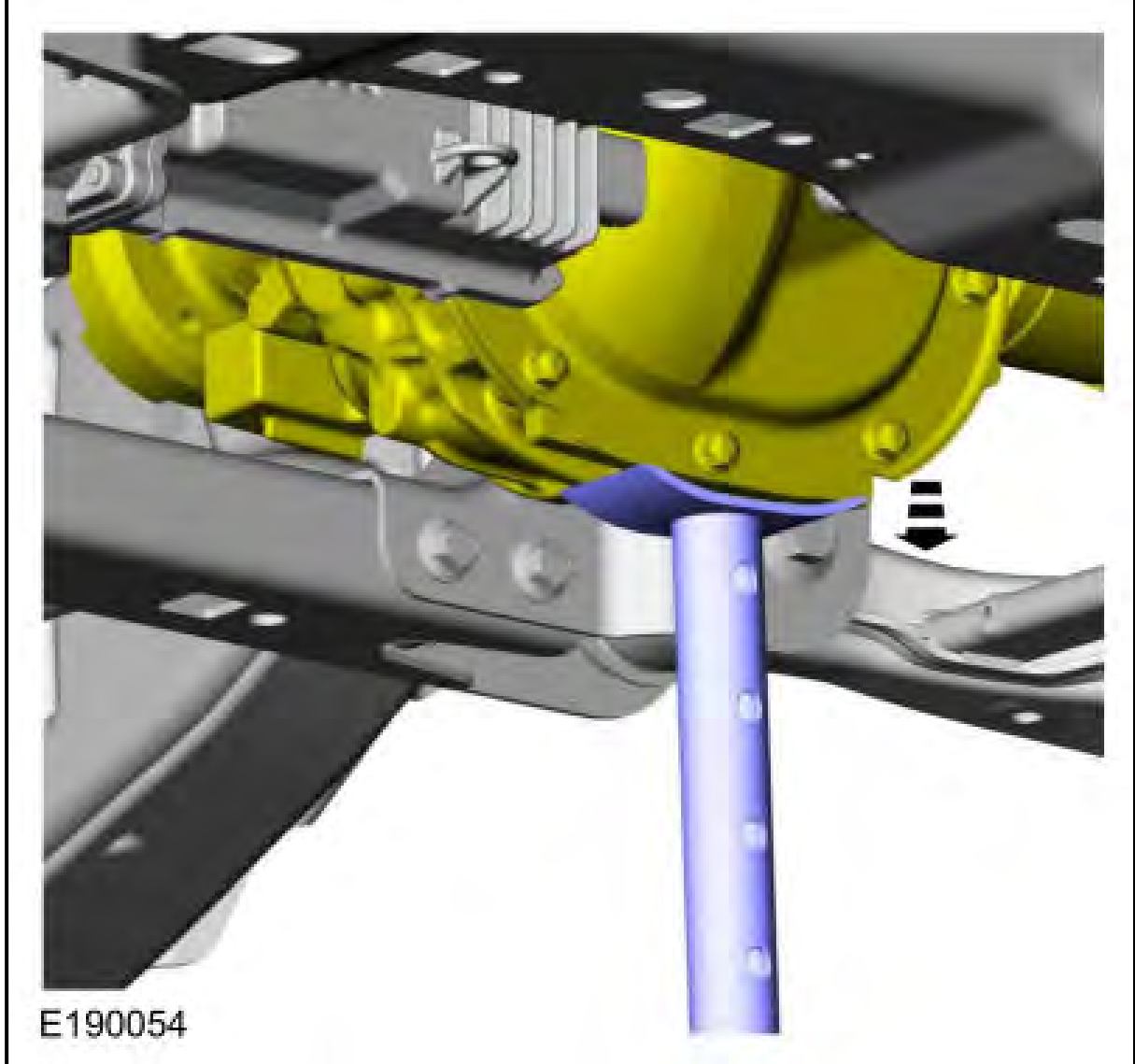
30. Remove the lower front axle carrier mounting bushing bolt.





31. Using an adjustable stand, lower the axle to allow clearance for the LH engine mount to be removed. Use the General Equipment: Vehicle/Axle Stands



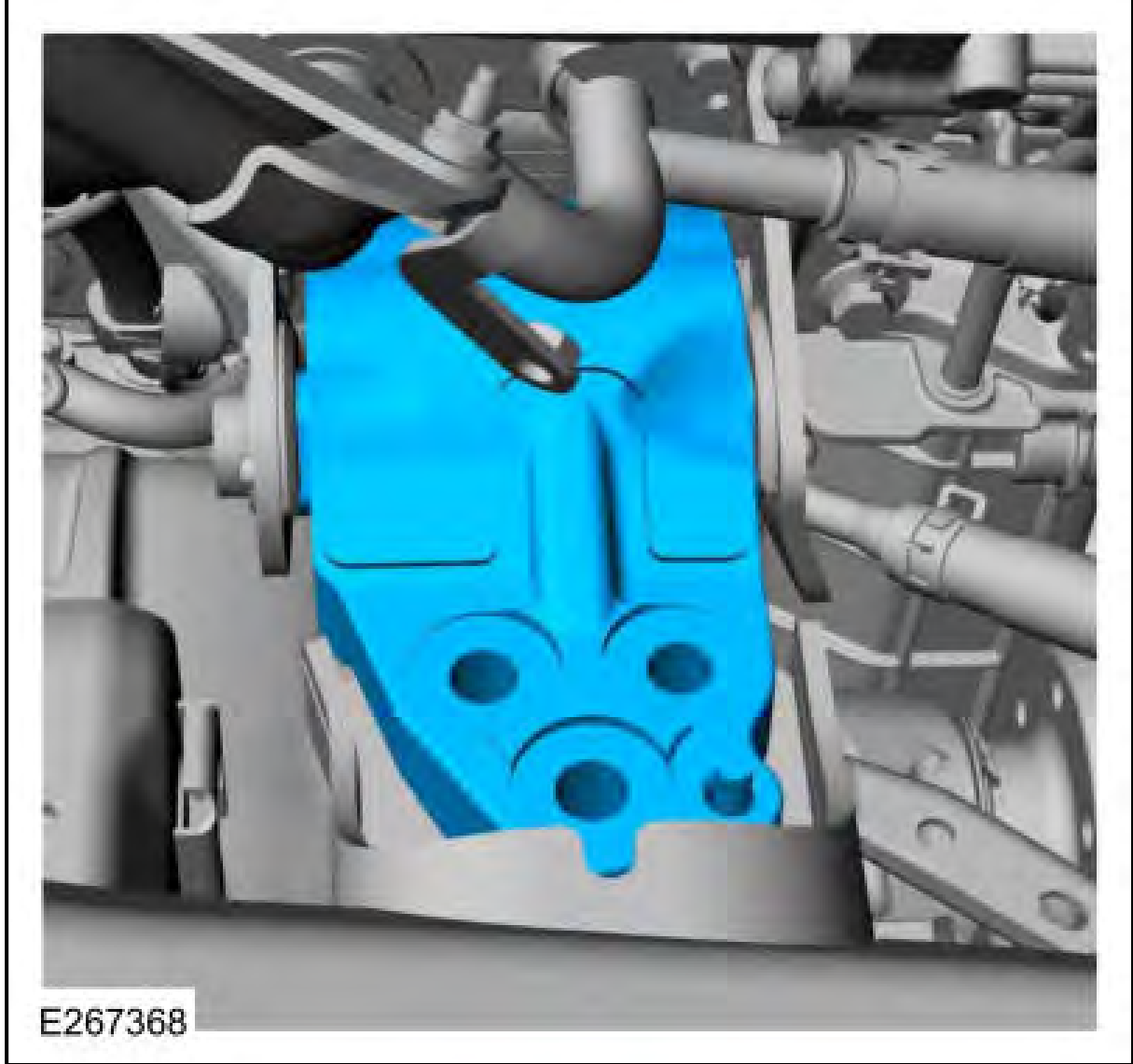


4x2/4x4

32. Remove the LH engine mount.

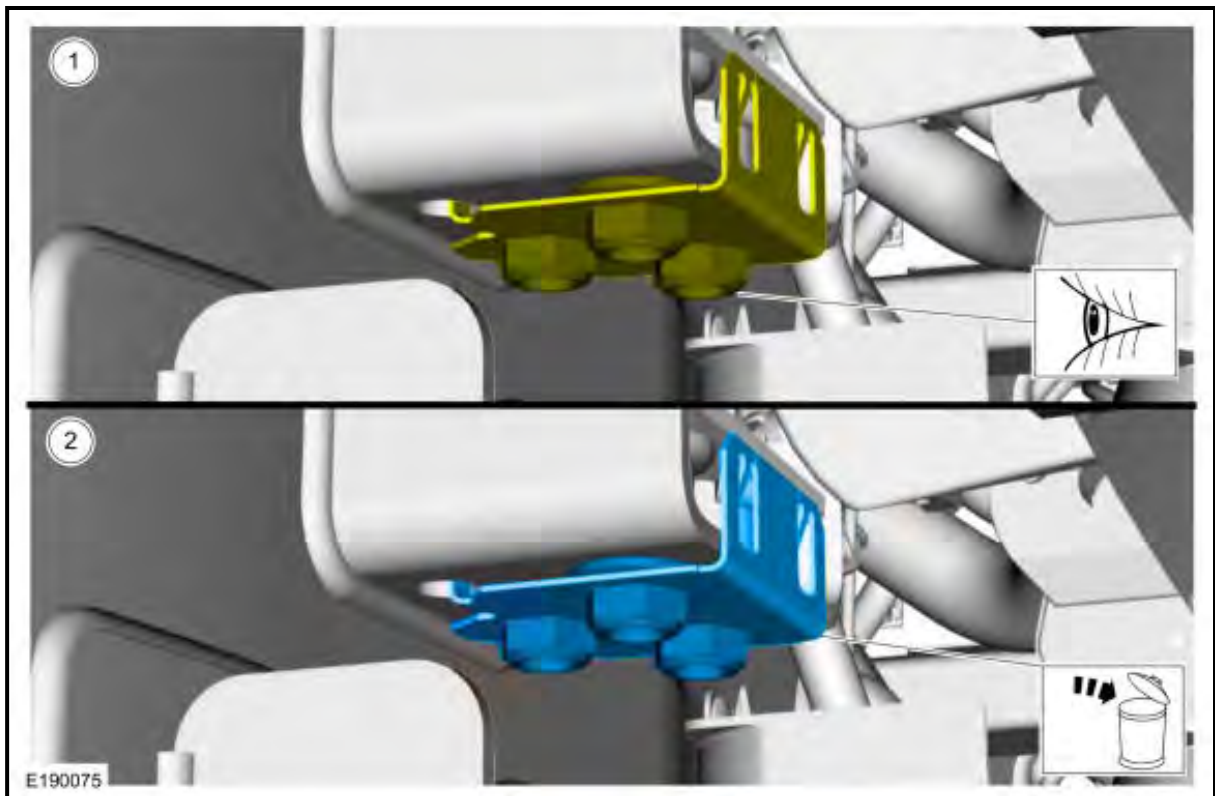




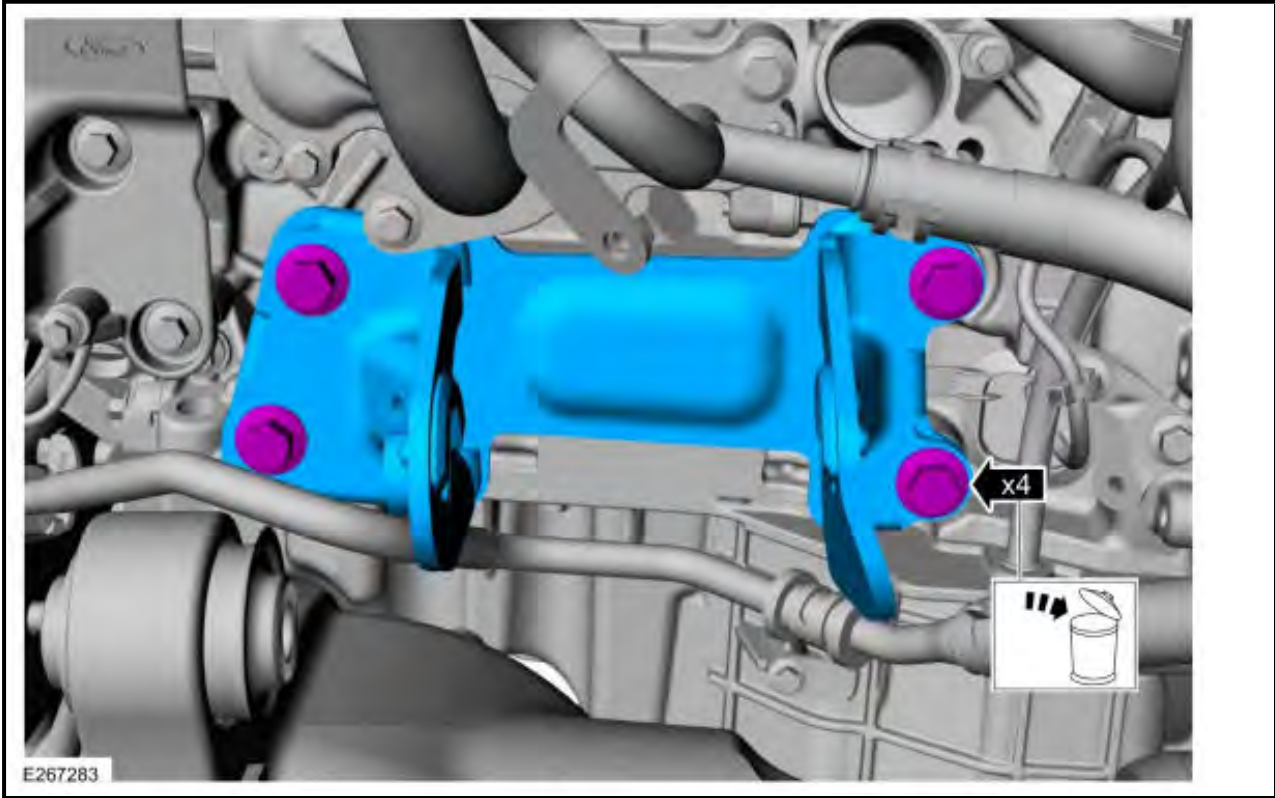


33.

1. Inspect the engine mount-to-frame nut plate for thread damage.
2. If the nut plate is damaged, remove and discard the engine mount-to-frame nut plate.



34. If necessary, remove the bolts and the LH engine mount-to-cylinder block bracket. Discard the bolts.

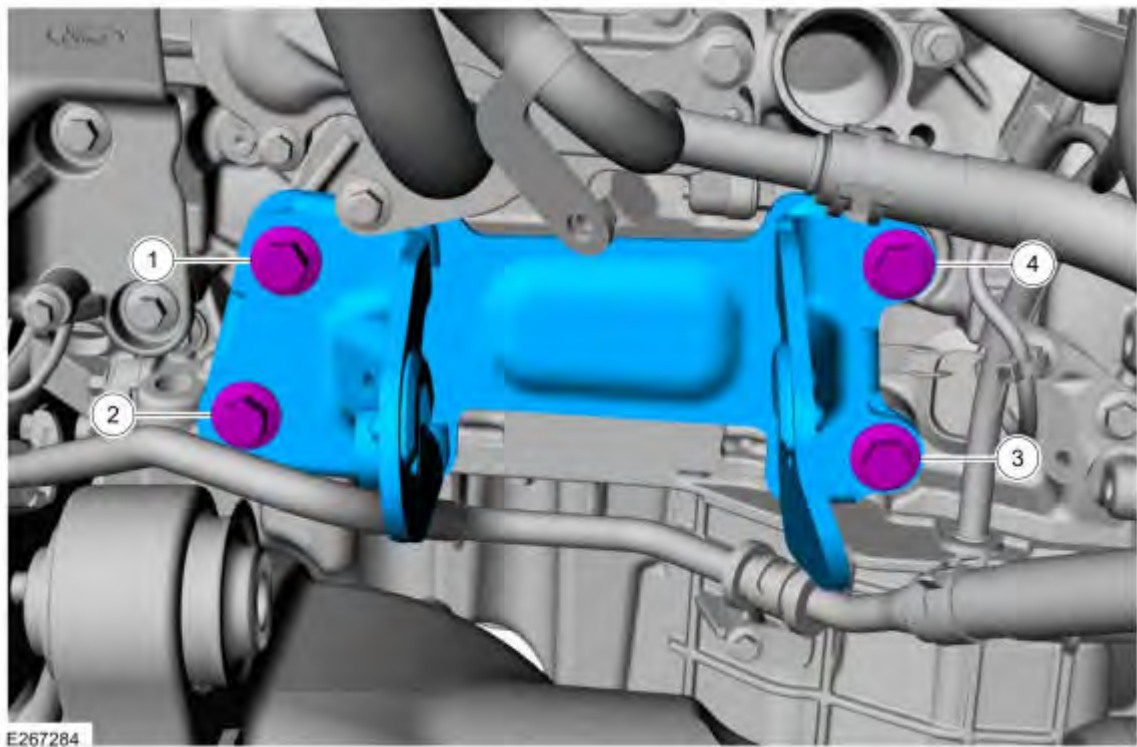


## INSTALLATION

### 4x2/4x4

1. Clean the engine mount-to-cylinder block and engine mount-to-frame mating surfaces of any dirt or foreign material prior to installation.
2. If removed, install the LH engine mount-to-cylinder block bracket and install the new bolts in the sequence shown.

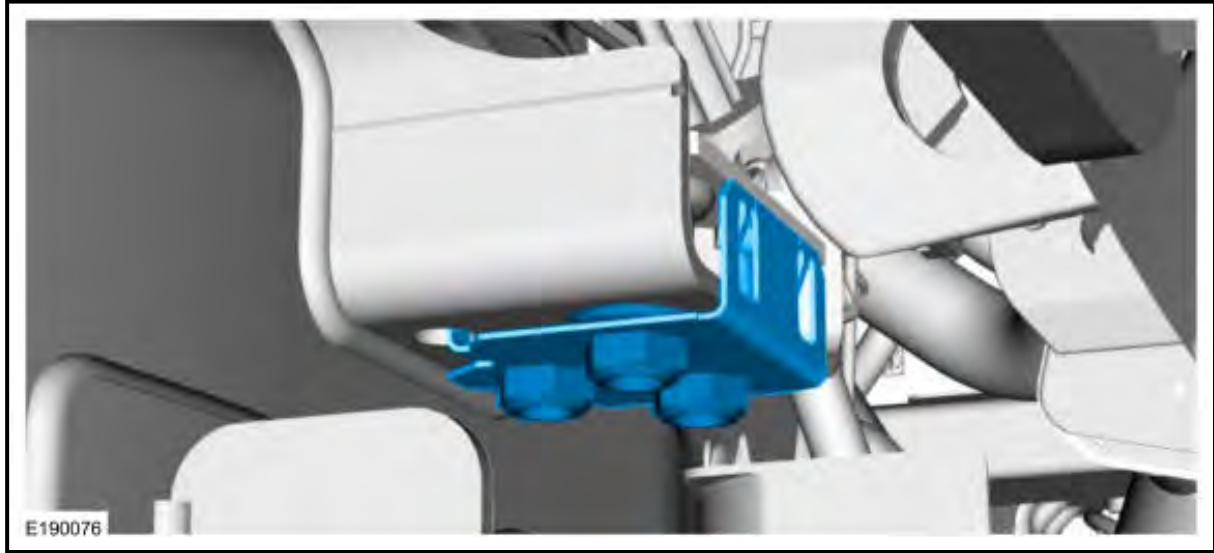
Torque: 76 lb.ft (103 Nm)



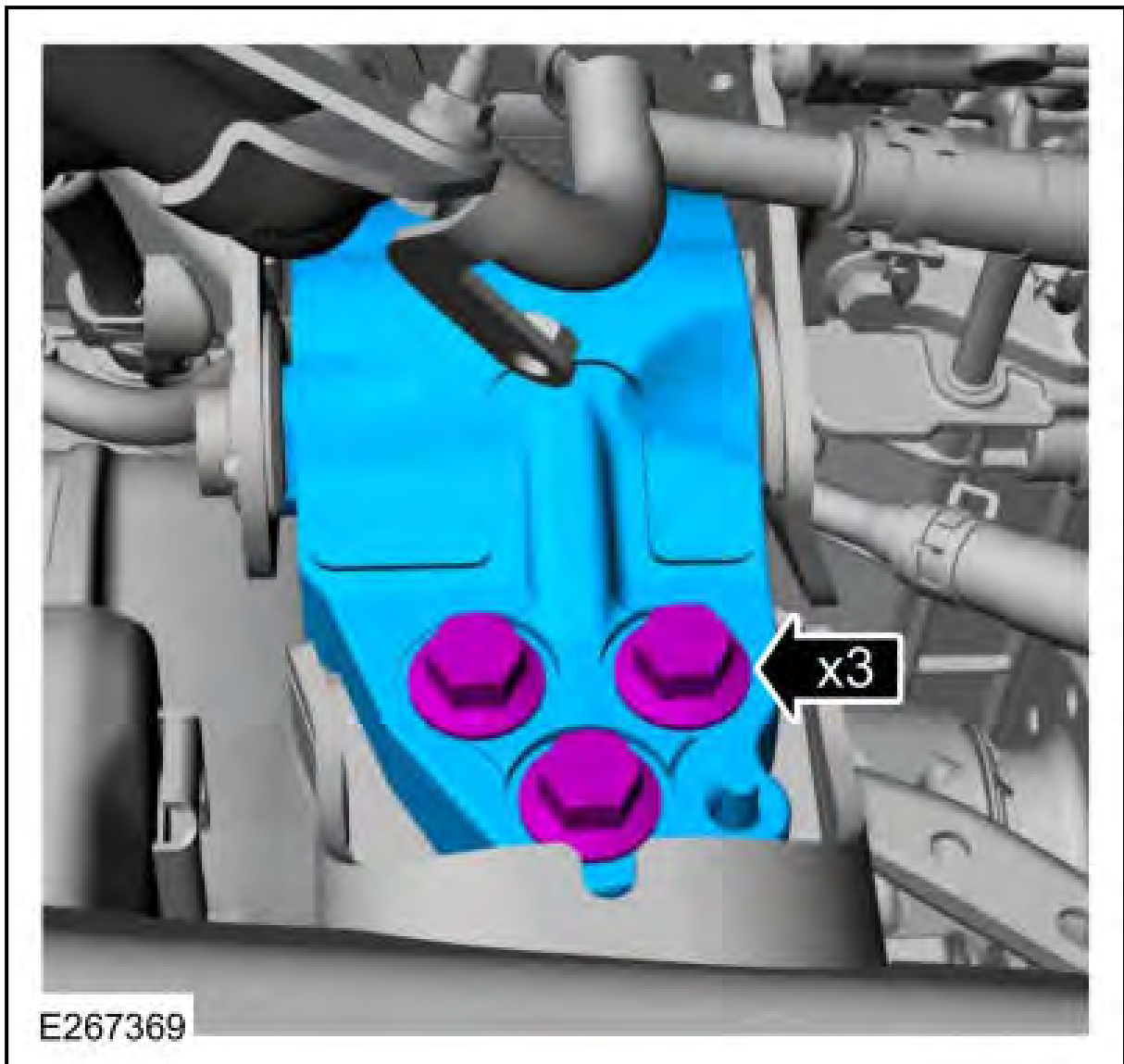
**Fig. 4: Engine Mount Bracket Tightening Sequence LH**  
Courtesy of FORD MOTOR COMPANY

3. **NOTE:** Replace the nut plate with part number W716699-S439.

If removed, install a new engine mount-to-frame nut plate.



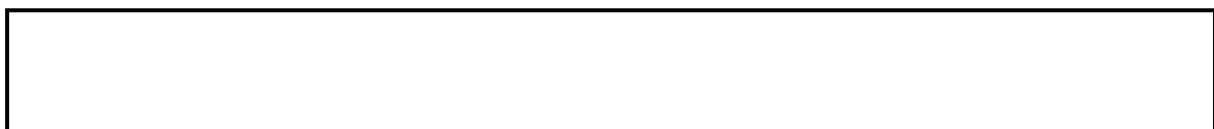
4. Position the LH engine mount and hand tighten the new engine mount-to-frame bolts.

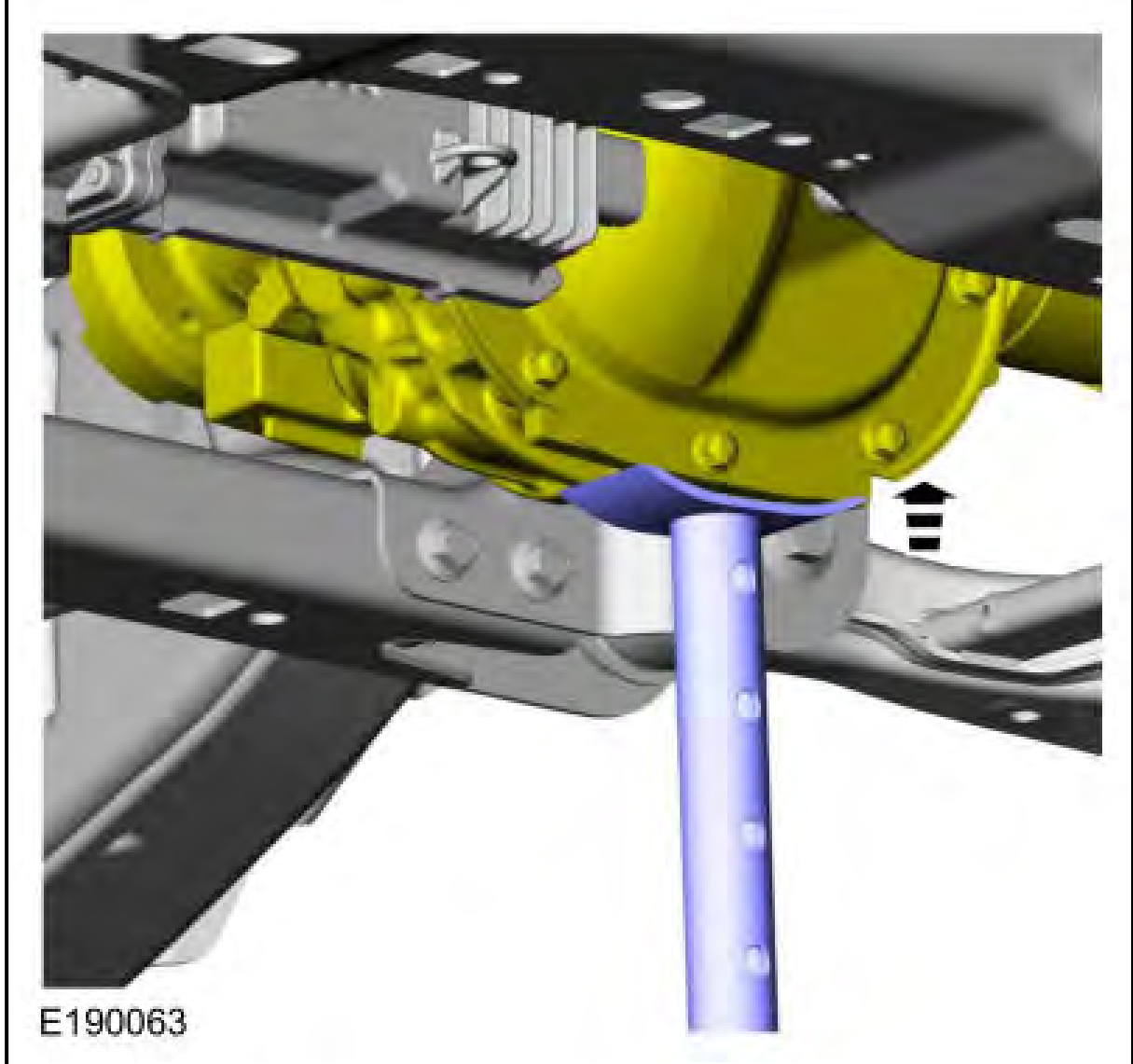


4x4

5. **NOTE:** Use care when positioning the front axle housing or the vacuum lines to the axle solenoid may become disconnected or damaged.

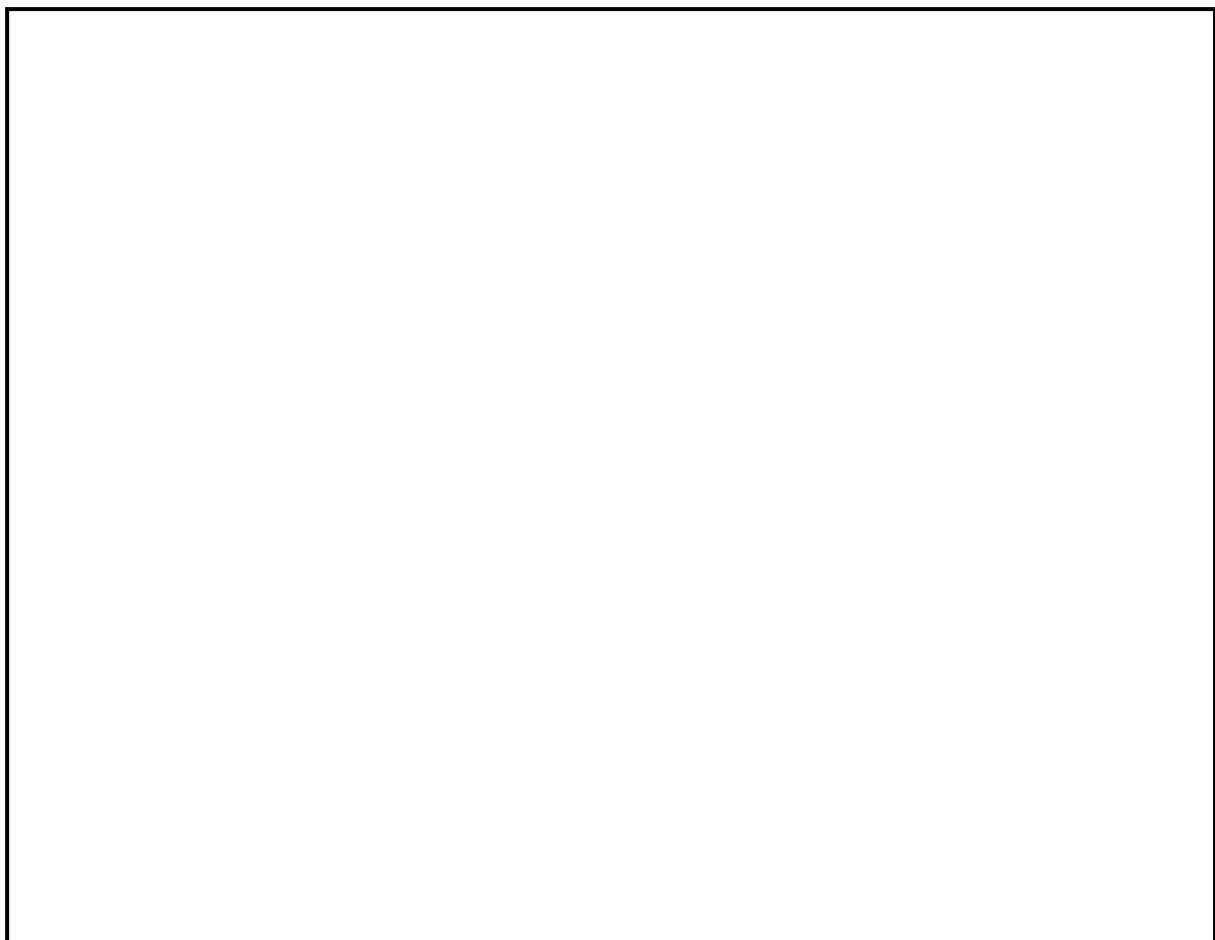
Using an adjustable stand, raise the front axle carrier into position. Use the General Equipment: Vehicle/Axle Stands

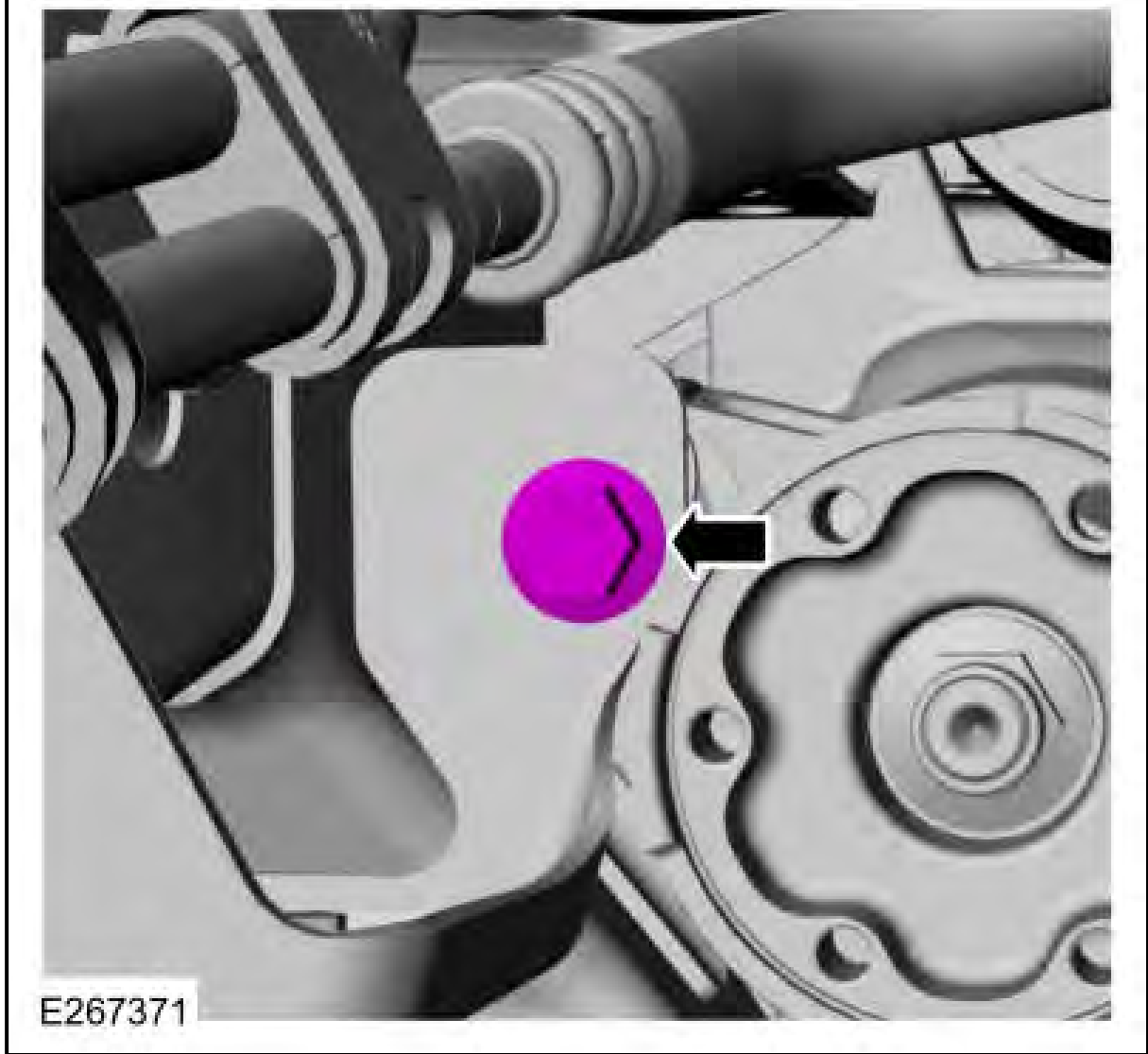




6. Install the lower front axle carrier mounting bushing bolt.

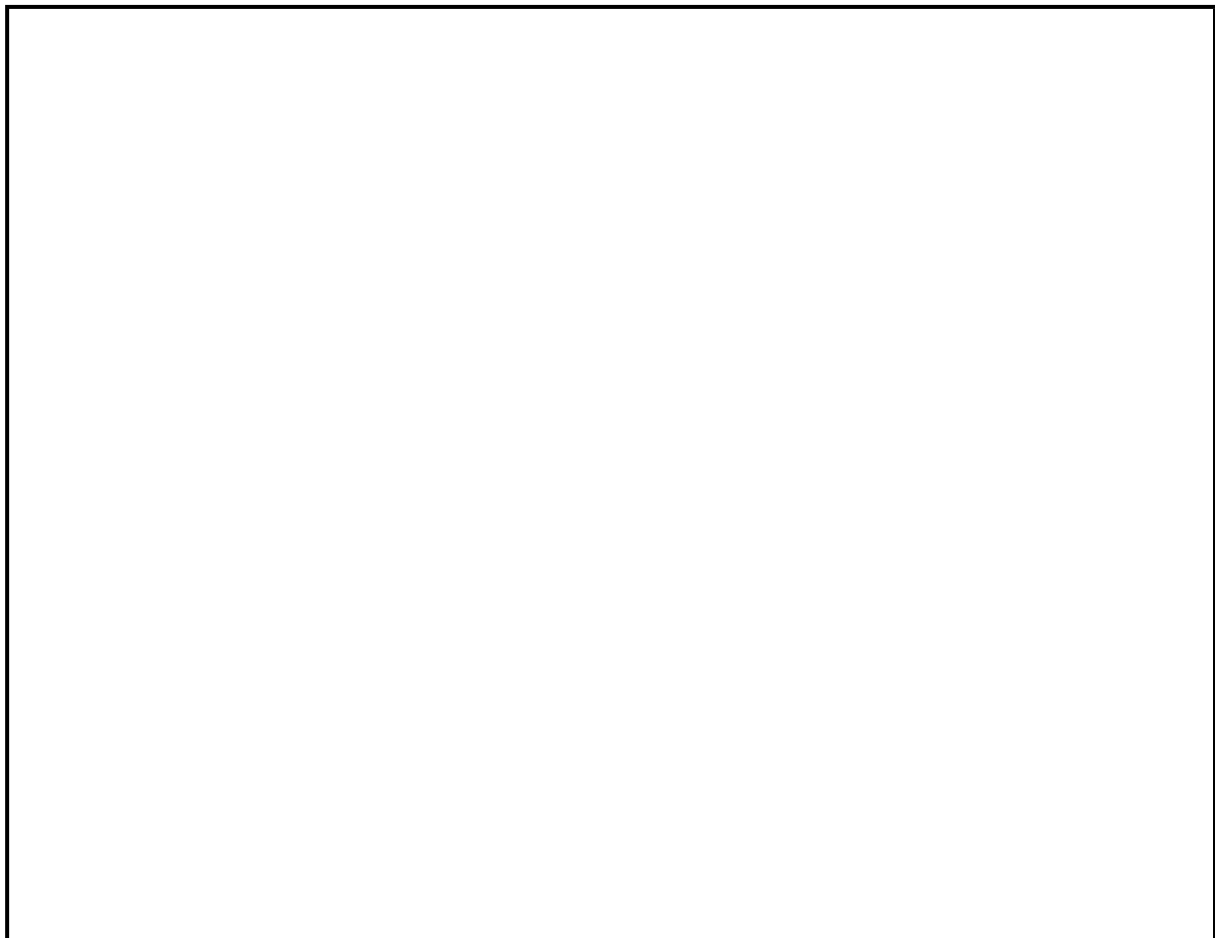
Torque: 129 lb.ft (175 Nm)

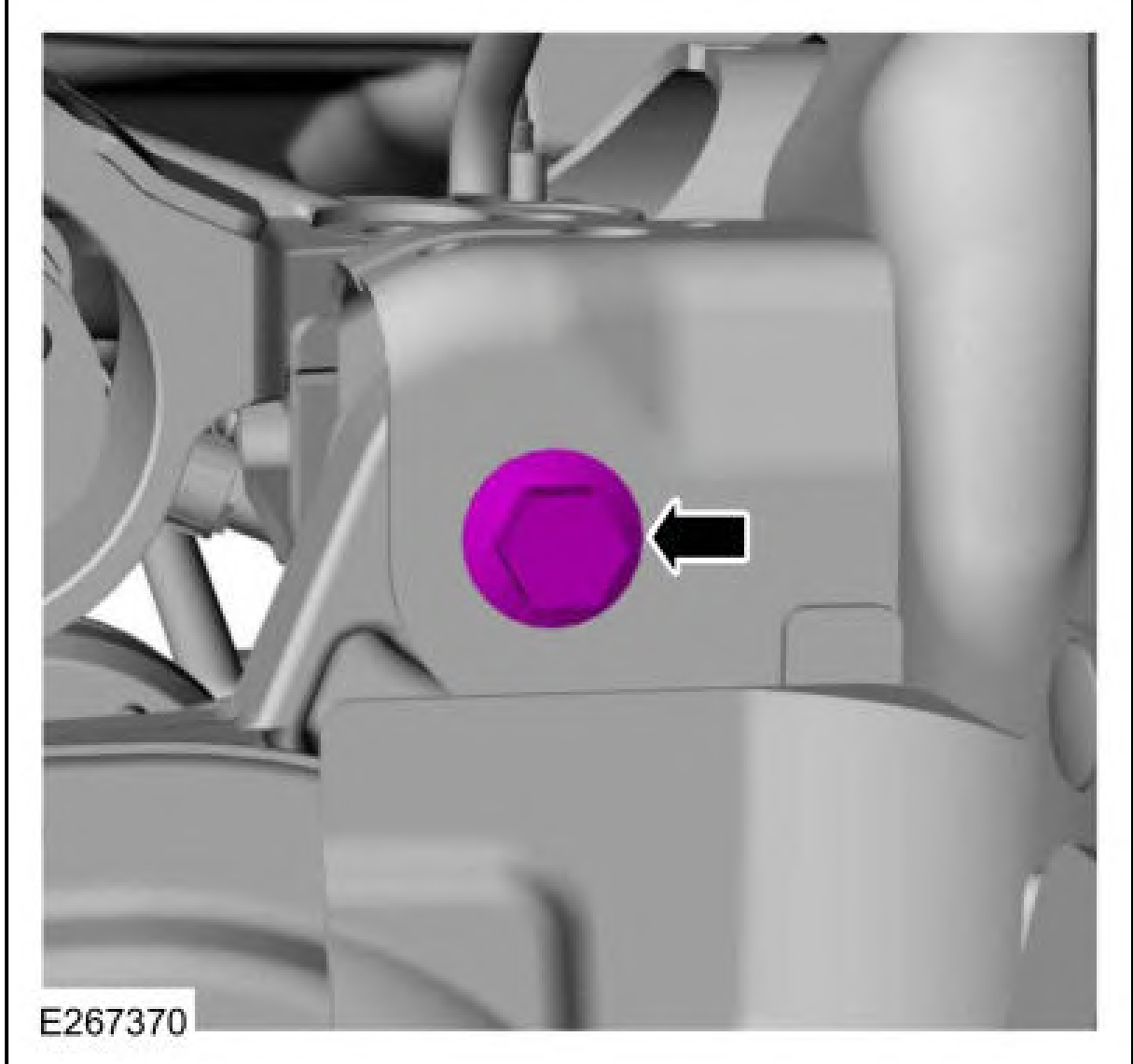




7. Install the upper front axle carrier mounting bushing bolt.

Torque: 111 lb.ft (150 Nm)

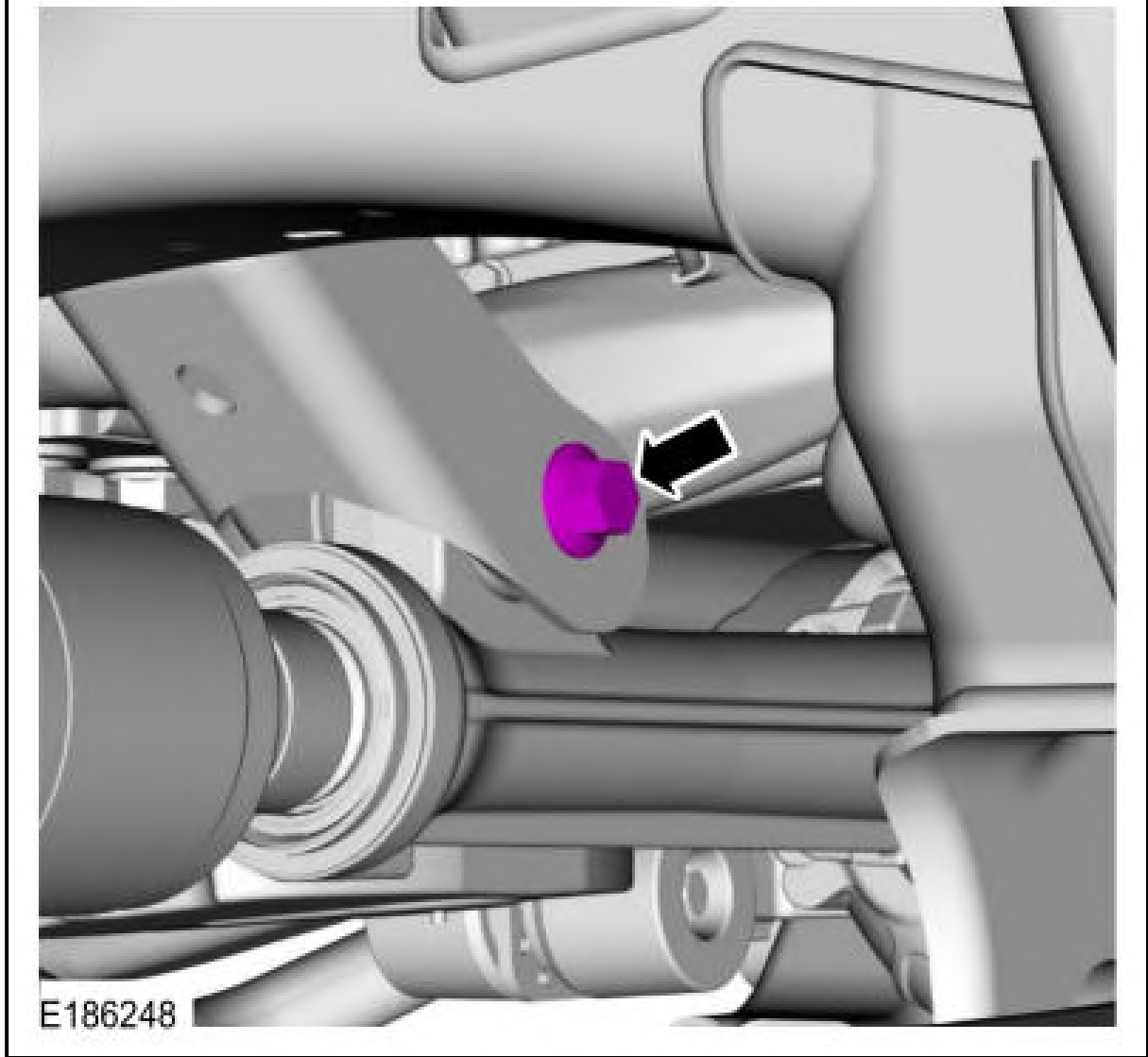




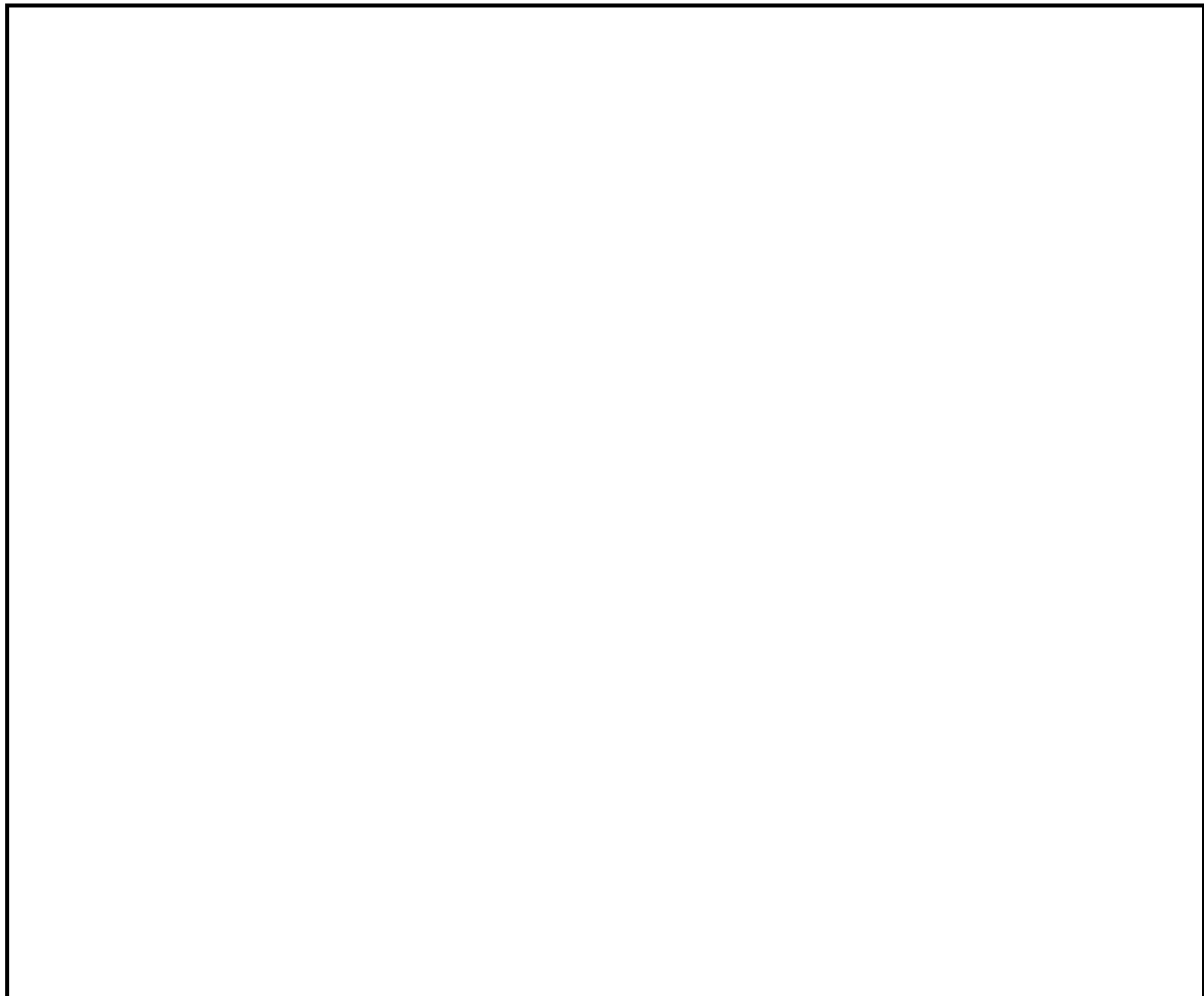
8. Install the axle shaft housing carrier bushing bolt.

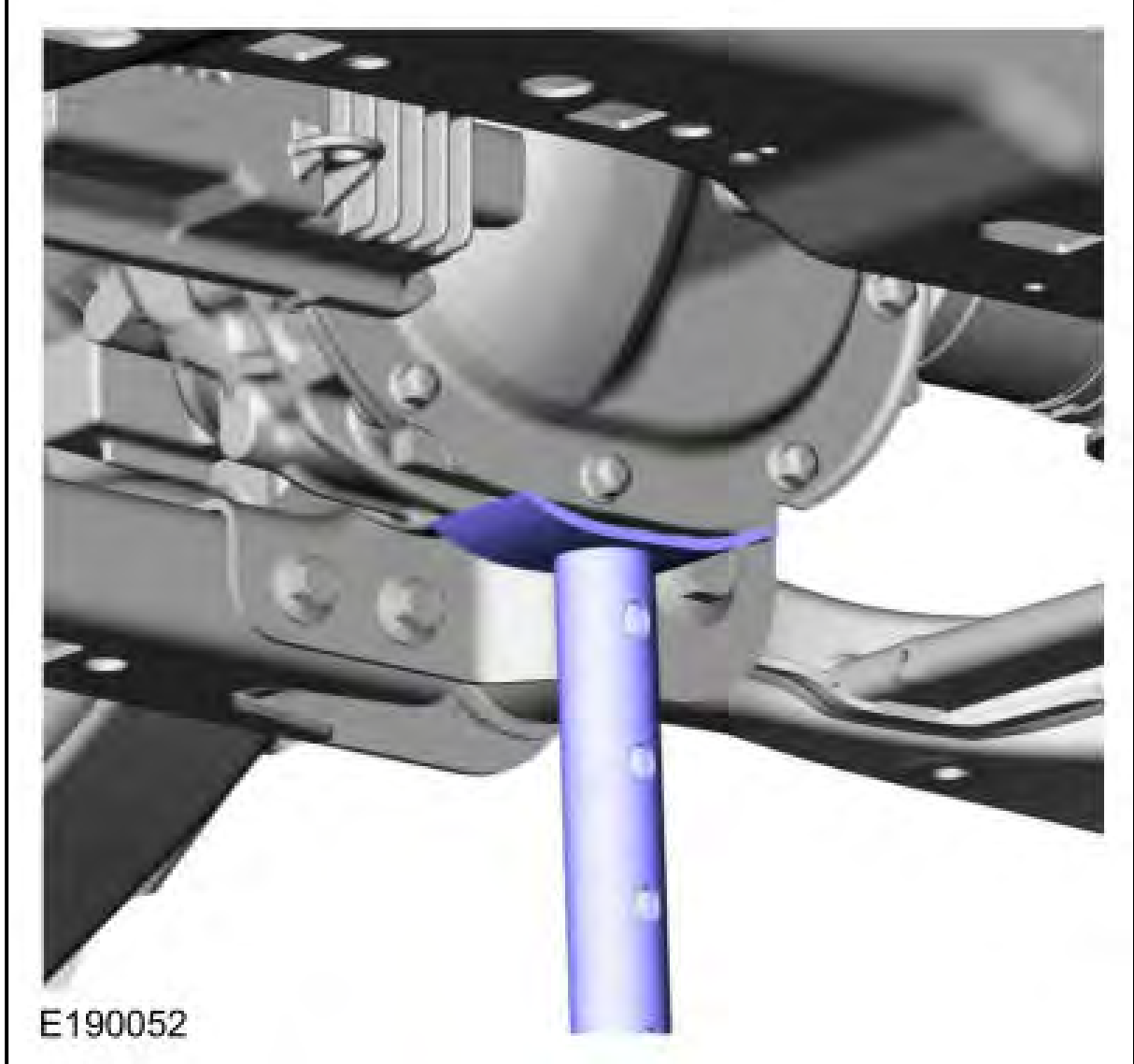
Torque: 111 lb.ft (150 Nm)





9. Remove the adjustable stand. Use the General Equipment: Vehicle/Axle Stands



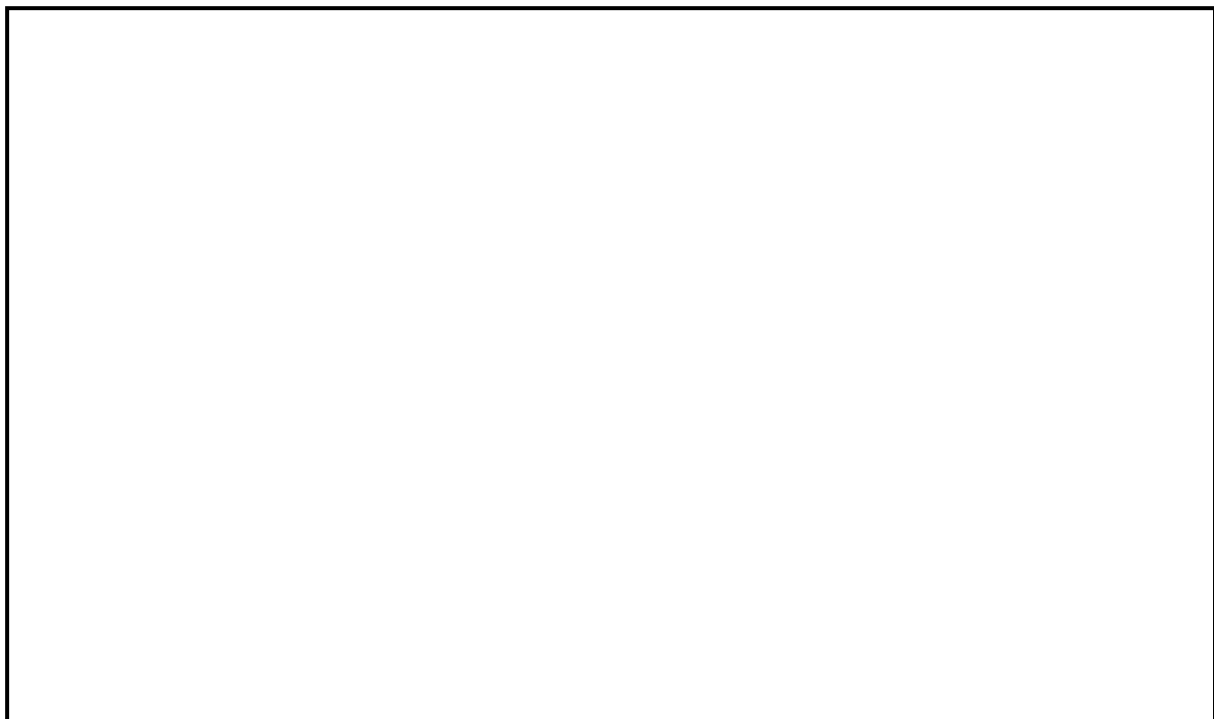


4x2/4x4

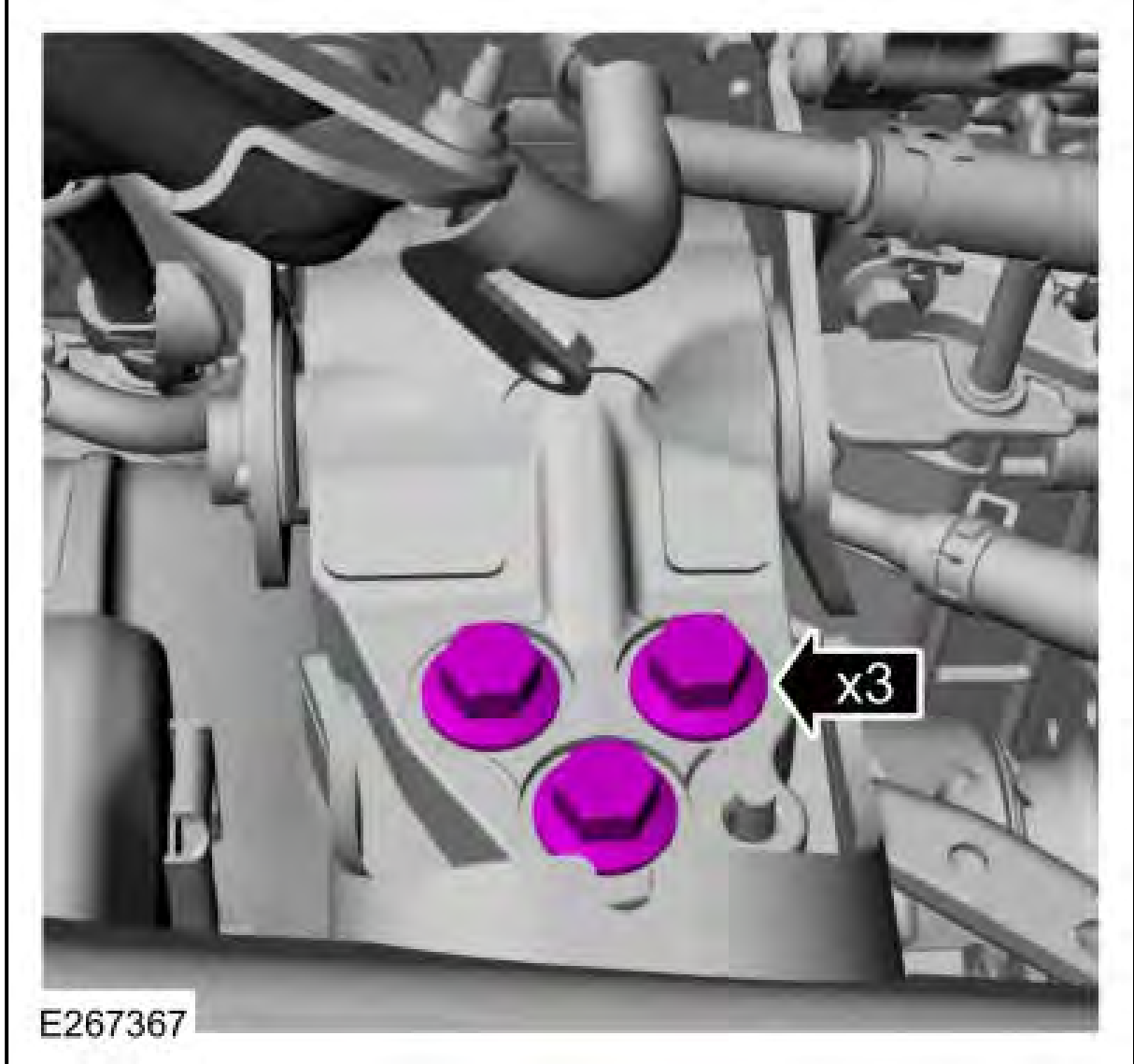
10. **NOTE:** Only use hand tools when removing or installing the engine mount-to-frame bolts or damage to the engine mount-to-frame nut plate can occur.

Torque the LH engine mount-to-frame bolts.

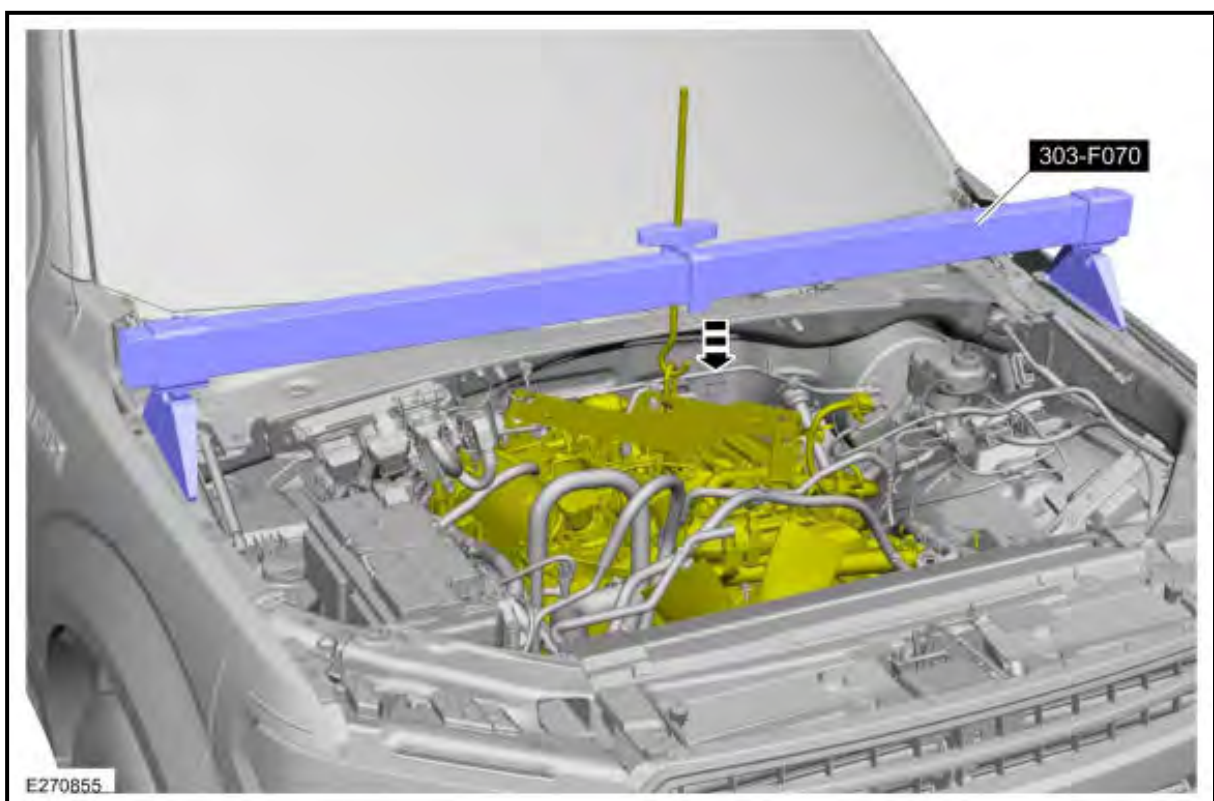
Torque: 129 lb.ft (175 Nm)







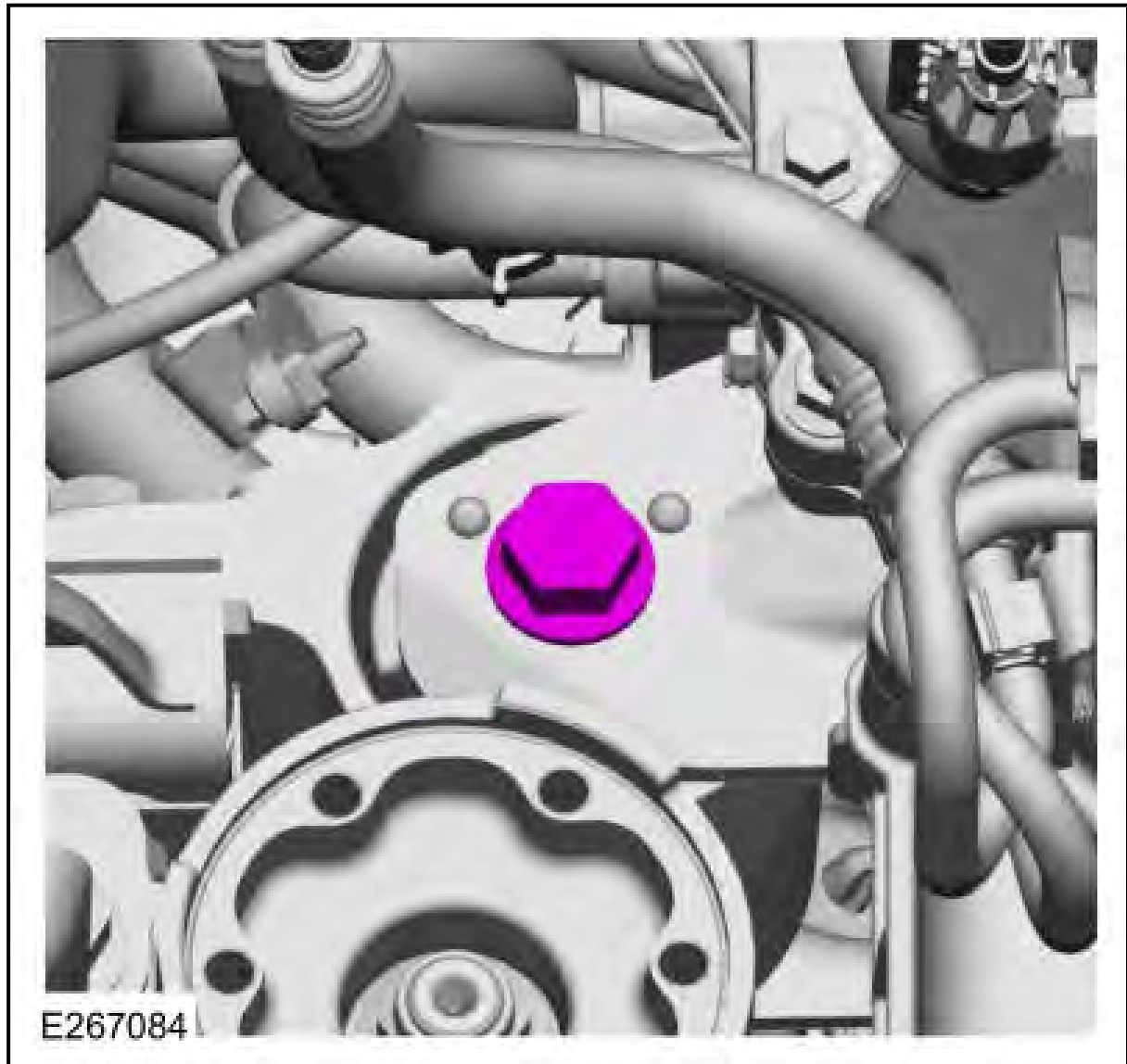
11. Lower the engine to the installed position. Use Special Service Tool: 303-F070 Support Bar, Engine.



12. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

Install the new LH engine mount through bolt.

Torque: 258 lb.ft (350 Nm)

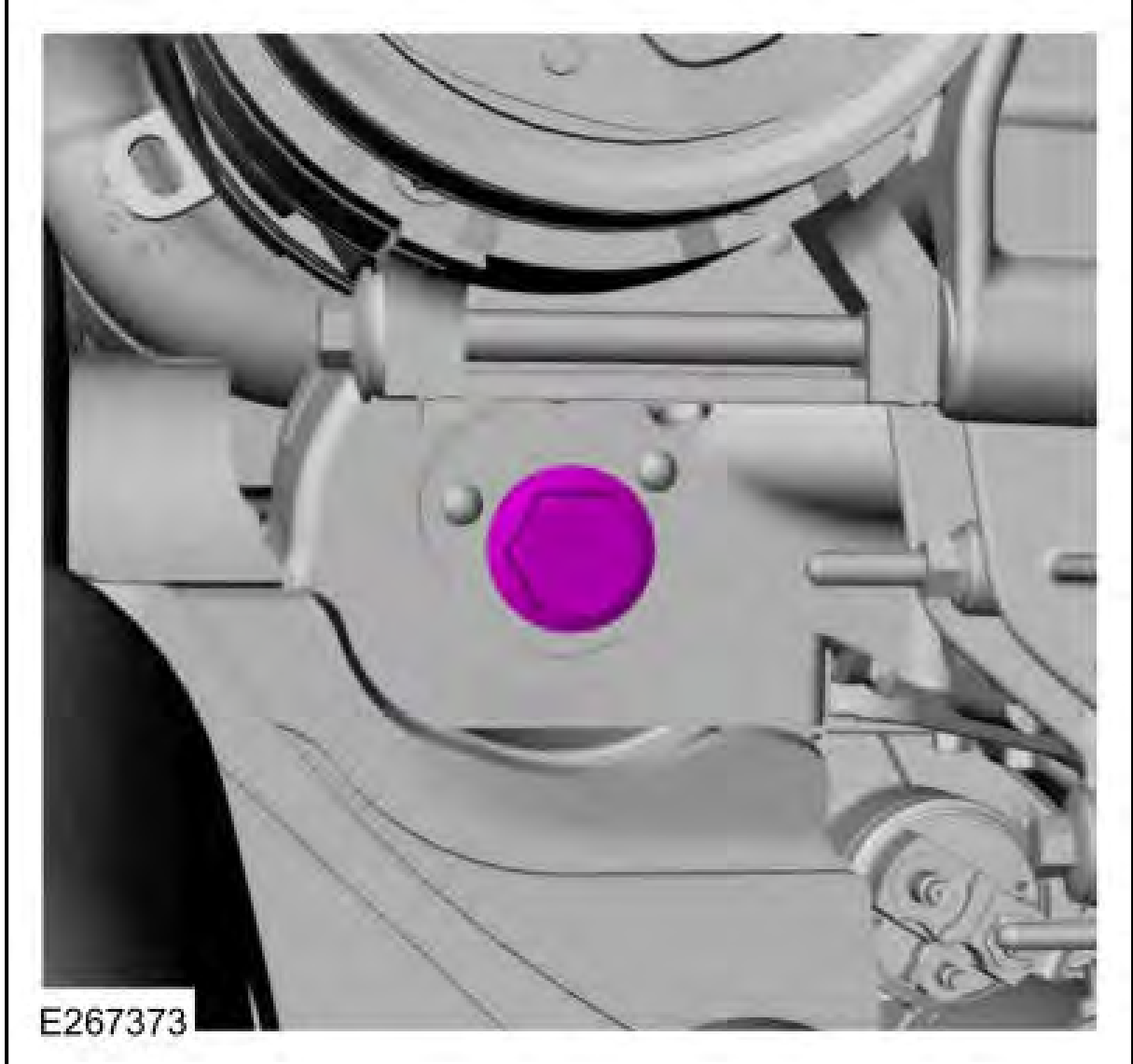


13. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

Install the new RH engine mount through bolt.

Torque: 258 lb.ft (350 Nm)



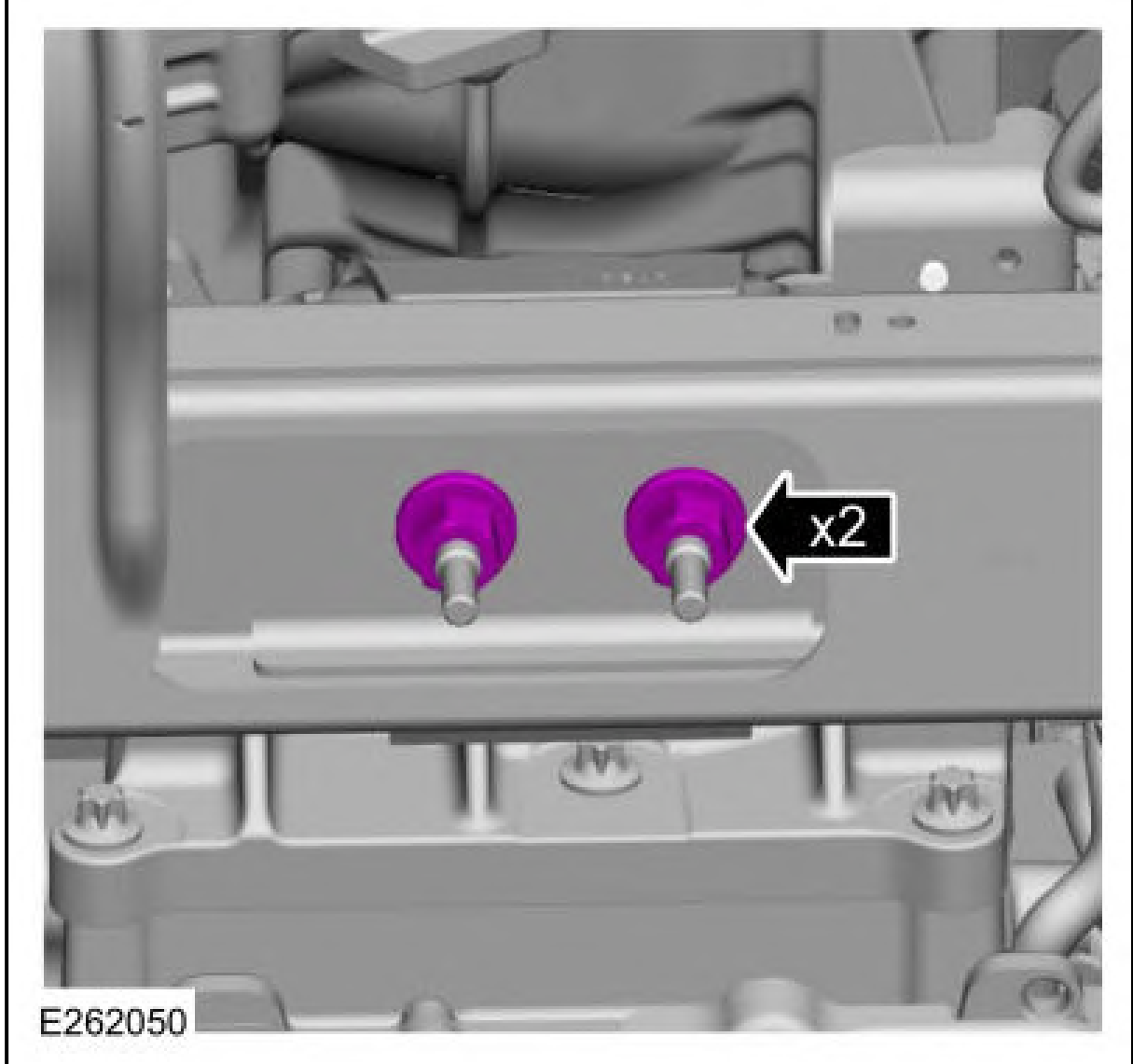


14. **NOTE:** Only use hand tools when loosening or tightening the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.

Remove and discard the transmission mount-to-crossmember nuts. Install new transmission mount-to-crossmember nuts.

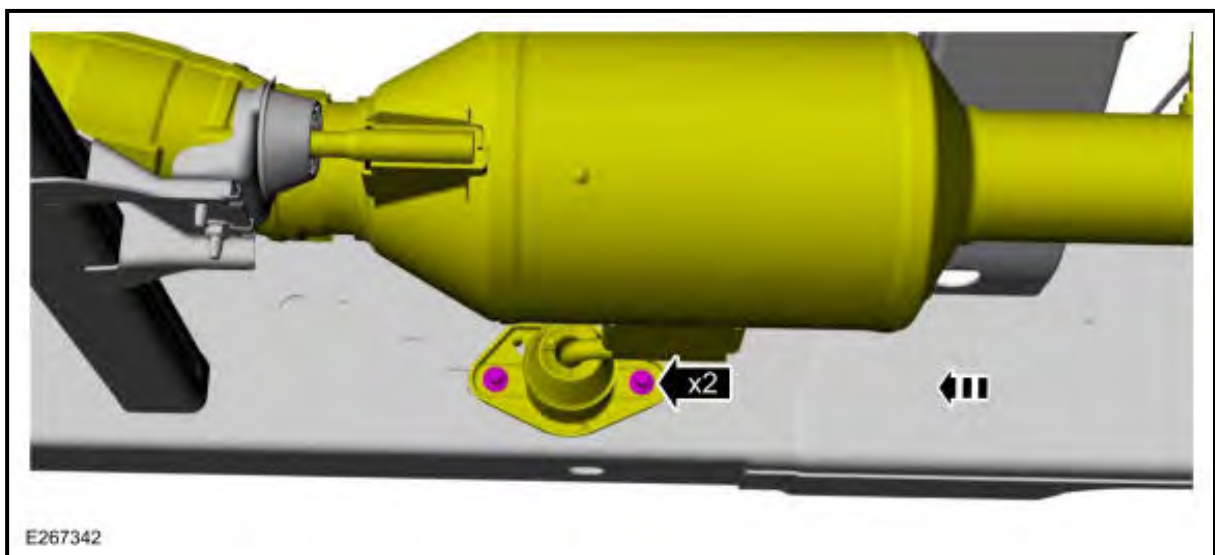
Torque: 85 lb.ft (115 Nm)





15. Position back the exhaust system and install the bolts.

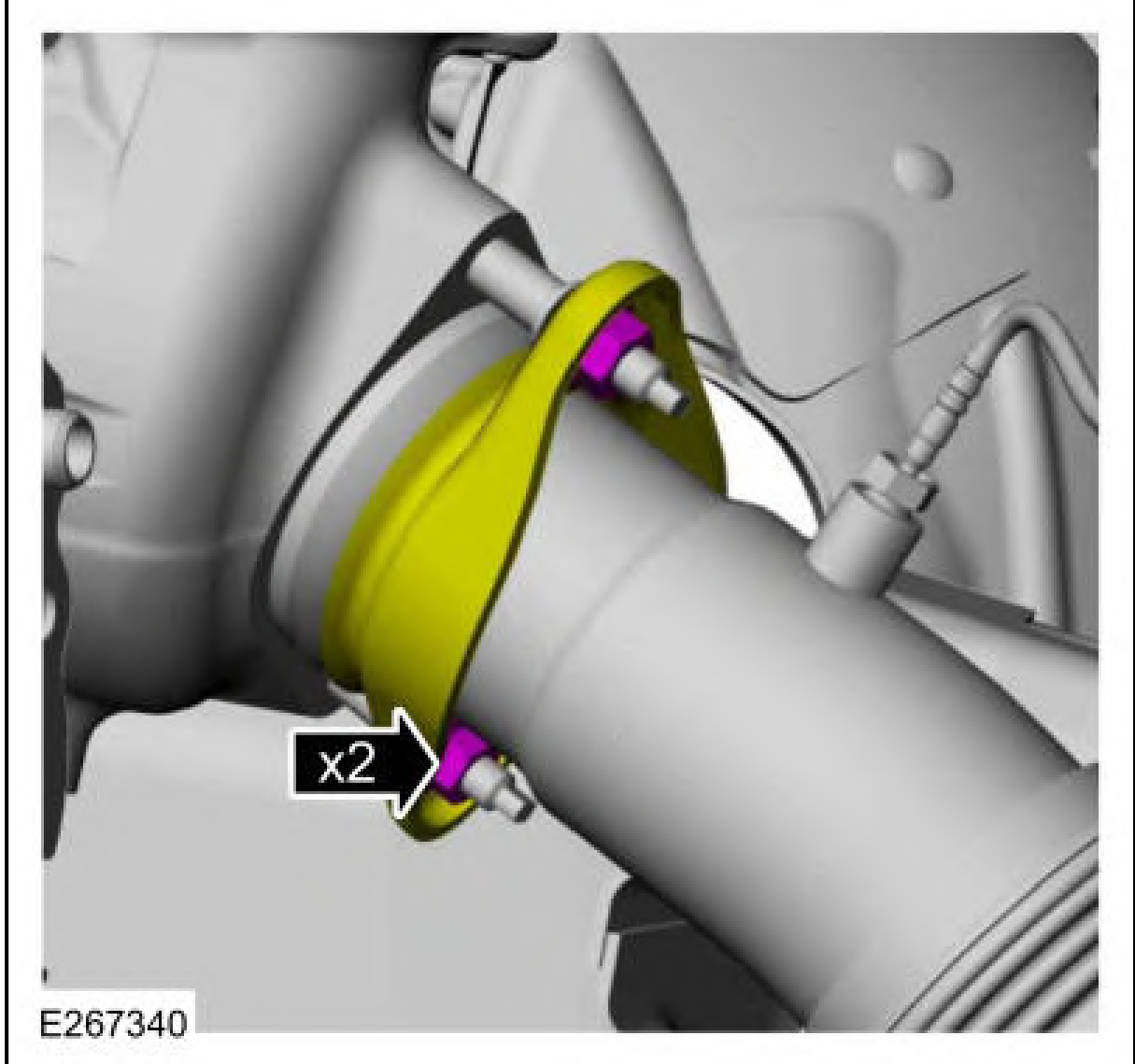
Torque: 22 lb.ft (30 Nm)



16. Install the new turbocharger flange nuts.

Torque: 30 lb.ft (40 Nm)

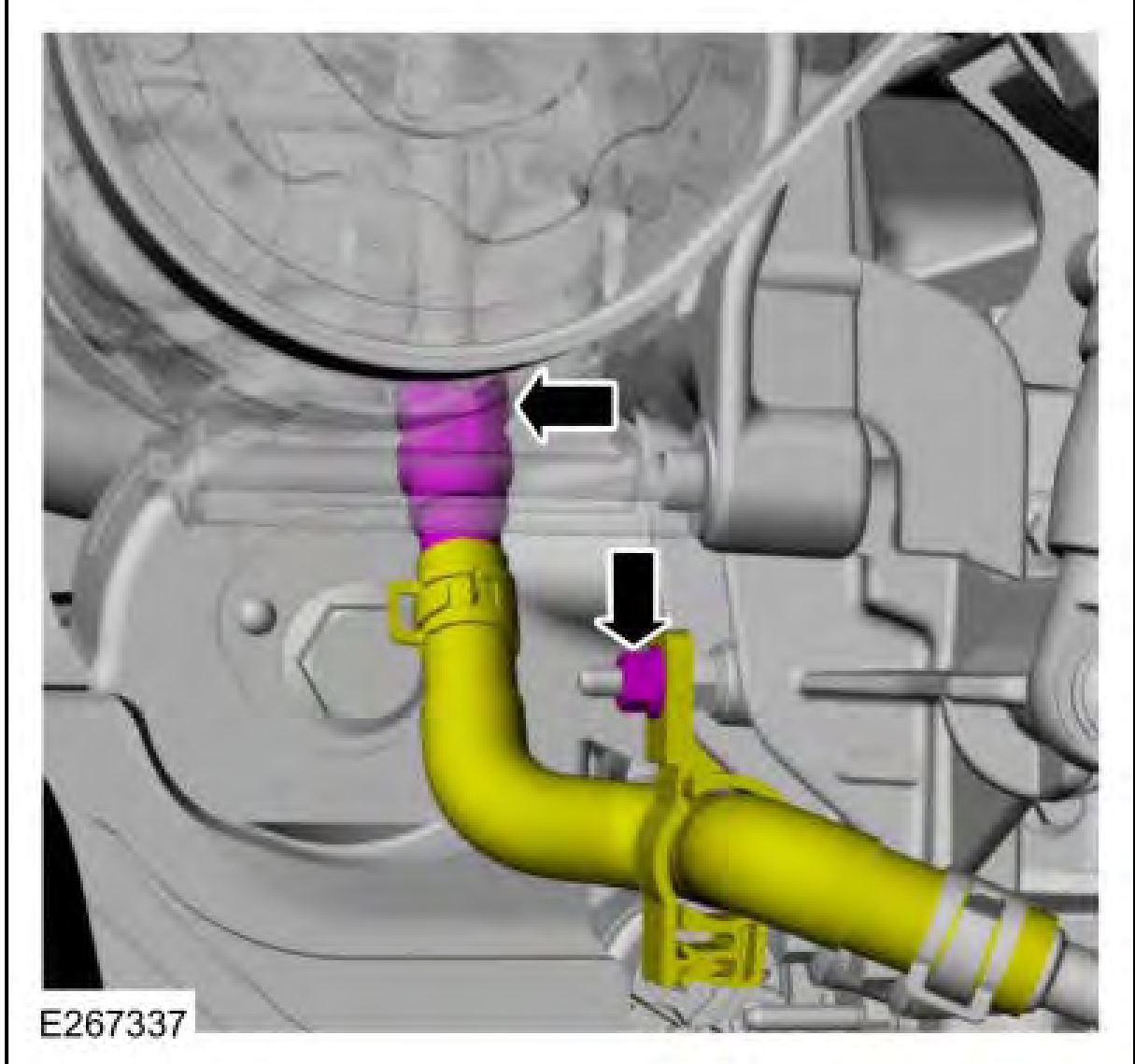




17. If equipped, install the front driveshaft. REFER to: [Front Driveshaft](#) .
18. Connect the RH side coolant hose. Position back the coolant hose and install the nut.

Torque: 106 lb.in (12 Nm)

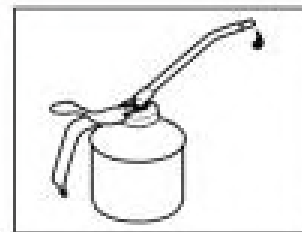




19. Install the new O-ring seal on the lower radiator coolant tube. Apply coolant to the O-ring seal.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)





E267083

20. **NOTE:** Apply coolant to the coolant connector opening before installing the tube.

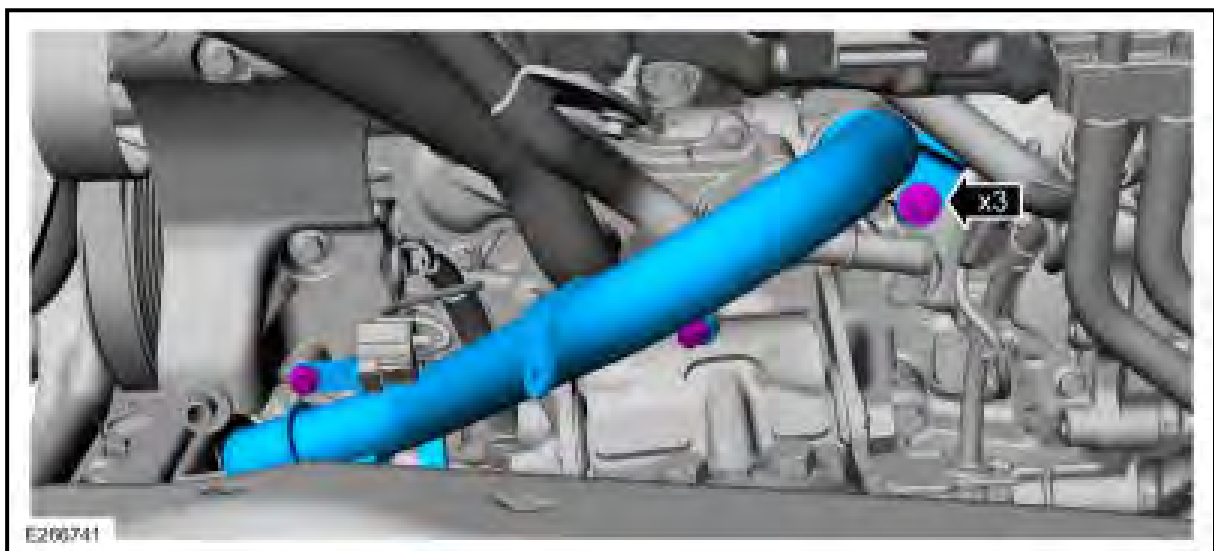
Install the lower radiator coolant tube and the bolts.

Material: Motorcraft  $\hat{A}$ ® Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

Torque:

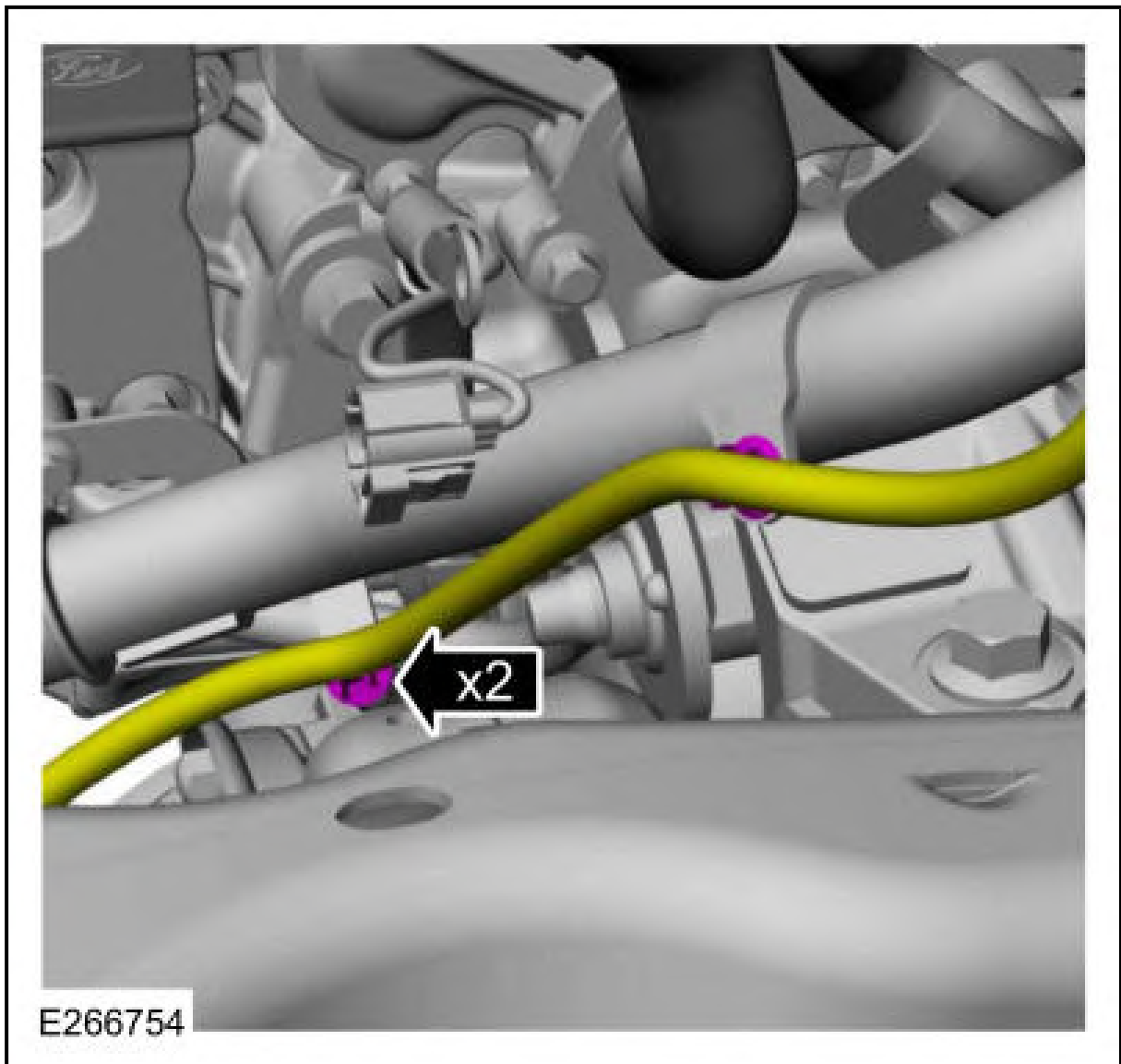
M8 bolt : 18 lb.ft (25 Nm)

M6 bolt : 71 lb.in (8 Nm)



E266741

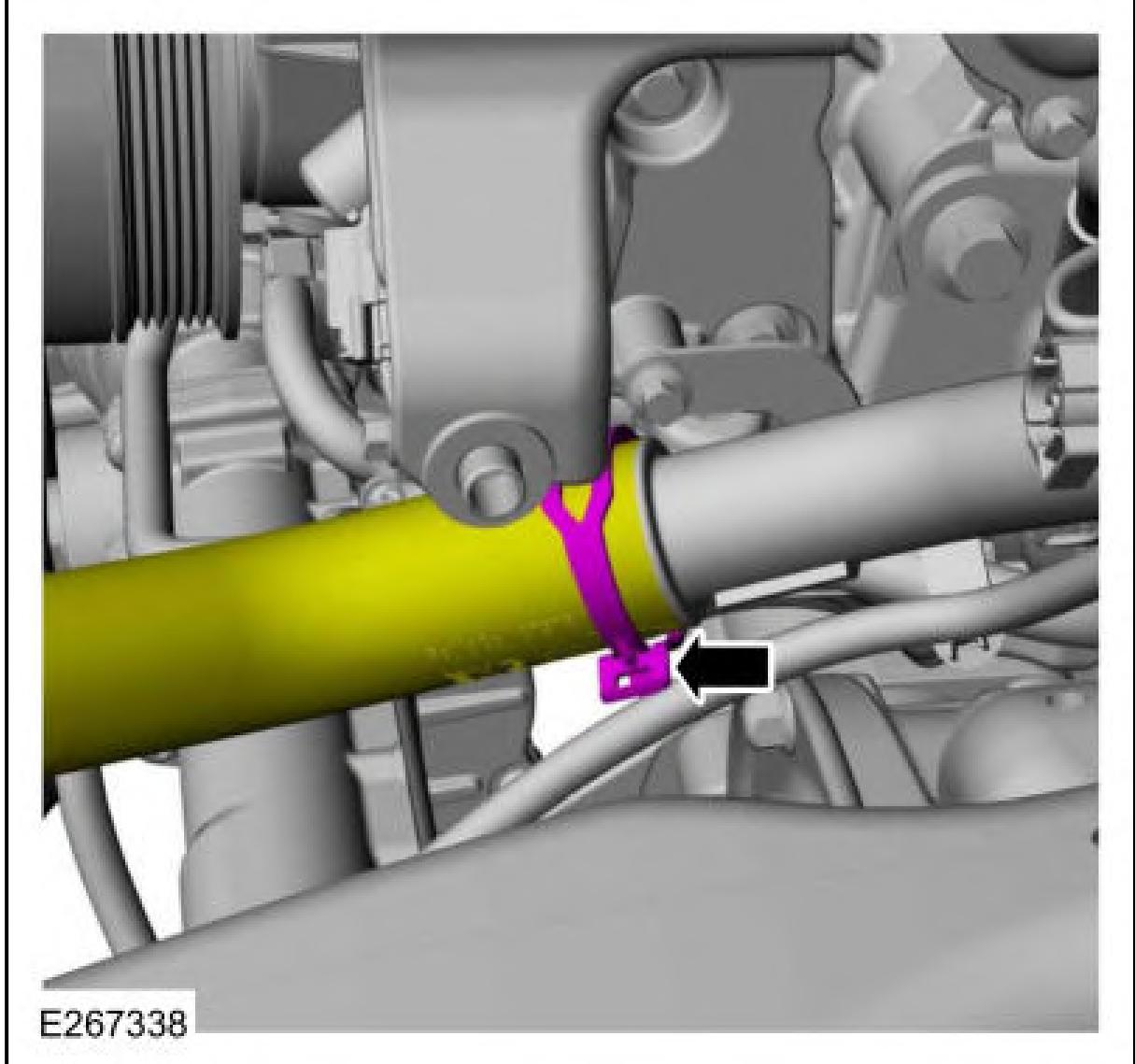
21. If equipped. Connect the block heater cord retainers.



22. Connect the lower radiator hose to the lower radiator coolant tube.

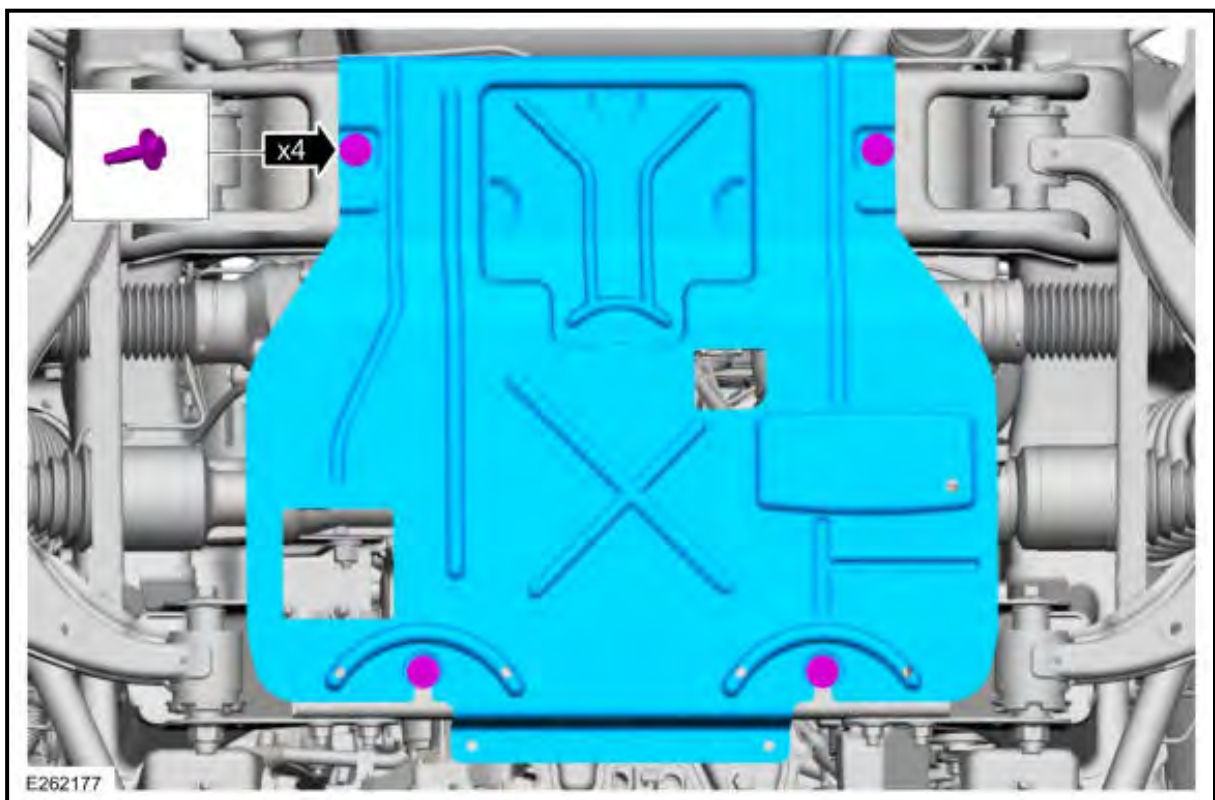






23. If equipped, install the skid plate and the bolts.

Torque: 30 lb.ft (40 Nm)

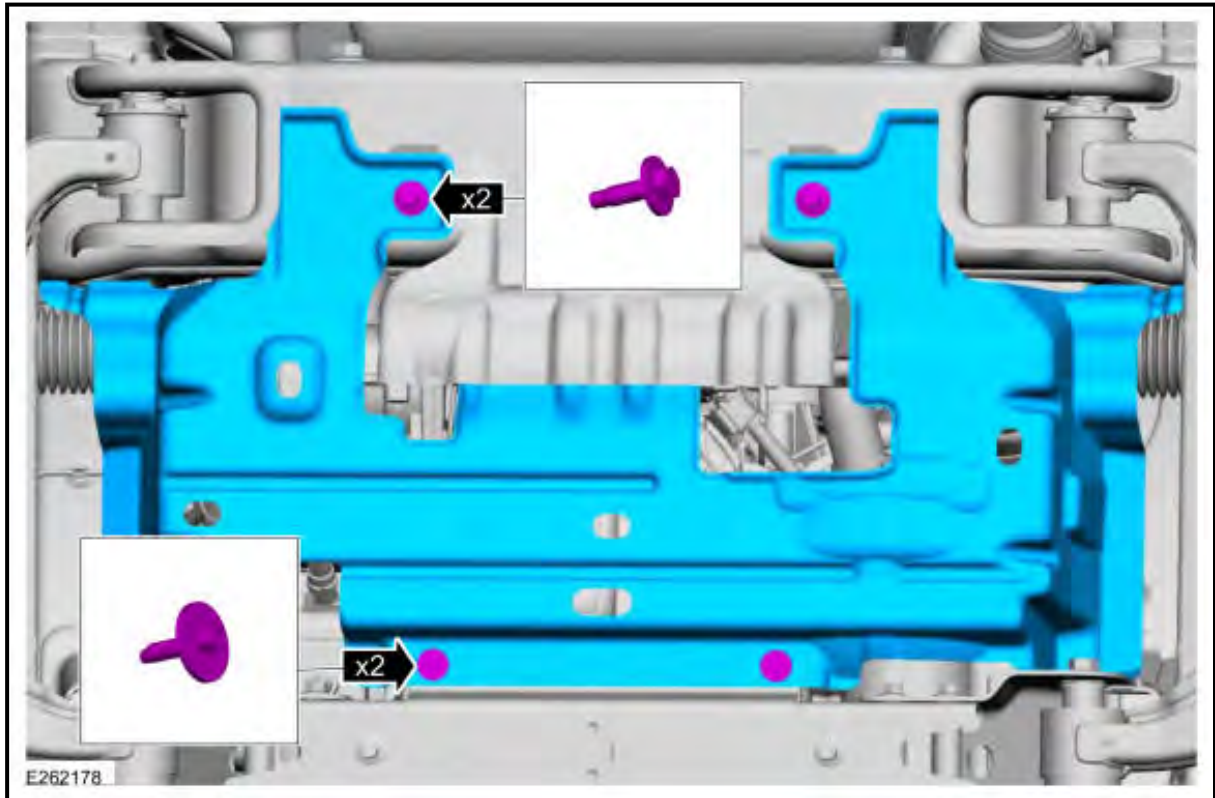


24. If equipped, install the underbody shield and the bolts.

Torque:

M8 bolt : 30 lb.ft (40 Nm)

M6 bolt : 71 lb.in (8 Nm)



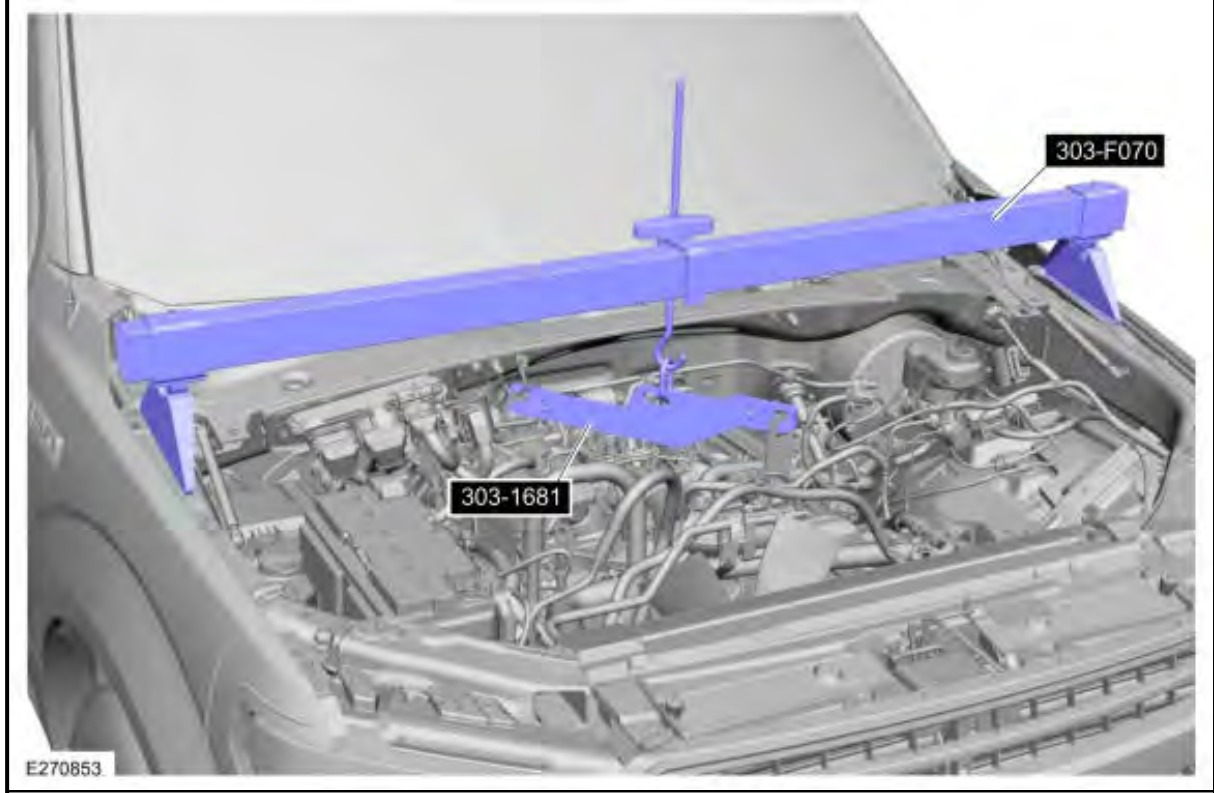
25. Install the transmission housing cover and the bolts. Install the retainer.

Torque: 71 lb.in (8 Nm)

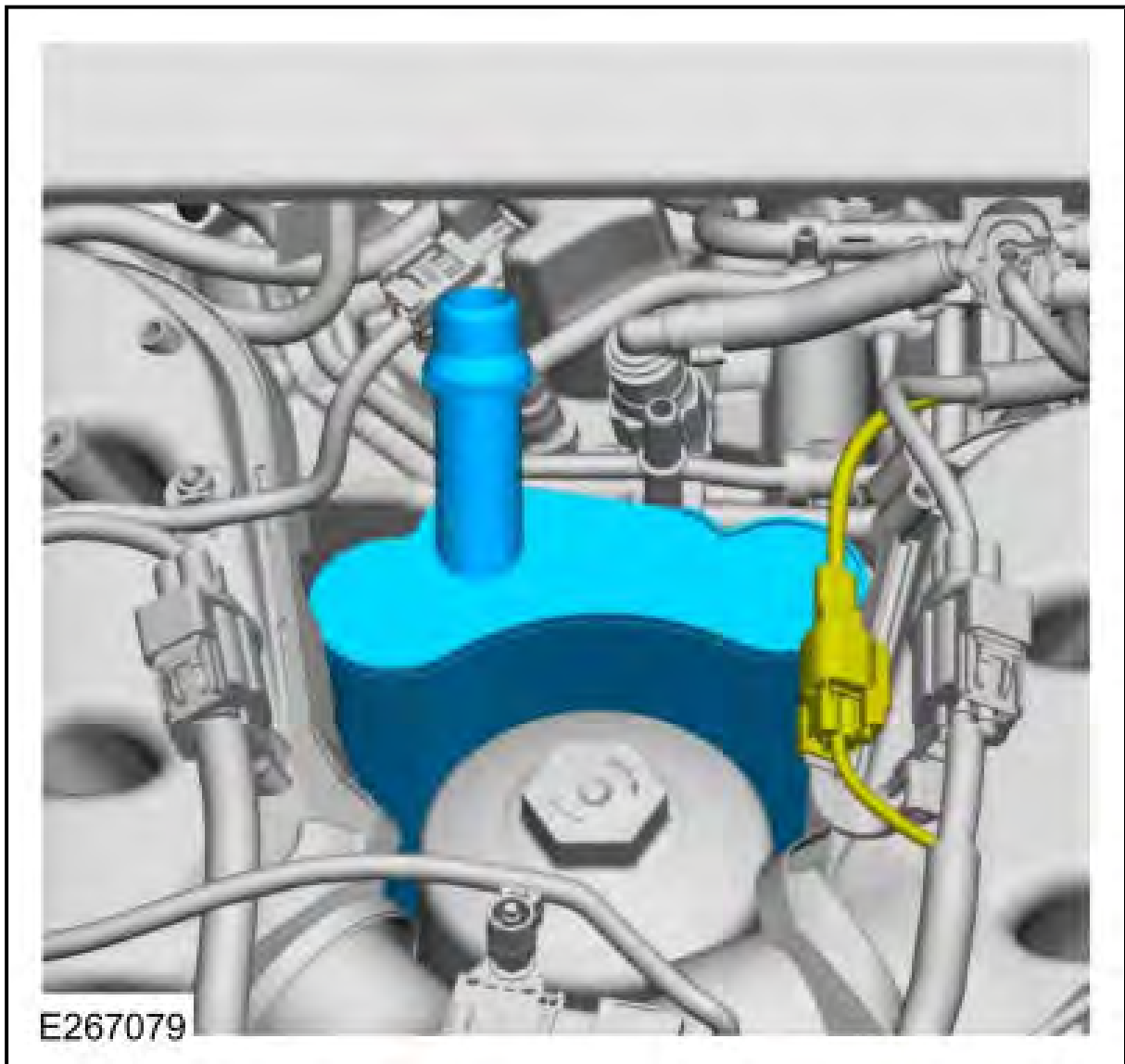


26. Remove Special Service Tool: 303-1681 Spreader Bar. , 303-F070 Support Bar, Engine.



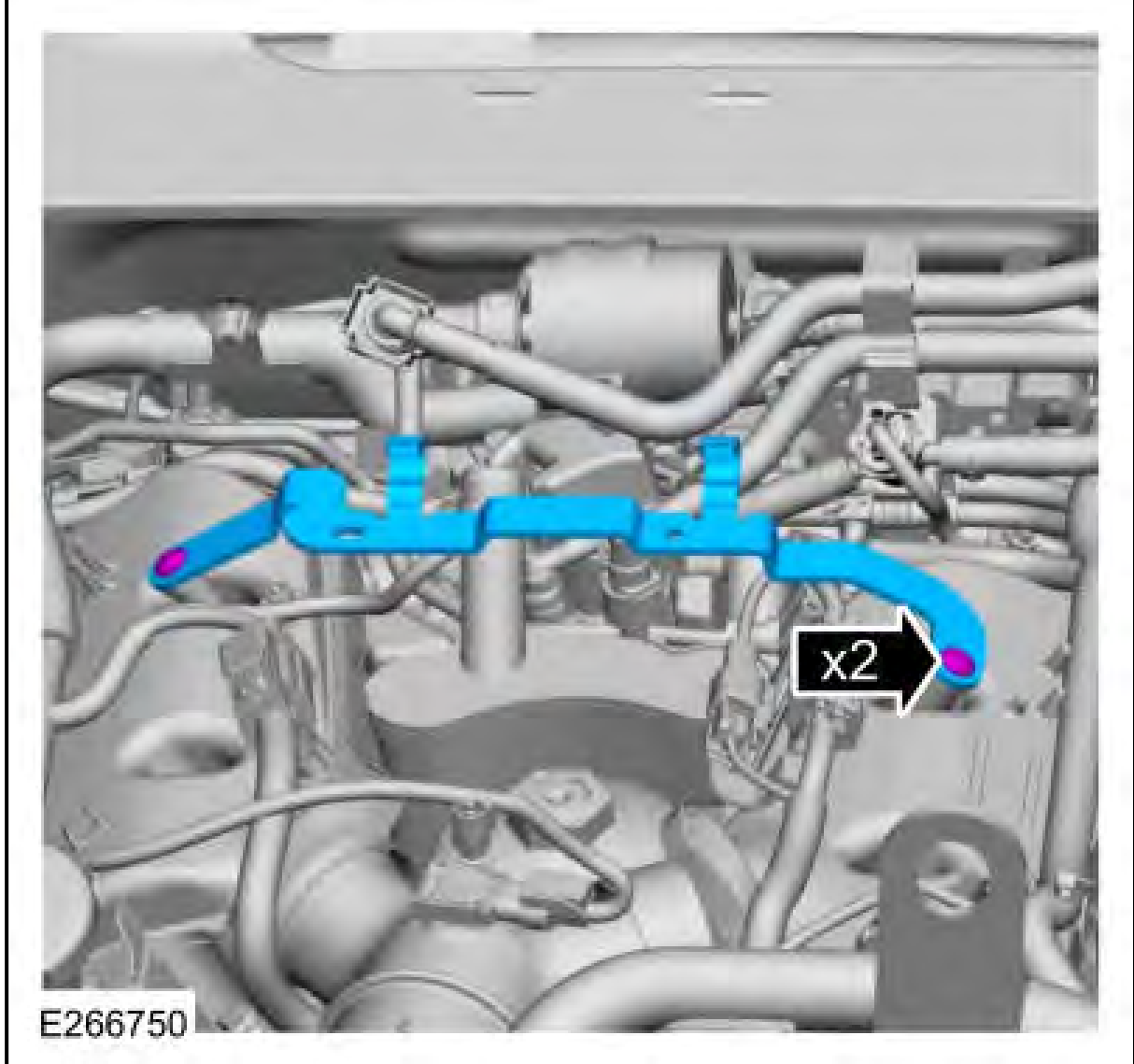


27. Install the crankcase vent oil separator and position back the wiring.



28. Install the engine appearance cover bracket.

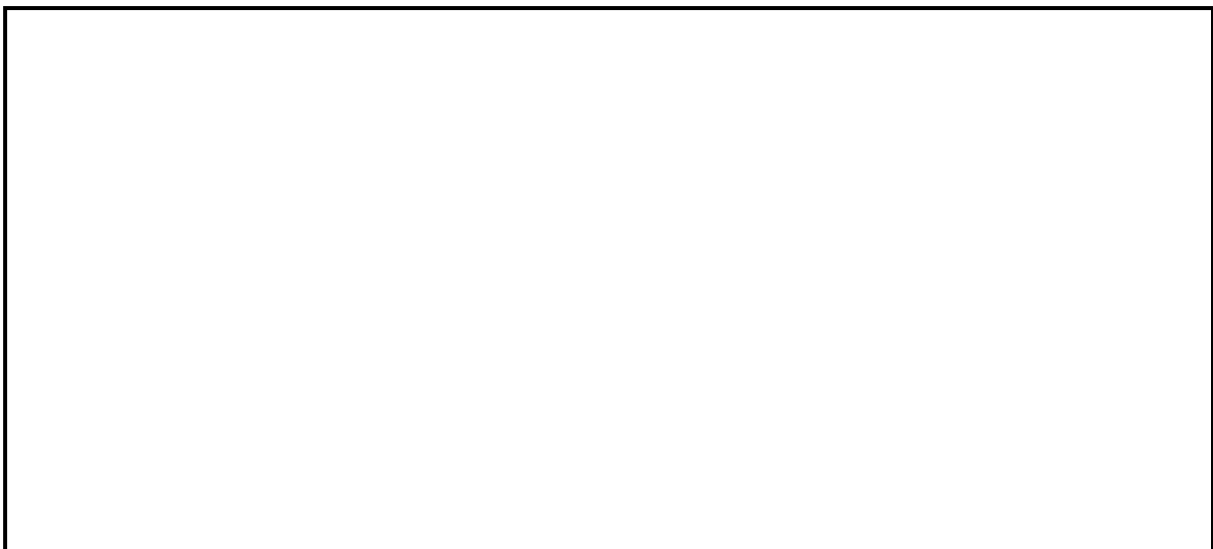
Torque: 44 lb.in (5 Nm)

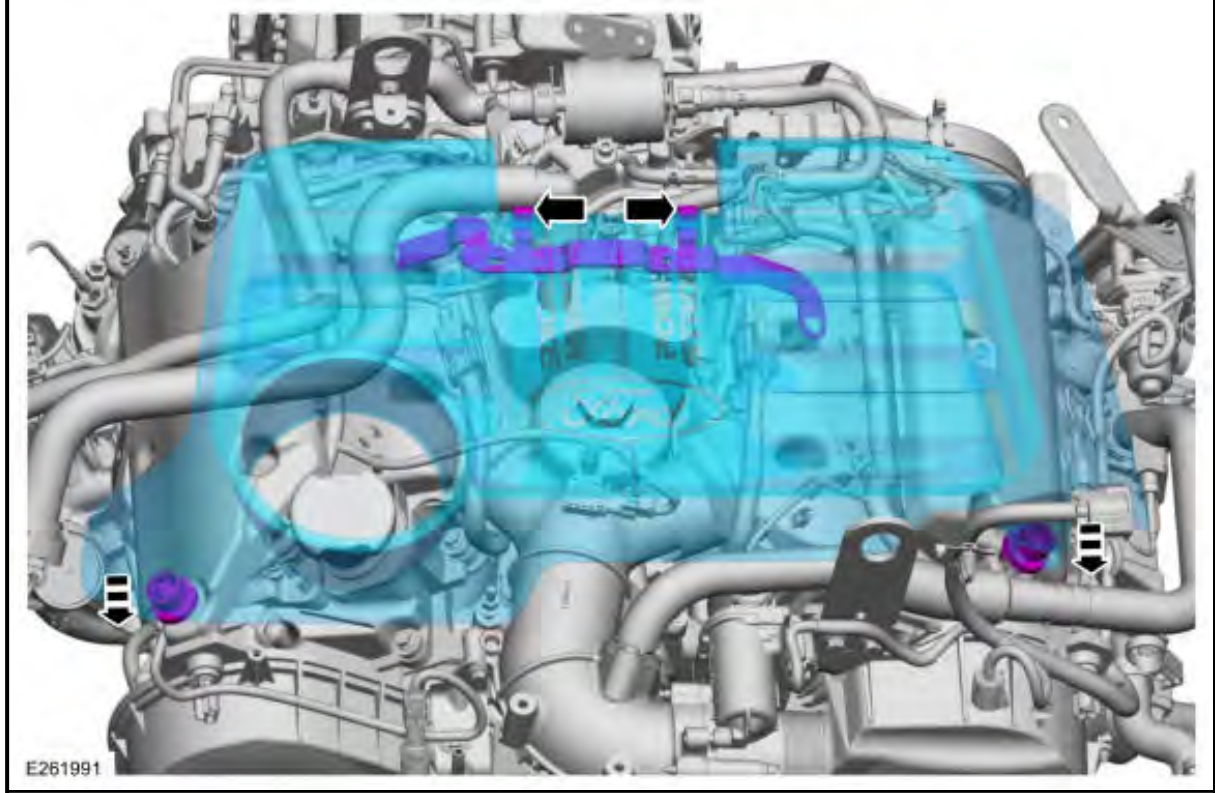


29. Install the following items:

1. Install the cooling fan upper shroud. REFER to: [Cooling Fan Upper Shroud](#) .
2. Install the generator. REFER to: [Generator - 3.0L Power Stroke Diesel](#) .
3. Install the CAC outlet pipe. REFER to: [Charge Air Cooler \(CAC\) Outlet Pipe](#) .
4. Install the CAC intake pipe. REFER to: [Charge Air Cooler \(CAC\) Intake Pipe](#) .
5. Install the air cleaner outlet tube. REFER to: [Air Cleaner Outlet Pipe](#) .
6. Install the air cleaner. REFER to: [Air Cleaner](#) .
7. Install the RH and the LH front fender splash shields. REFER to: [Fender Splash Shield](#) .
8. Install the cowl panel. REFER to: [Cowl Panel](#) .

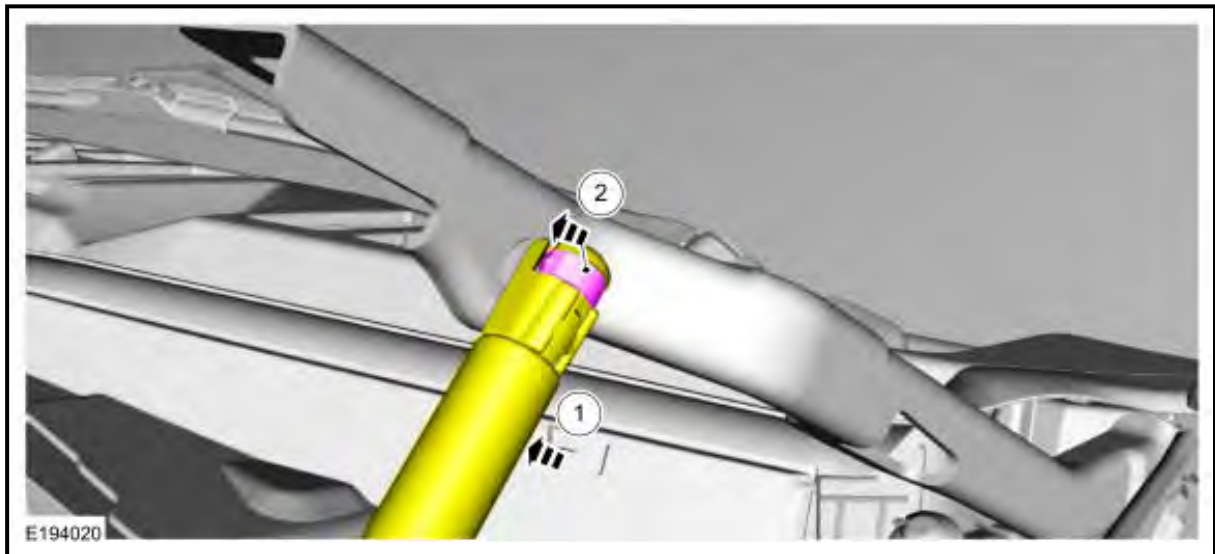
30. Install the engine appearance cover.





31. **NOTE:** LH shown, RH similar.

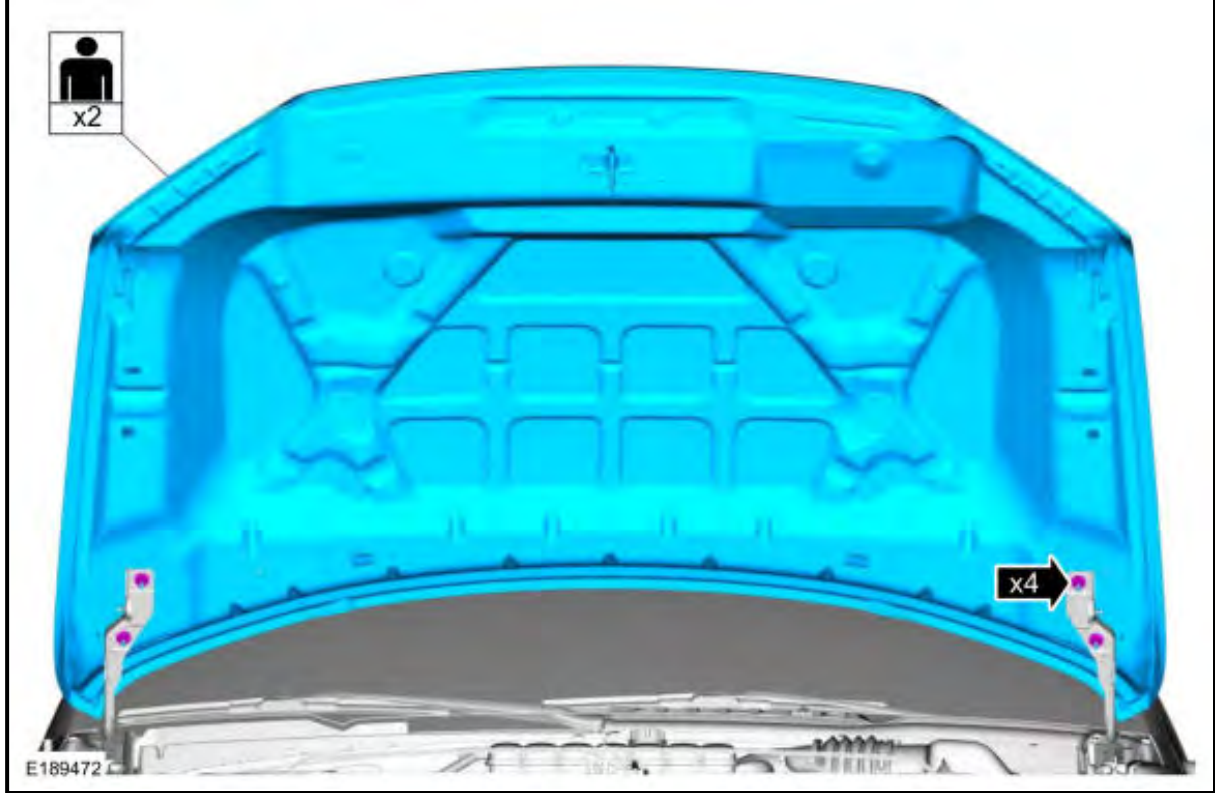
1. Position the hood shock and attach.
2. Install the clip.



32. Position the hood and install the nuts.

Torque: 18 lb.ft (25 Nm)







33. Evaluate the cooling system. REFER to: [Cooling System Condition Evaluation](#) .

34. Start and check the exhaust system for leaks.

### ENGINE MOUNT RH

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

### Special Tool(s) / General Equipment

|  |   |
|--|---|
|  <p>E274098</p> | <p><b>303-1681 Spreader Bar</b></p>                                   |
|                 | <p>303-F070 Support Bar, Engine TKIT-1999A-F/LT TKIT-1999A-FM/FLM</p> |

### Materials

| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> Threadlock 262 TA-26 | WSK-M2G351-A6 |

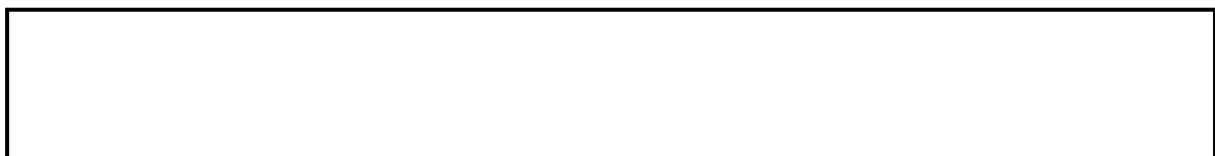
### REMOVAL

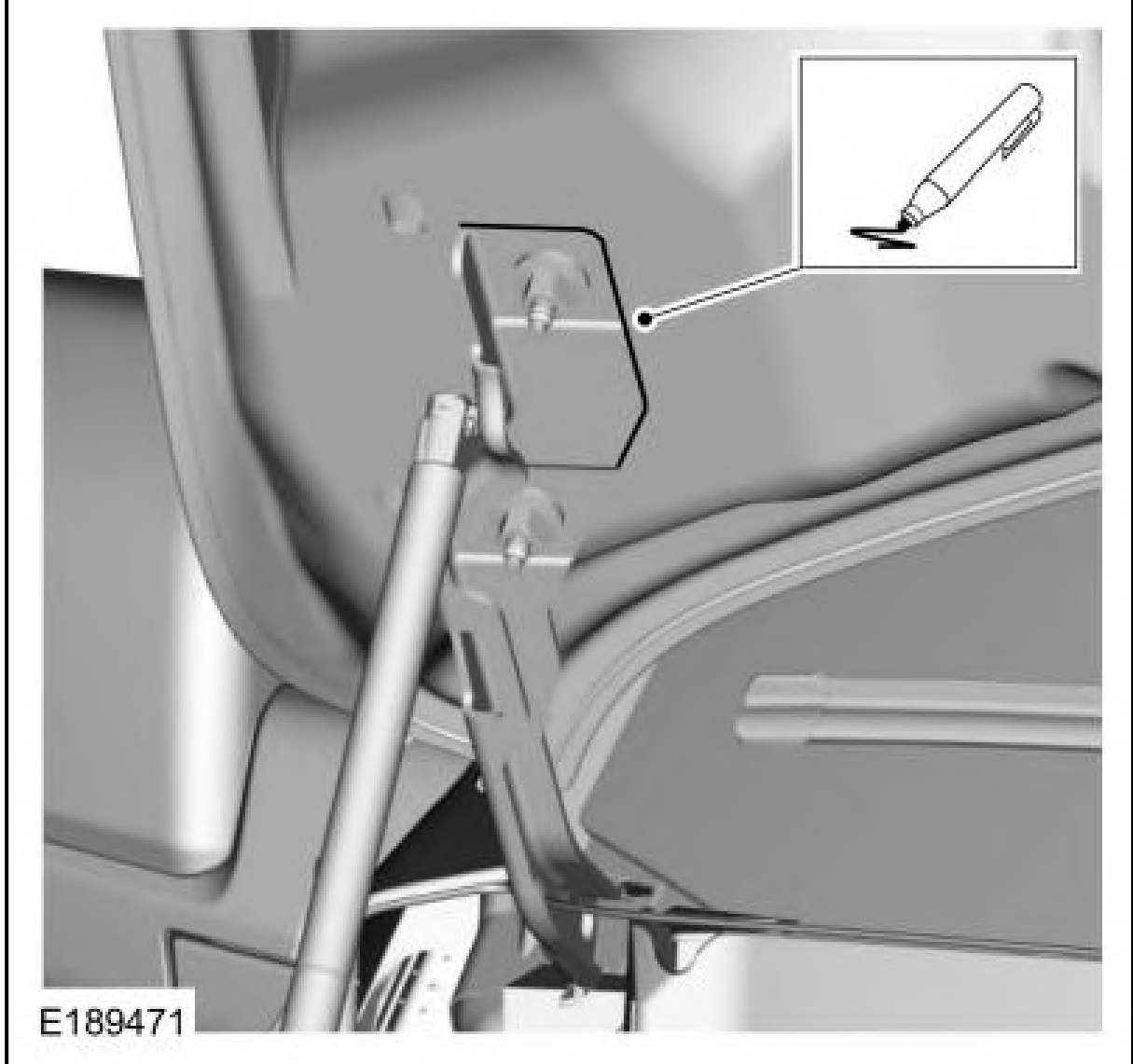
**NOTE:** Discard all engine mount fasteners and install new fasteners.

1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .

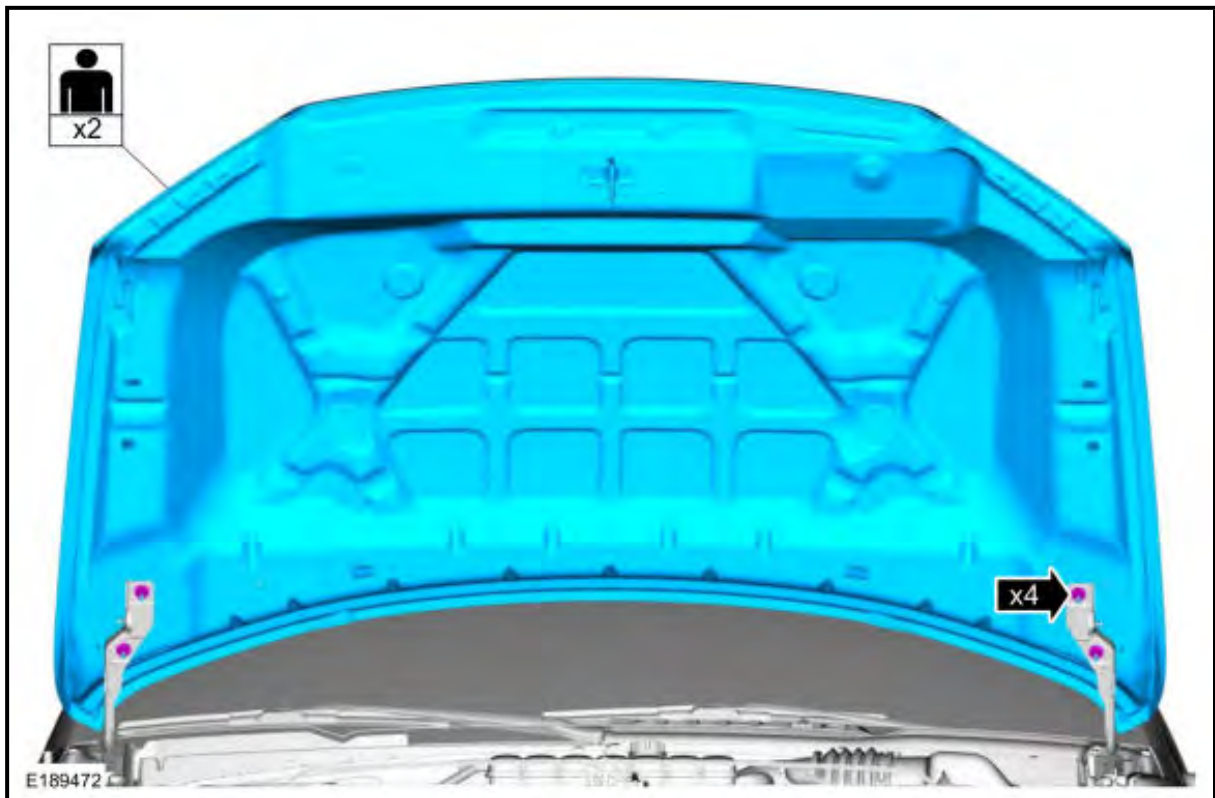
2. **NOTE:** RH shown, LH similar.

Index-mark the hood hinge location.



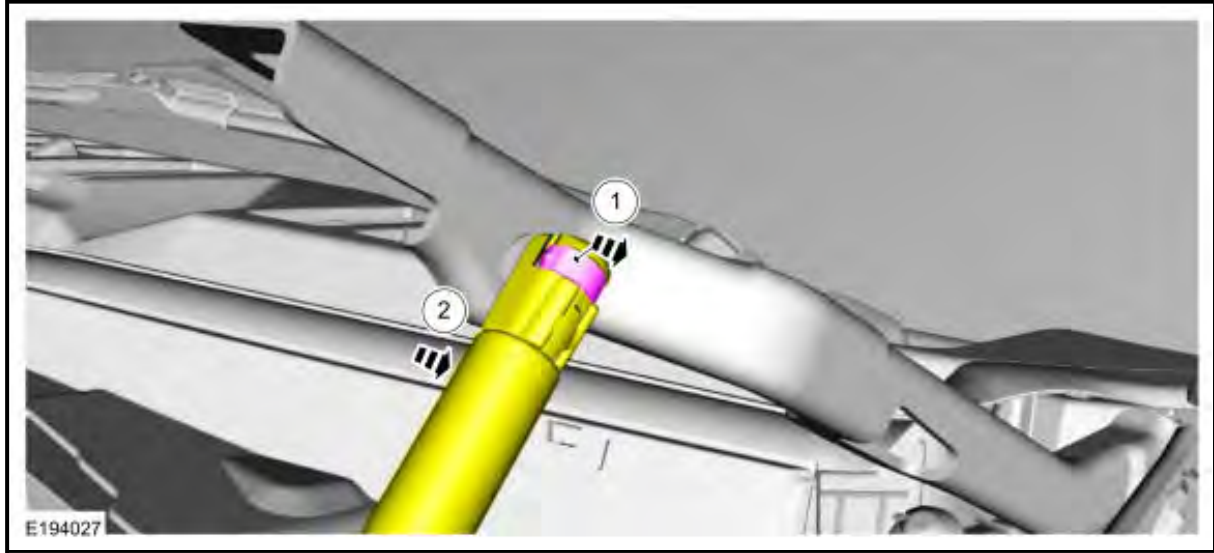


3. Remove the nuts and the hood.

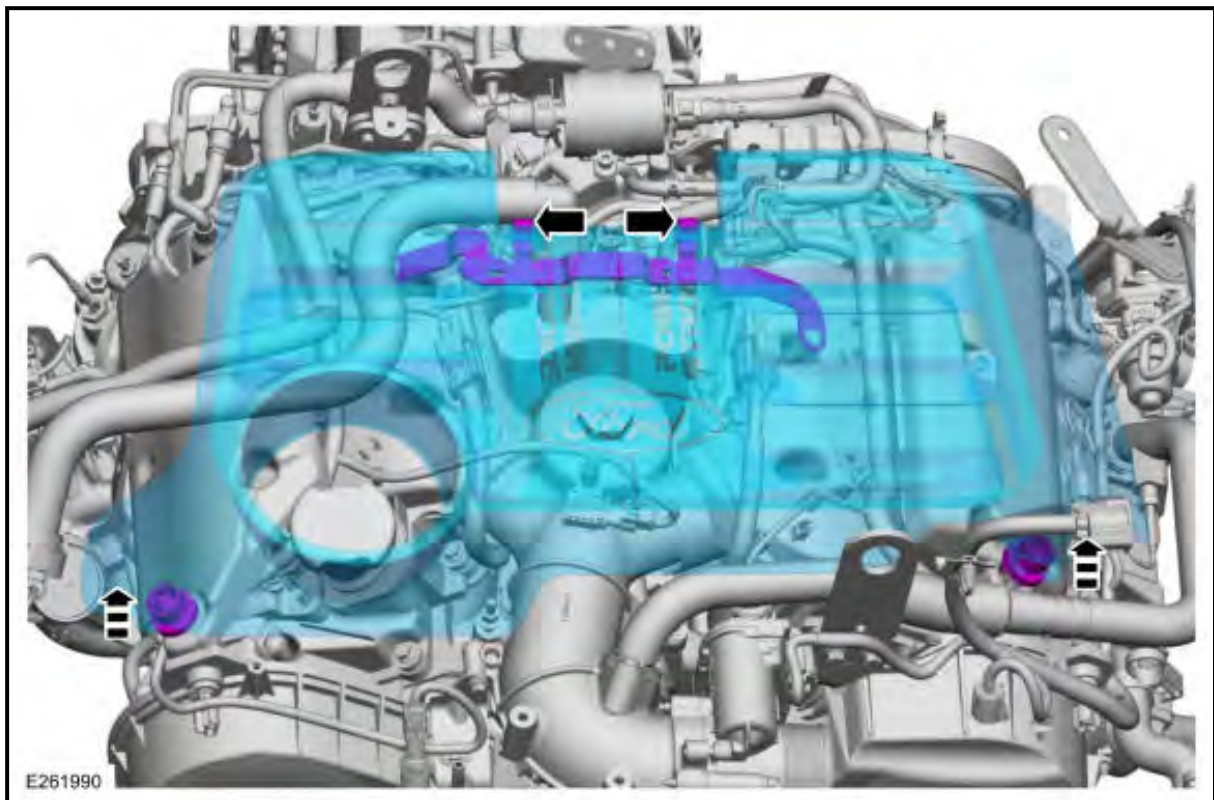


4. **NOTE:** LH shown, RH similar.

1. Release the clip.
2. Detach and position the hood shock aside.



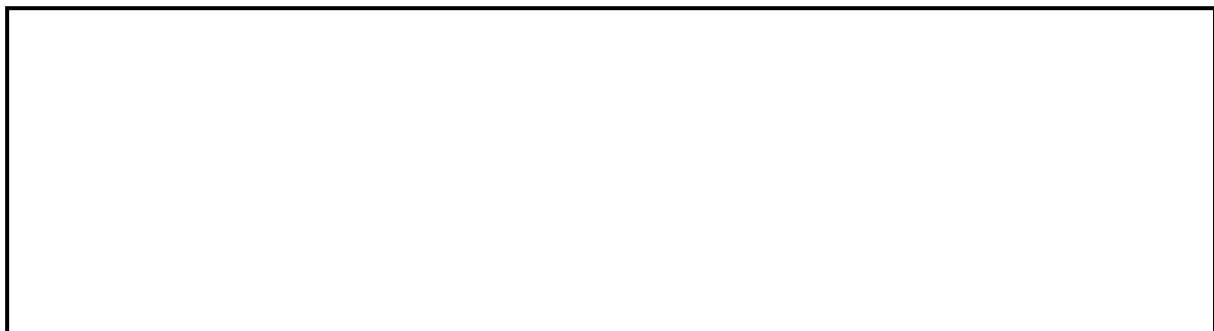
5. Remove the engine appearance cover.



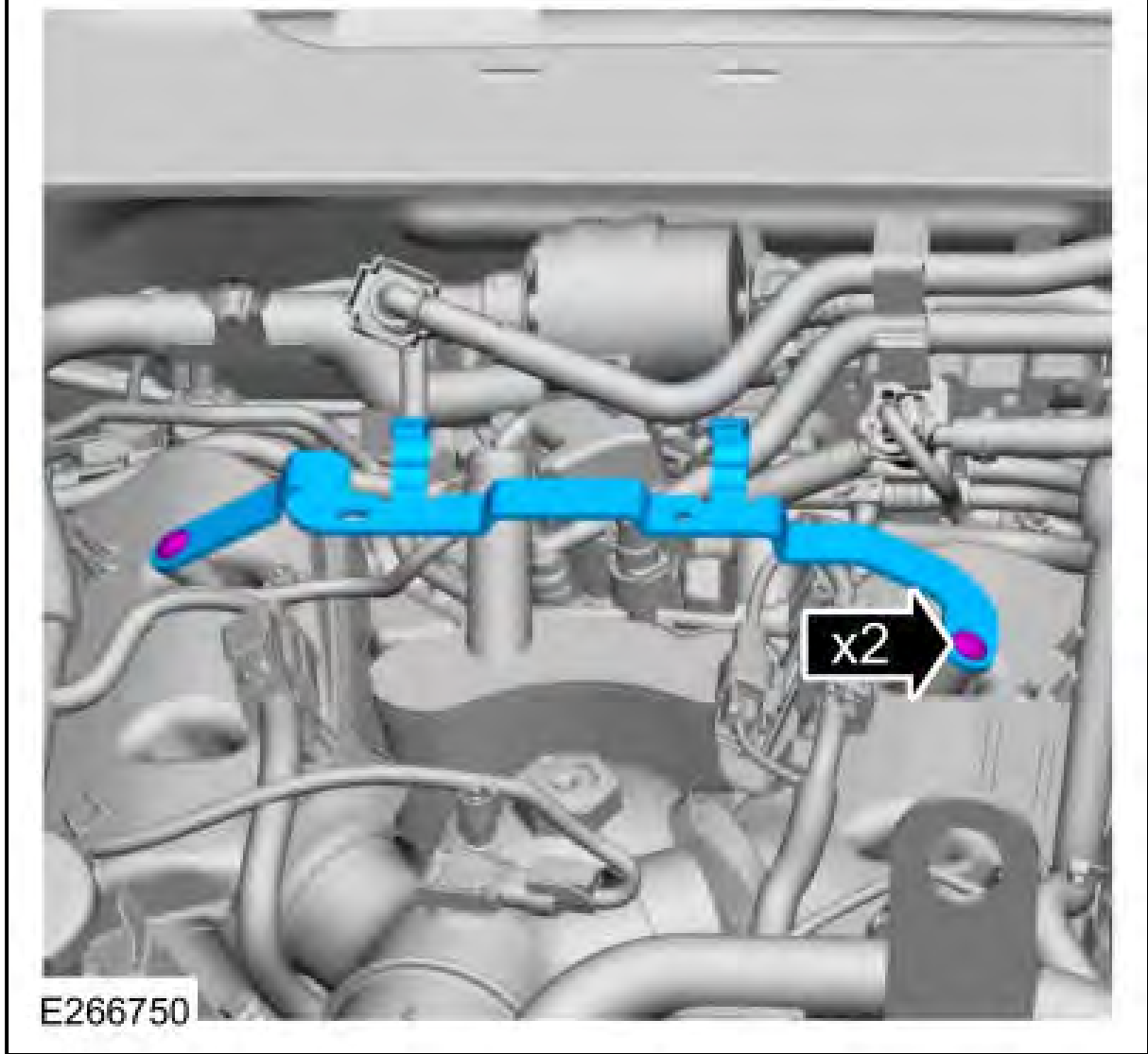
6. Remove the following items:

1. Remove the cowl panel. REFER to: [Cowl Panel](#) .
2. Remove the air cleaner outlet tube. REFER to: [Air Cleaner Outlet Pipe](#) .
3. Remove the CAC intake pipe. REFER to: [Charge Air Cooler \(CAC\) Intake Pipe](#) .
4. Remove the CAC outlet pipe. REFER to: [Charge Air Cooler \(CAC\) Outlet Pipe](#) .
5. Remove the cooling fan upper shroud. REFER to: [Cooling Fan Upper Shroud](#) .
6. Remove the turbocharger. REFER to: [Turbocharger](#) .

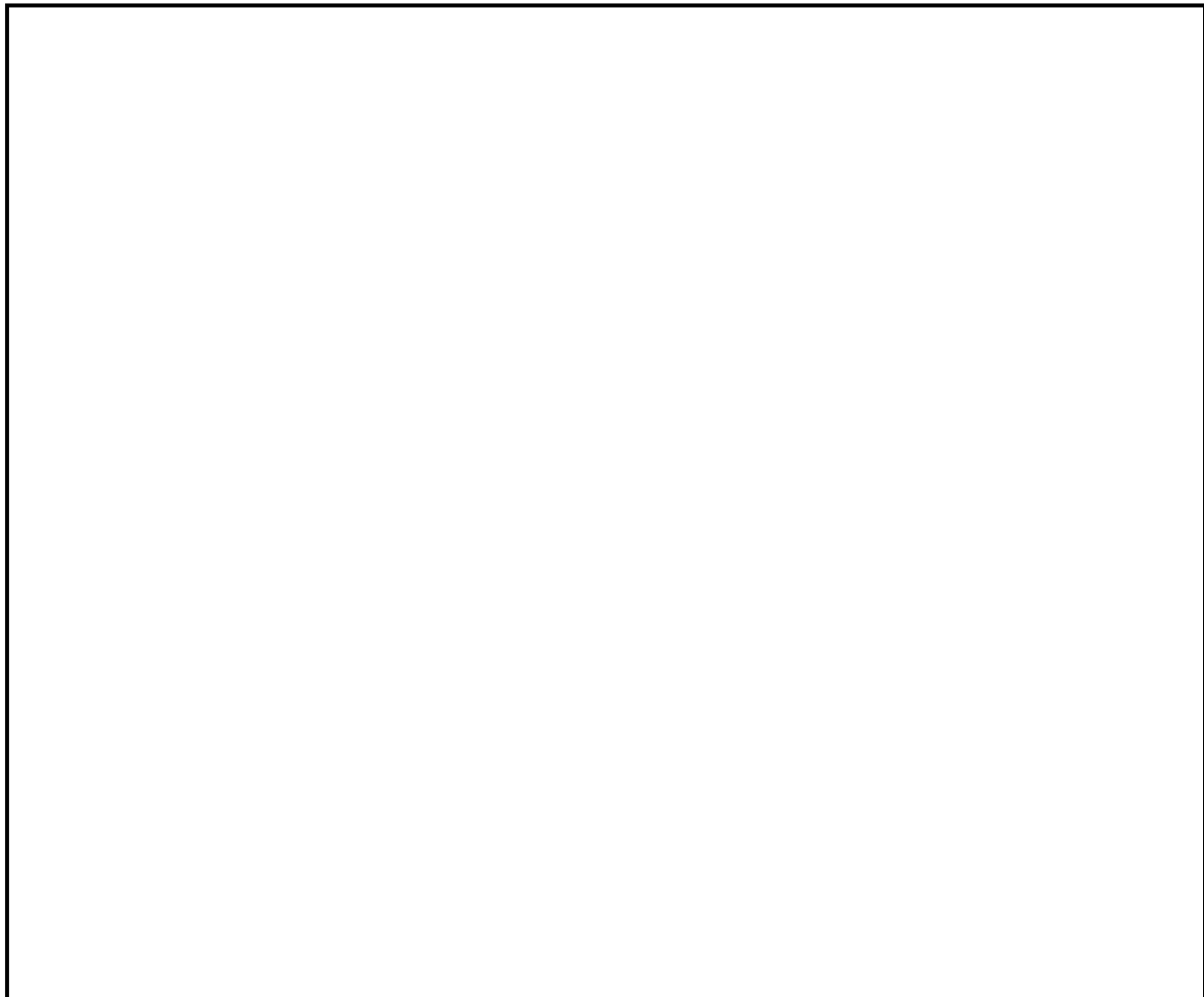
7. Remove the engine appearance cover bracket.

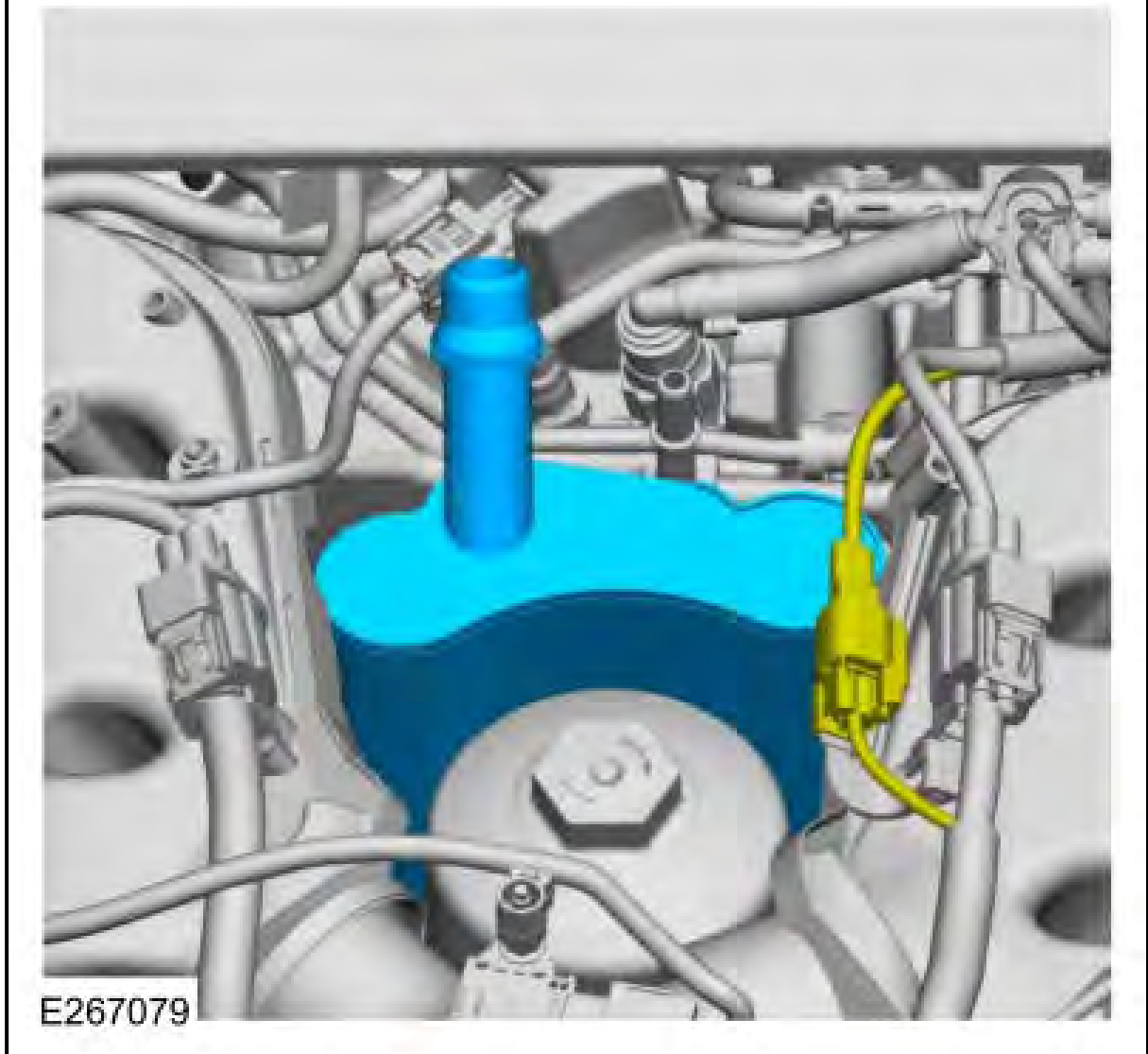






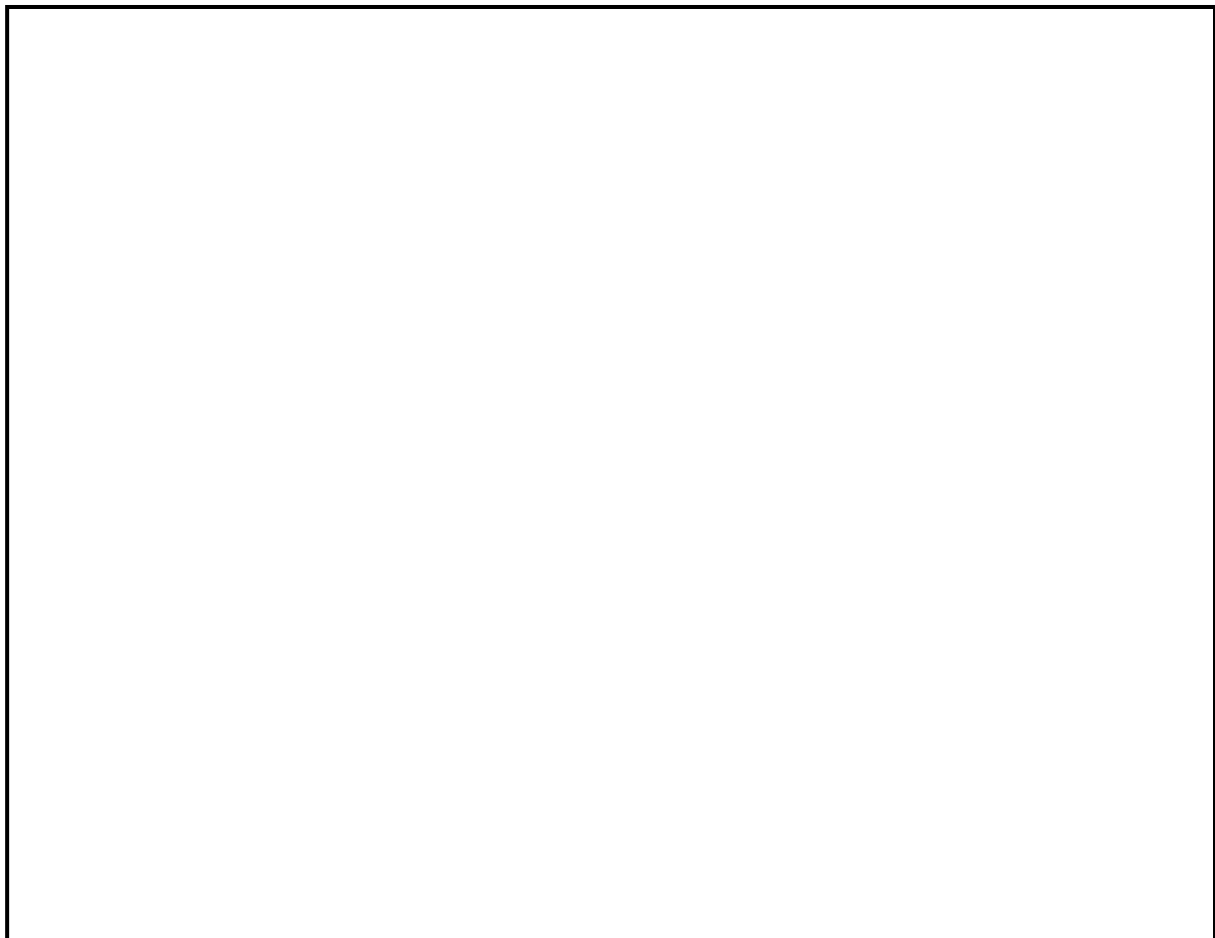
8. Position aside the wiring and remove the crankcase vent oil separator.

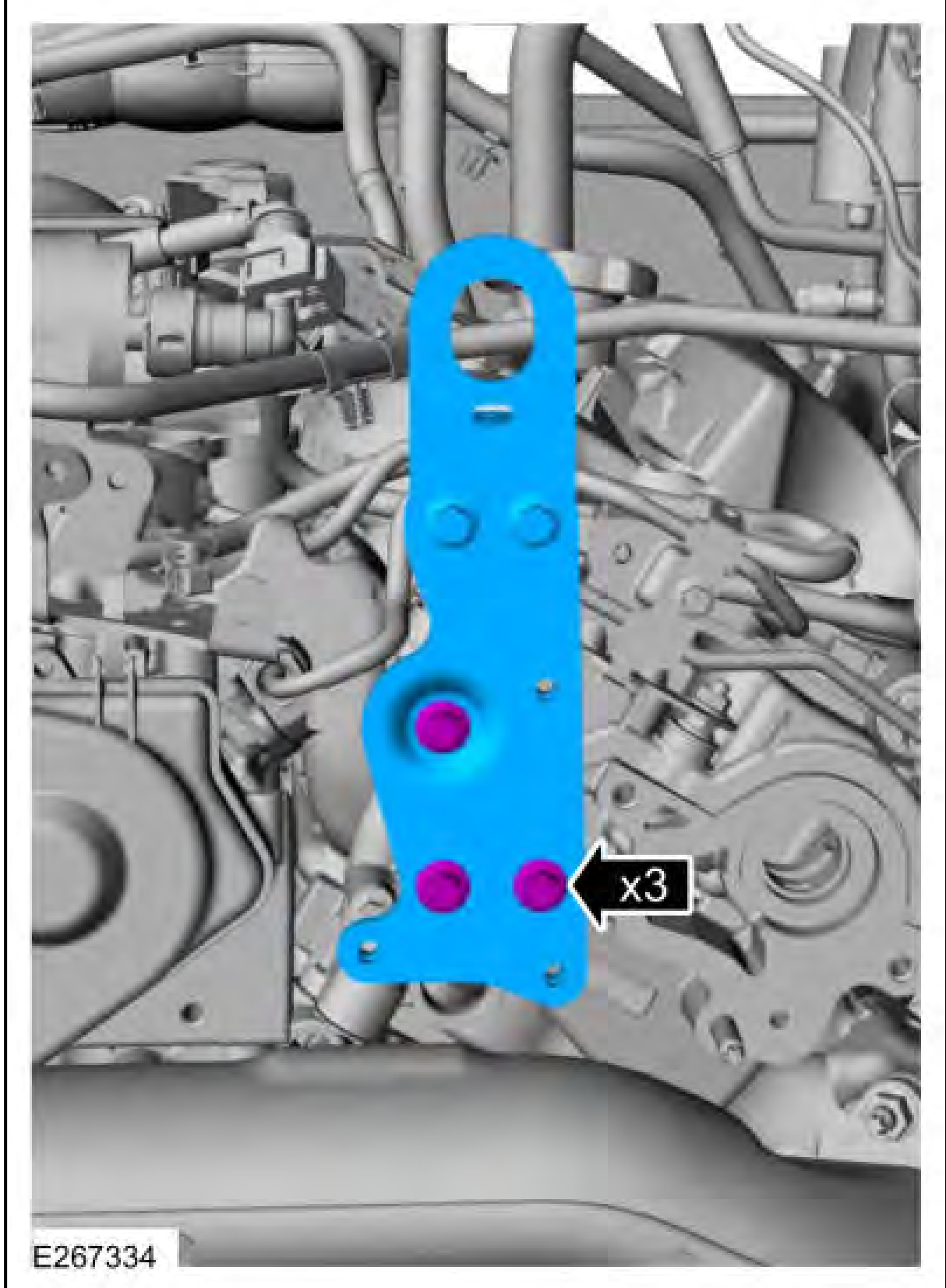




9. Install the engine rear lifting bracket.

Torque: 17 lb.ft (23 Nm)

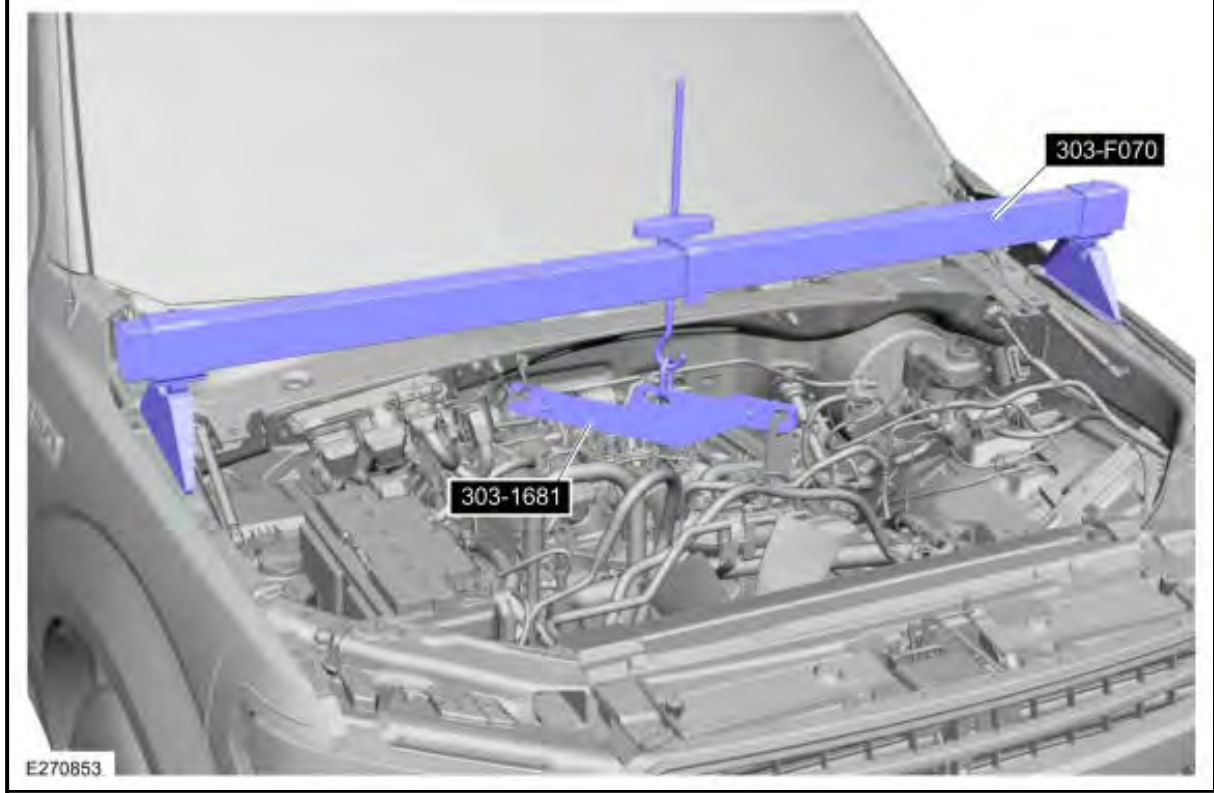




10. **NOTE:** Use a commercially available quick link.

Install Special Service Tool: 303-F070 Support Bar, Engine. , 303-1681 Spreader Bar.

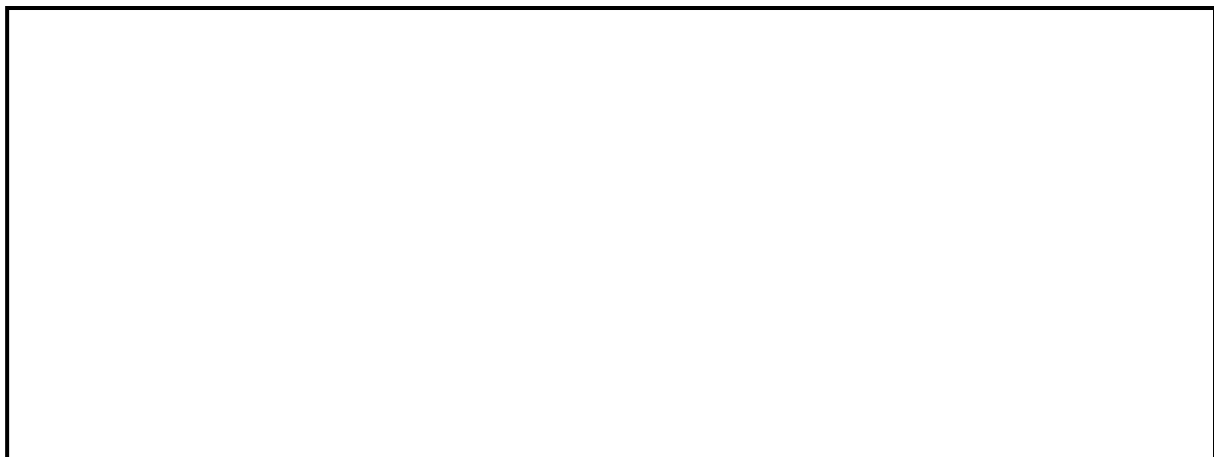


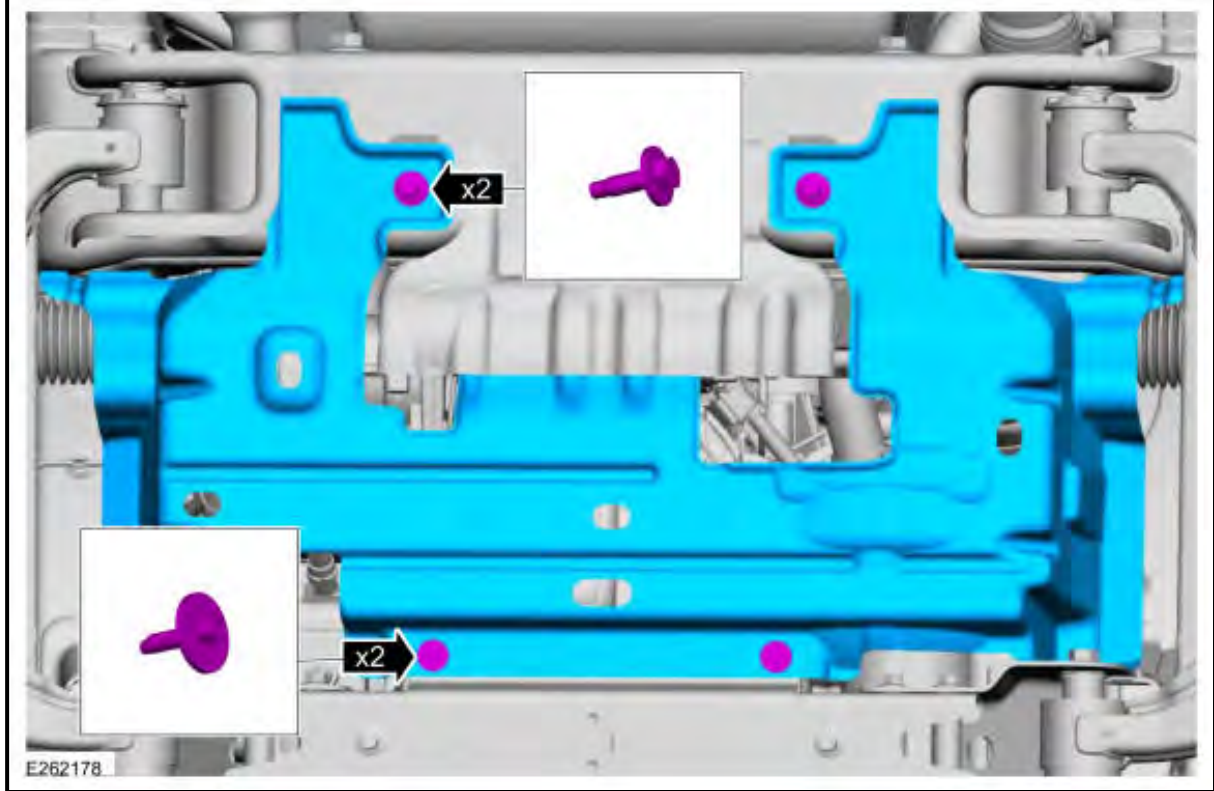


11. Remove the retainer. Remove the bolts and the transmission housing cover.

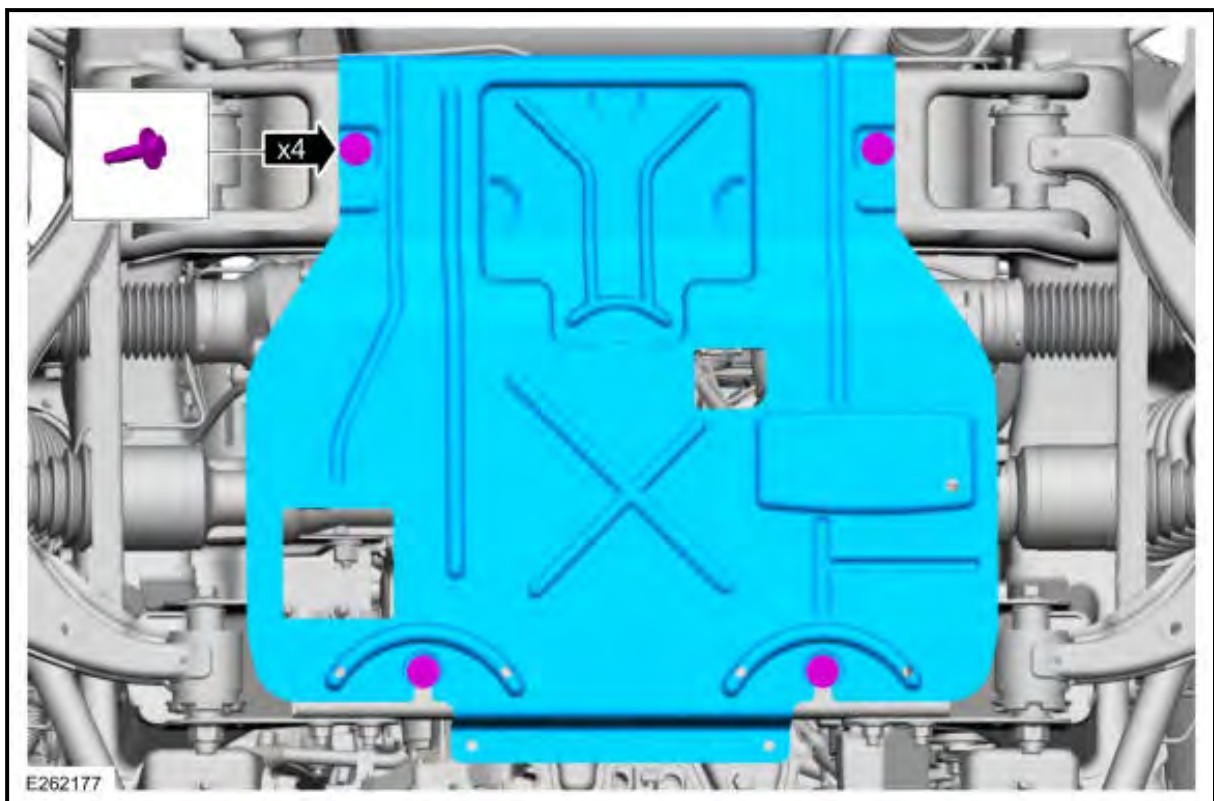


12. If equipped. Remove the bolts and the underbody shield.





13. If equipped. Remove the bolts and the skid plate.

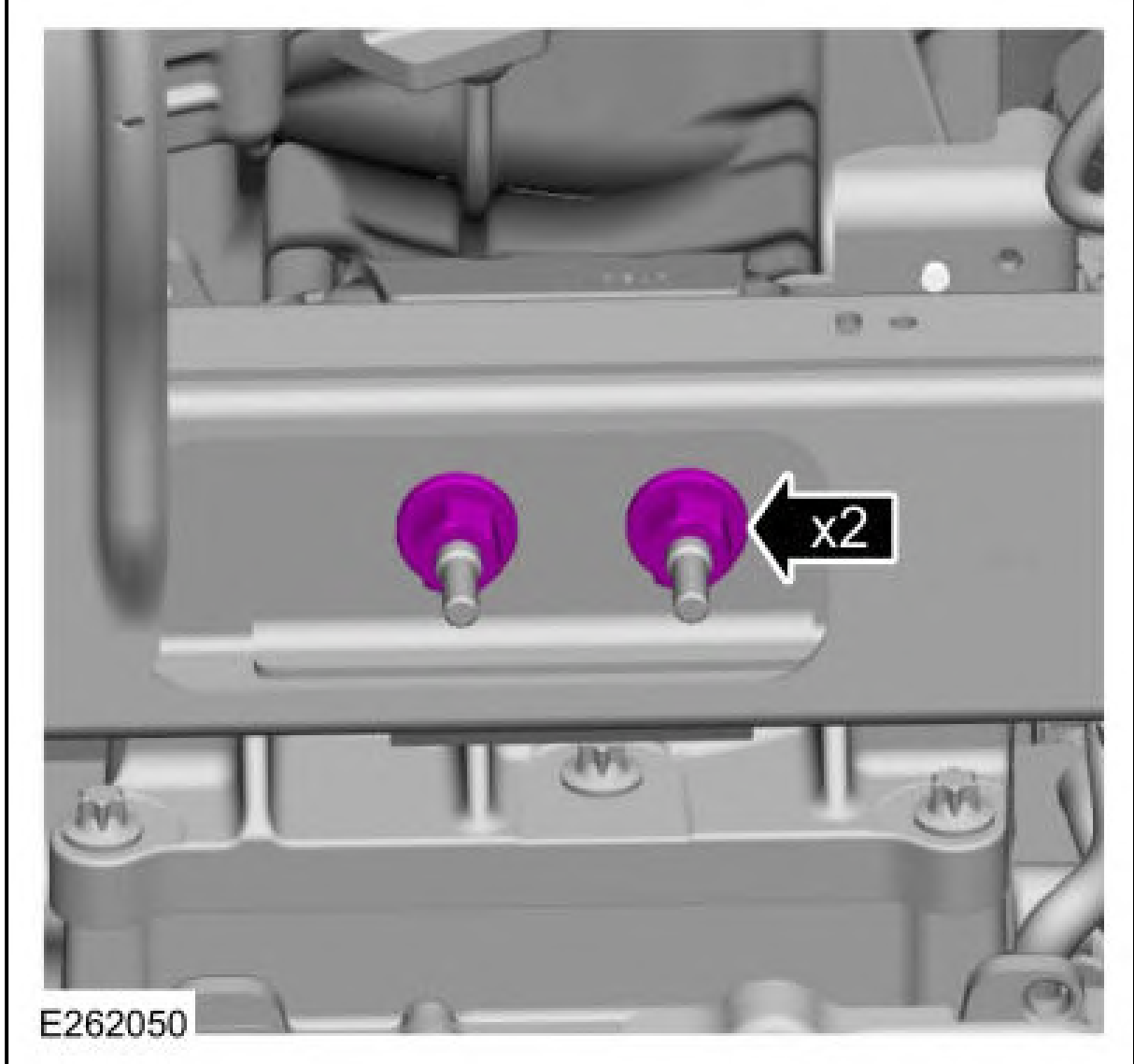


14. If equipped, remove the front driveshaft. REFER to: [Front Driveshaft](#).

15. **NOTE:** Only use hand tools when removing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.

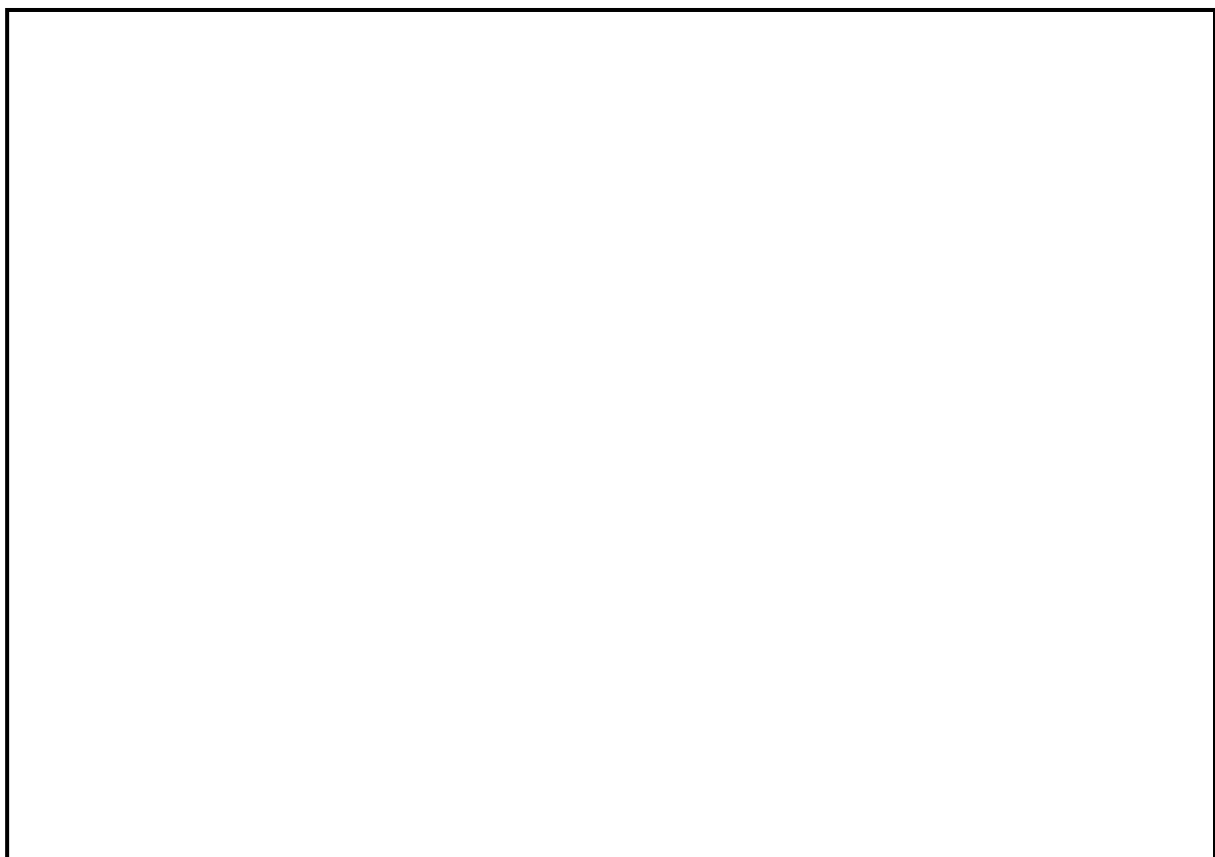
Loosen the transmission mount-to-crossmember nuts.

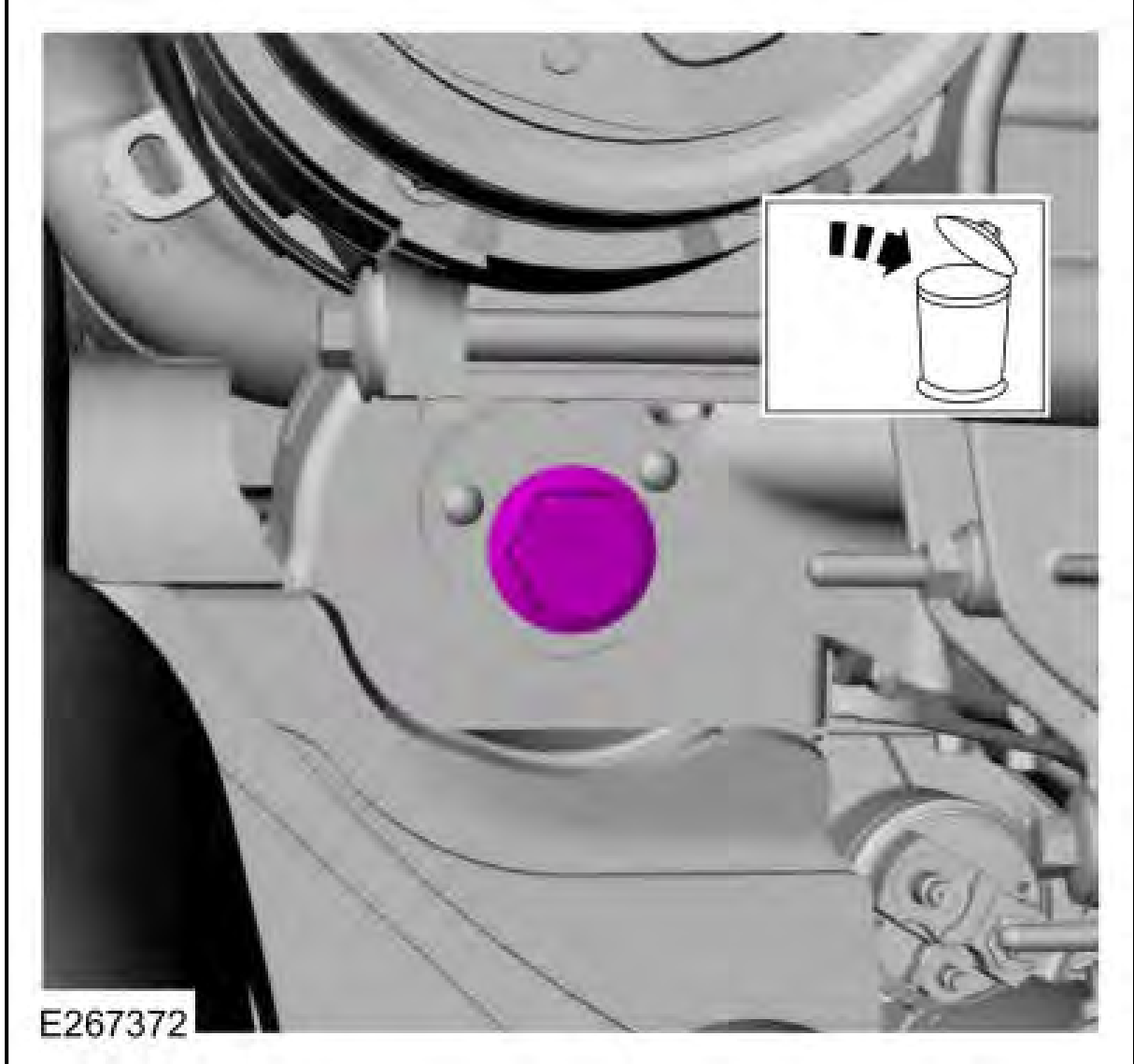




16. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

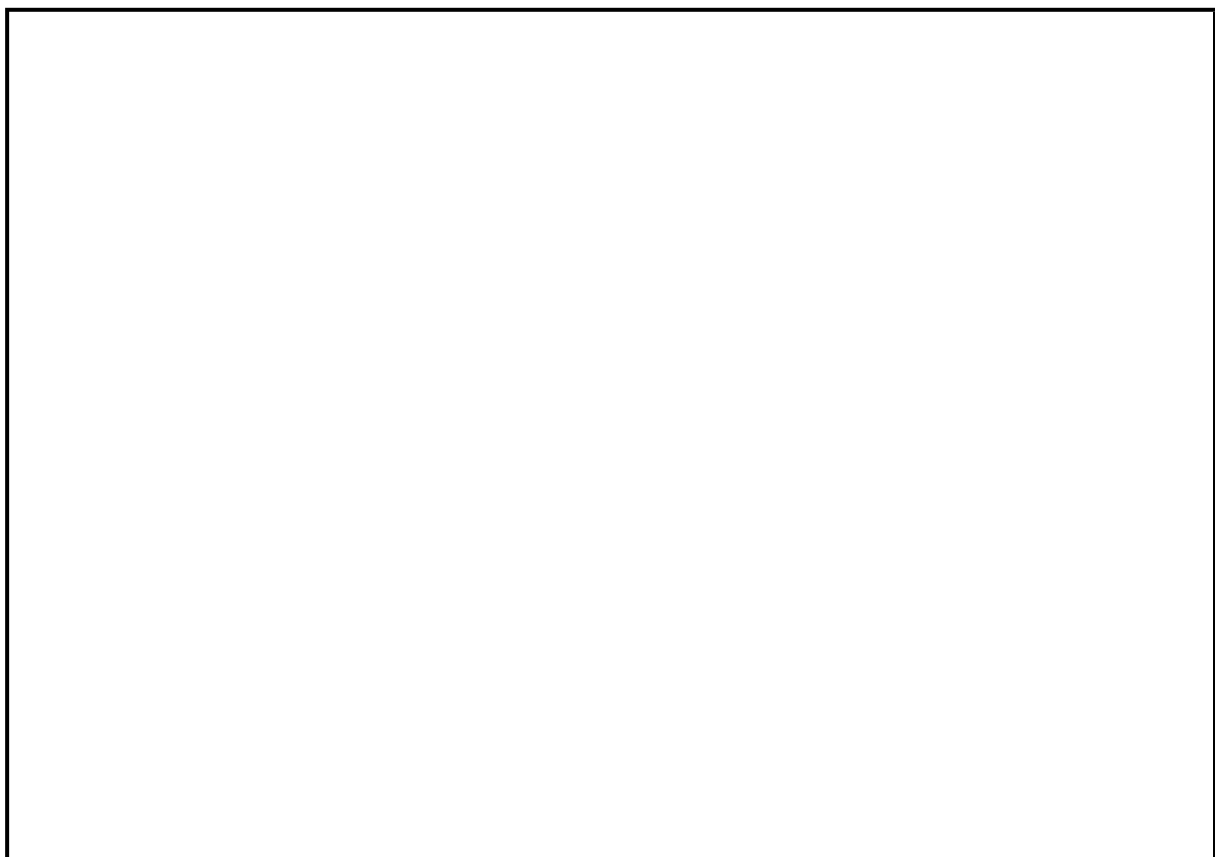
Remove and discard the RH engine mount through bolt.

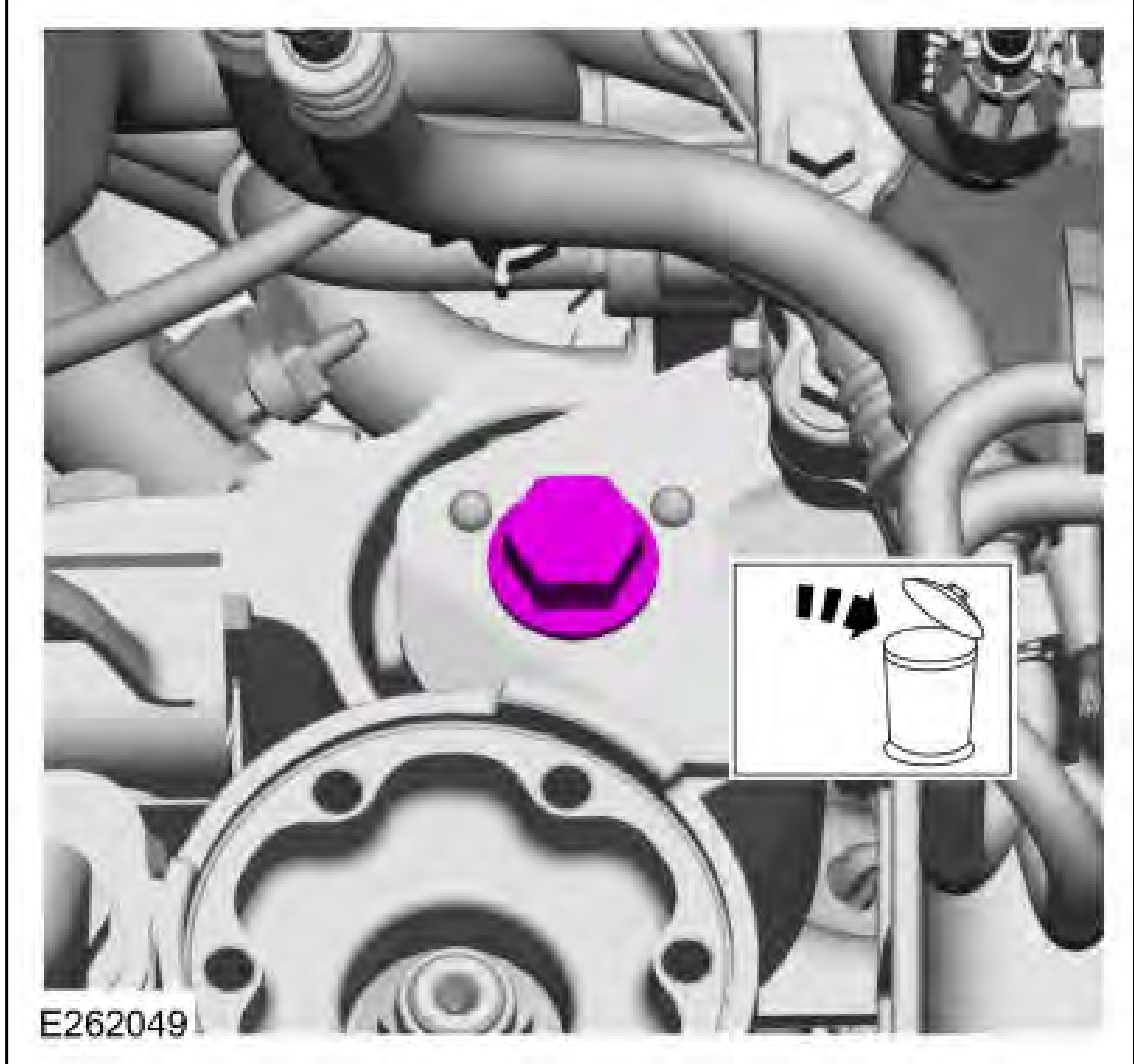




17. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

Remove and discard the LH engine mount through bolt.

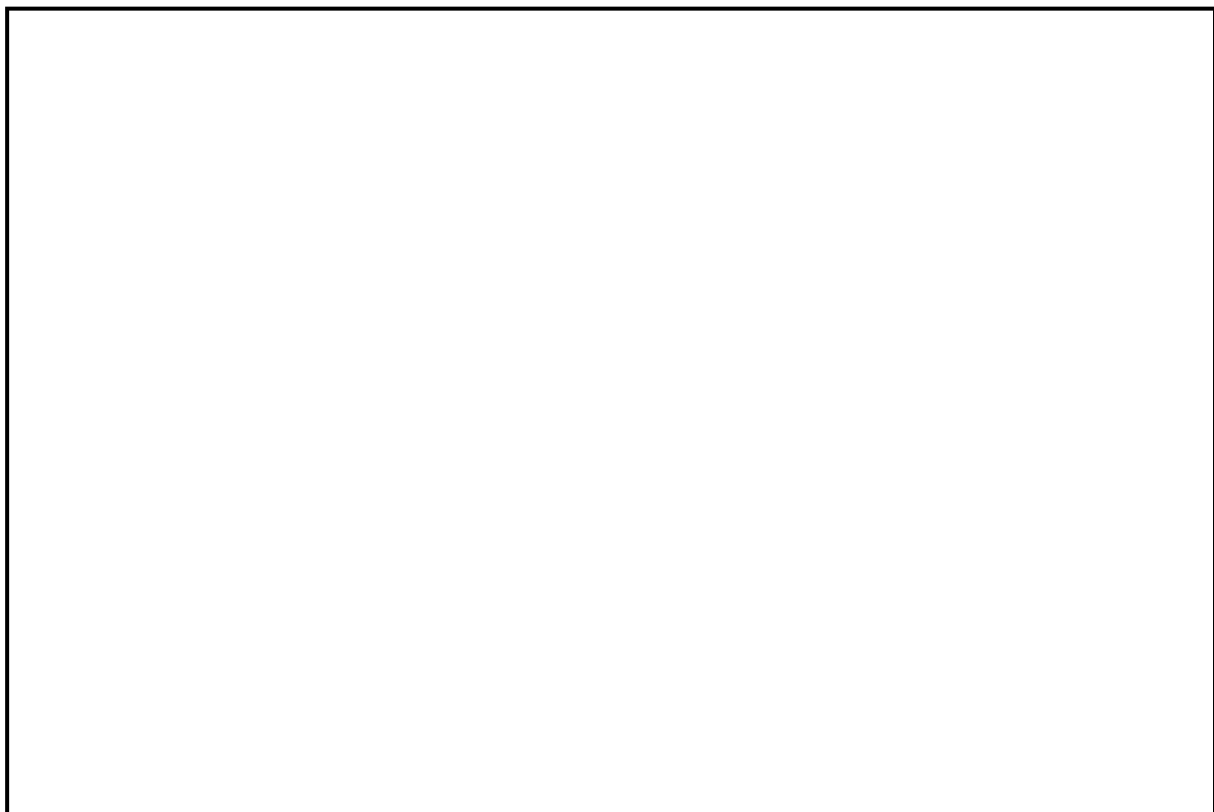




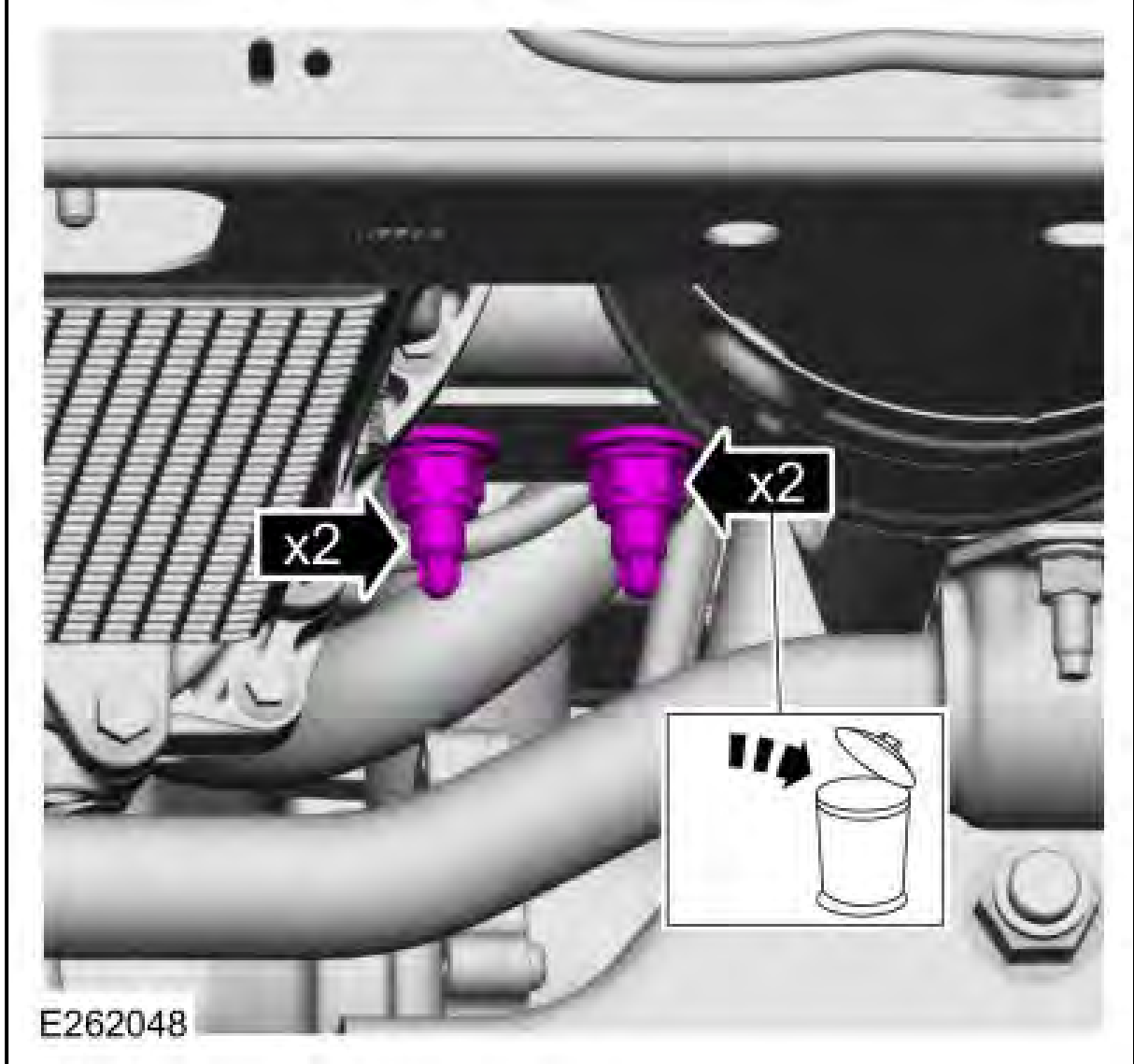
18. **NOTE:** Only use hand tools when loosening or tightening the engine mount nuts and studs or damage to the engine mount can occur.

**NOTE:** The engine mount studs may come off with the nuts.

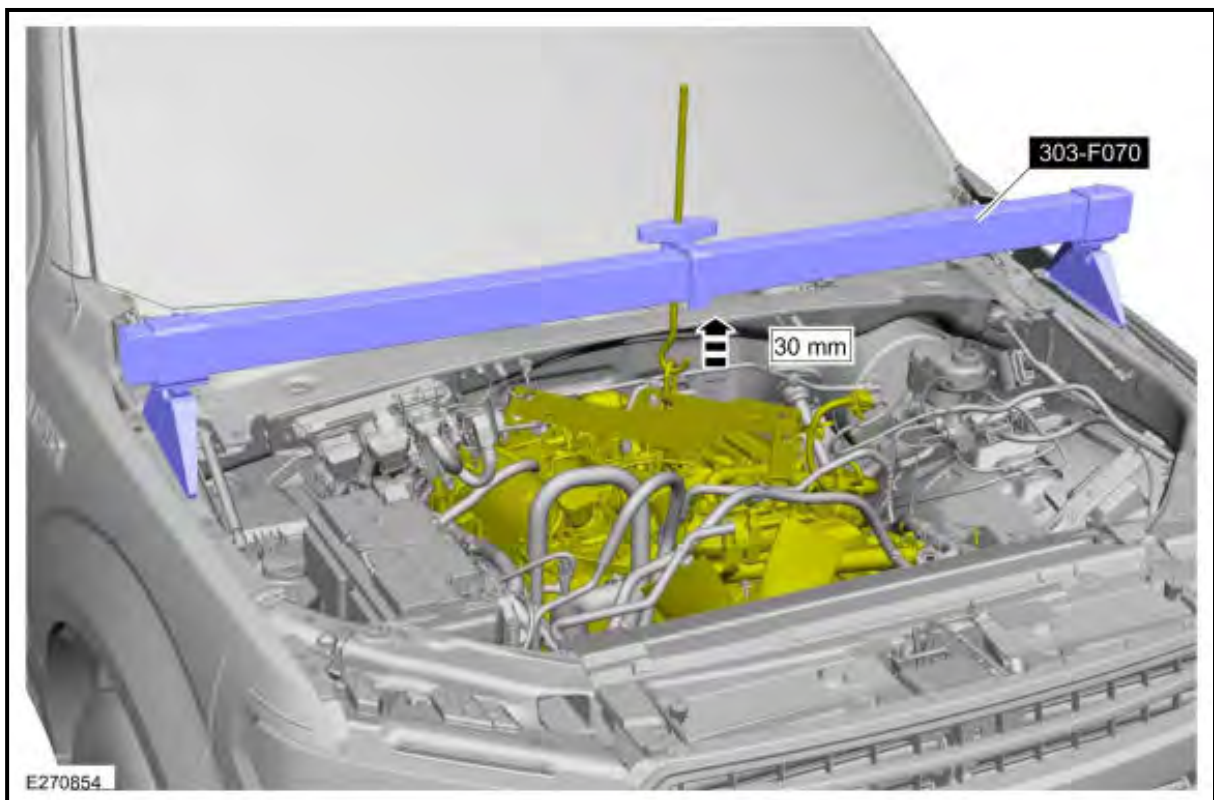
Remove and discard the engine mount nuts. Remove the engine mount studs.



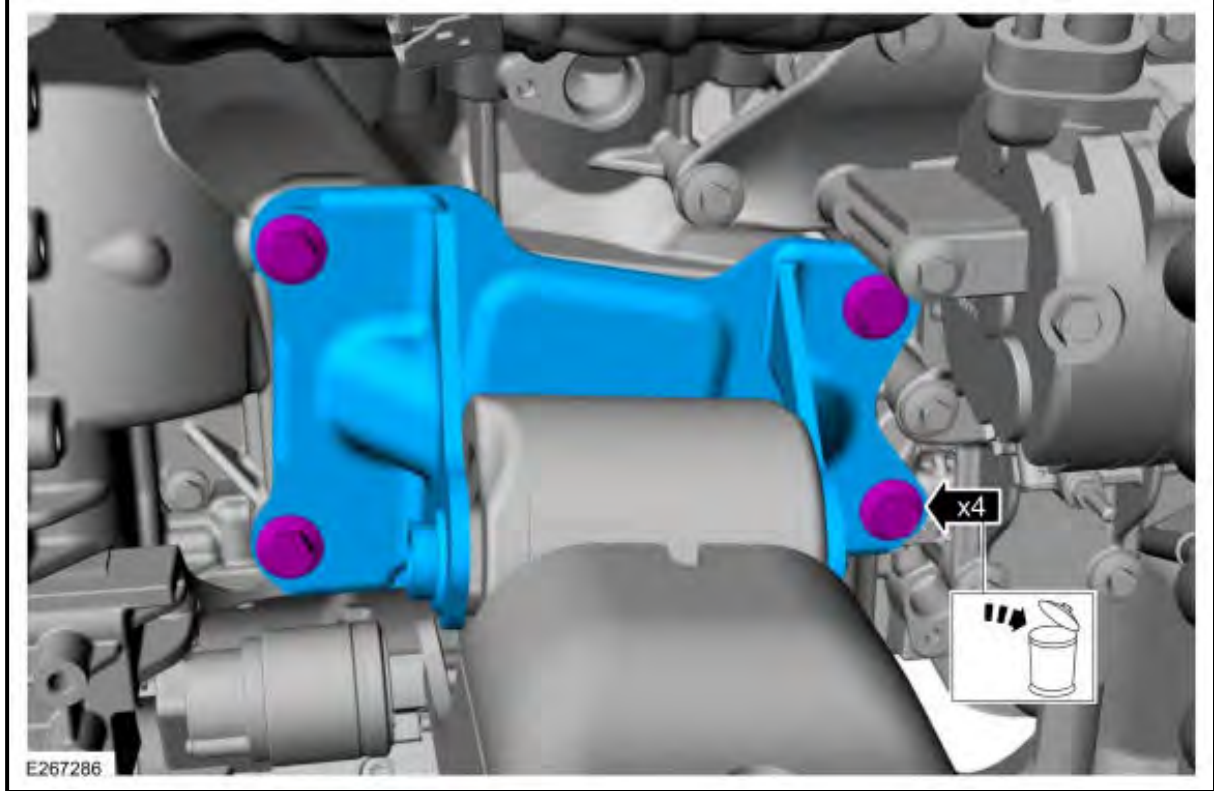




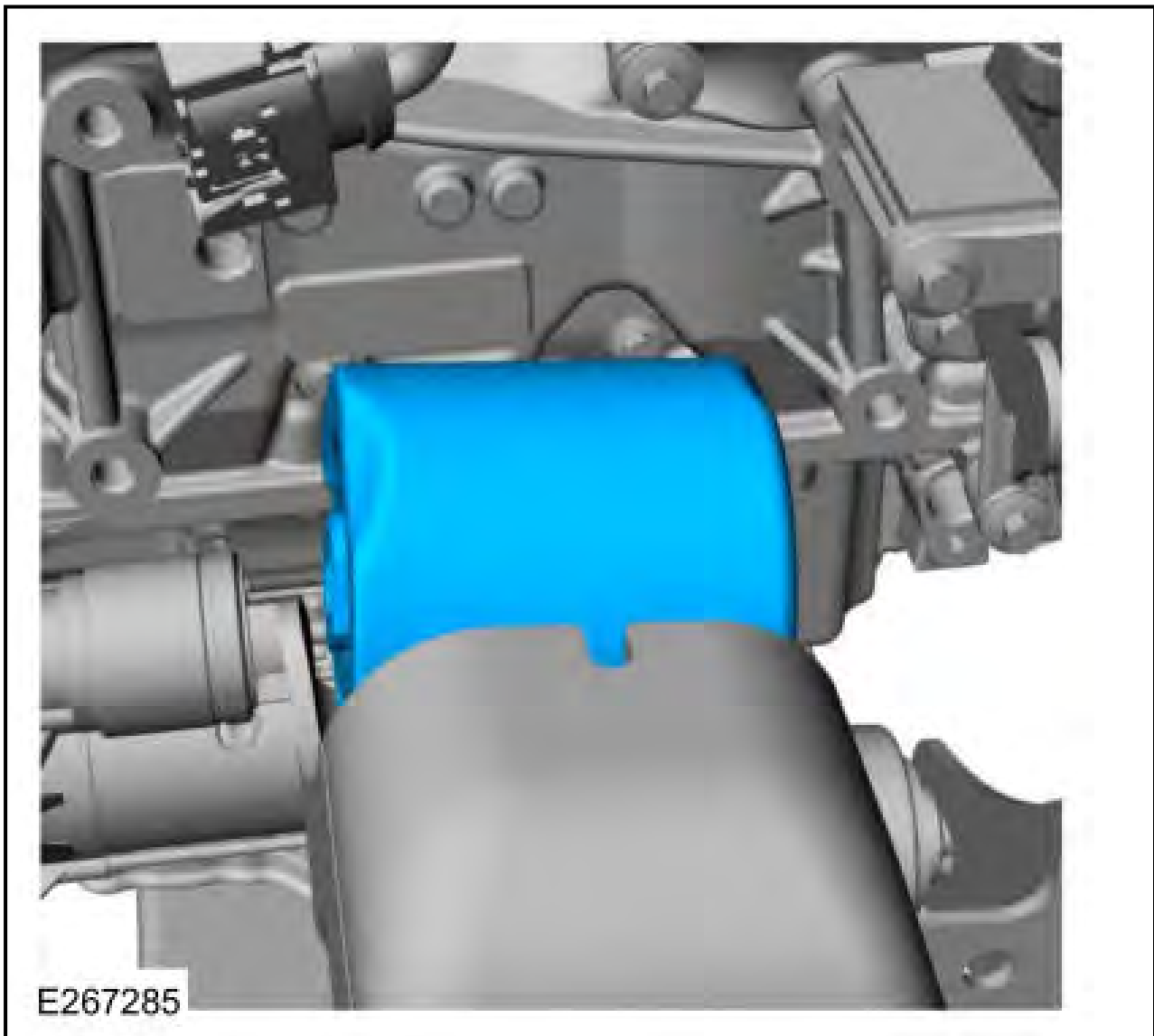
19. Raise the engine approximately 30 mm (1.18 in). Use Special Service Tool: 303-F070 Support Bar, Engine.



20. Remove the bolts and the RH engine mount-to-cylinder block bracket. Discard the bolts.



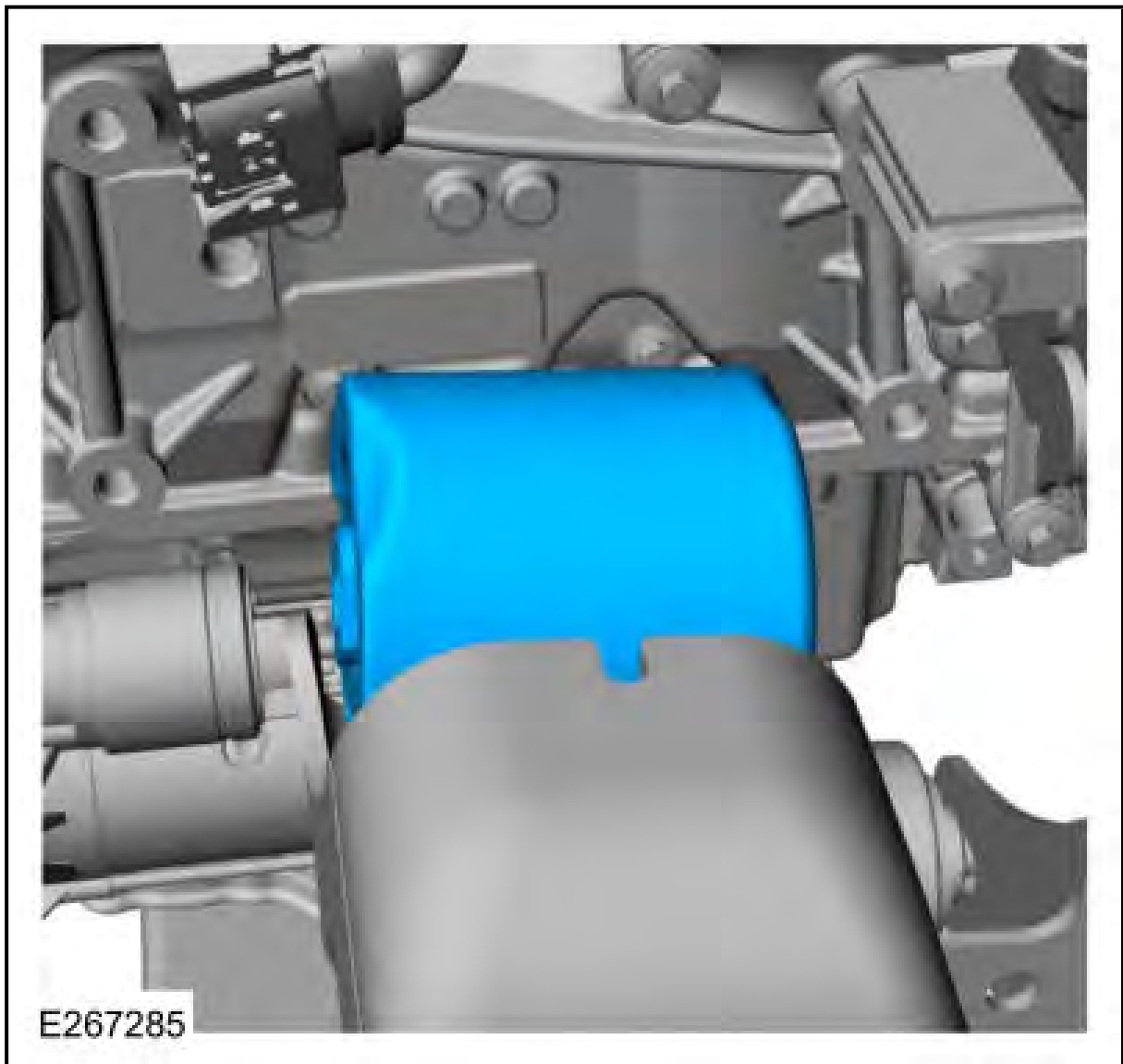
21. Remove the RH engine mount.



## INSTALLATION

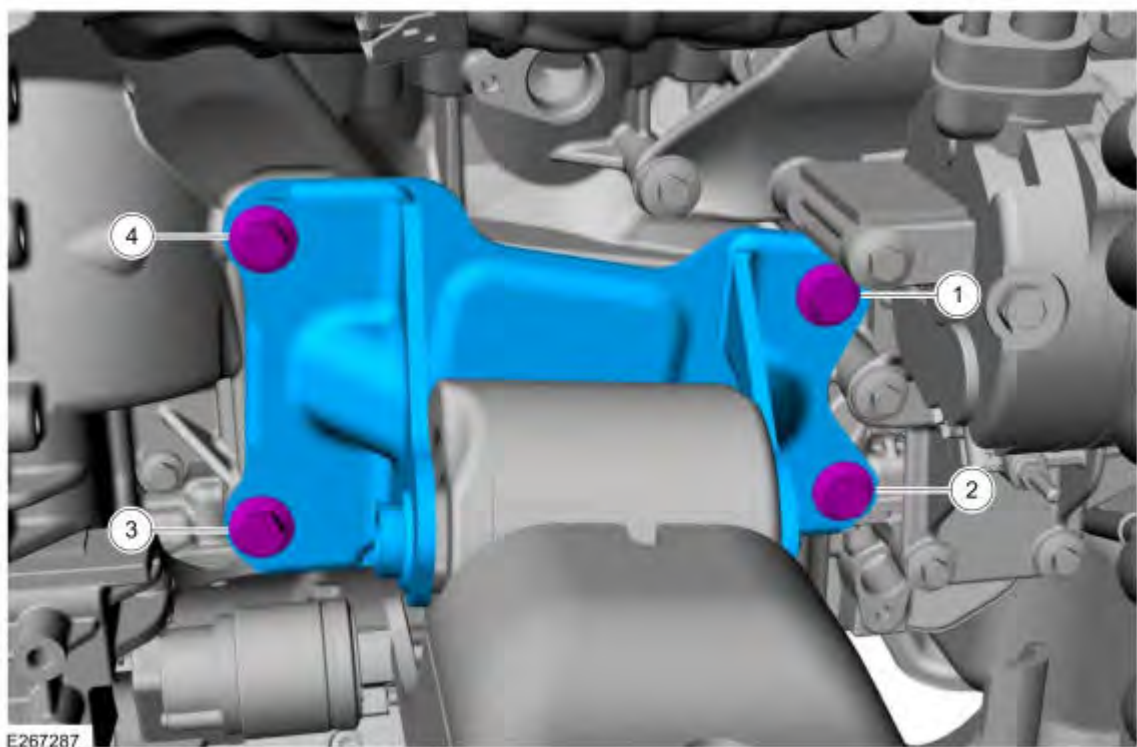
1. Clean the engine mount-to-cylinder block and engine mount-to-frame mating surfaces of any dirt or foreign material prior to installation.

2. Position the RH engine mount into the vehicle.



3. Position the RH engine mount-to-cylinder block bracket and install the new bolts in the sequence shown.

Torque: 85 lb.ft (115 Nm)



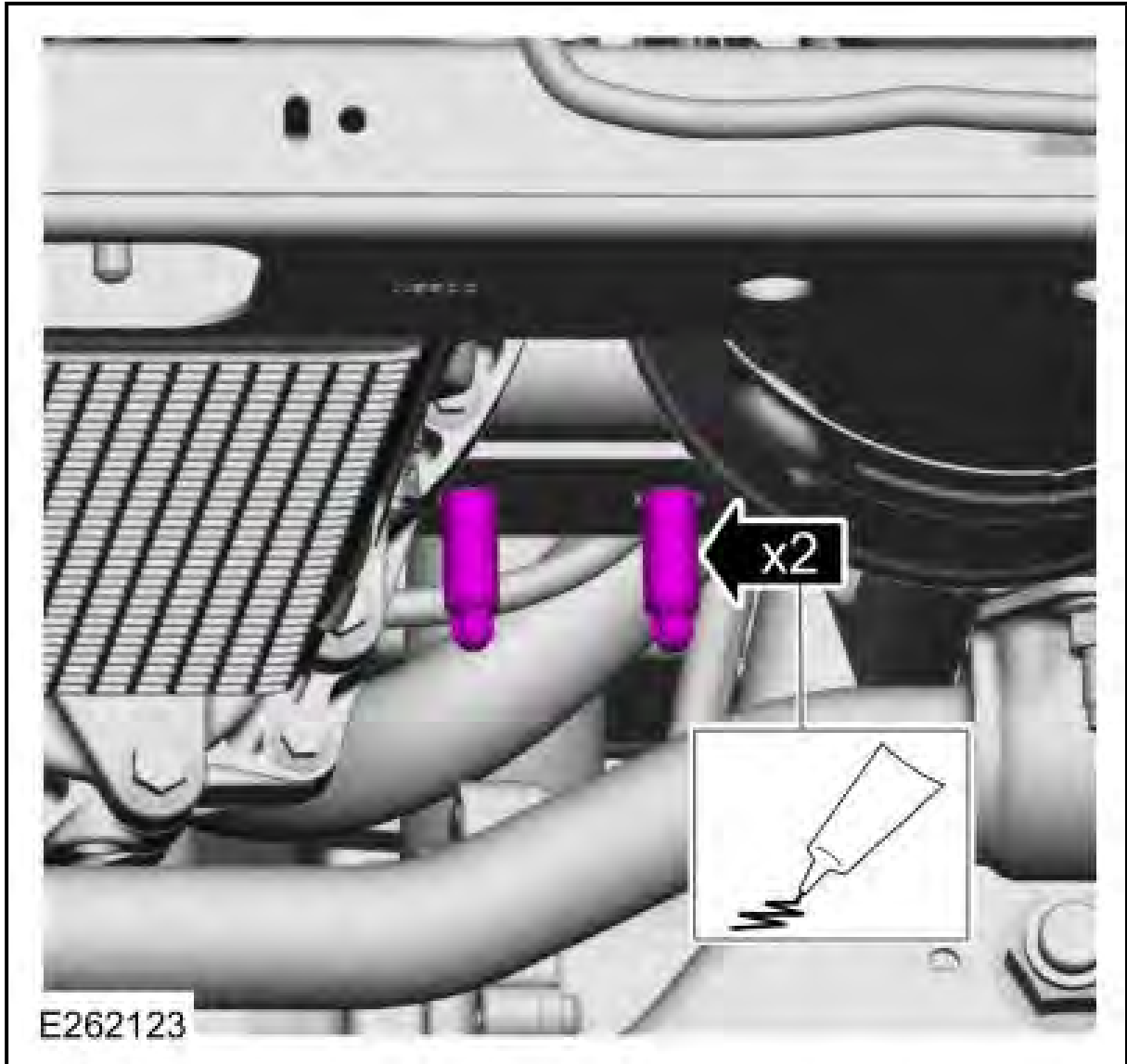
4. **NOTE:** Only use hand tools when installing the engine mount studs or damage to the engine mount can occur.

**NOTE:** Apply threadlock to the stud threads prior to installation.

Install the RH engine mount studs.

Material: Motorcraft <sup>Å</sup> Threadlock 262 / TA-26 (WSK-M2G351-A6)

Torque: 22 lb.ft (30 Nm)

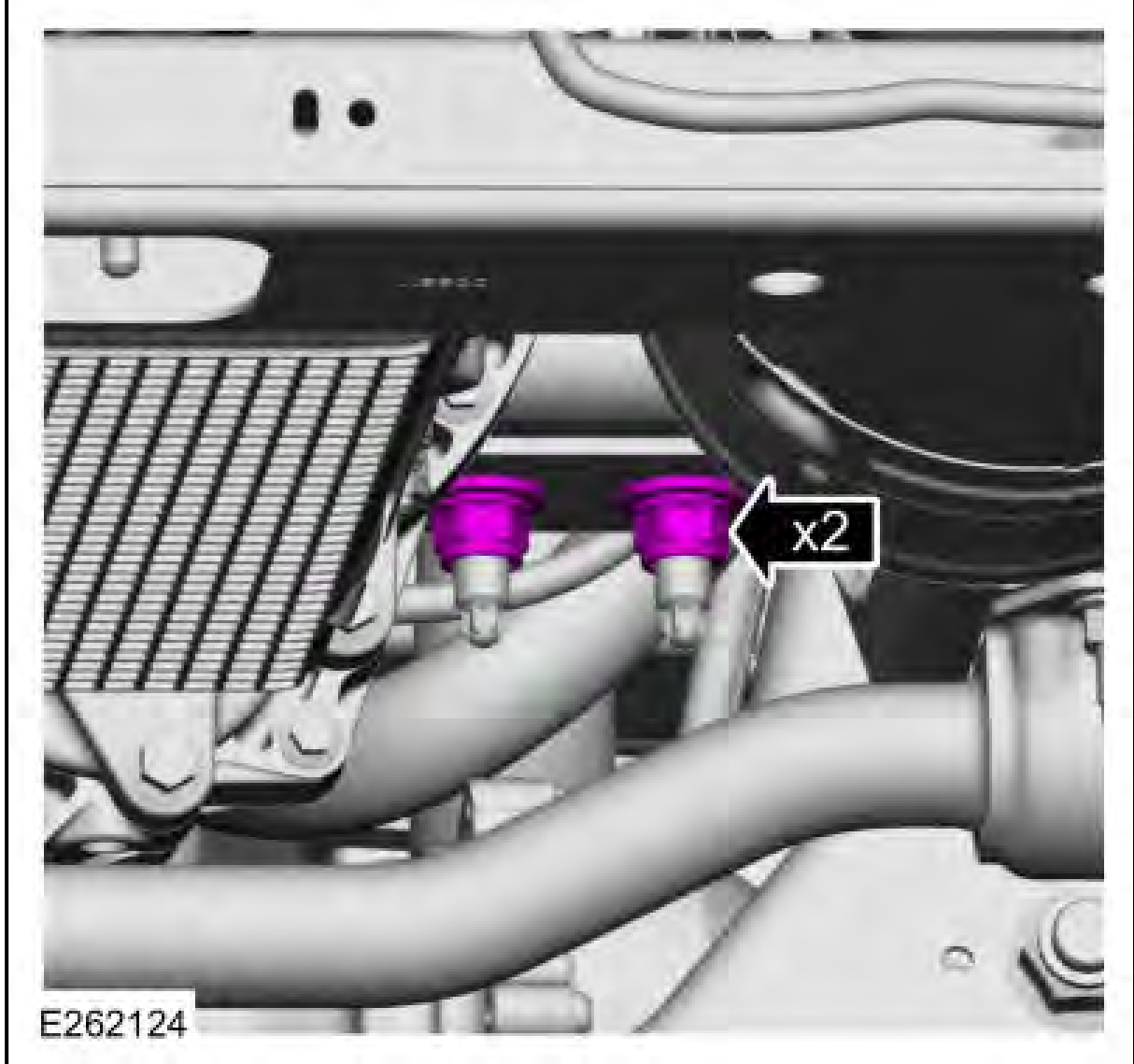


5. **NOTE:** Only use hand tools when installing the RH engine mount nuts or damage to the engine mount can occur.

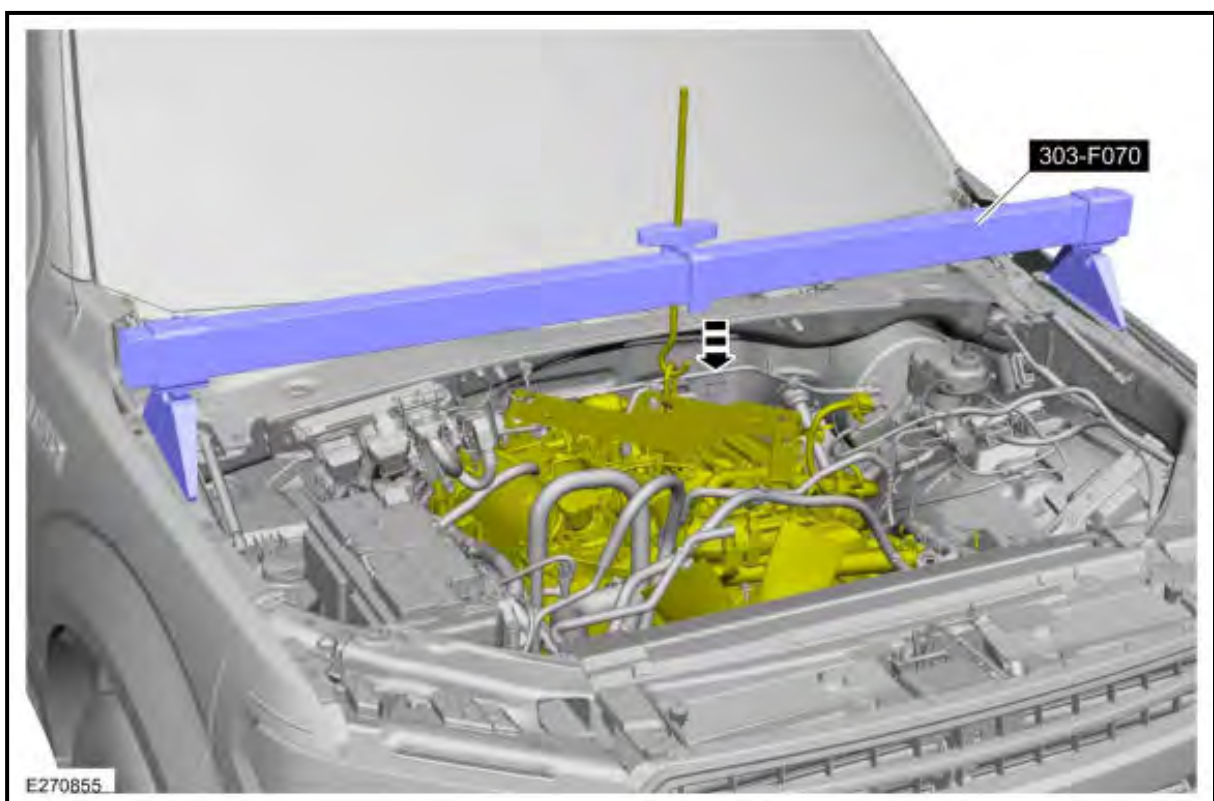
Install the new RH engine mount nuts.

Torque: 111 lb.ft (150 Nm)





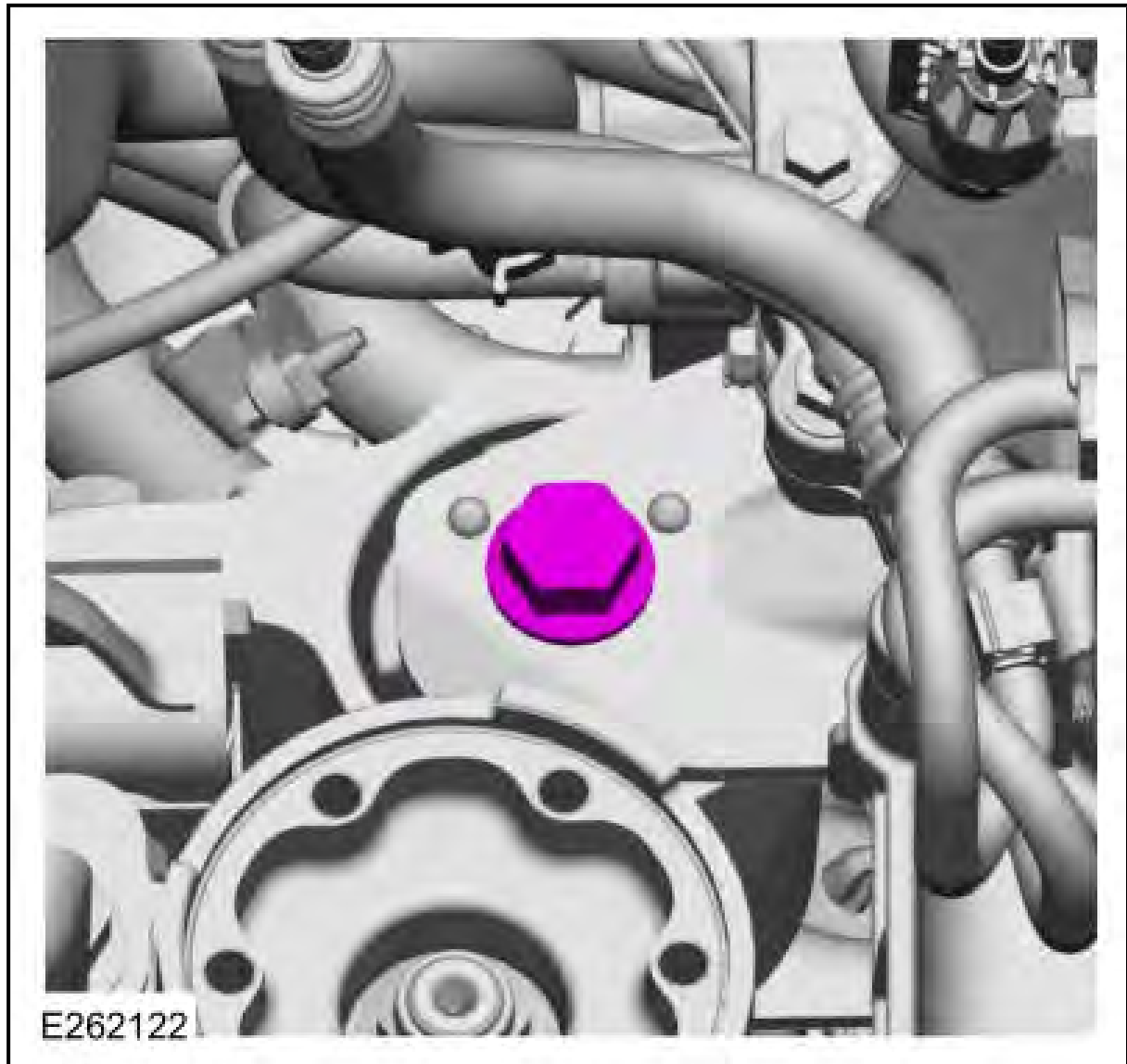
6. Lower the engine to the installed position. Use Special Service Tool: 303-F070 Support Bar, Engine.



7. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

Install the new LH engine mount through bolt.

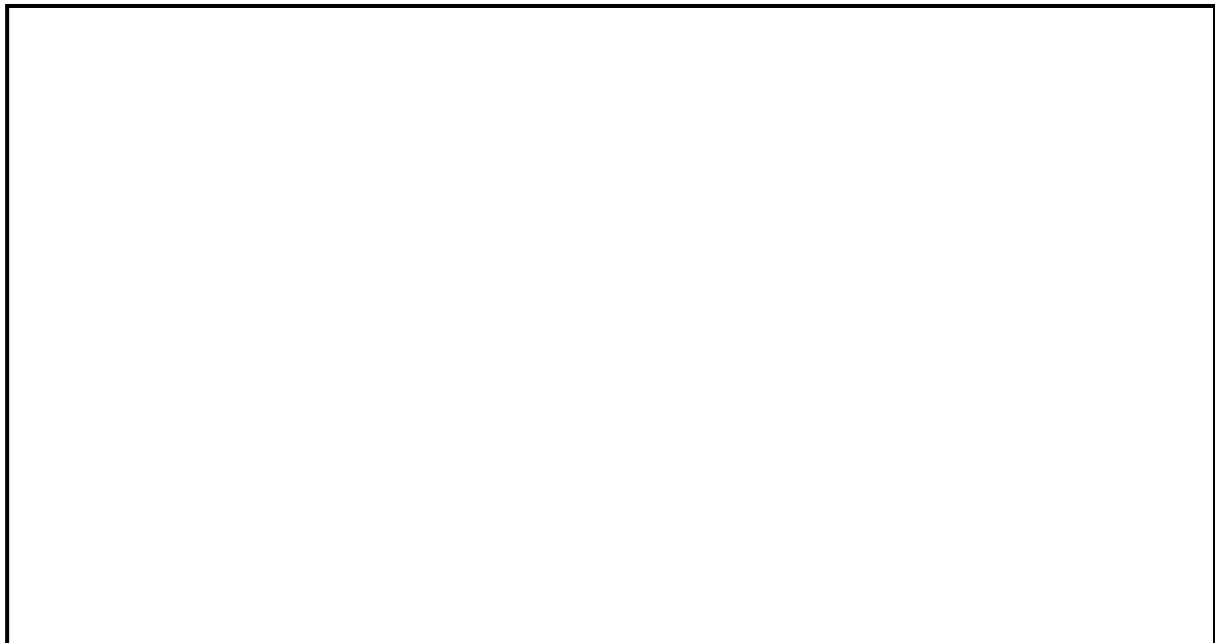
Torque: 258 lb.ft (350 Nm)

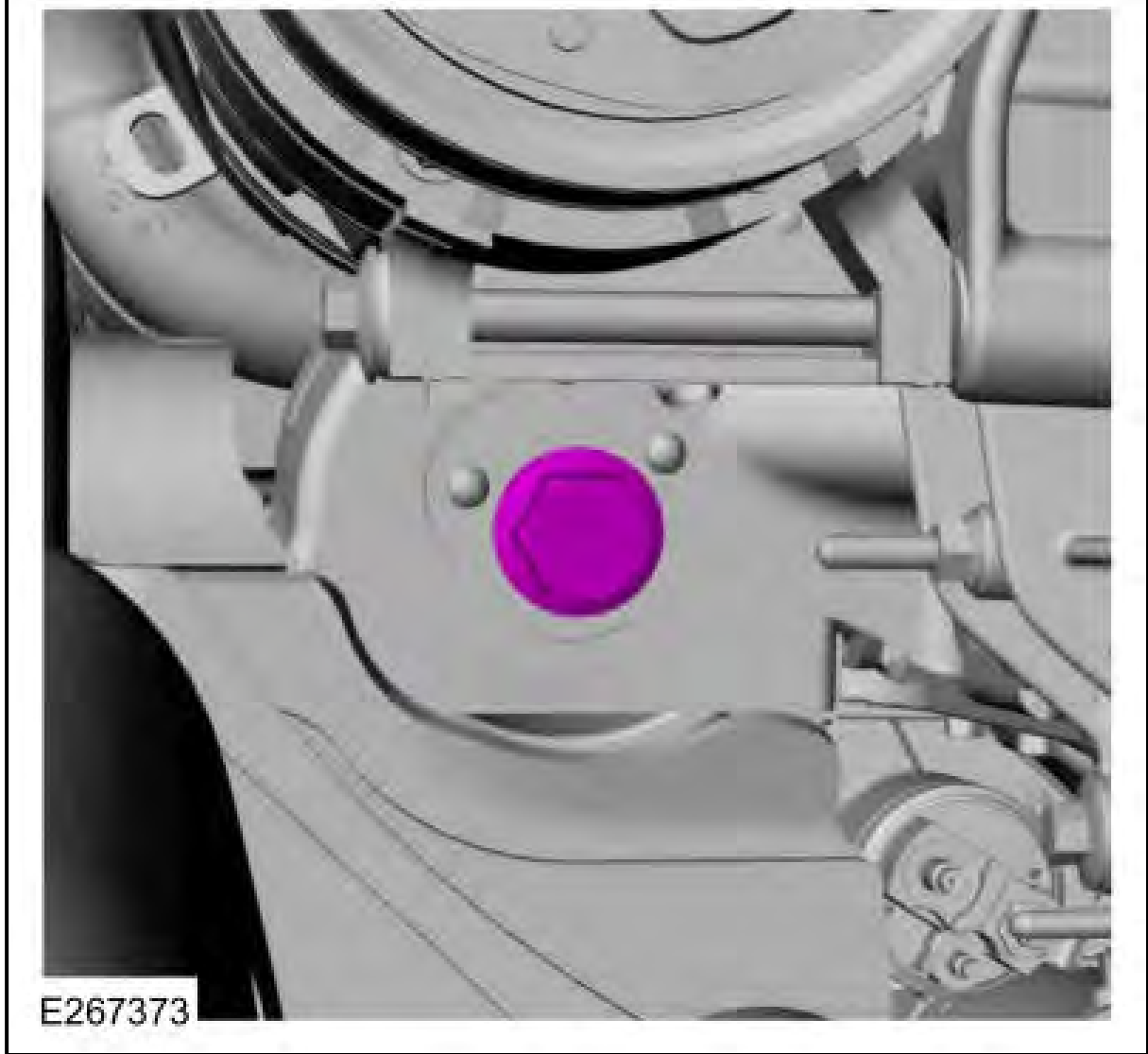


8. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

Install the new RH engine mount through bolt.

Torque: 258 lb.ft (350 Nm)



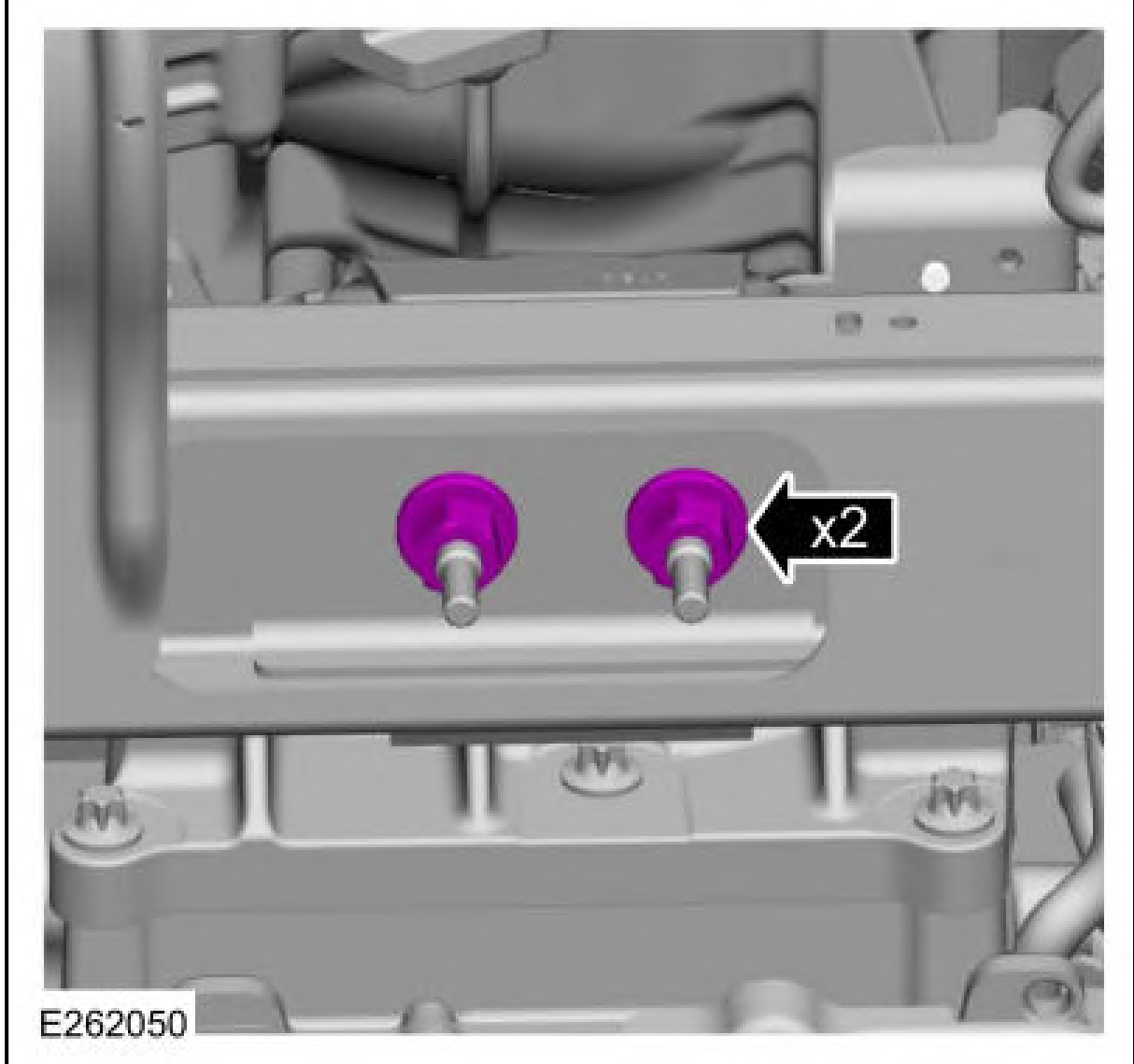


9. **NOTE:** Only use hand tools when loosening or tightening the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.

Remove and discard the transmission mount-to-crossmember nuts. Install new transmission mount-to-crossmember nuts.

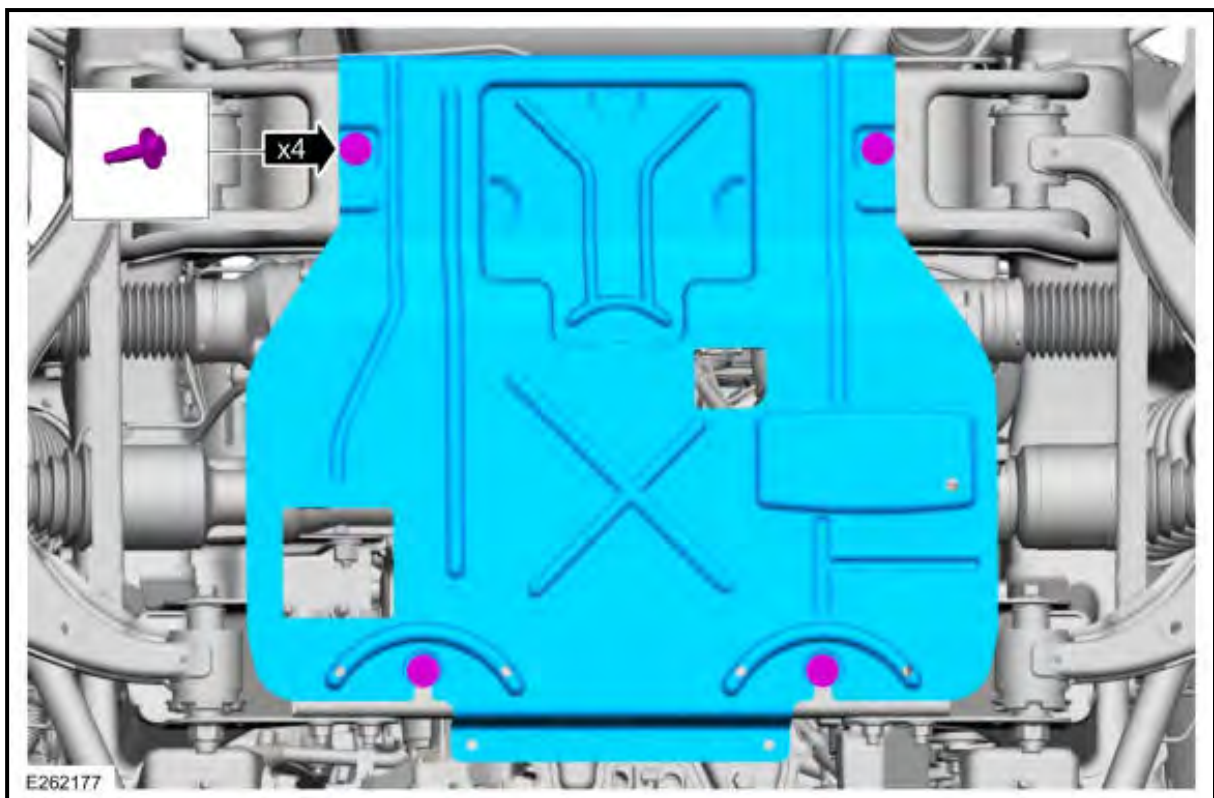
Torque: 85 lb.ft (115 Nm)





10. If equipped, install the front driveshaft. REFER to: [Front Driveshaft](#) .
11. If equipped. Install the skid plate and the bolts.

Torque: 30 lb.ft (40 Nm)



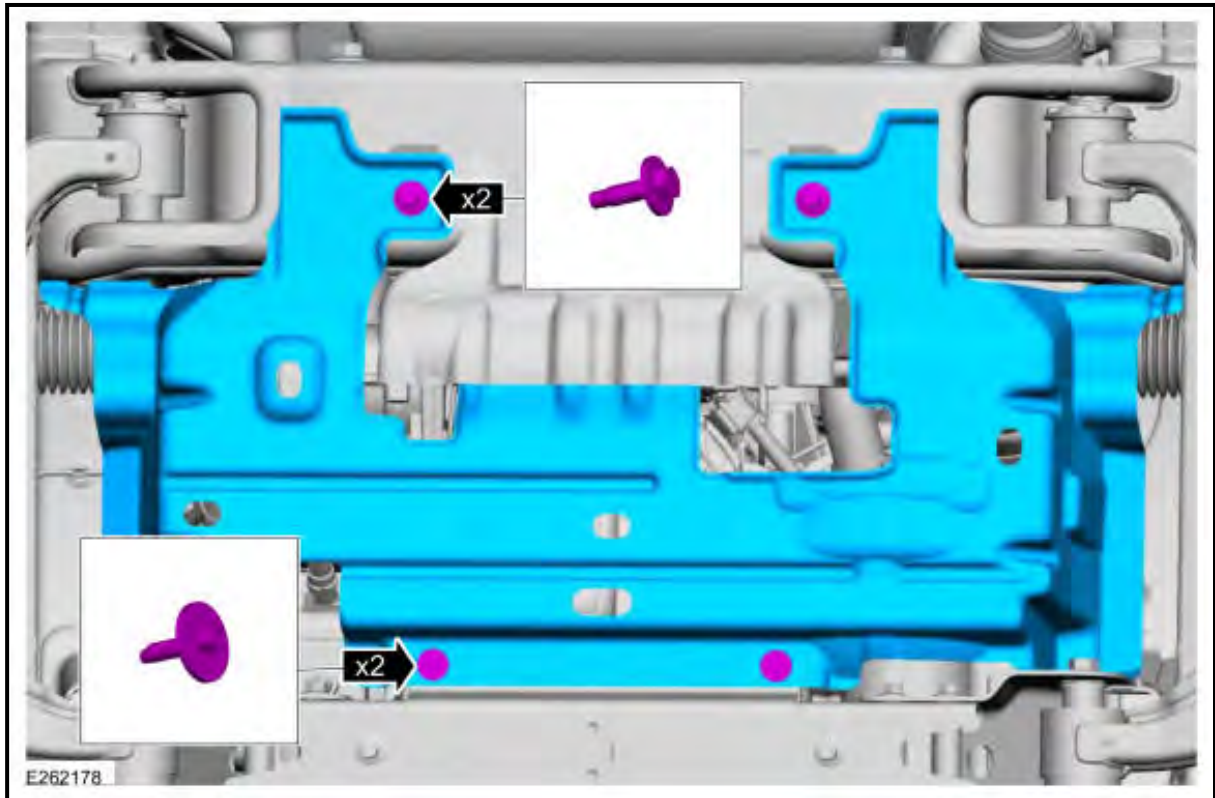
12. If equipped. Install the underbody shield and the bolts.



Torque:

M8 bolt : 30 lb.ft (40 Nm)

M6 bolt : 71 lb.in (8 Nm)

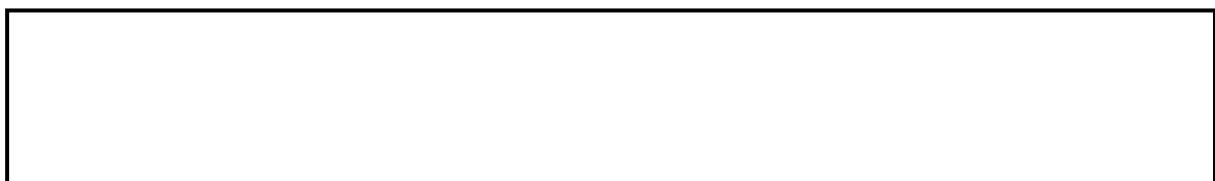


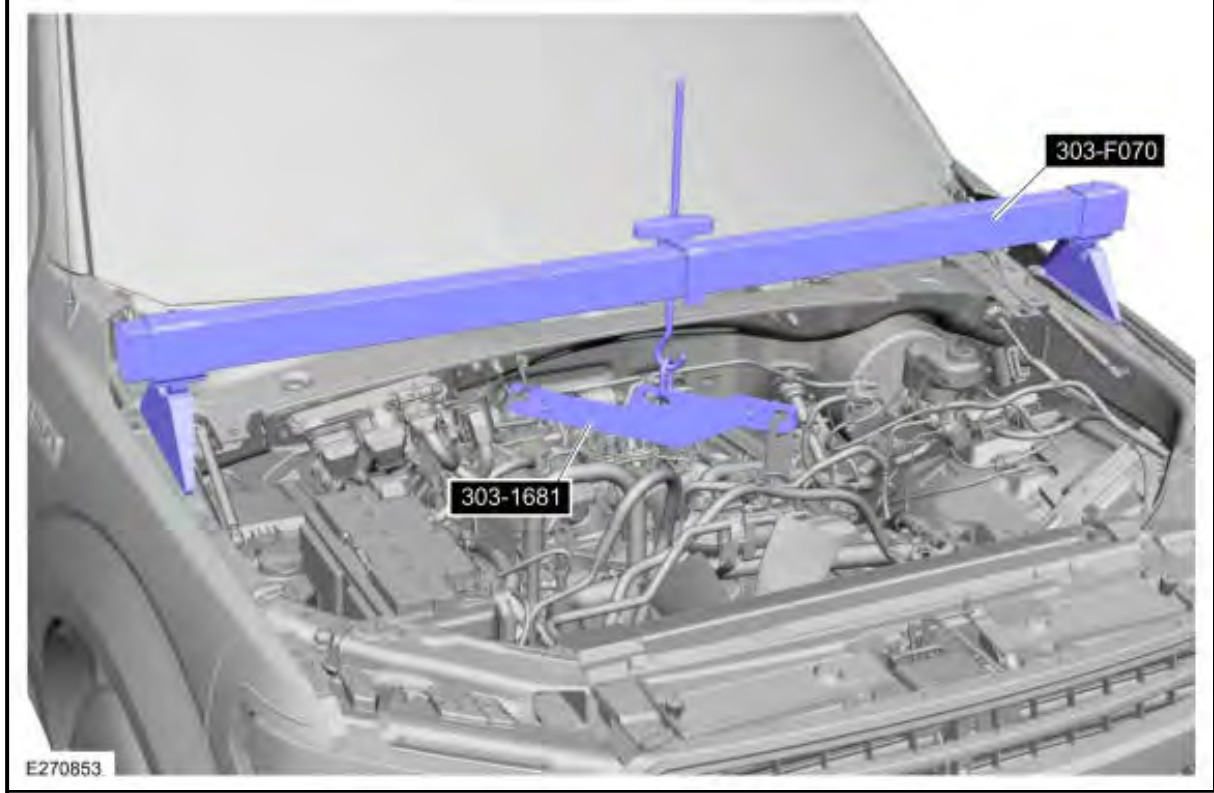
13. Install the transmission housing cover and the bolts. Install the retainer.

Torque: 71 lb.in (8 Nm)

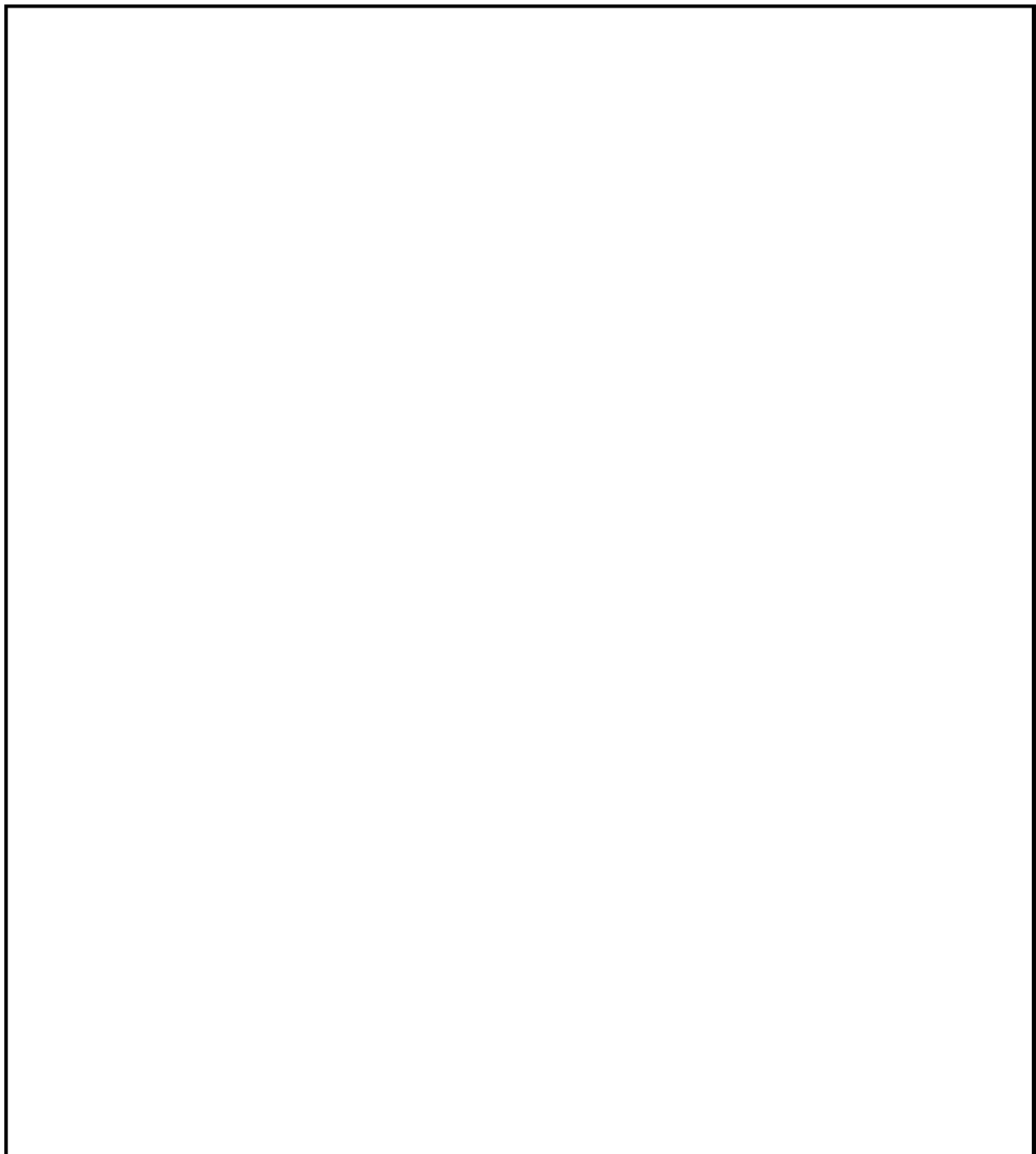


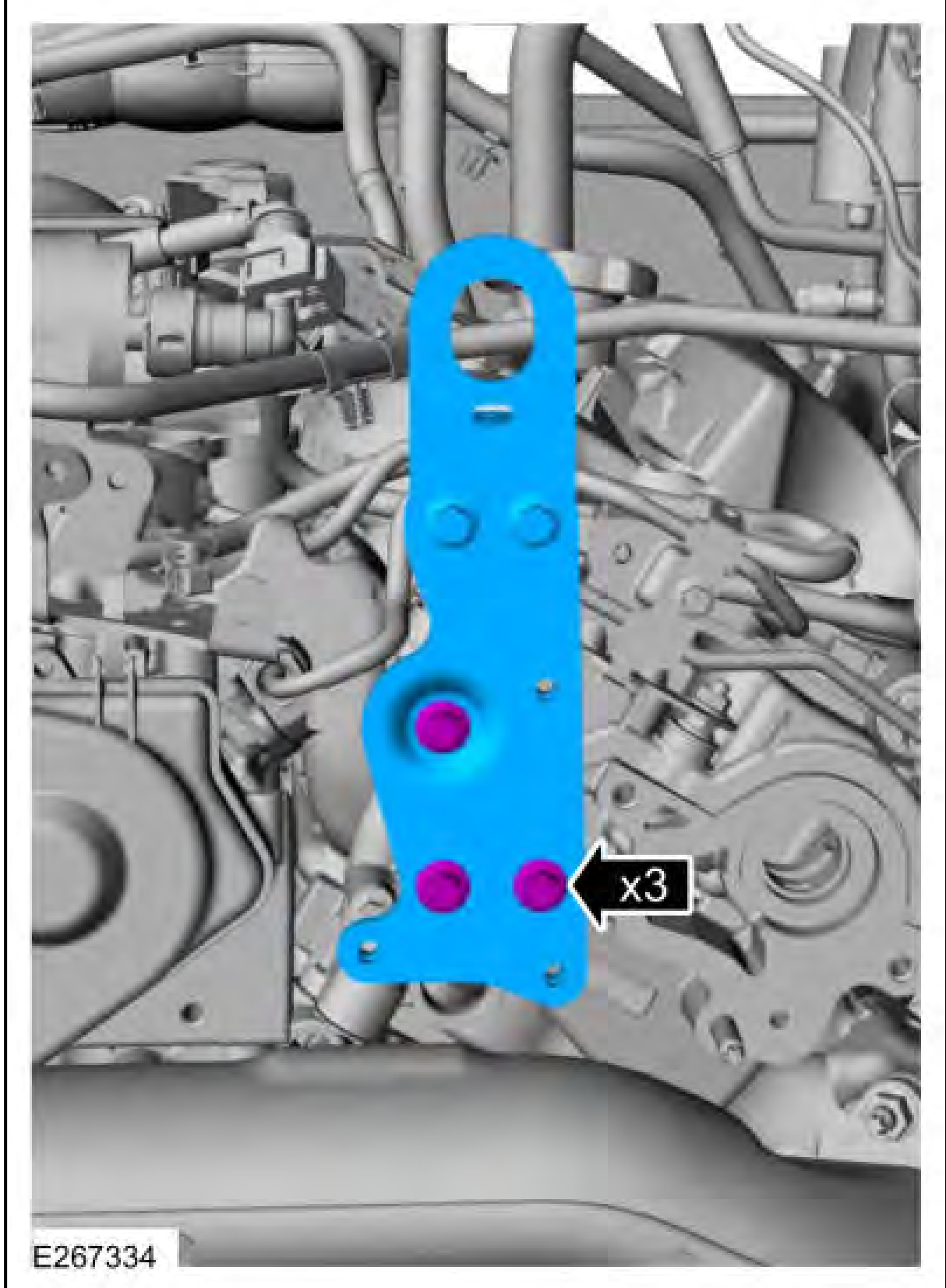
14. Remove Special Service Tool: 303-F070 Support Bar, Engine. , 303-1681 Spreader Bar.





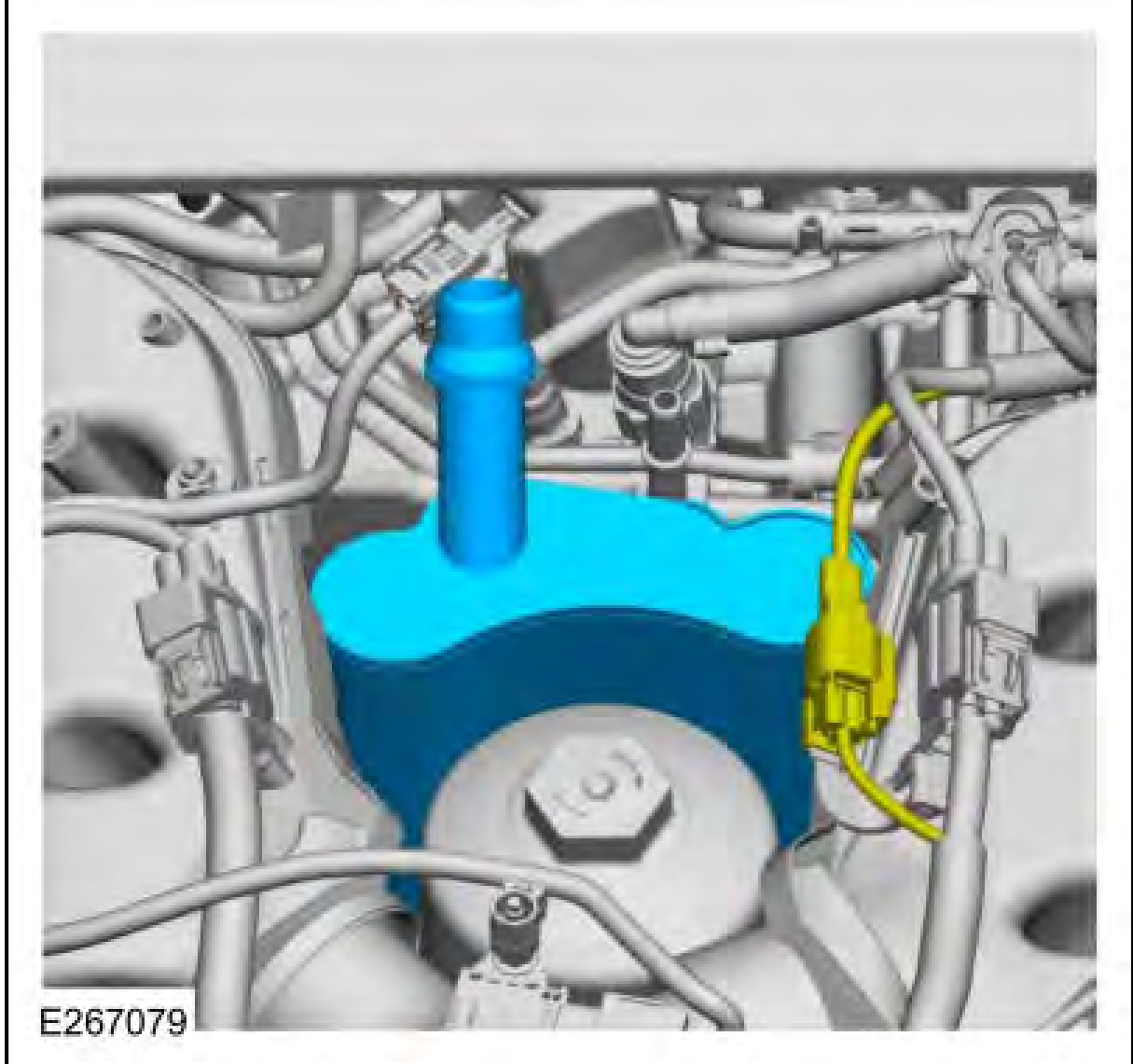
15. Remove the engine rear lifting bracket.





16. Install the crankcase vent oil separator and position back the wiring.

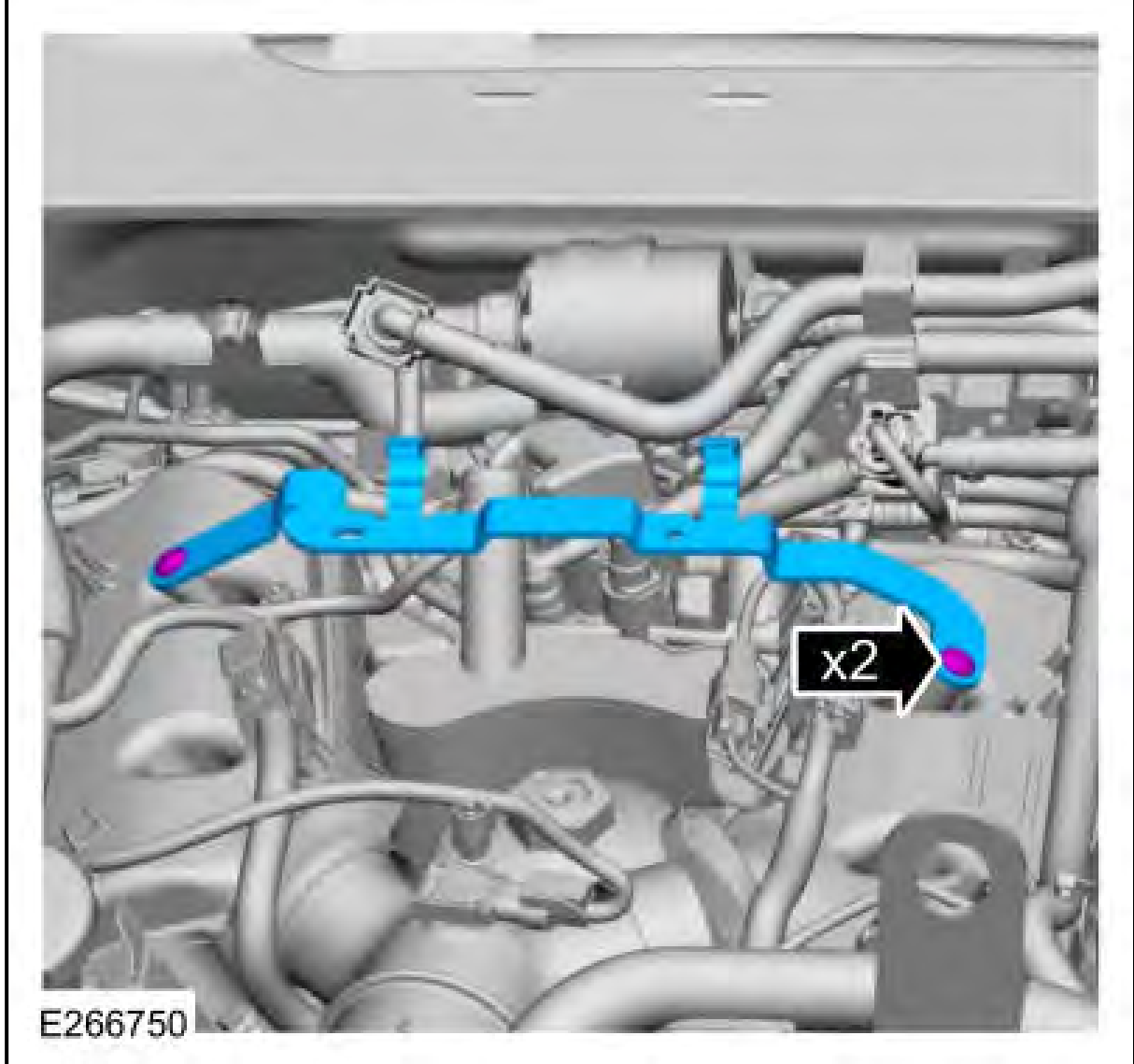




17. Install the engine appearance cover bracket.

Torque: 44 lb.in (5 Nm)

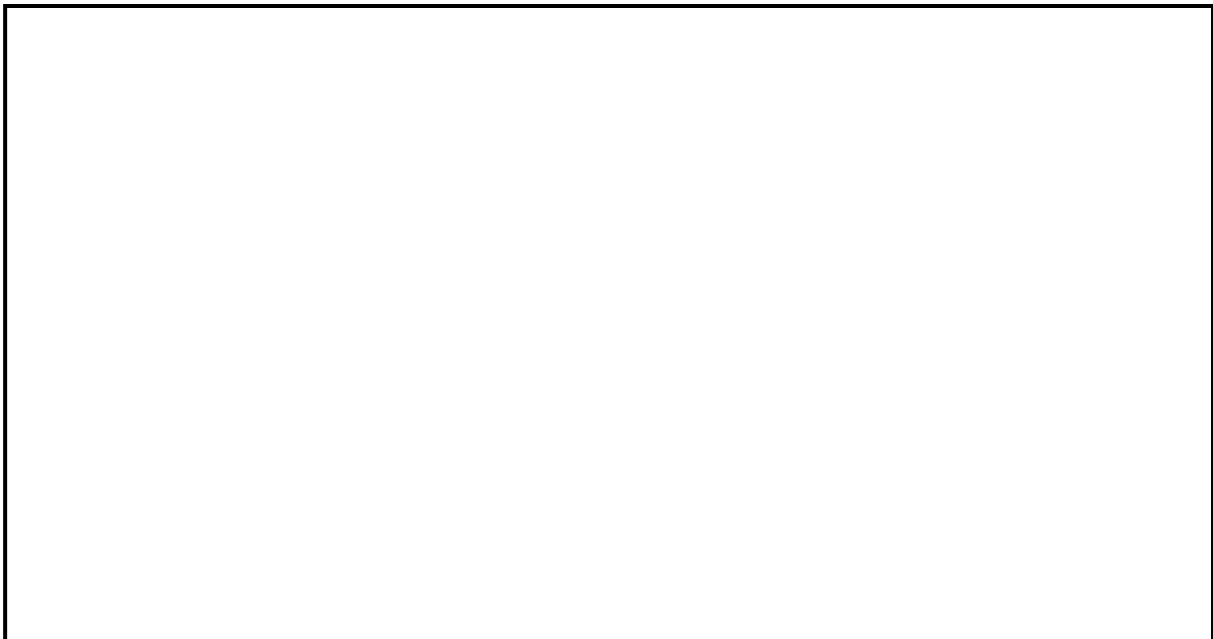


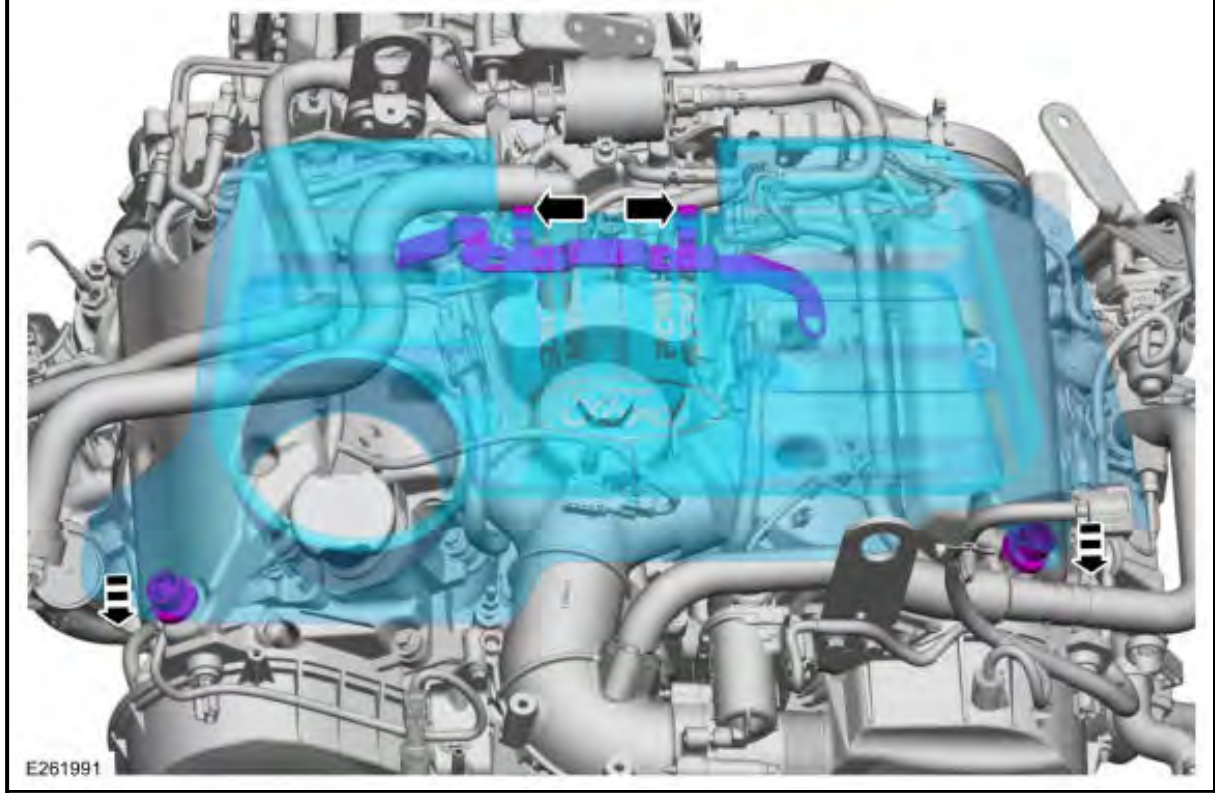


18. Install the following items:

1. Install the turbocharger. REFER to: [Turbocharger](#) .
2. Install the cooling fan upper shroud. REFER to: [Cooling Fan Upper Shroud](#) .
3. Install the CAC outlet pipe. REFER to: [Charge Air Cooler \(CAC\) Outlet Pipe](#) .
4. Install the CAC intake pipe. REFER to: [Charge Air Cooler \(CAC\) Intake Pipe](#) .
5. Install the air cleaner outlet tube. REFER to: [Air Cleaner Outlet Pipe](#) .
6. Install the cowl panel. REFER to: [Cowl Panel](#) .

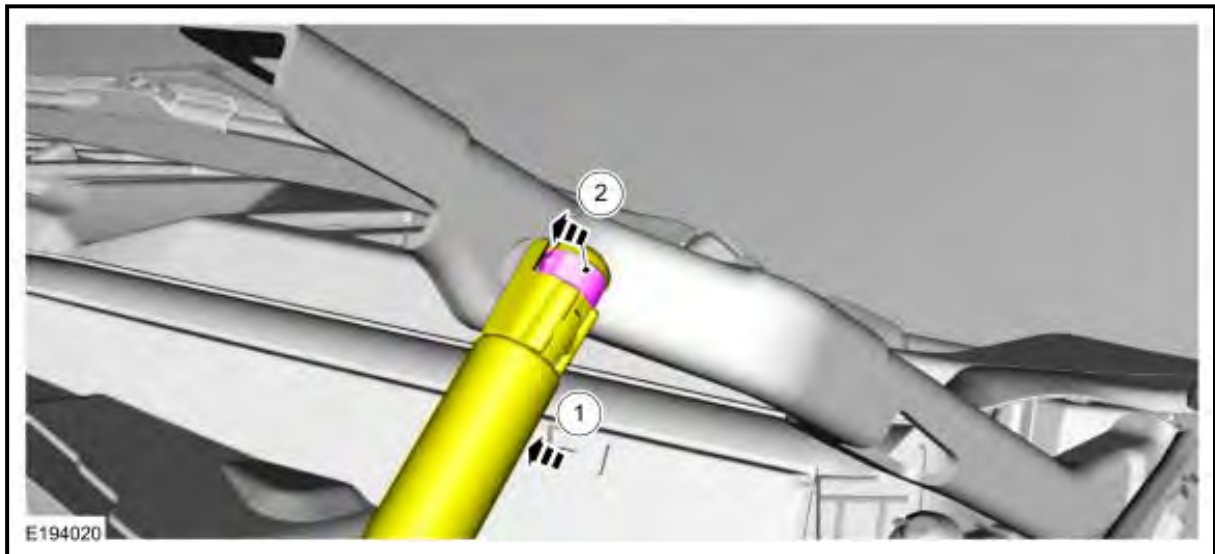
19. Install the engine appearance cover.





20. **NOTE:** LH shown, RH similar.

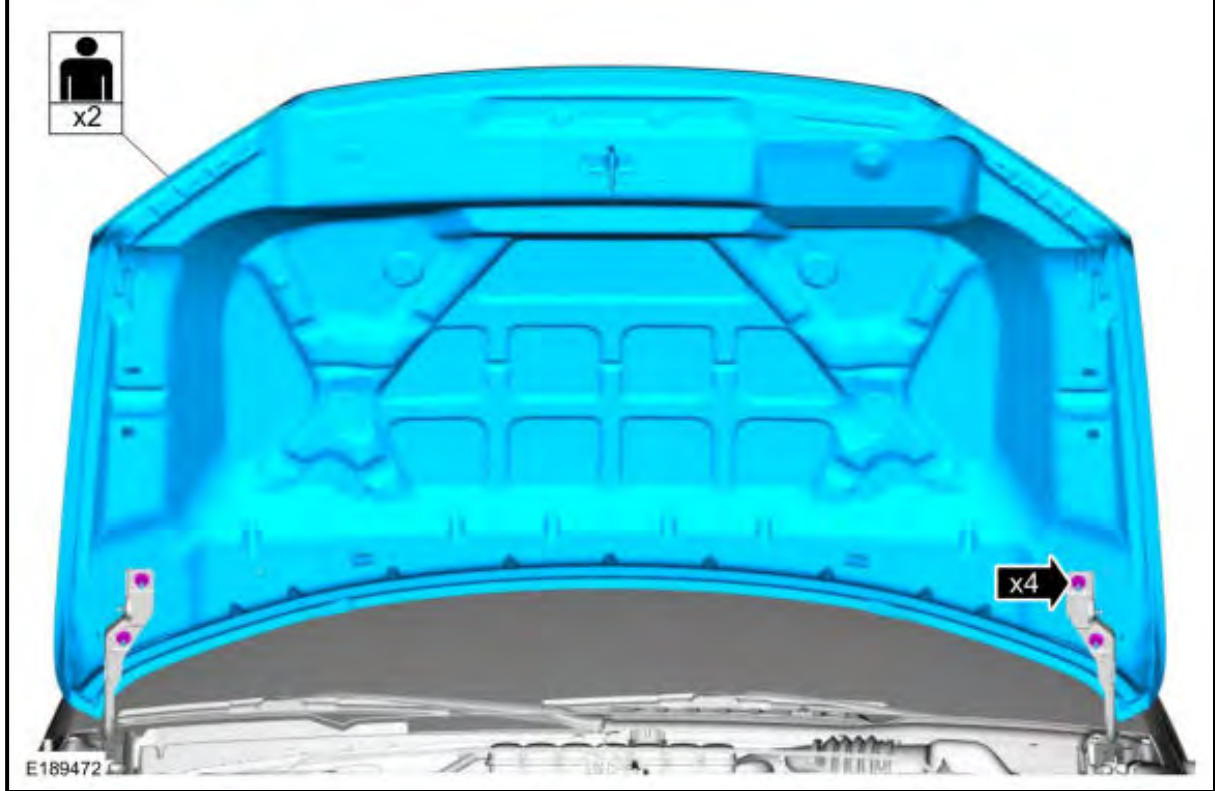
1. Position the hood shock and attach.
2. Install the clip.



21. Position the hood and install the nuts.

Torque: 18 lb.ft (25 Nm)





22. Start and check the exhaust system for leaks.

## EXHAUST MANIFOLD LH

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

### Special Tool(s) / General Equipment

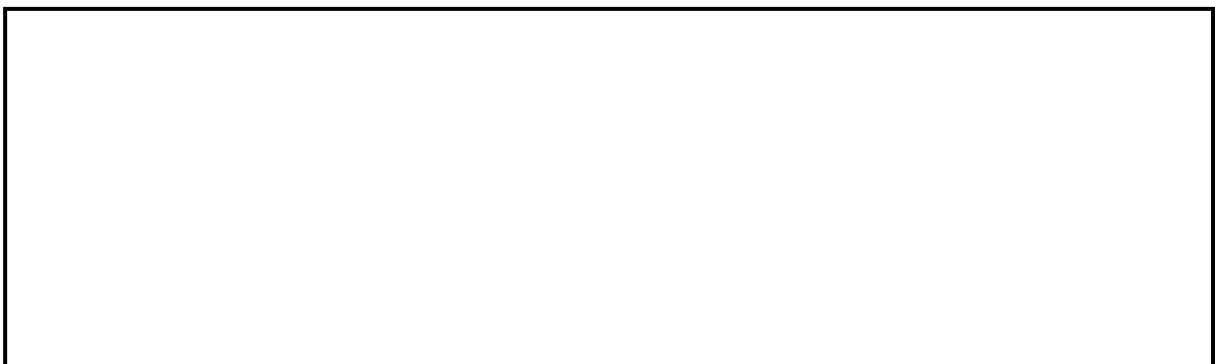
|                                     |
|-------------------------------------|
| <b>Hose Clamp Remover/Installer</b> |
|-------------------------------------|

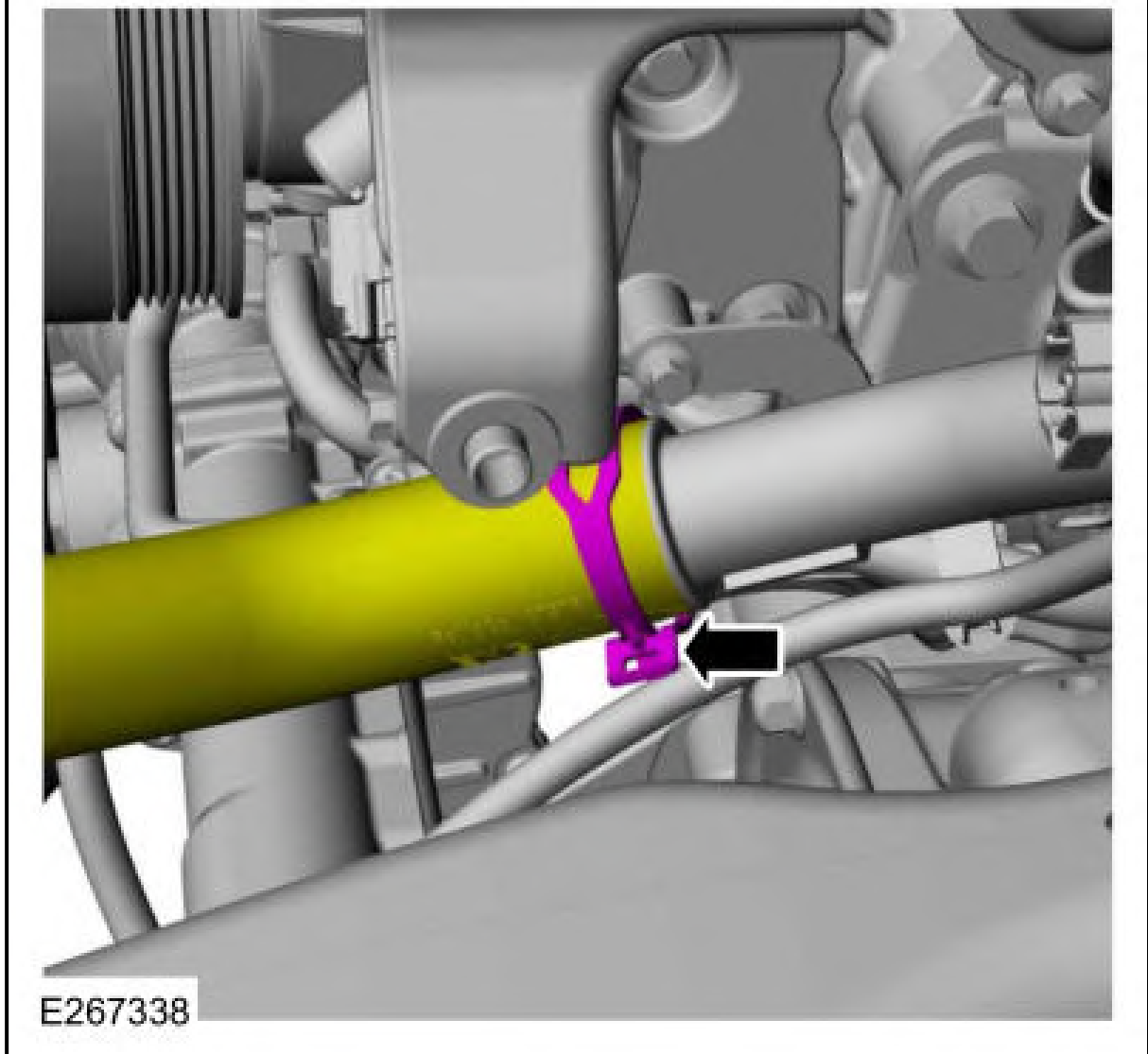
### Materials

| Name  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA  | WSS-M2C214-B1 |
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant VC-3-B | WSS-M97B44-D  |

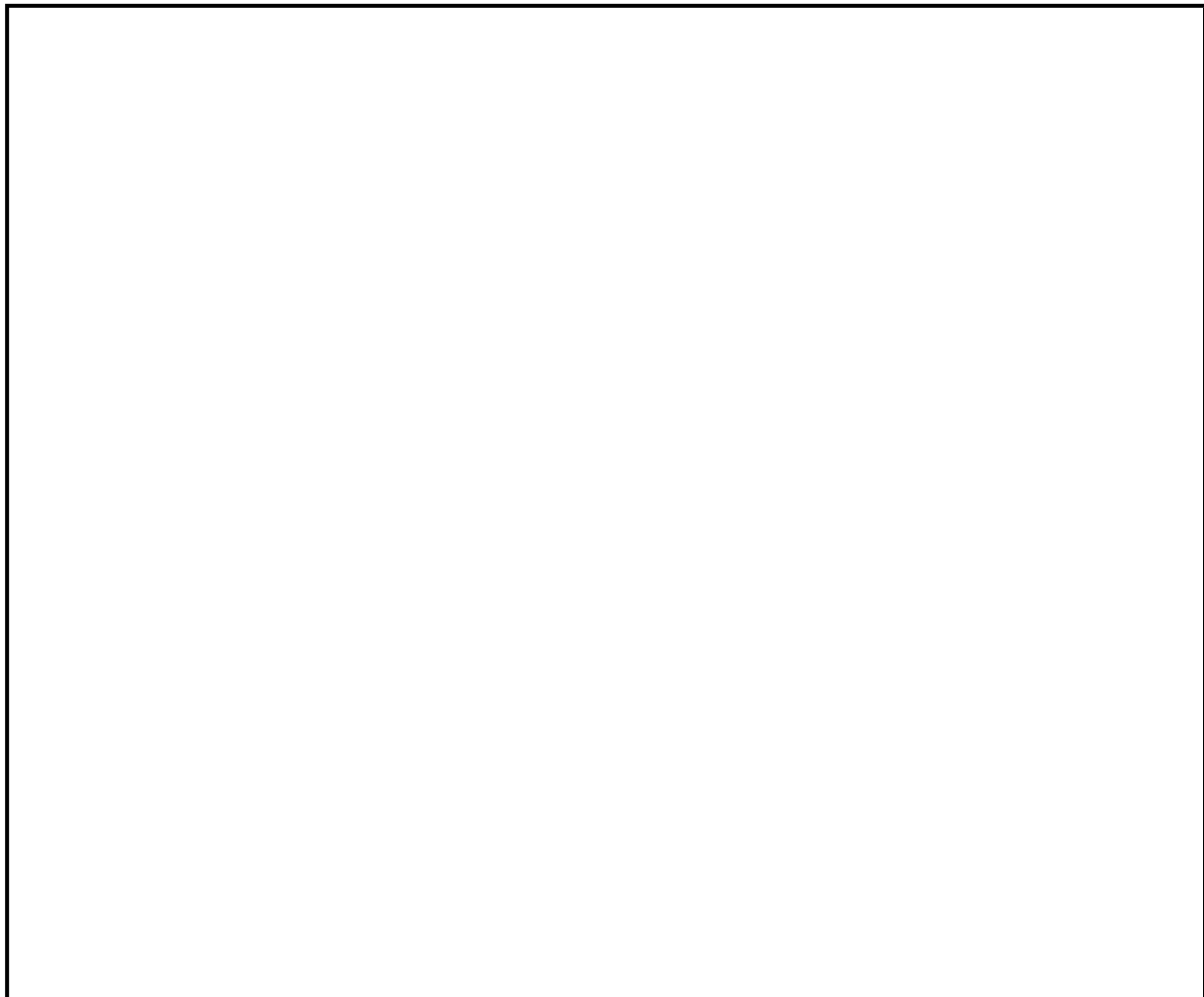
### REMOVAL

1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Drain the cooling system. REFER to: [Cooling System Draining, Vacuum Filling and Bleeding](#) .
3. Remove the following items:
  1. Remove the exhaust crossover pipe. REFER to: [Exhaust Crossover Pipe](#) .
  2. Remove the generator. REFER to: [Generator - 3.0L Power Stroke Diesel](#) .
4. Disconnect the lower radiator hose from the lower radiator coolant tube. Use the General Equipment: Hose Clamp Remover/Installer

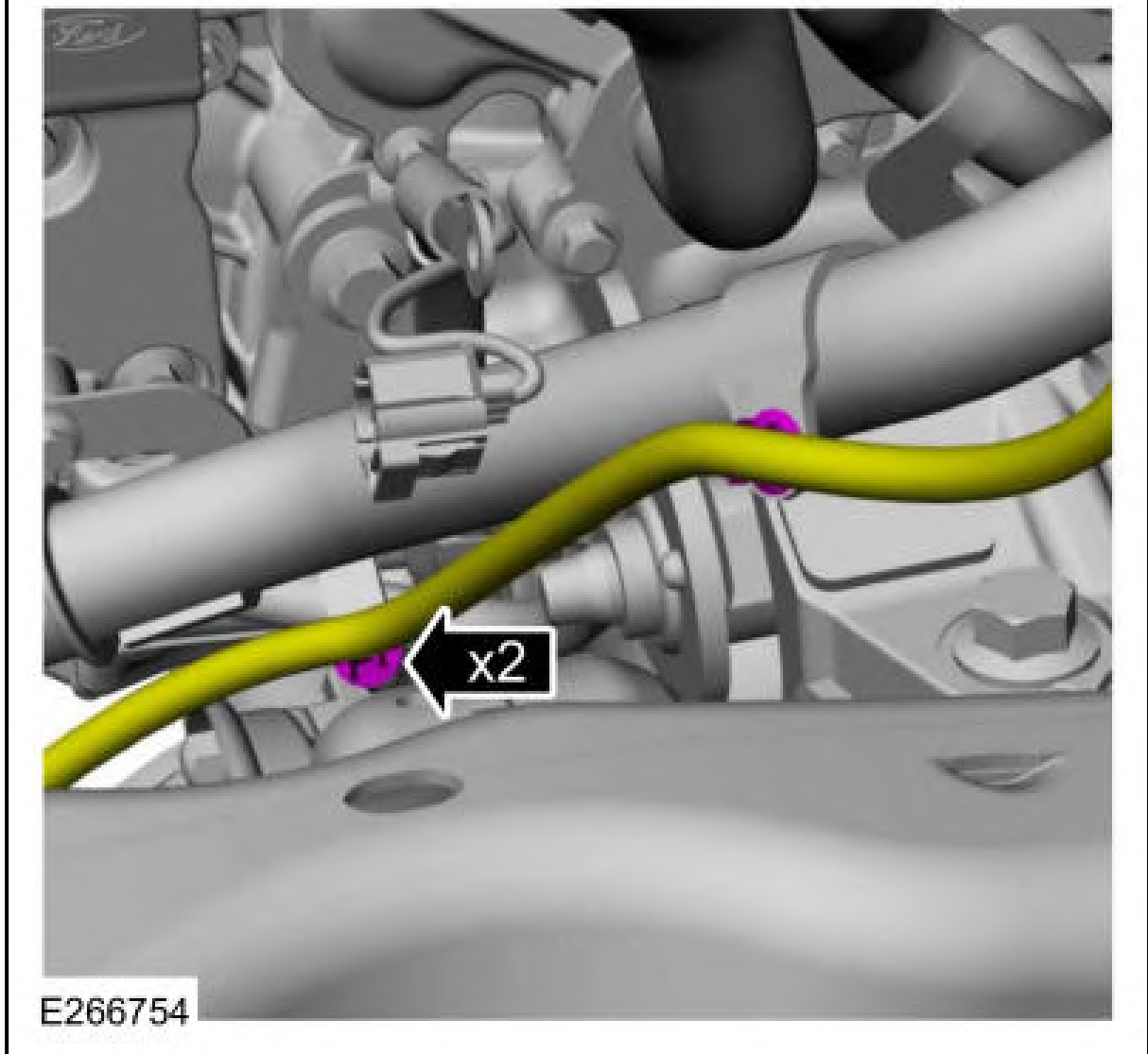




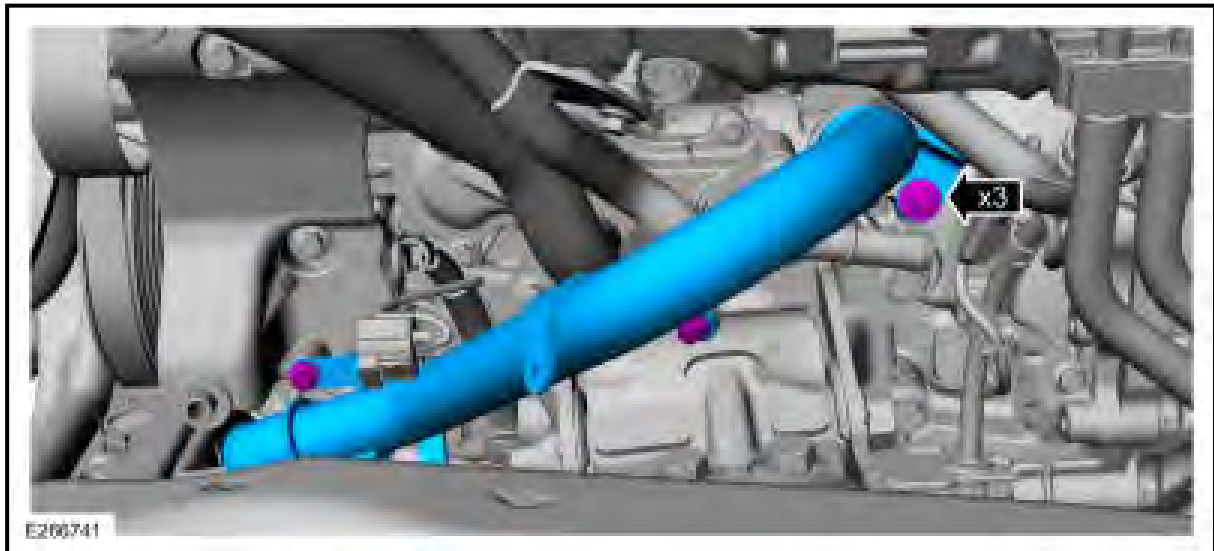
5. If equipped, disconnect the block heater cord retainers.



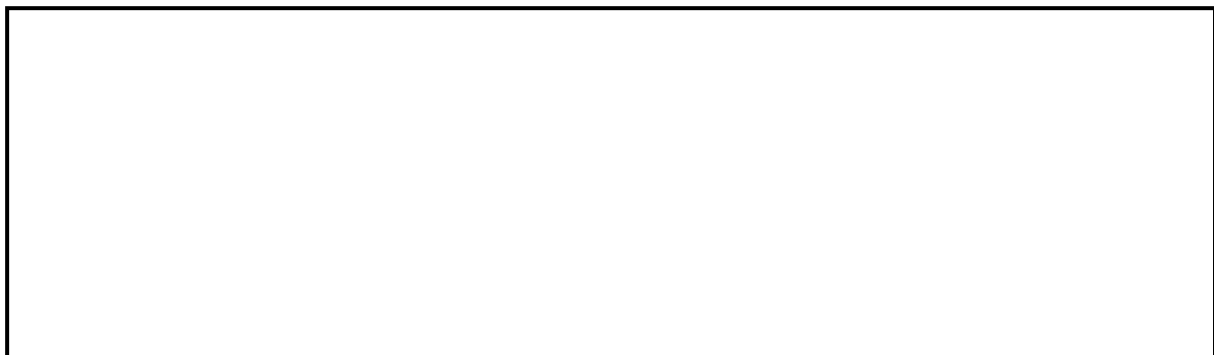


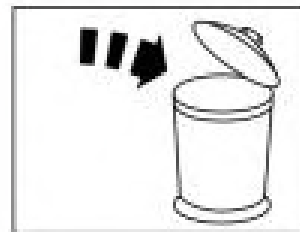


6. Remove the bolts and the lower radiator coolant tube.



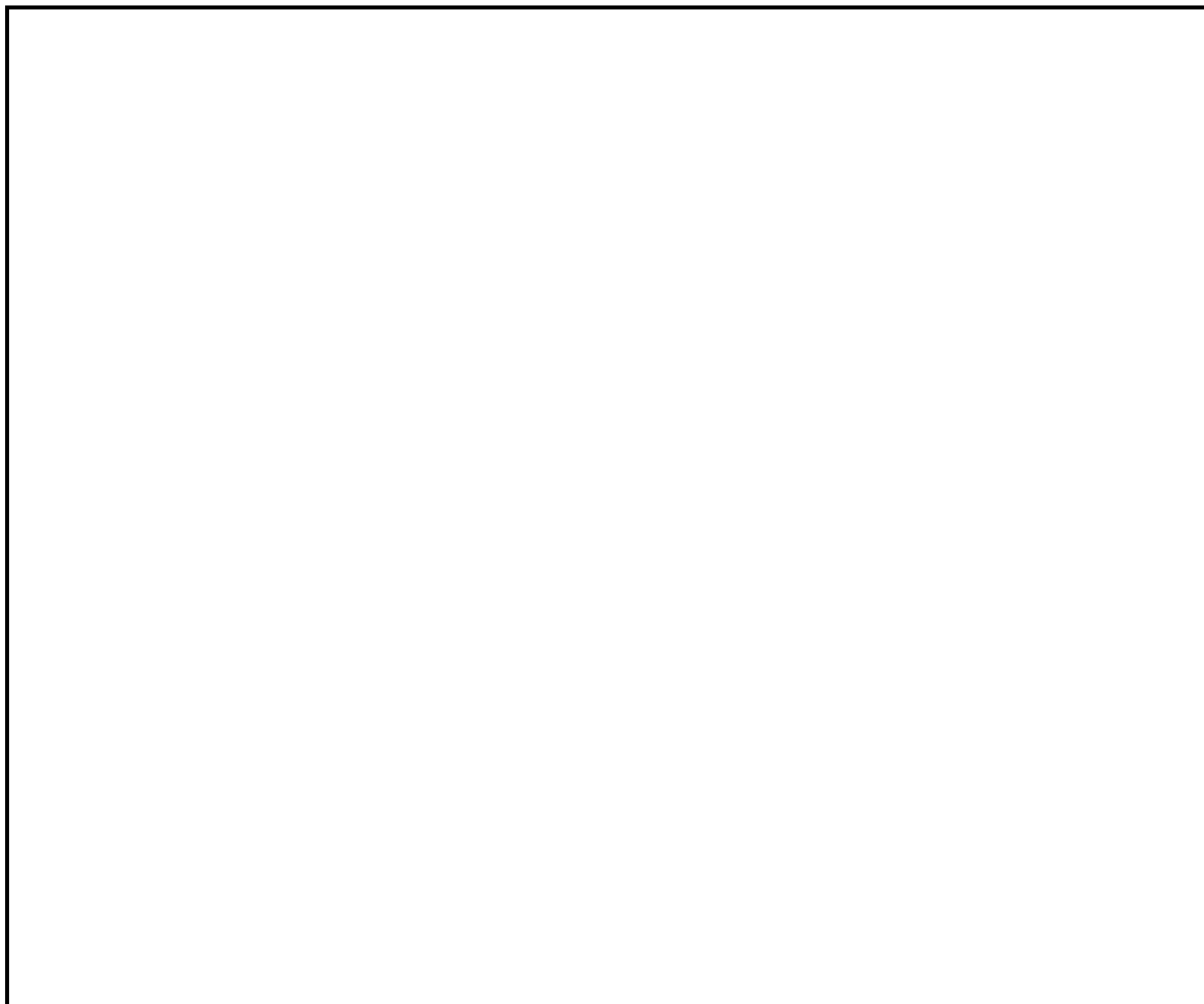
7. Remove and discard the O-ring seal from the lower radiator coolant tube.

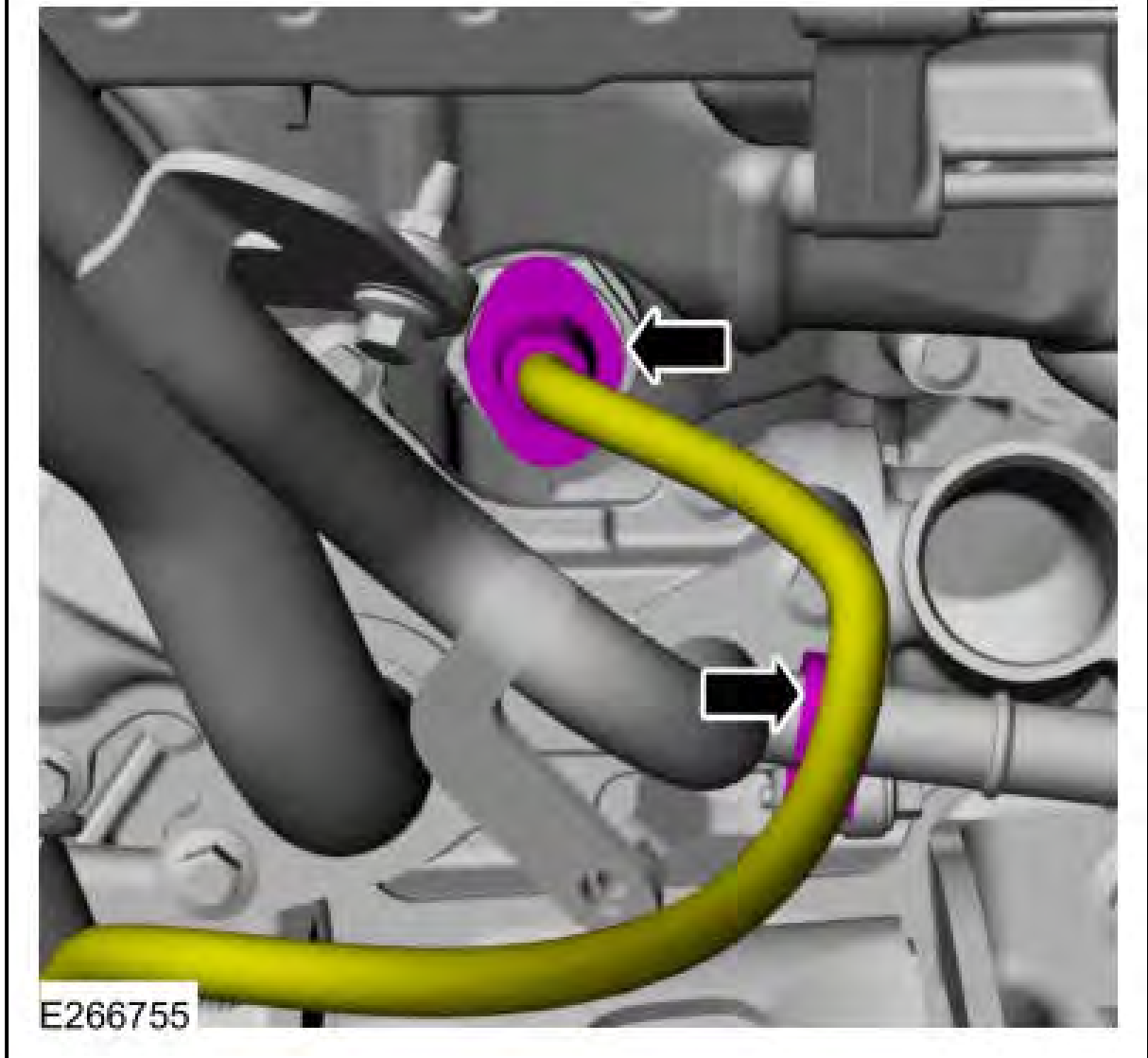




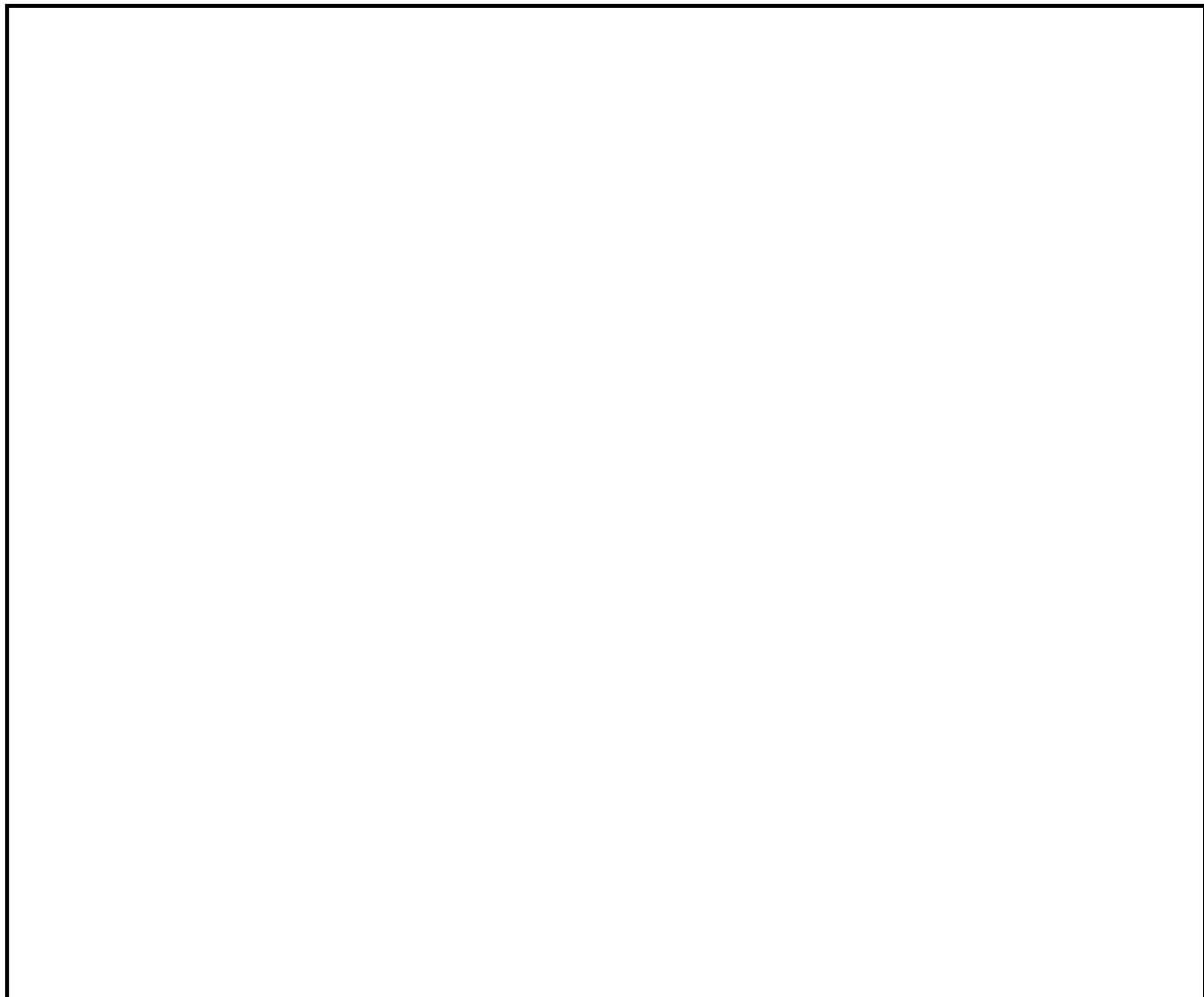
E267081

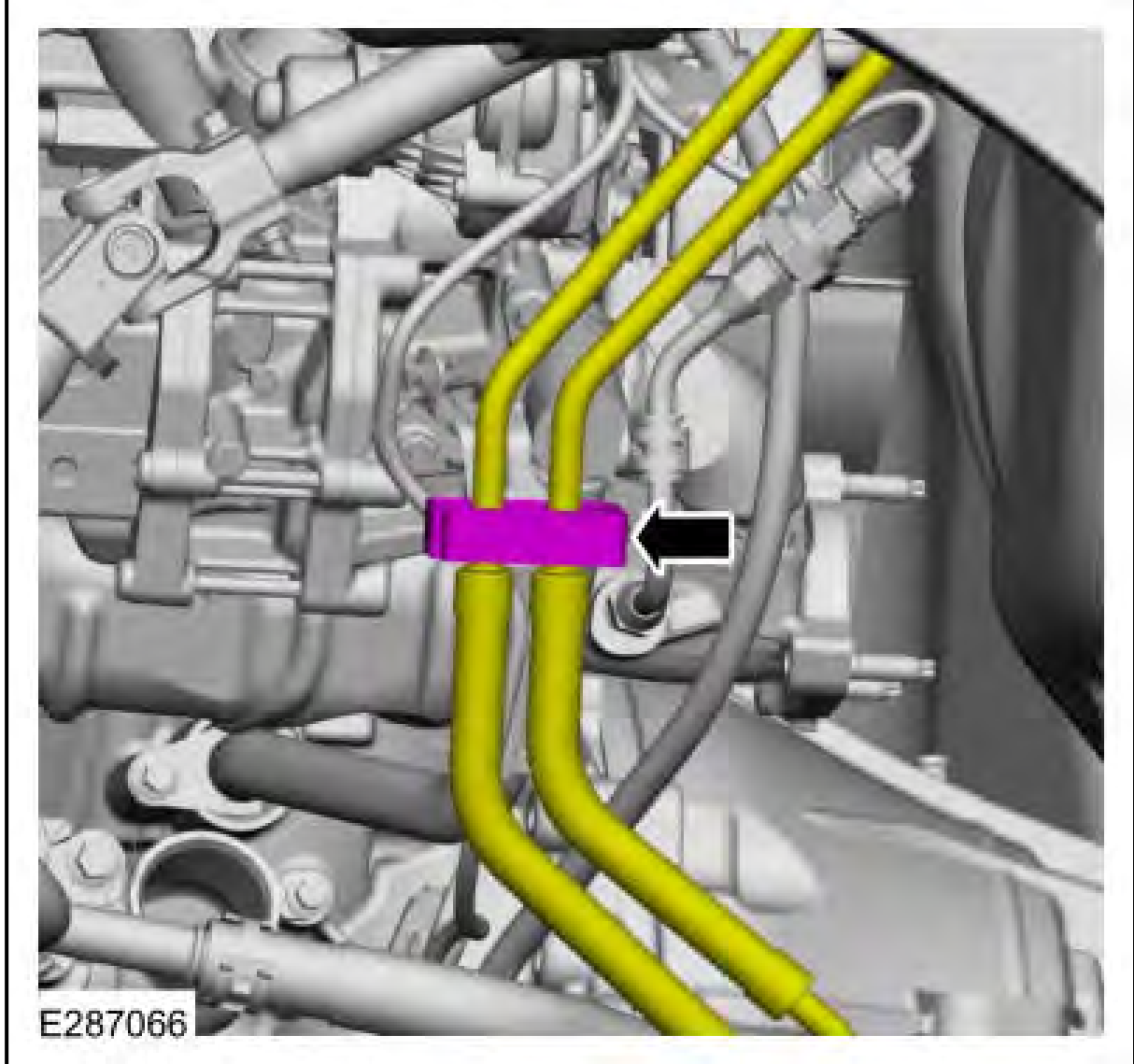
8. If equipped, disconnect the block heater cord retainer and the electrical connector.





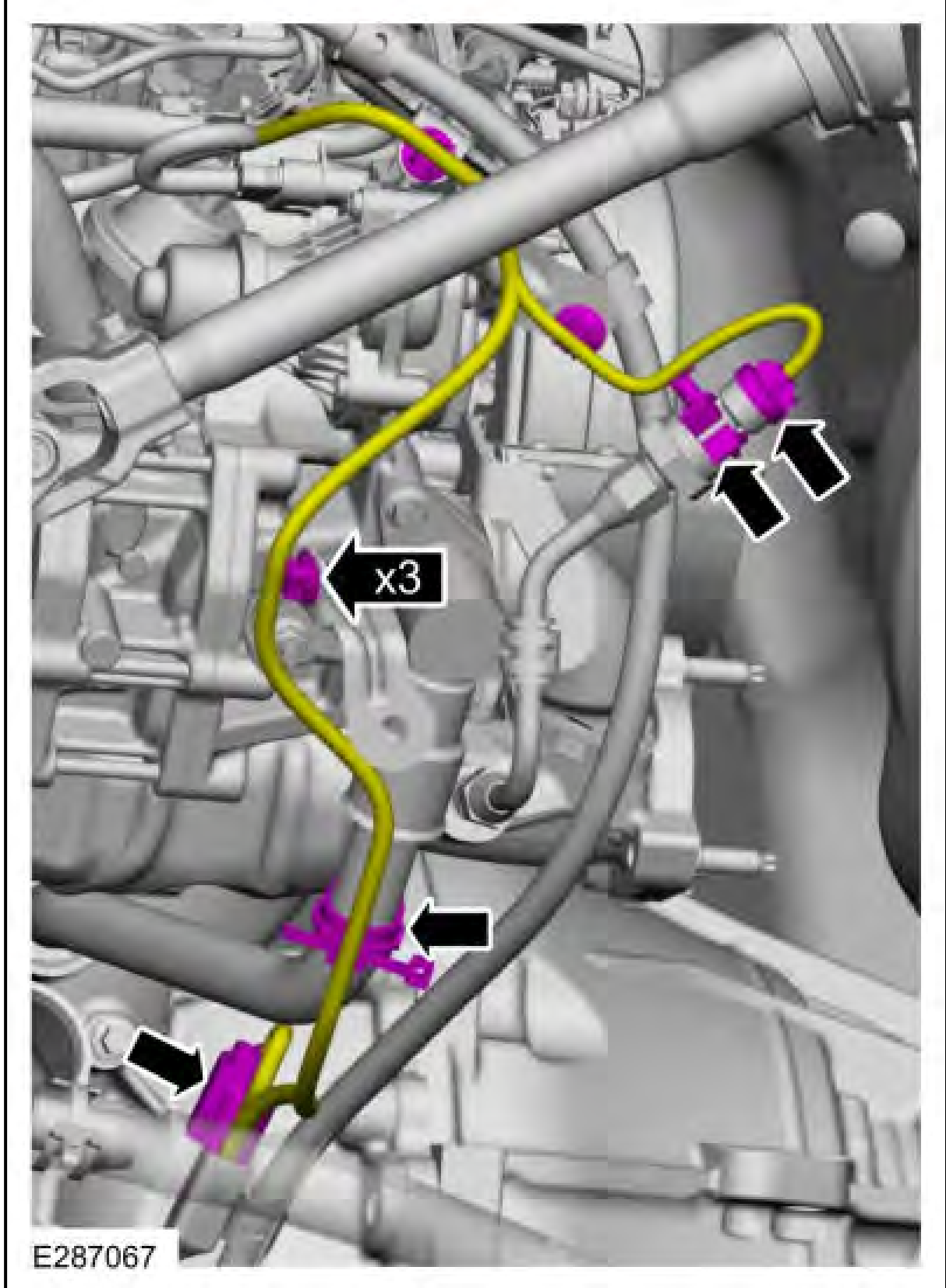
9. Disconnect and position aside the fuel tubes.





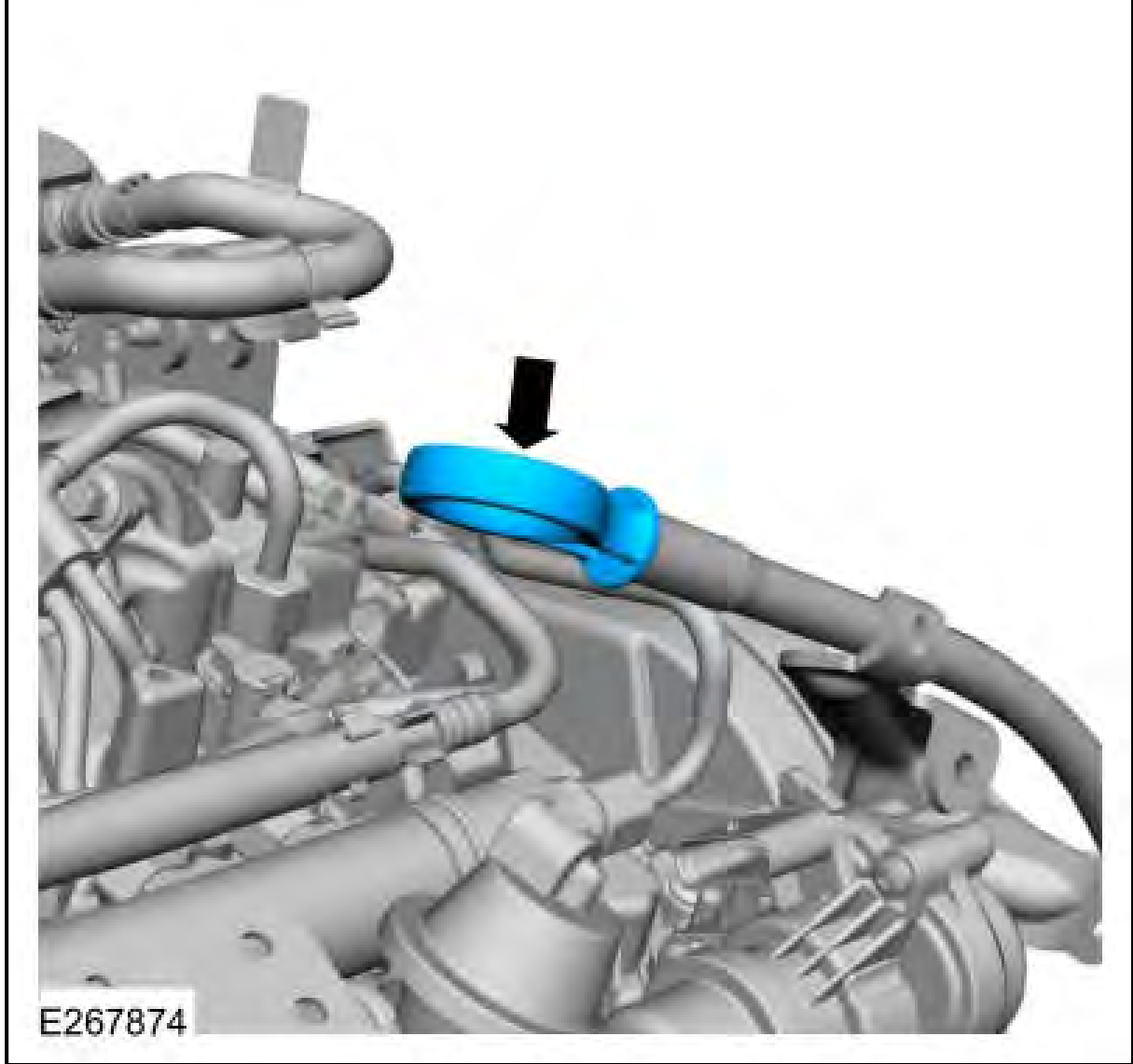
10. Disconnect the EP (exhaust pressure) sensor and the CKP sensor electrical connectors. Disconnect the retainers position aside the wiring.





11. Remove the oil level indicator.

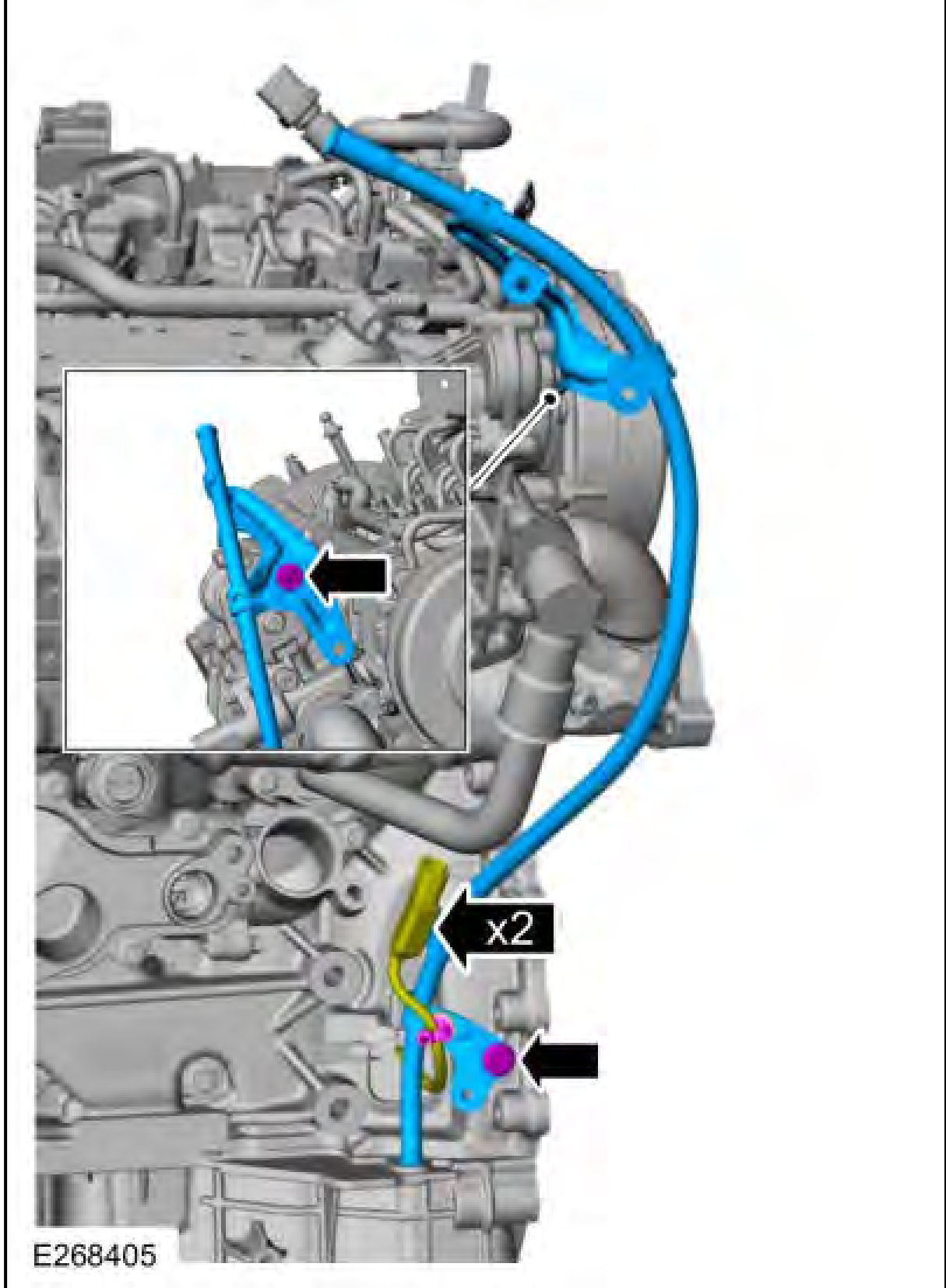




12.

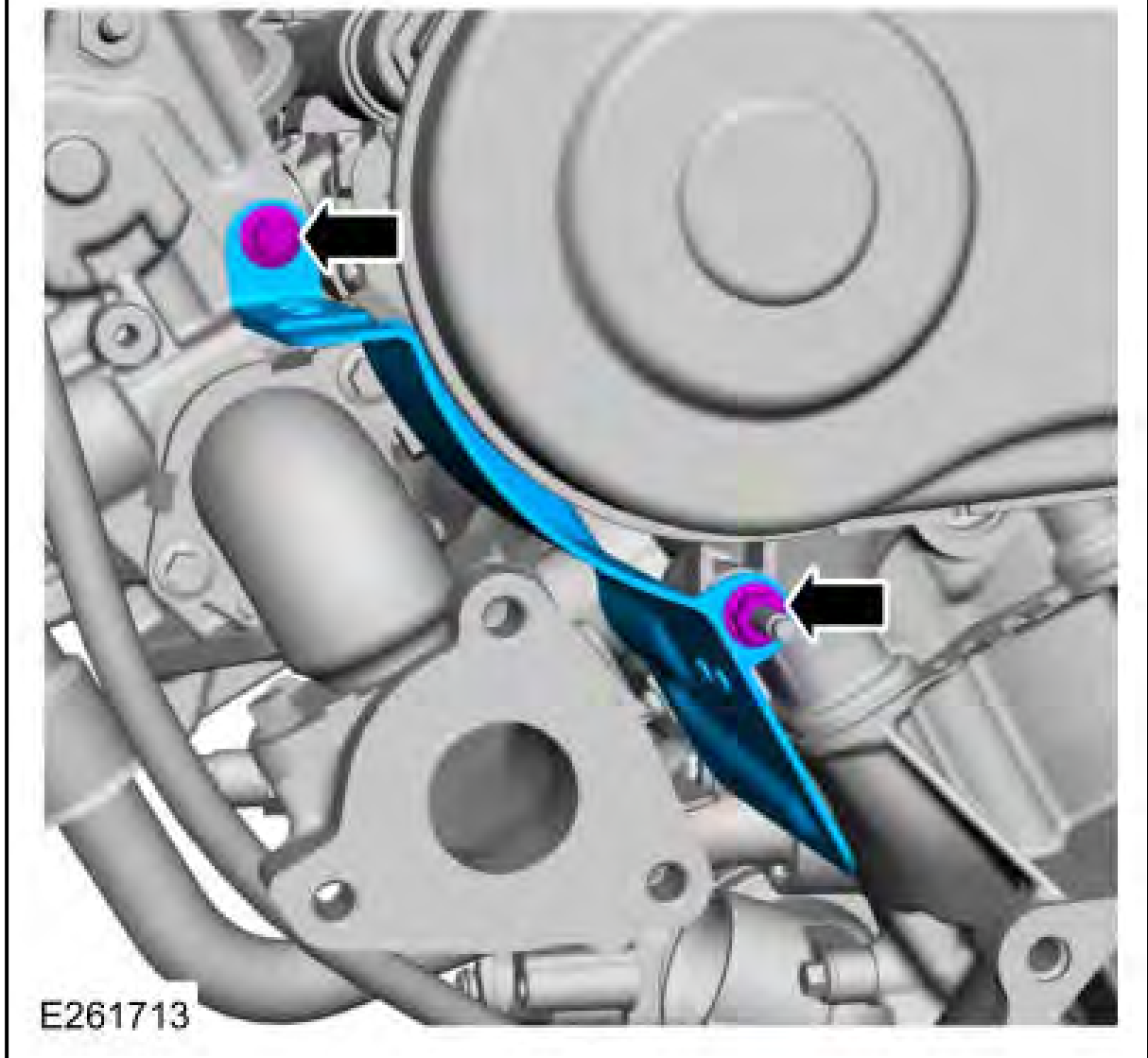
- Disconnect the wire retainers from the oil level indicator tube.
- Remove the stud bolt, the bolt and the oil level indicator tube.



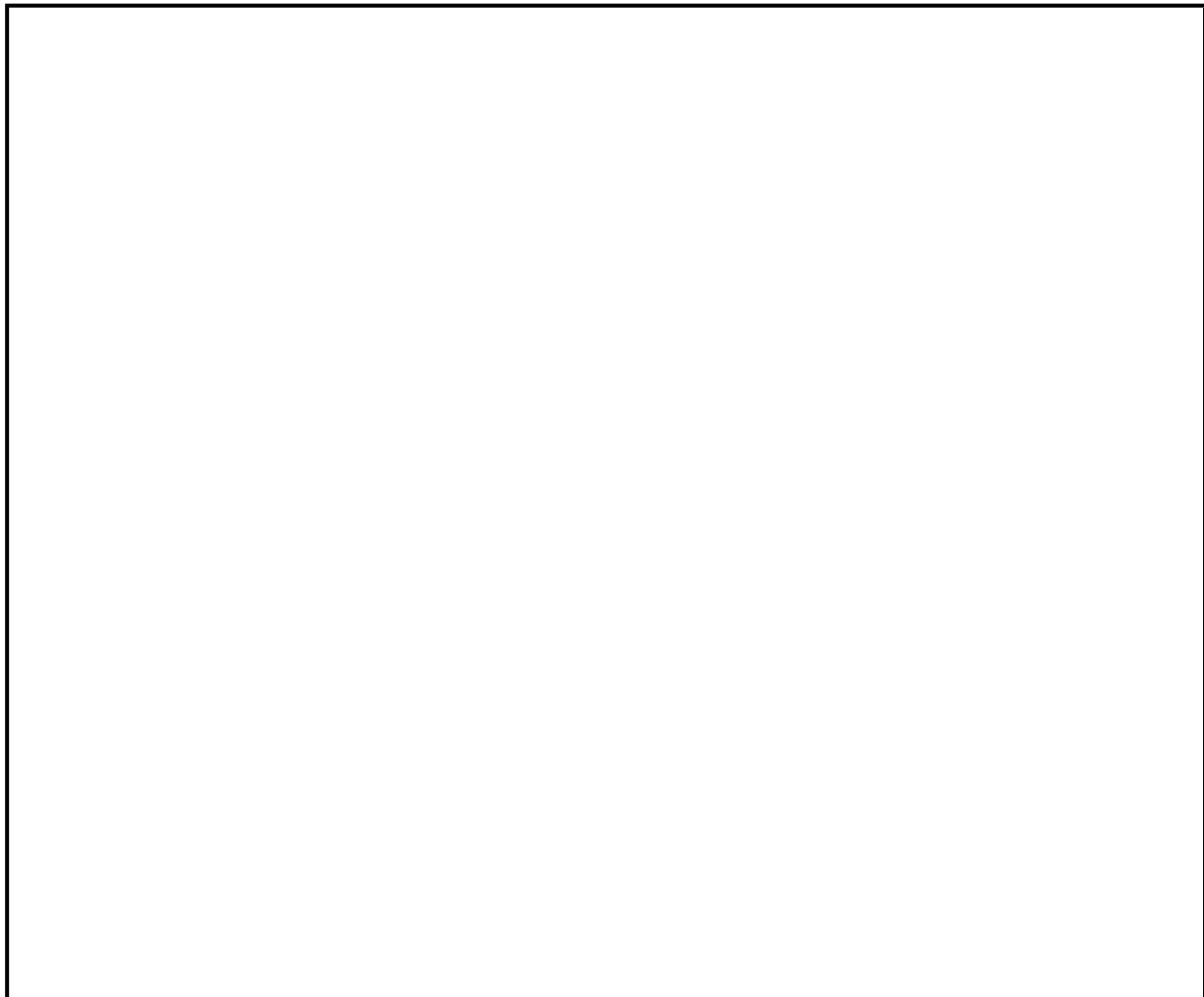


13. Remove the nut, the bolt and the LH exhaust manifold heat shield.

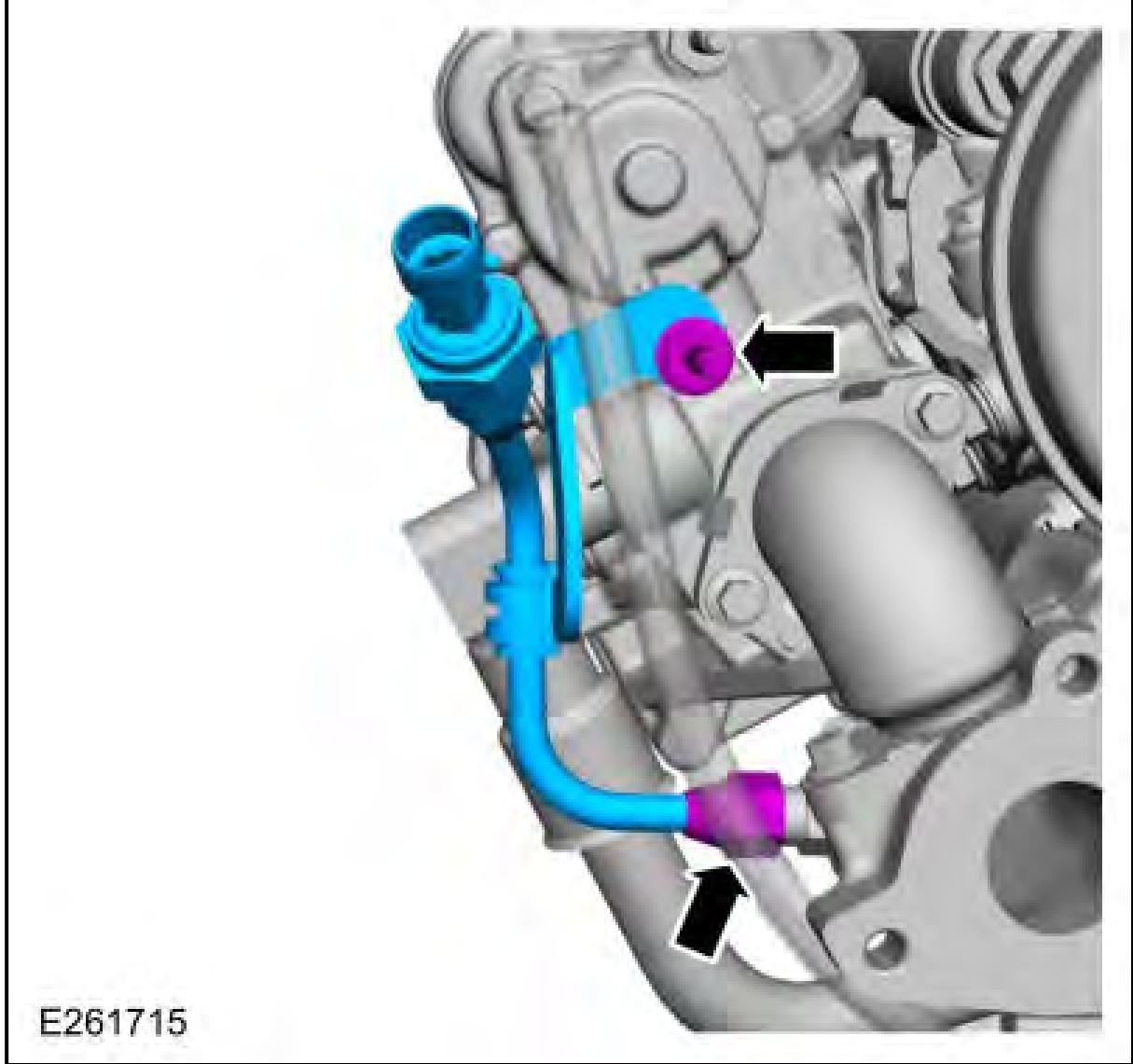




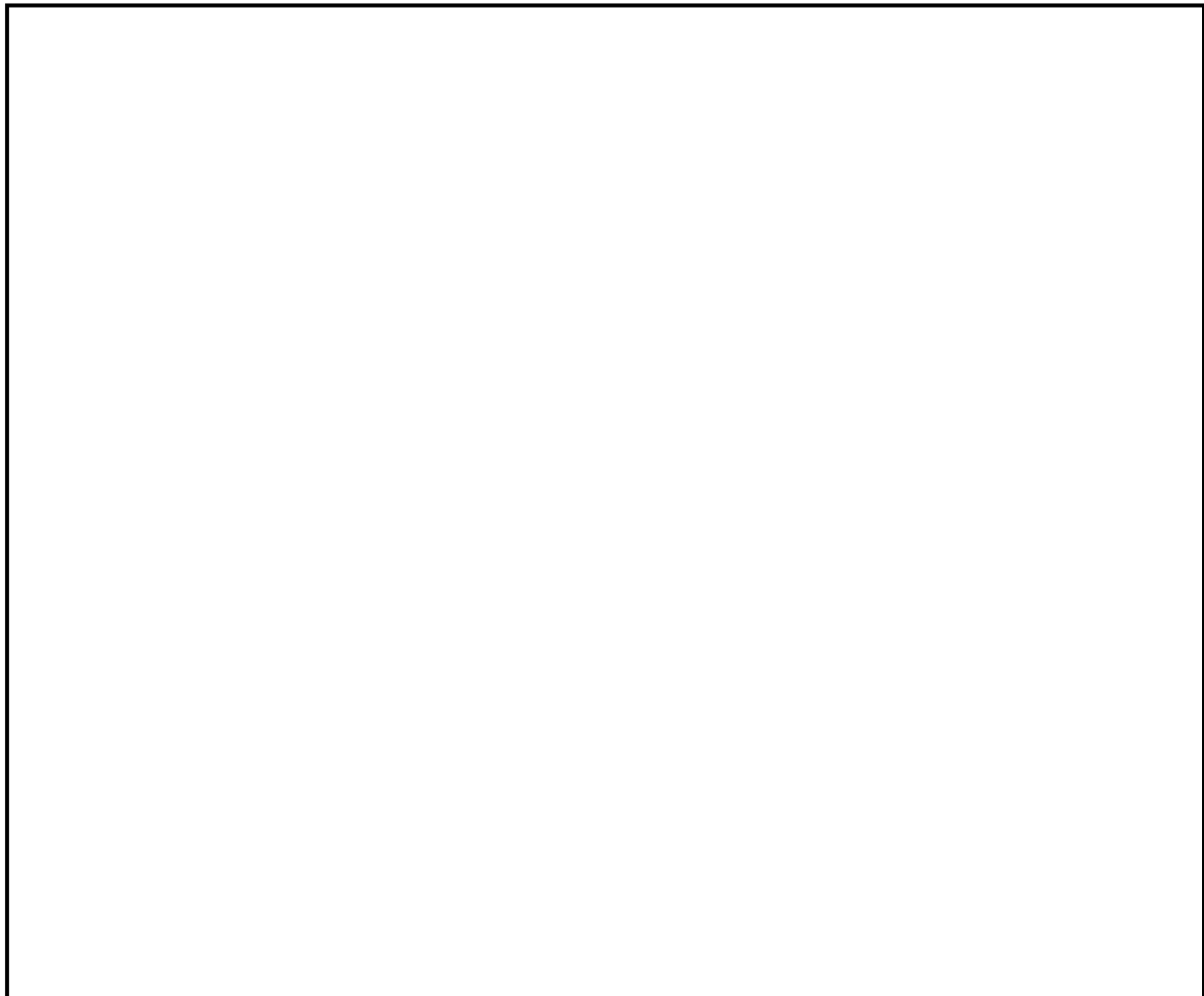
14. Remove the stud bolt. Disconnect the tube nut and remove the EP sensor assembly.

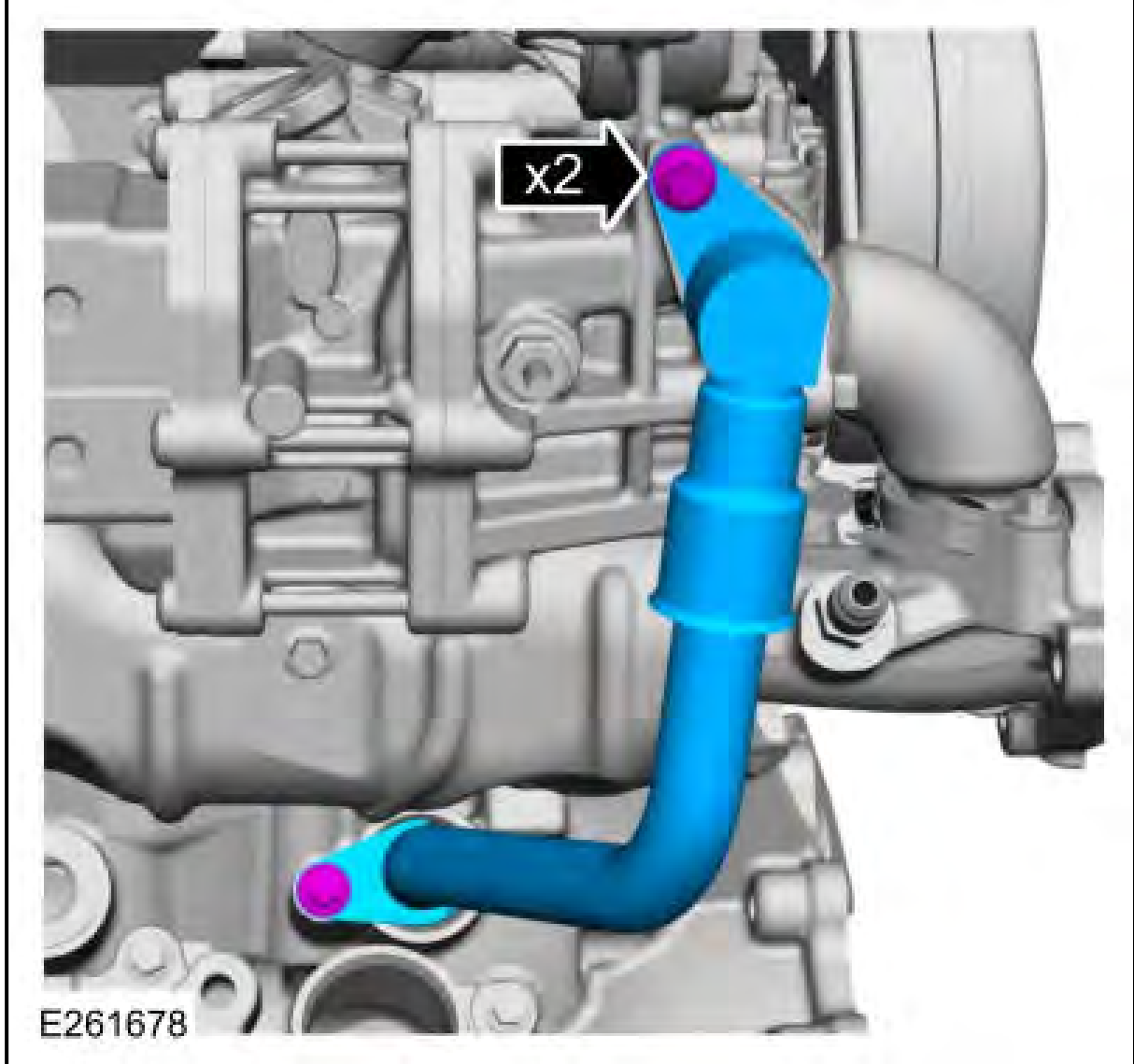






15. Remove the bolts and the EGR cooler coolant tube.



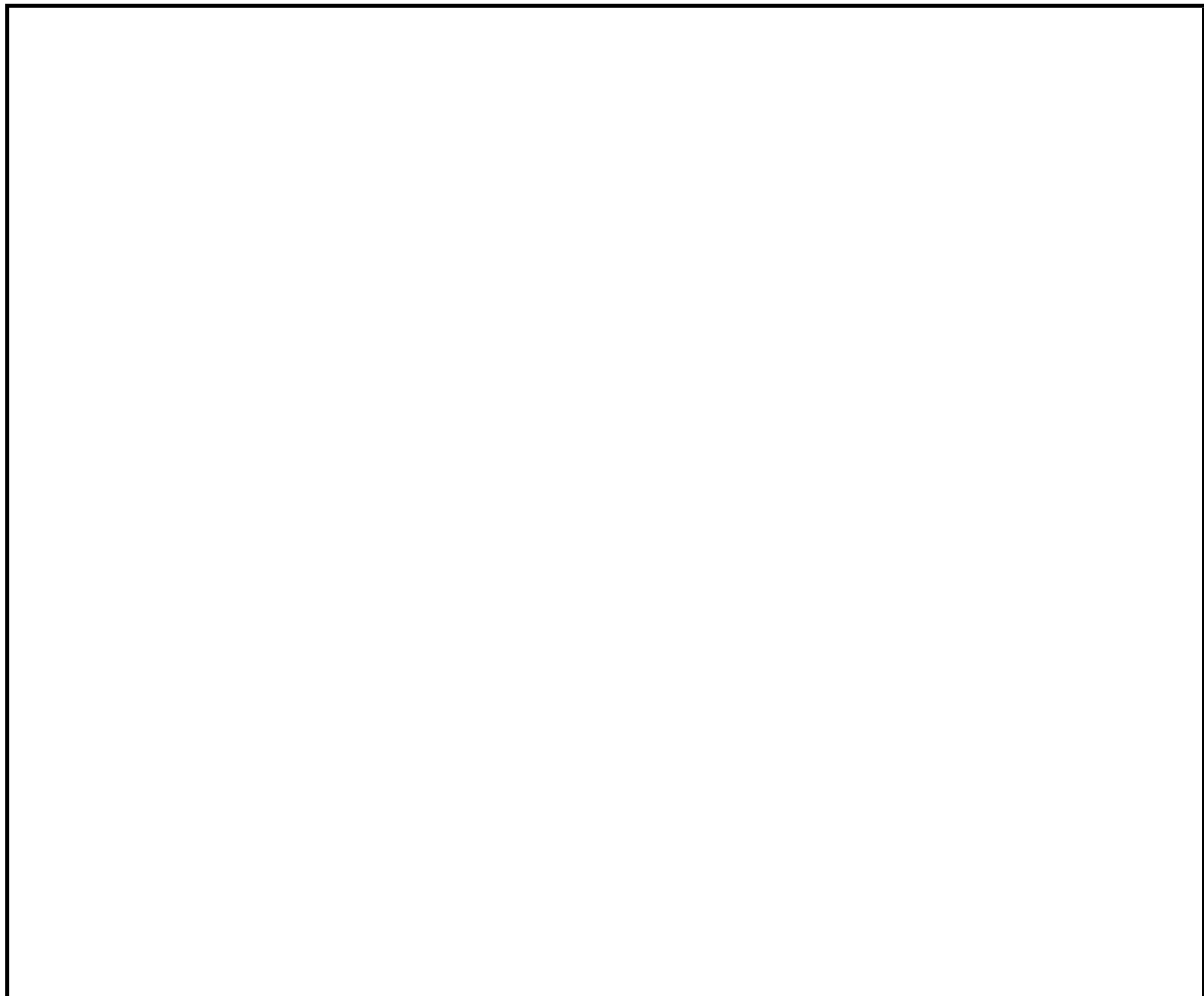


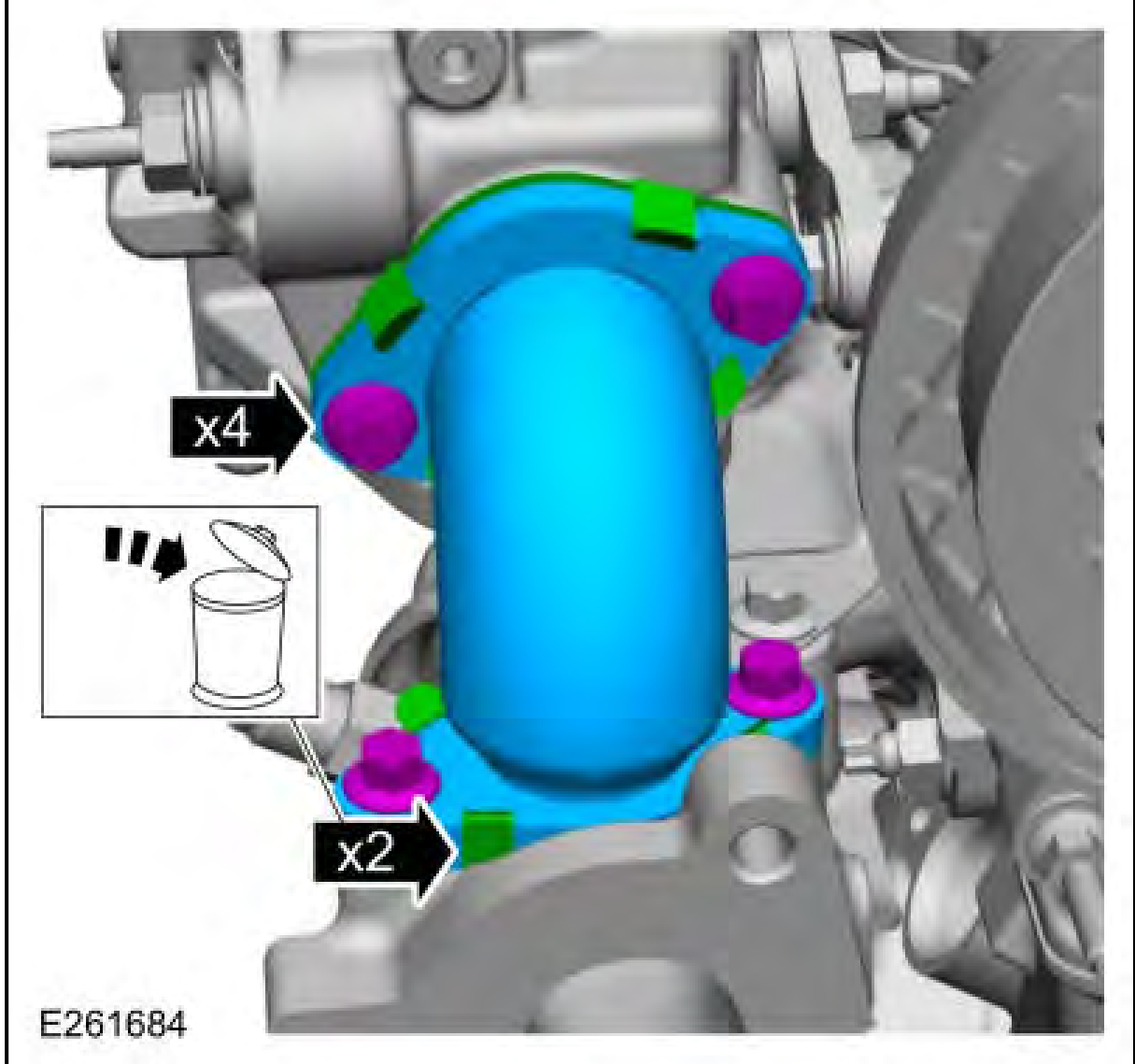
16. Remove and discard the EGR cooler coolant tube O-ring seals.





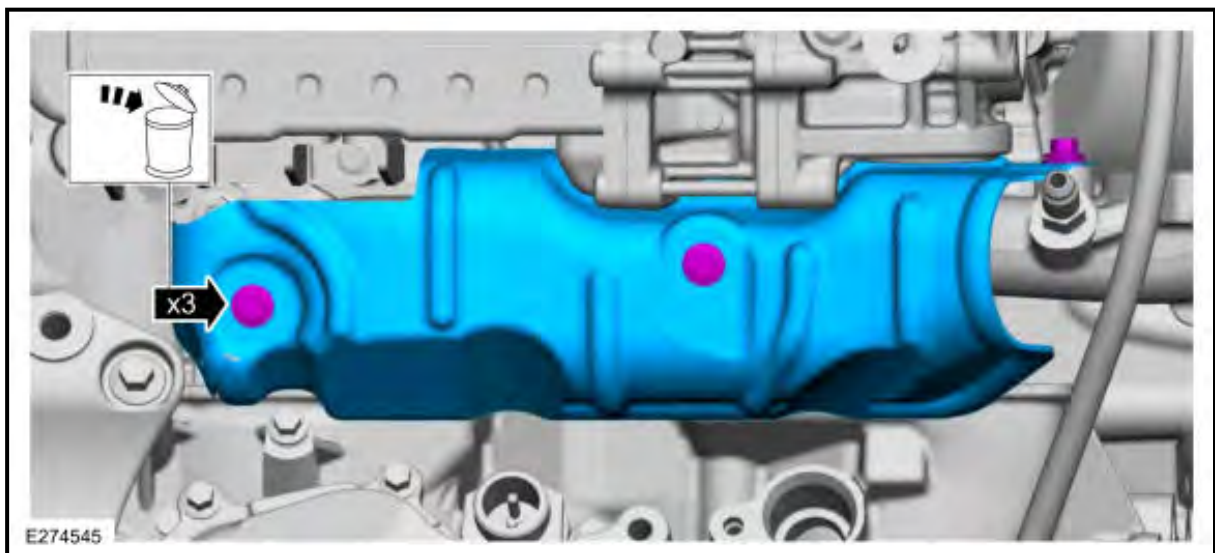
17. Remove the bolts and the EGR cooler-to-exhaust manifold tube. Remove and discard the gaskets.



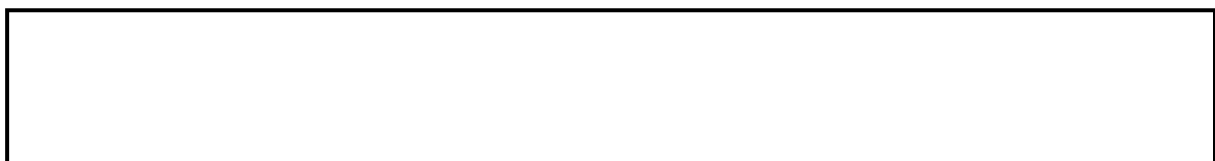


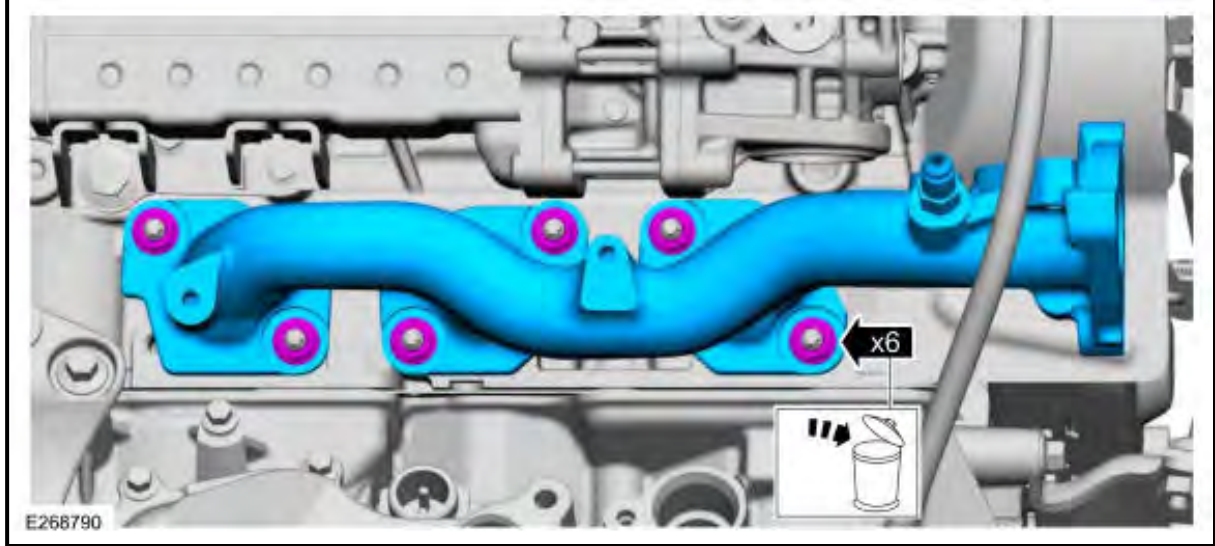
18. **NOTE:** Coolant tubes removed for clarity.

Remove the bolts and the exhaust manifold heat shield. Discard the bolts.



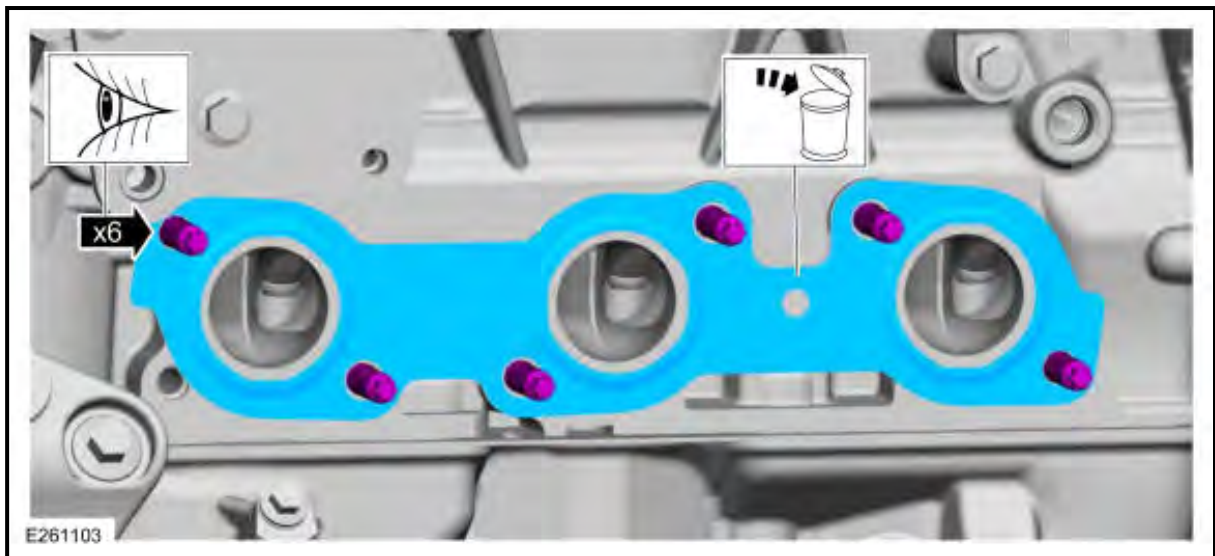
- 19.
- Remove and discard the nuts.
  - Remove the exhaust manifold.





20.

- Remove and discard the exhaust manifold gasket.
- Inspect the exhaust manifold studs. Replace as necessary.

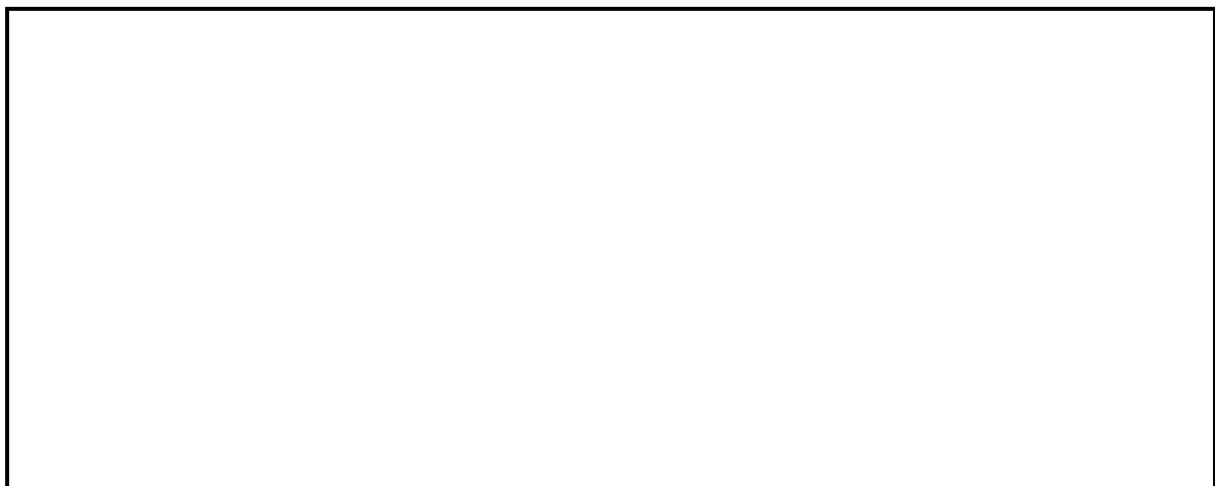


21. Clean and inspect the exhaust manifold. REFER to: [Exhaust Manifold Cleaning and Inspection](#)

## INSTALLATION

1.

- Install the exhaust manifold studs as needed.  
Torque: 115 lb.in (13 Nm)
- Install the new exhaust manifold gasket.



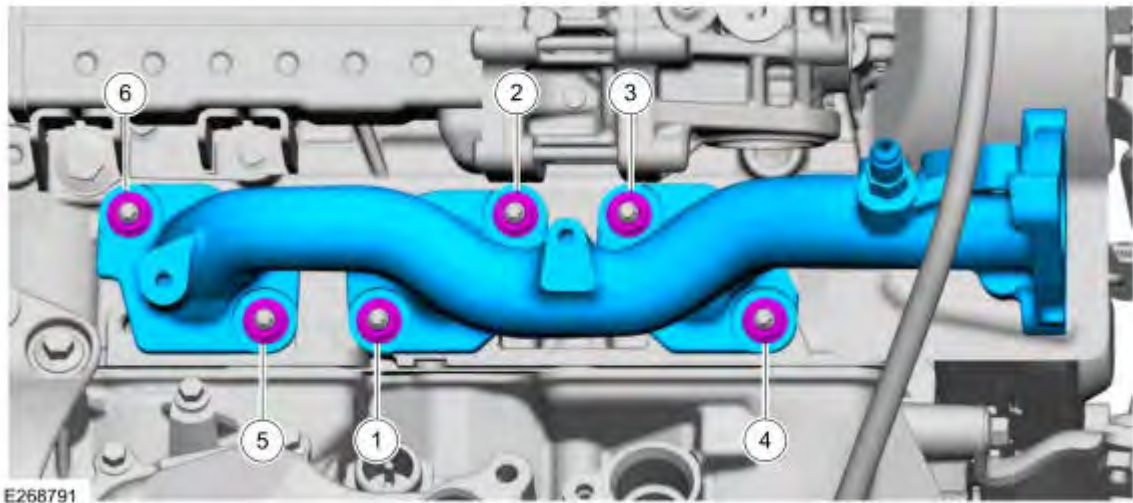


2. Install the exhaust manifold and the nuts.

Torque:

Tighten the nuts in the sequence shown to : 21 lb.ft (28 Nm)

Tighten the nuts in the following order 1, 2, 3, 5, 1, 2 to : 21 lb.ft (28 Nm)

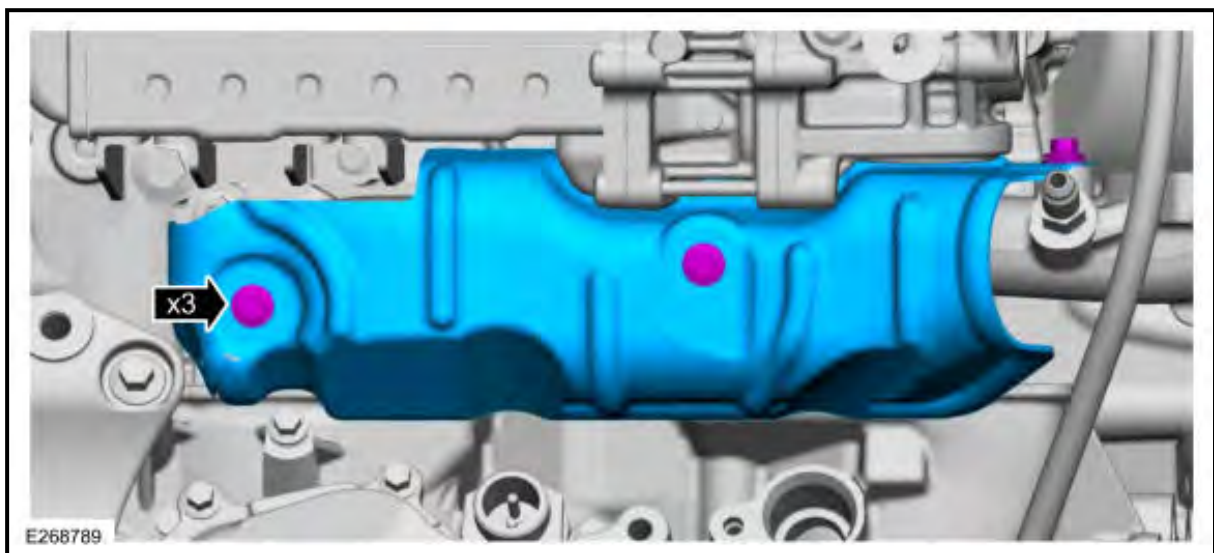


**Fig. 6: Exhaust manifold Tightening Sequence LH**

**Courtesy of FORD MOTOR COMPANY**

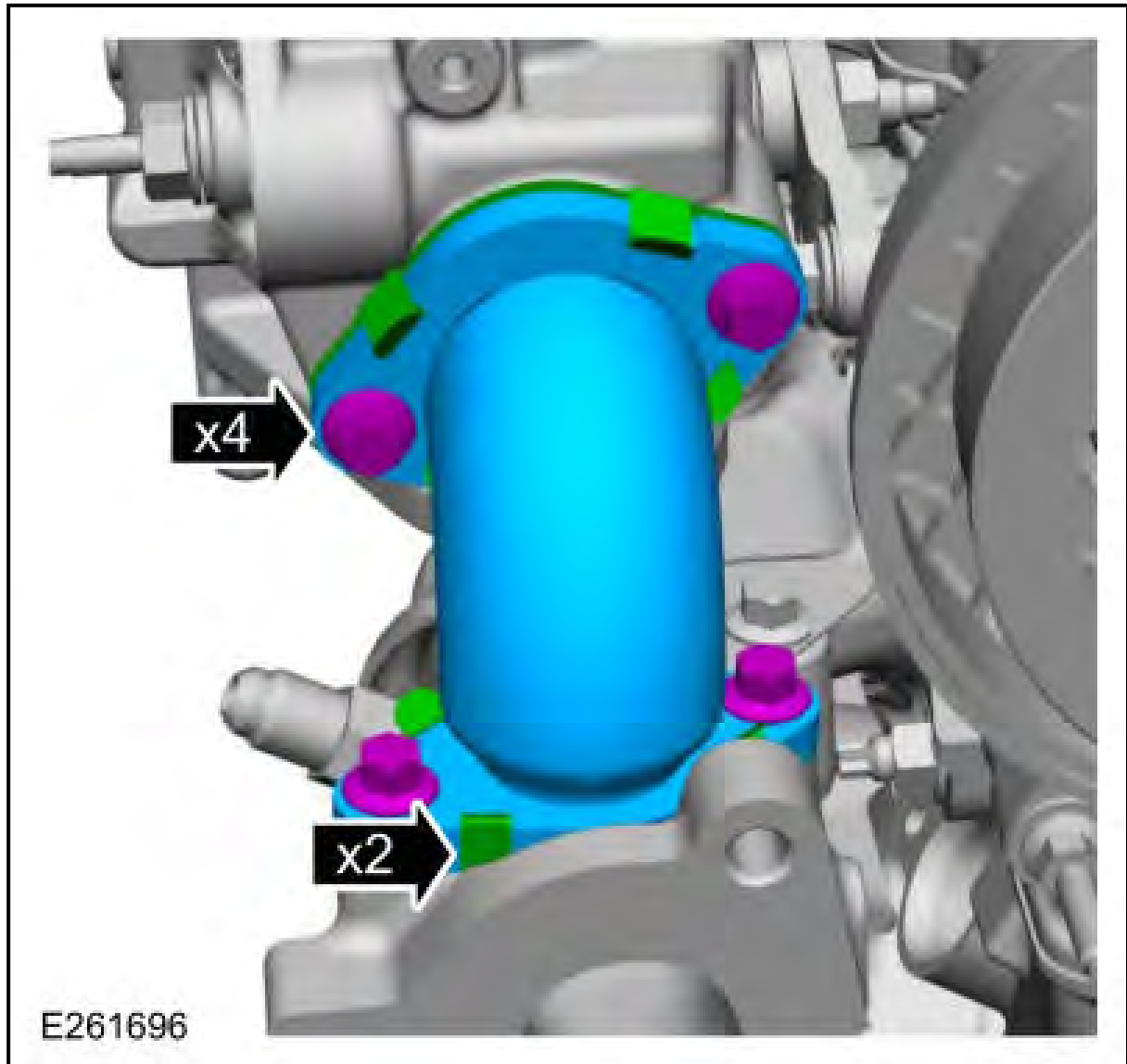
3. Install the exhaust manifold heat shield and the bolts.

Torque: 97 lb.in (11 Nm)



4. Using new gaskets, install the EGR cooler-to-exhaust manifold tube and the bolts.

Torque: 89 lb.in (10 Nm)



5. Remove and discard the EGR cooler coolant tube O-ring seals.

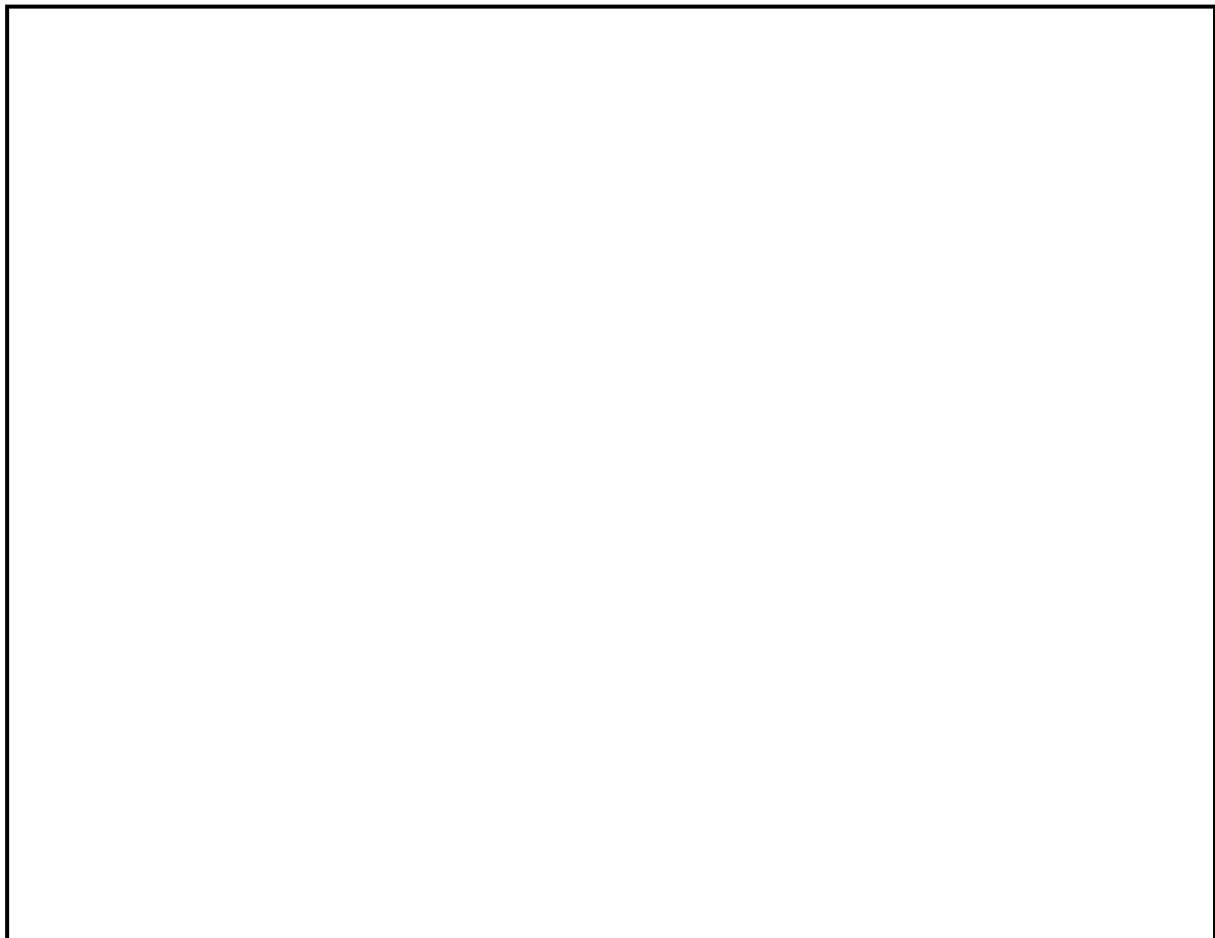
Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)



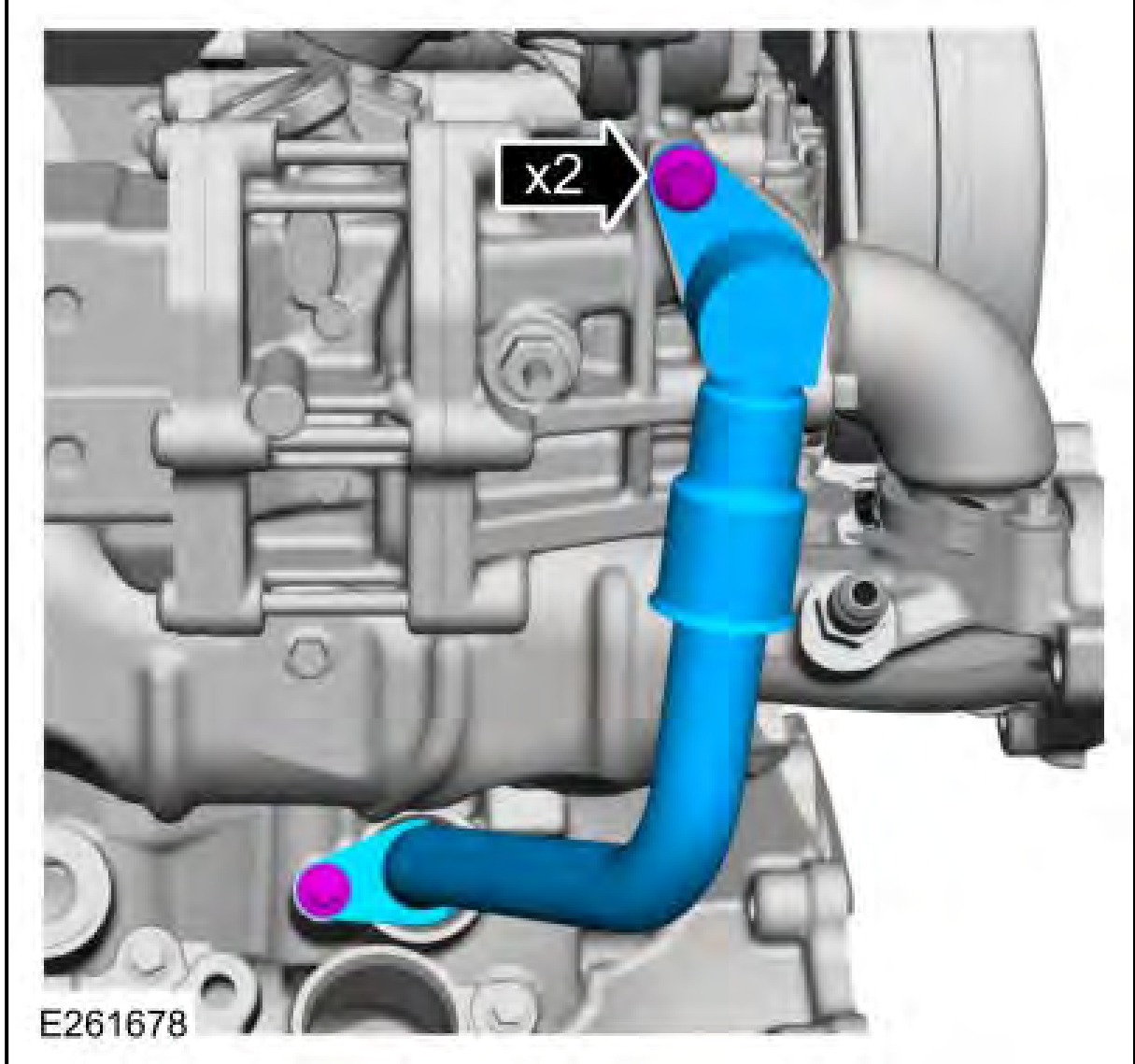


6. Install the EGR cooler coolant tube and the bolts.

Torque: 89 lb.in (10 Nm)







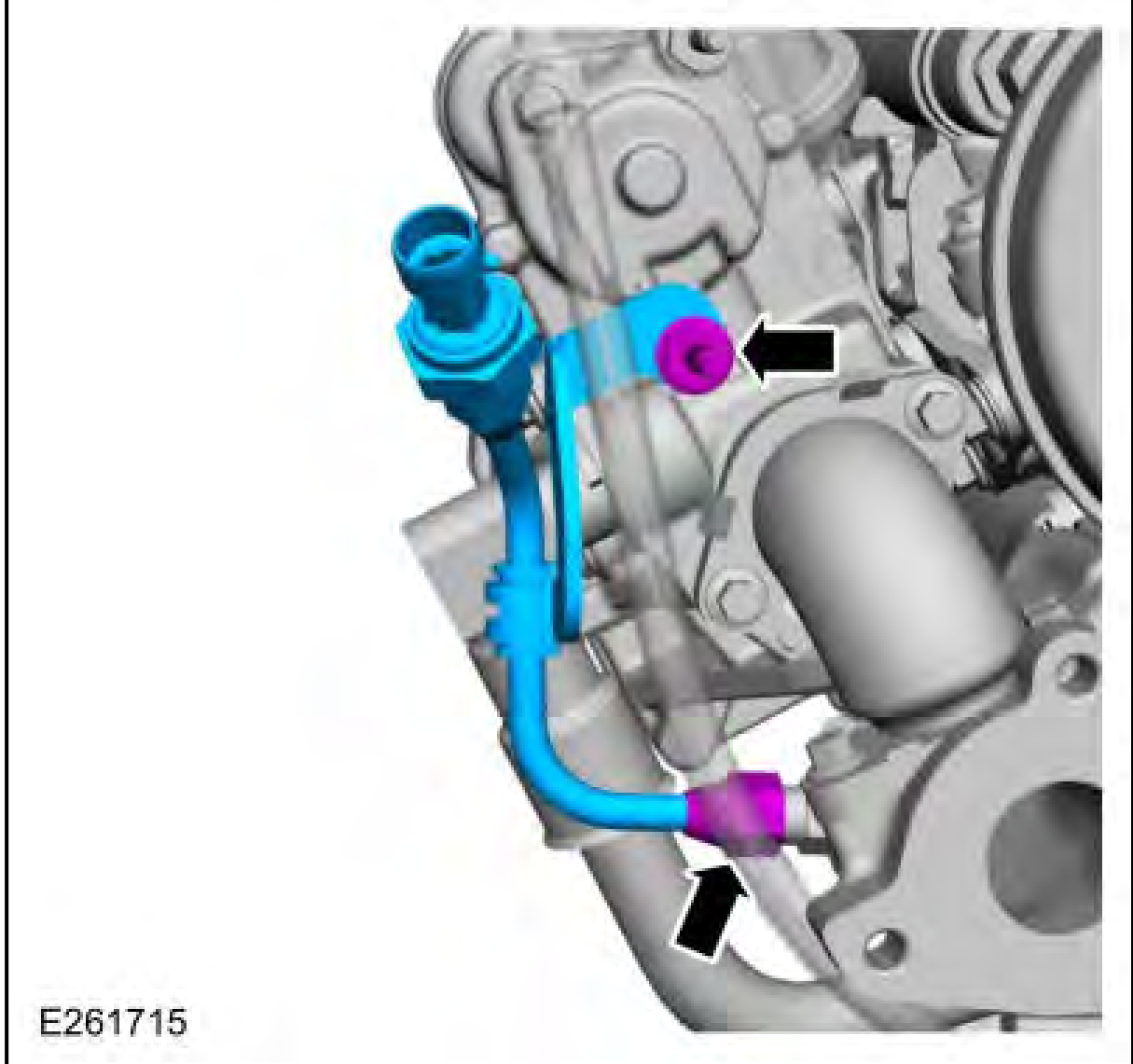
7. Install the EP sensor assembly and hand start the tube nut. Install the stud bolt.

Torque:

M6 stud bolt: : 89 lb.in (10 Nm)

Tube nut: : 177 lb.in (20 Nm)

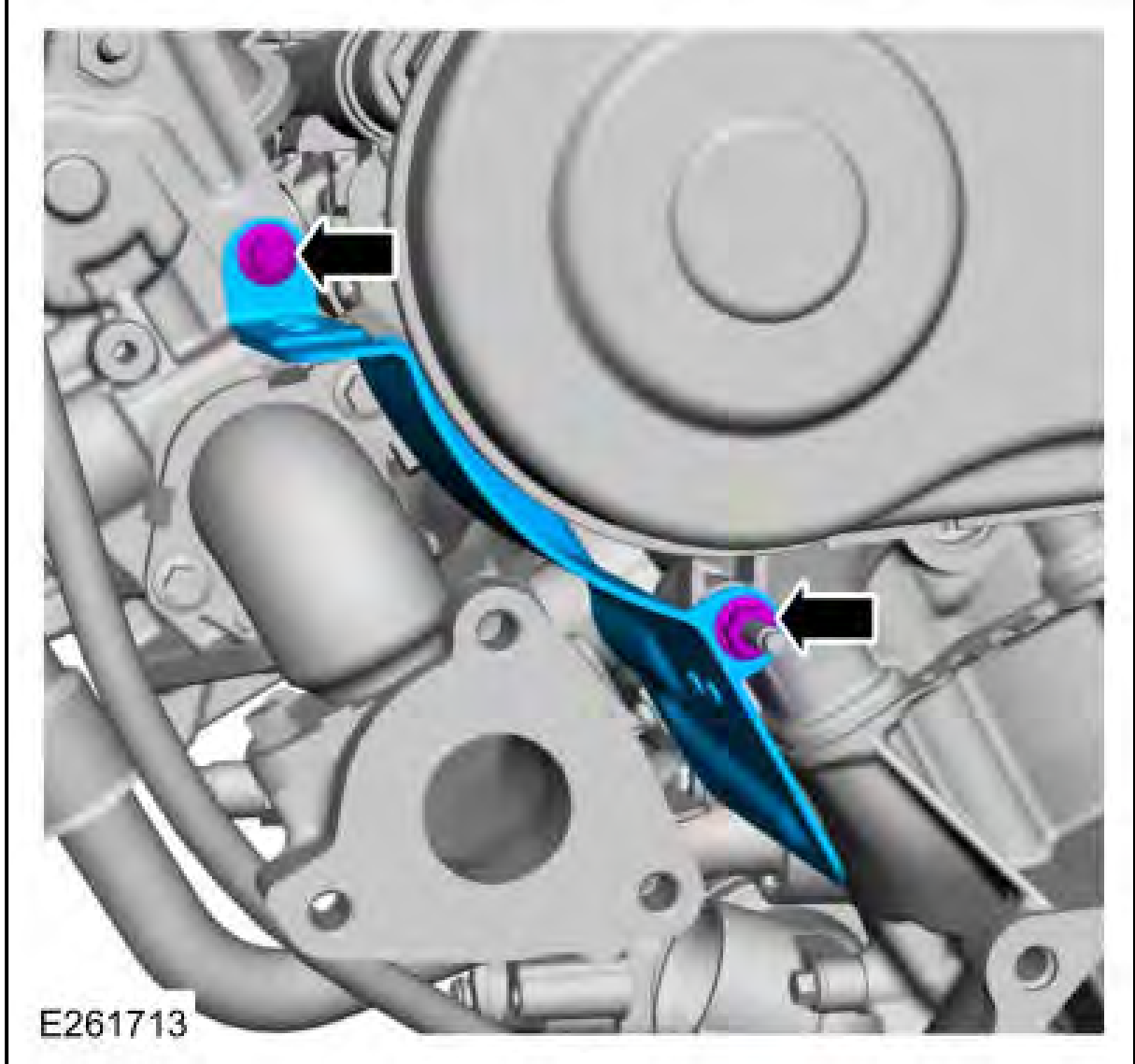




8. Install the LH exhaust manifold shield, the nut and the bolt.

Torque: 89 lb.in (10 Nm)





9. **NOTE:**      **Lubricate the O-ring seal prior to installing the oil level indicator tube.**

- Install the oil level indicator tube, the stud bolt and the bolt.

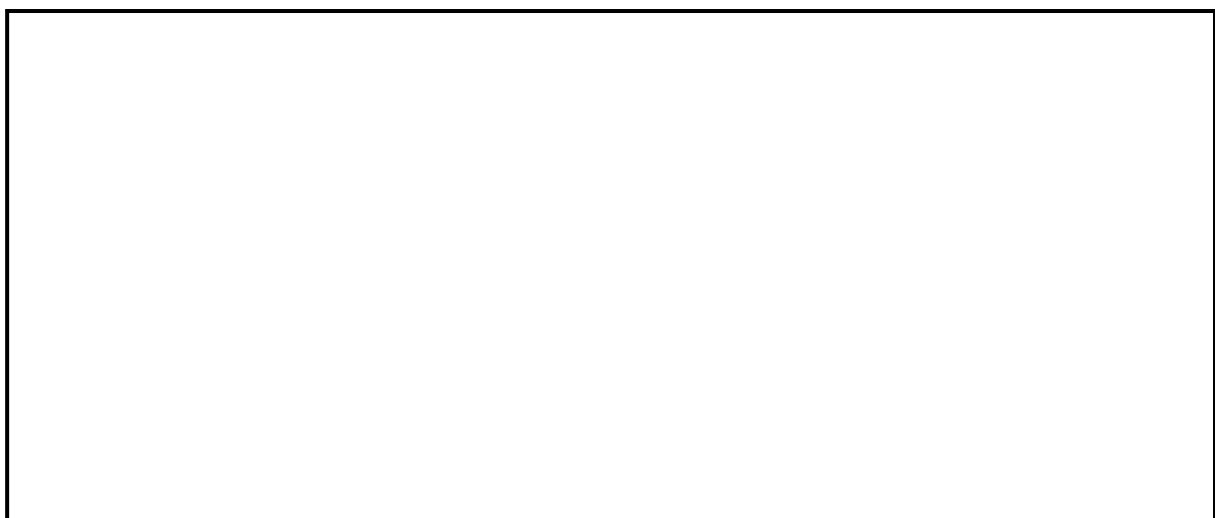
Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

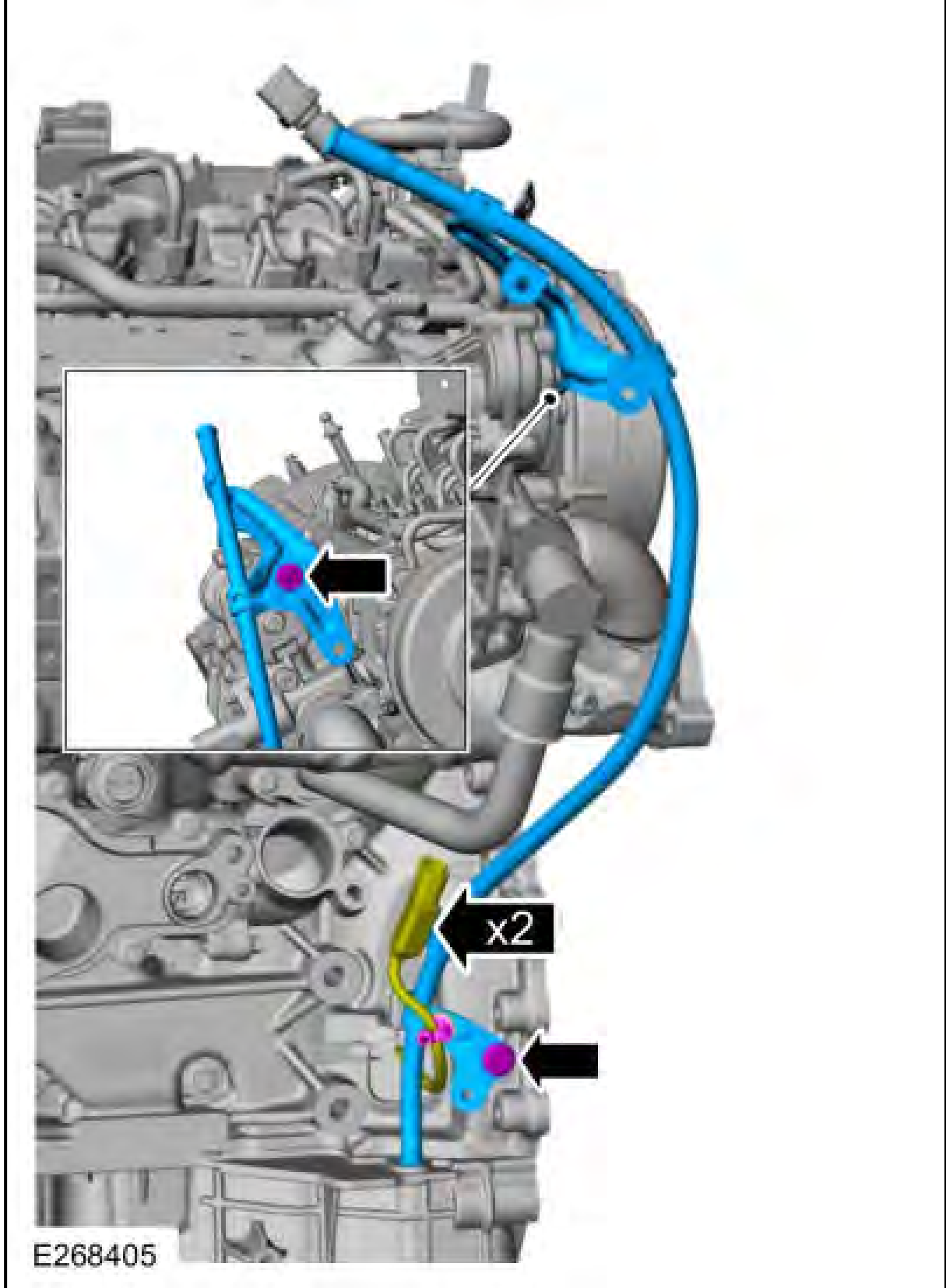
Torque:

M6 stud bolt: : 89 lb.in (10 Nm)

M8 bolt: : 17 lb.ft (23 Nm)

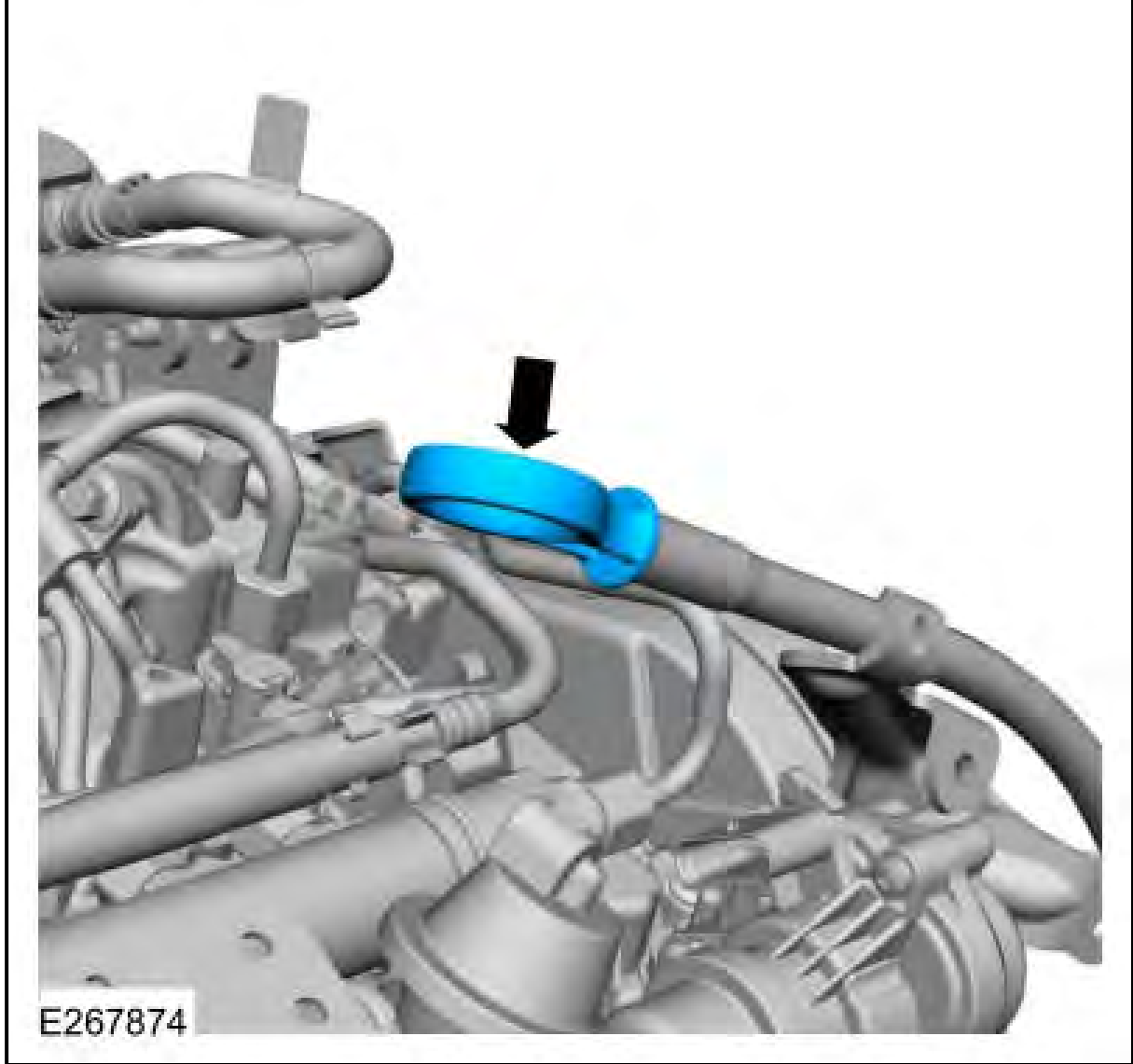
- Connect the wire retainers to the oil level indicator tube.



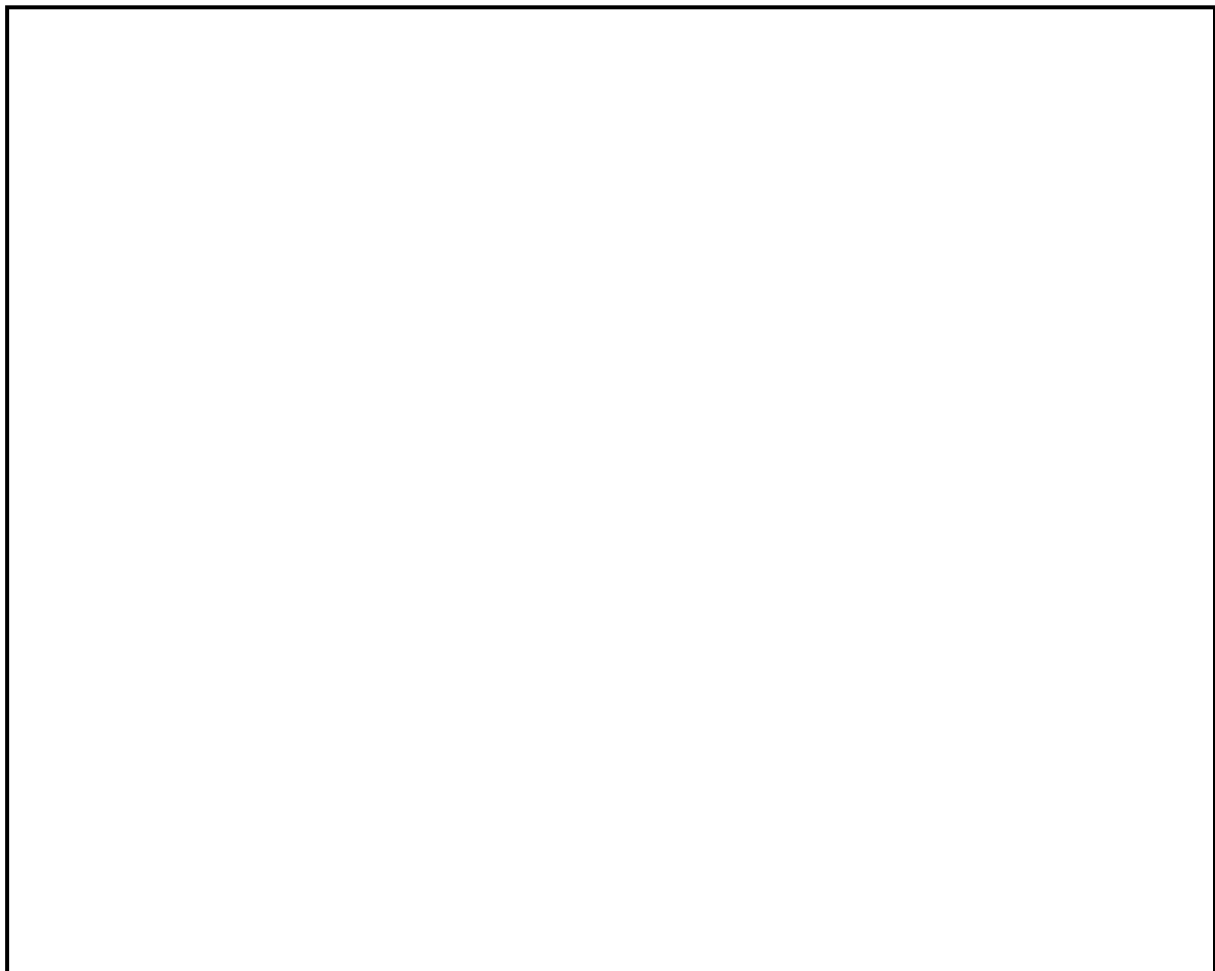


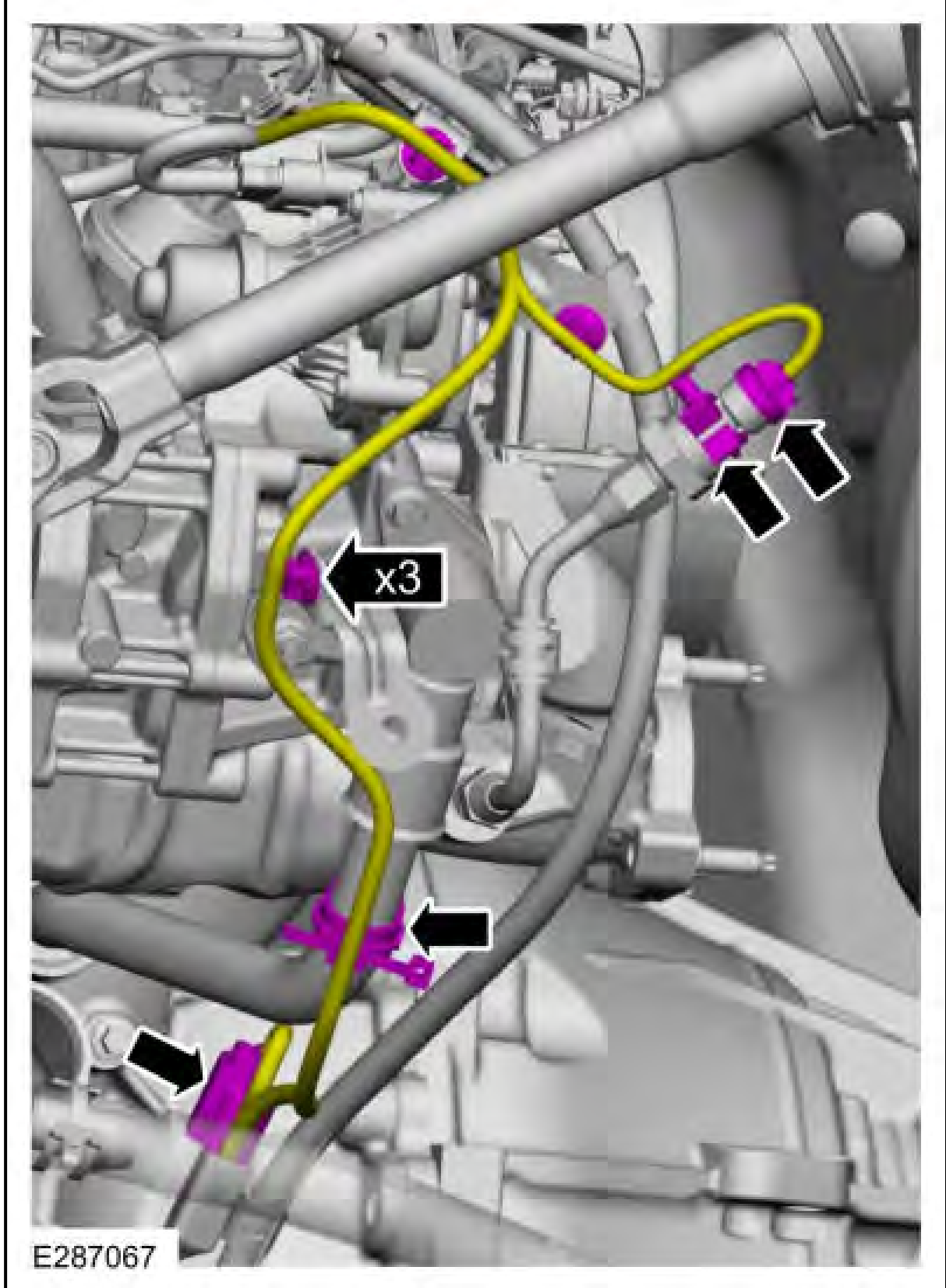
10. Install the oil level indicator.





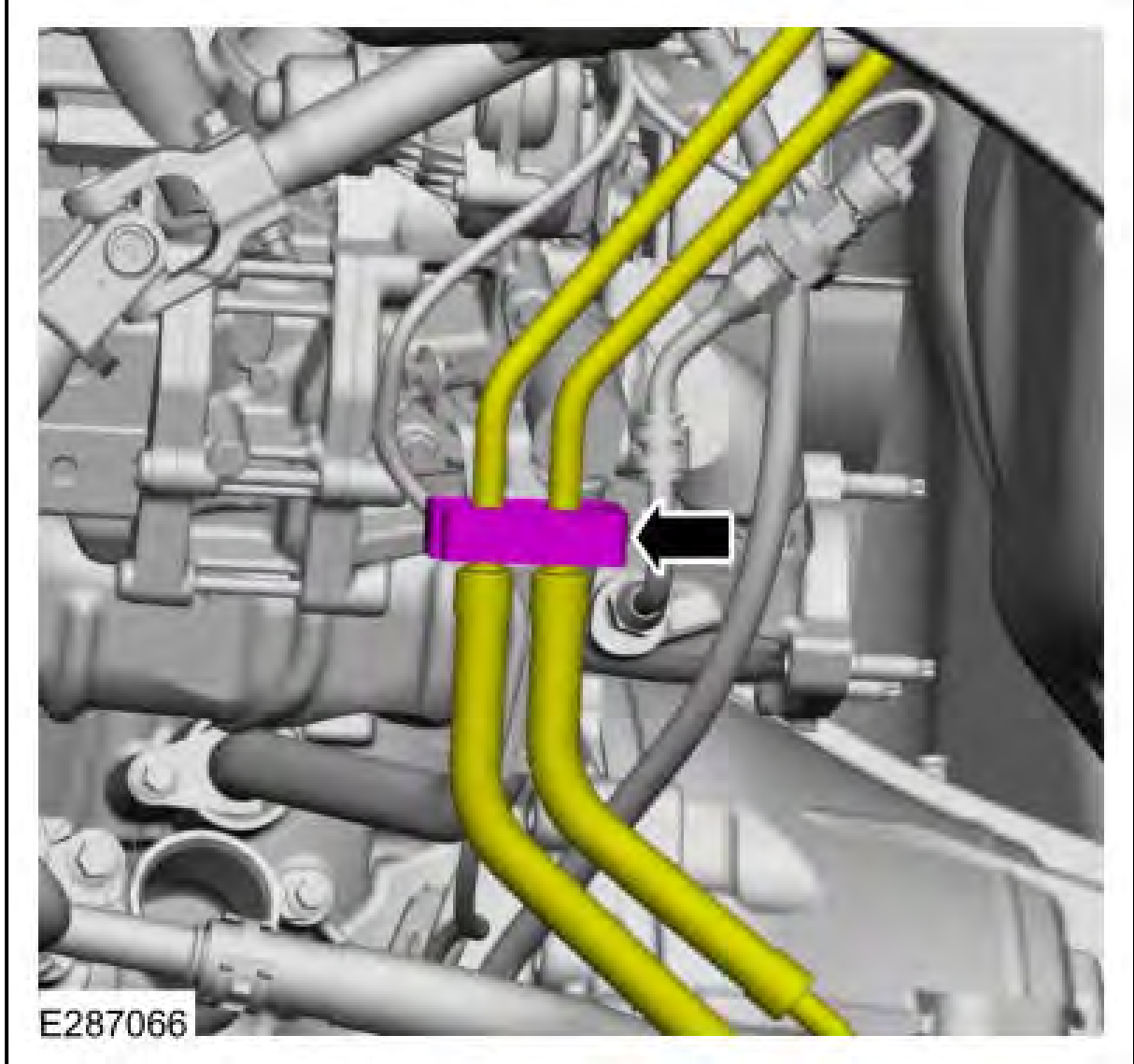
11. Position back the wiring and connect the retainers. Connect the EP sensor and the CKP sensor electrical connectors.





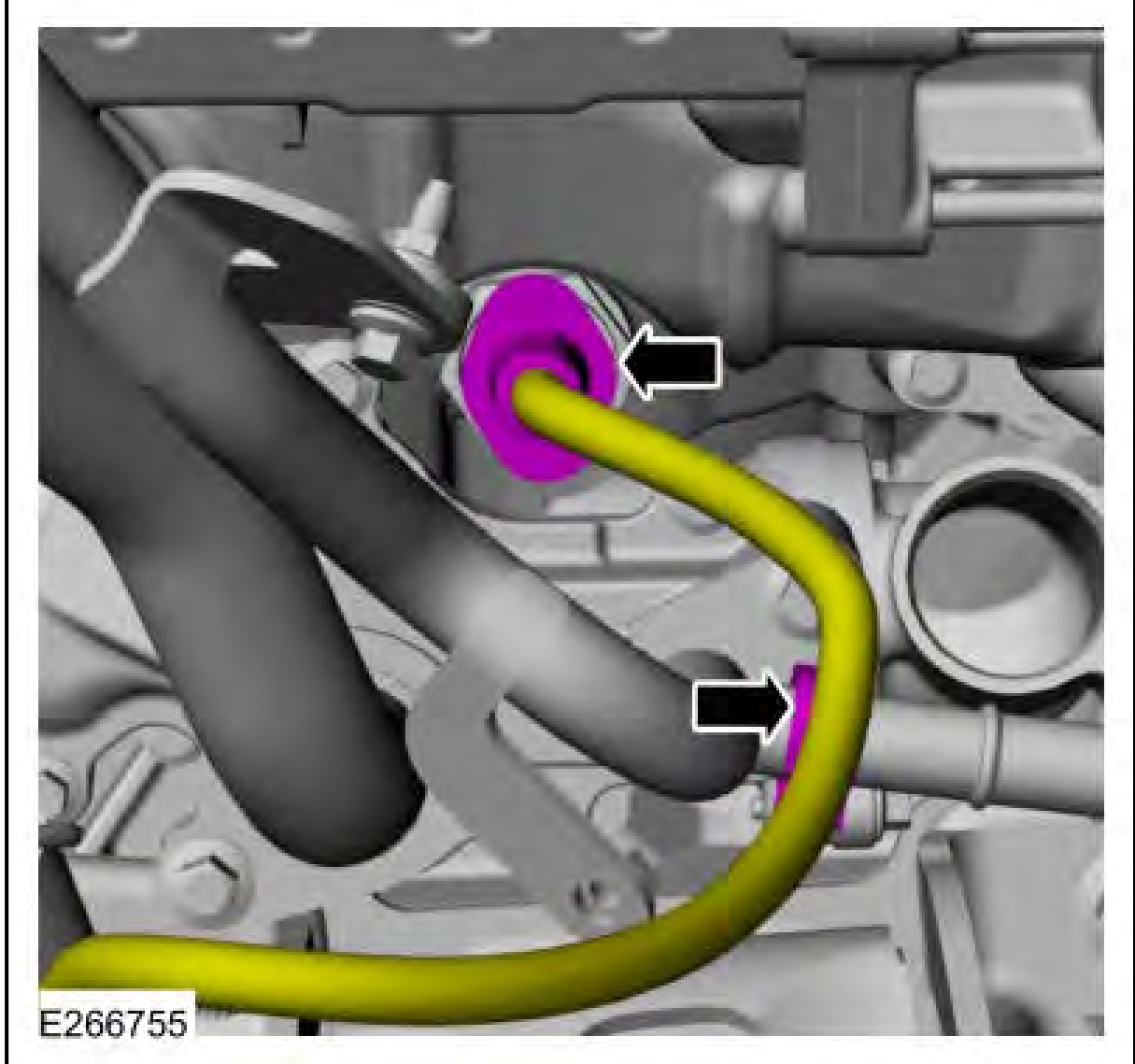
12. Position back and connect the fuel tubes.





13. If equipped, disconnect the block heater cord retainer and the electrical connector.





14. Install the new O-ring seal on the lower radiator coolant tube. Apply coolant to the O-ring seal.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)







15. **NOTE:**      **Apply coolant to the coolant connector opening before installing the tube.**

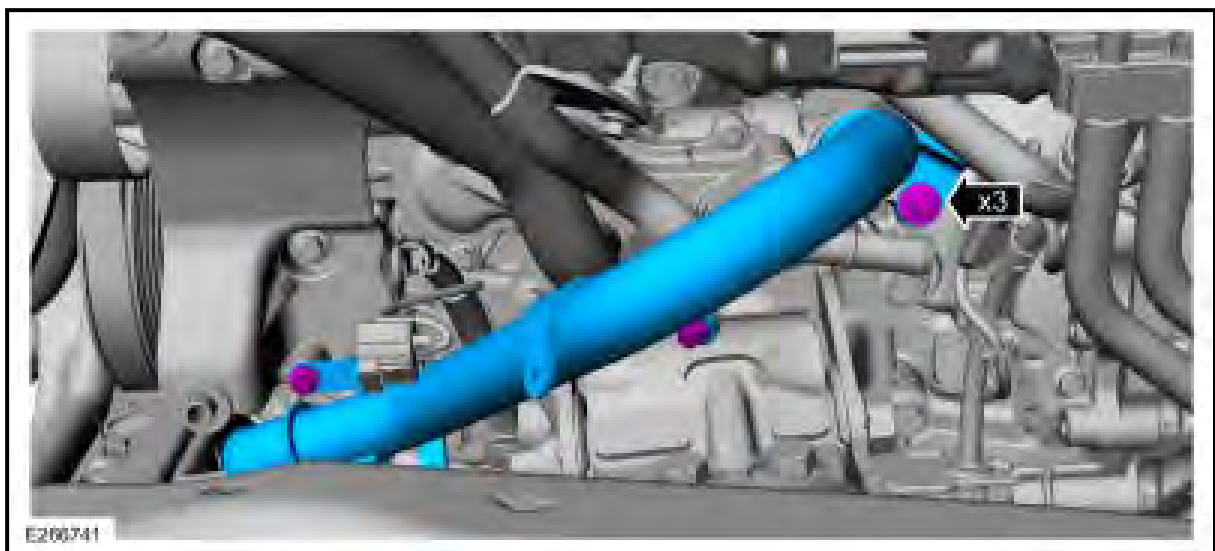
Install the lower radiator coolant tube and the bolts.

Material: Motorcraft <sup>Â</sup>® Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

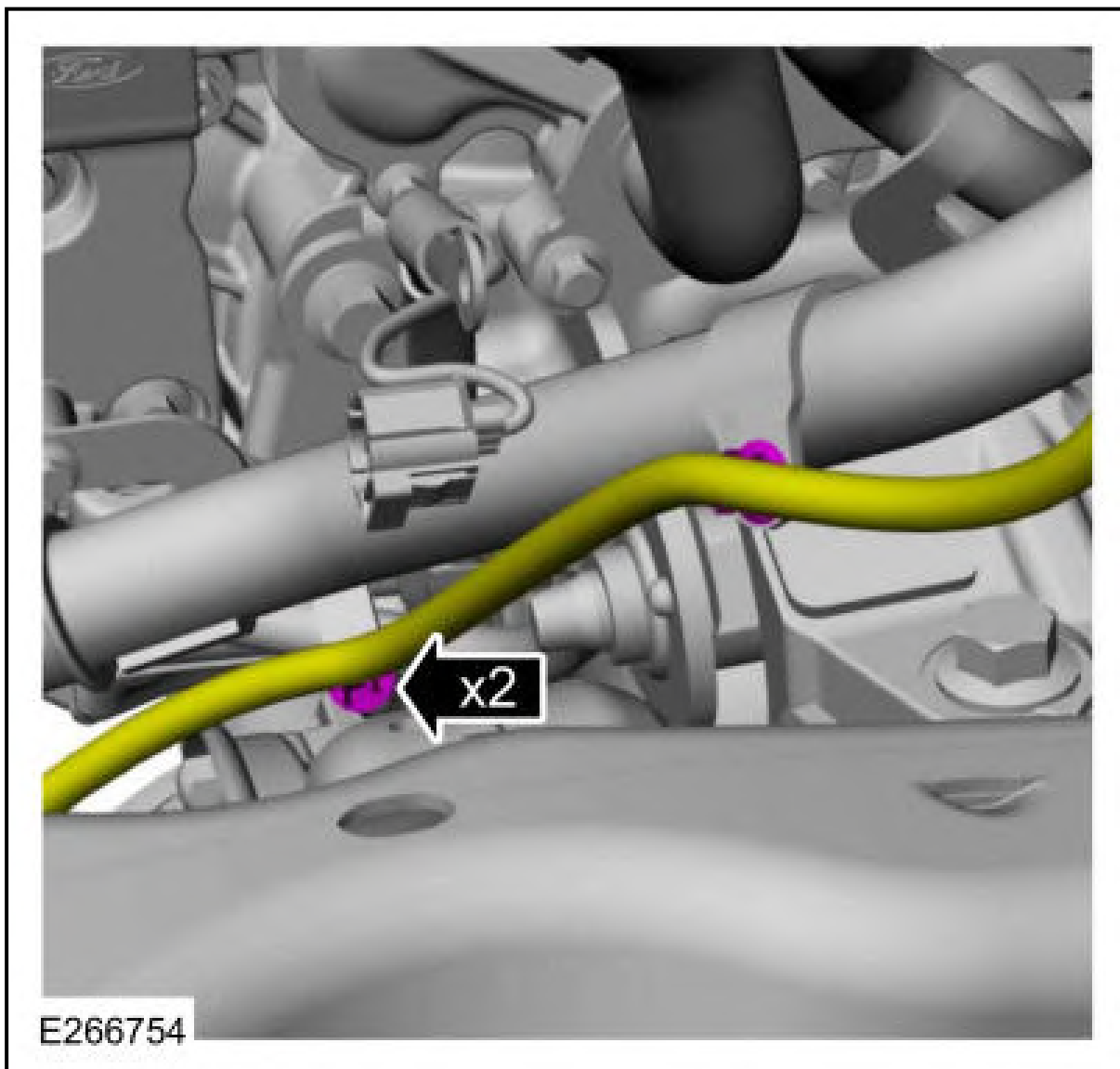
Torque:

M8 bolt : 18 lb.ft (25 Nm)

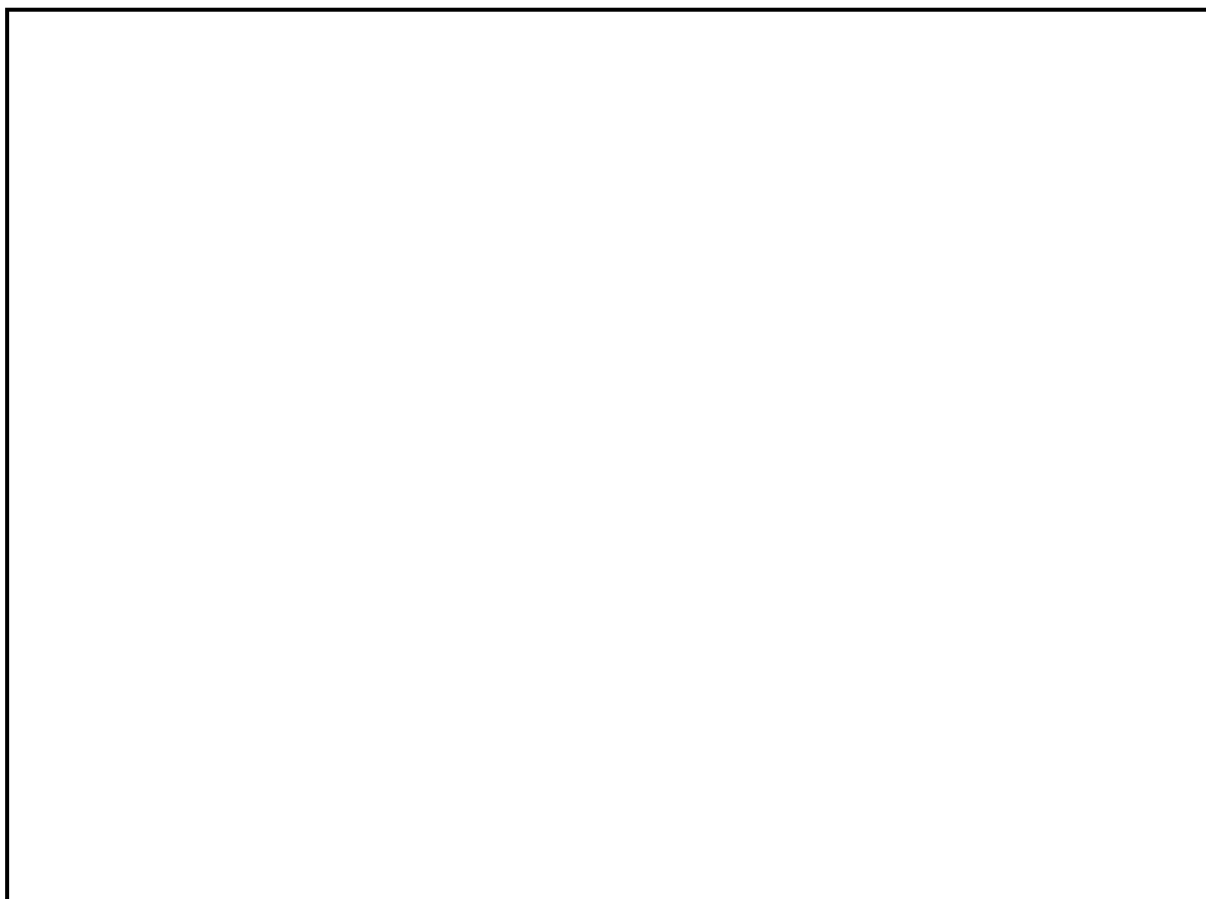
M6 bolt : 71 lb.in (8 Nm)

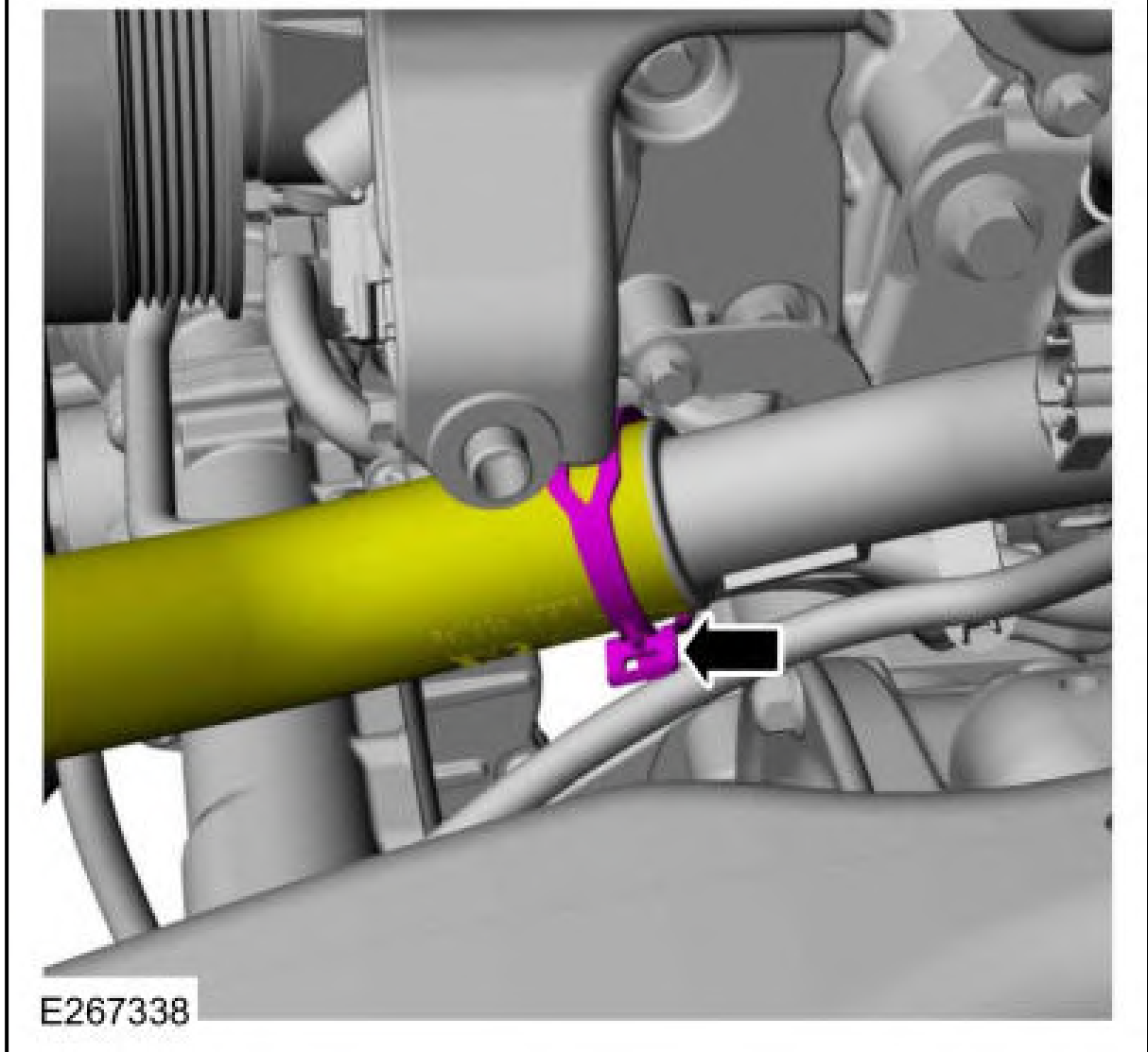


16. If equipped, connect the block heater cord retainers.



17. Connect the lower radiator hose to the lower radiator coolant tube. Use the General Equipment: Hose Clamp Remover/Installer





18. Install the following items:

1. Install the generator. REFER to: [Generator - 3.0L Power Stroke Diesel](#) .
2. Install the exhaust crossover pipe. REFER to: [Exhaust Crossover Pipe](#) .

19. Evaluate the cooling system condition. REFER to: [Cooling System Condition Evaluation](#) .

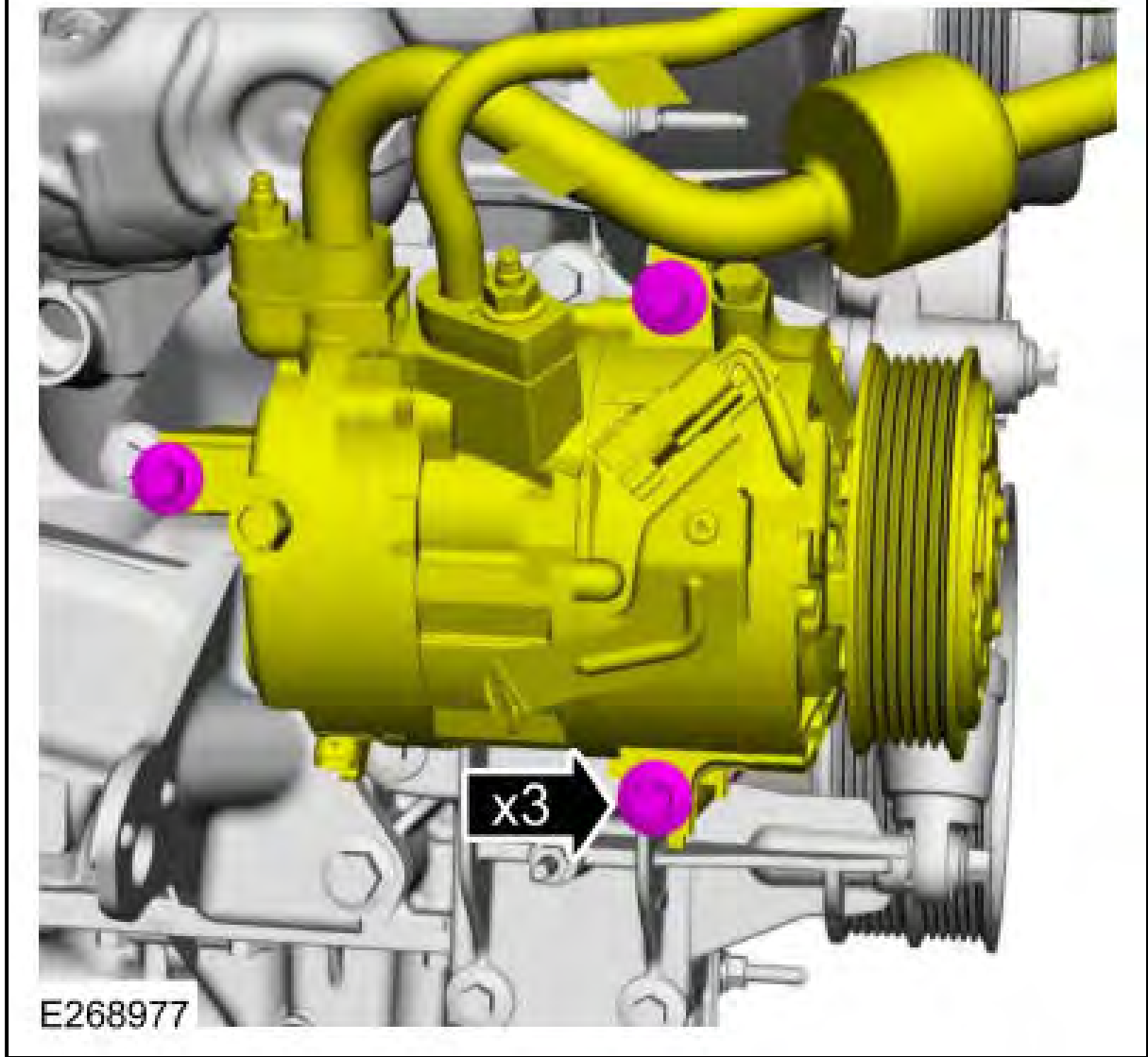
### **EXHAUST MANIFOLD RH**

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

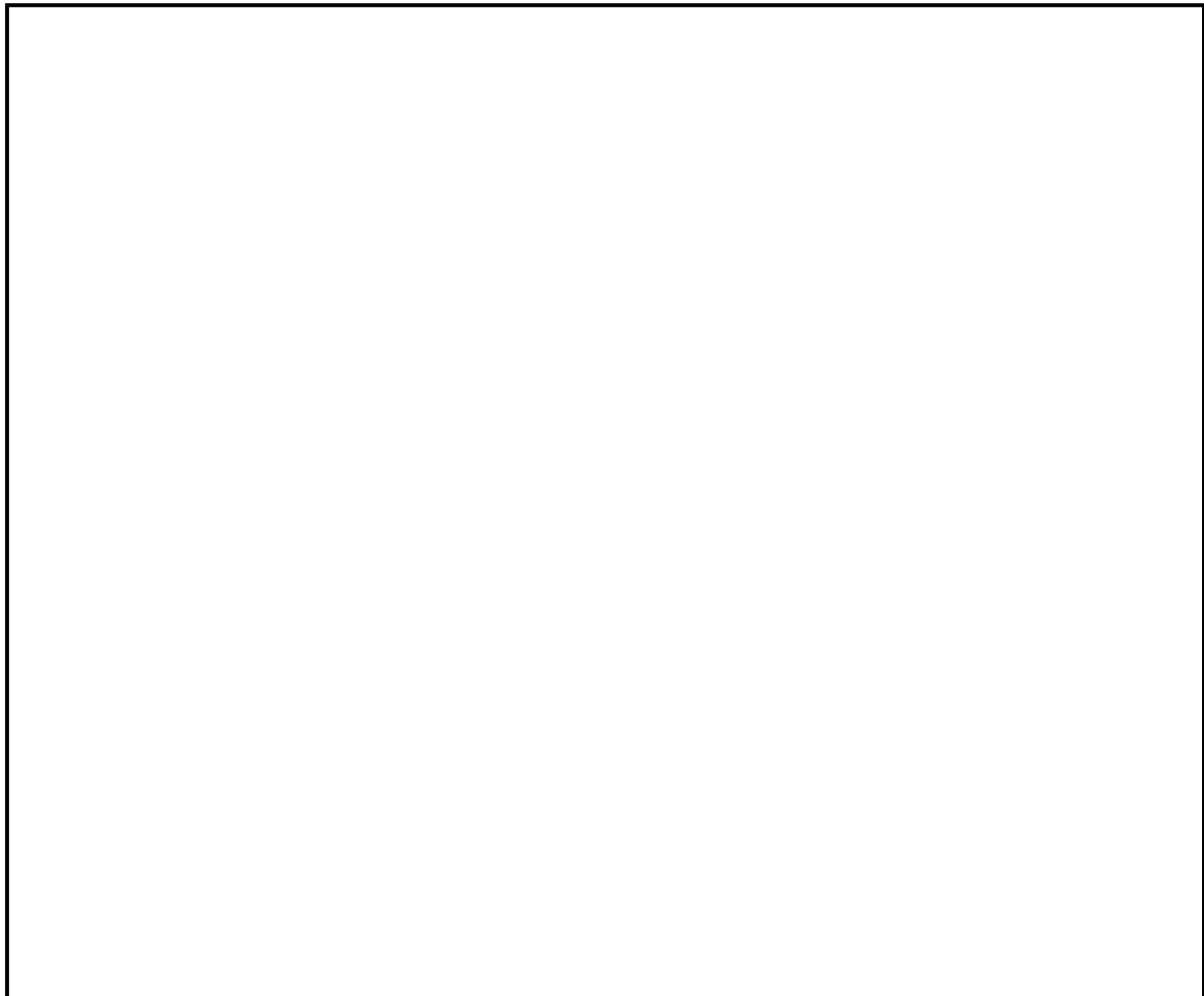
### **REMOVAL**

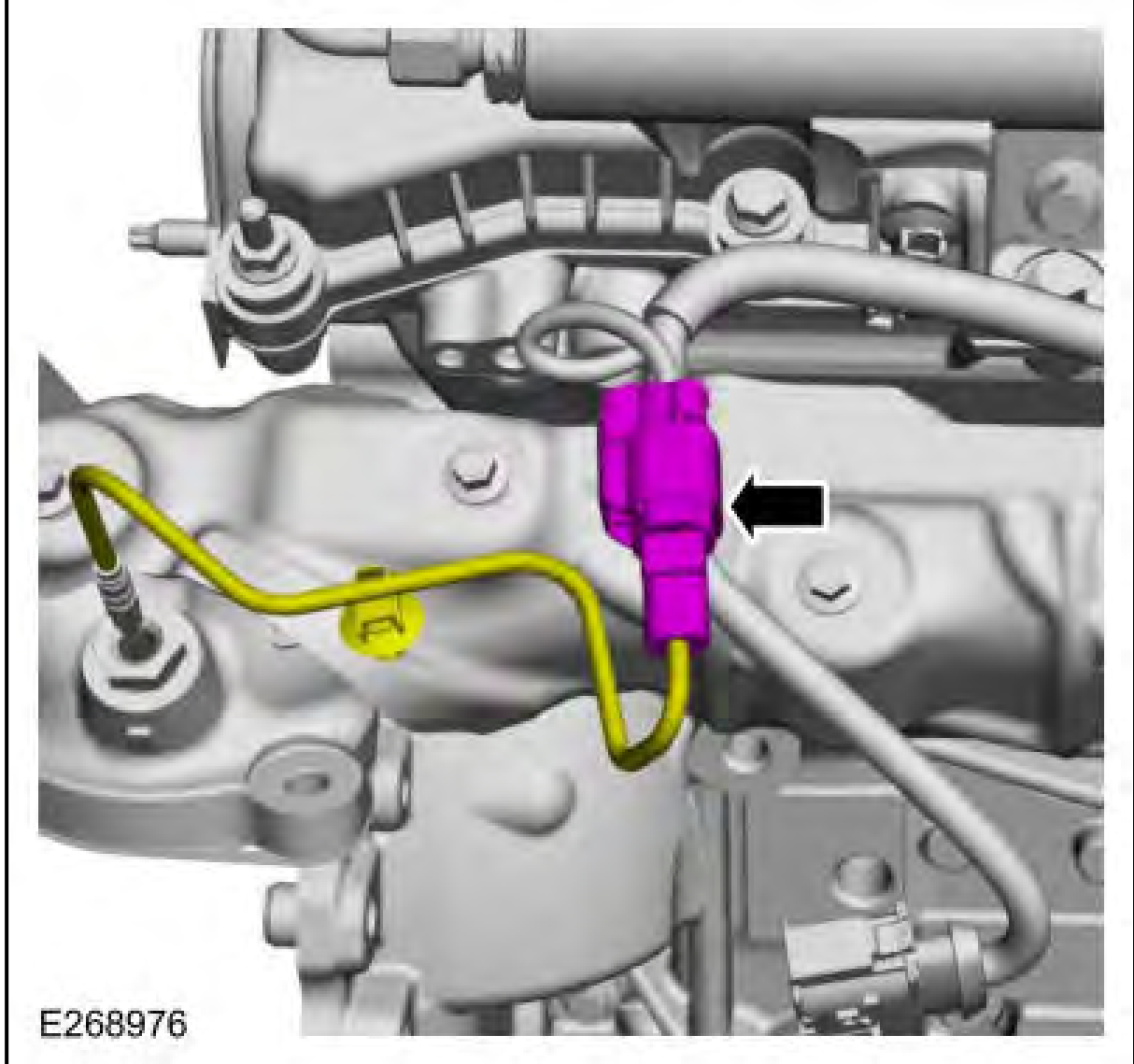
1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Remove the following items:
  1. Remove the turbocharger. REFER to: [Turbocharger](#) .
  2. Remove the exhaust crossover pipe. REFER to: [Exhaust Crossover Pipe](#) .
  3. Remove the A/C compressor belt. REFER to: [Air Conditioning \(A/C\) Compressor Belt](#) .
3. Remove the bolts and position aside the A/C compressor.



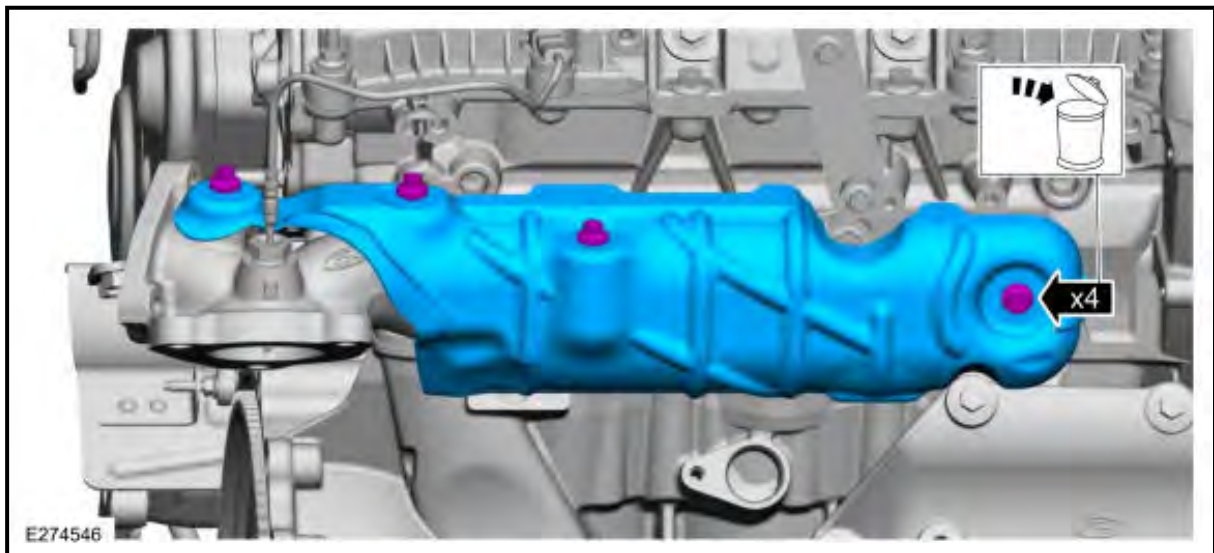


4. Disconnect the EGRT sensor electrical connector.



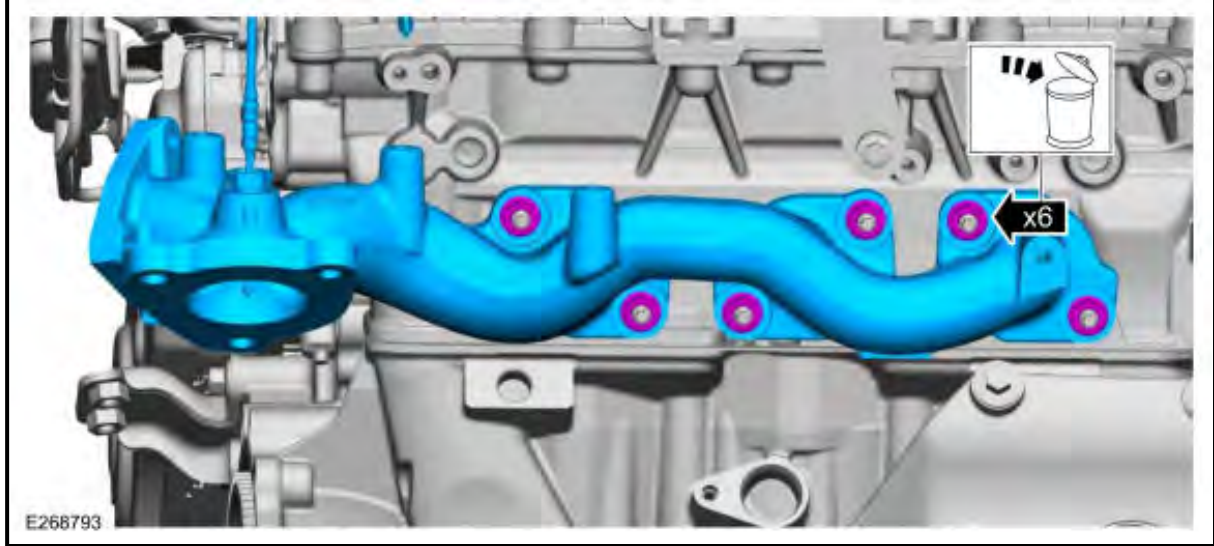


5. Remove the bolts and the exhaust manifold heat shield. Discard the bolts.



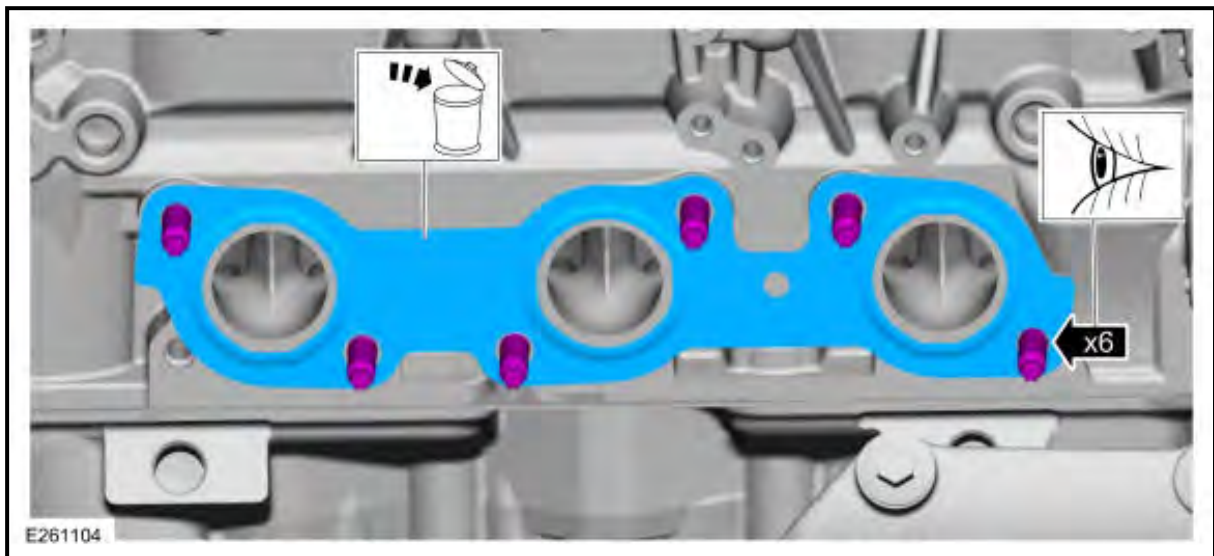
- 6.
- Remove and discard the nuts.
  - Remove the exhaust manifold.





7.

- Remove and discard the exhaust manifold gasket.
- Inspect the exhaust manifold studs. Replace as necessary.



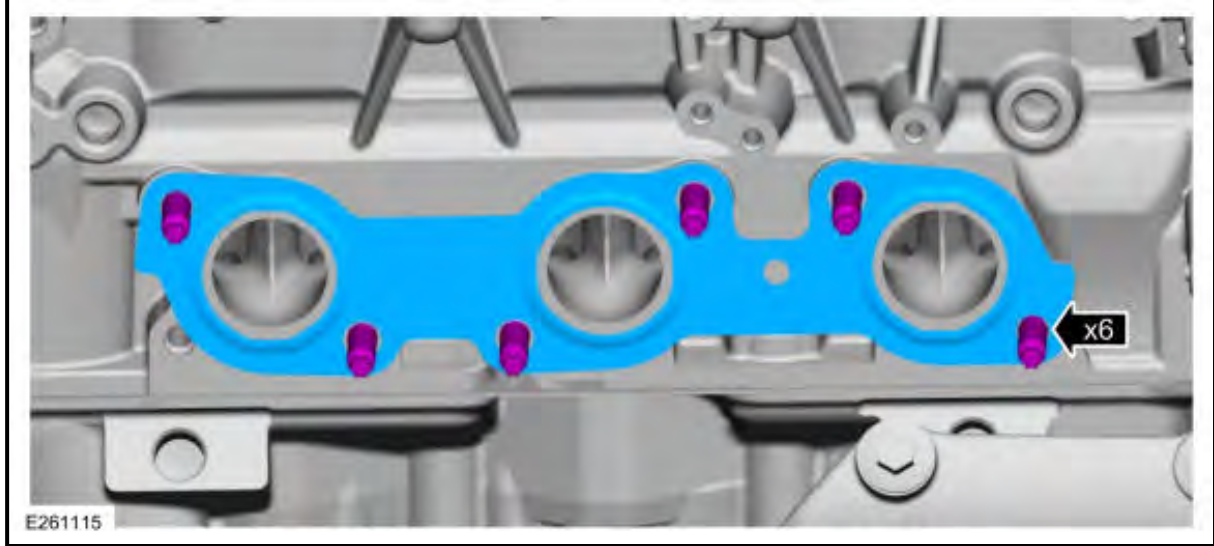
8. Clean and inspect the exhaust manifold. REFER to: [Exhaust Manifold Cleaning and Inspection](#)

## INSTALLATION

1.

- Install the exhaust manifold studs as needed.  
Torque: 115 lb.in (13 Nm)
- Install the exhaust manifold gasket.



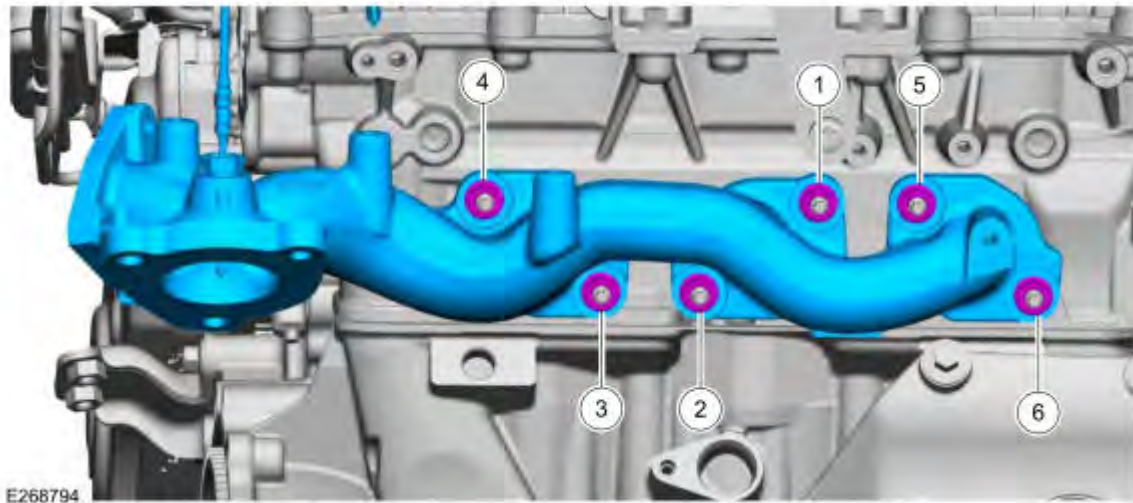


2. Install the exhaust manifold and the nuts.

Torque:

Tighten the nuts in the sequence shown to : 21 lb.ft (28 Nm)

Tighten the nuts in the following order 1, 2, 3, 5, 1, 2 to : 21 lb.ft (28 Nm)

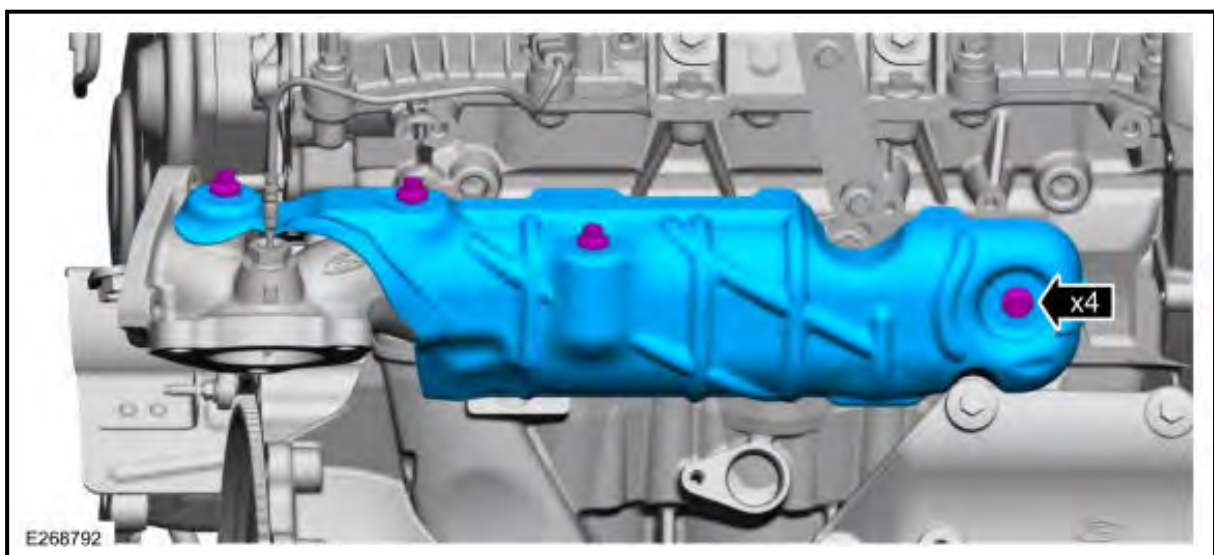


**Fig. 7: Exhaust Manifold Tightening Sequence RH**

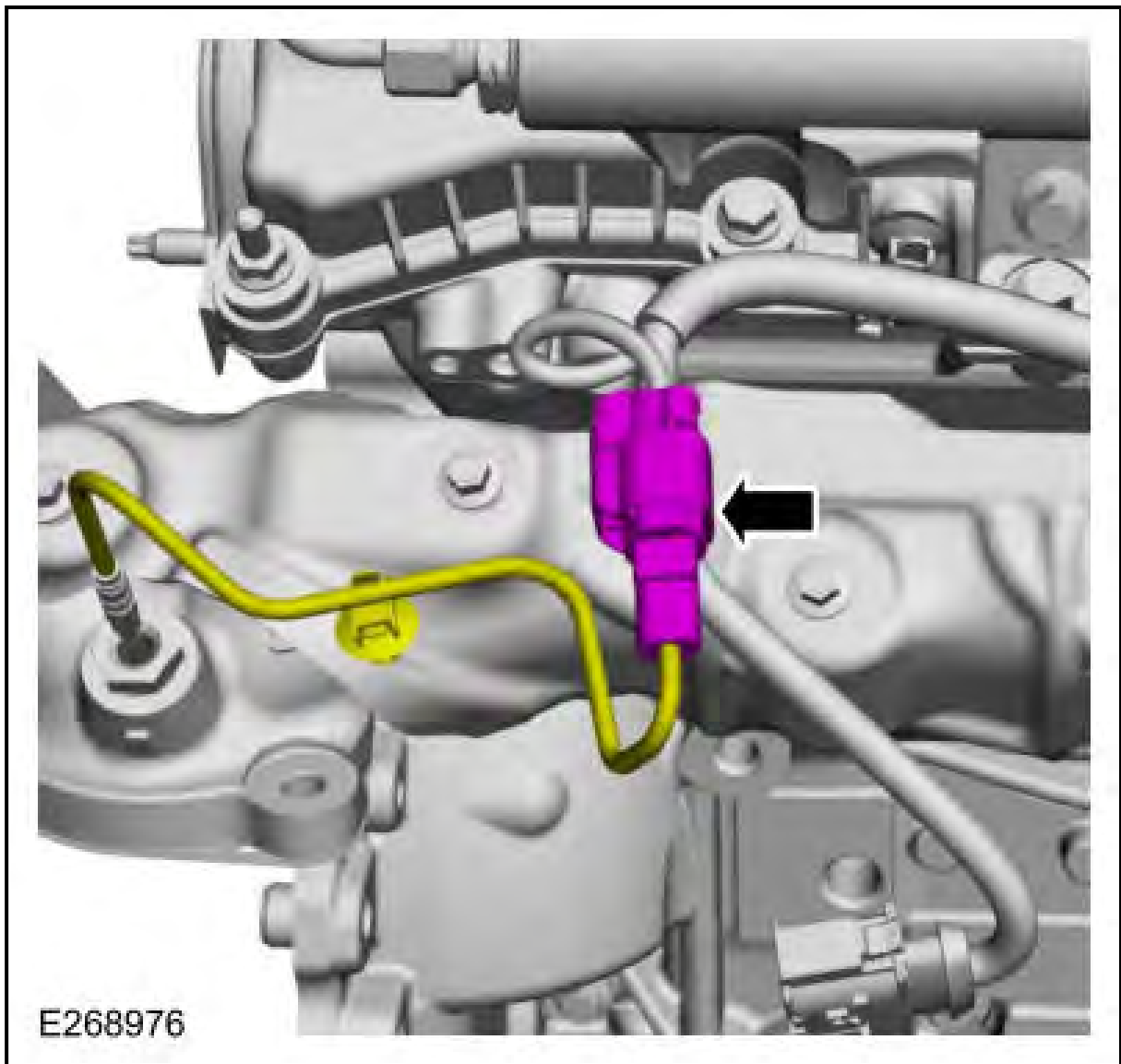
Courtesy of FORD MOTOR COMPANY

3. Install the exhaust manifold heat shield and the bolts.

Torque: 97 lb.in (11 Nm)

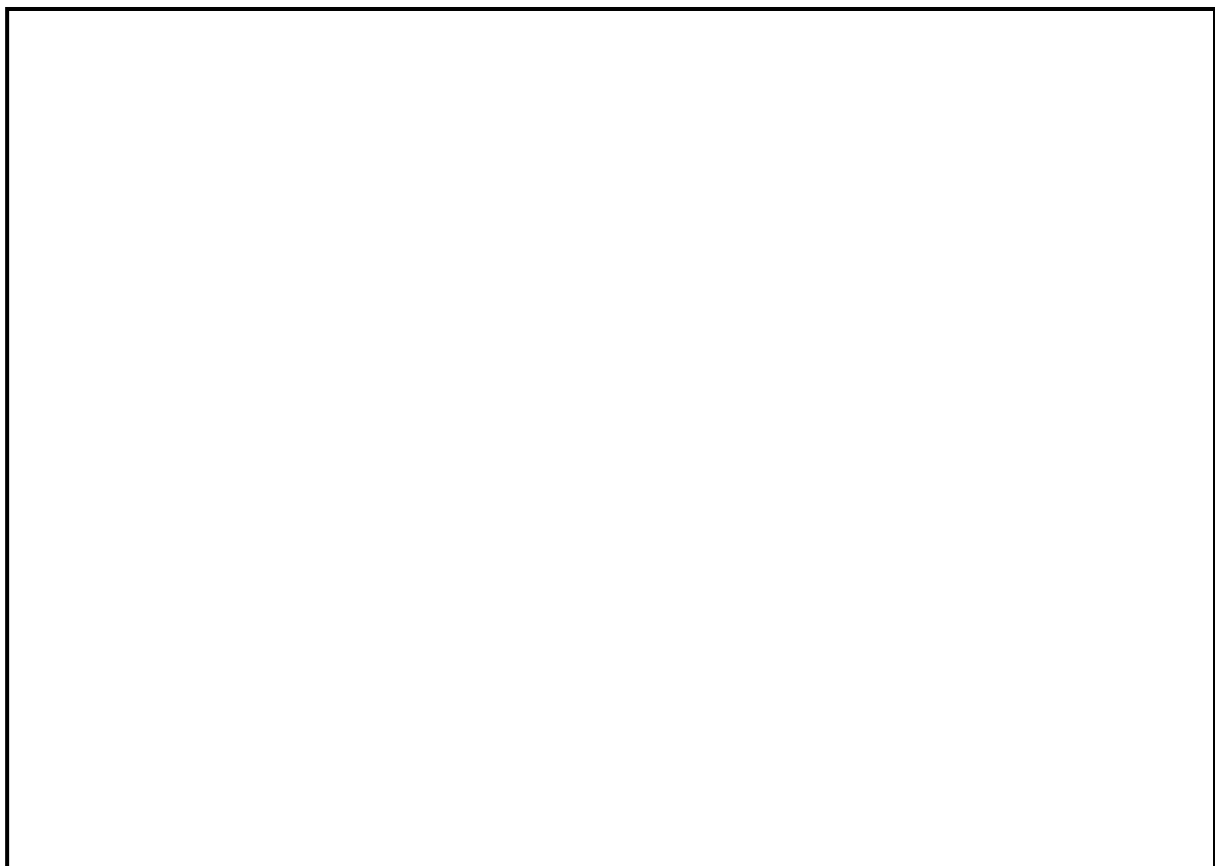


4. Connect the EGRT sensor electrical connector.

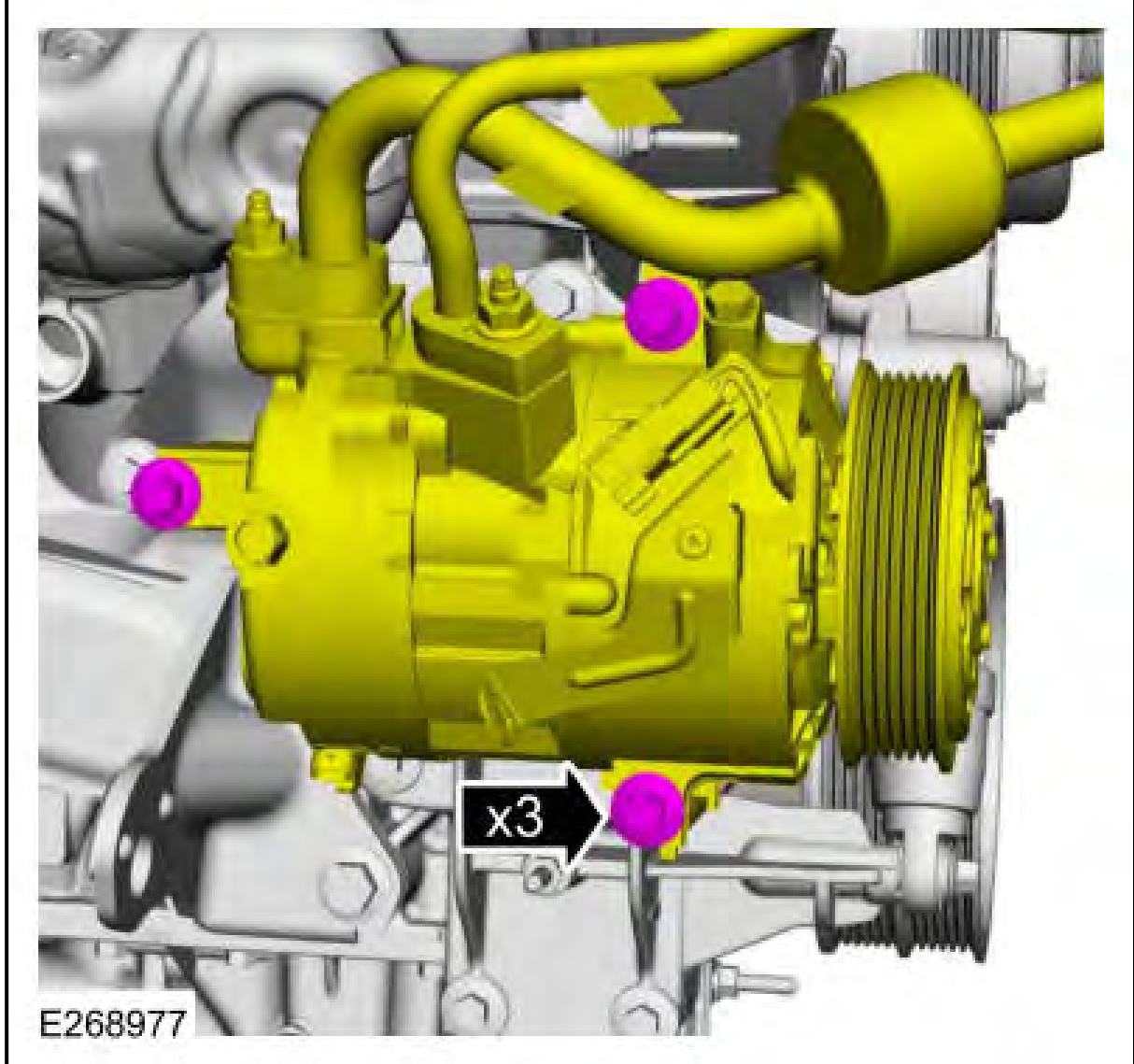


5. Position back the A/C compressor and install the bolts.

Torque: 18 lb.ft (25 Nm)







6. Install the following items:

1. Install the A/C compressor belt. REFER to: [Air Conditioning \(A/C\) Compressor Belt](#) .
2. Install the exhaust crossover pipe. REFER to: [Exhaust Crossover Pipe](#) .
3. Install the turbocharger. REFER to: [Turbocharger](#) .

### **FLEXPLATE**

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

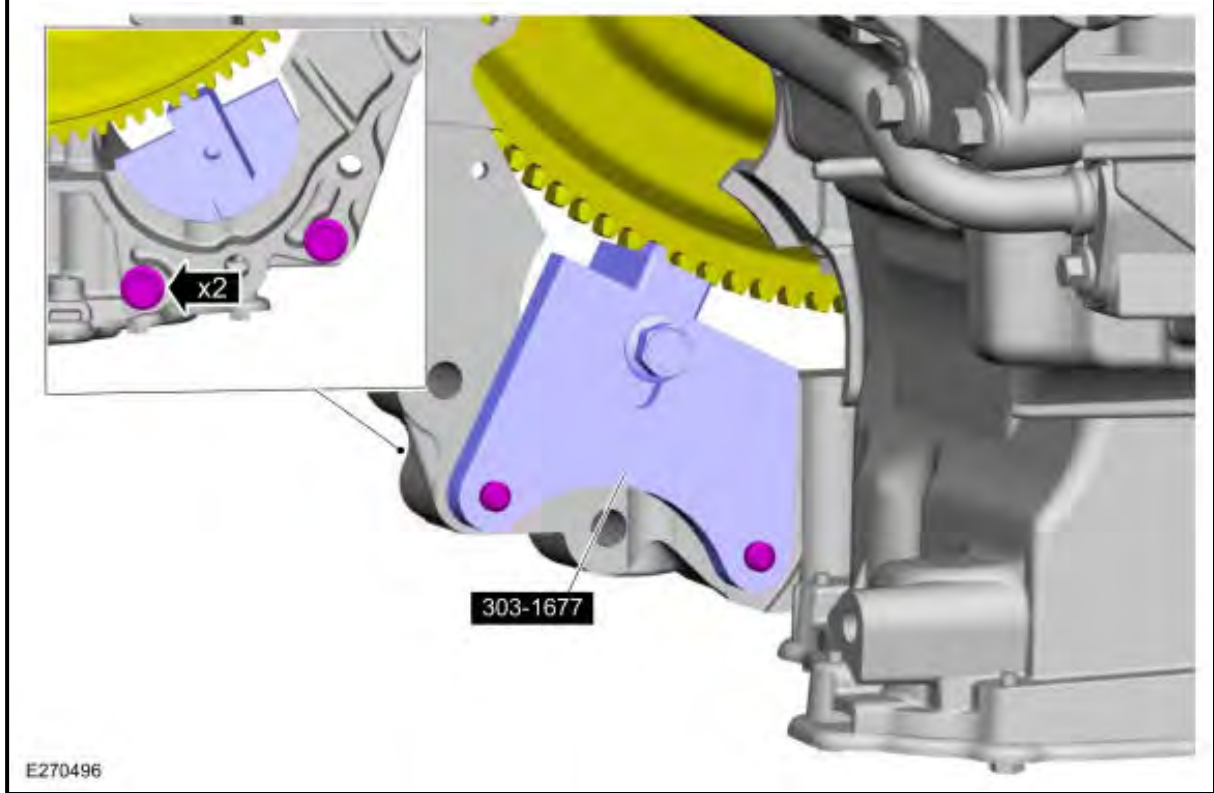
### **Special Tool(s) / General Equipment**

|  |   |
|--|---|
|  | <p><b>303-1677 Locking Tool, Flywheel</b></p> |
|--|---|

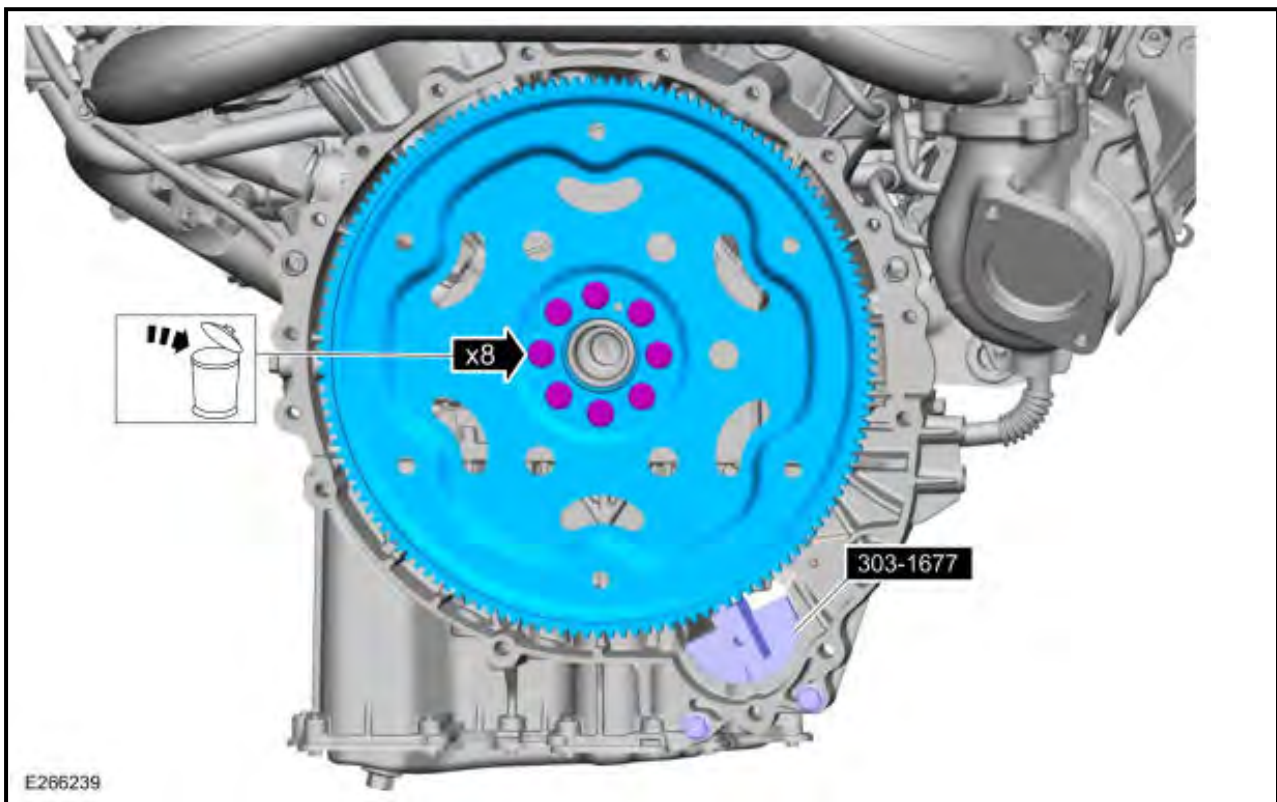
### **REMOVAL**

1. Remove the transmission. REFER to: [Transmission - 3.0L Power Stroke Diesel](#) .
2. **NOTE:**        **Only rotate the crankshaft clockwise.**

Install Special Service Tool: 303-1677 Locking Tool, Flywheel.



3. Remove the bolts and the flexplate. Discard the bolts.



## INSTALLATION

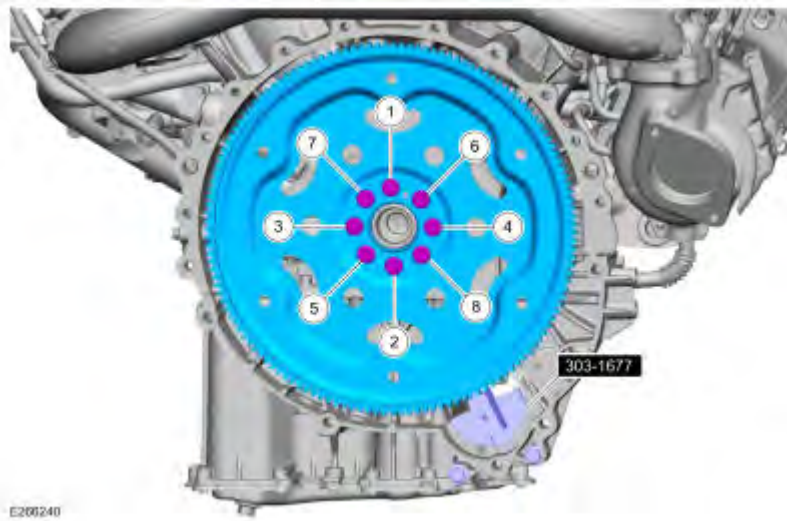
1. Install the flexplate and the bolts. Tighten in sequence shown.

Torque:

Stage 1: 37 lb.ft (50 Nm)

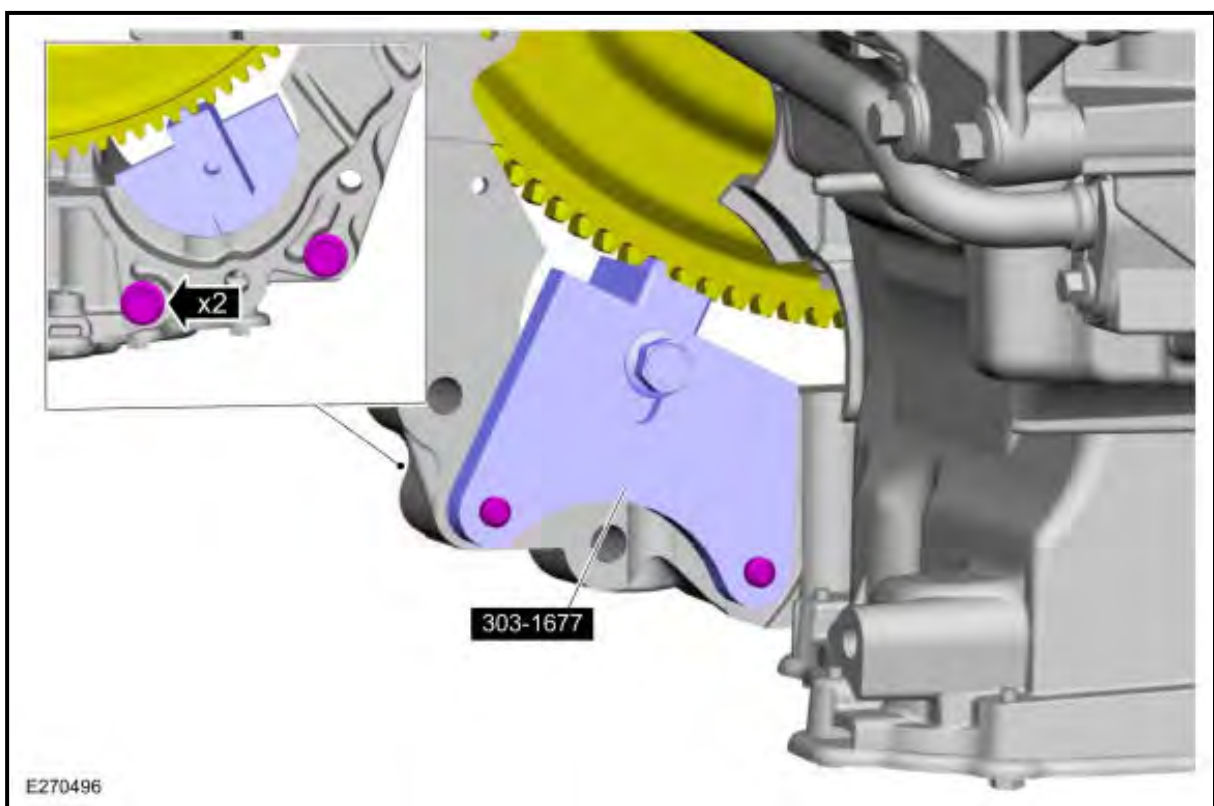
Stage 2: 45 Â°

Stage 3: 45 Â°



**Fig. 8: Flexplate Tightening Sequence**  
 Courtesy of FORD MOTOR COMPANY

2. Remove Special Service Tool: 303-1677 Locking Tool, Flywheel.



3. Install the transmission. REFER to: [Transmission - 3.0L Power Stroke Diesel](#) .

## INTAKE MANIFOLD

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

### Special Tool(s) / General Equipment

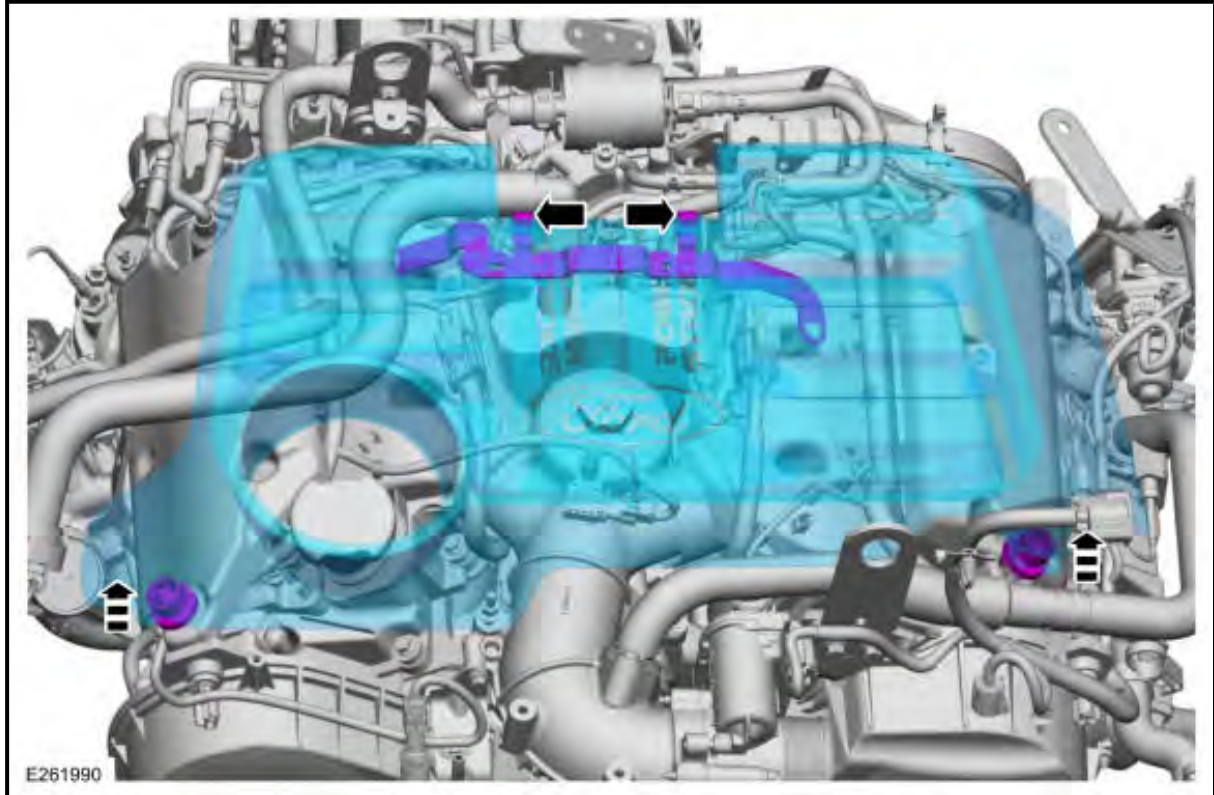
|                                     |
|-------------------------------------|
| <b>Hose Clamp Remover/Installer</b> |
|-------------------------------------|

### Materials

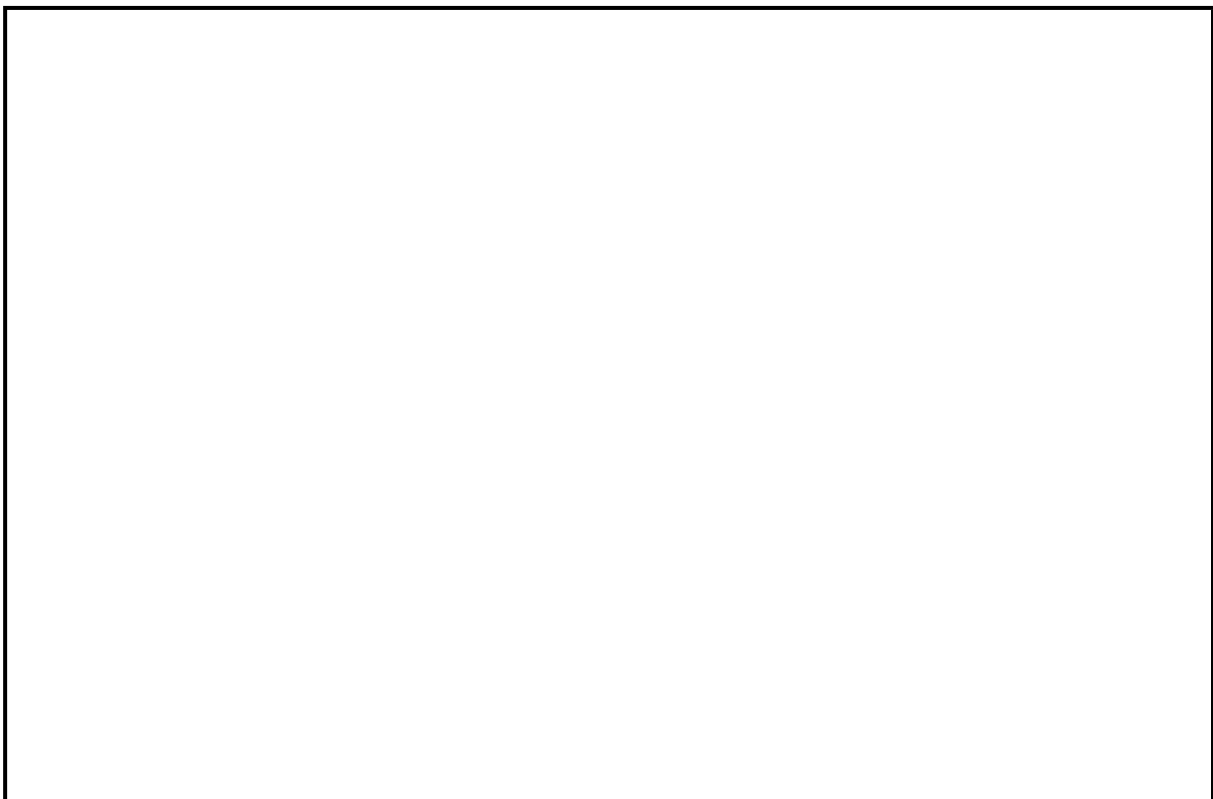
| Name  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA  | WSS-M2C214-B1 |
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant VC-3-B | WSS-M97B44-D  |

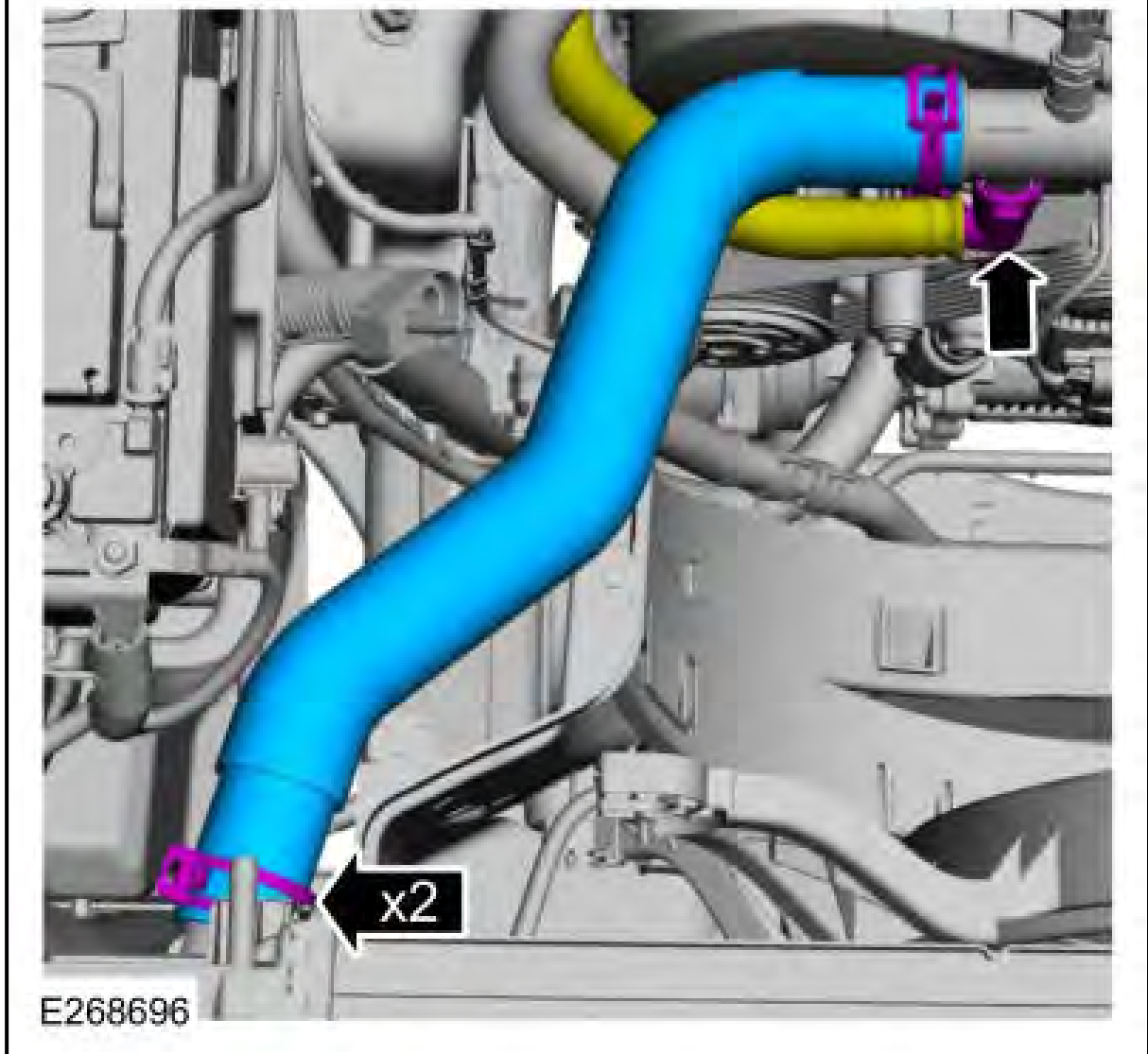
## REMOVAL

1. Remove the engine appearance cover.

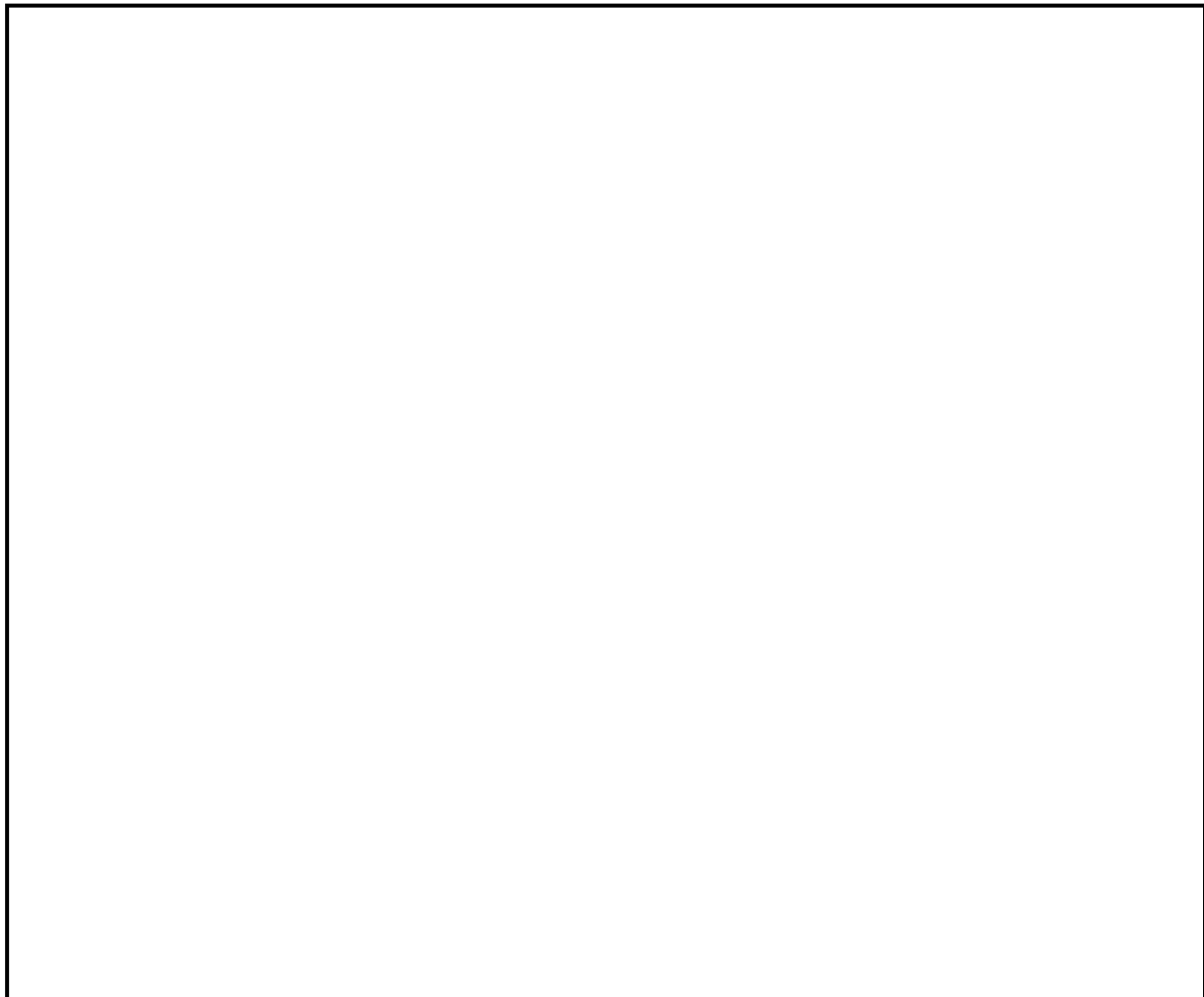


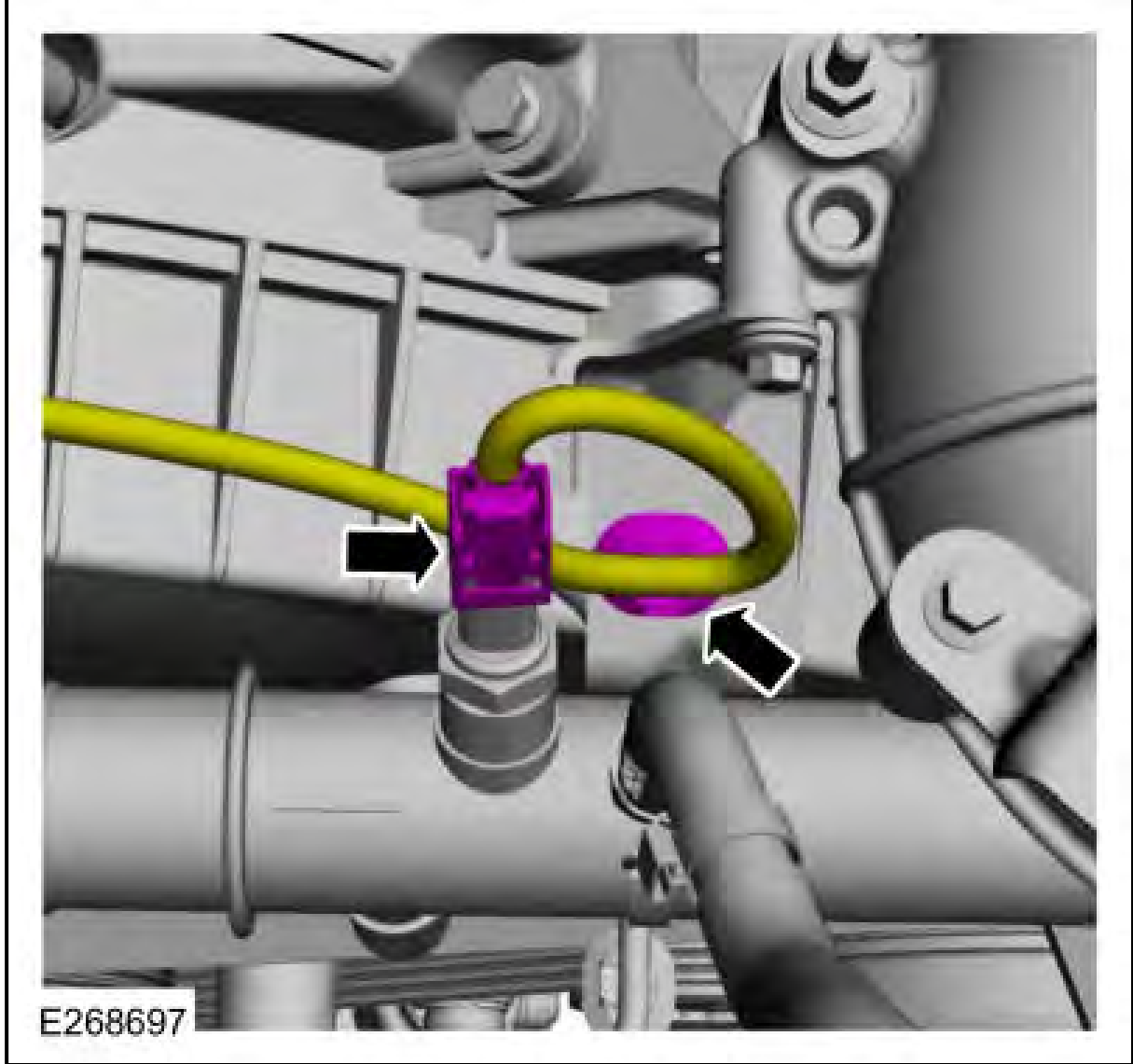
2. Drain the cooling system. REFER to: [Cooling System Draining, Vacuum Filling and Bleeding](#) .
3. Remove the following items:
  1. Remove the degas bottle. REFER to: [Degas Bottle](#) .
  2. Remove the cooling fan. REFER to: [Cooling Fan](#) .
  3. Remove the air cleaner outlet pipe. REFER to: [Air Cleaner Outlet Pipe](#) .
  4. Remove the EGR valve outlet tube. REFER to: [Exhaust Gas Recirculation \(EGR\) Outlet Tube](#) .
  5. Remove the LH CAC outlet pipe. REFER to: [Charge Air Cooler \(CAC\) Outlet Pipe](#) .
4.
  - Disconnect and remove the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer
  - Disconnect the heater hose and position aside.



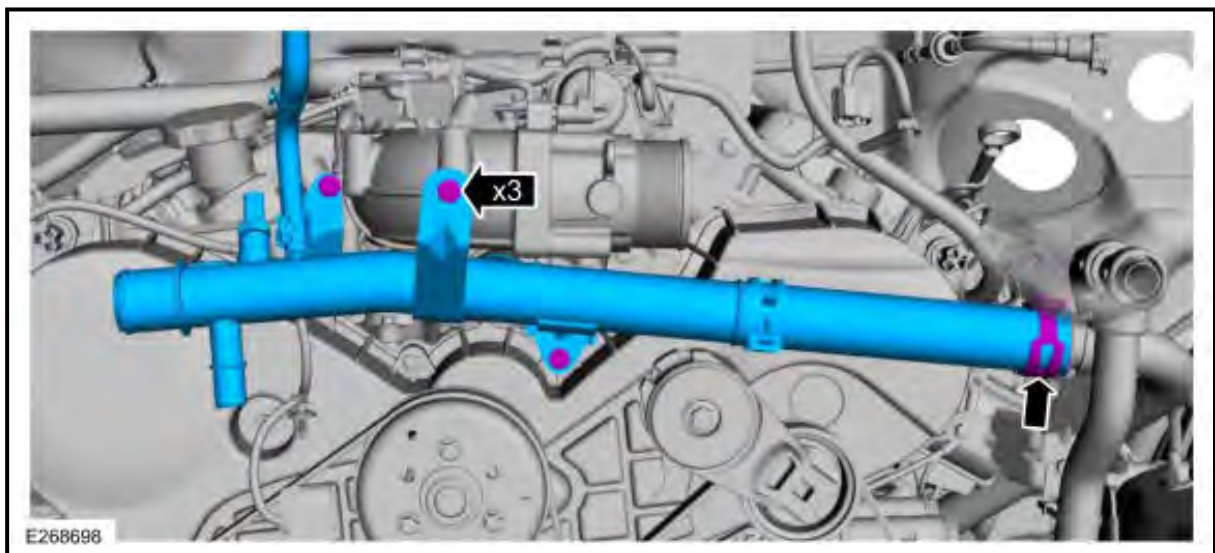


5. Disconnect the ECT sensor electrical connector and the wire retainer.



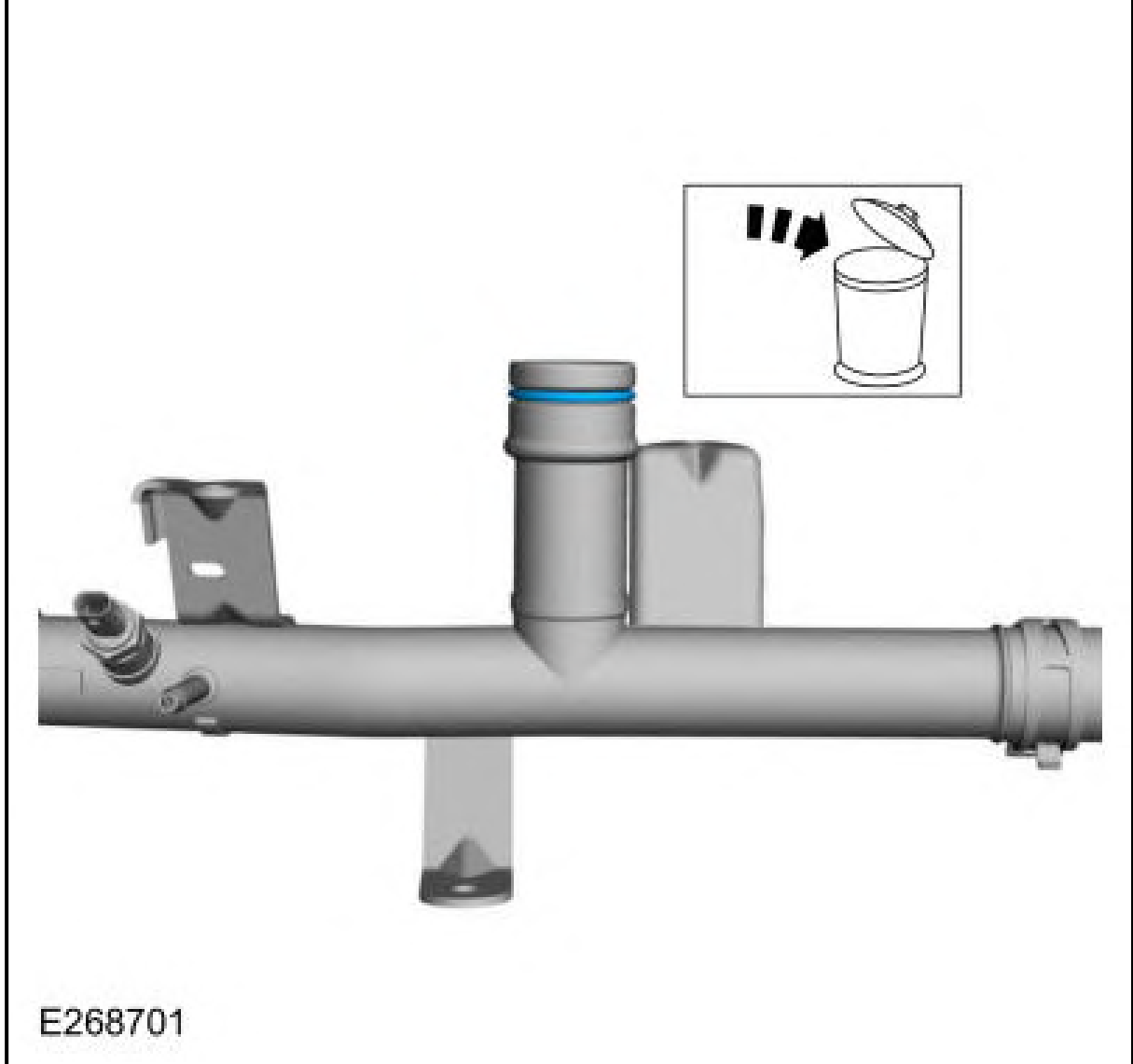


6. Remove the bolts for the coolant tube. Disconnect the clamp and remove the coolant tube. Use the General Equipment: Hose Clamp Remover/Installer



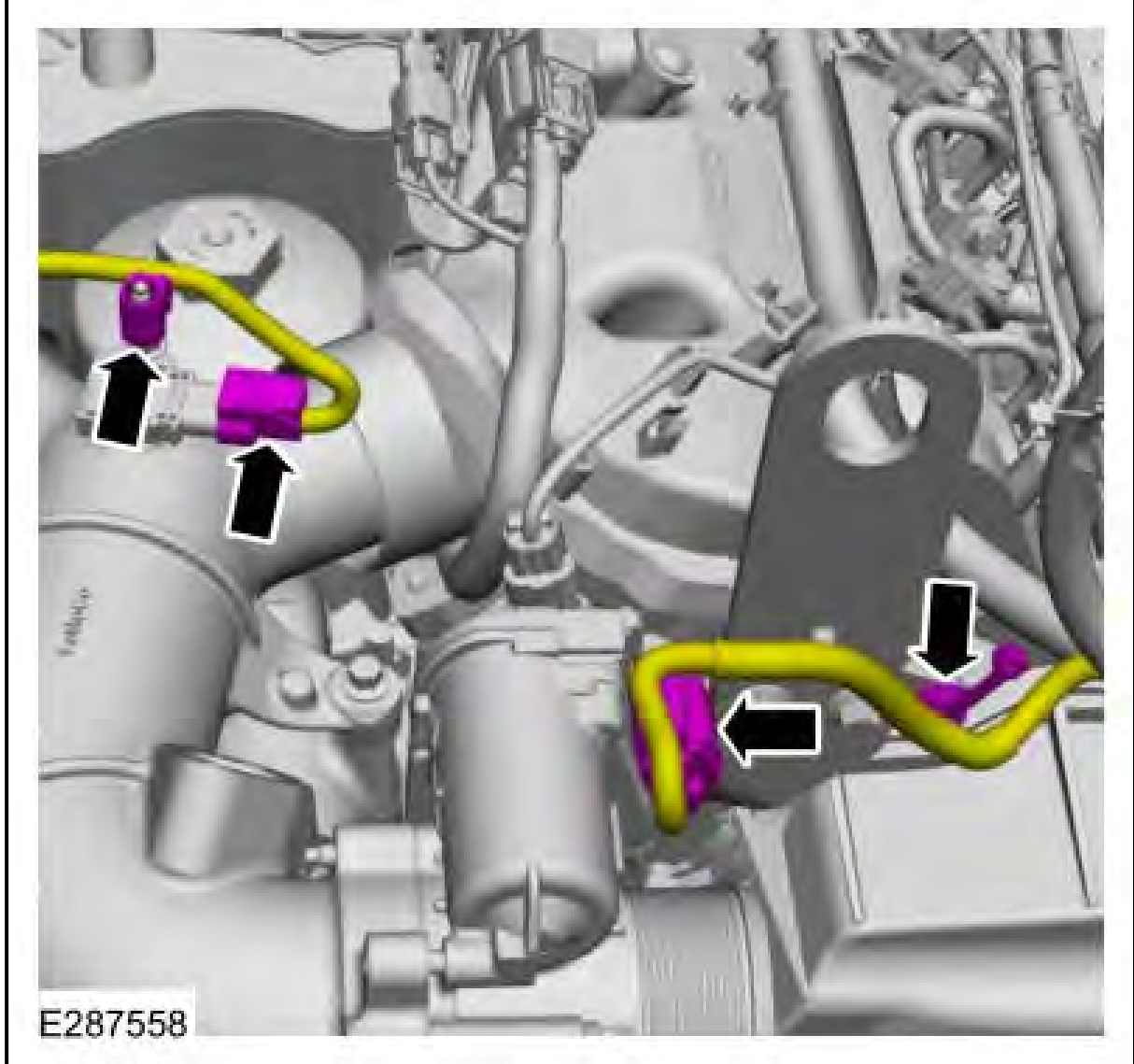
7. Remove and discard the O-ring seal.



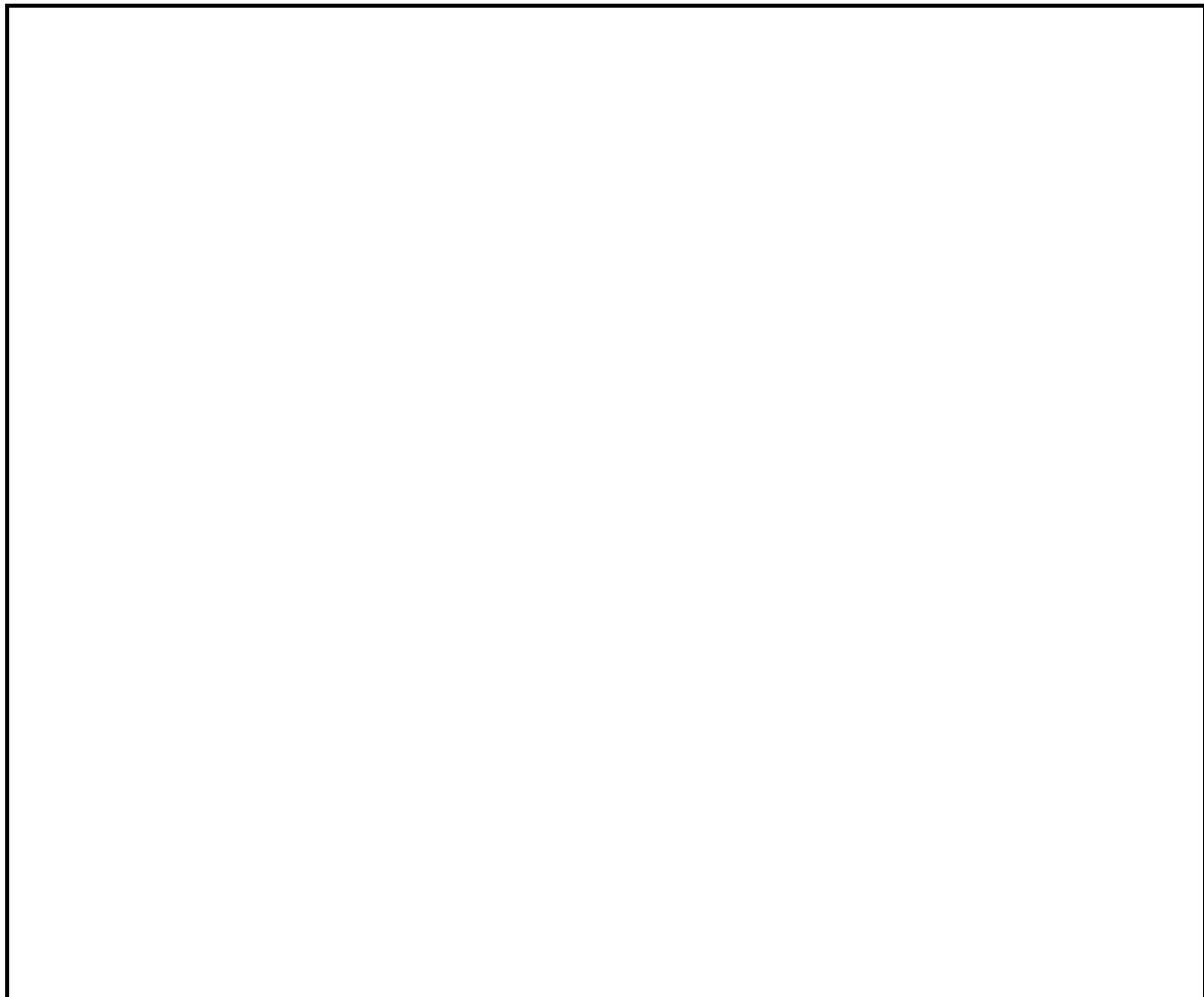


8. Disconnect the IAT sensor electrical connector and the wire retainer. Disconnect the TB (throttle body) electrical connector and the wire retainer.

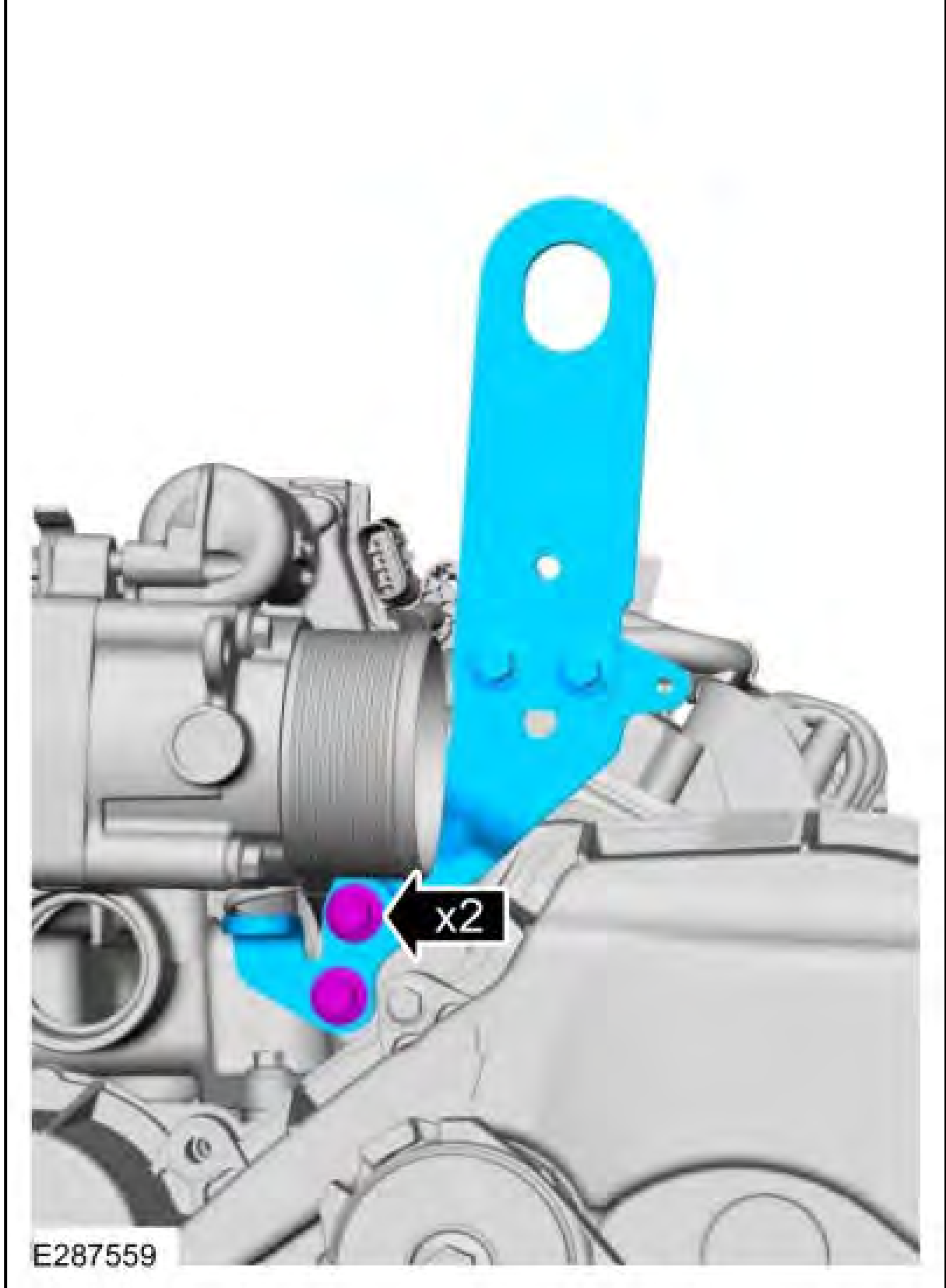




9. Remove the bolts and the lifting bracket.



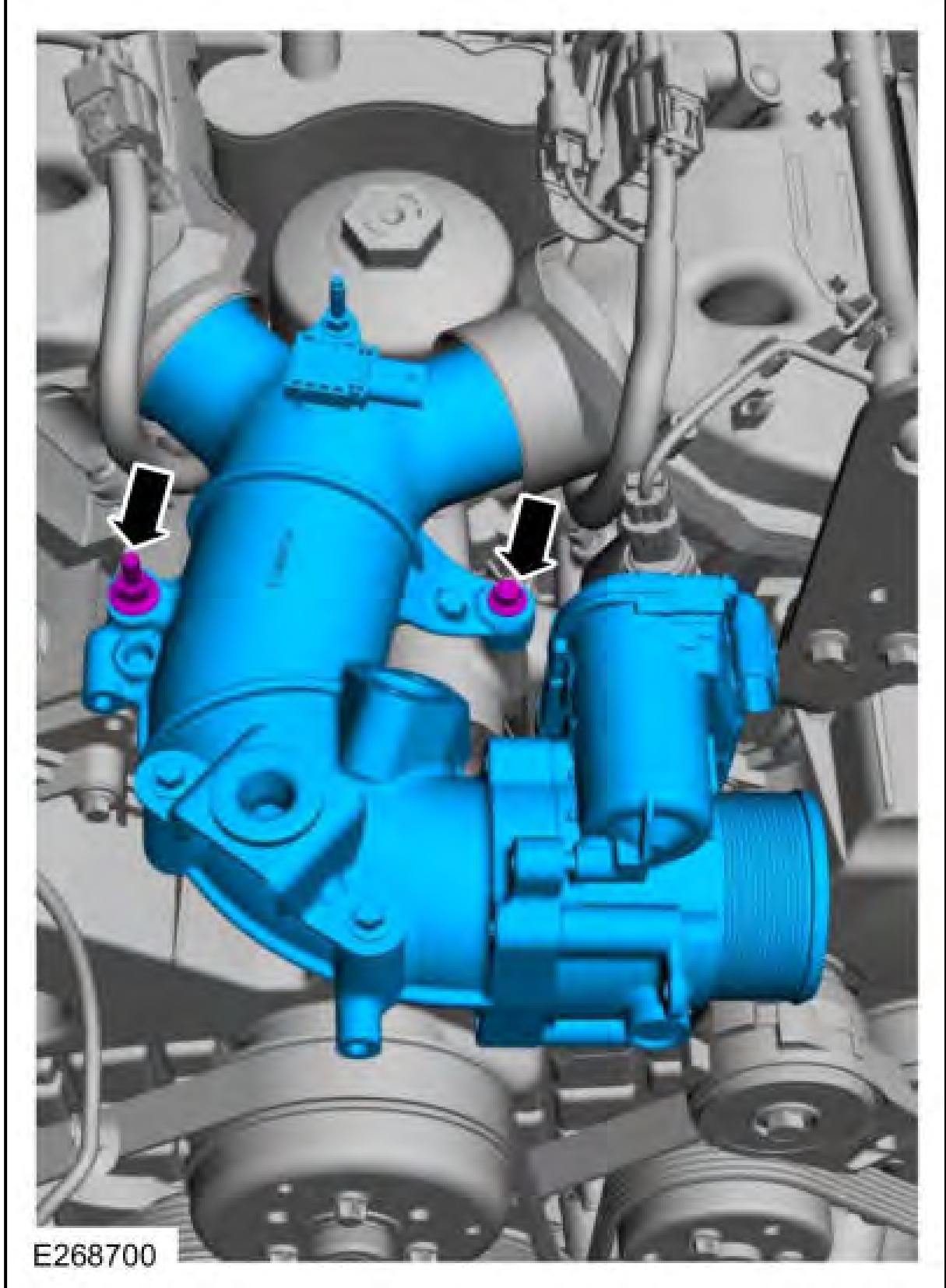




10. **NOTE:** Lift the front of the intake manifold up and slide the intake manifold to the right side of the vehicle to remove.

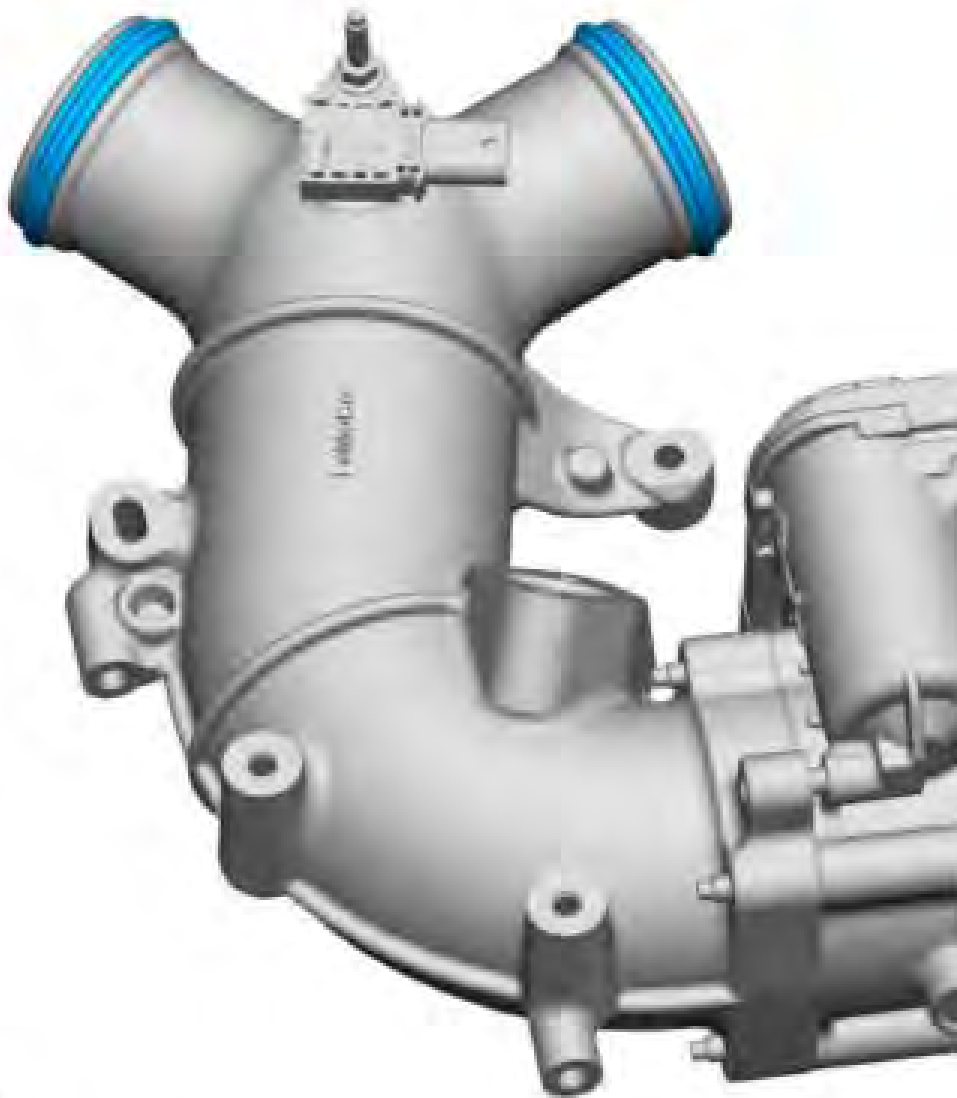
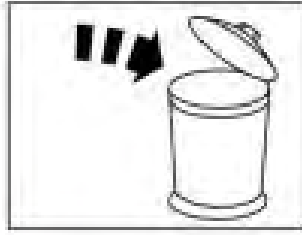
Remove the stud bolt, the bolt and the intake manifold.





11.

- Remove and discard the intake manifold gaskets.
- Clean and inspect all of the sealing surfaces of the intake manifold and the valve covers.



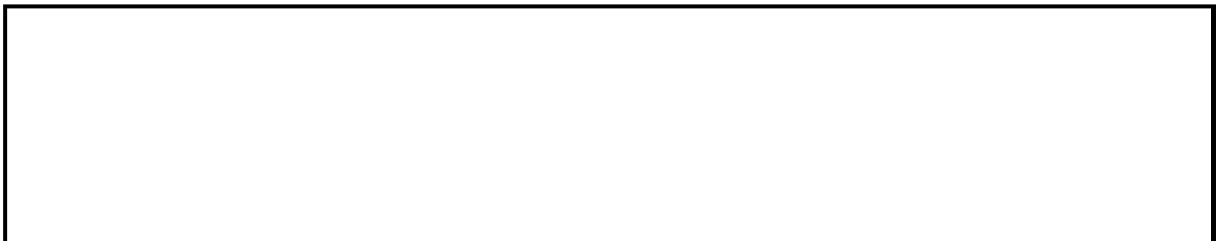
E261593

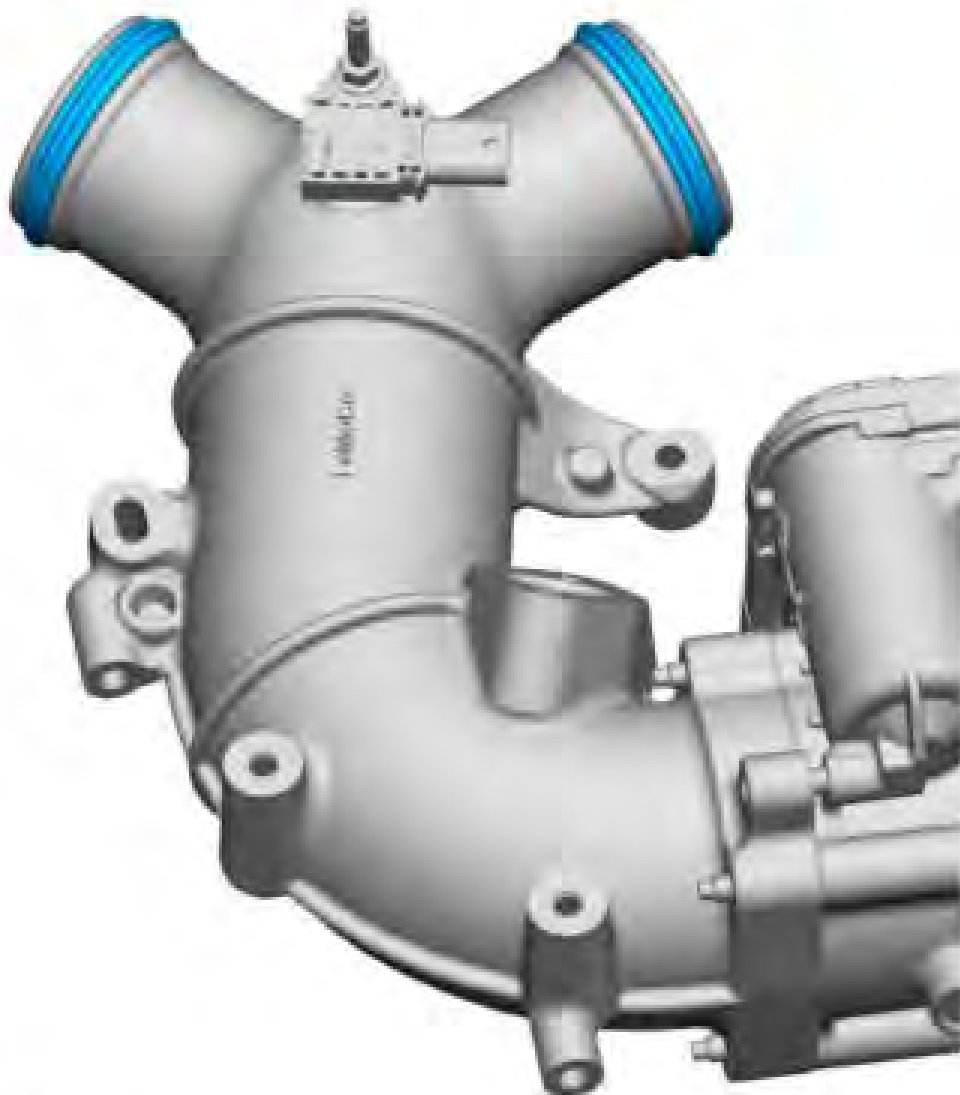
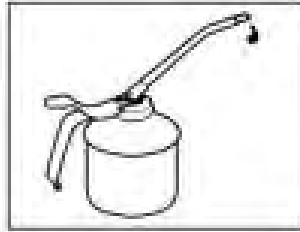
## INSTALLATION

1. **NOTE:** Lubricate the gaskets with clean engine oil.

Install the new intake manifold gaskets.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)



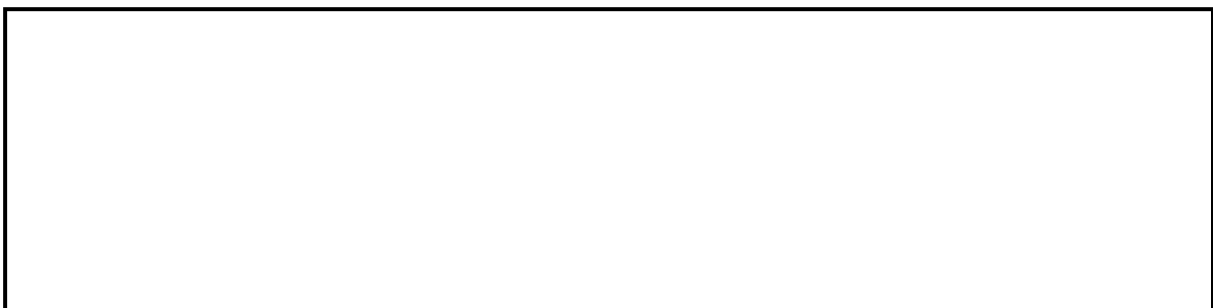


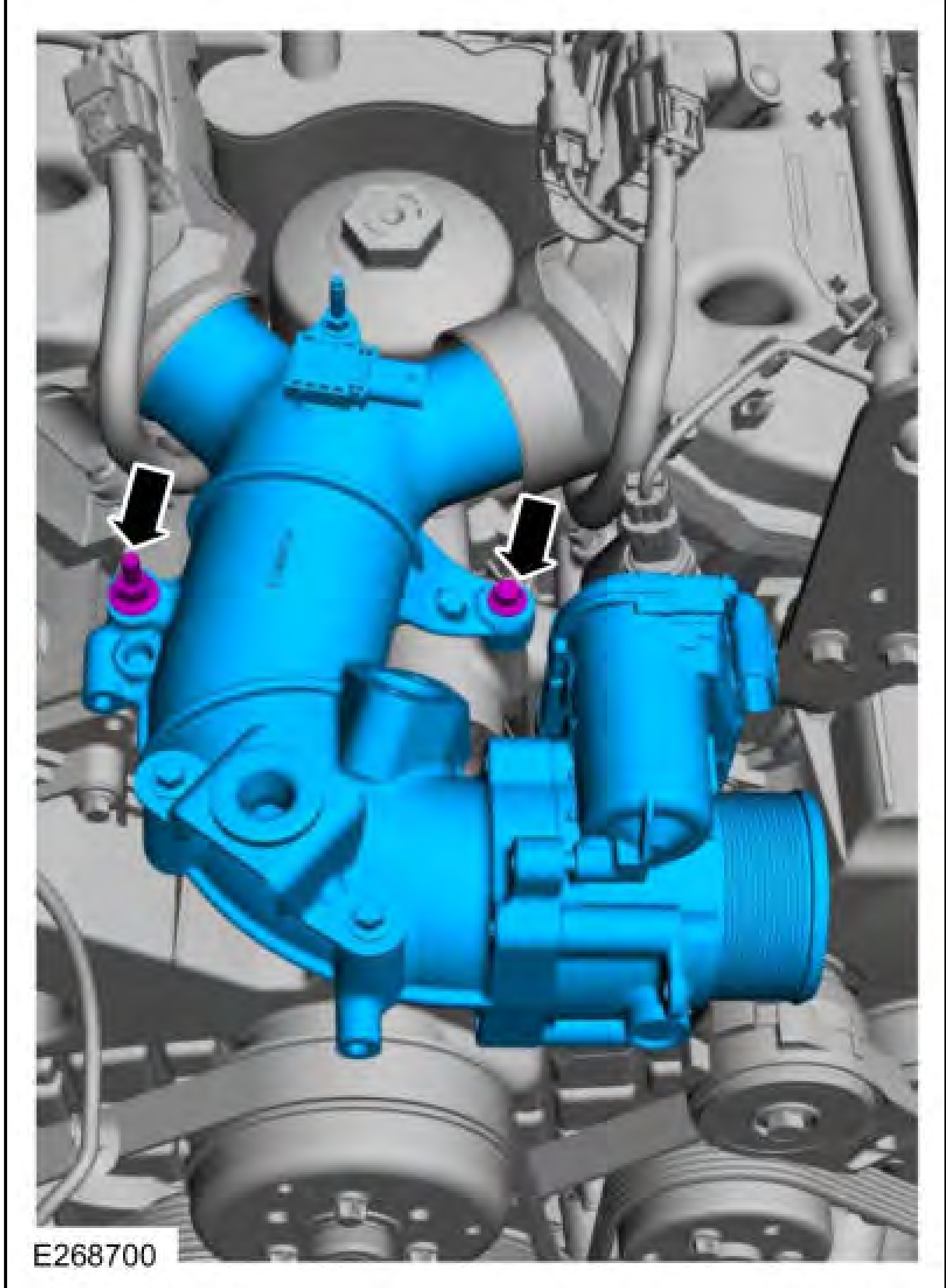
E261599

2. **NOTE:** Insert the intake manifold into the LH valve cover, then into the RH valve cover.

Install the intake manifold, the bolt and the stud bolt.

Torque: 89 lb.in (10 Nm)

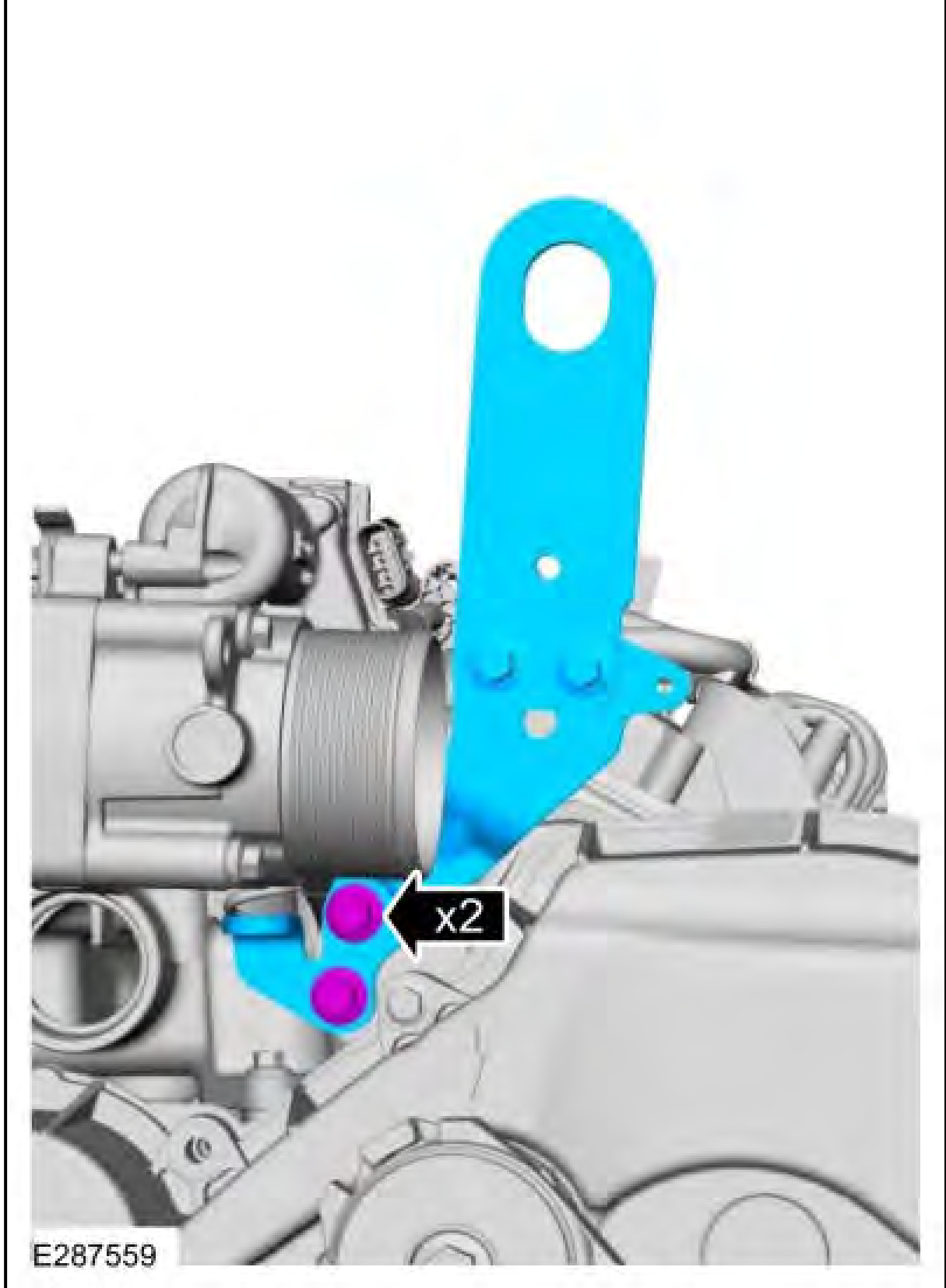




3. Install the lifting bracket and the bolts.

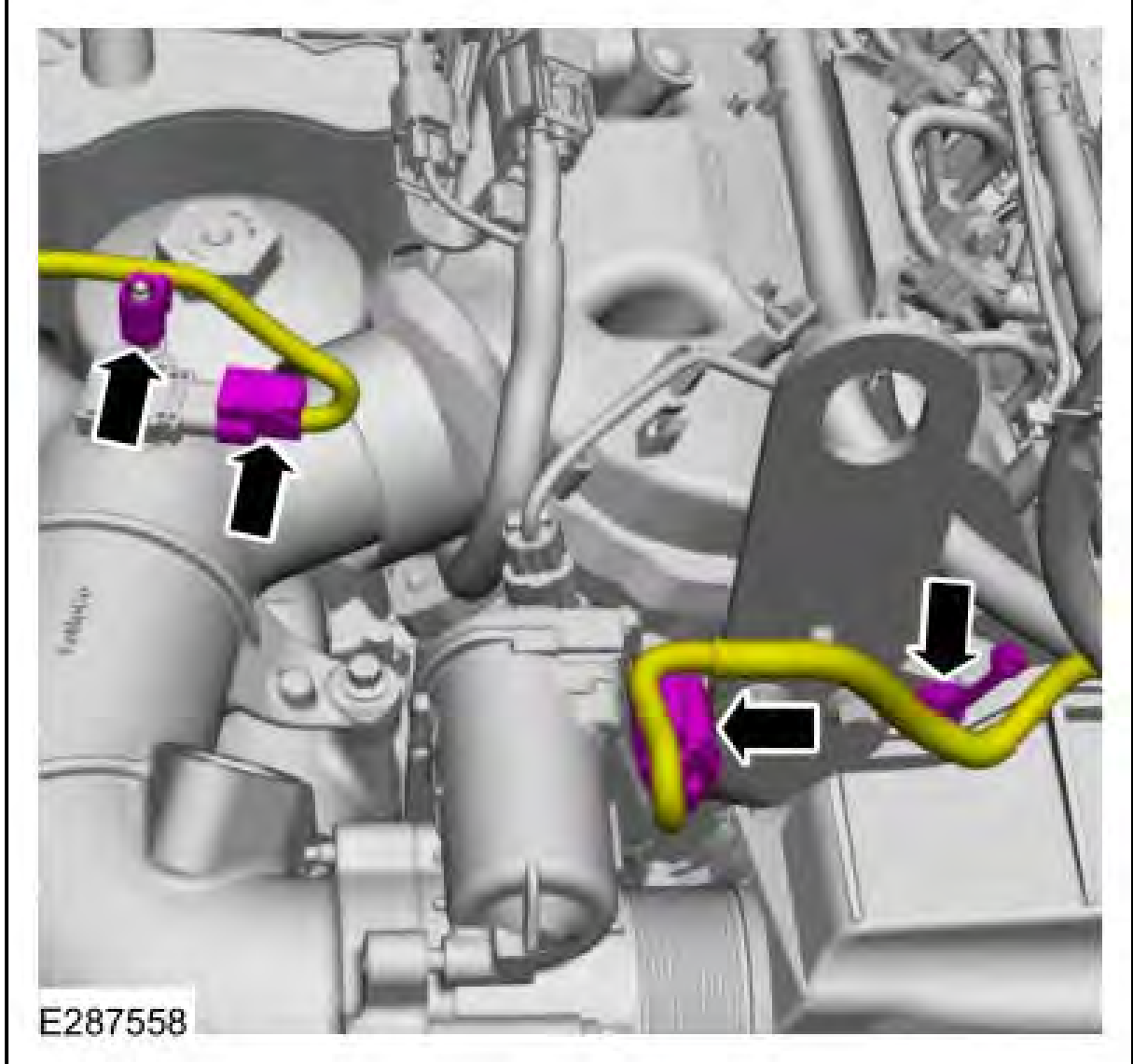
Torque: 17 lb.ft (23 Nm)





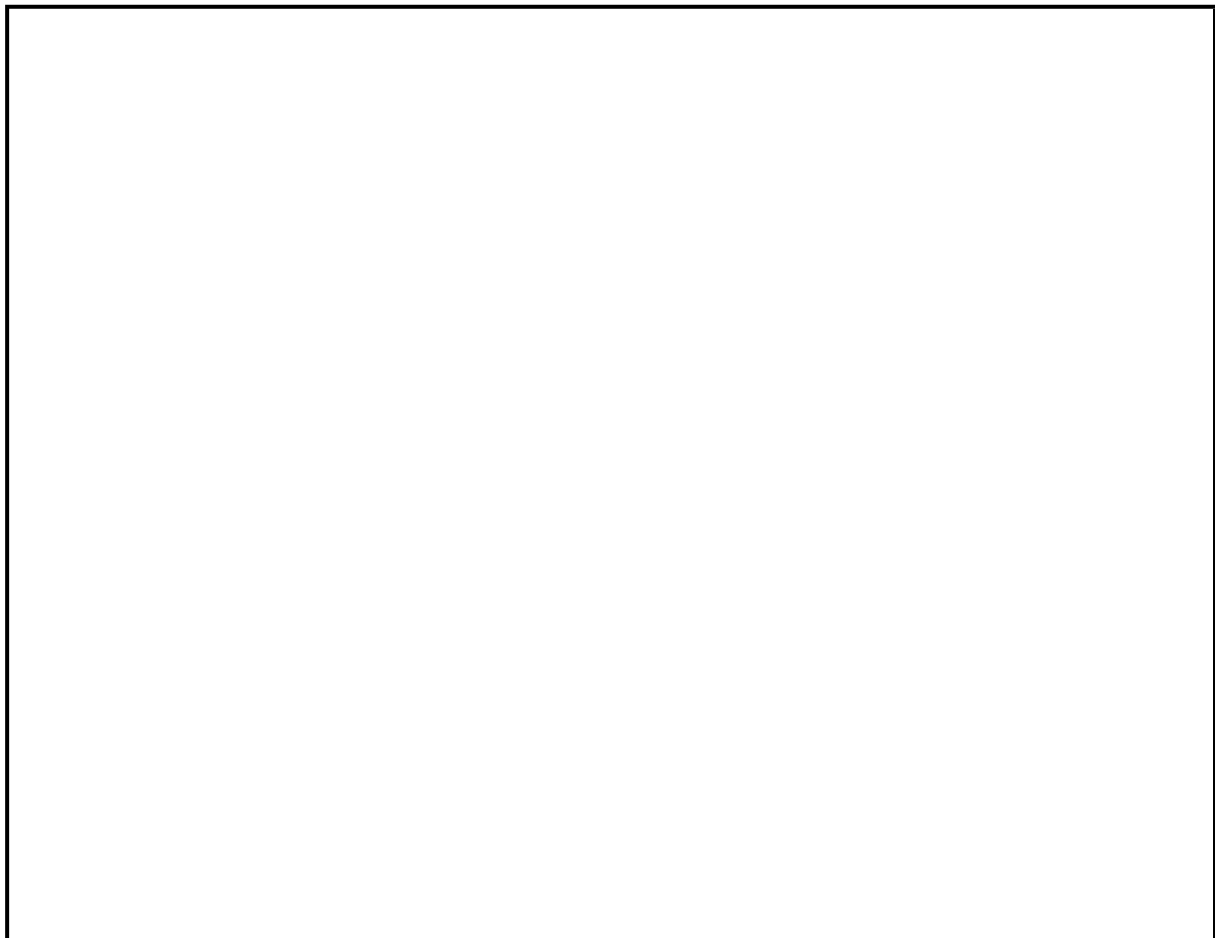
4. Connect the IAT sensor electrical connector and the wire retainer. Connect the TB (throttle body) electrical connector and the retainer.

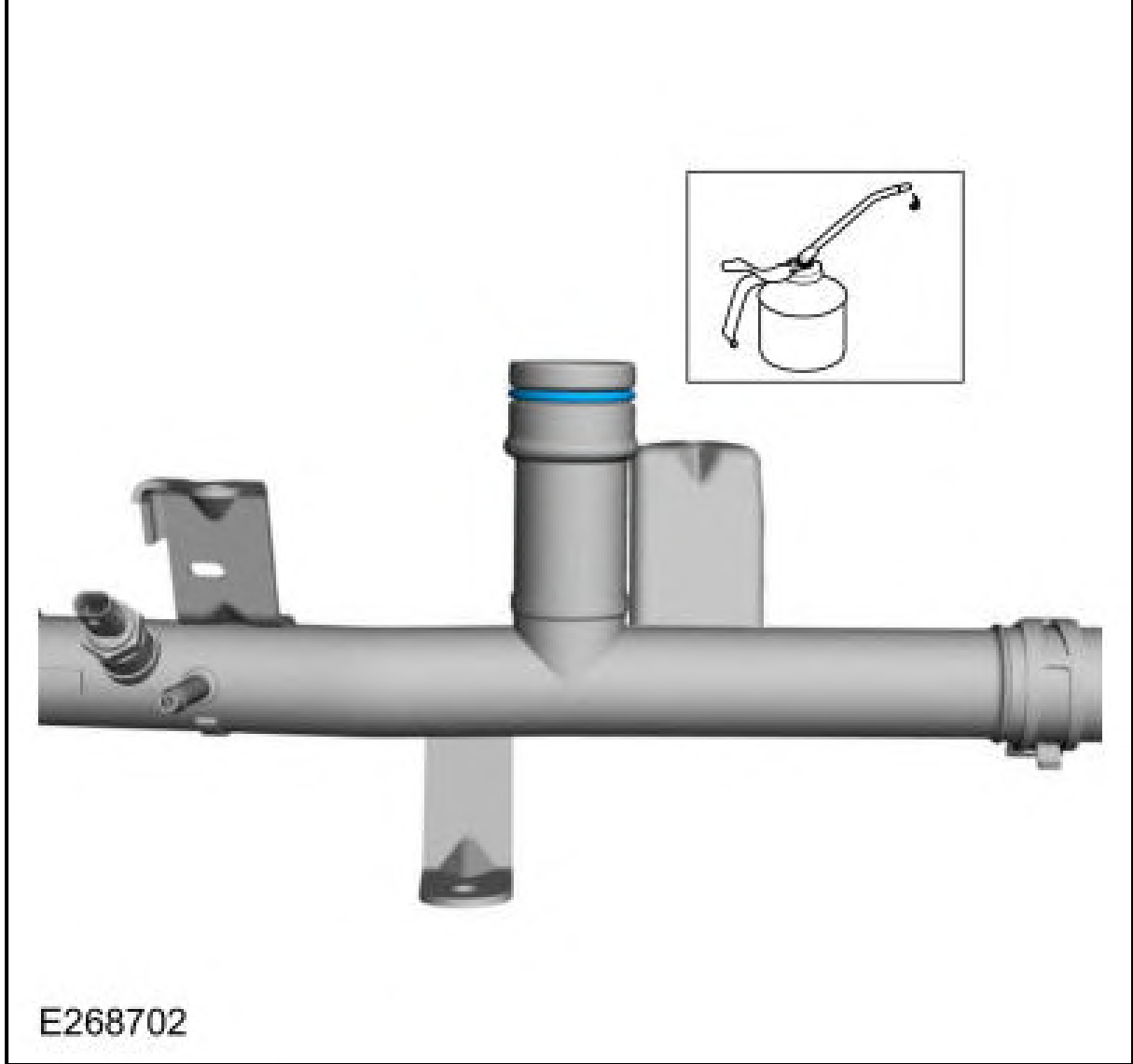




5. Install a new O-ring seal and lubricate.

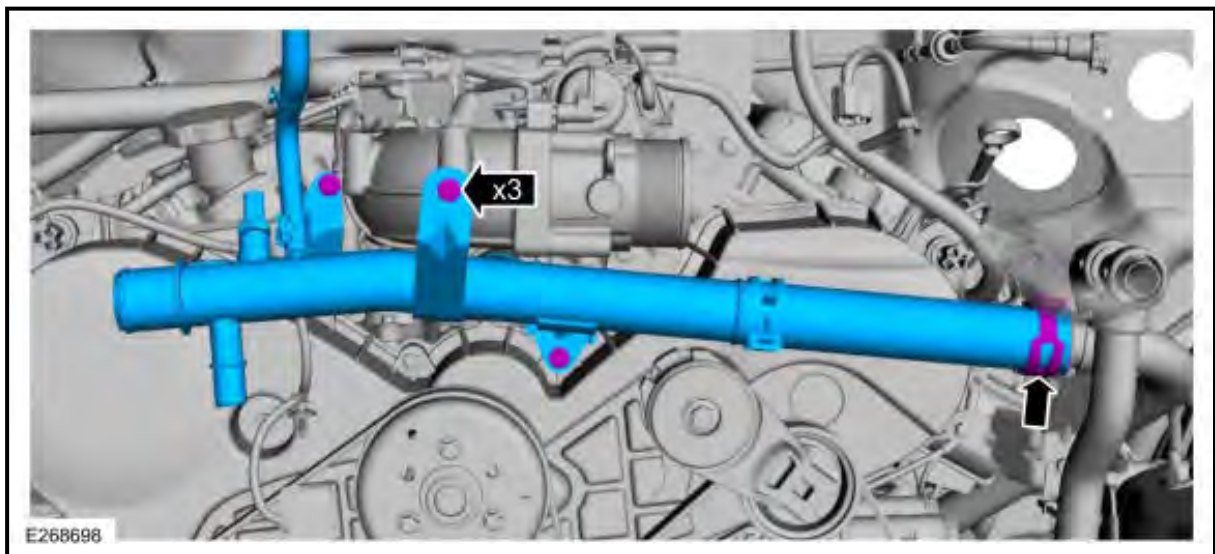
Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)





6. Install the coolant tube and connect the clamp. Install the bolts for the coolant tube. Use the General Equipment: Hose Clamp Remover/Installer

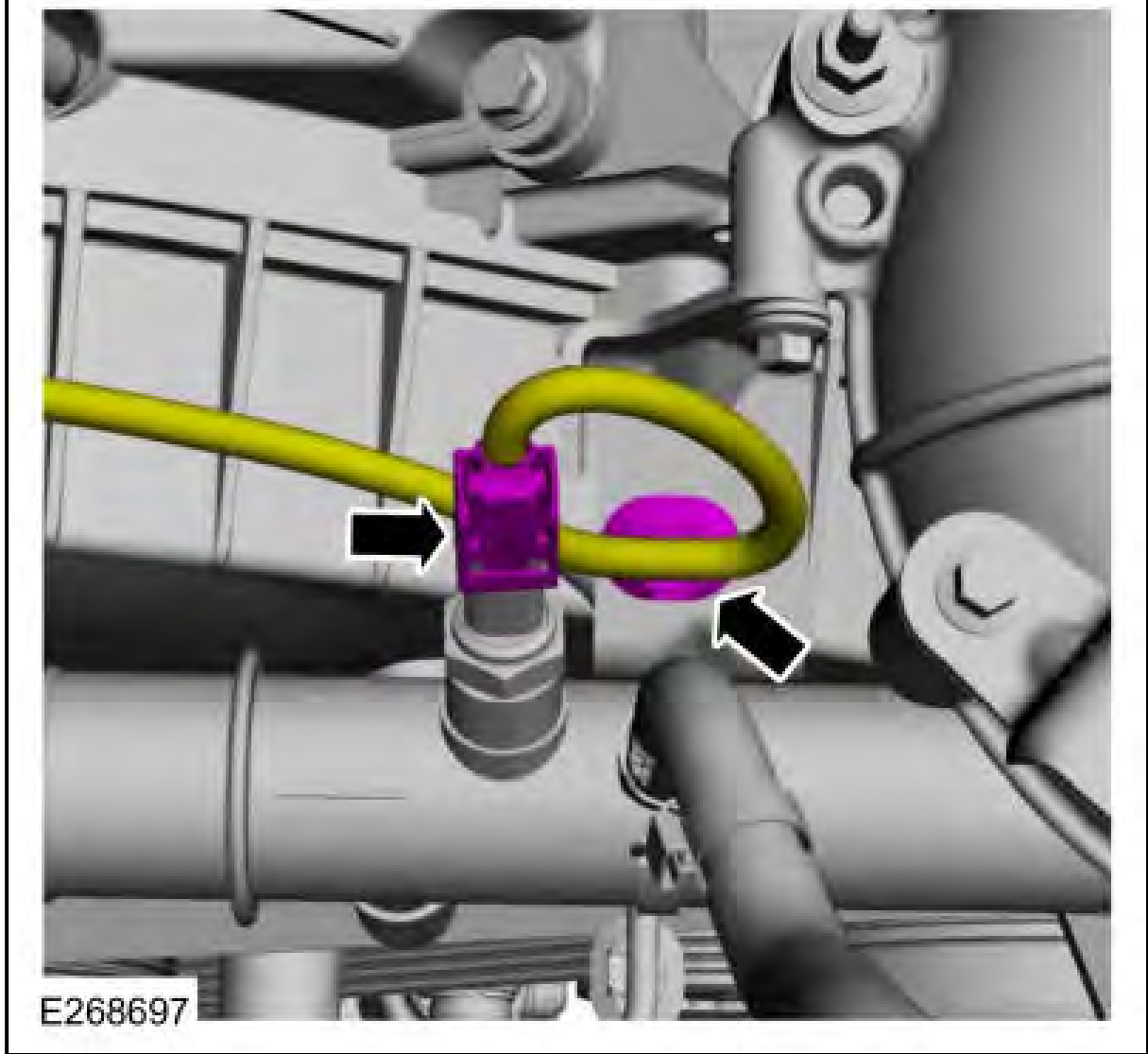
Torque: 89 lb.in (10 Nm)



7. Connect the ECT sensor electrical connector and the wire retainer.



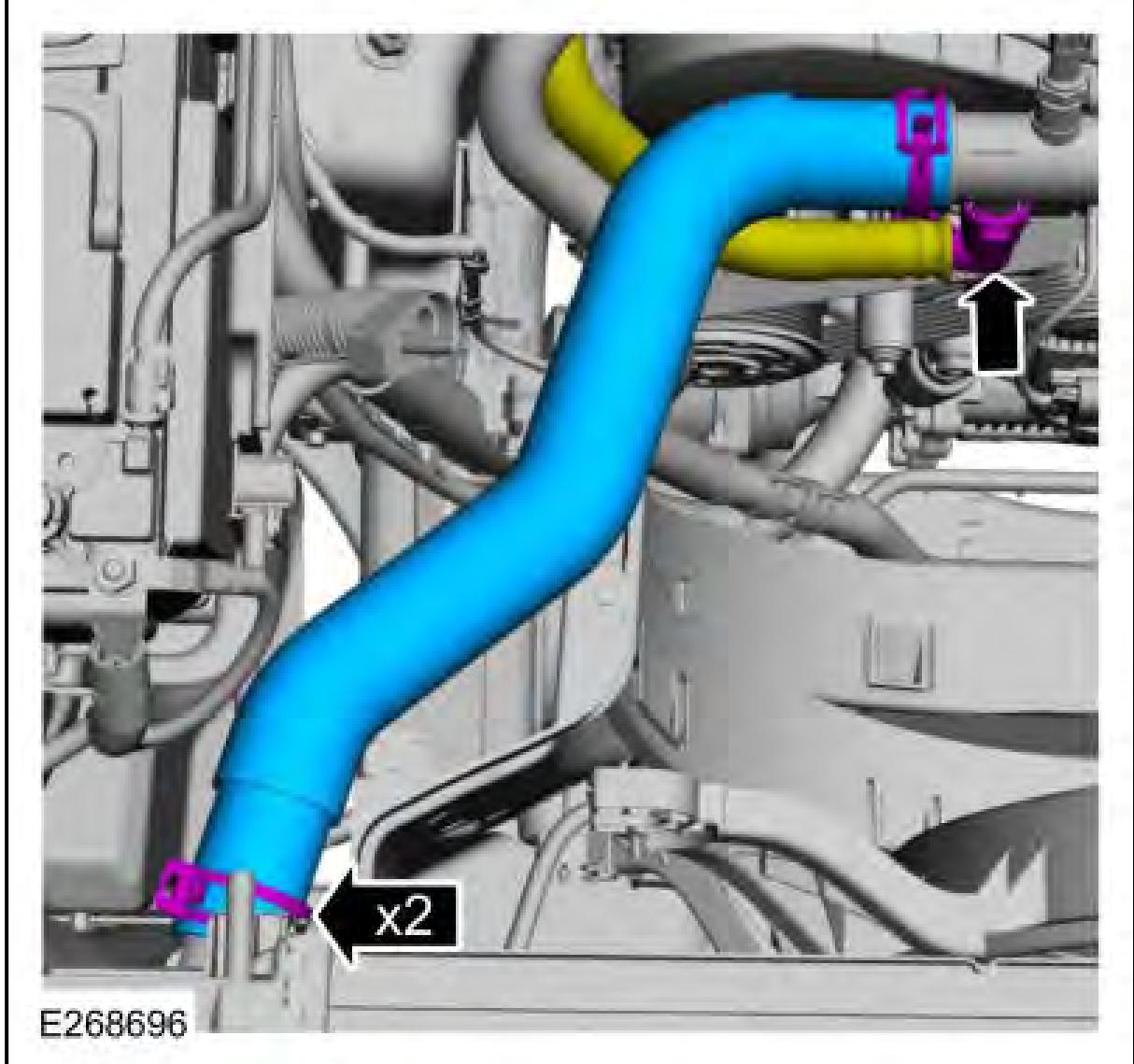




8.

- Position back and connect the heater hose.
- Install the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer





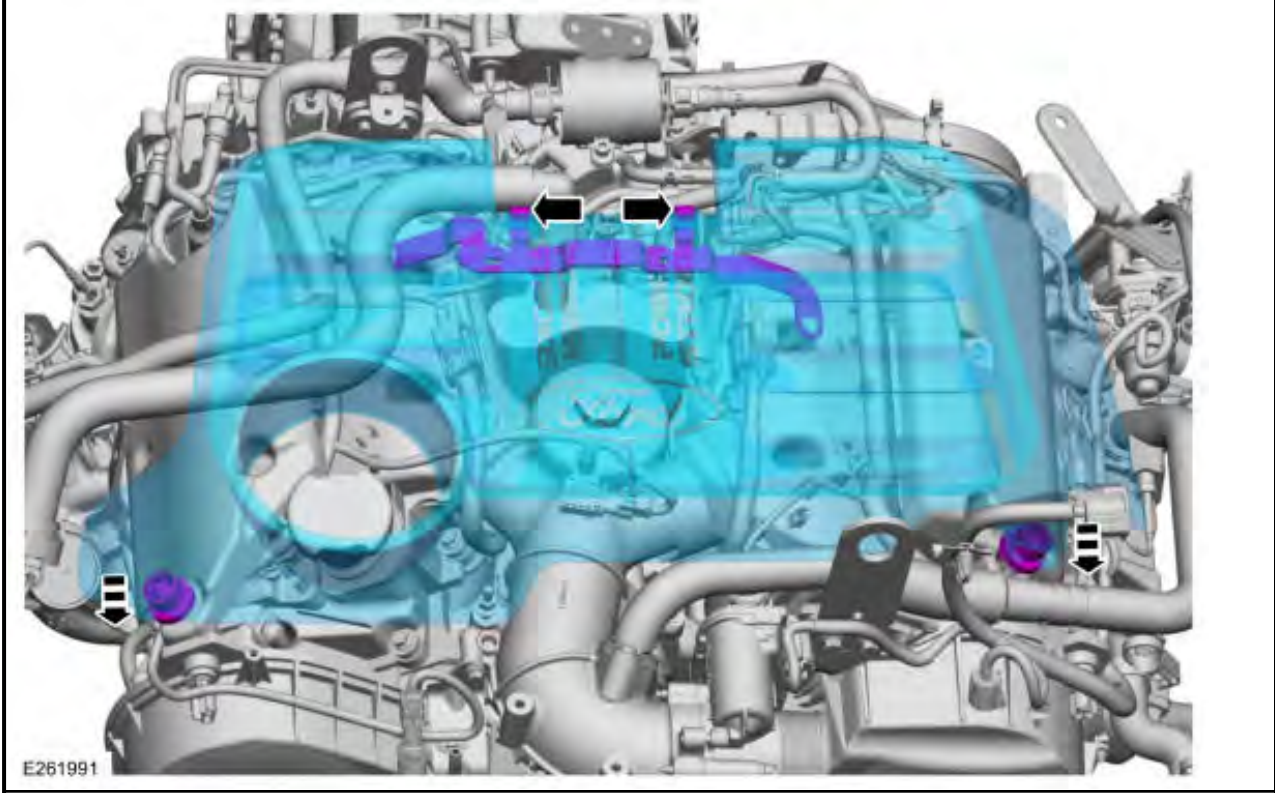
9. Install the following items:

1. Install the LH CAC outlet pipe. REFER to: [Charge Air Cooler \(CAC\) Outlet Pipe](#) .
2. Install the EGR valve outlet tube. REFER to: [Exhaust Gas Recirculation \(EGR\) Outlet Tube](#) .
3. Install the air cleaner outlet pipe. REFER to: [Air Cleaner Outlet Pipe](#) .
4. Install the cooling fan. REFER to: [Cooling Fan](#) .
5. Install the degas bottle. REFER to: [Degas Bottle](#) .

10. Evaluate the cooling system. REFER to: [Cooling System Condition Evaluation](#) .

11. Install the engine appearance cover.





## OIL COOLER

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

### Special Tool(s) / General Equipment

|                            |
|----------------------------|
| <b>Oil Drain Equipment</b> |
|----------------------------|

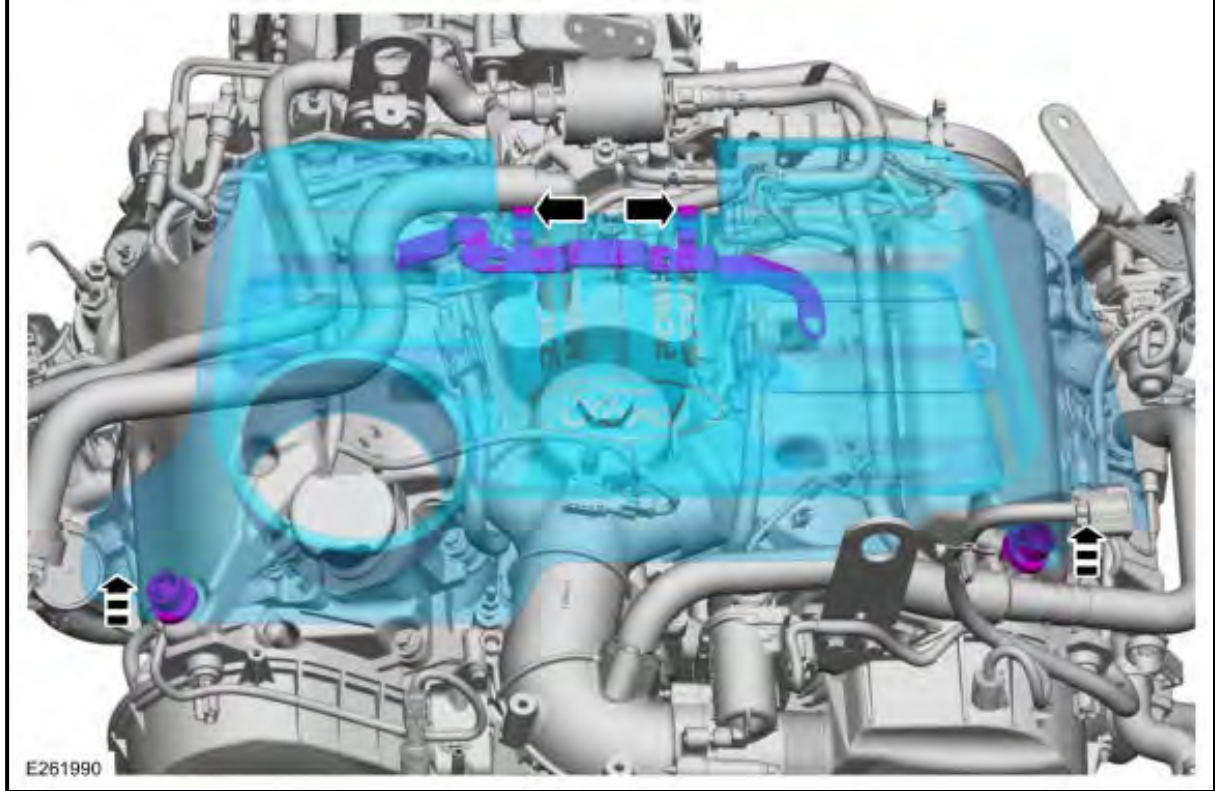
### Materials

| Name  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA  | WSS-M2C214-B1 |
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant VC-3-B | WSS-M97B44-D  |

### REMOVAL

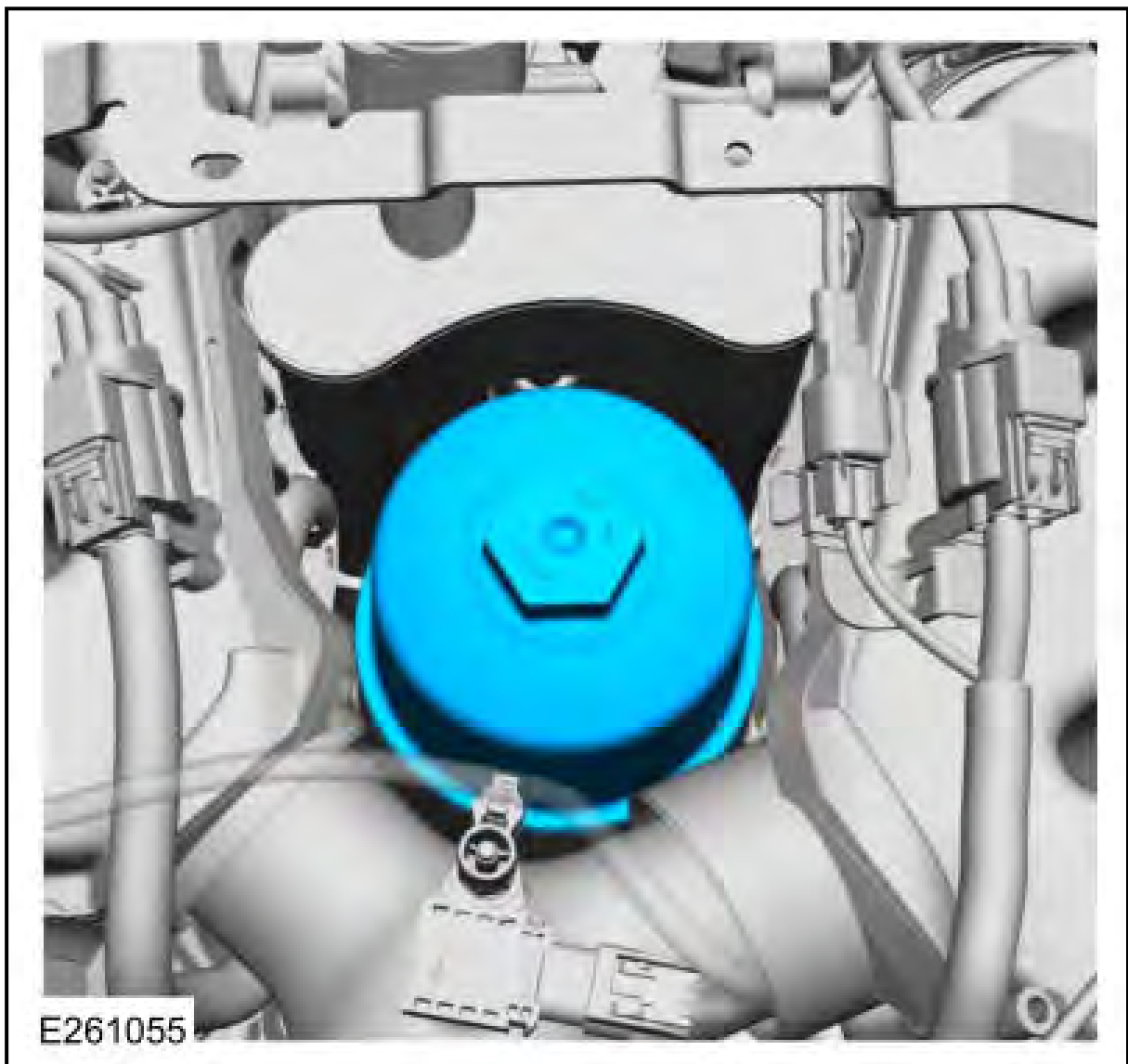
1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Drain the cooling system. REFER to: [Cooling System Draining, Vacuum Filling and Bleeding](#) .
3. Remove the engine appearance cover.



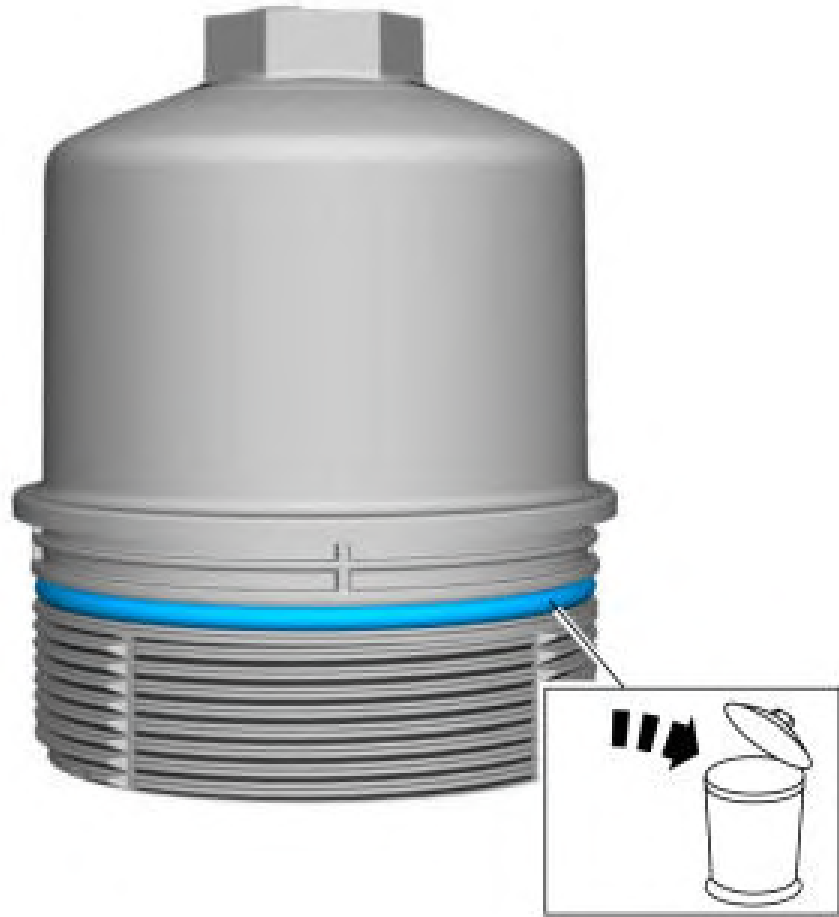


4. **NOTE:** The oil filter housing needs a minimum of 1 minute to allow the oil to drain out of the oil filter housing to minimize oil spillage.

Loosen the oil filter cap and let the oil filter drain. Remove the oil filter cap.

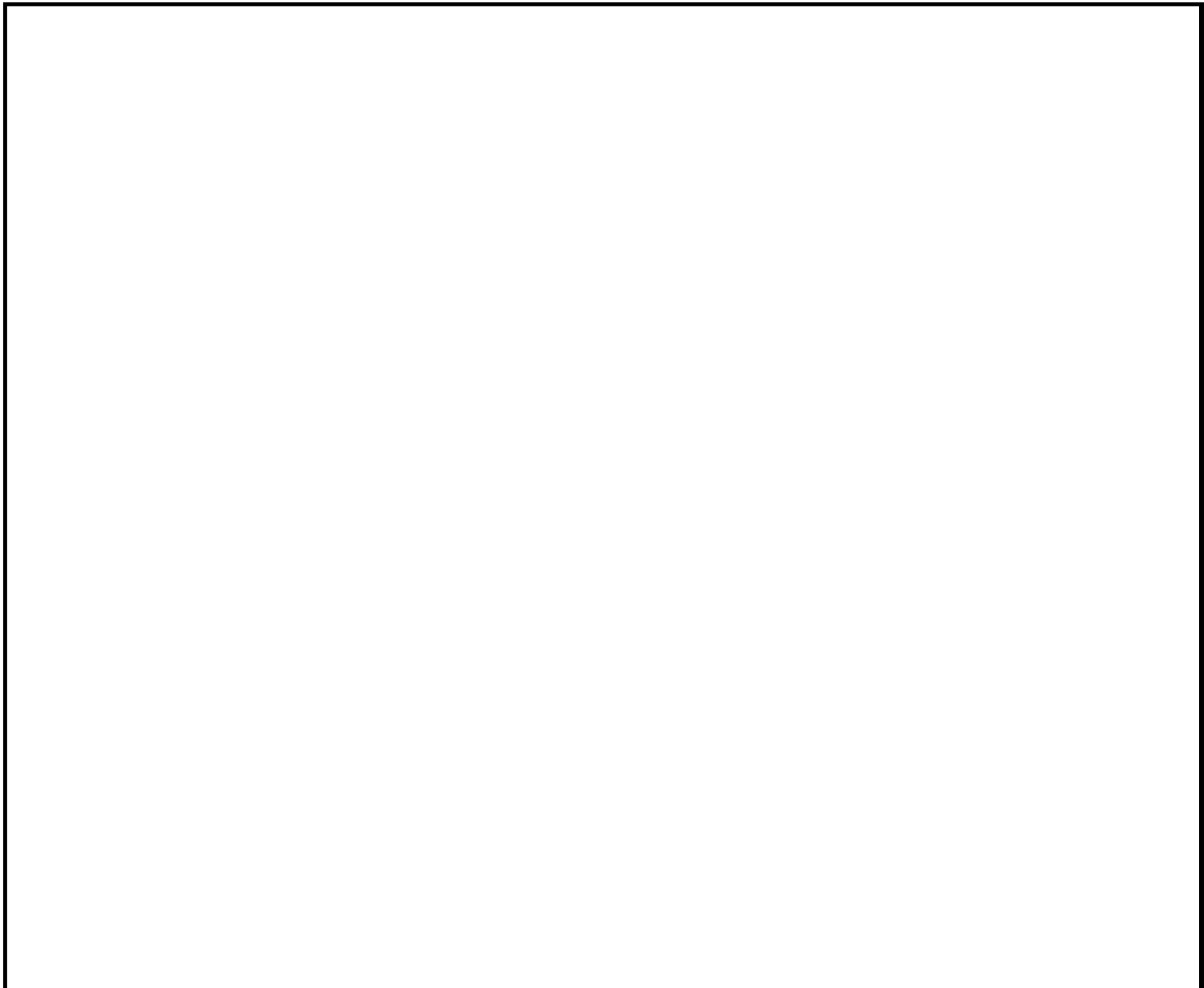


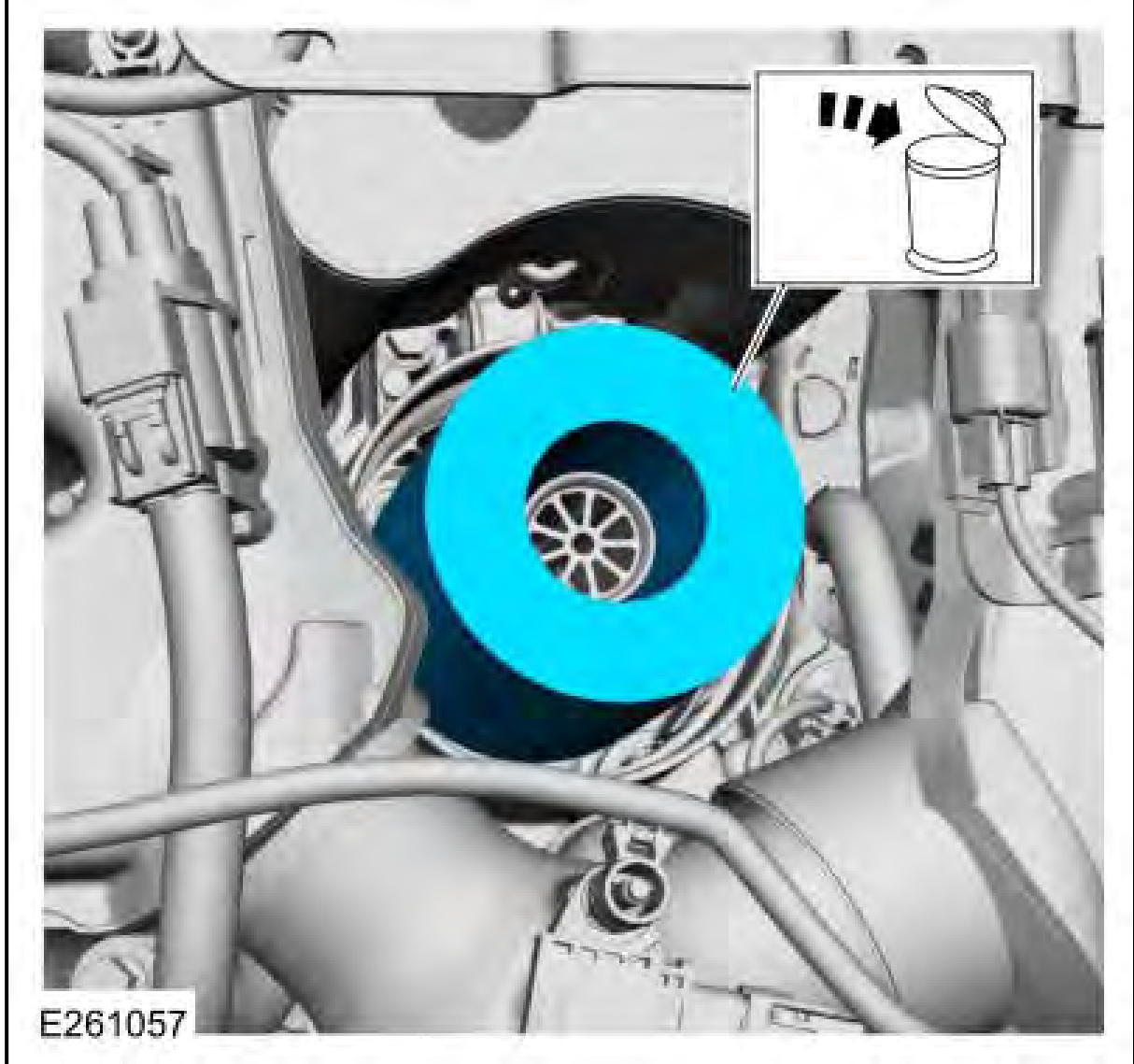
5. Remove and discard the oil filter O-ring seal.



E261056

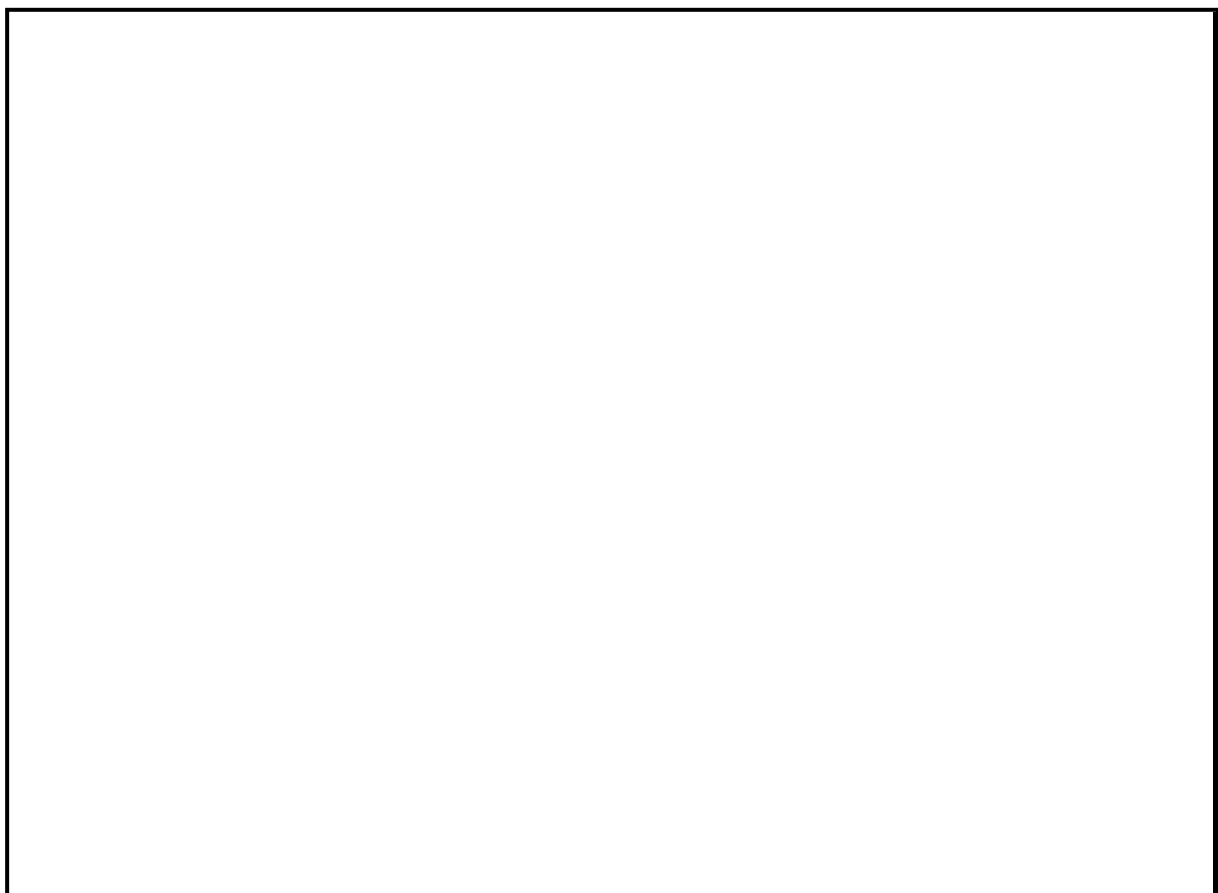
6. Remove and discard the oil filter. Use the General Equipment: Oil Drain Equipment

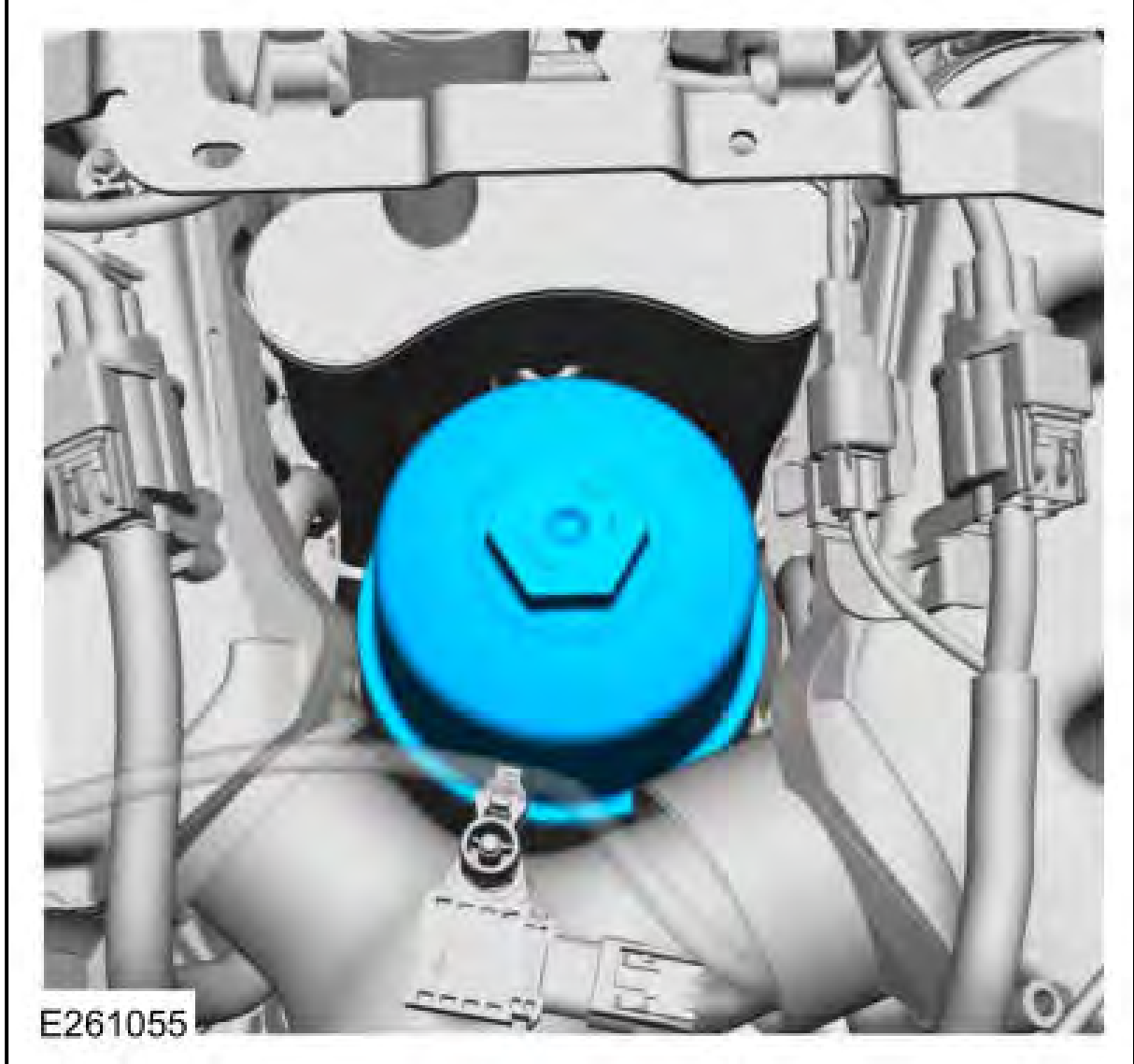




7. **NOTE:** Install the oil filter cap to prevent debris from entering the oil filter housing.

Install the oil filter cap.



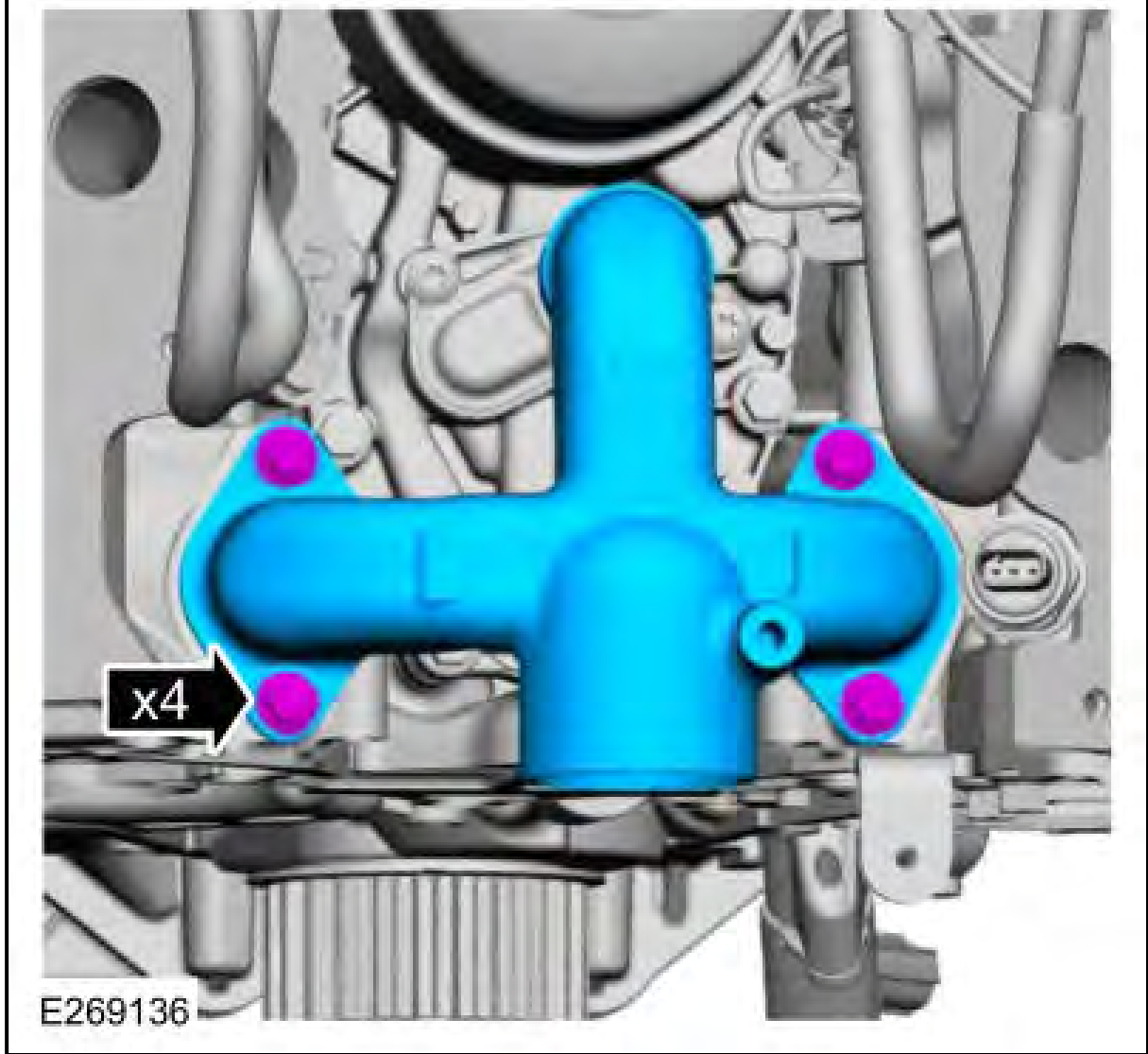


8. Remove the following items:

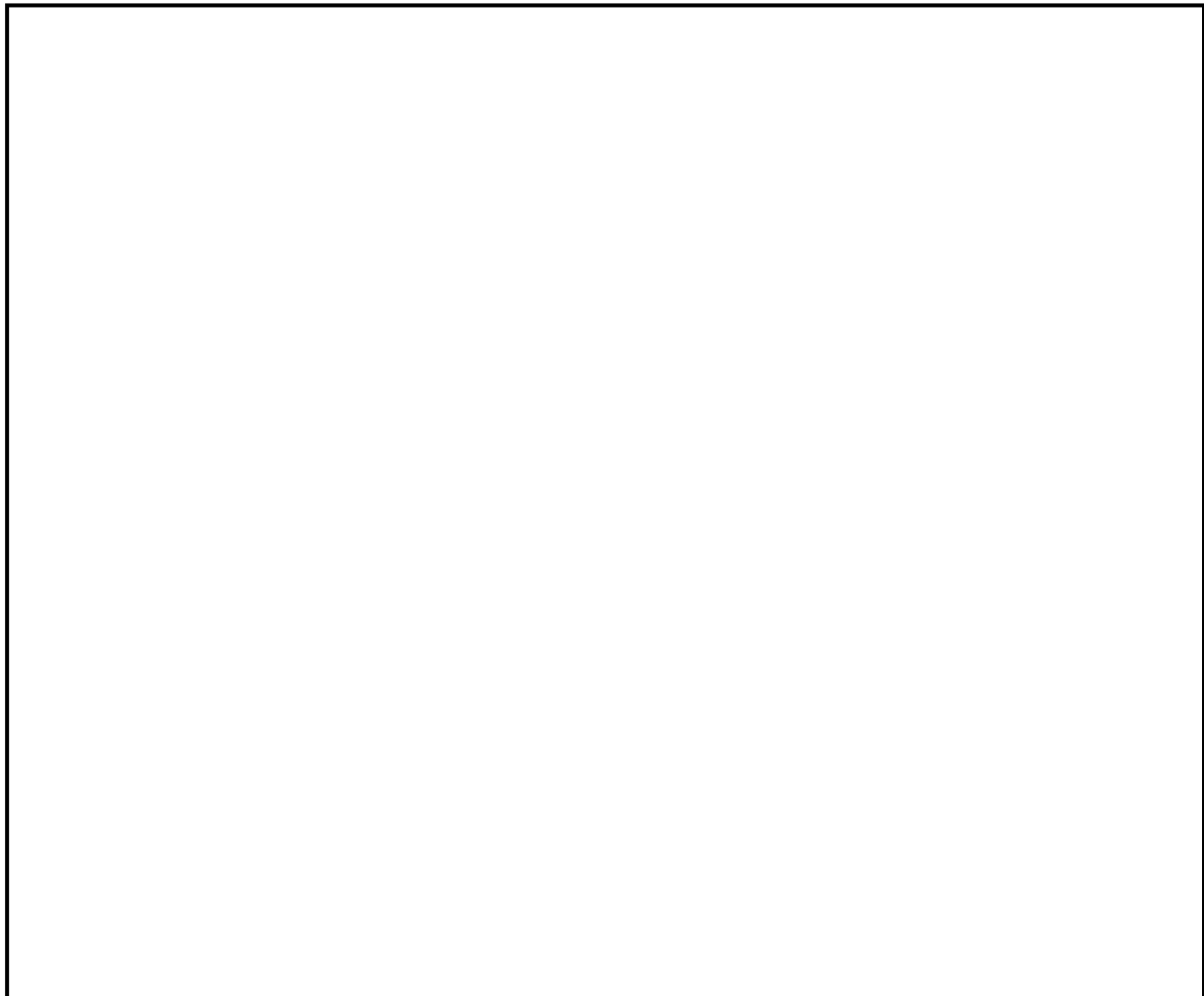
1. Remove the intake manifold. REFER to: [Intake Manifold](#) .
2. Remove the LH valve cover. REFER to: [Valve Cover LH](#) .

9. Remove the bolts and the coolant outlet connector.

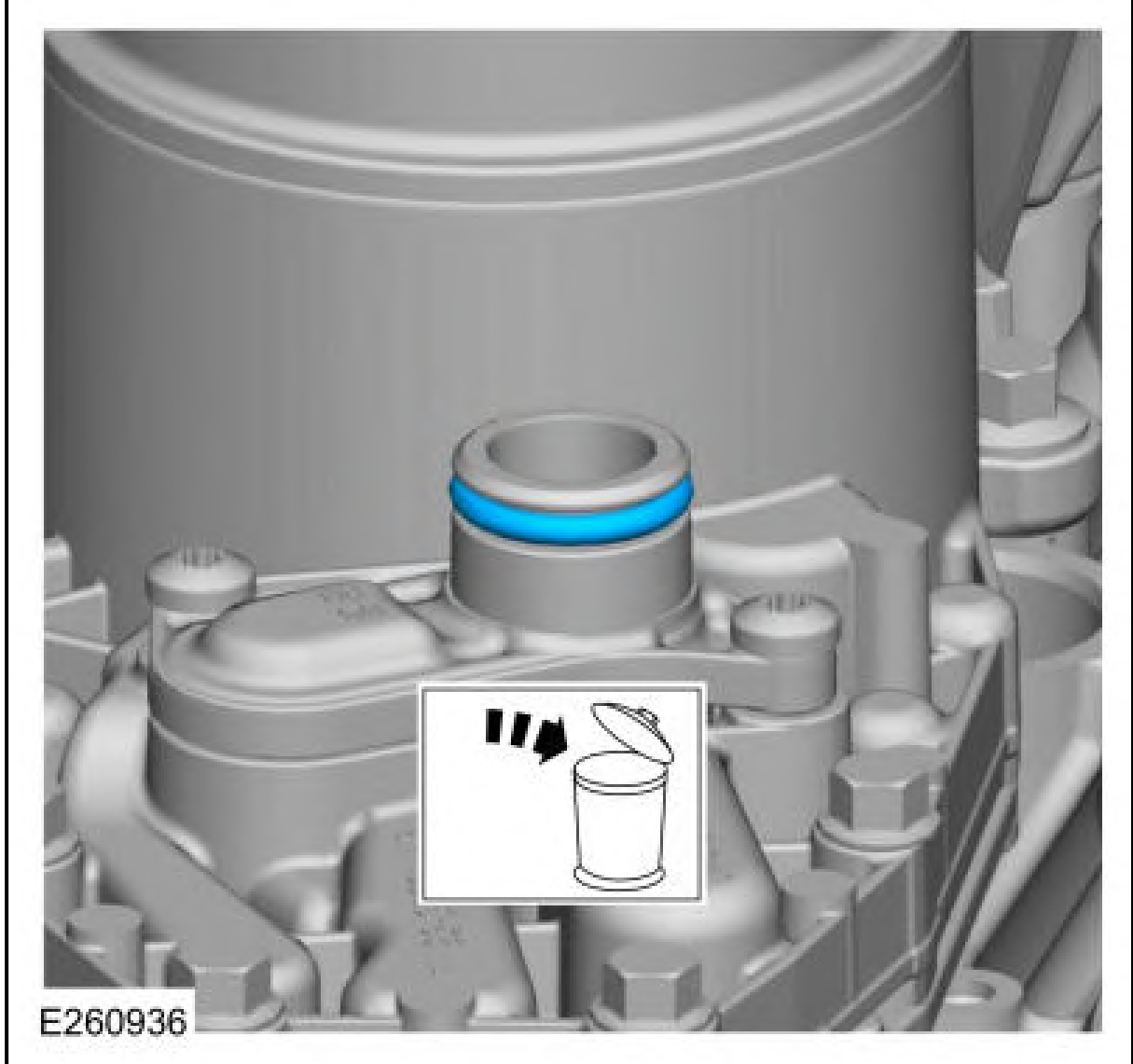




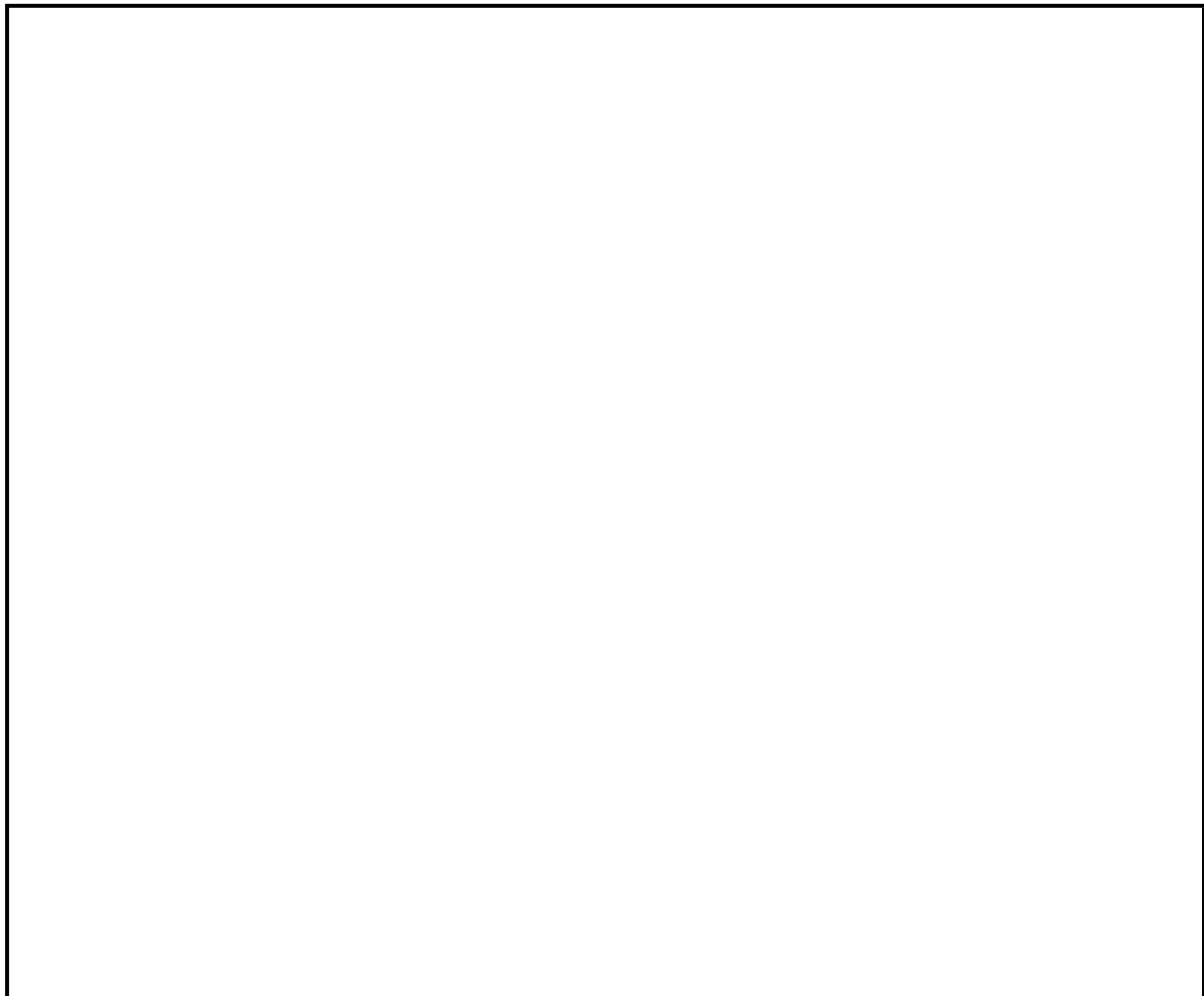
10. Remove and discard the O-ring seal.







11. Remove and discard the coolant outlet connector gaskets.

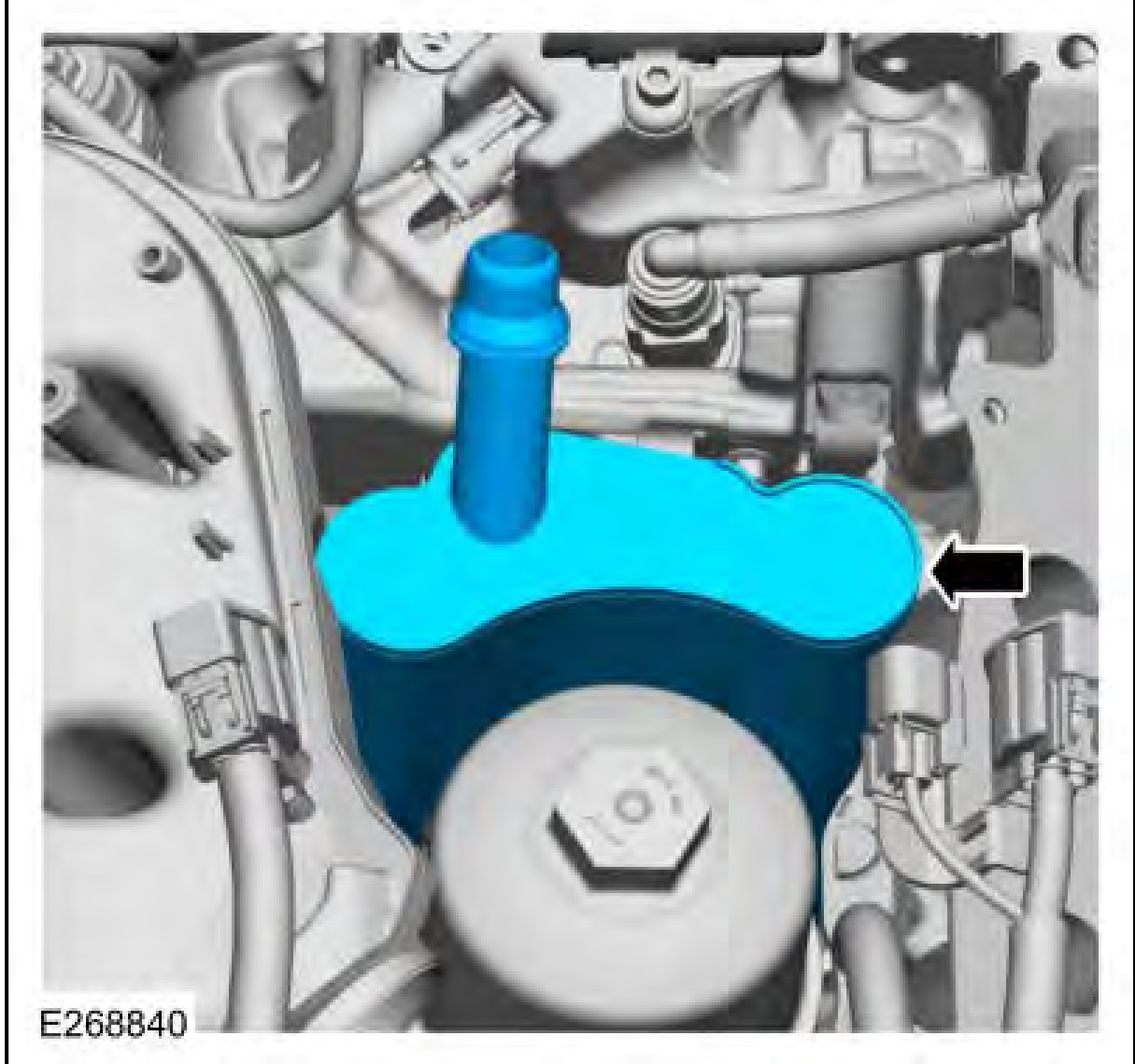




E261045

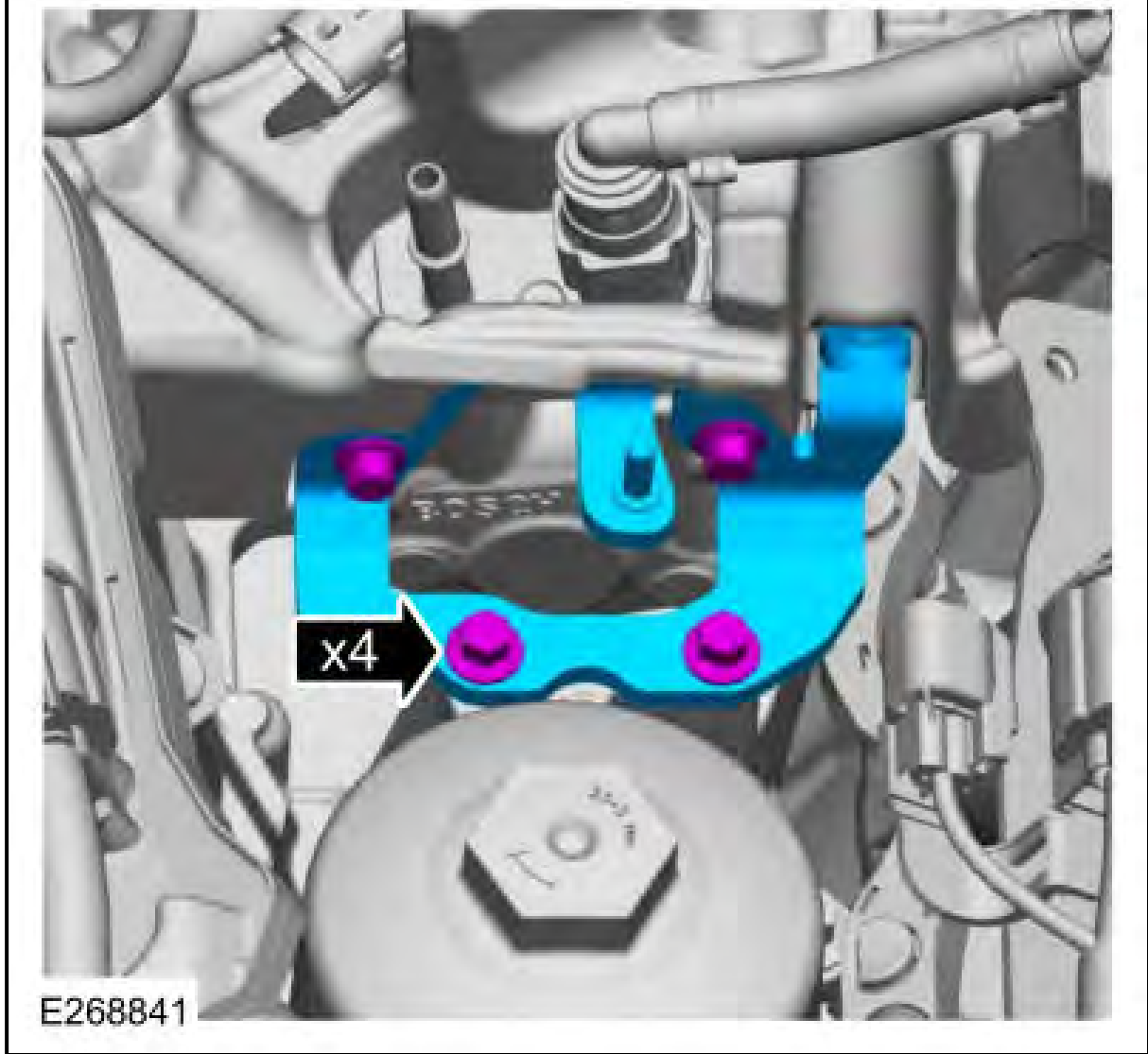
12. Remove the crankcase vent oil separator assembly.



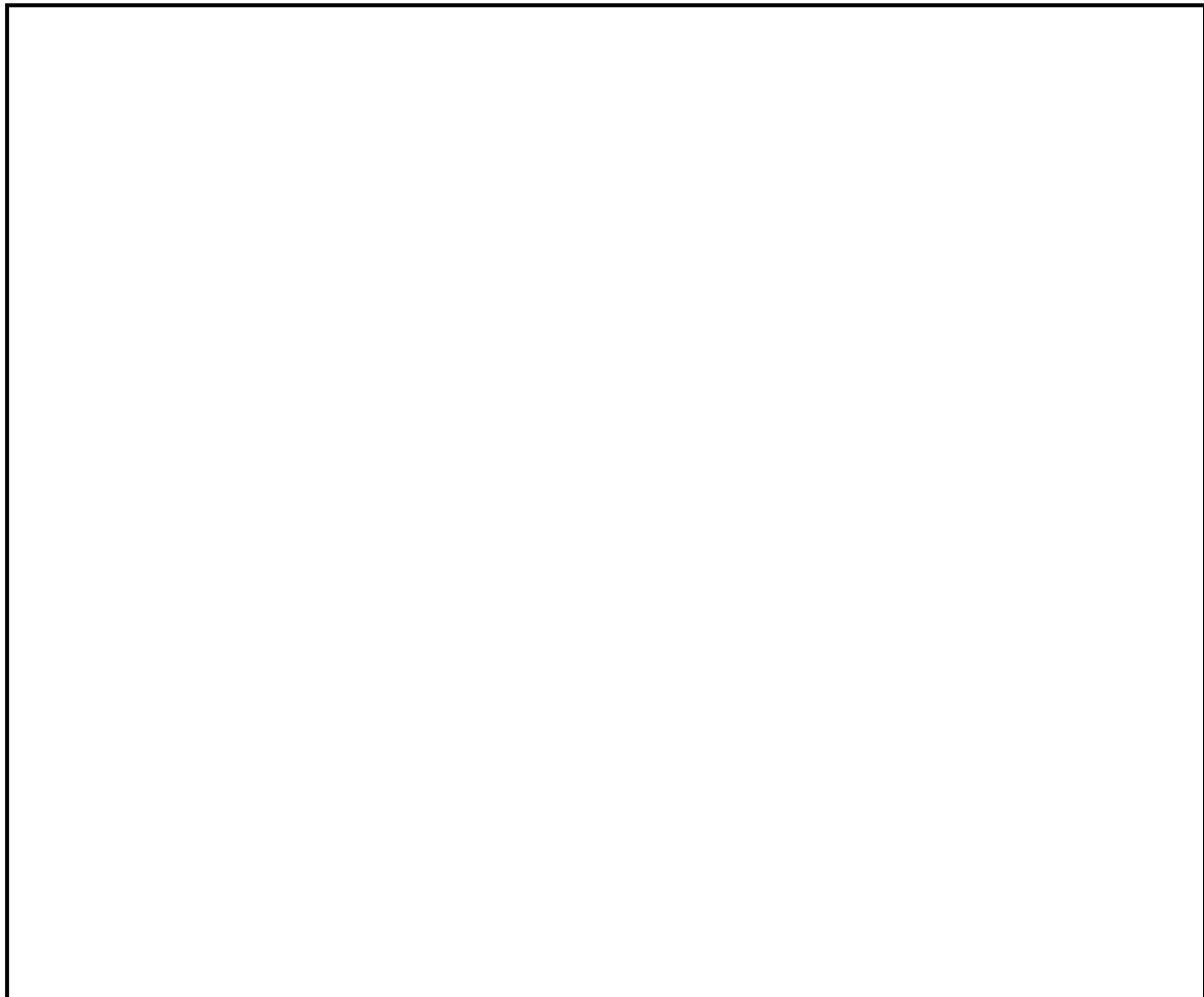


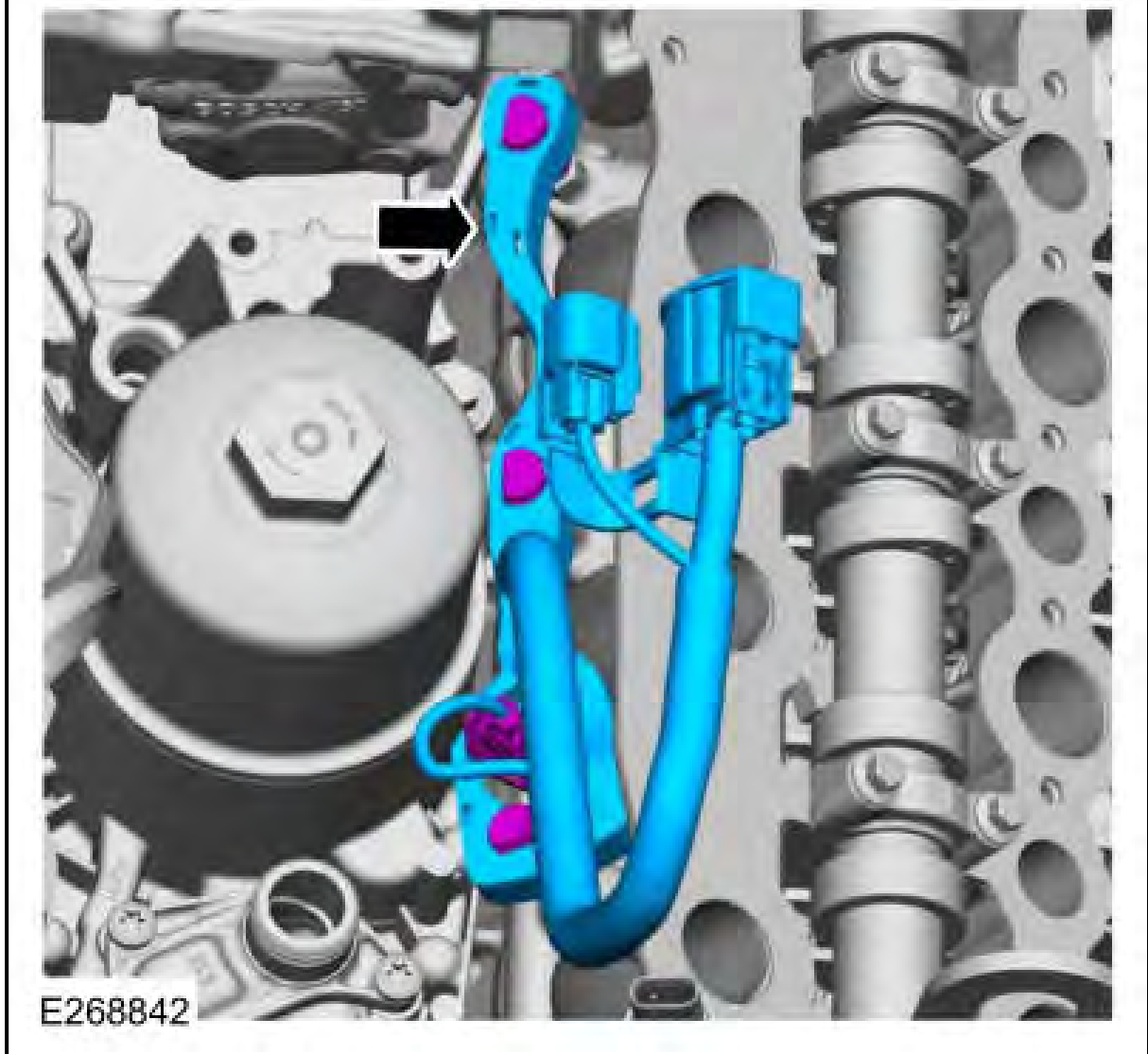
13. Remove the bolts and the fuel injection pump bracket.



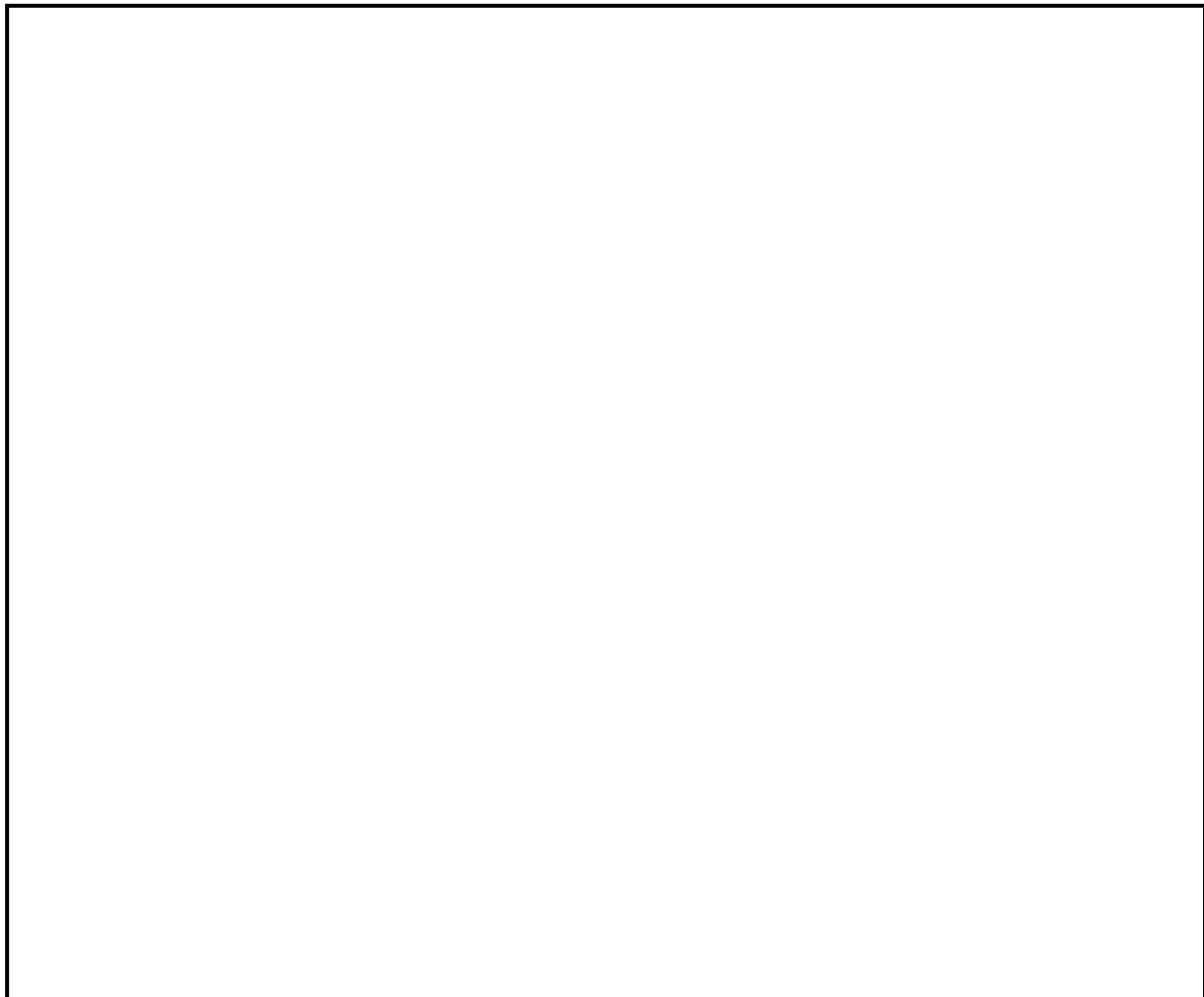


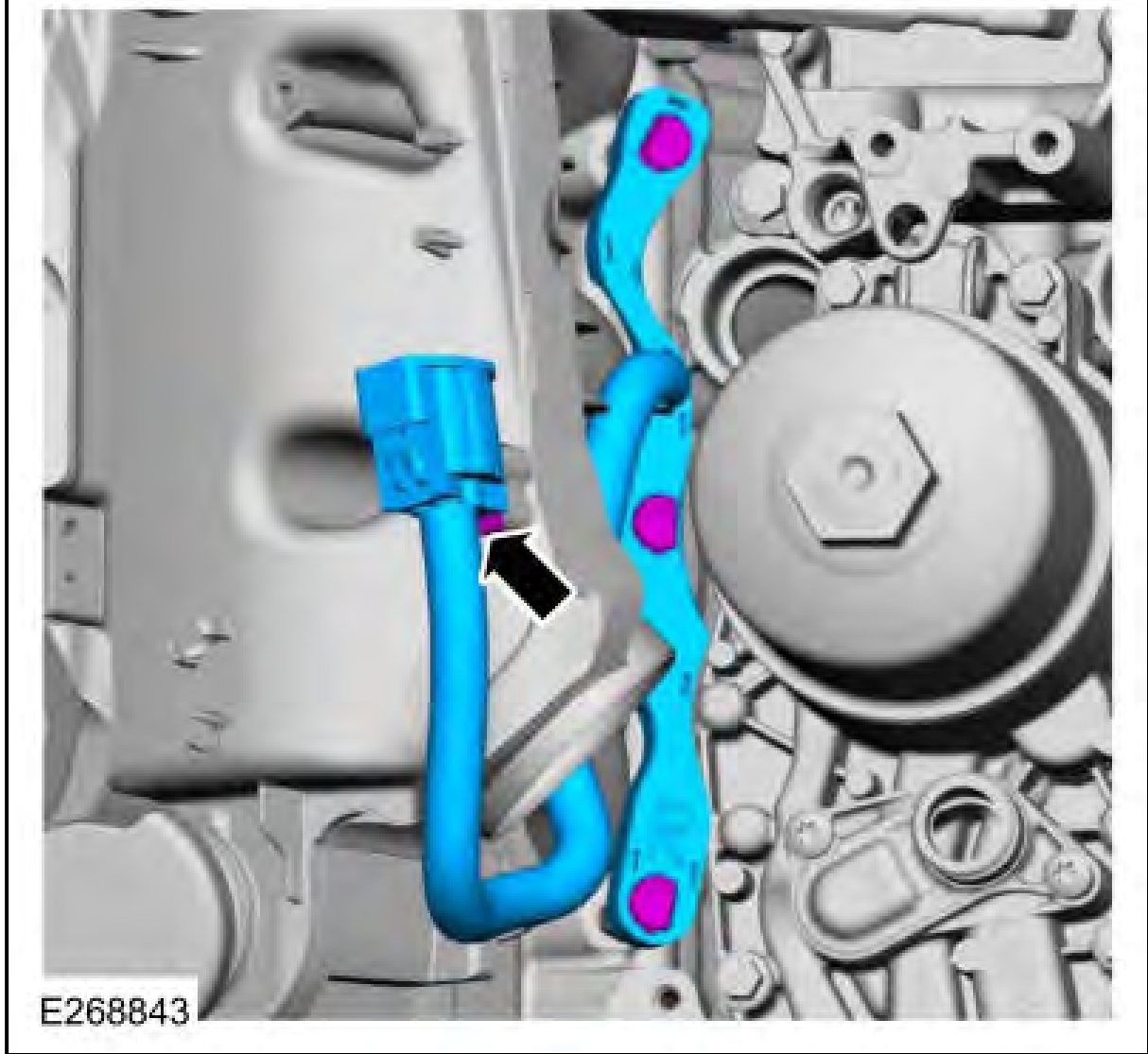
14. Remove the LH glow plug harnesses.



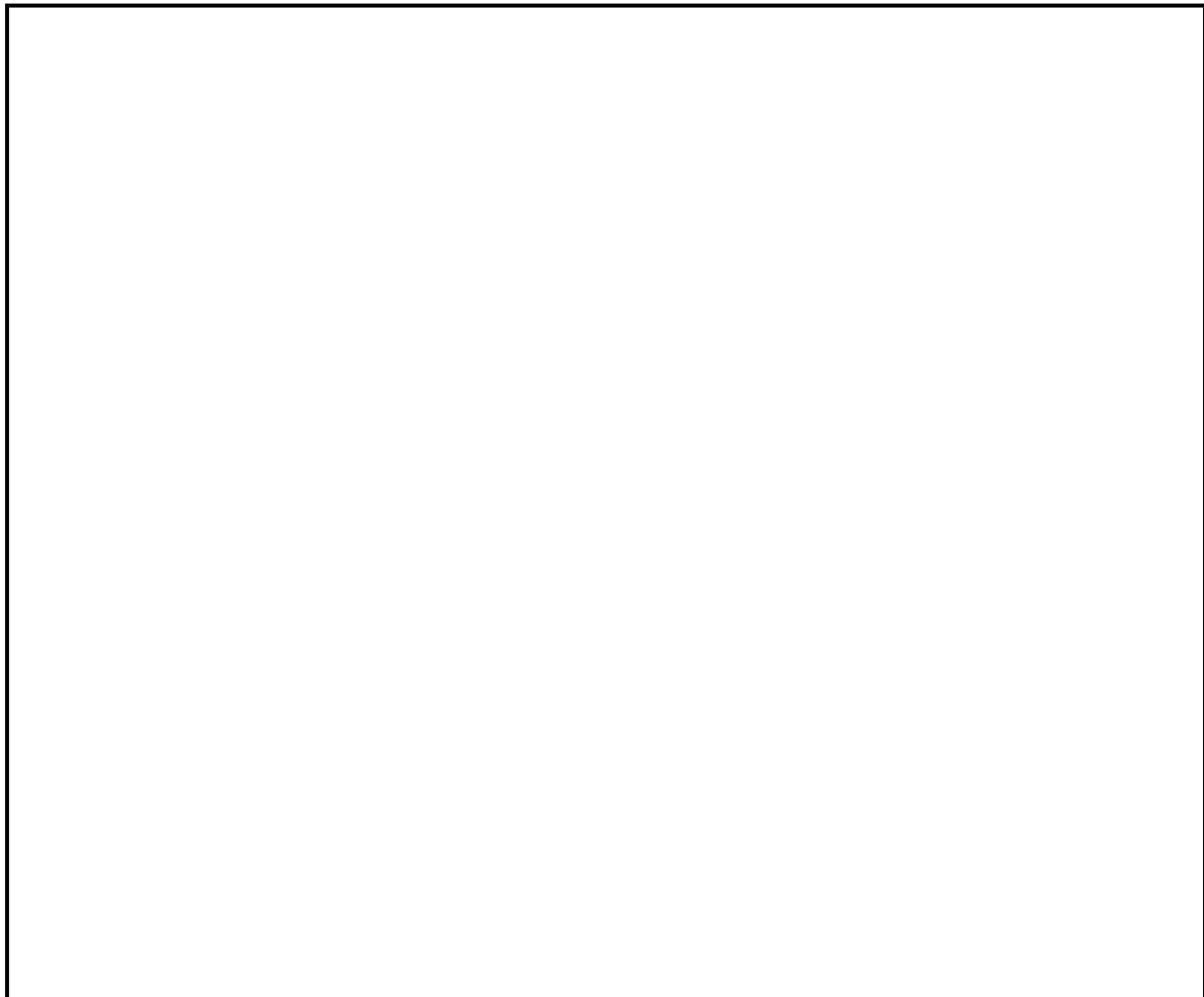


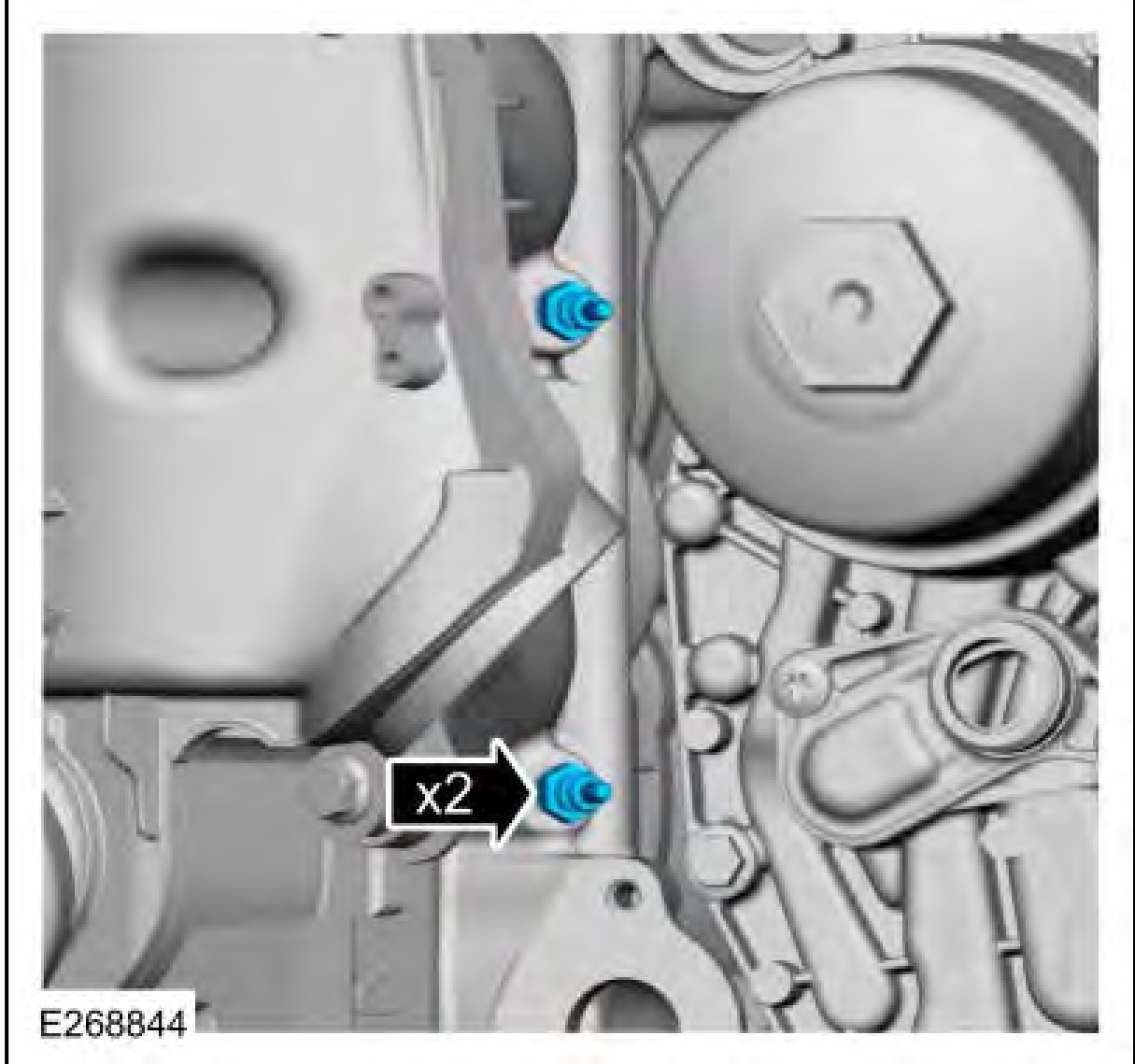
15. Remove the RH glow plug harnesses.





16. Remove the RH front 2 glow plugs.

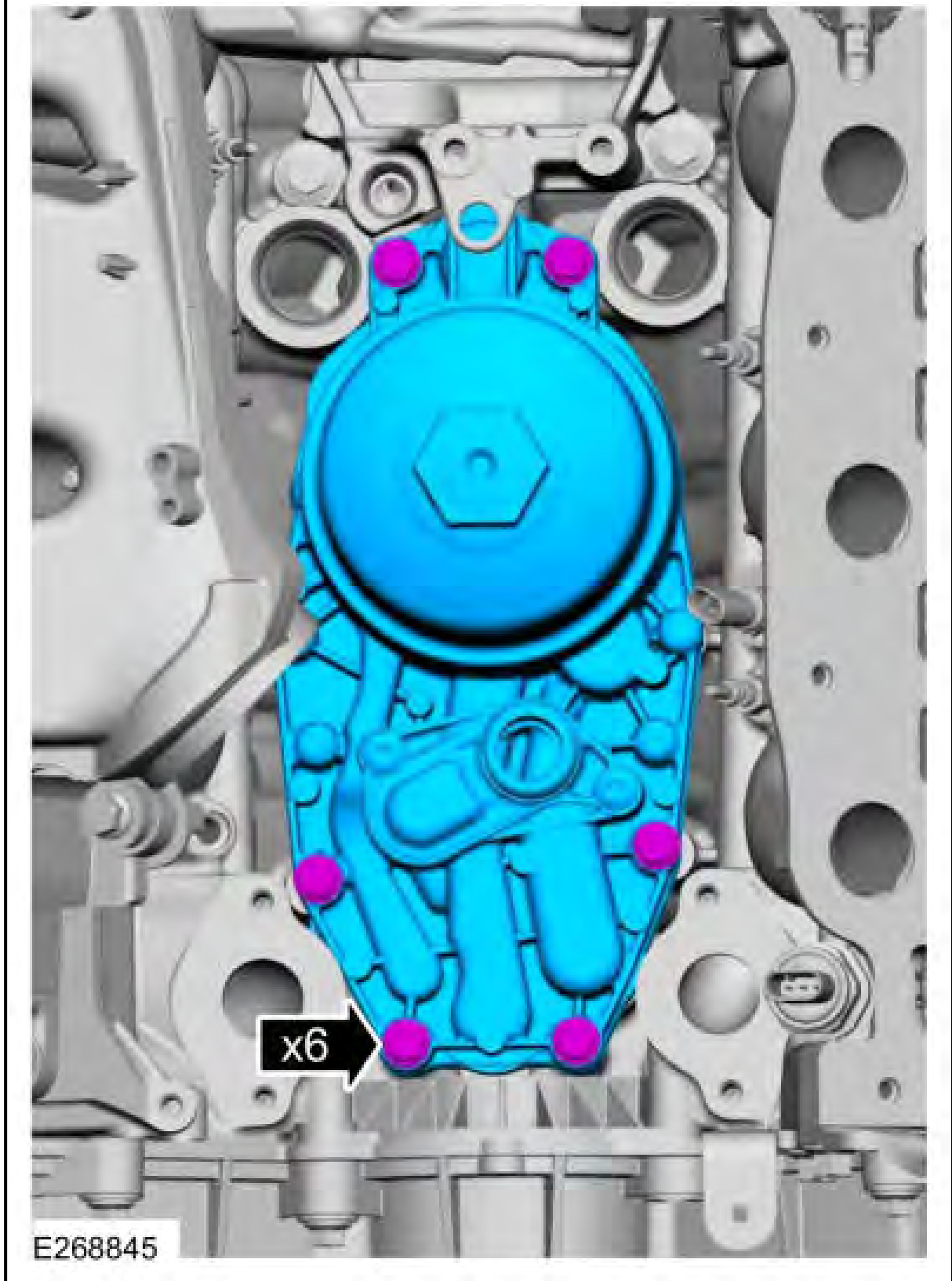




17. **NOTE:** If metal or foreign material is present in the oil cooler, mechanical concerns exist. To diagnose the mechanical concerns refer to Engine article.

Remove the bolts and the oil cooler.





18. Remove and discard the oil cooler O-rings.

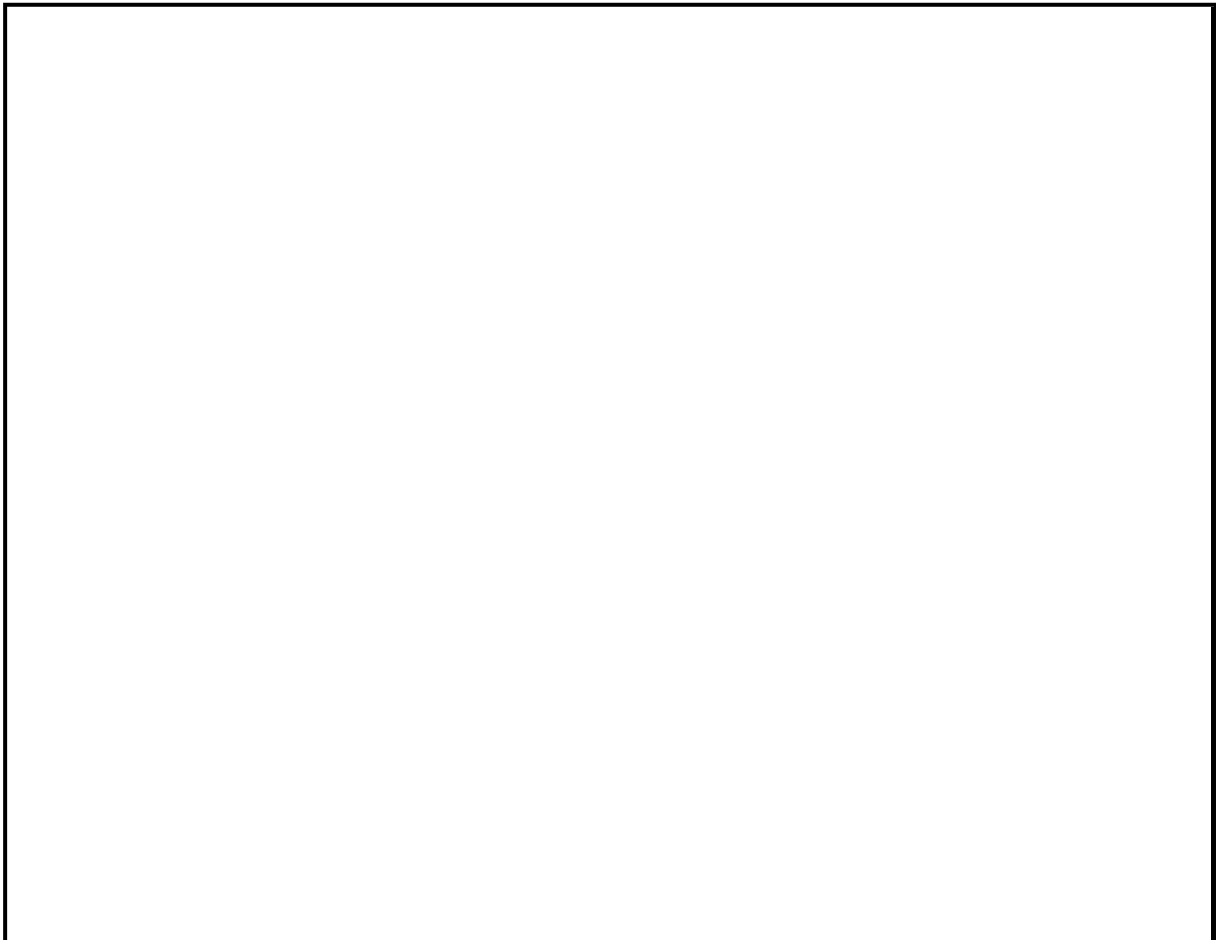




E260935

## INSTALLATION

1. Install the oil cooler O-rings.

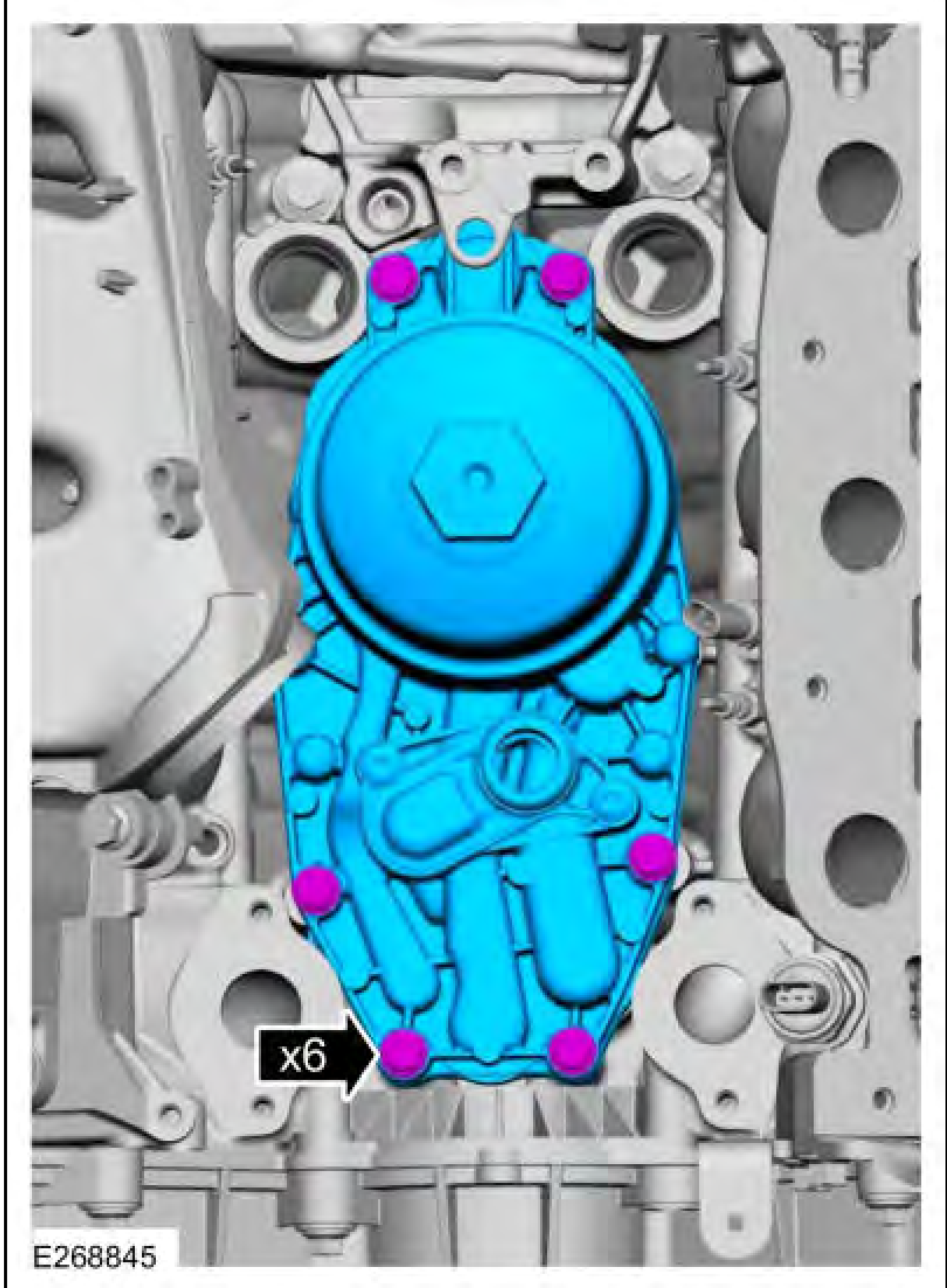




2. Install the oil cooler and the bolts.

Torque: 89 lb.in (10 Nm)

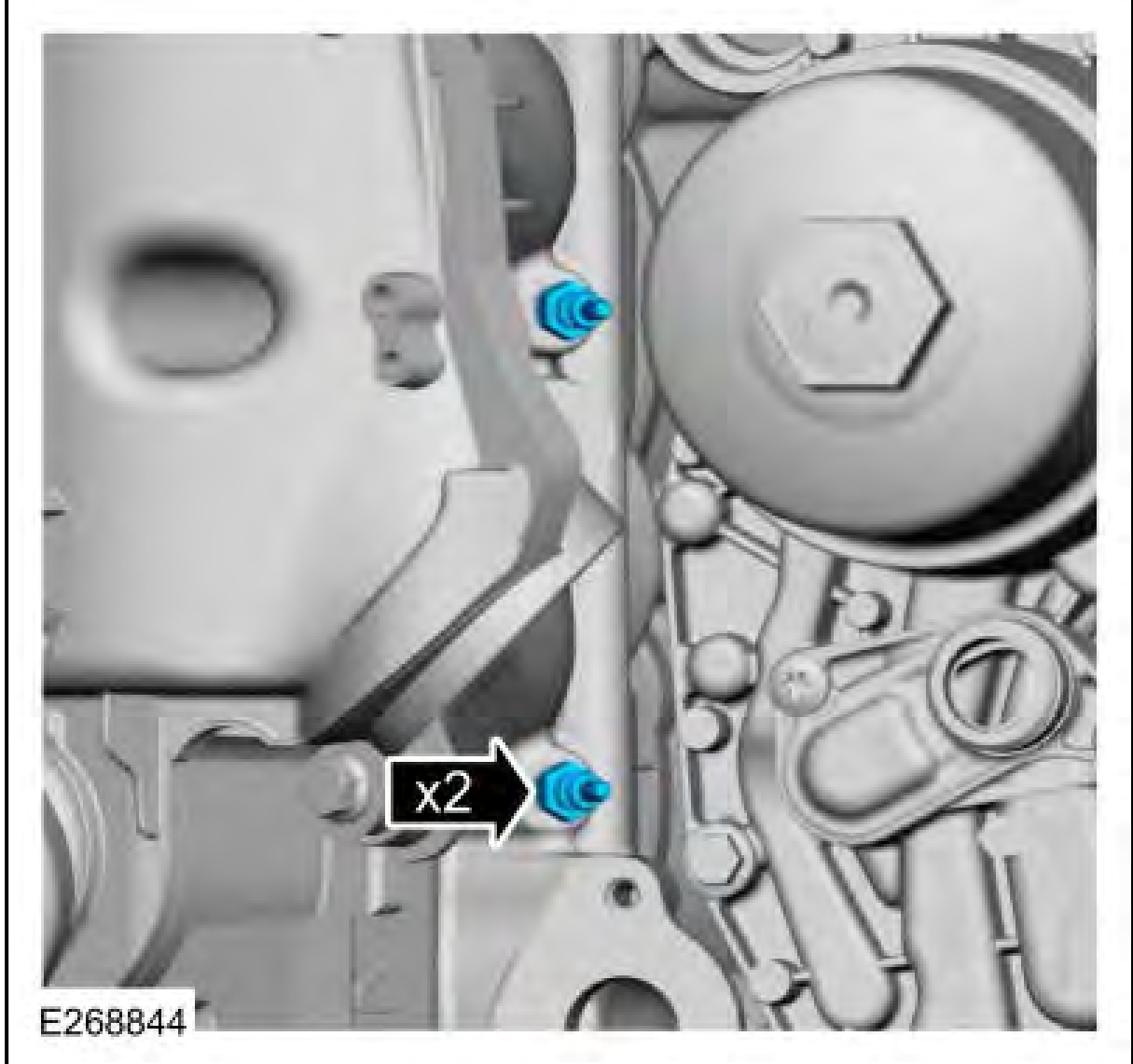




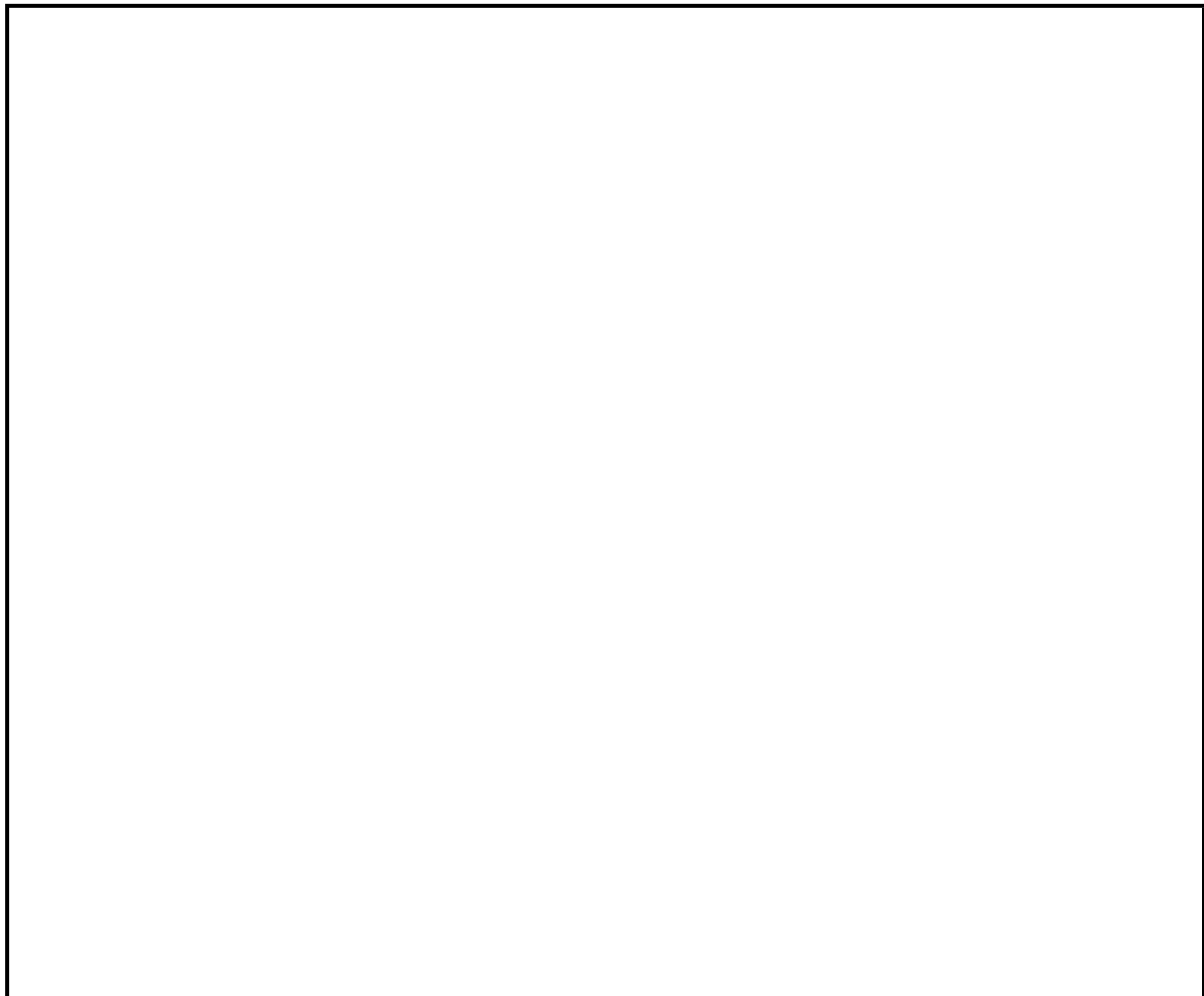
3. Install the RH front 2 glow plugs.

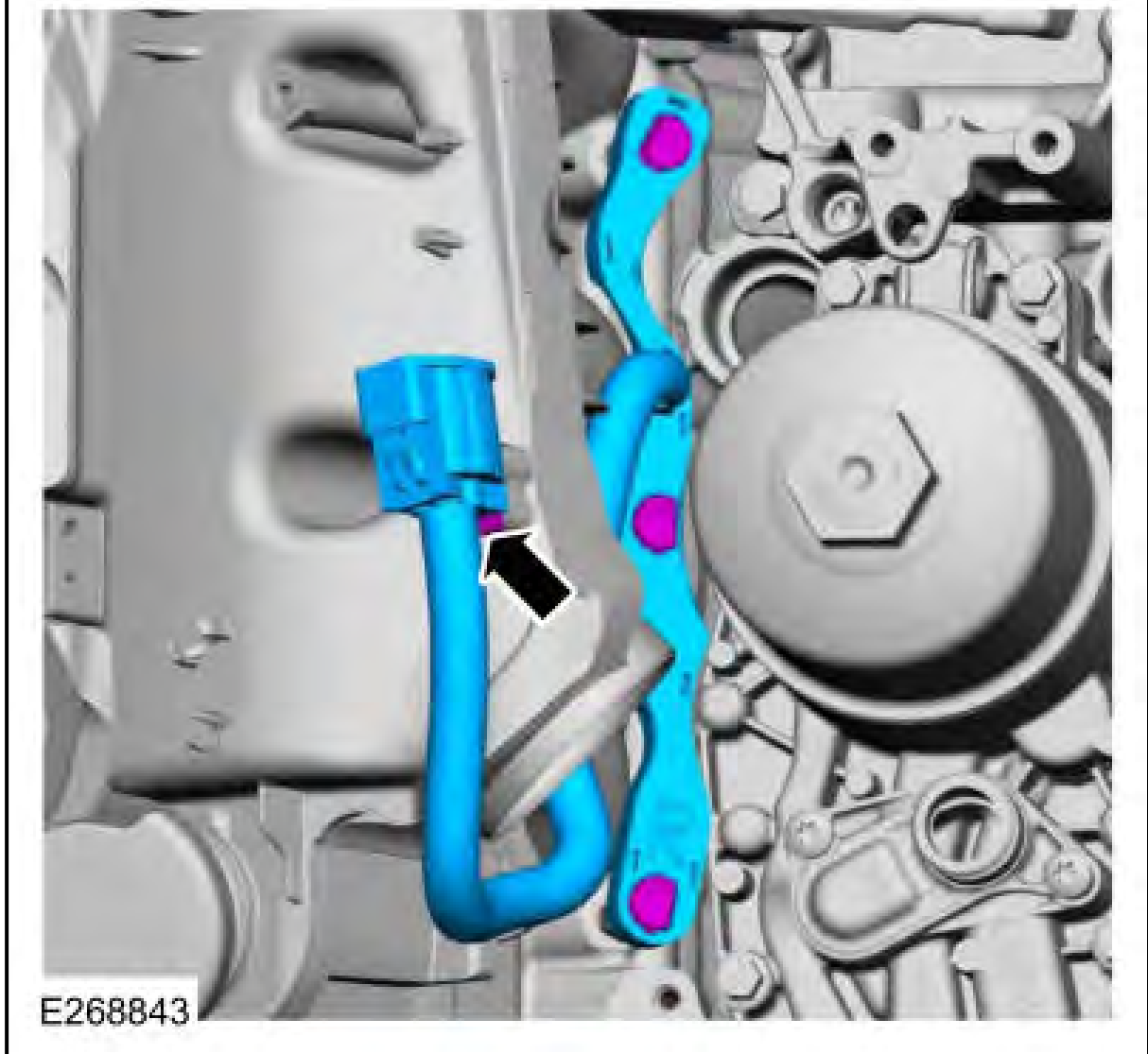
Torque: 97 lb.in (11 Nm)



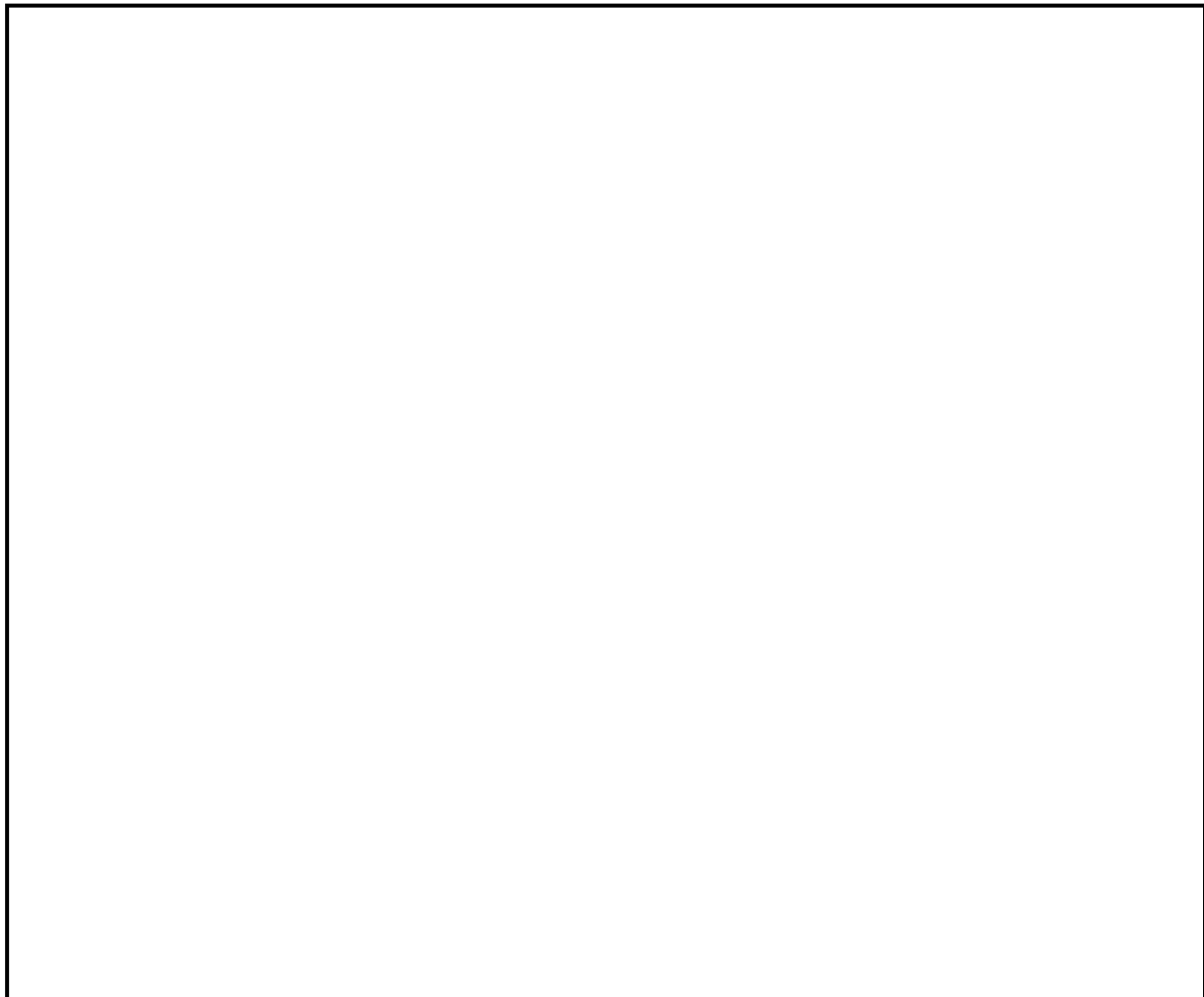


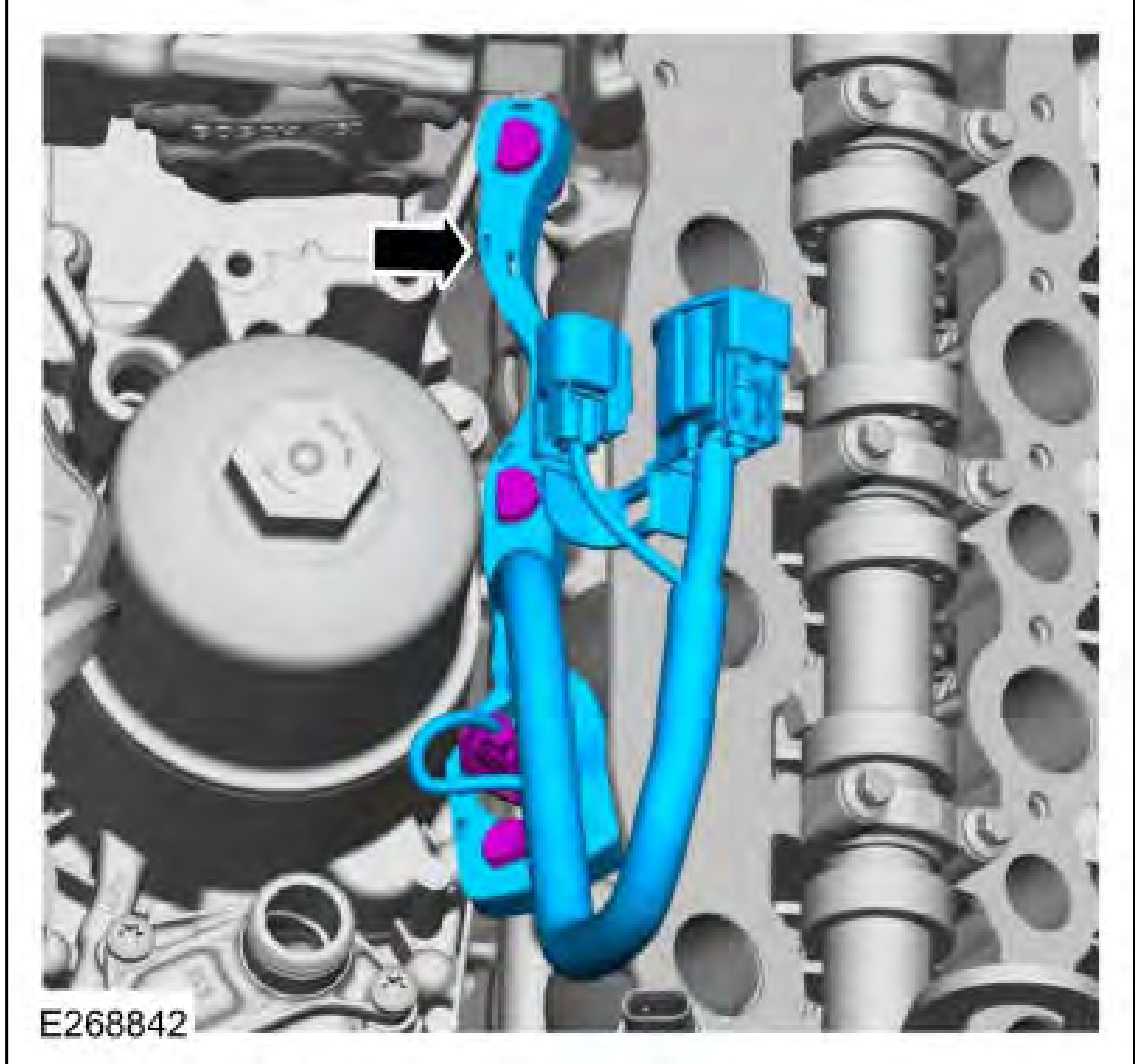
4. Install the RH glow plug harnesses.





5. Install the LH glow plug harnesses.



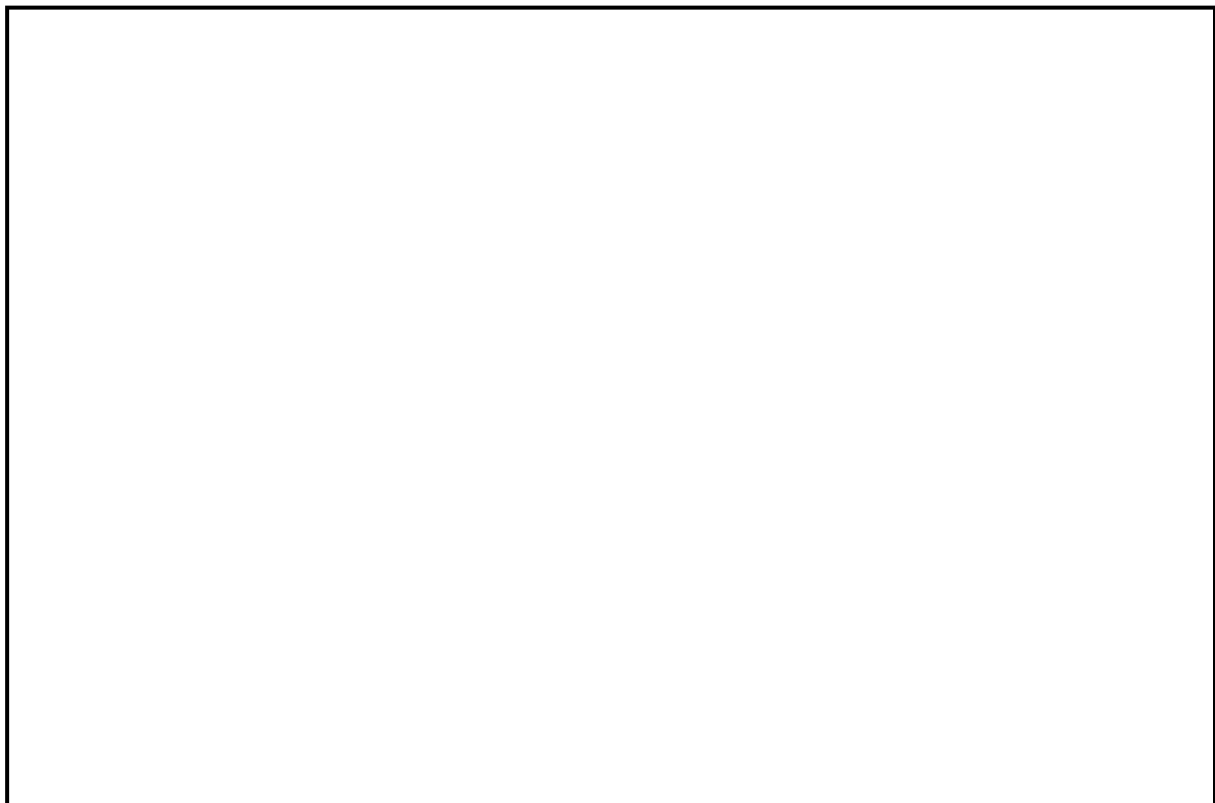


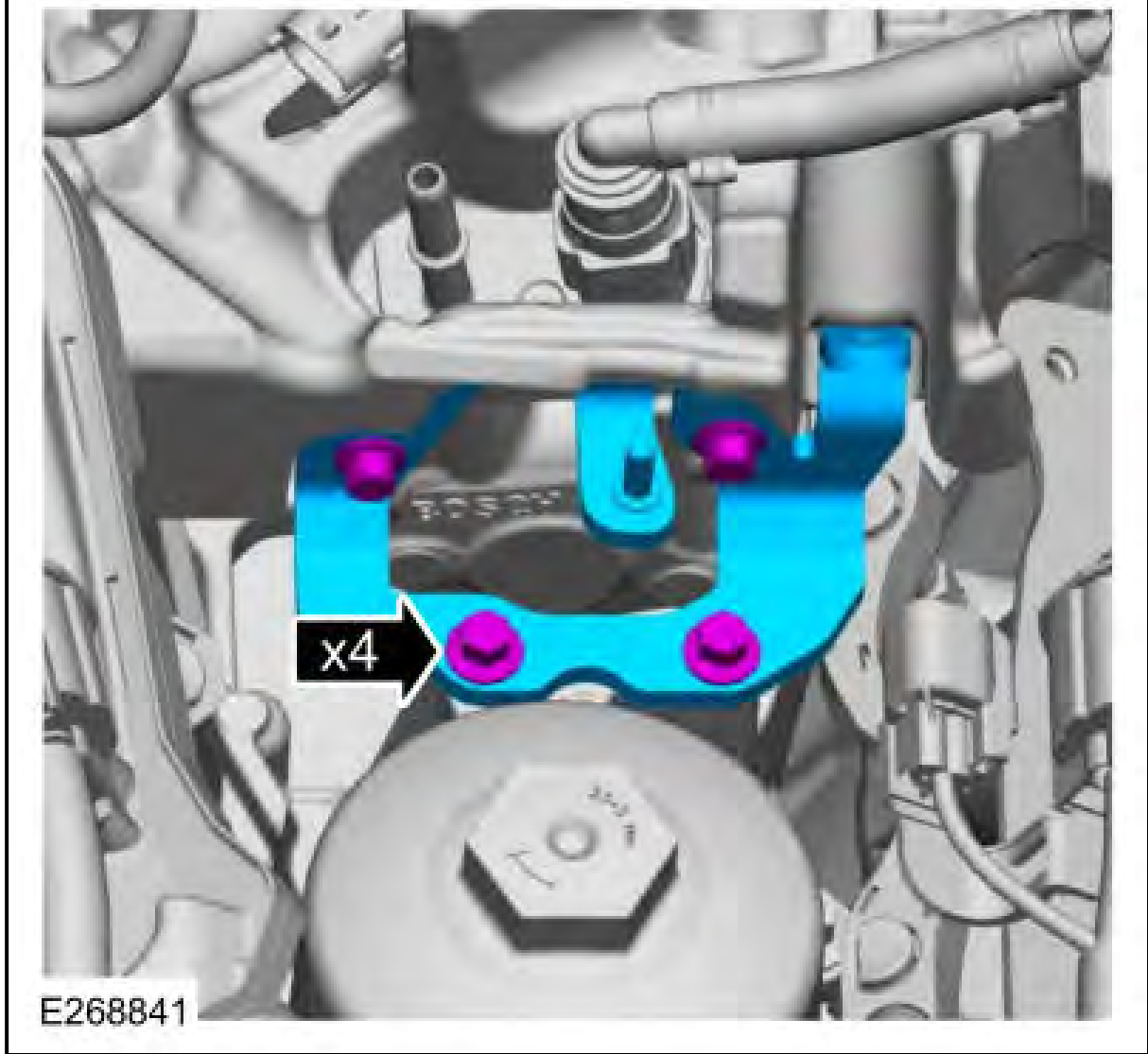
6. Install the fuel injection pump bracket and the bolts.

Torque:

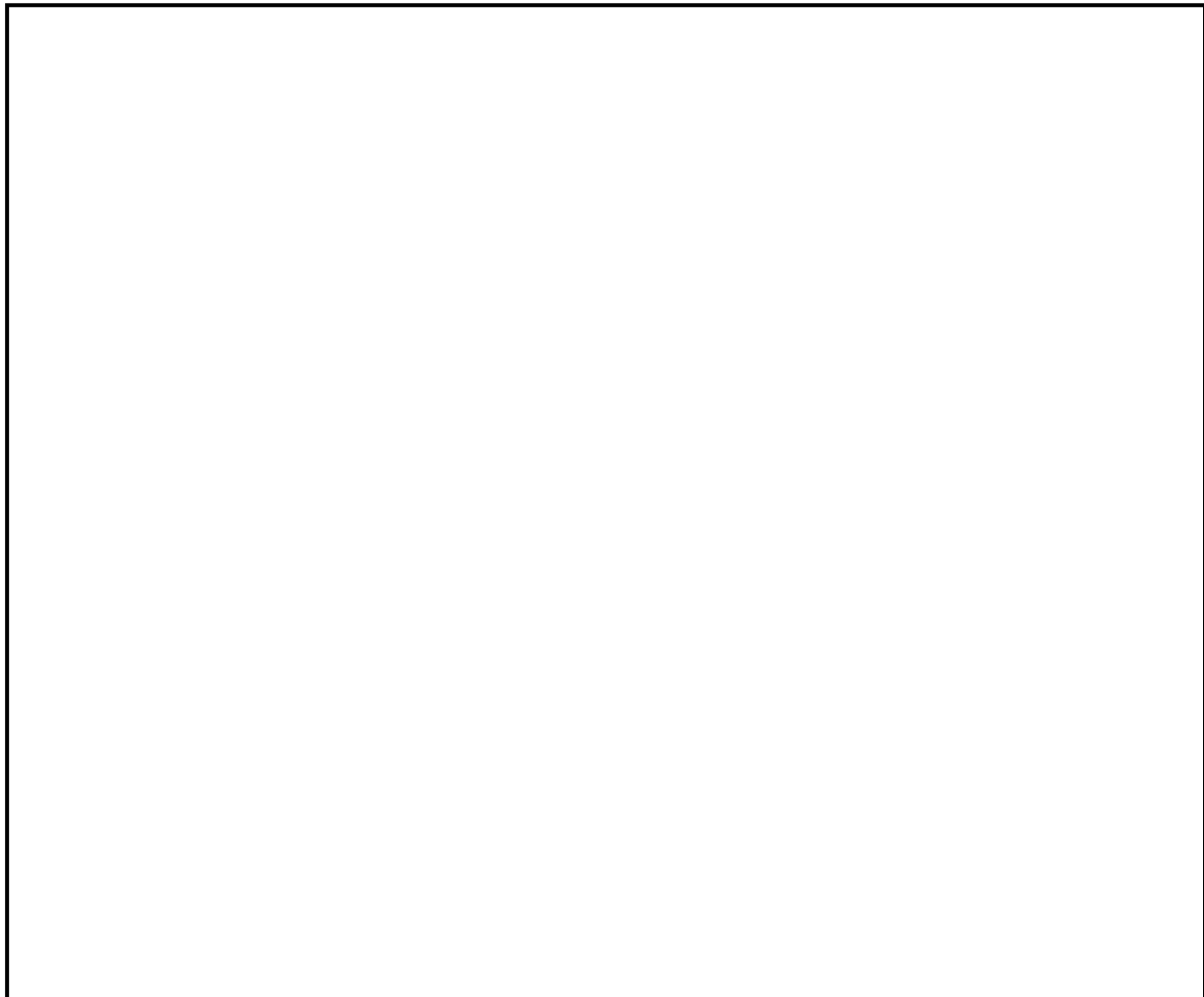
Fuel injection pump bolts: 106 lb.in (12 Nm)

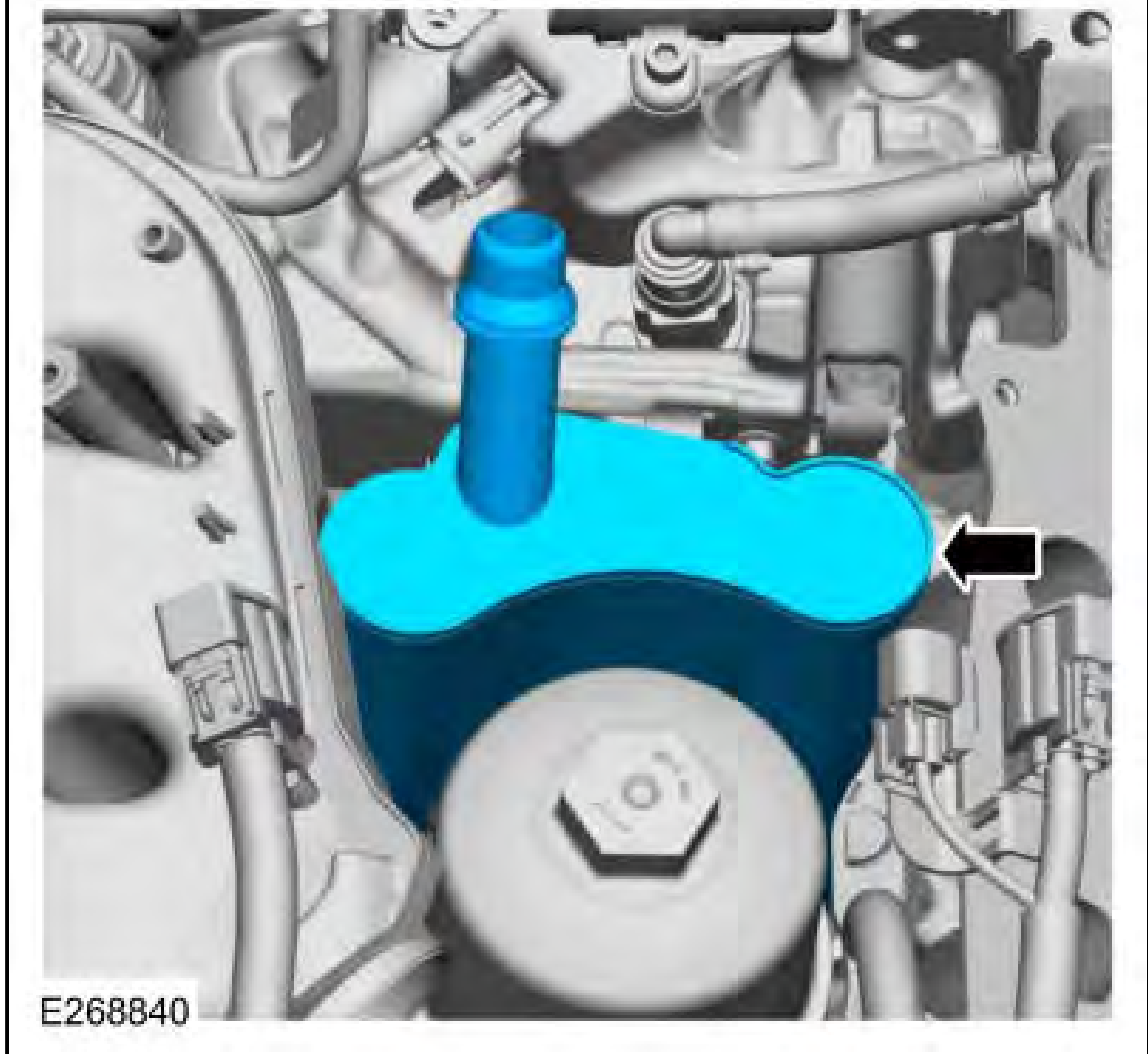
Fuel injection pump bracket bolts: 89 lb.in (10 Nm)



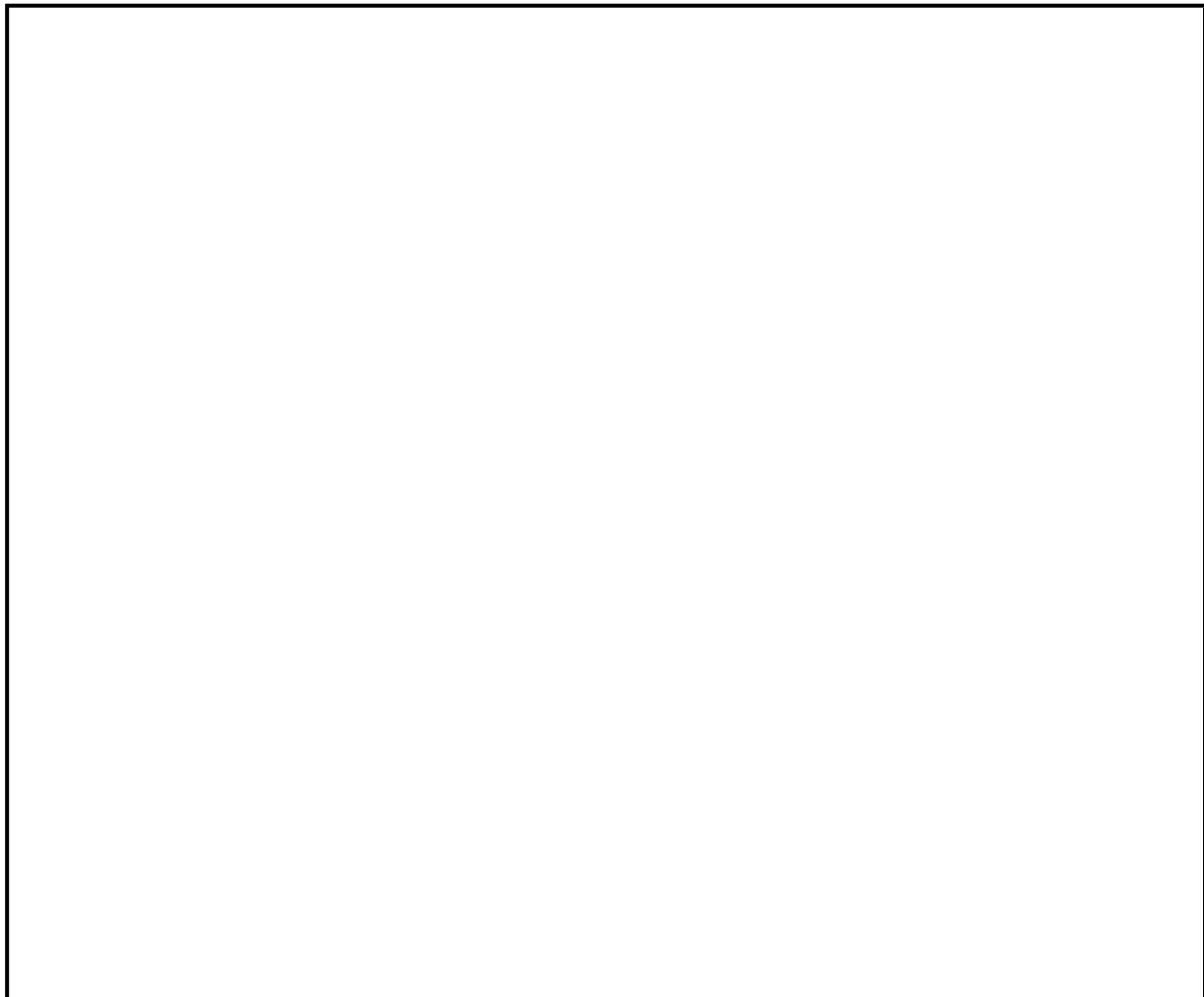


7. Install the crankcase vent oil separator assembly.





8. Install the coolant outlet connector gaskets.



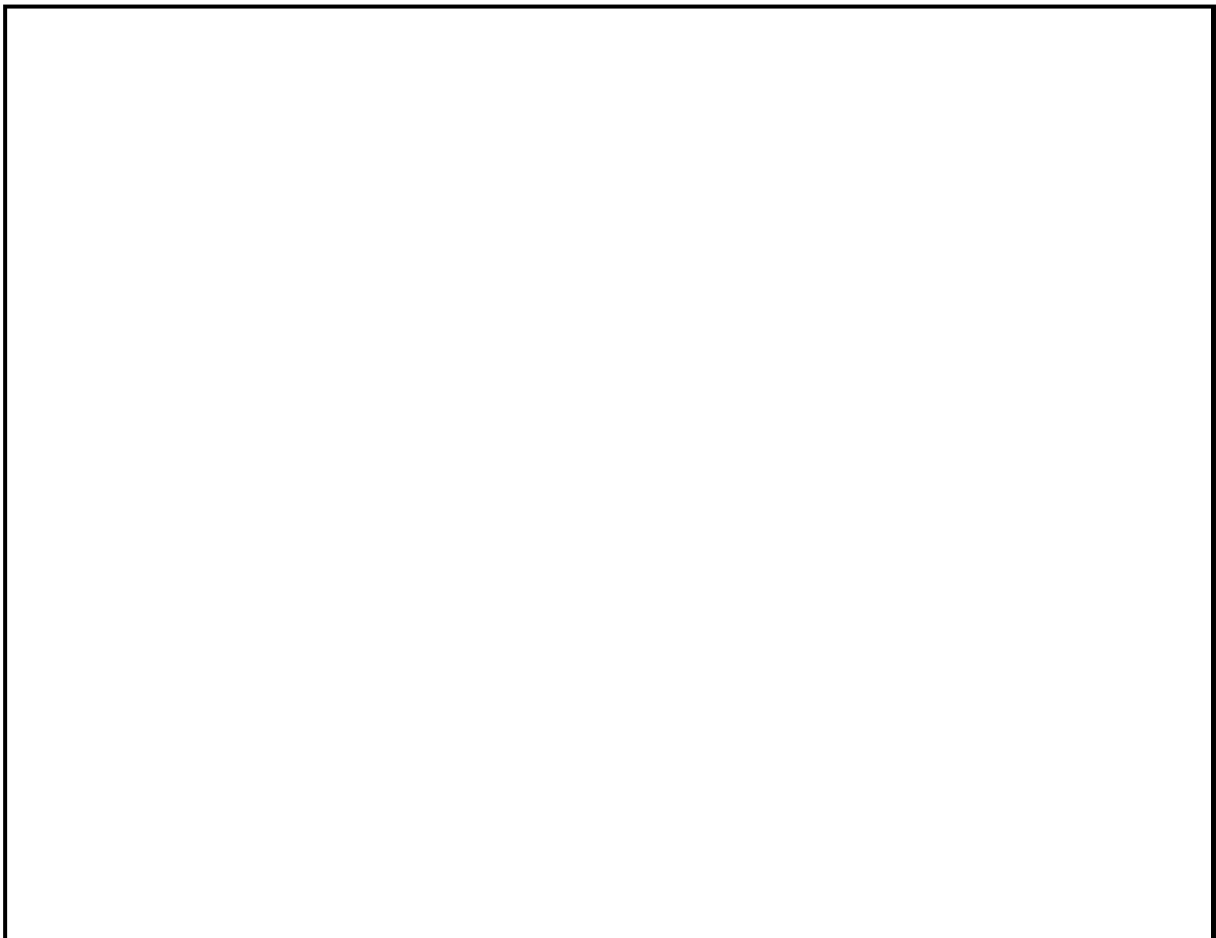


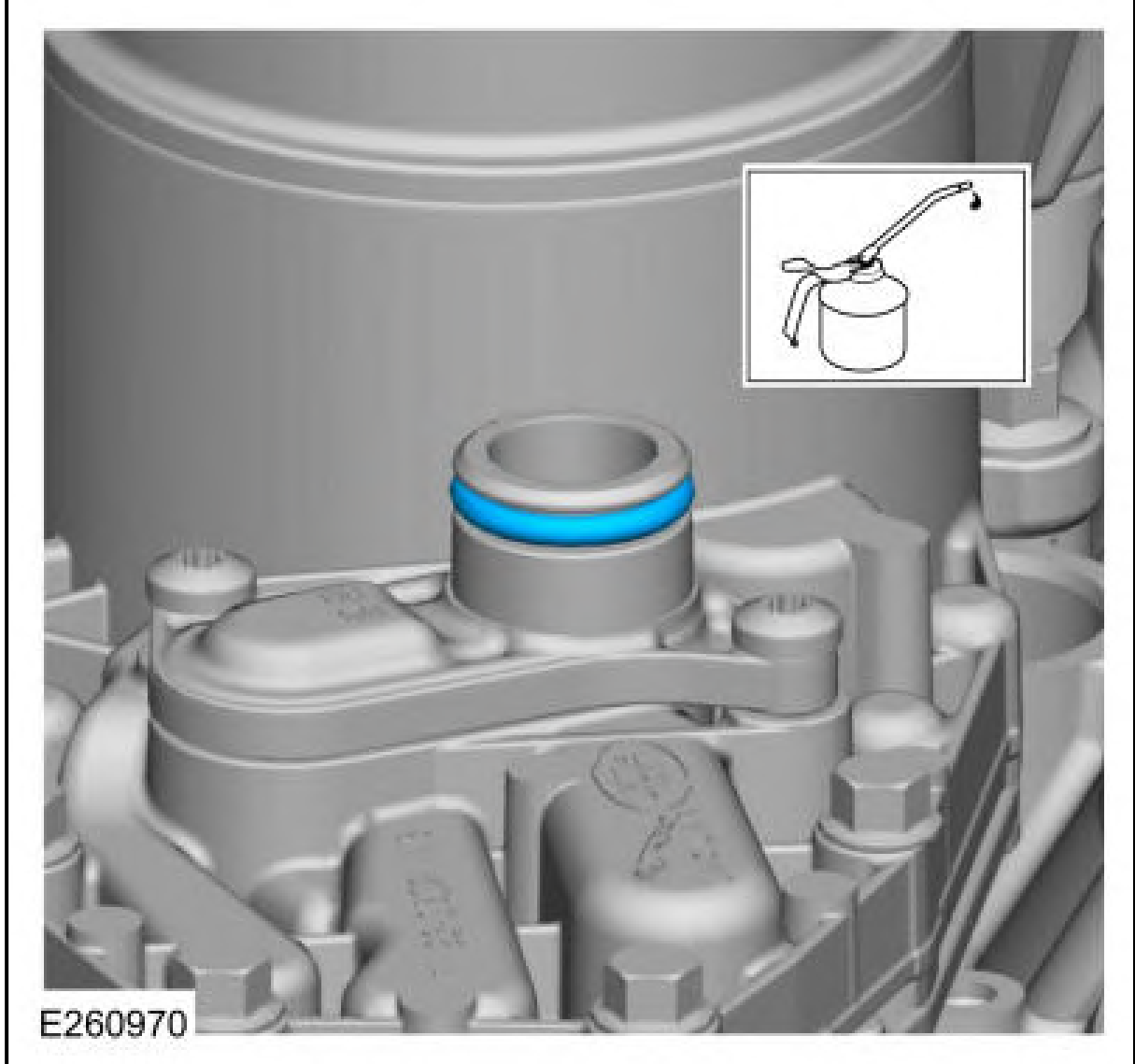


E261049

9. Install a new O-ring seal and lubricate.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

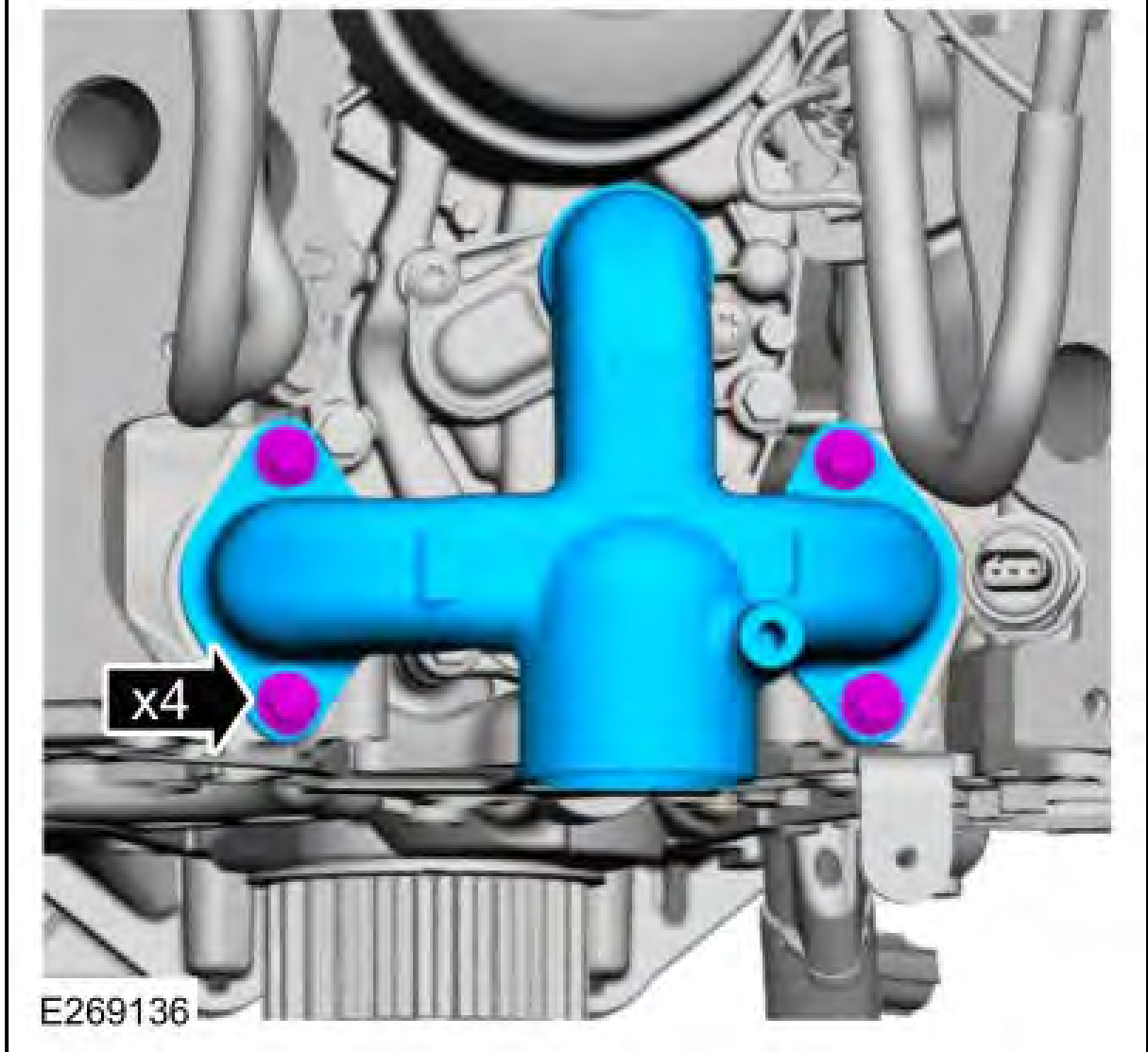




10. Install the coolant outlet connector and the bolts.

Torque: 89 lb.in (10 Nm)



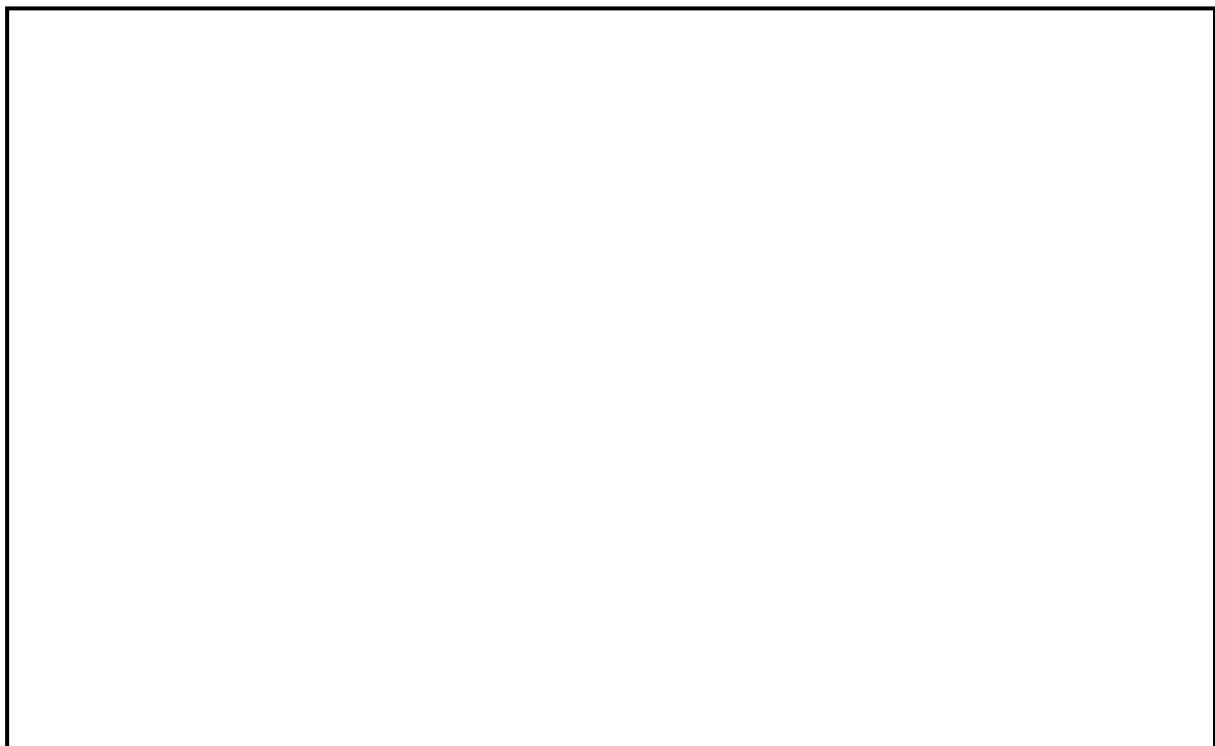


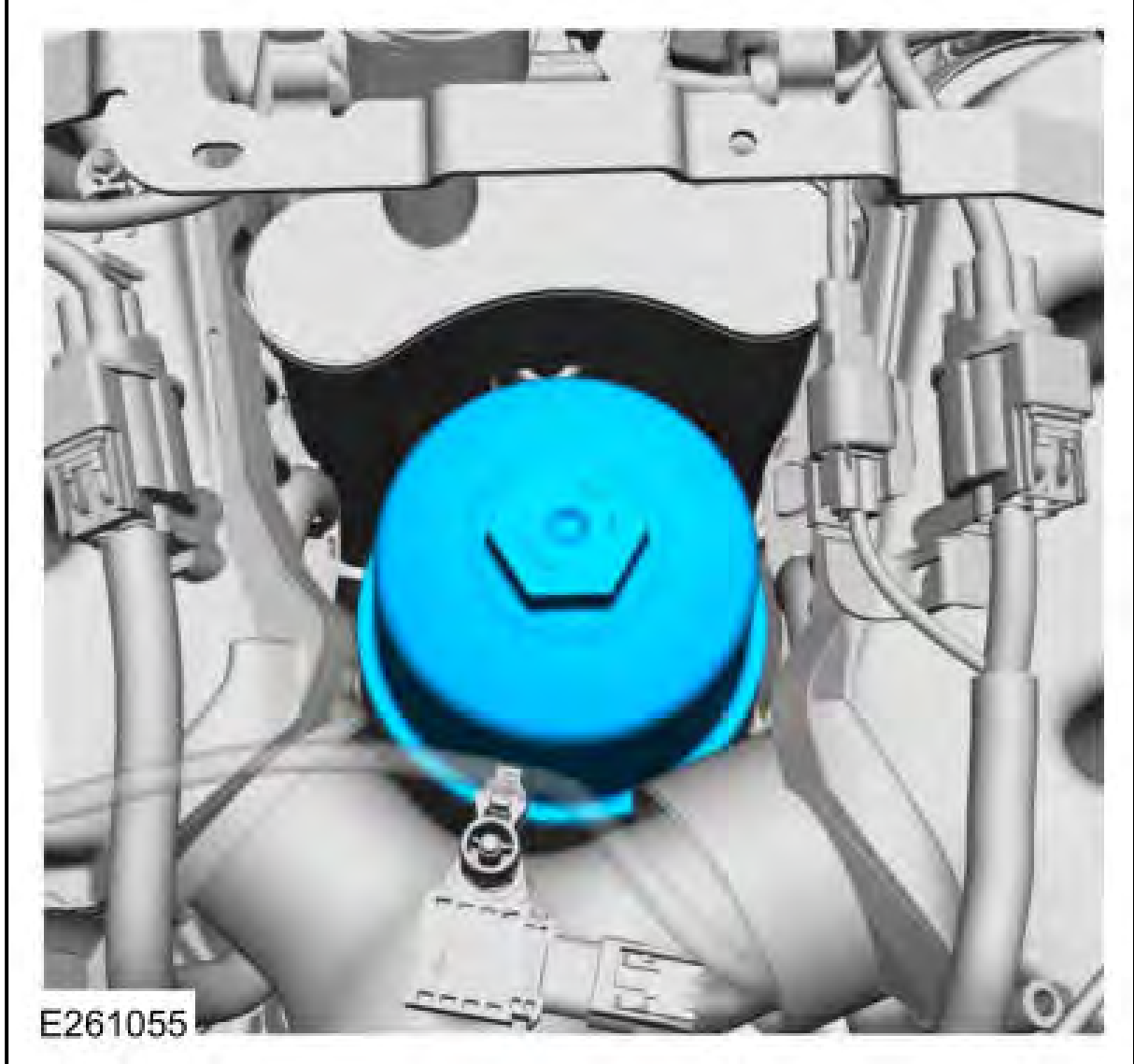
11. Install the following items:

1. Install the LH valve cover. REFER to: [Valve Cover LH](#) .
2. Install the intake manifold. REFER to: [Intake Manifold](#) .

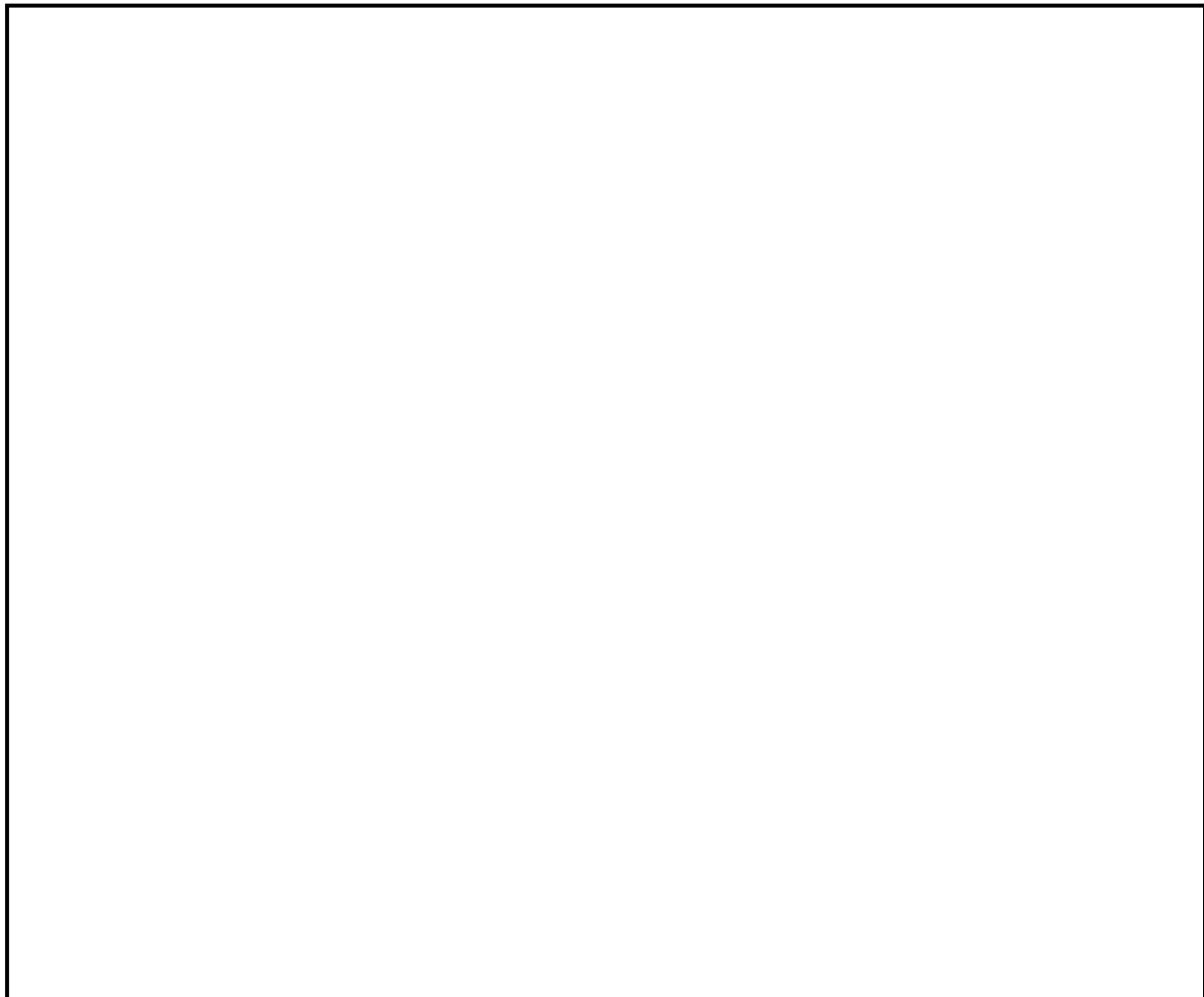
12. **NOTE:**        **Make sure that a new oil filter is installed.**

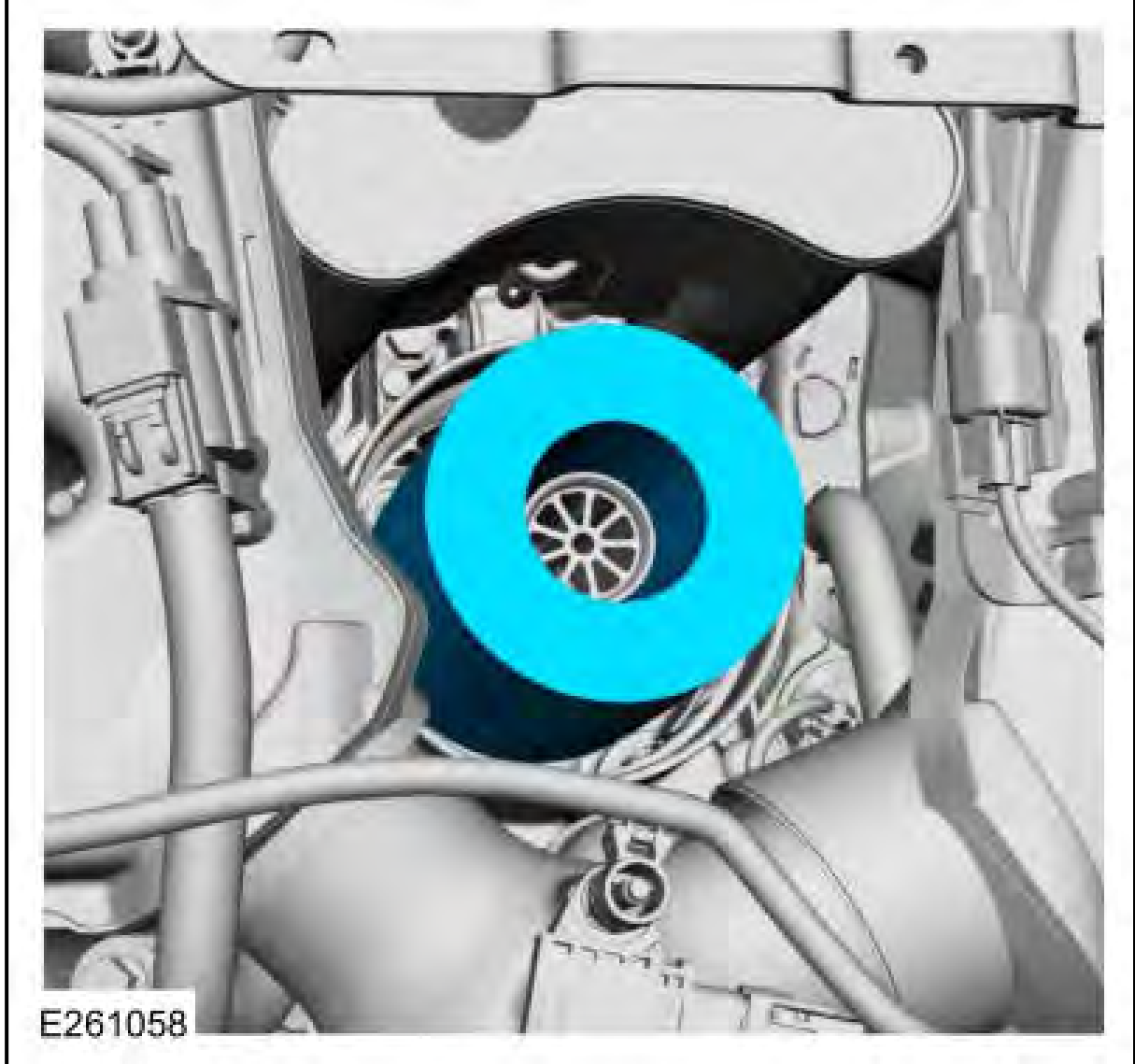
If necessary, remove the oil filter cap.





13. Install a new oil filter.

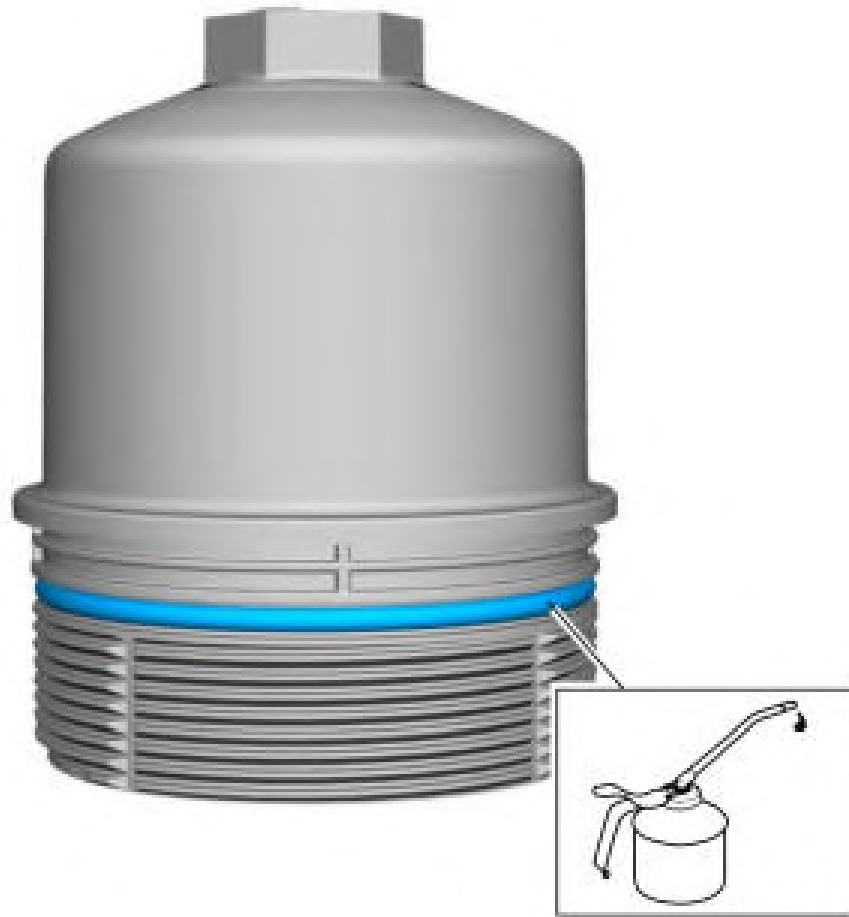




14. Install a new oil filter cap O-ring seal and lubricate.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

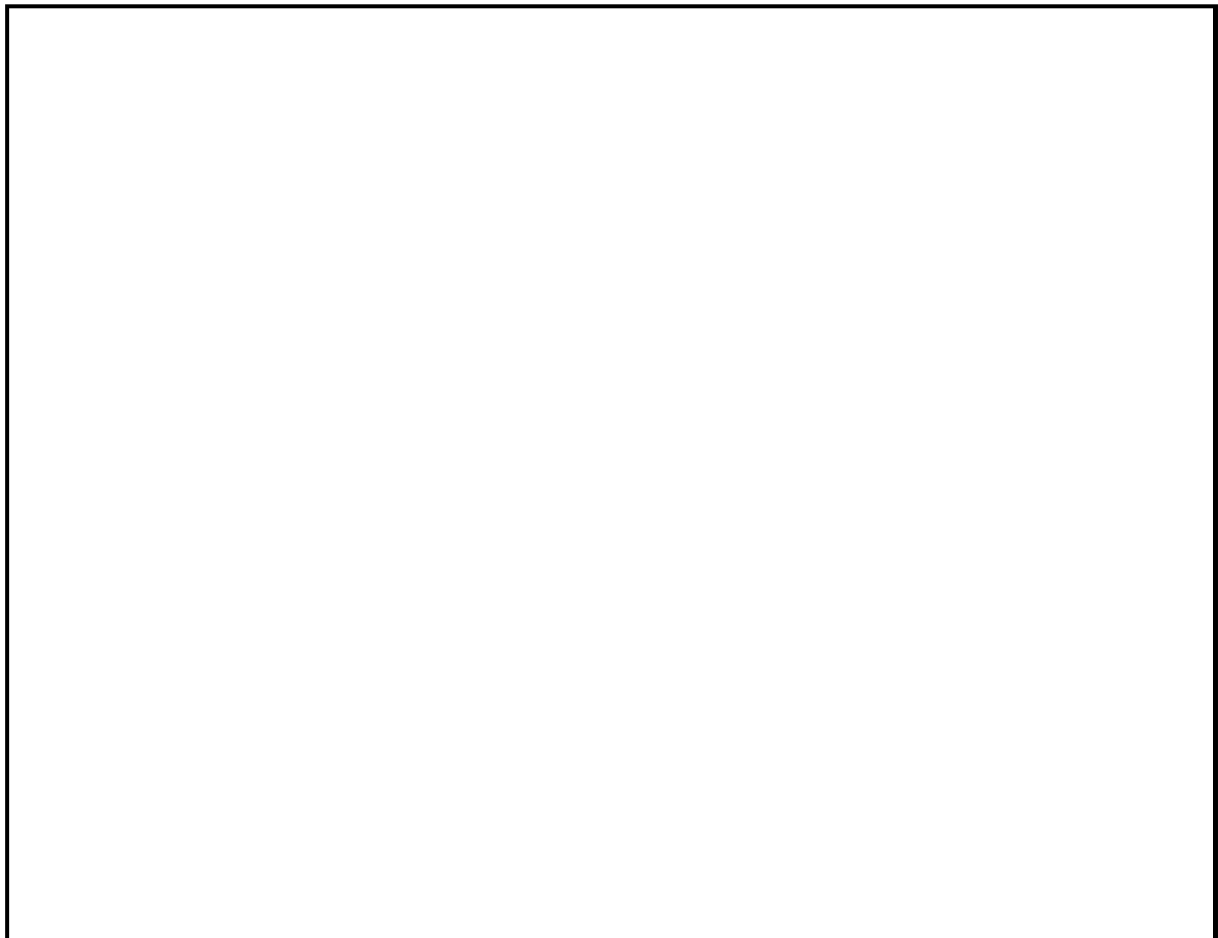


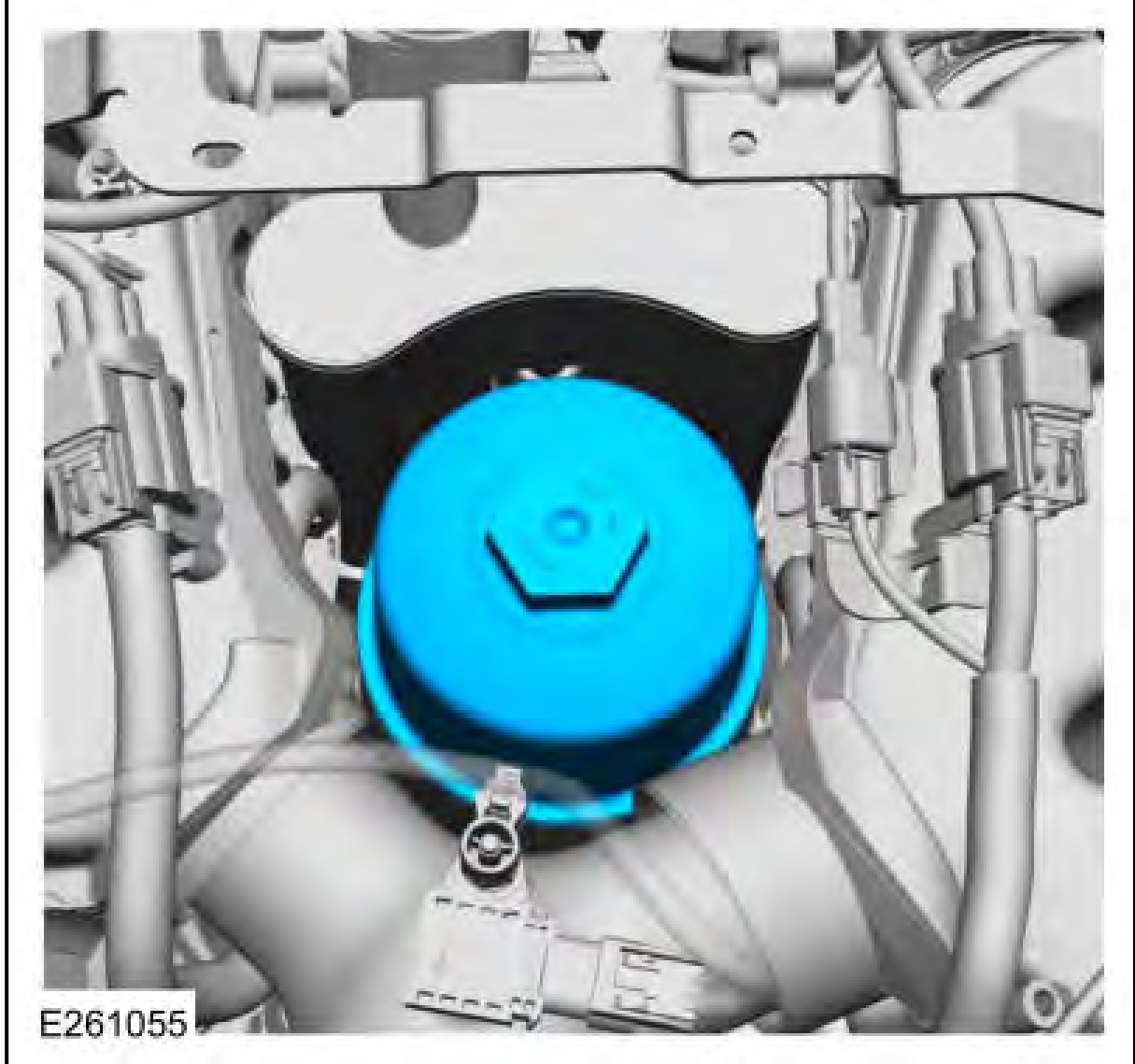


E261059

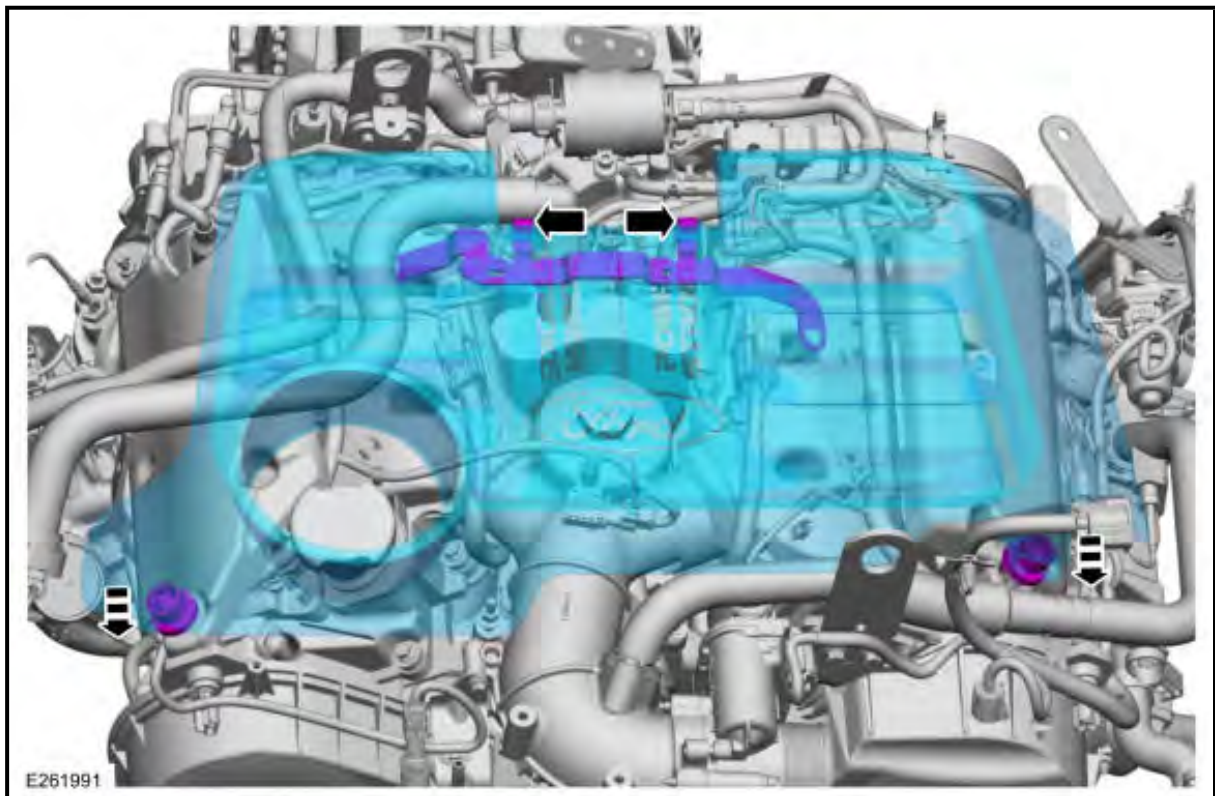
15. Install the oil filter cap.

Torque: 18 lb.ft (25 Nm)

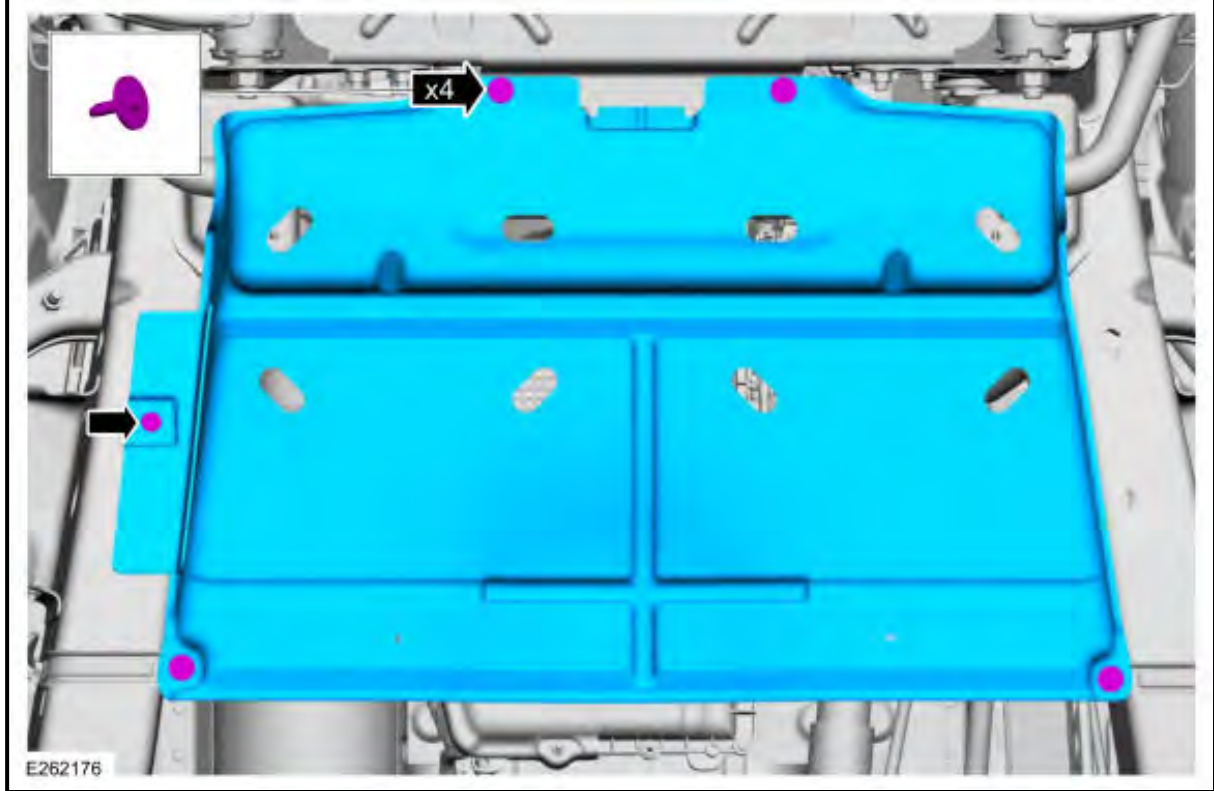




16. Install the engine appearance cover.

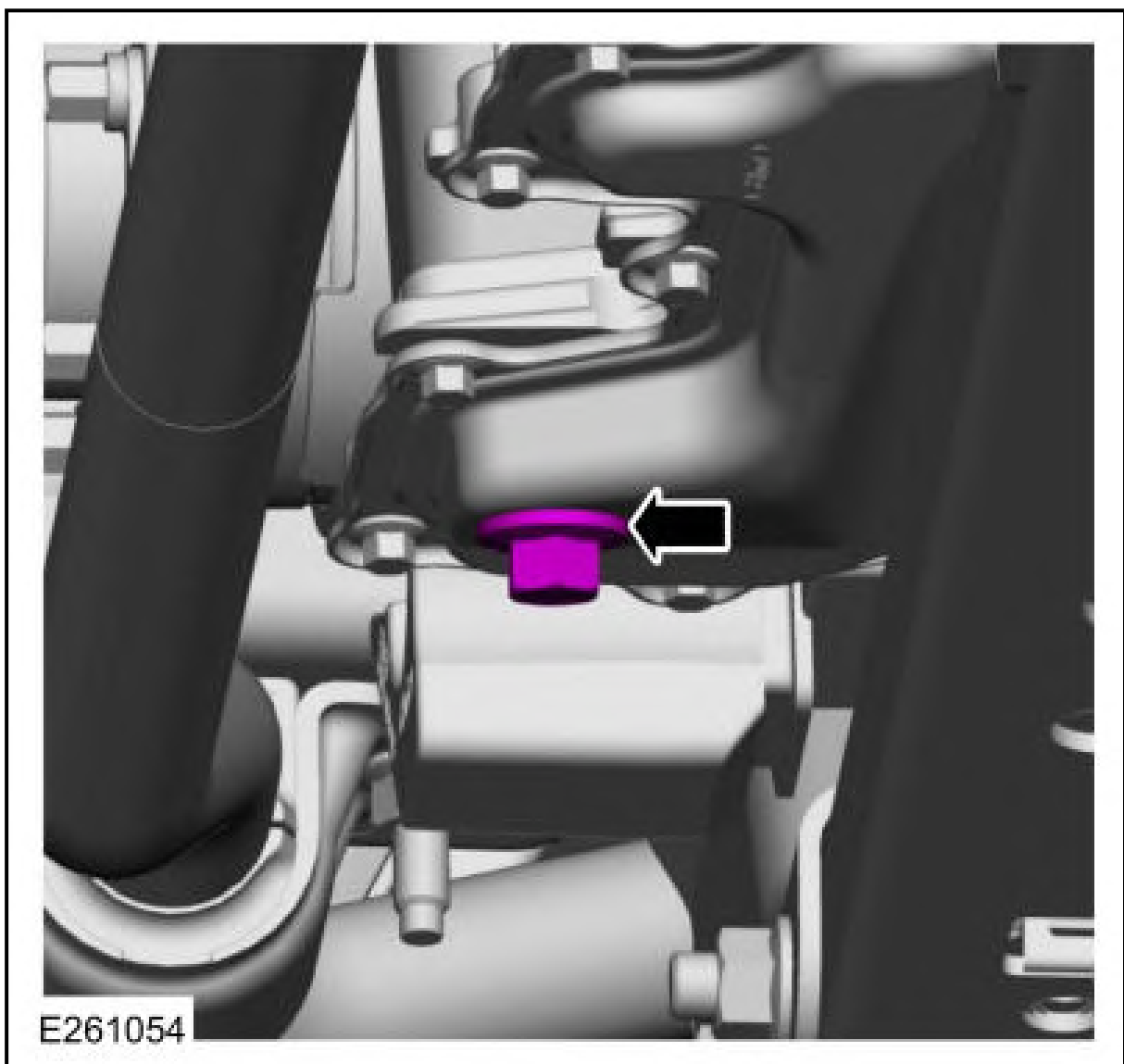


17. Remove the pin-type retainer. Remove the bolts and the transmission housing cover.



18. Remove the oil pan plug and drain the engine oil. Use the General Equipment: Oil Drain Equipment

Torque: 18 lb.ft (25 Nm)



19. Install the transmission housing cover and the bolts. Install the pin-type retainer.

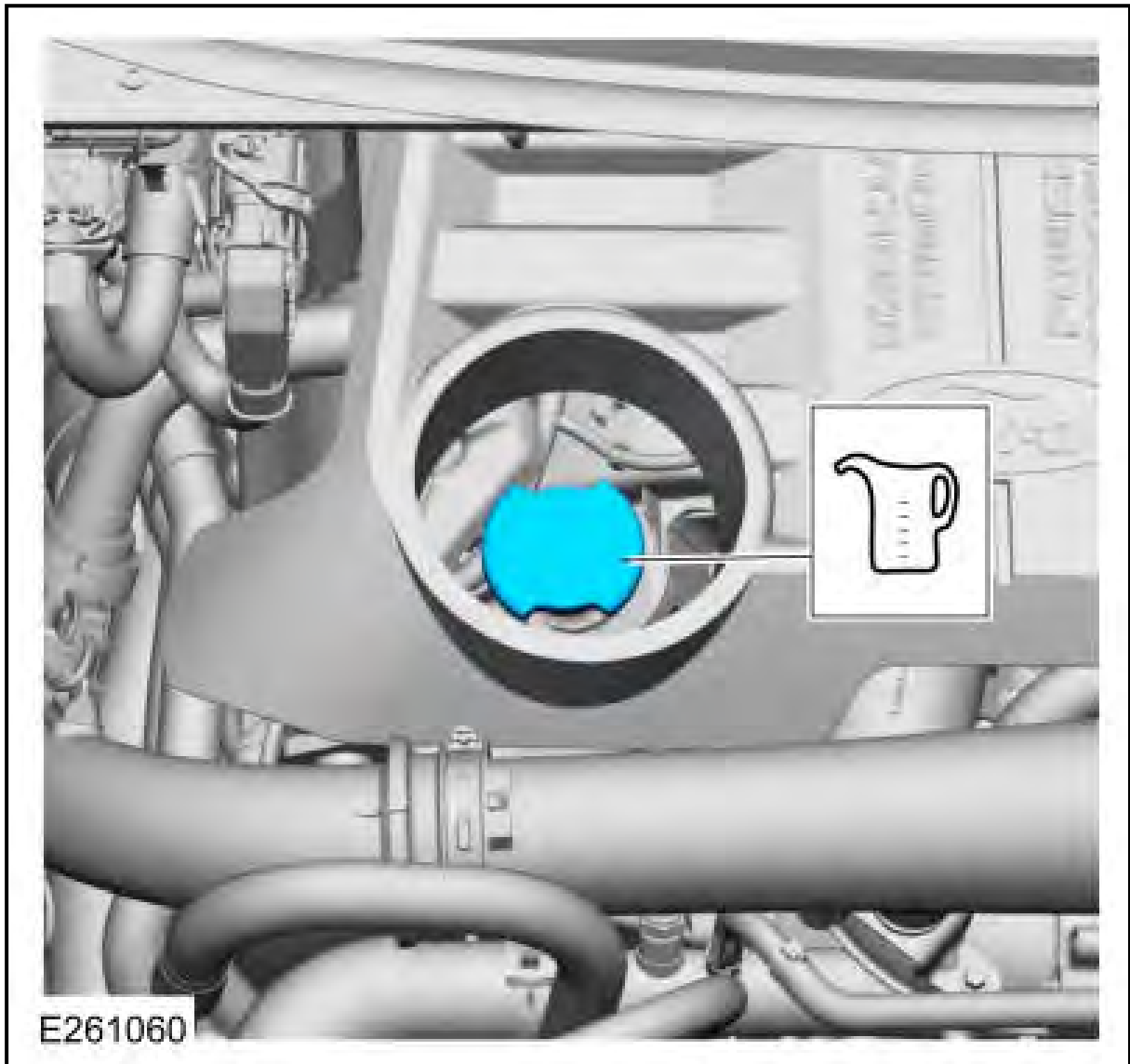


Torque: 71 lb.in (8 Nm)



20. Fill the engine with clean engine oil. REFER to: [Specifications](#) .

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)



**OIL PAN**

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

**Special Tool(s) / General Equipment**

|                        |
|------------------------|
| <b>Plastic Scraper</b> |
| Oil Drain Equipment    |

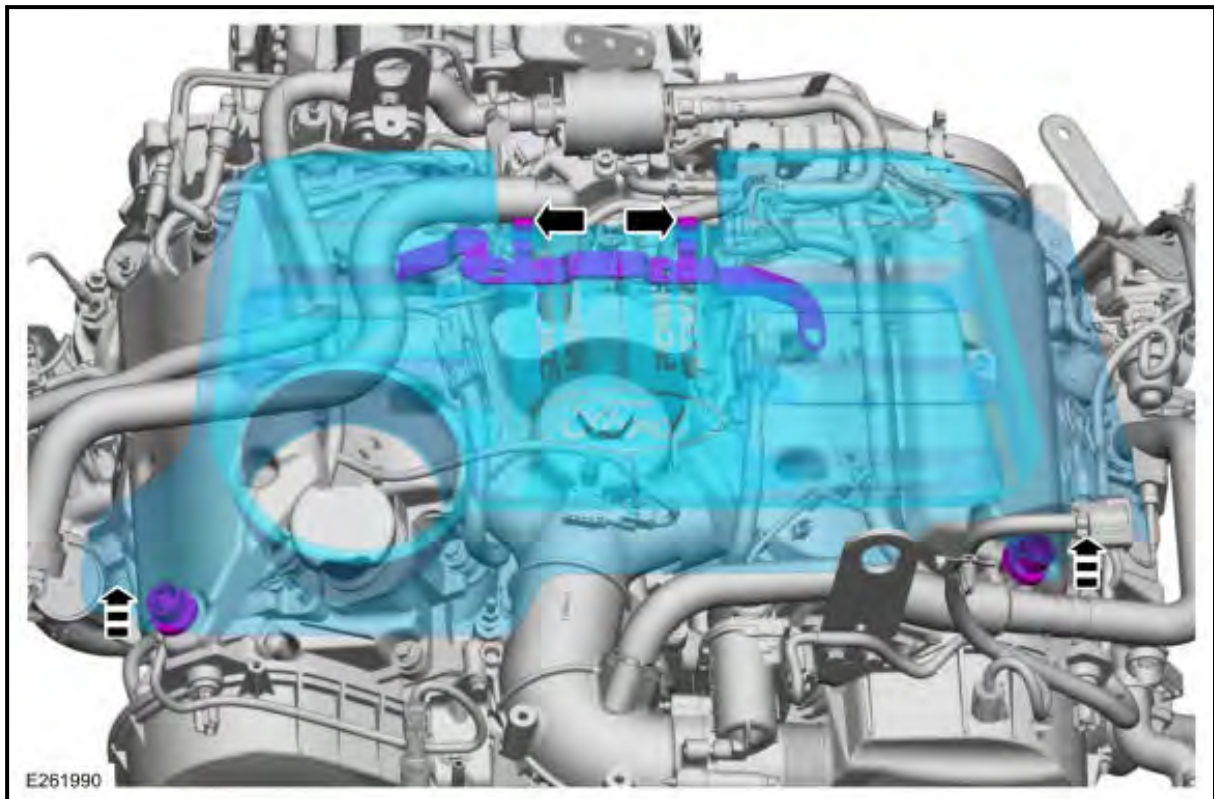
**Materials**

| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> High Performance Engine RTV Silicone TA-357  | WSE-M4G323-A6 |
| Motorcraft <sup>®</sup> Silicone Gasket Remover ZC-30-A              | -             |
| Motorcraft <sup>®</sup> Metal Surface Prep Wipes ZC-31-B             | -             |
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA | WSS-M2C214-B1 |
| Motorcraft <sup>®</sup> Metal Brake Parts Cleaner PM-4-A, PM-4-B     | -             |

**REMOVAL**

**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, may cause engine failure.

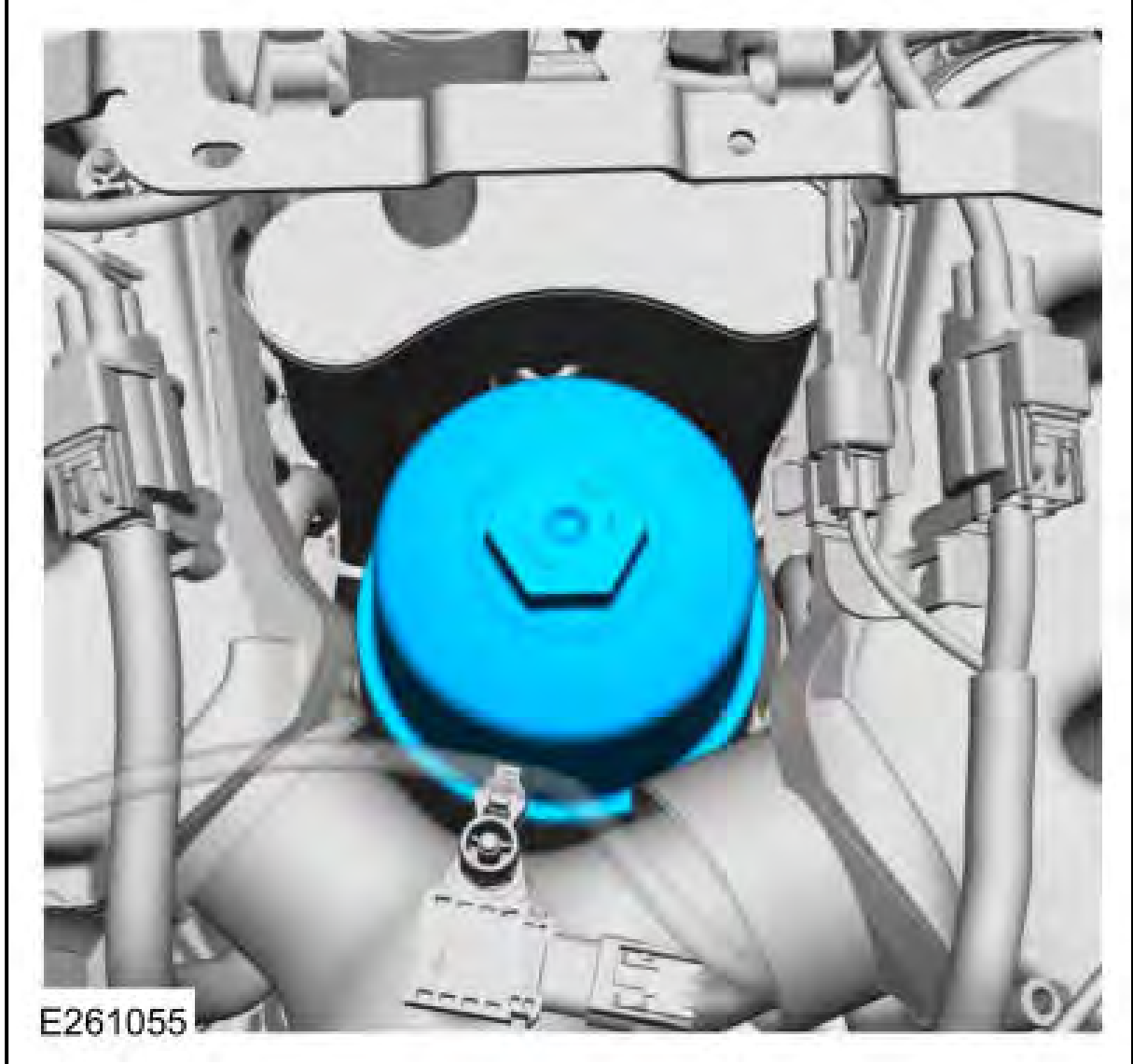
1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Remove the engine appearance cover.



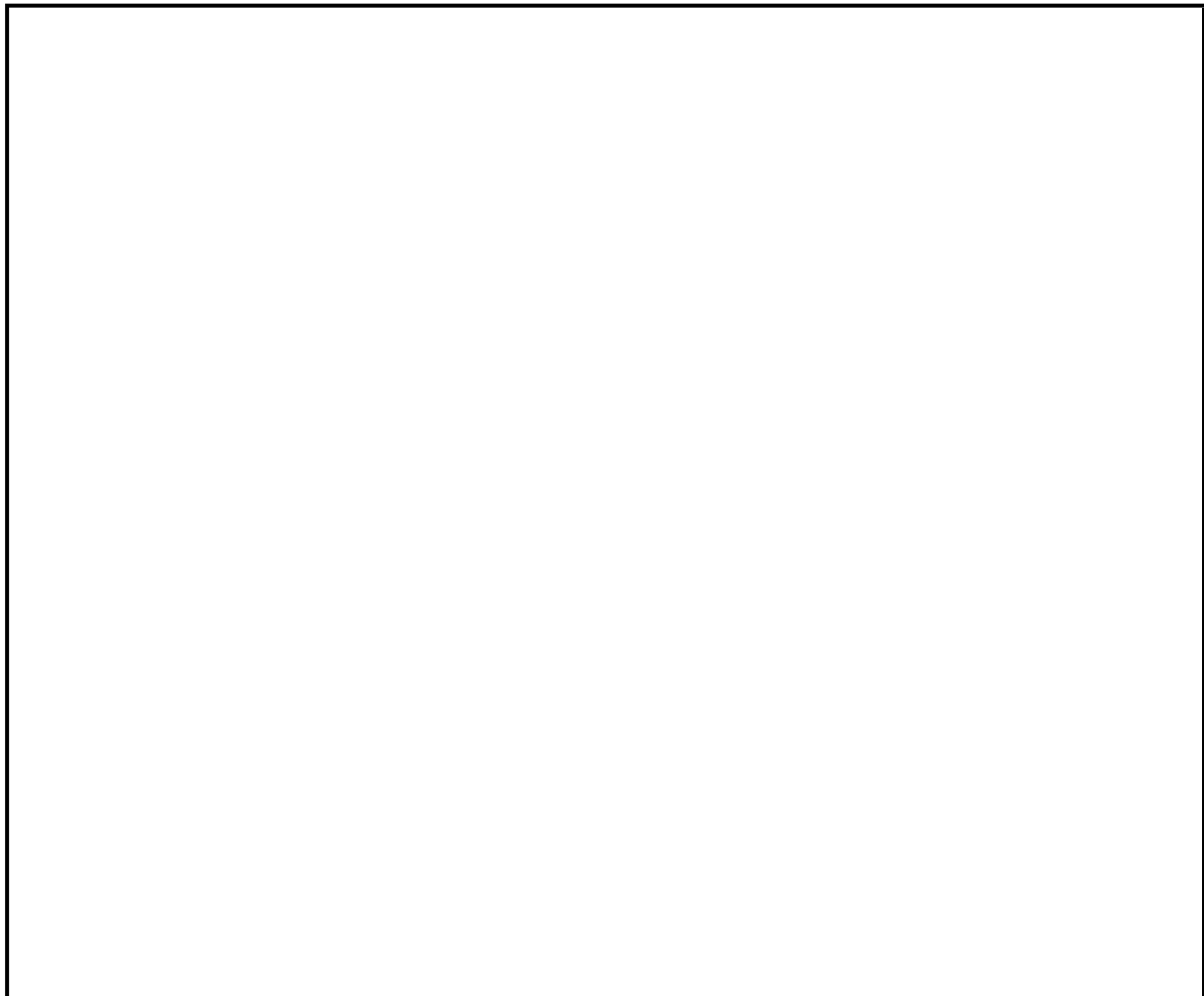
3. **NOTE:** The oil filter housing needs a minimum of 1 minute to allow the oil to drain out of the oil filter housing to minimize oil spillage.

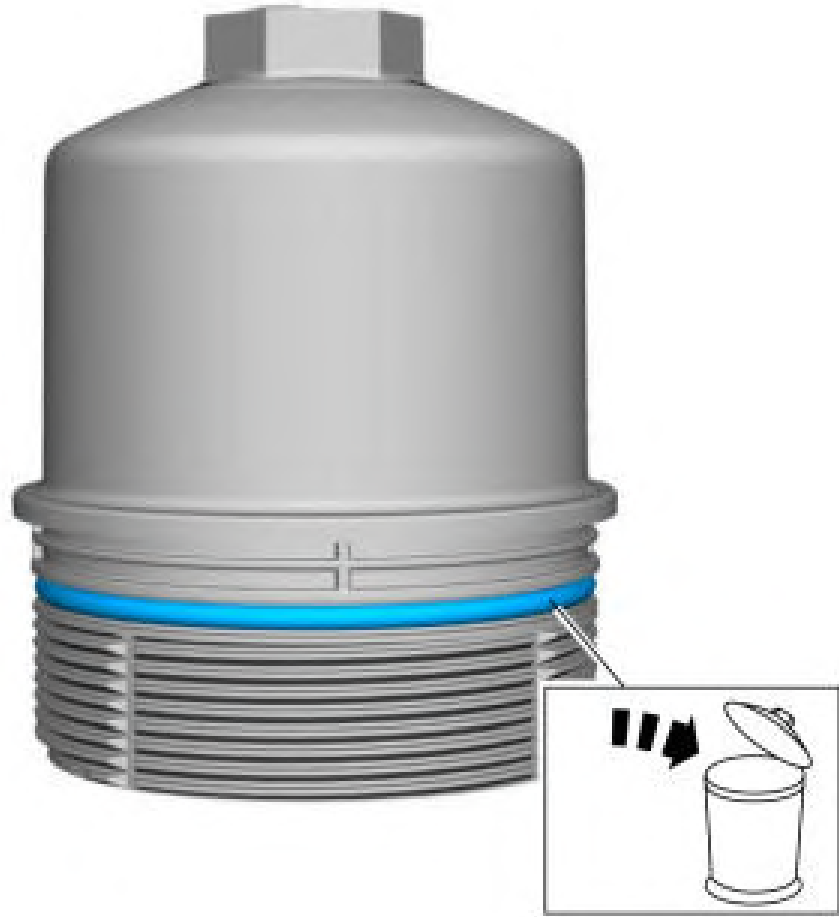
Loosen the oil filter cap and let the oil filter housing drain. Remove the oil filter cap.





4. Remove and discard the oil filter cap O-ring seal.

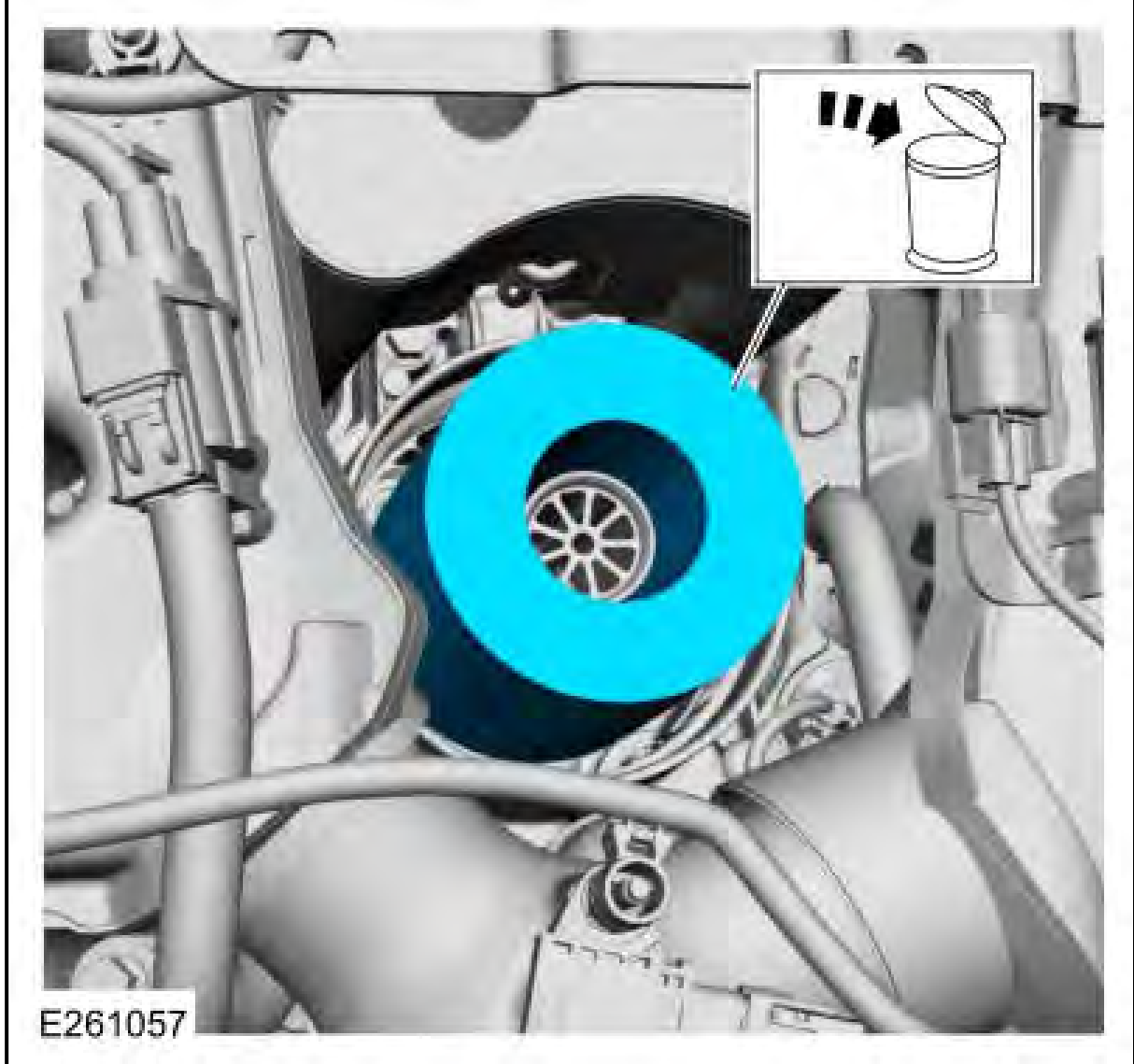




E261056

5. Remove and discard the oil filter. Use the General Equipment: Oil Drain Equipment



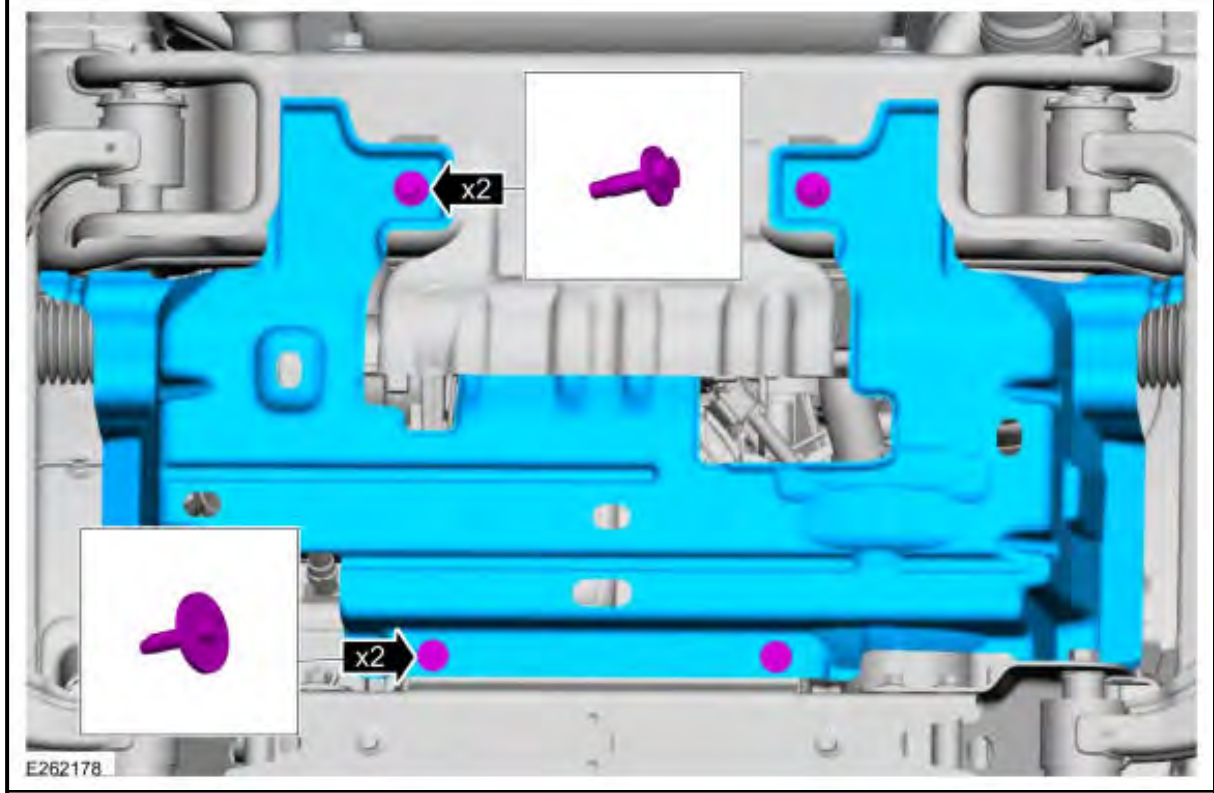


6. Remove the pin-type retainer. Remove the bolts and the transmission housing cover.

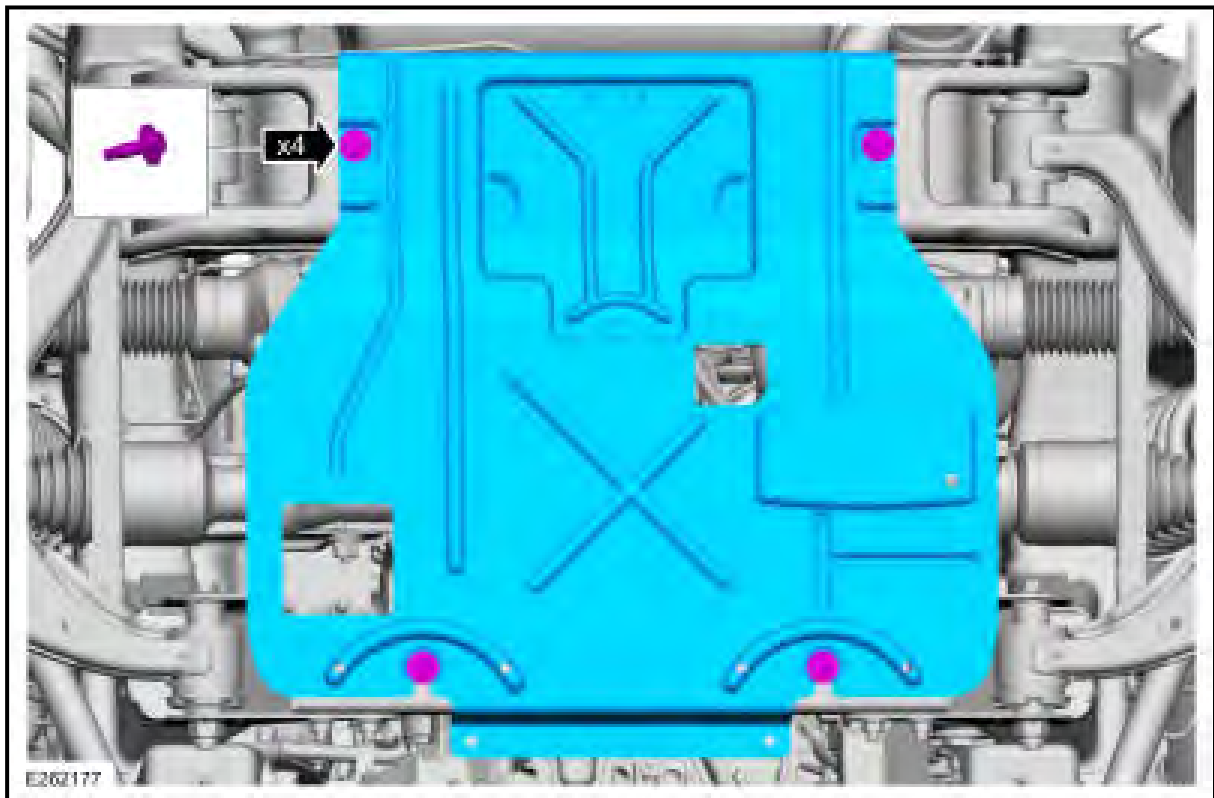


7. If equipped, remove the bolts and the underbody shield.





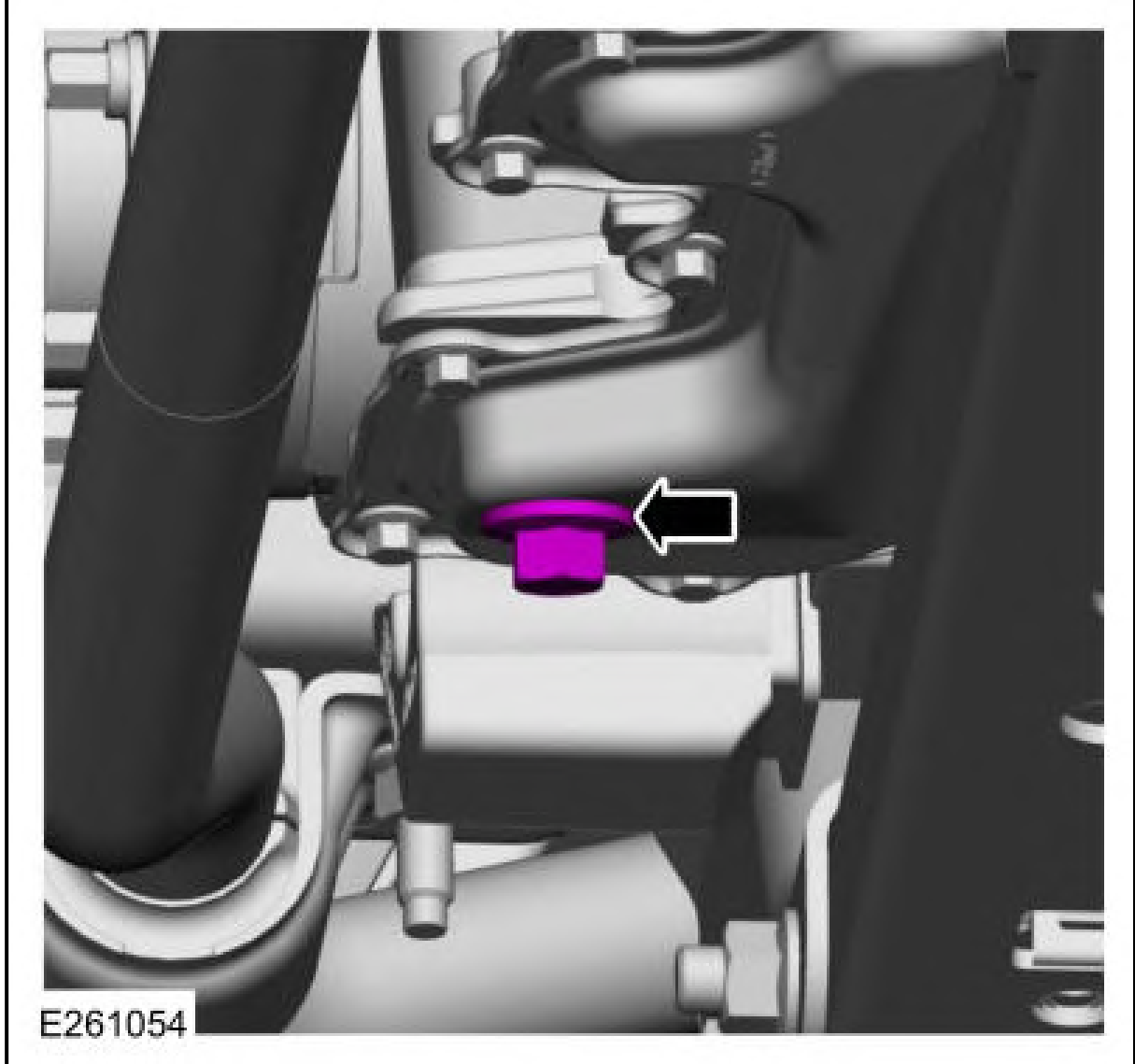
8. If equipped, remove the bolts and the skid plate.



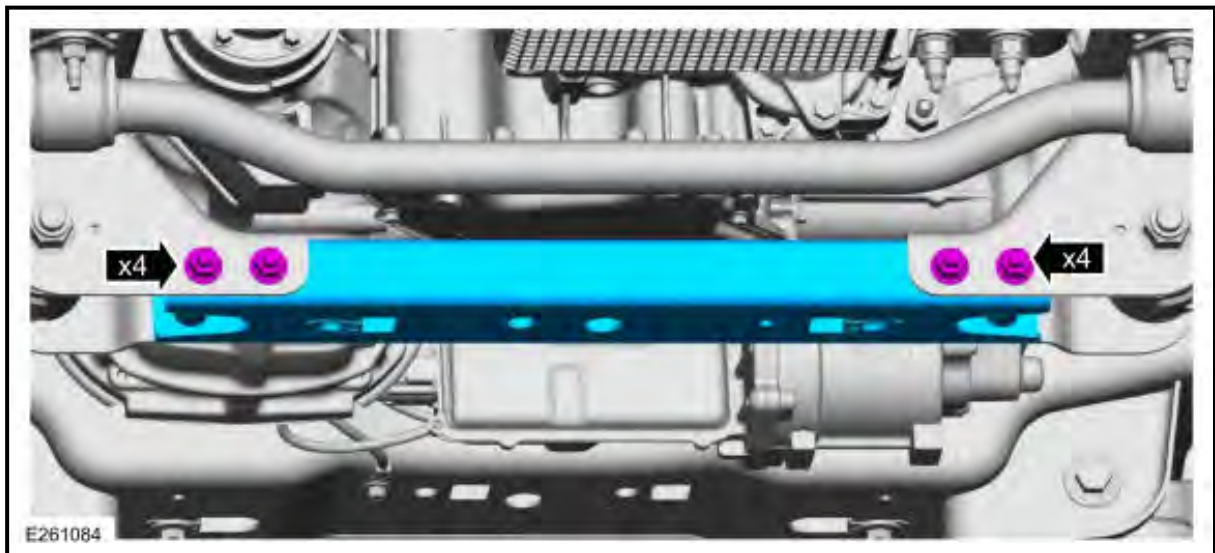
9. Remove the oil pan plug and drain the engine oil. Use the General Equipment: Oil Drain Equipment

Torque: 18 lb.ft (25 Nm)



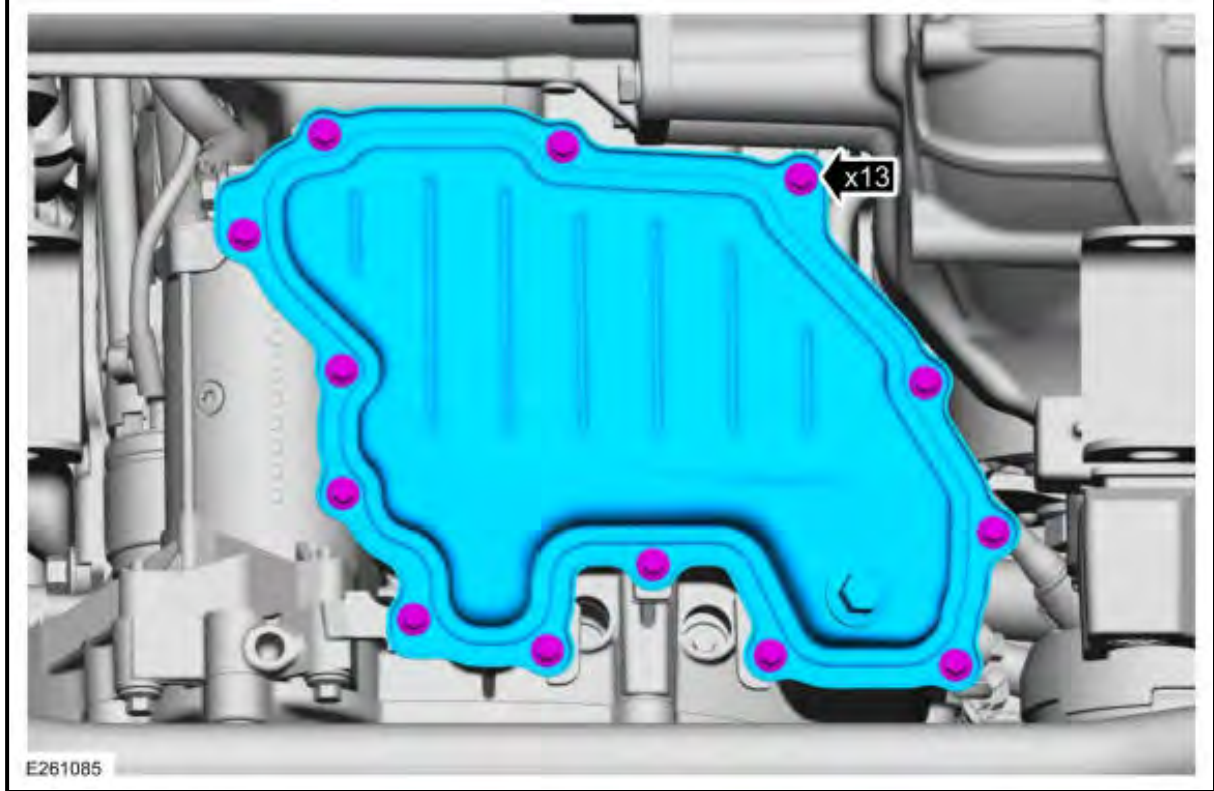


10. Remove the nuts, the bolts and the crossmember.



11. Remove the oil pan bolts.





12. **NOTE:** Do not use wire brushes, power abrasive discs or 3M™ Roloc Â® Bristle Disk (2-in white, part number 07528) to clean the sealing surfaces of the engine block skirt stiffener. These tools cause scratches and gouges that make leak paths. They also cause contamination that causes premature engine failure. Remove all traces of the gasket.

Make sure that the mating faces of the oil pan are clean and free of foreign material. REFER to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

Material: Motorcraft Â® Silicone Gasket Remover / ZC-30-A

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

Material: Motorcraft Â® Metal Brake Parts Cleaner / PM-4-A, PM-4-B

## INSTALLATION

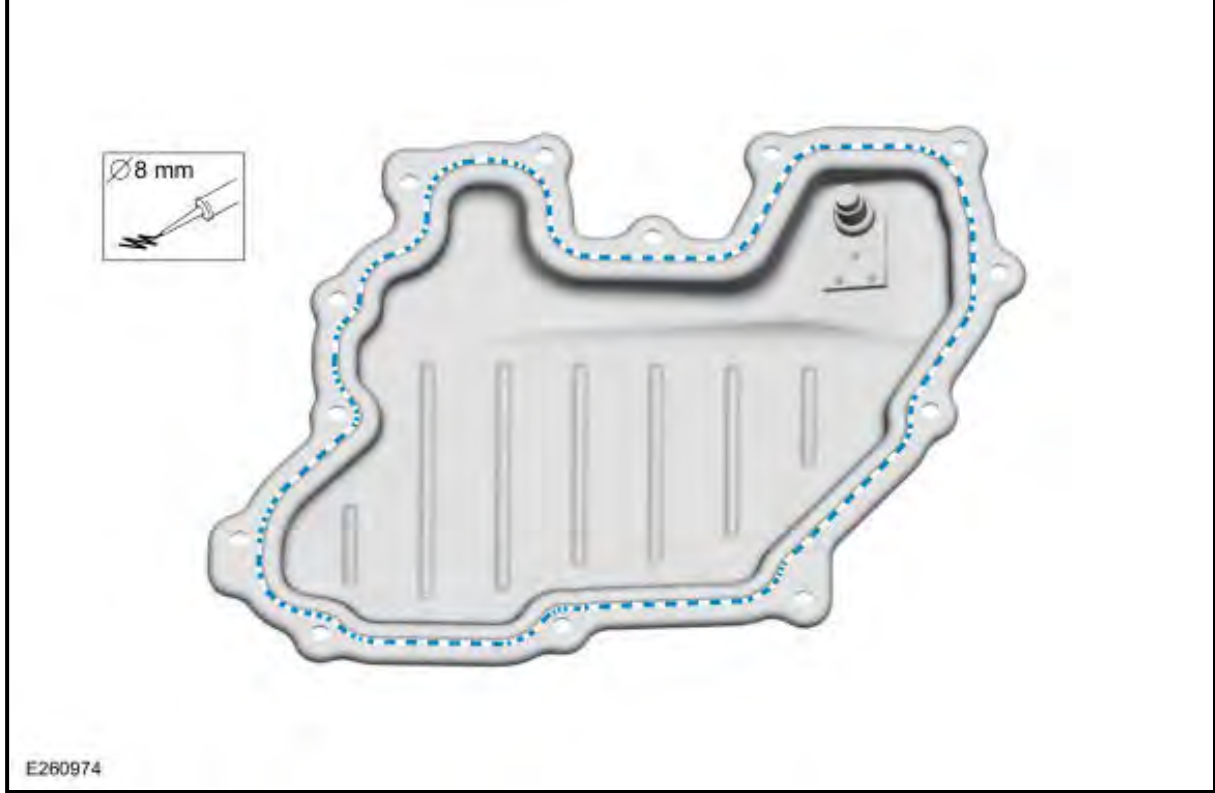
1. **NOTE:** The oil pan must be installed and the oil pan aligned to the cylinder block within 4 minutes of sealant application. Final tightening of the oil pan bolts must be carried out within 60 minutes of sealant application.

Apply a bead of Motorcraft Â® High Performance Engine RTV Silicone to the sealing surface of the oil pan.

Material: Motorcraft Â® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)

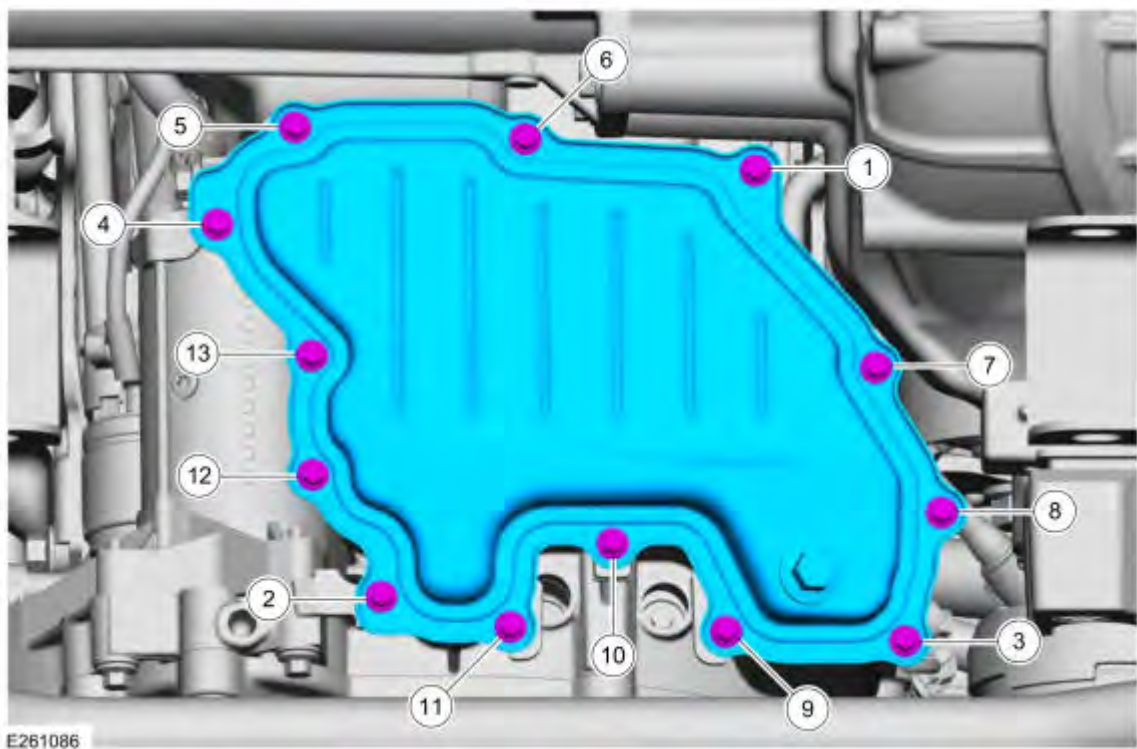






2. Install the oil pan and the bolts. Tighten in the sequence shown.

Torque: 89 lb.in (10 Nm)

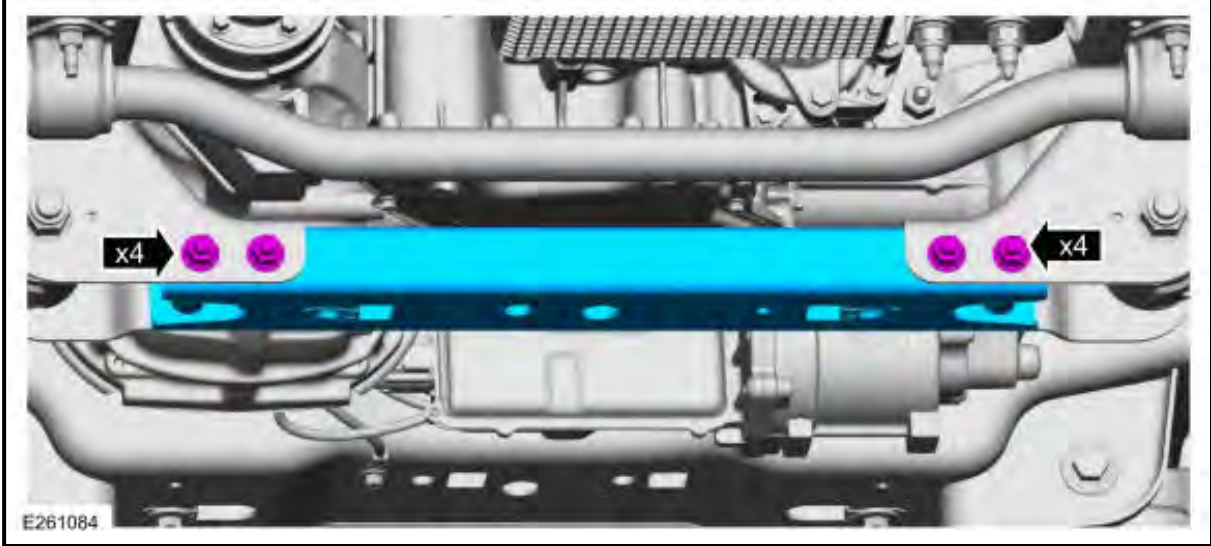


**Fig. 9: Oil Pan Tightening Sequence**  
Courtesy of FORD MOTOR COMPANY

3. Position the crossmember, install the nuts and the bolts.

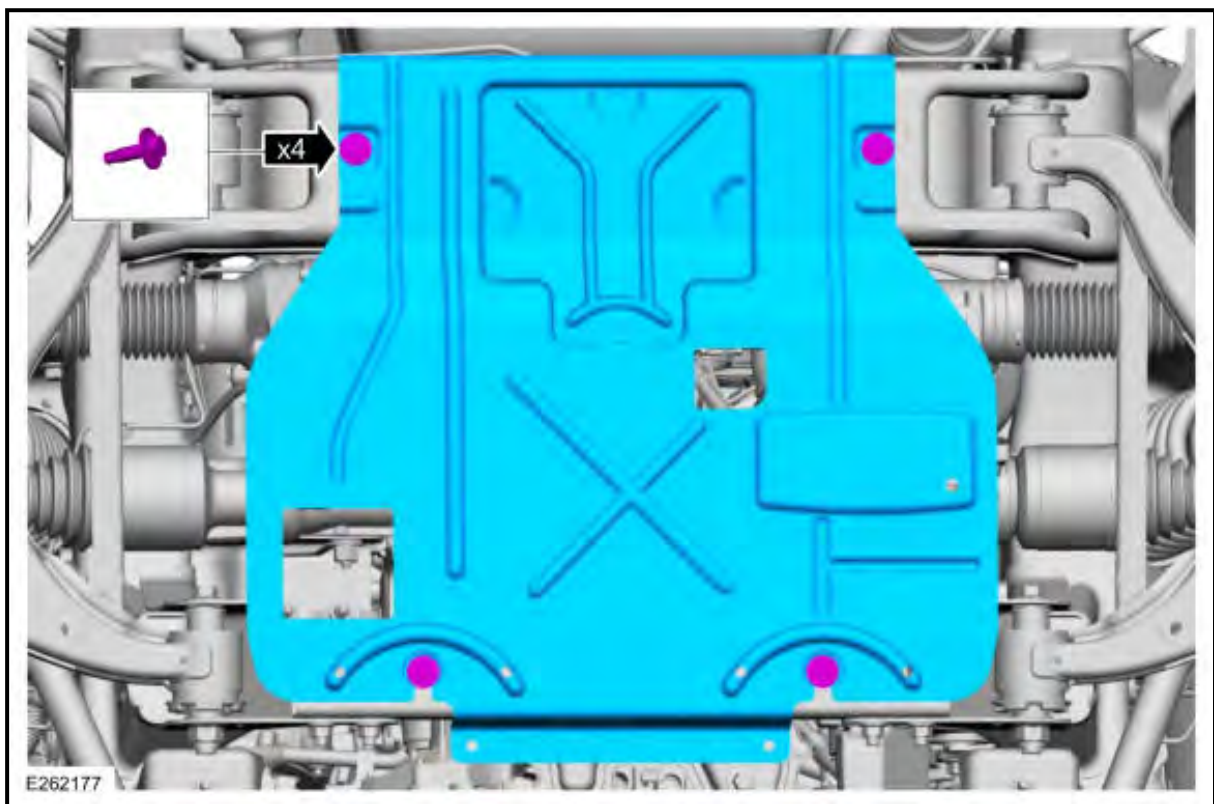
Torque: 66 lb.ft (90 Nm)





4. If equipped, install the skid plate and the bolts.

Torque: 30 lb.ft (40 Nm)



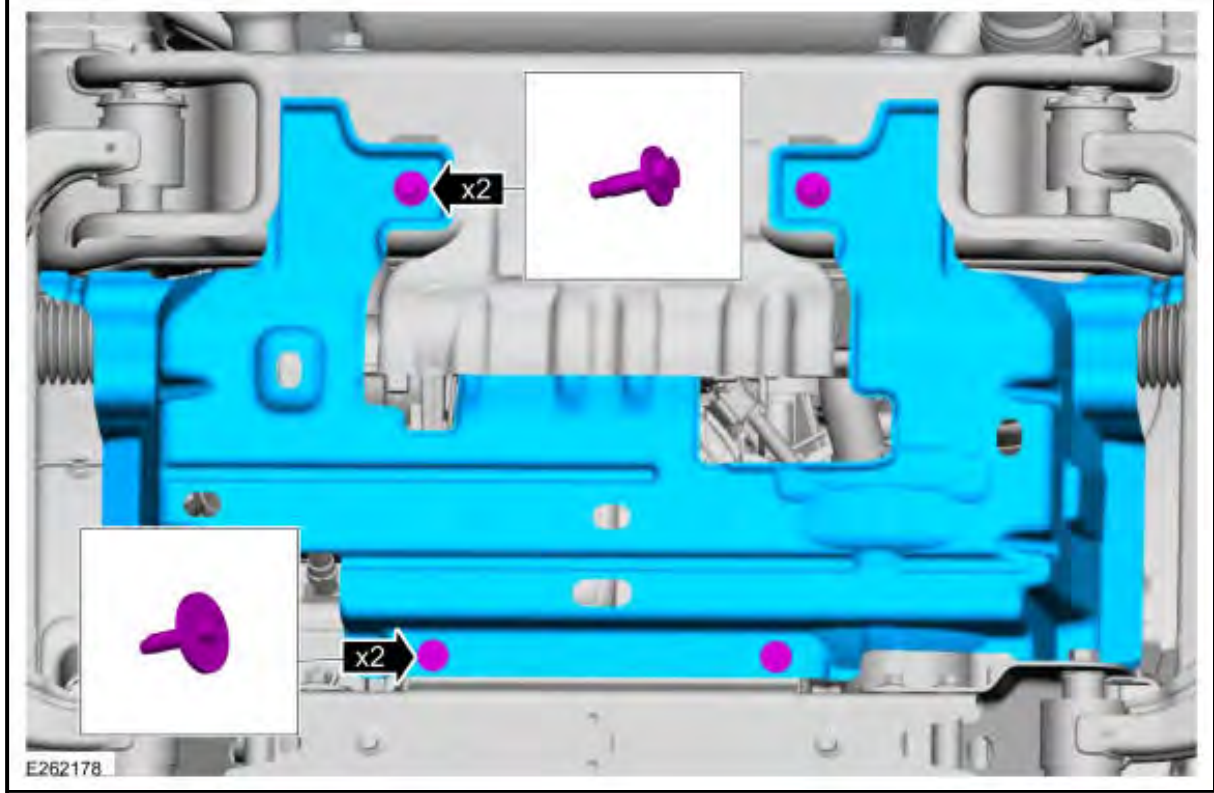
5. If equipped, install the underbody shield and the bolts.

Torque:

M8 bolt: 30 lb.ft (40 Nm)

M6 bolt: 71 lb.in (8 Nm)



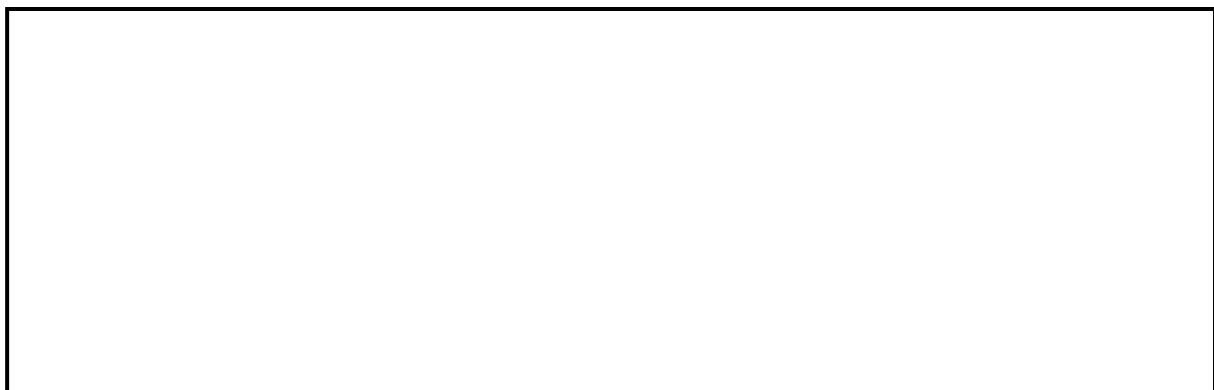


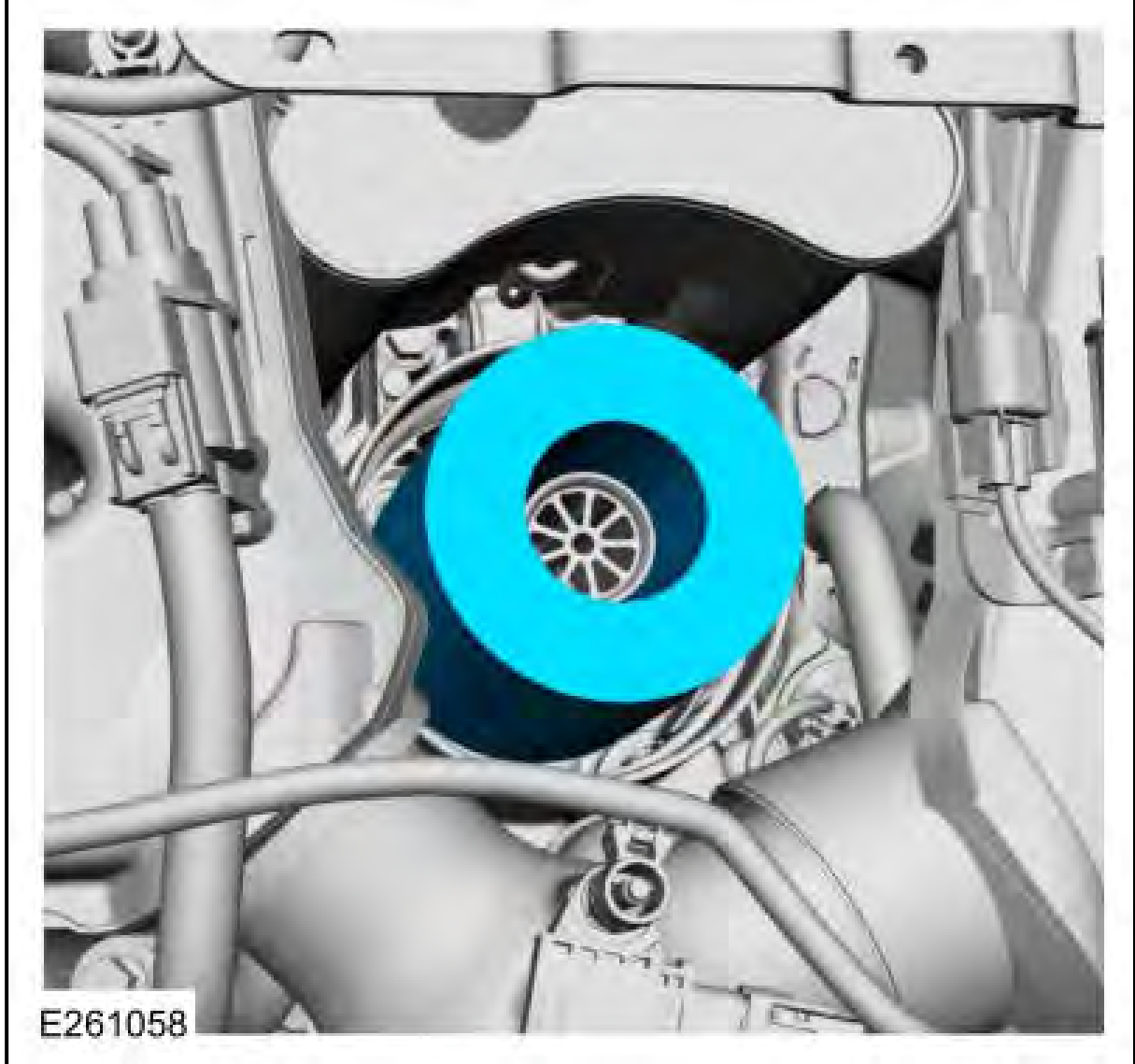
6. Install the transmission housing cover and the bolts. Install the pin-type retainer.

Torque: 71 lb.in (8 Nm)



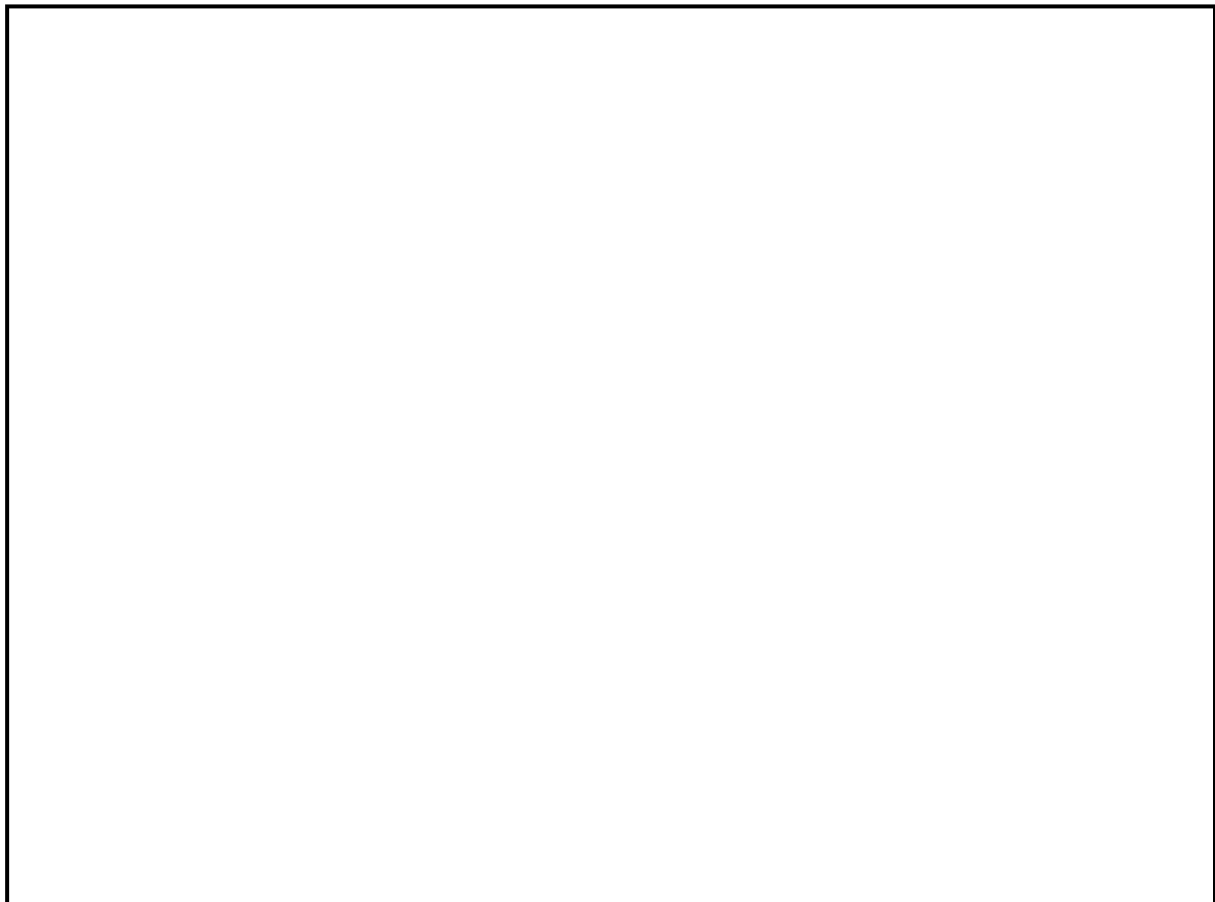
7. Install a new oil filter.

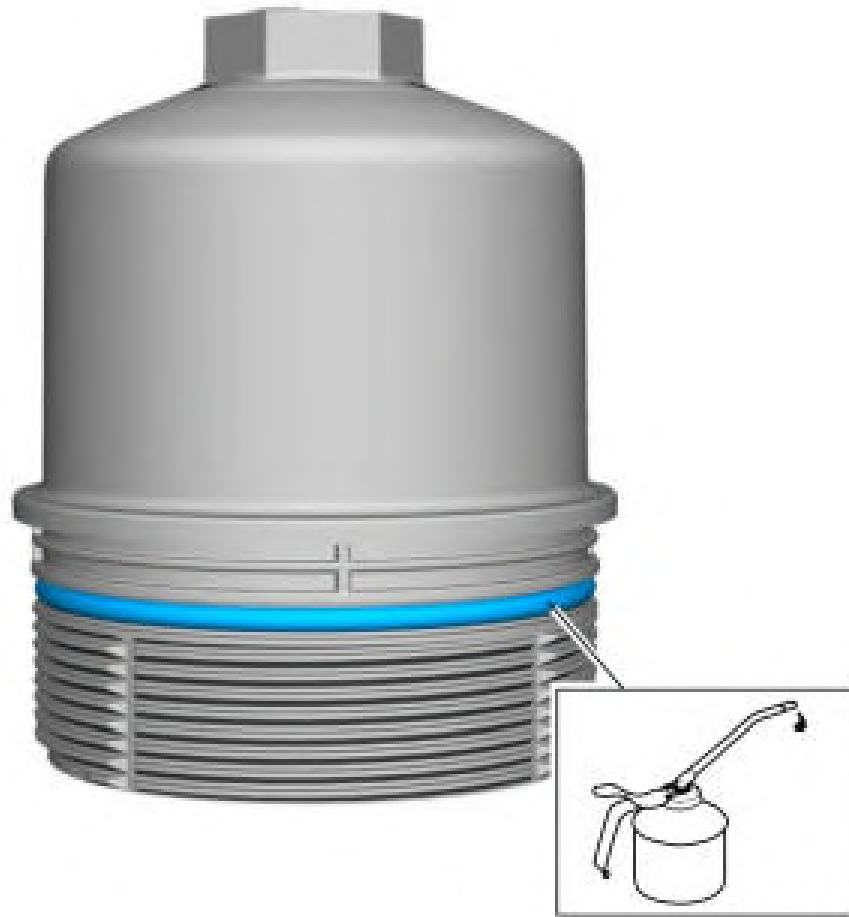




8. Install a new oil filter cap O-ring seal and lubricate.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

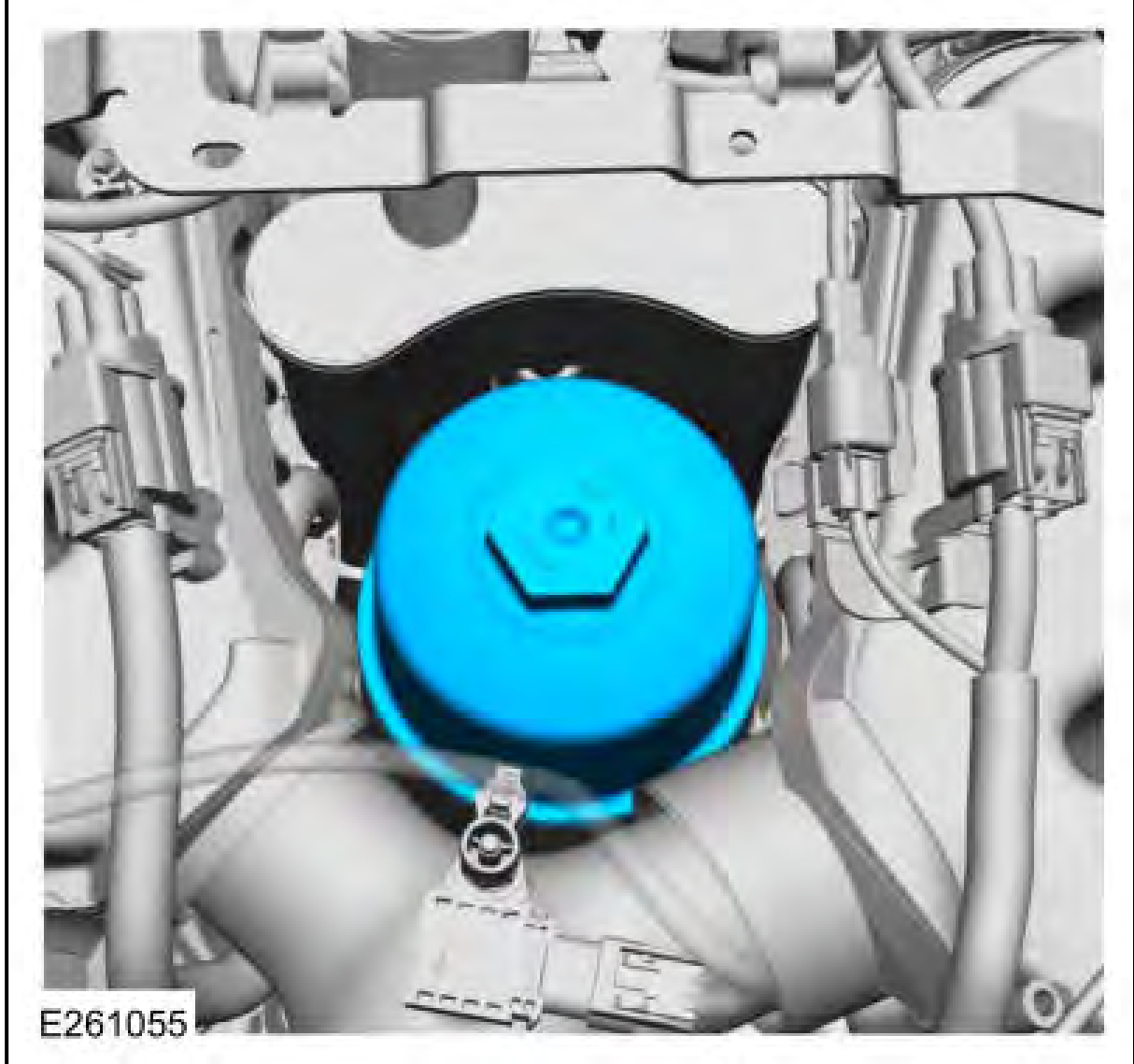




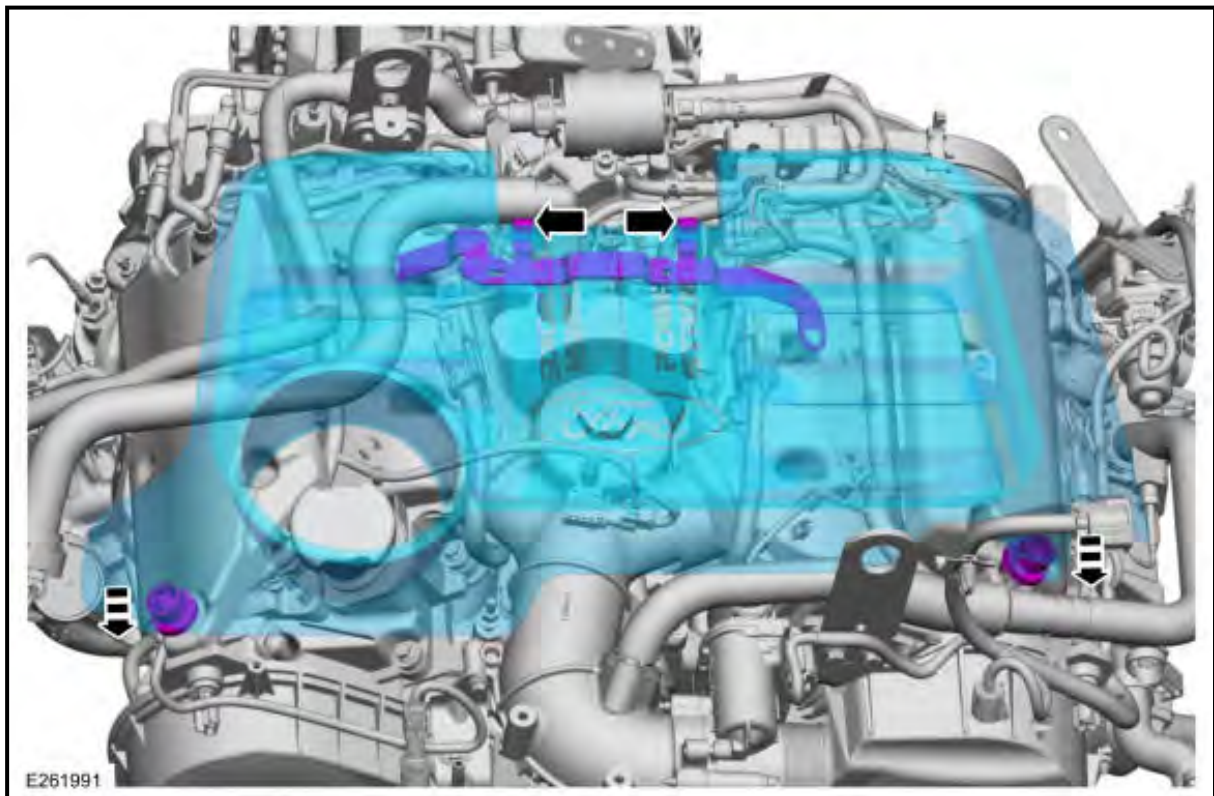
E261059

9. Install the oil filter cap.

Torque: 18 lb.ft (25 Nm)

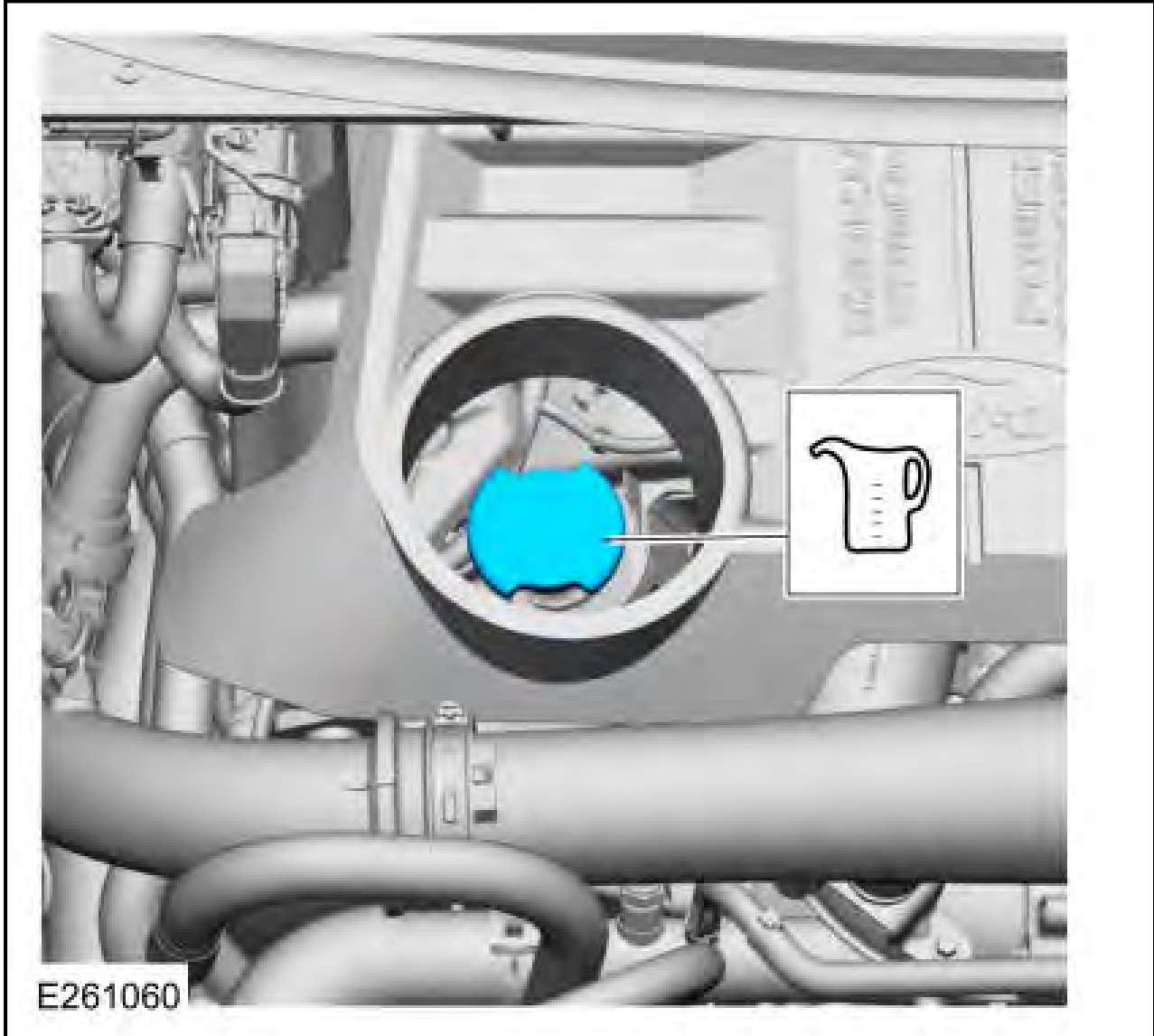


10. Install the engine appearance cover.



11. Fill the engine with clean engine oil. REFER to: [Specifications](#) .

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)



## OIL PUMP

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

### Special Tool(s) / General Equipment

|                 |
|-----------------|
| Plastic Scraper |
|-----------------|

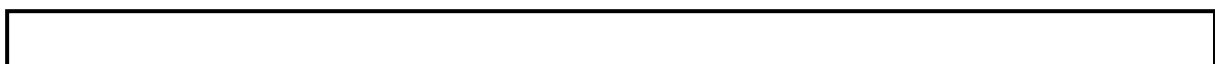
### Materials

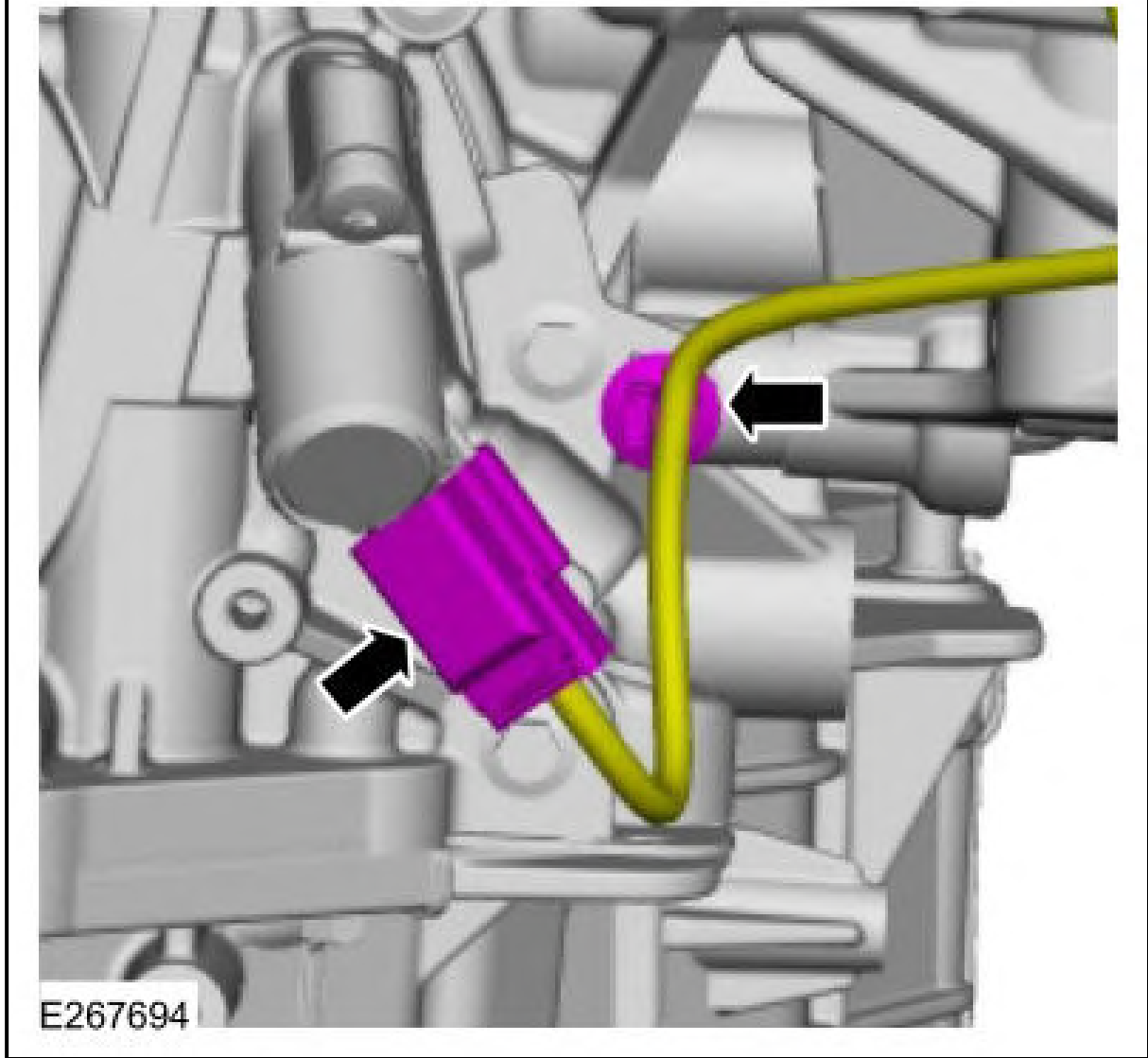
| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> High Performance Engine RTV Silicone TA-357  | WSE-M4G323-A6 |
| Motorcraft <sup>®</sup> Silicone Gasket Remover ZC-30-A              | -             |
| Motorcraft <sup>®</sup> Metal Surface Prep Wipes ZC-31-B             | -             |
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA | WSS-M2C214-B1 |
| Motorcraft <sup>®</sup> Metal Brake Parts Cleaner PM-4-A, PM-4-B     | -             |

## REMOVAL

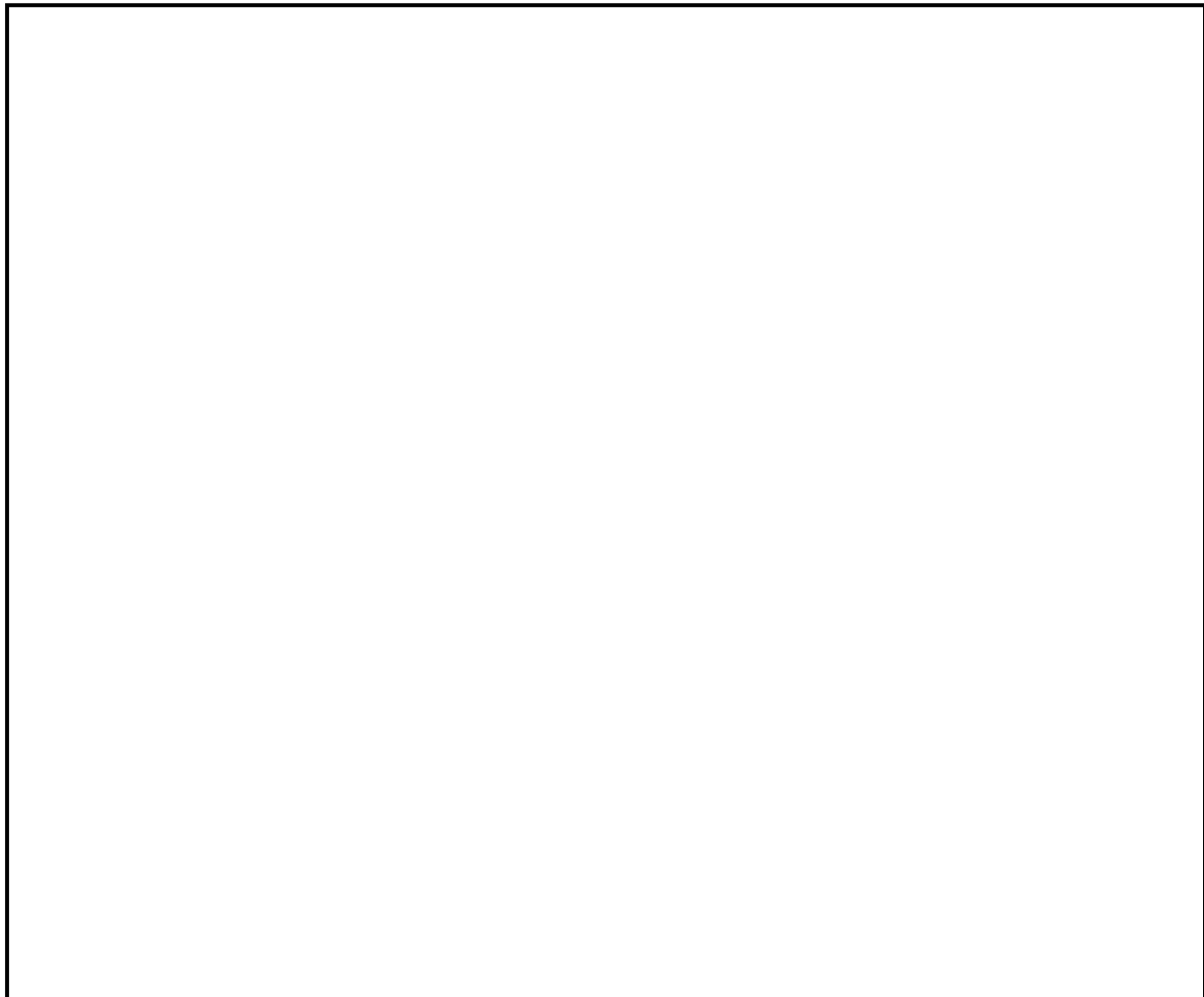
**NOTE:** During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan, may cause engine failure.

1. Remove the crankshaft front seal. REFER to: [Crankshaft Front Seal](#) .
2. Disconnect the oil pump electrical connector and the wire retainer.

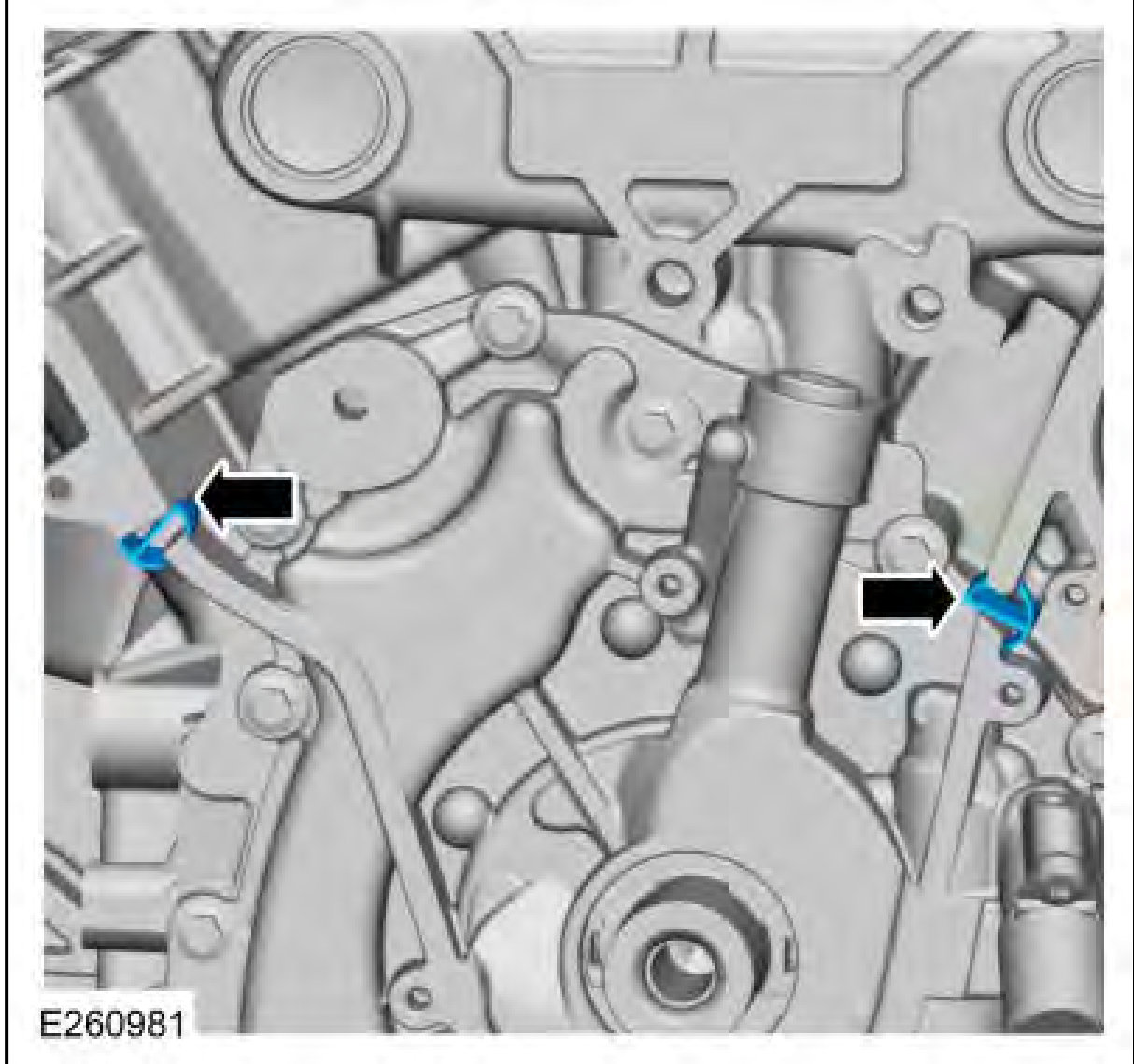




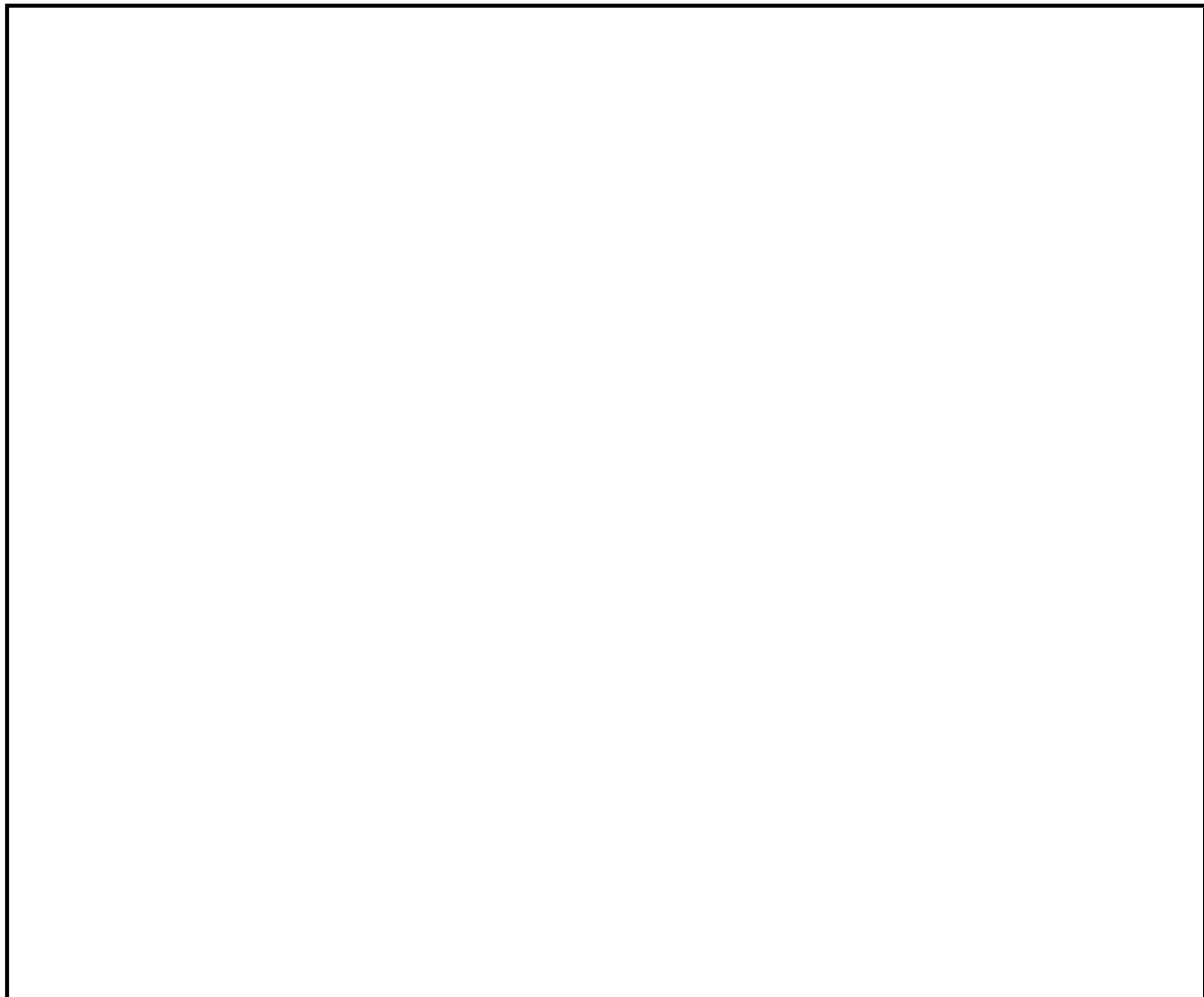
3. Remove the oil pump inserts.

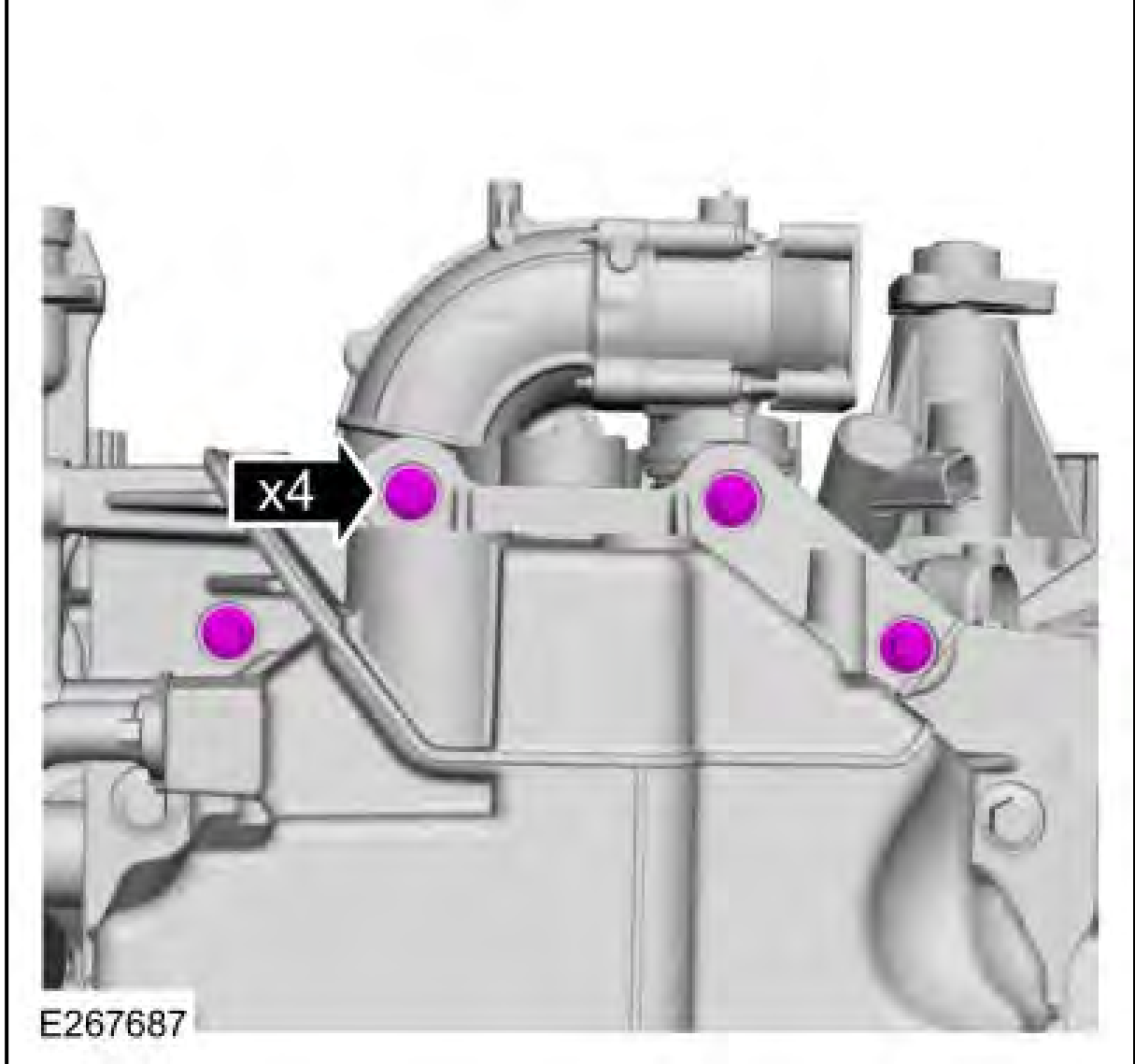






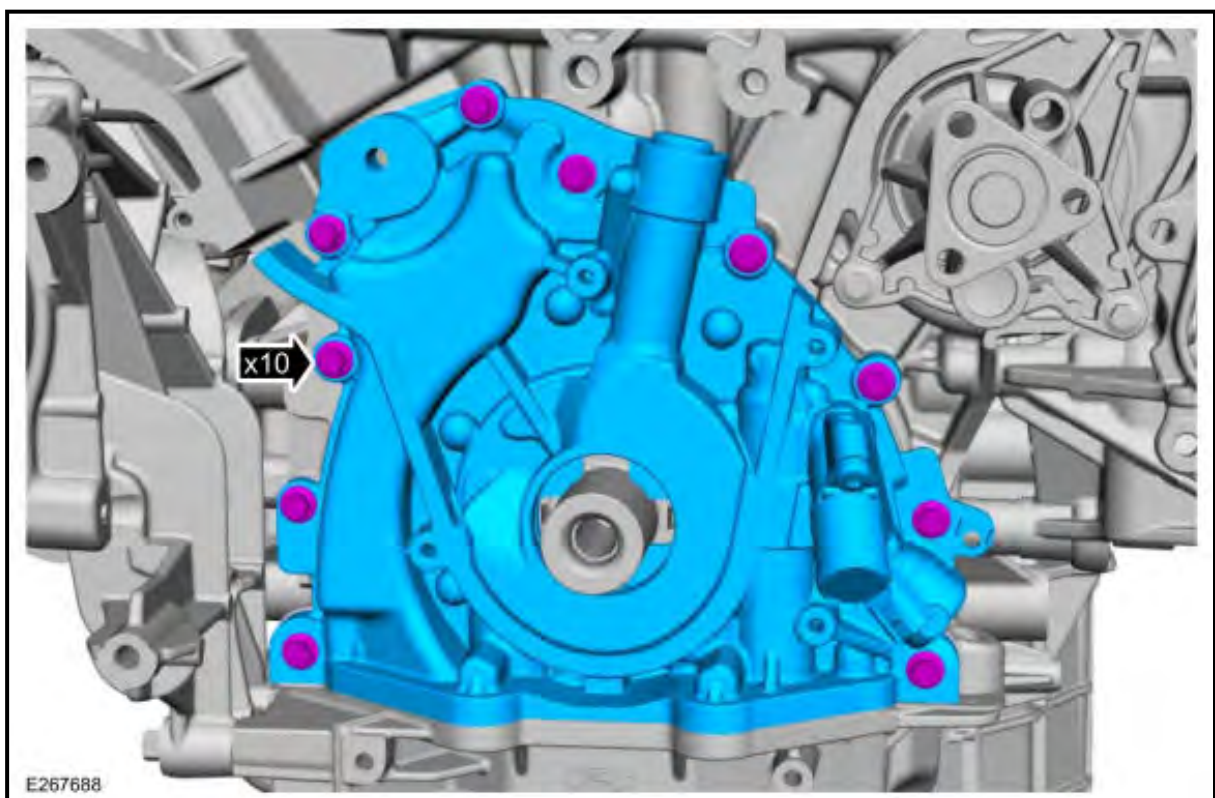
4. Remove the front oil pan bolts.



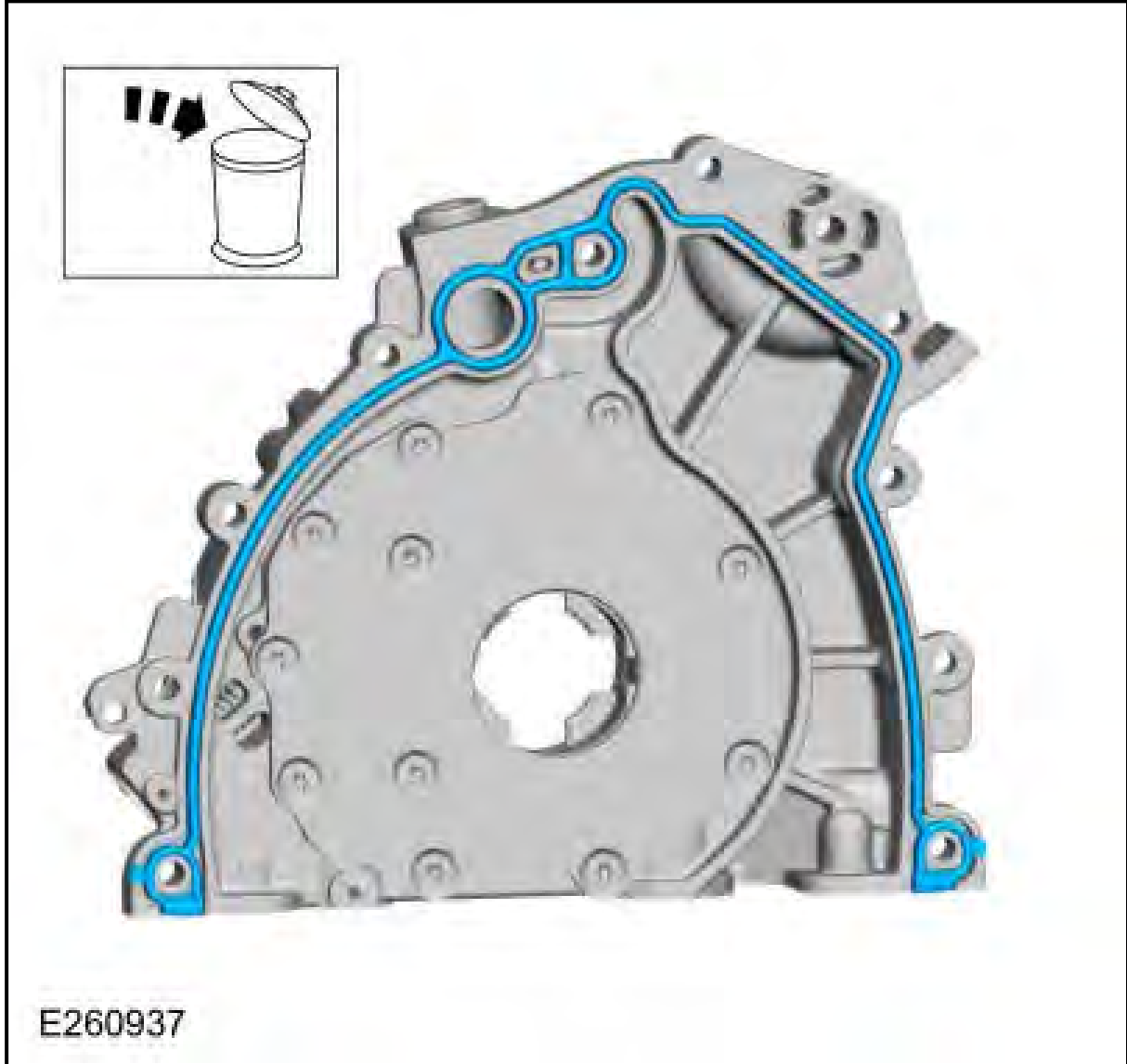


5. **NOTE:** Use care to not damage the engine block skirt stiffener gasket during removal and installation of the oil pump.

Remove the bolts and the oil pump.



6. Remove and discard the oil pump gasket.



7. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.

**NOTE:** Use care when cleaning around the engine block skirt stiffener gasket.

Clean and inspect the mating surface. REFER to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

Material: Motorcraft <sup>®</sup> Silicone Gasket Remover / ZC-30-A

Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B

Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

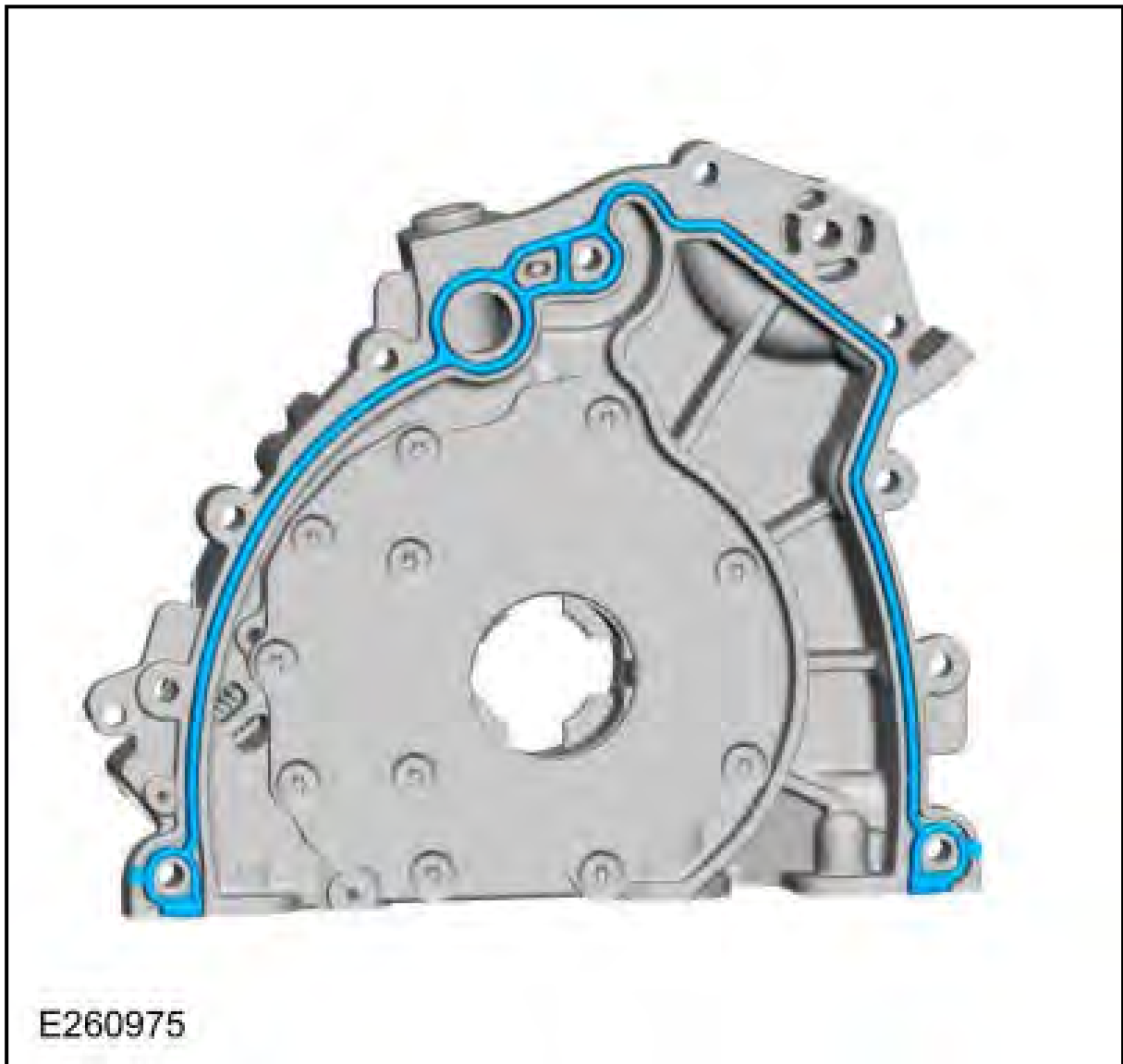
## INSTALLATION

1. **NOTE:** Only rotate the oil pump in the clockwise direction when viewed from the front. Counter clockwise rotation will cause damage to the oil pump assembly.

Prime the oil pump. Add 2 tablespoons of clean engine oil to the oil pump and rotate the oil pump by hand.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

2. Install a new oil pump gasket.

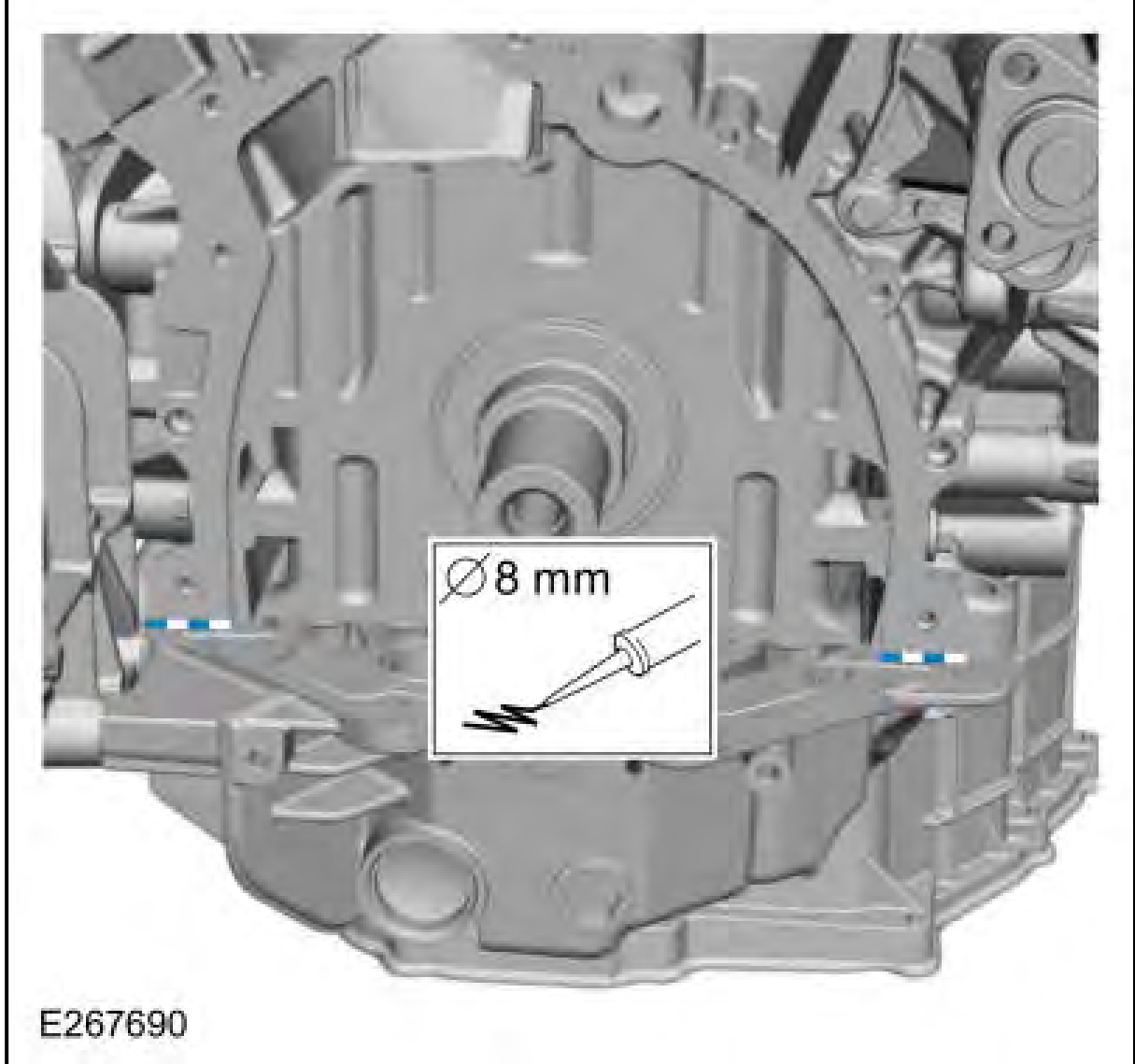


3. **NOTE:** The oil pump must be installed within 10 minutes of applying the sealer. Final tightening of the bolts must be completed within 60 minutes of applying the sealer. Failure to follow this procedure can cause future oil leakage.

Apply a bead of Motorcraft <sup>®</sup> High Performance Engine RTV Silicone to the cylinder block.

Material: Motorcraft <sup>®</sup> High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



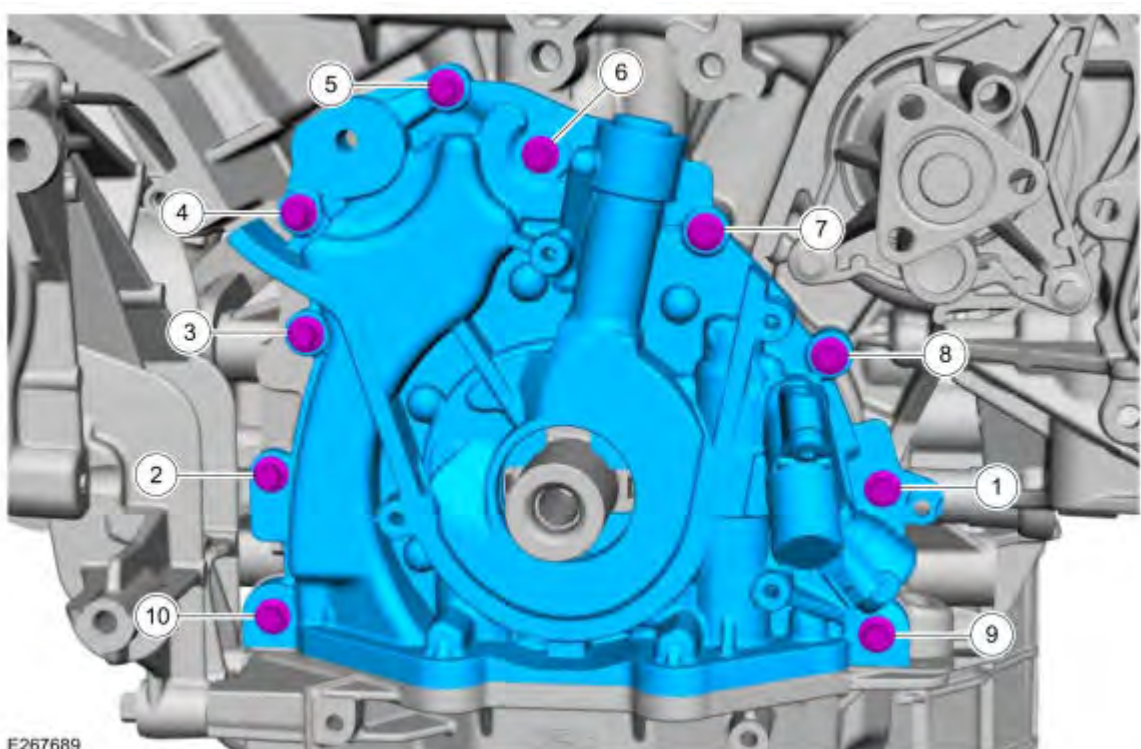


4. Install the oil pump and the bolts.

Torque:

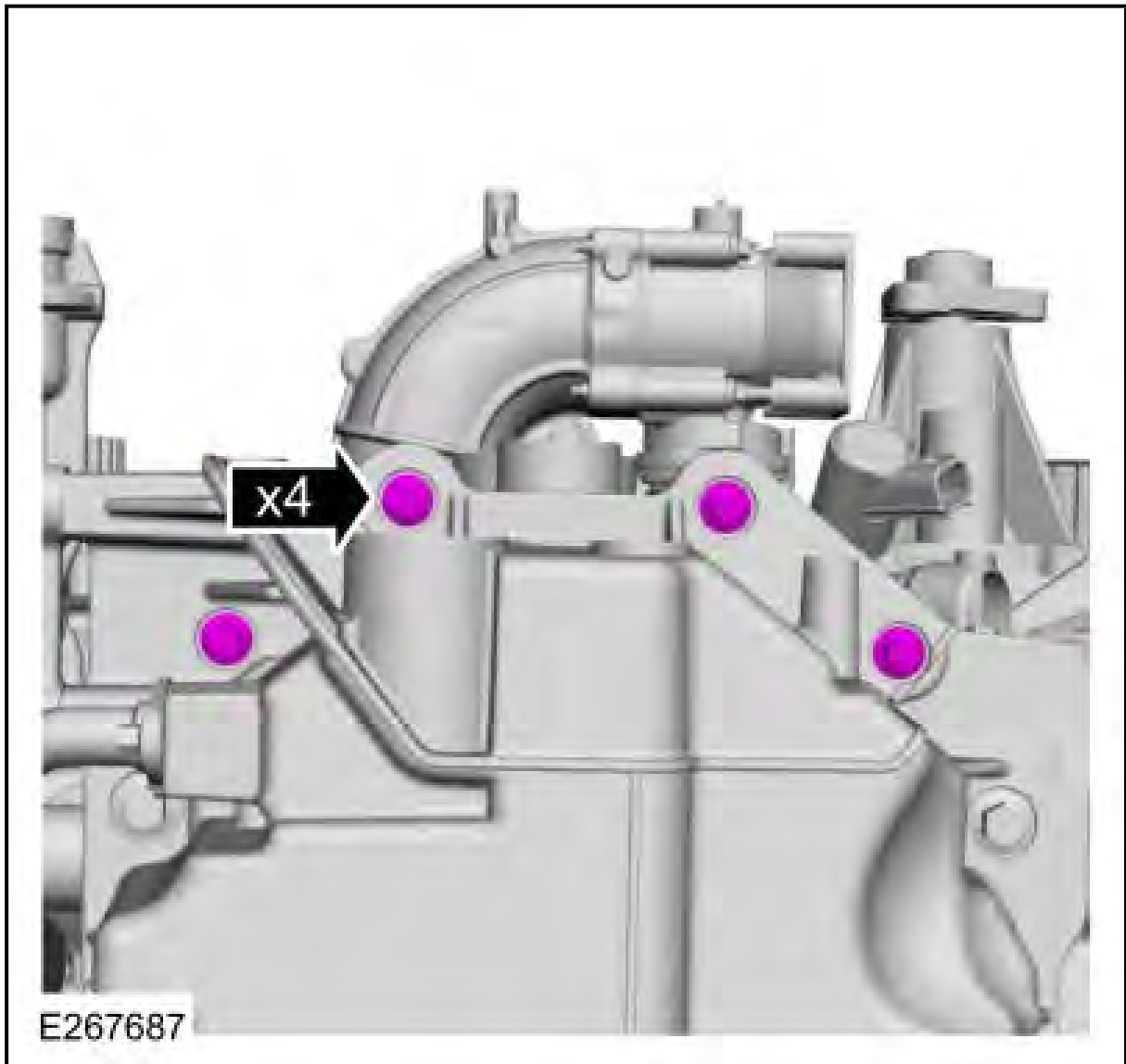
Torque all bolts to : 89 lb.in (10 Nm)

Retorque bolts 1, 2 and 3 to:: 89 lb.in (10 Nm)



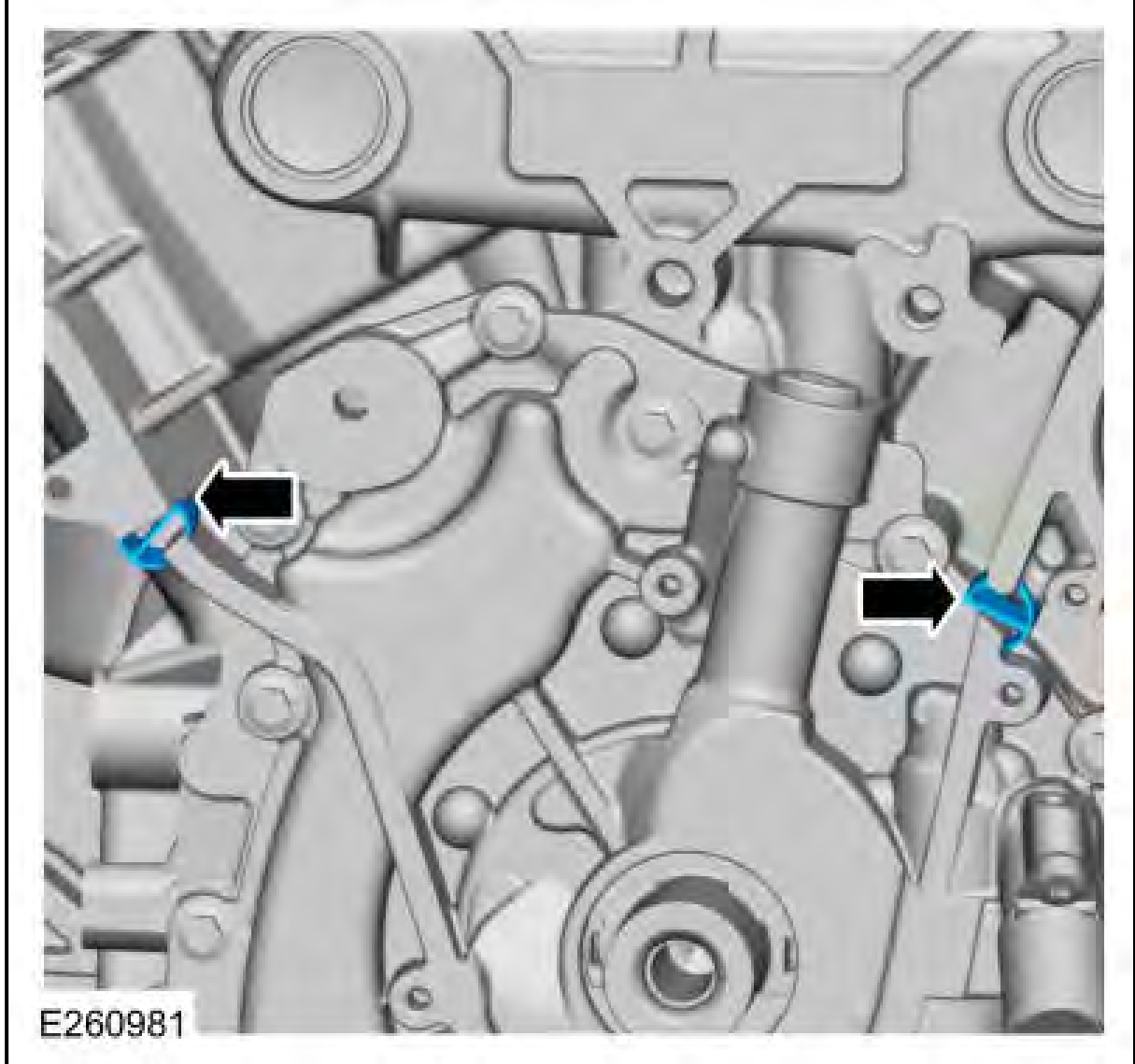
5. Install the front oil pan bolts.

Torque: 89 lb.in (10 Nm)

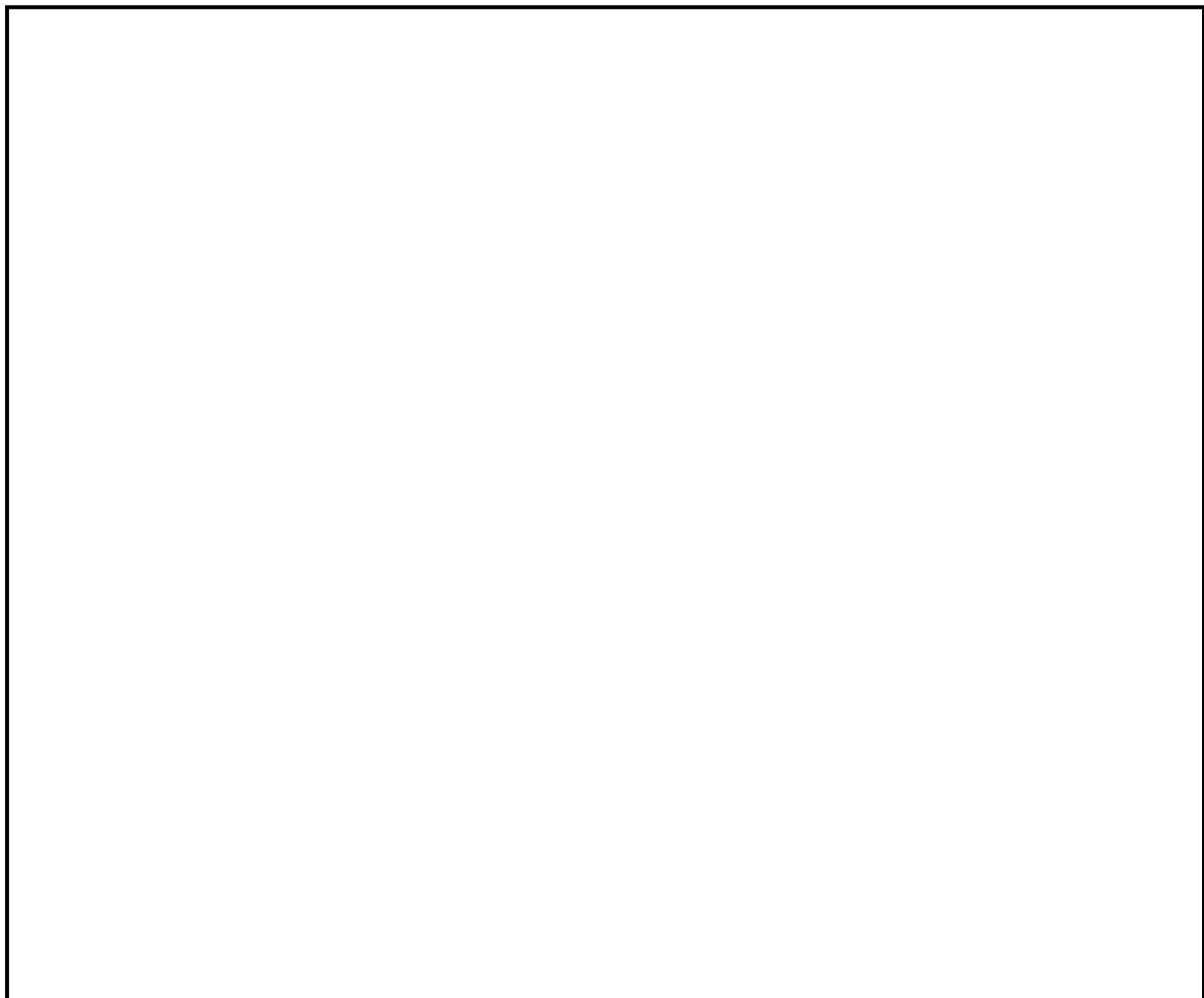


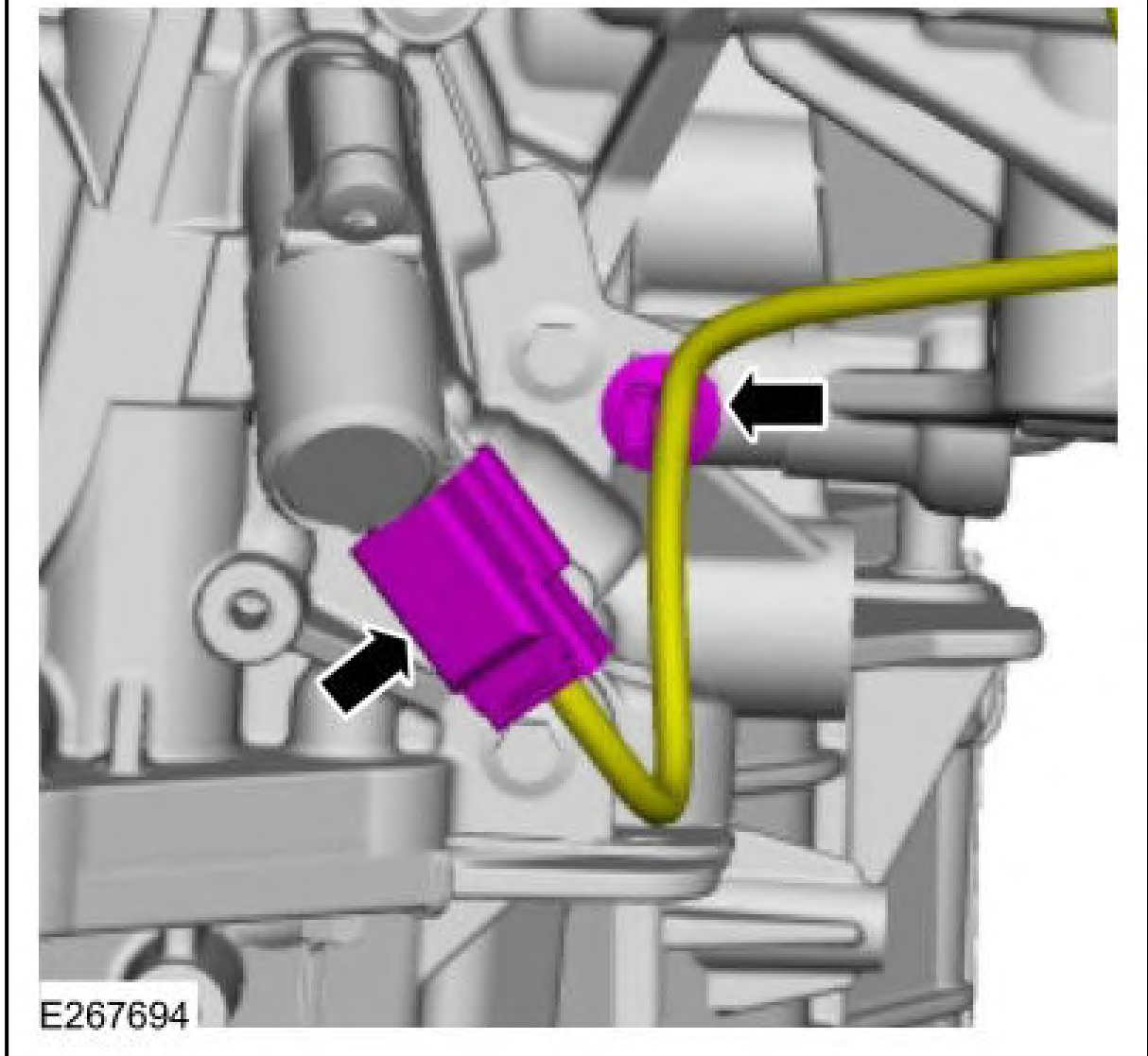
6. Install the oil pump inserts.





7. Connect the oil pump electrical connector and the wire retainer.





8. Install the crankshaft front seal. REFER to: [Crankshaft Front Seal](#) .

### **OIL PUMP SCREEN AND PICKUP TUBE**

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

#### **Materials**

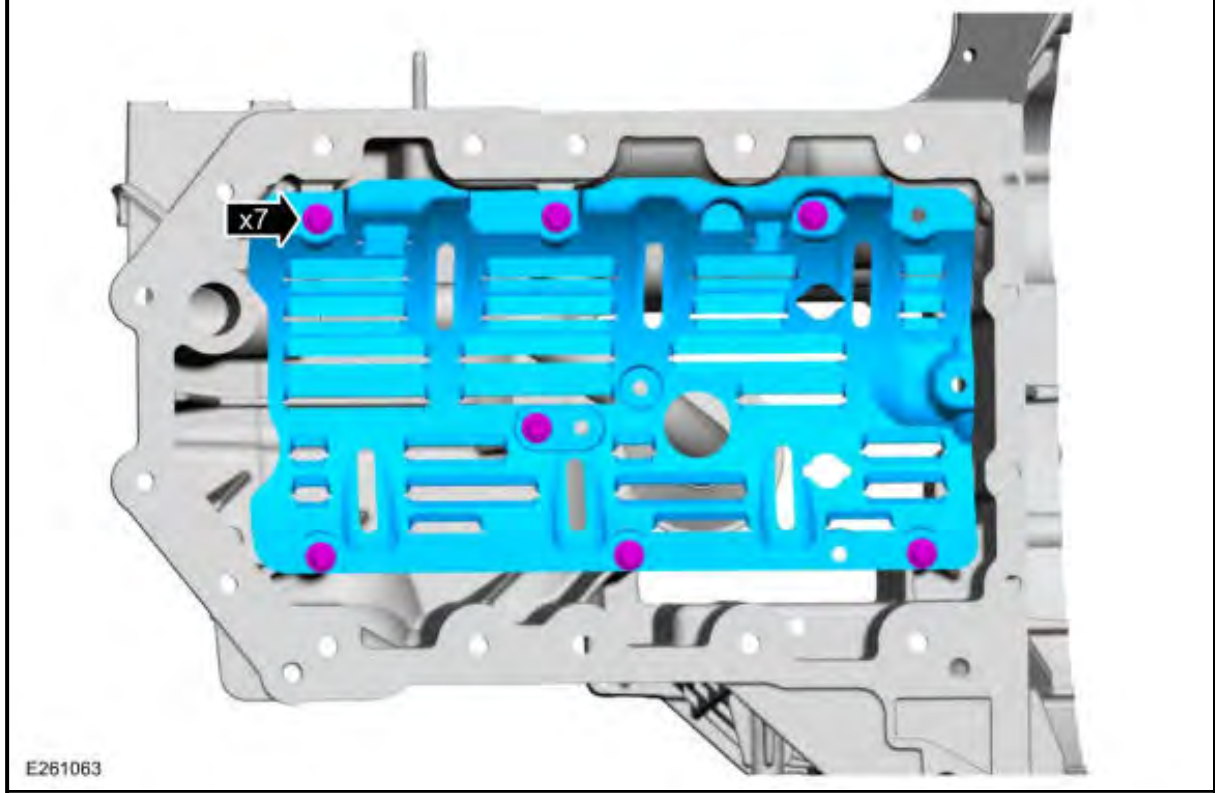
| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA | WSS-M2C214-B1 |

#### **REMOVAL**

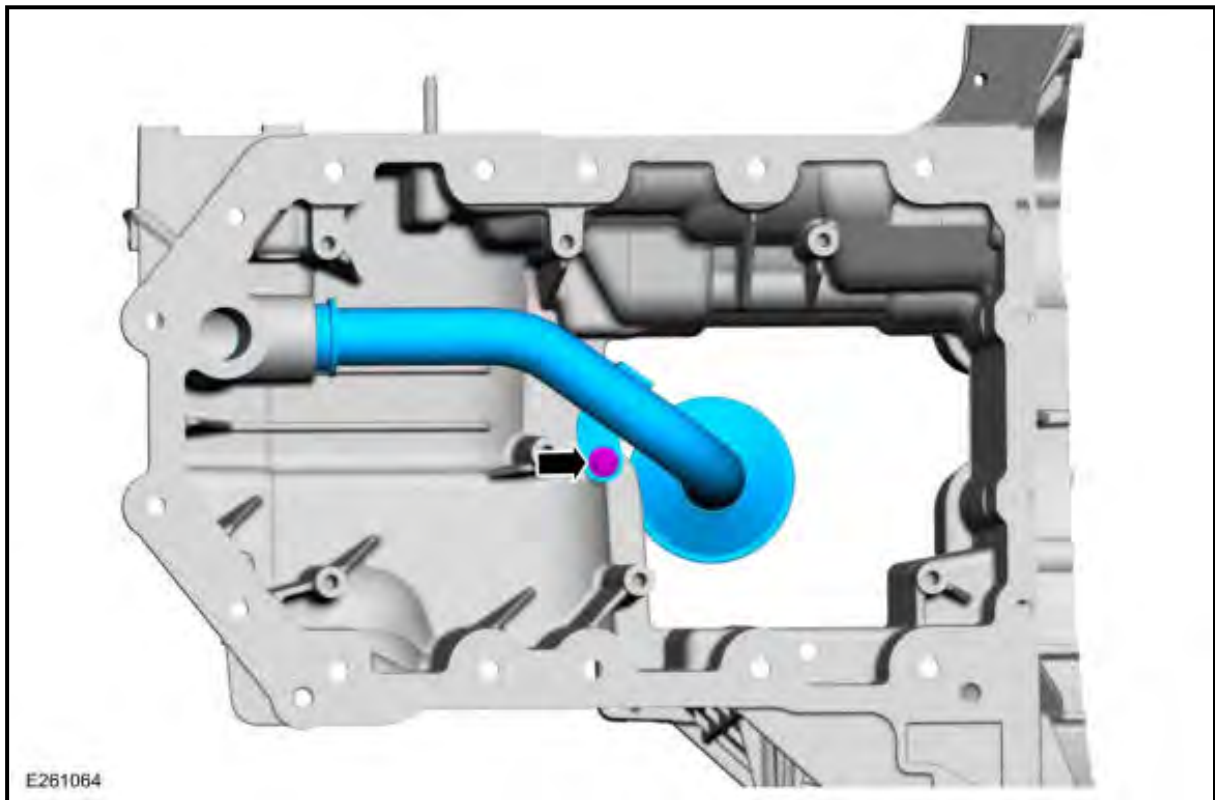
1. Remove the engine block skirt stiffener. REFER to: [Engine Block Skirt Stiffener](#) .
2. Remove the bolts and the oil pan baffle.





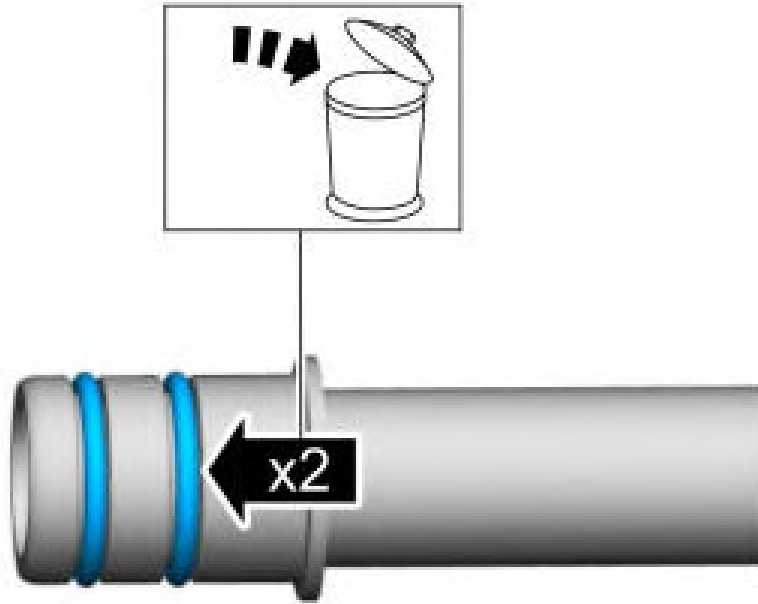


3. Remove the bolt and the oil pump screen and pickup tube.



4. Remove and discard the O-ring seals.





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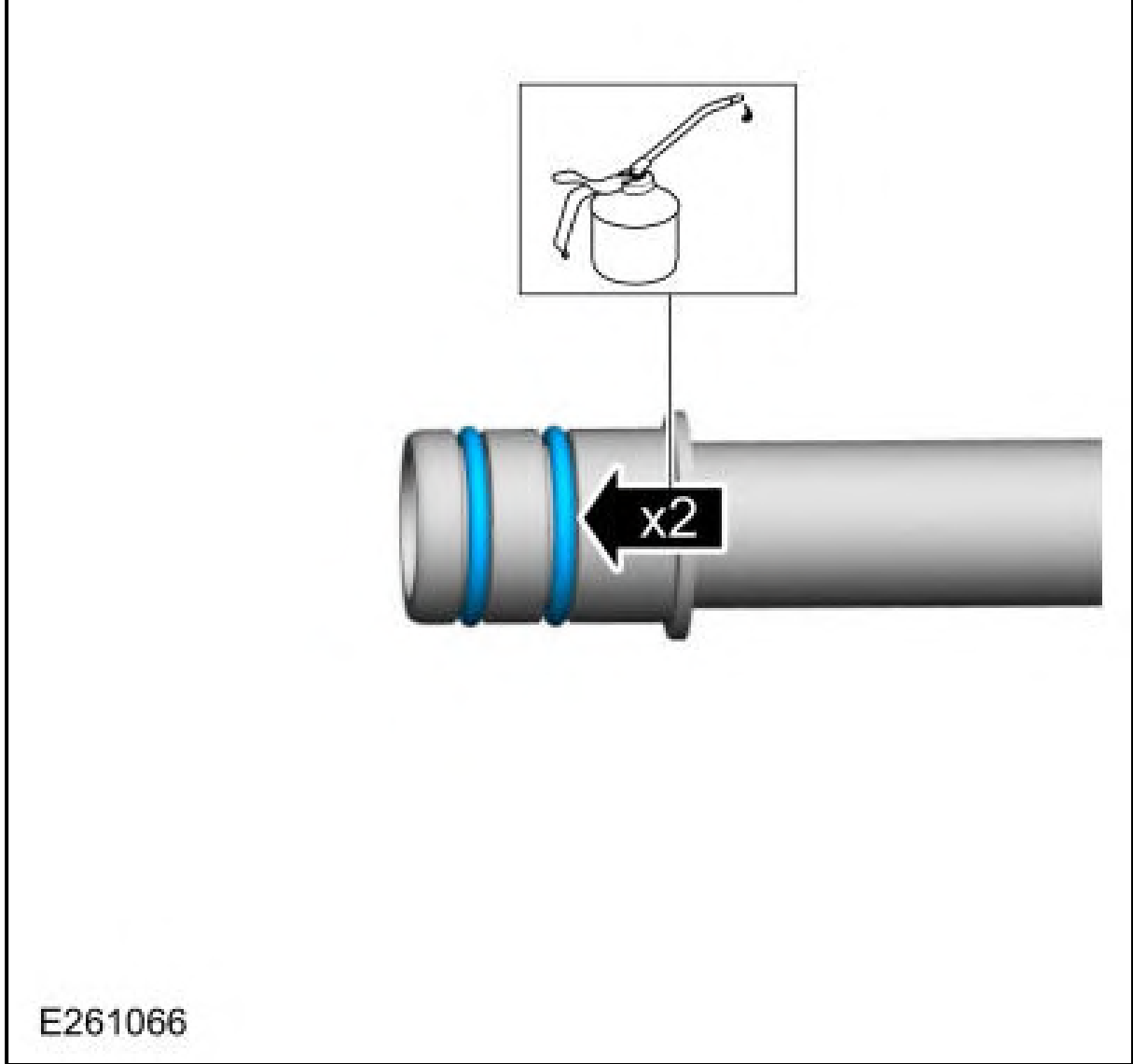
## INSTALLATION

1. **NOTE:** Apply clean engine oil to the O-ring seals prior to installing the oil pump screen and pickup tube.

Install new O-ring seals.

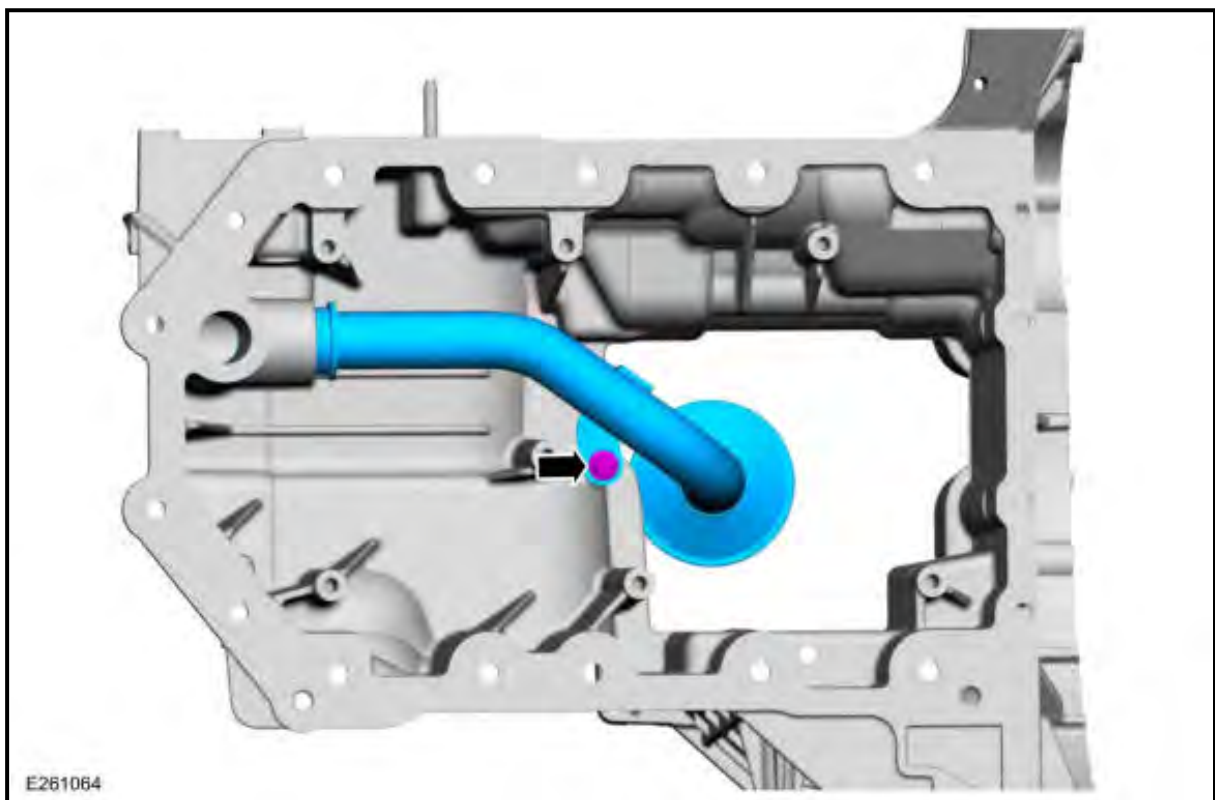
Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)





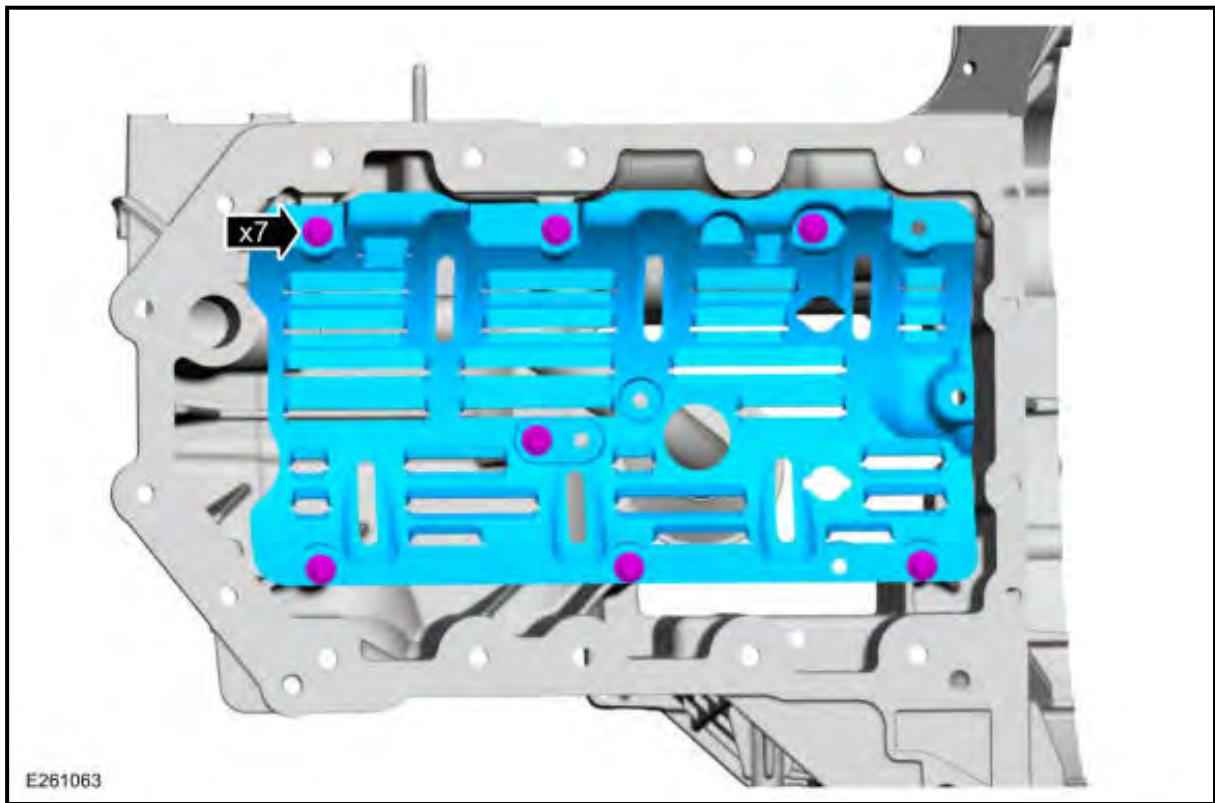
2. Install the oil pump screen and pickup tube and bolt.

Torque: 124 lb.in (14 Nm)



3. Install the oil pan baffle and bolts.

Torque: 124 lb.in (14 Nm)


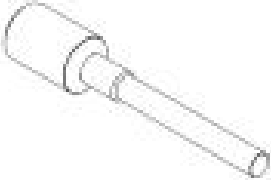


4. Install the engine block skirt stiffener. REFER to: [Engine Block Skirt Stiffener](#) .

## TIMING BELT

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

### Special Tool(s) / General Equipment

|  |   |
|--|---|
|  <p>E274086</p> | <p>303-1670 Pins, Camshaft Locking</p>  |
|  <p>E274087</p> | <p>303-1671 Pin, Locking Crankshaft</p> |

## REMOVAL

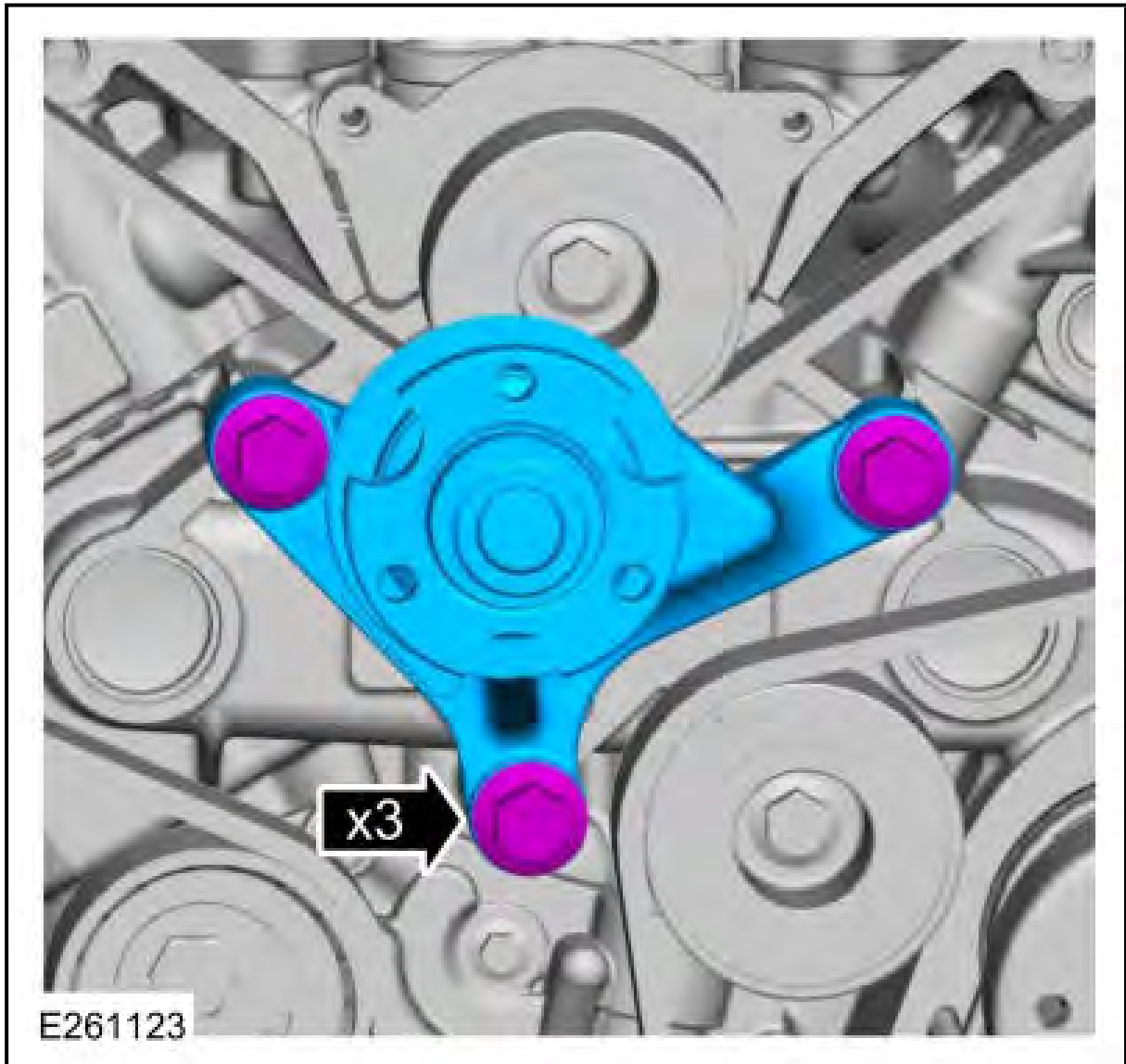
**NOTE:** The crankshaft or camshaft must not be rotated while the timing belt is removed.

1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Disconnect the battery ground cable. REFER to: [Battery Disconnect and Connect](#) .
3. Remove the following items:

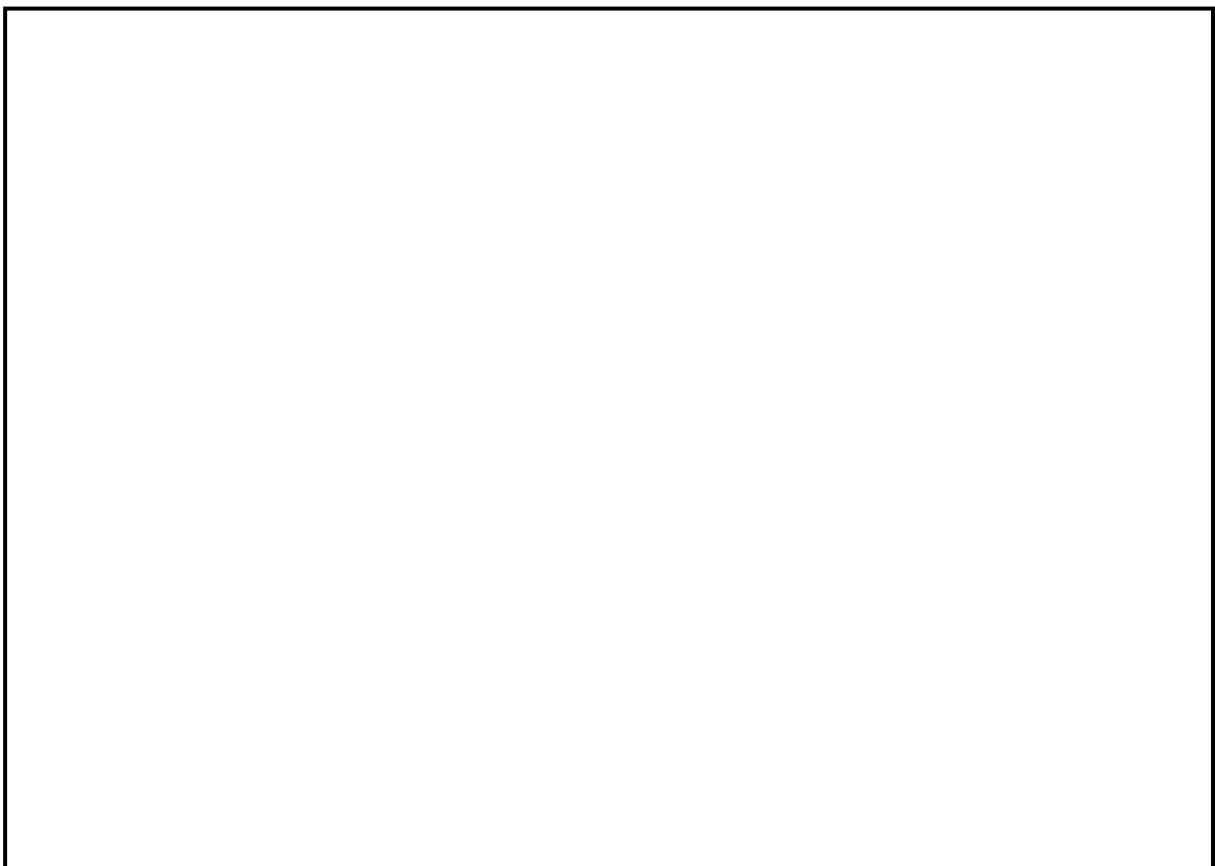
1. Remove the timing belt cover. REFER to: [Timing Belt Cover](#) .

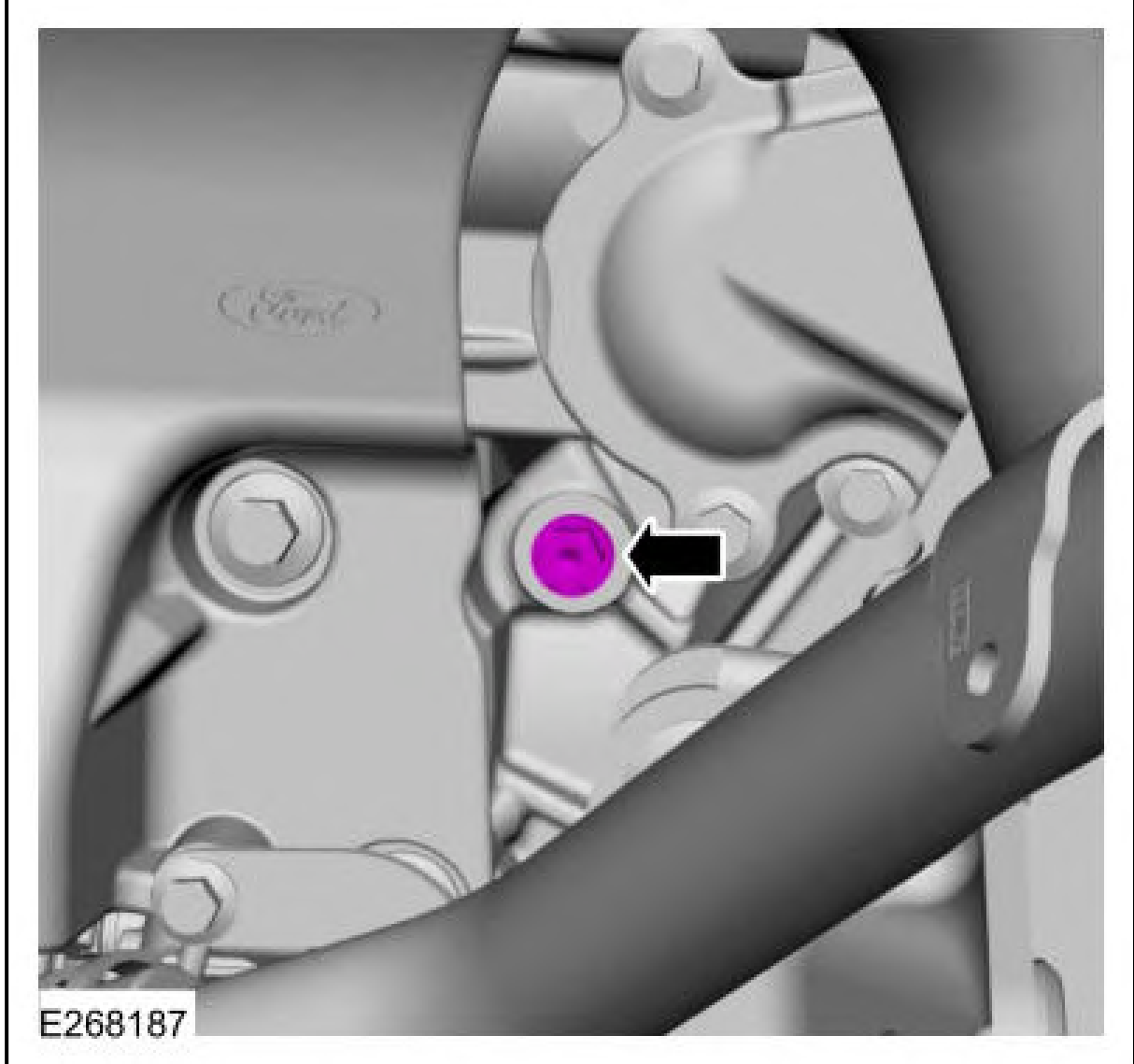
2. Remove the generator. REFER to: [Generator - 3.0L Power Stroke Diesel](#) .

4. Remove the bolts and the fan drive.



5. Remove the timing pin bolt at the left front of the engine.



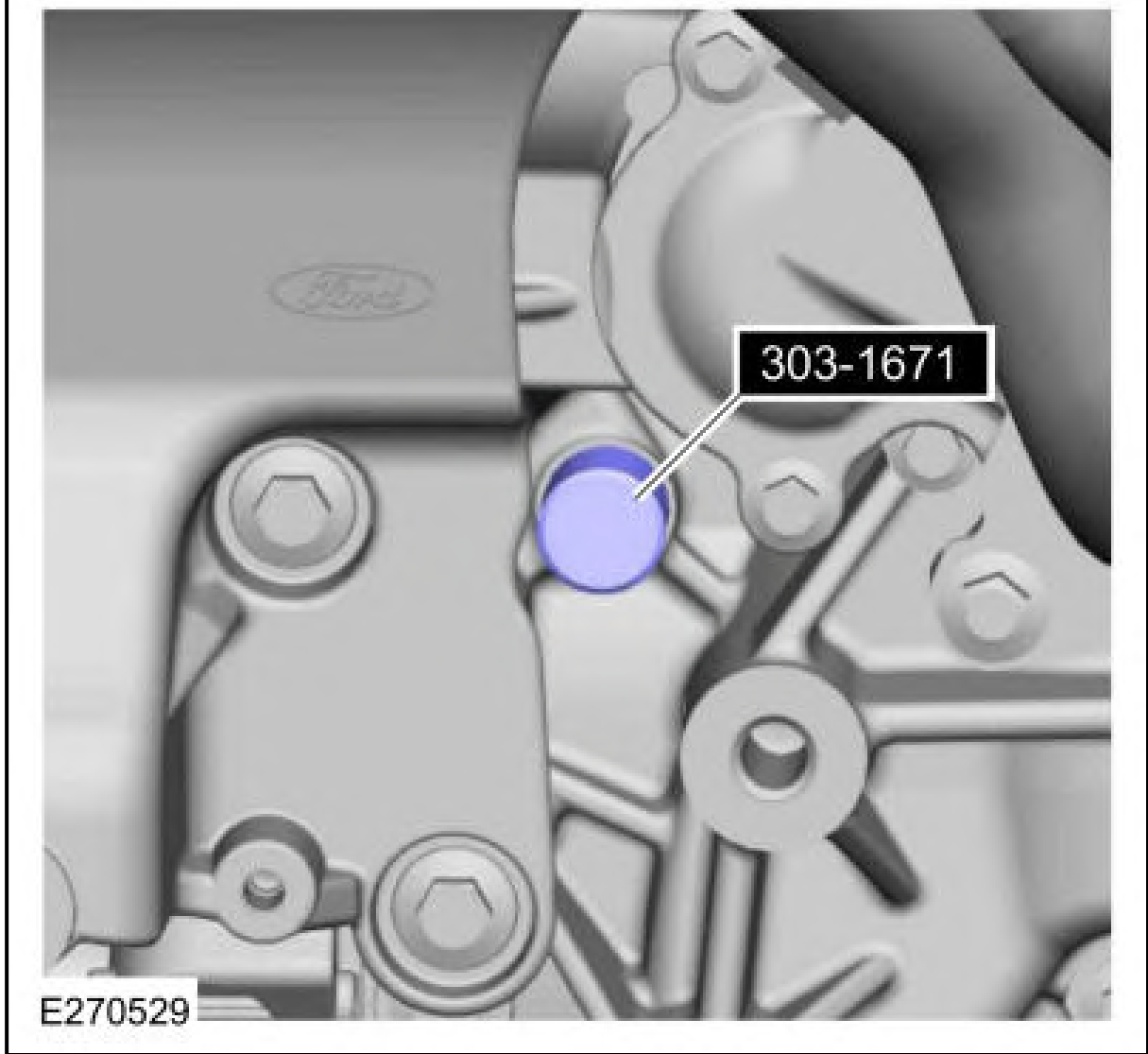


6. Install special tool.

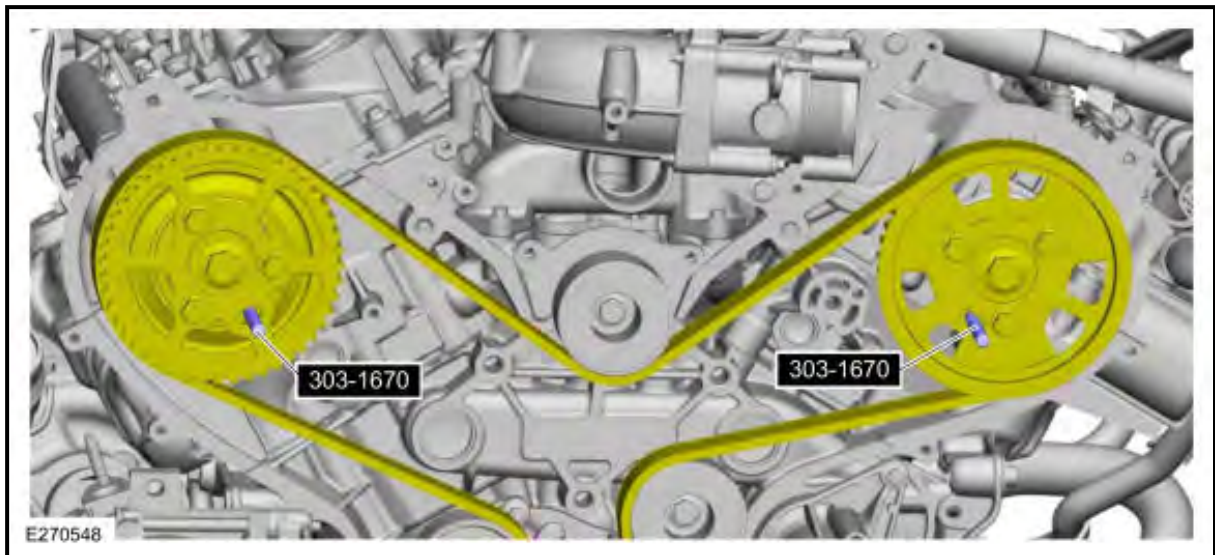
- **NOTE:** Only rotate the crankshaft clockwise.
- NOTE:** Verify that the camshaft timing holes are aligned with the cylinder head.
- NOTE:** The Locking Crankshaft Pin must be bottomed out against the cylinder block.

Rotate the crankshaft clockwise so the crankshaft contacts the locking crankshaft pin. Use Special Service Tool: 303-1671 Pin, Locking Crankshaft.





7. Install Special Service Tool: 303-1670 Pins, Camshaft Locking.



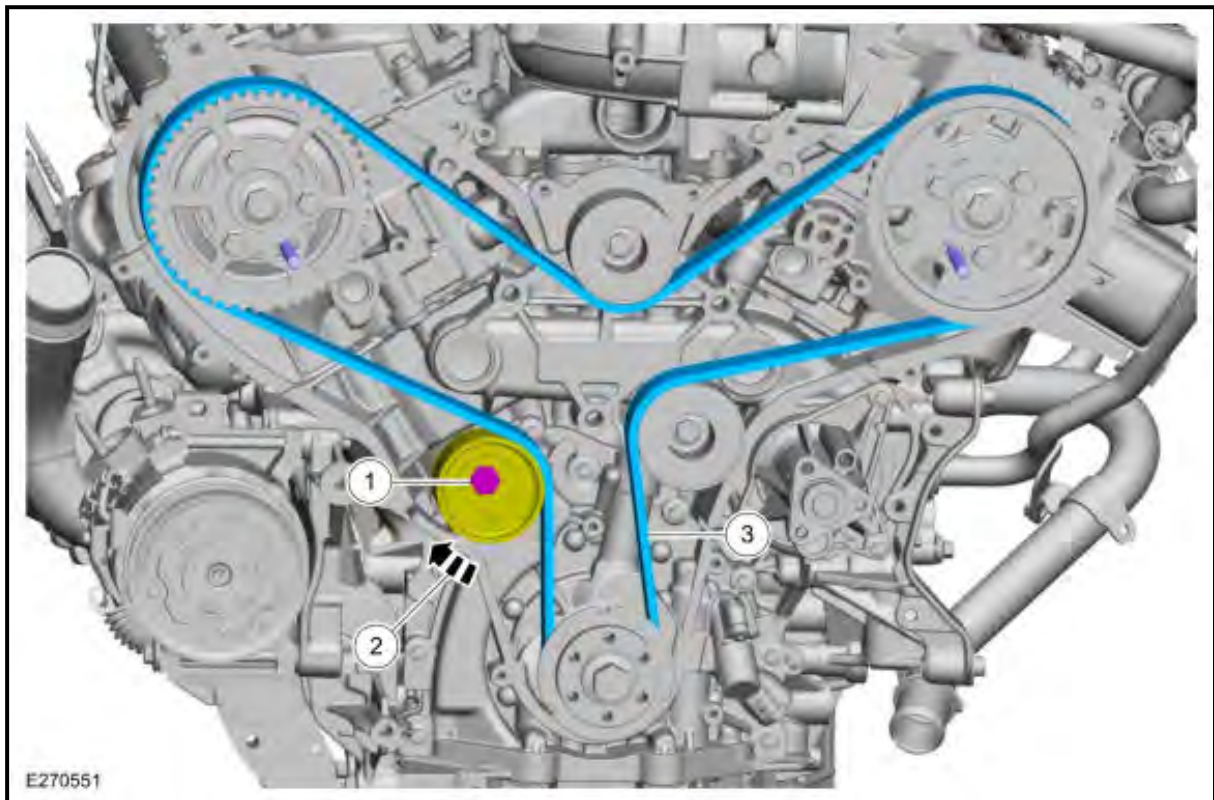
8. Loosen the camshaft pulley bolts.





9.

1. Loosen the timing belt tensioner bolt.
2. Rotate the timing belt tensioner clockwise.
3. Remove the timing belt.

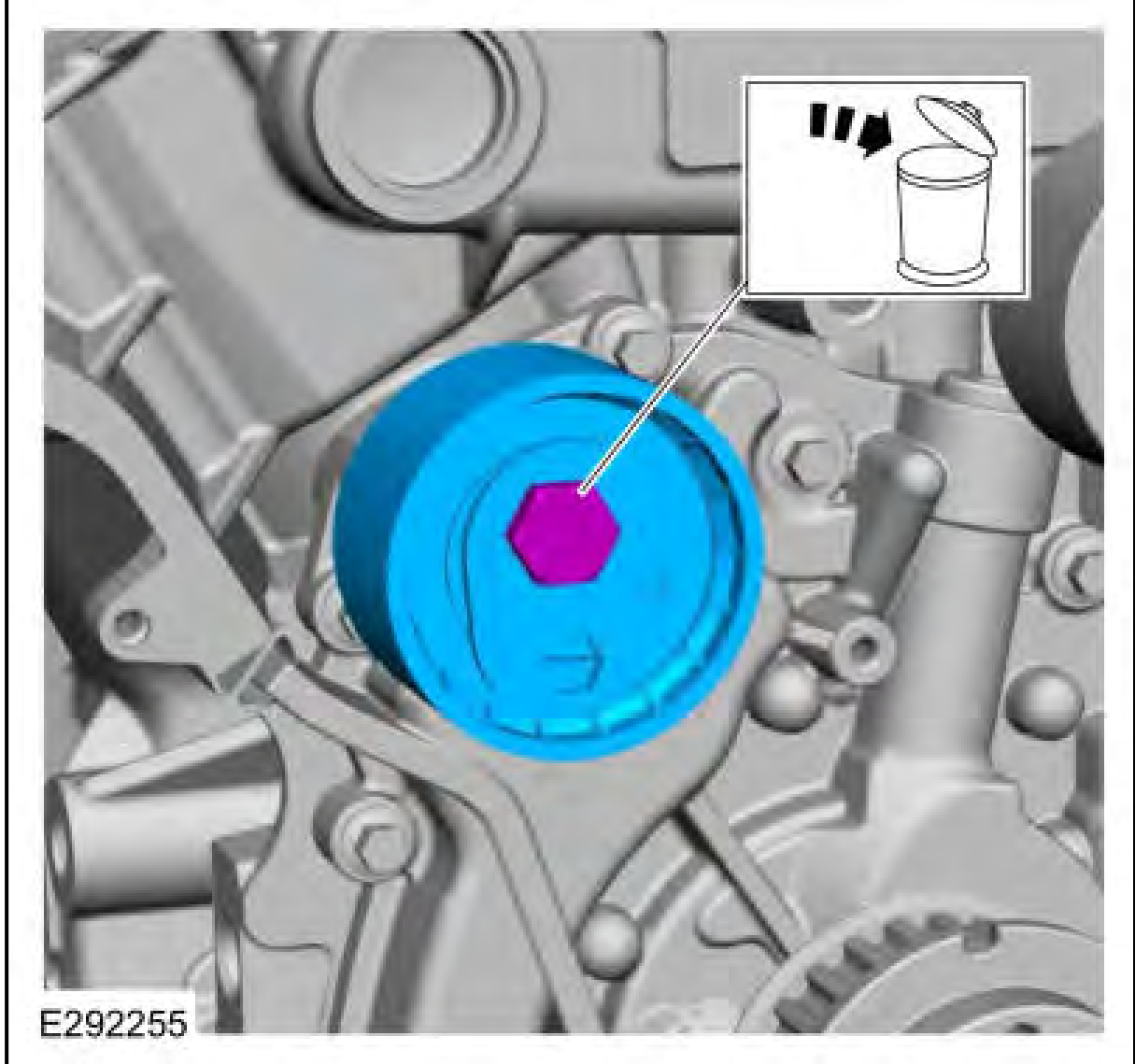


10. **NOTE:** Replace the timing belt tensioner if damage or excessive wear is found.

Remove the bolt and the timing belt tensioner. Discard the bolt.

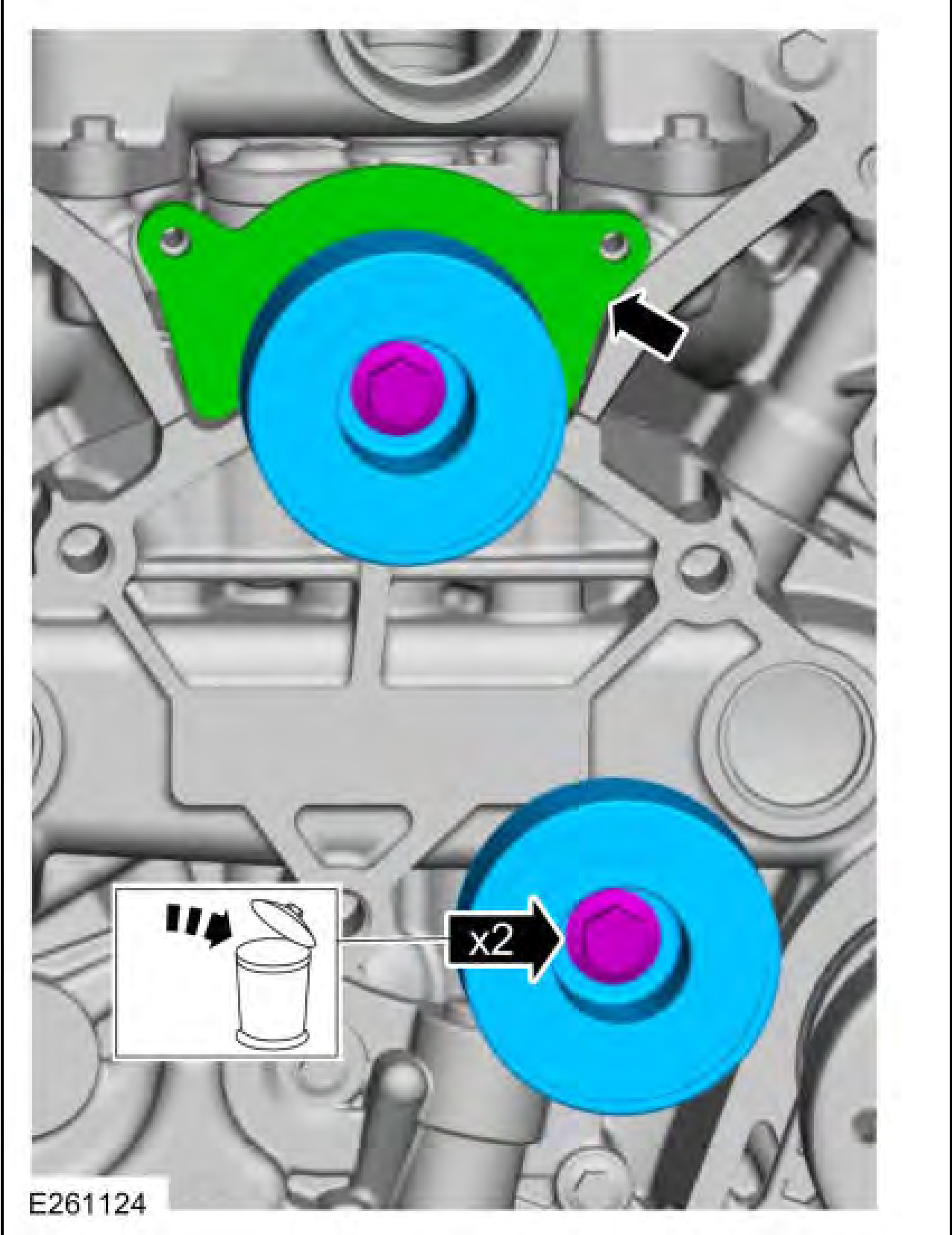






11. **NOTE:** Only remove the timing belt idler pulleys if damage or excessive wear is found.

Remove the bolts and the timing belt idler pulleys. Remove the dust shield. Discard the bolts.



## INSTALLATION

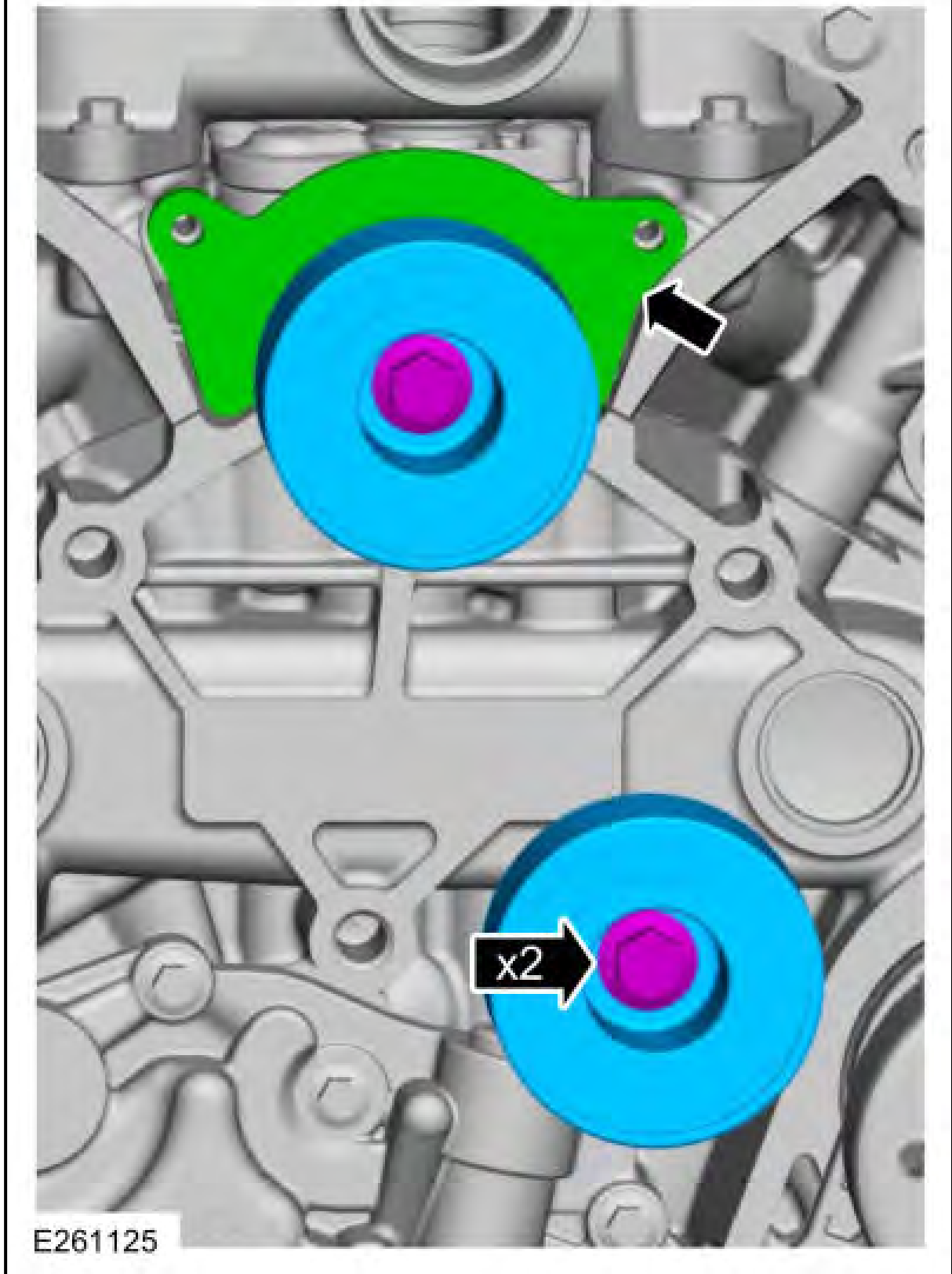
1. Install the dust shield. Install the timing belt idler pulleys and the bolts.

Torque:

Stage 1: 177 lb.in (20 Nm)

Stage 2: 45 Â°

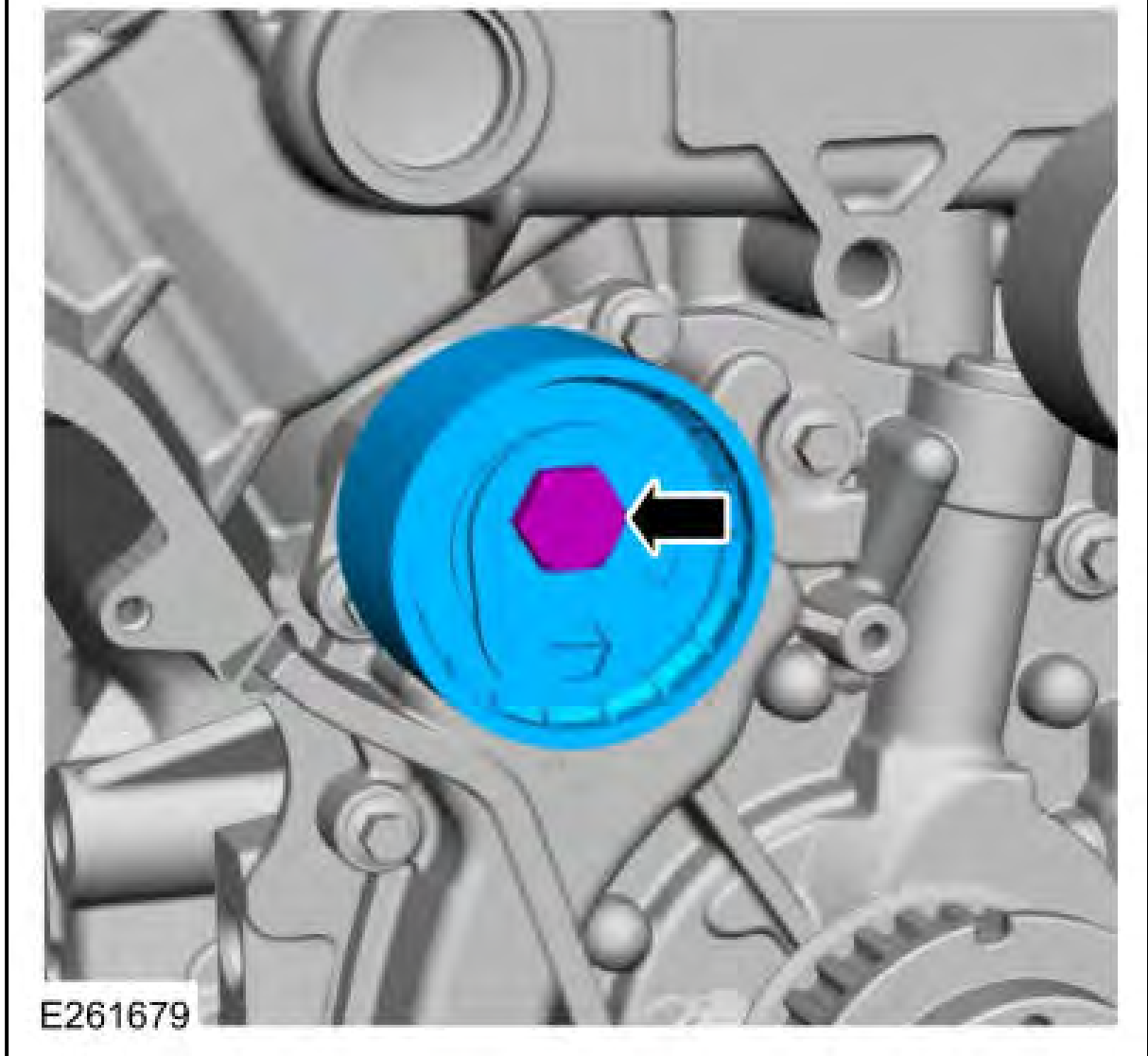




2. **NOTE:** Only tighten the bolt finger tight at this stage.

Install the bolt and the timing belt tensioner.





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

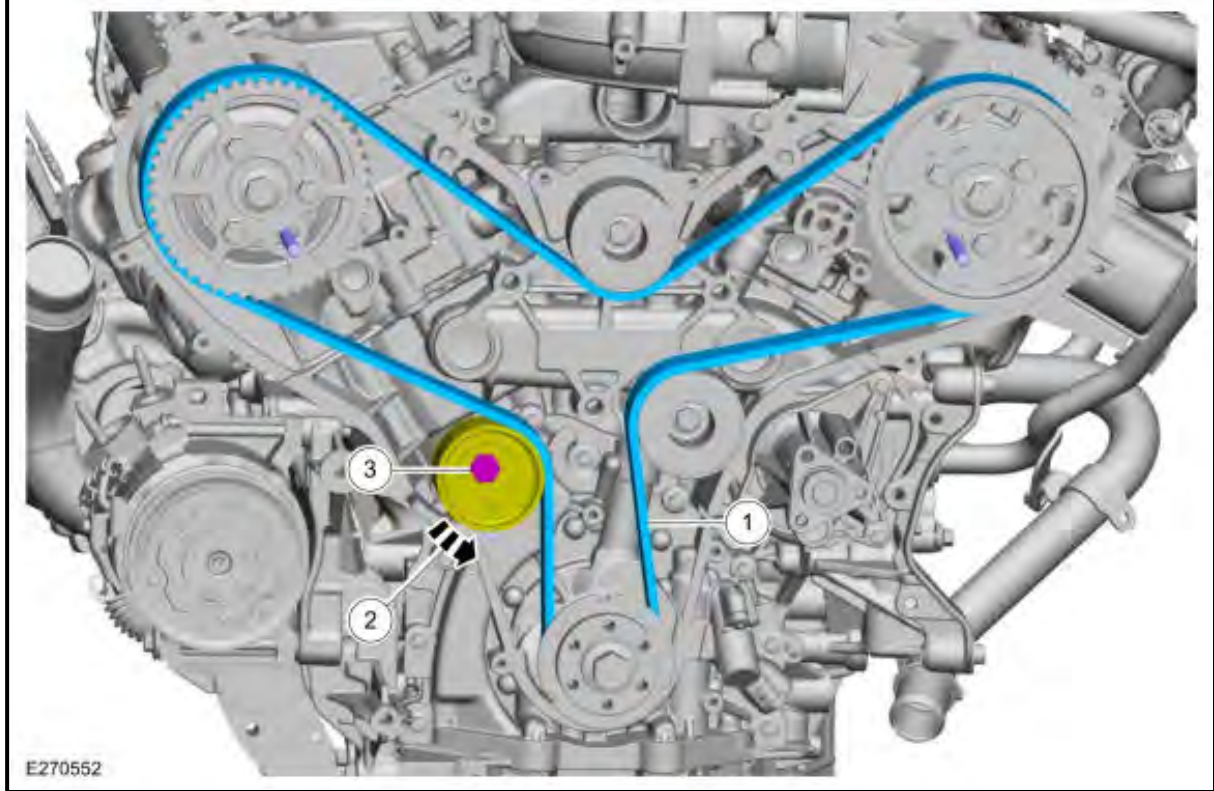
**NOTE:** It may be necessary to rotate the camshaft pulleys slightly to ensure the bolts are not at the end of the slots.

1. Install the timing belt.
2. Rotate the timing belt tensioner.
3. Tighten the timing belt tensioner bolt.

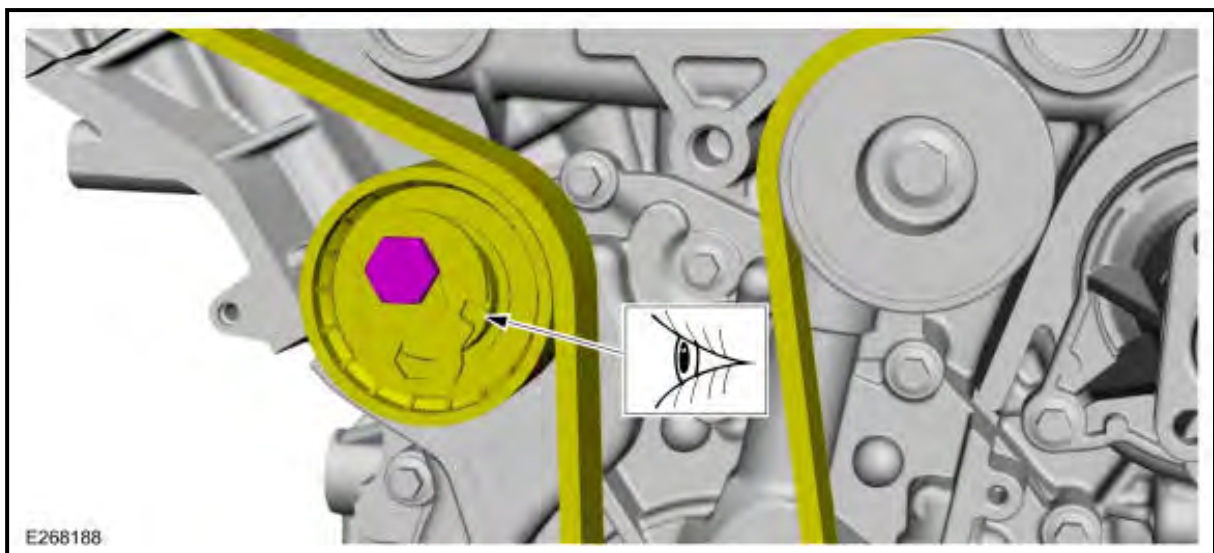
Torque:

Stage 1: 177 lb.in (20 Nm)

Stage 2: 45 Å°

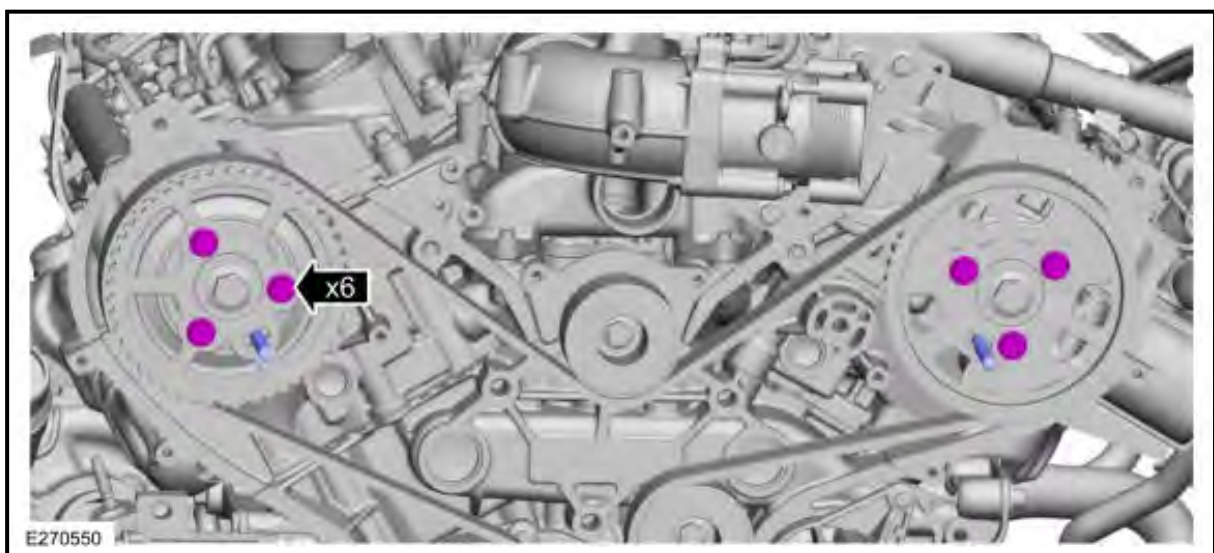


4. If the timing belt tensioner pointer is not visible in the window, the timing belt tensioning step must be repeated.

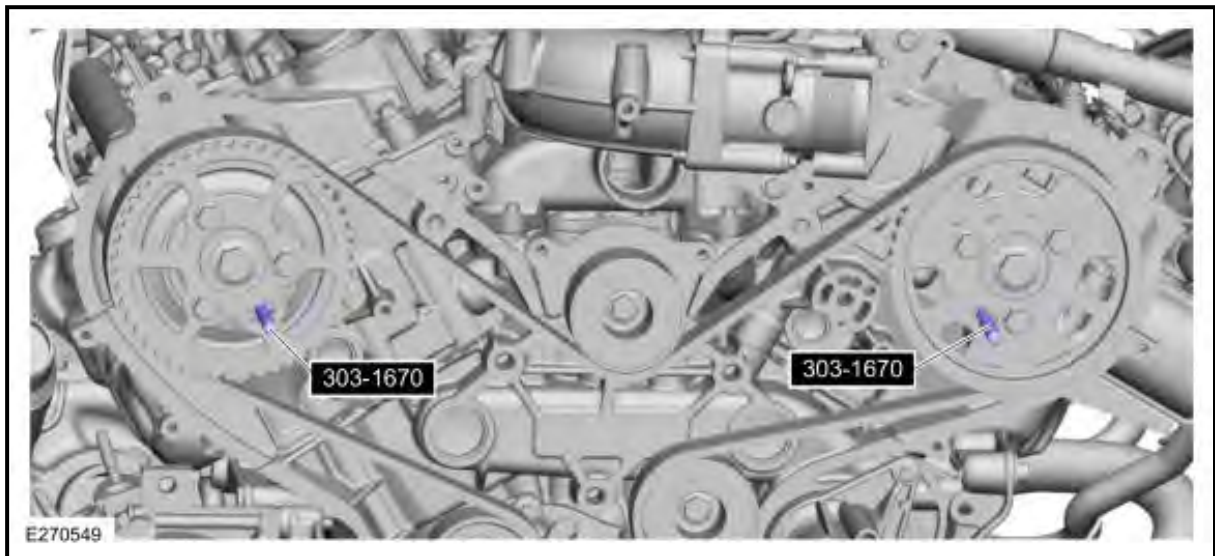


5. Tighten the camshaft pulley bolts.

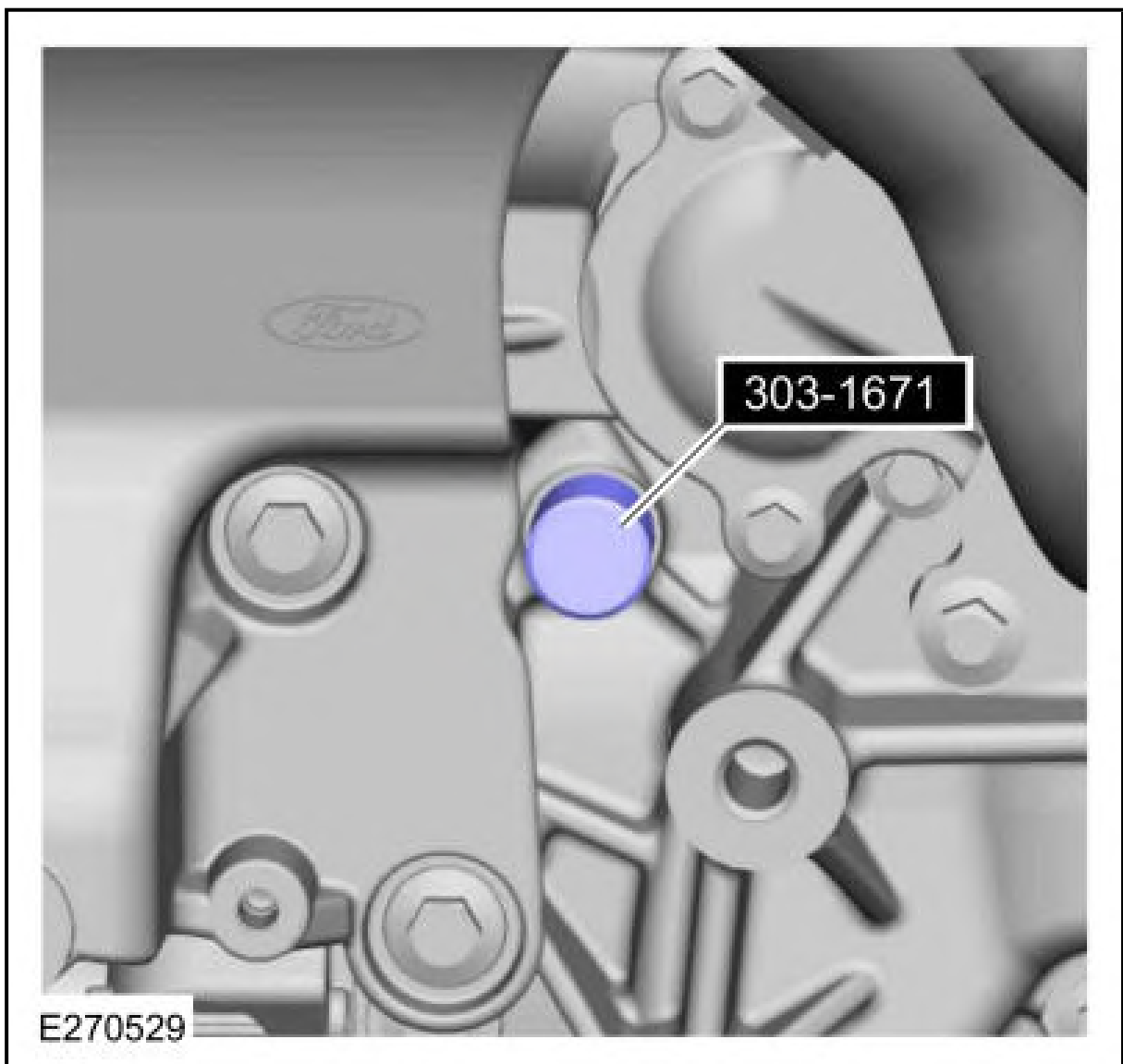
Torque: 17 lb.ft (23 Nm)



6. Remove Special Service Tool: 303-1670 Pins, Camshaft Locking.



7. Remove Special Service Tool: 303-1671 Pin, Locking Crankshaft.



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

This step is to verify that the timing is correct. Rotate the engine  $1 \frac{7}{8}$  revolutions.

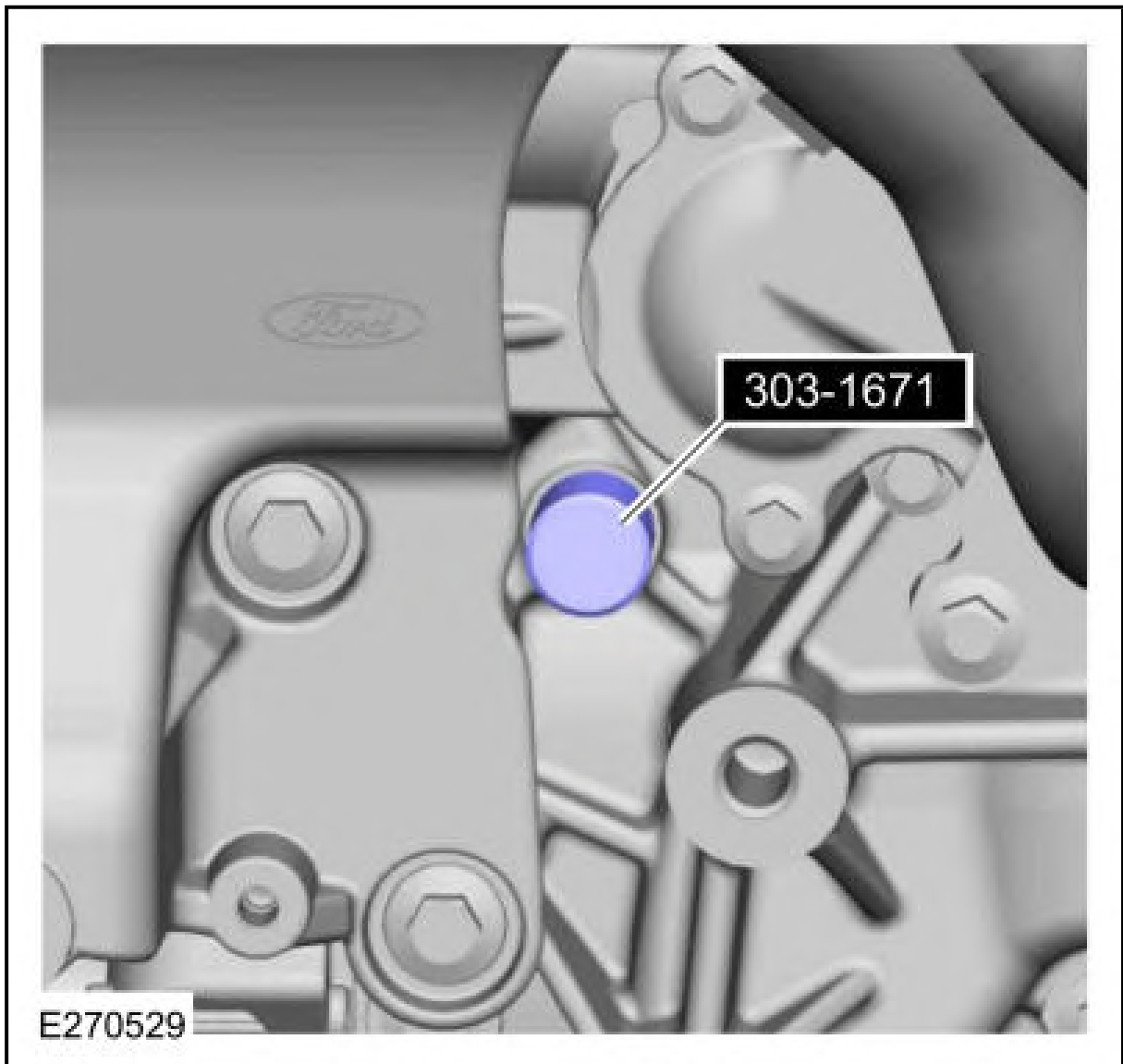
9. Install special tool.

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

**NOTE:** The Locking Crankshaft Pin must be bottomed out against the

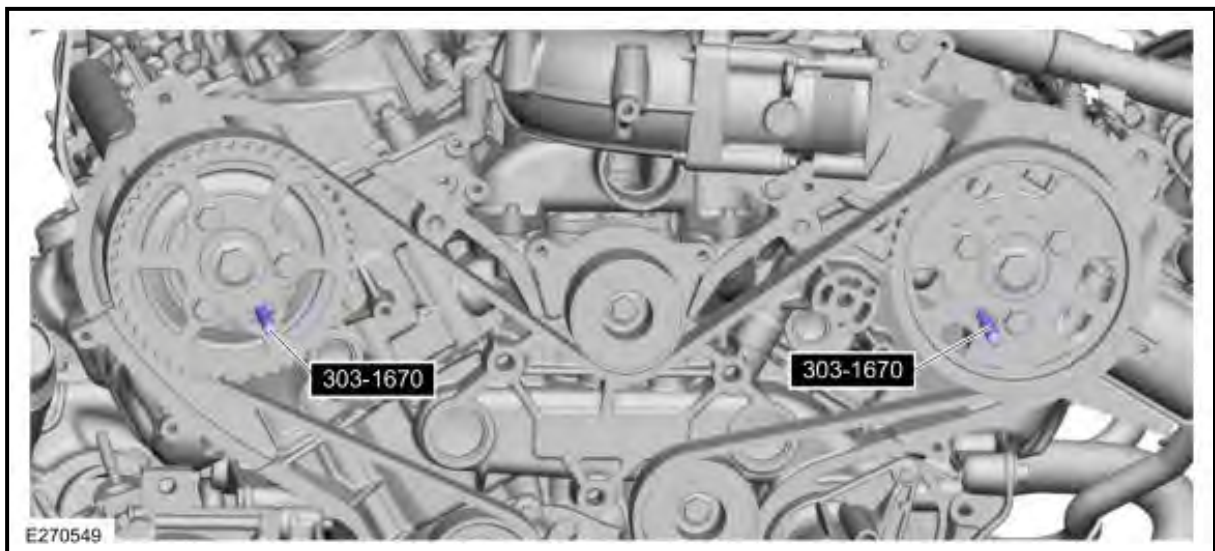
**cylinder block.**

Rotate the crankshaft clockwise so the crankshaft contacts the locking crankshaft pin. Install Special Service Tool: 303-1671 Pin, Locking Crankshaft.

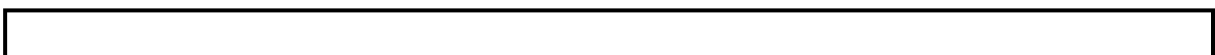


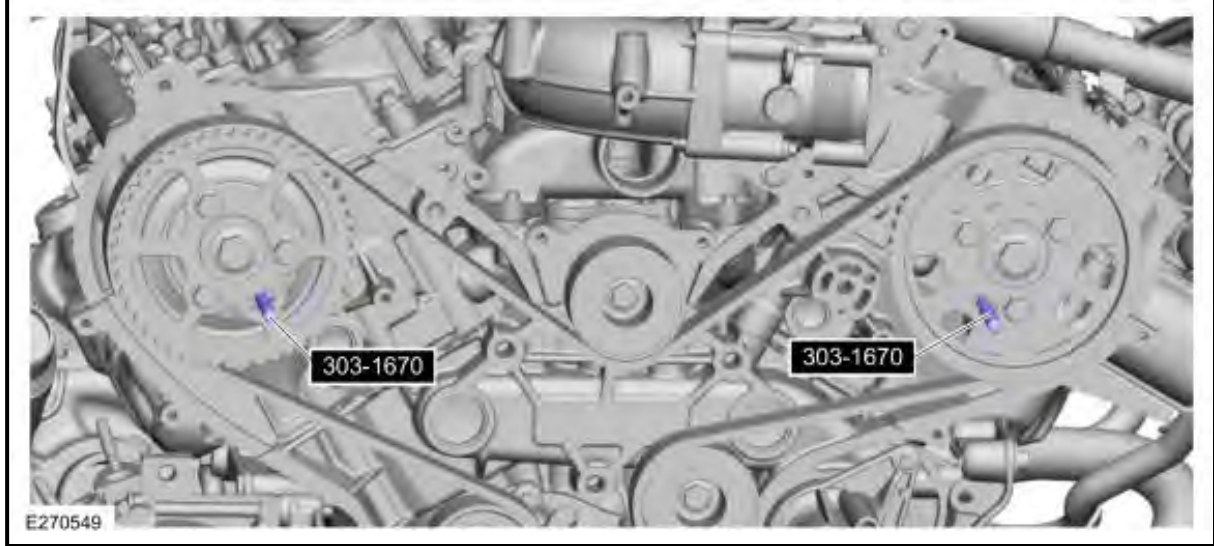
10. **NOTE:** The special tool can only be installed if the valve timing is correct.

If the special tools do not install correctly, repeat the timing belt installation steps. Install Special Service Tool: 303-1670 Pins, Camshaft Locking.

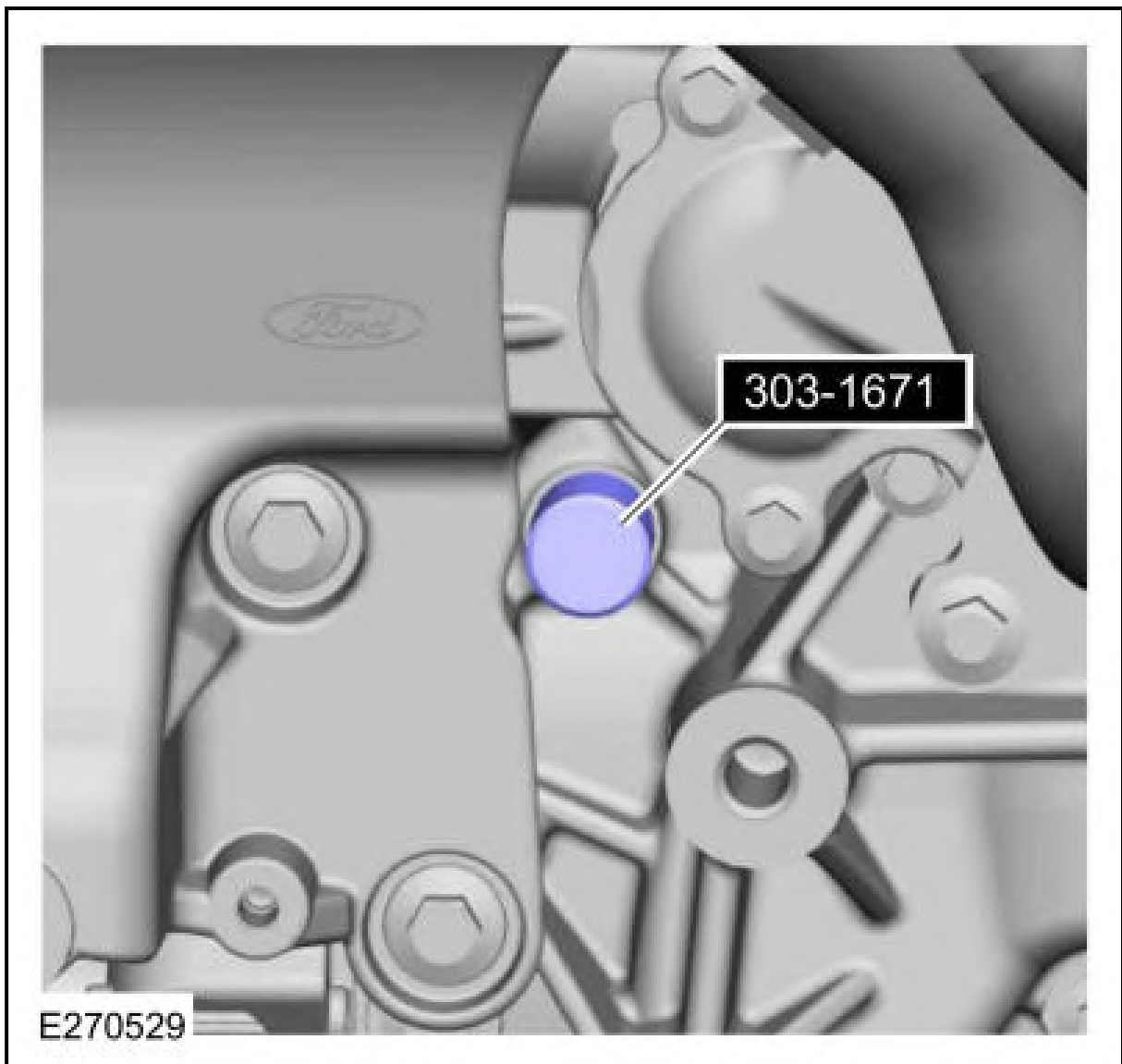


11. Remove Special Service Tool: 303-1670 Pins, Camshaft Locking.





12. Remove Special Service Tool: 303-1671 Pin, Locking Crankshaft.

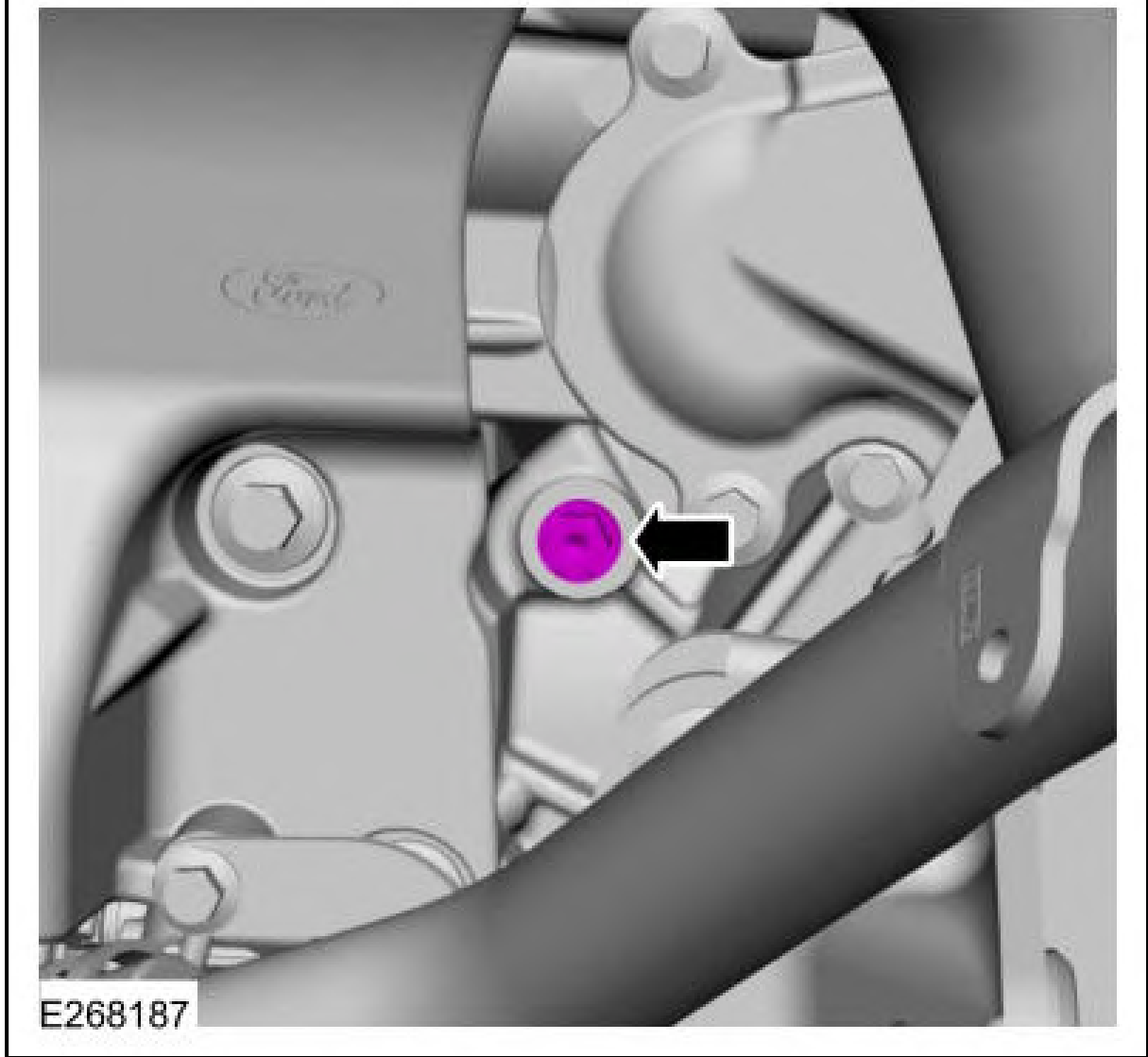


13. Install the timing pin bolt.

Torque: 17 lb.ft (23 Nm)



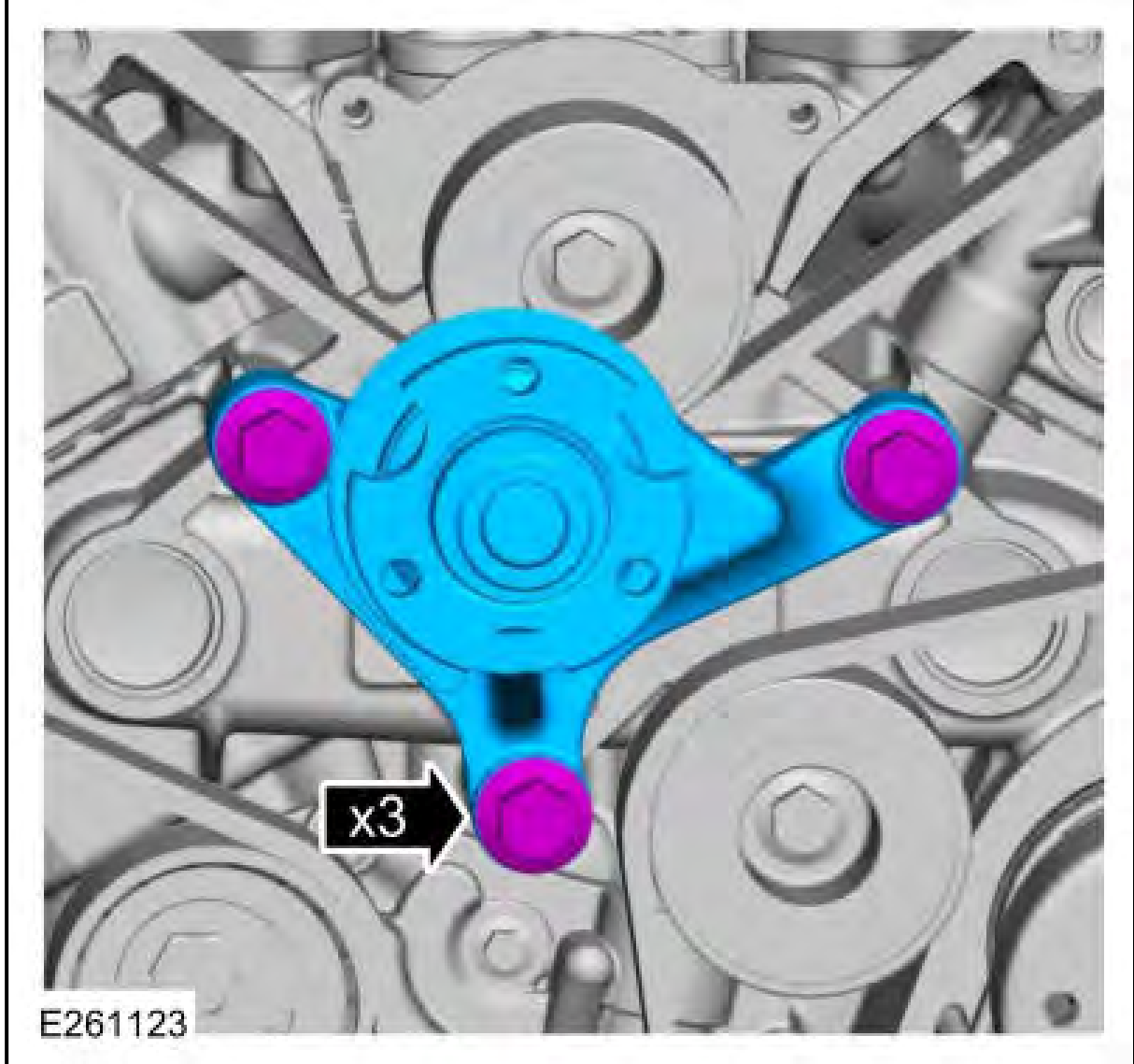




14. Install the fan drive and the bolts.

Torque: 61 lb.ft (83 Nm)





15. Install the following items:

1. Install the generator. REFER to: [Generator - 3.0L Power Stroke Diesel](#) .
2. Install the timing belt cover. REFER to: [Timing Belt Cover](#) .

16. Connect the battery ground cable. REFER to: [Battery Disconnect and Connect](#) .

### **TIMING BELT COVER**

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

#### **Special Tool(s) / General Equipment**

|                                     |
|-------------------------------------|
| <b>Hose Clamp Remover/Installer</b> |
|-------------------------------------|

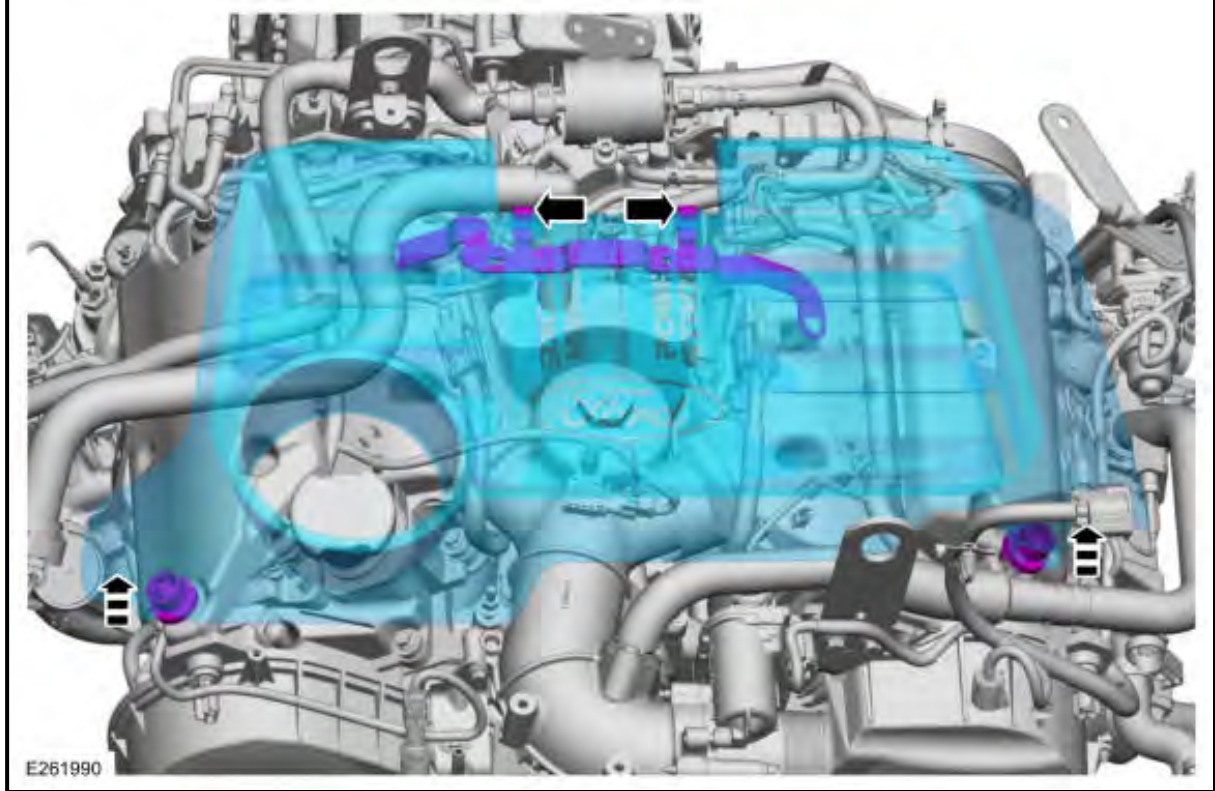
#### **Materials**

| Name  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant VC-3-B | WSS-M97B44-D  |

### **REMOVAL**

1. Remove the engine appearance cover.





2. Drain the cooling system. REFER to: [Cooling System Draining, Vacuum Filling and Bleeding](#) .

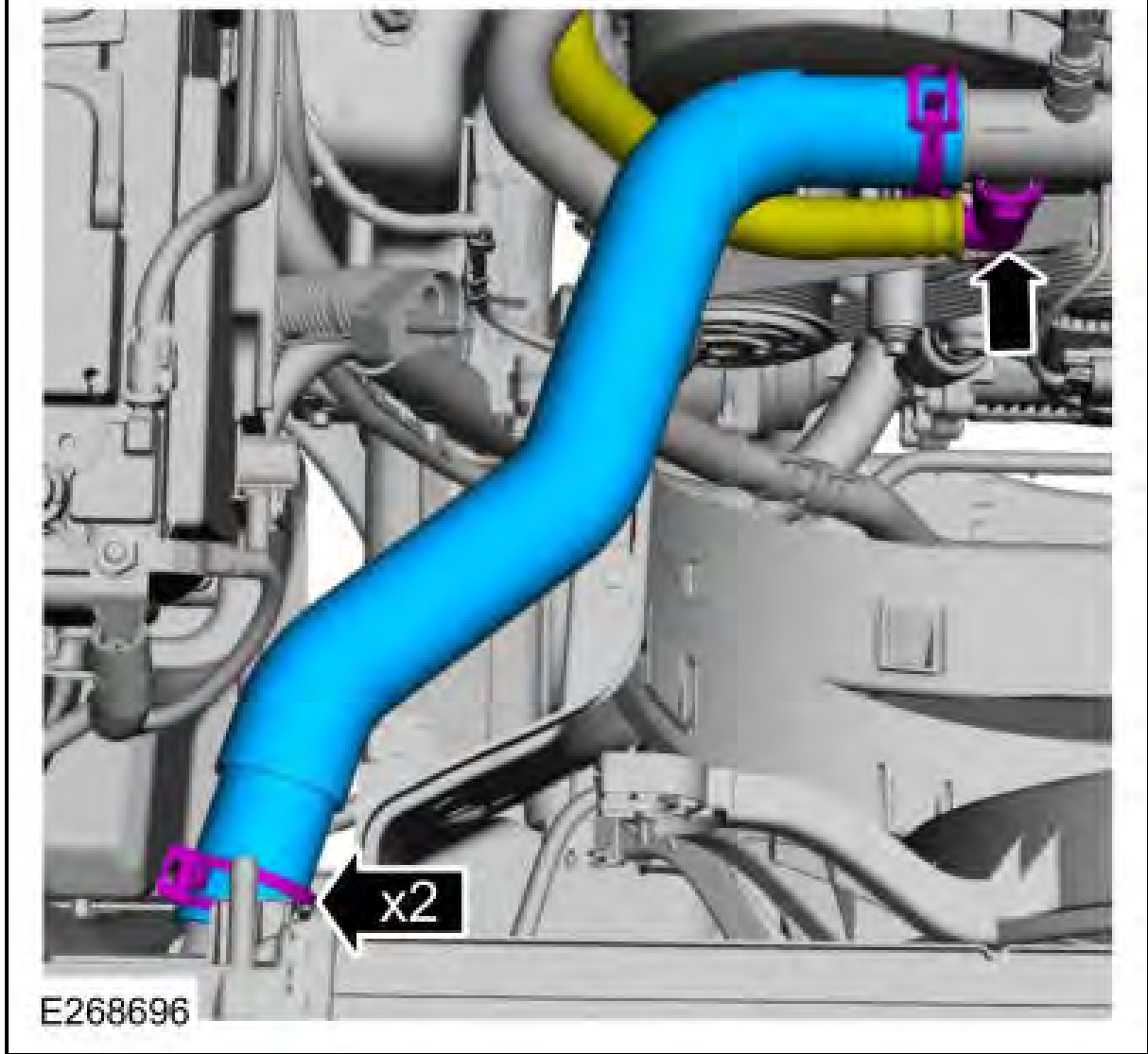
3. Remove the following items:

1. Remove the cooling fan. REFER to: [Cooling Fan](#) .
2. Remove the air cleaner outlet pipe. REFER to: [Air Cleaner Outlet Pipe](#) .
3. Remove the CAC outlet pipe. REFER to: [Charge Air Cooler \(CAC\) Outlet Pipe](#) .
4. Remove the accessory drive belt. REFER to: [Accessory Drive Belt](#) .

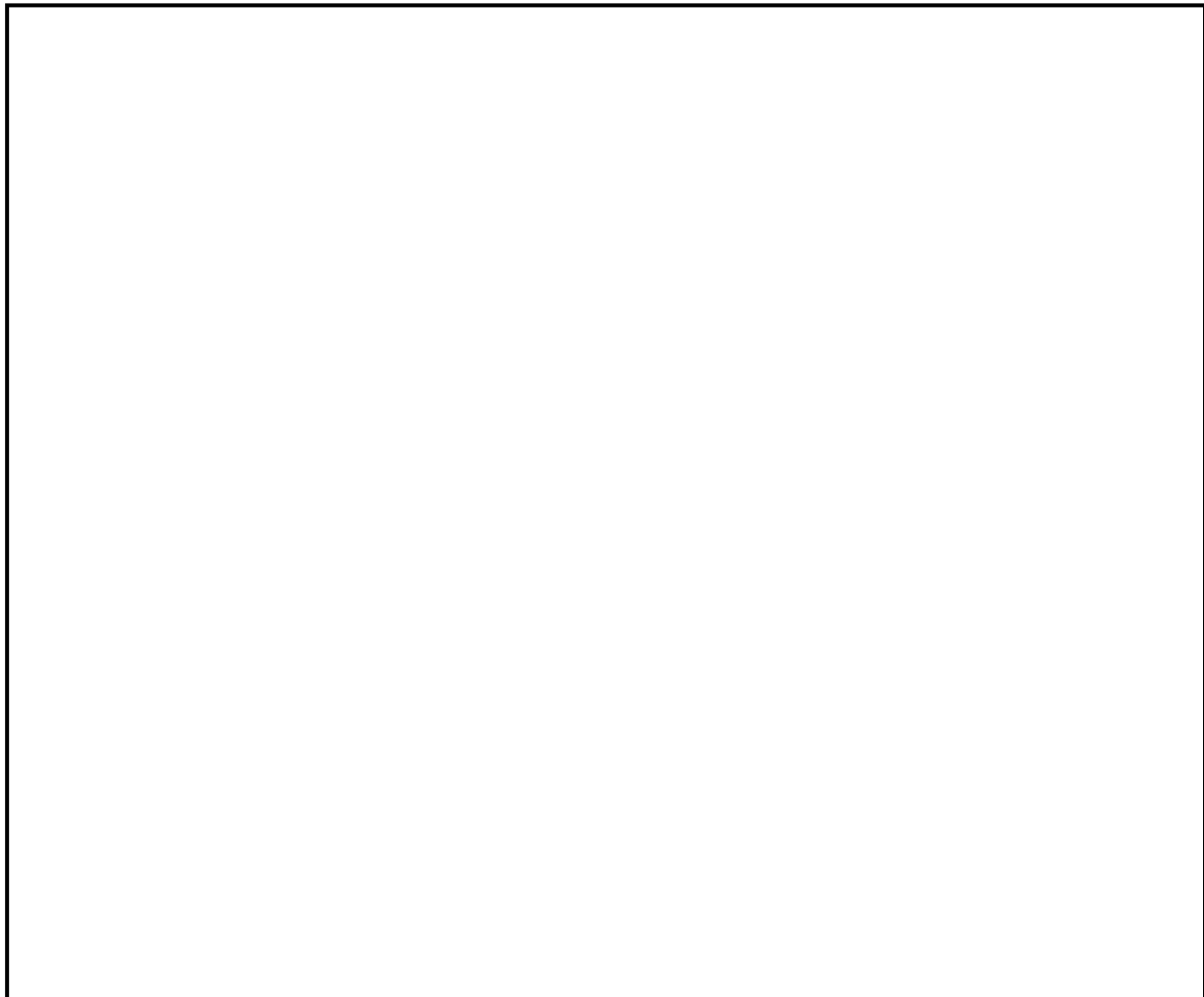
4.

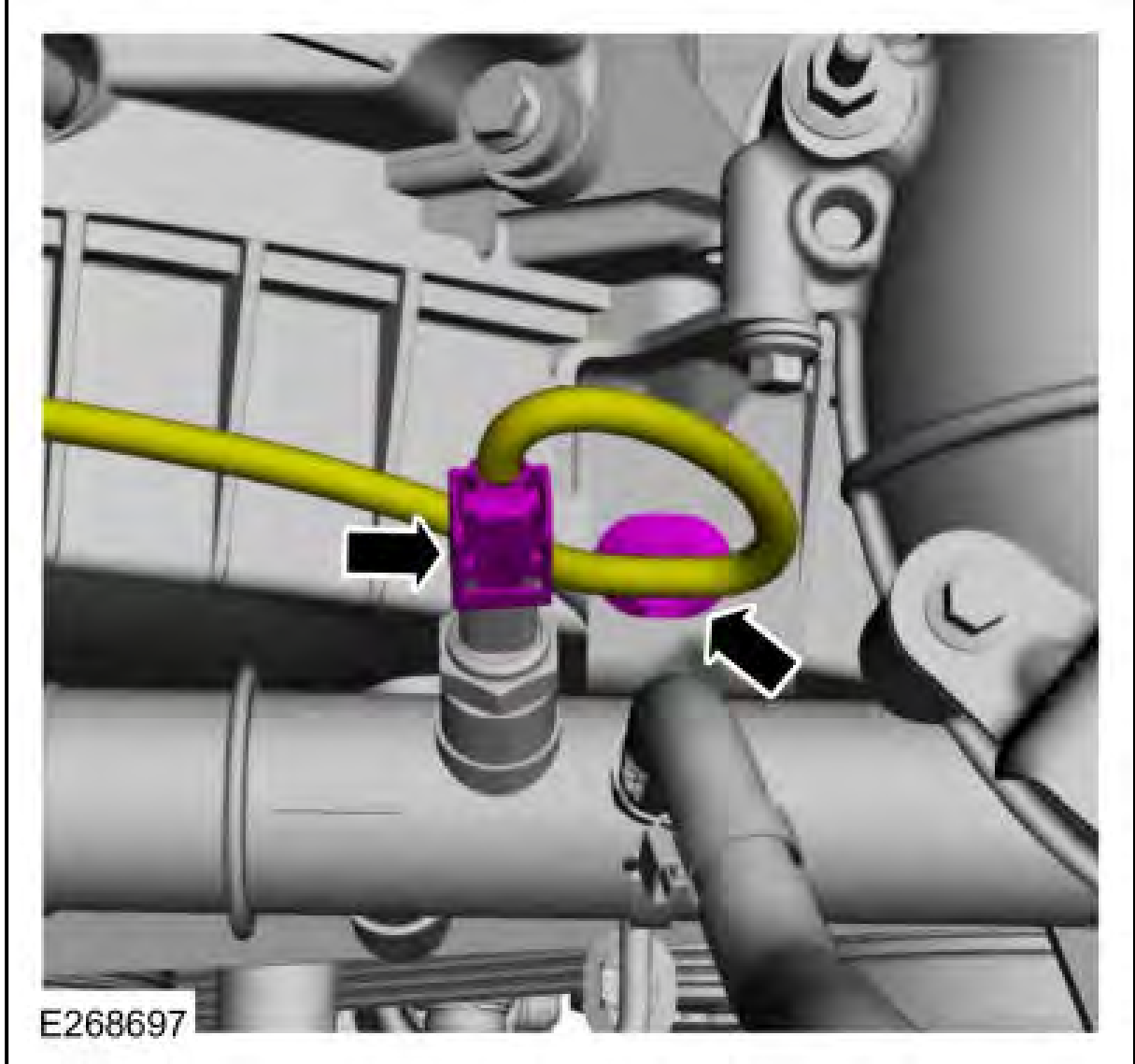
- Disconnect and remove the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer
- Disconnect the heater hose and position aside.



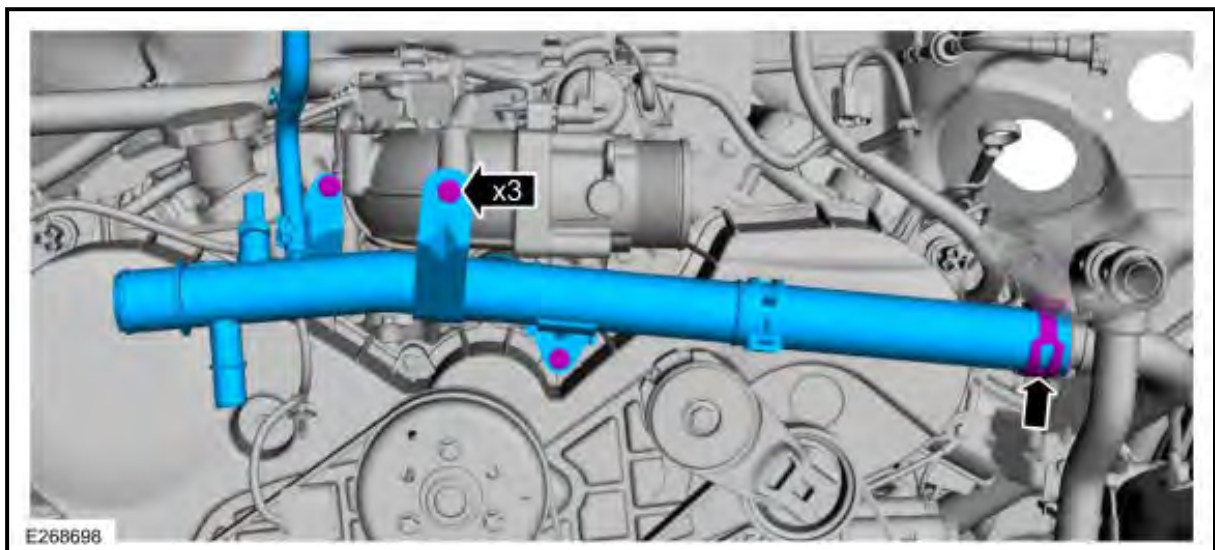


5. Disconnect the ECT sensor electrical connector and the wire retainer.



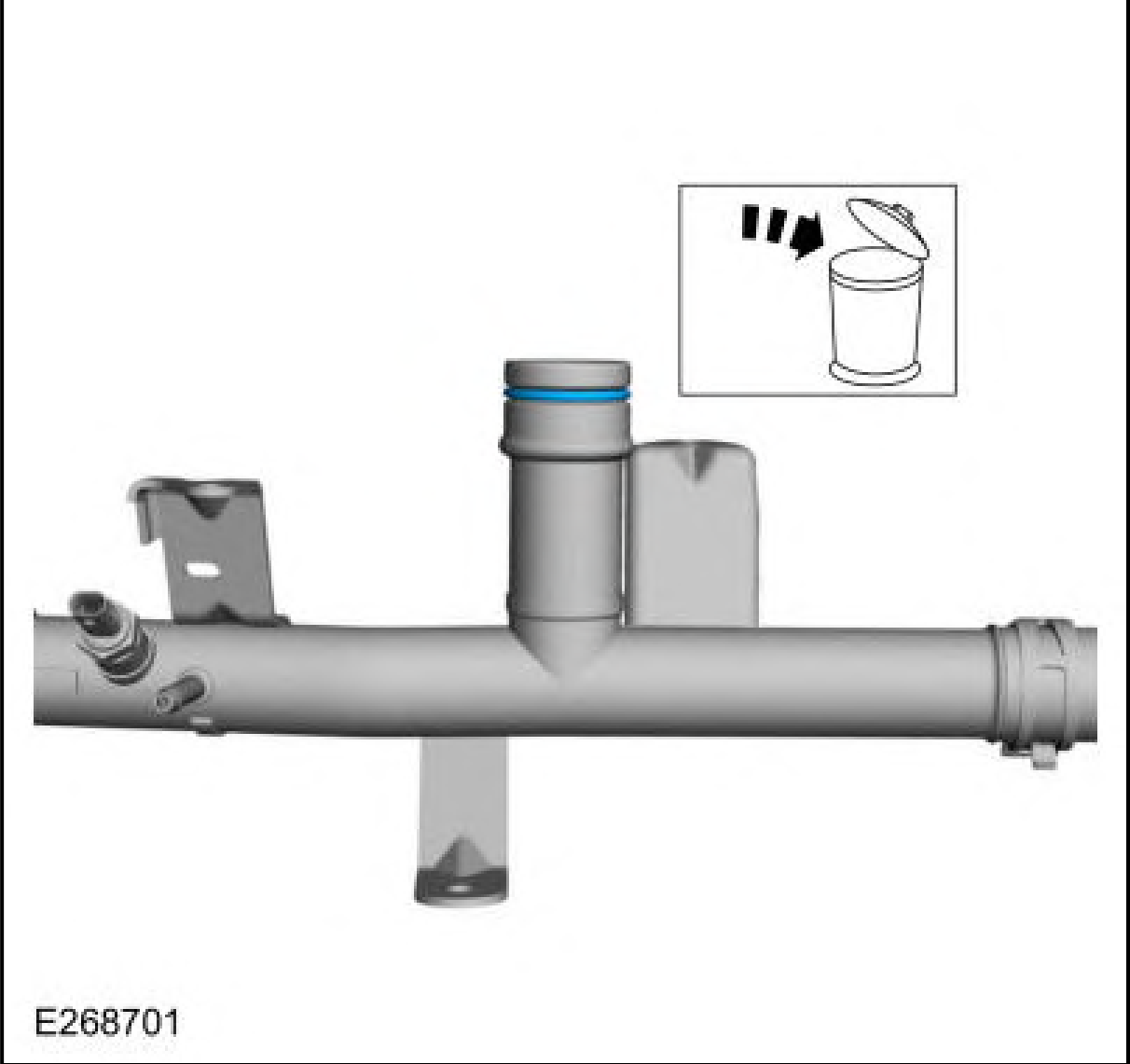


6. Remove the bolts for the coolant tube. Disconnect the clamp and remove the coolant tube. Use the General Equipment: Hose Clamp Remover/Installer



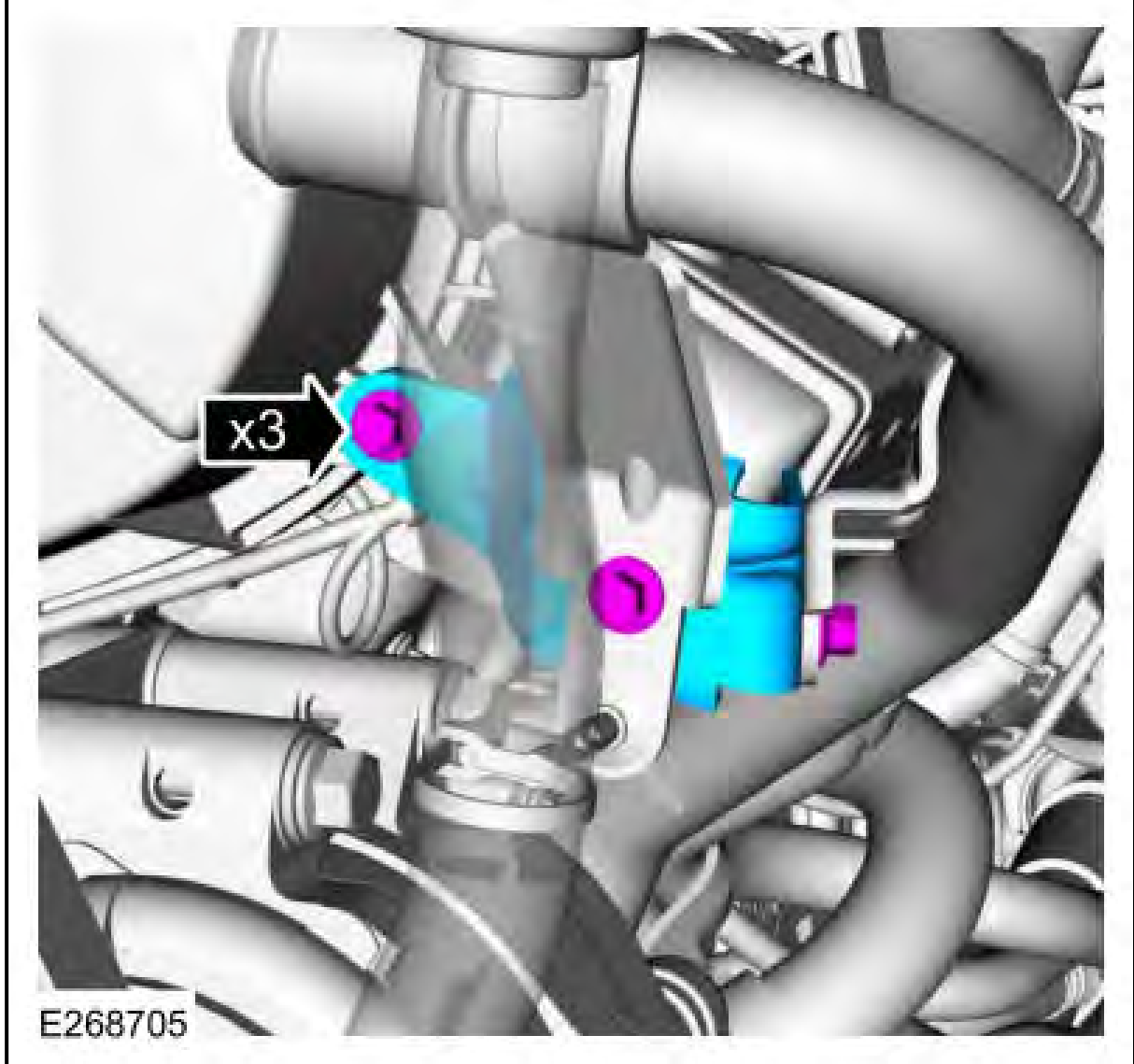
7. Remove and discard the O-ring seal.





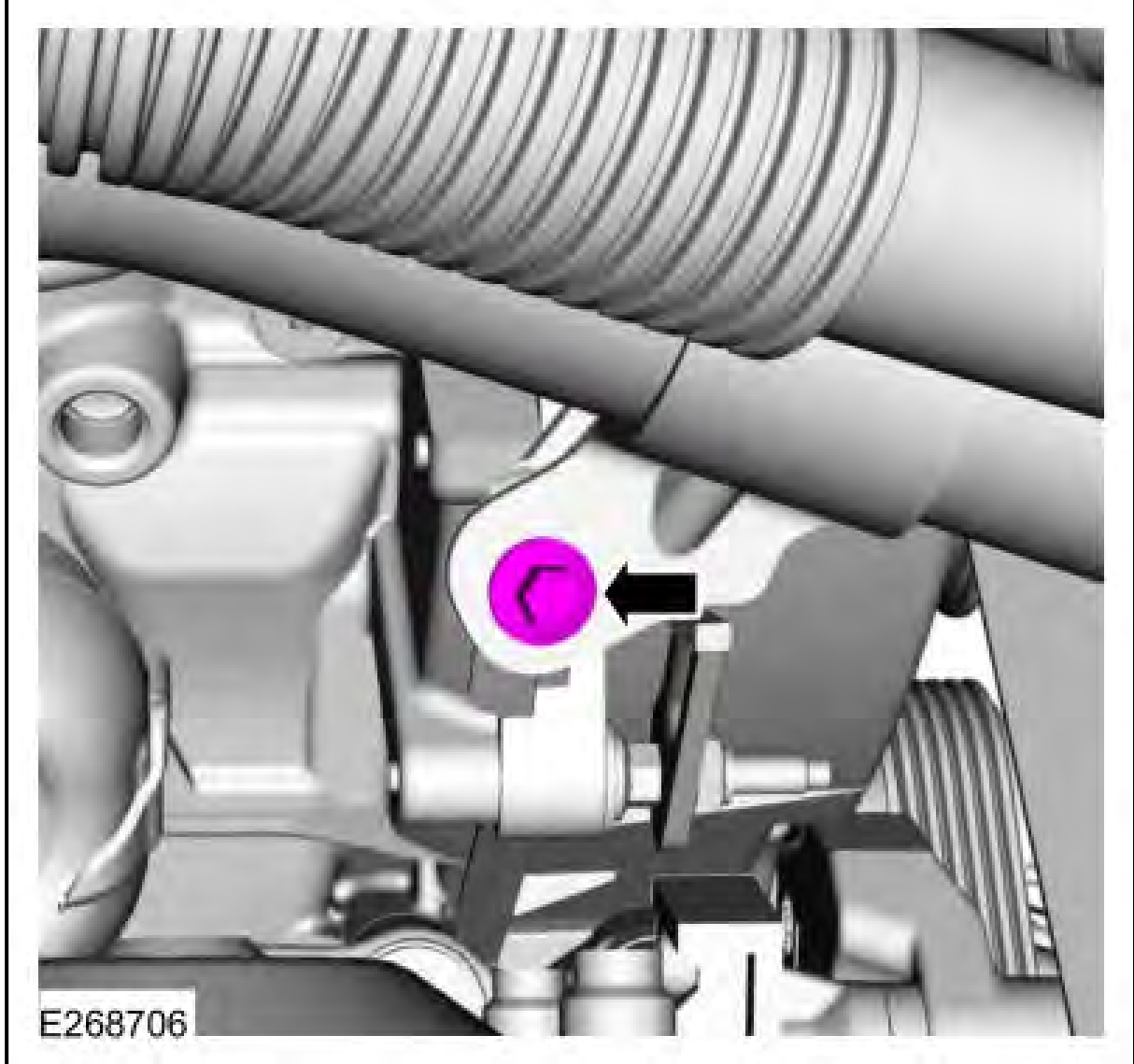
8. Remove the bolts and the coolant tube bracket.



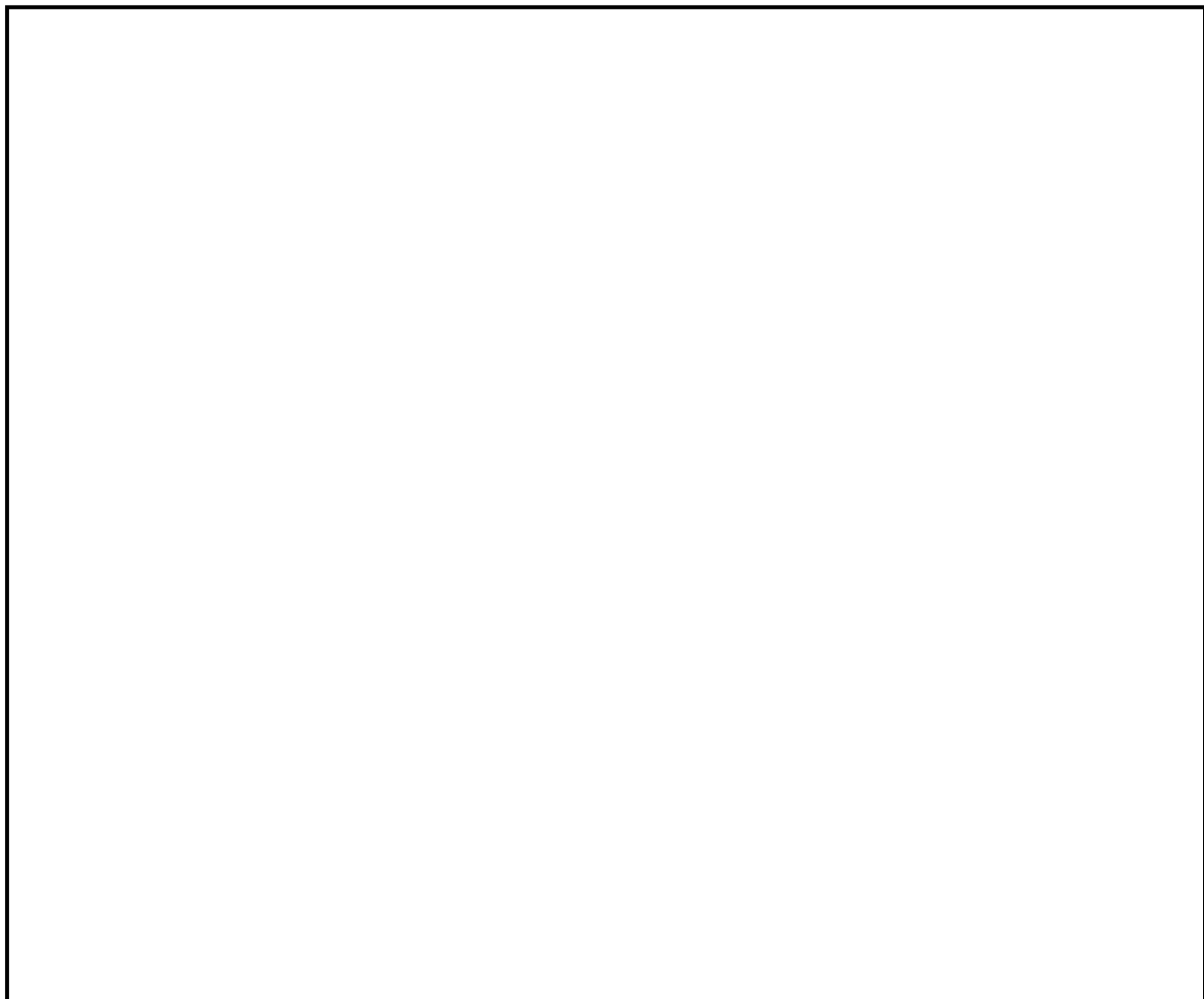


9. Remove the bolt for the CAC tube.

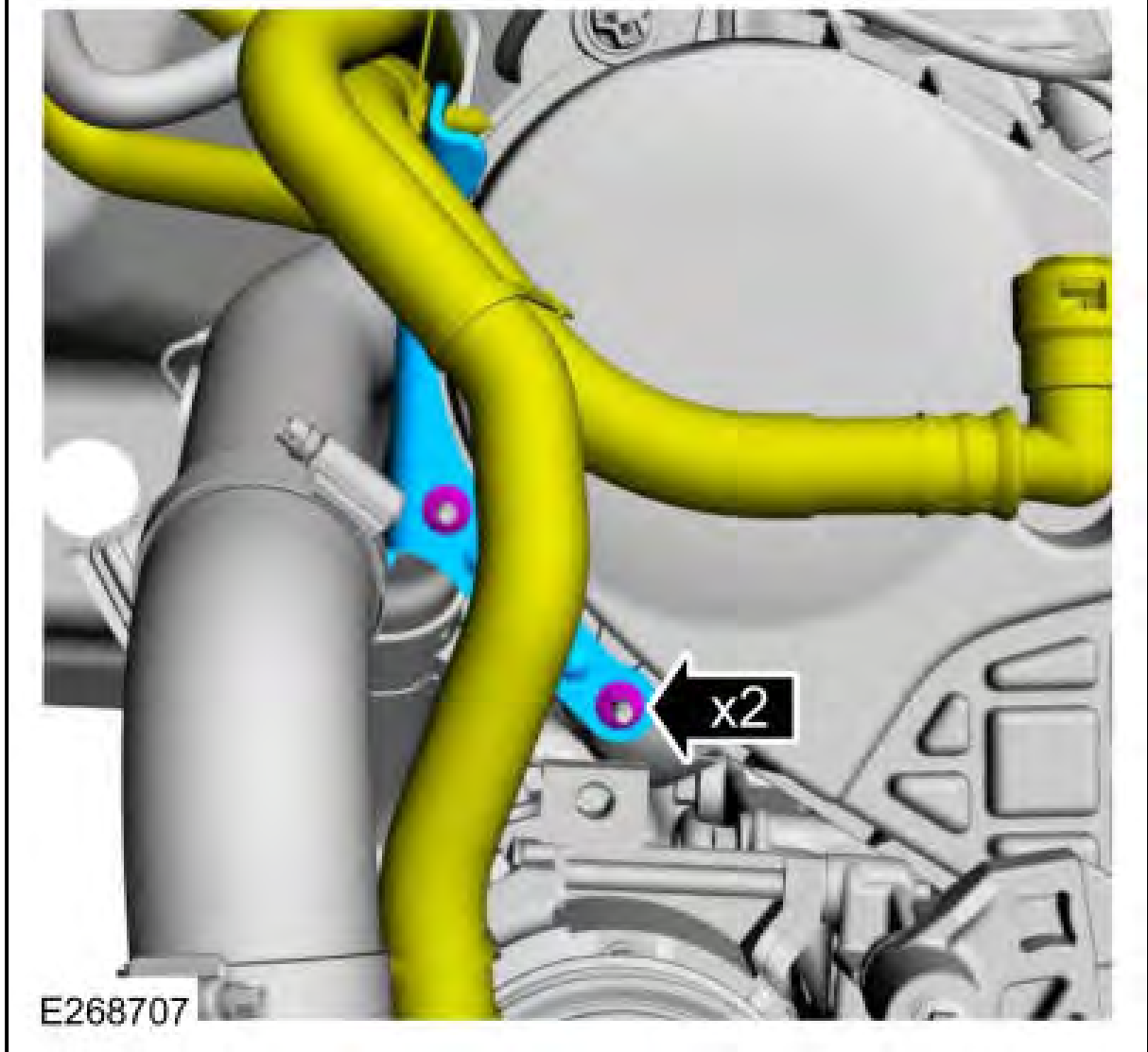




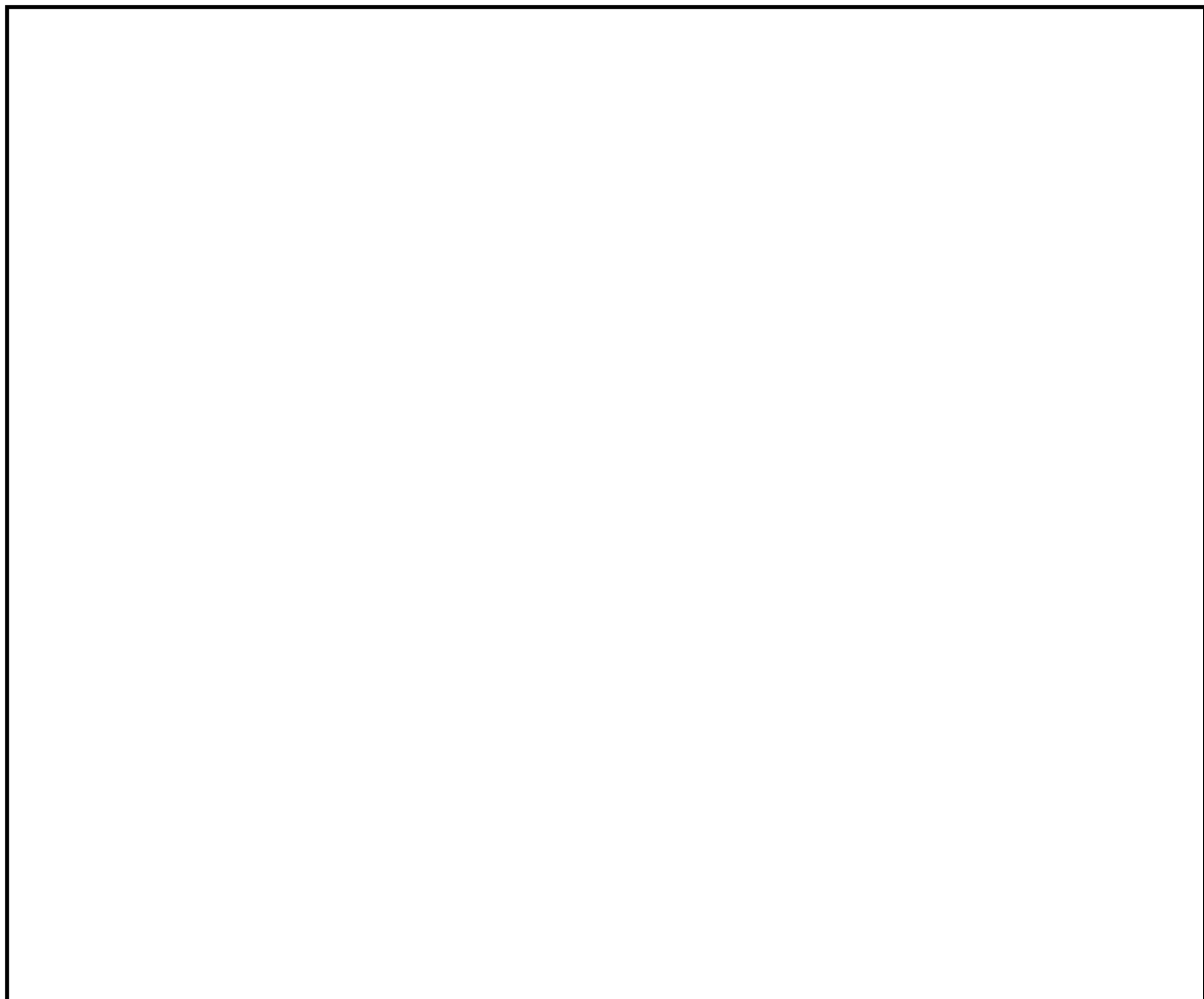
10. Remove the nuts for the CAC tube bracket. Position aside the heater hoses.

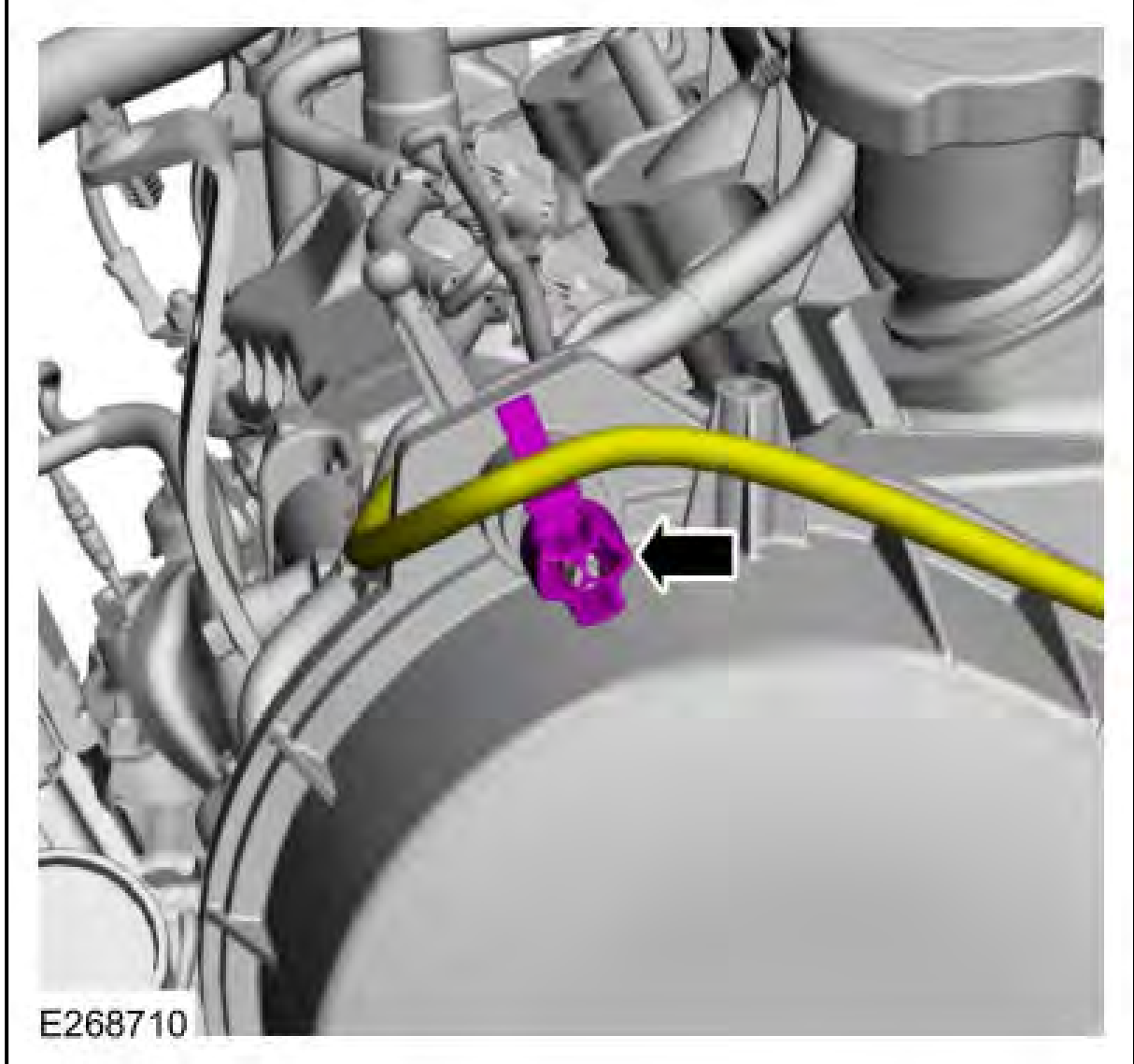




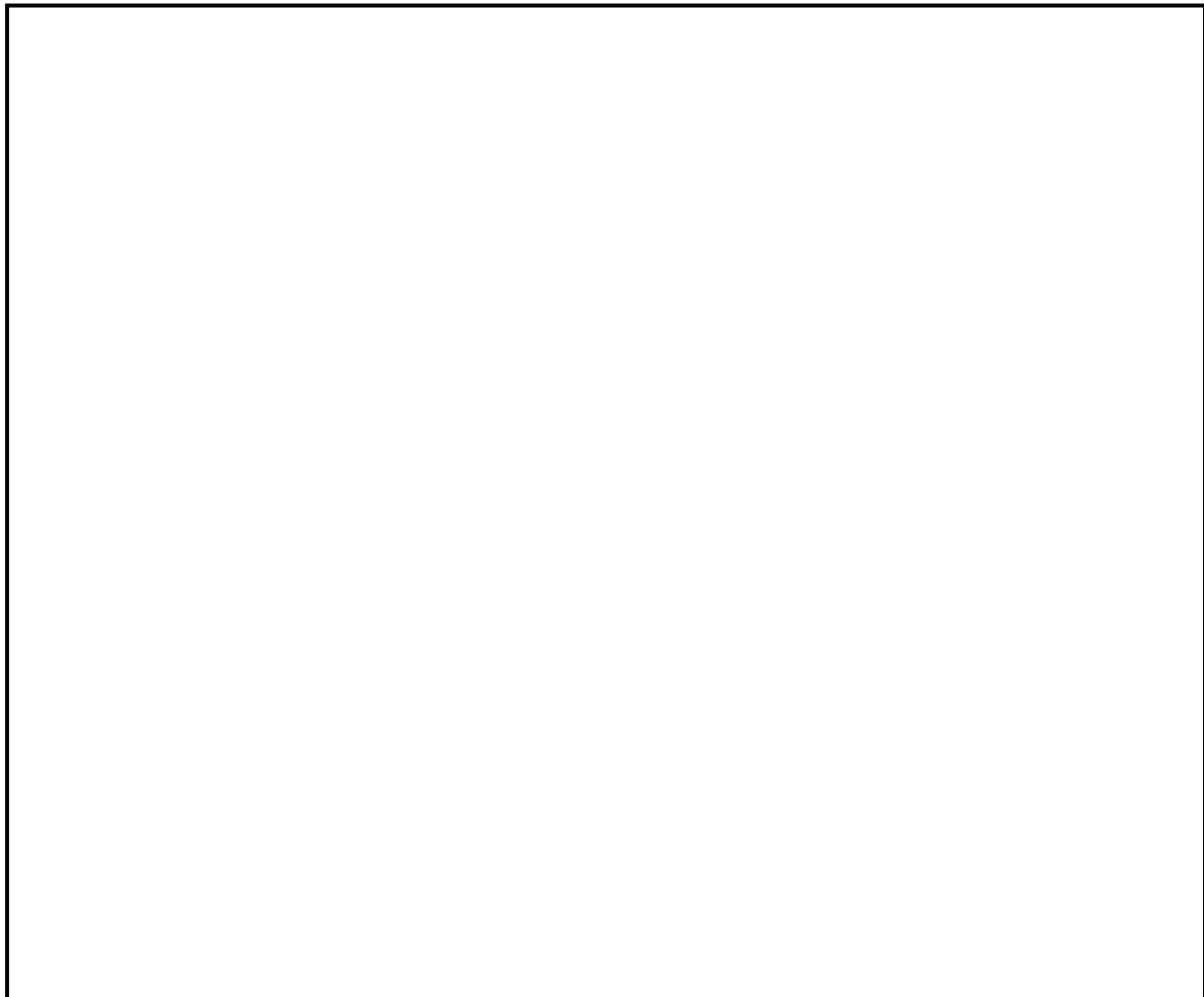


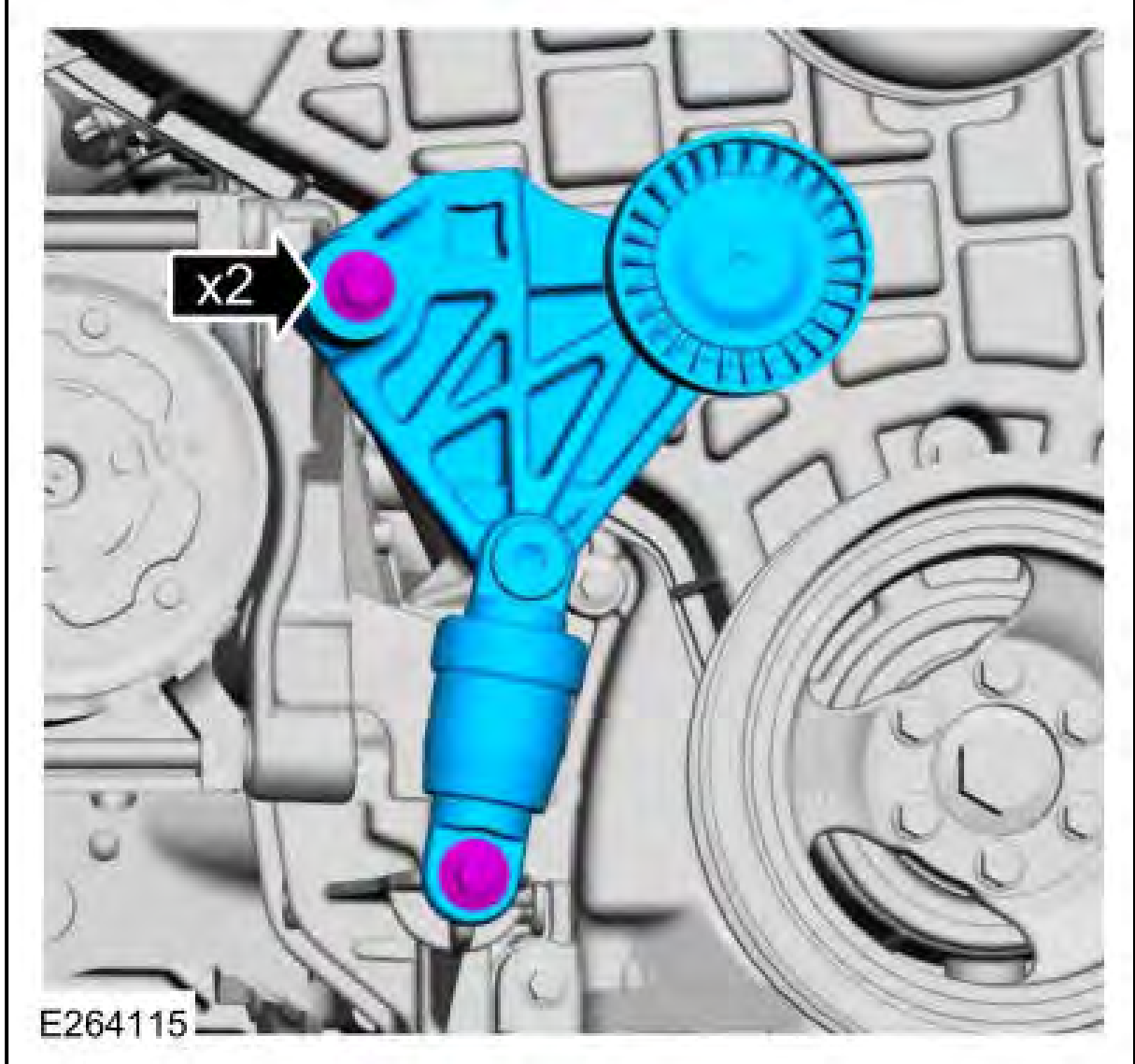
11. Disconnect the wire retainer and position aside the wiring.



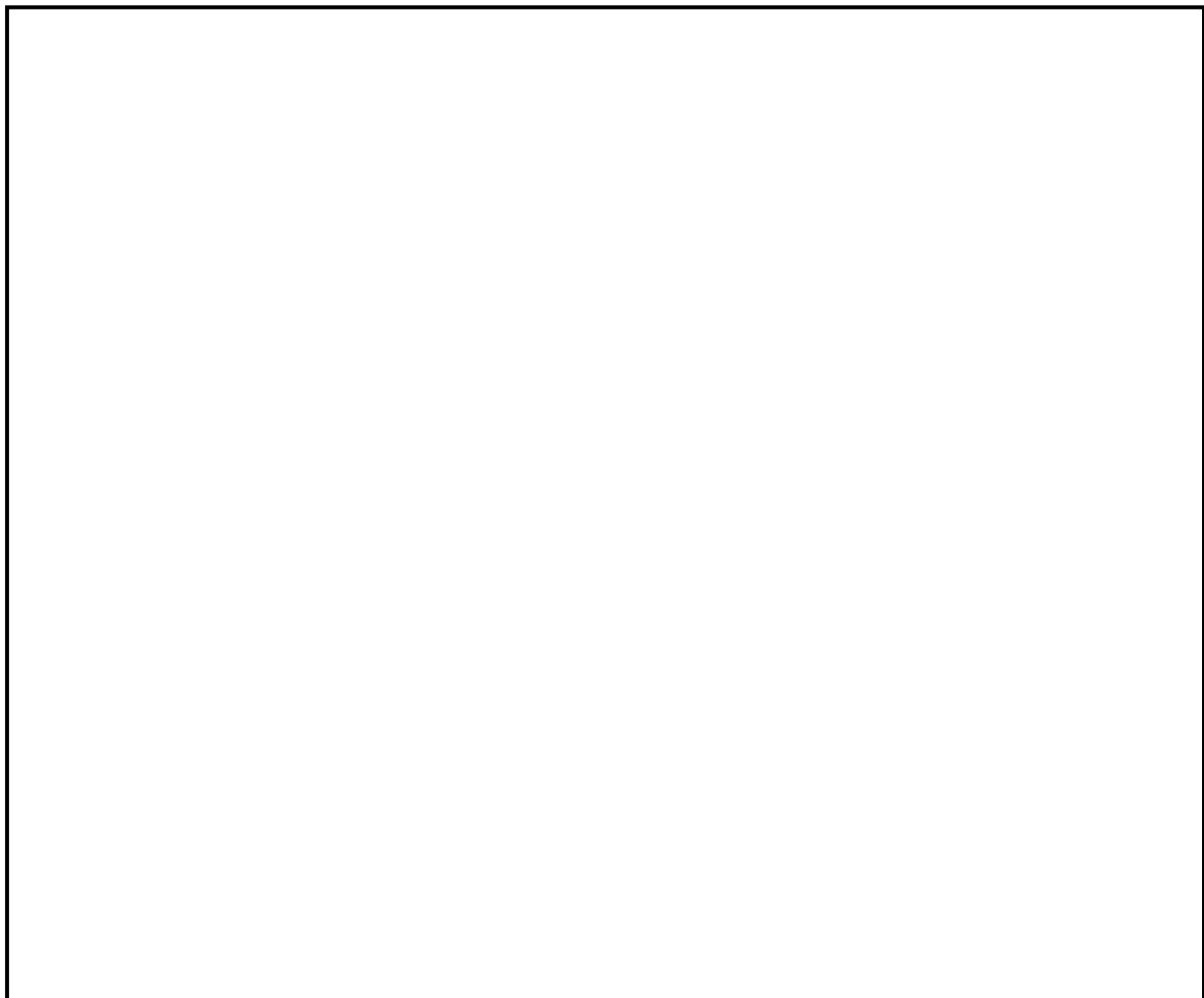


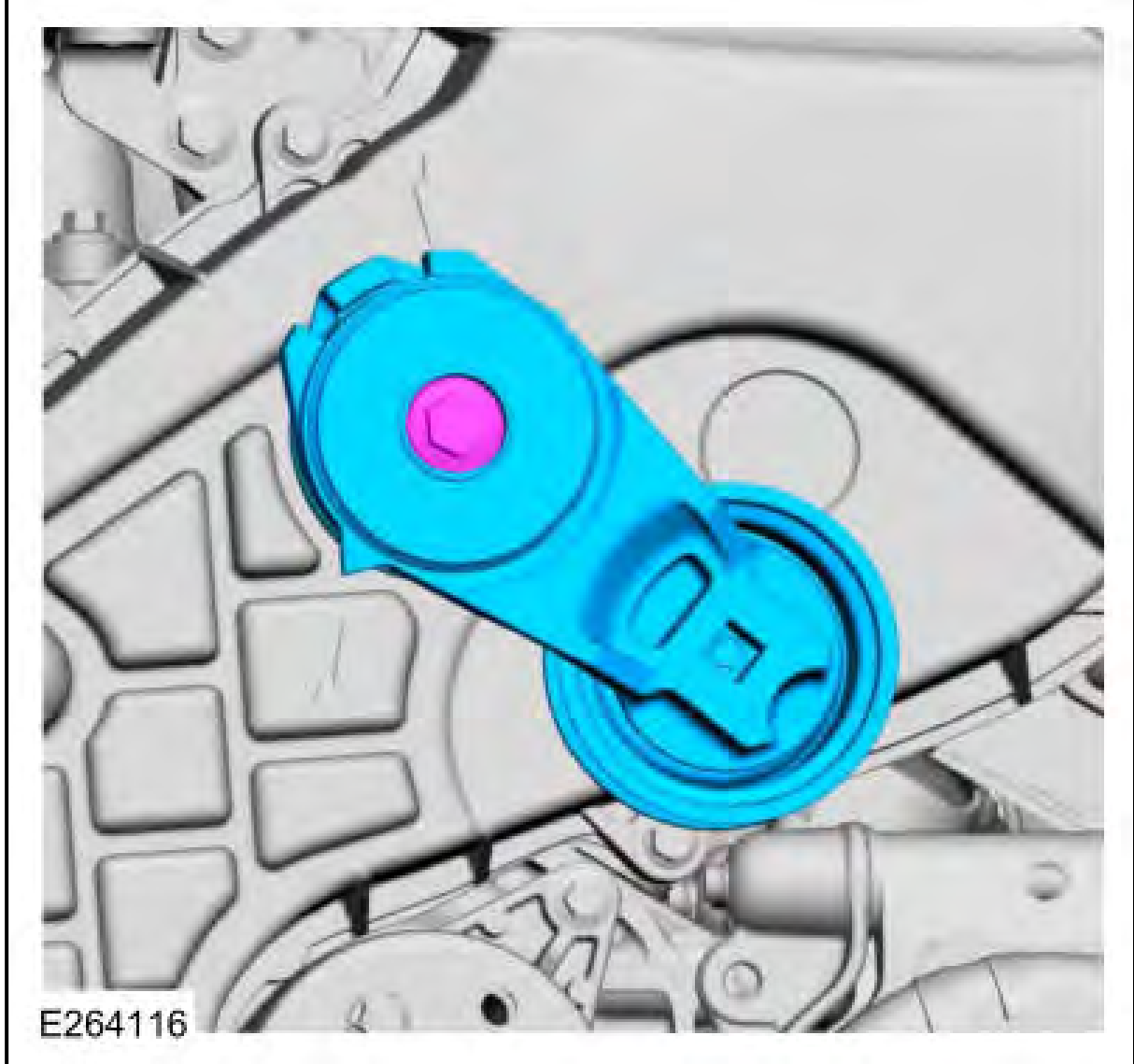
12. Remove the bolts and the accessory drive belt tensioner.



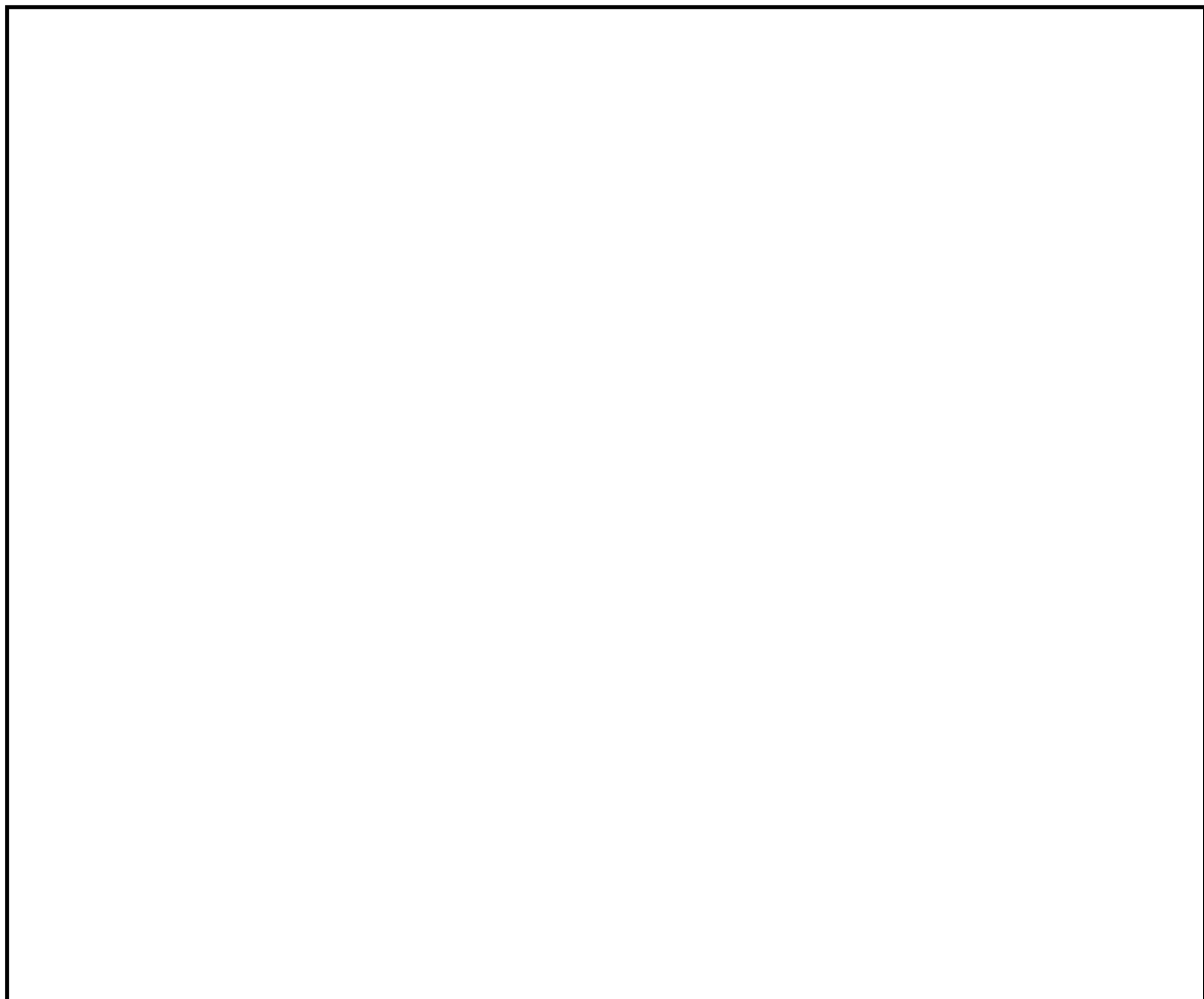


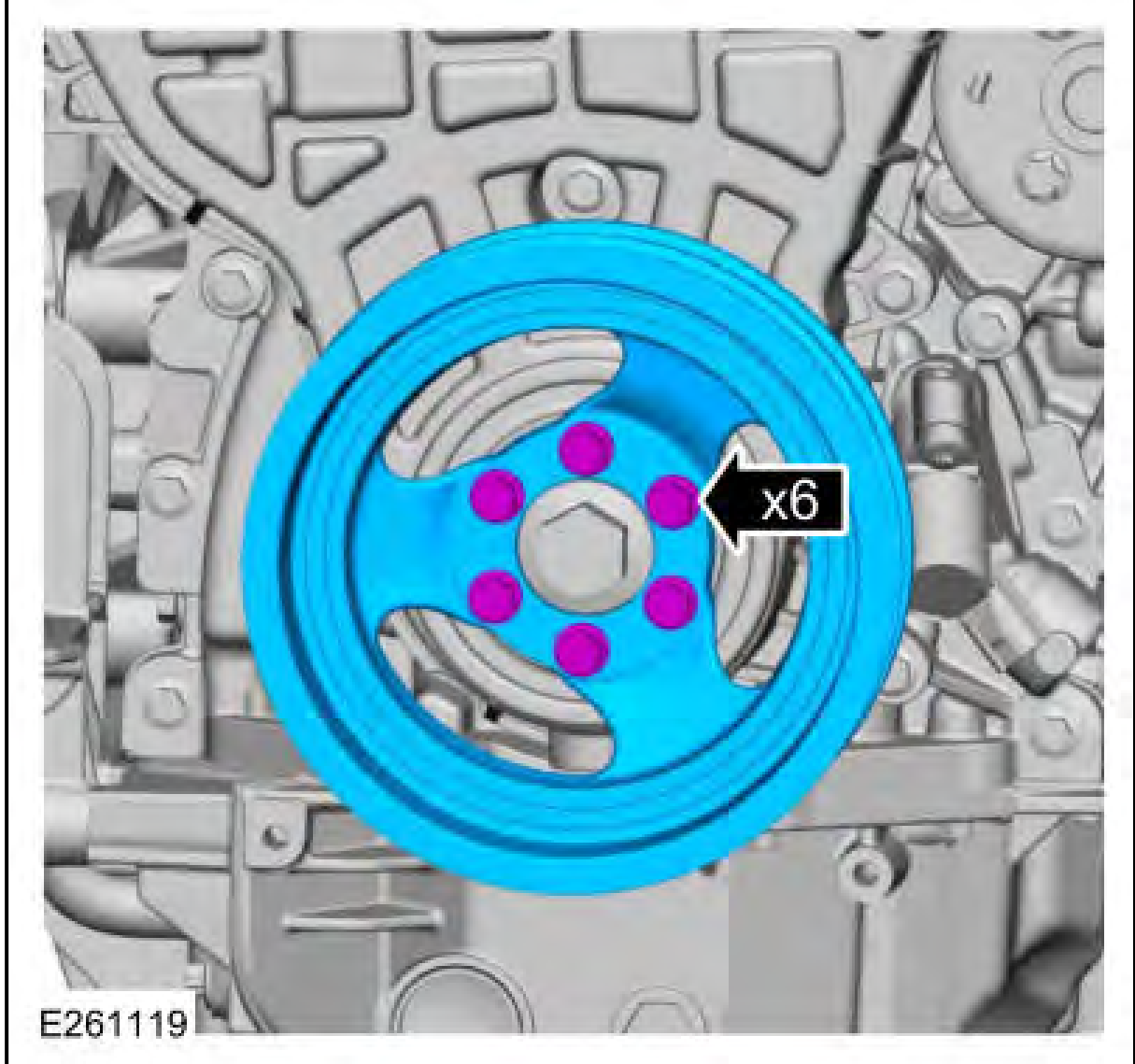
13. Remove the bolt and the accessory drive belt tensioner.



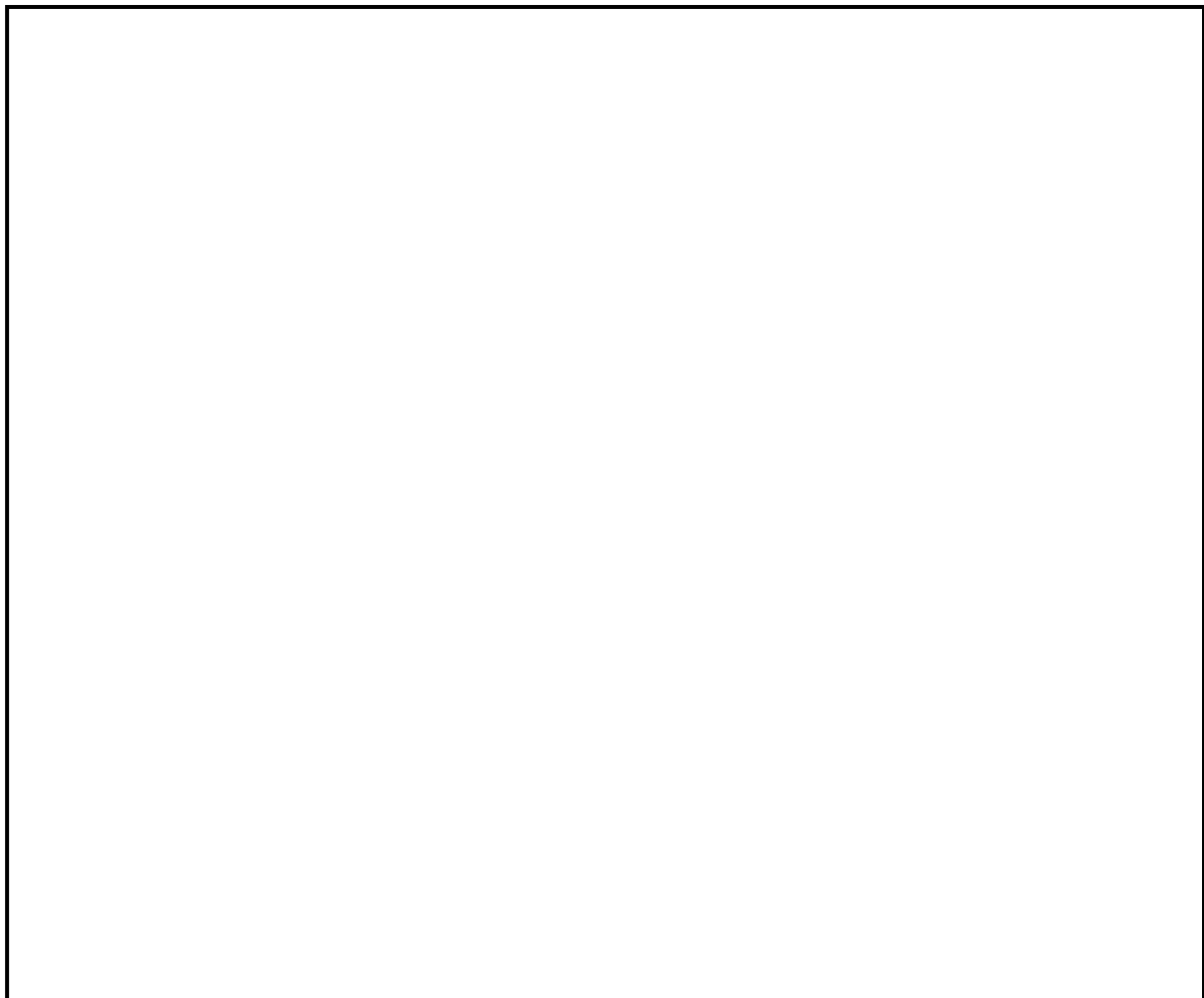


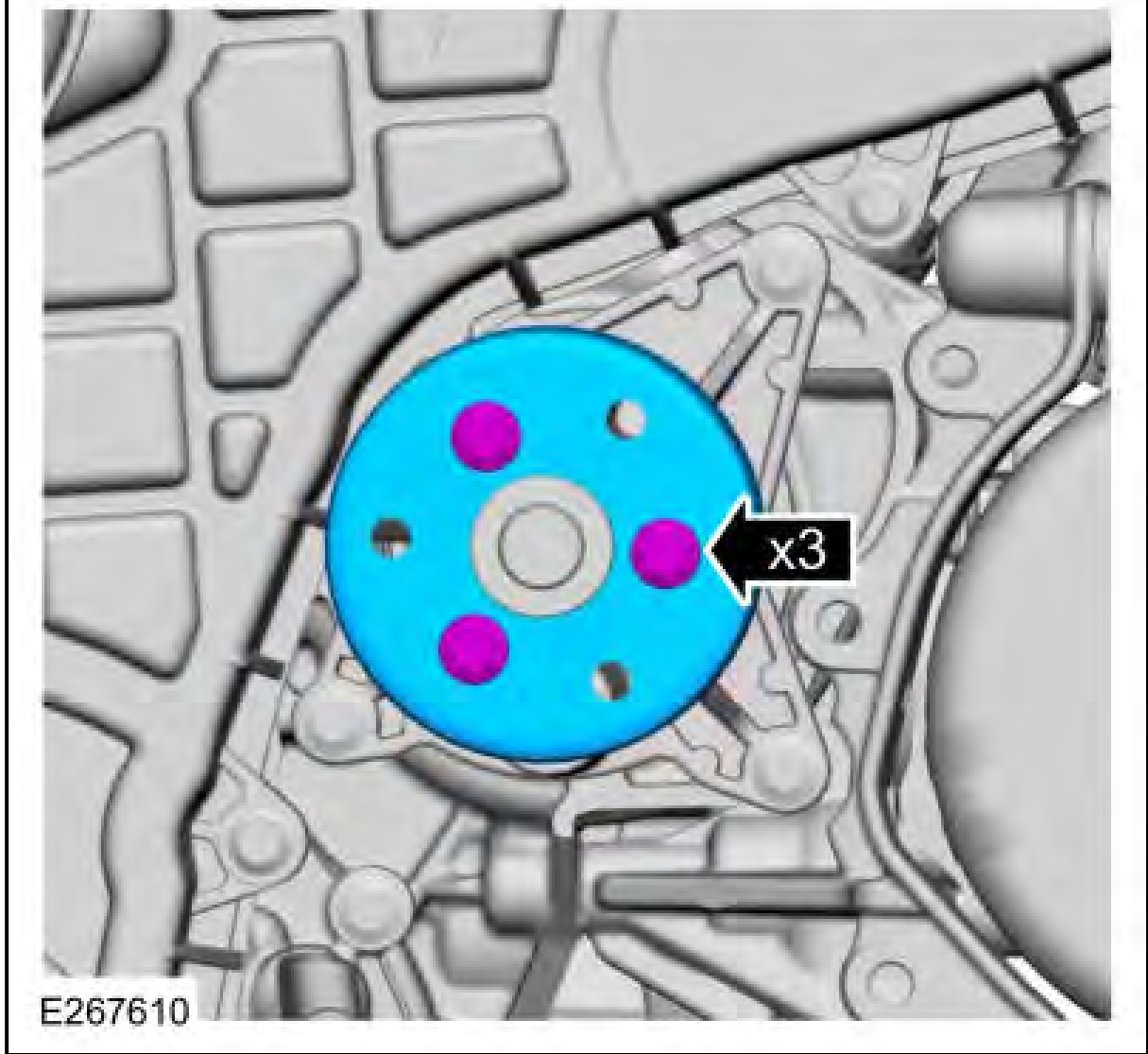
14. Remove the bolts and the crankshaft vibration damper.



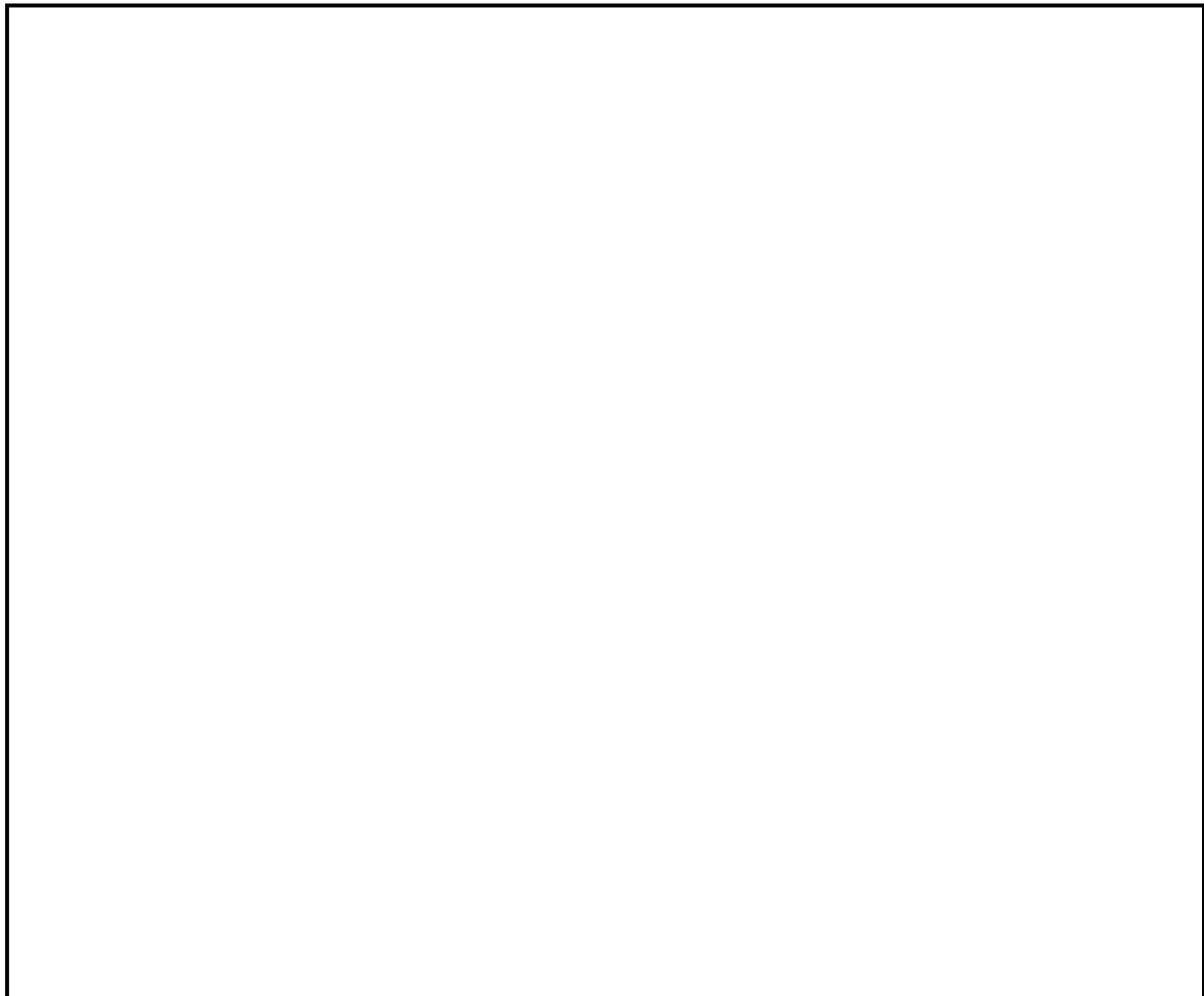


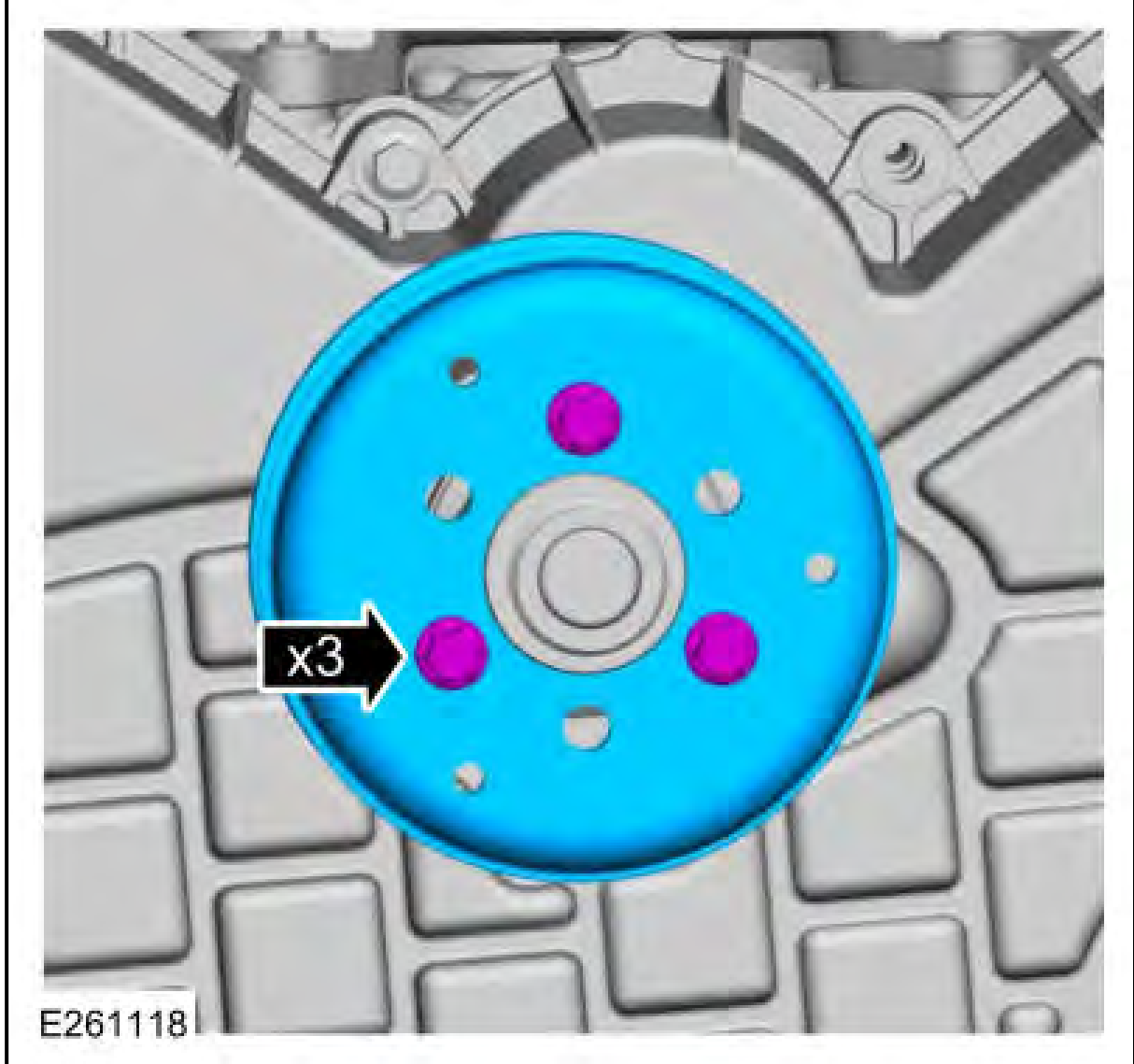
15. Remove the bolts and the coolant pump pulley.





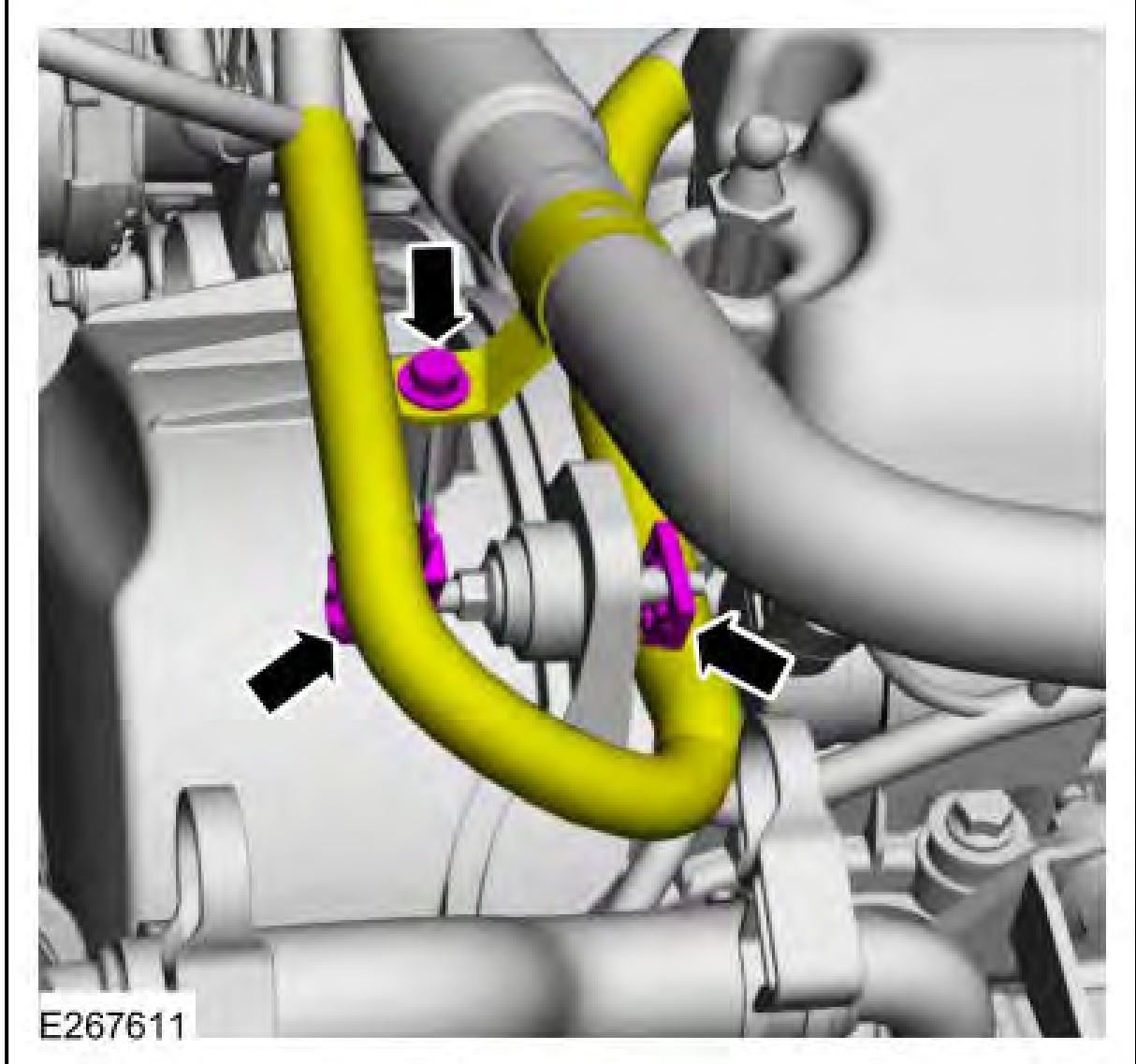
16. Remove the bolts and the fan pulley.



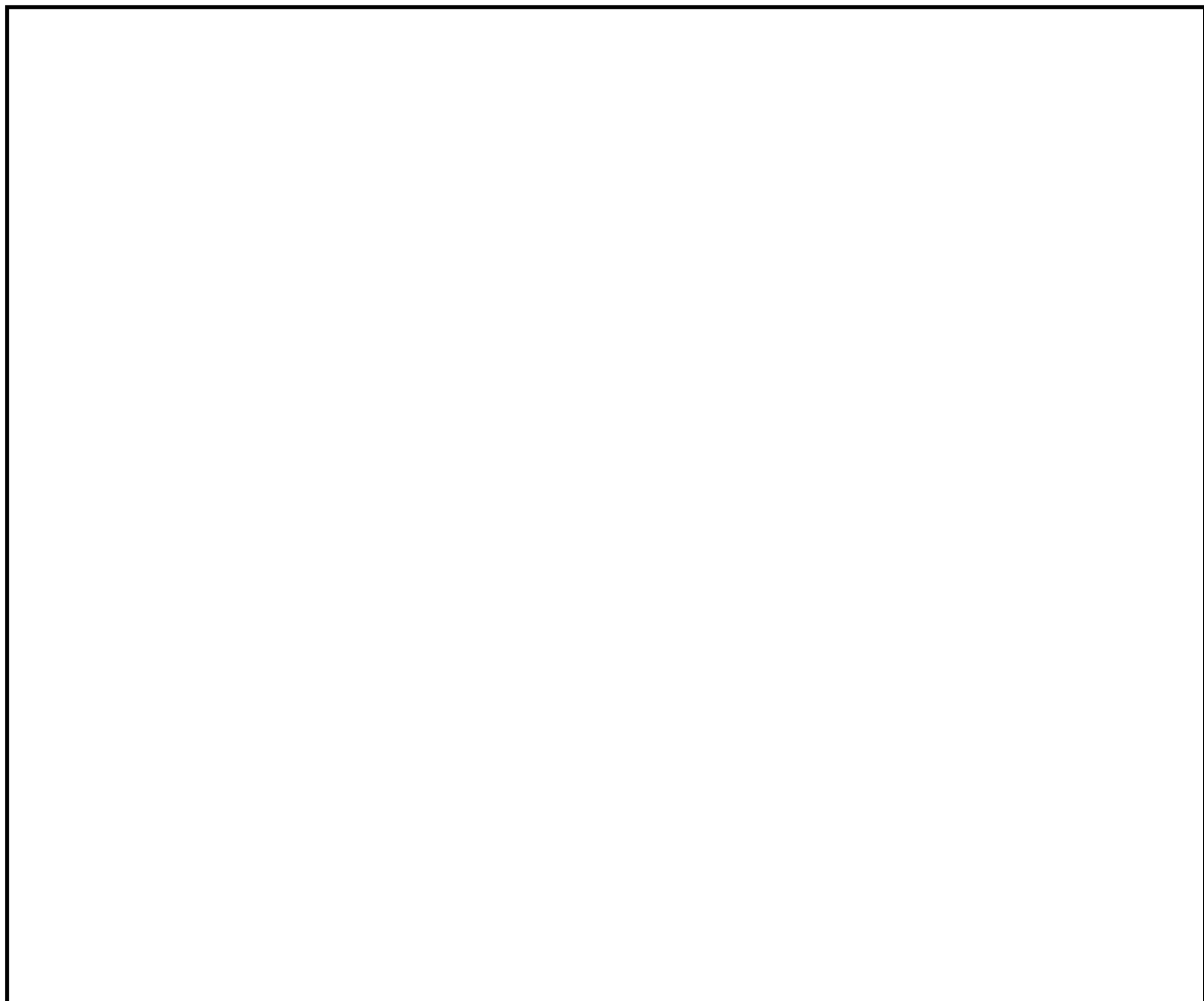


17. Disconnect the retainer and position aside the engine wiring. Remove the bolt and position aside the bracket.

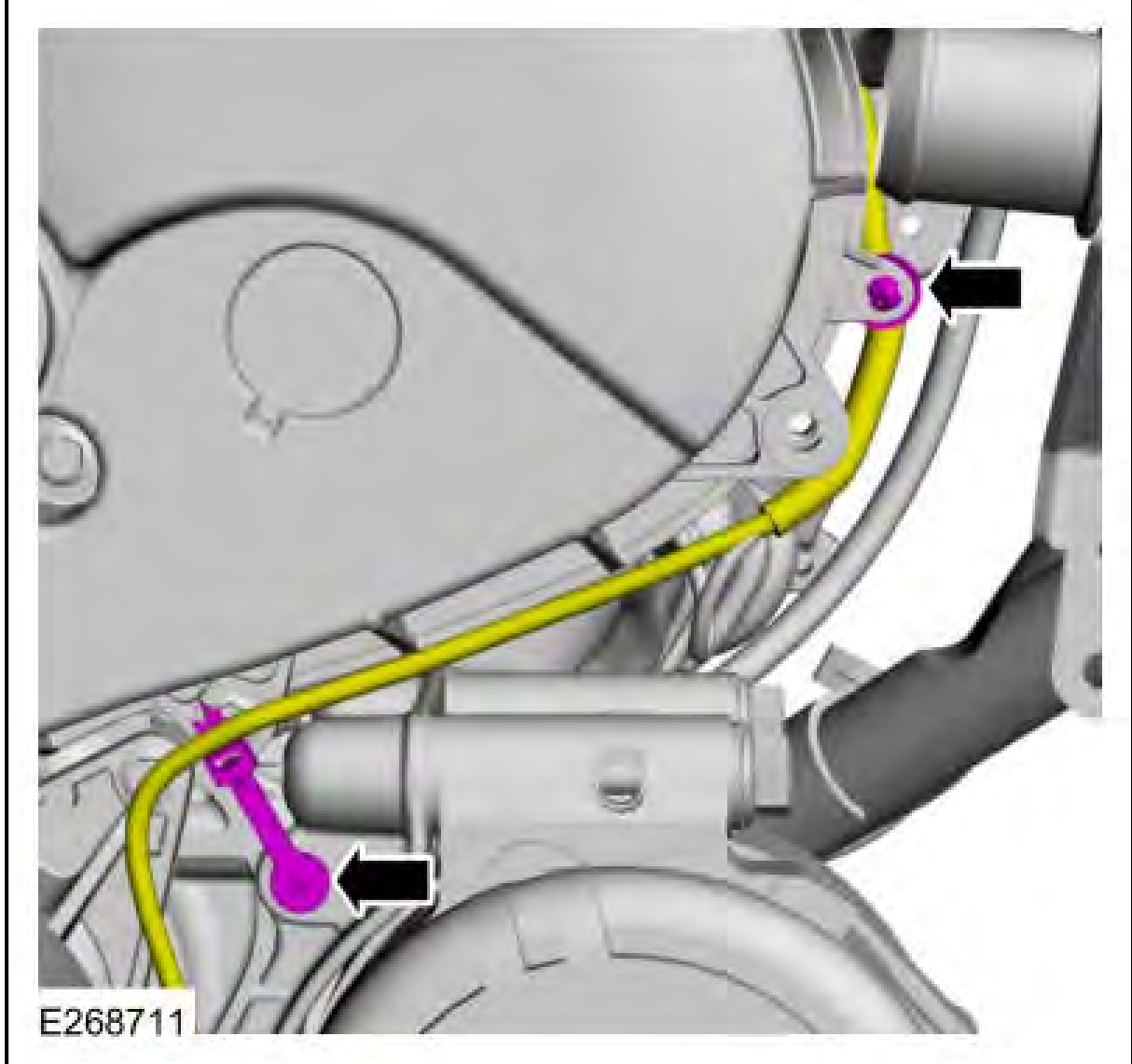




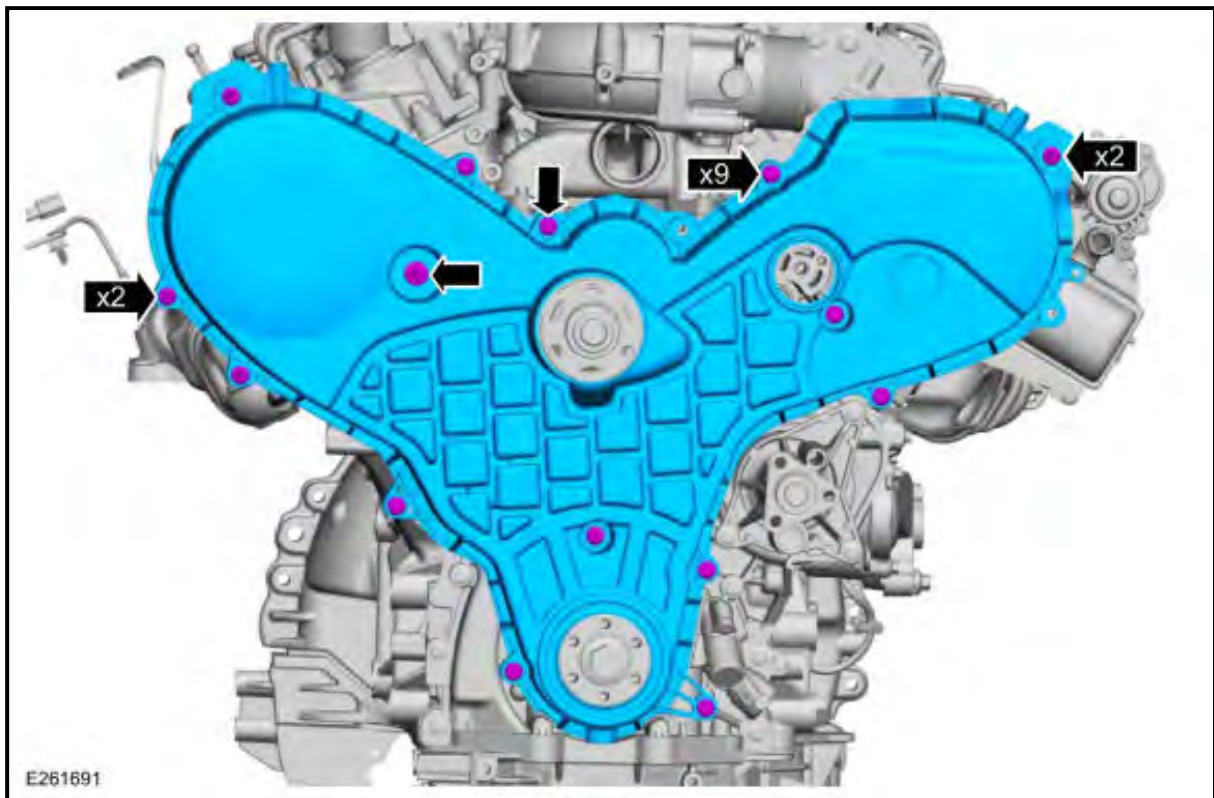
18. Disconnect the retainers and position aside the engine wiring.



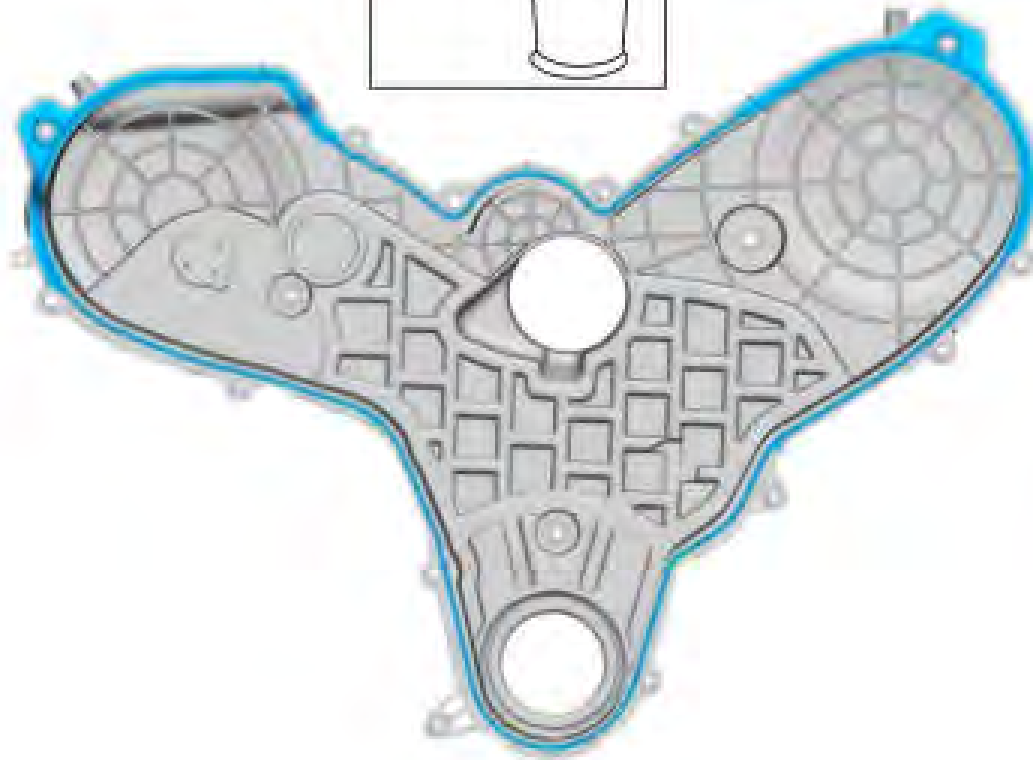




19. Remove the bolts and the timing belt cover.



20. Remove and discard the timing belt cover gasket.

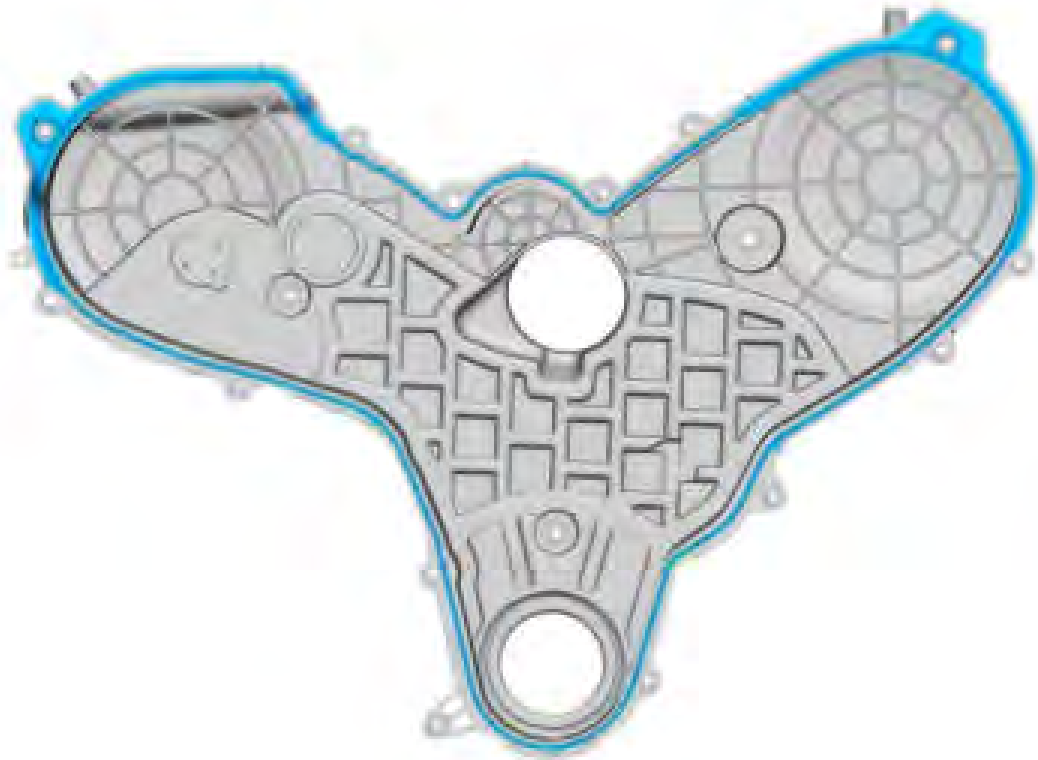


E261121

### INSTALLATION

1. Install a new gasket for the timing belt cover.

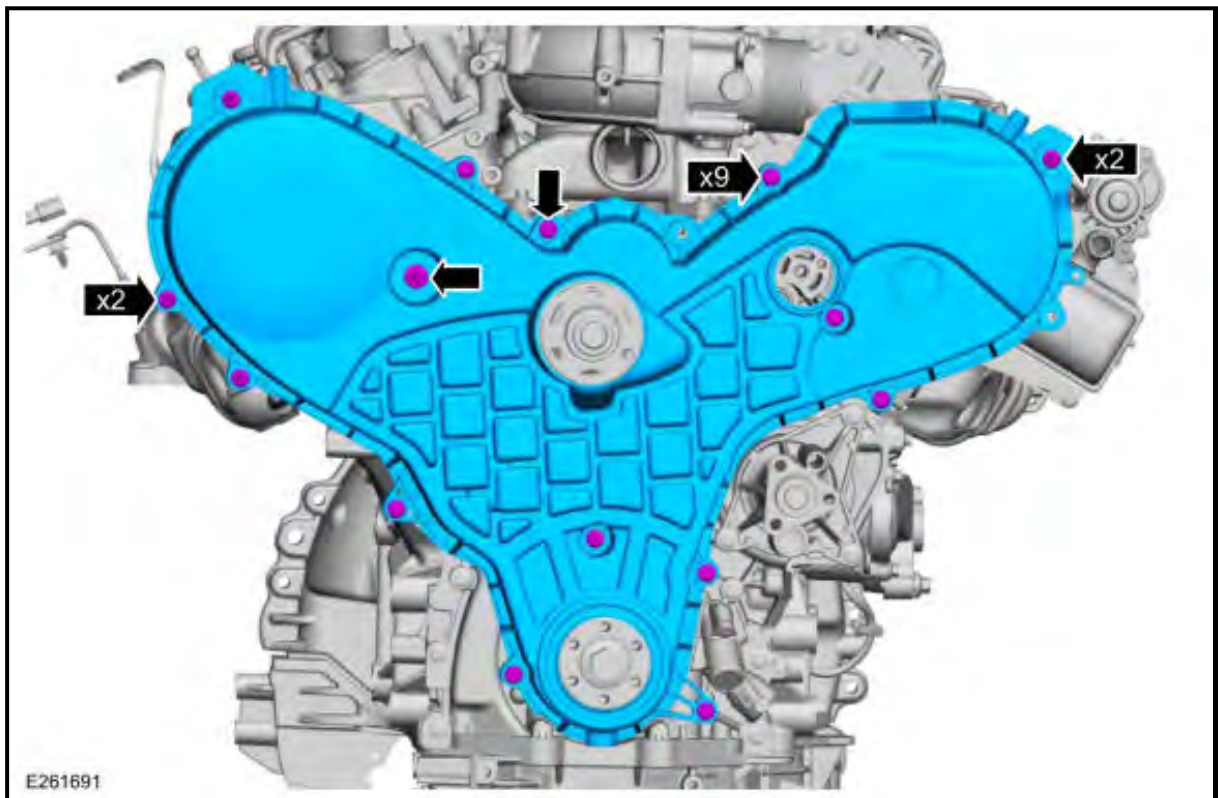




E261122

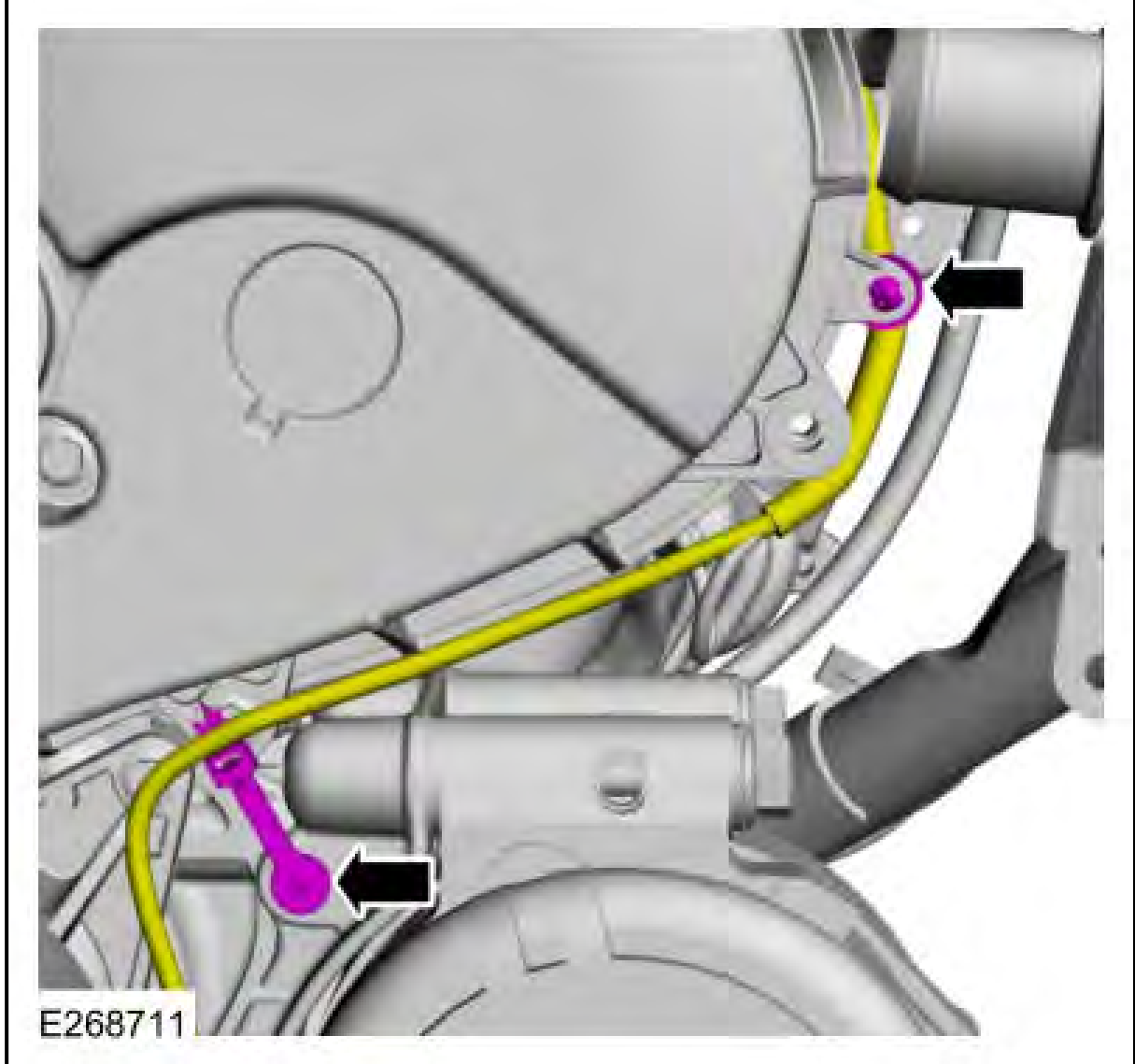
2. Install the timing belt cover and the bolts.

Torque: 89 lb.in (10 Nm)



E261691

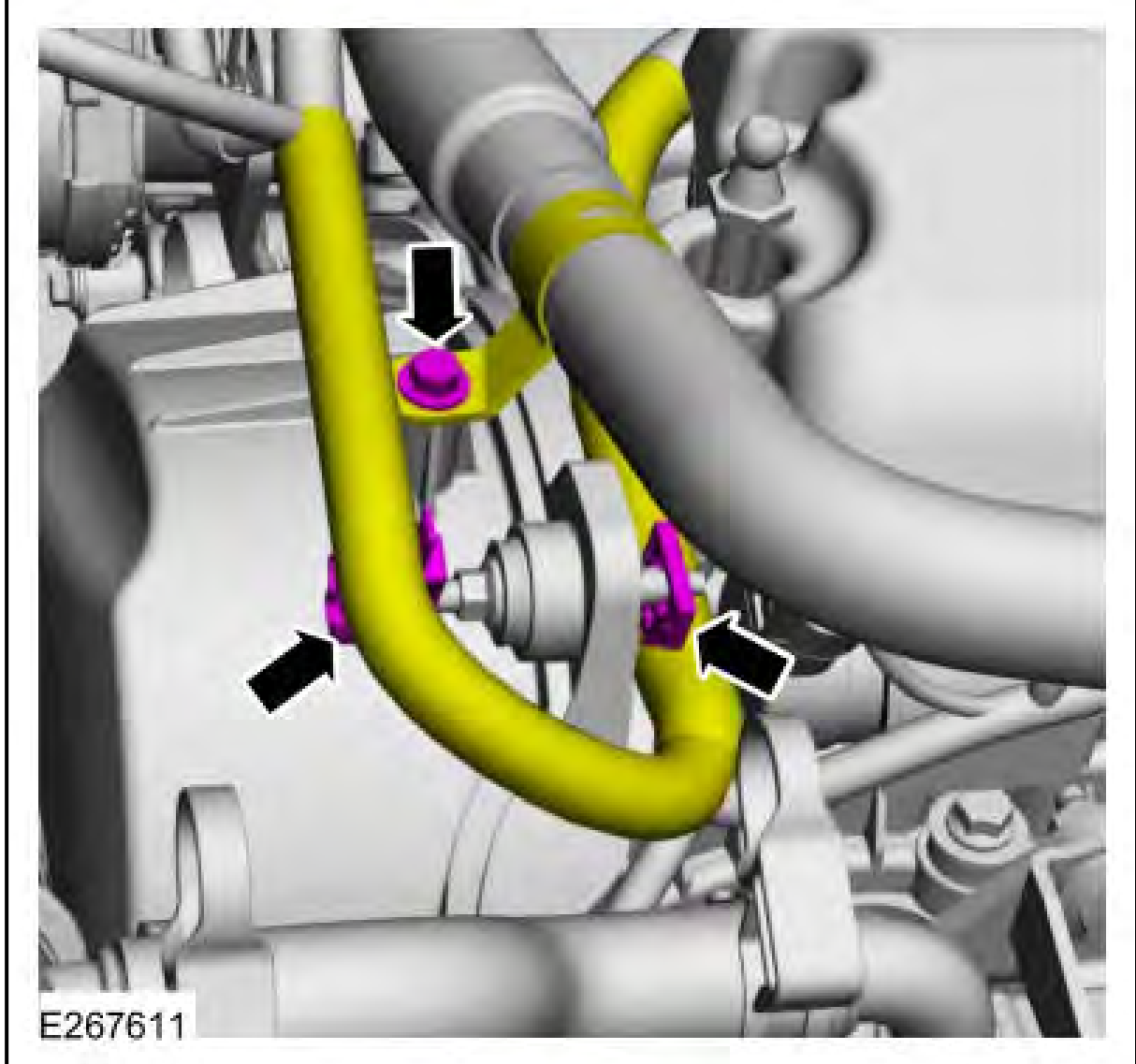
3. Position back the engine wiring and connect the retainers.



4. Position back the bracket and install the bolt. Position back the engine wiring and connect the retainers.

Torque: 31 lb.in (3.5 Nm)

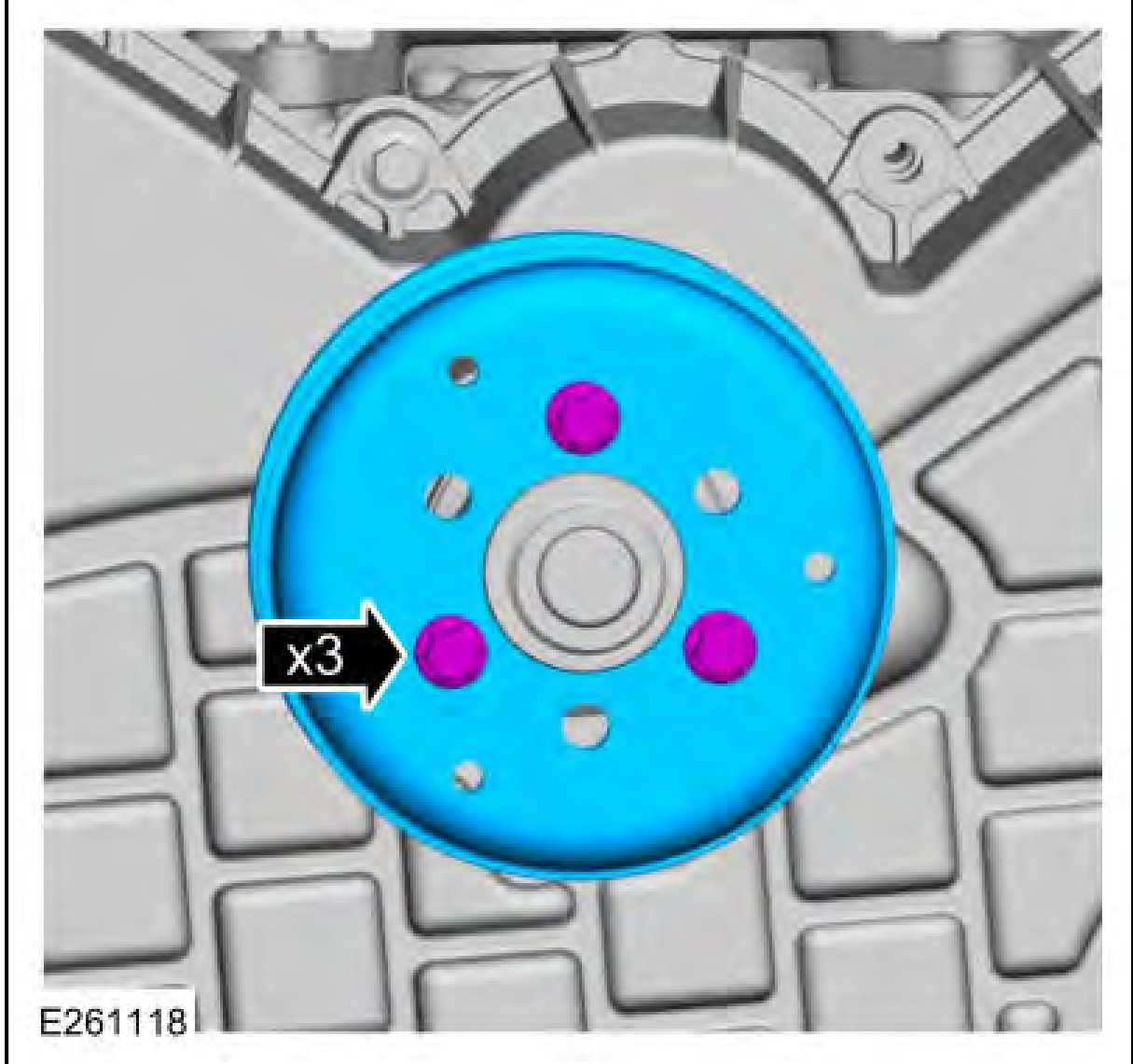




5. Install the fan pulley and the bolts.

Torque: 18 lb.ft (25 Nm)

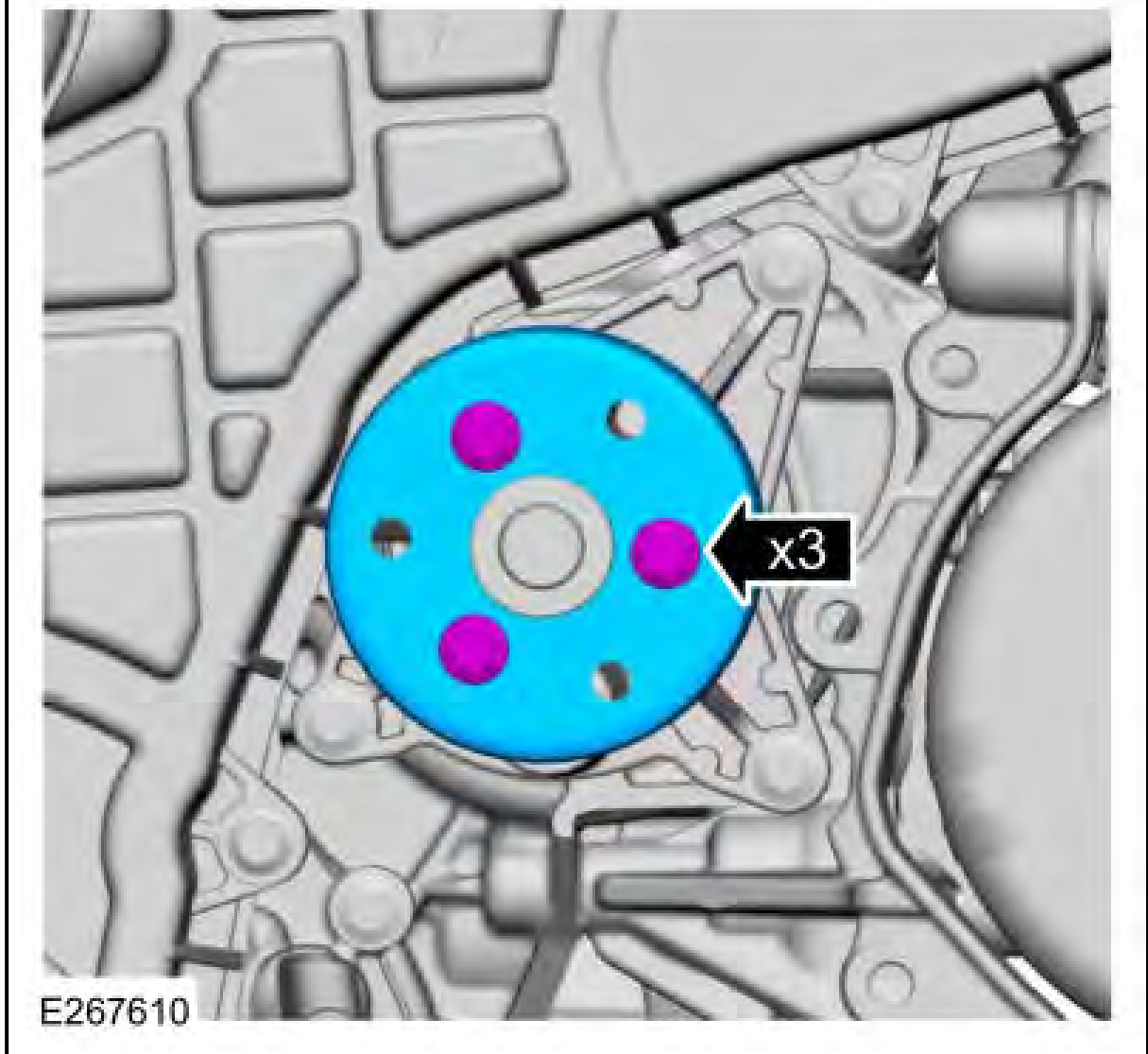




6. Install the coolant pump pulley and the bolts.

Torque: 18 lb.ft (25 Nm)

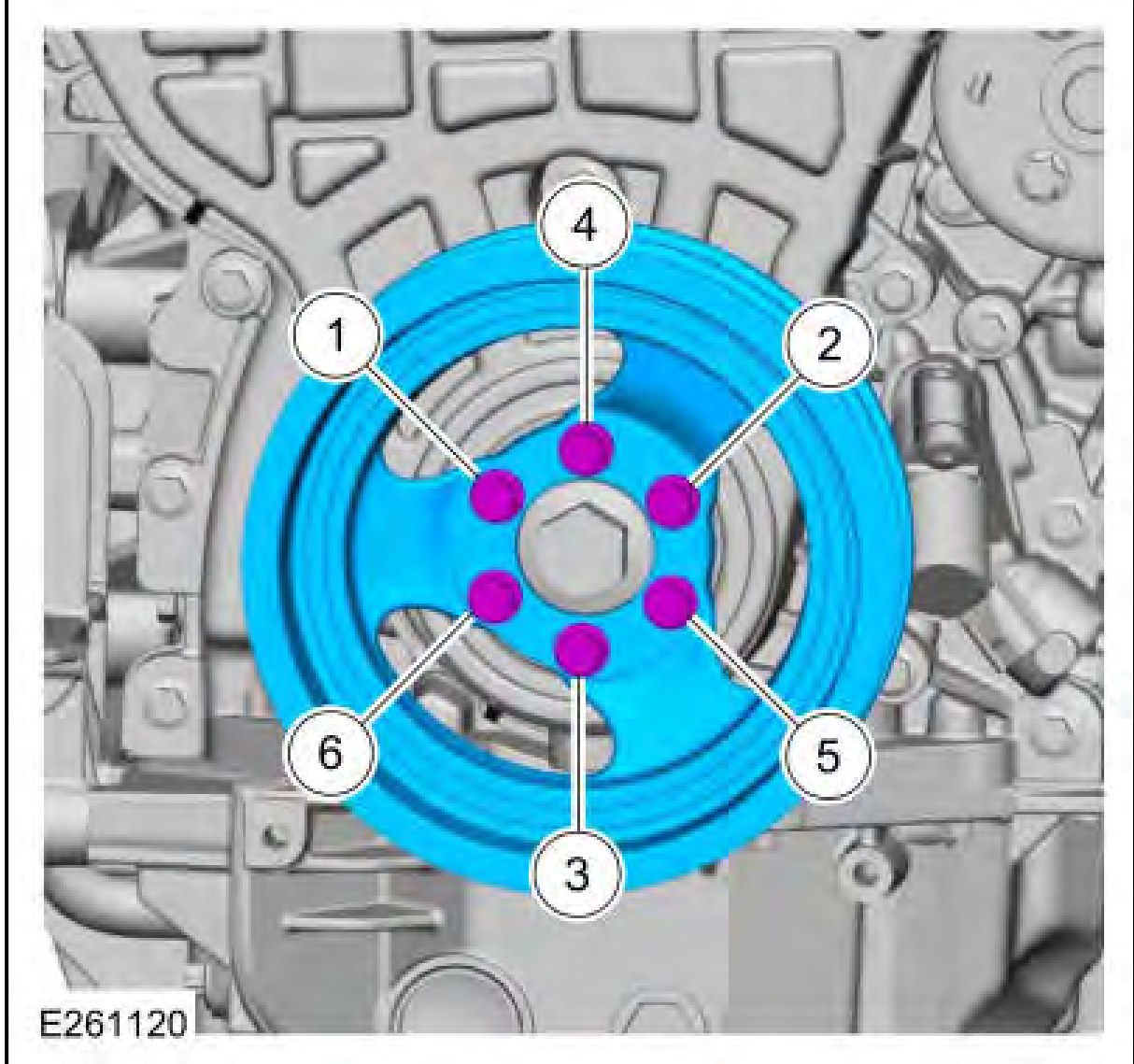




7. Install the crankshaft vibration damper and the bolts.

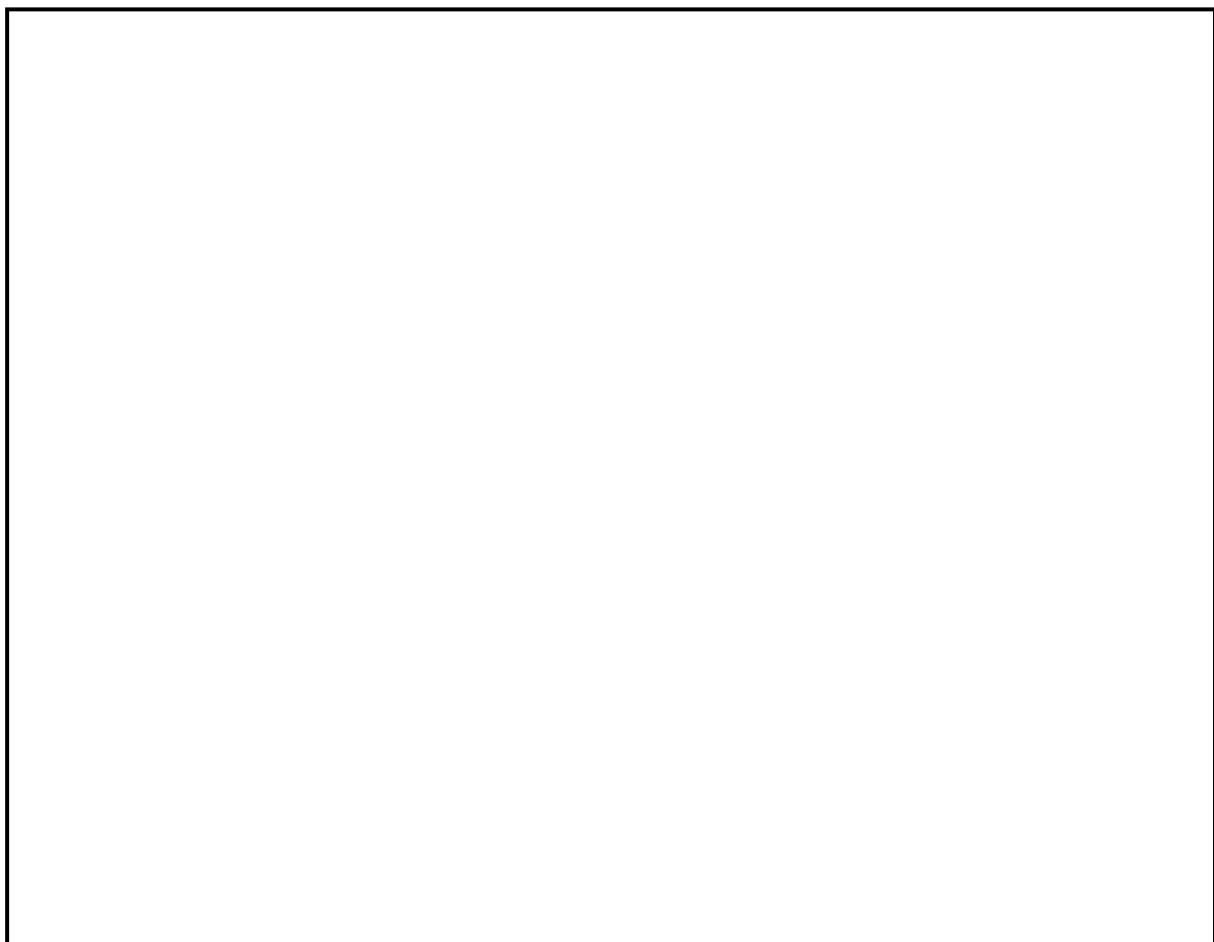
Torque: 18 lb.ft (25 Nm)



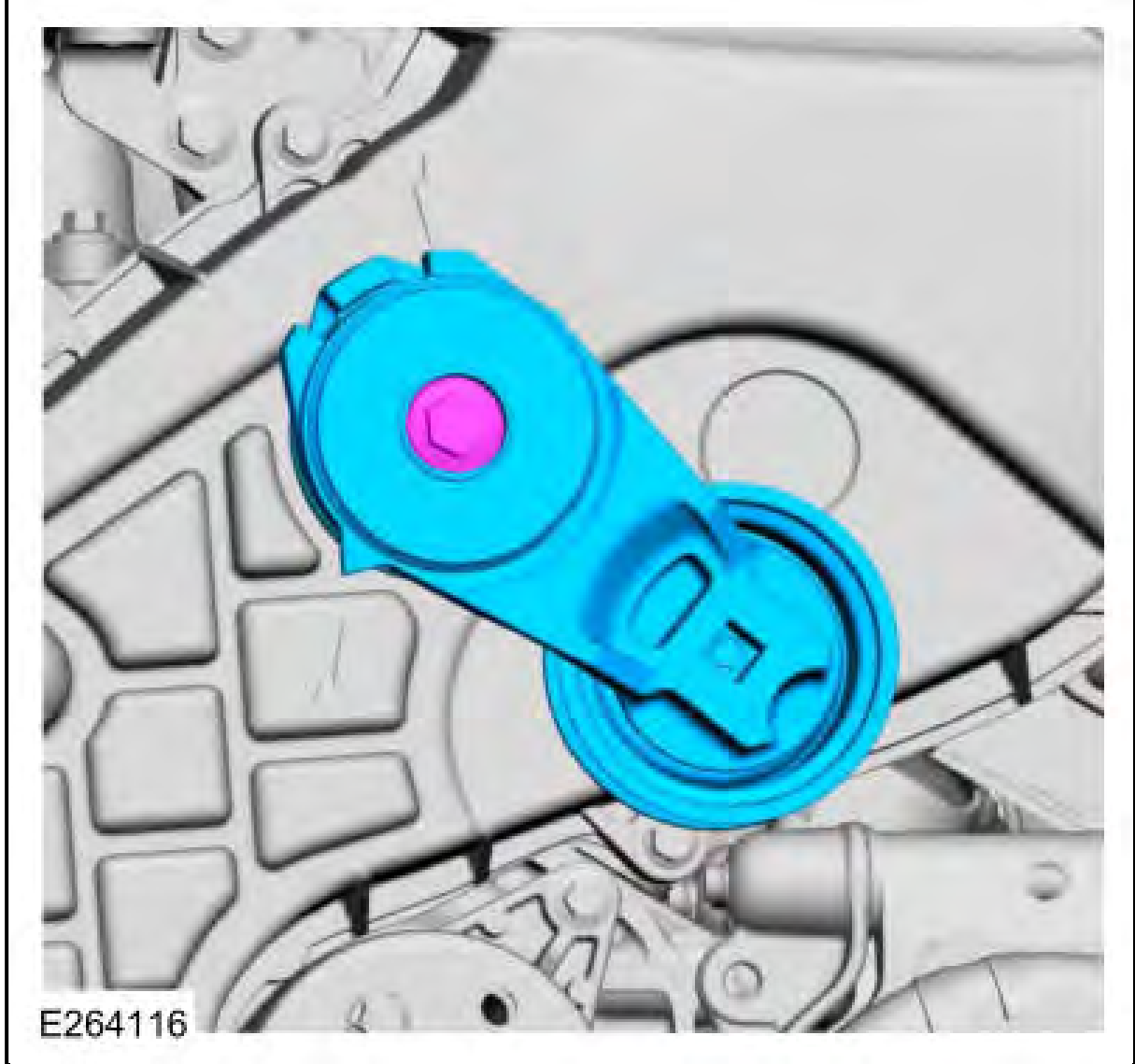


8. Install the accessory drive belt tensioner and the bolt.

Torque: 35 lb.ft (48 Nm)



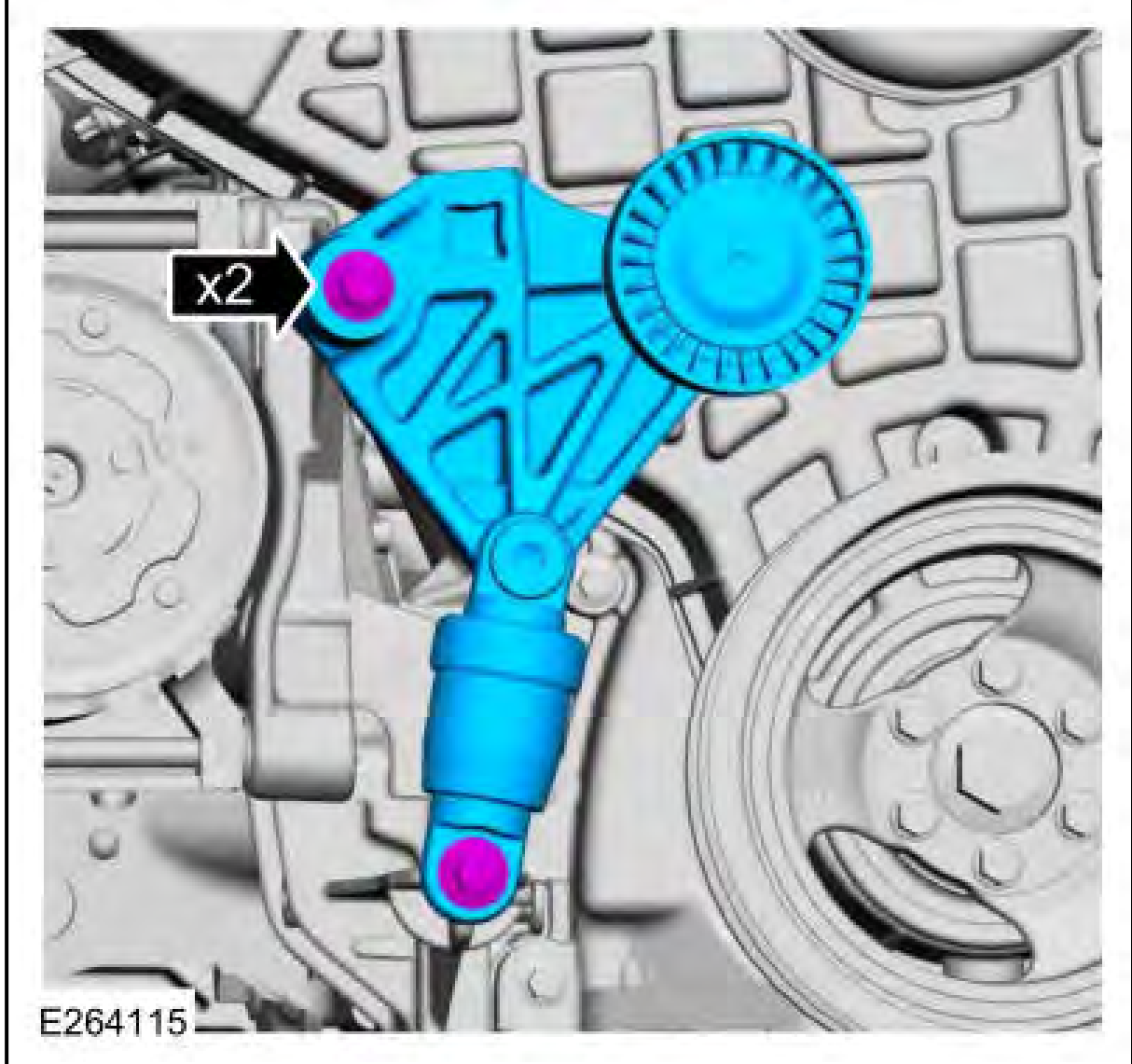




9. Install the accessory drive belt tensioner and the bolts.

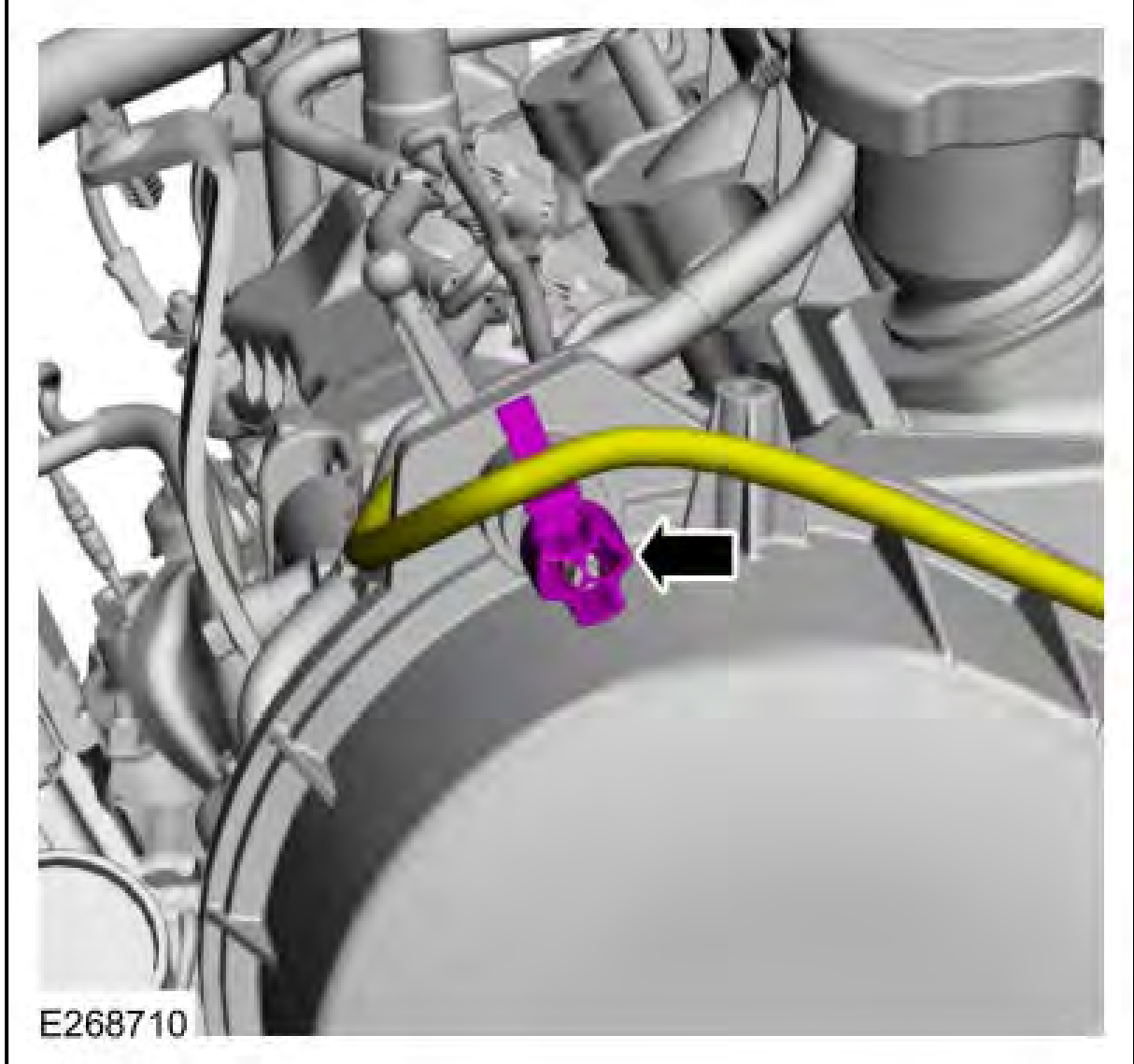
Torque: 18 lb.ft (25 Nm)





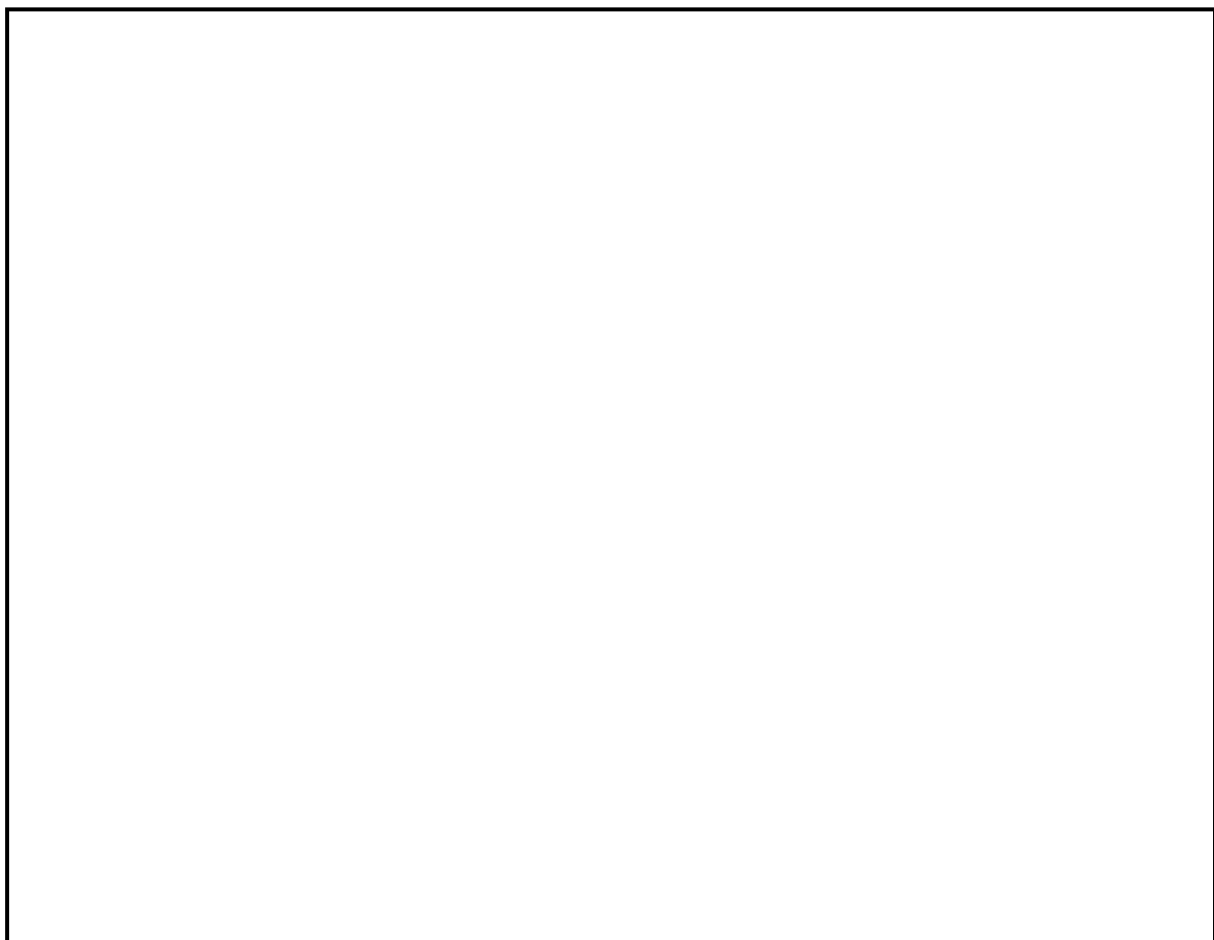
10. Position back the wiring and connect the wire retainer.

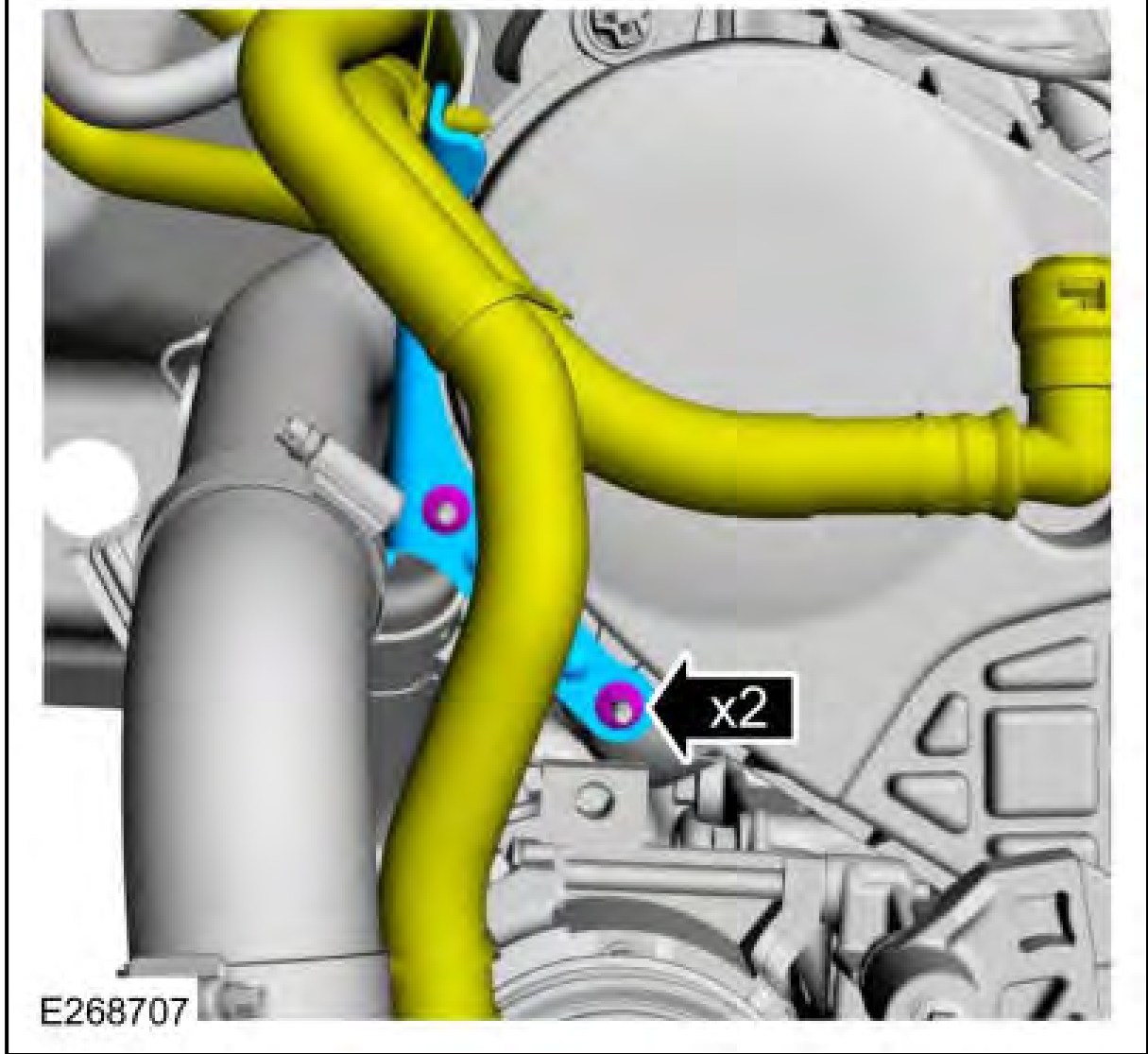




11. Position back the heater hoses. Install the nuts for the CAC tube bracket.

Torque: 53 lb.in (6 Nm)

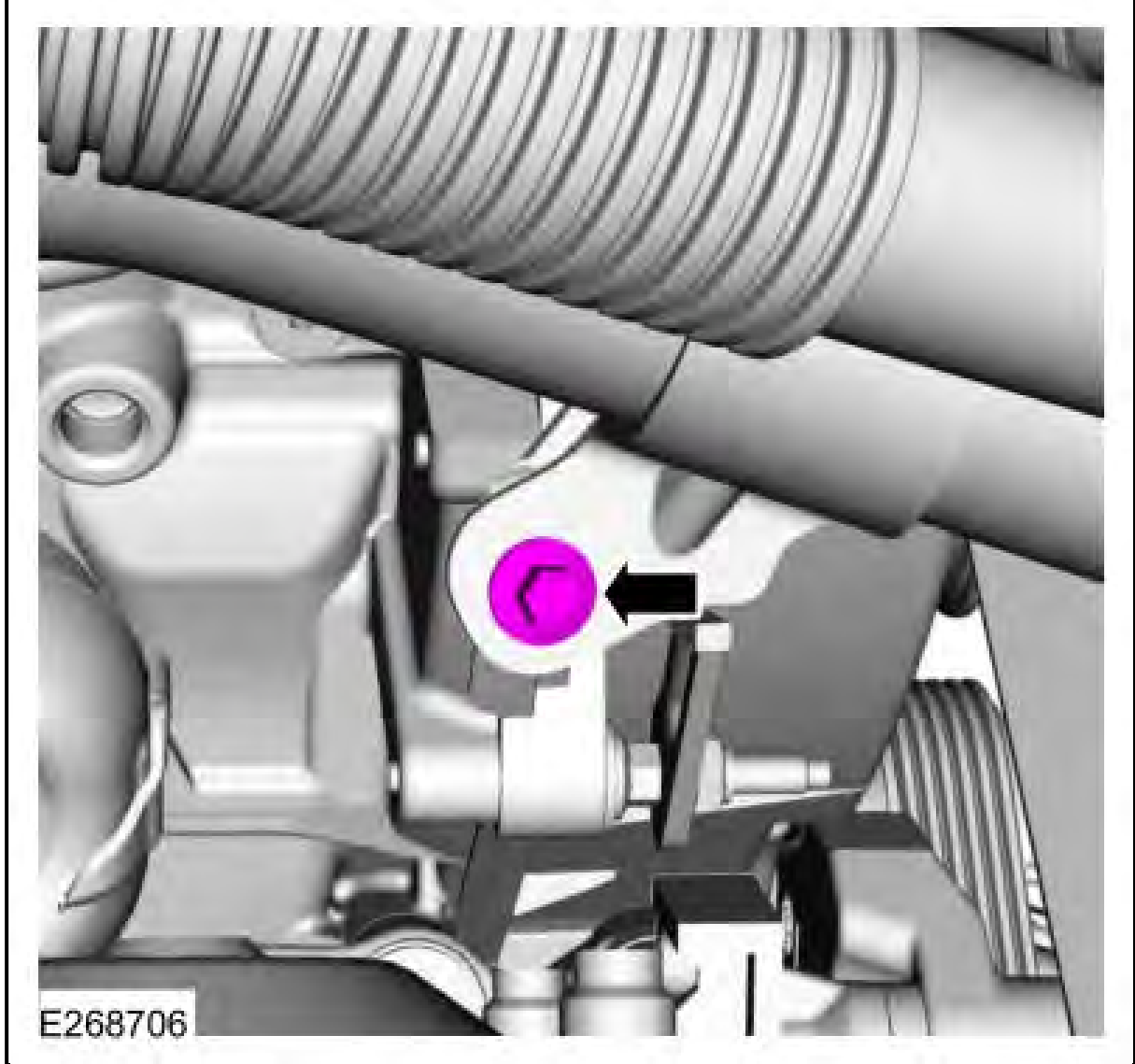




12. Install the bolt for the CAC tube.

Torque: 53 lb.in (6 Nm)

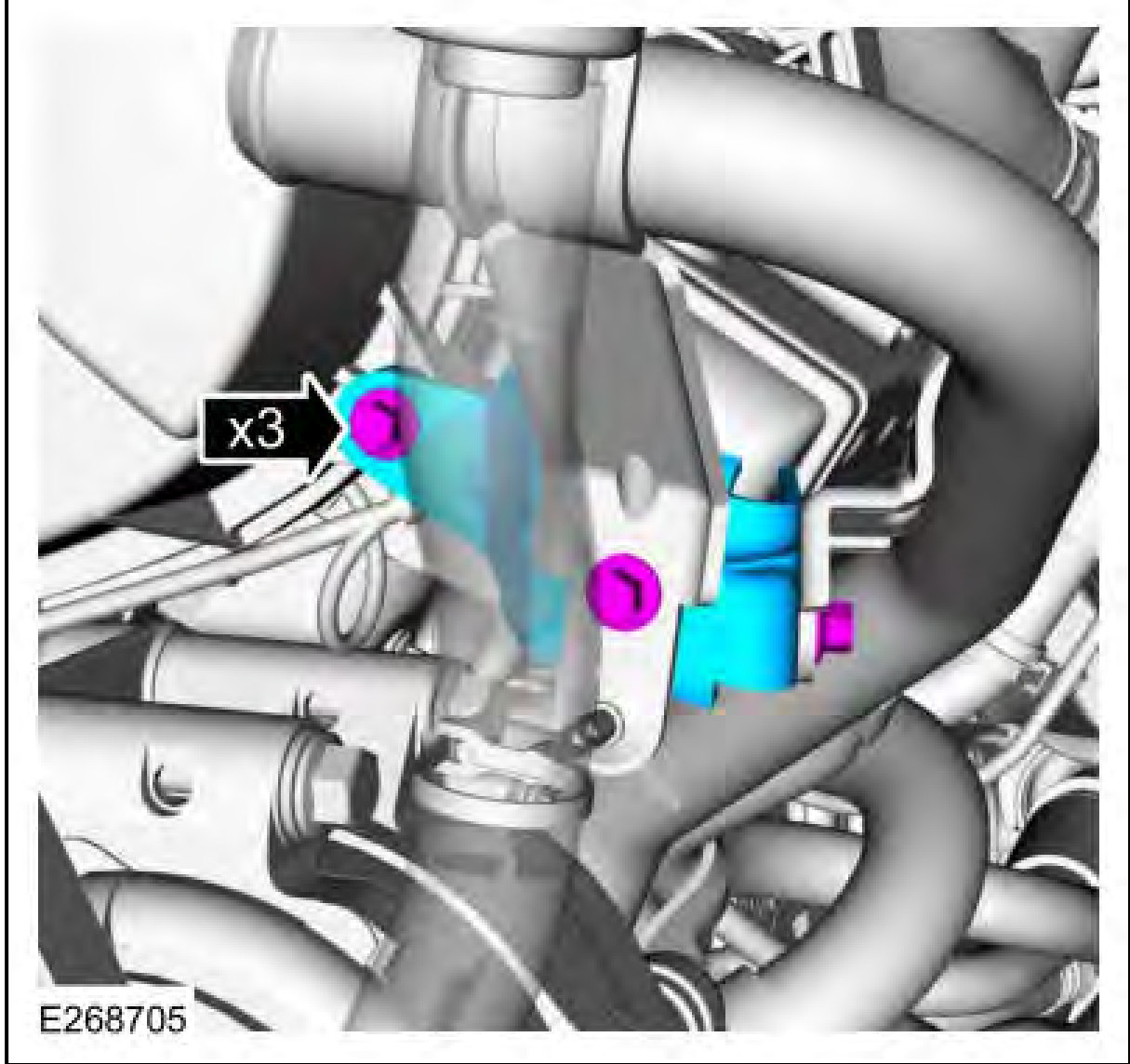




13. Install the coolant tube bracket and the bolts.

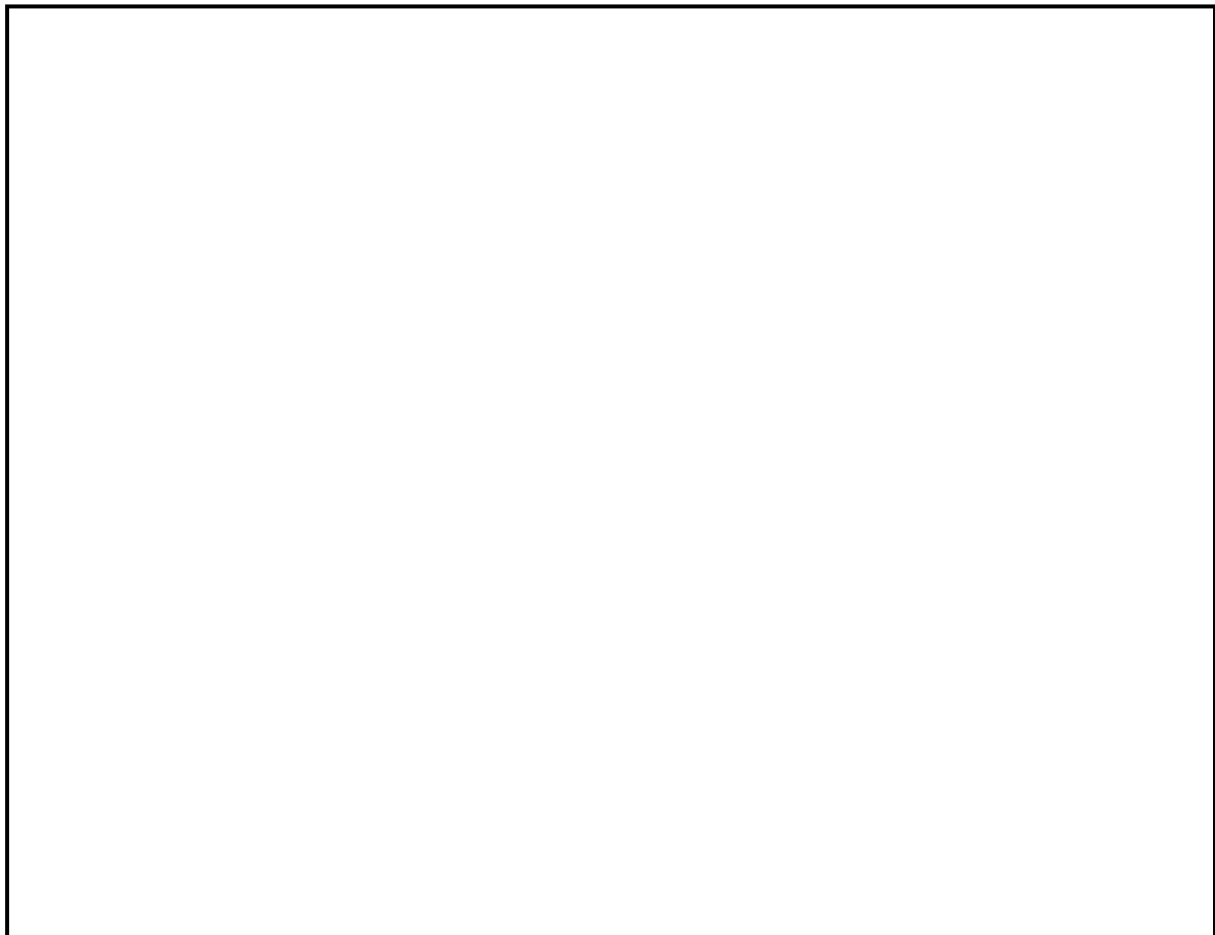
Torque: 89 lb.in (10 Nm)

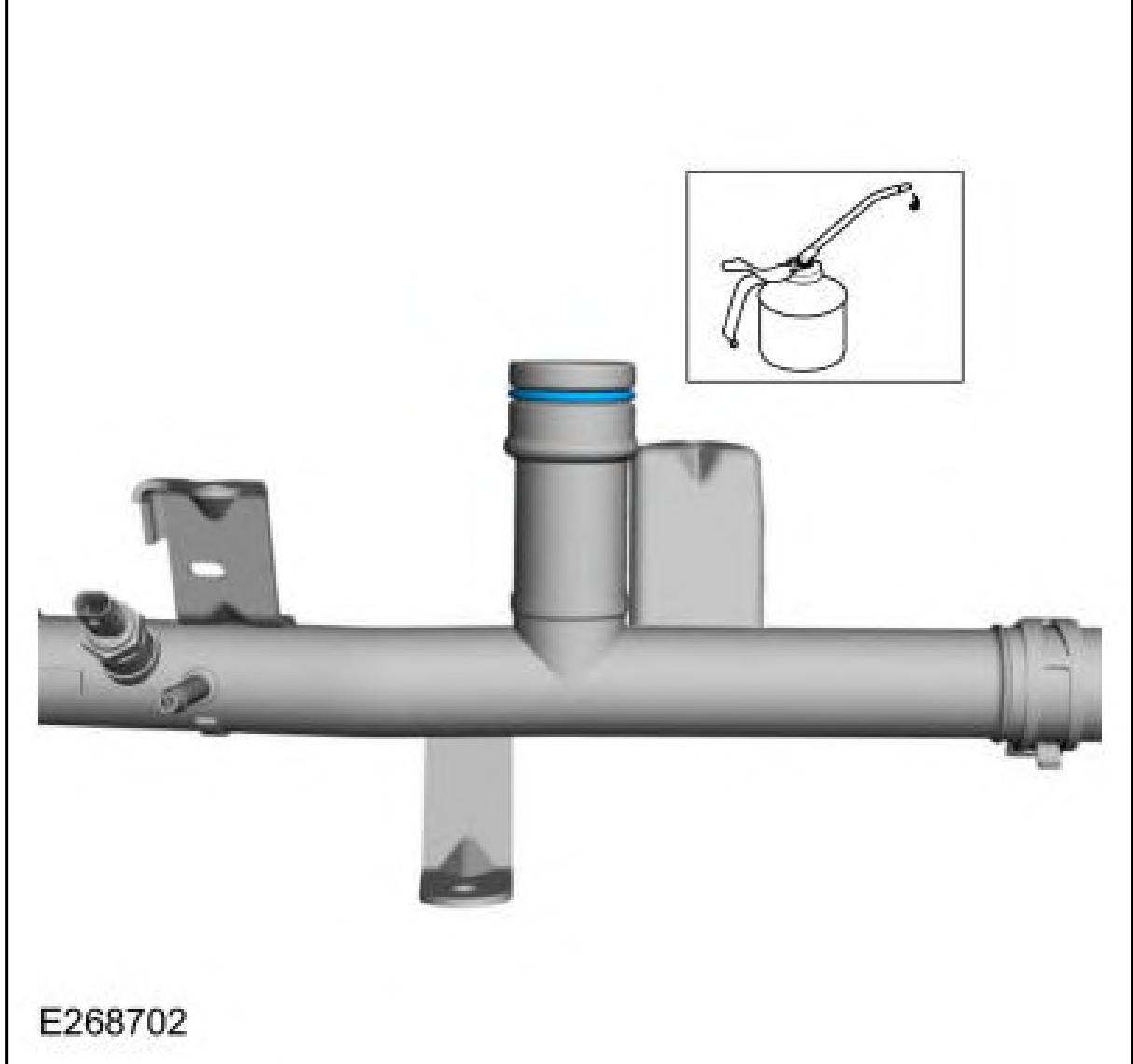




14. Install a new O-ring seal and lubricate.

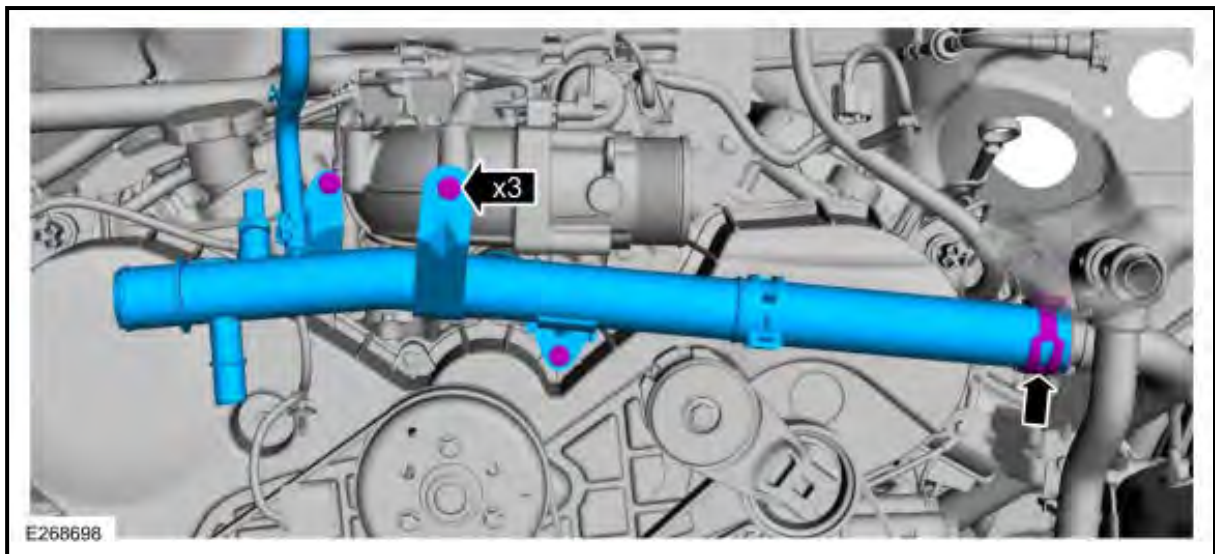
Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)





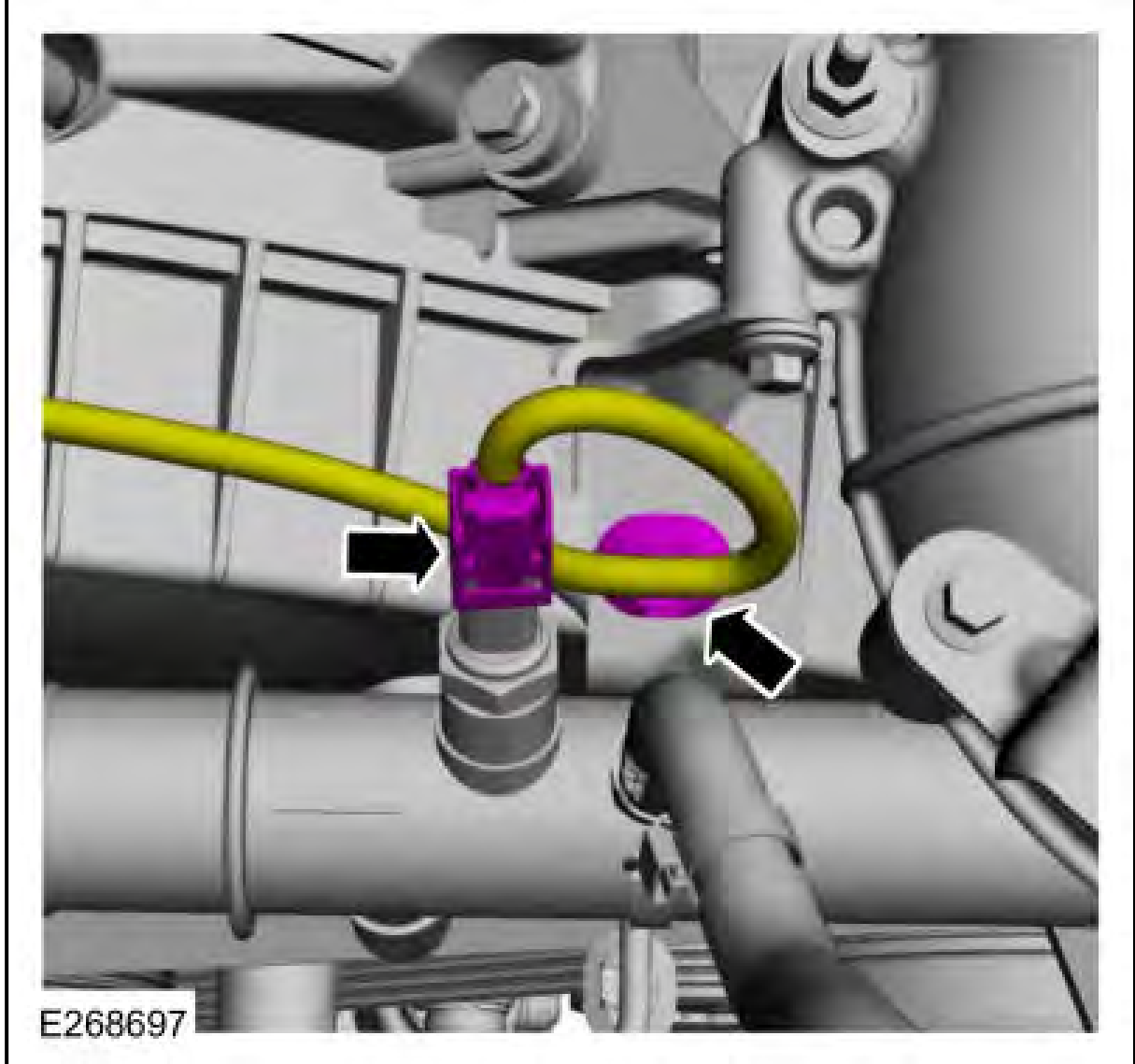
15. Install the coolant tube and connect the clamp. Install the bolts for the coolant tube. Use the General Equipment: Hose Clamp Remover/Installer

Torque: 89 lb.in (10 Nm)



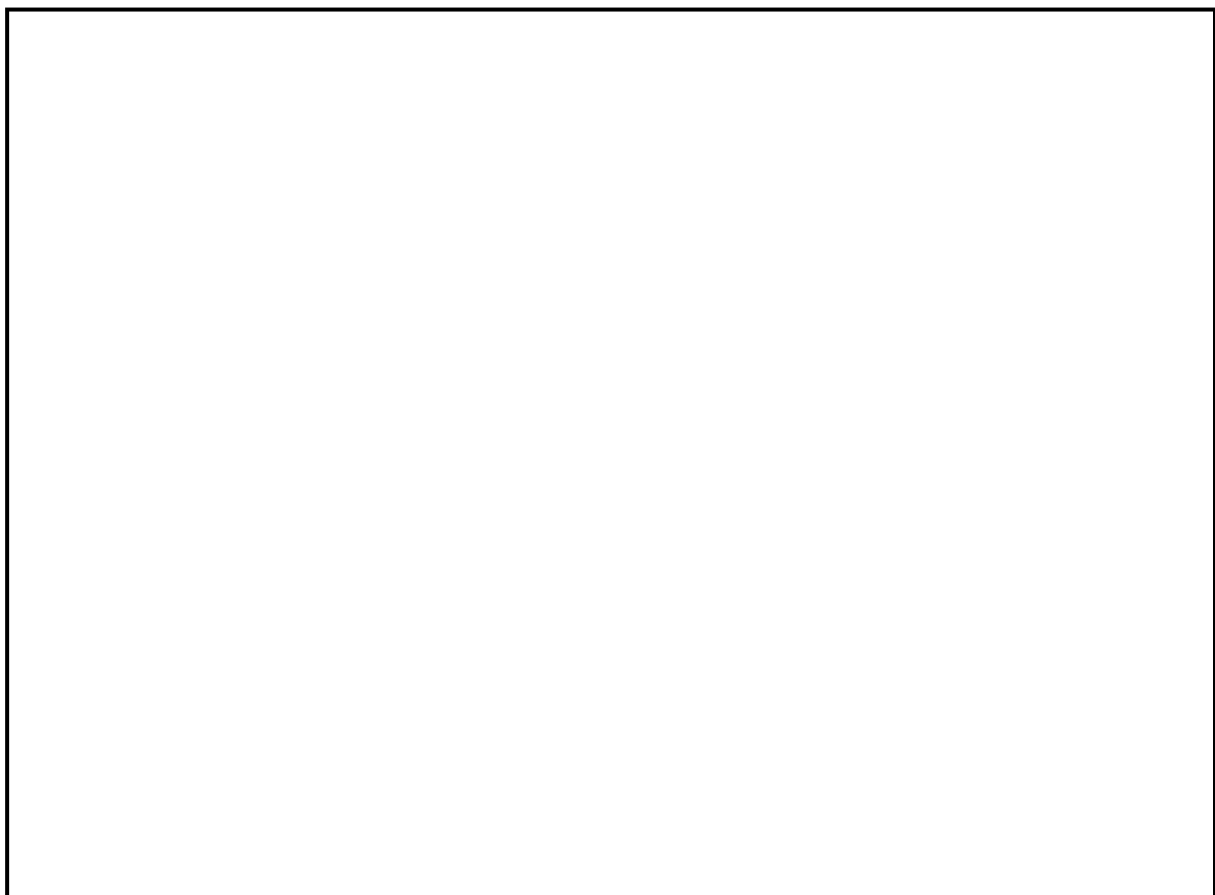
16. Connect the ECT sensor electrical connector and the wire retainer.



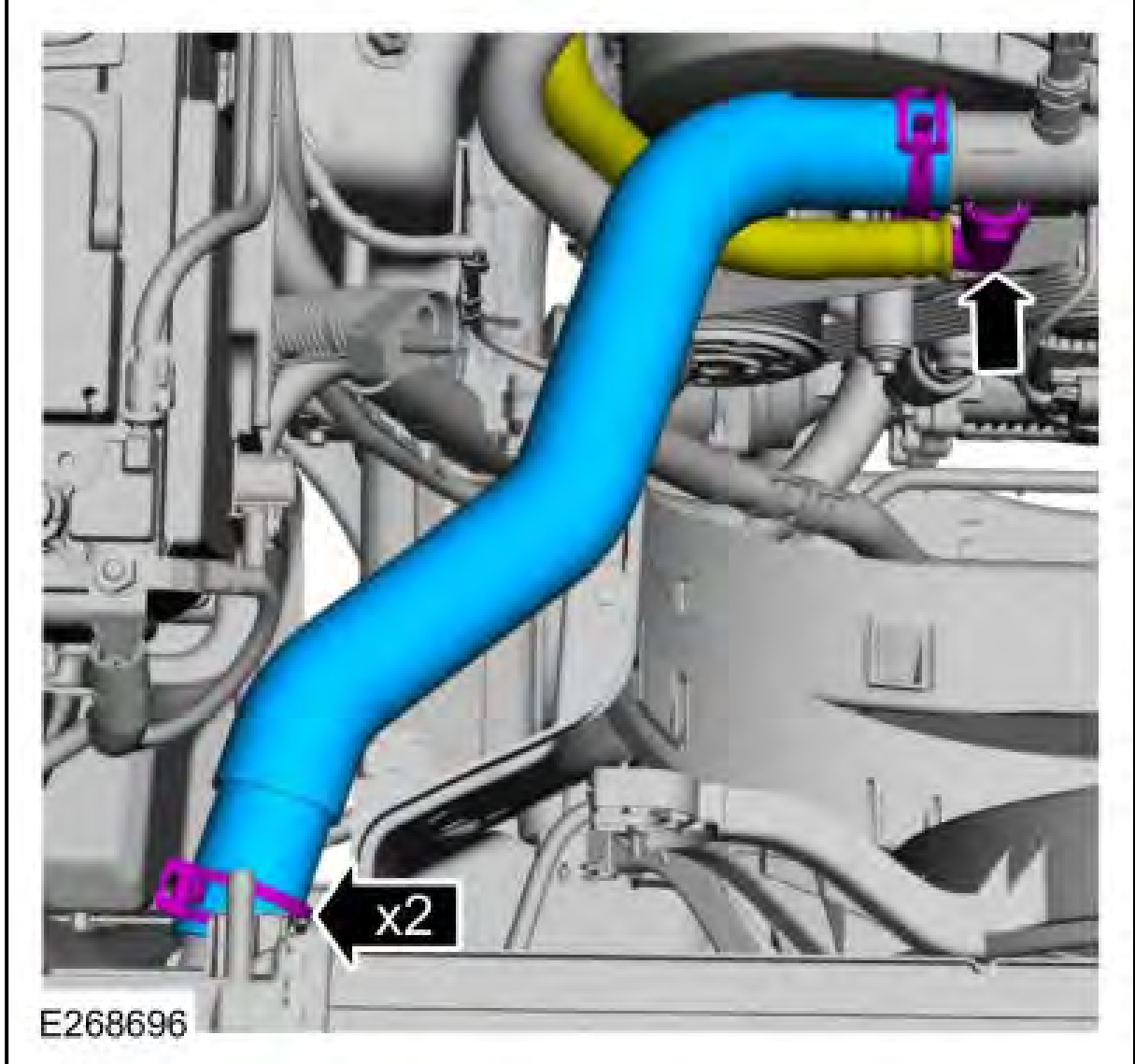


17.

- Position back and connect the heater hose.
- Install the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer





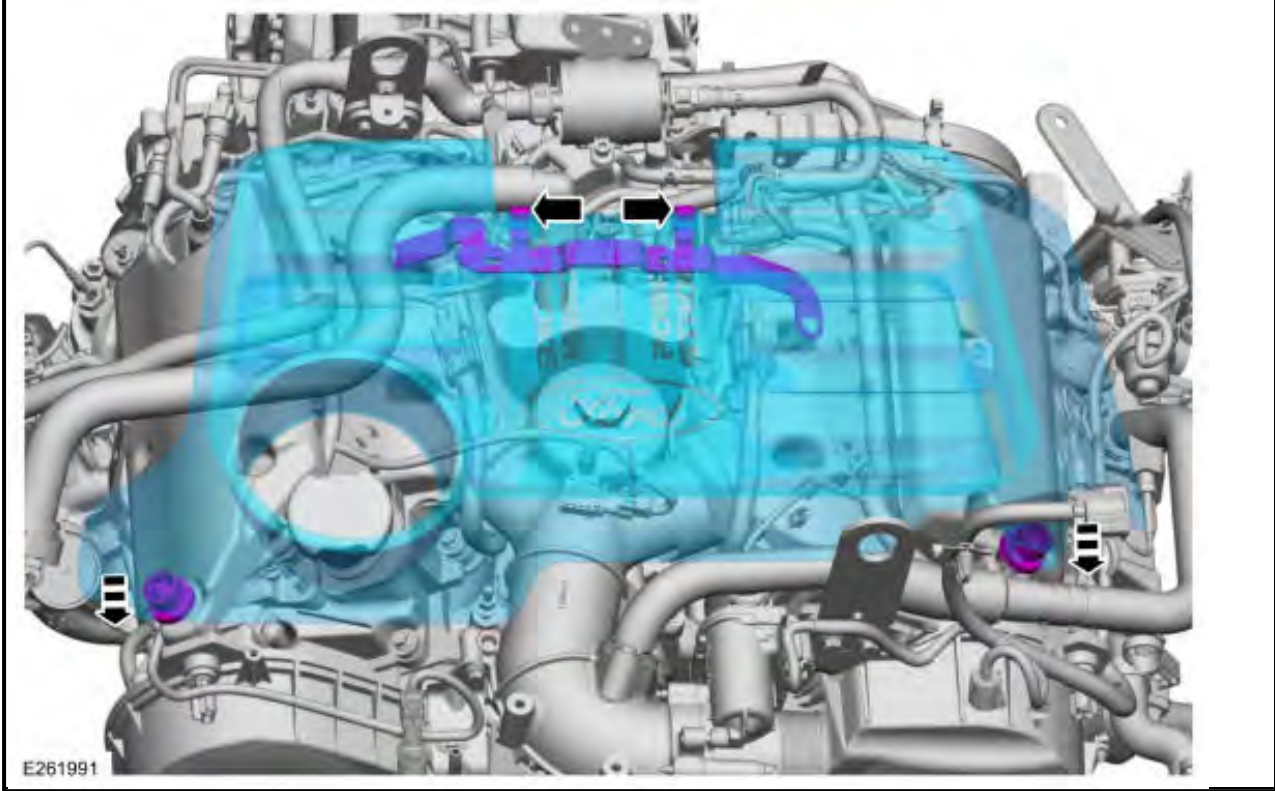


18. Install the following items:

1. Install the accessory drive belt. REFER to: [Accessory Drive Belt](#) .
2. Install the CAC outlet pipe. REFER to: [Charge Air Cooler \(CAC\) Outlet Pipe](#) .
3. Install the air cleaner outlet pipe. REFER to: [Air Cleaner Outlet Pipe](#) .
4. Install the cooling fan. REFER to: [Cooling Fan](#) .

19. Evaluate the cooling condition. REFER to: [Cooling System Condition Evaluation](#) .

20. Install the engine appearance cover.



## VALVE COVER LH

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

### Special Tool(s) / General Equipment

|                 |
|-----------------|
| Plastic Scraper |
|-----------------|

### Materials

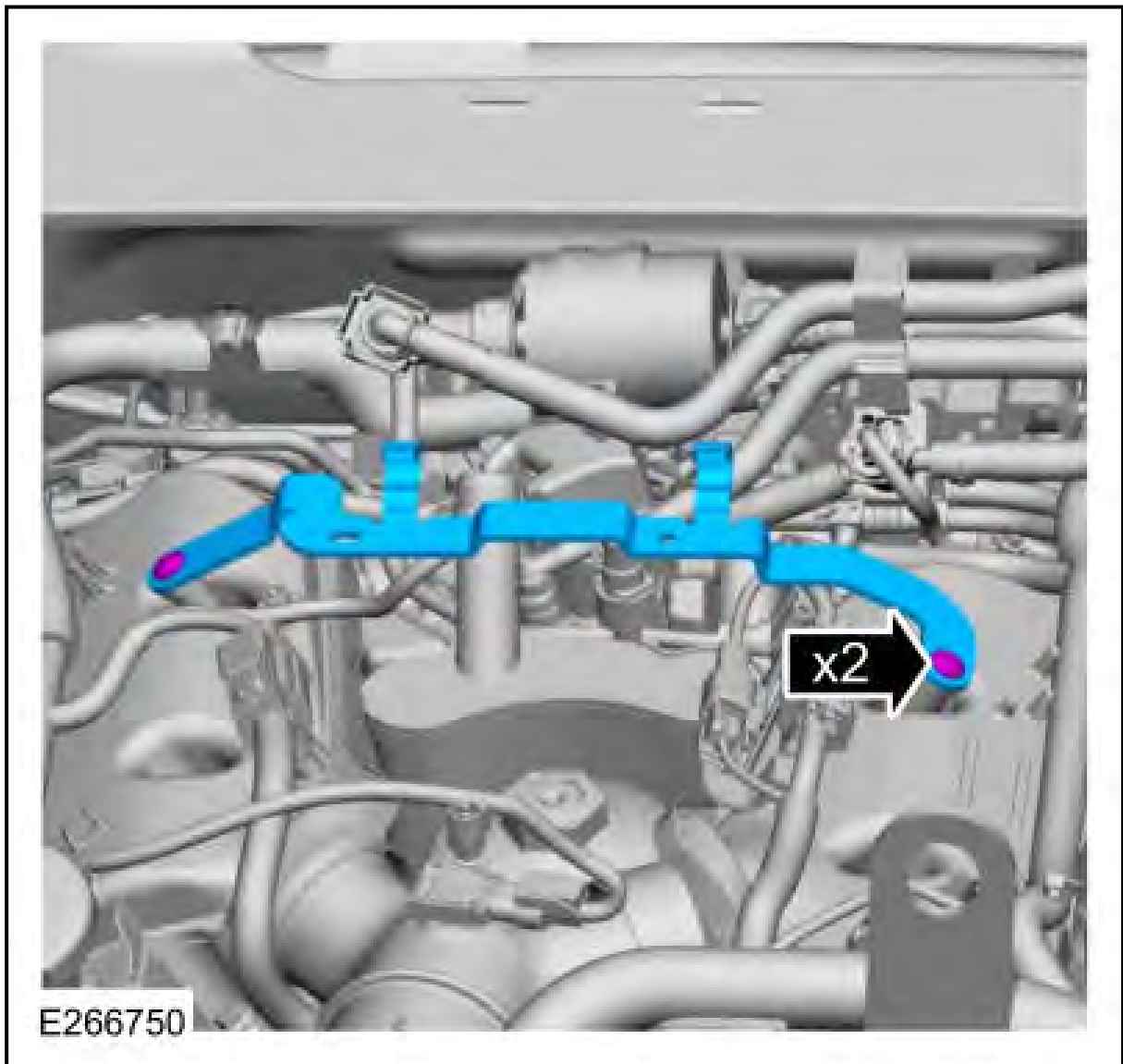
| Name  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> High Performance Engine RTV Silicone TA-357 | WSE-M4G323-A6 |
| Motorcraft <sup>®</sup> Silicone Gasket Remover ZC-30-A             | -             |
| Motorcraft <sup>®</sup> Metal Surface Prep ZC-31-A                  | -             |
| Motorcraft <sup>®</sup> Metal Brake Parts Cleaner PM-4-A, PM-4-B    | -             |

## REMOVAL

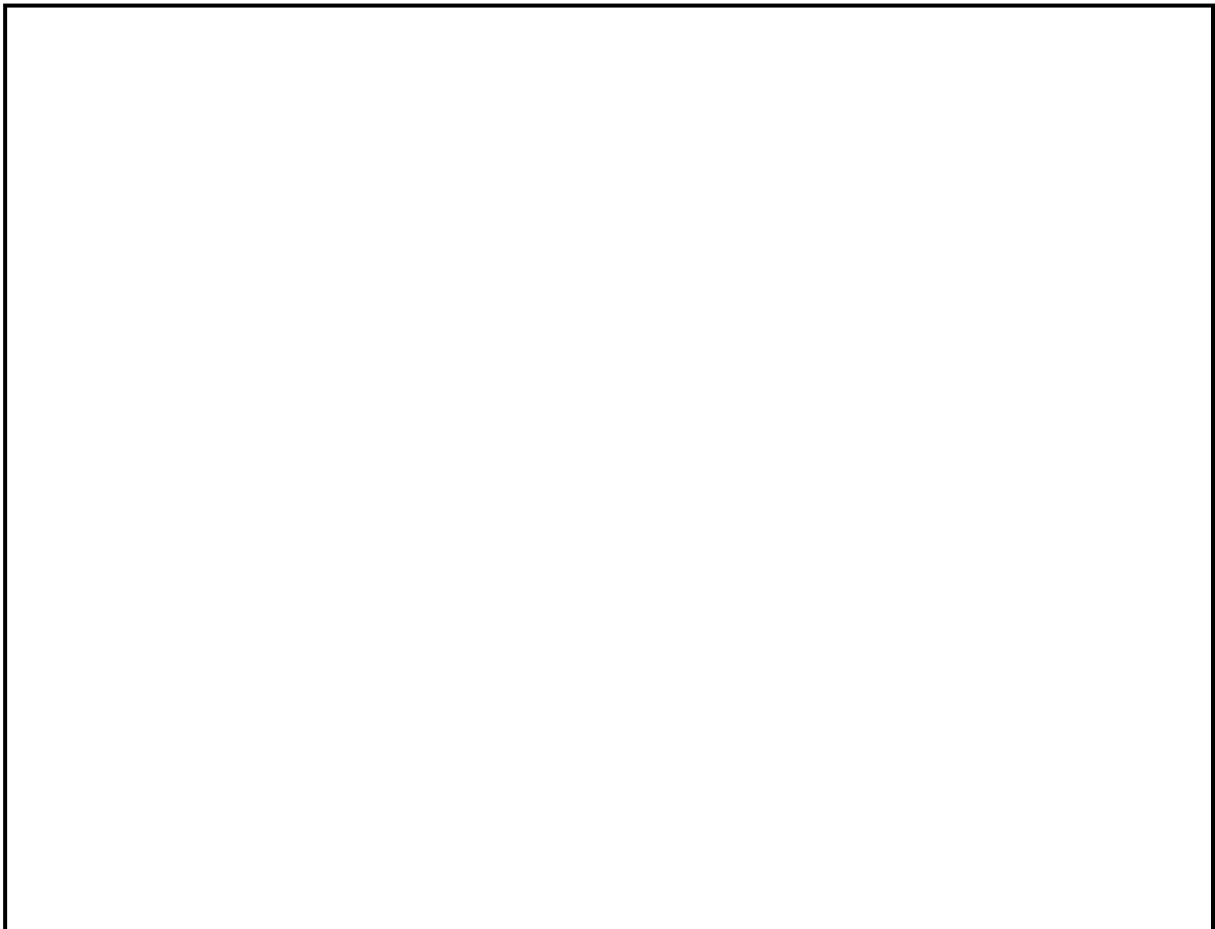
**NOTE:** During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

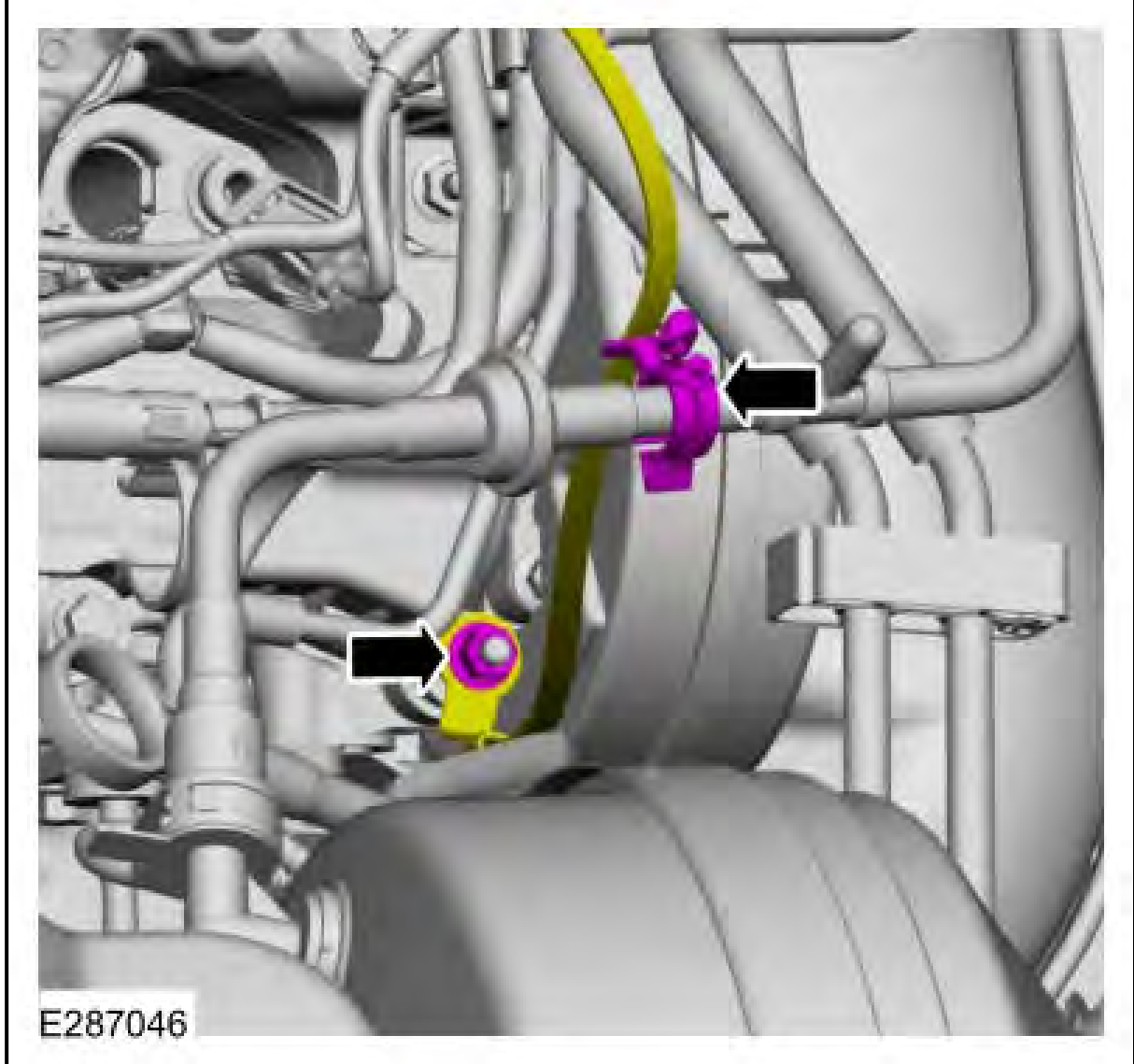
1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Remove the following items:
  1. Remove the intake manifold. REFER to: [Intake Manifold](#) .
  2. Remove the EGR system module. REFER to: [Exhaust Gas Recirculation \(EGR\) System Module](#) .
  3. Remove the fuel rail balance tube. REFER to: [Fuel Rail Balance Tube](#) .
  4. Remove the LH fuel rail supply tube. REFER to: [Fuel Rail Supply Tube LH](#) .
  5. Remove the LH fuel injector supply tube. REFER to: [Fuel Injector Supply Tube LH](#) .
  6. Remove the LH fuel injectors. REFER to: [Fuel Injectors LH](#) .
  7. Remove the LH fuel rail. REFER to: [Fuel Rail LH](#) .
  8. Remove the accessory drive belt. REFER to: [Accessory Drive Belt](#) .

3. Remove the retainers and the engine appearance cover bracket.

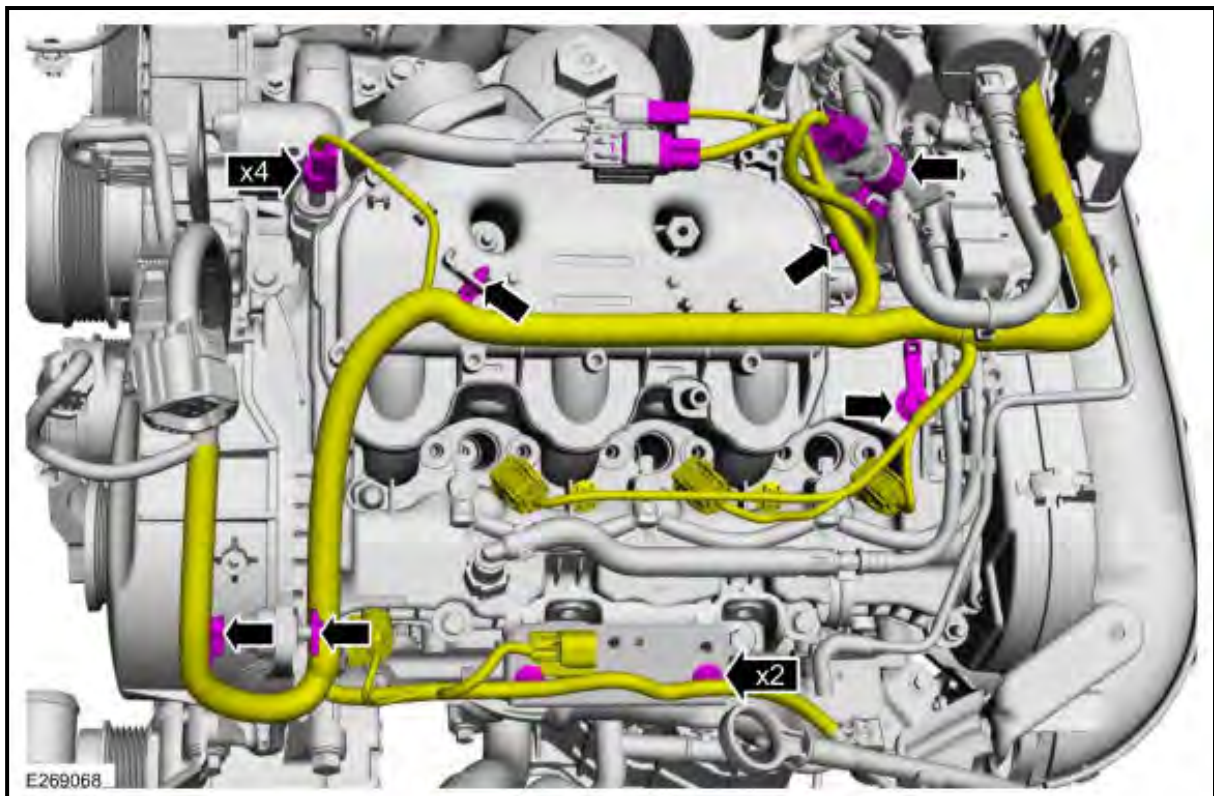


4. Disconnect the wire retainer. Remove the nut and position aside the ground strap.

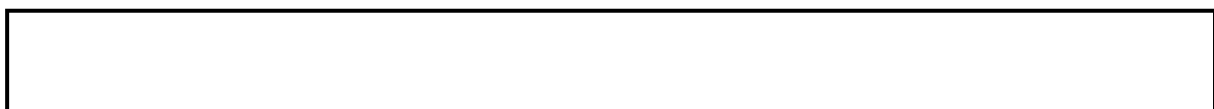


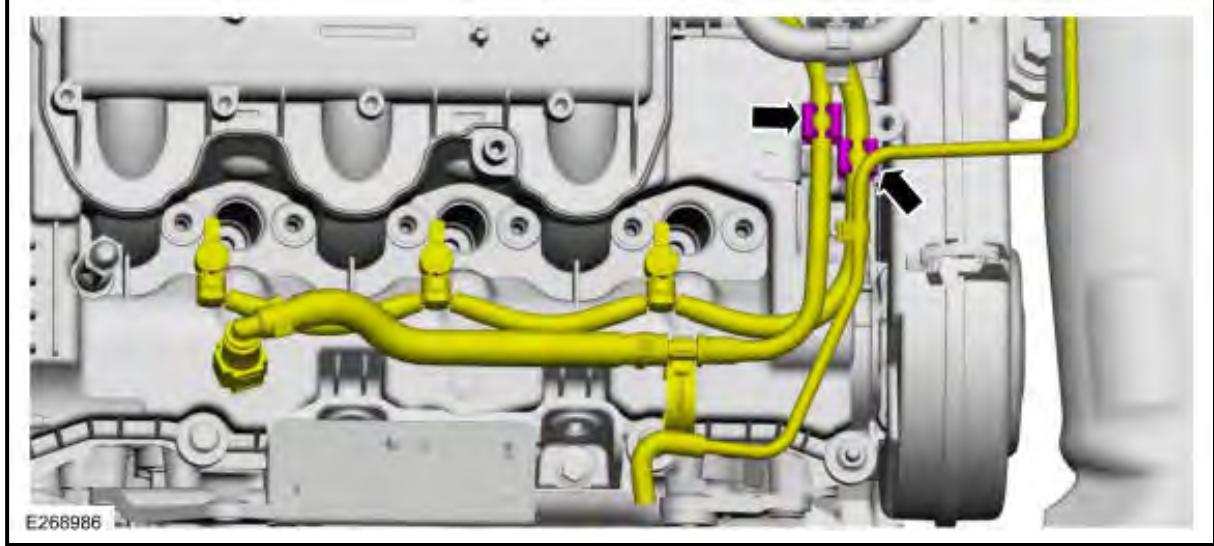


5. Disconnect the electrical connectors and wire harness retainers. Position aside the wire harness.

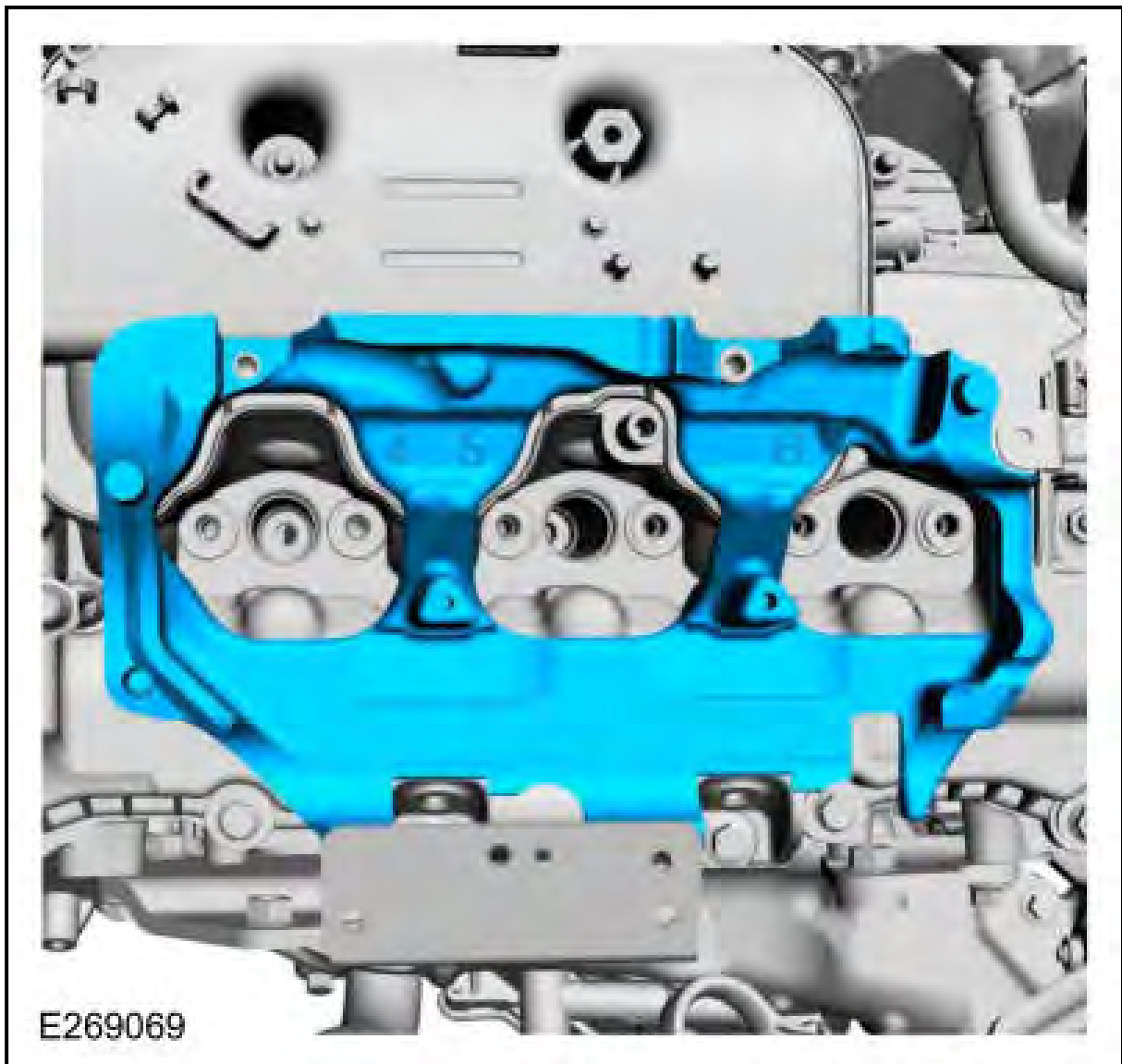


6. Disconnect the fuel hoses and position aside.



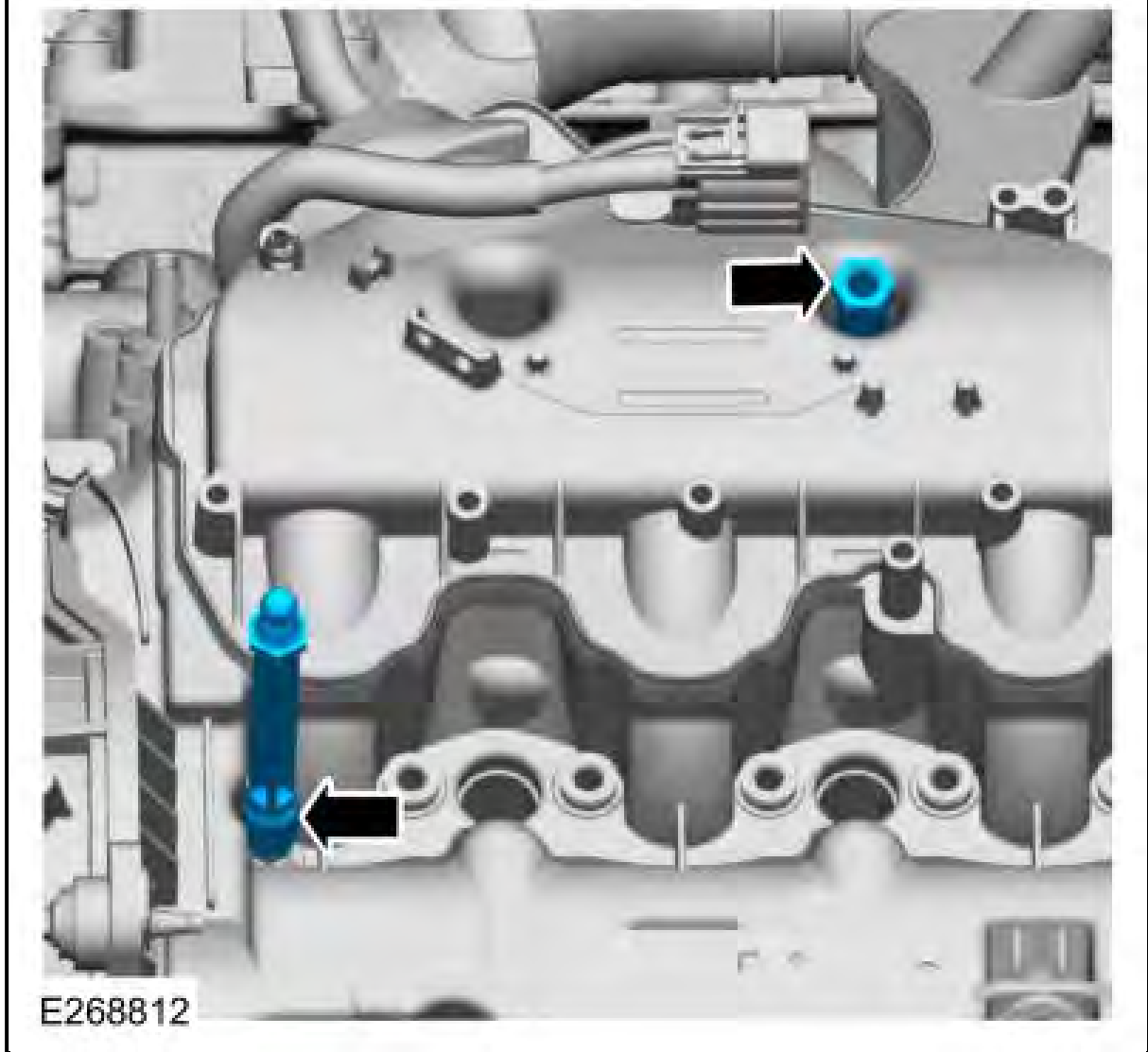


7. Remove the LH lower insulator.

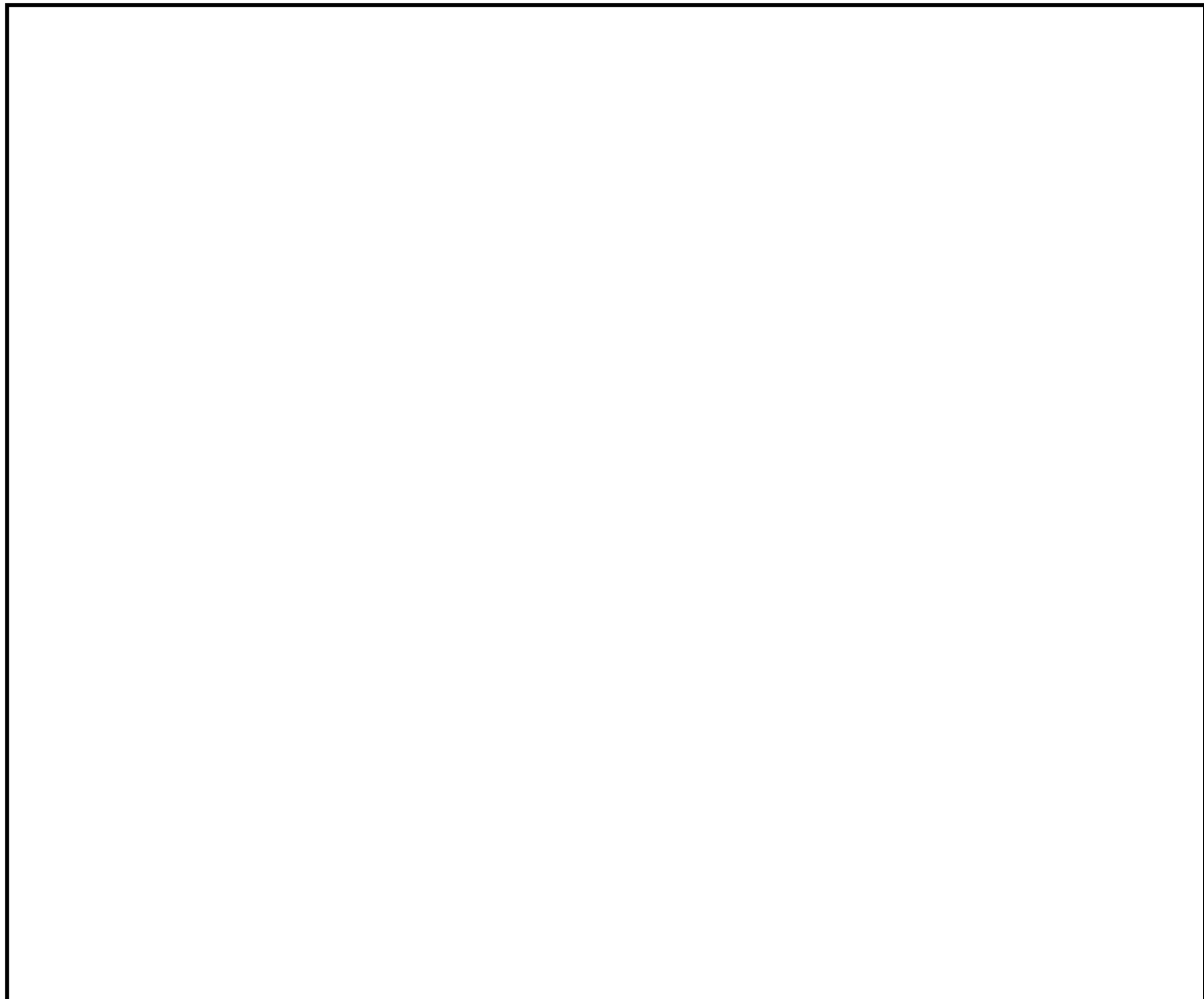


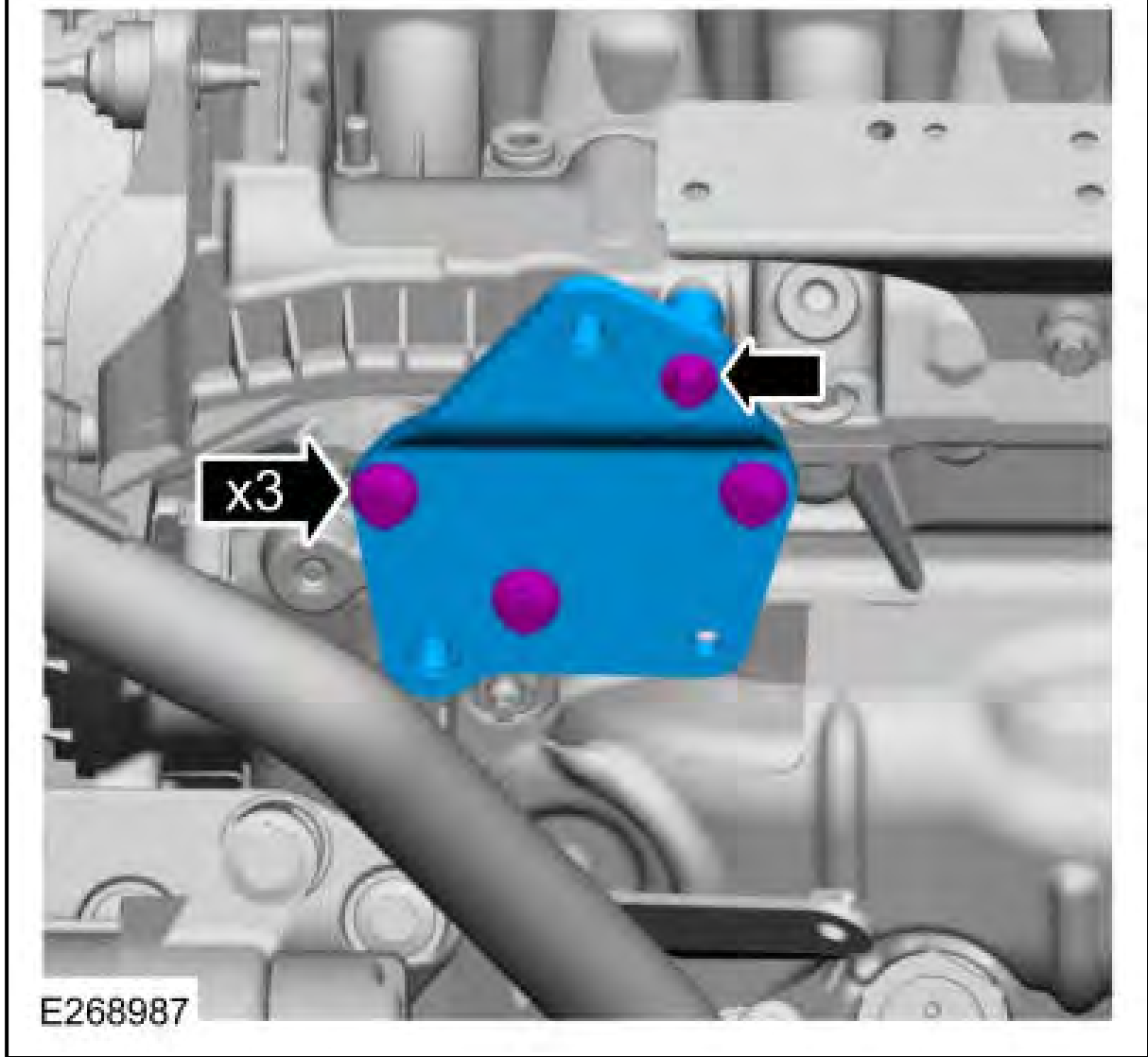
8. Remove the LH engine cover stud assemblies.



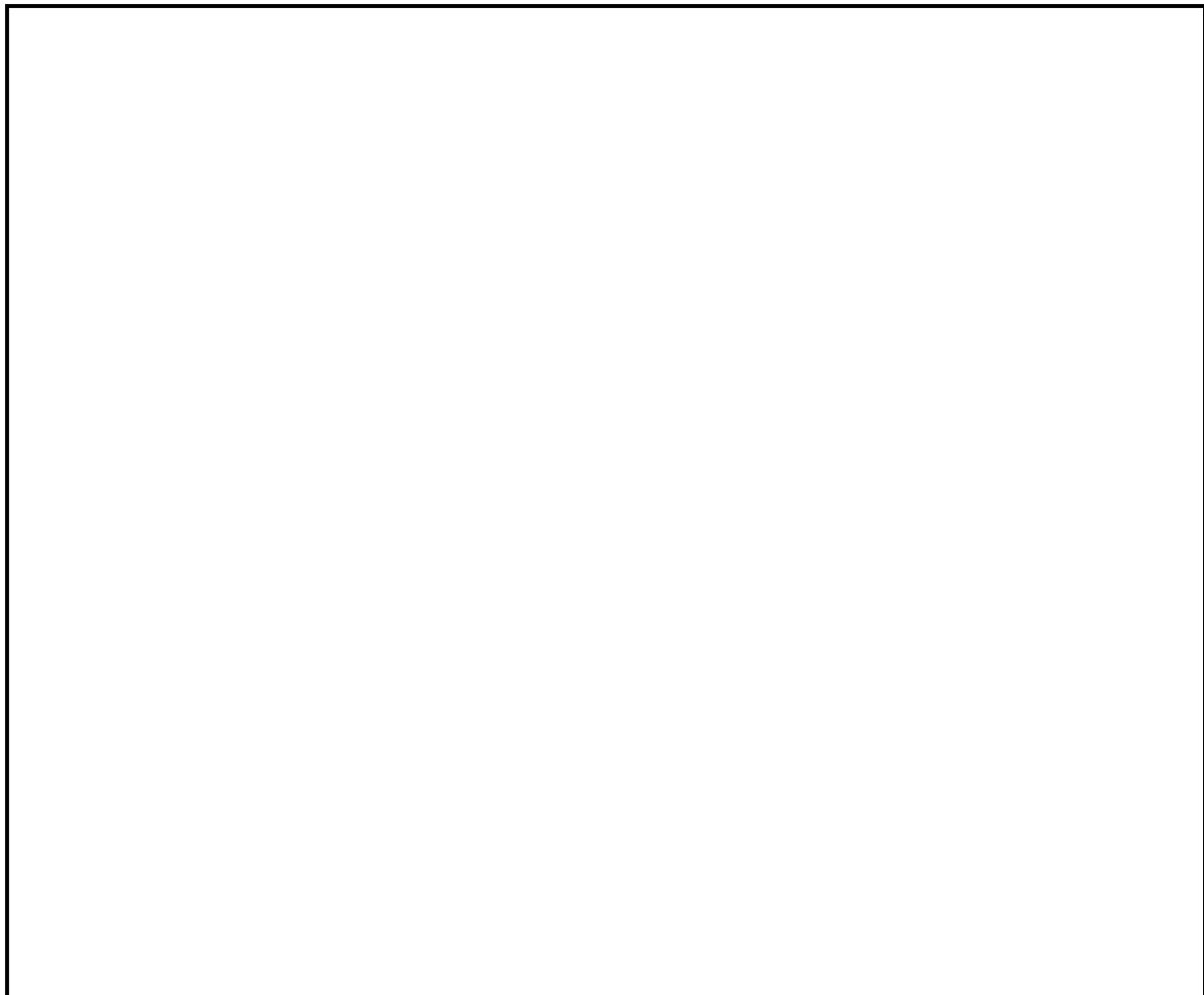


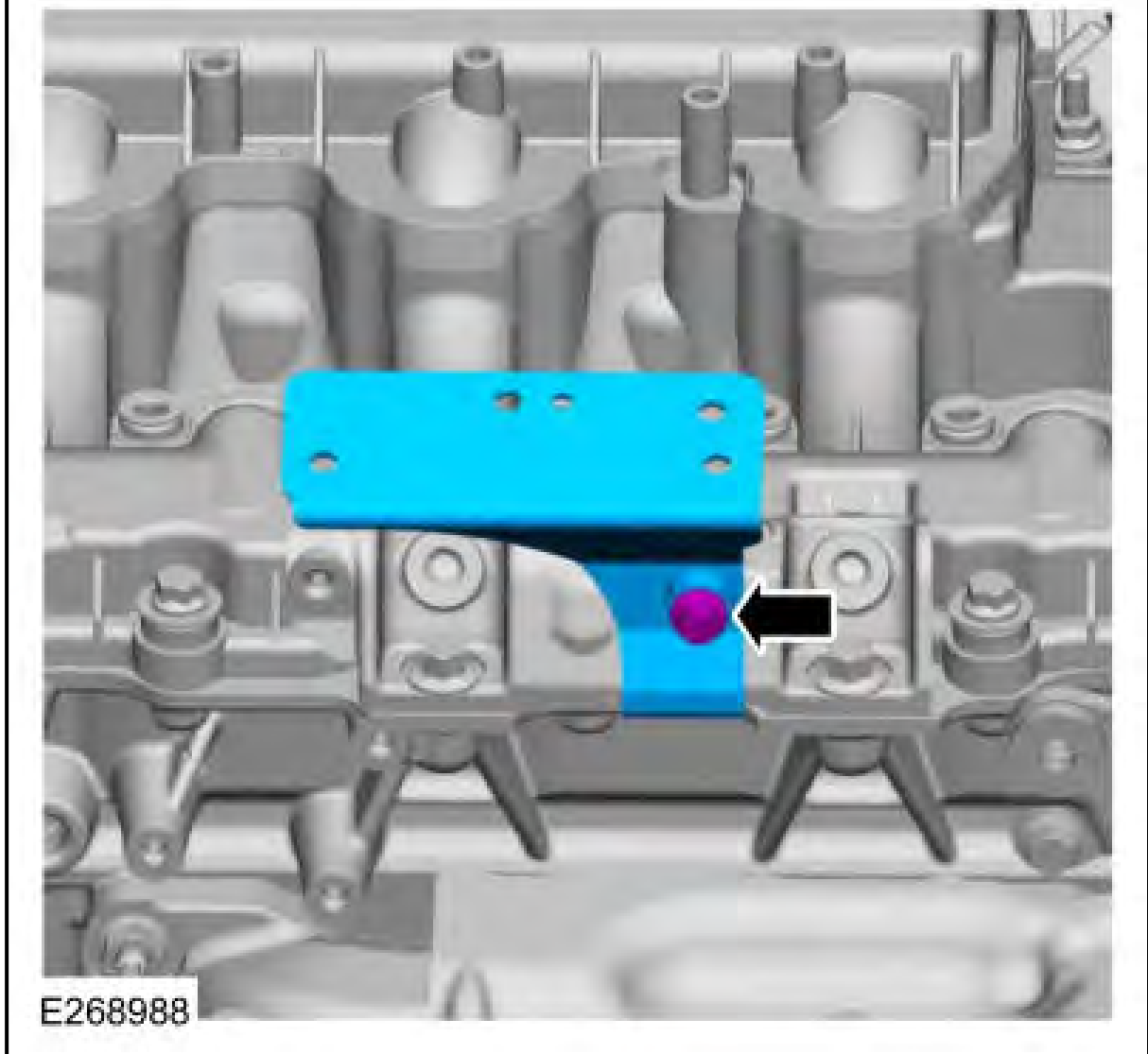
9. Remove the bolts and the EGR cooler mounting bracket.



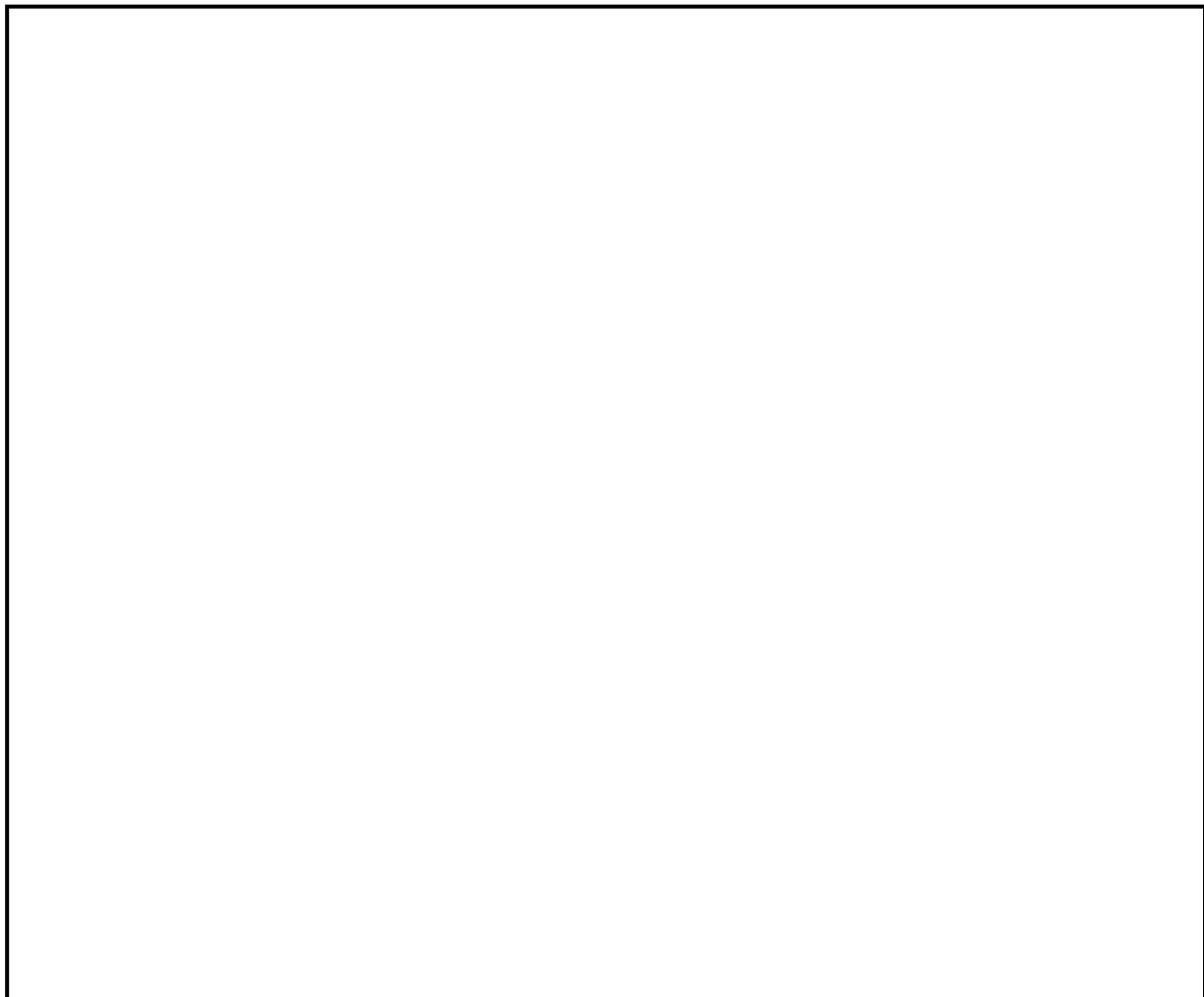


10. Remove the bolt and the wire harness bracket.

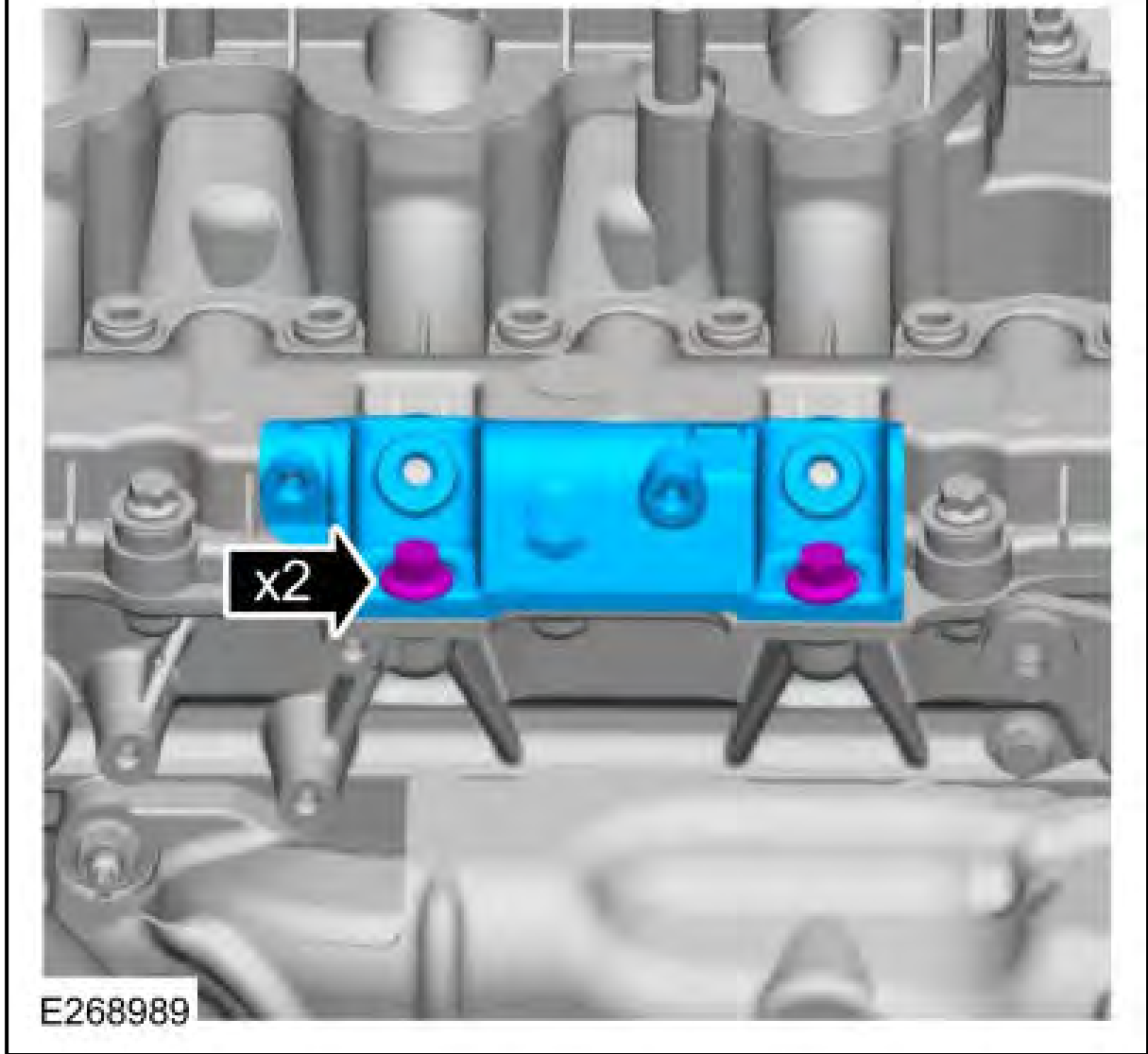




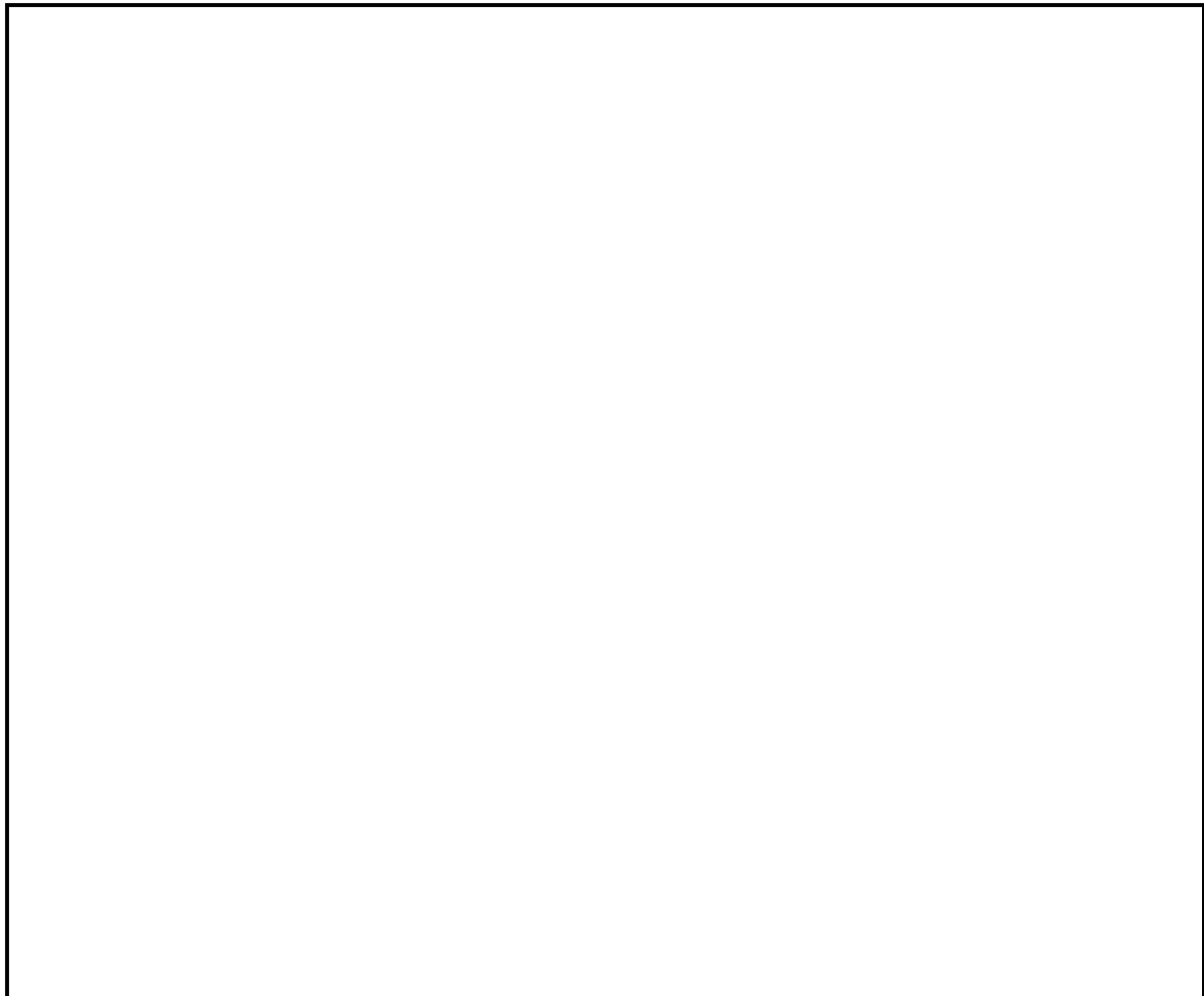
11. Remove the bolts and the LH fuel rail bracket.

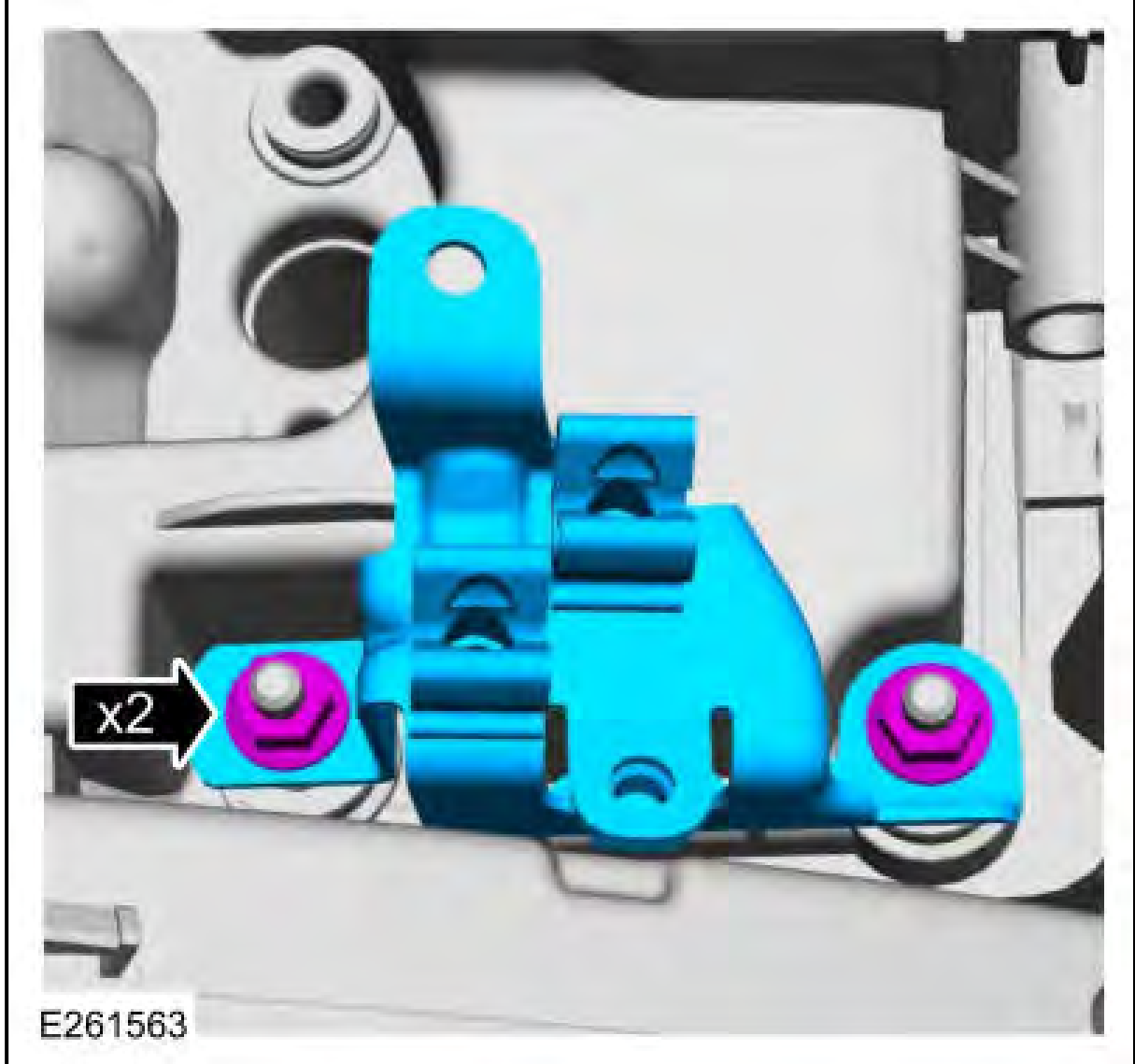




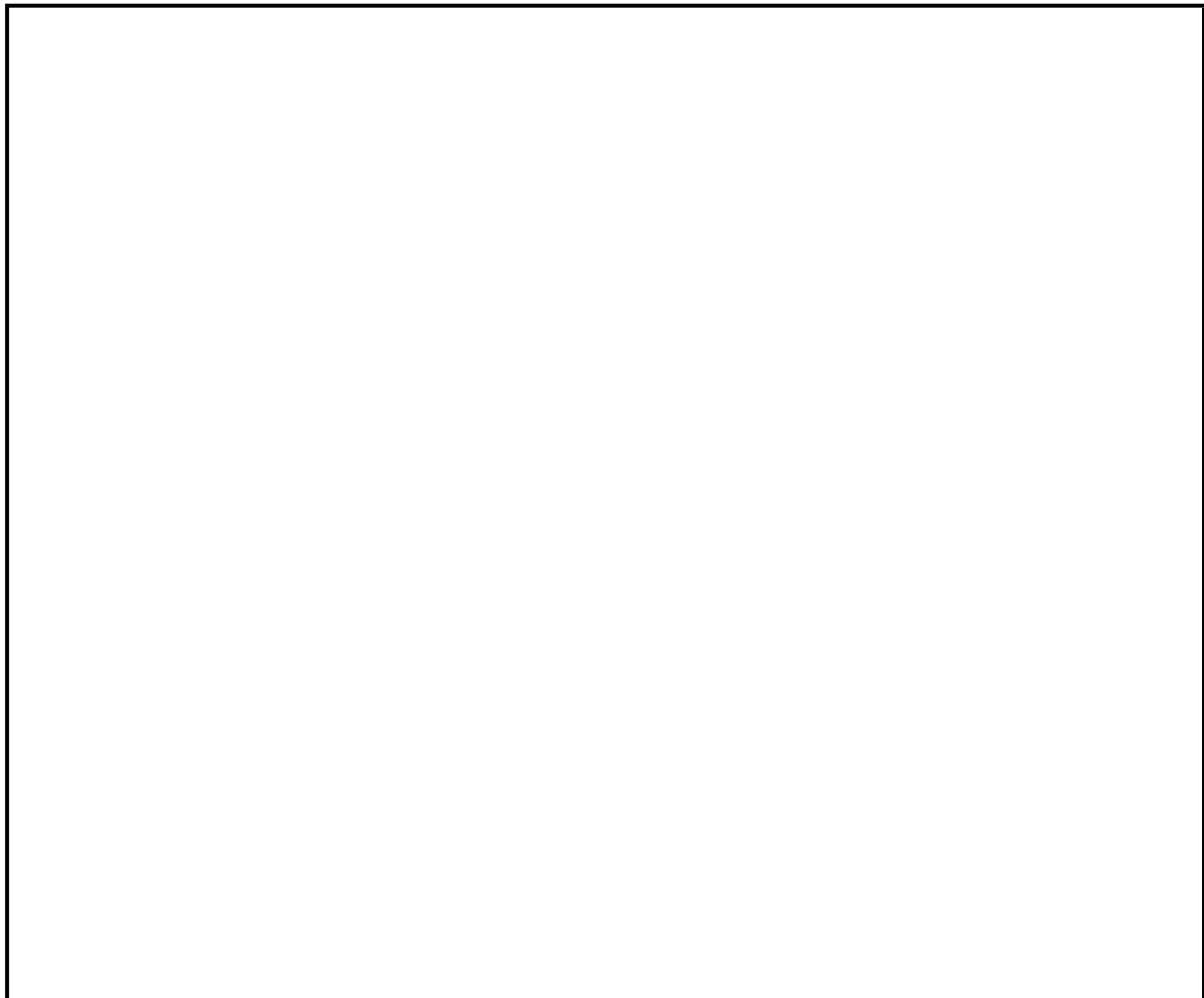


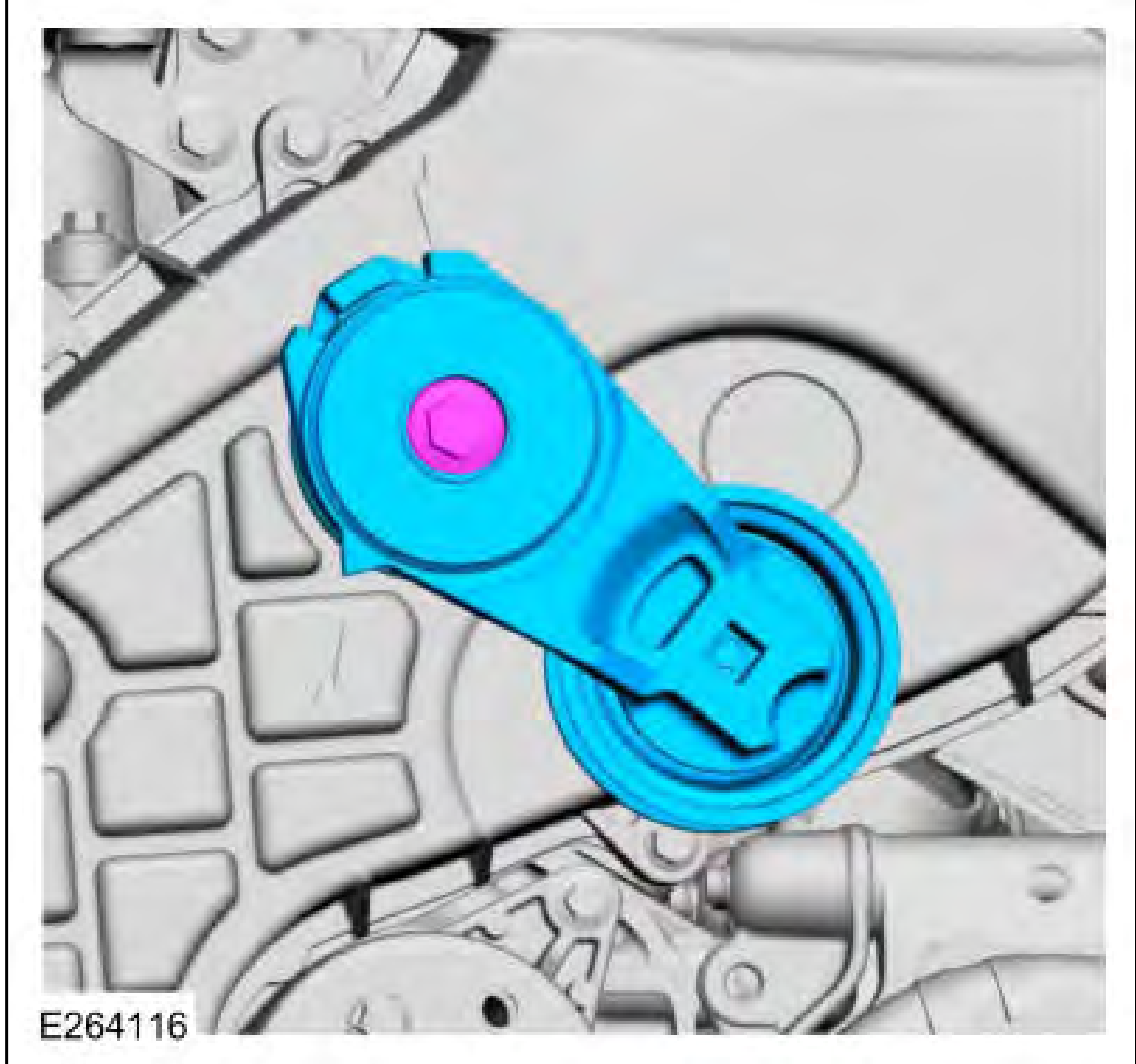
12. Remove the nuts and the LH fuel tube bracket.



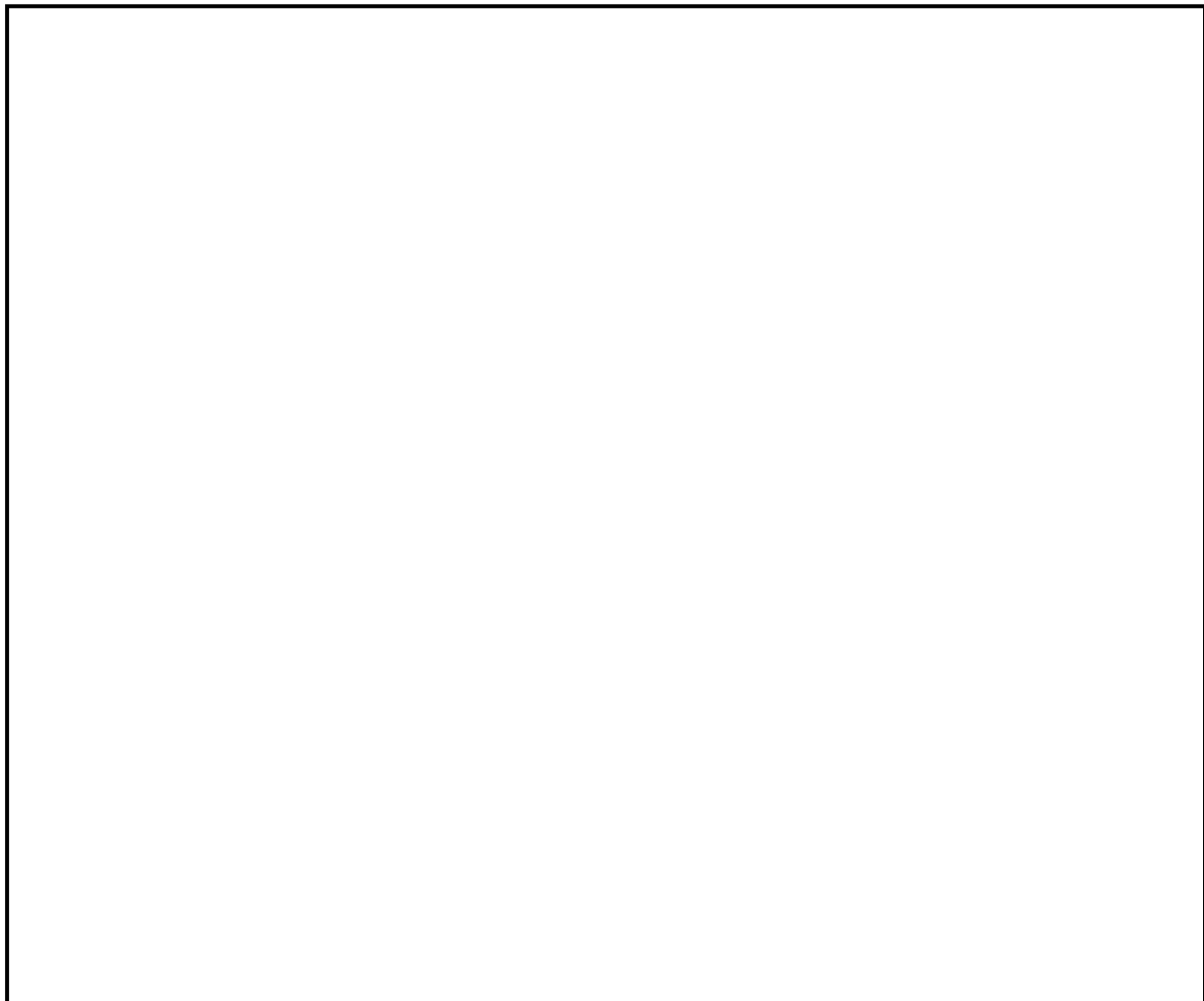


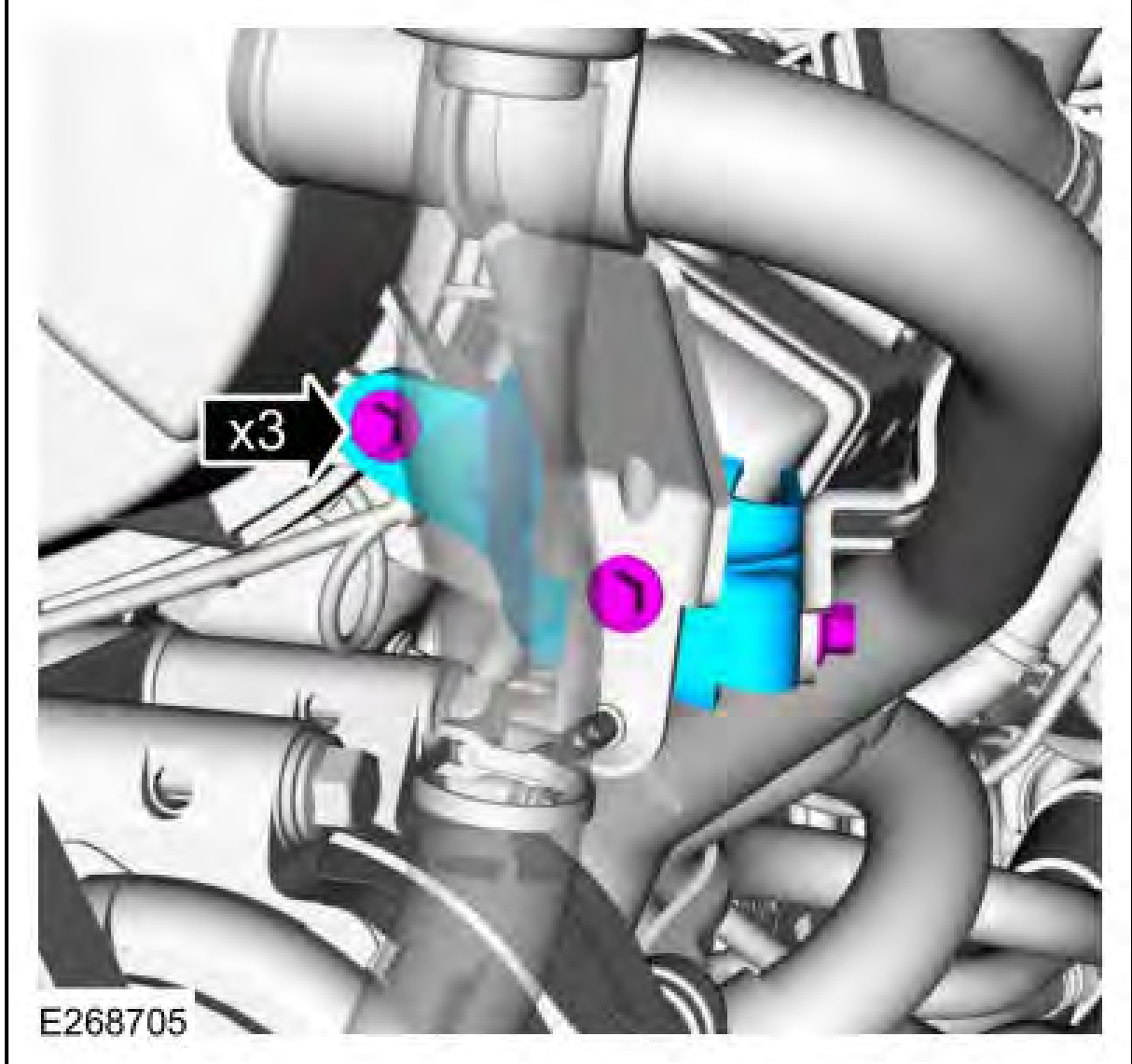
13. Remove the bolt and the accessory drive belt tensioner.



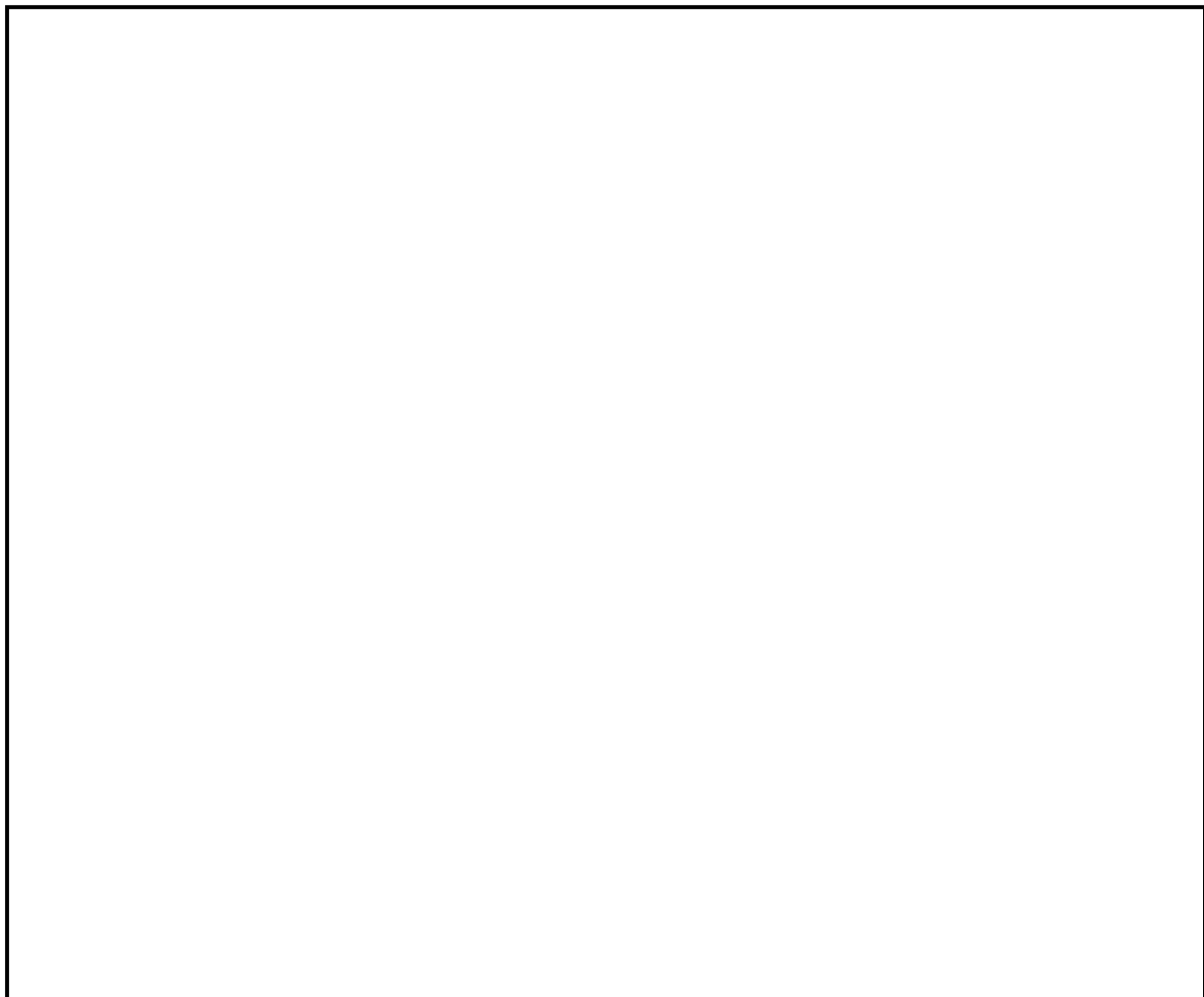


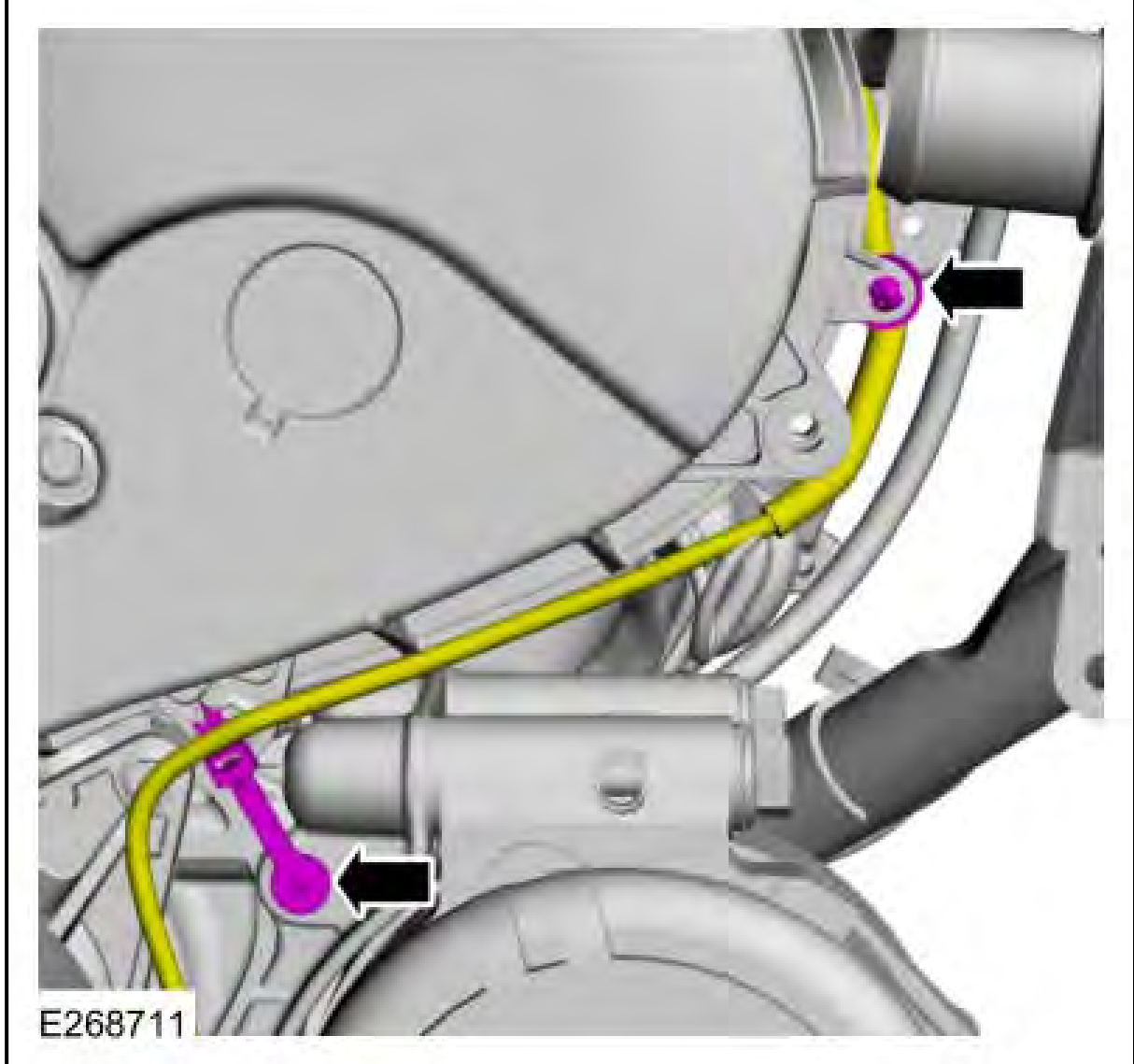
14. Remove the bolts and the coolant tube bracket.



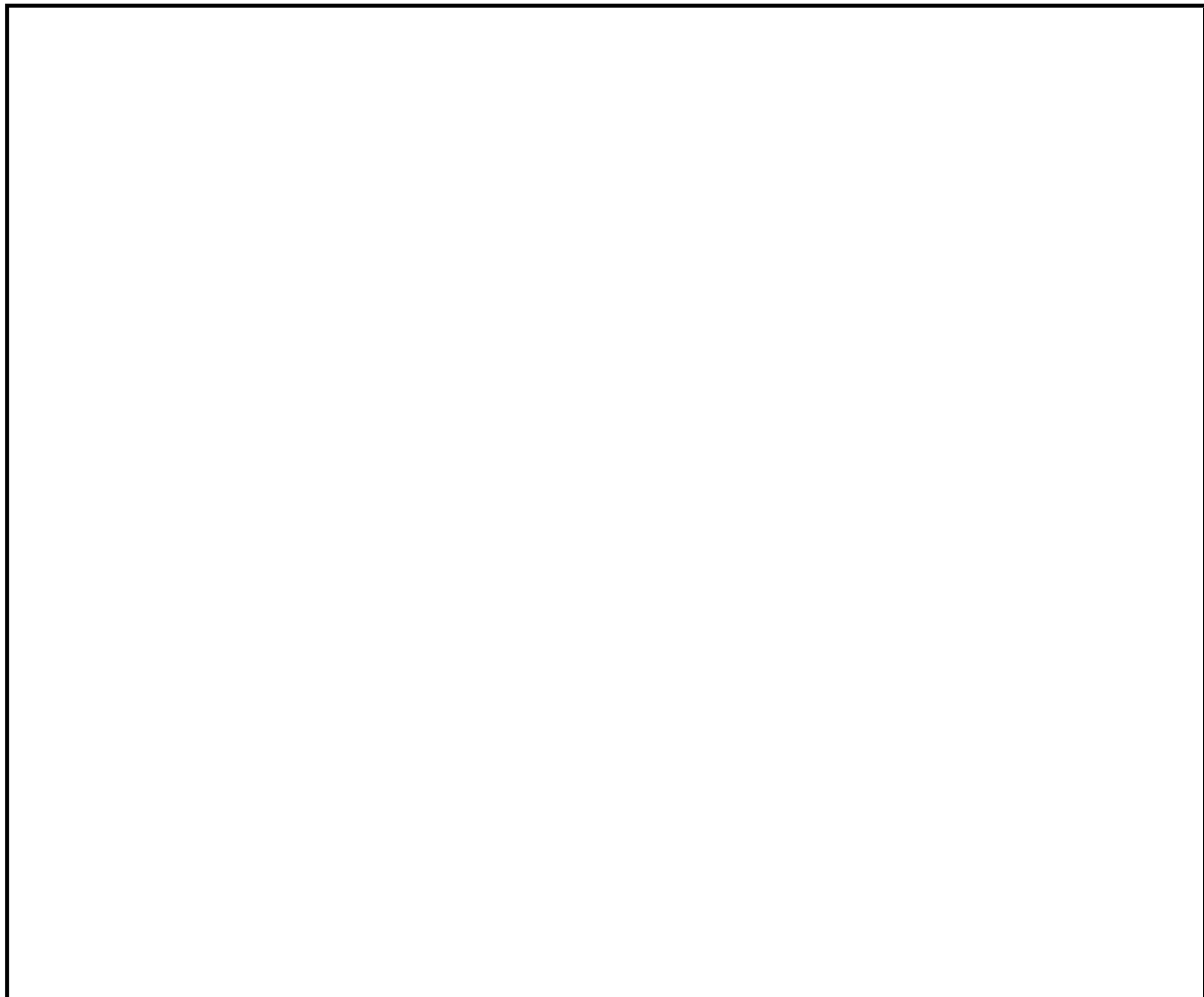


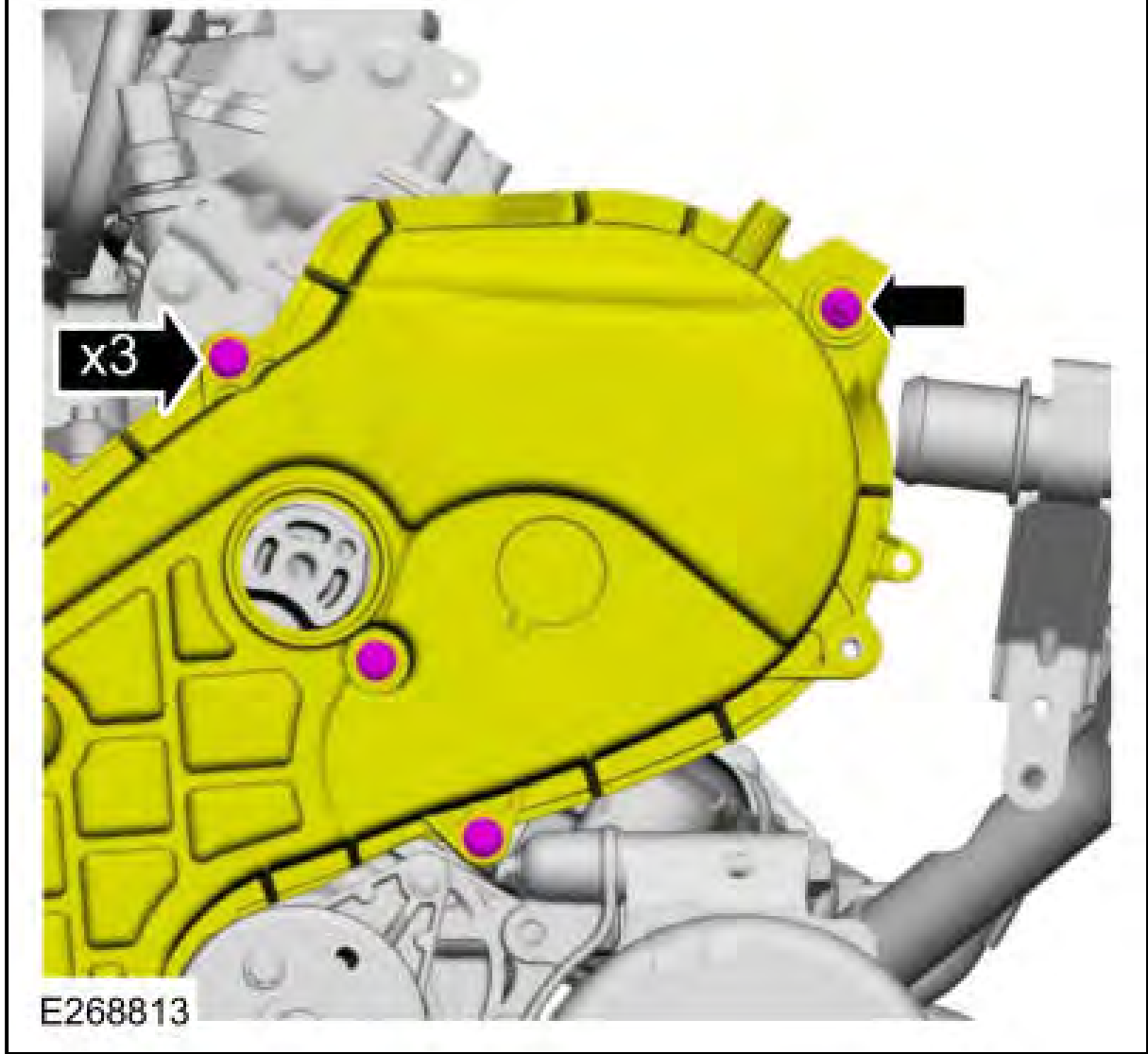
15. Disconnect the retainers and position aside the engine wiring.



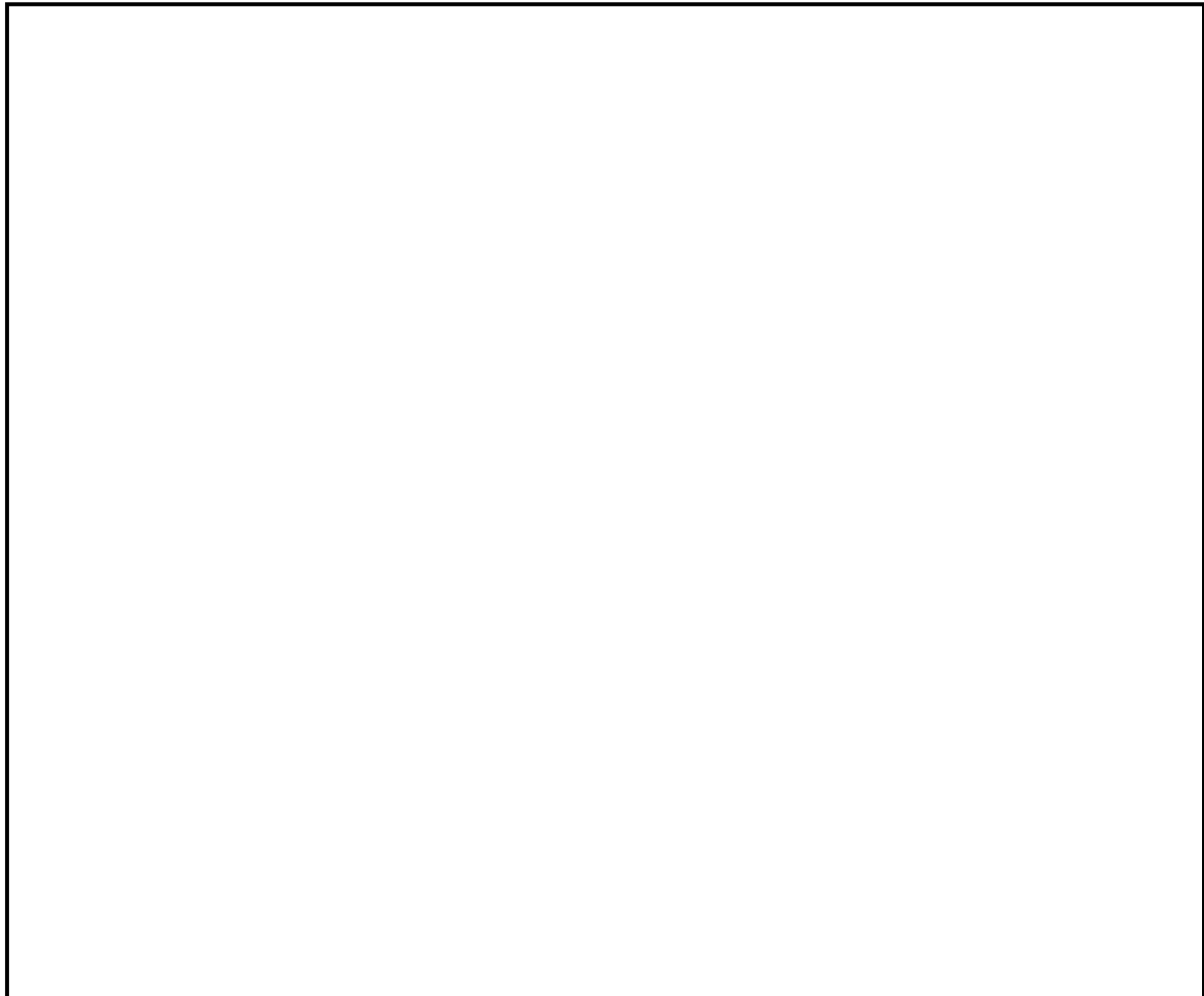


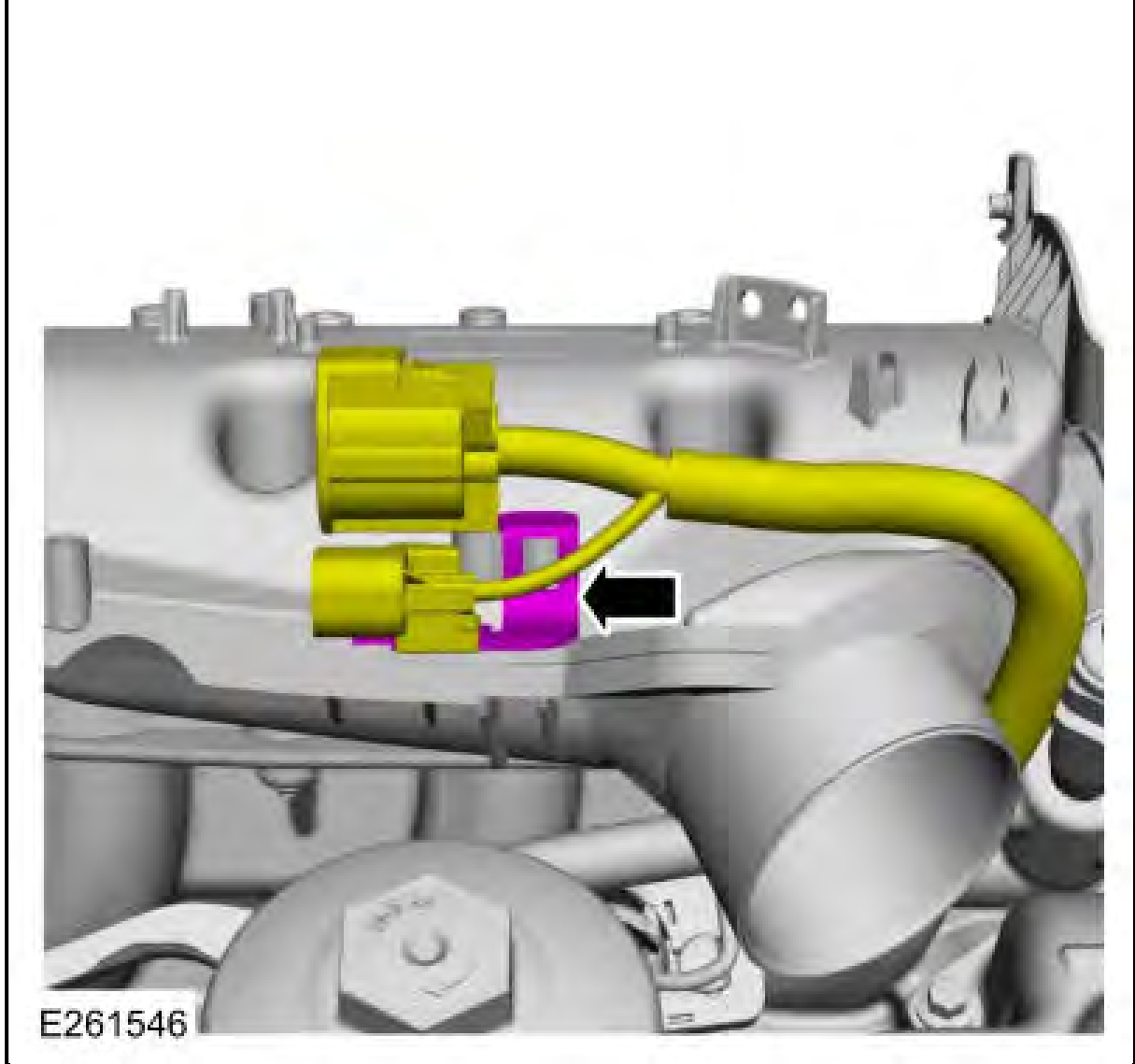
16. Loosen the retainers and position out the engine front cover.



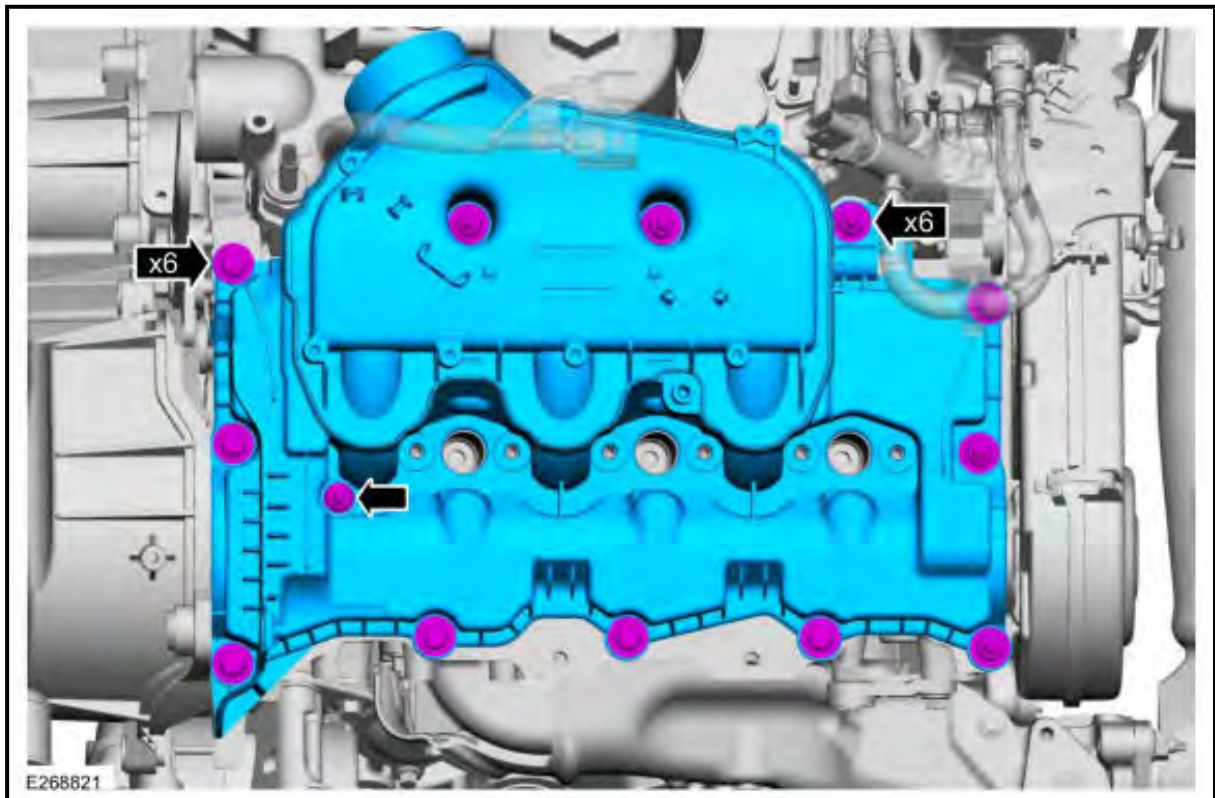


17. Disconnect the glow plug electrical connector and position aside.

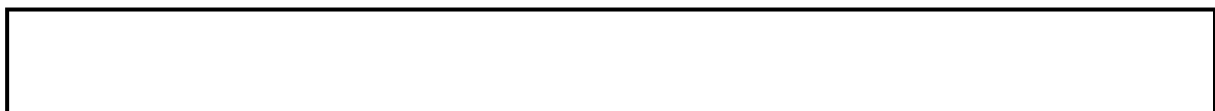


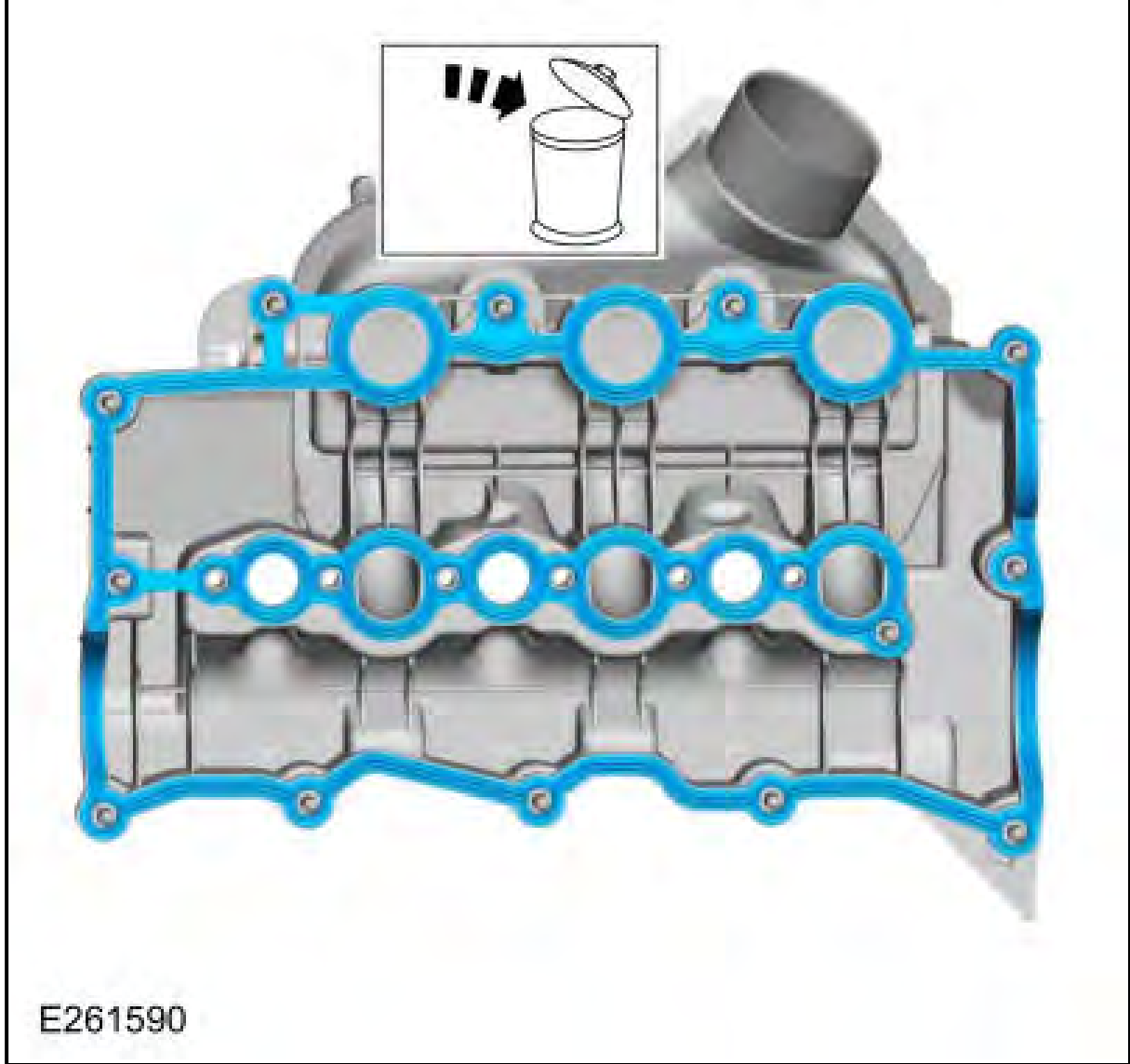


18. Remove the fasteners and the valve cover.



19. Remove and discard the valve cover gasket.





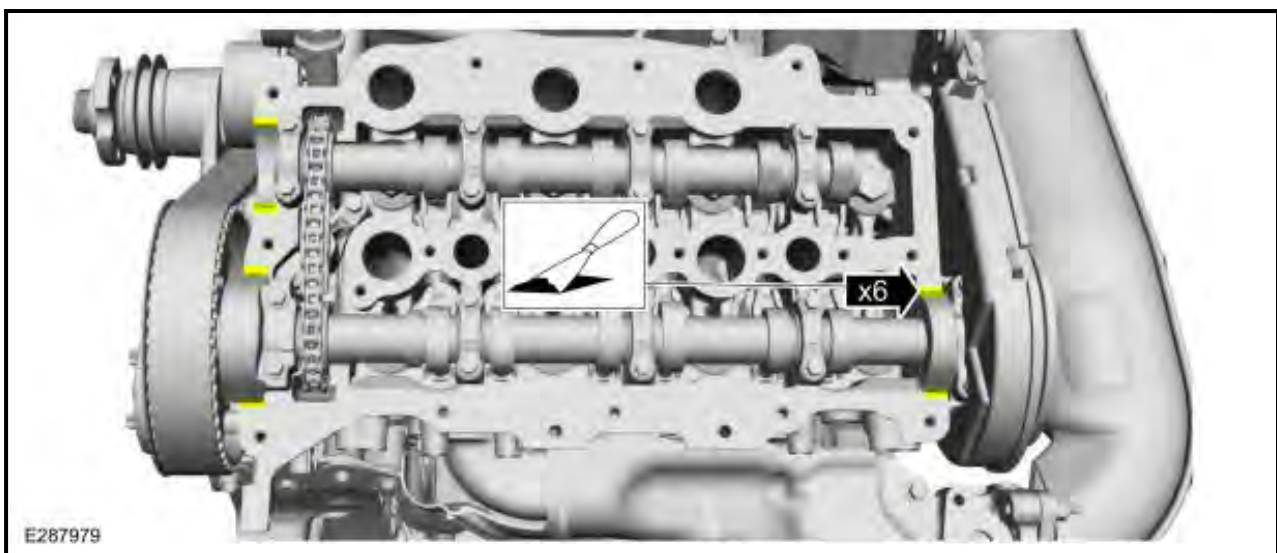
20. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.

Clean the valve cover mating surface of the cylinder head and engine front cover. REFER to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

Material: Motorcraft <sup>Â</sup> Silicone Gasket Remover / ZC-30-A

Material: Motorcraft <sup>Â</sup> Metal Surface Prep / ZC-31-A

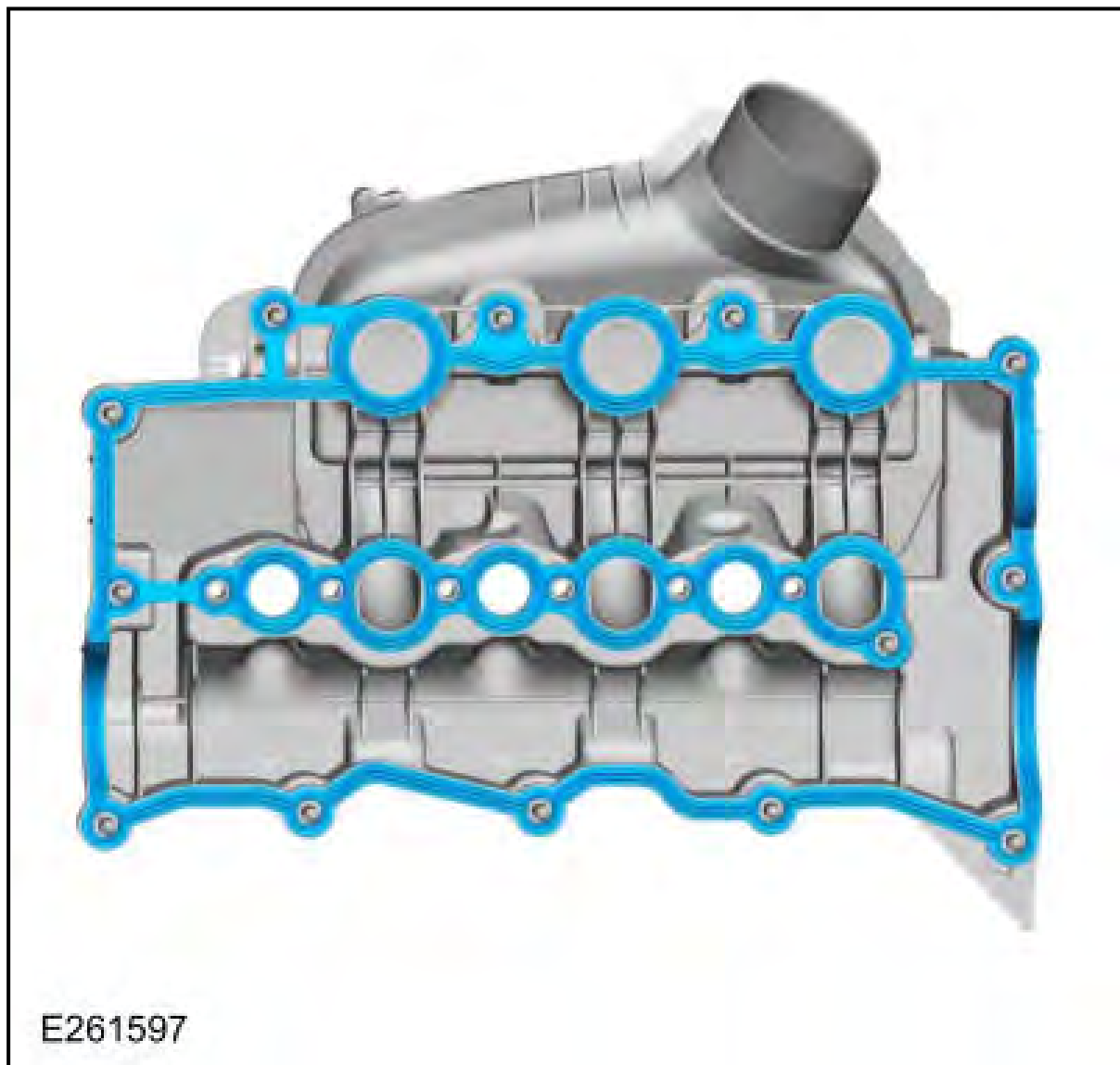
Material: Motorcraft <sup>Â</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B





## INSTALLATION

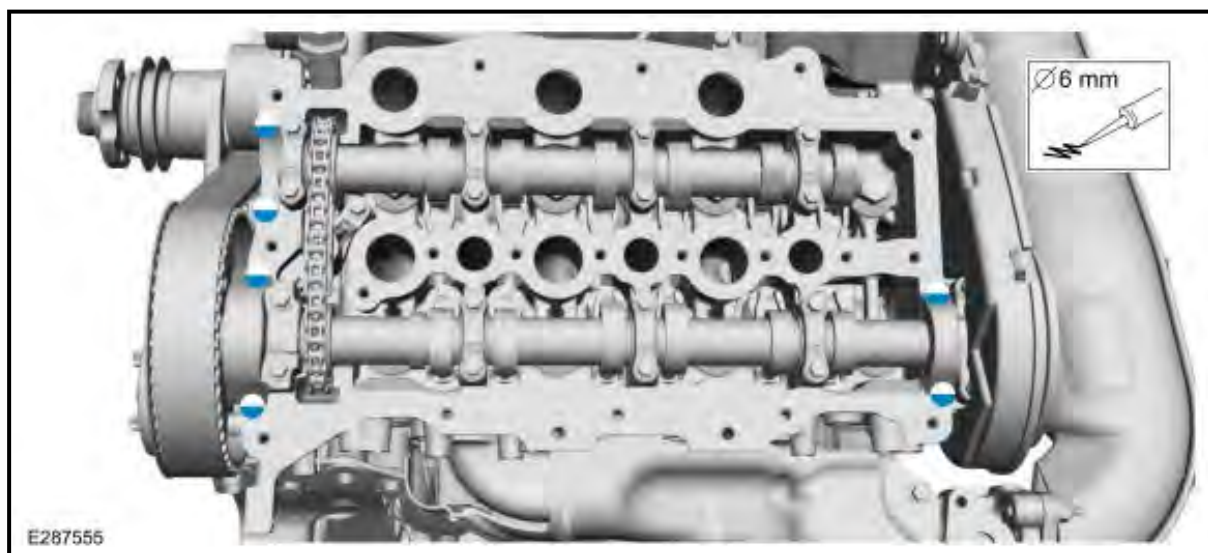
1. Install a new valve cover gasket.



2. **NOTE:** If the valve cover is not installed and the fasteners tightened within 10 minutes, the sealant must be removed and the sealing area cleaned.

Apply an 6 mm dot of Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone to the locations shown.

Material: Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)

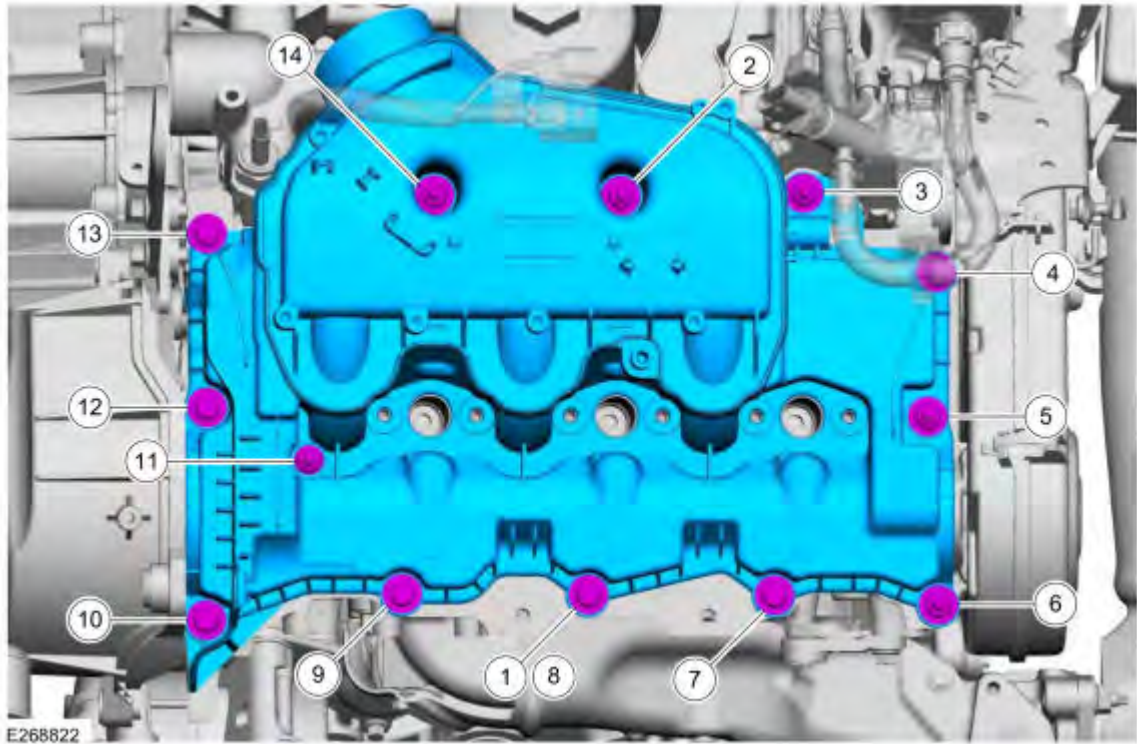


3. Install the valve cover and tighten the fasteners in the sequence shown.

Torque:

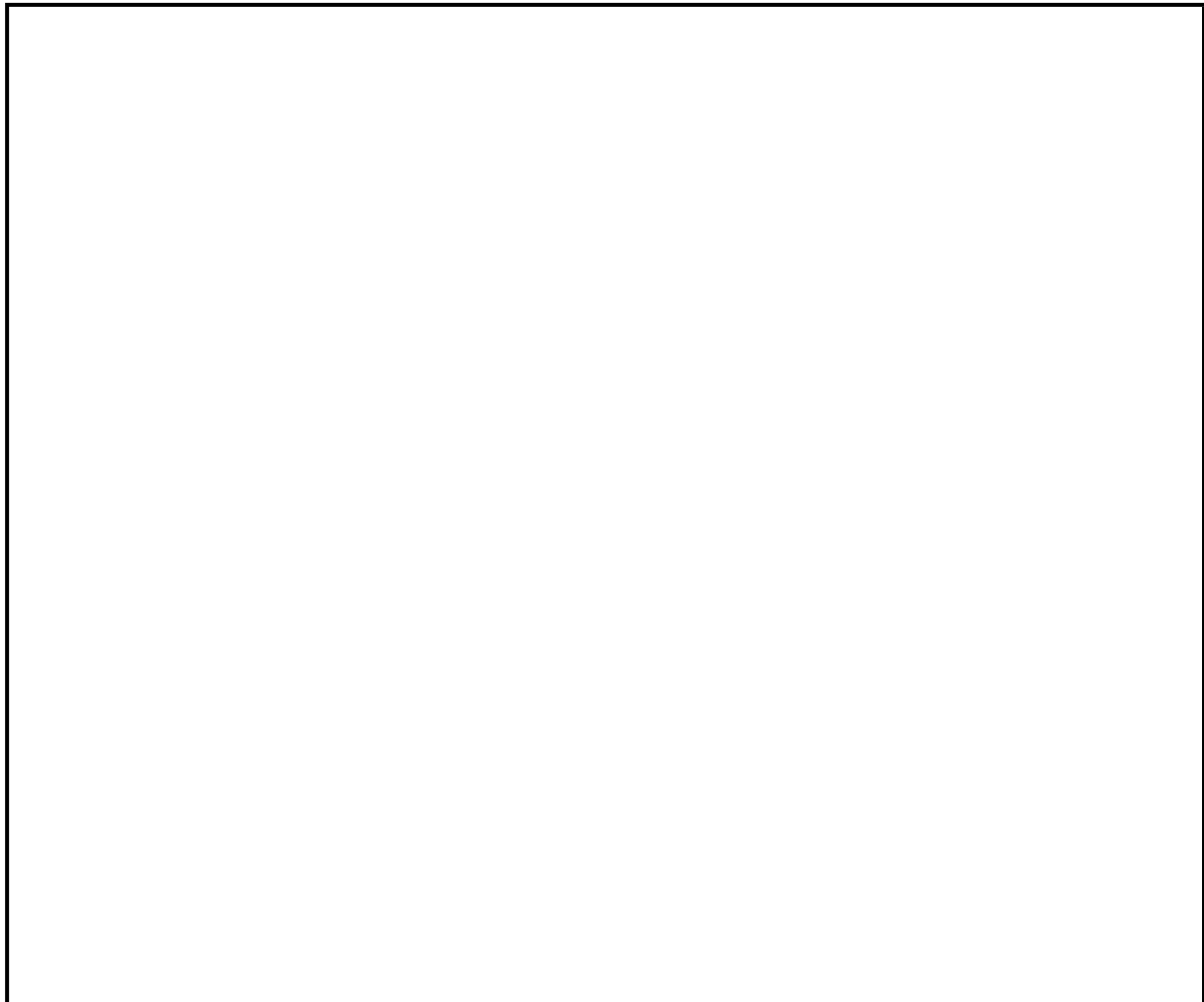
Stage 1: Tighten bolt number 1 to : 9 lb.in (1 Nm)

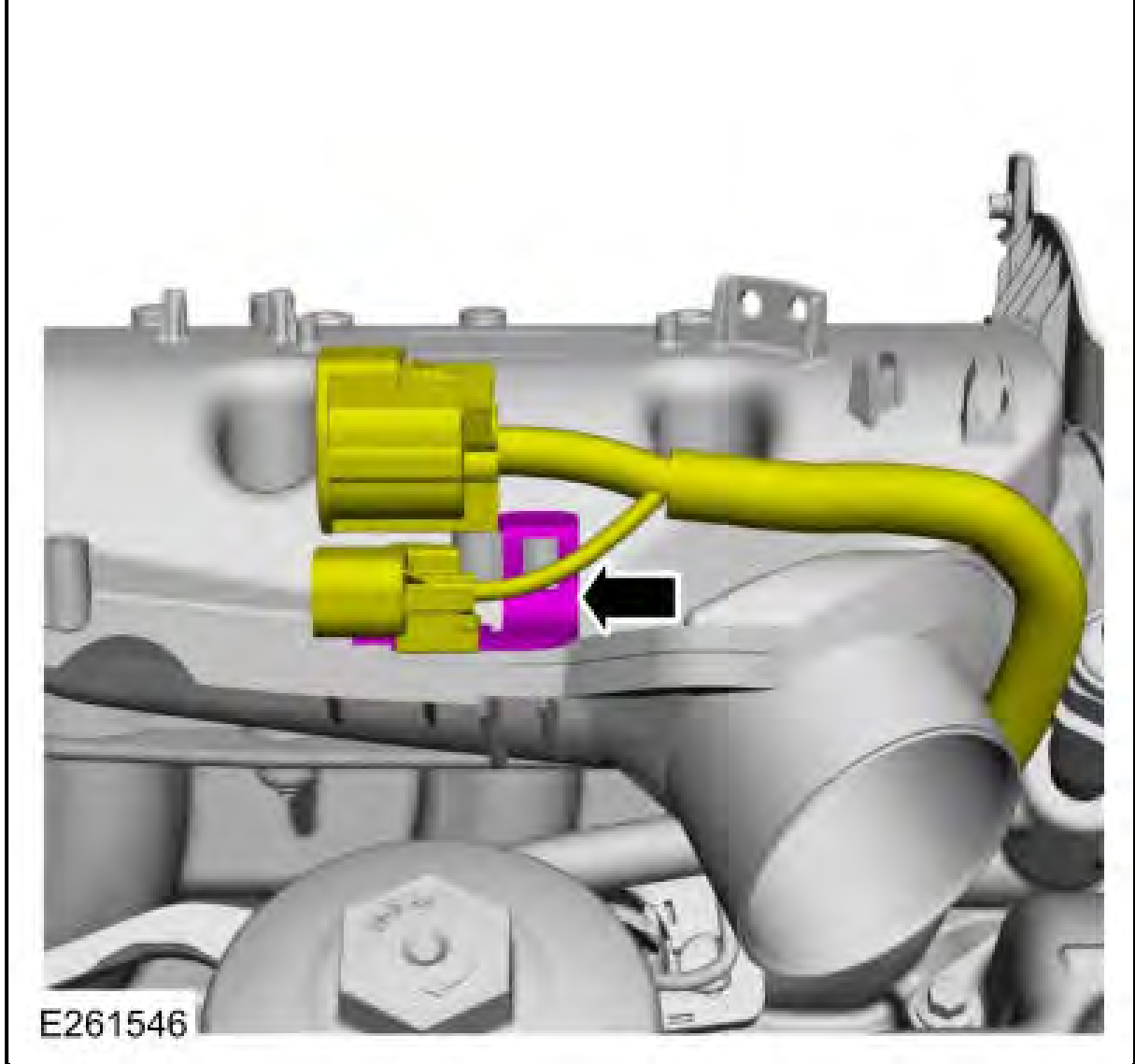
Stage 2: Tighten bolts 2 thru 14 to : 89 lb.in (10 Nm)



**Fig. 11: Valve Cover Tightening Sequence LH**  
Courtesy of FORD MOTOR COMPANY

4. Position back and connect the glow plug electrical connector.

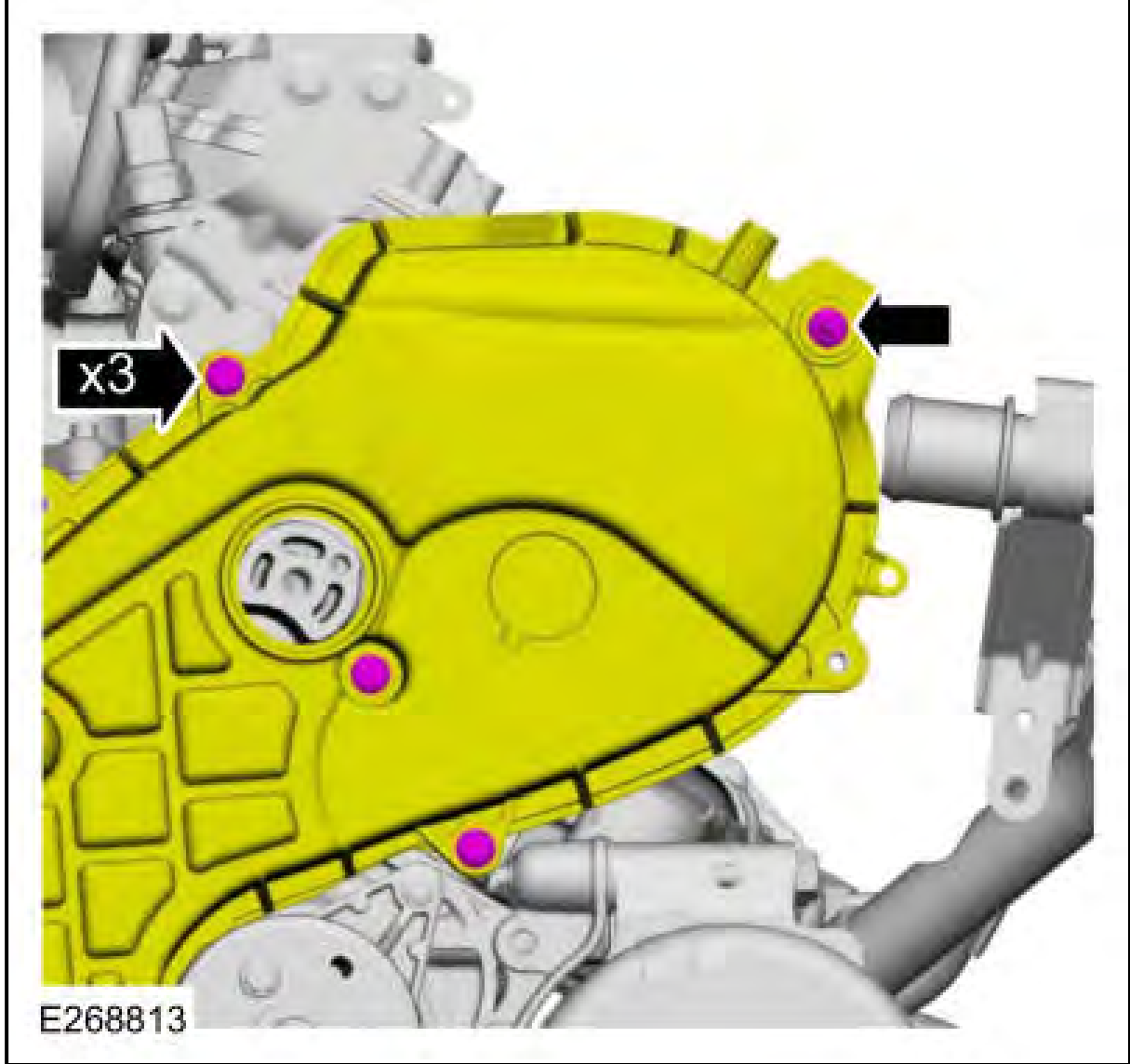




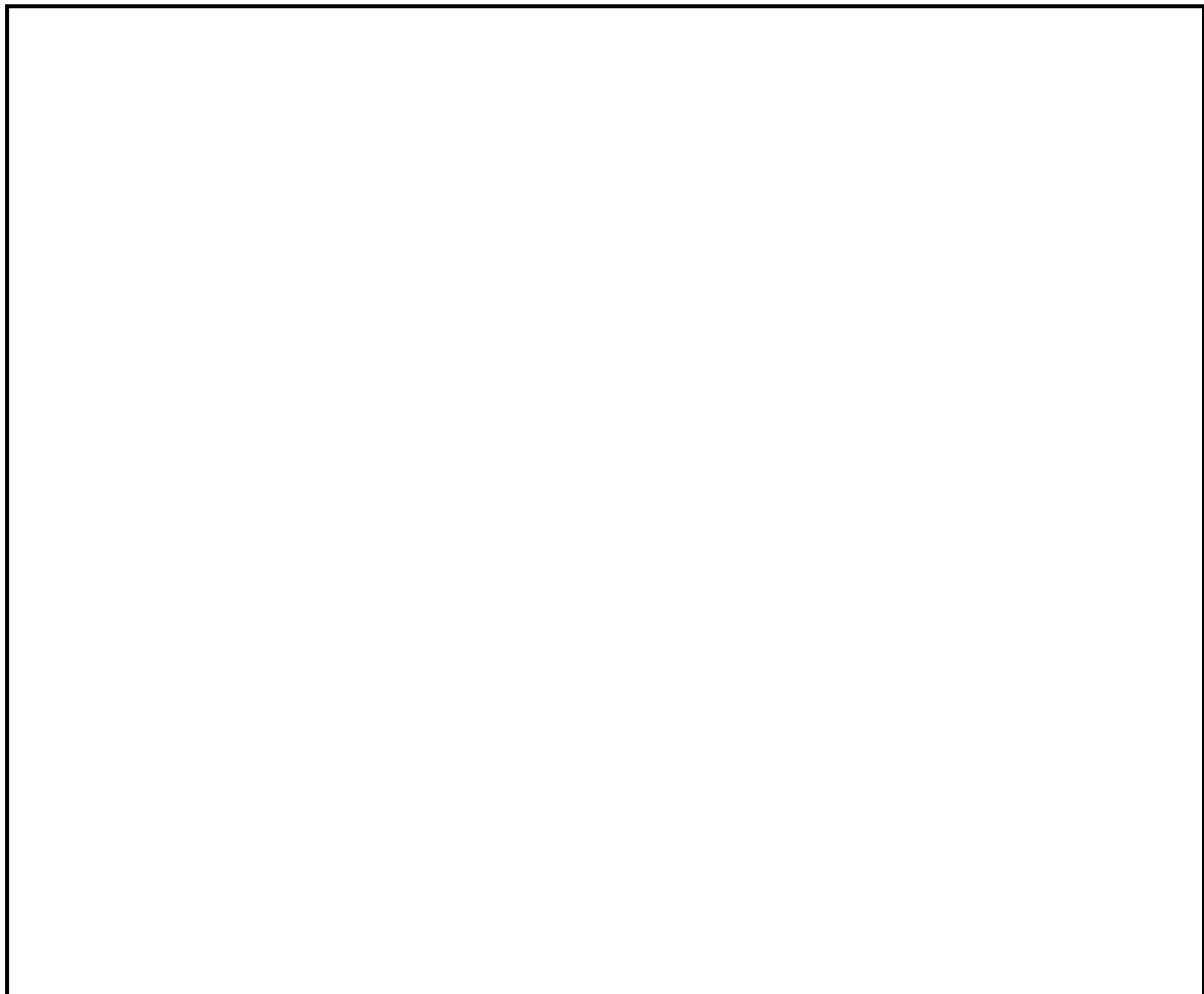
5. Position back the engine front cover and install the retainers.

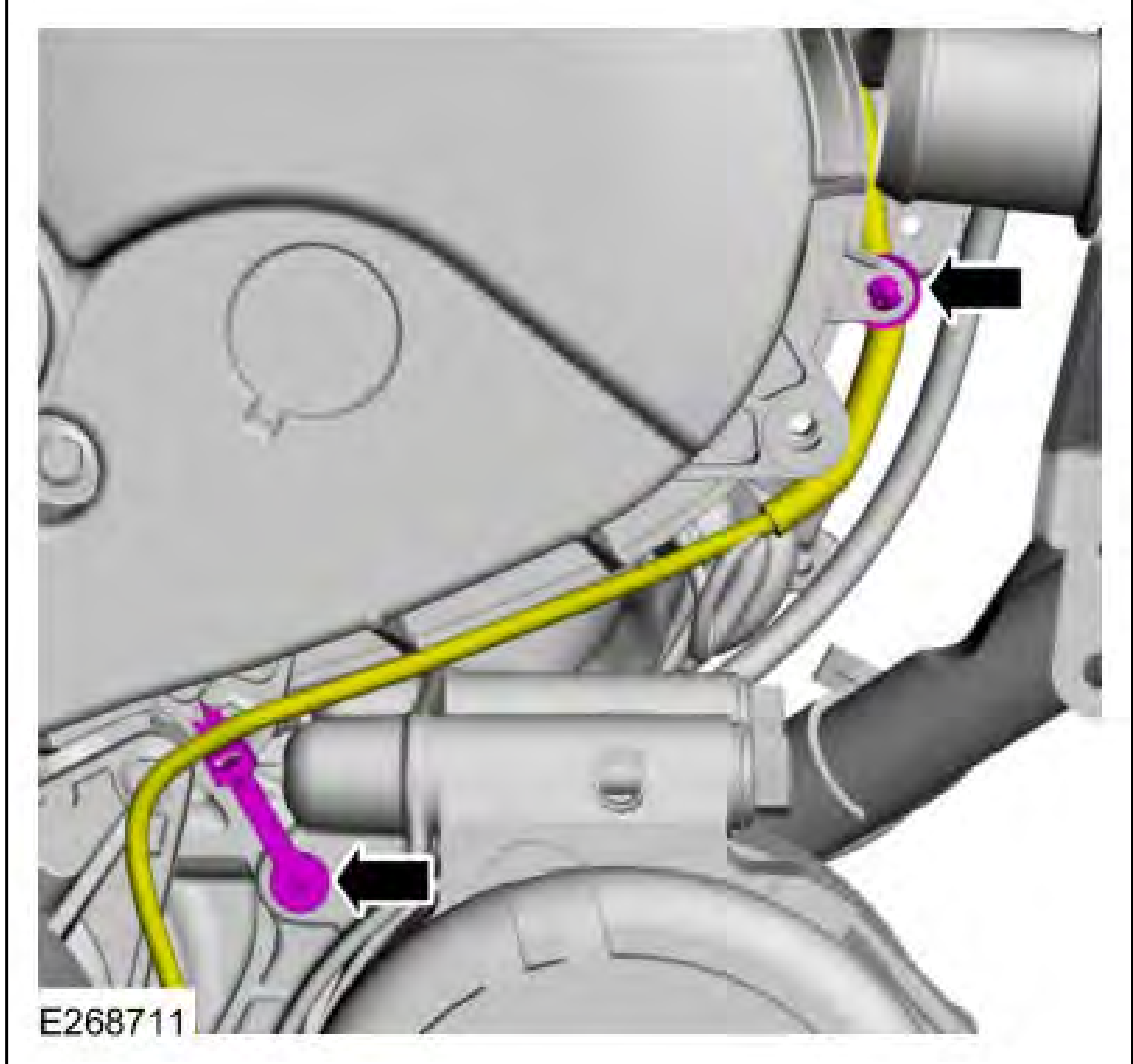
Torque: 89 lb.in (10 Nm)





6. Position back the engine wiring and connect the retainers.

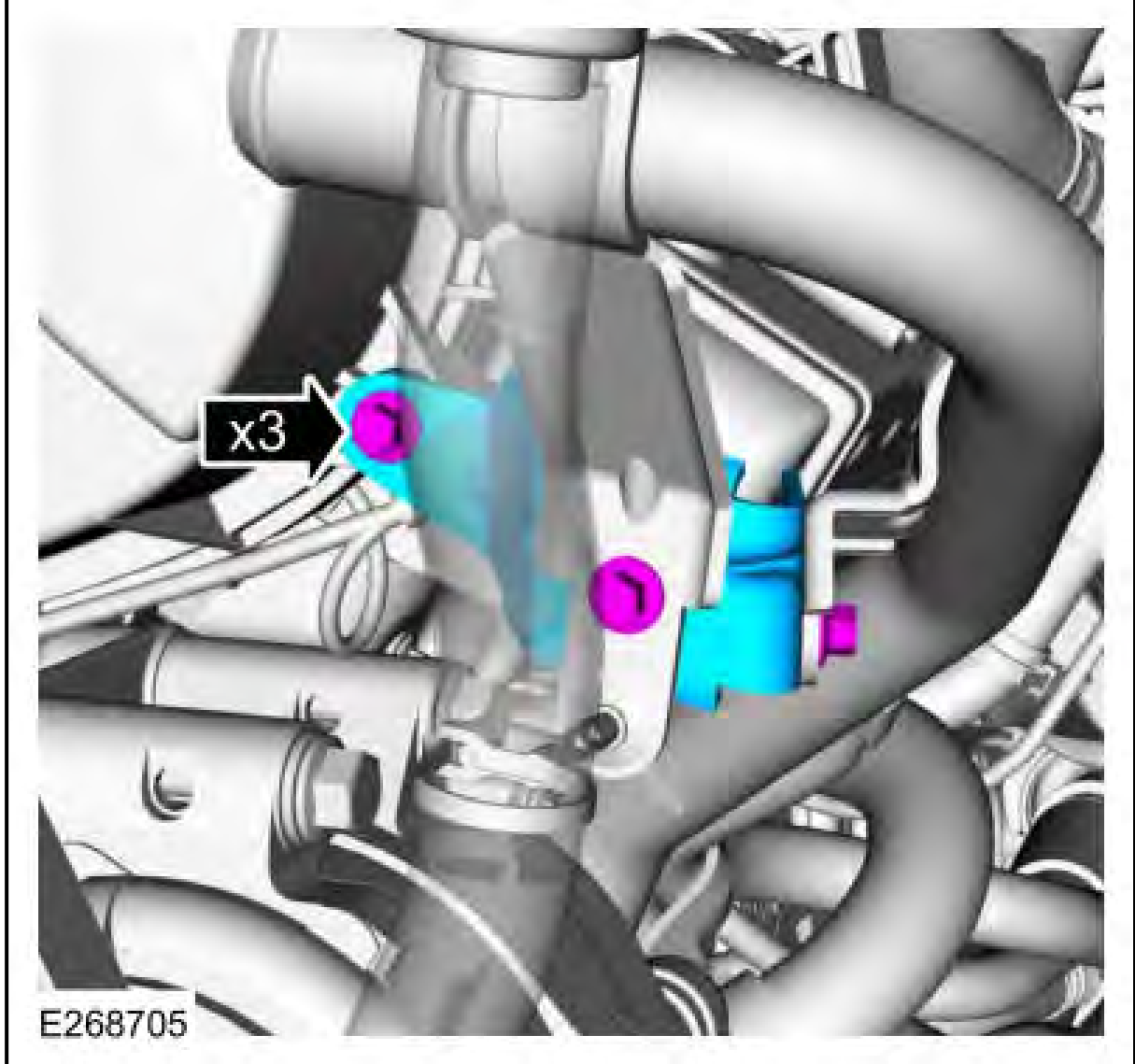




7. Install the coolant tube bracket and the bolts.

Torque: 89 lb.in (10 Nm)

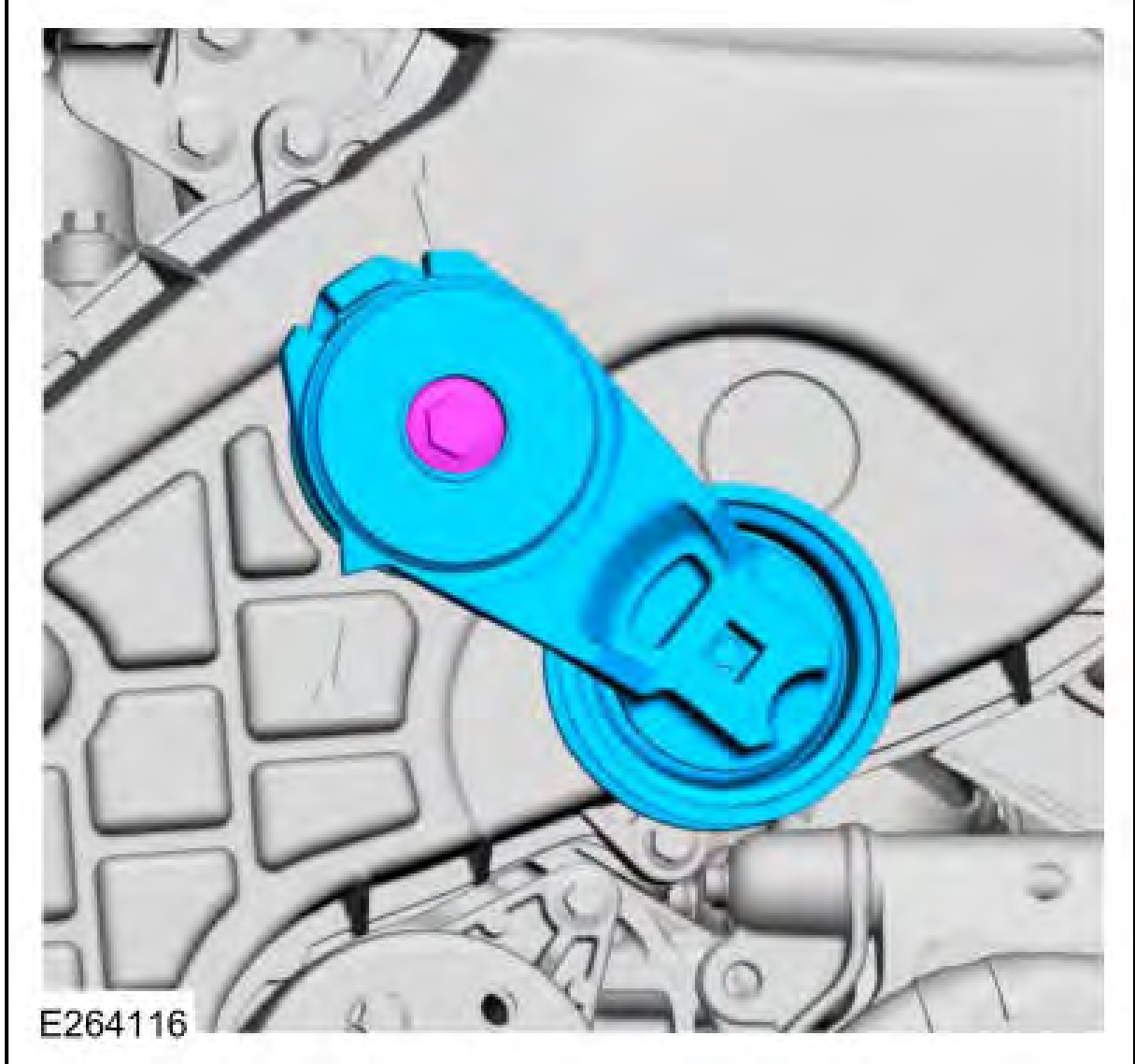




8. Install the accessory drive belt tensioner and the bolt.

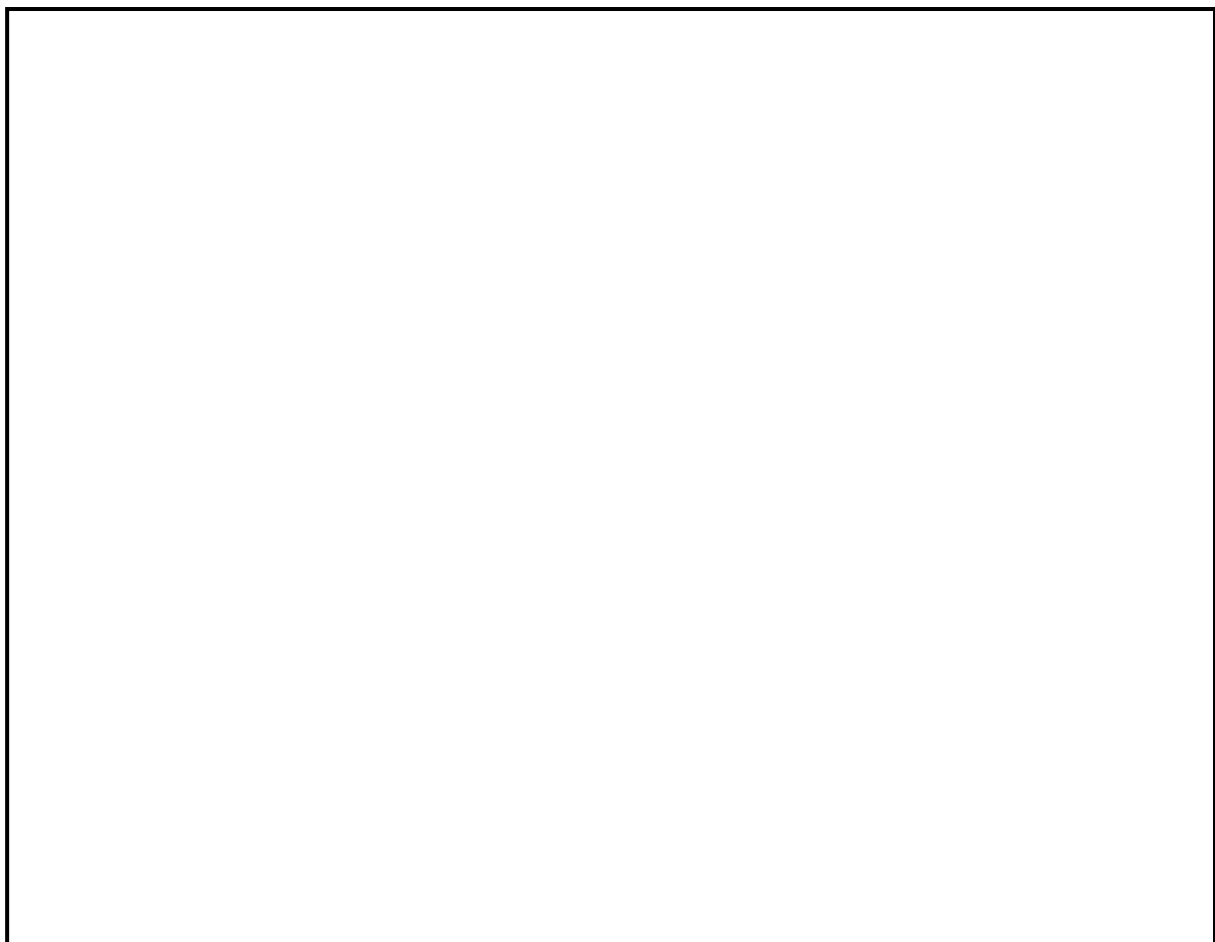
Torque: 35 lb.ft (48 Nm)

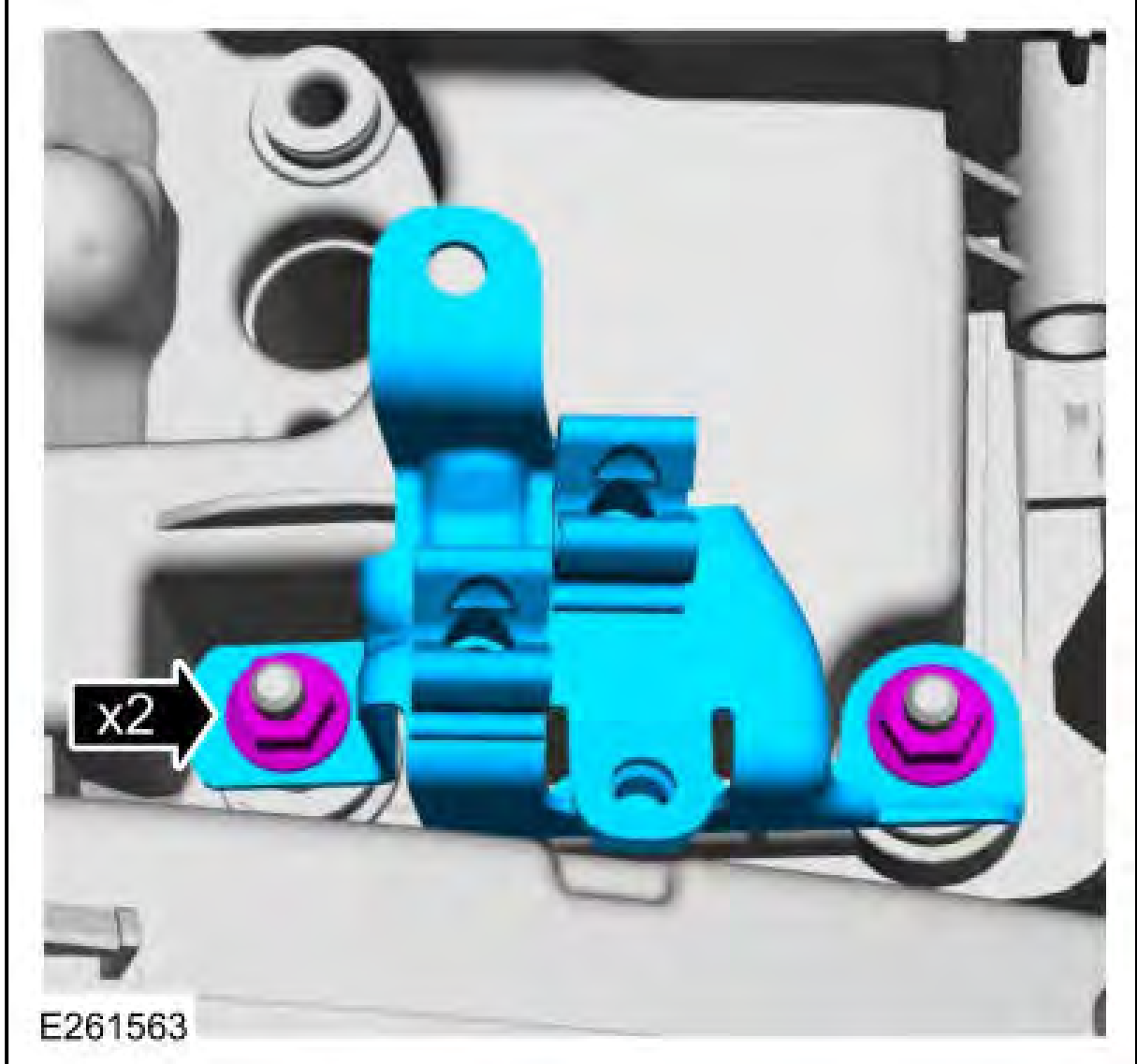




9. Install the LH fuel tube bracket and the nuts.

Torque: 89 lb.in (10 Nm)



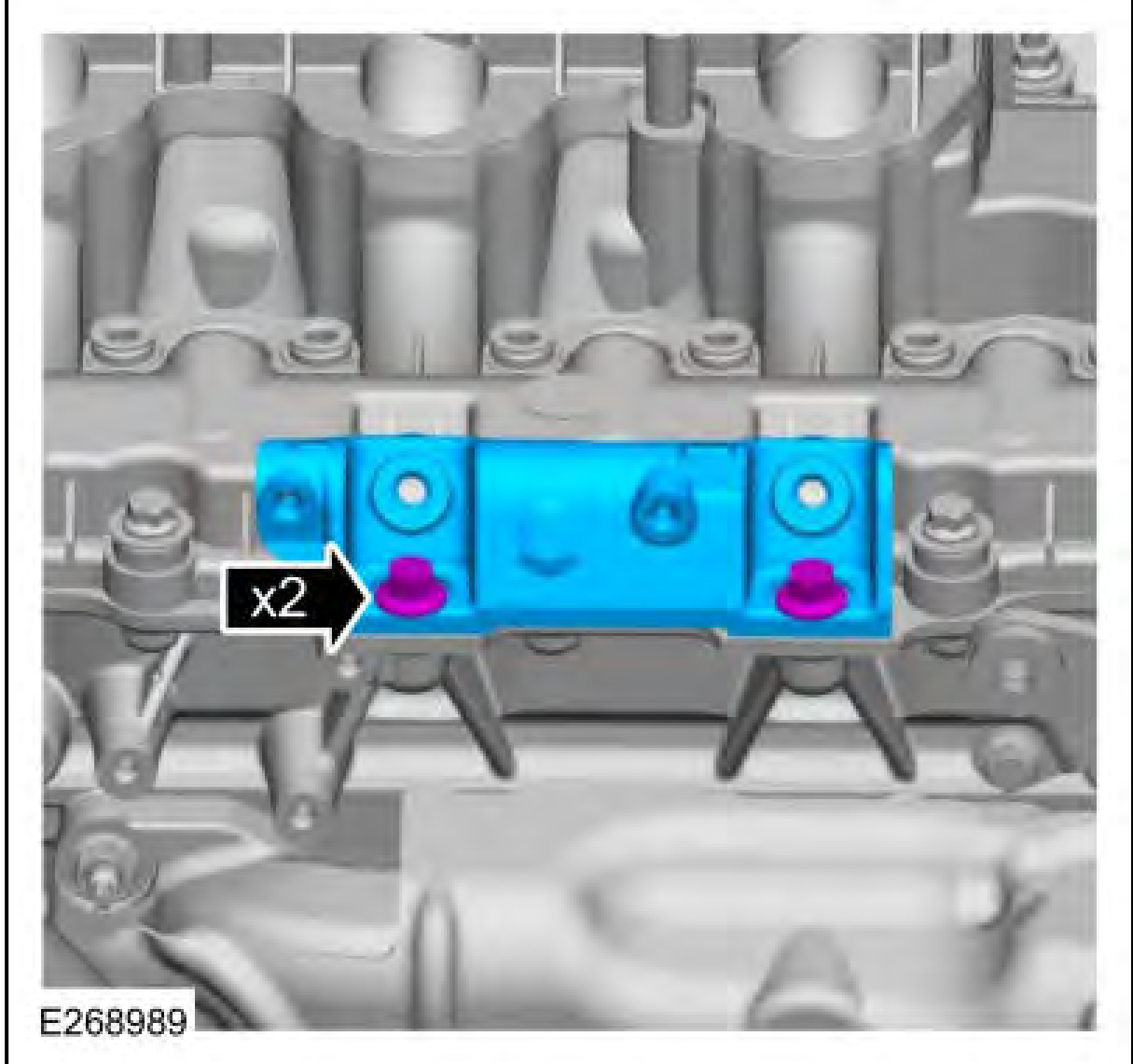


10. Install the LH fuel rail bracket and the bolts.

Torque: 17 lb.ft (23 Nm)



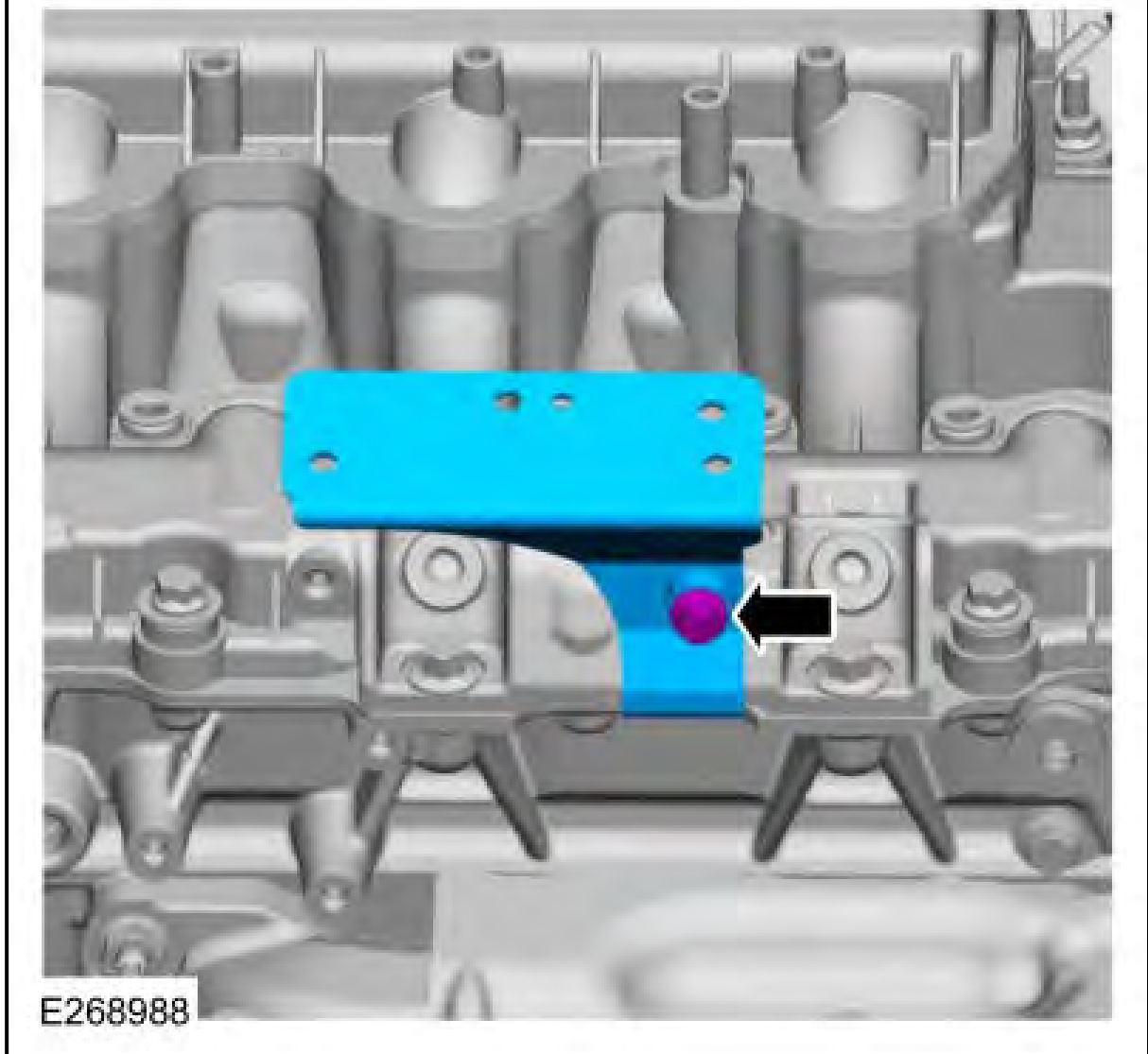




11. Install the wire harness bracket and the bolt.

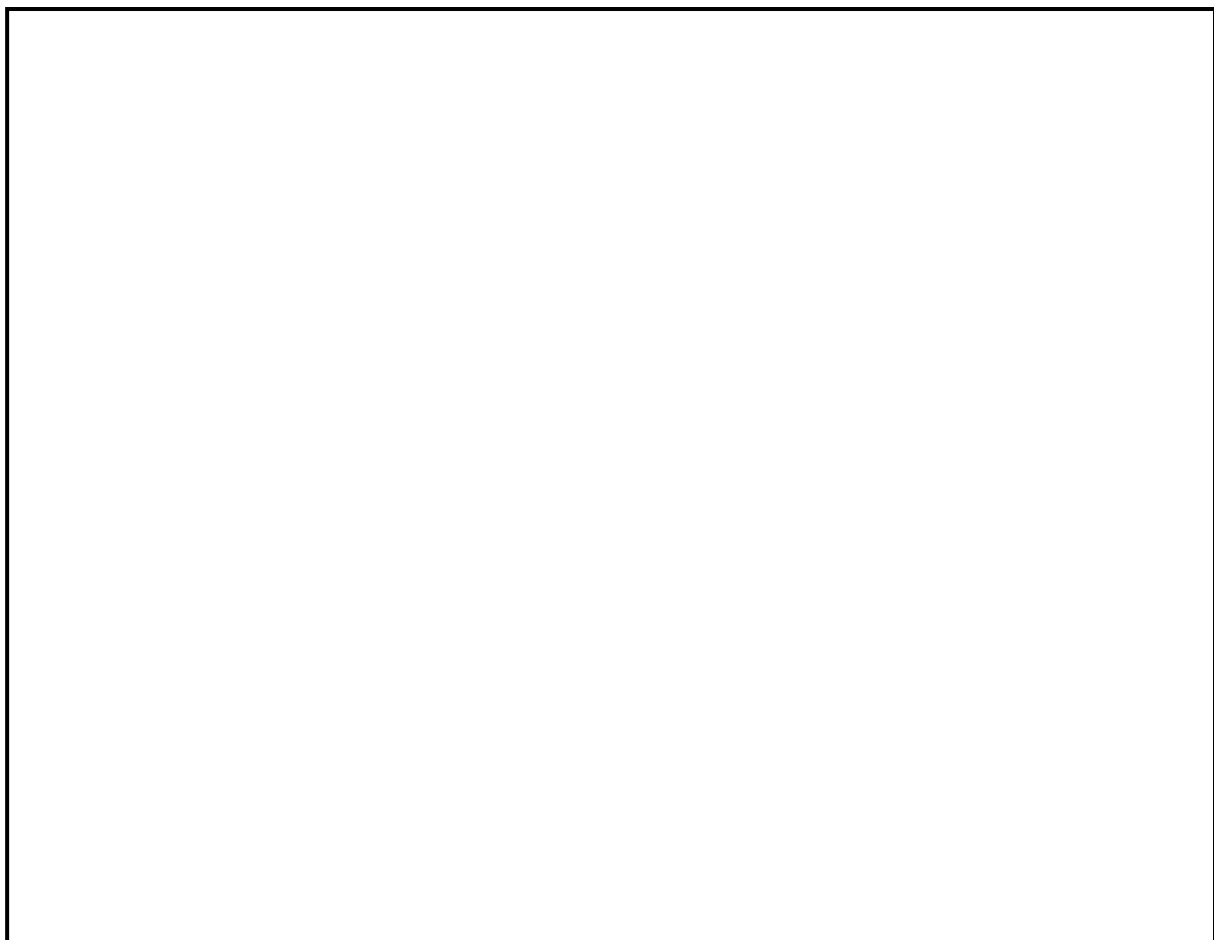
Torque: 89 lb.in (10 Nm)

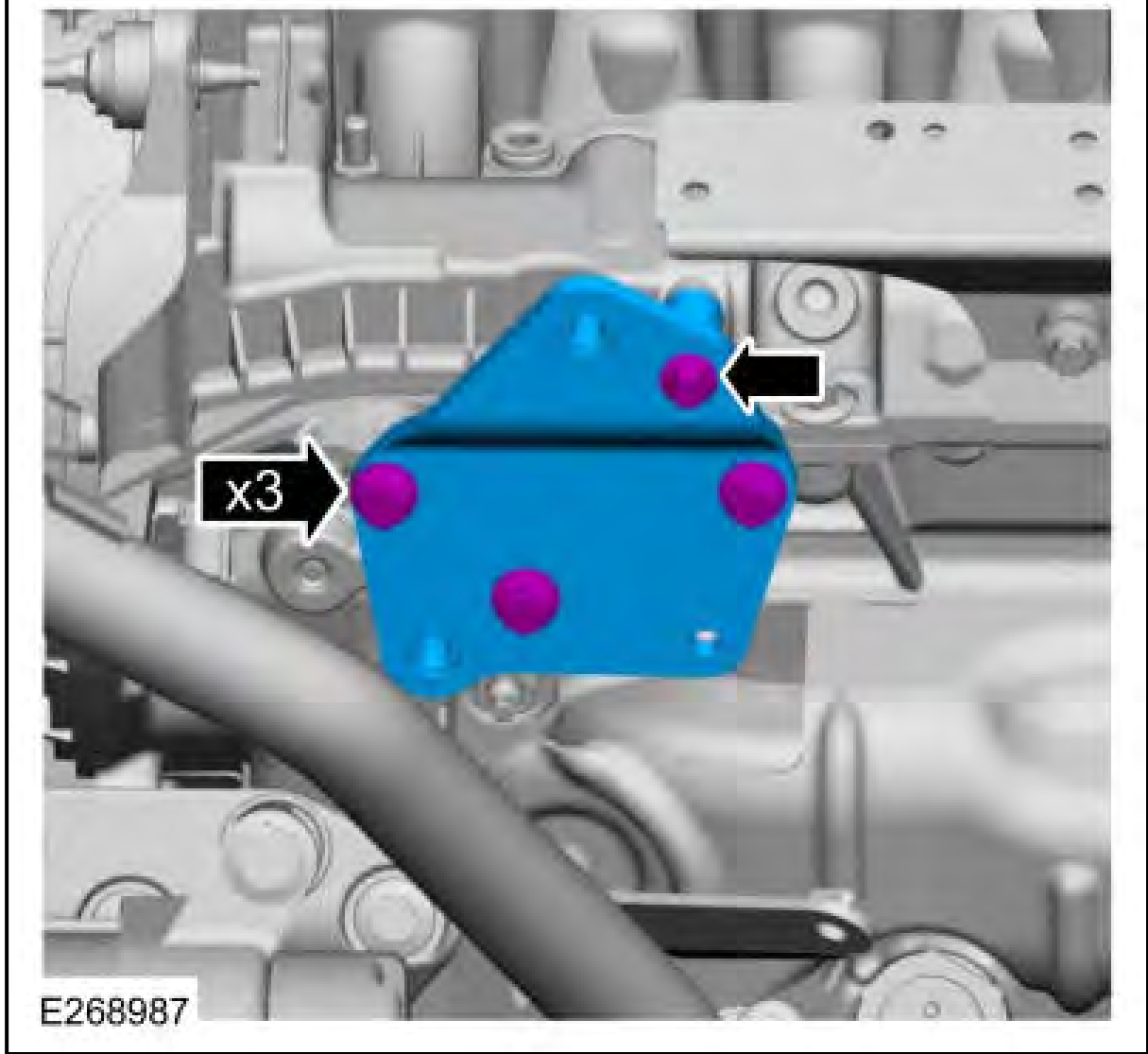




12. Install the EGR cooler mounting bracket and the bolts.

Torque: 89 lb.in (10 Nm)

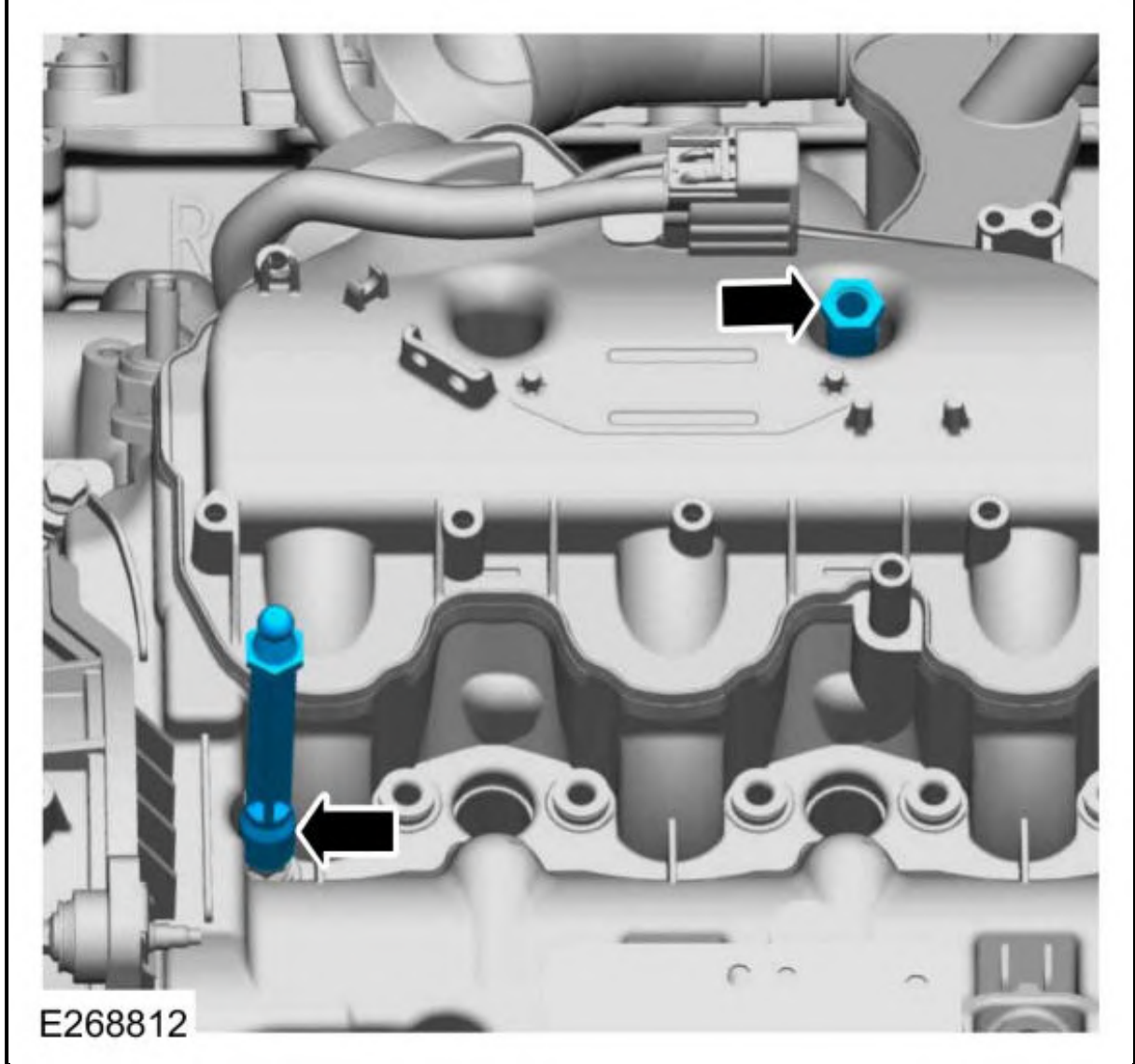




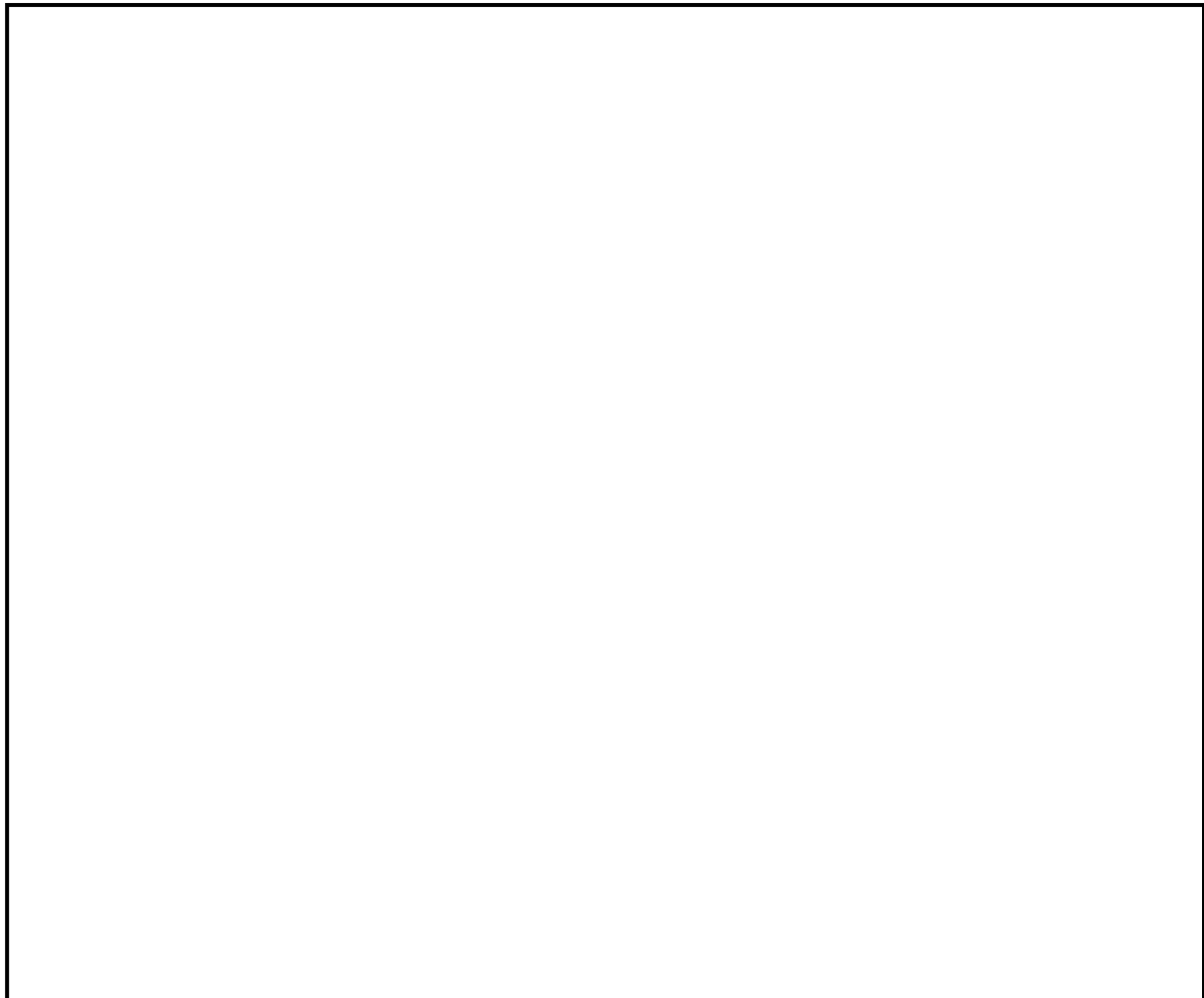
13. Install the LH engine cover stud assemblies.

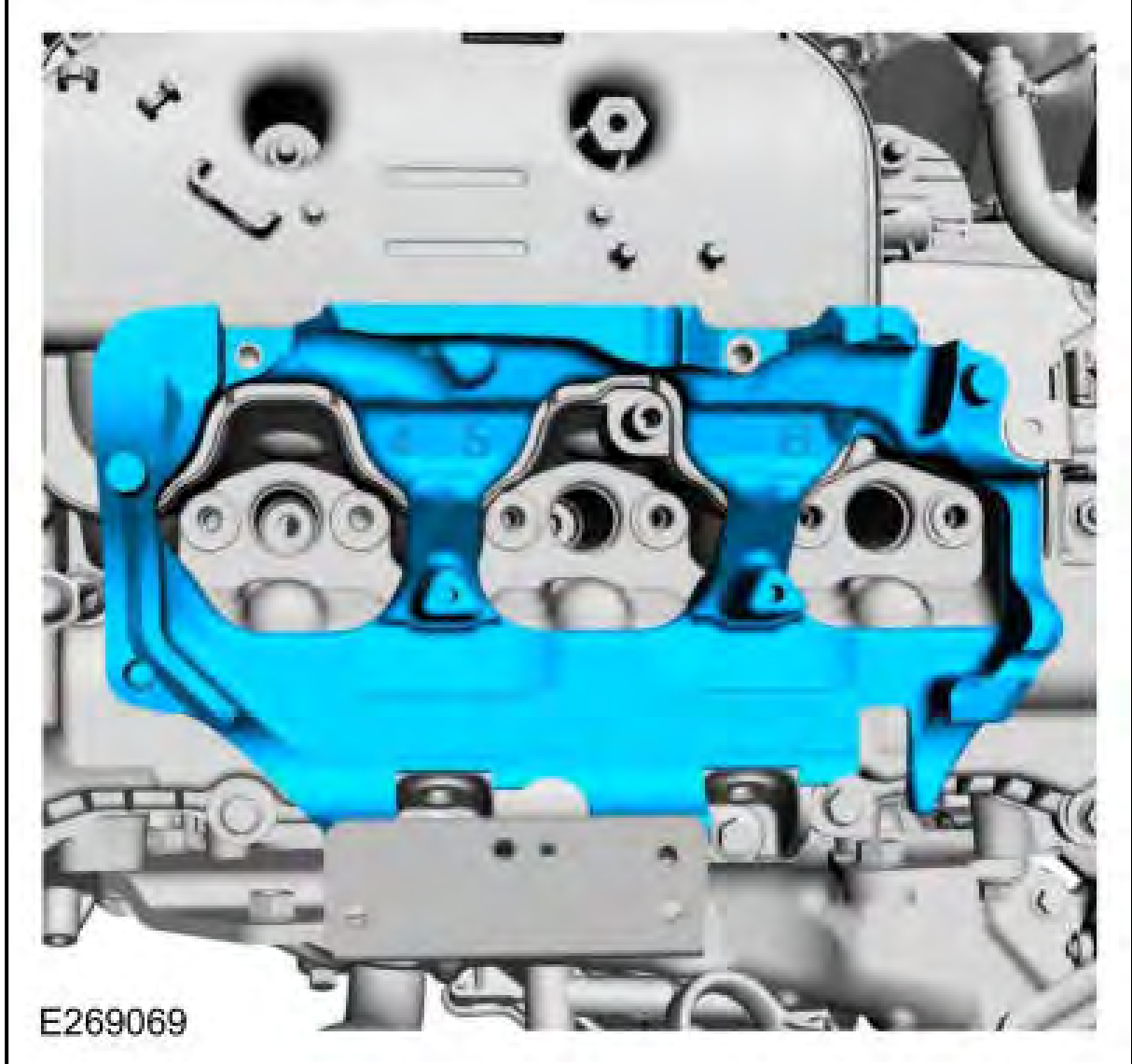
Torque: 44 lb.in (5 Nm)



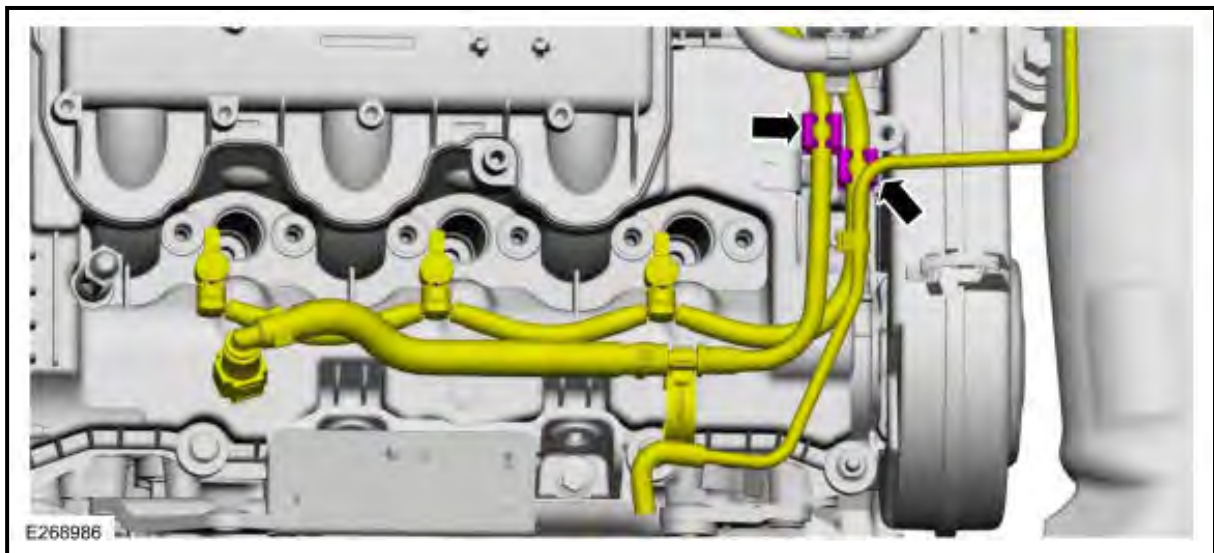


14. Install the LH lower insulator.



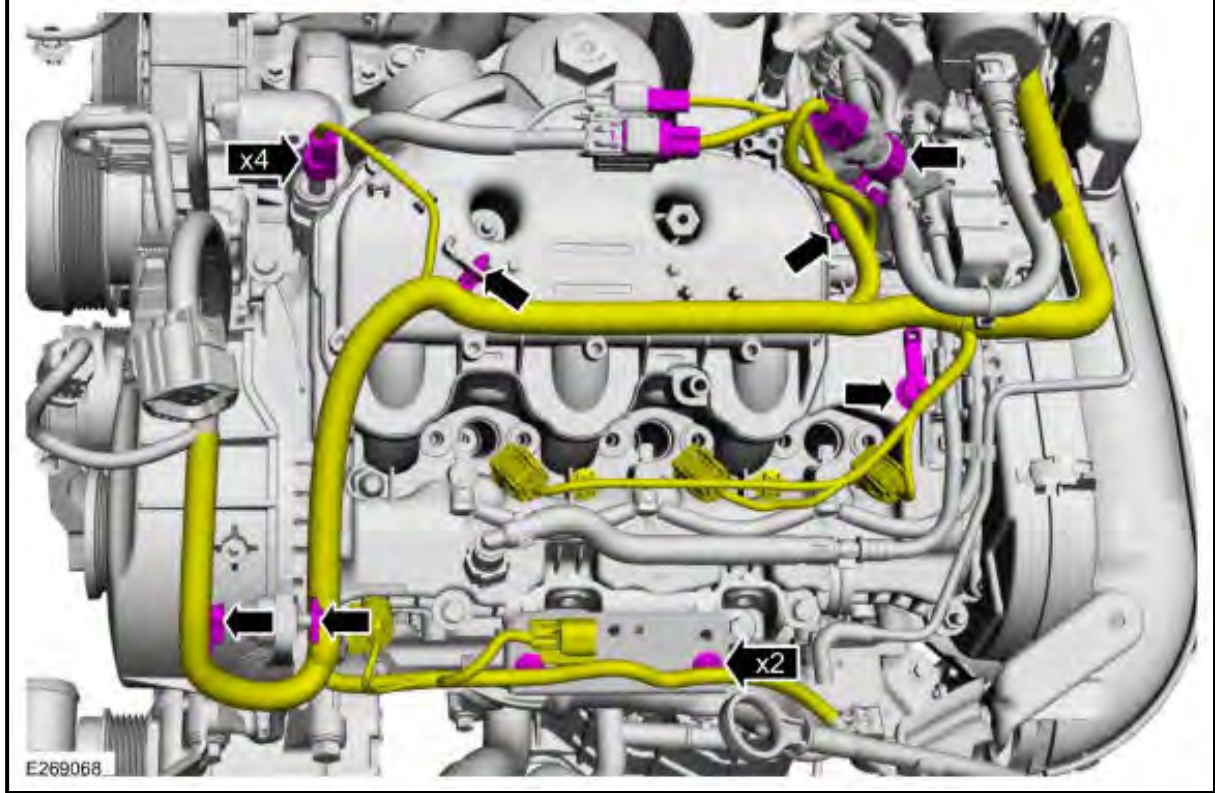


15. Position back and connect the fuel hoses

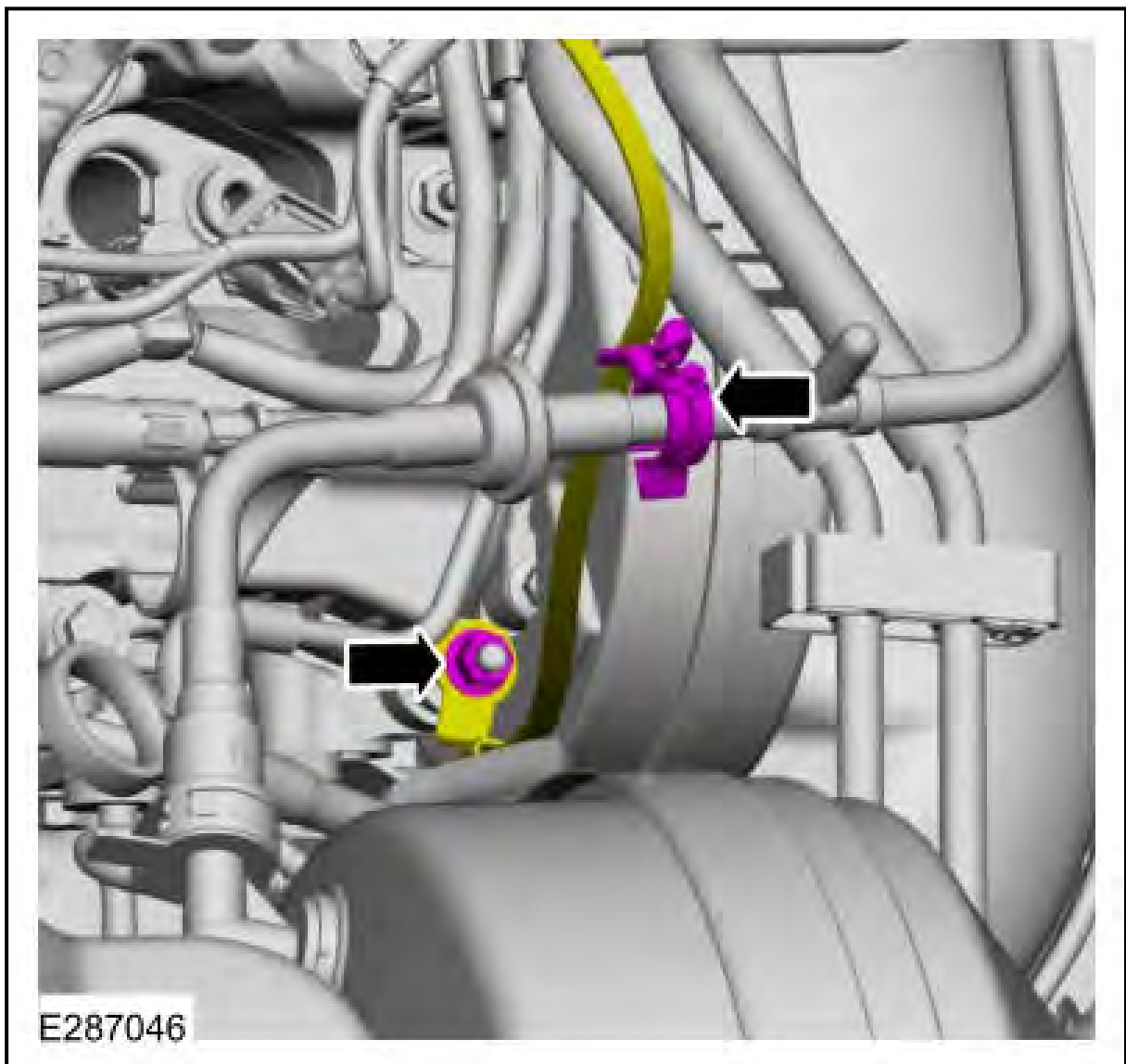


16. Position back the wire harness. Connect the electrical connectors and wire harness retainers.

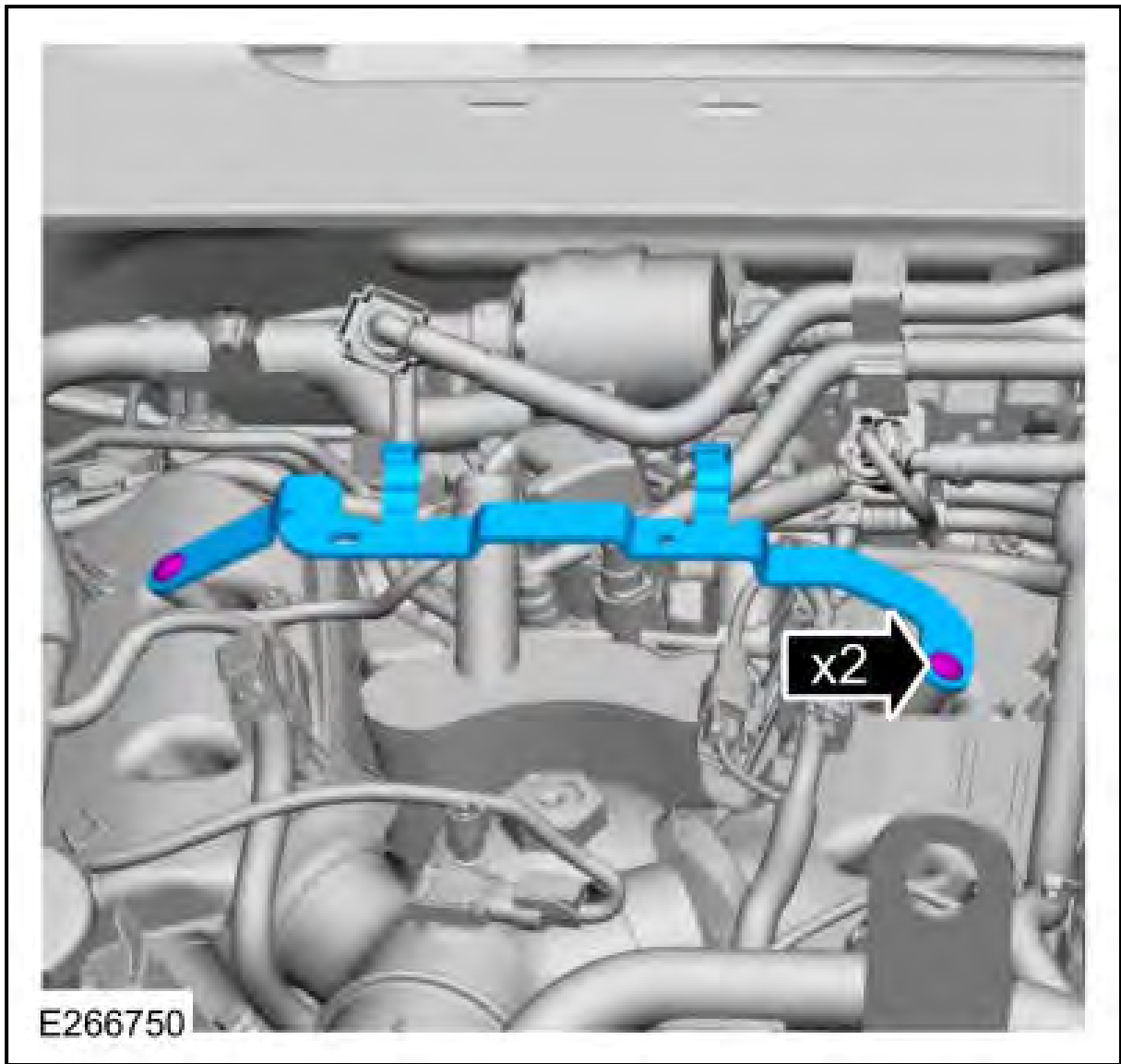




17. Position back the ground strap and install the nut. Connect the wire retainer,  
Torque: 80 lb.in (9 Nm)



18. Install the engine appearance cover bracket and the retainers.



19. Install the following items:

1. Install the accessory drive belt. REFER to: [Accessory Drive Belt](#) .
2. Install the LH fuel rail. REFER to: [Fuel Rail LH](#) .
3. Install the LH fuel injectors. REFER to: [Fuel Injectors LH](#) .
4. Install the LH fuel injector supply tube. REFER to: [Fuel Injector Supply Tube LH](#) .
5. Install the LH fuel rail supply tube. REFER to: [Fuel Rail Supply Tube LH](#) .
6. Install the fuel rail balance tube. REFER to: [Fuel Rail Balance Tube](#) .
7. Install the EGR system module. REFER to: [Exhaust Gas Recirculation \(EGR\) System Module](#) .
8. Install the intake manifold. REFER to: [Intake Manifold](#) .

### VALVE COVER RH

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

### Special Tool(s) / General Equipment

|                        |
|------------------------|
| <b>Plastic Scraper</b> |
|------------------------|

### Materials

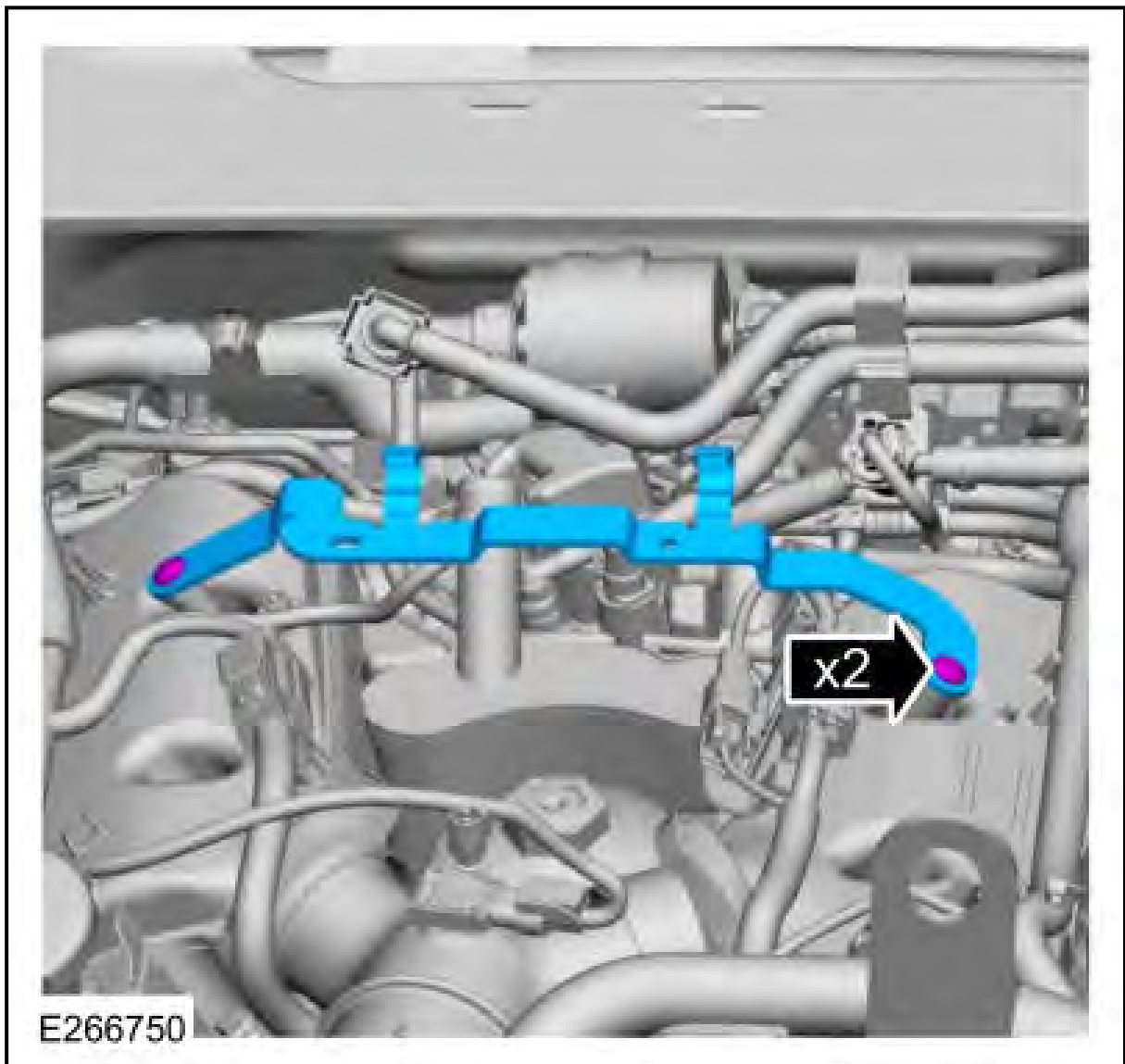
| Name  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> High Performance Engine RTV Silicone TA-357 | WSE-M4G323-A6 |
| Motorcraft <sup>®</sup> Silicone Gasket Remover ZC-30-A             | -             |

| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> Metal Surface Prep ZC-31-A               | -             |
| Motorcraft <sup>®</sup> Metal Brake Parts Cleaner PM-4-A, PM-4-B | -             |

## REMOVAL

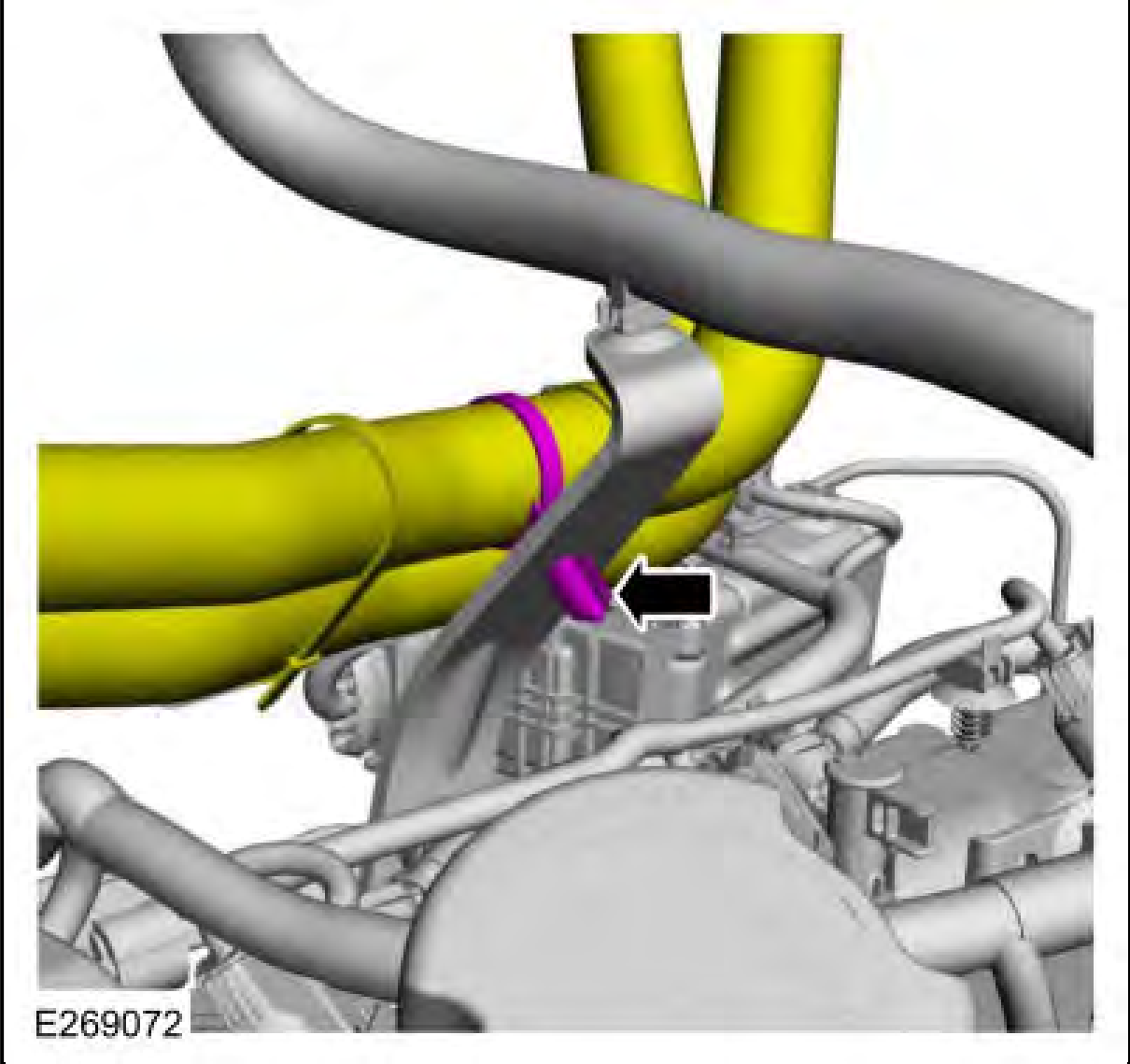
**NOTE:** During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Remove the following items:
  1. Remove the intake manifold. REFER to: [Intake Manifold](#) .
  2. Remove the fuel rail balance tube. REFER to: [Fuel Rail Balance Tube](#) .
  3. Remove the RH fuel rail supply tube. REFER to: [Fuel Rail Supply Tube RH](#) .
  4. Remove the RH fuel injector supply tube. REFER to: [Fuel Injector Supply Tube RH](#) .
  5. Remove the RH fuel injectors. REFER to: [Fuel Injectors RH](#) .
  6. Remove the RH fuel rail. REFER to: [Fuel Rail RH](#) .
3. Remove the retainers and the engine appearance cover bracket.



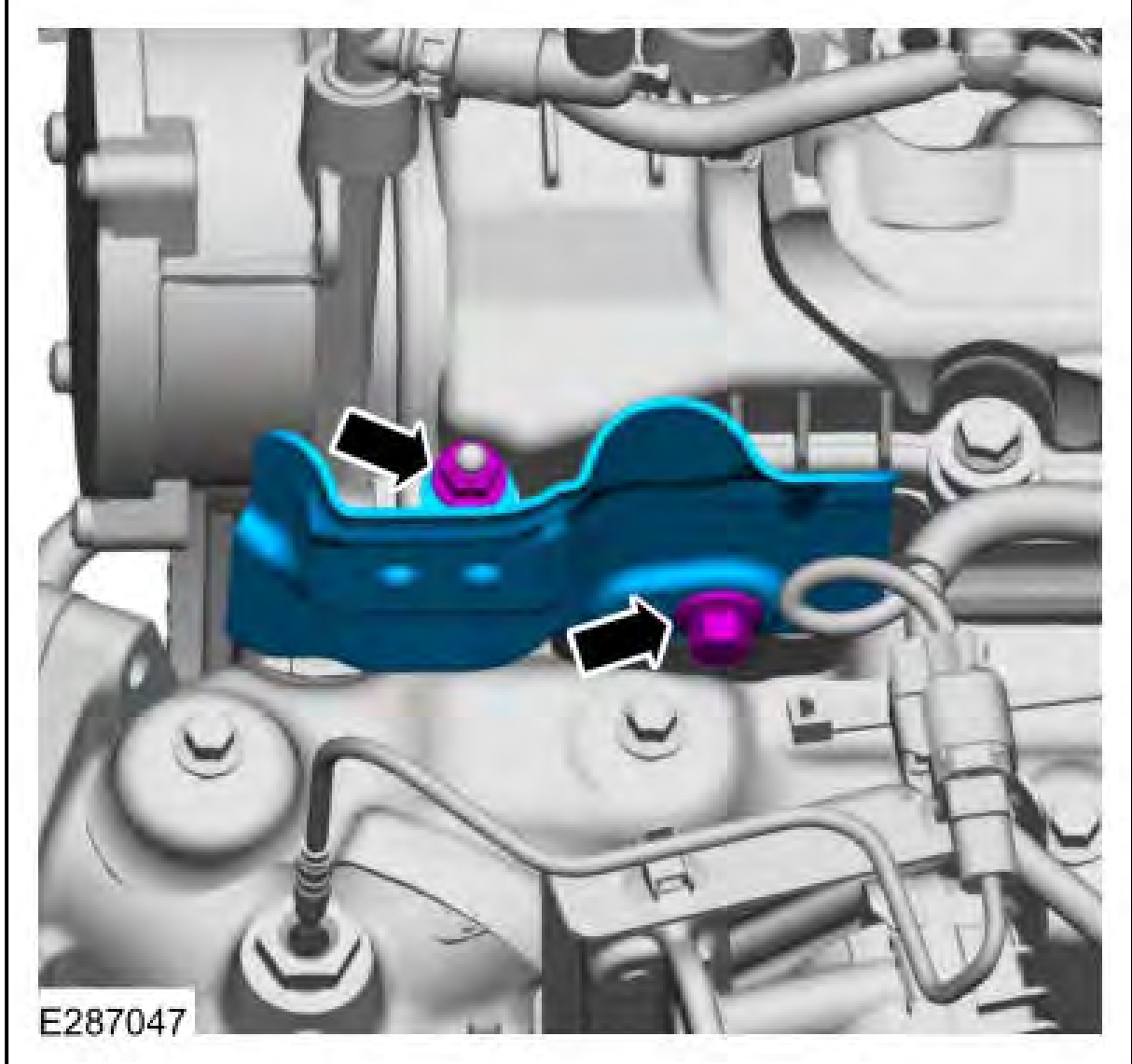
4. Disconnect the heater hoses and position aside.





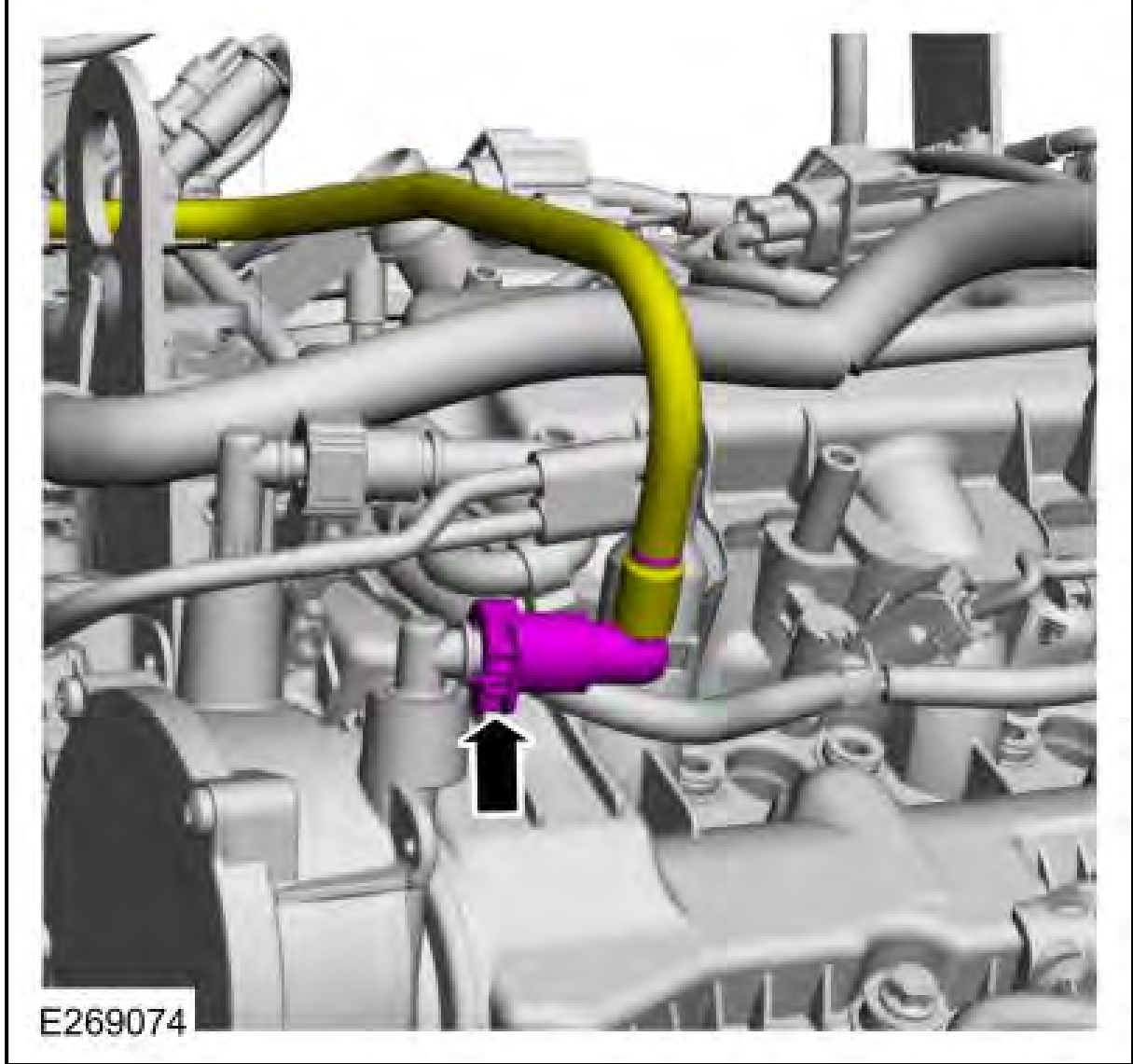
5. Remove the nut, the bolt and the turbocharger heat shield.



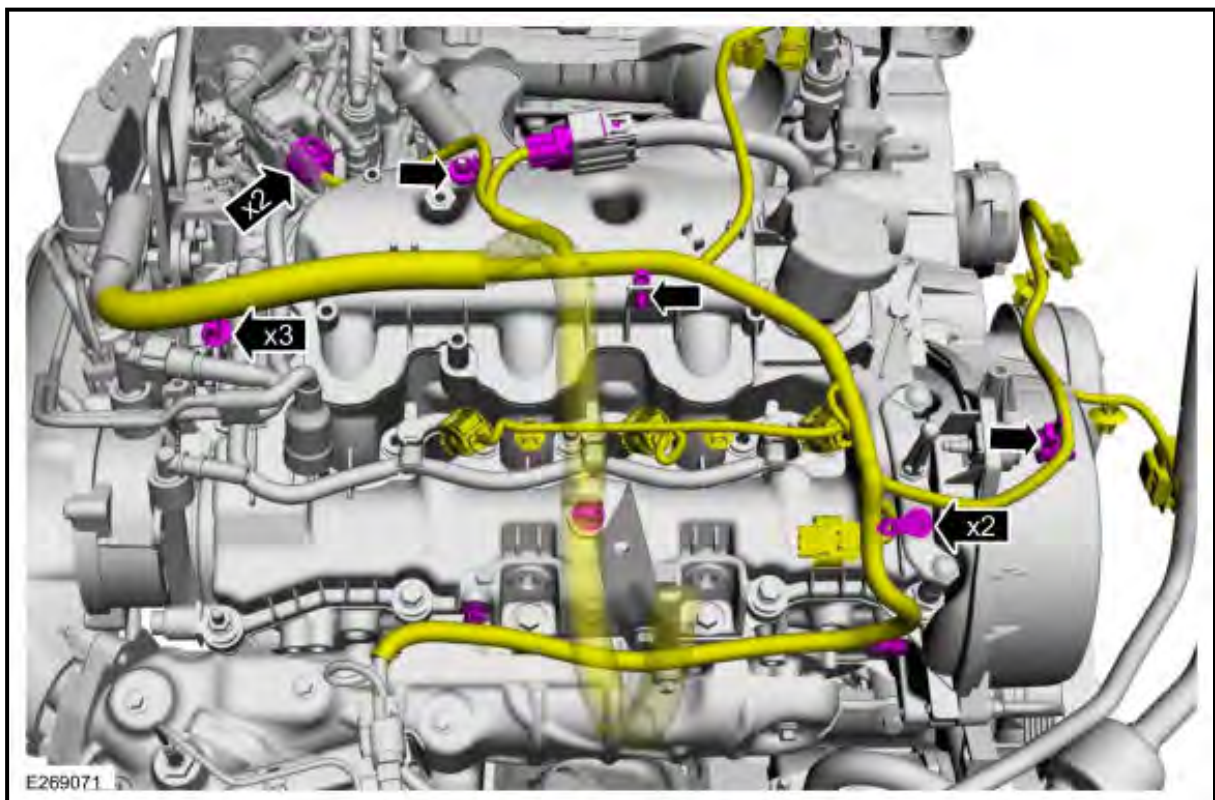


6. Disconnect the brake booster vacuum pump tube and position aside. REFER to: [Quick Release Coupling](#) .





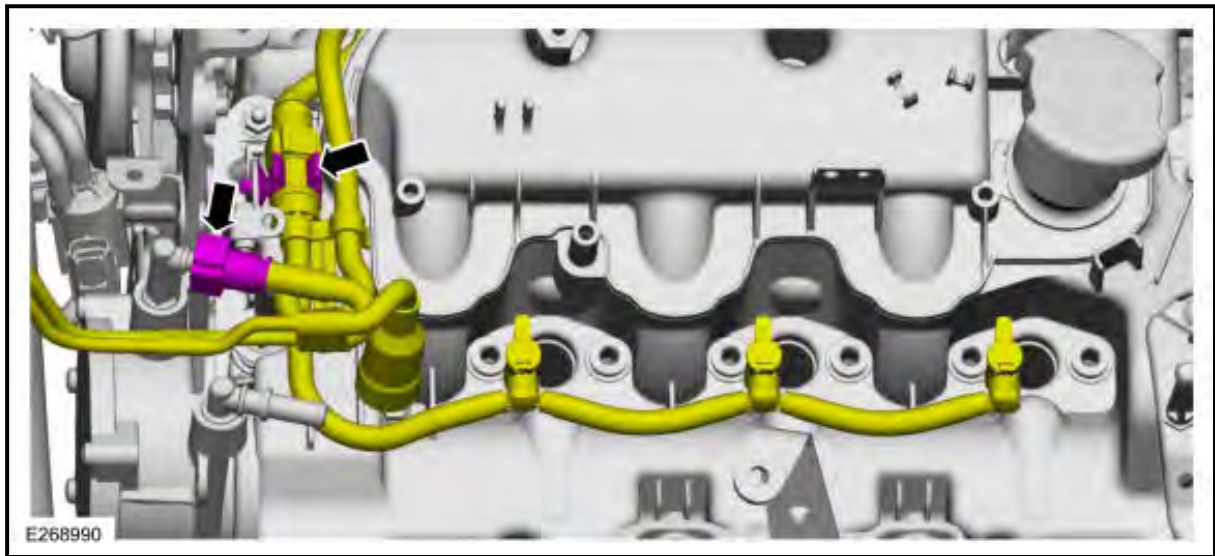
7. Disconnect the electrical connectors and the wire harness retainers. Position aside the wire harness.



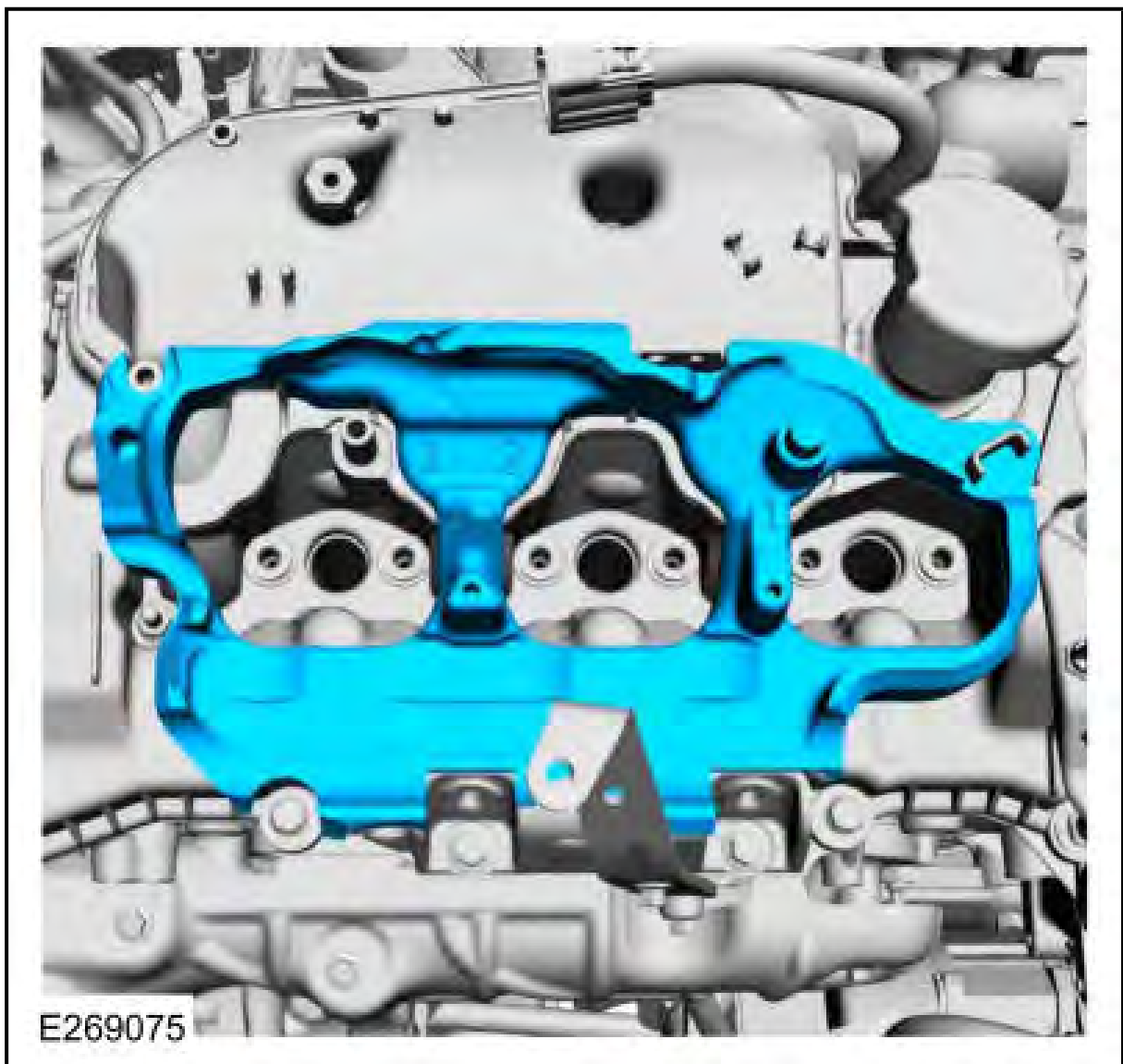
8.

- Disconnect and position aside the vacuum harness. REFER to: [Quick Release Coupling](#).

- Disconnect the fuel hoses and position aside.

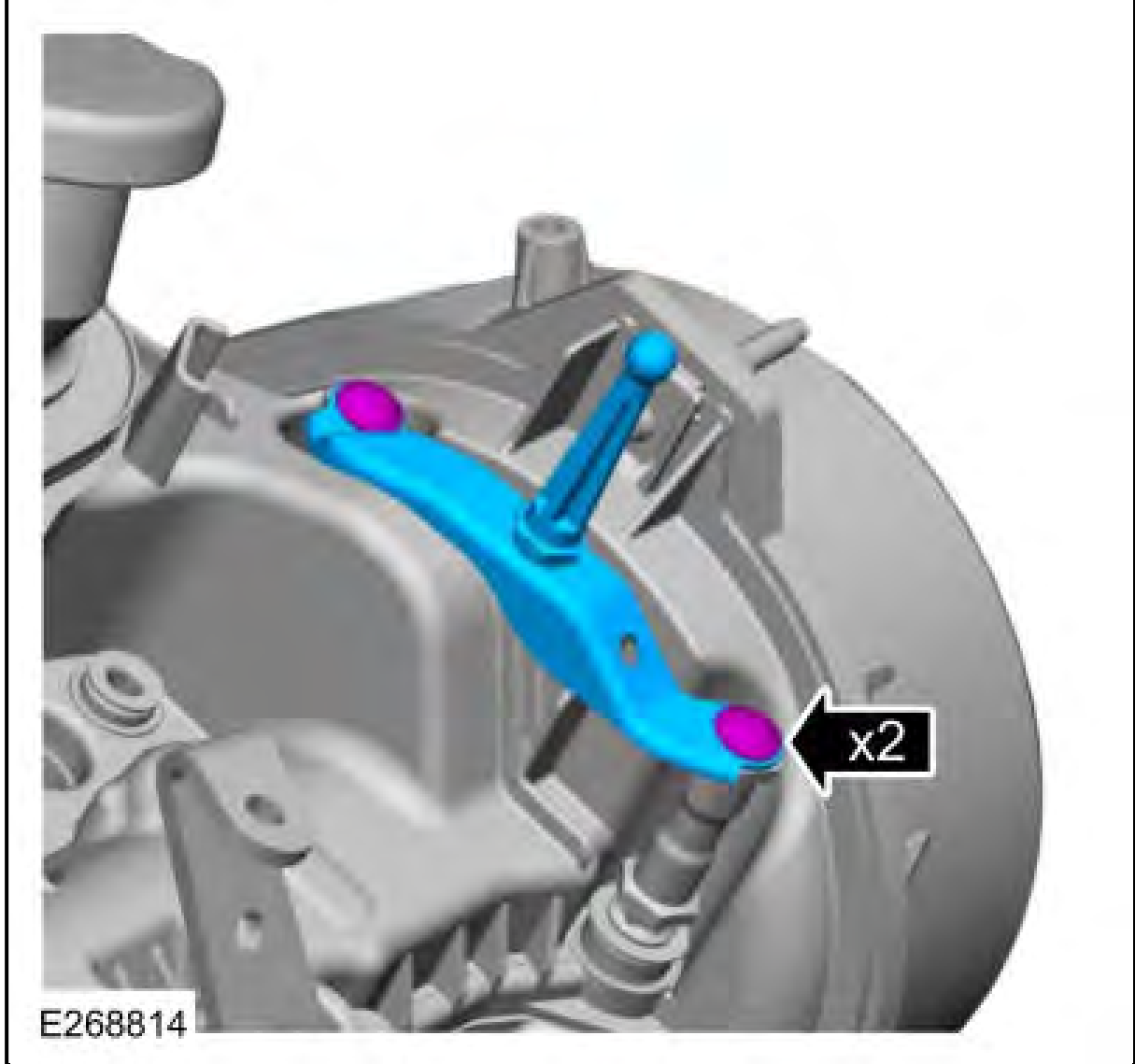


9. Remove the LH lower insulator.

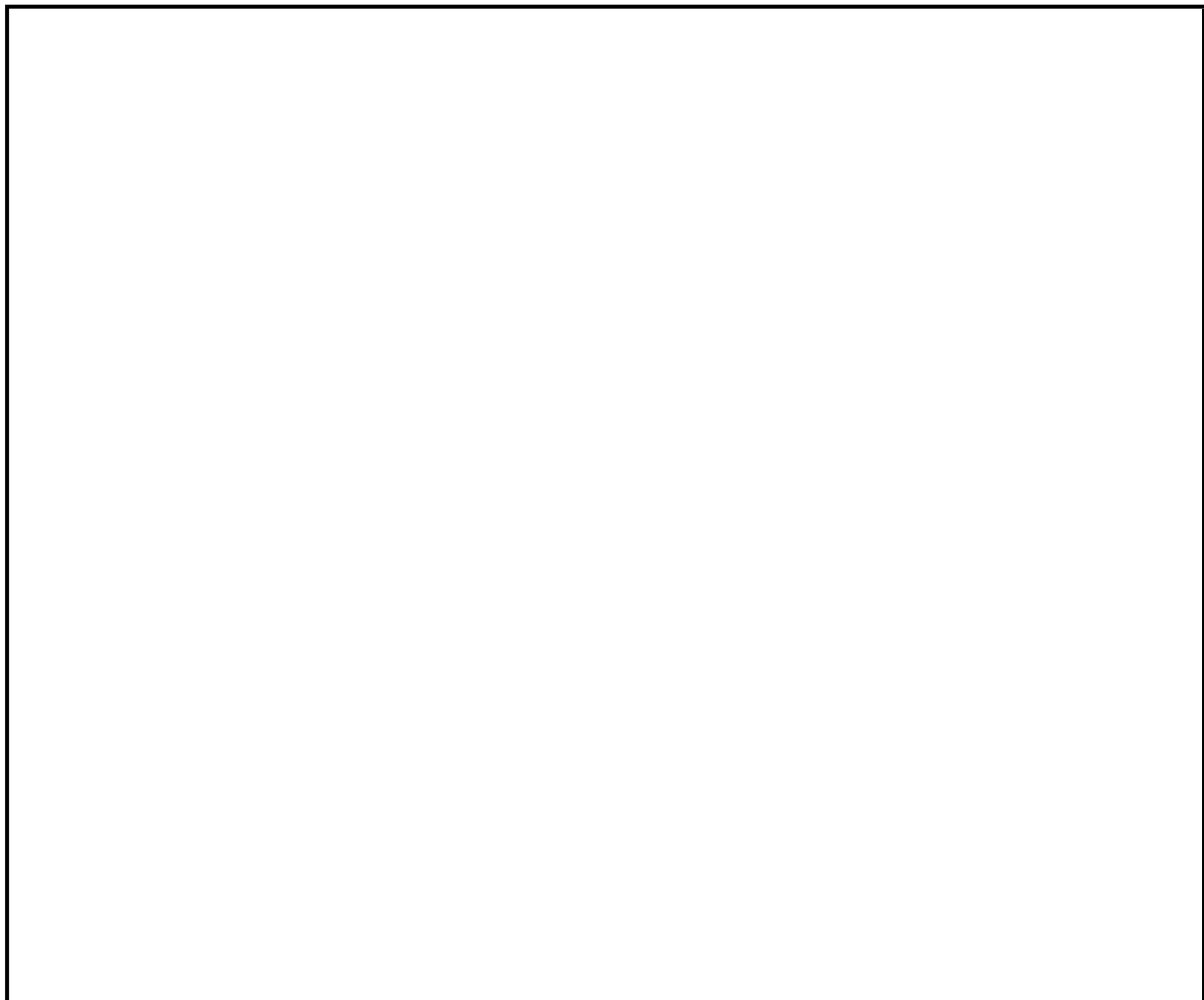


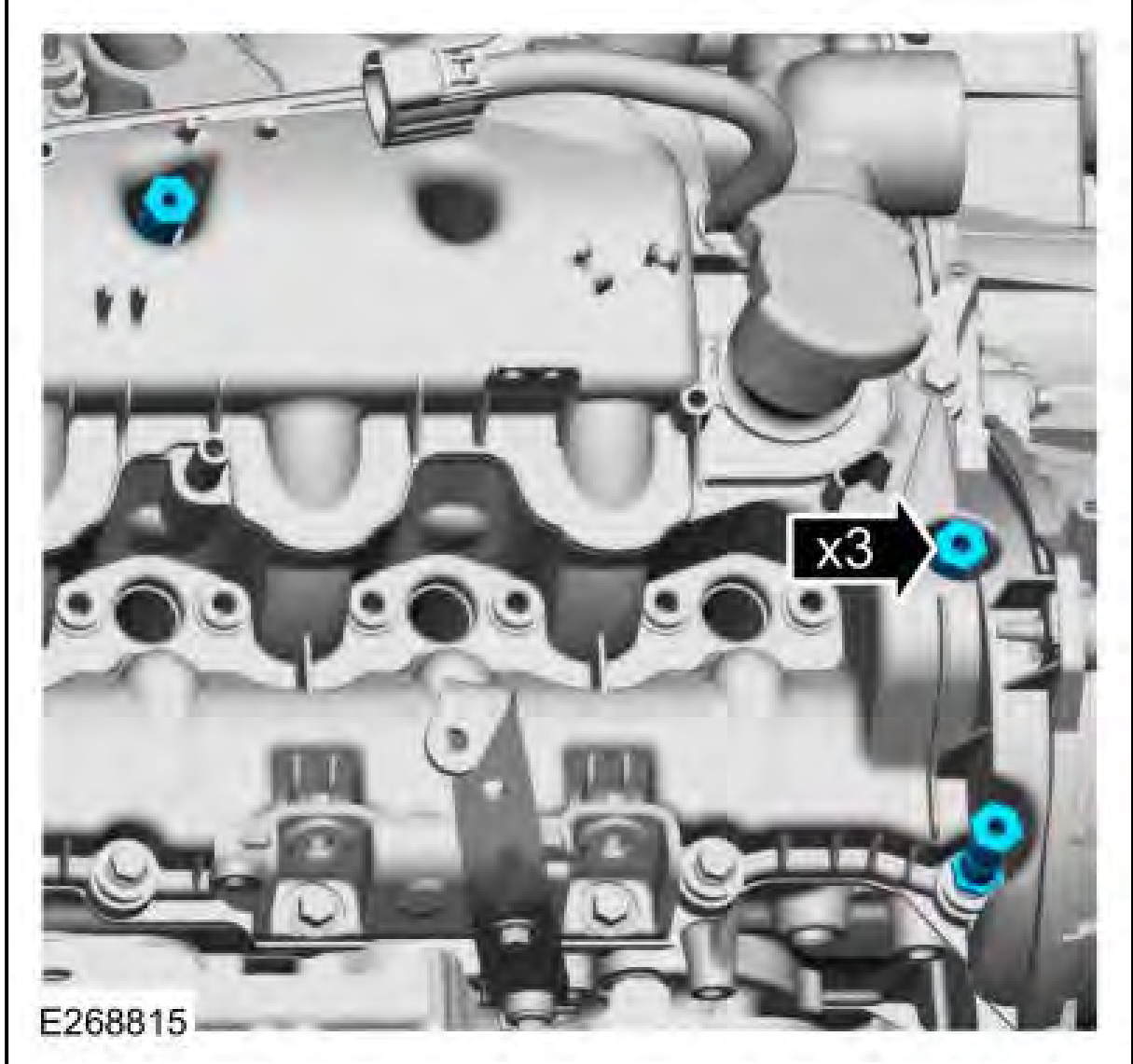
10. Remove the retainers and the engine appearance support bracket.





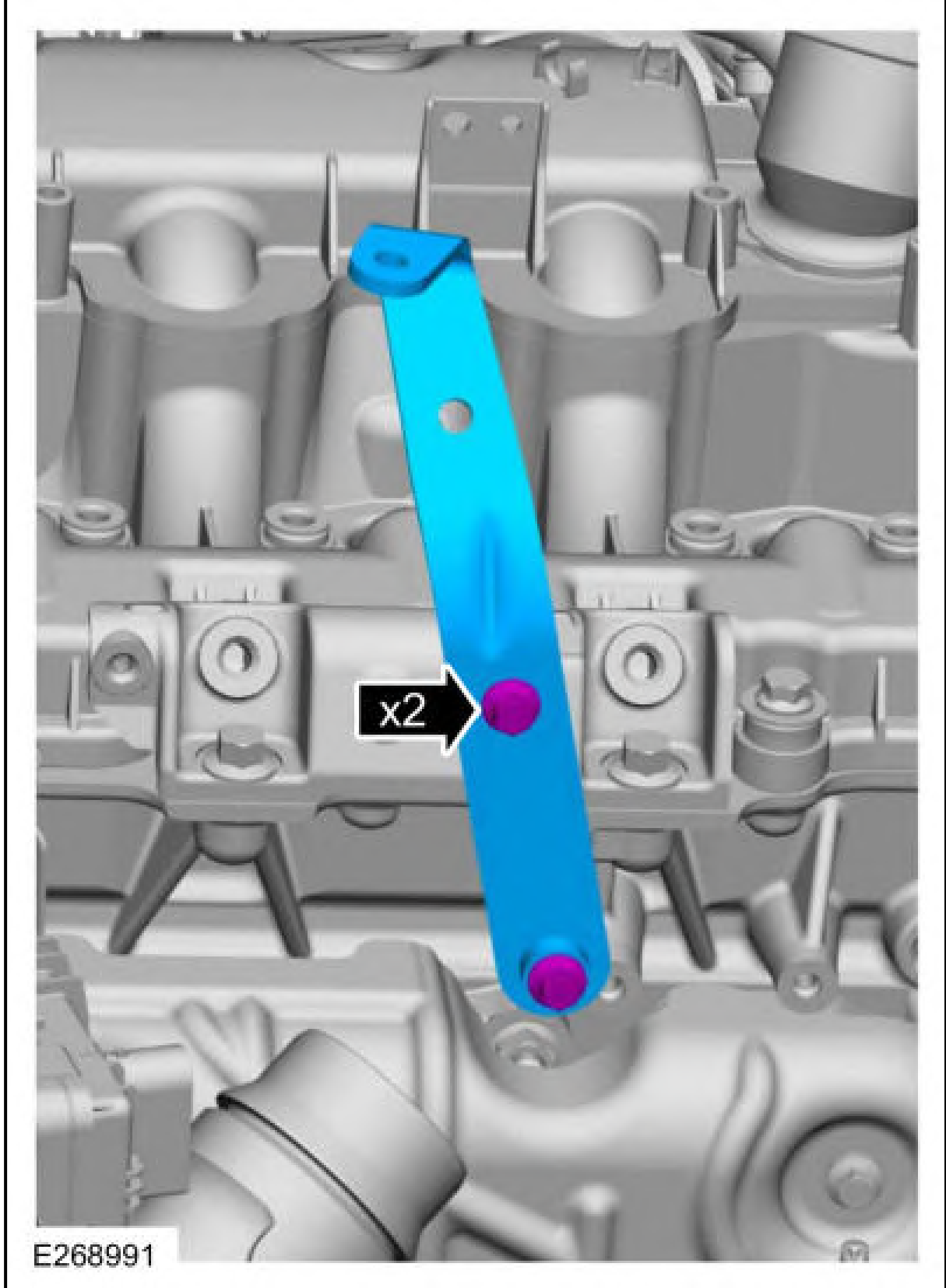
11. Remove the RH engine cover stud assemblies.





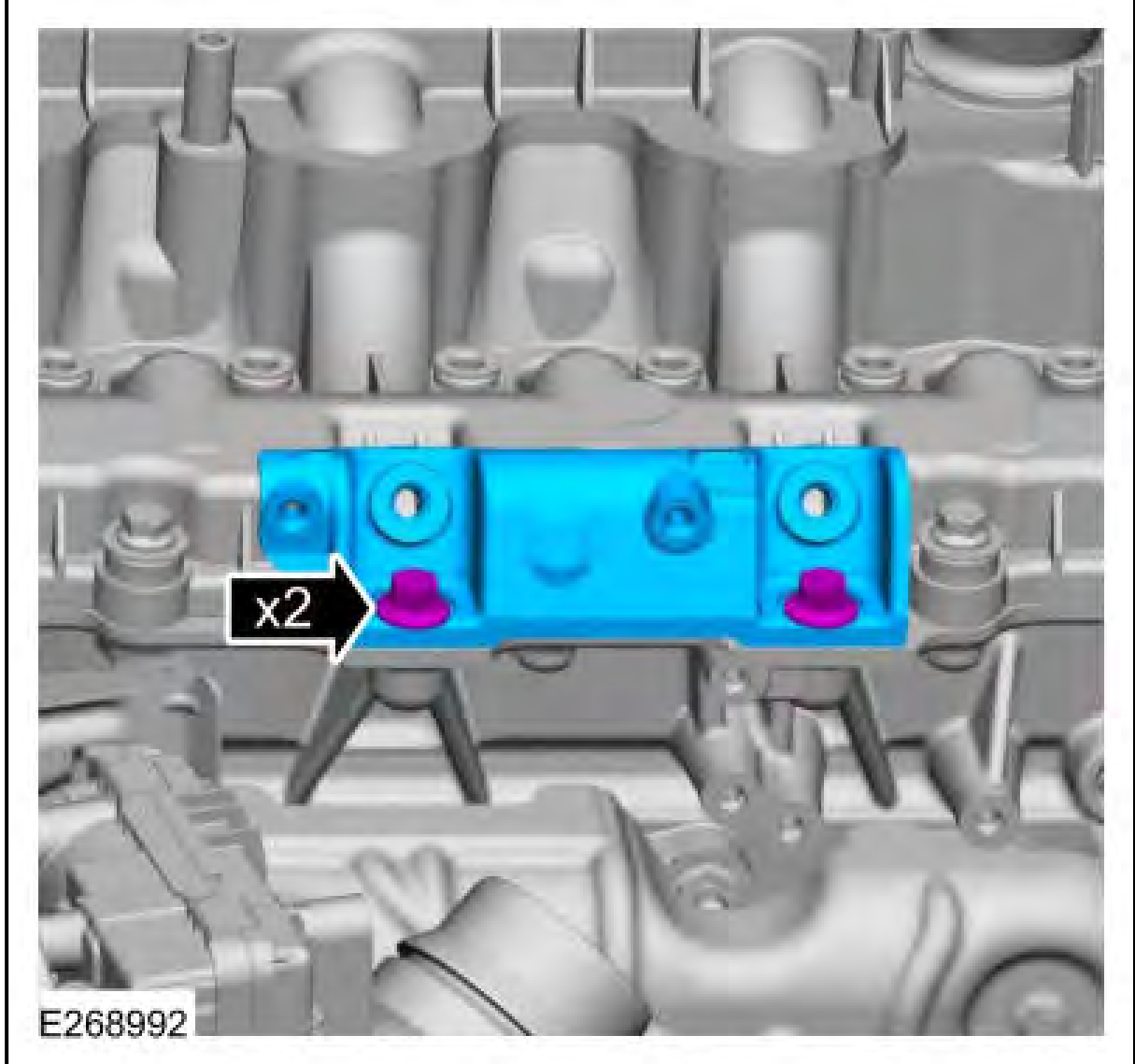
12. Remove the bolts and the heater hose support bracket.



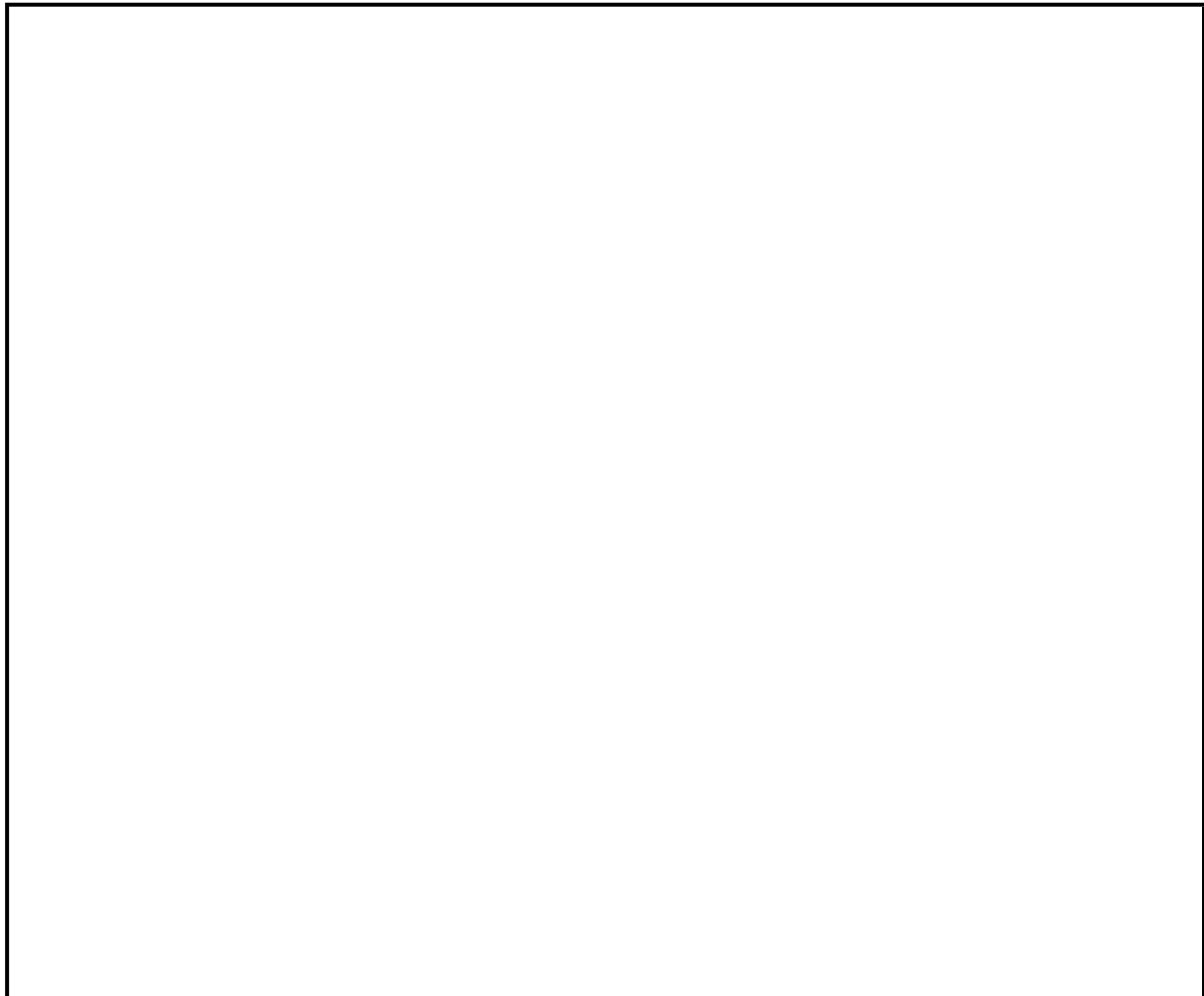


13. Remove the bolts and the RH fuel rail bracket.

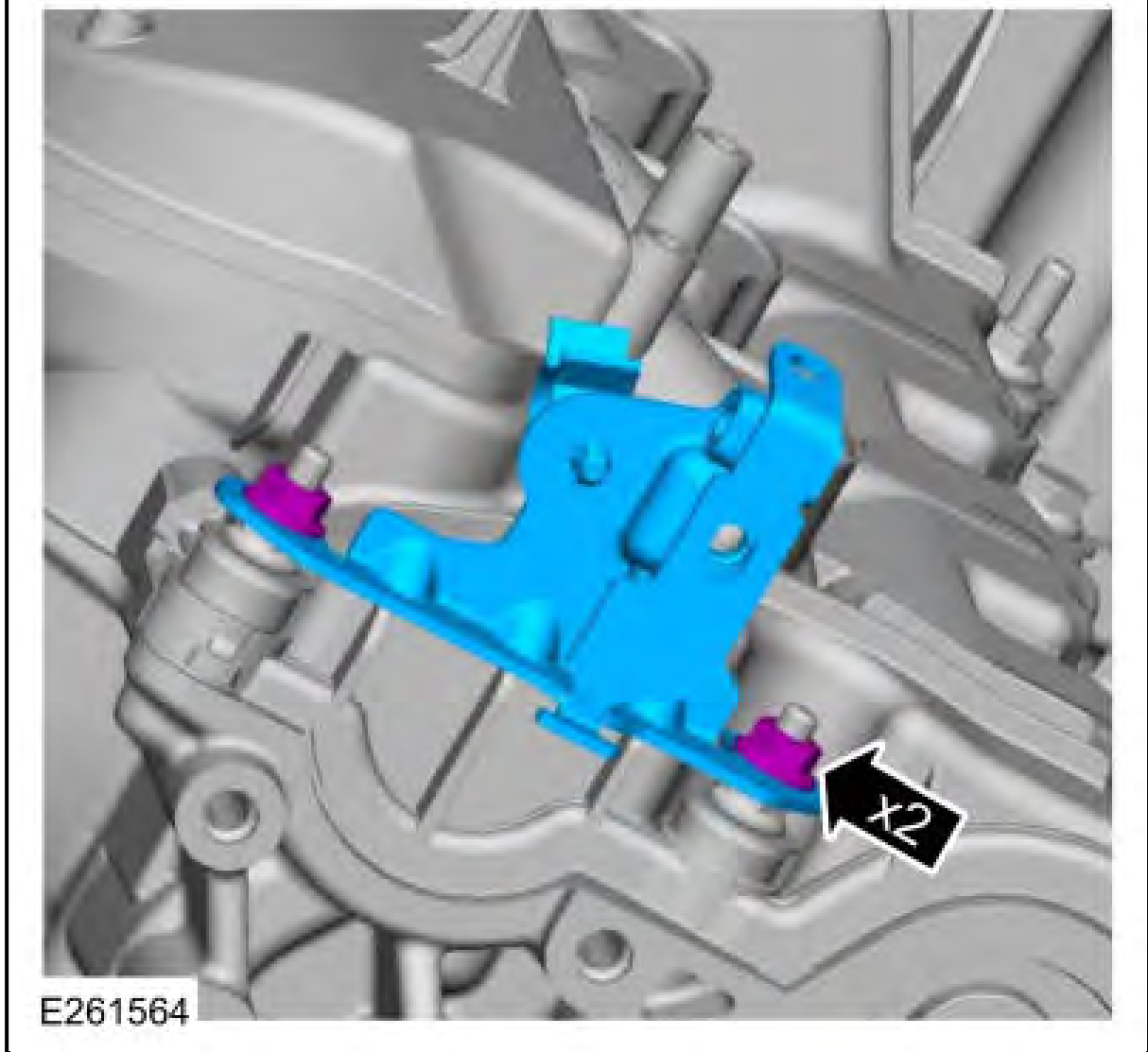




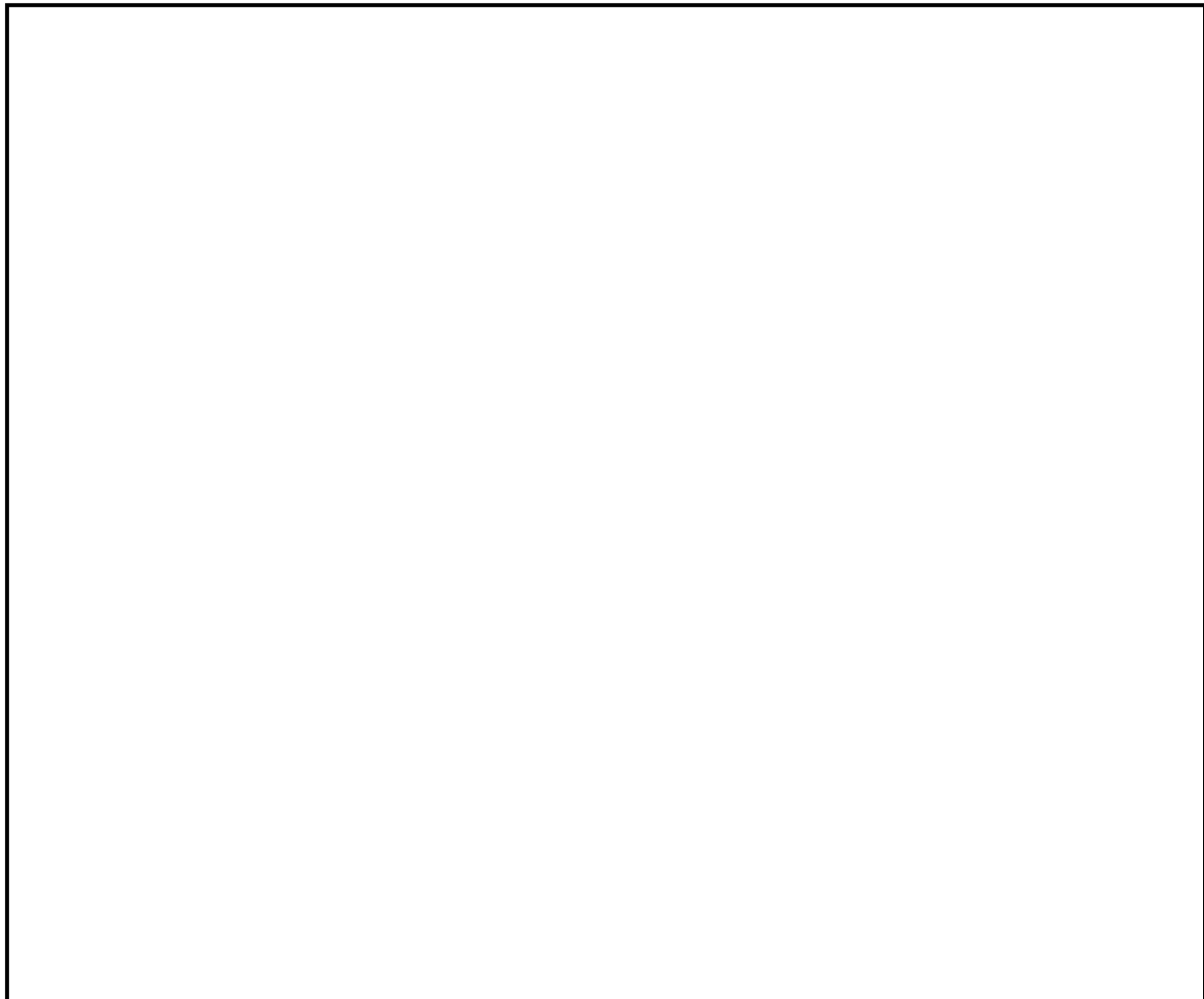
14. Remove the nuts and the RH fuel tube bracket.

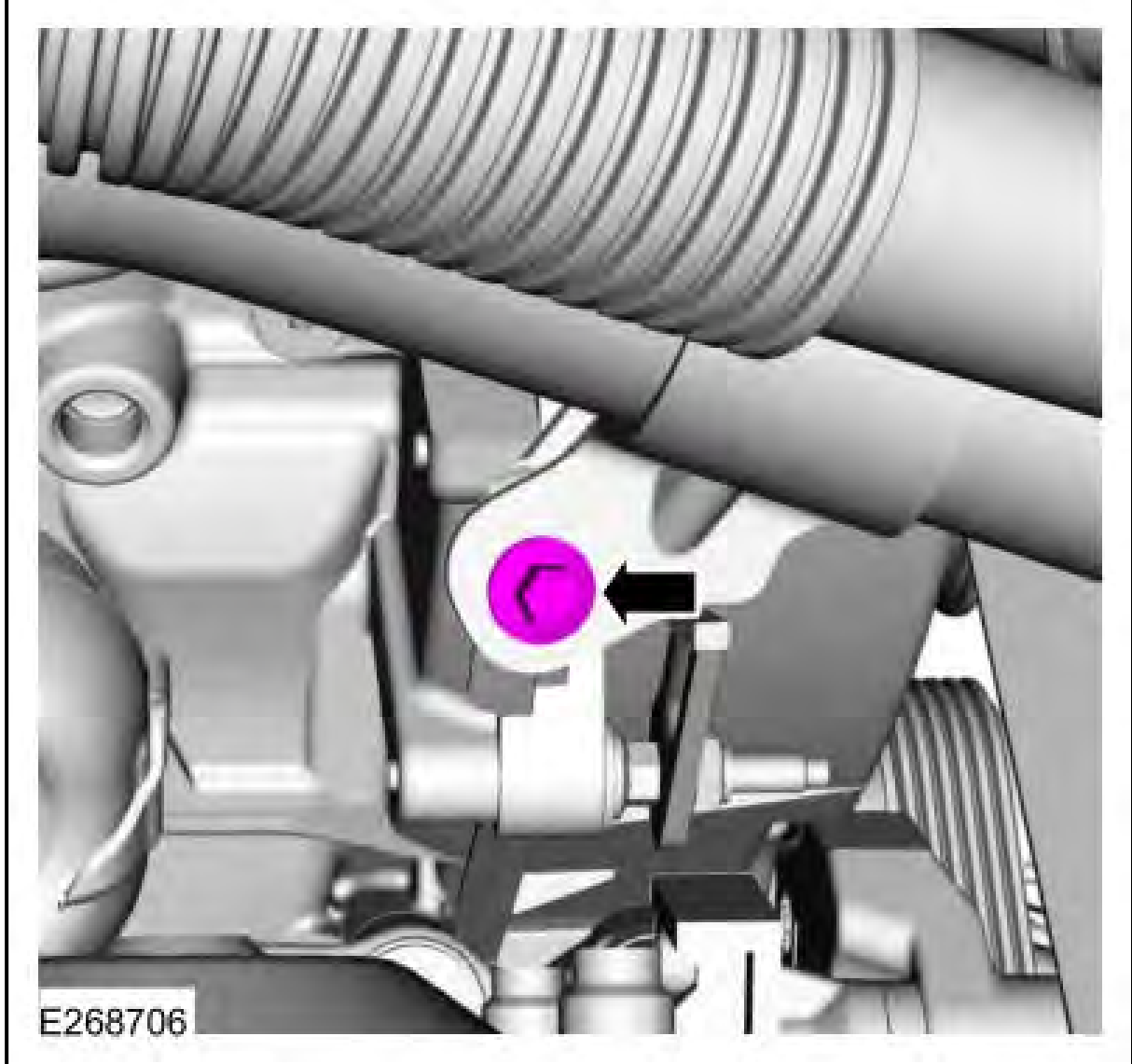






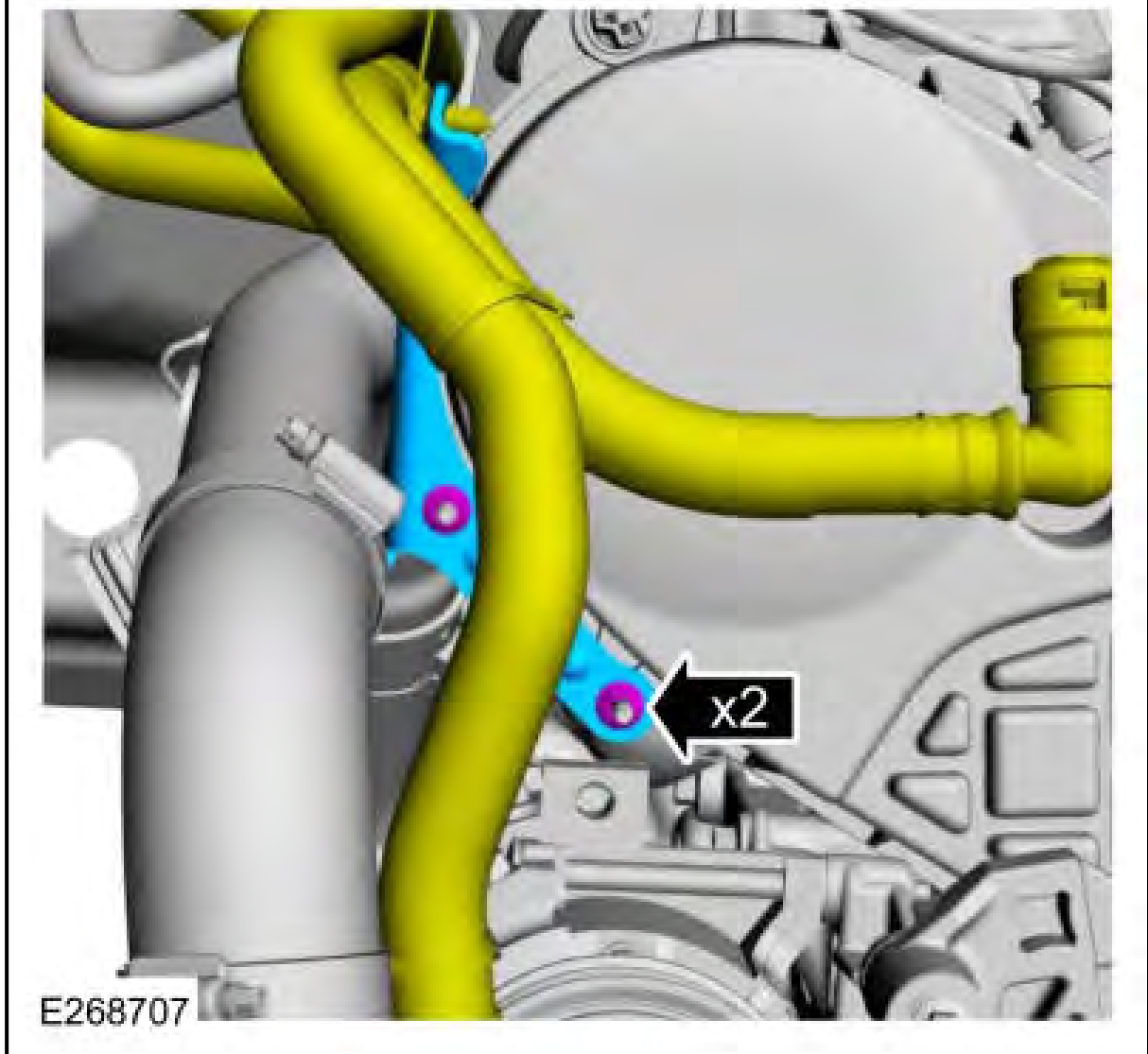
15. Remove the bolt for the CAC tube.



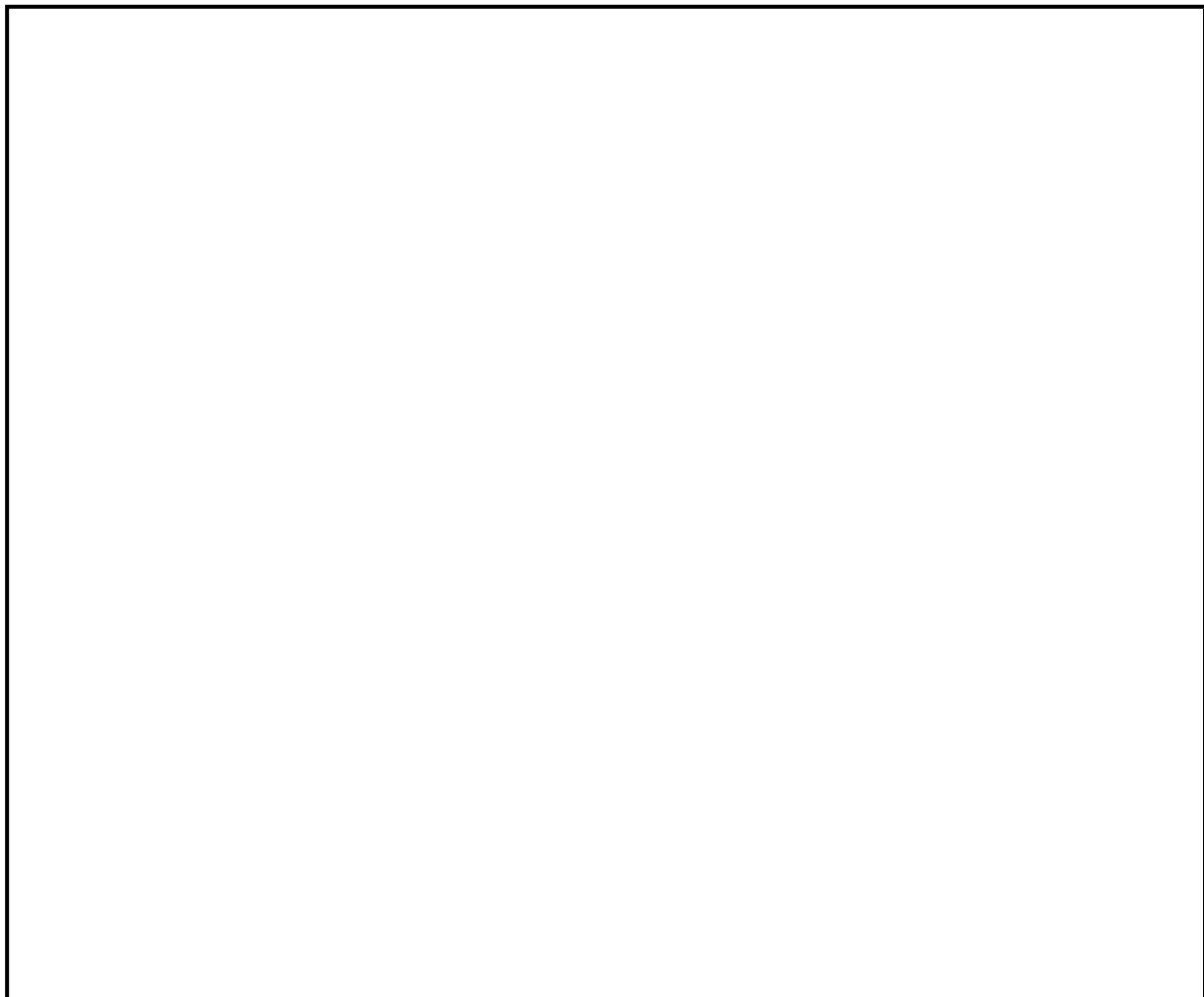


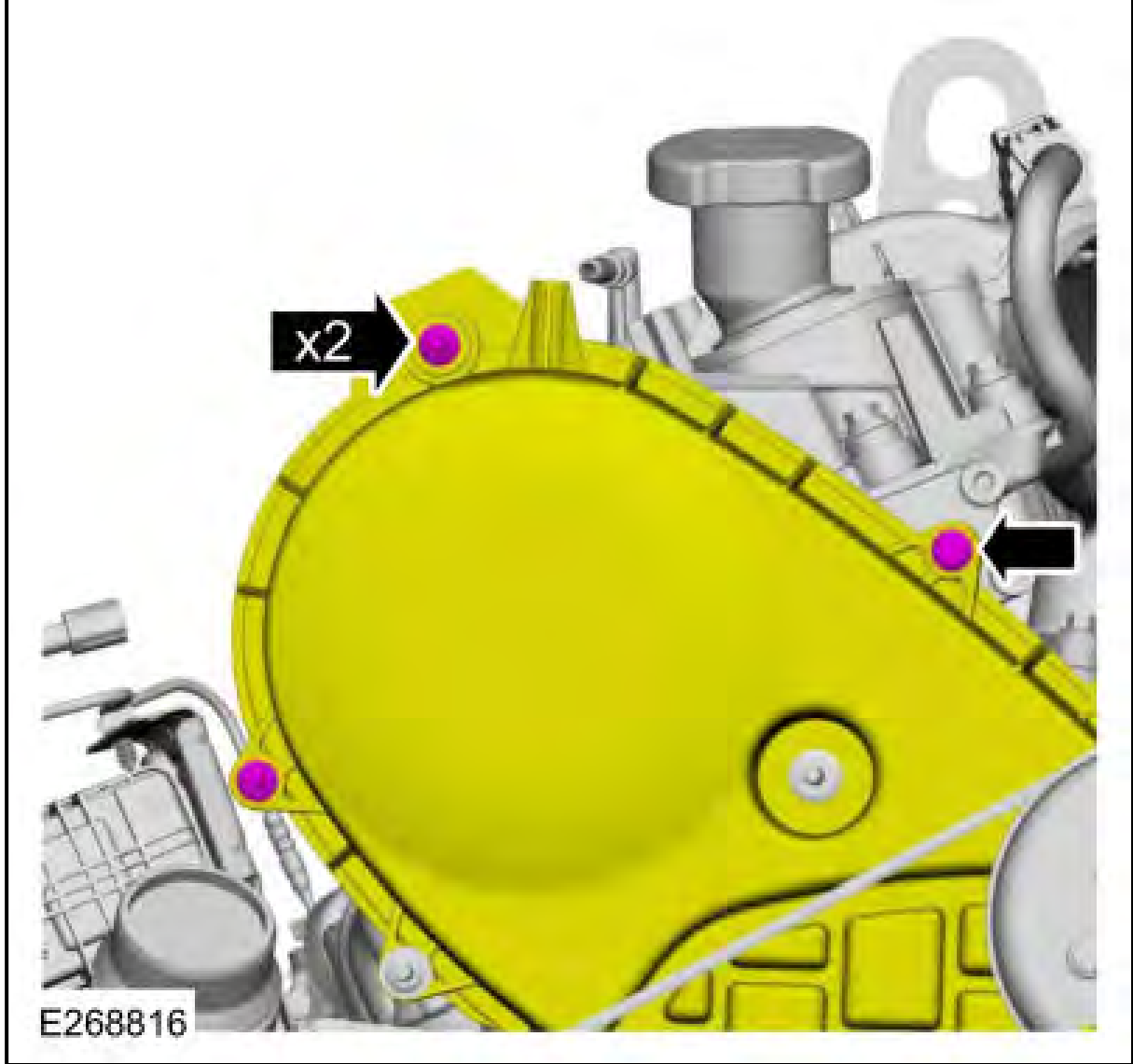
16. Remove the nuts for the CAC tube bracket. Position aside the heater hoses.



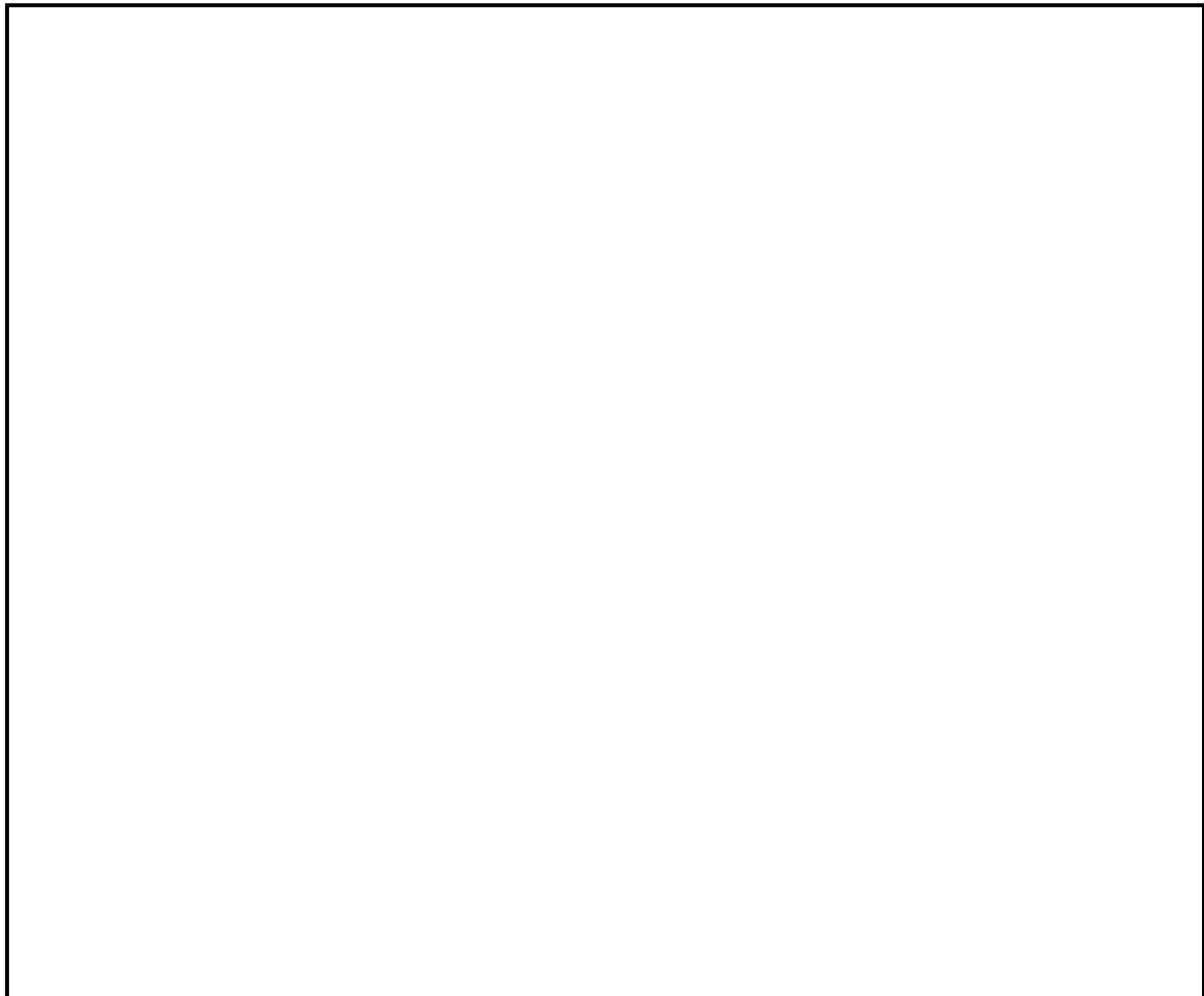


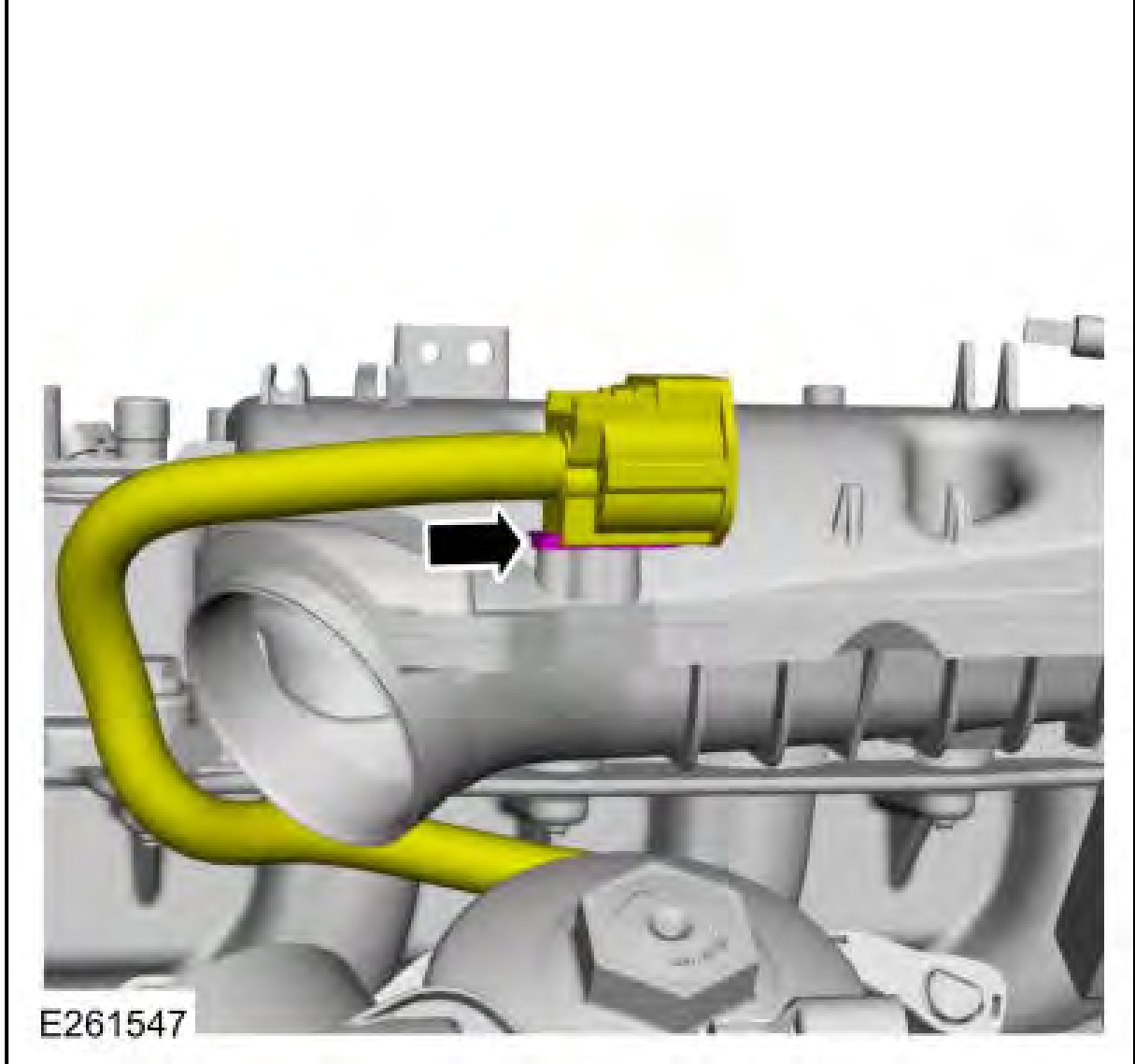
17. Loosen the retainers and position out the engine front cover.



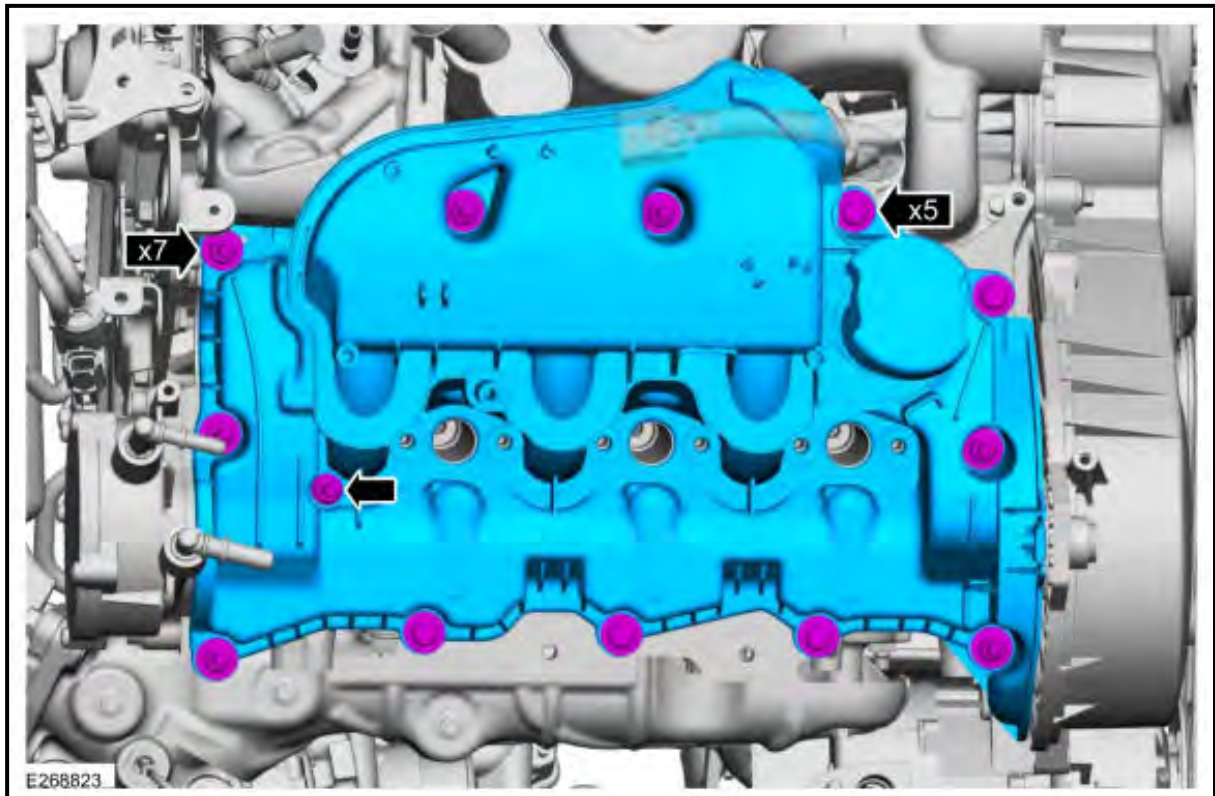


18. Disconnect the glow plug electrical connector and position aside.

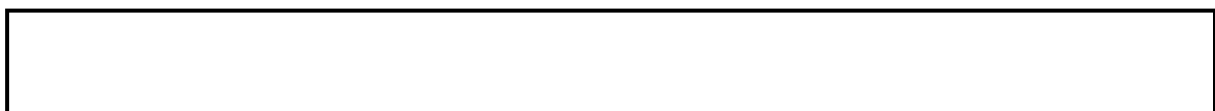


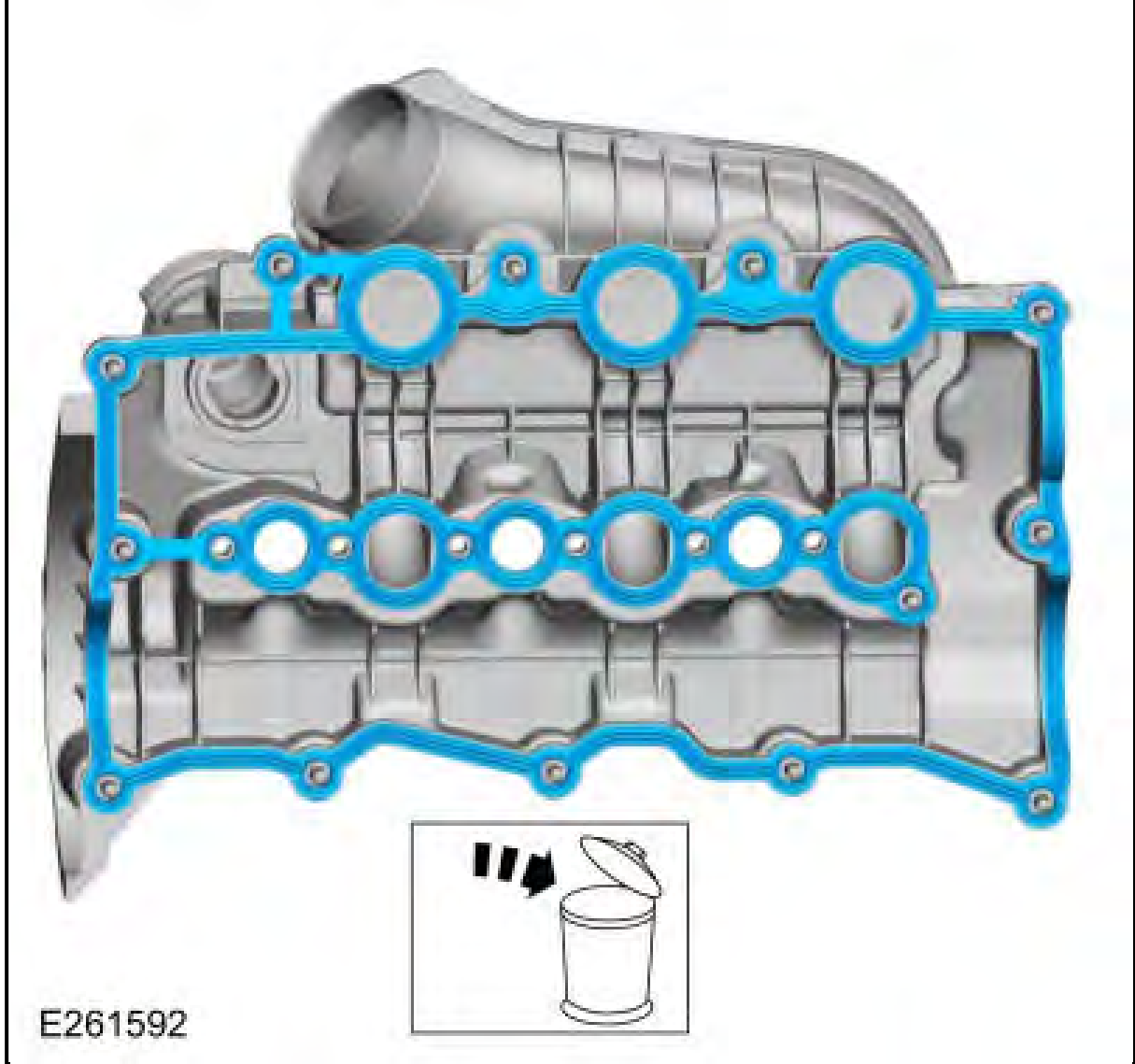


19. Remove the fasteners and the valve cover.



20. Remove and discard the valve cover gasket.





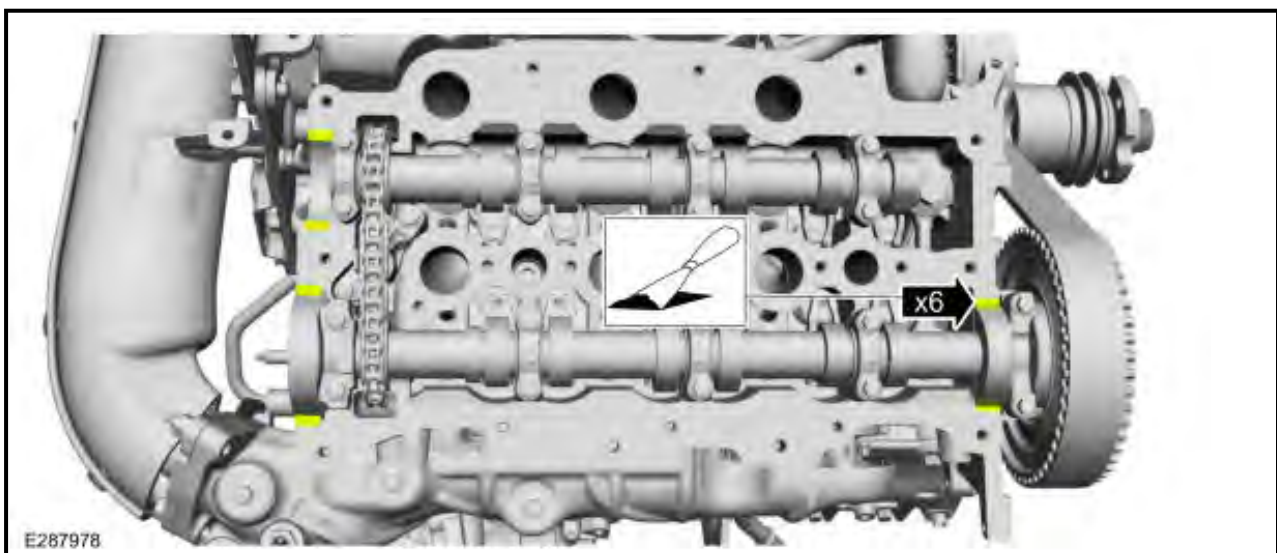
21. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.

Clean the valve cover mating surface of the cylinder head and engine front cover. REFER to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

Material: Motorcraft <sup>®</sup> Silicone Gasket Remover / ZC-30-A

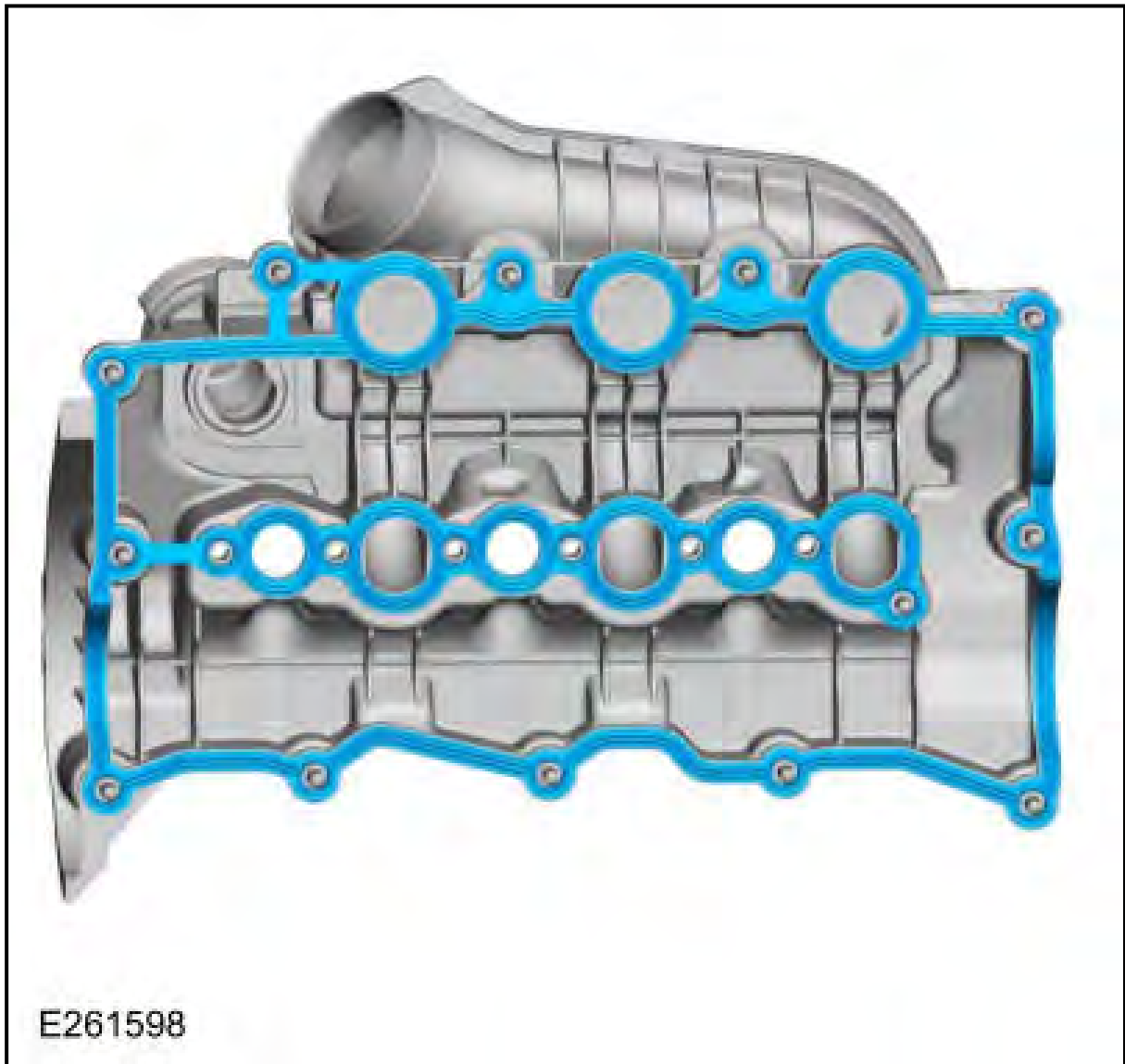
Material: Motorcraft <sup>®</sup> Metal Surface Prep / ZC-31-A

Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B



## INSTALLATION

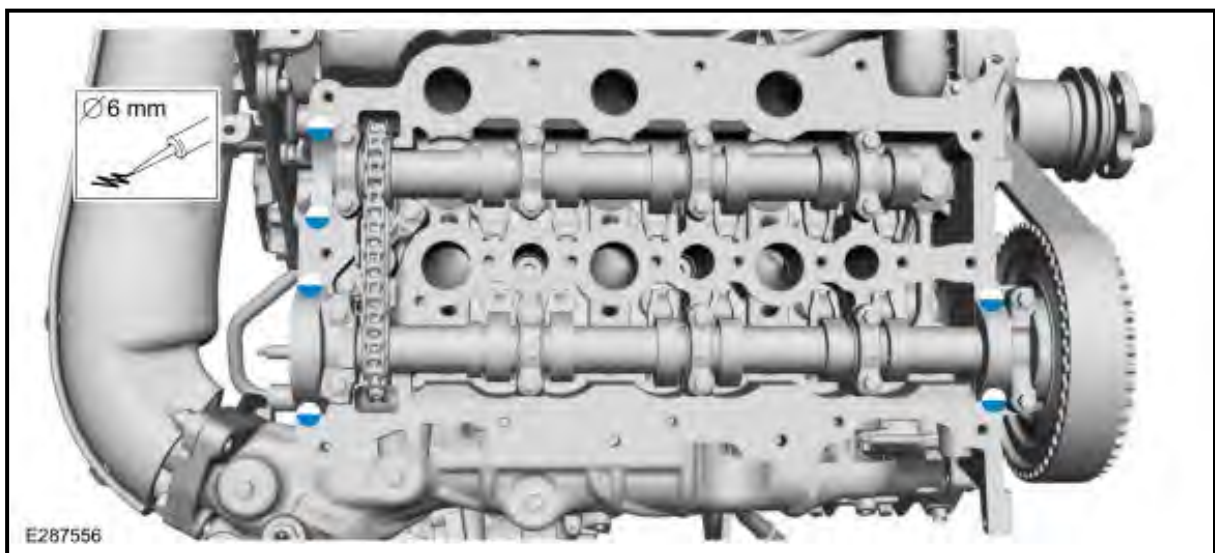
1. Install a new valve cover gasket.



2. **NOTE:** If the valve cover is not installed and the fasteners tightened within 10 minutes, the sealant must be removed and the sealing area cleaned.

Apply an 6 mm dot of Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone to the locations shown.

Material: Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)

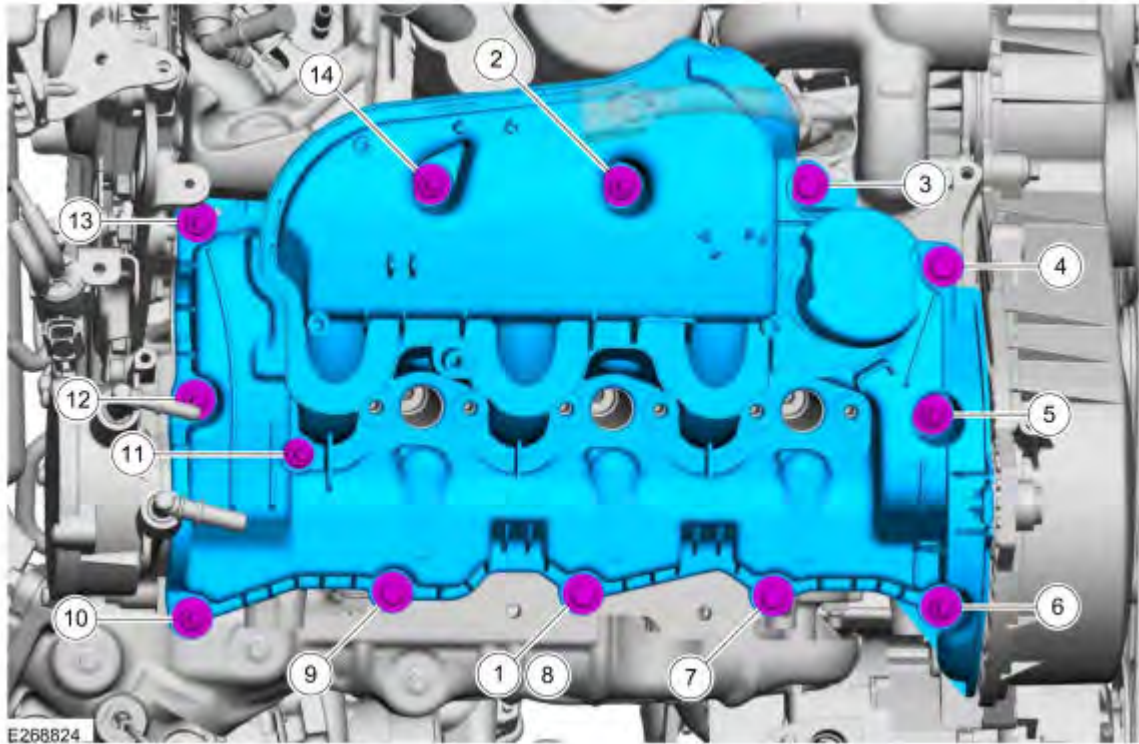


3. Install the valve cover and tighten the fasteners in the sequence shown.

Torque:

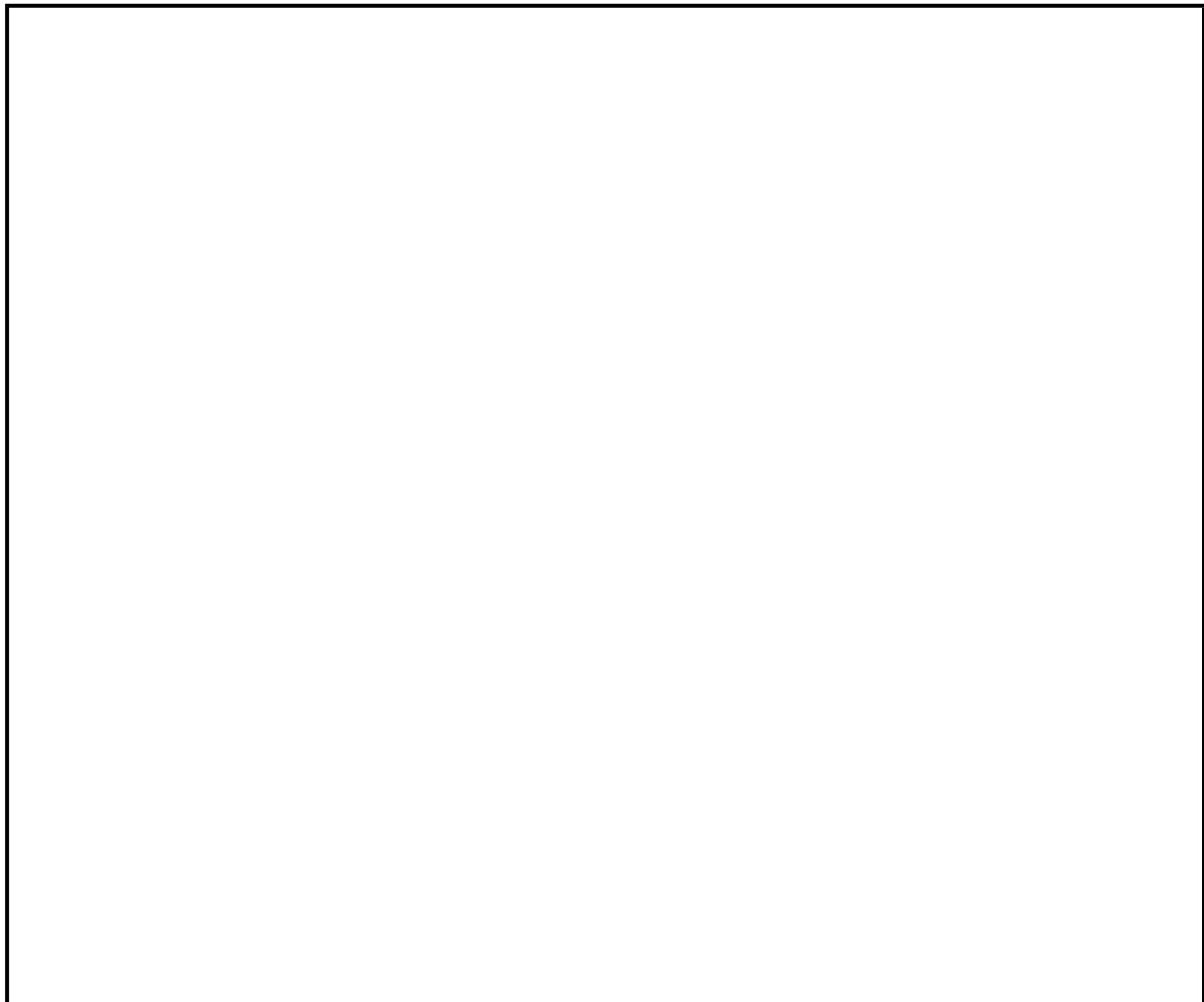
Stage 1: Tighten bolt number 1 to : 9 lb.in (1 Nm)

Stage 2: Tighten bolts 2 thru 14 to : 89 lb.in (10 Nm)

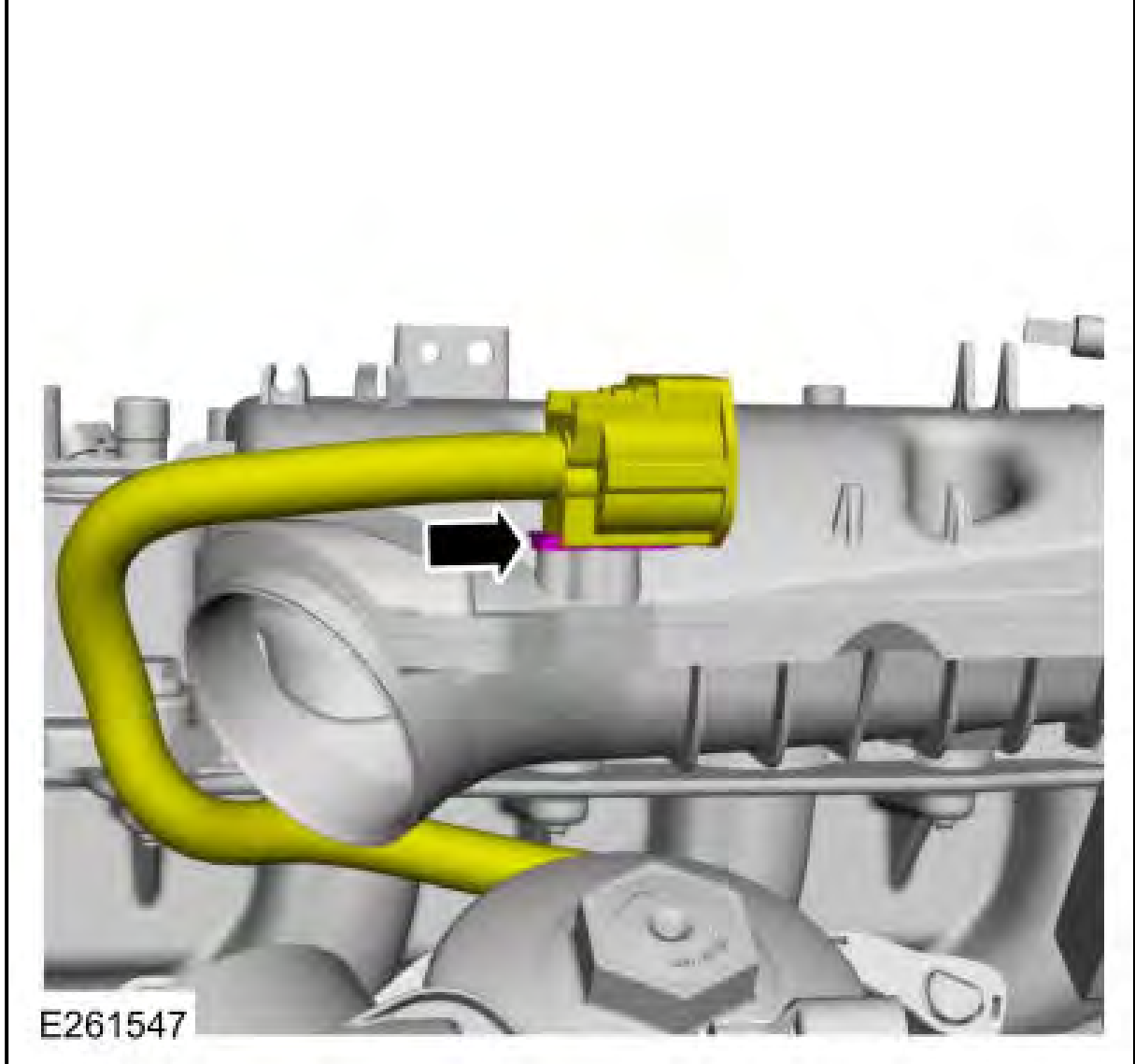


**Fig. 12: Valve Cover Tightening Sequence RH**  
Courtesy of FORD MOTOR COMPANY

4. Connect the glow plug electrical connector and position aside.

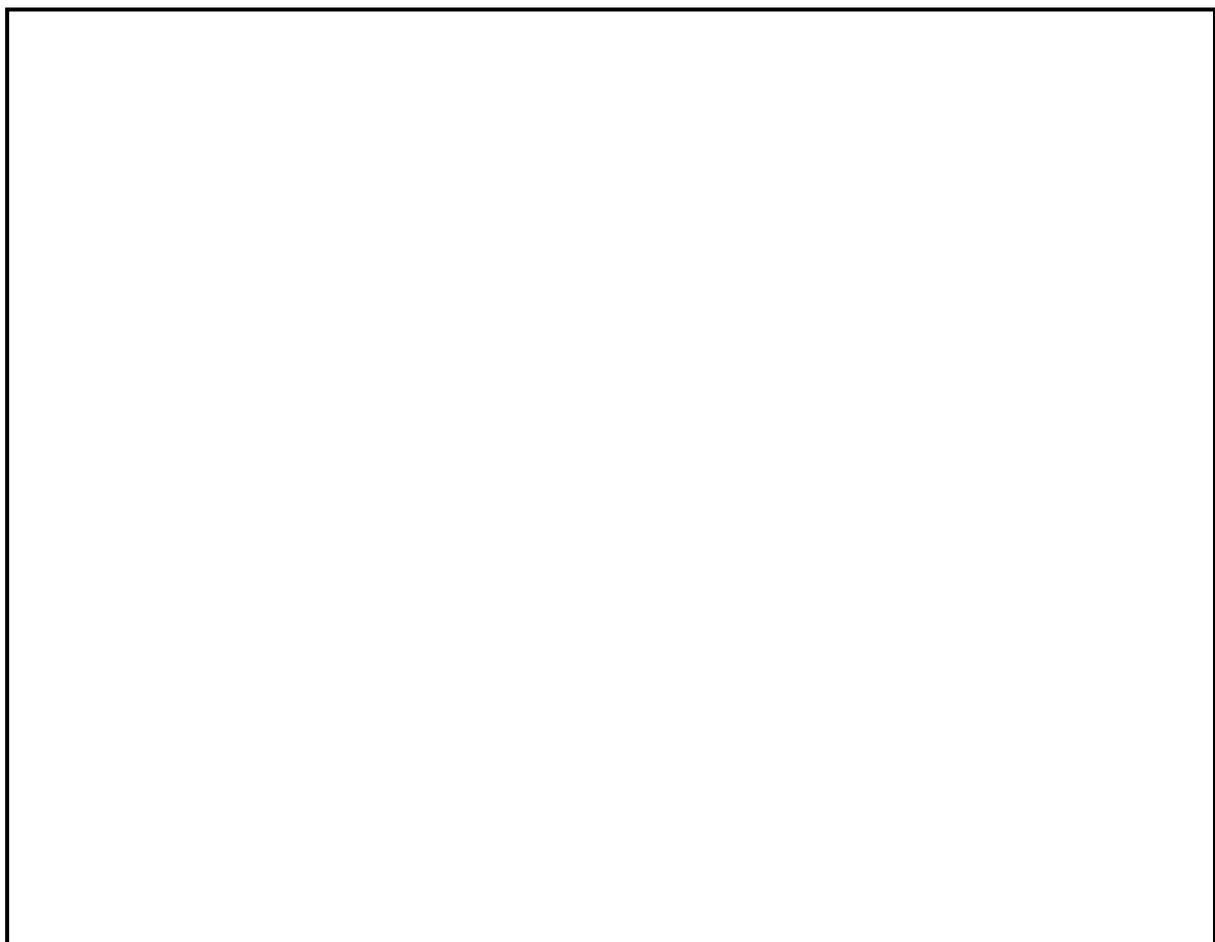


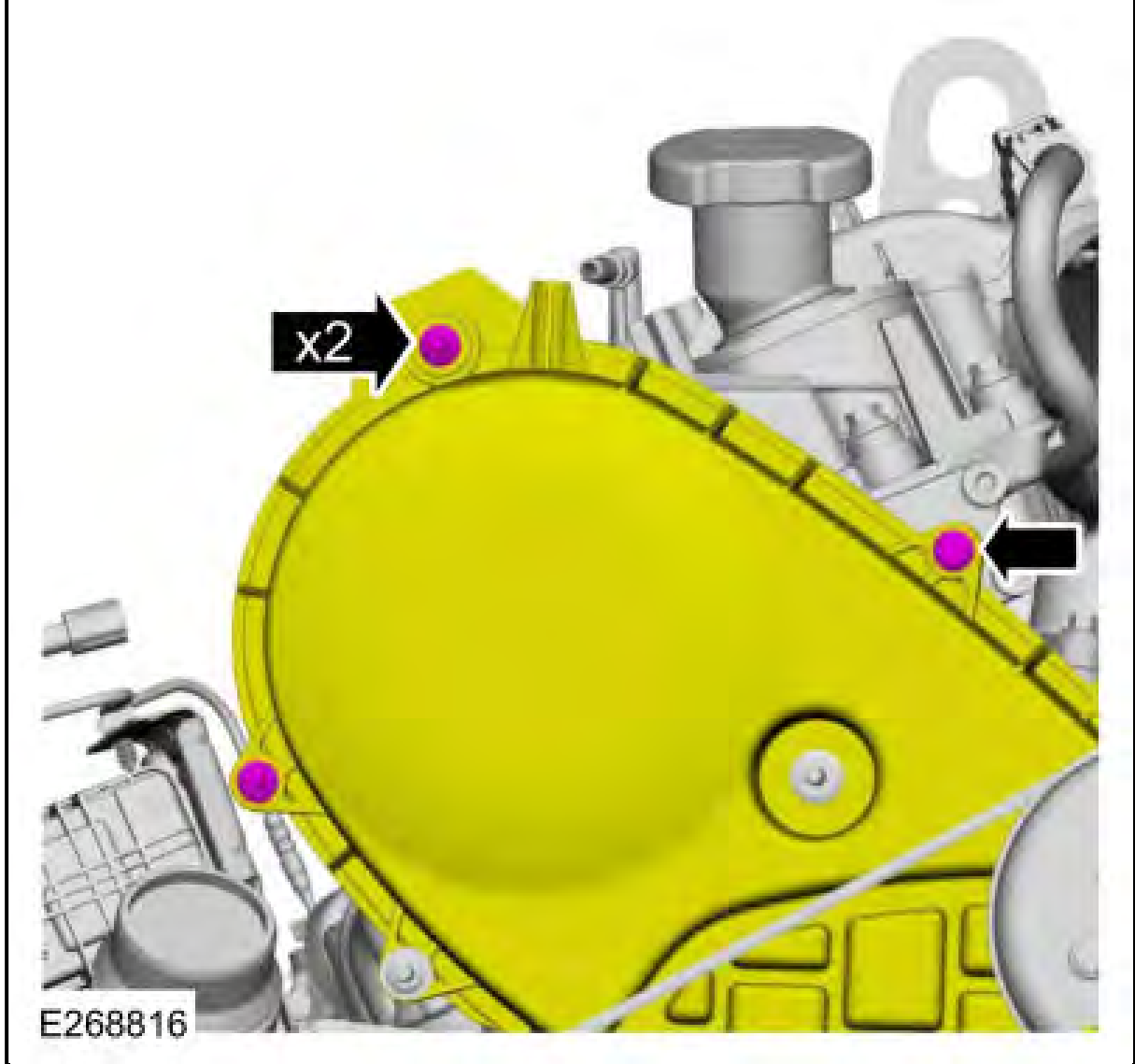




5. Position back the engine front cover and install the retainers.

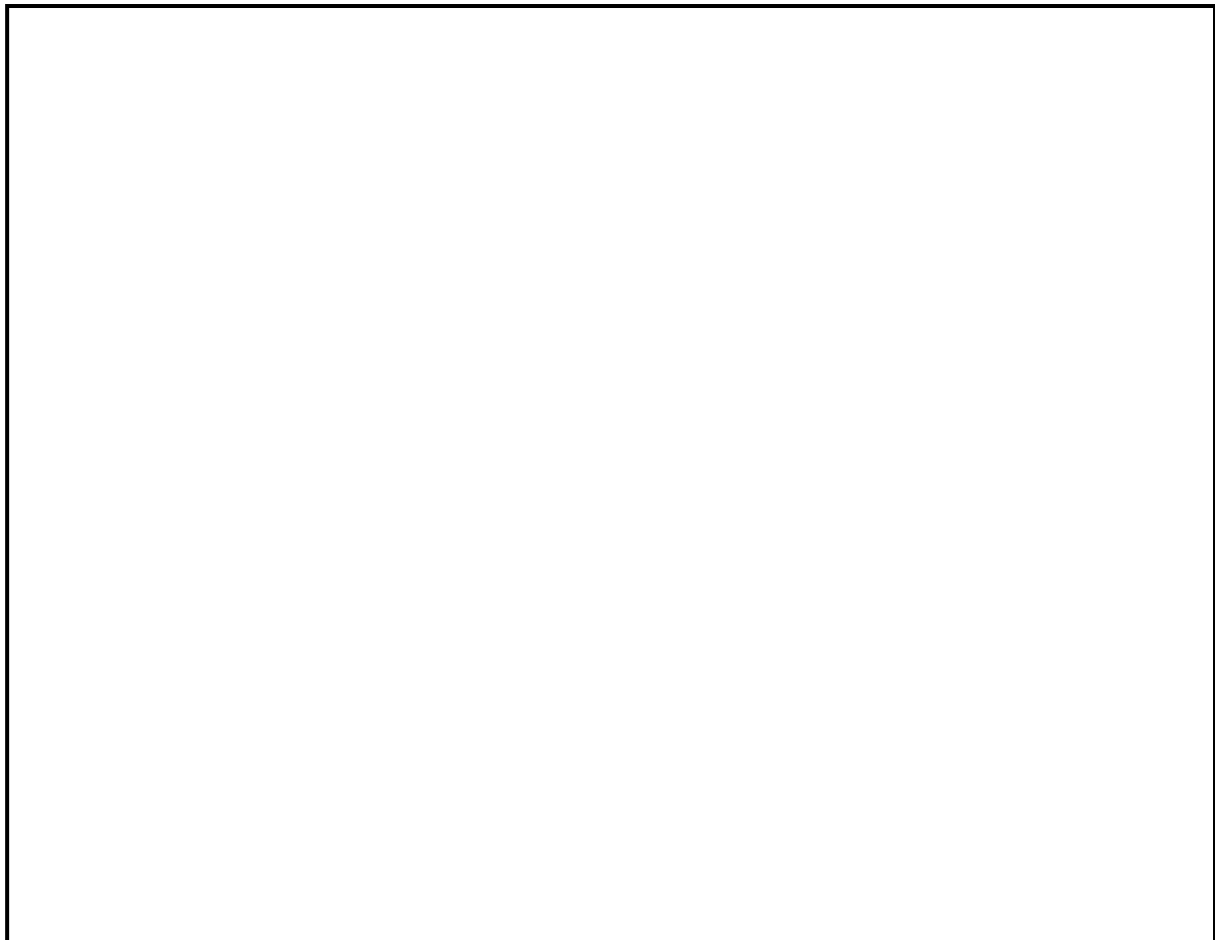
Torque: 89 lb.in (10 Nm)

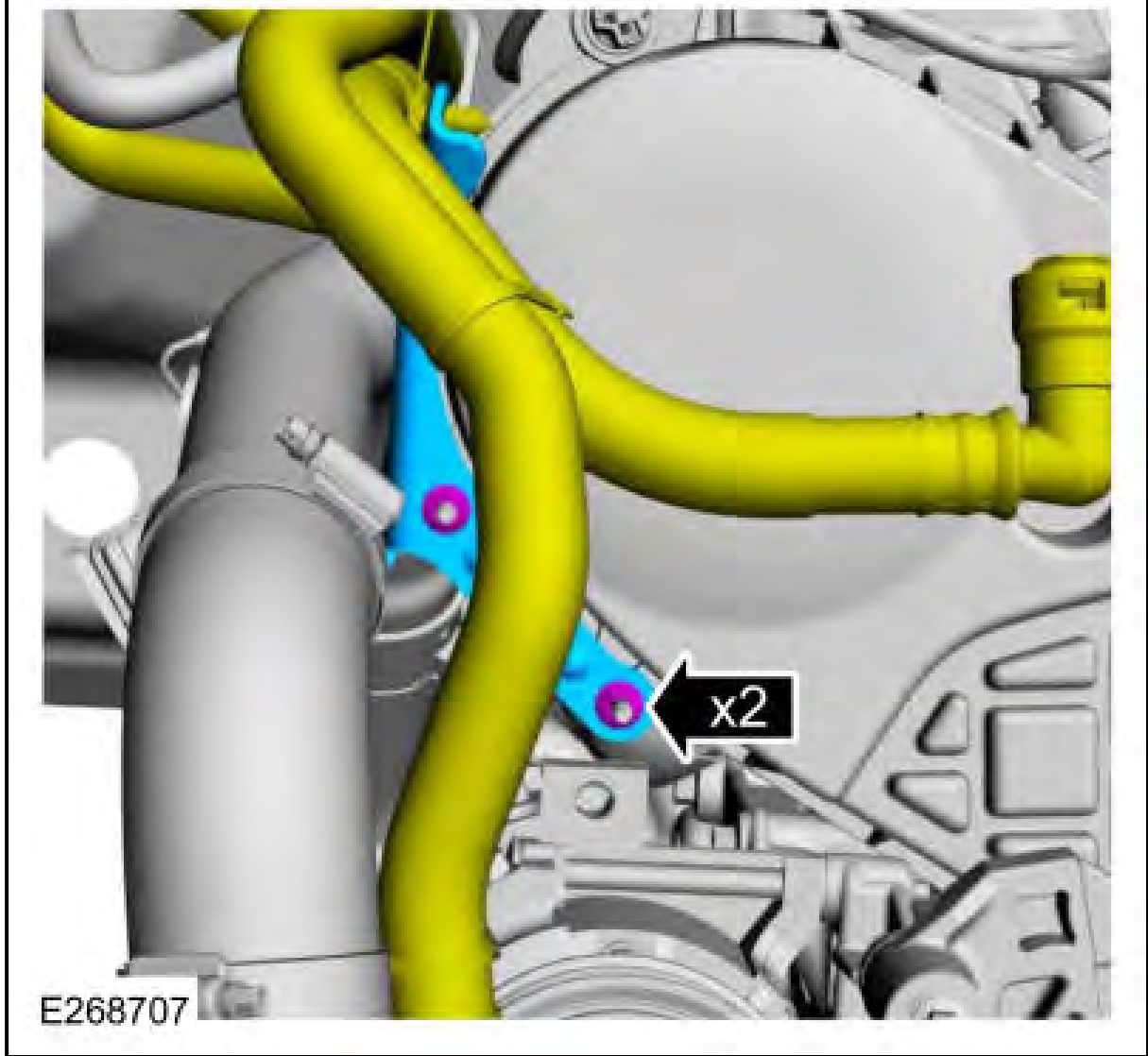




6. Position back the heater hoses. Install the nuts for the CAC tube bracket.

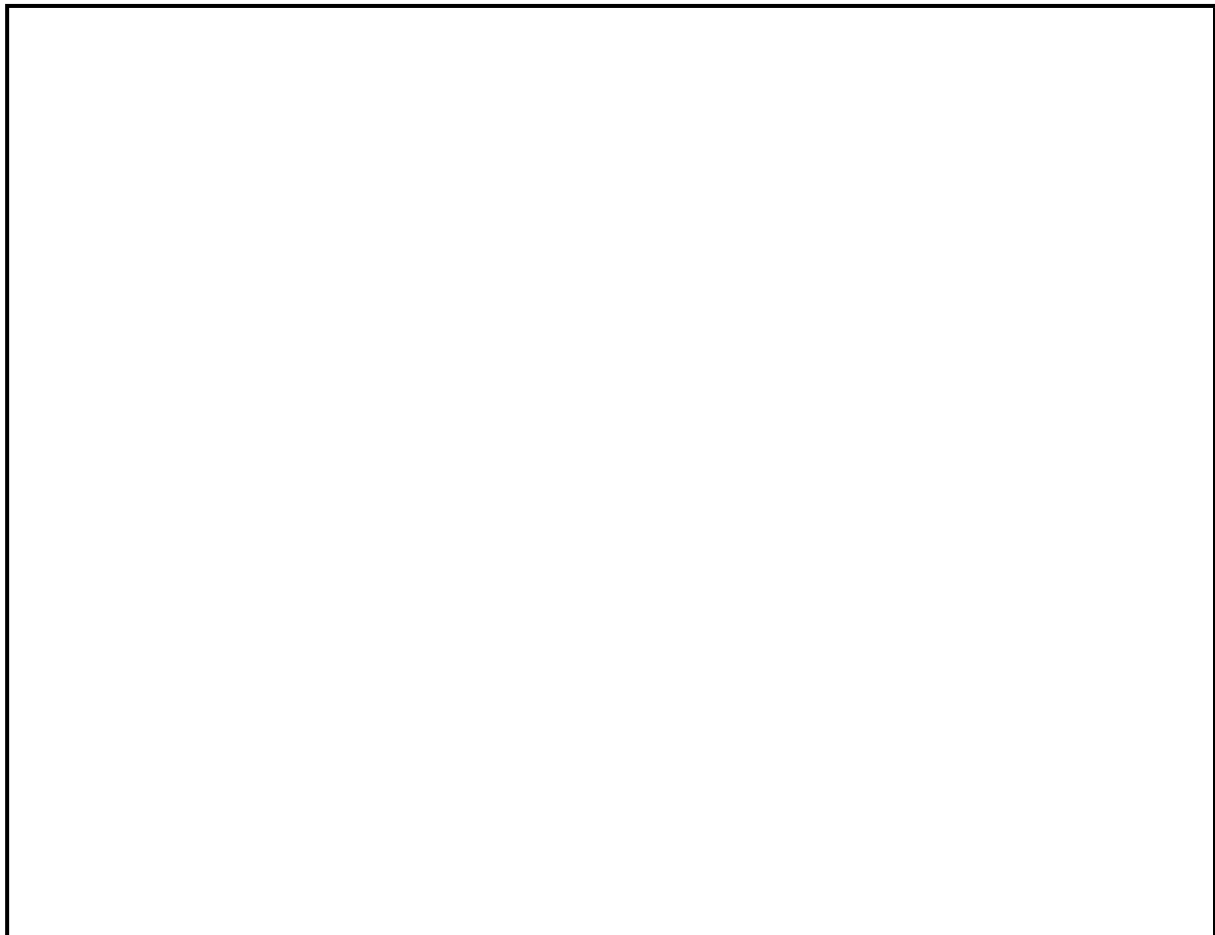
Torque: 53 lb.in (6 Nm)

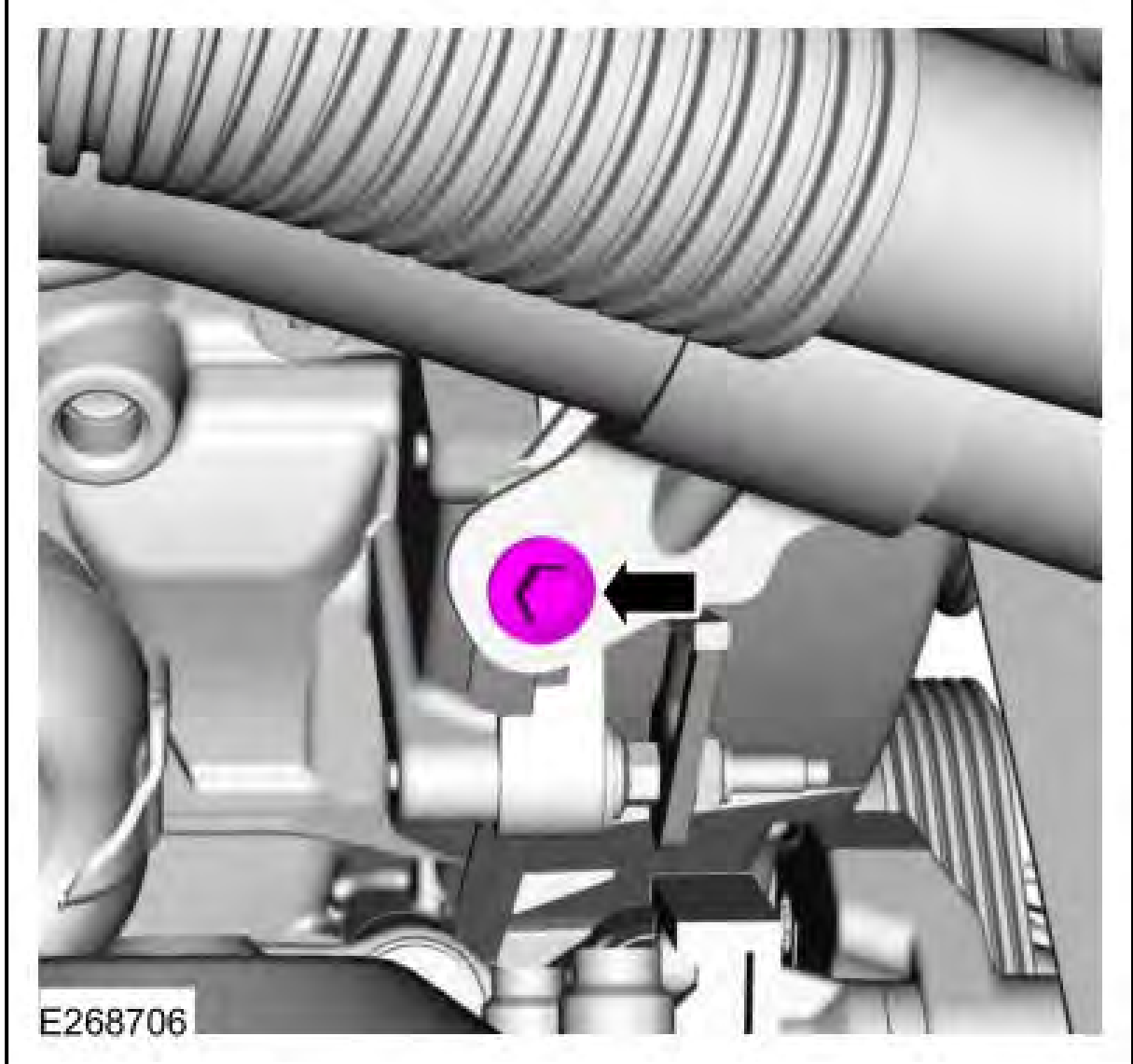




7. Install the bolt for the CAC tube.

Torque: 53 lb.in (6 Nm)

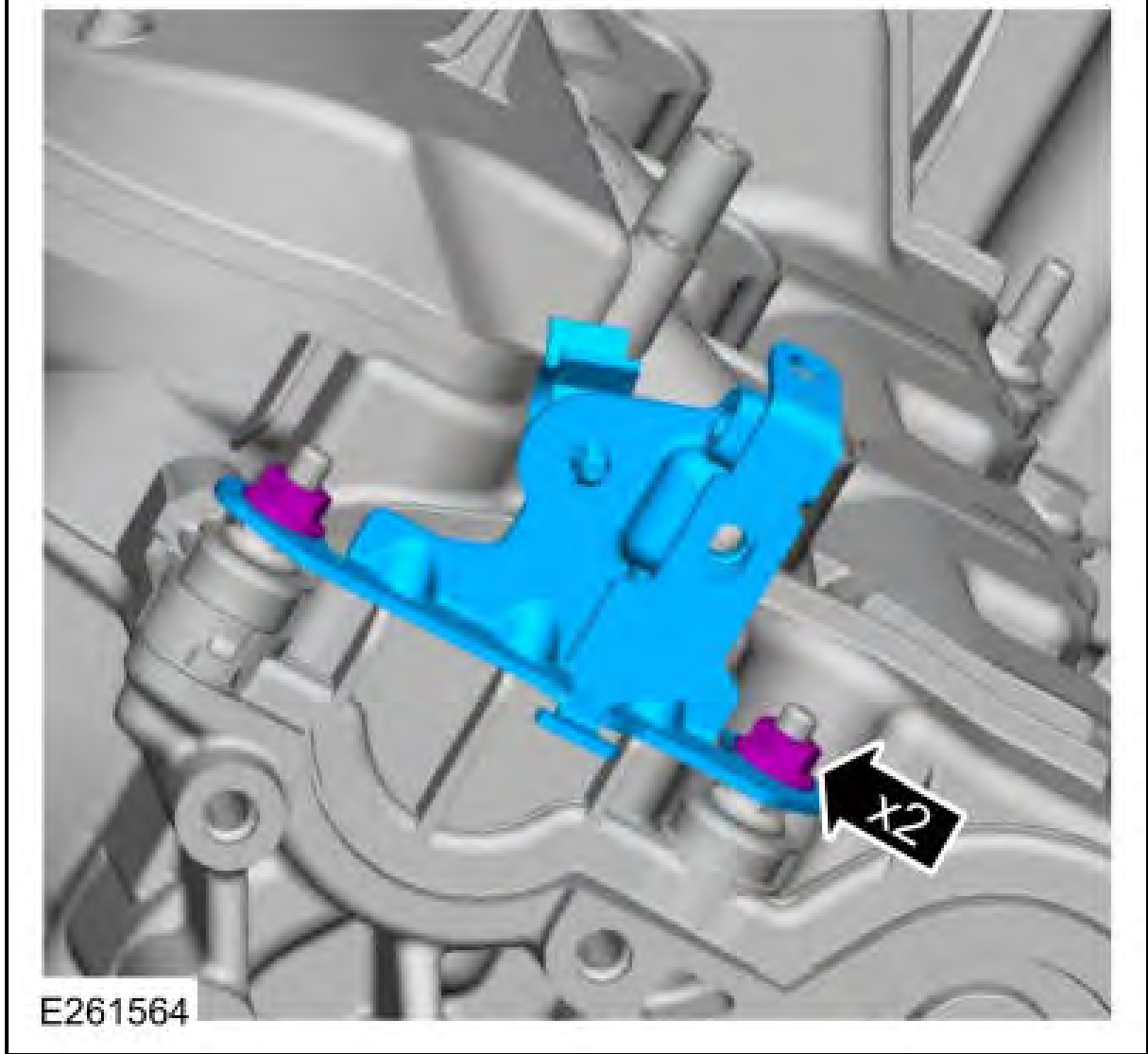




8. Install the RH fuel tube bracket and the nuts.

Torque: 89 lb.in (10 Nm)

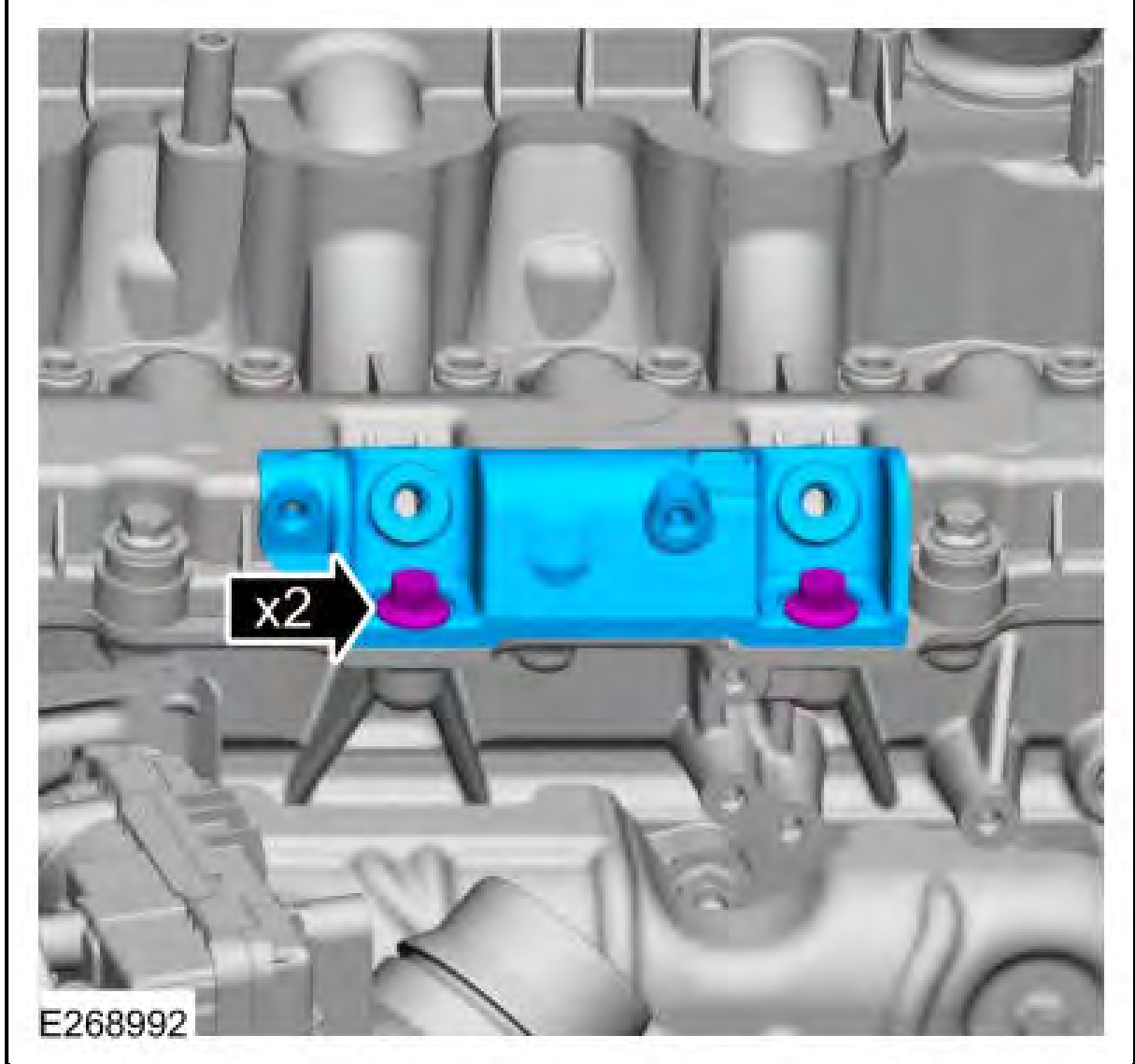




9. Install the RH fuel rail bracket and the bolts.

Torque: 17 lb.ft (23 Nm)

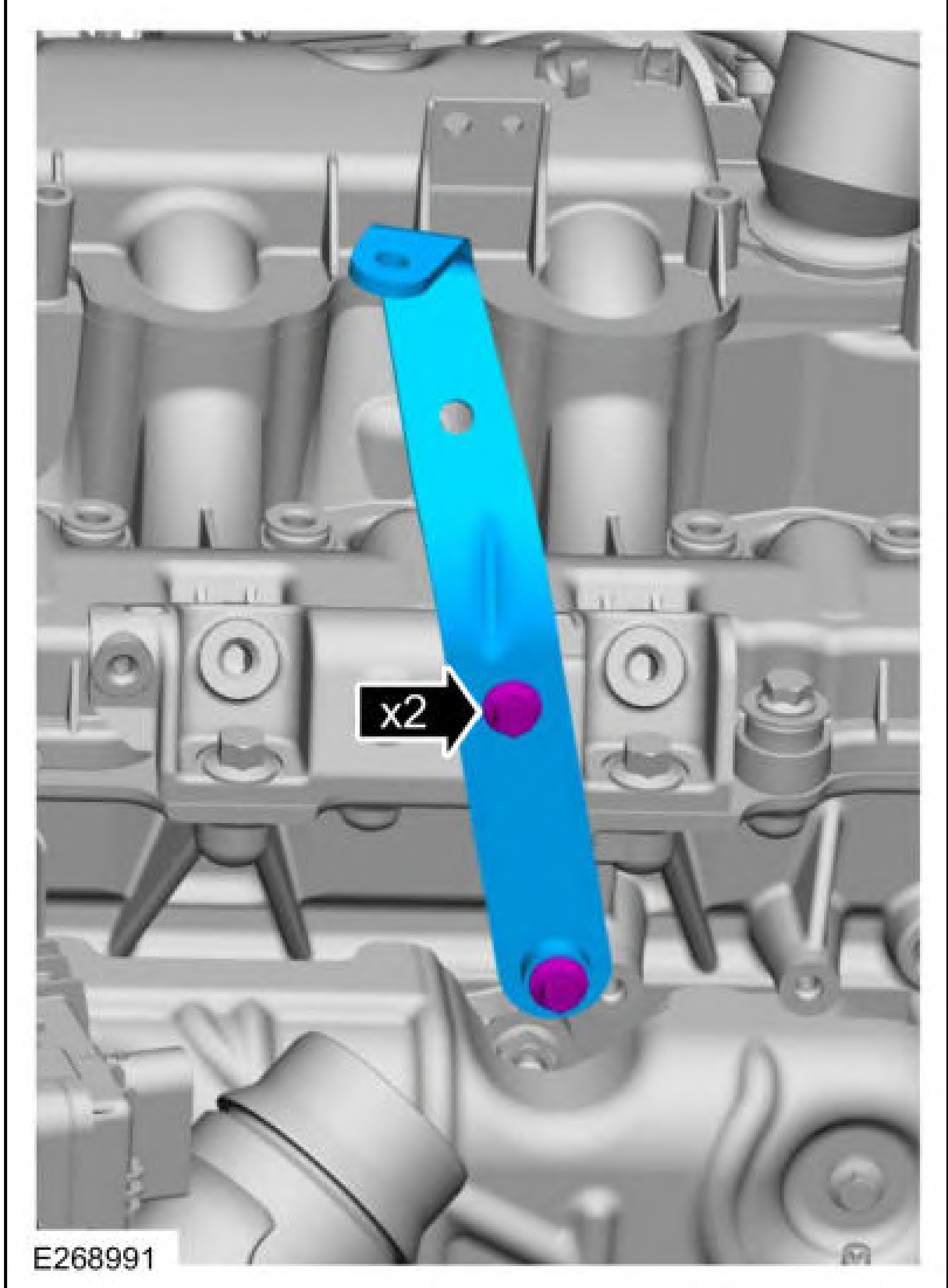




10. Install the heater hose support bracket and the bolts.

Torque: 89 lb.in (10 Nm)





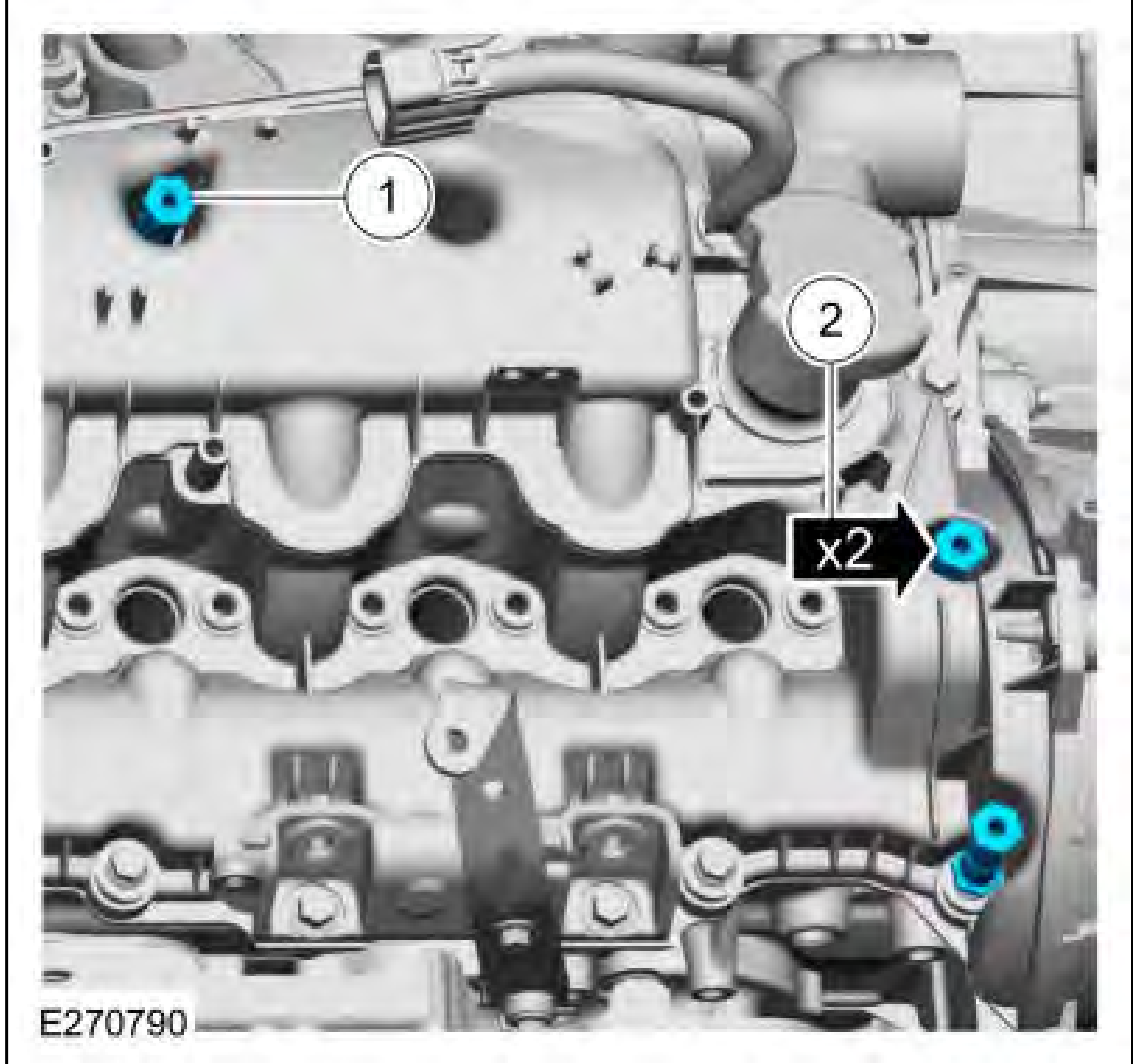
11. Install the RH engine cover stud assemblies.

Torque:

1 : 44 lb.in (5 Nm)

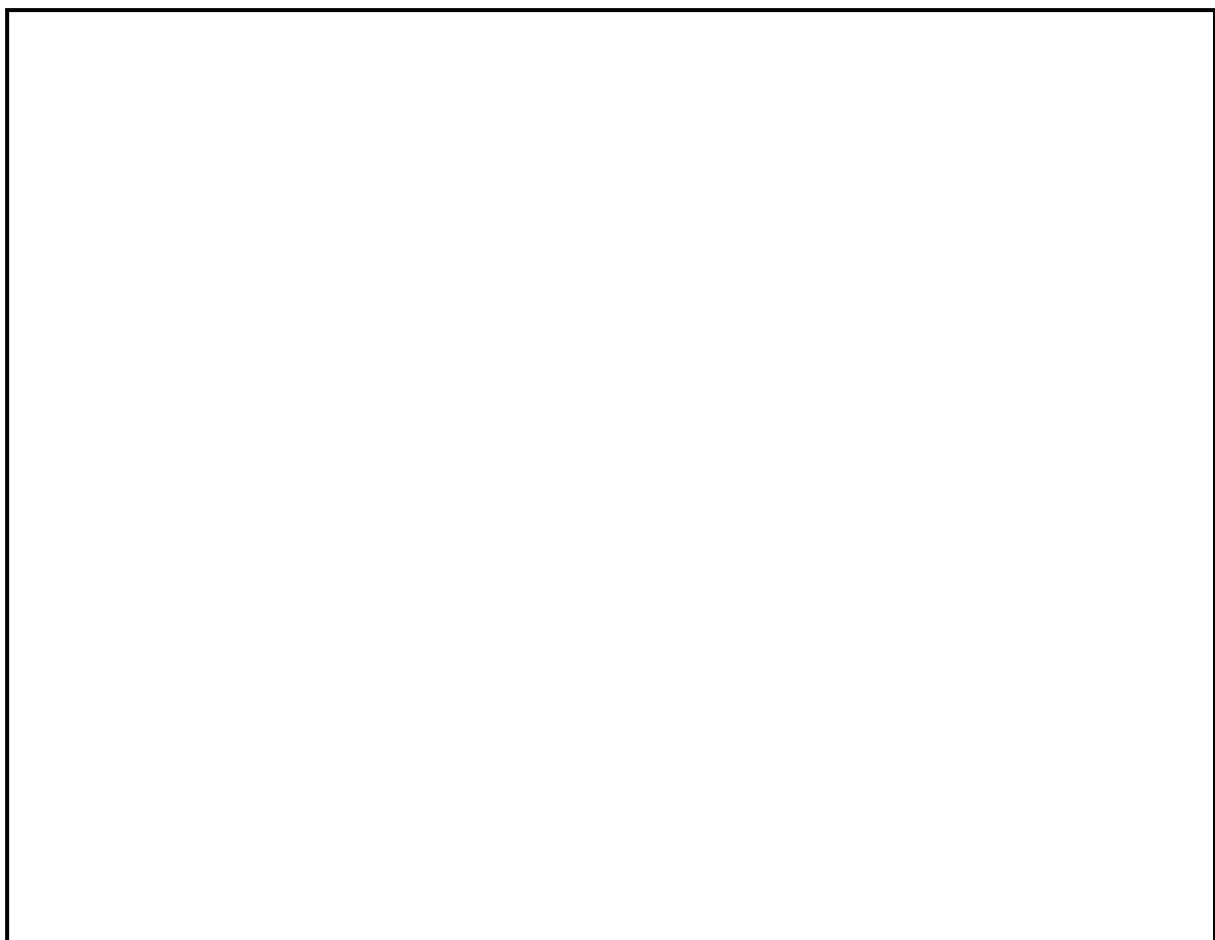
2 : 62 lb.in (7 Nm)



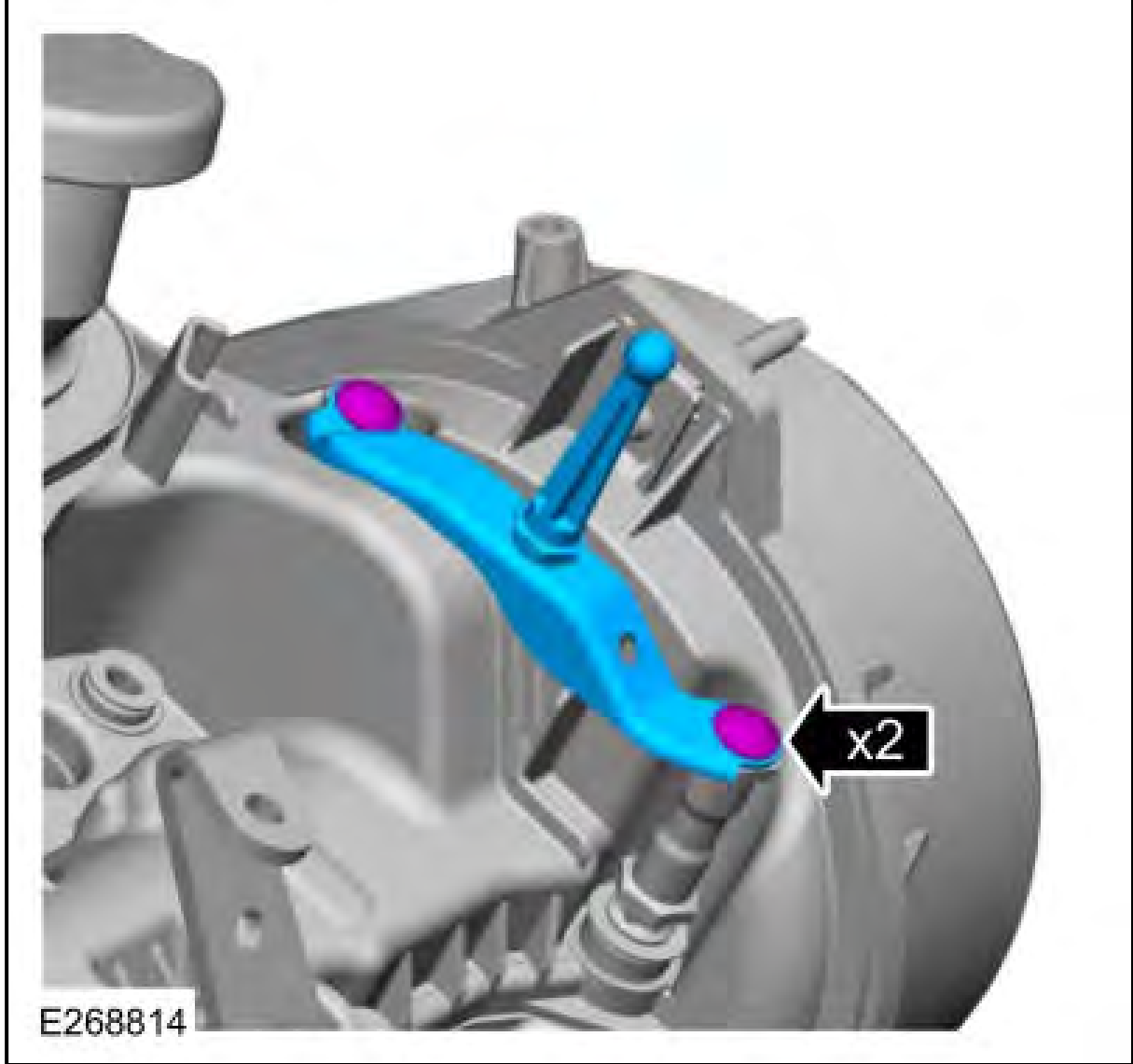


12. Install the engine appearance support bracket and the retainers.

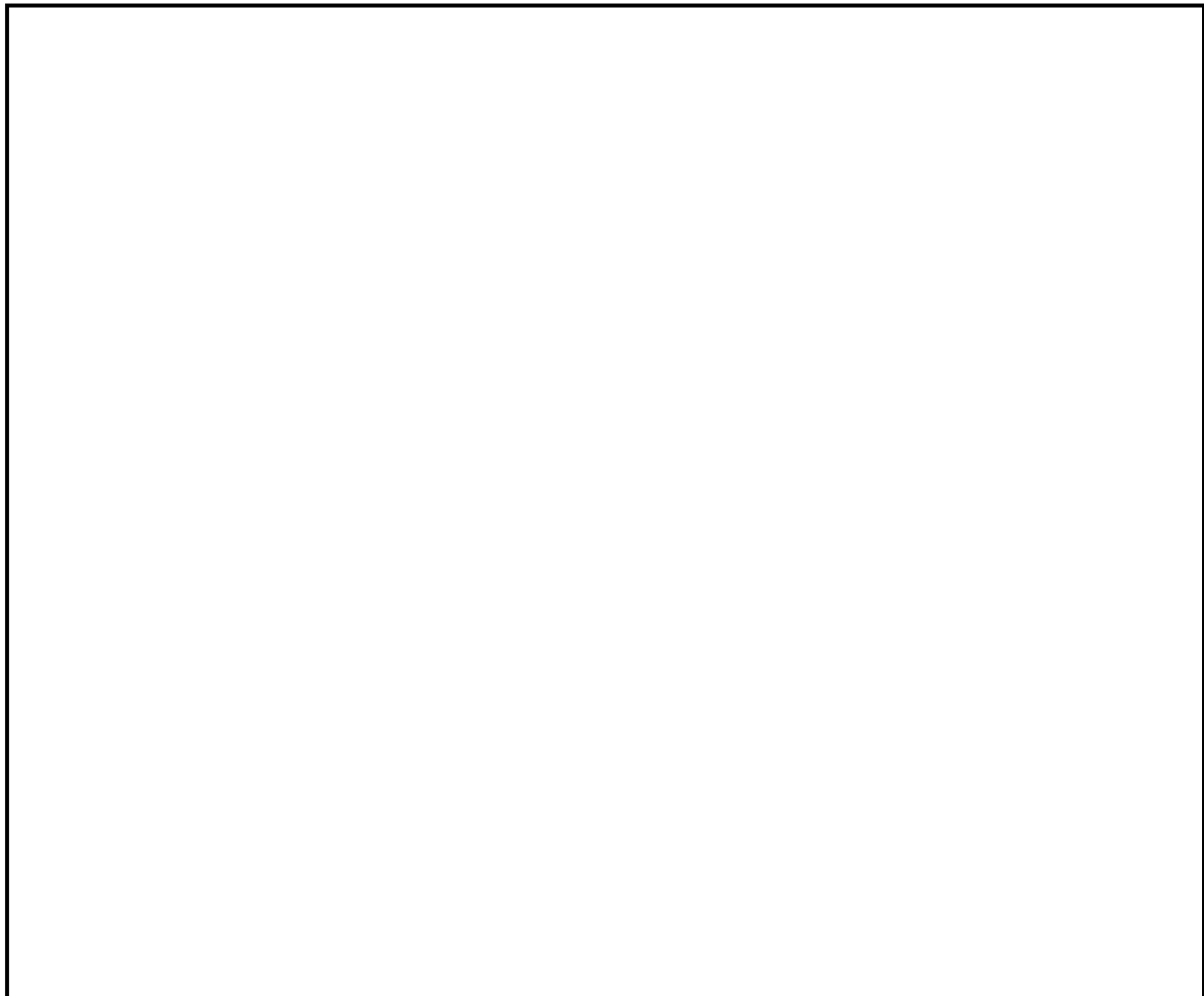
Torque: 62 lb.in (7 Nm)







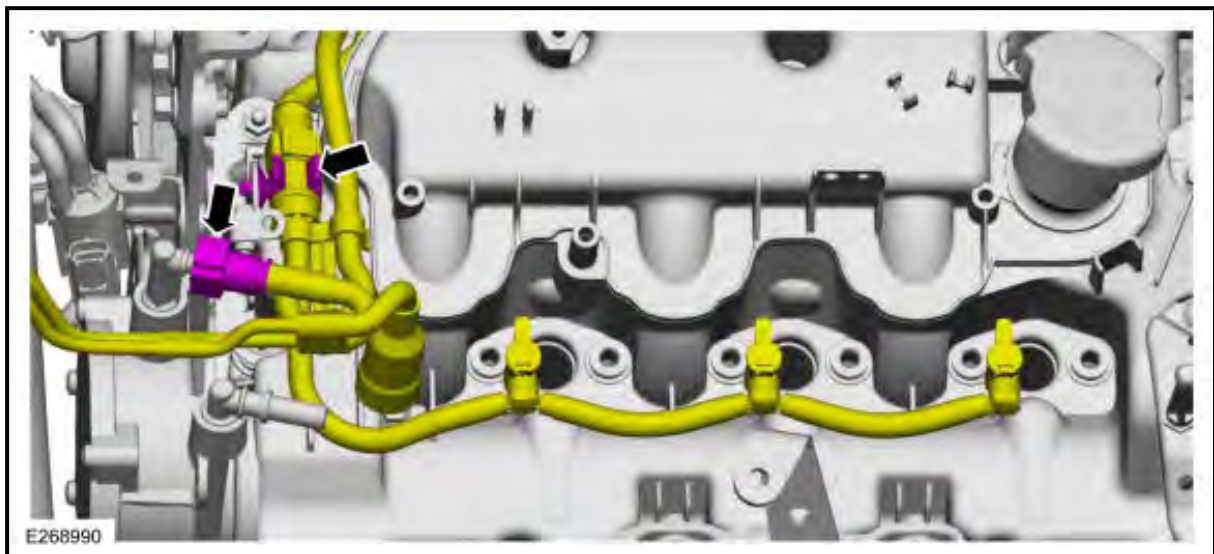
13. Install the LH lower insulator.





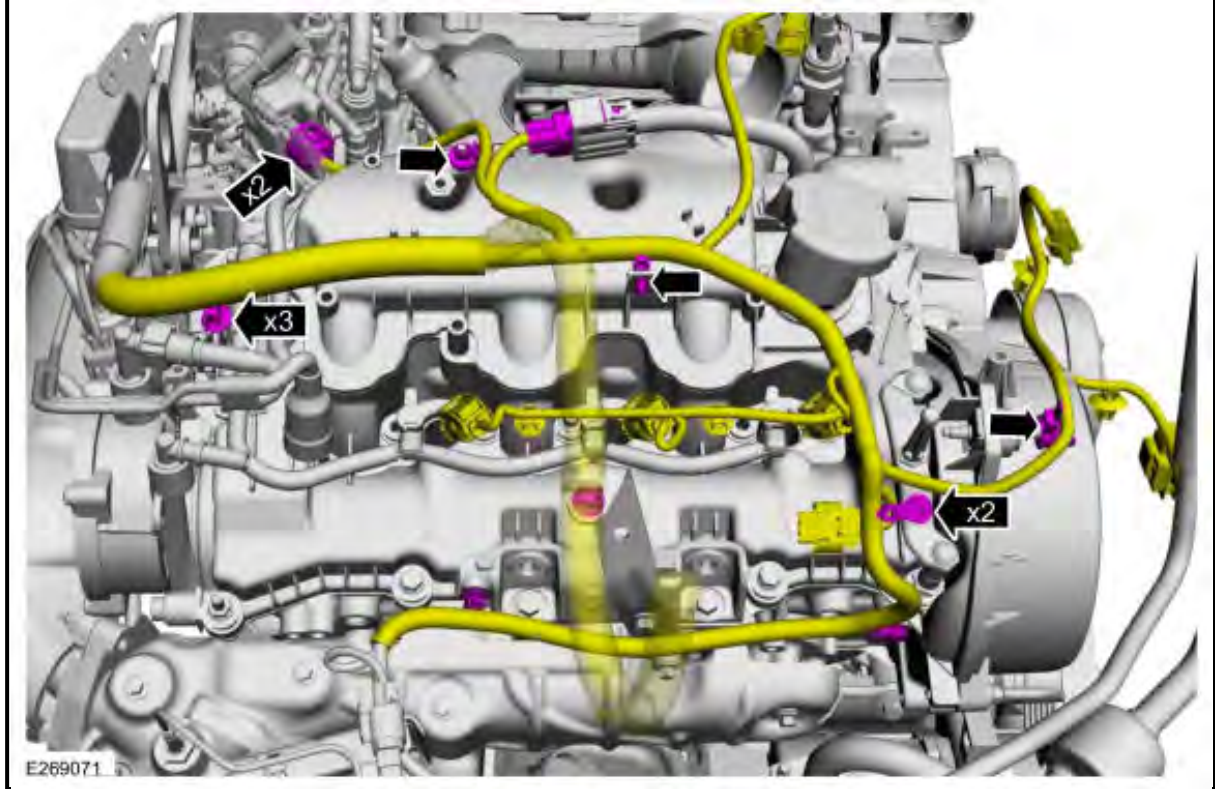
14.

- Position back the fuel hoses.
- Position back the vacuum harness and connect. REFER to: [Quick Release Coupling](#) .

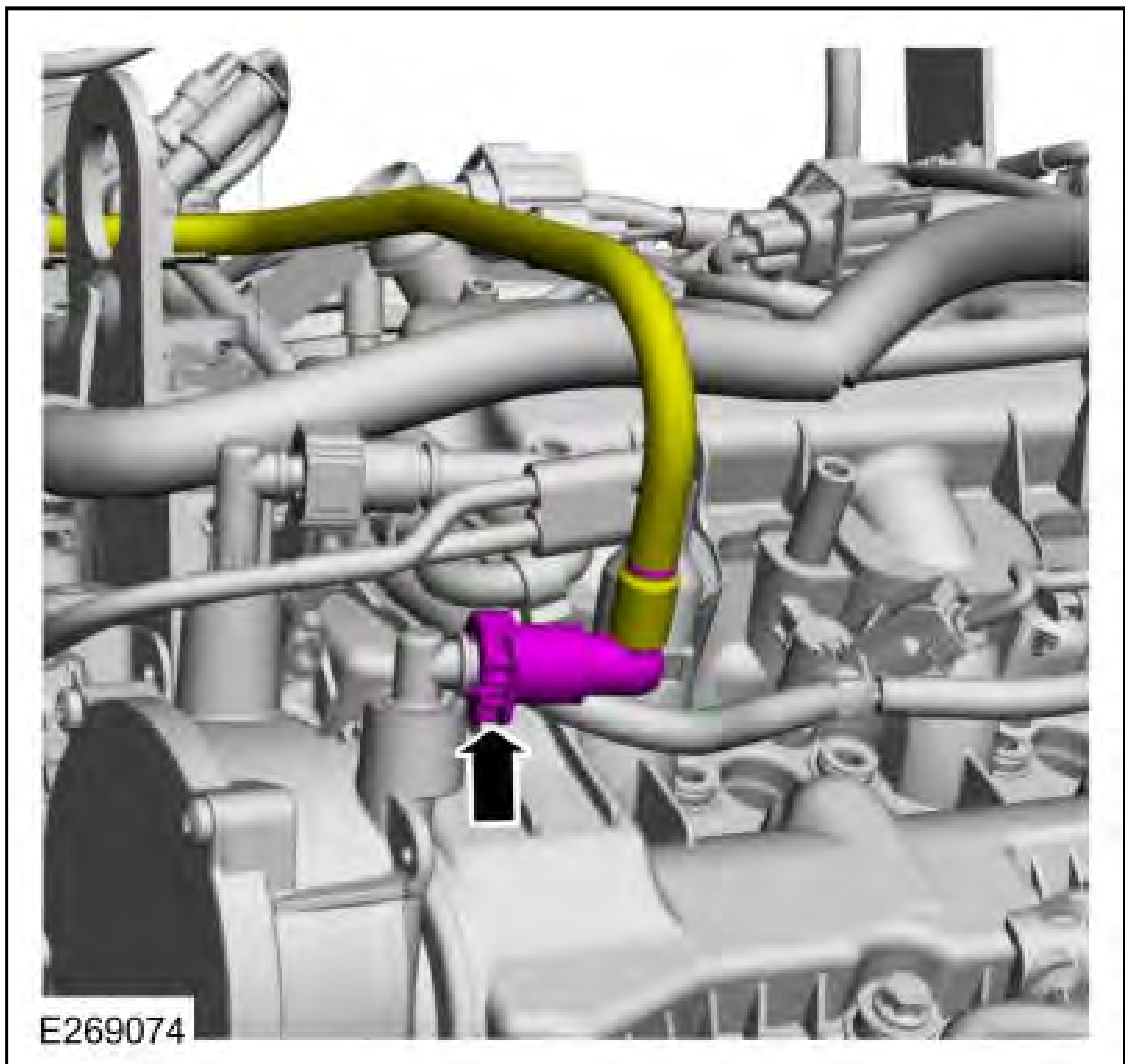


15. Position back the wire harness. Connect the electrical connectors and the wire harness retainers.





16. Position back and connect the brake booster vacuum pump tube. REFER to: [Quick Release Coupling](#).

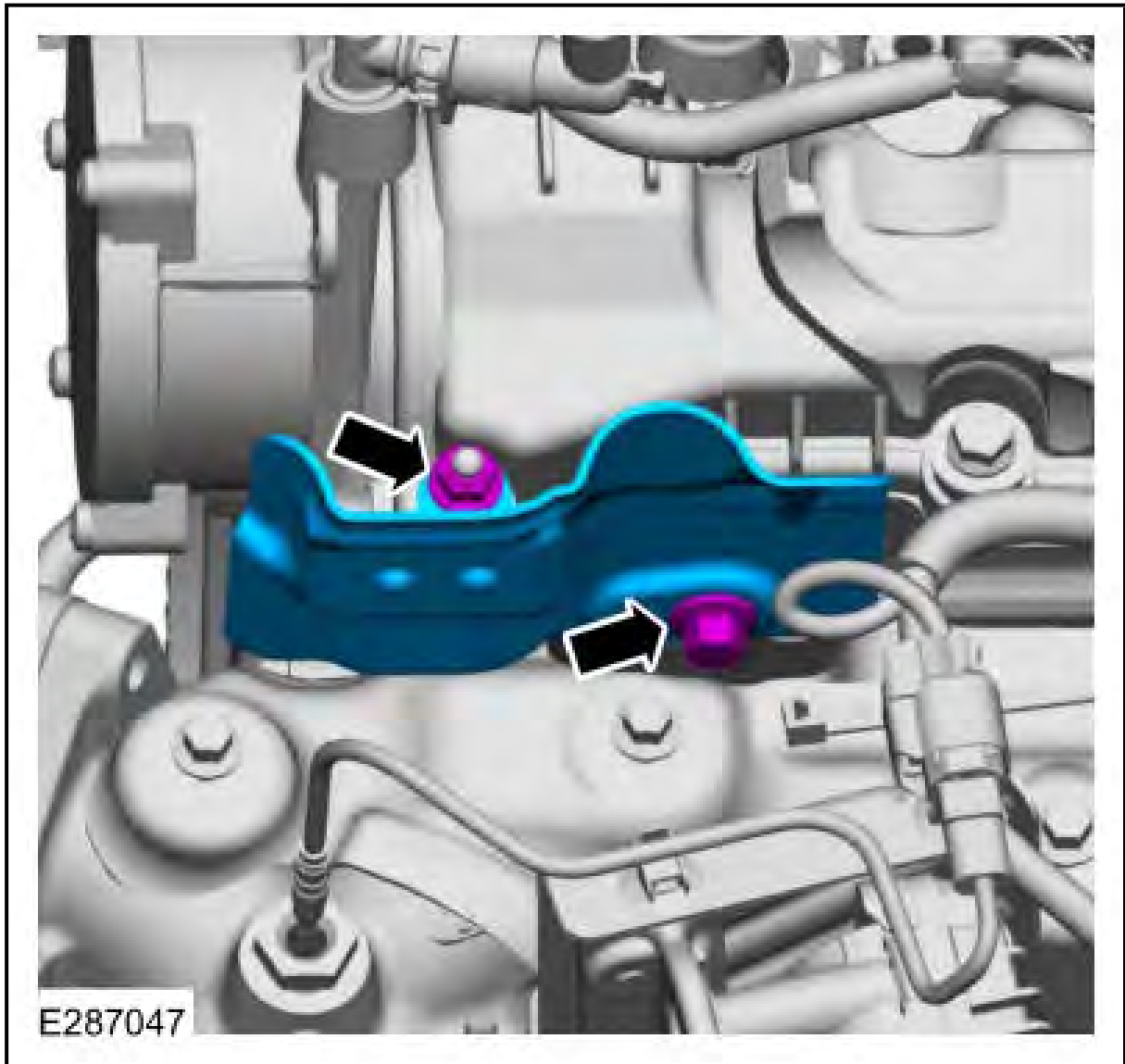


17. Install the turbocharger heat shield, the nut and the bolt.

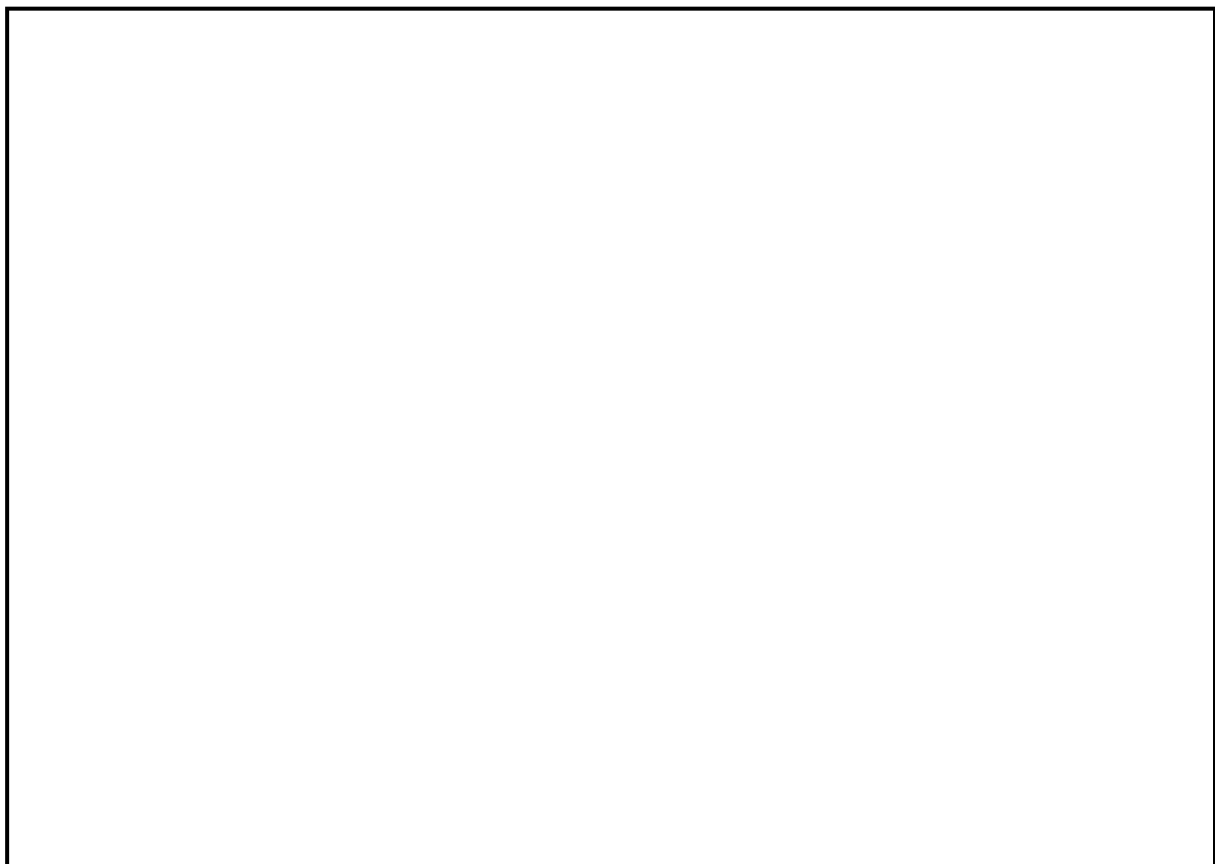
Torque:

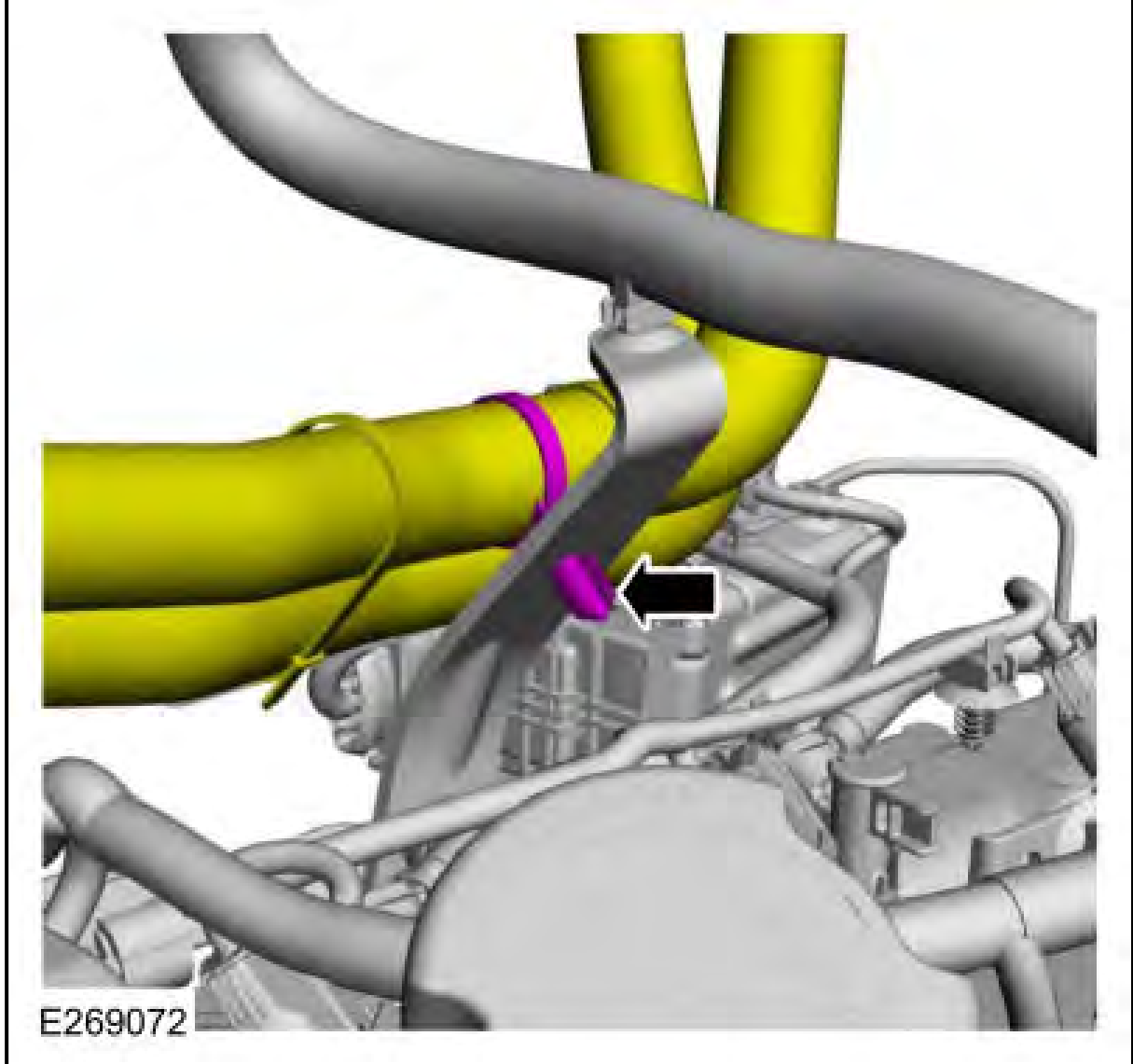
Nut : 53 lb.in (6 Nm)

Bolt : 18 lb.ft (24 Nm)



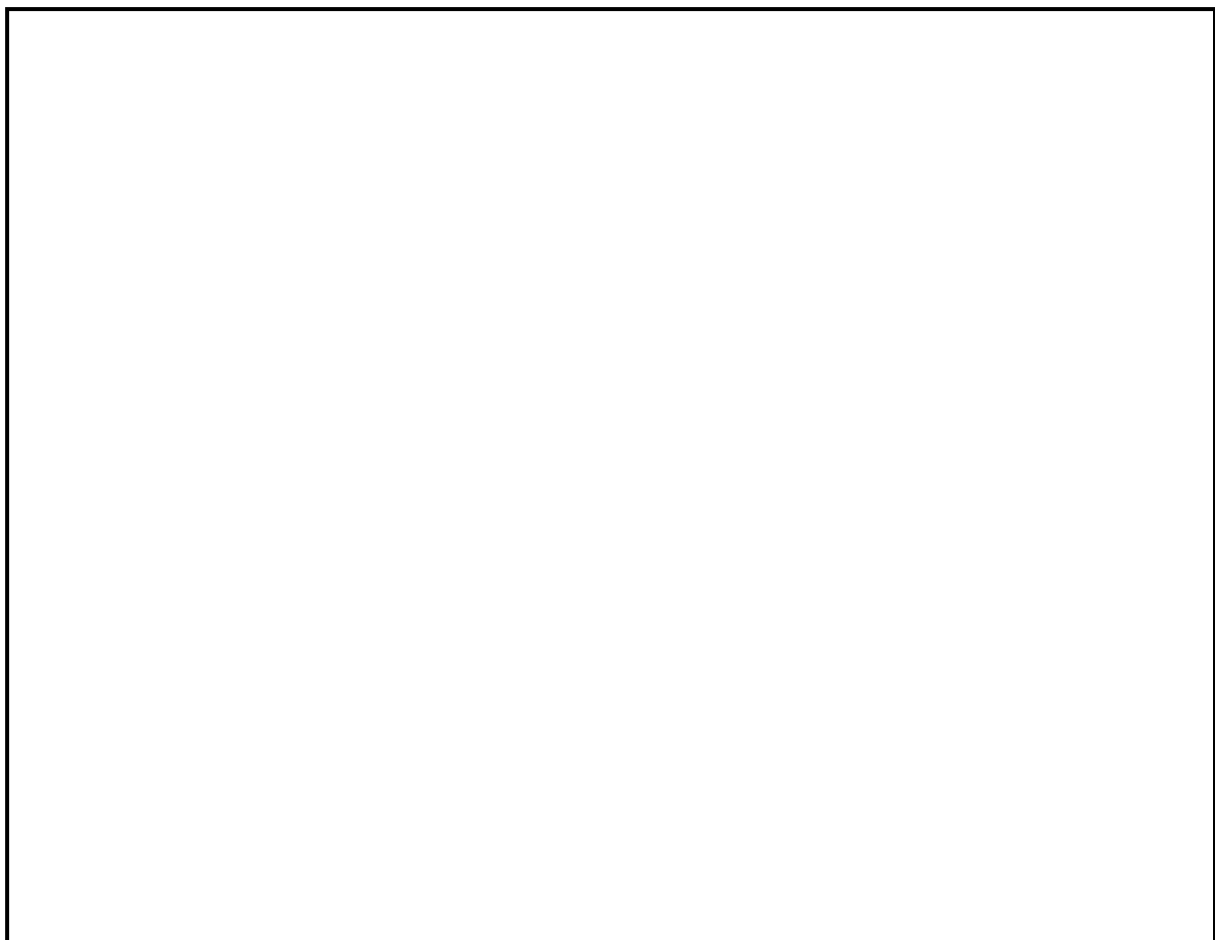
18. Position back the heater hoses and connect the retainer.

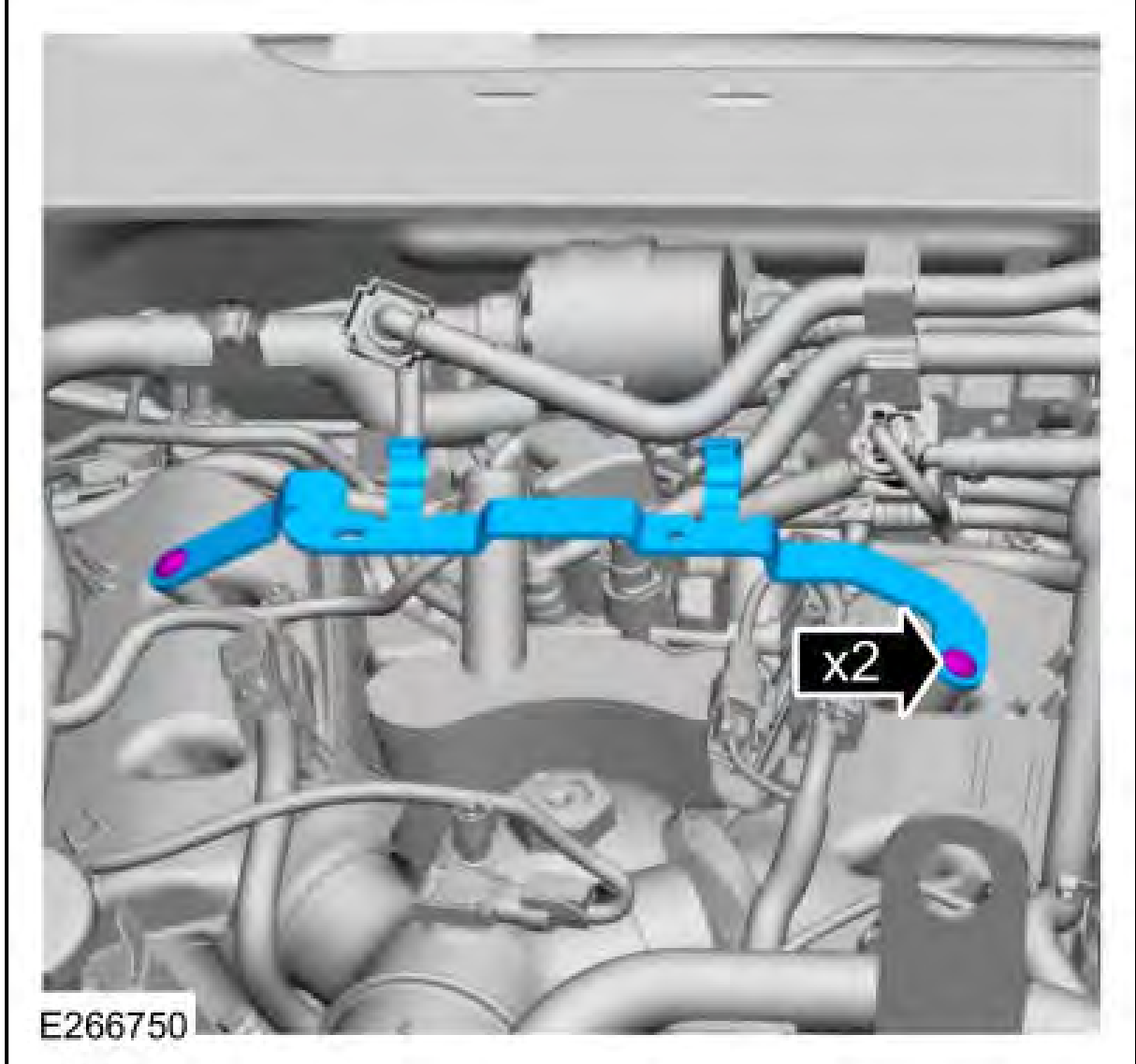




19. Install the engine appearance cover bracket and the retainers.

Torque: 44 lb.in (5 Nm)





20. Install the following items:

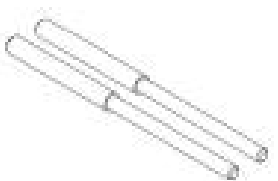
1. Install the RH fuel rail. REFER to: [Fuel Rail RH](#) .
2. Install the RH fuel injectors. REFER to: [Fuel Injectors RH](#) .
3. Install the RH fuel injector supply tube. REFER to: [Fuel Injector Supply Tube RH](#) .
4. Install the RH fuel rail supply tube. REFER to: [Fuel Rail Supply Tube RH](#) .
5. Install the fuel rail balance tube. REFER to: [Fuel Rail Balance Tube](#) .
6. Install the intake manifold. REFER to: [Intake Manifold](#) .

## REMOVAL

### CYLINDER HEAD - BODY OFF - LH

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

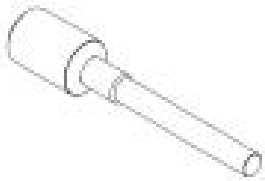
#### Special Tool(s) / General Equipment

|  |   |
|--|---|
|  <p>E274096</p> | <p><b>303-1670 Pins, Camshaft Locking</b></p> |
|--|---|



E274086

**303-1670 Pins, Camshaft Locking**



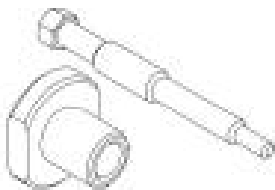
E274087

303-1671 Pin, Locking Crankshaft



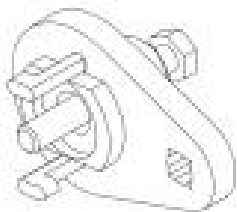
E274080

303-1674 Tool, Holding Camshaft Sprocket



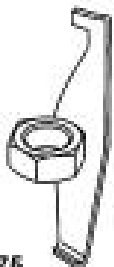
E274091

303-1675 Adapter, Seal Remover



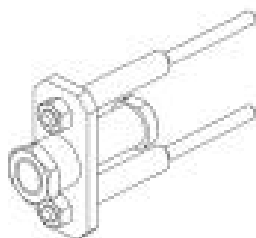
E274094

303-1678 Remover, Fuel Pump Pulley Holding Tool



308-375

308-375 Remover, Input Shaft Seal TKIT-2005U-M TKIT-1999-F/FLM/LT



E274100

310-266 Remover, Fuel Injector

Plastic Scraper

Hose Clamp  
Remover/Installer

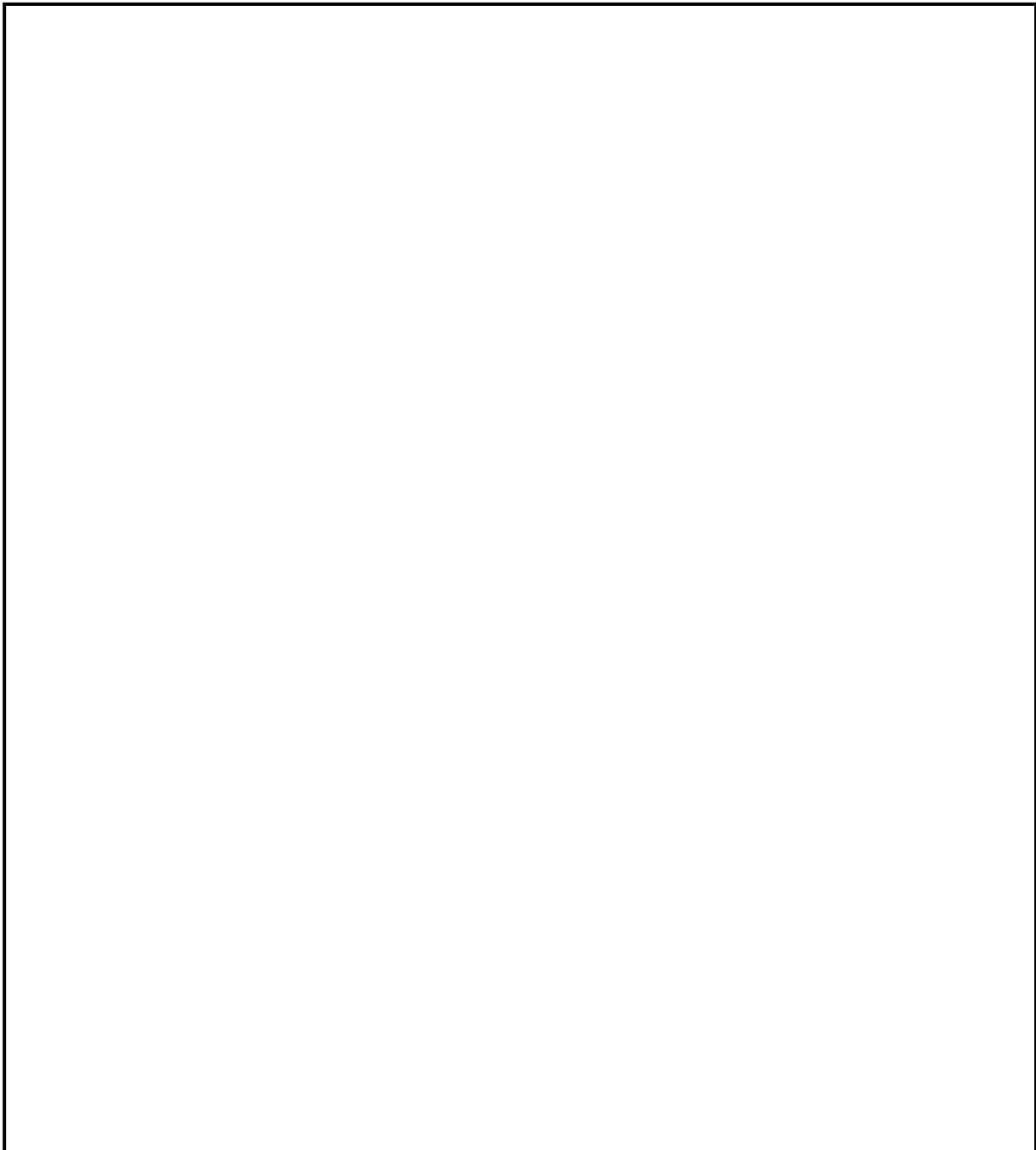
## Materials

| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> Silicone Gasket Remover ZC-30-A          | -             |
| Motorcraft <sup>®</sup> Metal Surface Prep Wipes ZC-31-B         | -             |
| Motorcraft <sup>®</sup> Metal Brake Parts Cleaner PM-4-A, PM-4-B | -             |

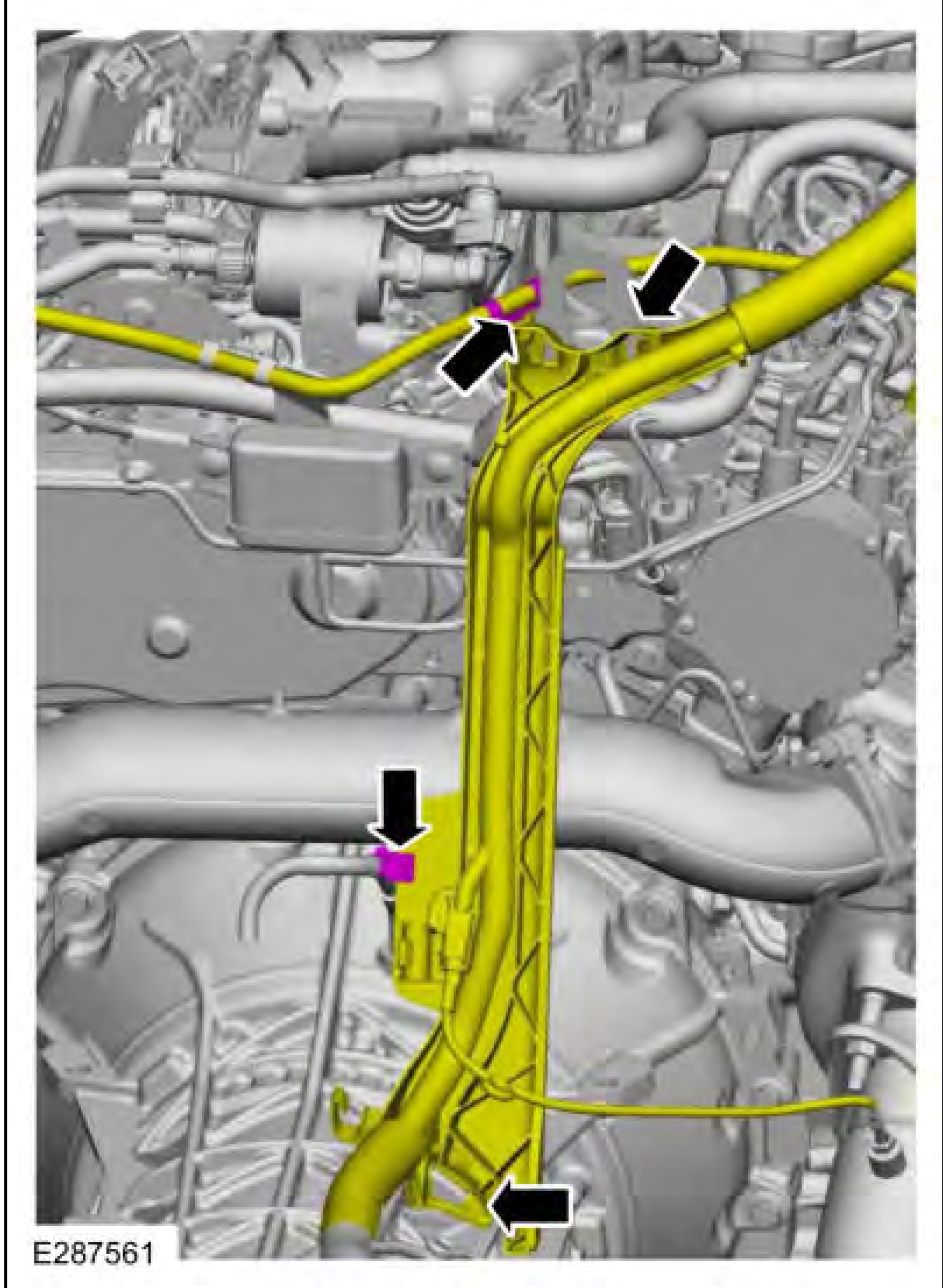
**NOTE:** During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

**NOTE:** It is recommended that this component be serviced with the vehicle body removed. If the body cannot be removed, refer to [Cylinder Head - Body On - LH](#) or [Cylinder Head - Body On - RH](#).

1. Remove the body. REFER to: [Body - 3.0L Power Stroke Diesel](#) .
2. Roll the chassis out from under the body.
  - Install wheel chocks at the front and back of one wheel.
3. Disconnect the vacuum hose retainer and the transmission vent tube. Disconnect the wire harness housing and position aside.

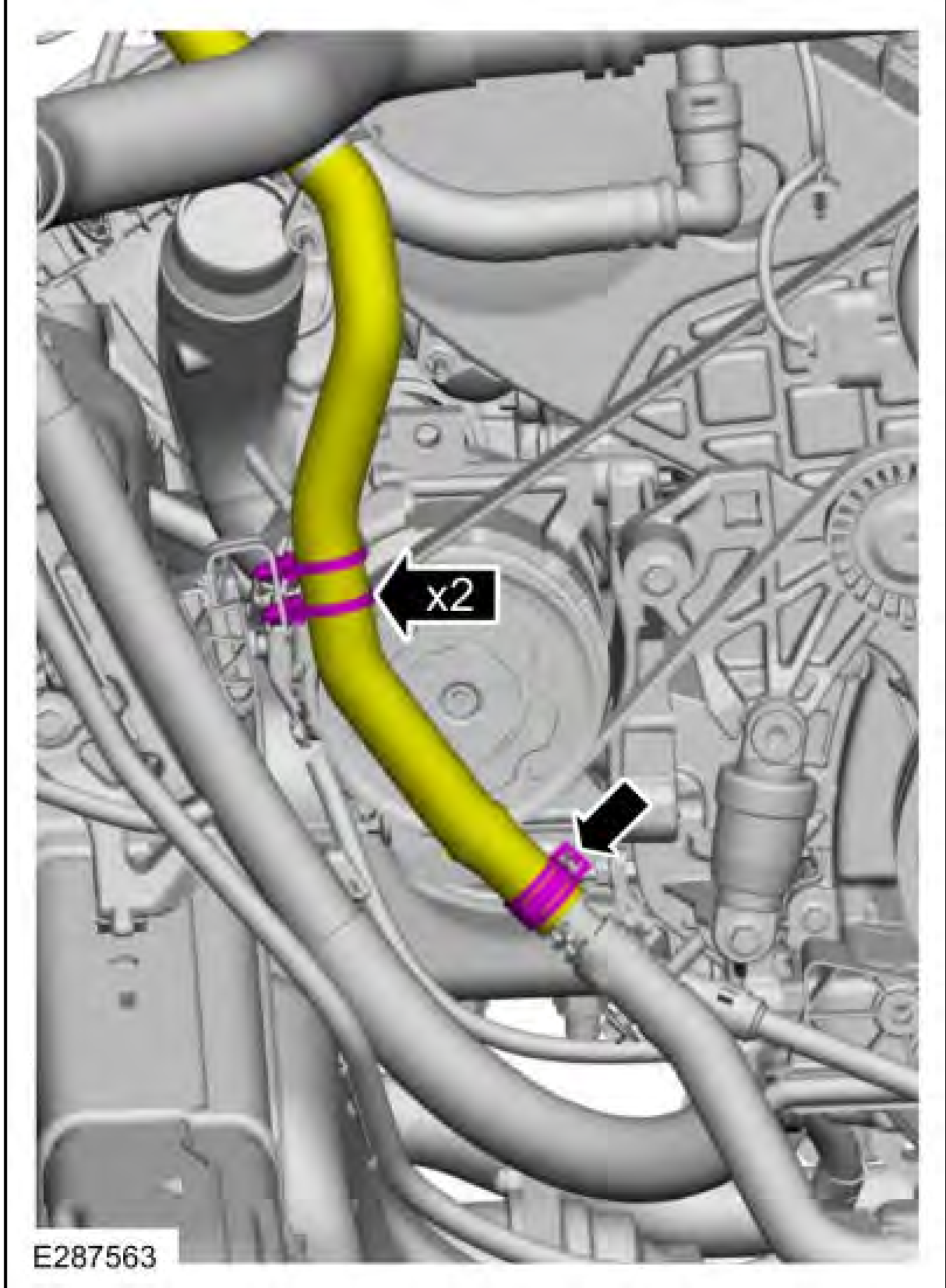






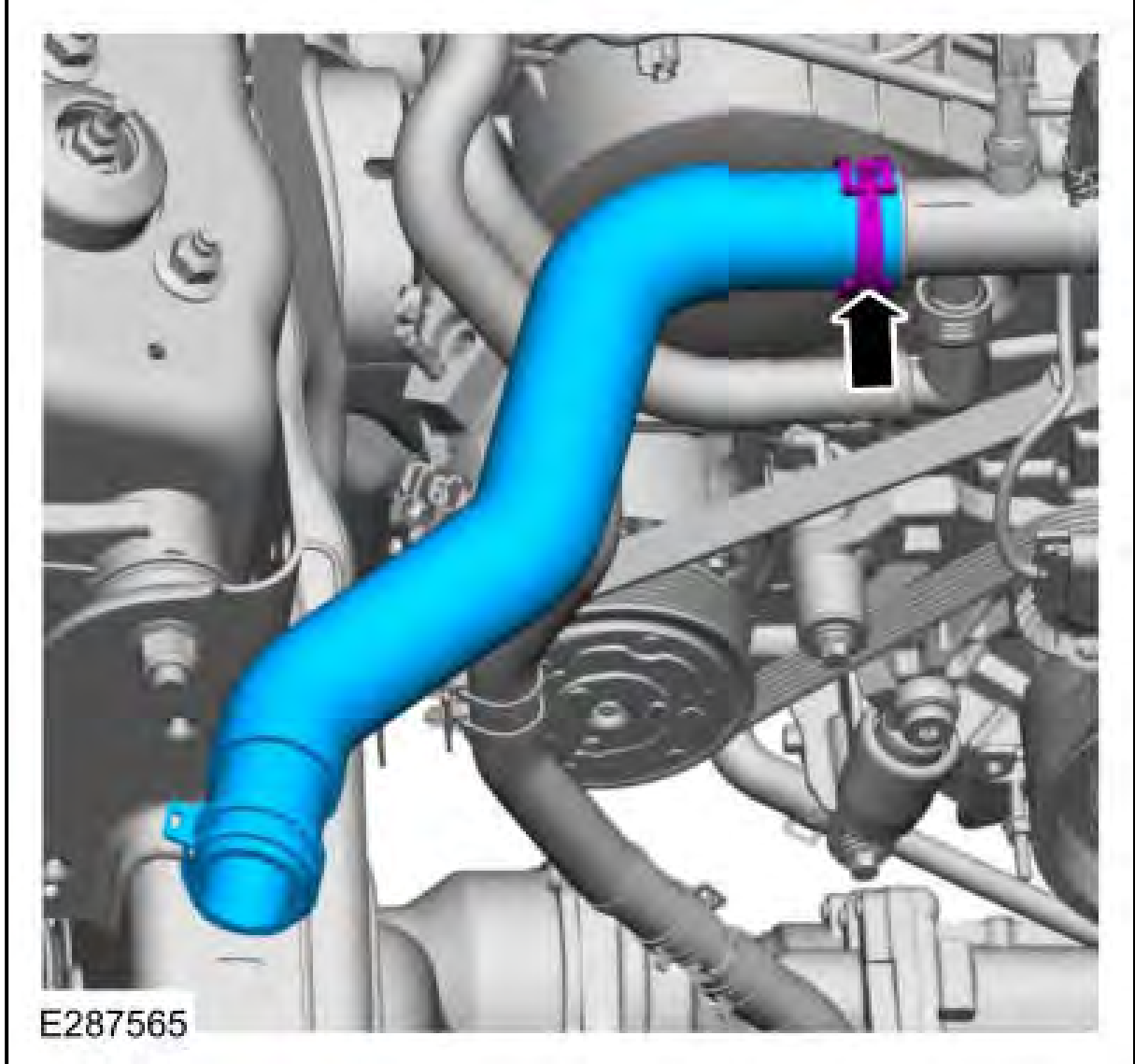
4. Disconnect the coolant hose. Disconnect the retainers and position aside the coolant hose. Use the General Equipment: Hose Clamp Remover/Installer



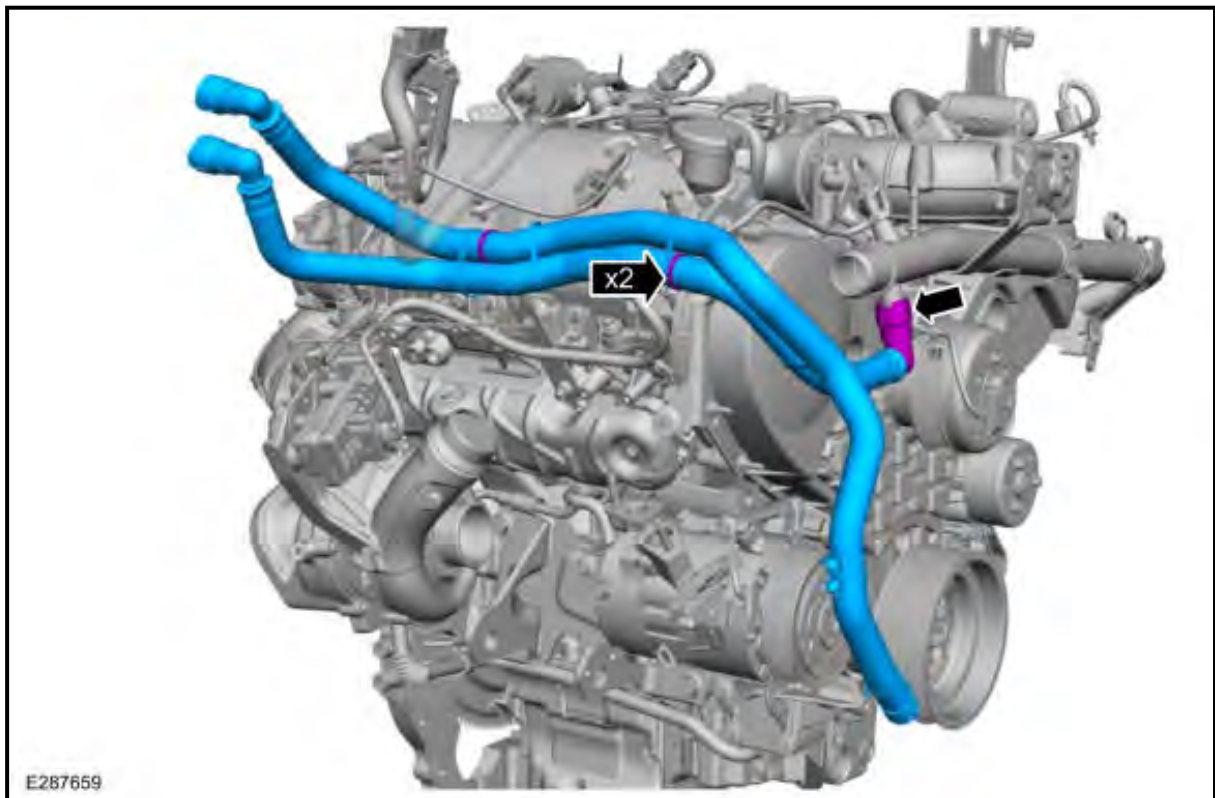


5. Remove the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer

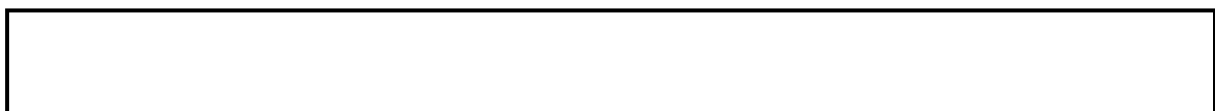


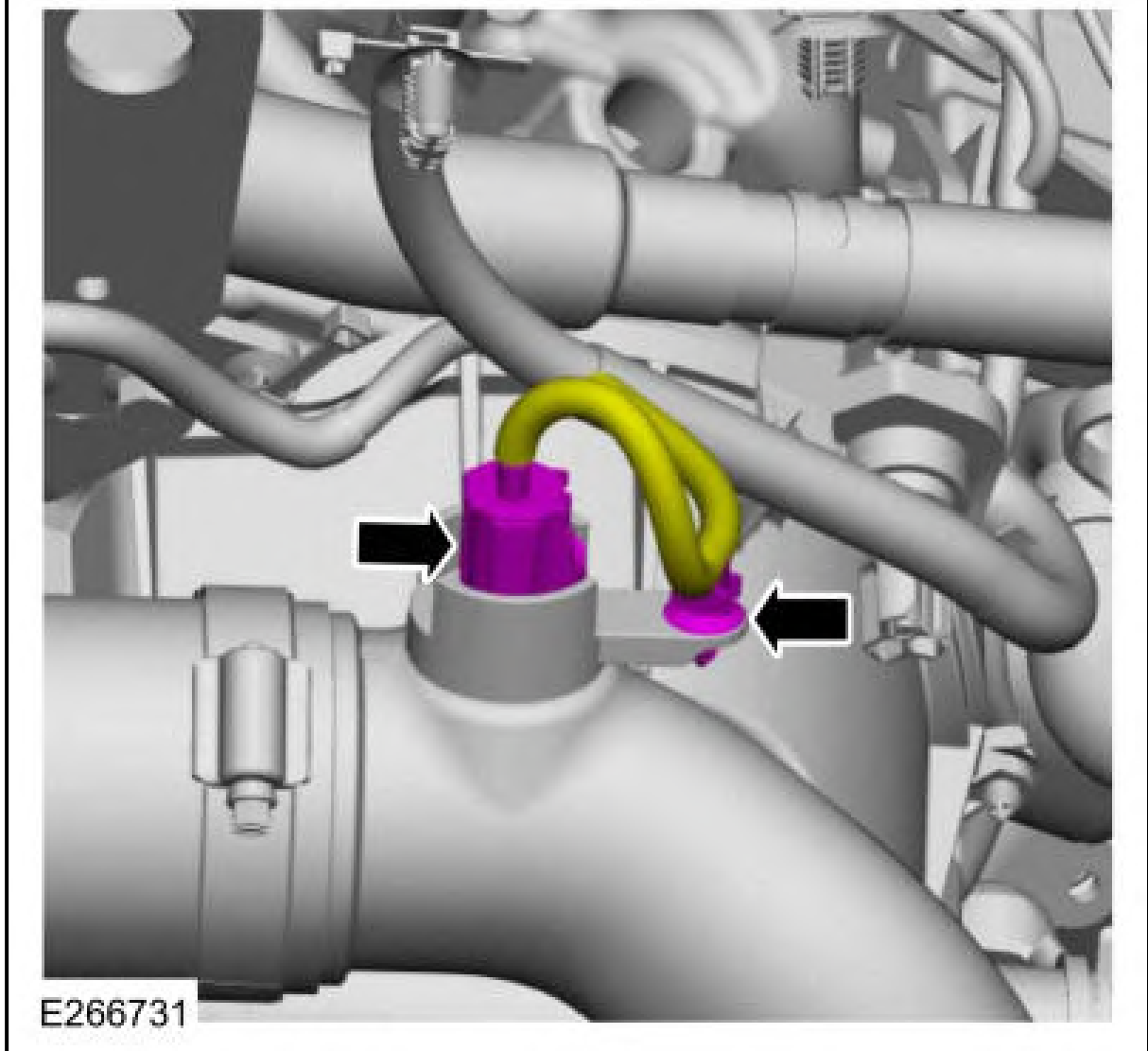


6. Disconnect the coolant hose. Disconnect the retainers and remove the coolant hoses.



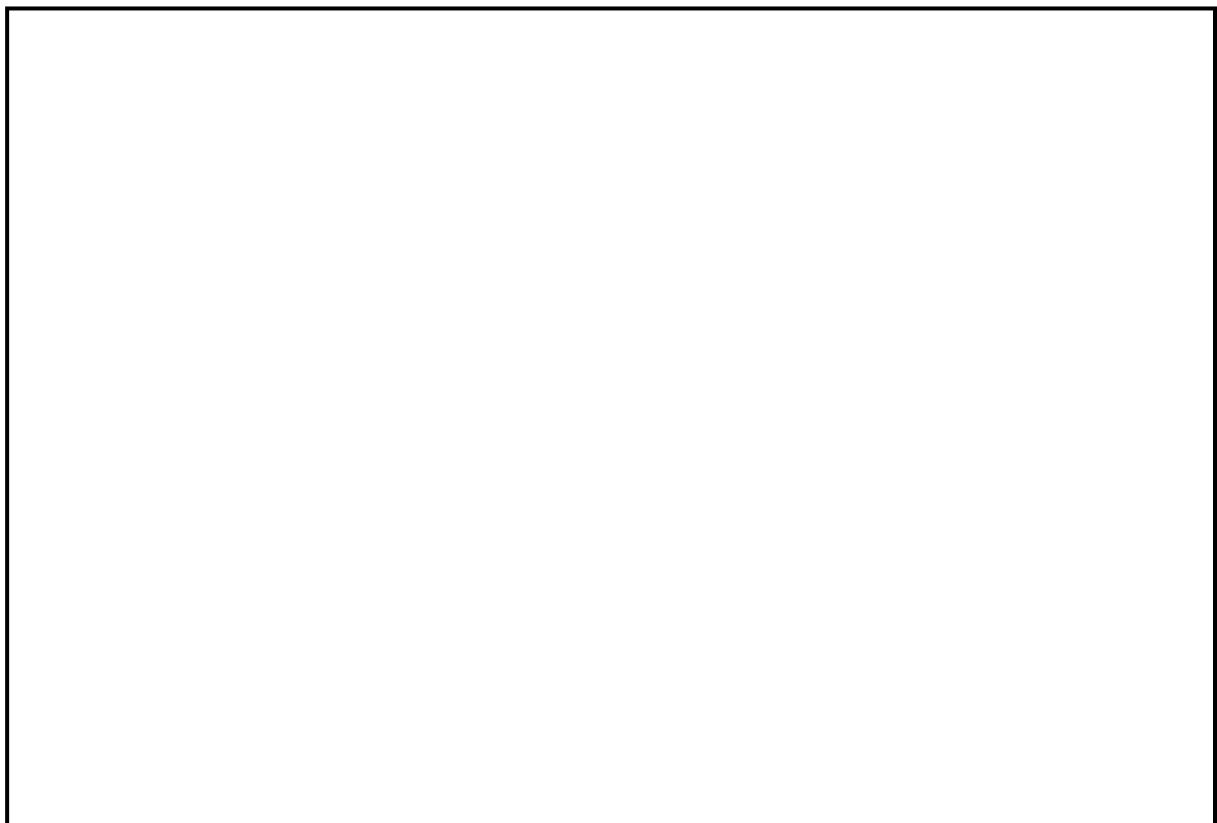
7. Disconnect the electrical connector and the wire retainer.

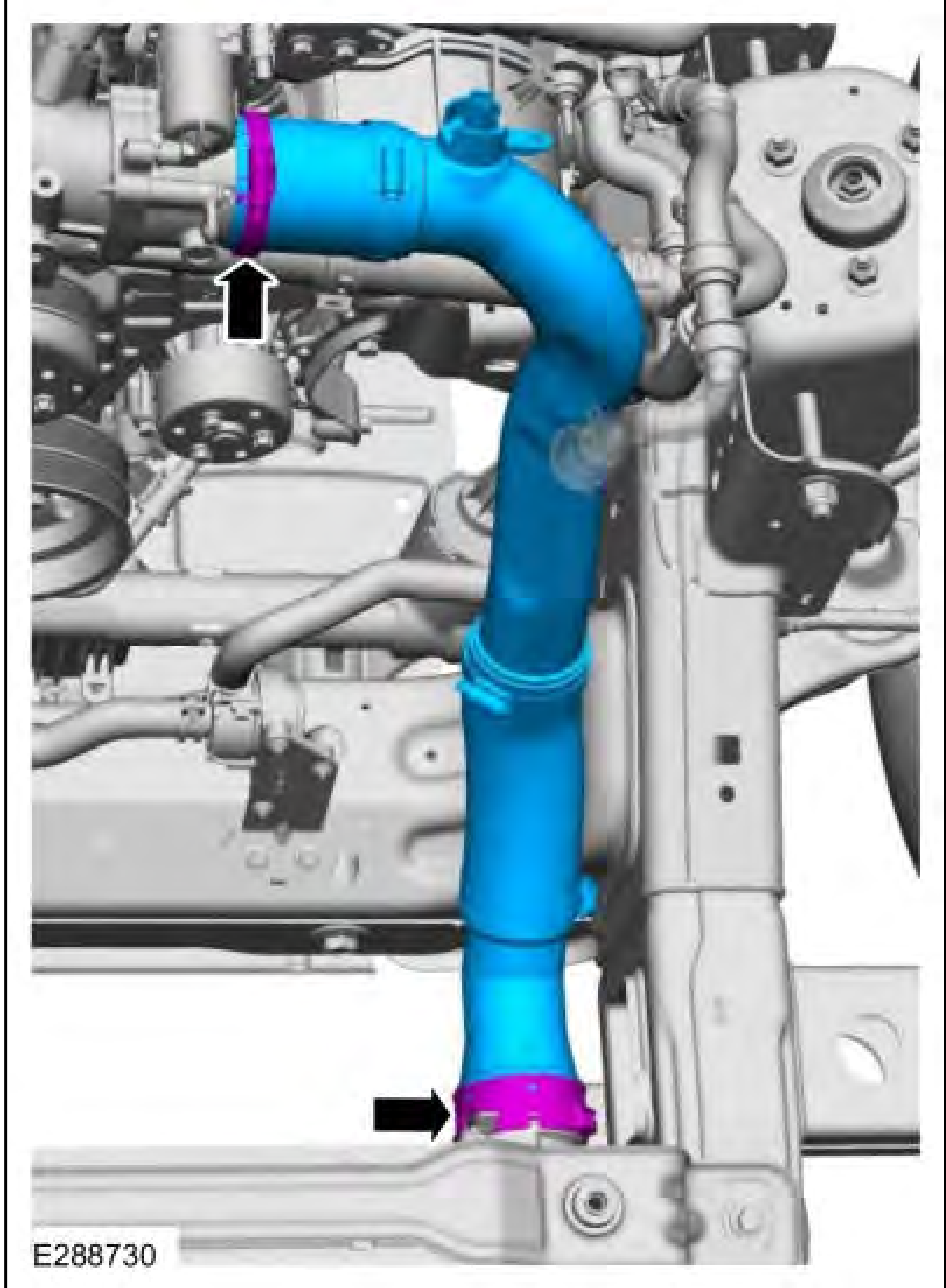




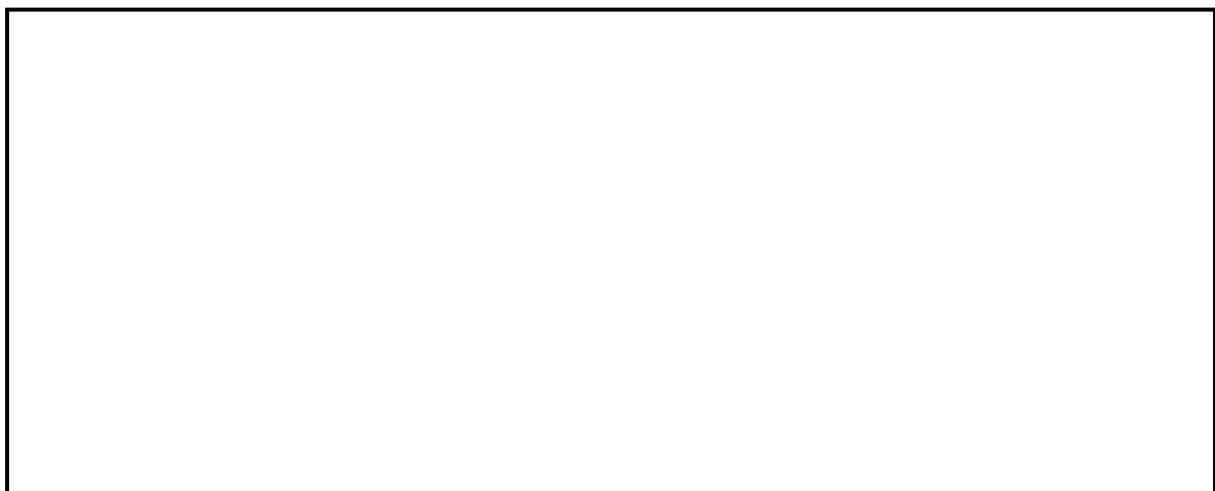
8. **NOTE:** The turbocharger compressor vanes can be damaged by even the smallest particles. When removing any turbocharger or engine air intake system component, ensure that no debris enters the system. Failure to do so may result in damage to the turbocharger.

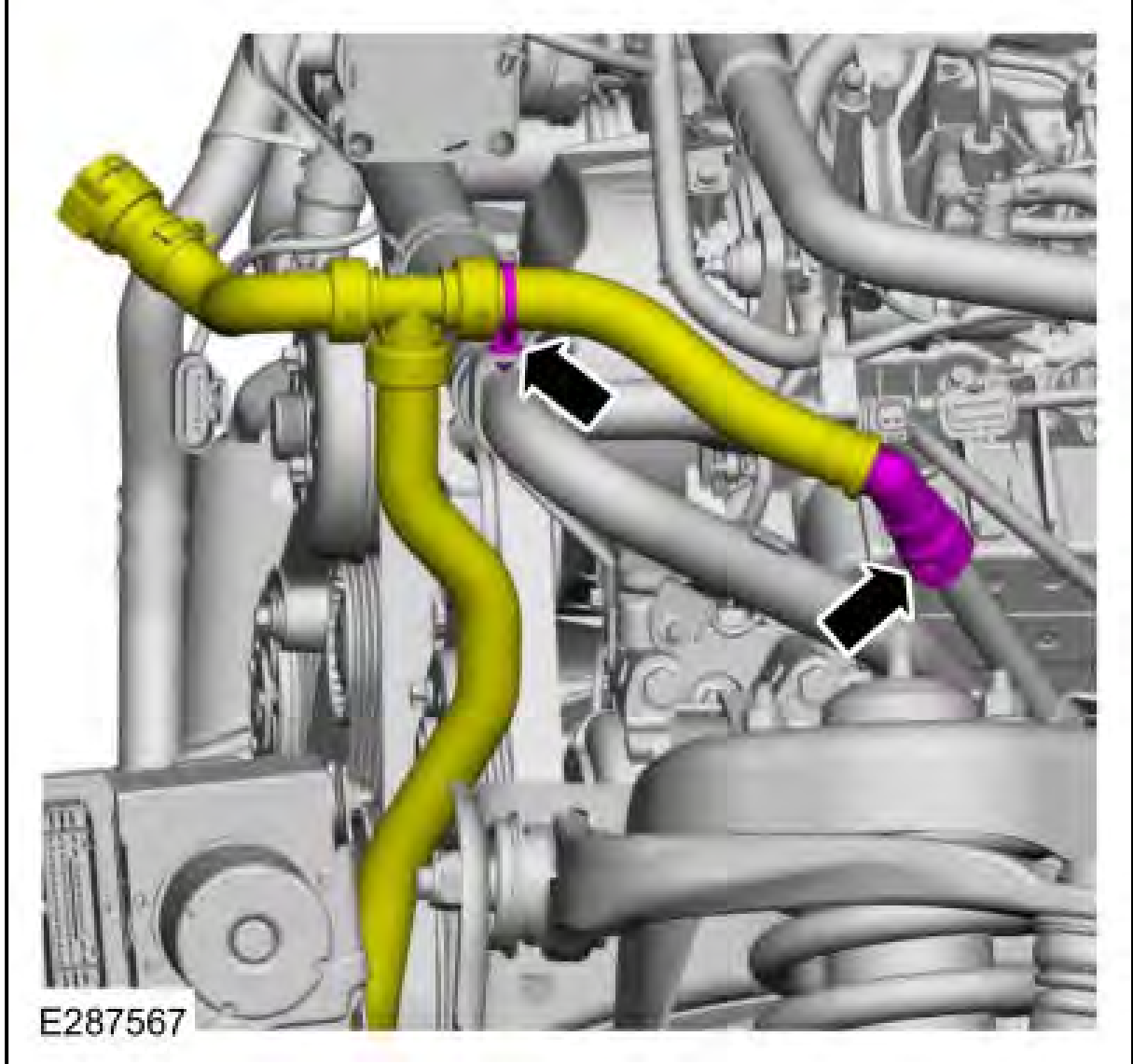
Loosen the clamp, release the clip and remove the LH CAC intake pipe.



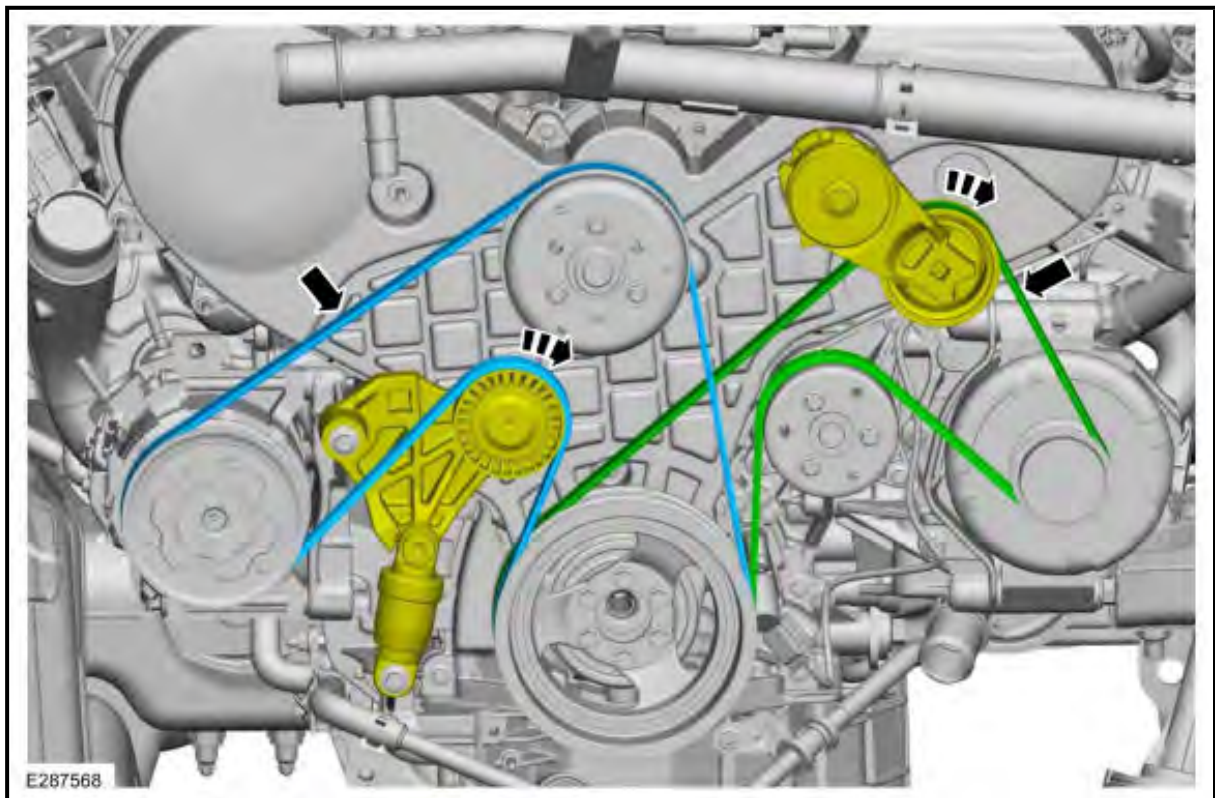


9. Disconnect the coolant hose connector and the retainer.

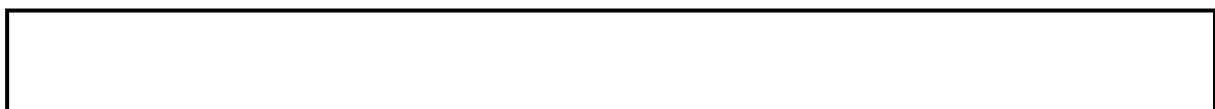


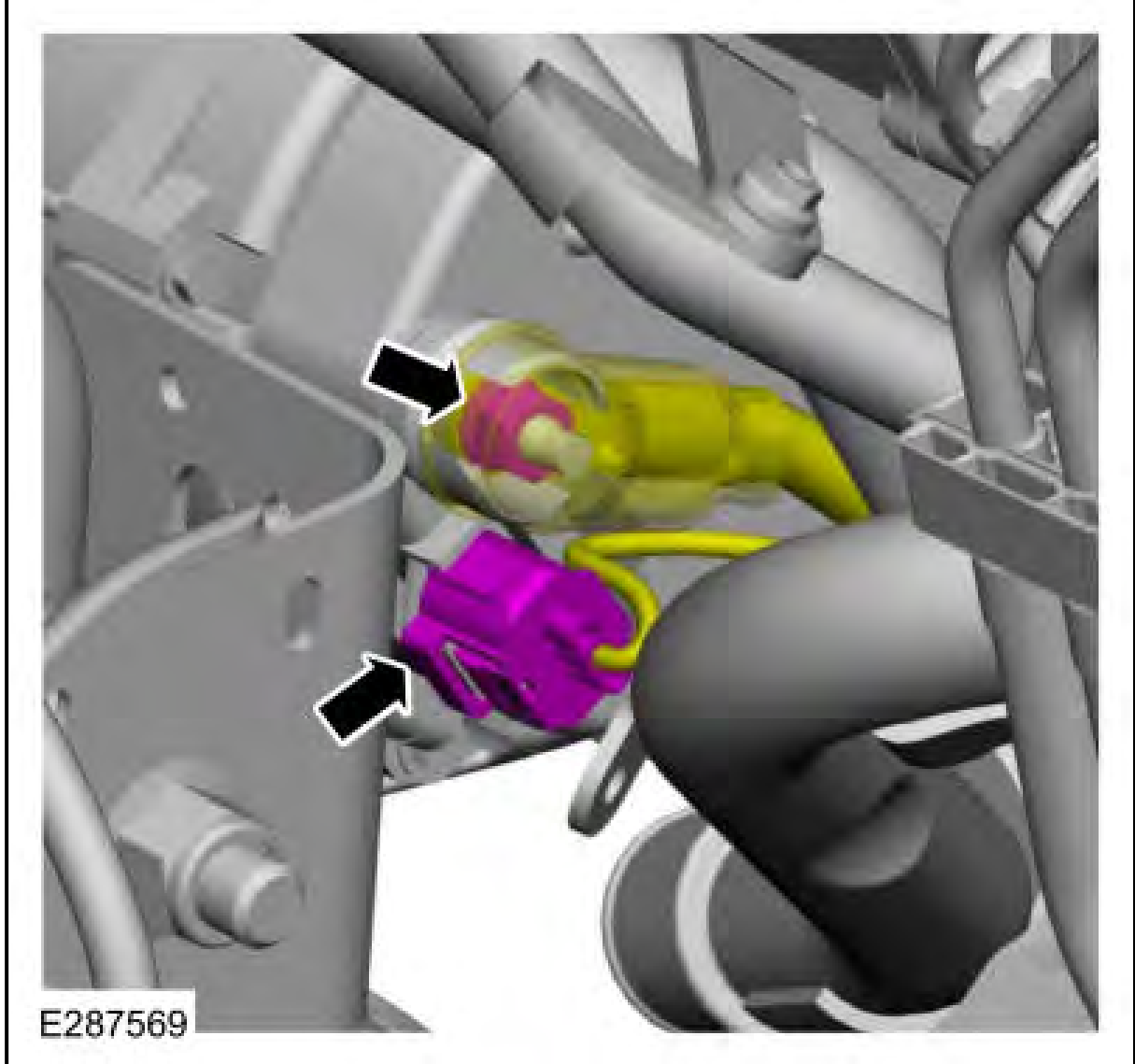


10. Remove the A/C belt and the accessory drive belt.

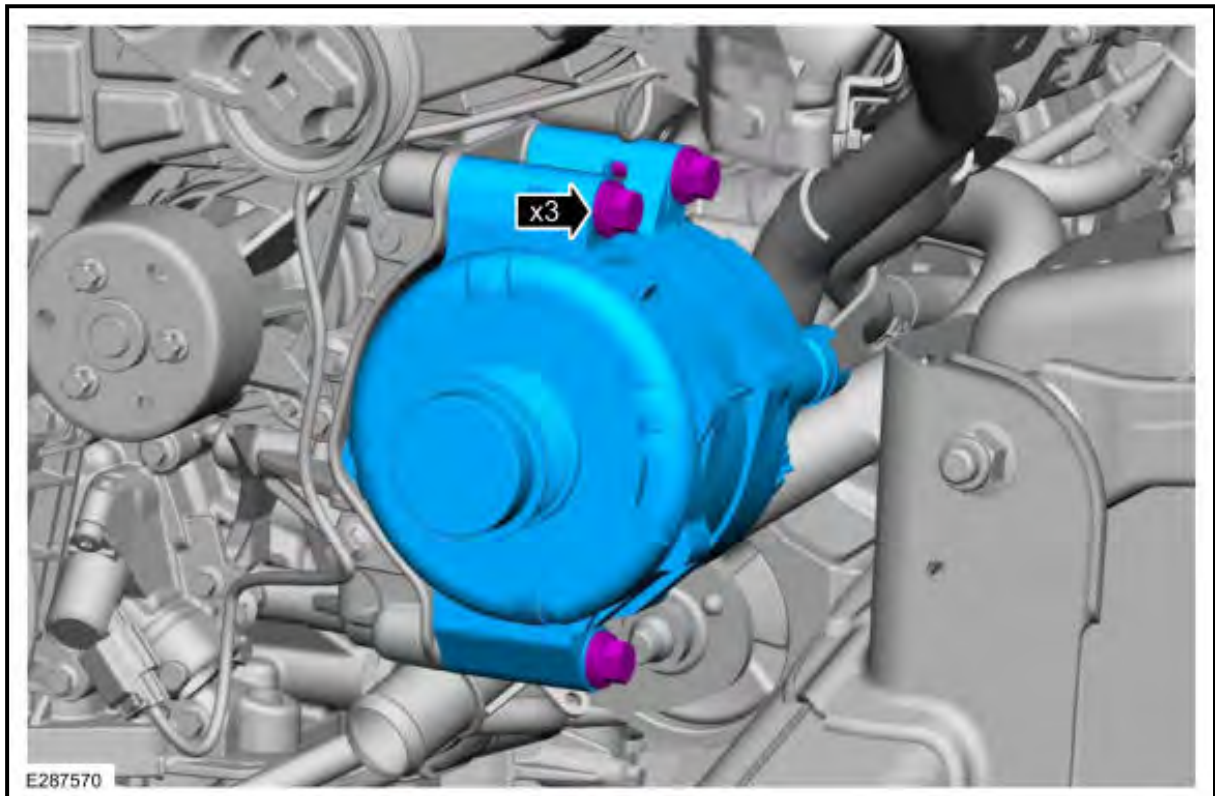


11. Disconnect the electrical connector and the generator output wire.



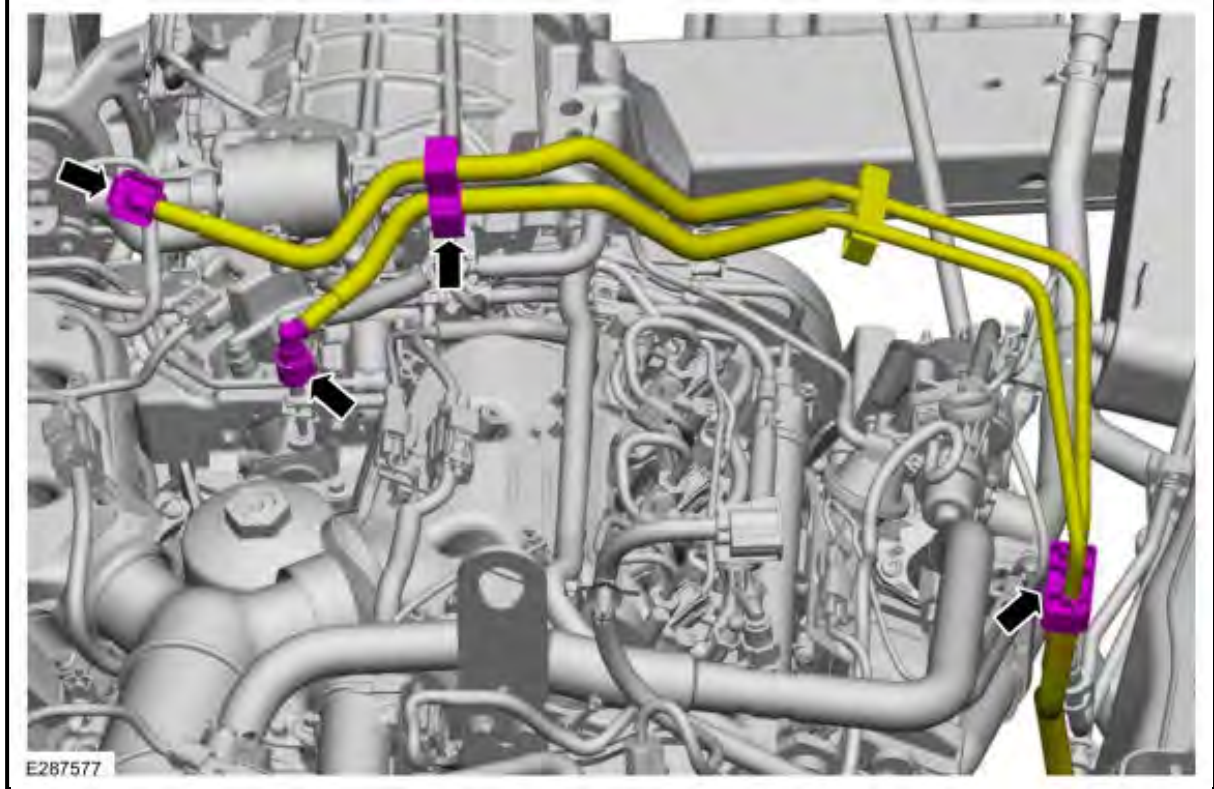


12. Remove the bolts and the generator.

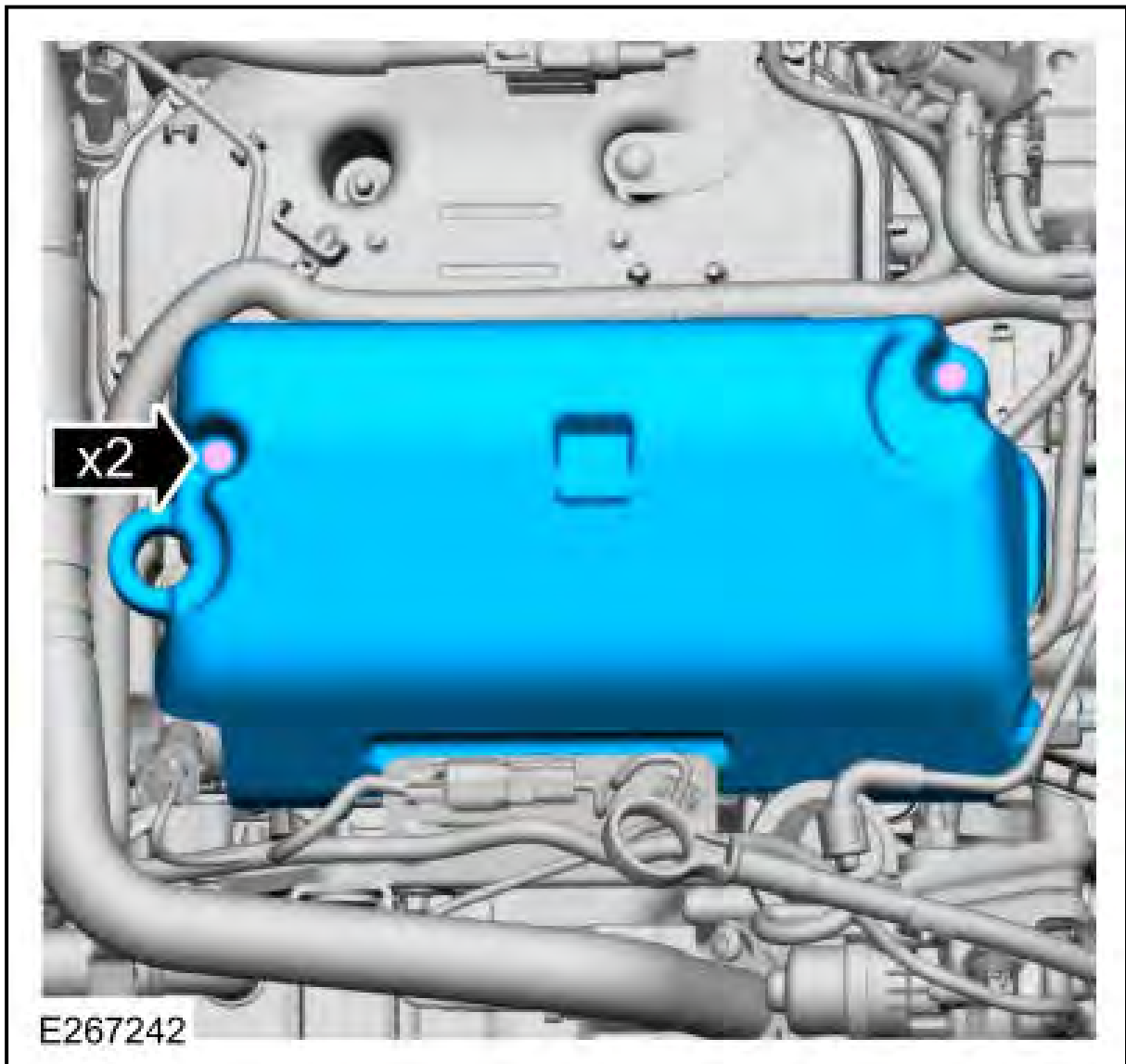


13. Disconnect and position aside the fuel tubes. REFER to: [Quick Release Coupling](#) .



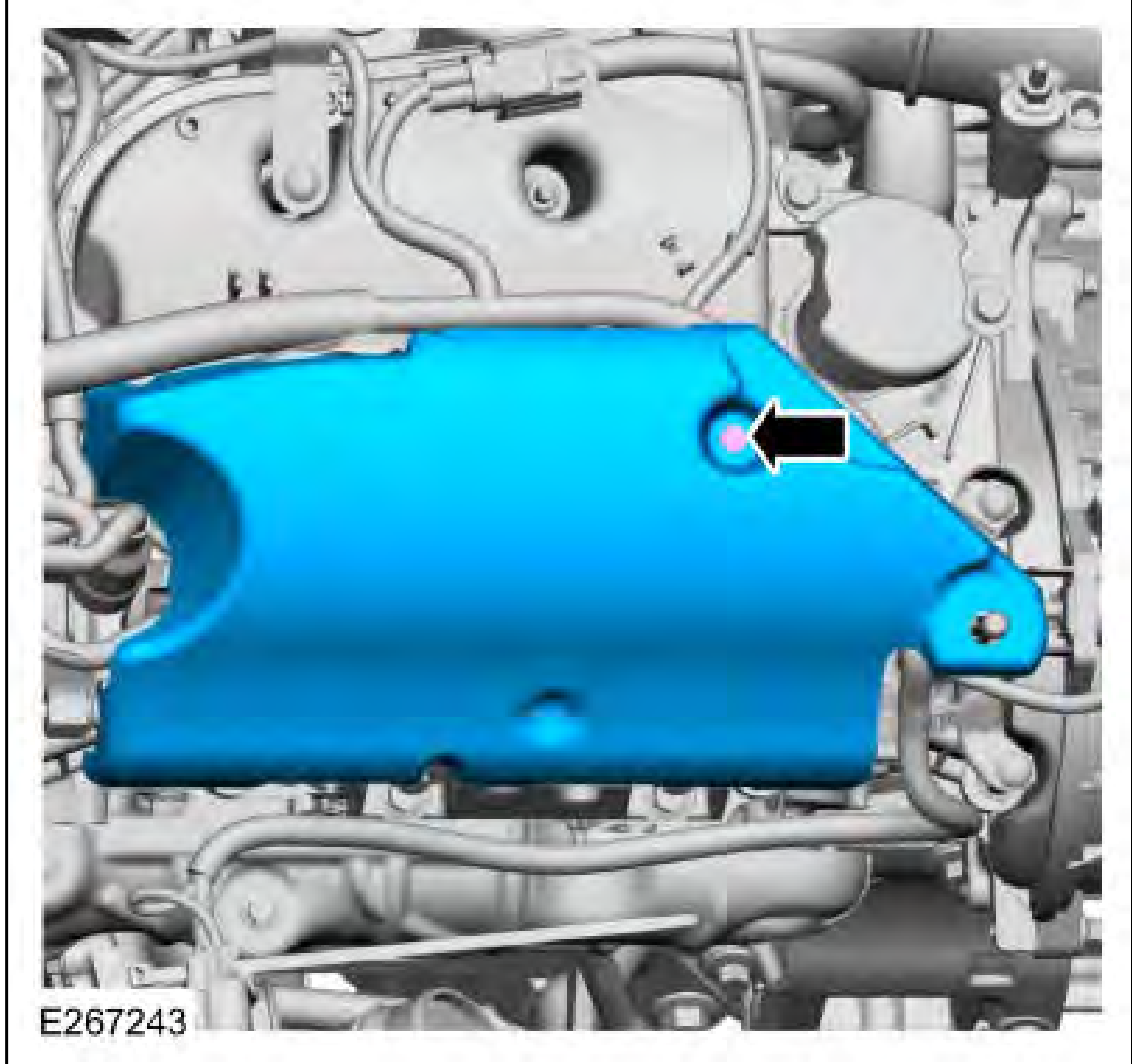


14. Remove the LH fuel injector noise insulator.

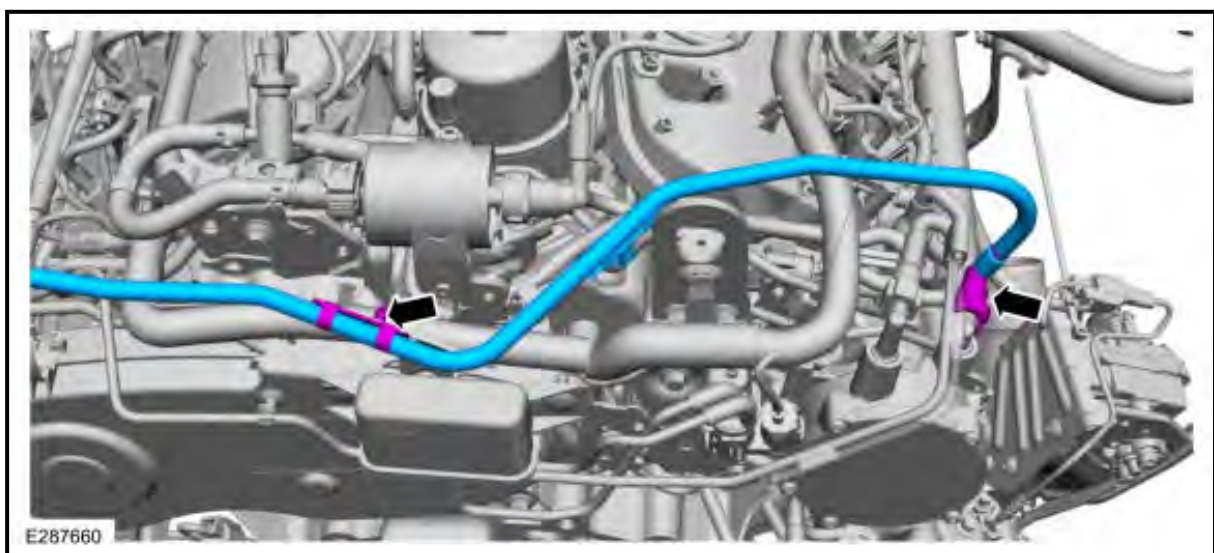


15. Remove the RH fuel injector noise insulator.



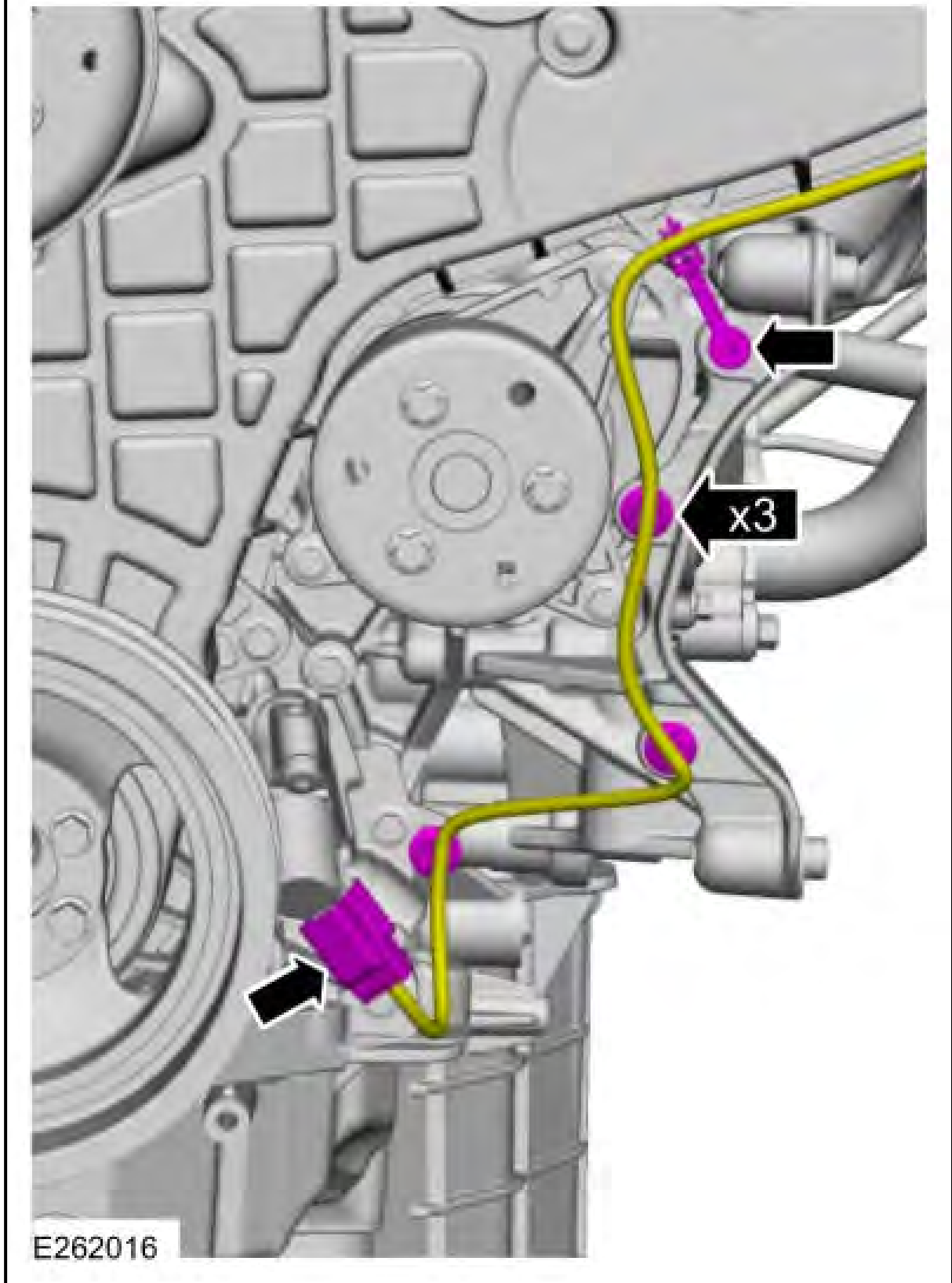


16. Disconnect the retainer. Disconnect and remove the brake vacuum hose. REFER to: [Quick Release Coupling](#) .



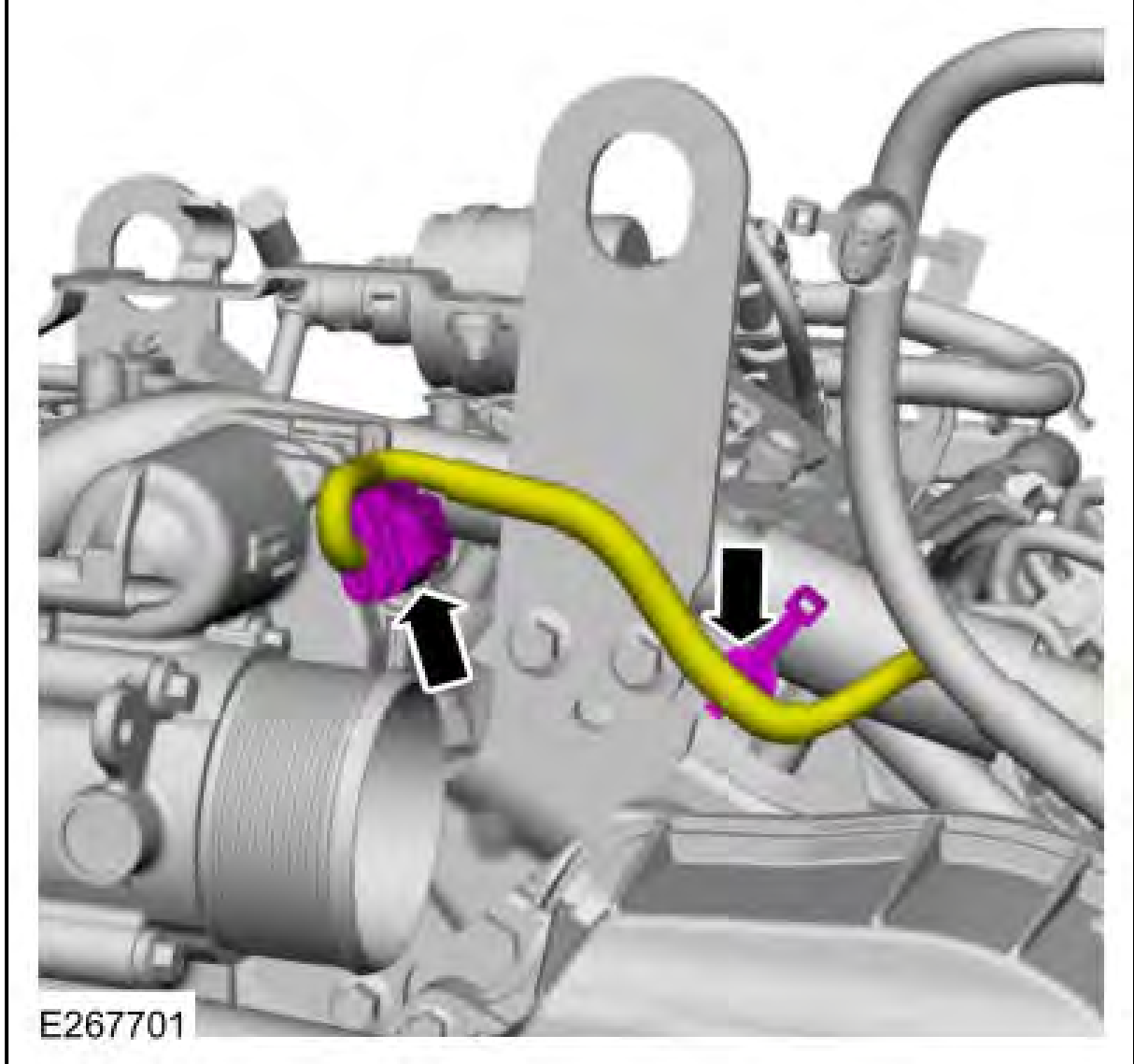
17. Disconnect the oil pump electrical connector and the wire retainers.



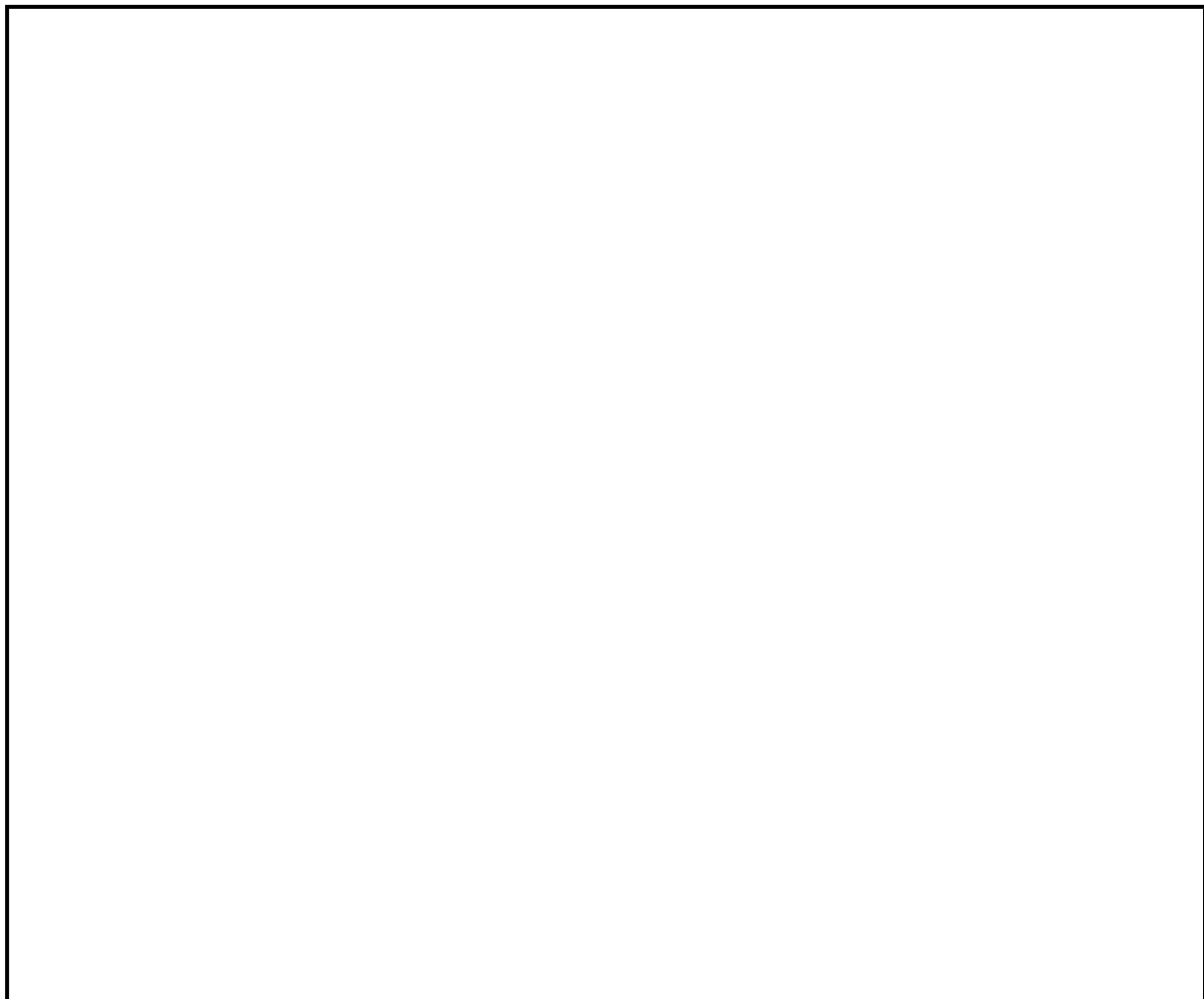


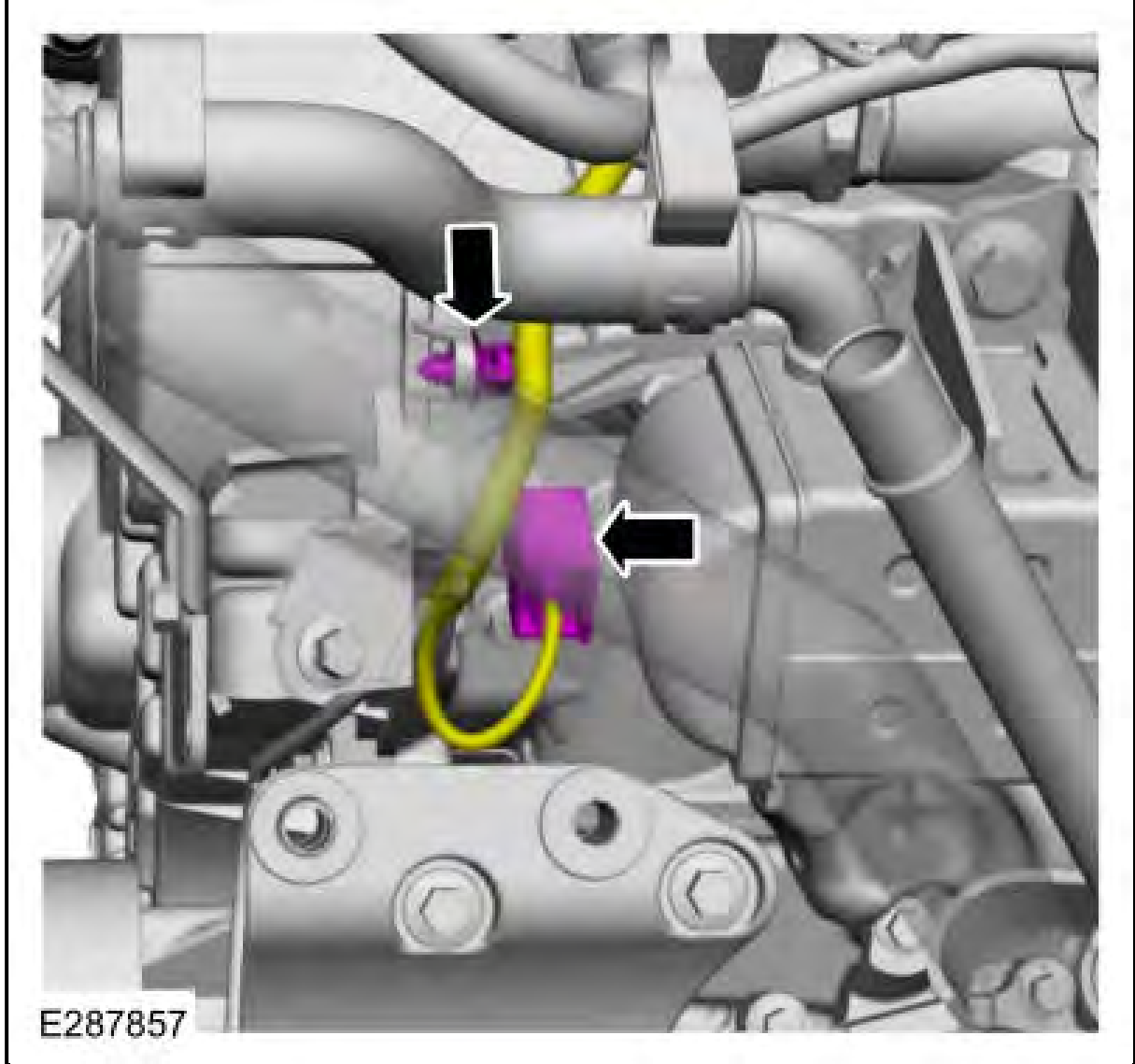
18. Disconnect the TB (throttle body) electrical connector and the wire retainer.



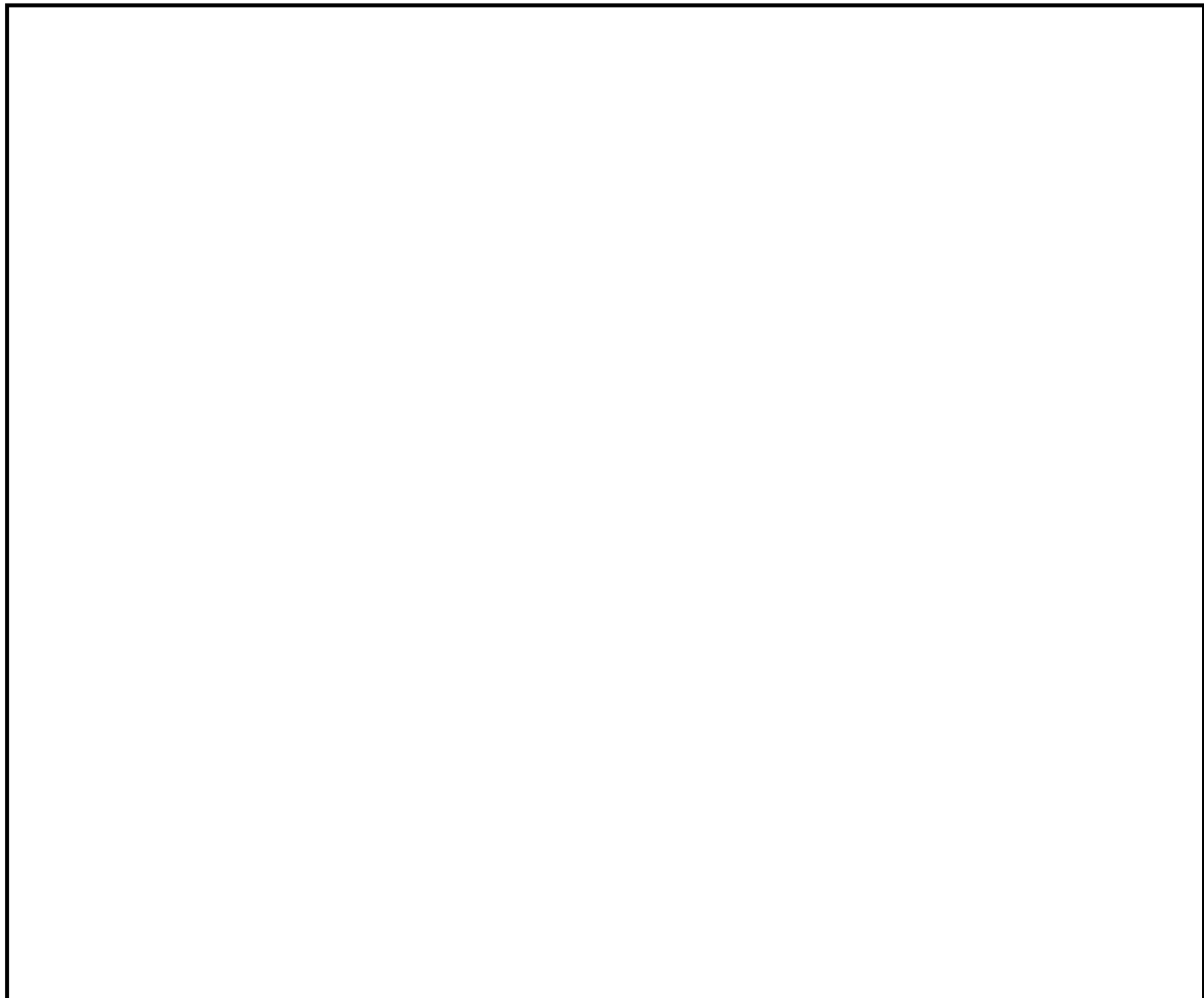


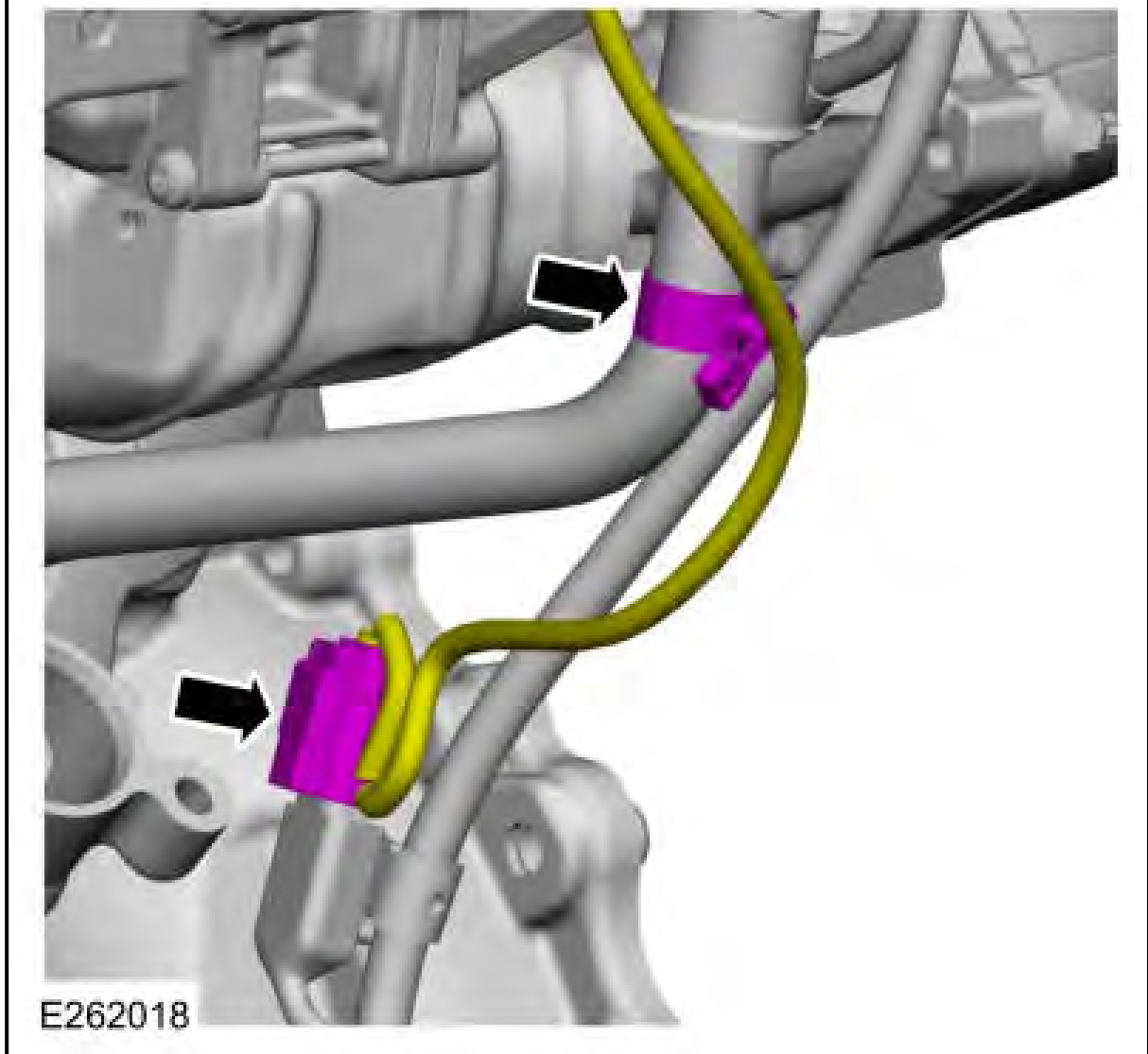
19. Disconnect the CMP electrical connector and the wire retainer.





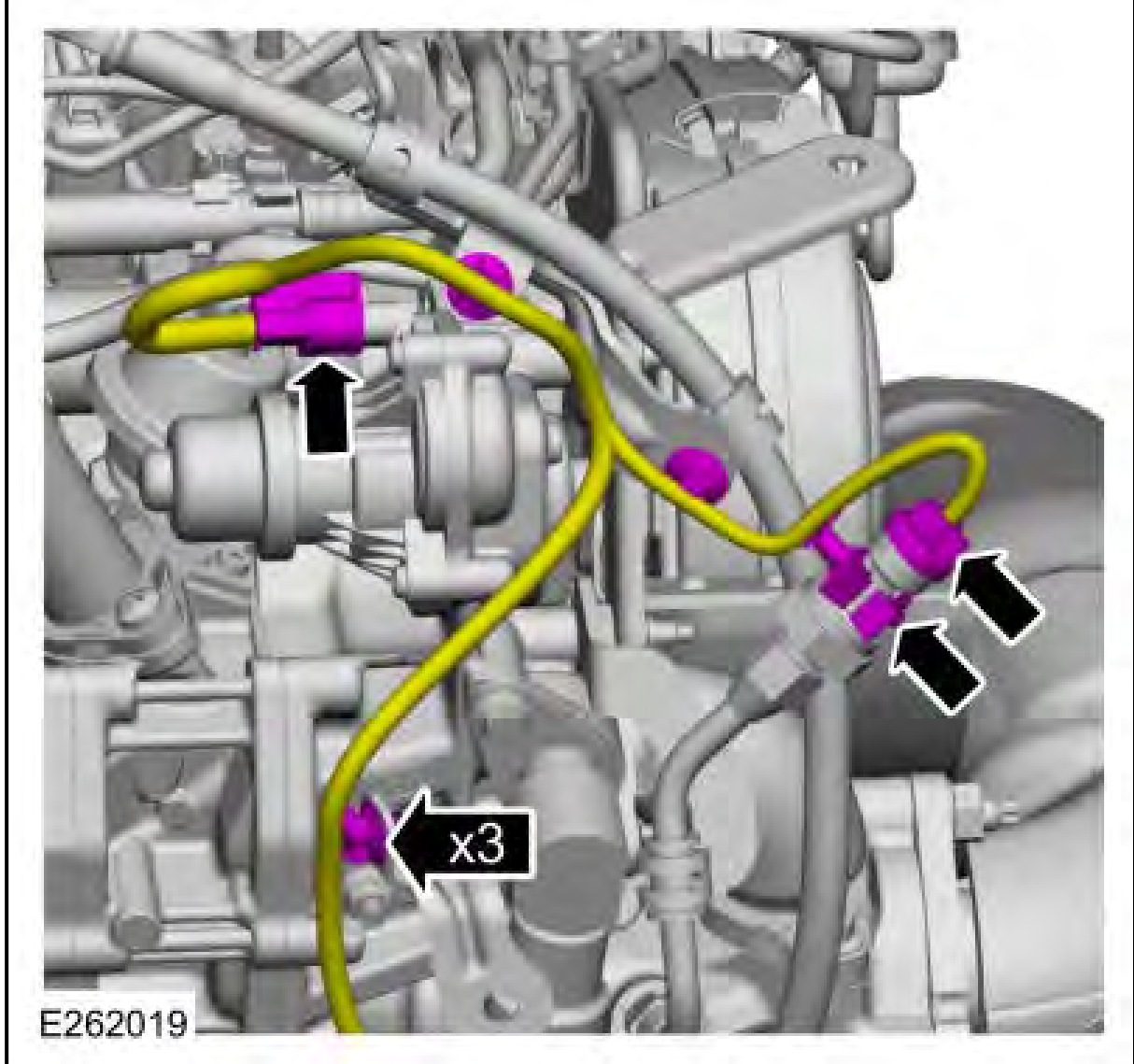
20. Disconnect the CKP electrical connector and the wire retainer.



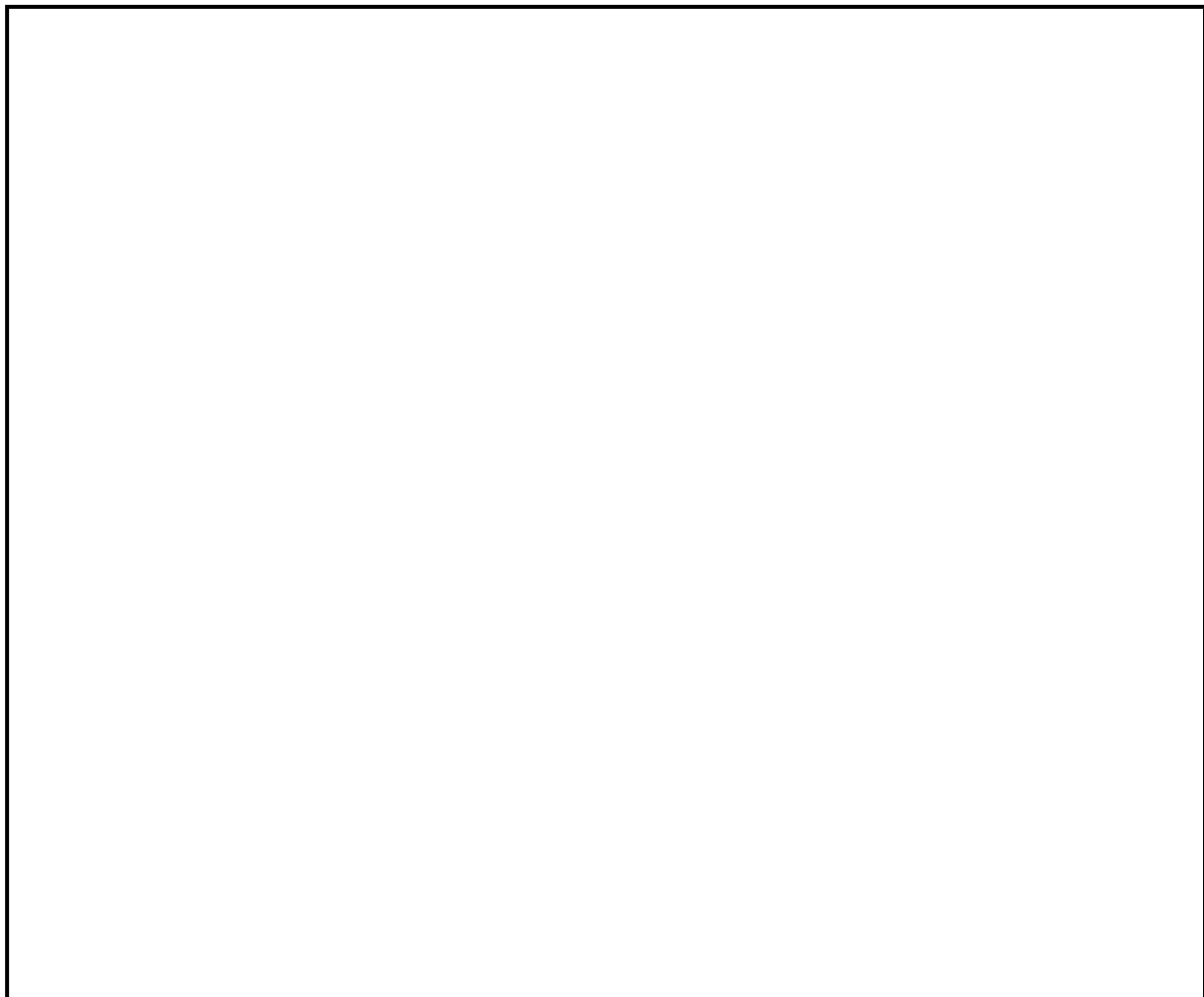


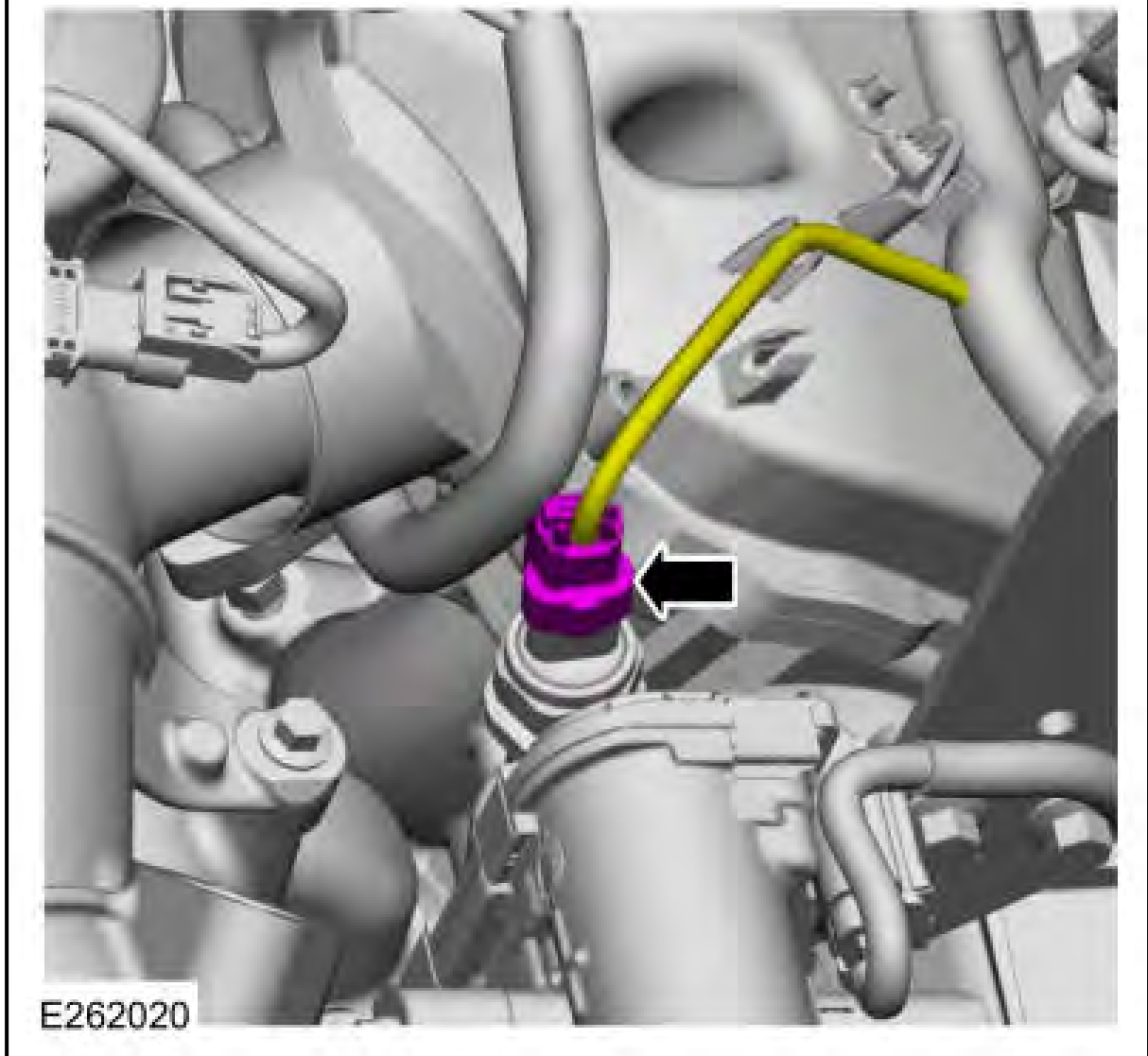
21. Disconnect the EGR valve and the EP (exhaust pressure) sensor electrical connectors. Disconnect the wire retainers.



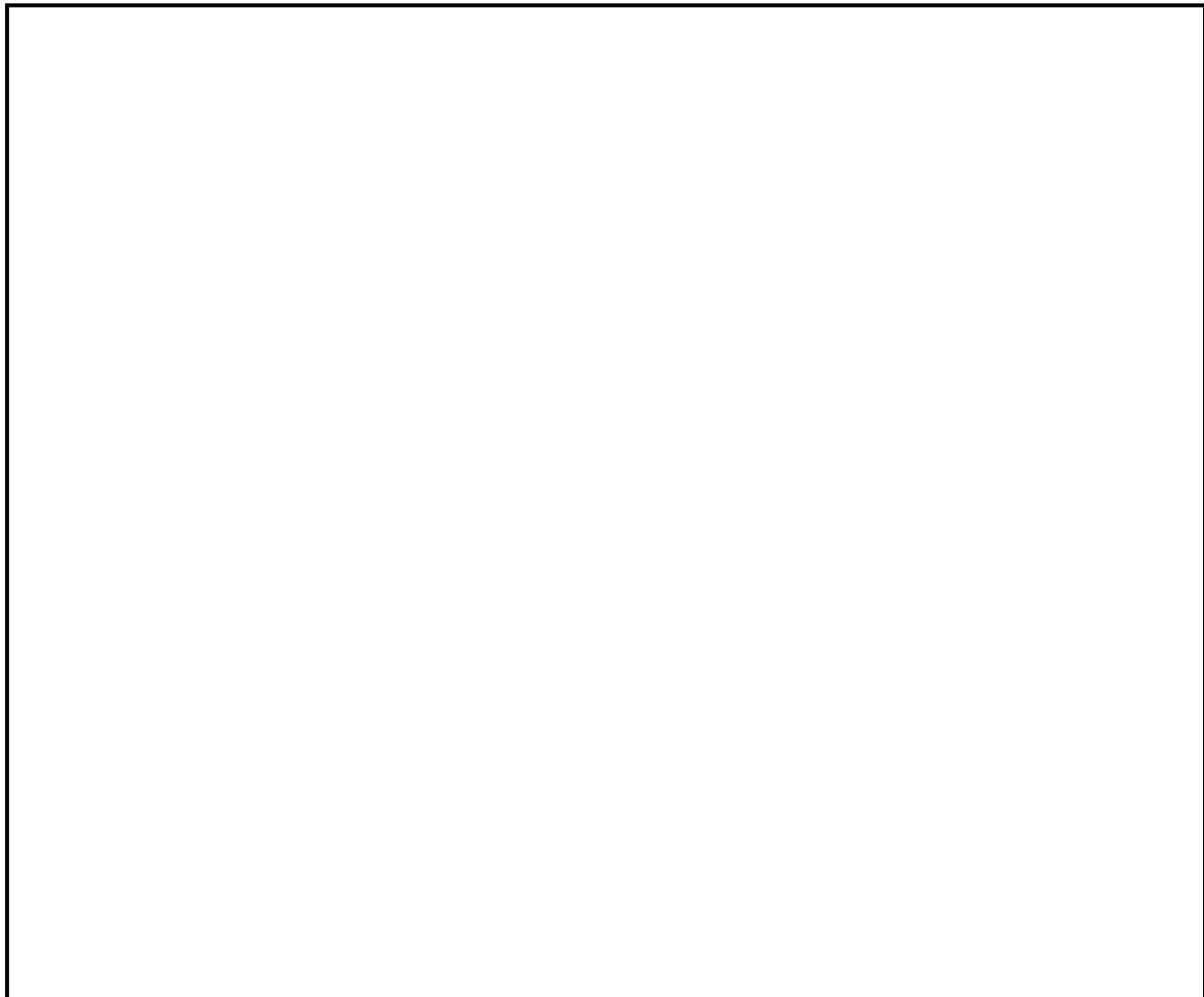


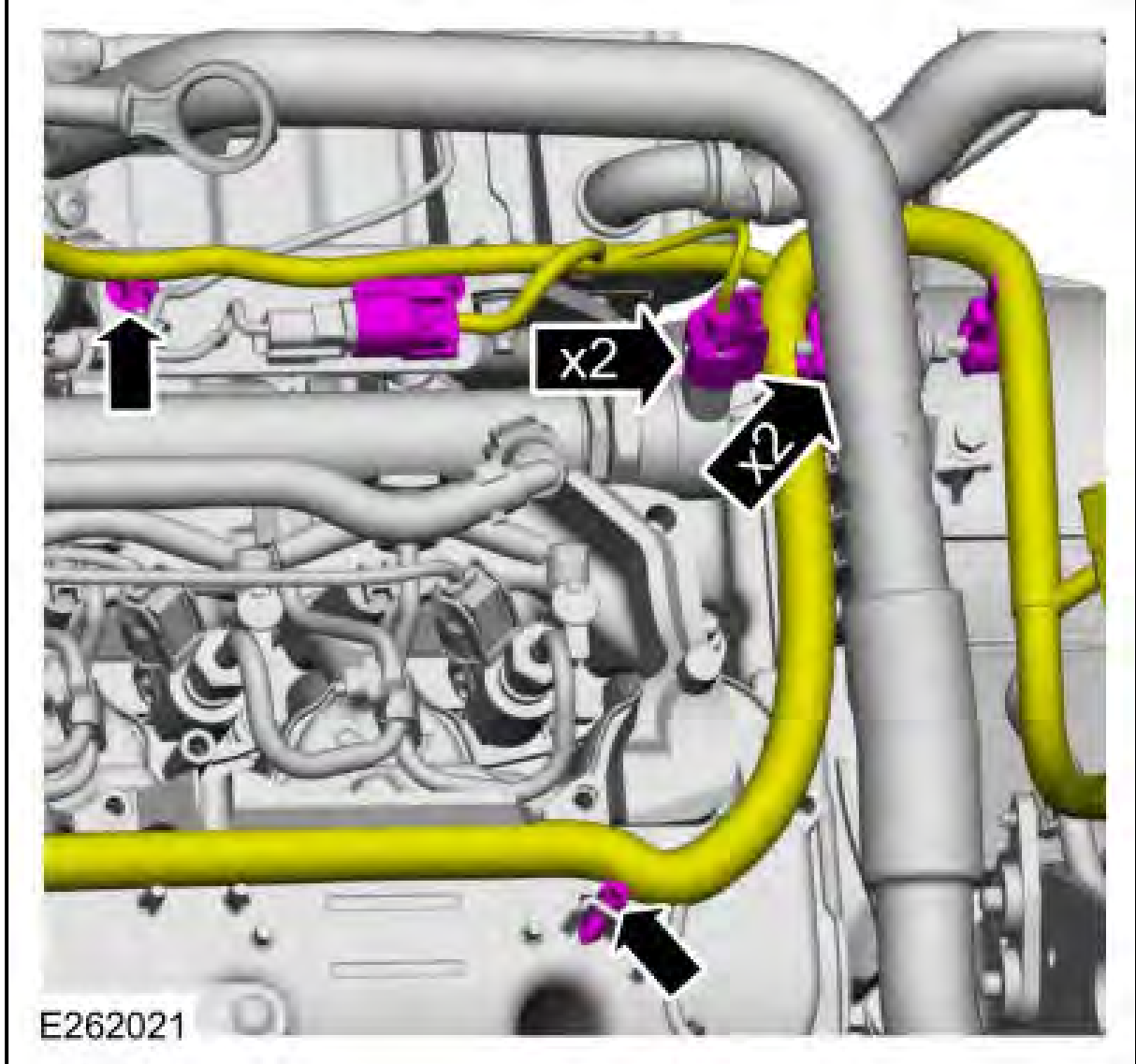
22. Disconnect the EOP sensor electrical connector.





23. Disconnect the electrical connectors and the wire retainers.

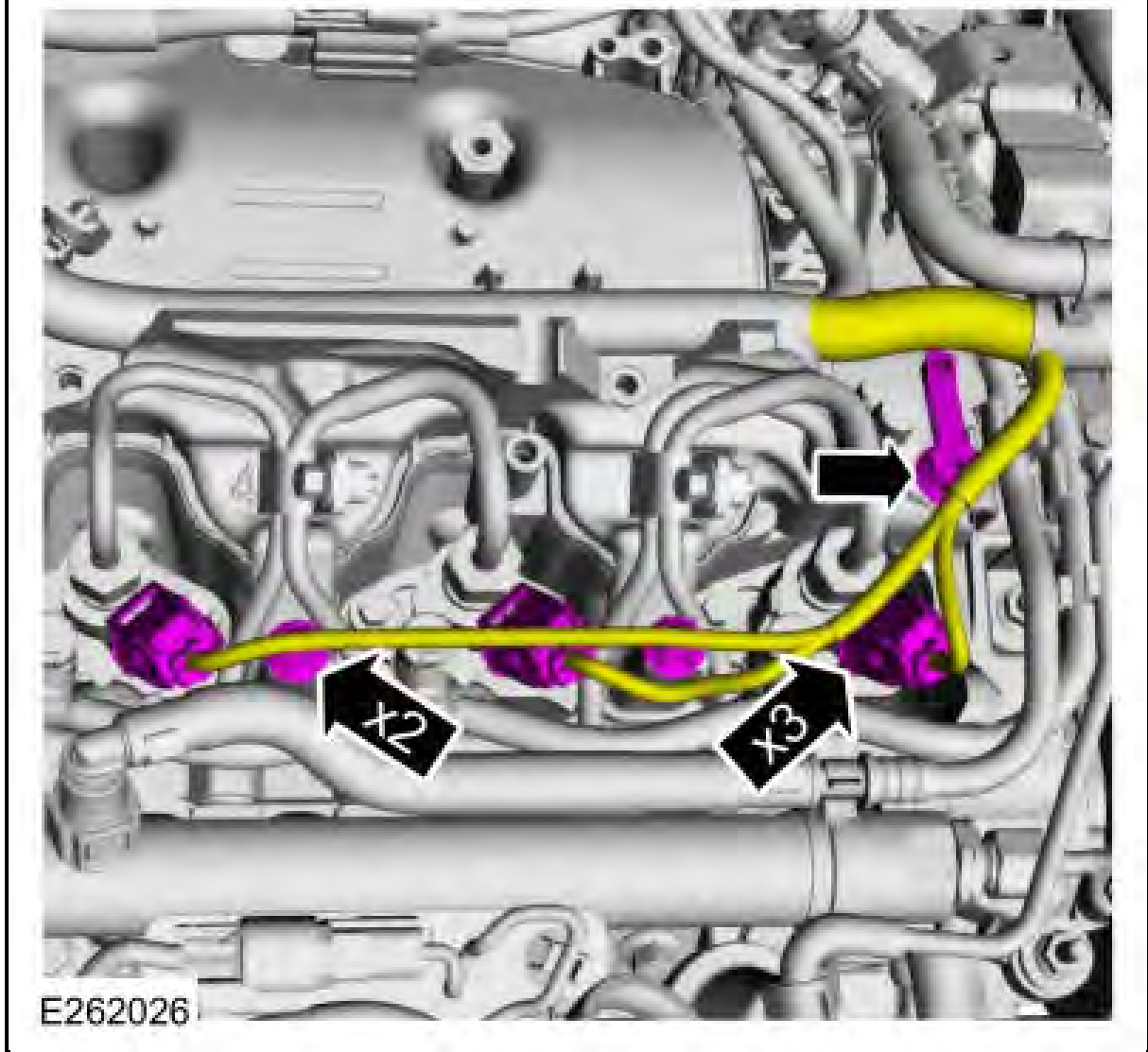




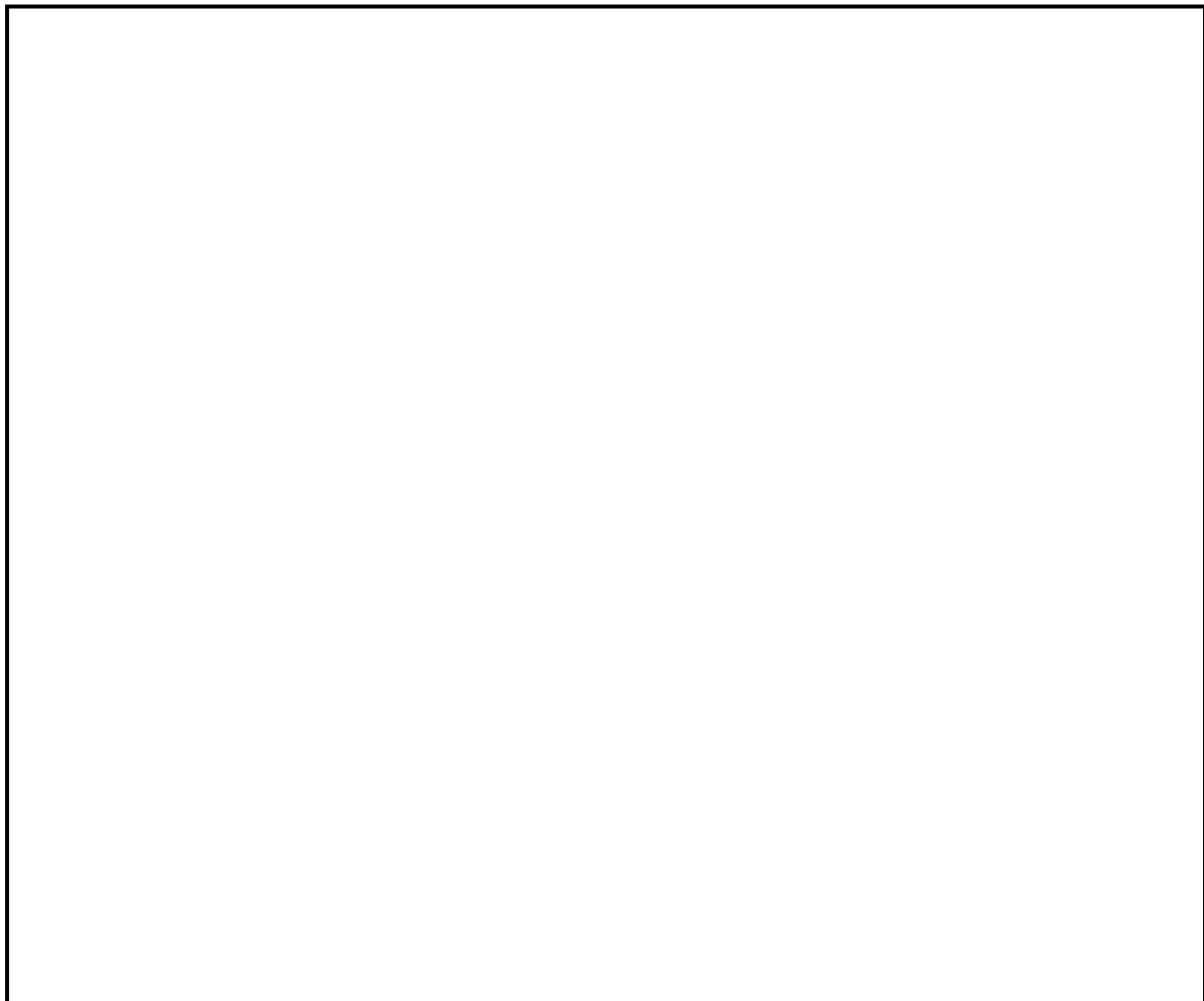
24. Disconnect the fuel injectors electrical connectors and the wire retainers.

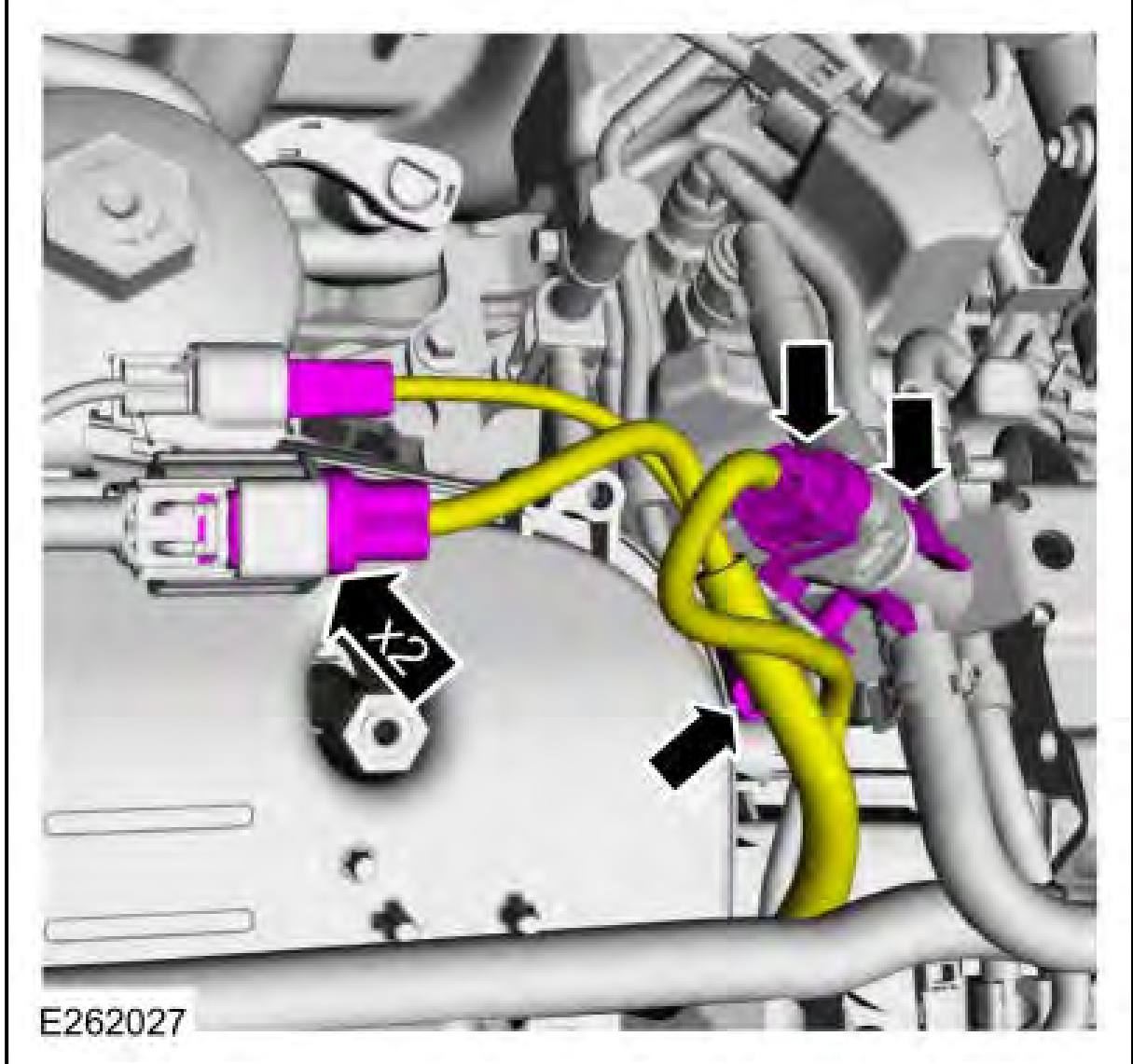




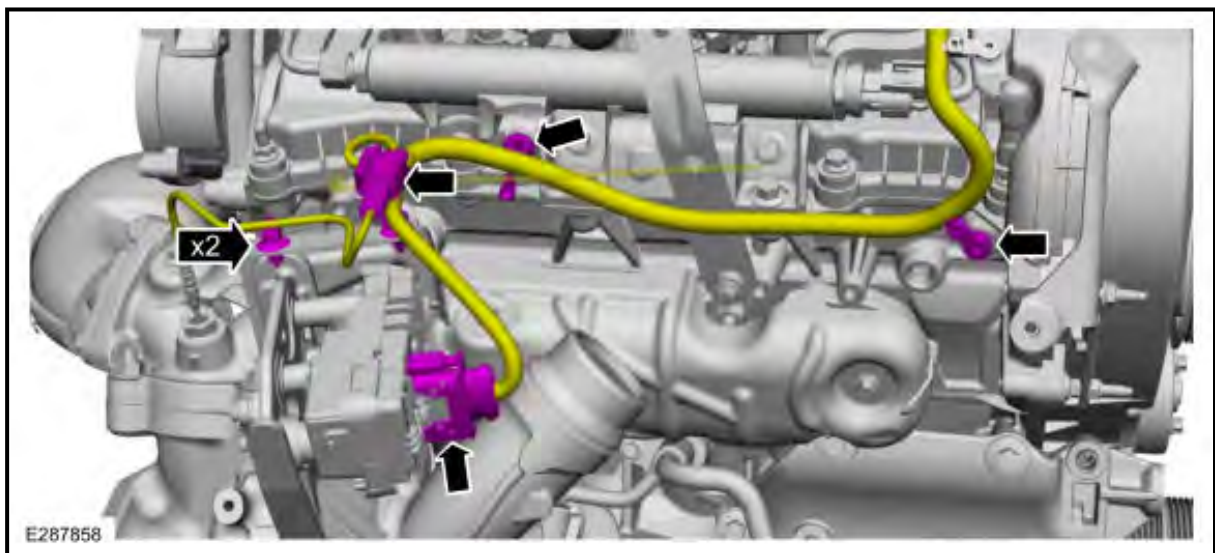


25. Disconnect the electrical connectors and the wire retainer.



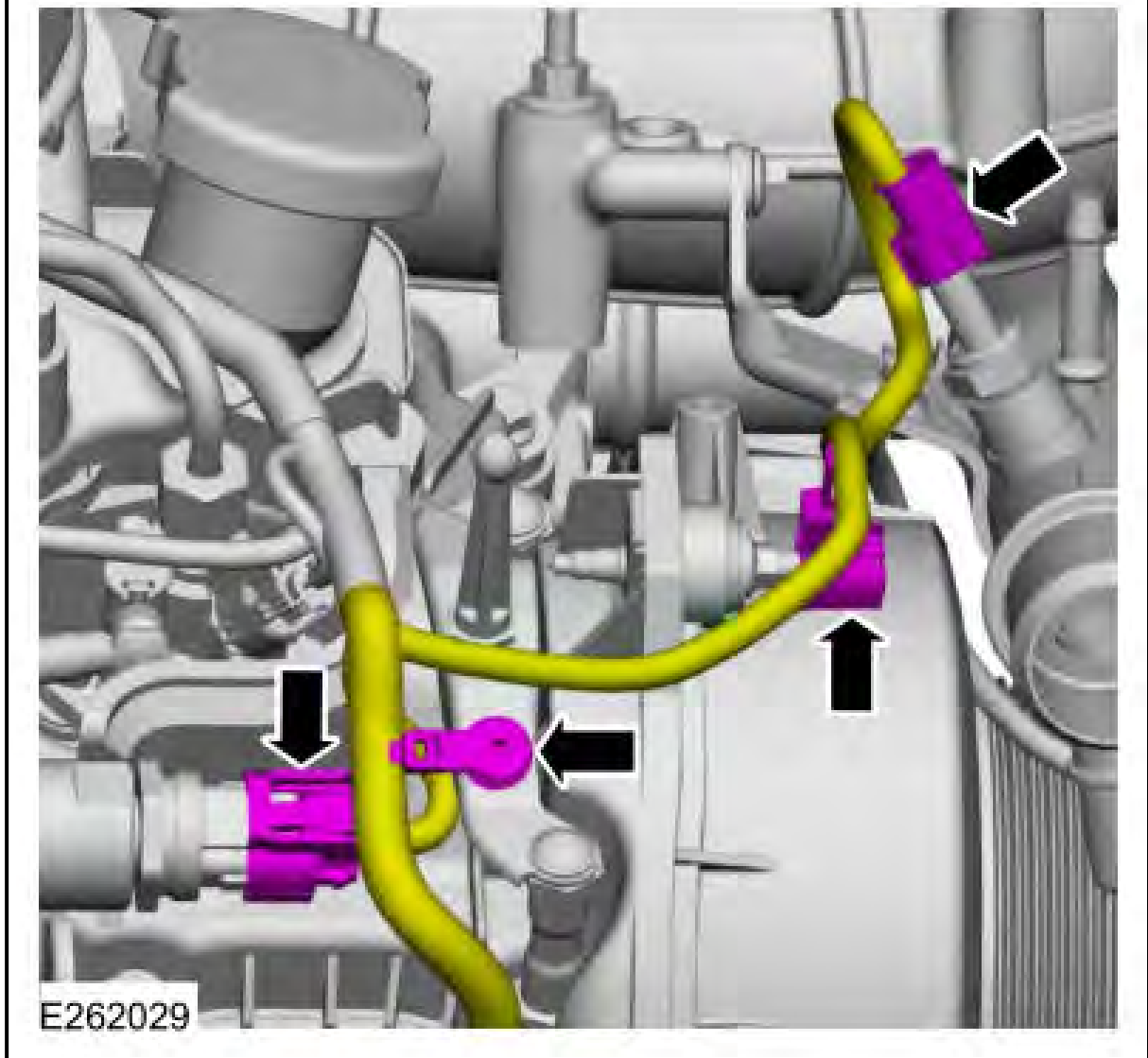


26. Disconnect the turbocharger actuator electrical connector. Disconnect the EGRT electrical connector and the wire retainers.

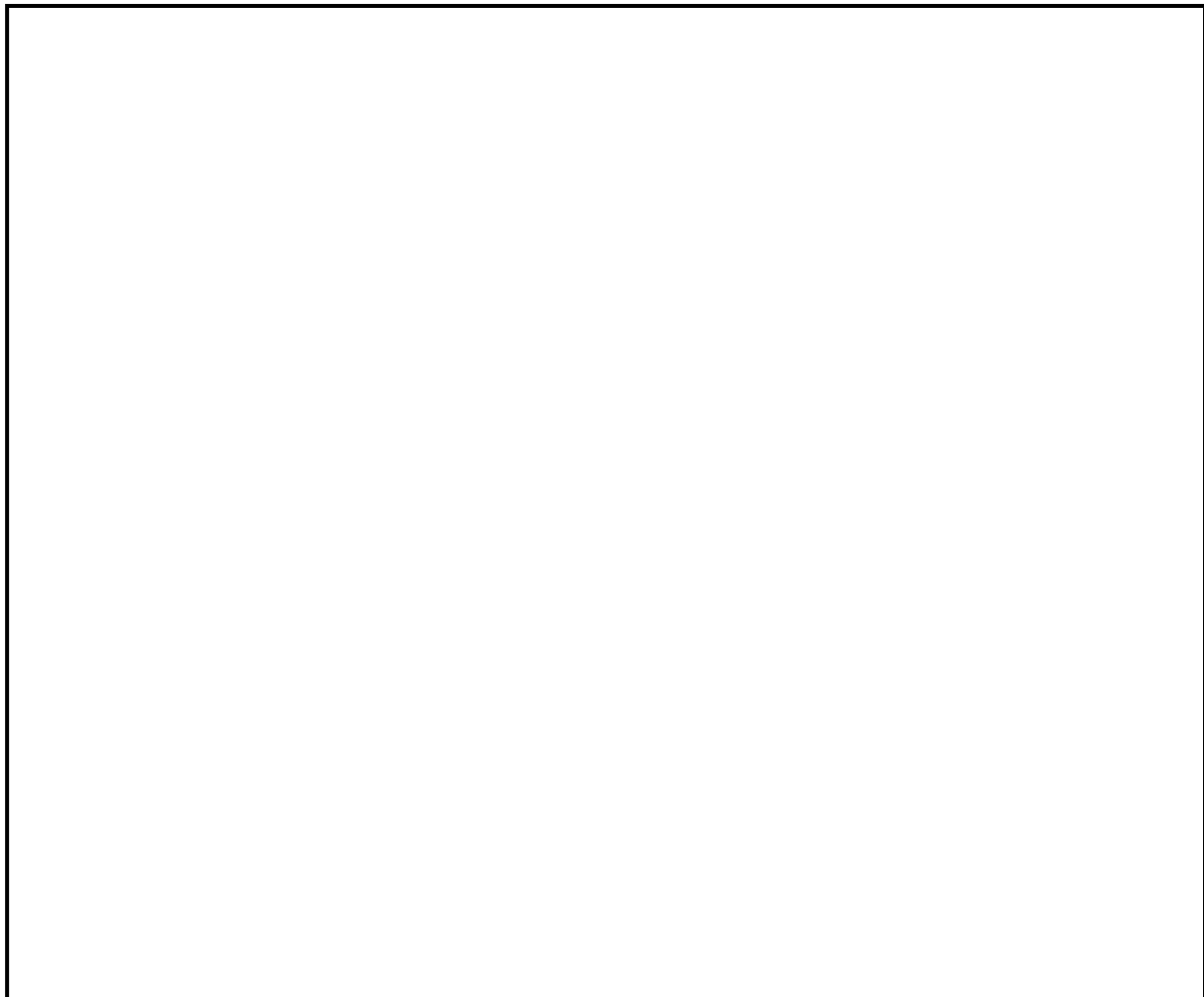


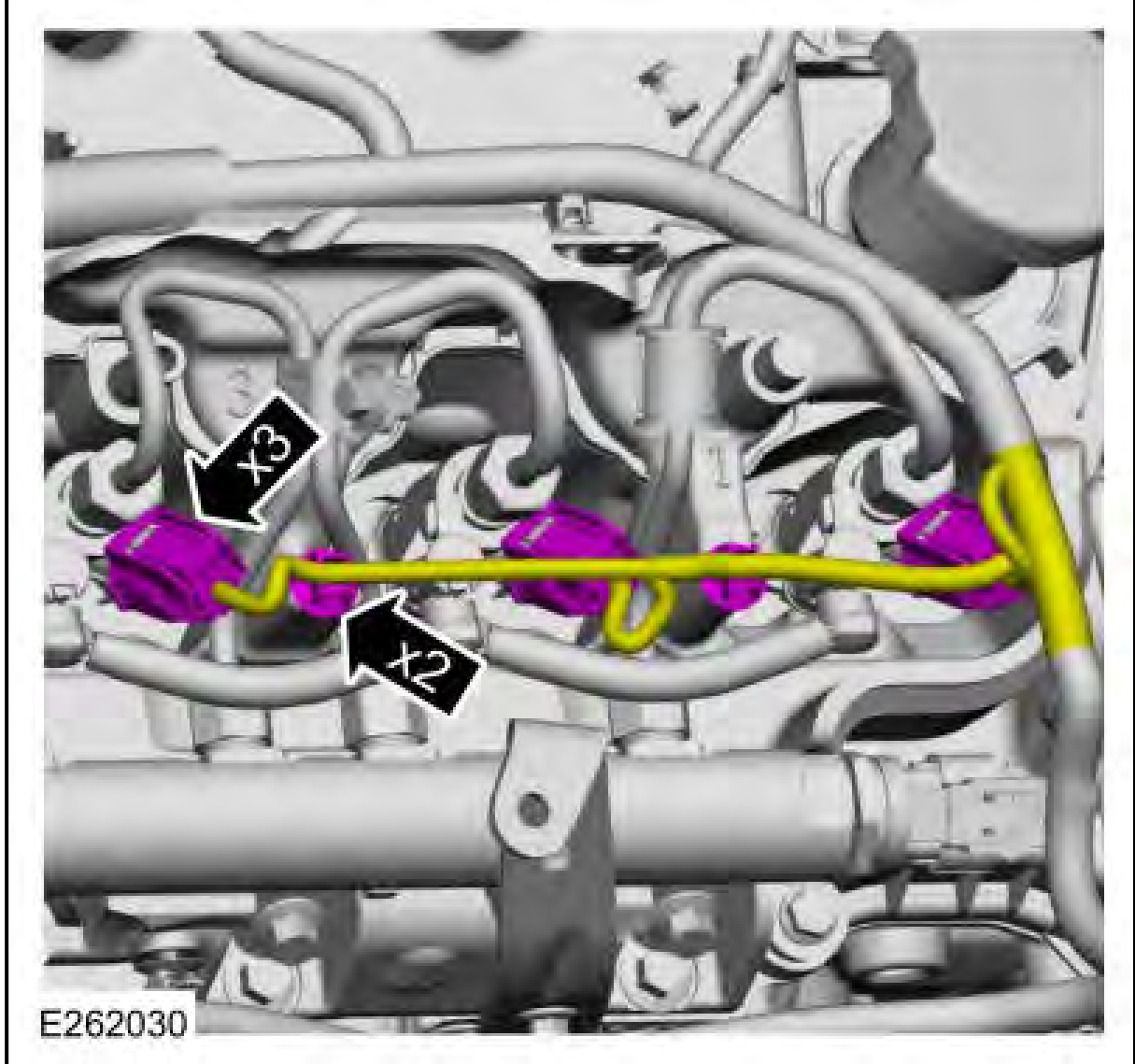
27. Disconnect the electrical connectors and the wire retainers.



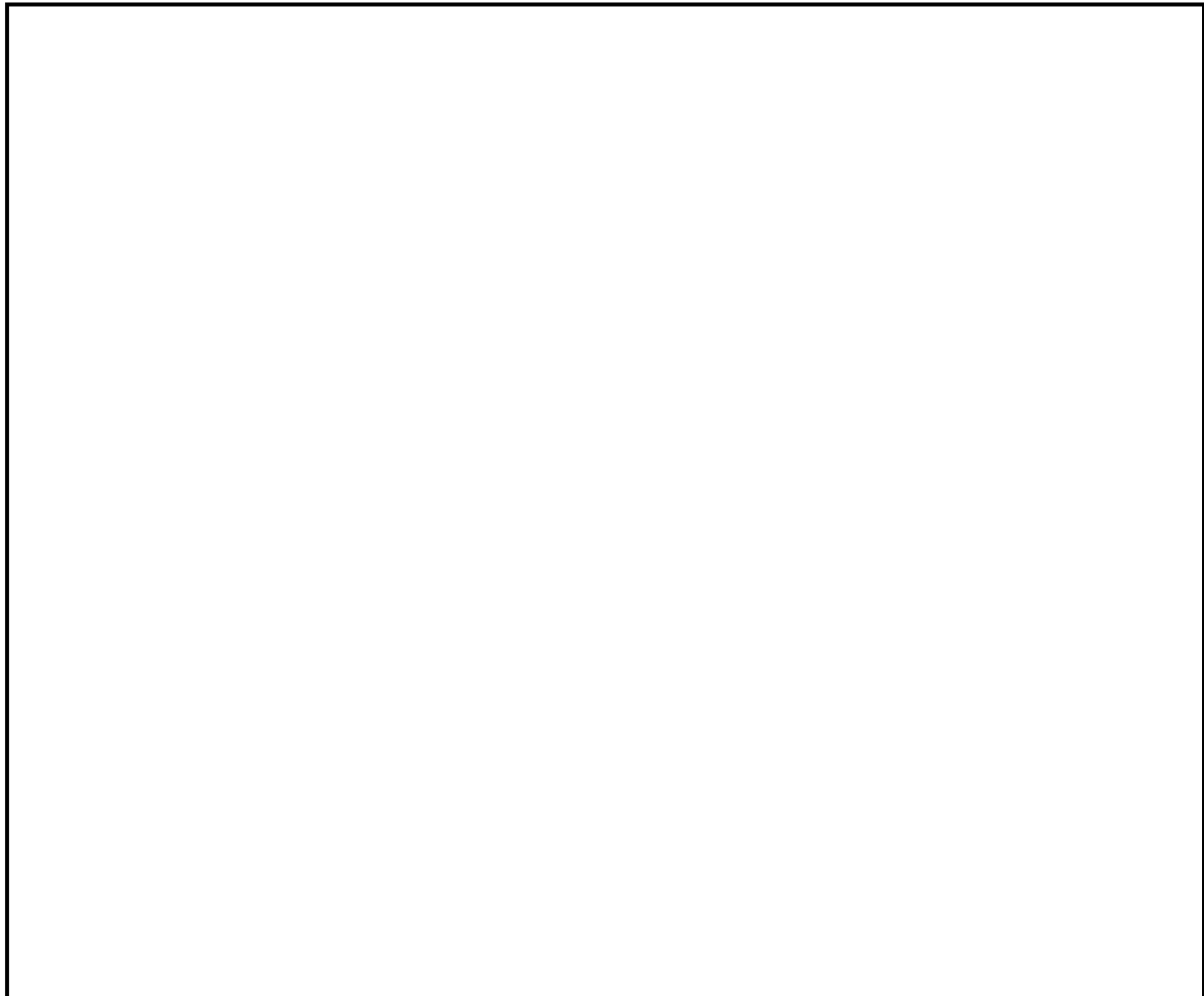


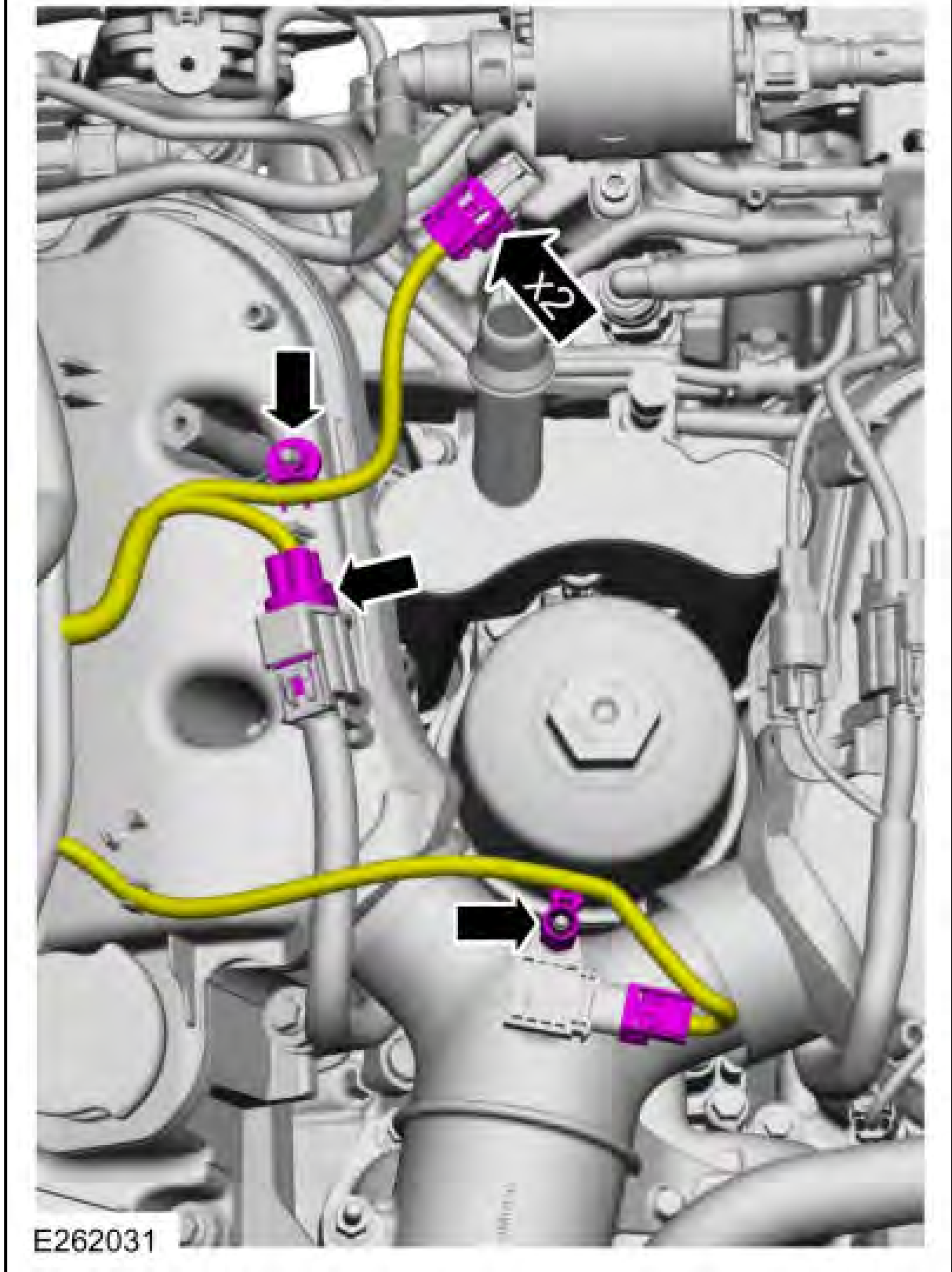
28. Disconnect the fuel injectors electrical connectors and the wire retainers.





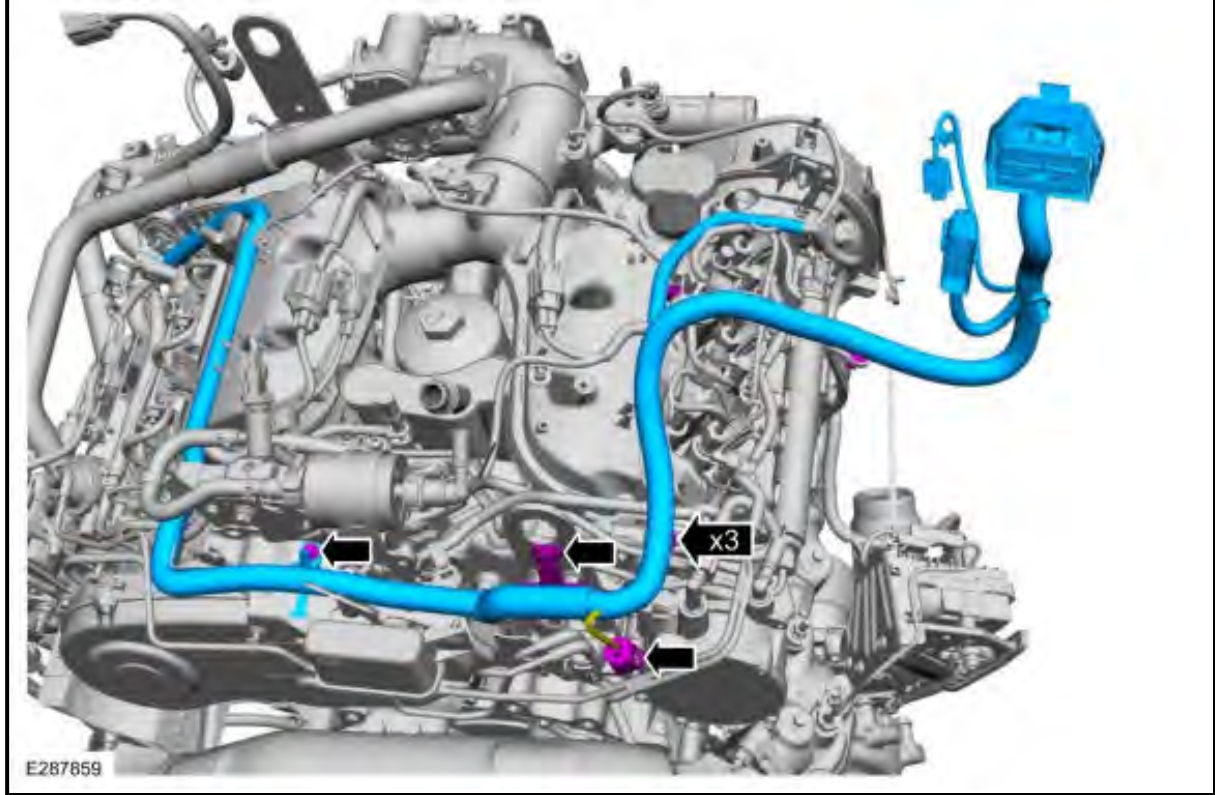
29. Disconnect the electrical connectors and the wire retainers.



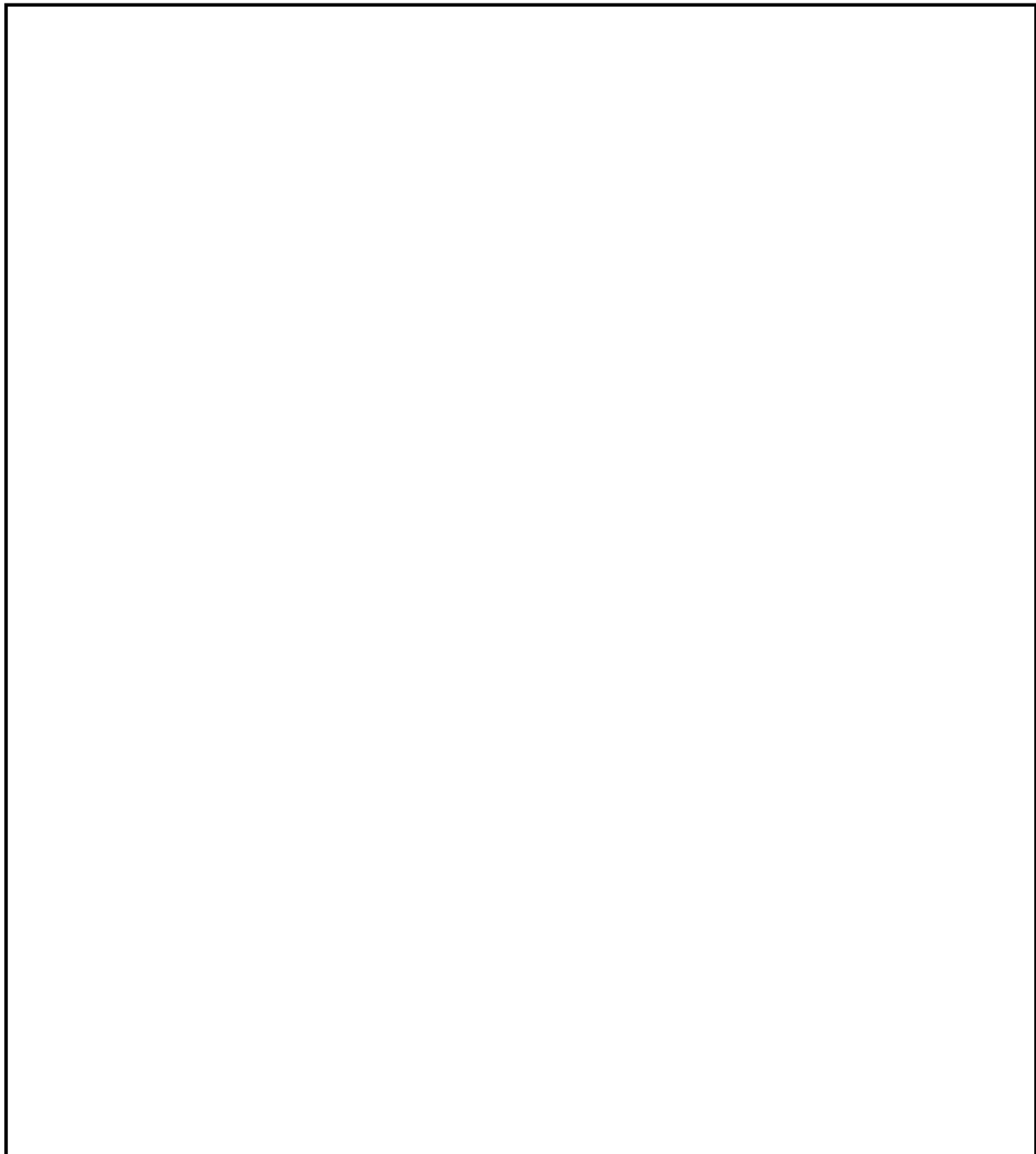


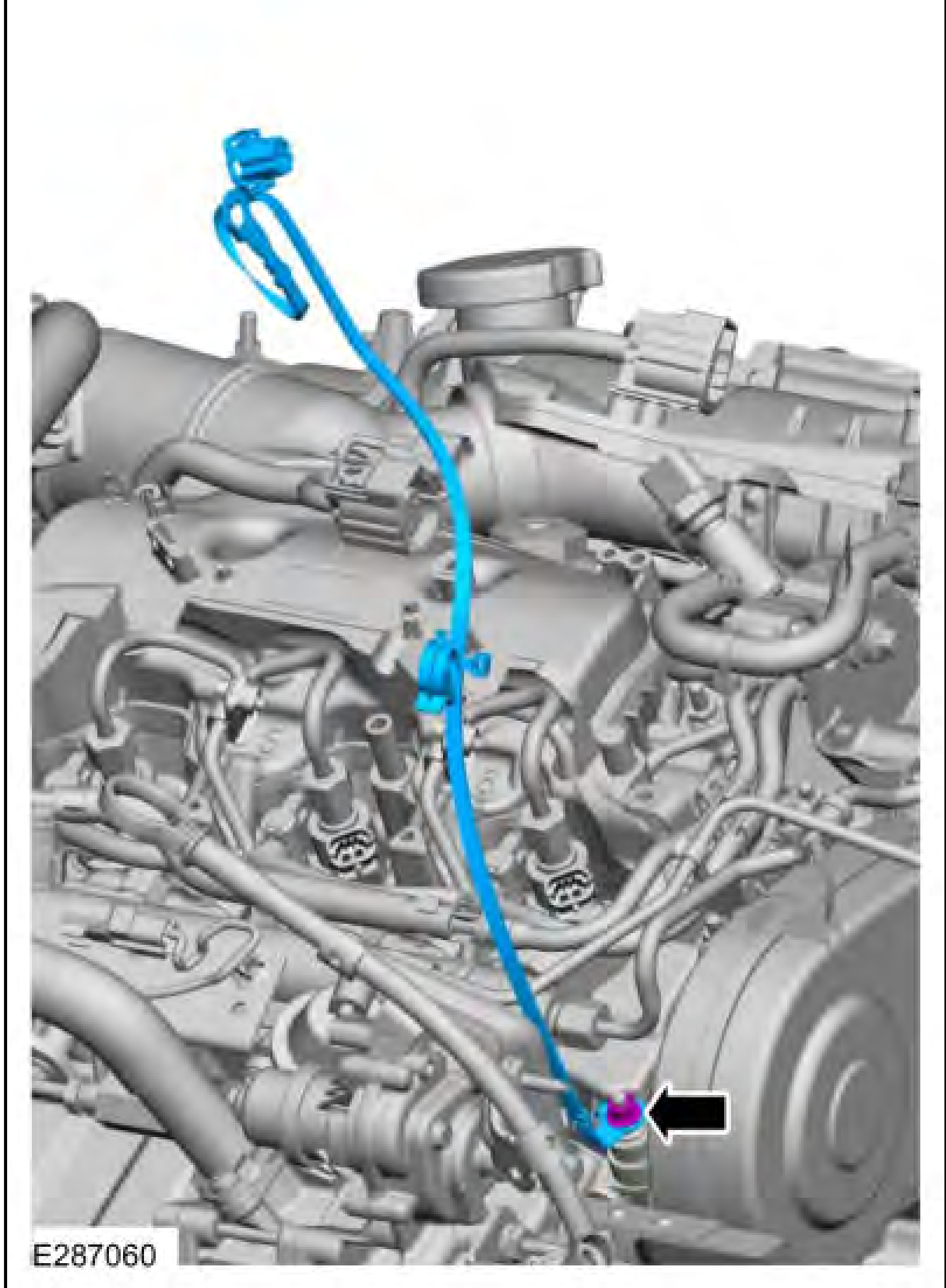
30. Disconnect the electrical connector and remove the bolt. Disconnect the wire harness retainers and remove the engine wire harness.





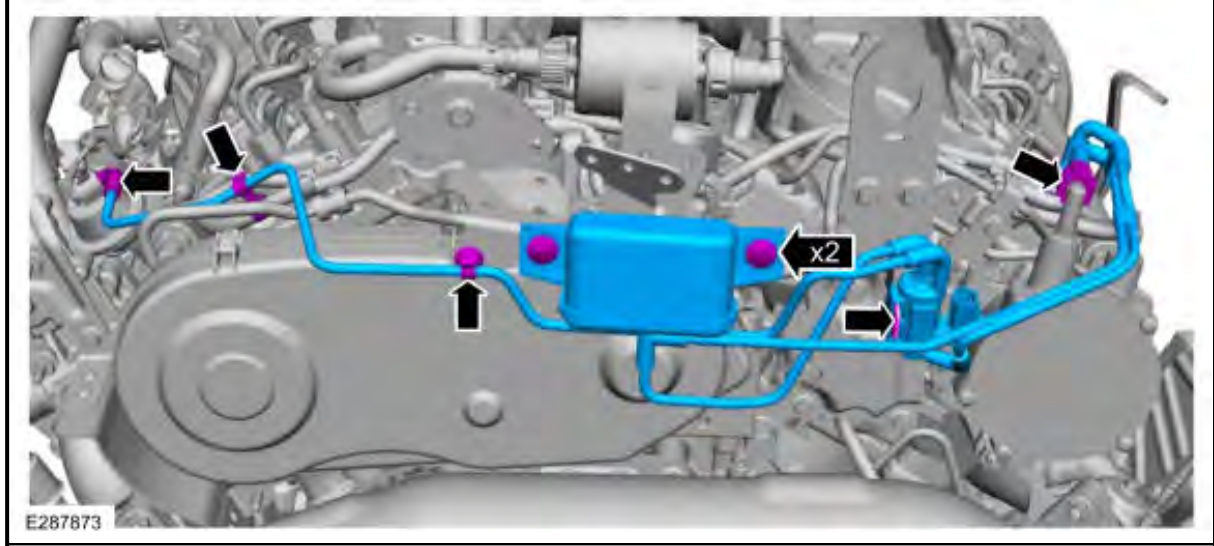
31. Remove the nut and the ground strap.





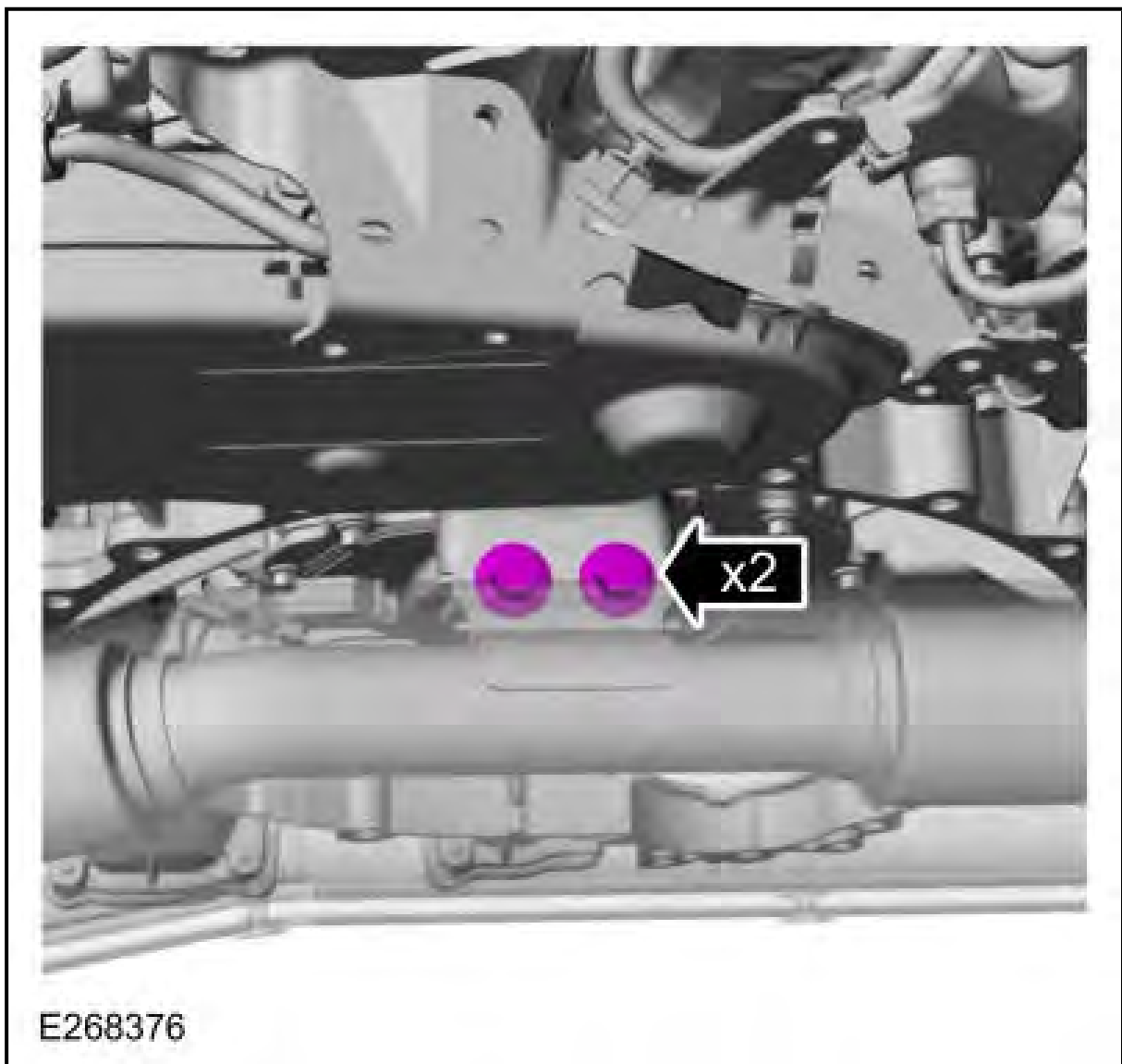
32. Disconnect the vacuum pump connector. Remove the retainers and remove the vacuum hose assembly. REFER to: [Quick Release Coupling](#) .





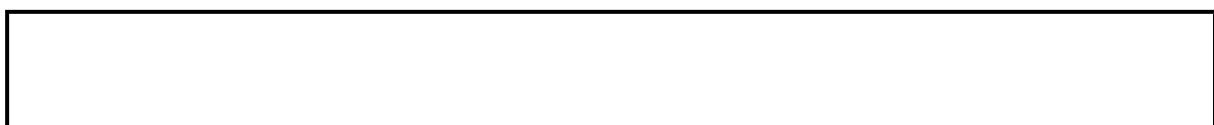
33. **NOTE:** If any snaps become undone on the exhaust crossover pipe wrap. Replace the exhaust crossover pipe wrap.

Remove the bolts for the exhaust crossover pipe.

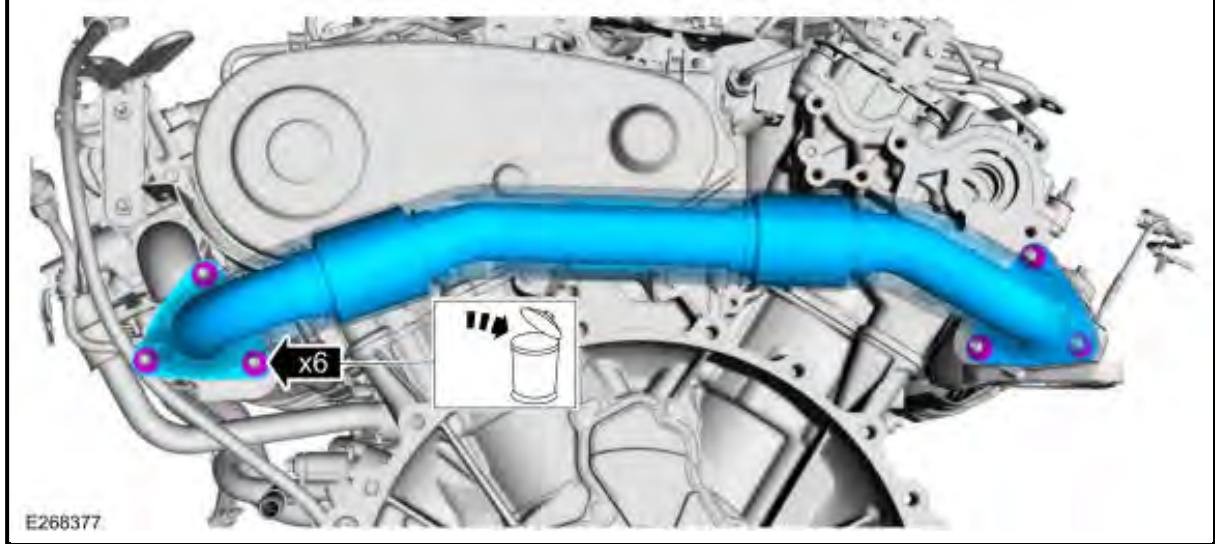


34. **NOTE:** If any snaps become undone on the exhaust crossover pipe wrap. Replace the exhaust crossover pipe wrap.

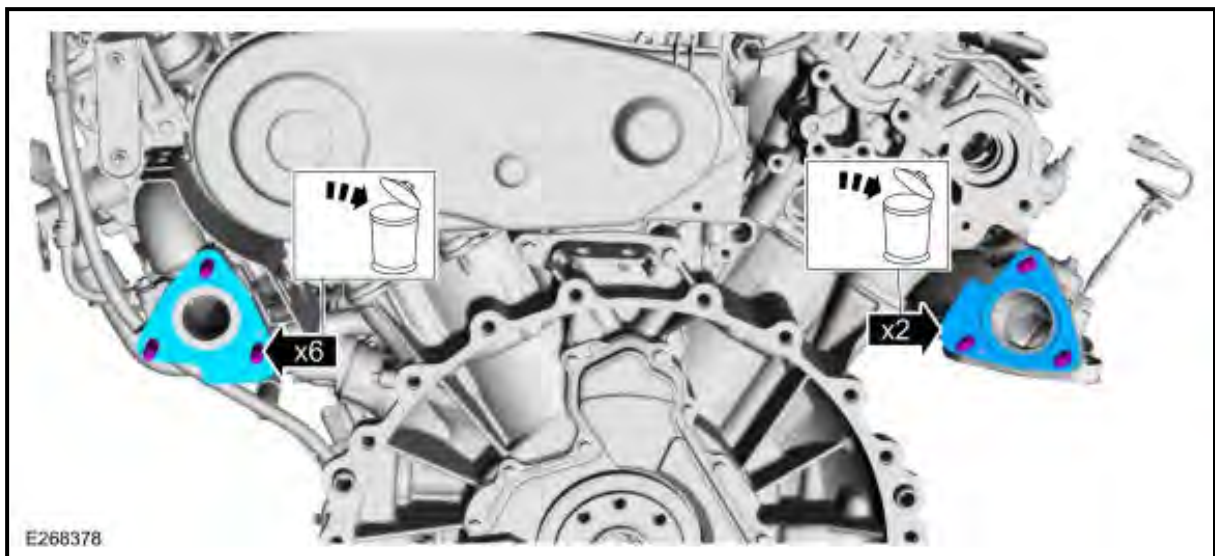
Remove the nuts and the exhaust crossover pipe. Discard the nuts.





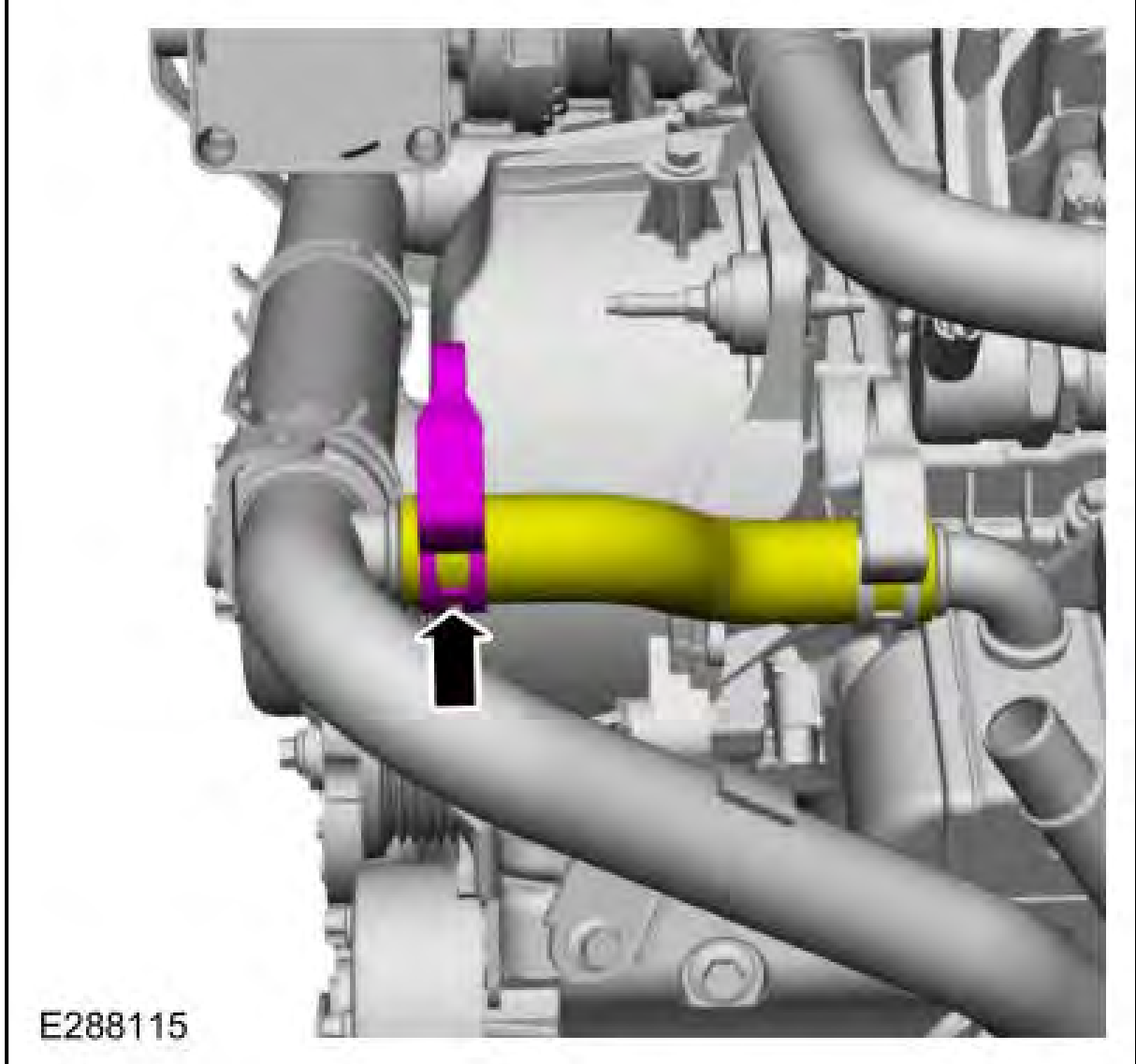


35. Remove and discard the exhaust crossover pipe gaskets and the studs.

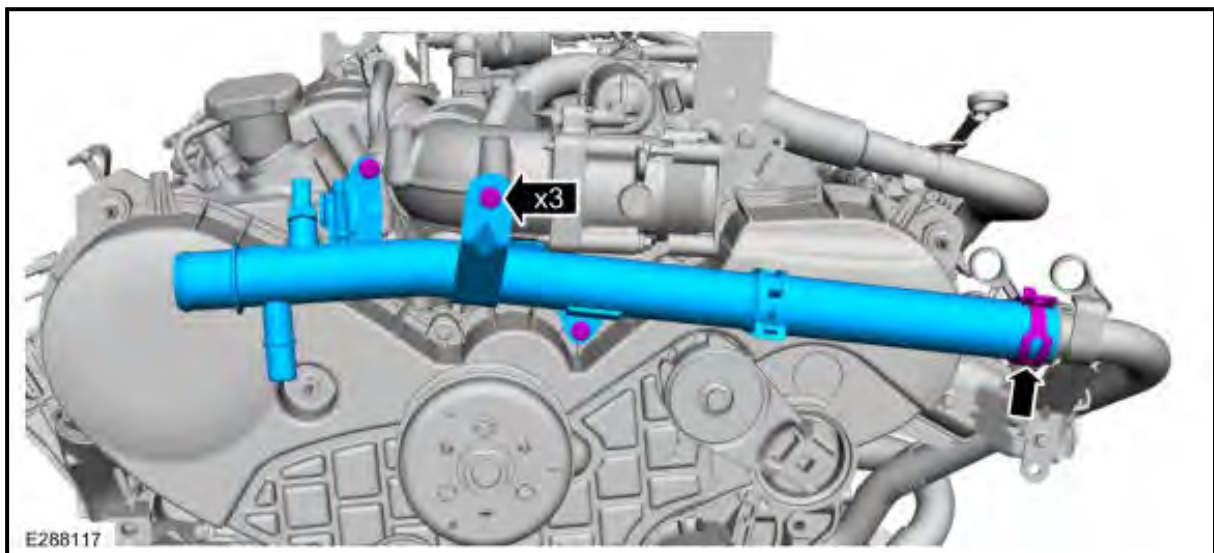


36. Release the clamp and disconnect the EGR cooler coolant hose. Use the General Equipment: Hose Clamp Remover/Installer



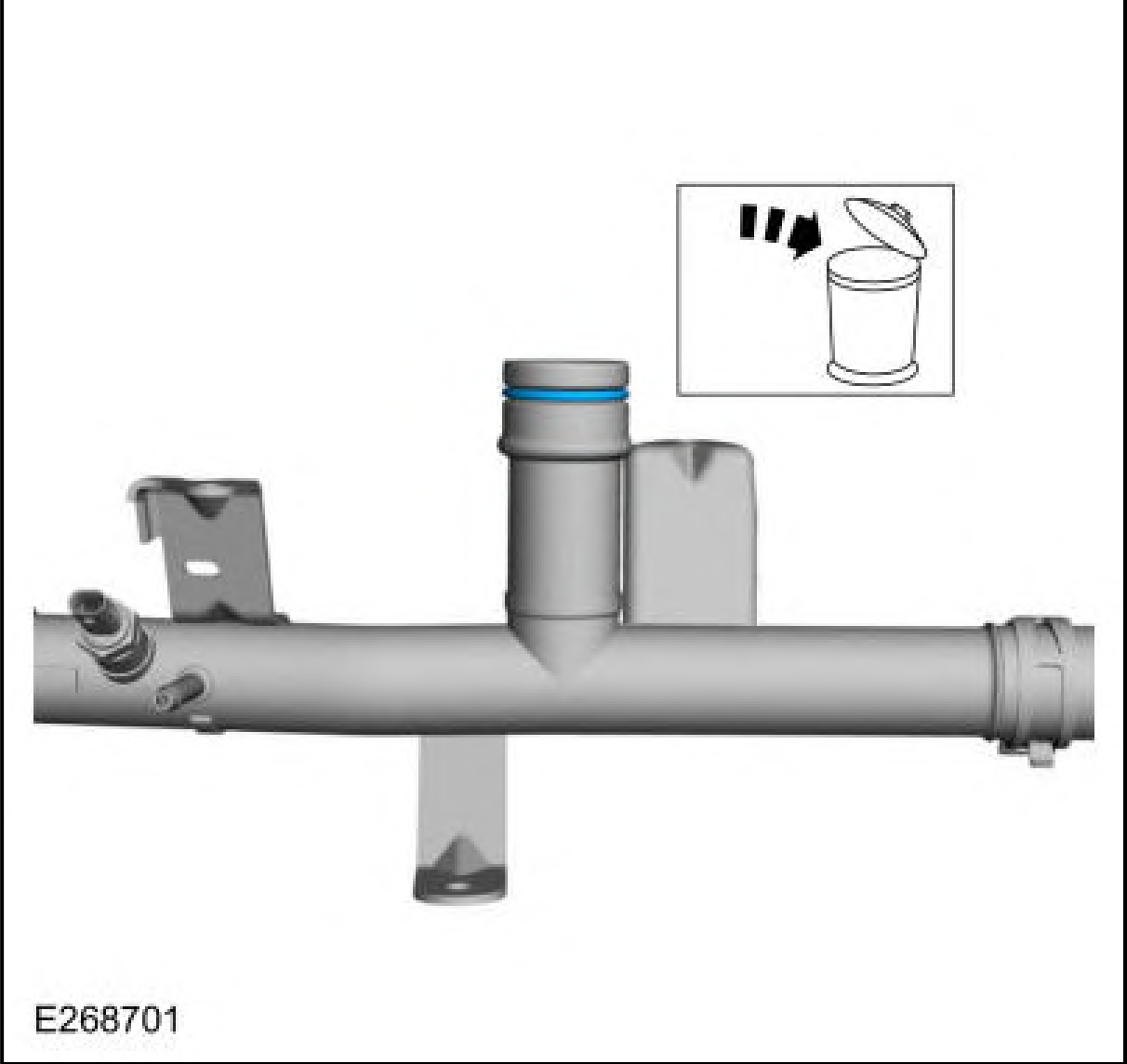


37. Remove the bolts and the coolant tube assembly. Use the General Equipment: Hose Clamp Remover/Installer



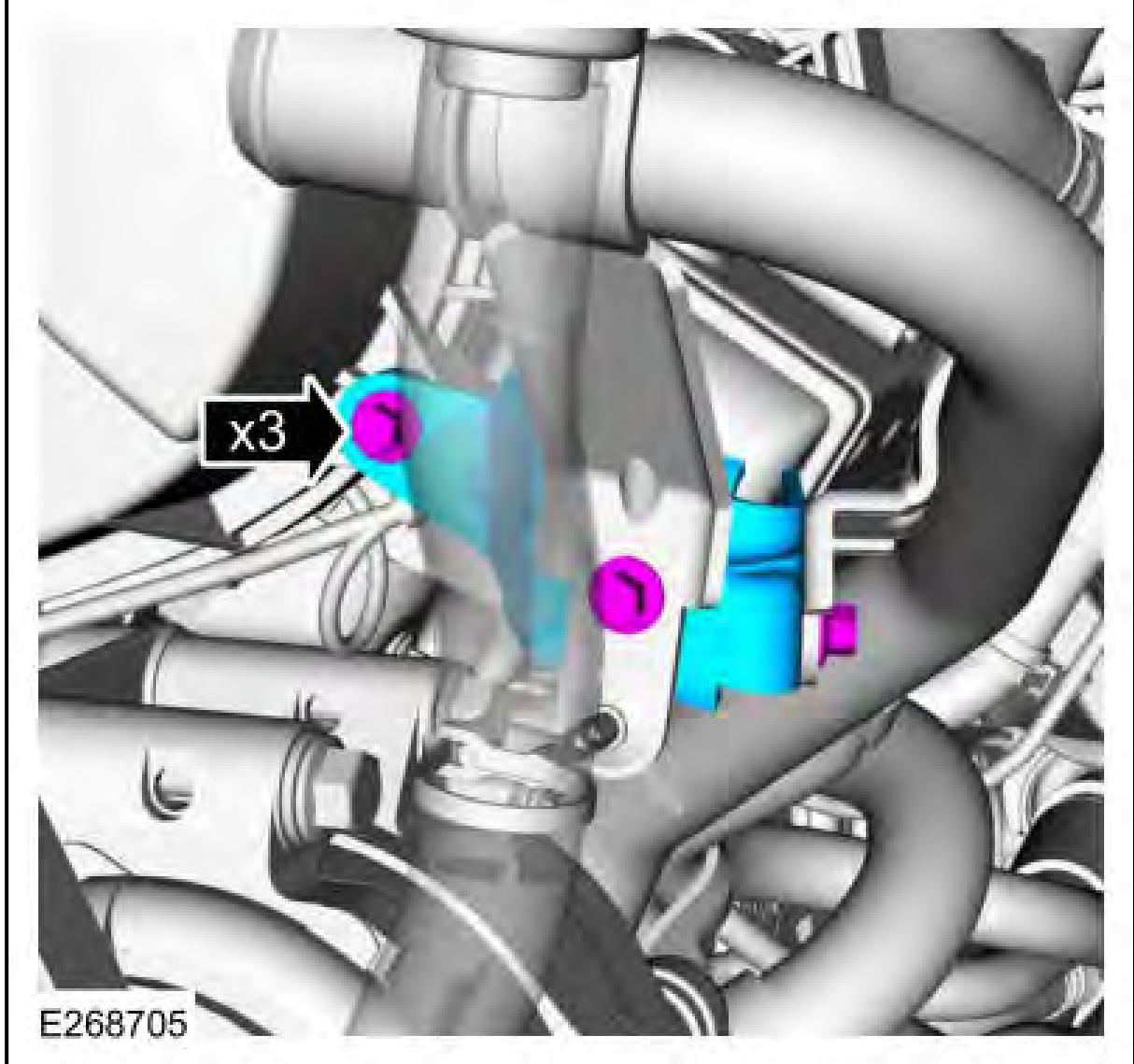
38. Remove and discard the coolant tube assembly O-ring.



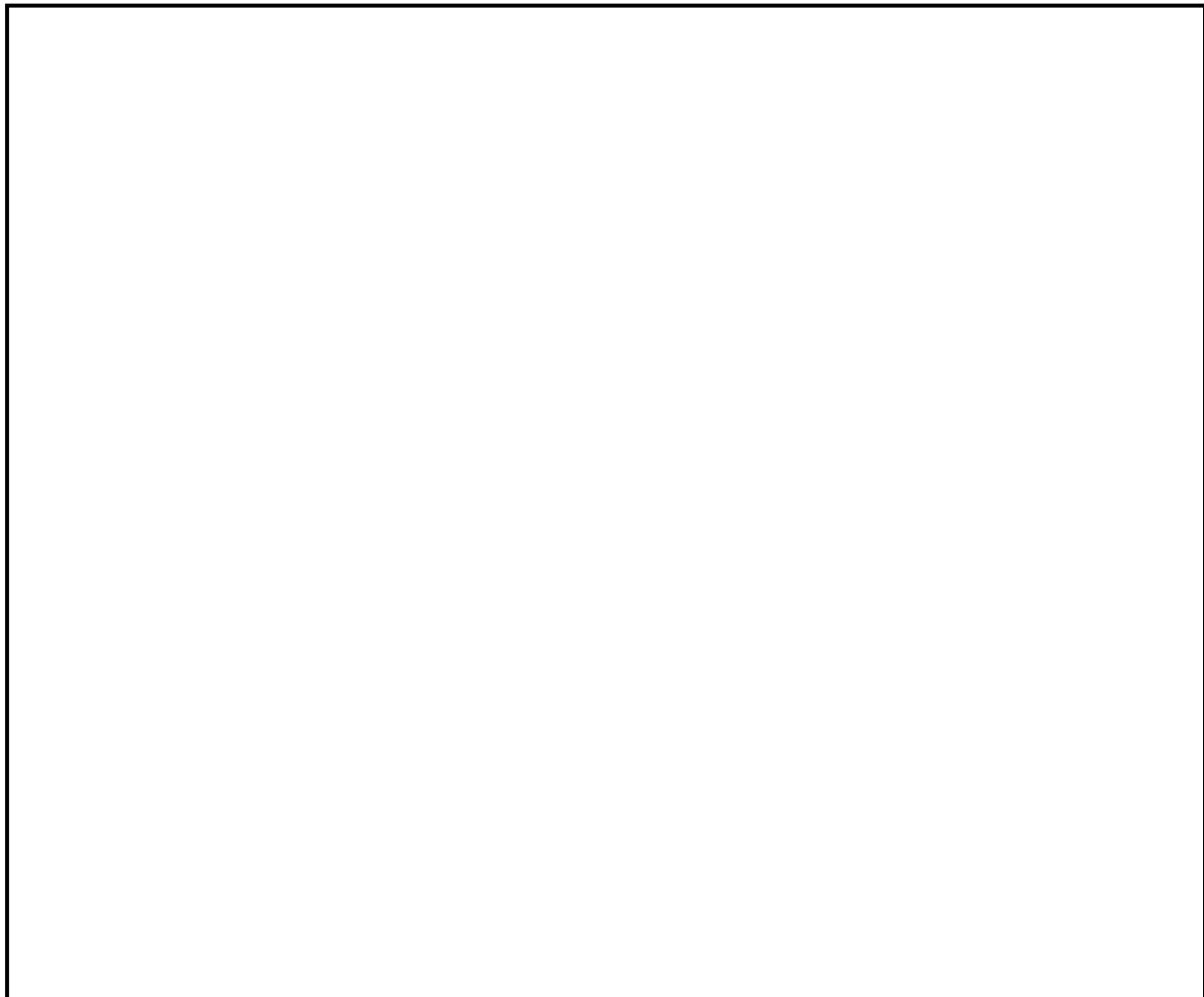


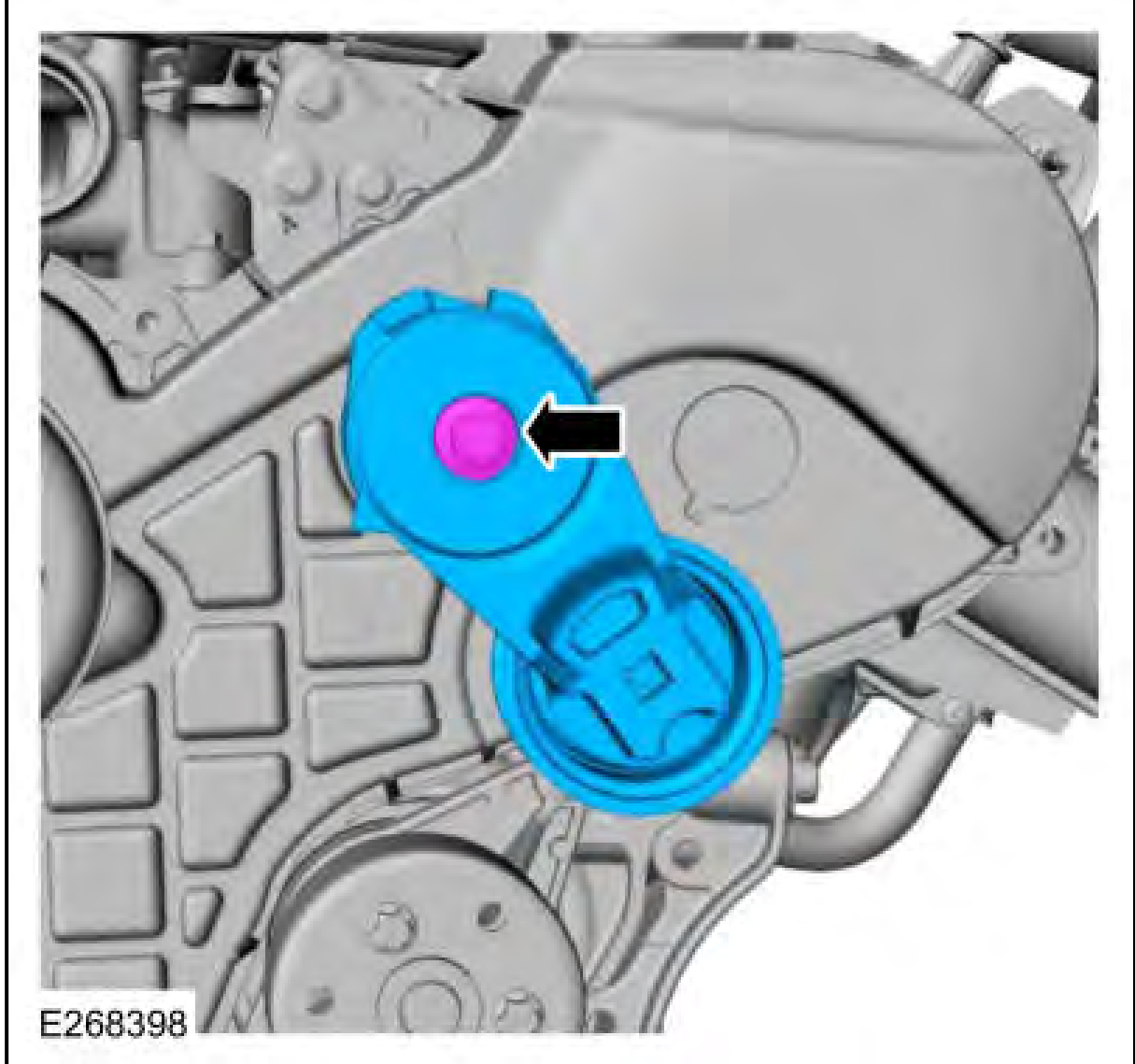
39. Remove the bolts and the coolant tube bracket.



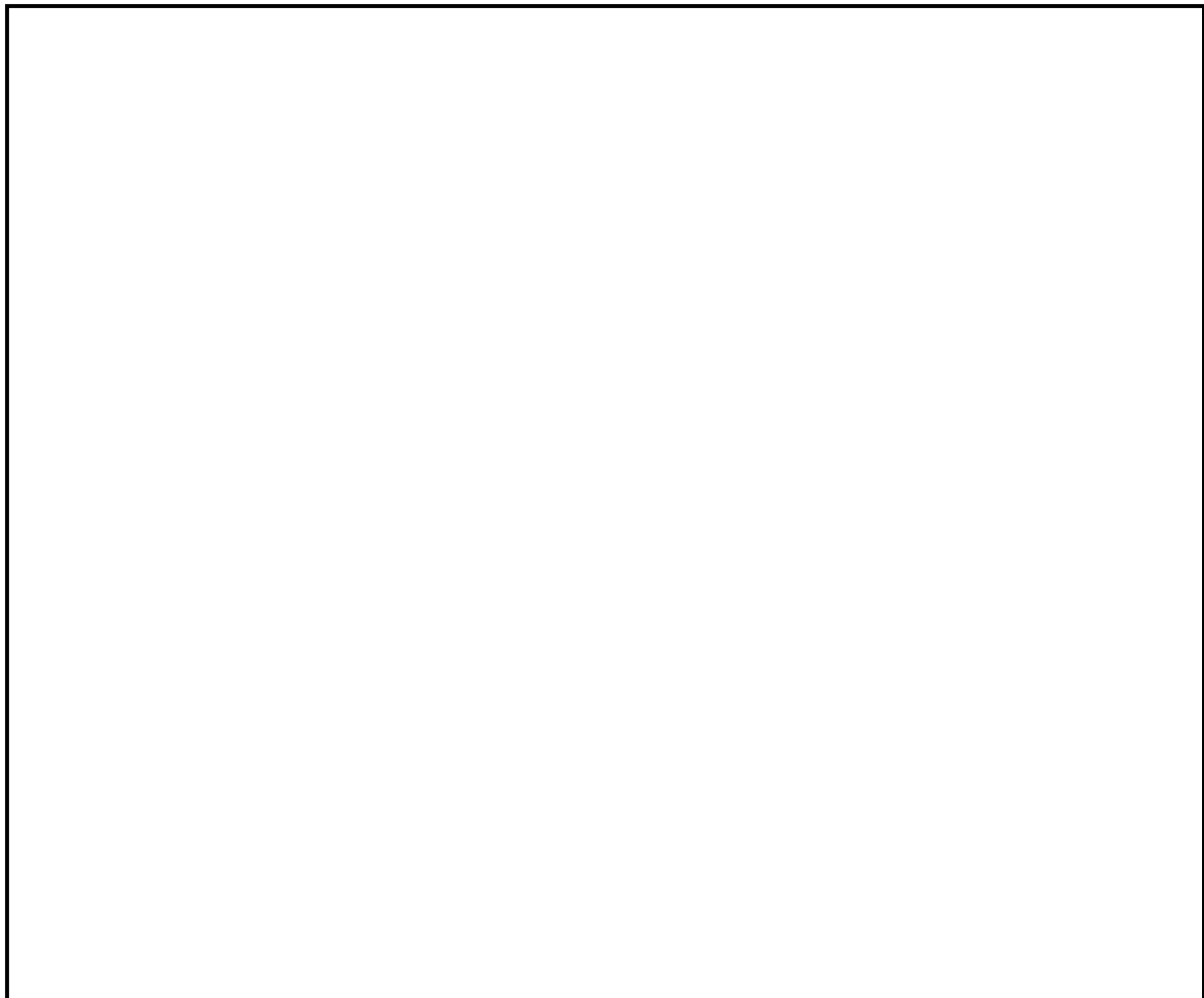


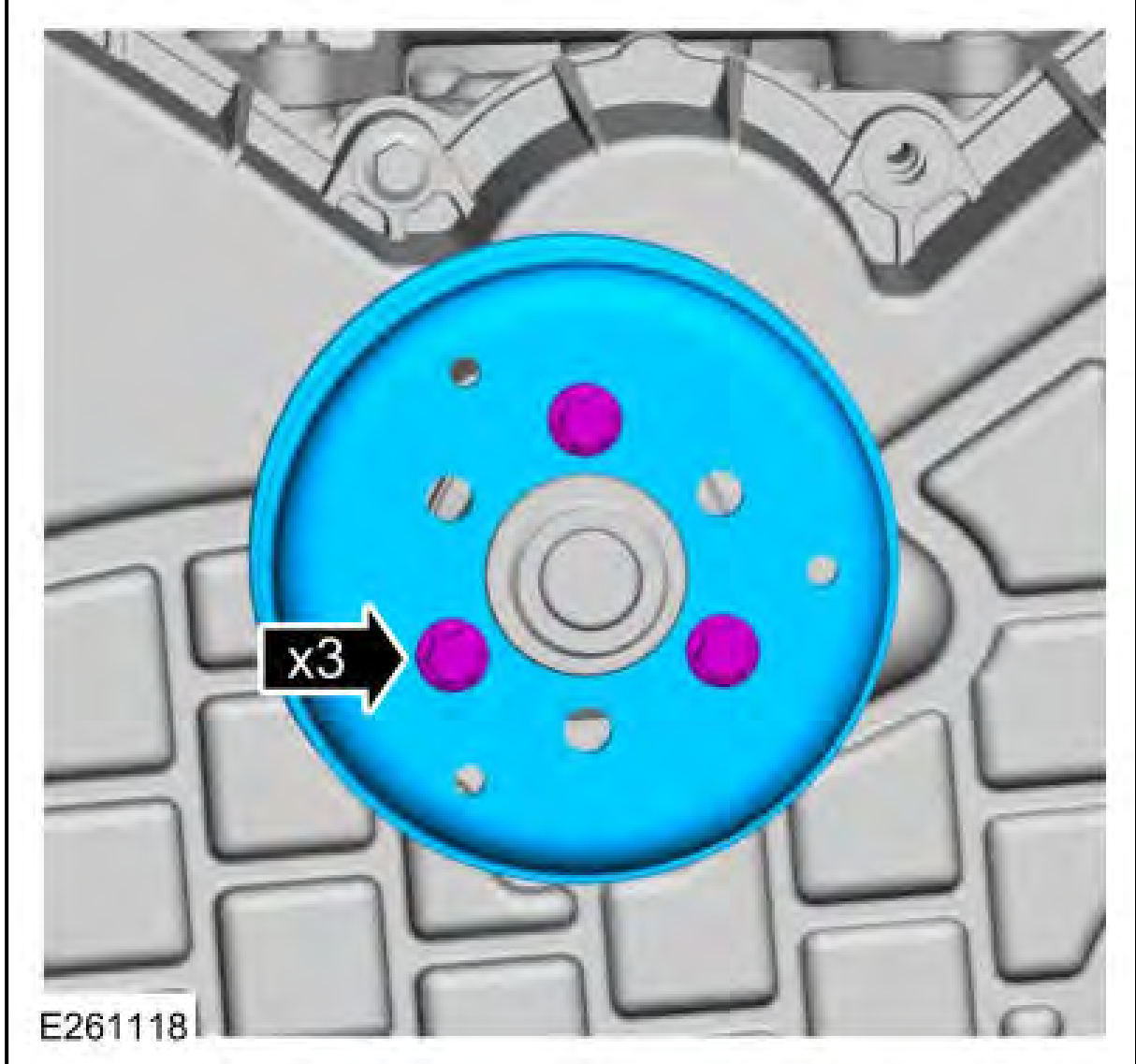
40. Remove the bolt and the accessory drive belt tensioner.



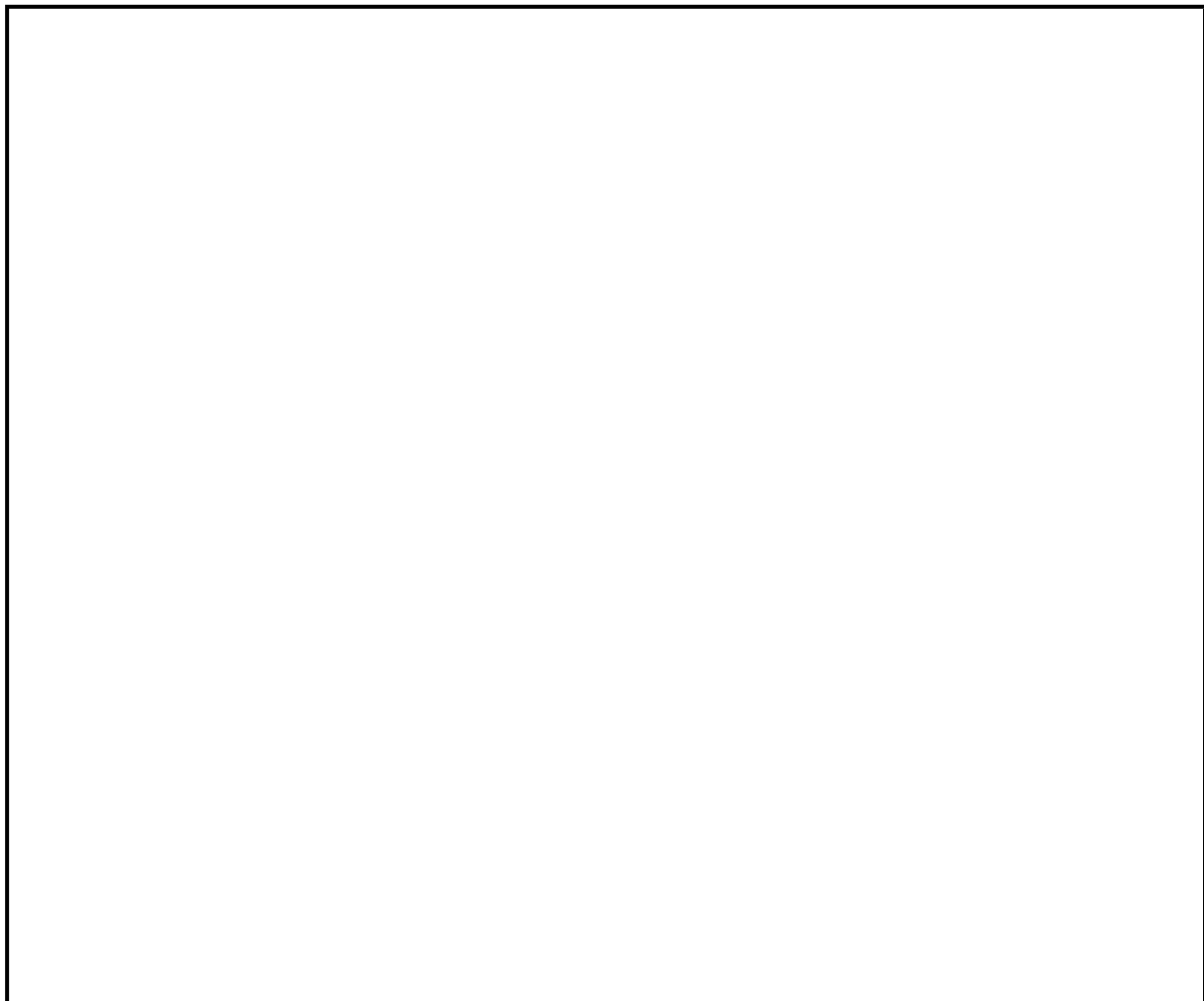


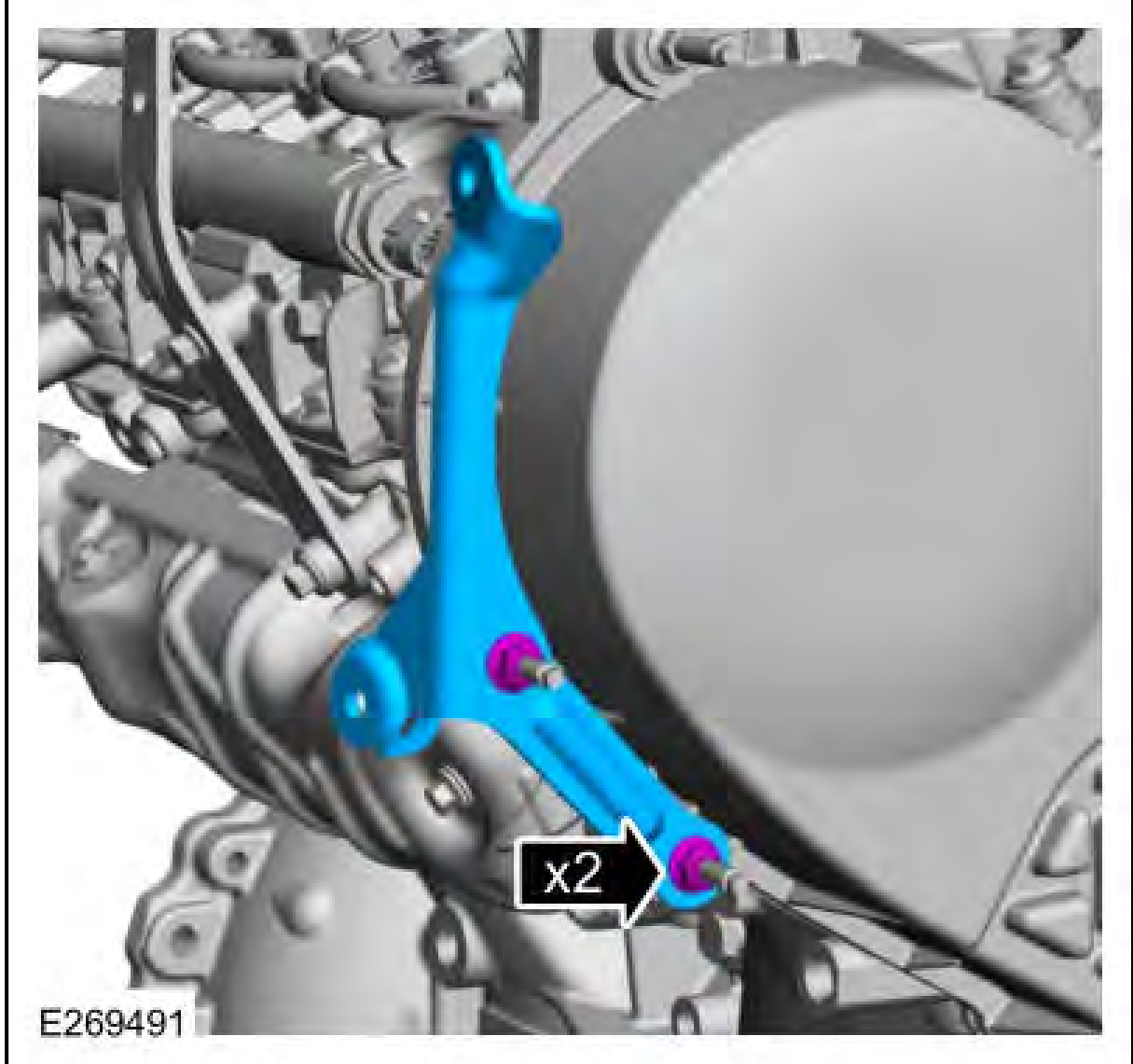
41. Remove the bolts and the fan pulley.



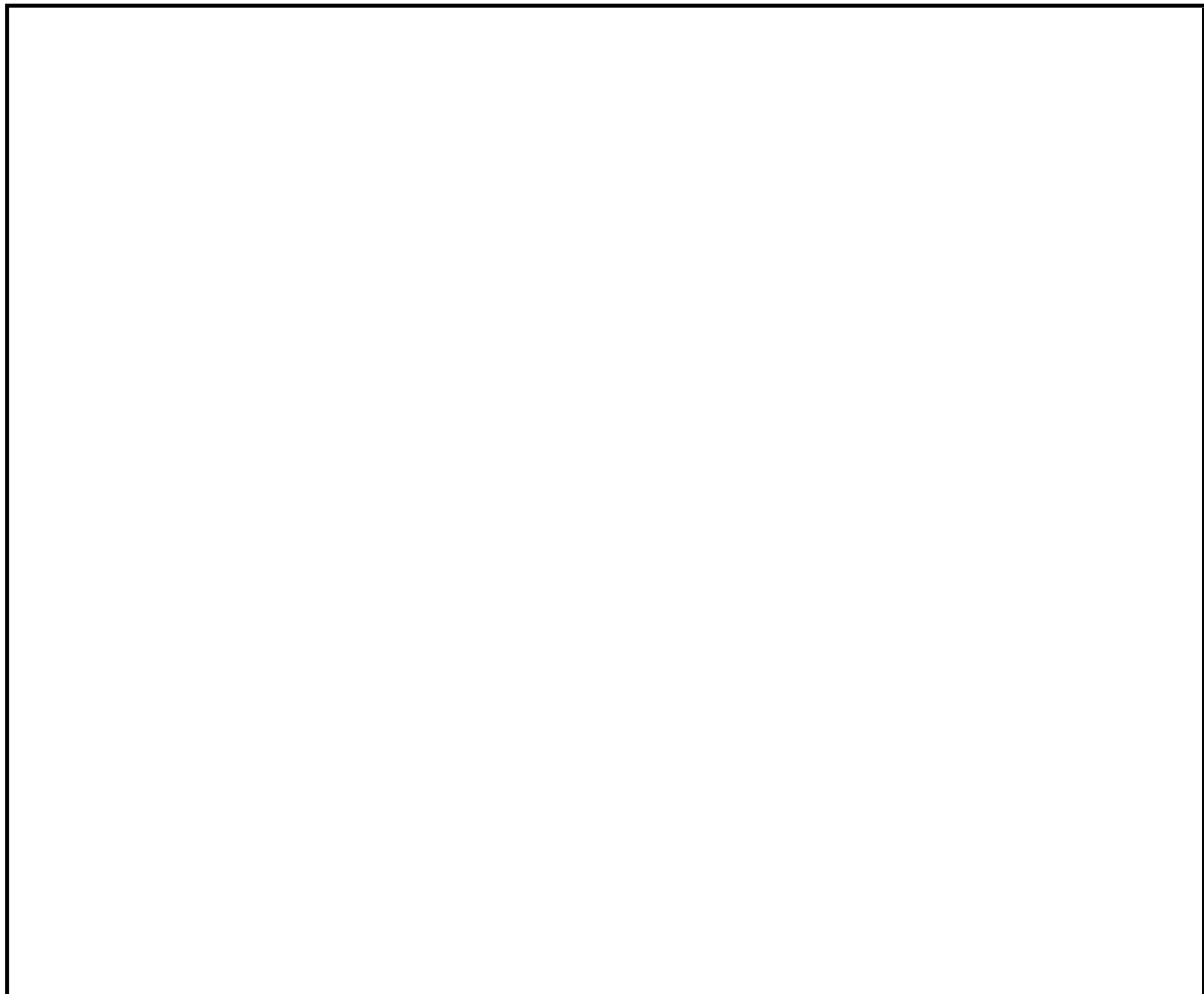


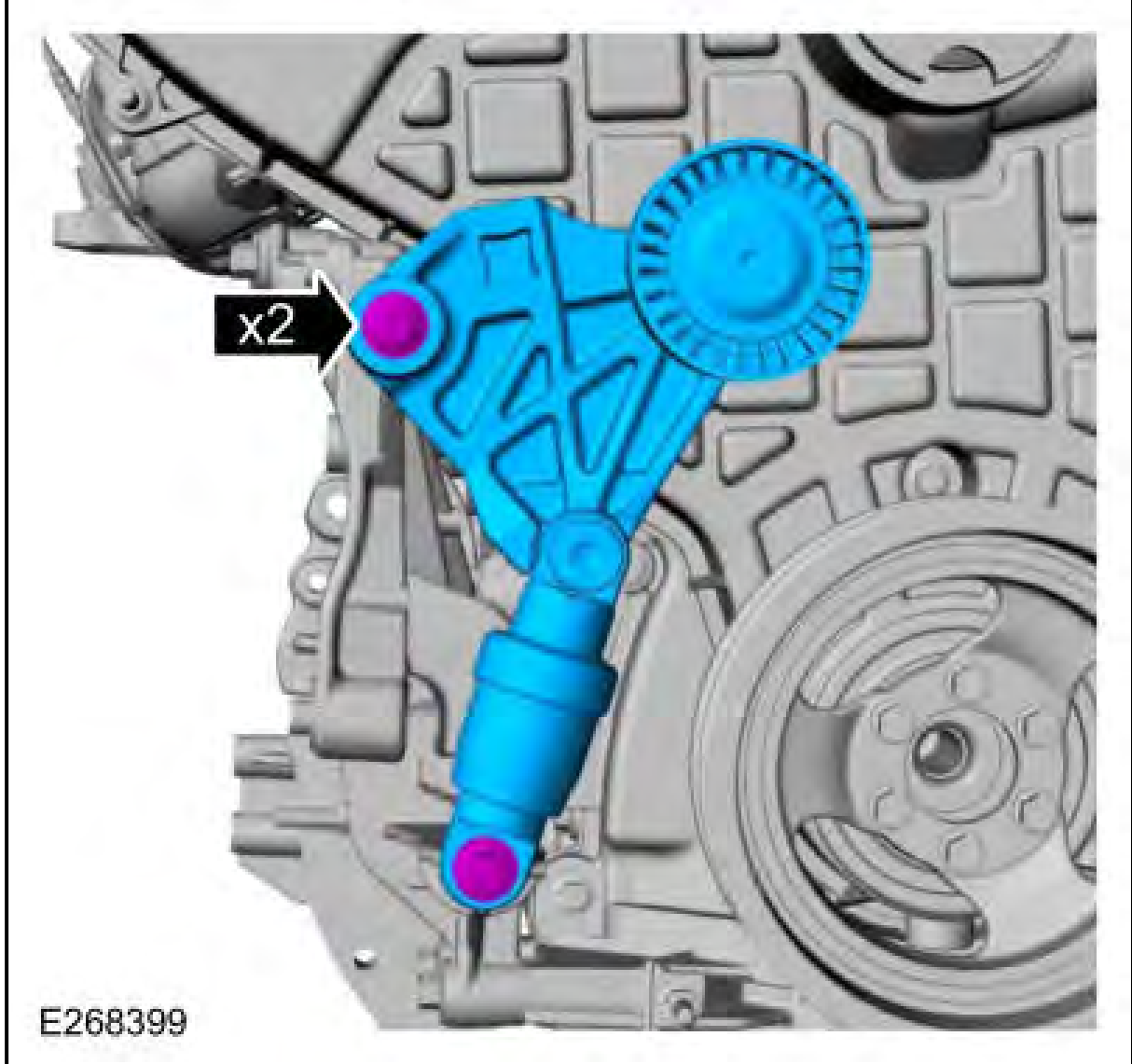
42. Remove the nuts and the CAC tube bracket.



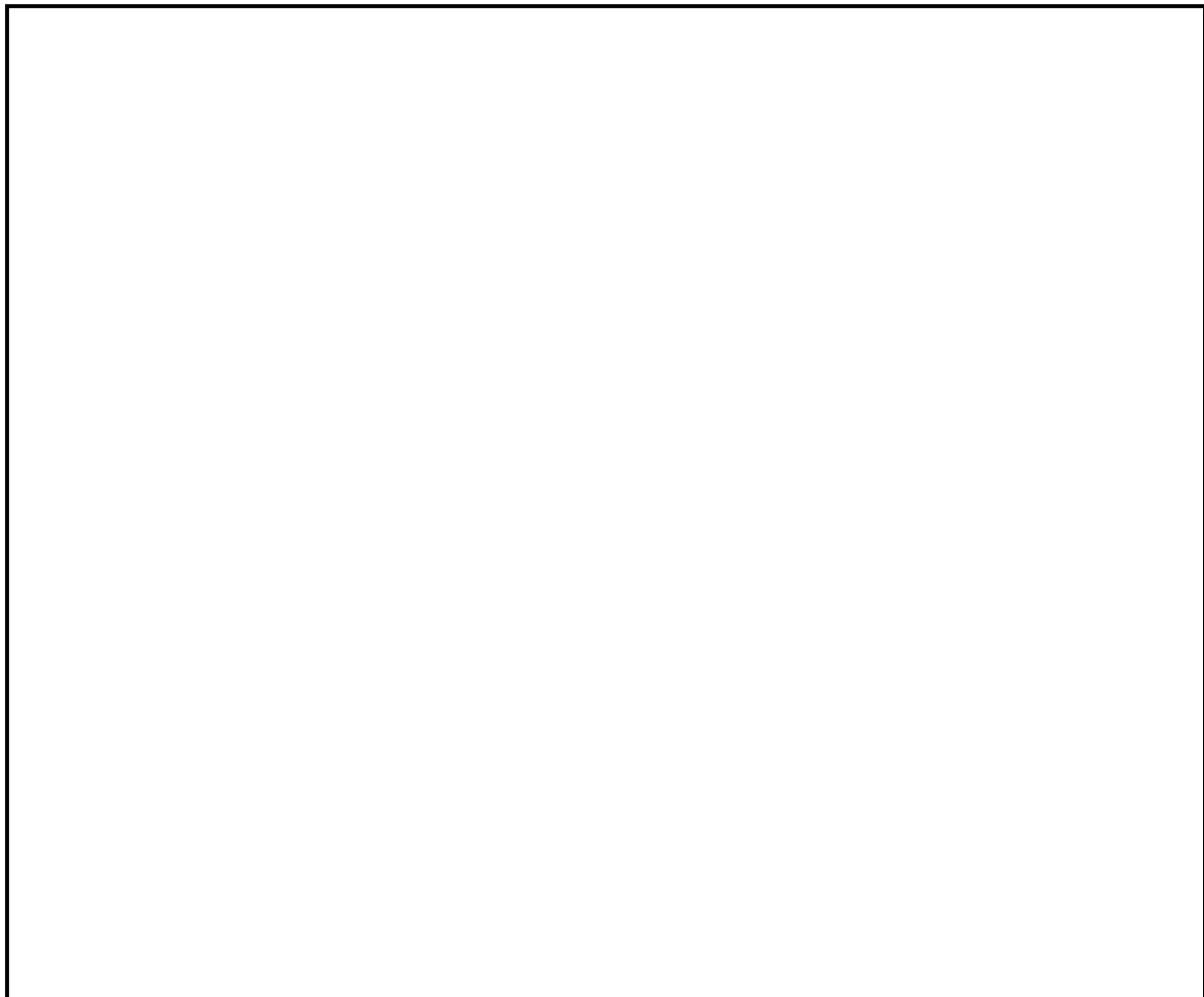


43. Remove the bolts and the accessory drive belt tensioner.

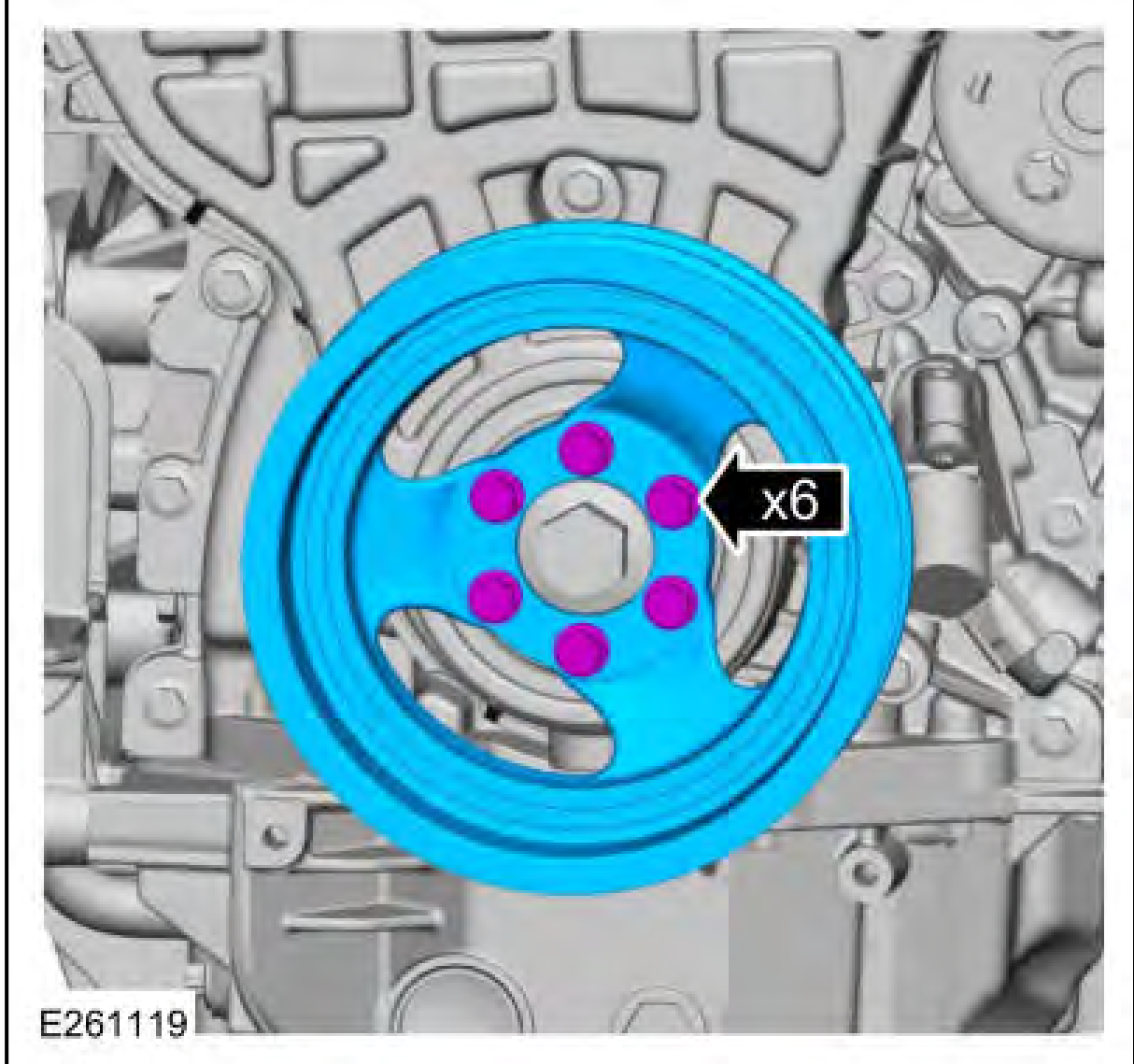




44. Remove the bolts and the crankshaft vibration damper.



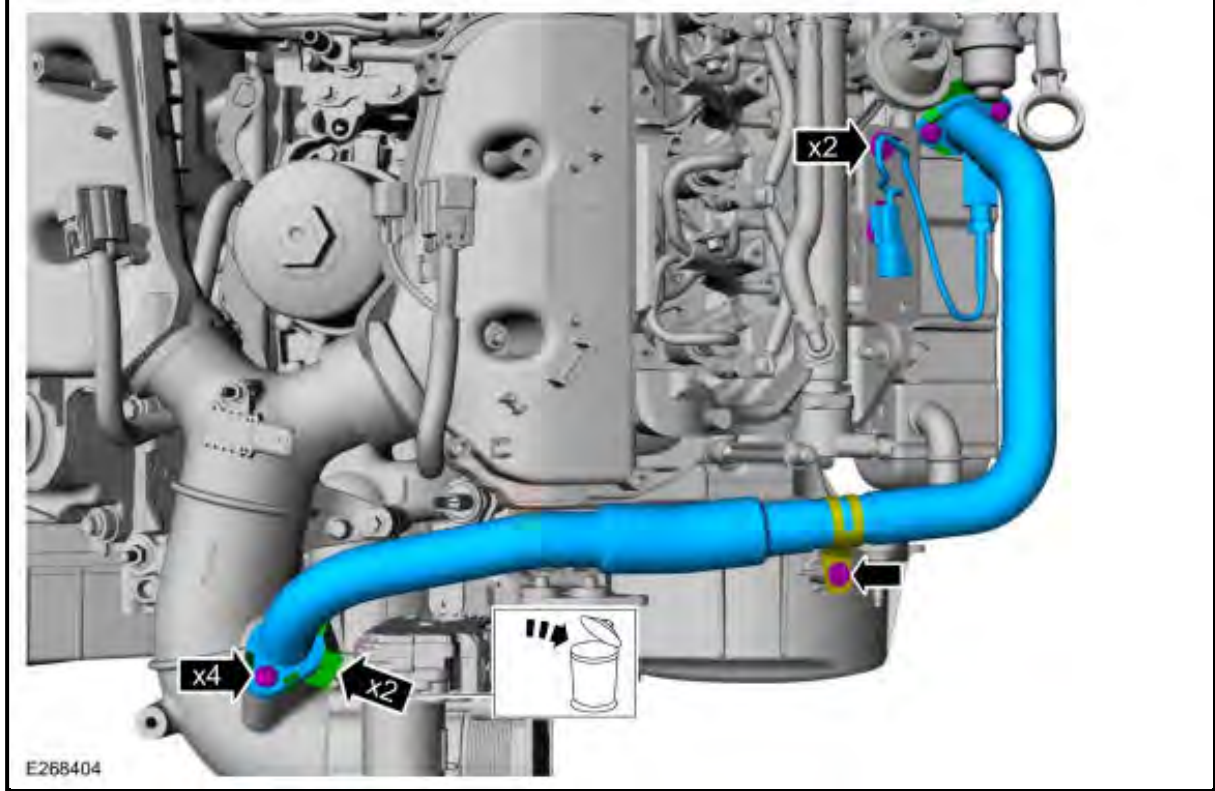




45.

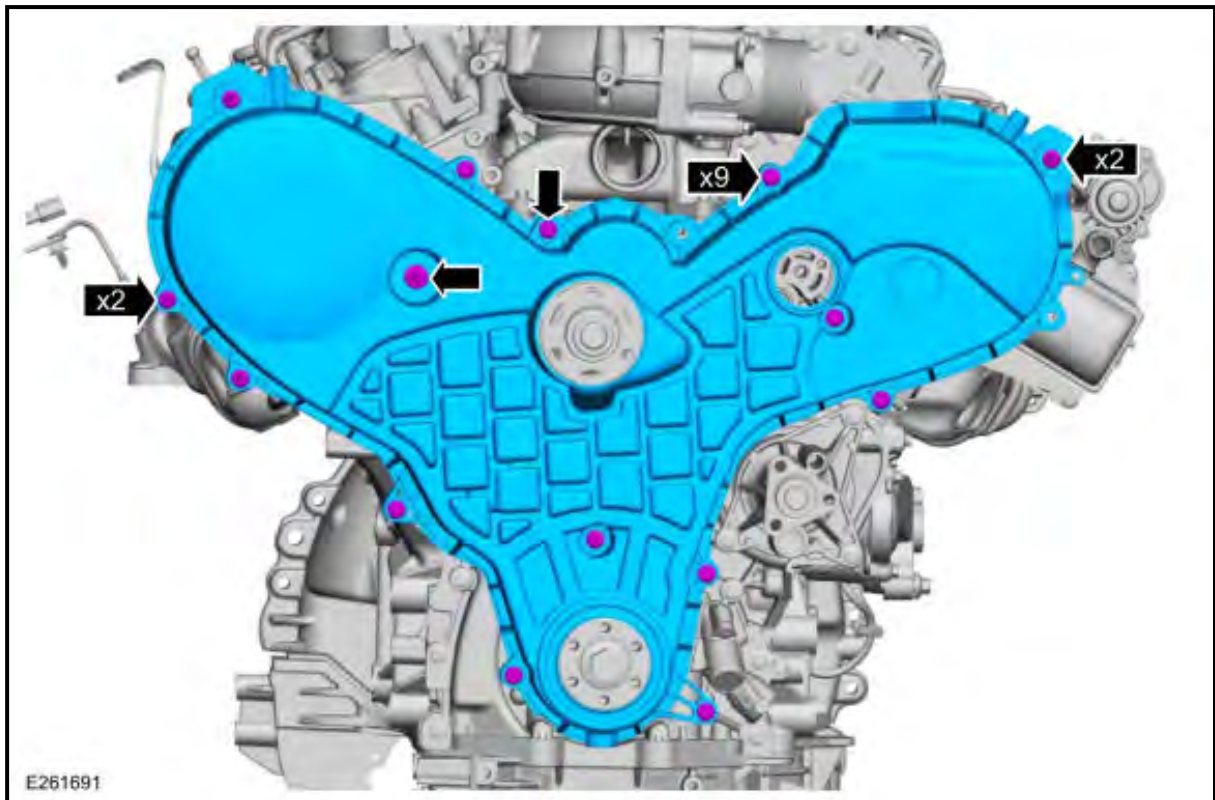
- Disconnect the wire retainers.
- Remove the retainer from the timing belt cover.
- Remove the retainers and the EGR outlet tube.
- Remove and discard the gaskets.





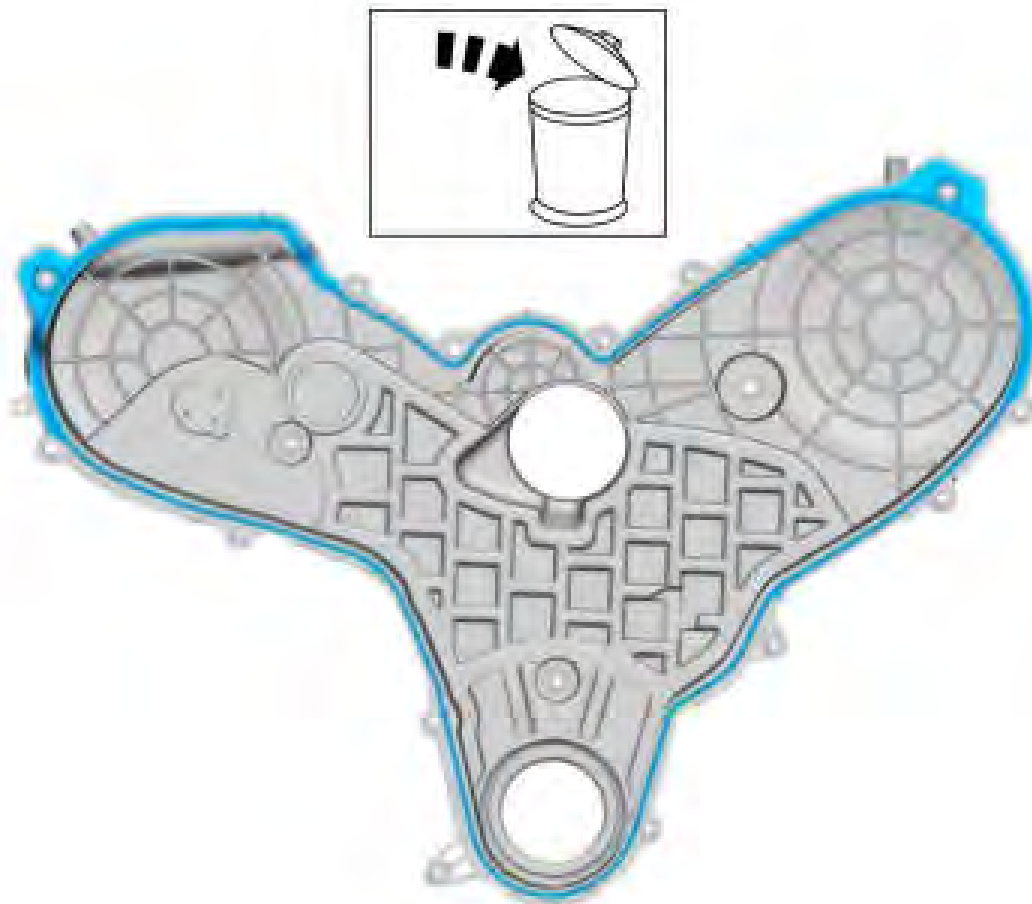
46. **NOTE:** Mark the locations of the fasteners before removal.

Remove the bolts, the stud bolts and the timing belt cover.



47. Remove and discard the timing belt cover gasket.

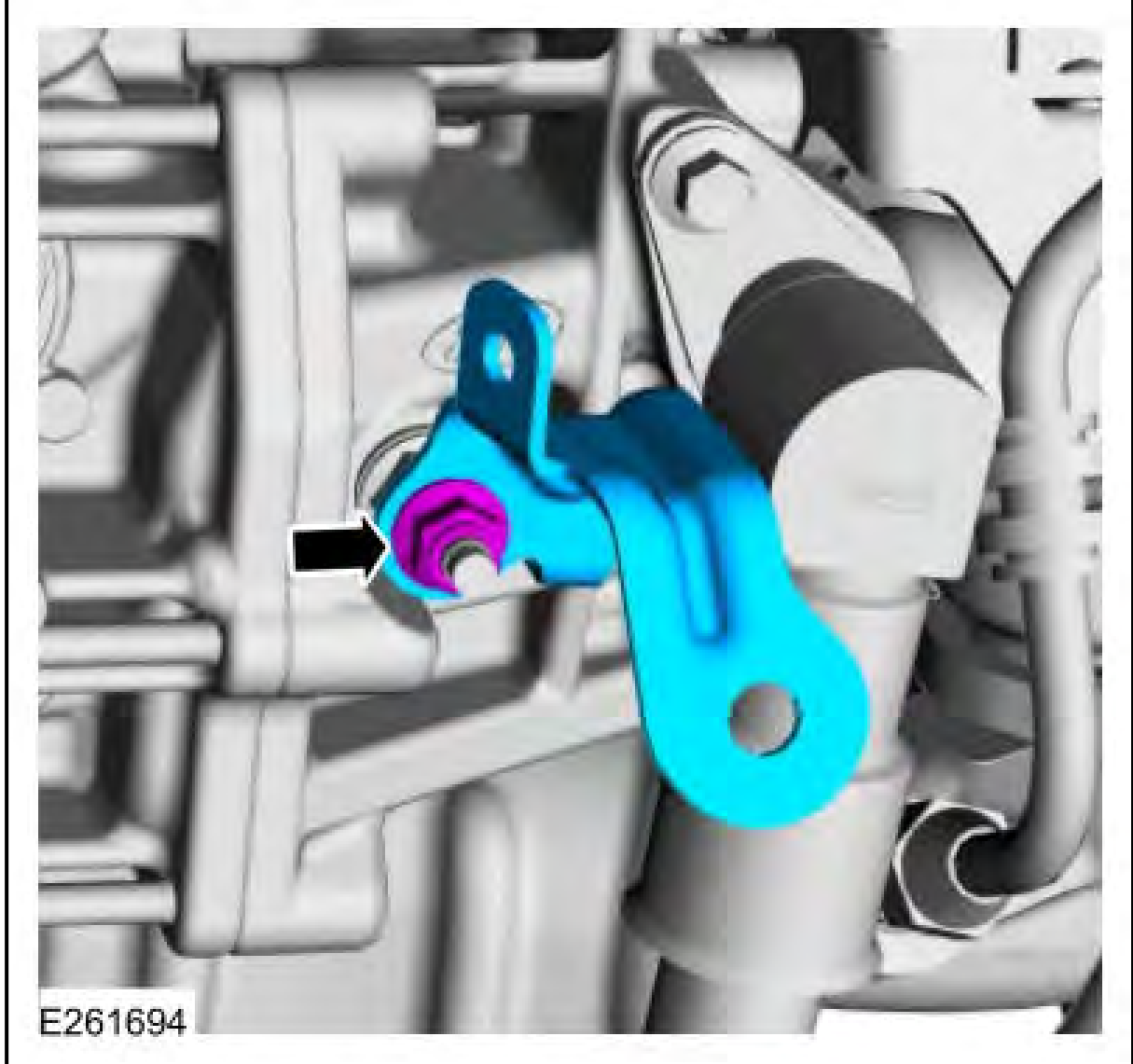




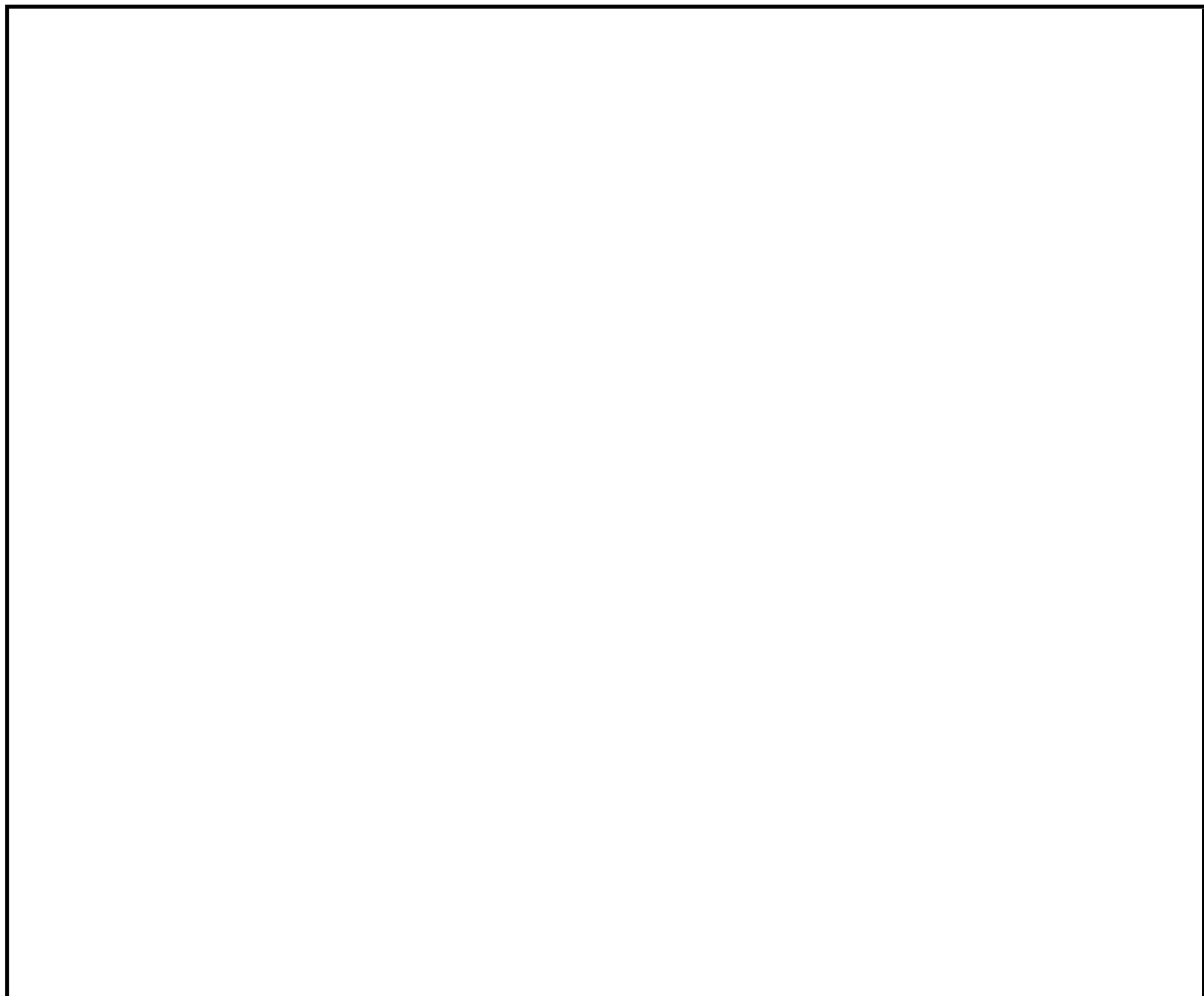
E261121

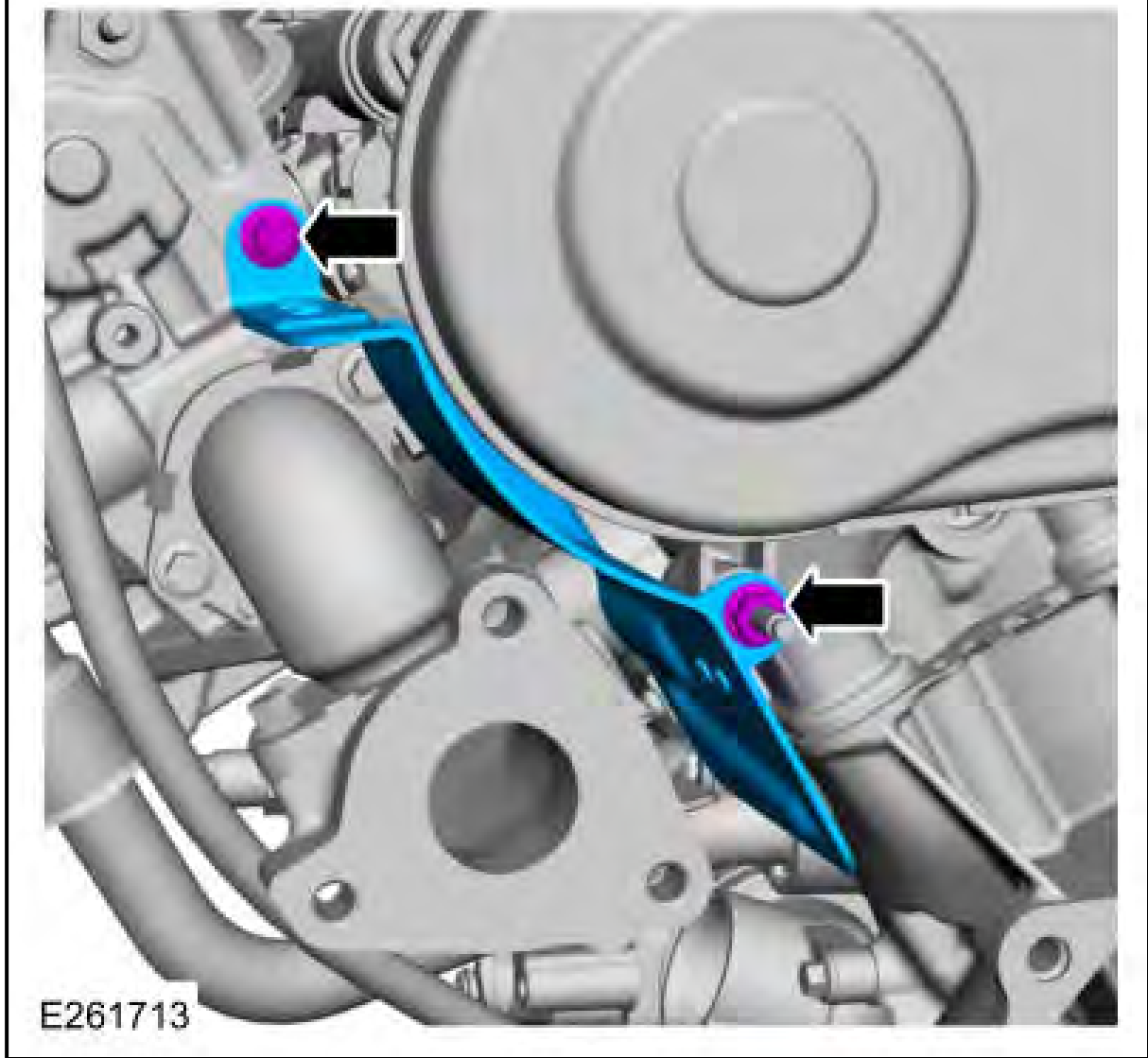
48. Remove the nut and the front fuel tube support bracket.



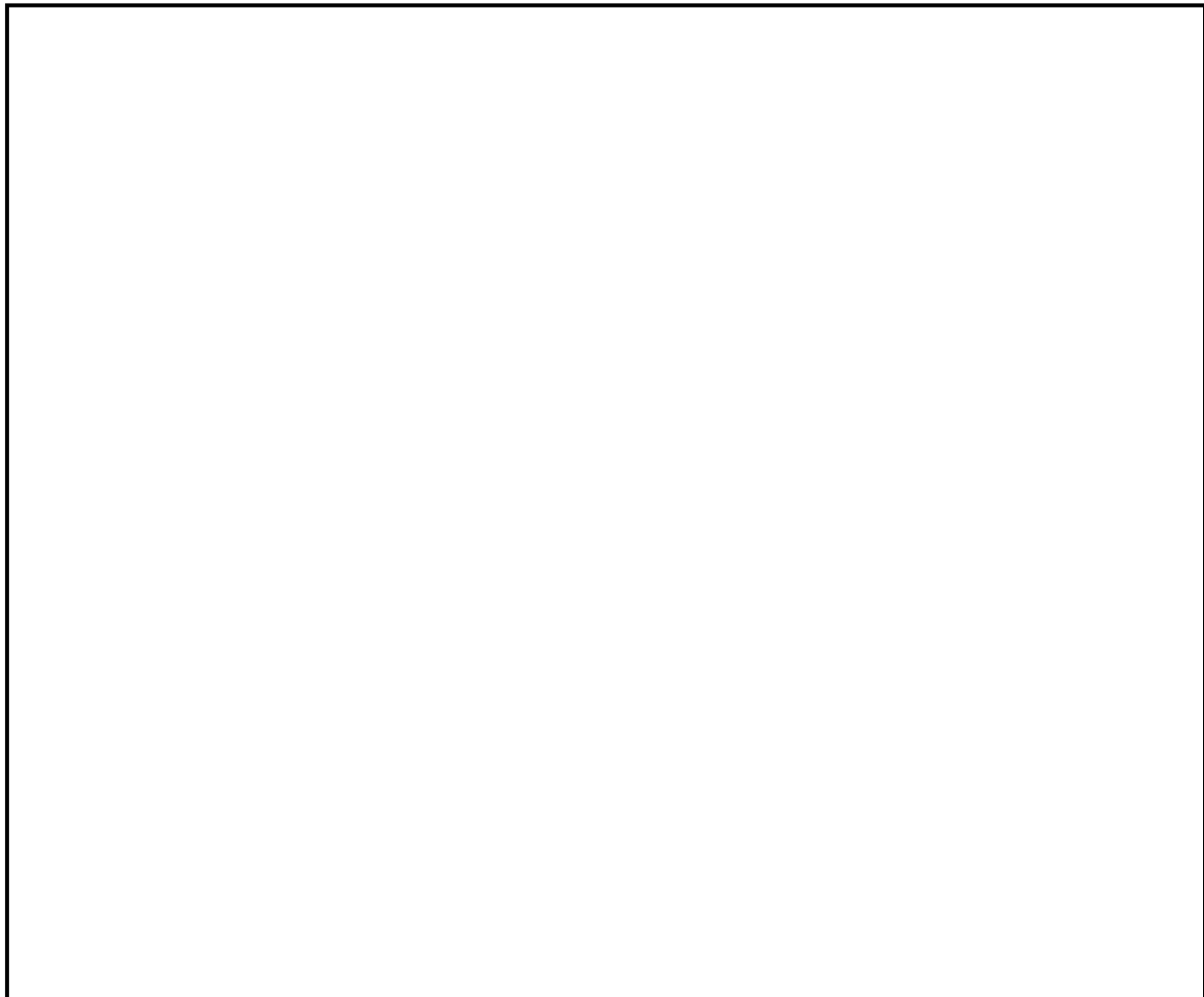


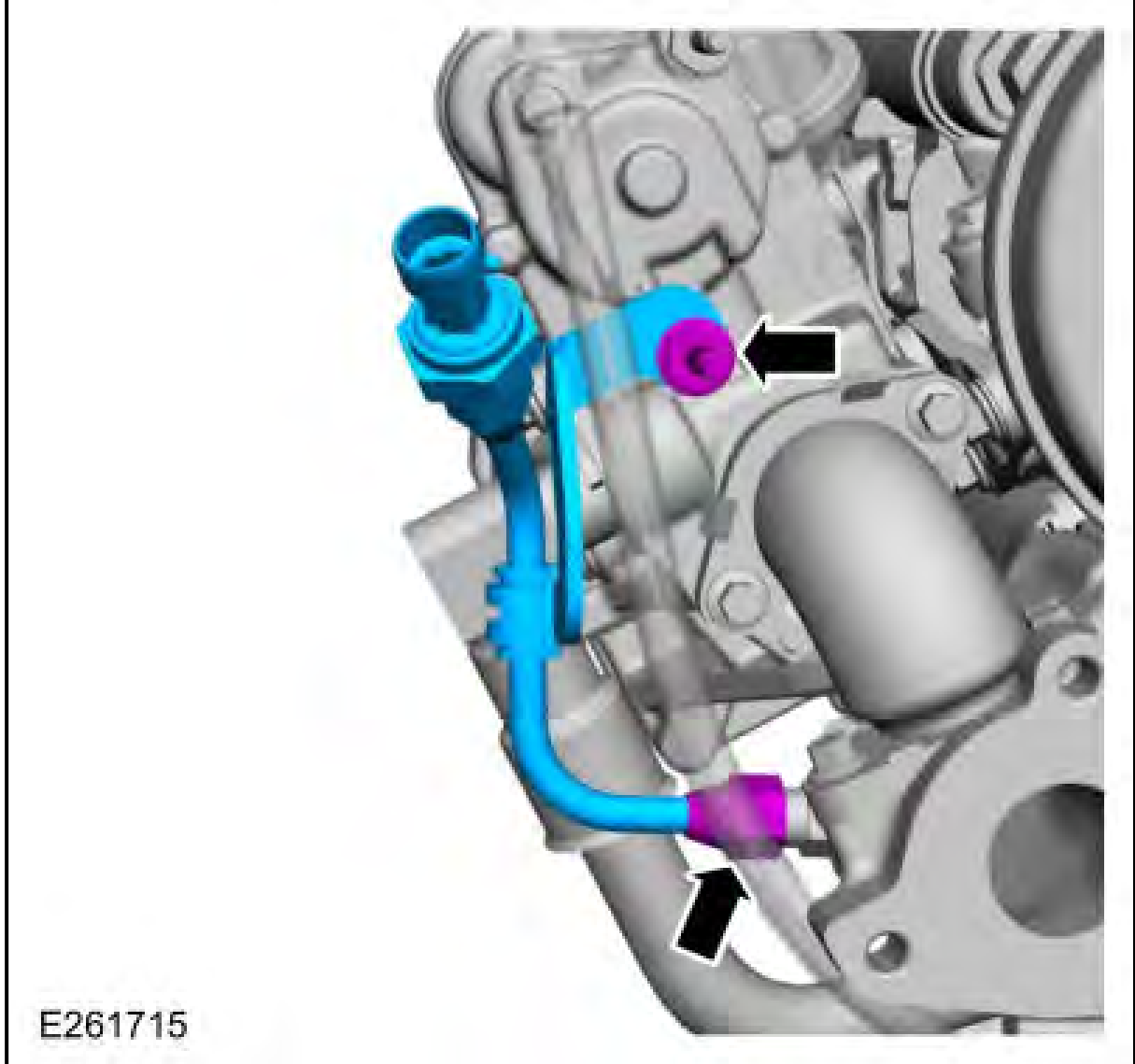
49. Remove the nut, the bolt and the LH exhaust manifold heat shield.



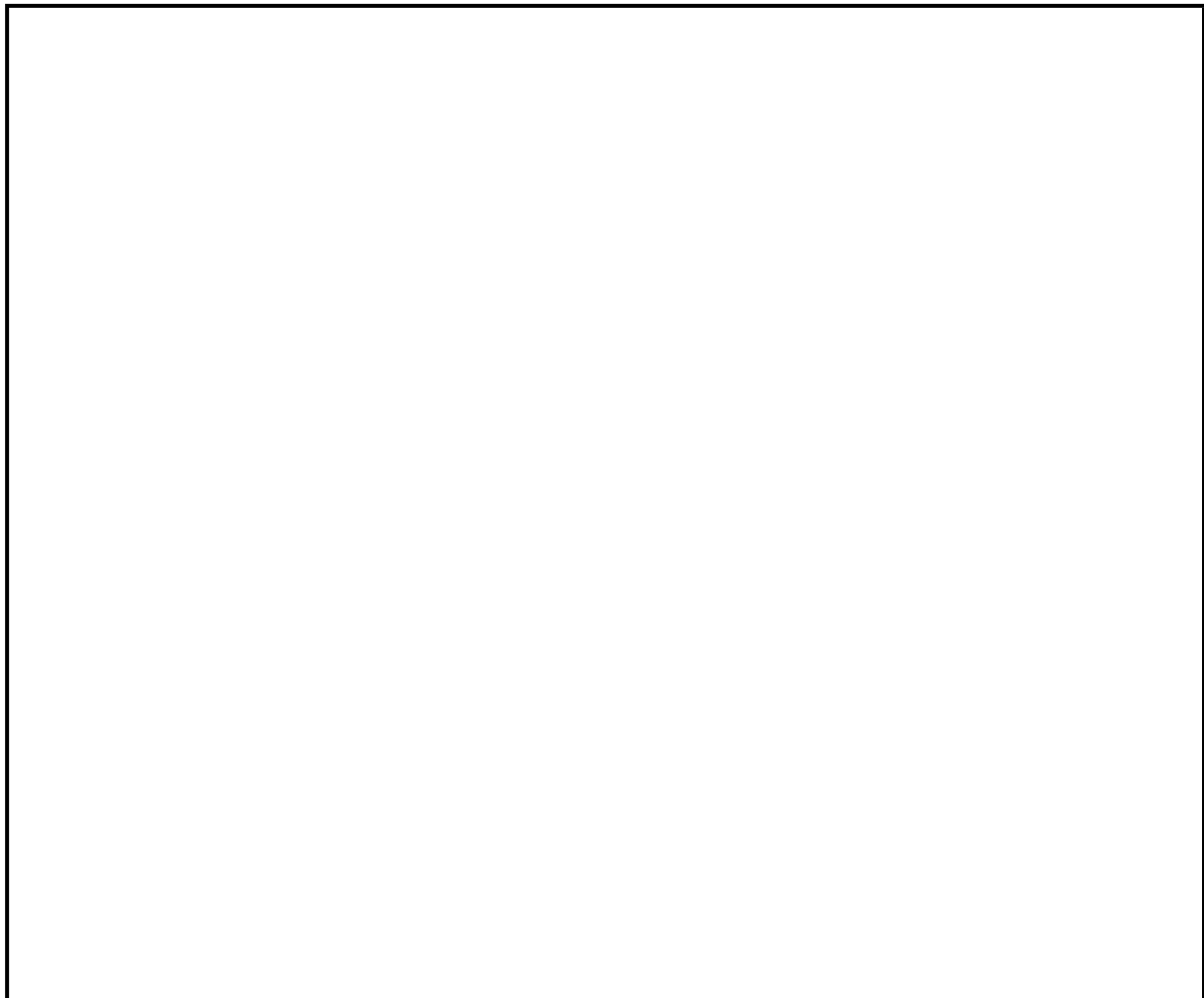


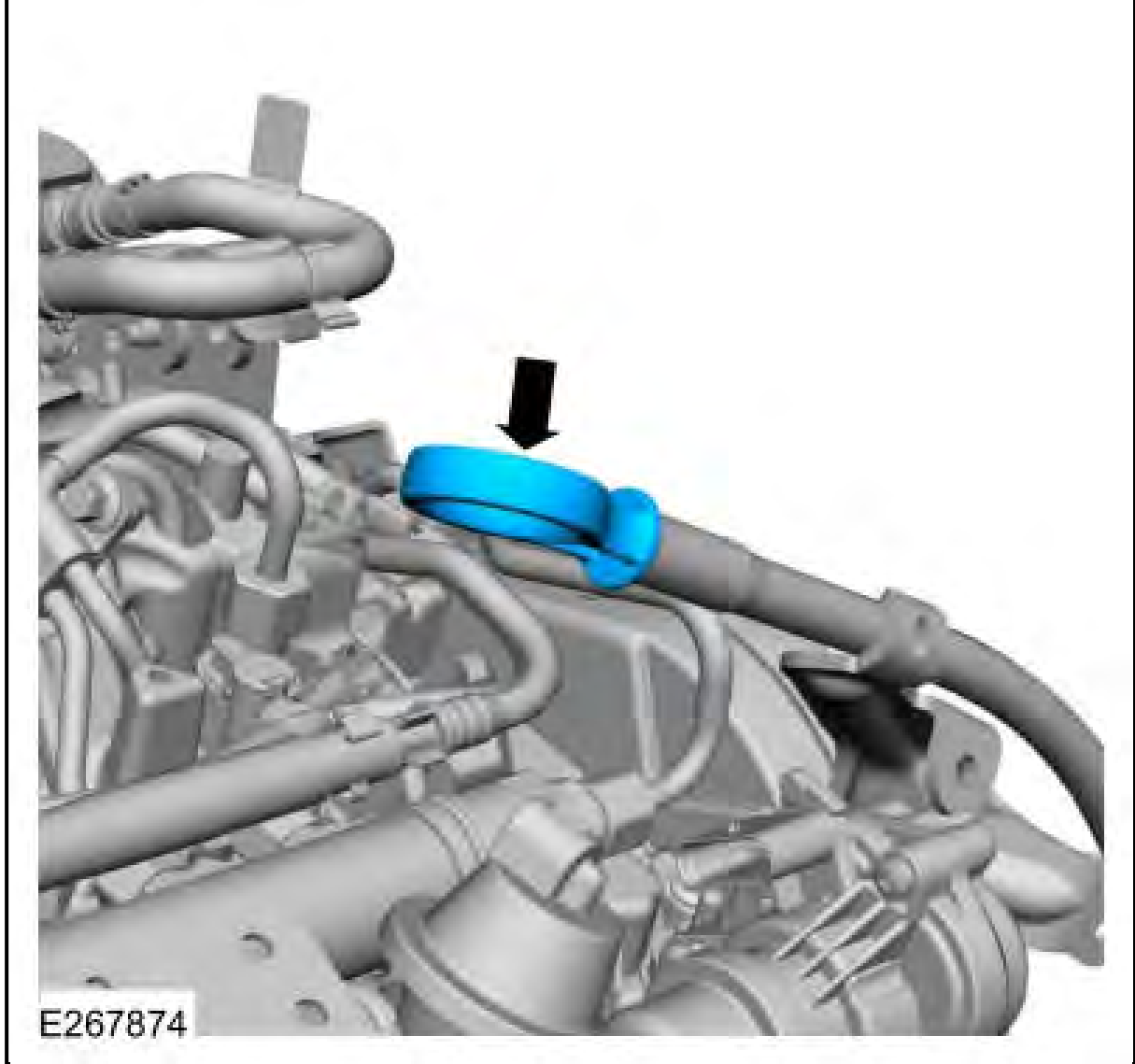
50. Remove the stud bolt. Disconnect the tube nut and remove the EP sensor assembly.





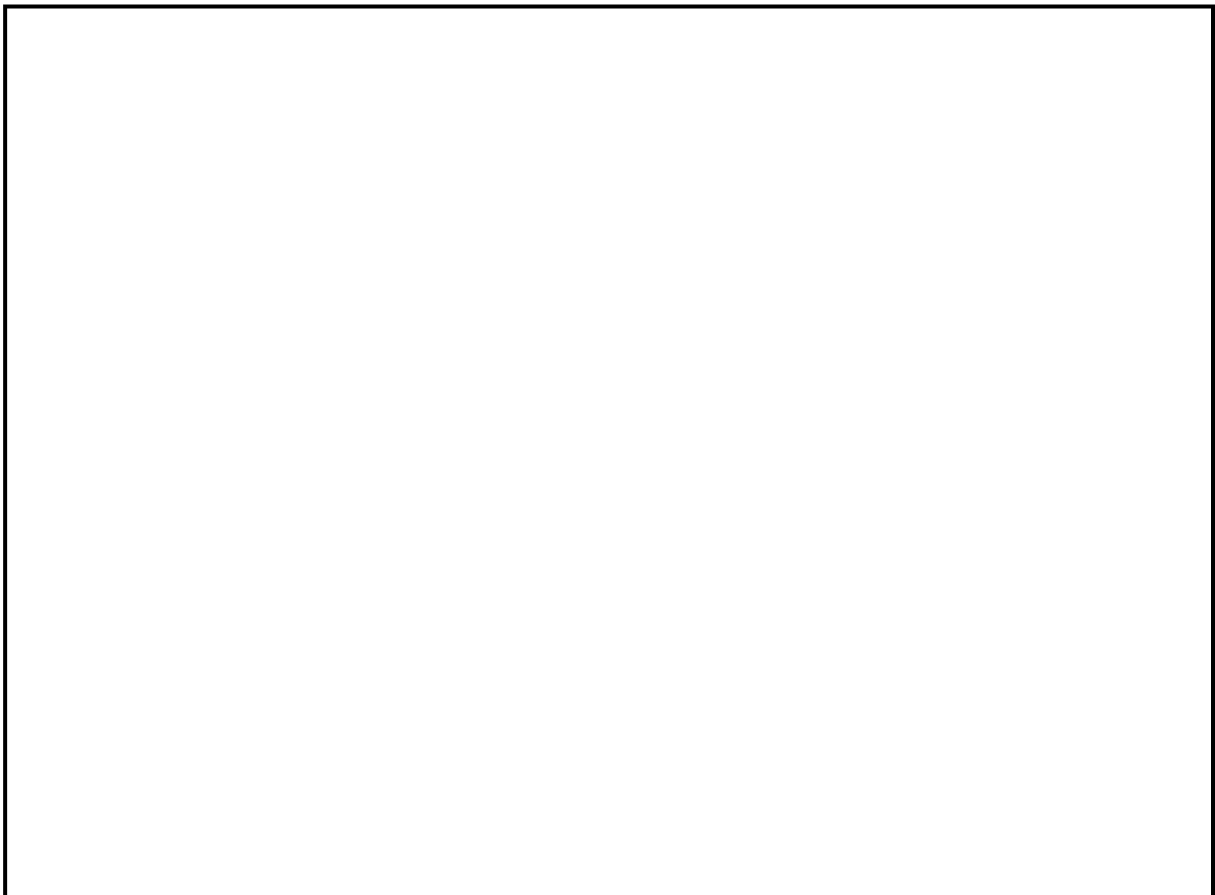
51. Remove the oil level indicator.

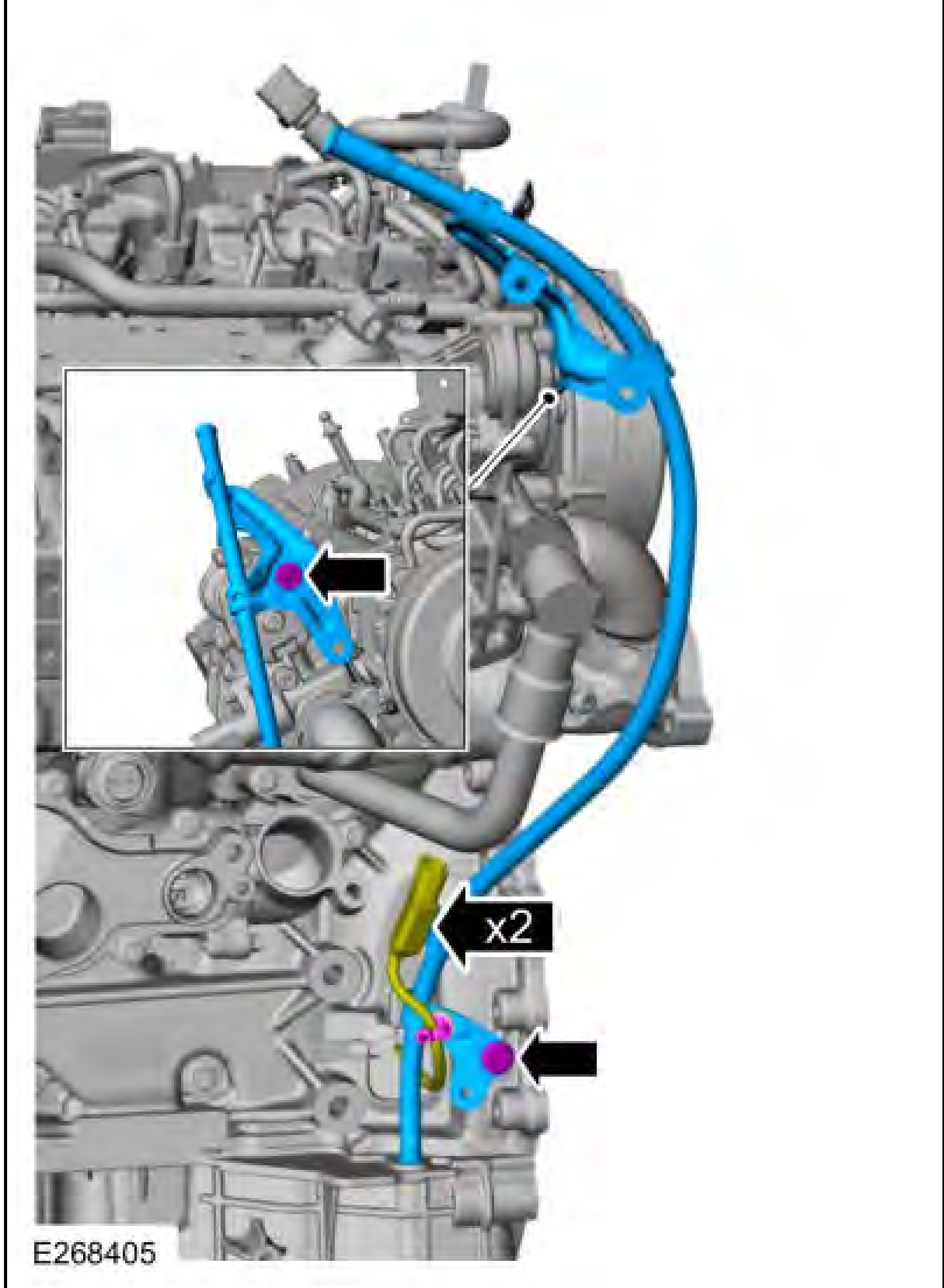




52.

- Disconnect the wire retainers from the oil level indicator tube.
- Remove the stud bolt, the bolt and the oil level indicator tube.

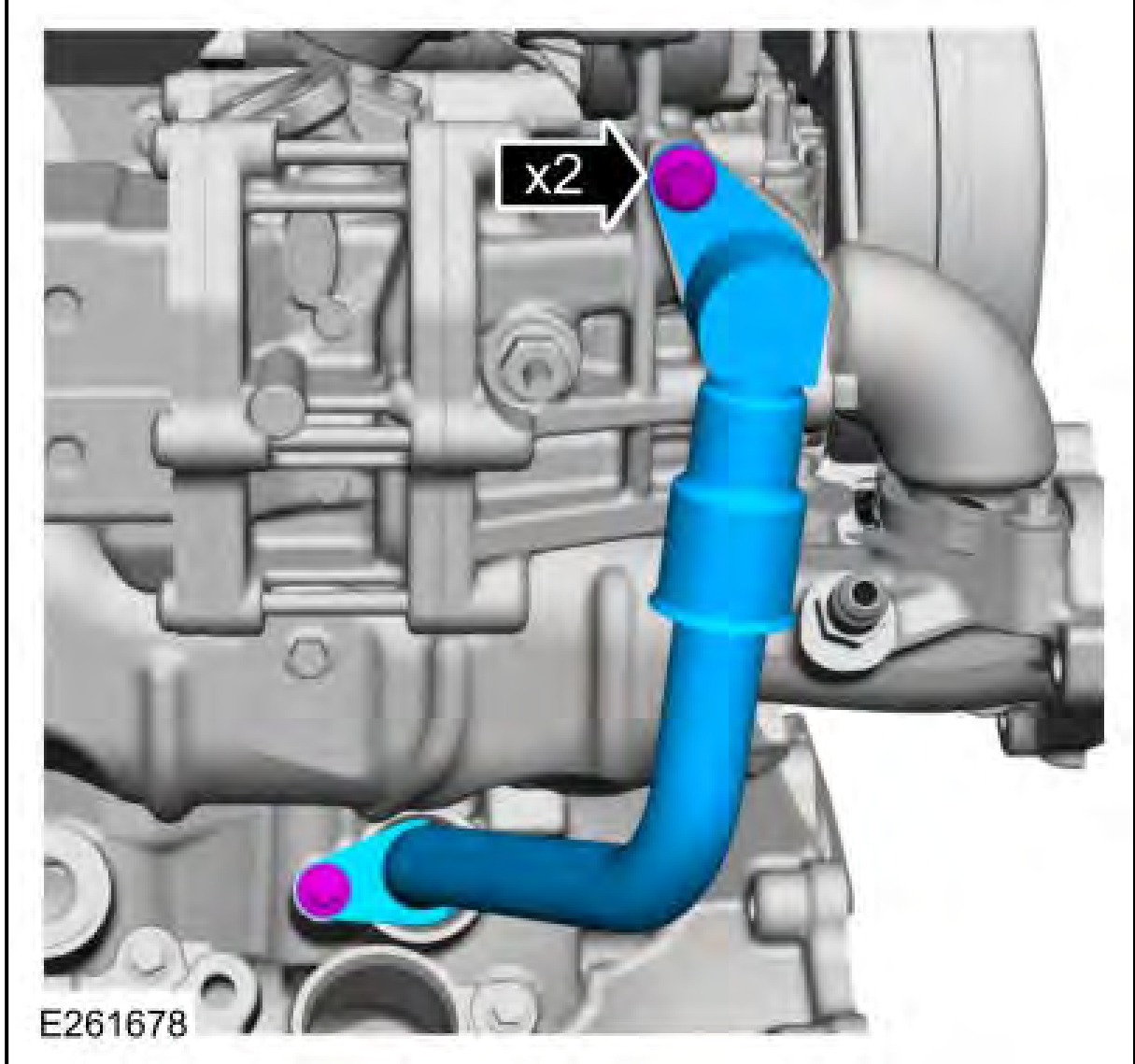




53. Remove the bolts and the EGR coolant tube.





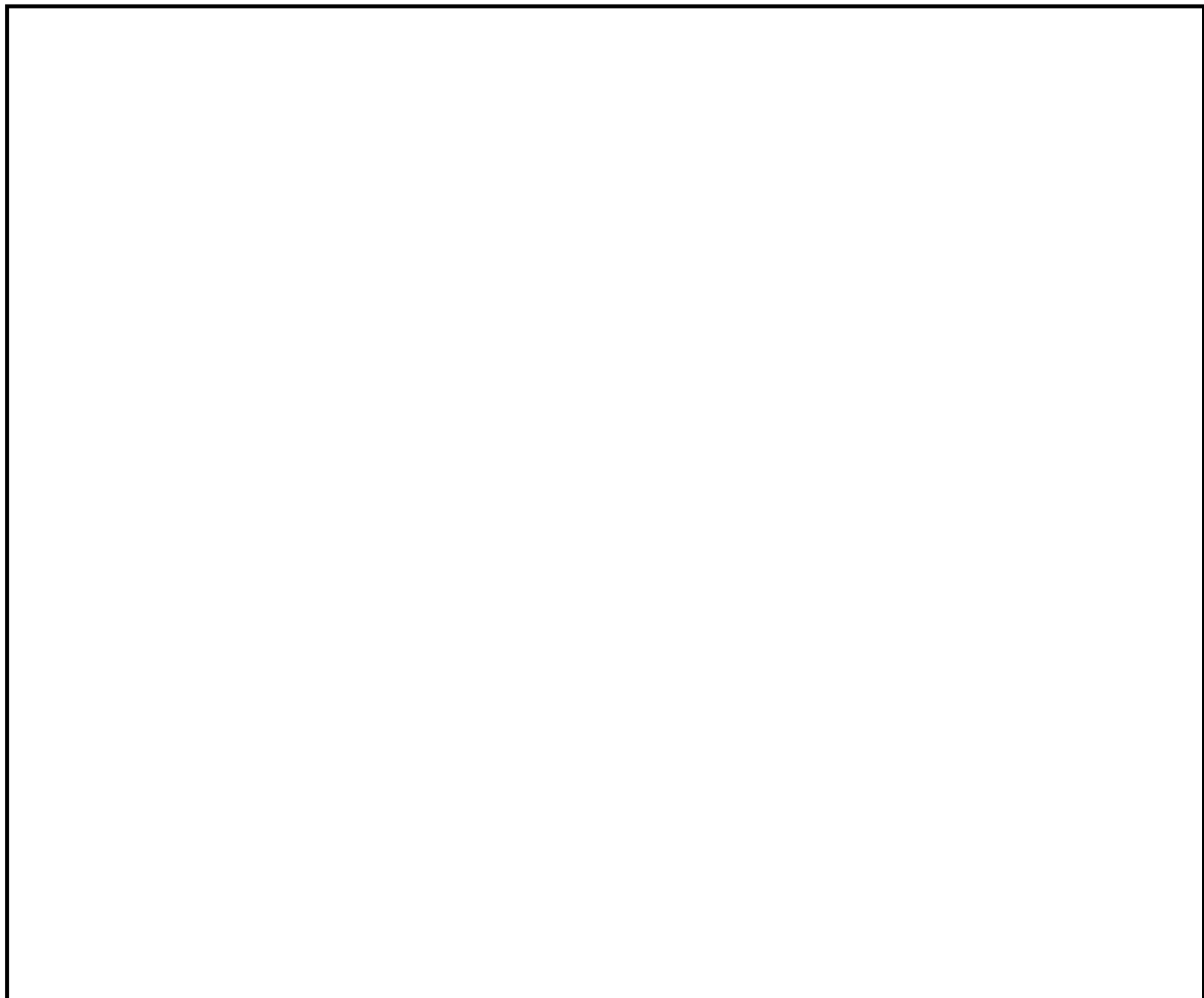


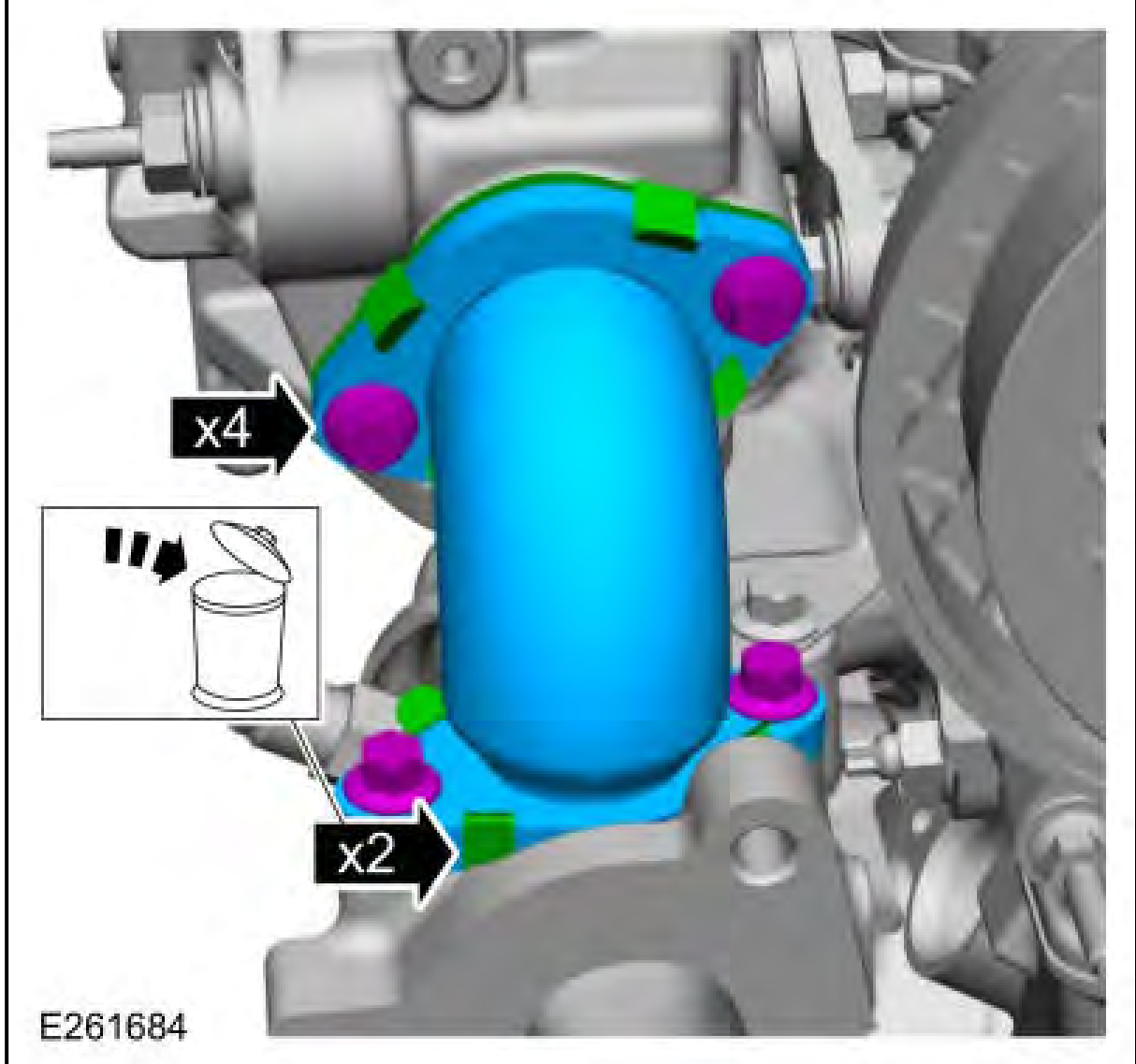
54. Remove and discard the EGR coolant tube O-rings.



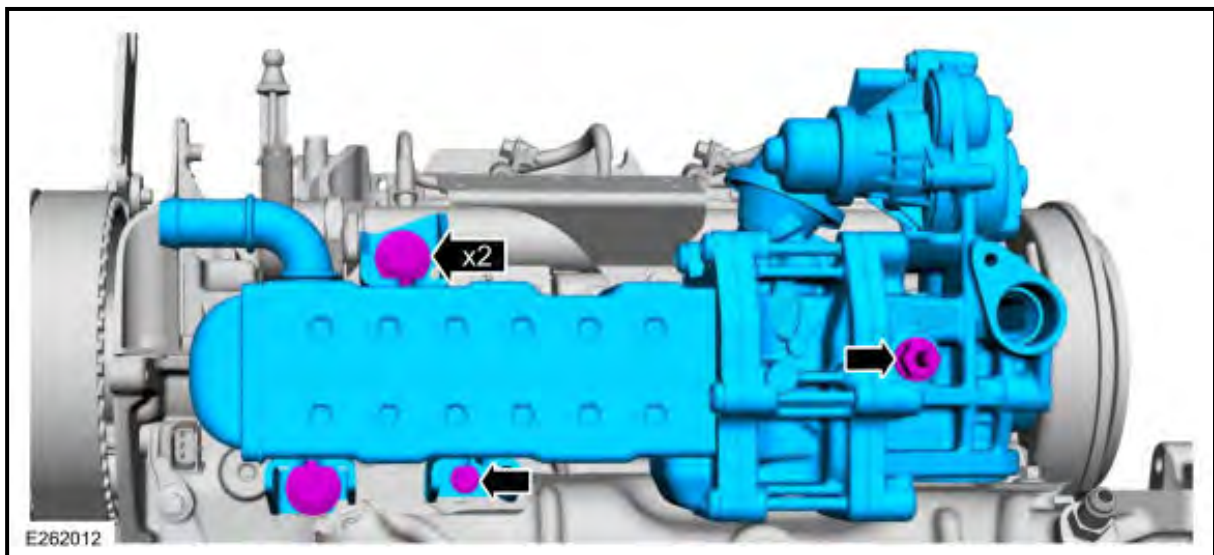


55. Remove the bolts and the EGR cooler-to-exhaust manifold pipe. Remove and discard the gaskets.



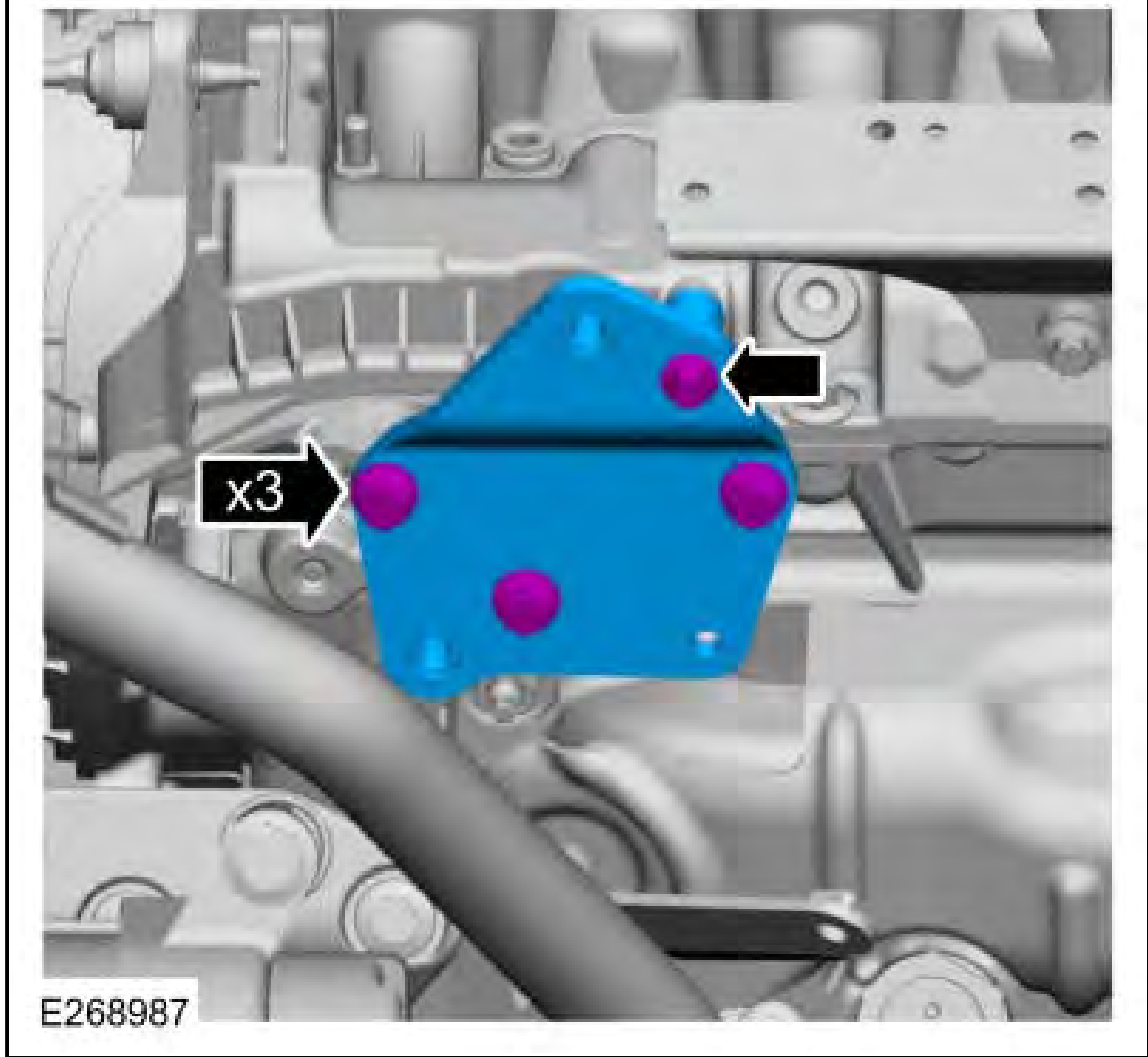


56. Remove the bolts and the EGR cooler.



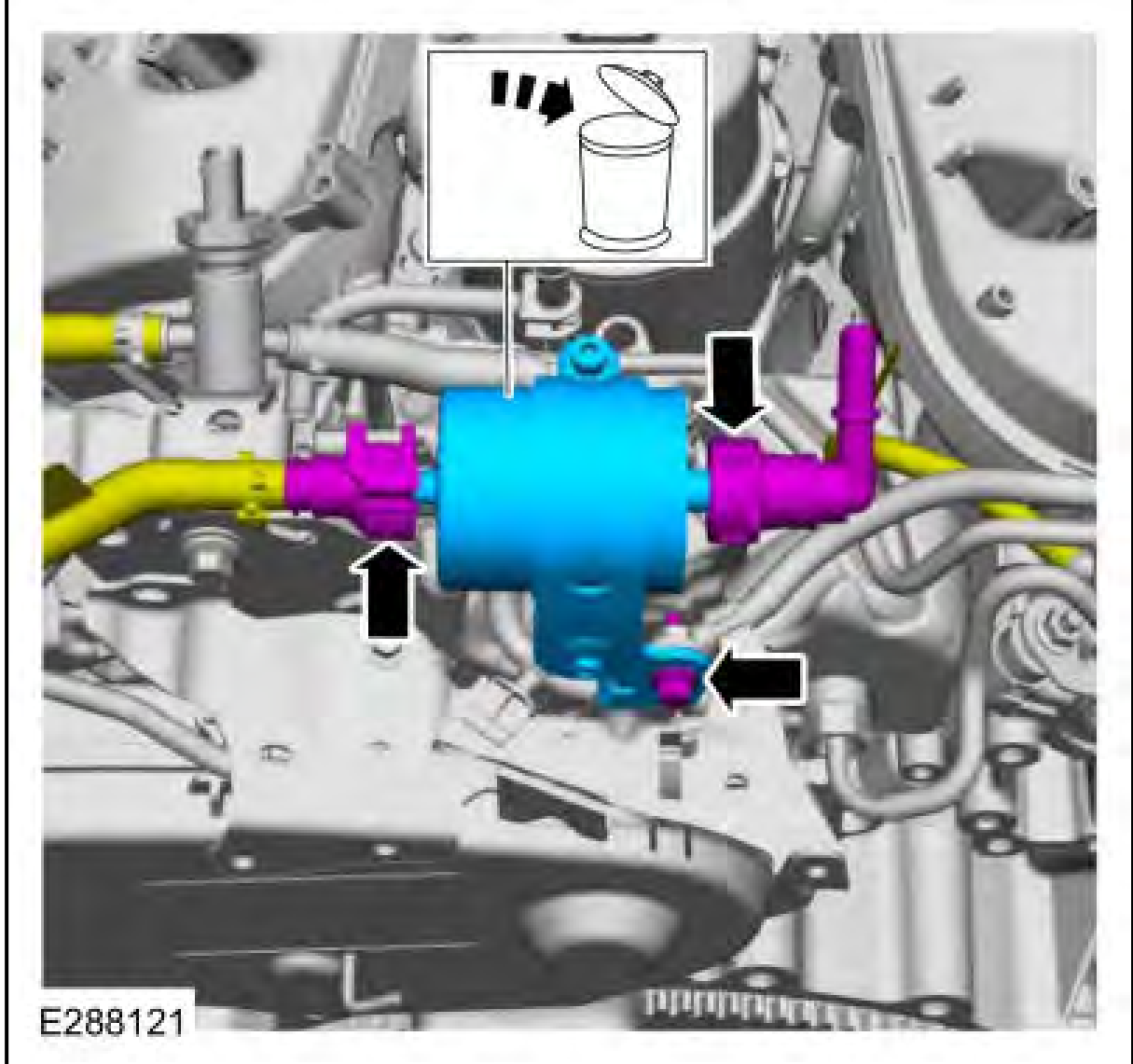
57. Remove the bolts and the EGR cooler bracket.



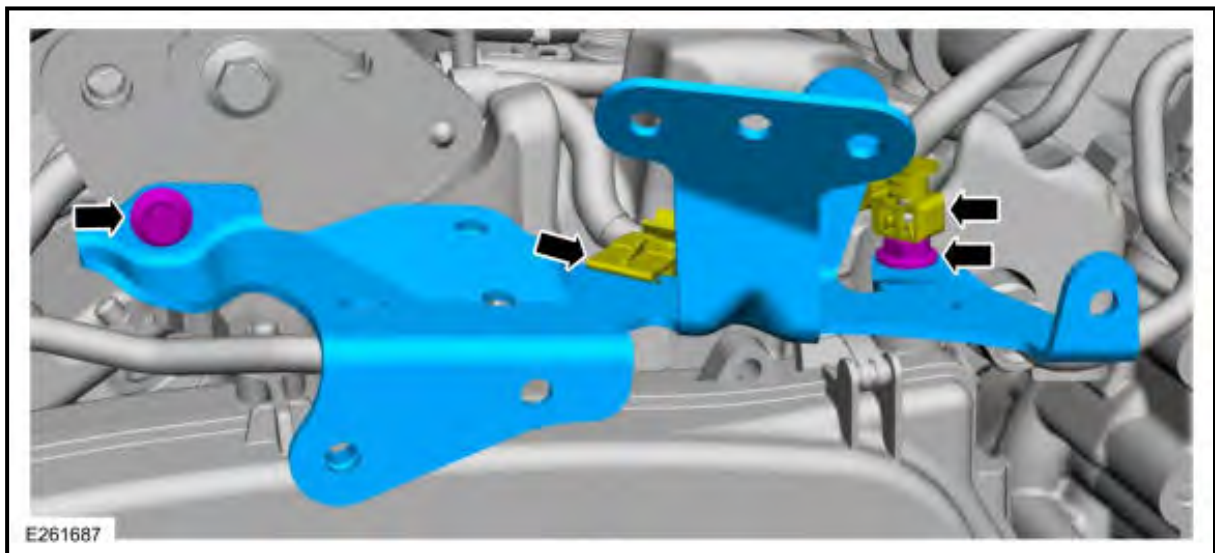


58. Disconnect the fuel lines. Remove the bolt and the secondary fuel filter. Discard the secondary fuel filter. REFER to: [Quick Release Coupling](#) .

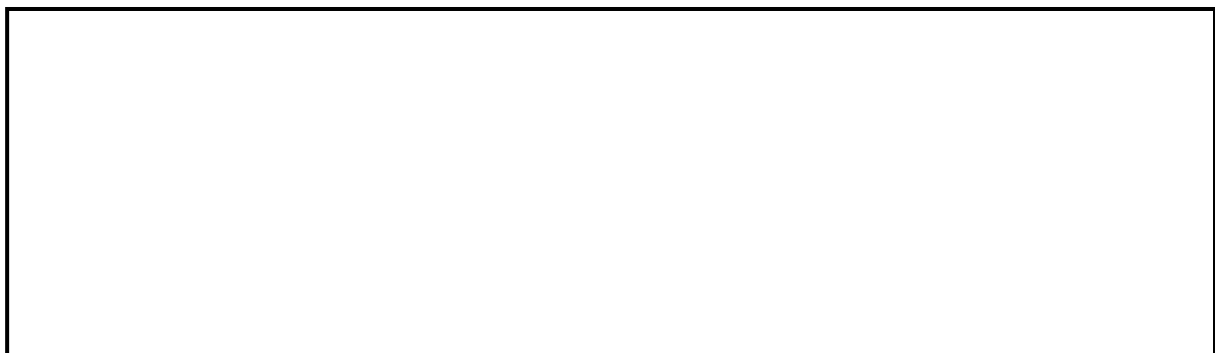


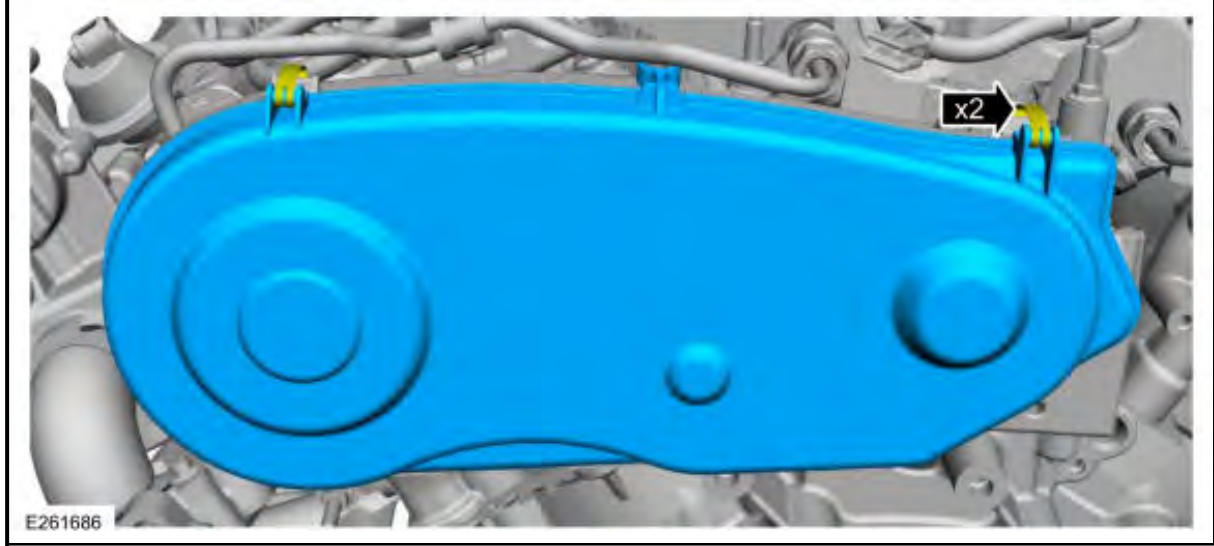


59. Disconnect the retainers. Remove the nut, the bolt and the wiring harness bracket.

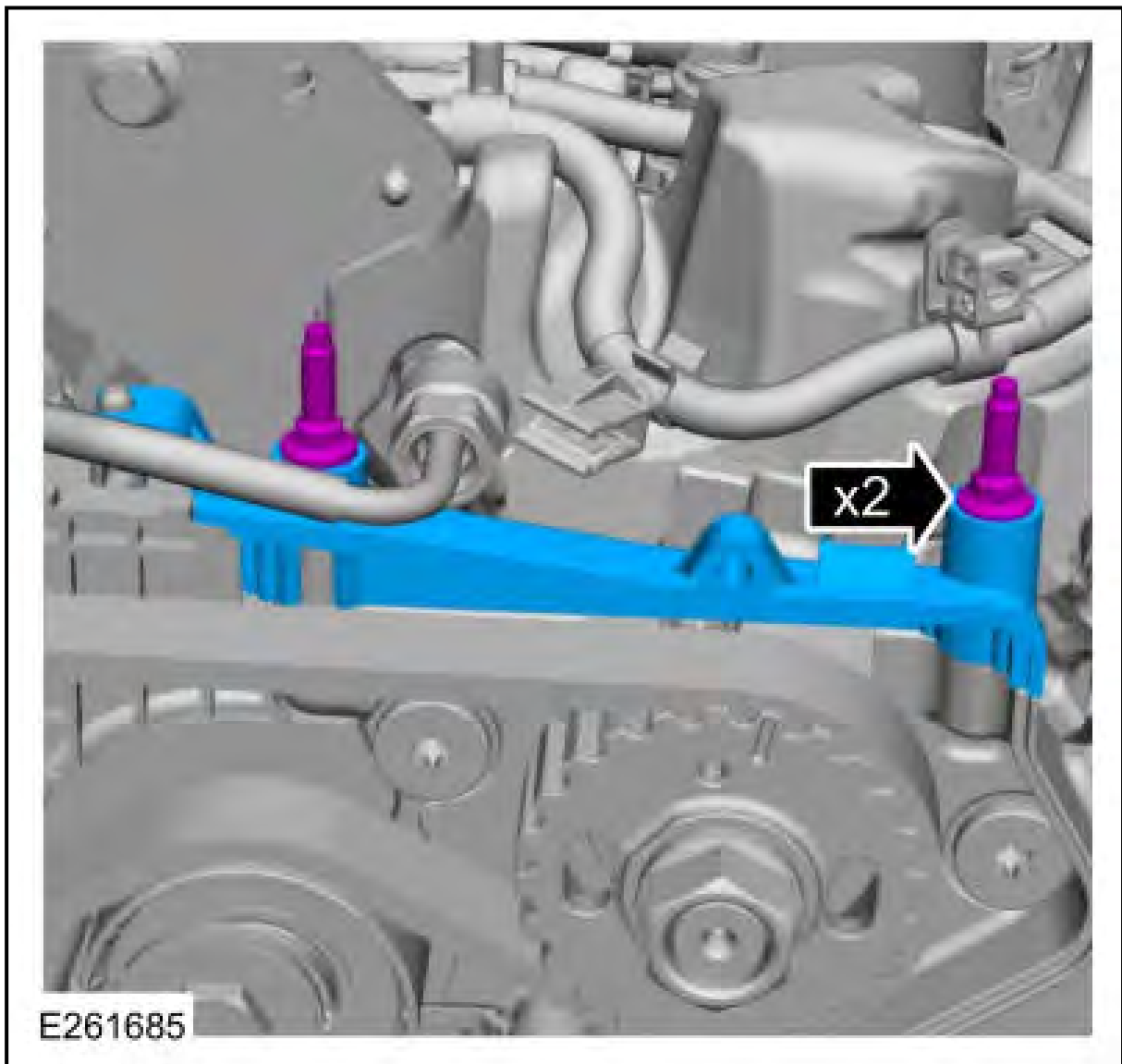


60. Remove the accessory drive cover.



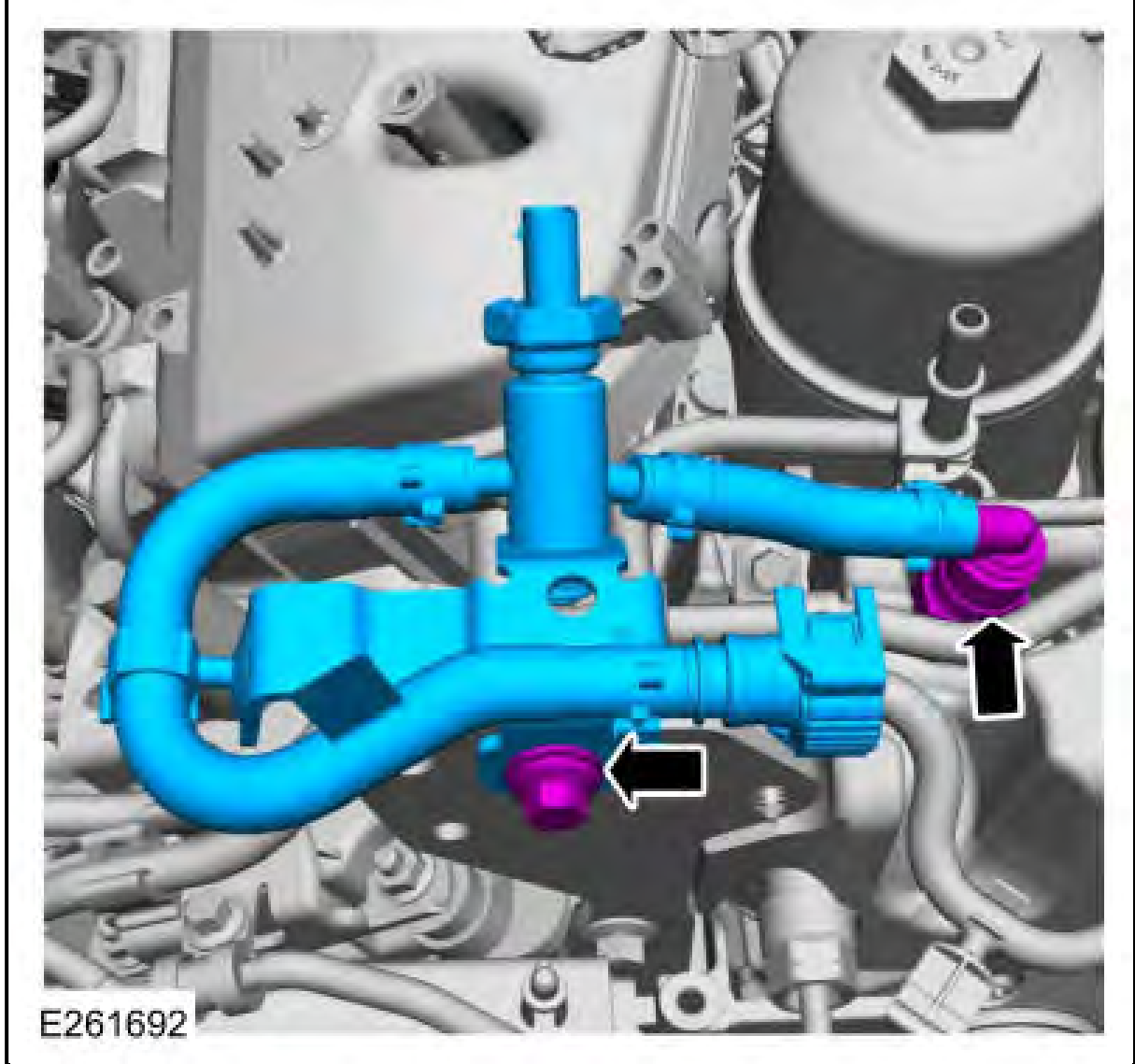


61. Remove the stud bolts and the accessory drive cover.

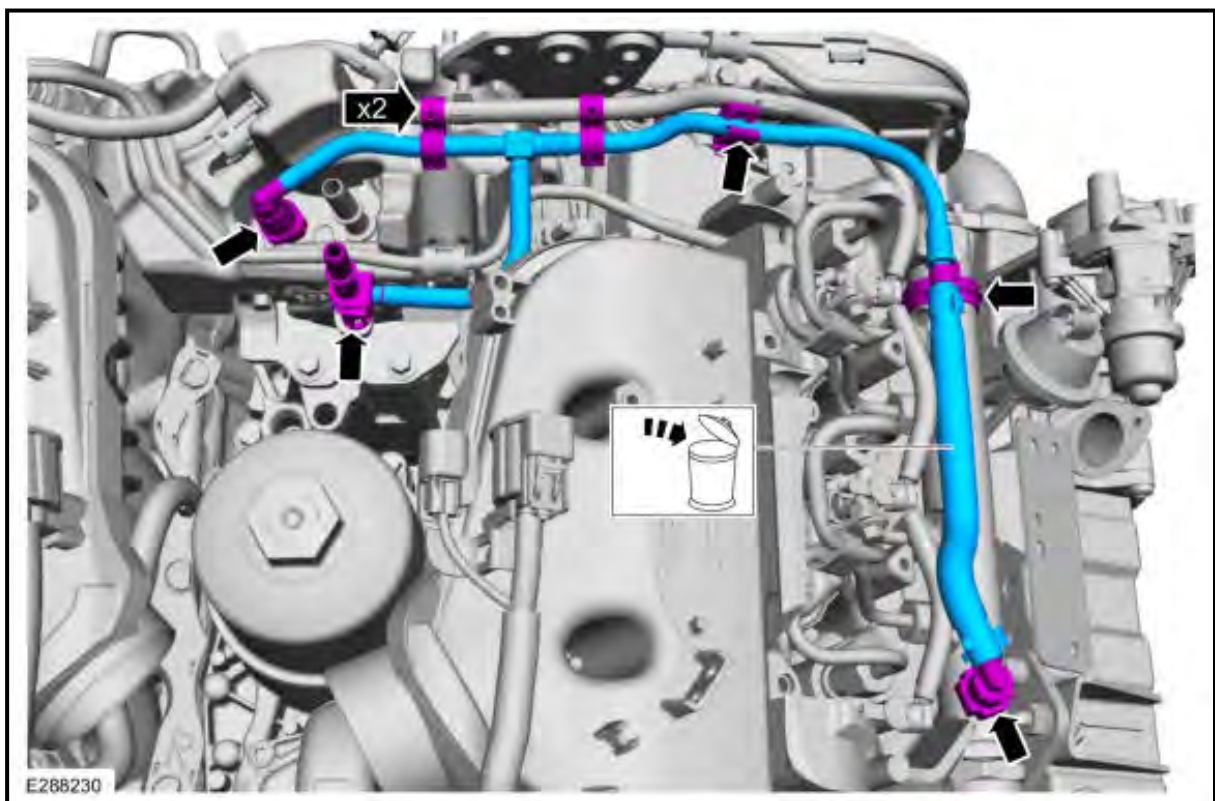


62. Remove the bolt. Disconnect and remove the fuel supply tube. REFER to: [Quick Release Coupling](#) .

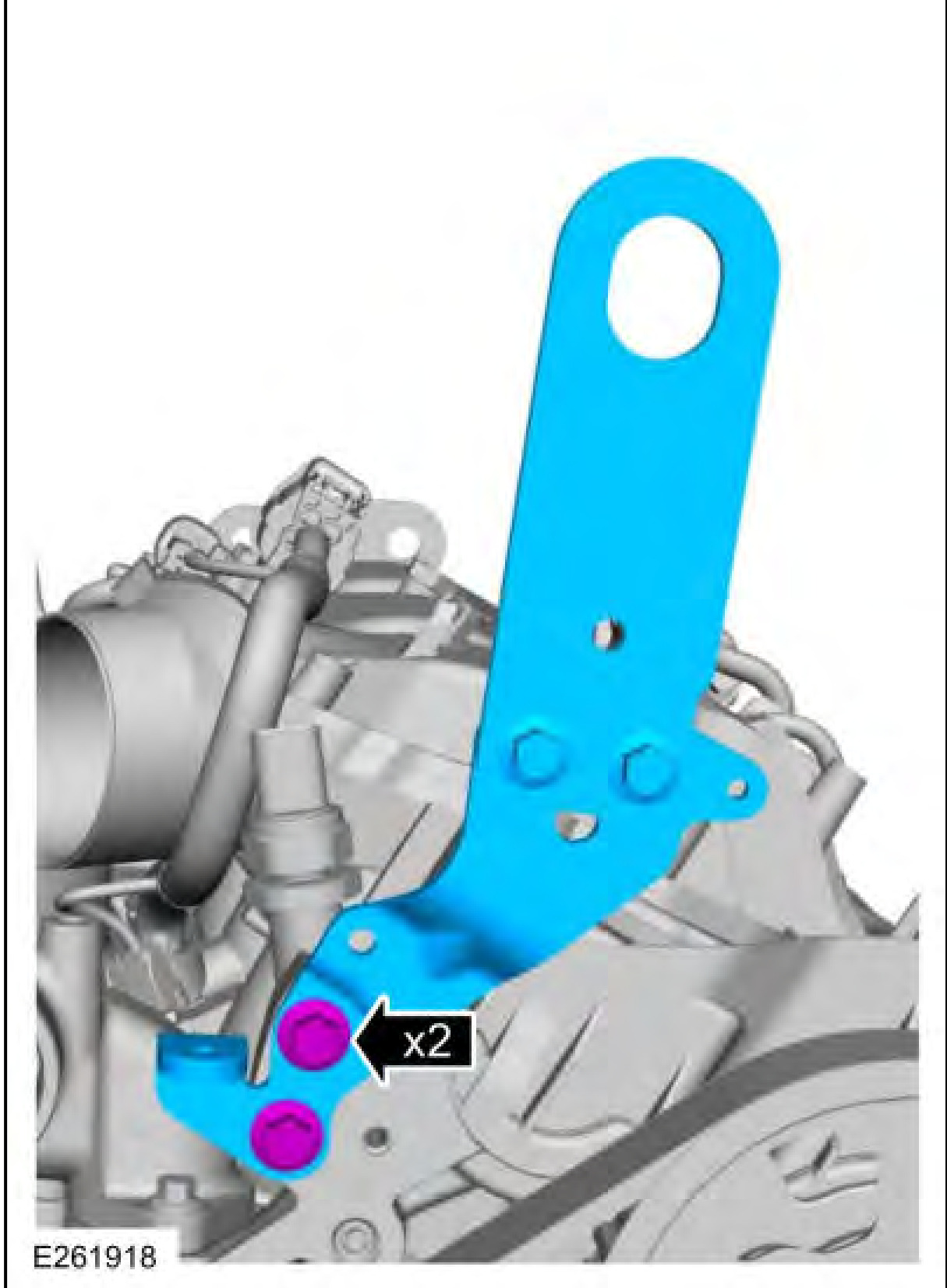




63. Disconnect and remove the fuel return tube assembly. Discard the fuel return tube assembly. REFER to: [Quick Release Coupling](#) .



64. Remove the bolts and the front engine lifting eye.

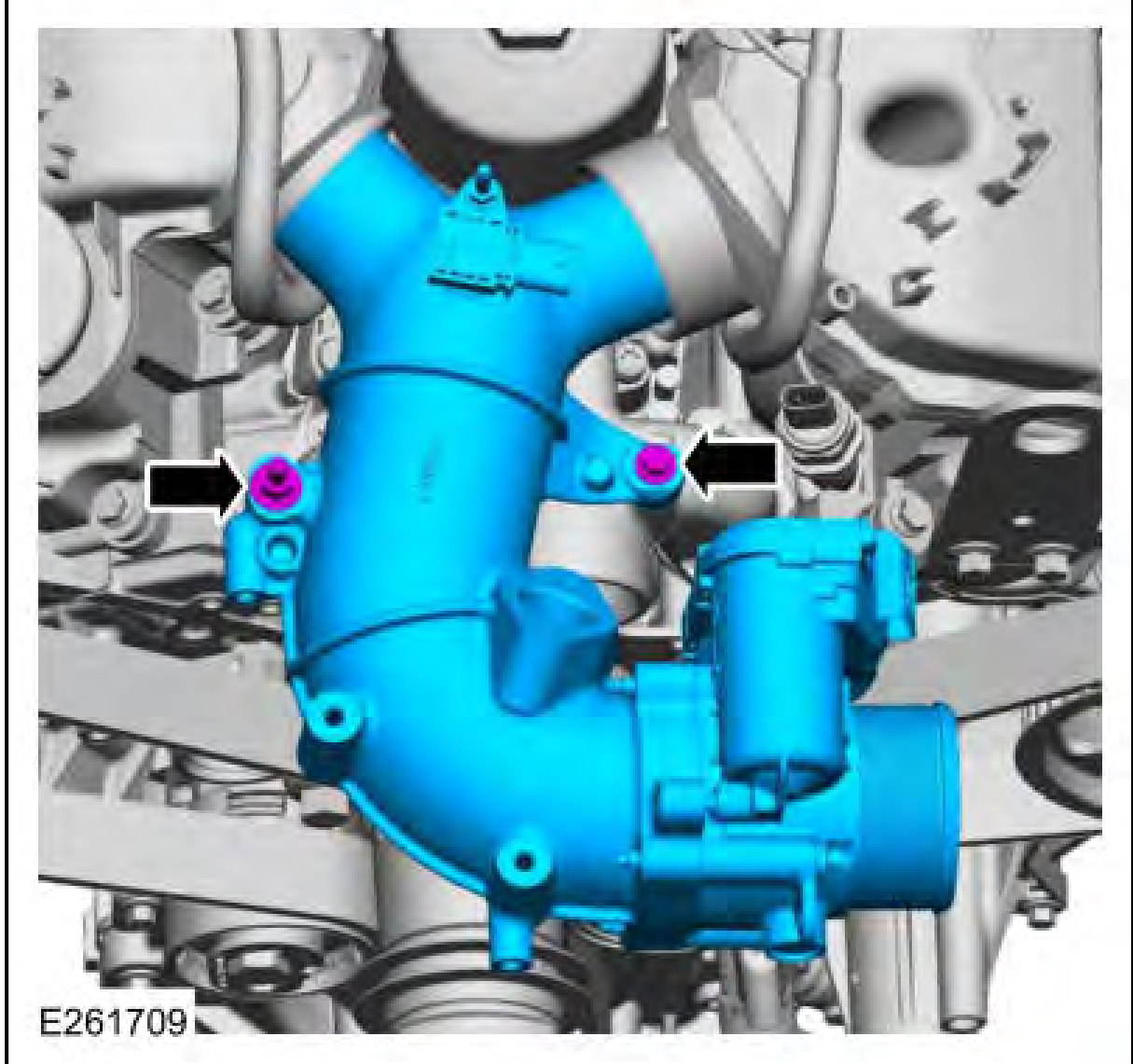


65. **NOTE:** Lift the front of the intake manifold up and slide the intake manifold to the right to remove.

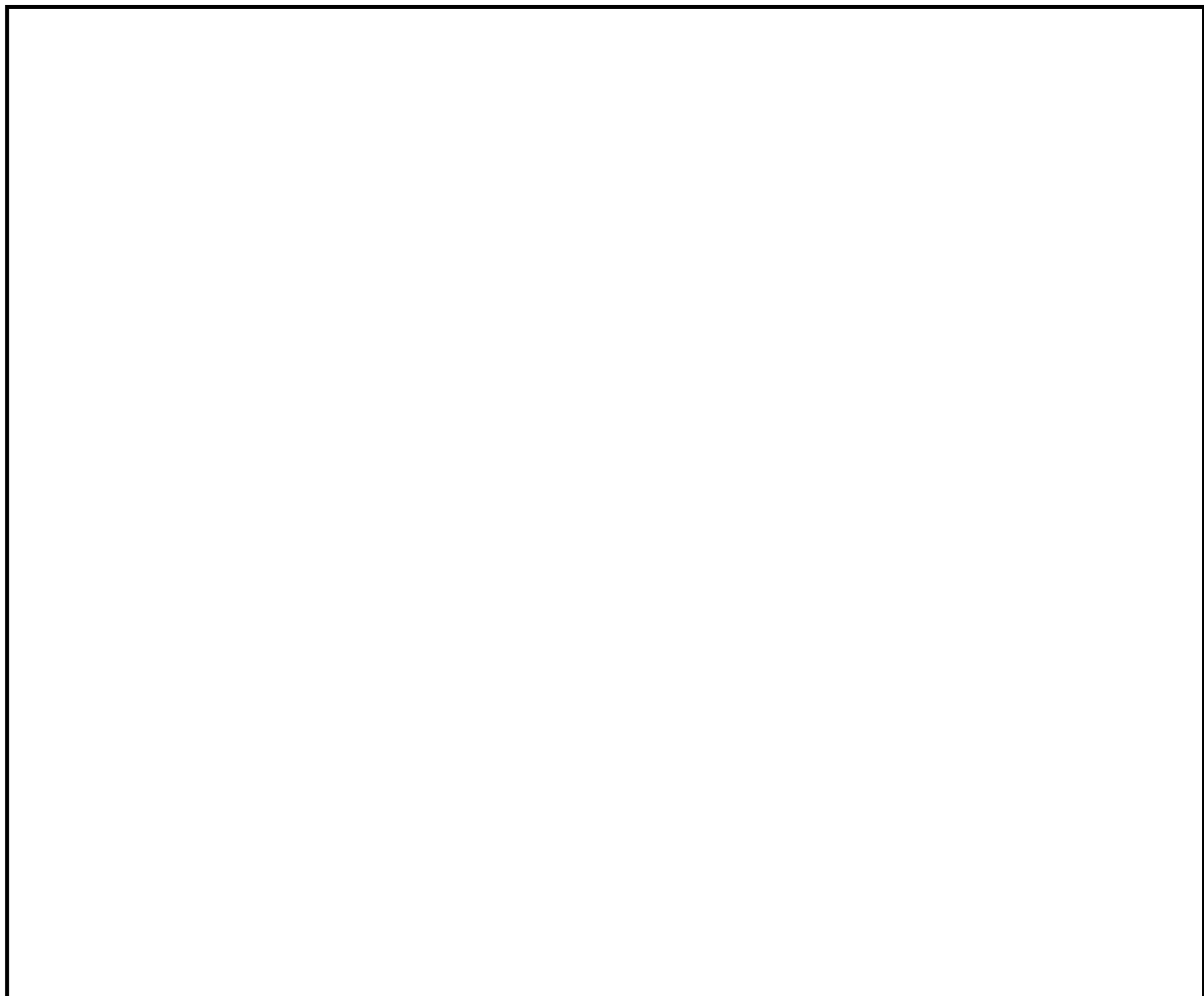
Remove the stud bolt, the bolt and the intake manifold.

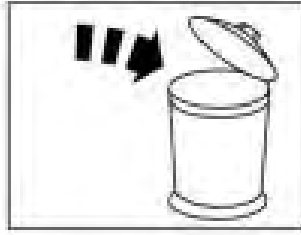






66. Remove and discard the intake manifold gaskets.

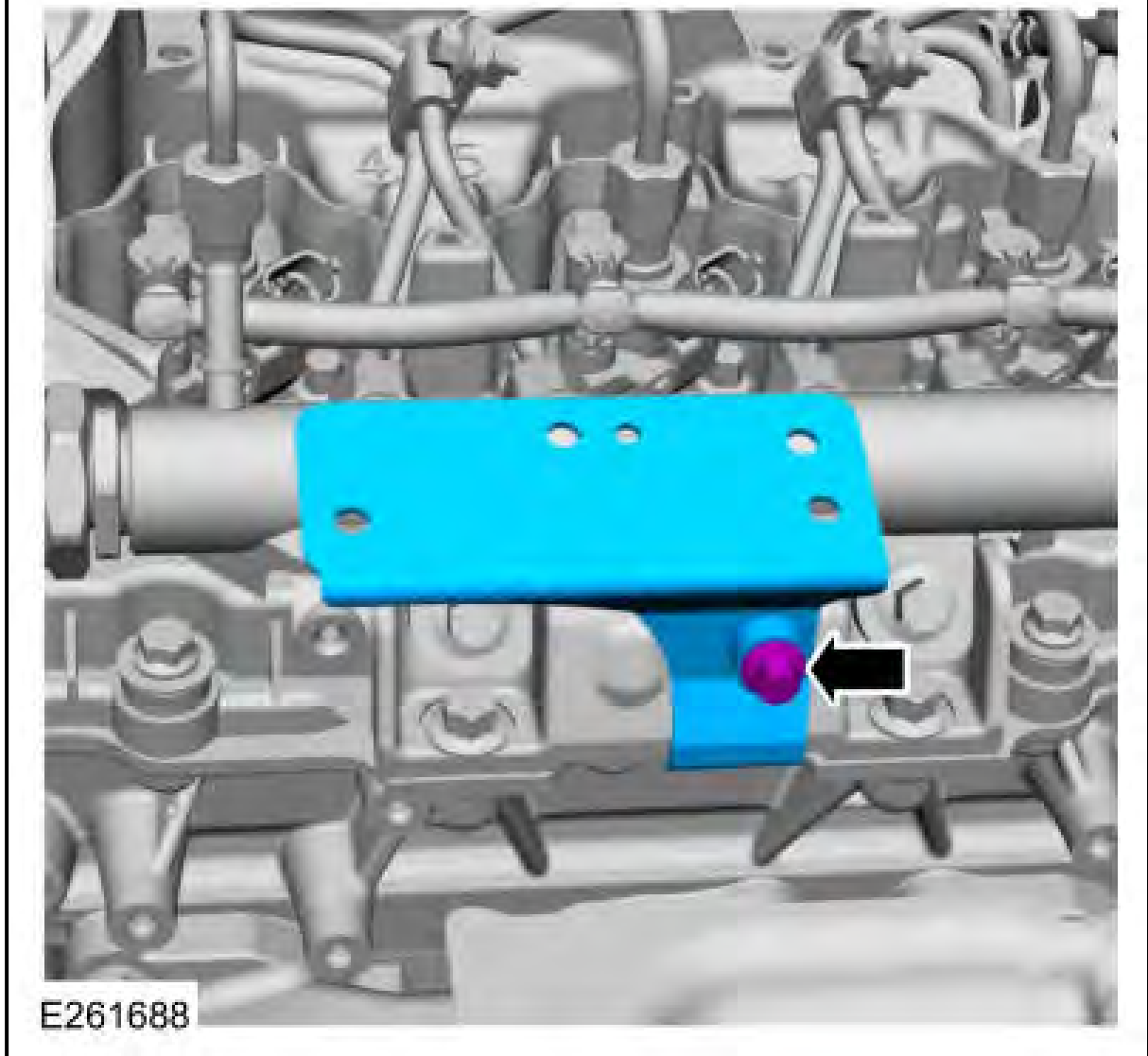




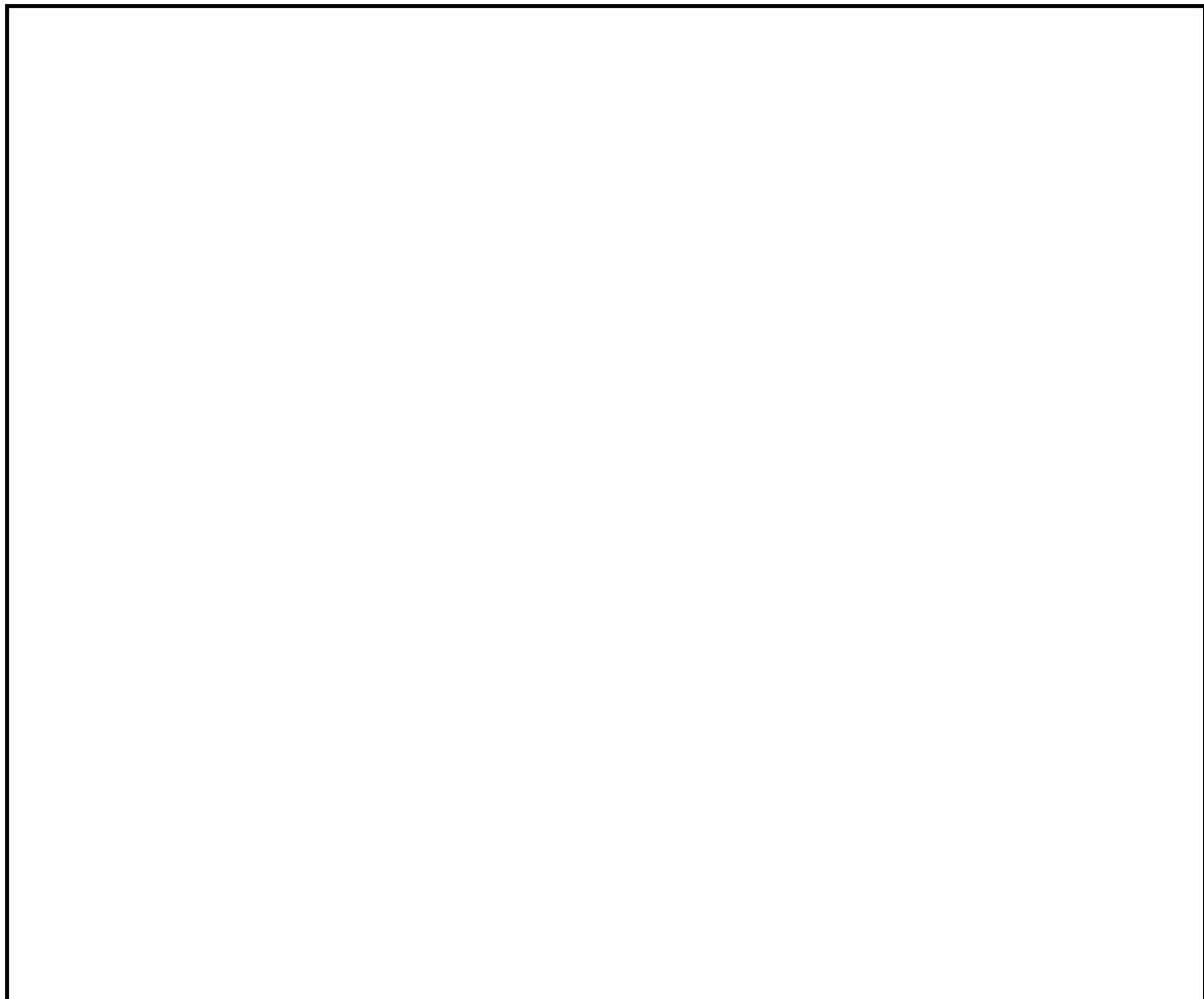
E261593

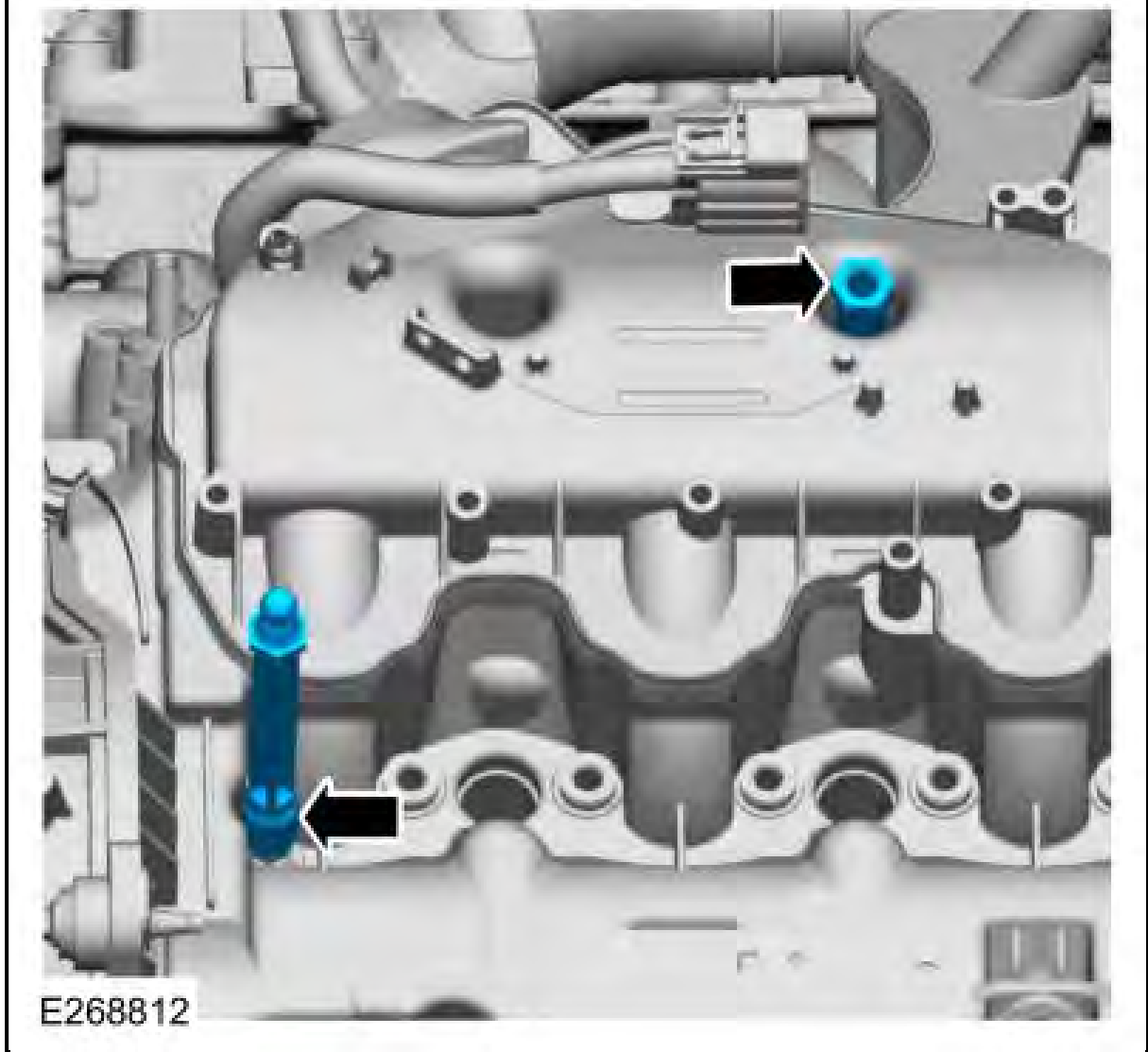
67. Remove the bolt and the wire harness bracket.



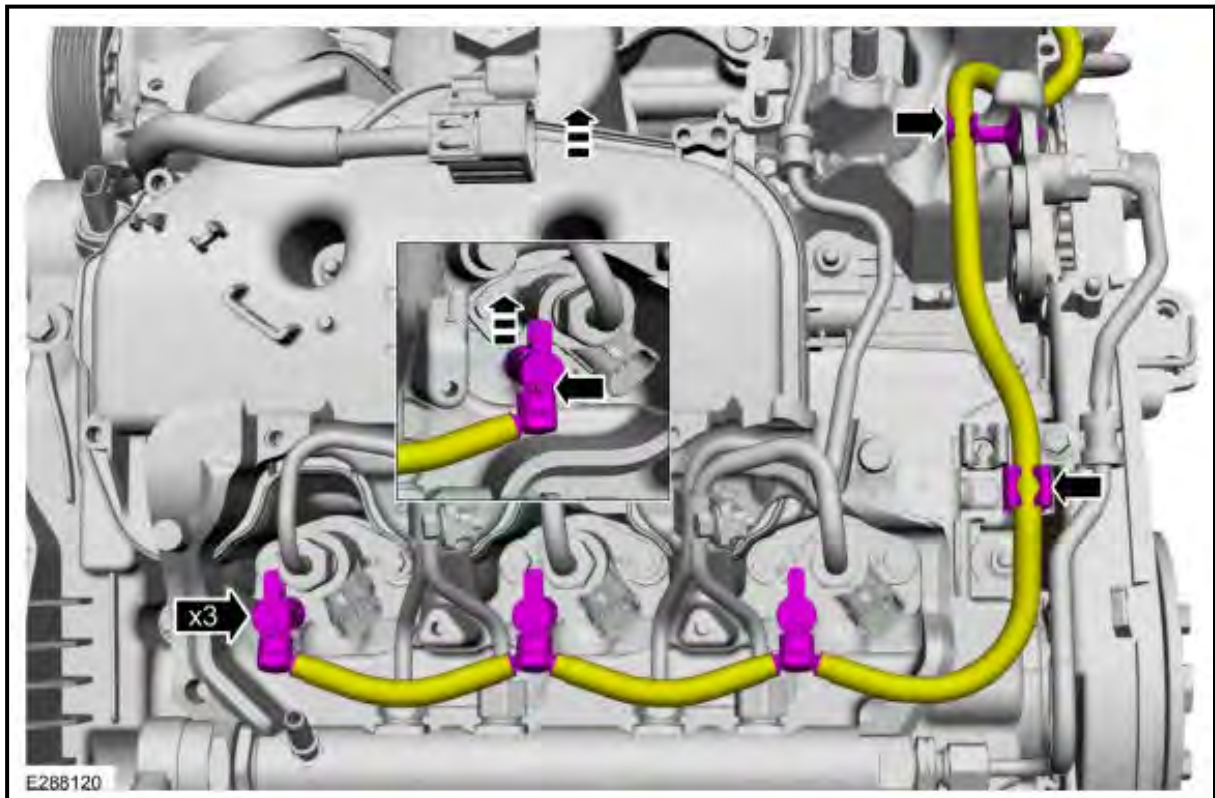


68. Remove the LH engine cover stud assemblies.

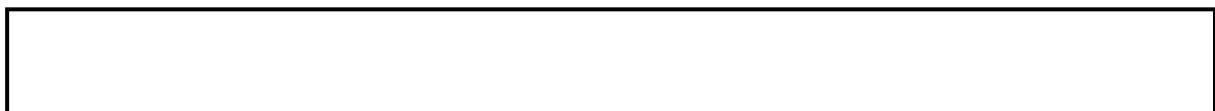


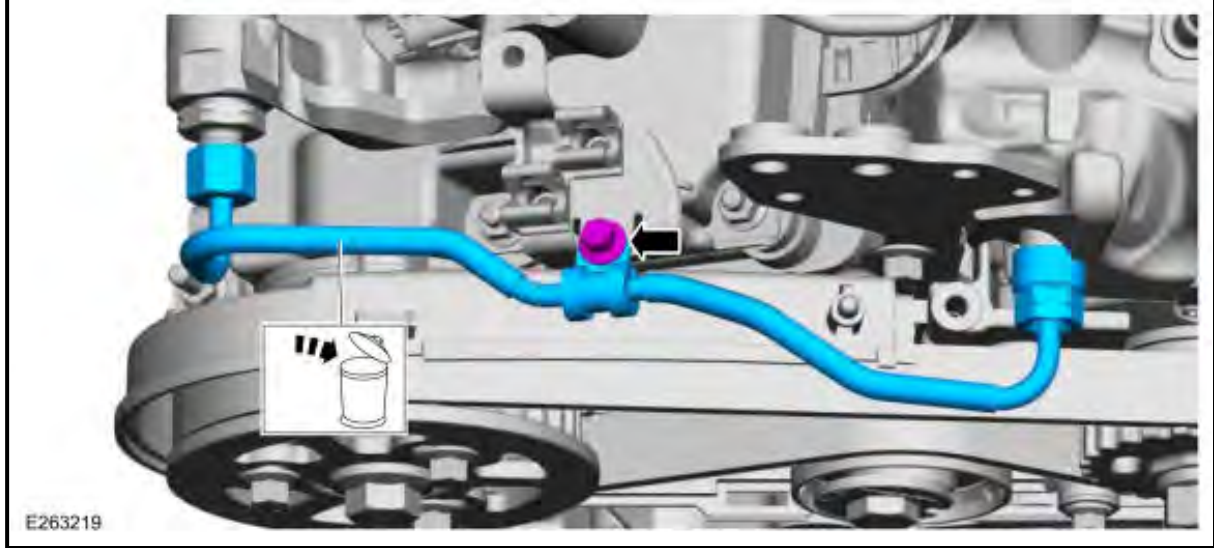


69. Disconnect and position aside the LH fuel return hose assembly.



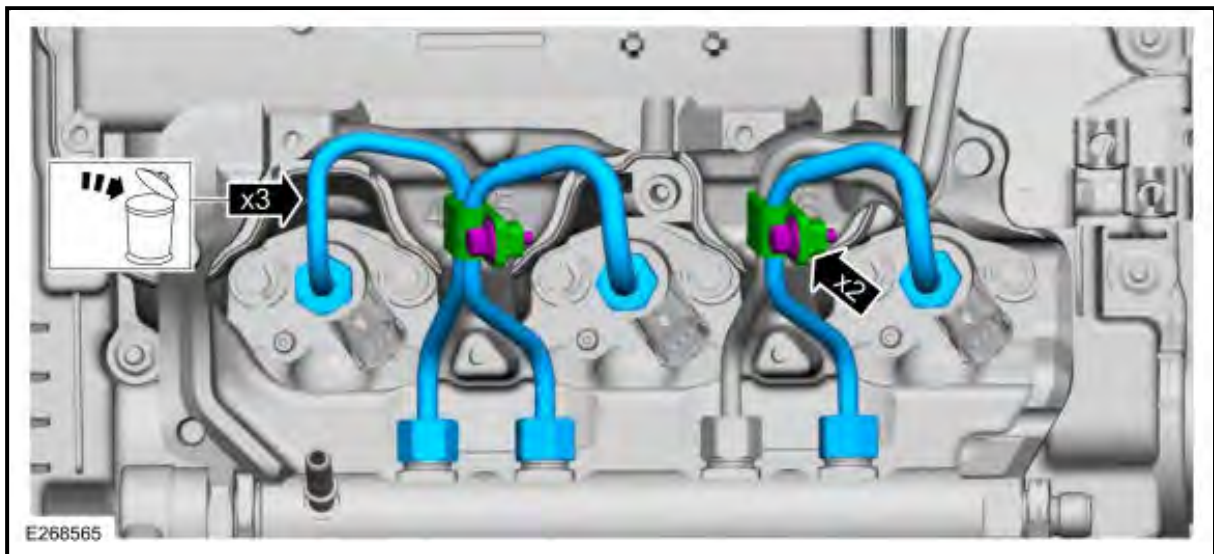
70. Remove the bolt. Remove and discard the LH fuel supply tube.





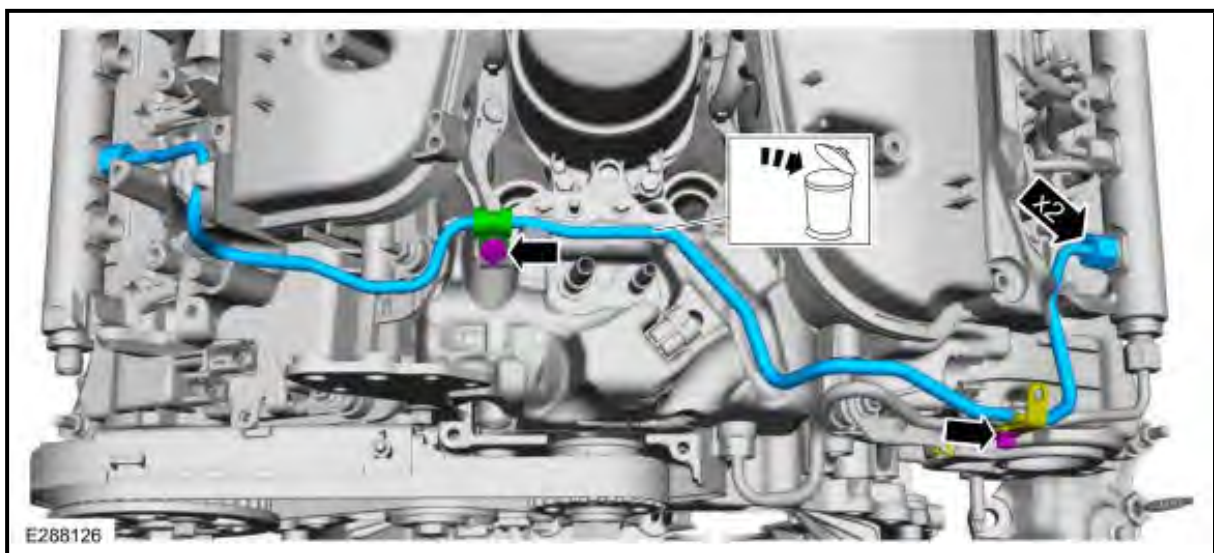
71.

- Remove the bolts and the clamp. Remove and discard the fuel injection pump balance tube. Remove the bolts and the clamps.
- Remove and discard the LH fuel injector supply tubes.

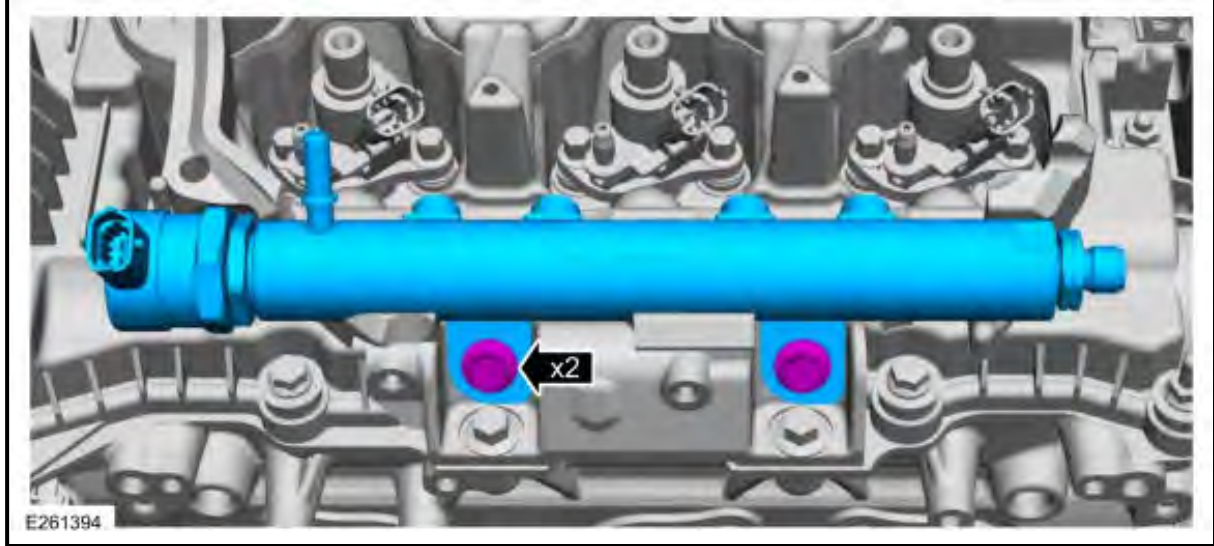


72.

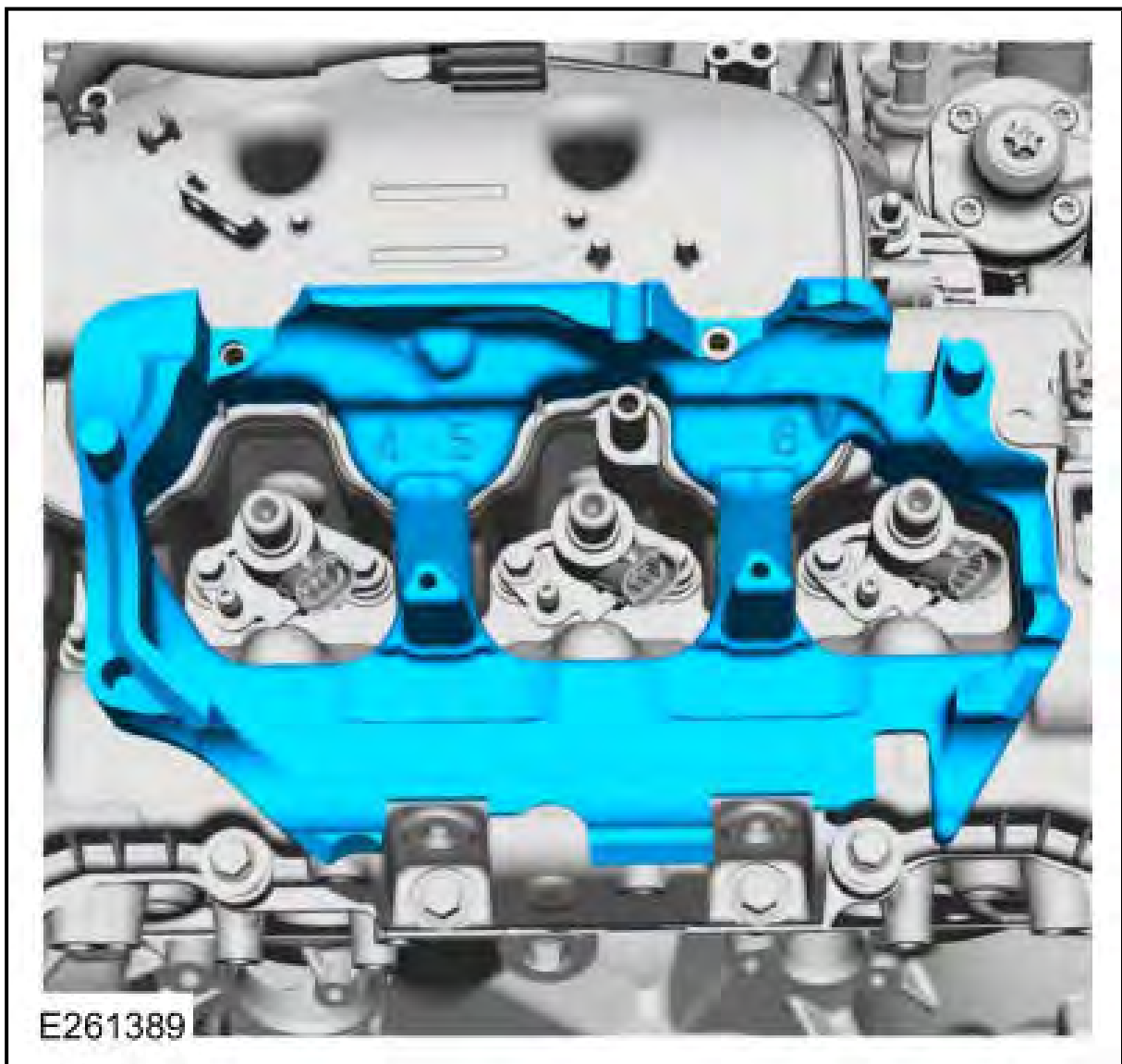
- Remove the bolts and the clamp.
- Remove and discard the fuel injection pump balance tube.



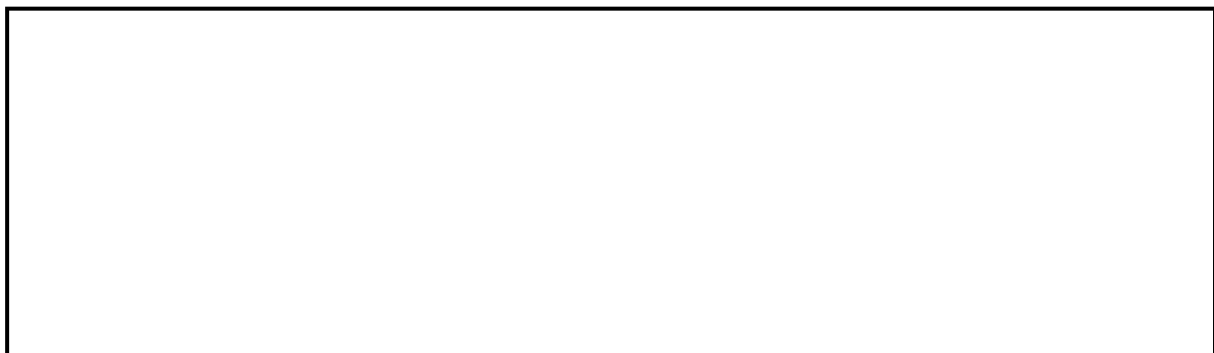
73. Remove the bolts and the LH fuel rail.

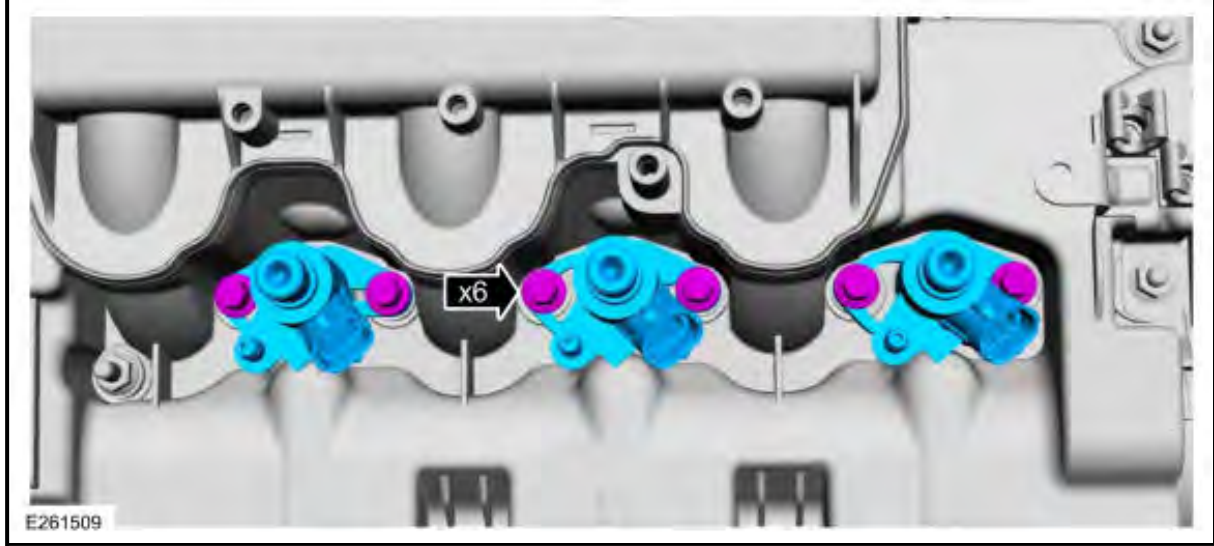


74. Remove the LH fuel injector noise insulator.



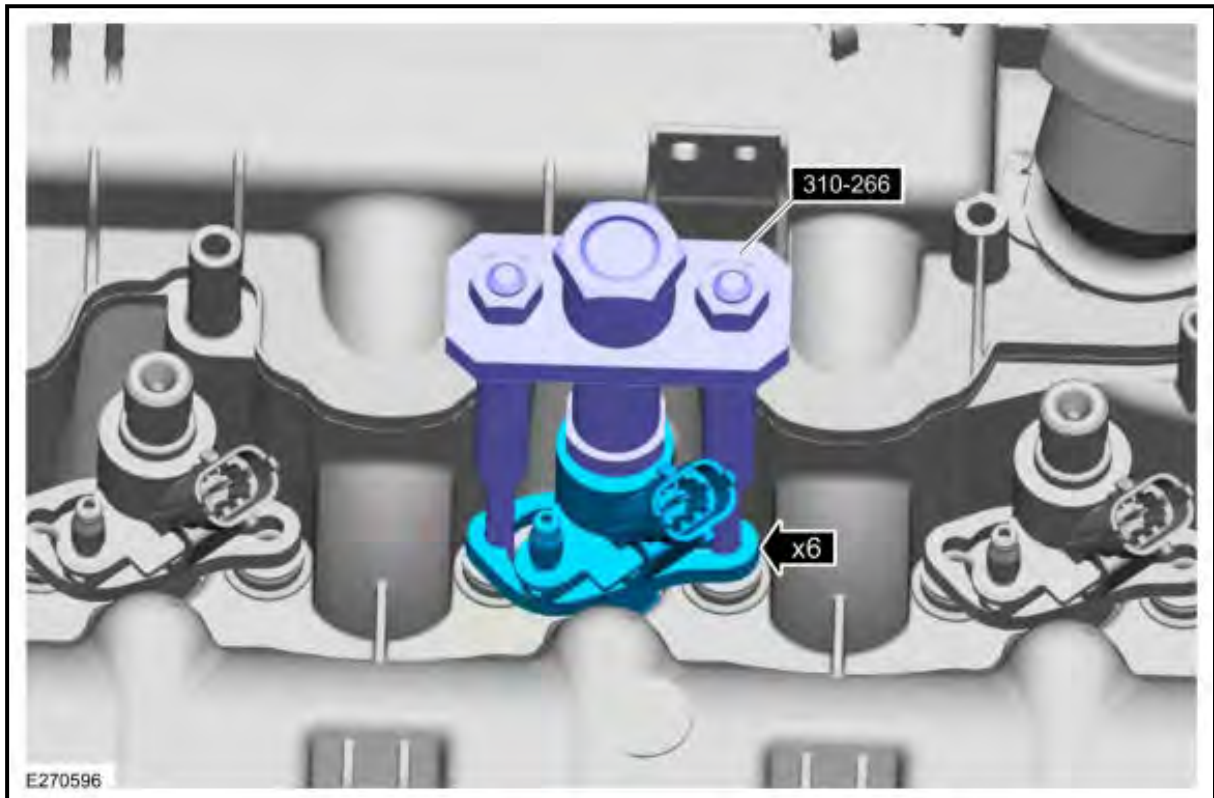
75. Remove the bolts for the LH fuel injectors.



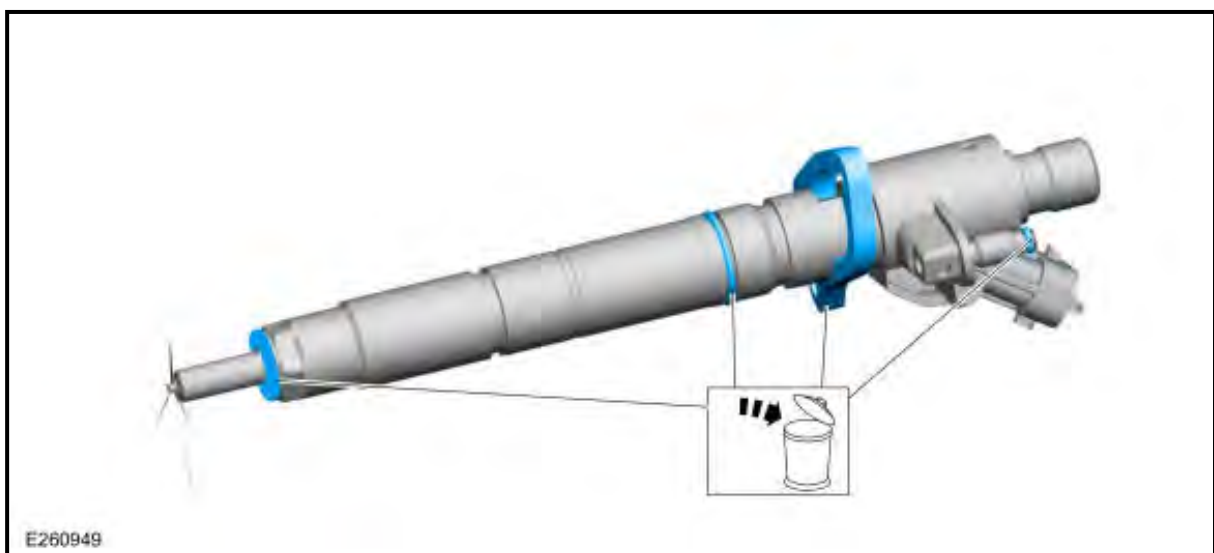


76. **NOTE:** Only one fuel injector shown.

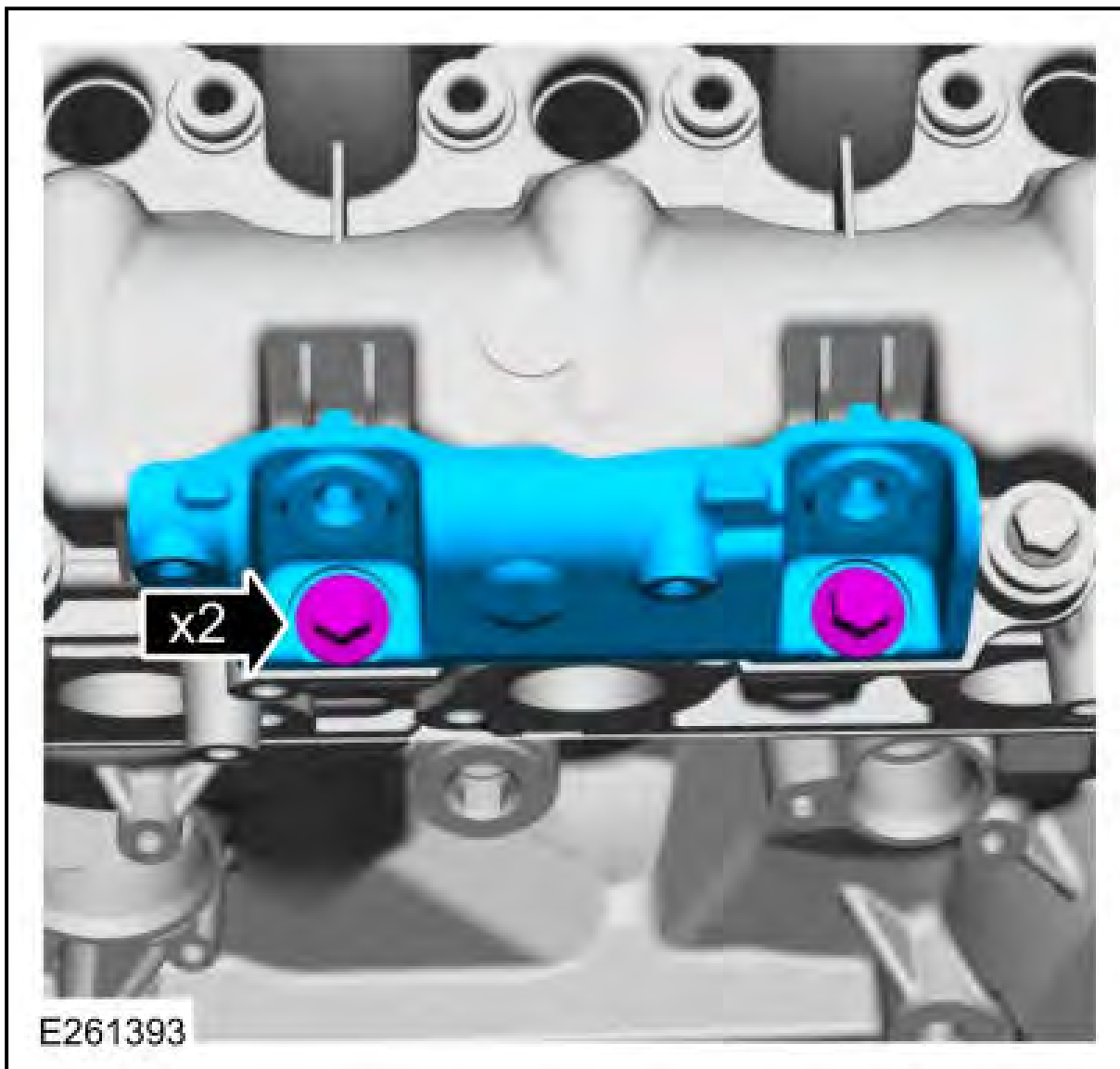
Using the special tool, remove the fuel injectors. Use Special Service Tool: 310-266 Remover, Fuel Injector.



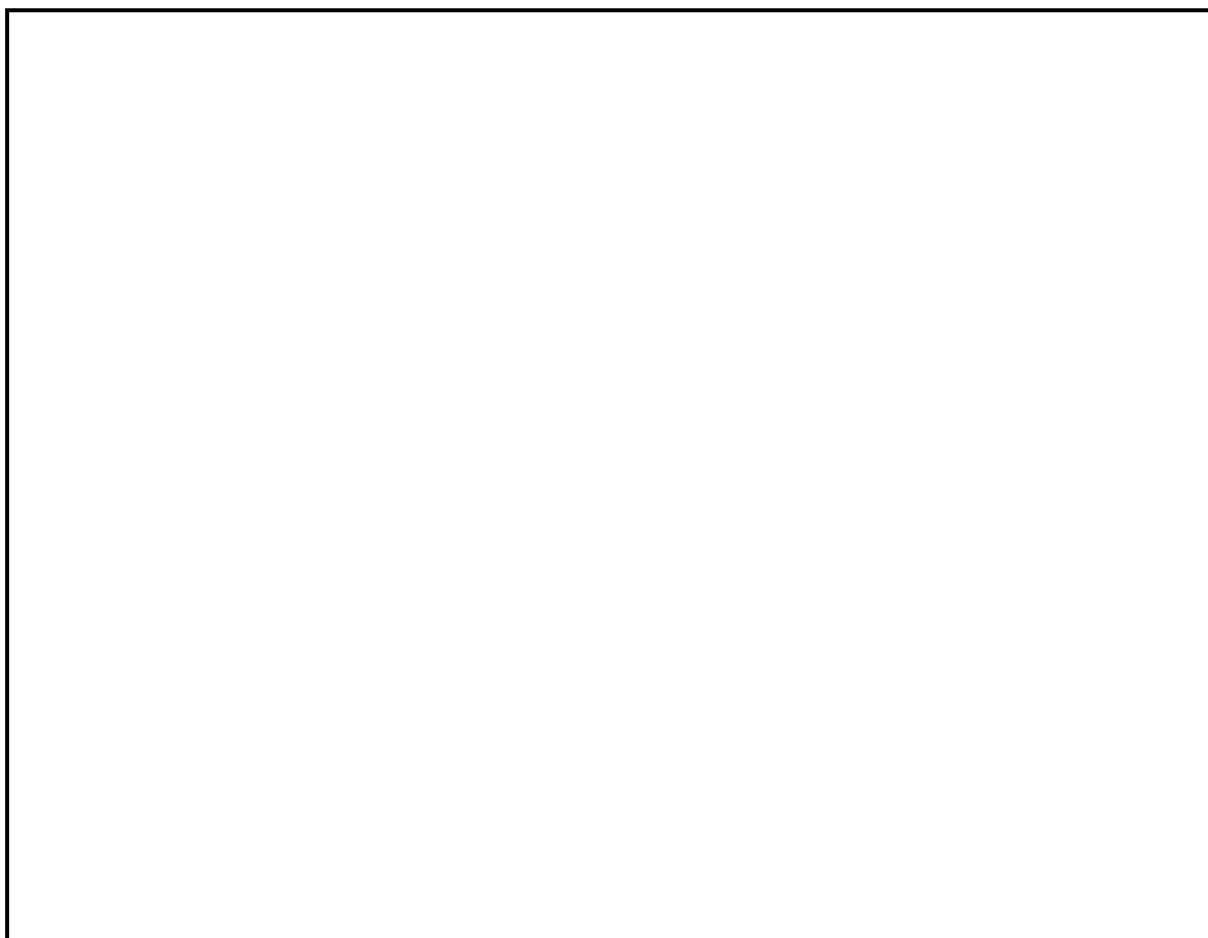
77. Remove and discard the sealing washer, the O-rings and the fuel injector hold down.



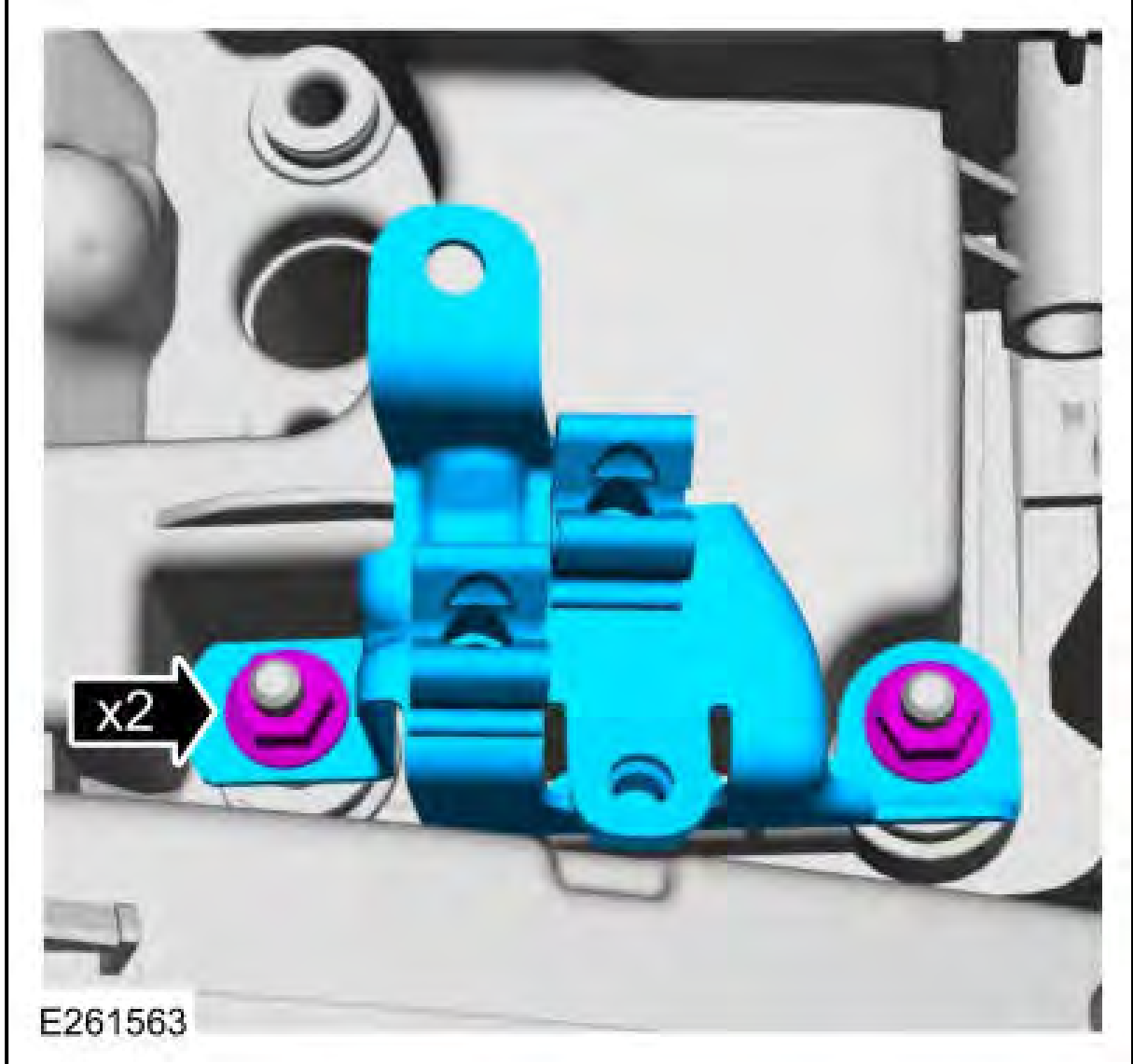
78. Remove the bolts and the LH fuel rail bracket.



79. Remove the nuts and the LH fuel tube bracket.

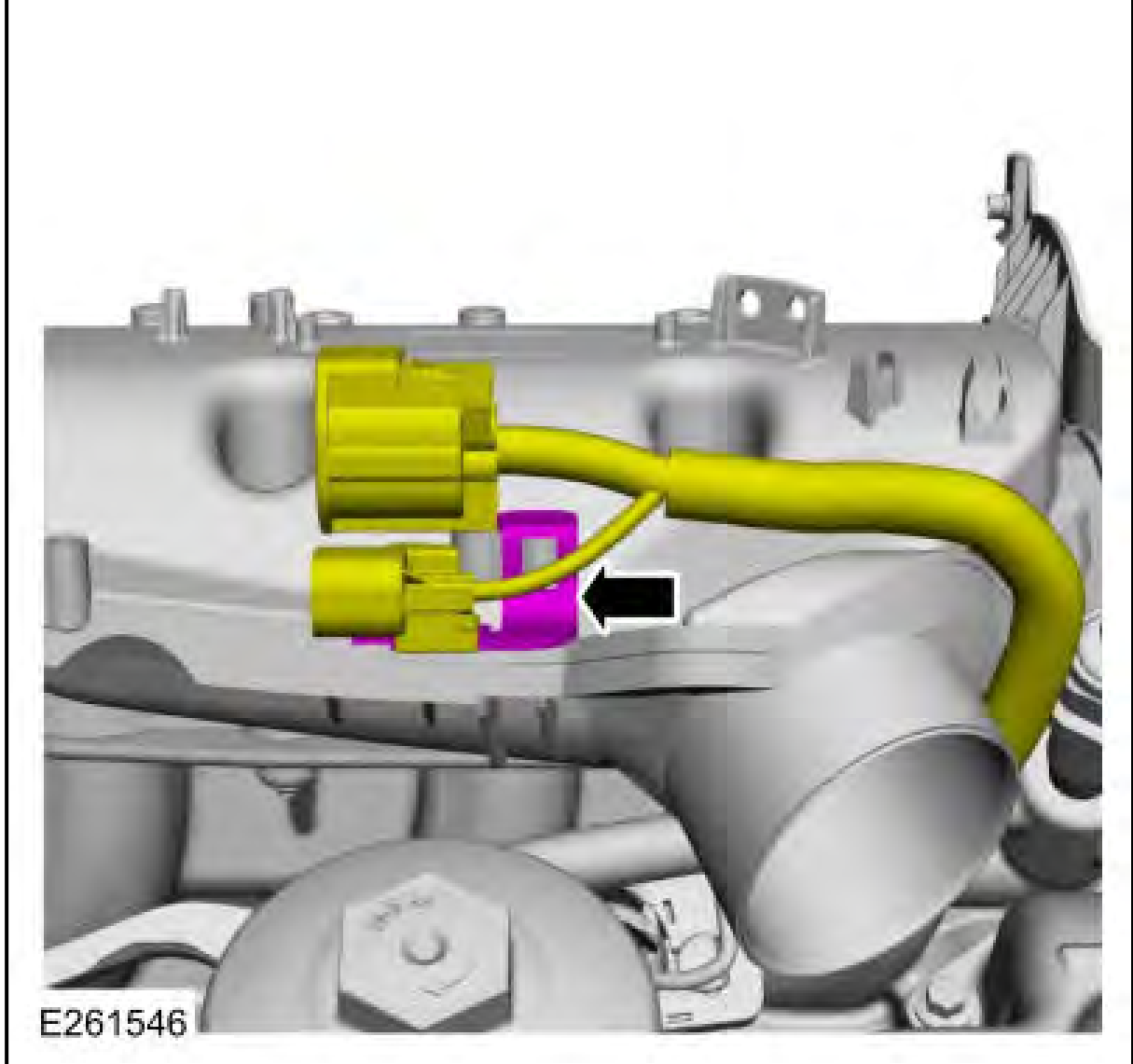




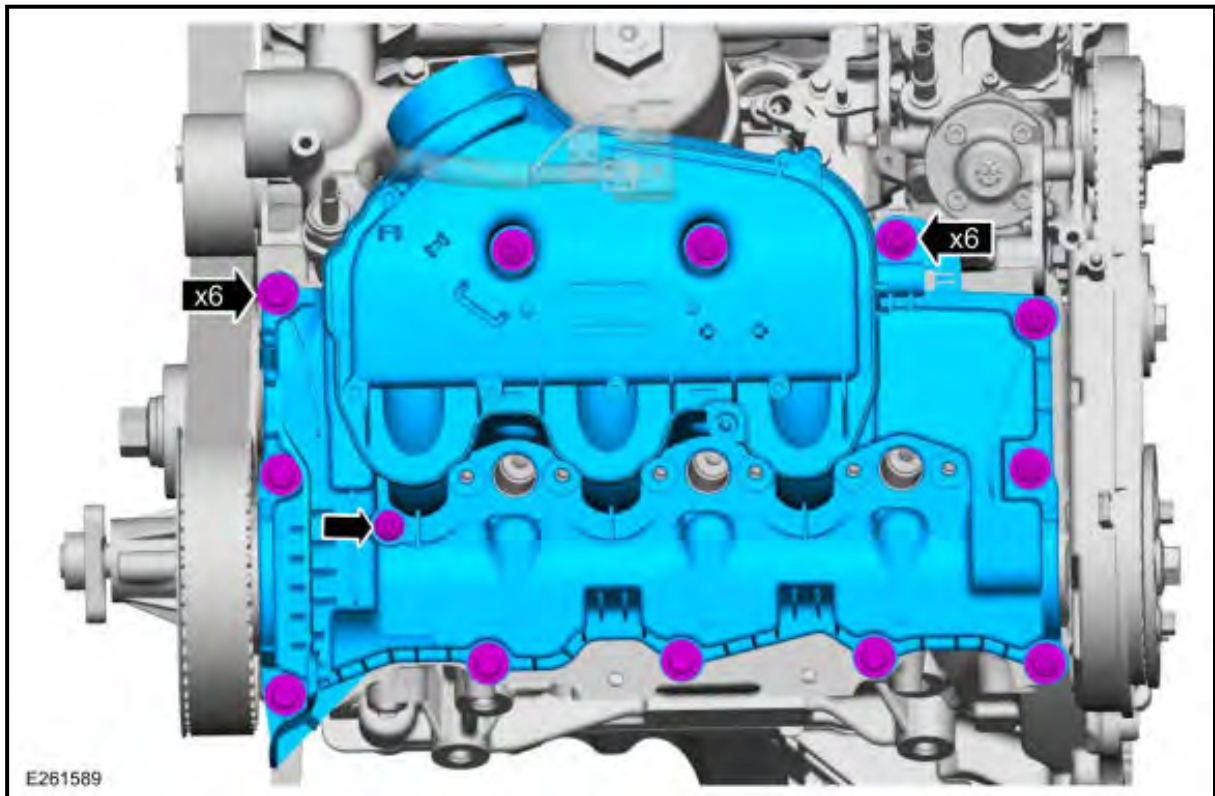


80. Disconnect the LH glow plug electrical connector.

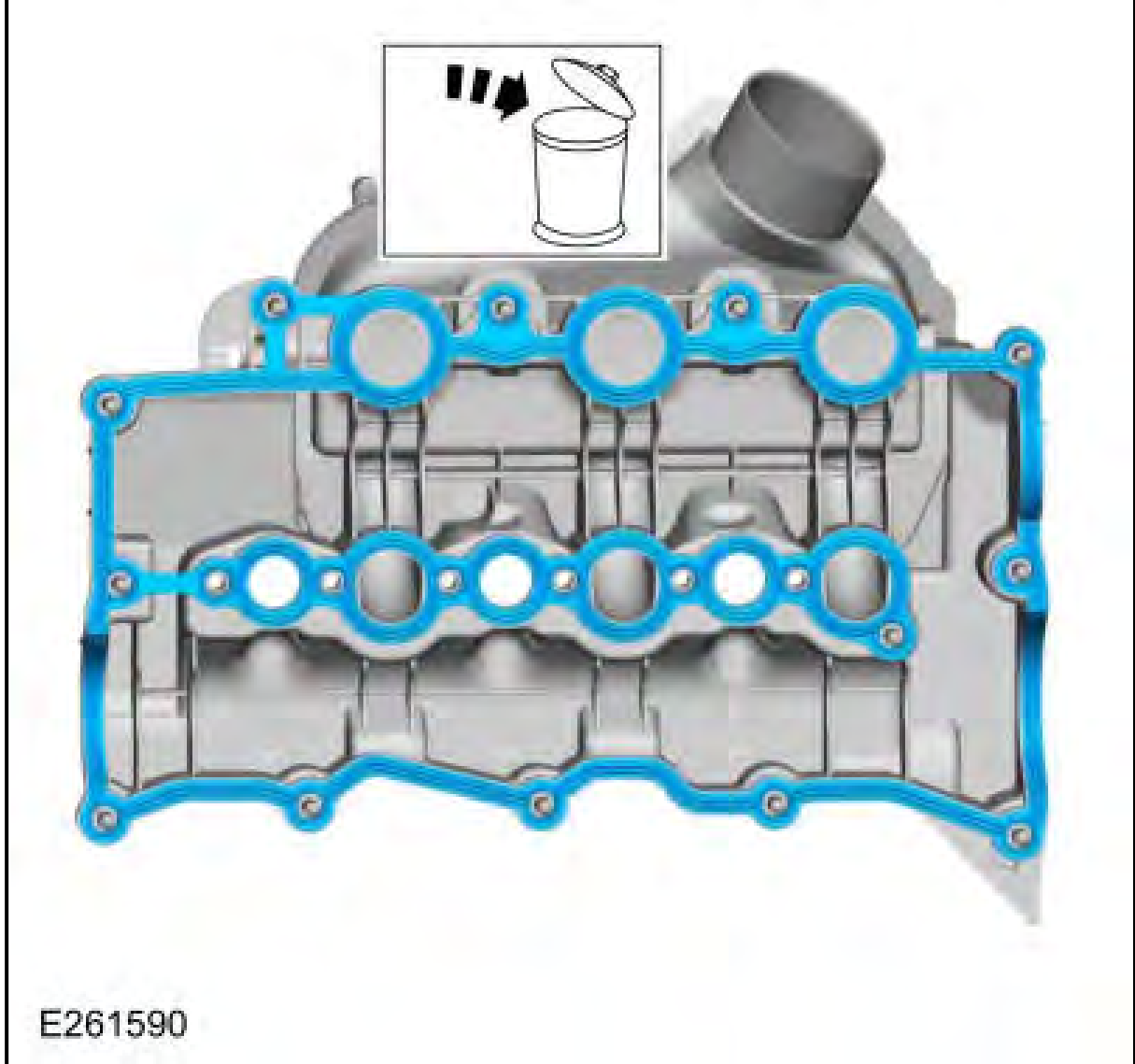




81. Loosen the fasteners and remove the LH valve cover.



82. Remove and discard the LH valve cover gasket.



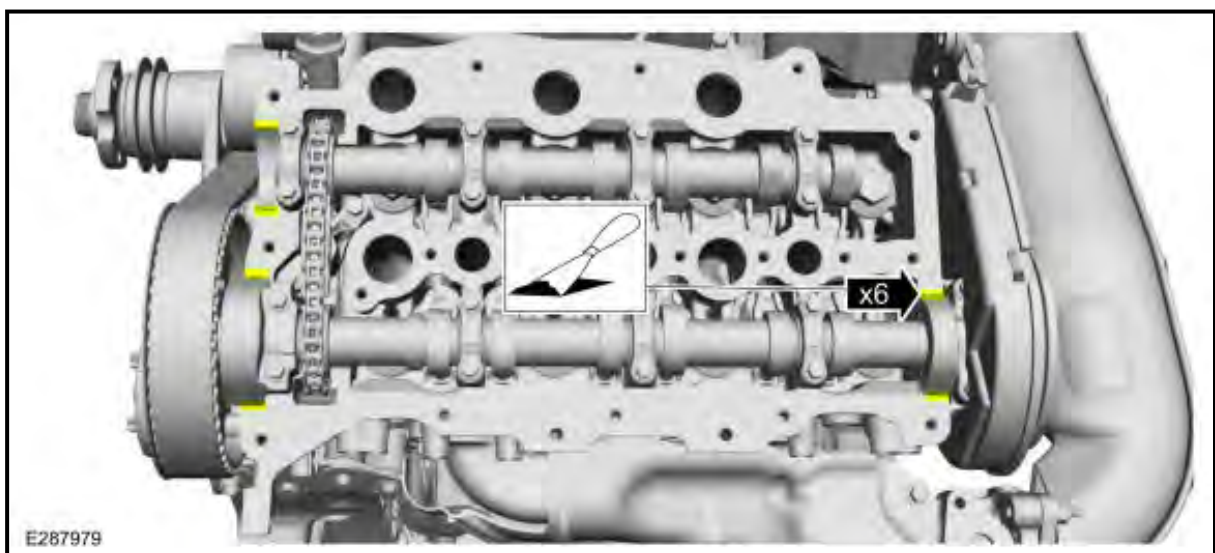
83. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.

Clean the valve cover mating surface of the cylinder head and engine front cover. REFER to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

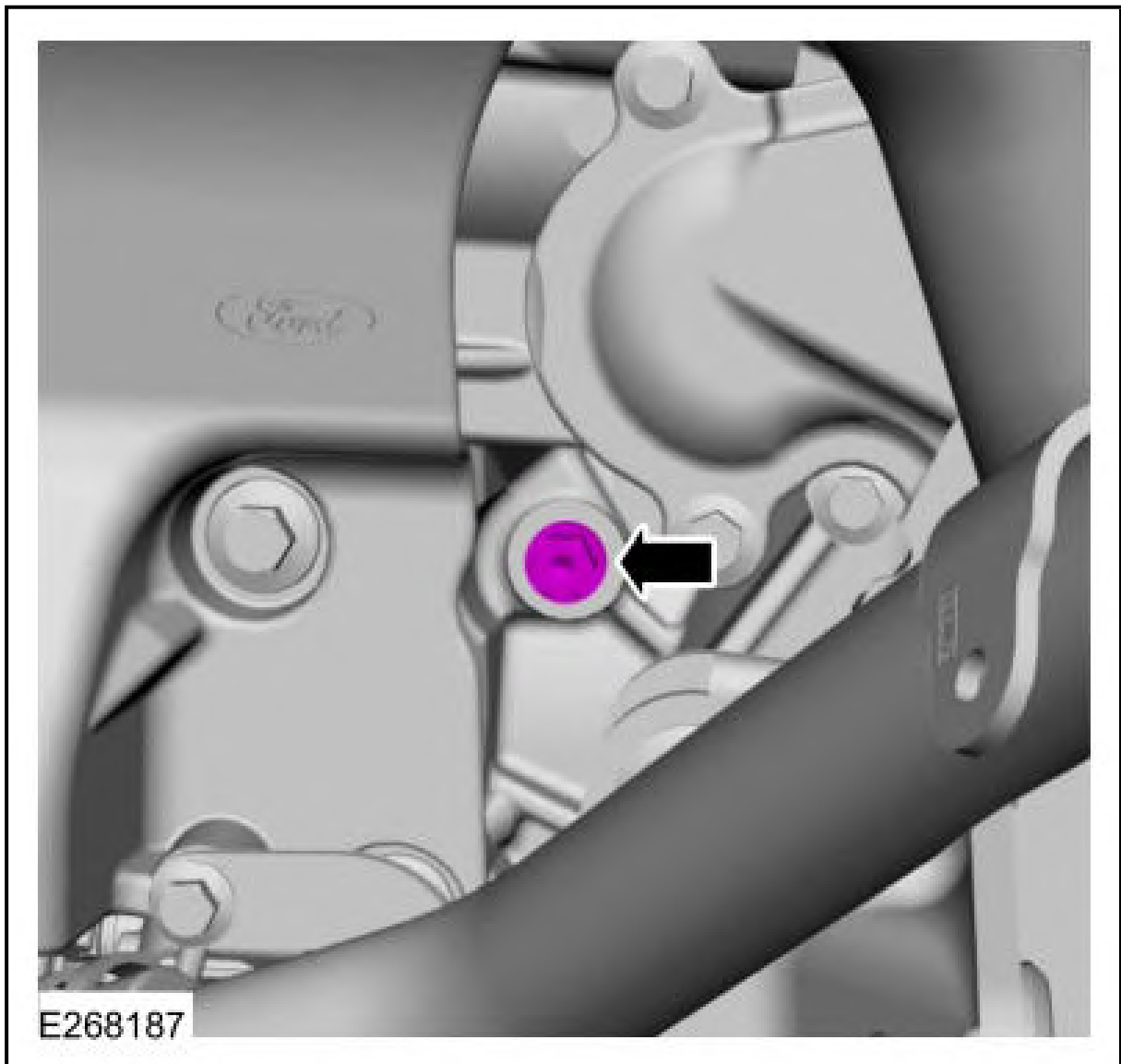
Material: Motorcraft <sup>®</sup> Silicone Gasket Remover / ZC-30-A

Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B



84. Remove the timing pin bolt at the left front of the engine.

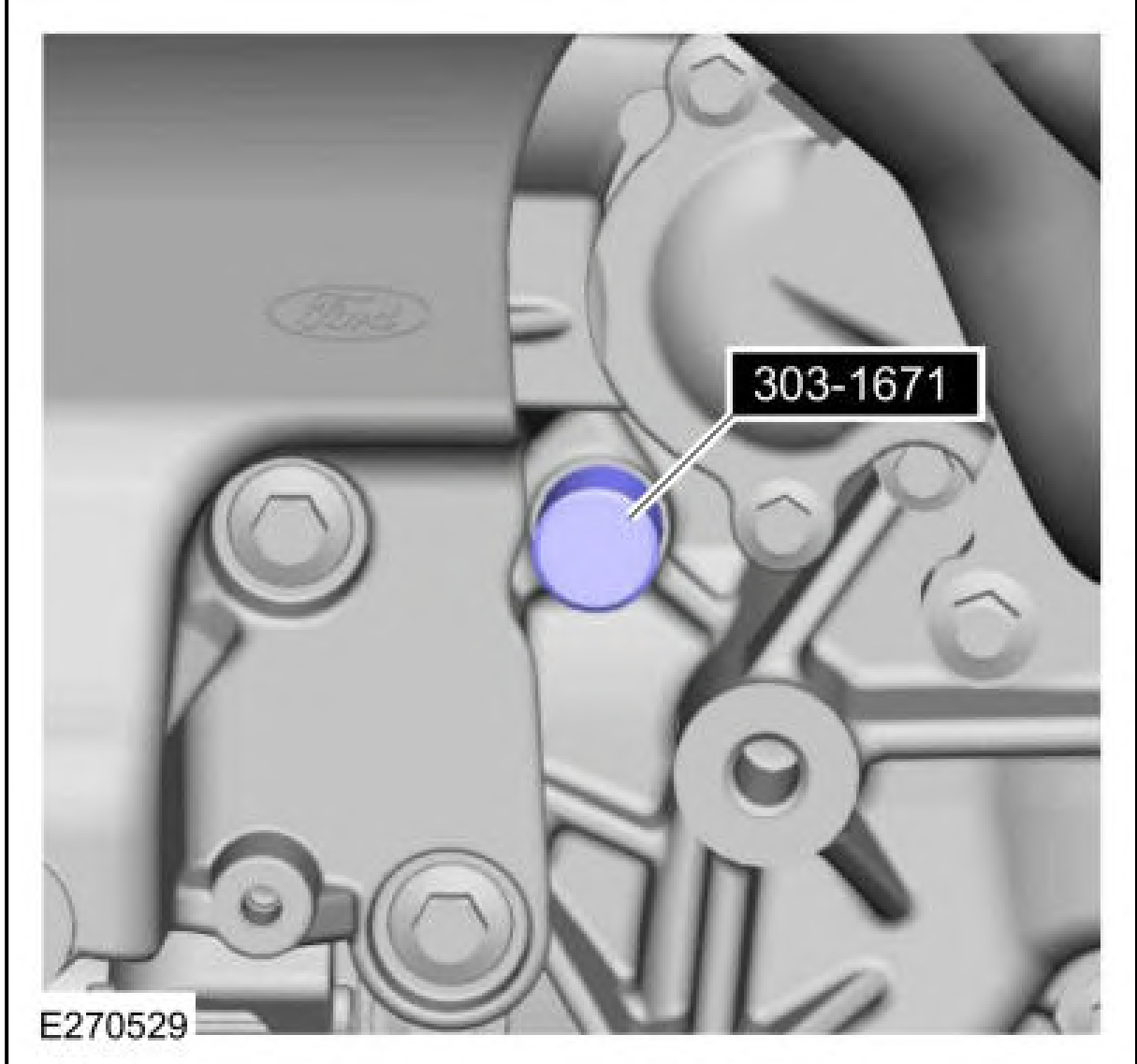


85. Install special tool.

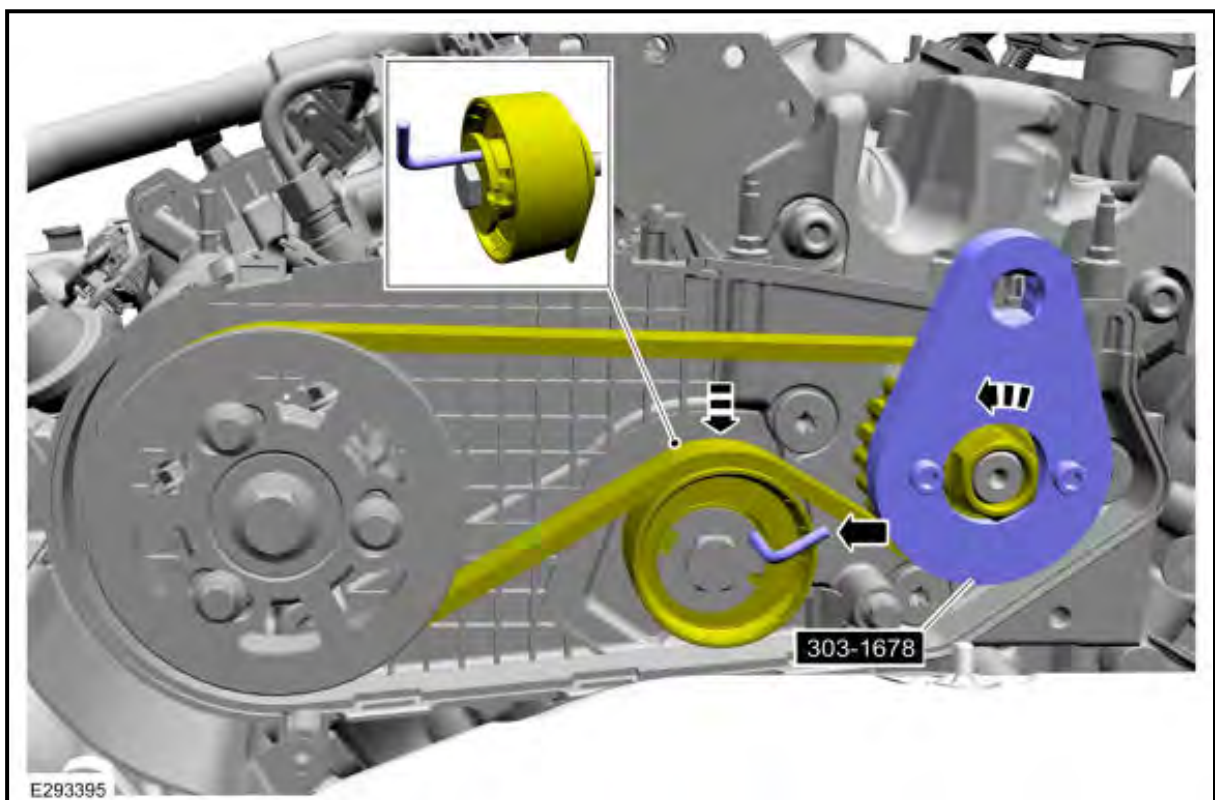
- **NOTE:** Only rotate the crankshaft clockwise.
- NOTE:** Verify that the camshaft timing holes are aligned with the cylinder head.
- NOTE:** The Locking Crankshaft Pin must be bottomed out against the cylinder block.

Rotate the crankshaft clockwise so the crankshaft contacts the locking crankshaft pin. Use Special Service Tool: 303-1671 Pin, Locking Crankshaft.



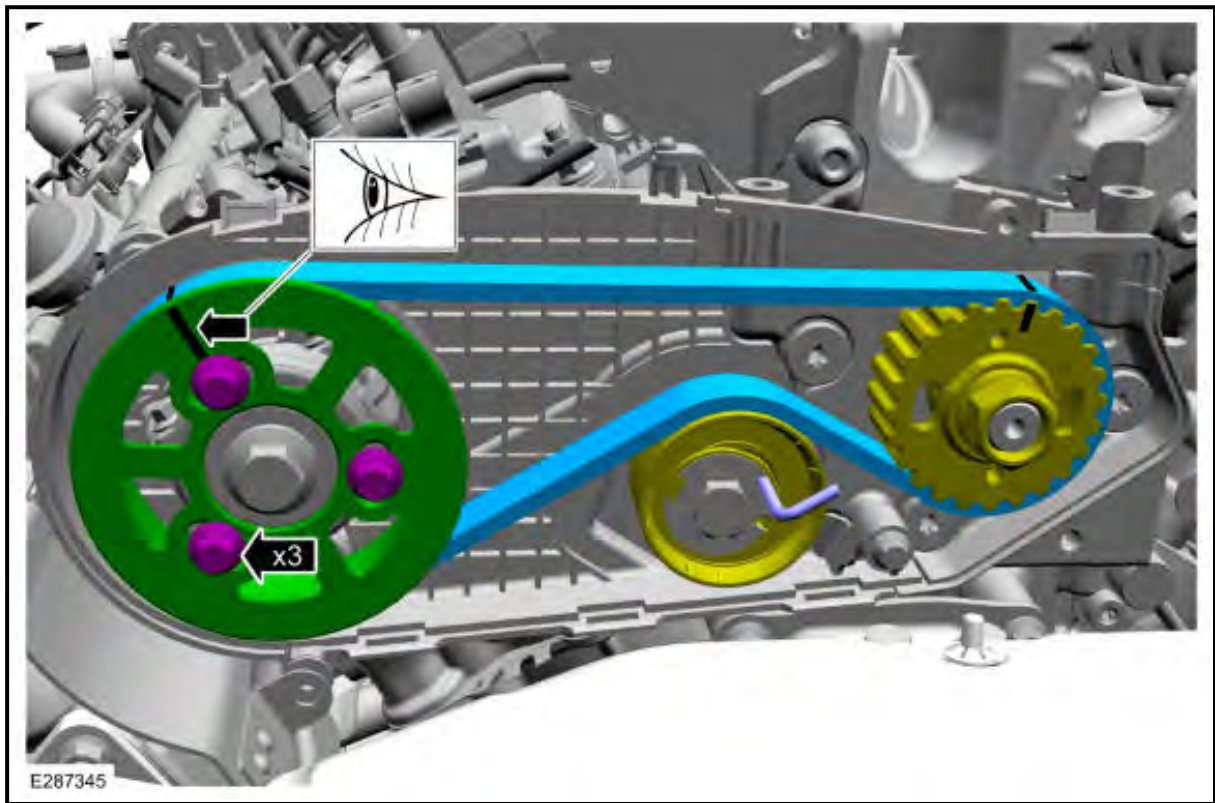


86. Using the special tool, rotate the fuel pump sprocket to push down on the READ belt tensioner until the openings are aligned, install the lock pin. Use Special Service Tool: 303-1678 Remover, Fuel Pump Pulley Holding Tool.

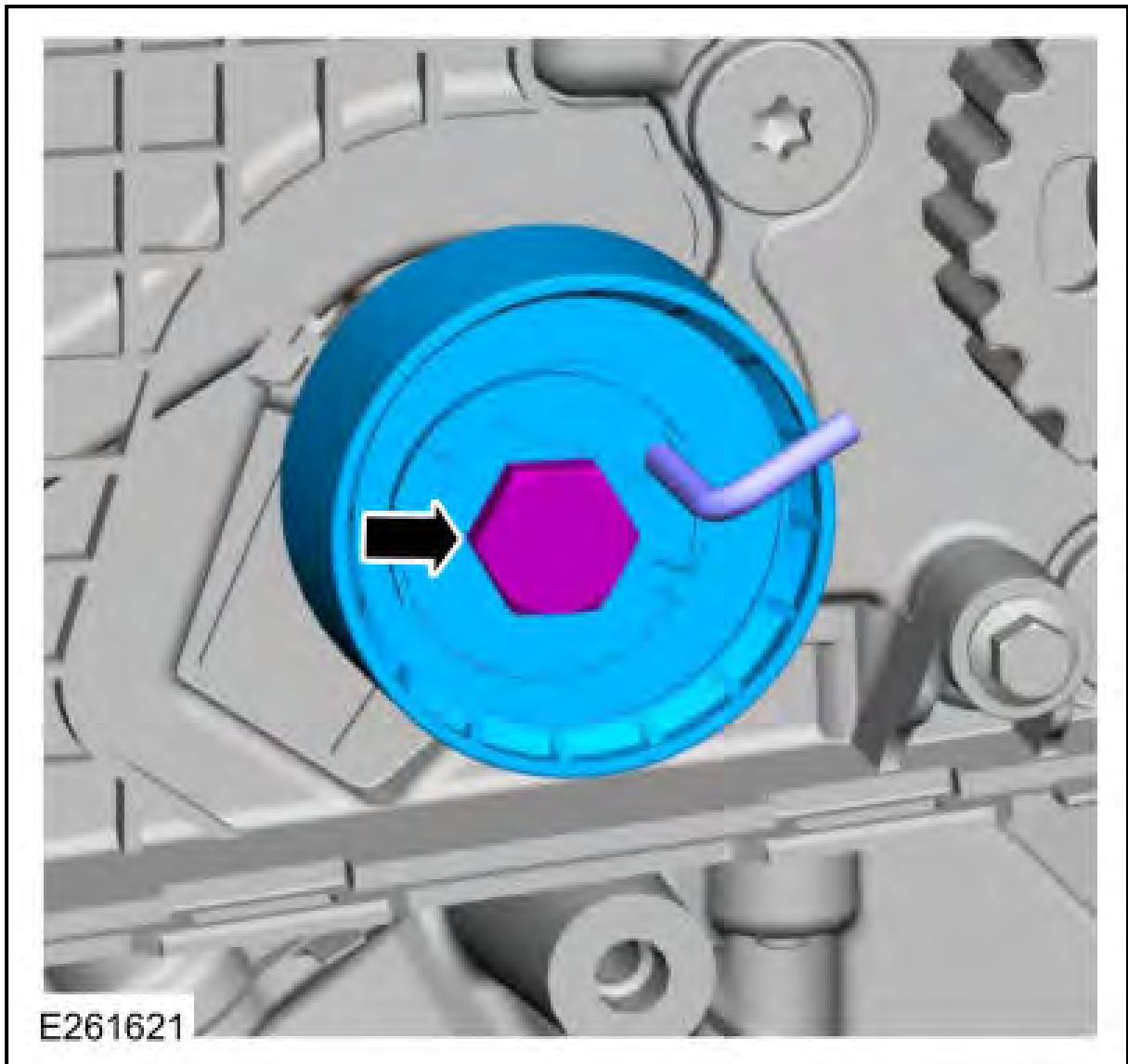


87. **NOTE:** Note the position of the camshaft pulley prior to removal.

Remove the bolts, the camshaft pulley and the READ belt.

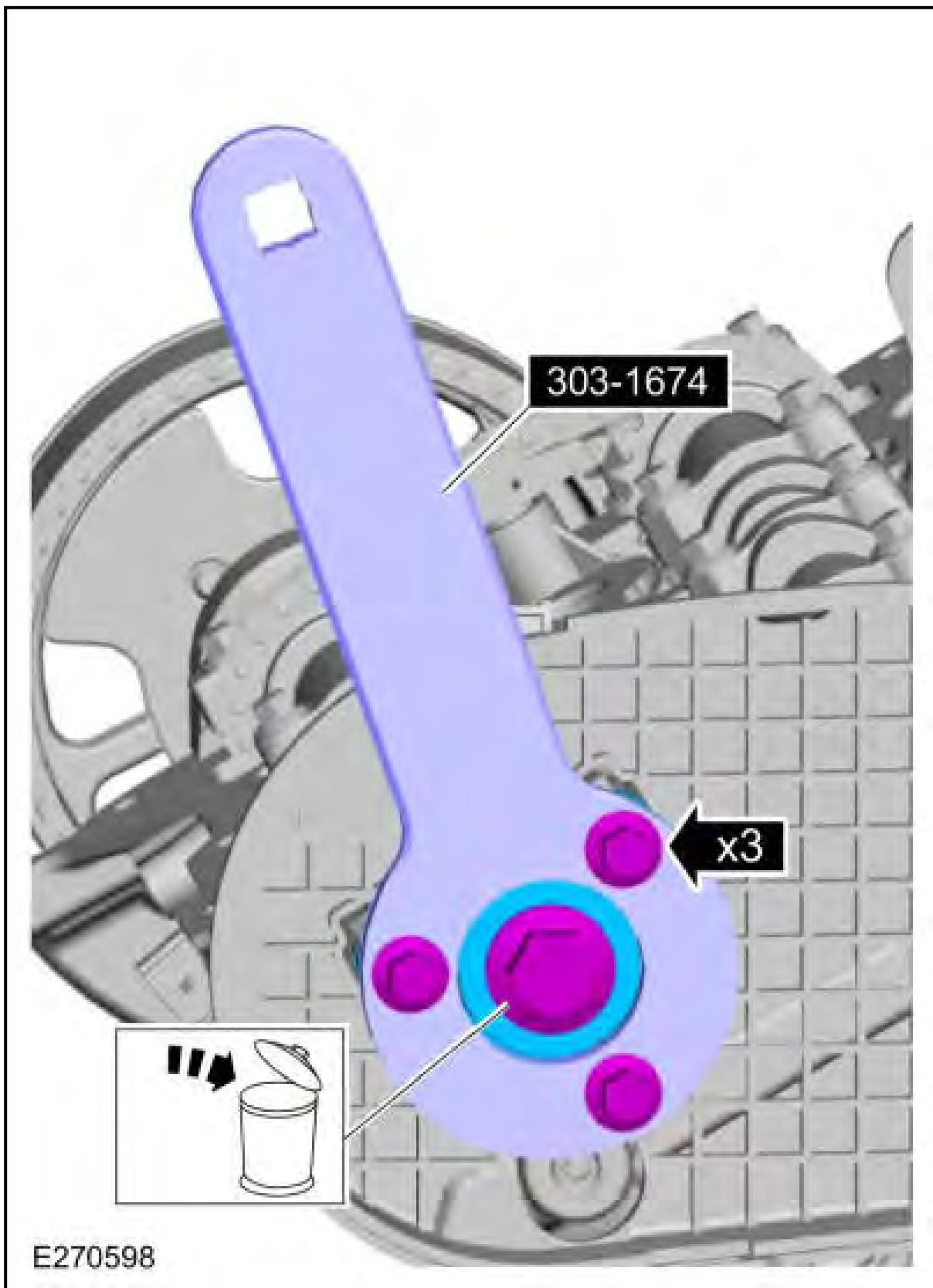


88. Remove the bolt and the READ belt tensioner.



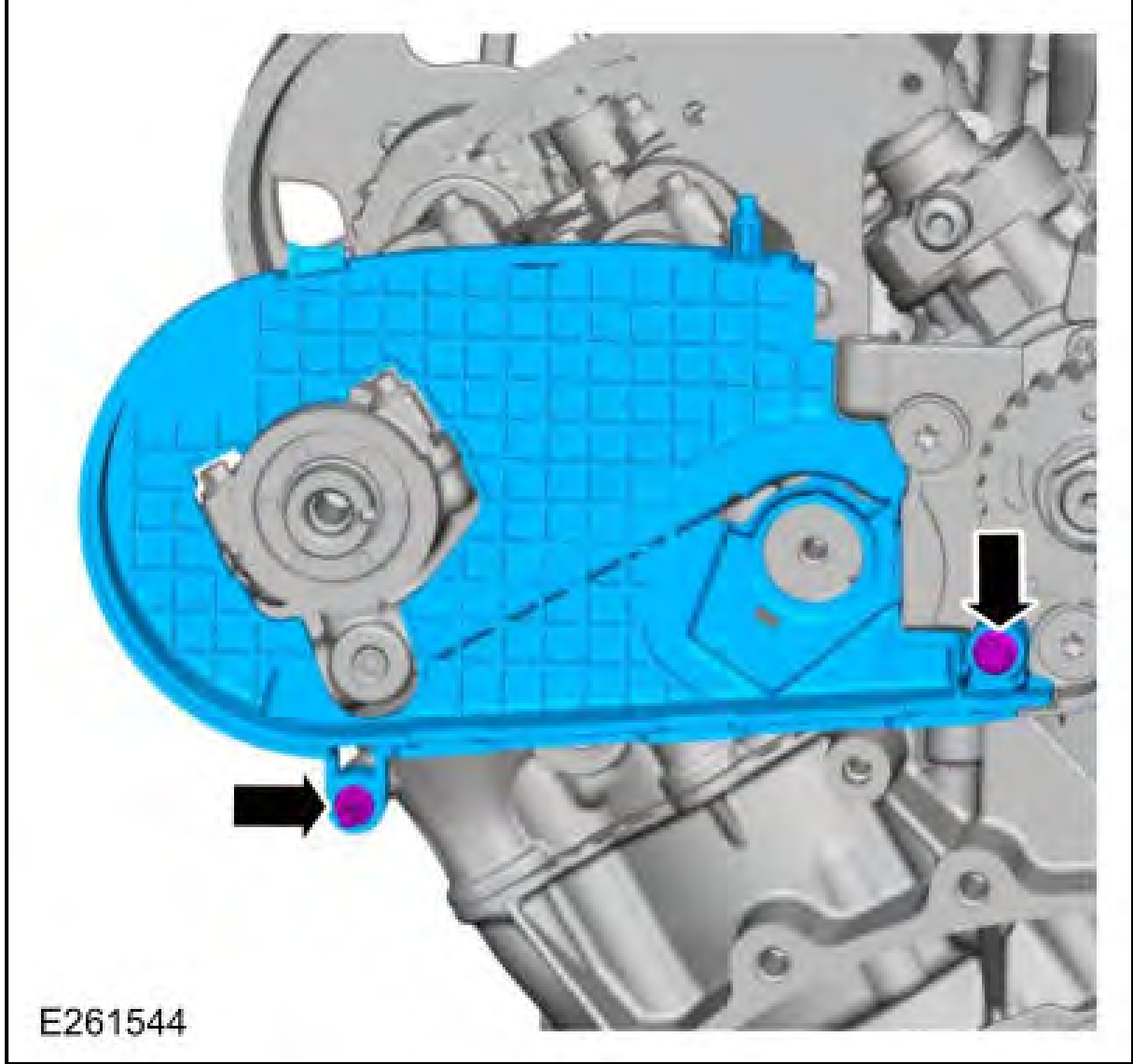
89. **NOTE:** Use the original bolts for the special tool.

Using the special tool, remove the bolt and the camshaft gear hub. Discard the bolt. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.

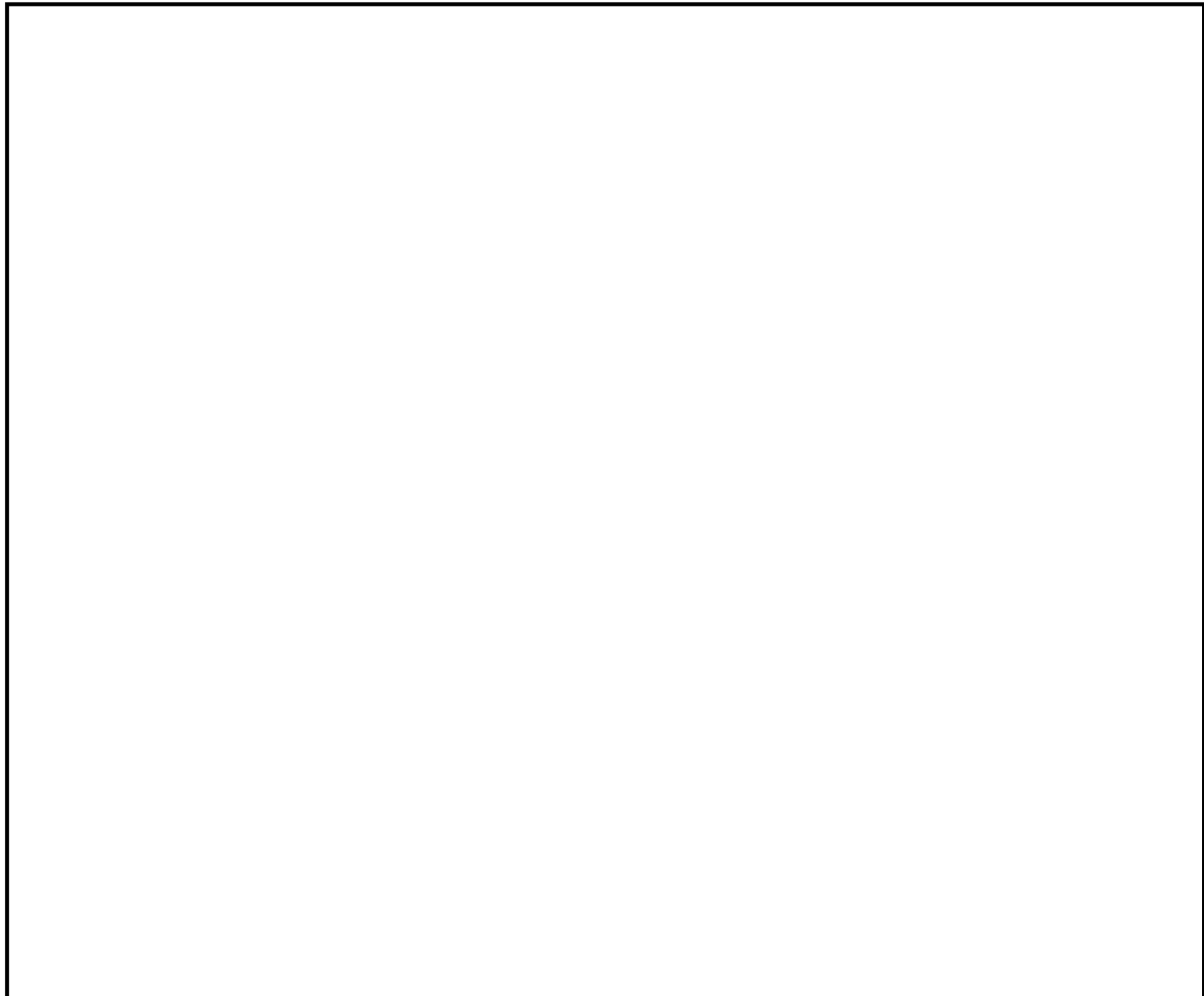


90. Remove the nut, the bolt and the accessory drive cover.

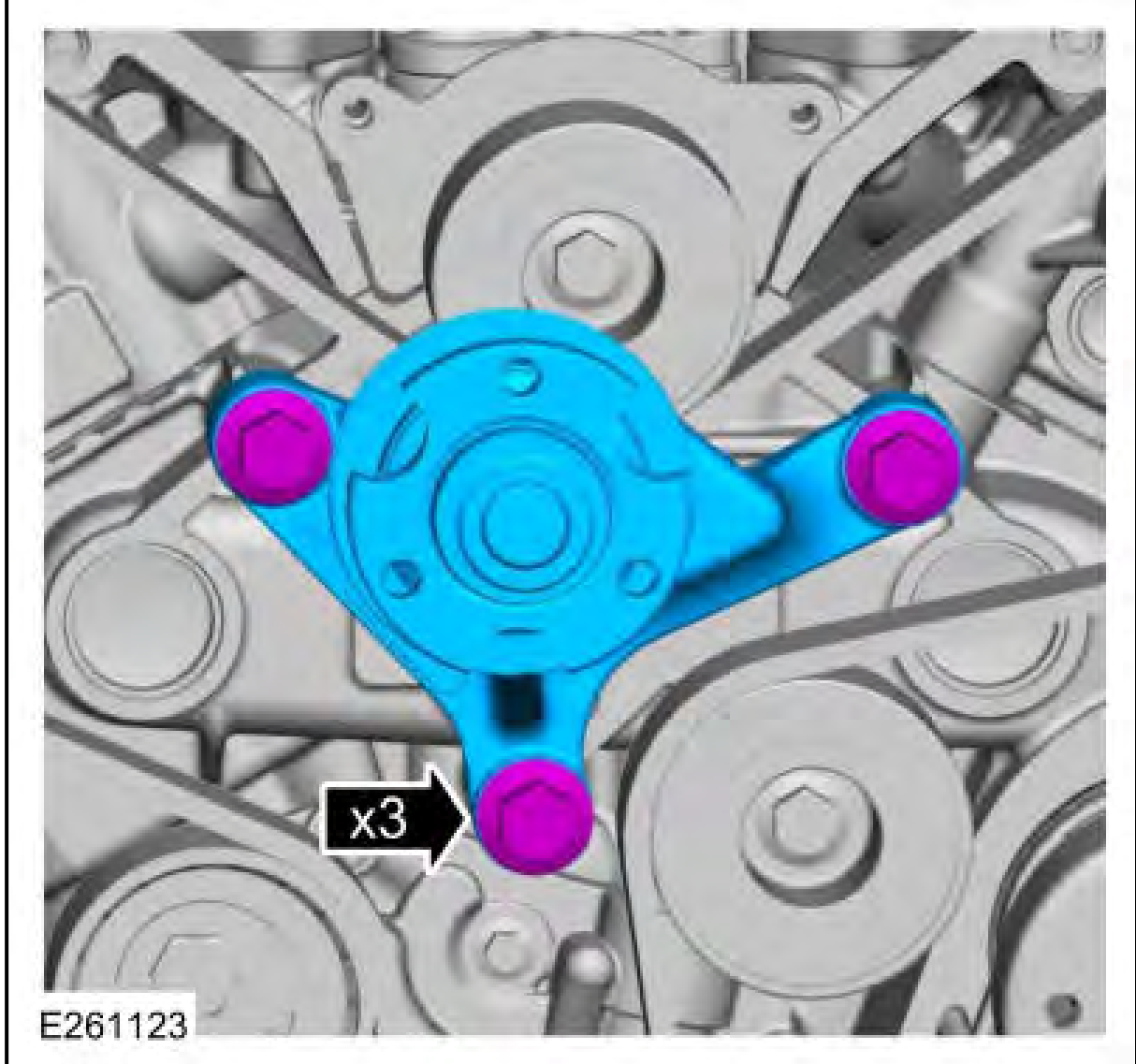




91. Remove the bolts and the fan drive.

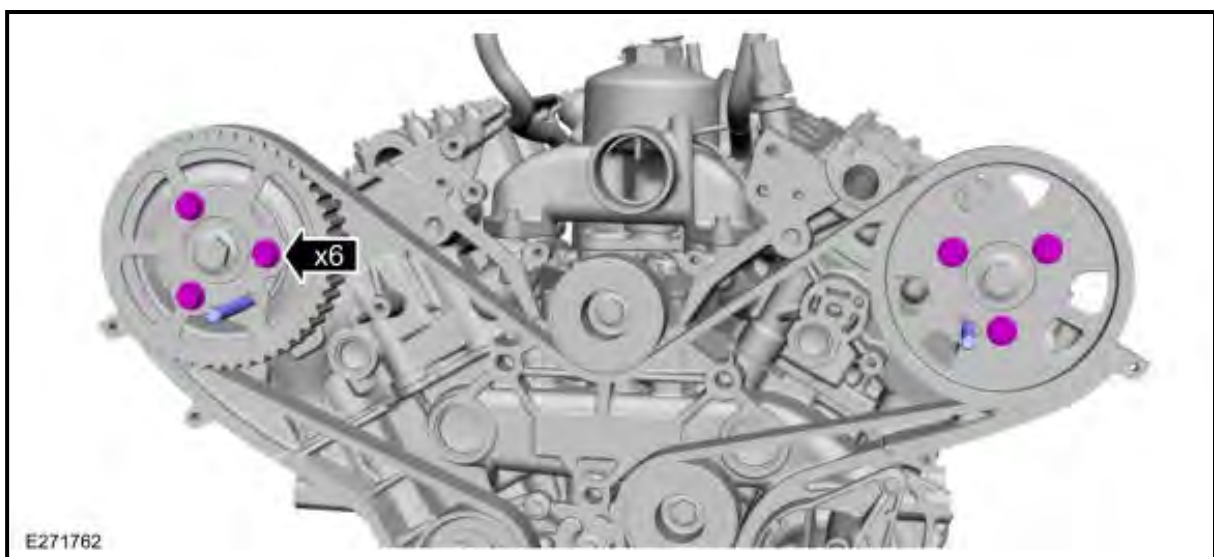






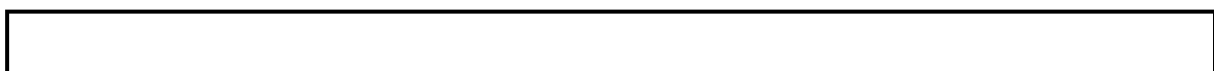
92.

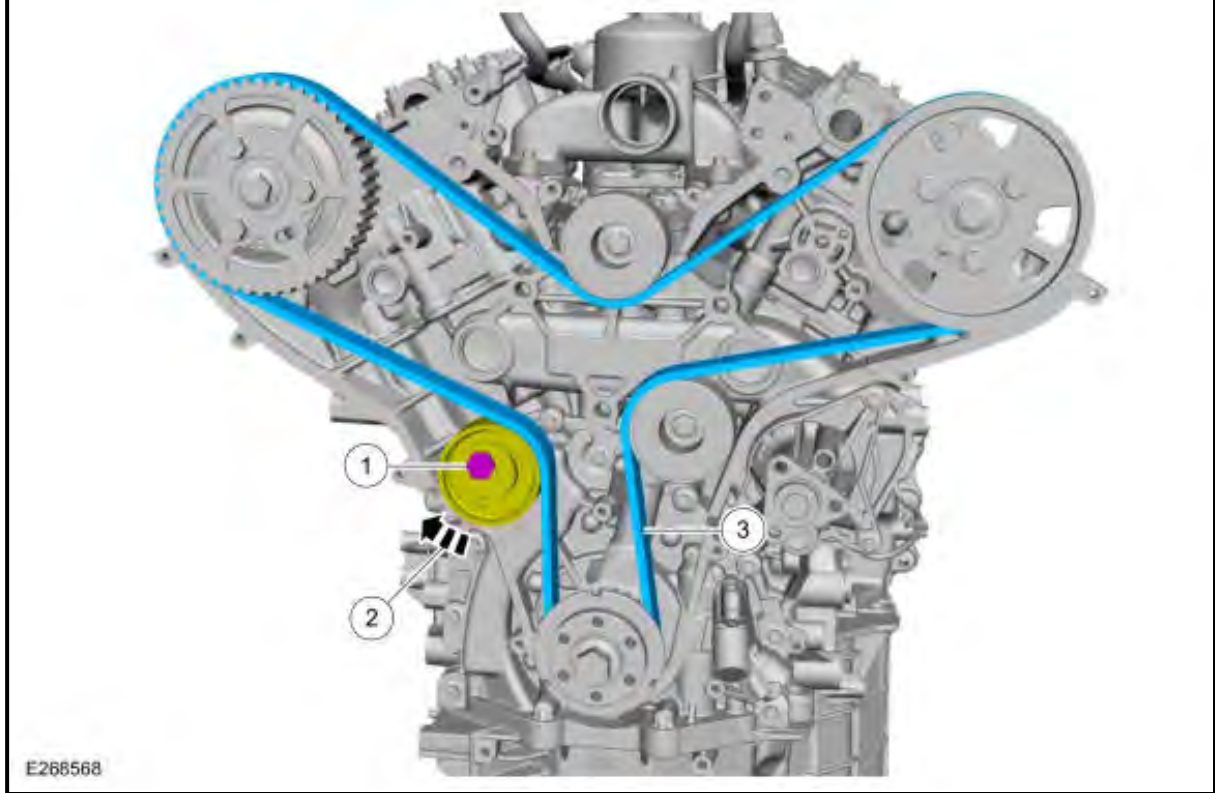
- Using the special tools, verify the camshaft timing. Use Special Service Tool: 303-1670 Pins, Camshaft Locking.
- Loosen the bolts on the camshaft pulleys.



93.

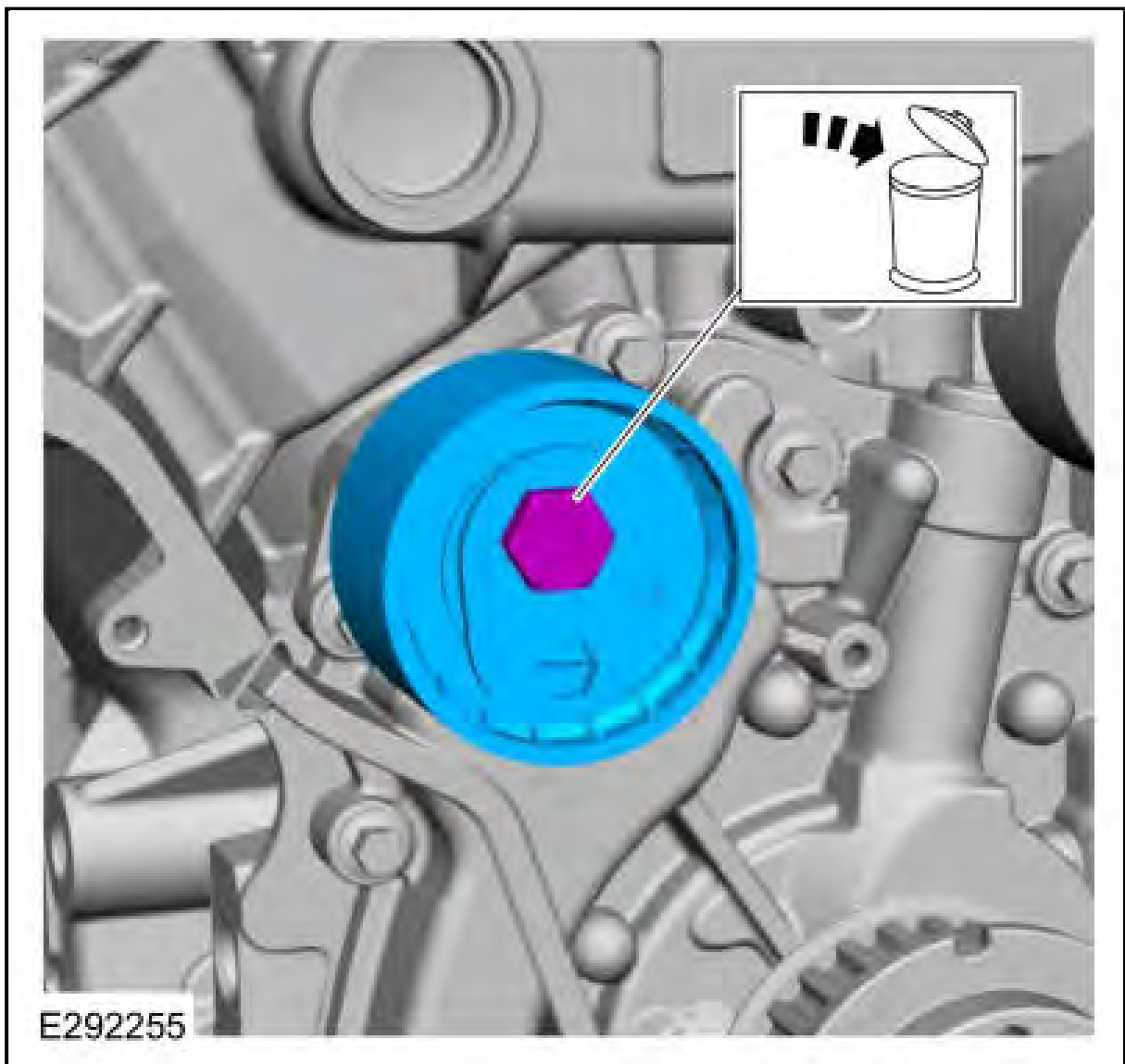
1. Loosen the timing belt tensioner bolt.
2. Rotate the timing belt tensioner clockwise.
3. Remove the timing belt.





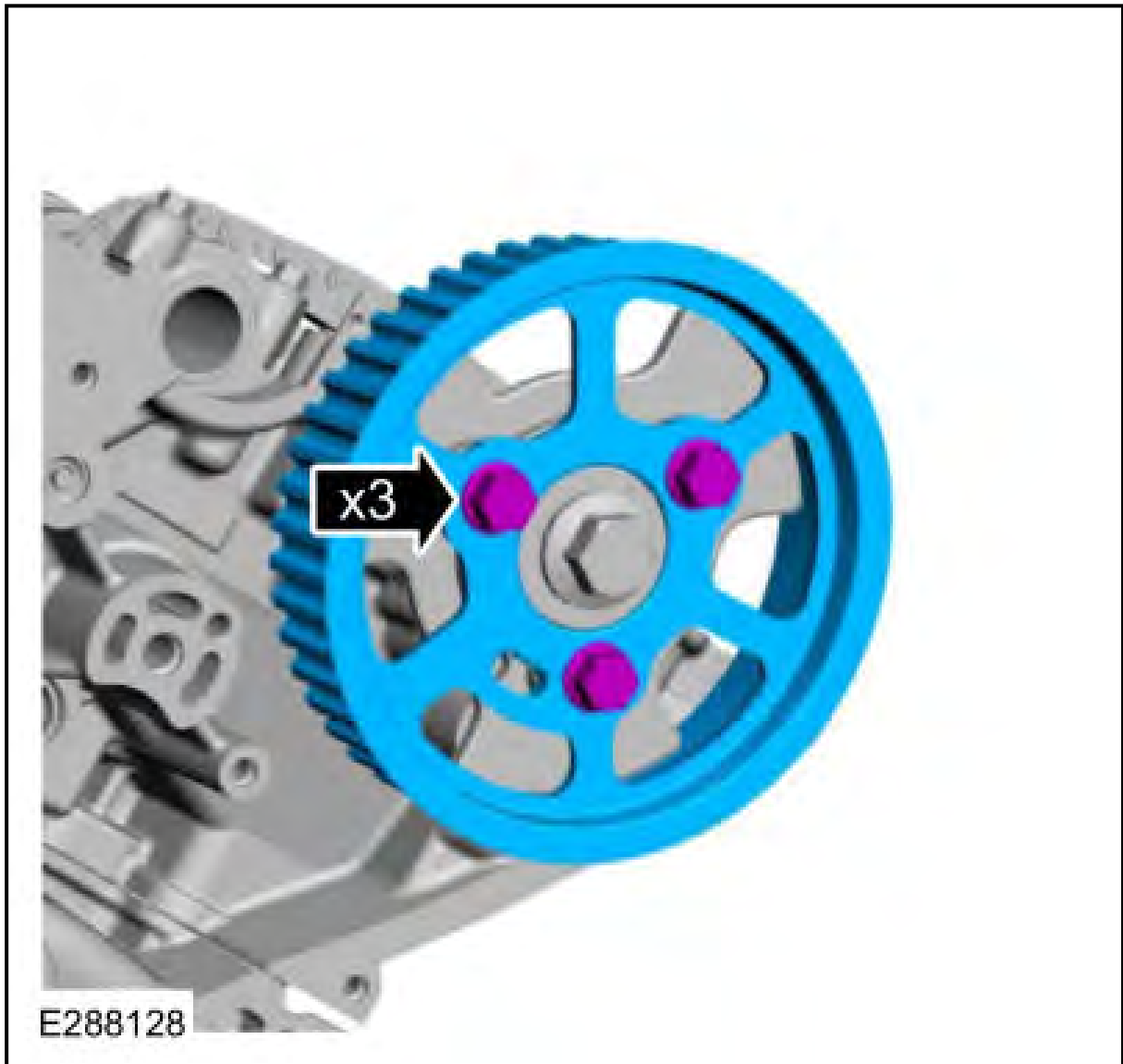
94. **NOTE:** Replace the timing belt tensioner if damage or excessive wear is found.

Remove the bolt and the timing belt tensioner. Discard the bolt.



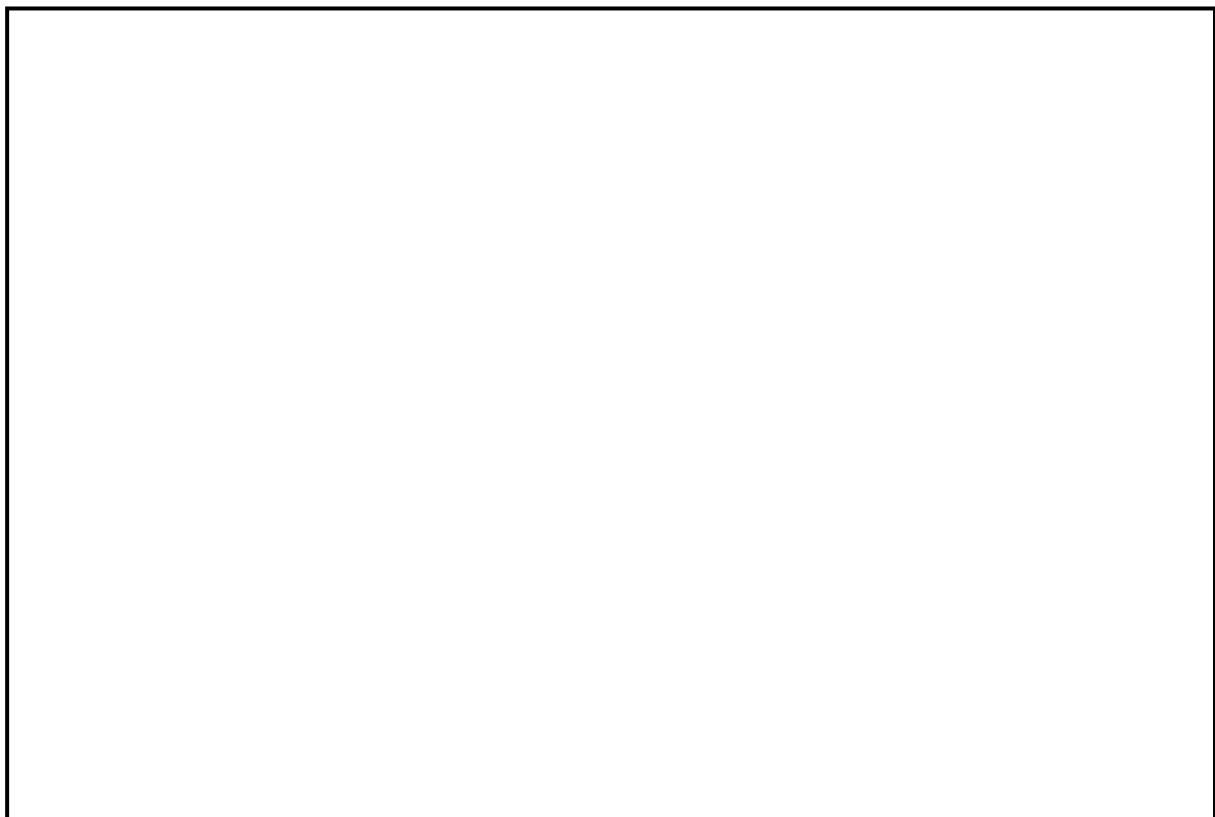
95. **NOTE:** Note the position of the camshaft pulley prior to removal.

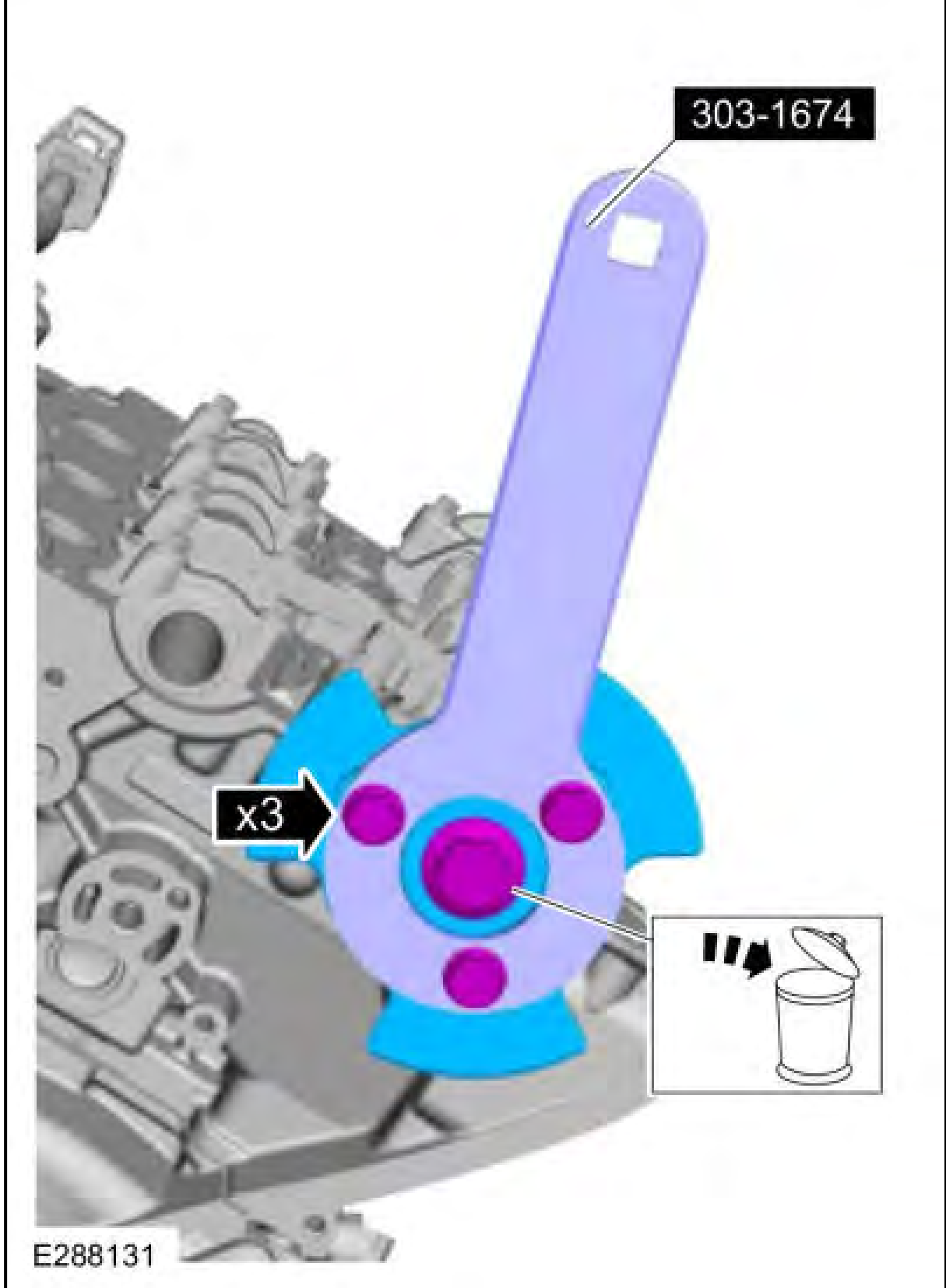
Remove the bolts and the LH camshaft pulley.



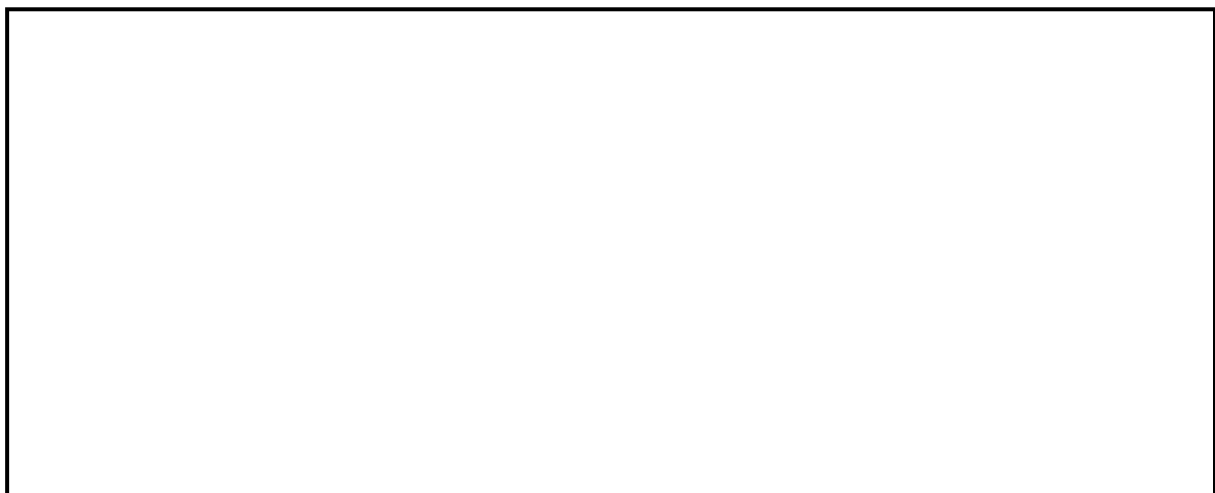
96. **NOTE:** Use the original bolts for the special tool.

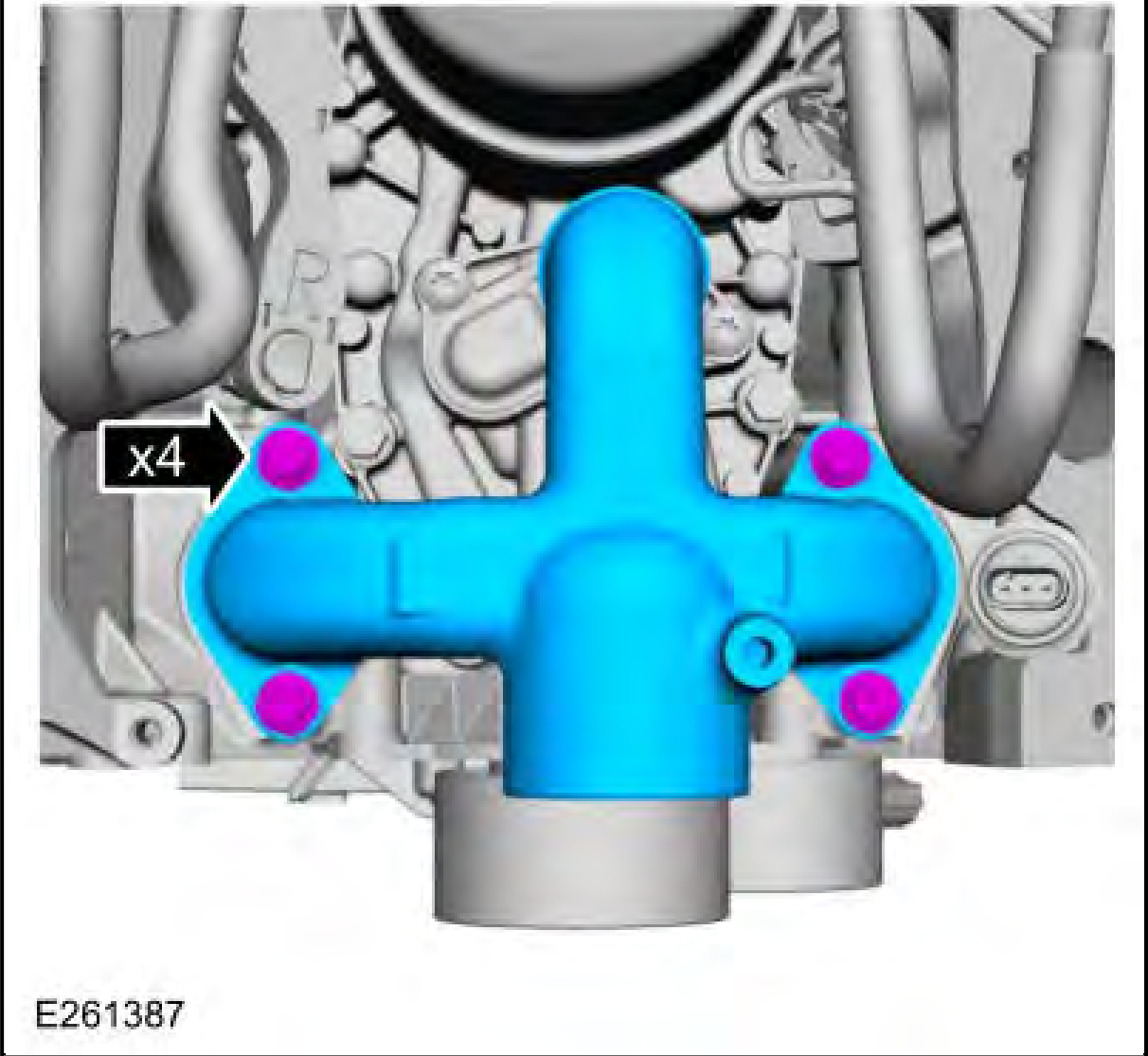
Using the special tool, remove the bolts and the LH camshaft gear hub. Discard the bolt. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.



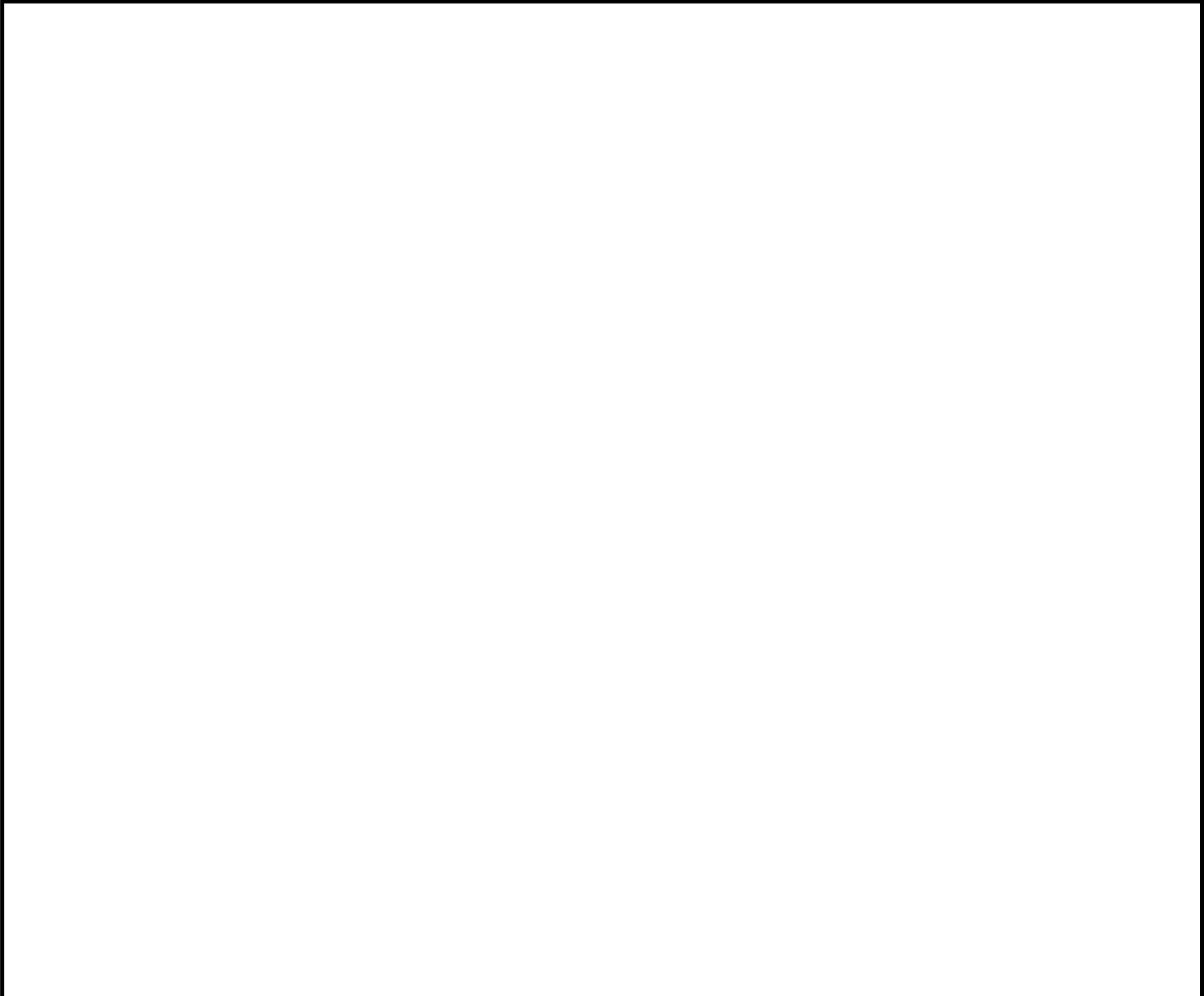


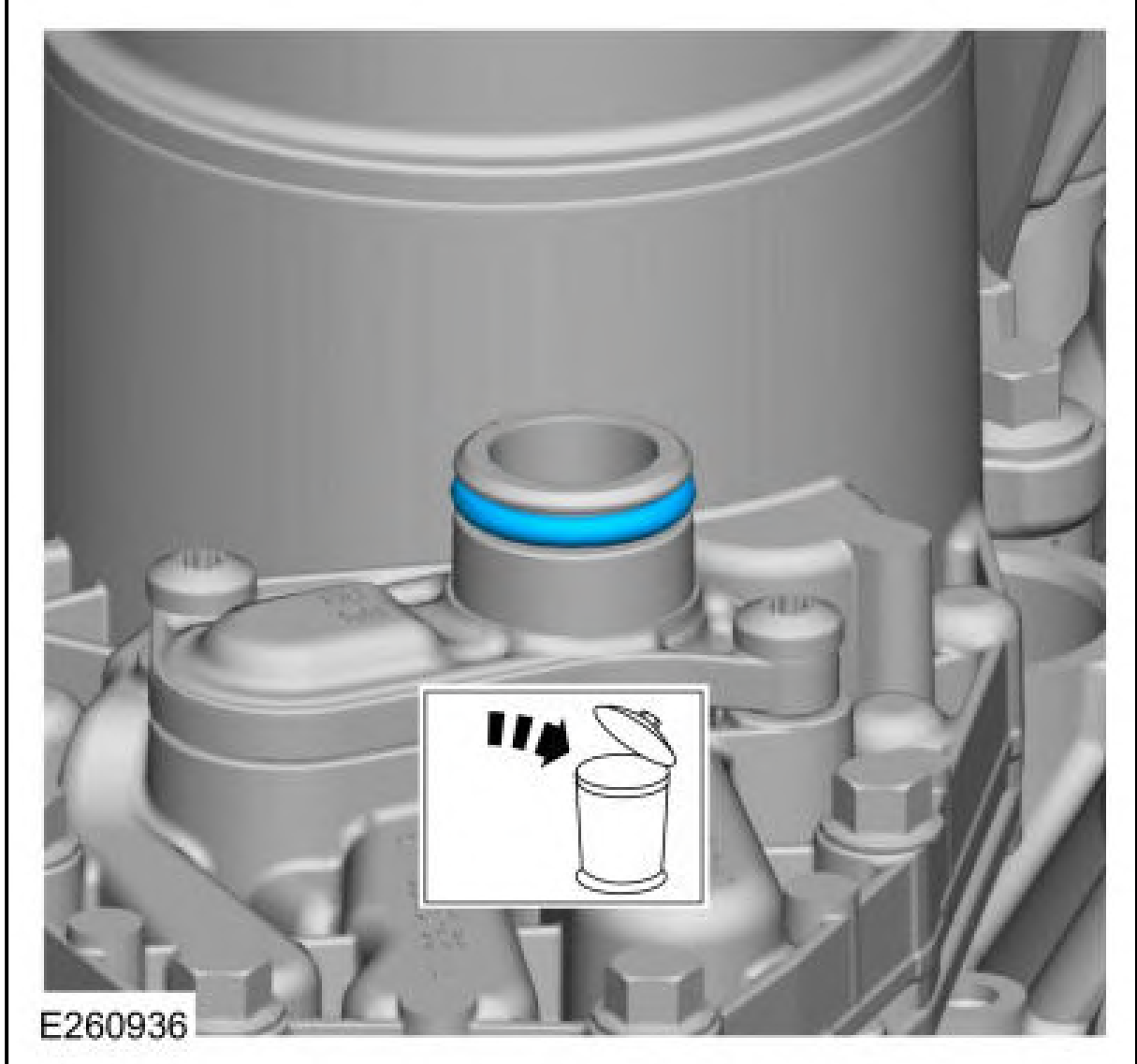
97. Remove the bolts and the coolant outlet connector.



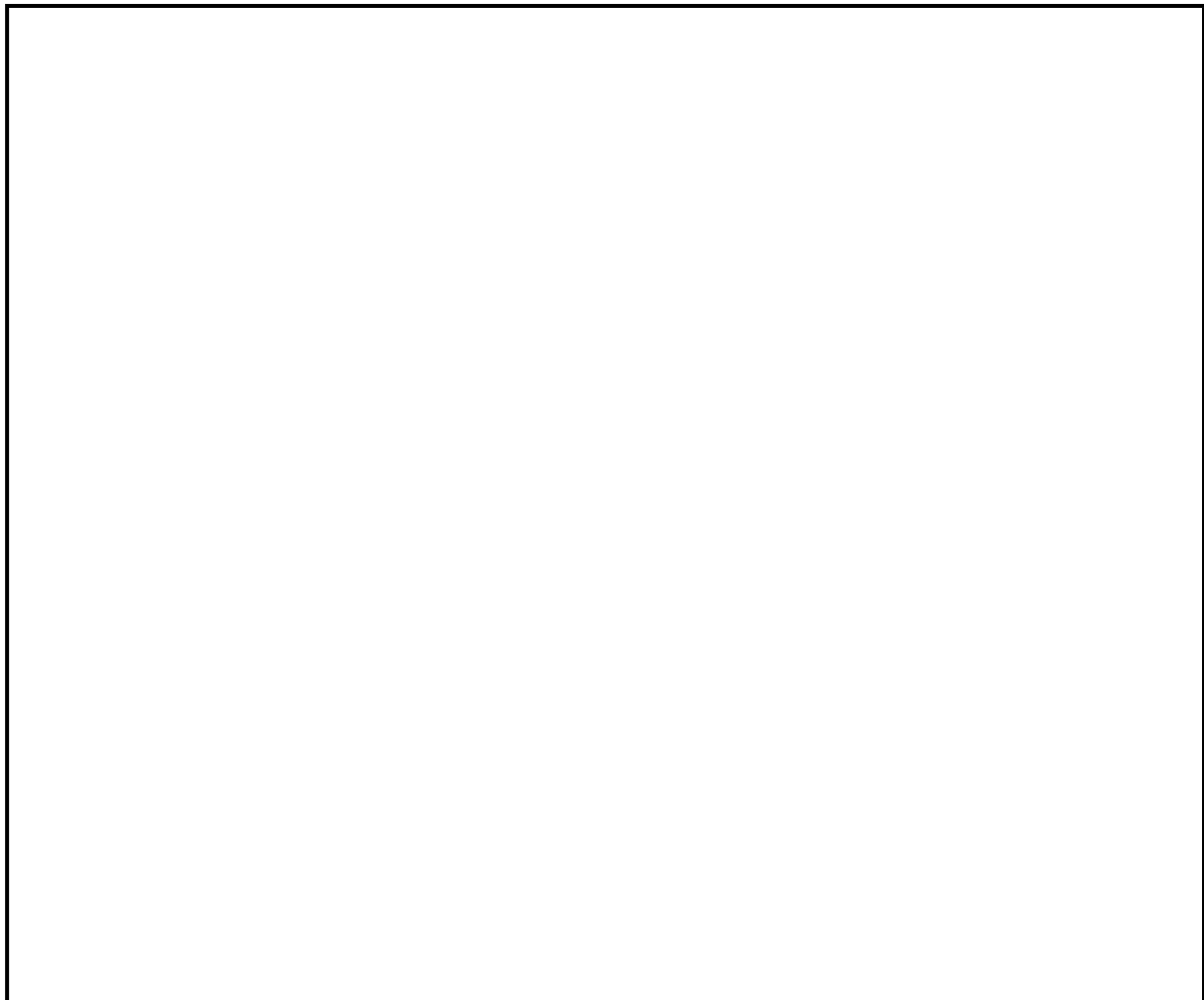


98. Remove and discard the oil cooler O-ring.





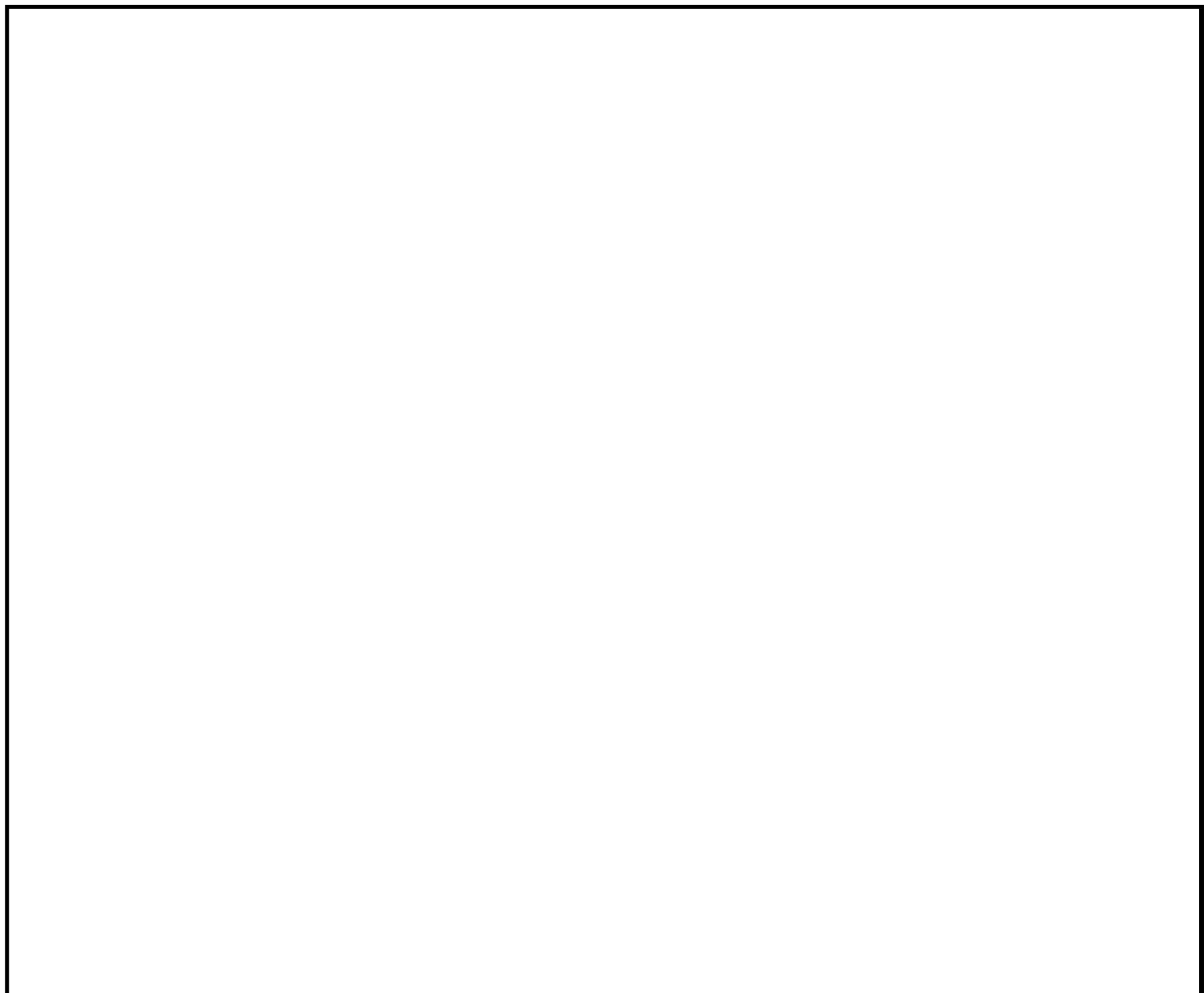
99. Remove and discard the coolant outlet connector gaskets.

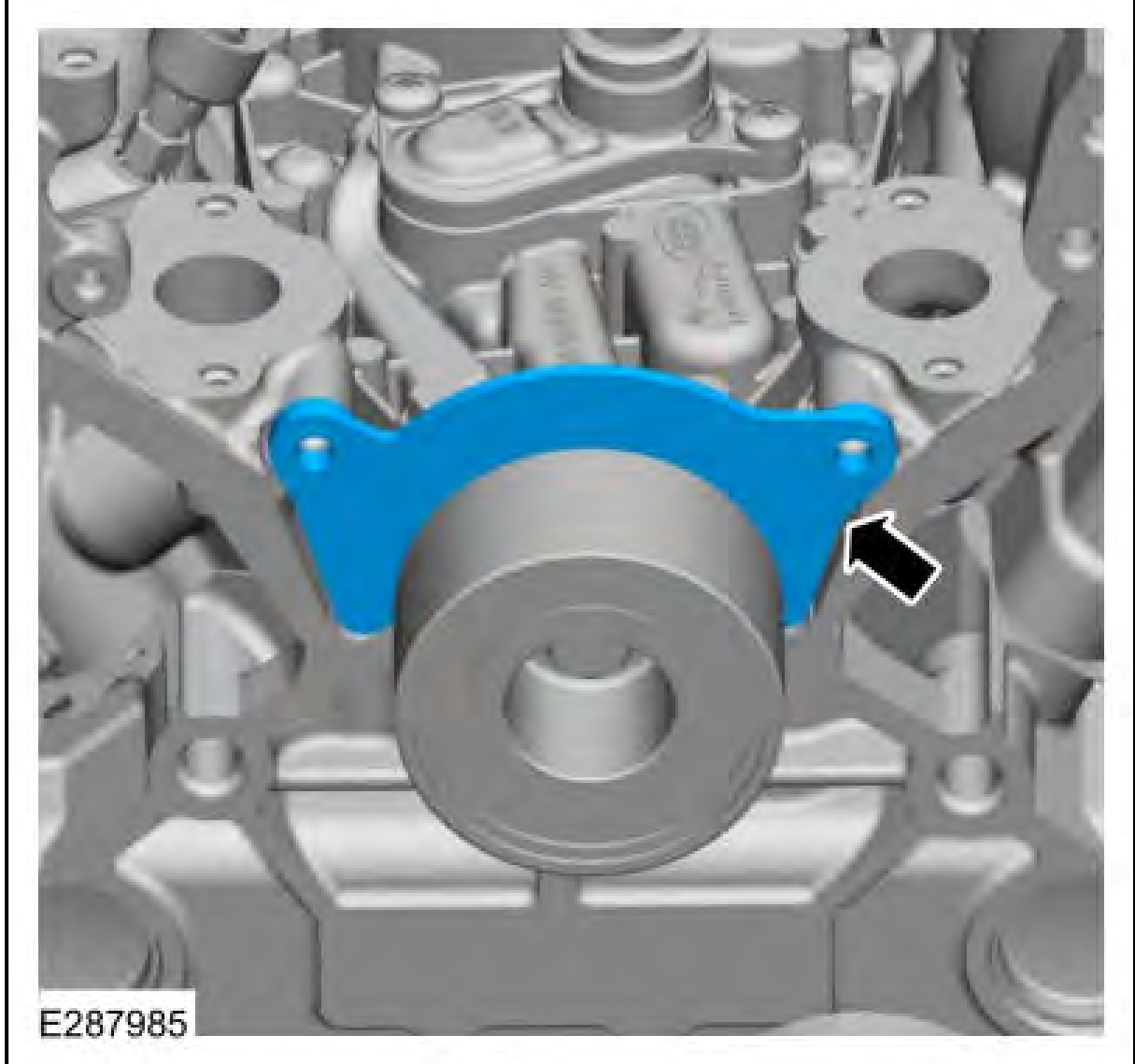




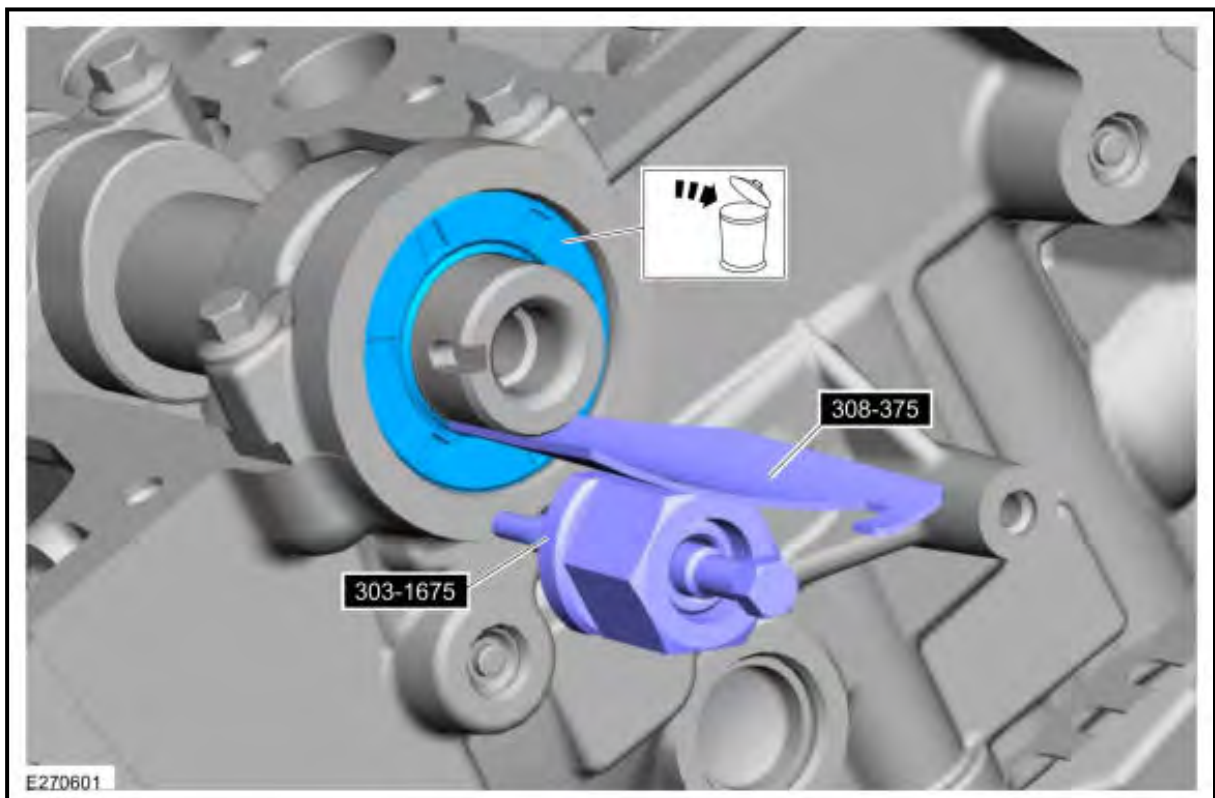
E261045

100. Remove the dust shield.



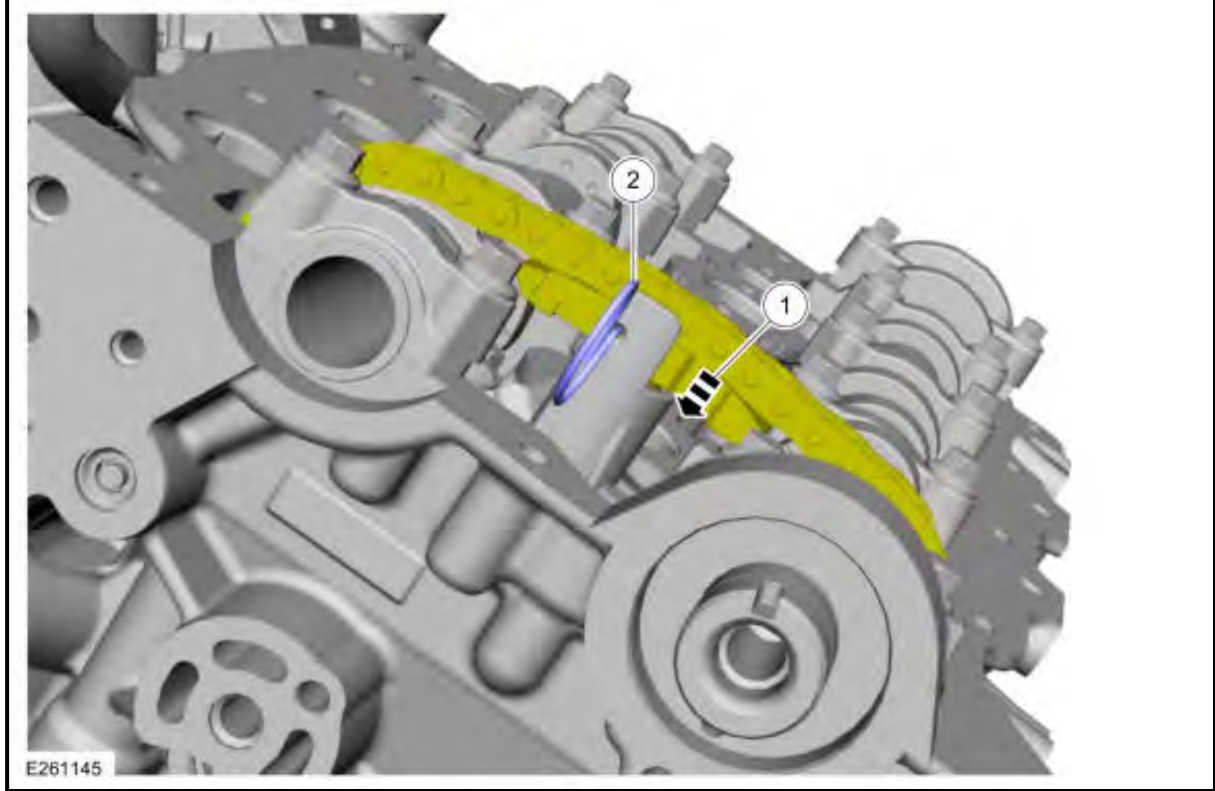


101. Using the special tools, remove and discard the camshaft seals. Use Special Service Tool: 303-1675 Adapter, Seal Remover. , 308-375 Remover, Input Shaft Seal.



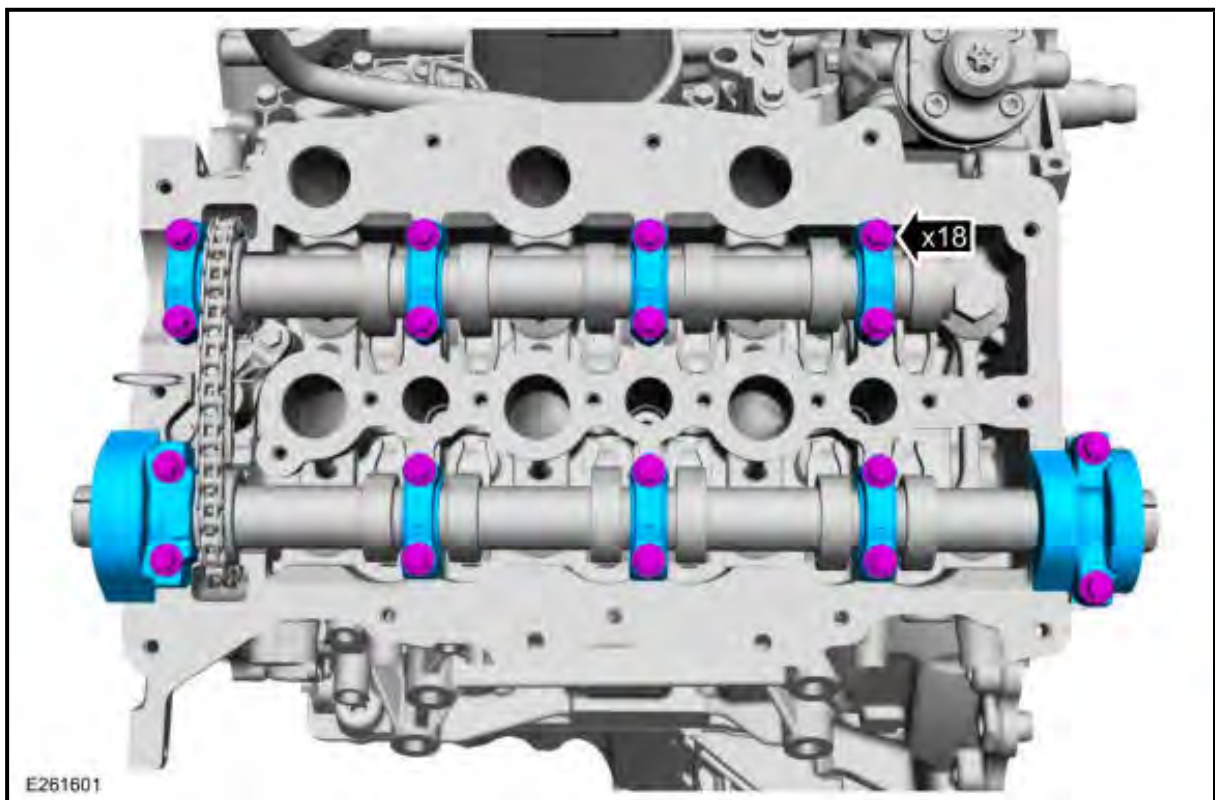
102. Compress the camshaft chain and install the retaining pin.





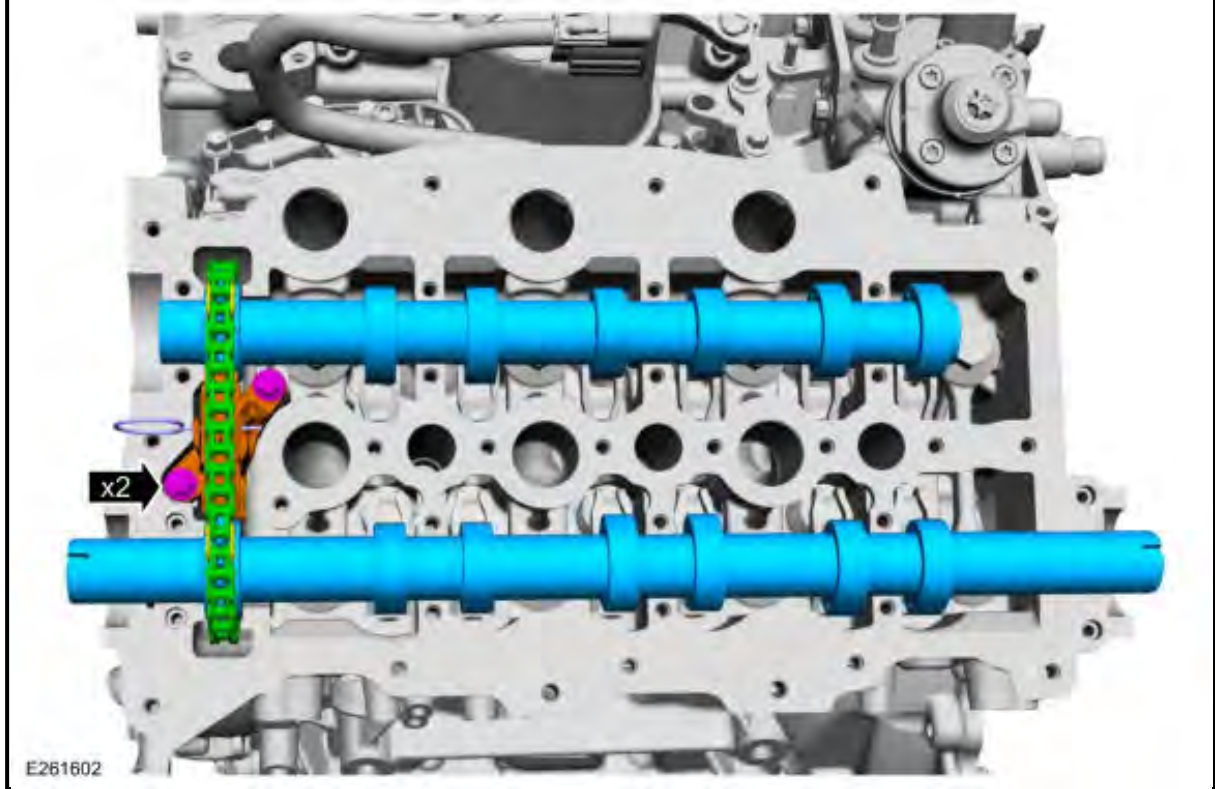
103. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

Remove the bolts and the camshaft bearing caps.



104. Remove the bolts and the LH camshafts, camshaft chain and the secondary timing chain tensioner.





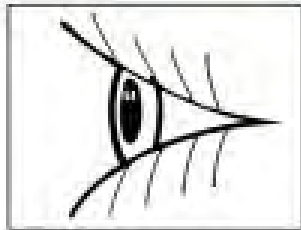
105. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

Remove the LH camshaft roller follower and hydraulic lash adjuster assemblies.



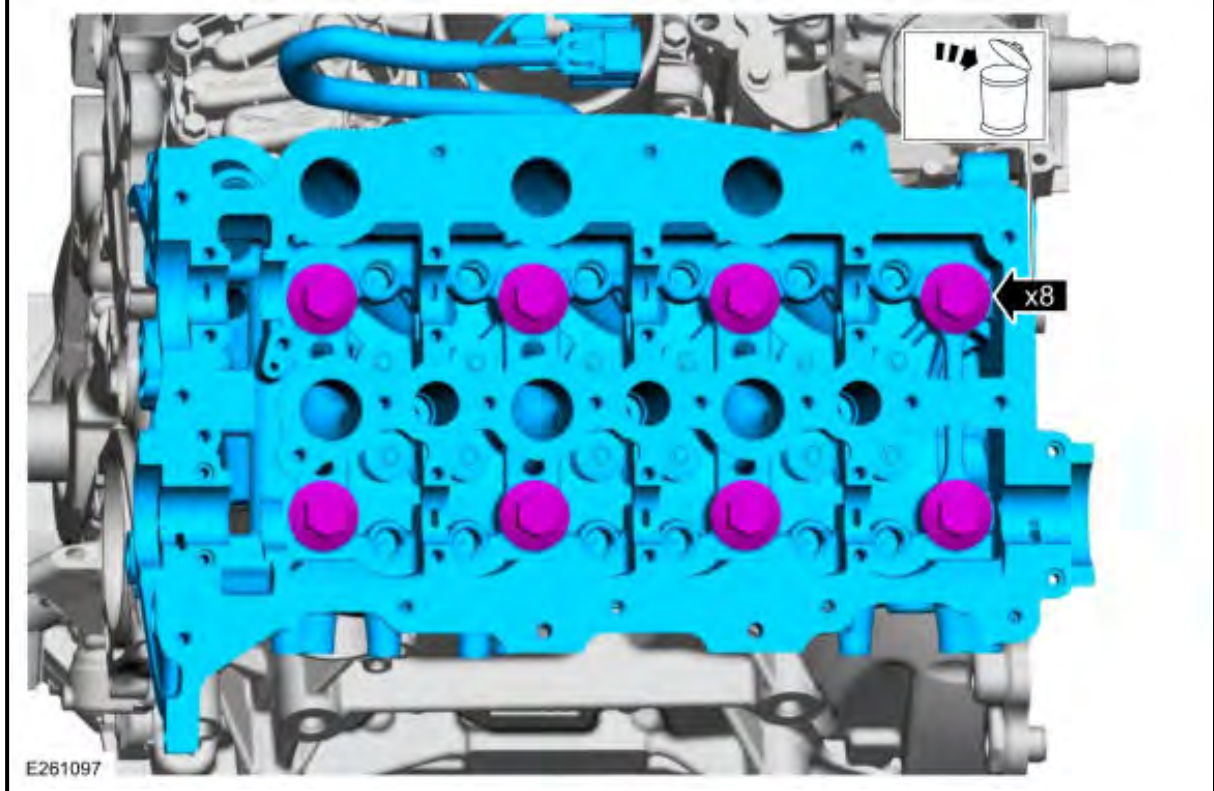
106. Inspect the hydraulic lash adjuster and roller follower for damage. If any damage is found, inspect the camshaft lobes and valves for damage. Replace damaged components as necessary.



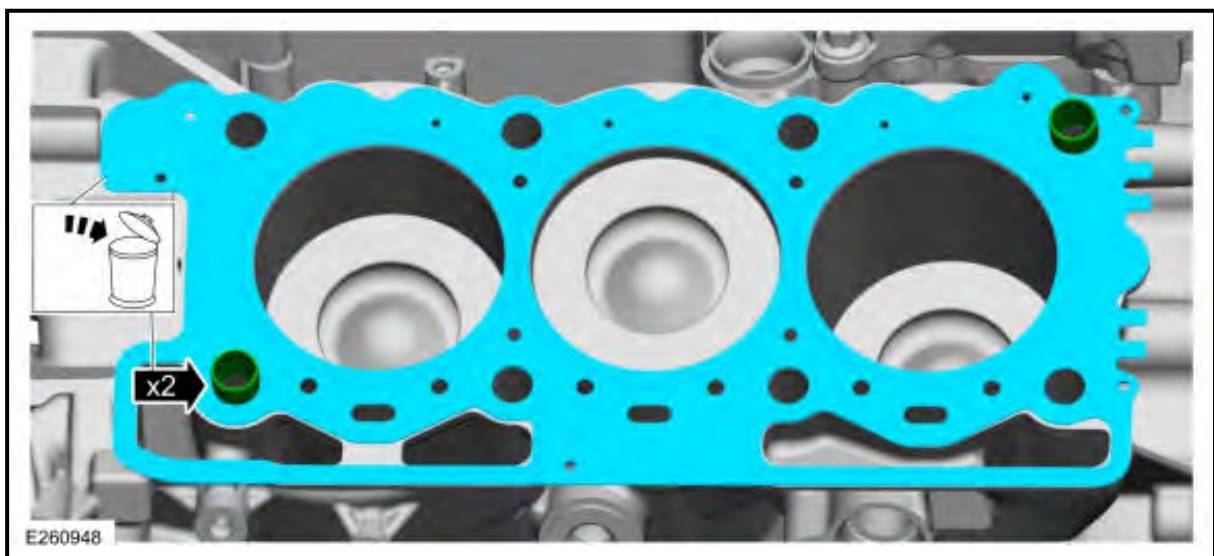


E260940

107. **NOTE:** Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may 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:** The glow plugs protrude past the lower face of the cylinder head, any impact on the tip of the glow plug may result in glow plug damage.
- NOTE:** The cylinder head bolts must be discarded and new bolts must be installed. They are tighten-to-yield designed and cannot be reused.
- Remove and discard the bolts from the LH cylinder head.
  - Remove the cylinder head.



108. Remove and discard the LH cylinder head gasket and the cylinder head dowels.



109. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

**NOTE:** Observe all warnings or cautions and follow all application directions contained on the packaging.

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

Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B


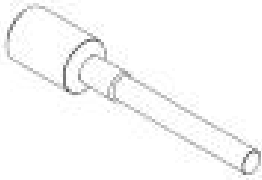

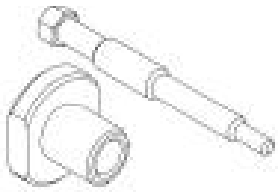

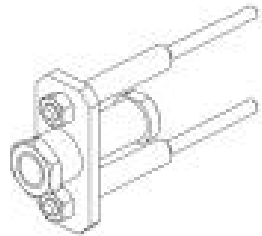
110. Check the cylinder head distortion. REFER to: [Cylinder Head Distortion](#) .

111. Check the cylinder block distortion. REFER to: [Cylinder Block Distortion](#) .

## **CYLINDER HEAD - BODY OFF - RH**

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

**Special Tool(s) / General Equipment**

|  |  |
|--|--|
|  <p>E274086</p>   | <p><b>303-1670 Pins, Camshaft Locking</b></p>                            |
|  <p>E274087</p>   | <p>303-1671 Pin, Locking Crankshaft</p>                                  |
|  <p>E274090</p>   | <p>303-1674 Tool, Holding Camshaft Sprocket</p>                          |
|  <p>E274091</p> | <p>303-1675 Adapter, Seal Remover</p>                                    |
|  <p>308-375</p> | <p>308-375 Remover, Input Shaft Seal TKIT-2005U-M TKIT-1999-F/FLM/LT</p> |
|  <p>E274100</p> | <p>310-266 Remover, Fuel Injector</p>                                    |
| <p>Plastic Scraper<br/>Hose Clamp<br/>Remover/Installer</p>  |  |

**Materials**

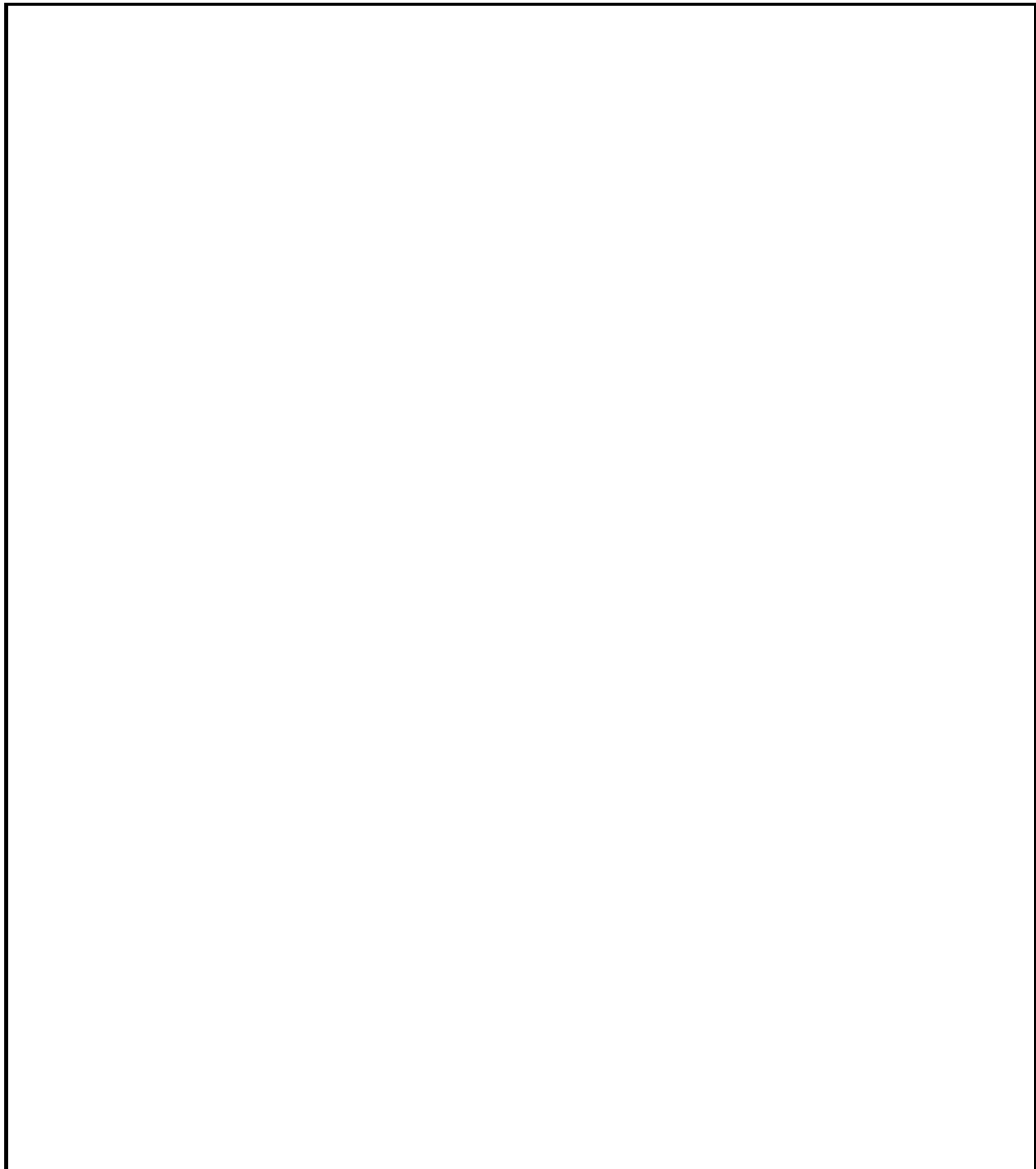
| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> Silicone Gasket Remover ZC-30-A  | -             |
| Motorcraft <sup>®</sup> Metal Surface Prep Wipes ZC-31-B | -             |

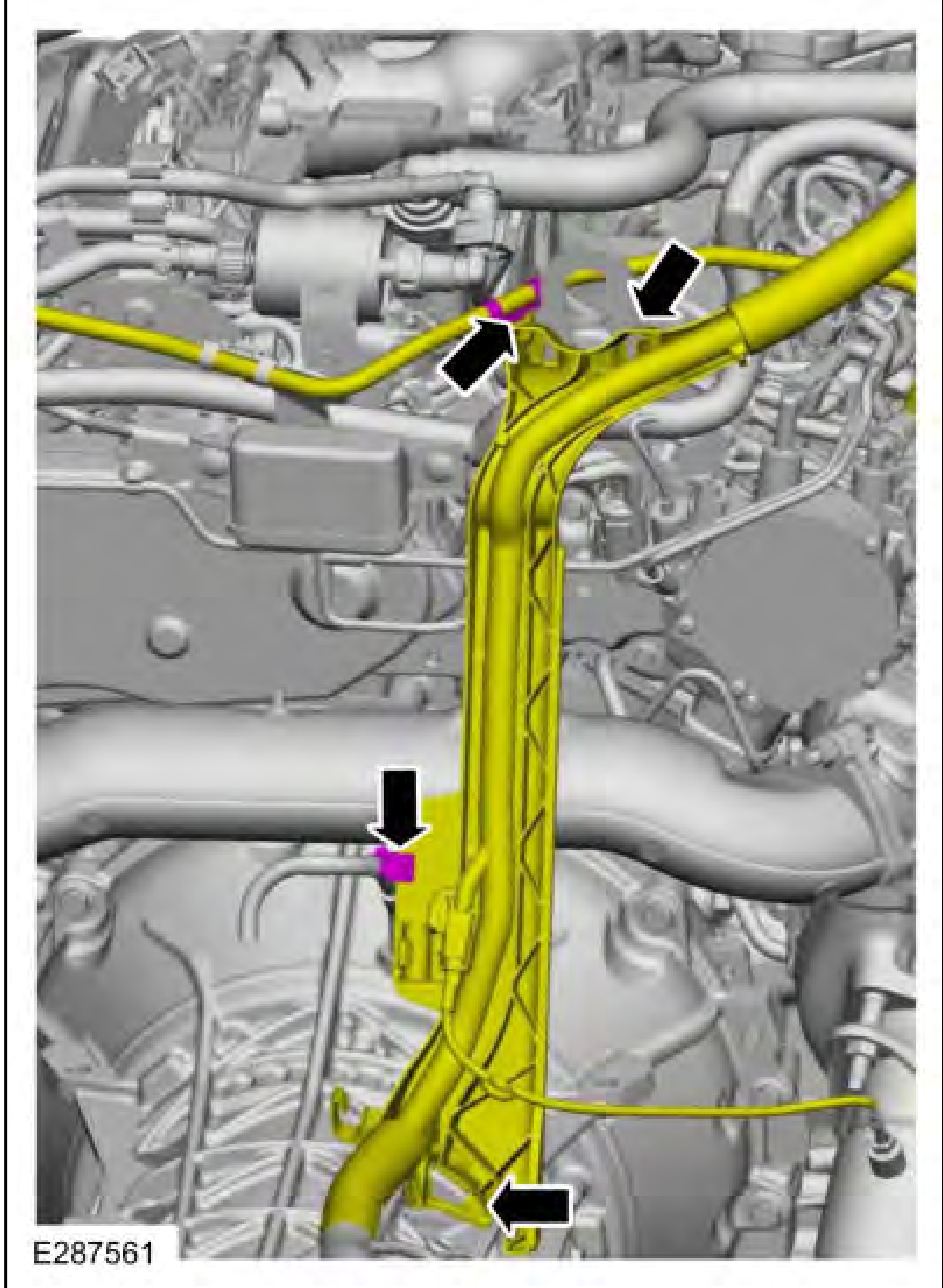
| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> Metal Brake Parts Cleaner PM-4-A, PM-4-B | -             |

**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:** It is recommended that this component be serviced with the vehicle body removed. If the body cannot be removed, refer to [Cylinder Head - Body On - LH](#) or [Cylinder Head - Body On - RH](#).

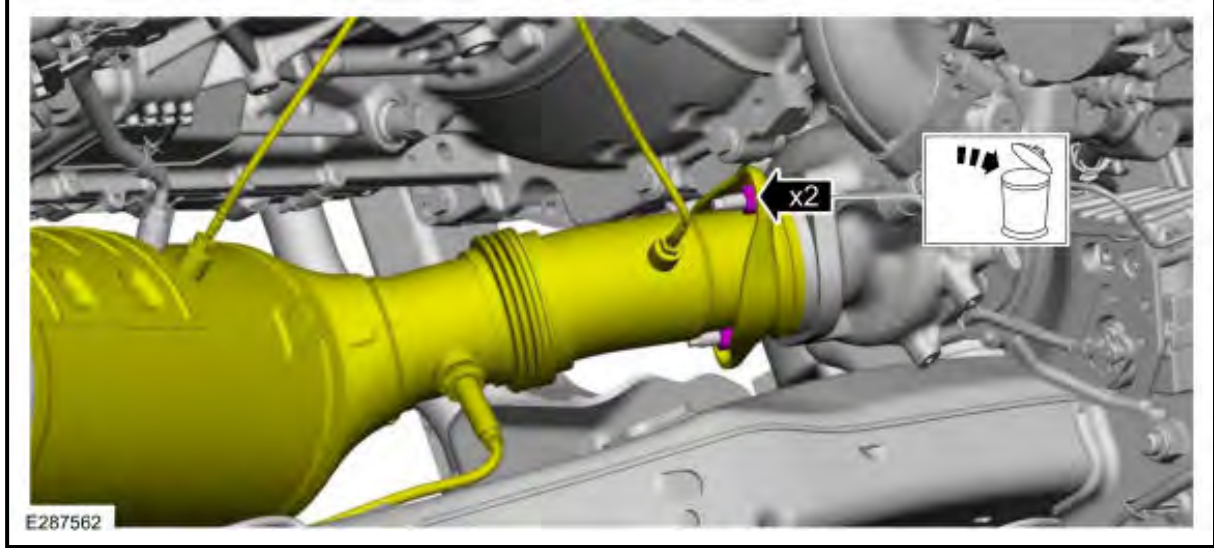
1. Remove the following items:
  1. Remove the turbocharger oil return tube. REFER to: [Turbocharger Oil Return Tube](#) .
  2. Remove the body. REFER to: [Body - 3.0L Power Stroke Diesel](#) .
2. Roll the chassis out from under the body.
  - Install wheel chocks at the front and back of one wheel.
3. Disconnect the vacuum hose retainer and the transmission vent tube. Disconnect the wire harness housing and position aside.



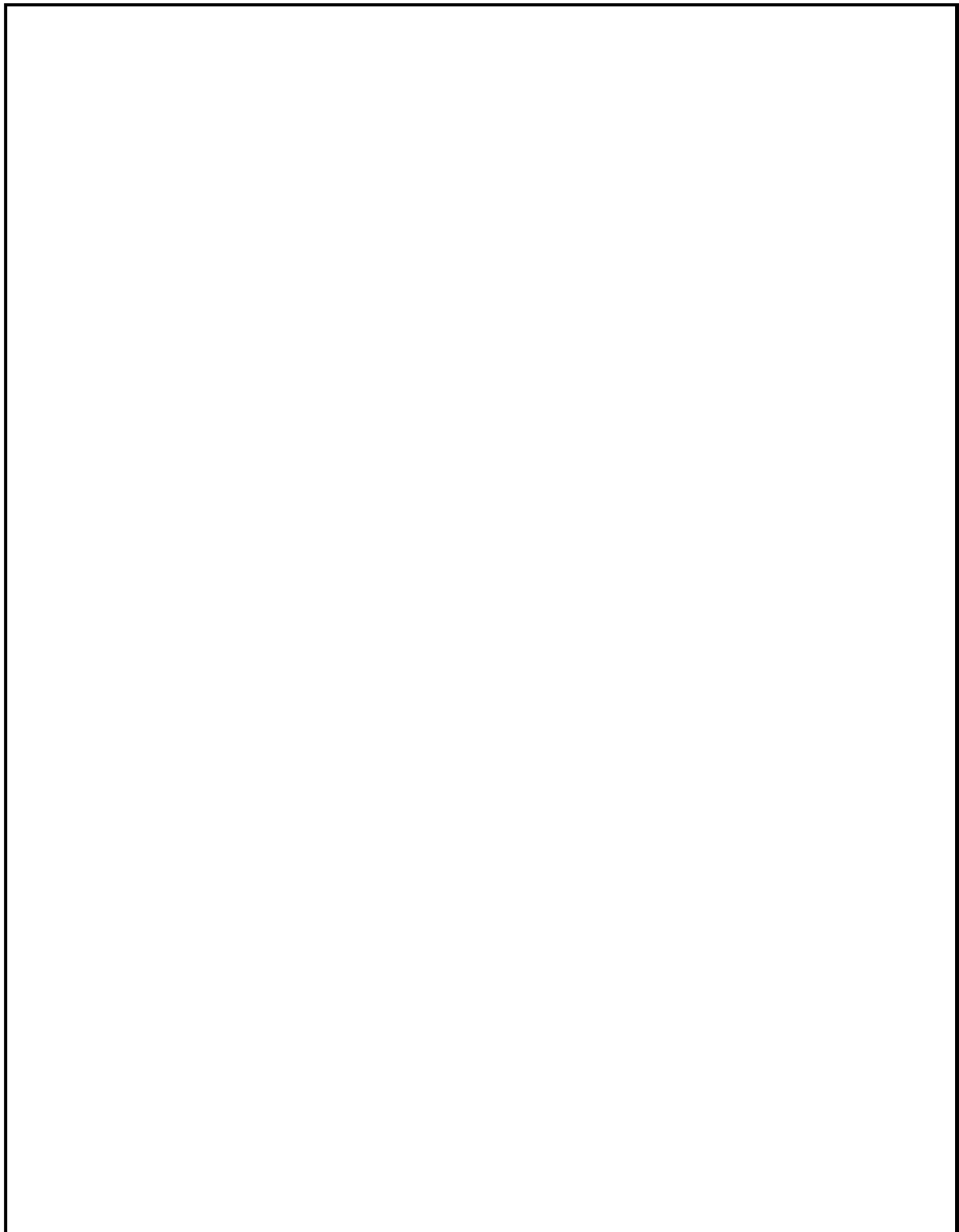


4. Remove the nuts and position aside the exhaust. Discard the nuts.

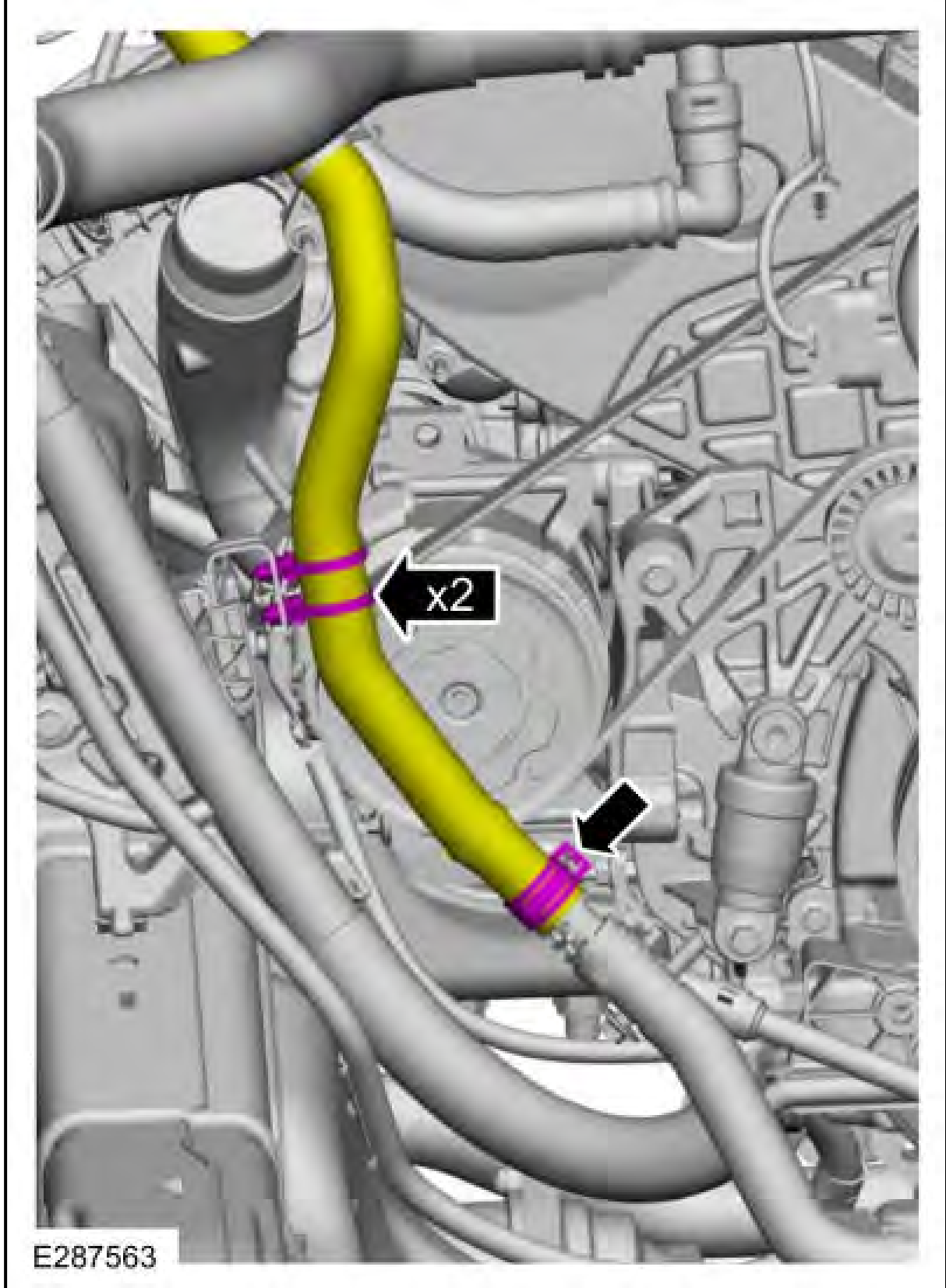




5. Disconnect the coolant hose. Disconnect the retainers and position aside the coolant hose. Use the General Equipment: Hose Clamp Remover/Installer

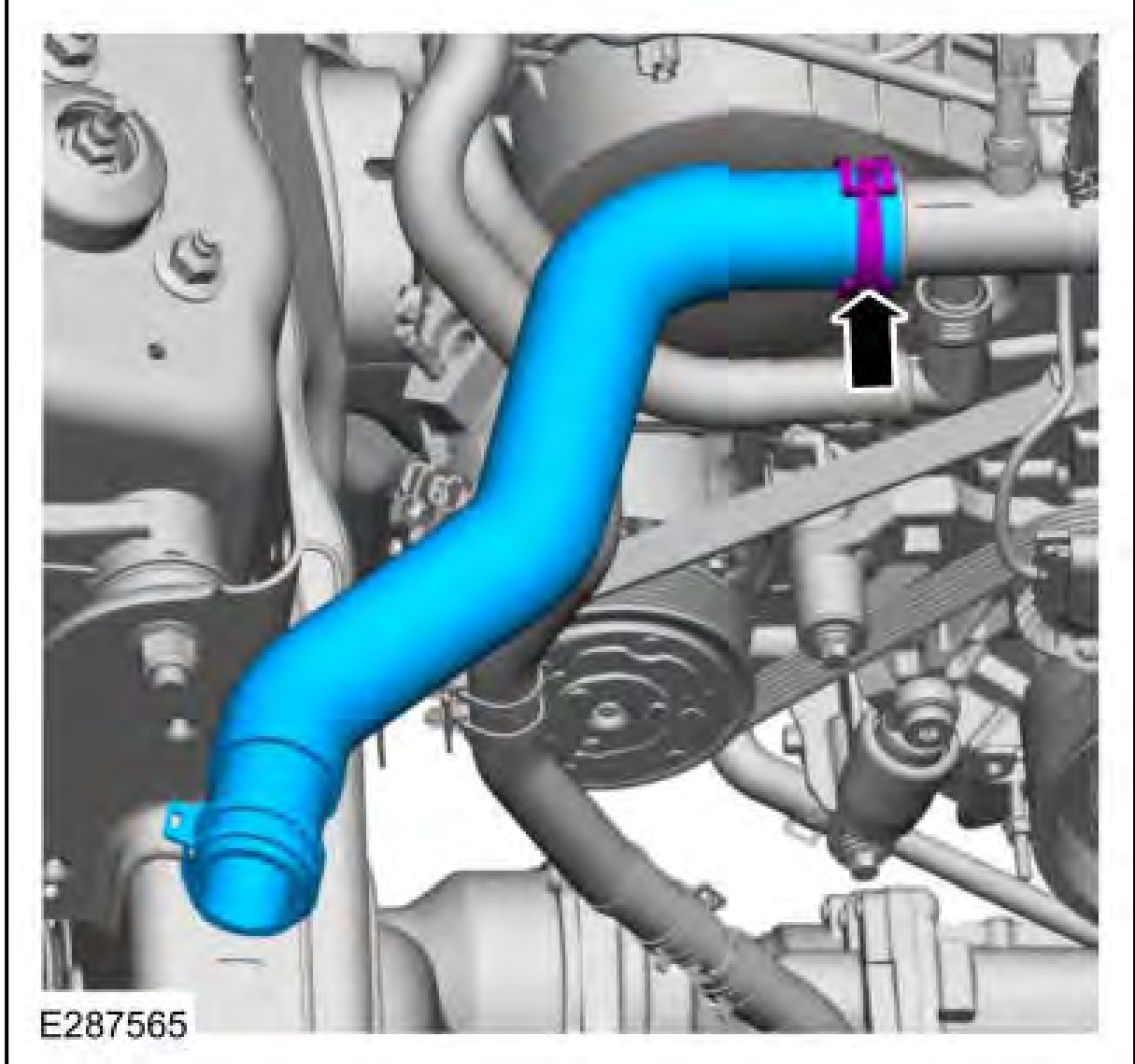




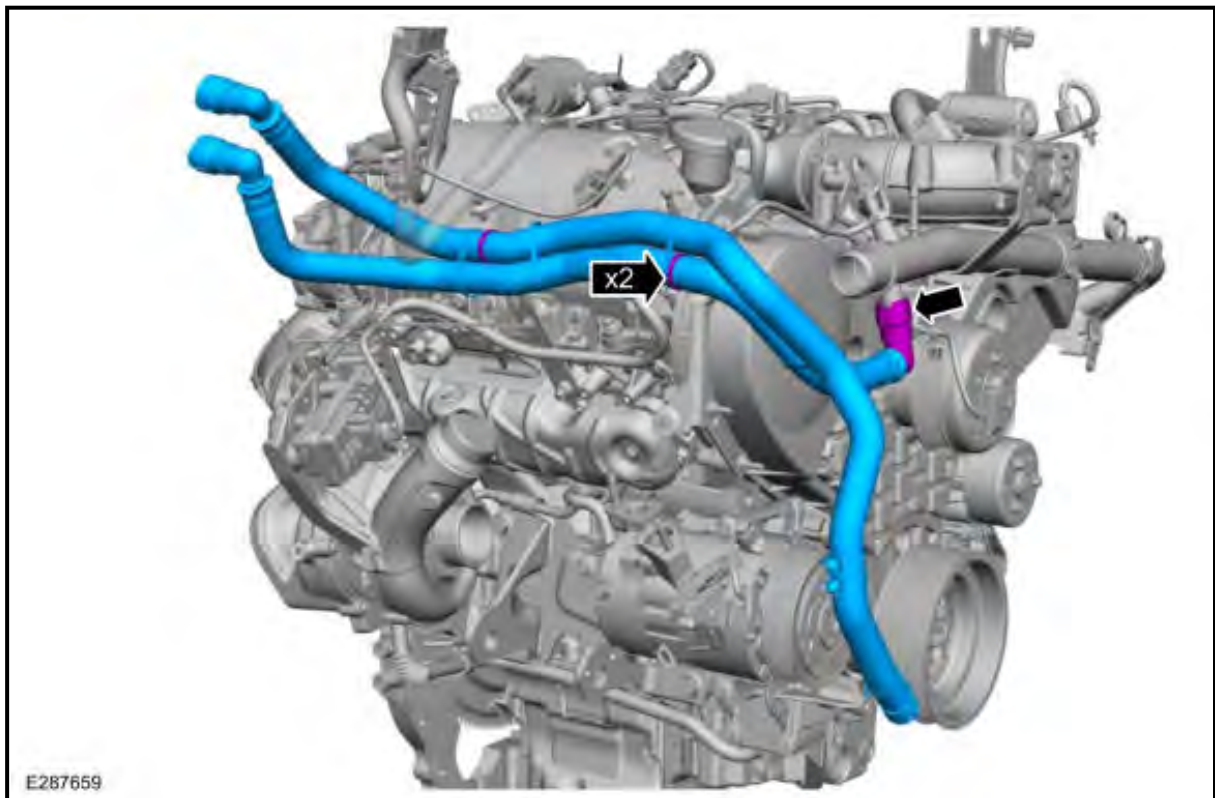


6. Remove the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer

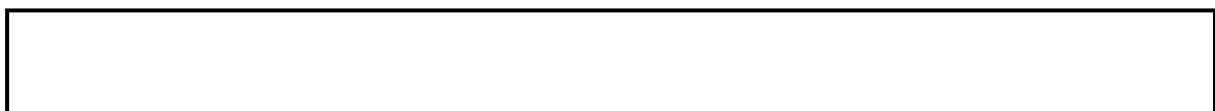


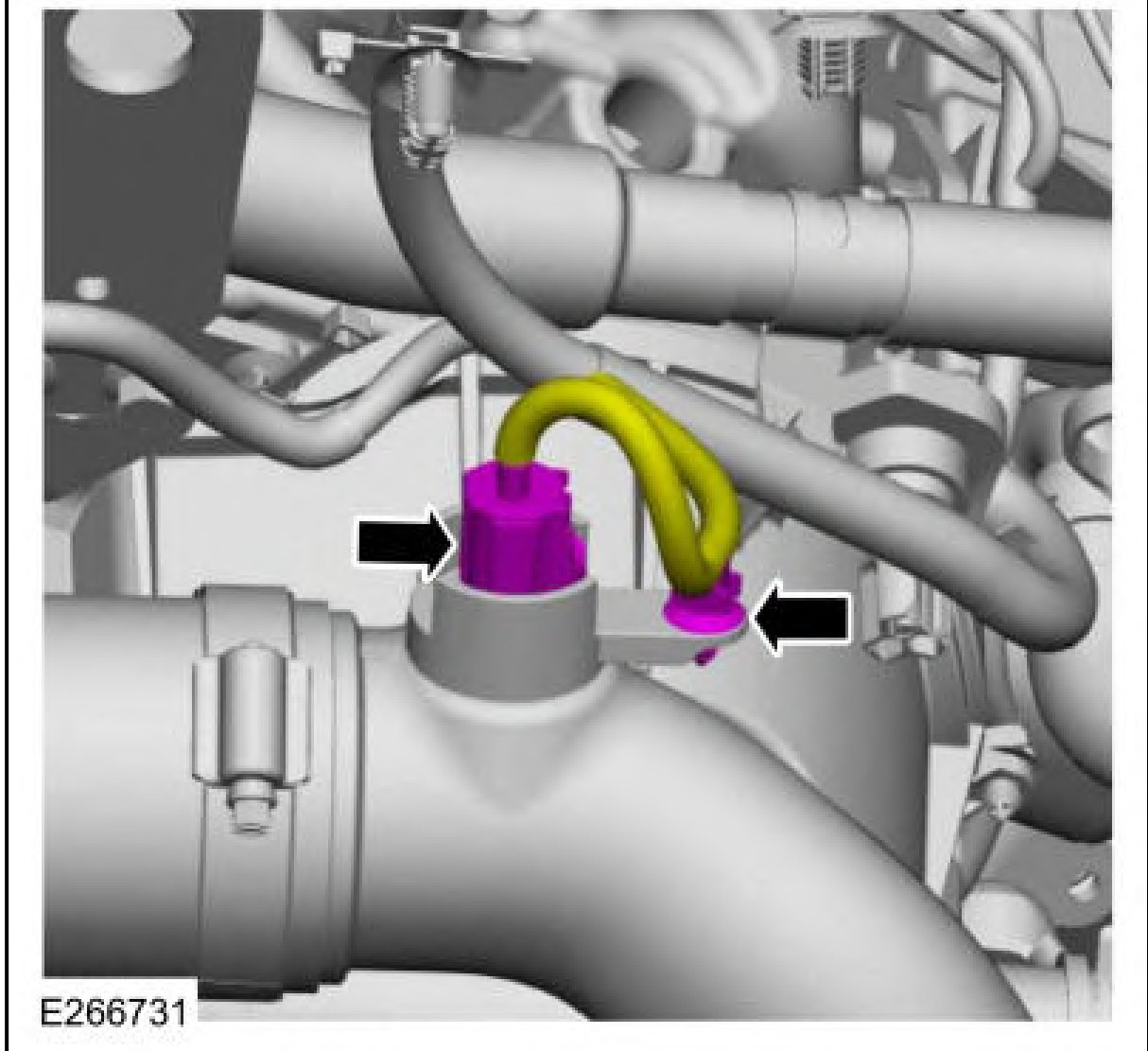


7. Disconnect the coolant hose. Disconnect the retainers and remove the coolant hoses.



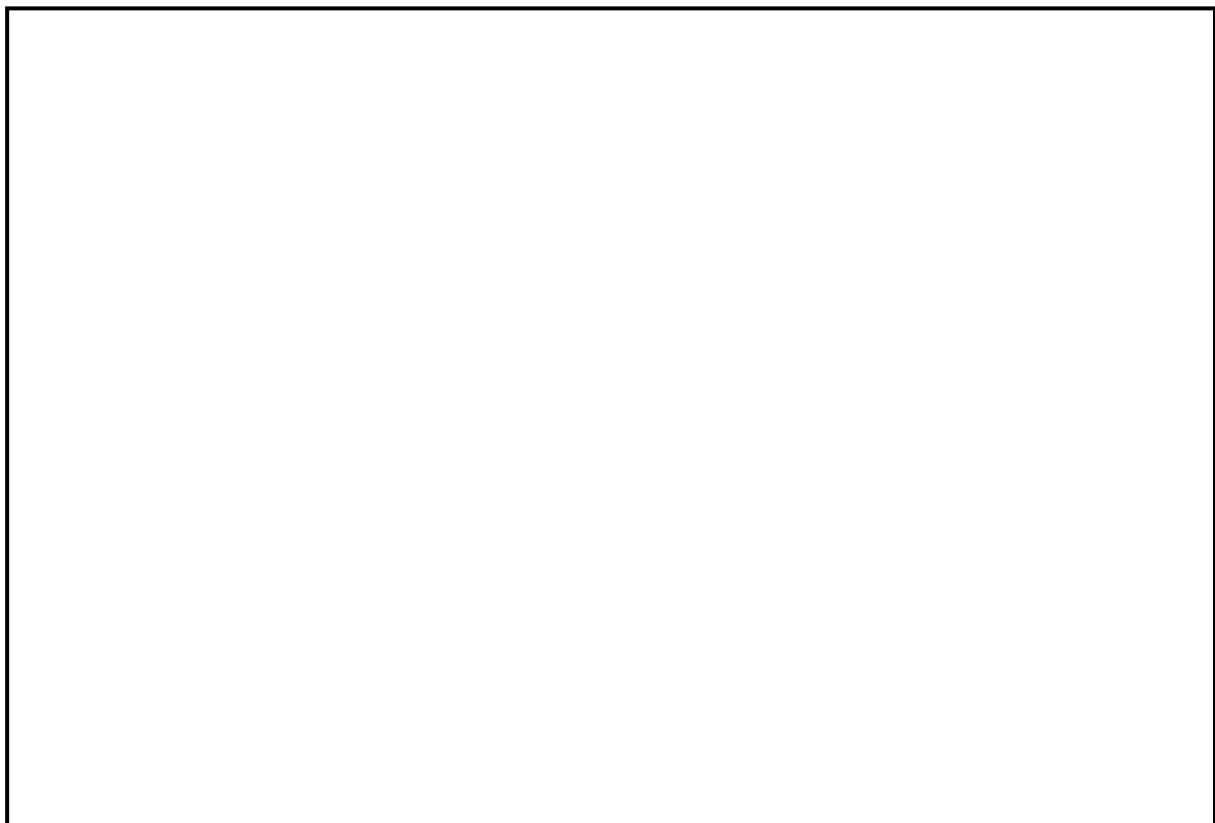
8. Disconnect the electrical connector and the wire retainer.

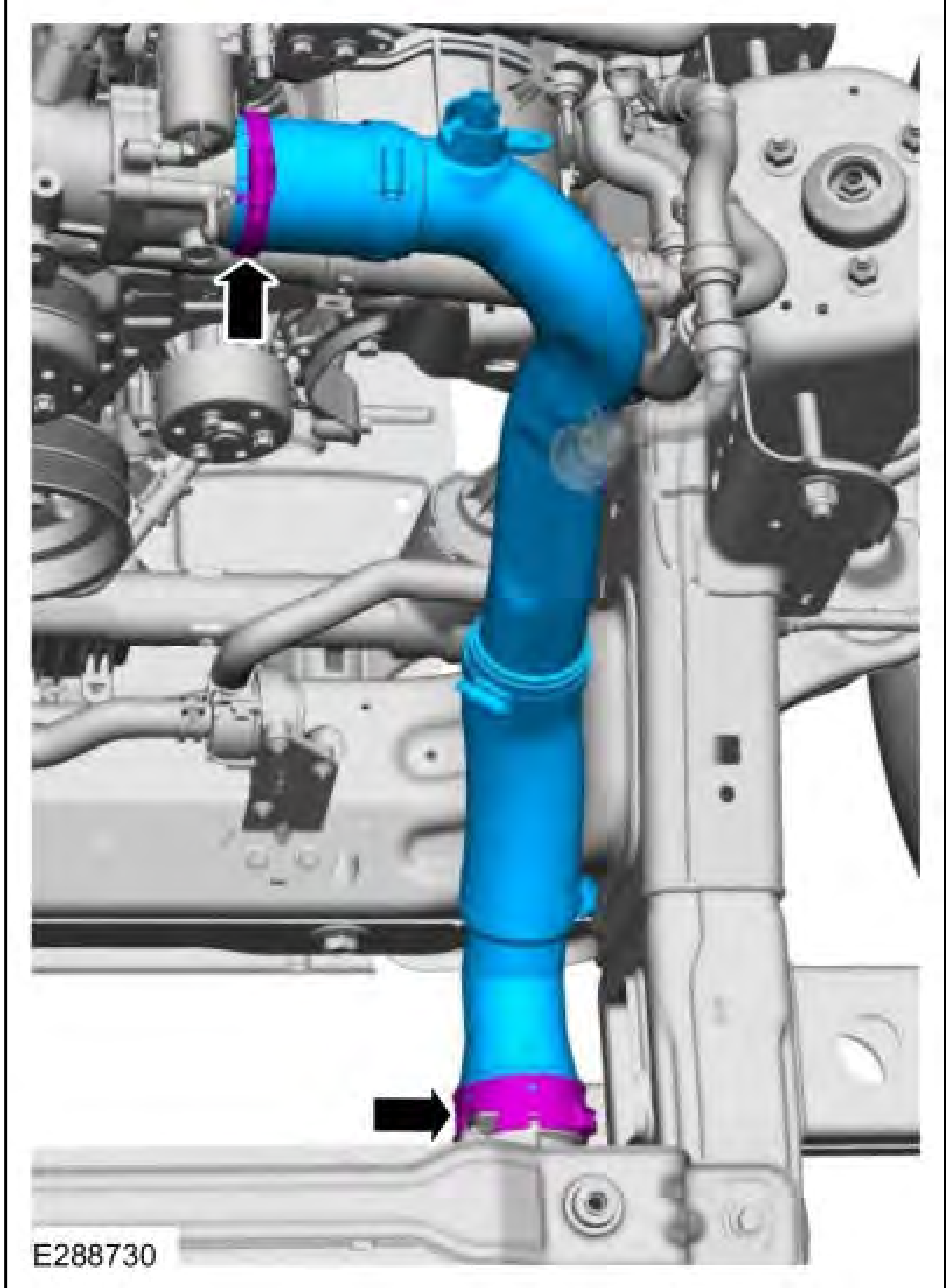




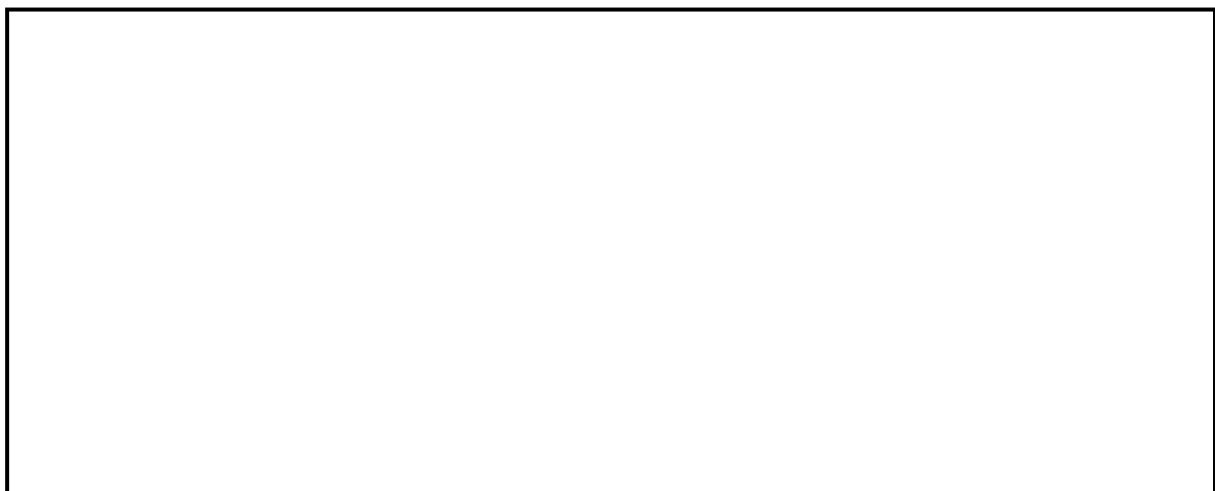
9. **NOTE:** The turbocharger compressor vanes can be damaged by even the smallest particles. When removing any turbocharger or engine air intake system component, ensure that no debris enters the system. Failure to do so may result in damage to the turbocharger.

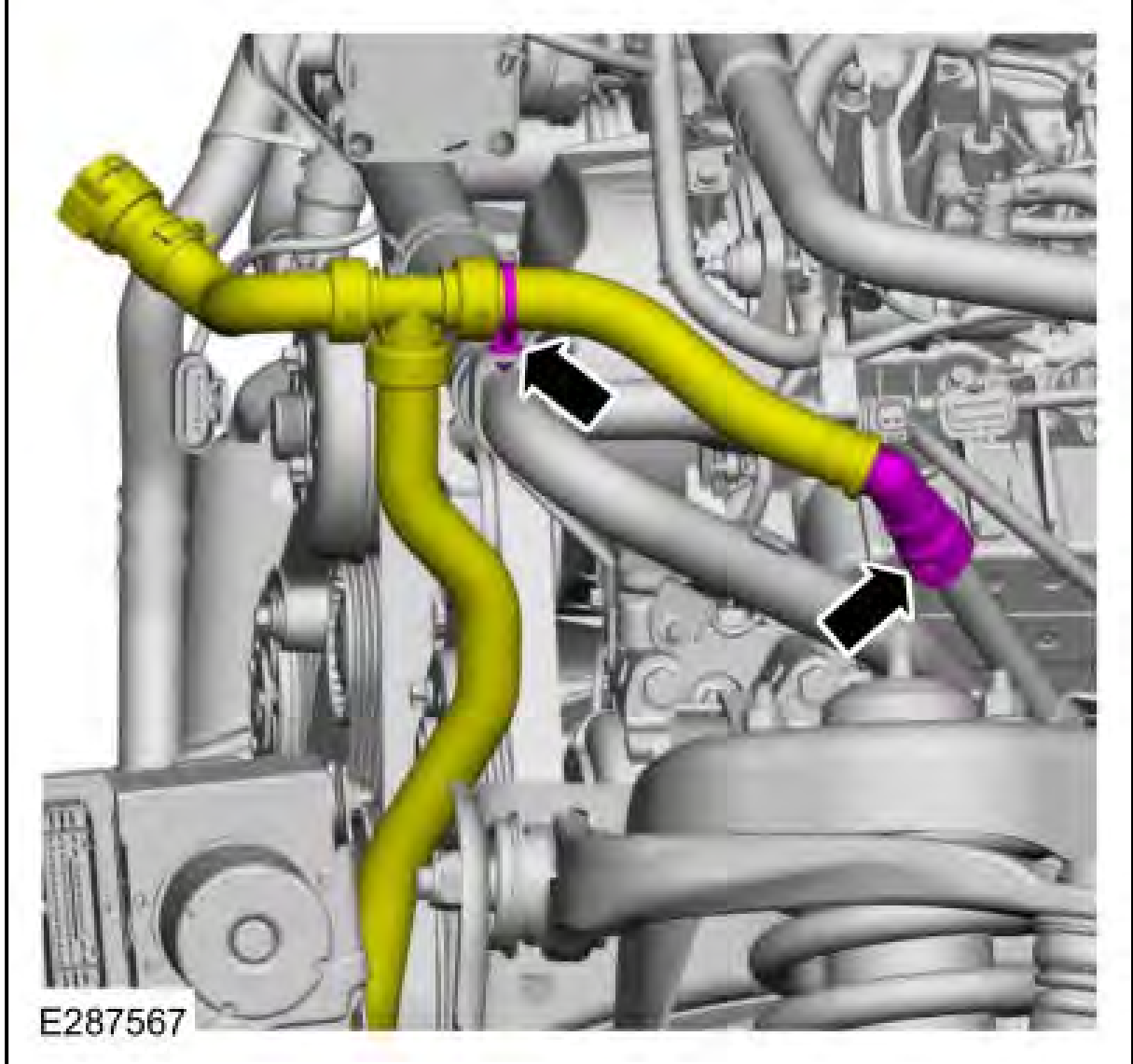
Loosen the clamp, release the clip and remove the LH CAC intake pipe.



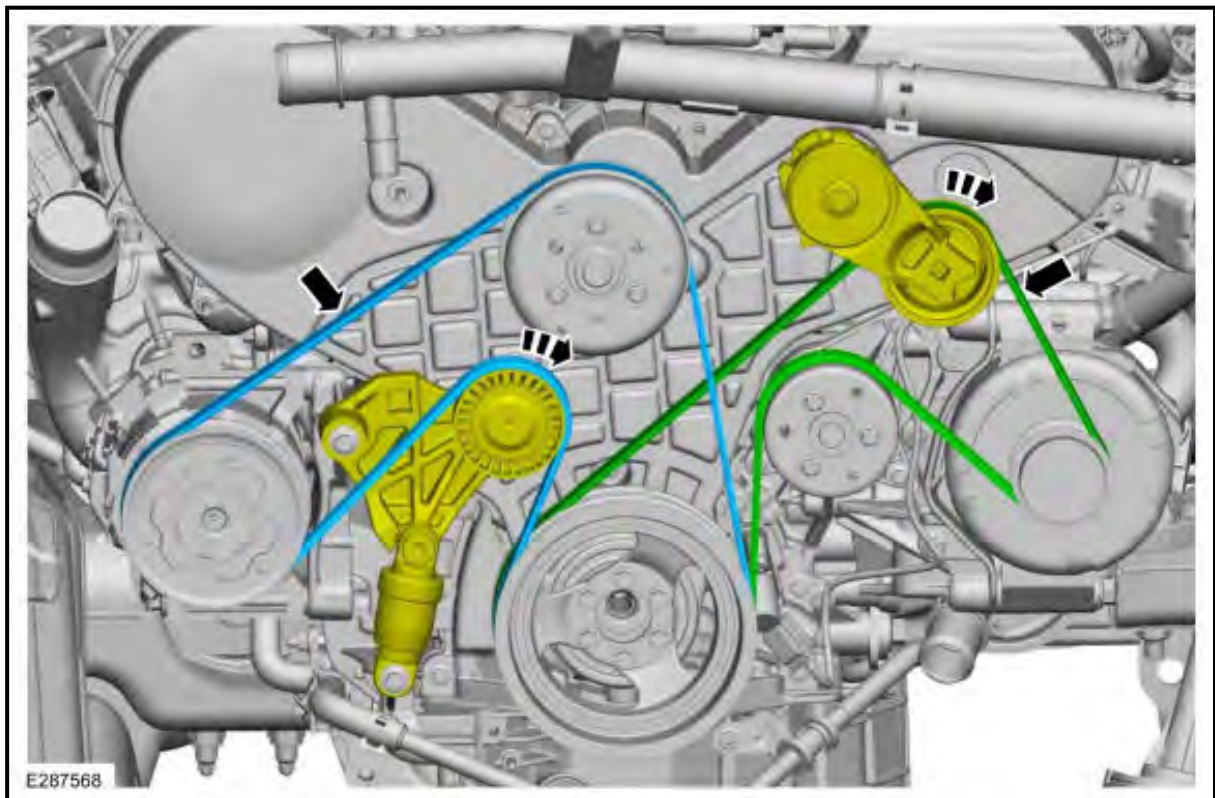


10. Disconnect the coolant hose connector and the retainer.

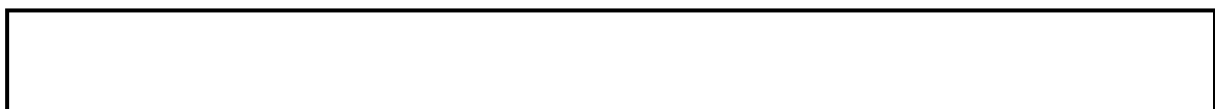


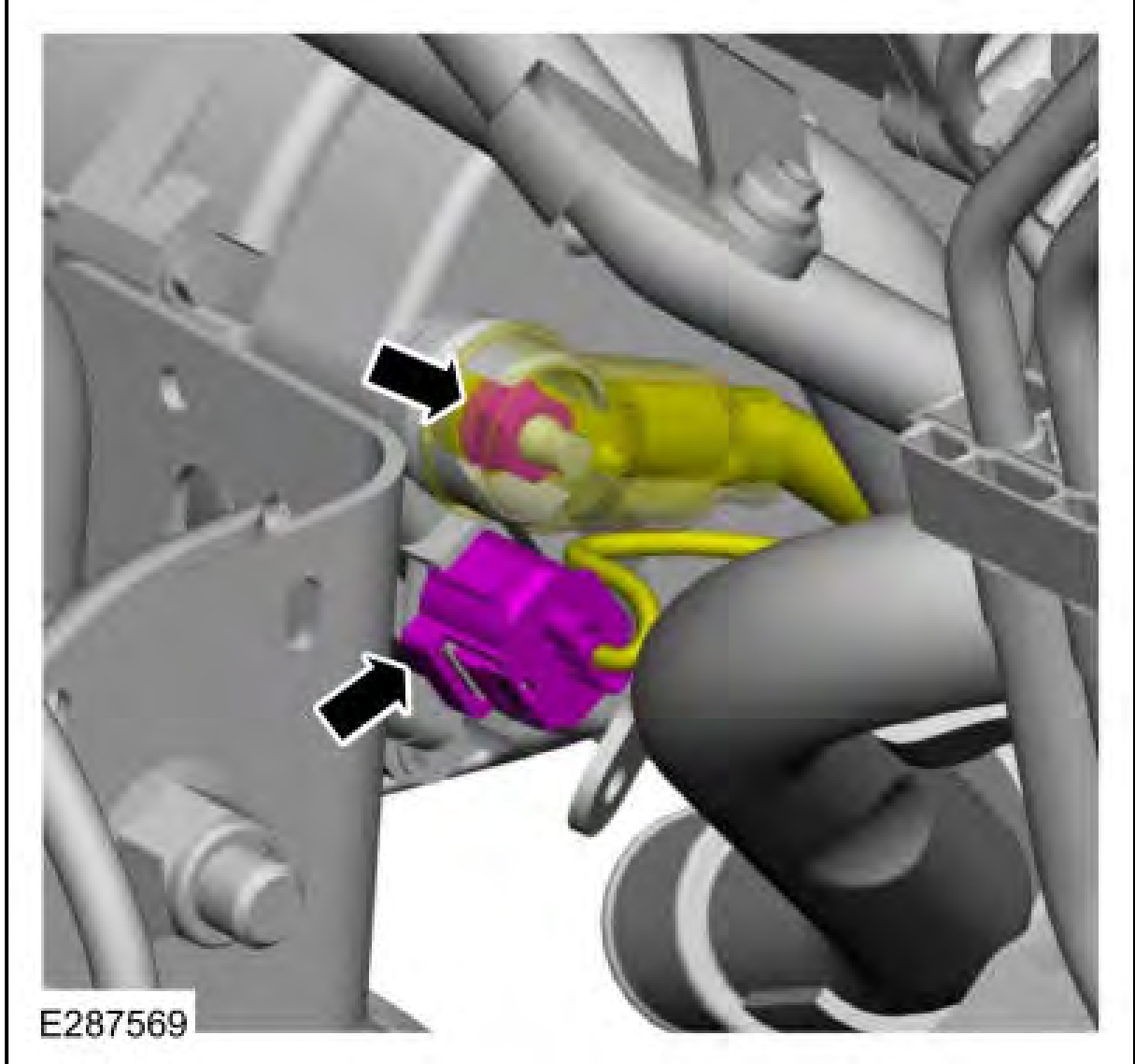


11. Remove the A/C belt and the accessory drive belt.

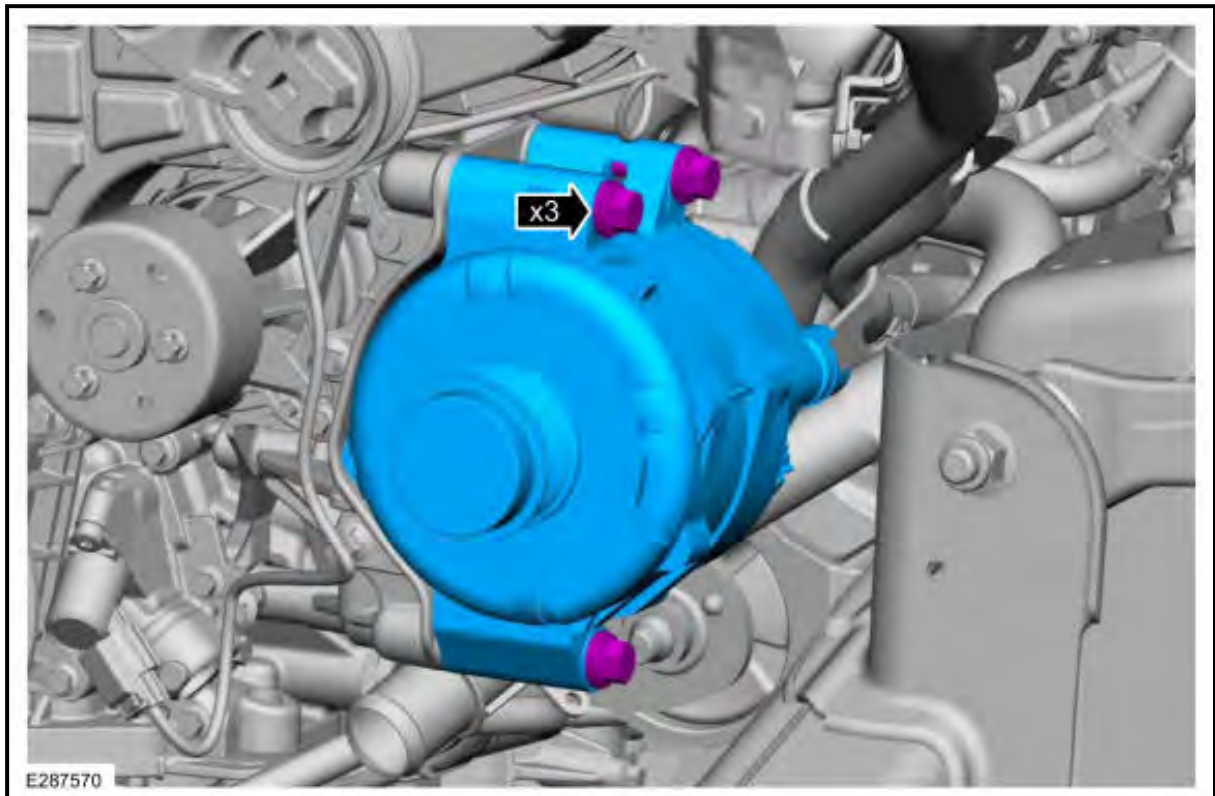


12. Disconnect the electrical connector and the generator output wire.

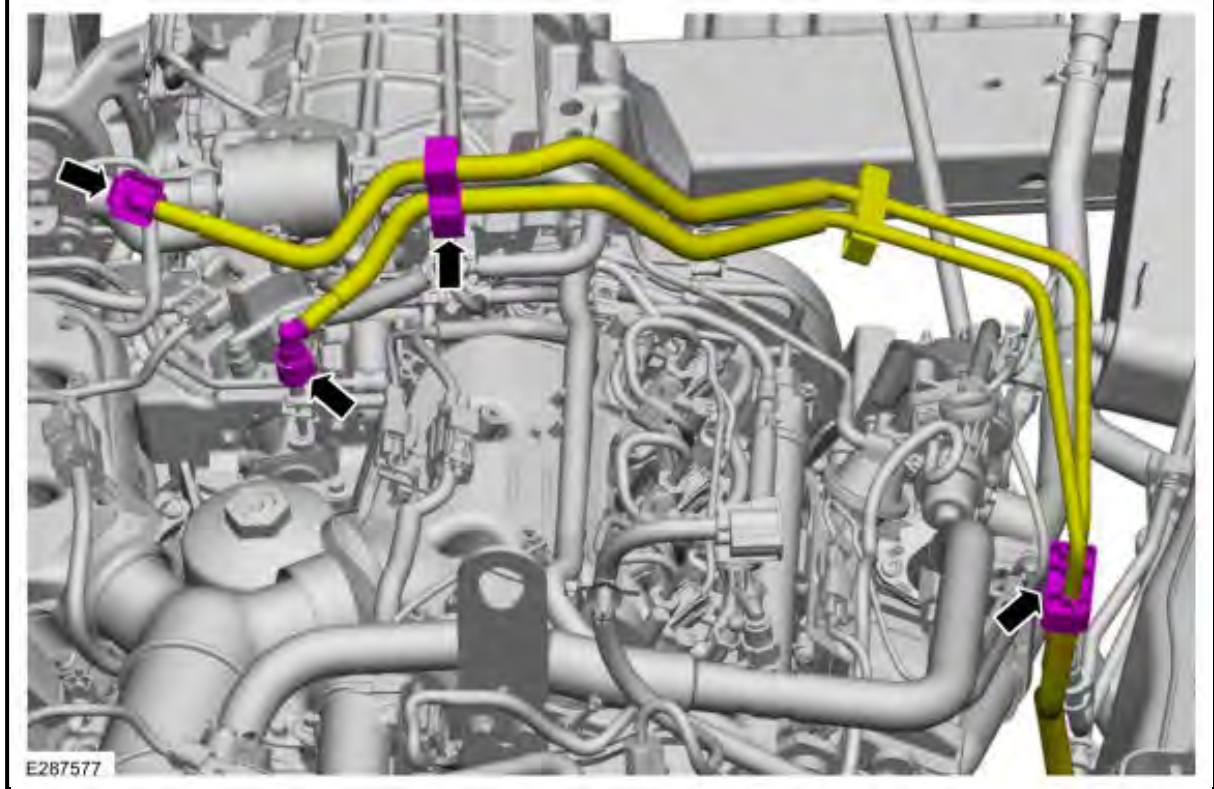




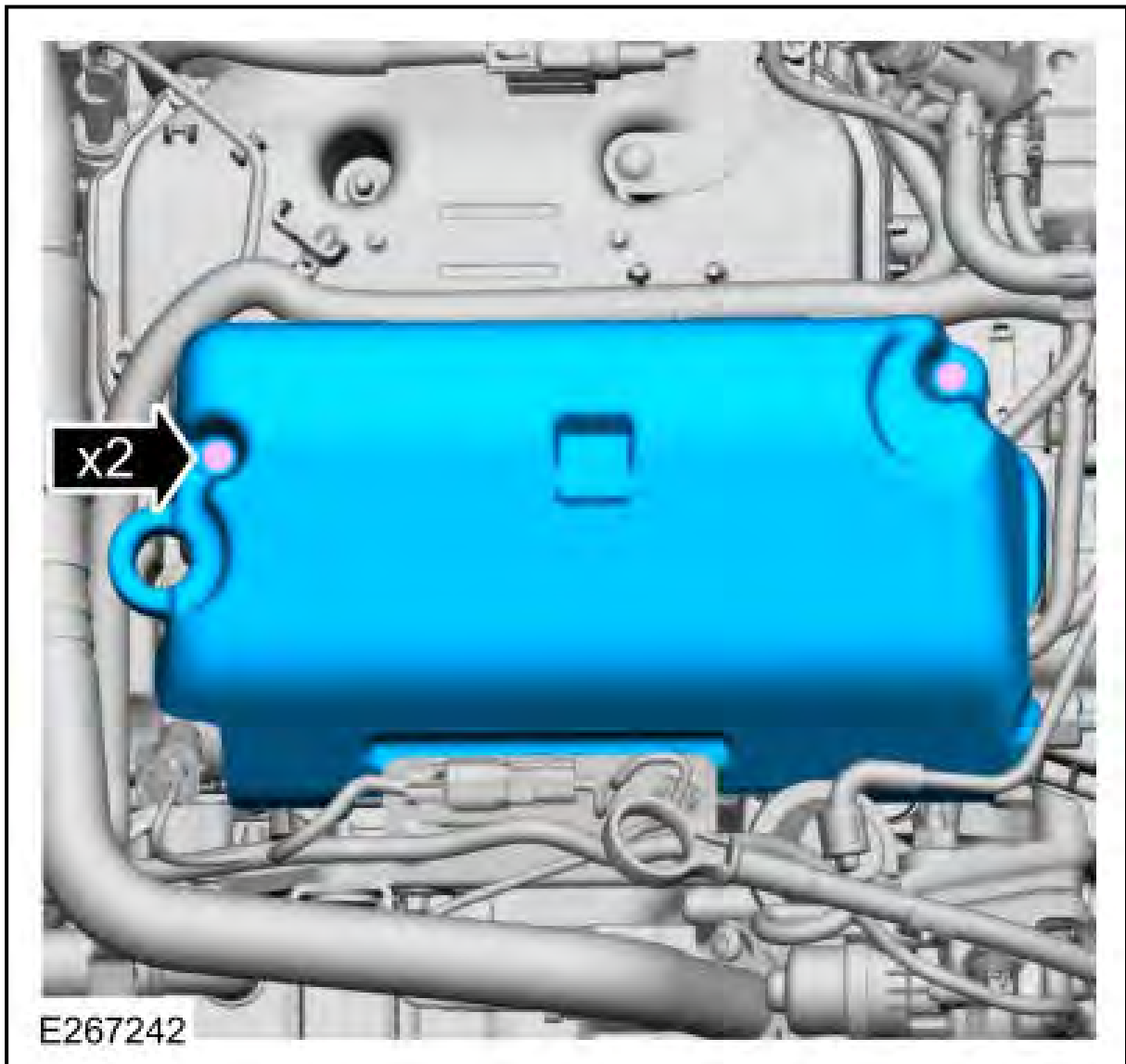
13. Remove the bolts and the generator.



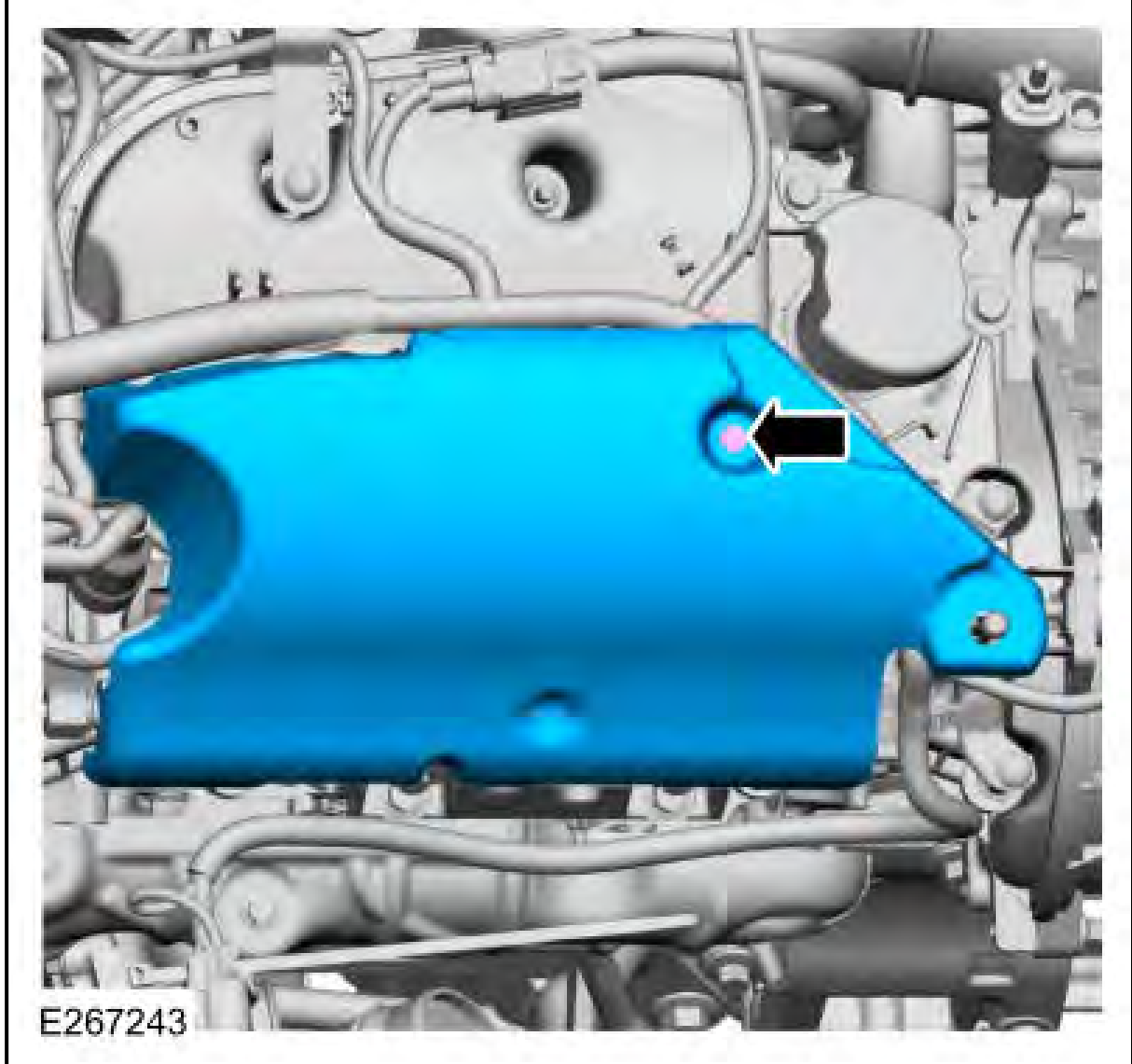
14. Disconnect and position aside the fuel tubes. REFER to: [Quick Release Coupling](#) .



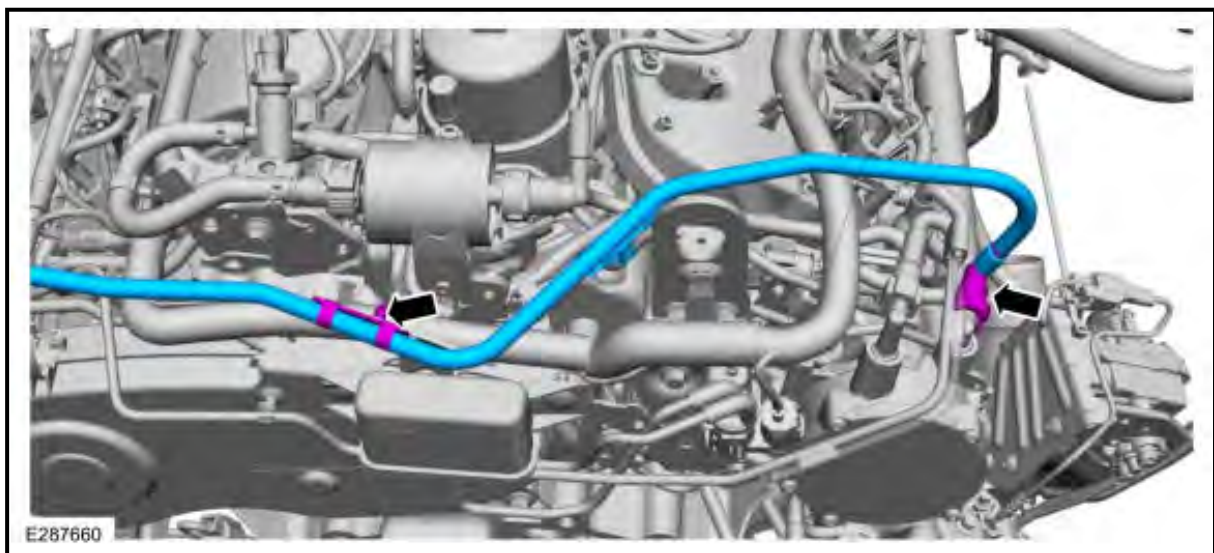
15. Remove the LH fuel injector noise insulator.



16. Remove the RH fuel injector noise insulator.



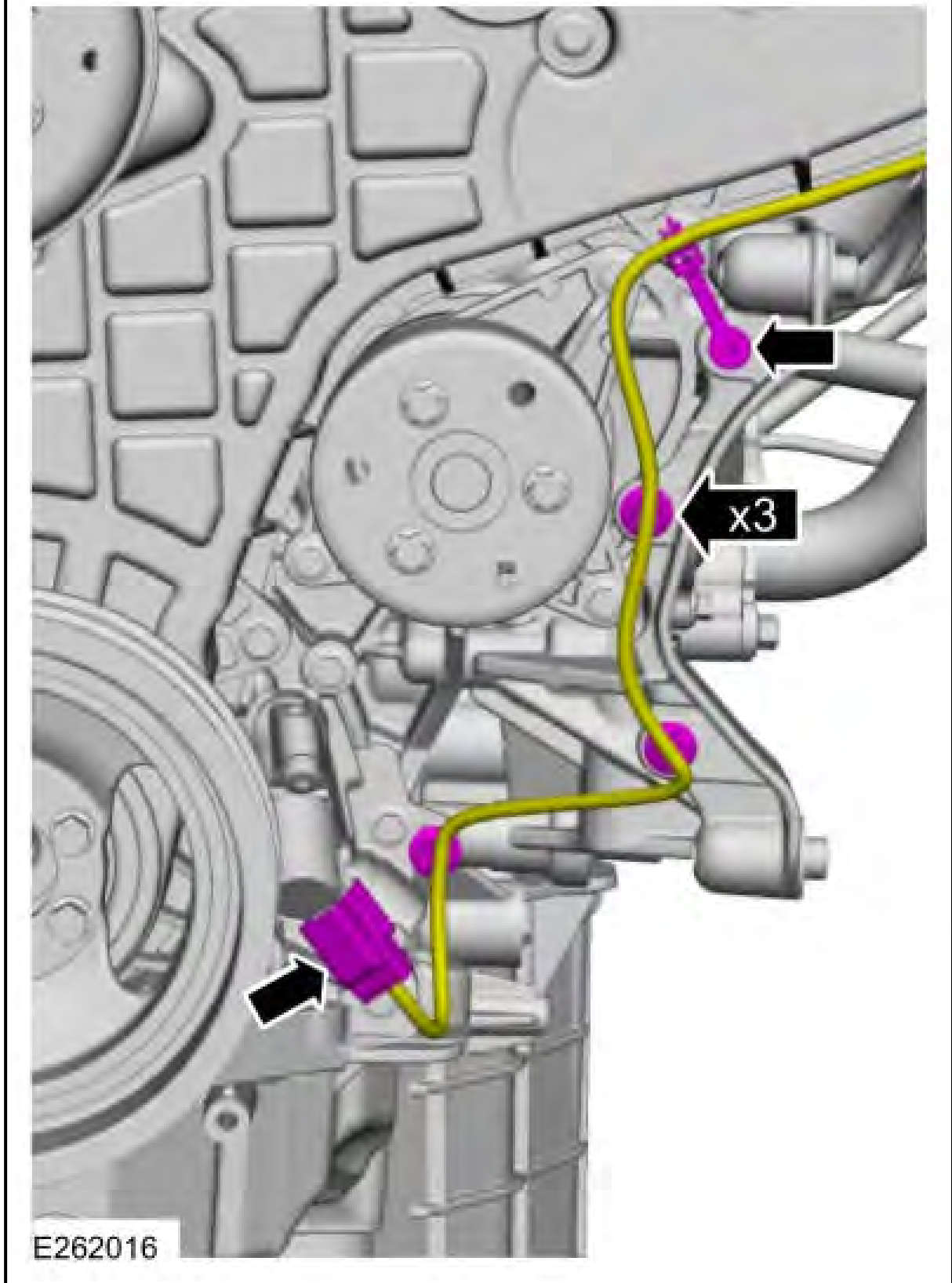
17. Disconnect the retainer. Disconnect and remove the brake vacuum hose. REFER to: [Quick Release Coupling](#) .



18. Disconnect the oil pump electrical connector and the wire retainers.

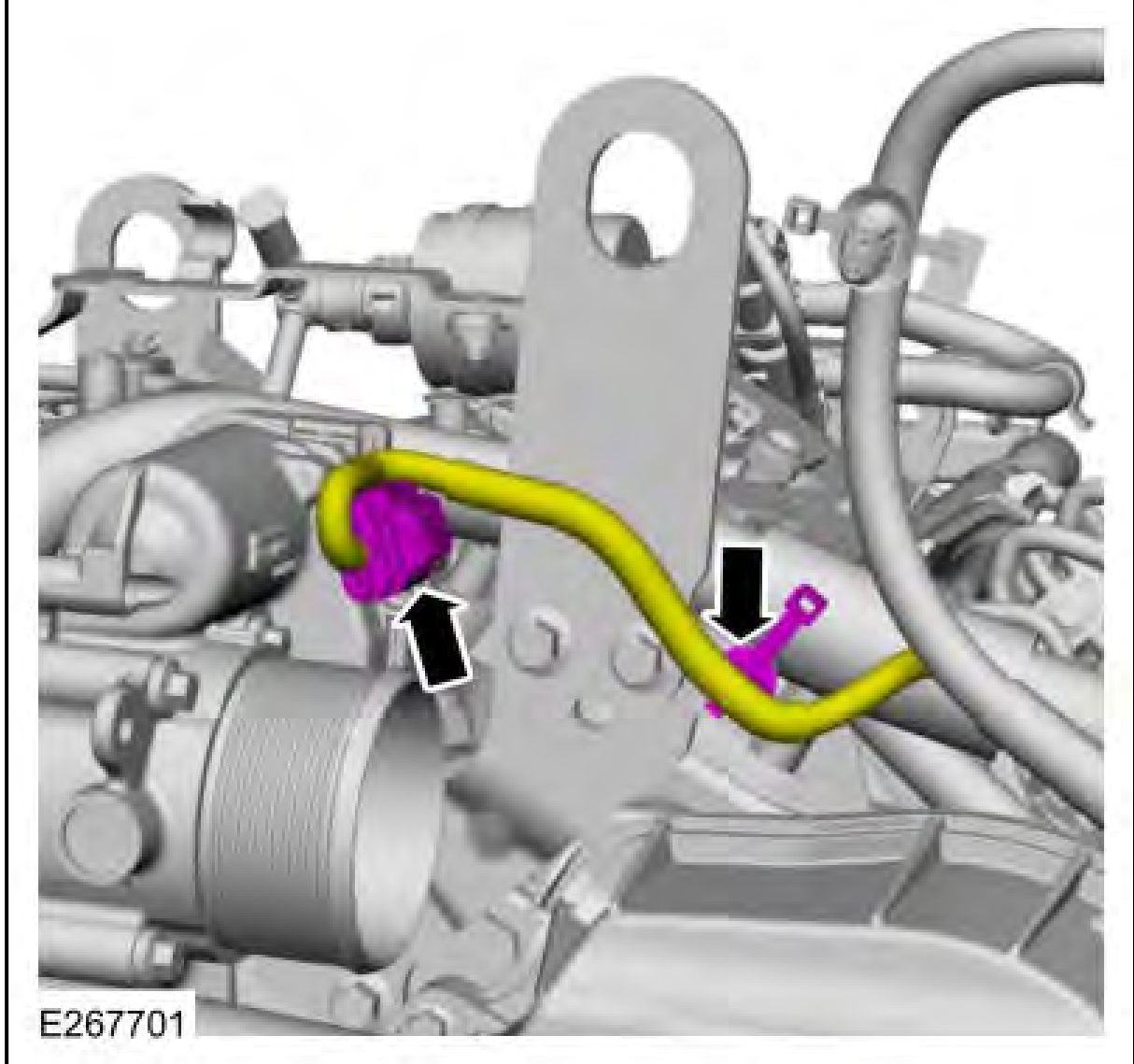




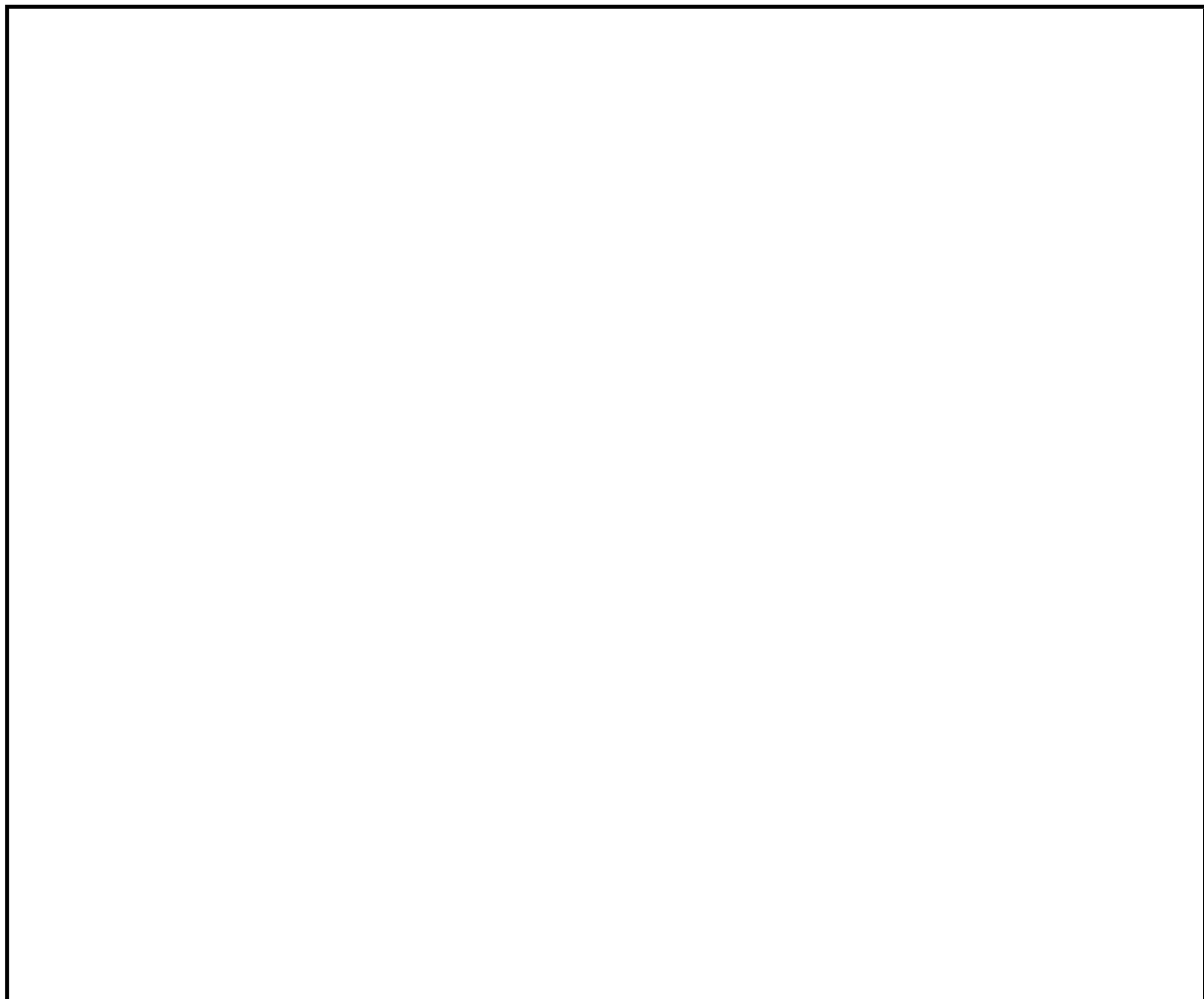


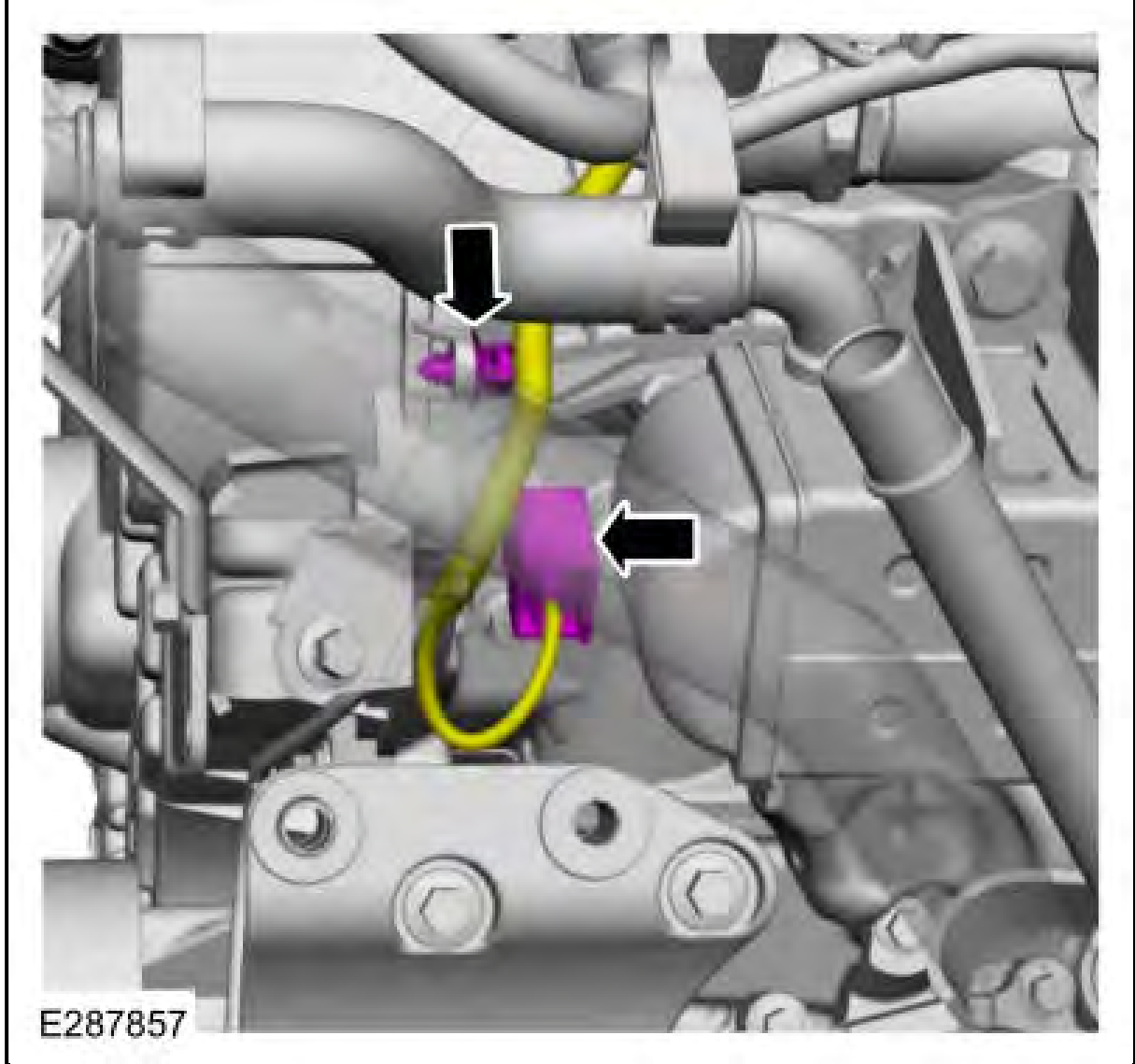
19. Disconnect the TB (throttle body) electrical connector and the wire retainer.



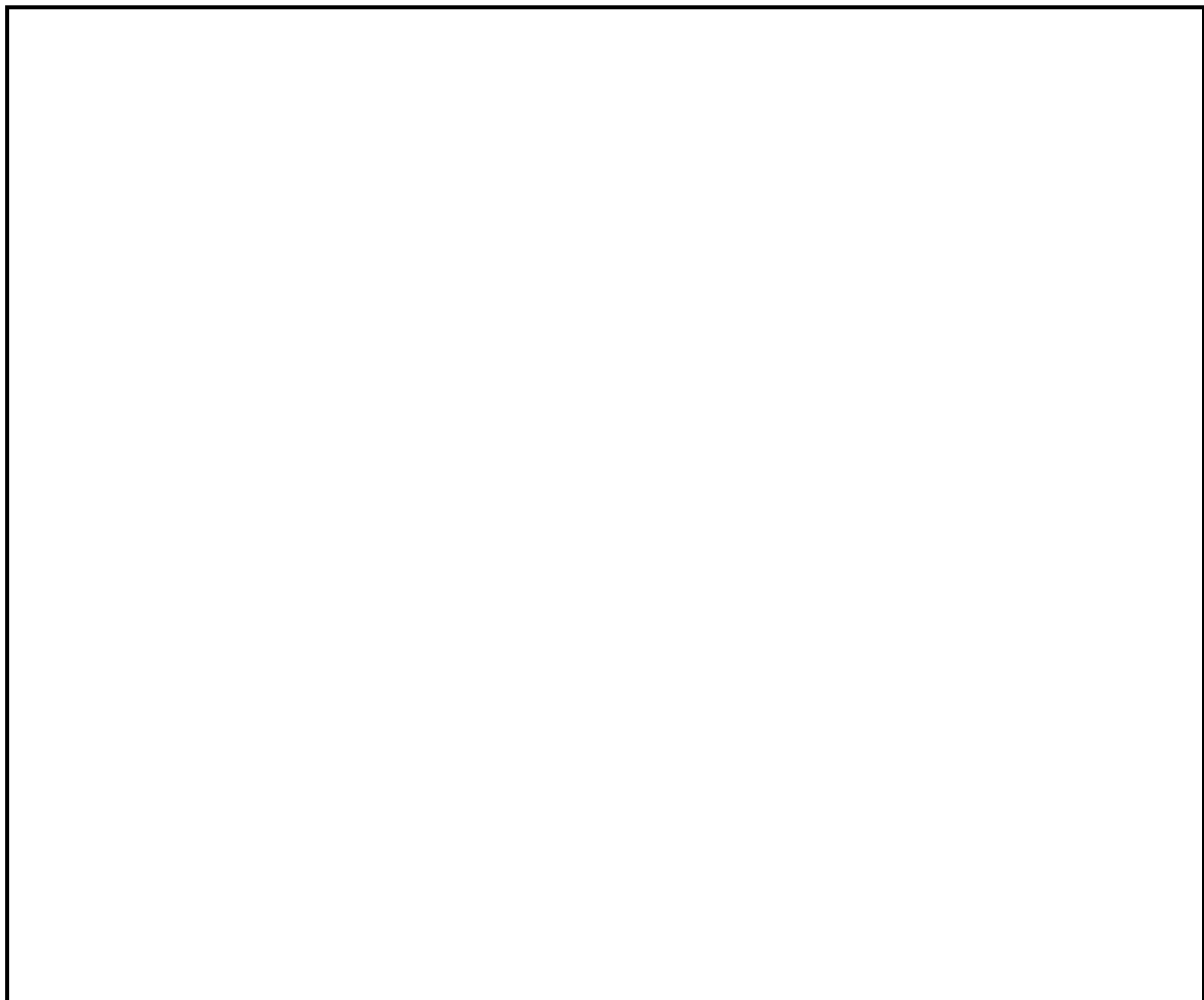


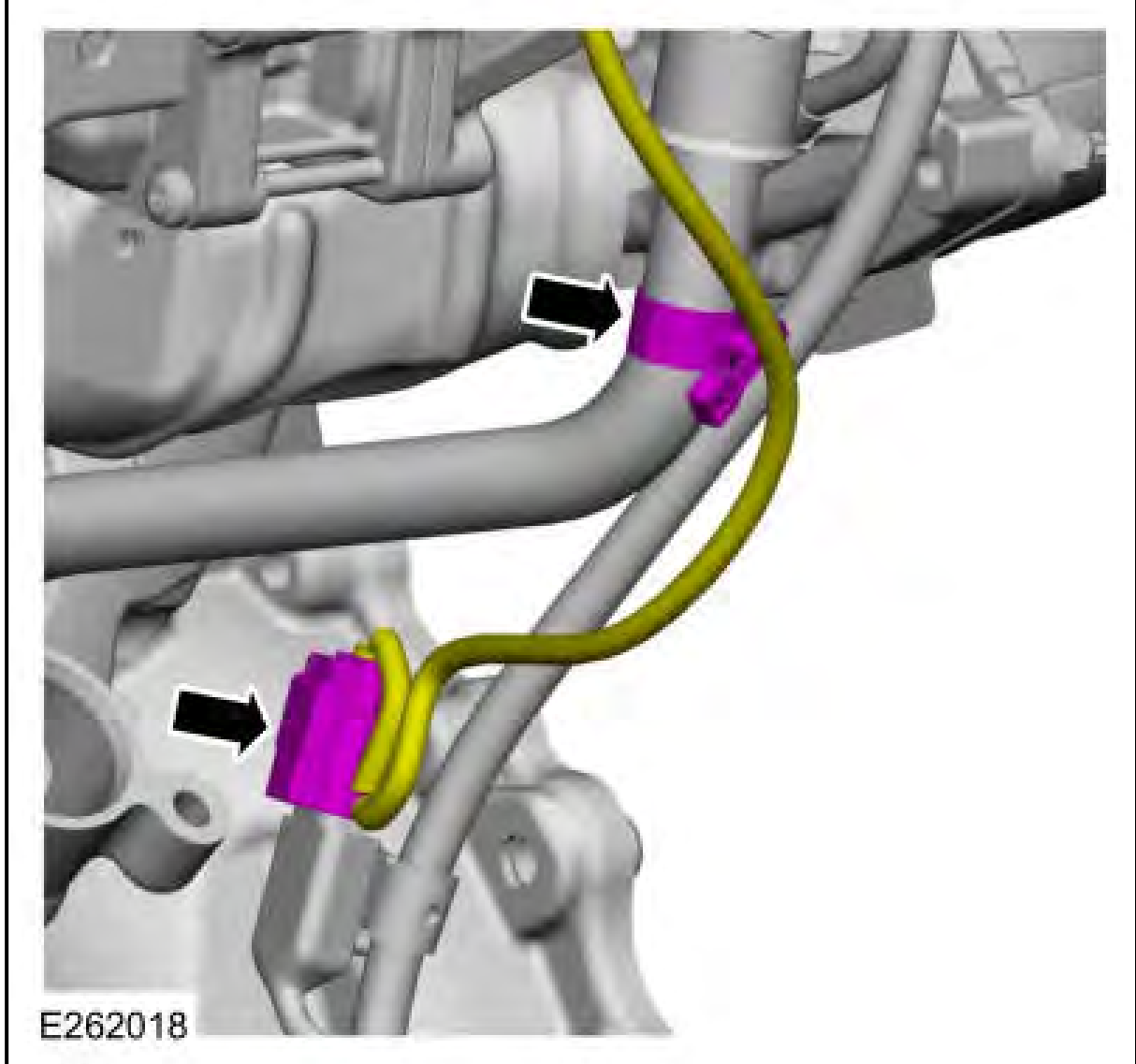
20. Disconnect the CMP electrical connector and the wire retainer.





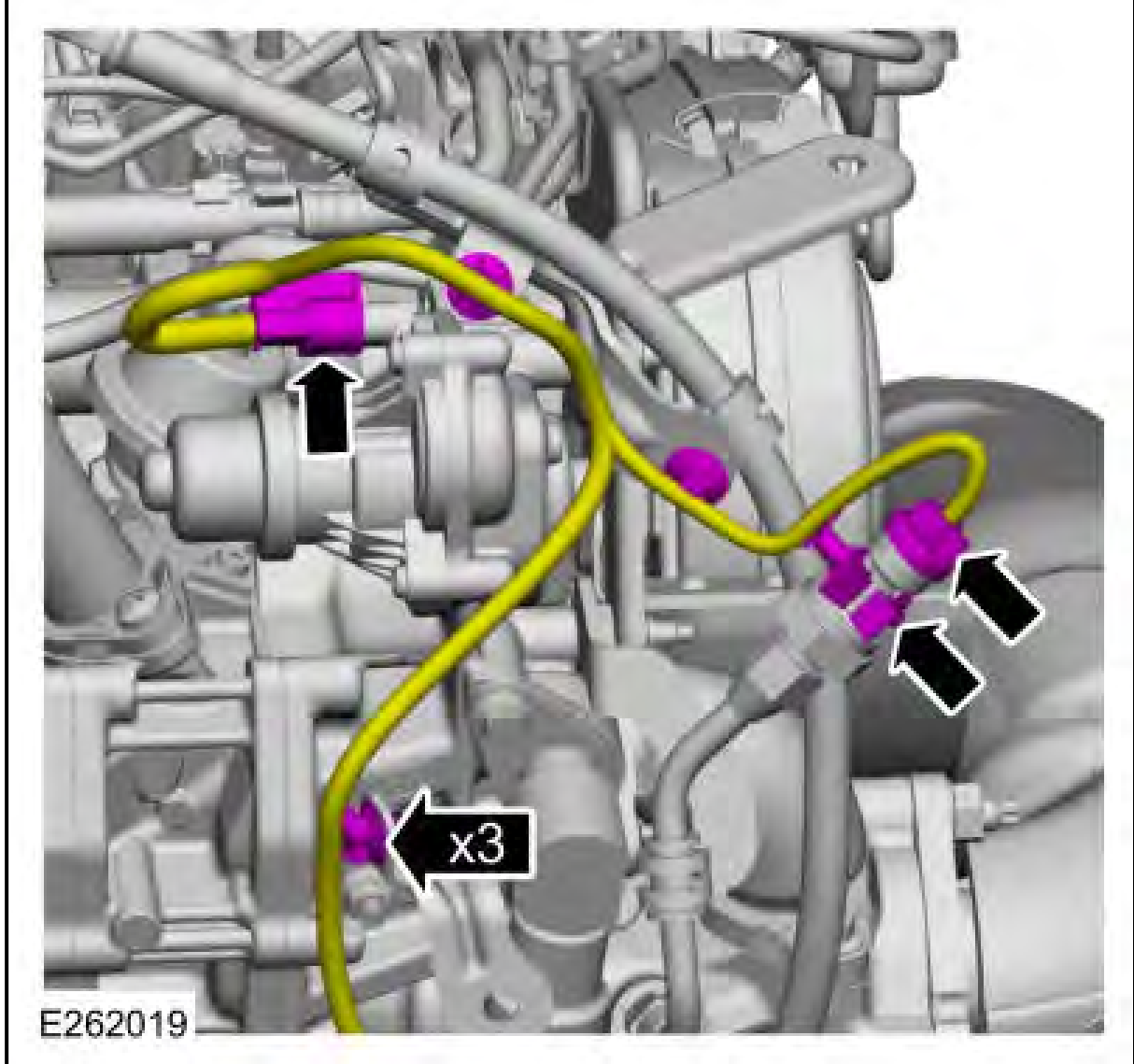
21. Disconnect the CKP electrical connector and the wire retainer.



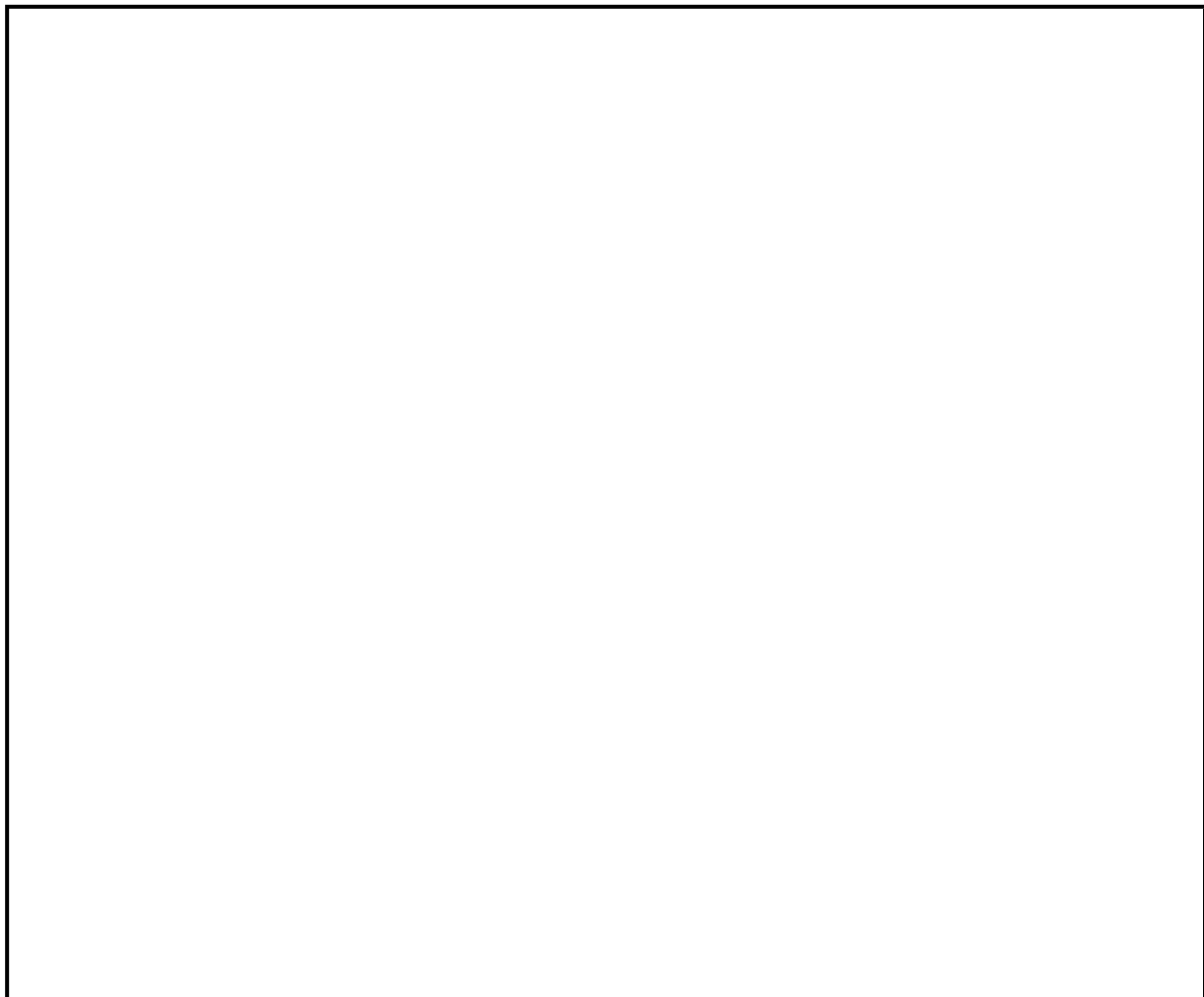


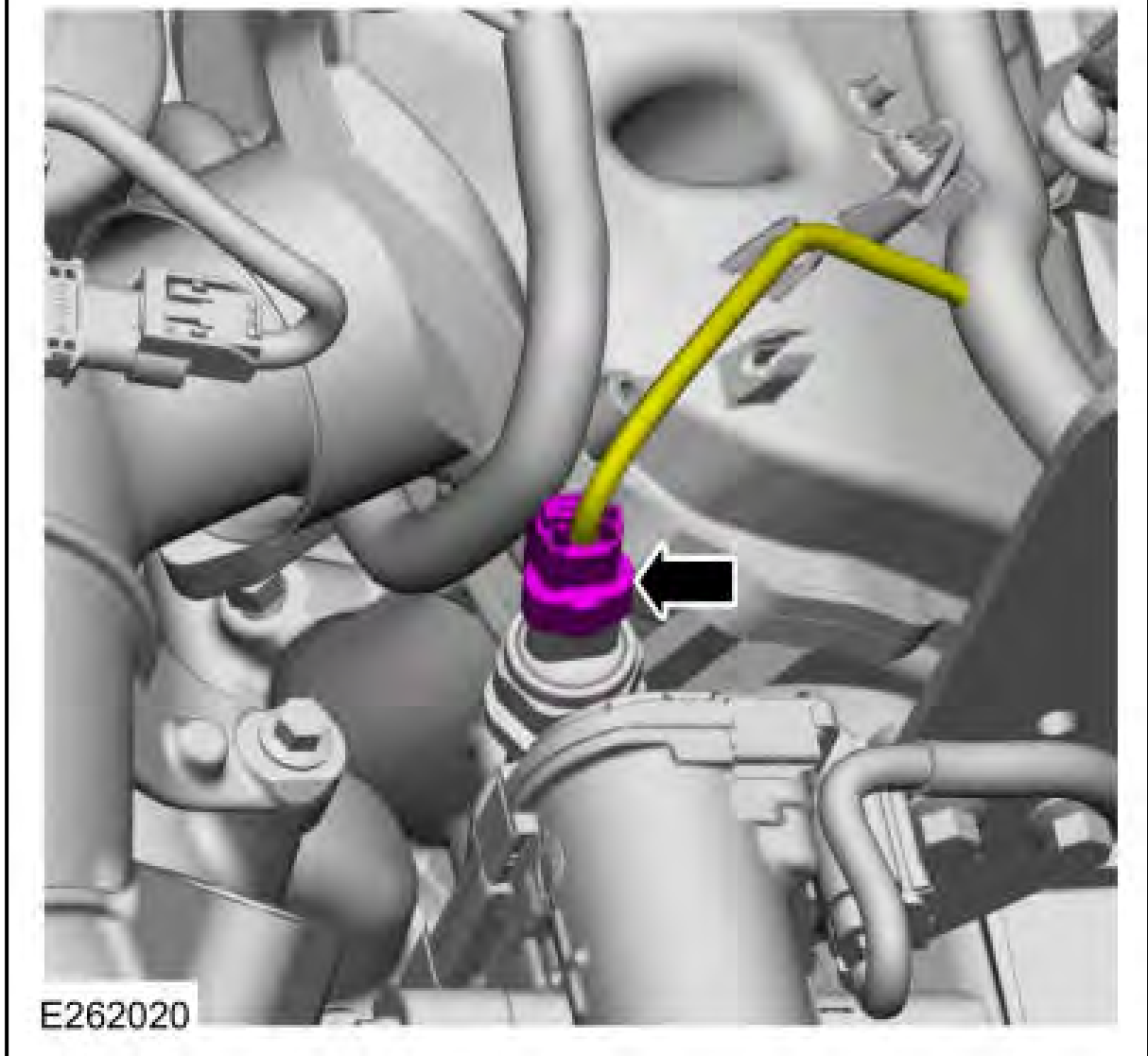
22. Disconnect the EGR valve and the EP (exhaust pressure) sensor electrical connectors. Disconnect the wire retainers.



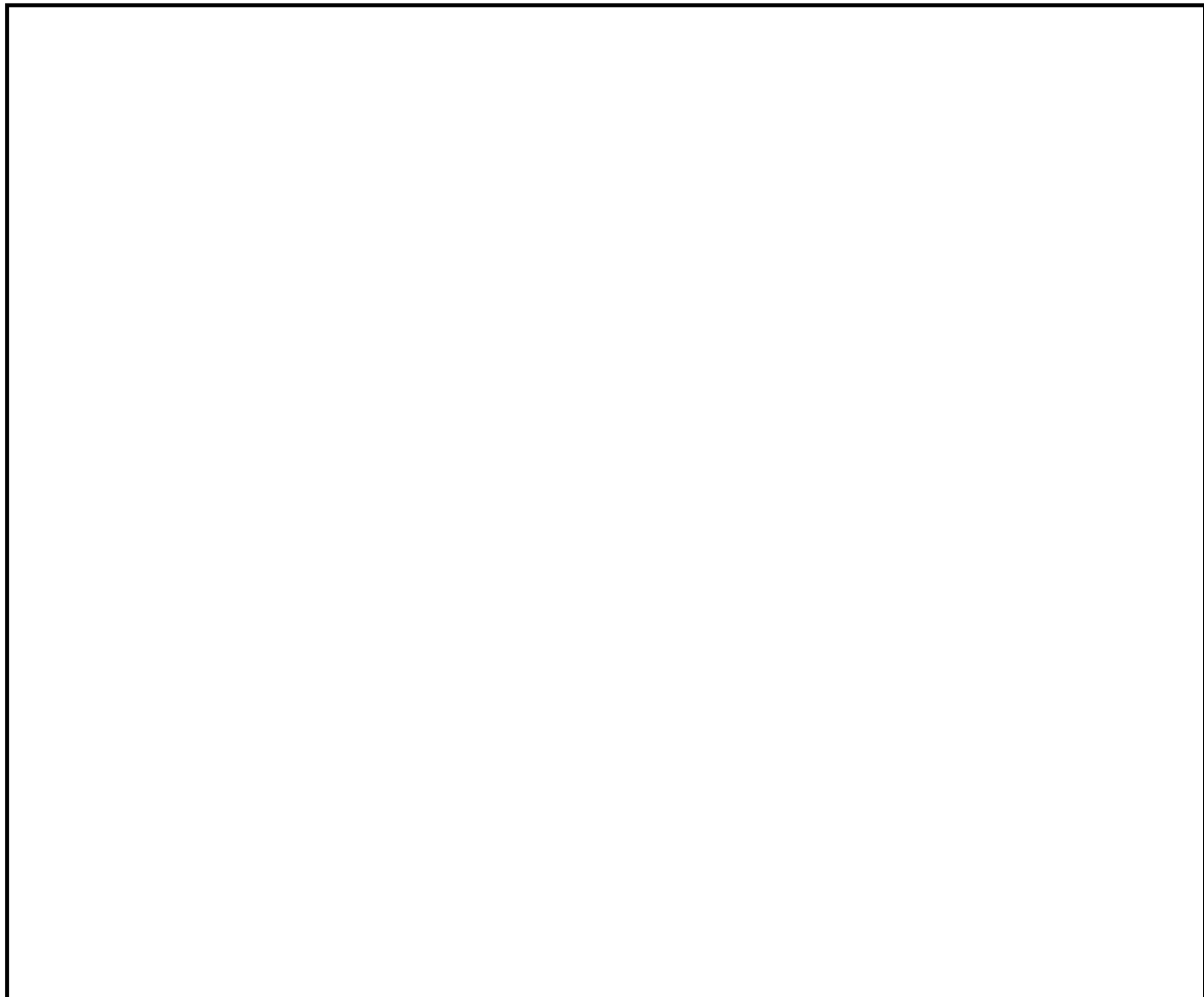


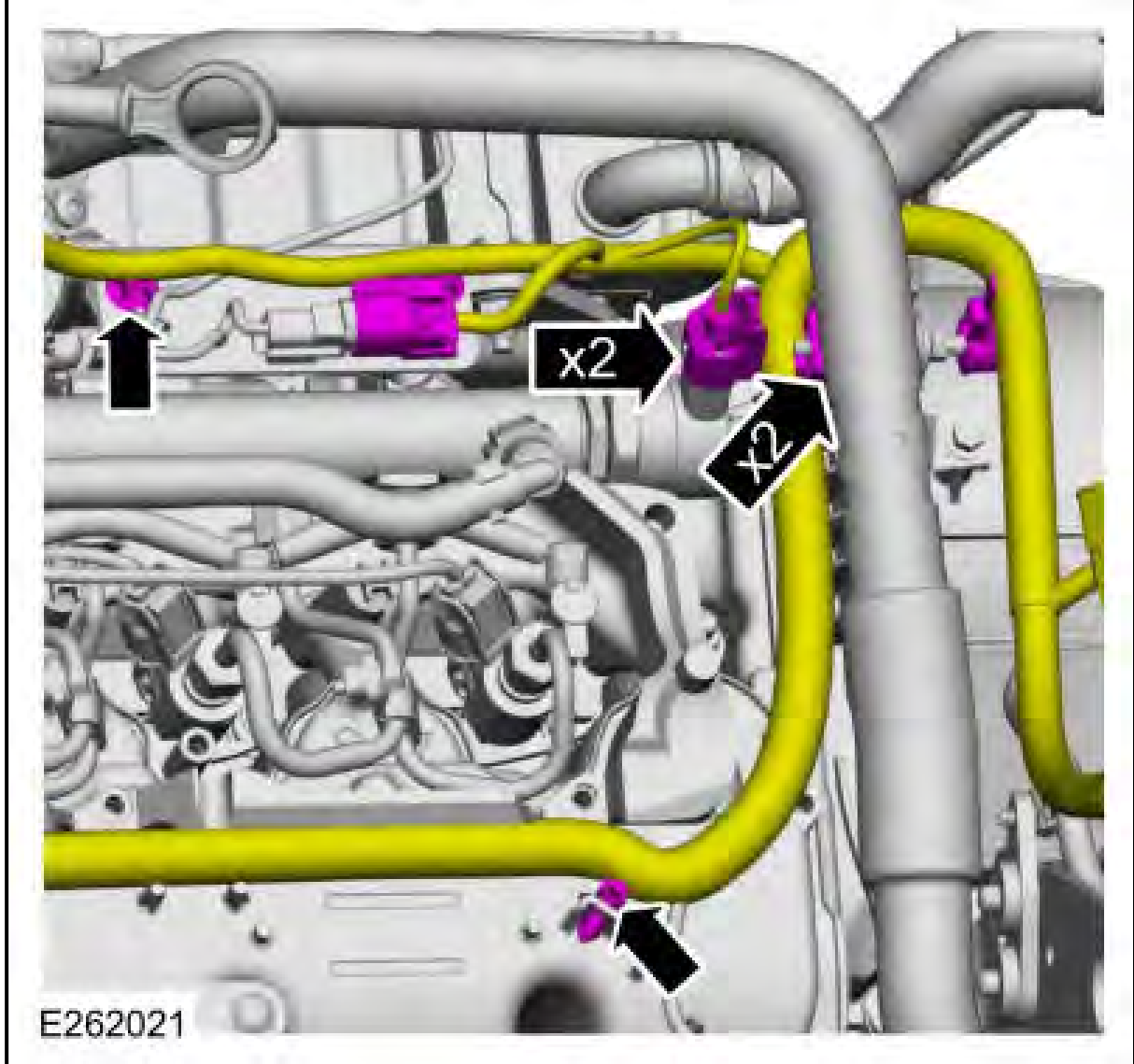
23. Disconnect the EOP sensor electrical connector.



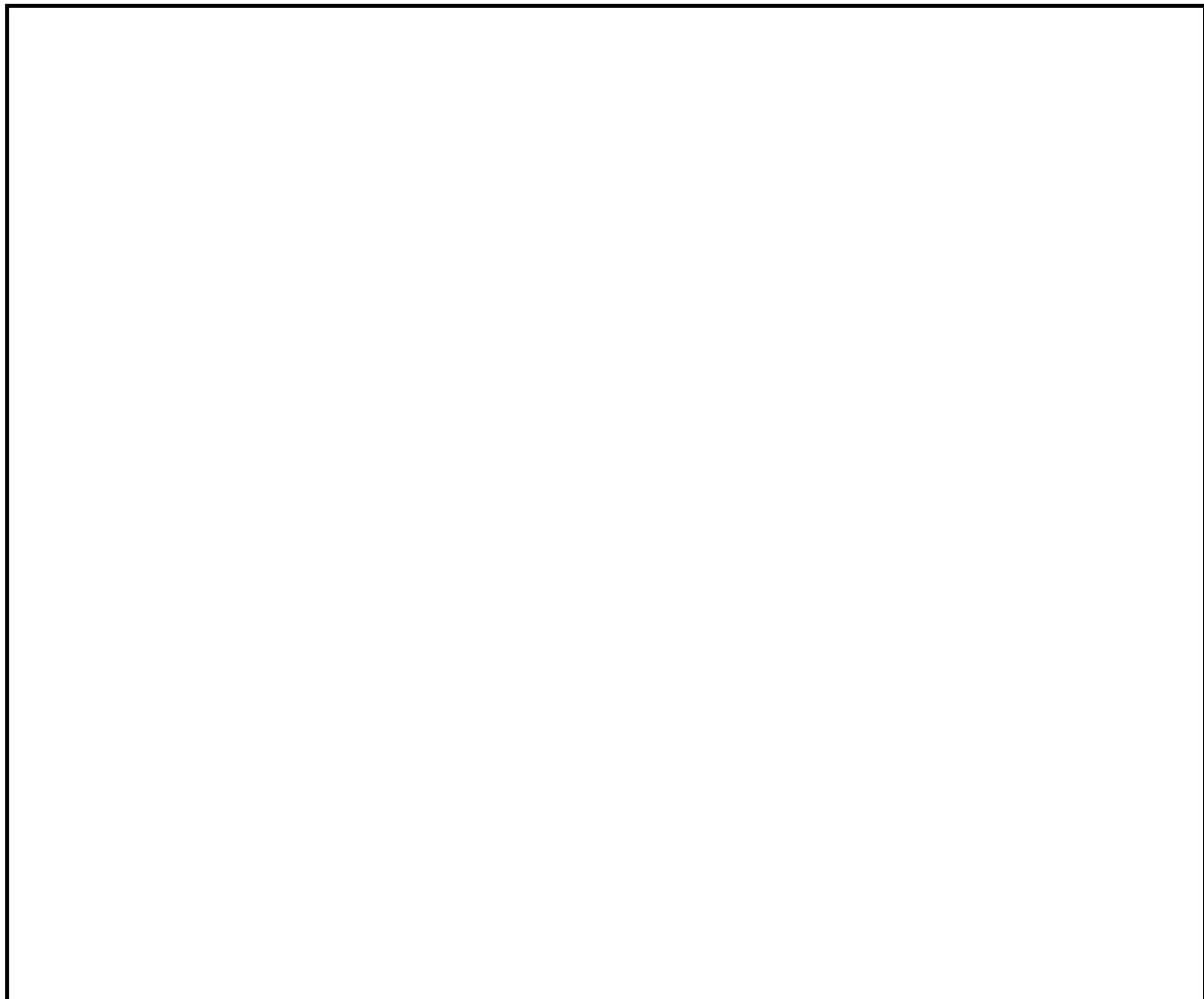


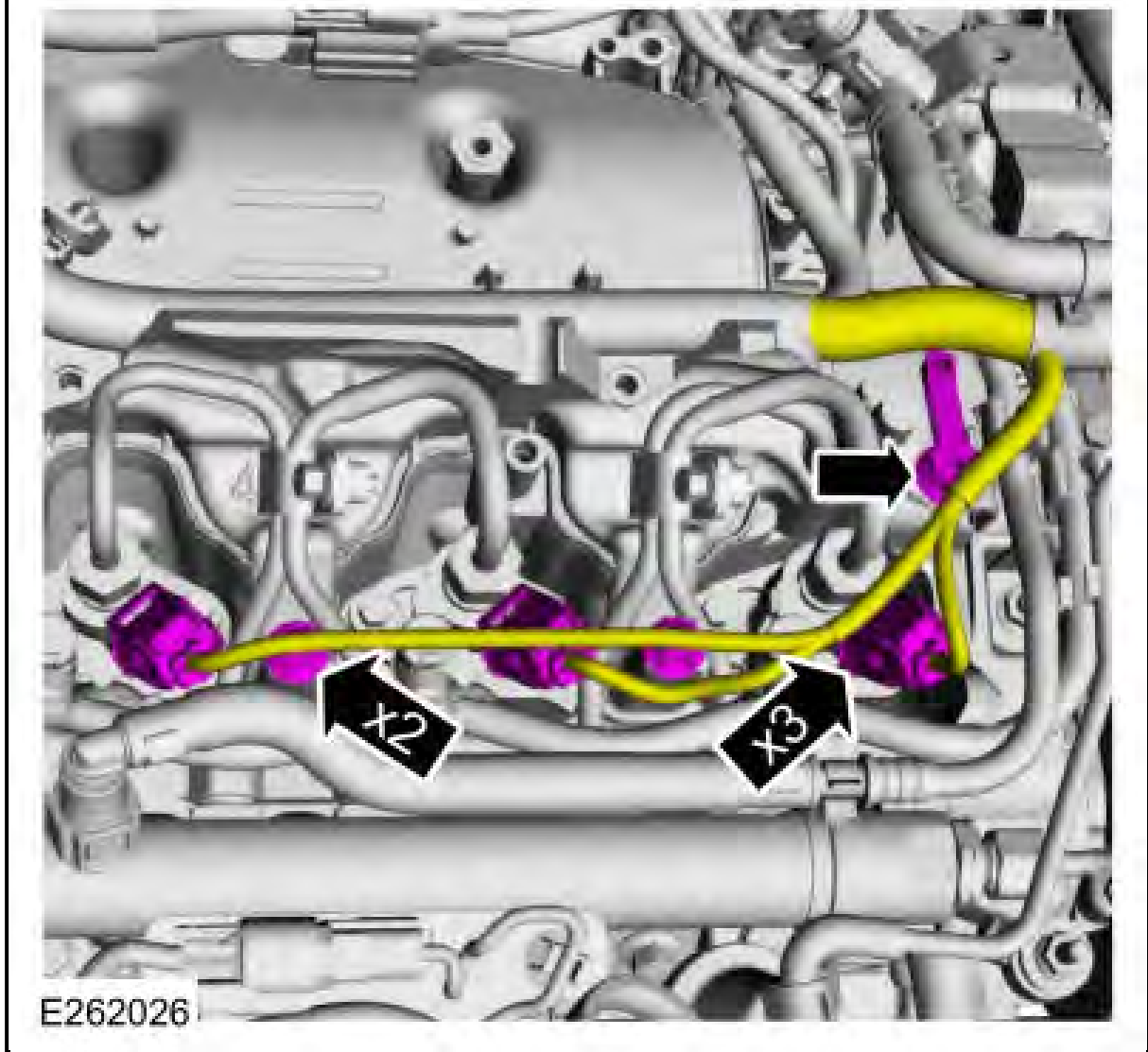
24. Disconnect the electrical connectors and the wire retainers.



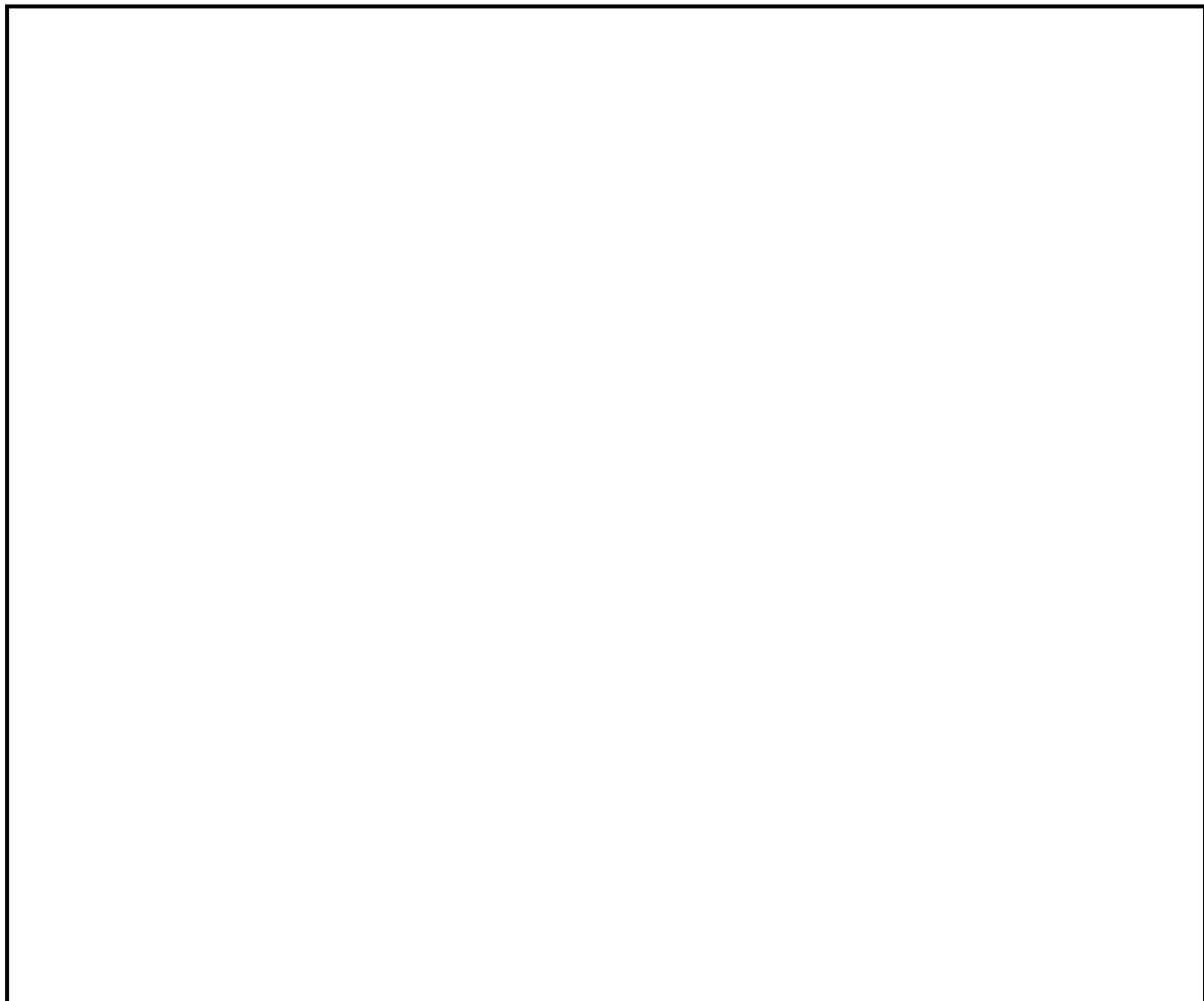


25. Disconnect the fuel injectors electrical connectors and the wire retainers.

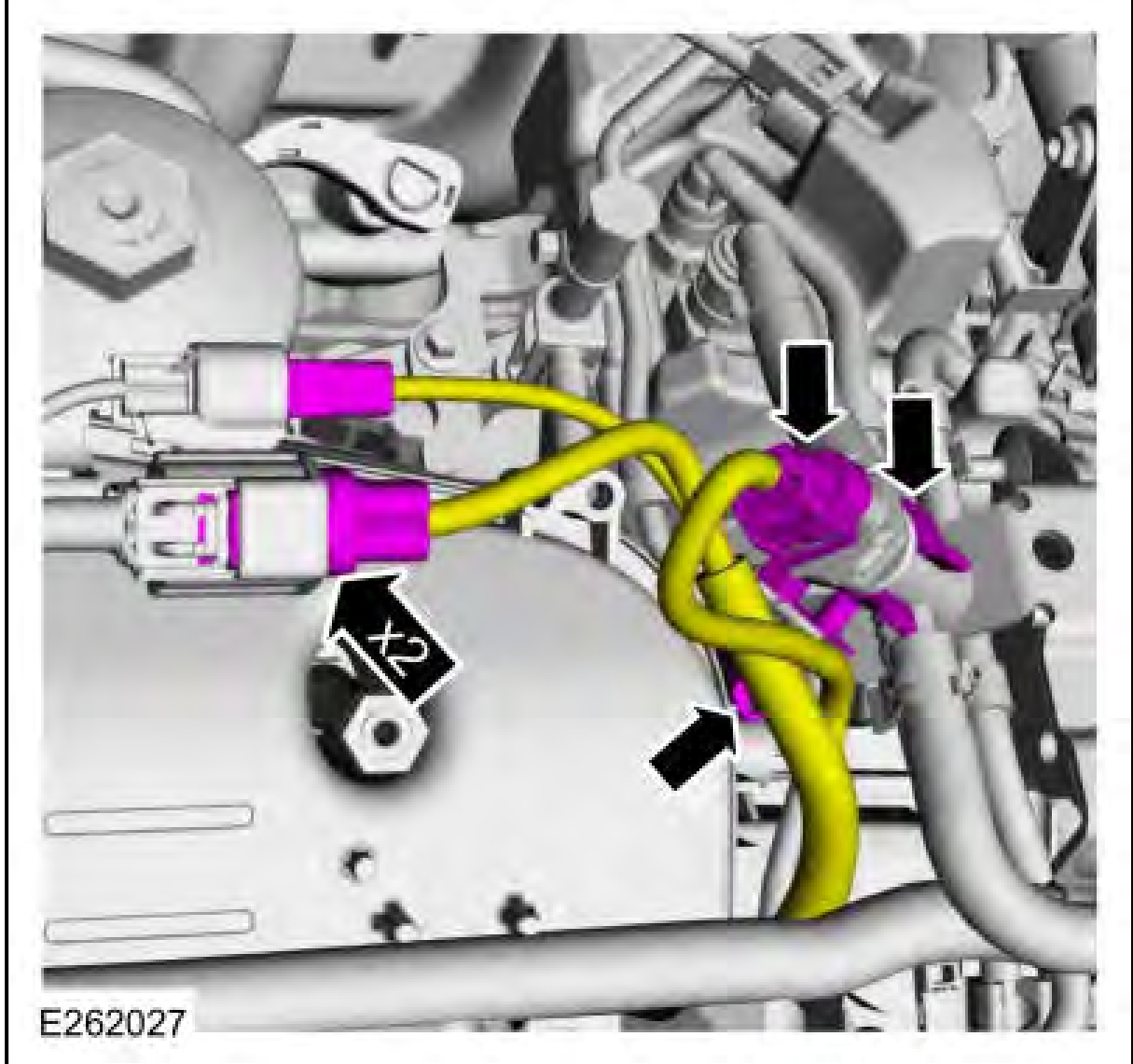




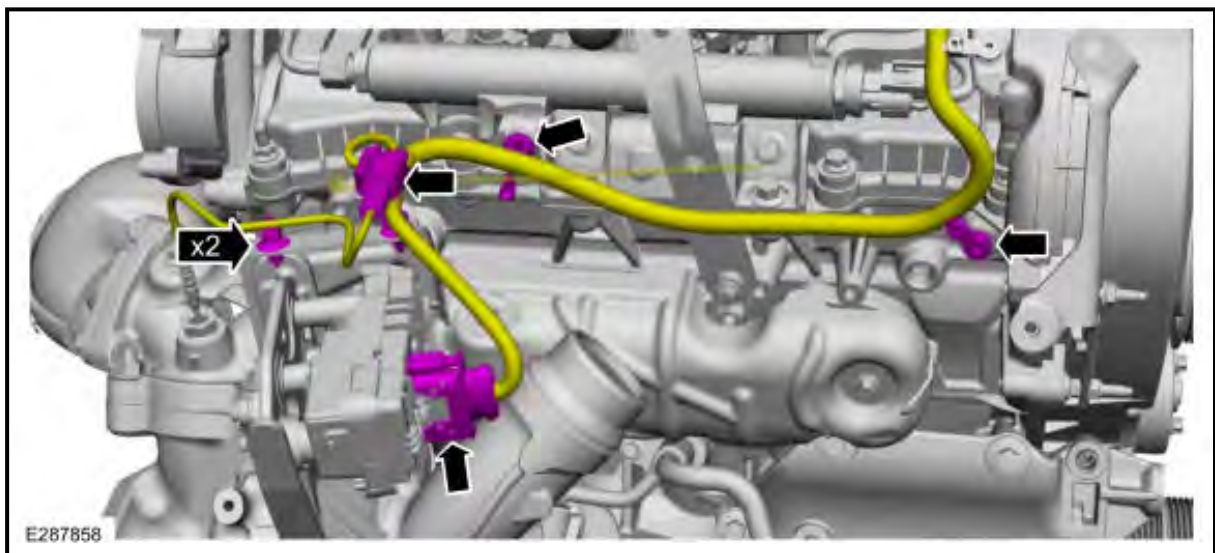
26. Disconnect the electrical connectors and the wire retainer.





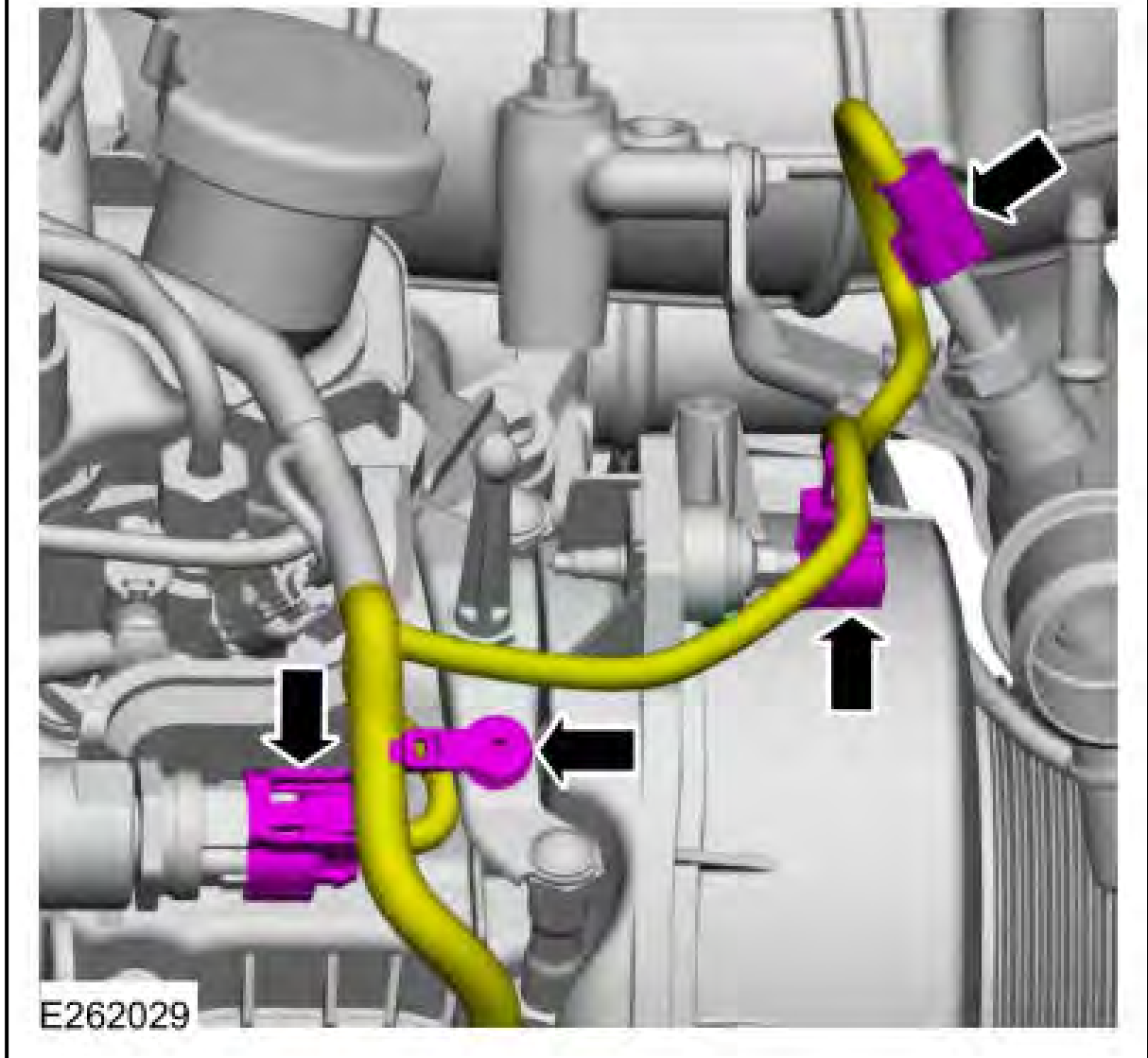


27. Disconnect the turbocharger actuator electrical connector. Disconnect the EGRT electrical connector and the wire retainers.

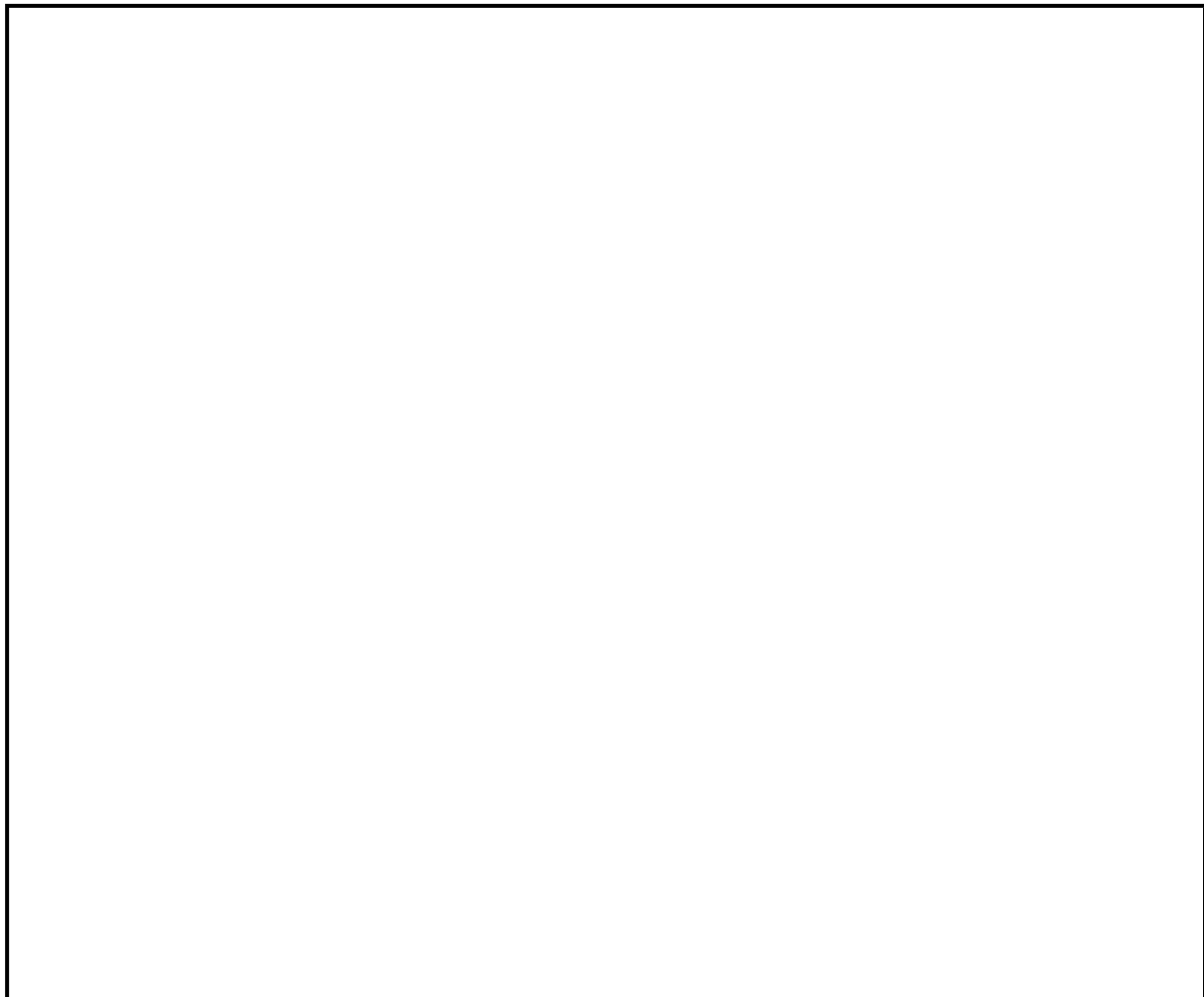


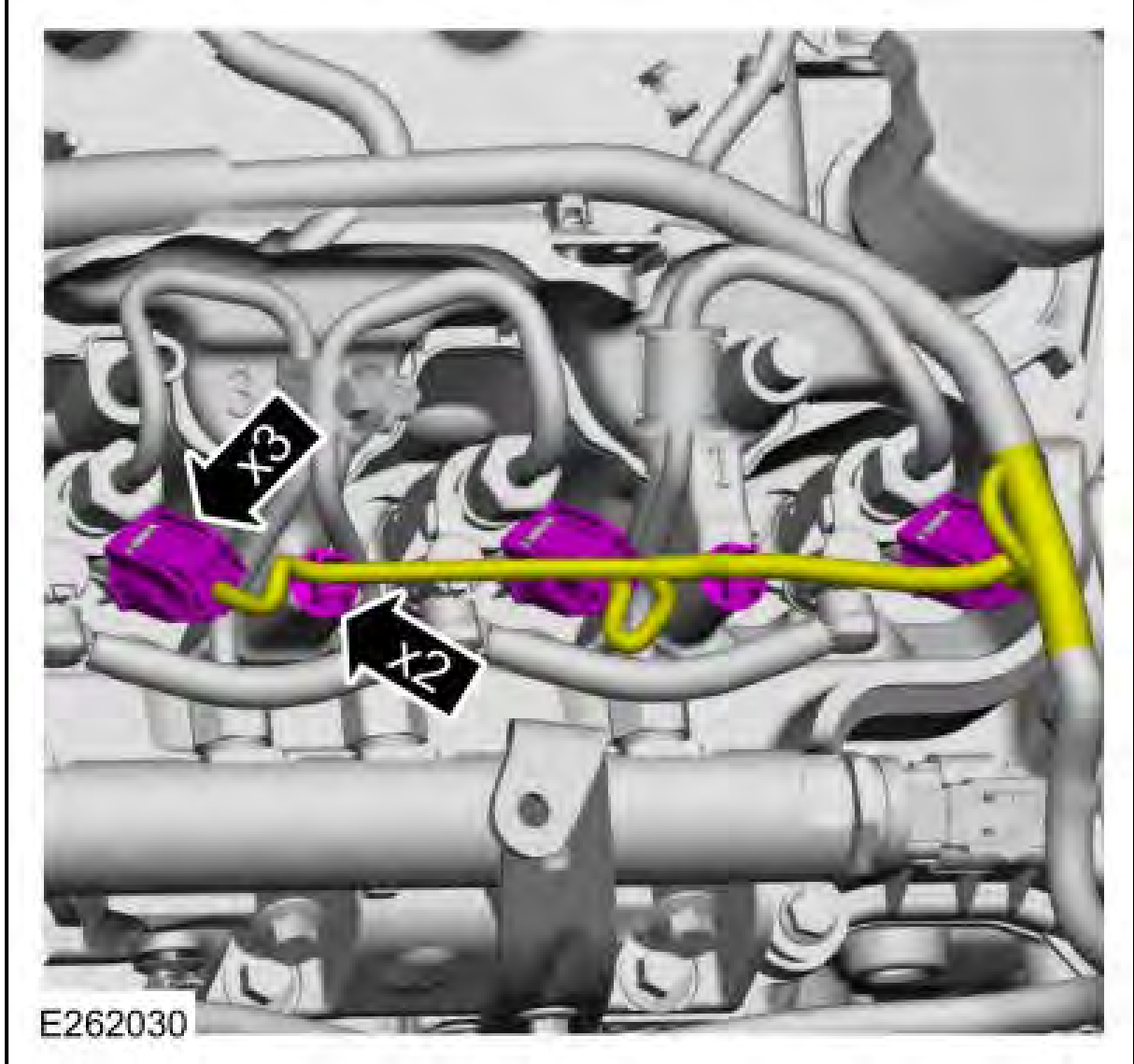
28. Disconnect the electrical connectors and the wire retainers.



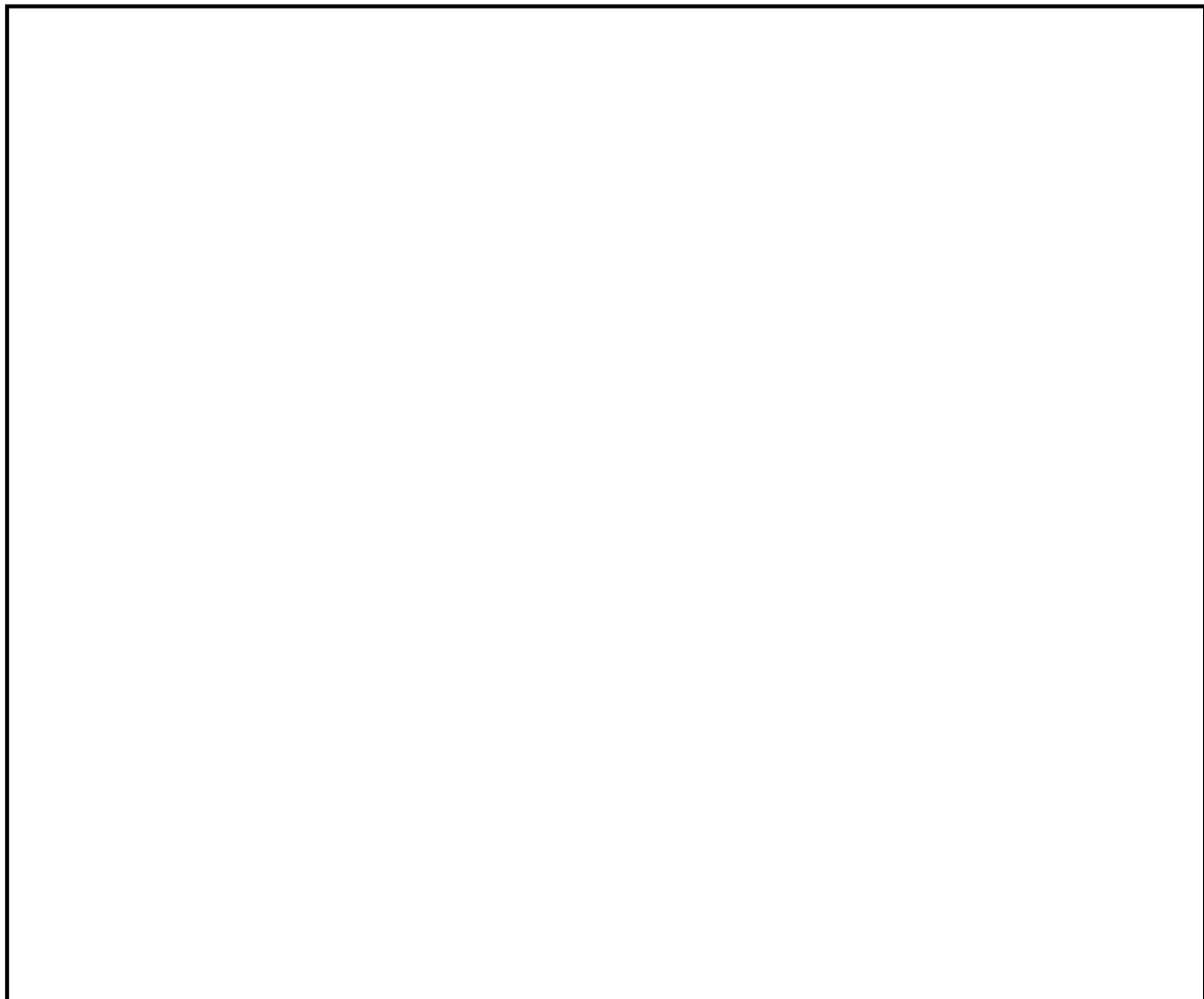


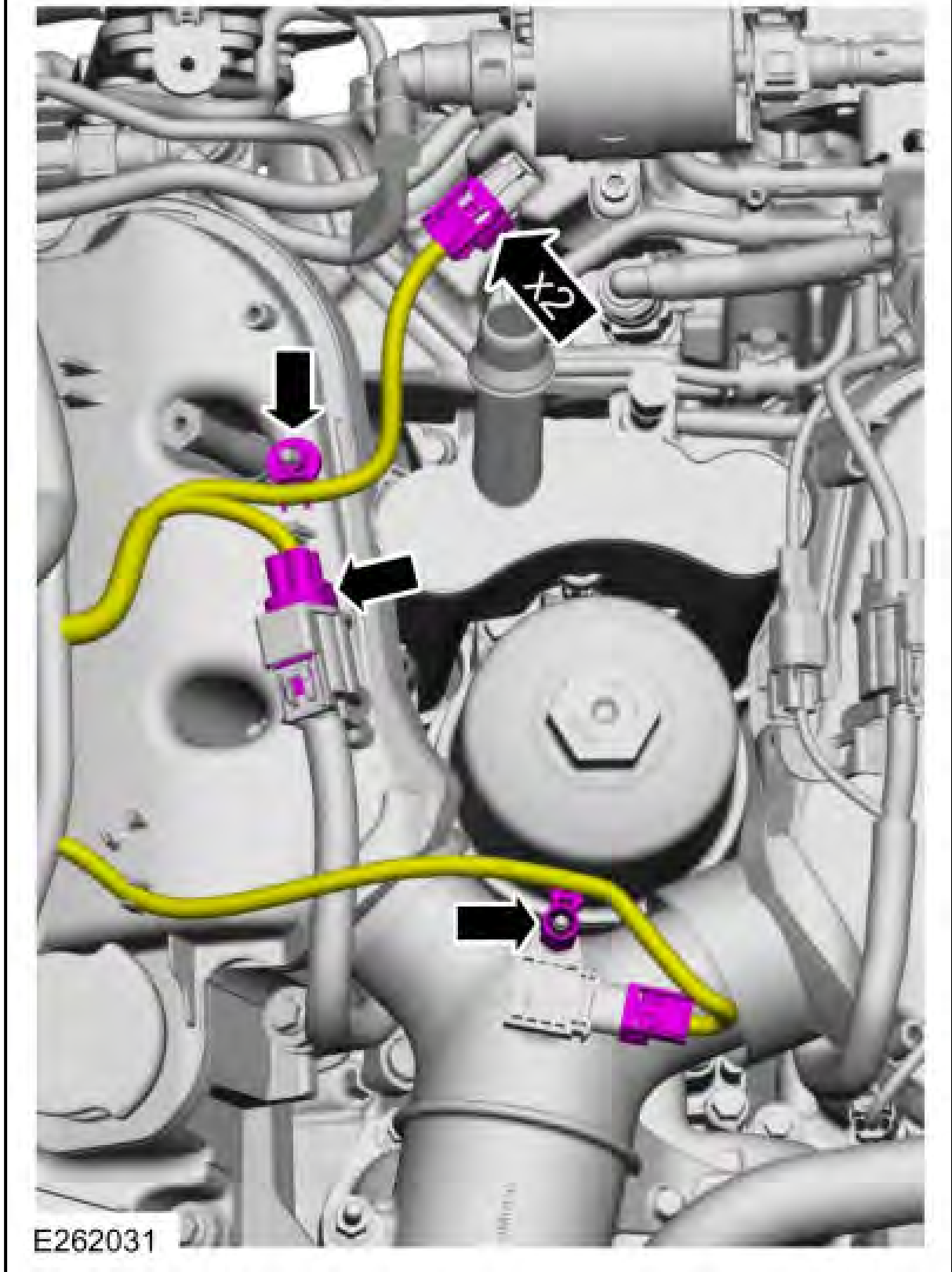
29. Disconnect the fuel injectors electrical connectors and the wire retainers.





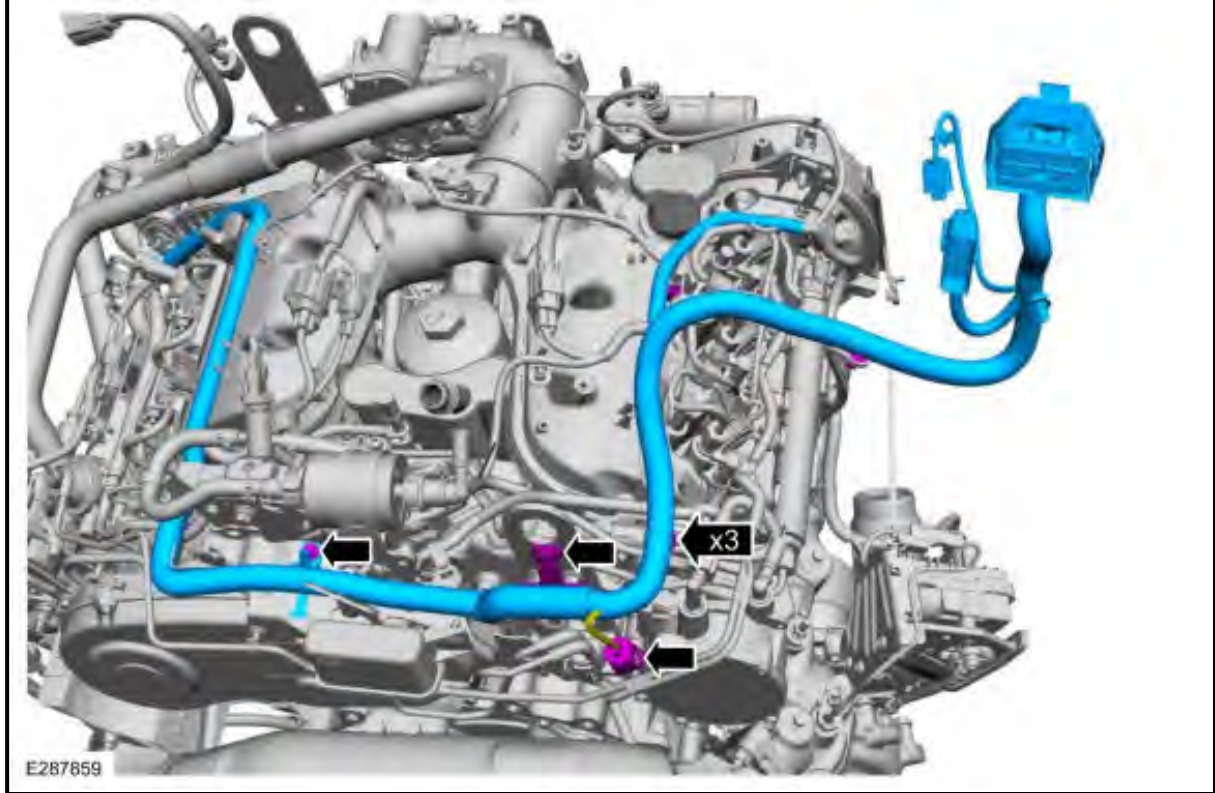
30. Disconnect the electrical connectors and the wire retainers.



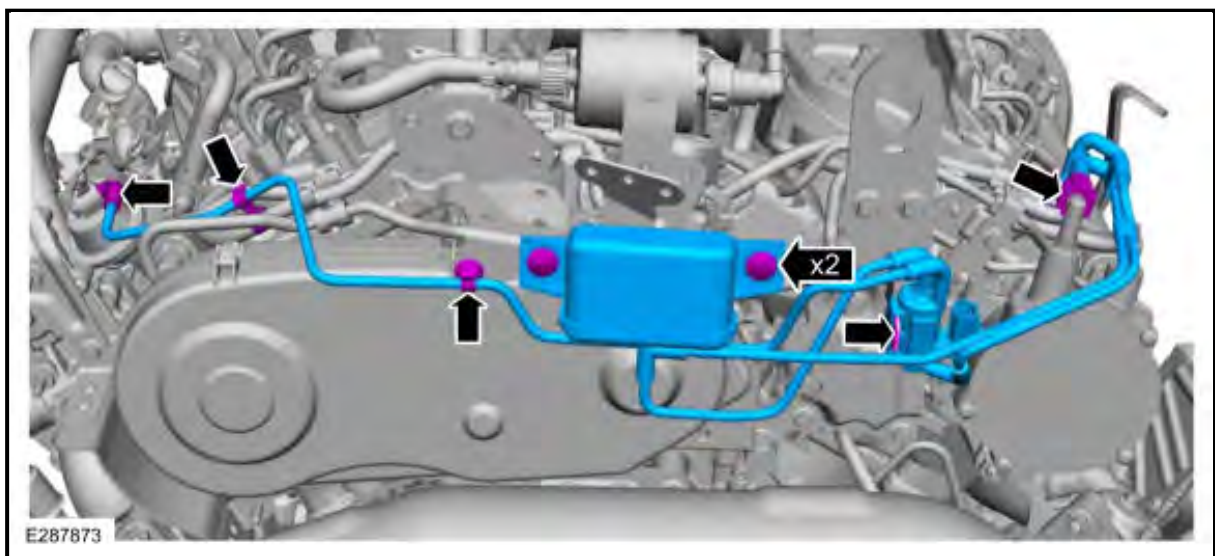


31. Disconnect the electrical connector and remove the bolt. Disconnect the wire harness retainers and remove the engine wire harness.



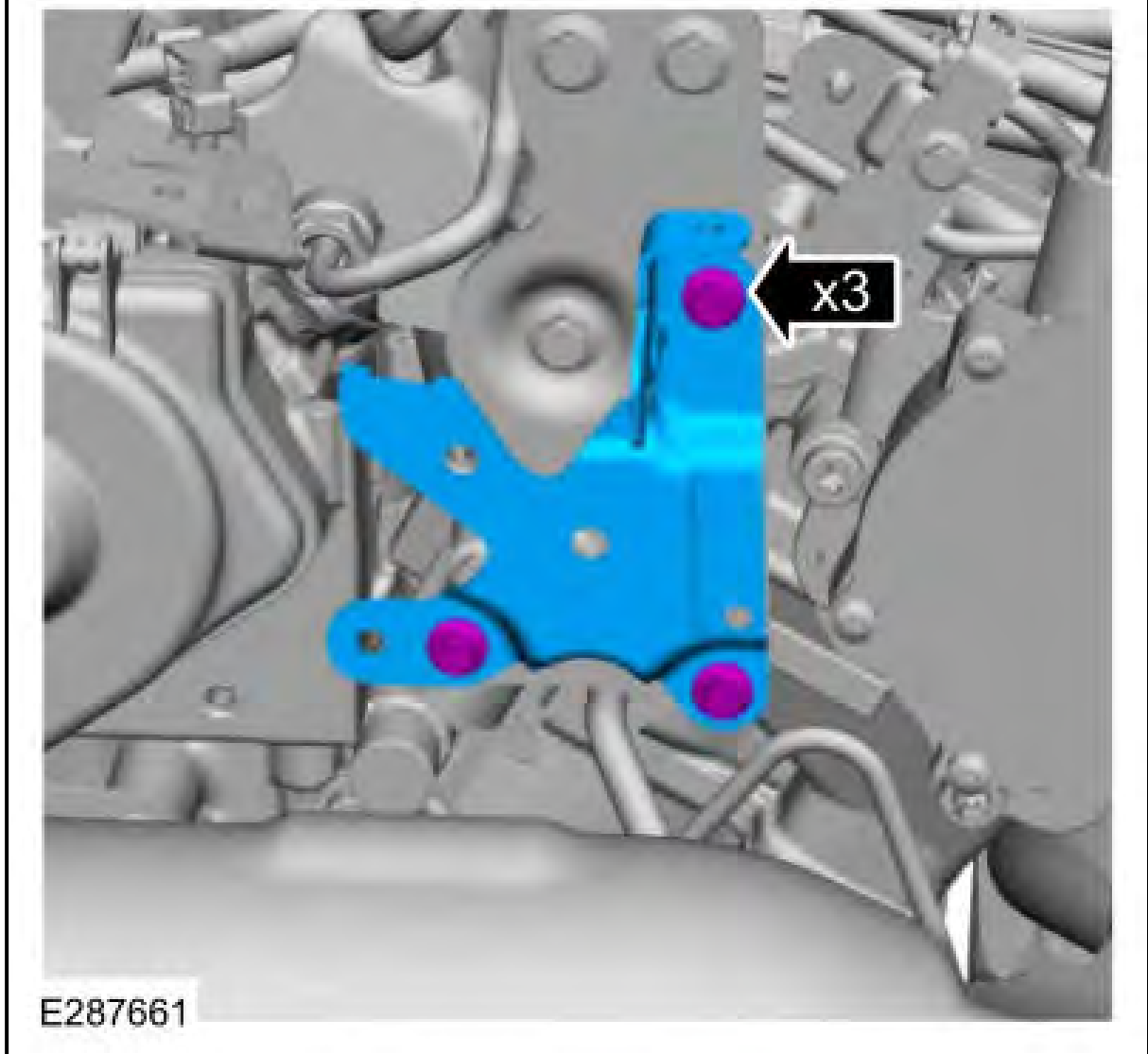


32. Disconnect the vacuum pump connector. Remove the retainers and remove the vacuum hose assembly. REFER to: [Quick Release Coupling](#) .

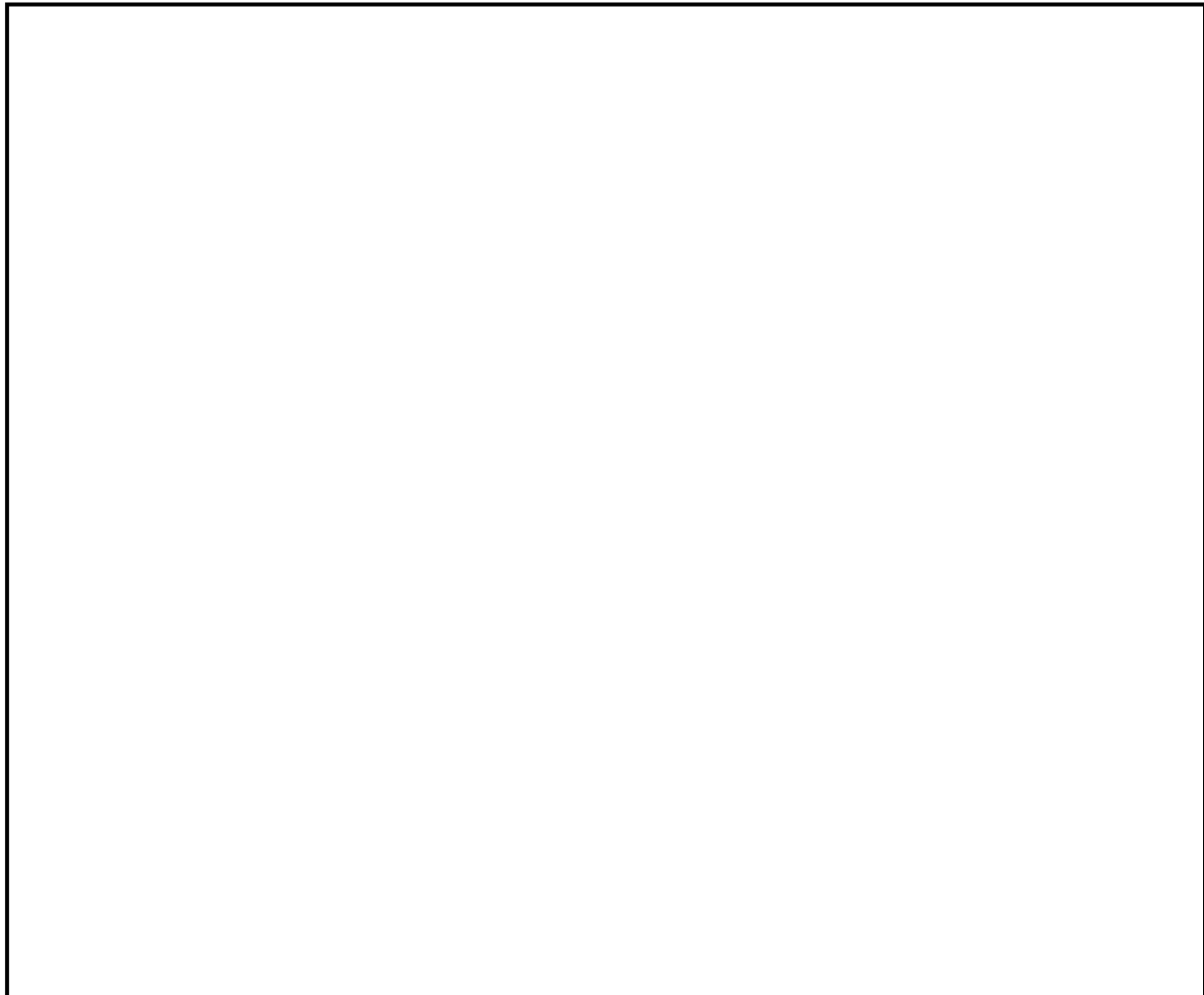


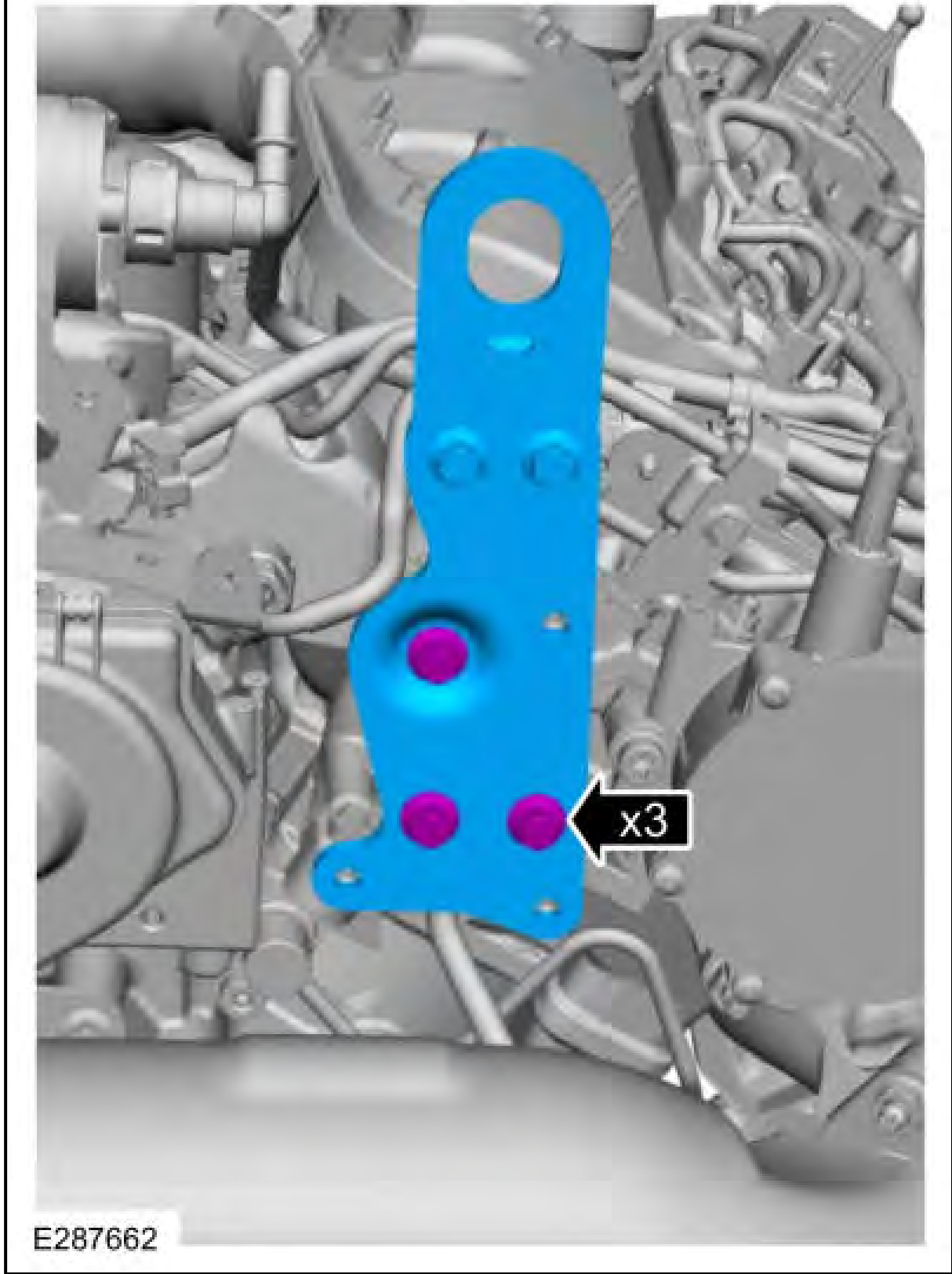
33. Remove the bolts and the valve bracket.



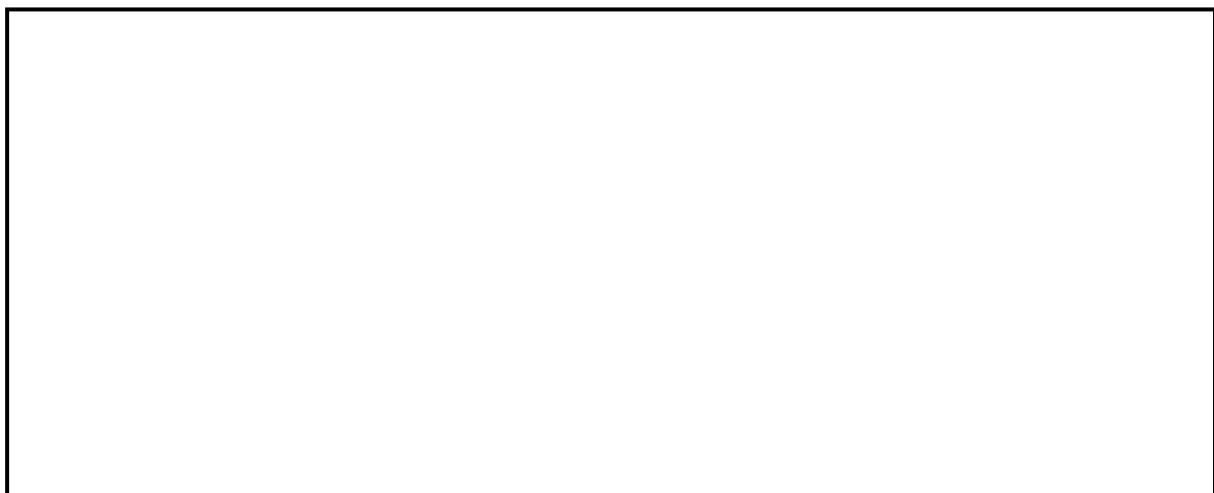


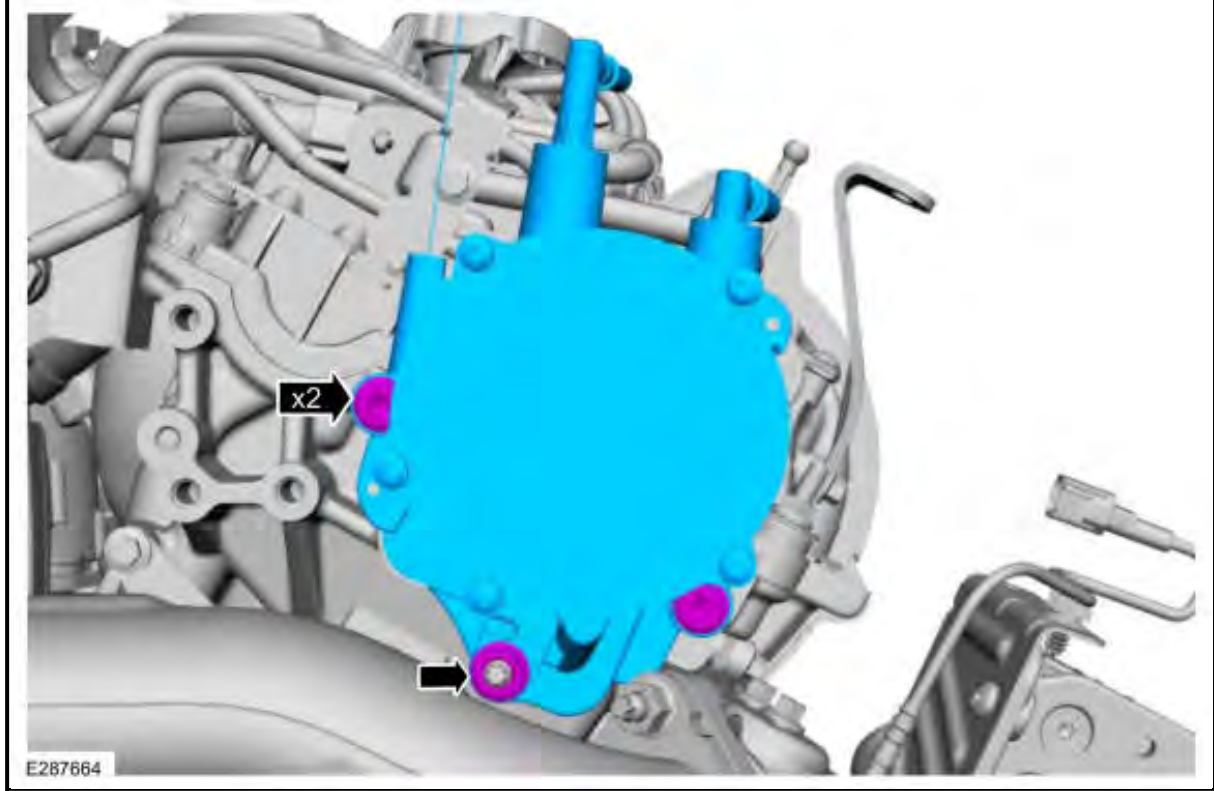
34. Remove the bolts and the lifting bracket.



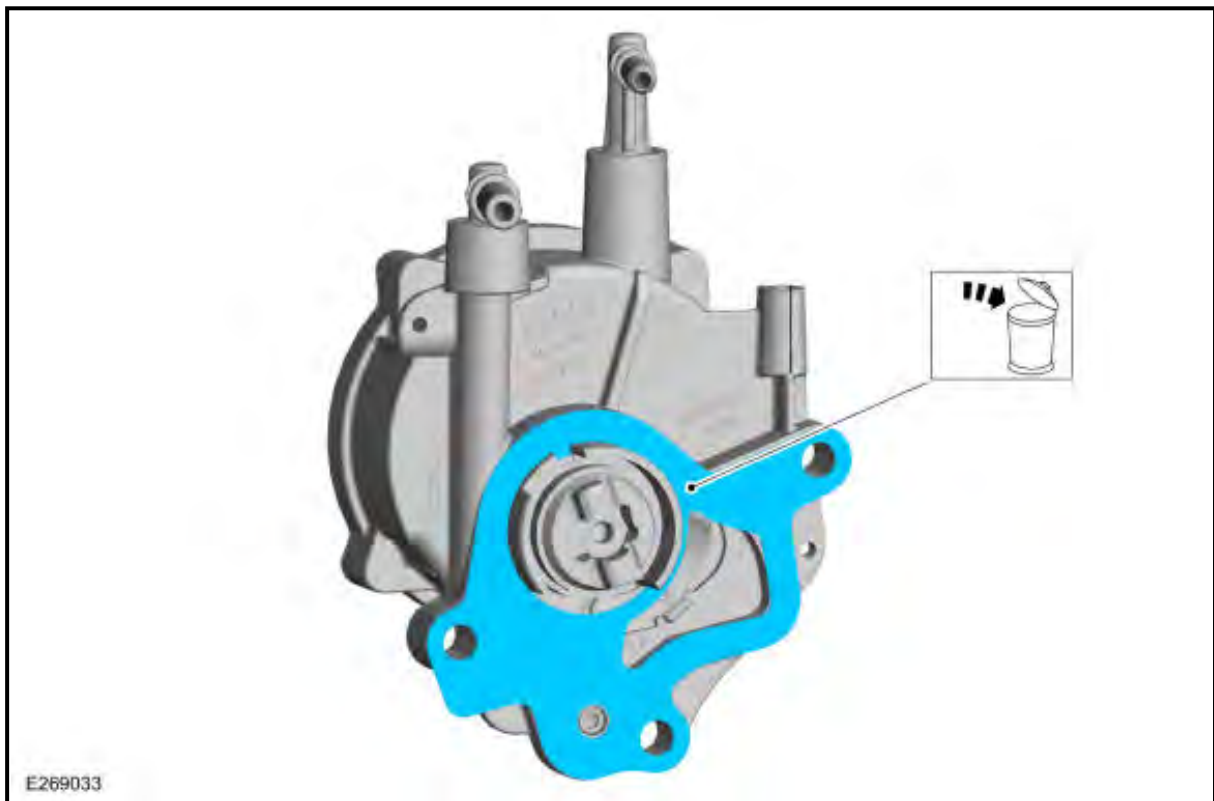


35. Remove the retainers and the vacuum pump.



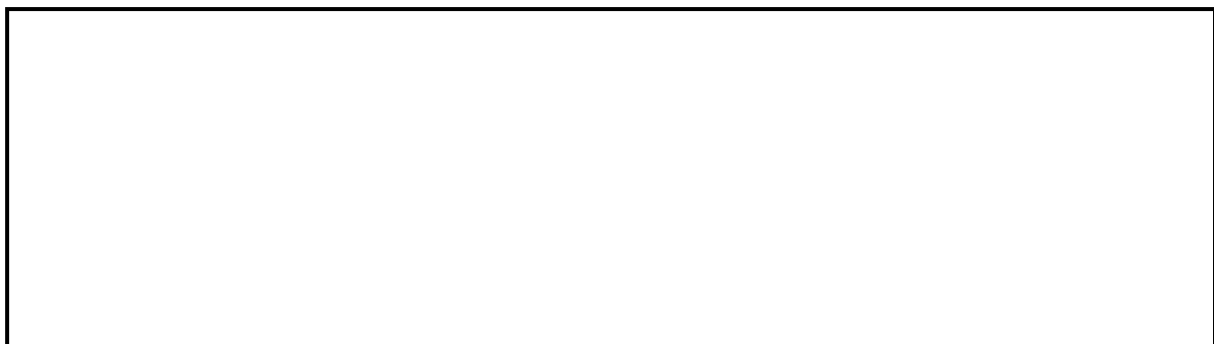


36. Remove and discard the vacuum pump gasket.

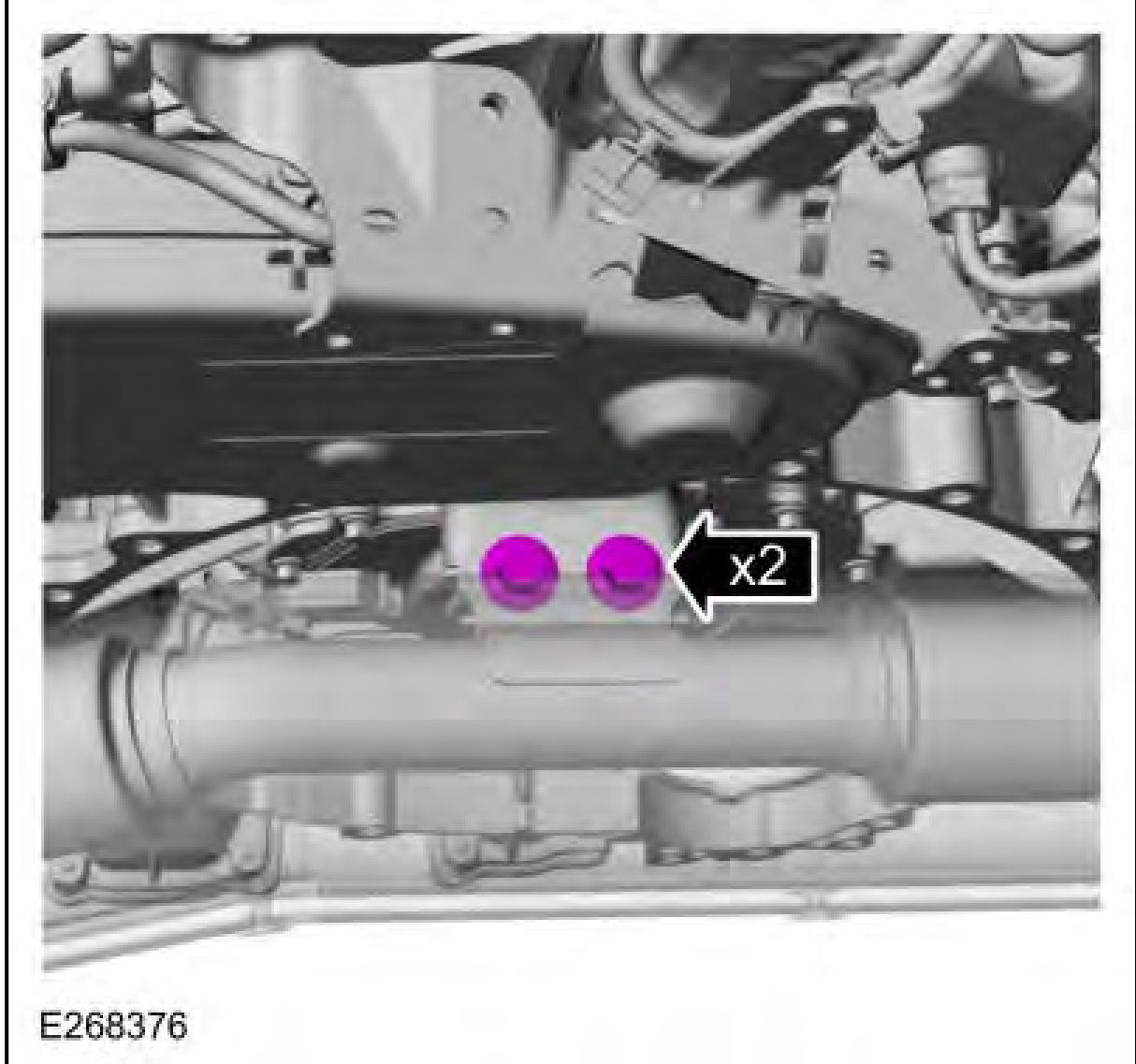


37. **NOTE:** If any snaps become undone on the exhaust crossover pipe wrap. Replace the exhaust crossover pipe wrap.

Remove the bolts for the exhaust crossover pipe.

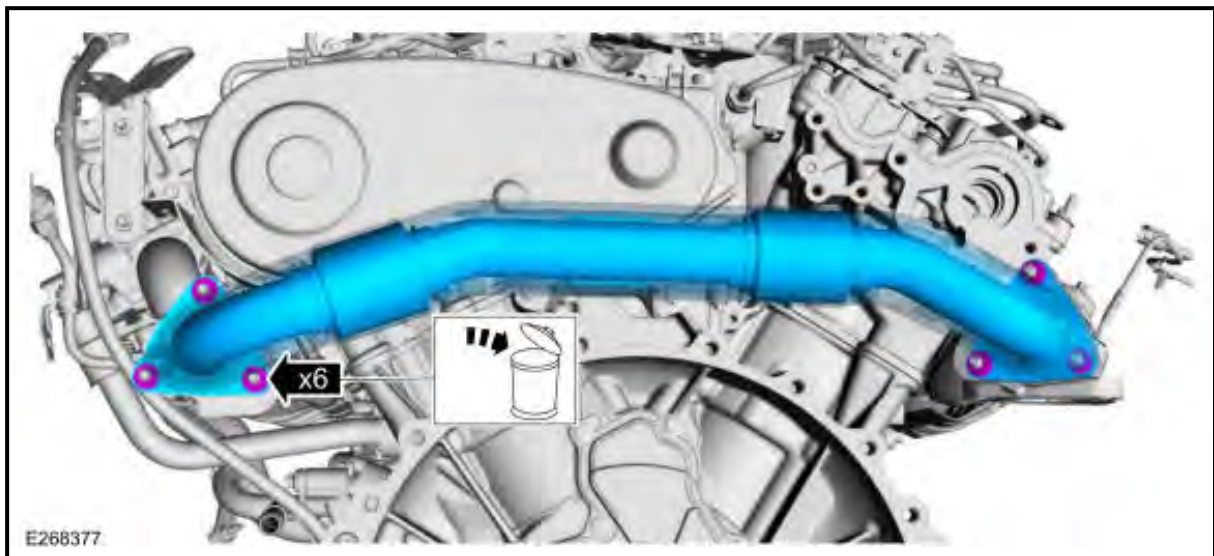






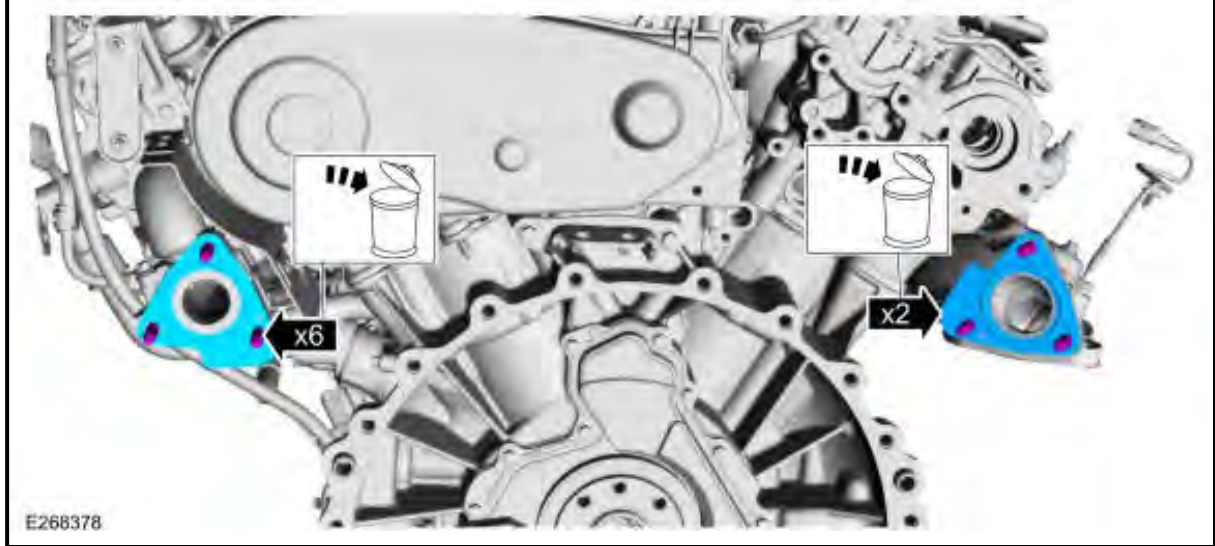
38. **NOTE:** If any snaps become undone on the exhaust crossover pipe wrap. Replace the exhaust crossover pipe wrap.

Remove the nuts and the exhaust crossover pipe. Discard the nuts.

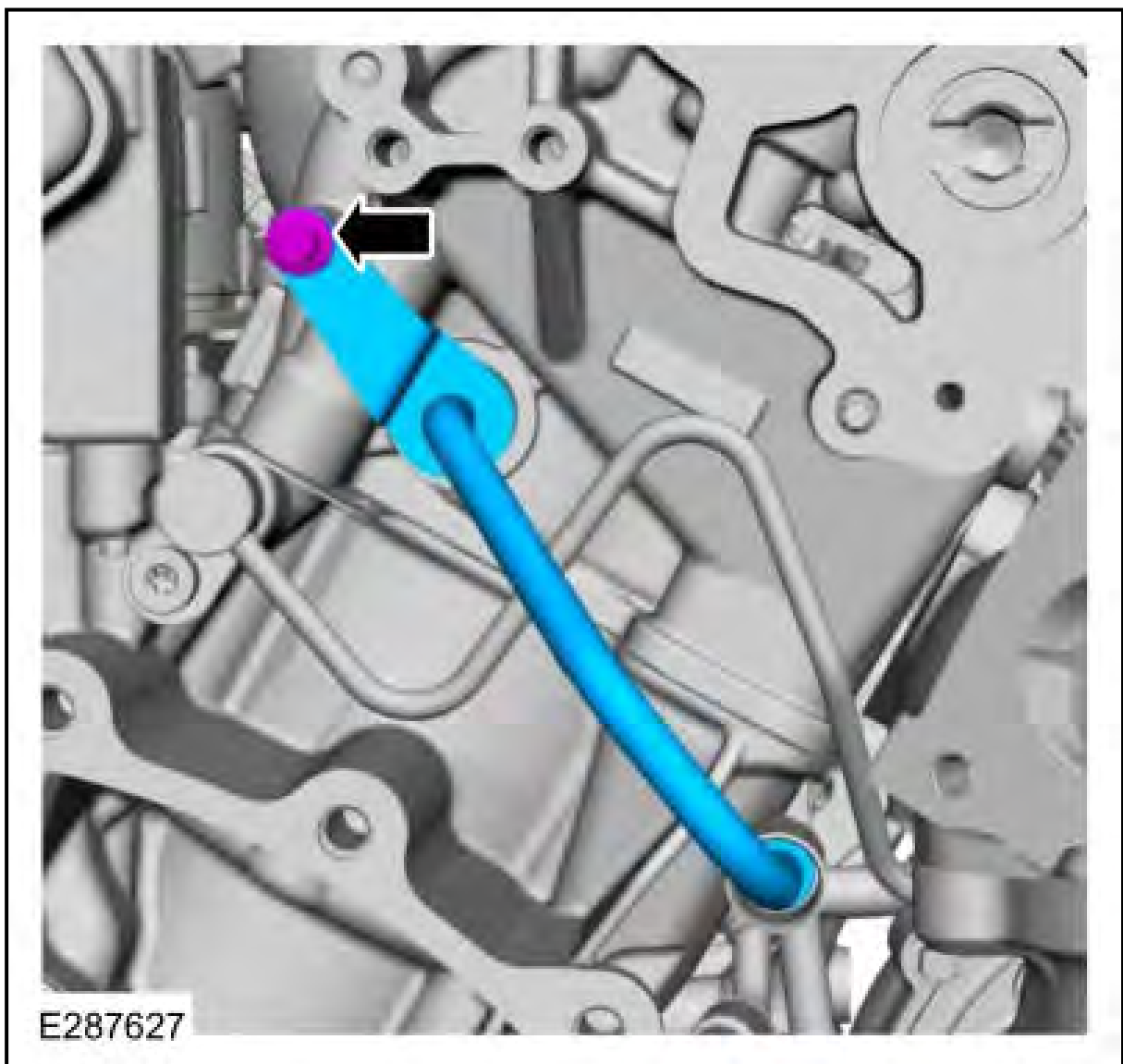


39. Remove and discard the exhaust crossover pipe gaskets and the studs.





40. Remove the bolt and the coolant return tube.

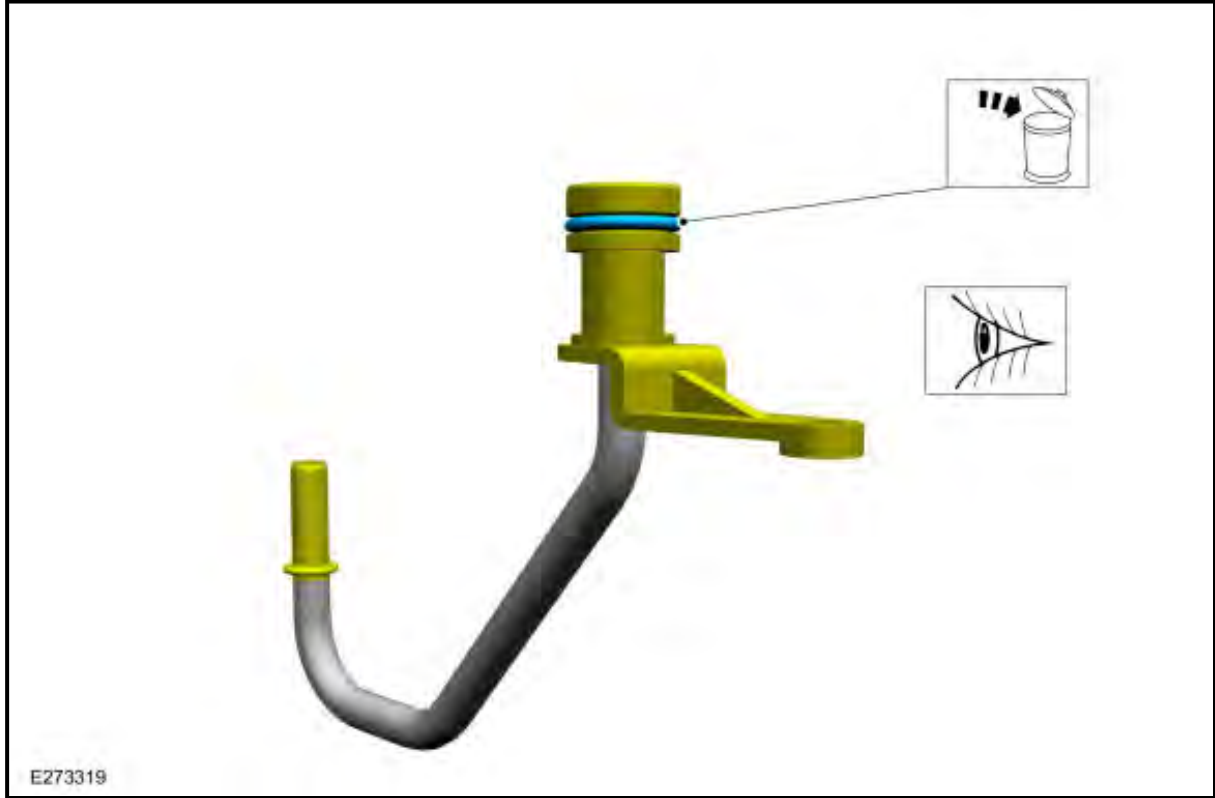


41.

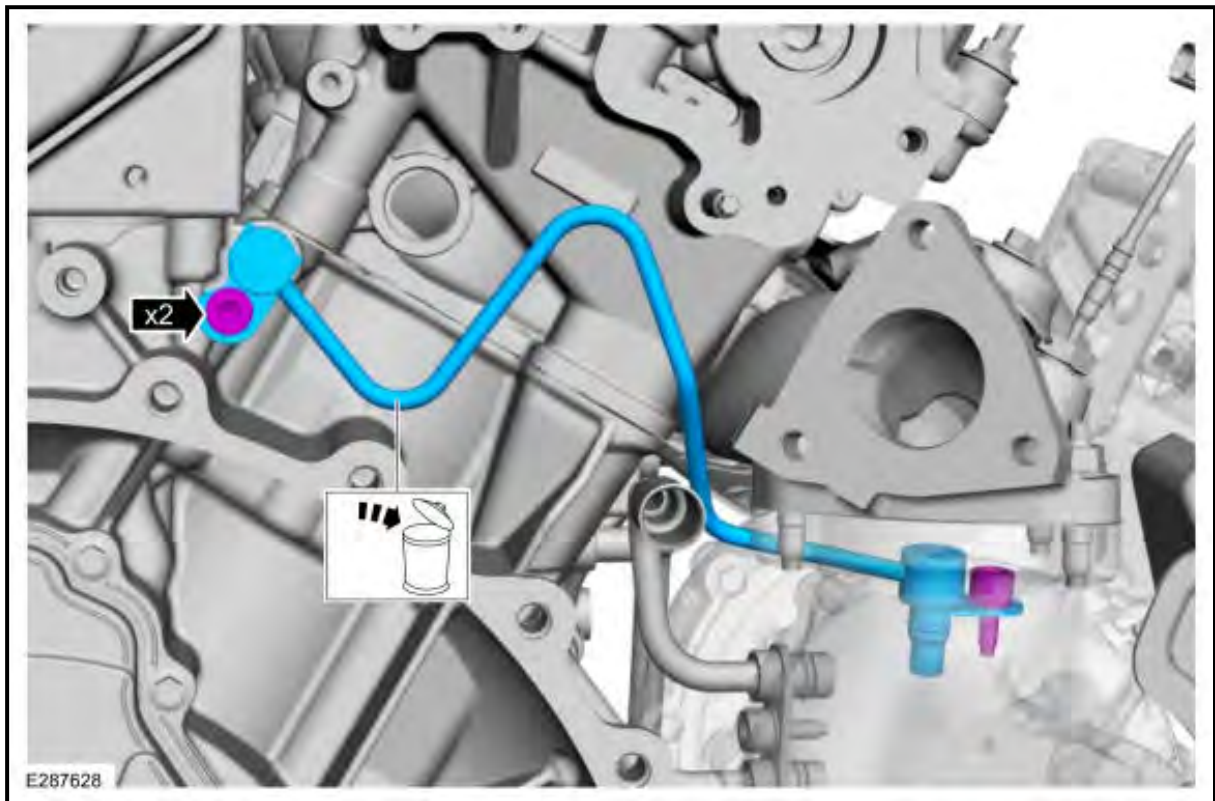
1. Remove and discard the turbocharger coolant return tube O-ring seal.
2. **NOTE:** Use brake cleaner and a nylon brush to clean. Do not use a metal brush, damage to sealing area will result in leaks.

Clean the turbocharger coolant tube sealing surfaces. Inspect the sealing surfaces for debris or damage and make sure the retaining bracket is not bent, check for squareness of the O-ring area. Install new components if needed.

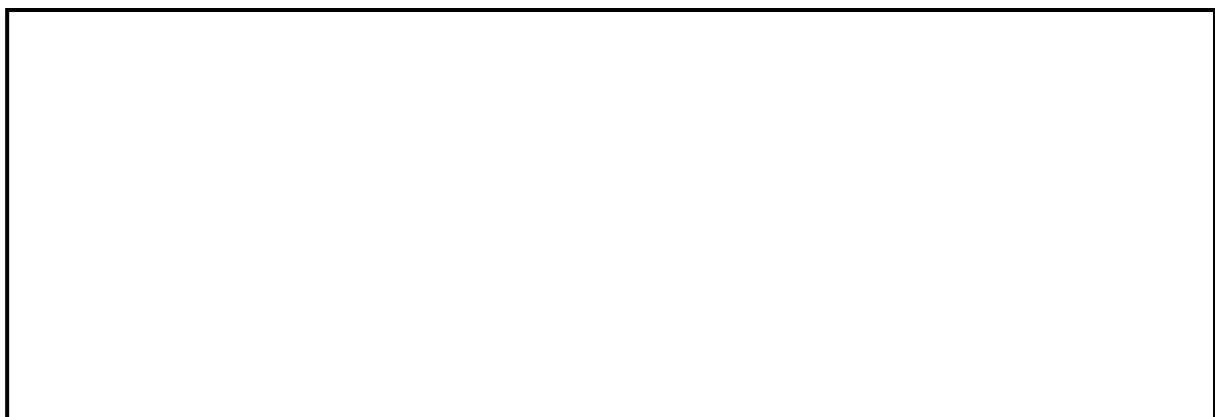
Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B

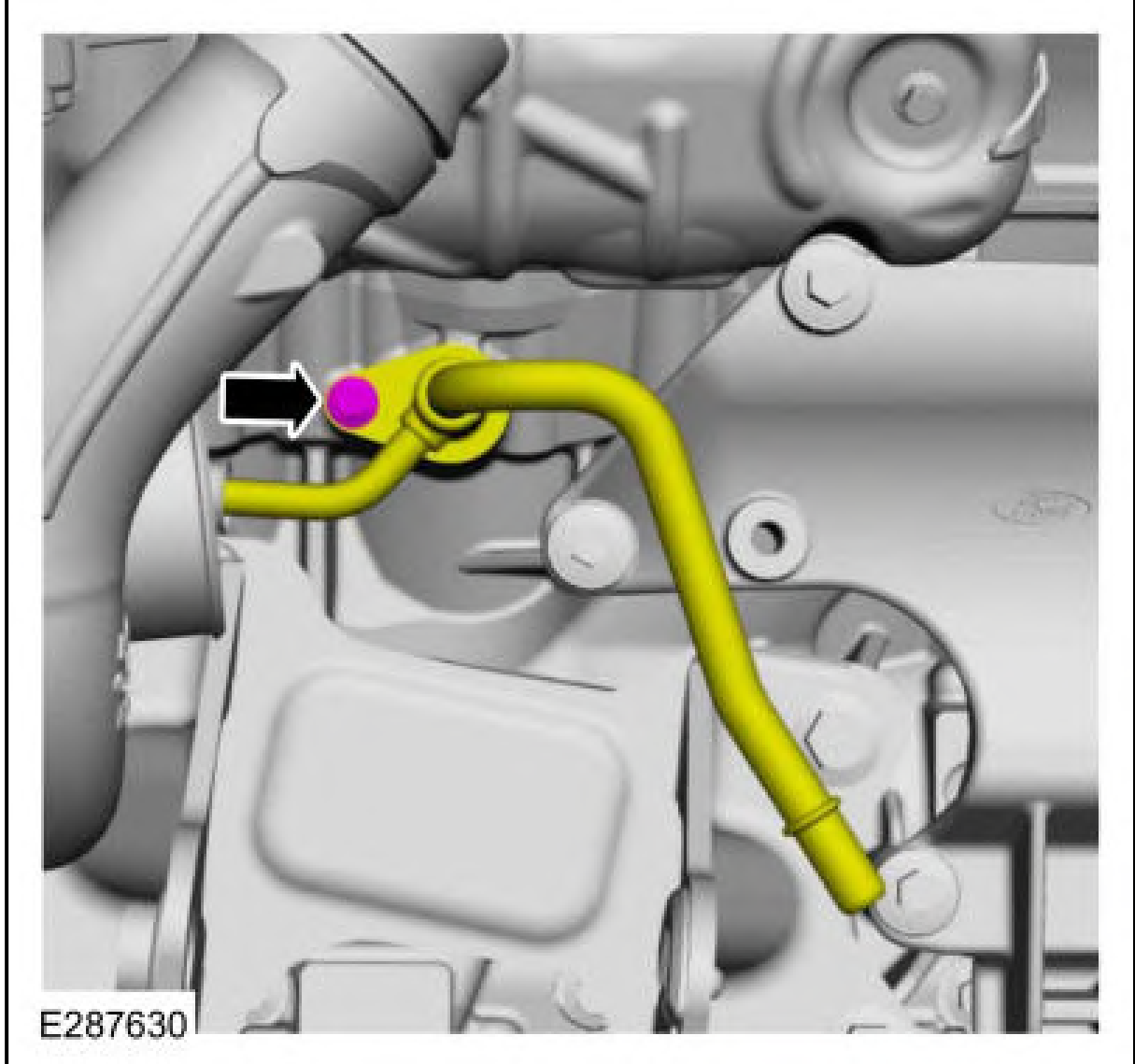


42. Remove the bolts and the turbocharger oil supply tube. Discard the turbocharger oil supply tube.

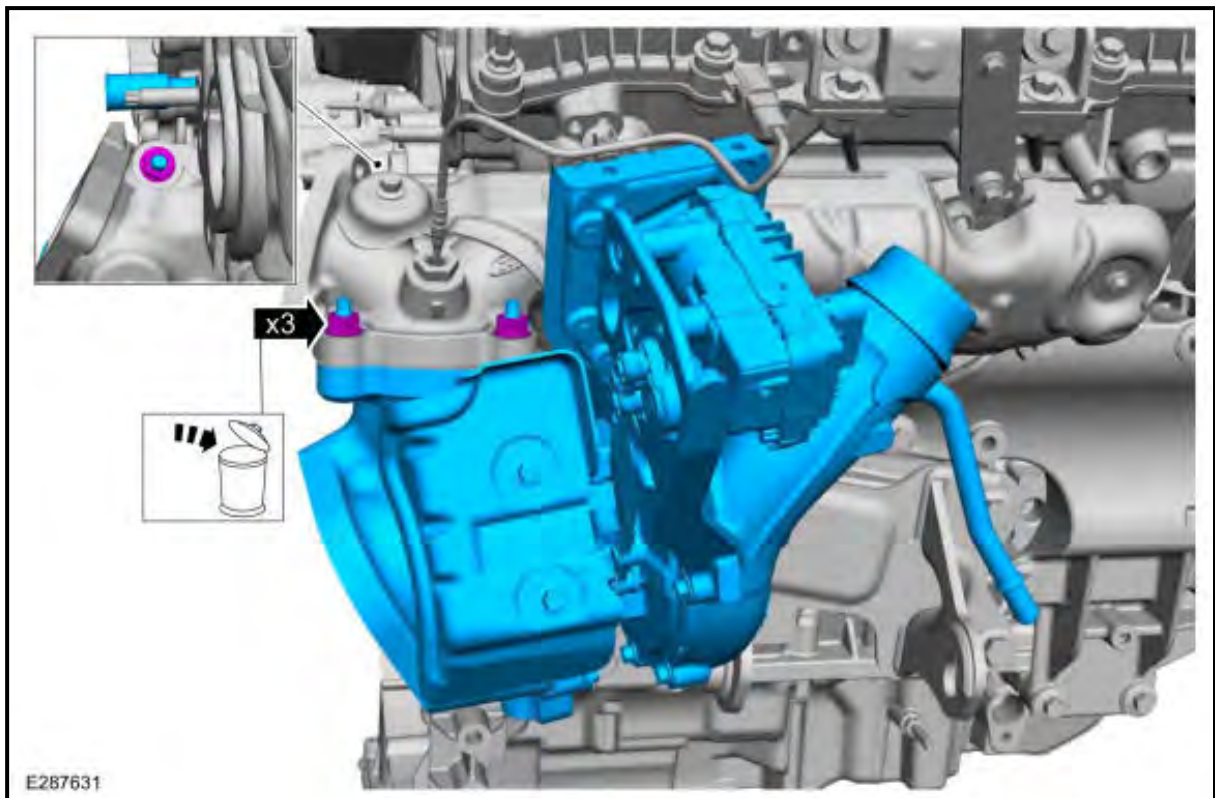


43. Remove the bolt for the turbocharger coolant supply tube. Disconnect the turbocharger coolant supply tube from the engine.

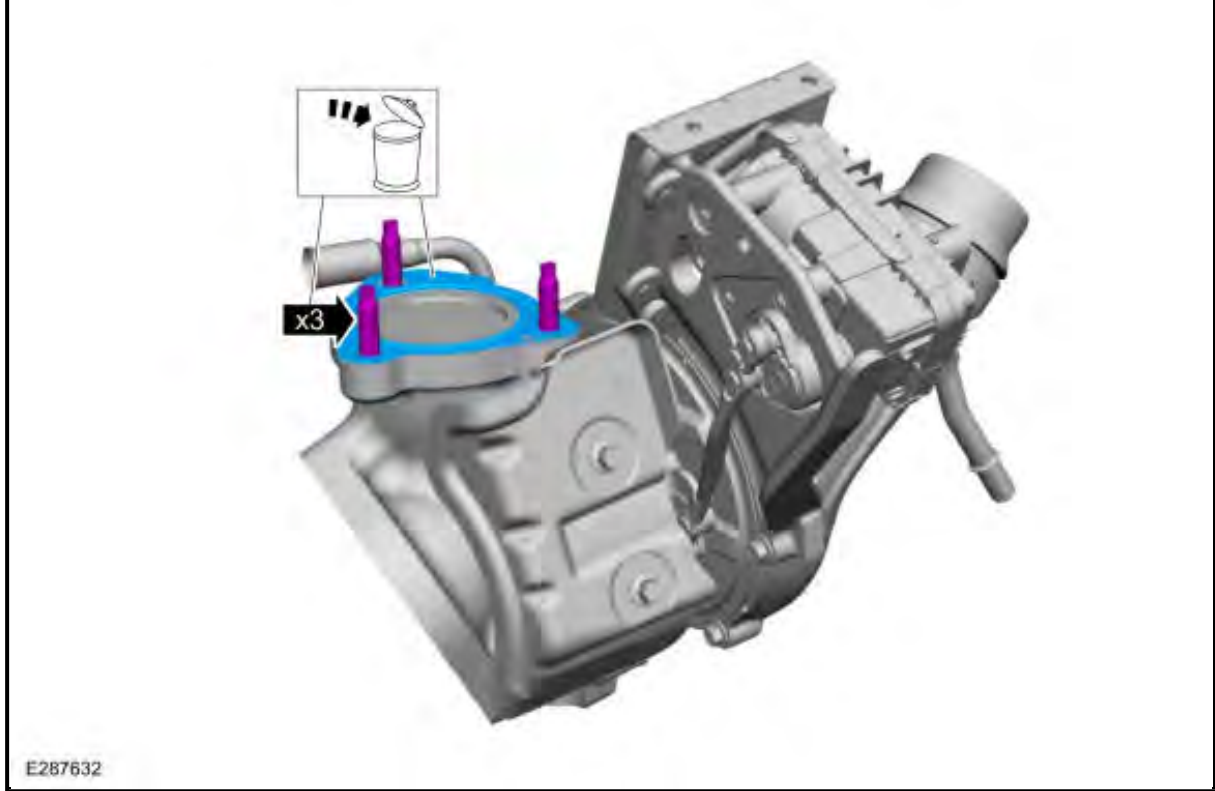




44. Remove the nuts and the turbocharger. Discard the nuts.

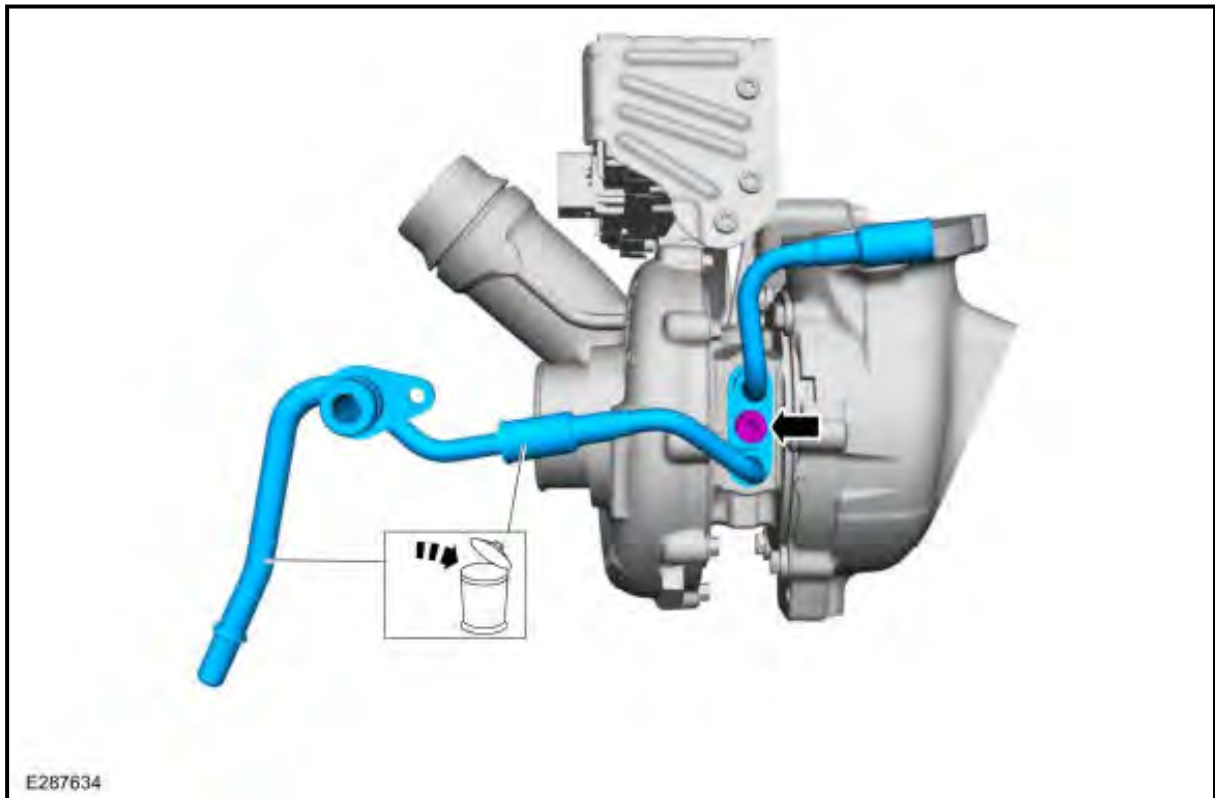


45. Remove and discard the turbocharger gasket and the studs.



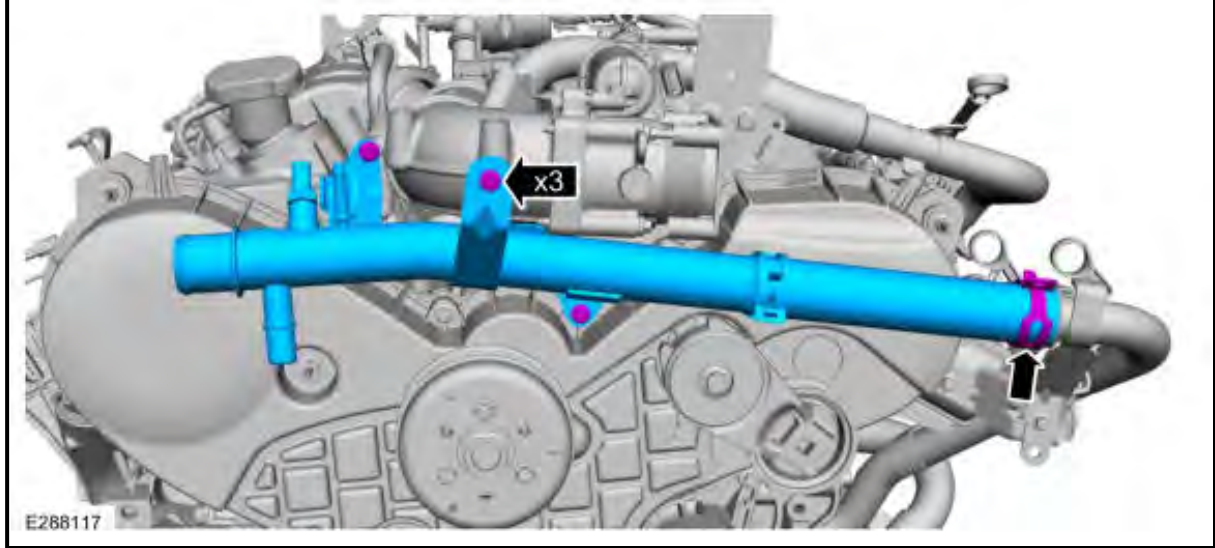
46. **NOTE:** Make note of turbocharger coolant tube manifold orientation to aid in proper installation.

Remove the bolt and the turbocharger coolant tube manifold. Discard the turbocharger coolant tube manifold.

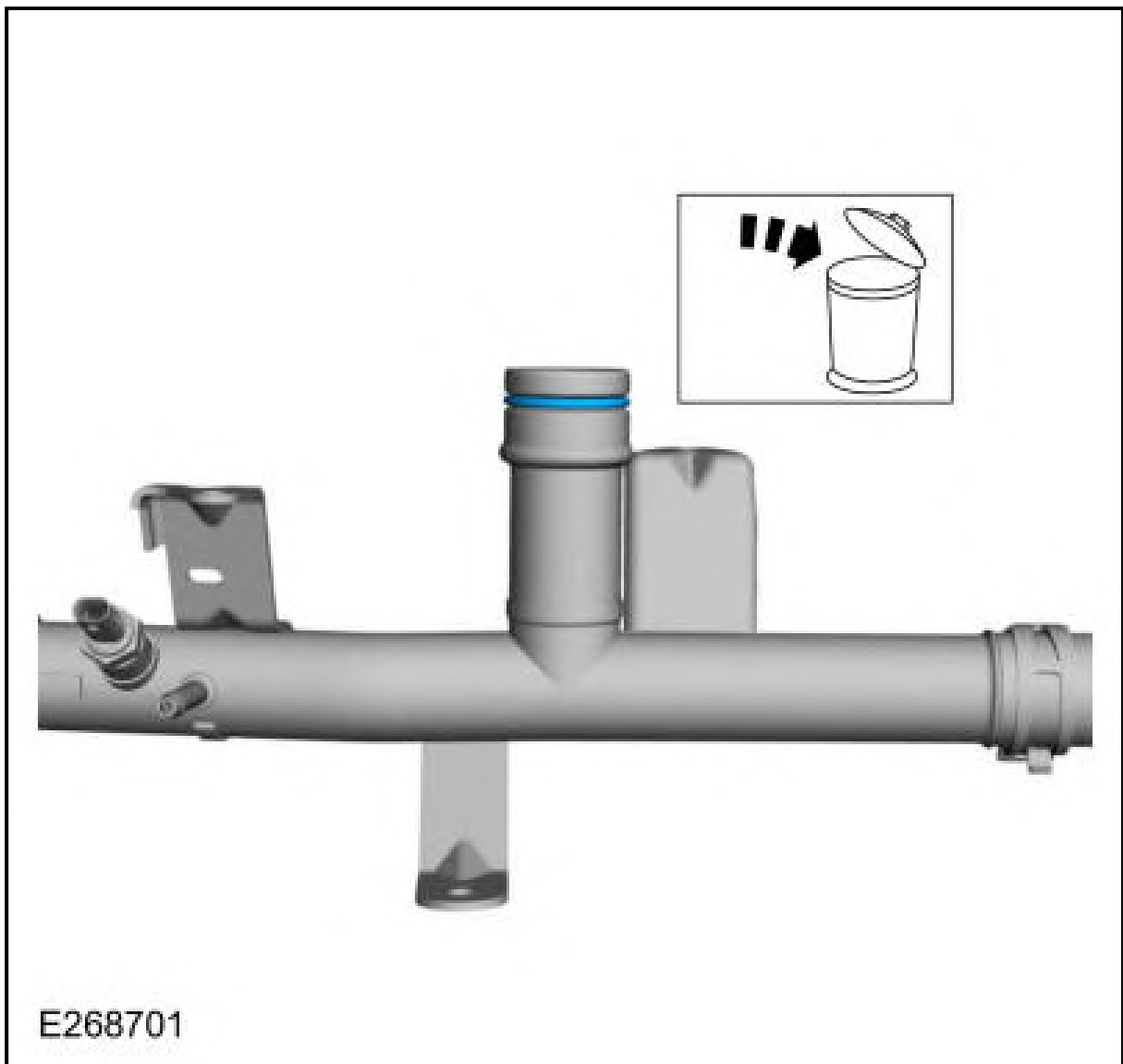


47. Remove the bolts and the coolant tube assembly. Use the General Equipment: Hose Clamp Remover/Installer

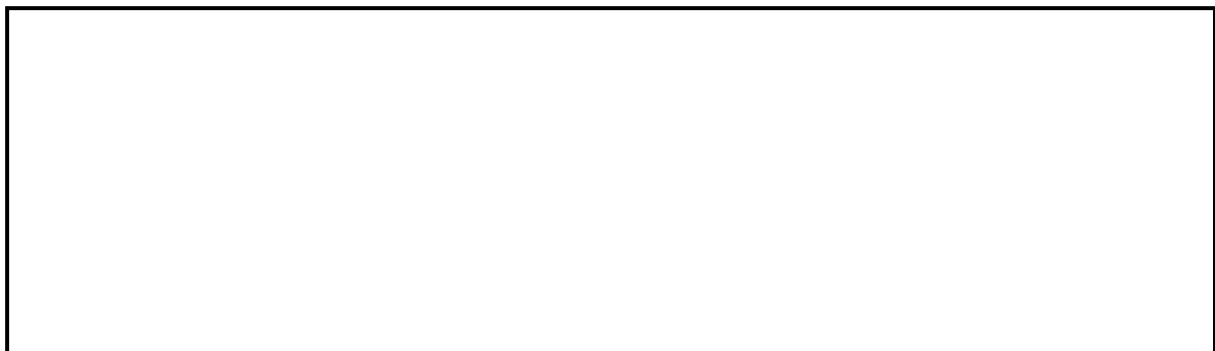


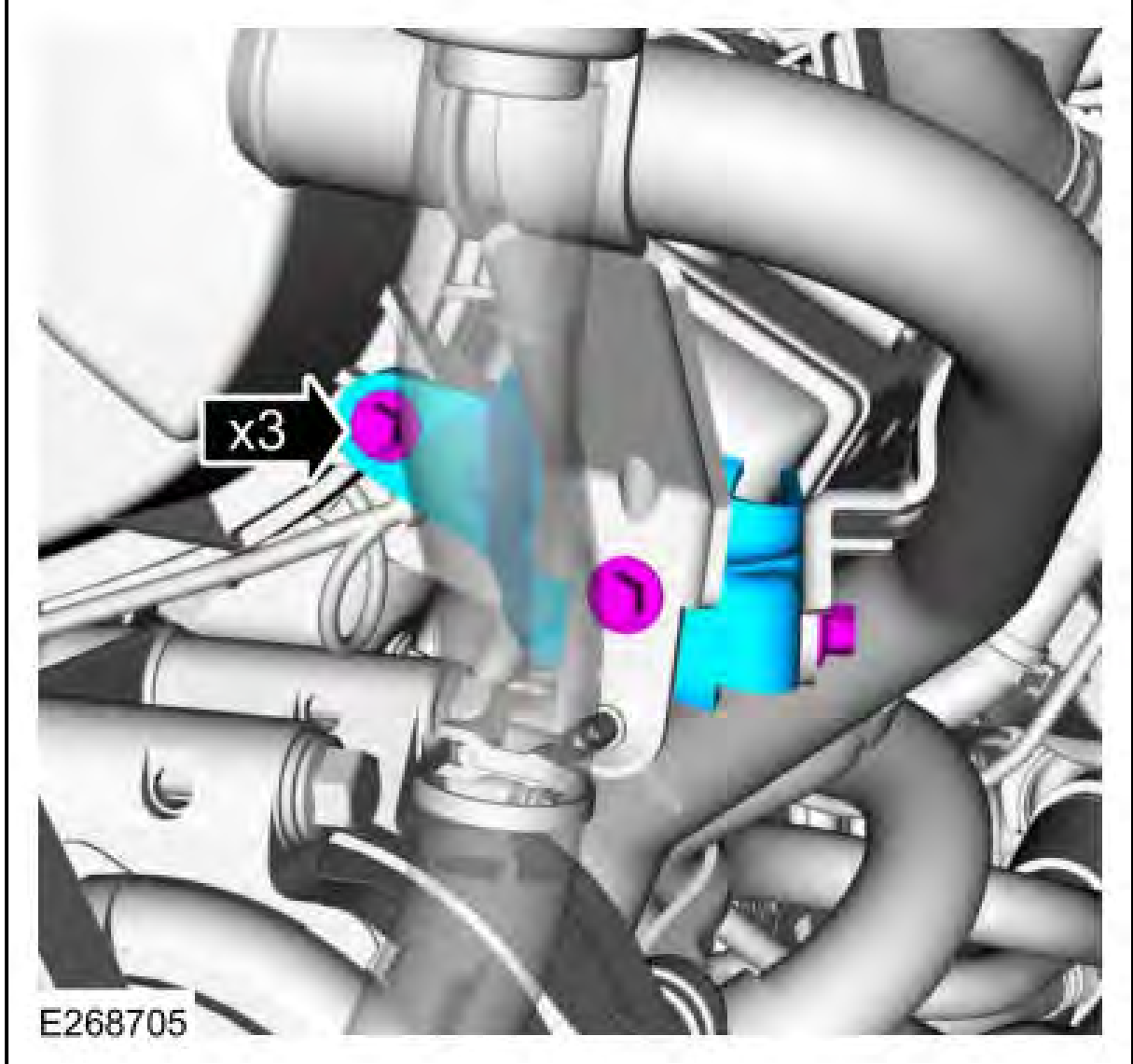


48. Remove and discard the coolant tube assembly O-ring.

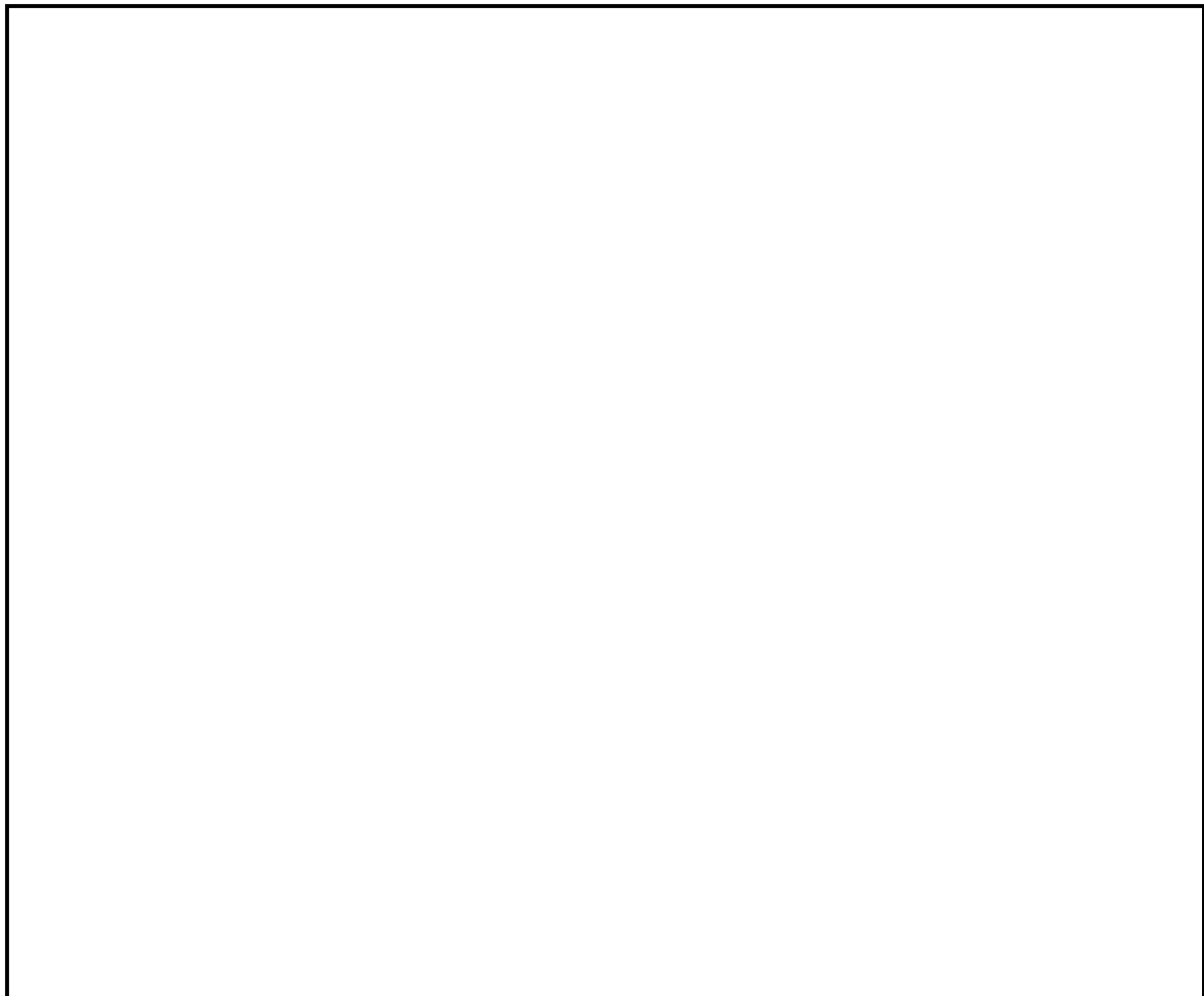


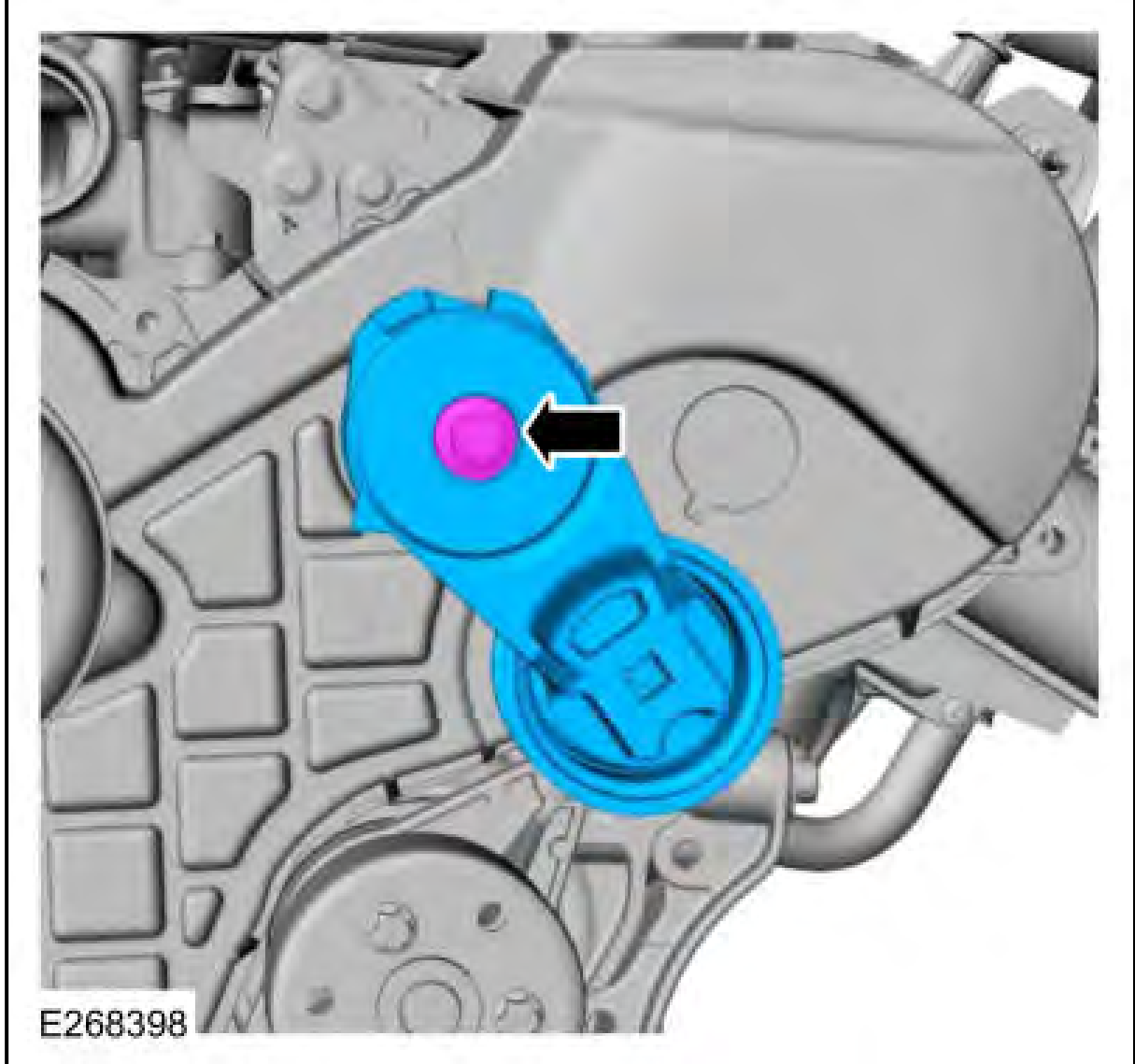
49. Remove the bolts and the coolant tube bracket.



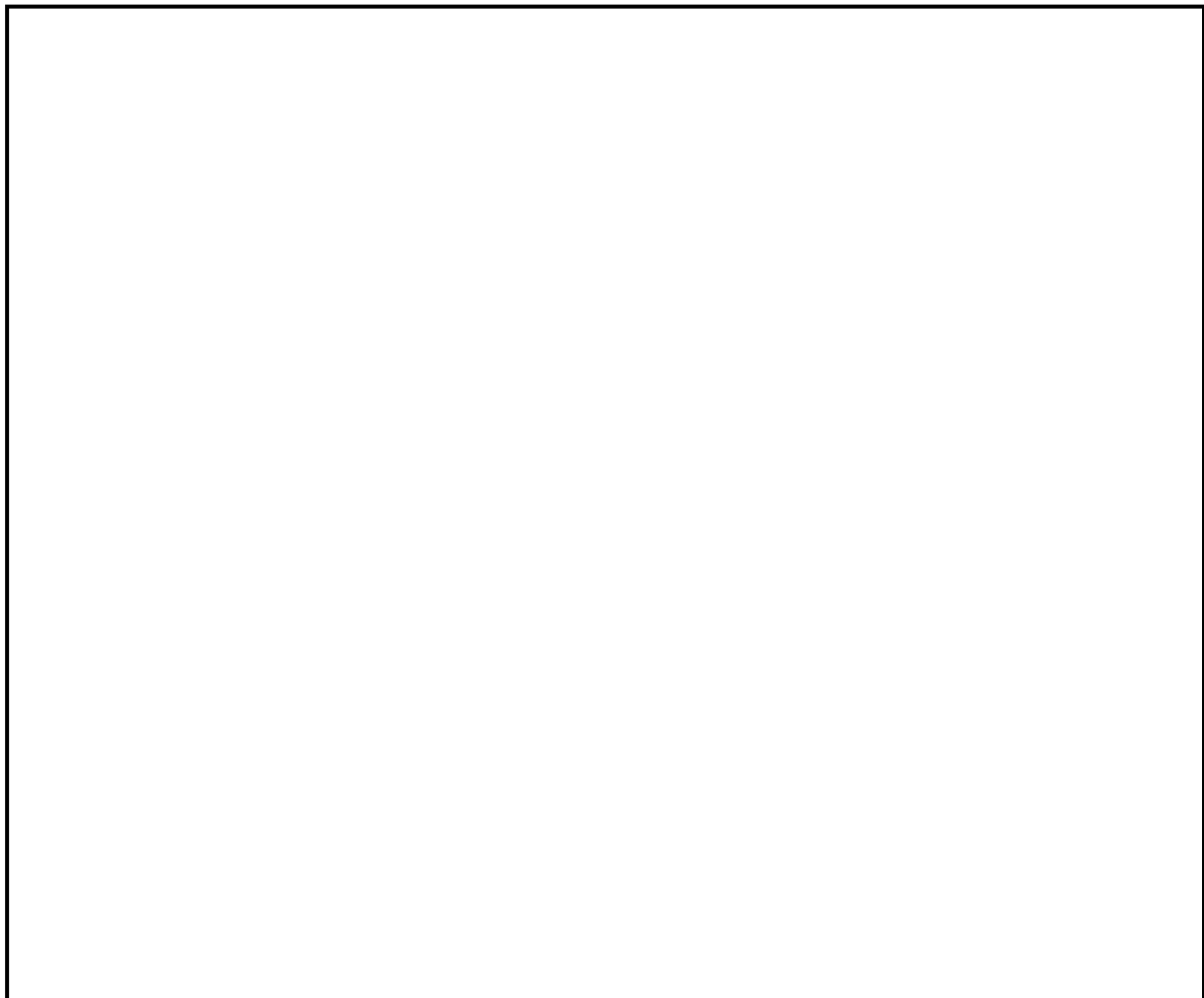


50. Remove the bolt and the accessory drive belt tensioner.

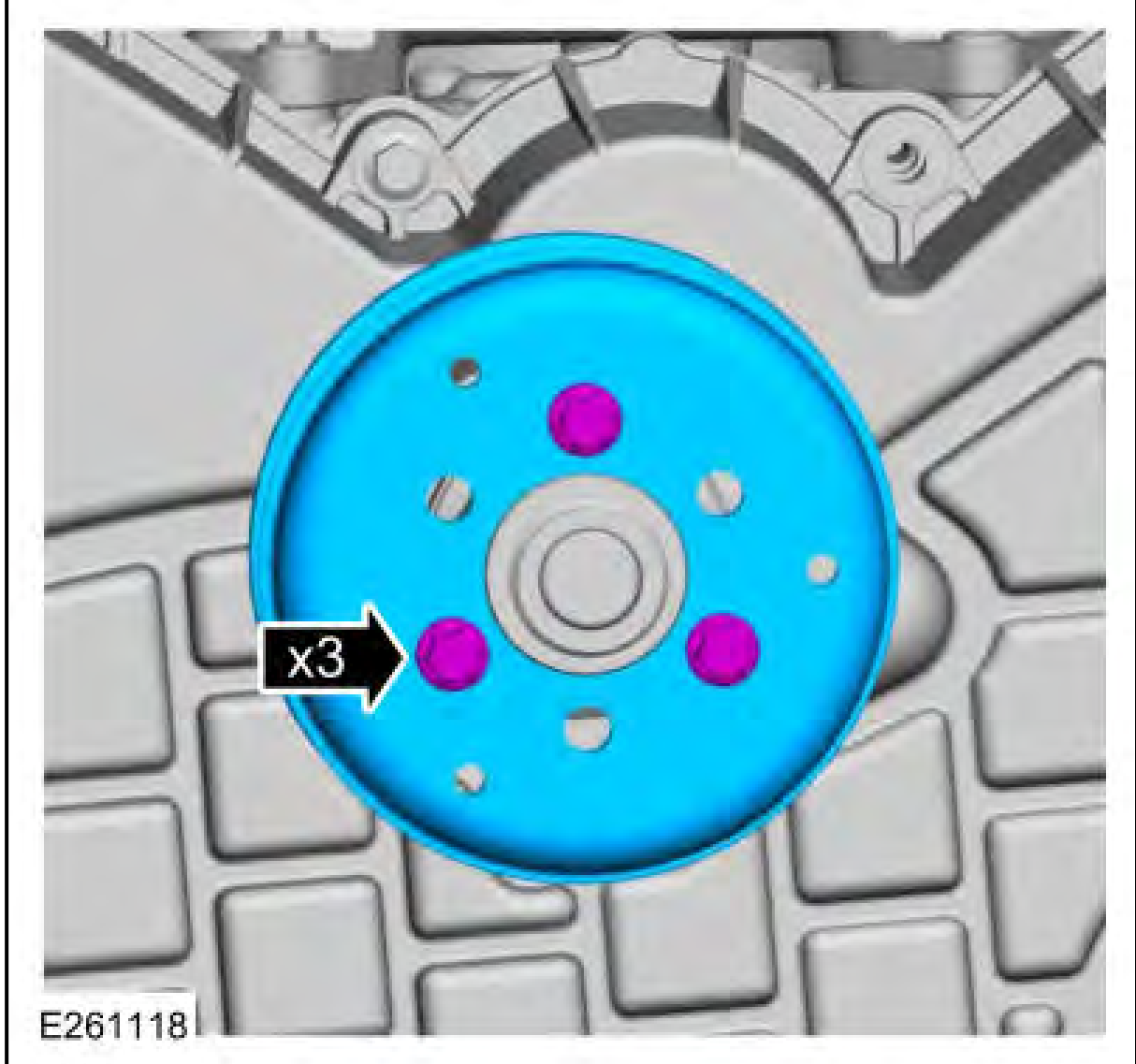




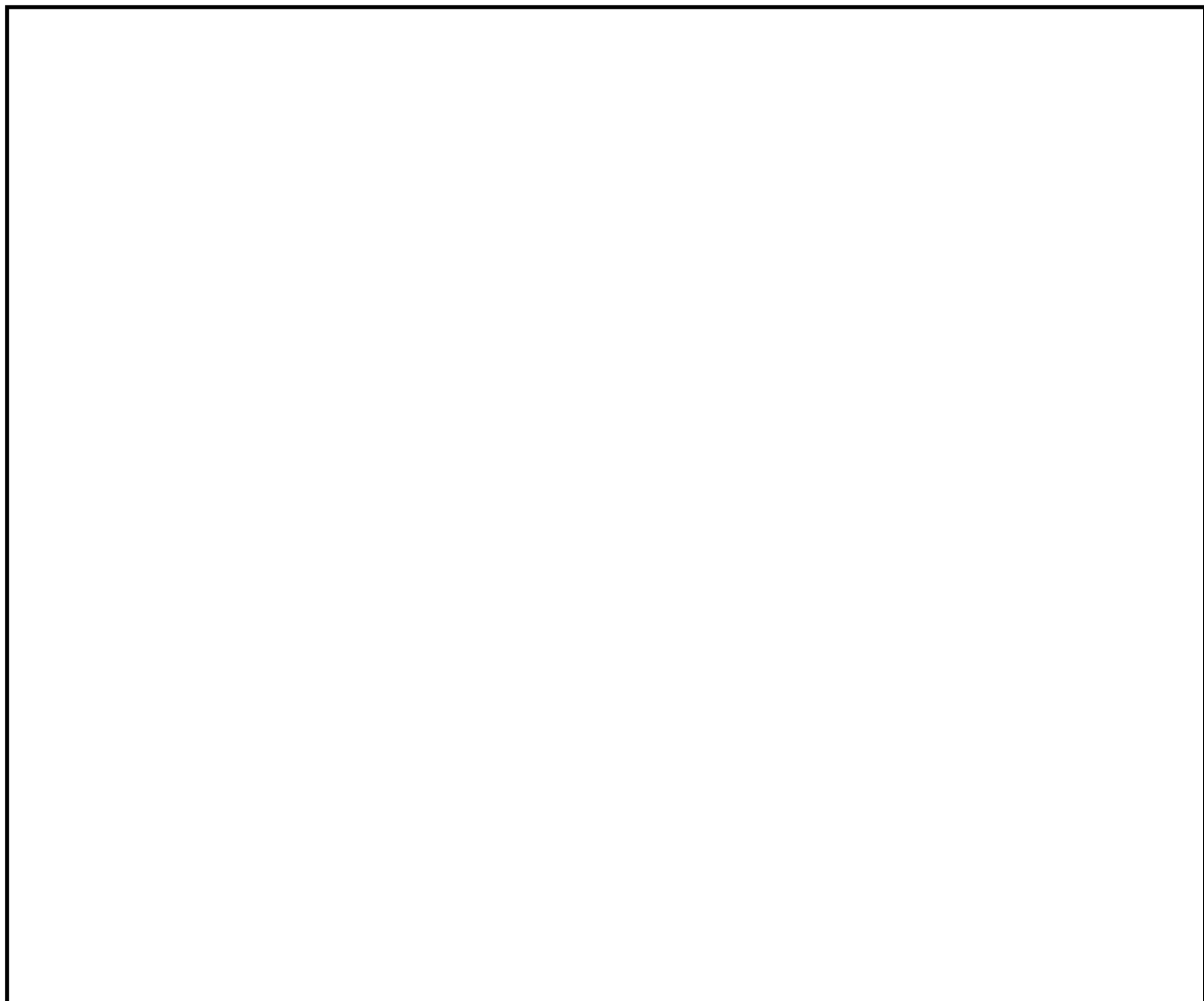
51. Remove the bolts and the fan pulley.

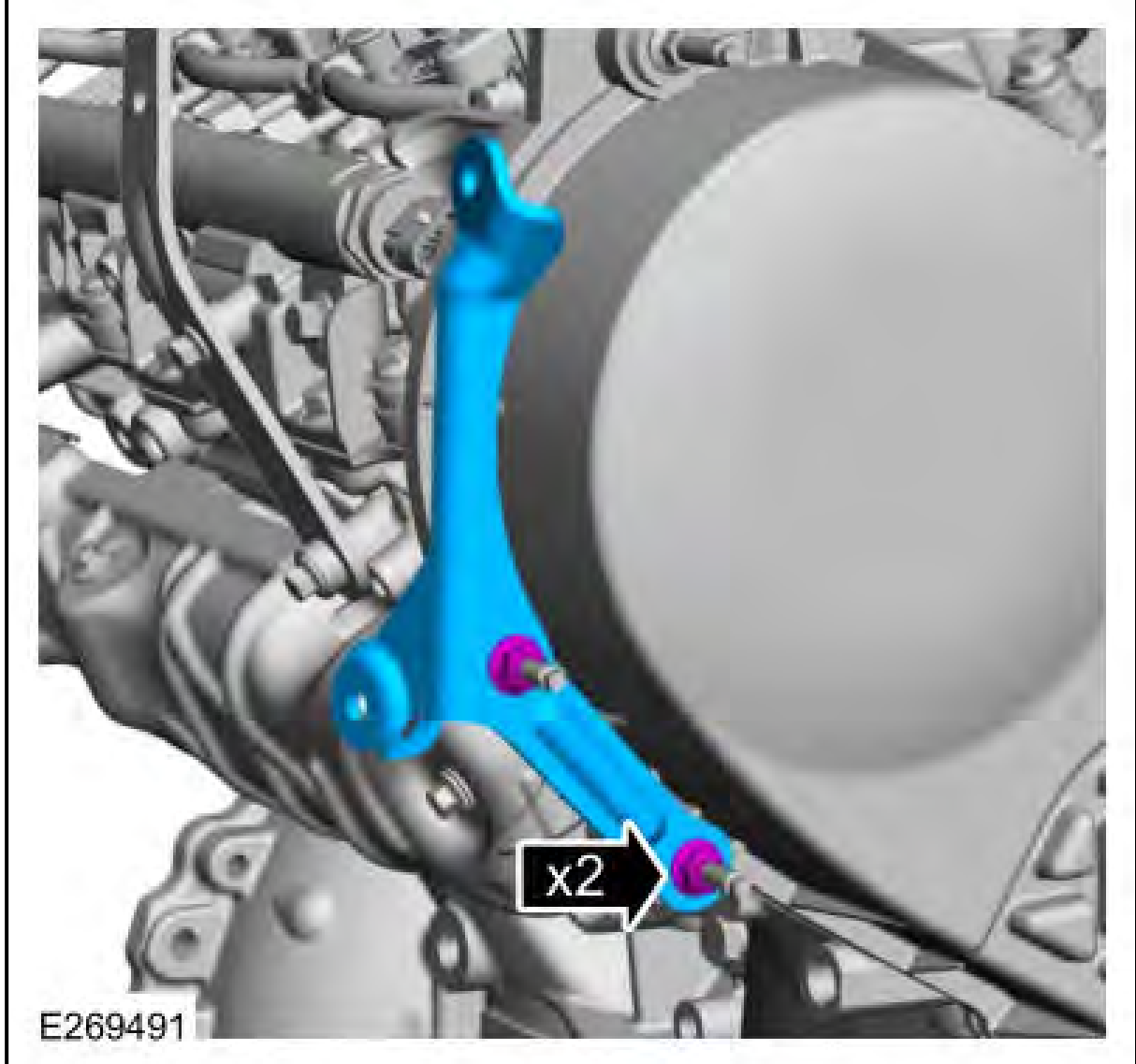




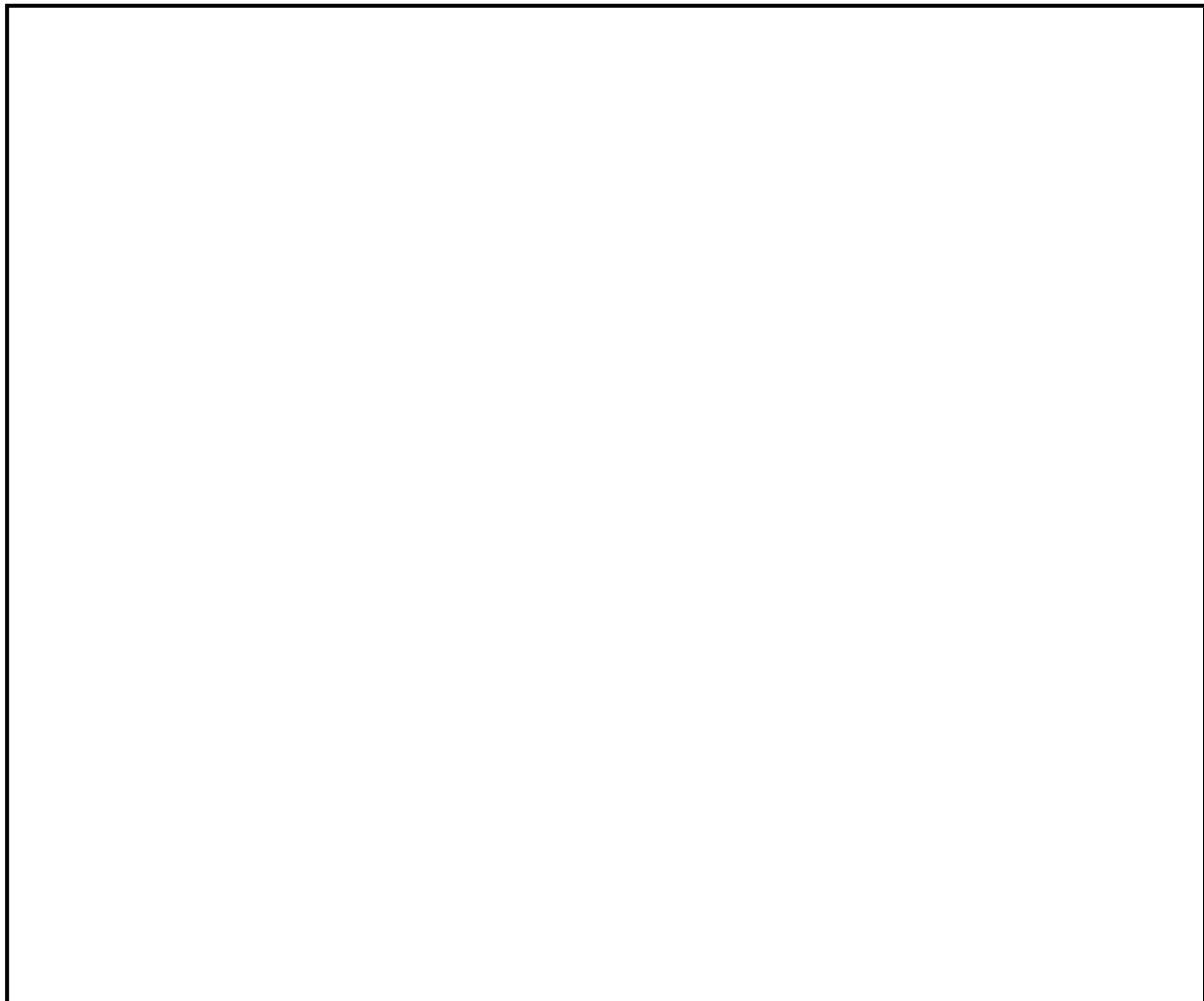


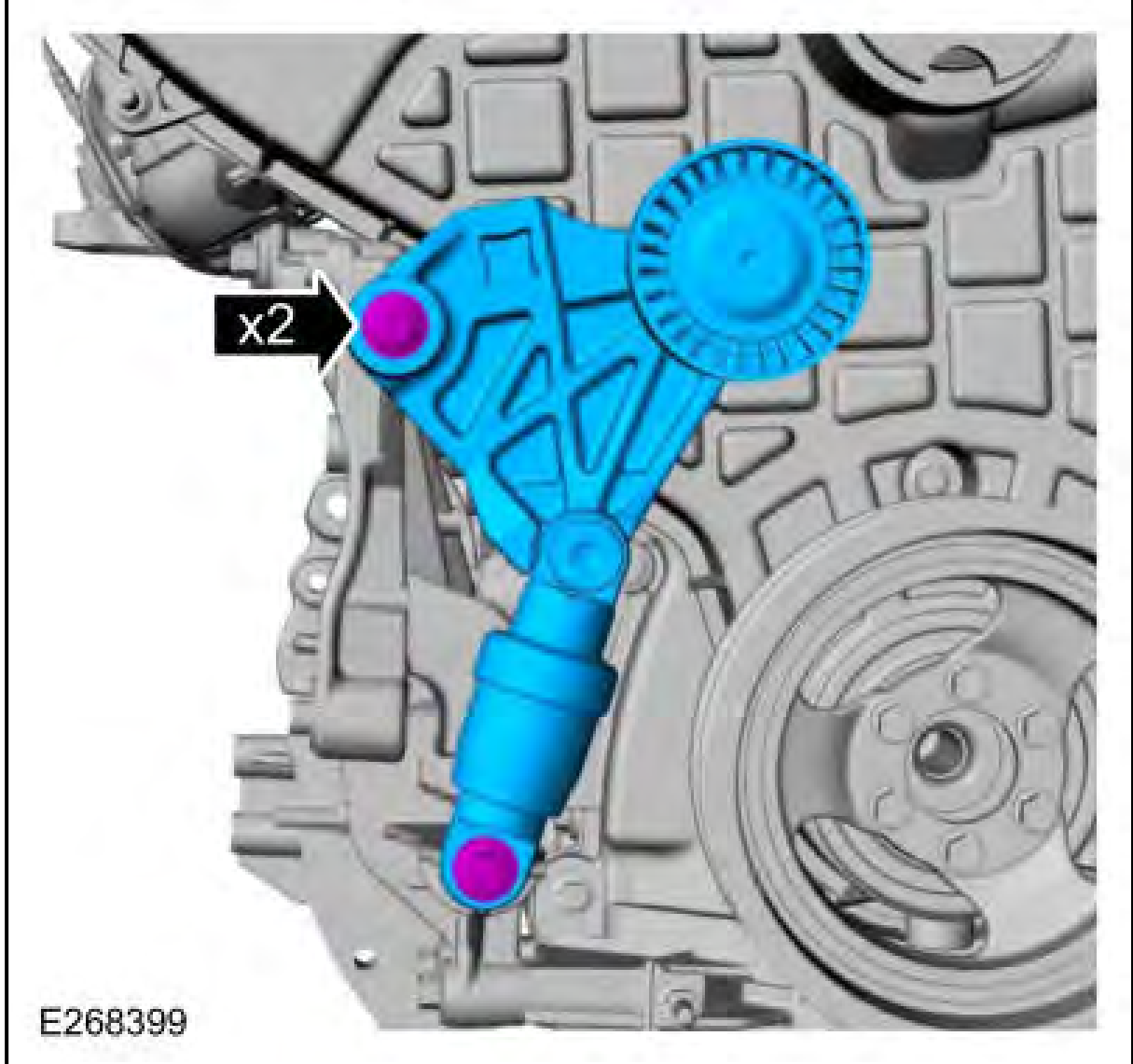
52. Remove the nuts and the CAC tube bracket.



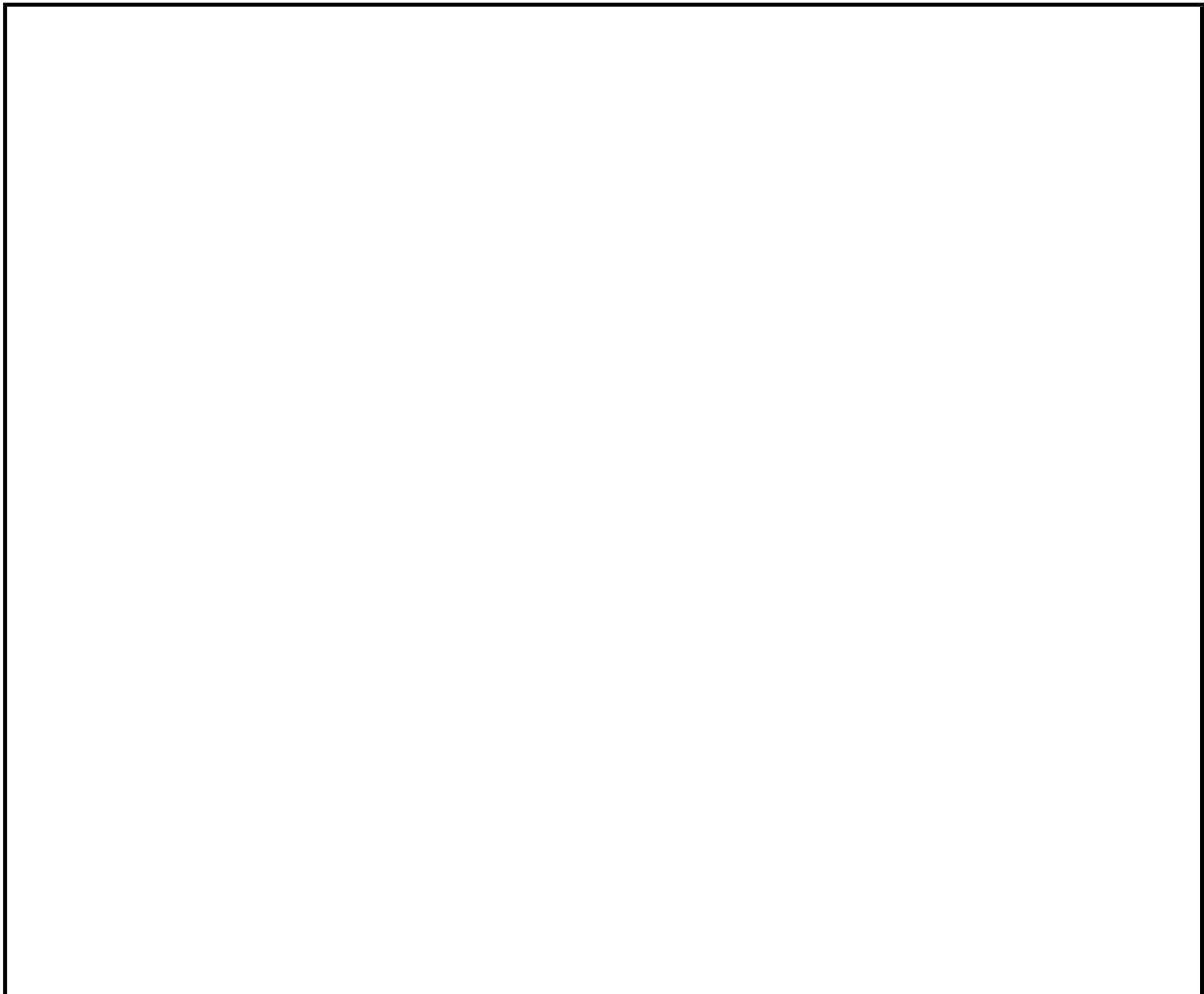


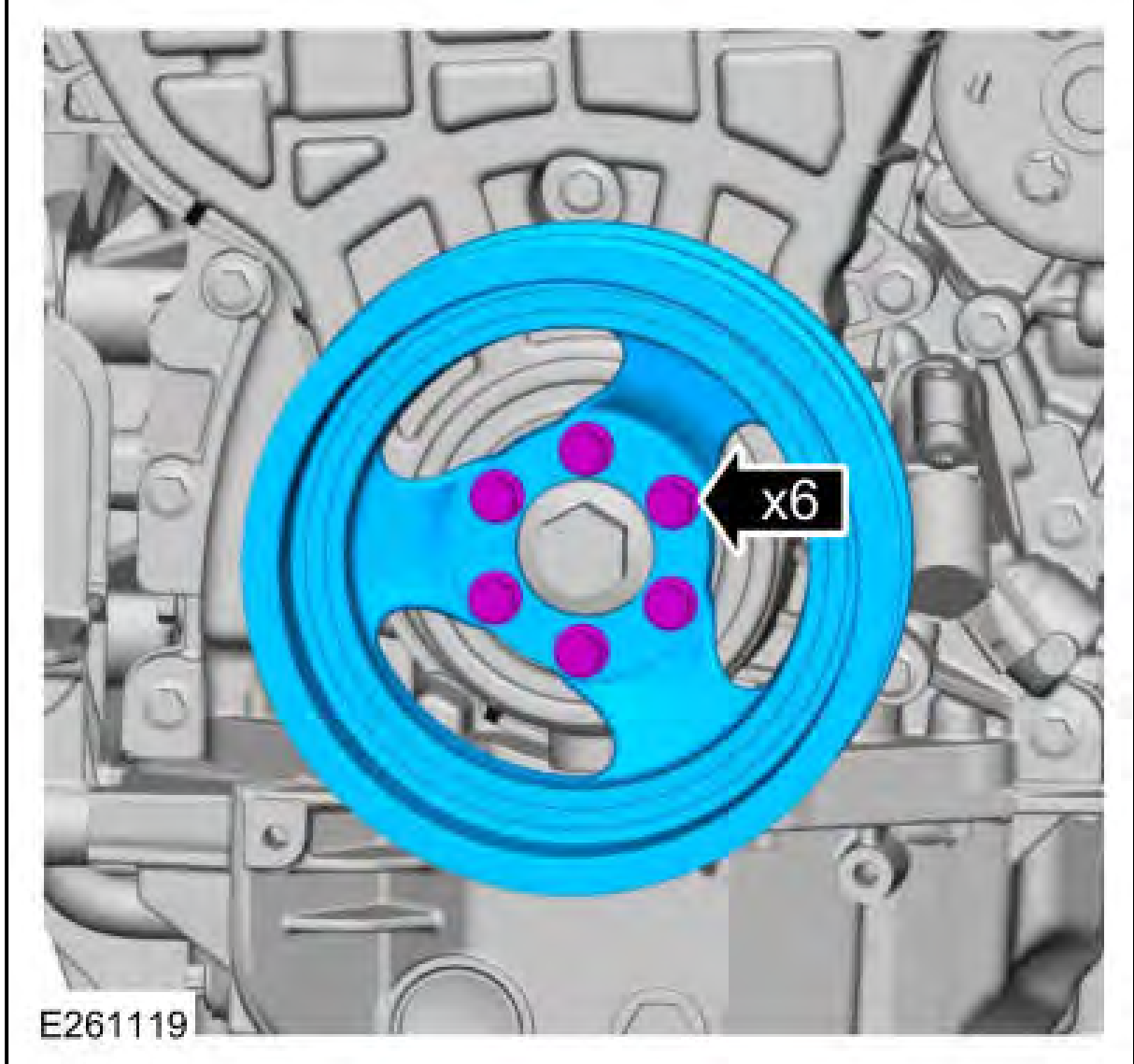
53. Remove the bolts and the accessory drive belt tensioner.





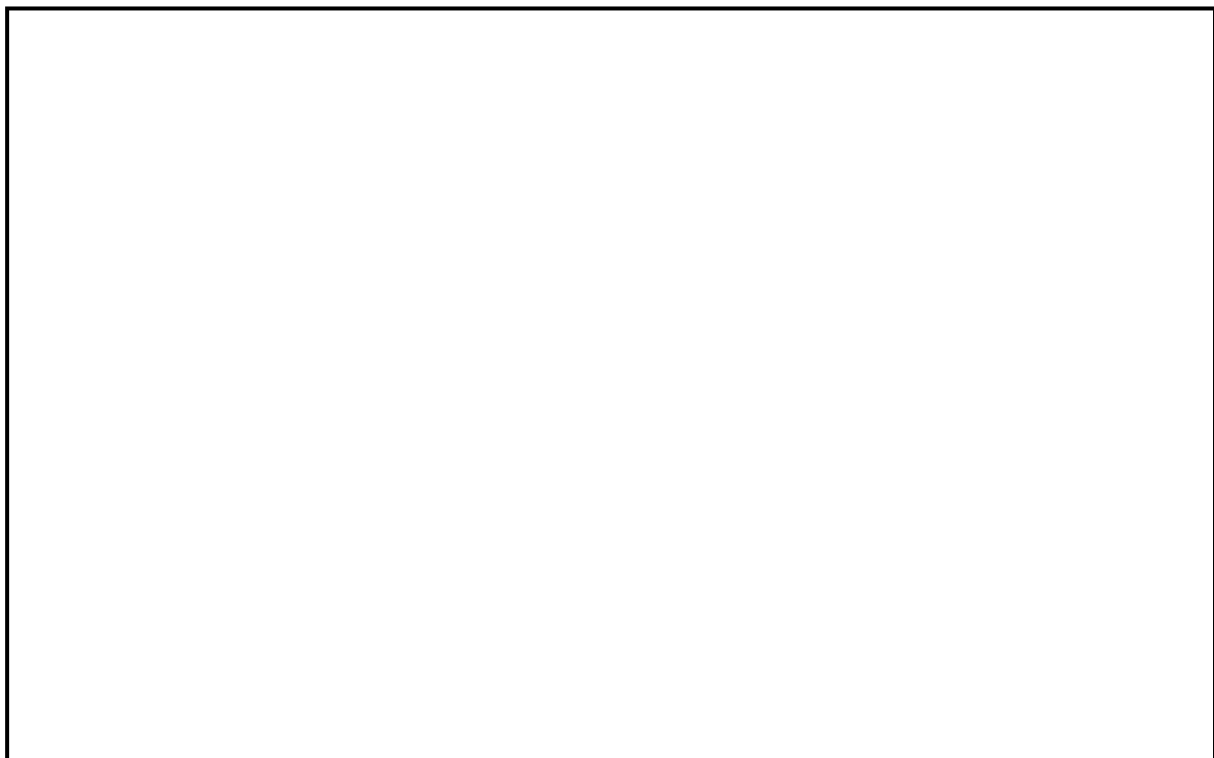
54. Remove the bolts and the crankshaft vibration damper.

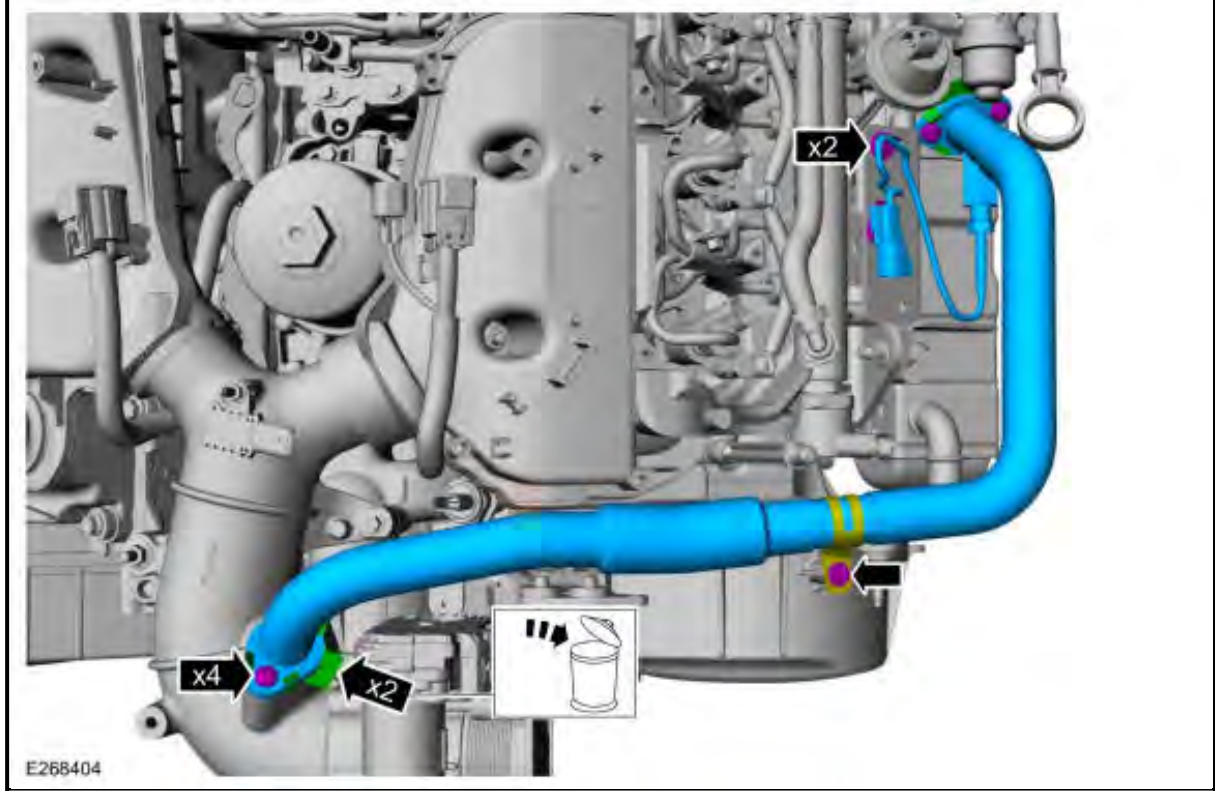




55.

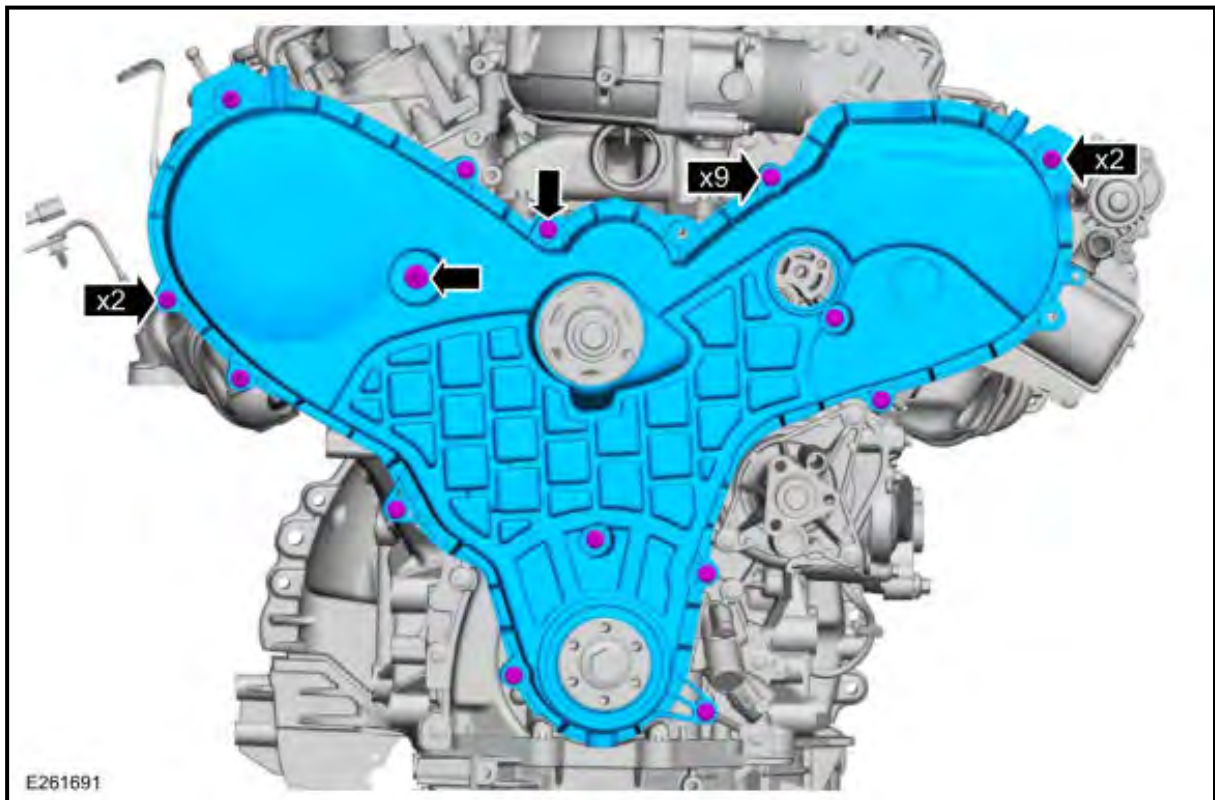
- Disconnect the wire retainers.
- Remove the retainer from the timing belt cover.
- Remove the retainers and the EGR outlet tube.
- Remove and discard the gaskets.





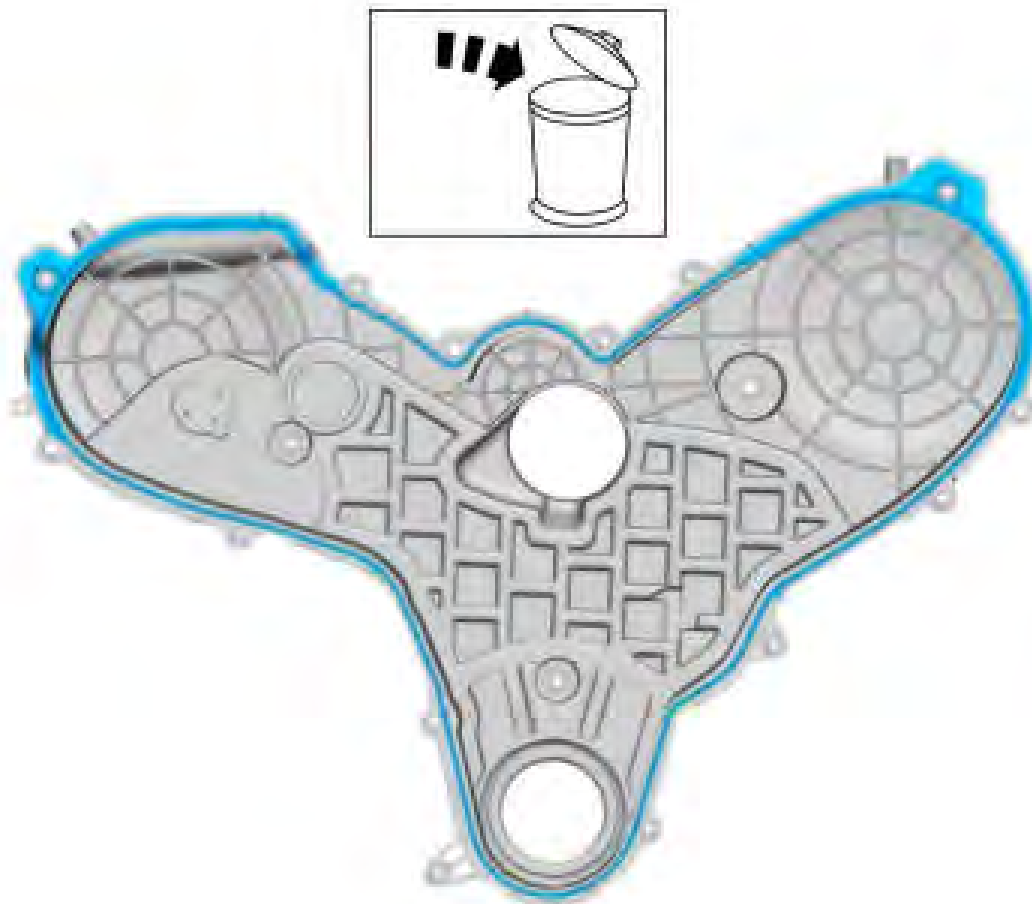
56. **NOTE:** Mark the locations of the fasteners before removal.

Remove the bolts, the stud bolts and the timing belt cover.



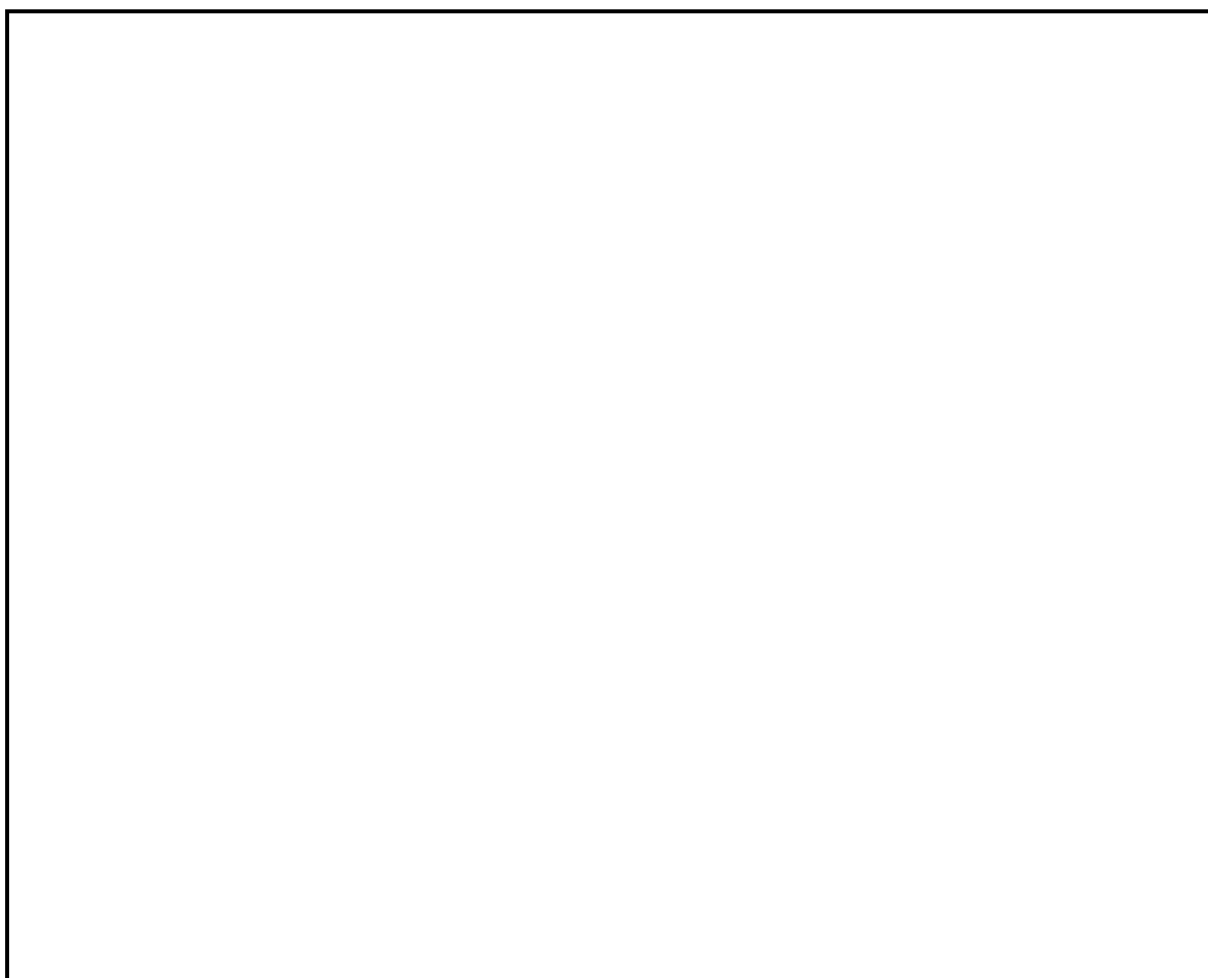
57. Remove and discard the timing belt cover gasket.

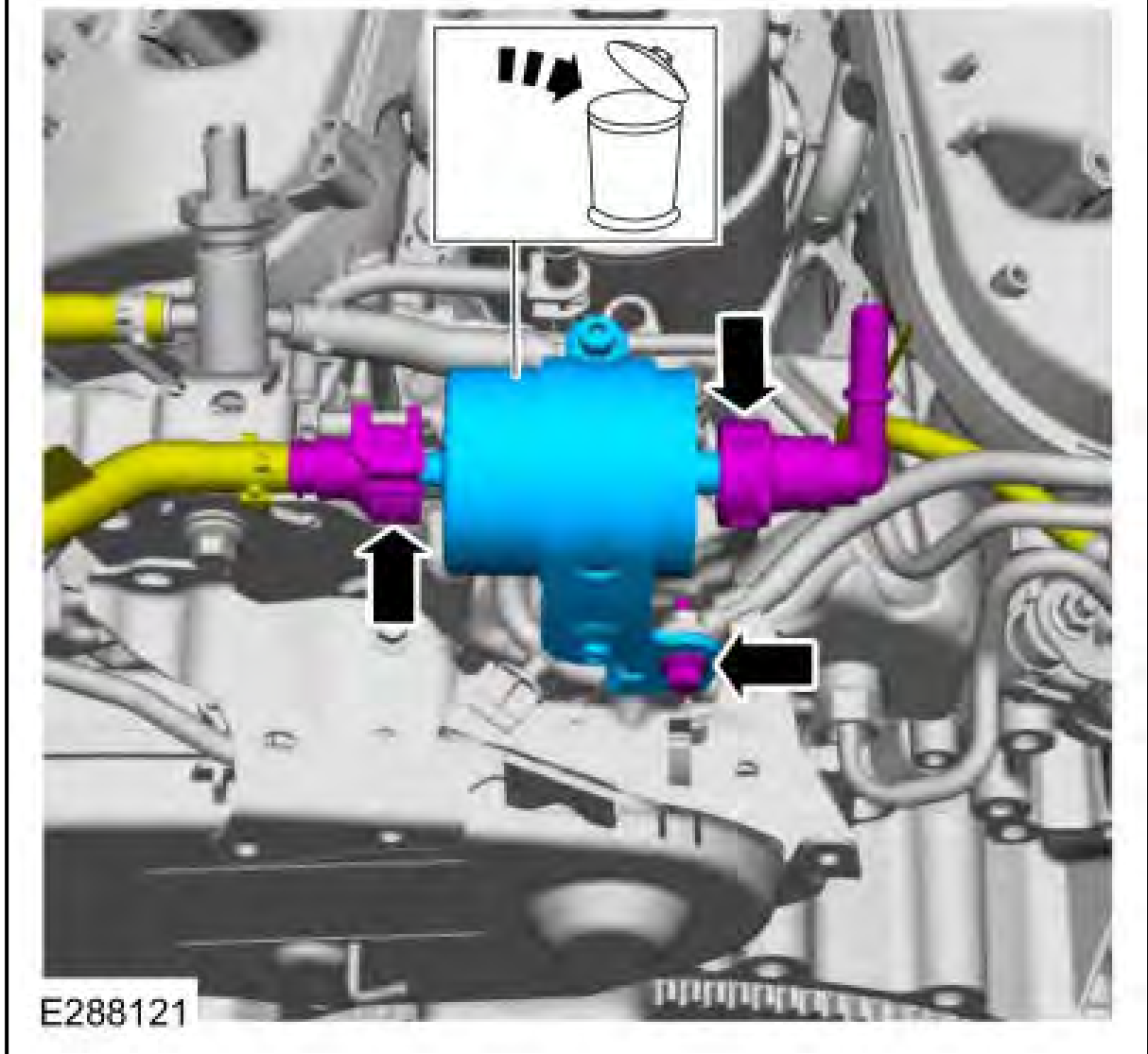




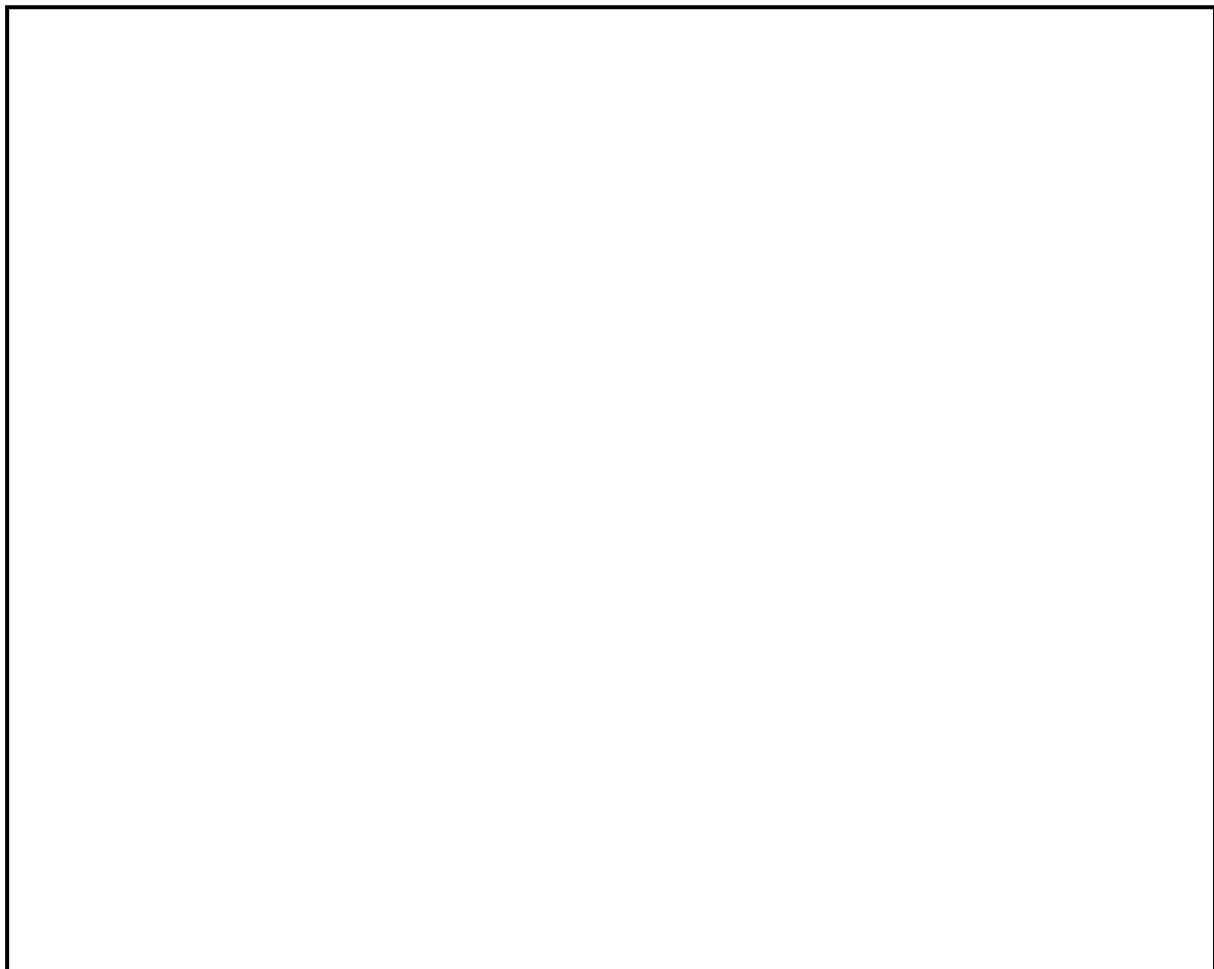
E261121

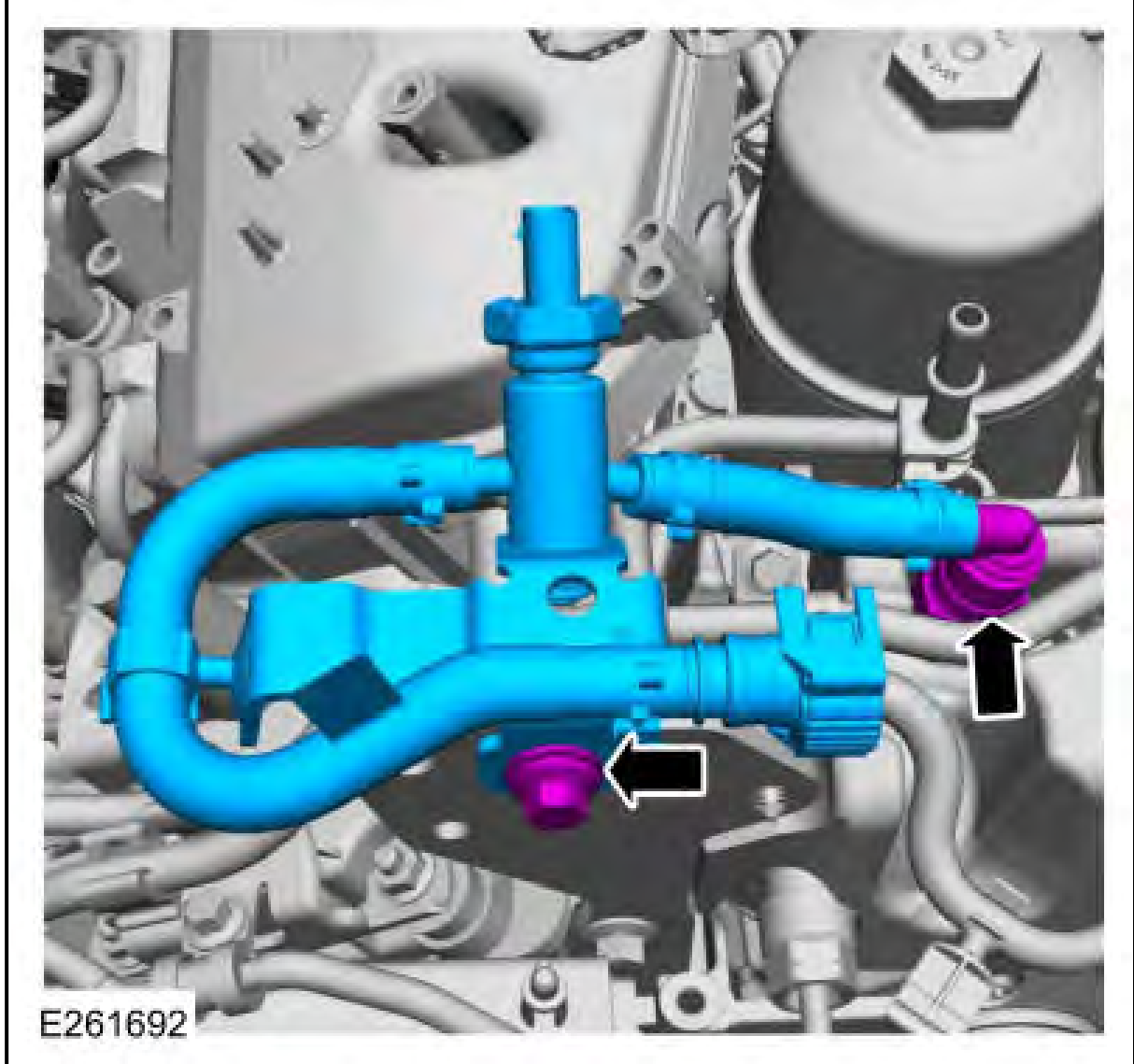
58. Disconnect the fuel lines. Remove the bolt and the secondary fuel filter. Discard the secondary fuel filter. REFER to: [Quick Release Coupling](#) .



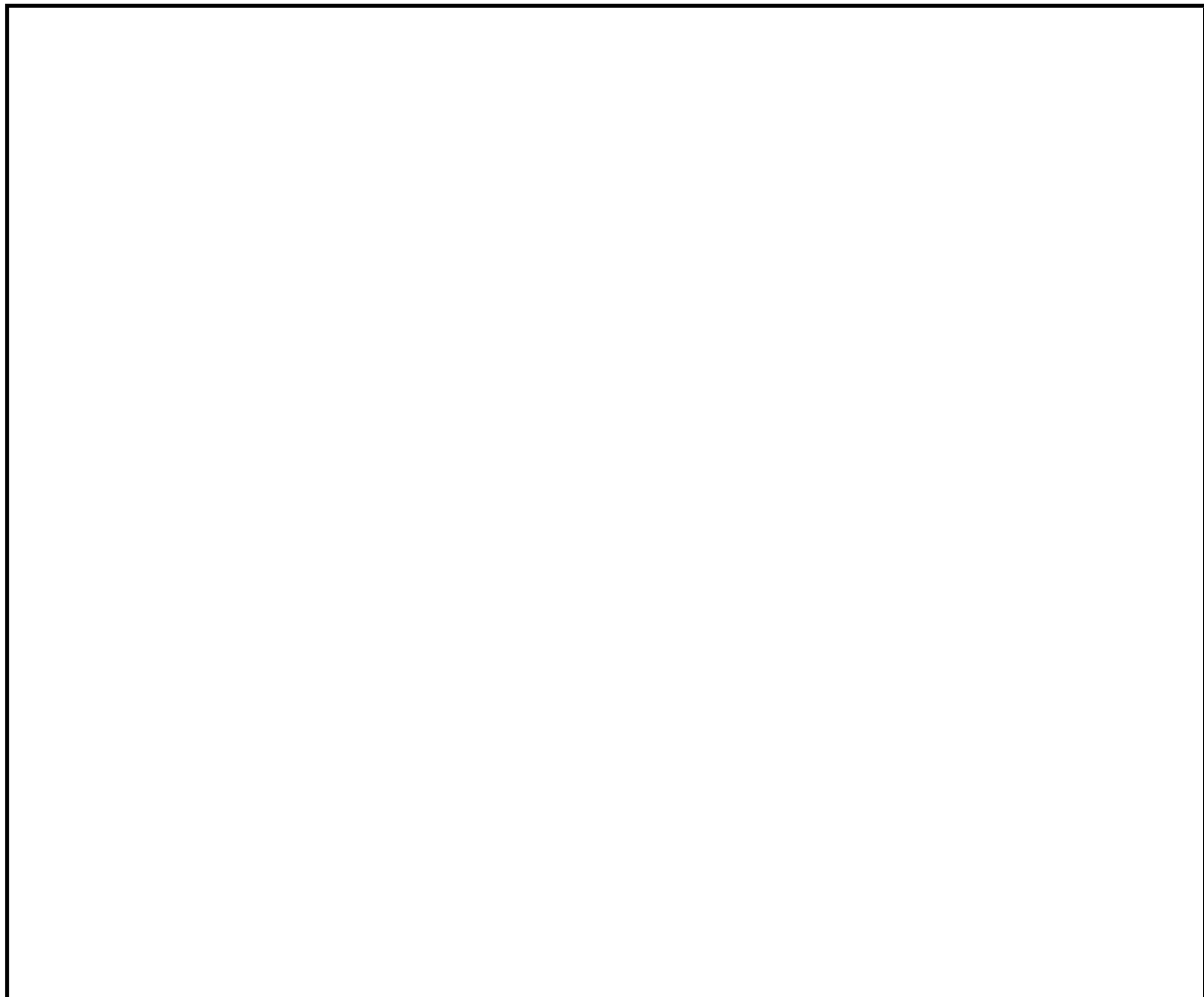


59. Remove the bolt. Disconnect and remove the fuel supply tube. REFER to: [Quick Release Coupling](#) .

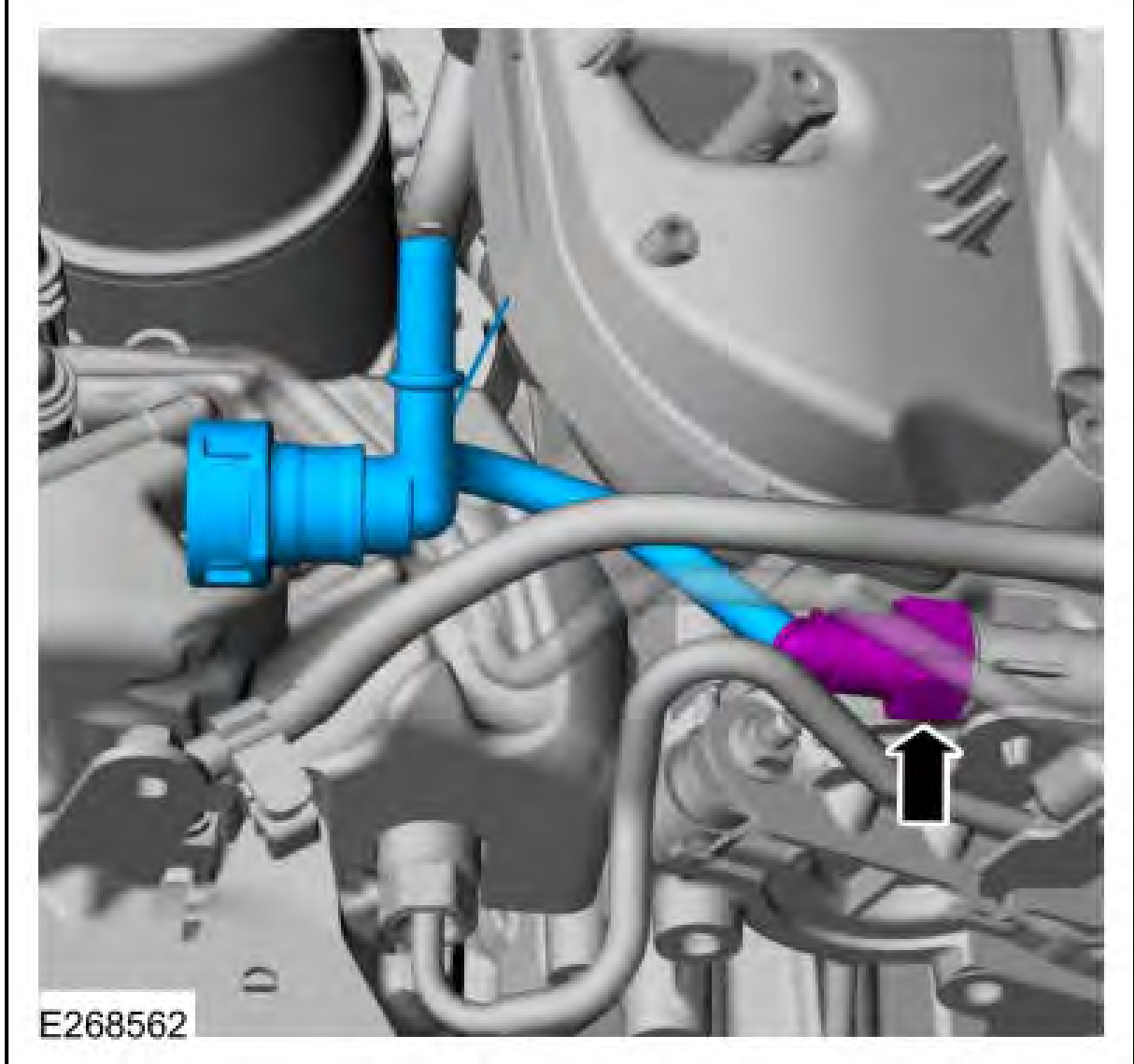




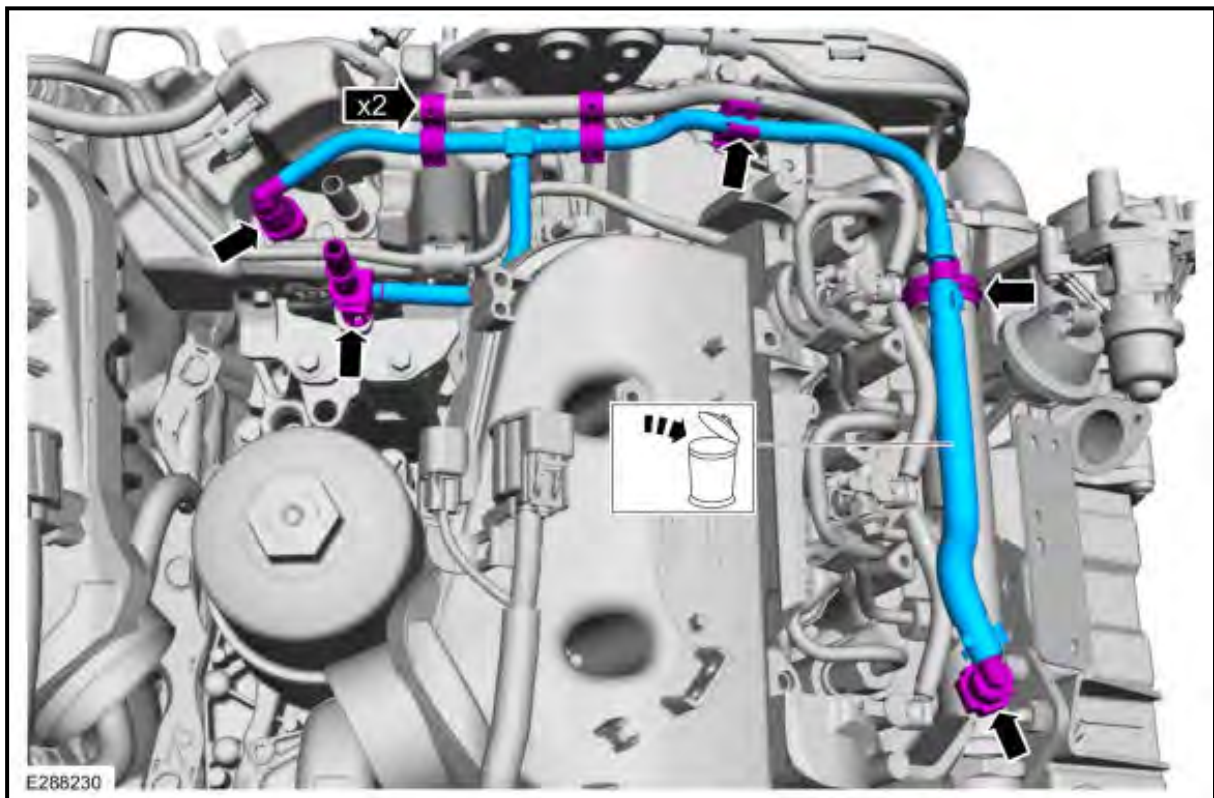
60. Disconnect and remove the fuel supply tube. REFER to: [Quick Release Coupling](#) .



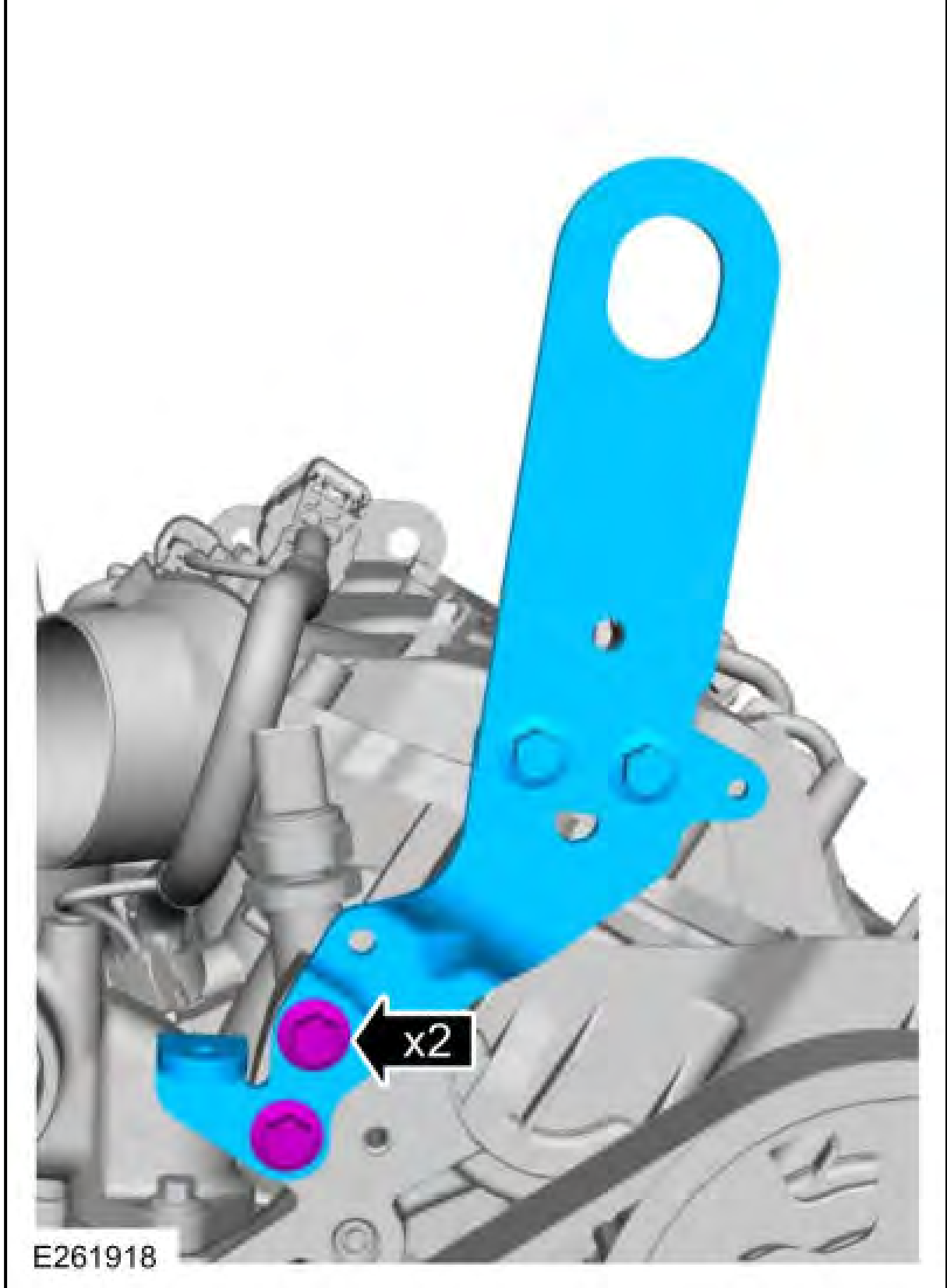




61. Disconnect and remove the fuel return tube assembly. Discard the fuel return tube assembly. REFER to: [Quick Release Coupling](#) .



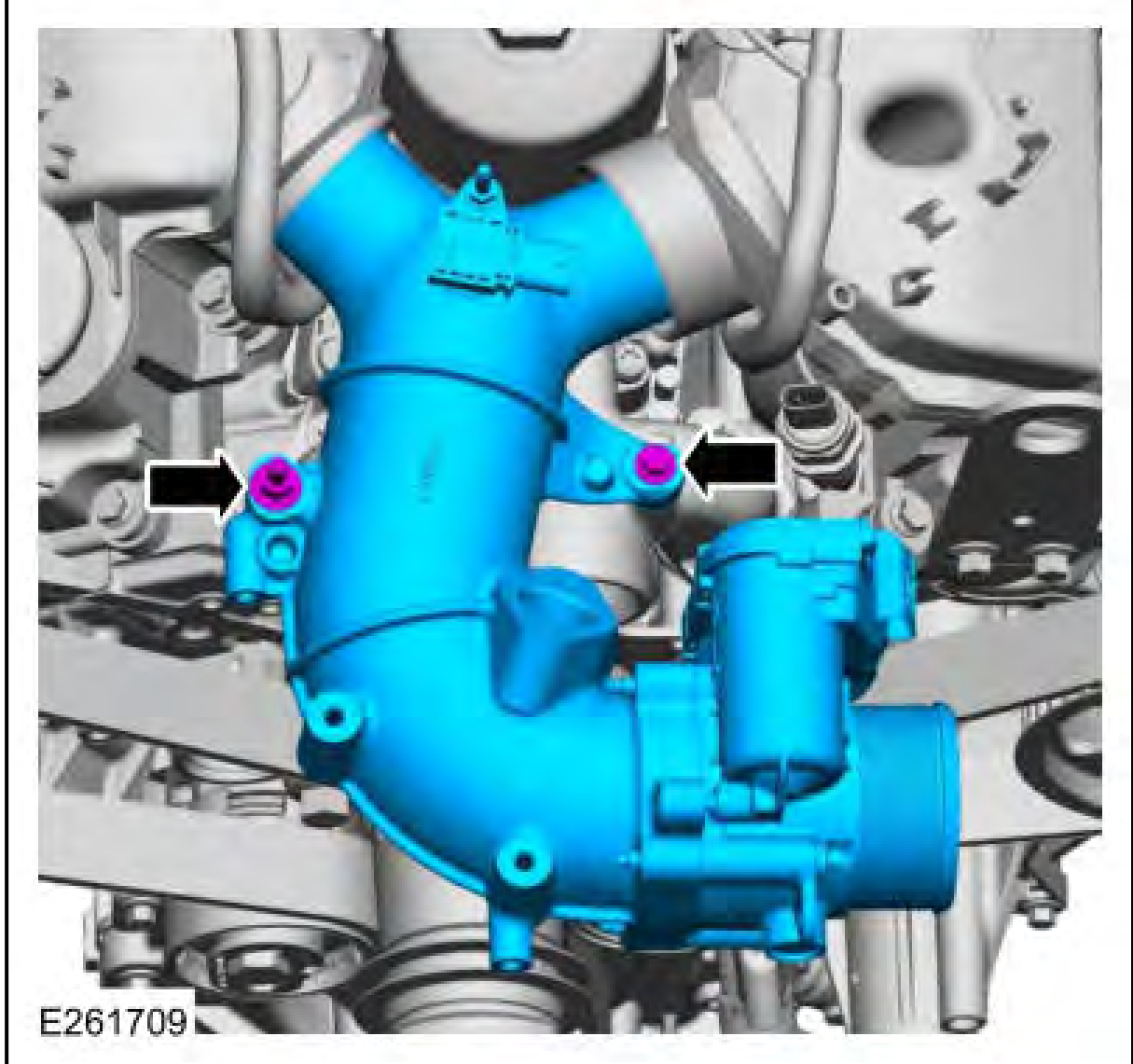
62. Remove the bolts and the front engine lifting eye.



63. **NOTE:** Lift the front of the intake manifold up and slide the intake manifold to the right to remove.

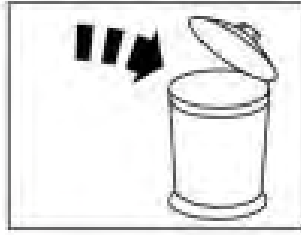
Remove the stud bolt, the bolt and the intake manifold.





64. Remove and discard the intake manifold gaskets.

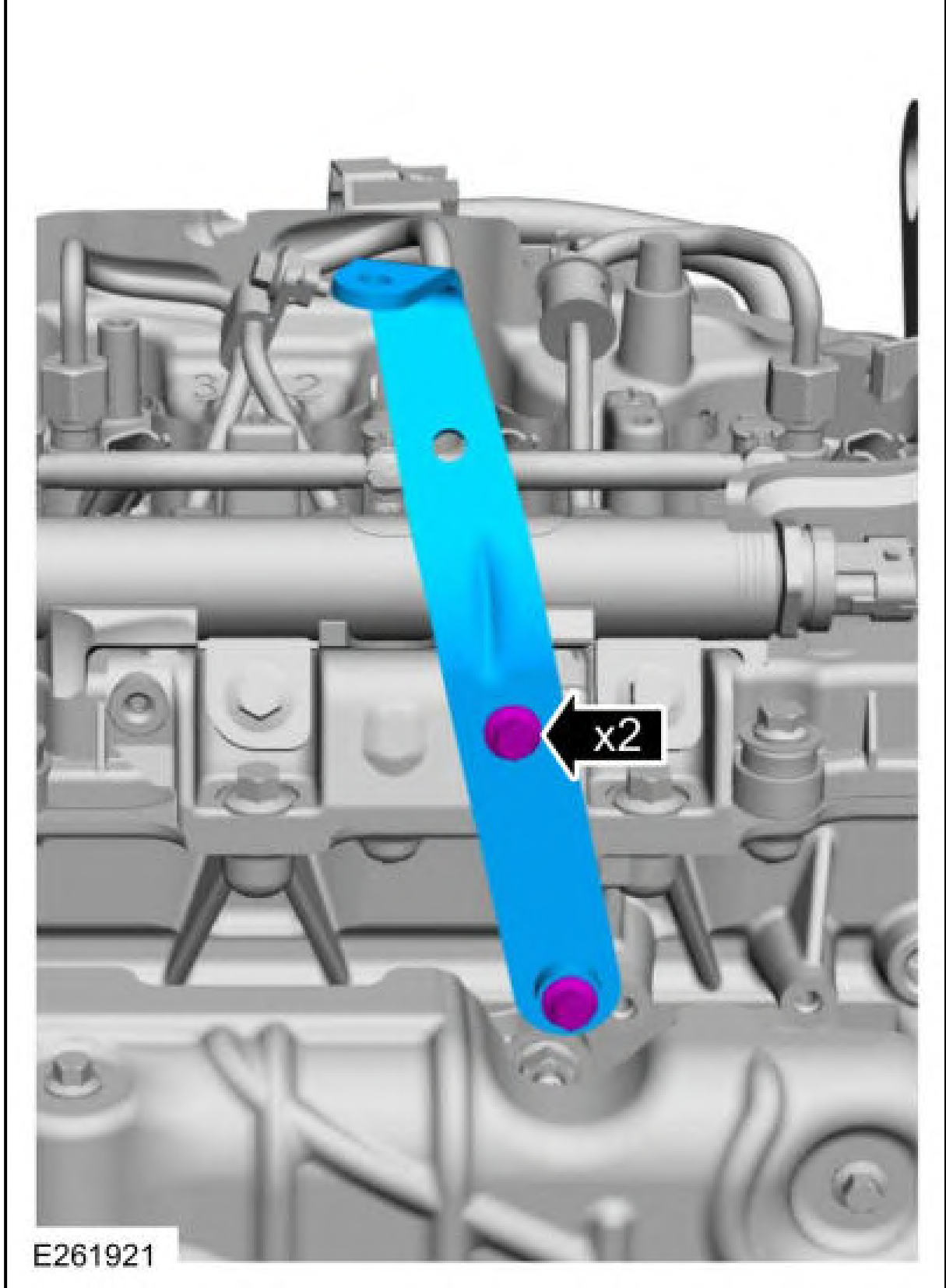




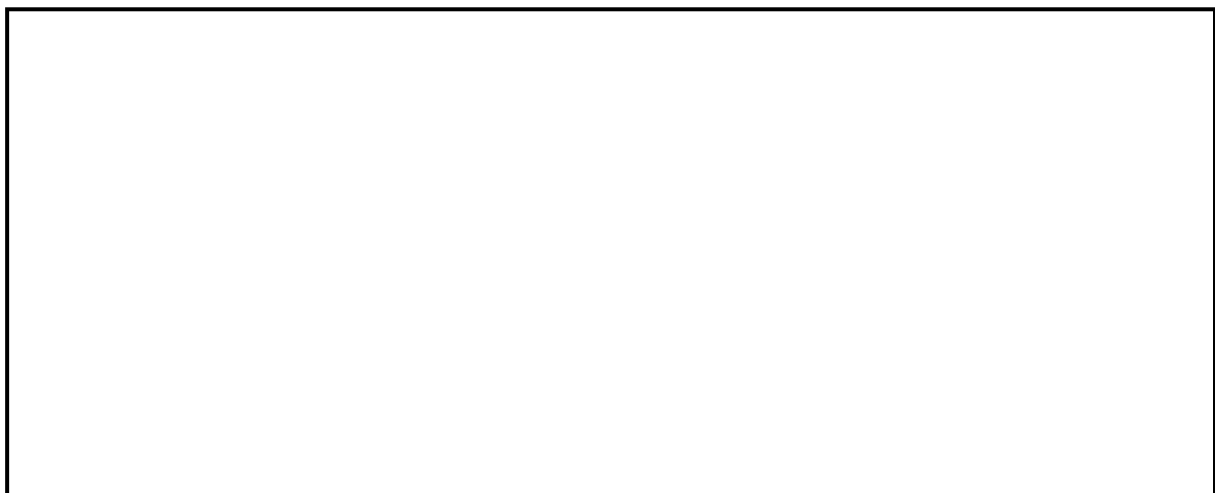
E261593

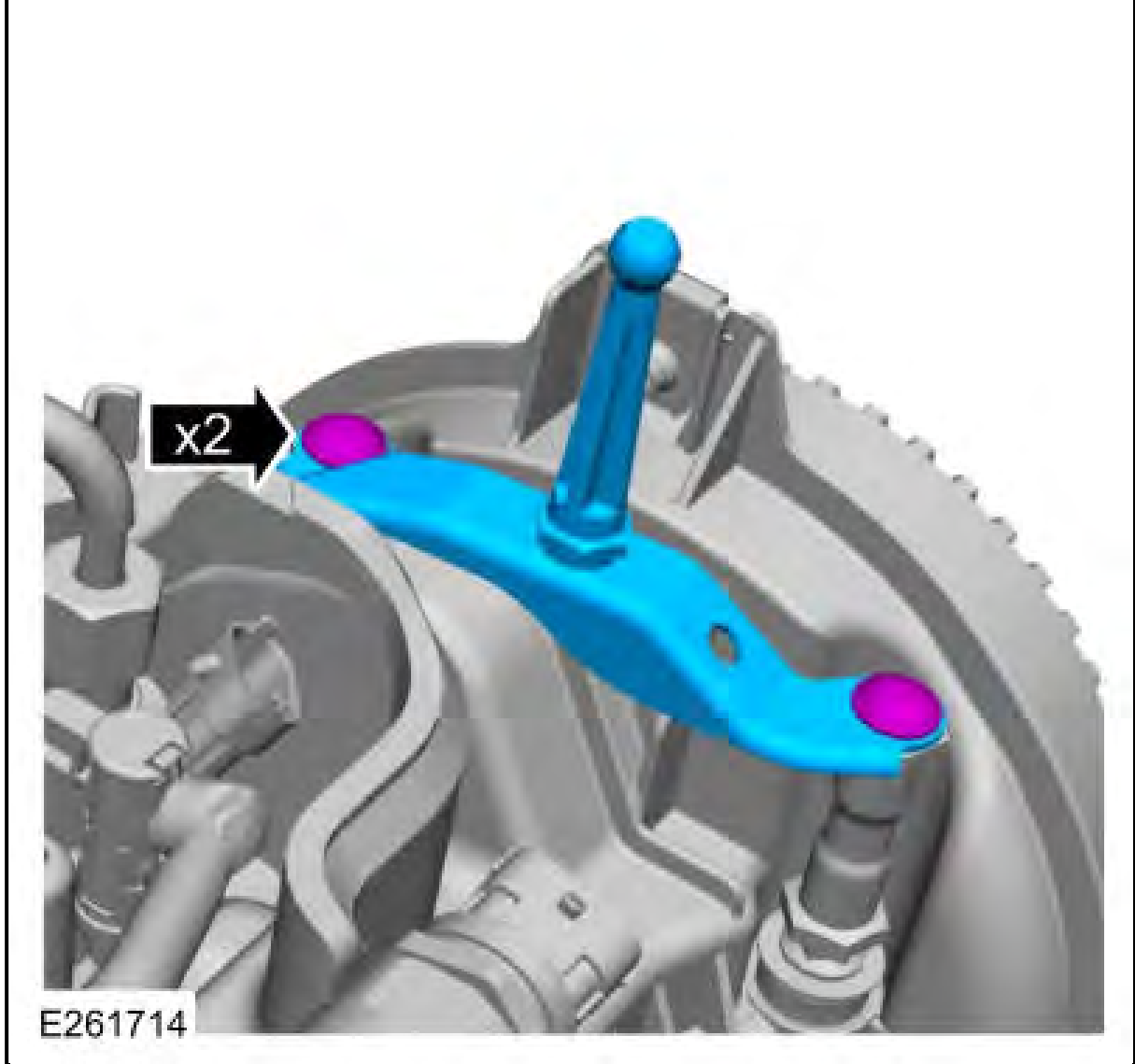
65. Remove the bolts and the heater hose support bracket.



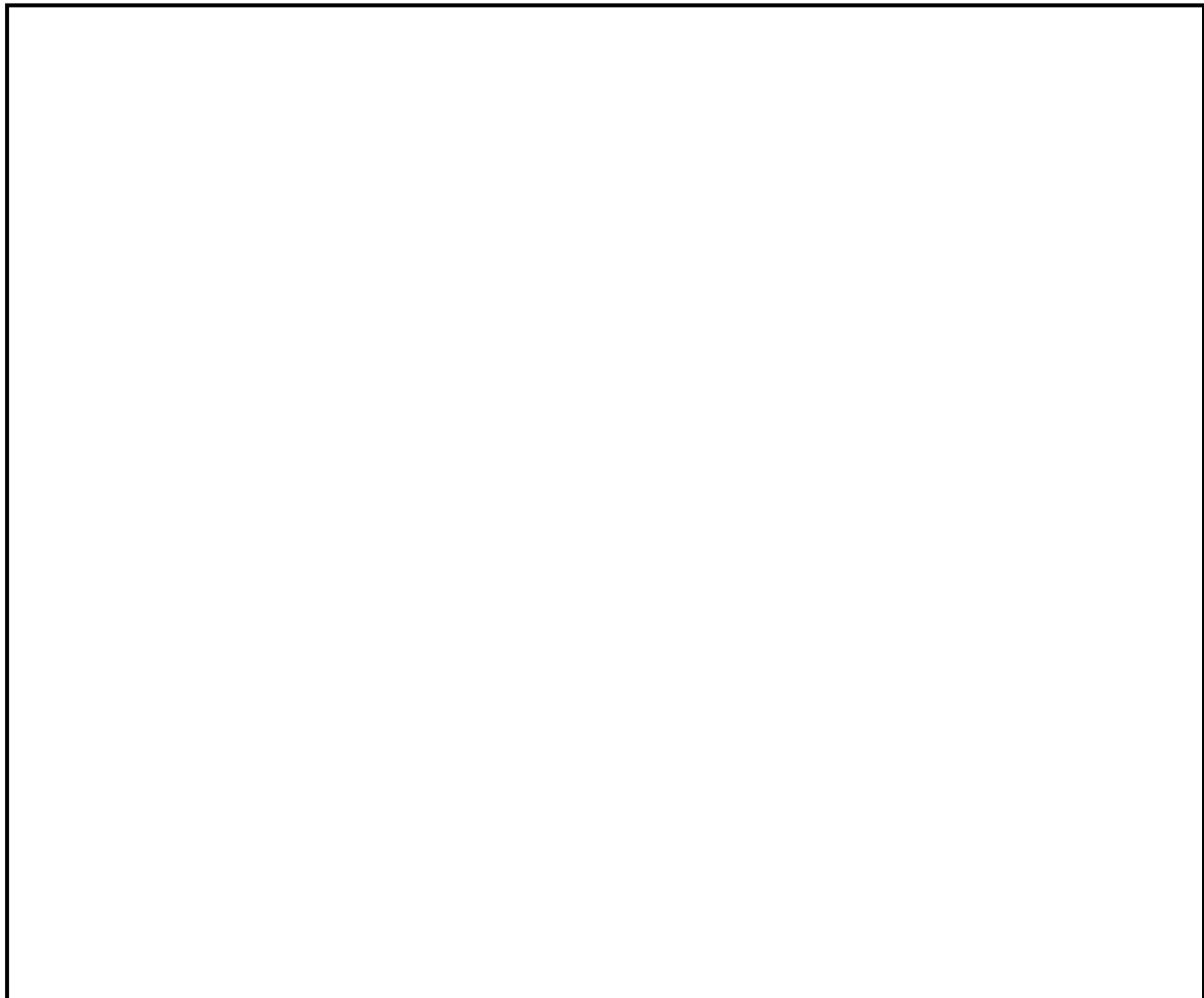


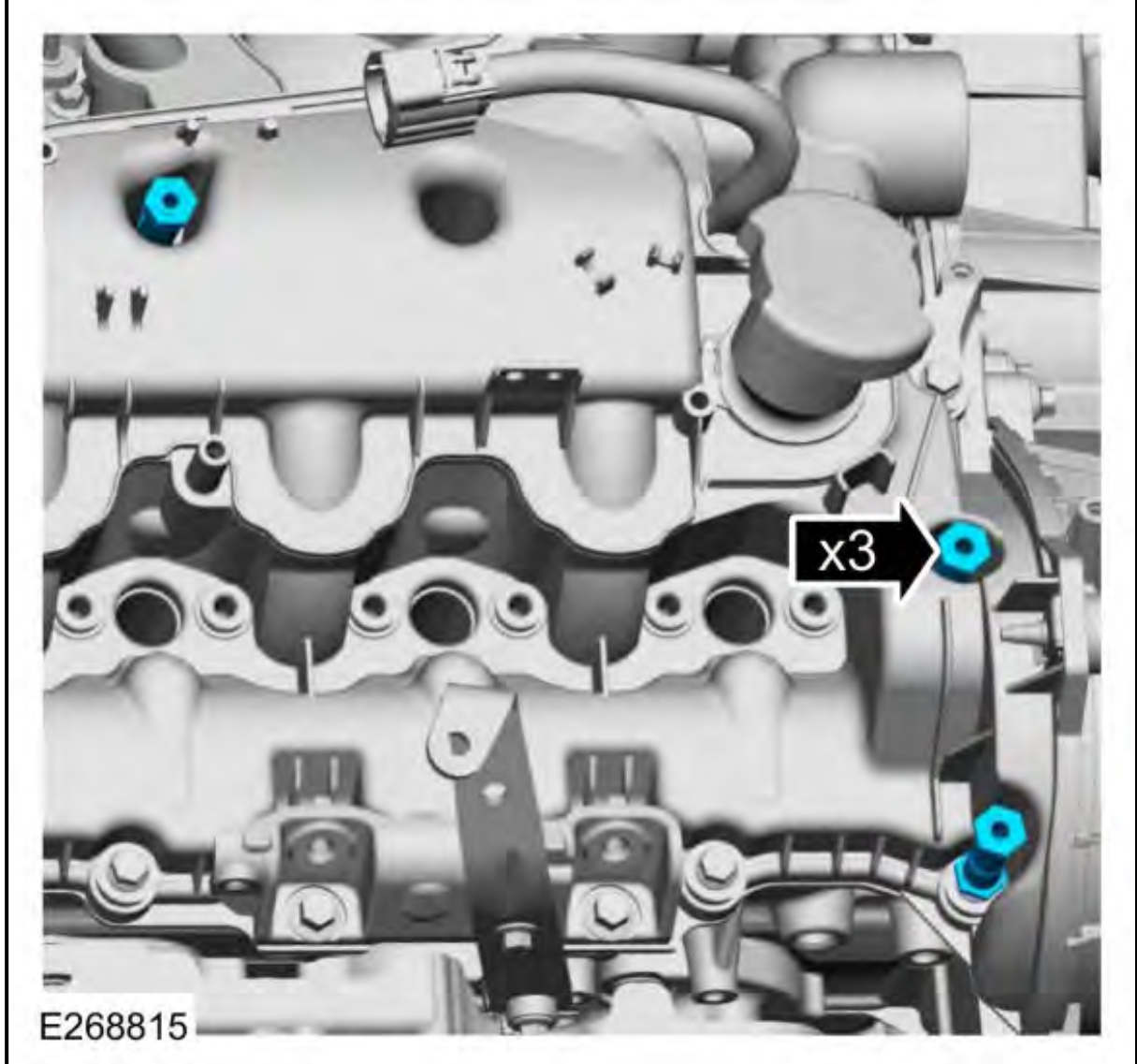
66. Remove the retainers and the engine support bracket.



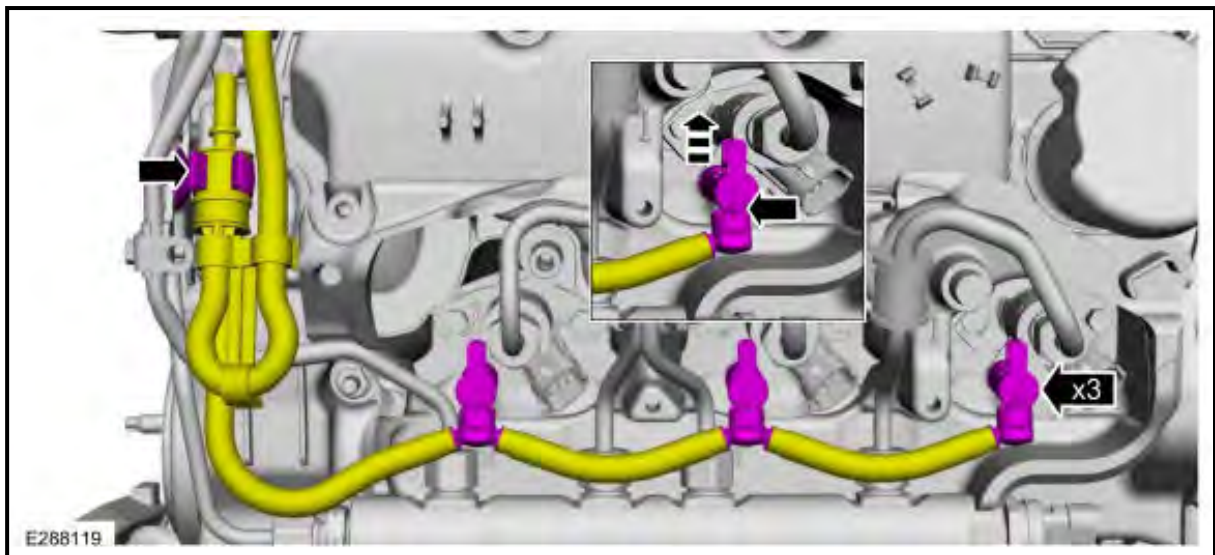


67. Remove the RH engine cover stud assemblies.



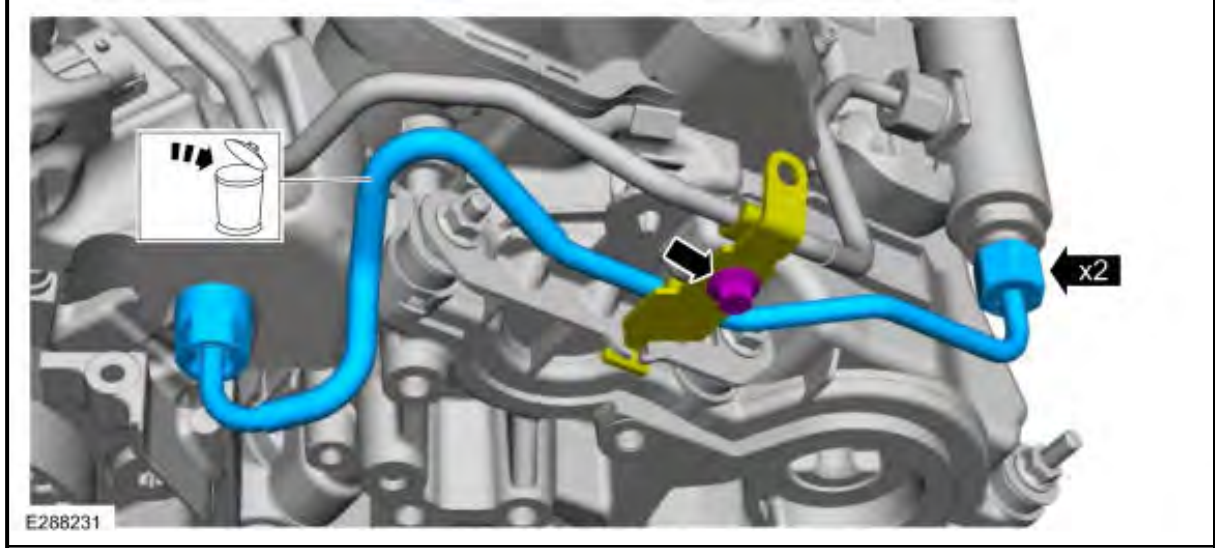


68. Disconnect and position aside the RH fuel return hose assembly.



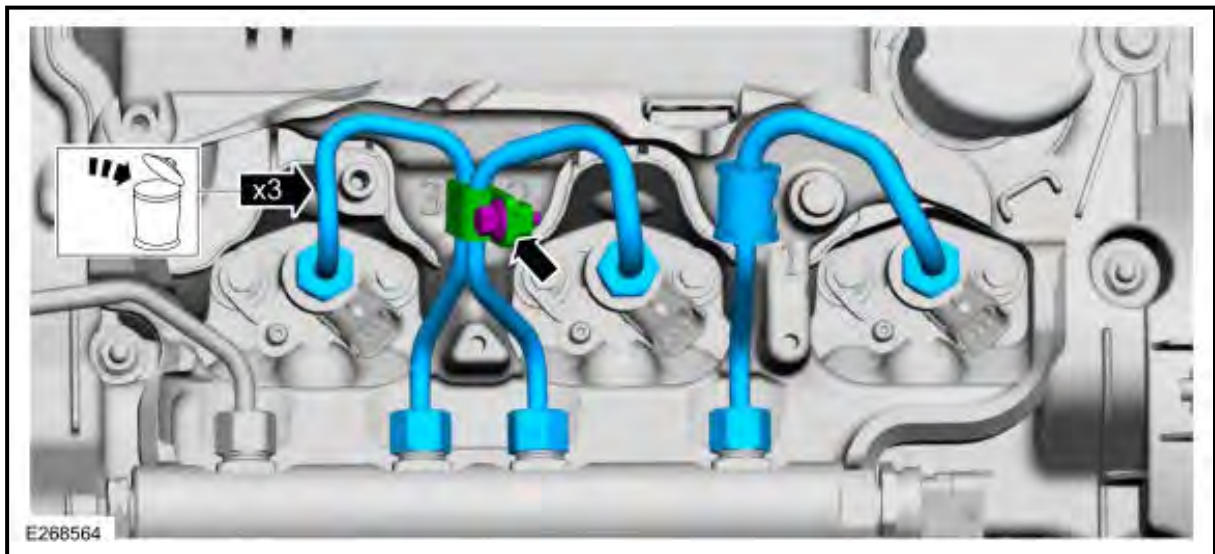
69. Remove and discard the RH fuel supply tube.





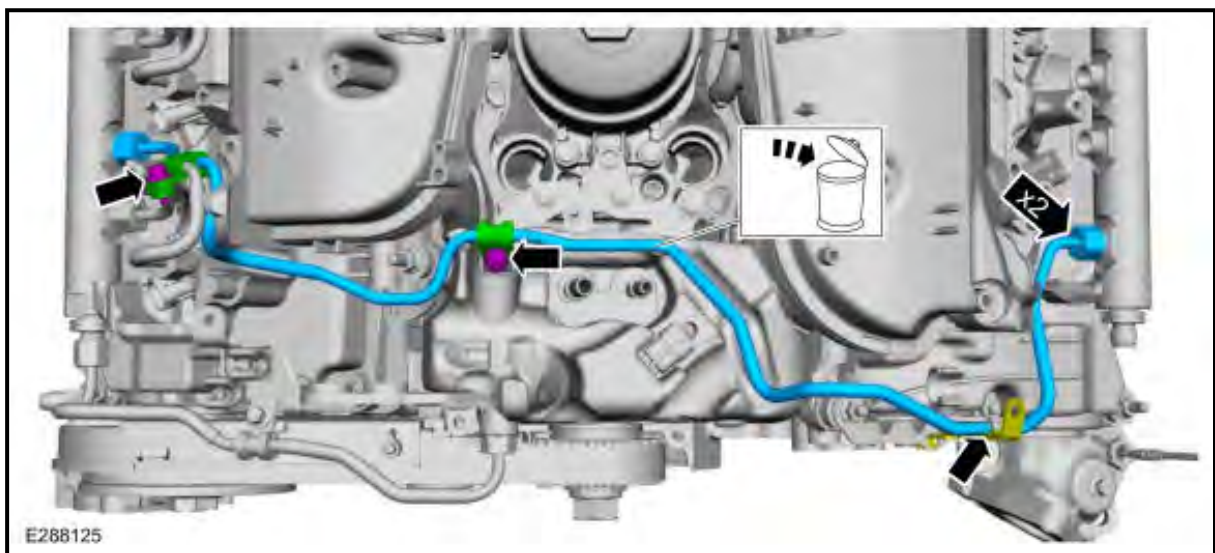
70.

- Remove the bolt and the clamp.
- Remove the bolts. Remove and discard the fuel injection pump balance tube and the clamps. Remove and discard the RH fuel injector supply tubes.



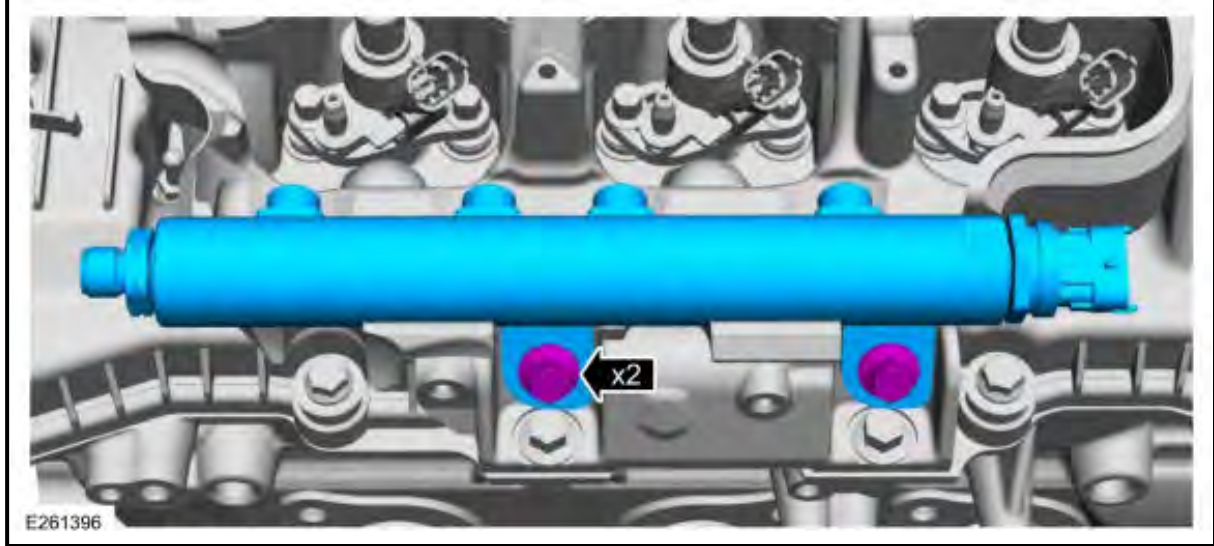
71.

- Remove the bolts and the clamps.
- Remove and discard the fuel injection pump balance tube.

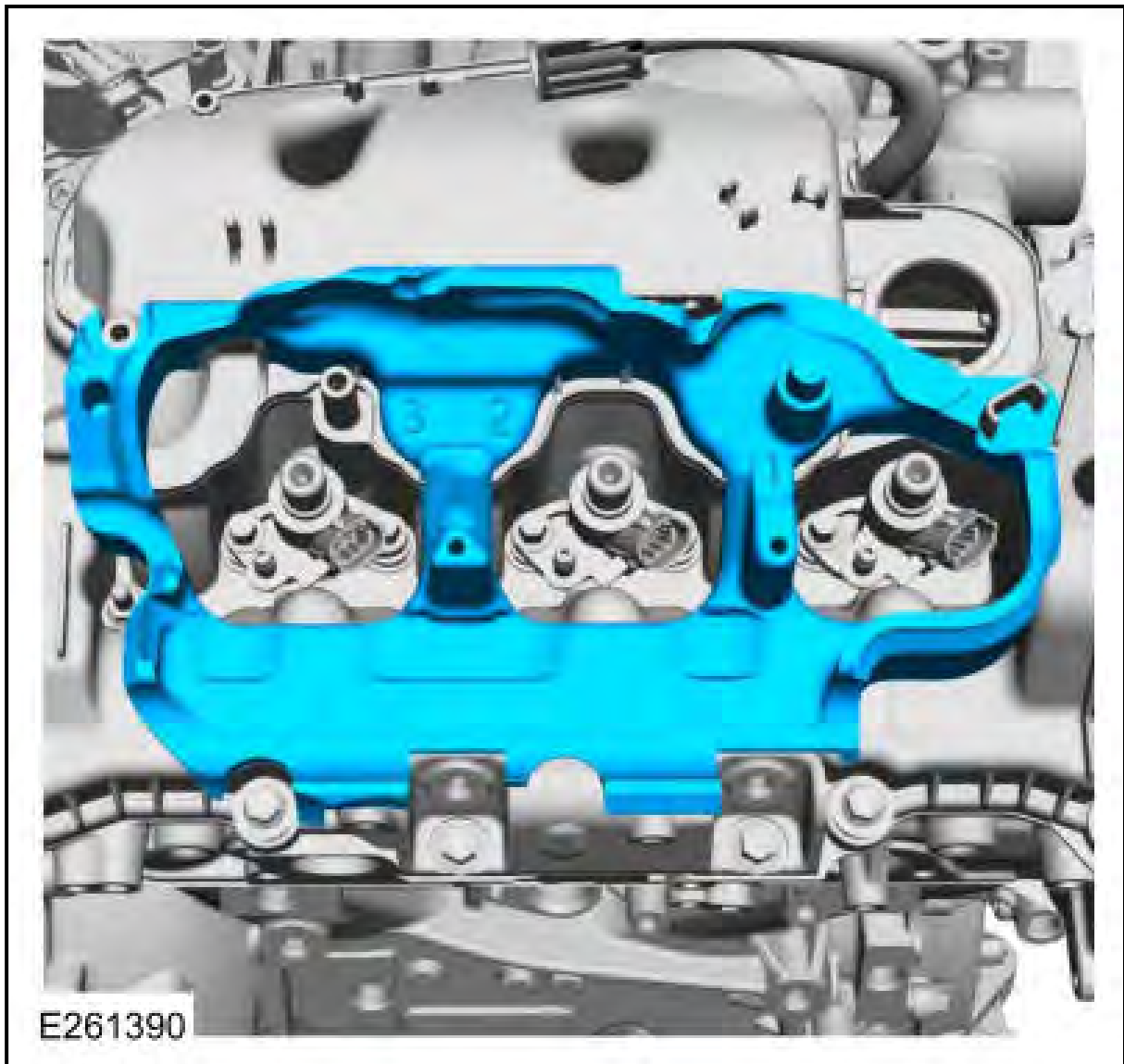


72. Remove the bolts and the RH fuel rail.



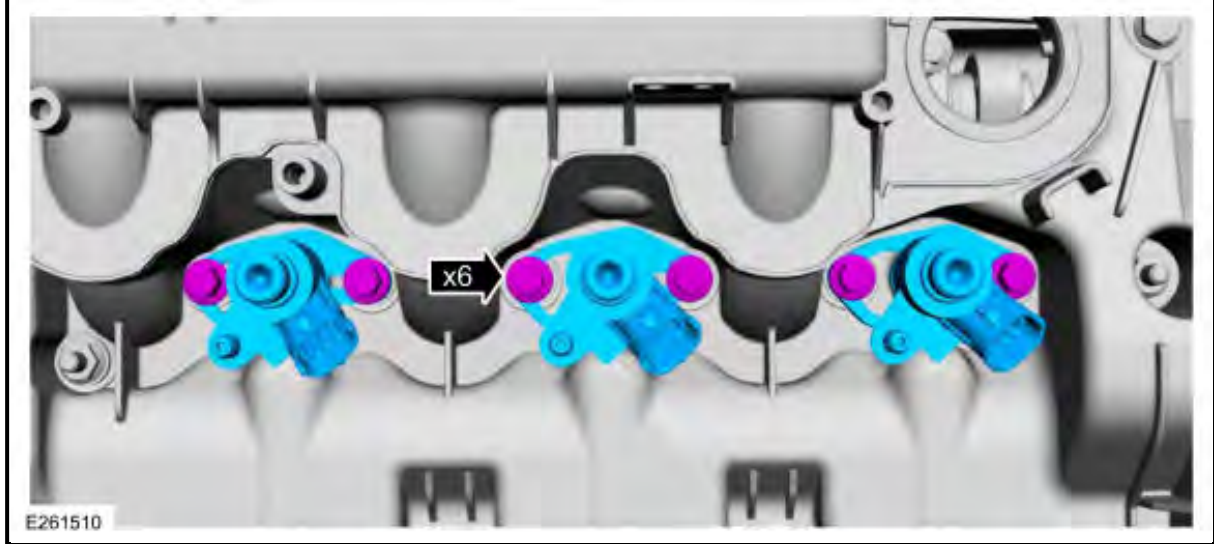


73. Remove the RH fuel injector noise insulator.



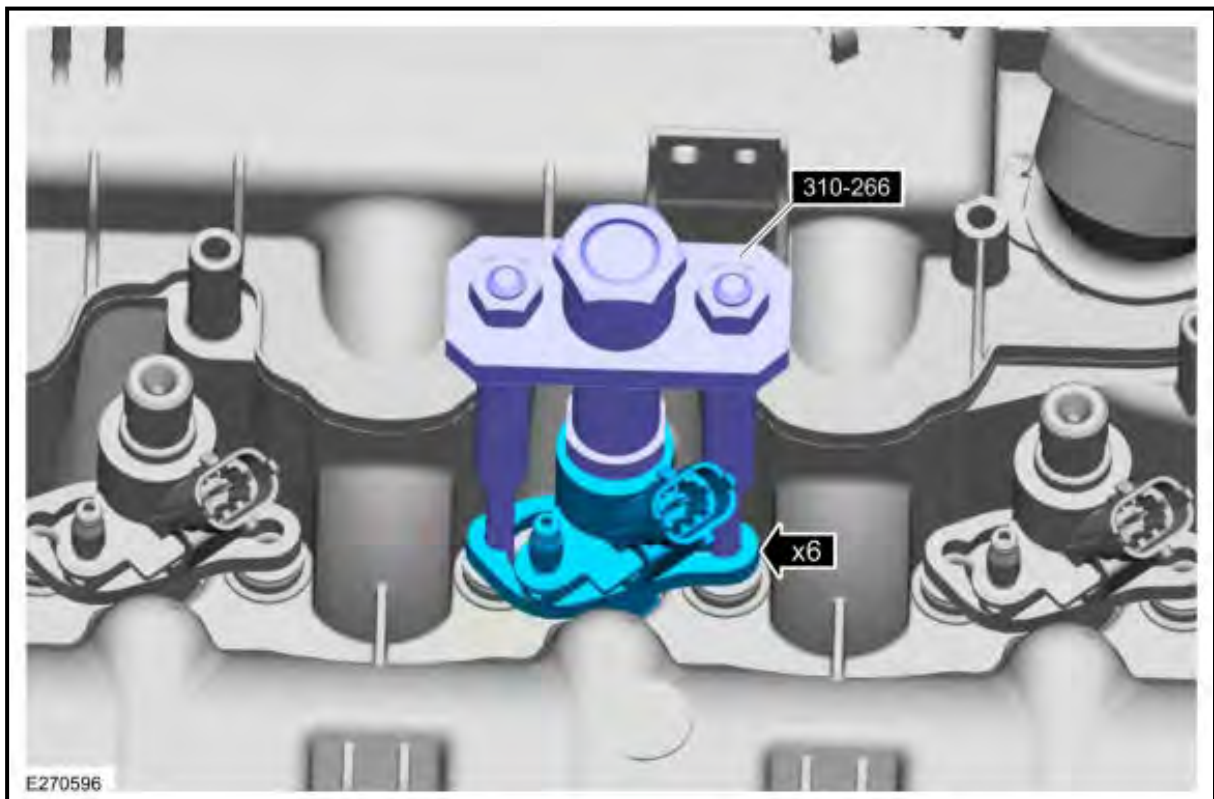
74. Remove the bolts for the RH fuel injectors.



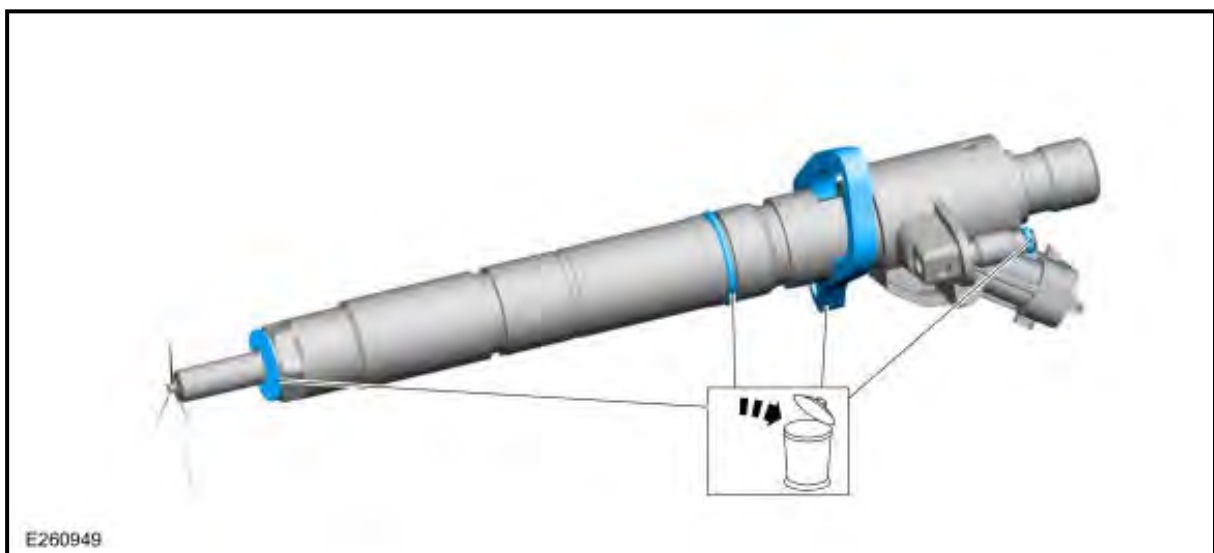


75. **NOTE:** Only one fuel injector shown.

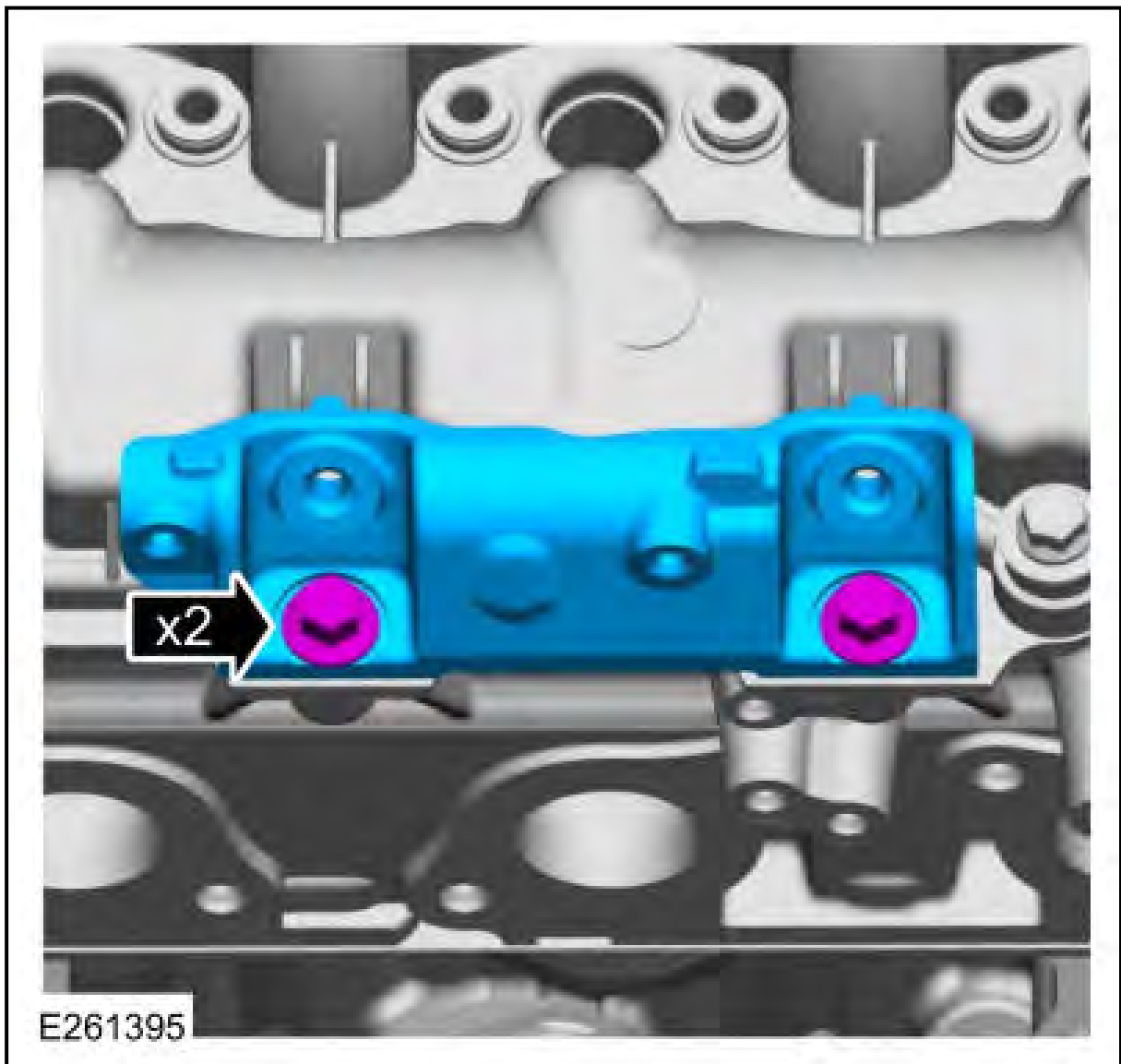
Using the special tool, remove the fuel injectors. Use Special Service Tool: 310-266 Remover, Fuel Injector.



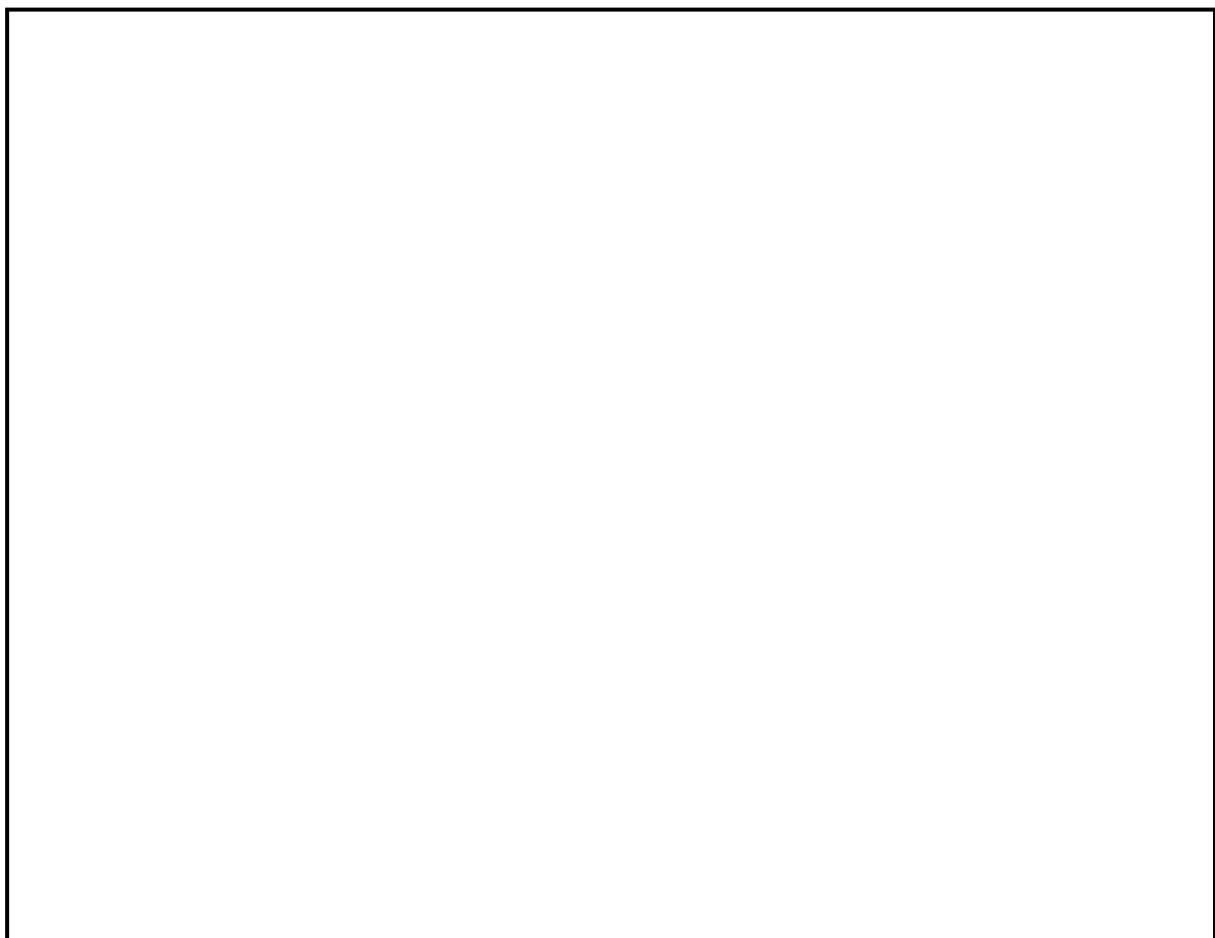
76. Remove and discard the sealing washer, the O-rings and the fuel injector hold down.

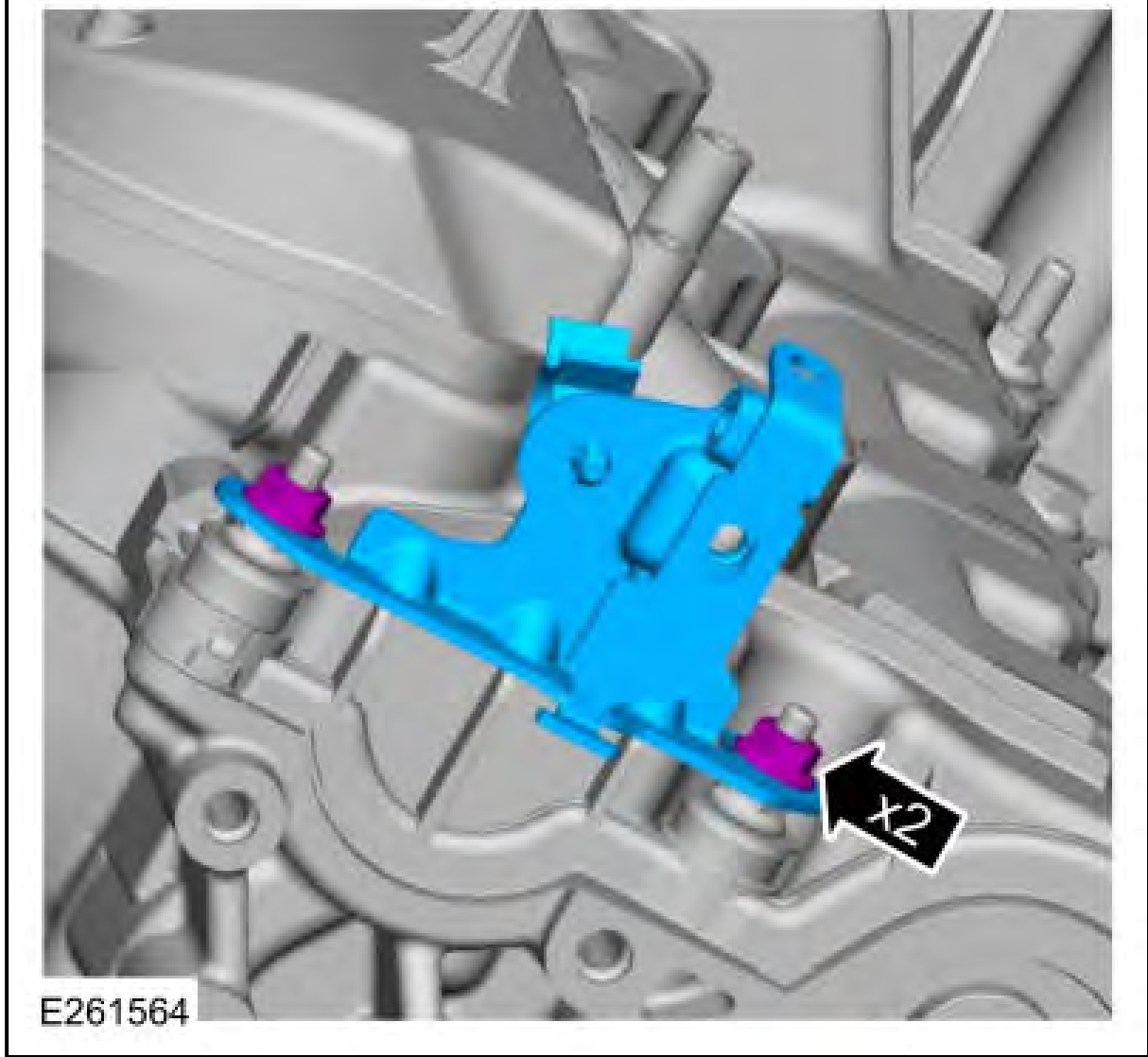


77. Remove the bolts and the RH fuel rail bracket.

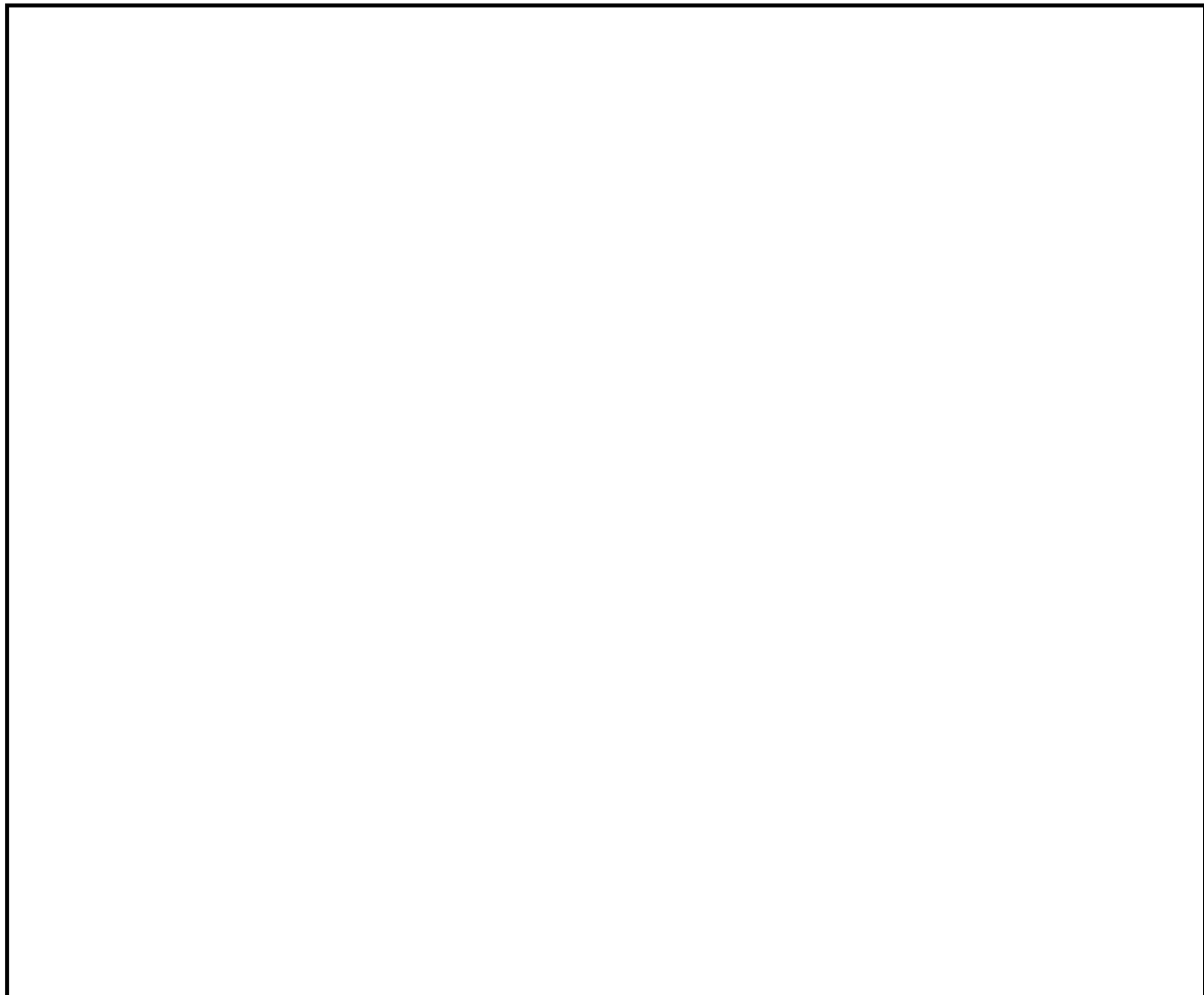


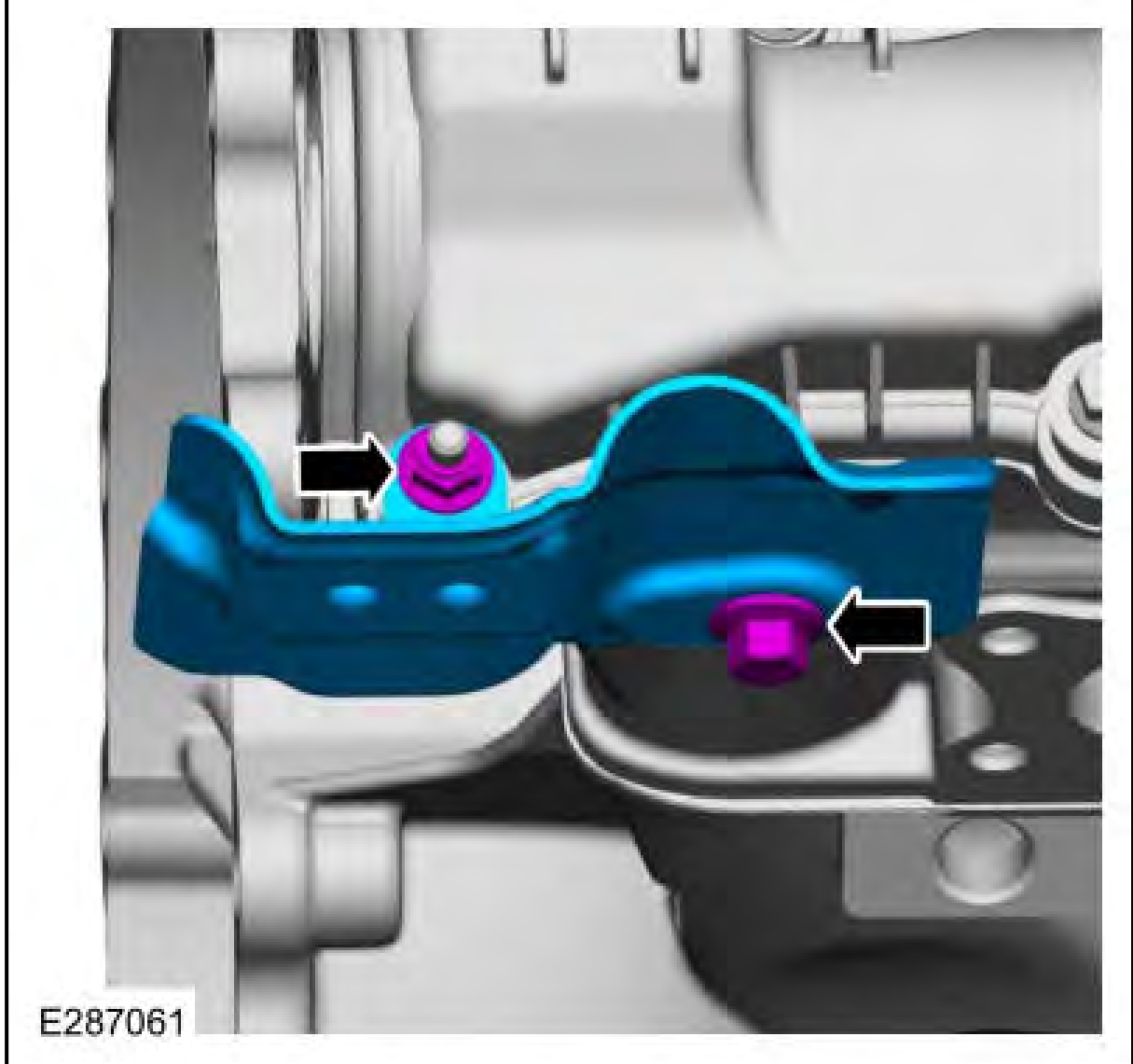
78. Remove the nuts and the RH fuel tube bracket.



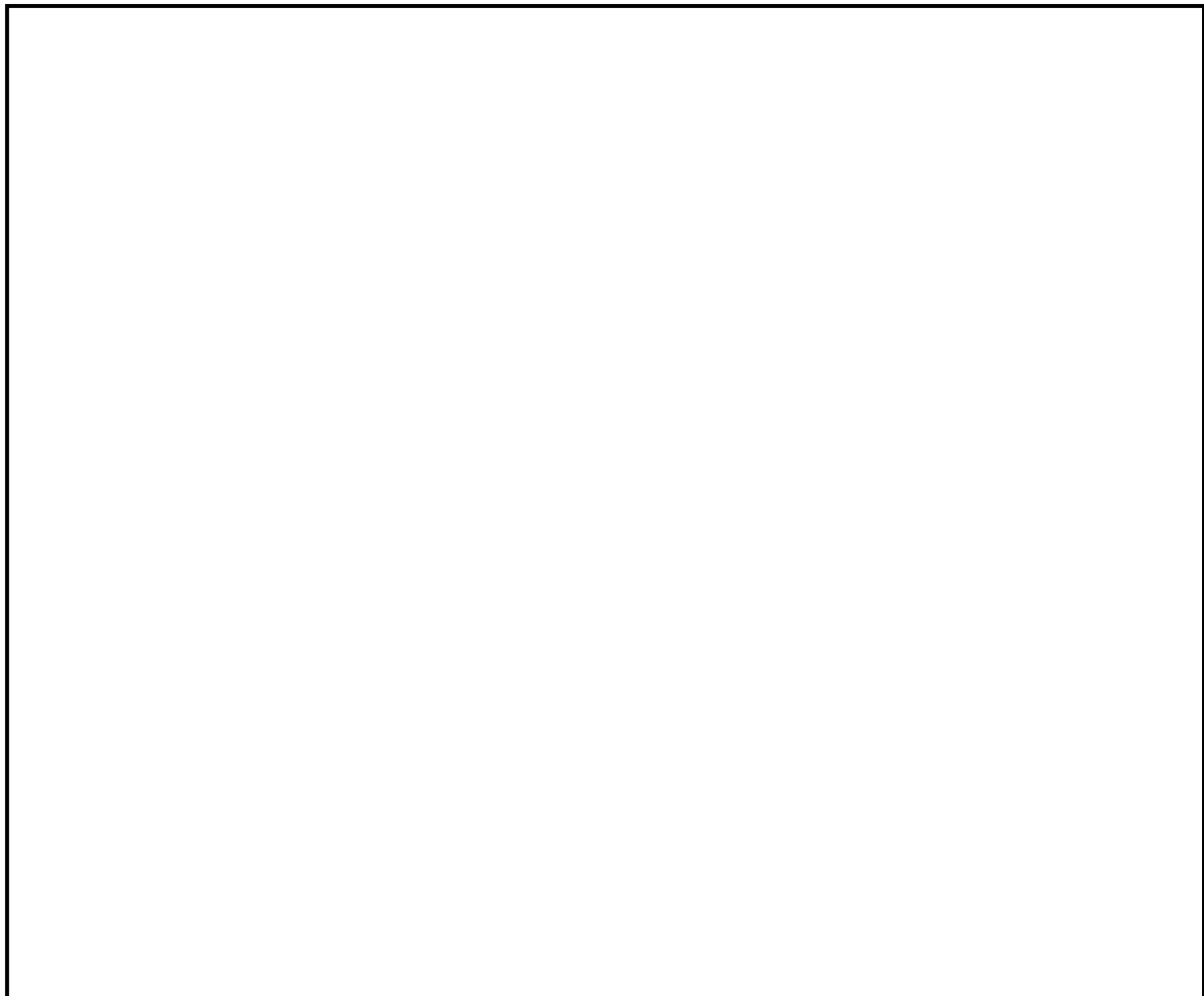


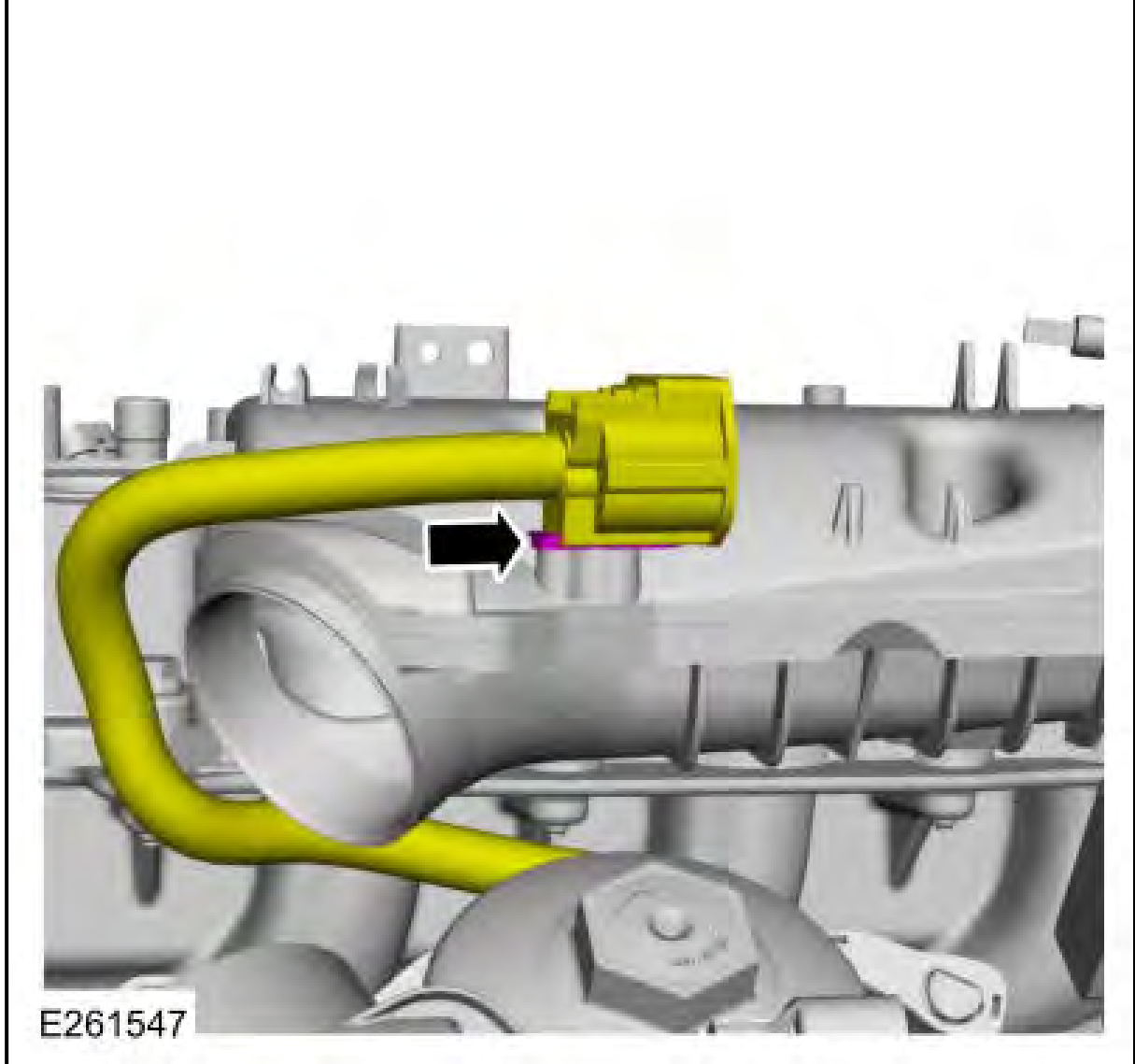
79. Remove the nut, the bolt and the turbocharger heat shield.



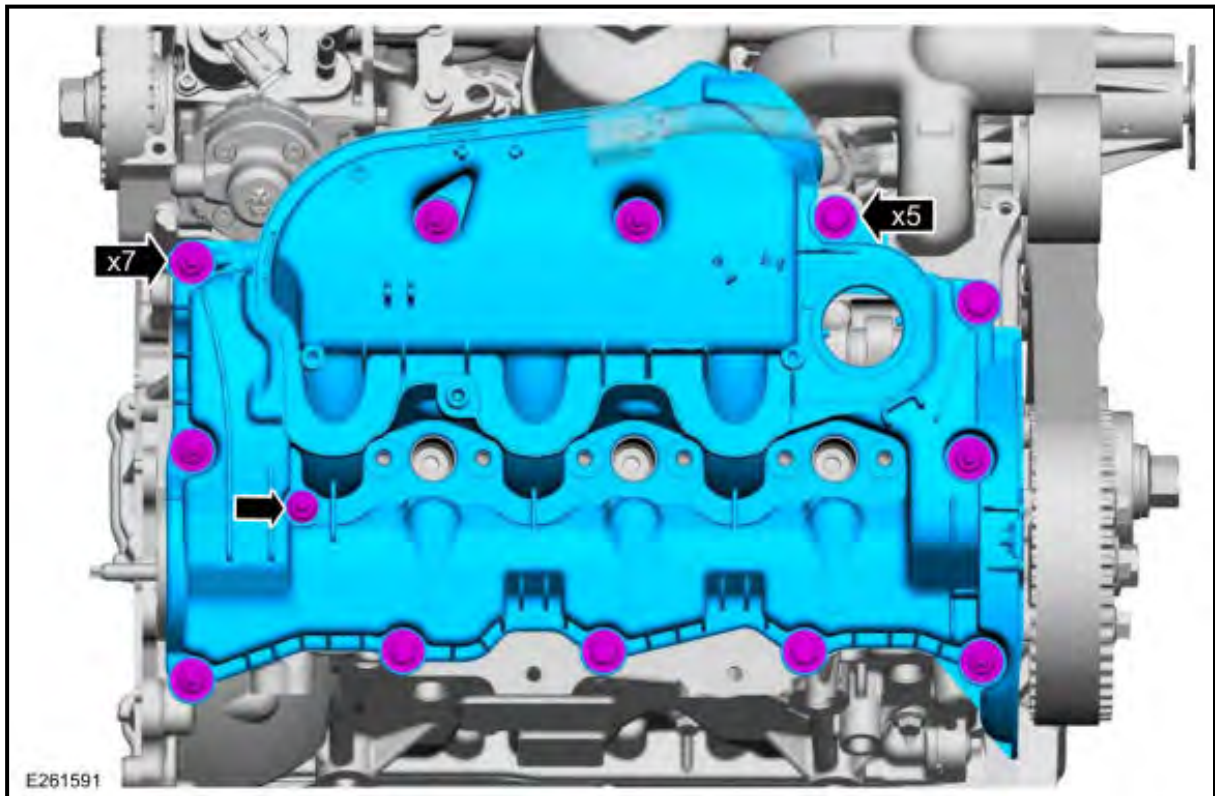


80. Disconnect the RH glow plug electrical connector.

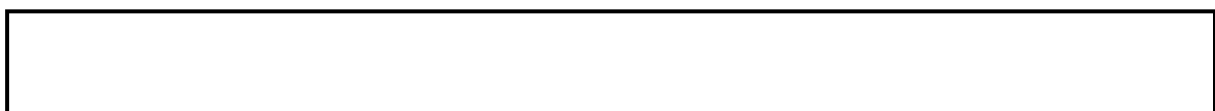


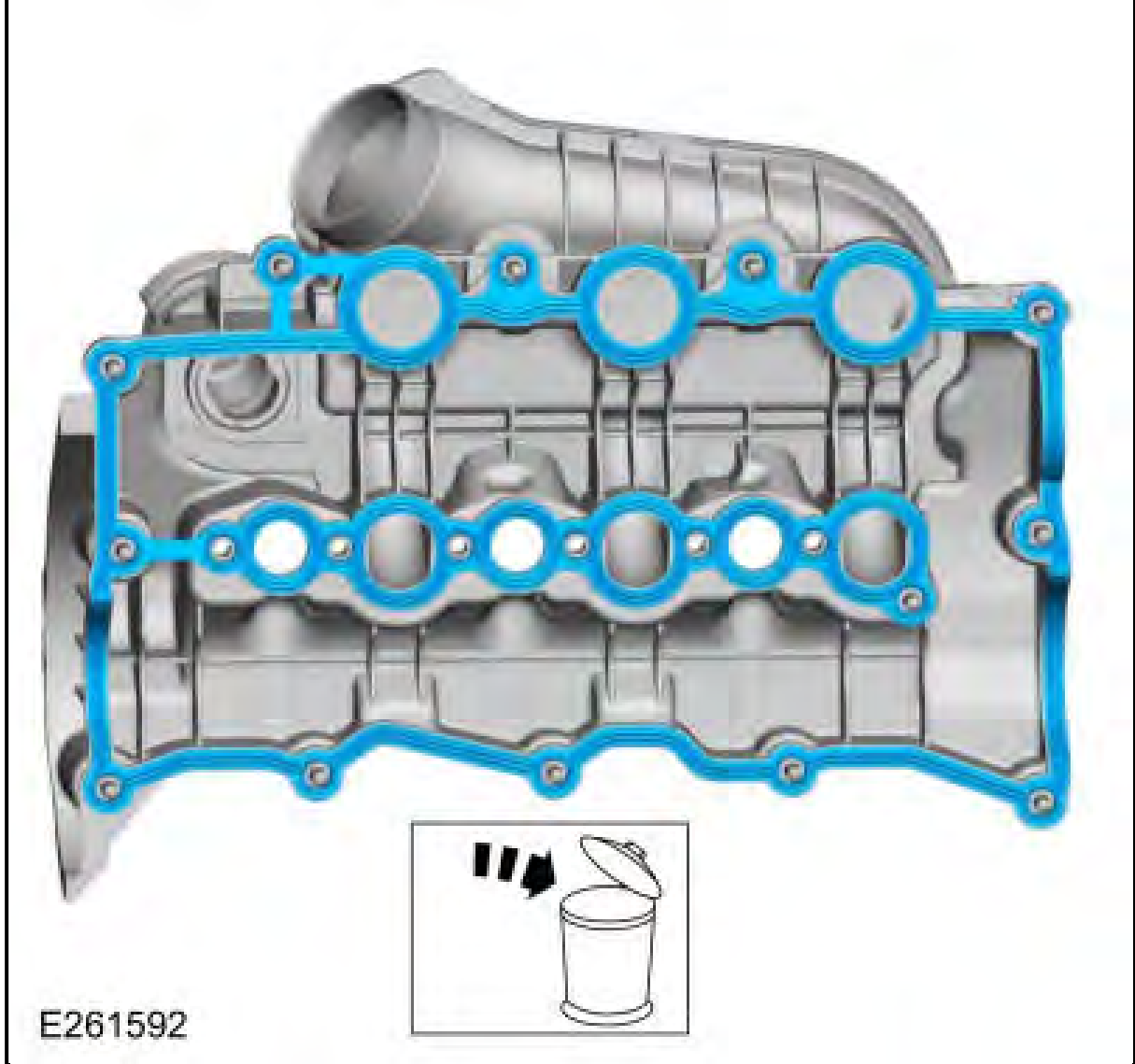


81. Loosen the fasteners and remove the RH valve cover.



82. Remove and discard the RH valve cover gasket.





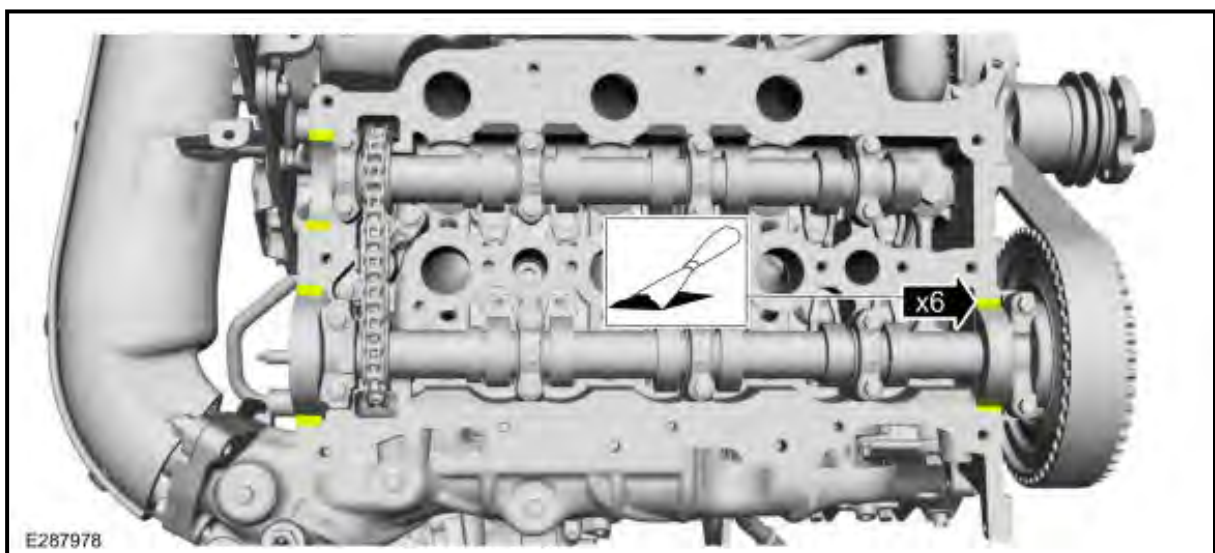
83. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.

Clean the valve cover mating surface of the cylinder head and engine front cover. REFER to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

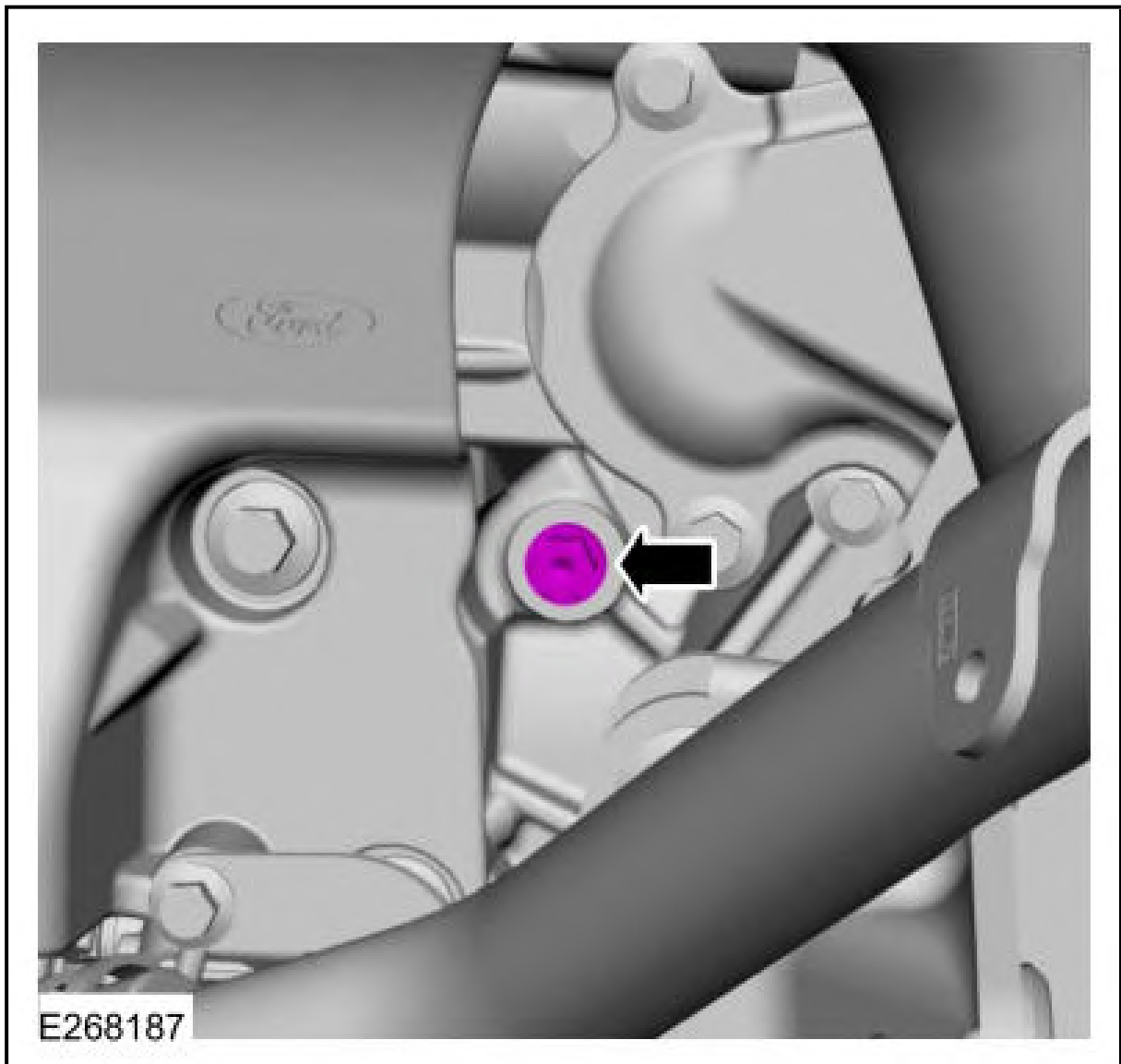
Material: Motorcraft <sup>®</sup> Silicone Gasket Remover / ZC-30-A

Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B



84. Remove the timing pin bolt at the left front of the engine.



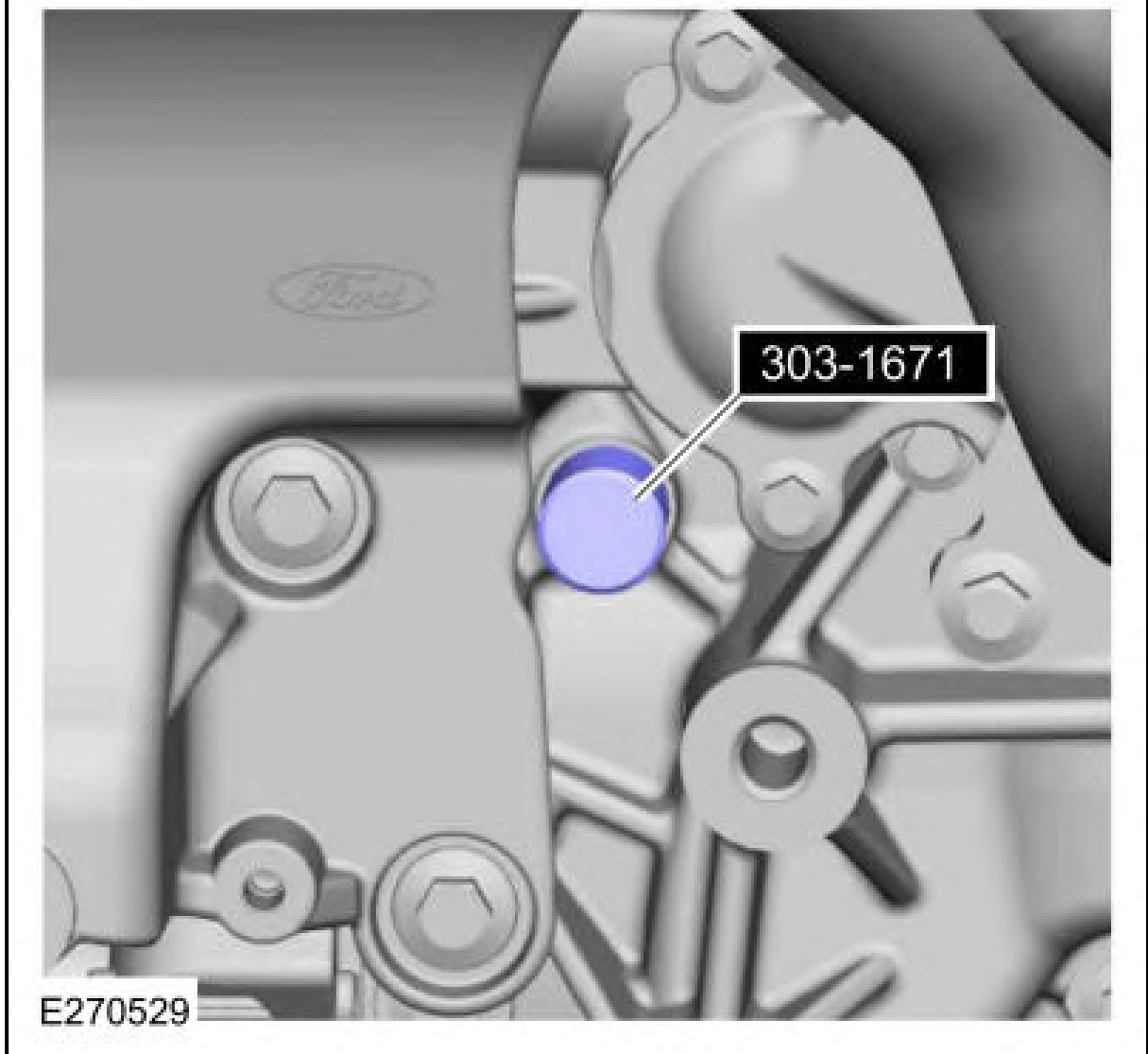
85. Install special tool.

- **NOTE:** Only rotate the crankshaft clockwise.
- NOTE:** Verify that the camshaft timing holes are aligned with the cylinder head.
- NOTE:** The Locking Crankshaft Pin must be bottomed out against the cylinder block.

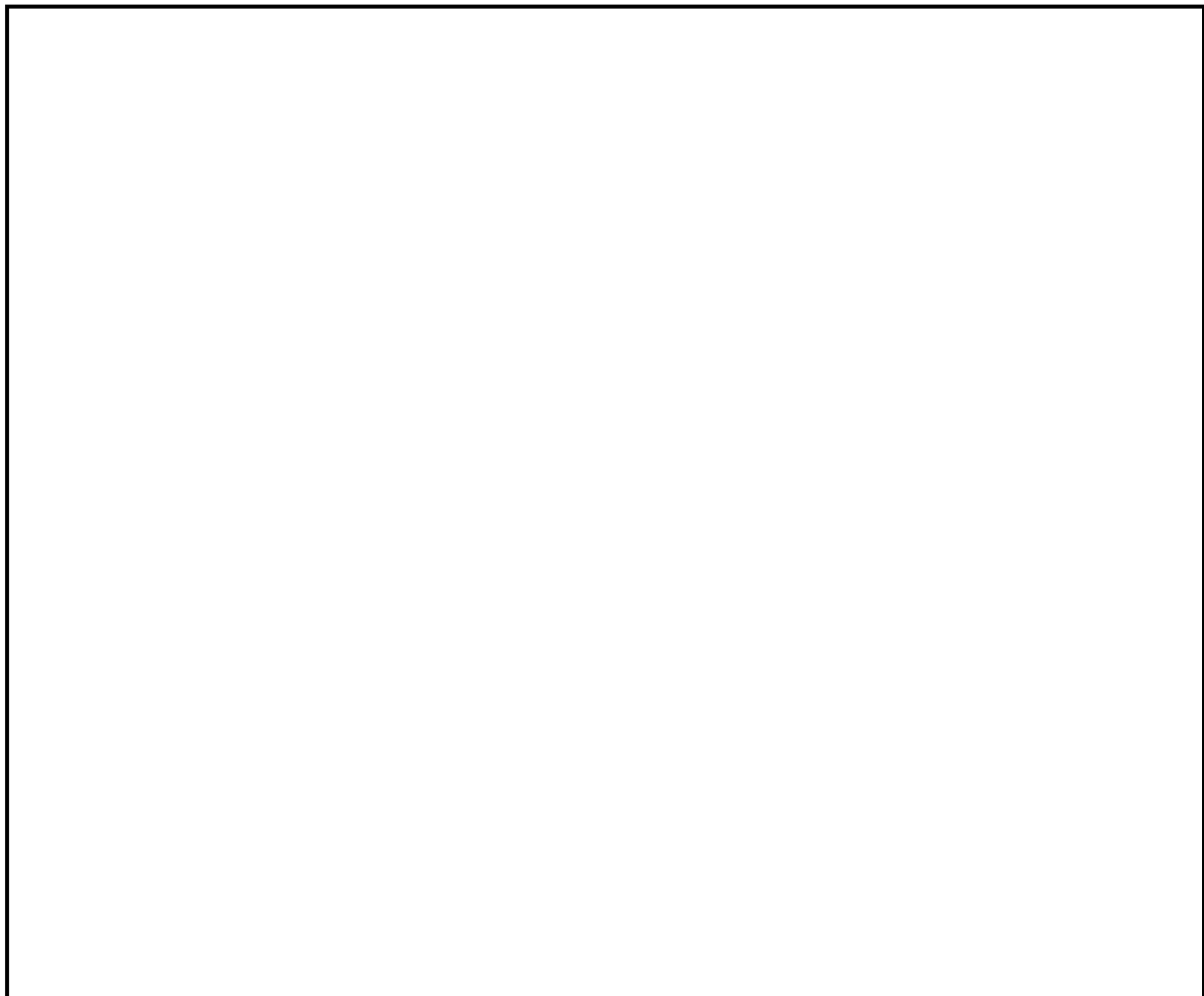
Rotate the crankshaft clockwise so the crankshaft contacts the locking crankshaft pin. Use Special Service Tool: 303-1671 Pin, Locking Crankshaft.

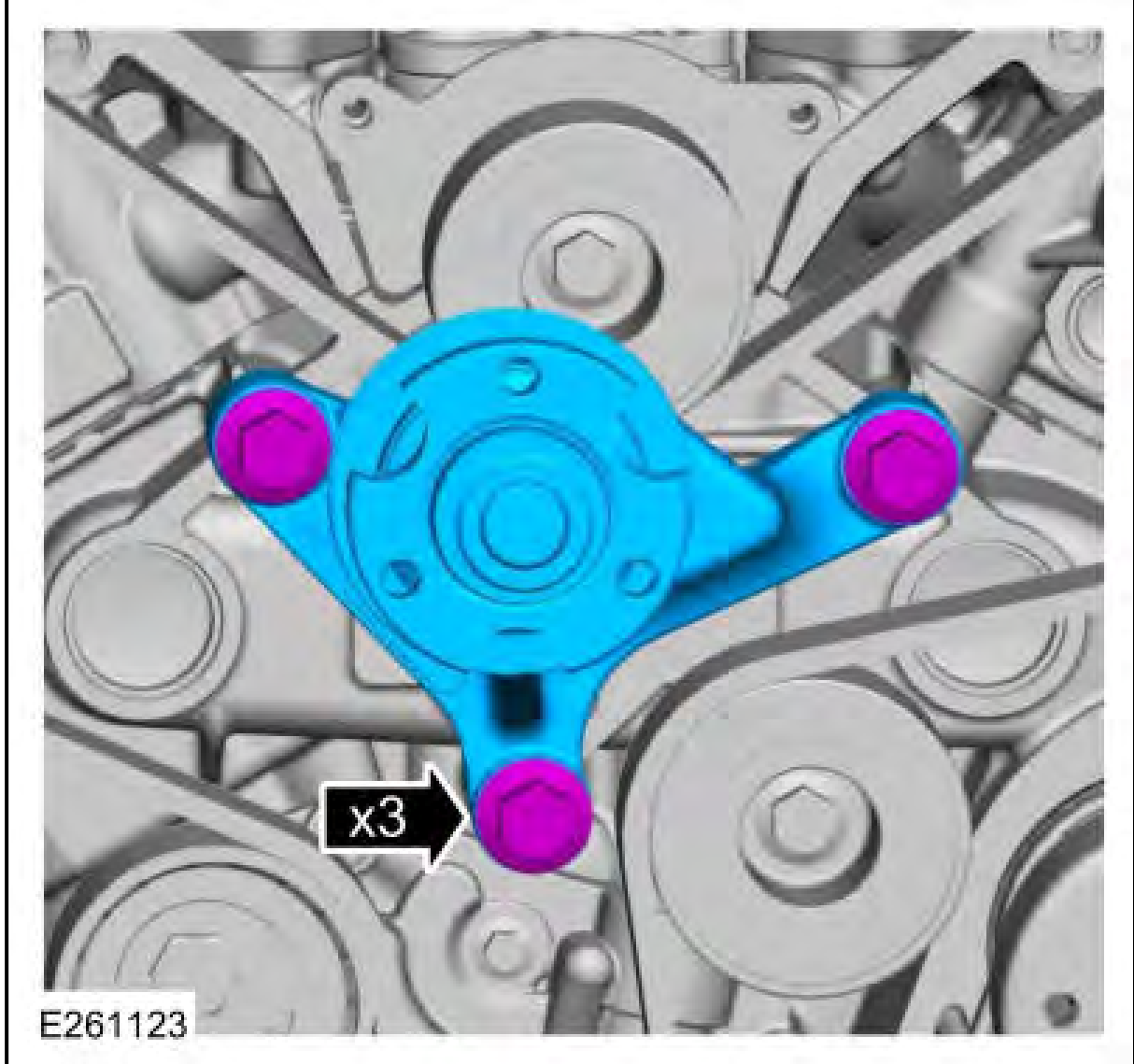






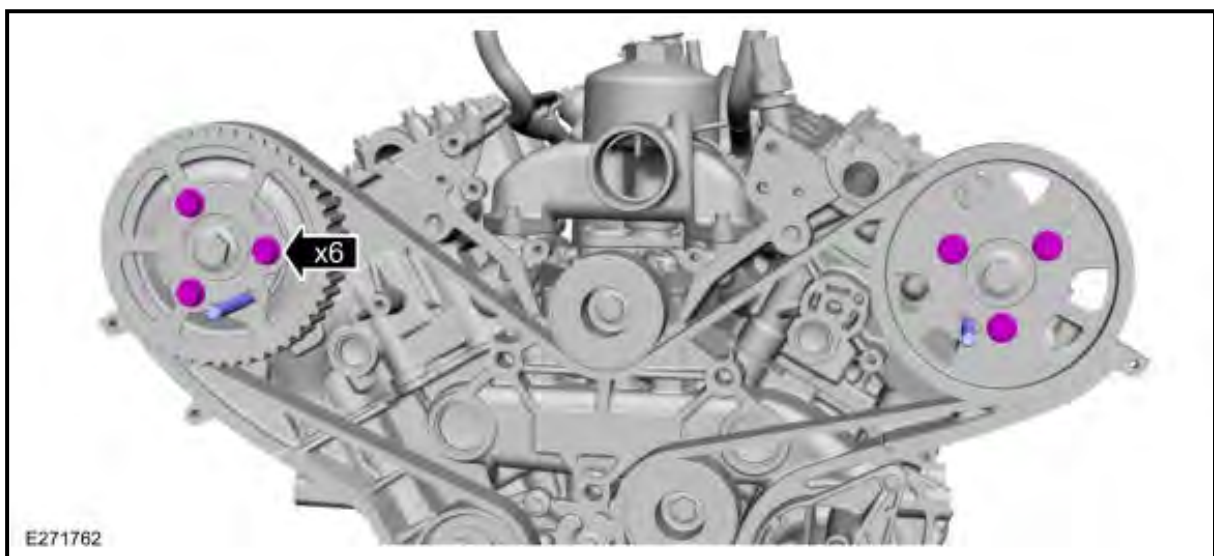
86. Remove the bolts and the fan drive.





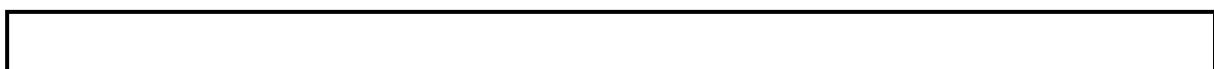
87.

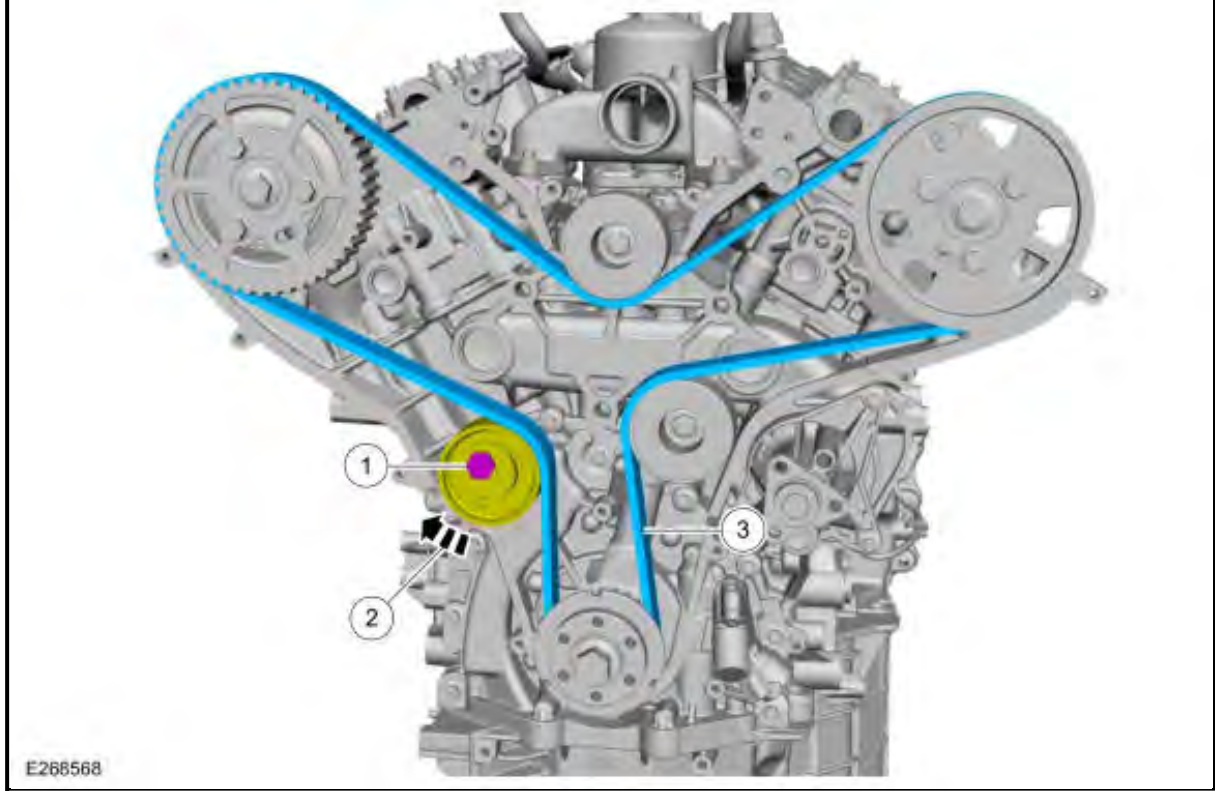
- Using the special tools, verify the camshaft timing. Use Special Service Tool: 303-1670 Pins, Camshaft Locking.
- Loosen the bolts on the camshaft pulleys.



88.

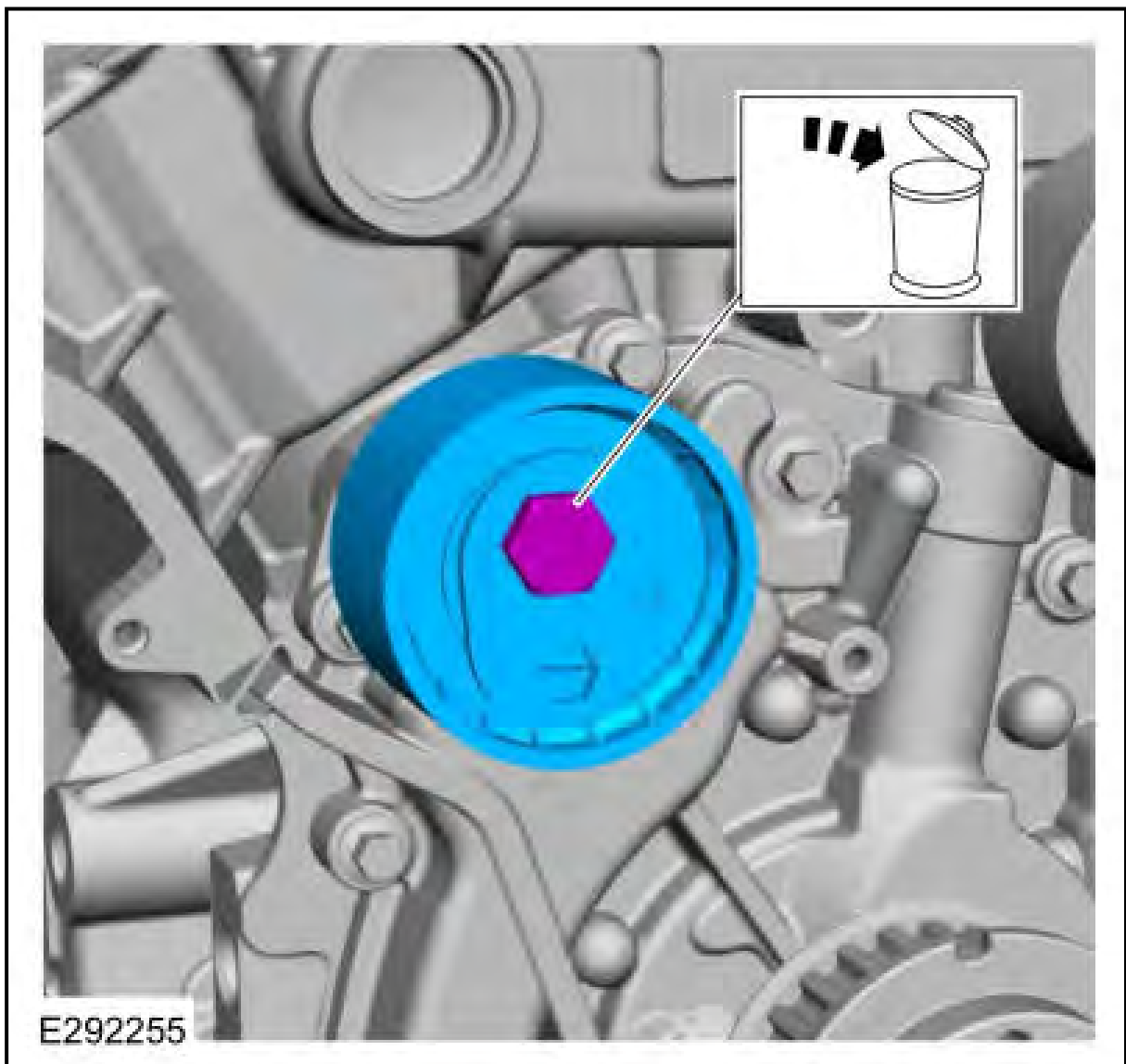
1. Loosen the timing belt tensioner bolt.
2. Rotate the timing belt tensioner clockwise.
3. Remove the timing belt.





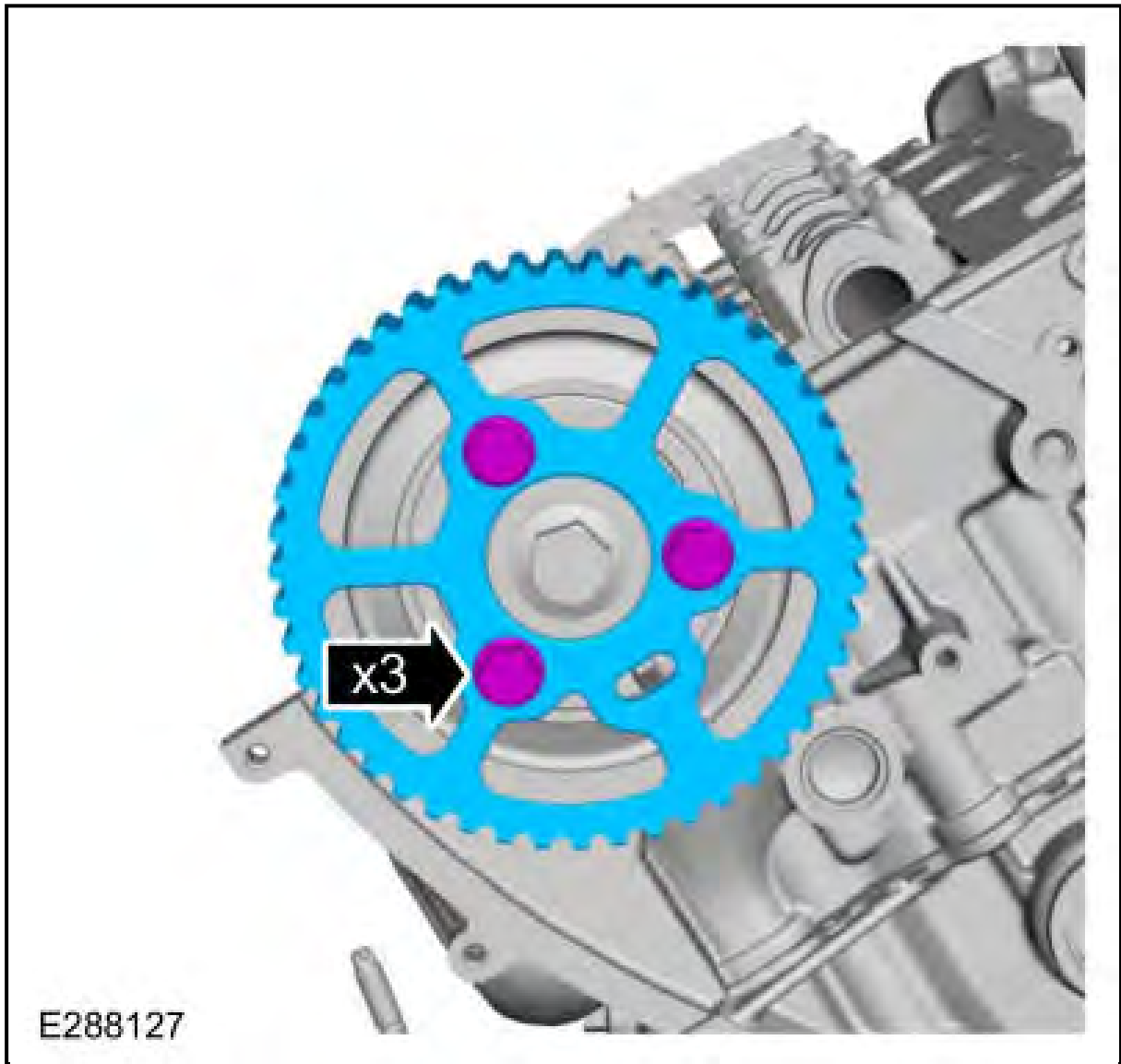
89. **NOTE:** Replace the timing belt tensioner if damage or excessive wear is found.

Remove the bolt and the timing belt tensioner. Discard the bolt.



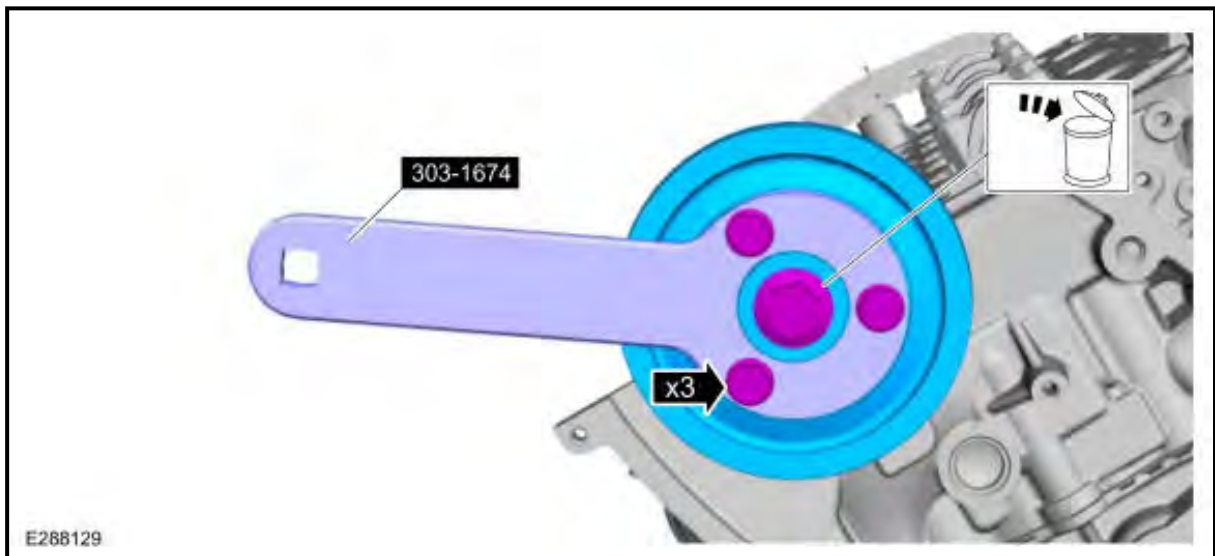
90. **NOTE:** Note the position of the camshaft pulley prior to removal.

Remove the bolts and the RH camshaft pulley.



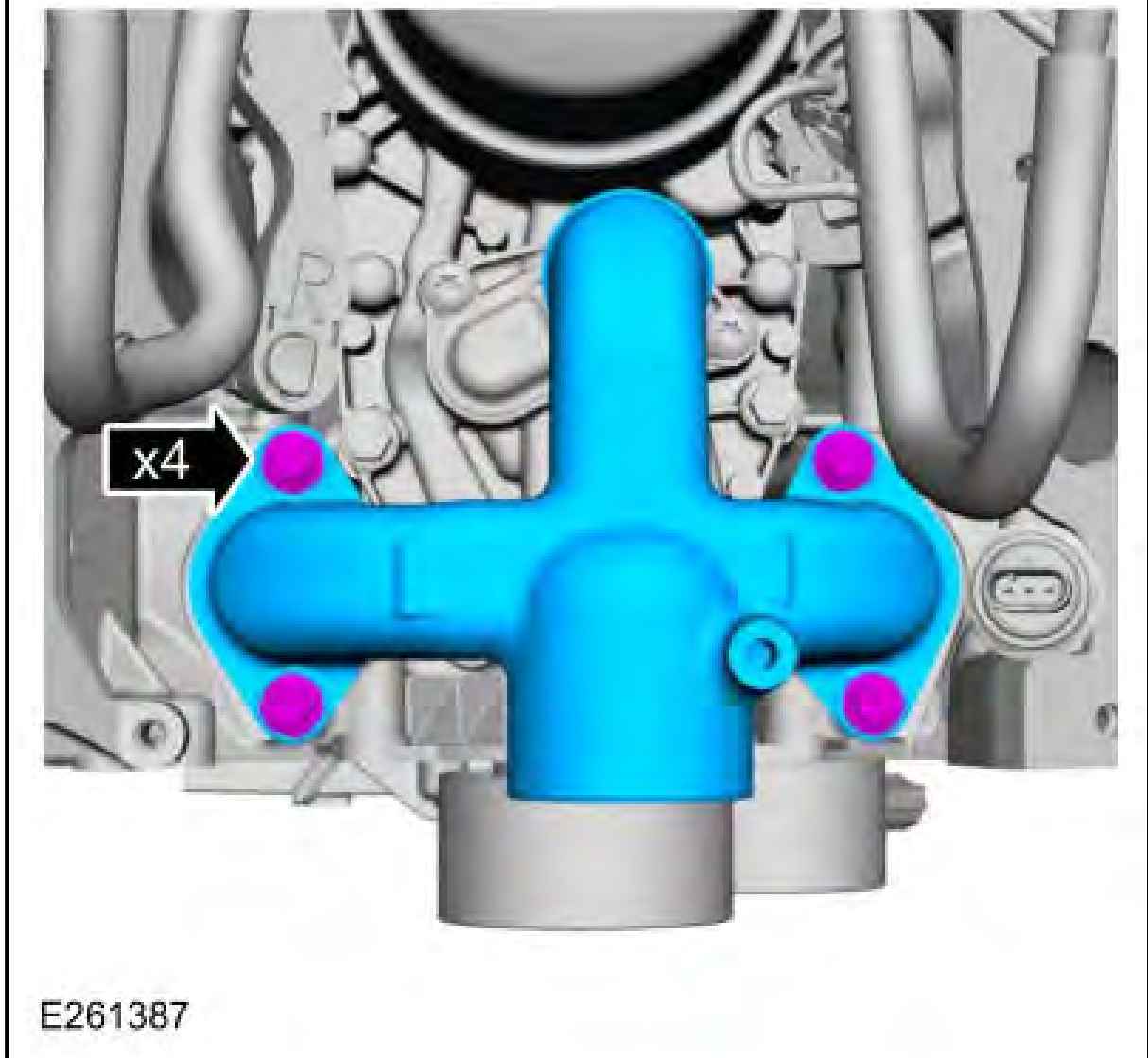
91. **NOTE:** Use the original bolts for the special tool.

Using the special tool, remove the bolts and the RH camshaft gear hub. Discard the bolt. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.

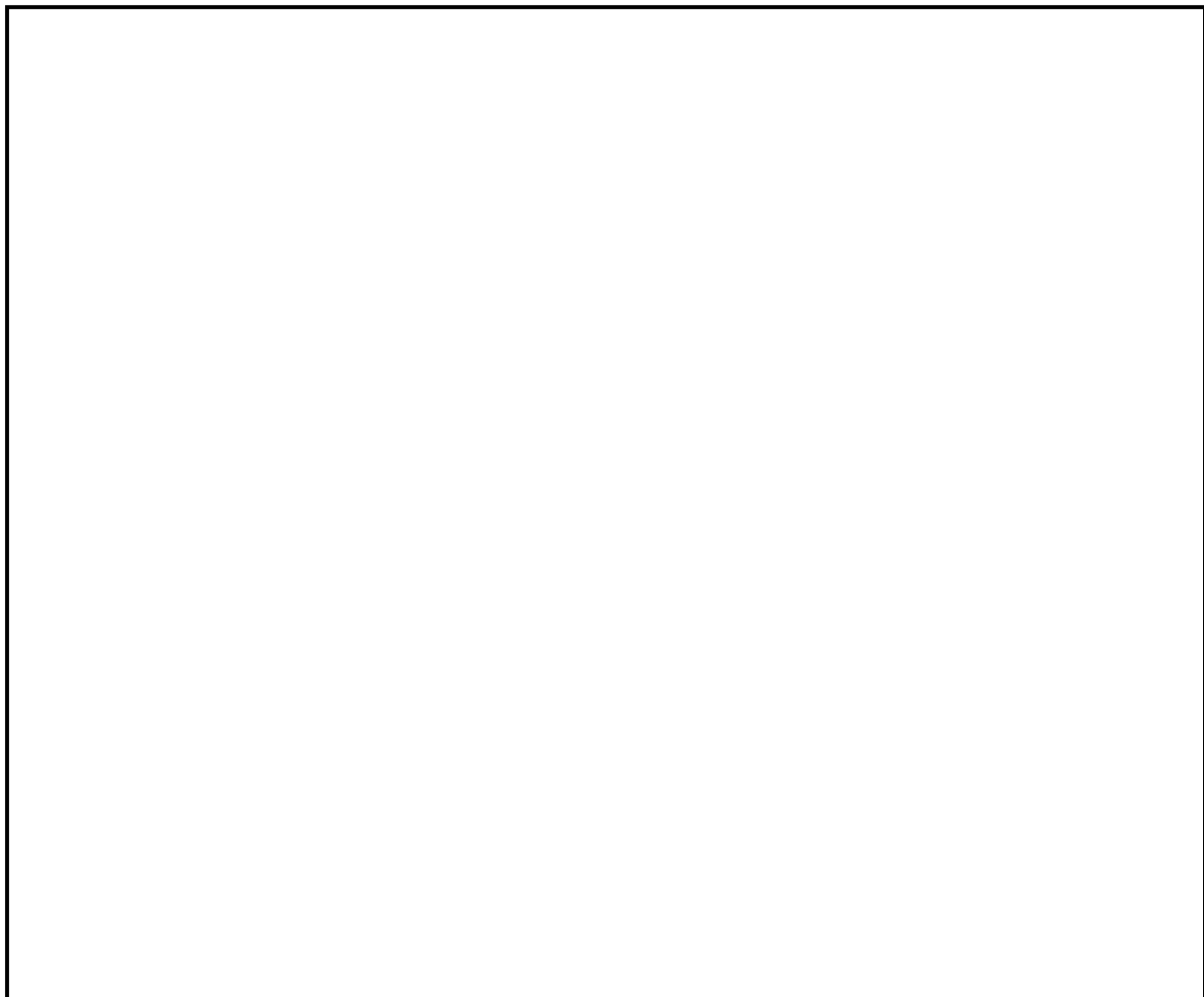


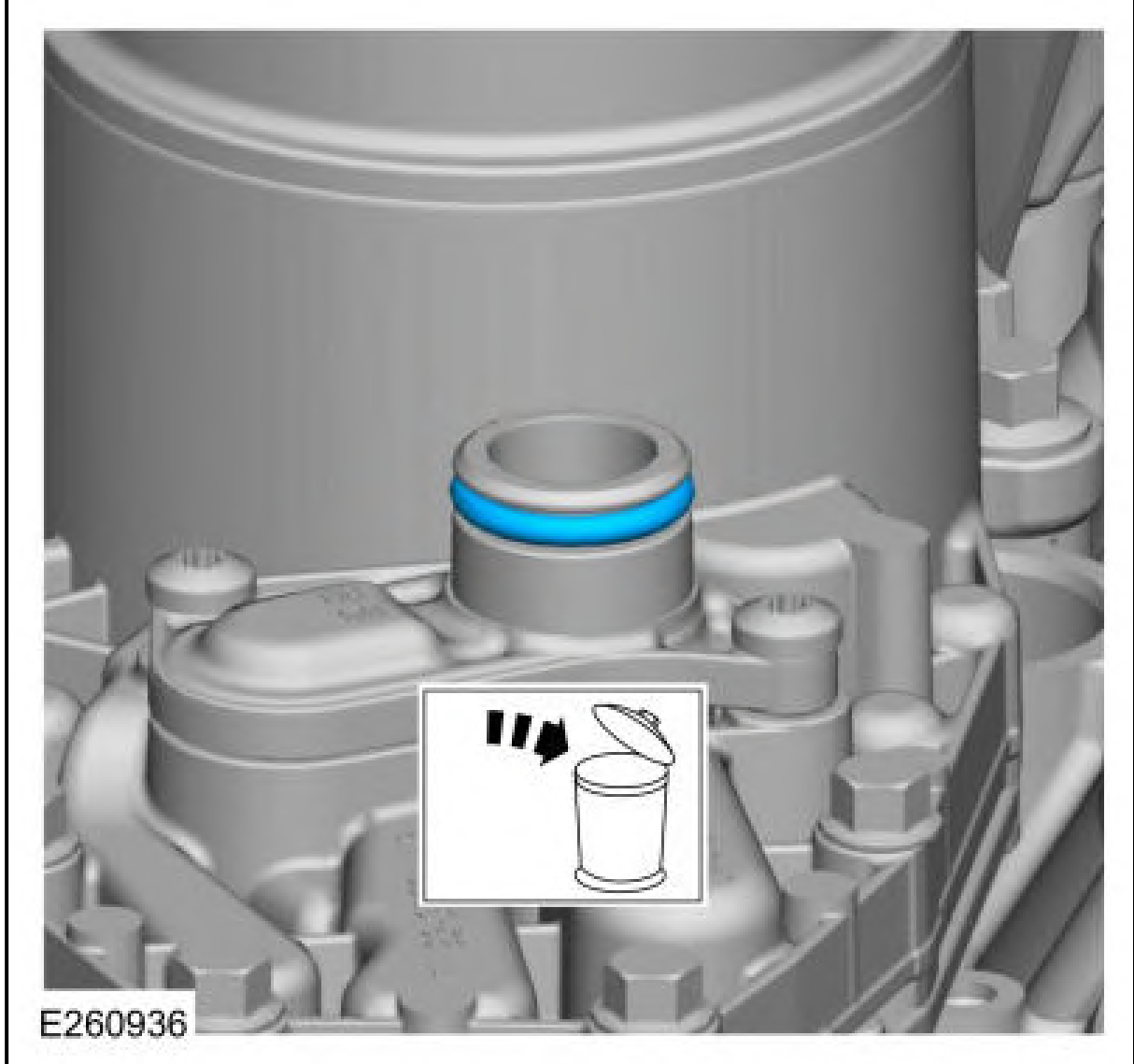
92. Remove the bolts and the coolant outlet connector.



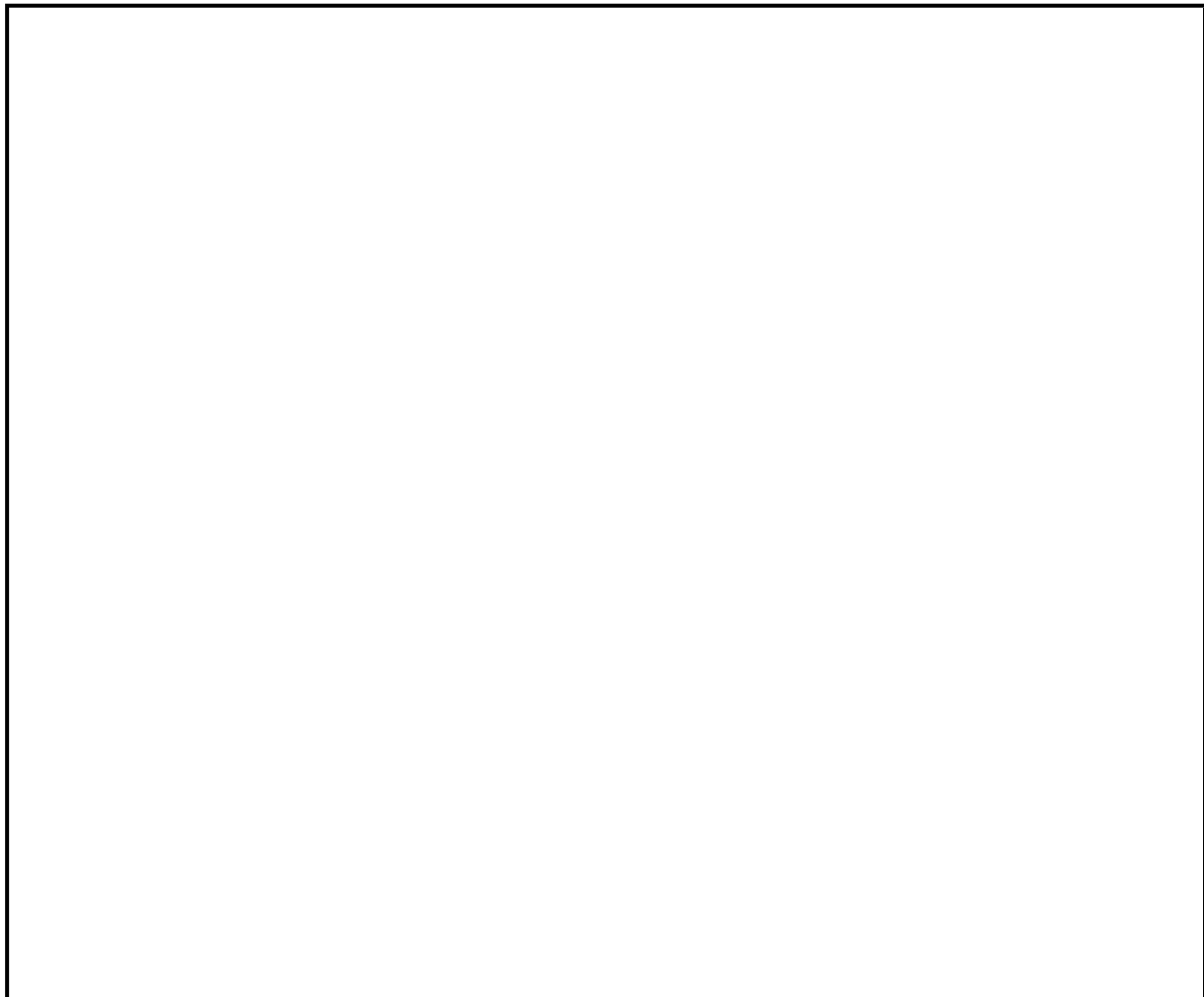


93. Remove and discard the oil cooler O-ring.





94. Remove and discard the coolant outlet connector gaskets.

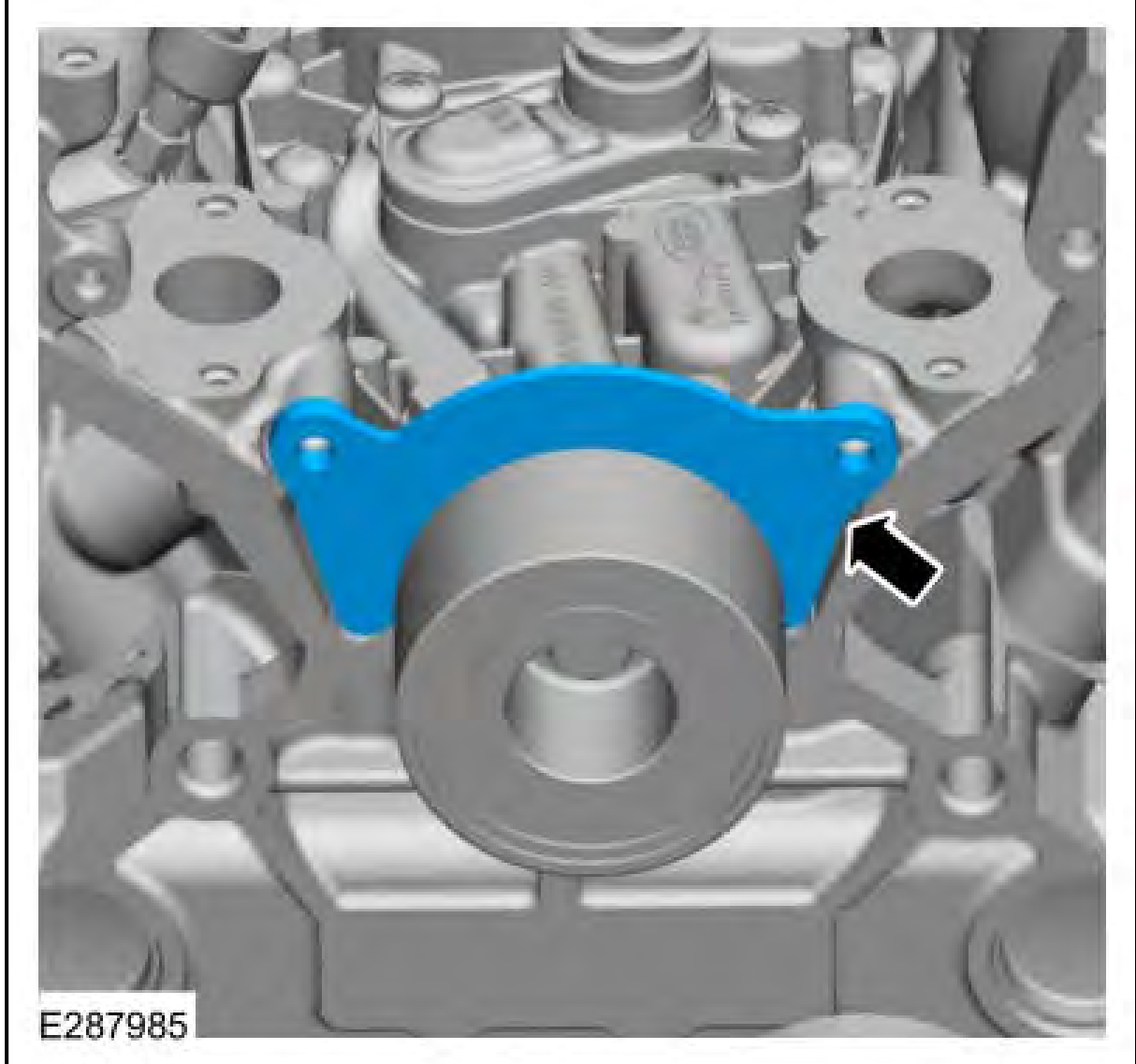




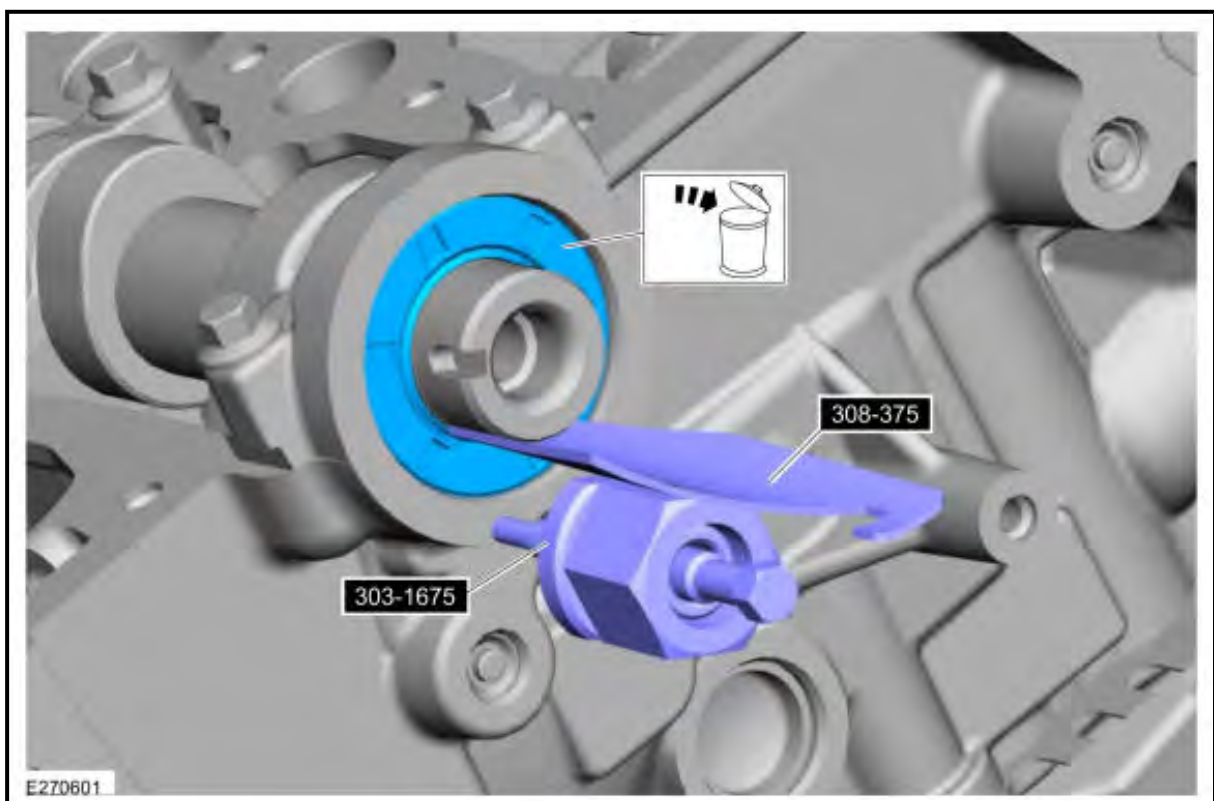
E261045

95. Remove the dust shield.



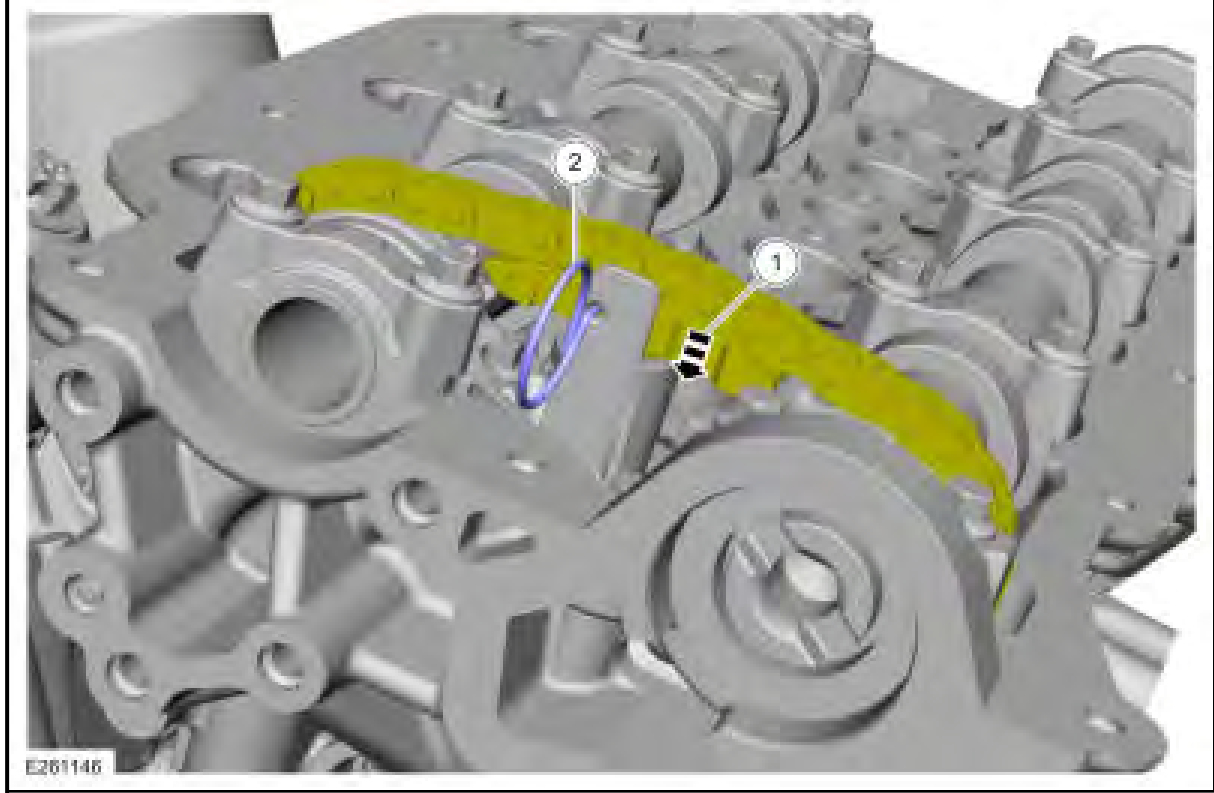


96. Using the special tools, remove and discard the camshaft seals. Use Special Service Tool: 303-1675 Adapter, Seal Remover. , 308-375 Remover, Input Shaft Seal.



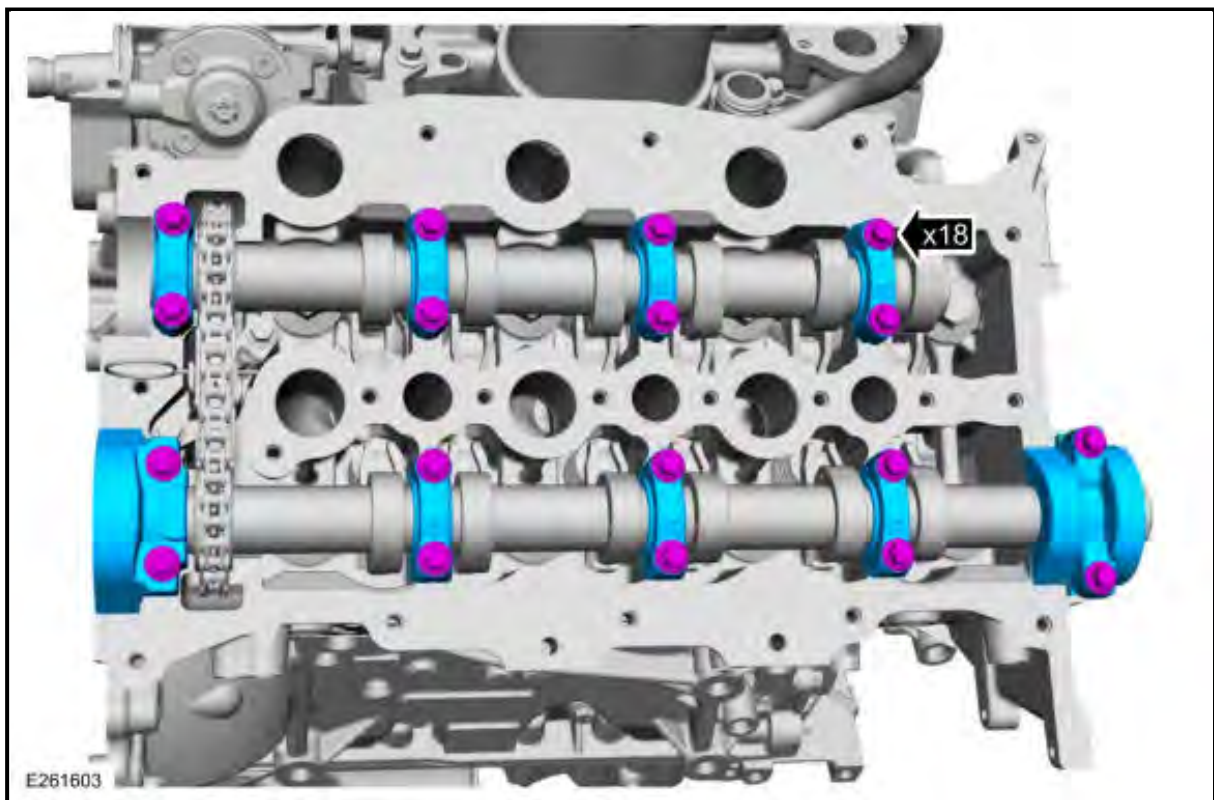
97. Compress the camshaft chain and install the retaining pin.





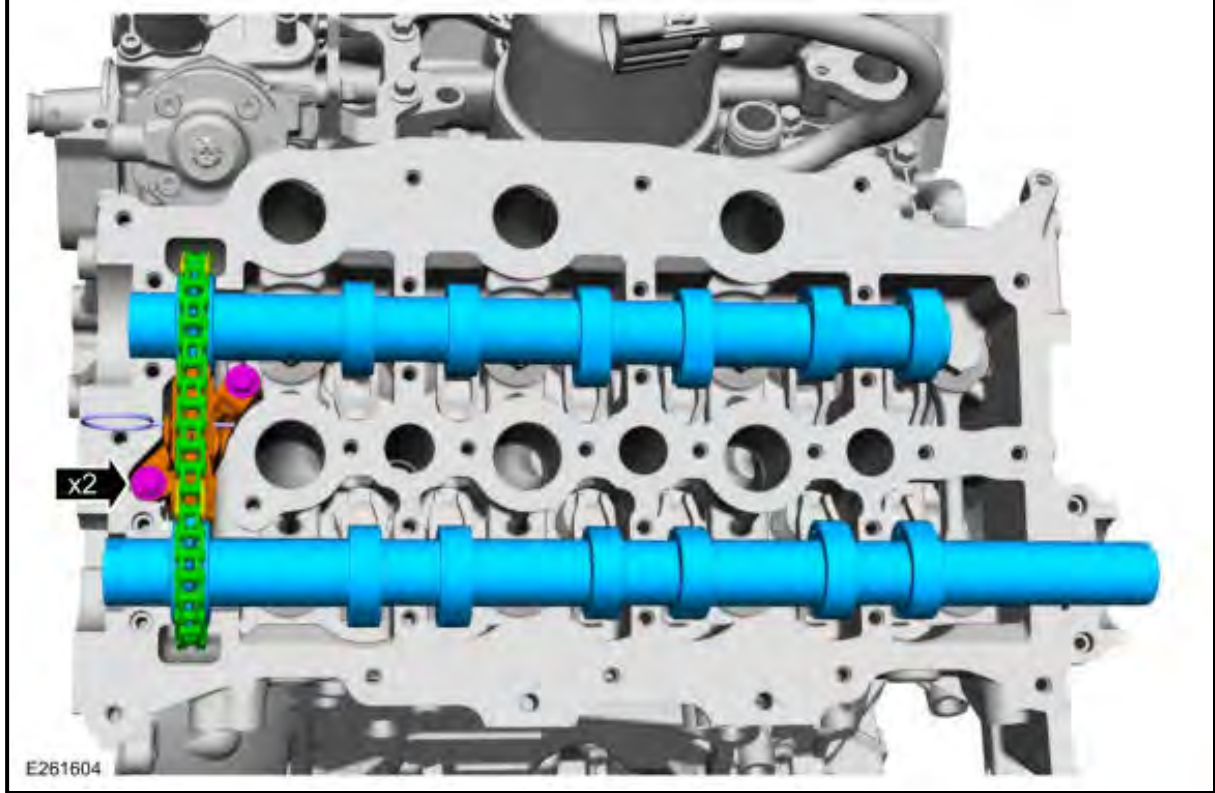
98. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

Remove the bolts and the camshaft bearing caps.



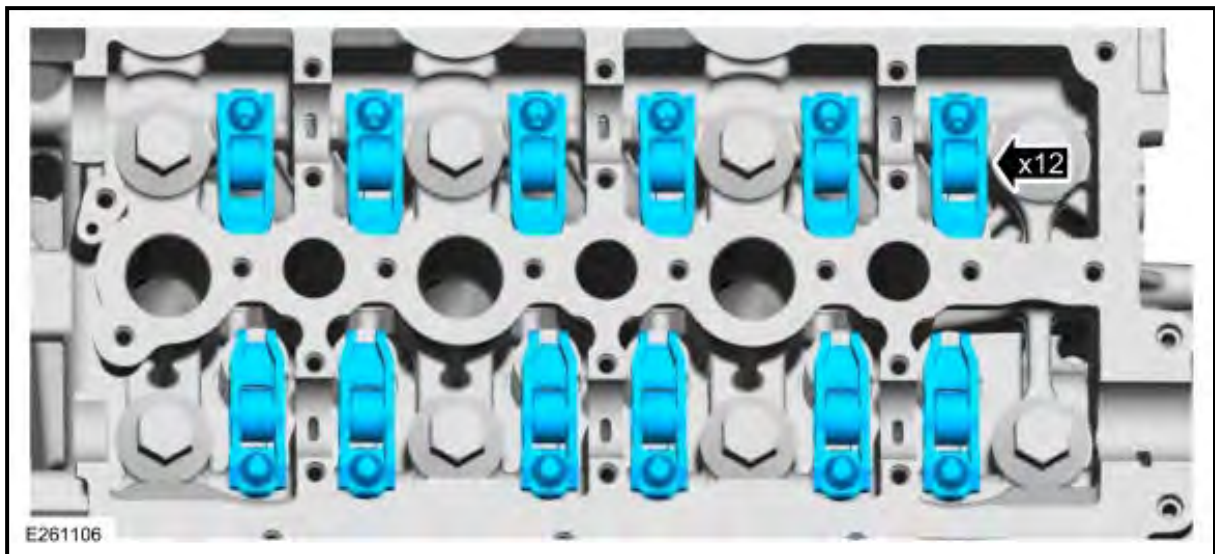
99. Remove the bolts and the RH camshafts, camshaft chain and the secondary timing chain tensioner.





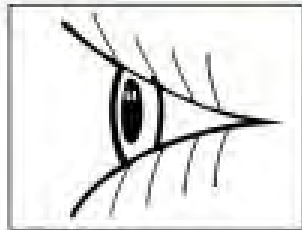
100. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

Remove the RH camshaft roller follower and hydraulic lash adjuster assemblies.



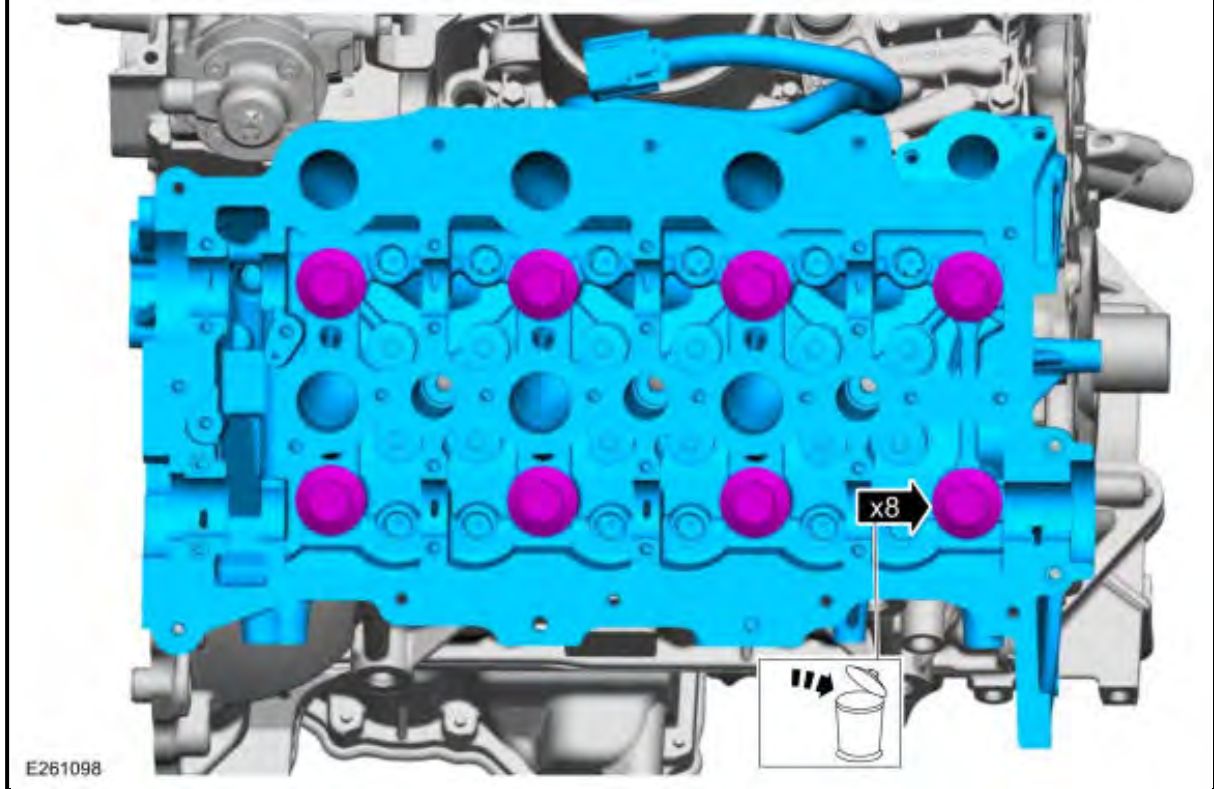
101. Inspect the hydraulic lash adjuster and roller follower for damage. If any damage is found, inspect the camshaft lobes and valves for damage. Replace damaged components as necessary.



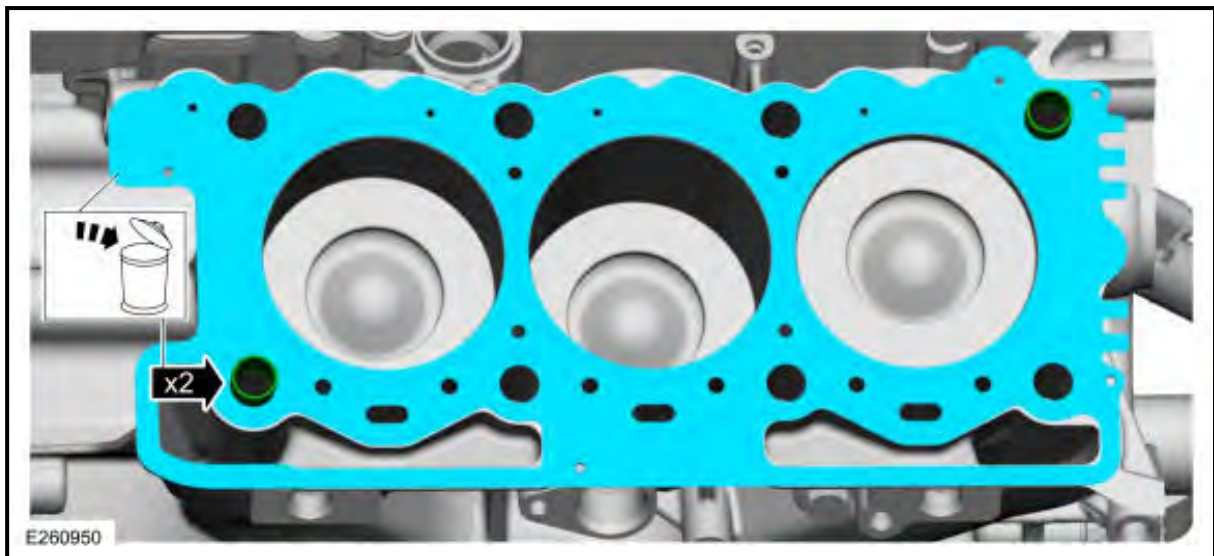


E260940

102. **NOTE:** Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may 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:** The glow plugs protrude past the lower face of the cylinder head, any impact on the tip of the glow plug may result in glow plug damage.
- NOTE:** The cylinder head bolts must be discarded and new bolts must be installed. They are tighten-to-yield designed and cannot be reused.
- Remove and discard the bolts from the RH cylinder head.
  - Remove the cylinder head.



103. Remove and discard the RH cylinder head gasket and the cylinder head dowels.



104. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

**NOTE:** Observe all warnings or cautions and follow all application directions contained on the packaging.

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

Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B

105. Check the cylinder head distortion. REFER to: [Cylinder Head Distortion](#) .

106. Check the cylinder block distortion. REFER to: [Cylinder Block Distortion](#) .

## CYLINDER HEAD - BODY ON - LH

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

## Materials

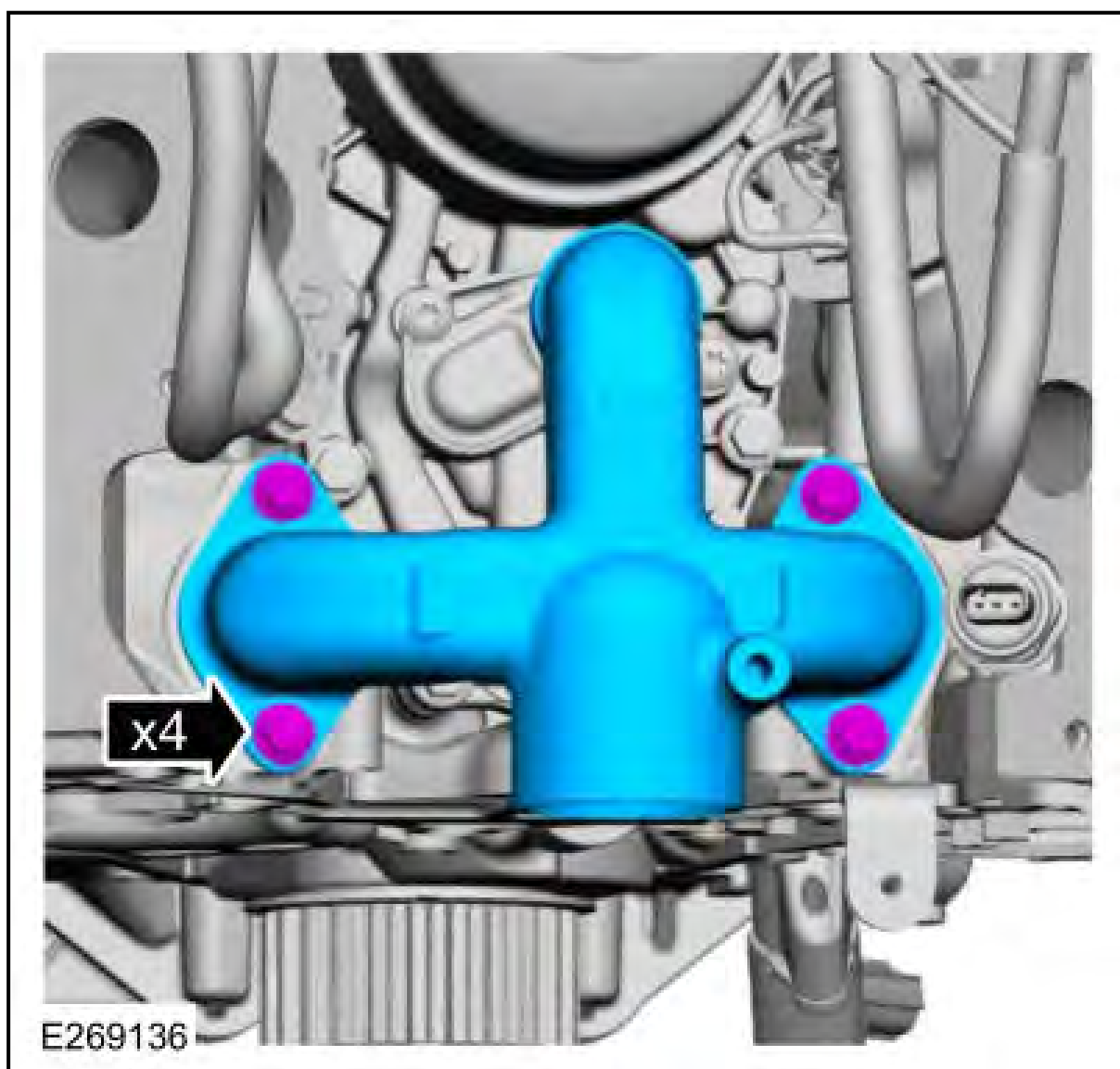
| Name  | Specification |
|---|---------------|
| Motorcraft $\hat{A}$ ® Silicone Gasket Remover ZC-30-A  | -             |
| Motorcraft $\hat{A}$ ® Metal Surface Prep Wipes ZC-31-B | -             |

**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.

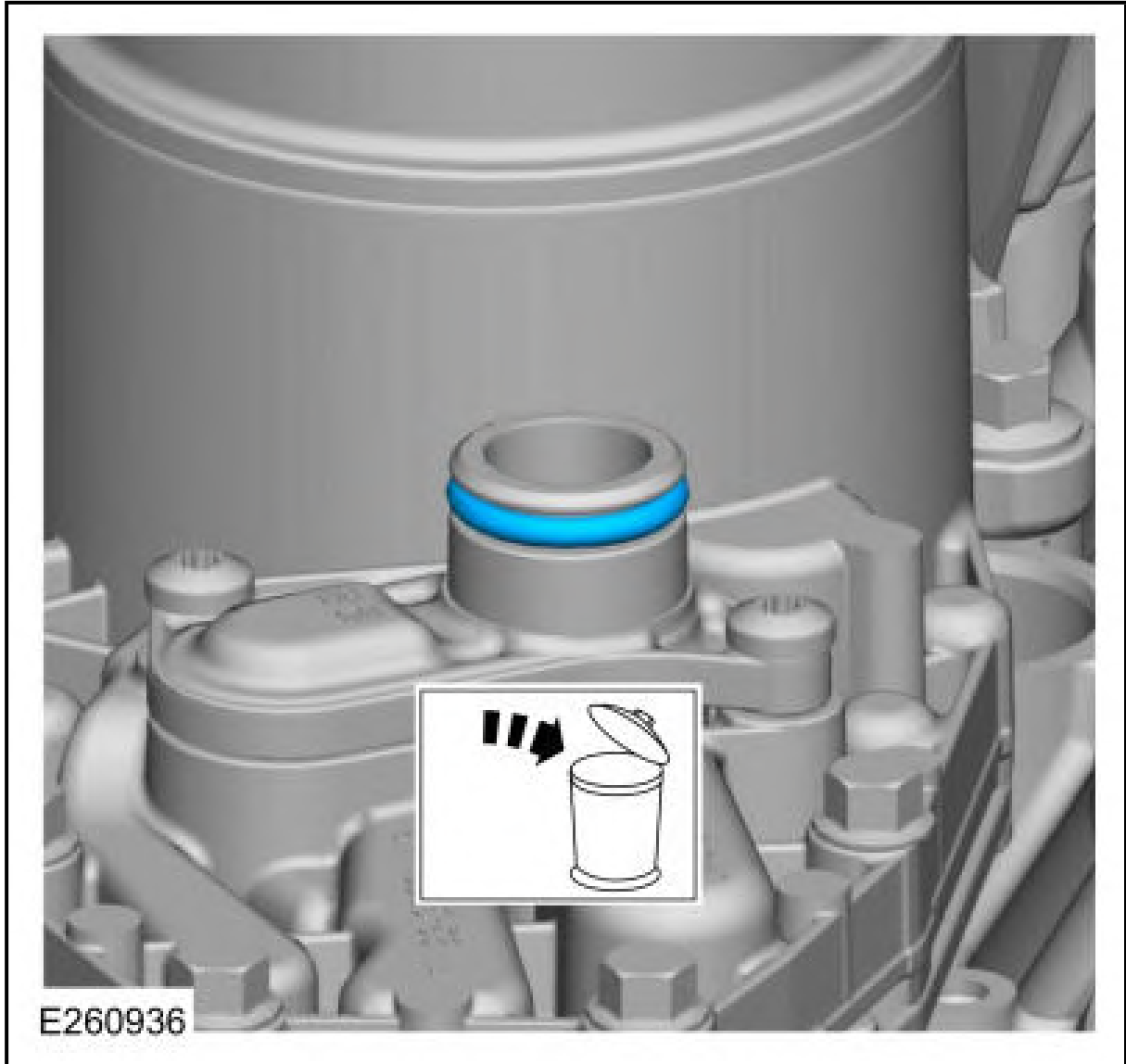
**NOTE:** Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

**NOTE:** It is recommended that this component be serviced with the vehicle body removed. If the vehicle body can be removed, refer to [Cylinder Head - Body Off - LH](#) or [Cylinder Head - Body Off - RH](#).

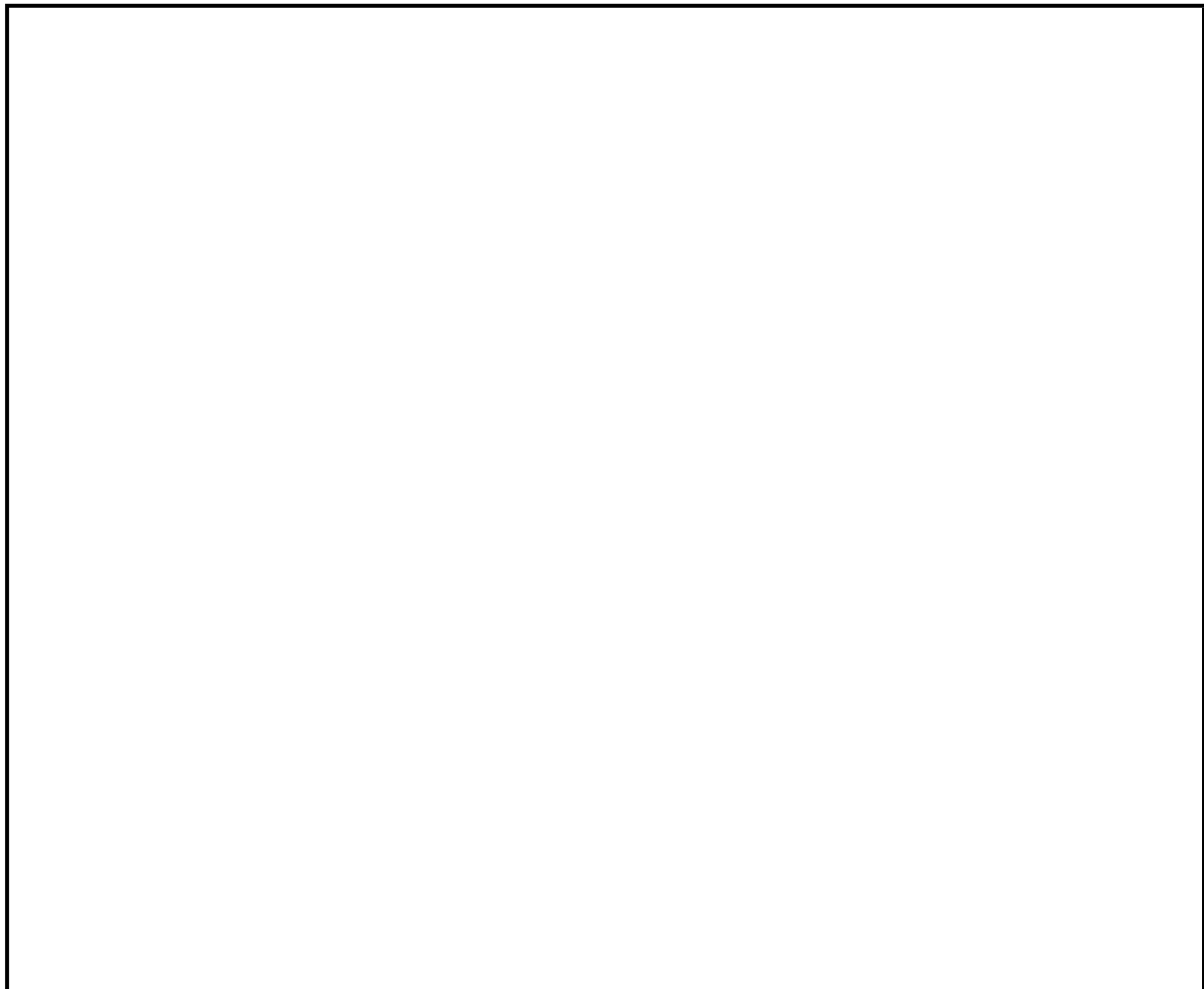
1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Remove the following items:
  1. Remove the LH camshafts. REFER to: [Camshaft LH](#) .
  2. Remove the exhaust crossover pipe. REFER to: [Exhaust Crossover Pipe](#) .
3. Remove the bolts and the coolant outlet connector.



4. Remove and discard the oil cooler O-ring.



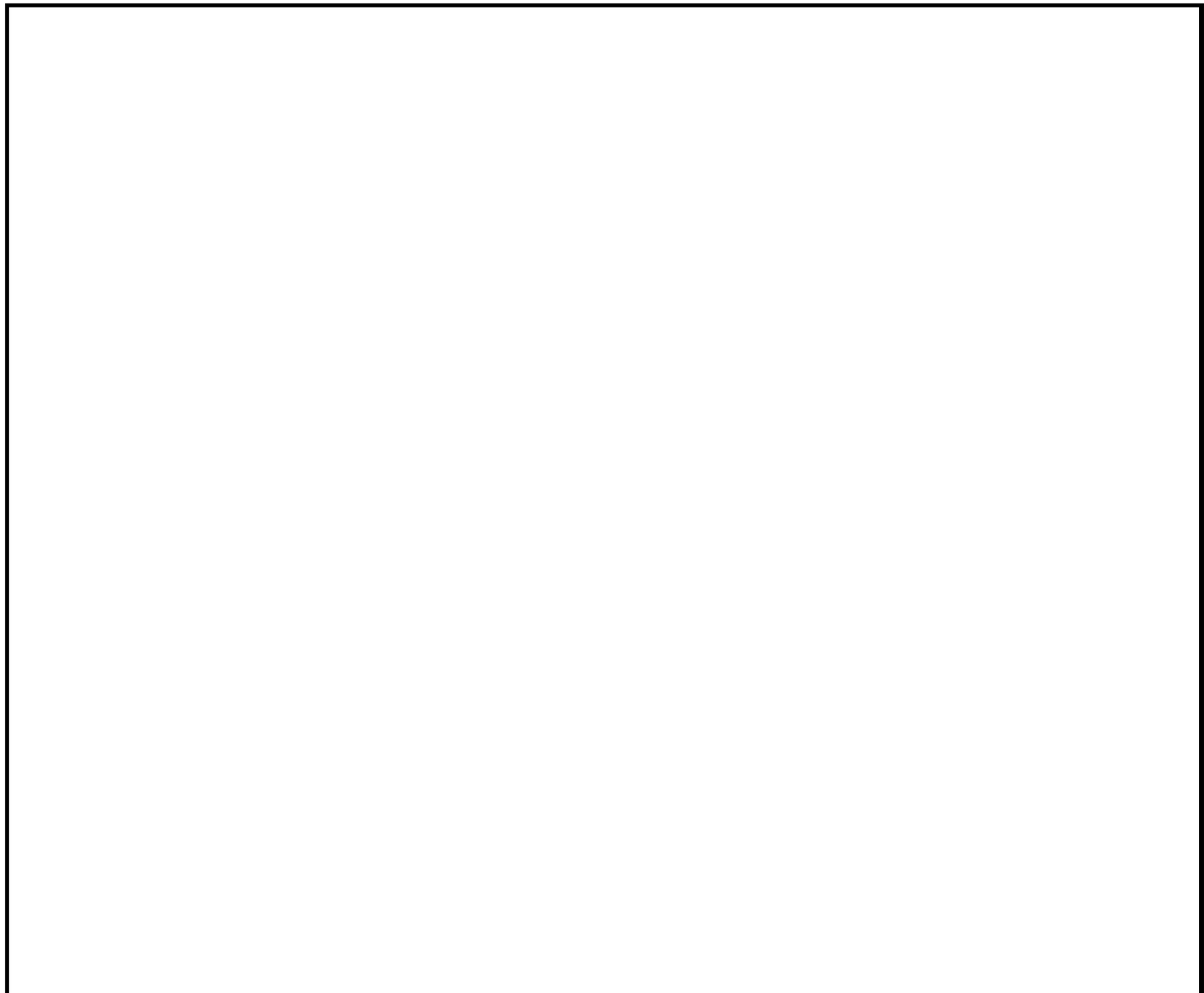
5. Remove and discard the coolant outlet connector gaskets.

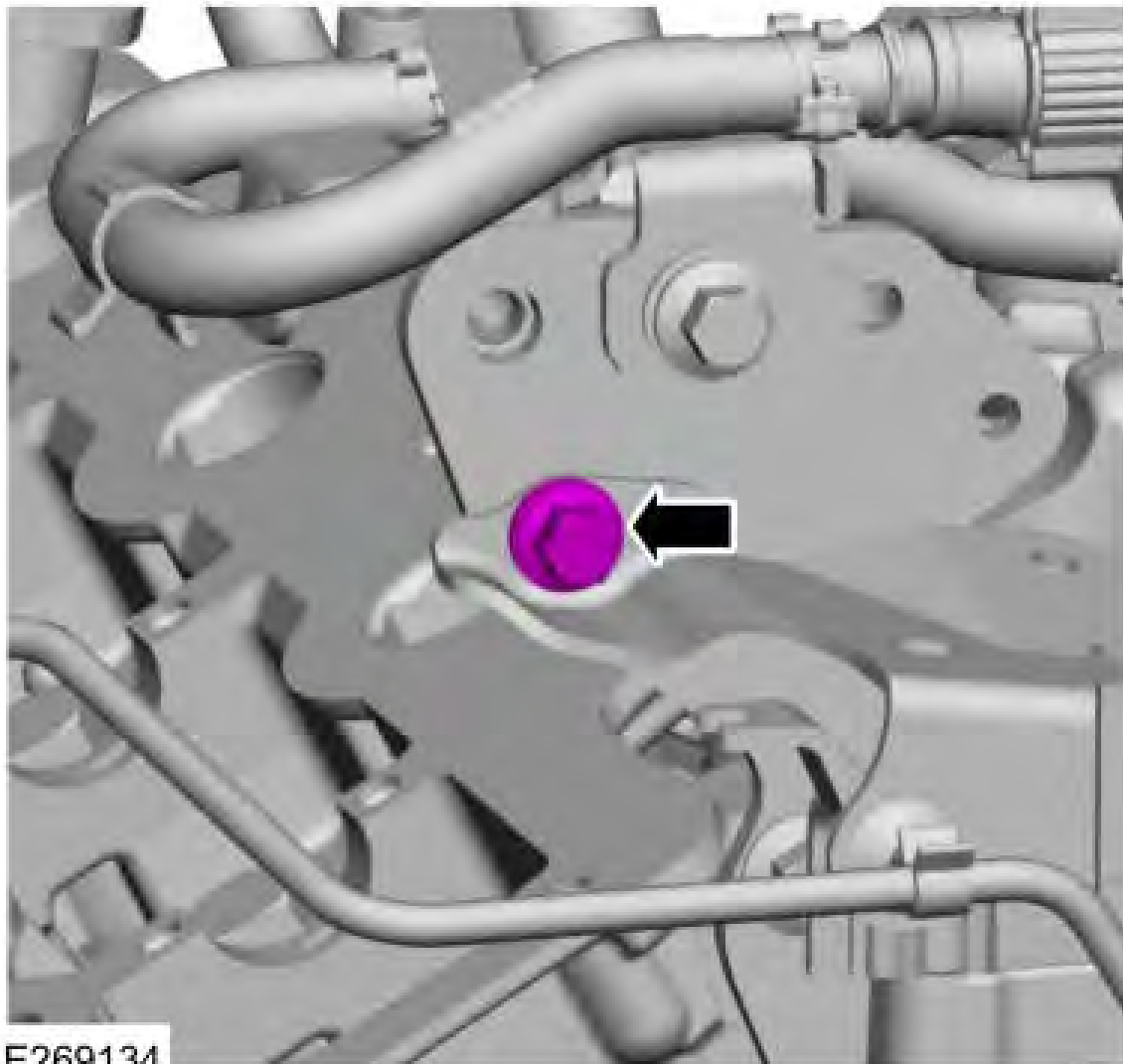




E261045

6. Remove the bolt from the bracket.

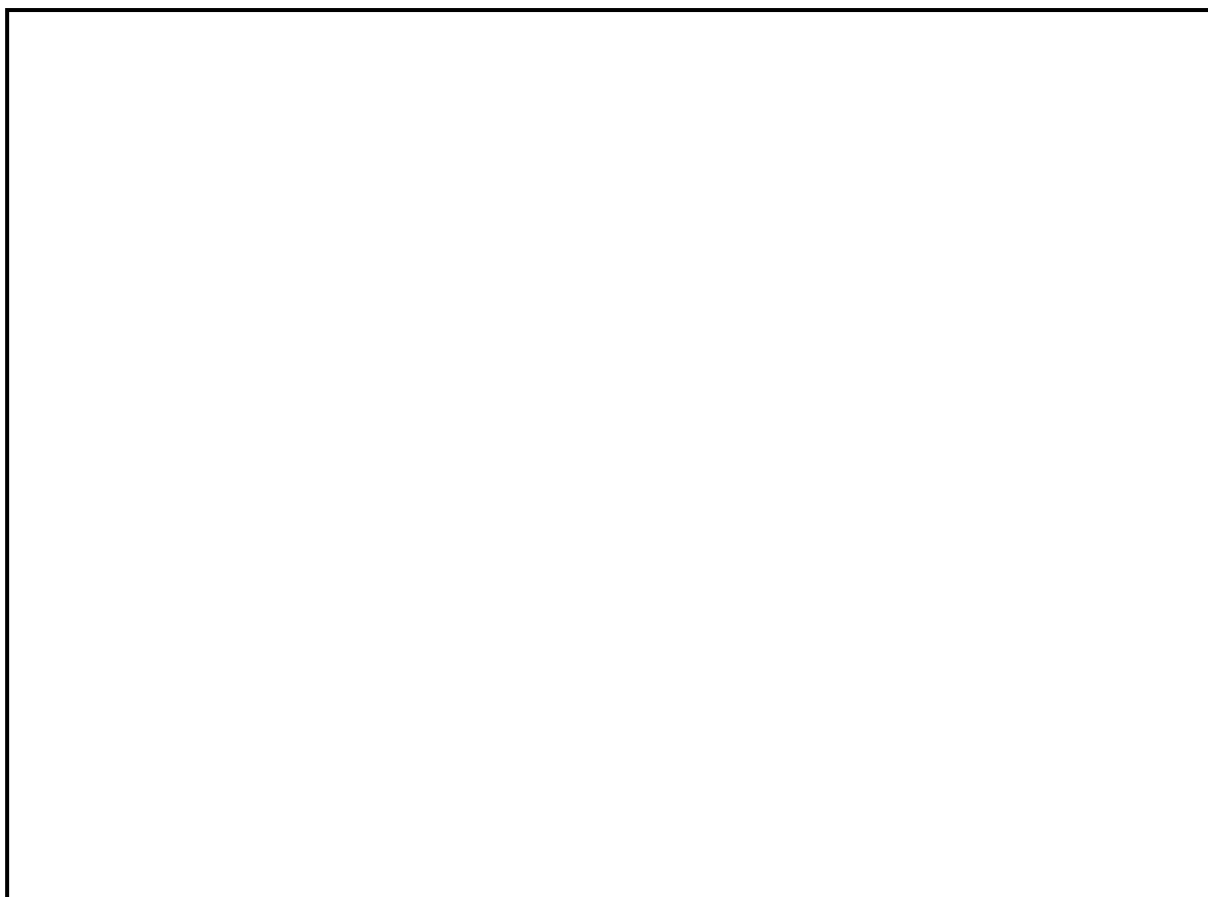




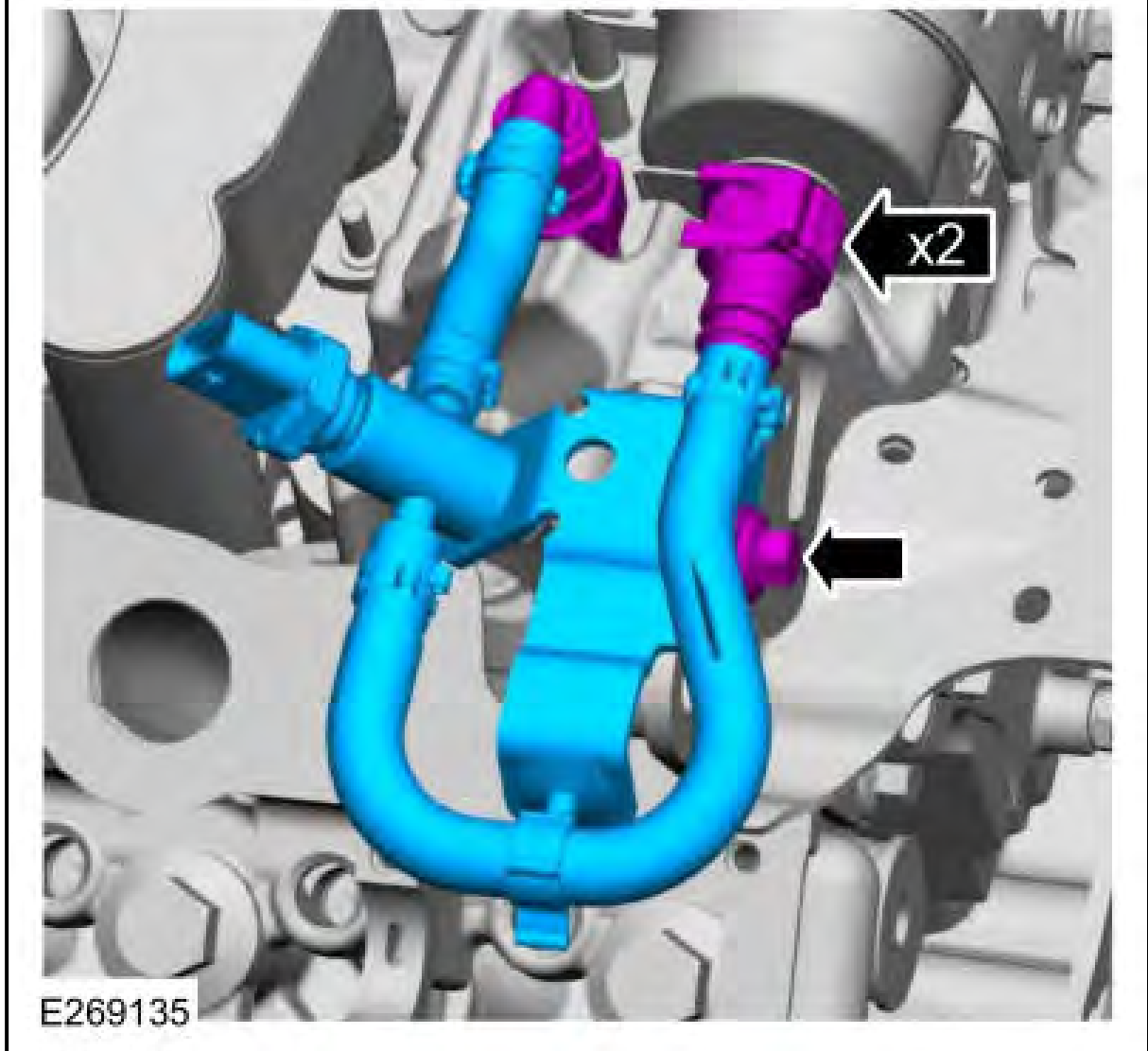
E269134

7.

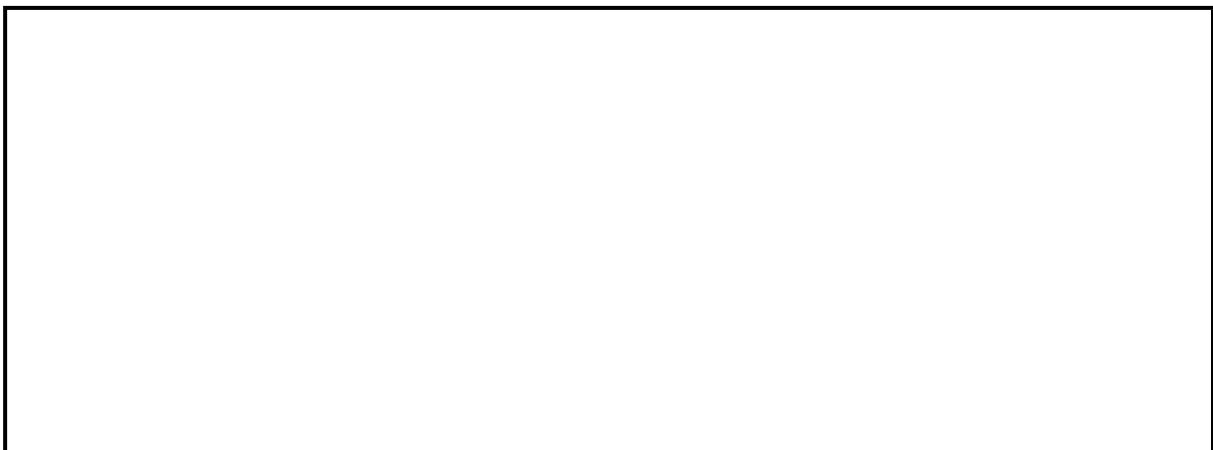
- Disconnect the fuel line connectors. REFER to: [Quick Release Coupling](#) .
- Remove the bolt and the fuel line.

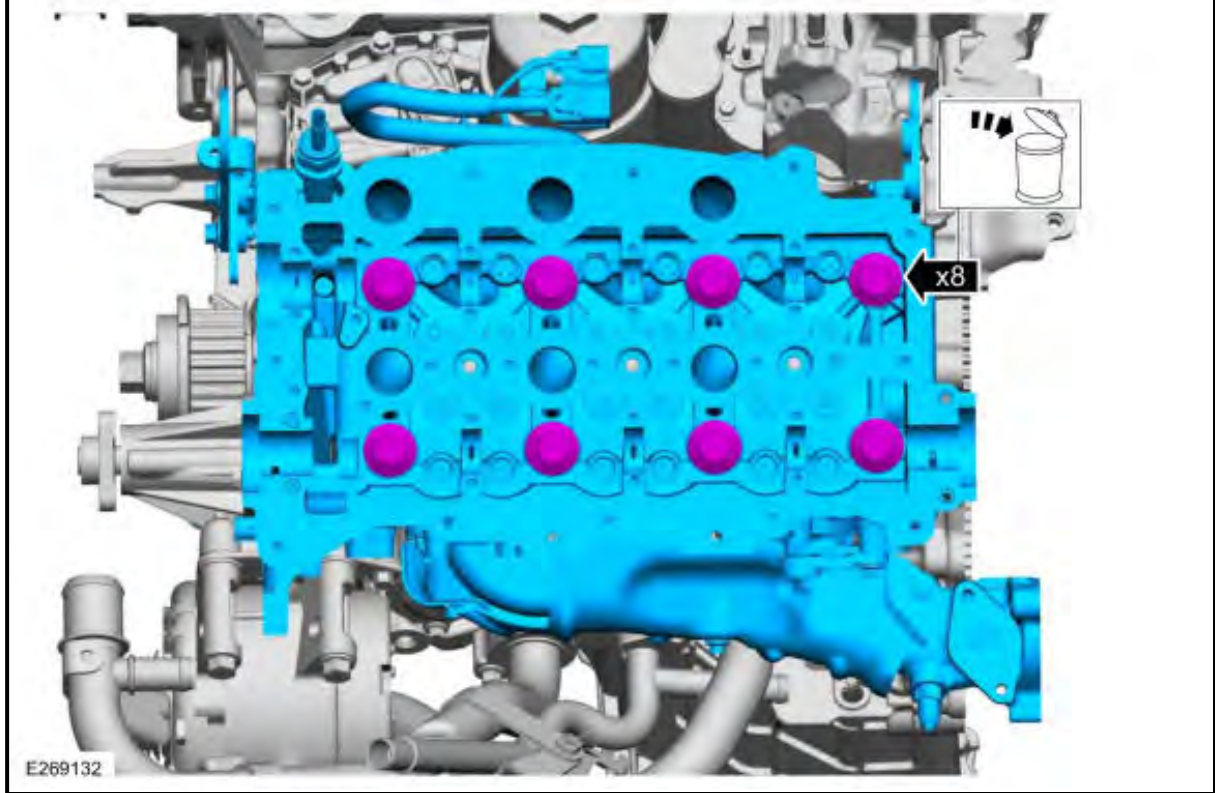




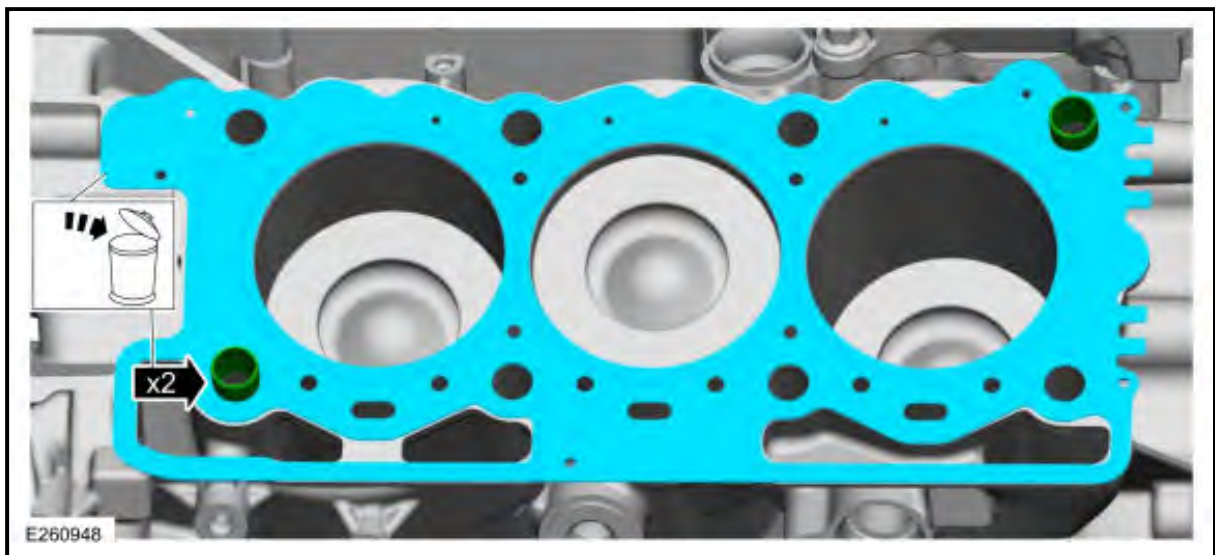


8. **NOTE:** Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.
- NOTE:** The glow plugs protrude past the lower face of the cylinder head, any impact on the tip of the glow plug may result in glow plug damage.
- NOTE:** The cylinder head bolts must be discarded and new bolts must be installed. They are tighten-to-yield designed and cannot be reused.
- Remove and discard the bolts from the LH cylinder head.
  - Remove the cylinder head.





9. Remove and discard the LH cylinder head gasket and the cylinder head dowels.



10. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

**NOTE:** Observe all warnings or cautions and follow all application directions contained on the packaging.

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

Material: Motorcraft <sup>®</sup> Silicone Gasket Remover / ZC-30-A

Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

11. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. REFER to: [Cylinder Head Distortion](#) . REFER to: [Cylinder Block Distortion](#) .

## CYLINDER HEAD - BODY ON - RH

For information on Ford Color Coded Illustrations refer to [OEM Color Coding](#) .

## Materials

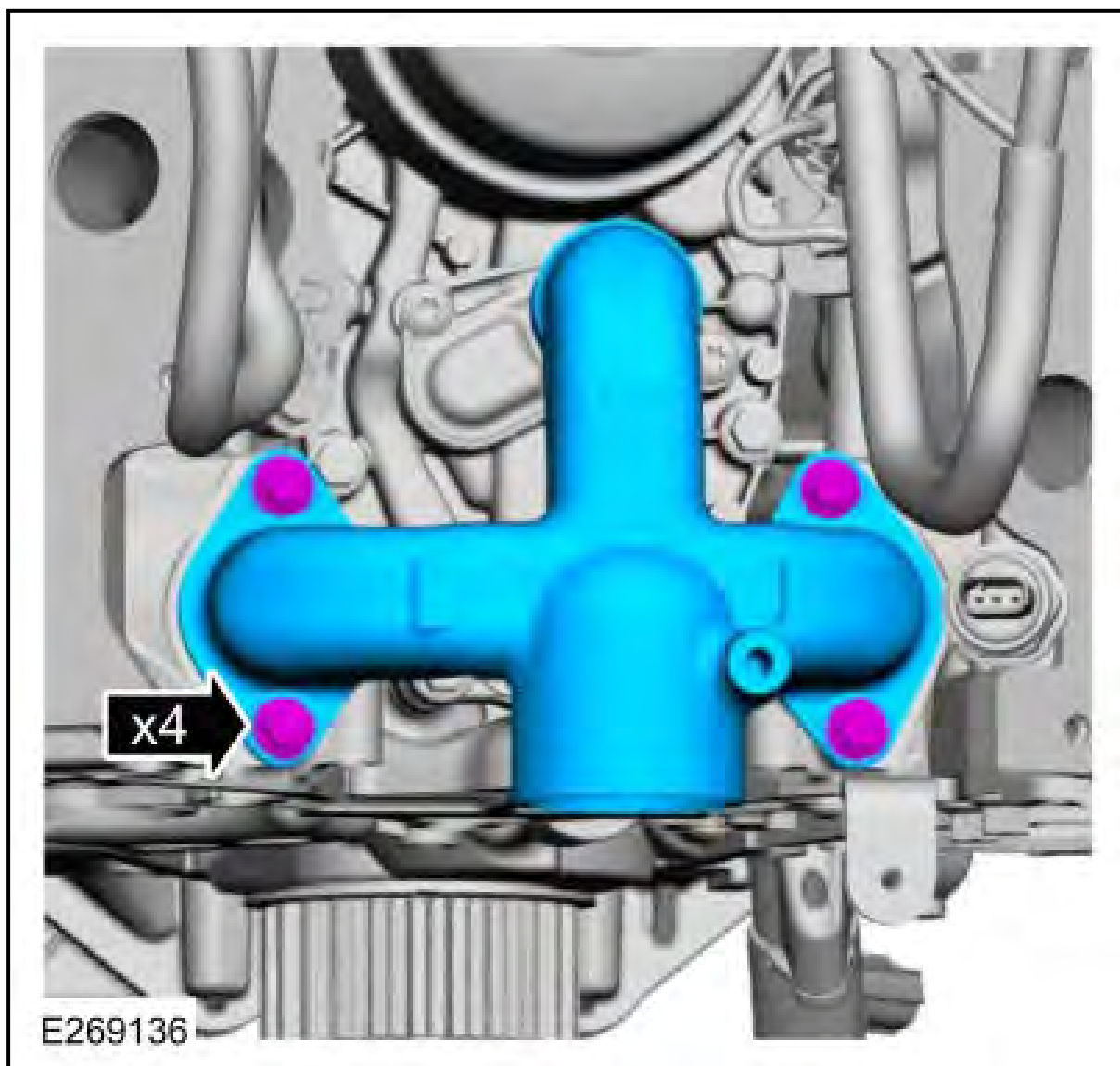
| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> Silicone Gasket Remover ZC-30-A  | -             |
| Motorcraft <sup>®</sup> Metal Surface Prep Wipes ZC-31-B | -             |

**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.

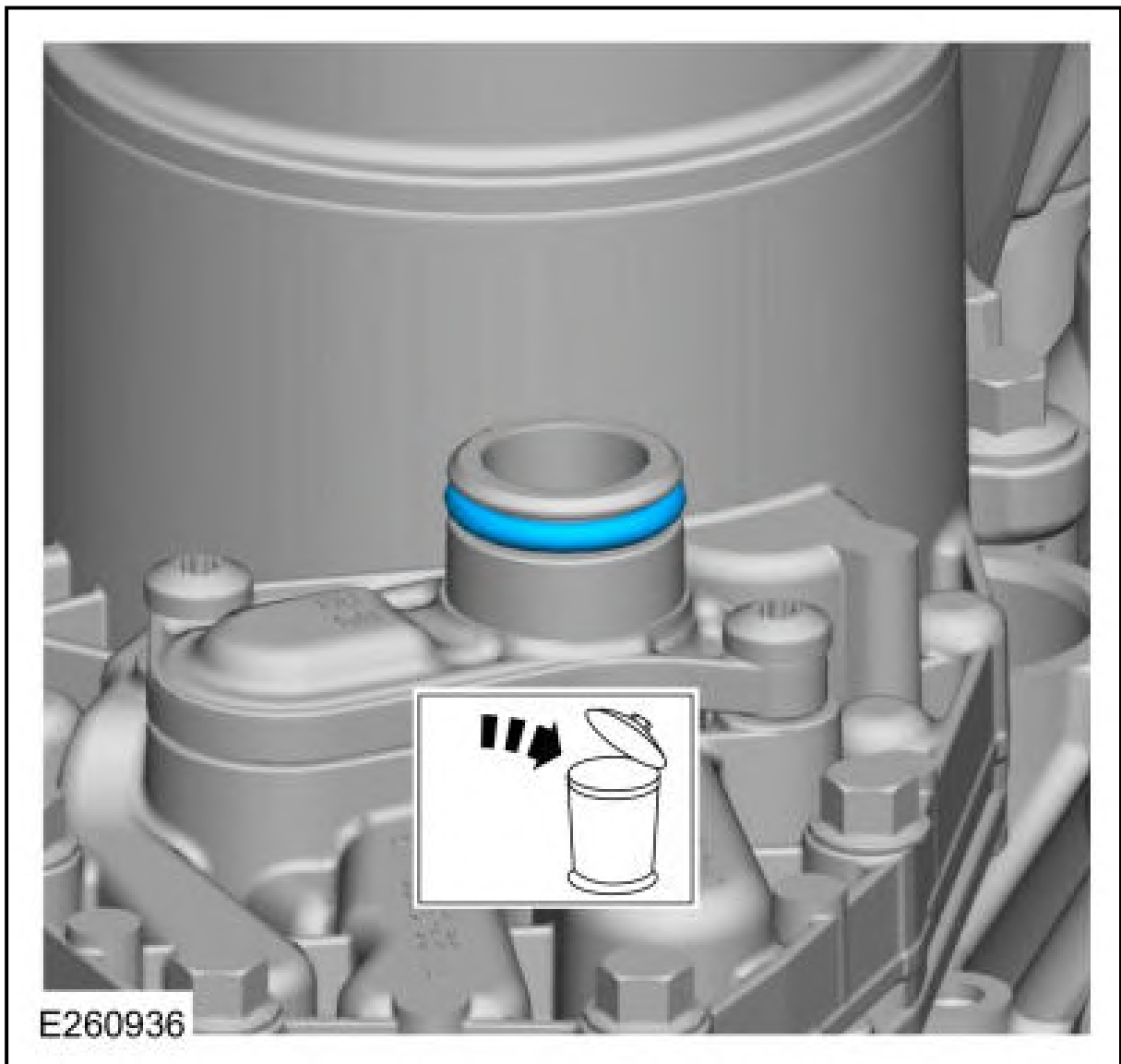
**NOTE:** Aluminum surfaces are soft and can be scratched easily. Never place the cylinder head gasket surface, unprotected, on a bench surface.

**NOTE:** It is recommended that this component be serviced with the vehicle body removed. If the vehicle body can be removed, refer to [Cylinder Head - Body Off - LH](#) or [Cylinder Head - Body Off - RH](#).

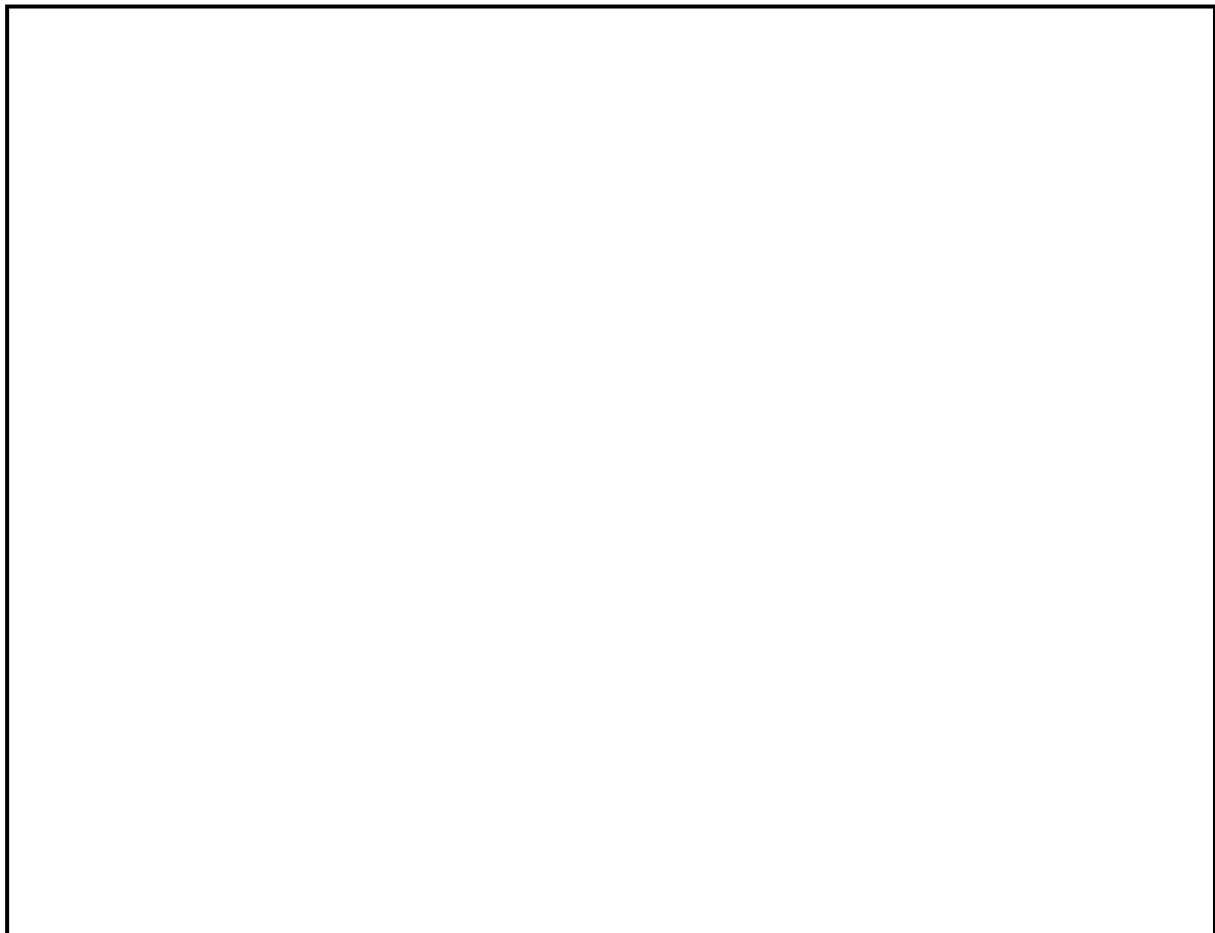
1. With the vehicle in NEUTRAL, position it on a hoist. REFER to: [Jacking and Lifting - Overview](#) .
2. Remove the following items:
  1. Remove the RH camshafts. REFER to: [Camshaft RH](#) .
  2. Remove the turbocharger. REFER to: [Turbocharger](#) .
  3. Remove the exhaust crossover pipe. REFER to: [Exhaust Crossover Pipe](#) .
3. Remove the bolts and the coolant outlet connector.



4. Remove and discard the oil cooler O-ring.



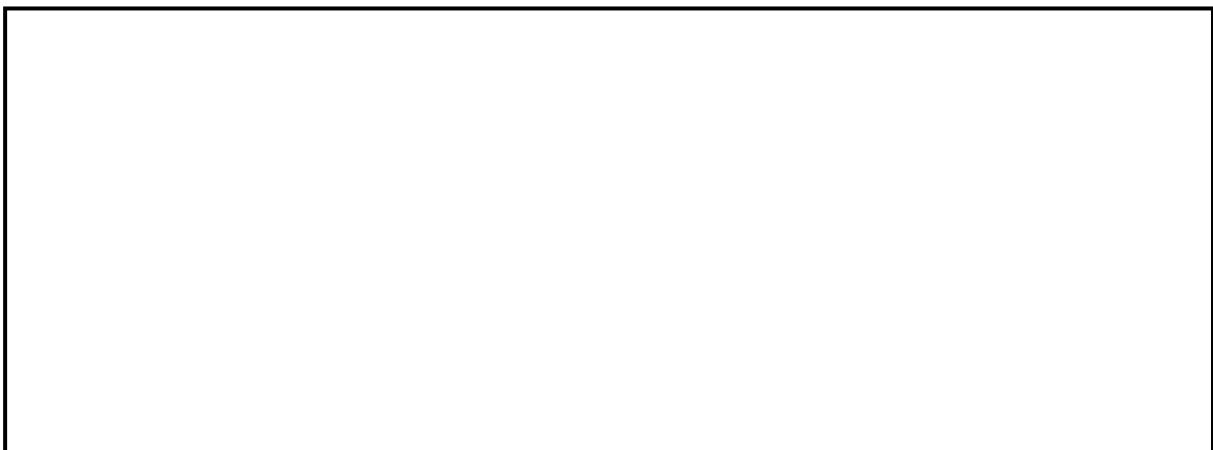
5. Remove and discard the coolant outlet connector gaskets.

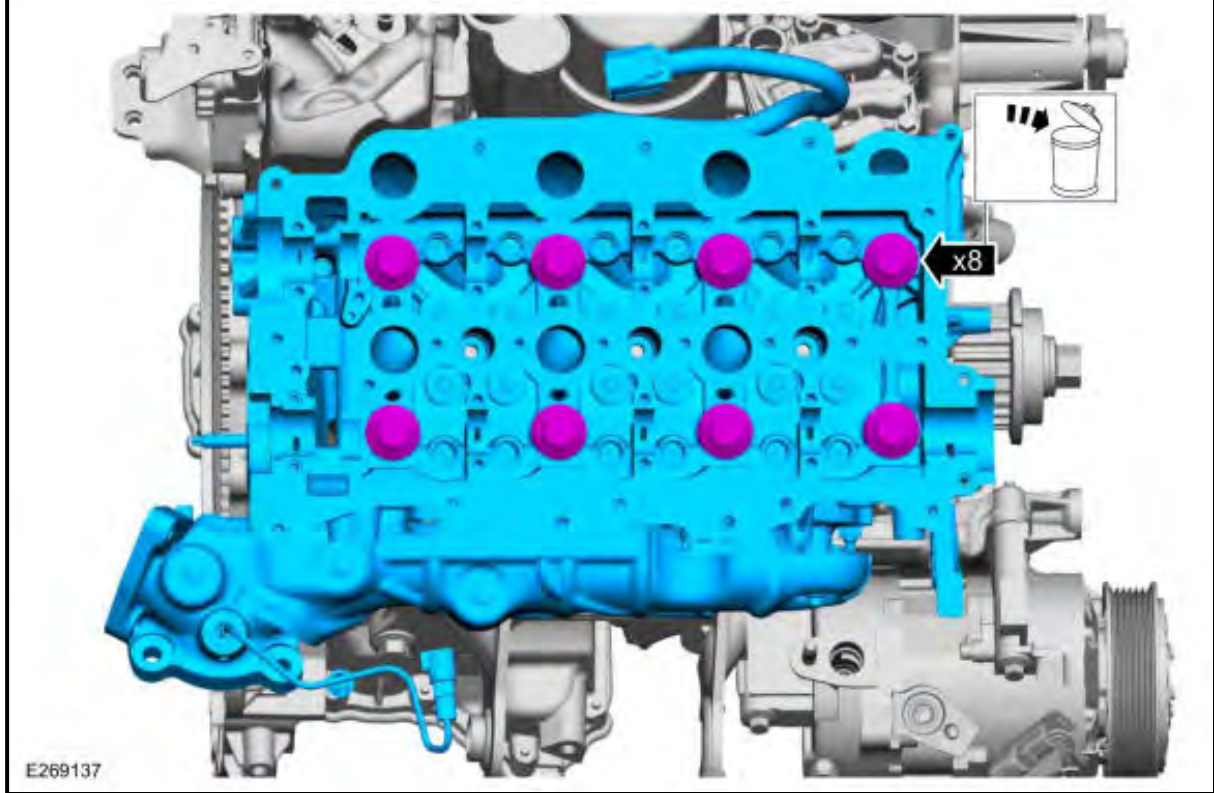




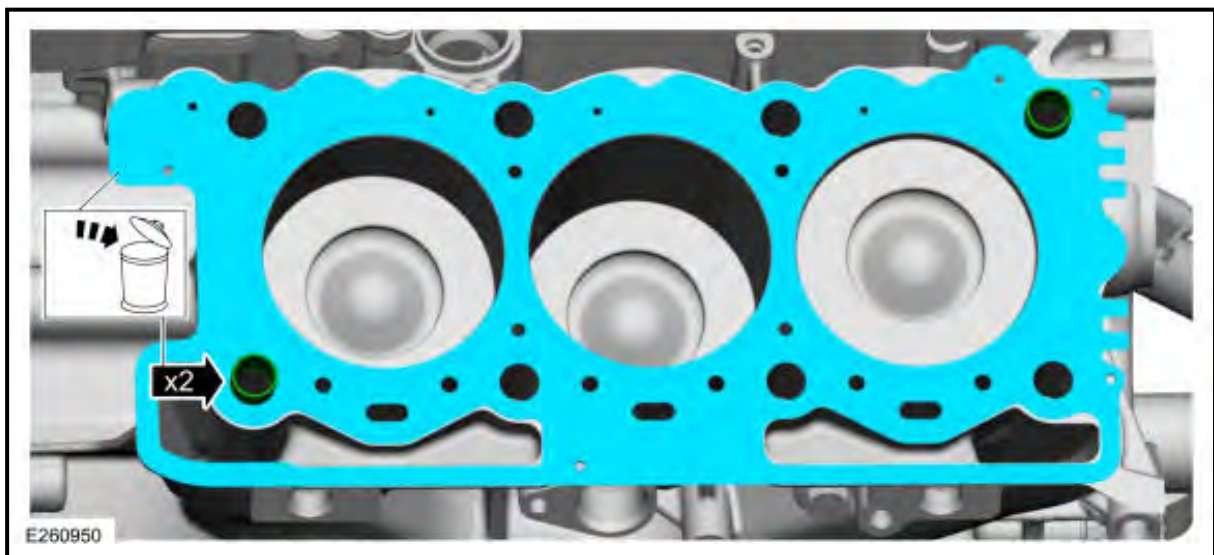
E261045

6. **NOTE:** Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.
- NOTE:** The glow plugs protrude past the lower face of the cylinder head, any impact on the tip of the glow plug may result in glow plug damage.
- NOTE:** The cylinder head bolts must be discarded and new bolts must be installed. They are tighten-to-yield designed and cannot be reused.
- Remove and discard the bolts from the RH cylinder head.
  - Remove the cylinder head.





7. Remove and discard the RH cylinder head gasket and the cylinder head dowels.



8. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

**NOTE:** Observe all warnings or cautions and follow all application directions contained on the packaging.

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

Material: Motorcraft <sup>®</sup> Silicone Gasket Remover / ZC-30-A

Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

9. Support the cylinder head on a bench with the head gasket side up. Check the cylinder head distortion and the cylinder block distortion. REFER to: [Cylinder Head Distortion](#) . REFER to: [Cylinder Block Distortion](#) .



## 2018 ENGINE

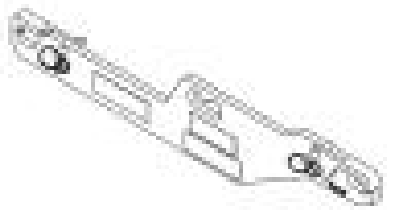
### Engine - 3.0L Power Stroke Diesel (2 OF 2) - F150

## REMOVAL

### ENGINE BLOCK SKIRT STIFFENER

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

#### Special Tool(s) / General Equipment

|  |                       |
|--|-----------------------|
| <br>E274098 | 303-1681 Spreader Bar |
| Floor Crane  |                       |
| Mounting Stand   |                       |
| Plastic Scraper  |                       |

#### Materials

| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> Silicone Gasket Remover ZC-30-A          | -             |
| Motorcraft <sup>®</sup> Metal Surface Prep Wipes ZC-31-B         | -             |
| Motorcraft <sup>®</sup> Metal Brake Parts Cleaner PM-4-A, PM-4-B | -             |

**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:** This procedure assumes that the engine was removed using the recommended body off engine removal procedure. If it was necessary to remove the engine using the alternate body on engine removal procedure, some of the components in this procedure will have already been removed.

Remove the engine from the vehicle. Refer to: [Engine - Body Off](#). Refer to: [Engine - Body On](#).

- Remove the bolts and the flexplate. Discard the bolts.

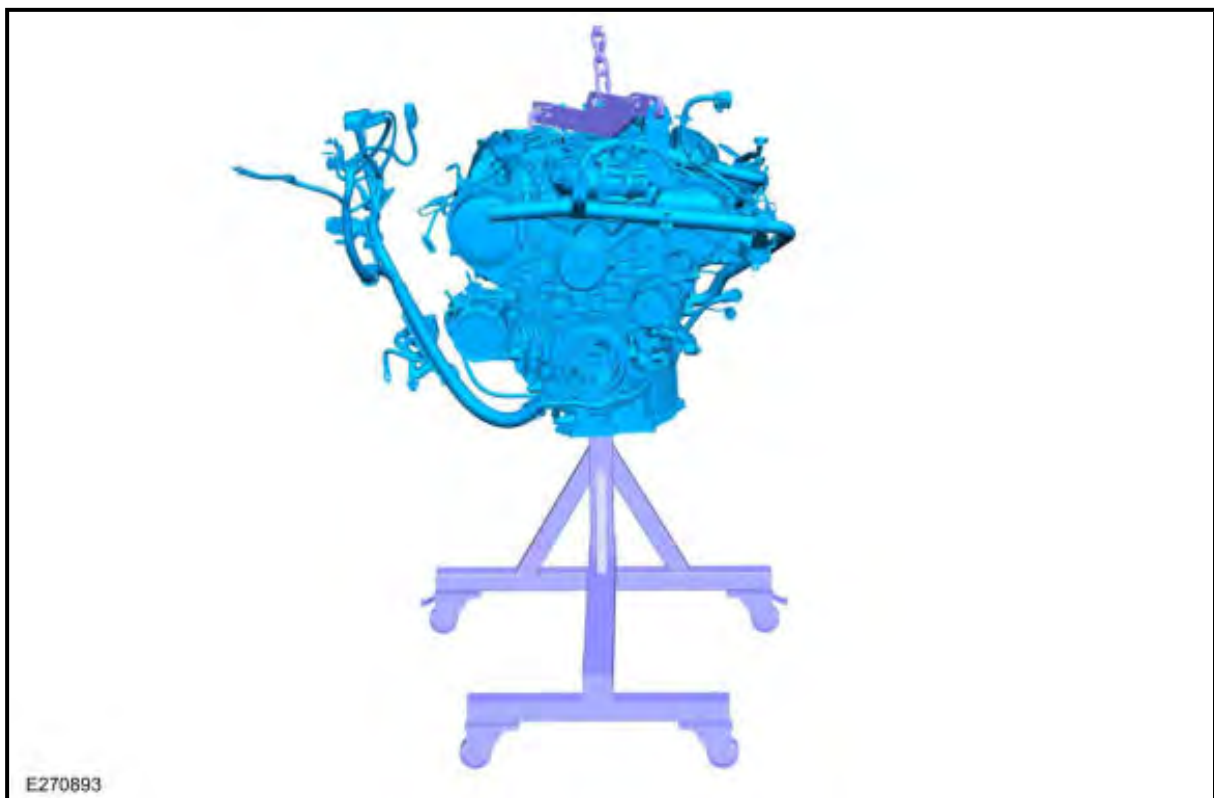






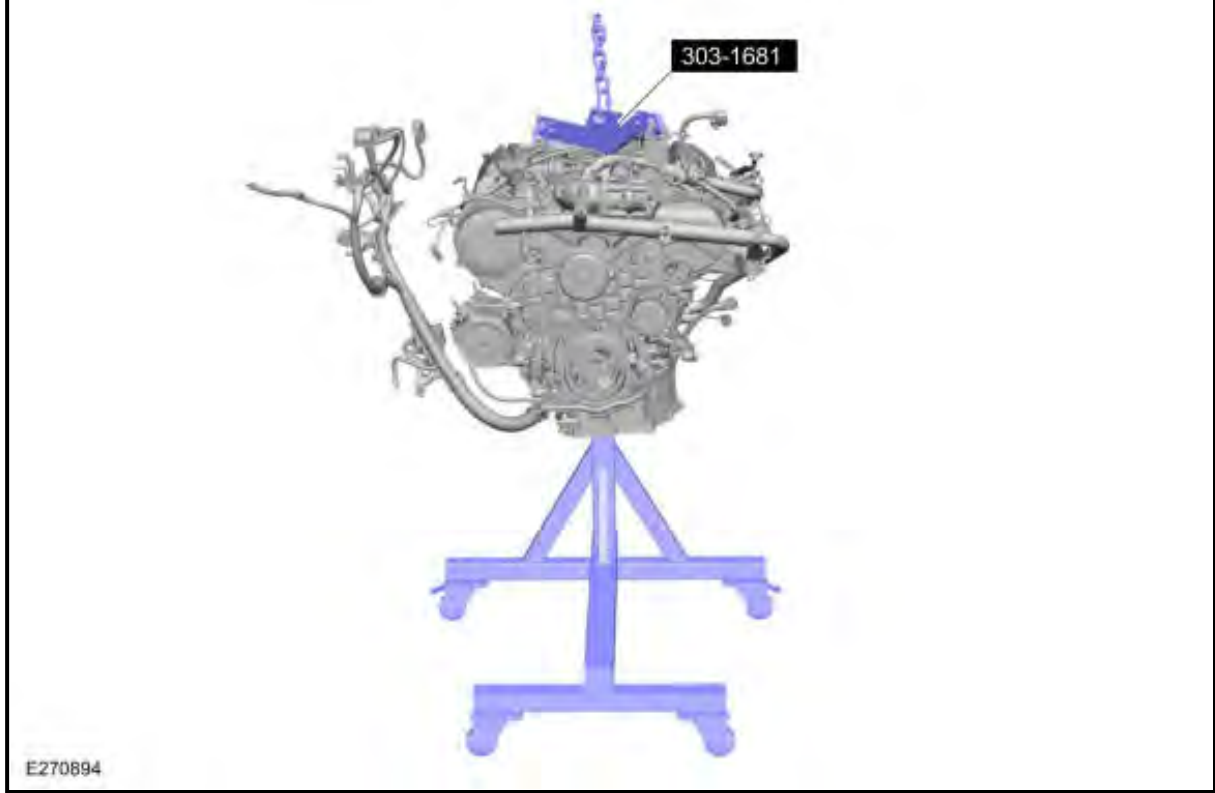
3. **NOTE:** Install the engine stand bolts into the cylinder block only. Do not install the bolts into the engine block skirt stiffener.

Using a floor crane, install the engine on a mounting stand. Use the General Equipment: Floor Crane Use the General Equipment: Mounting Stand

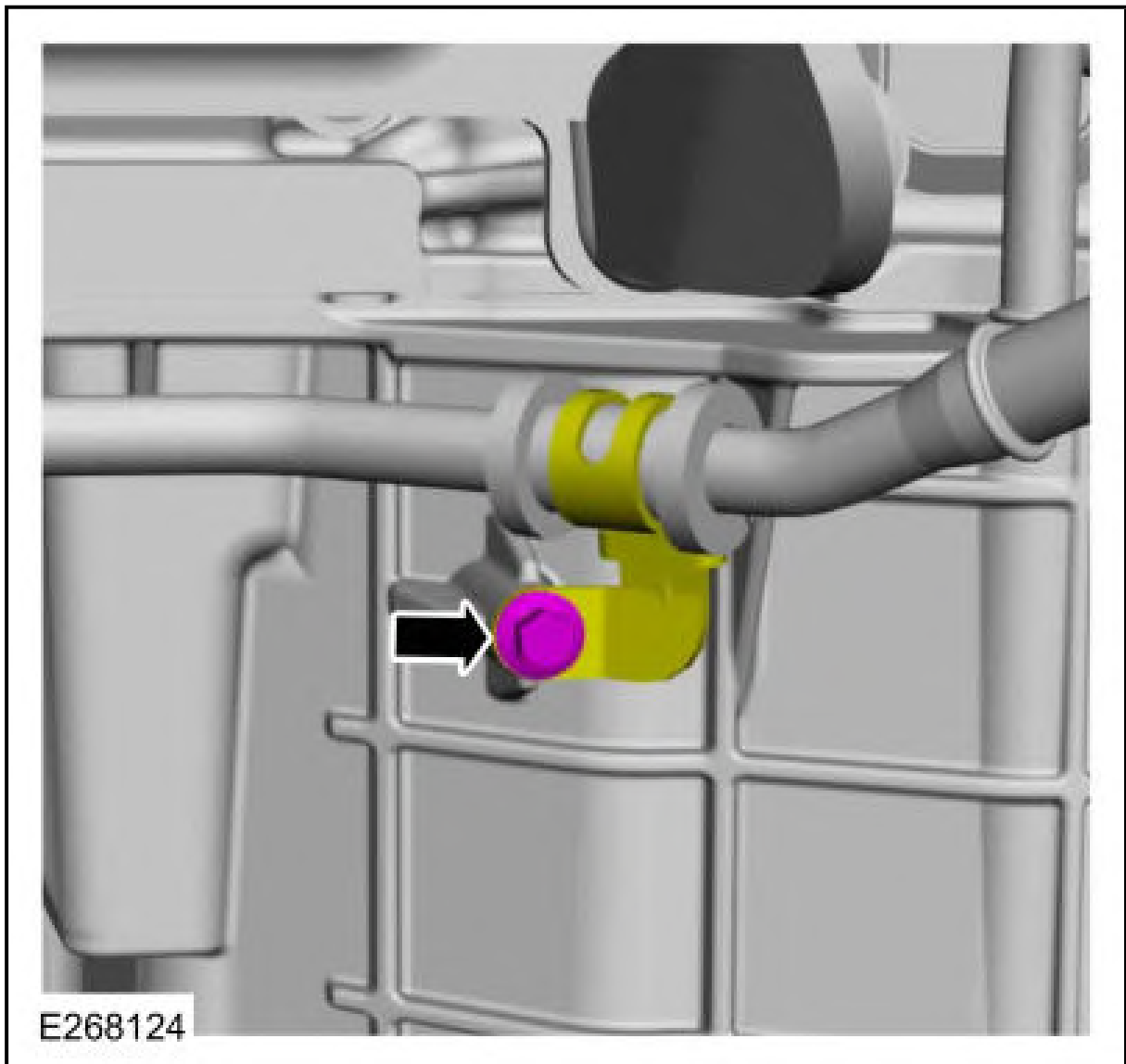


4. Remove the floor crane and service tool. Use Special Service Tool: 303-1681 Spreader Bar. Use the General Equipment: Floor Crane

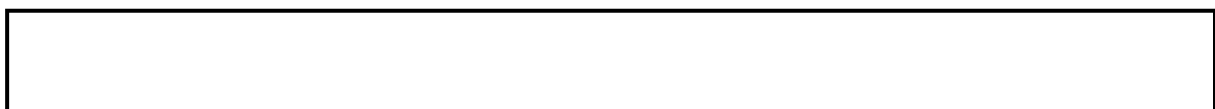


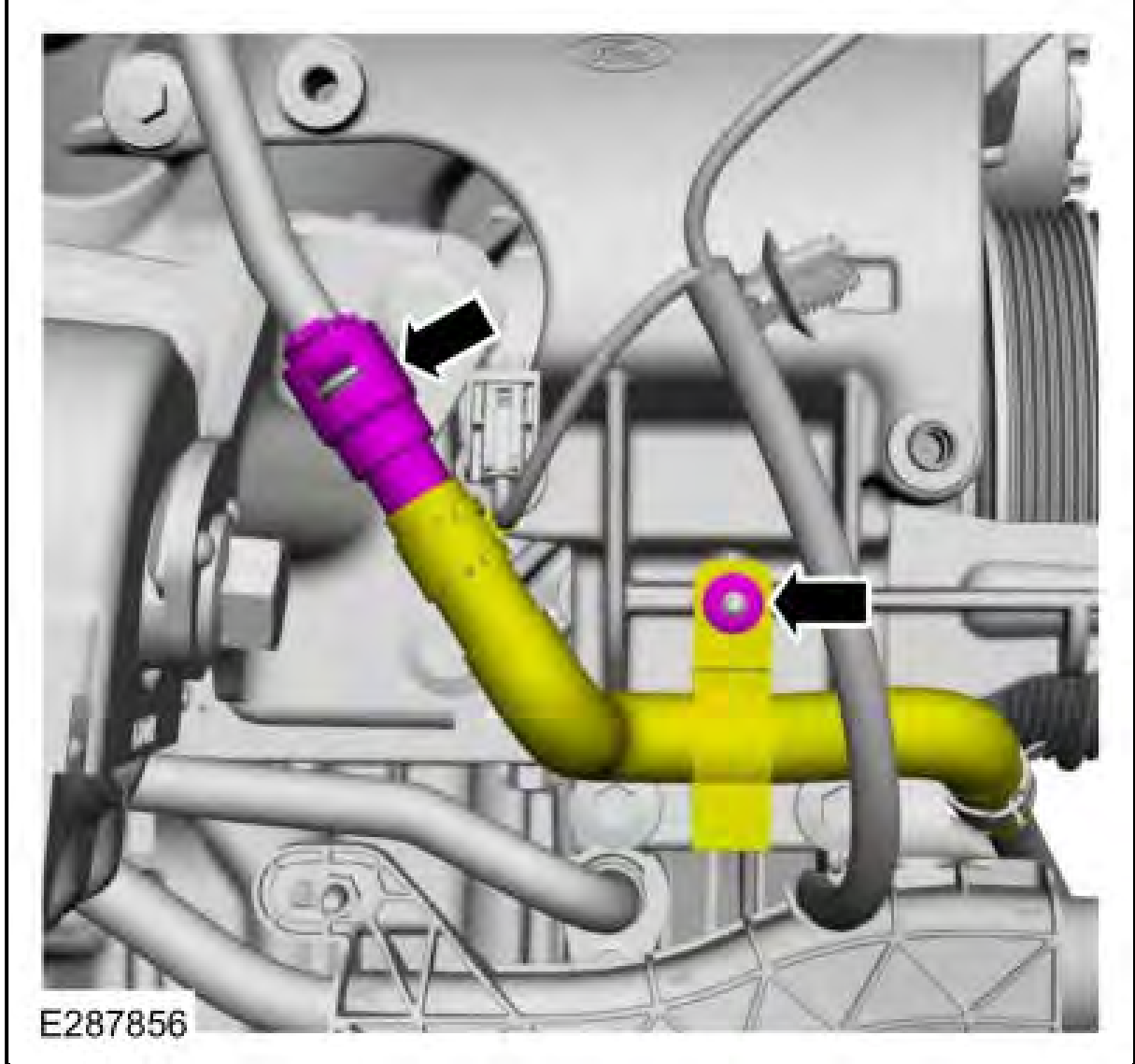


5. Remove the bolt for the coolant tube.

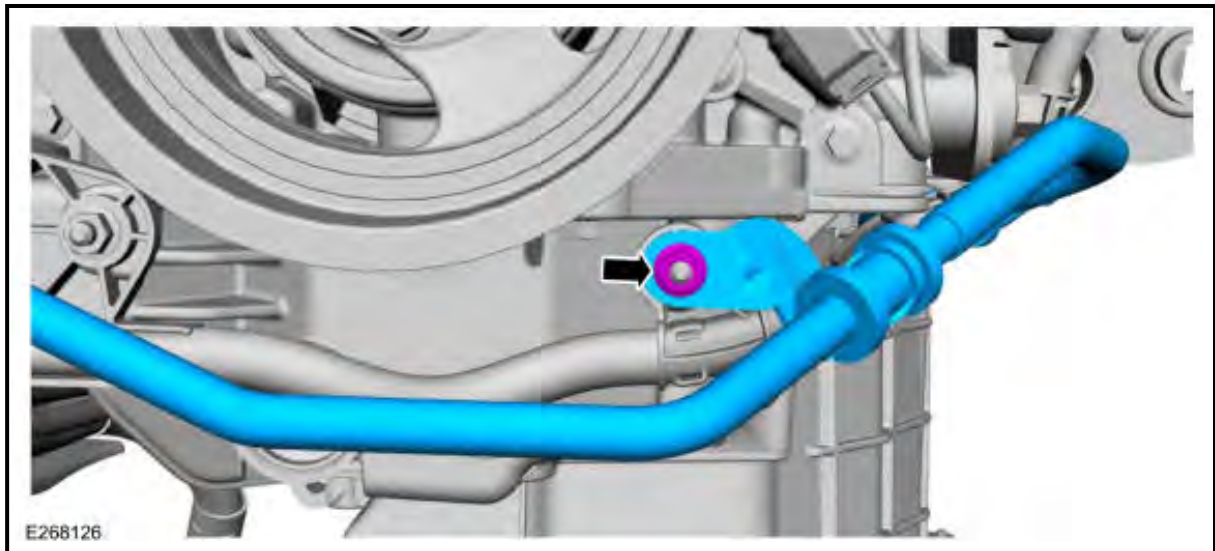


6. Disconnect the coolant hose. Remove the nut for the coolant hose bracket.



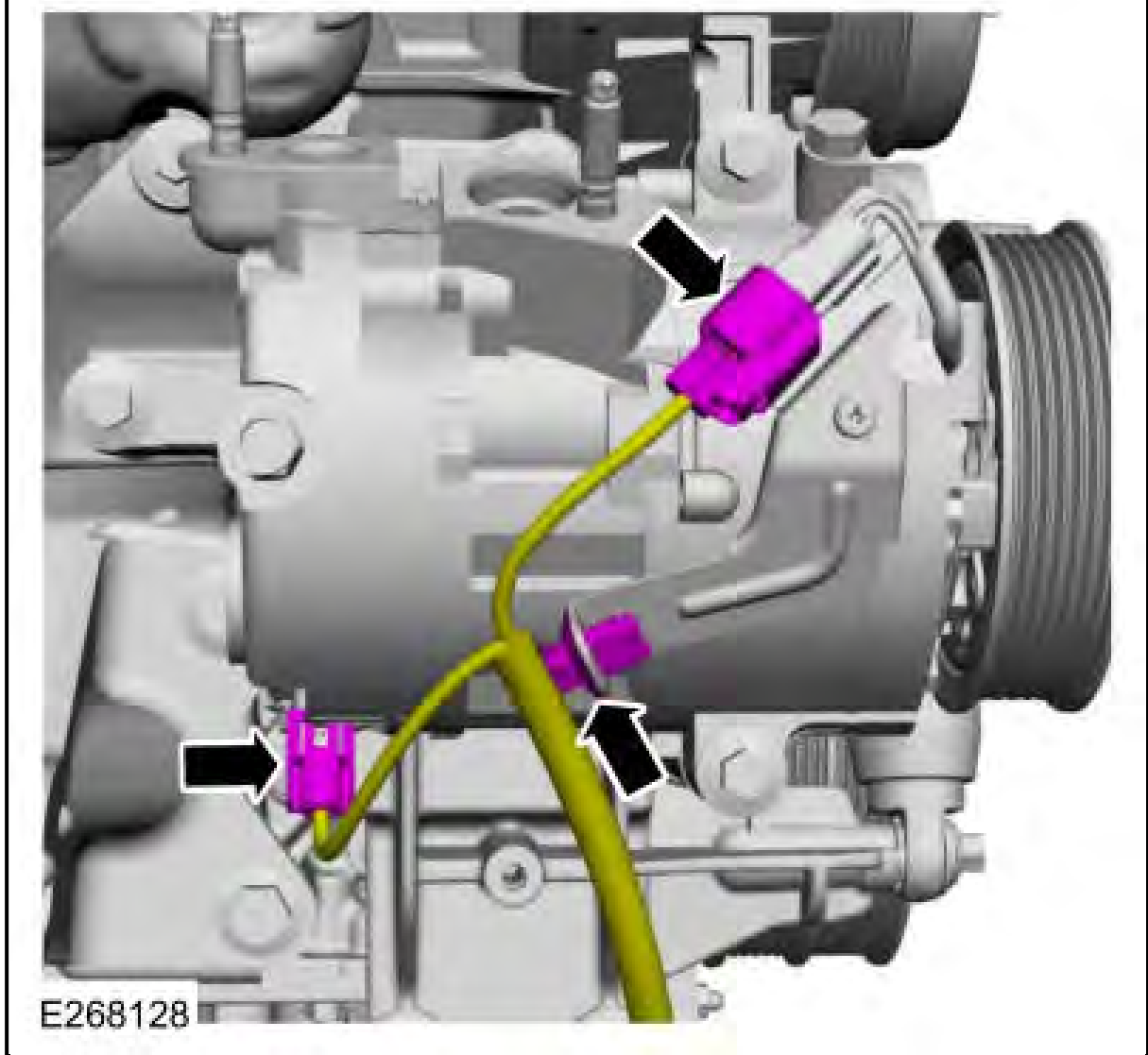


7. Remove the nut and the coolant tube.

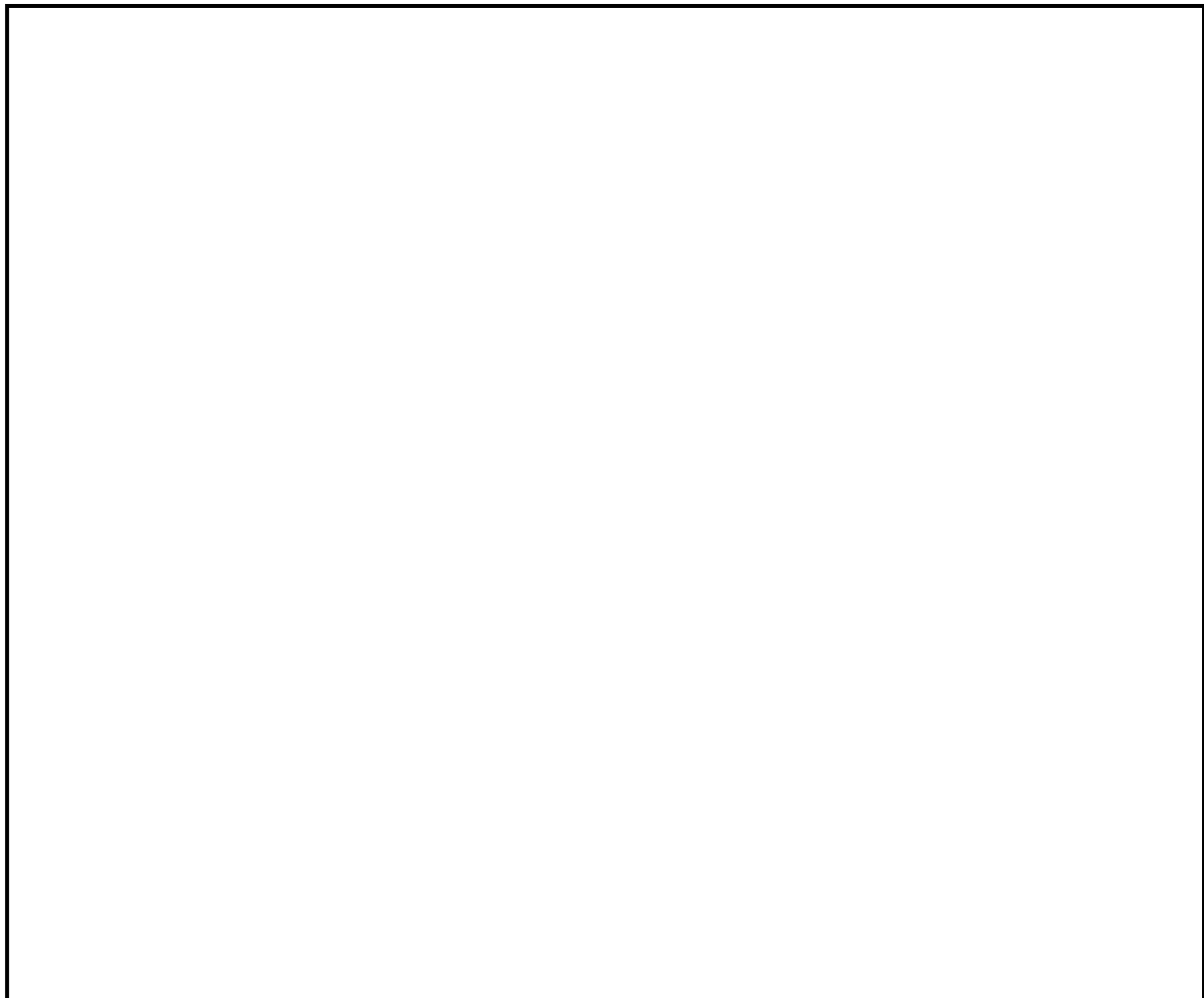


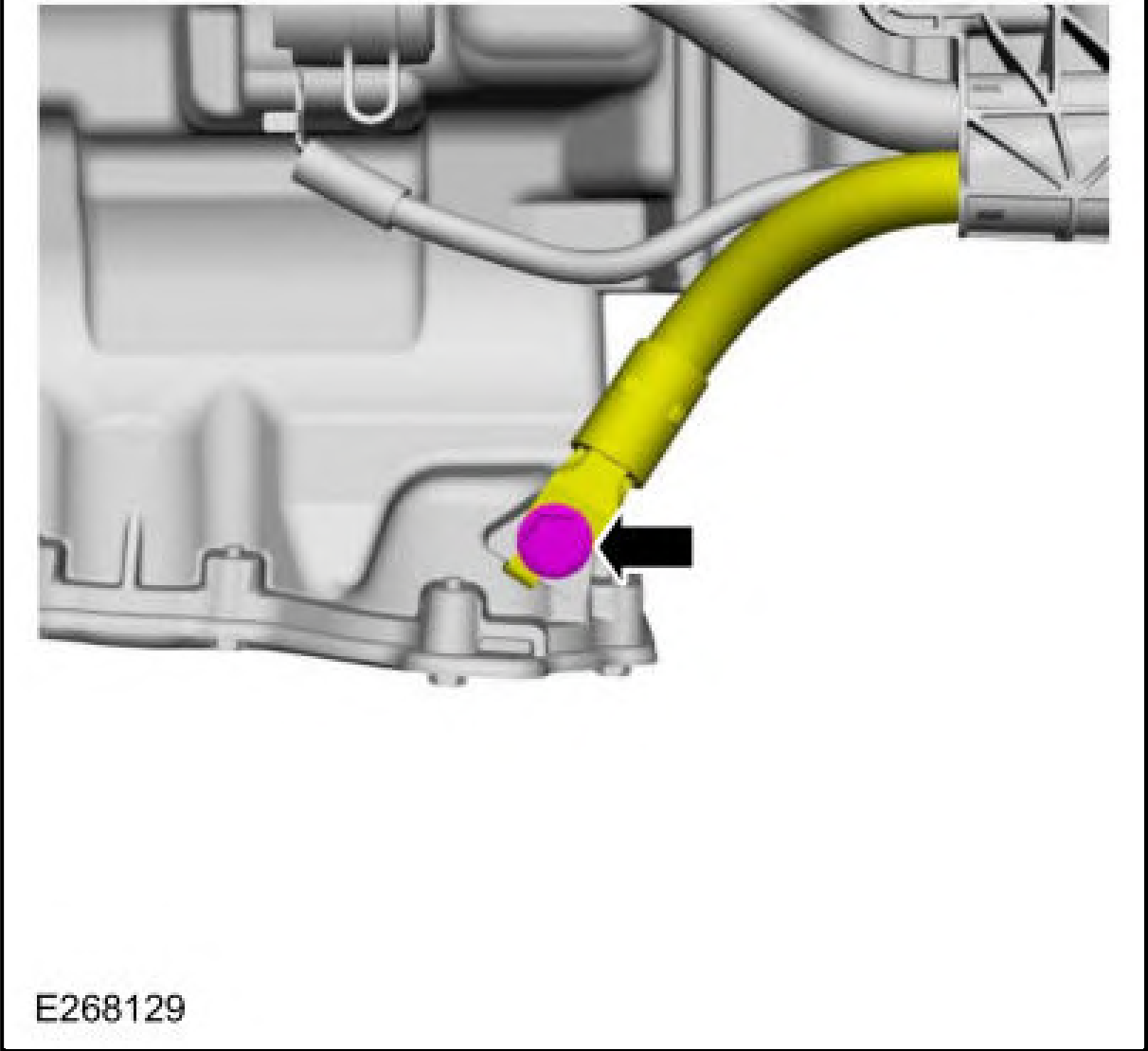
8. Disconnect the A/C electrical connectors and the wire retainer.



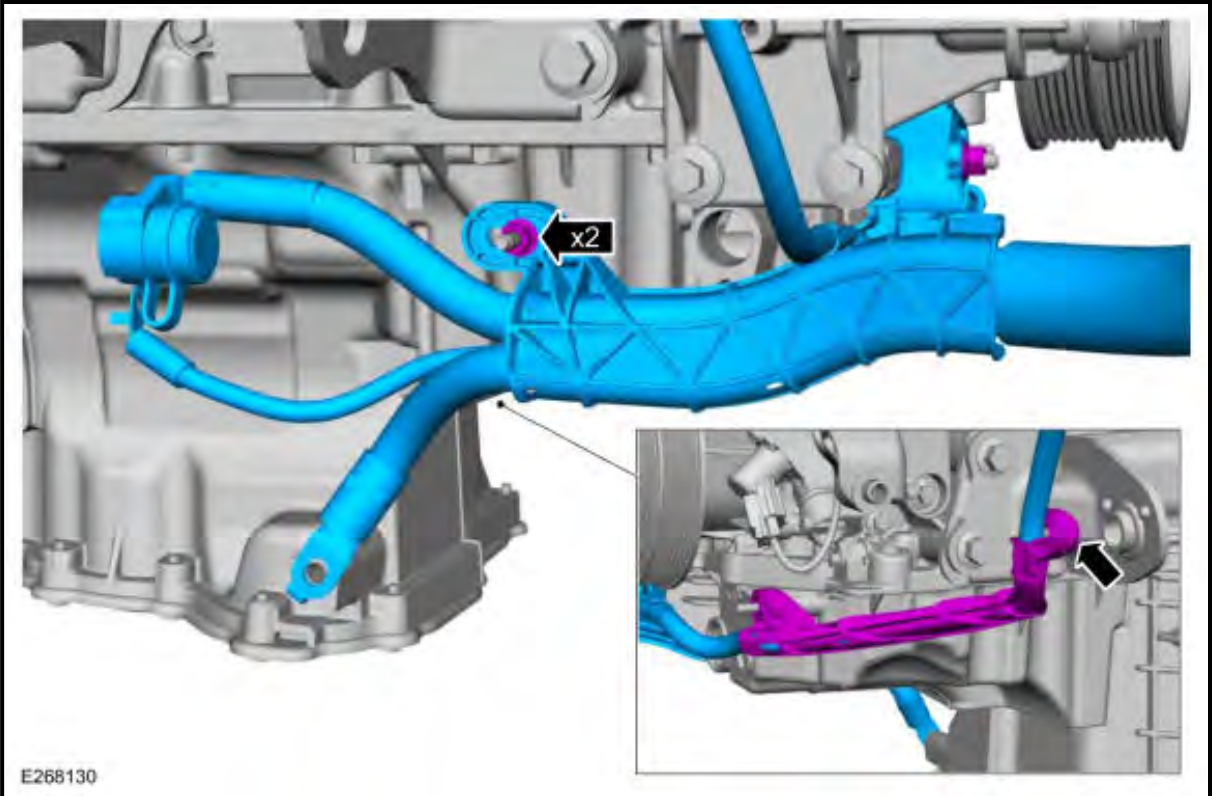


9. Remove the ground cable bolt.



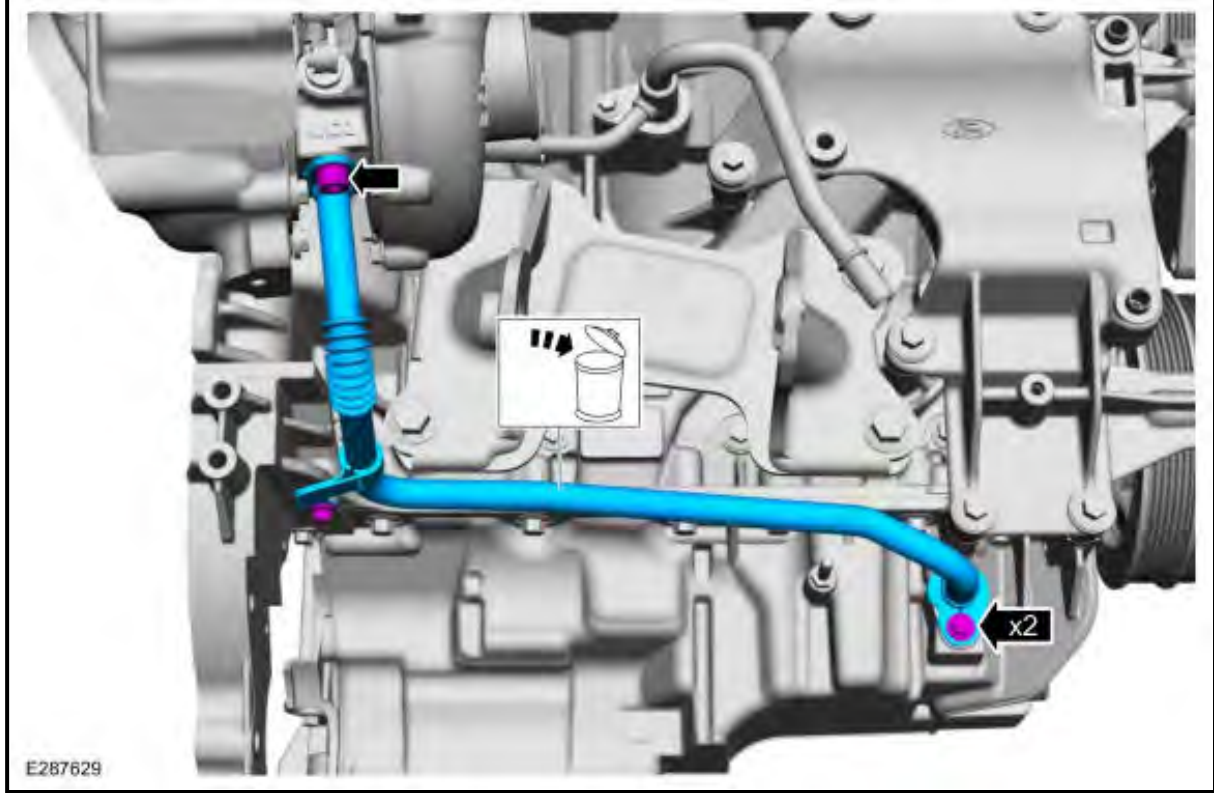


10. Remove the nuts, disconnect the wire harness retainer and remove the battery cable harness.

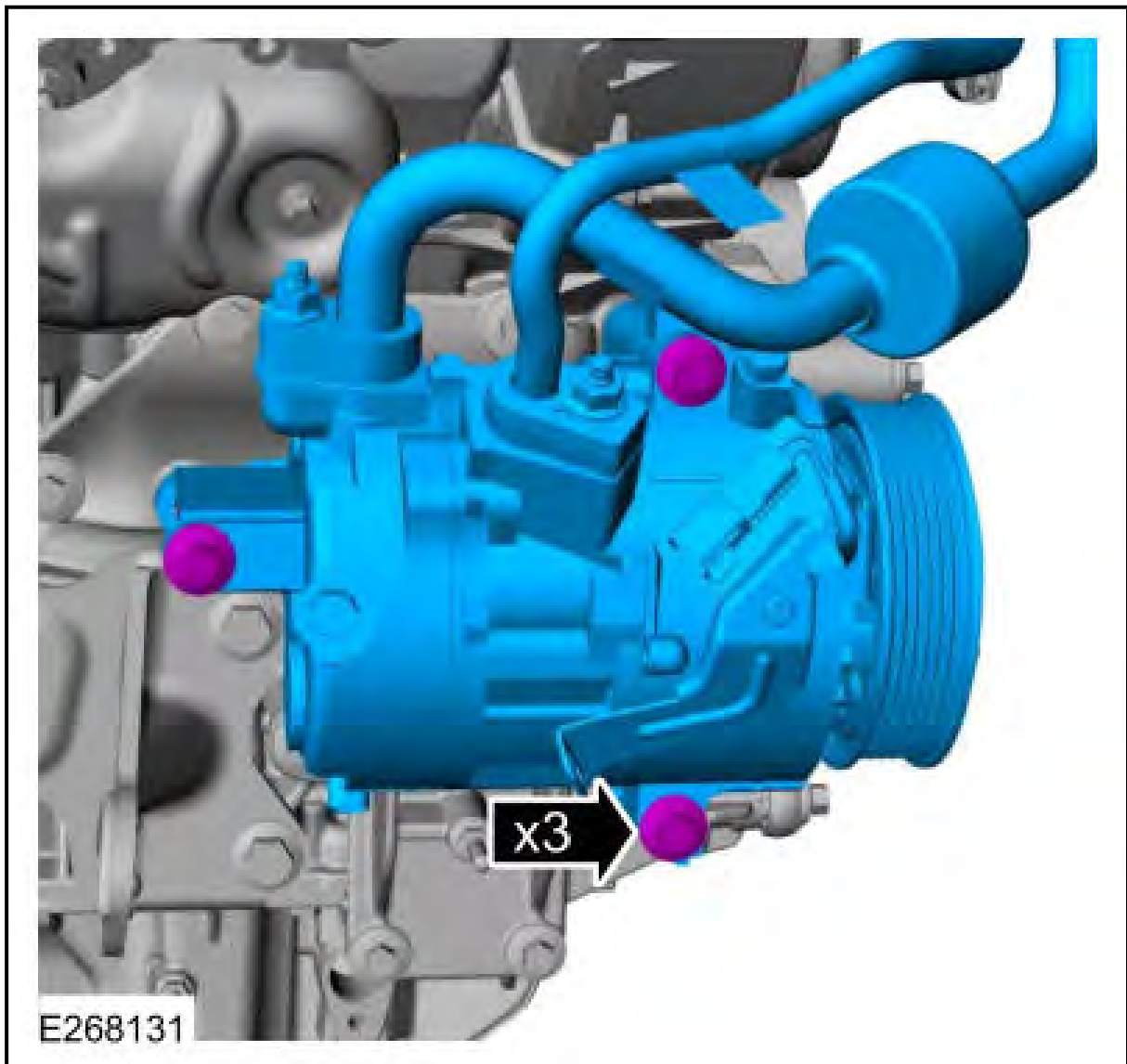


11. Remove the bolts and the turbocharger oil return tube. Discard the turbocharger oil return tube.

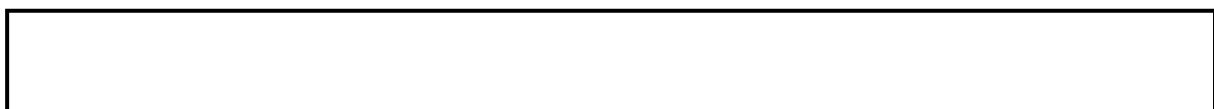


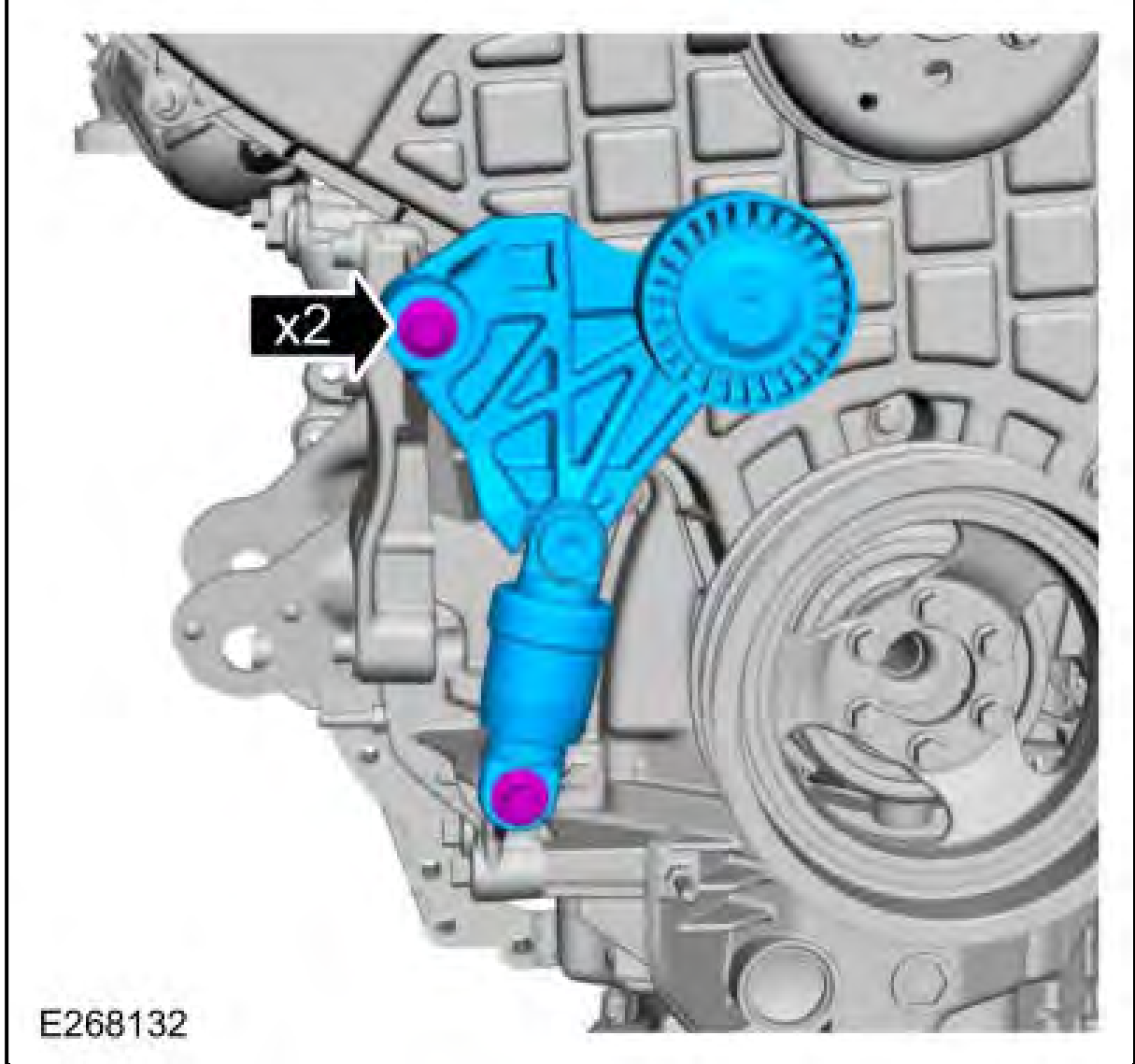


12. Remove the bolts and the A/C compressor.

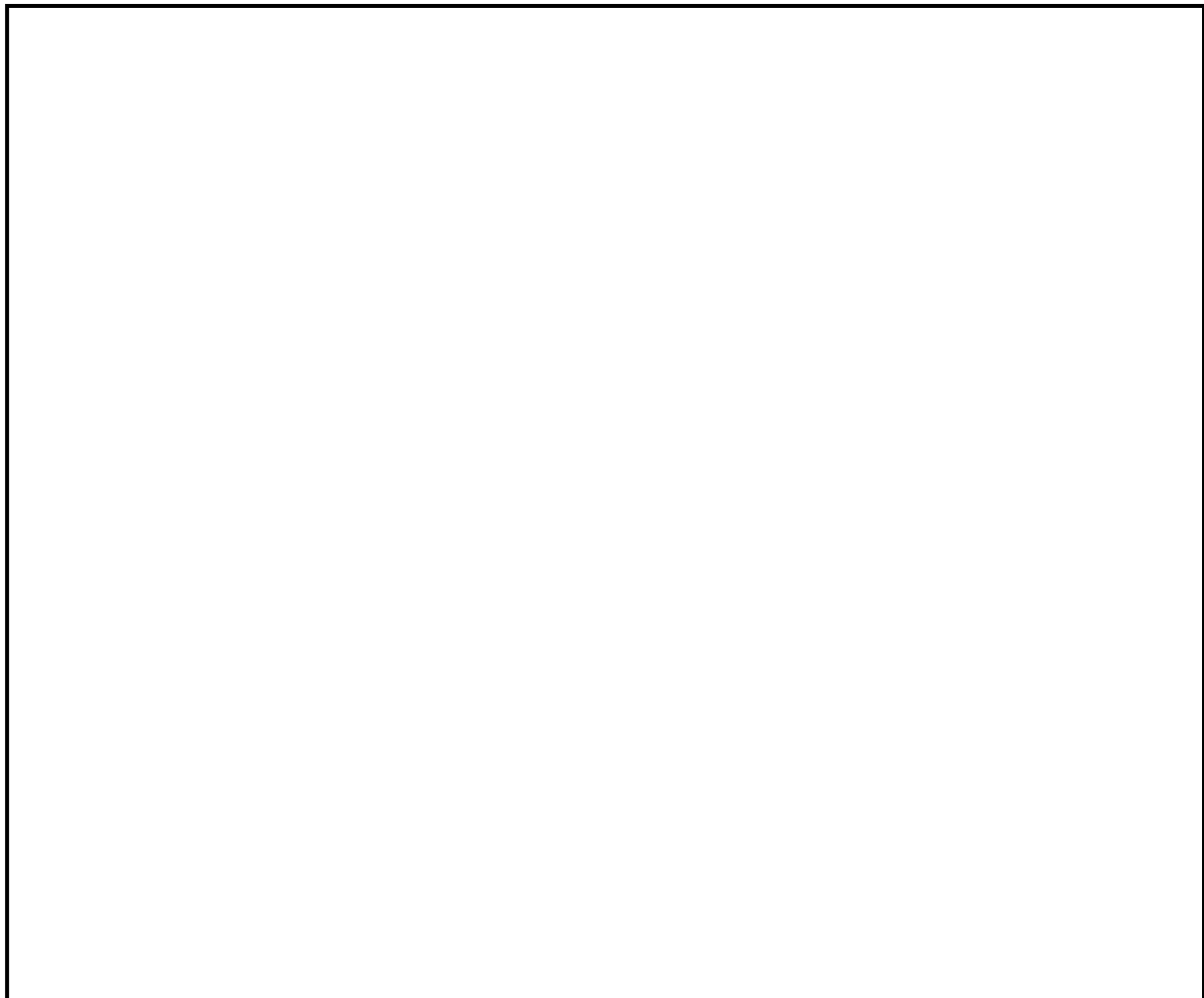


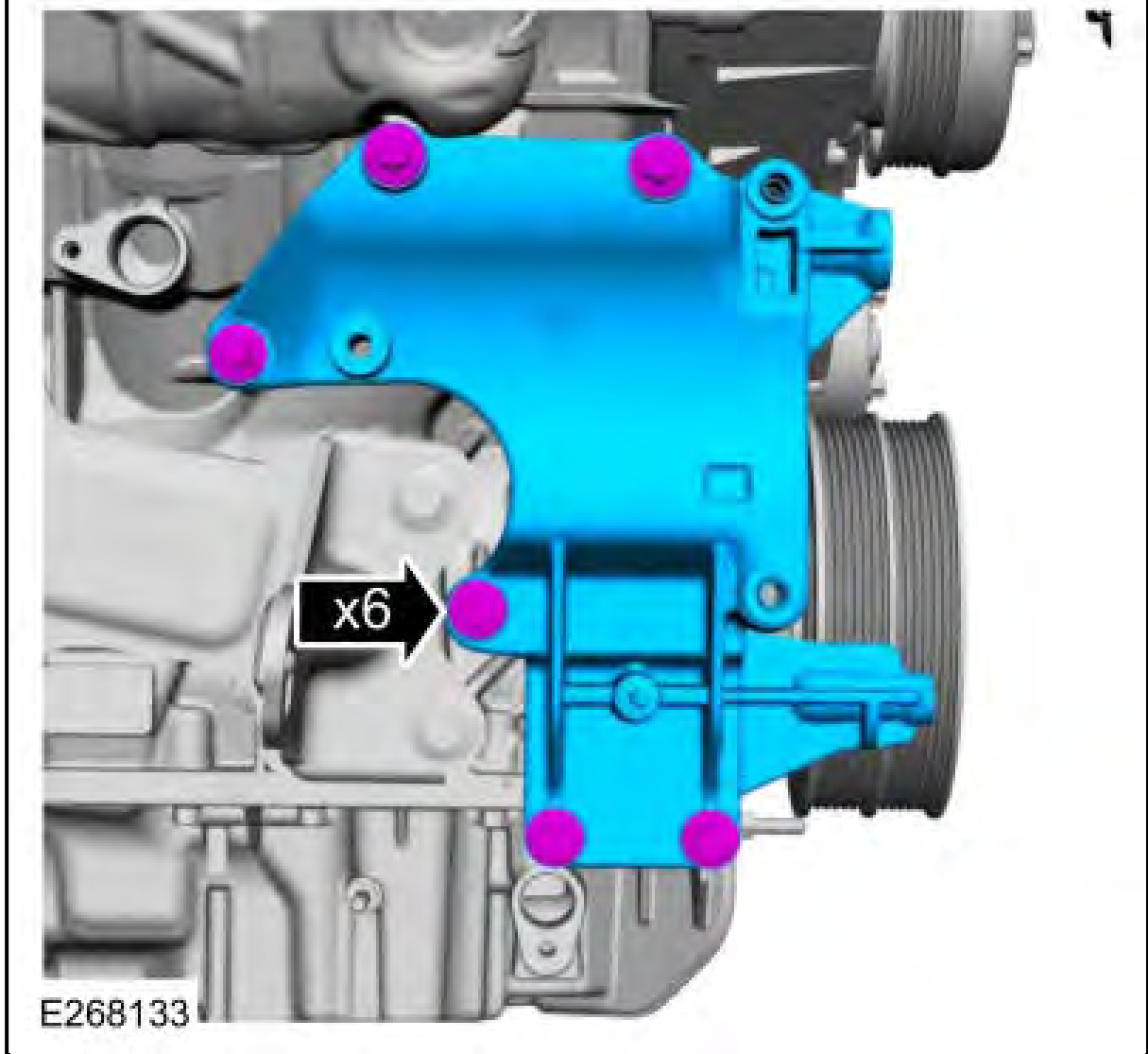
13. Remove the bolts and the accessory drive belt tensioner.



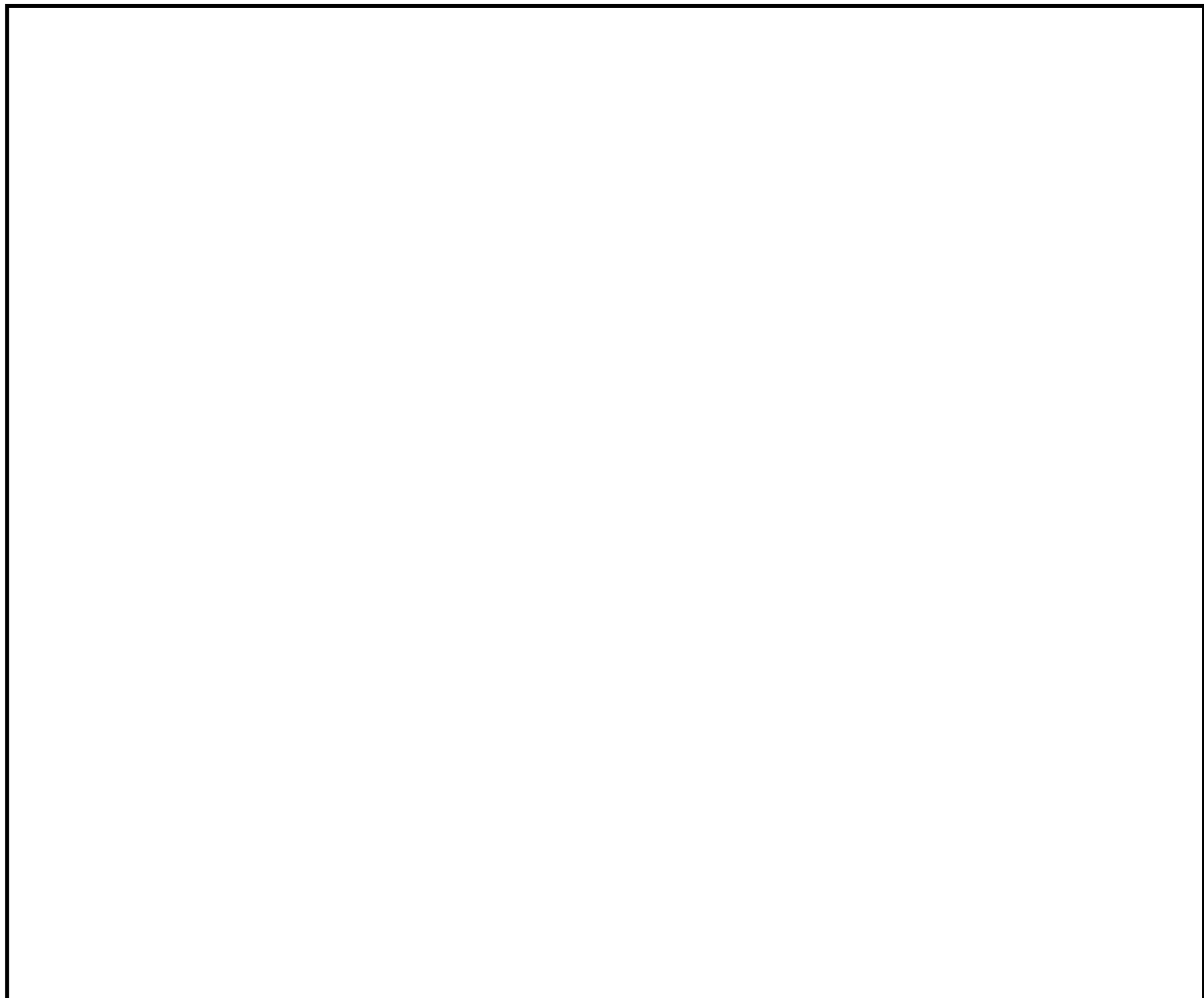


14. Remove the bolts and the A/C mounting bracket.

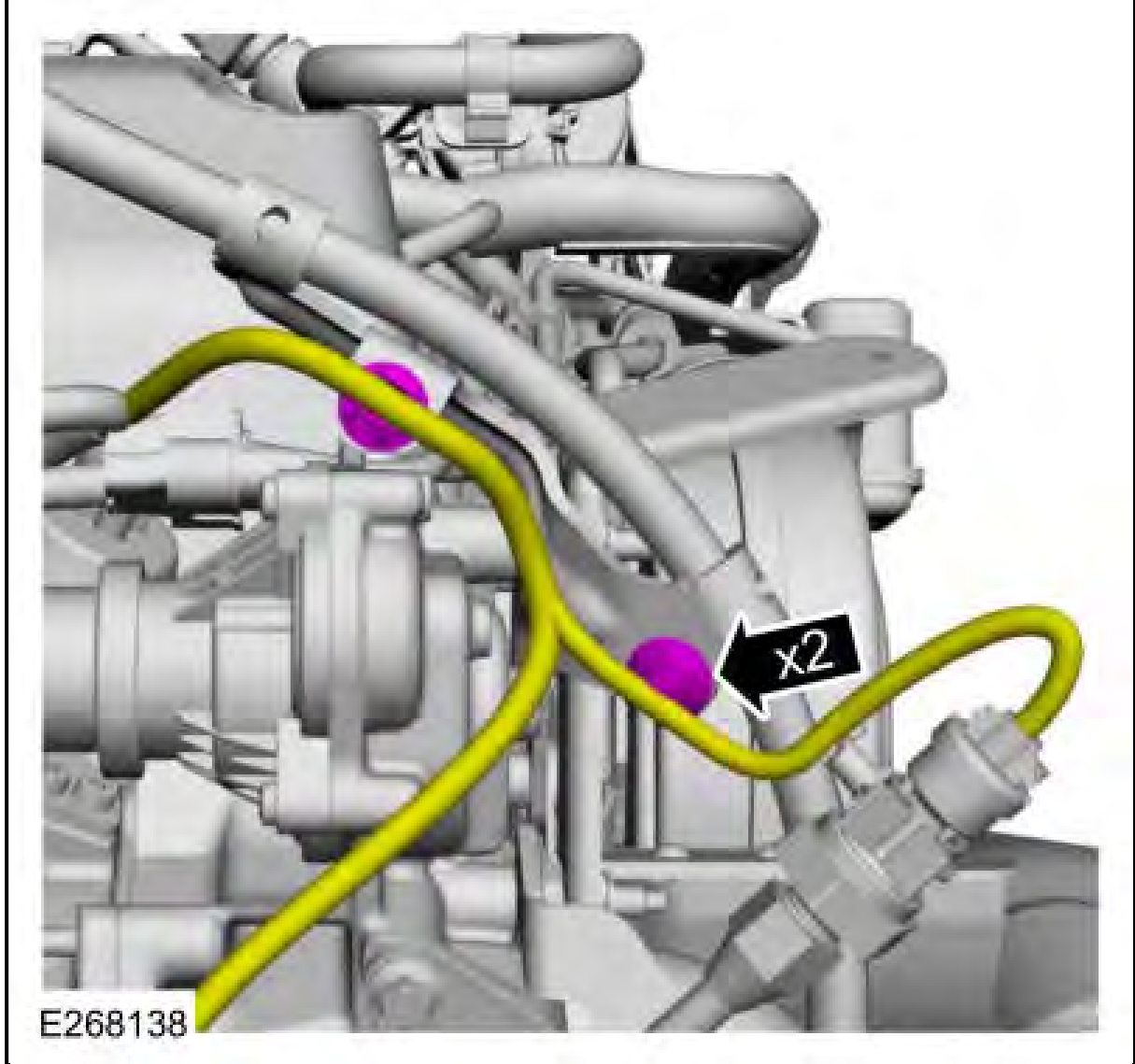




15. Disconnect the wire retainers from the oil level indicator.



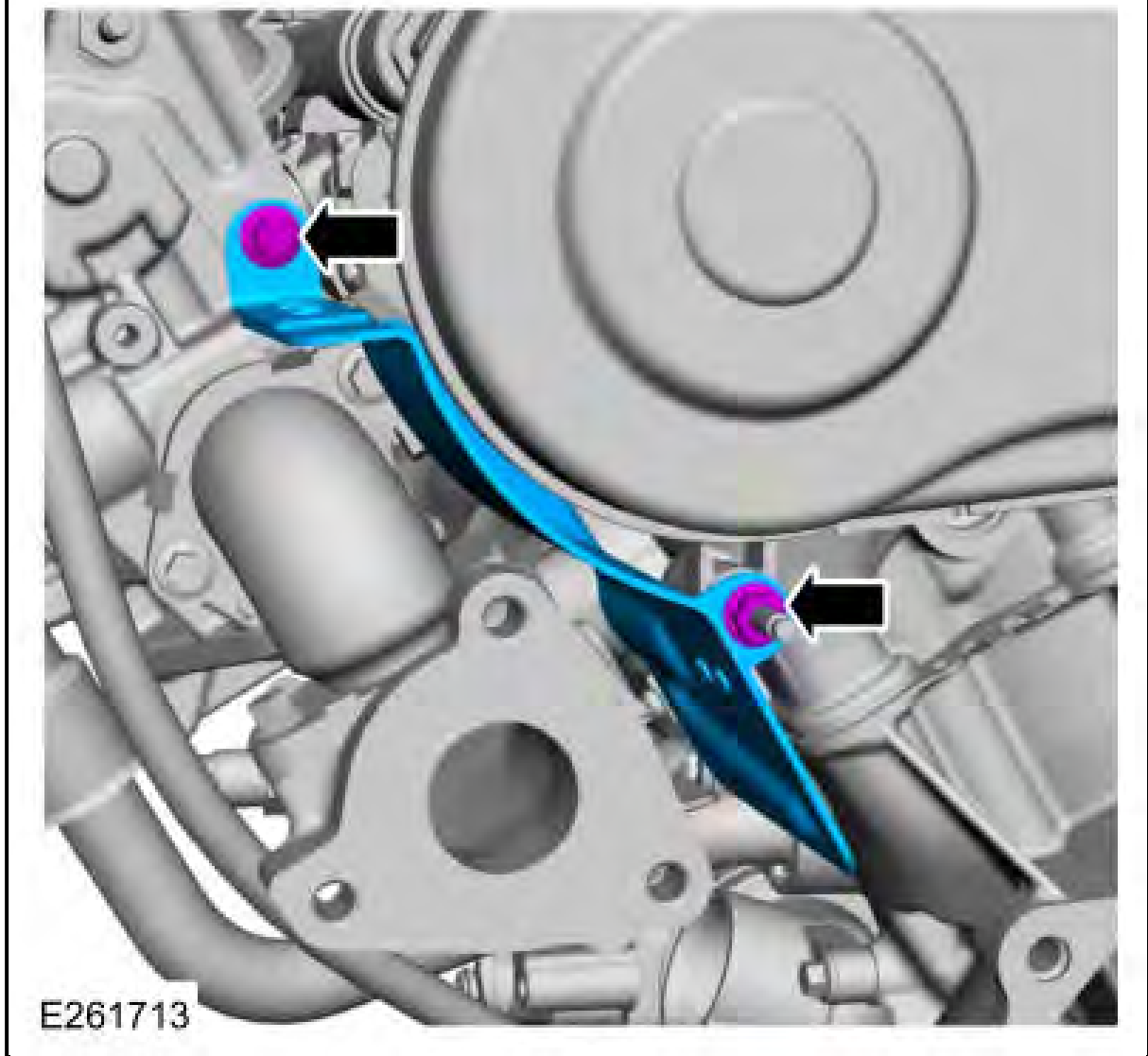




16. **NOTE:** Exhaust crossover pipe removed for clarity.

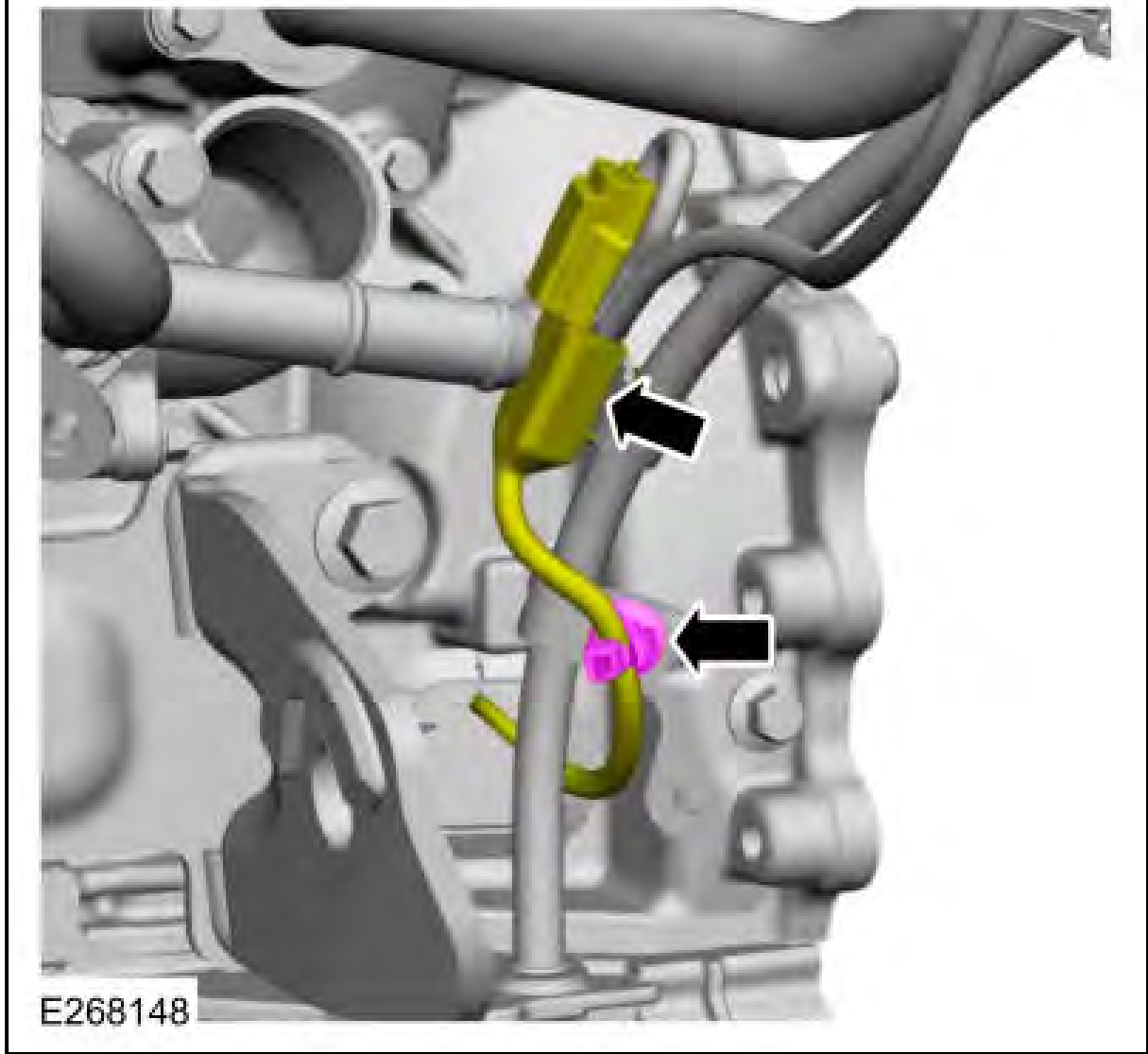
Remove the nut, the bolt and the heat shield.





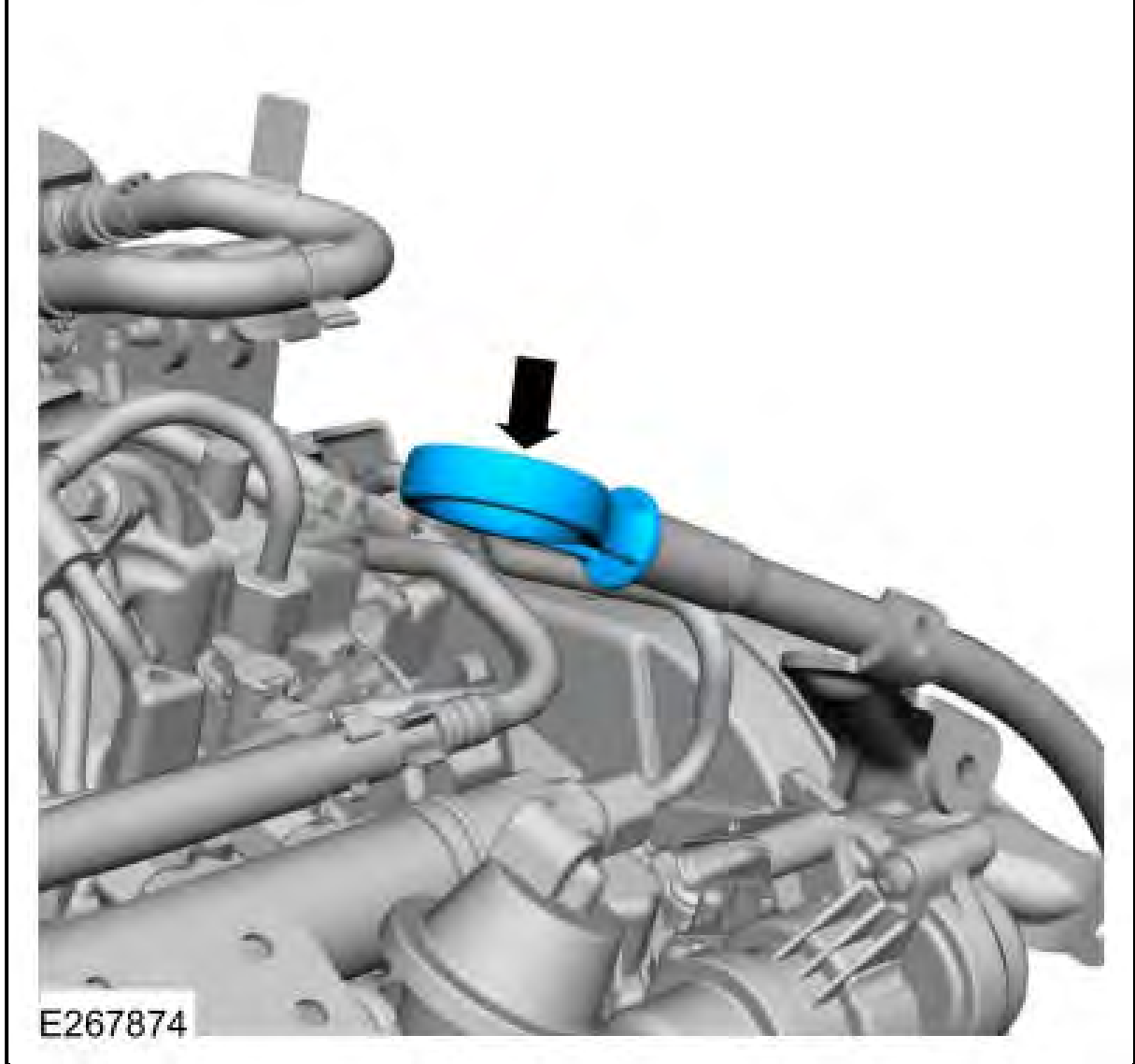
17. Disconnect the wire retainers from the oil level indicator tube.



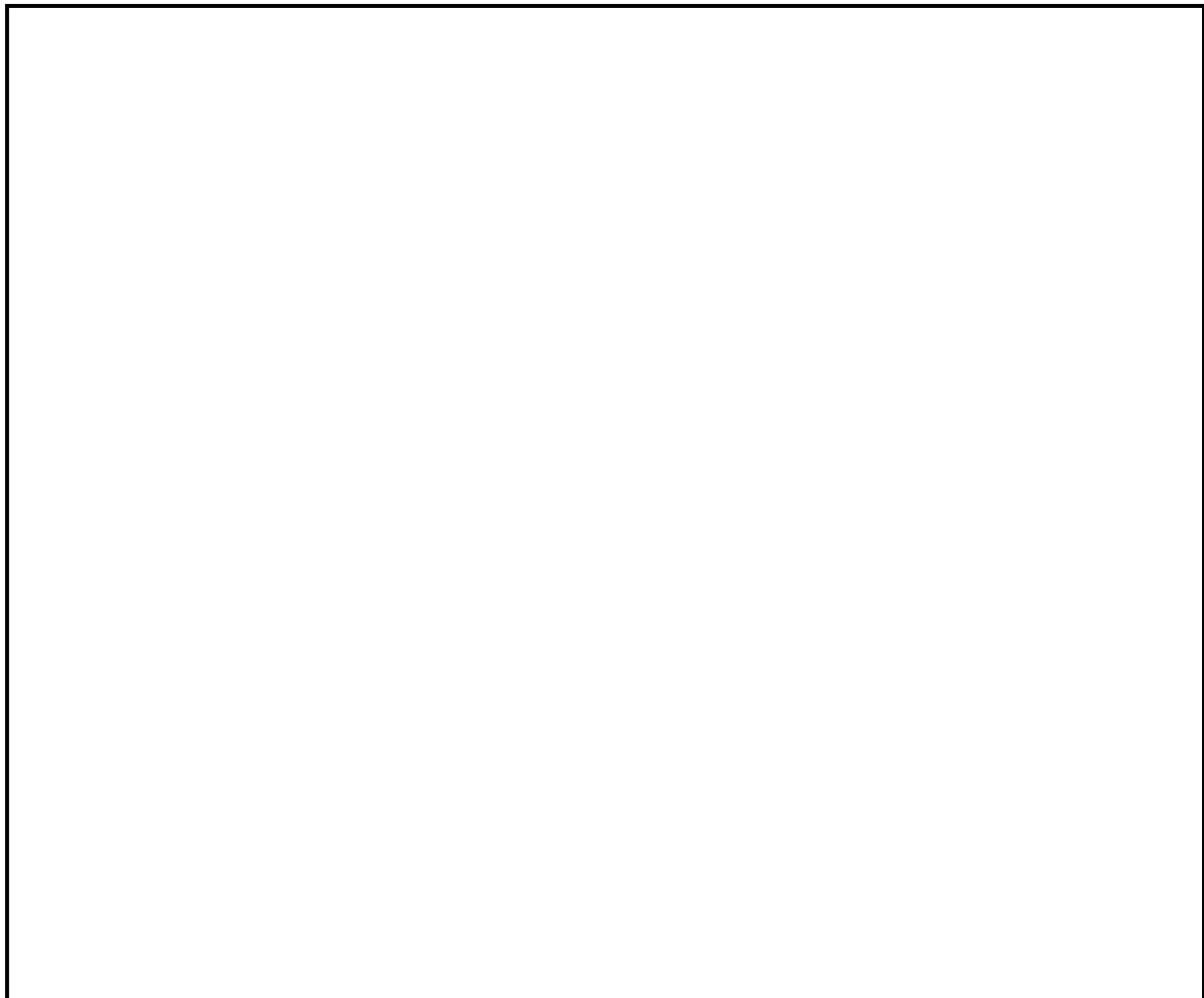


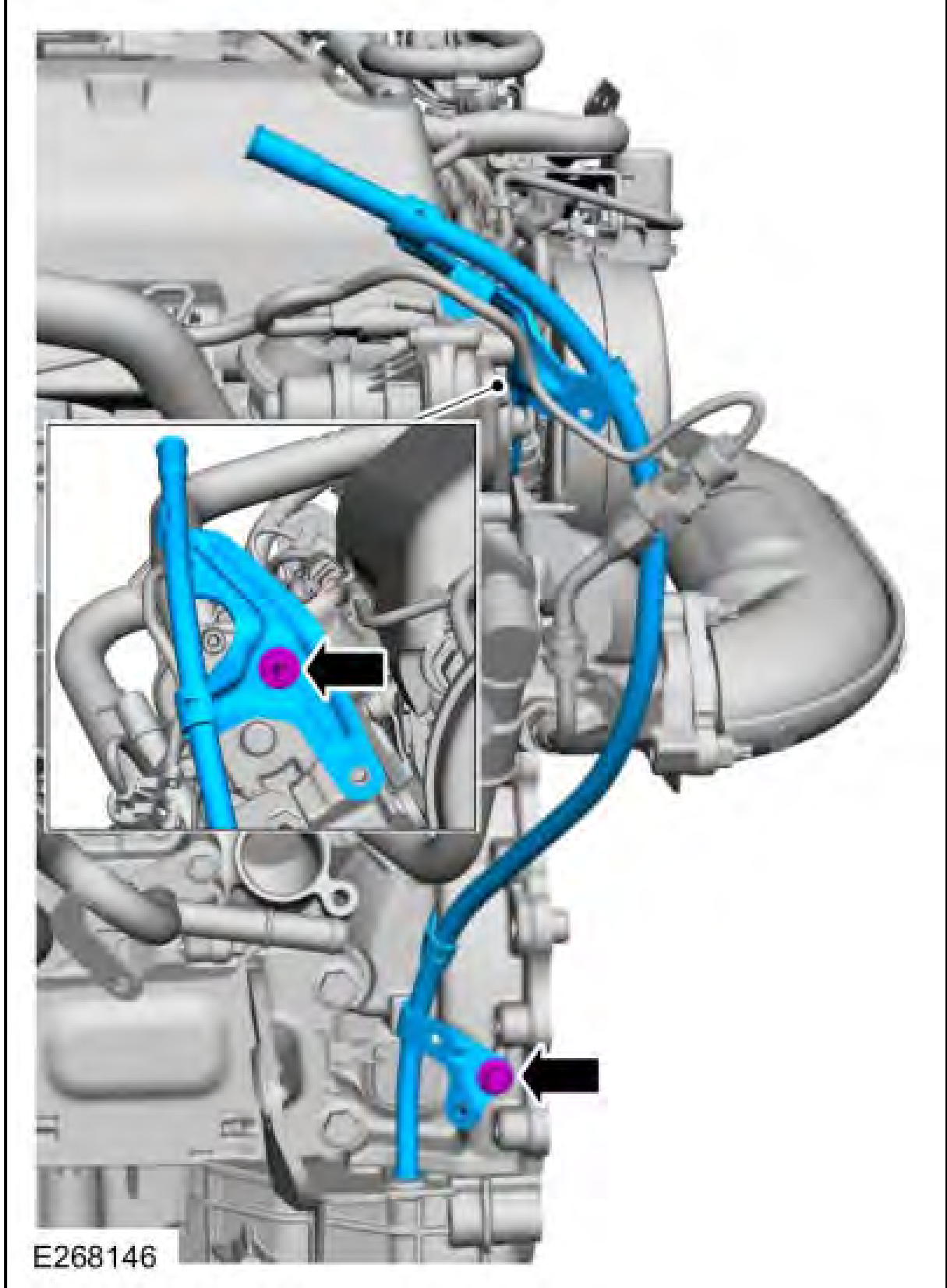
18. Remove the oil level indicator.





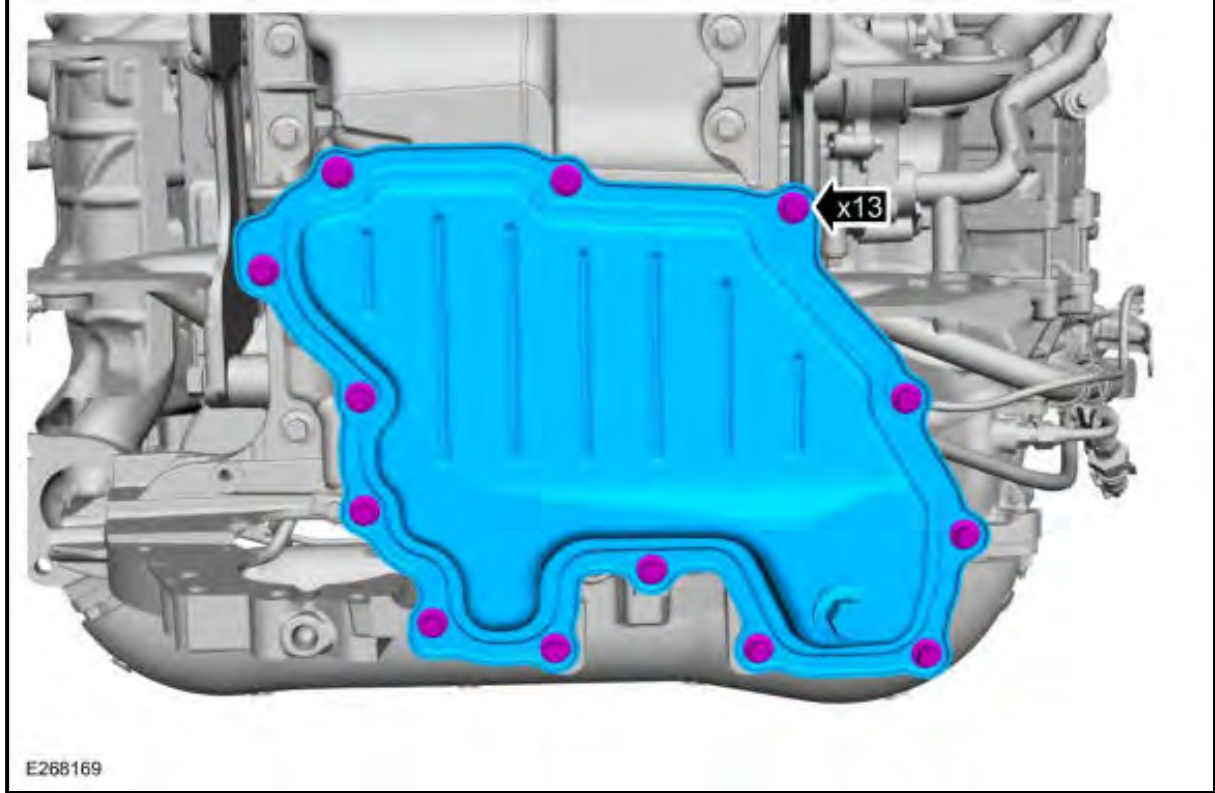
19. Remove the stud bolt, bolt and the oil level indicator.





20. Remove the bolts and the oil pan.





21. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.

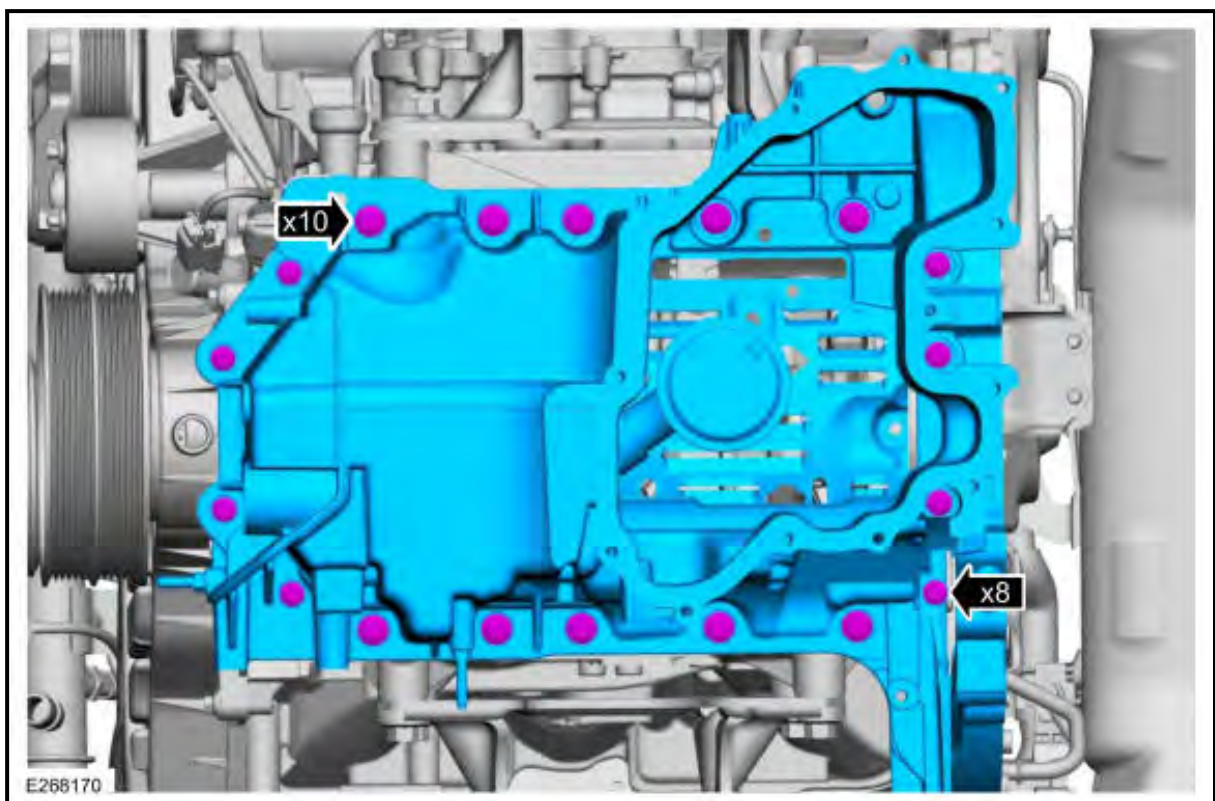
Make sure that the oil pan sealing surfaces are free of foreign material. Refer to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

Material: Motorcraft <sup>®</sup> Silicone Gasket Remover / ZC-30-A

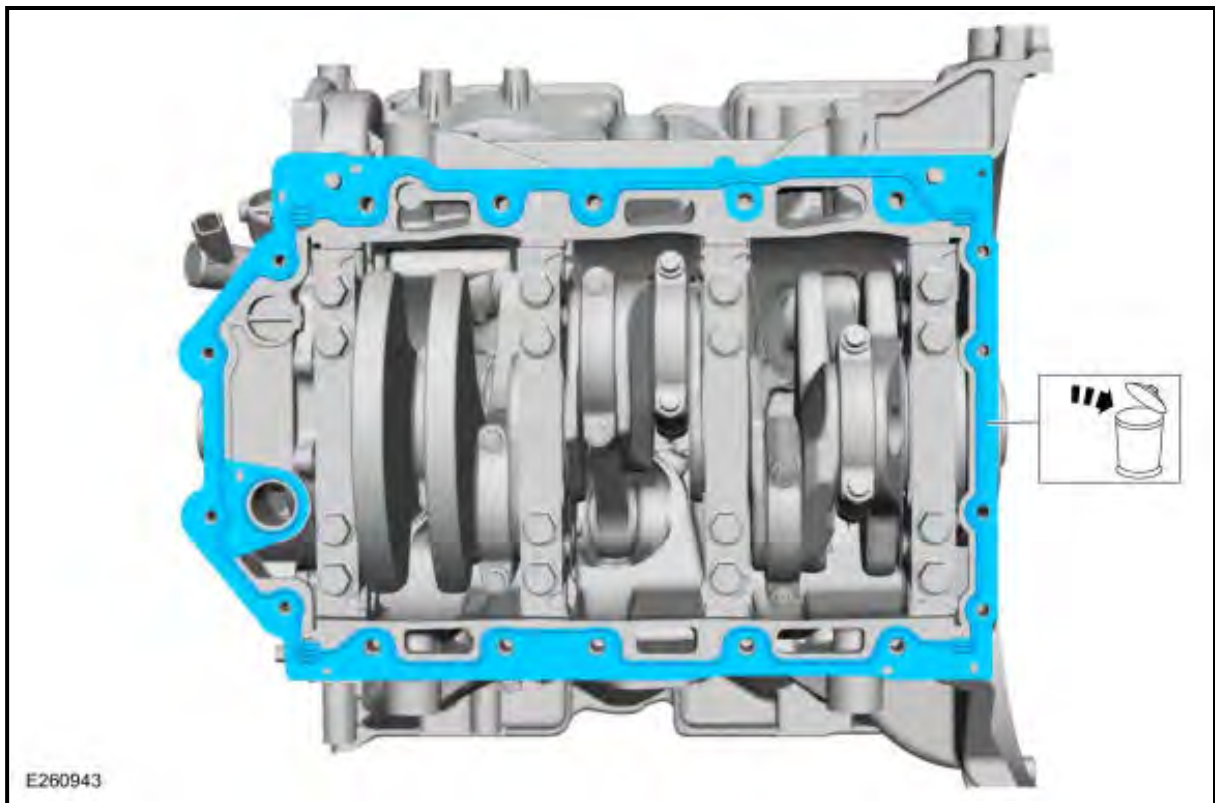
Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B

Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

22. Remove the bolts and the engine block skirt stiffener.



23. Remove and discard the engine block stiffener gasket.



24. Remove the engine block skirt stiffener alignment dowels.



25. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools

cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.

Clean and inspect the mating surfaces. Refer to: [RTV Sealing Surface Cleaning and Preparation](#)  
 . Use the General Equipment: Plastic Scraper

Material: Motorcraft Â® Silicone Gasket Remover / ZC-30-A

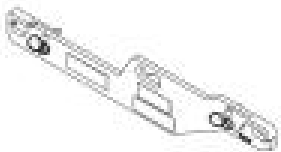
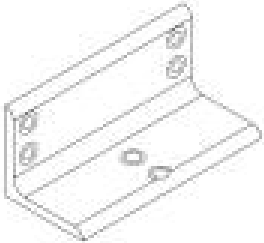
Material: Motorcraft Â® Metal Brake Parts Cleaner / PM-4-A, PM-4-B

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

**ENGINE - BODY OFF**

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

**Special Tool(s) / General Equipment**

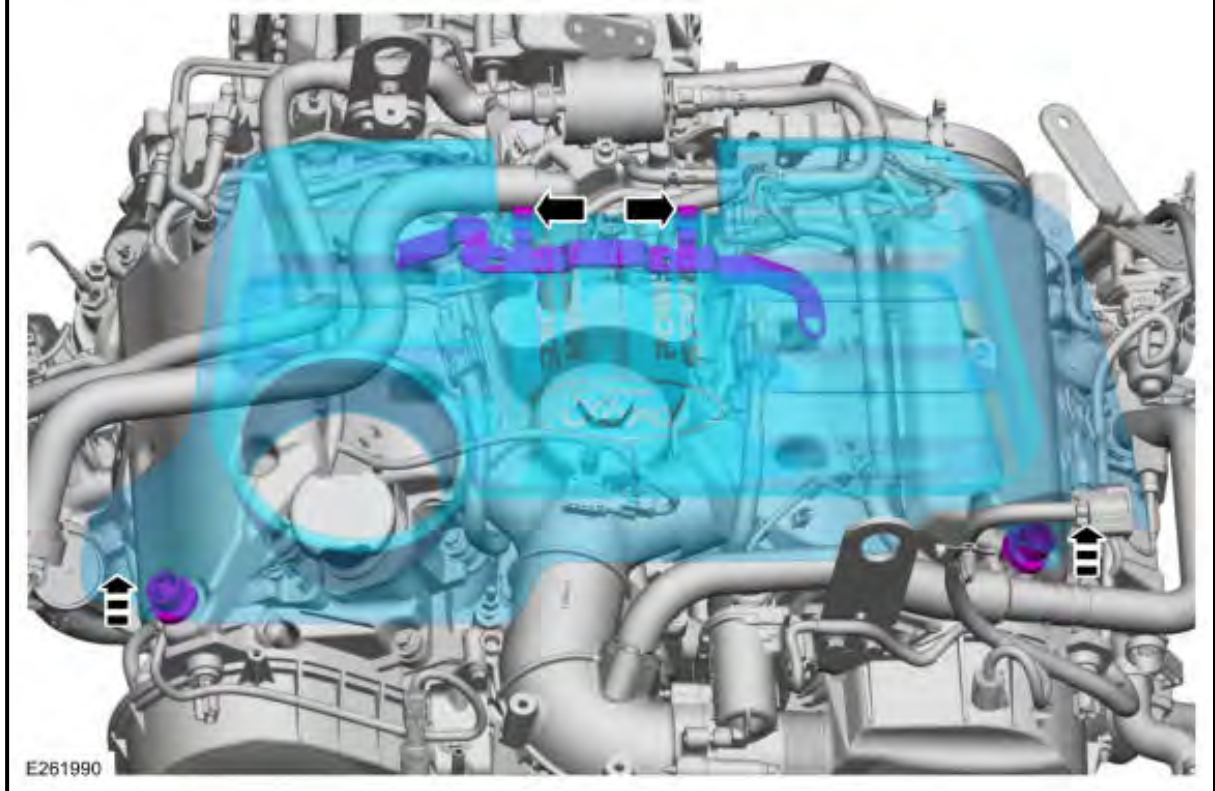
|   |  |
|---|--|
|  <p>E274098</p>  | <p>303-1681 Spreader Bar</p>   |
|  <p>E216422</p> | <p>307-625 Fixture, Bench Mounting<br/>                 TKIT-2008ET-FLM<br/>                 TKIT-2008ET-ROW</p> |
| <p>Floor Crane</p>  |  |
| <p>Oil Drain Equipment</p>  |  |
| <p>Trolley Jack</p>   |  |
| <p>Hose Clamp Remover/Installer</p>   |  |
| <p>Wooden Block</p>   |  |

**NOTE:** It is recommended that this component be serviced with the vehicle body removed. If the body cannot be removed, refer to Engine - Body On in this section.

1. With the vehicle in NEUTRAL, position it on a hoist. Refer to: [Jacking and Lifting - Overview](#) .
2. Release the fuel system pressure. Refer to: [Fuel System Pressure Release](#) .
3. Disconnect the battery ground cable. Refer to: [Battery Disconnect and Connect](#) .
4. Remove the engine appearance cover.

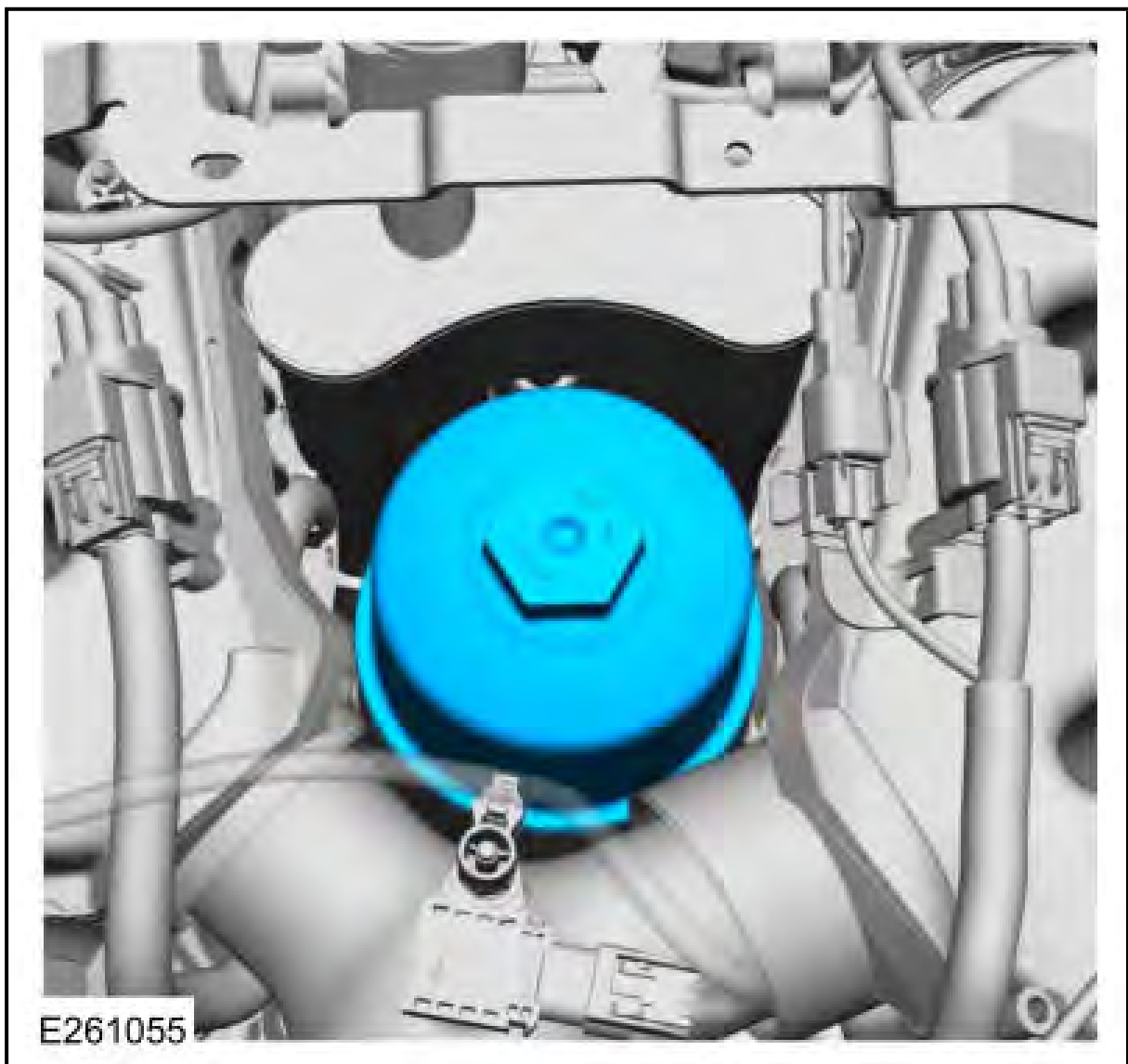




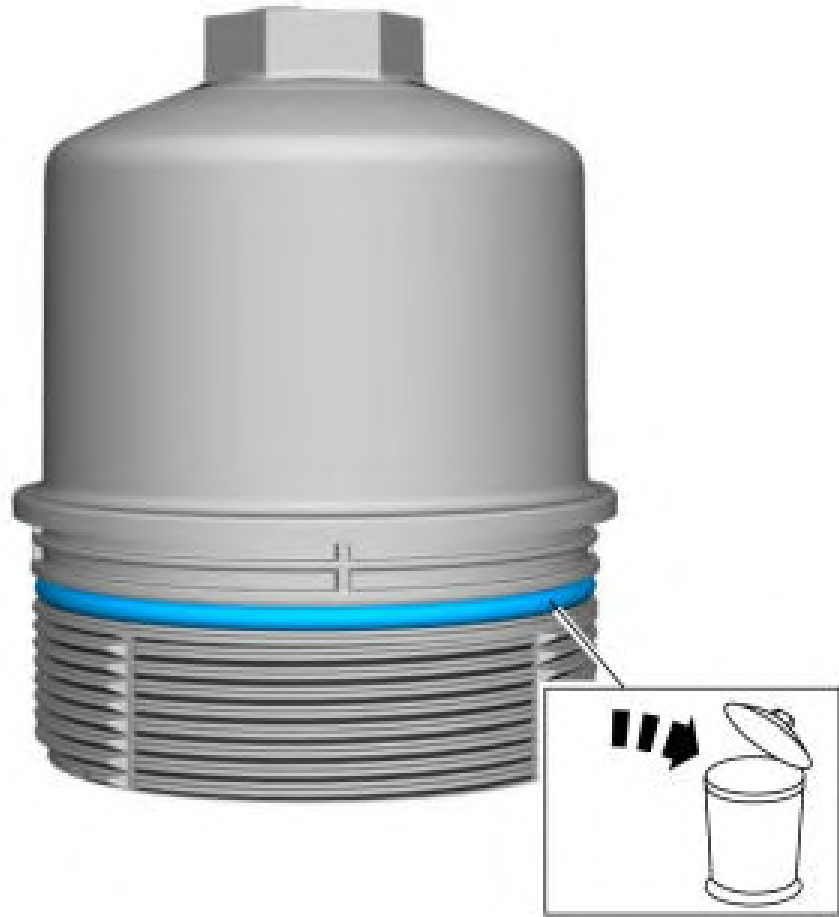


5. **NOTE:** The oil filter housing needs a minimum of 1 minute to allow the oil to drain out of the oil filter housing to minimise oil spillage.

Loosen the oil filter cap and let the oil filter housing drain. Remove the oil filter cap.

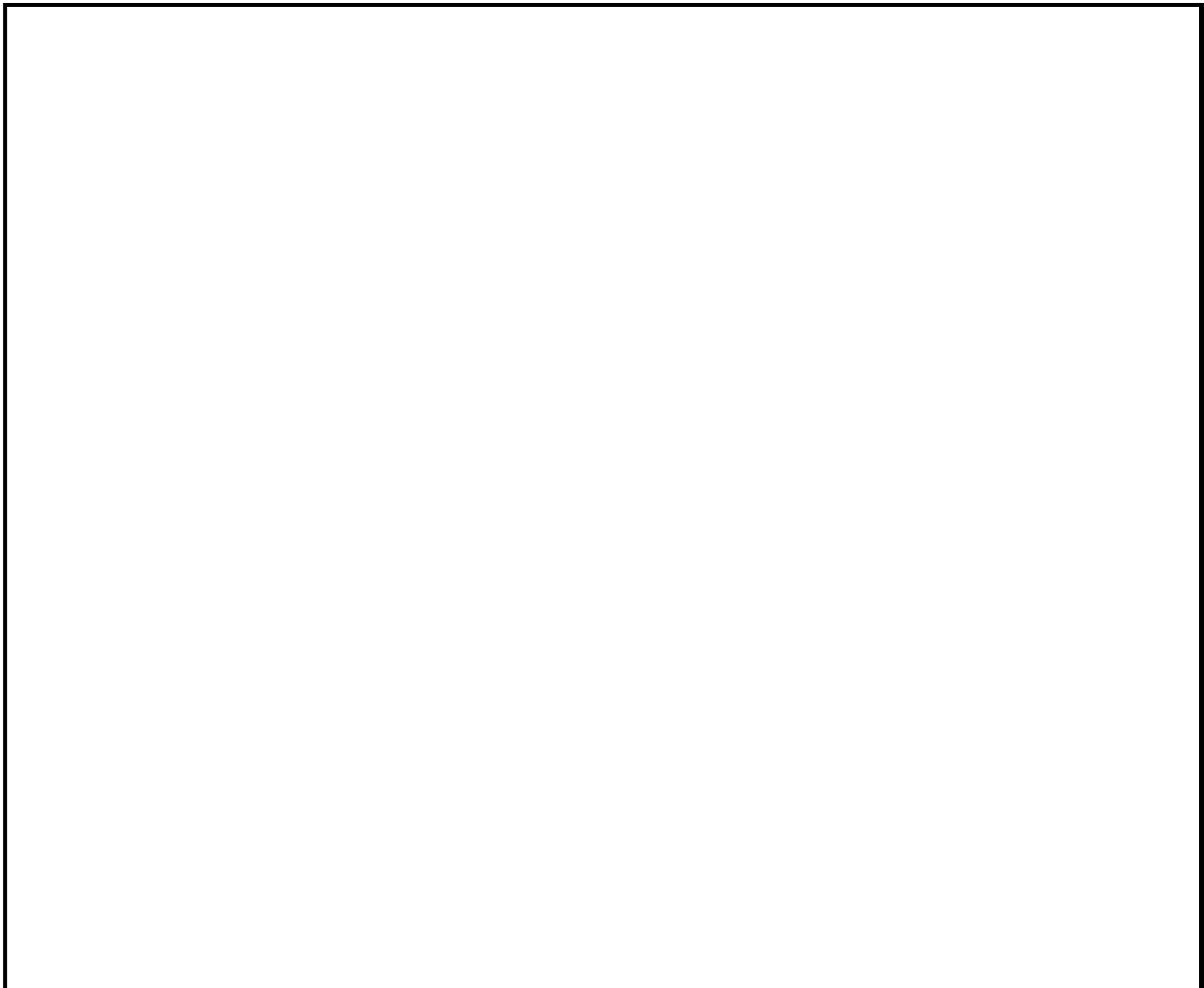


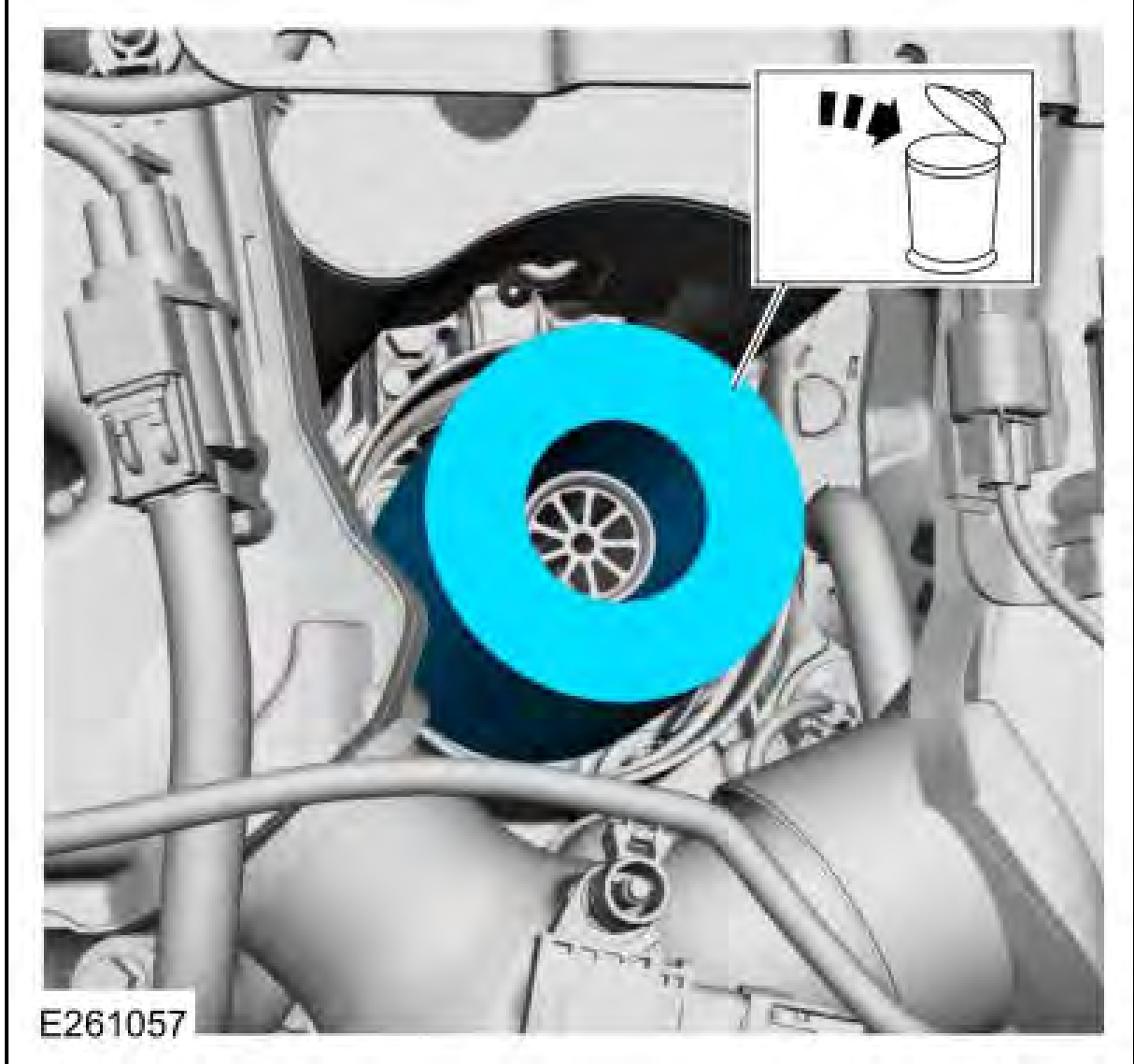
6. Remove and discard the oil filter cap O-ring seal.



E261056

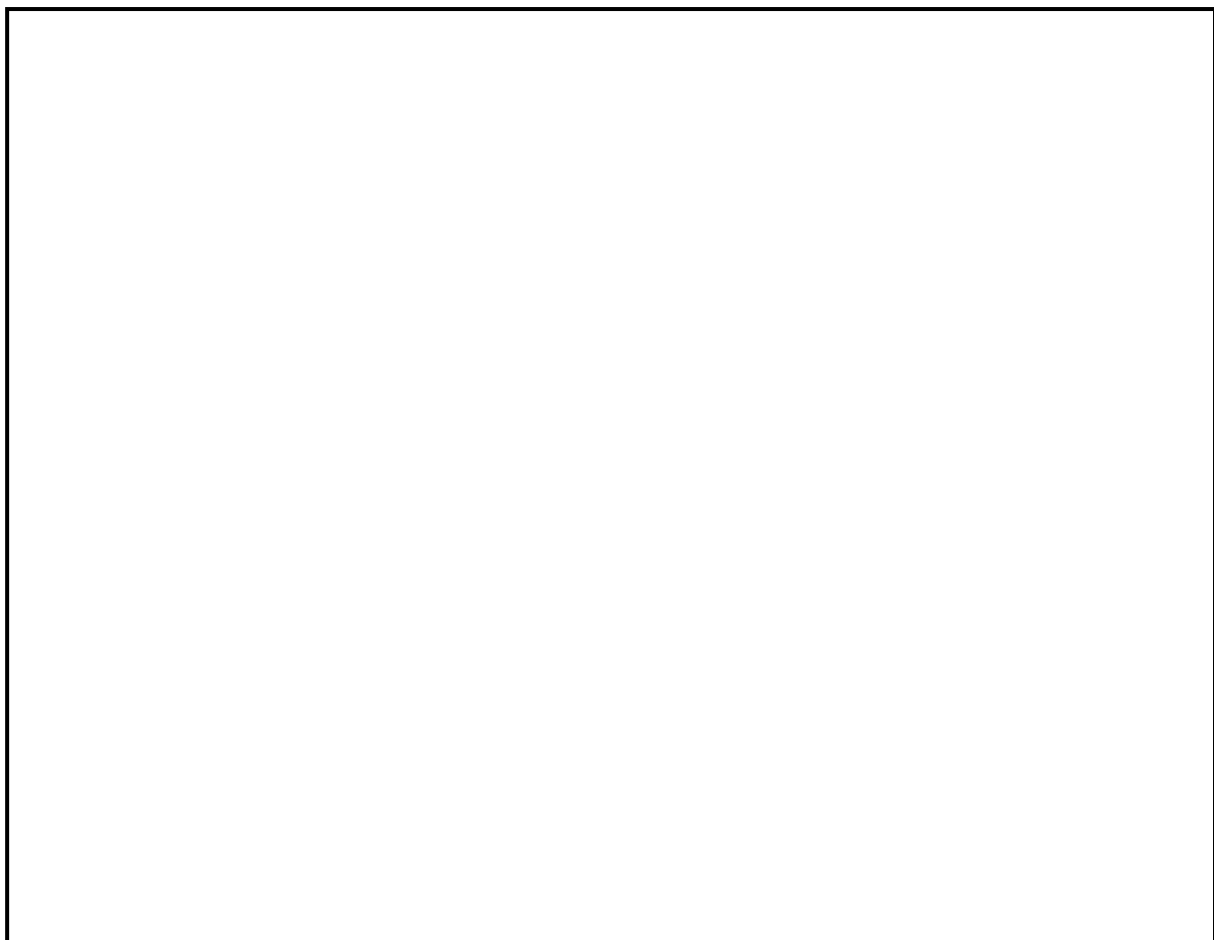
7. Remove and discard the oil filter. Use the General Equipment: Oil Drain Equipment

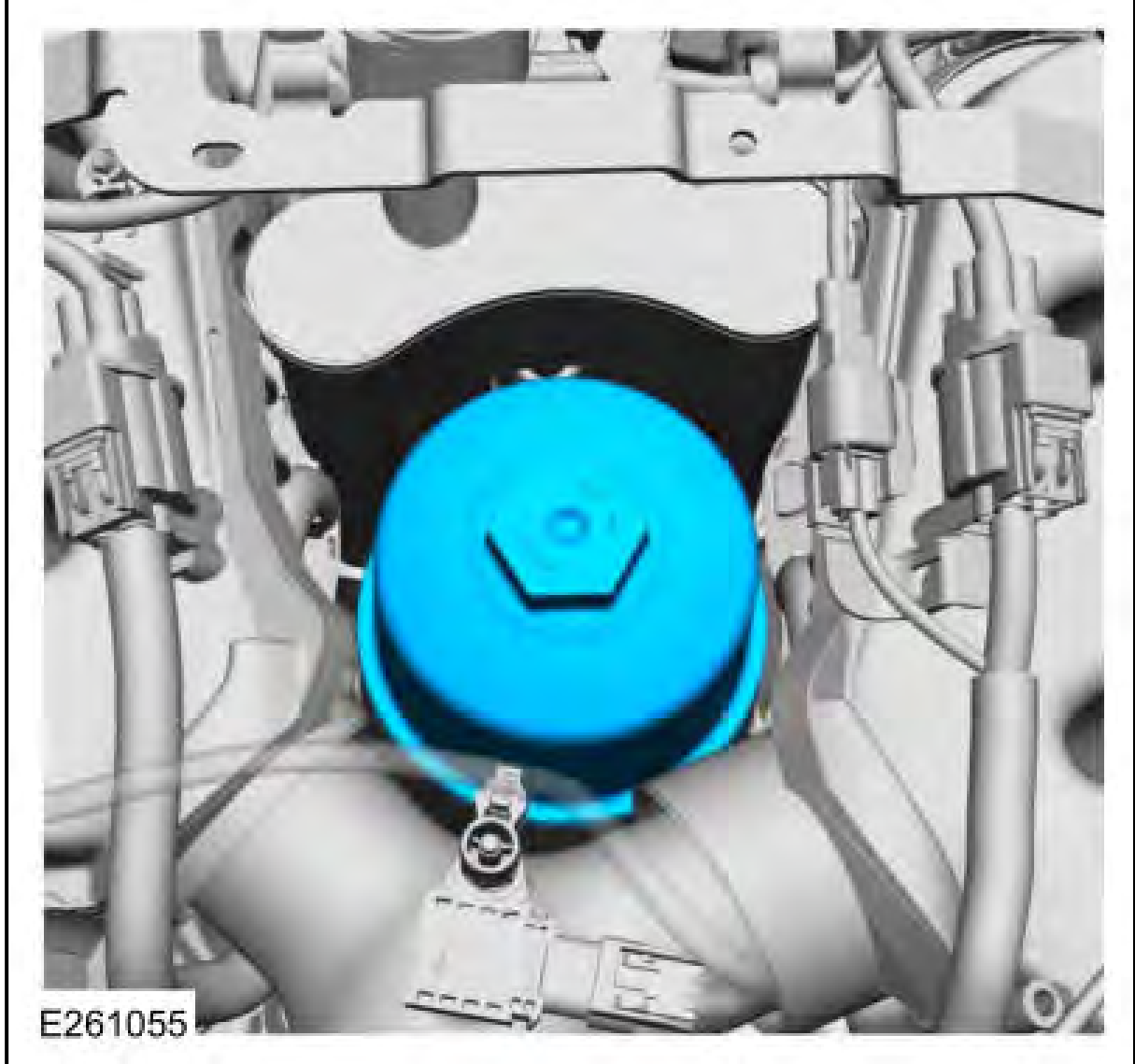




8. Install the oil filter cap

Torque: 18 lb.ft (25 Nm)

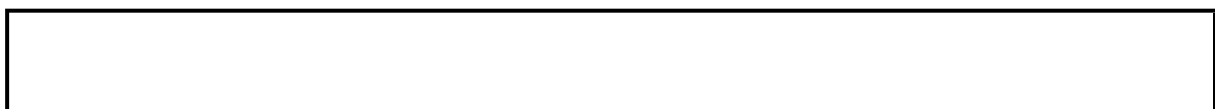


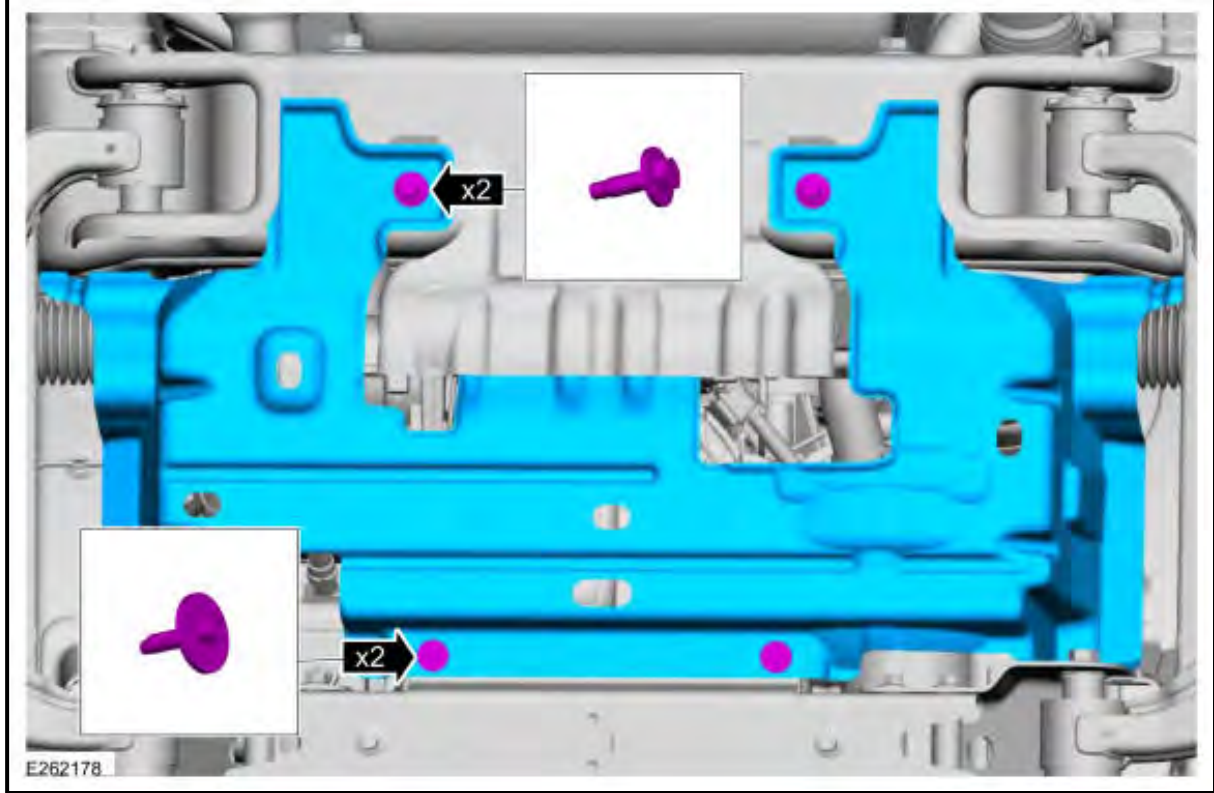


9. Remove the retainer. Remove the bolts and the transmission housing cover.

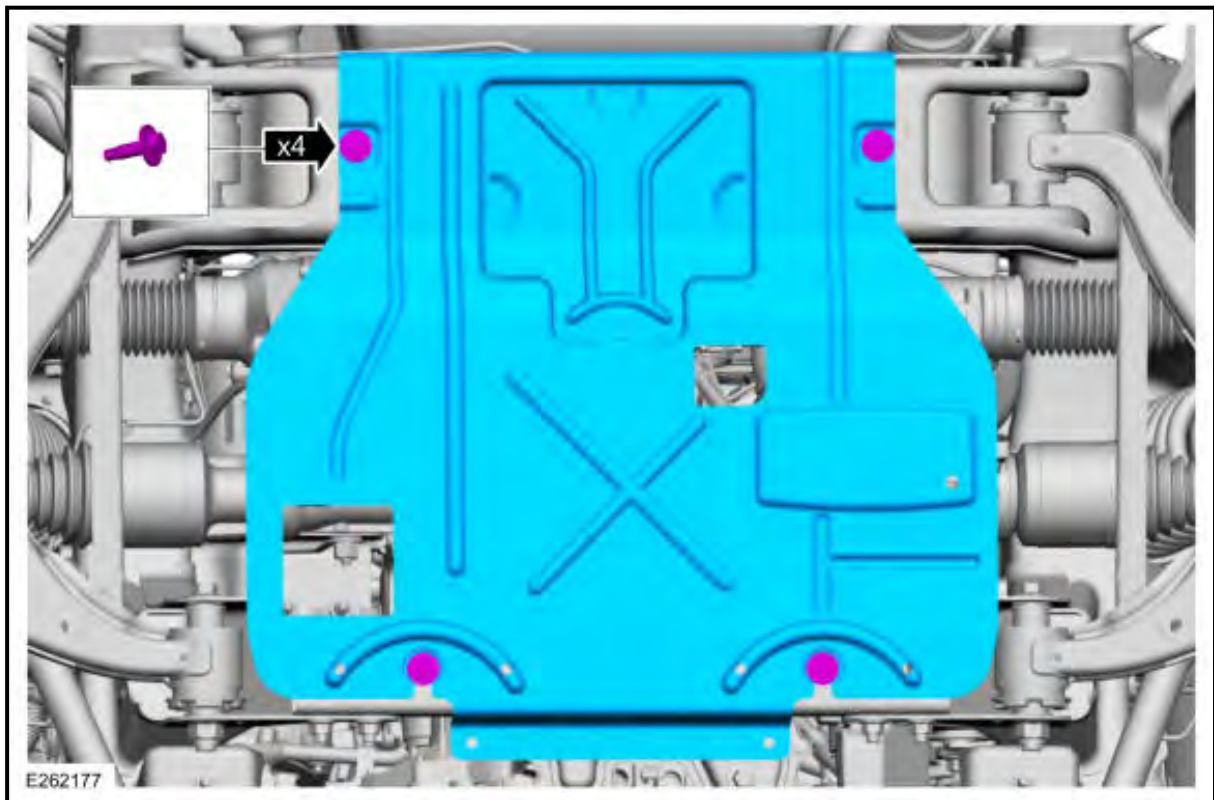


10. If equipped, remove the bolts and the underbody shield.





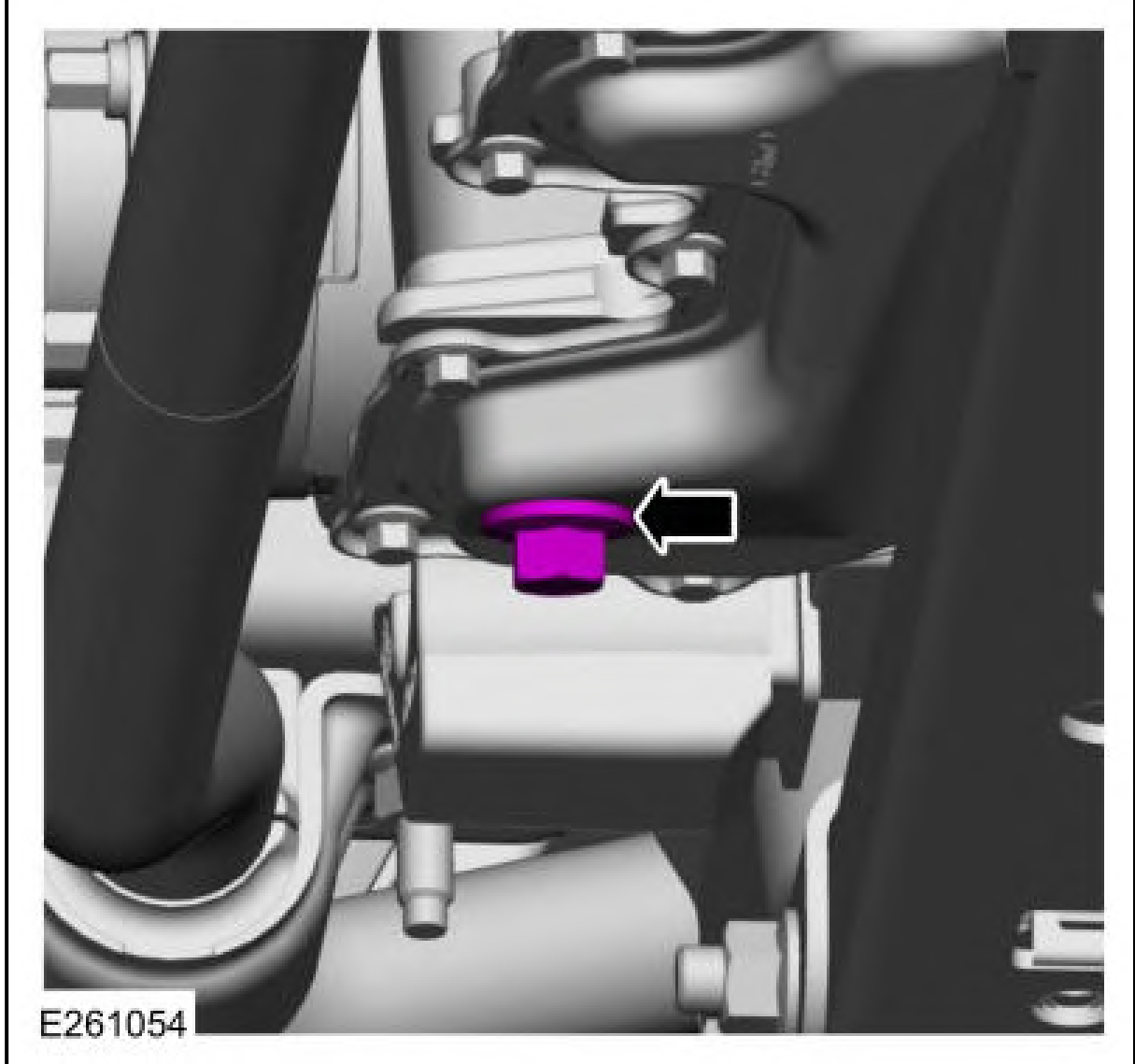
11. If equipped, remove the bolts and the skid plate.



12. Remove the oil pan plug and drain the engine oil. Use the General Equipment: Oil Drain Equipment

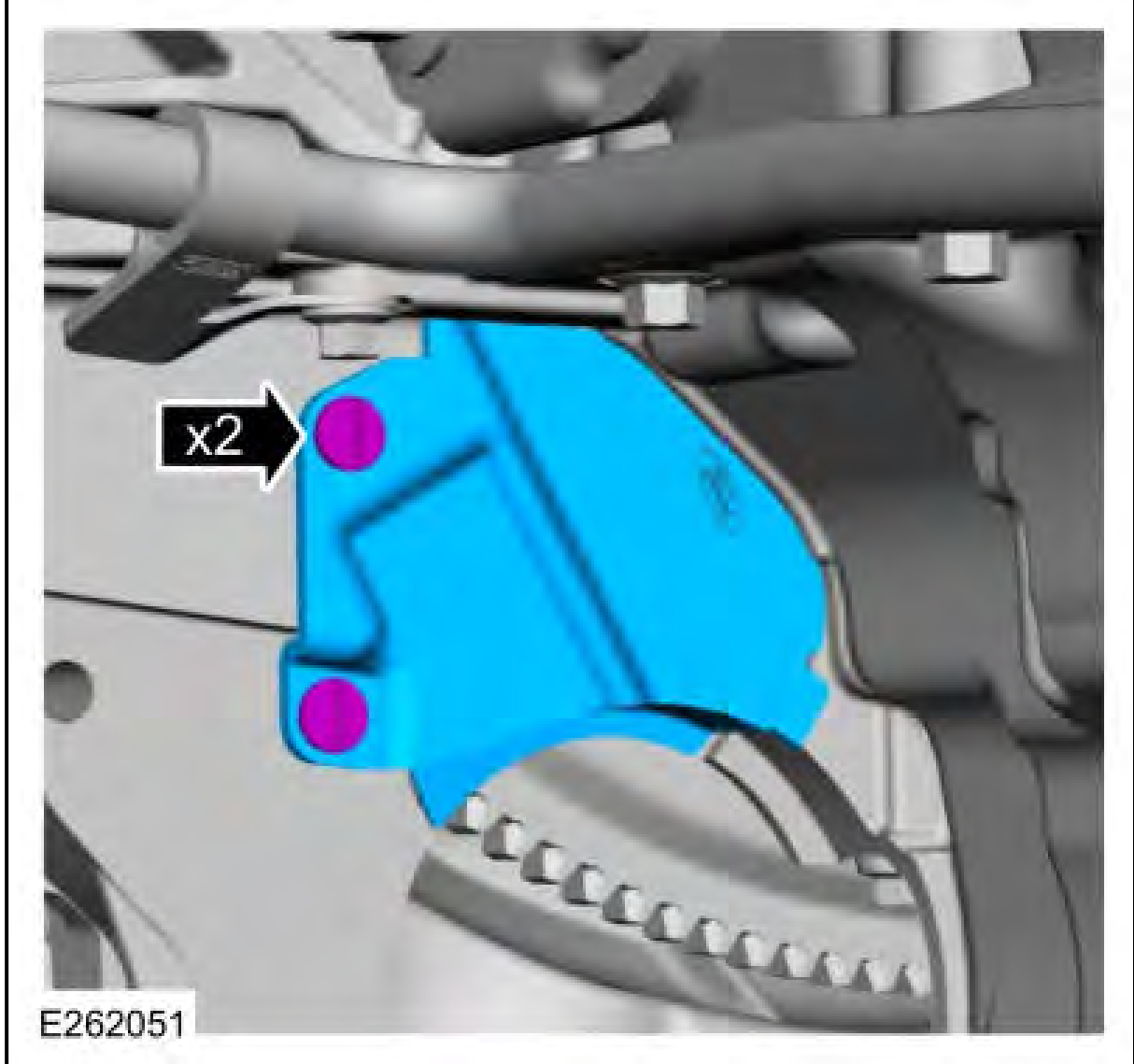
Torque: 18 lb.ft (25 Nm)





13. Remove the starter motor. Refer to: [Starter Motor](#) .
14. Remove the retainers and the access cover.

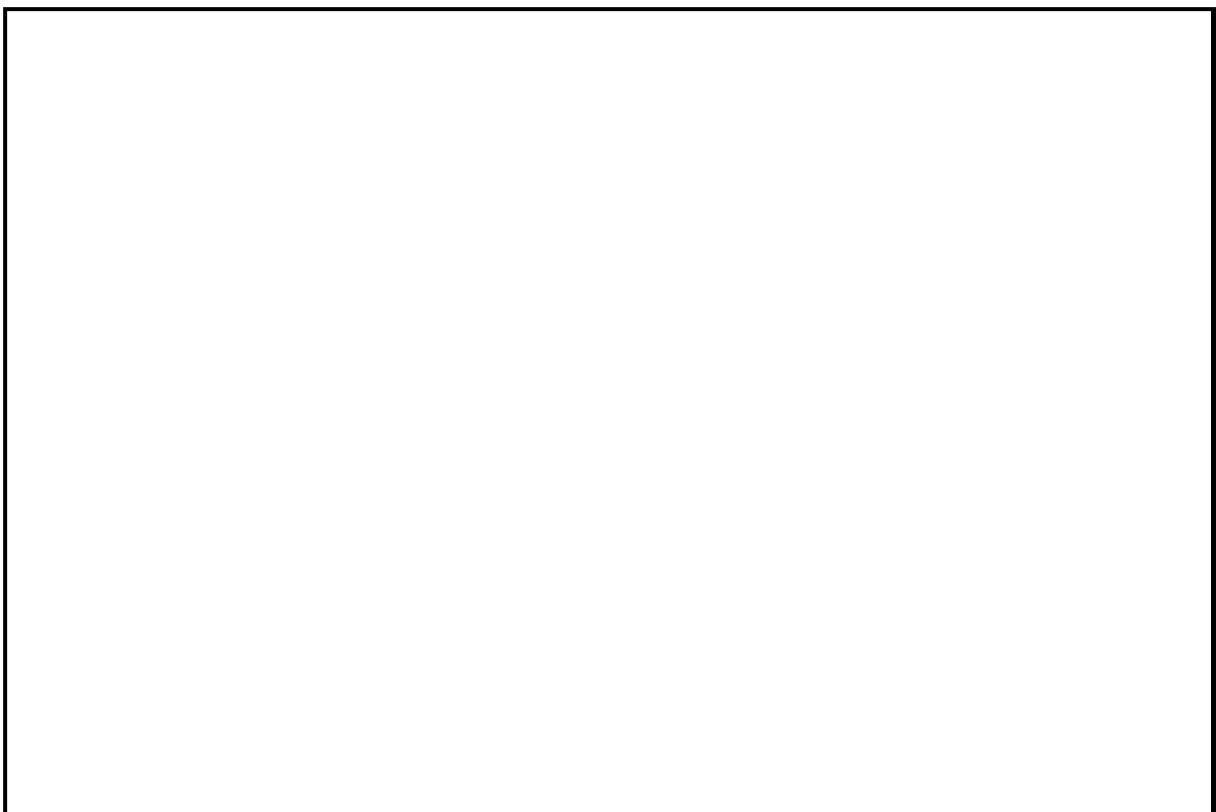


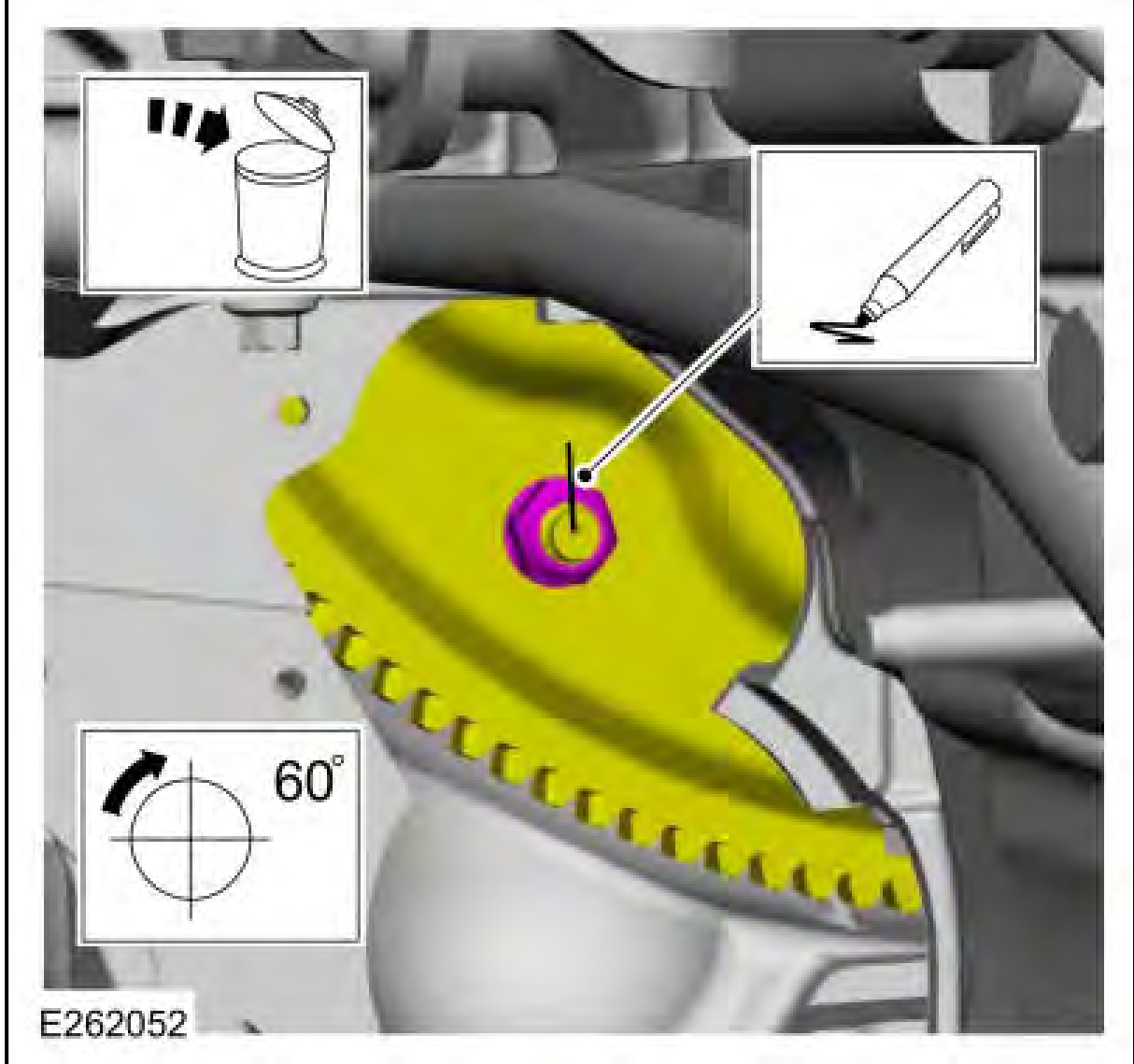


15. **NOTE:** Index-mark the end of one torque converter stud and the flexplate for installation.

**NOTE:** Using the crankshaft pulley bolt, turn the engine clockwise.

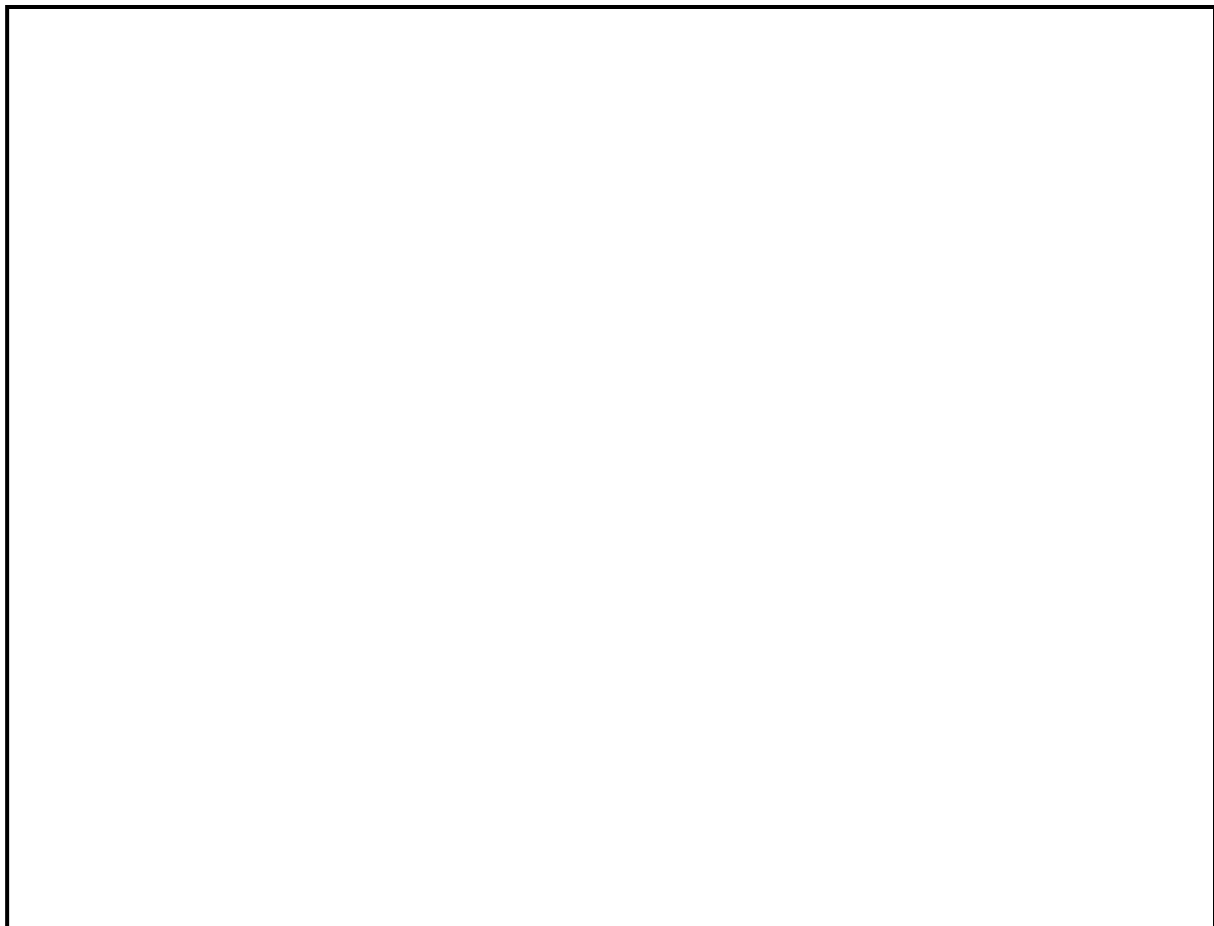
Remove and discard the torque converter nuts.



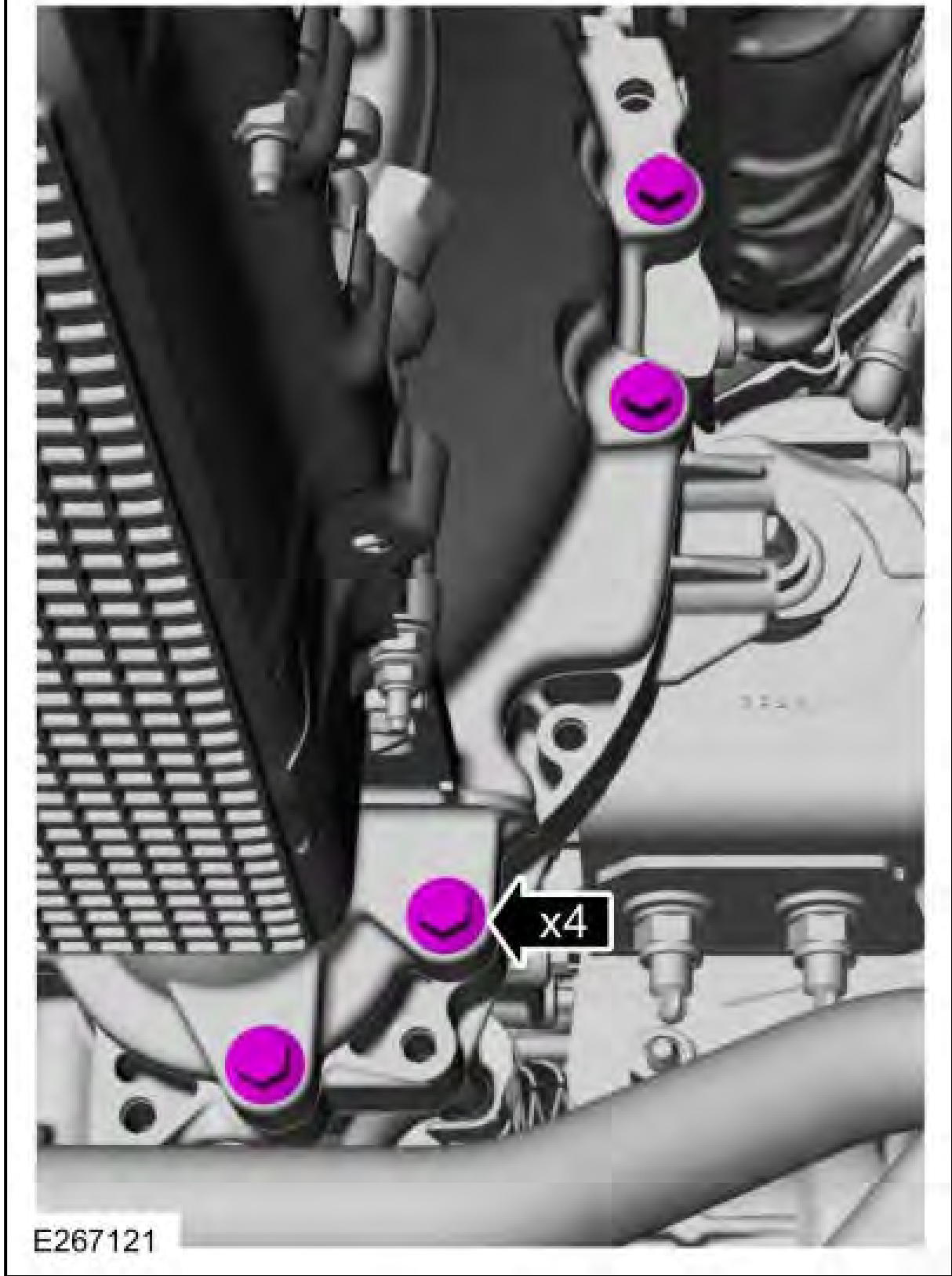


16. **NOTE:** Mark the location of the bolts during removal.

Remove the RH side bellhousing bolts.

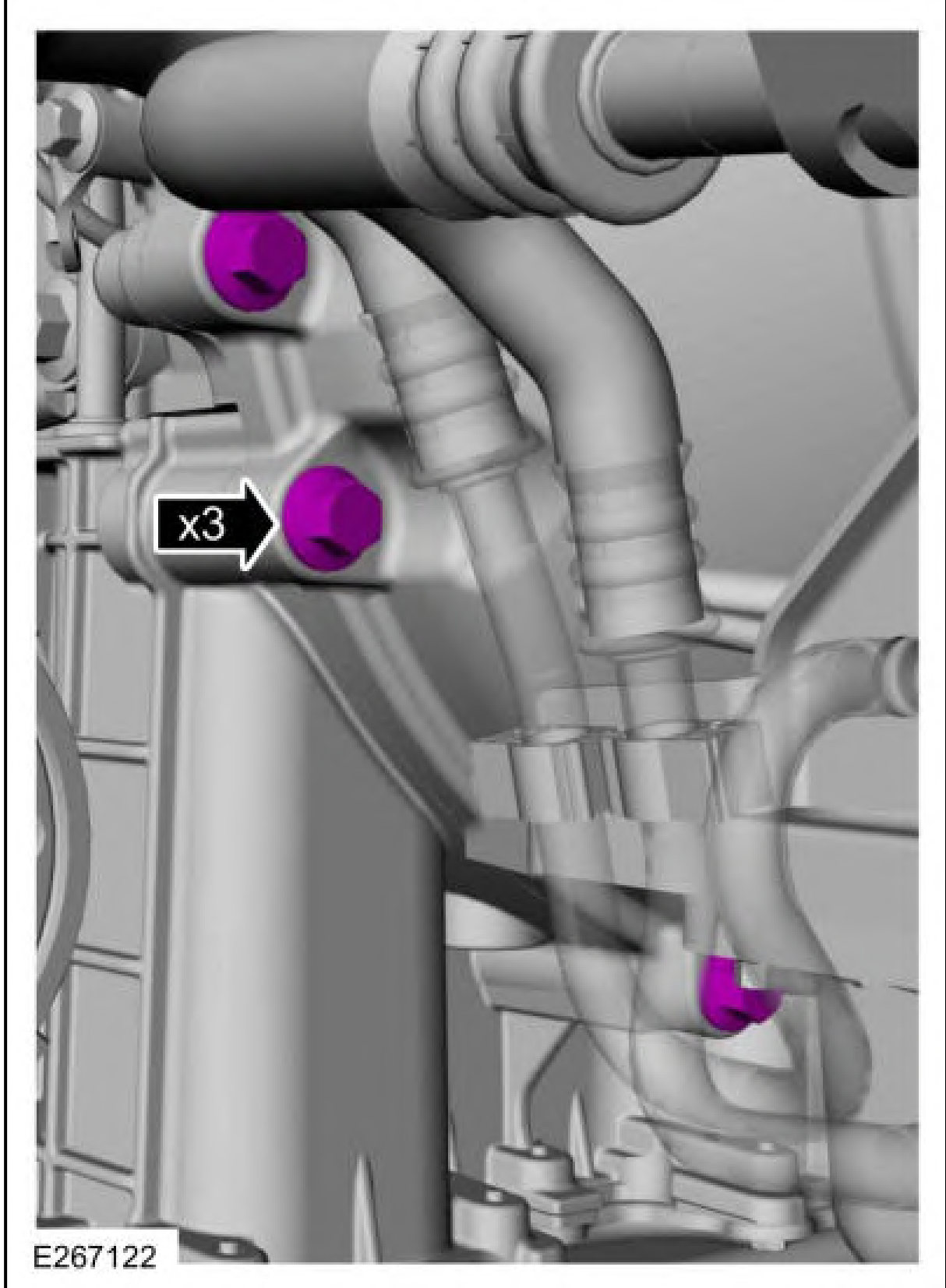






17. Remove the LH side bellhousing bolts.

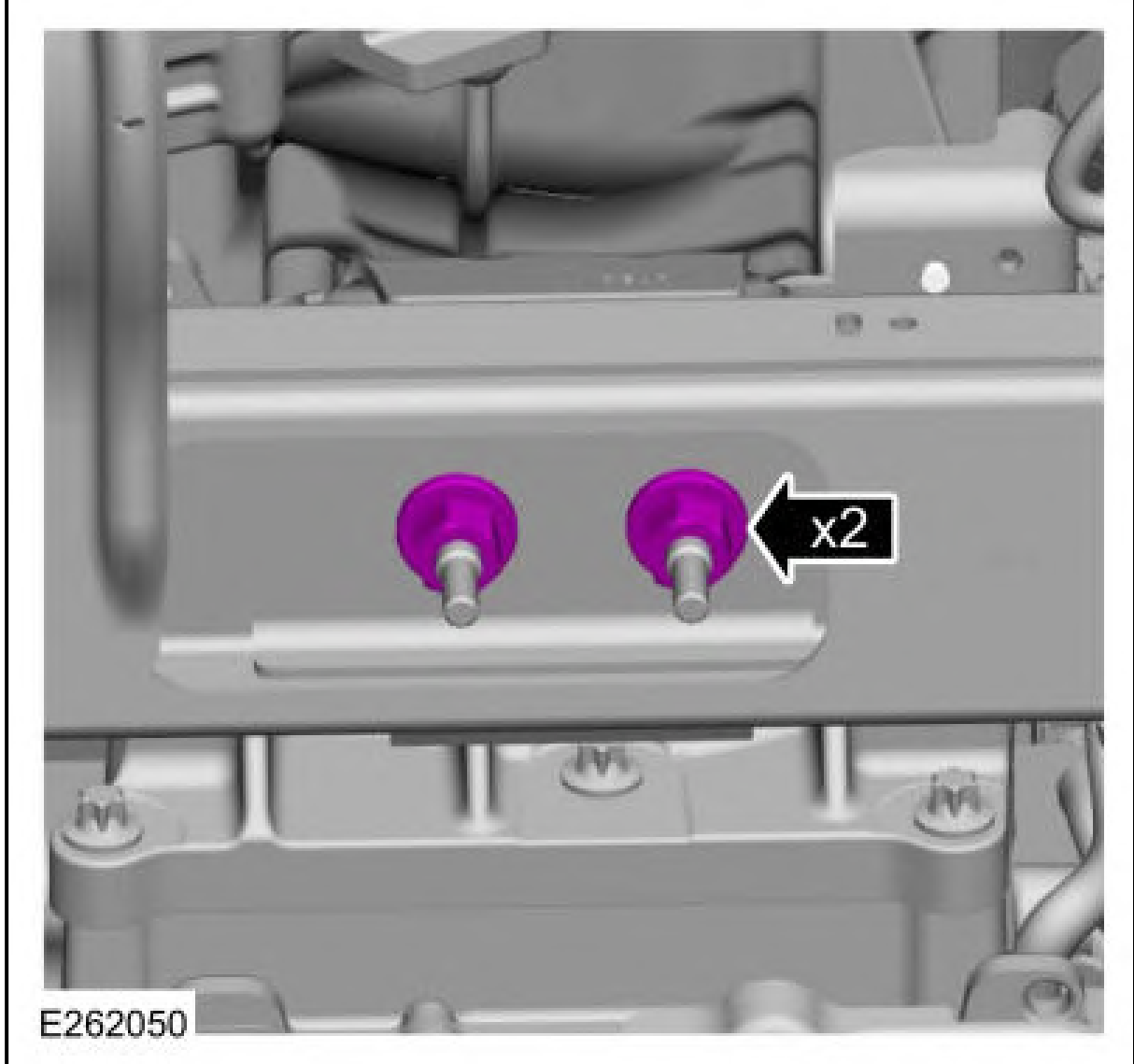




18. **NOTE:** Only use hand tools when removing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.

Loosen the transmission mount-to-crossmember nuts.

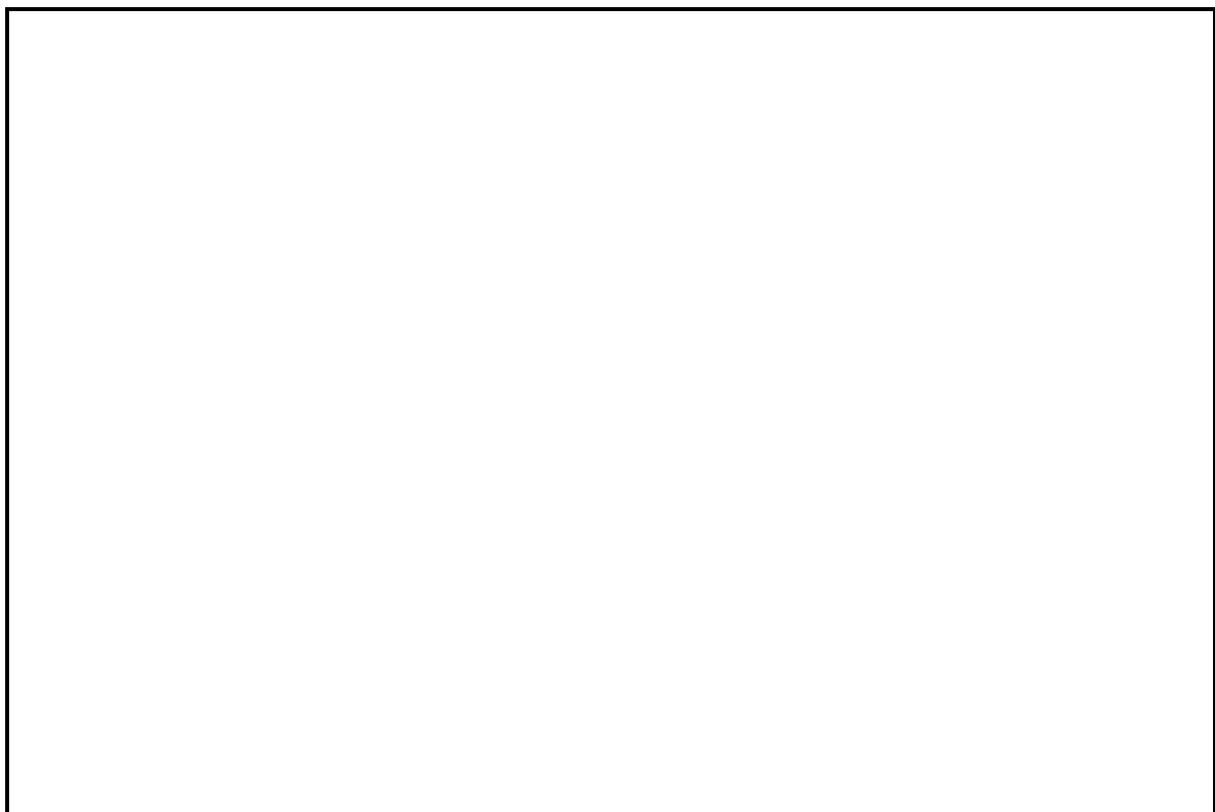


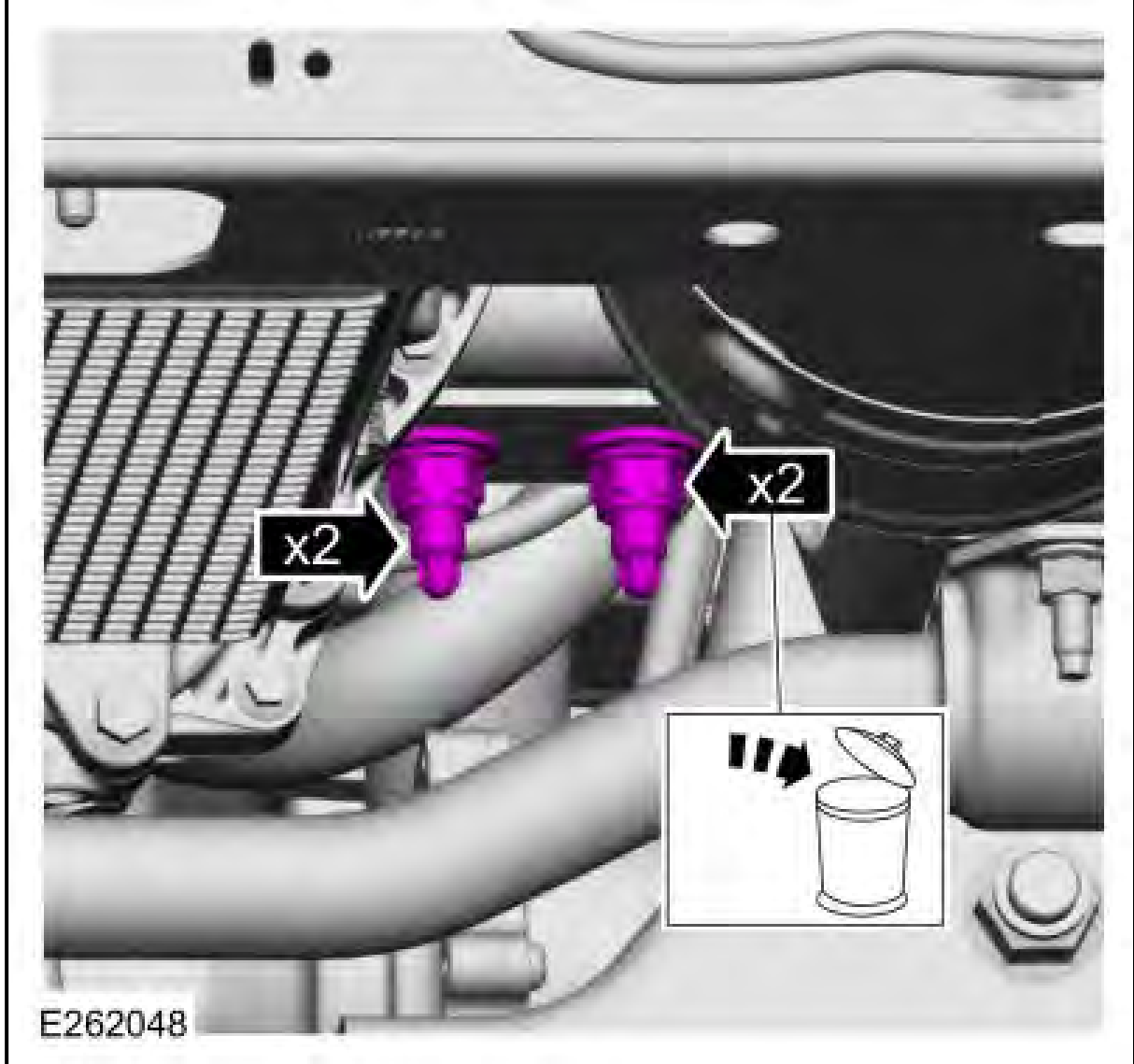


19. **NOTE:** Only use hand tools when removing the engine mount nuts and studs or damage to the engine mount can occur.

**NOTE:** The engine mount studs may come off with the nuts.

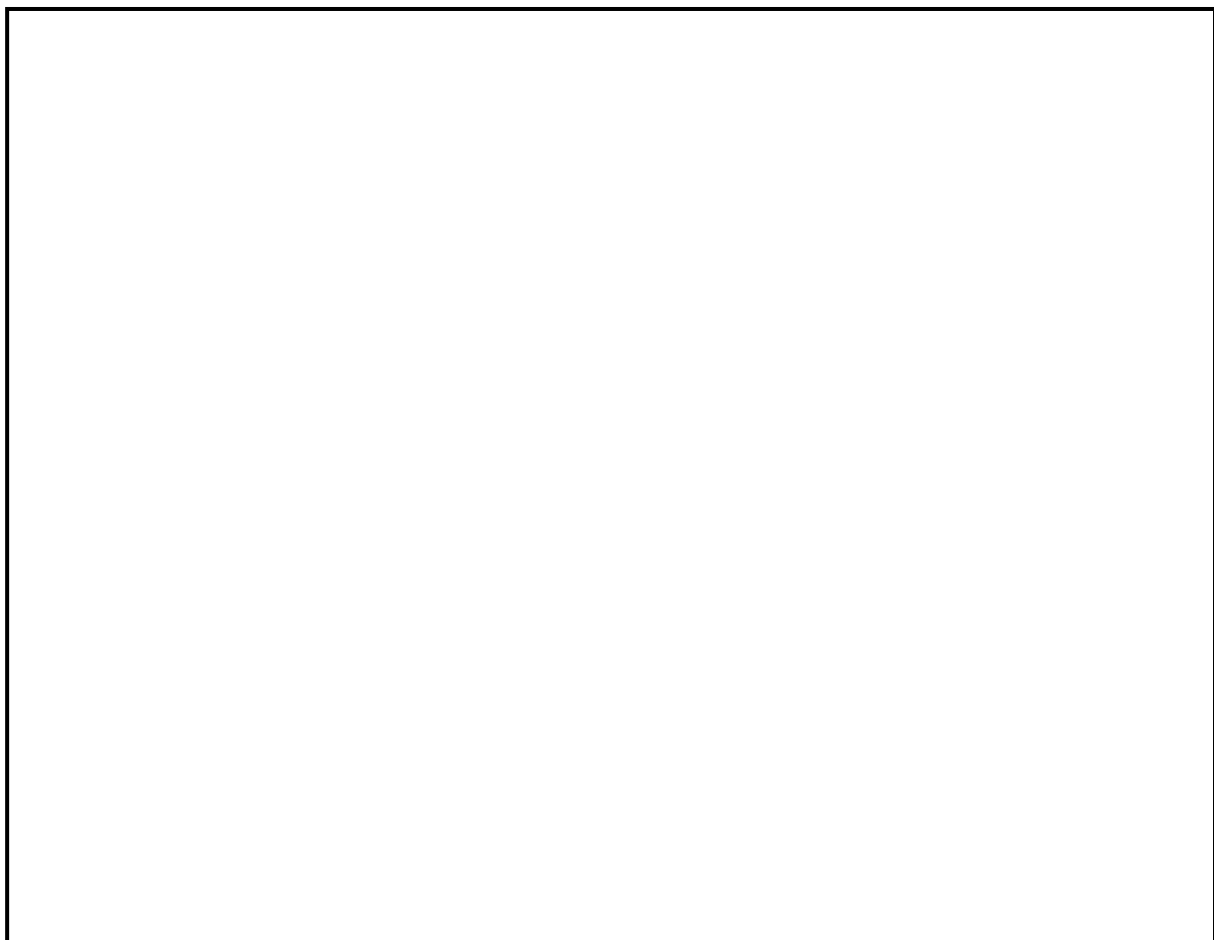
Remove and discard the RH engine mount nuts. Remove the engine mount studs.

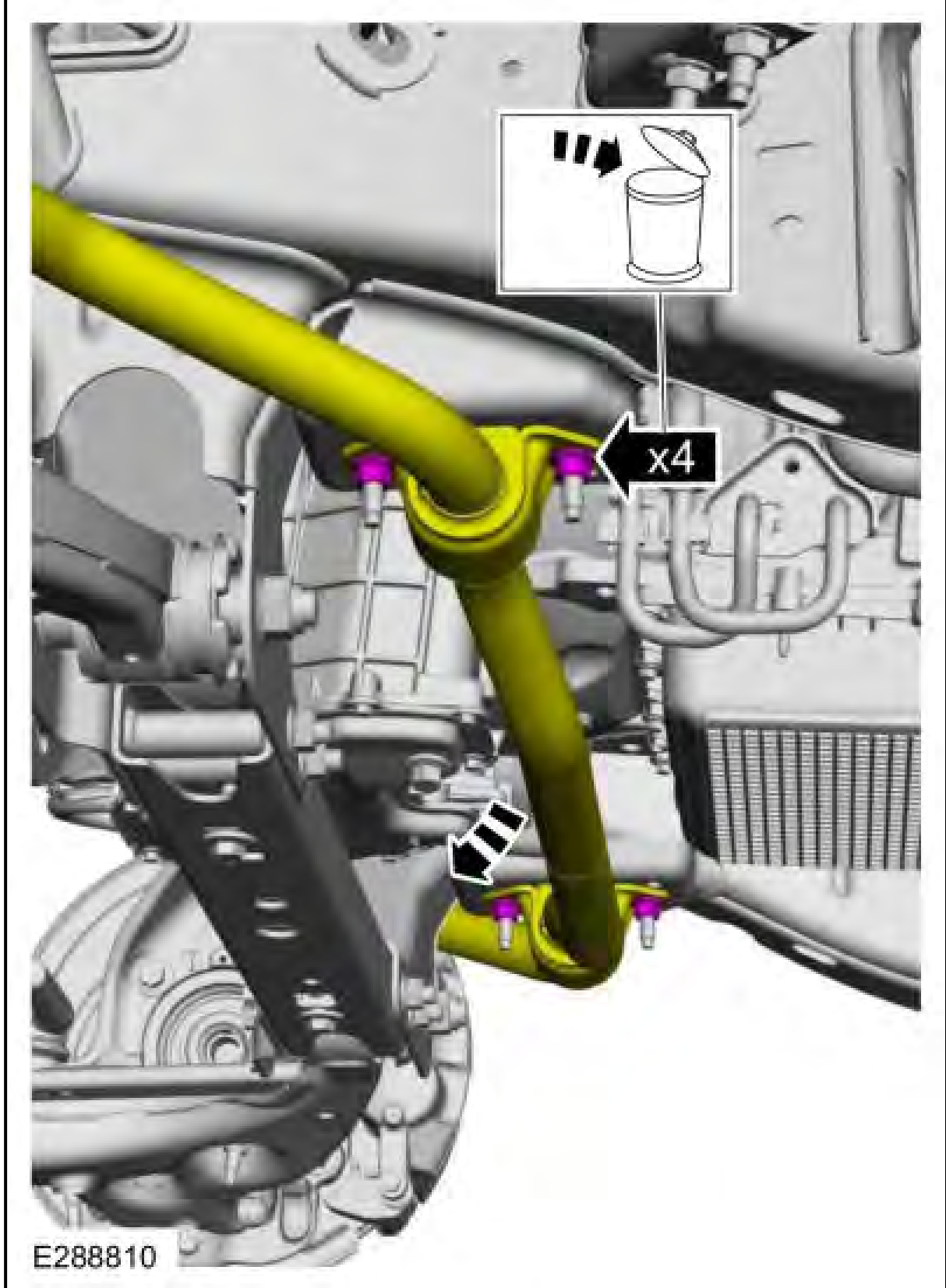




20. Remove and discard the stabilizer nuts.

- Allow the stabilizer bar to swing downward.





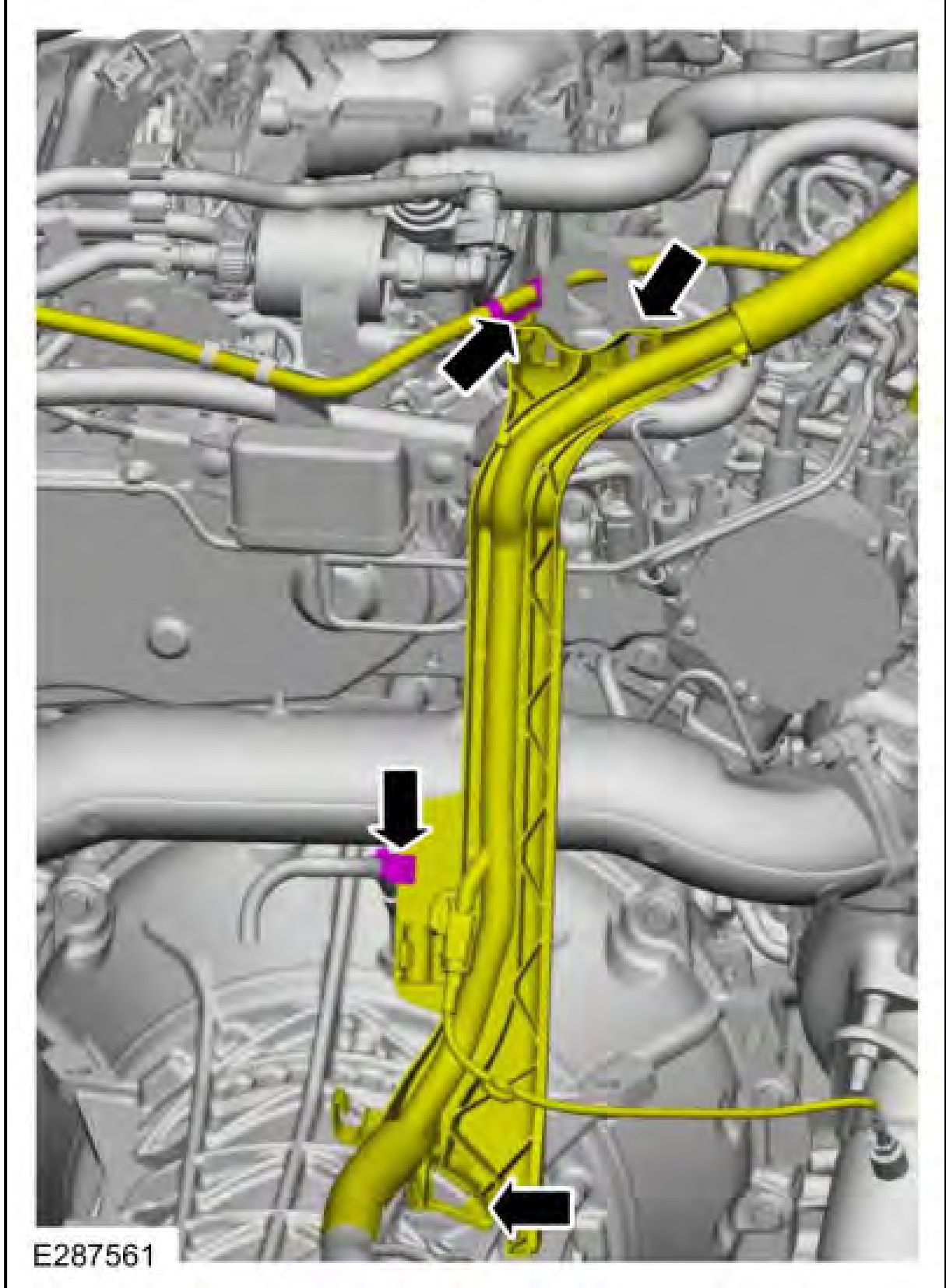
21. Remove the body. Refer to: [Body - 3.0L Power Stroke Diesel](#).

22. Roll the chassis out from under the body.

- Install wheel chocks at the front and back of one wheel.

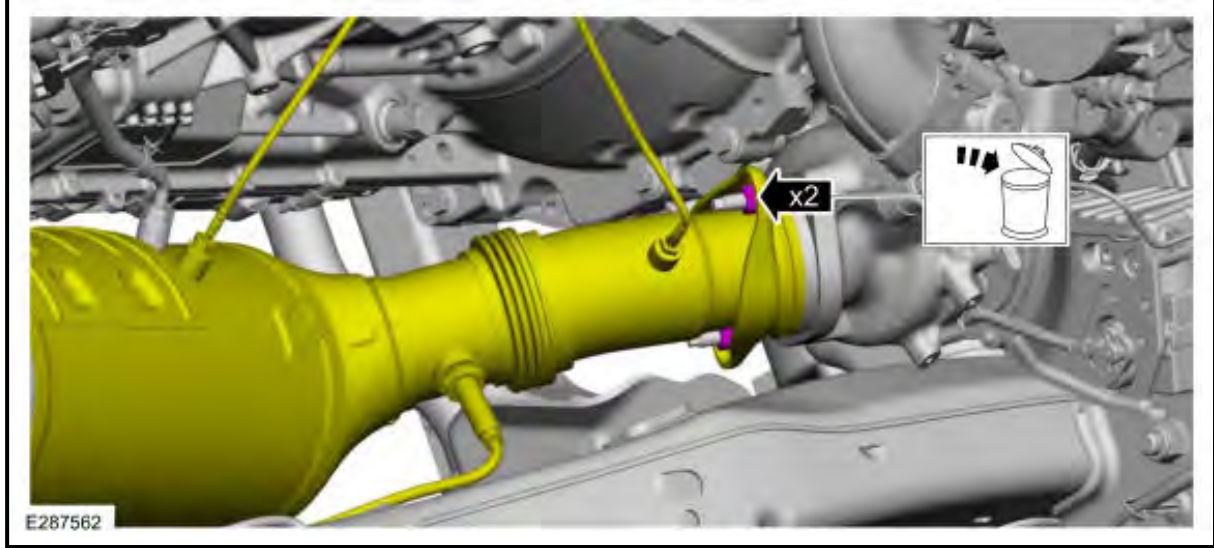
23. Disconnect the vacuum hose retainer and the transmission vent tube. Disconnect the wire harness housing and position aside.



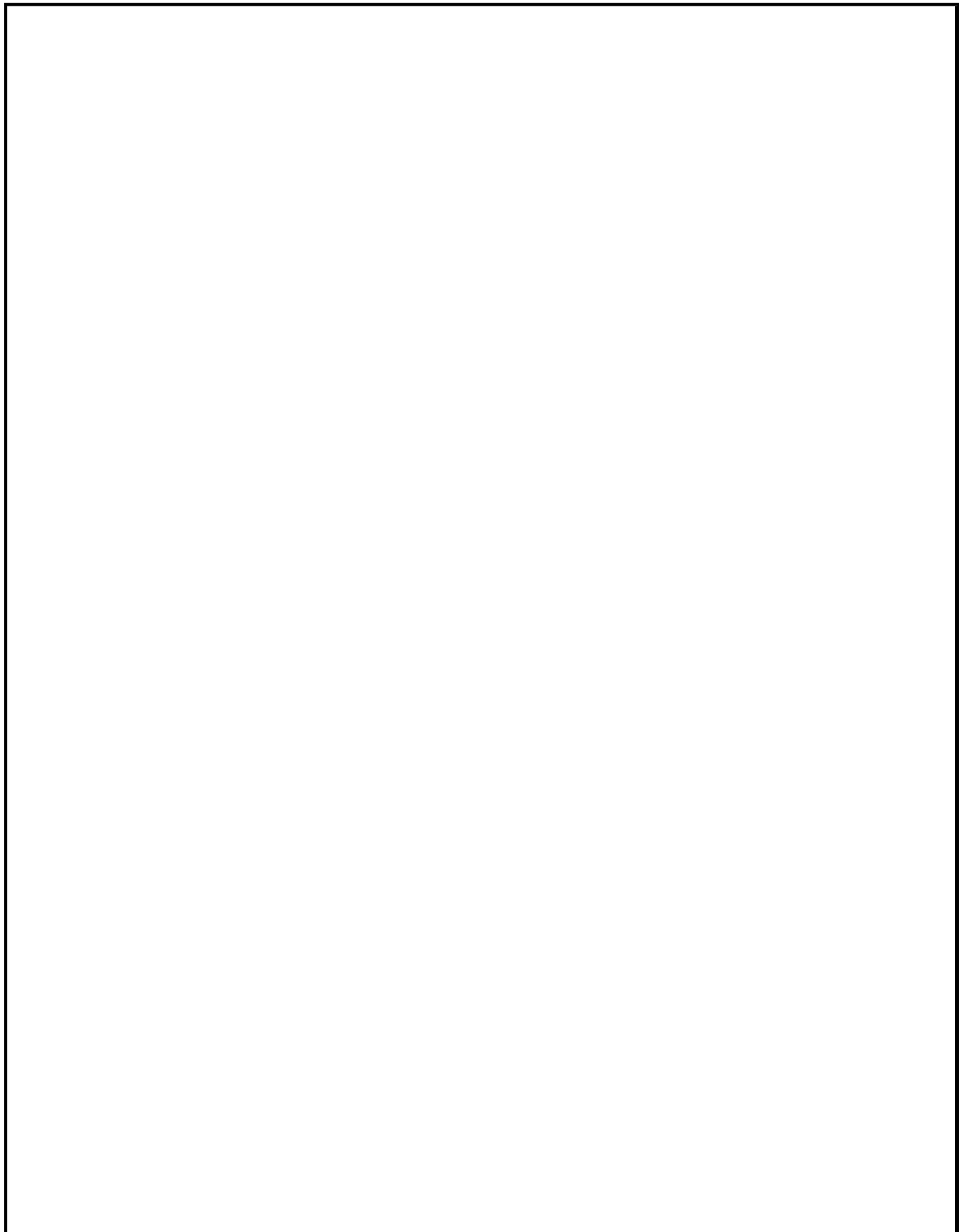


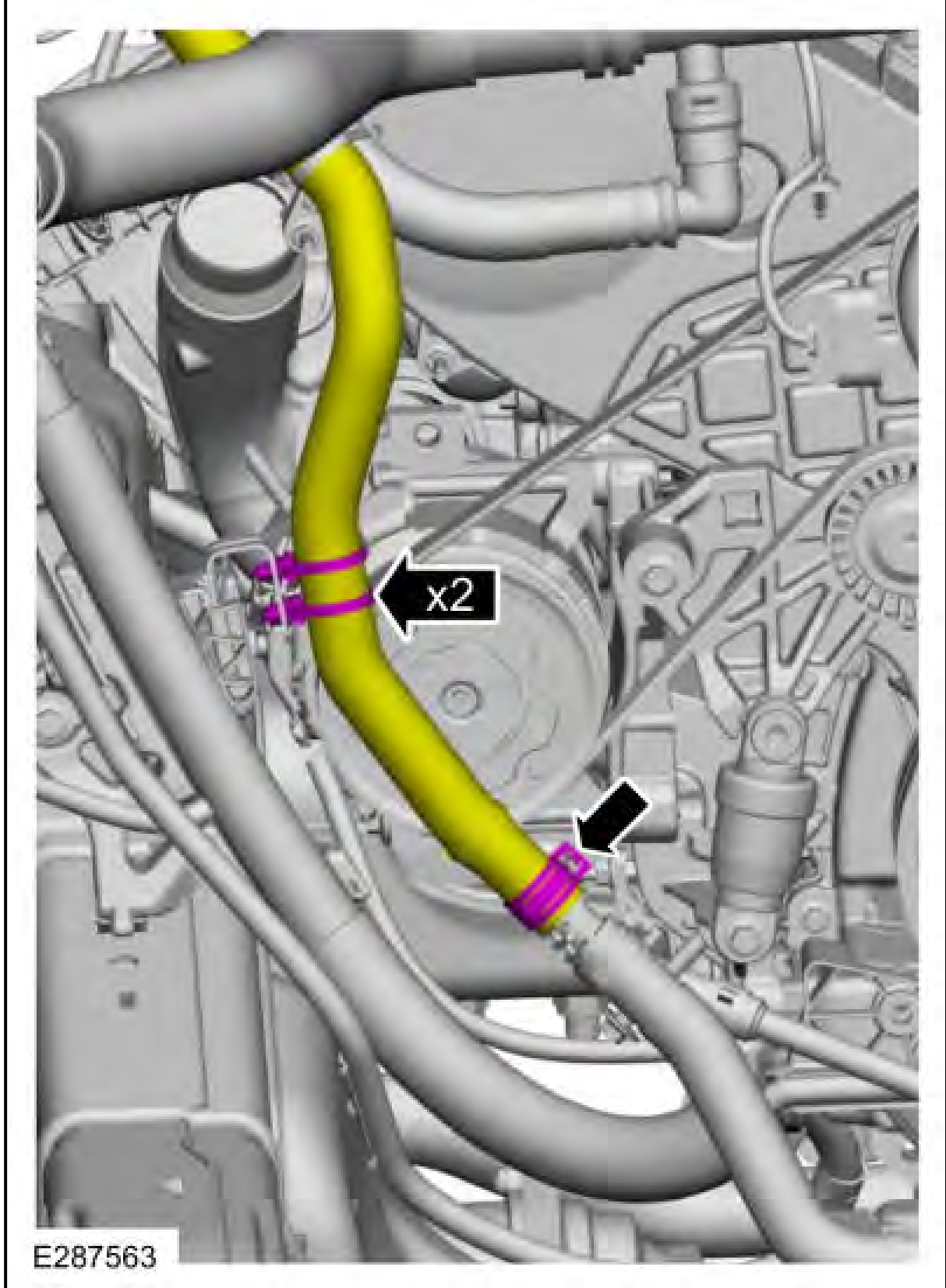
24. Remove the nuts and position aside the exhaust. Discard the nuts.





25. Disconnect the coolant hose. Disconnect the retainers and position aside the coolant hose. Use the General Equipment: Hose Clamp Remover/Installer

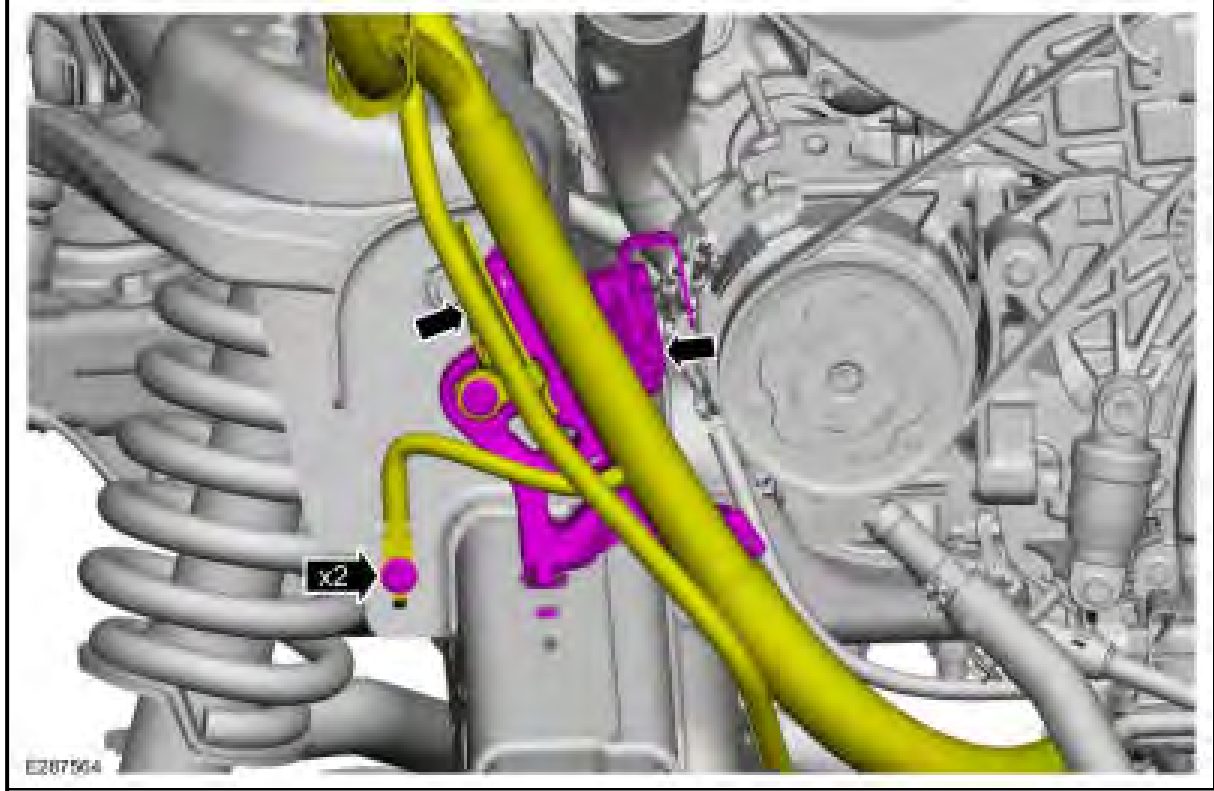




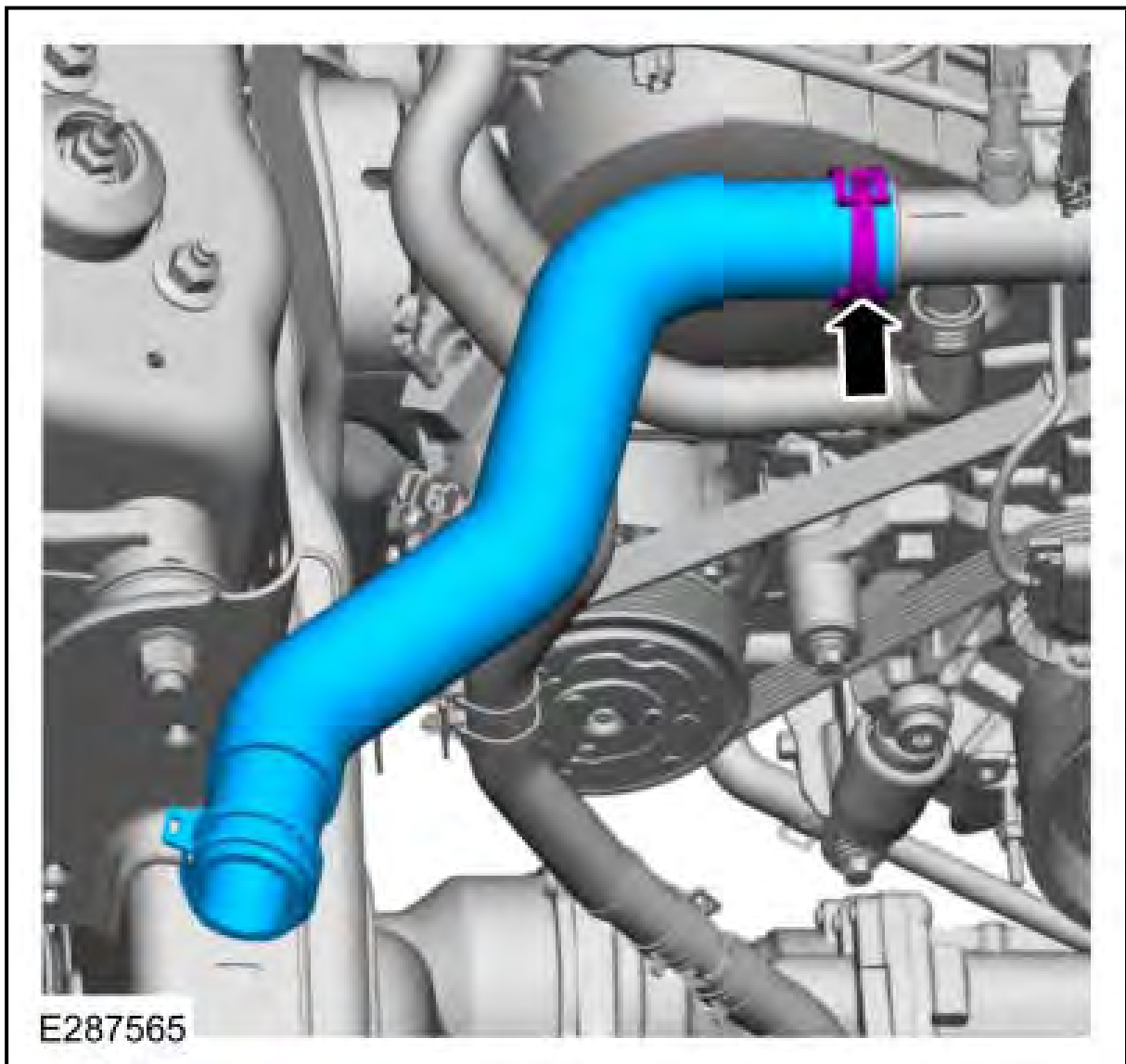
26. Remove the bolts and position out the power steering power cable. Position the battery wire harness on the engine.



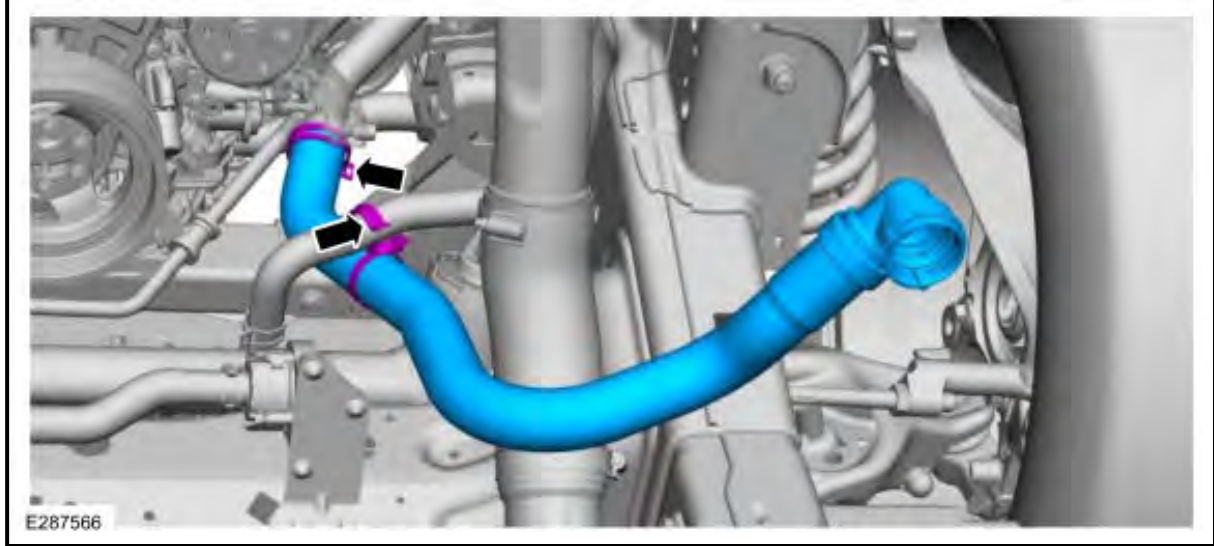




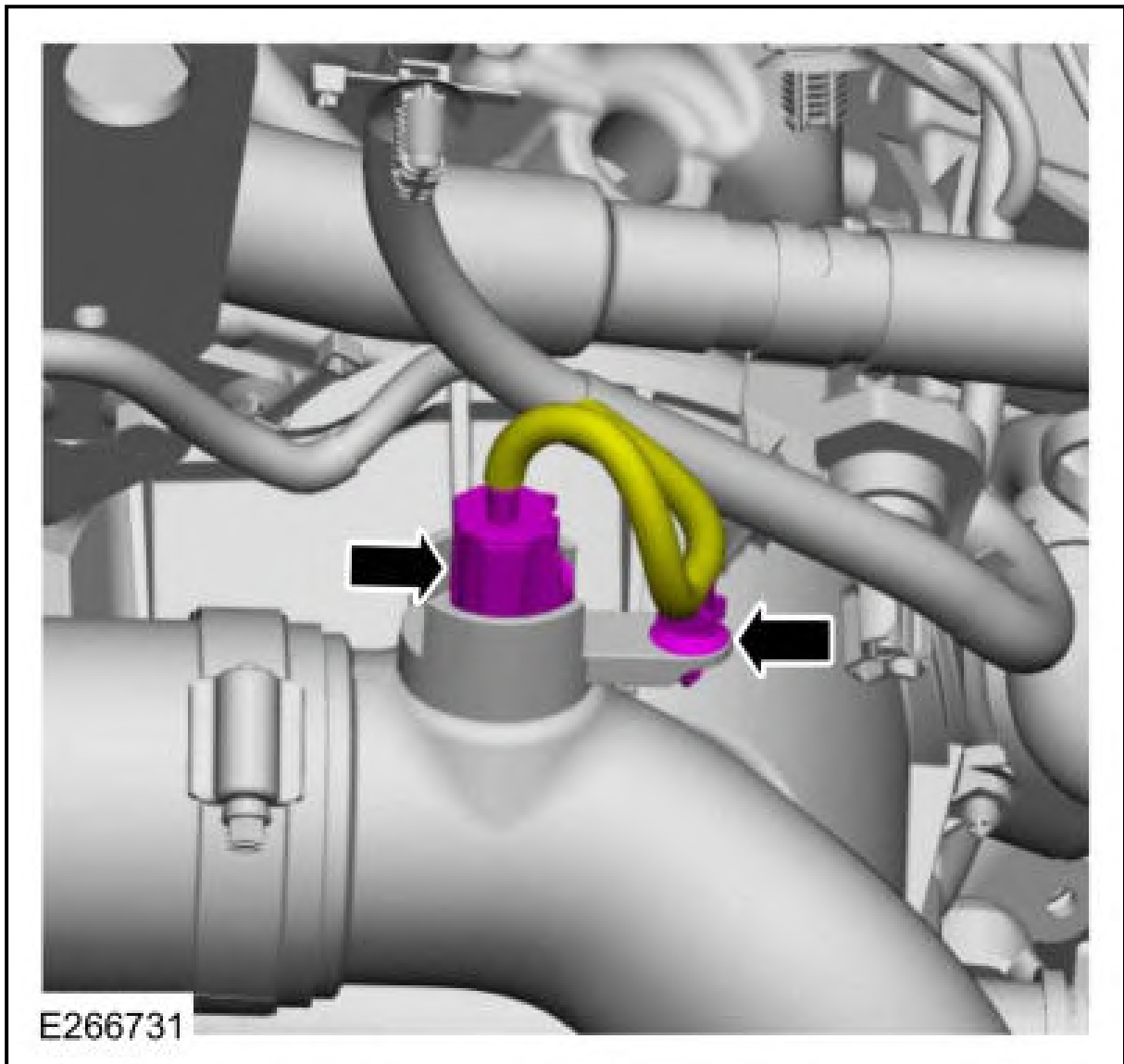
27. Remove the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer



28. Disconnect the retainer. Remove the lower radiator hose. Use the General Equipment: Hose Clamp Remover/Installer



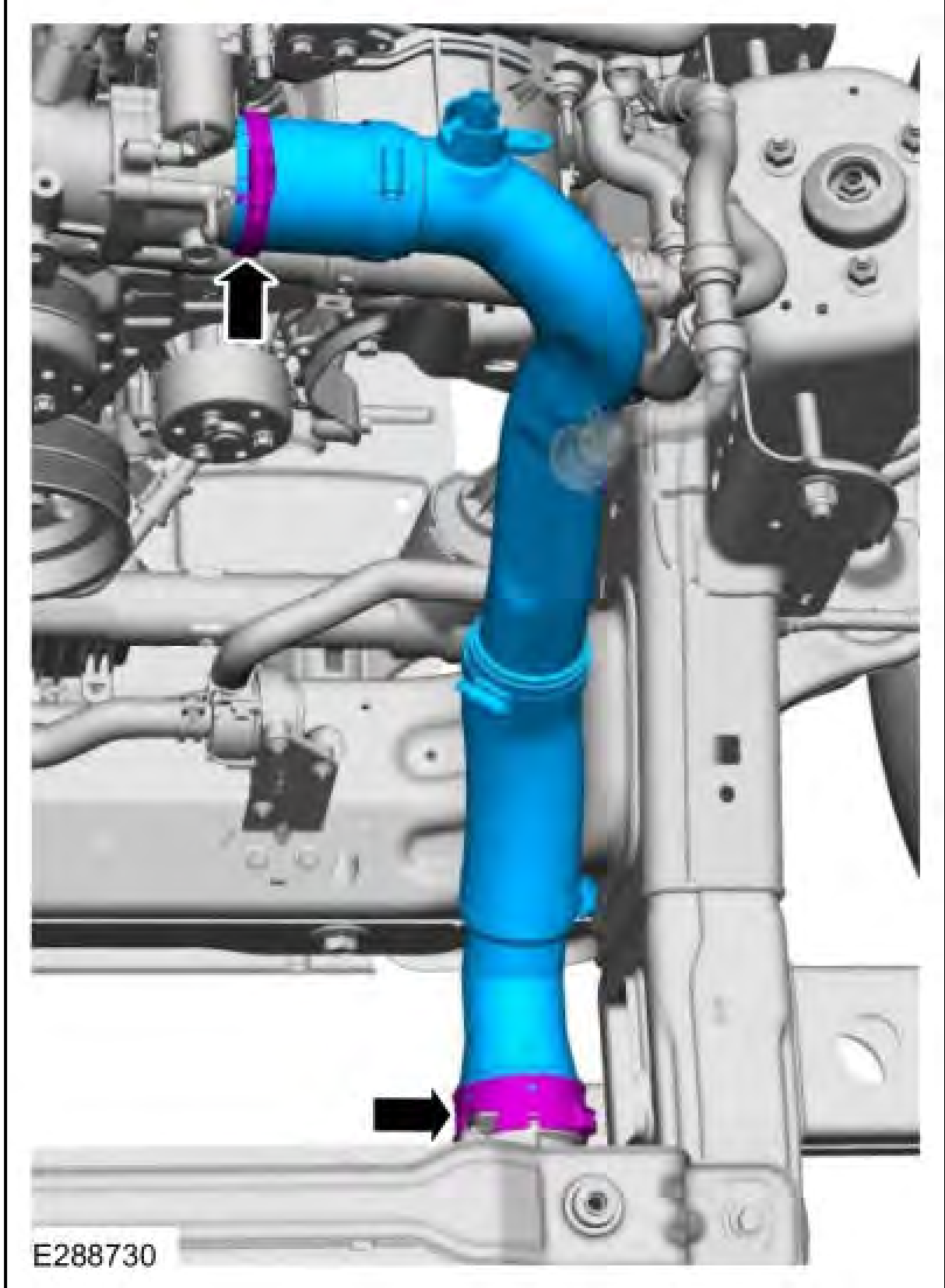
29. Disconnect the electrical connector and the wire retainer.



30. **NOTE:** The turbocharger compressor vanes can be damaged by even the smallest particles. When removing any turbocharger or engine air intake system component, ensure that no debris enters the system. Failure to do so may result in damage to the turbocharger.

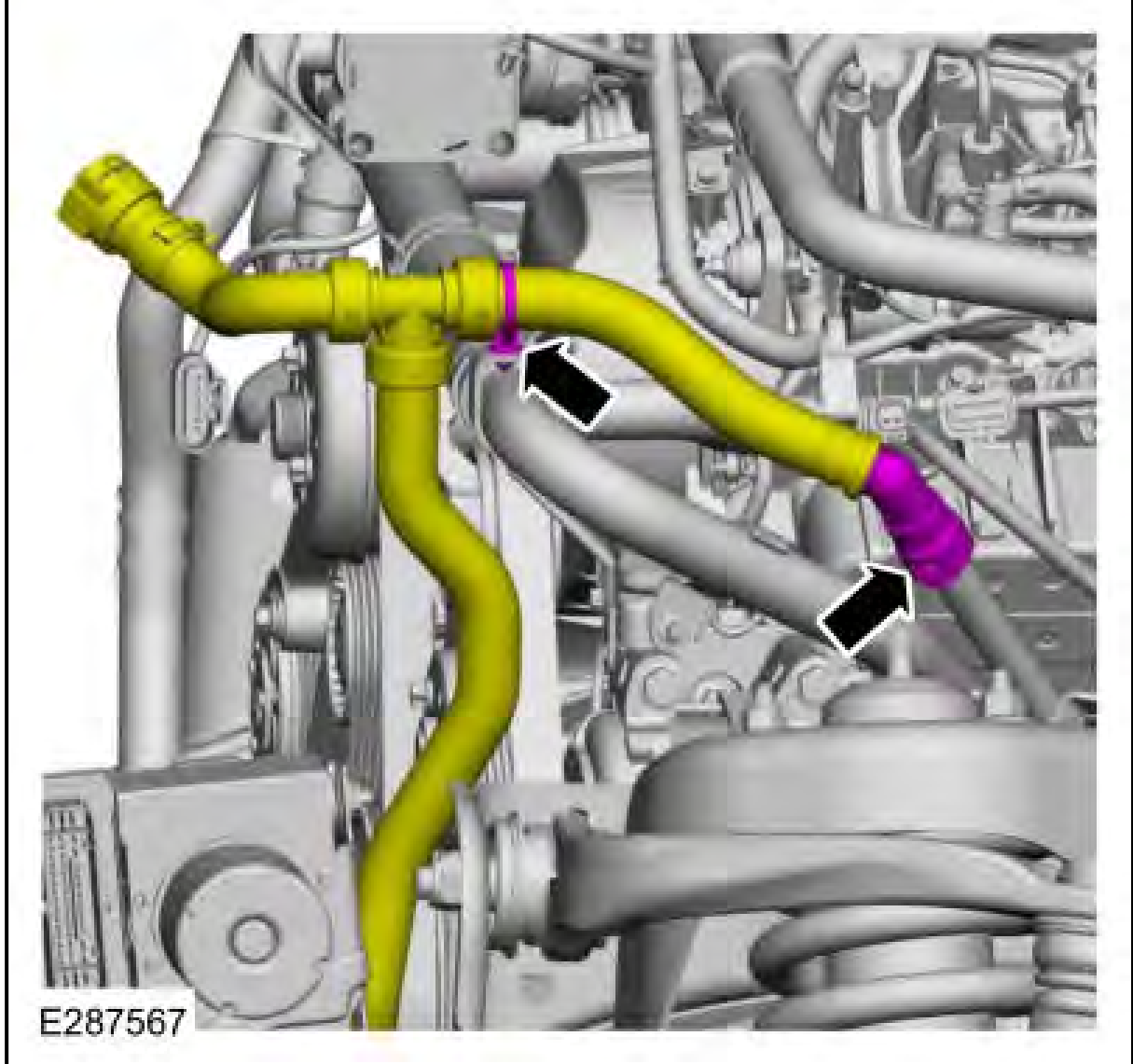
Loosen the clamp, release the clip and remove the LH CAC intake pipe.





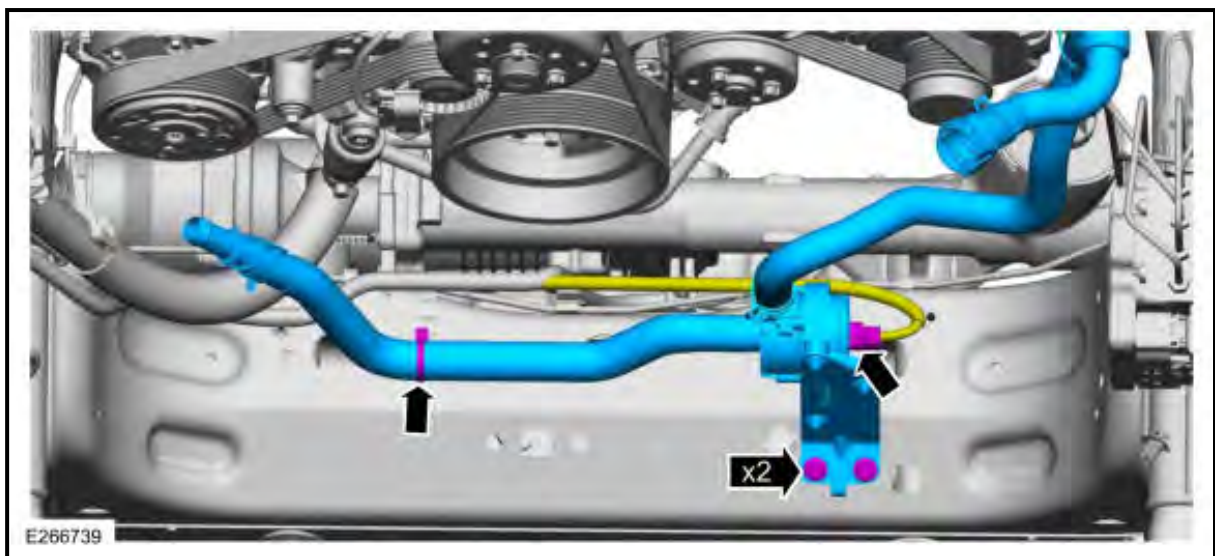
31. Disconnect the coolant hose connector and the retainer.





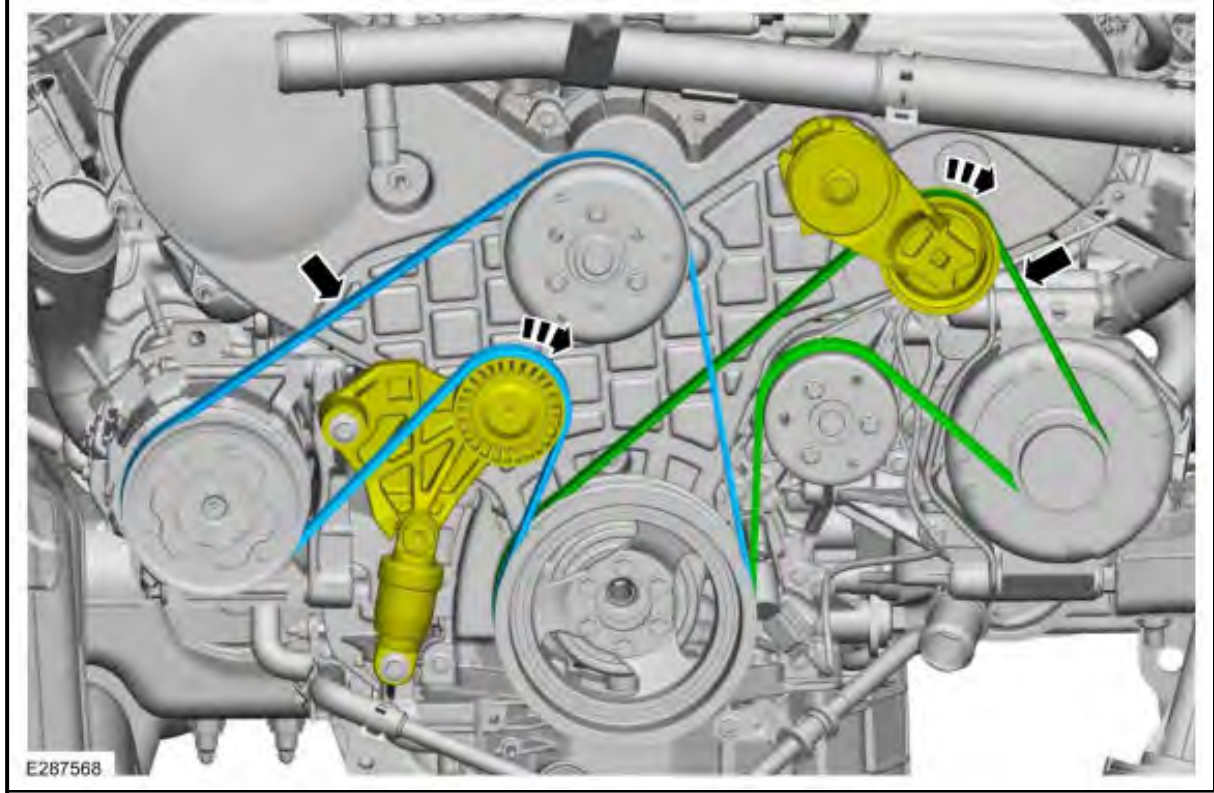
32.

- Disconnect the electrical connector and the coolant hose retainer.
- Remove the bolts and the coolant pump.

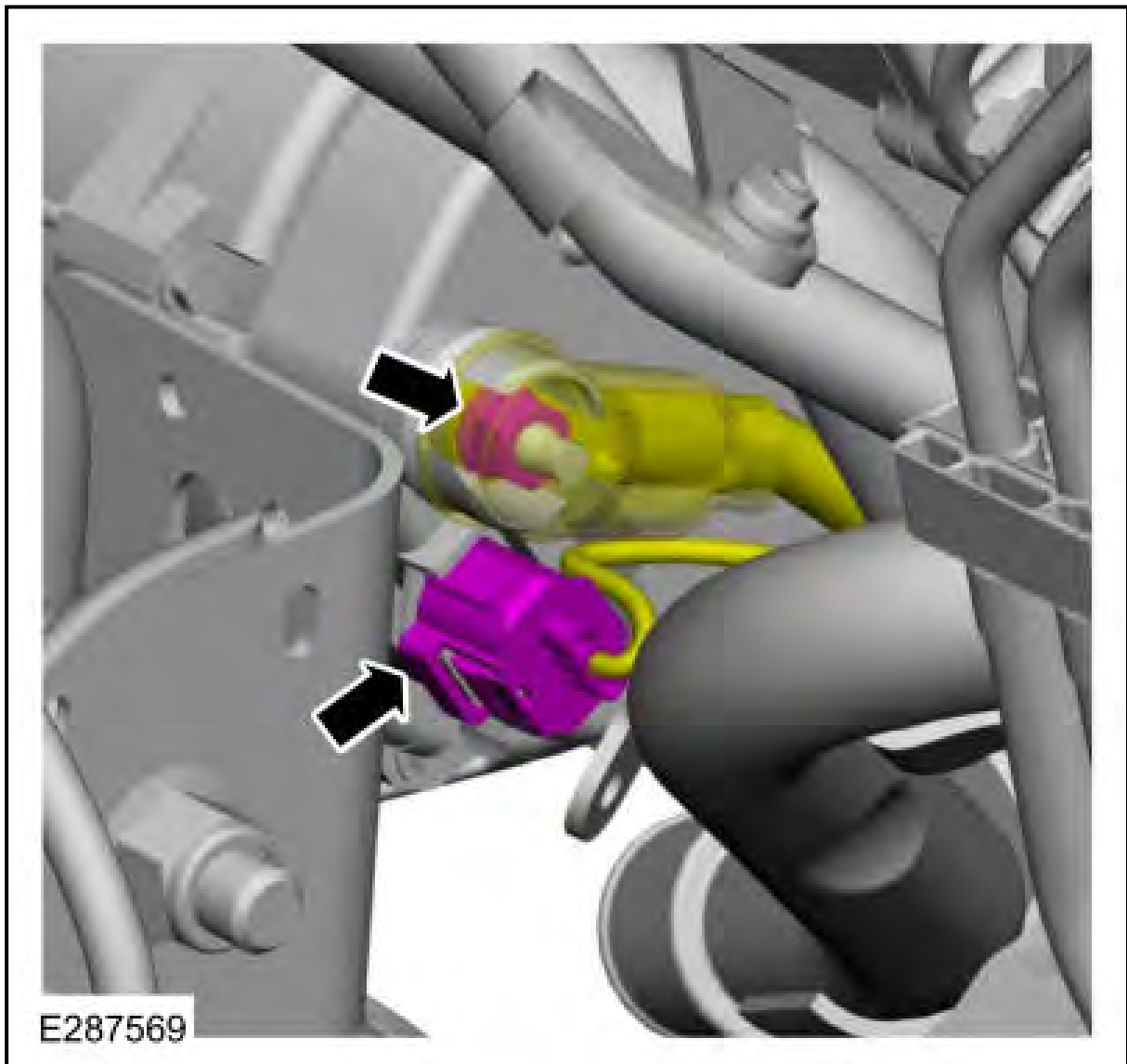


33. Remove the A/C belt and the accessory drive belt.

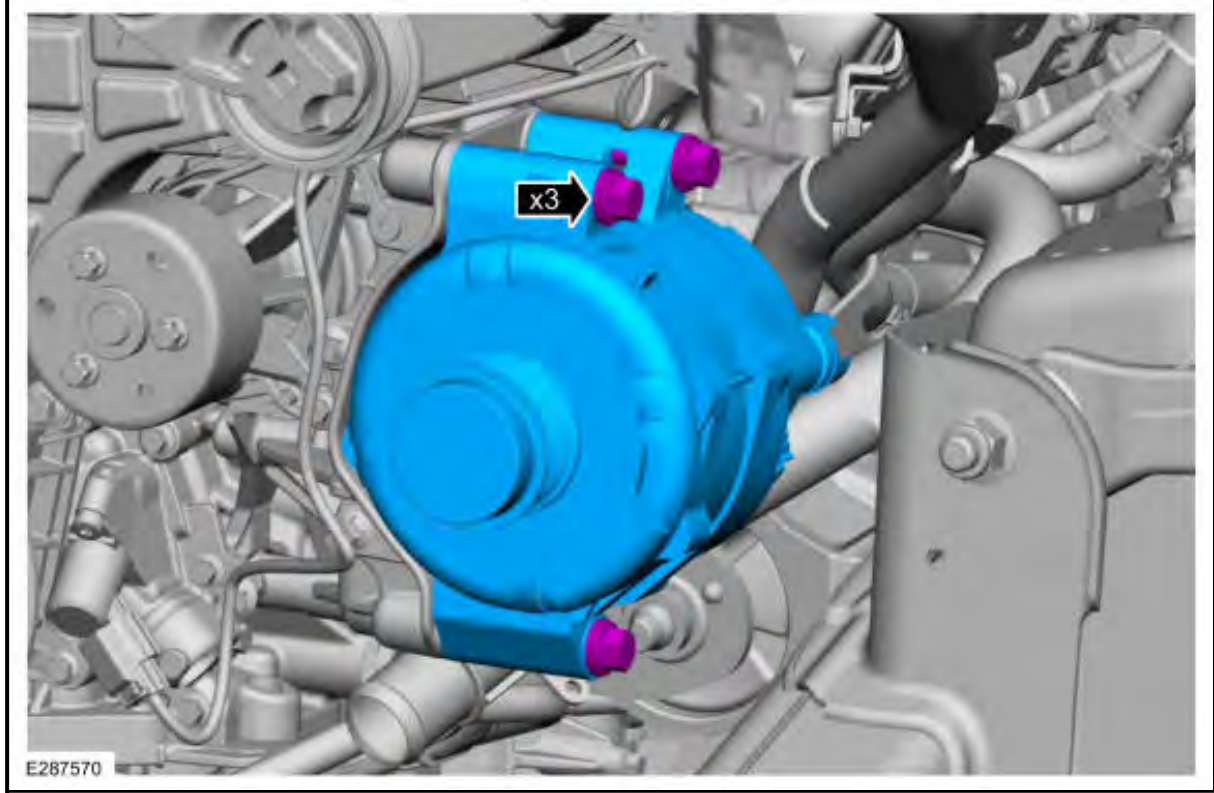




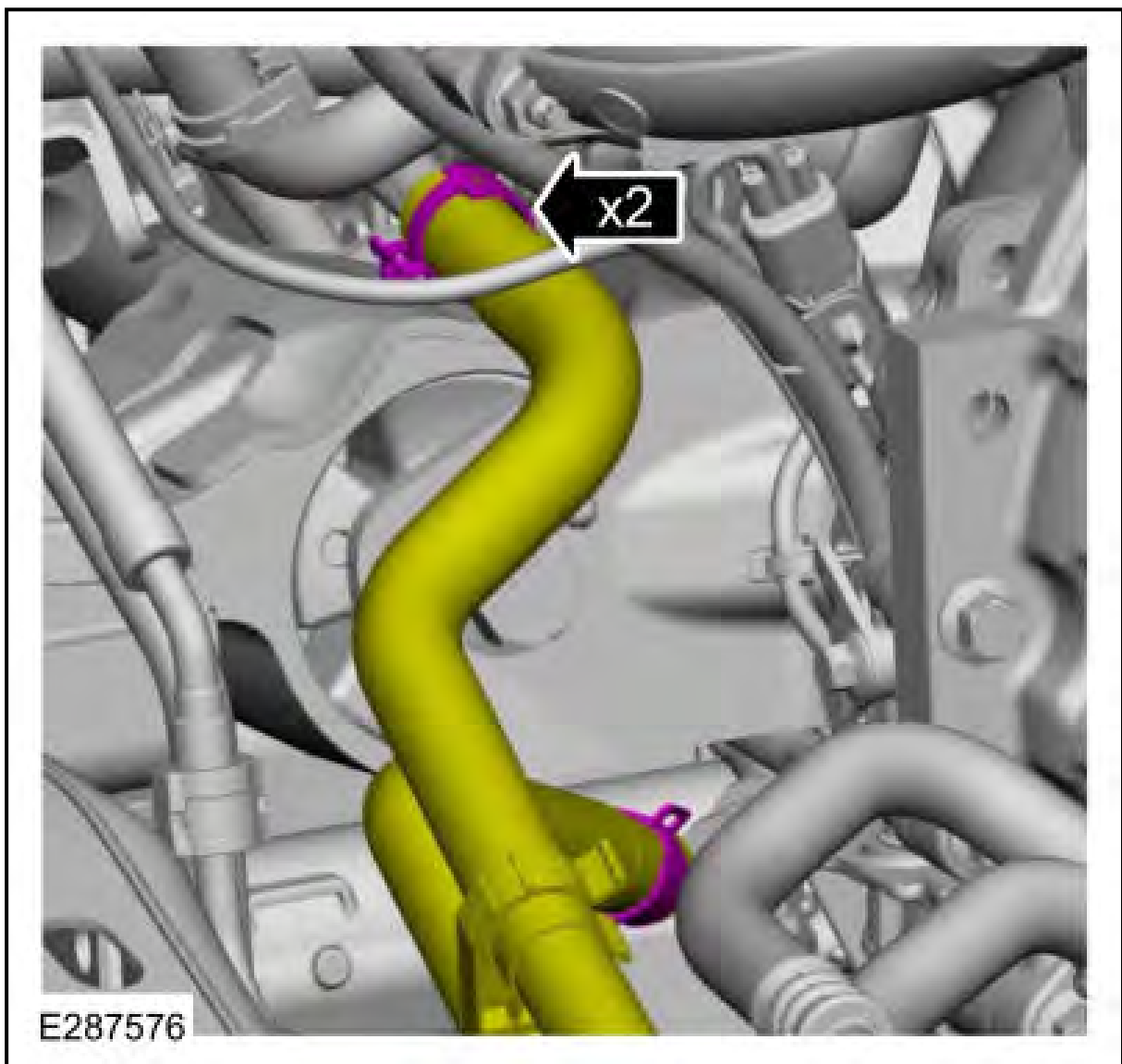
34. Disconnect the electrical connector and the generator output wire.



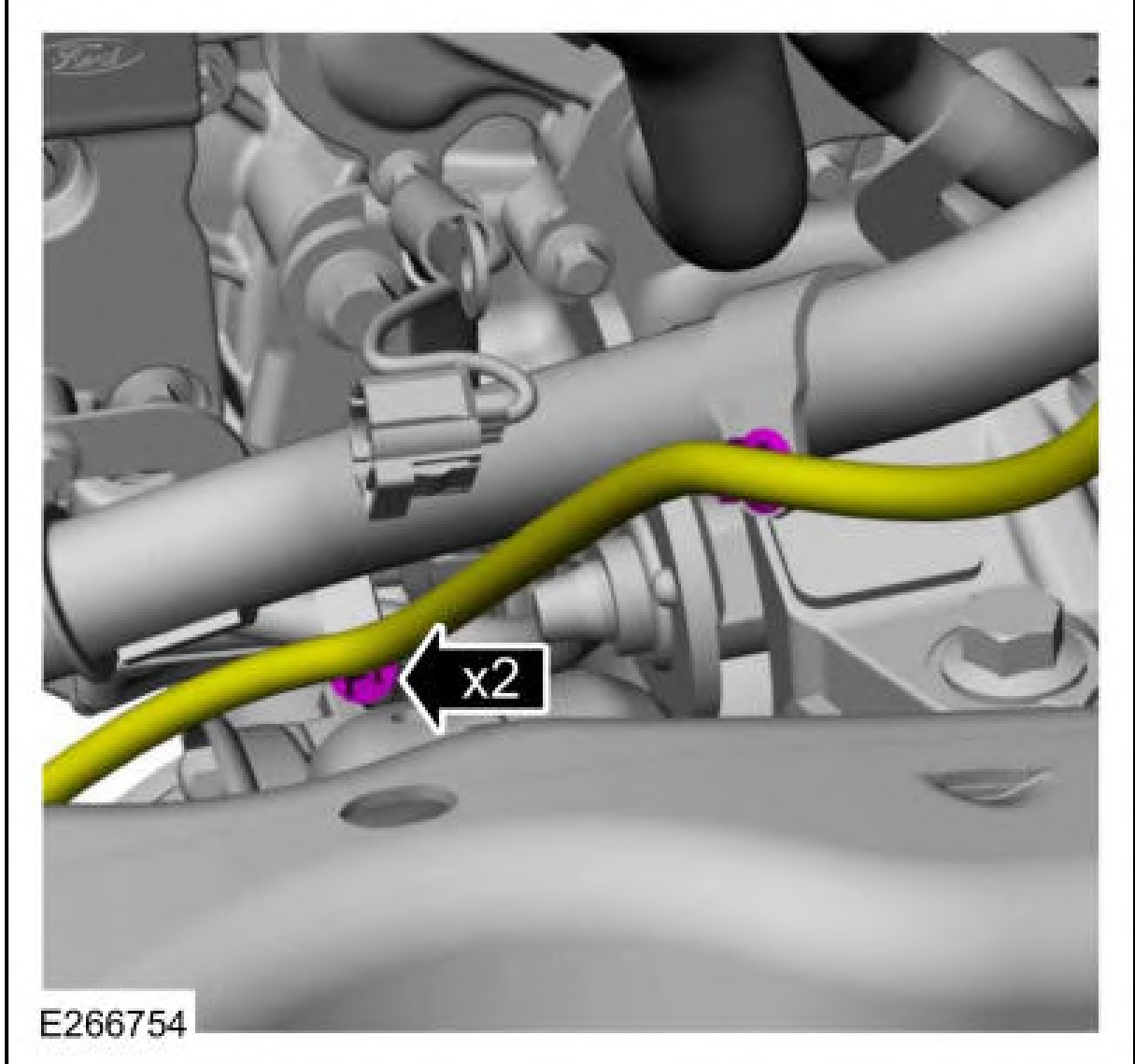
35. Remove the bolts and the generator.



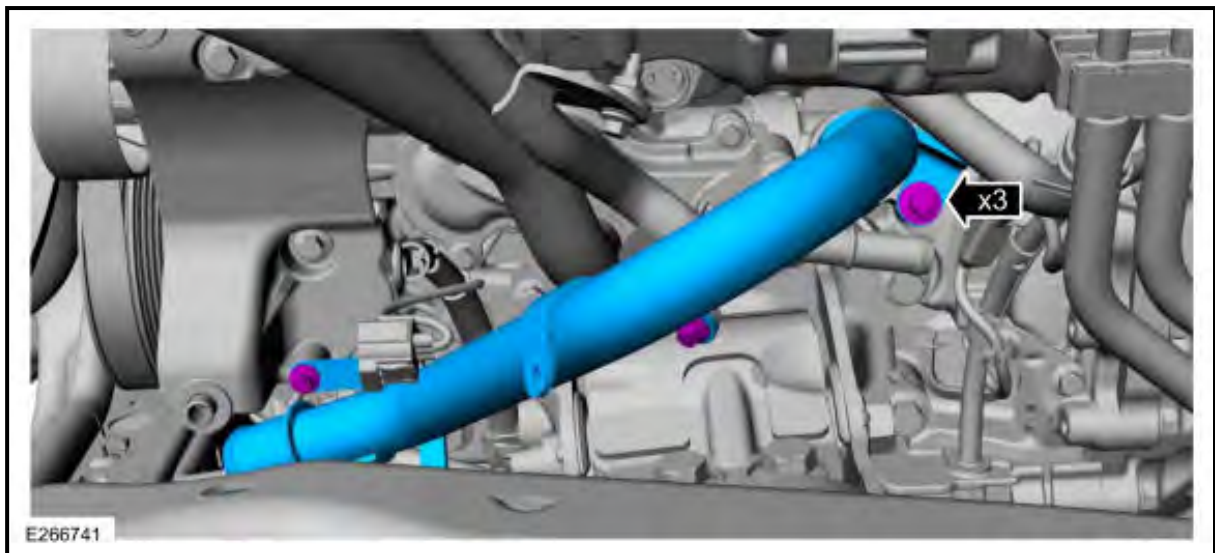
36. Disconnect the coolant hoses and position aside. Use the General Equipment: Hose Clamp Remover/Installer



37. If equipped, disconnect the block heater cord retainers.

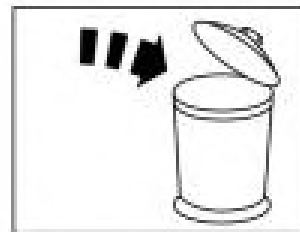


38. Remove the bolts and the lower radiator coolant tube.



39. Remove and discard the lower radiator coolant tube O-ring seal.



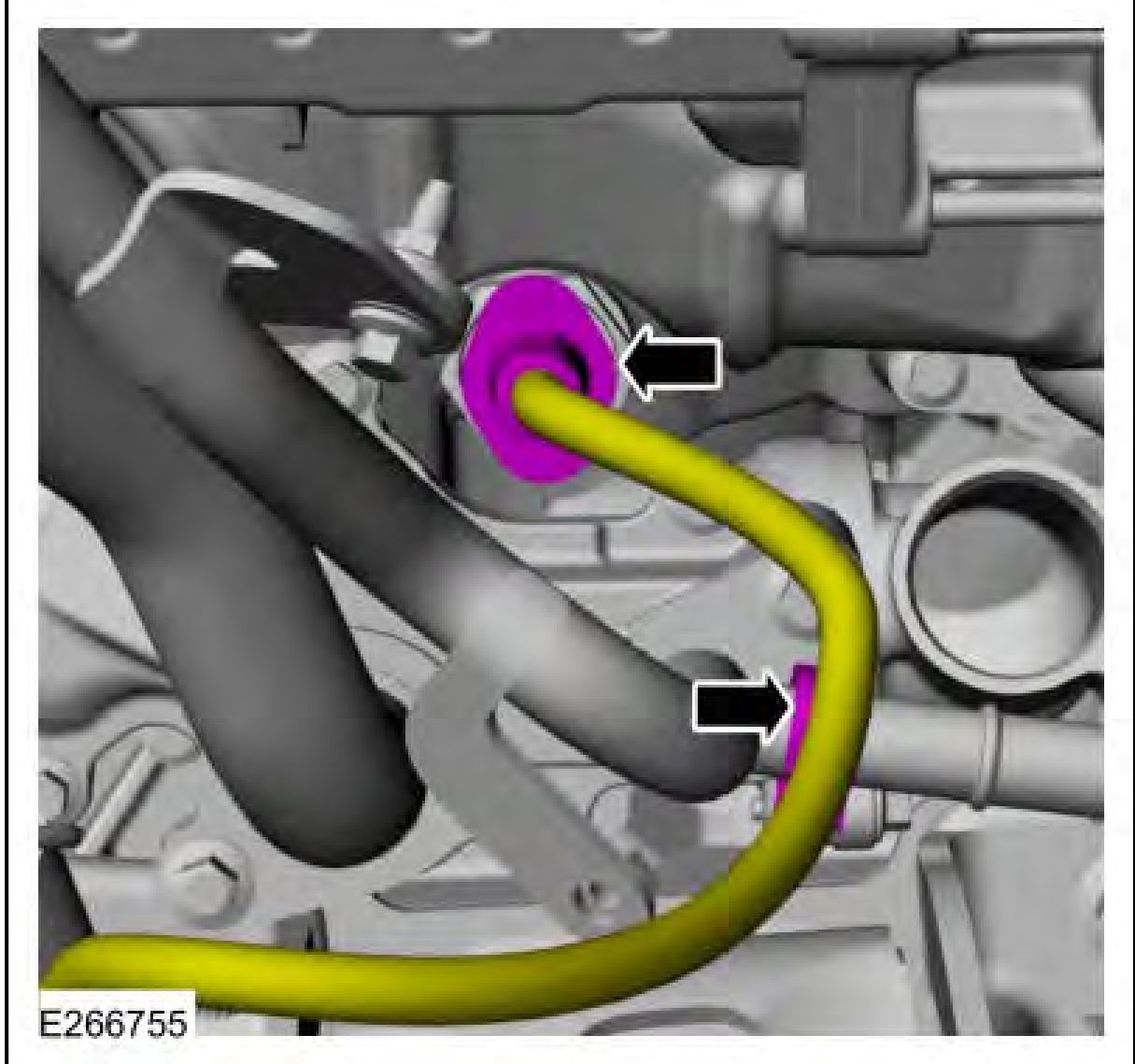


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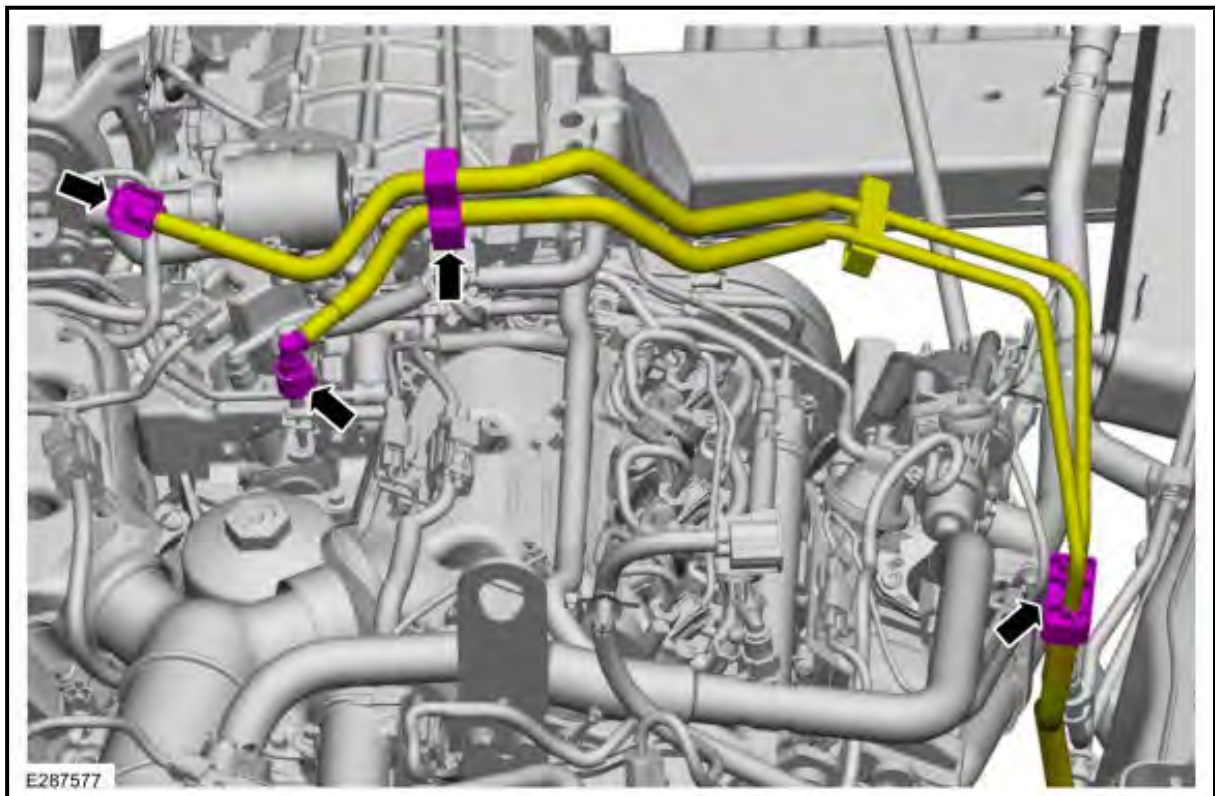
40. If equipped, disconnect the block heater cord retainer and the electrical connector.



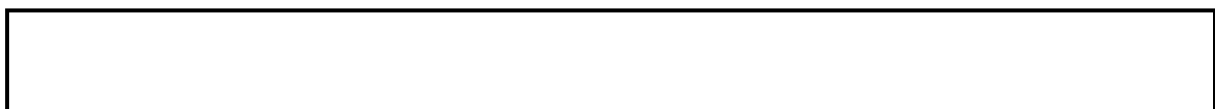


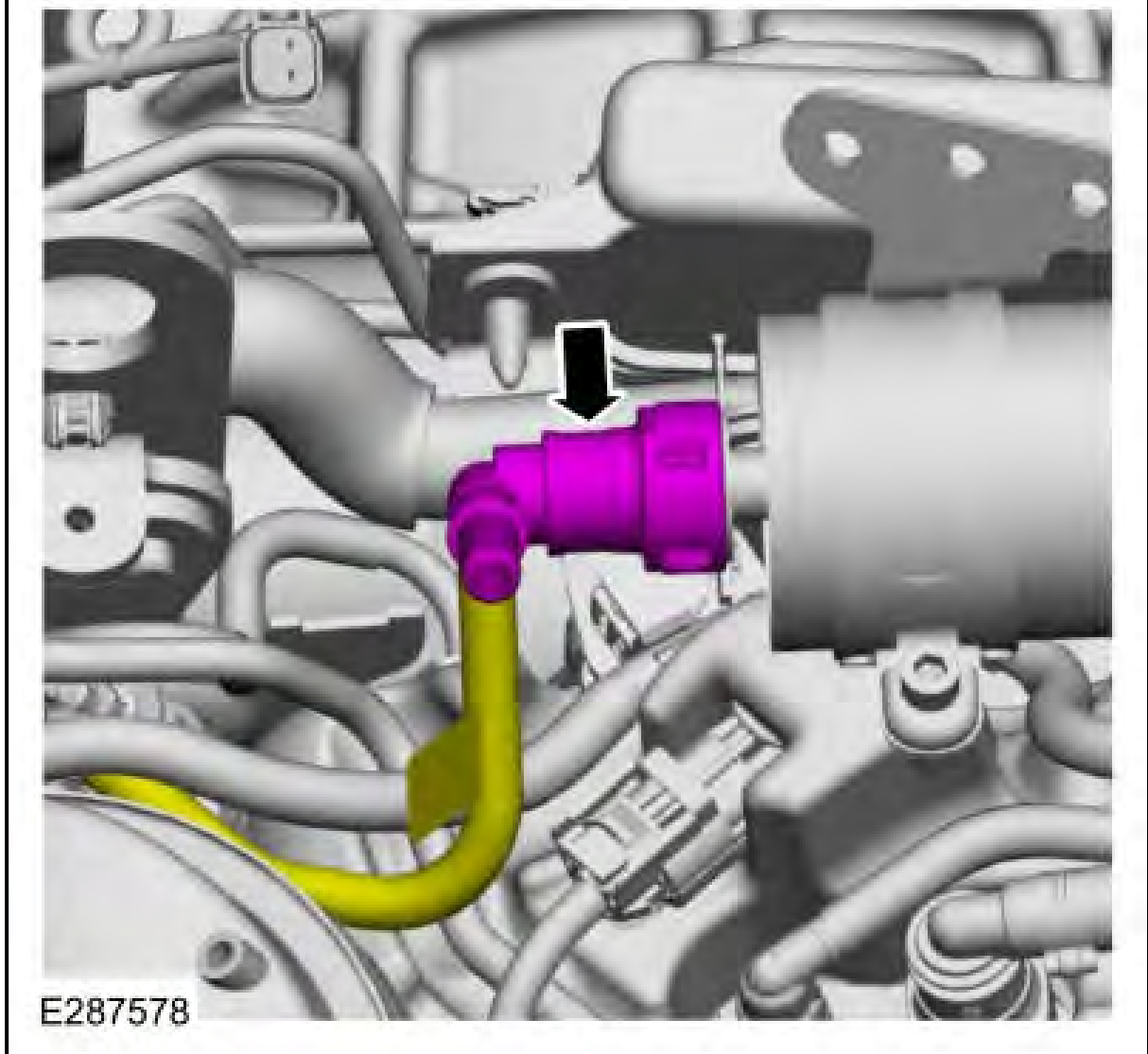


41. Disconnect and position aside the fuel tubes. Refer to: [Quick Release Coupling](#) .



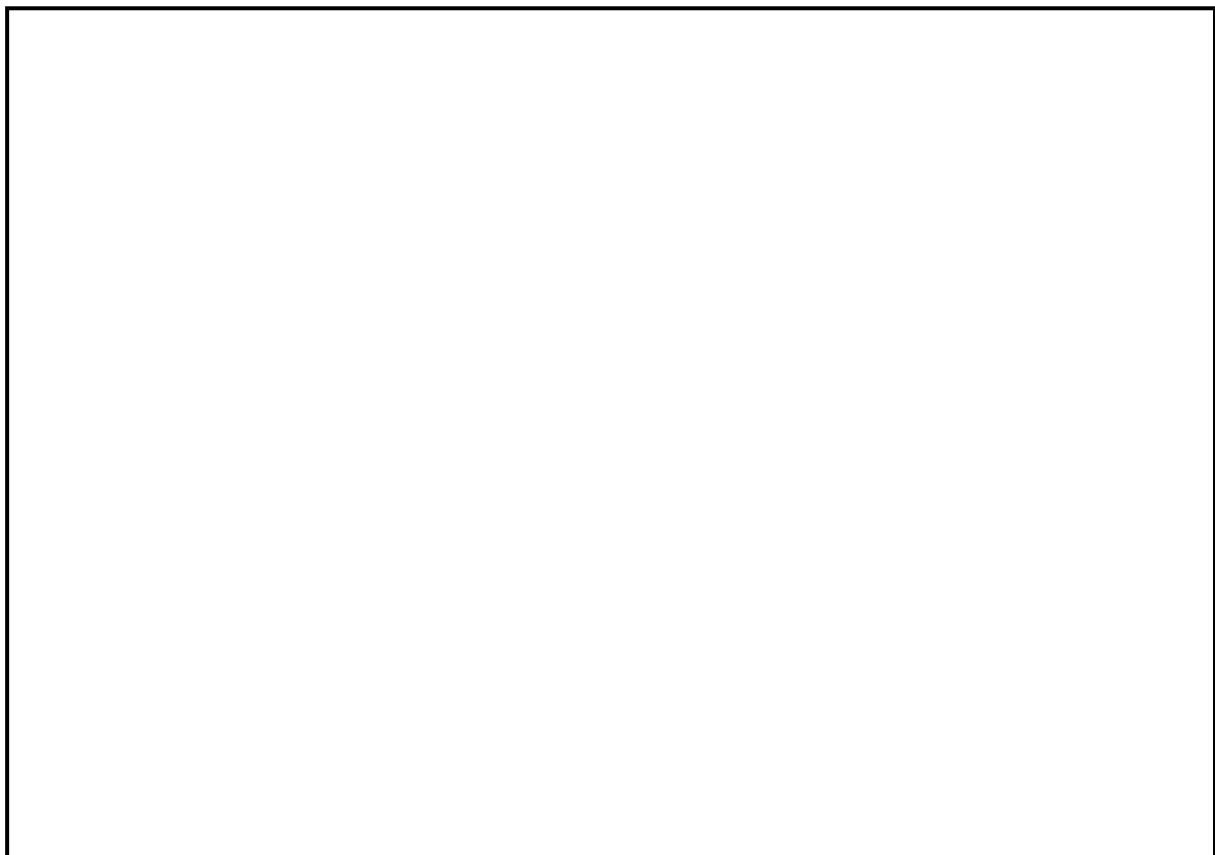
42. Disconnect the secondary fuel filter line. Refer to: [Quick Release Coupling](#) .

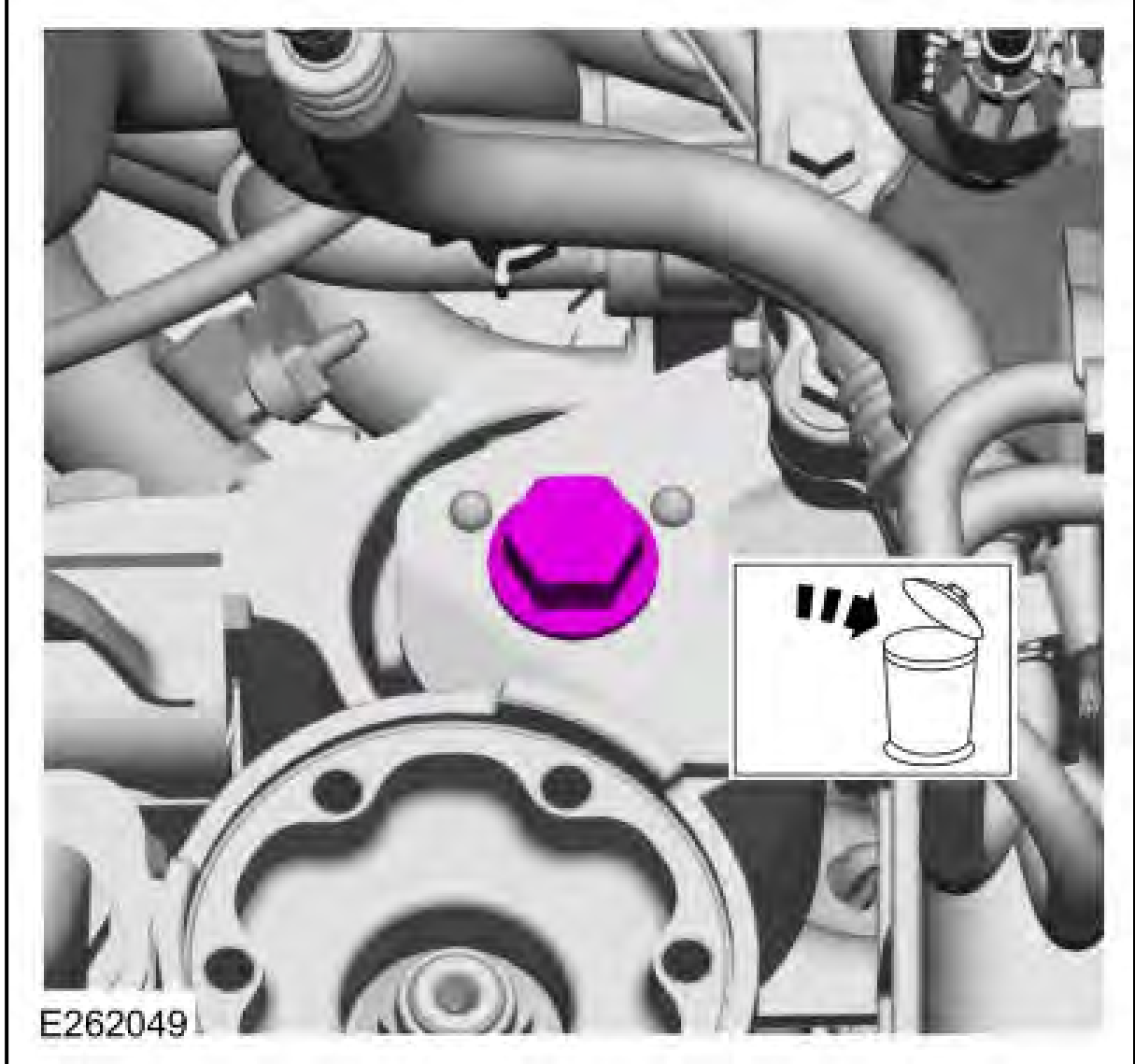




43. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

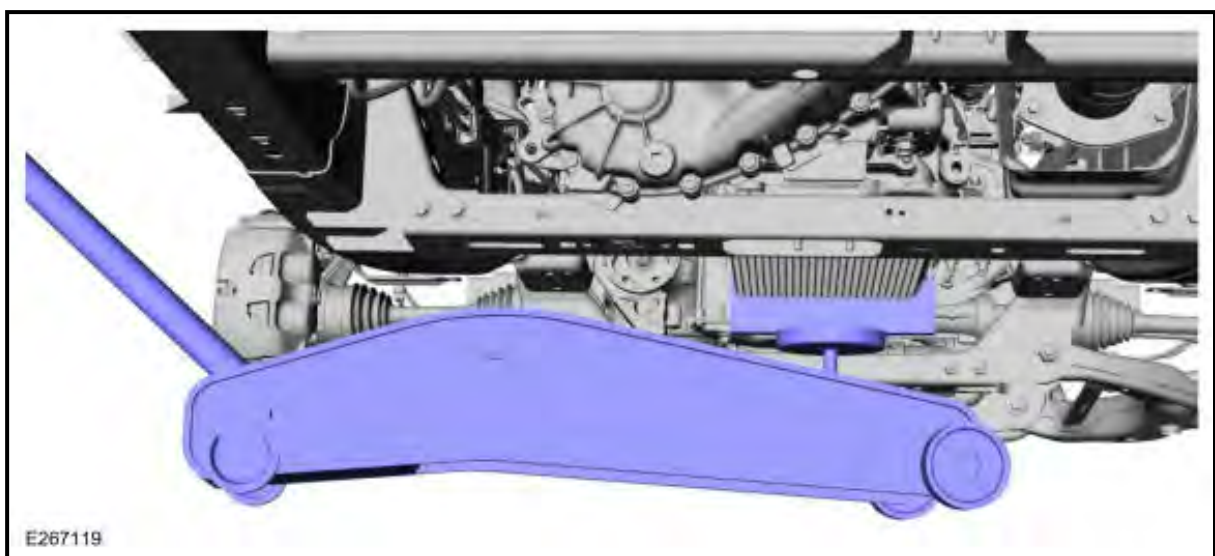
Remove and discard the LH engine mount through bolt.





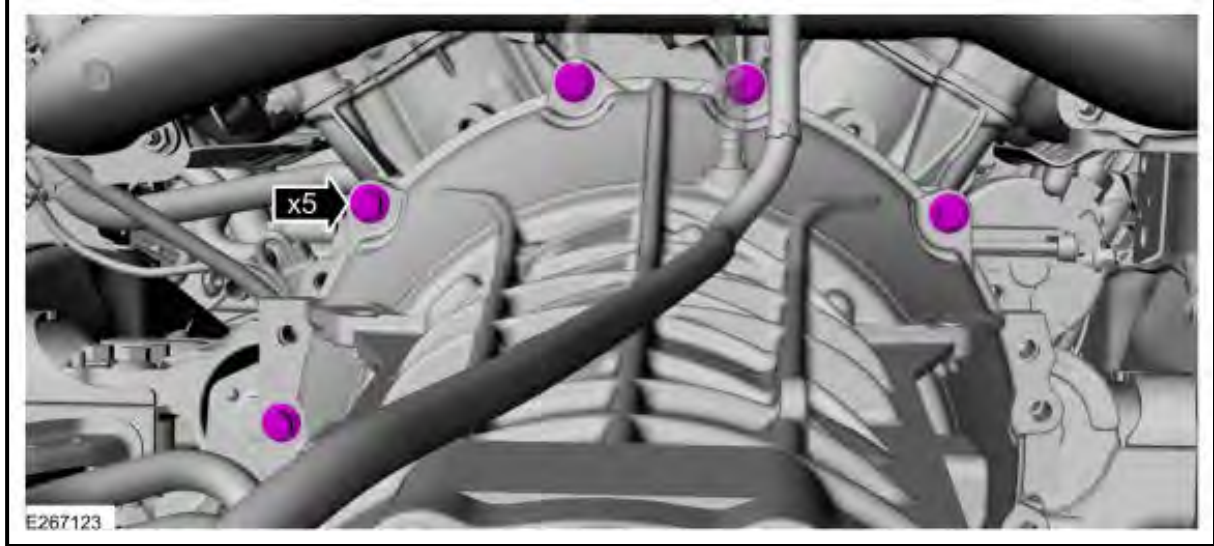
44. **NOTE:** Do not support the transmission by the fluid pan, failure to follow instruction may result in serious damage to the transmission.

Support the bellhousing of the transmission with a suitable floor jack and a block of wood. Use the General Equipment: Trolley Jack Use the General Equipment: Wooden Block



45. Remove the upper bellhousing bolts.

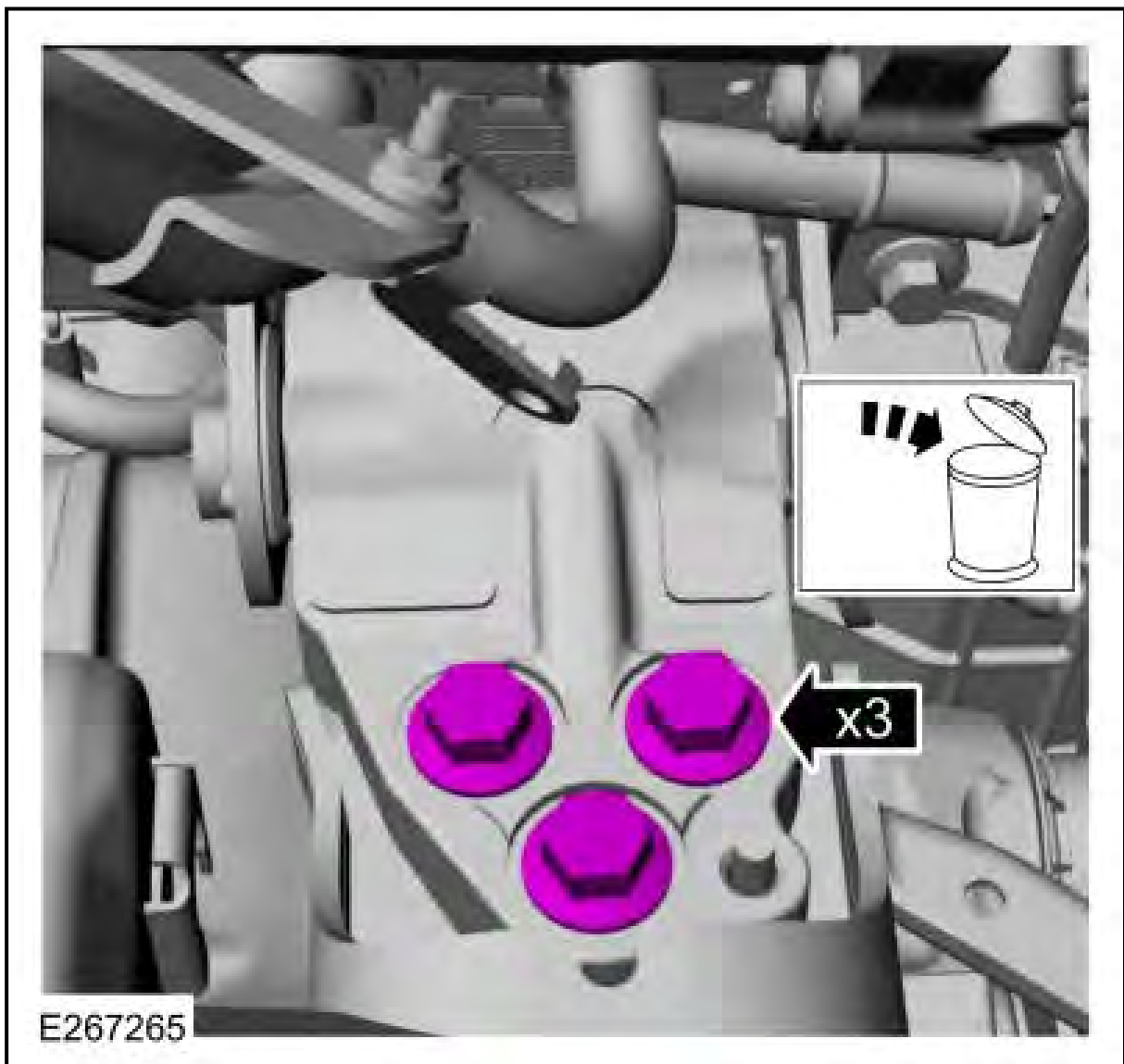




46. **NOTE:** Only use hand tools when loosening or tightening the engine mount-to-frame bolts or damage to the engine mount-to-frame nut plate can occur.

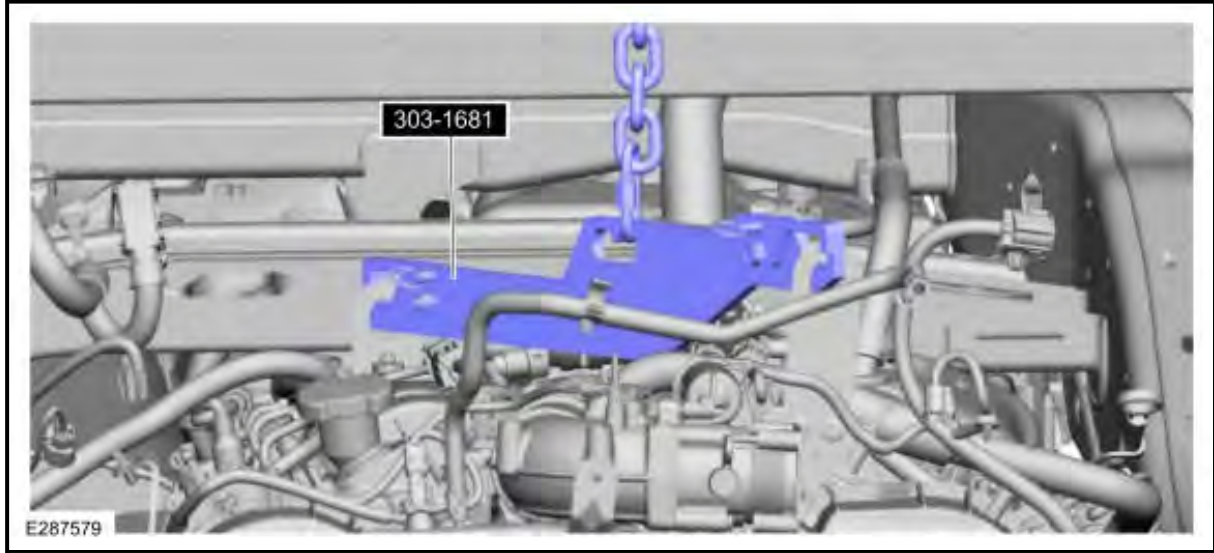
**NOTE:** Leave the LH engine mount in place.

Remove and discard the LH engine mount bolts.



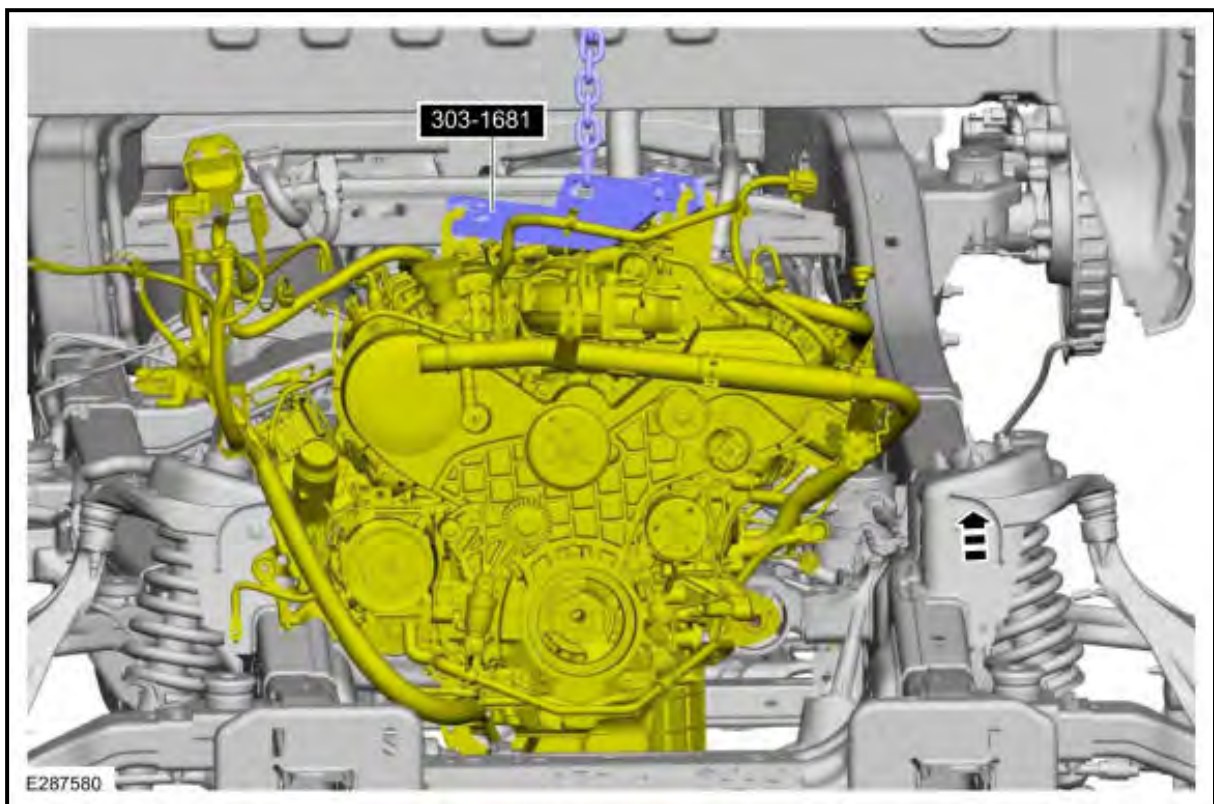
47. **NOTE:** Use a commercially available quick link.

Install the special tool and the floor crane. Use Special Service Tool: 303-1681 Spreader Bar. Use the General Equipment: Floor Crane

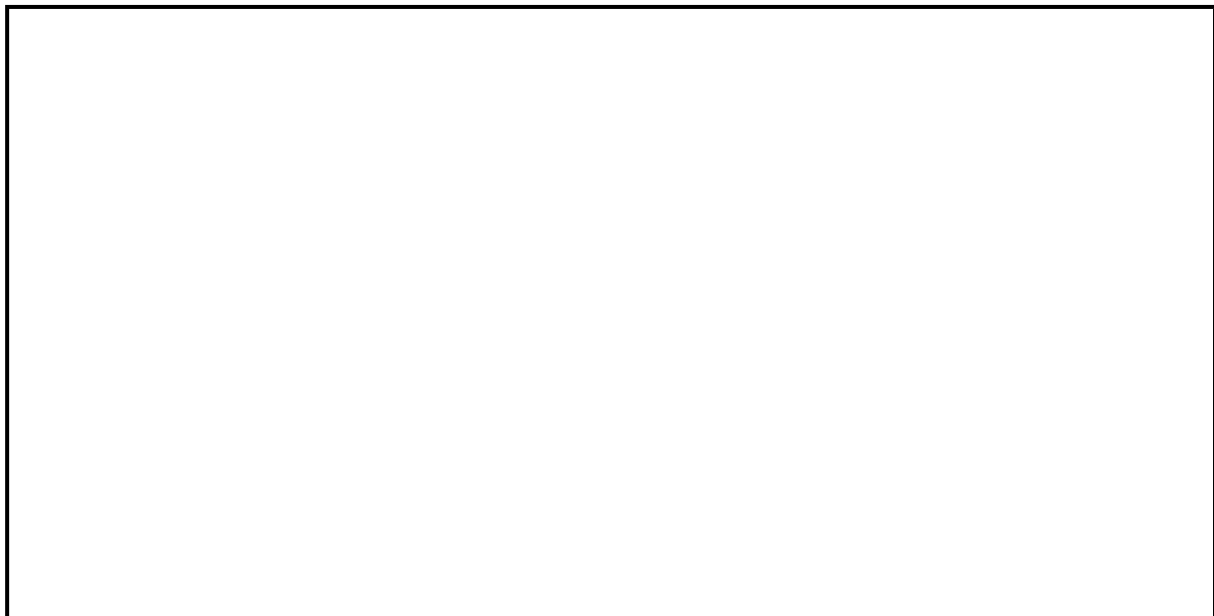


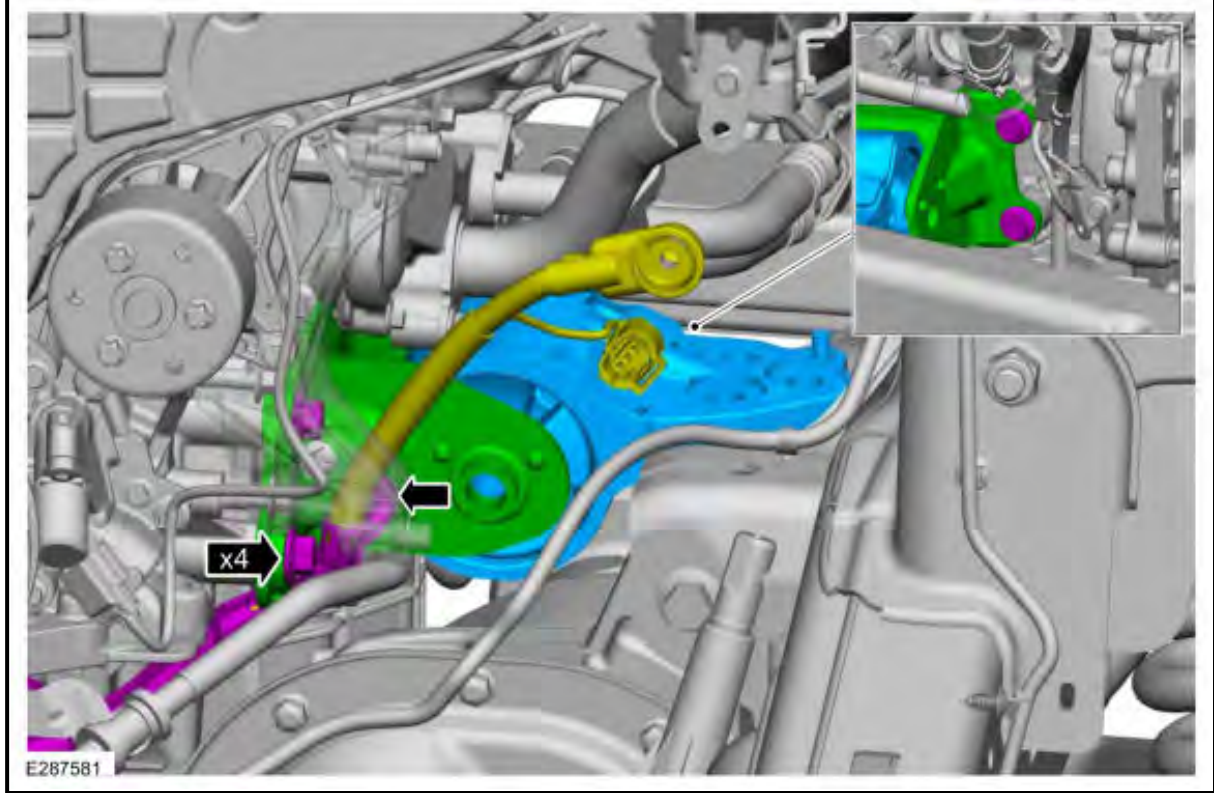
48. **NOTE:** The use of a ratchet strap may be needed to level the engine.

Using the floor crane and the Spreader Bar, lift the engine.

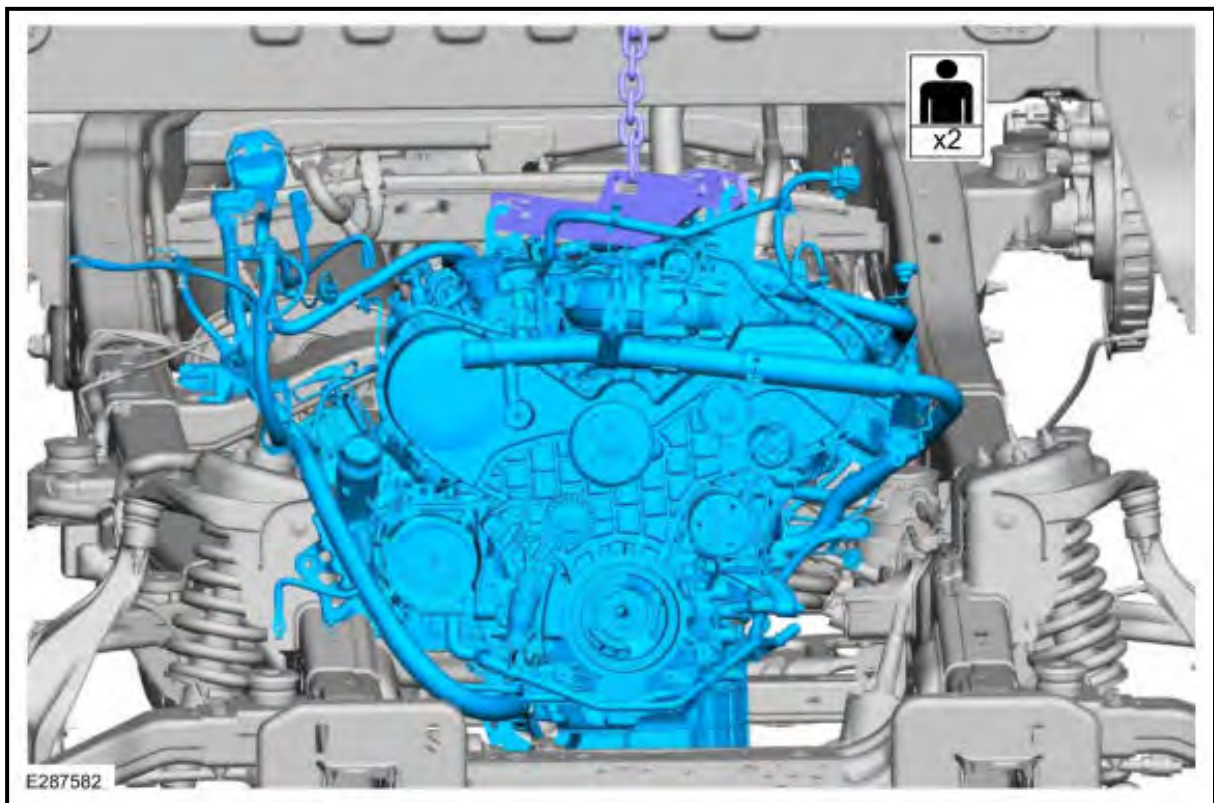


49. Remove the bolts and the engine mount bracket. Remove the LH engine mount.



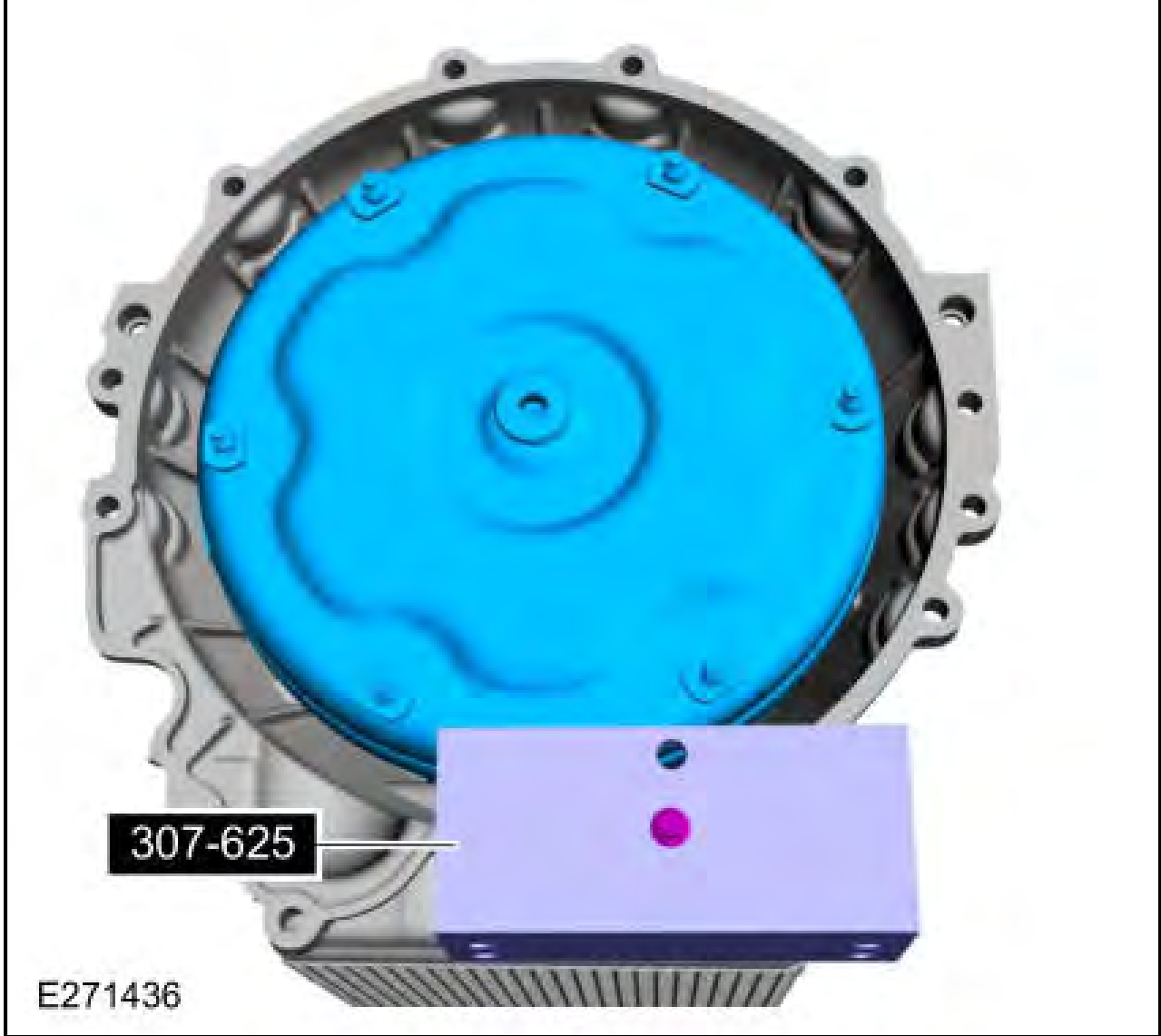


50. Using the floor crane and the spreader bar, remove the engine. Use the General Equipment: Floor Crane



51. Install Special Service Tool: 307-625 Fixture, Bench Mounting.

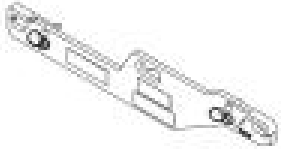



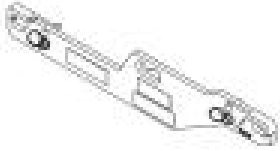
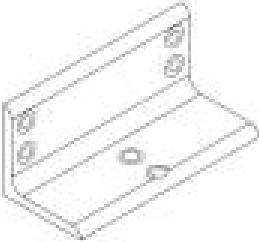


**ENGINE - BODY ON**

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

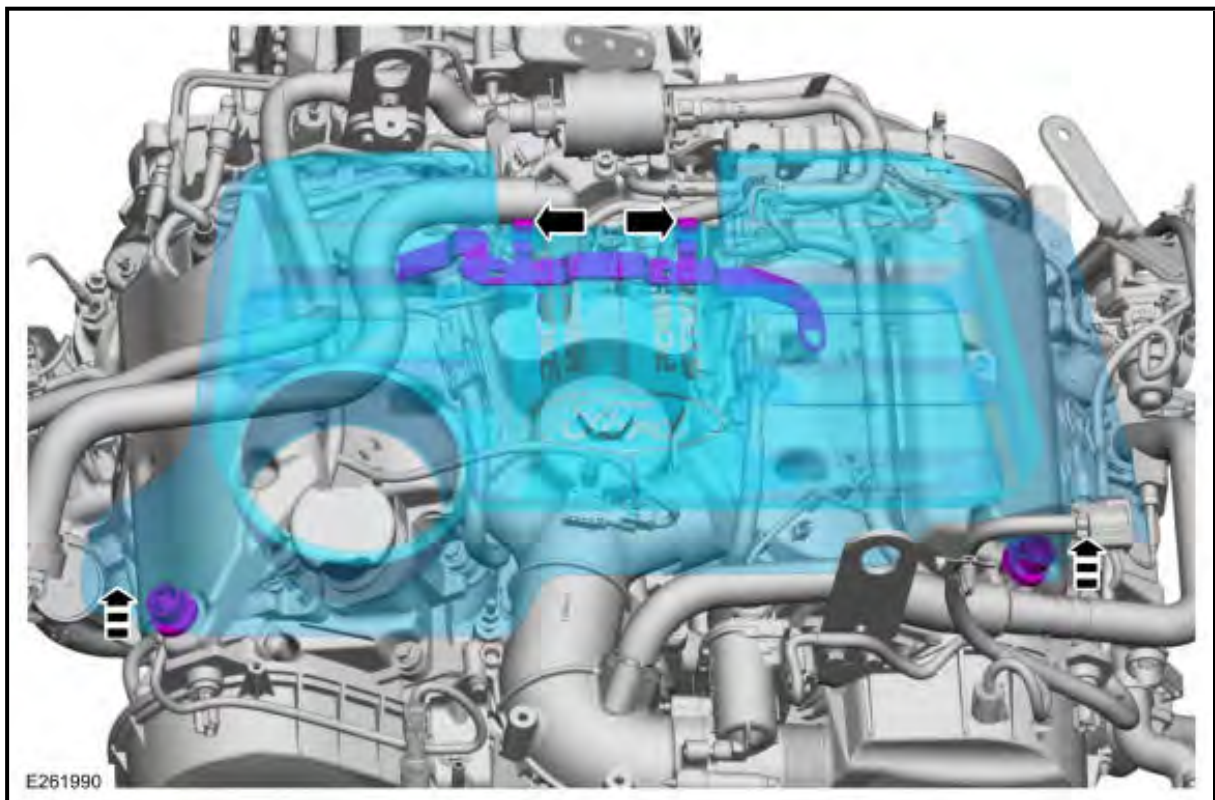
**Special Tool(s) / General Equipment**

|  |                              |
|--|------------------------------|
|  <p>E274098</p> | <p>303-1681 Spreader Bar</p> |
|  <p>E274099</p> | <p>303-1684 Lifting Eye</p>  |

|   |  |
|---|--|
|  <p>E274098</p>               | <p>303-1681 Spreader Bar</p>   |
|  <p>E216422</p>              | <p>307-625 Fixture, Bench Mounting<br/>TKIT-2008ET-FLM<br/>TKIT-2008ET-ROW</p> |
| <p>Floor Crane<br/>Oil Drain Equipment<br/>Trolley Jack<br/>Hose Clamp Remover/Installer<br/>Wooden Block</p> |  |

**NOTE:** It is recommended that this component be serviced with the vehicle body removed. If the body can be removed, refer to Engine - Body Off in this section.

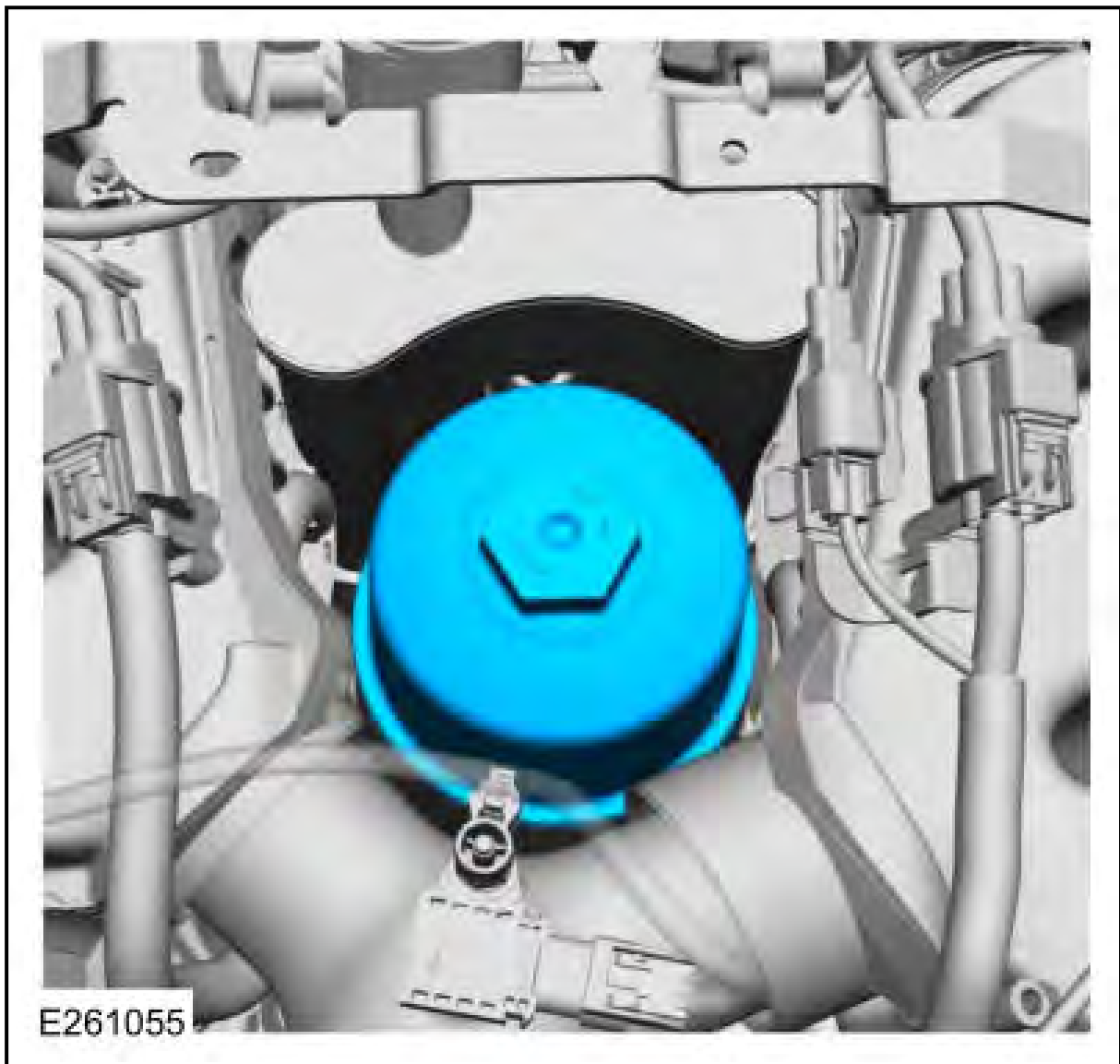
1. With the vehicle in NEUTRAL, position it on a hoist. Refer to: [Jacking and Lifting - Overview](#) .
2. Disconnect the battery ground cable. Refer to: [Battery Disconnect and Connect](#) .
3. Remove the engine appearance cover.



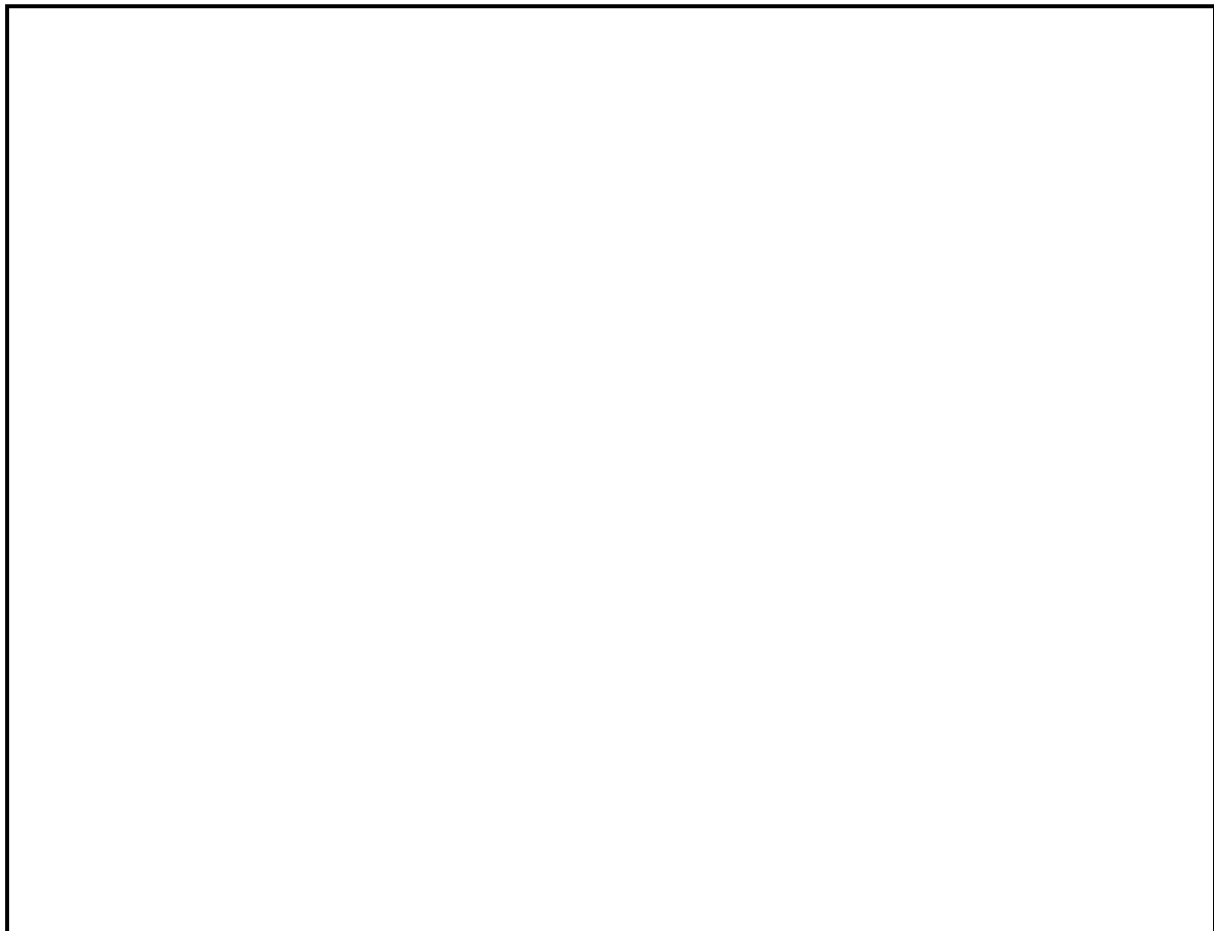
4. Release the fuel system pressure. Refer to: [Fuel System Pressure Release](#) .
5. **NOTE:** The oil filter housing needs a minimum of 1 minute to allow the oil to drain out of the oil filter housing to minimise oil spillage.

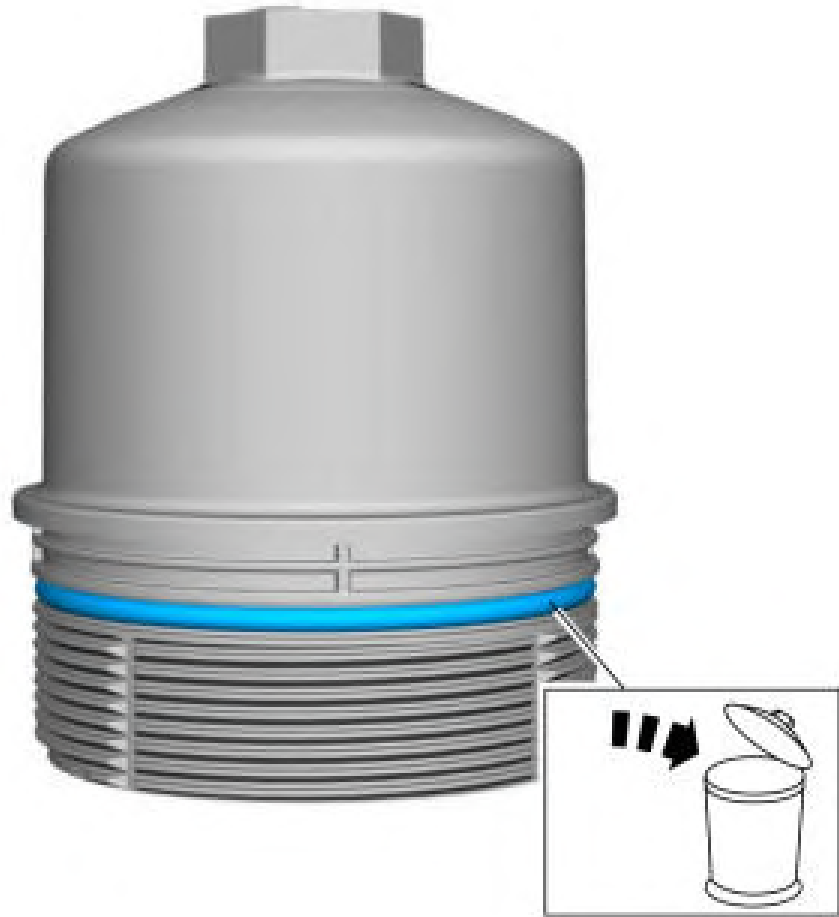


Loosen the oil filter cap and let the oil filter housing drain. Remove the oil filter cap.



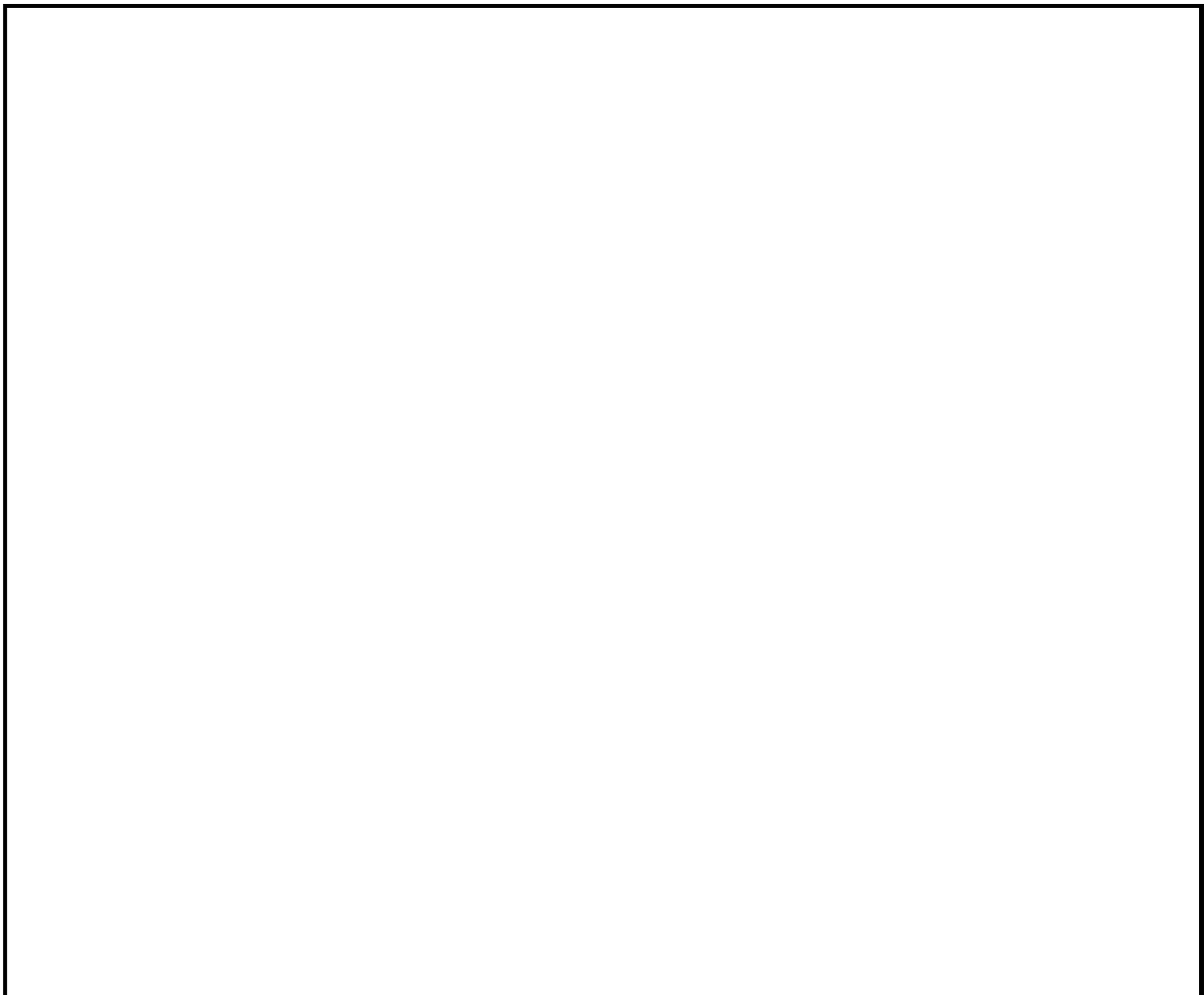
6. Remove and discard the oil filter cap O-ring seal.

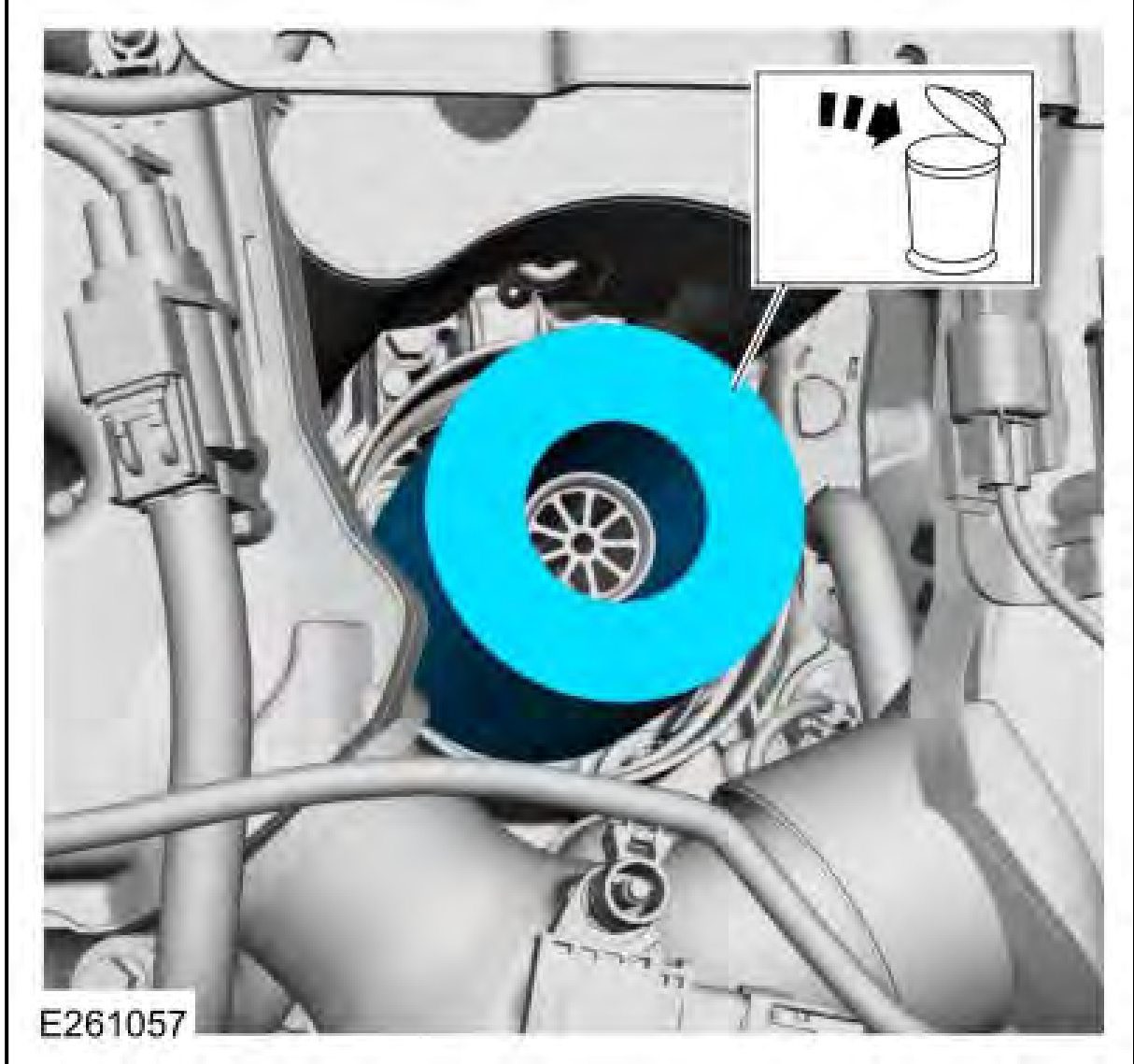




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7. Remove and discard the oil filter. Use the General Equipment: Oil Drain Equipment

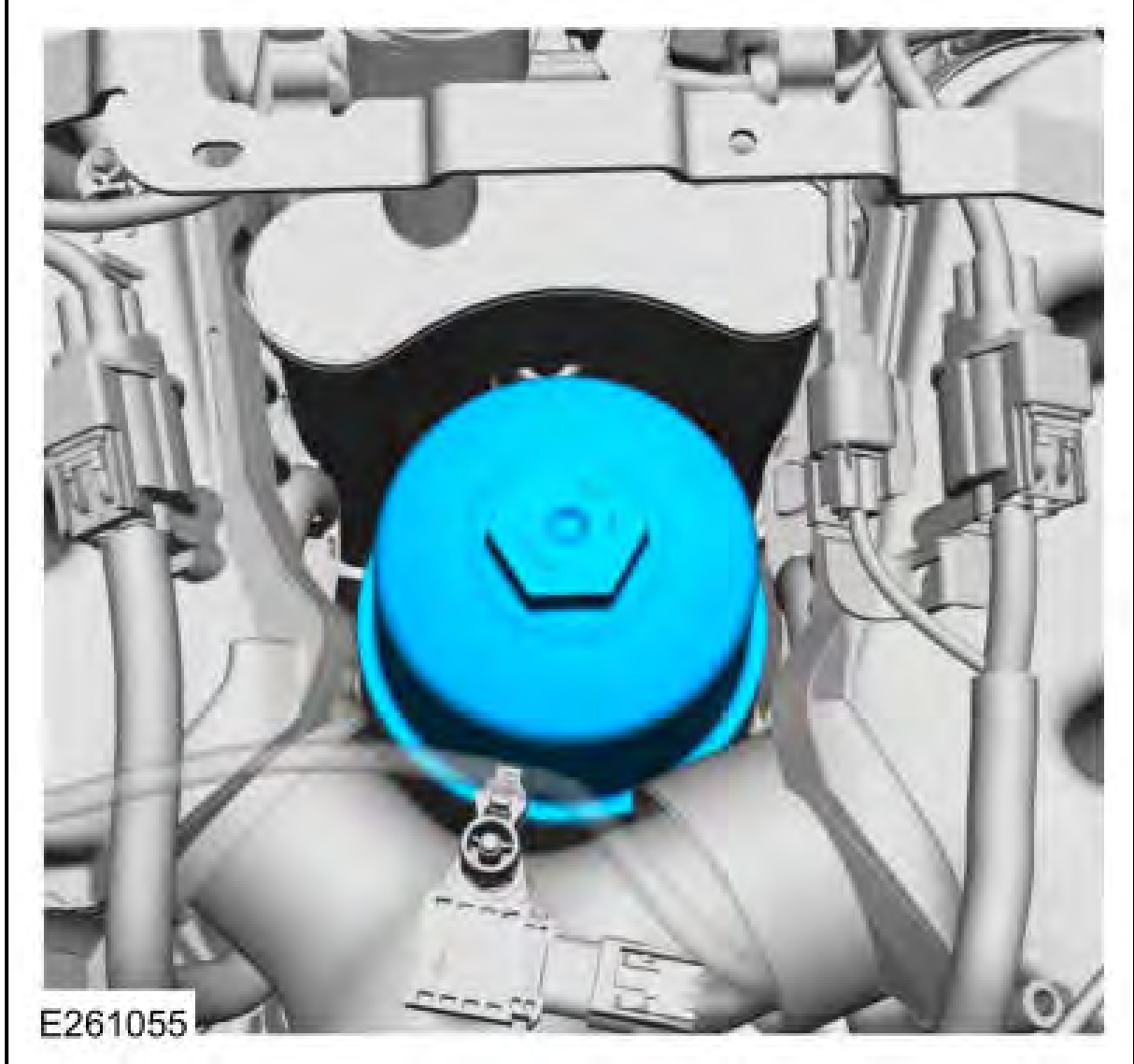




8. Install the oil filter cap

Torque: 18 lb.ft (25 Nm)

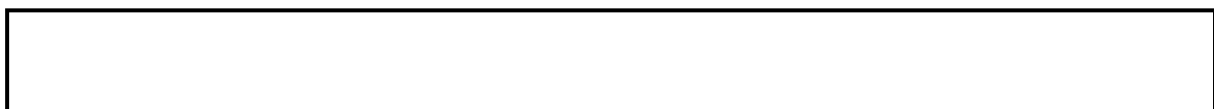


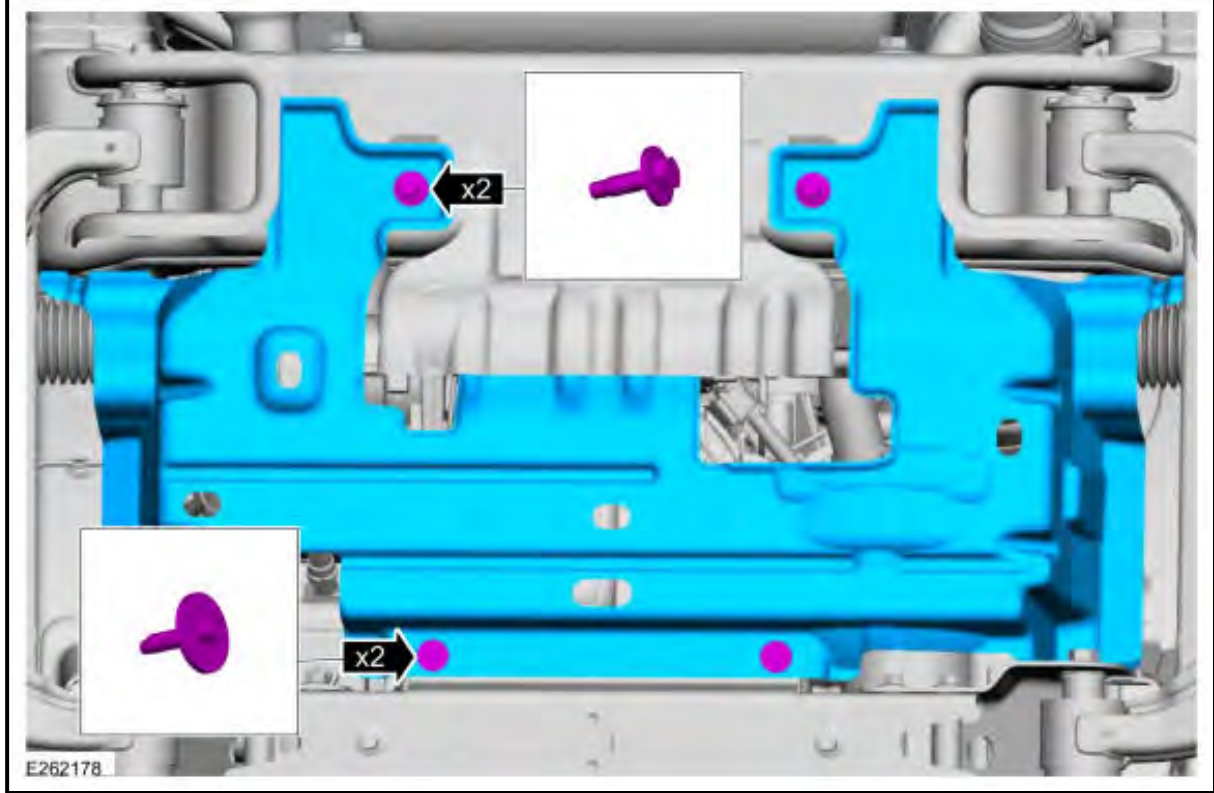


9. Remove the retainer. Remove the bolts and the transmission housing cover.

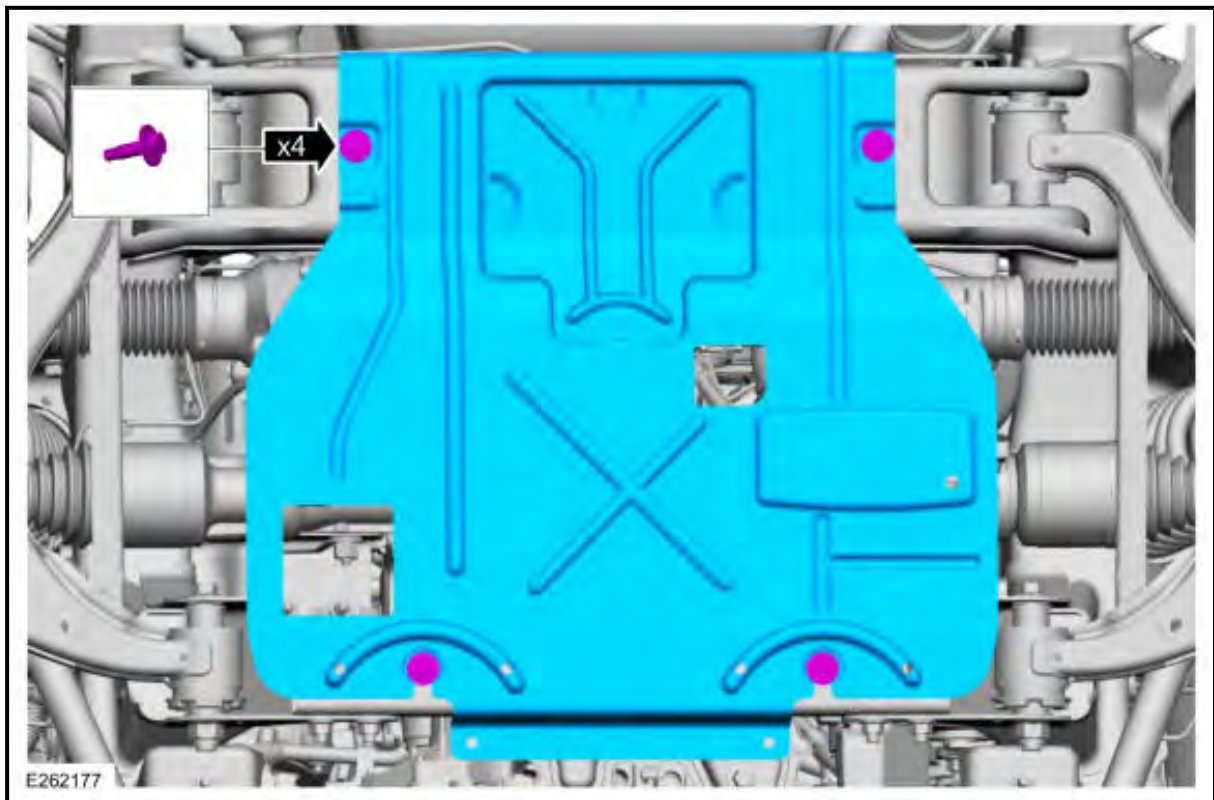


10. If equipped. Remove the bolts and the underbody shield.





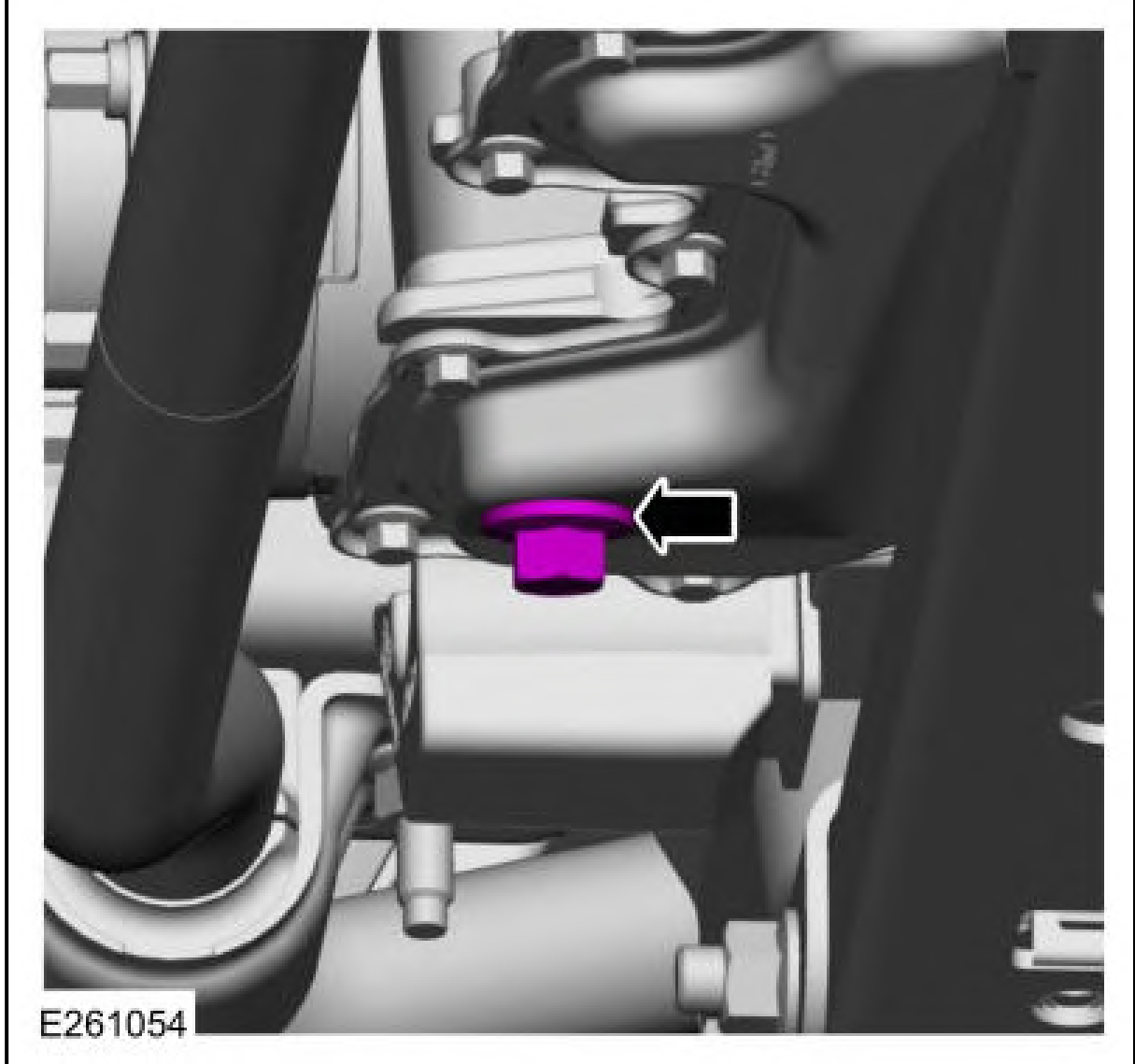
11. If equipped. Remove the bolts and the skid plate.



12. Remove the oil pan plug and drain the engine oil. Use the General Equipment: Oil Drain Equipment

Torque: 18 lb.ft (25 Nm)





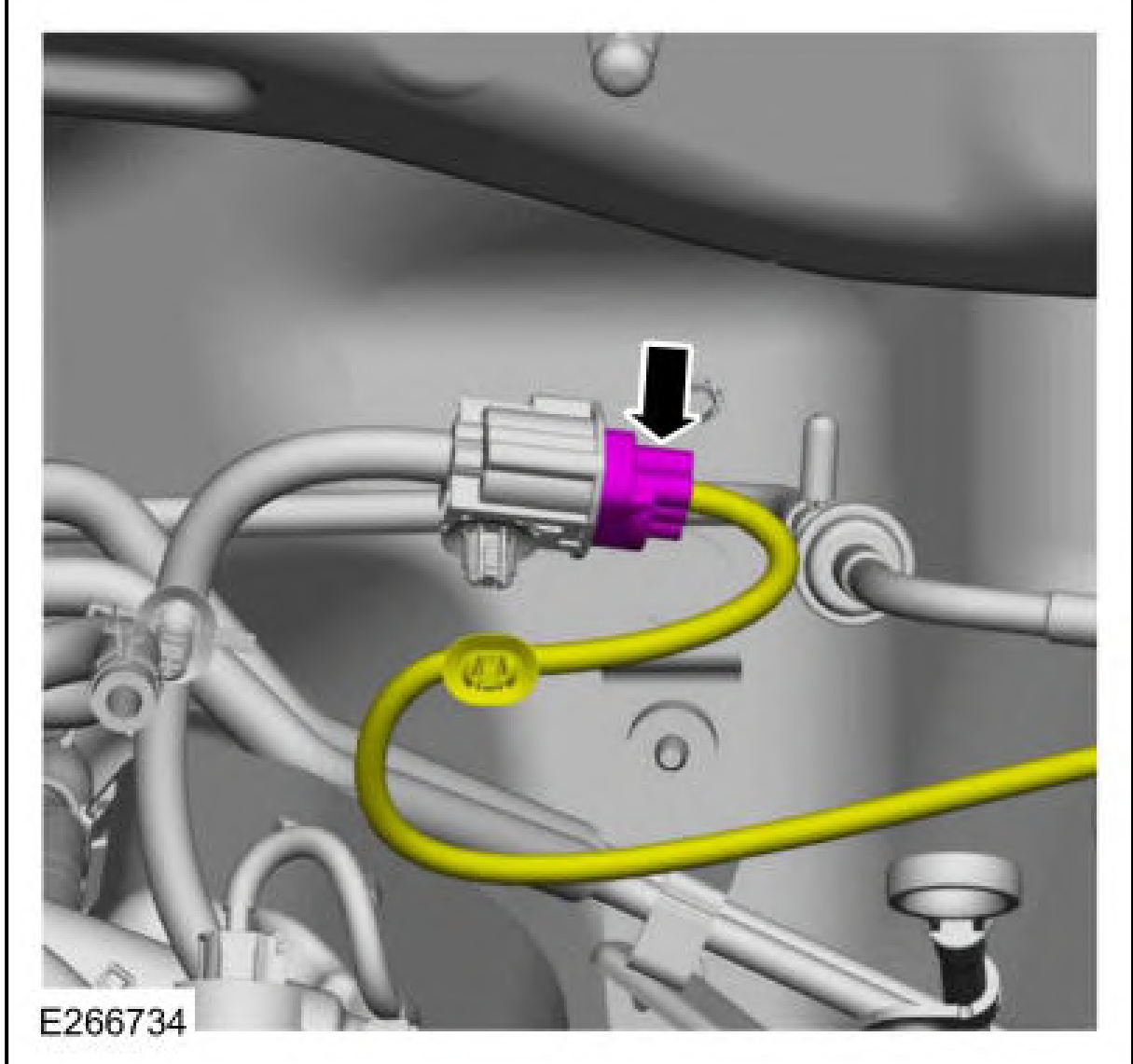
13. Drain the cooling system. Refer to: [Cooling System Draining, Vacuum Filling and Bleeding](#) .

14. Remove the following items:

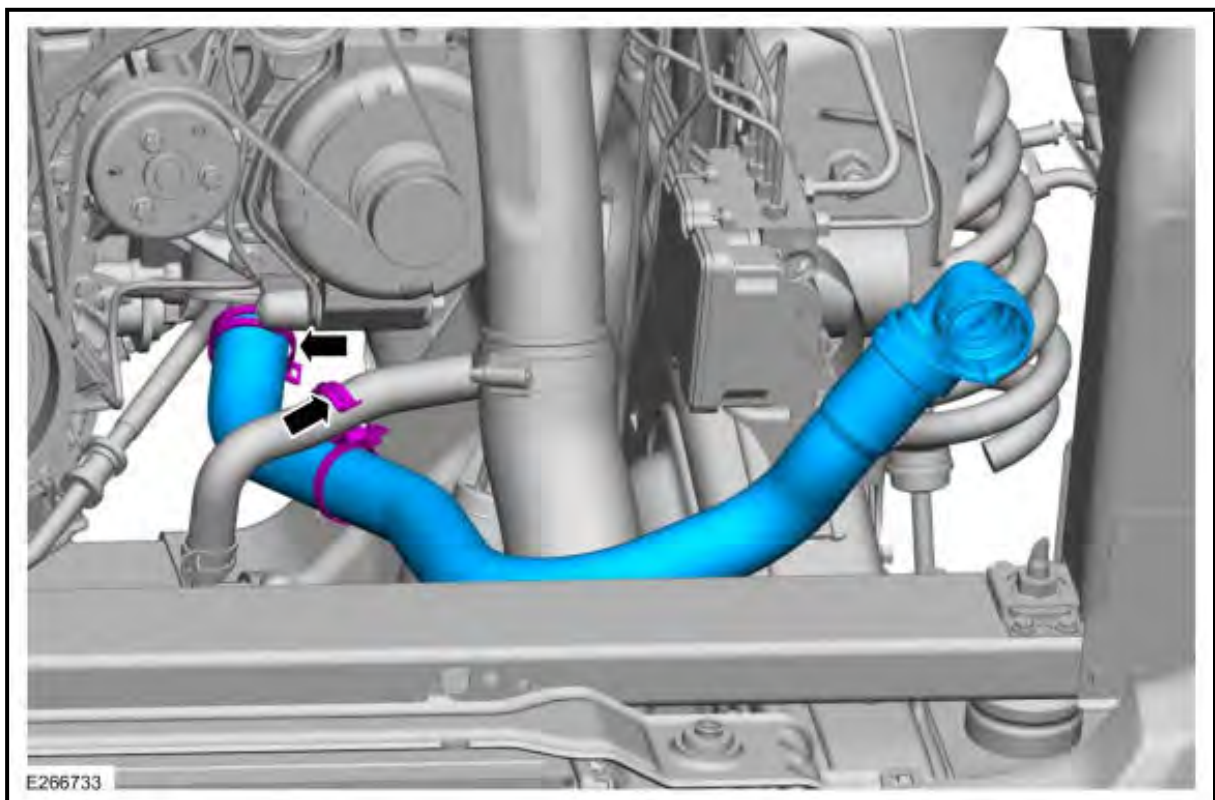
1. Remove the degas bottle. Refer to: [Degas Bottle](#) .
2. Remove the cooling module. Refer to: [Cooling Module](#) .
3. Remove the air cleaner outlet tube. Refer to: [Air Cleaner Outlet Pipe](#) .
4. Remove the battery tray. Refer to: [Battery Tray](#) .
5. Remove the LH and the RH fender splash shields. Refer to: [Fender Splash Shield](#) .
6. Remove the turbocharger. Refer to: [Turbocharger](#) .

15. Disconnect the electrical connector and position side the wire harness.

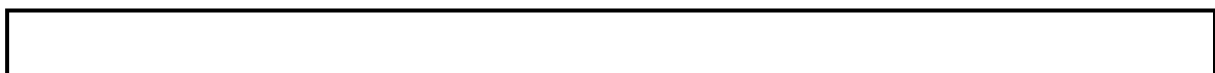


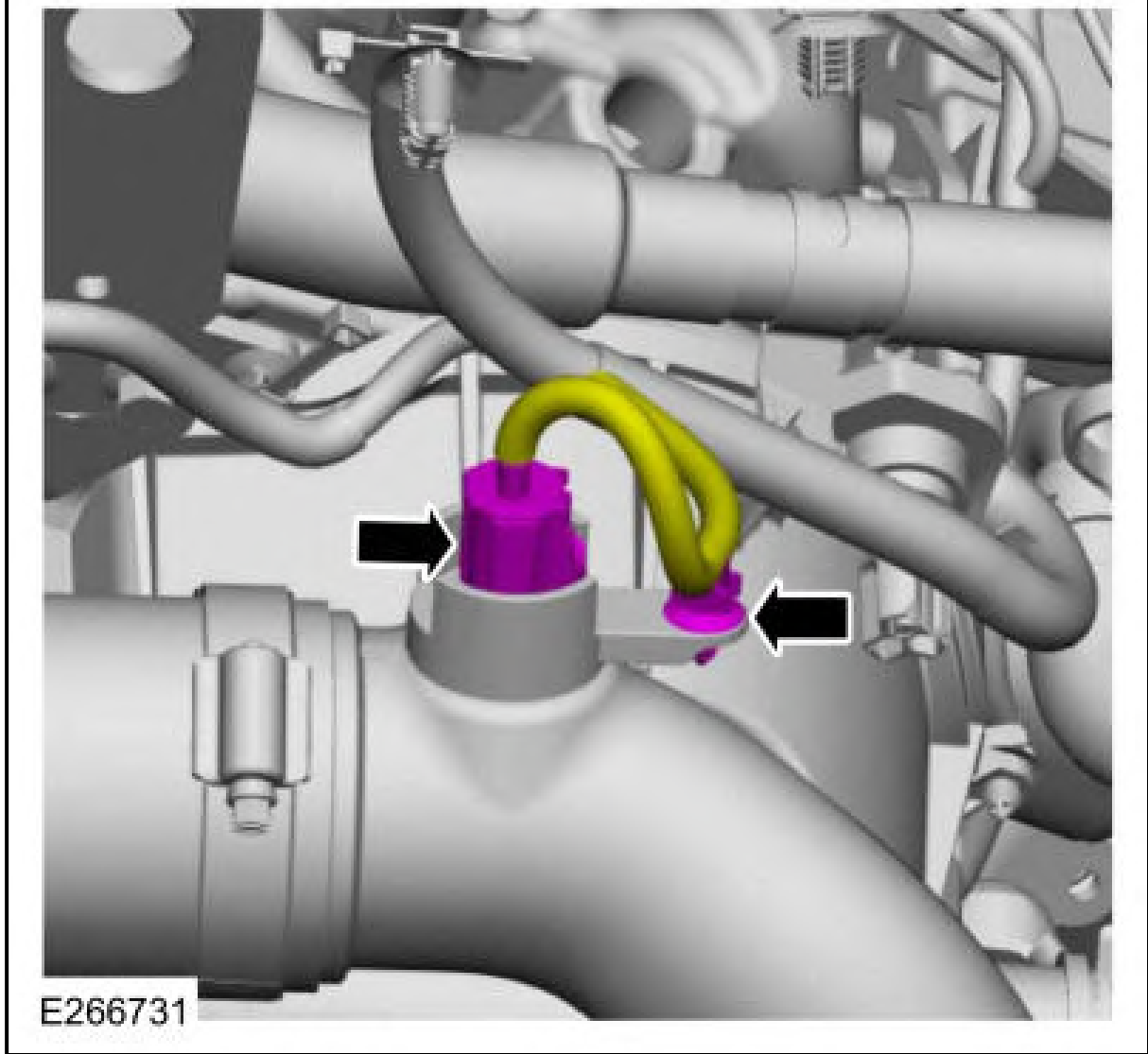


16. Disconnect the retainer. Remove the lower radiator hose. Use the General Equipment: Hose Clamp Remover/Installer



17. Disconnect the electrical connector and the wire retainer.



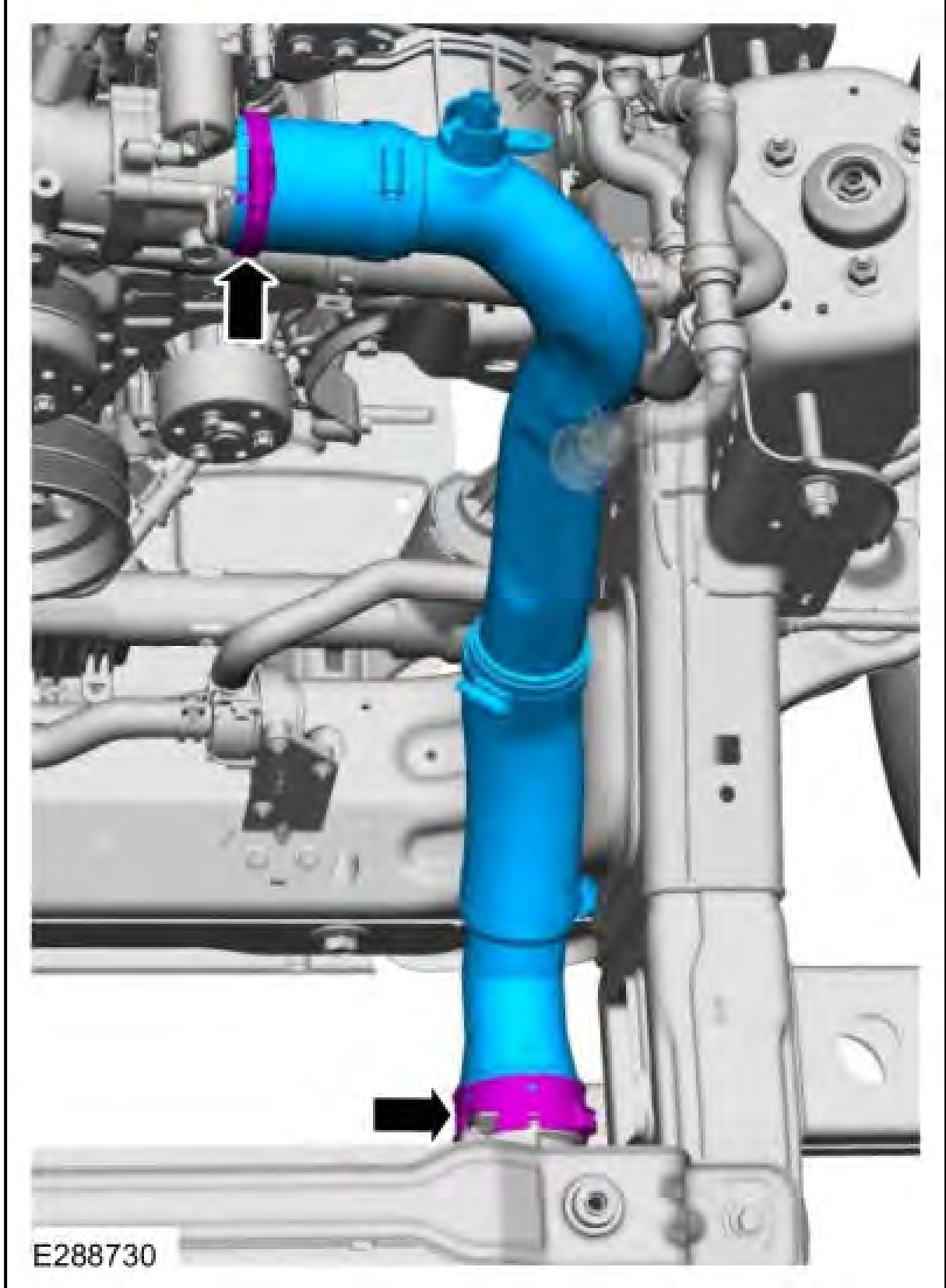


18. **NOTE:** The turbocharger compressor vanes can be damaged by even the smallest particles. When removing any turbocharger or engine air intake system component, ensure that no debris enters the system. Failure to do so may result in damage to the turbocharger.

Loosen the clamp, release the clip and remove the LH CAC intake pipe.

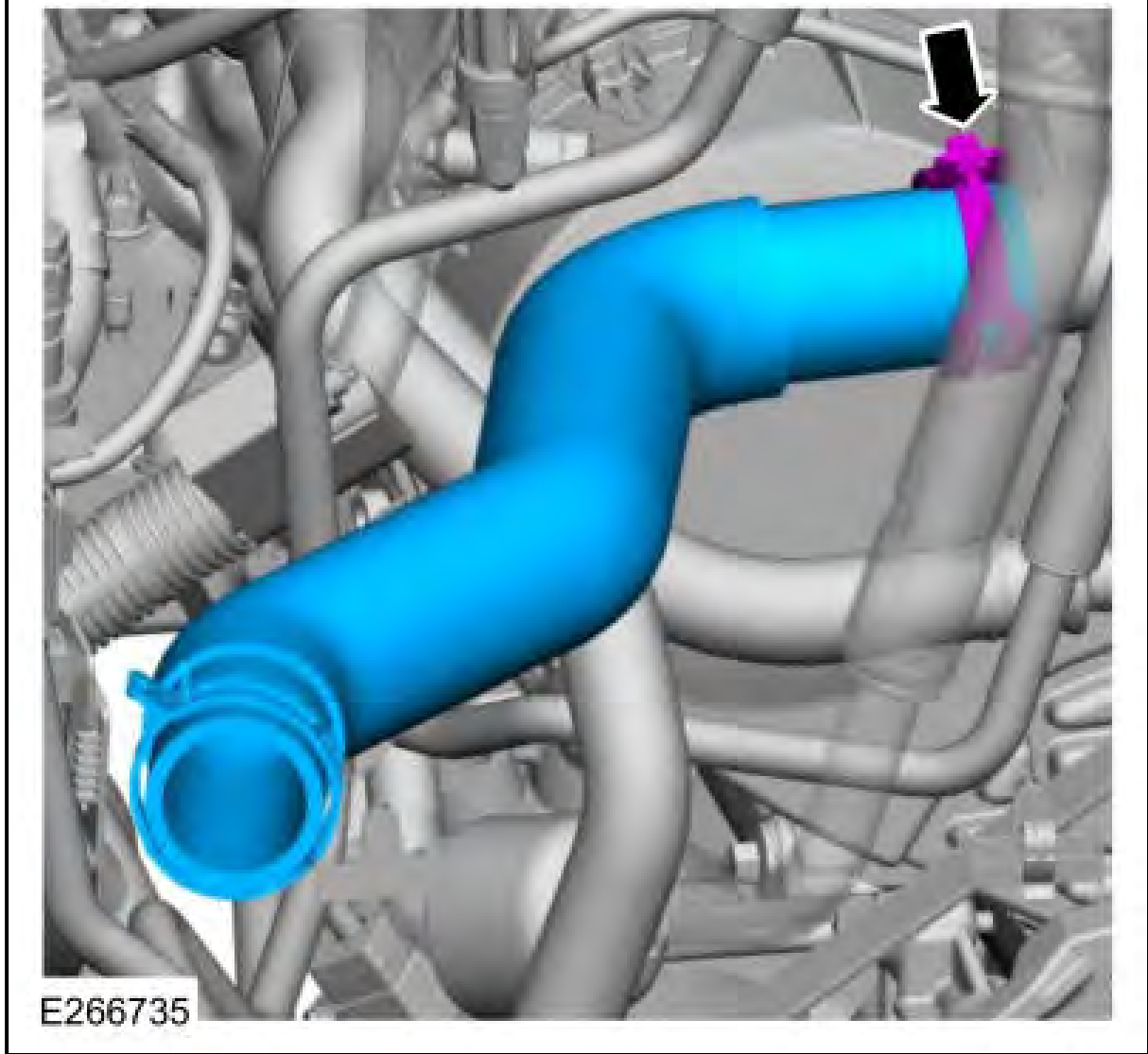






19. Remove the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer

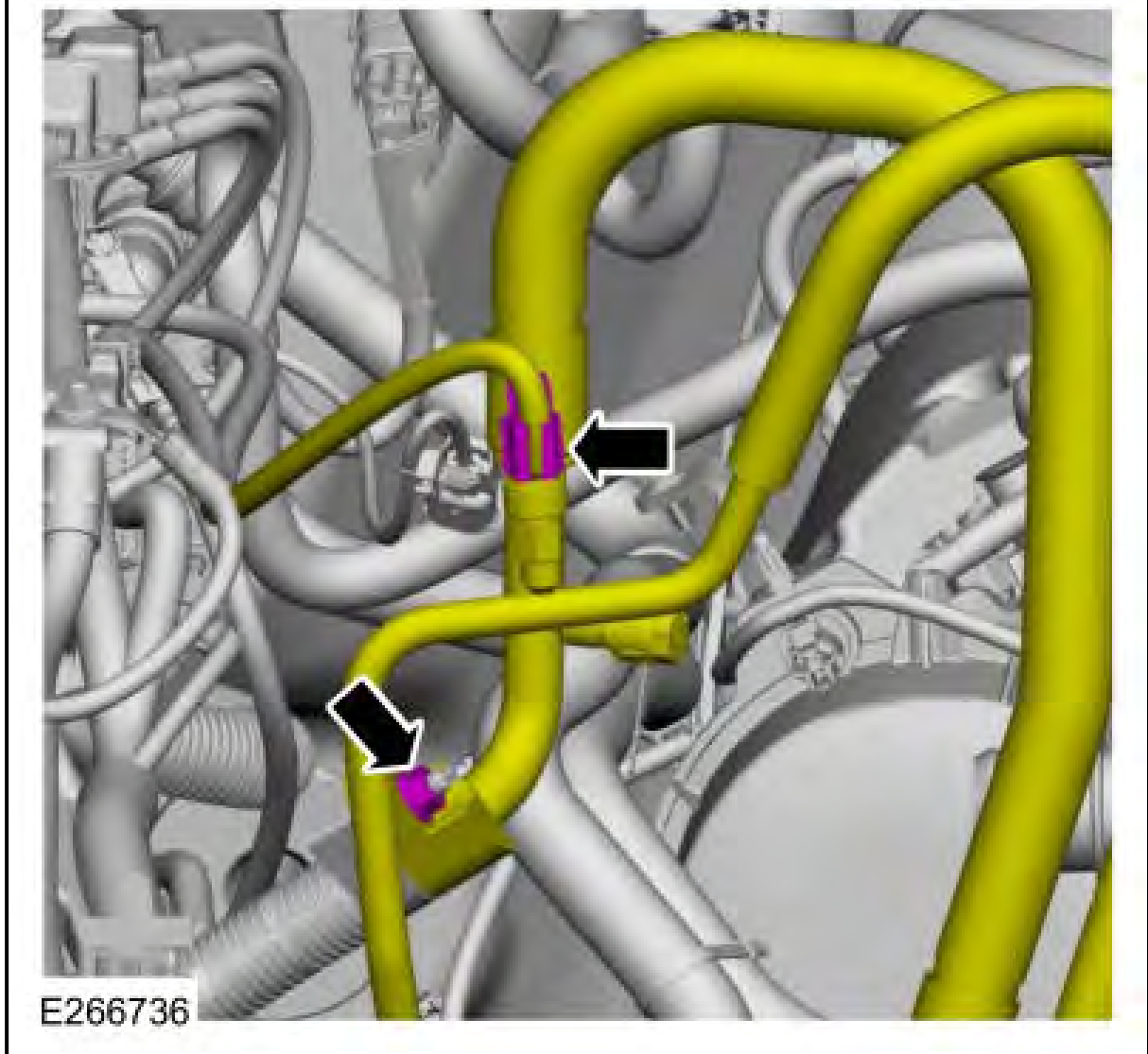




20. **NOTE:**        **Make sure that all openings are sealed.**

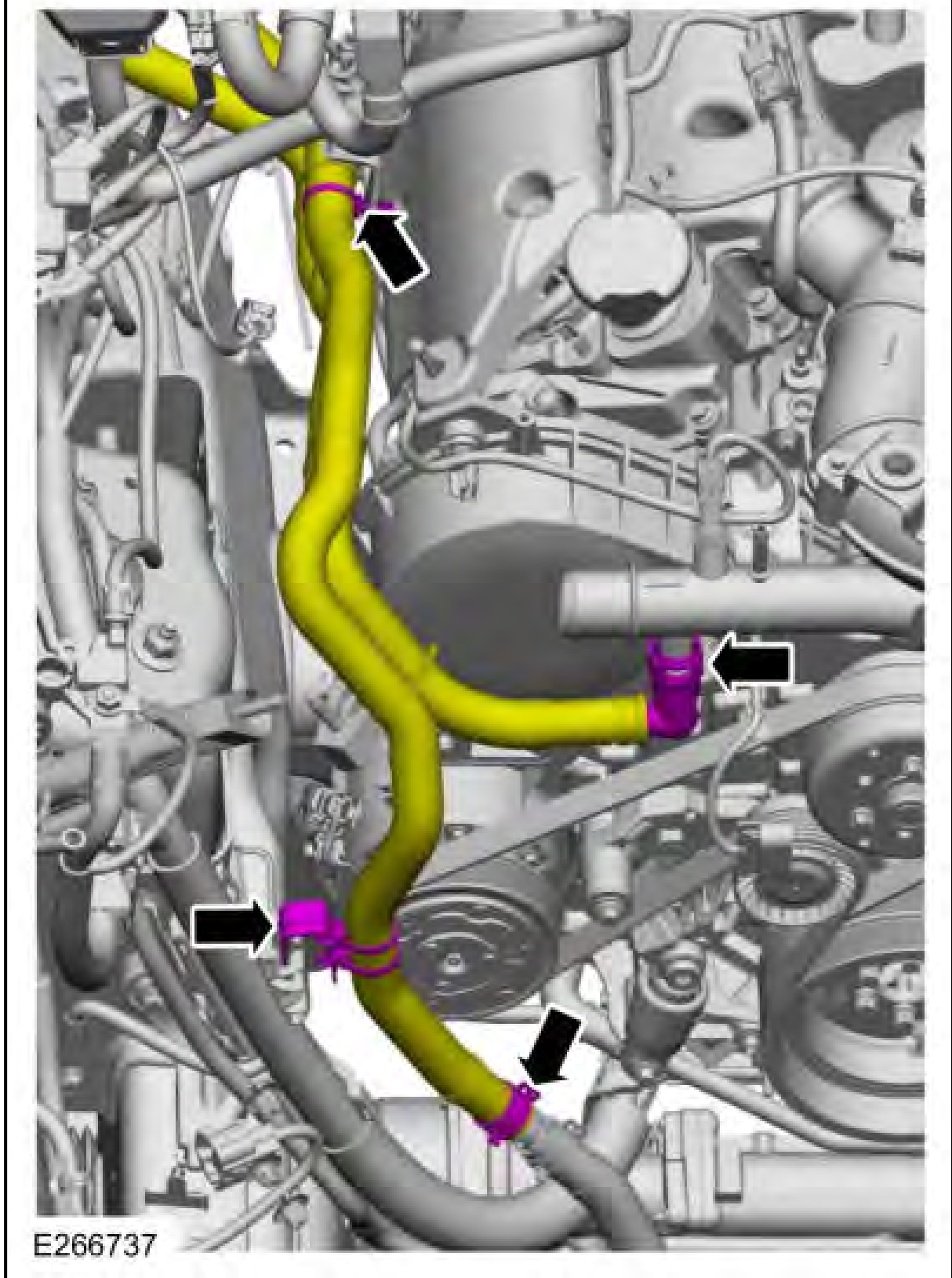
- Remove the nut and disconnect the A/C compressor inlet line.
- Remove and discard the O-ring seal.
- Disconnect the A/C pressure transducer electrical connector.





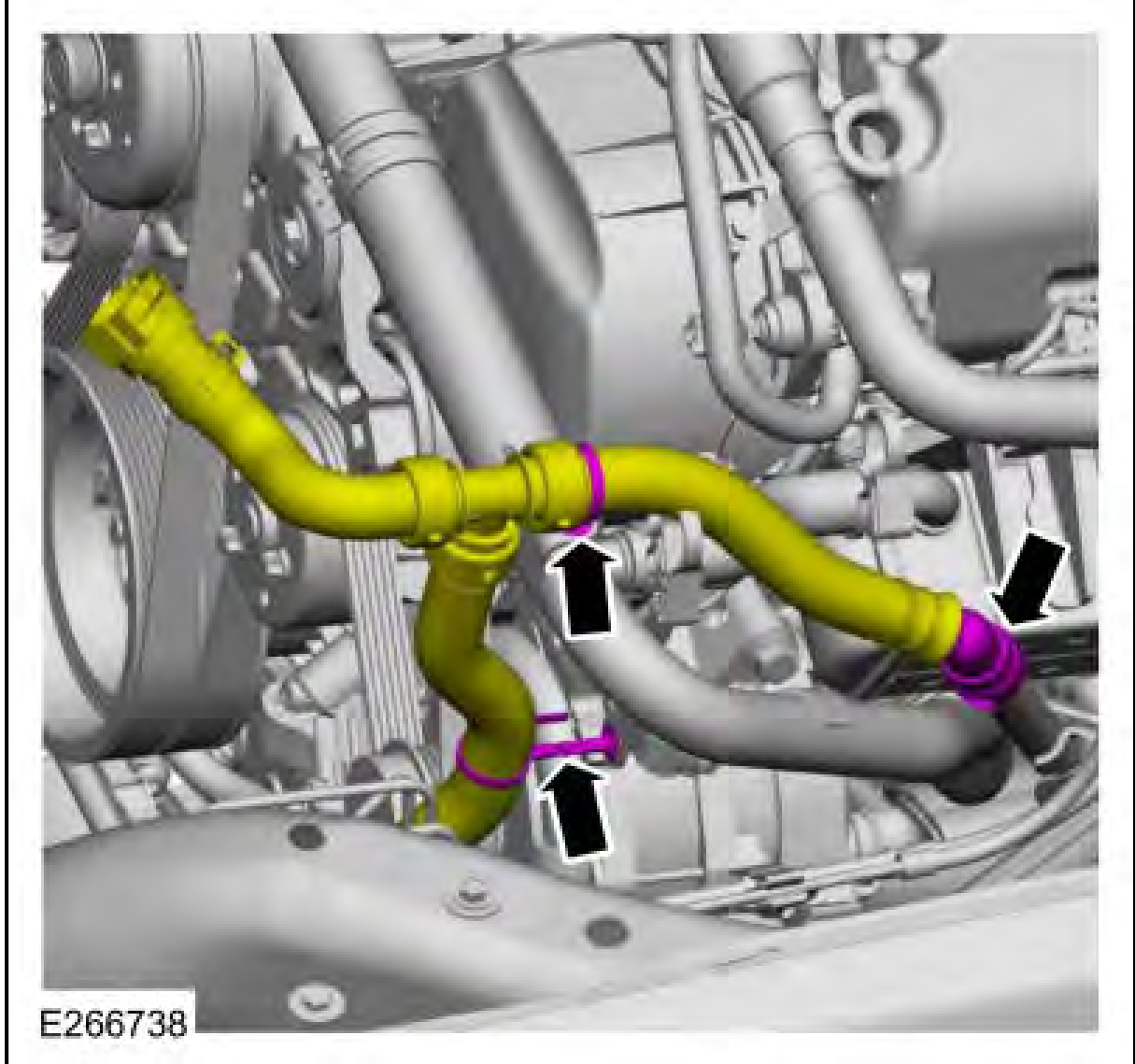
21. Disconnect the heater hoses and the retainers. Use the General Equipment: Hose Clamp Remover/Installer





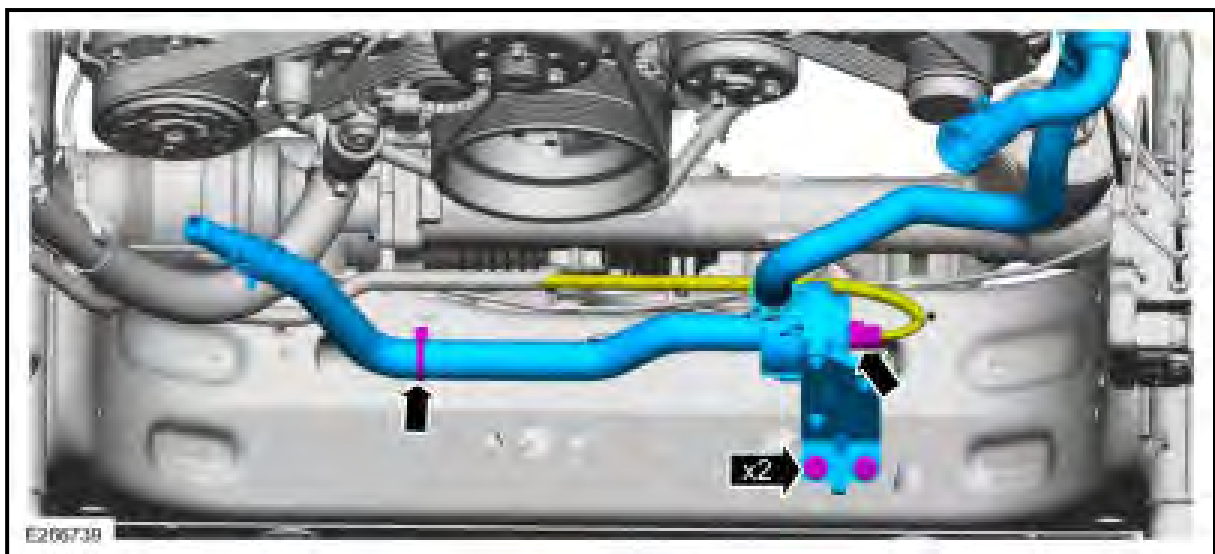
22. Disconnect the coolant hose connector and the retainers.





23.

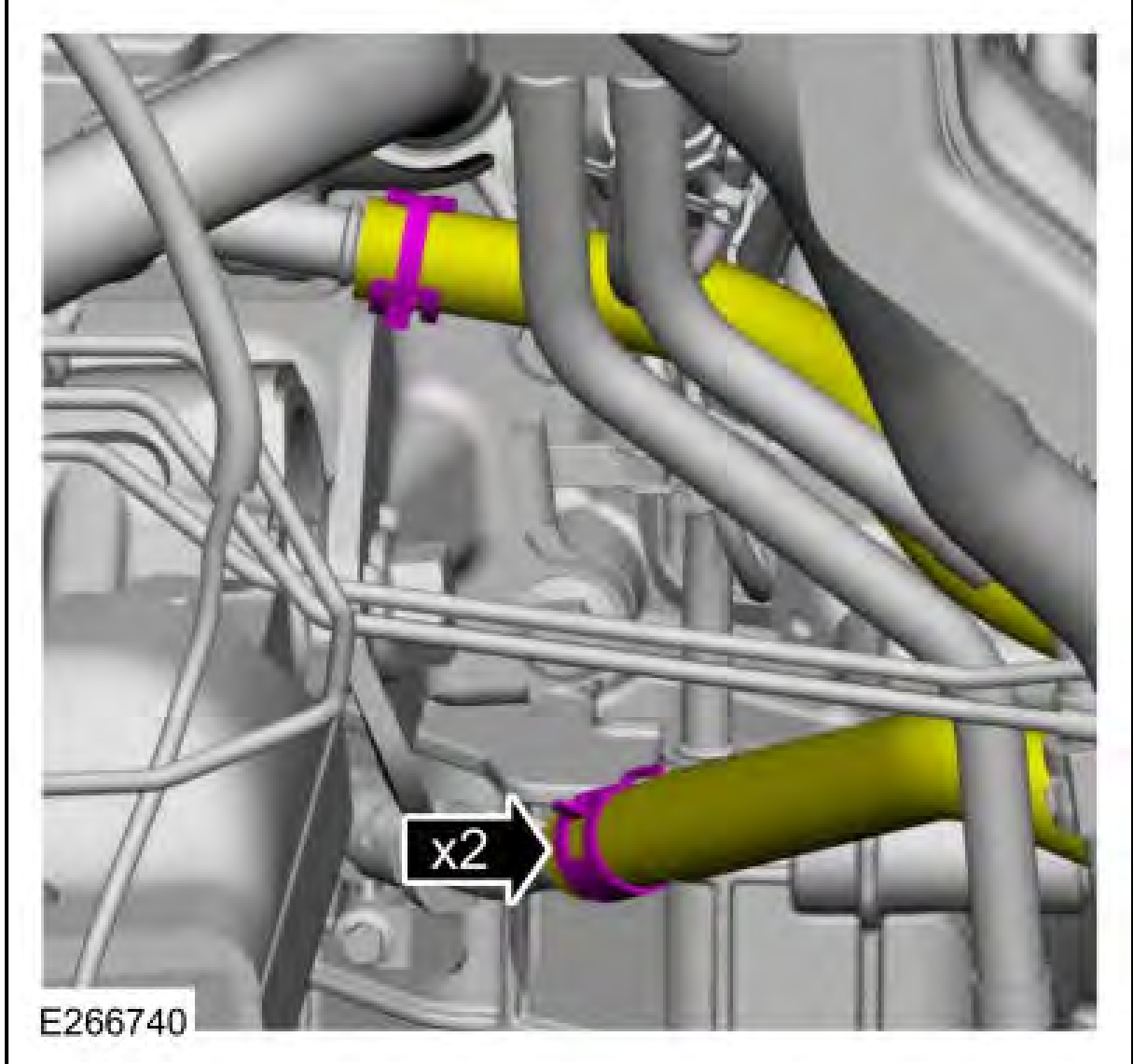
- Disconnect the electrical connector and the coolant hose retainer.
- Remove the bolts and the coolant pump.



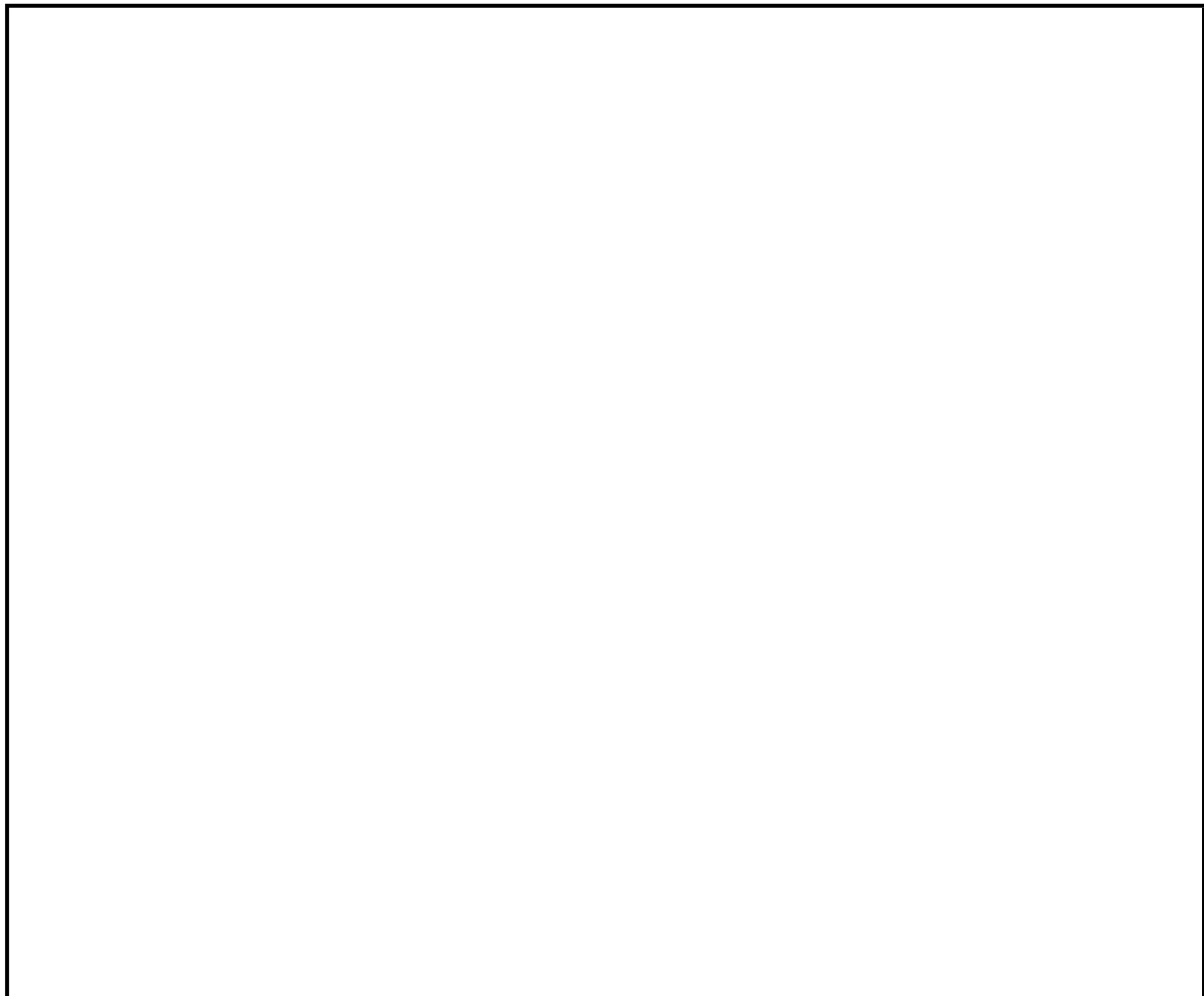
24. Remove the following items:

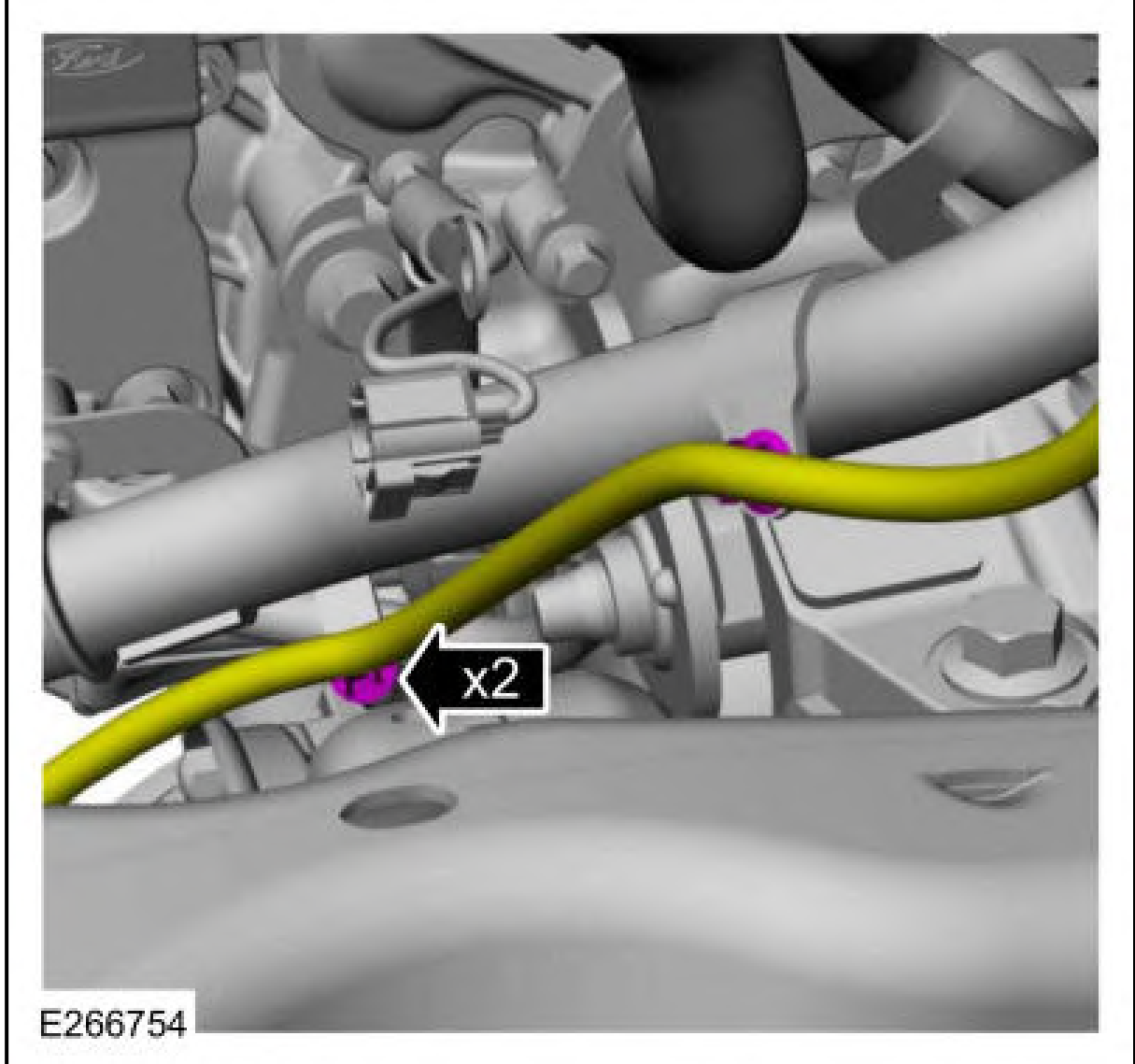
1. Remove the cowl panel. Refer to: [Cowl Panel](#) .
2. Remove the generator. Refer to: [Generator - 3.0L Power Stroke Diesel](#) .

25. Disconnect the coolant hoses and position aside. Use the General Equipment: Hose Clamp Remover/Installer

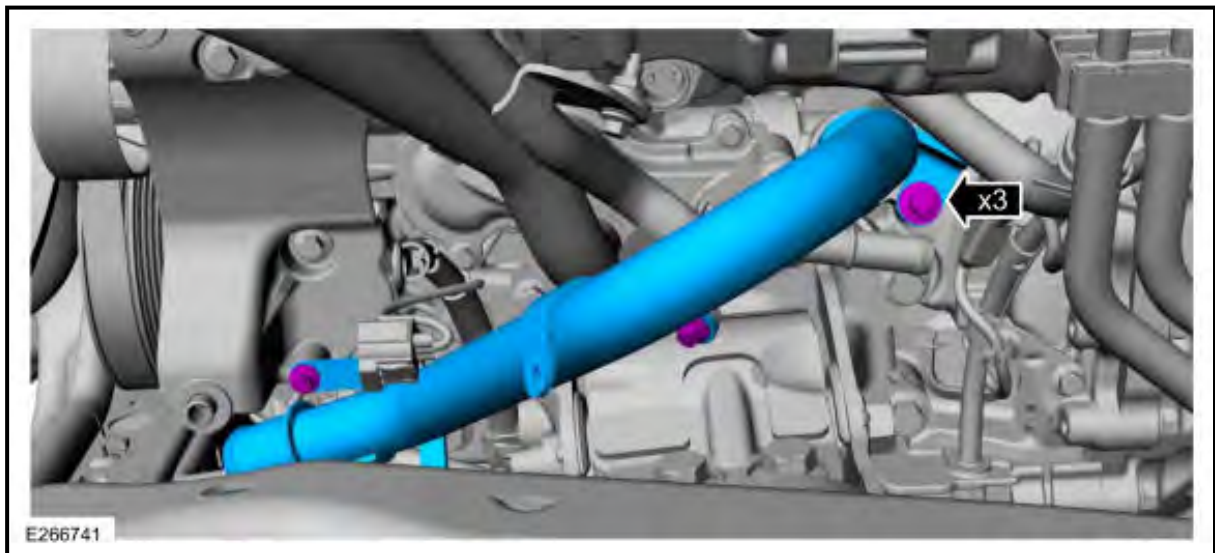


26. If equipped. Disconnect the block heater cord retainers.



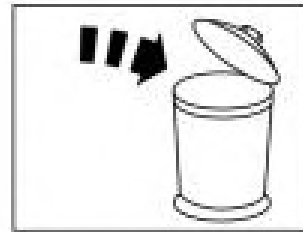


27. Remove the bolts and the lower radiator coolant tube.



28. Remove and discard the lower radiator coolant tube O-ring seal.



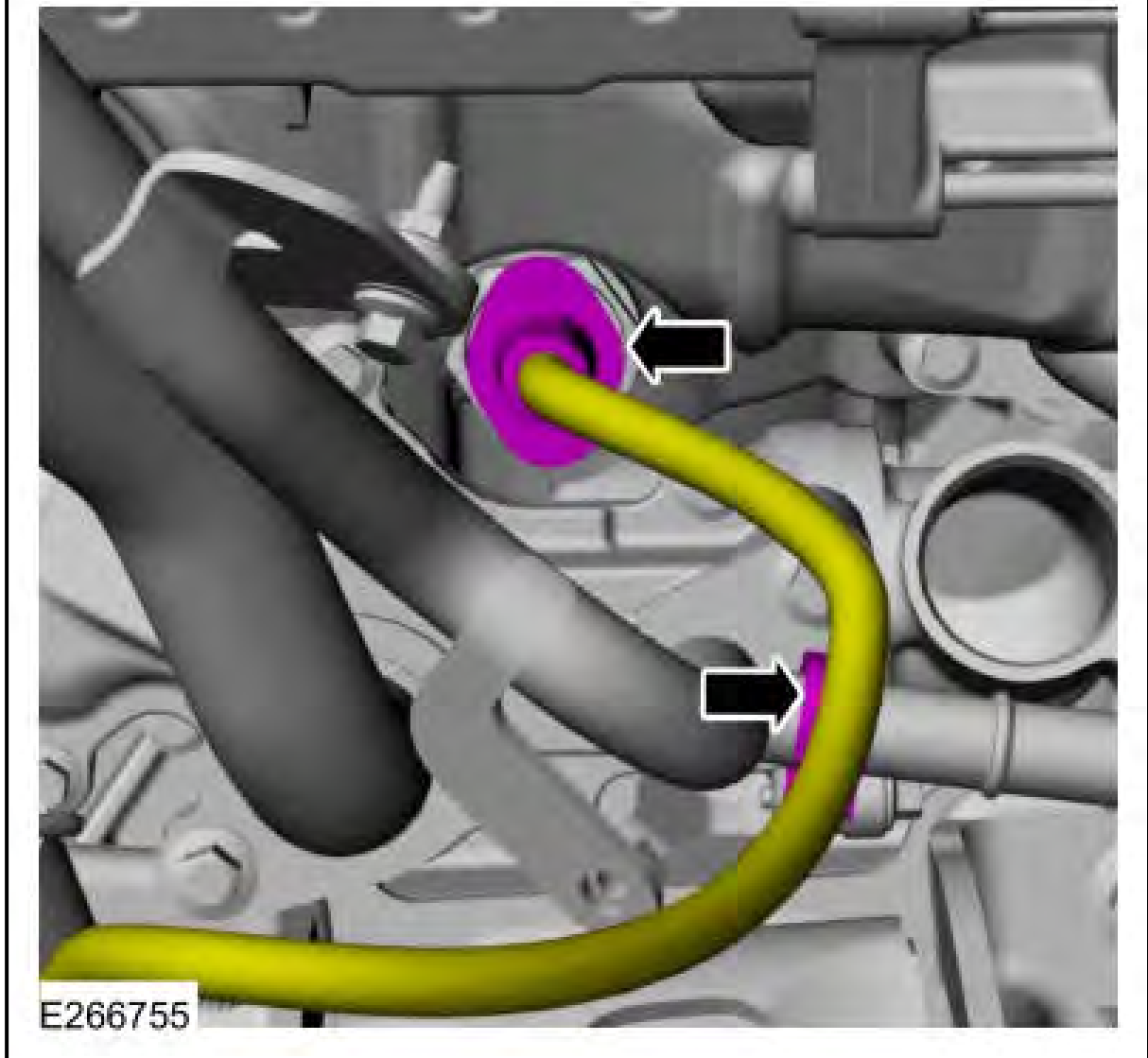


E267081

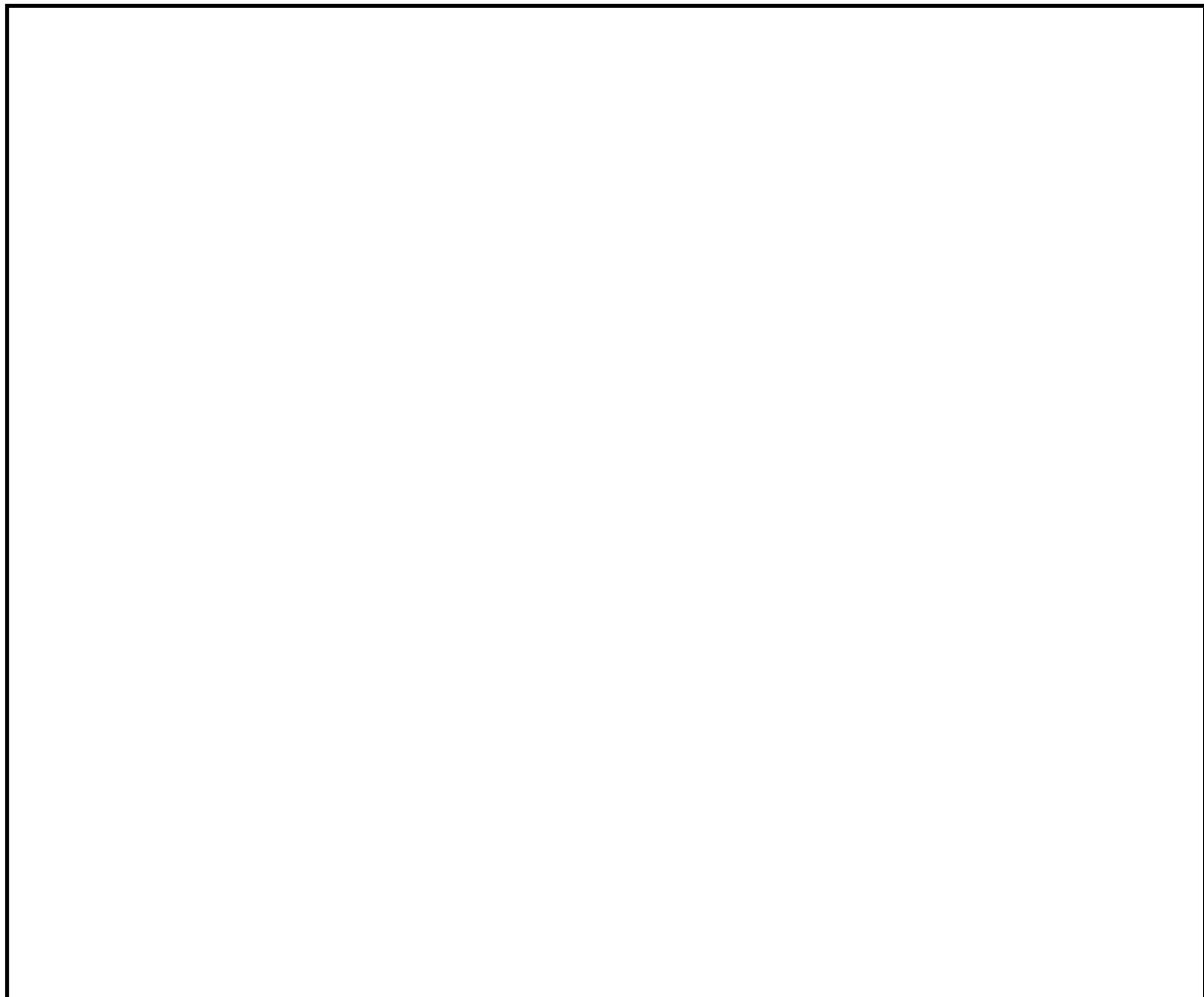
29. If equipped. Disconnect the block heater cord retainer and the electrical connector.

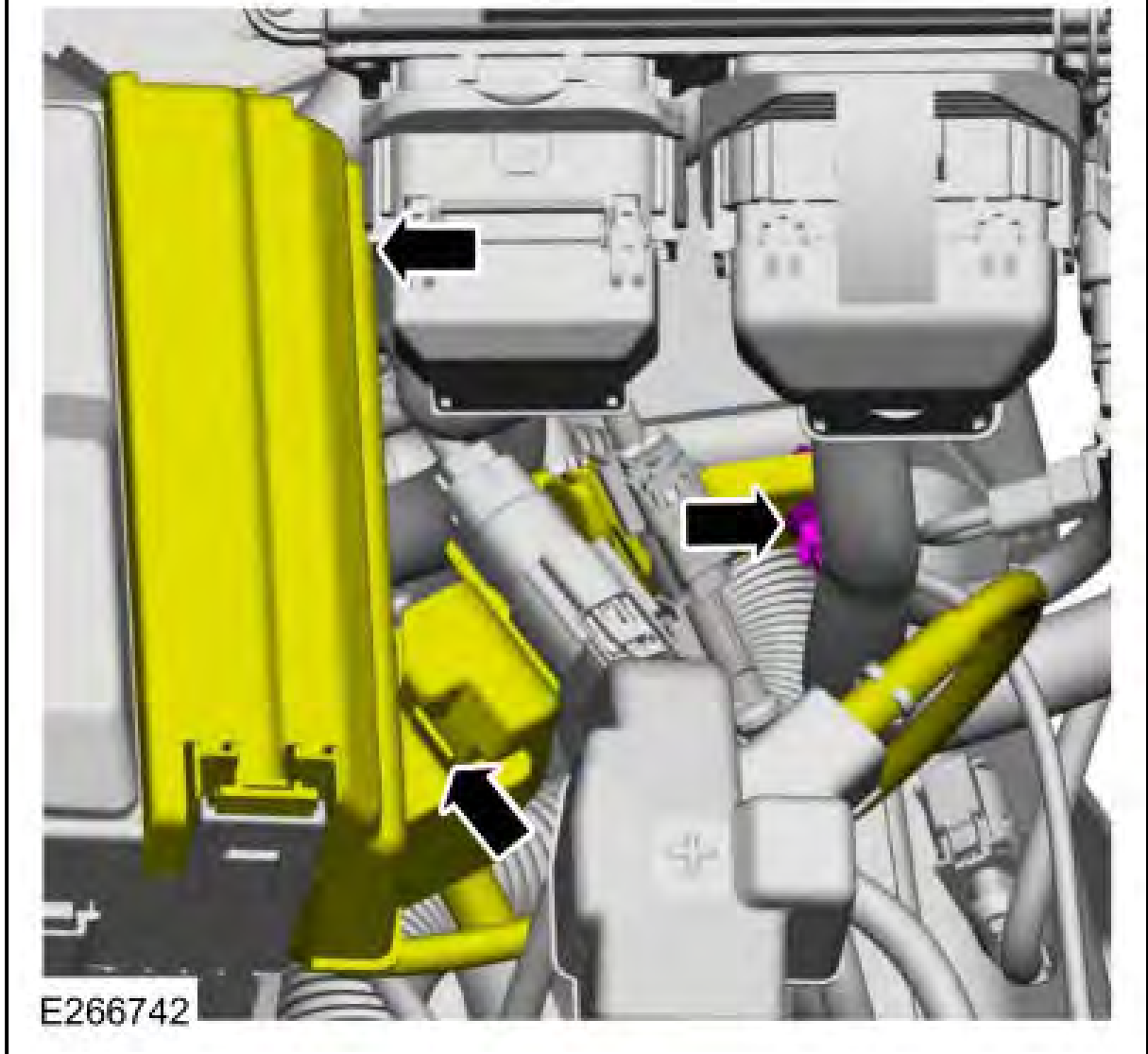




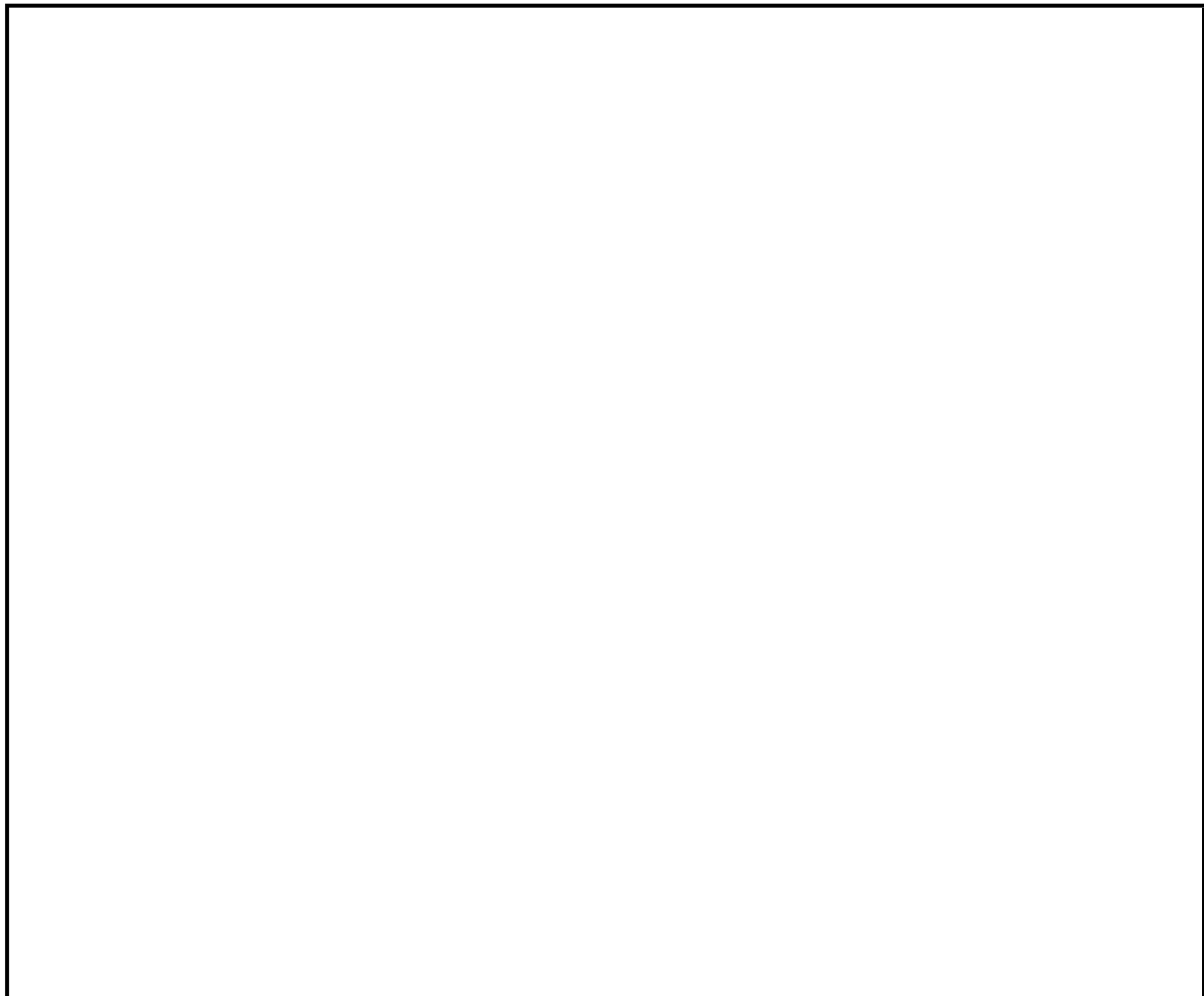


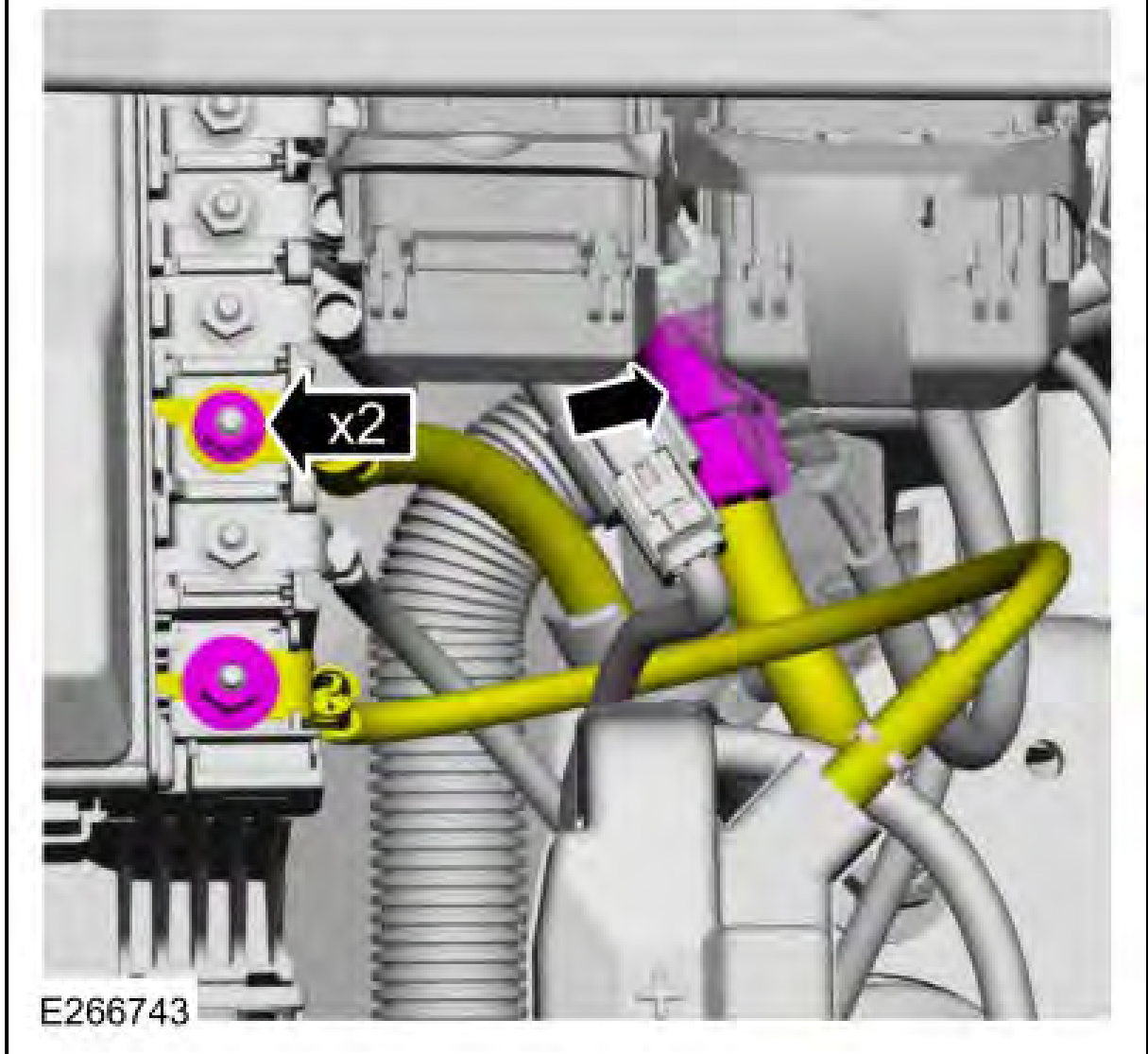
30. Disconnect the retainer. Remove the power distribution box cover.



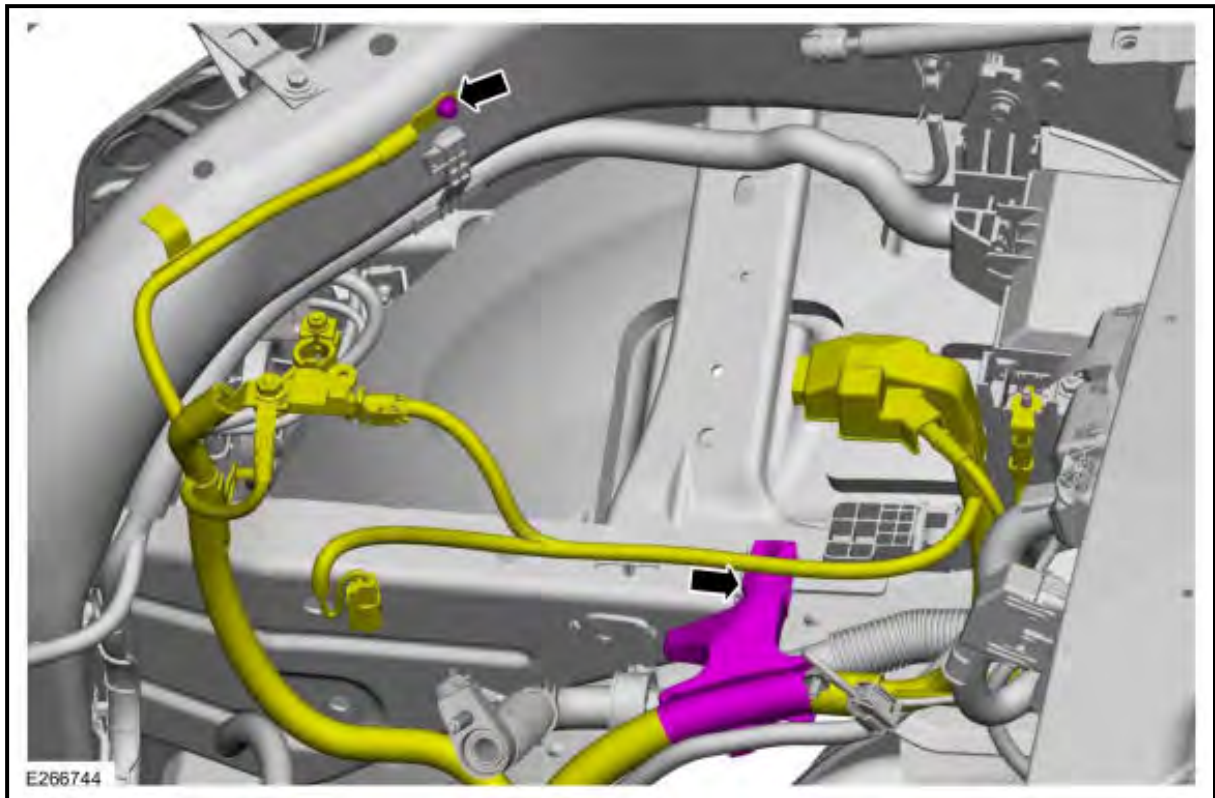


31. Remove the nuts and position out the battery wire harness. Disconnect the electrical connector.



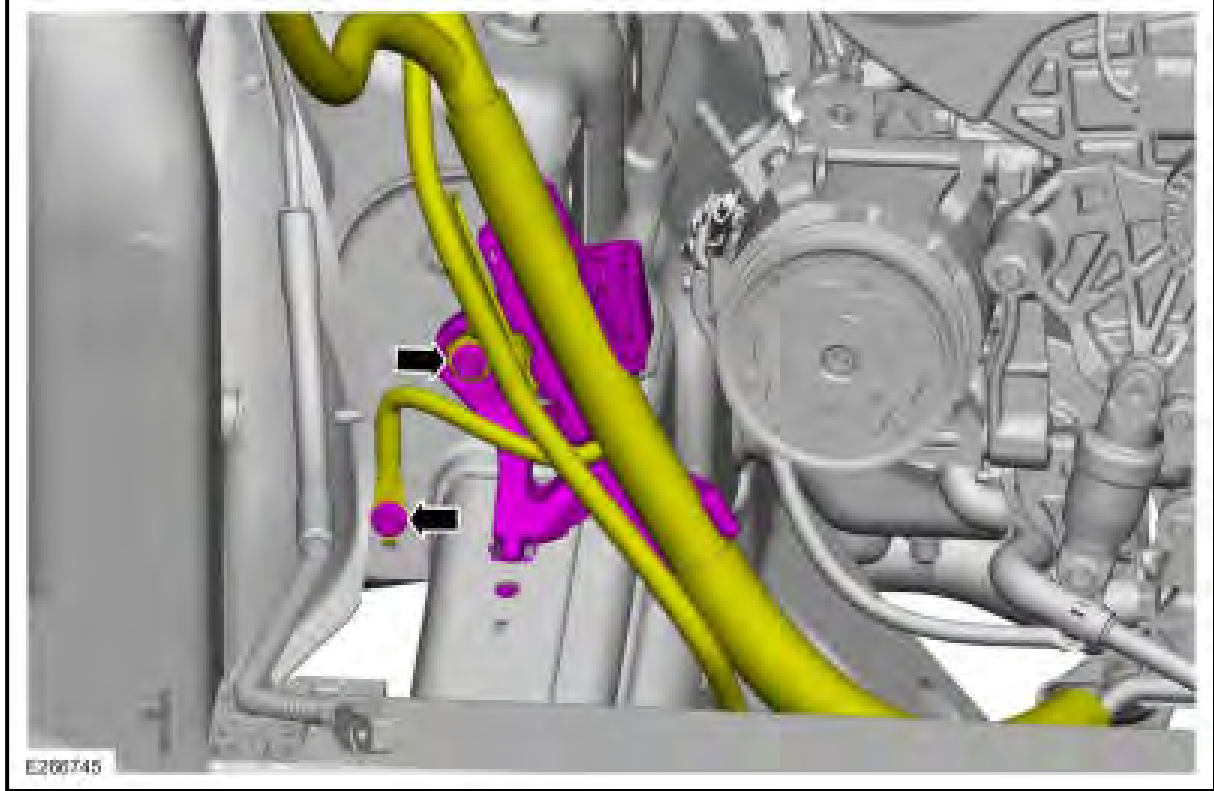


32. Remove the bolt for the ground wire. Disconnect the wire harness retainer.

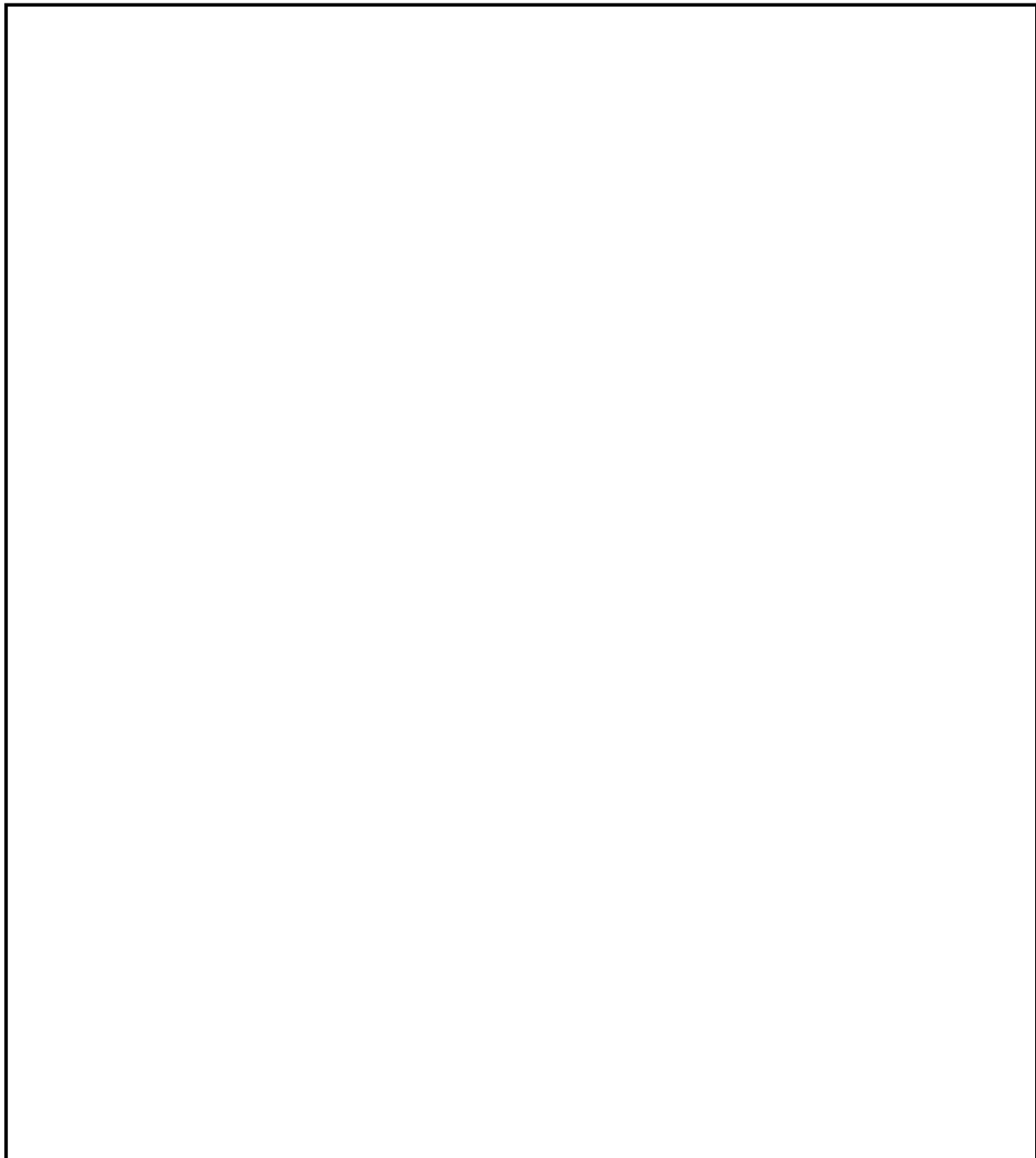


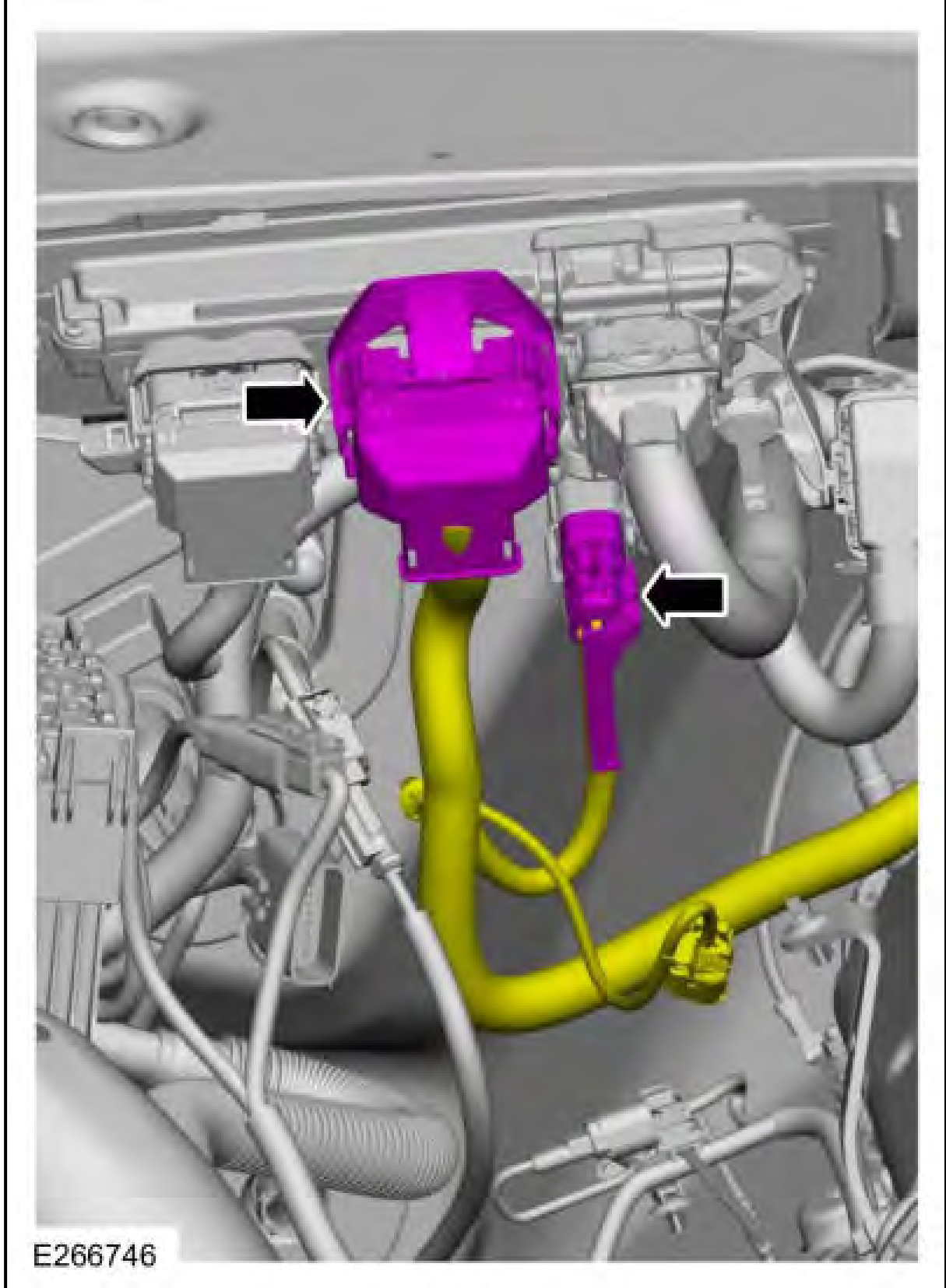
33. Remove the bolts and position aside the battery cable harness.





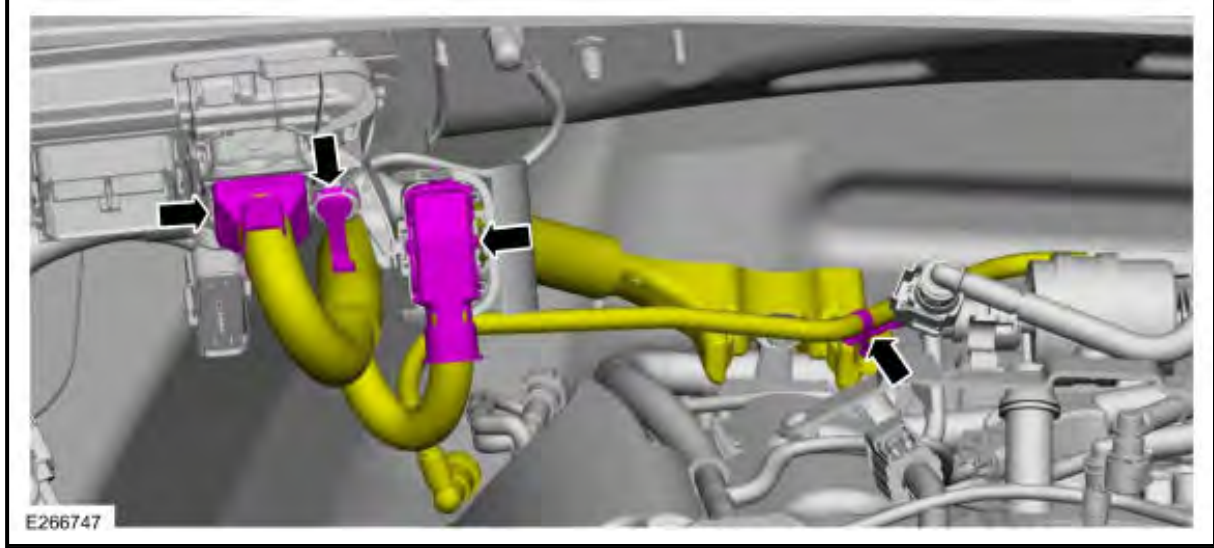
34. Disconnect the PCM electrical connector and the electrical connector.



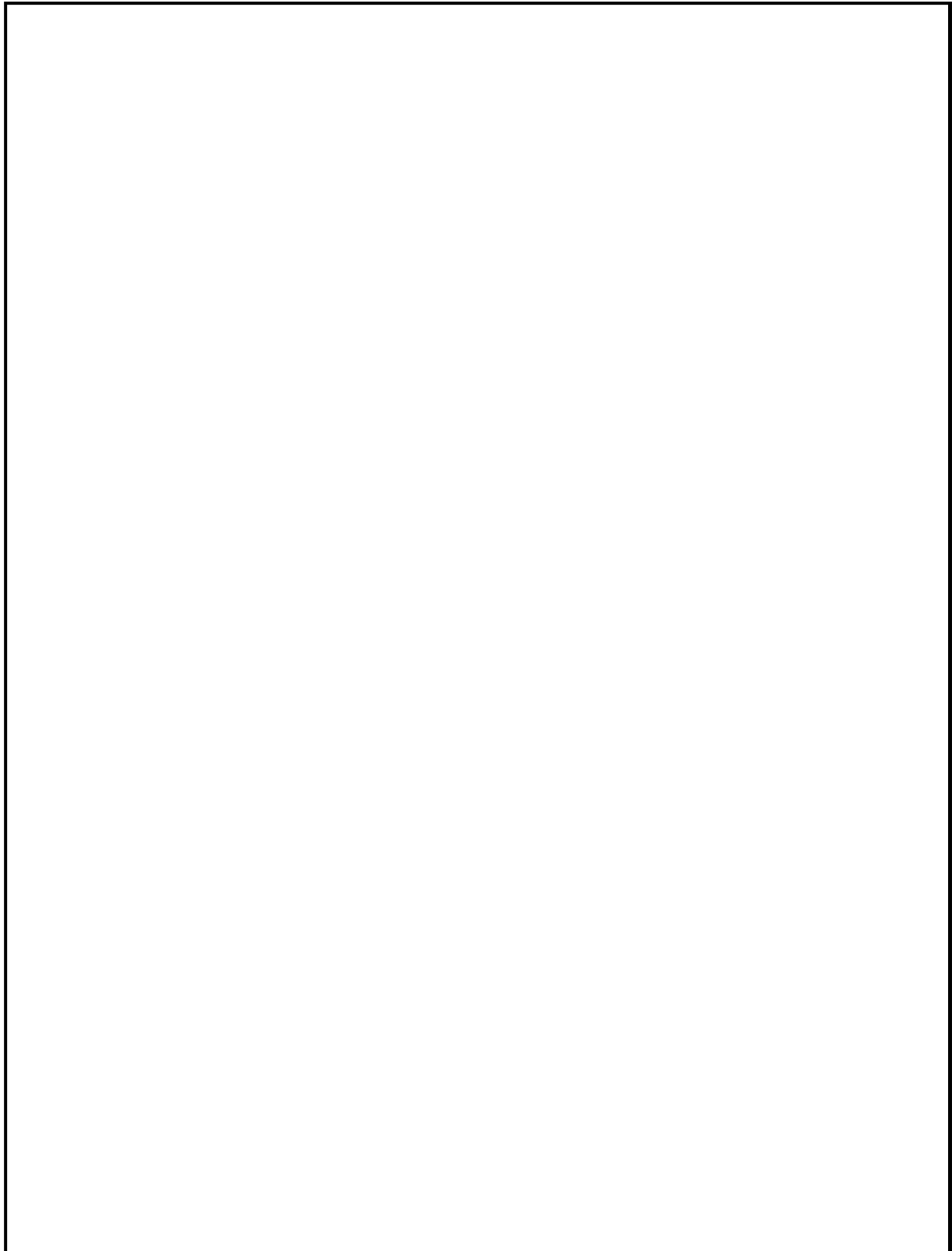


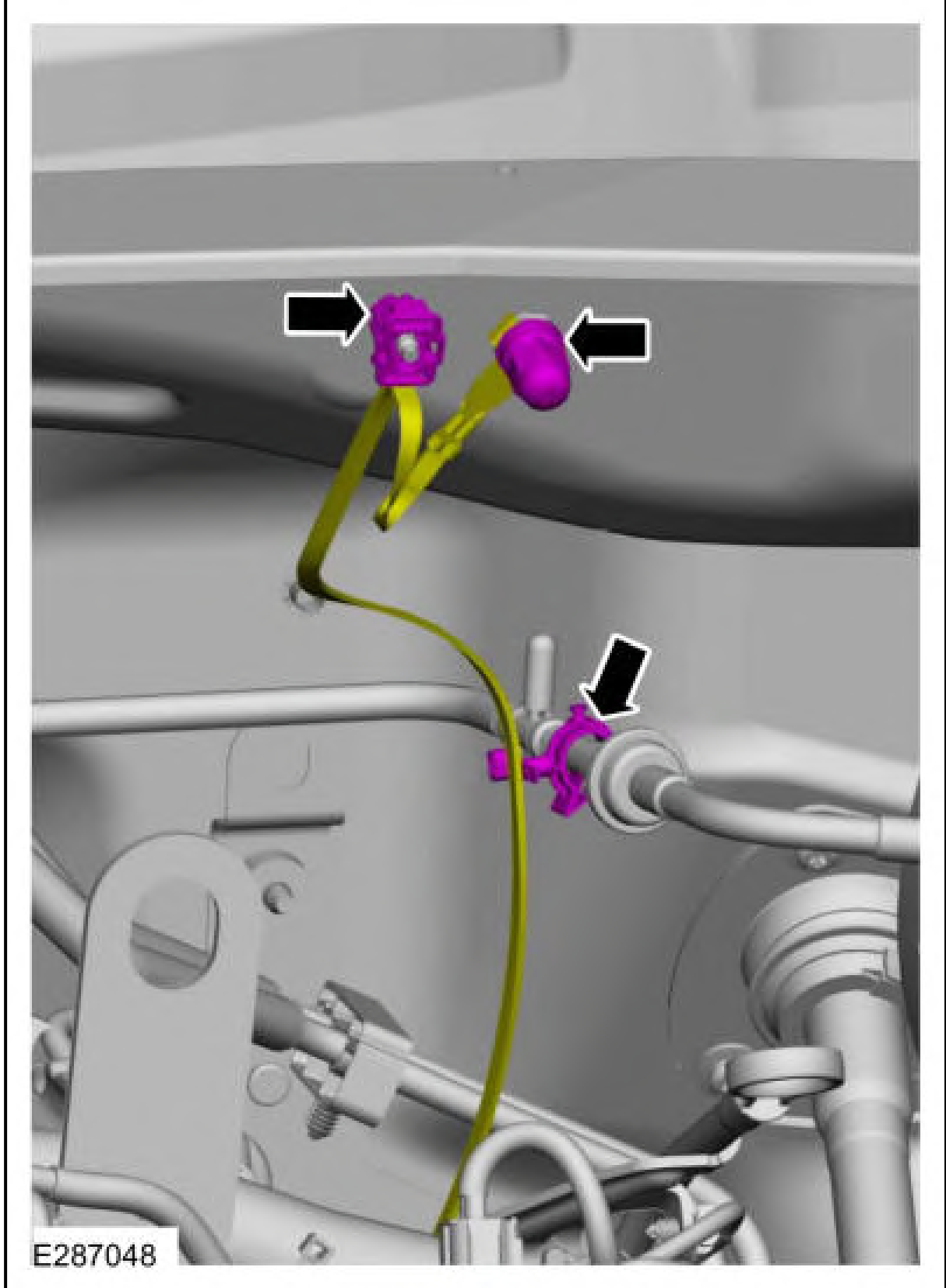
35. Disconnect the transmission electrical connectors and the retainers. Position aside the wiring harness.





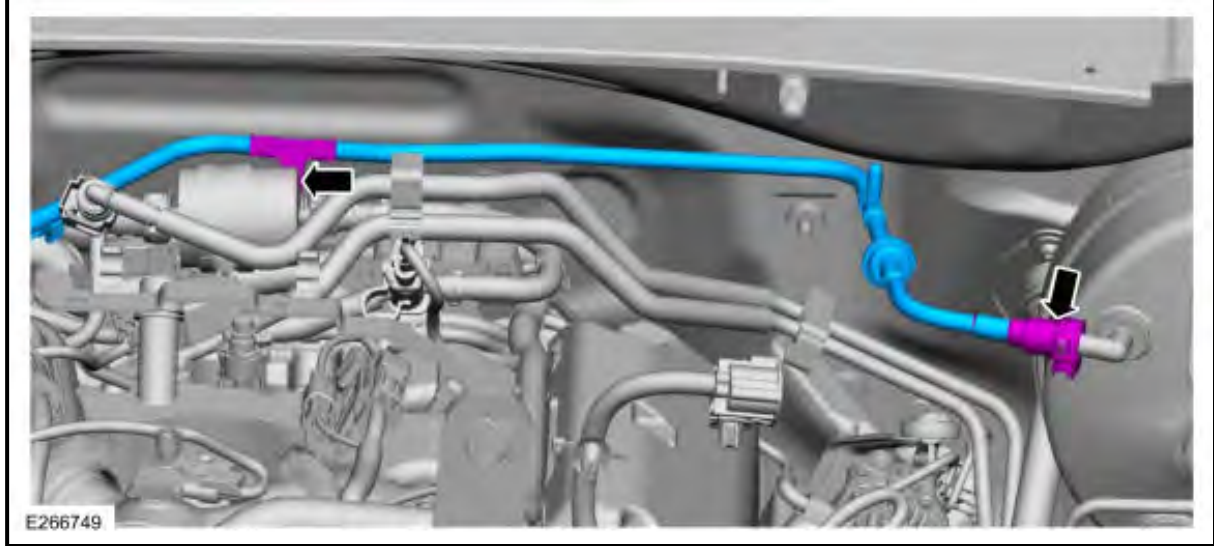
36. Disconnect the ground strap retainers. Remove the nut and the ground strap.



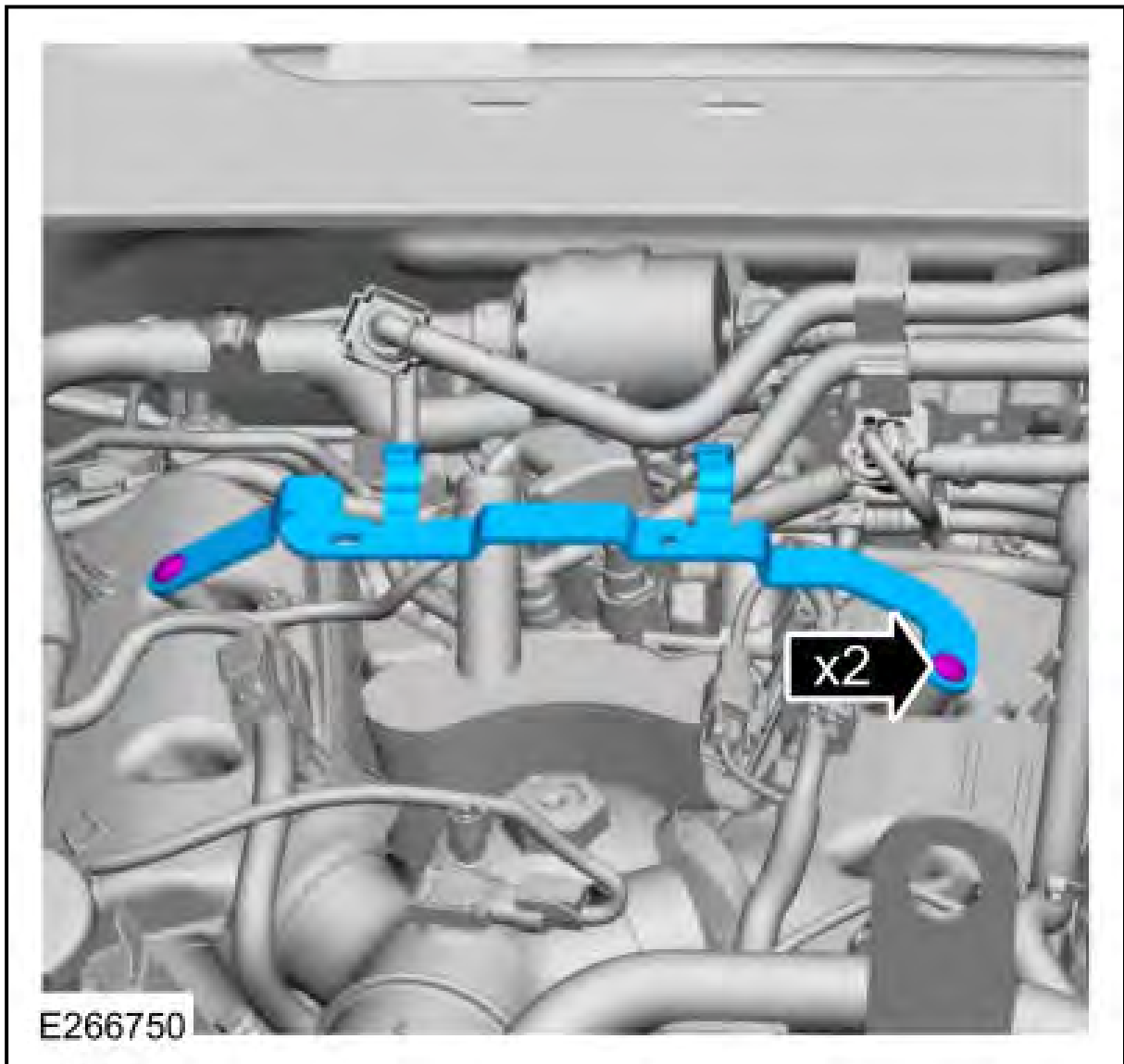


37. Disconnect and remove the brake booster tube.





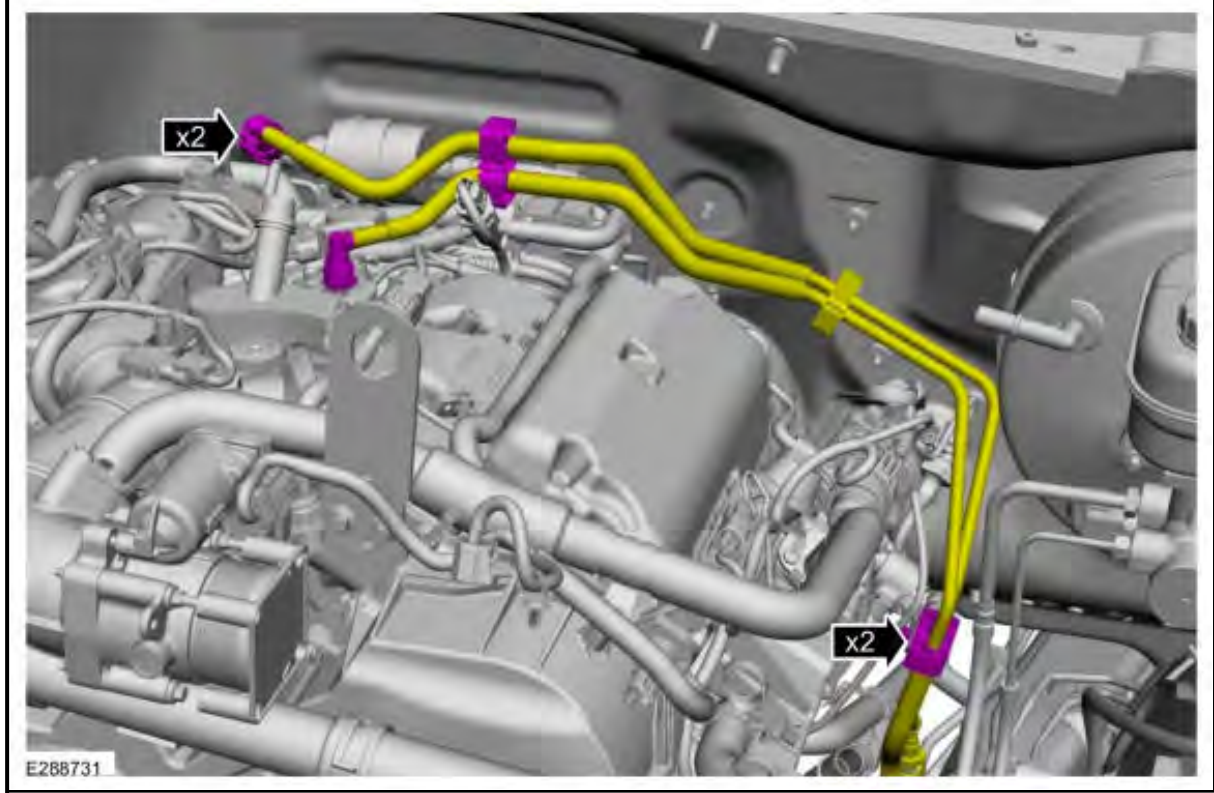
38. Remove the retainers and the engine appearance cover bracket.



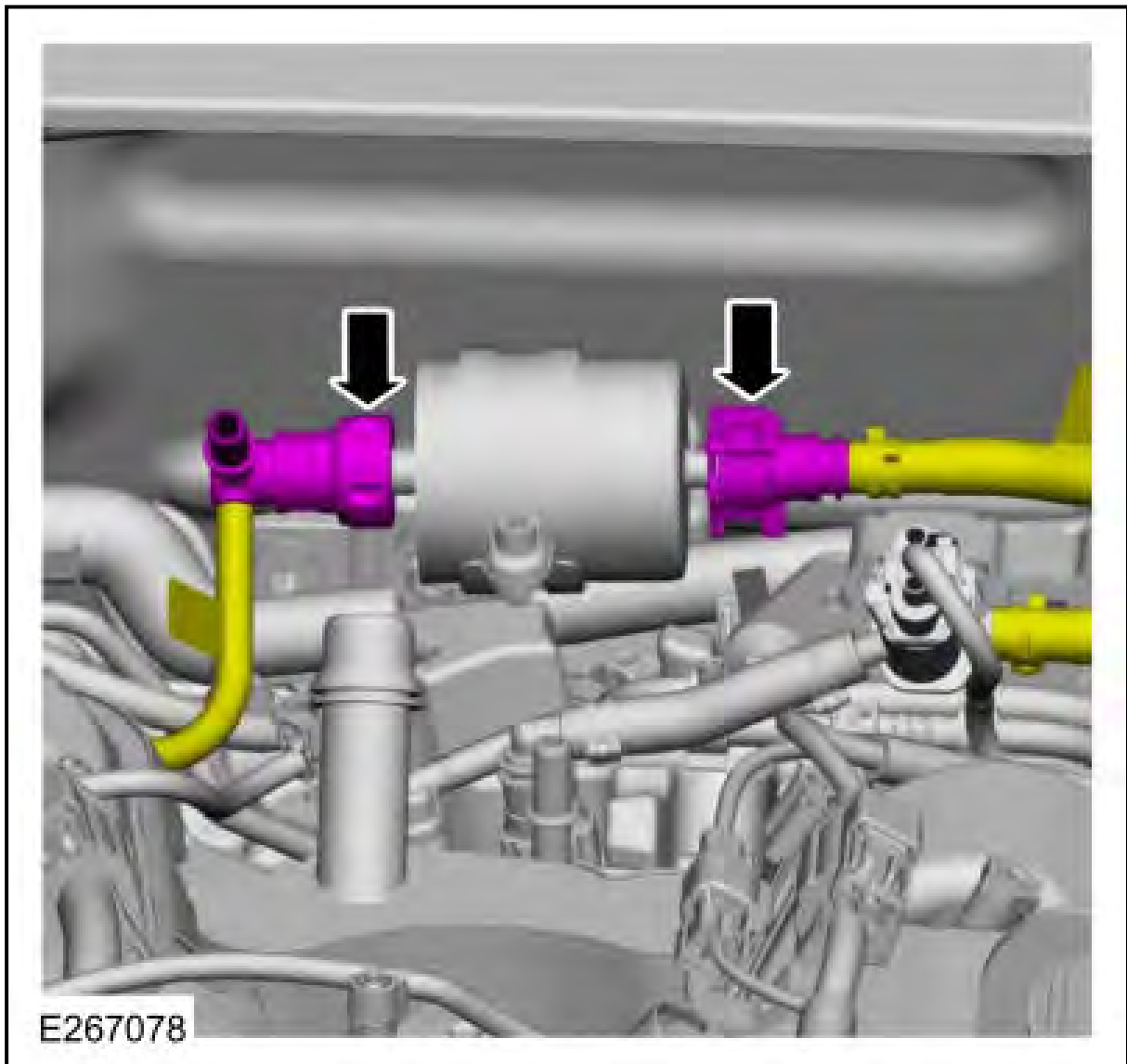
39. Disconnect and position aside the fuel tubes. Refer to: [Quick Release Coupling](#) .



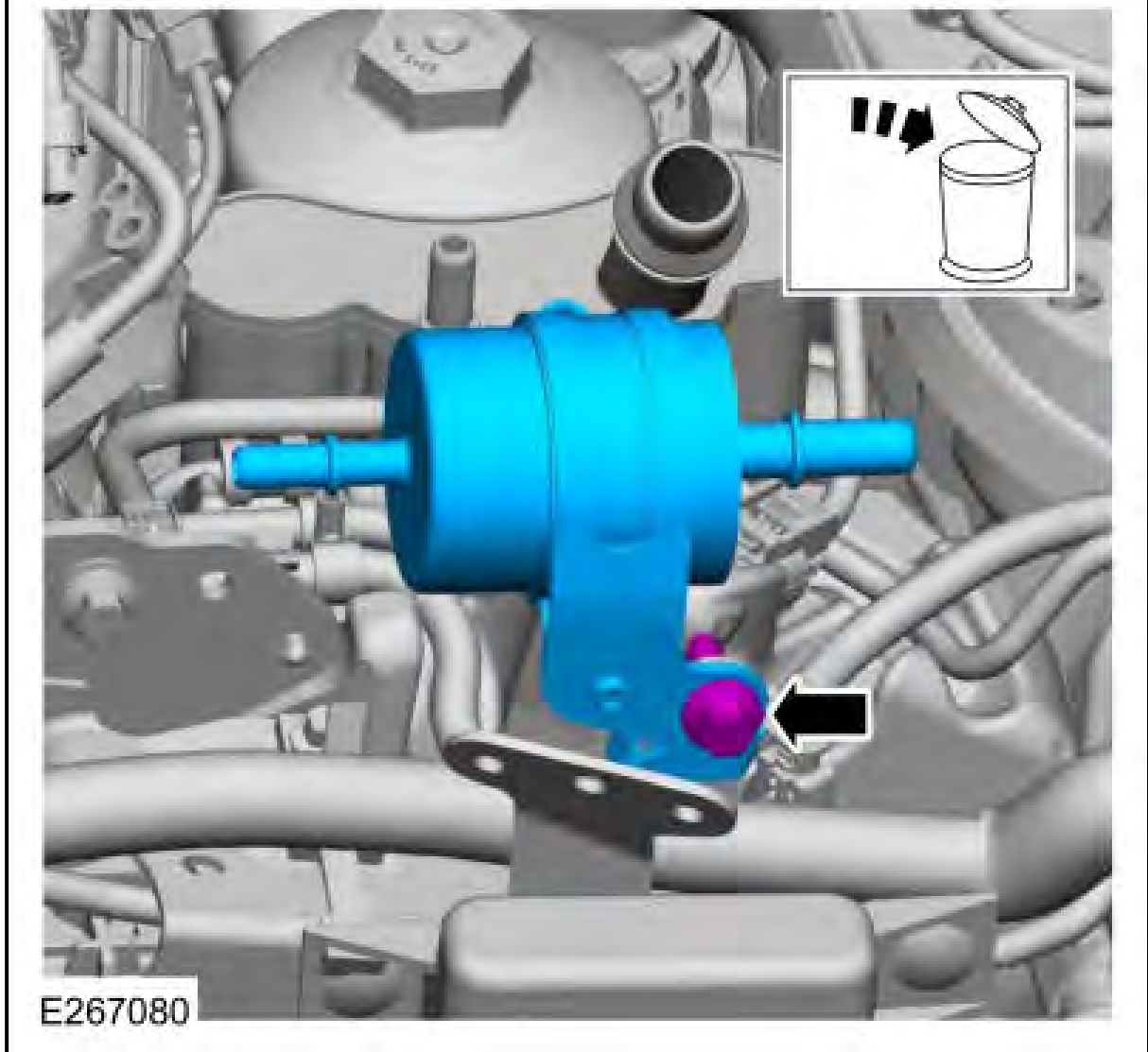




40. Disconnect the secondary fuel filter lines. Refer to: [Quick Release Coupling](#) .



41. Remove the bolt and the secondary fuel filter. Discard the secondary fuel filter.

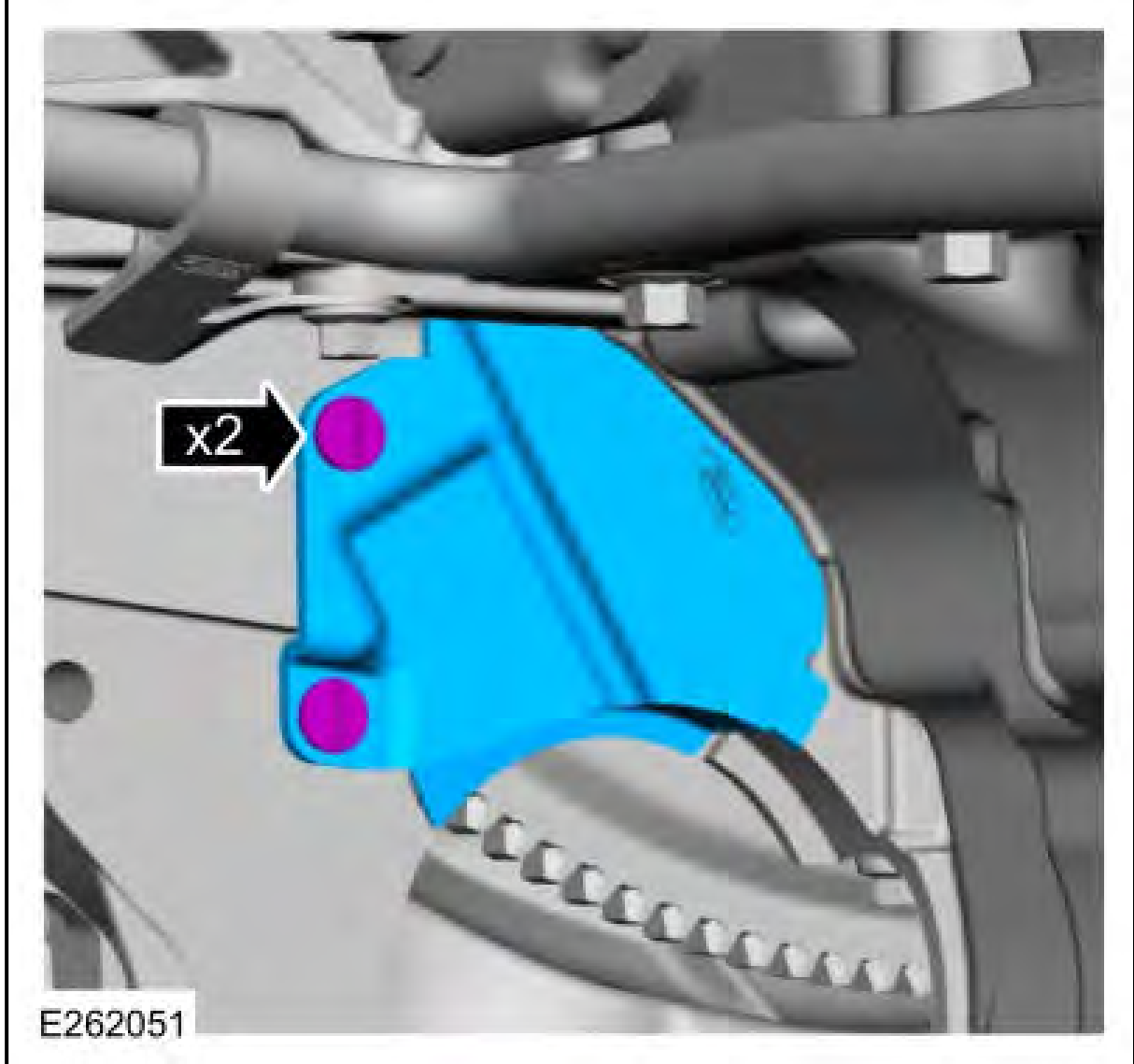


42. Remove the following items:

1. If equipped, remove the front driveshaft. Refer to: [Front Driveshaft](#) .
2. Remove the starter motor. Refer to: [Starter Motor](#) .

43. Remove the retainers and the access cover.

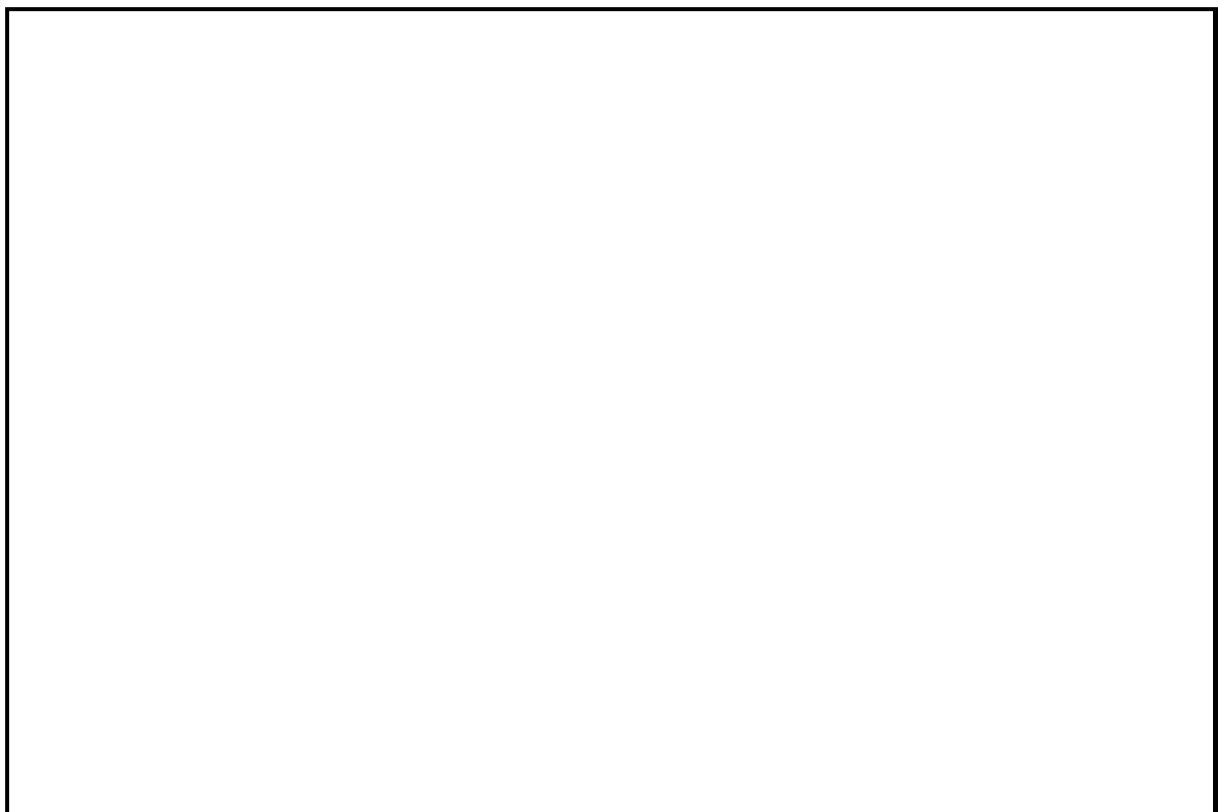


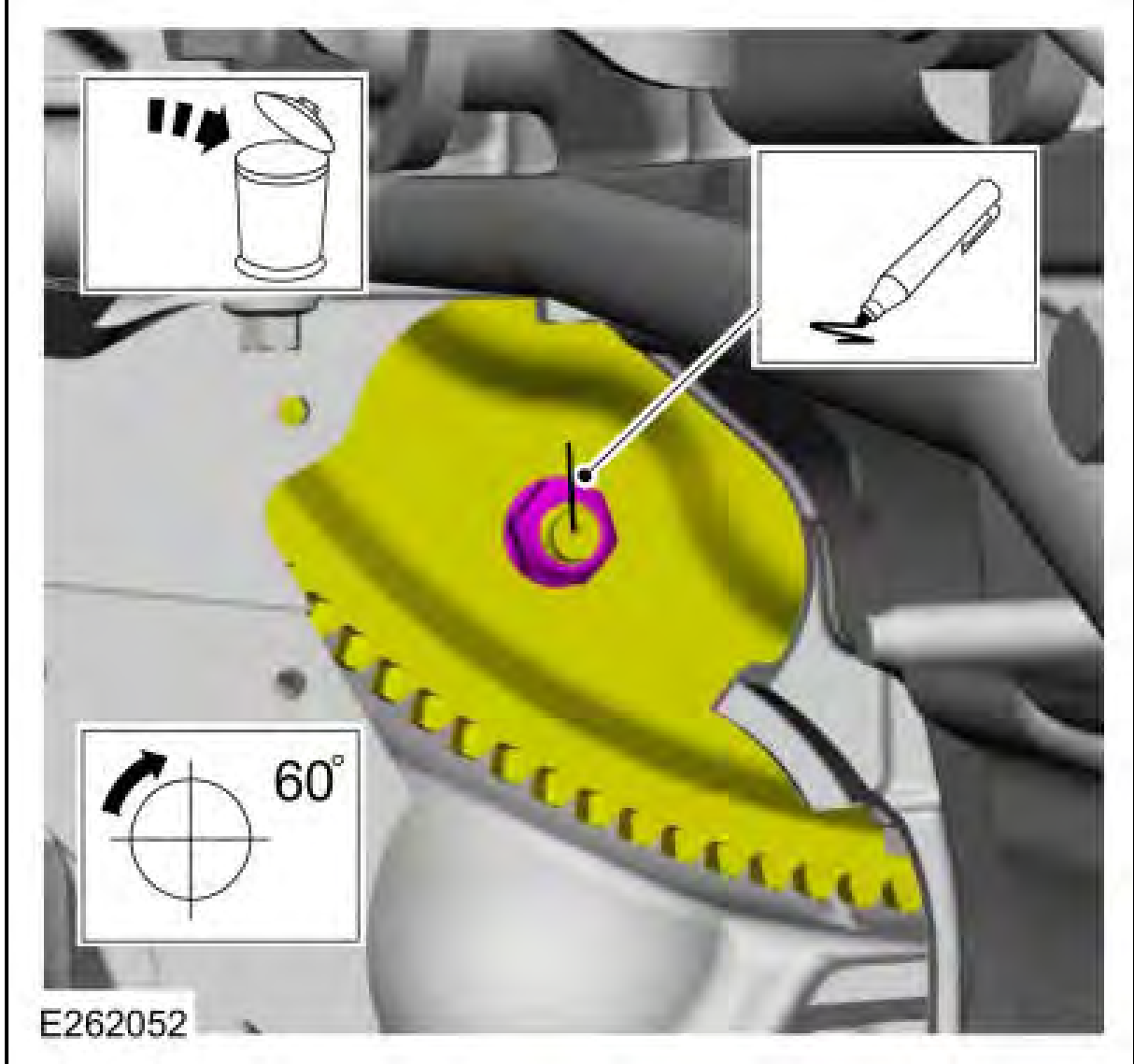


44. **NOTE:** Index-mark the end of one torque converter stud and the flexplate for installation.

**NOTE:** Using the crankshaft pulley bolt, turn the engine clockwise.

Remove and discard the torque converter nuts.

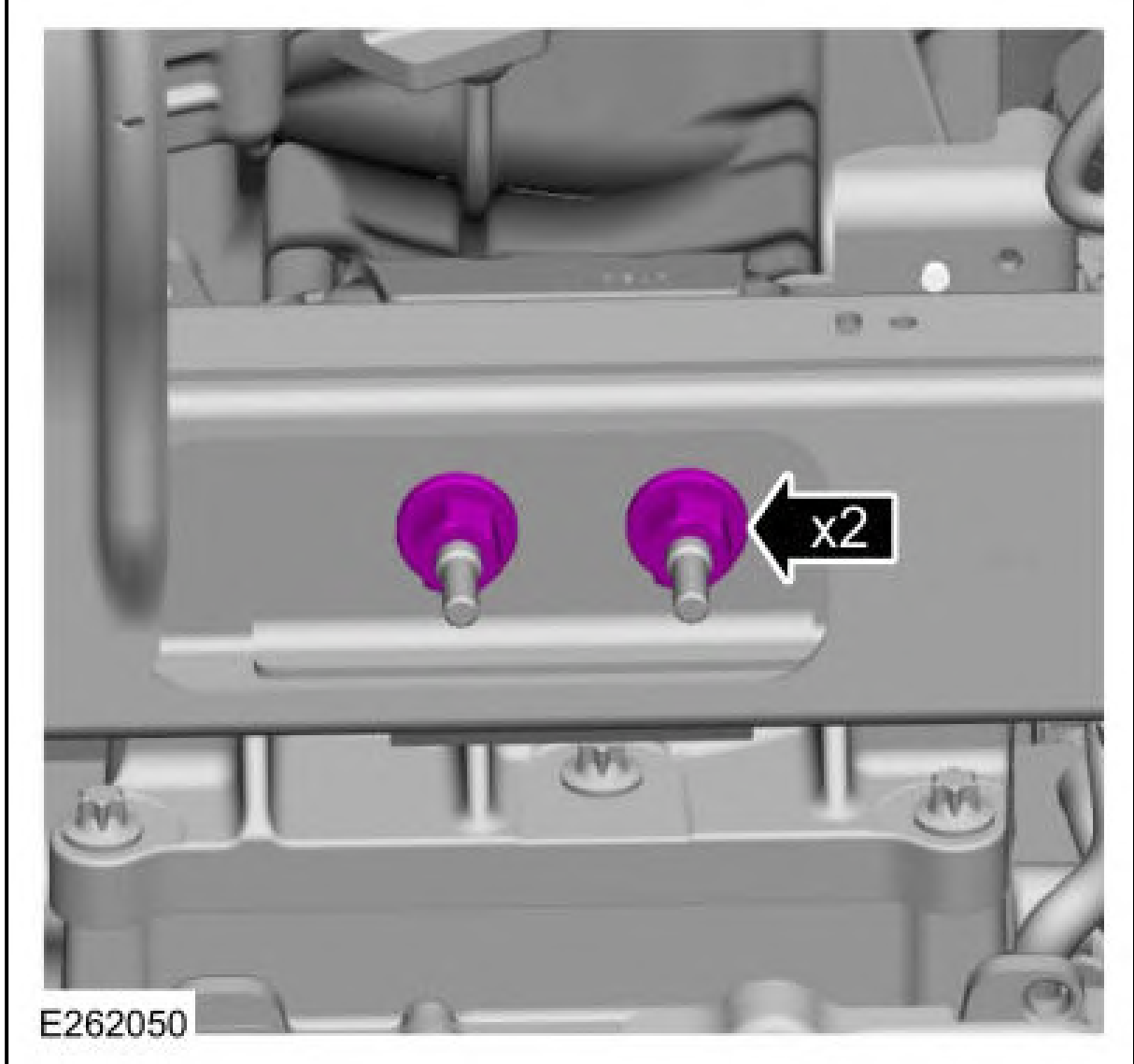




45. **NOTE:** Only use hand tools when removing the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.

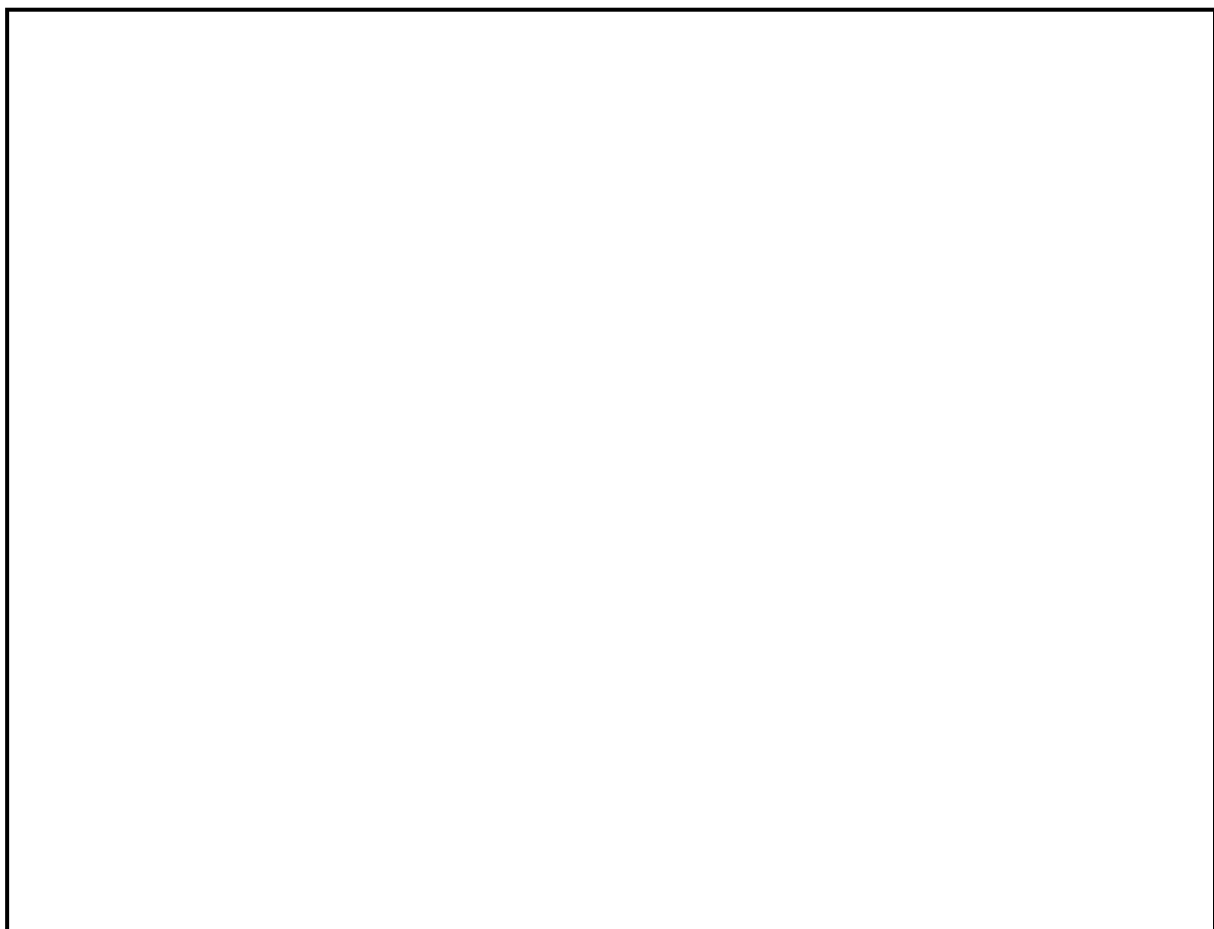
Loosen the transmission mount-to-crossmember nuts.

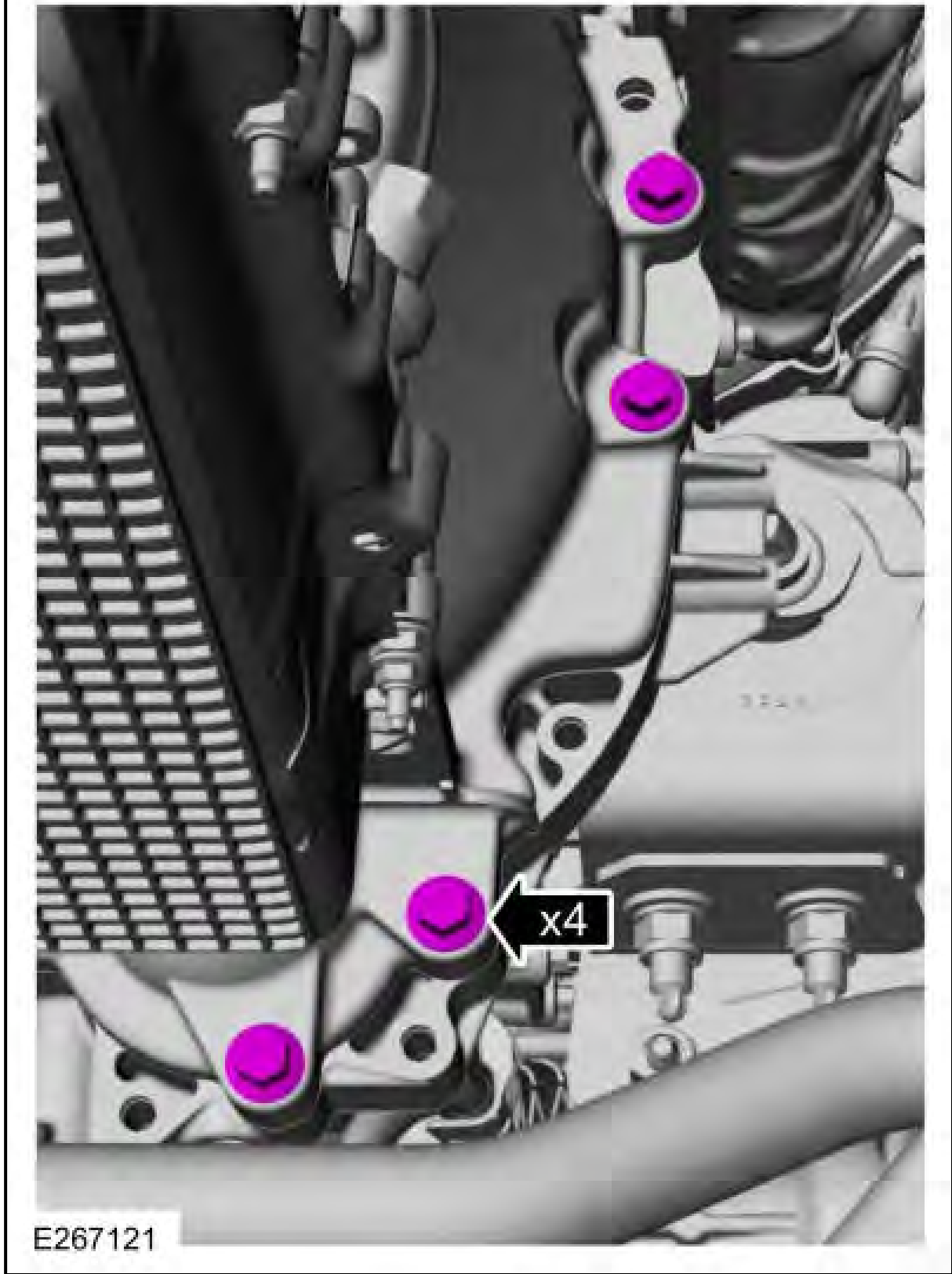




46. **NOTE:** Mark the location of the bolts during removal.

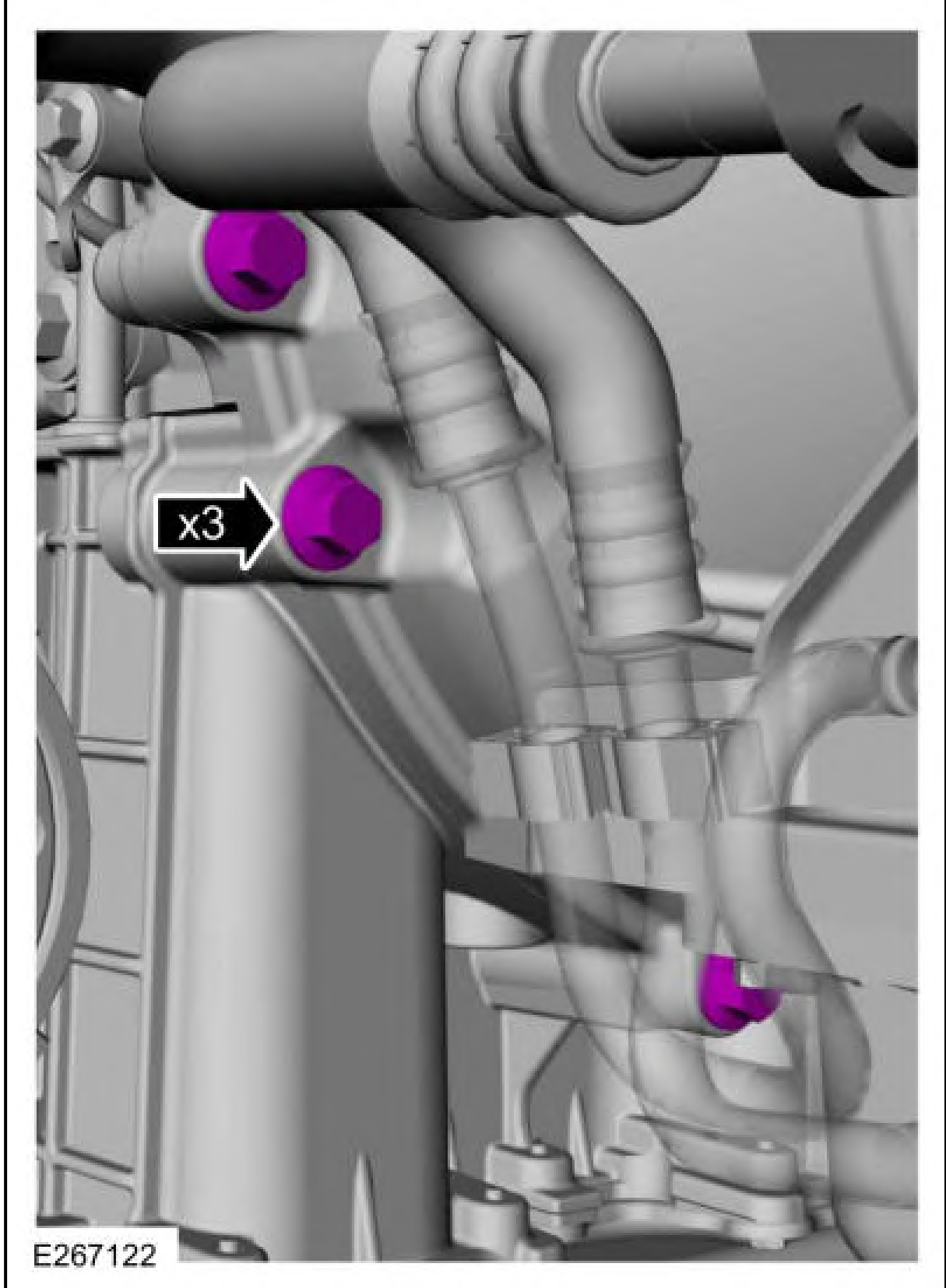
Remove the RH side bellhousing bolts.





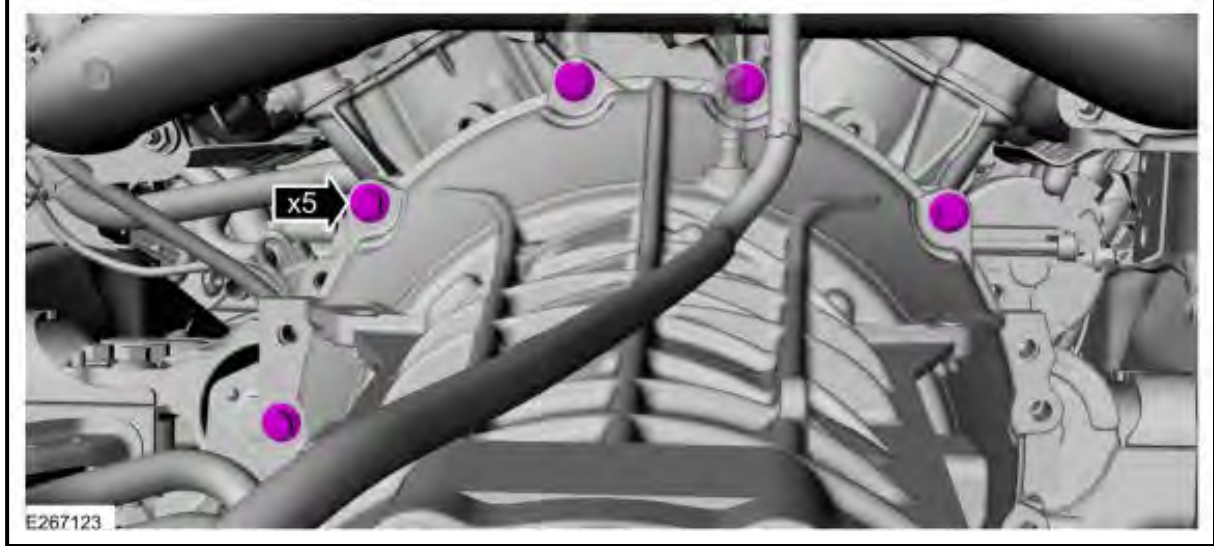
47. Remove the LH side bellhousing bolts.





48. Remove the upper bellhousing bolts.

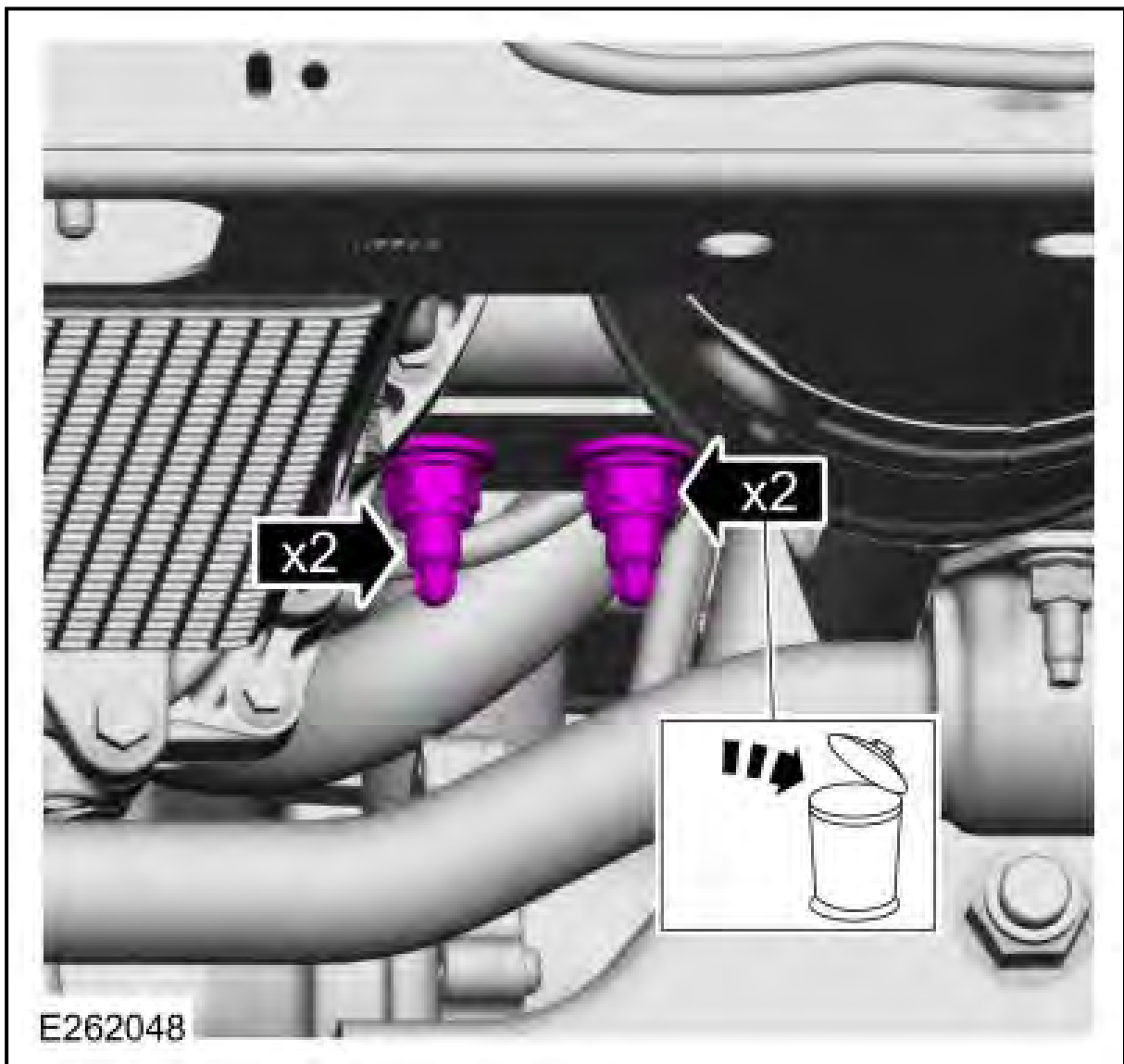




49. **NOTE:** Only use hand tools when removing the engine mount nuts and studs or damage to the engine mount can occur.

**NOTE:** The engine mount studs may come off with the nuts.

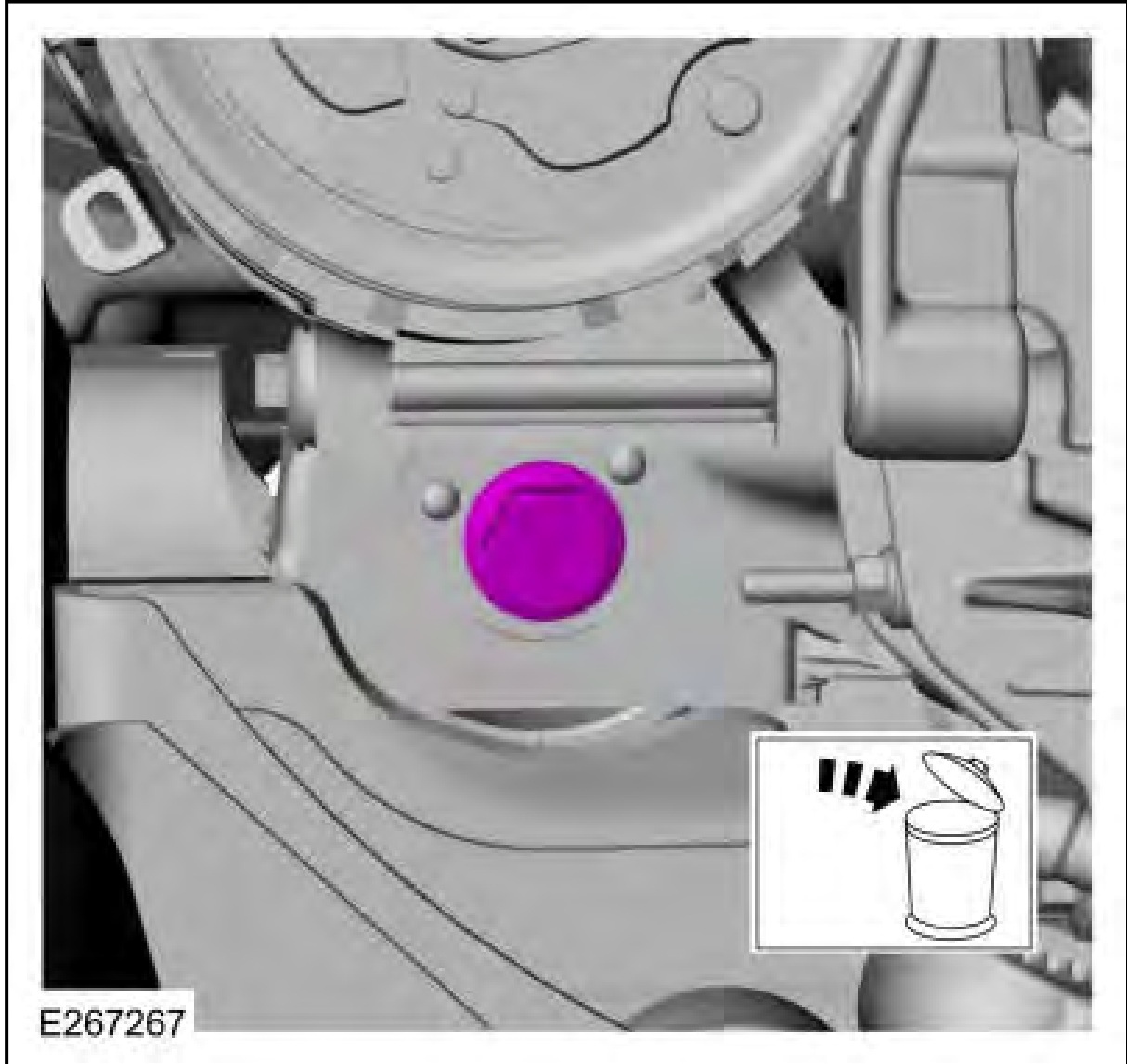
Remove and discard the RH engine mount nuts. Remove the engine mount studs.



50. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

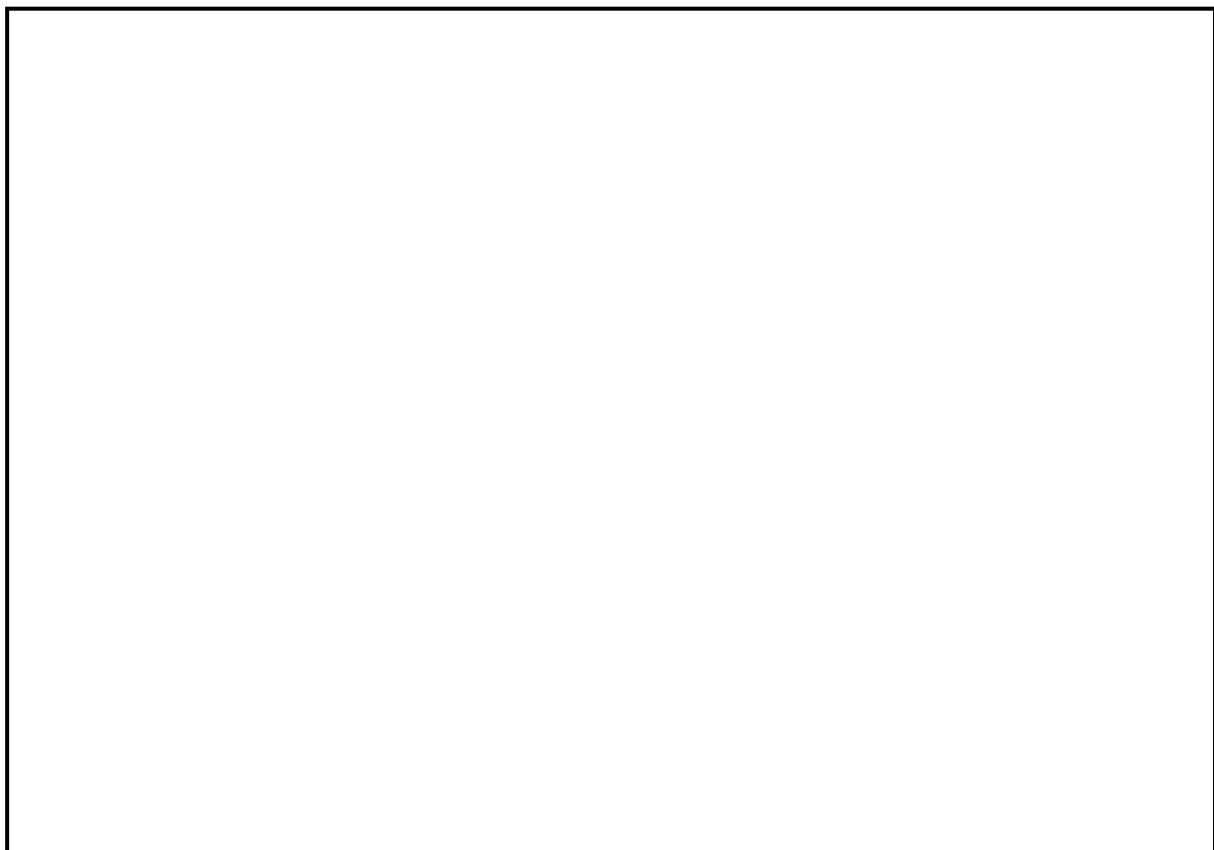
Remove and discard the RH engine mount through bolt.

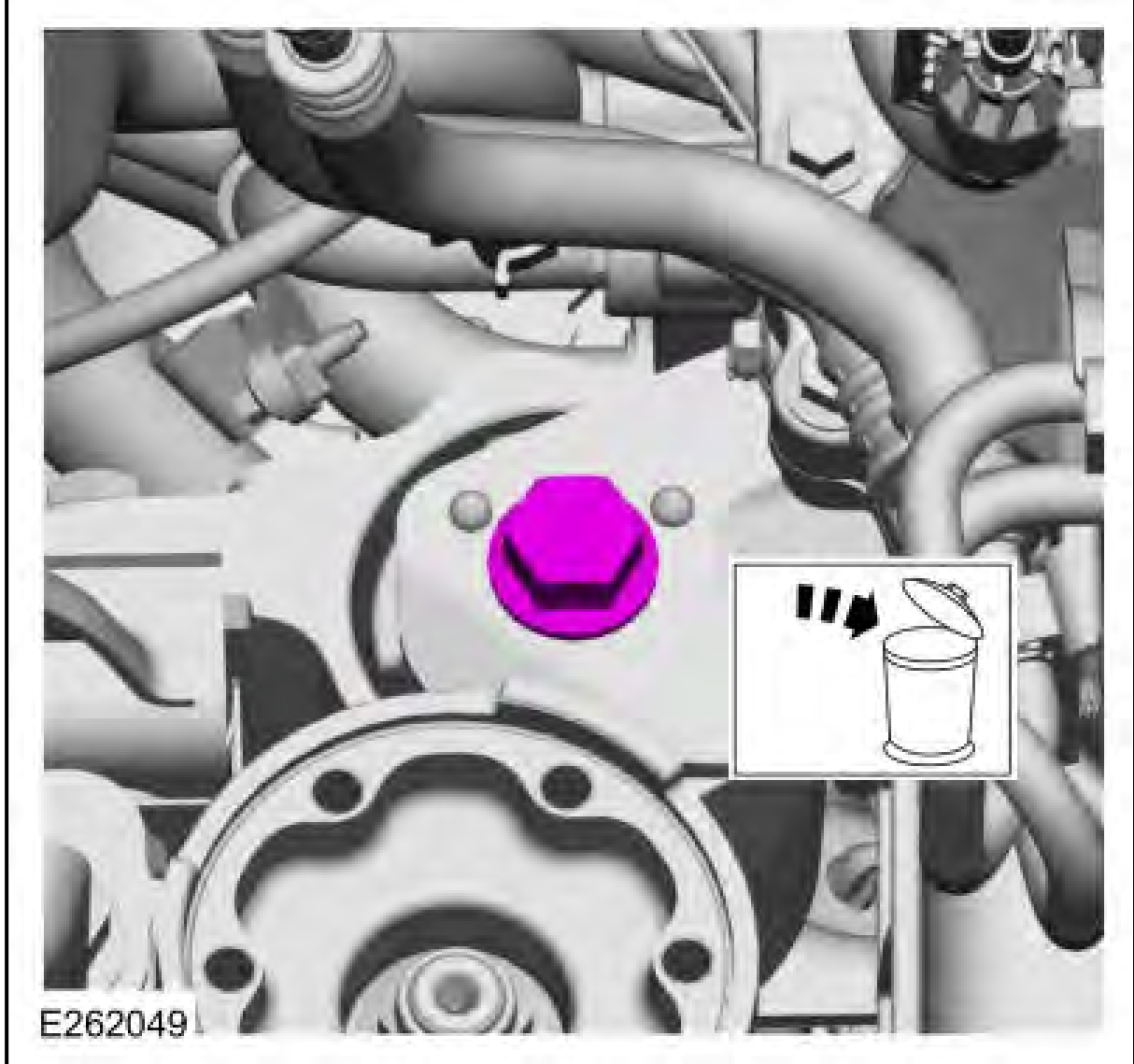




51. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

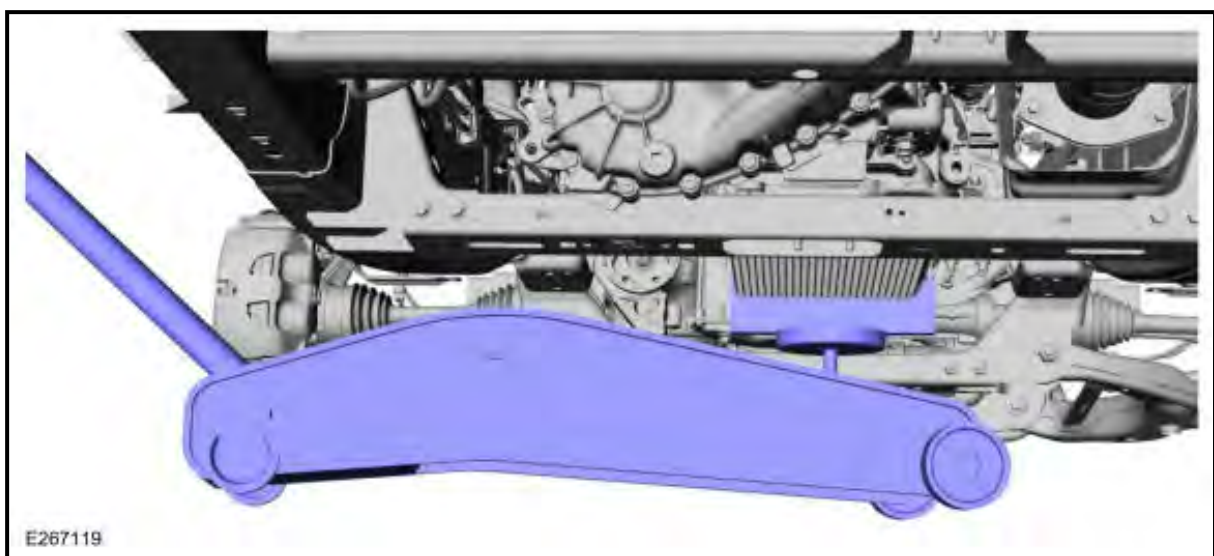
Remove and discard the LH engine mount through bolt.



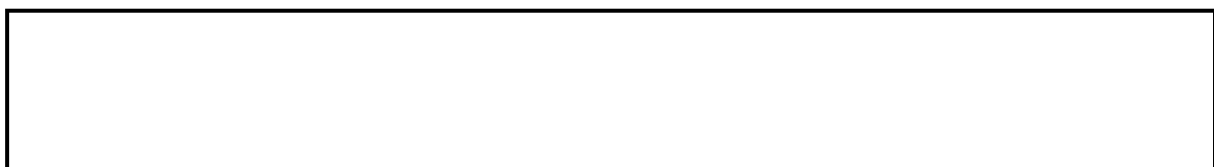


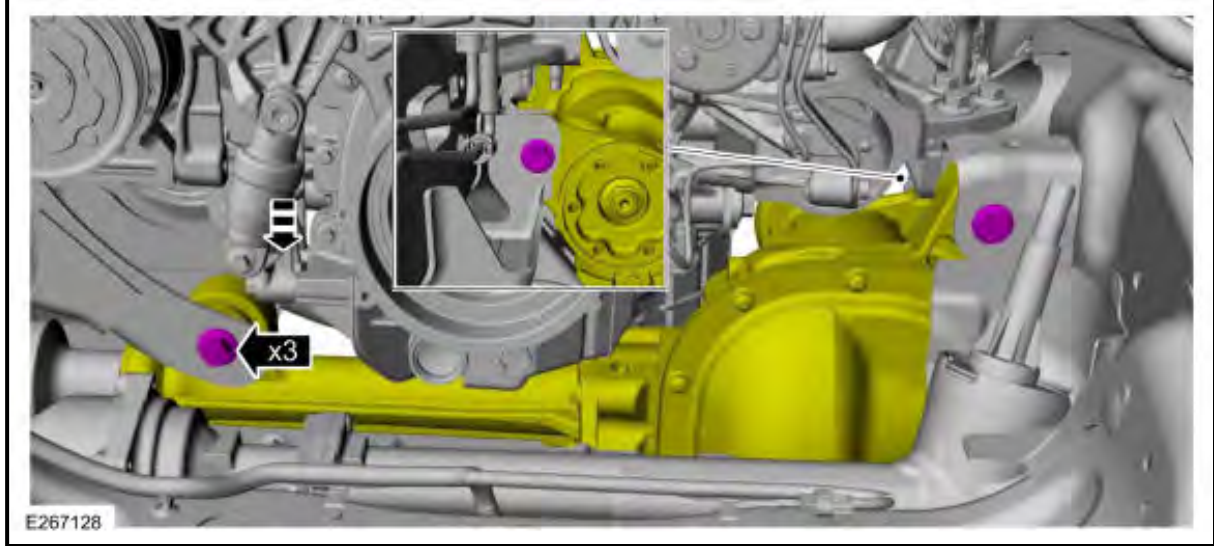
52. **NOTE:** Do not support the transmission by the fluid pan, failure to follow instruction may result in serious damage to the transmission.

Support the bellhousing of the transmission with a suitable floor jack and a block of wood. Use the General Equipment: Trolley Jack Use the General Equipment: Wooden Block



53. If equipped, using a floor jack, remove the bolts and lower the front axle. Use the General Equipment: Trolley Jack

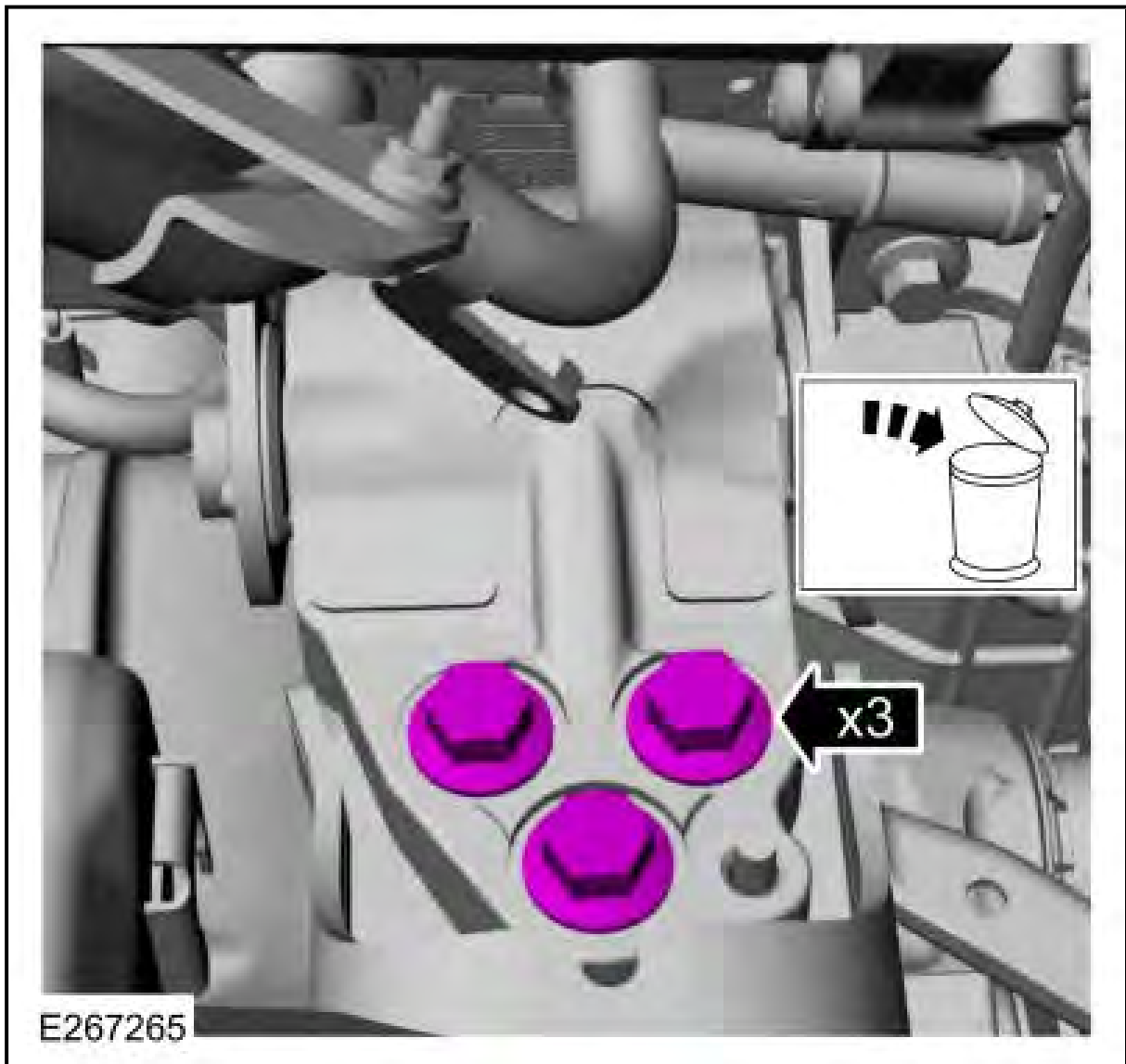




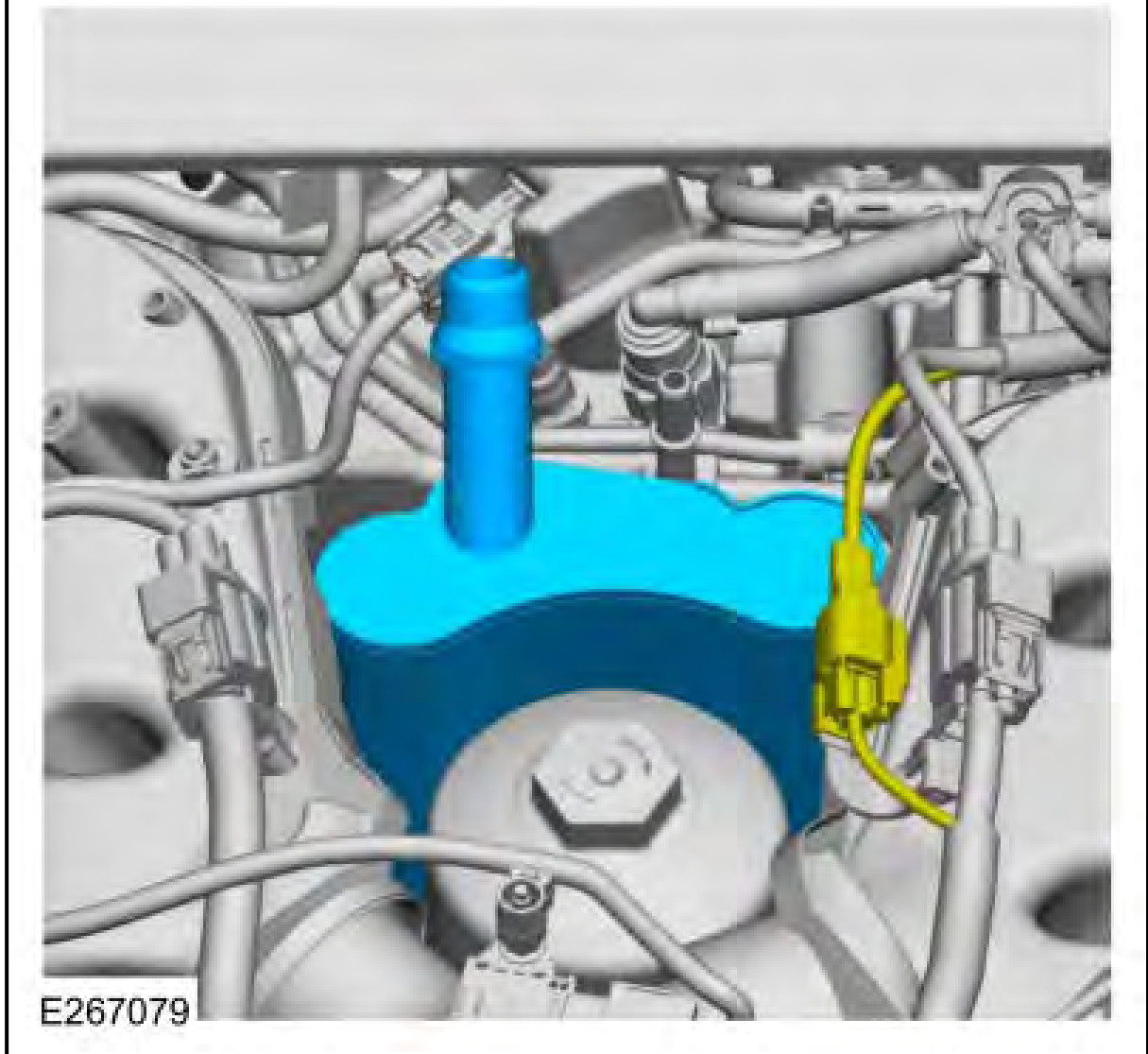
54. **NOTE:** Only use hand tools when loosening or tightening the engine mount-to-frame bolts or damage to the engine mount-to-frame nut plate can occur.

**NOTE:** Leave the LH engine mount in place.

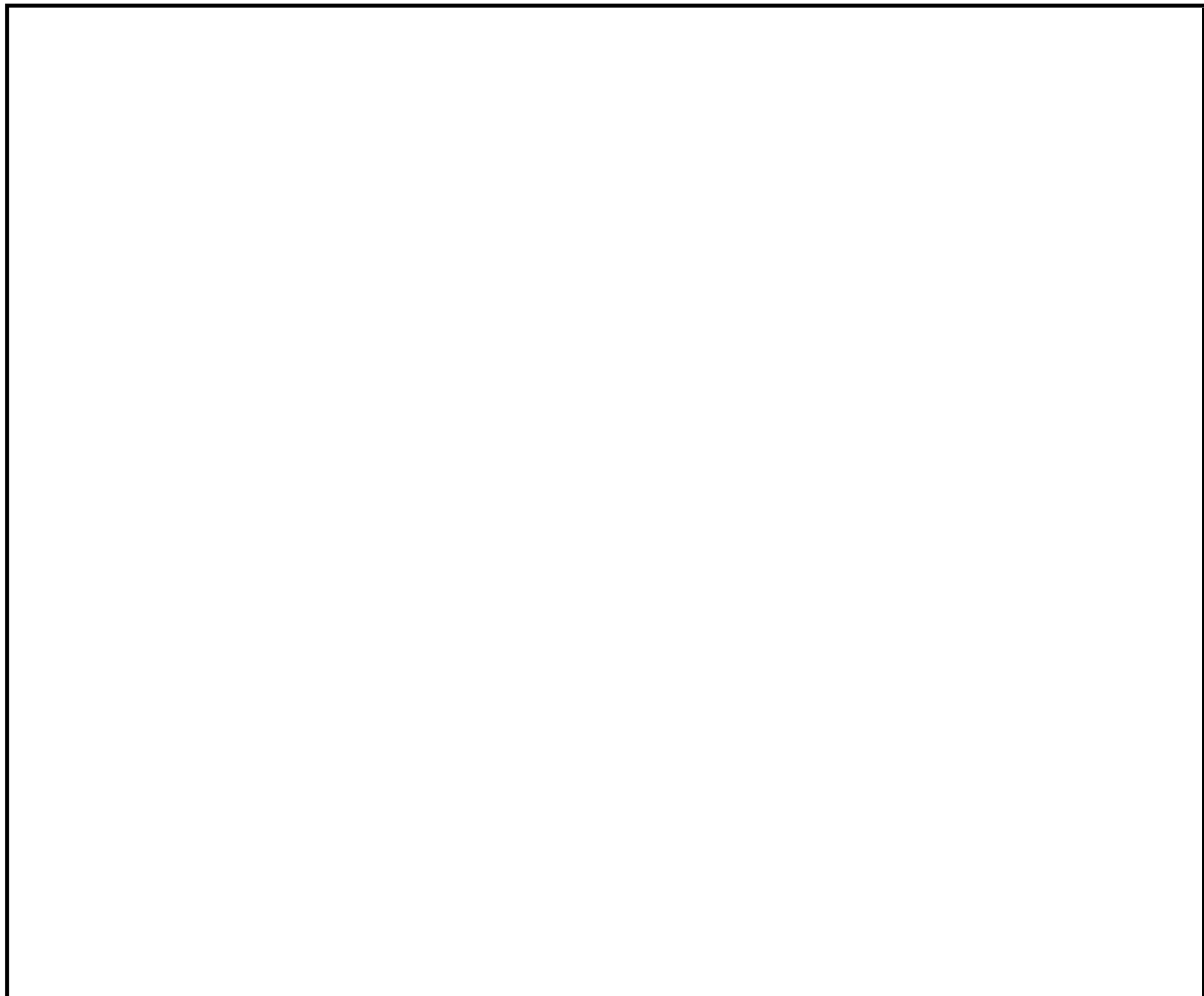
Remove and discard the LH engine mount bolts.



55. Position aside the wiring and remove the crankcase vent oil separator.



56. Remove the bolts and the upper lifting bracket.





57. Install the special tool and the bolts. Use Special Service Tool: 303-1684 Lifting Eye.

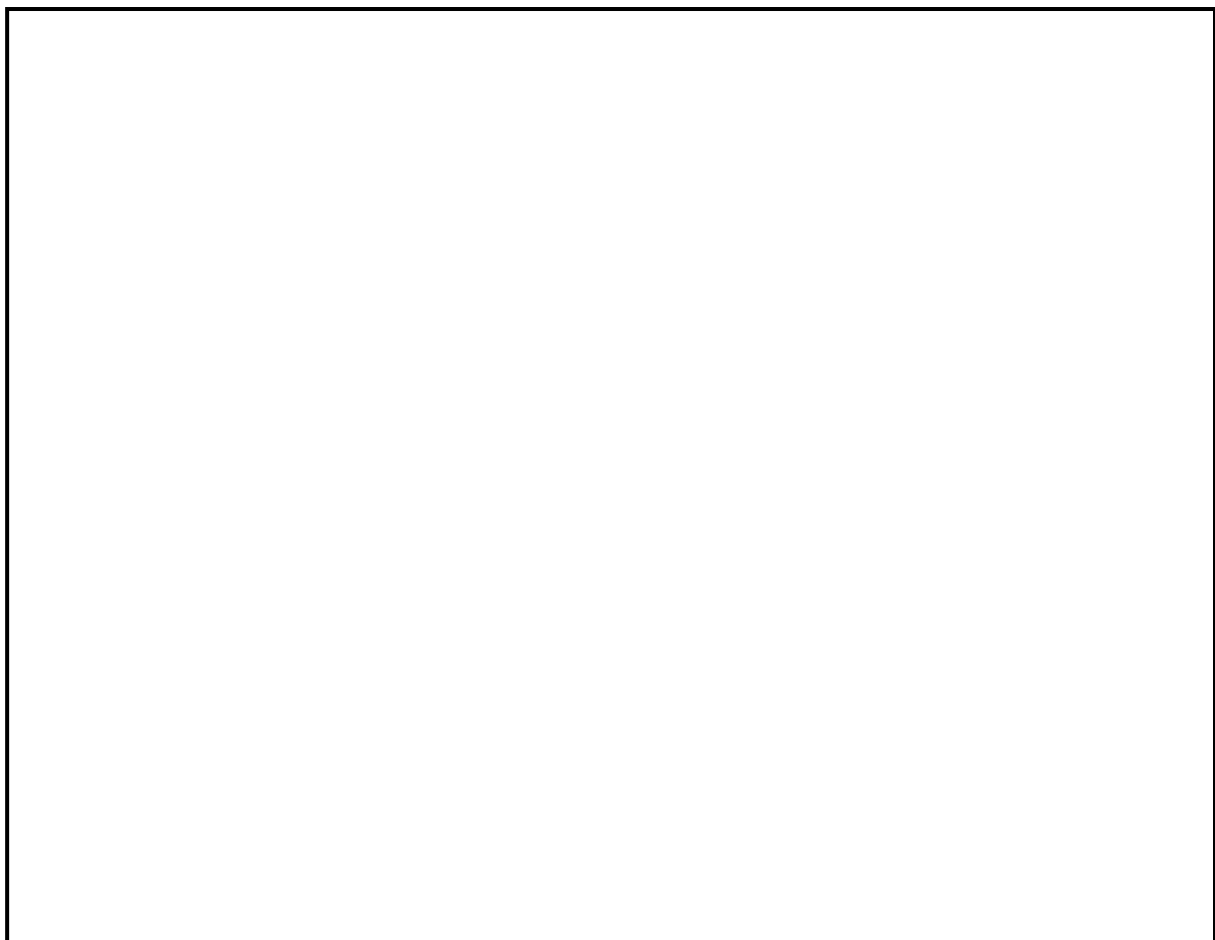
Torque: 17 lb.ft (23 Nm)

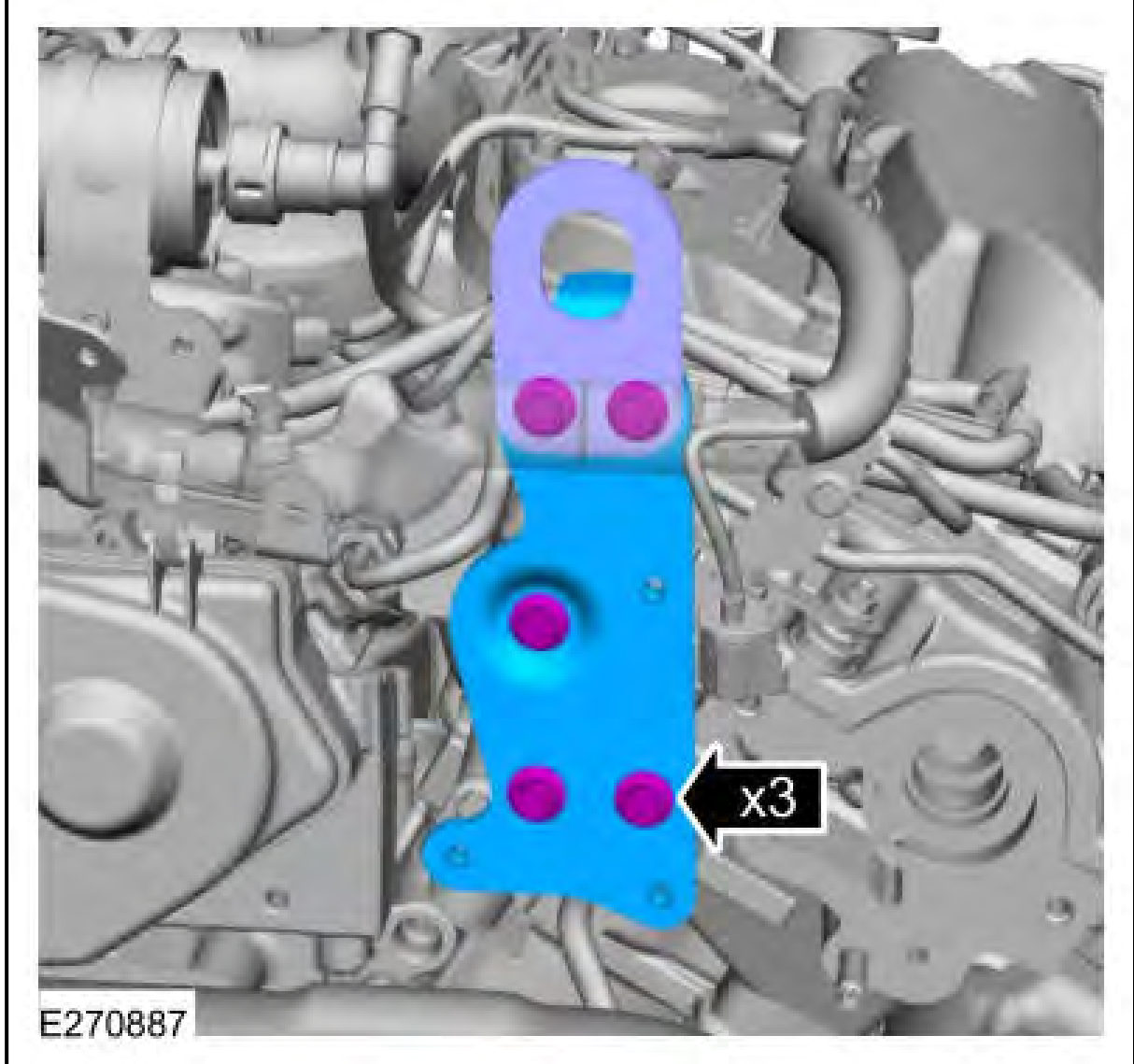




58. Install the factory lifting eye with the special tool on the engine.

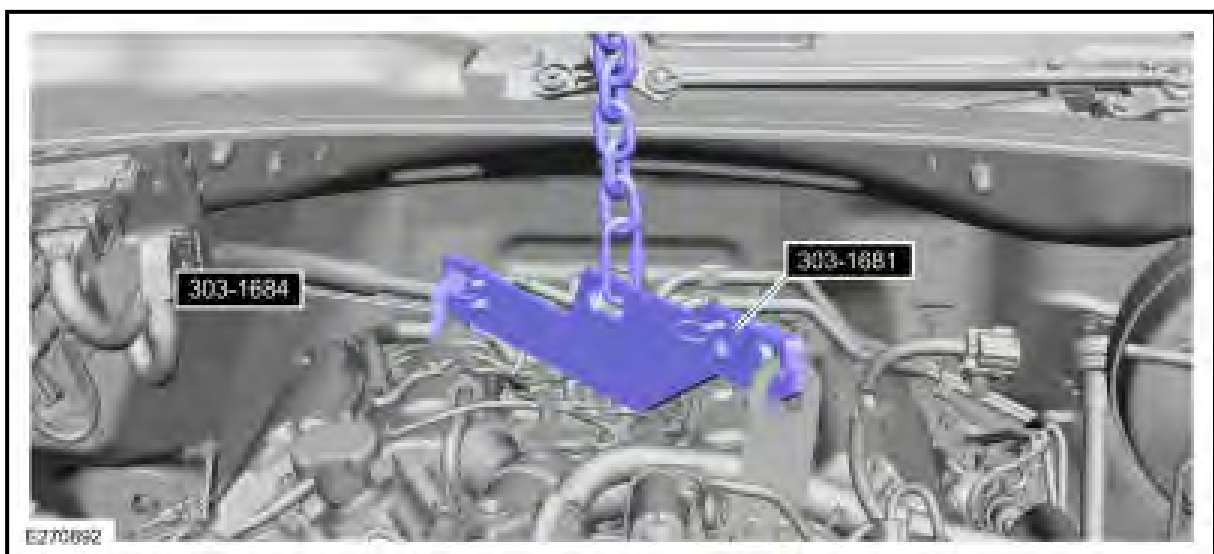
Torque: 17 lb.ft (23 Nm)





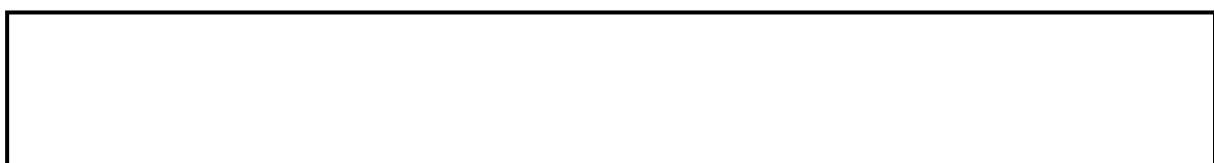
59. **NOTE:** Use a commercially available quick link.

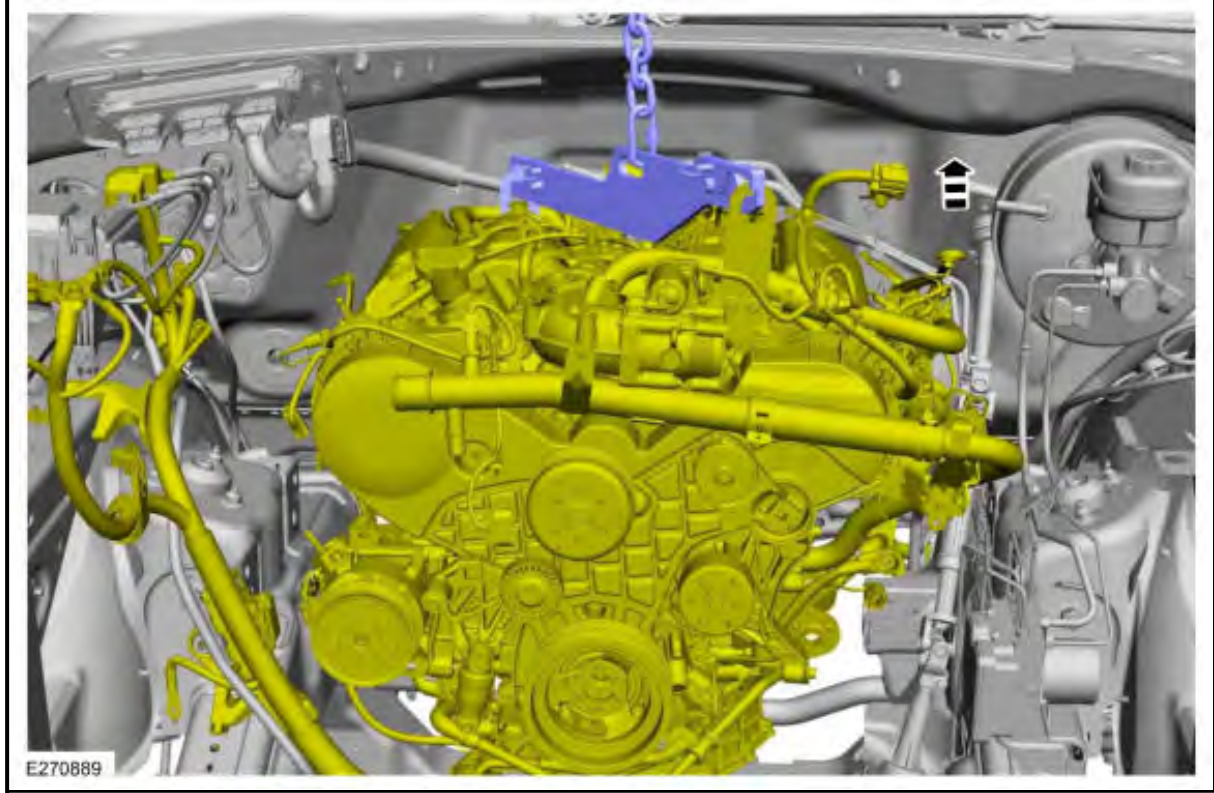
Install the special tools and the floor crane. Use Special Service Tool: 303-1681 Spreader Bar., 303-1684 Lifting Eye. Use the General Equipment: Floor Crane



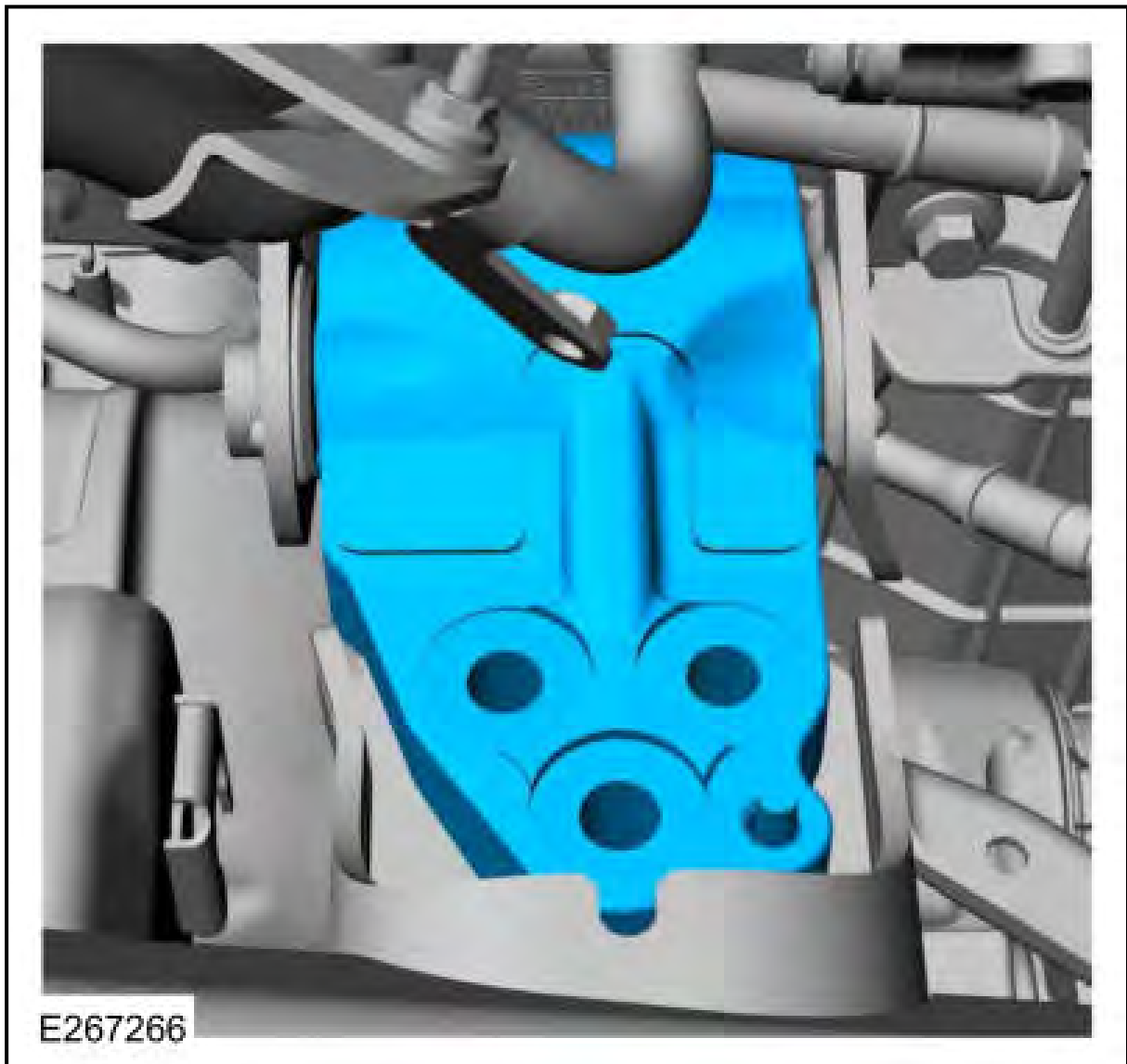
60. **NOTE:** The use of a ratchet strap may be needed to level the engine.

Using the floor crane and the Spreader Bar, lift the engine.



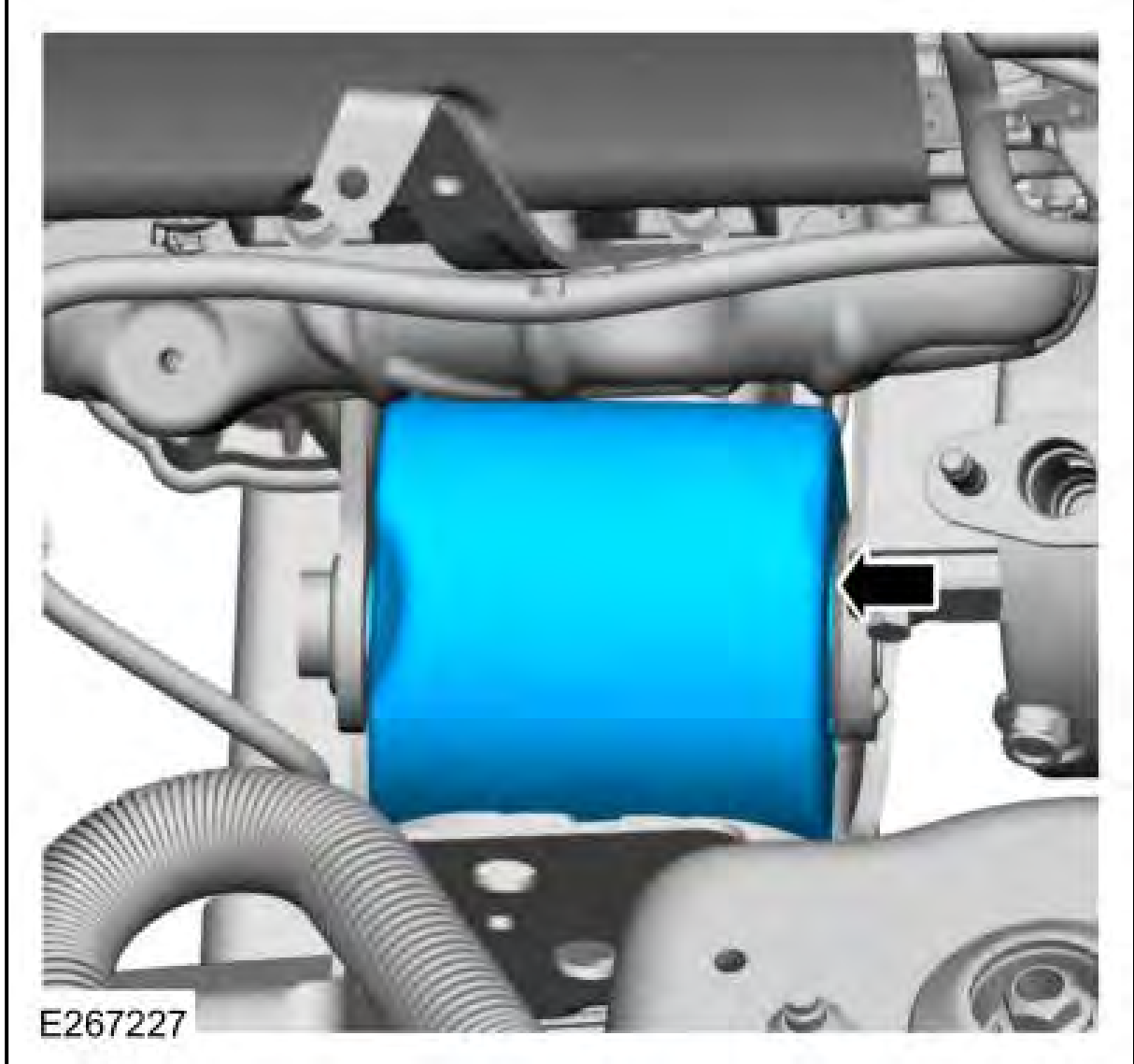


61. Remove the LH engine mount.

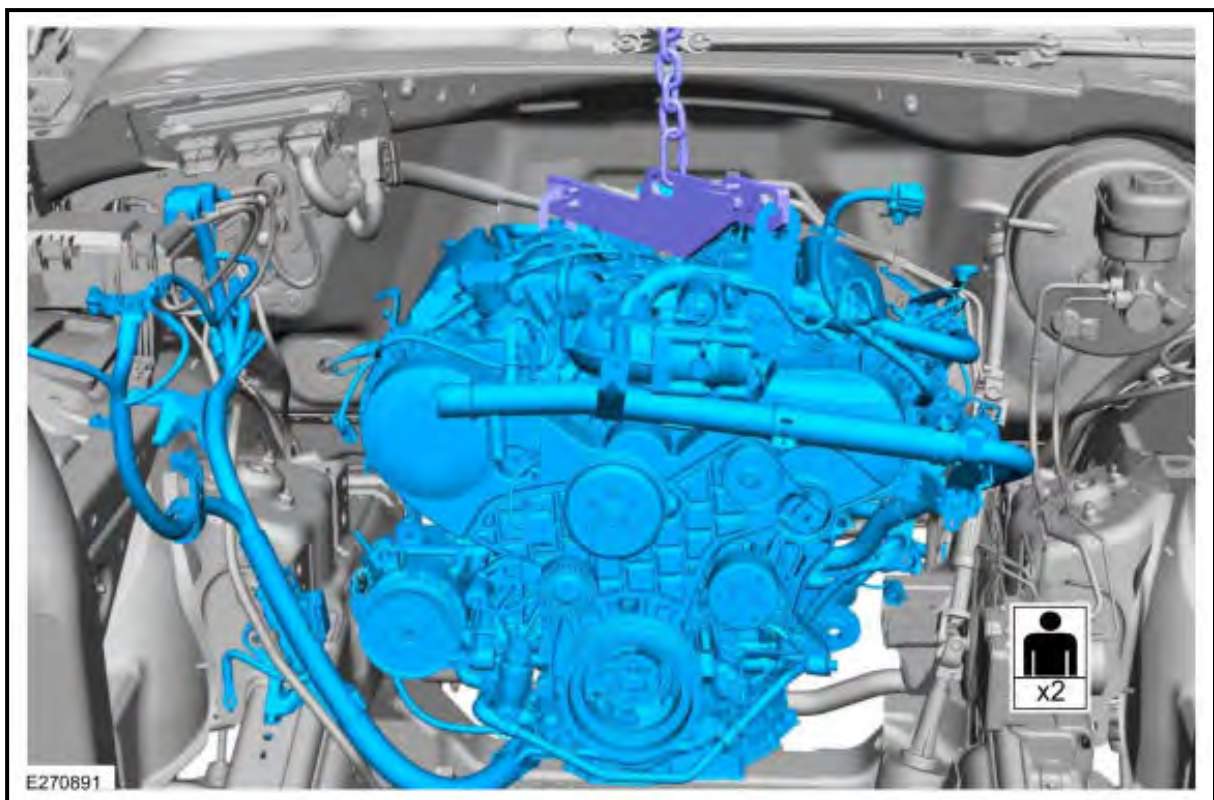


62. Remove the RH engine mount.

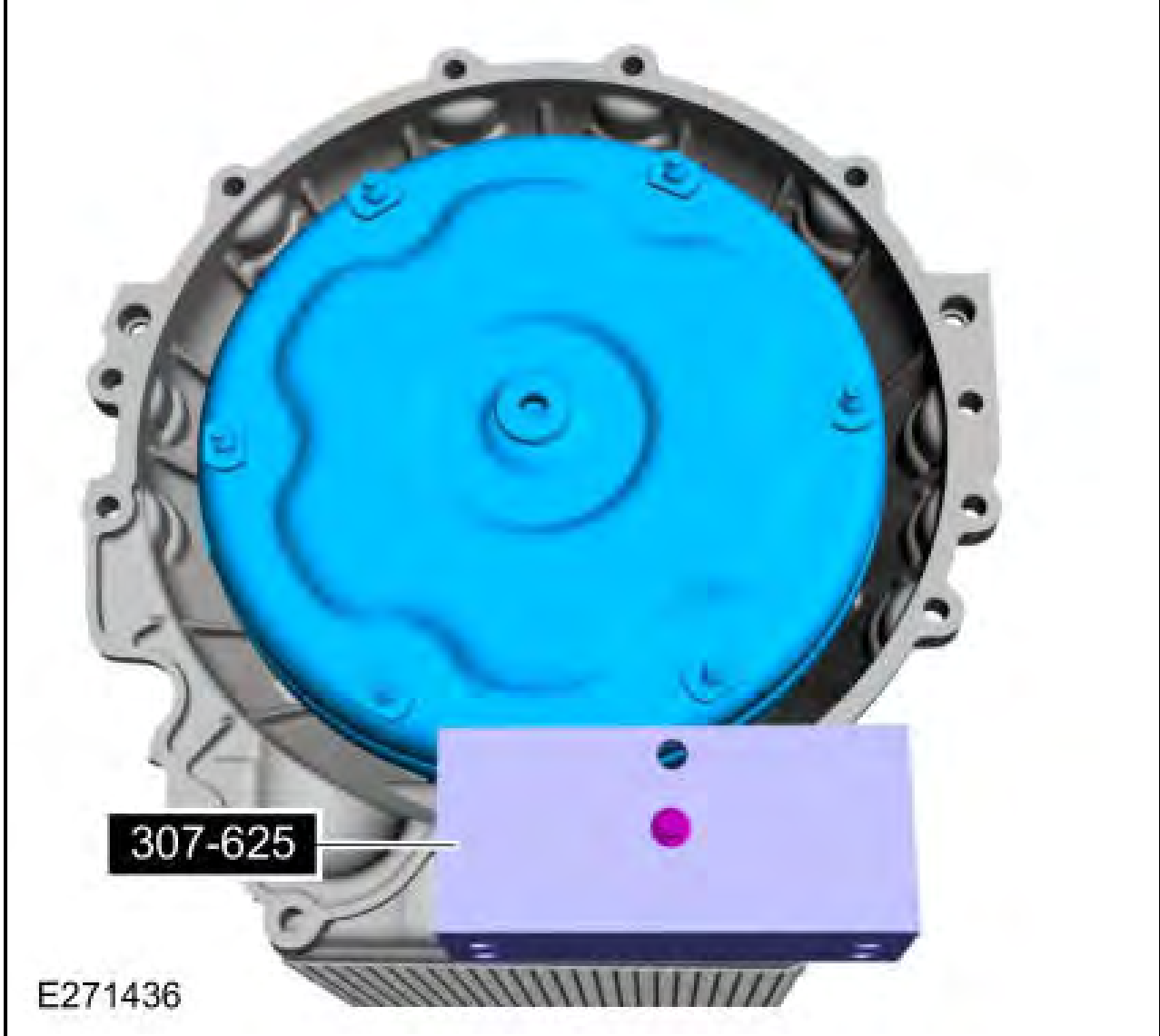




63. Using the floor crane and the spreader bar, remove the engine. Use the General Equipment: Floor Crane



64. Install Special Service Tool: 307-625 Fixture, Bench Mounting.



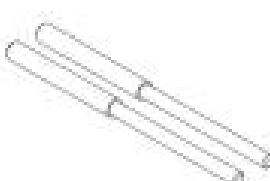
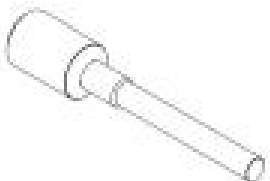
## DISASSEMBLY

### ENGINE

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

Base Part Number: 6L084

### Special Tool(s) / General Equipment

|  |   |
|--|---|
|  <p>E274086</p> | <p><b>303-1670 Pins, Camshaft Locking</b></p> |
|  <p>E274087</p> | <p>303-1671 Pin, Locking Crankshaft</p>       |



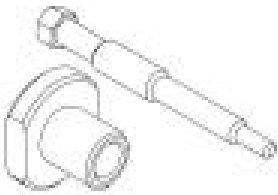
E274086

**303-1670 Pins, Camshaft Locking**



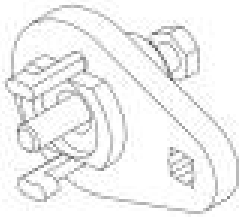
E274090

303-1674 Tool, Holding Camshaft Sprocket



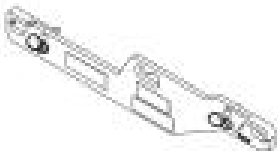
E274091

303-1675 Adapter, Seal Remover



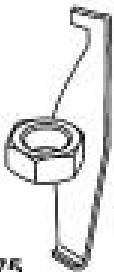
E274094

303-1678 Remover, Fuel Pump Pulley Holding Tool



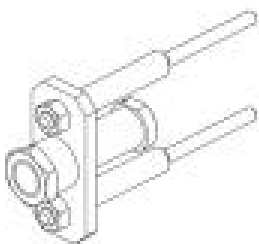
E274098

303-1681 Spreader Bar



308-375

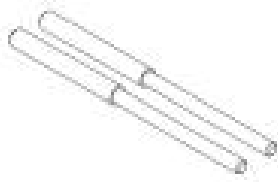
308-375 Remover, Input Shaft Seal  
TKIT-2005U-MTKIT-1999-F/FLM/LT



E274100

310-266 Remover, Fuel Injector

Floor Crane  
Mounting Stand



E274086

**303-1670 Pins, Camshaft Locking**

Plastic Scraper

Hose Clamp  
Remover/Installer

**Materials**

| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> Silicone Gasket Remover ZC-30-A          | -             |
| Motorcraft <sup>®</sup> Metal Surface Prep Wipes ZC-31-B         | -             |
| Motorcraft <sup>®</sup> Metal Brake Parts Cleaner PM-4-A, PM-4-B | -             |

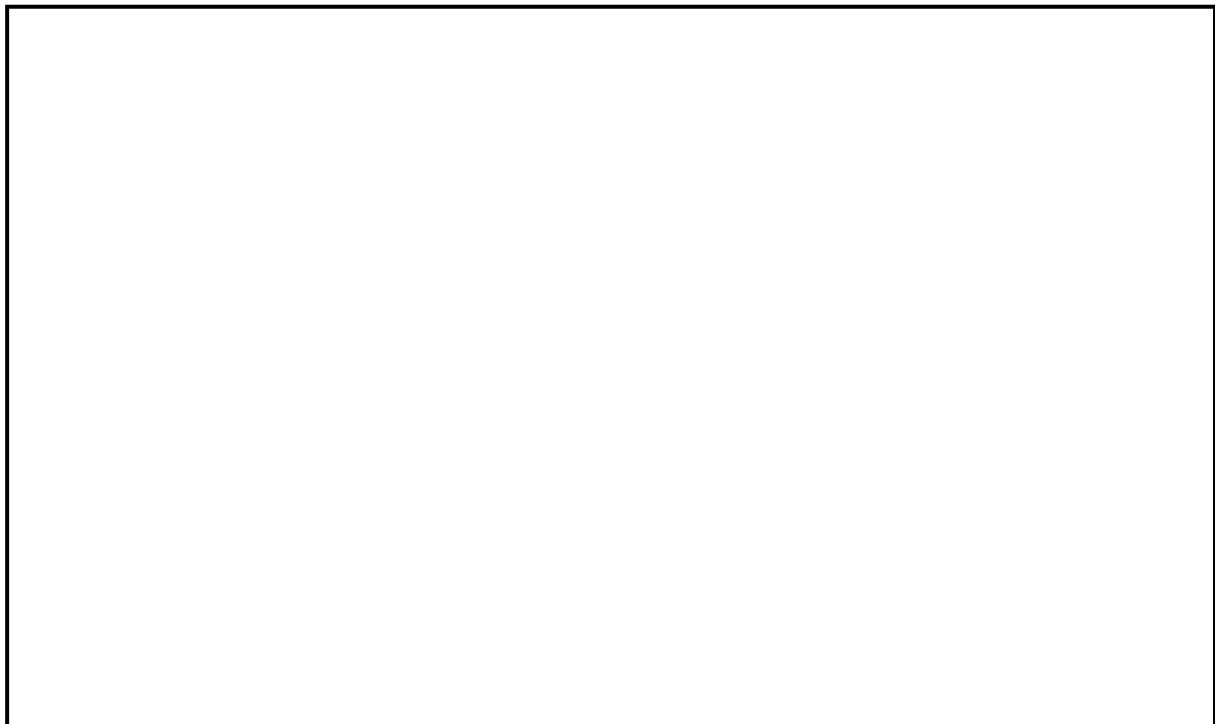
**NOTE:** During engine repair procedures, cleanliness is extremely important. Any foreign material, including any material created while cleaning gasket surfaces that enters the oil passages, coolant passages or the oil pan, can cause engine failure.

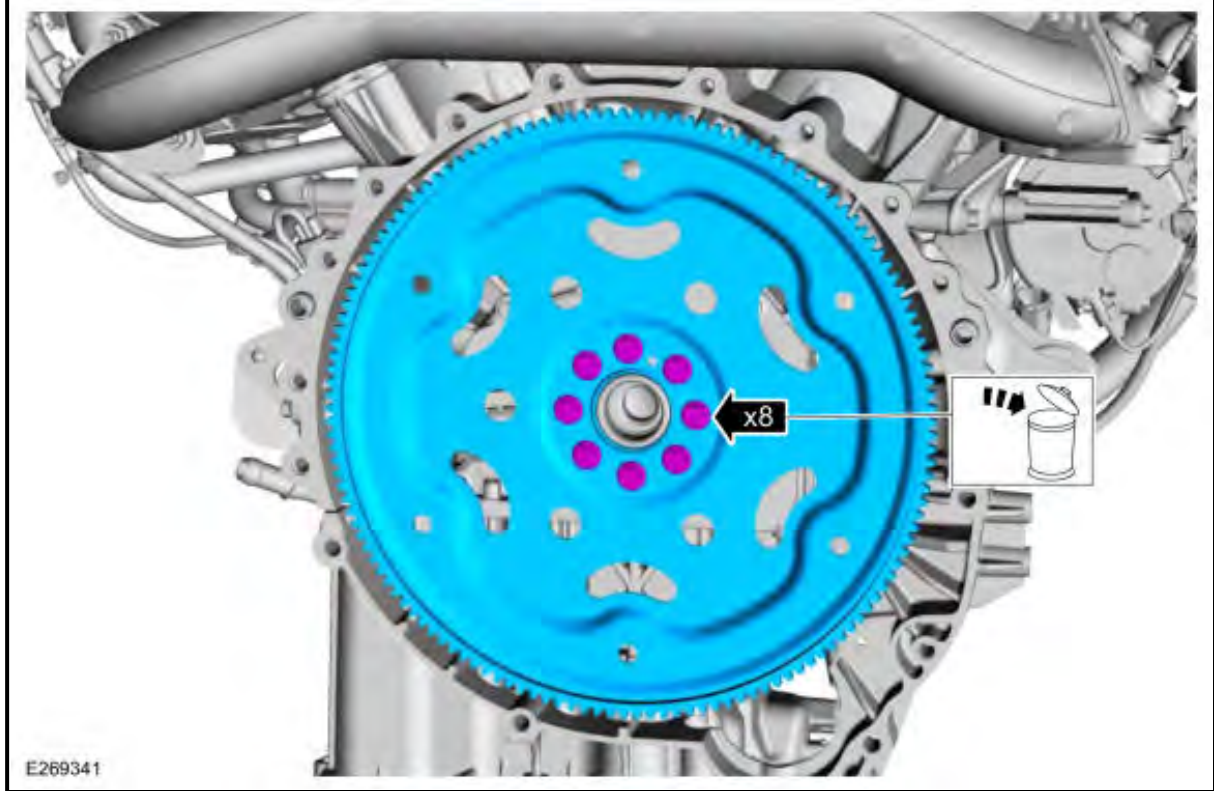
**NOTE:** This procedure assumes that the engine was removed using the recommended body off engine removal procedure. If it was necessary to remove the engine using the alternate body on engine removal procedure, some of the components in this procedure will have already been removed.

**NOTE:** Disassembly of the engine requires various inspections/measurements of the engine components. These inspections/measurements will aid in determining if the engine components will require replacement.

**NOTE:** Refer to the exploded view under the Engine Component View in the Description and Operation.

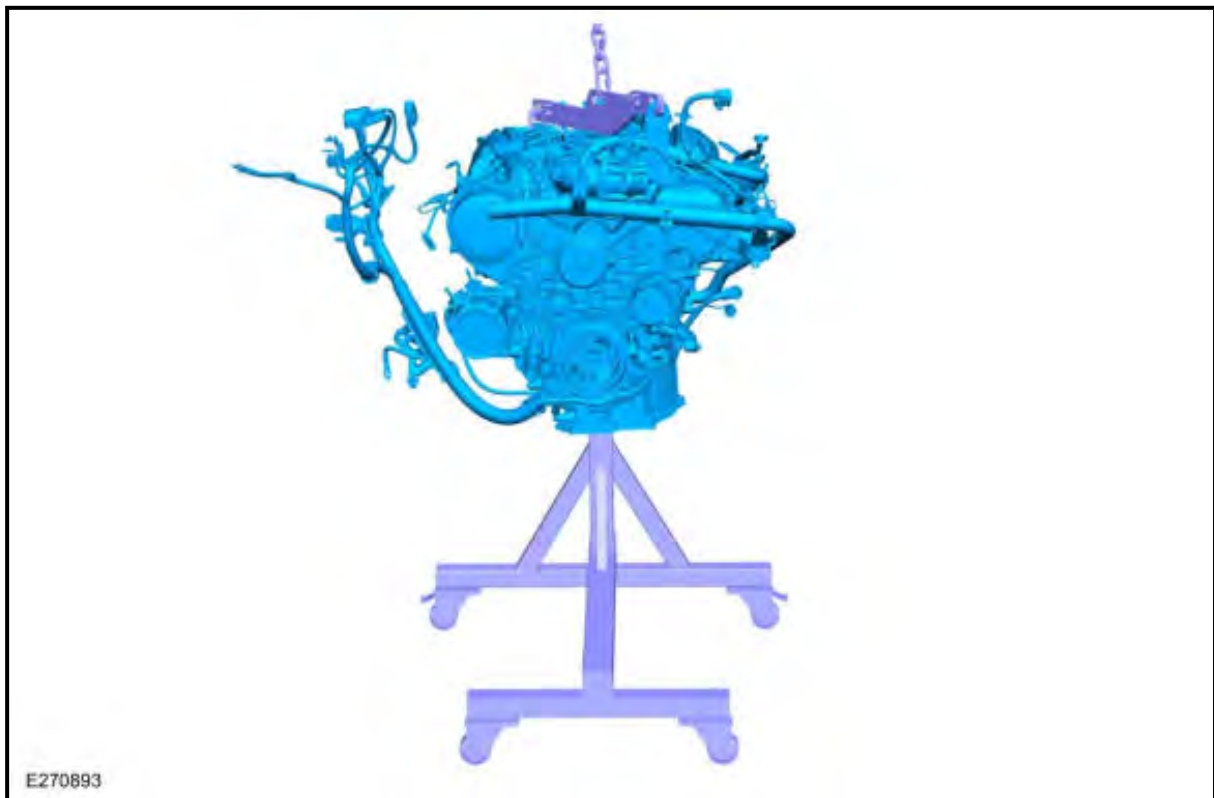
1. Remove the engine from the vehicle. Refer to: [Engine - Body Off](#). Refer to: [Engine - Body On](#).
2. Remove the bolts and the flexplate. Discard the bolts.





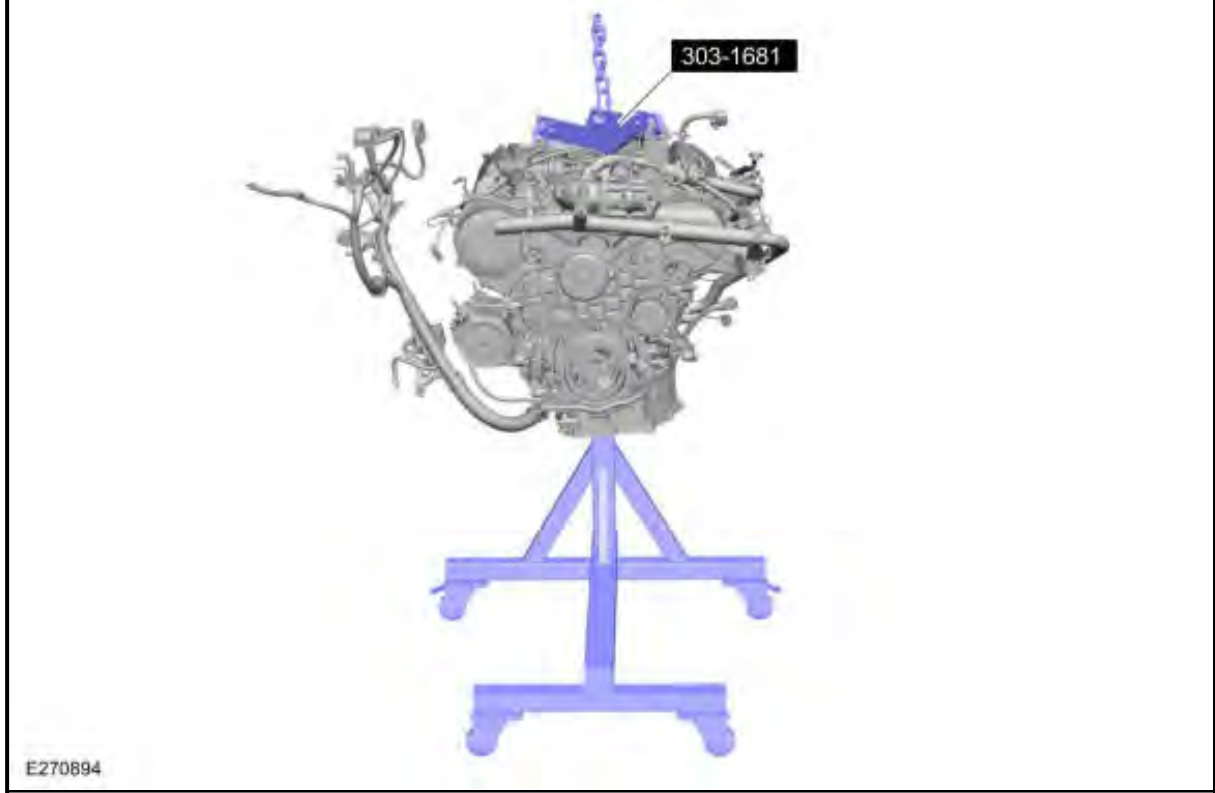
3. **NOTE:** Install the engine stand bolts into the cylinder block only. Do not install the bolts into the engine block skirt stiffener.

Using a floor crane, install the engine on a mounting stand. Use the General Equipment: Floor Crane Use the General Equipment: Mounting Stand

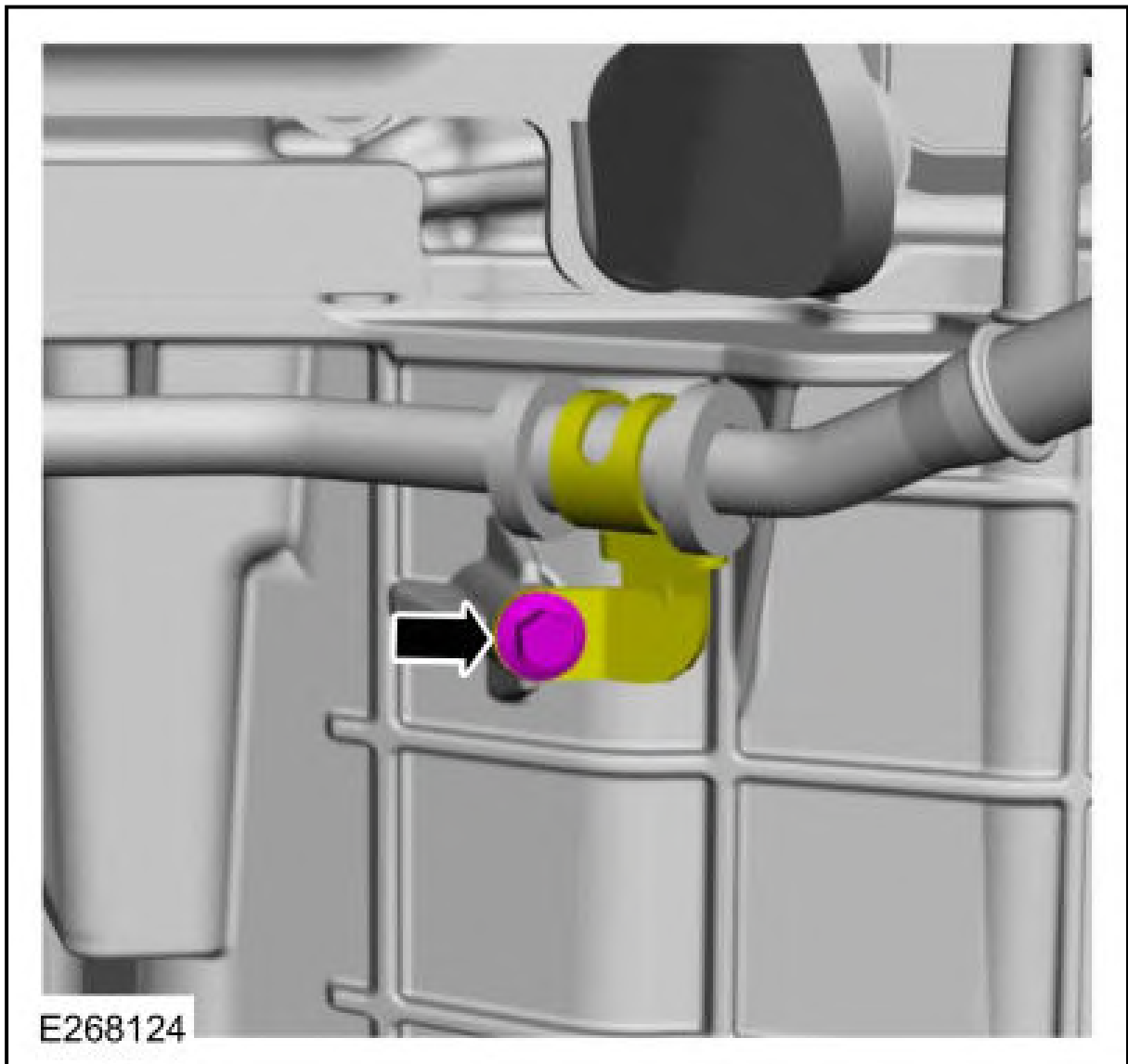


4. Remove the floor crane and the special tool. Use Special Service Tool: 303-1681 Spreader Bar. Use the General Equipment: Floor Crane

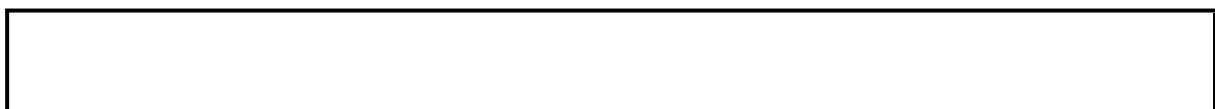


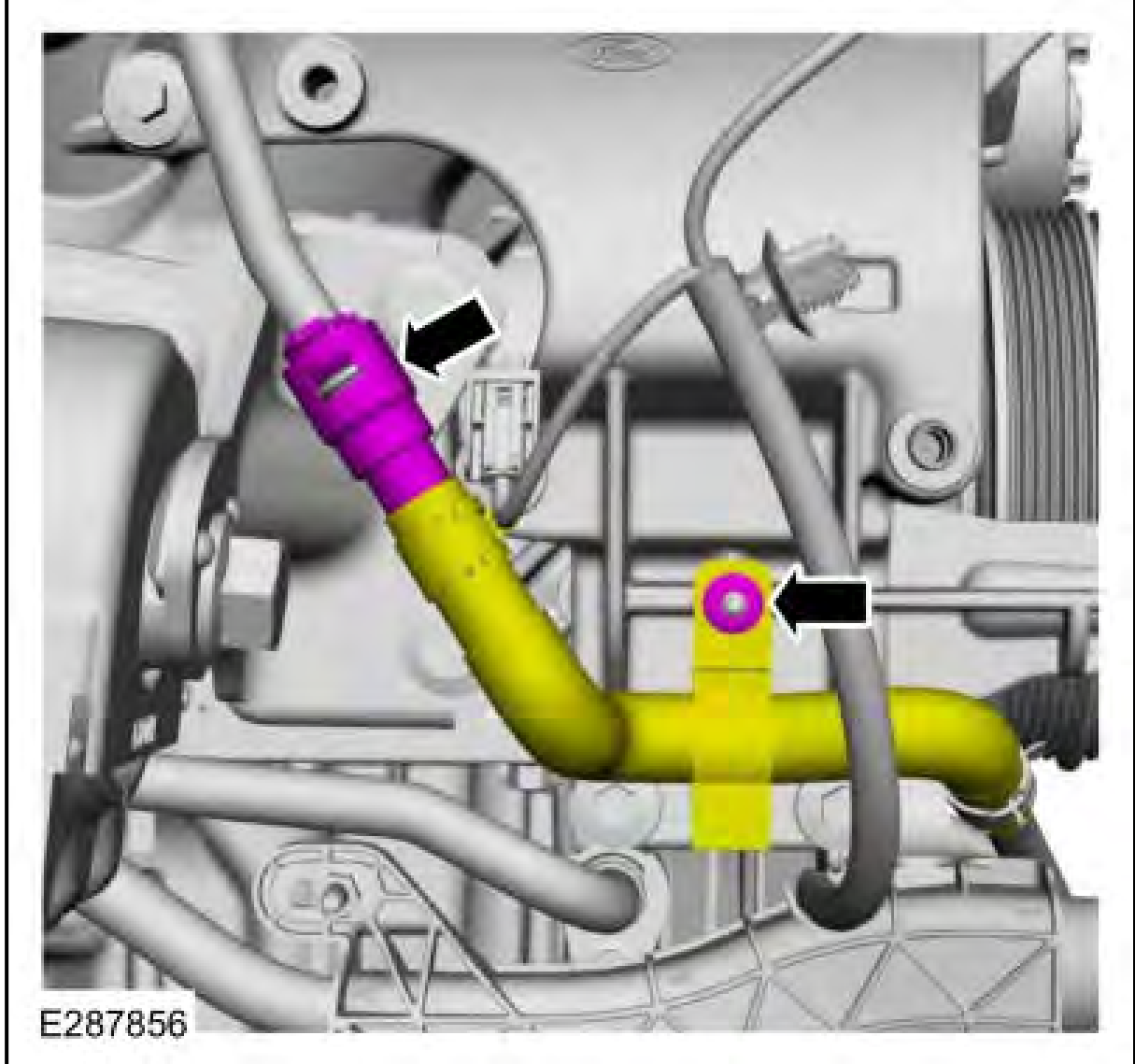


5. Remove the bolt for the coolant tube.

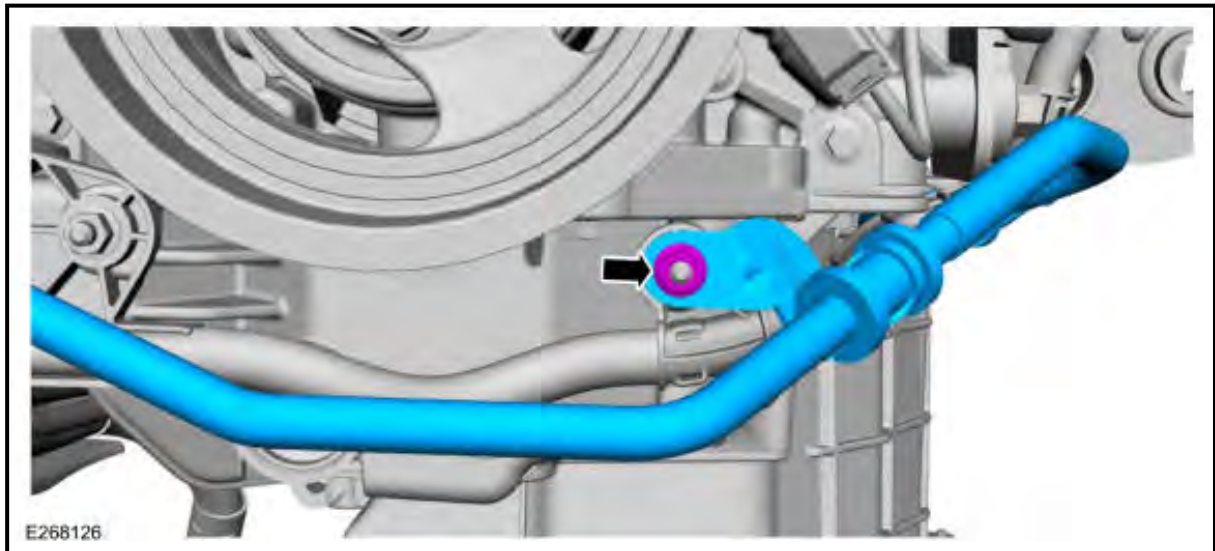


6. Disconnect the coolant hose. Remove the nut for the coolant hose bracket.



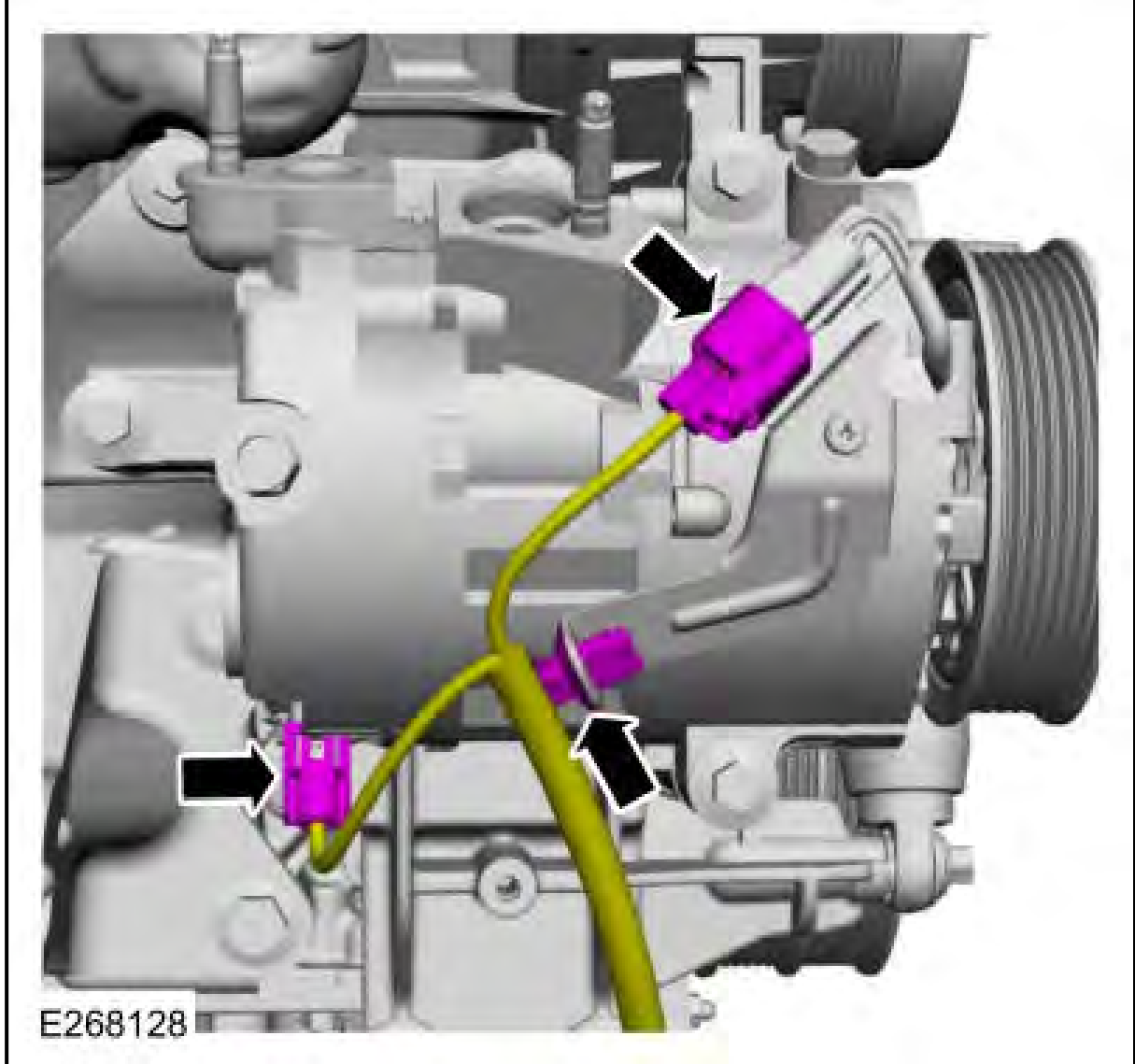


7. Remove the nut and the coolant tube.

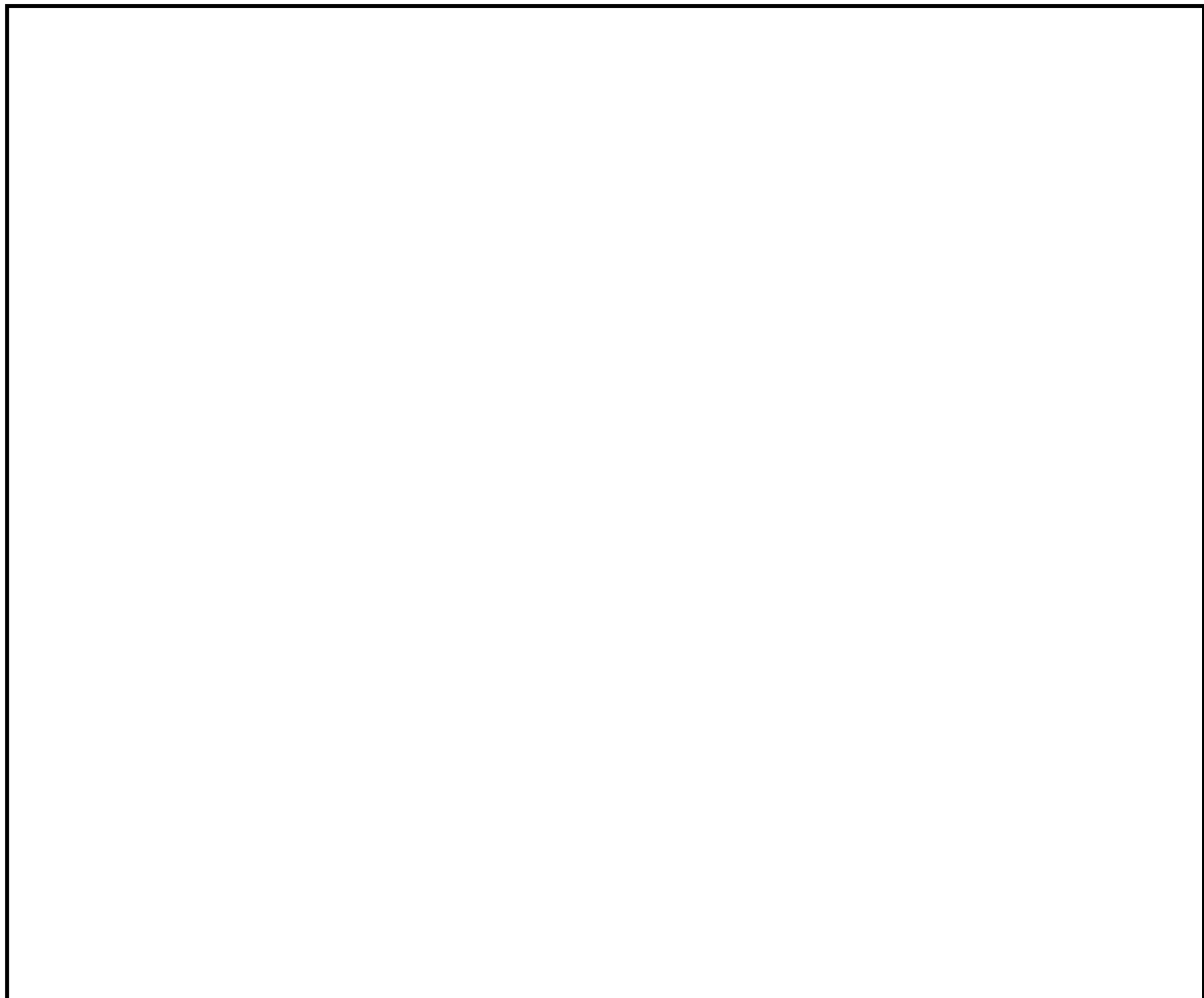


8. Disconnect the A/C electrical connectors and the wire retainer.

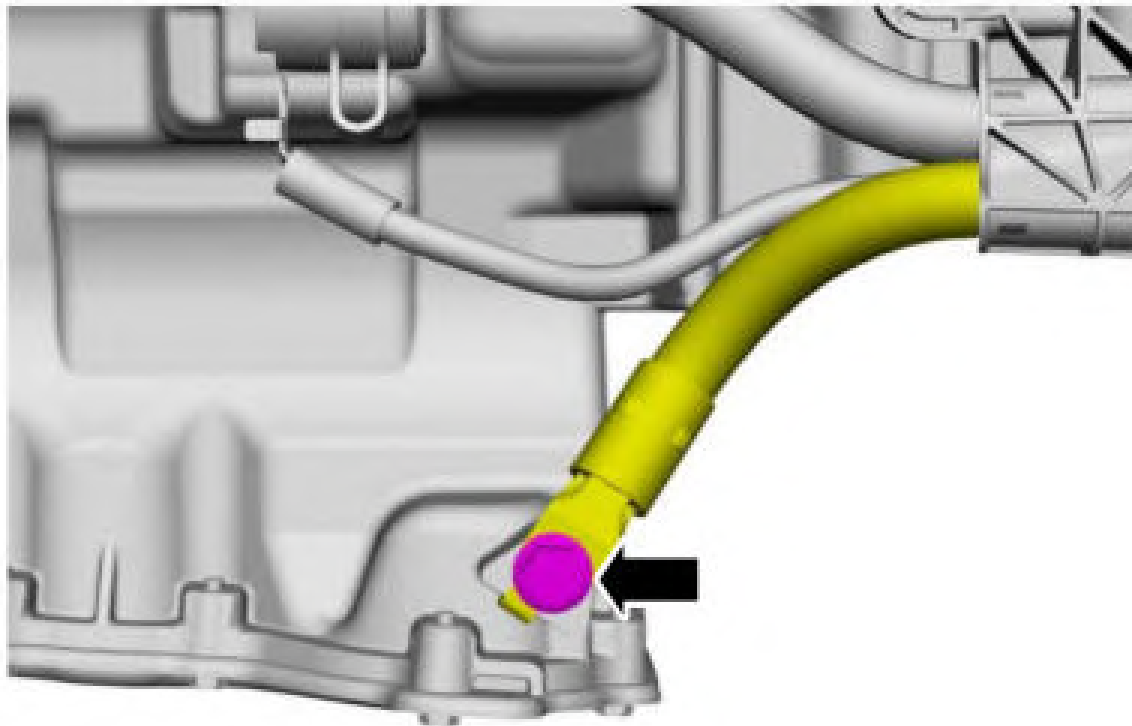




9. Remove the ground cable bolt.

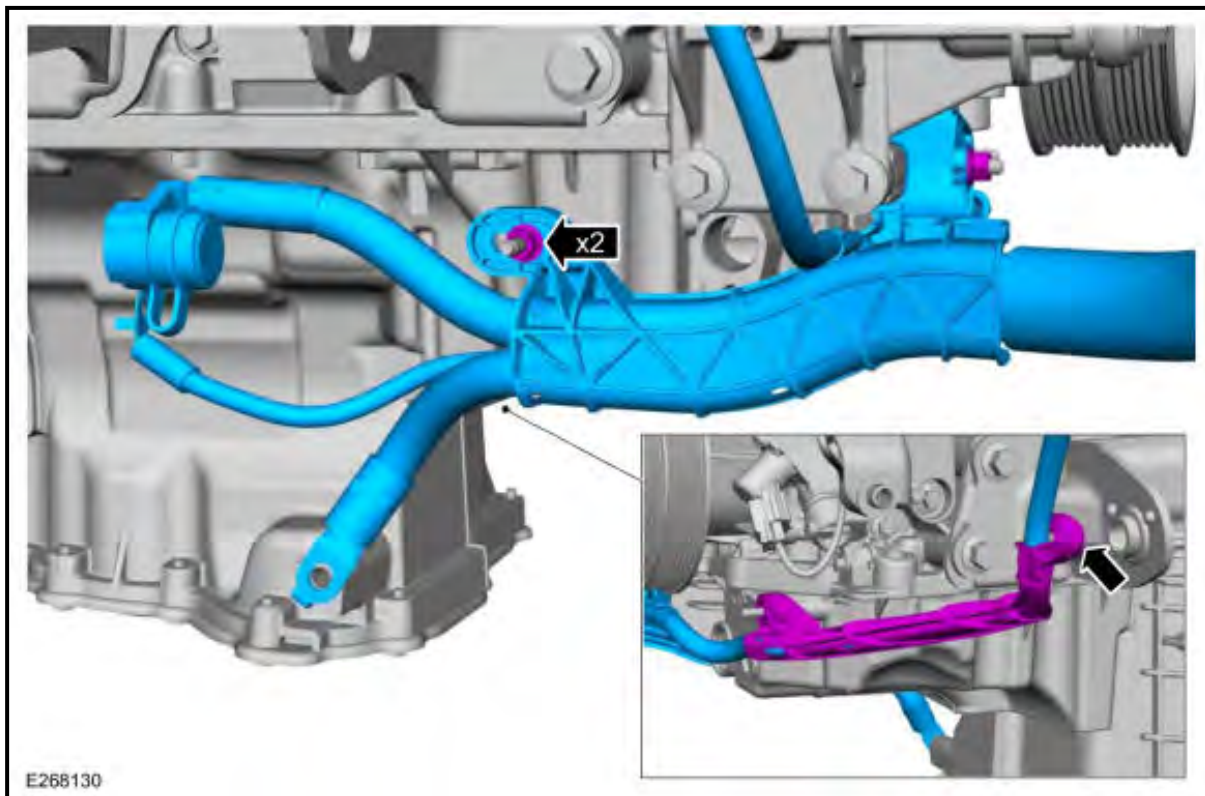






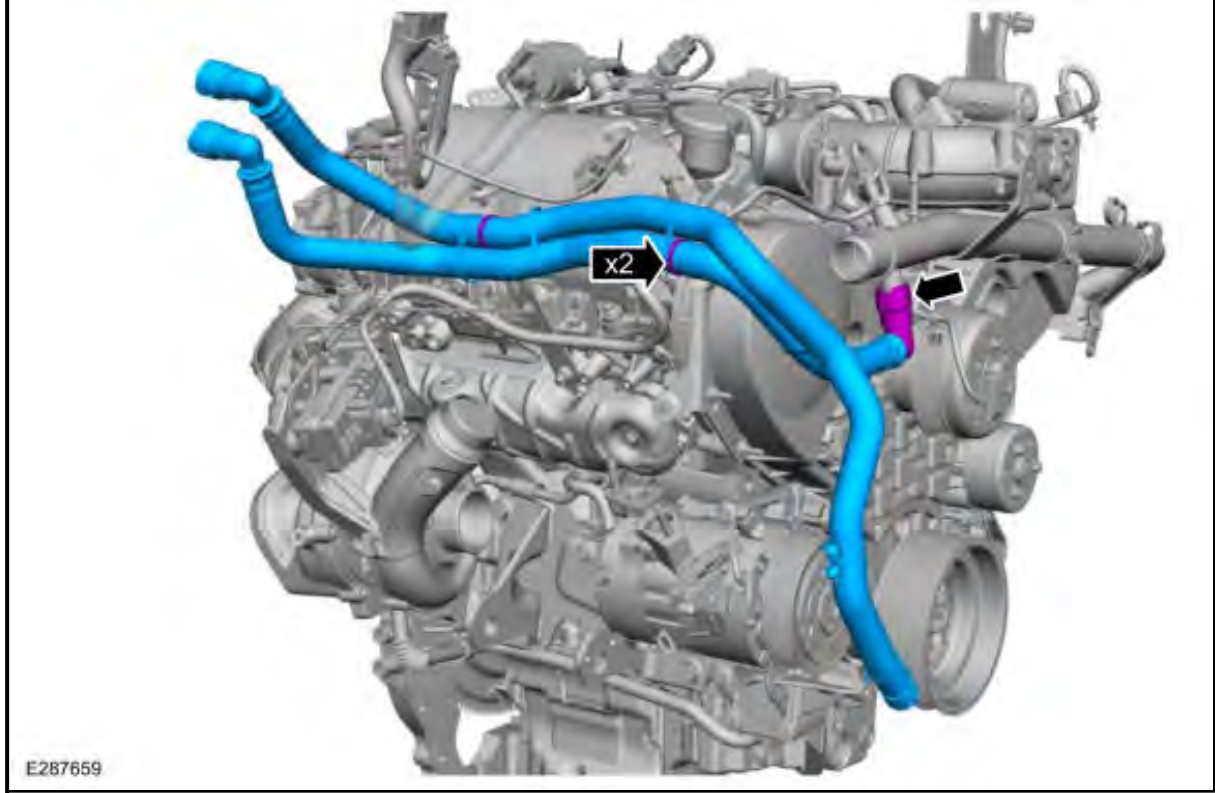
E268129

10. Remove the nuts, disconnect the wire harness retainer and remove the battery cable harness.

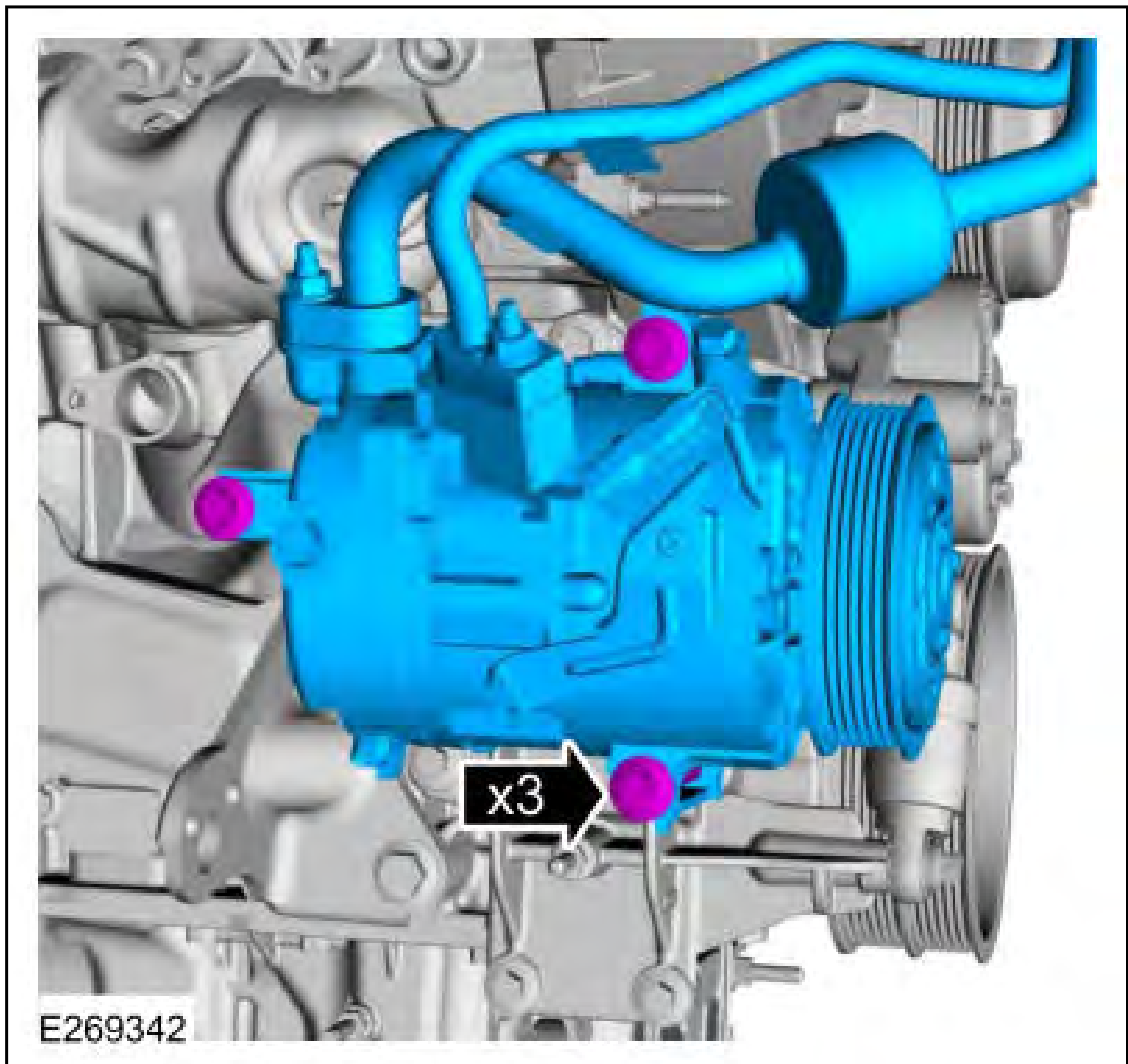


E268130

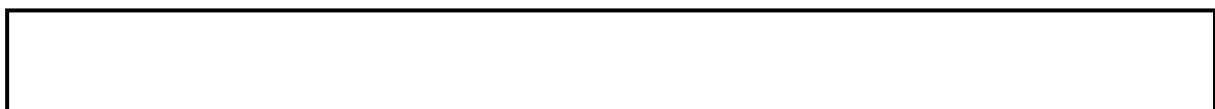
11. Disconnect the coolant hose. Disconnect the retainers and remove the coolant hoses.

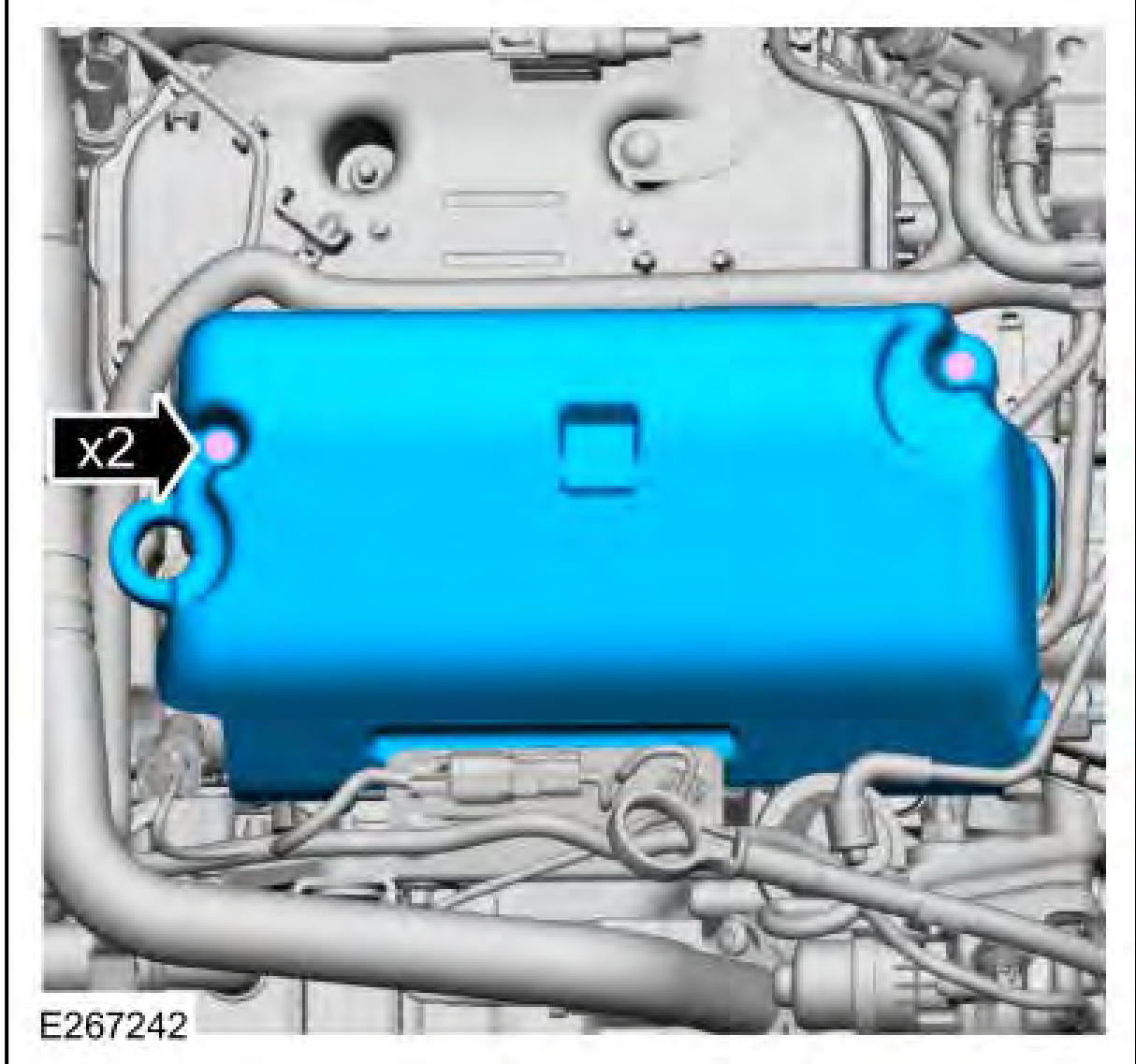


12. Remove the bolts and the A/C compressor.

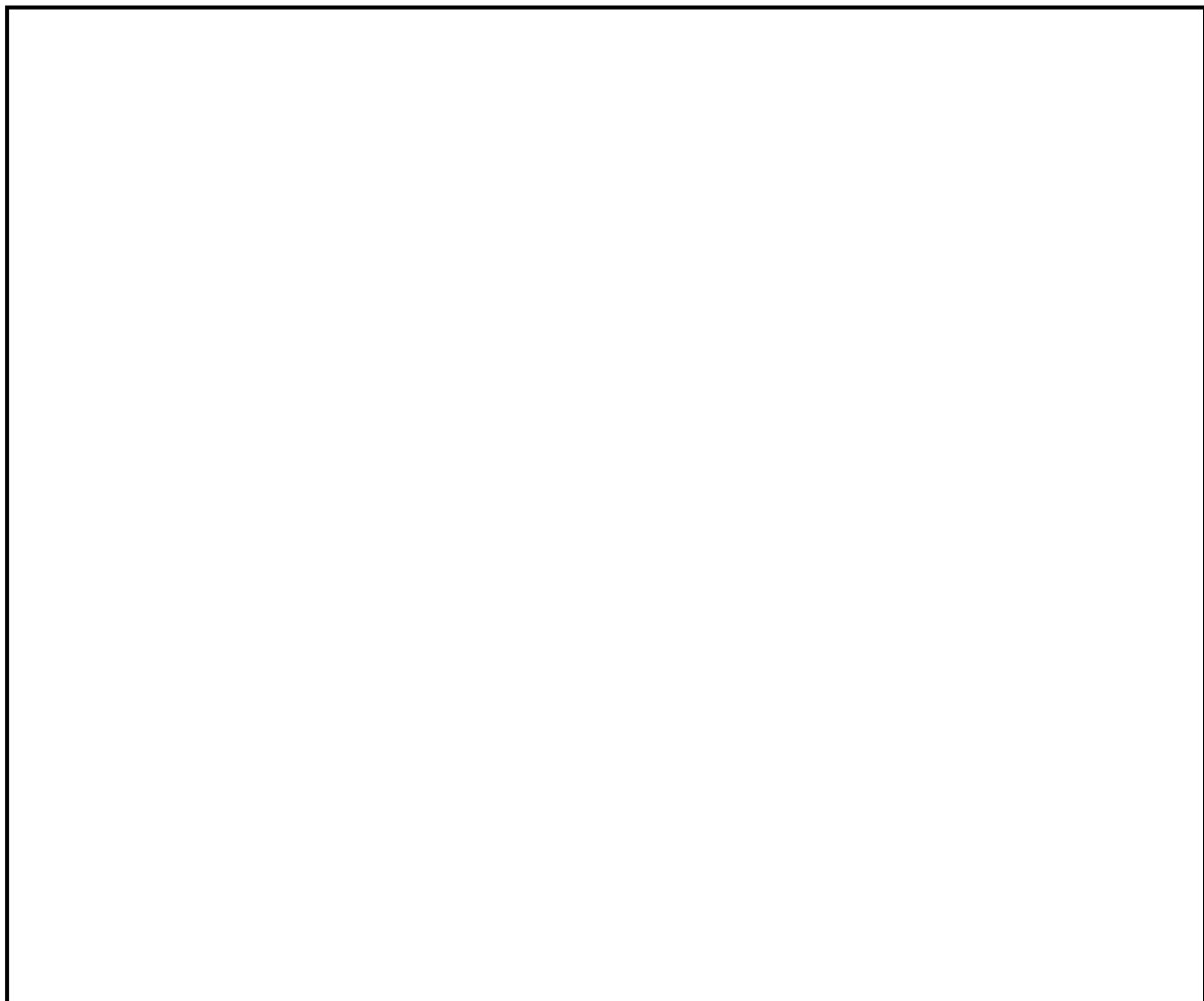


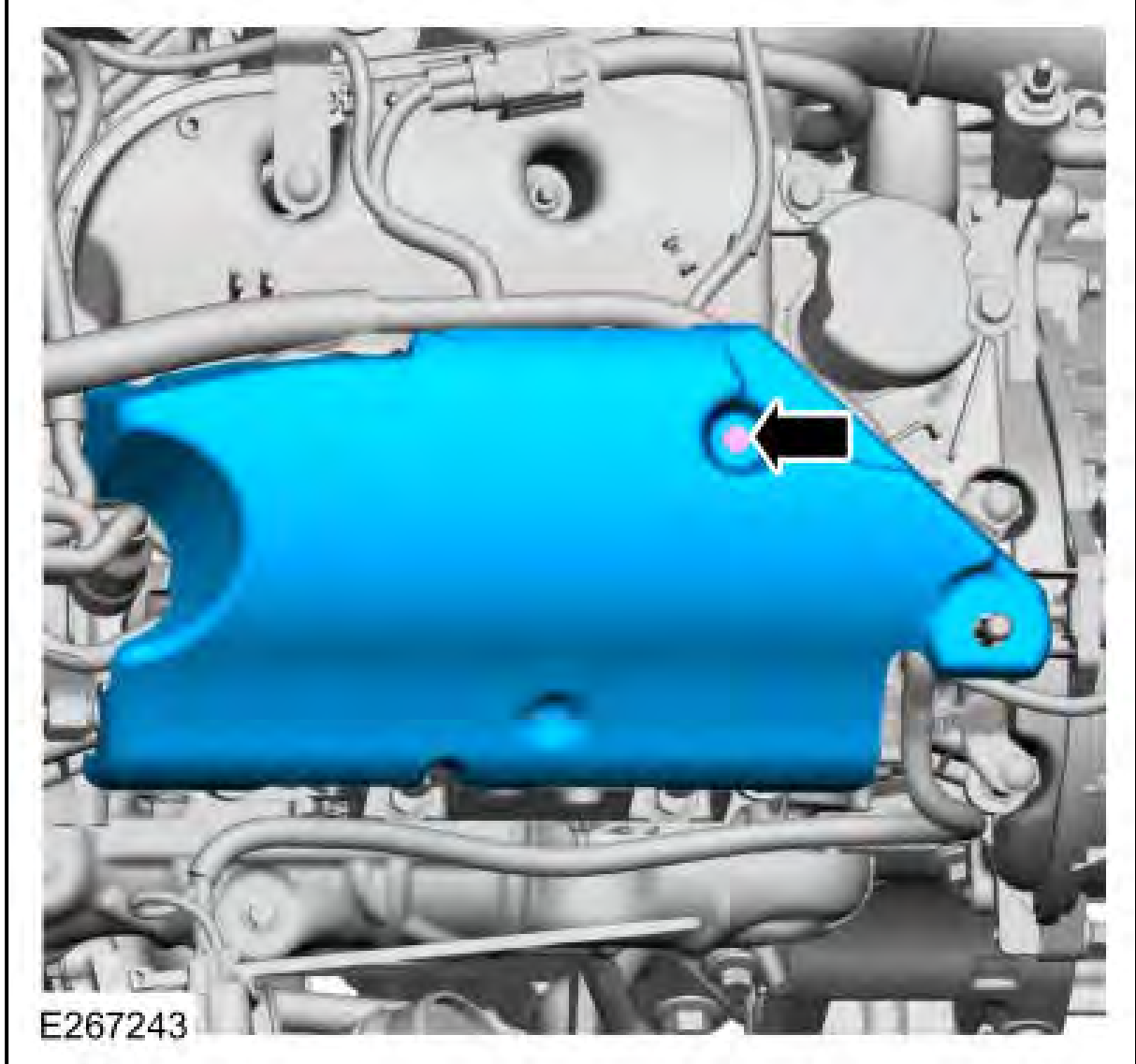
13. Remove the LH fuel injector noise insulator.



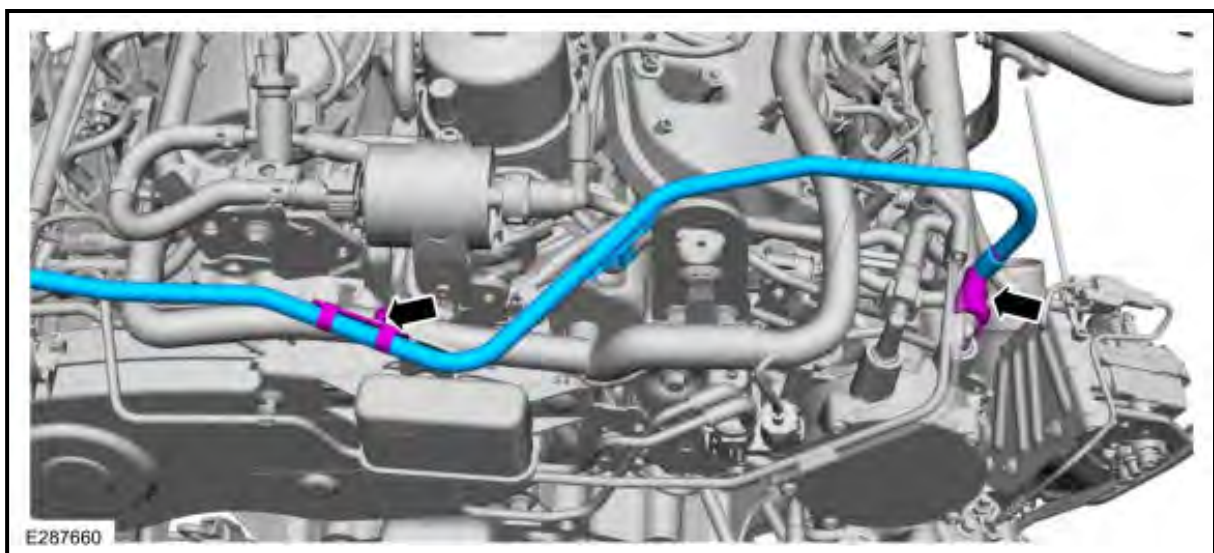


14. Remove the RH fuel injector noise insulator.



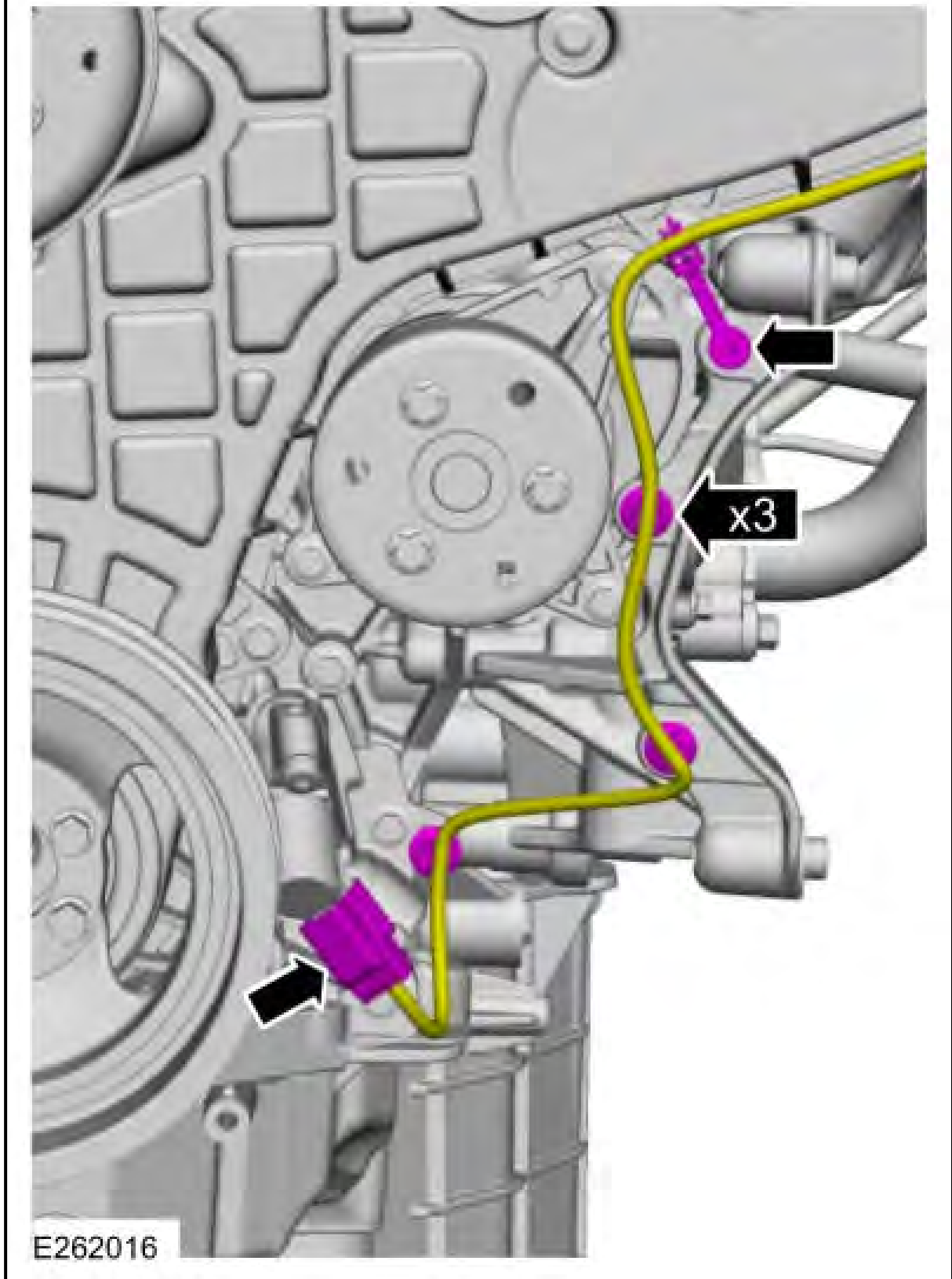


15. Disconnect the retainer. Disconnect and remove the brake vacuum hose. Refer to: [Quick Release Coupling](#) .



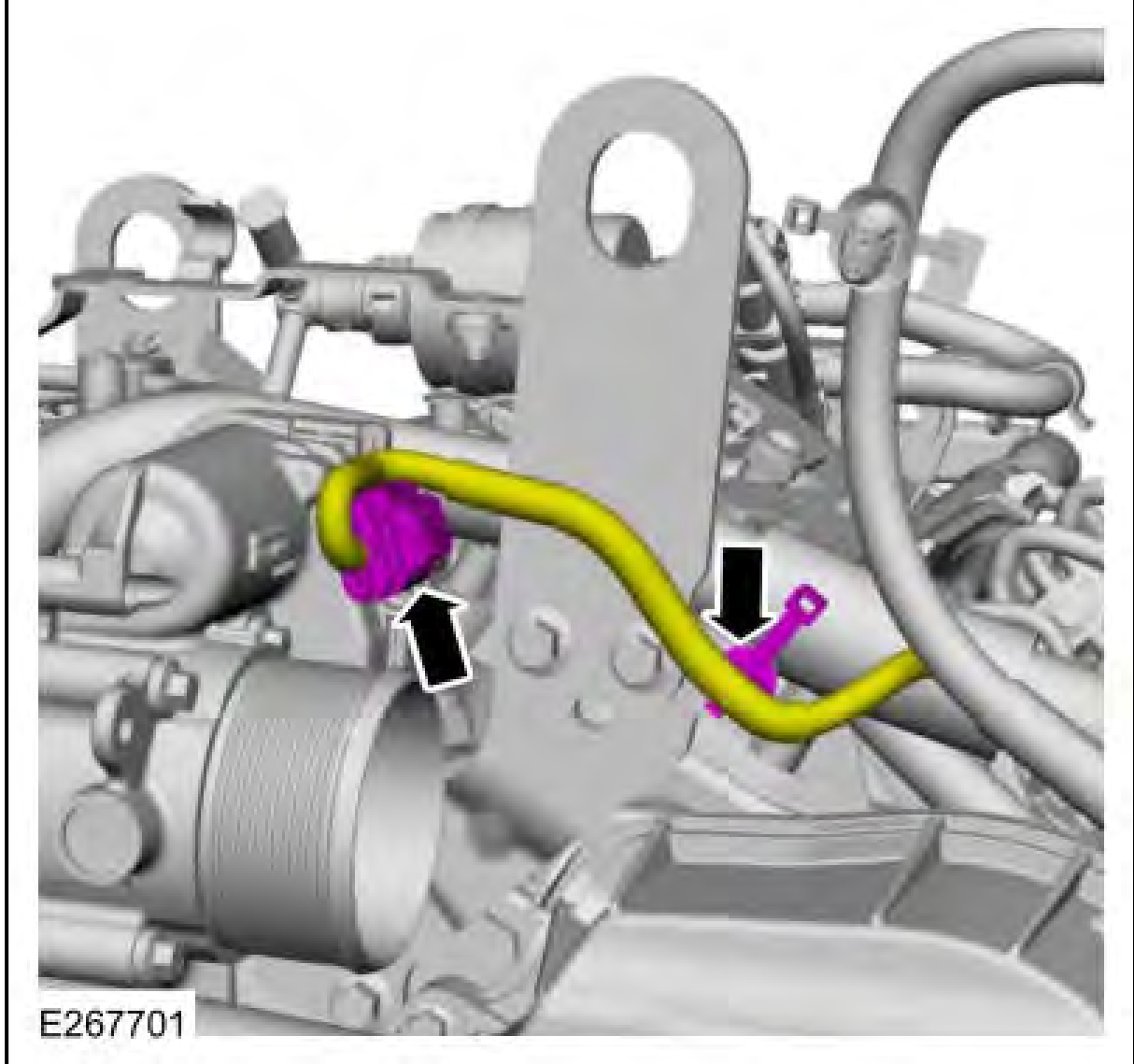
16. Disconnect the oil pump electrical connector and the wire retainers.





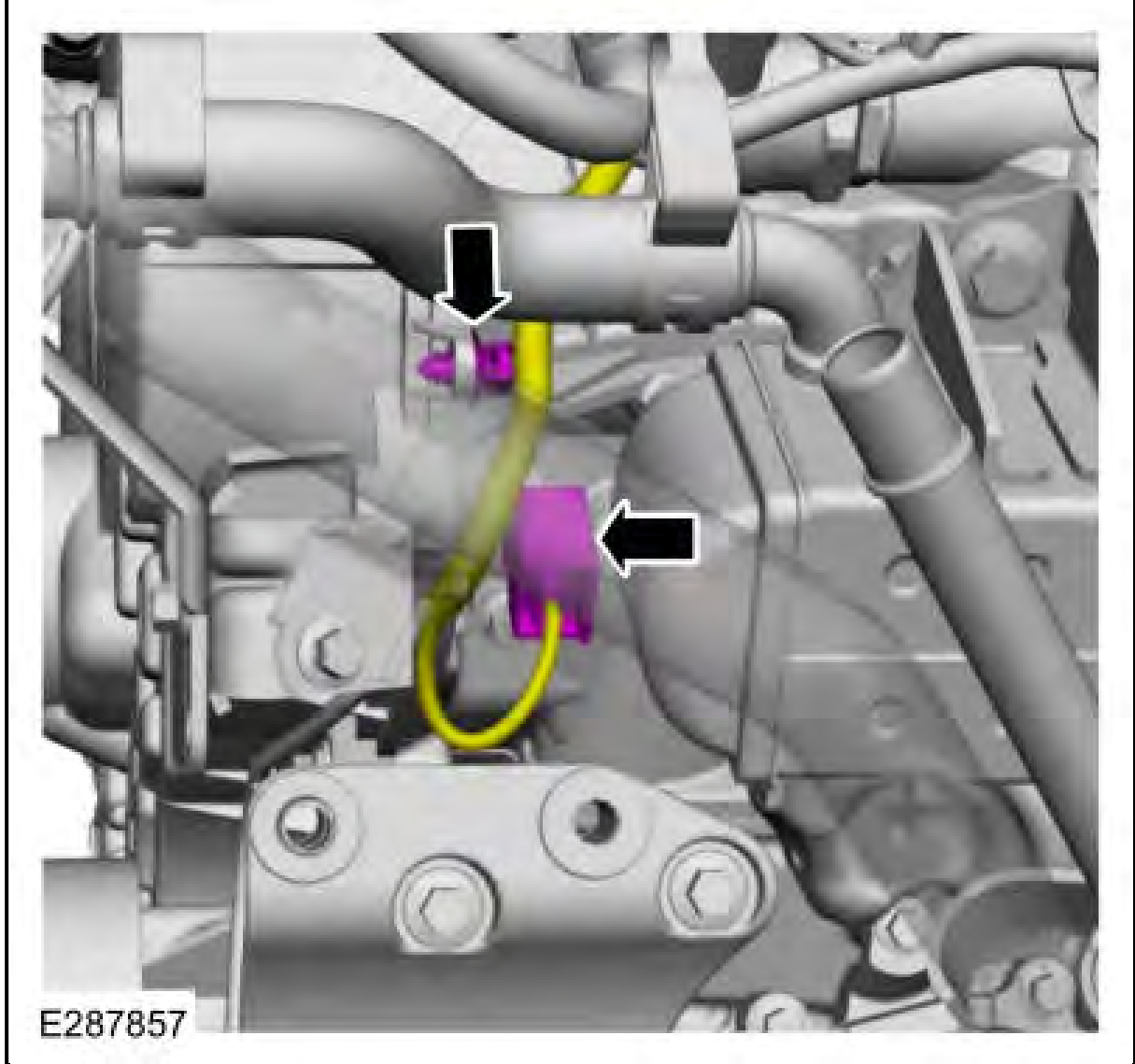
17. Disconnect the TB (throttle body) electrical connector and the wire retainer.



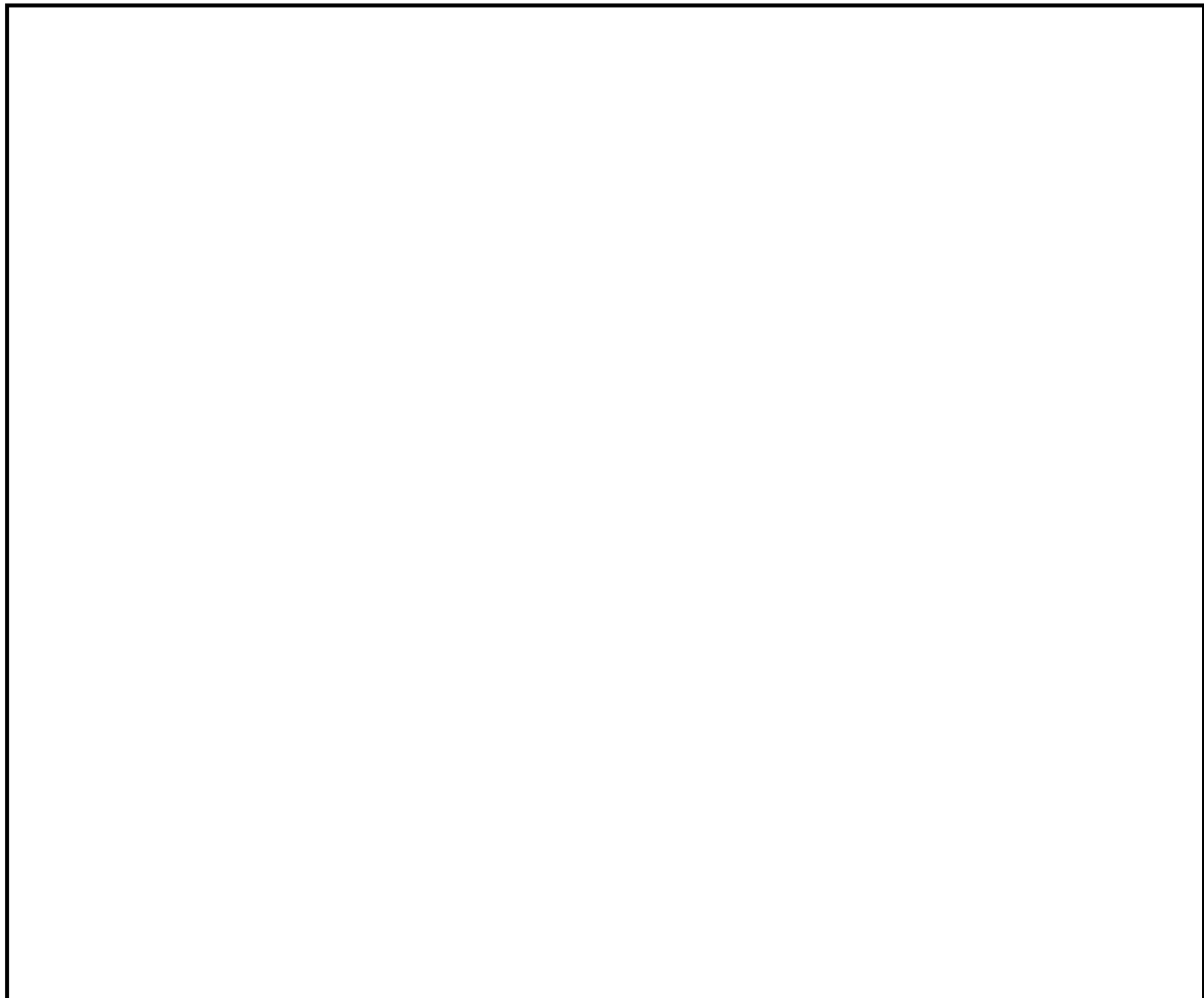


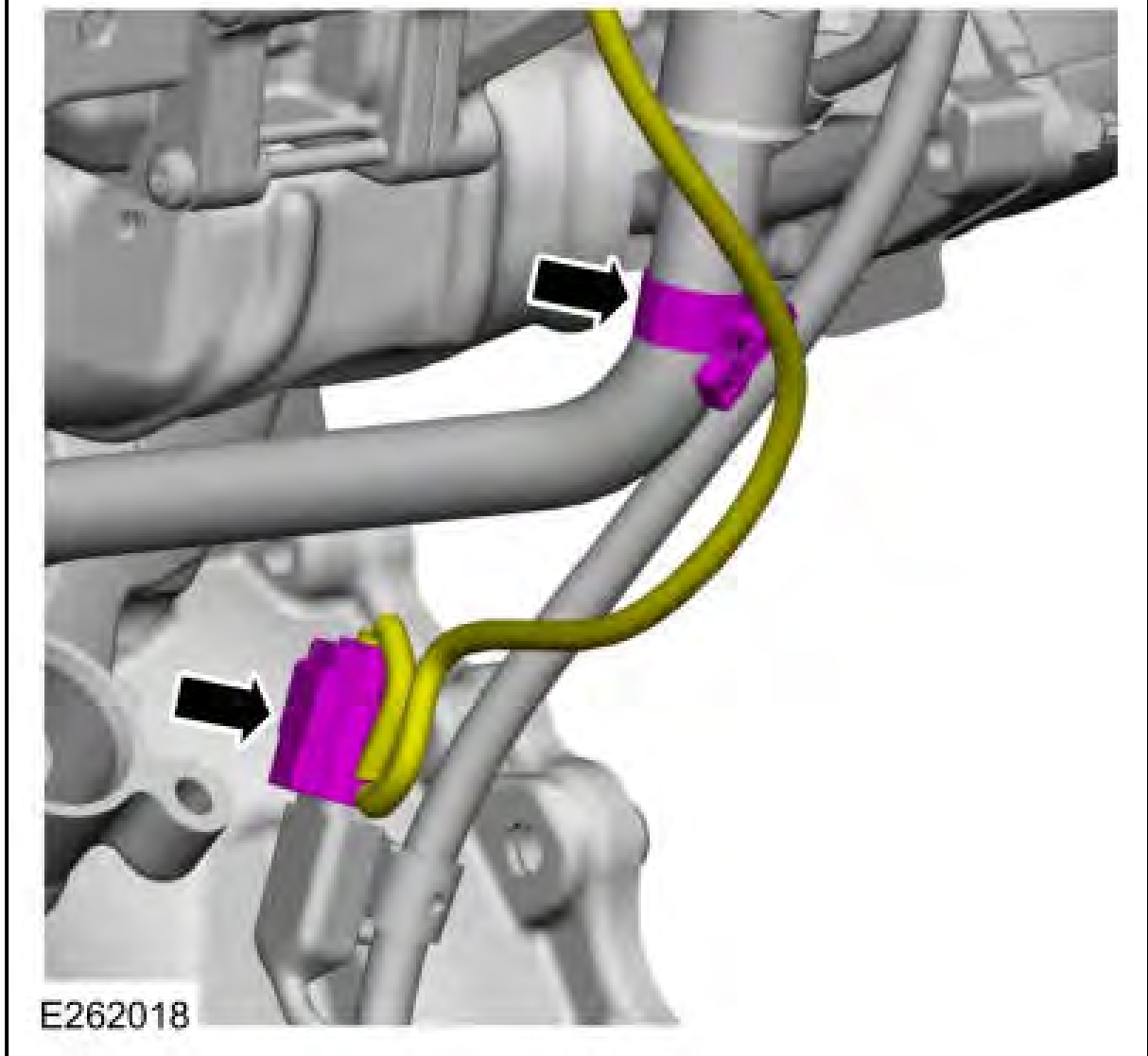
18. Disconnect the CMP electrical connector and the wire retainer.





19. Disconnect the CKP electrical connector and the wire retainer.

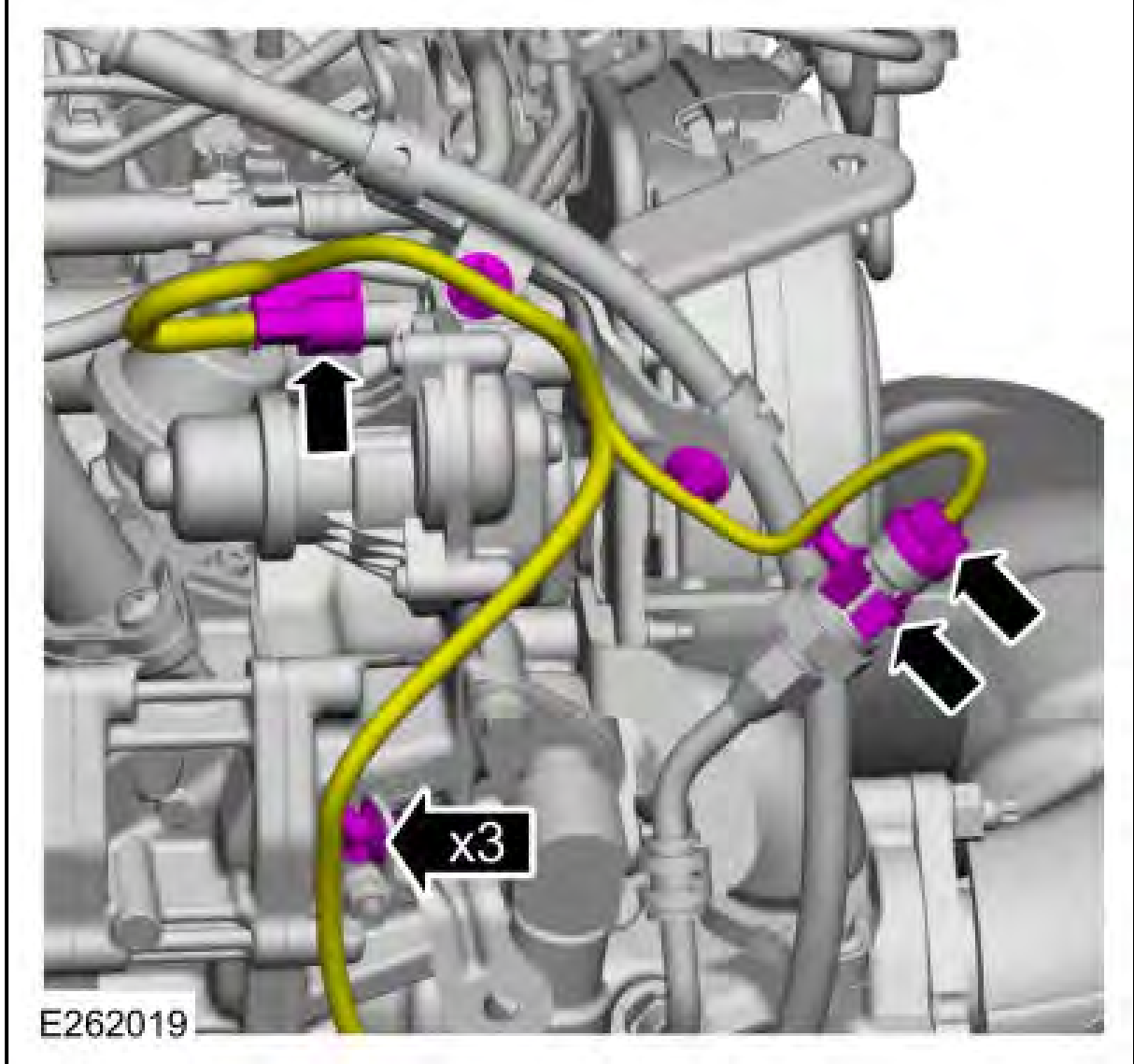




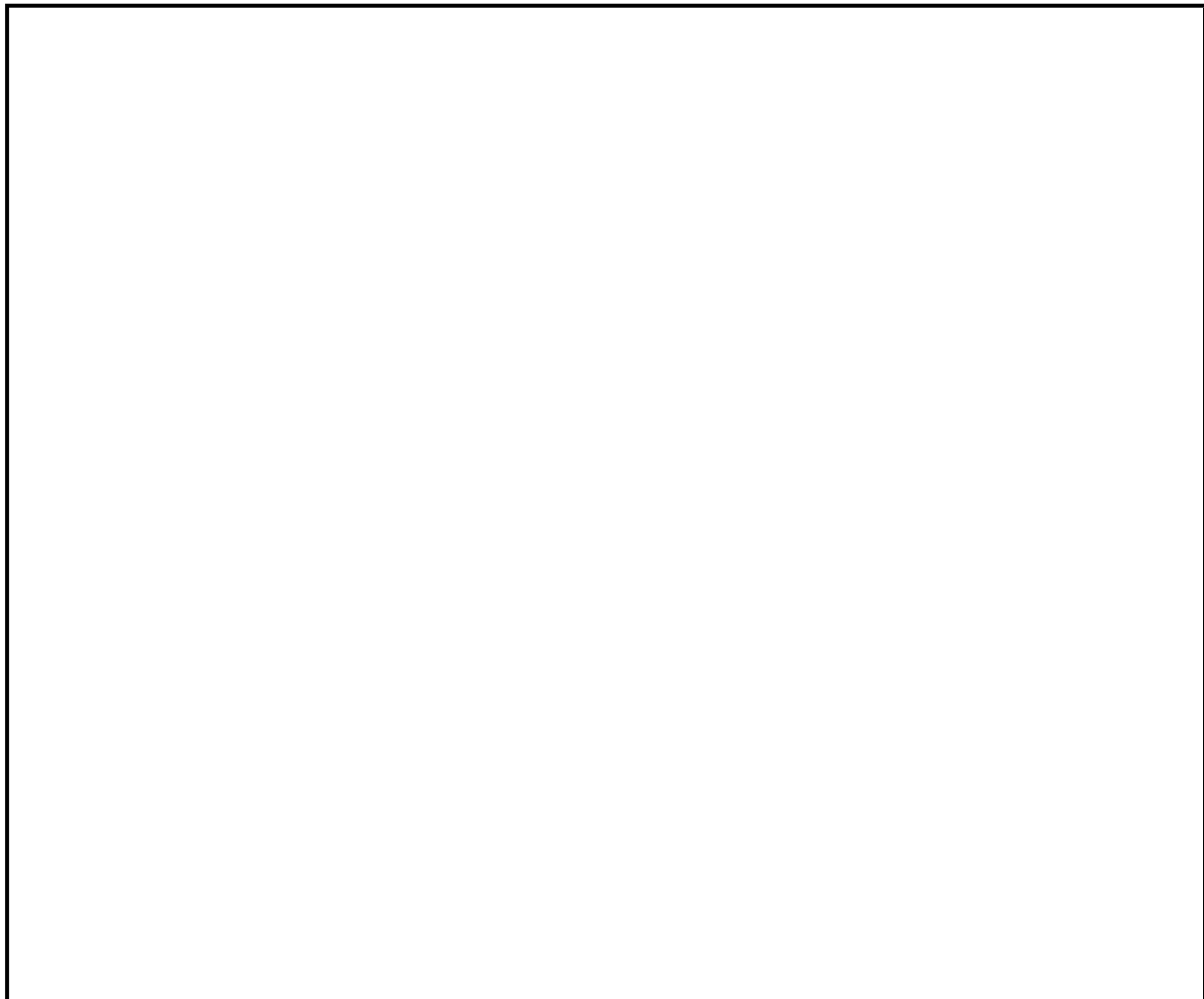
20. Disconnect the EGR valve and the EP (exhaust pressure) sensor electrical connectors. Disconnect the wire retainers.

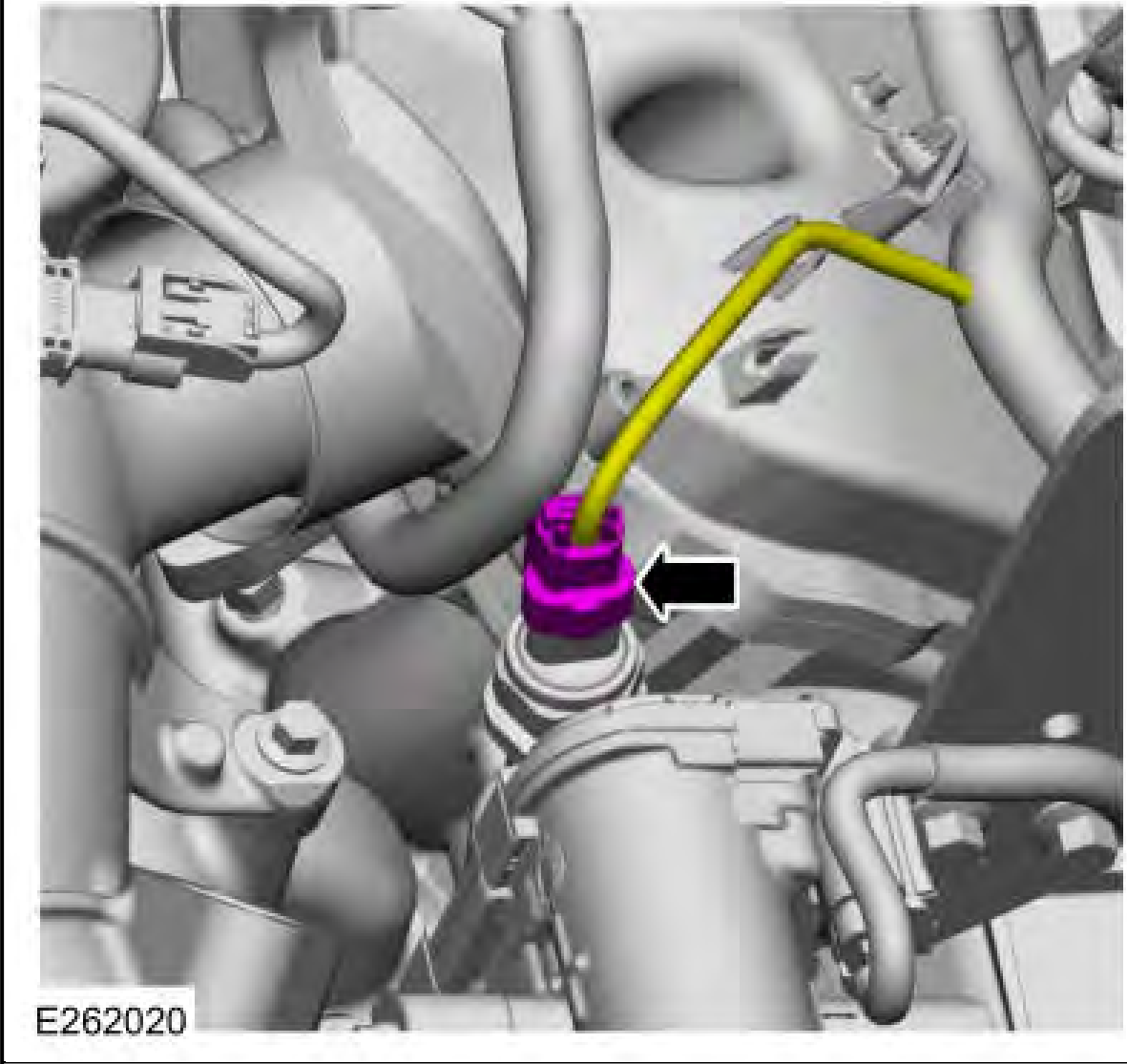






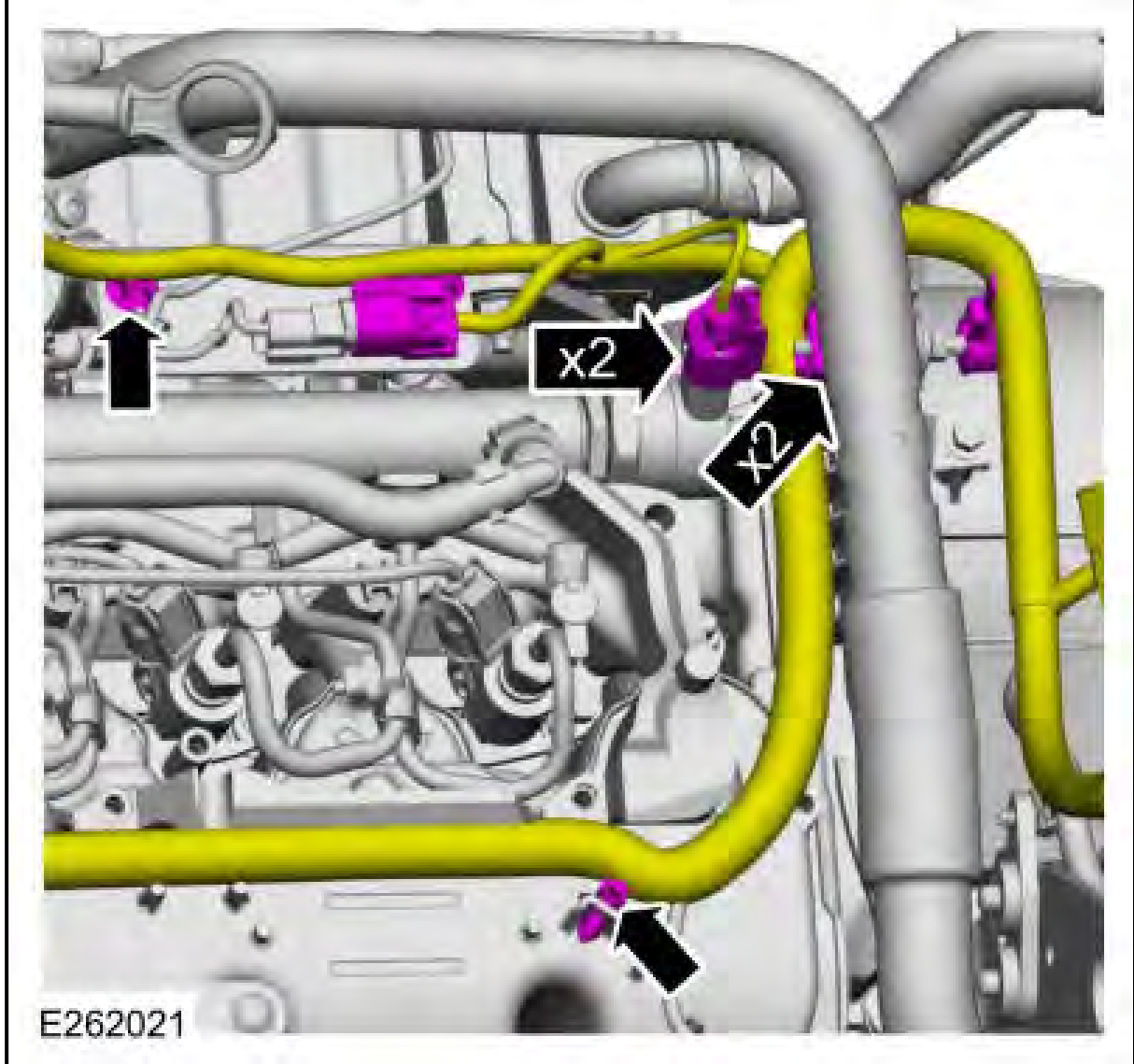
21. Disconnect the EOP sensor electrical connector.



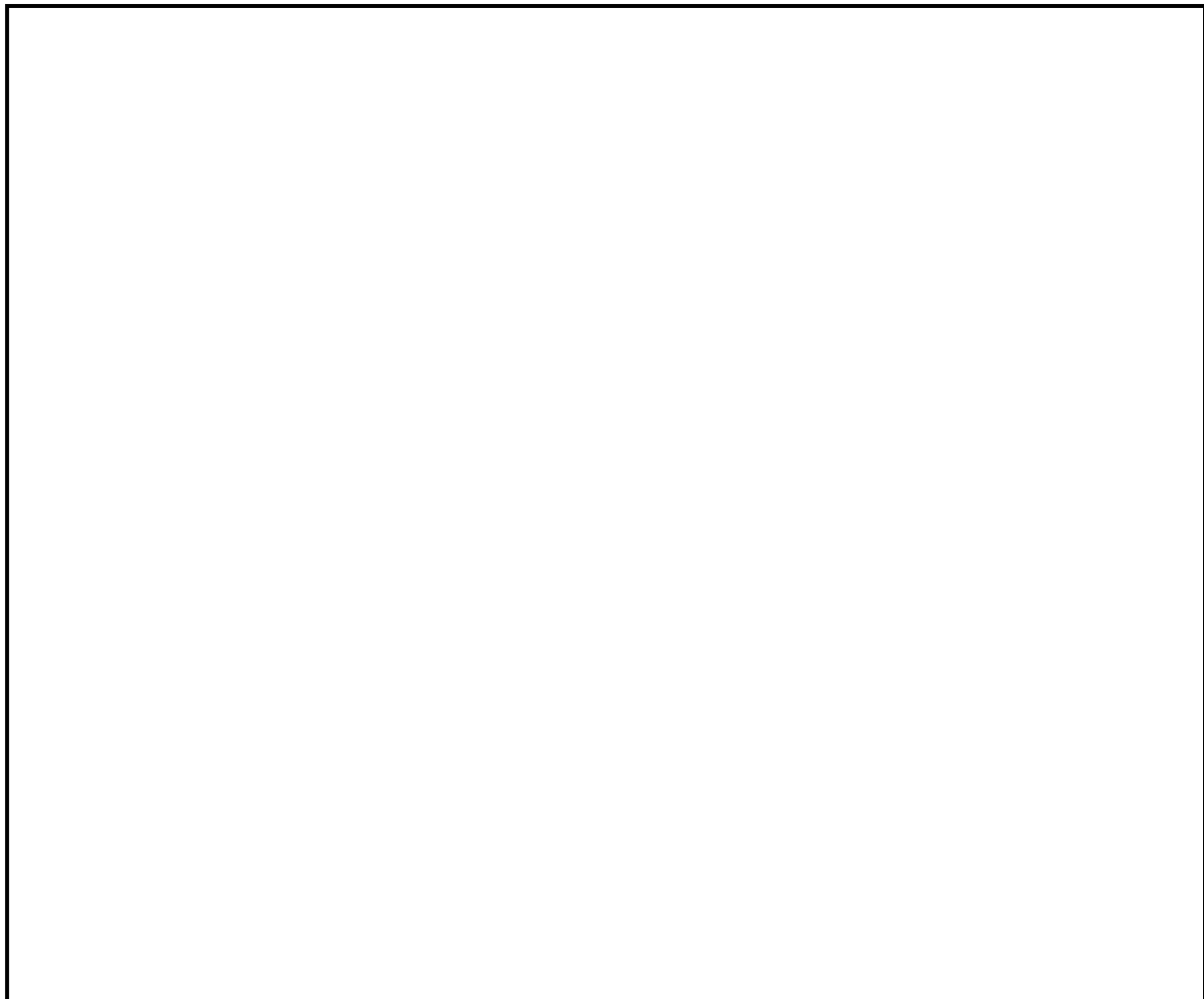


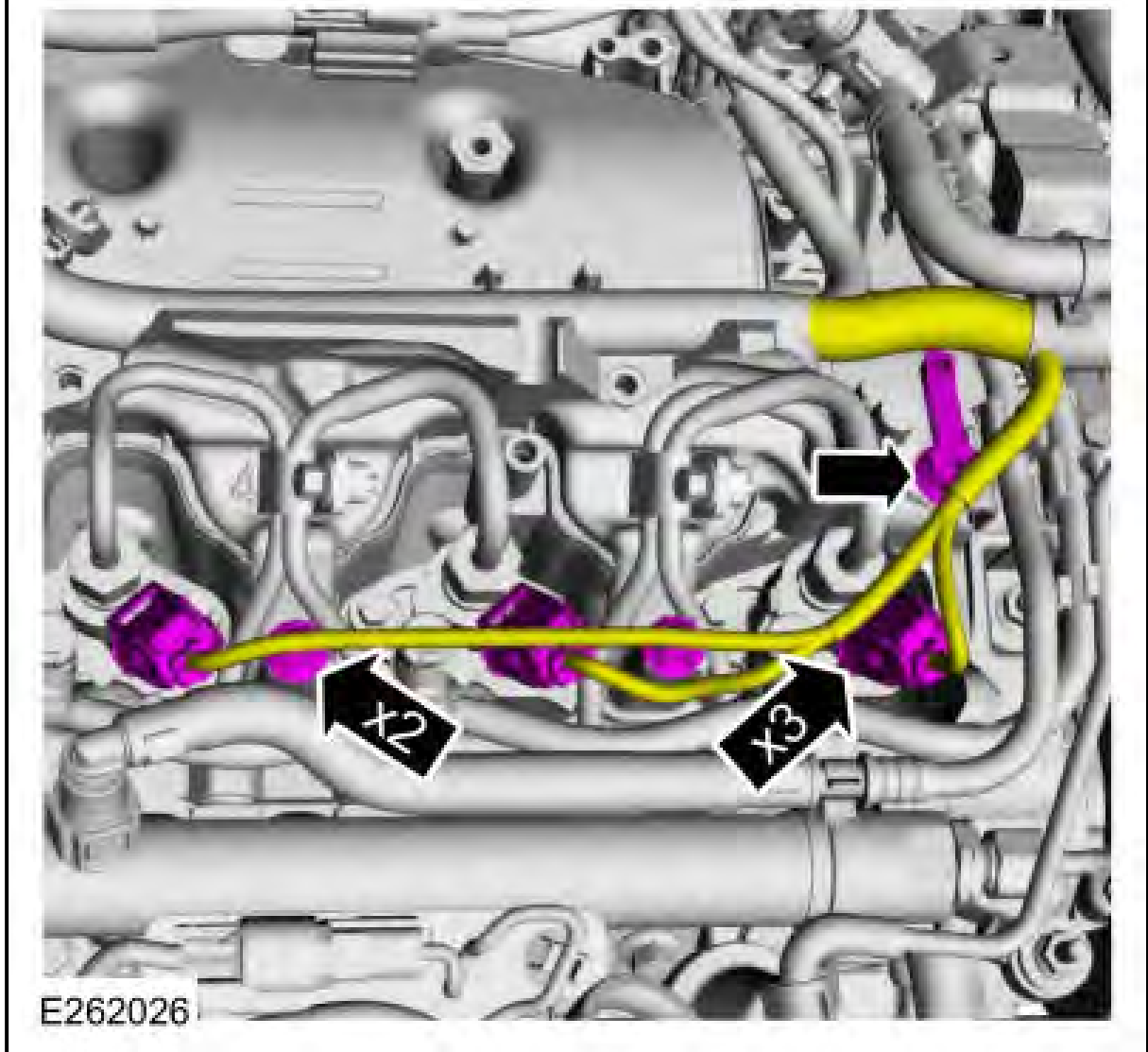
22. Disconnect the electrical connectors and the wire retainers.



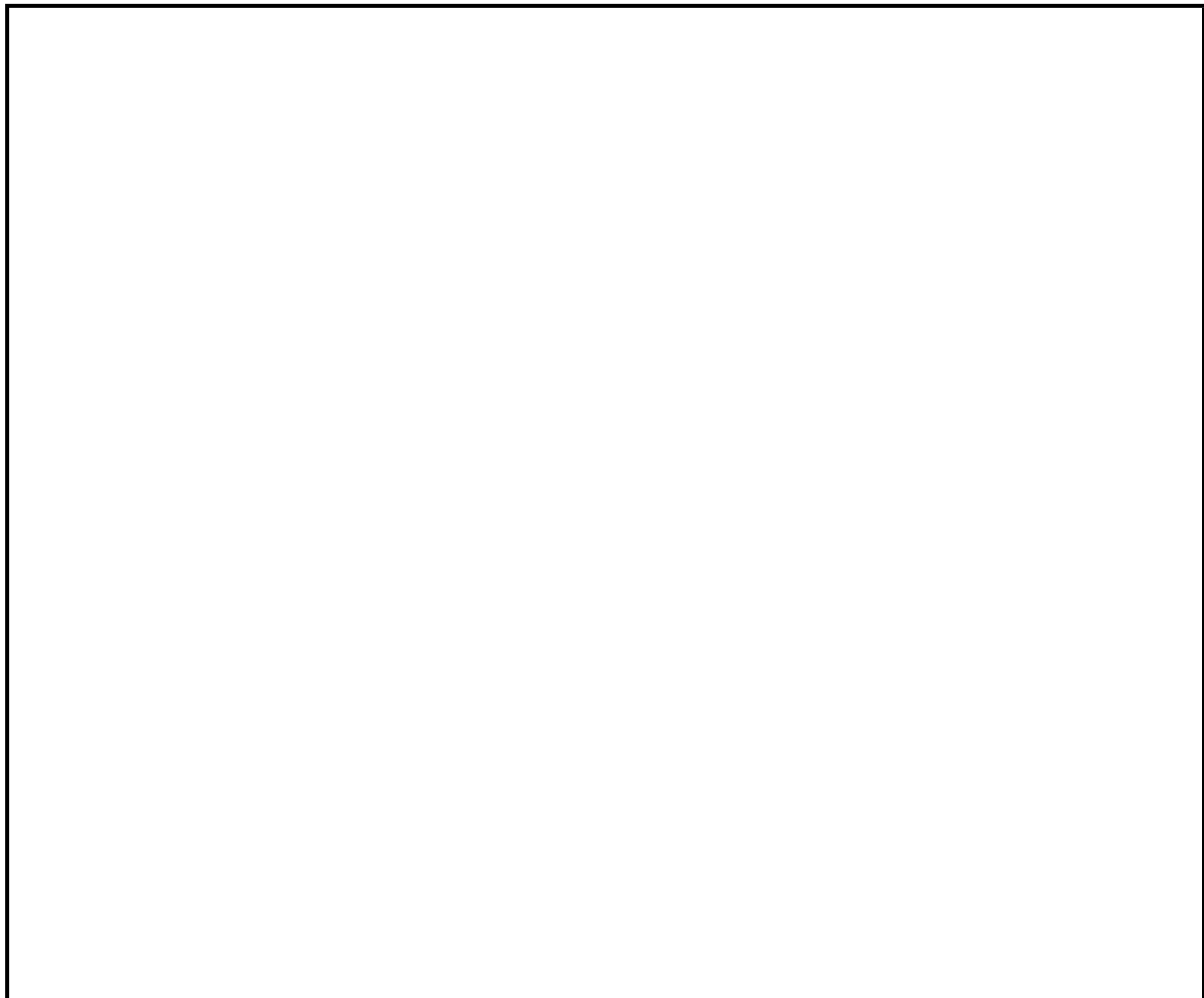


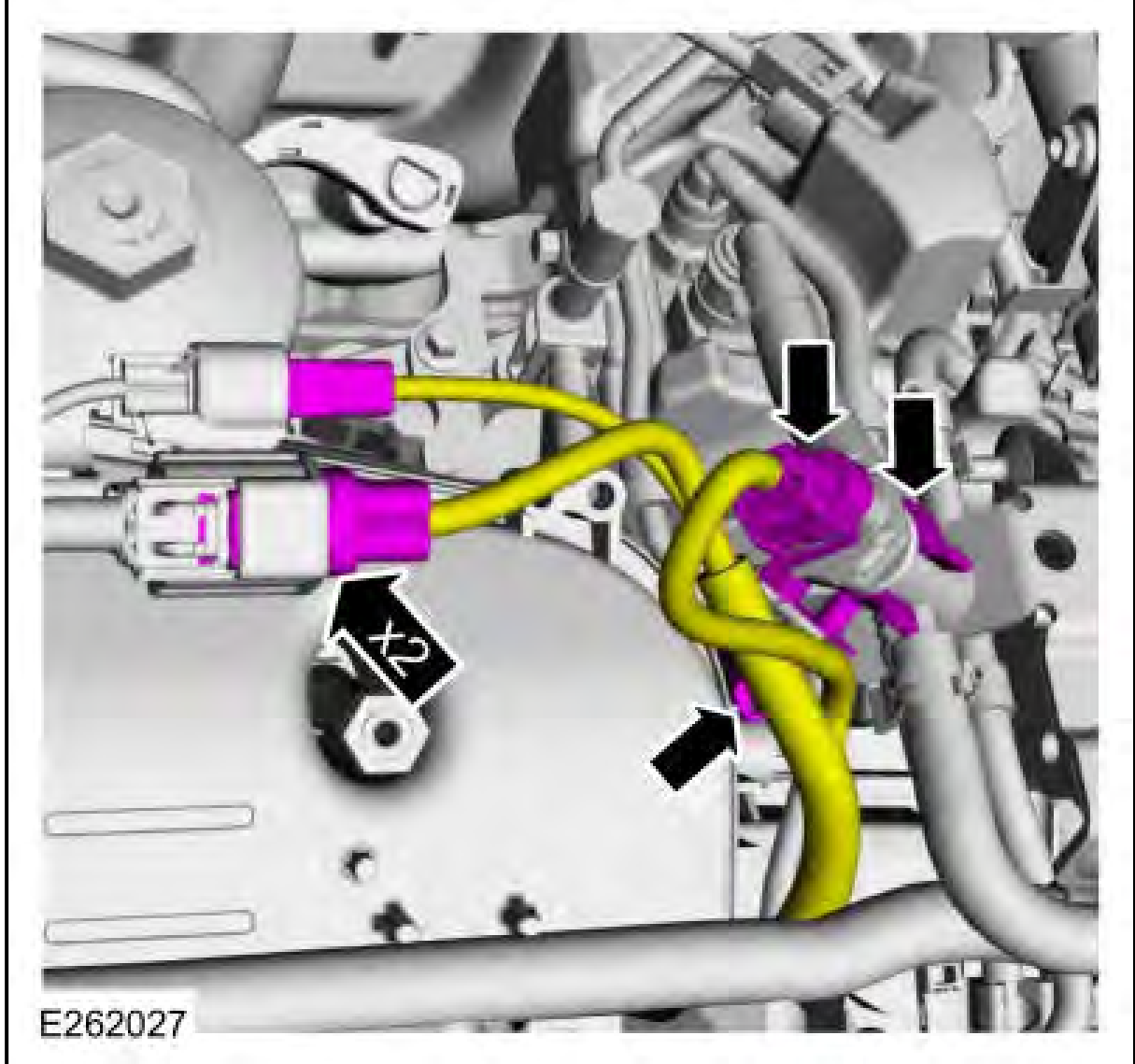
23. Disconnect the fuel injectors electrical connectors and the wire retainers.



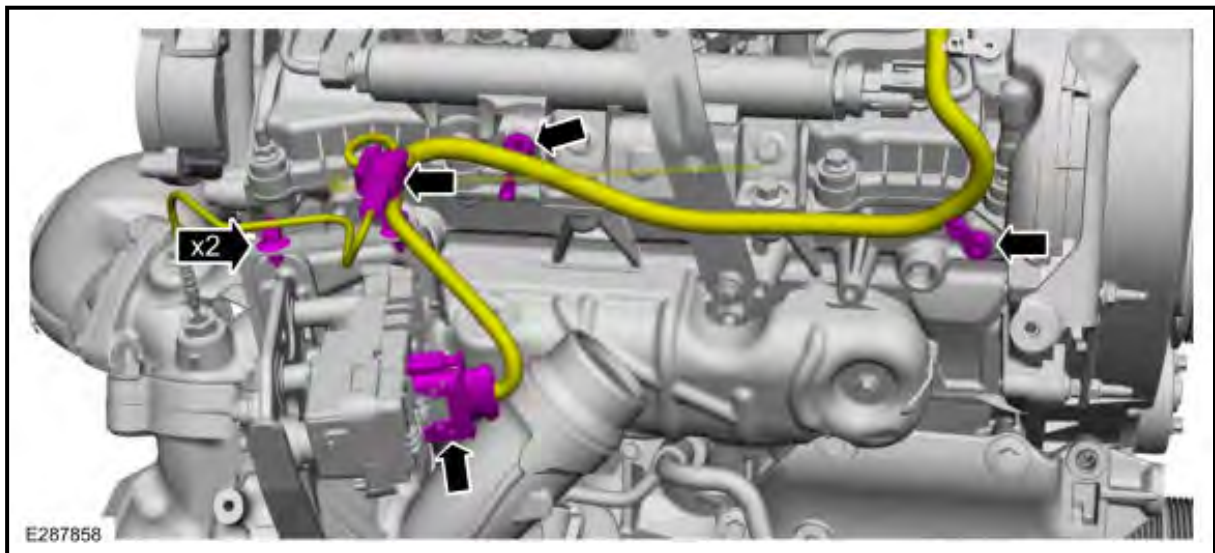


24. Disconnect the electrical connectors and the wire retainer.



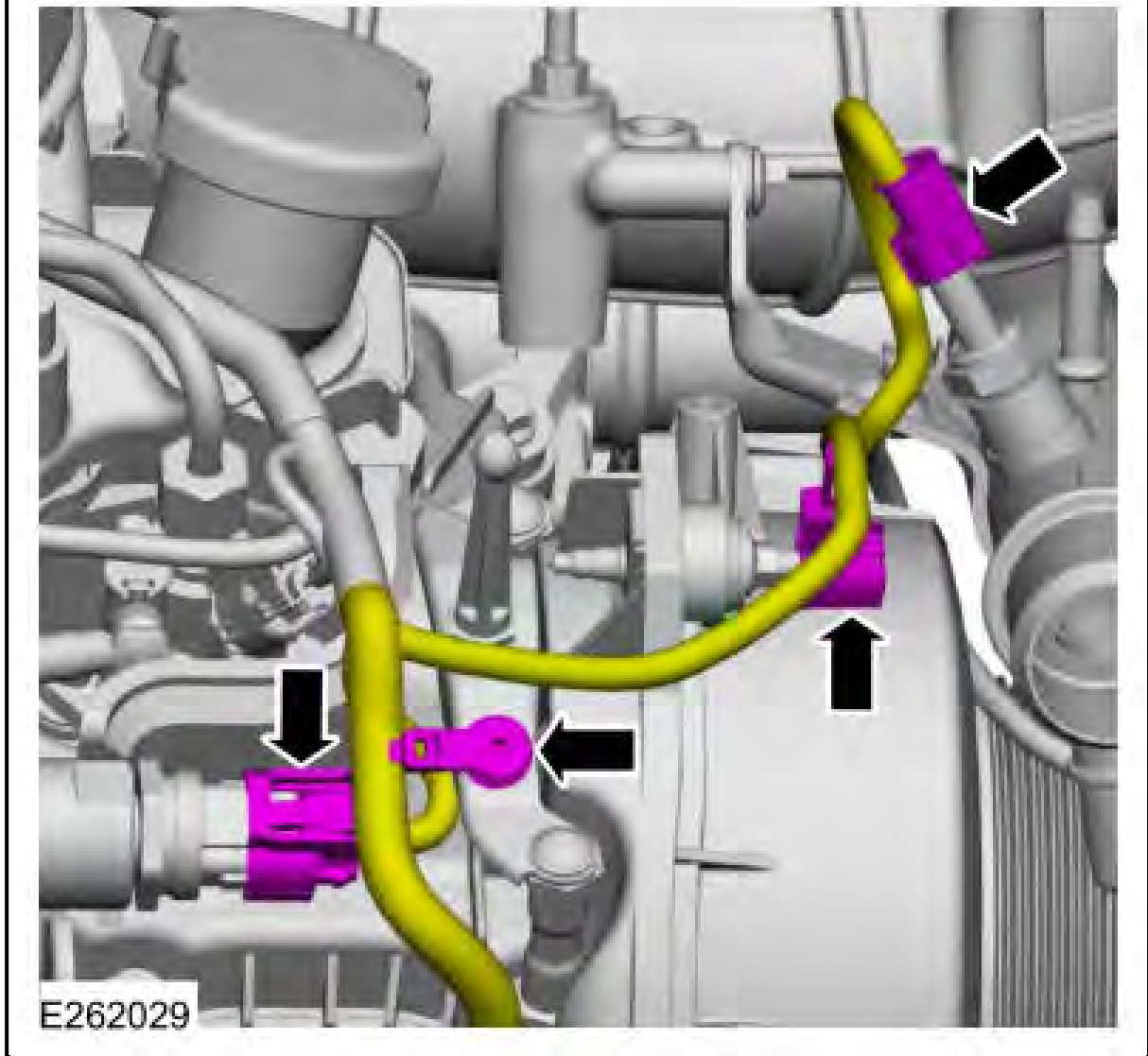


25. Disconnect the turbocharger actuator electrical connector. Disconnect the EGRT electrical connector and the wire retainers.

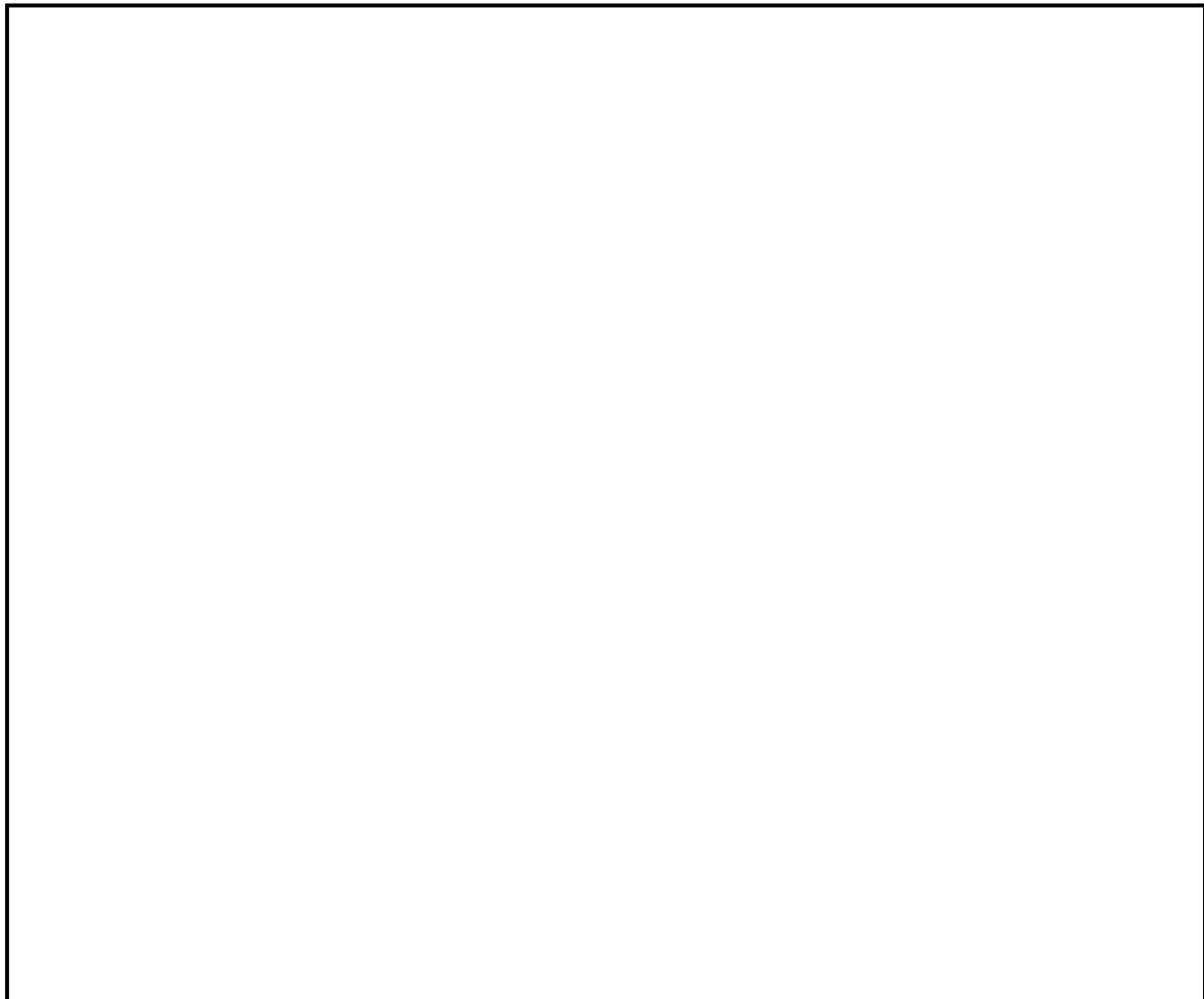


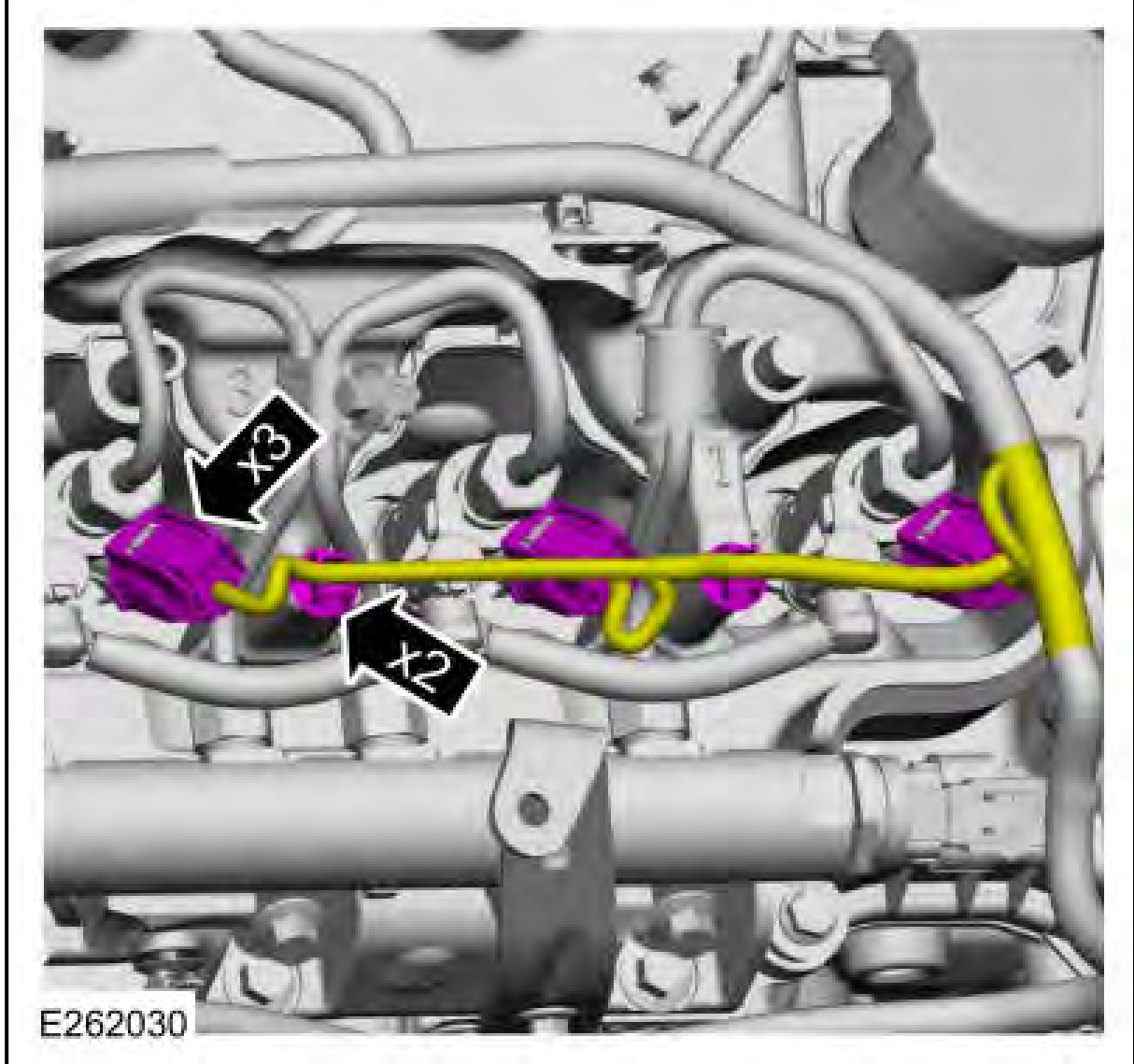
26. Disconnect the electrical connectors and the wire retainers.



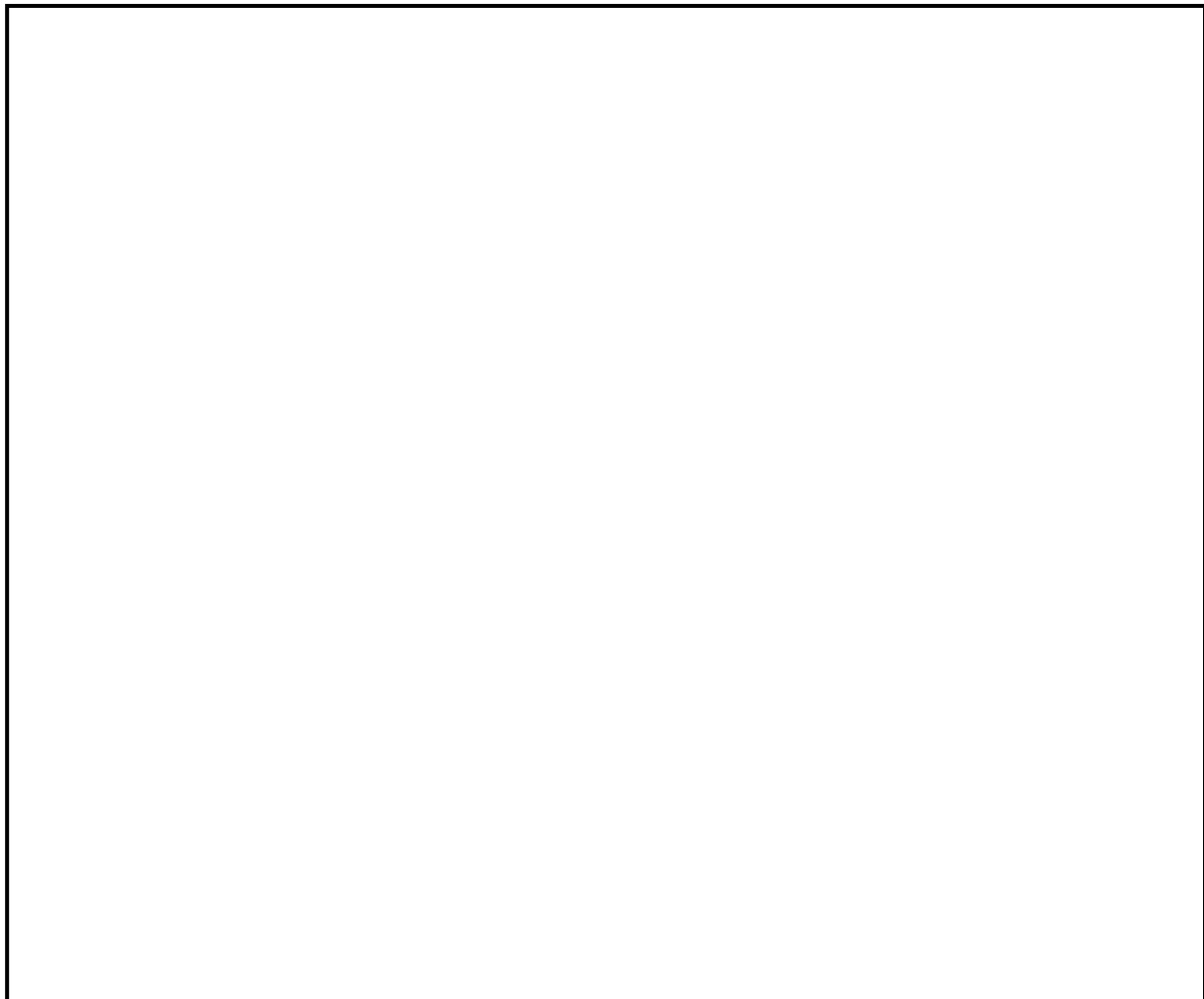


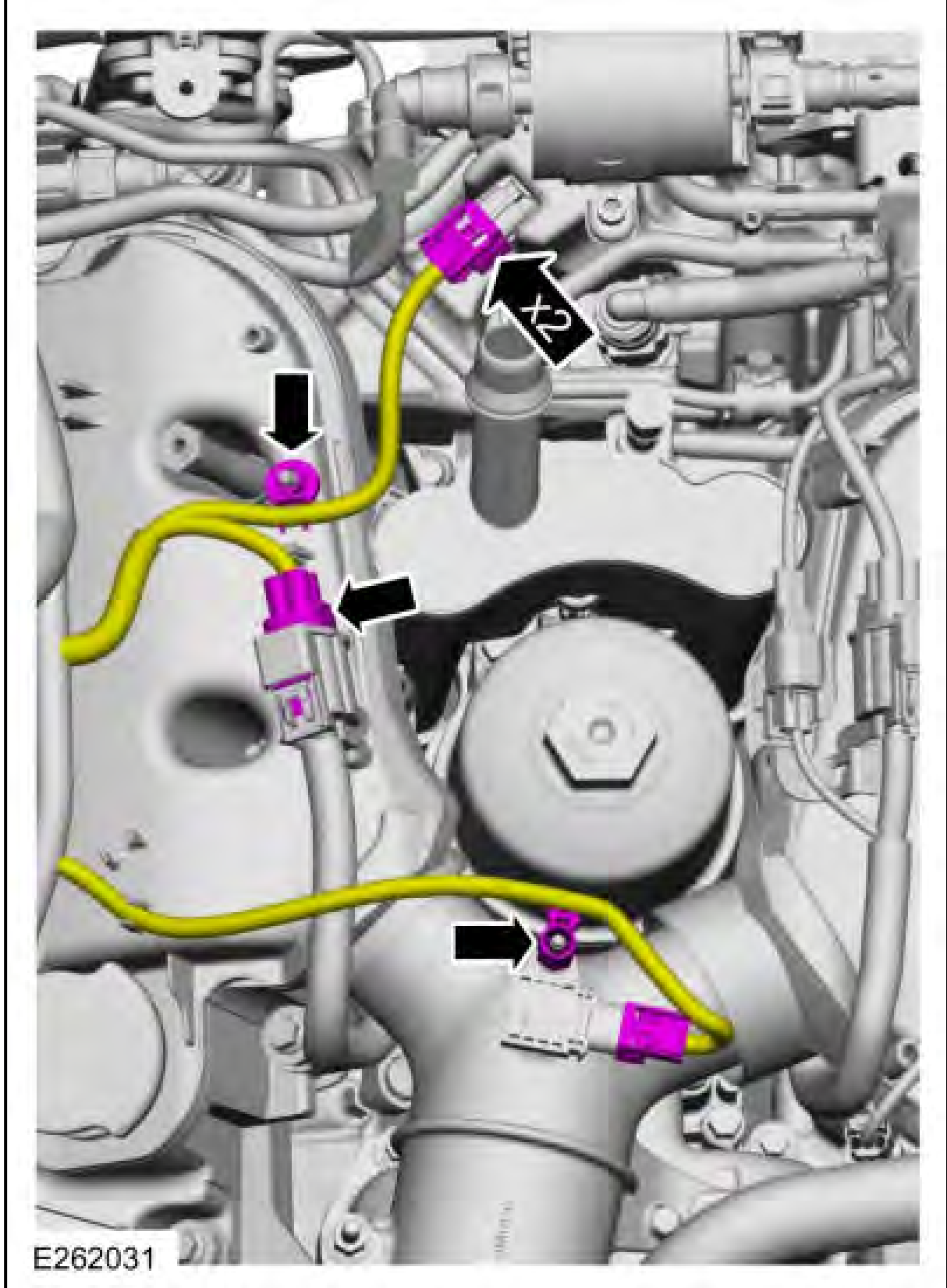
27. Disconnect the fuel injectors electrical connectors and the wire retainers.





28. Disconnect the electrical connectors and the wire retainers.

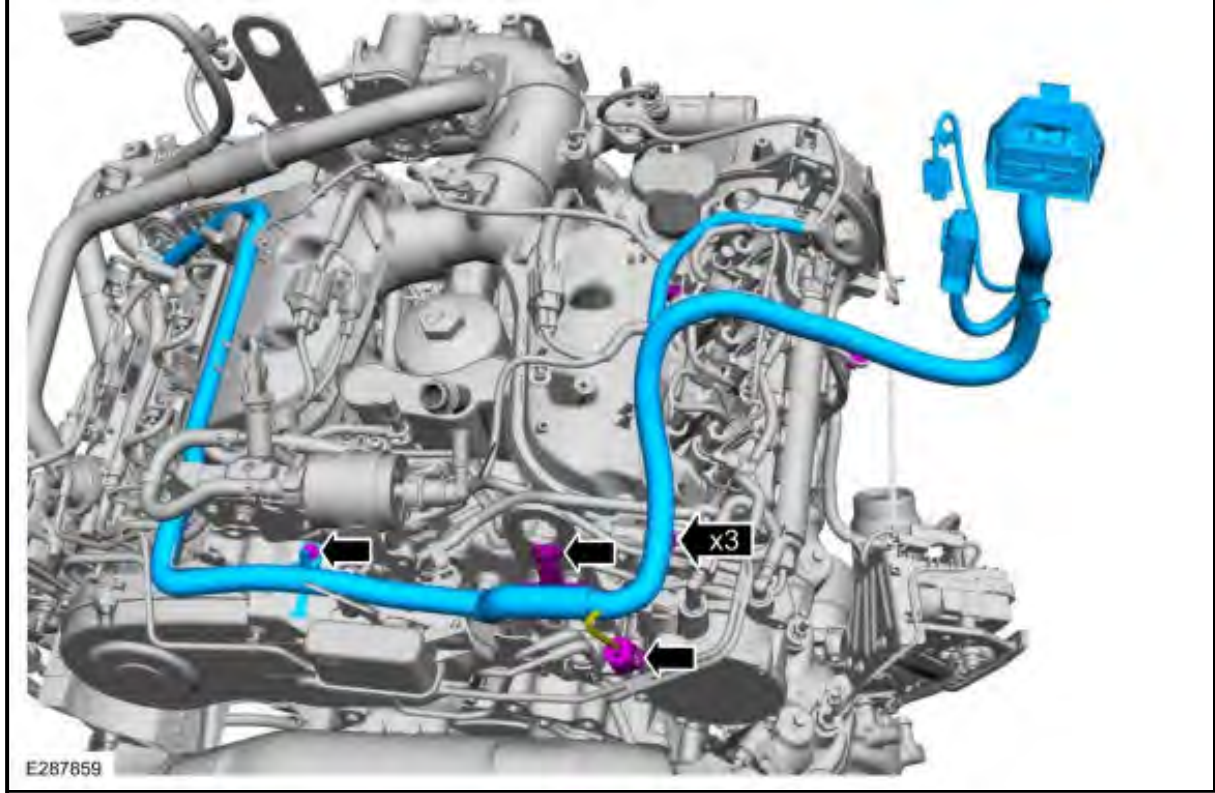




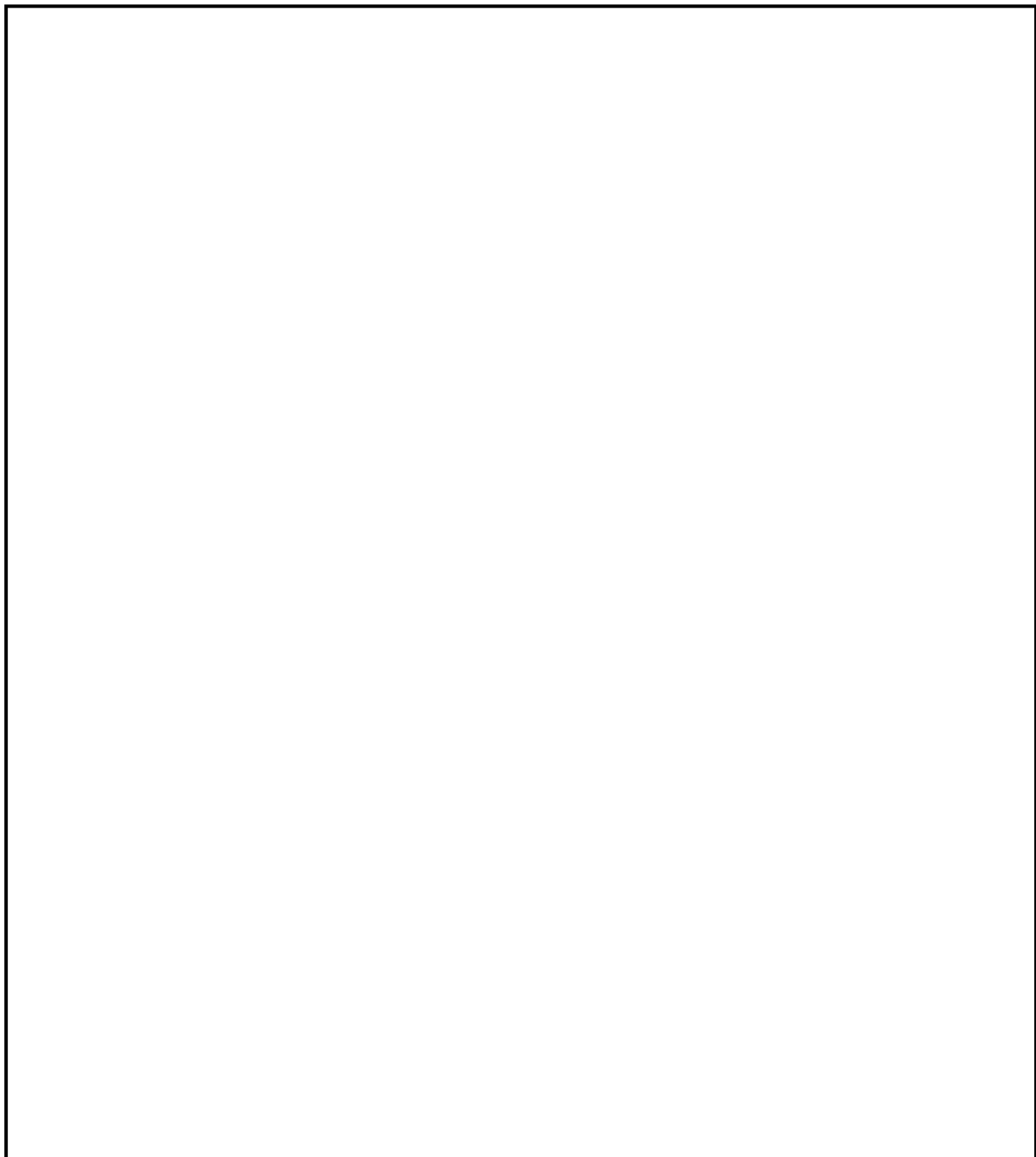
29. Disconnect the electrical connector and remove the bolt. Disconnect the wire harness retainers and remove the engine wire harness.

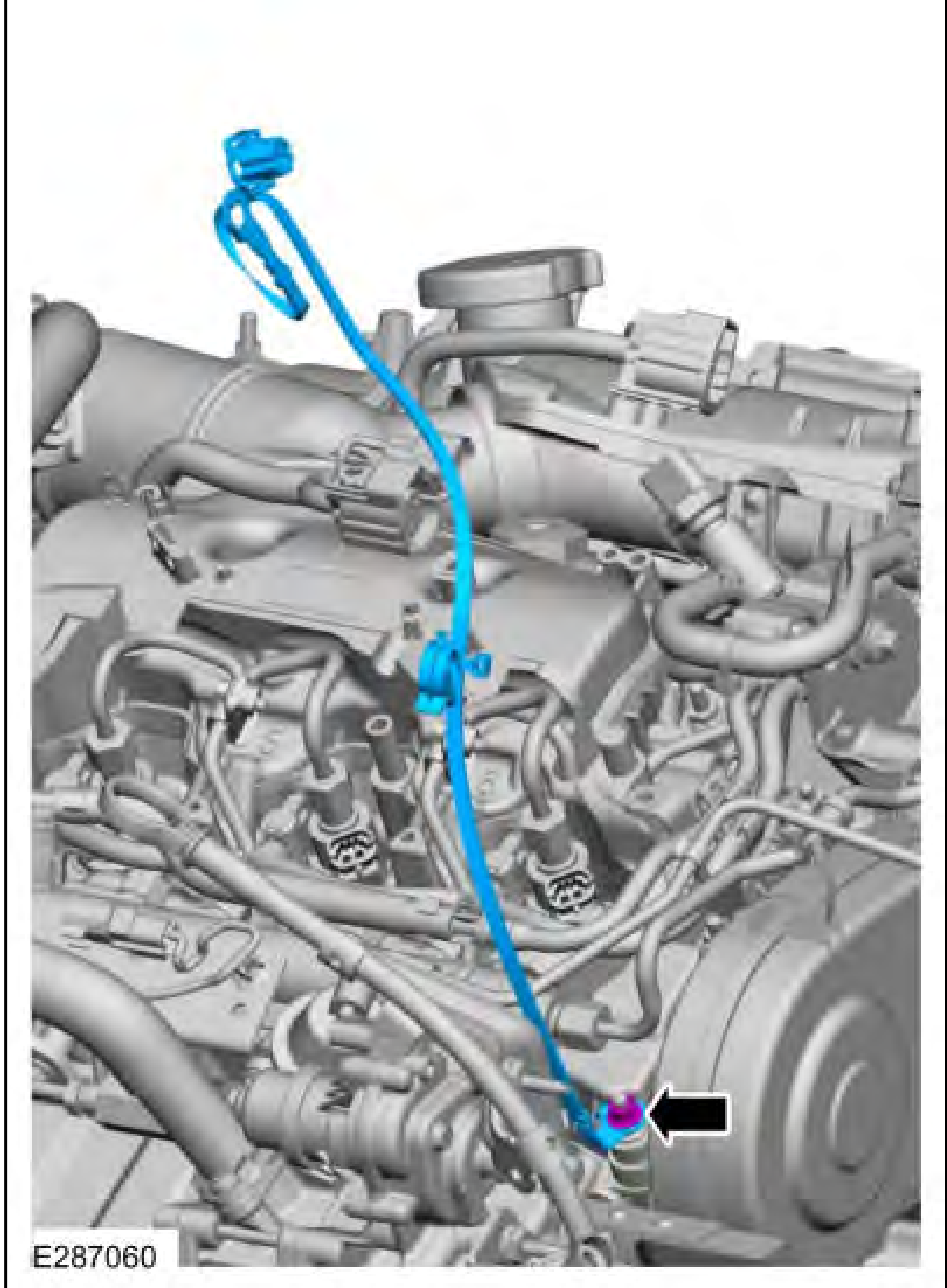




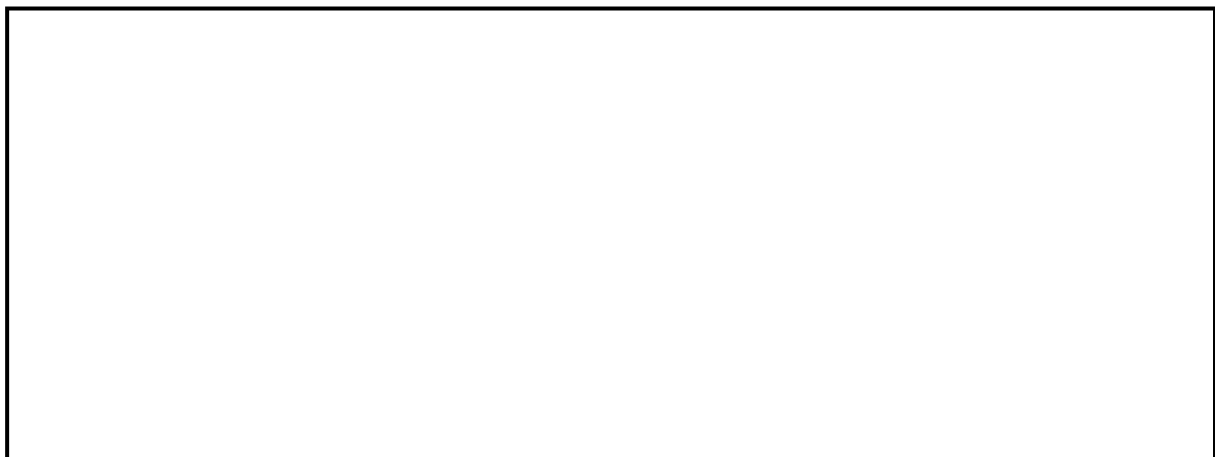


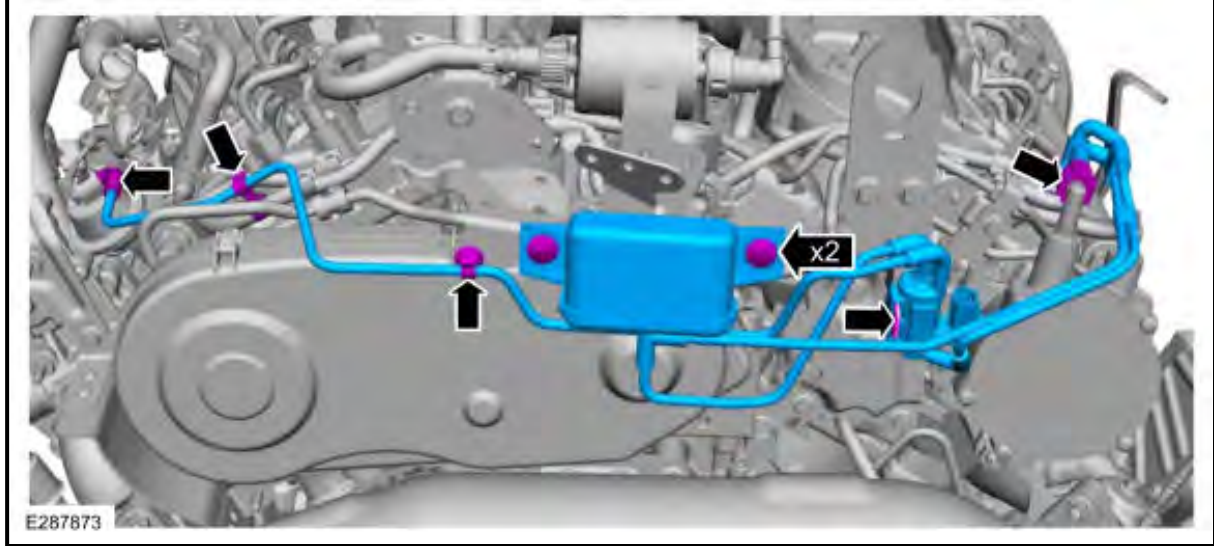
30. Remove the nut and the ground strap.



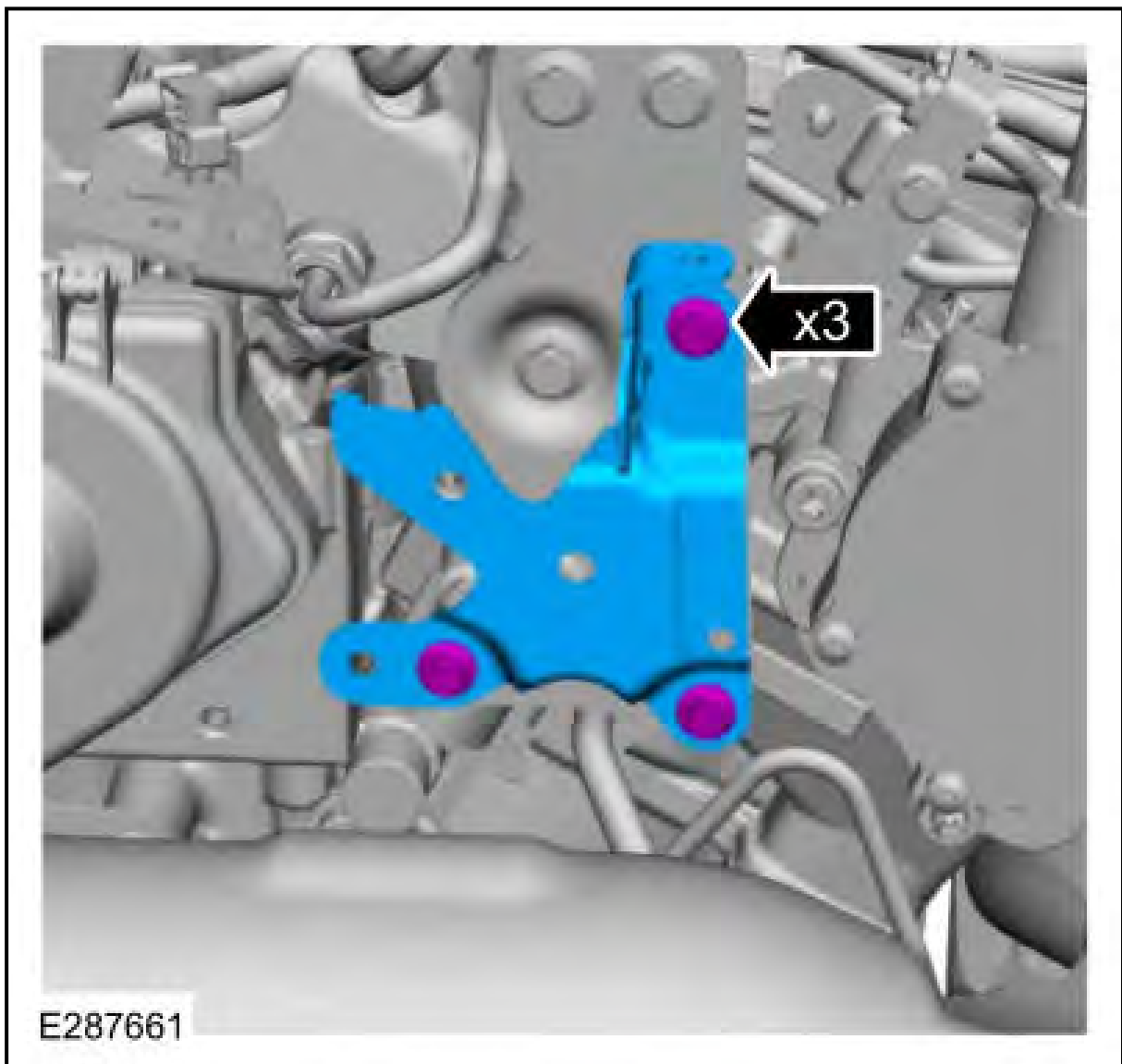


31. Disconnect the vacuum pump connector. Remove the retainers and remove the vacuum hose assembly. Refer to: [Quick Release Coupling](#) .



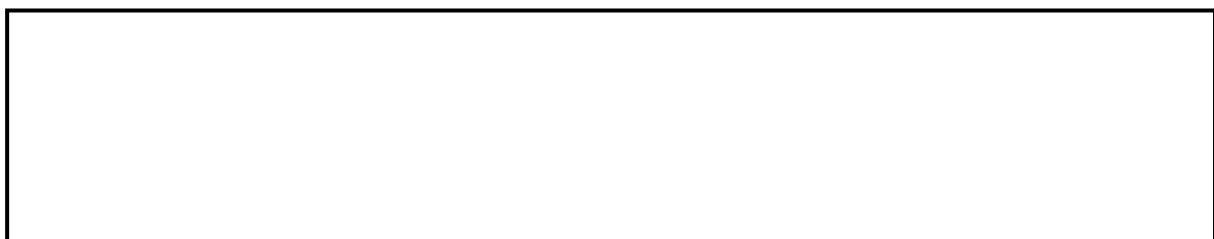


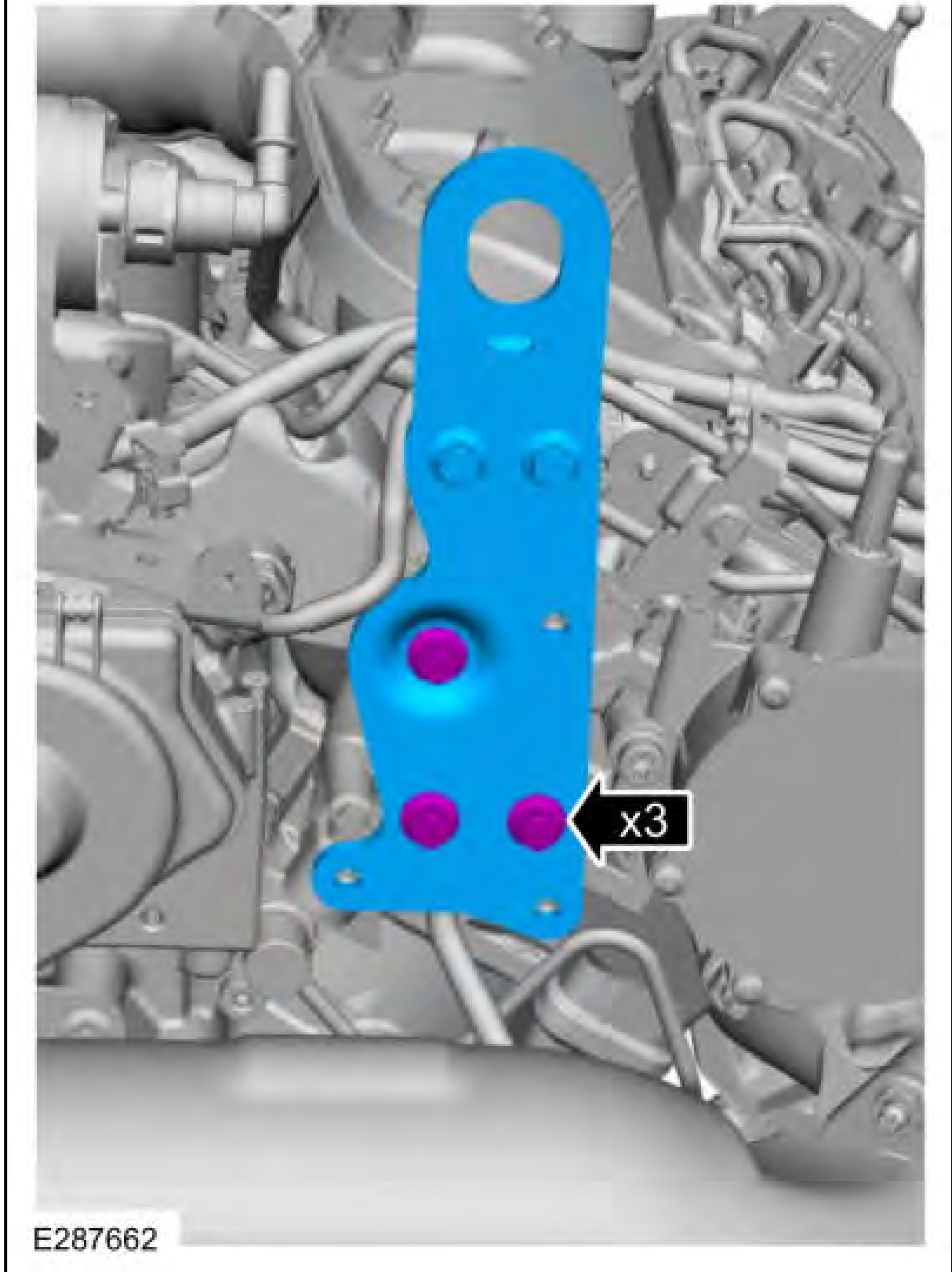
32. Remove the bolts and the valve bracket.



33. **NOTE:** If the engine was removed Body On, the lifting bracket will have a special tool bolted on.

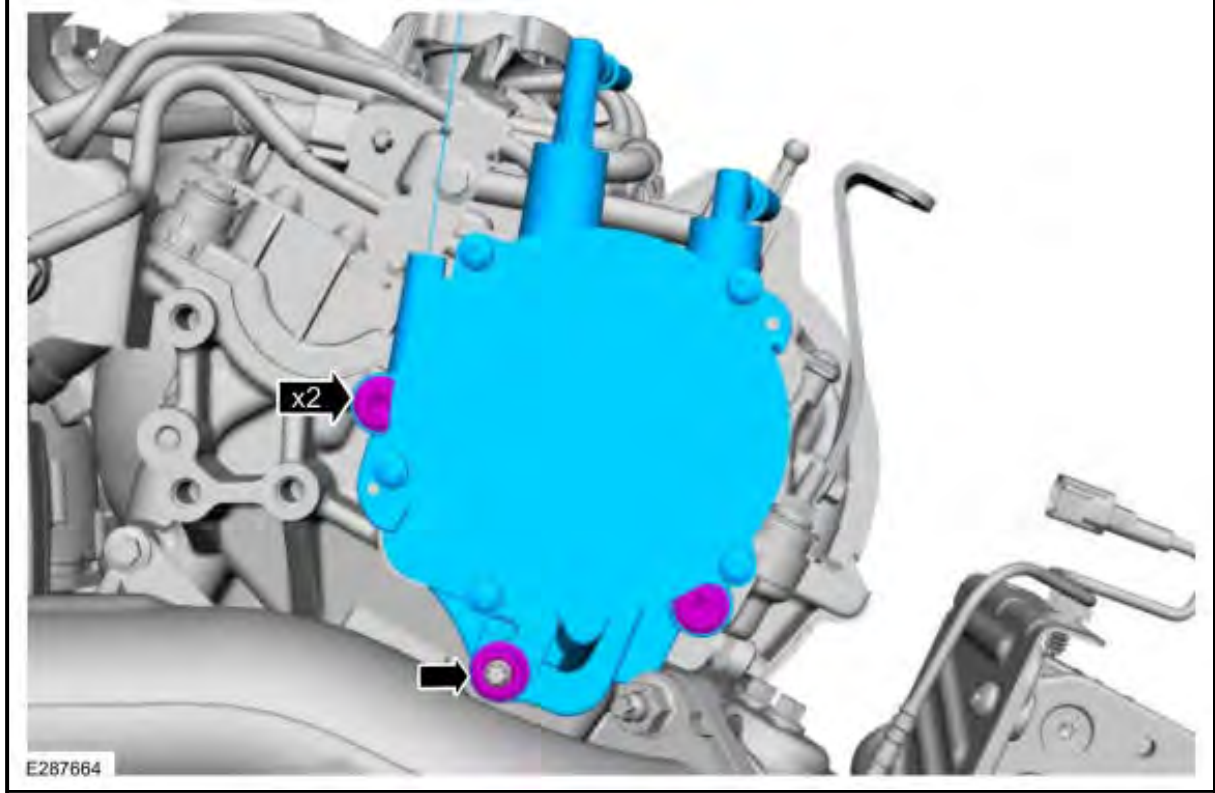
Remove the bolts and the lifting bracket.



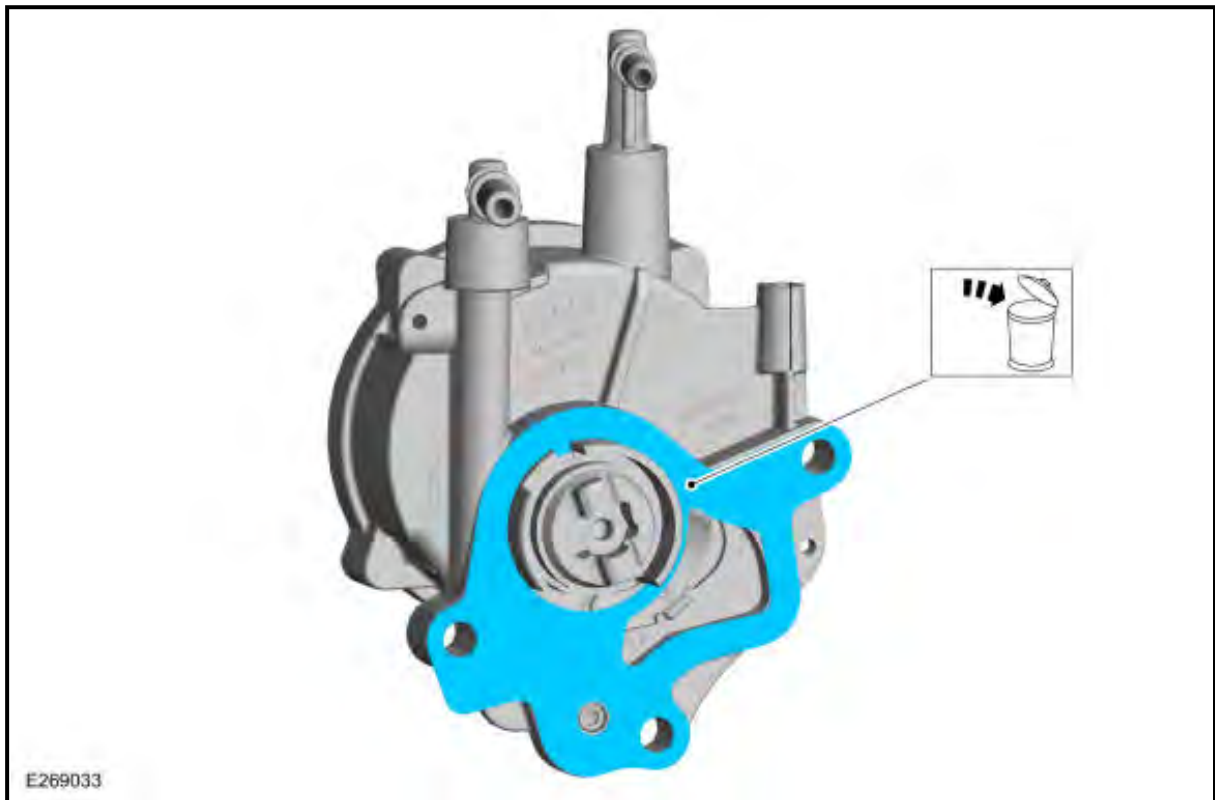


34. Remove the retainers and the vacuum pump.





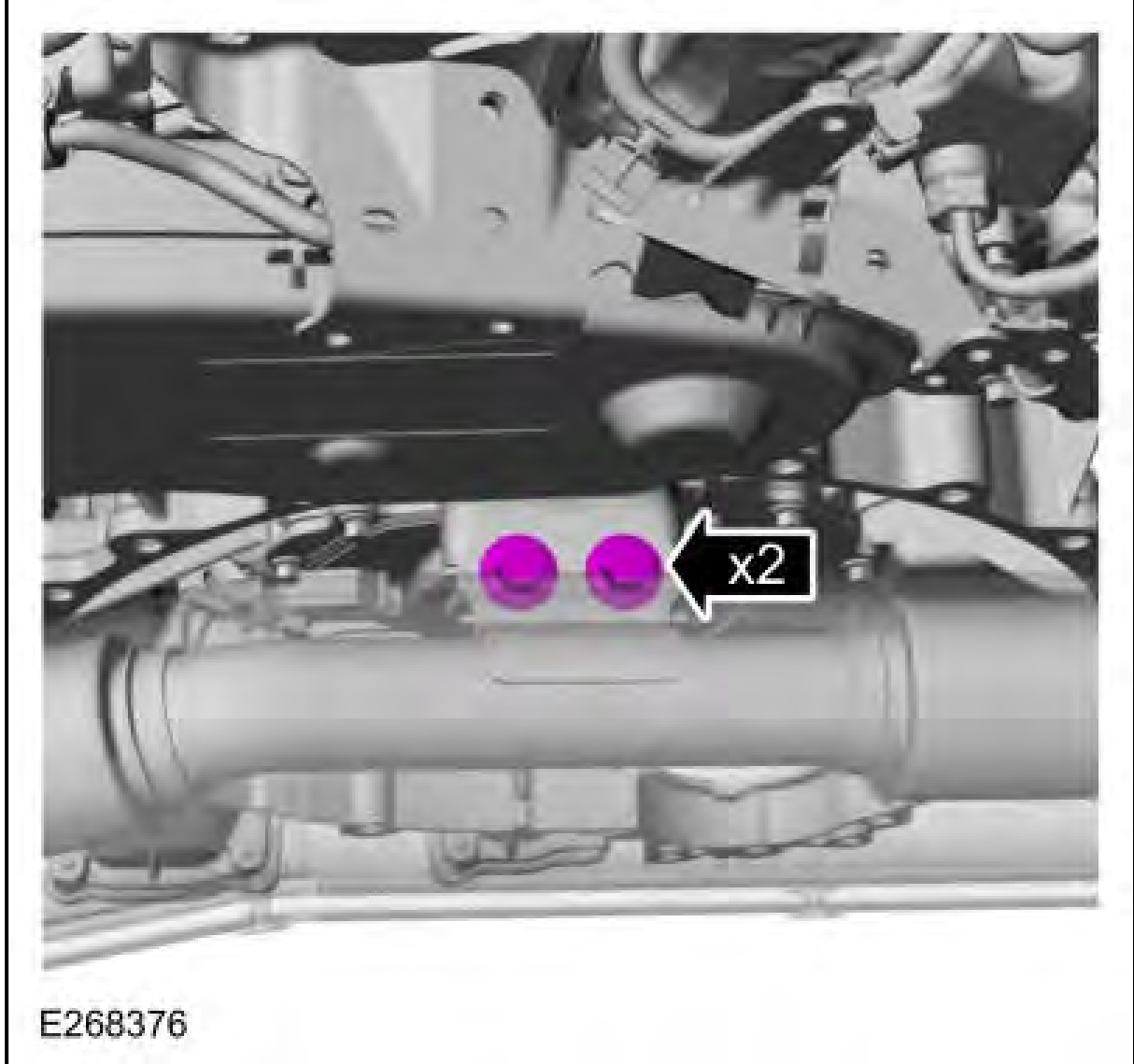
35. Remove and discard the vacuum pump gasket.



36. **NOTE:** If any snaps become undone on the exhaust crossover pipe wrap. Replace the exhaust crossover pipe wrap.

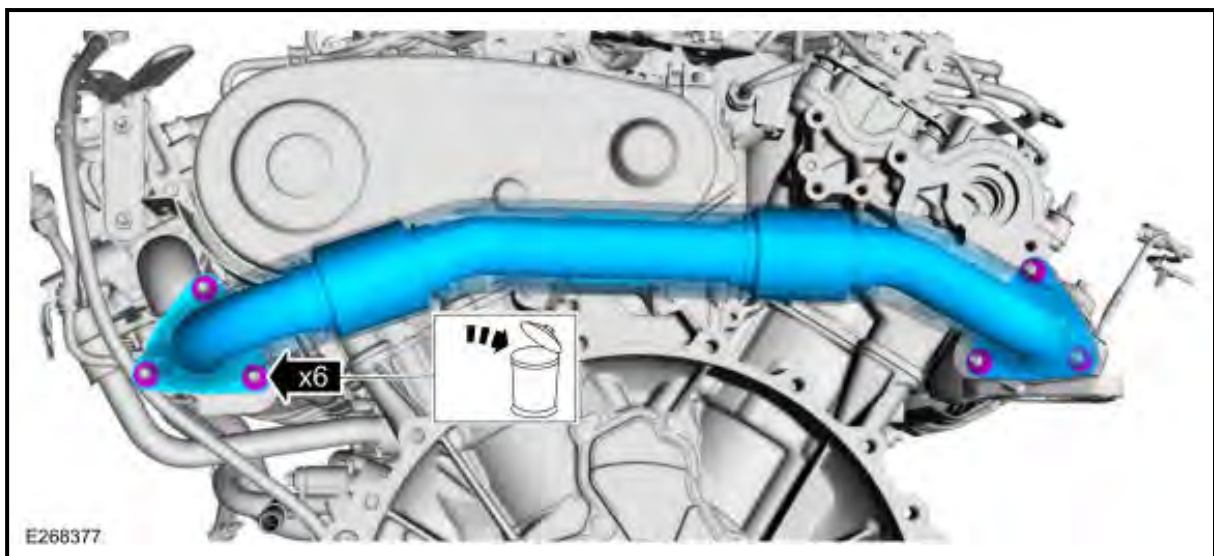
Remove the bolts for the exhaust crossover pipe.





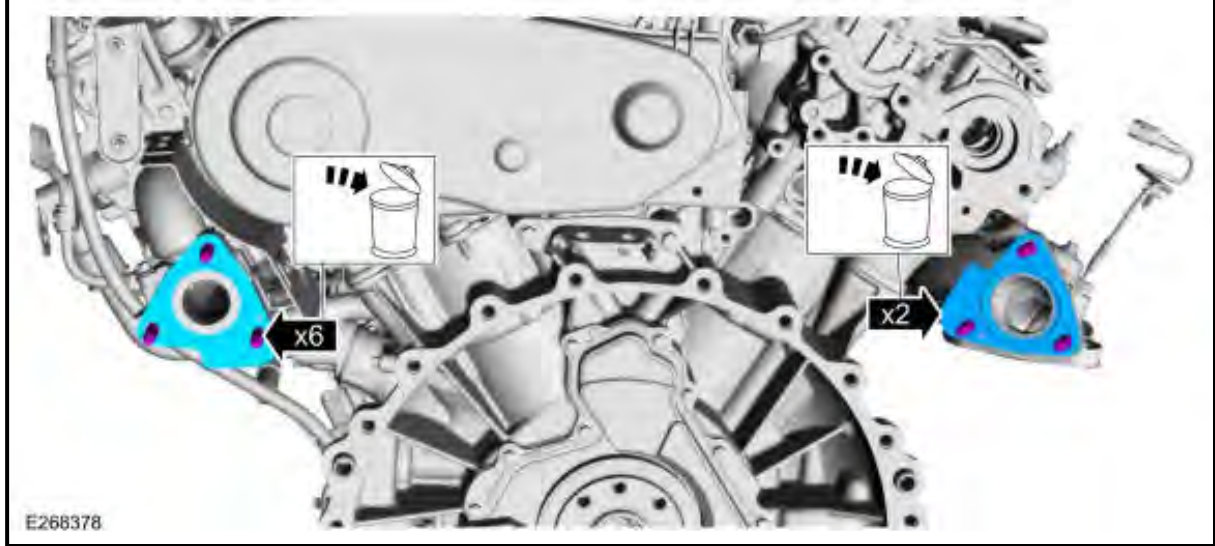
37. **NOTE:** If any snaps become undone on the exhaust crossover pipe wrap. Replace the exhaust crossover pipe wrap.

Remove the nuts and the exhaust crossover pipe. Discard the nuts.

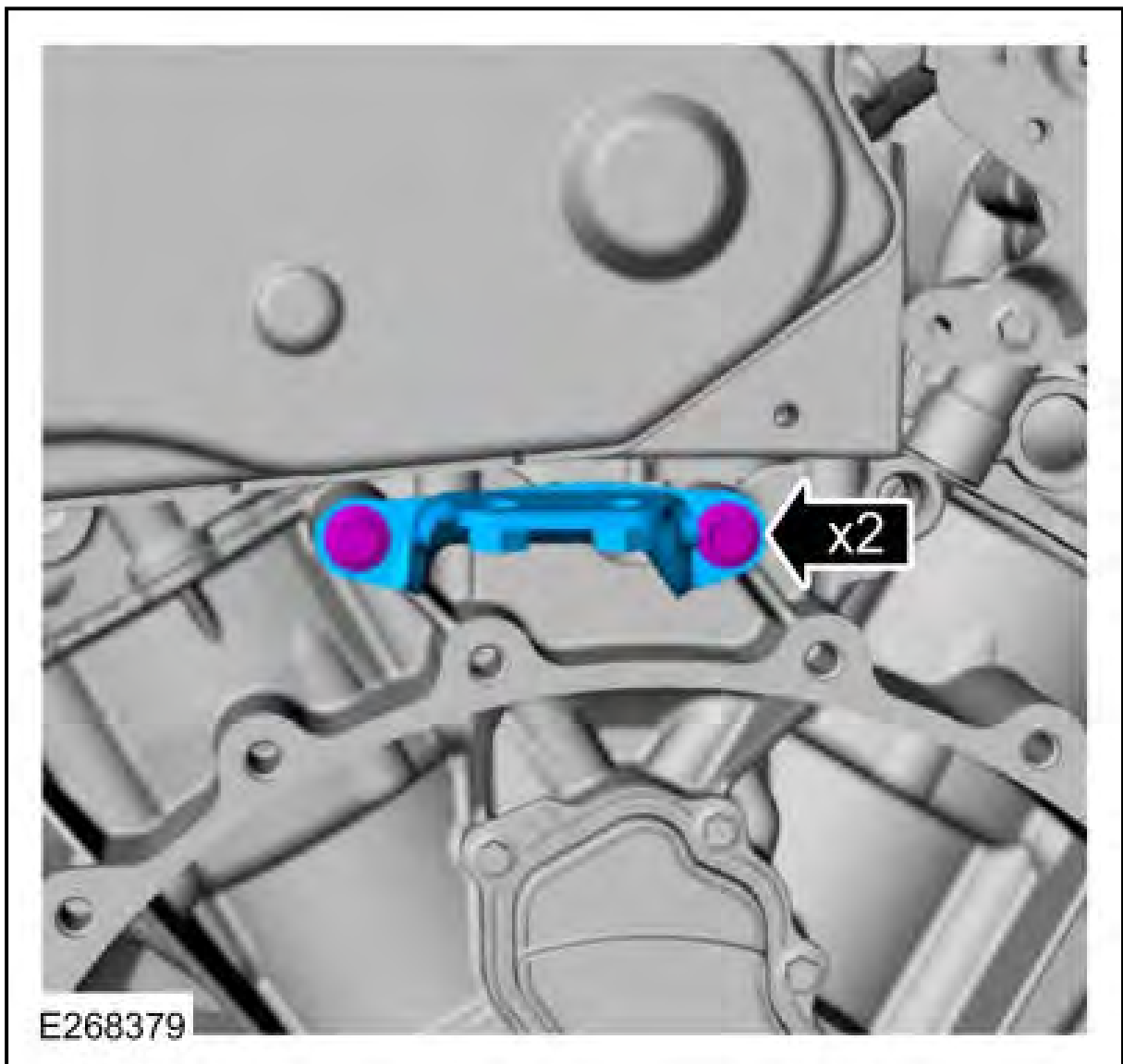


38. Remove and discard the exhaust crossover pipe gaskets and the studs.



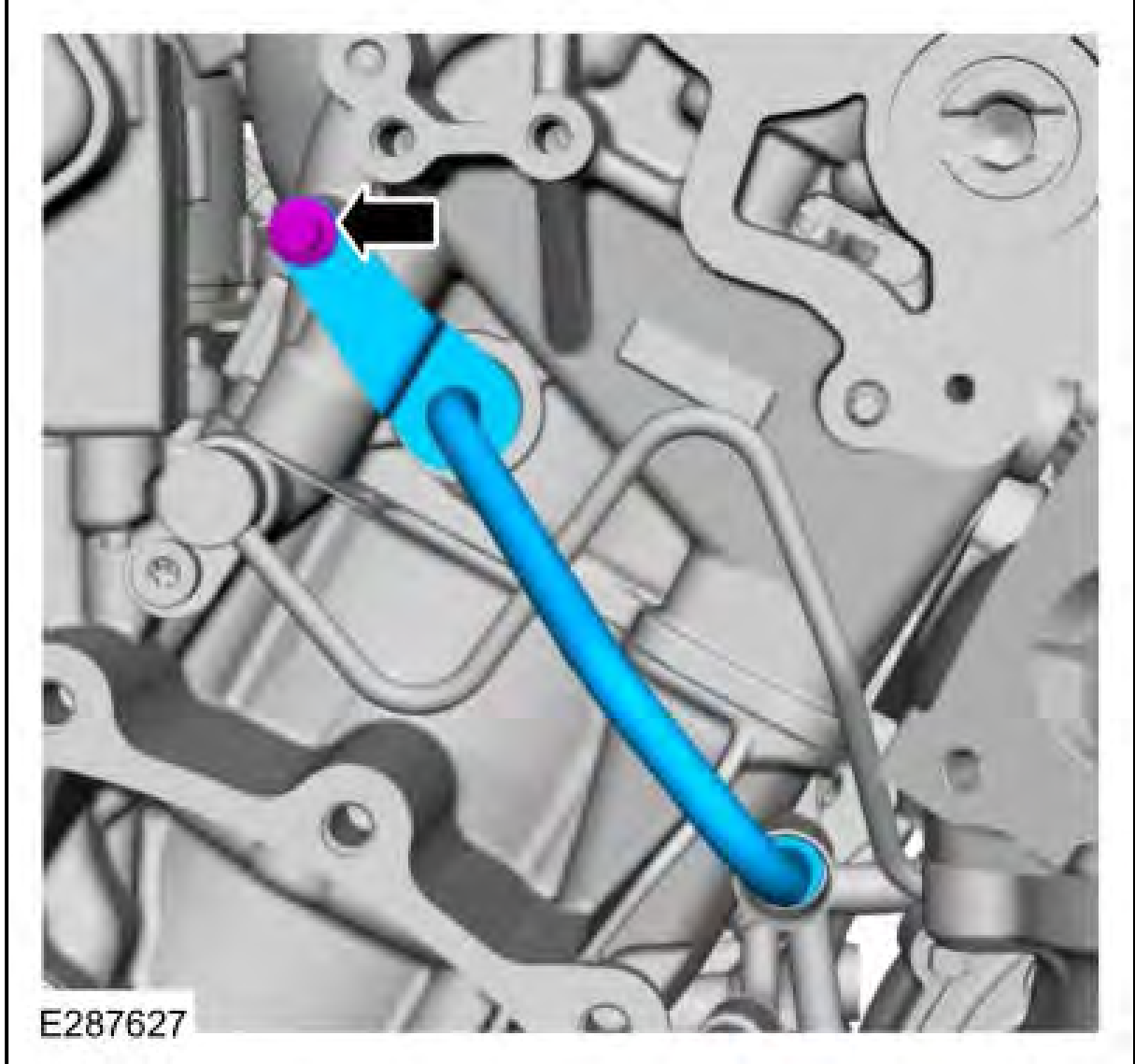


39. Remove the bolts and the exhaust crossover pipe bracket.



40. Remove the bolt and the coolant return tube.





41.

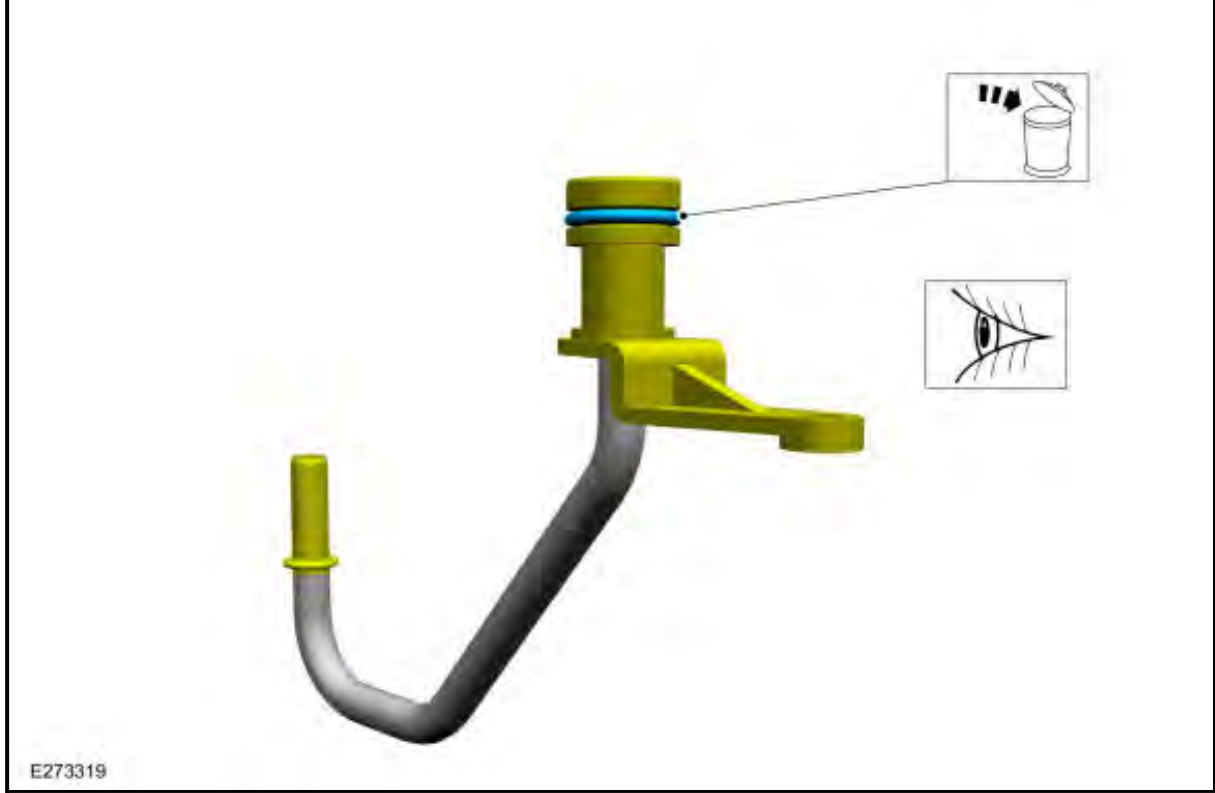
1. Remove and discard the turbocharger coolant return tube O-ring seal.
2. **NOTE:** Use brake cleaner and a nylon brush to clean. Do not use a metal brush, damage to sealing area will result in leaks.

Clean the turbocharger coolant tube sealing surfaces. Inspect the sealing surfaces for debris or damage and make sure the retaining bracket is not bent, check for squareness of the O-ring area. Install new components if needed.

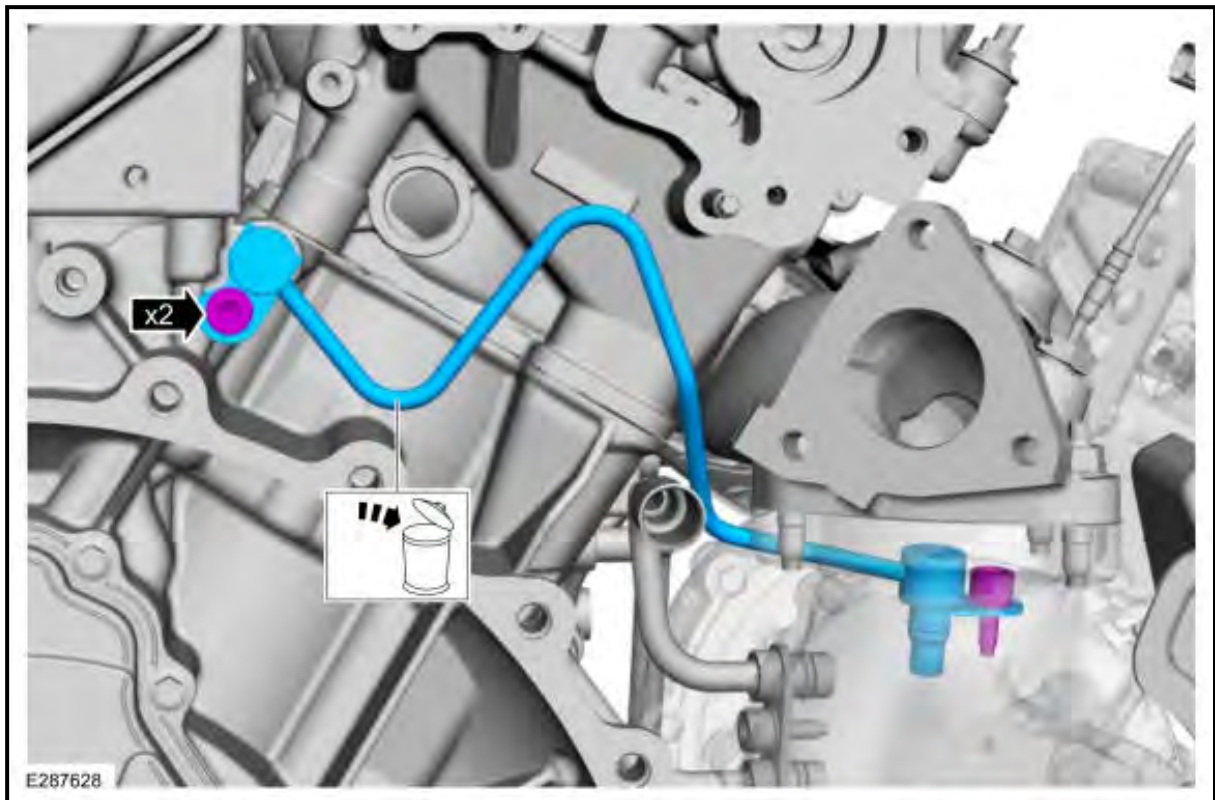
Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B





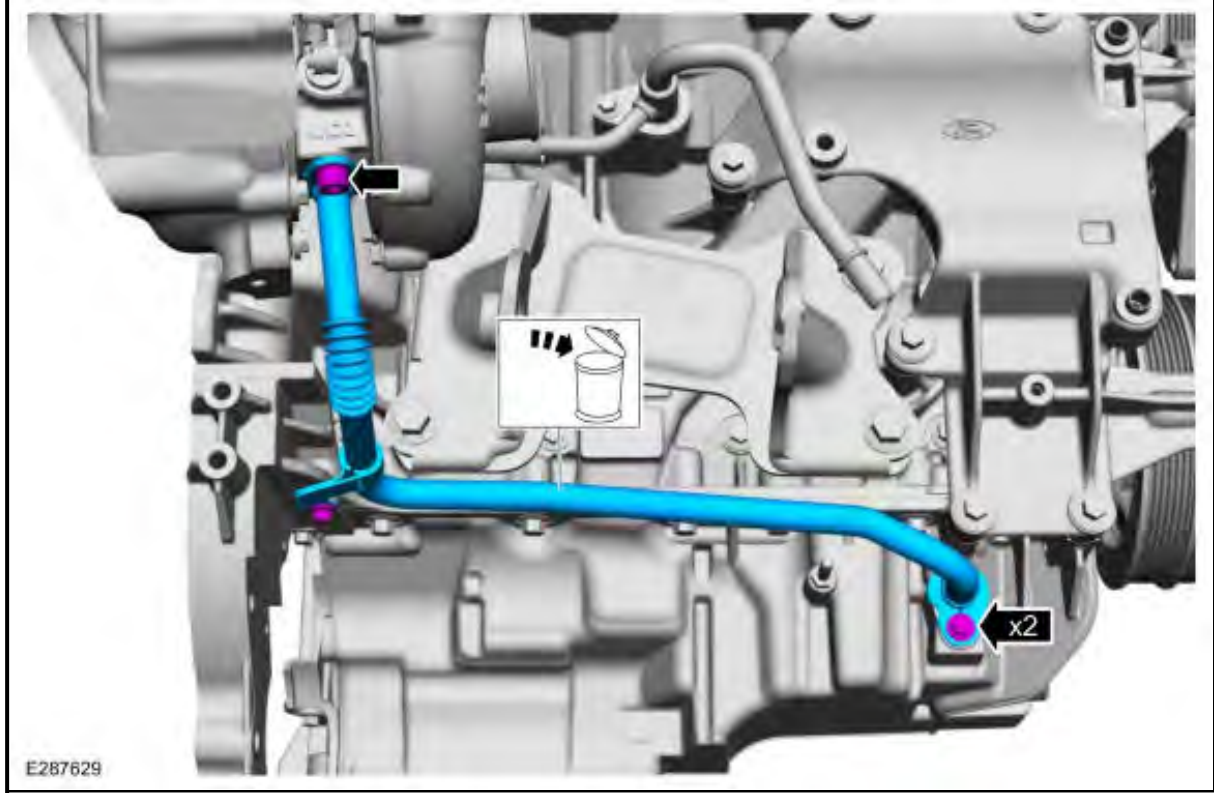


42. Remove the bolts and the turbocharger oil supply tube. Discard the turbocharger oil supply tube.

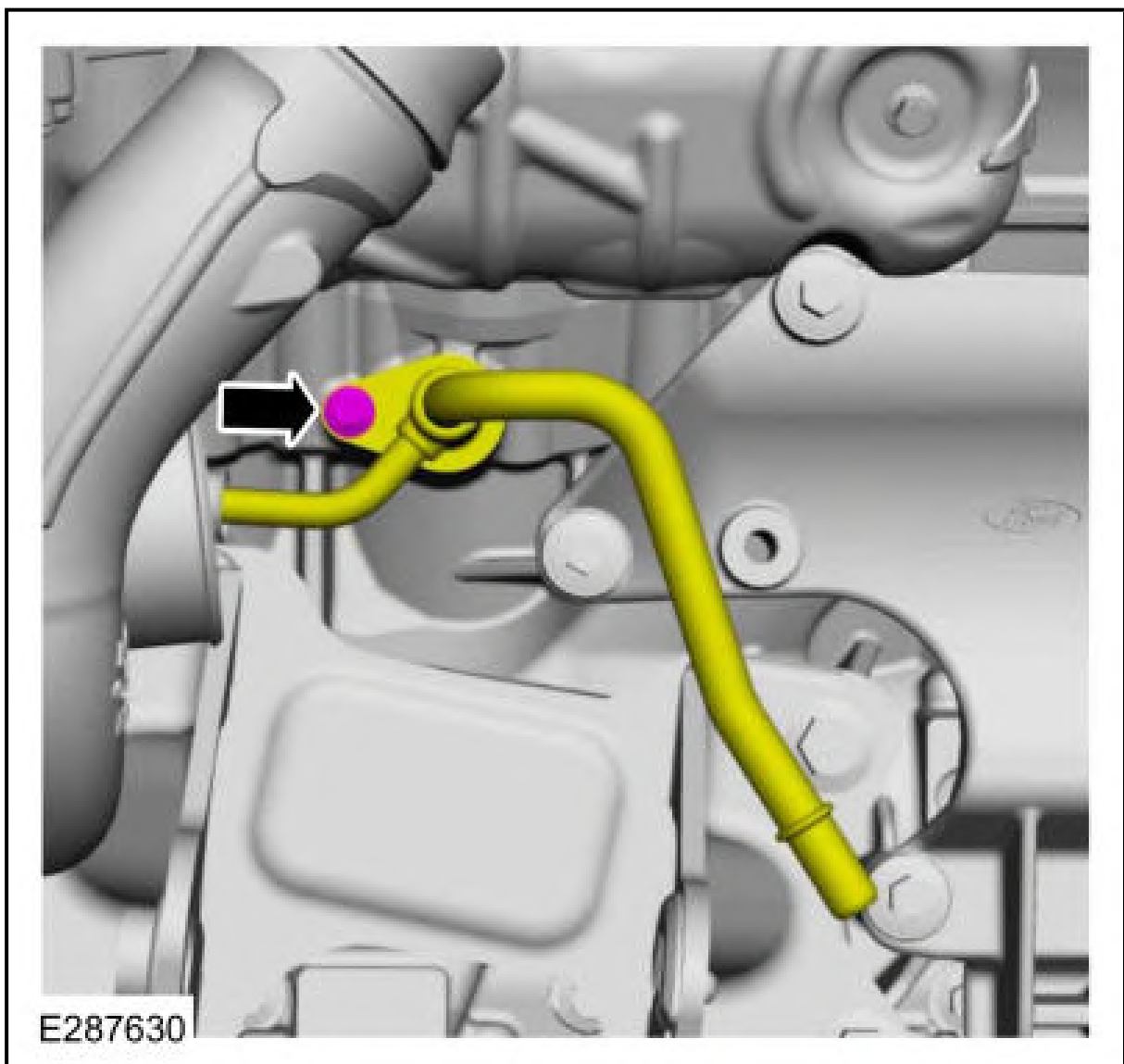


43. Remove the bolts and the turbocharger oil return tube. Discard the turbocharger oil return tube.

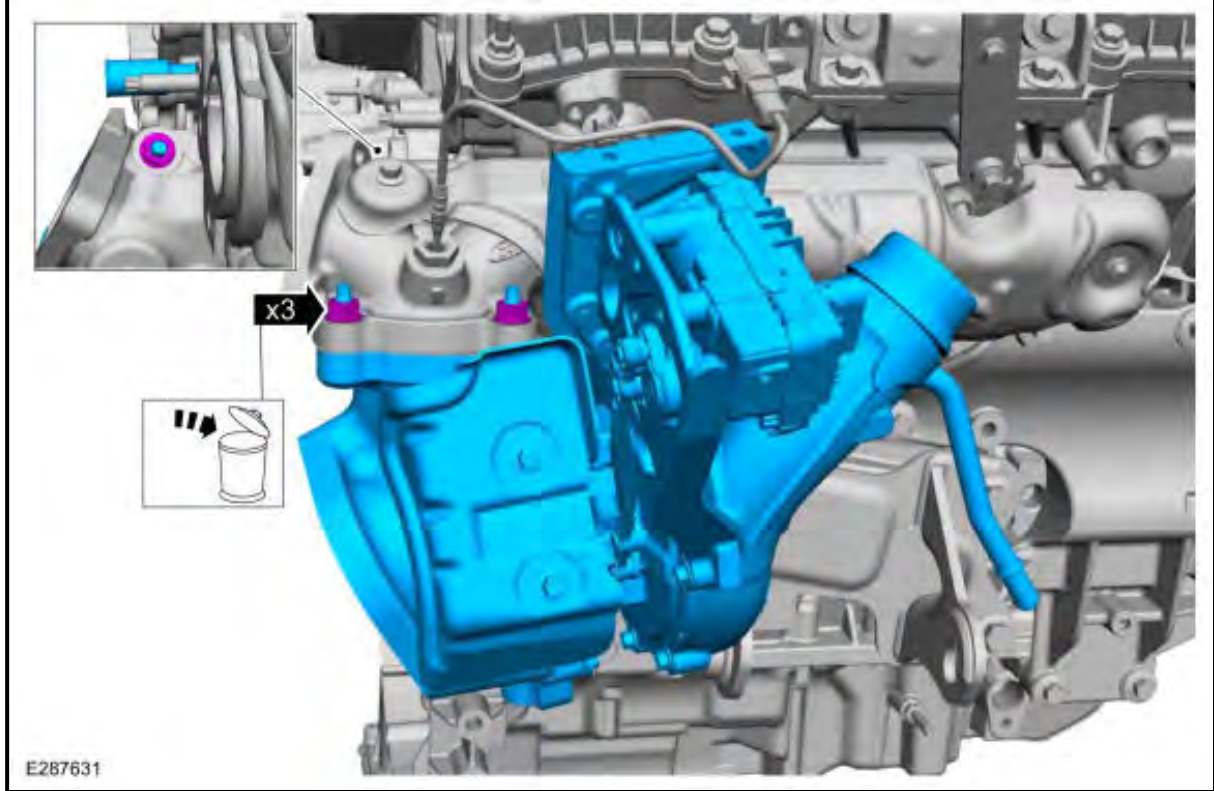




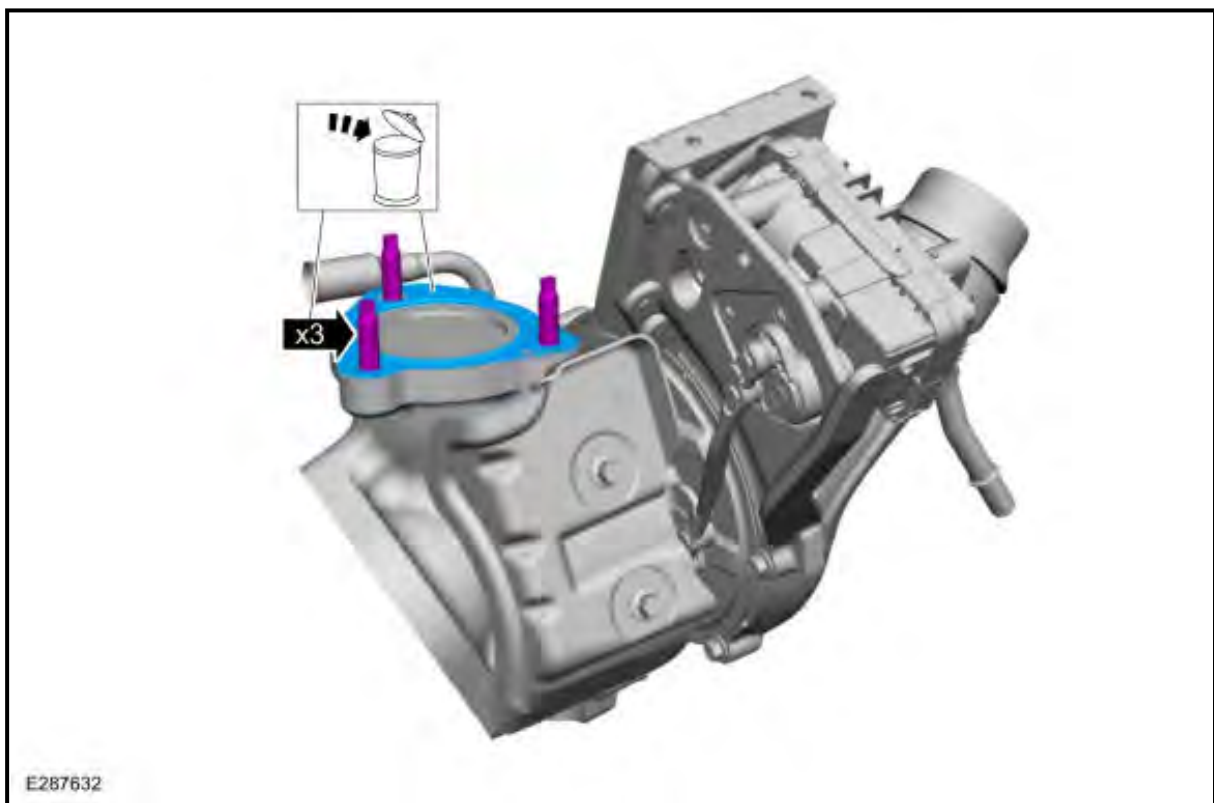
44. Remove the bolt for the turbocharger coolant supply tube. Disconnect the turbocharger coolant supply tube from the engine.



45. Remove the nuts and the turbocharger. Discard the nuts.



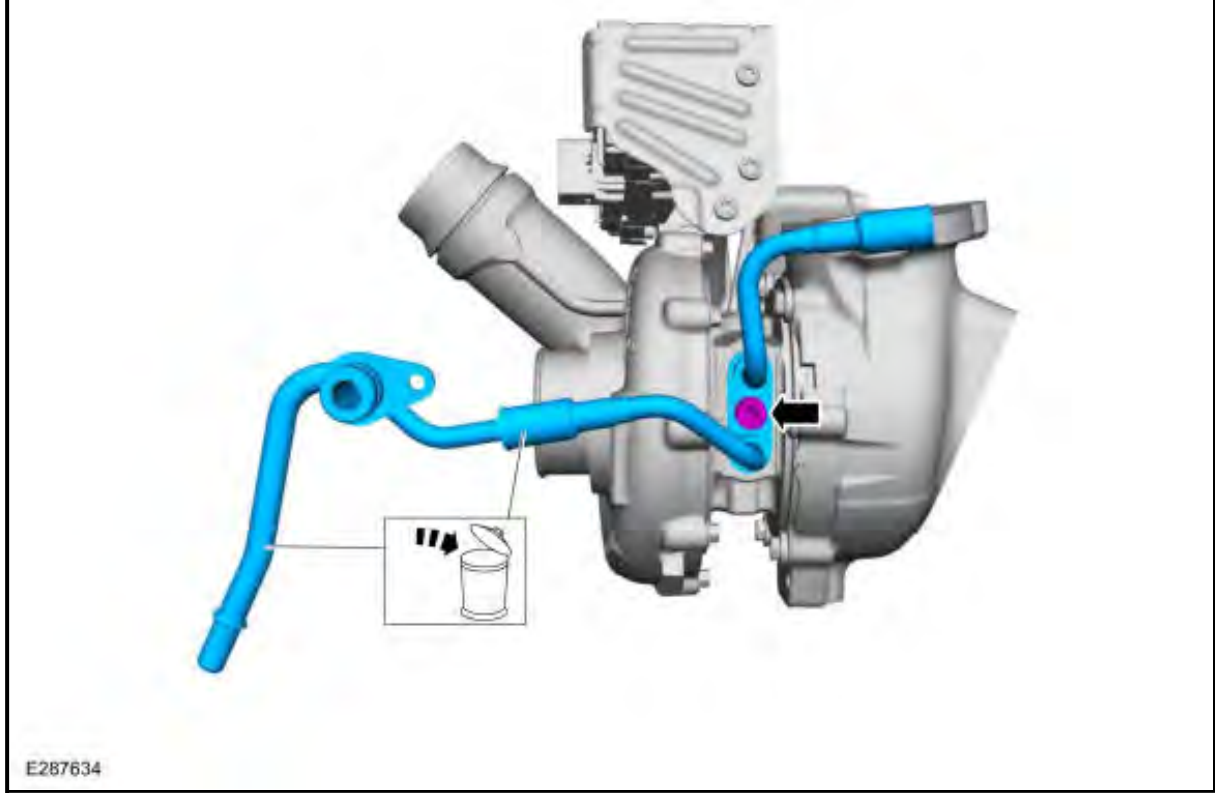
46. Remove and discard the turbocharger gasket and the studs.



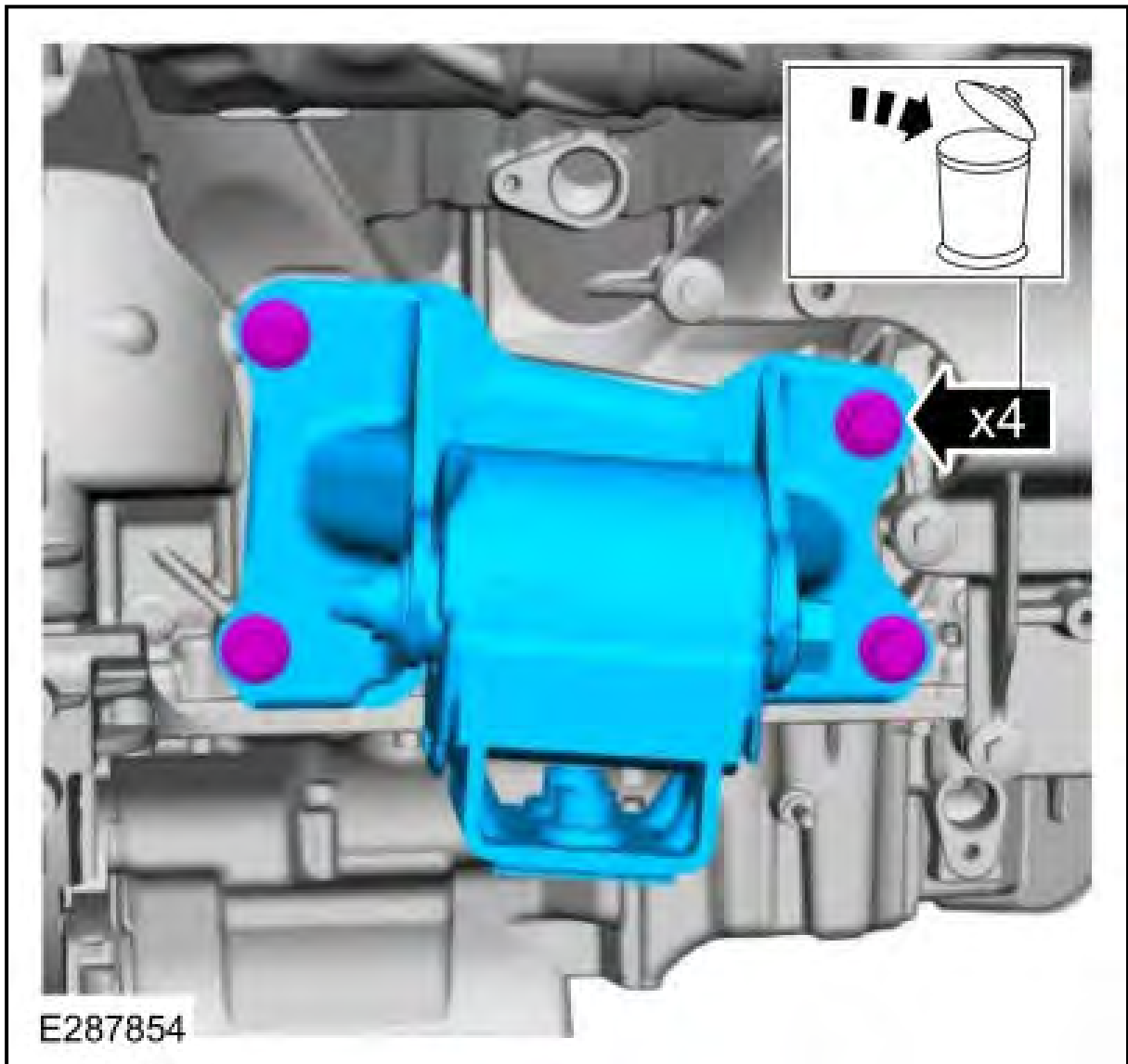
47. **NOTE:** Make note of turbocharger coolant tube manifold orientation to aid in proper installation.

Remove the bolt and the turbocharger coolant tube manifold. Discard the turbocharger coolant tube manifold.

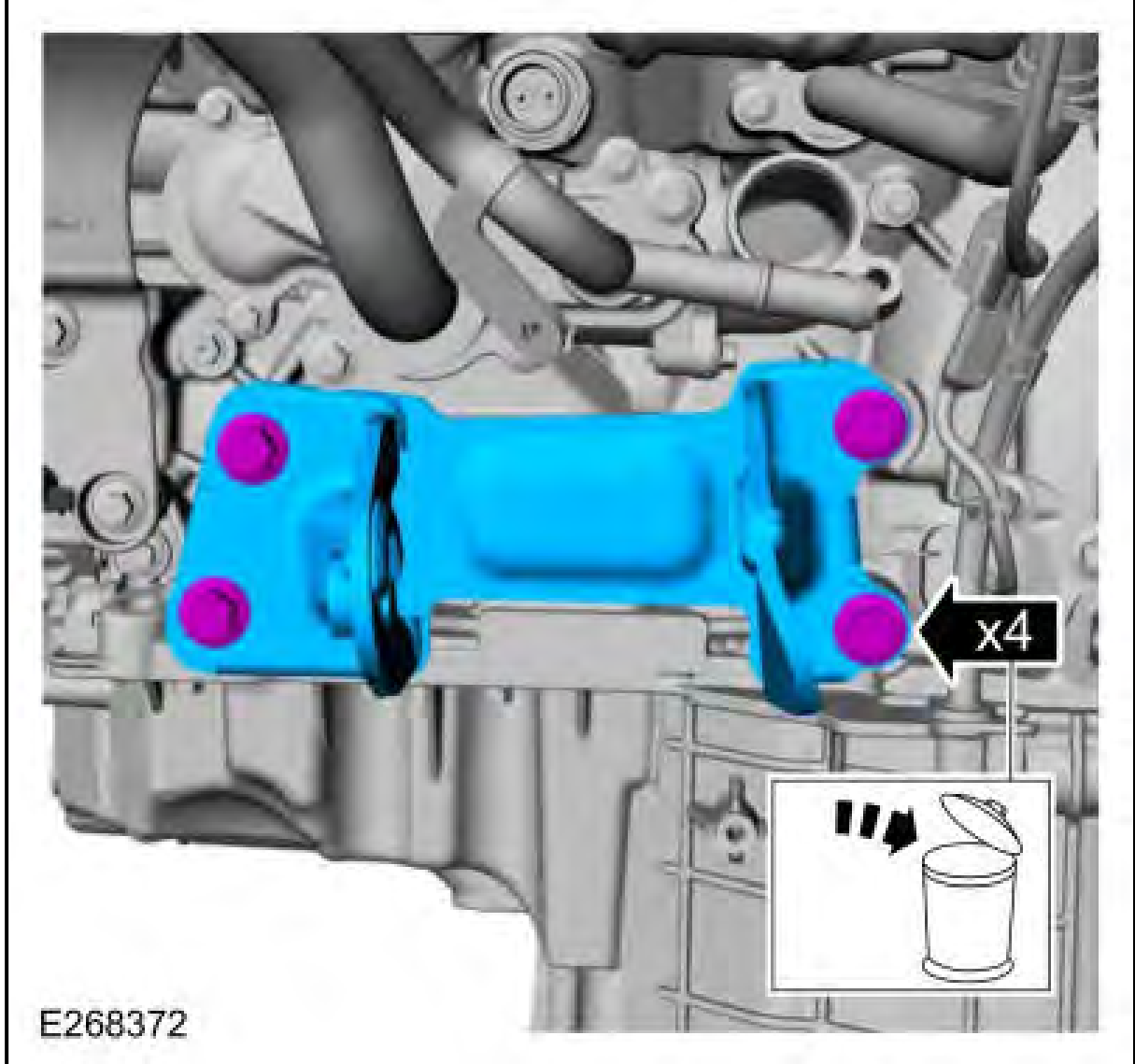




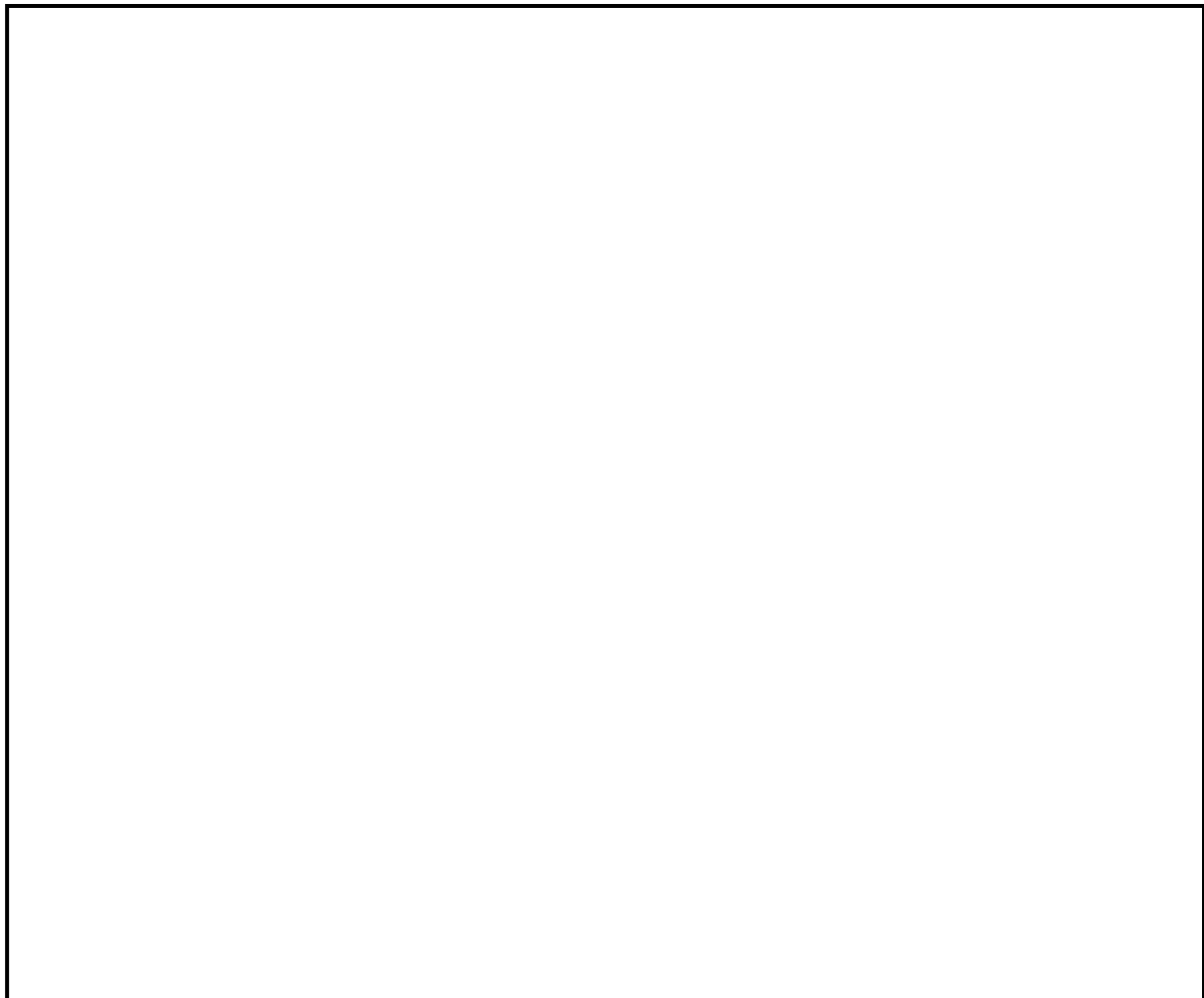
48. Remove the bolts and the RH engine mount bracket. Discard the bolts.

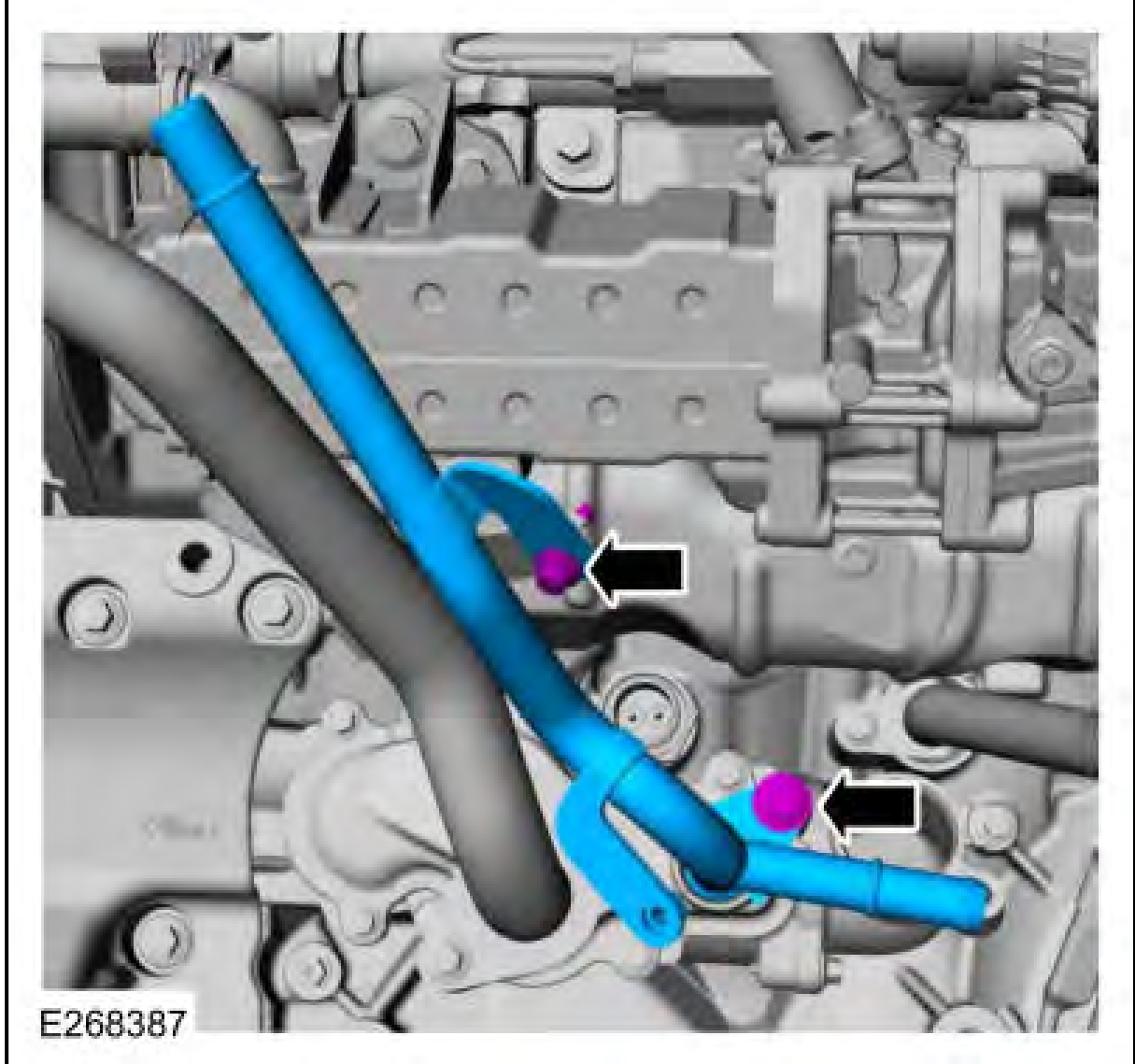


49. Remove the bolts and the LH engine mount bracket. Discard the bolts.

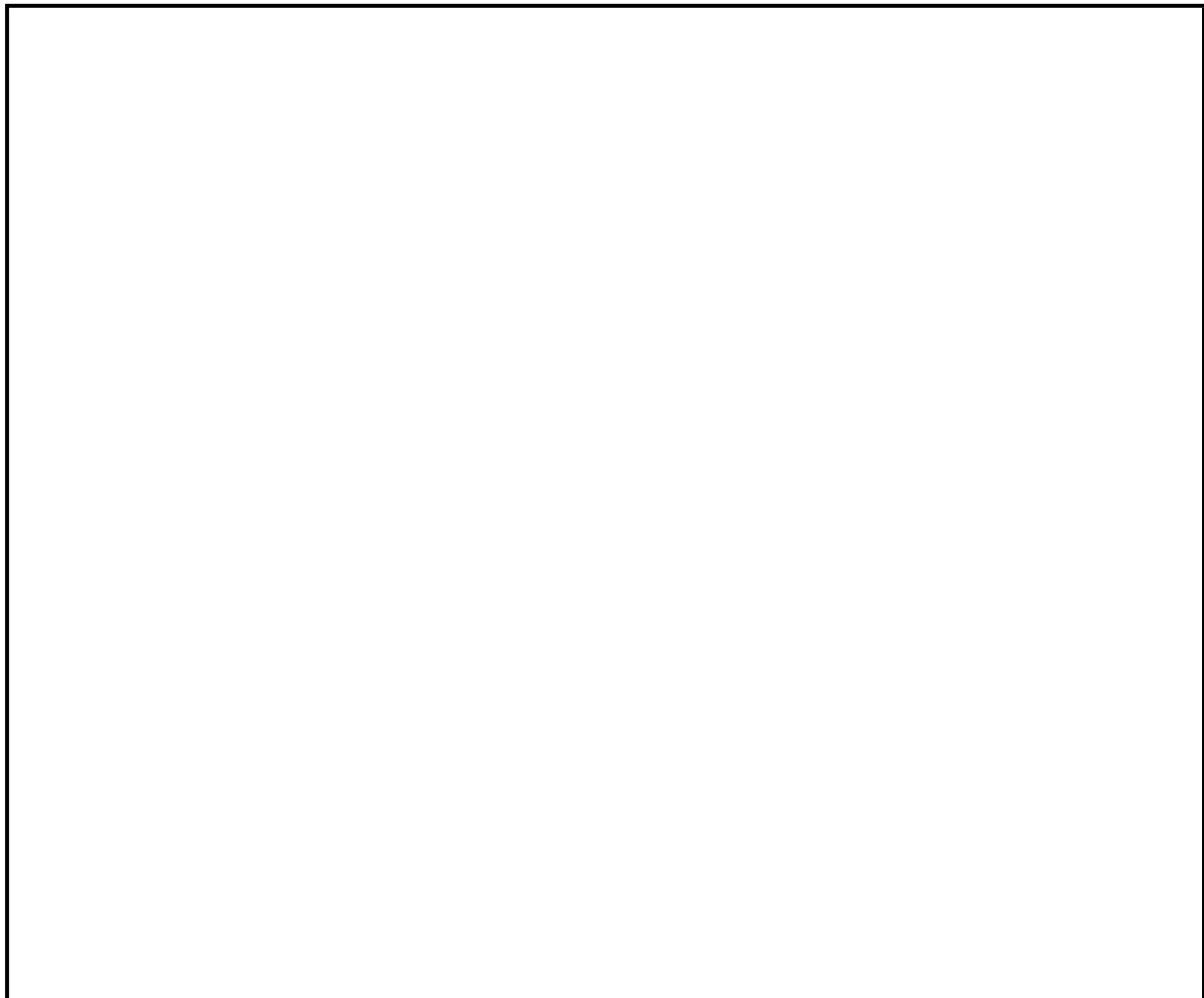


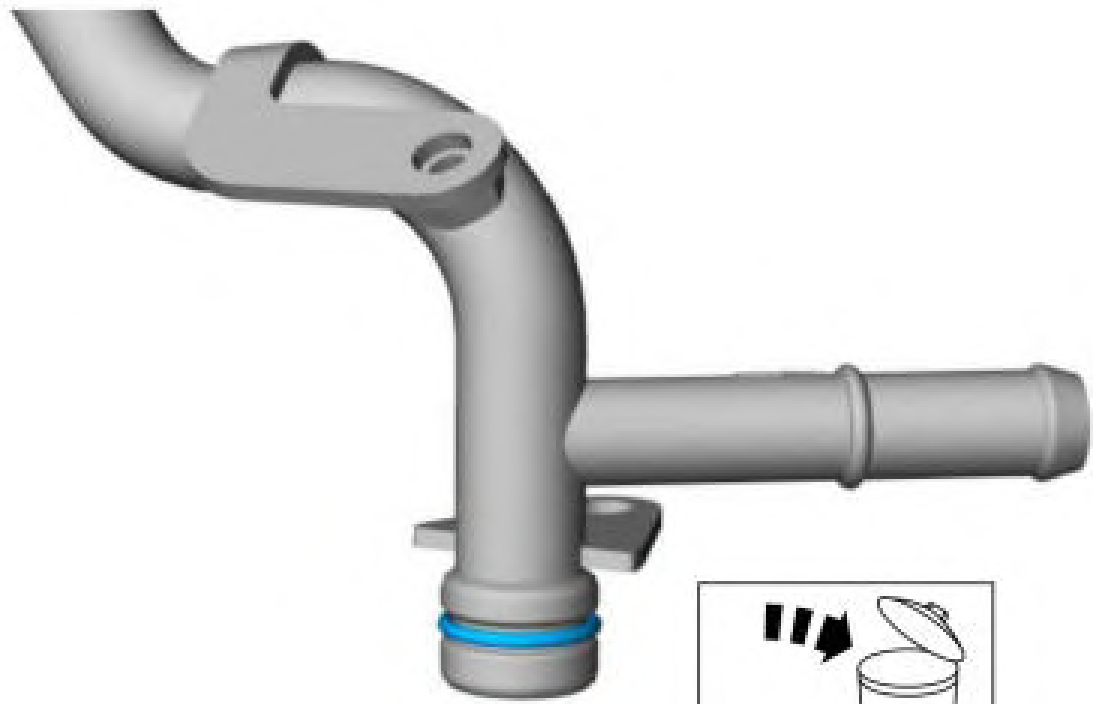
50. Remove the bolts and the coolant tube.





51. Remove and discard the coolant tube O-ring seal.

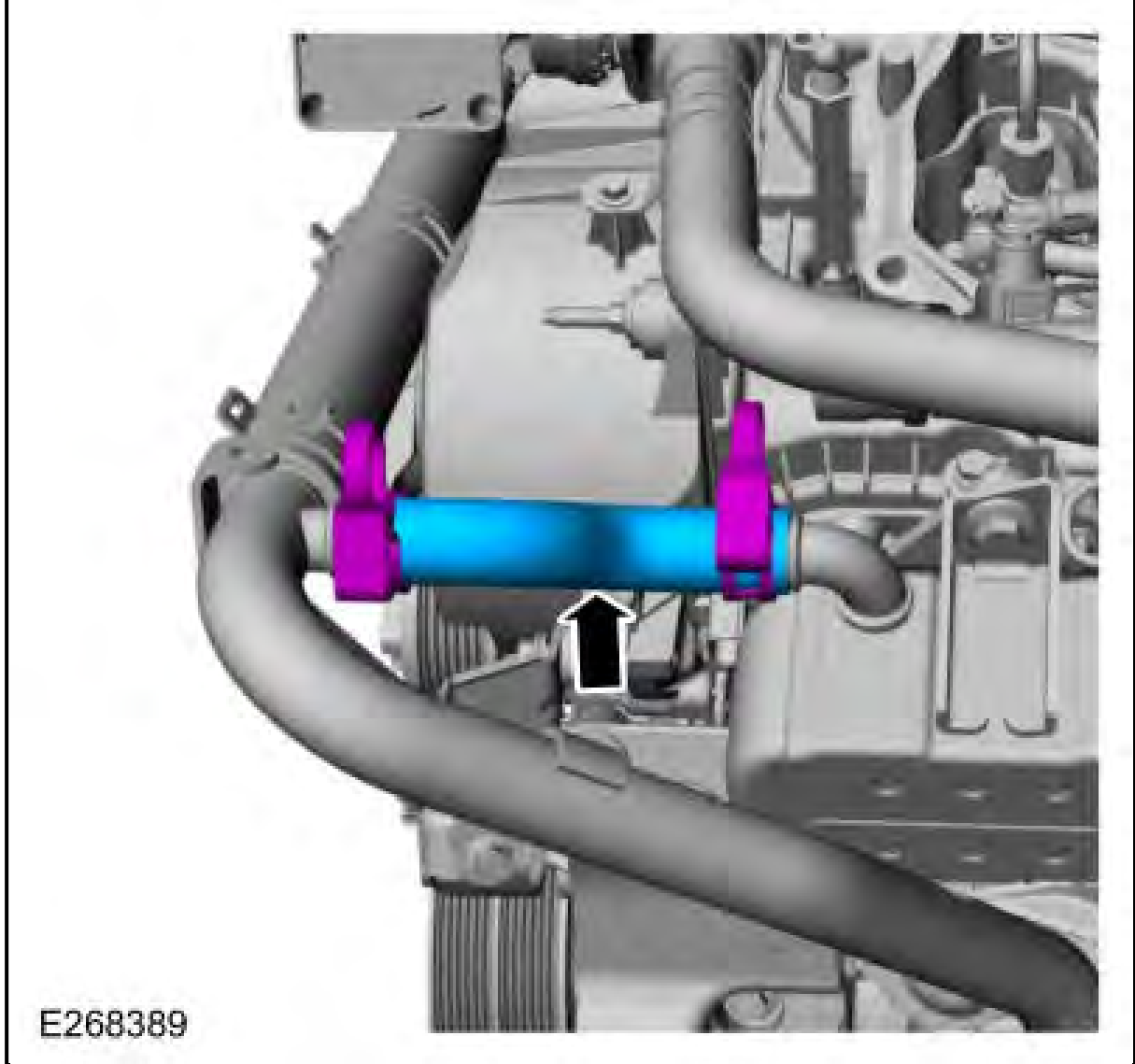




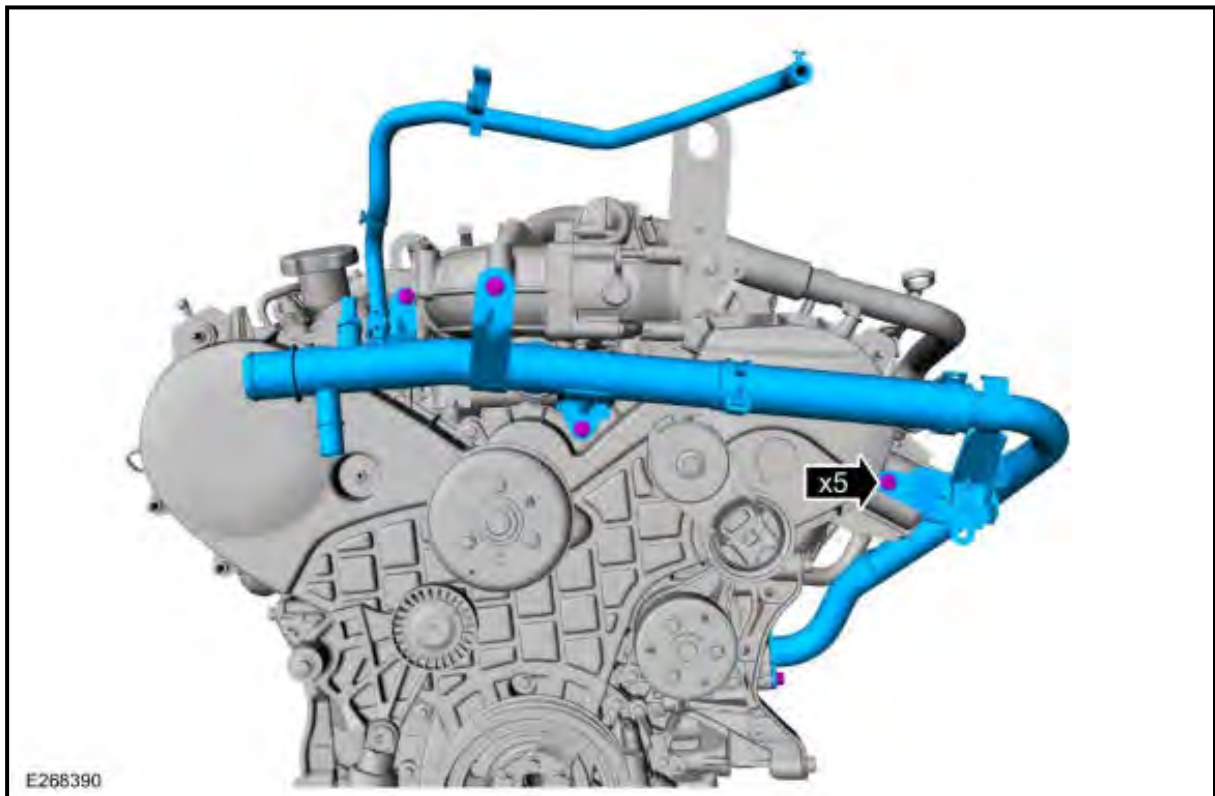
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52. Release the clamps and remove the EGR cooler coolant hose. Use the General Equipment: Hose Clamp Remover/Installer



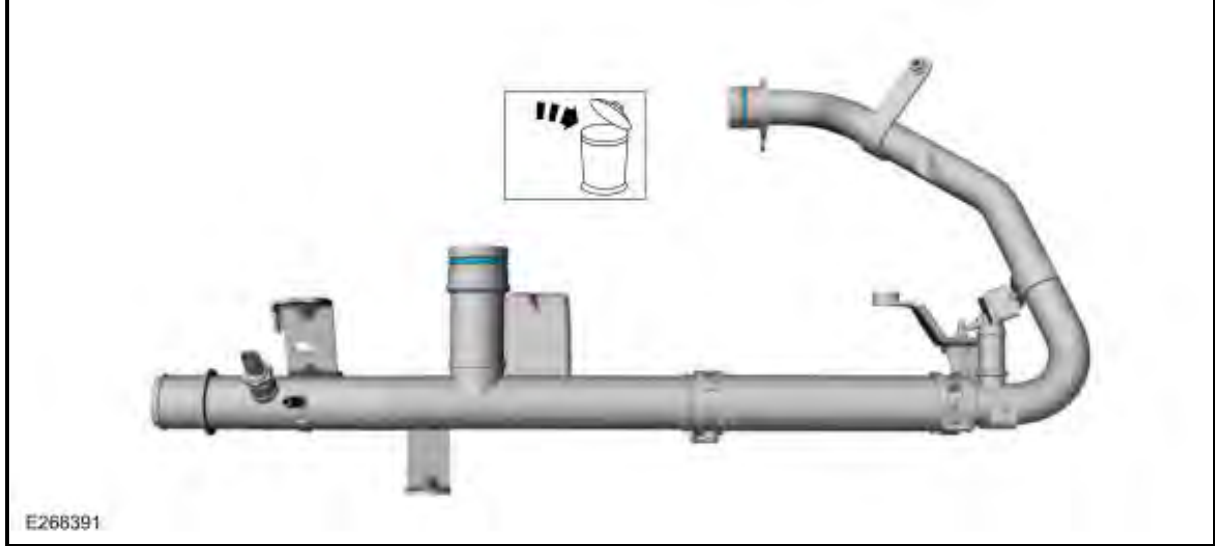


53. Remove the bolts and the coolant tube assembly.

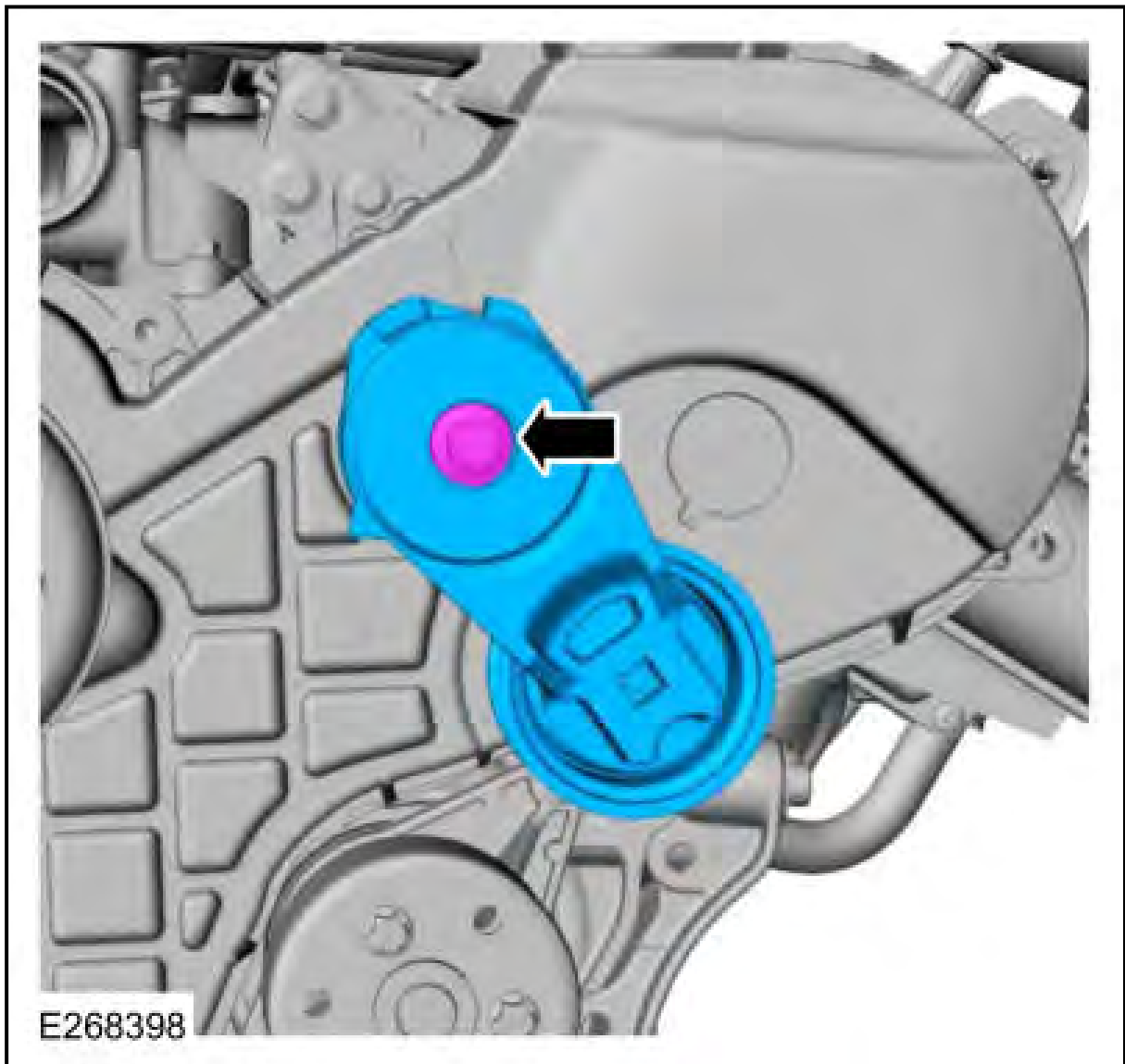


54. Remove and discard the coolant tube assembly O-rings.



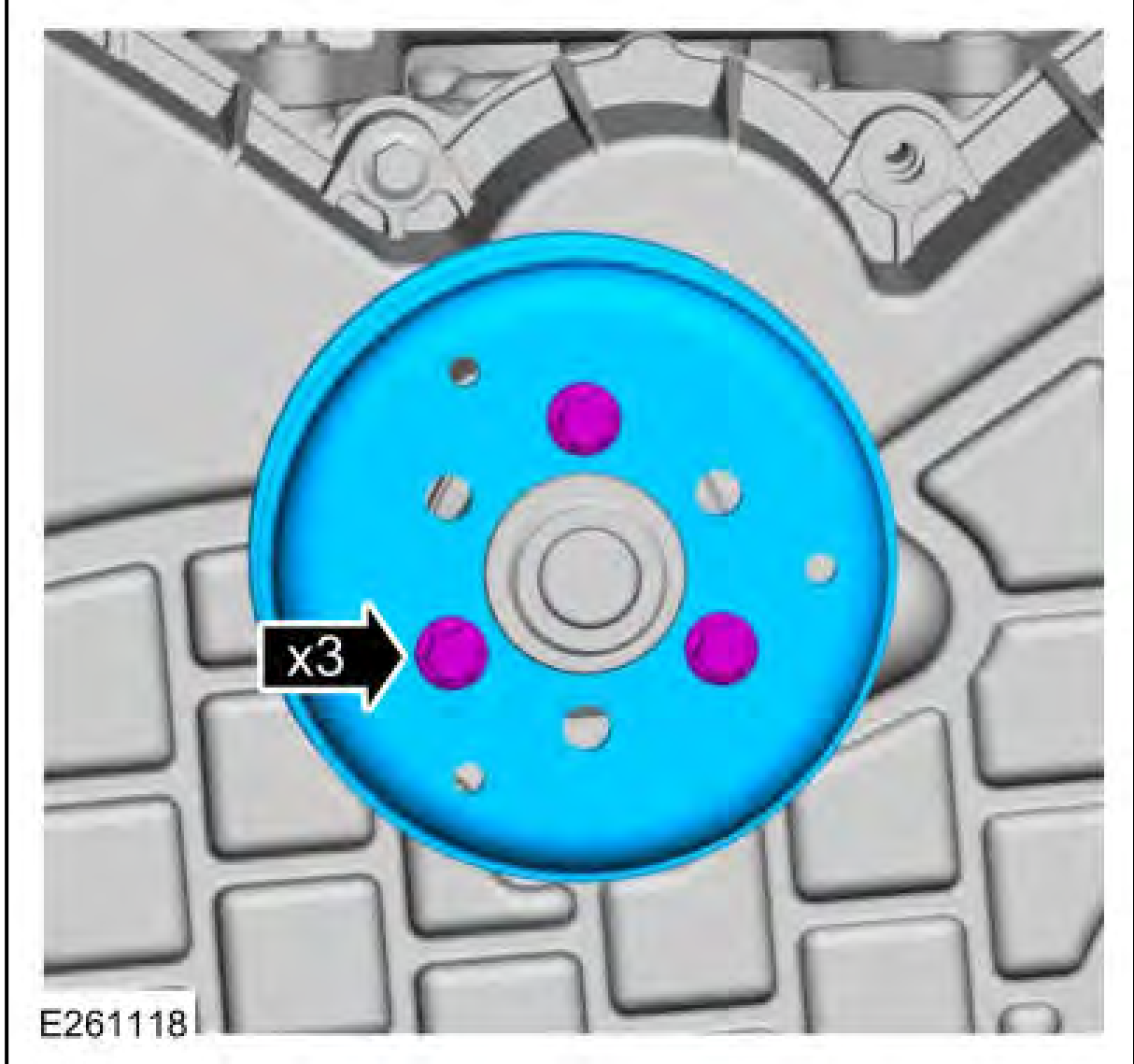


55. Remove the bolt and the accessory drive belt tensioner.

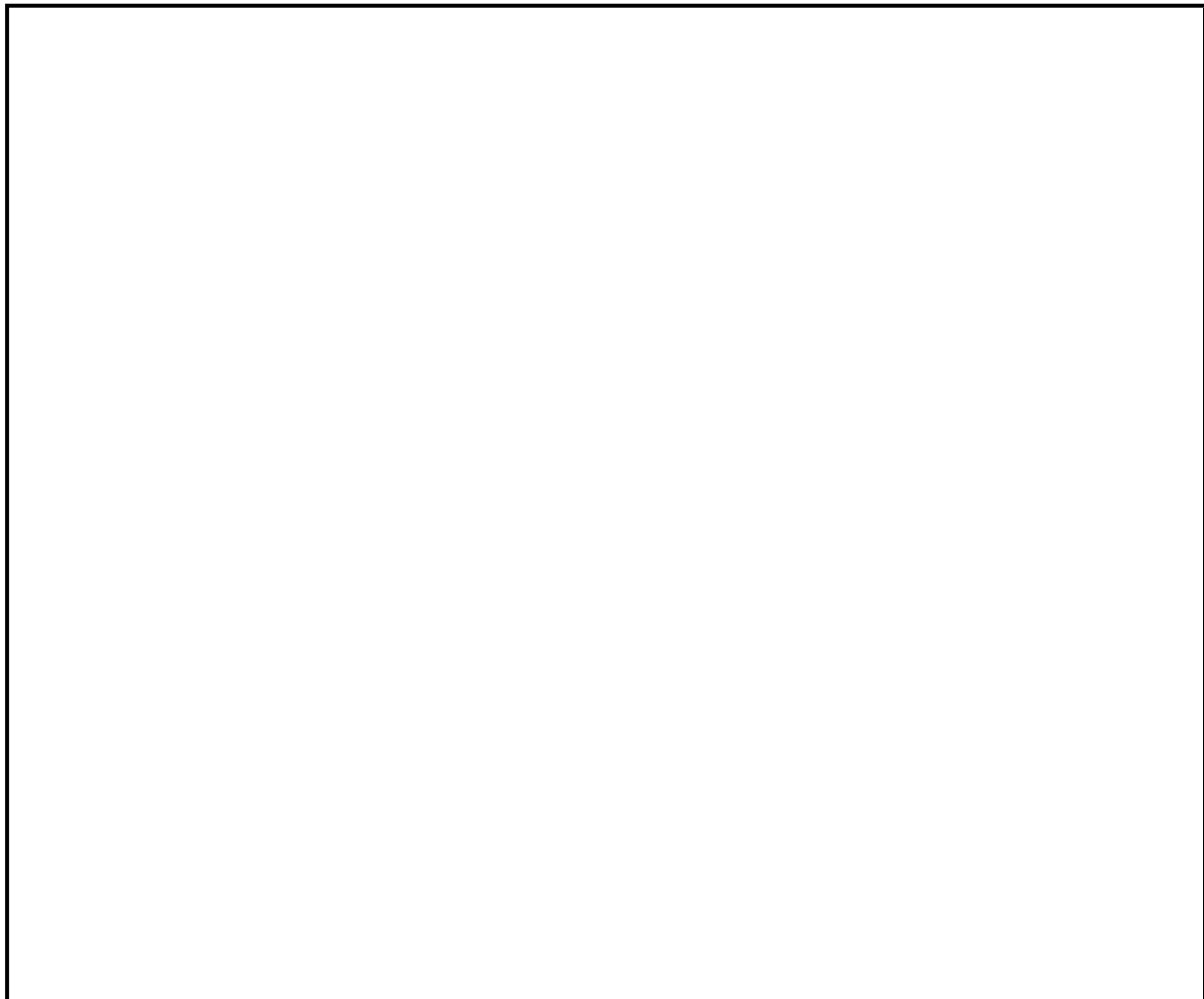


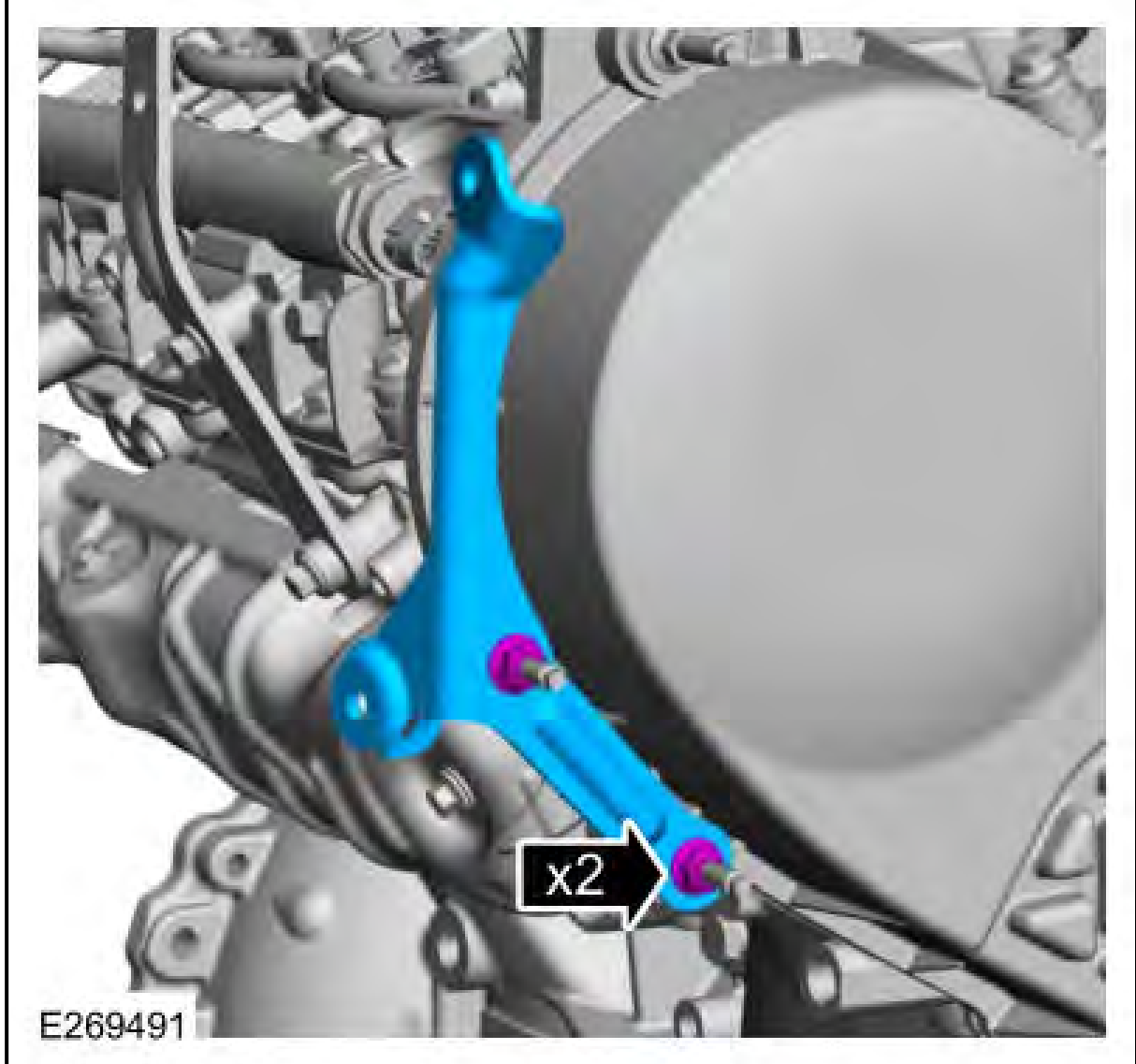
56. Remove the bolts and the fan pulley.



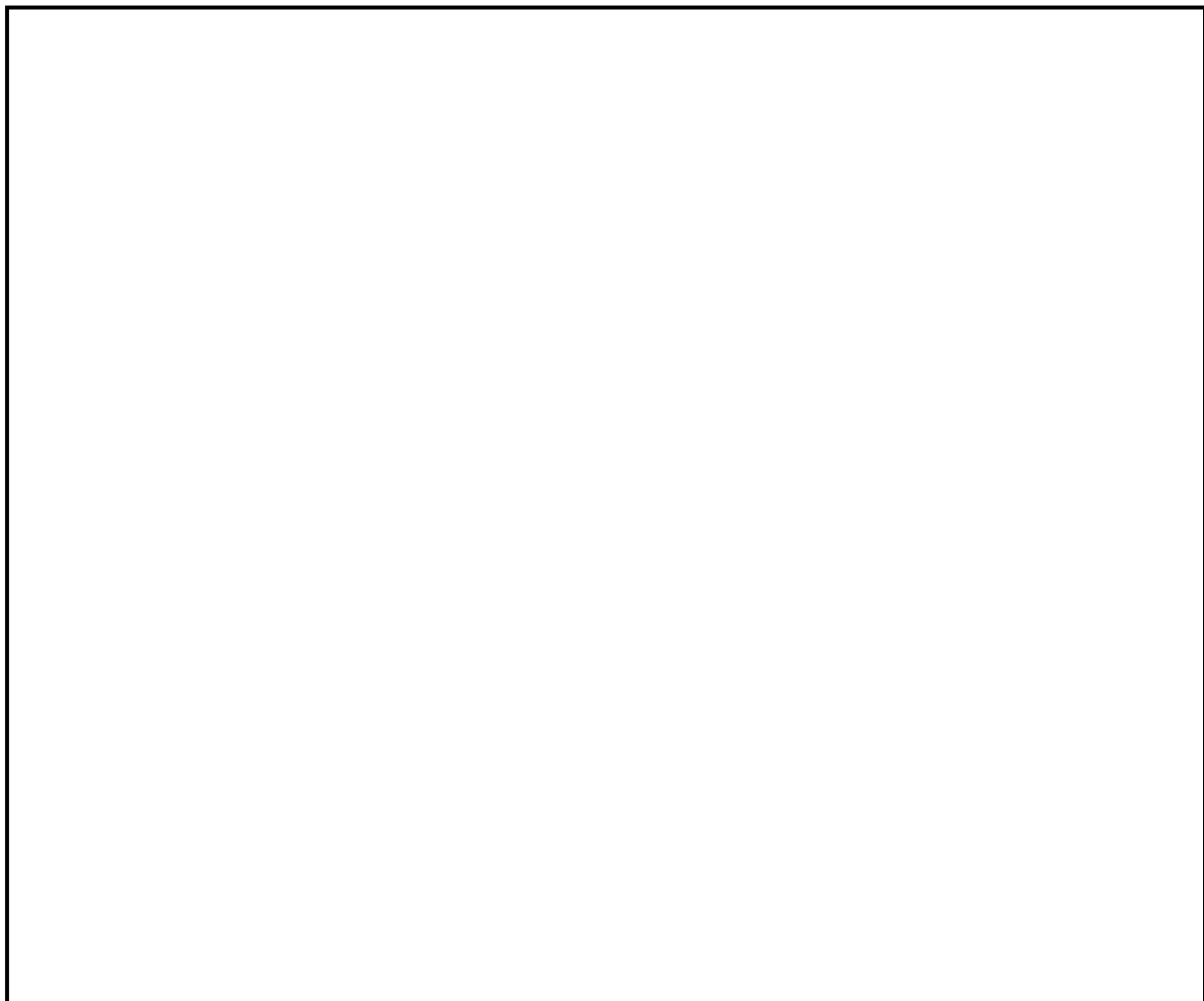


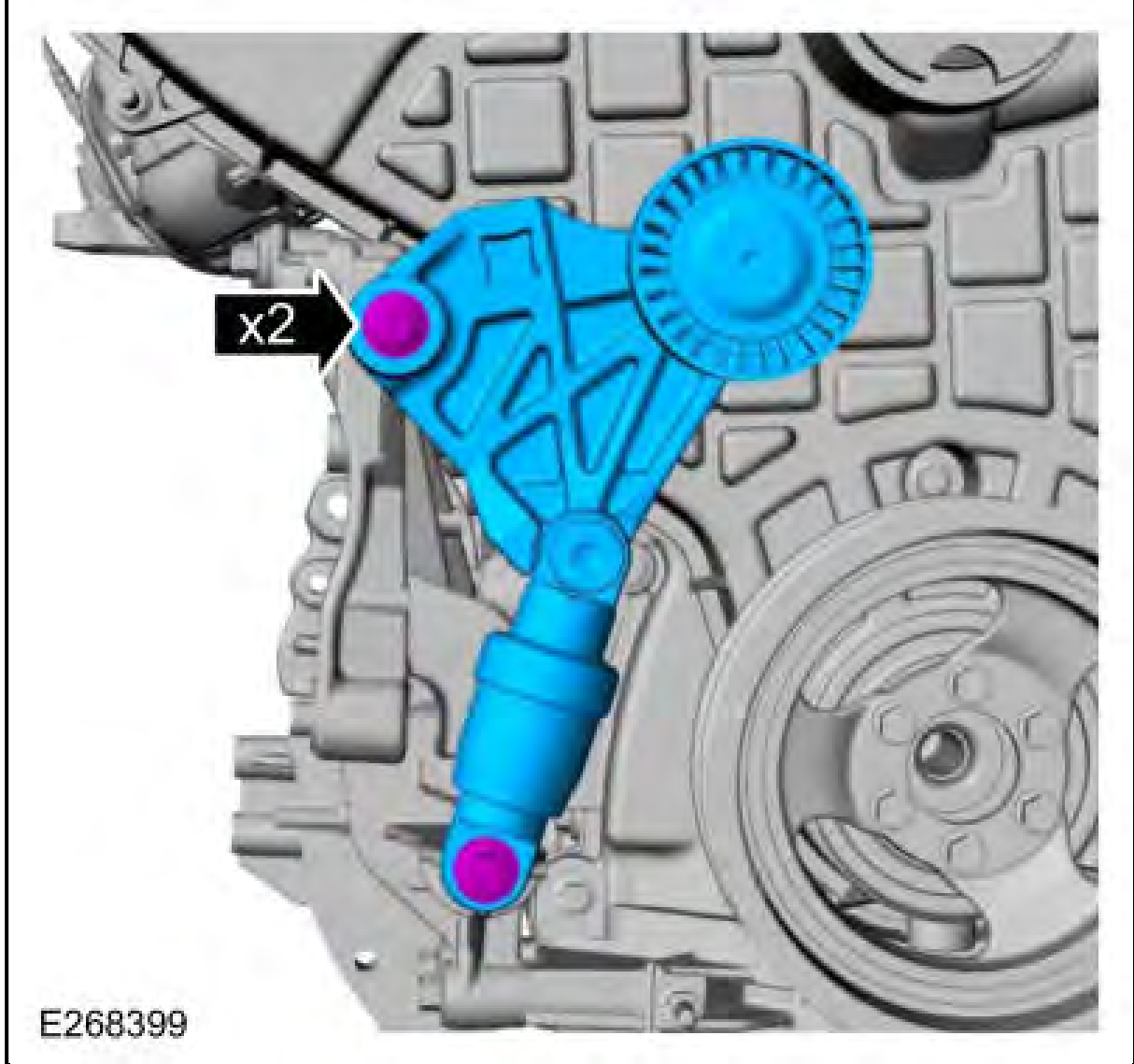
57. Remove the nuts and the CAC tube bracket.





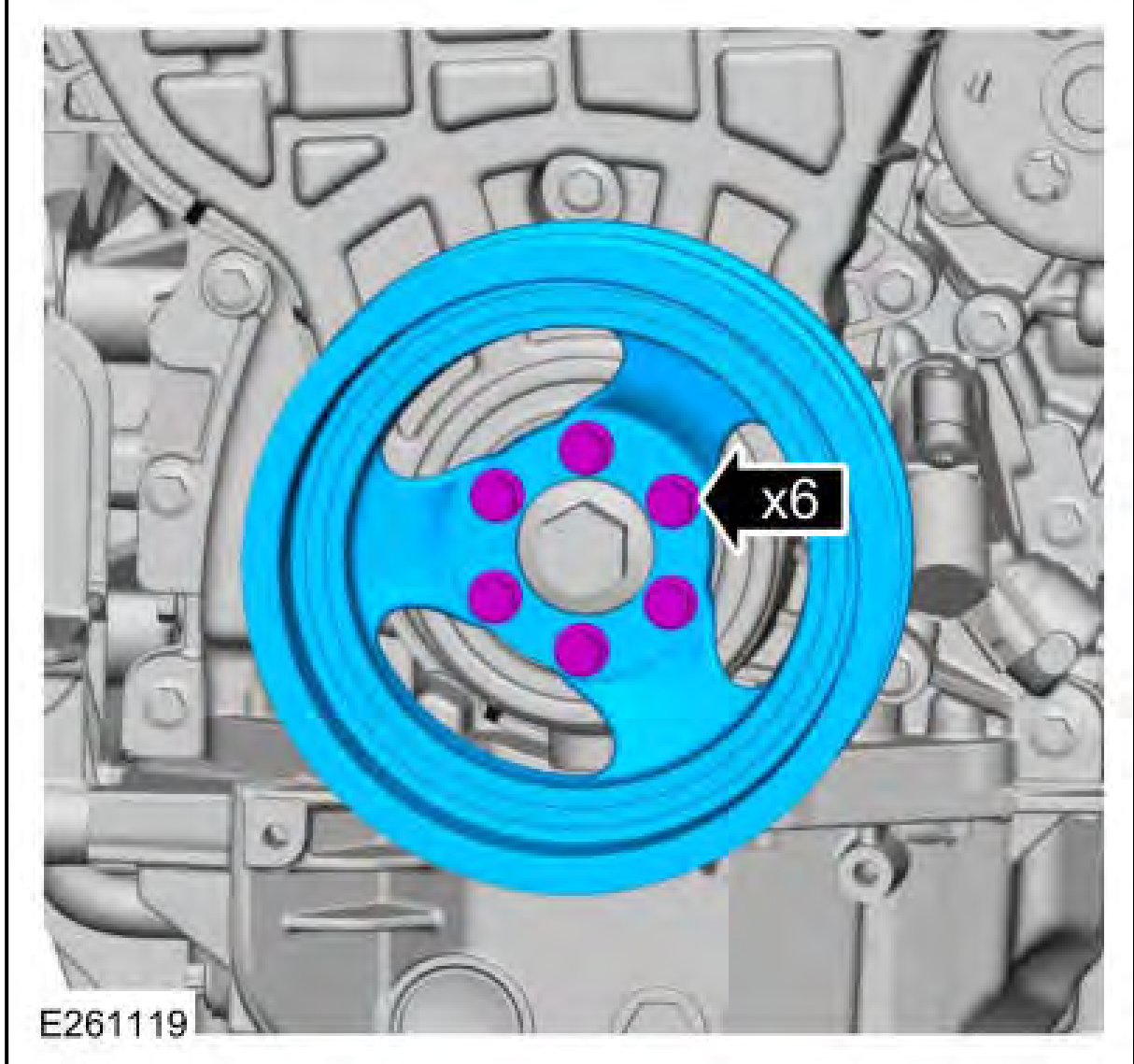
58. Remove the bolts and the accessory drive belt tensioner.



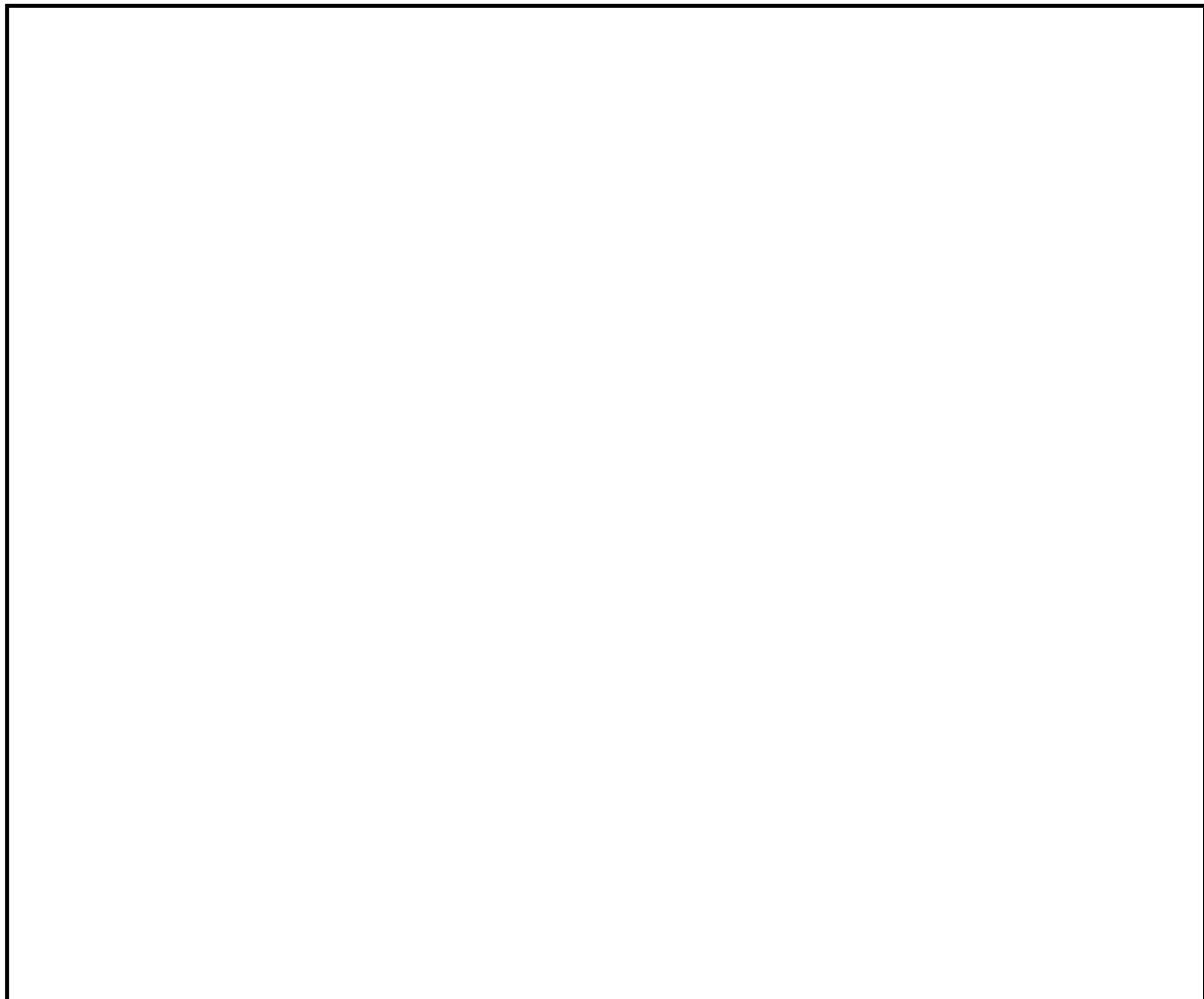


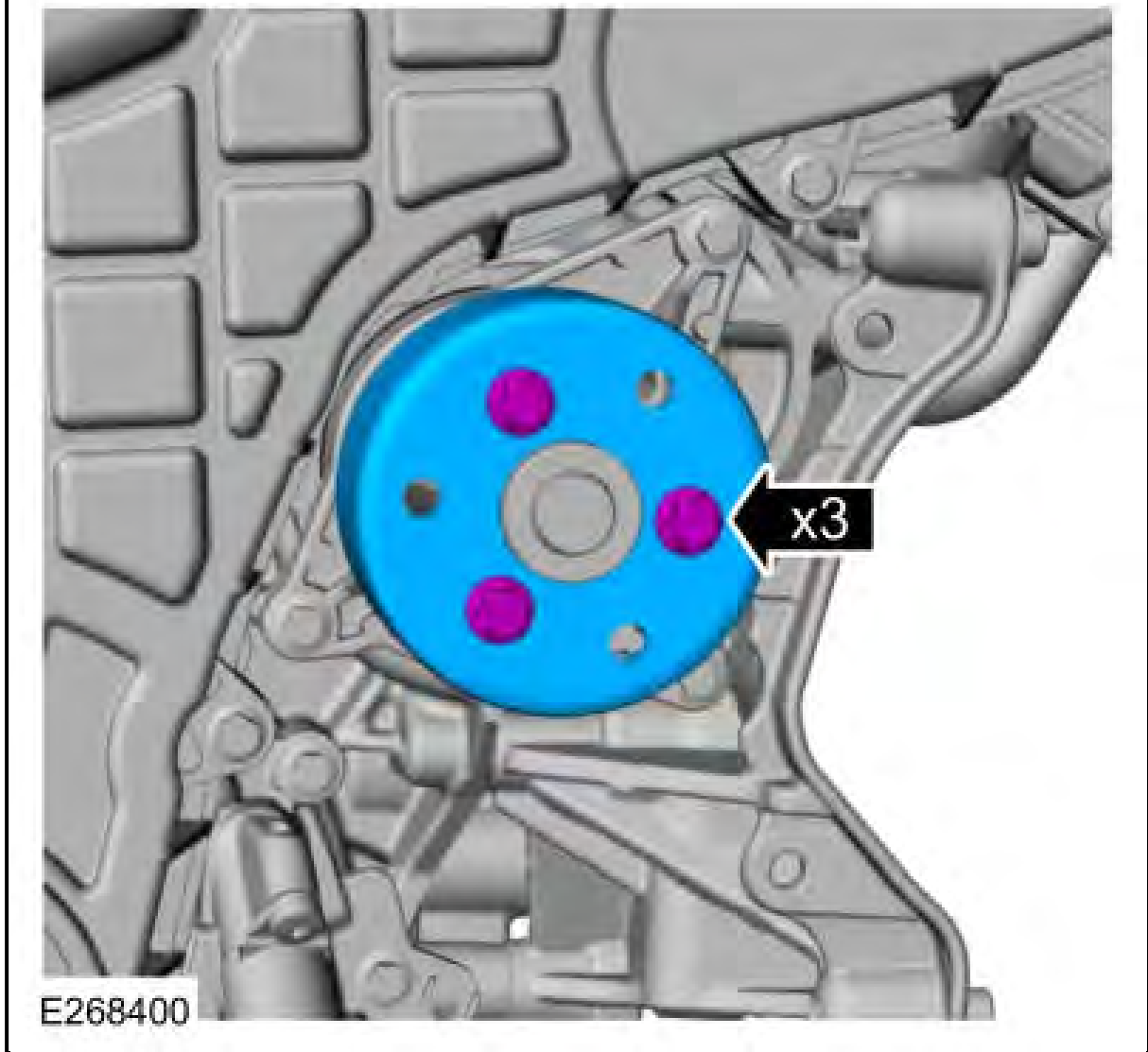
59. Remove the bolts and the crankshaft vibration damper.



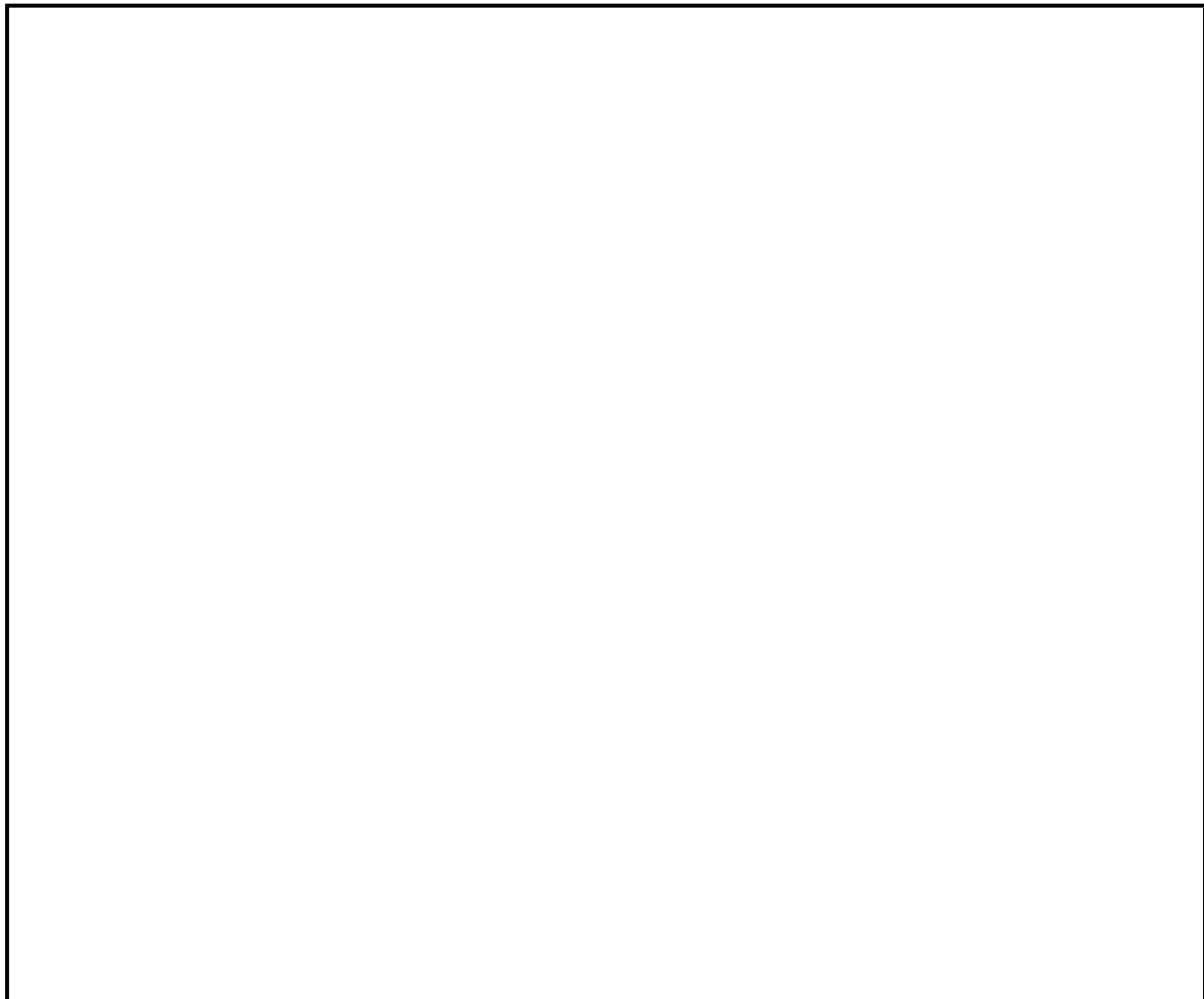


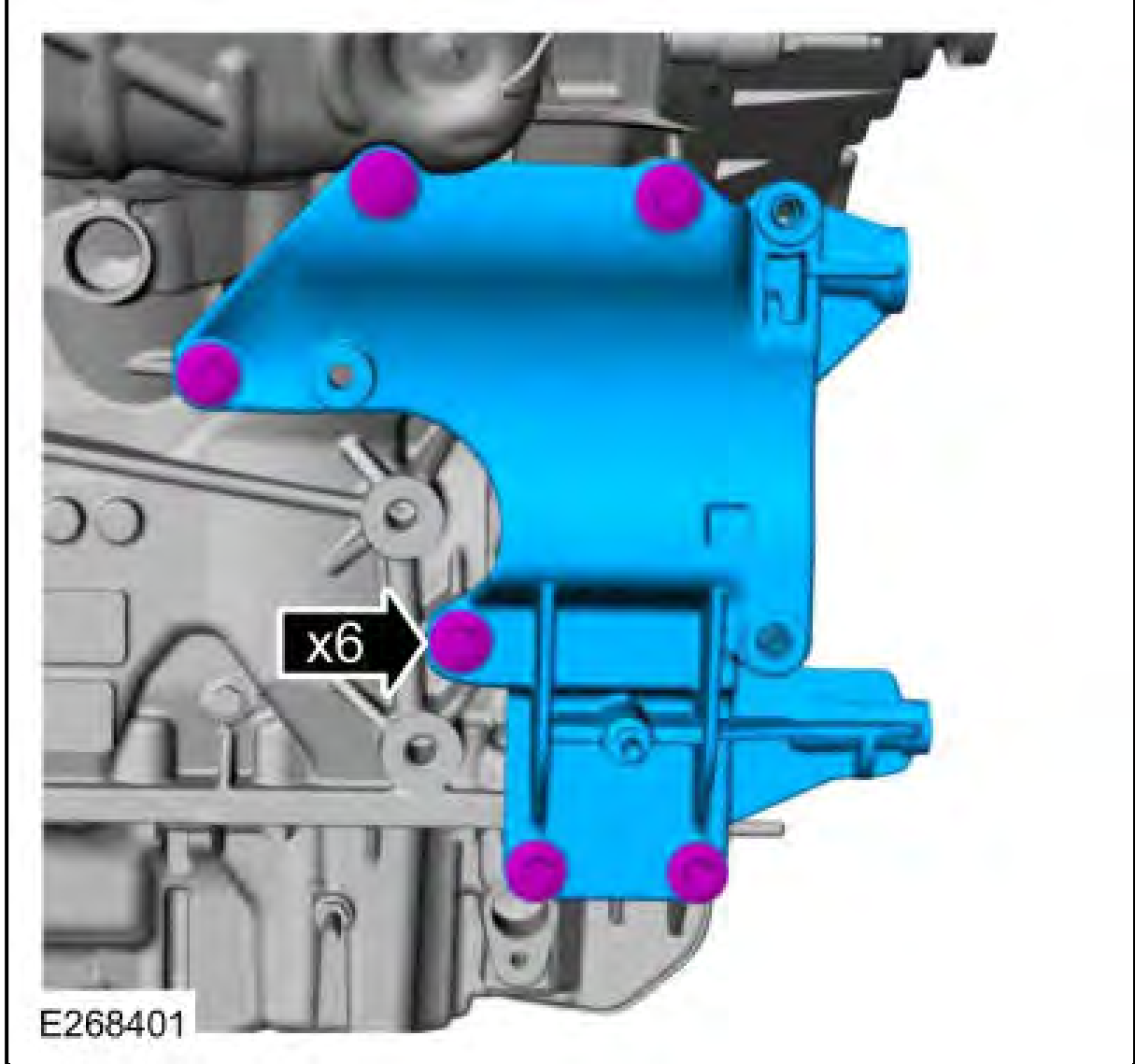
60. Remove the bolts and the coolant pump pulley.



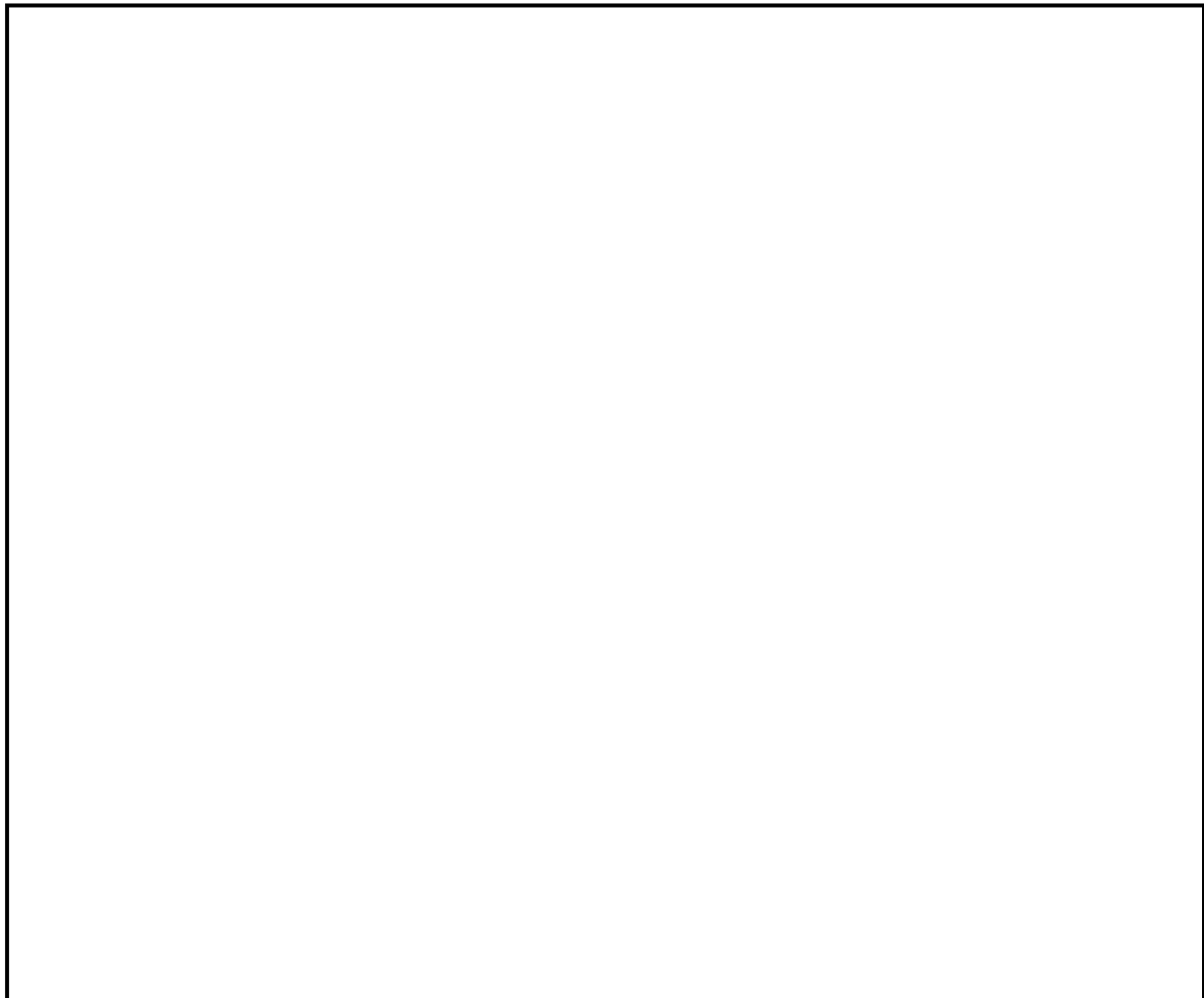


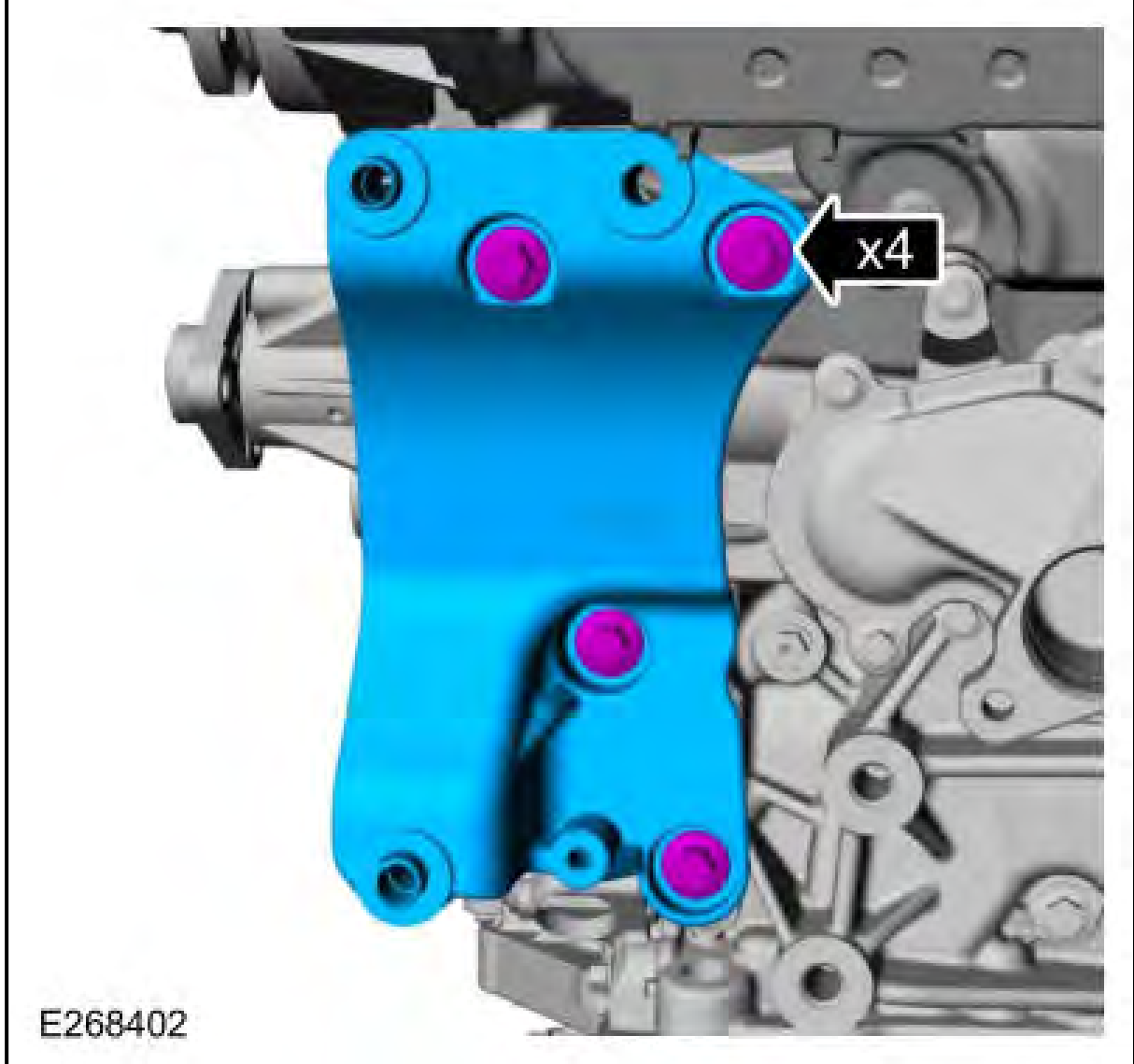
61. Remove the bolts and the A/C mounting bracket.





62. Remove the bolts and the generator mounting bracket.



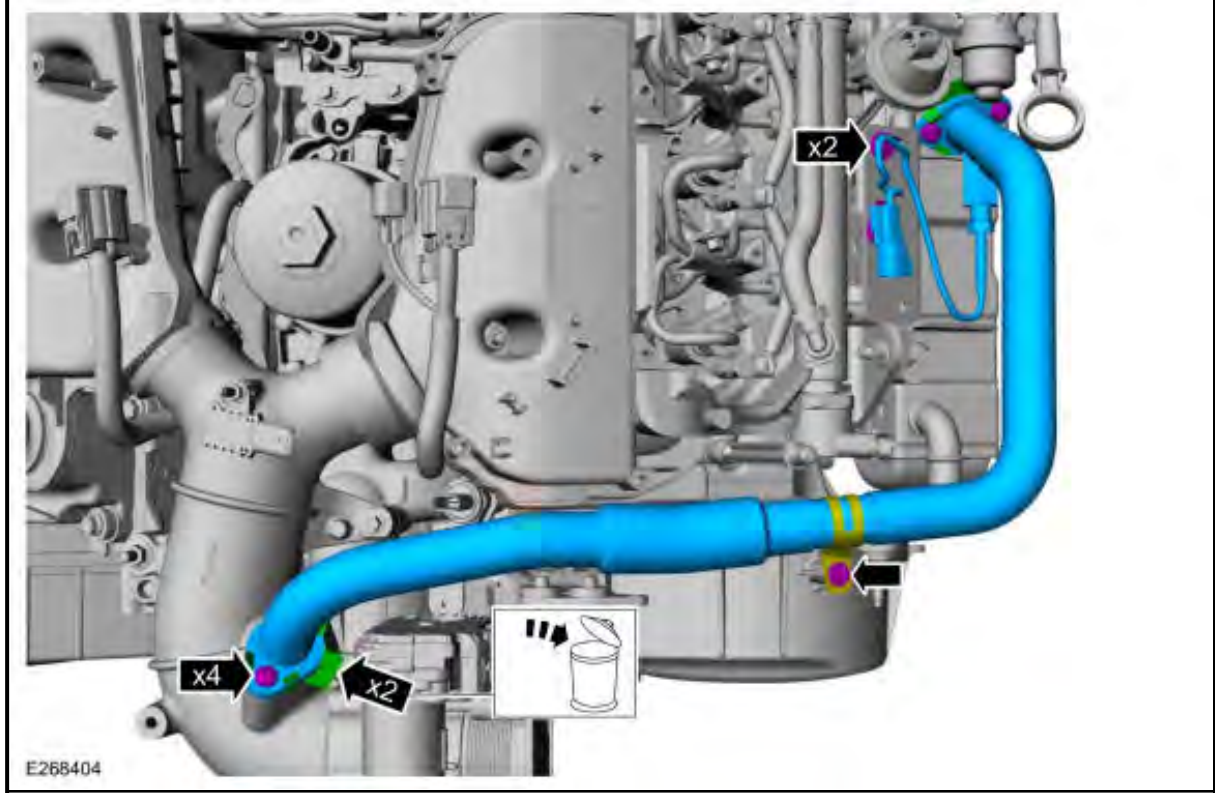


63.

- Disconnect the wire retainers.
- Remove the retainer from the timing belt cover.
- Remove the retainers and the EGR outlet tube.
- Remove and discard the gaskets.

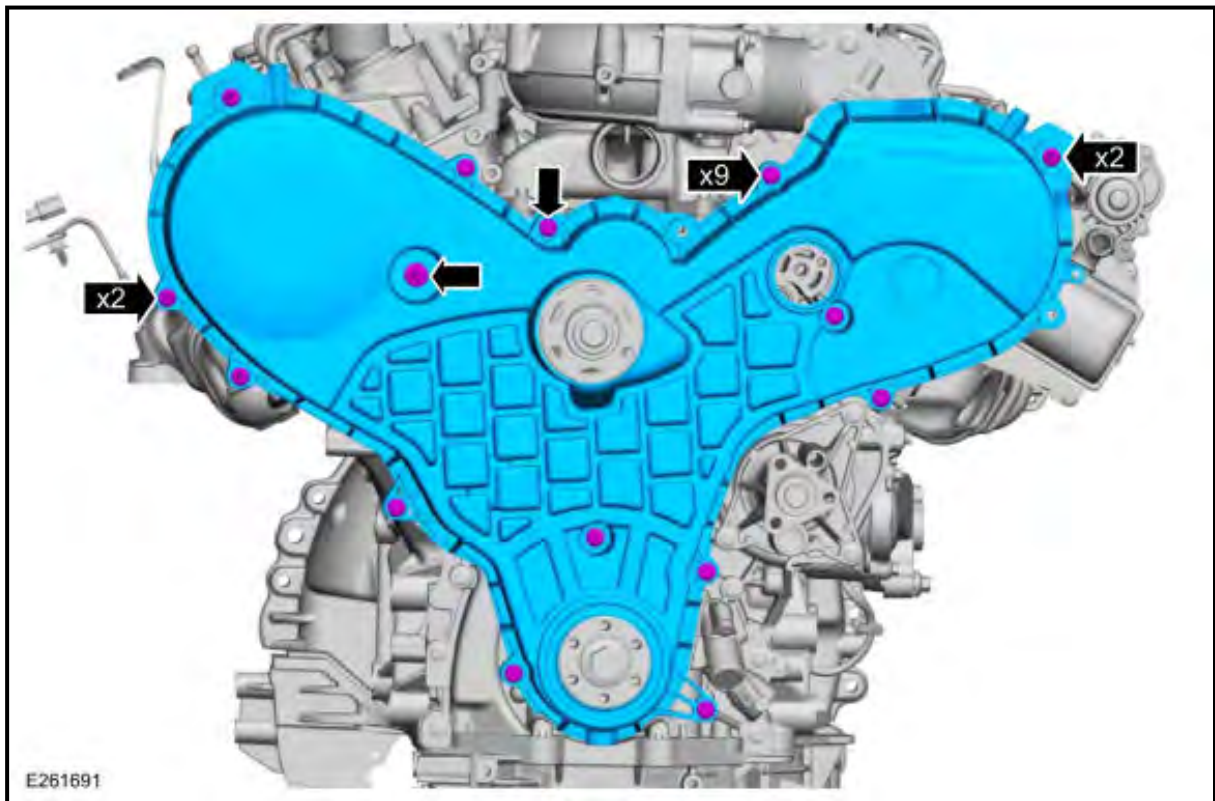






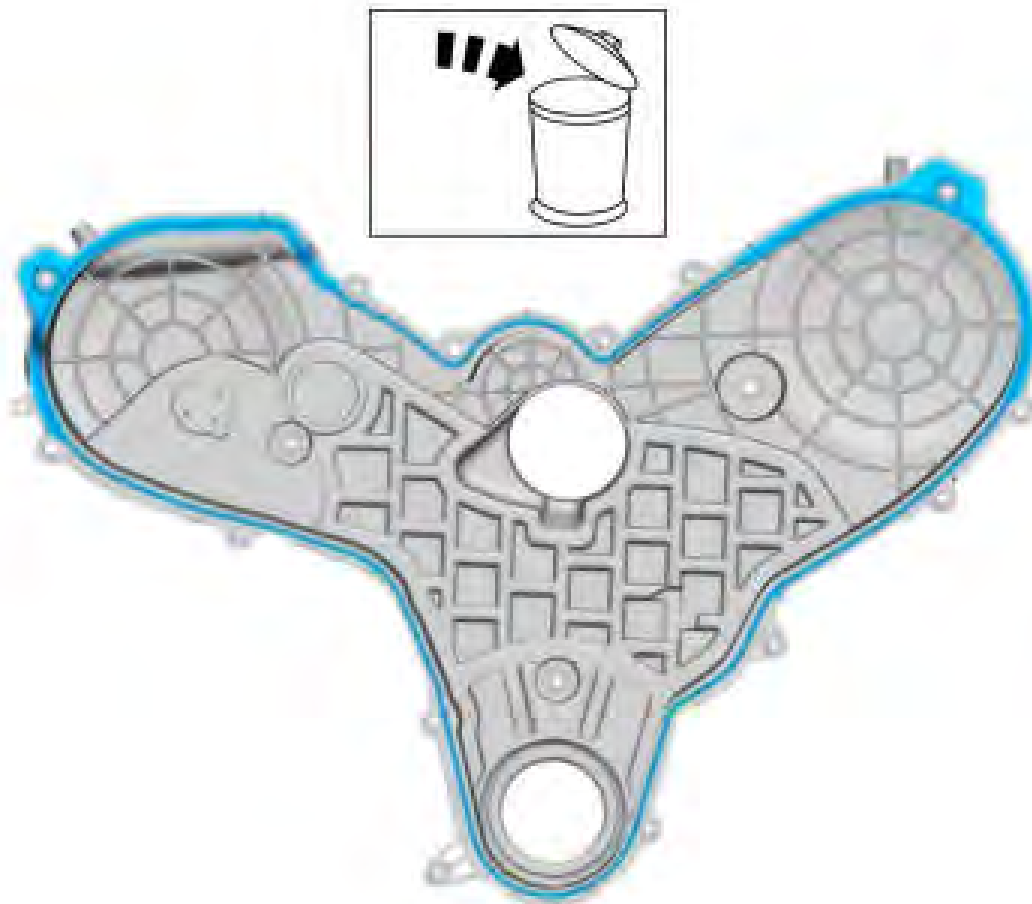
64. **NOTE:** Mark the locations of the fasteners before removal.

Remove the bolts, the stud bolts and the timing belt cover.



65. Remove and discard the timing belt cover gasket.

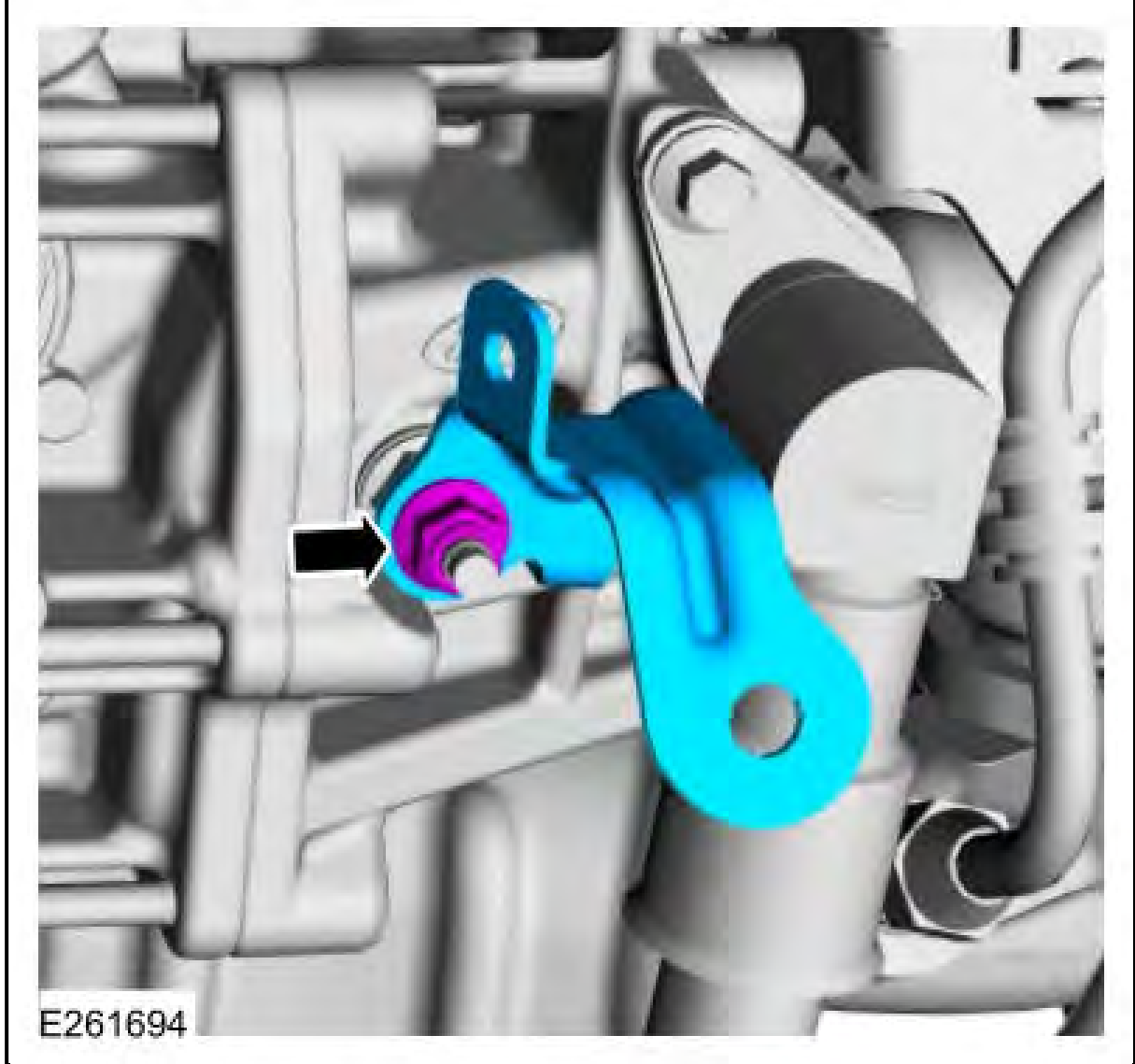




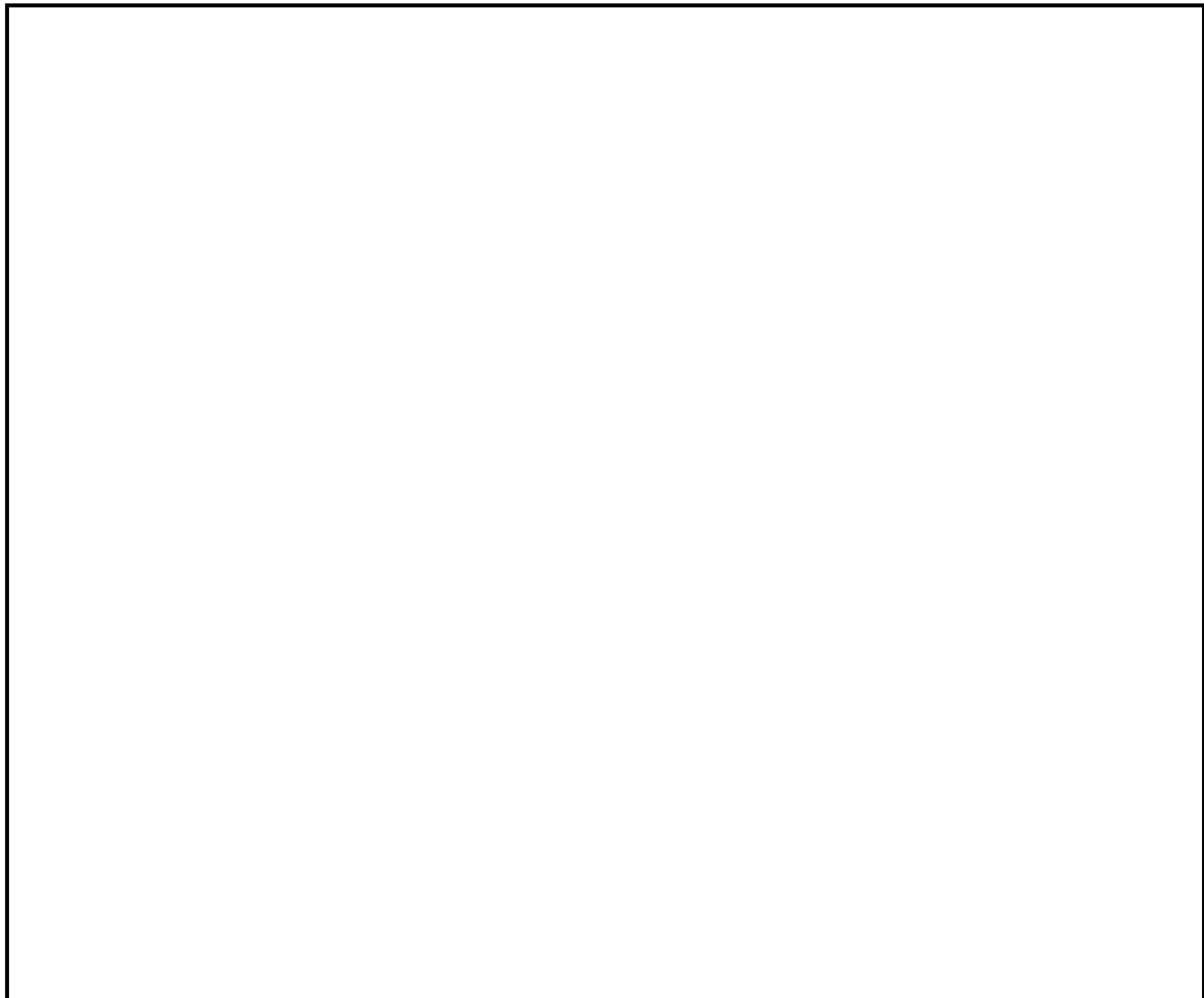
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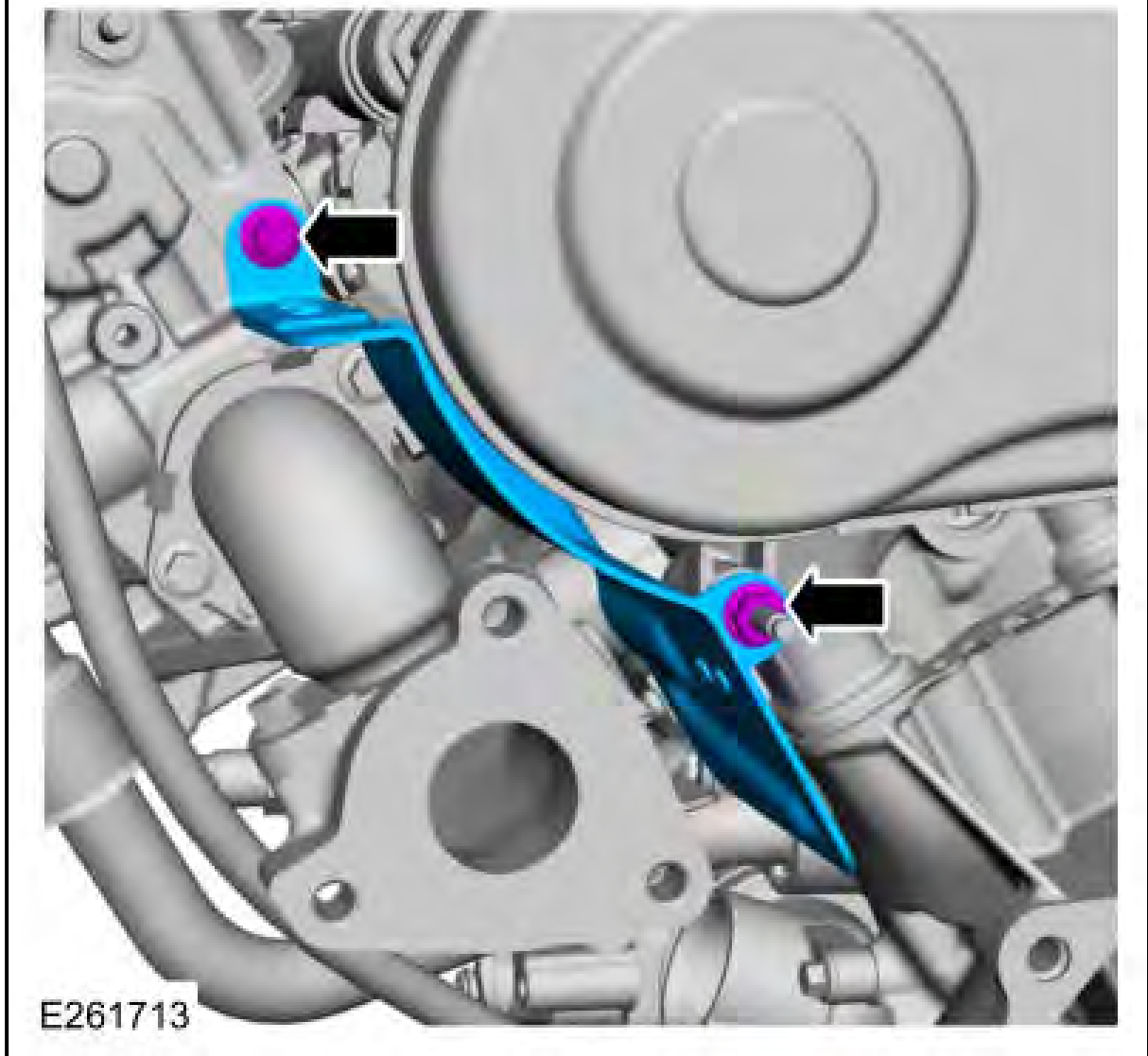
66. Remove the nut and the front fuel tube support bracket.



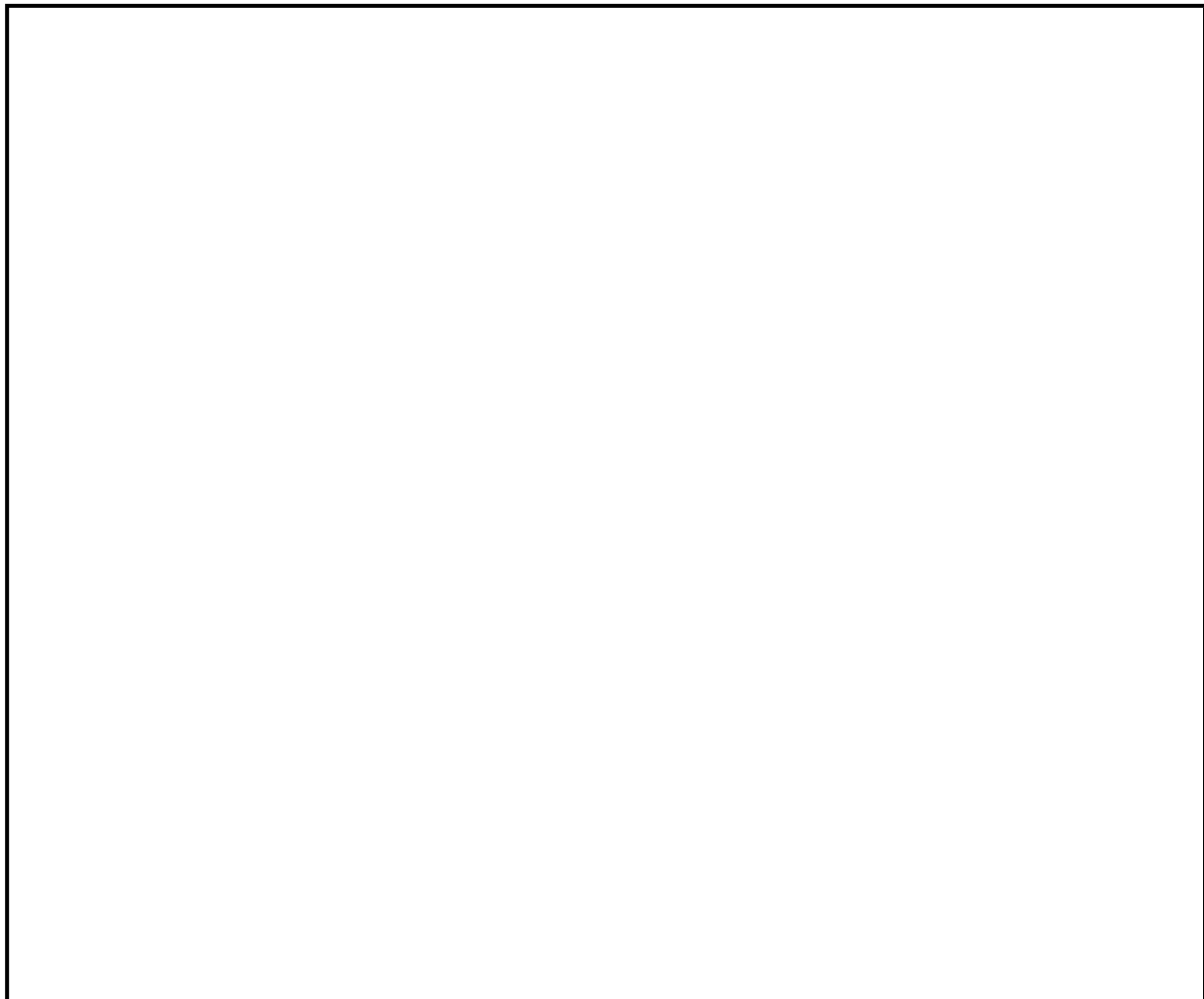


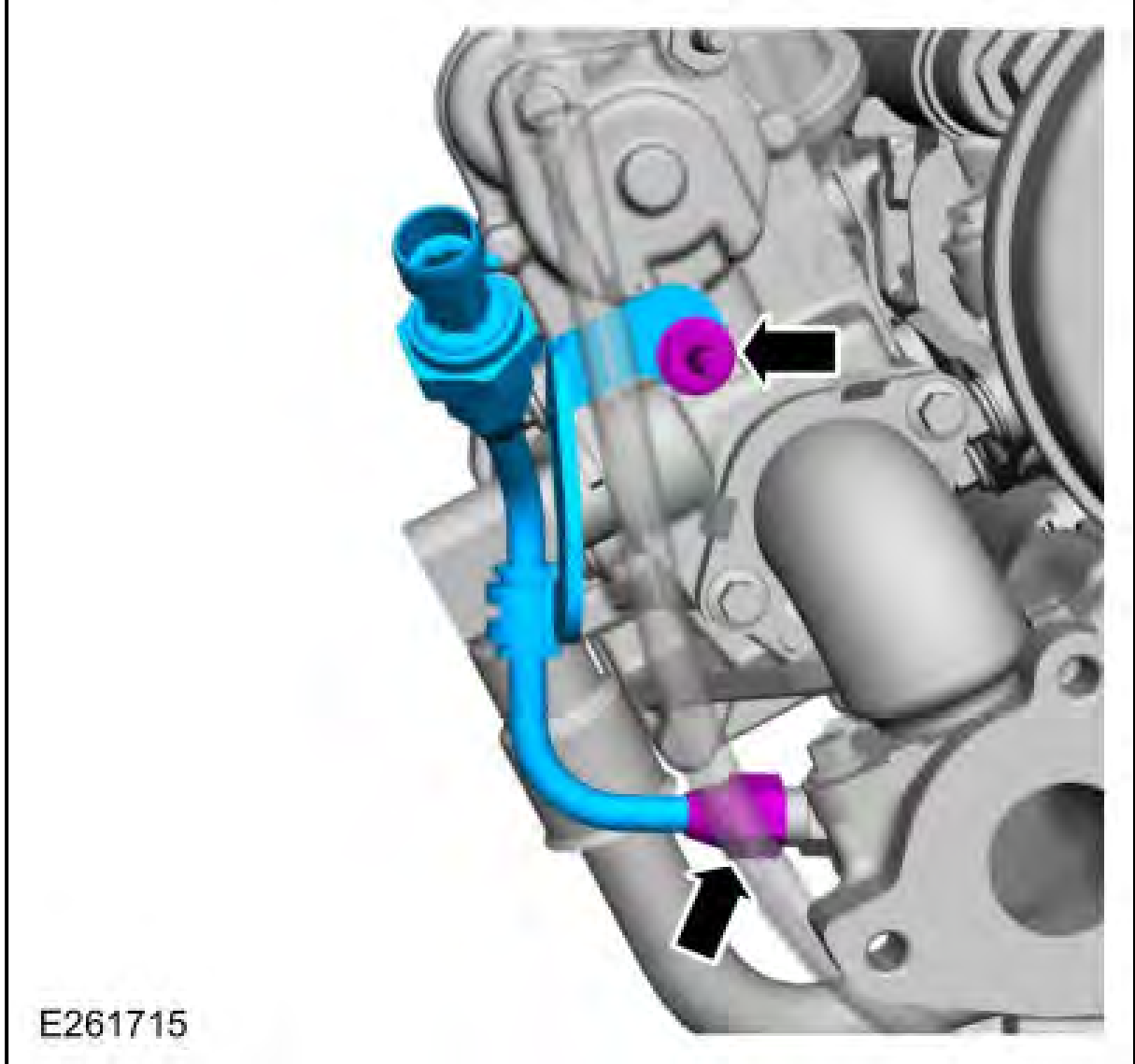
67. Remove the nut, the bolt and the LH exhaust manifold heat shield.



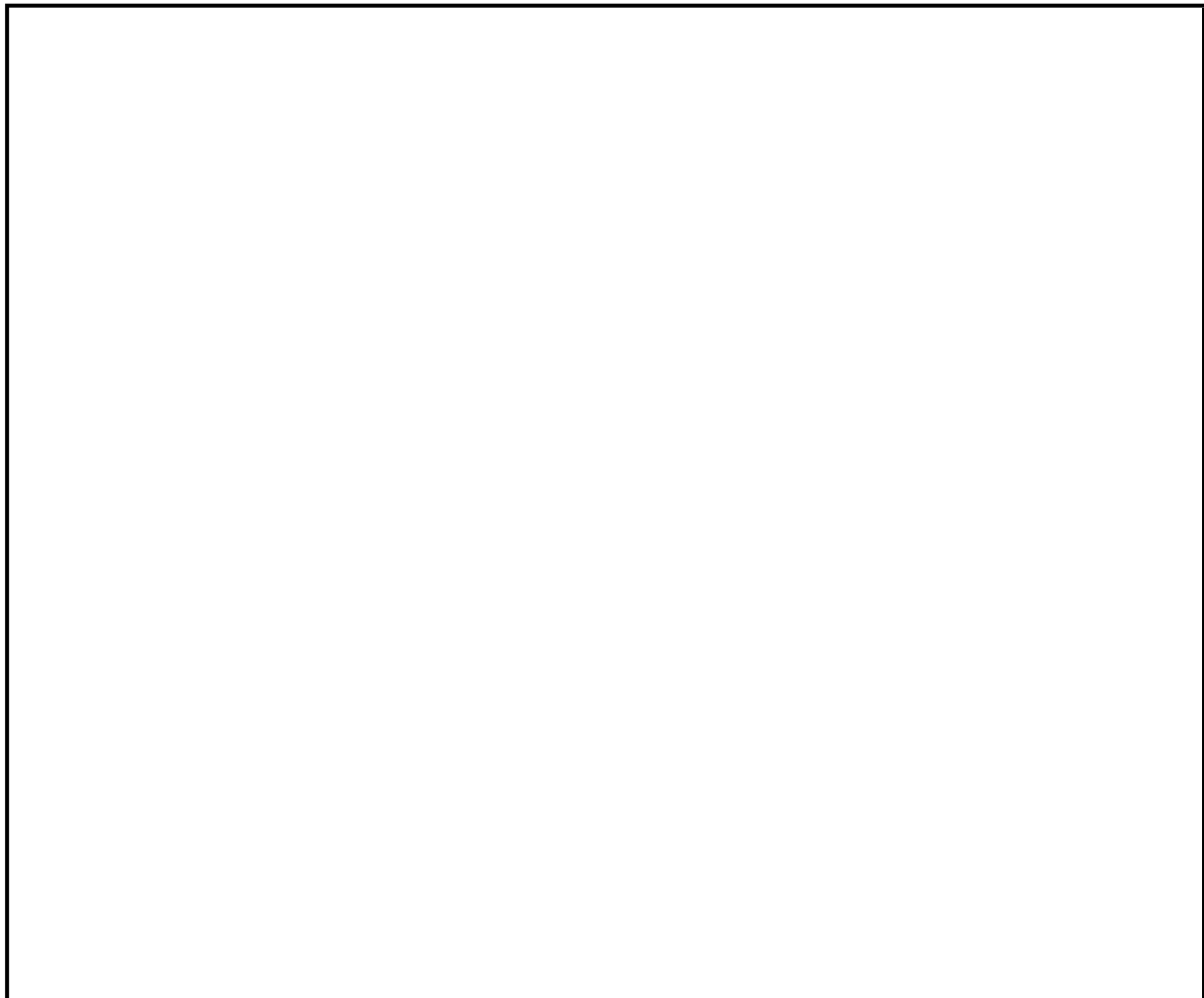


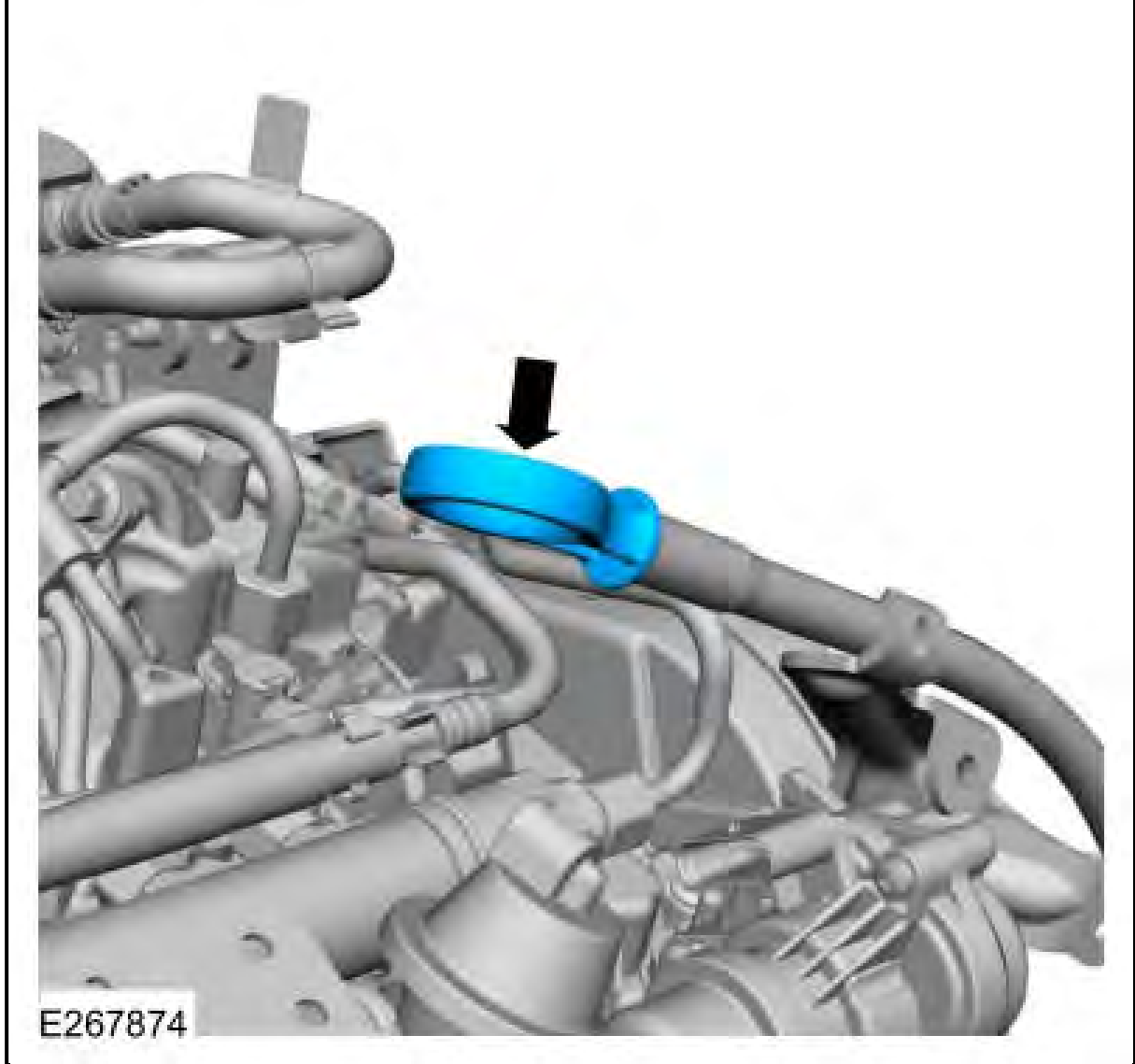
68. Remove the stud bolt. Disconnect the tube nut and remove the EP sensor assembly.





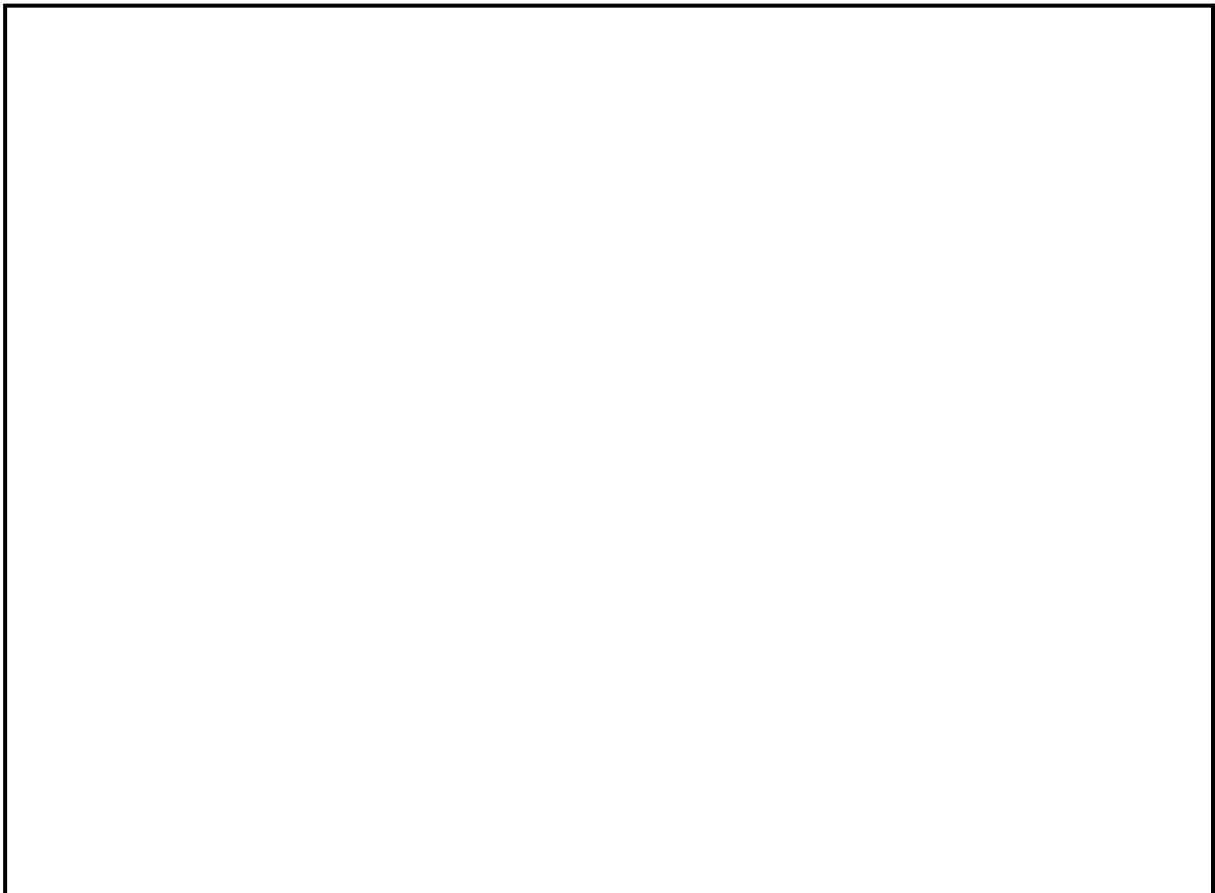
69. Remove the oil level indicator.

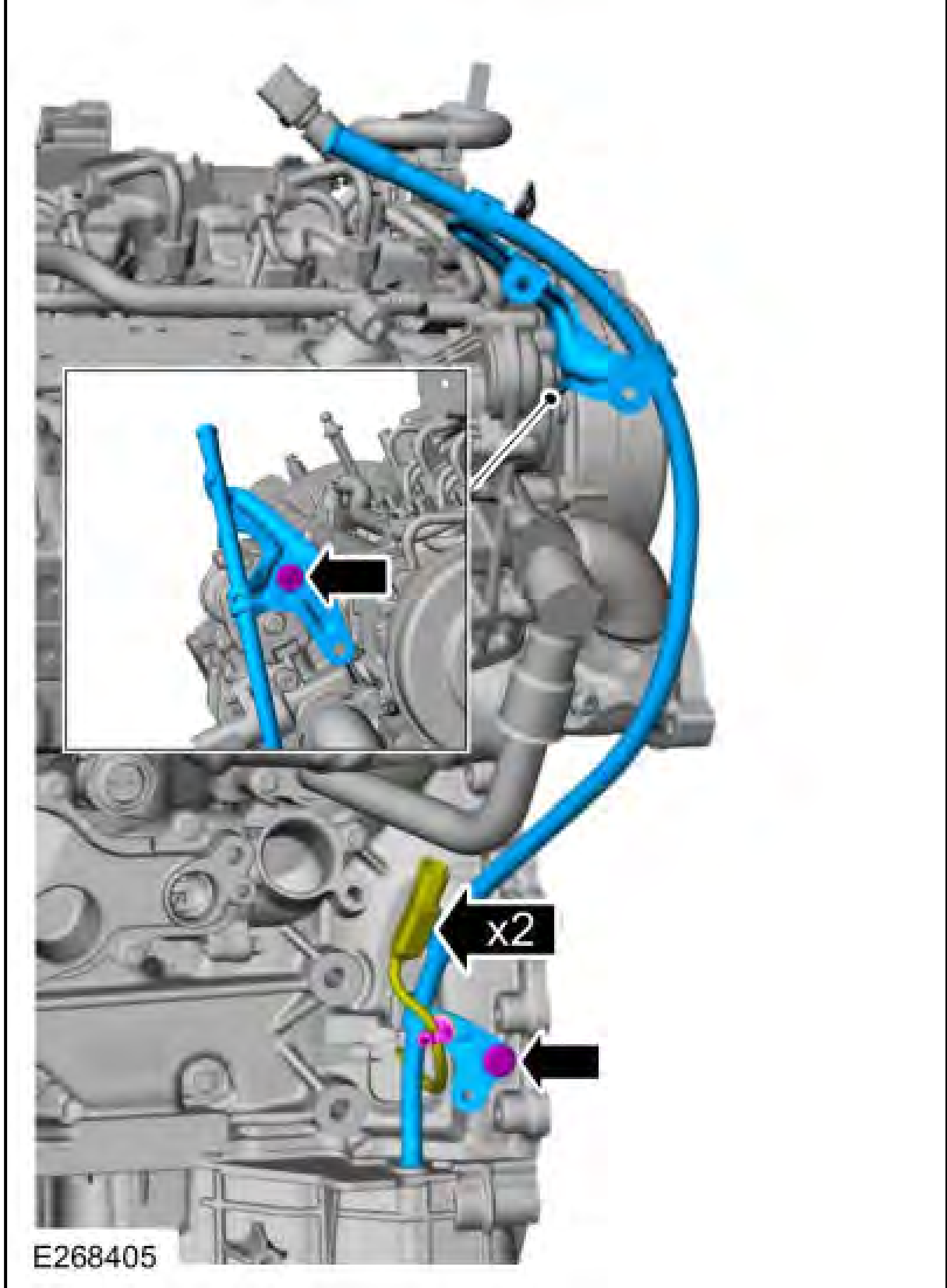




70.

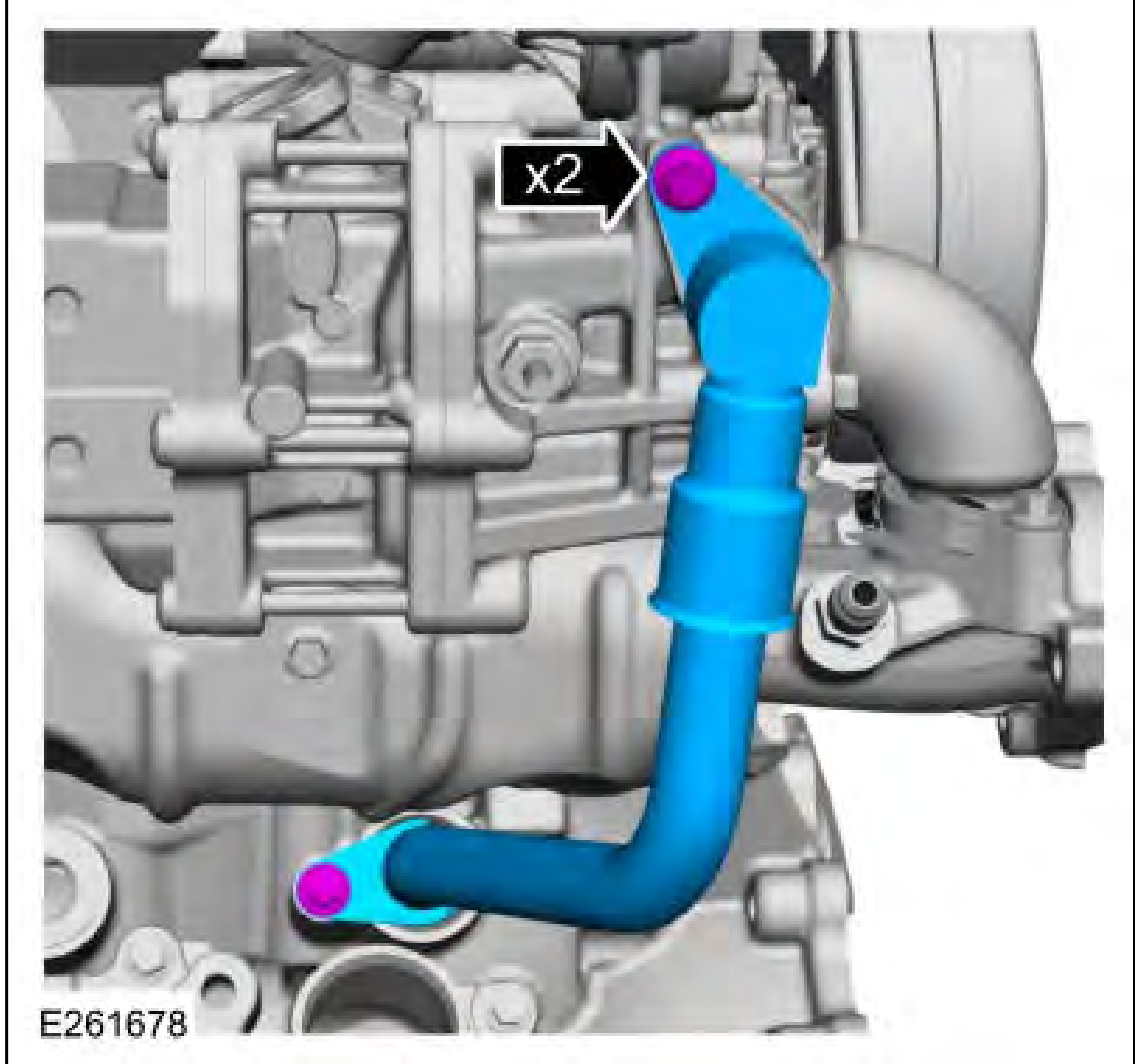
- Disconnect the wire retainers from the oil level indicator tube.
- Remove the stud bolt, the bolt and the oil level indicator tube.



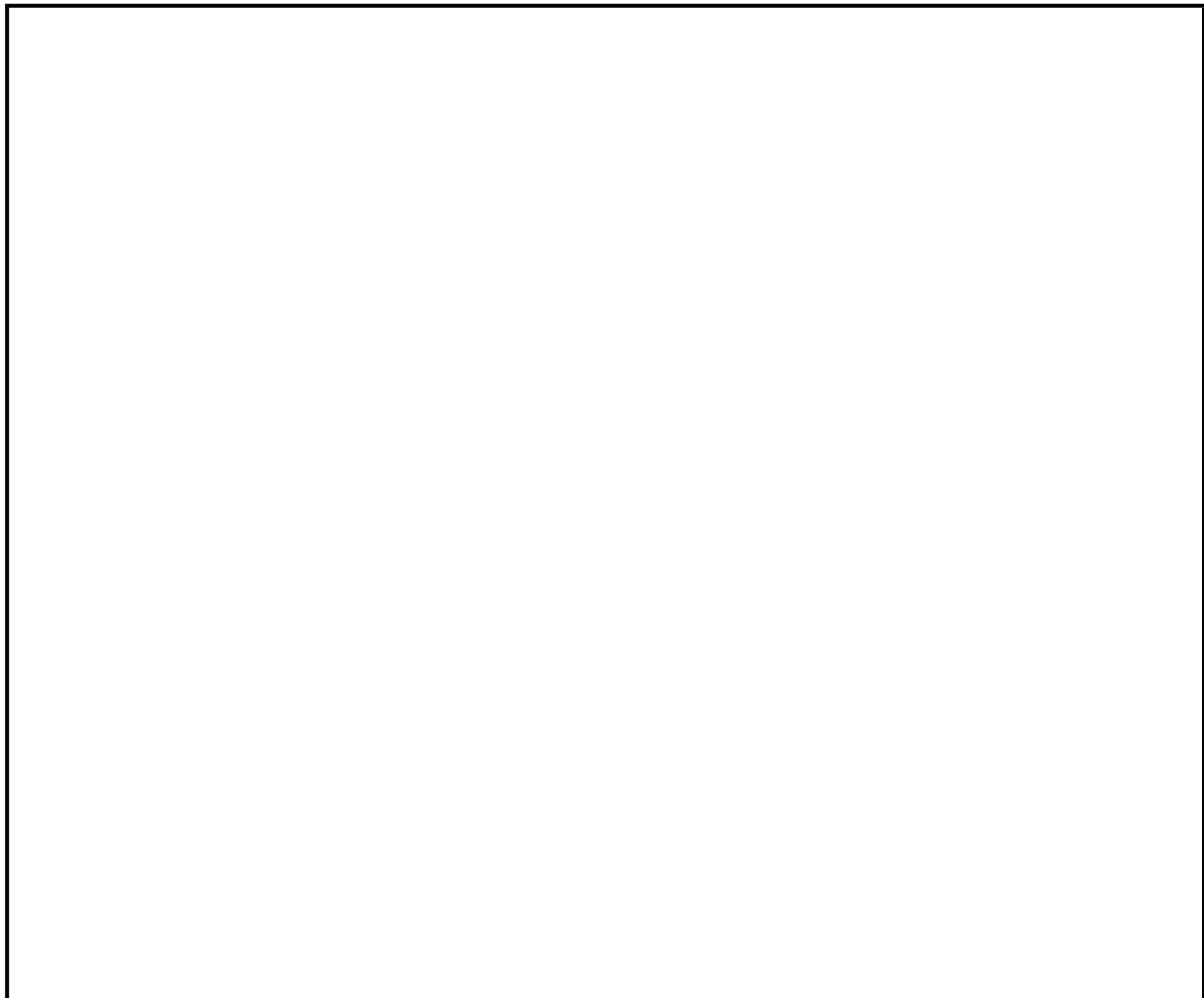


71. Remove the bolts and the EGR coolant tube.





72. Remove and discard the EGR coolant tube O-rings.

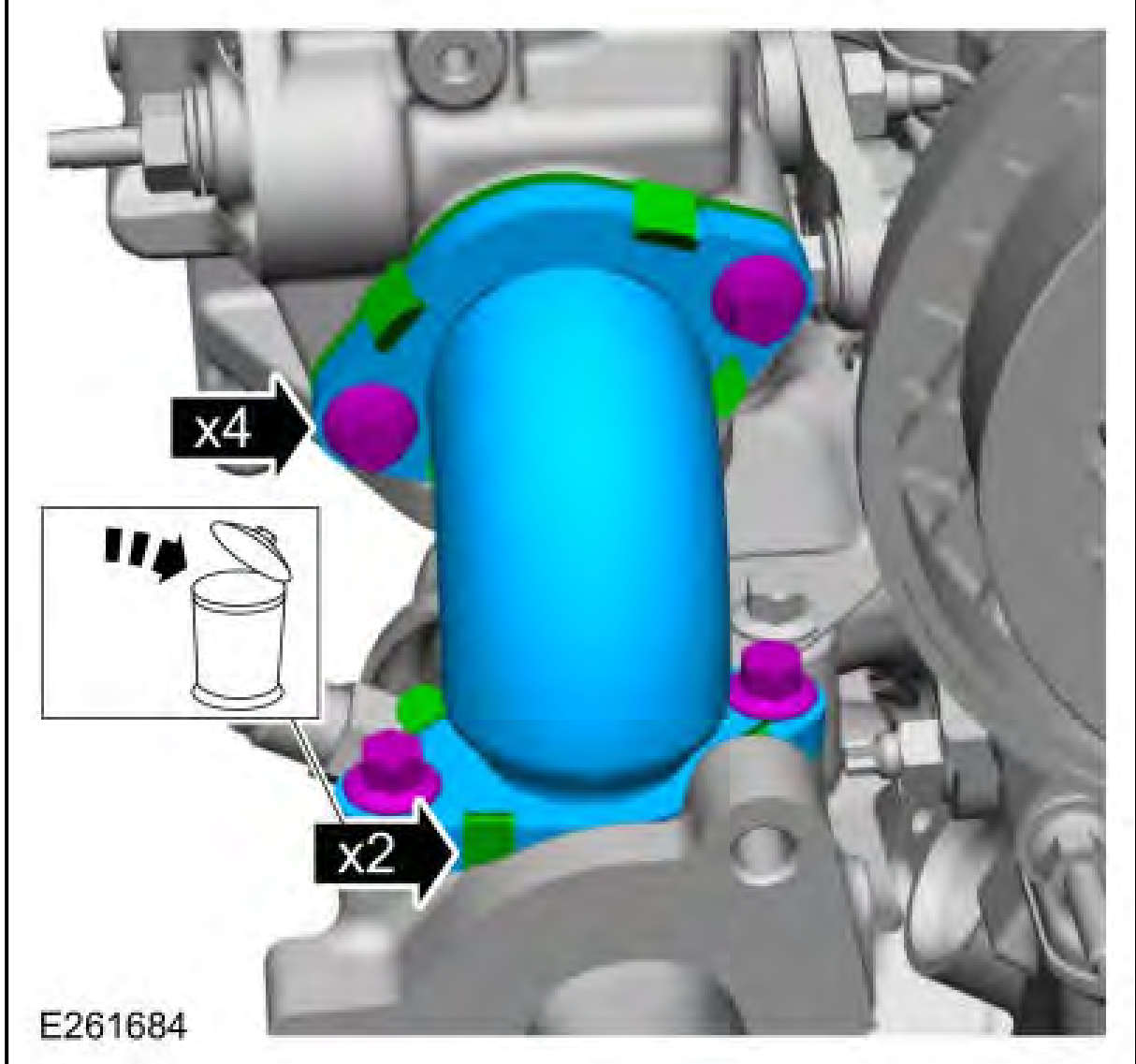




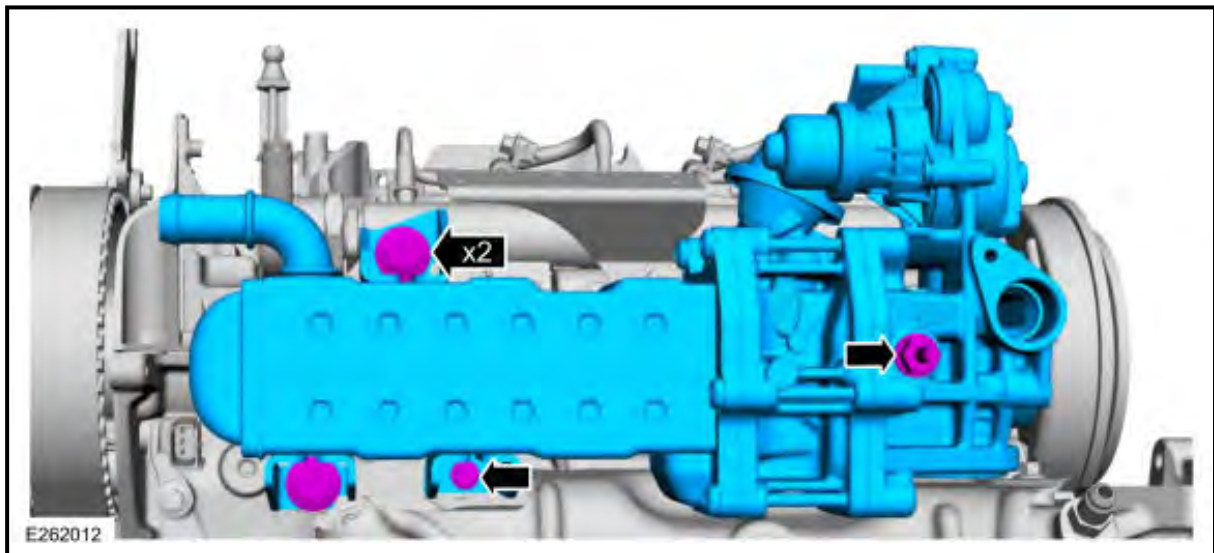


73. Remove the bolts and the EGR cooler-to-exhaust manifold pipe. Remove and discard the gaskets.



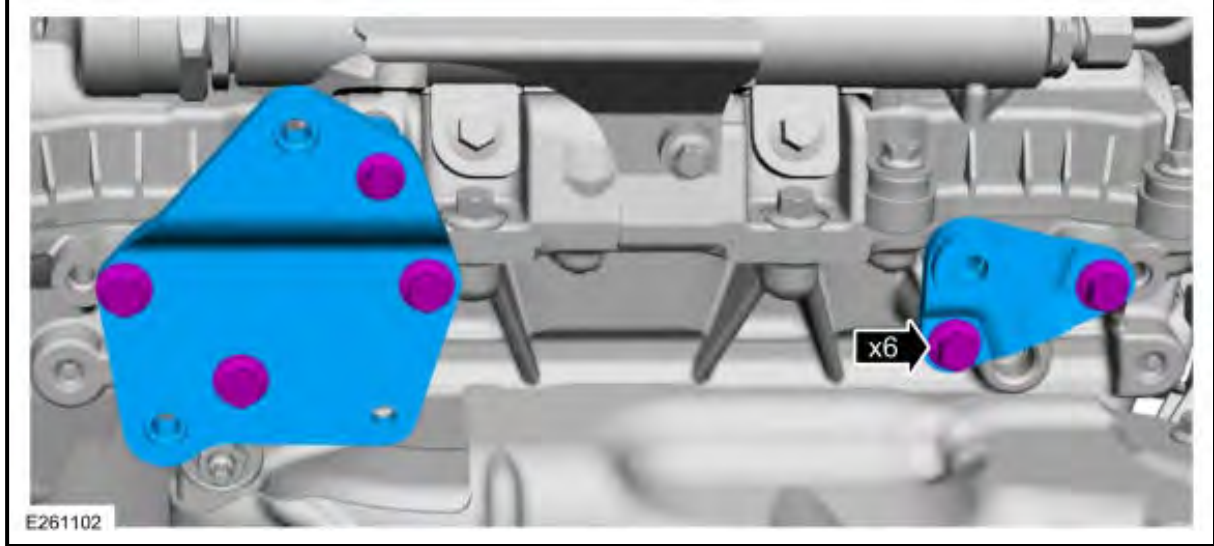


74. Remove the bolts and the EGR cooler.

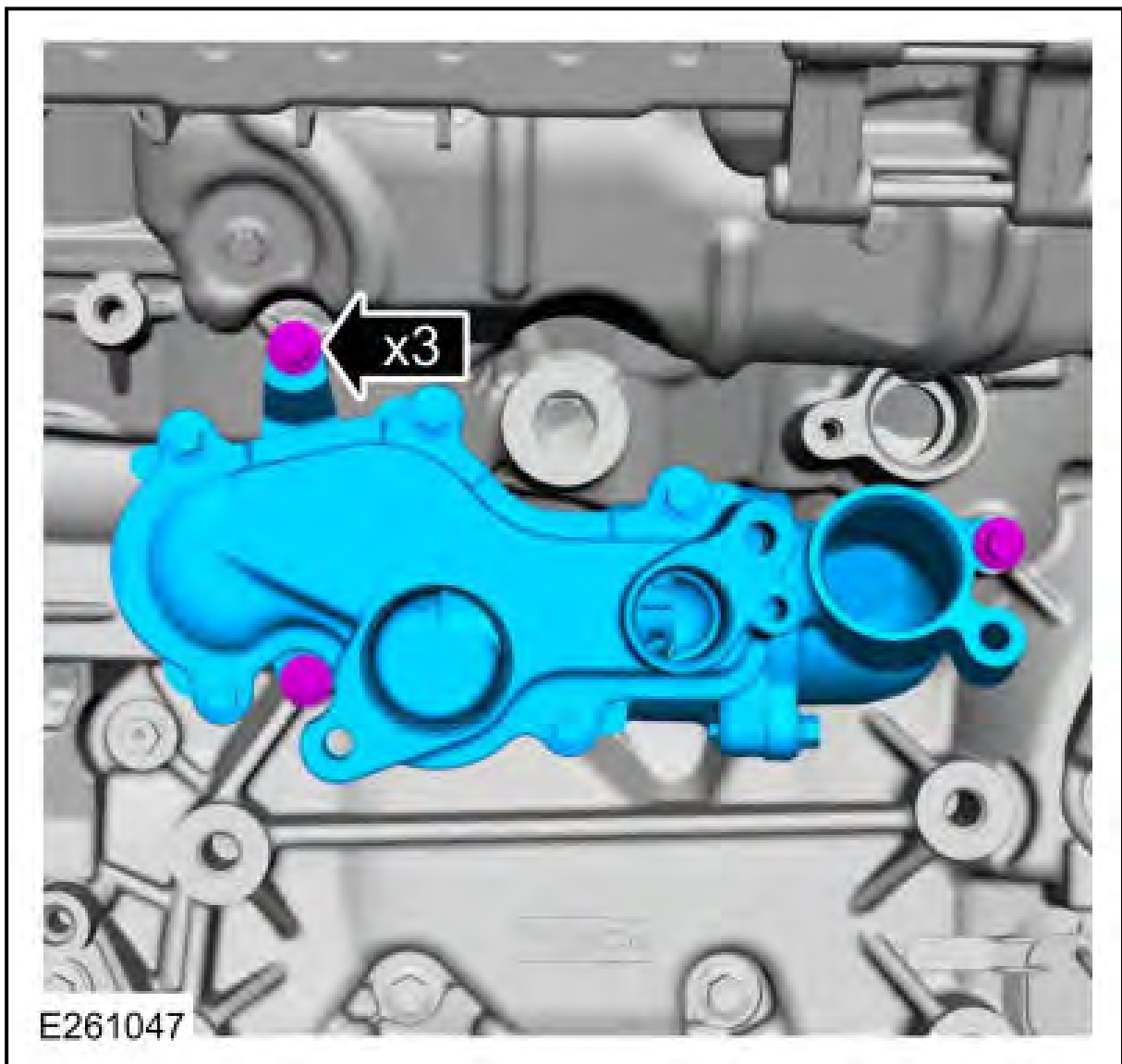


75. Remove the bolts and the EGR cooler brackets.



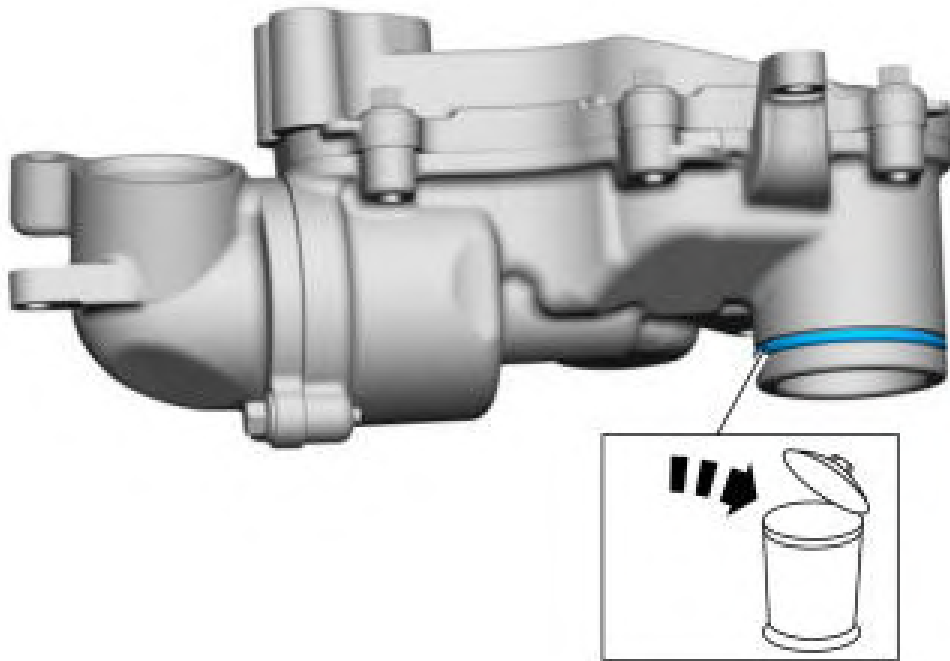


76. Remove the bolts and the coolant inlet connector,



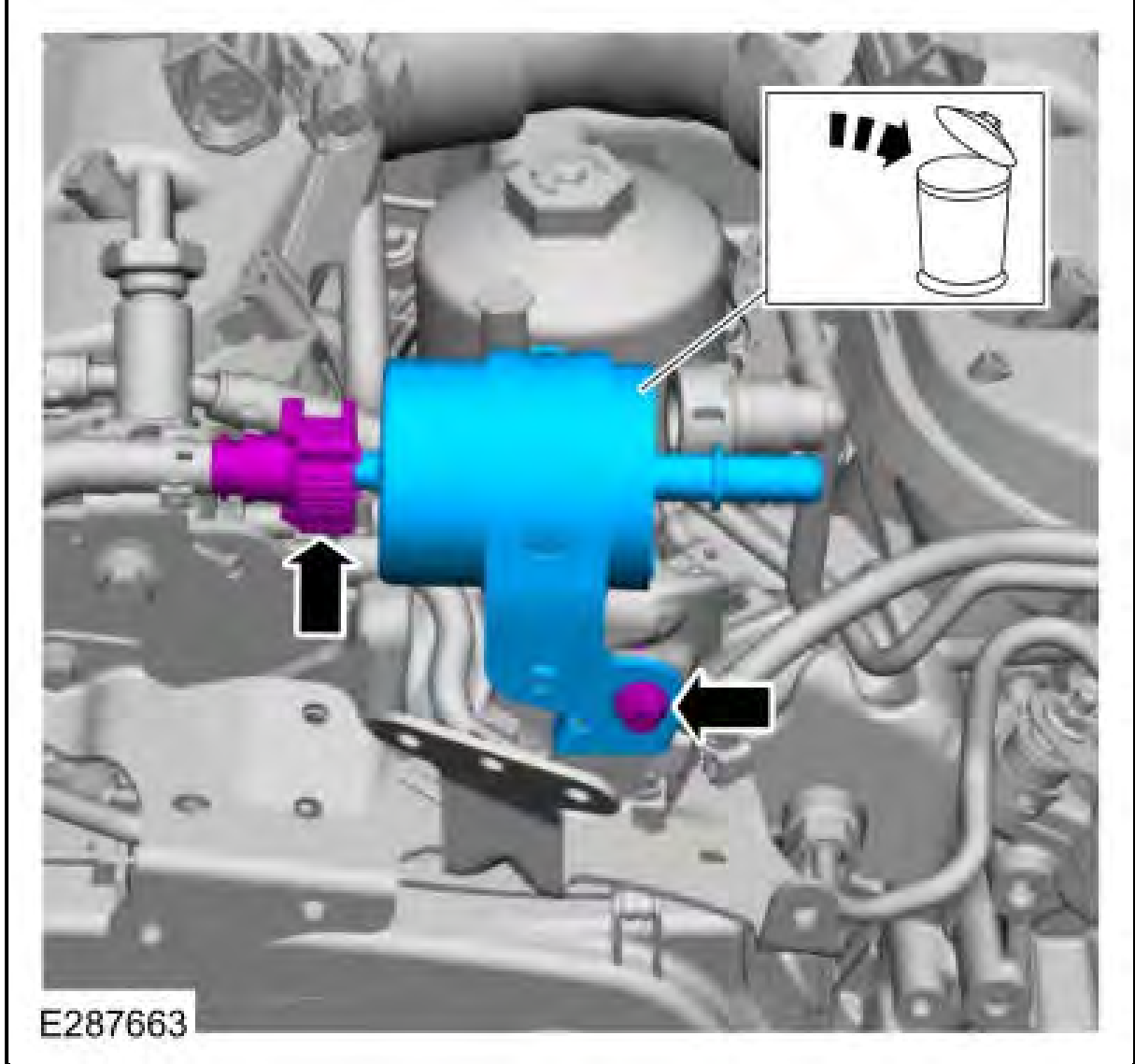
77. Remove and discard the coolant inlet connector O-ring.



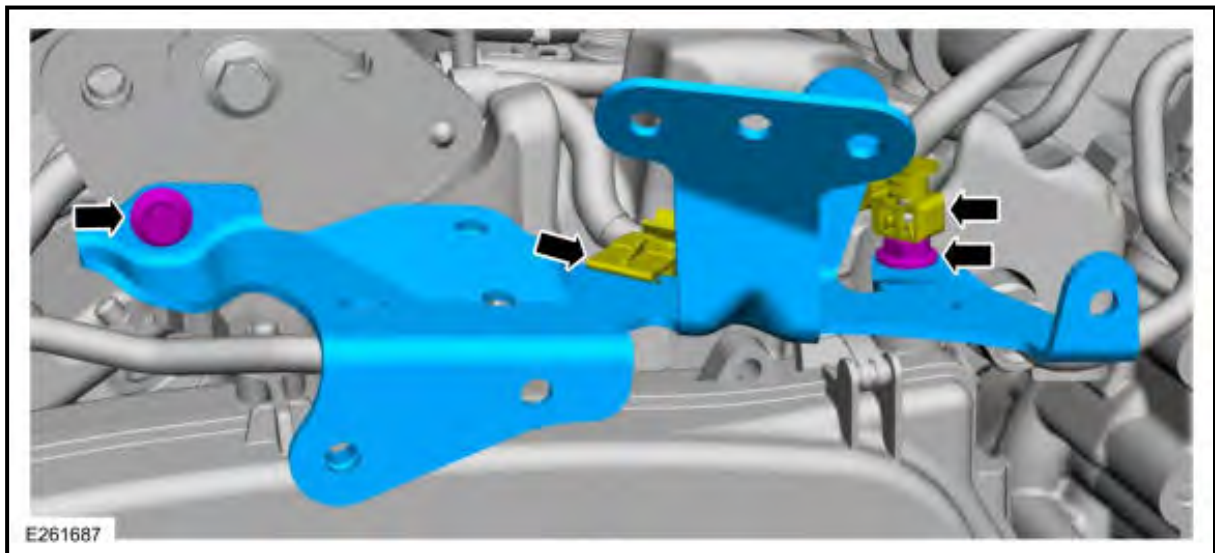


E260941

78. Disconnect the fuel line. Remove the bolt and the secondary fuel filter. Discard the secondary fuel filter. Refer to: [Quick Release Coupling](#) .

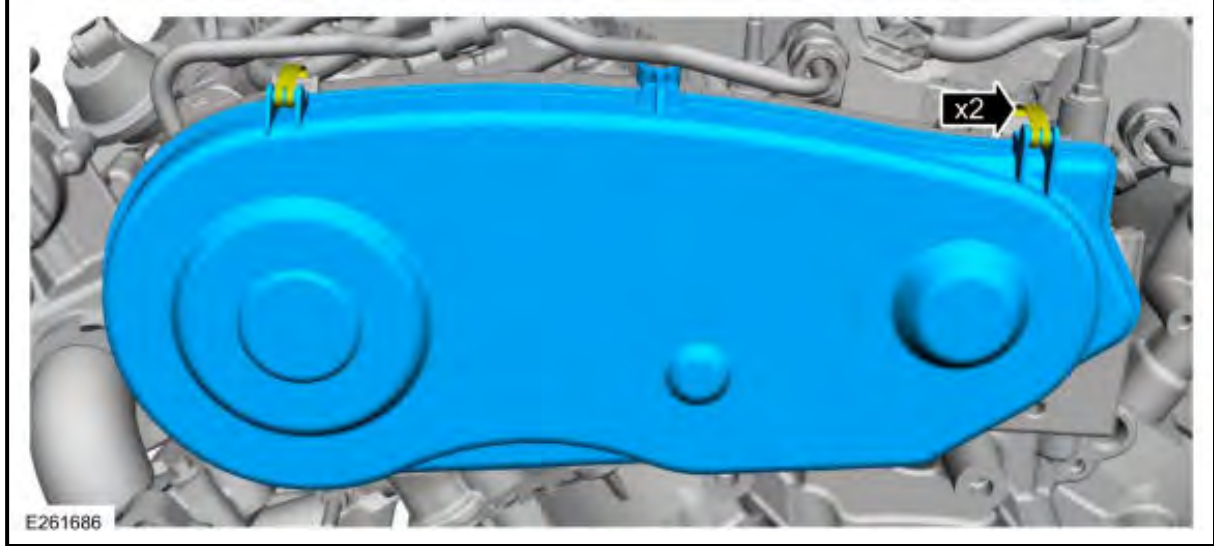


79. Disconnect the retainers. Remove the nut, the bolt and the wiring harness bracket.

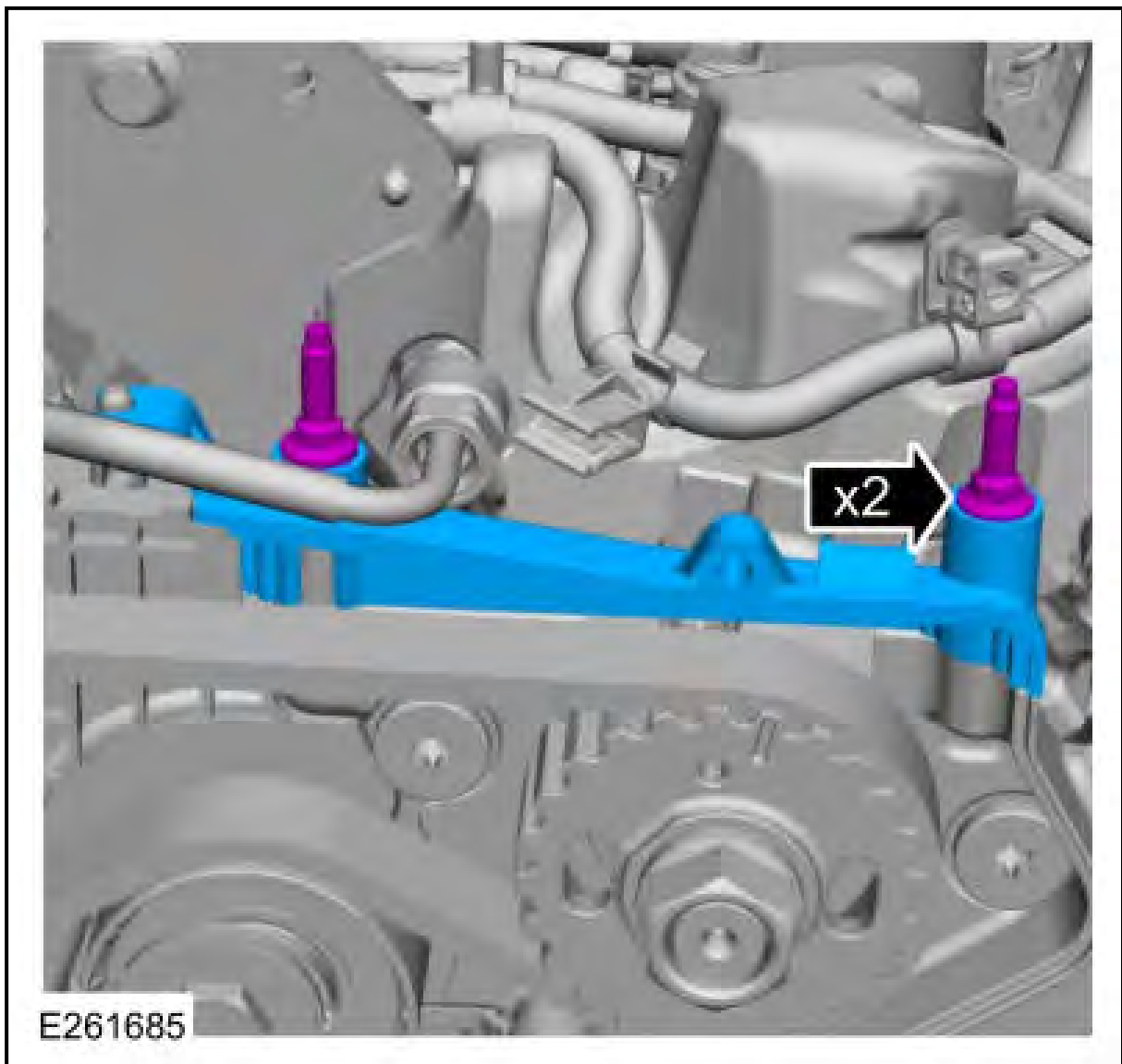


80. Remove the accessory drive cover.

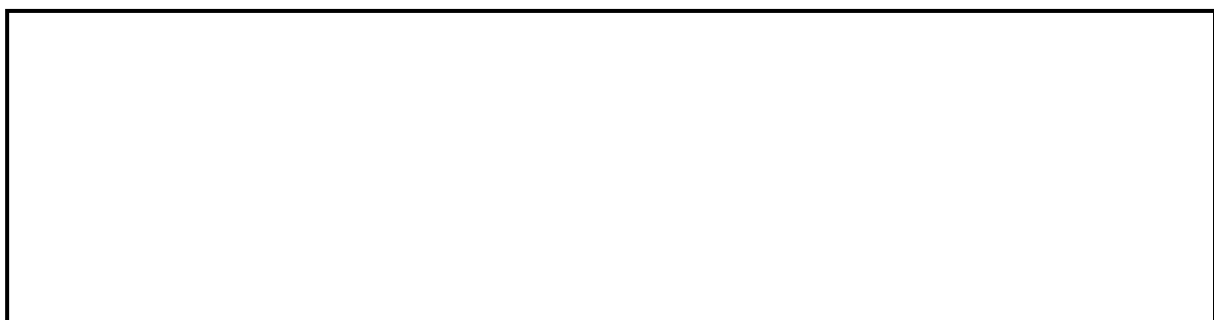


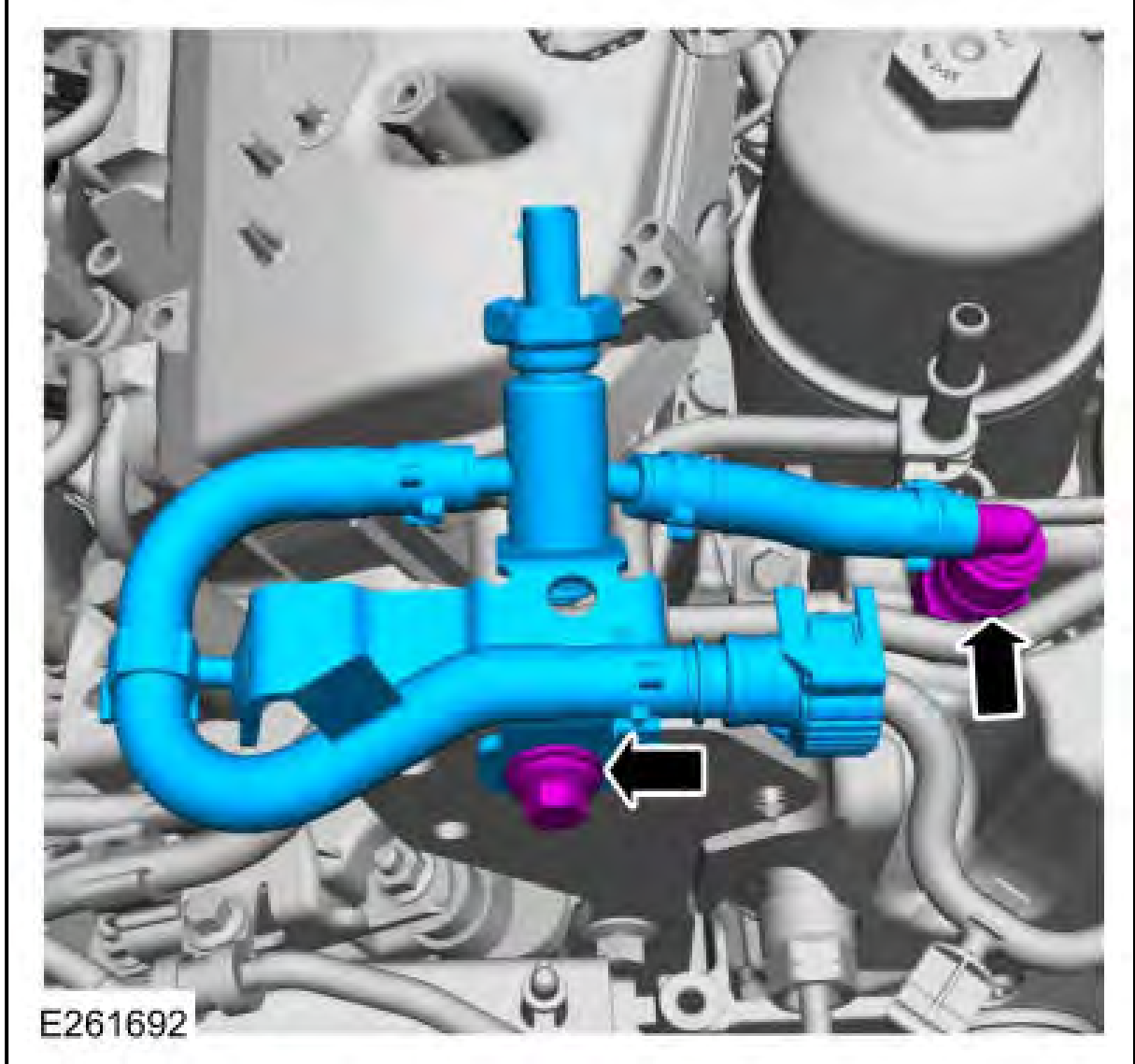


81. Remove the stud bolts and the accessory drive cover.

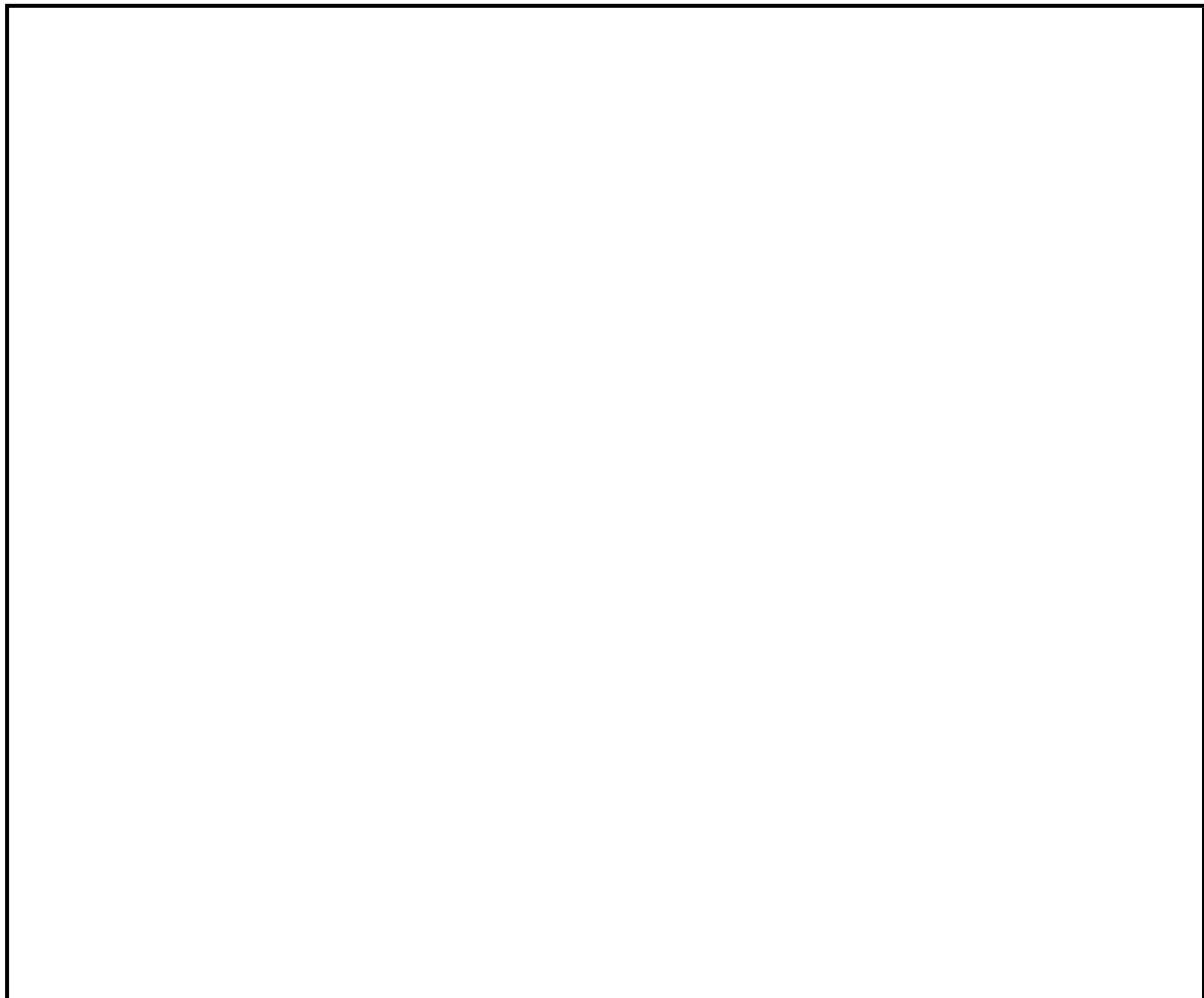


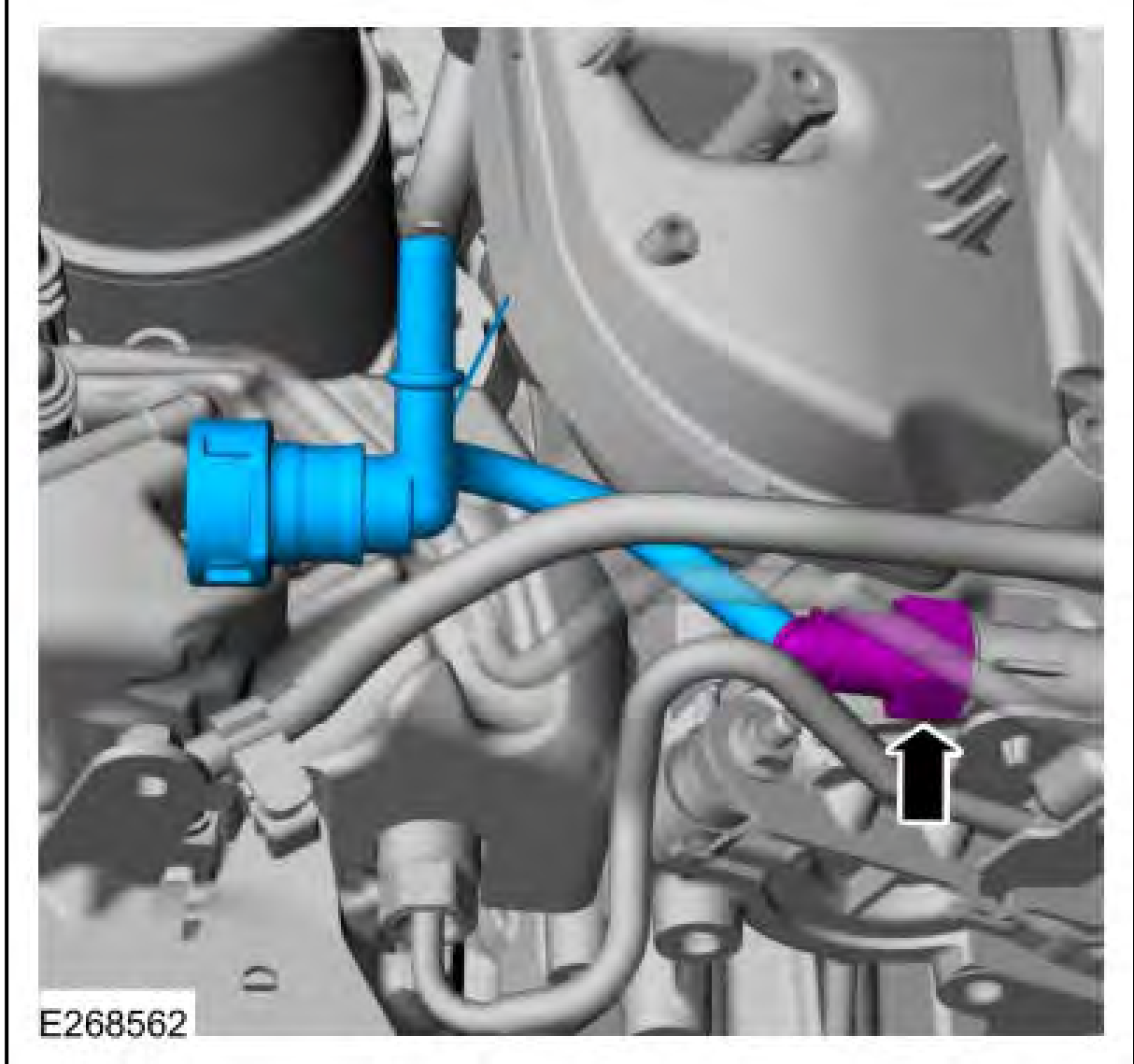
82. Remove the bolt. Disconnect and remove the fuel supply tube. Refer to: [Quick Release Coupling](#)



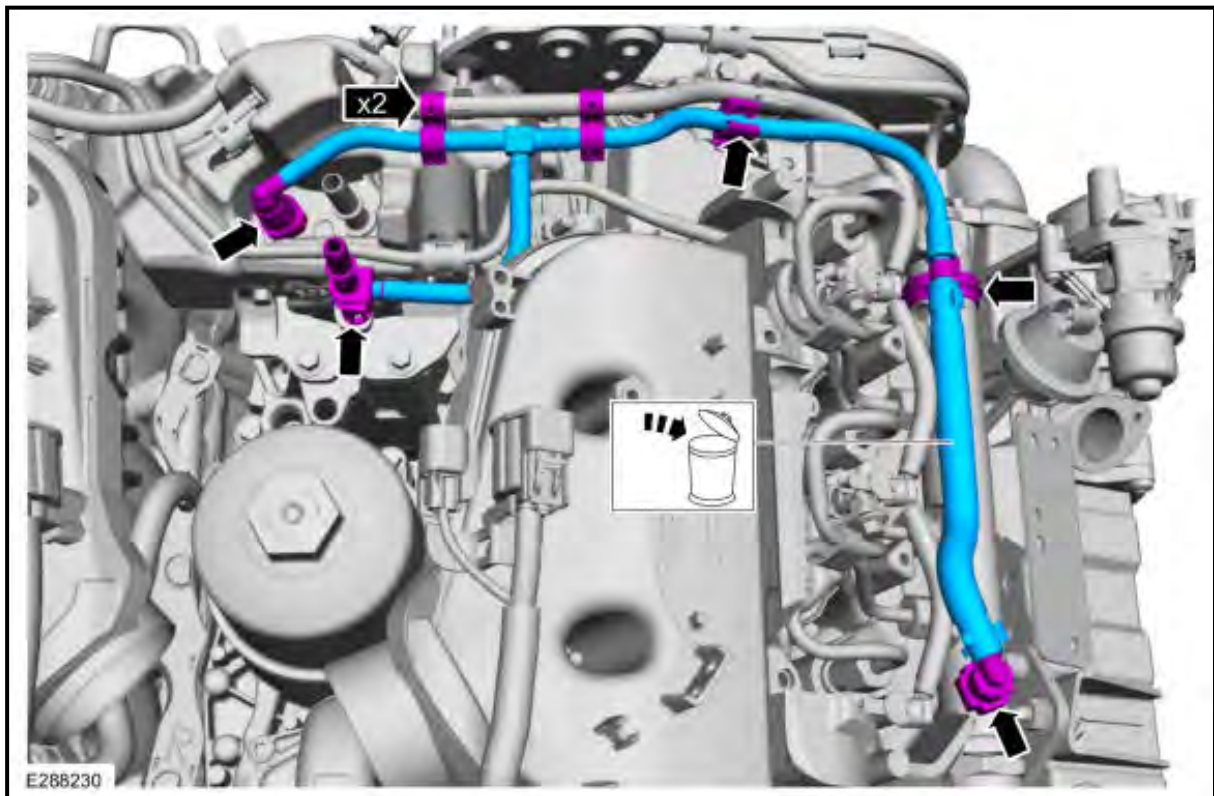


83. Disconnect and remove the fuel supply tube. Refer to: [Quick Release Coupling](#) .

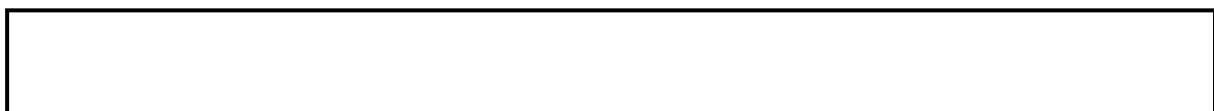




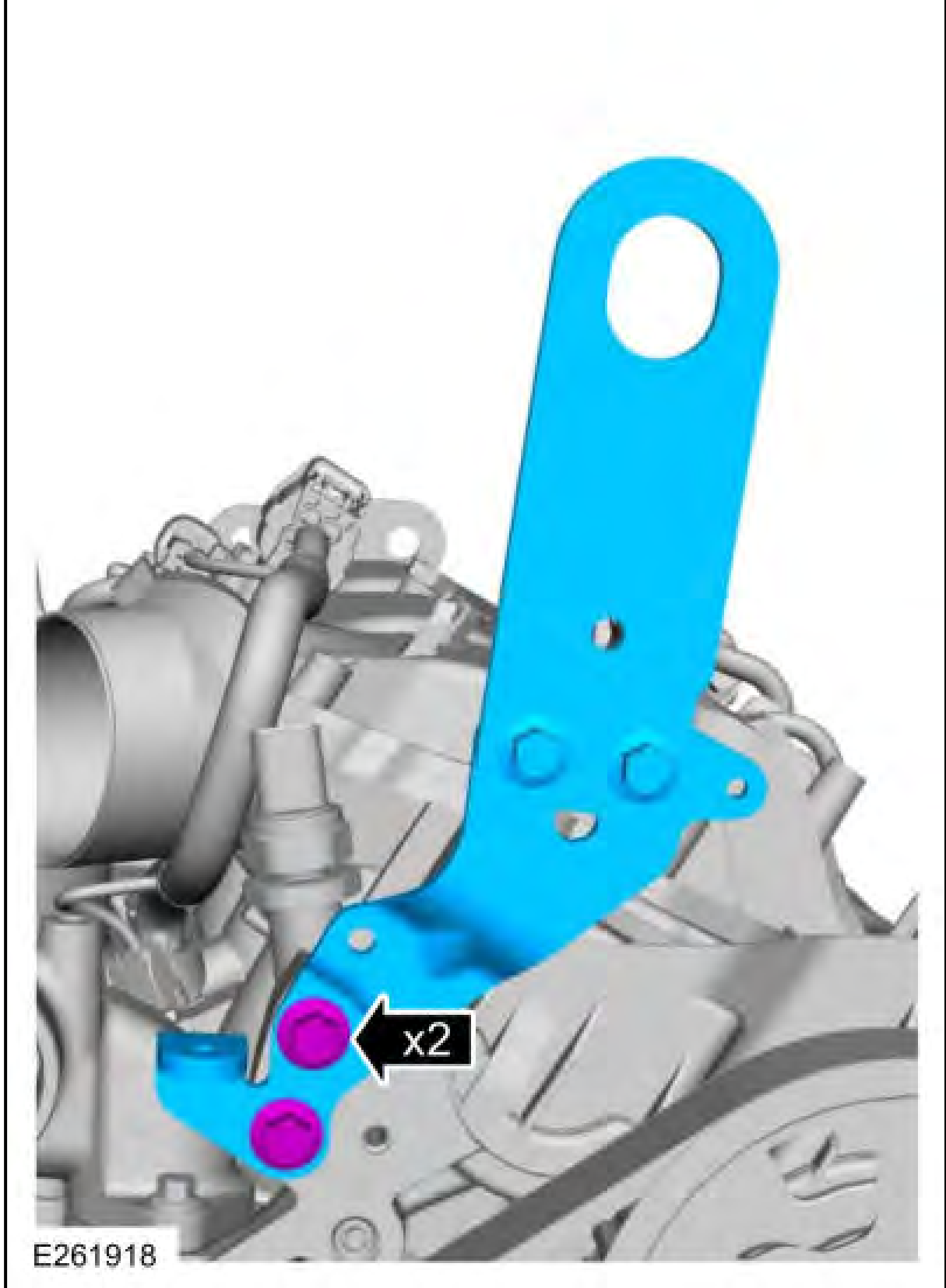
84. Remove and discard the fuel return tube assembly. Refer to: [Quick Release Coupling](#) .



85. Remove the bolts and the front engine lifting eye.



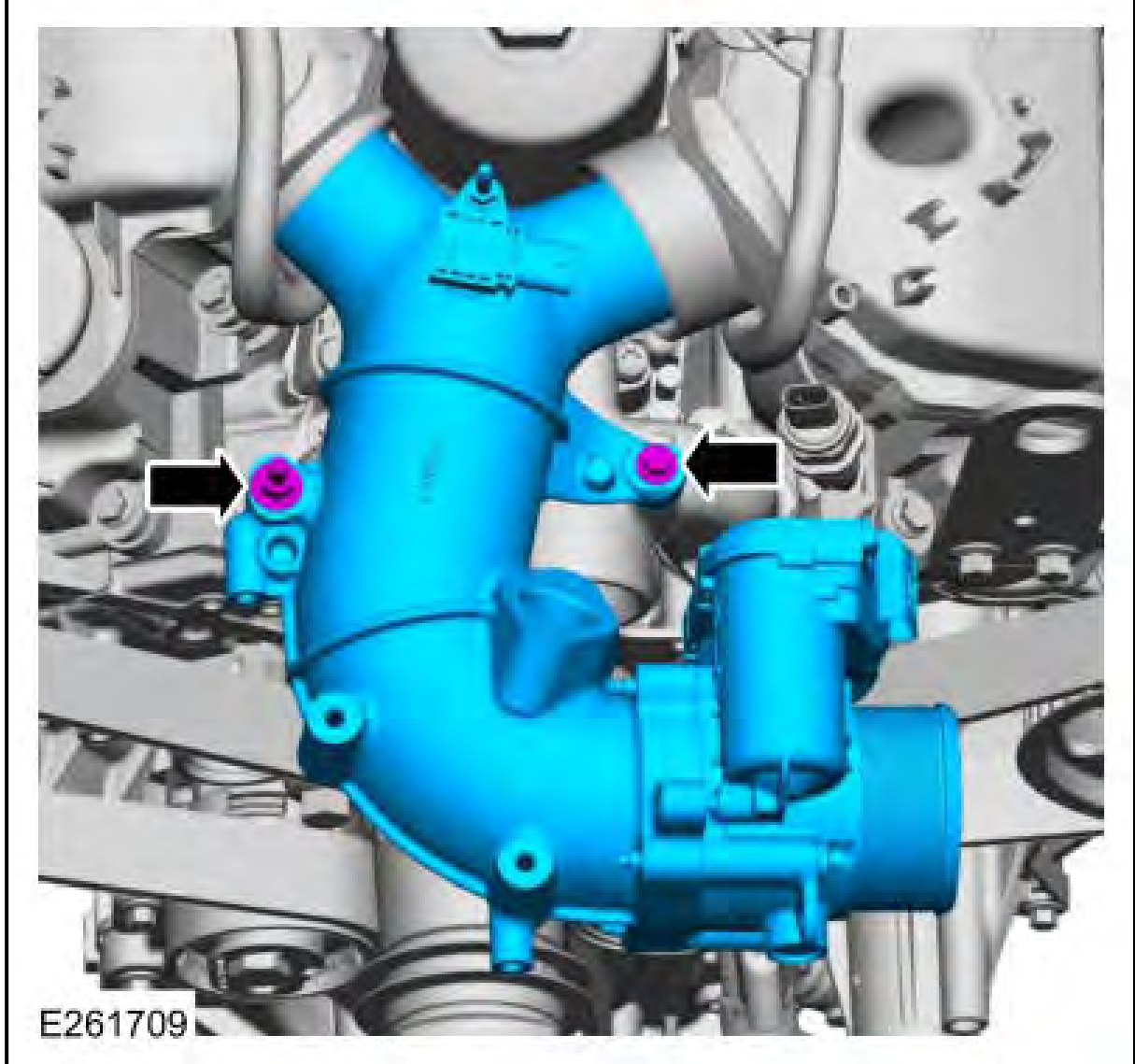




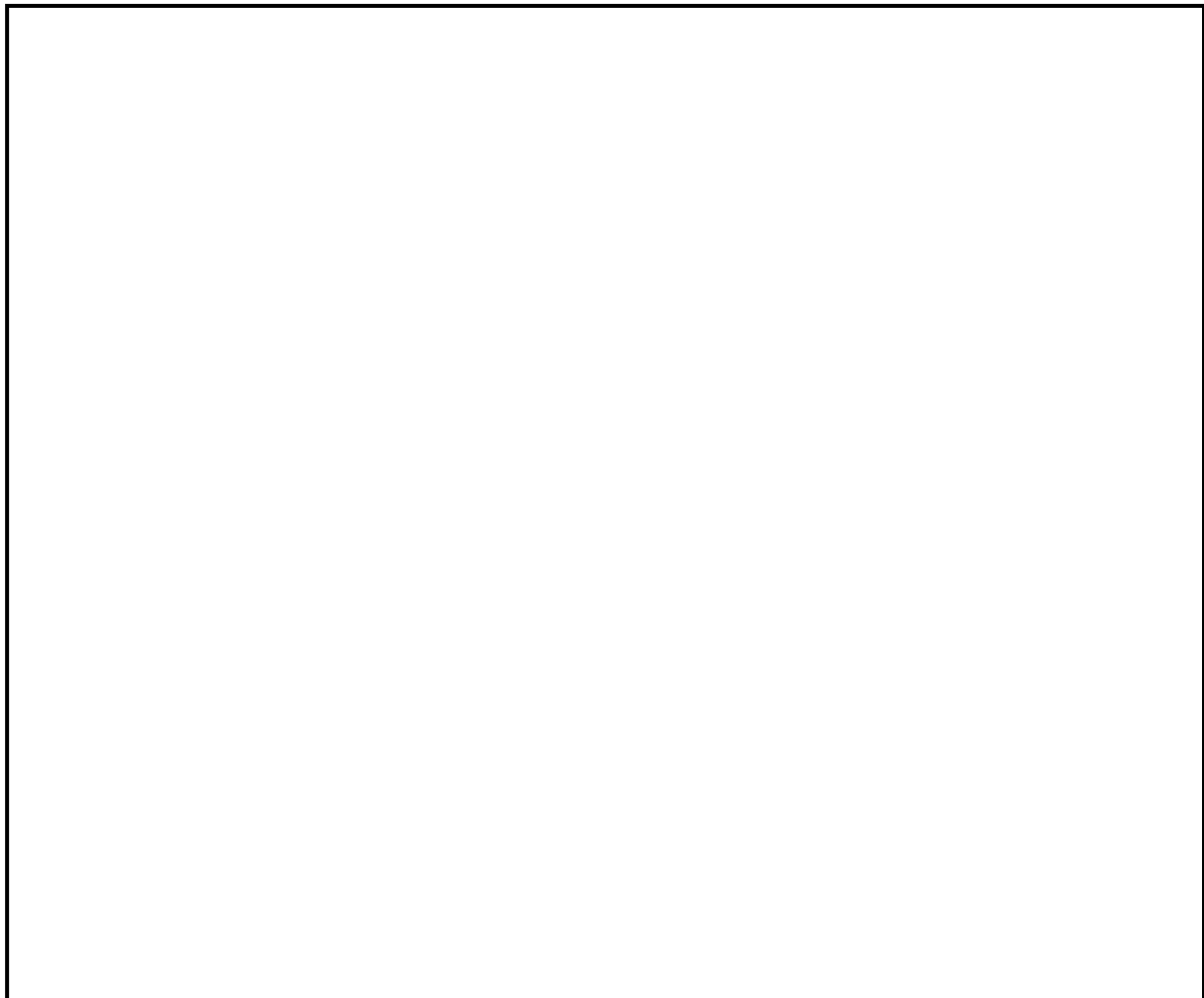
86. **NOTE:** Lift the front of the intake manifold up and slide the intake manifold to the right to remove.

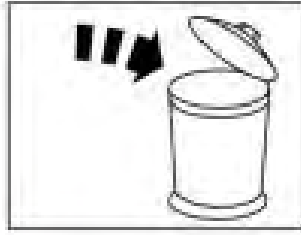
Remove the stud bolt, the bolt and the intake manifold.





87. Remove and discard the intake manifold gaskets.

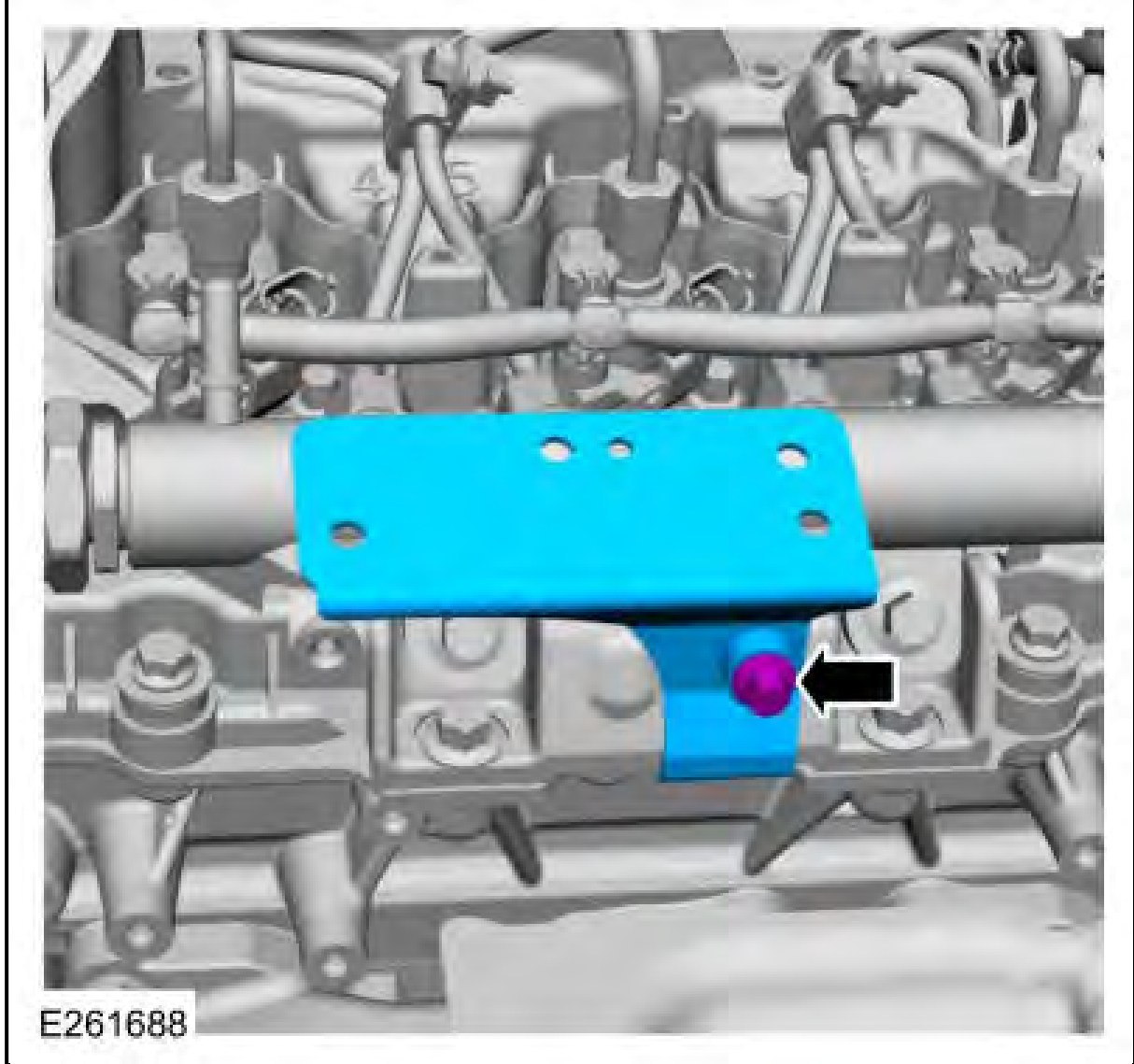




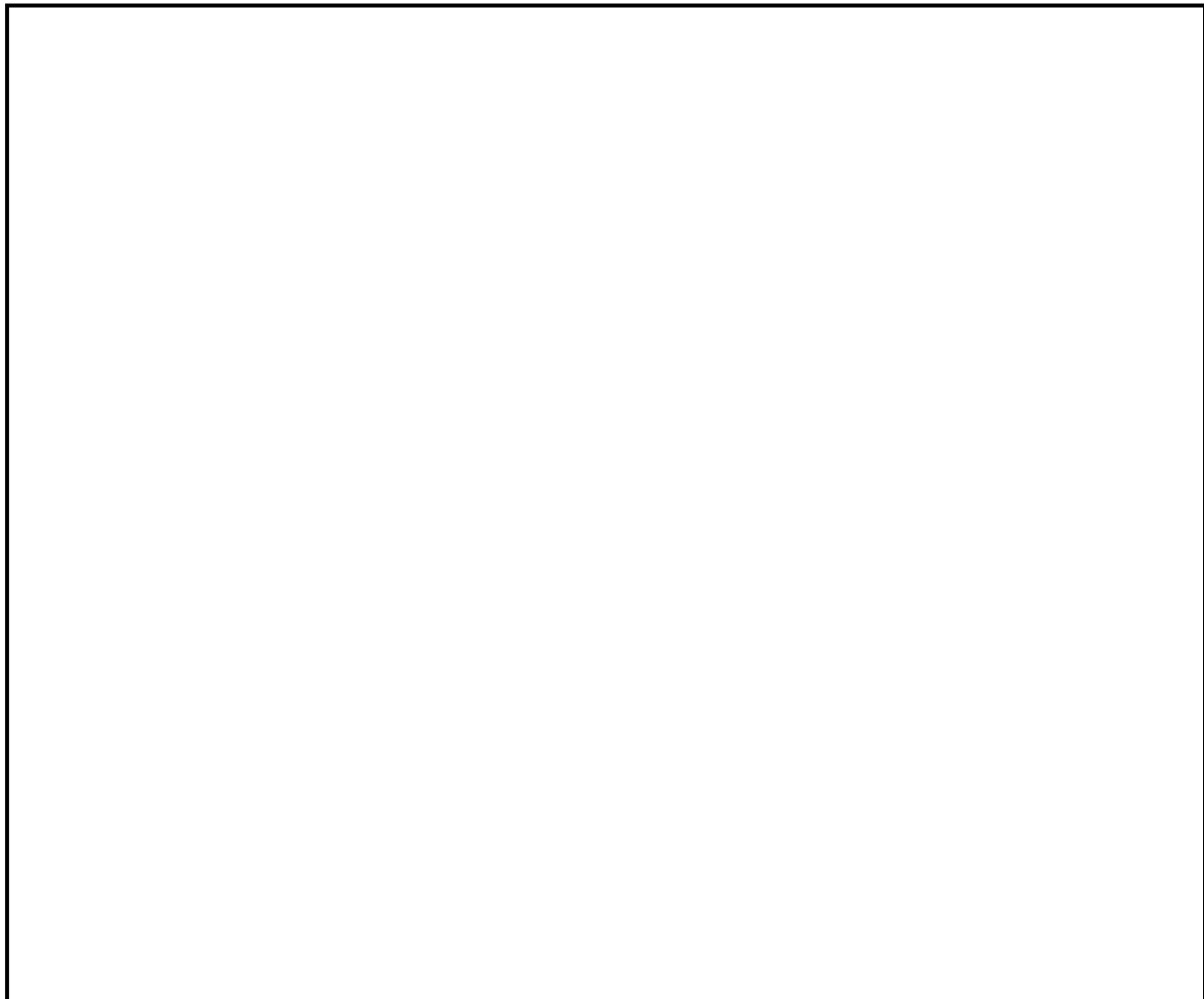
E261593

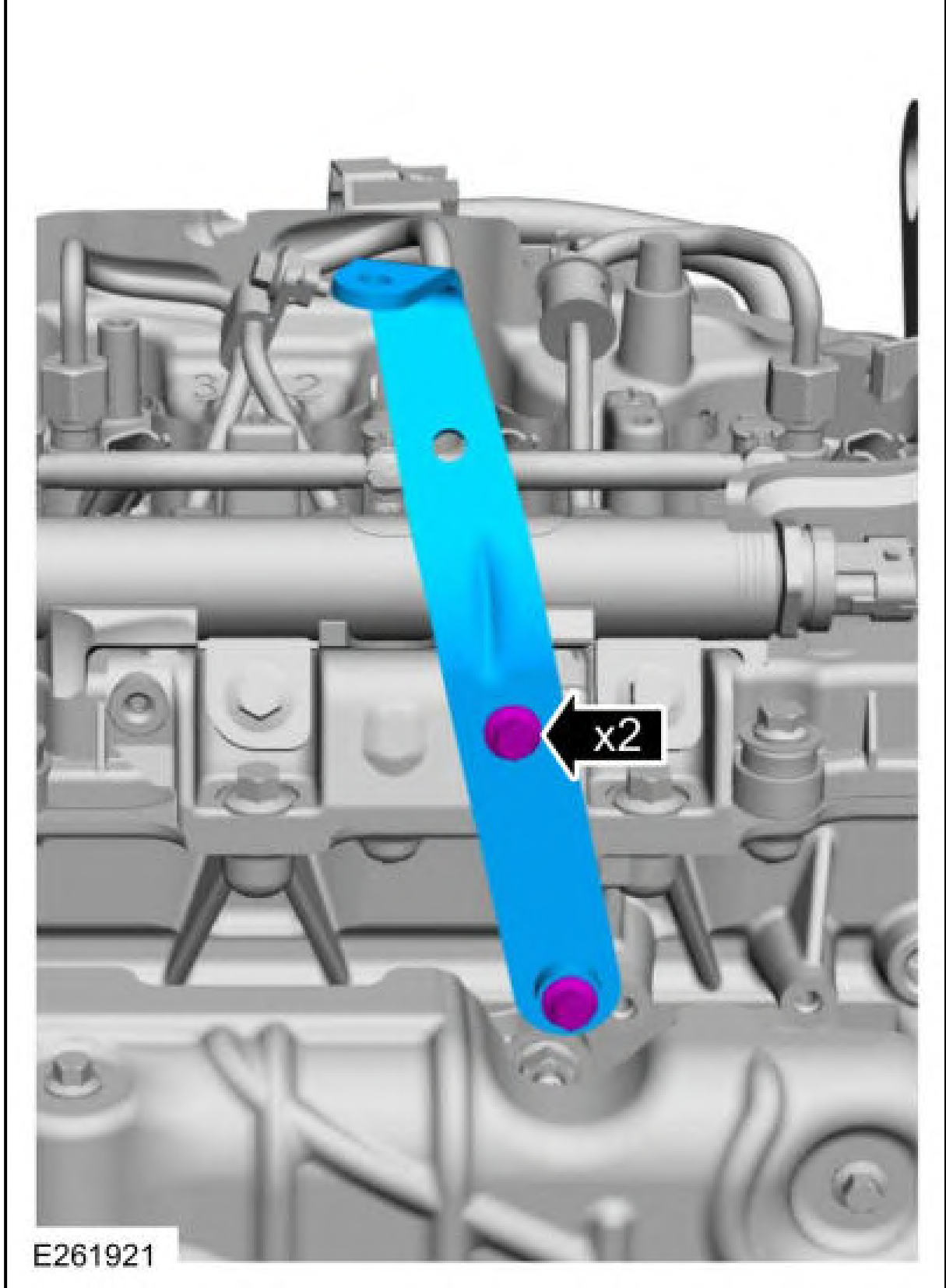
88. Remove the bolt and the wire harness bracket.





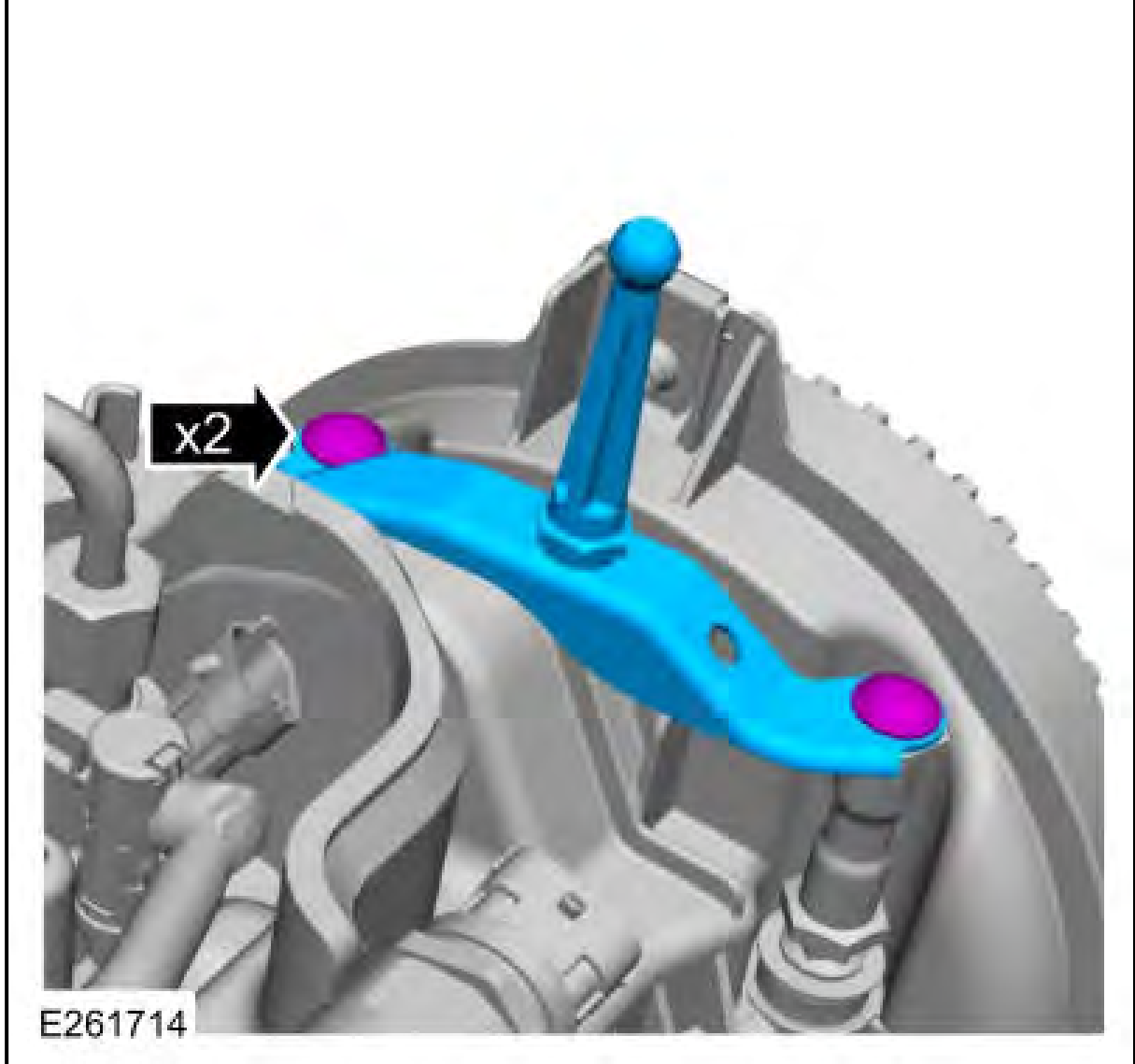
89. Remove the bolts and the heater hose support bracket.



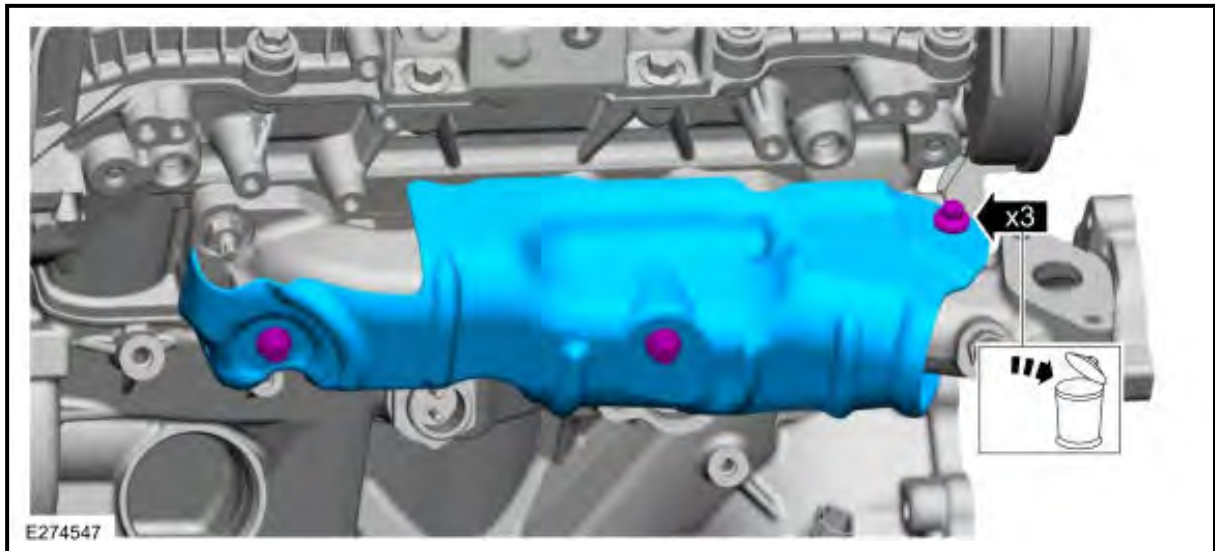


90. Remove the retainers and the engine support bracket.



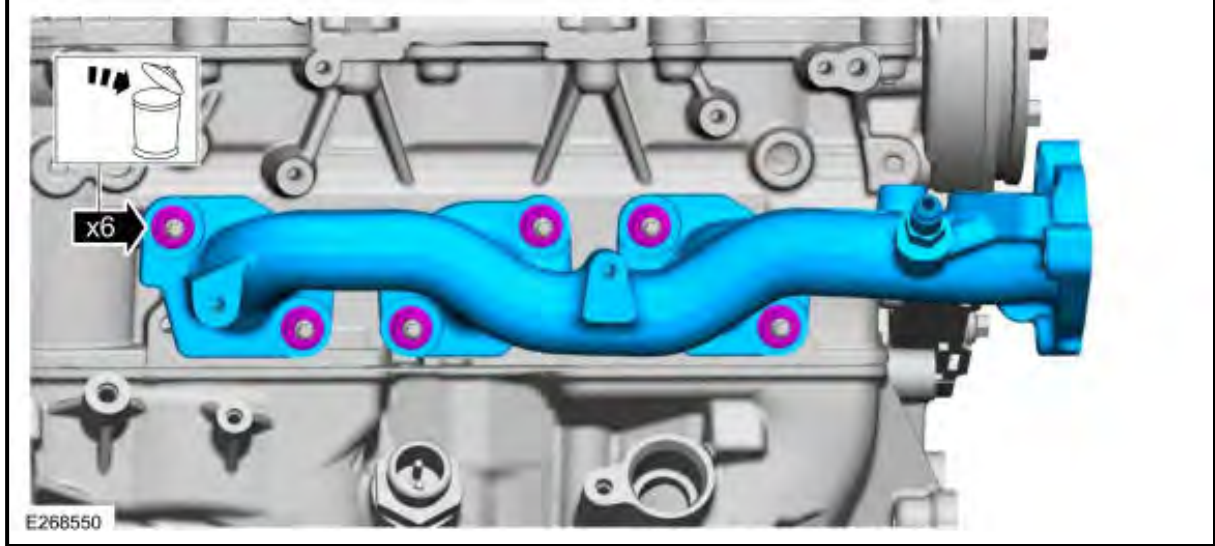


91. Remove the bolts and the LH exhaust manifold heat shield. Discard the bolts.



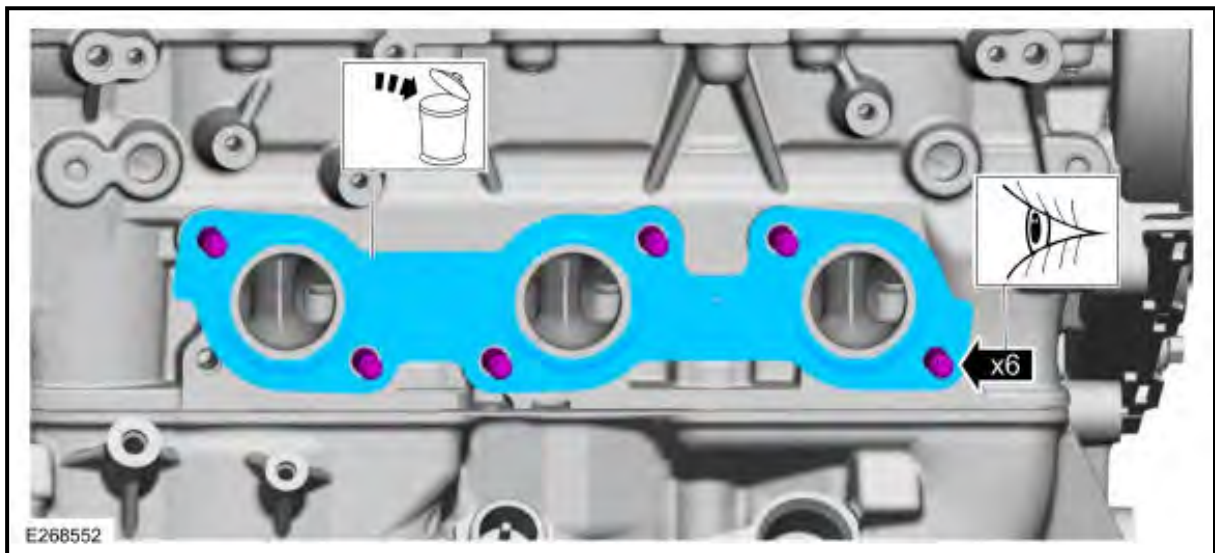
92. Remove the nuts and the LH exhaust manifold. Discard the nuts.



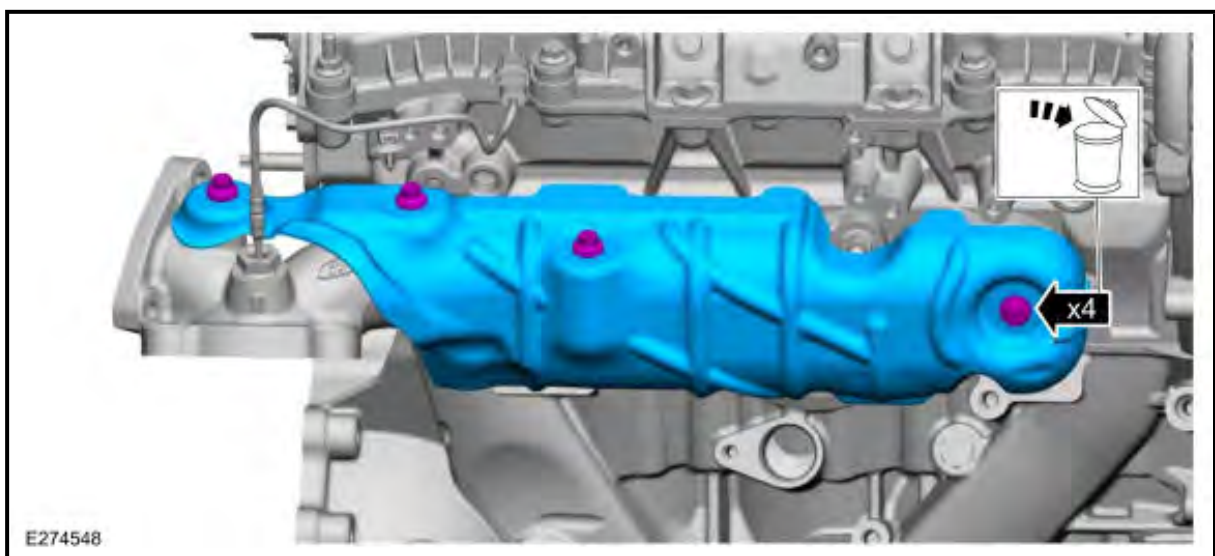


93.

- Remove and discard the LH exhaust manifold gasket.
- Inspect the exhaust manifold studs. Replace as necessary.

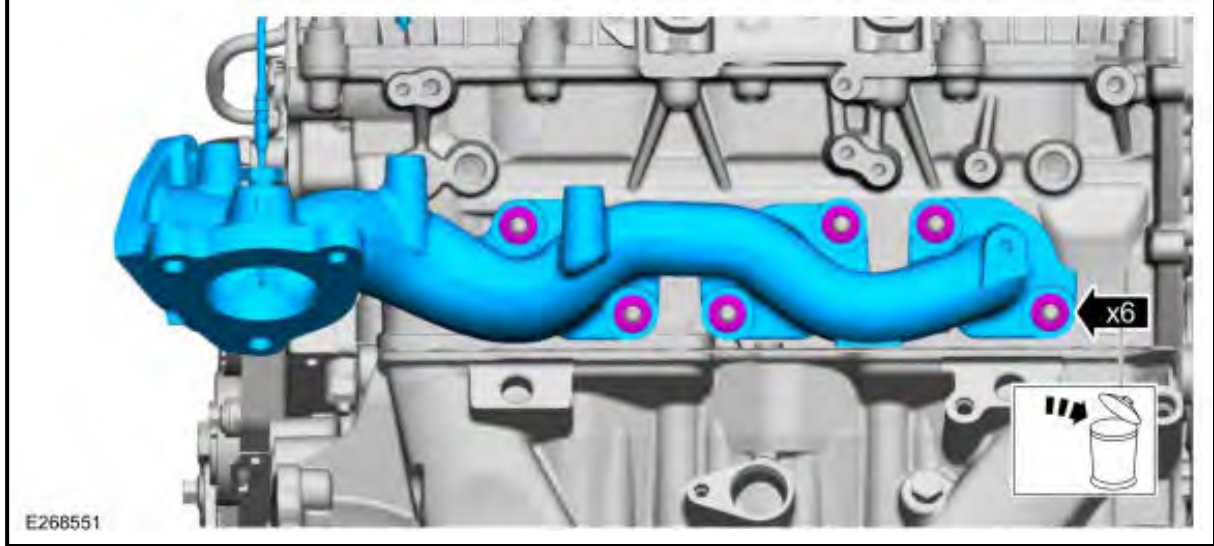


94. Remove the bolts and the RH exhaust manifold heat shield. Discard the bolts.



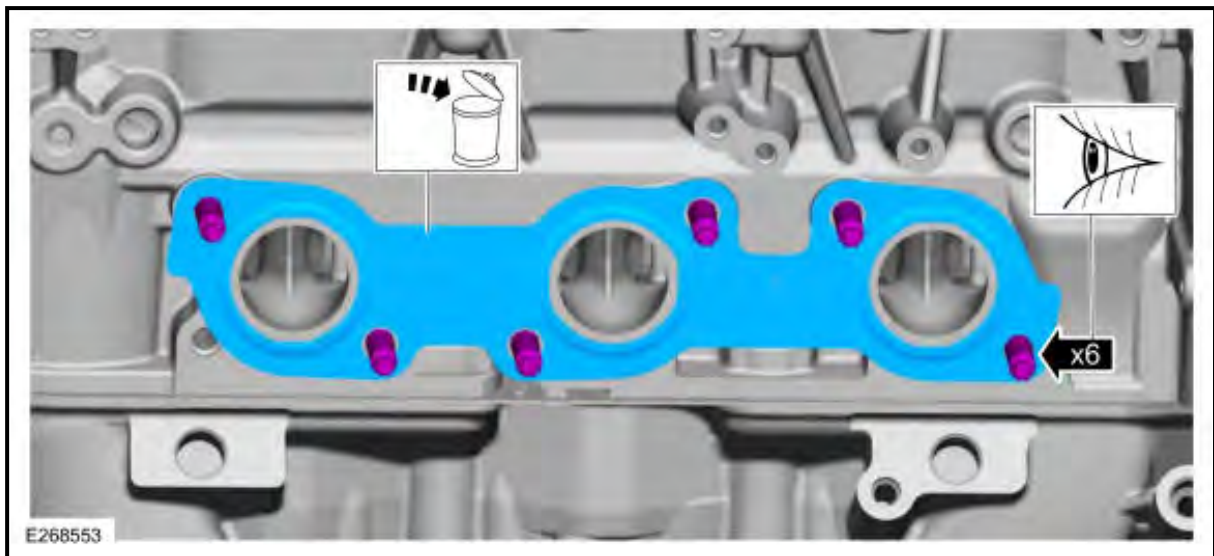
95. Remove the nuts and the RH exhaust manifold.





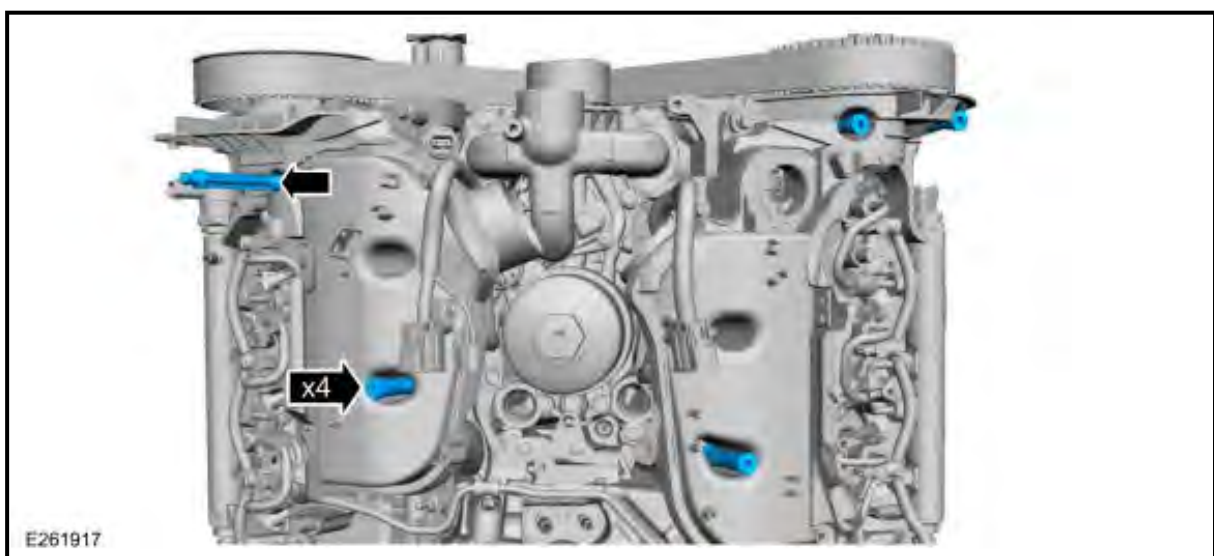
96.

- Remove and discard the RH exhaust manifold gasket.
- Inspect the exhaust manifold studs. Replace as necessary.

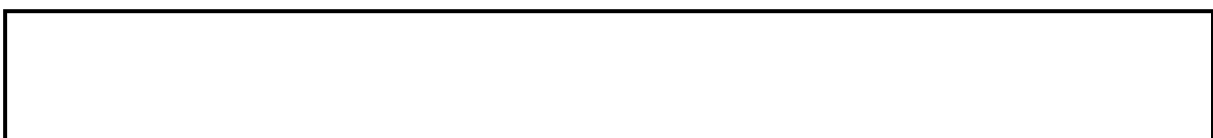


97. Clean and inspect the exhaust manifolds. Refer to: [Exhaust Manifold Cleaning and Inspection](#) .

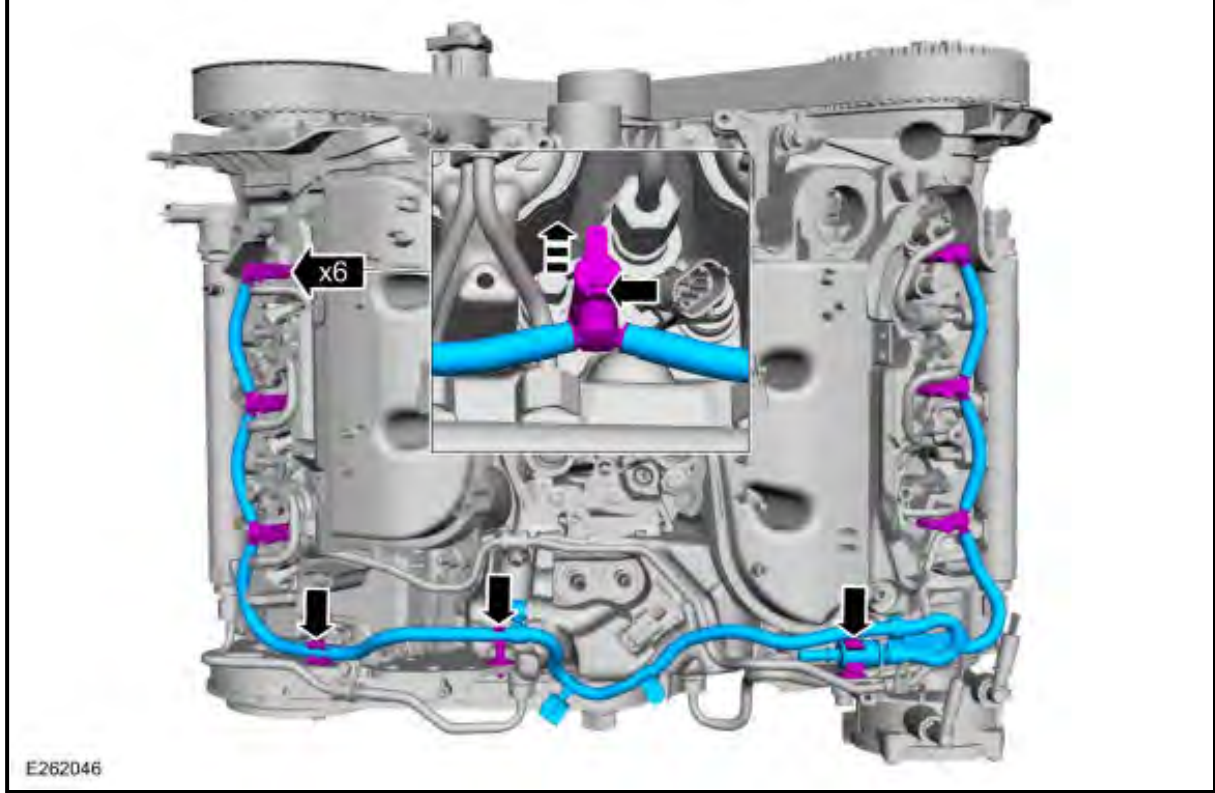
98. Remove the engine cover stud assemblies.



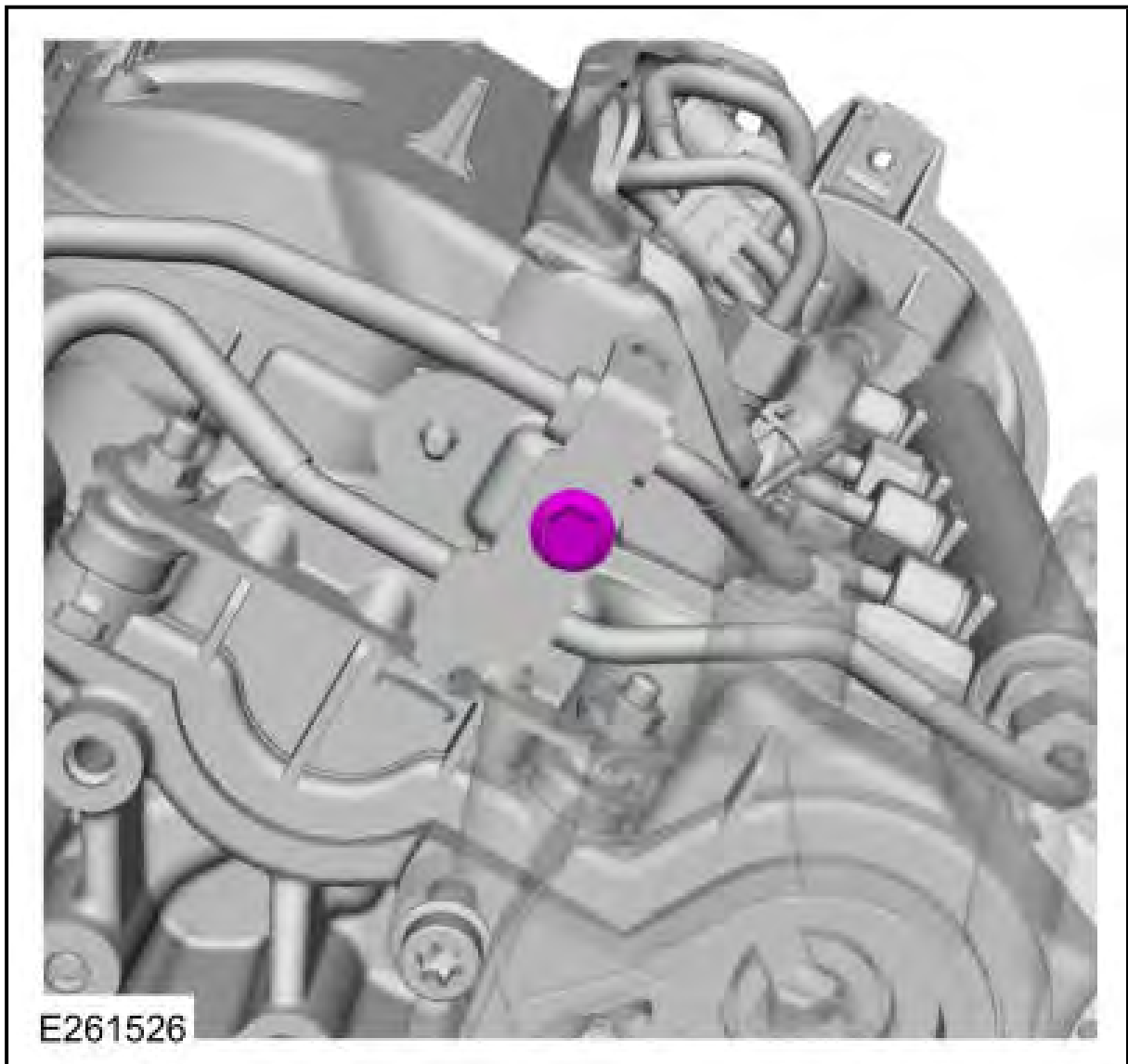
99. Remove the fuel return hose assembly.



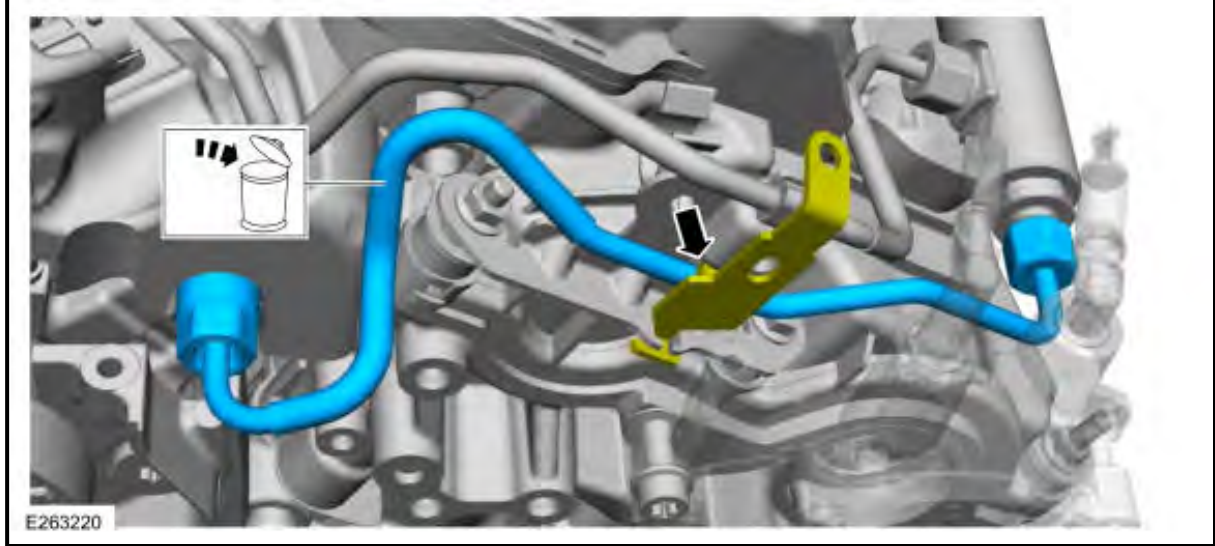




100. Remove the fuel tube bracket bolt.

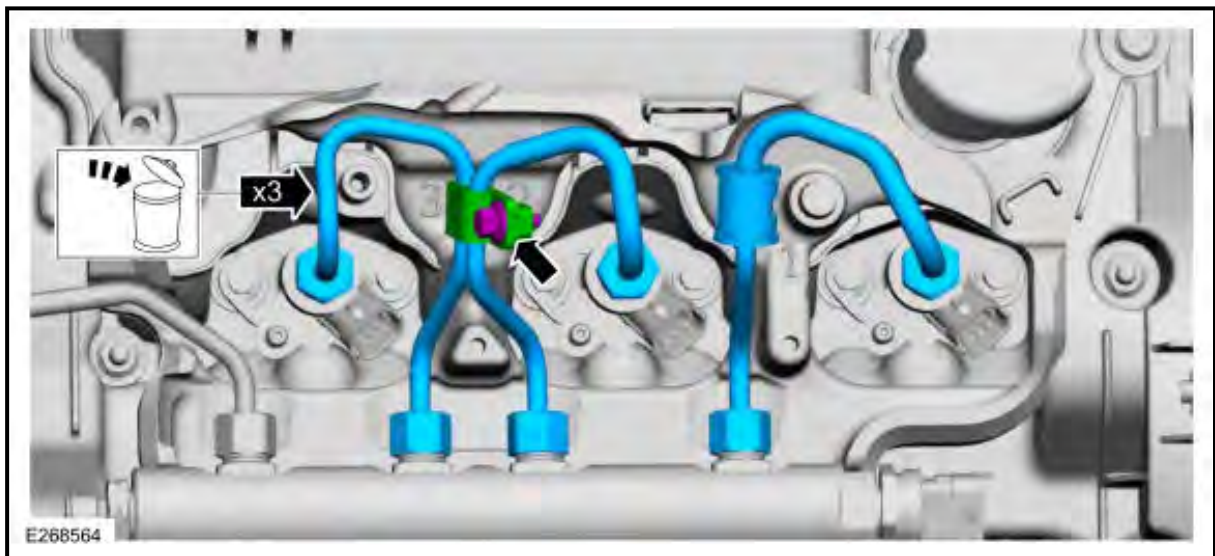


101. Remove and discard the RH fuel supply tube.

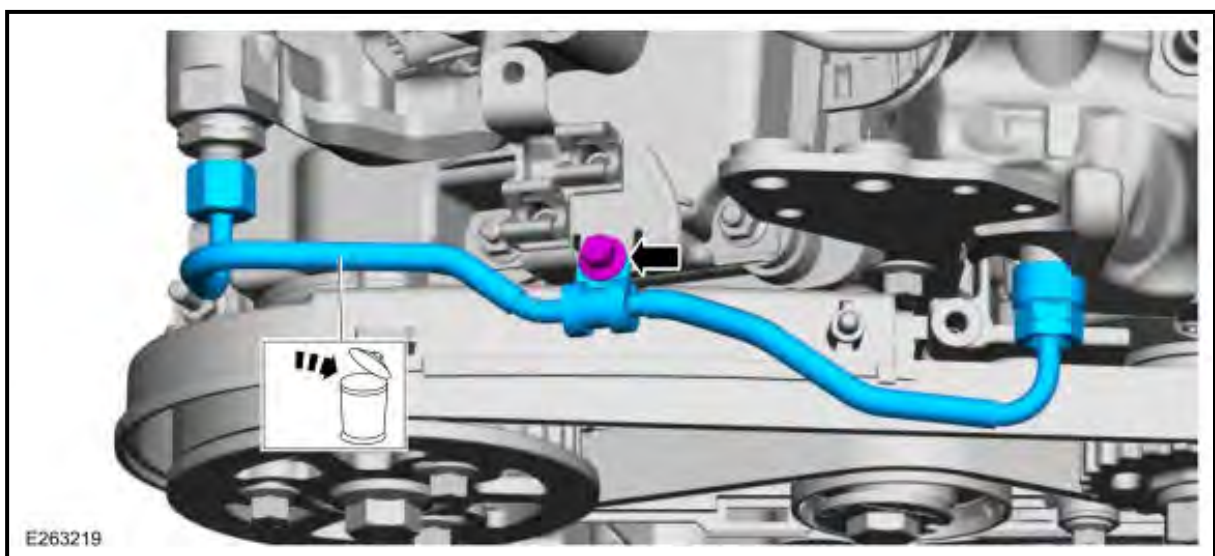


102.

- Remove the bolt and the clamp.
- Remove and discard the RH fuel injector supply tubes.

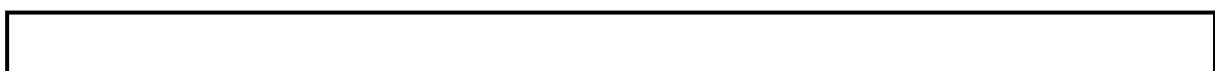


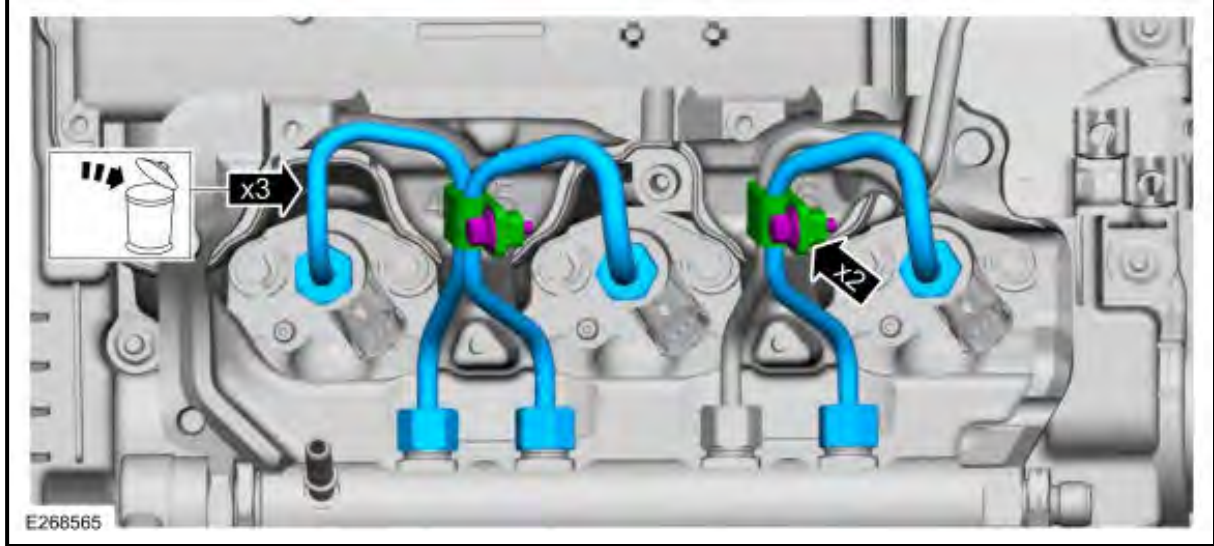
103. Remove the bolt. Remove and discard the LH fuel supply tube.



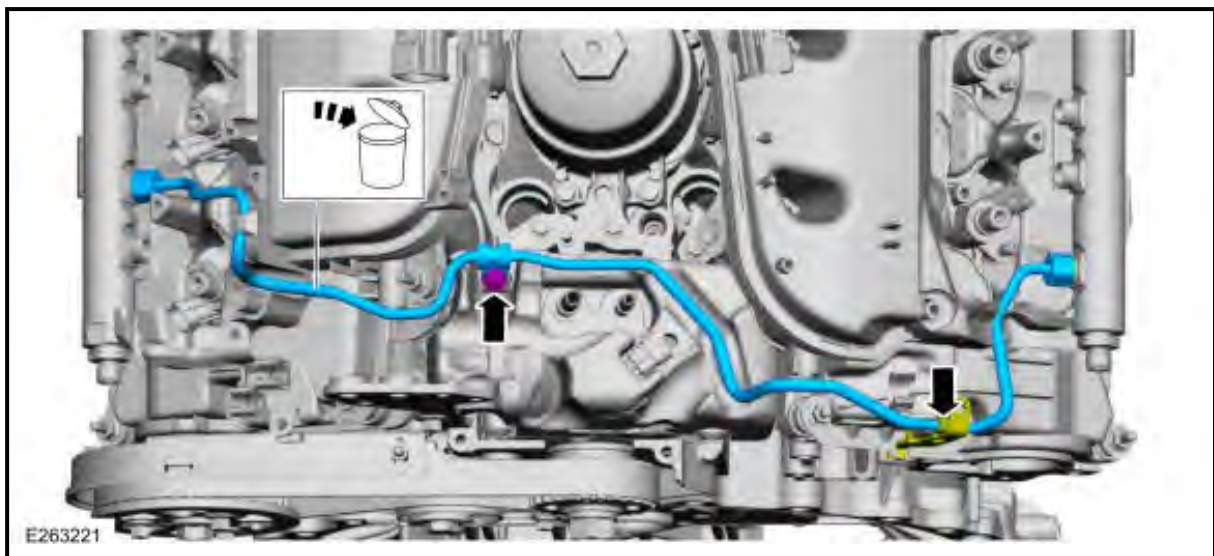
104.

- Remove the bolts and the clamps.
- Remove and discard the LH fuel injector supply tubes.

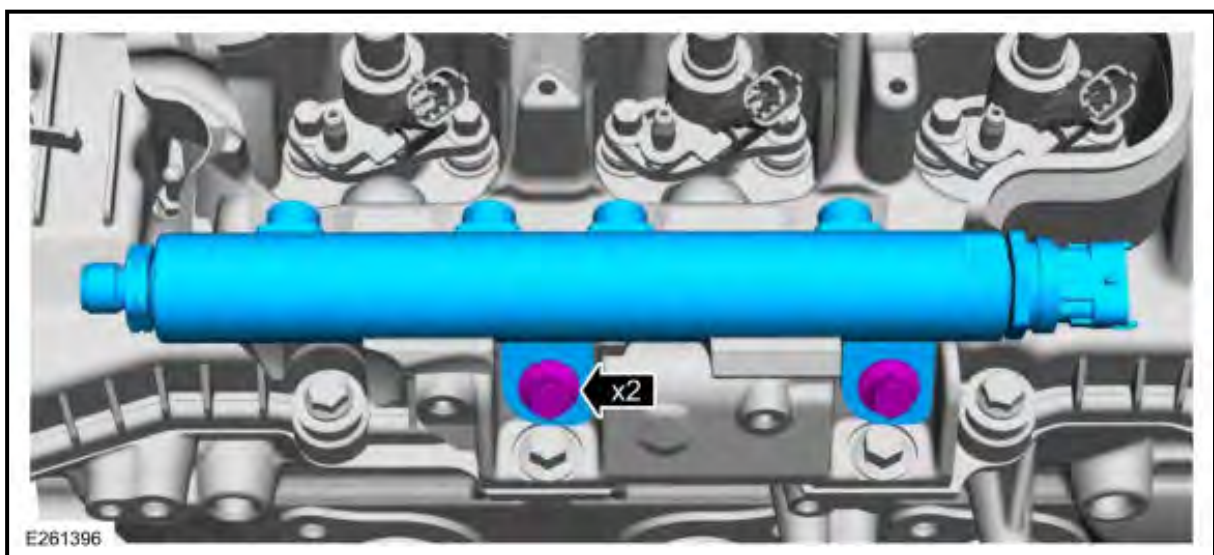




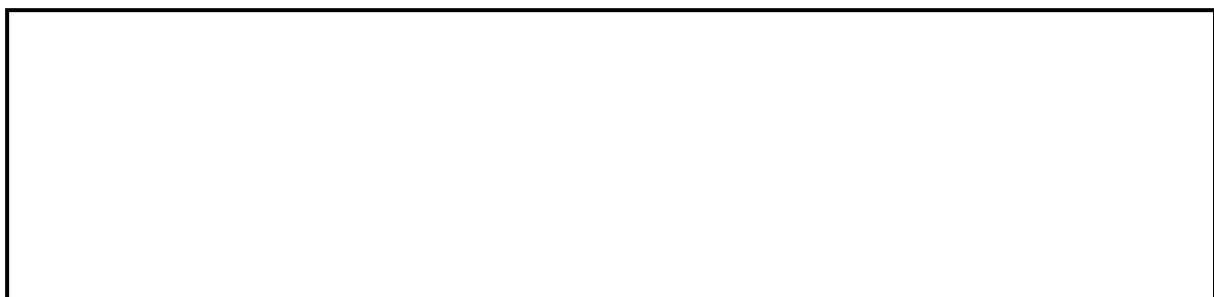
105. Remove the bolt. Remove and discard the fuel injection pump balance tube.

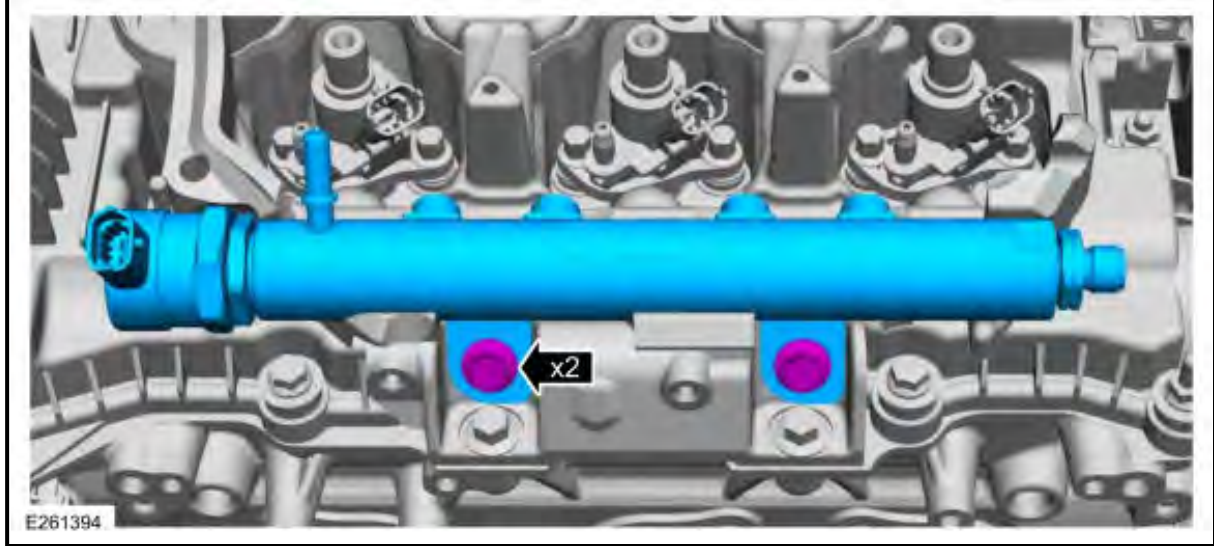


106. Remove the bolts and the RH fuel rail.

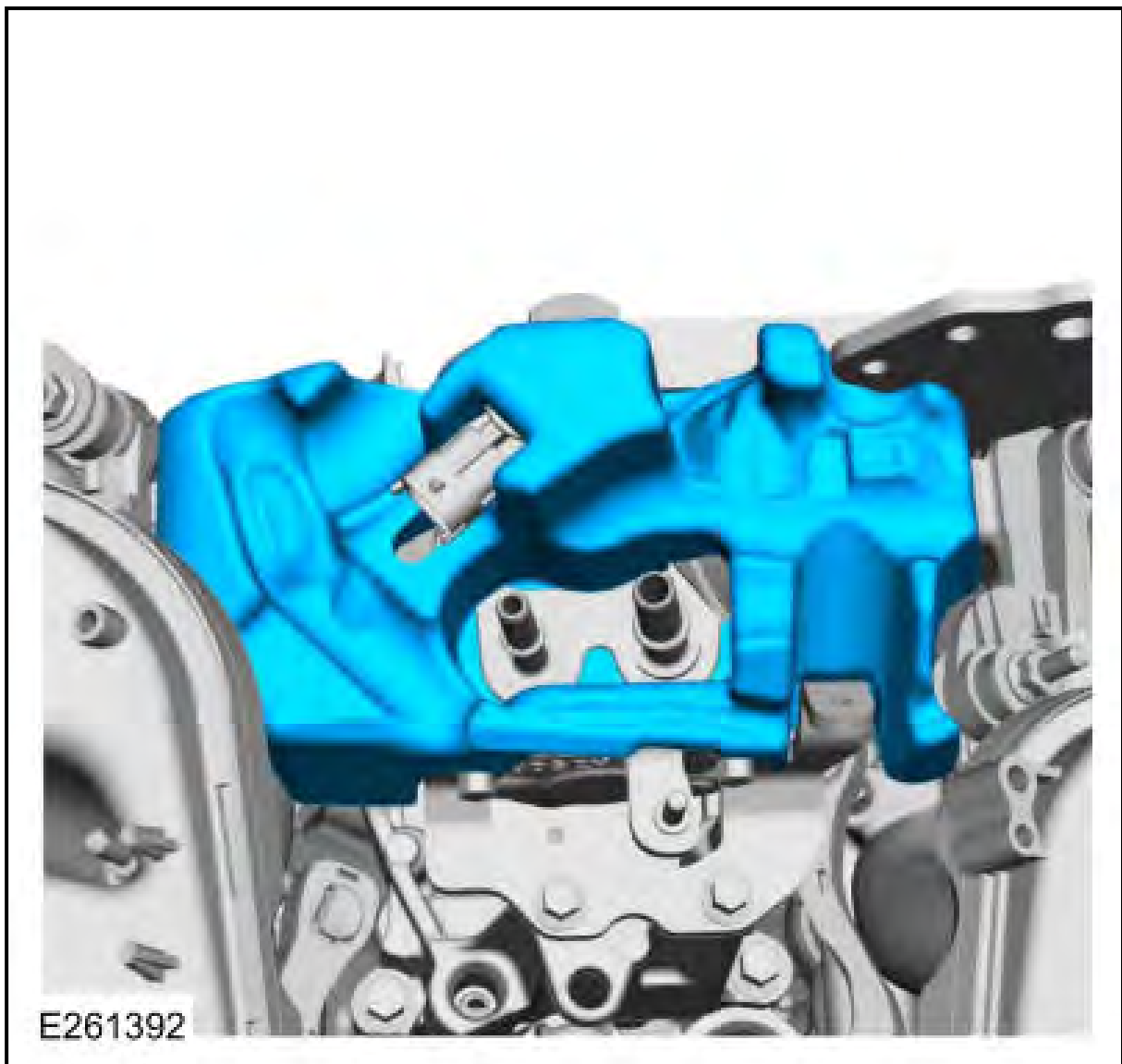


107. Remove the bolts and the LH fuel rail.



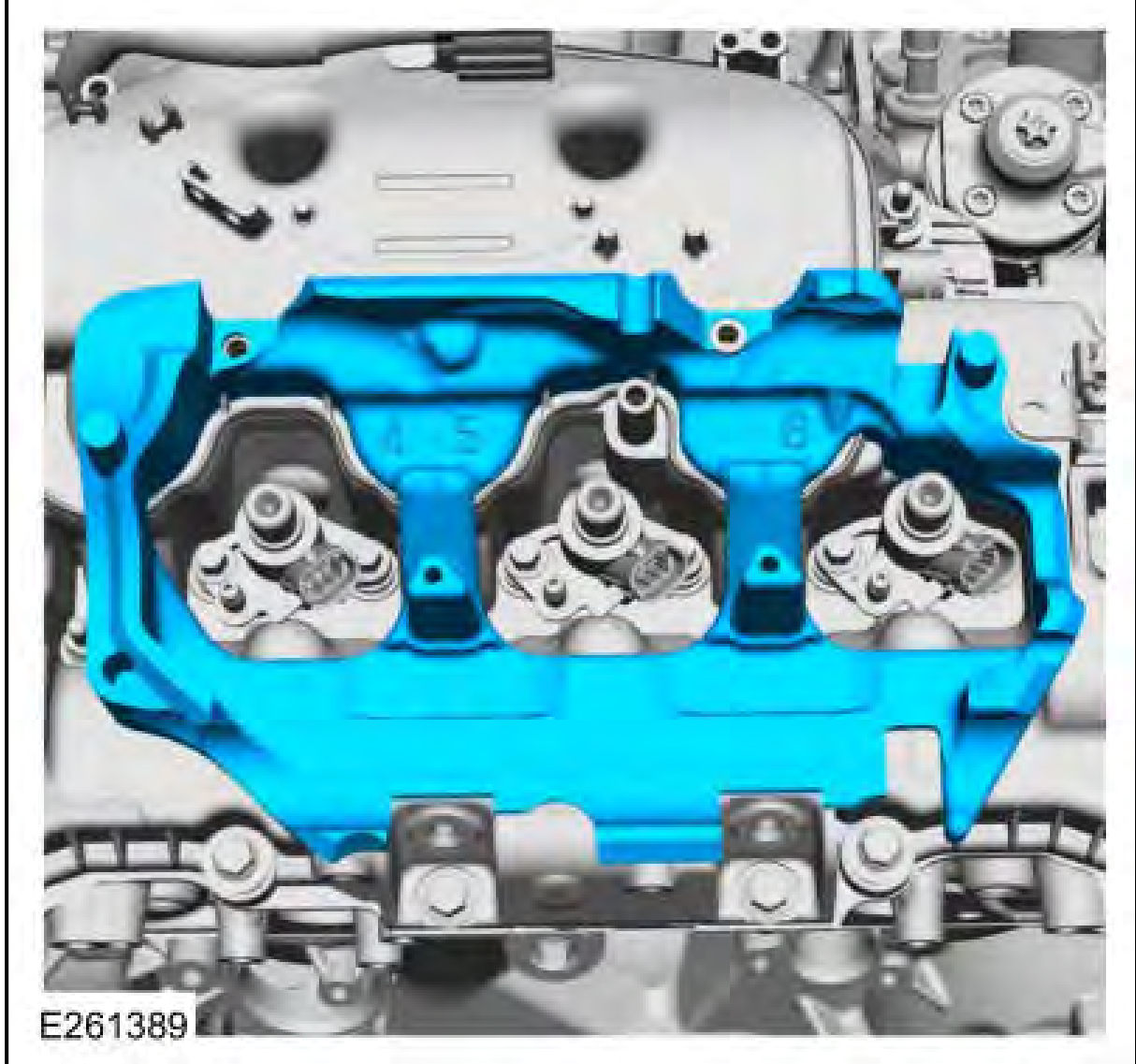


108. Remove the fuel injection pump noise insulator.

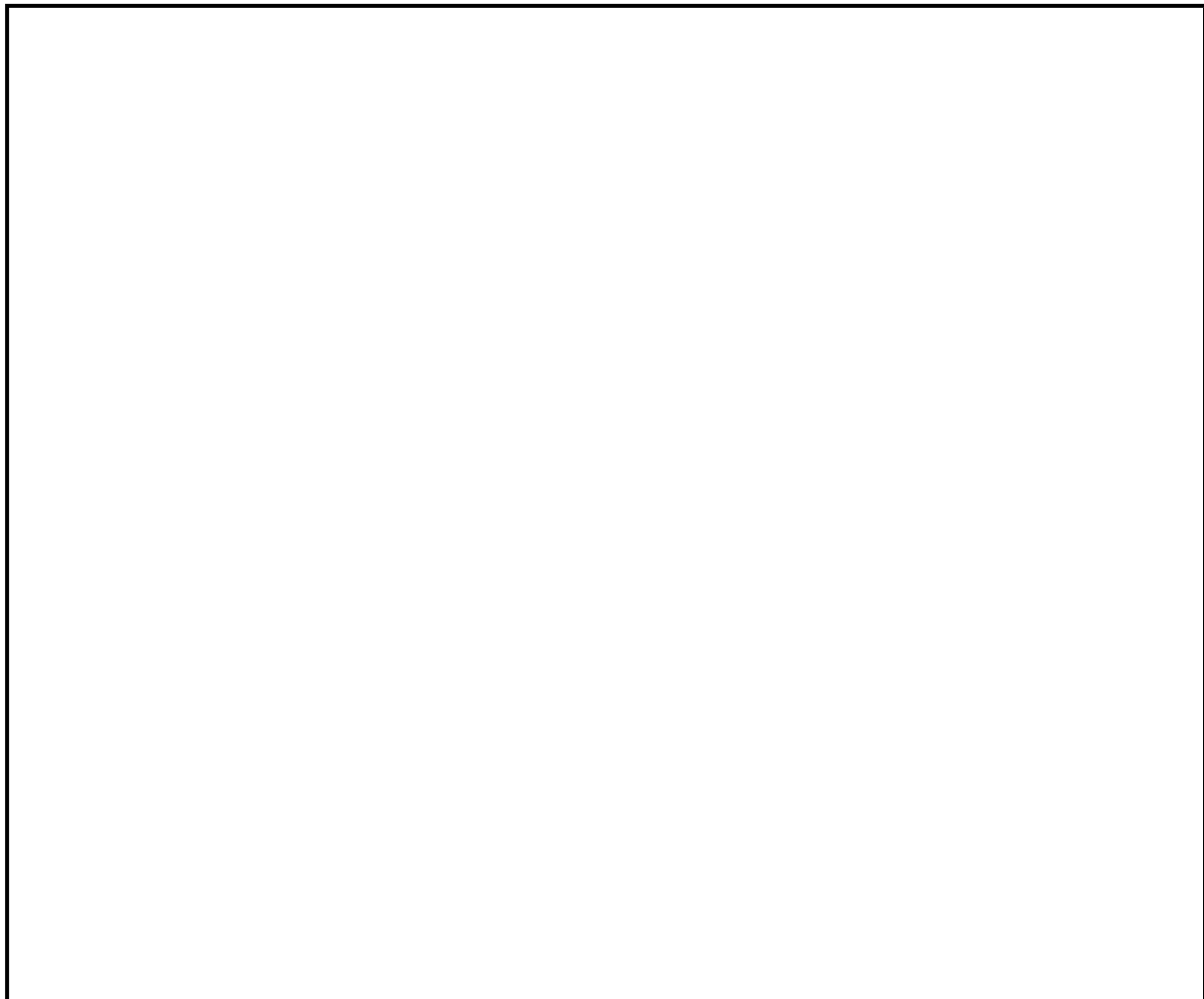


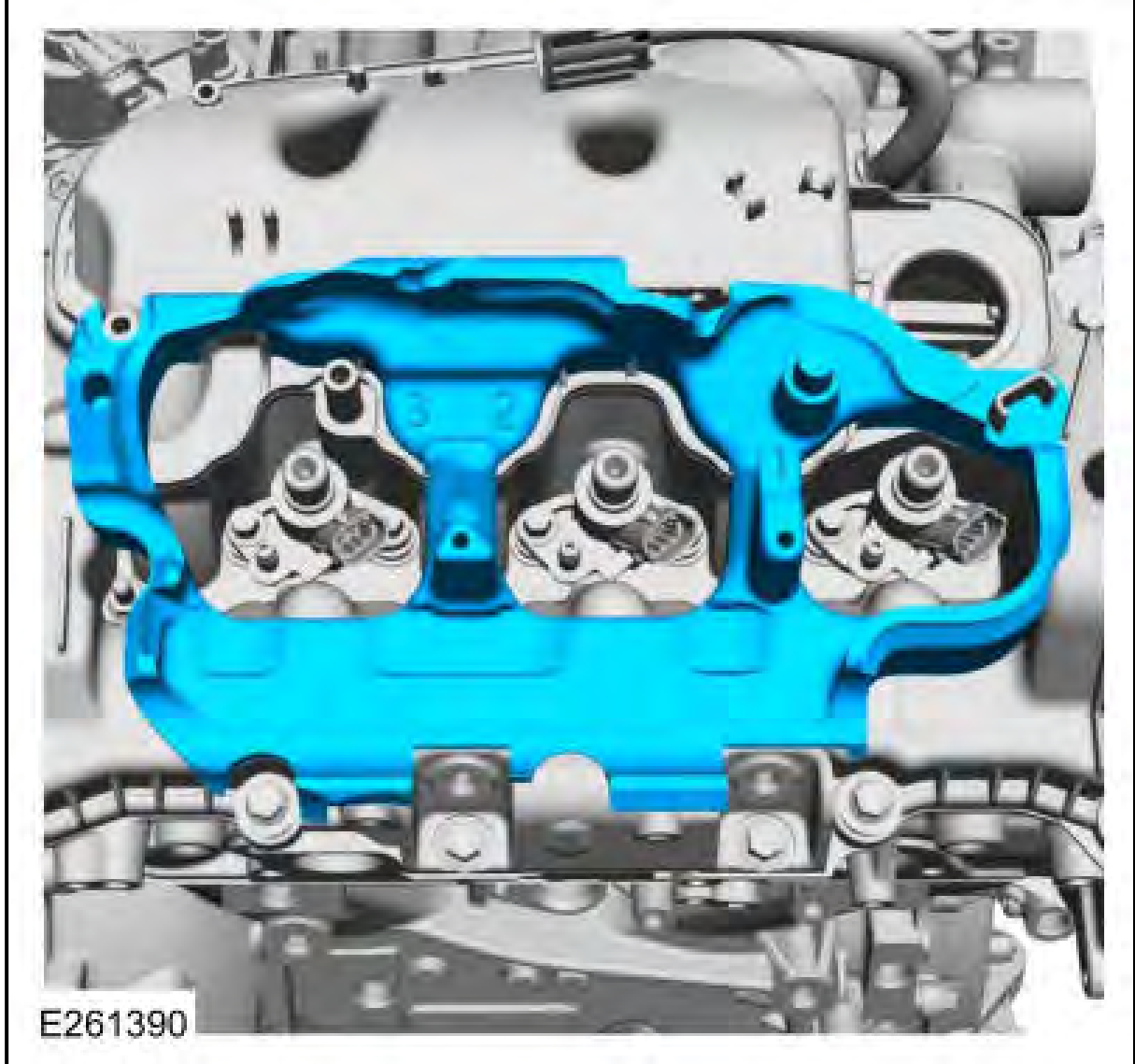
109. Remove the LH fuel injector noise insulator.



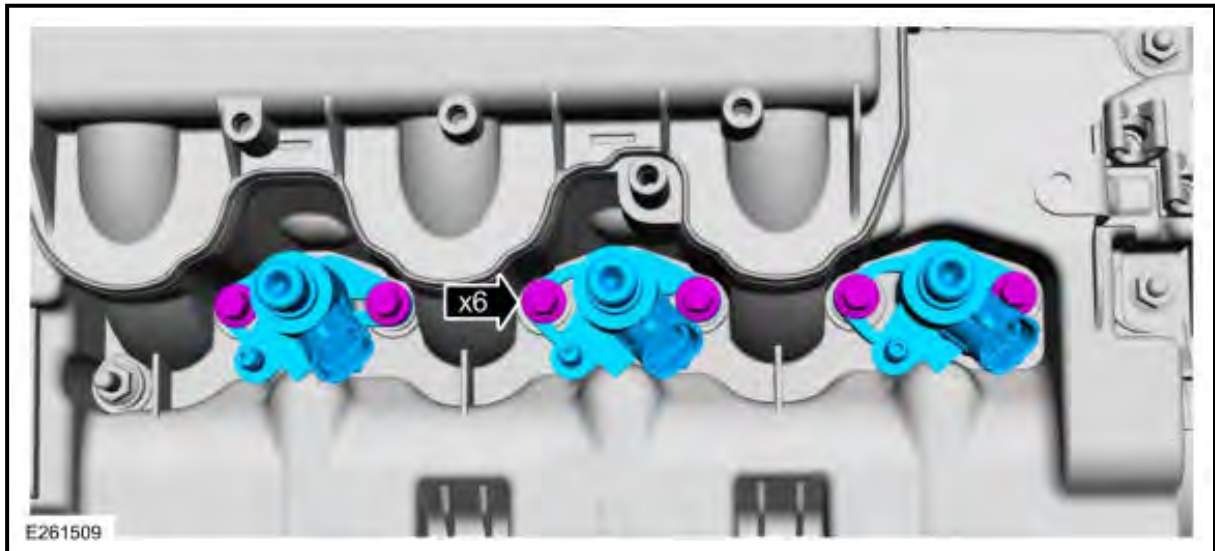


110. Remove the RH fuel injector noise insulator.

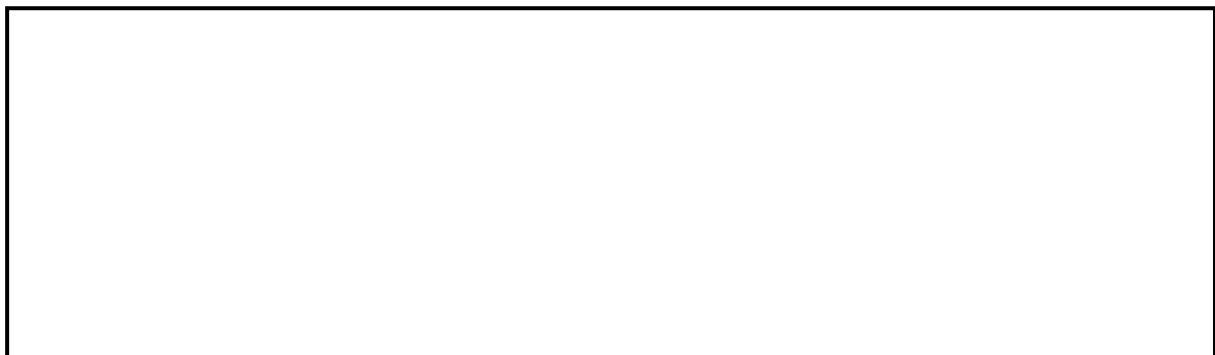


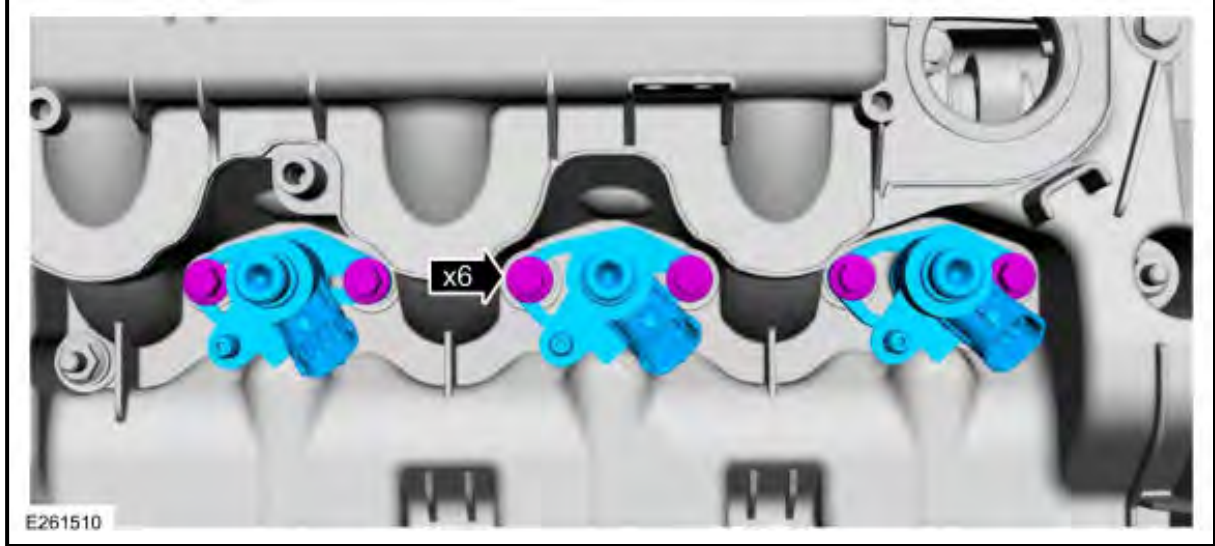


111. Remove the bolts for the LH fuel injectors.



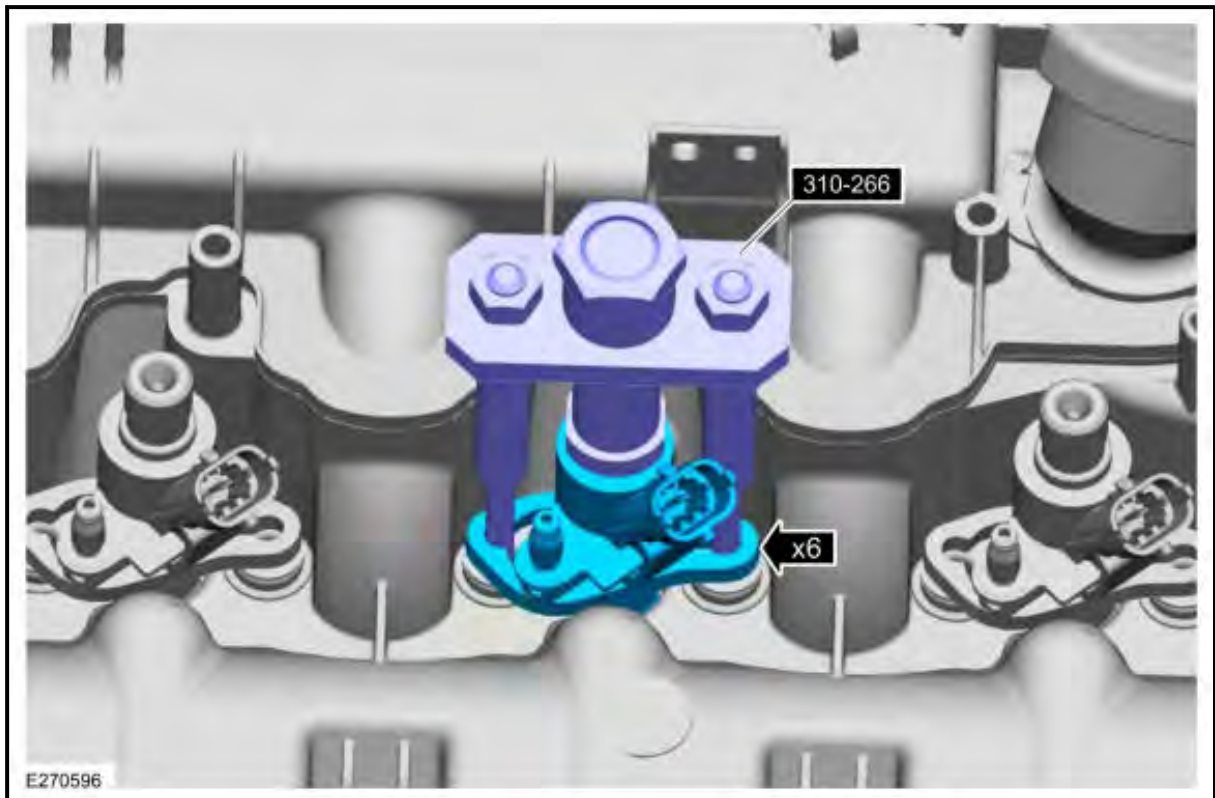
112. Remove the bolts for the RH fuel injectors.



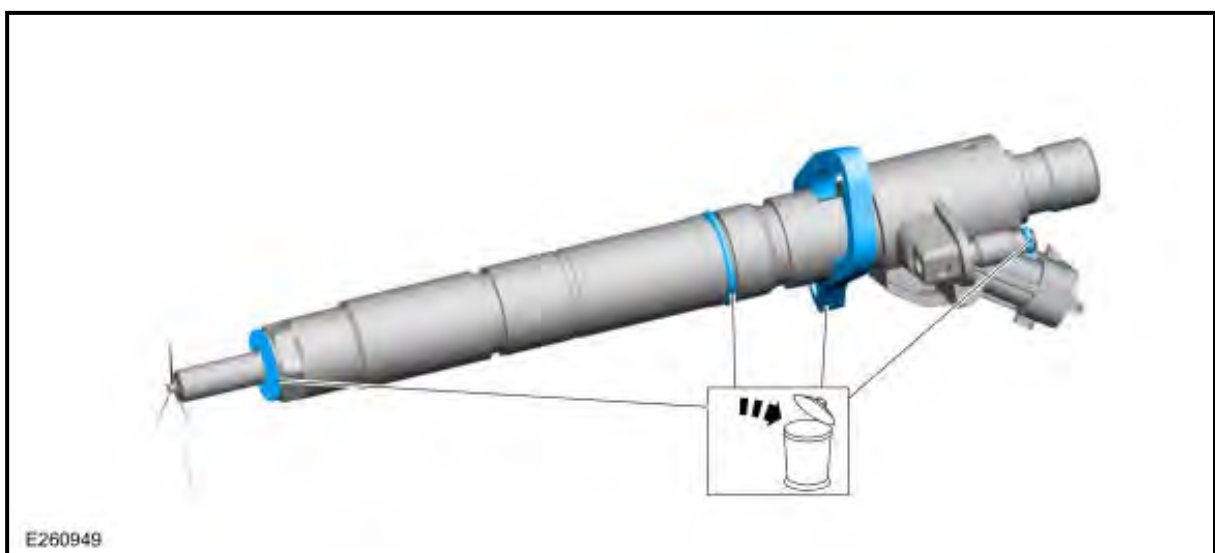


113. **NOTE:** Only one fuel injector shown.

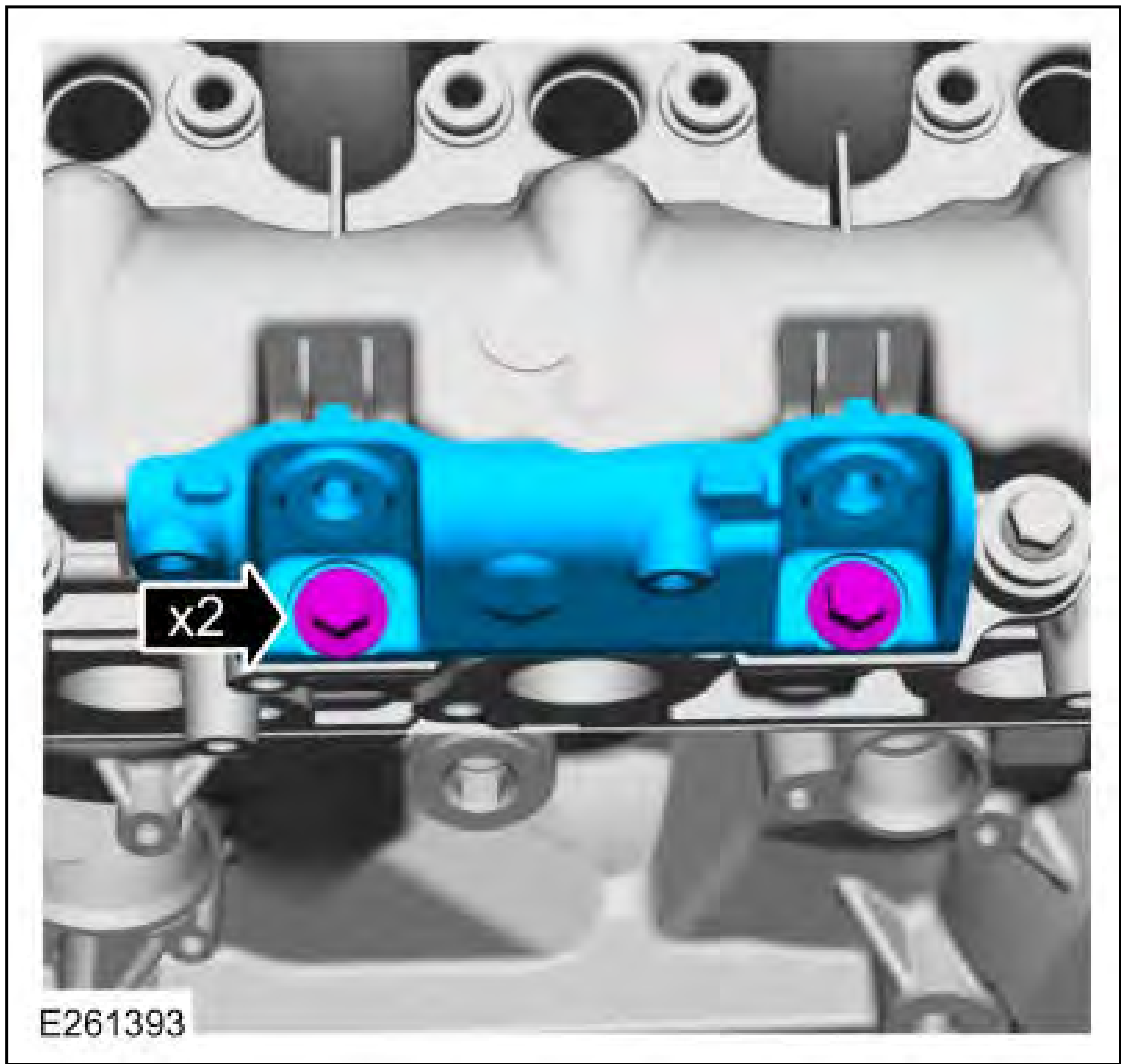
Using the special tool, remove the fuel injectors. Use Special Service Tool: 310-266 Remover, Fuel Injector.



114. Remove and discard the sealing washer, the O-rings and the fuel injector hold down.



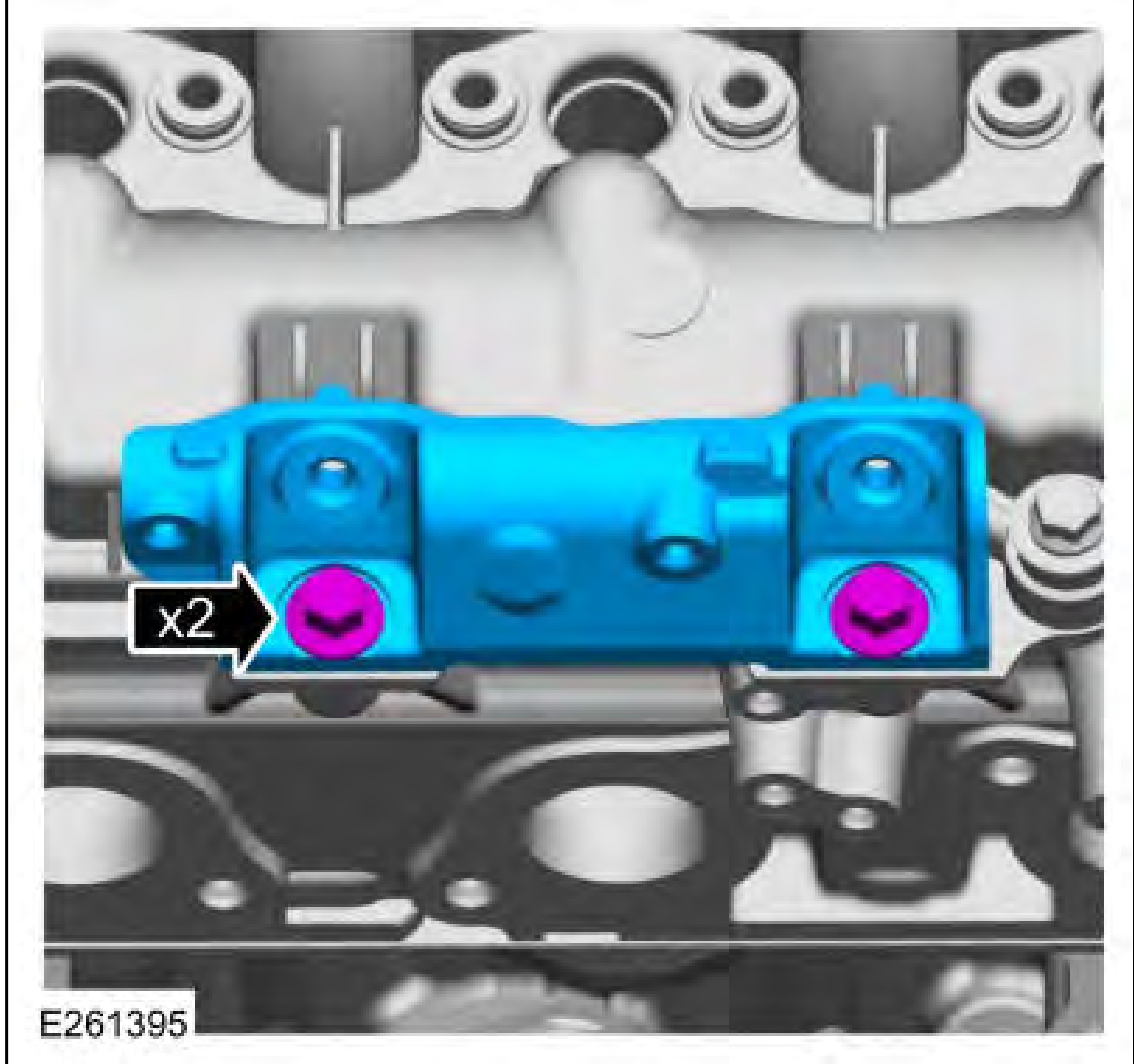
115. Remove the bolts and the LH fuel rail bracket.



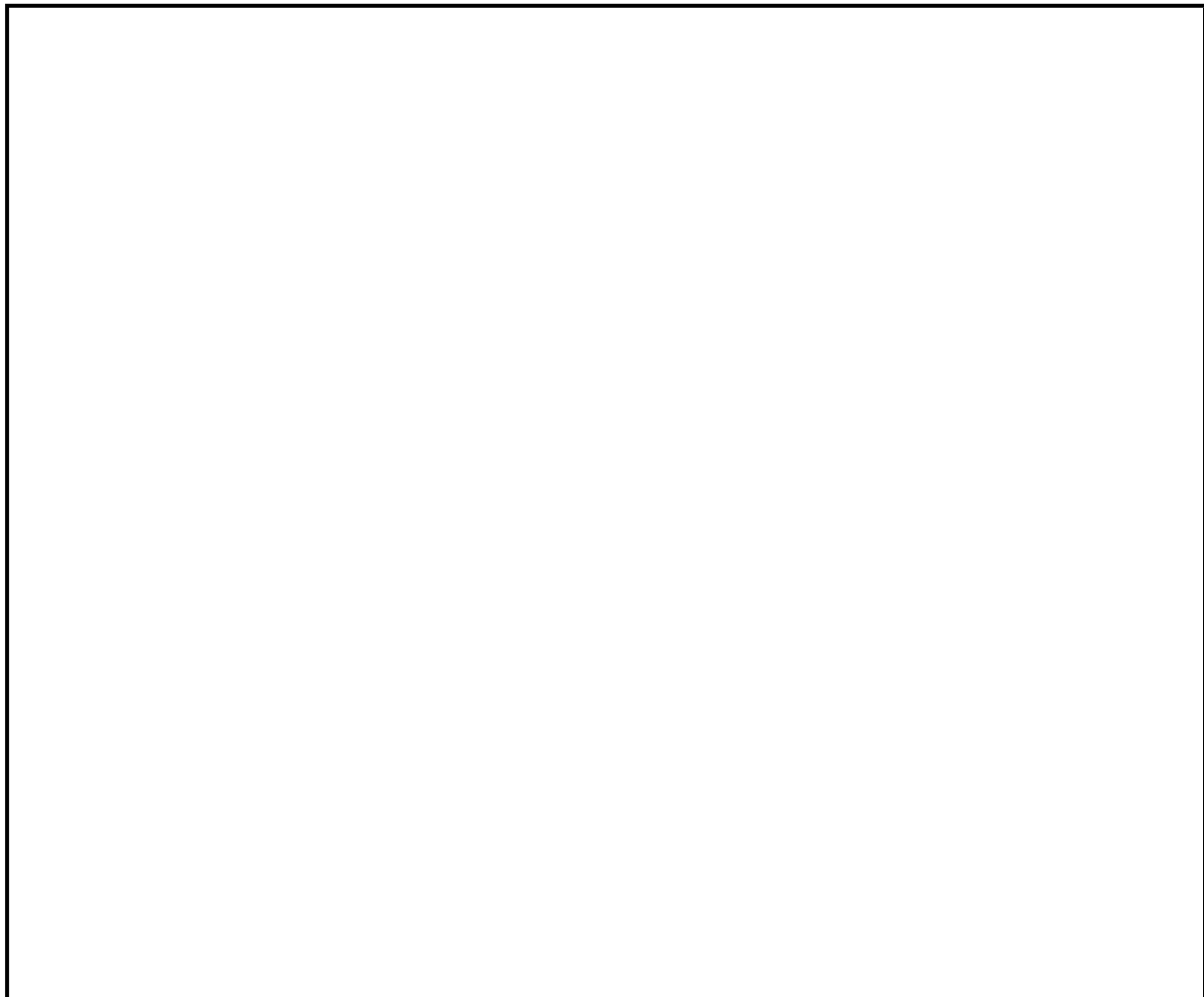
116. Remove the bolts and the RH fuel rail bracket.

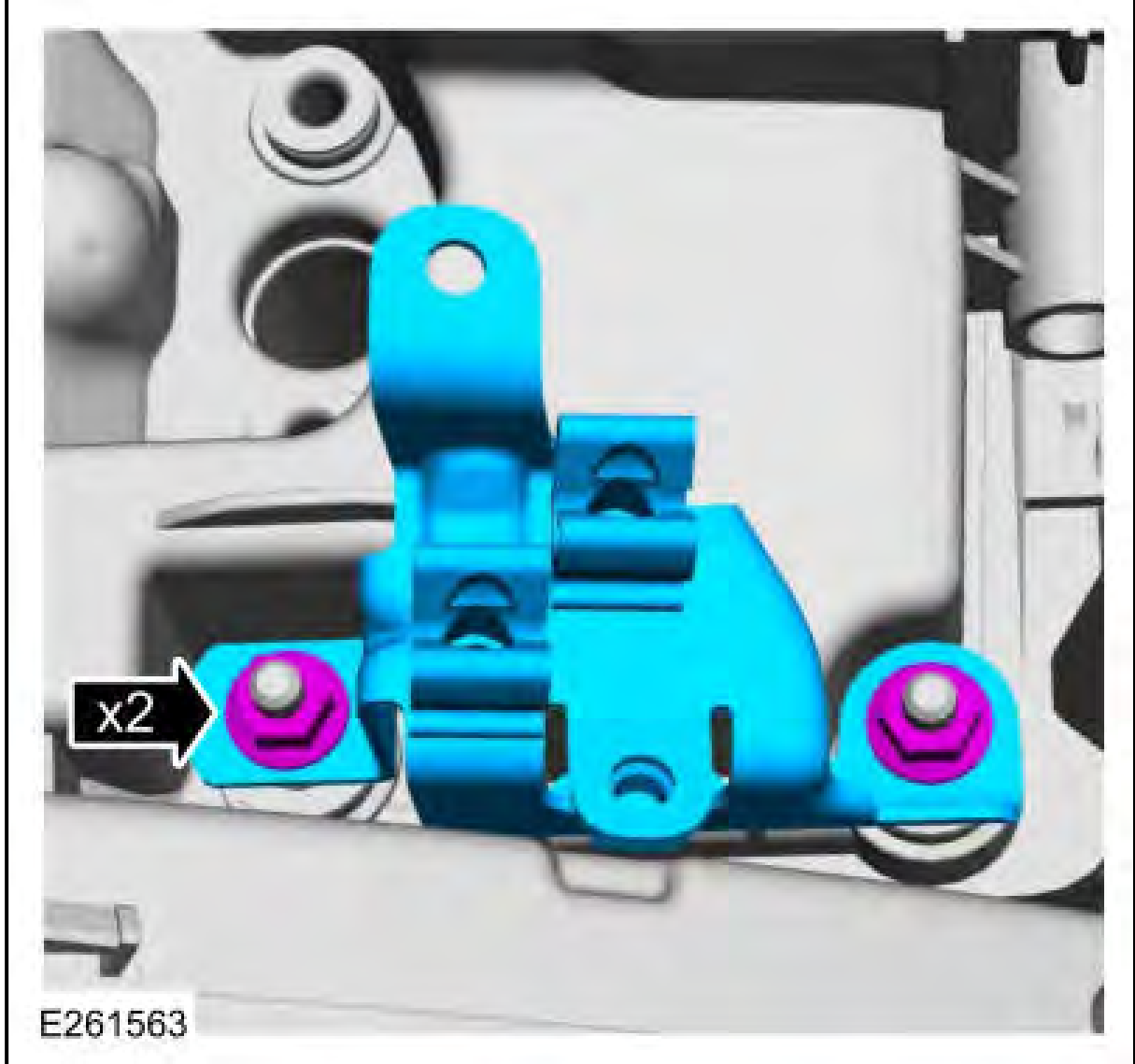






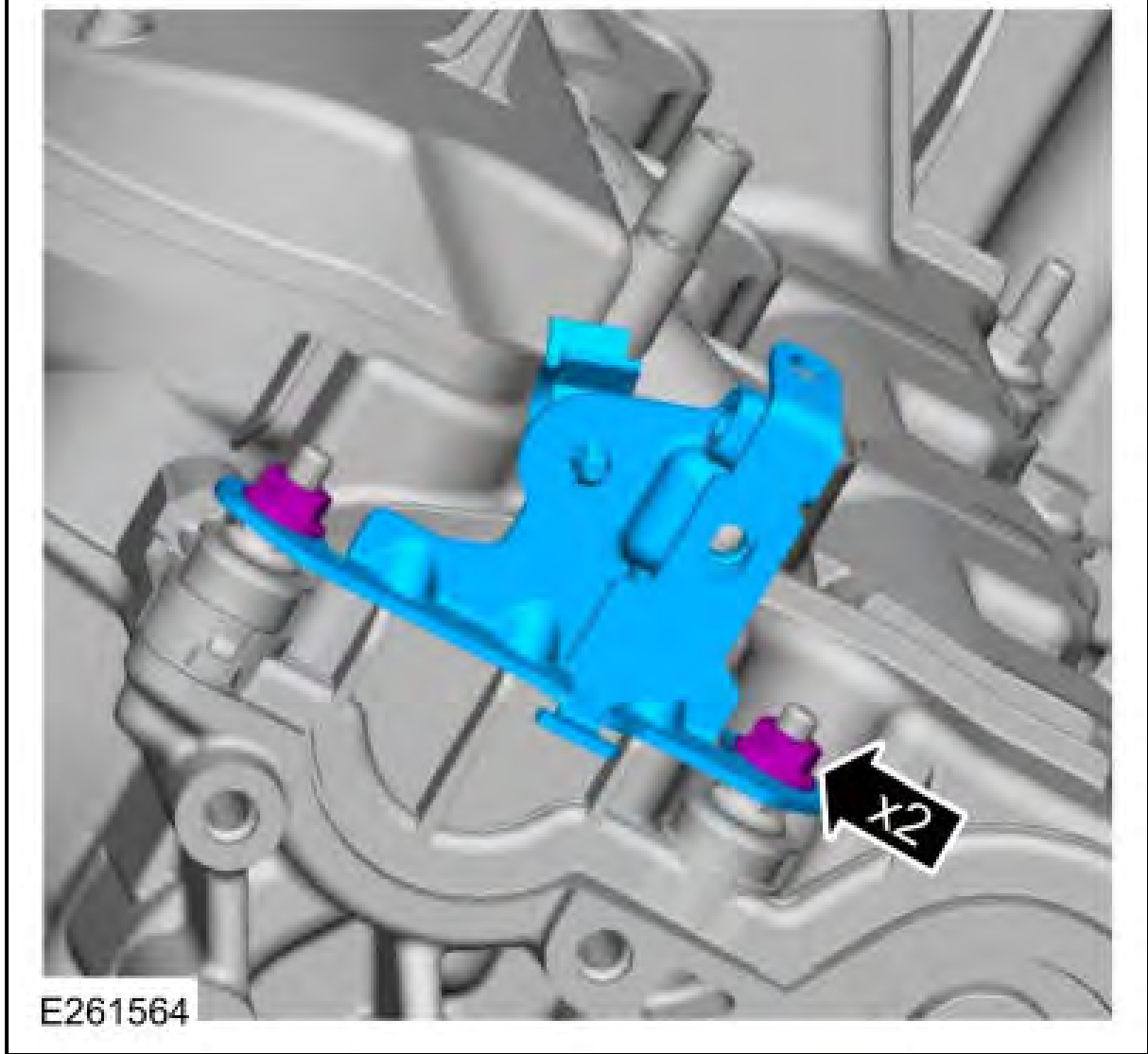
117. Remove the nuts and the LH fuel tube bracket.



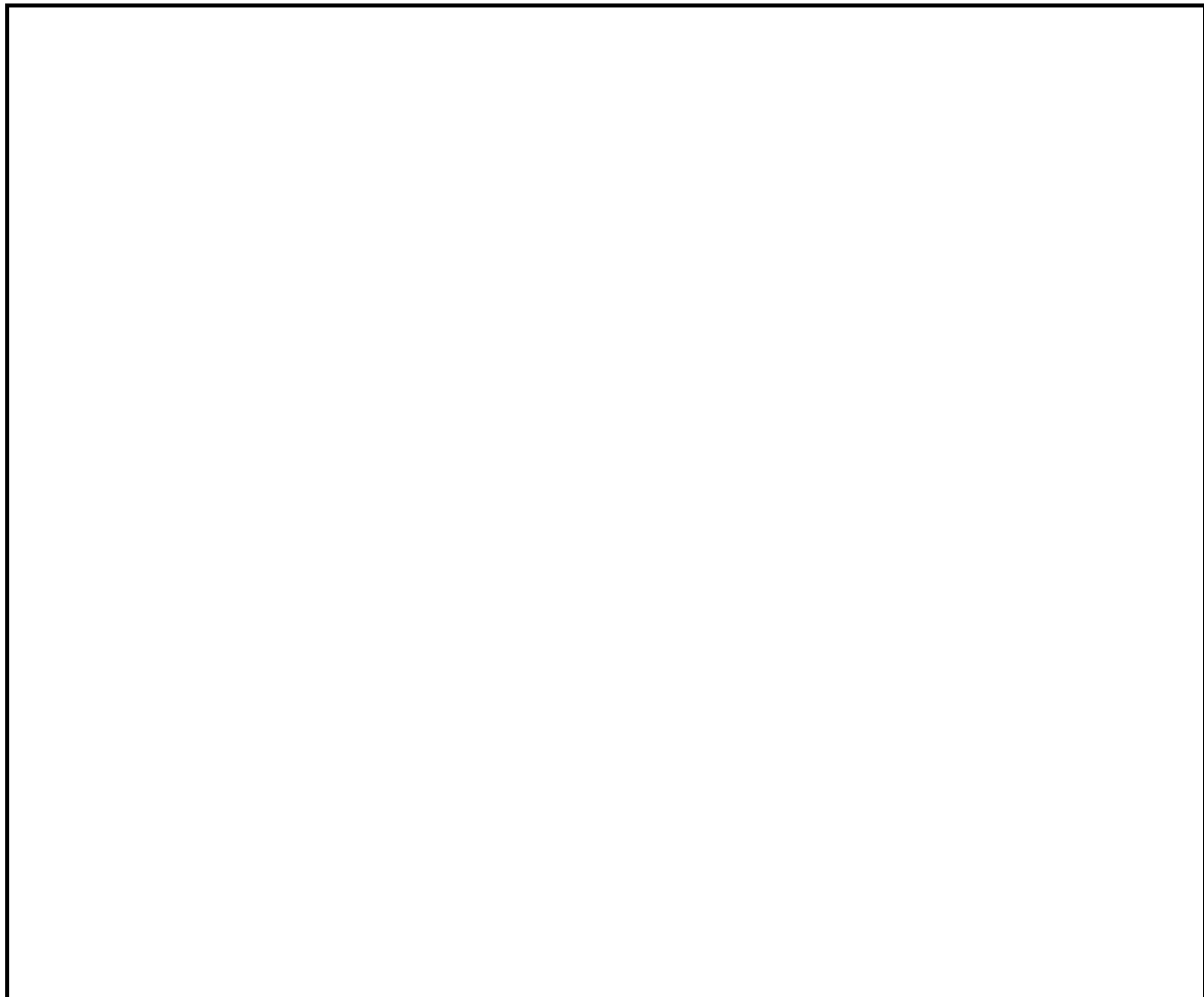


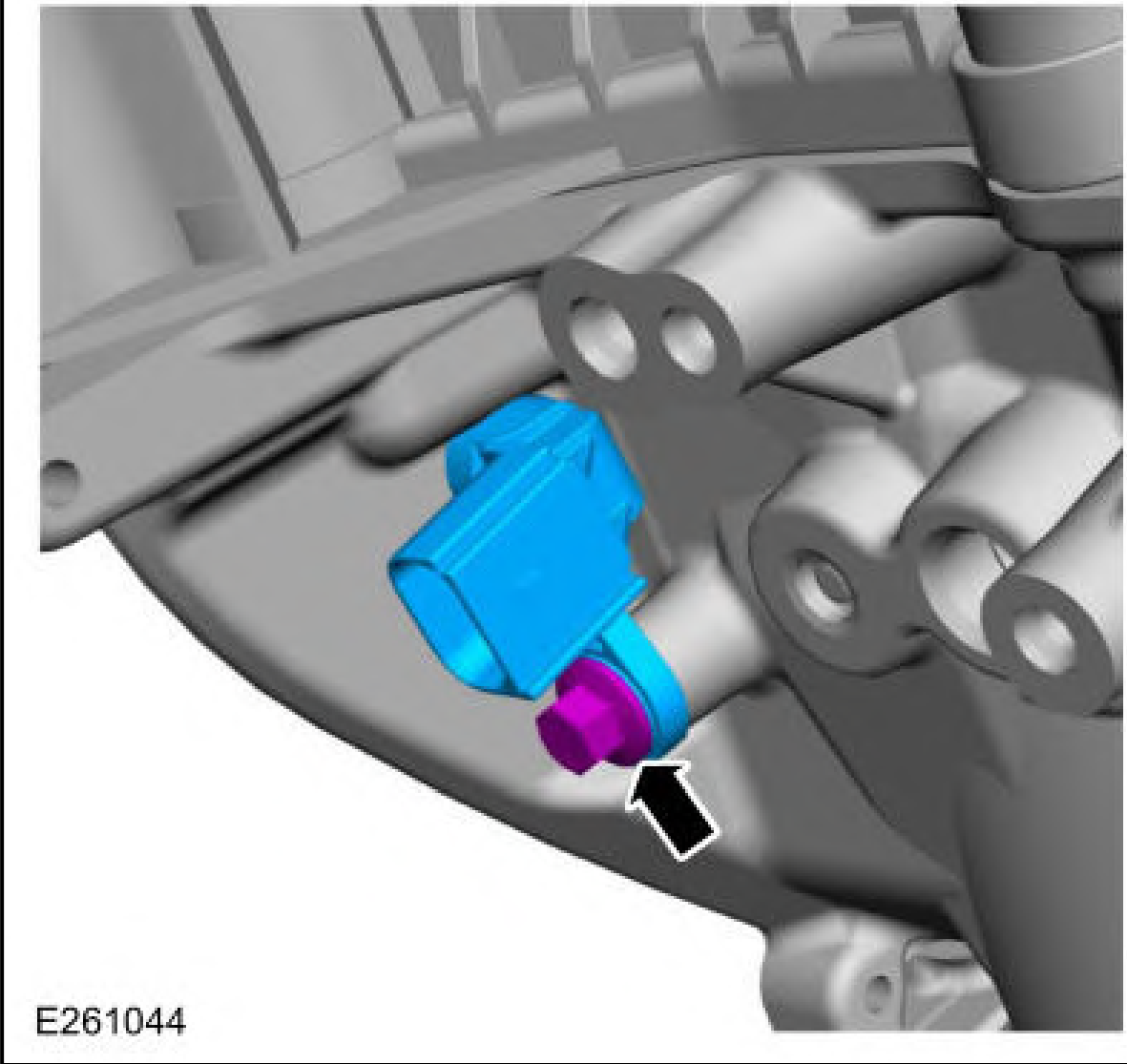
118. Remove the nuts and the RH fuel tube bracket.





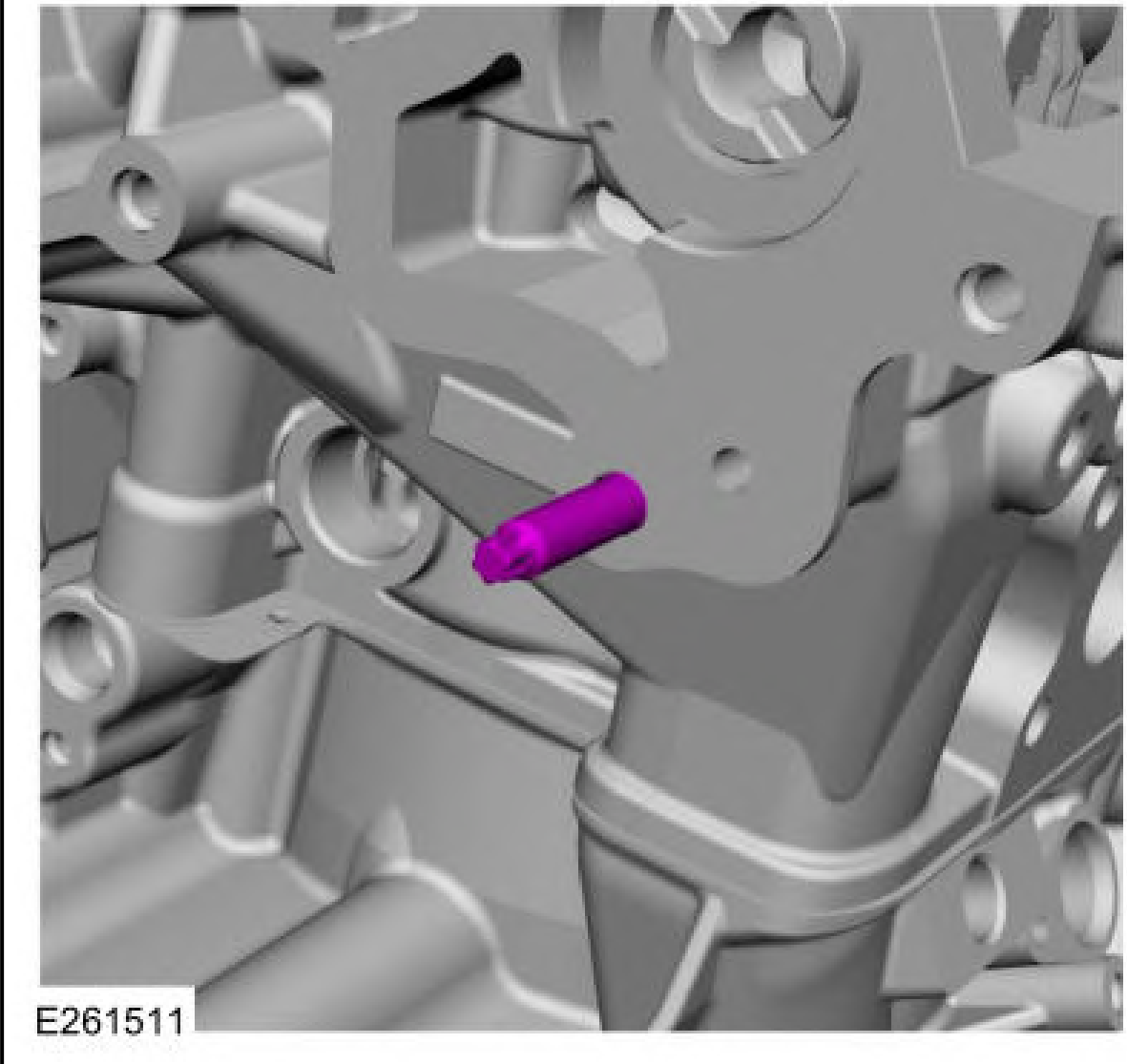
119. Remove the bolt and the CMP sensor.





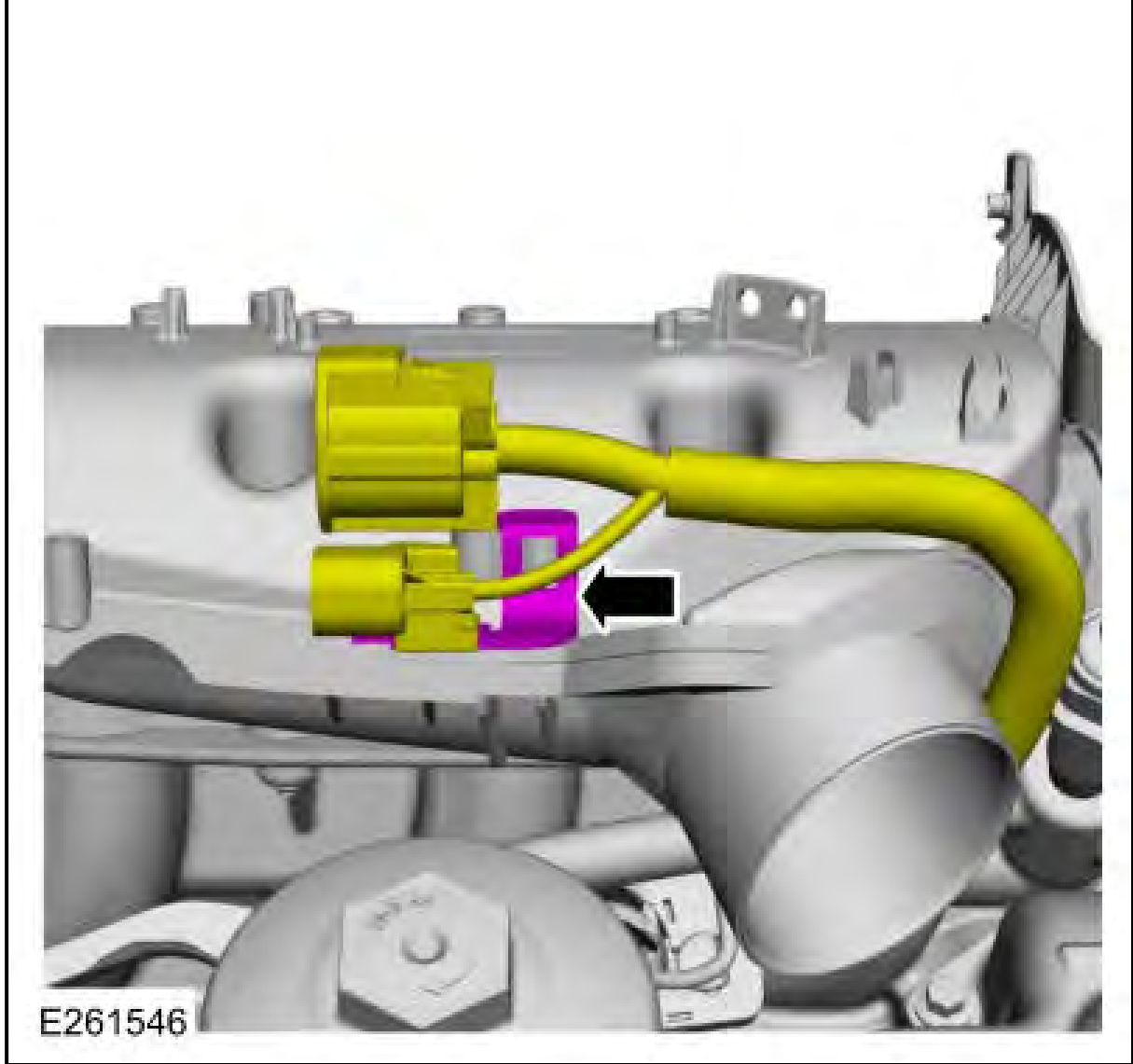
120. Remove the vacuum pump stud.



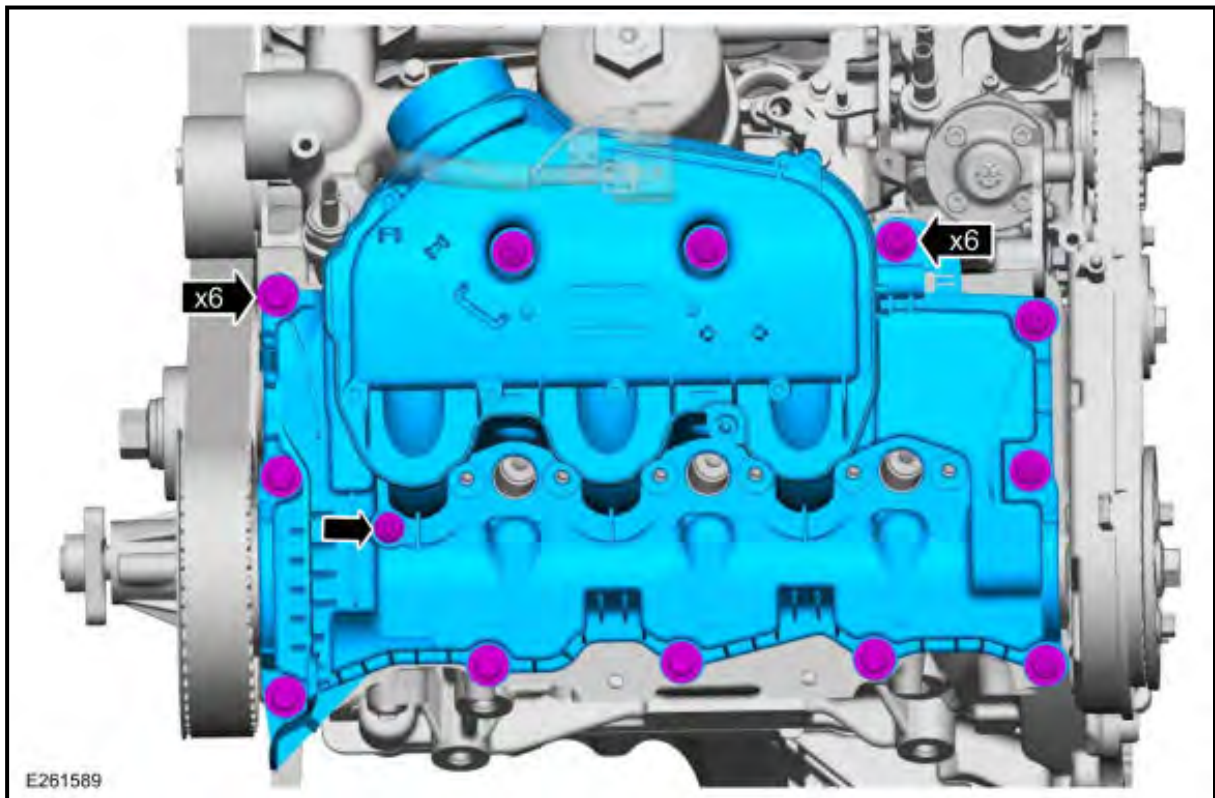


121. Disconnect the LH glow plug electrical connector.

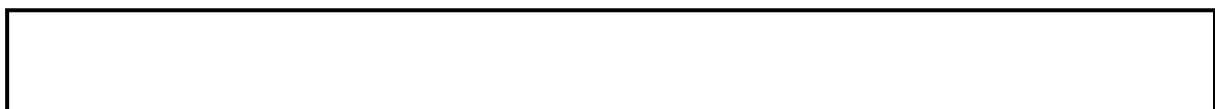


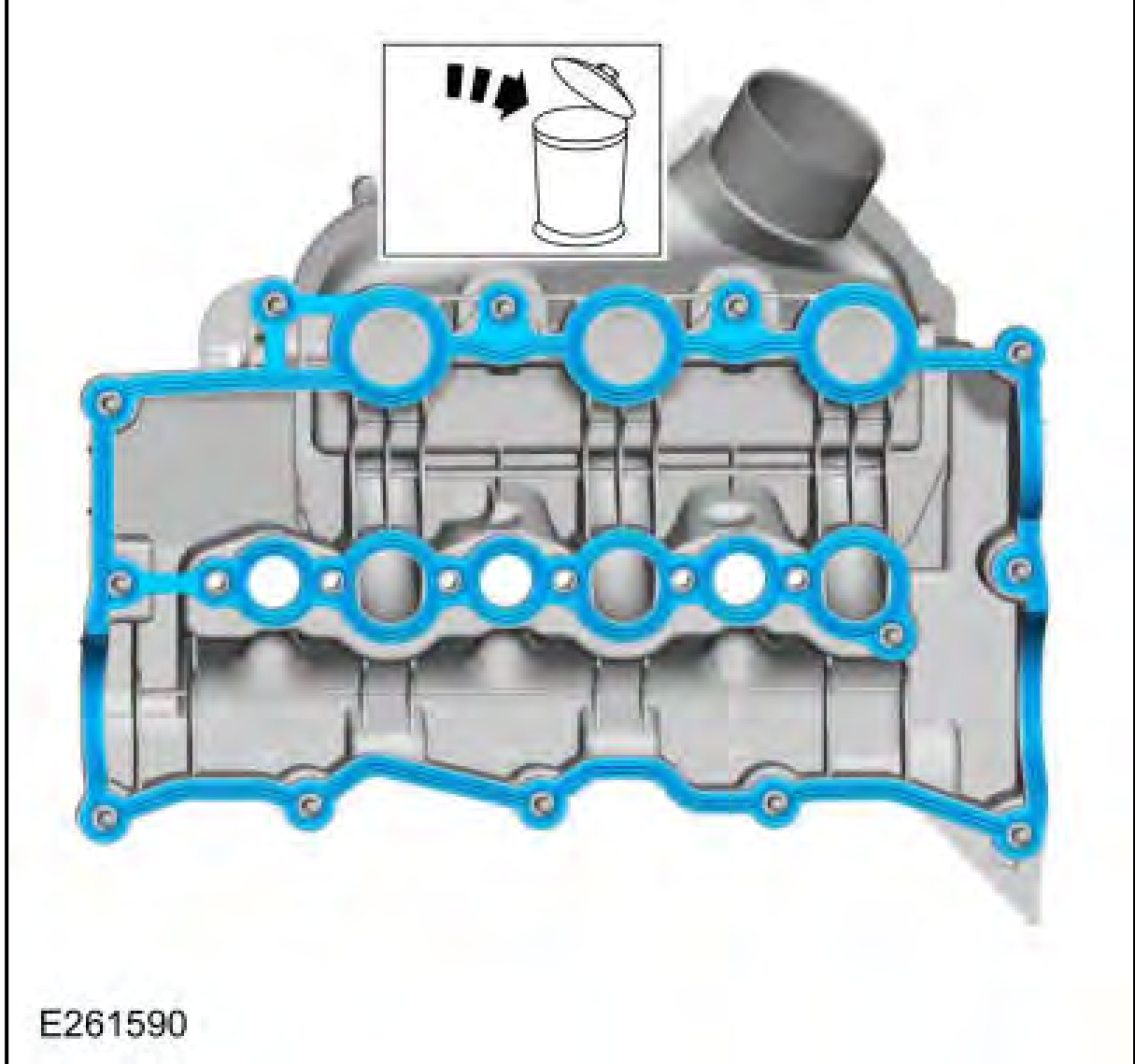


122. Loosen the fasteners and remove the LH valve cover.



123. Remove and discard the LH valve cover gasket.





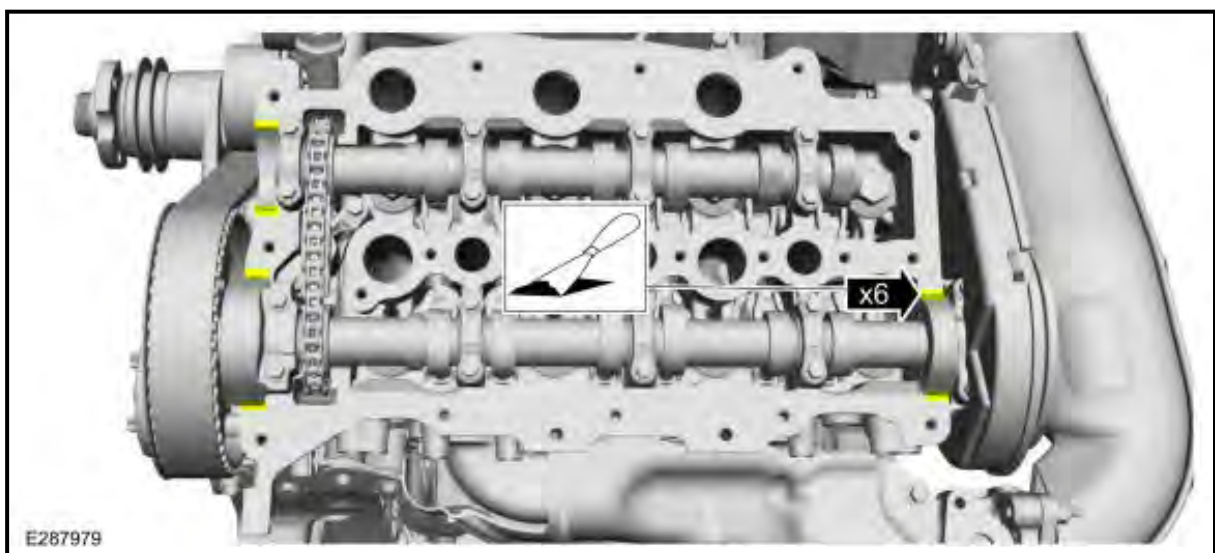
124. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.

Clean the valve cover mating surface of the cylinder head and engine front cover. Refer to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

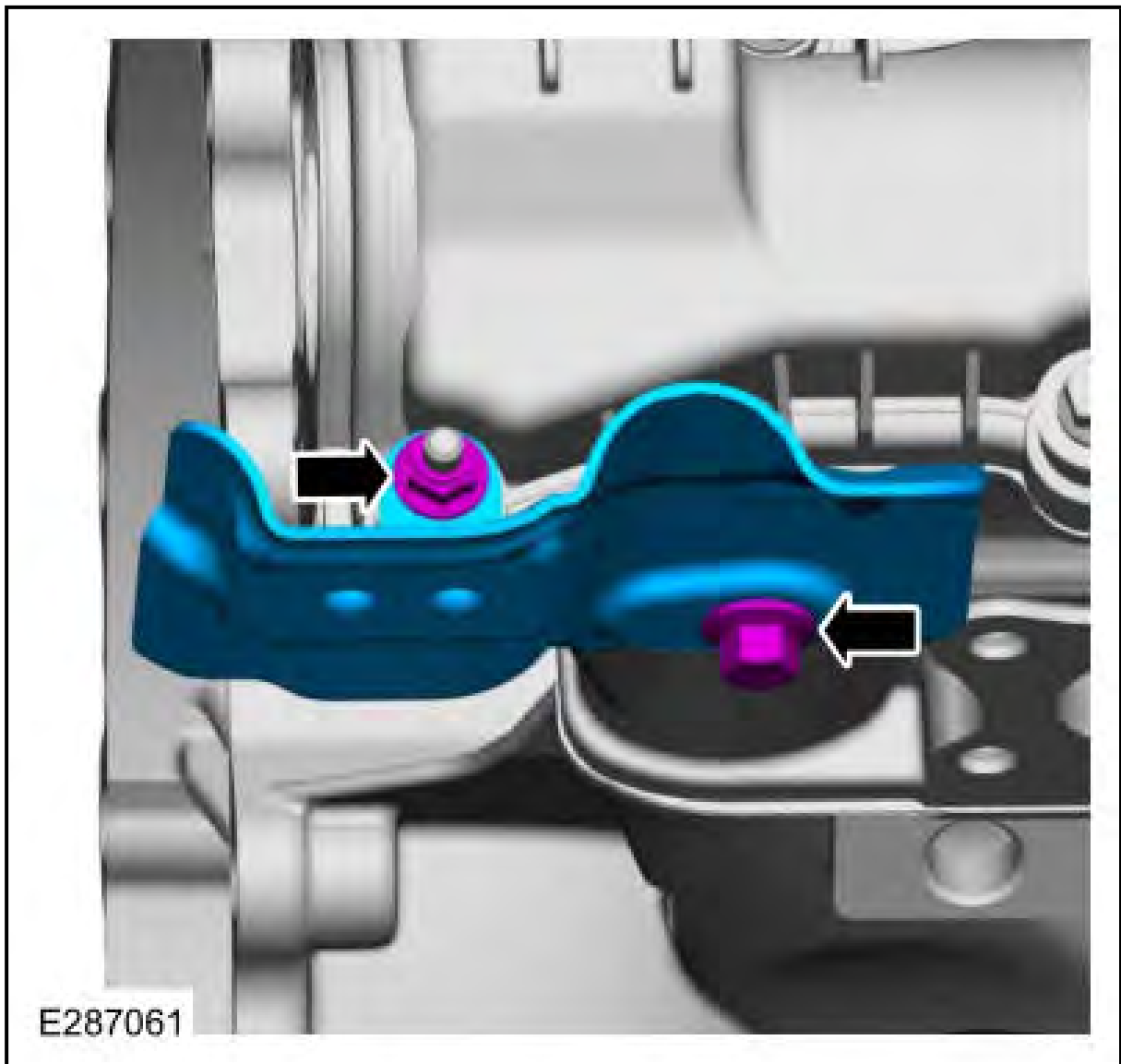
Material: Motorcraft <sup>Â</sup> Silicone Gasket Remover / ZC-30-A

Material: Motorcraft <sup>Â</sup> Metal Surface Prep Wipes / ZC-31-B

Material: Motorcraft <sup>Â</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B



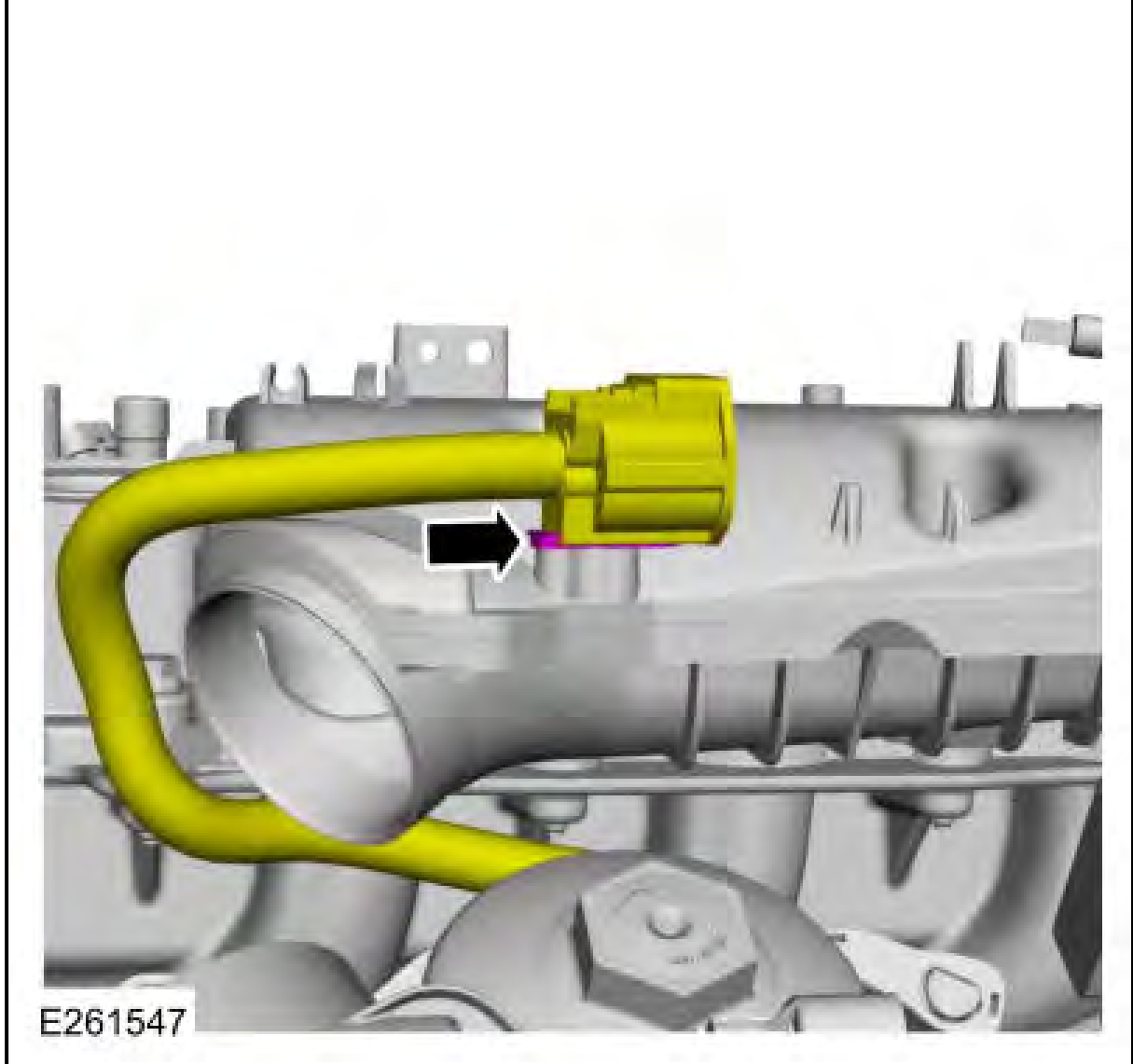
125. Remove the nut, the bolt and the turbocharger heat shield.



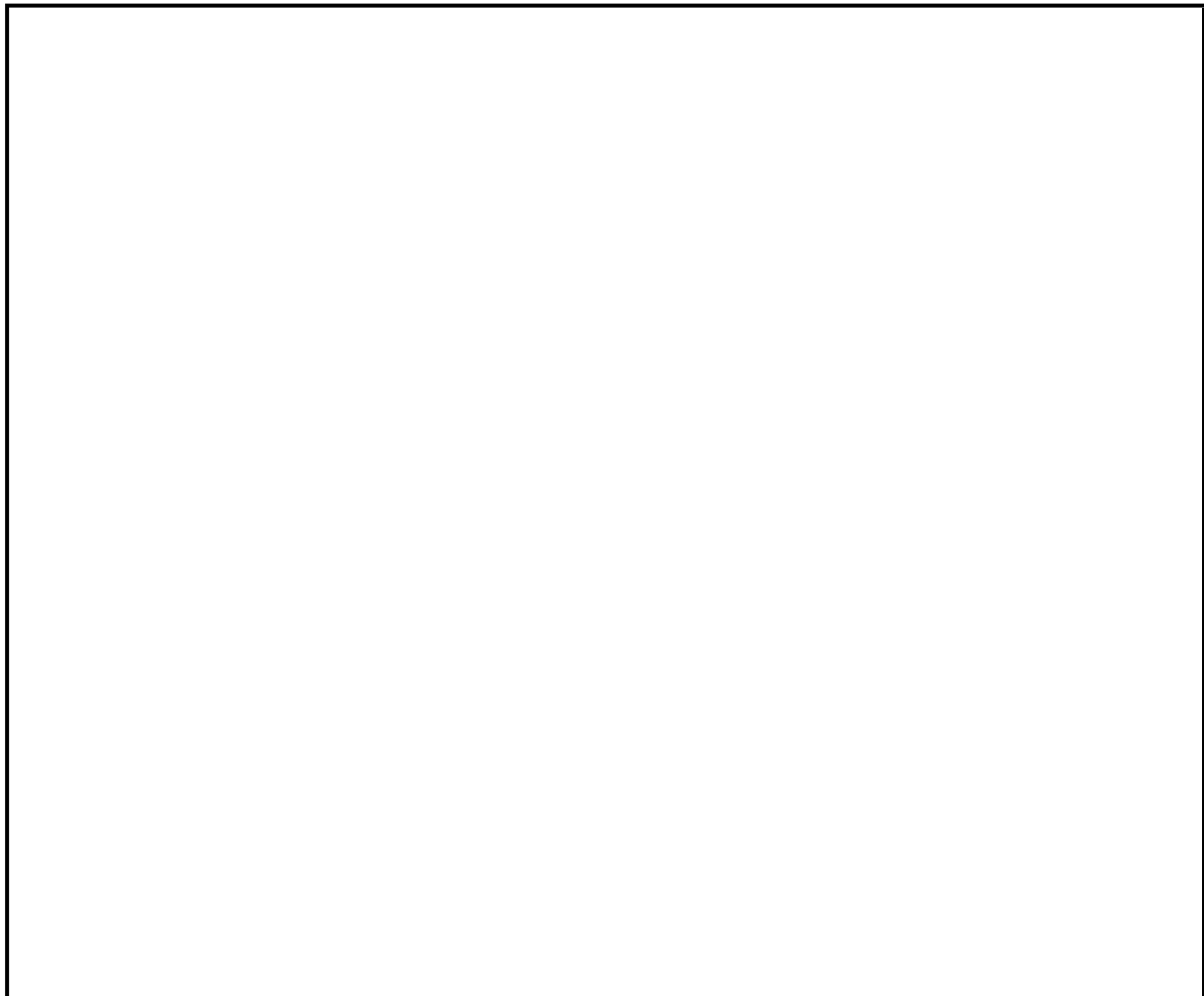
126. Disconnect the RH glow plug electrical connector.

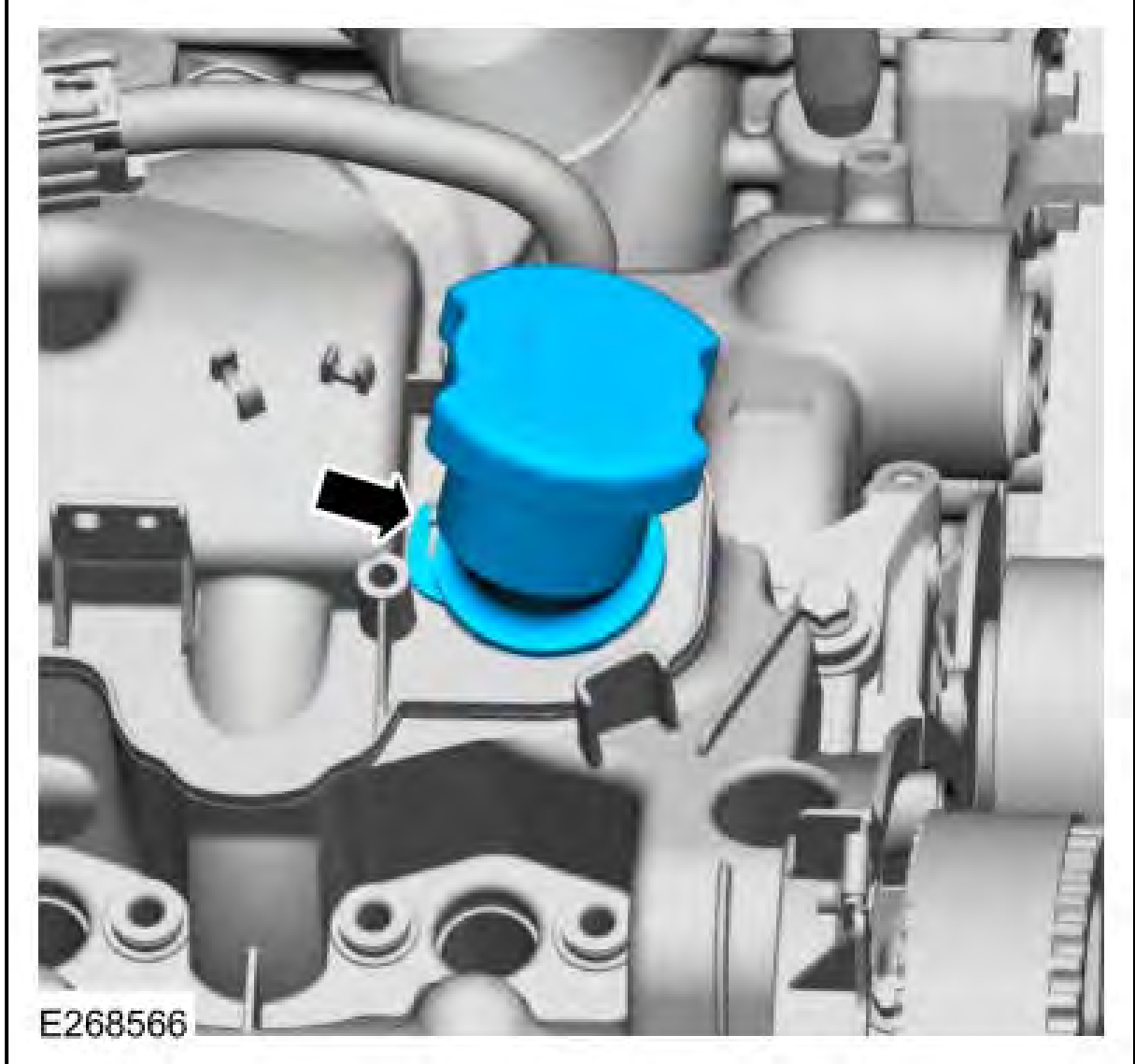




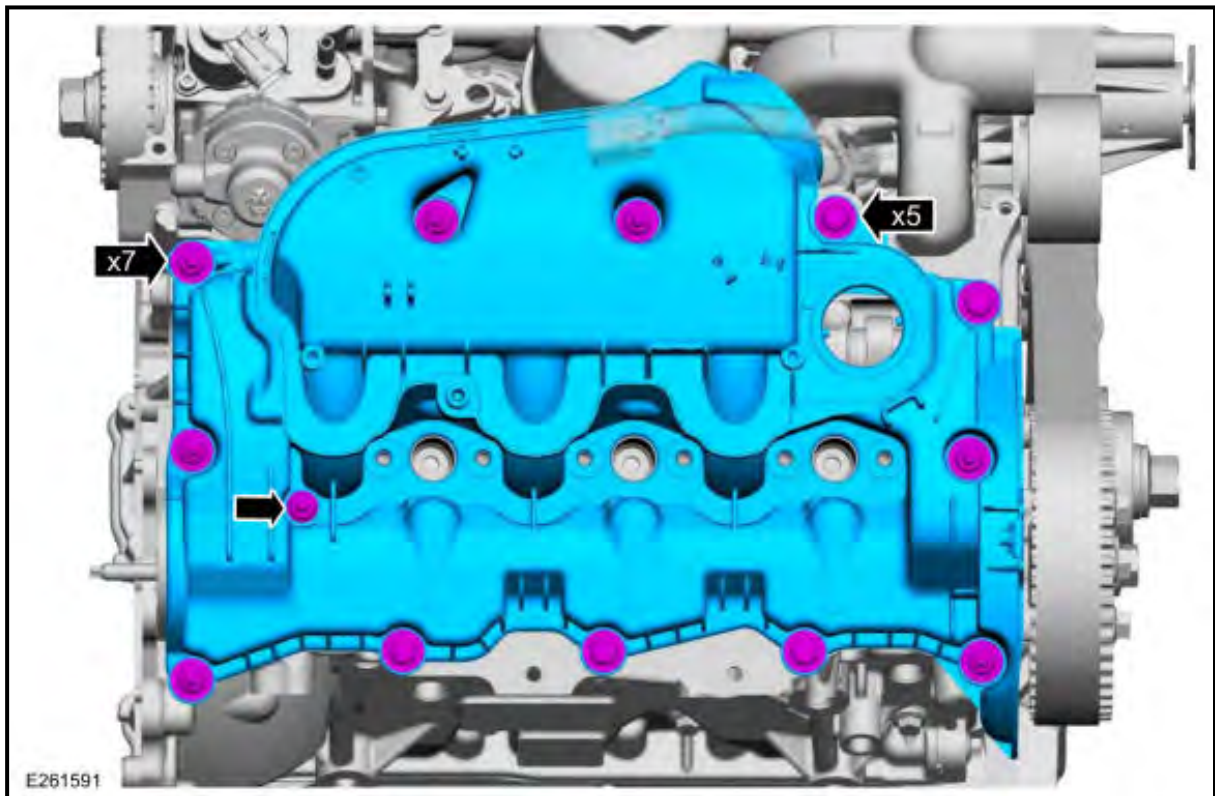


127. Remove the oil fill cap assembly.

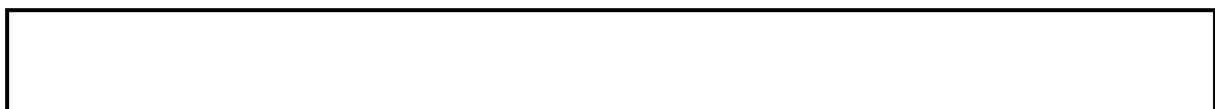


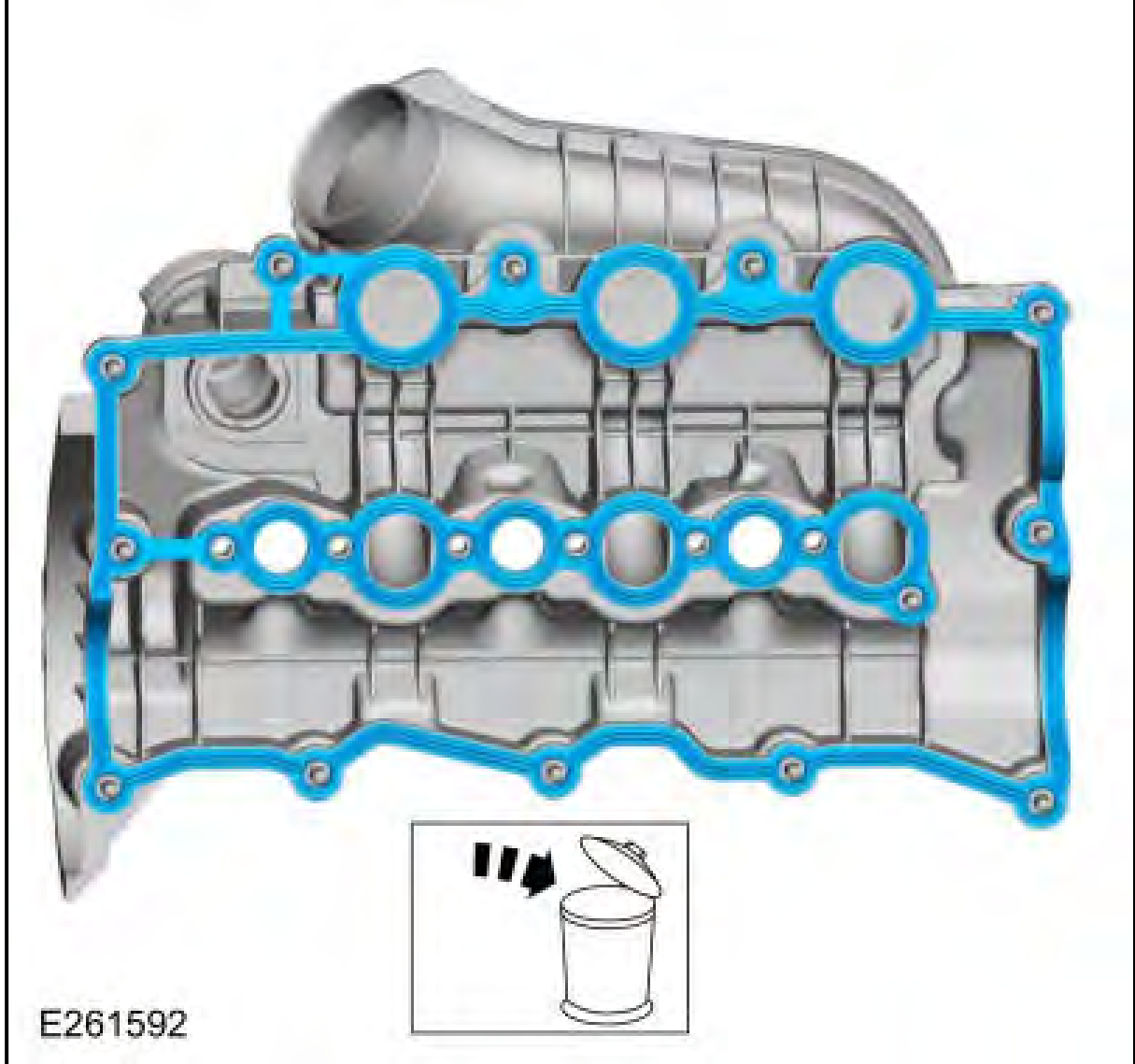


128. Loosen the fasteners and remove the RH valve cover.



129. Remove and discard the RH valve cover gasket.





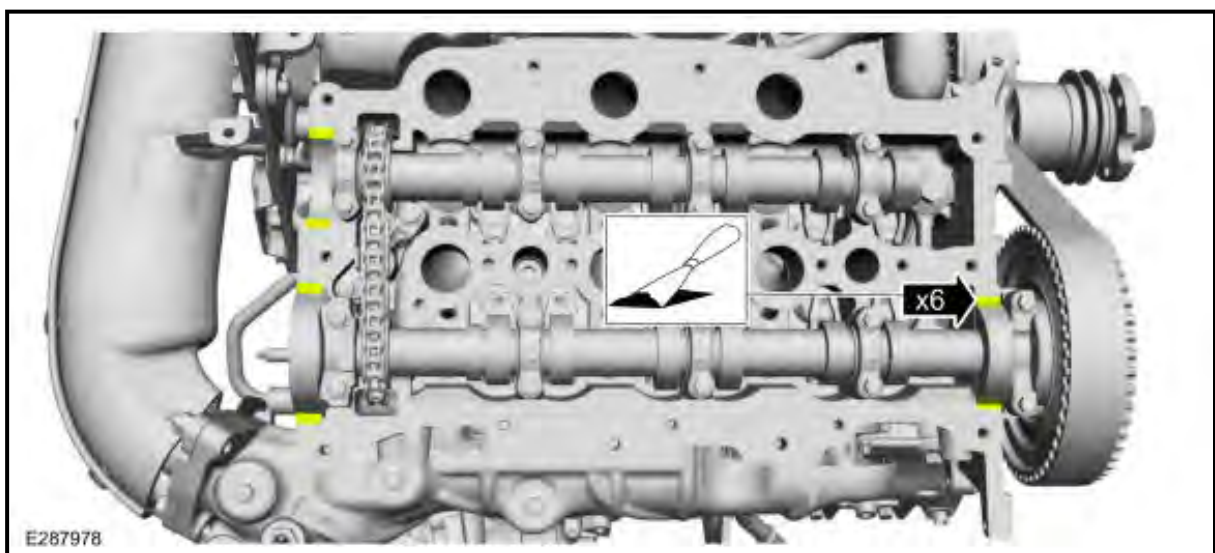
130. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.

Clean the valve cover mating surface of the cylinder head and engine front cover. Refer to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

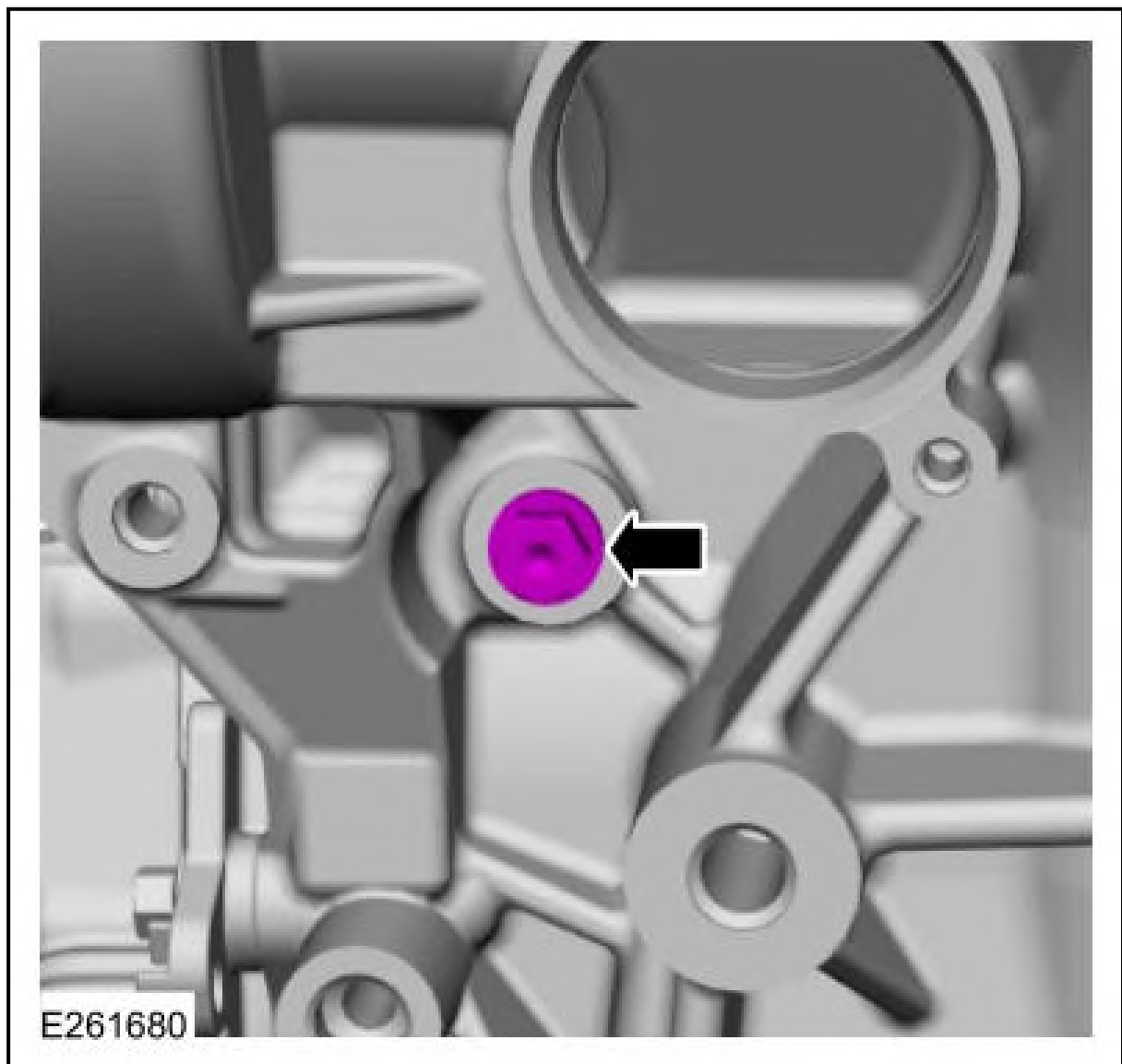
Material: Motorcraft <sup>®</sup> Silicone Gasket Remover / ZC-30-A

Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B



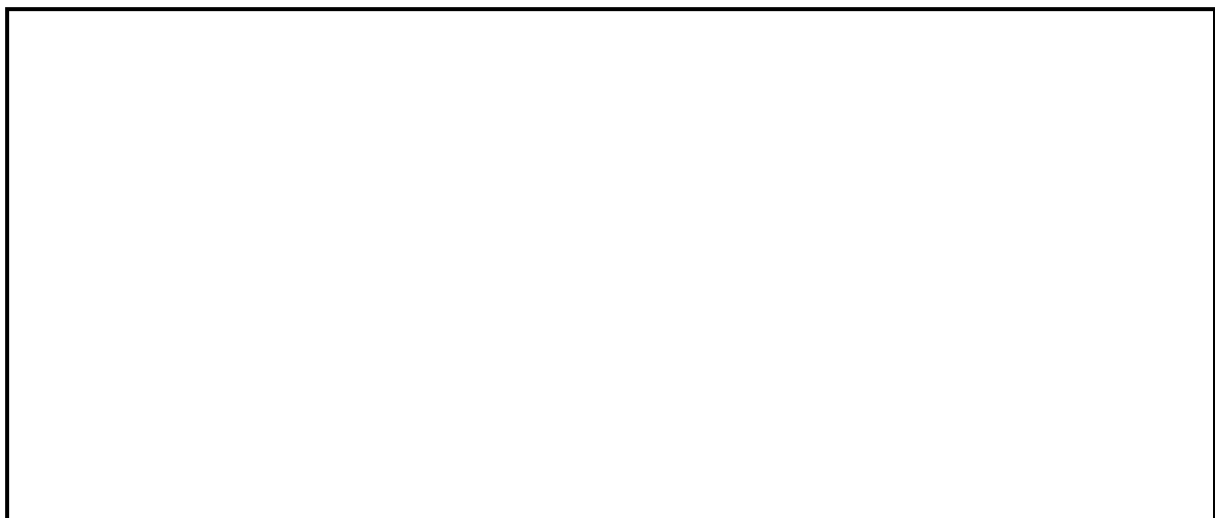
131. Remove the timing pin bolt at the left front of the engine.

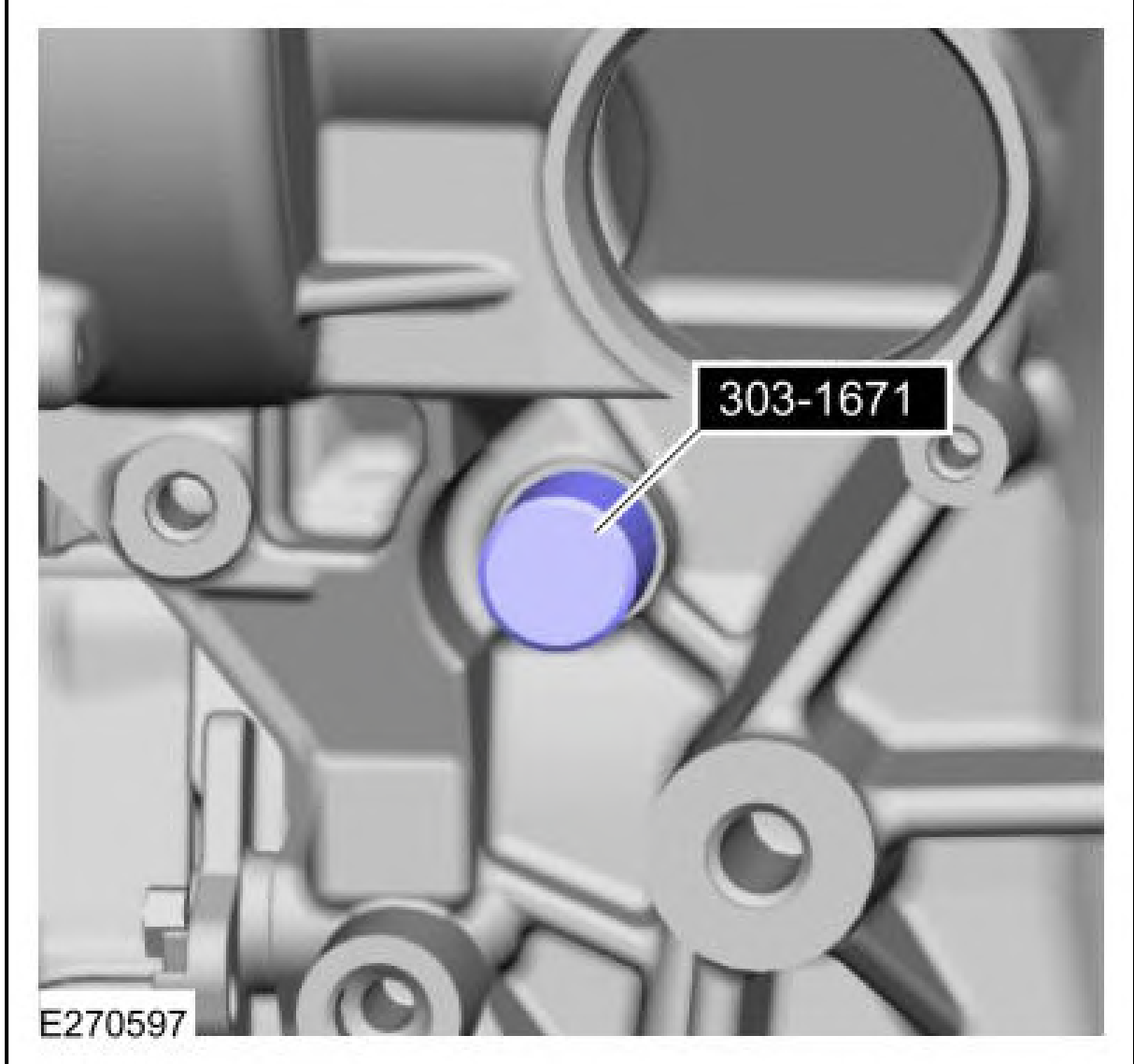


132. Install special tool.

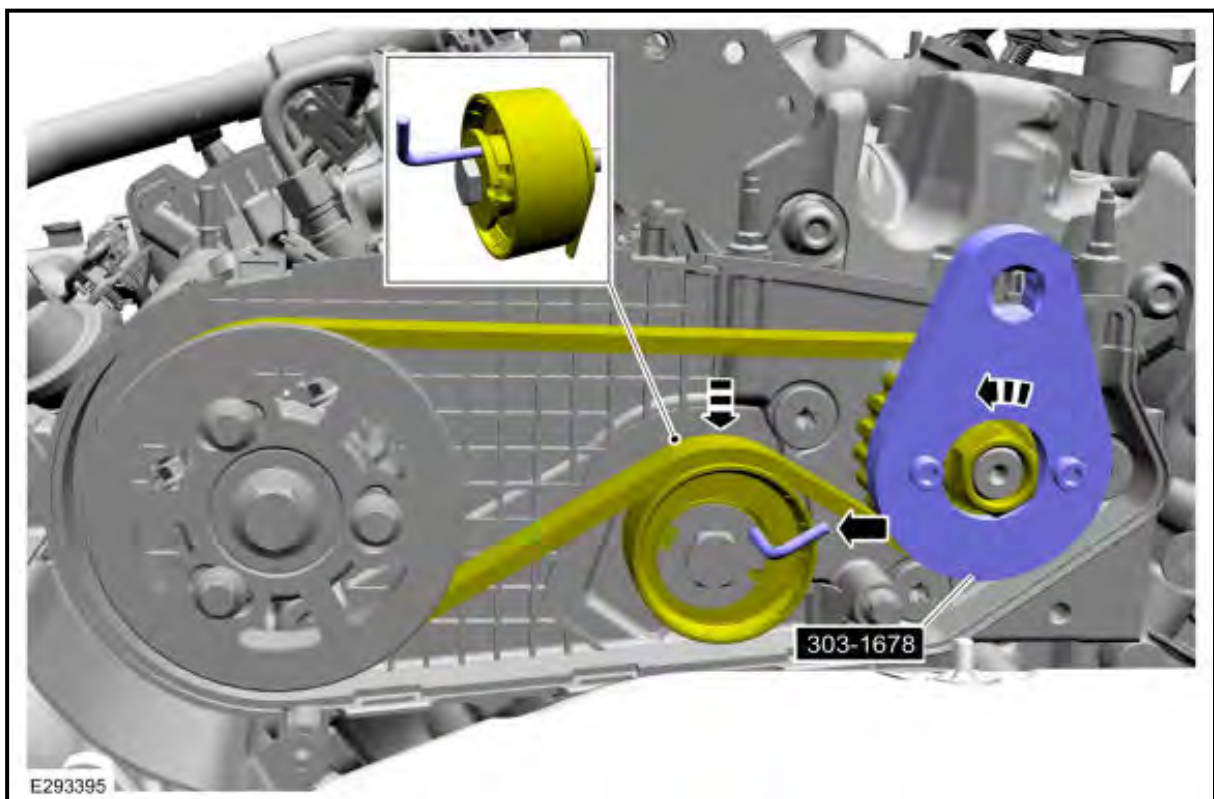
- **NOTE:** Only rotate the crankshaft clockwise.
- NOTE:** Verify that the camshaft timing holes are aligned with the cylinder head.
- NOTE:** The Locking Crankshaft Pin must be bottomed out against the cylinder block.

Rotate the crankshaft clockwise so the crankshaft contacts the locking crankshaft pin. Use Special Service Tool: 303-1671 Pin, Locking Crankshaft.



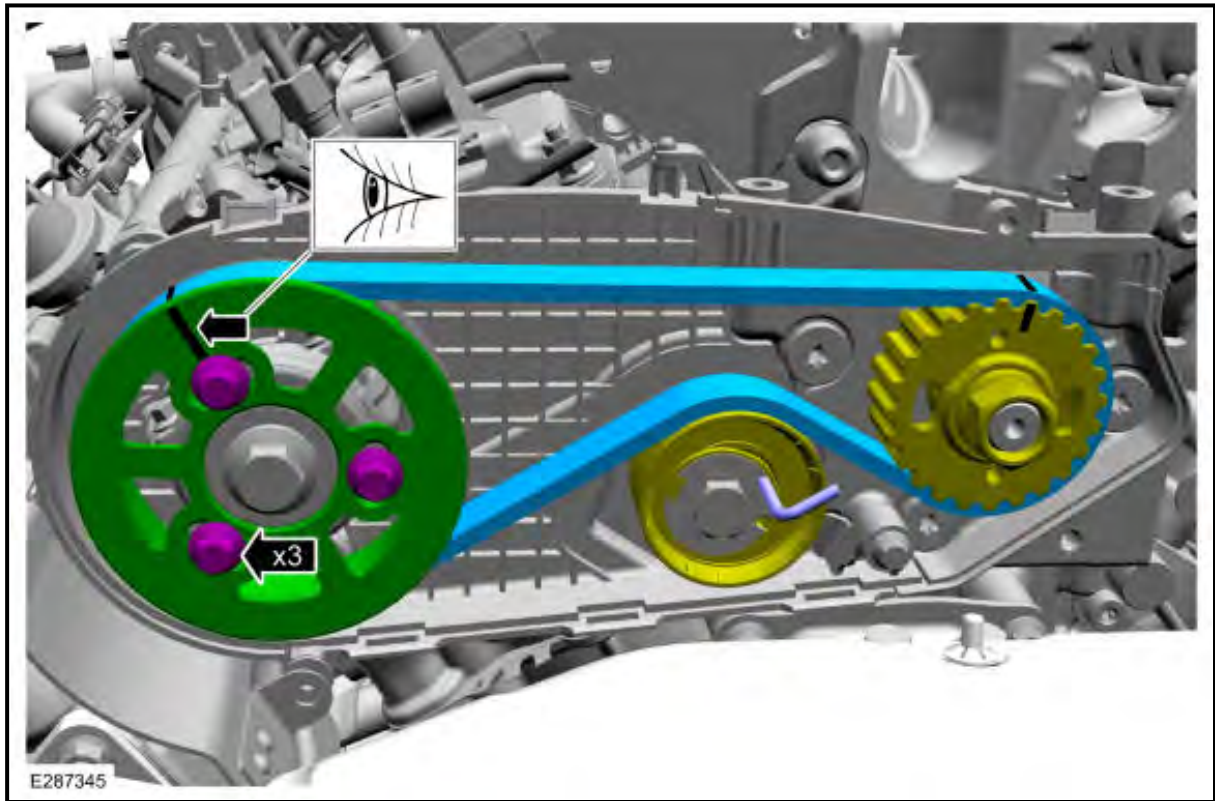


133. Using the special tool, rotate the fuel pump sprocket to push down on the READ belt tensioner until the openings are aligned, install the lock pin. Use Special Service Tool: 303-1678 Remover, Fuel Pump Pulley Holding Tool.

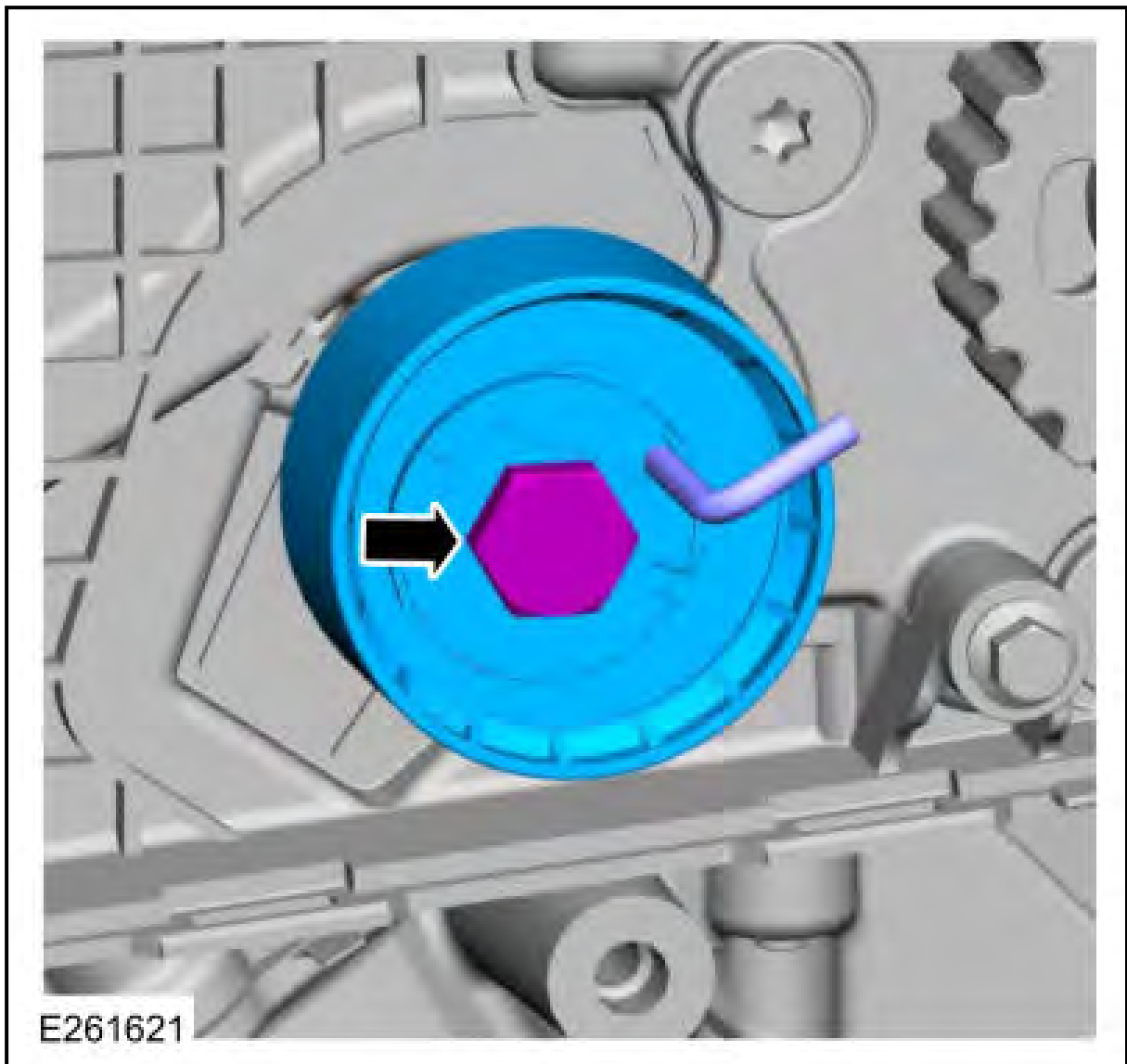


134. **NOTE:** Note the position of the camshaft pulley prior to removal.

Remove the bolts, the camshaft pulley and the READ belt.

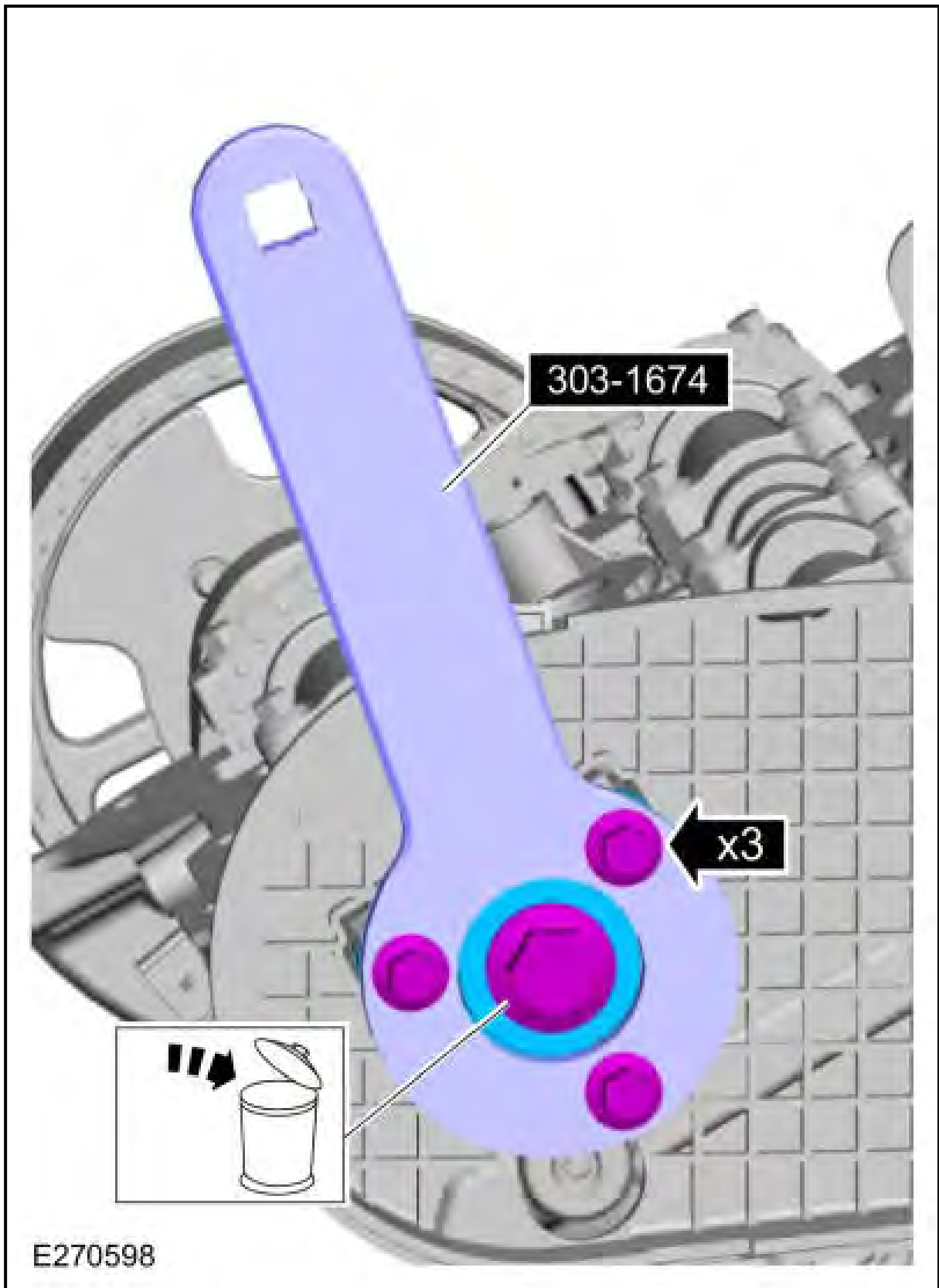


135. Remove the bolt and the READ belt tensioner.



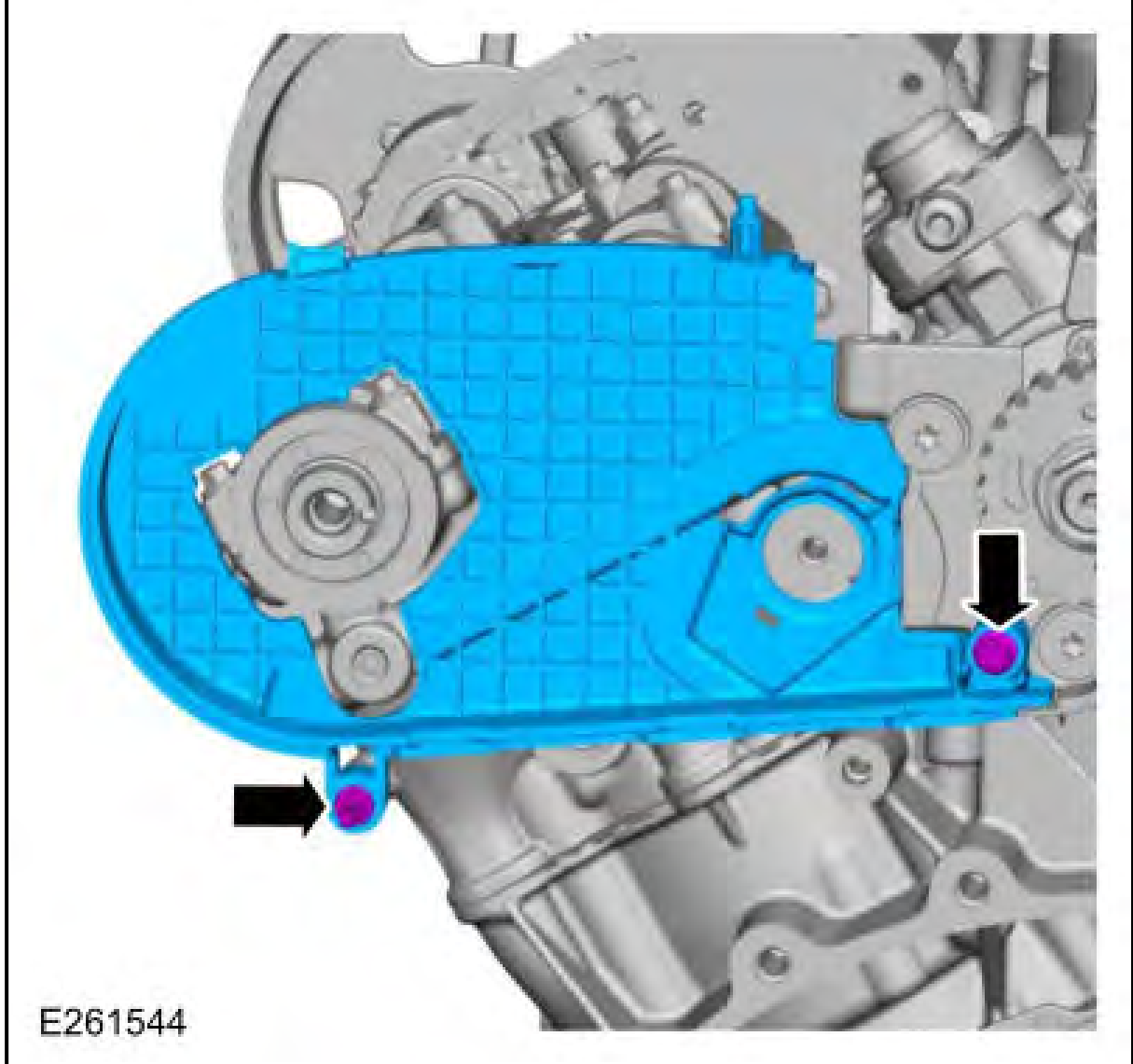
136. **NOTE:** Use the original bolts for the special tool.

Using the special tool, remove the bolt and the camshaft gear hub. Discard the bolt. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.



137. Remove the nut, the bolt and the accessory drive cover.

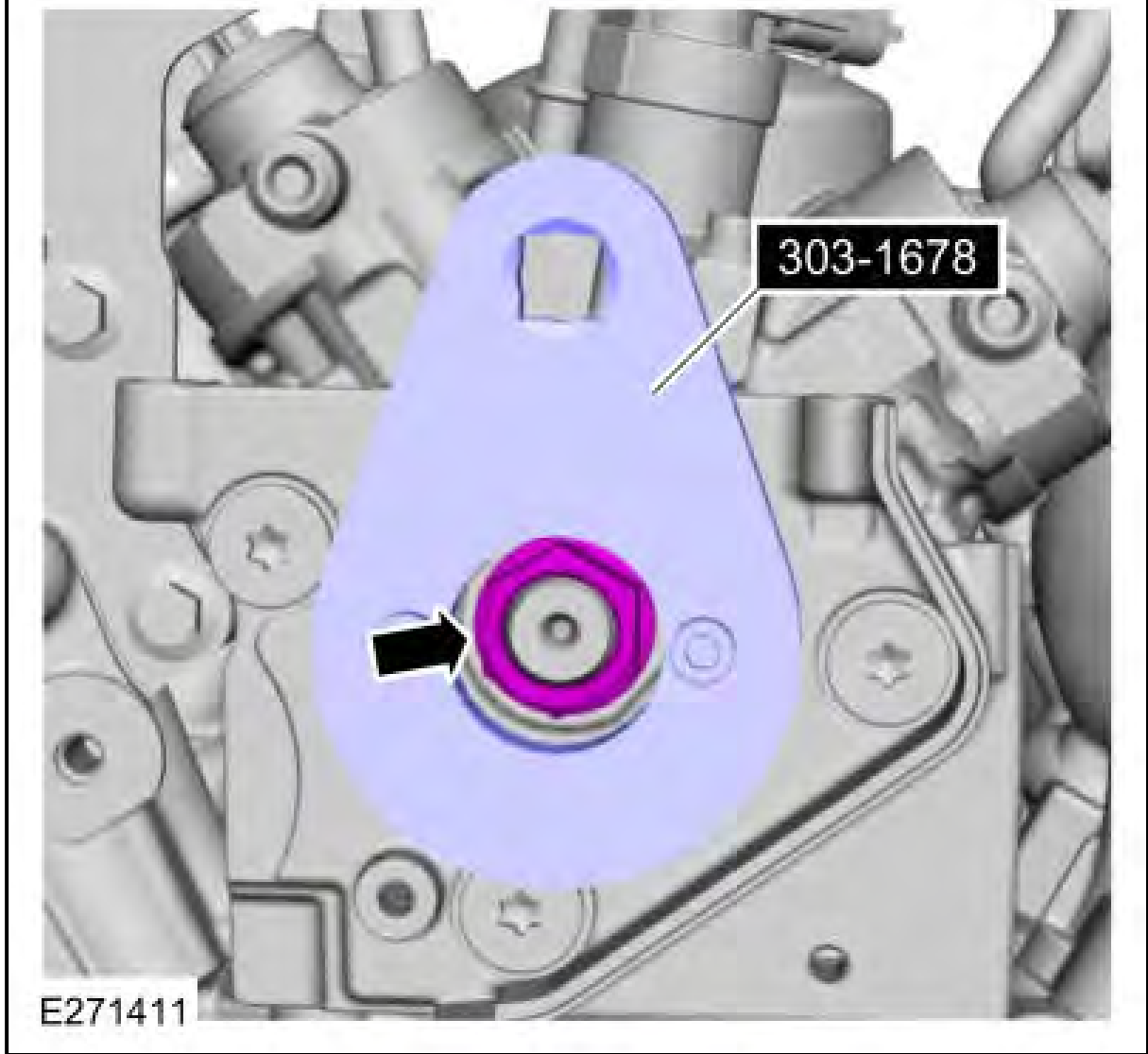




138. Using the special tool, remove the nut for the fuel injection pump pulley. Use Special Service Tool: 303-1678 Remover, Fuel Pump Pulley Holding Tool.

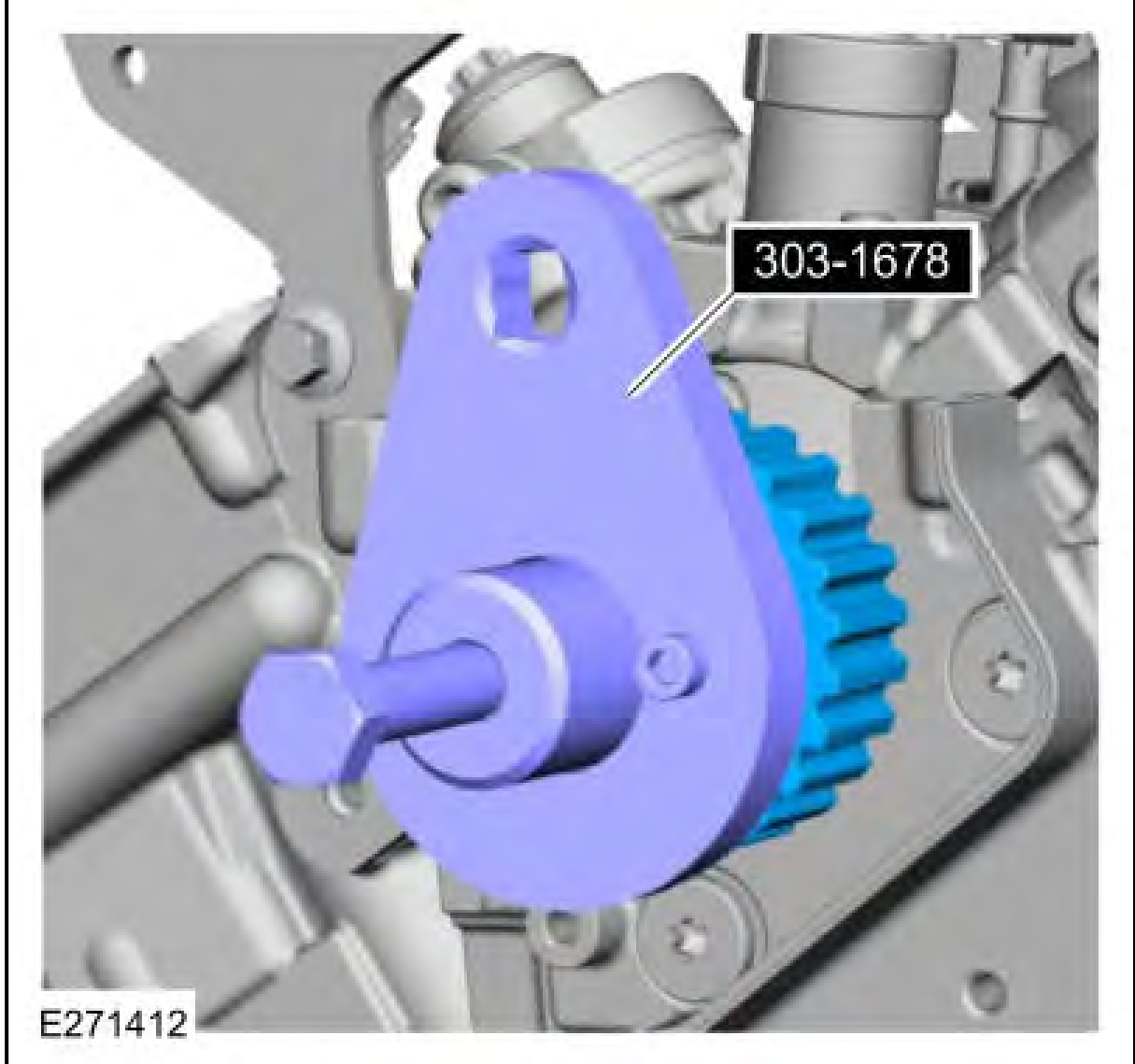




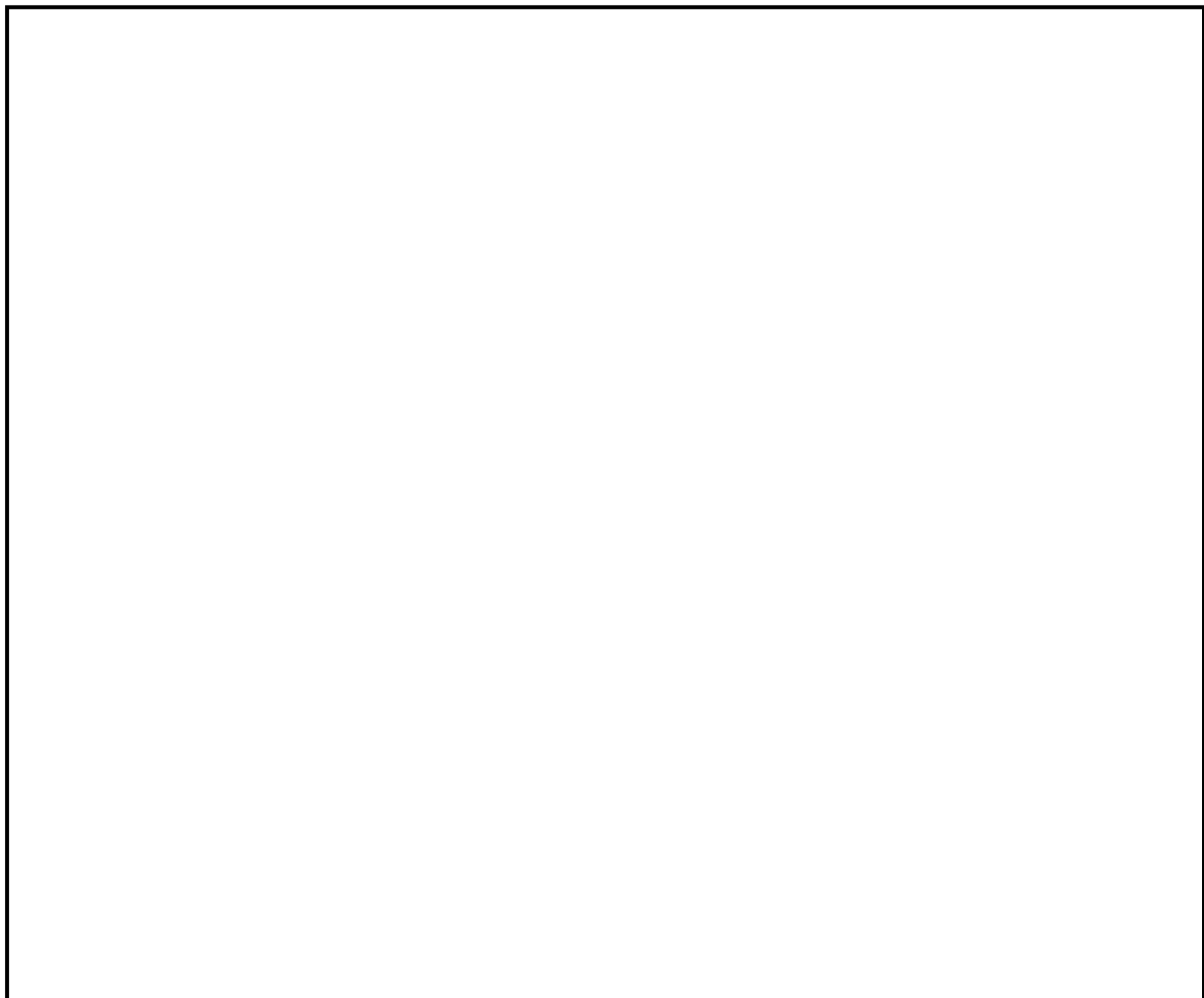


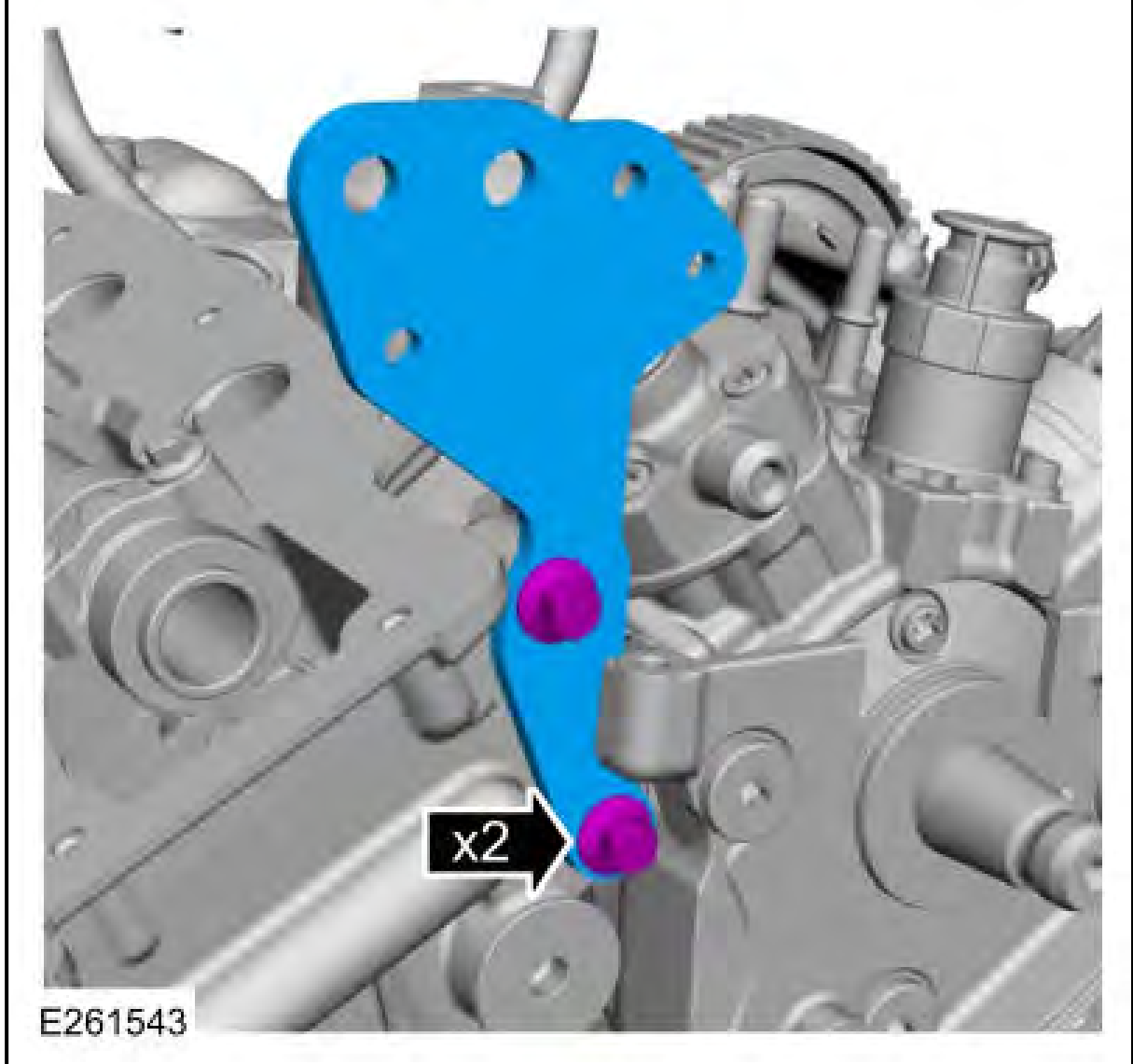
139. Using the special tool, remove the fuel injection pump pulley. Use Special Service Tool: 303-1678 Remover, Fuel Pump Pulley Holding Tool.



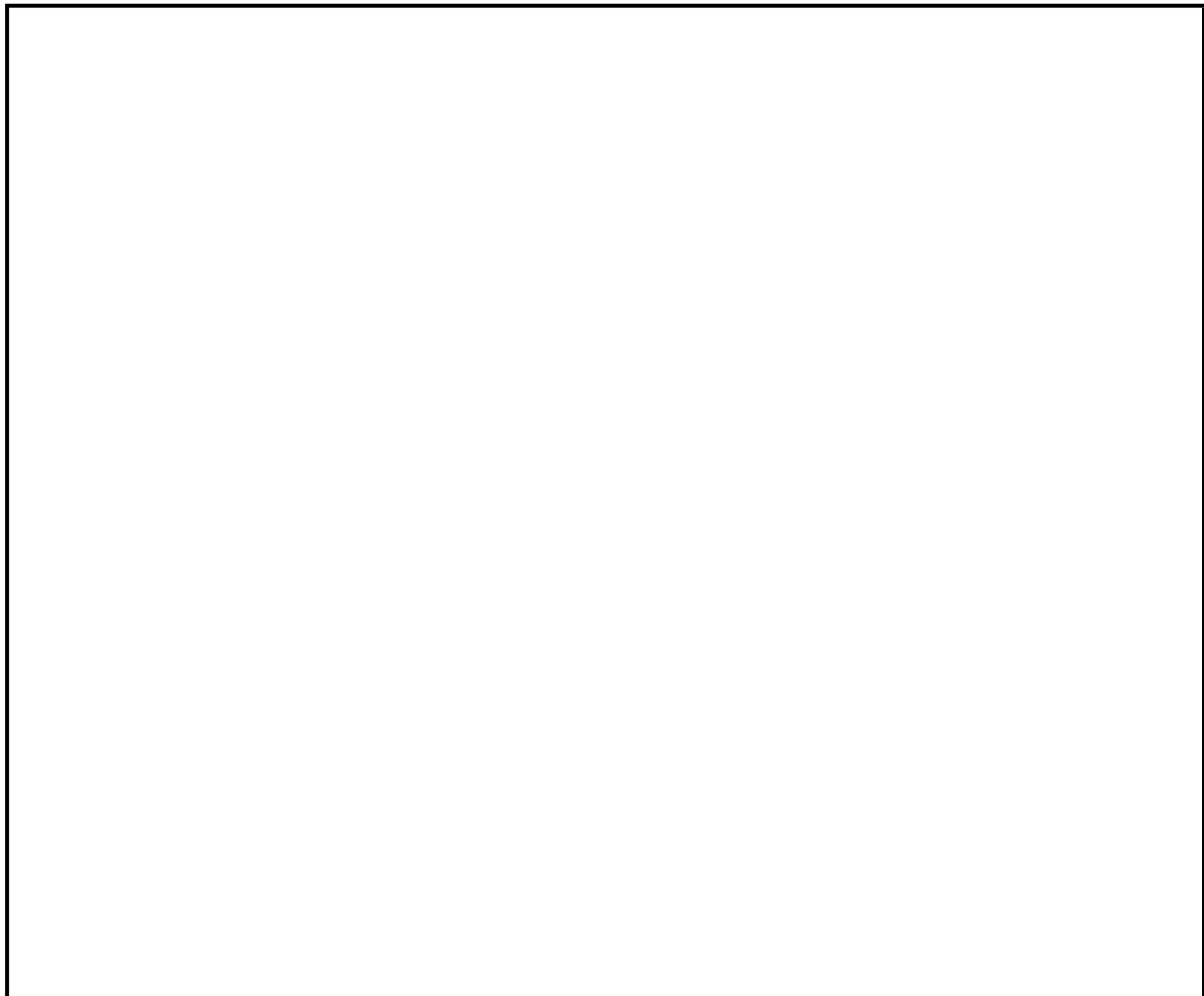


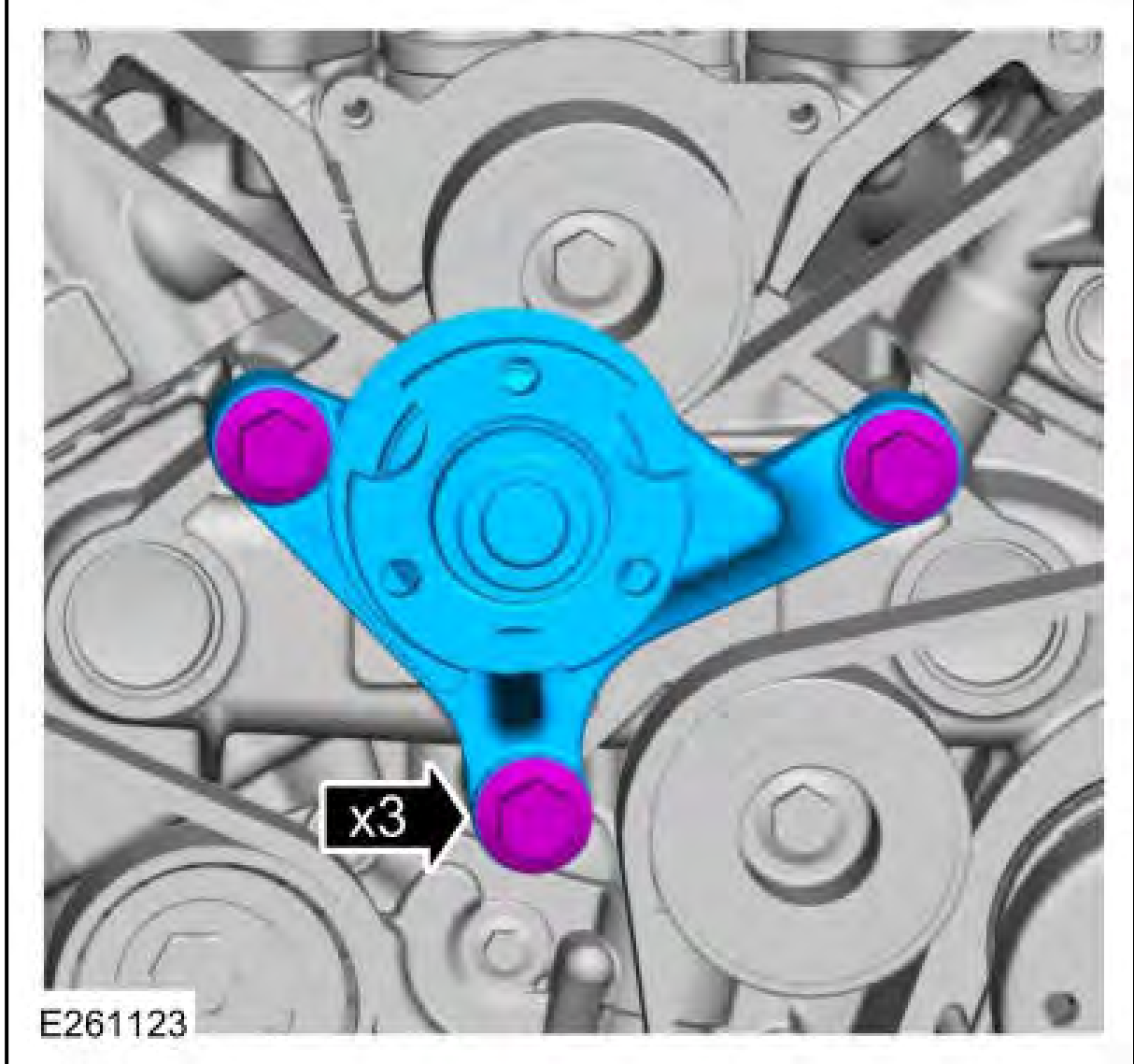
140. Remove the bolts and the rear engine lifting bracket.



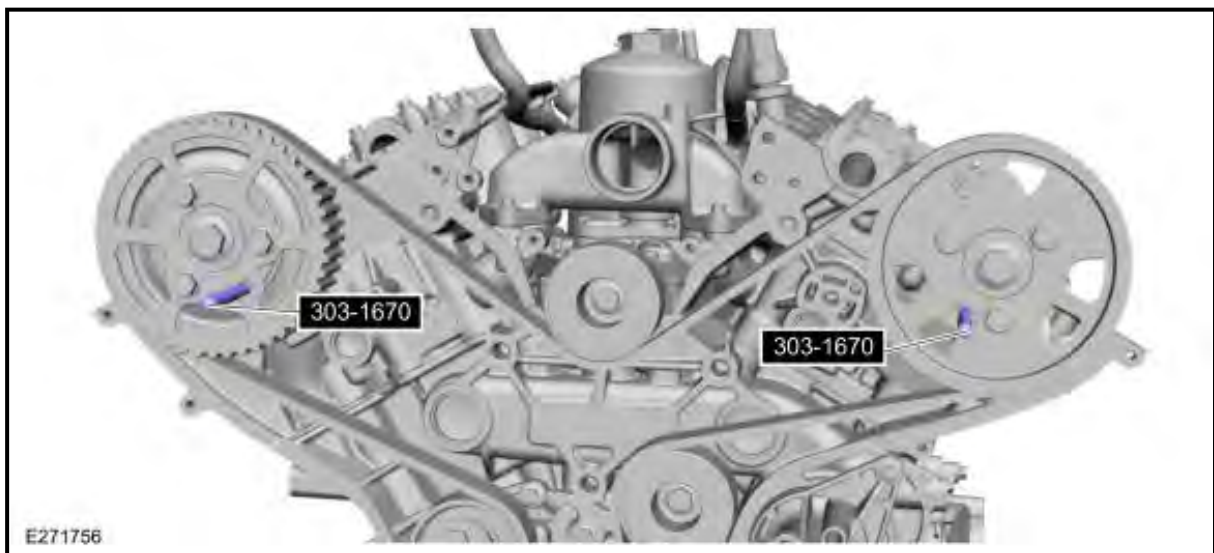


141. Remove the bolts and the fan drive.





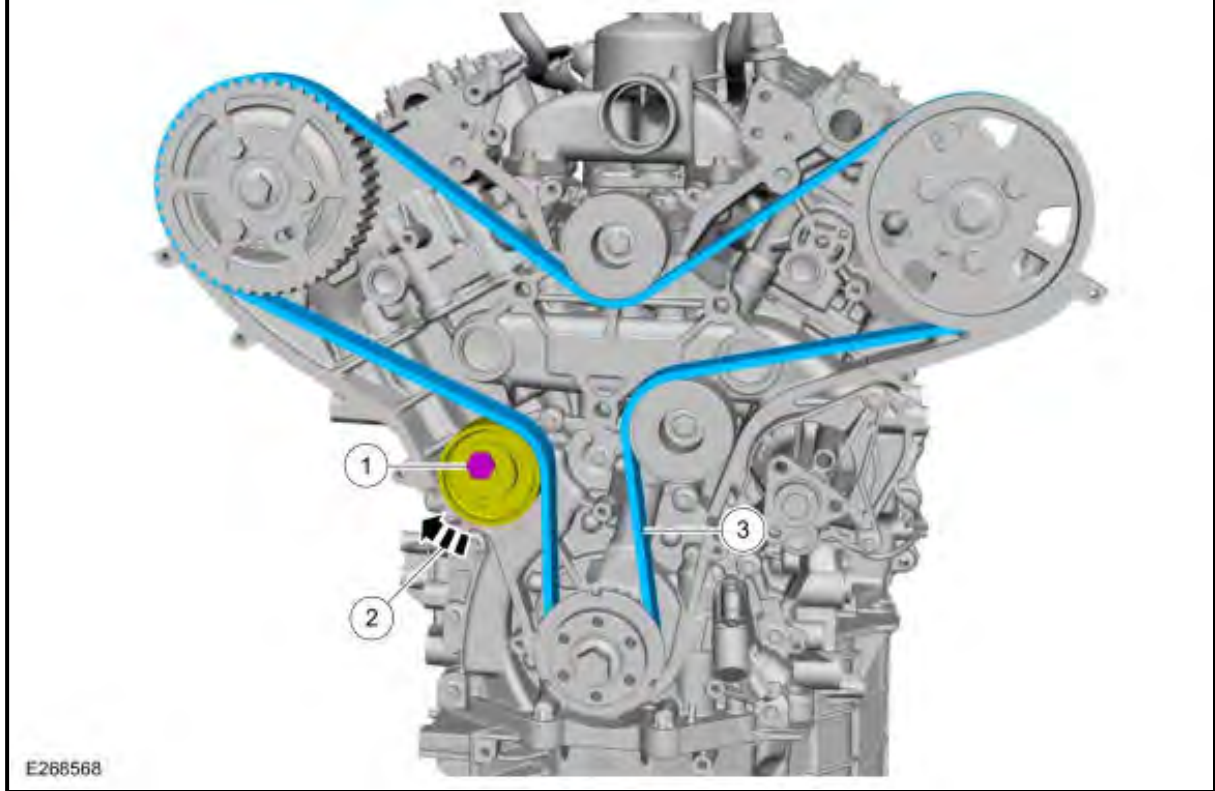
142. Using the special tools, verify the camshaft timing. Use Special Service Tool: 303-1670 Pins, Camshaft Locking.



143.

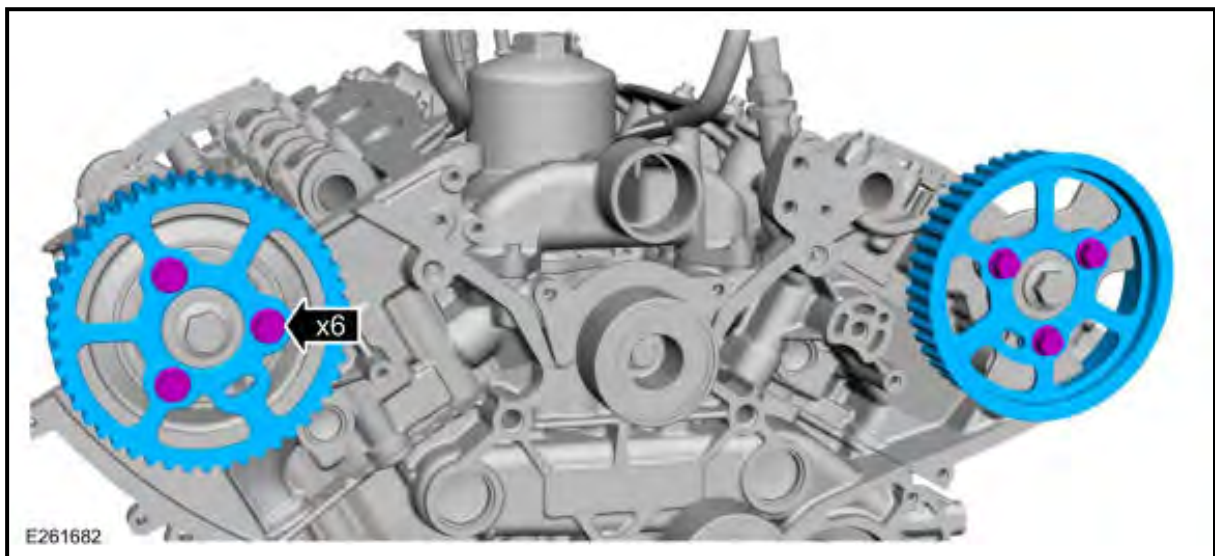
1. Loosen the timing belt tensioner bolt.
2. Rotate the timing belt tensioner clockwise.
3. Remove the timing belt.





144. **NOTE:** Note the position of the camshaft pulleys prior to removal.

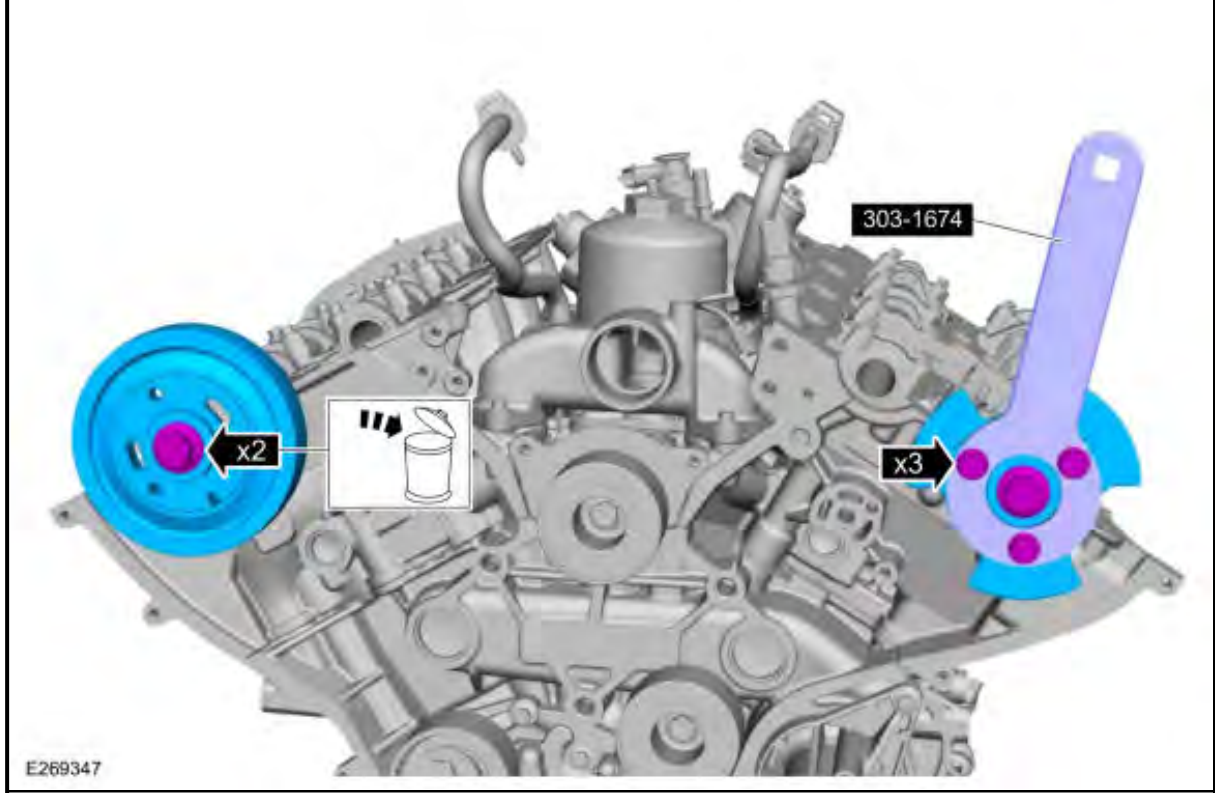
Remove the bolts and the camshaft pulleys.



145. **NOTE:** Use the original bolts for the special tool.

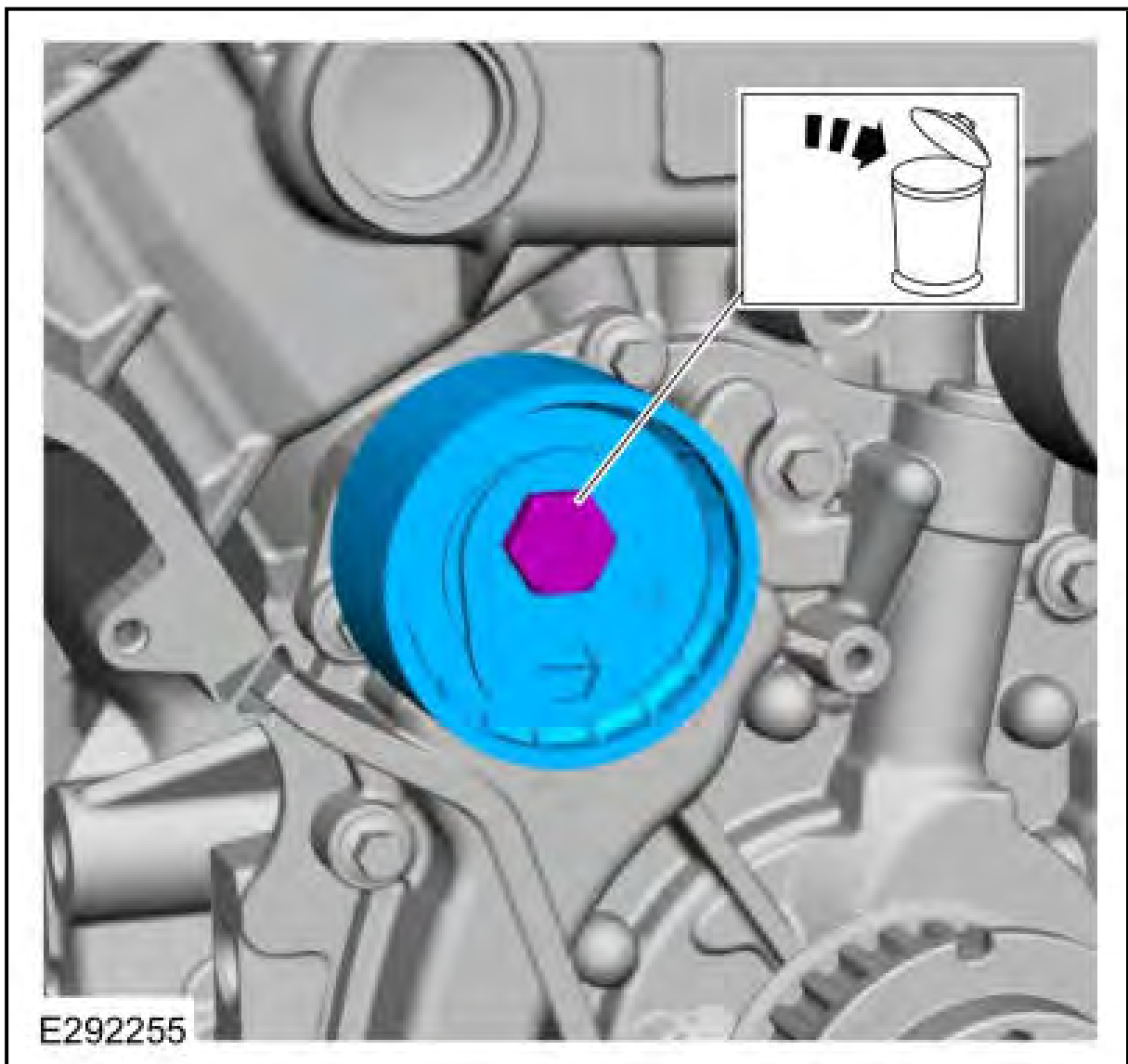
Using the special tool, remove the bolts and the camshaft gear hubs. Discard the bolts. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.



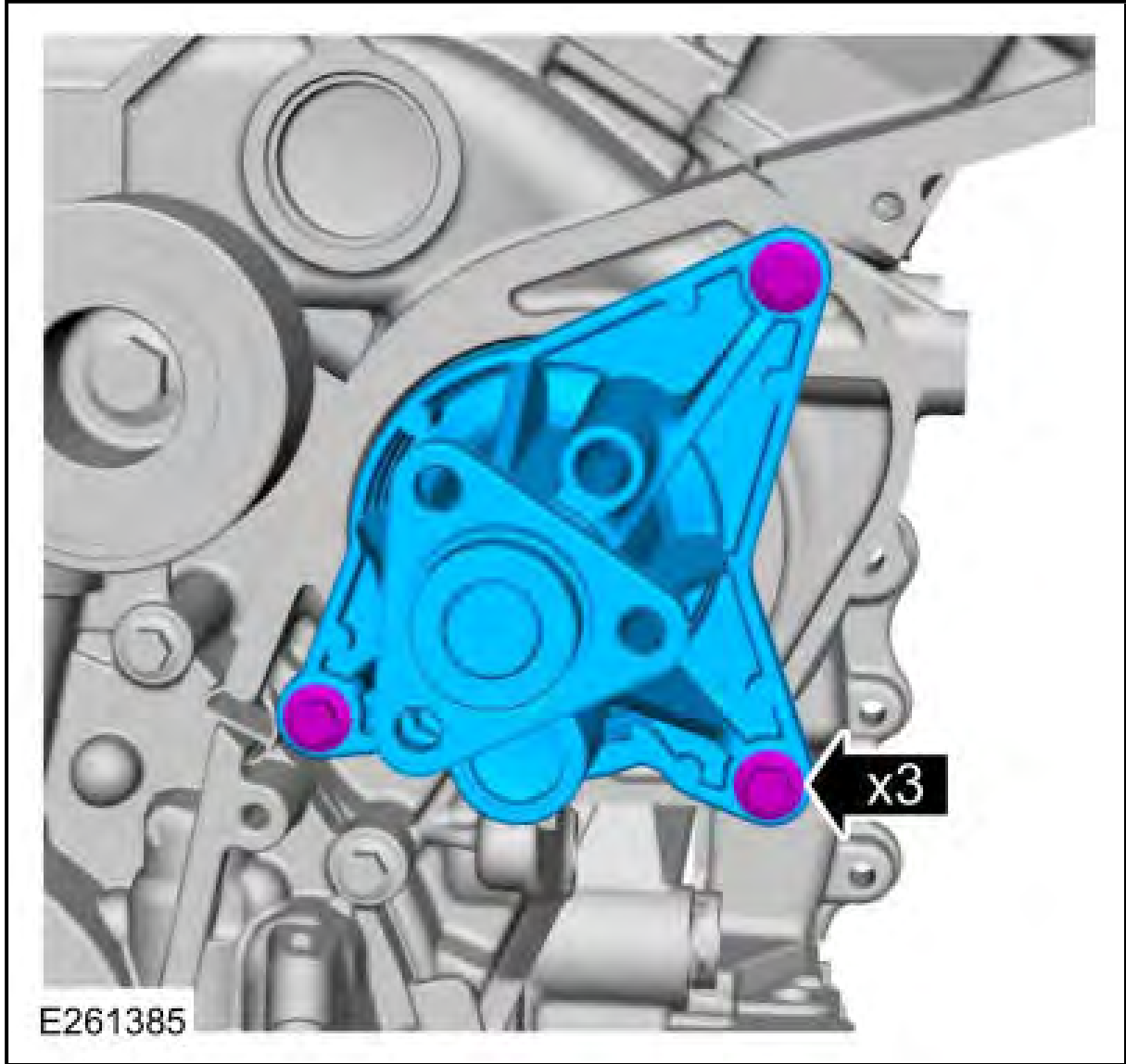


146. **NOTE:** Replace the timing belt tensioner if damage or excessive wear is found.

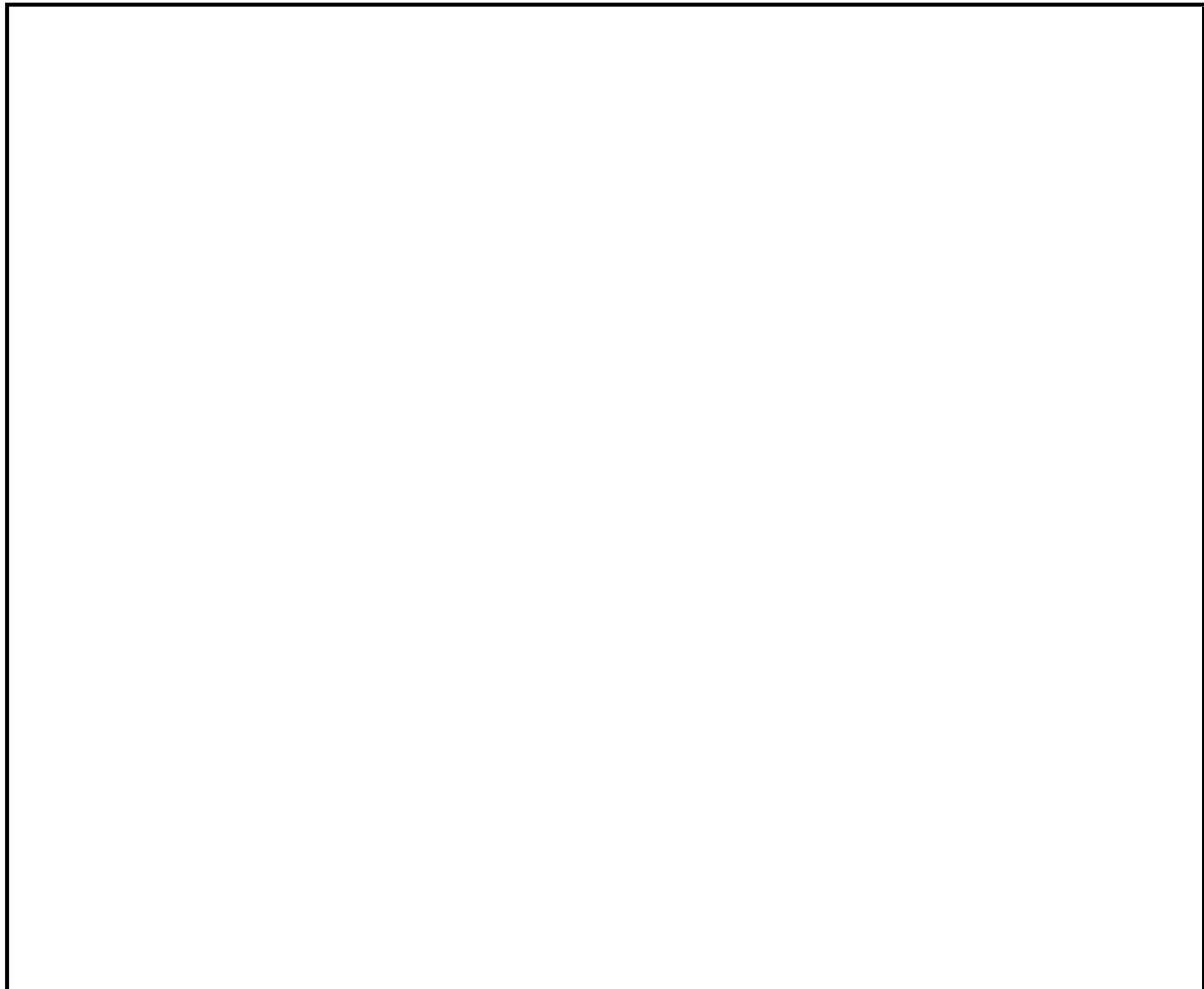
Remove the bolt and the timing belt tensioner. Discard the bolt.



147. Remove the bolts and the coolant pump.



148. Remove and discard the coolant pipe O-ring.

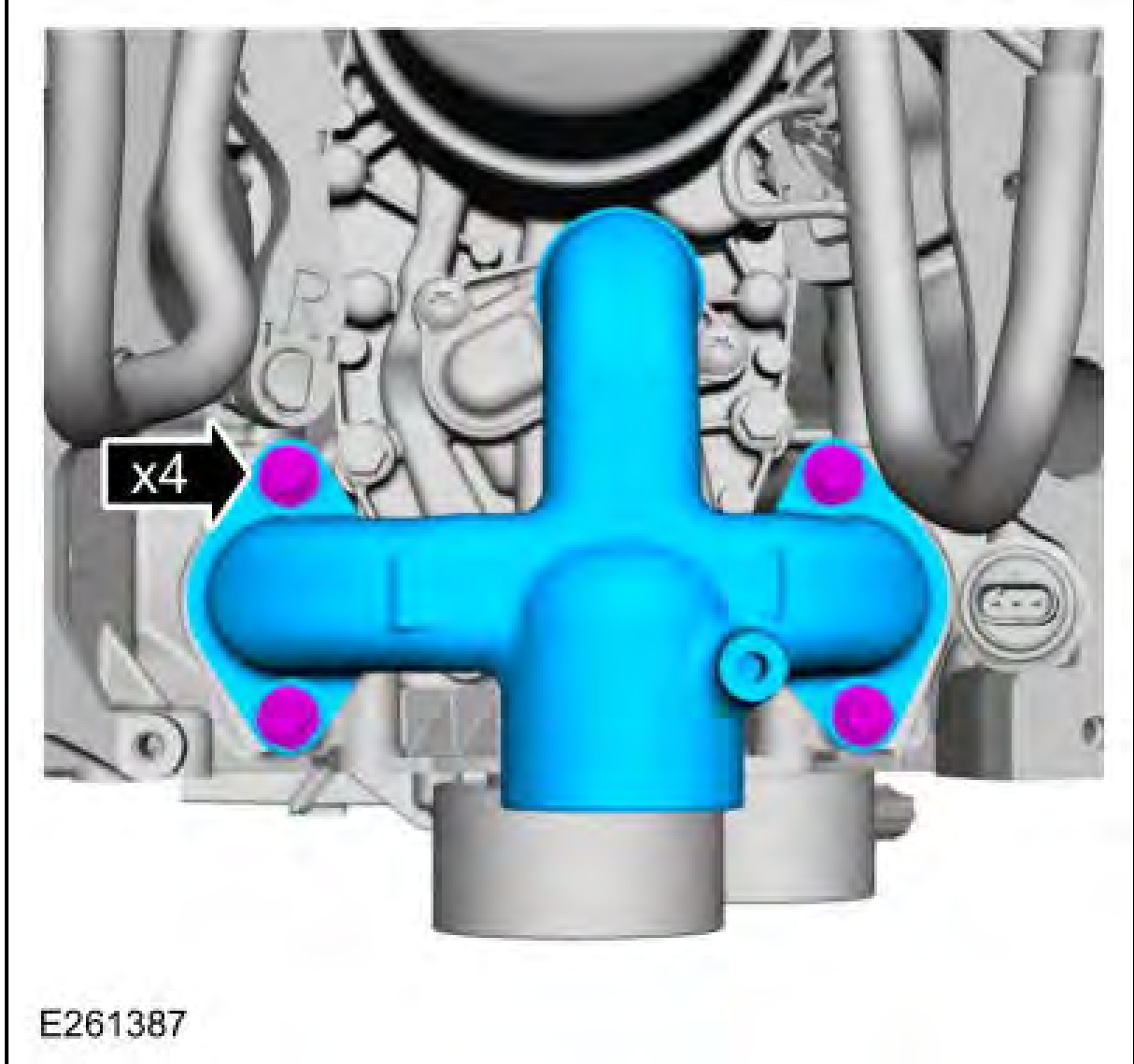




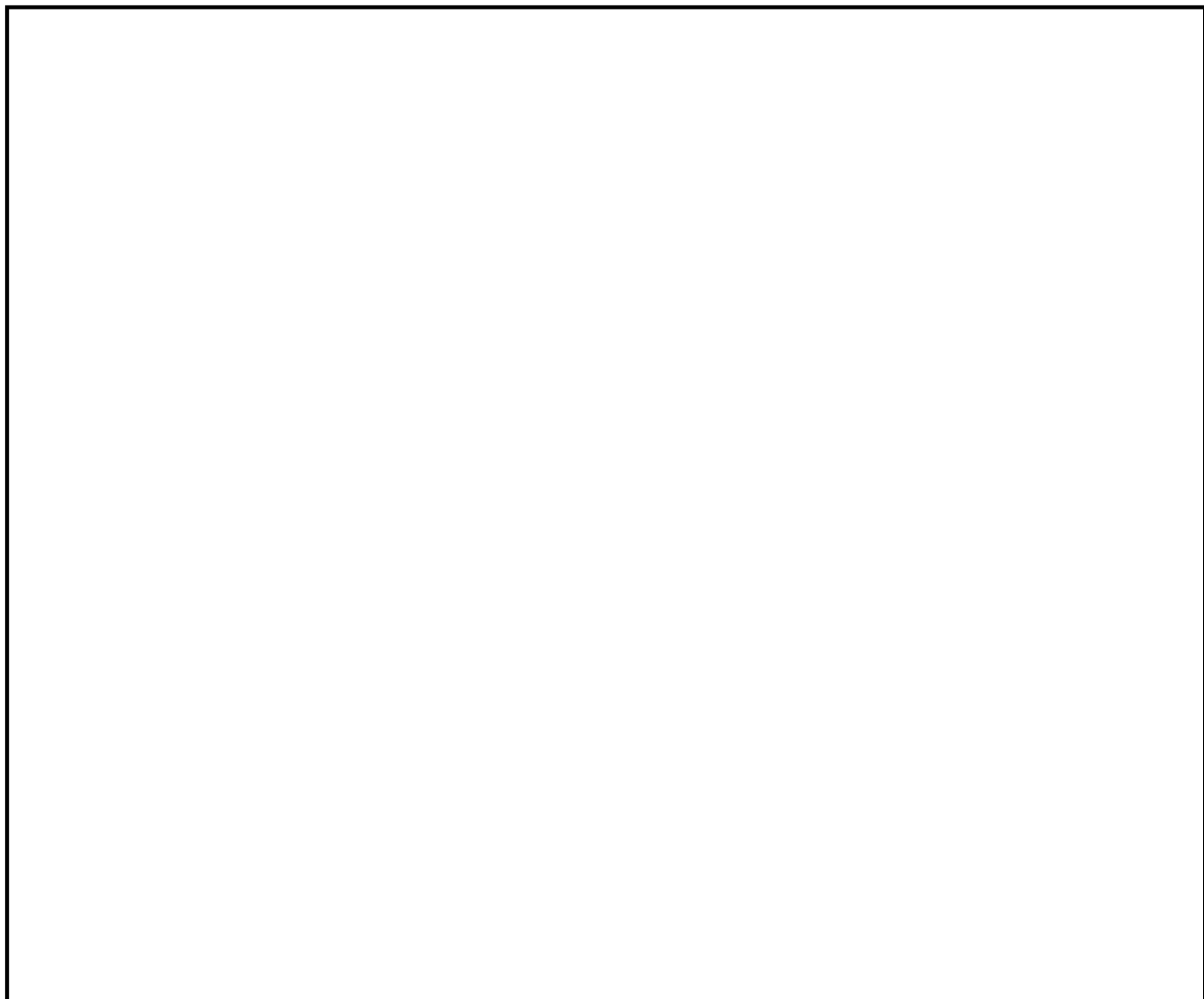
149. Remove the bolts and the coolant outlet connector.

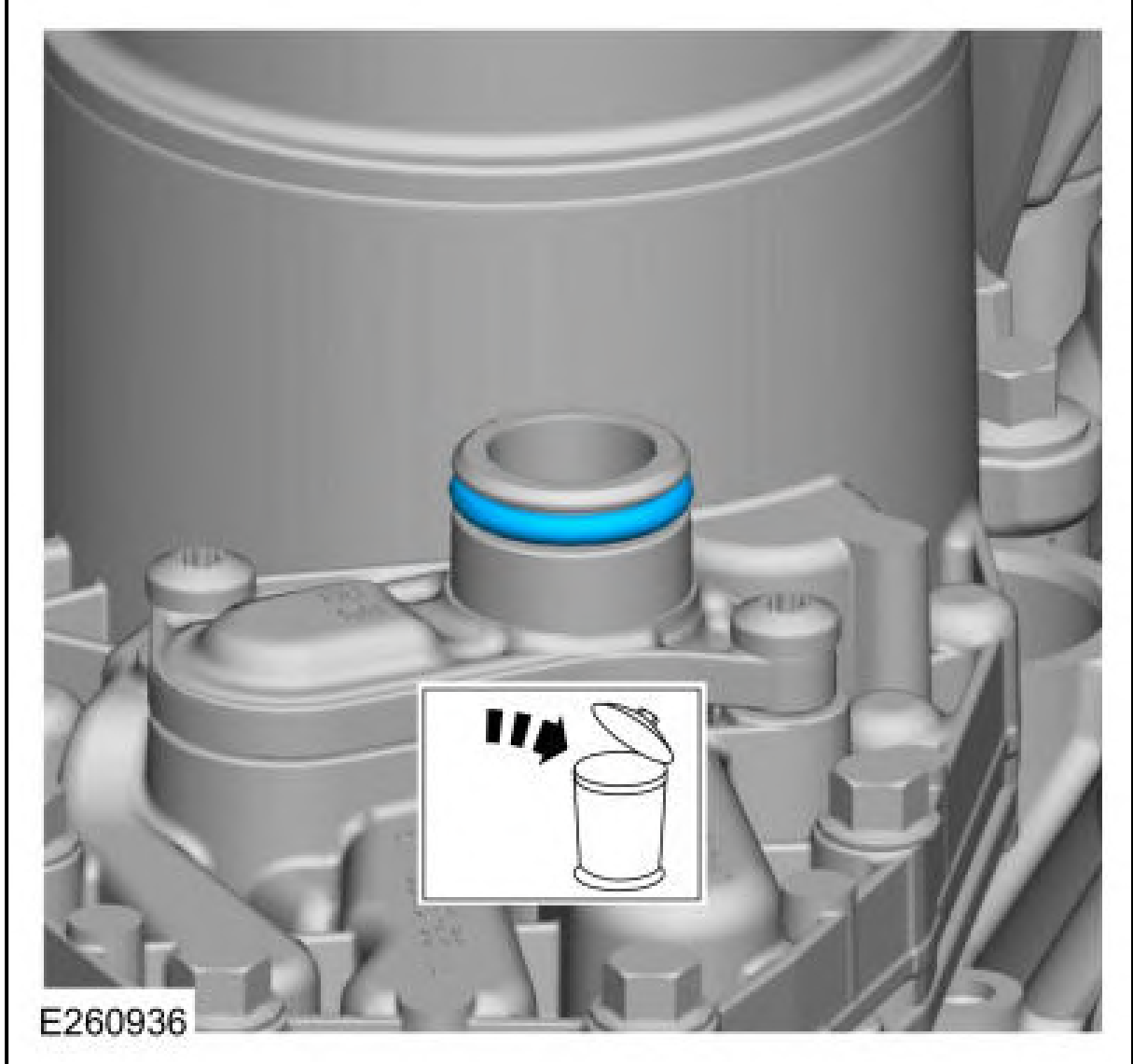




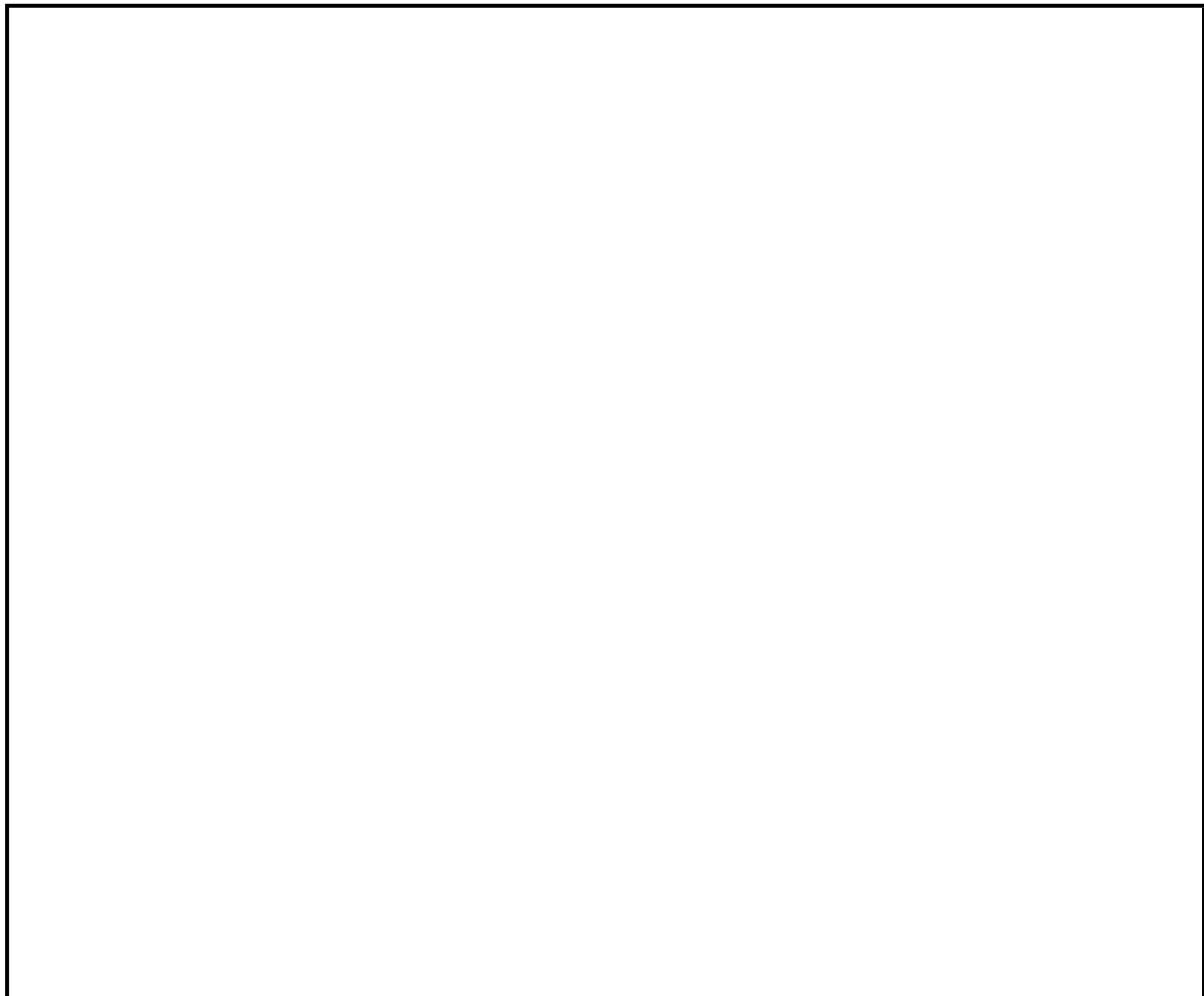


150. Remove and discard the oil cooler O-ring.





151. Remove and discard the coolant outlet connector gaskets.



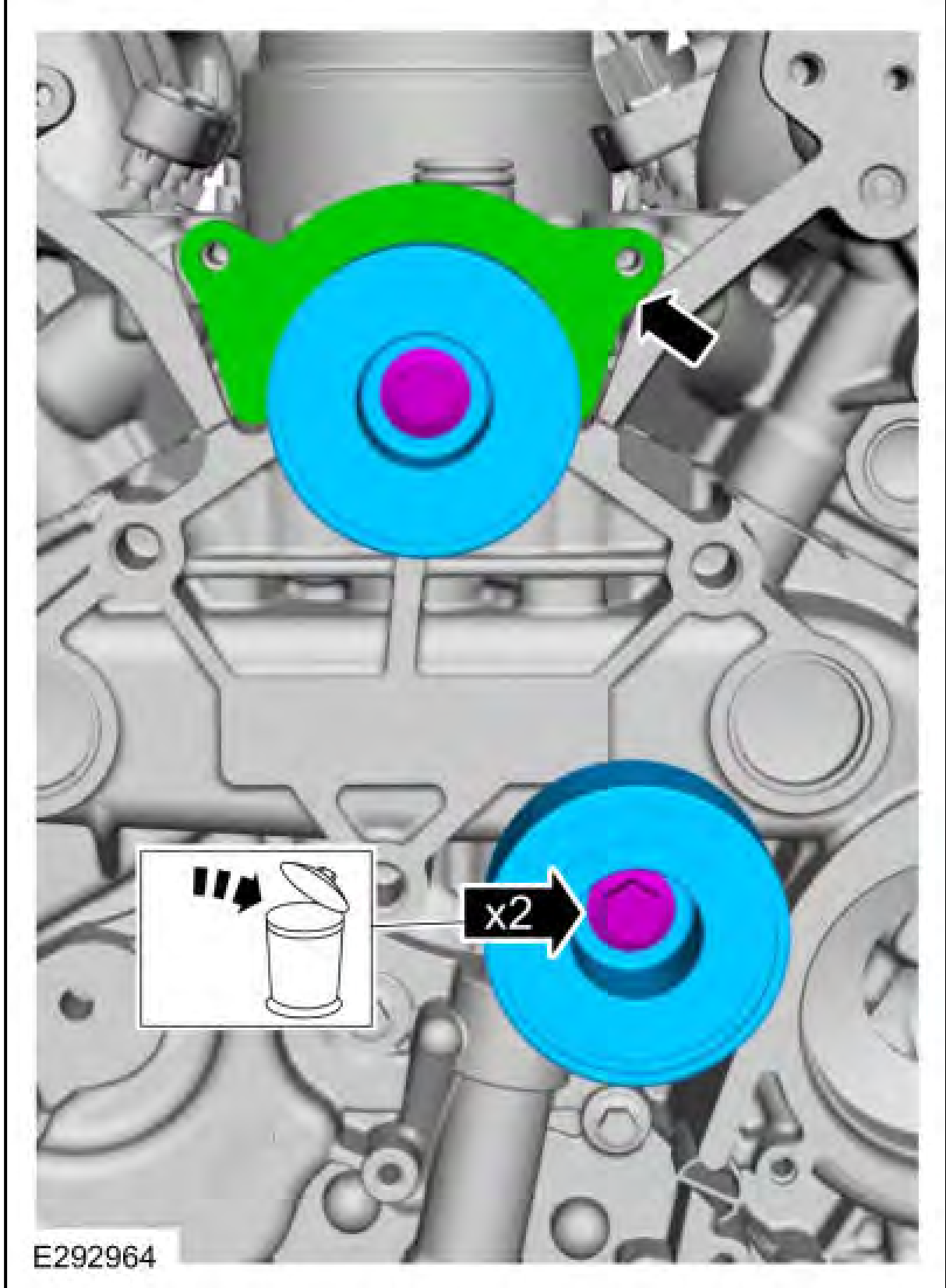


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152. **NOTE:** Replace the timing belt idler pulleys if damage or excessive wear is found.

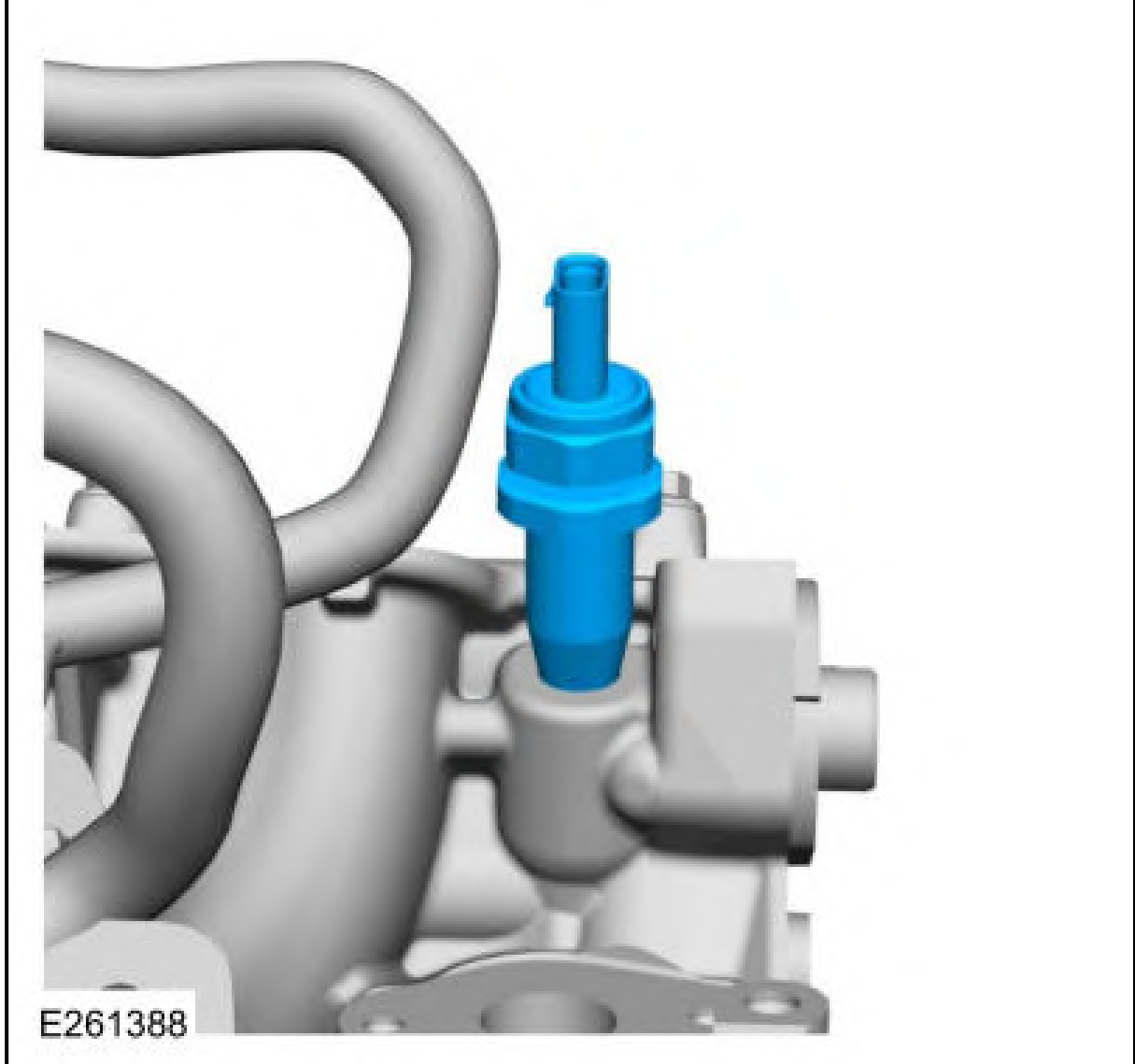
Remove the bolts and the timing belt idler pulleys. Remove the dust shield. Discard the bolts.





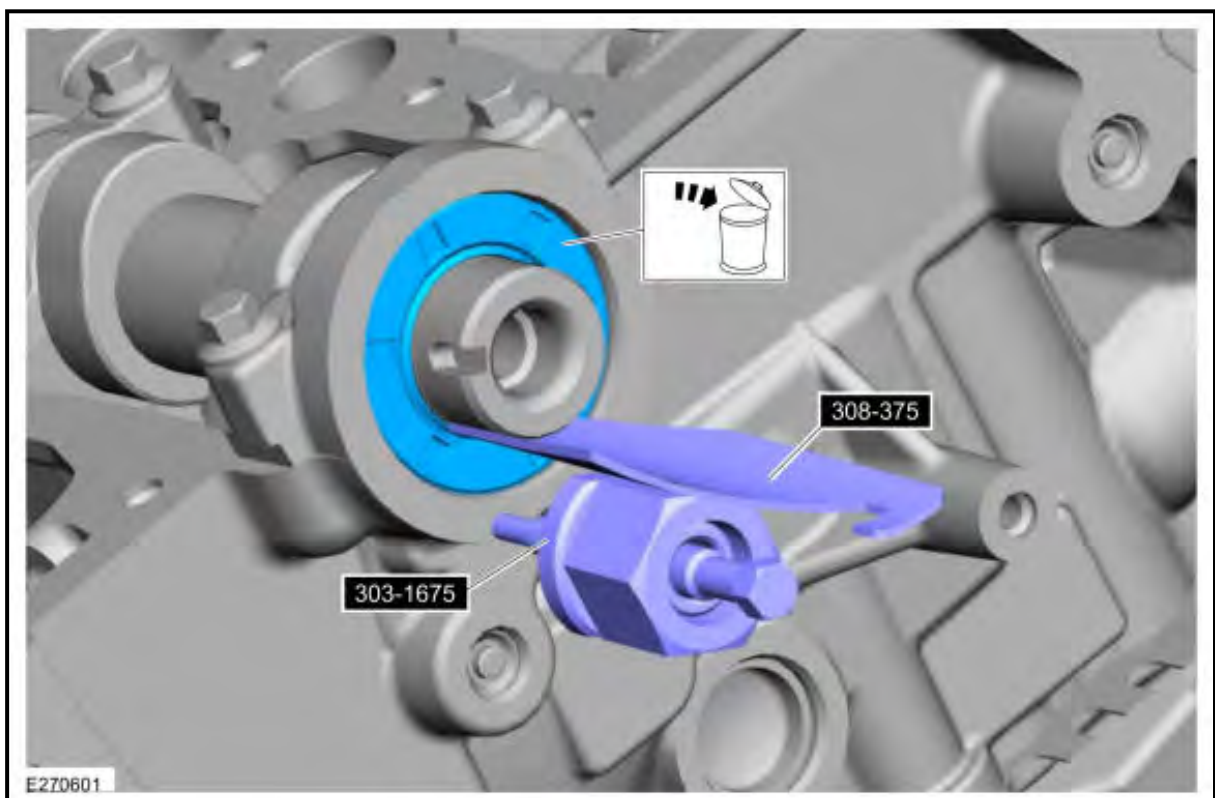
153. Remove the EOP sensor.



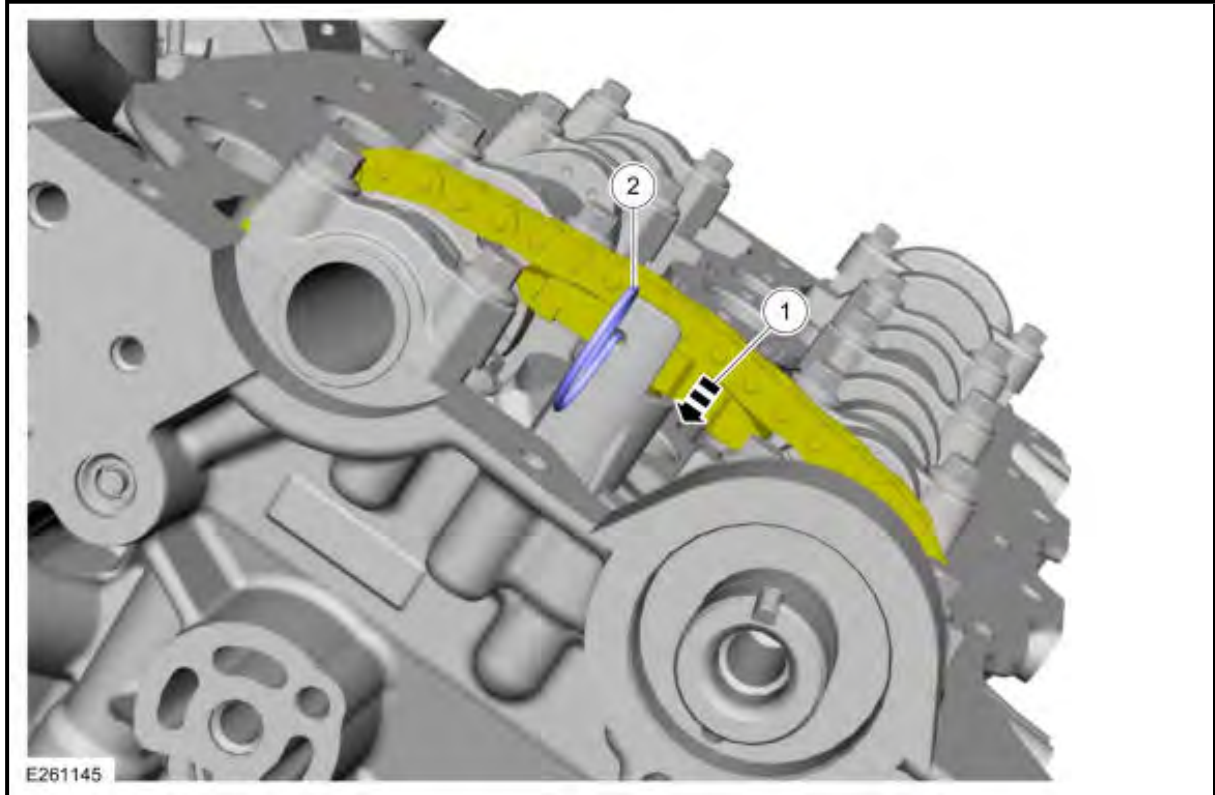


154. **NOTE:** Right side shown, left side front and rear similar.

Using the special tools, remove and discard the camshaft seals. Use Special Service Tool: 303-1675 Adapter, Seal Remover., 308-375 Remover, Input Shaft Seal.

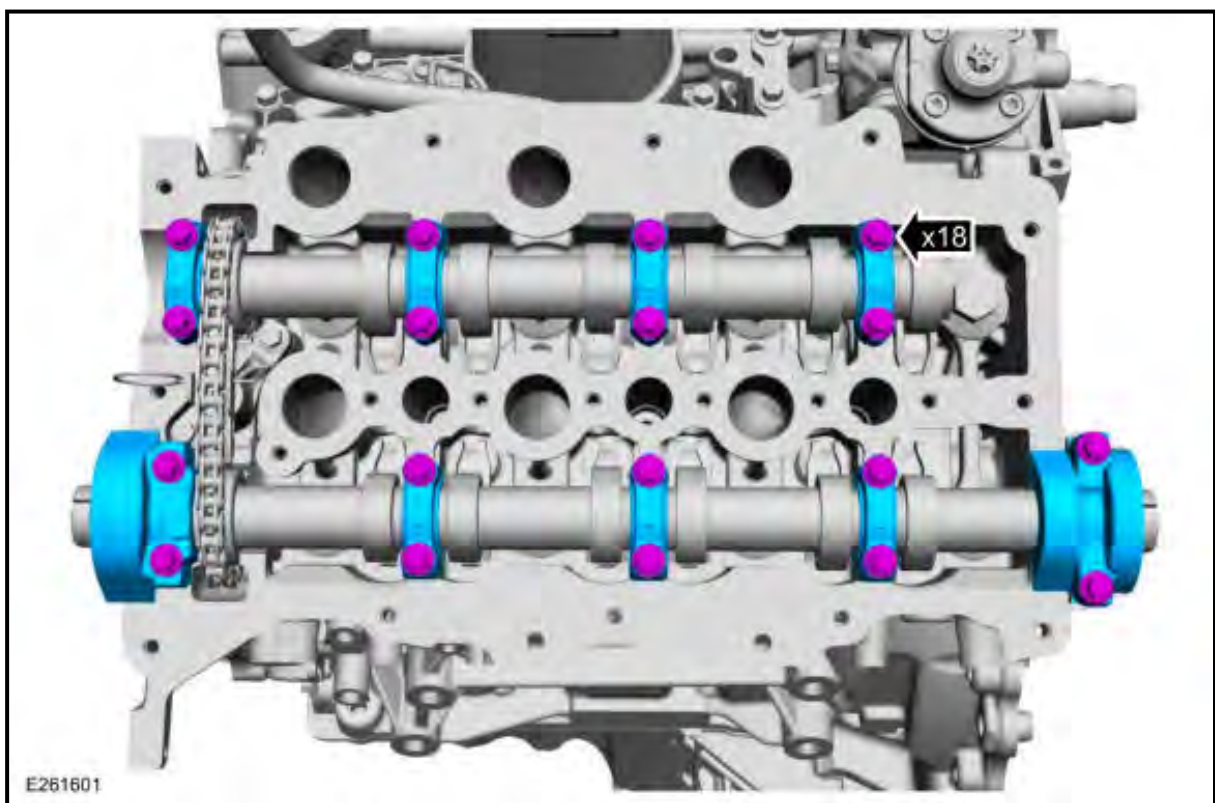


155. Compress the camshaft chain and install the retaining pin.

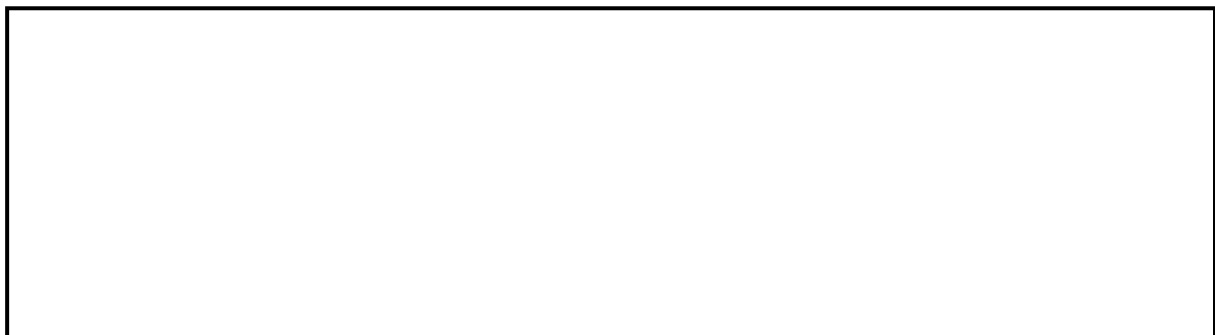


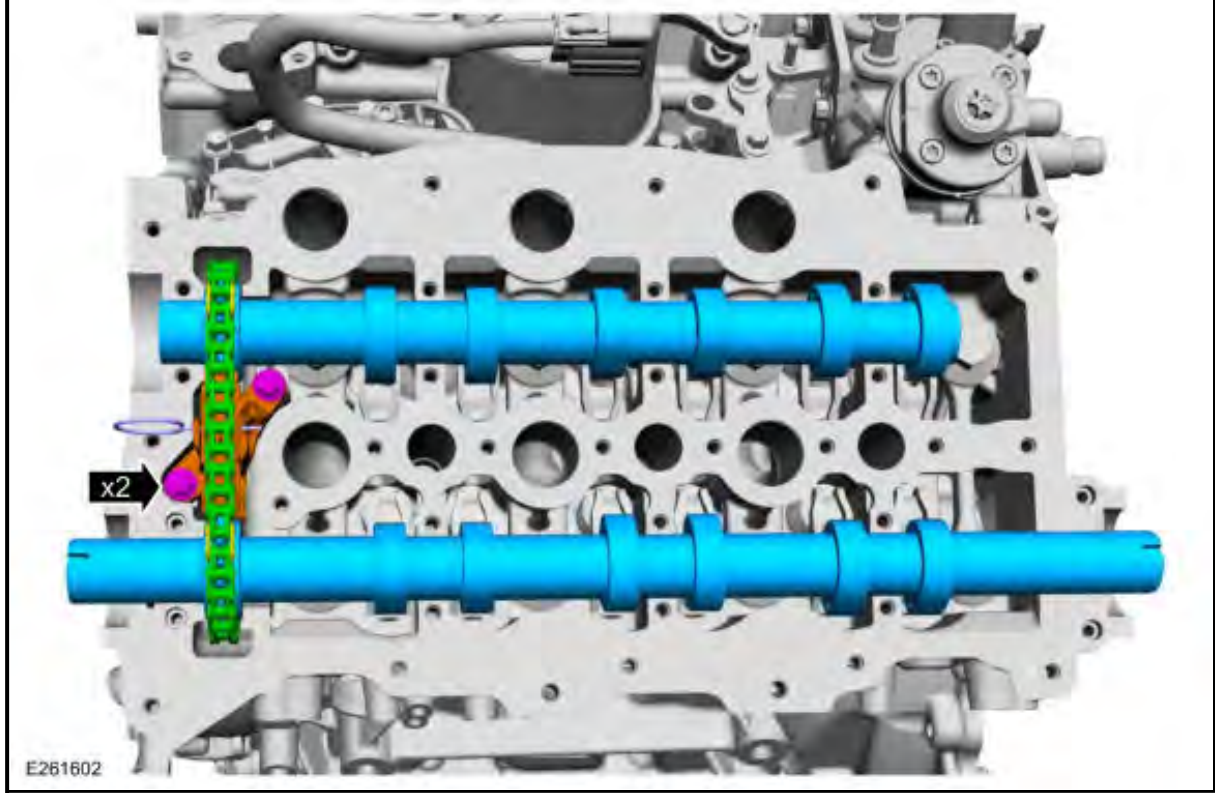
156. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

Remove the bolts and the camshaft bearing caps.

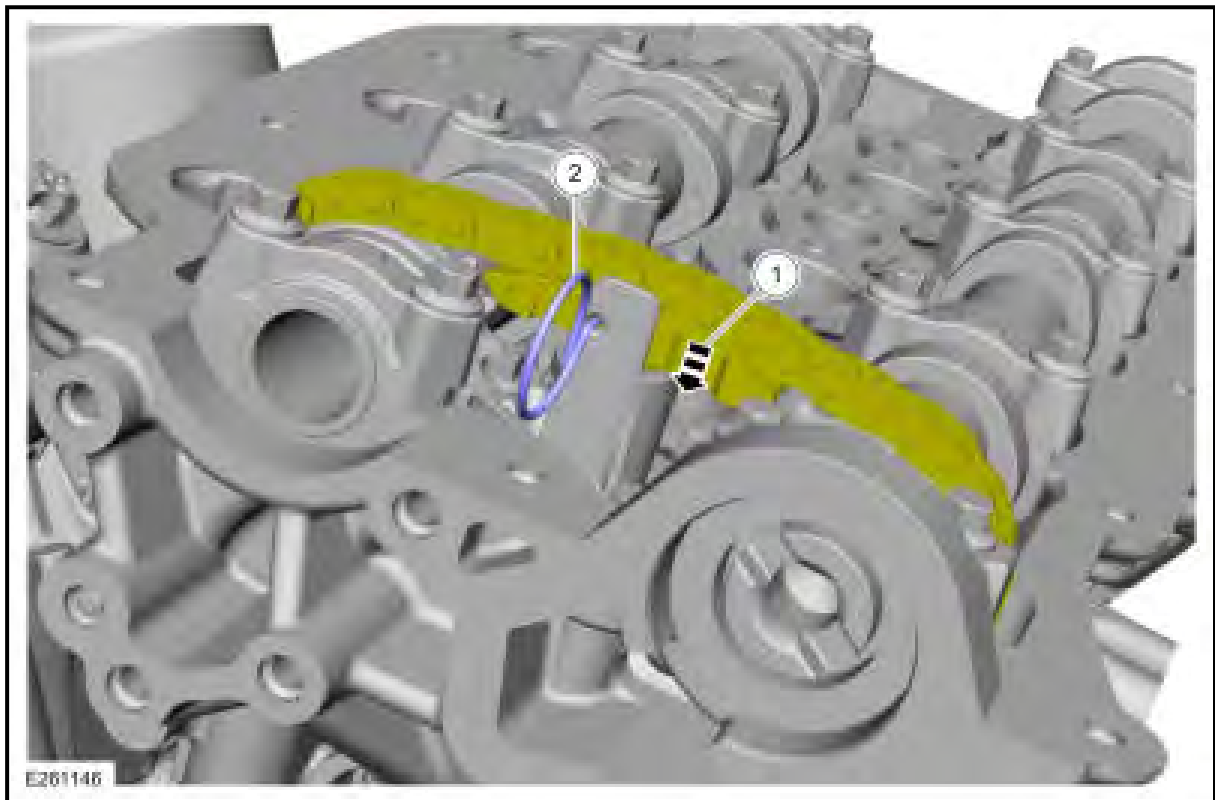


157. Remove the bolts and the LH camshafts, camshaft chain and the secondary timing chain tensioner.



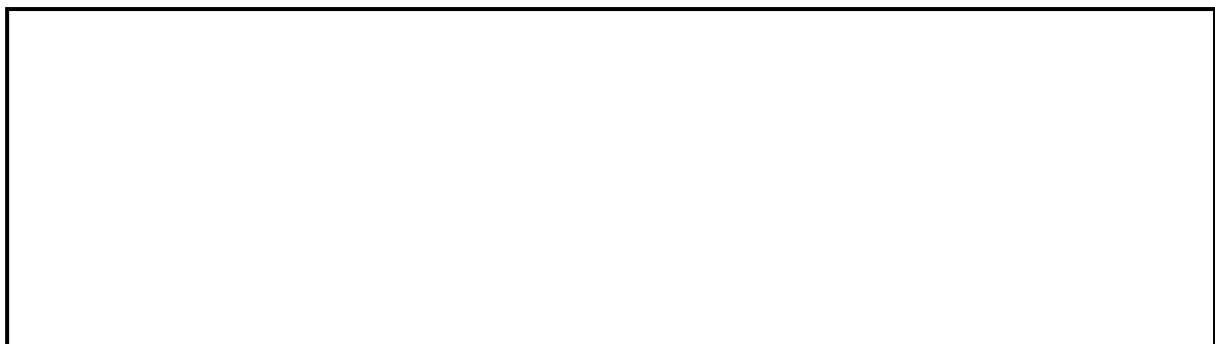


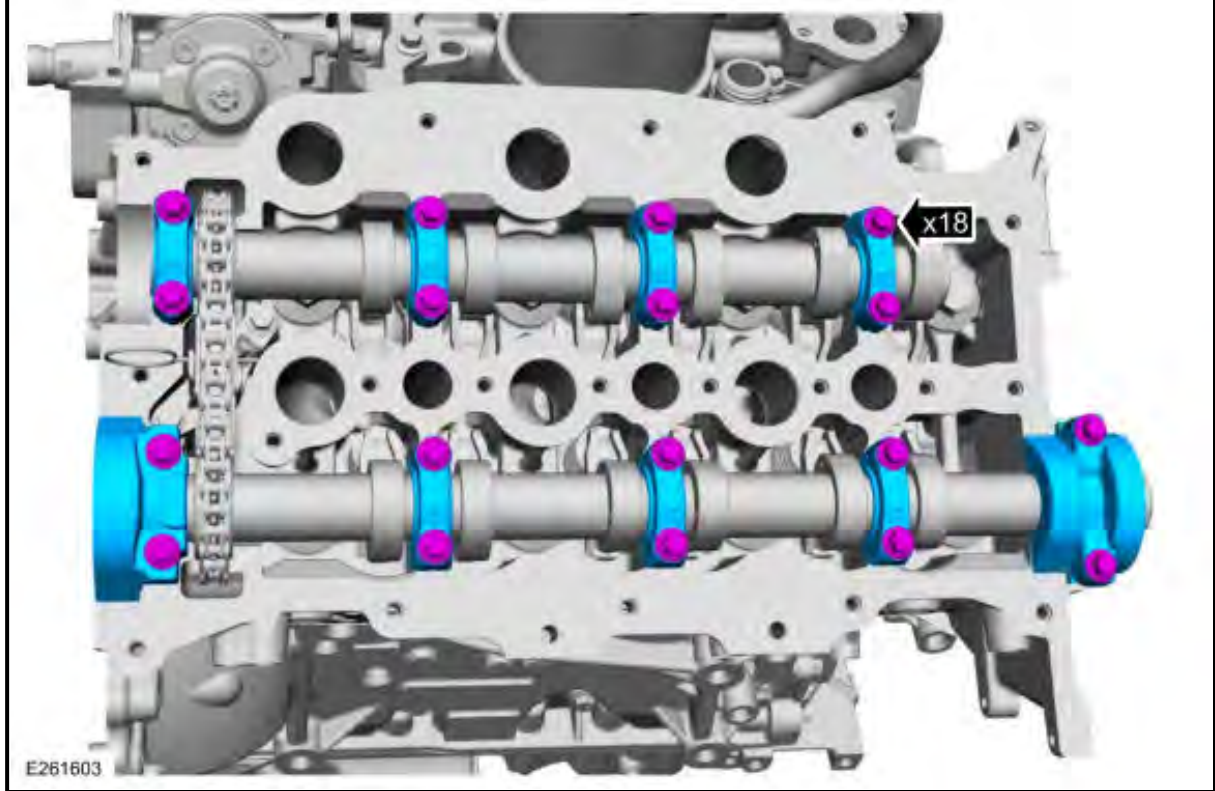
158. Compress the camshaft chain and install the retaining pin.



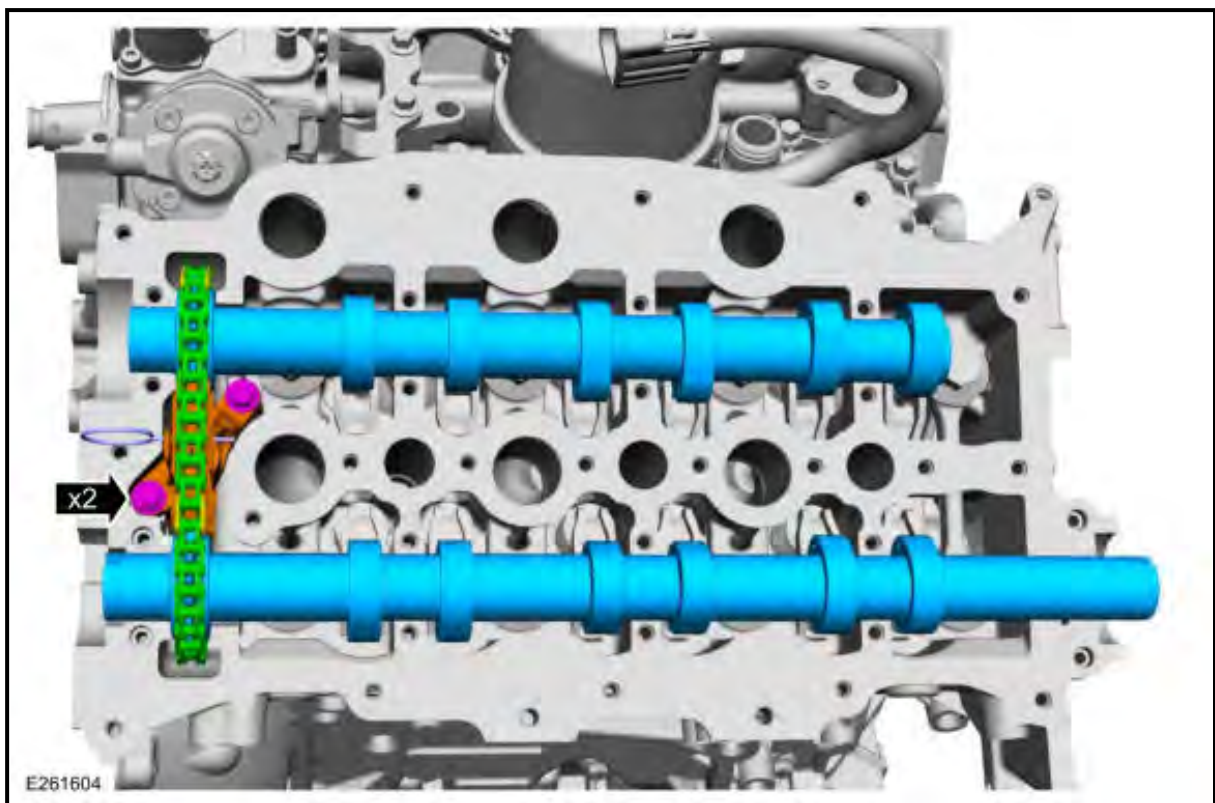
159. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

Remove the bolts and the camshaft bearing caps.





160. Remove the bolts and the RH camshafts, camshaft chain and the secondary timing chain tensioner.

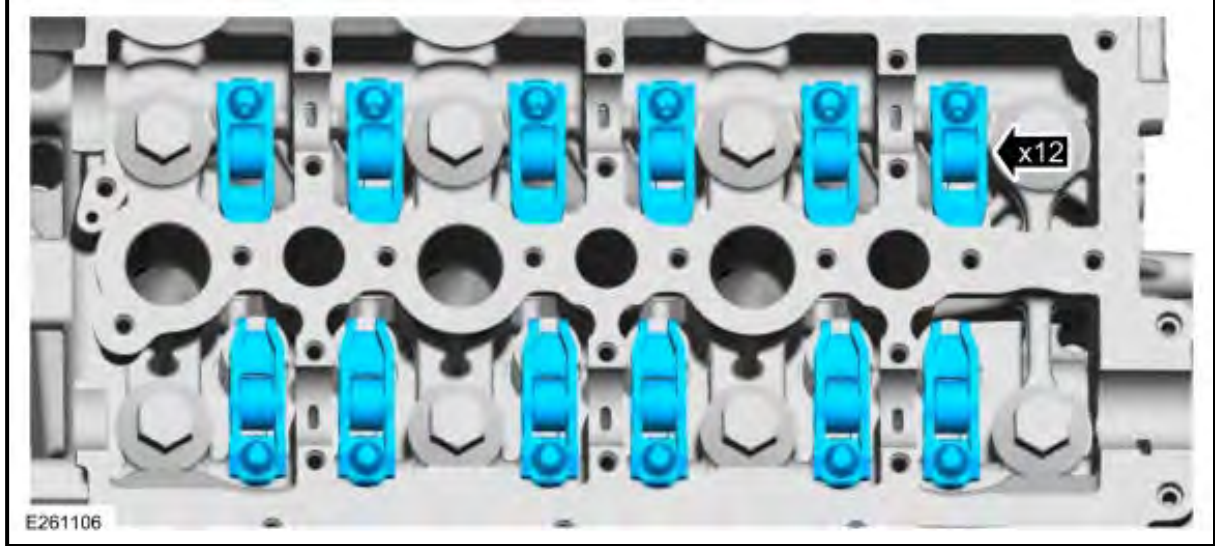


161. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

Remove the RH camshaft roller follower and hydraulic lash adjuster assemblies.







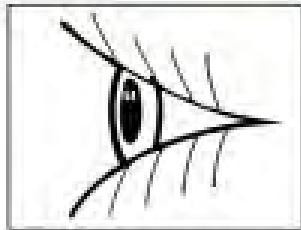
162. **NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

Remove the LH camshaft roller follower and hydraulic lash adjuster assemblies.



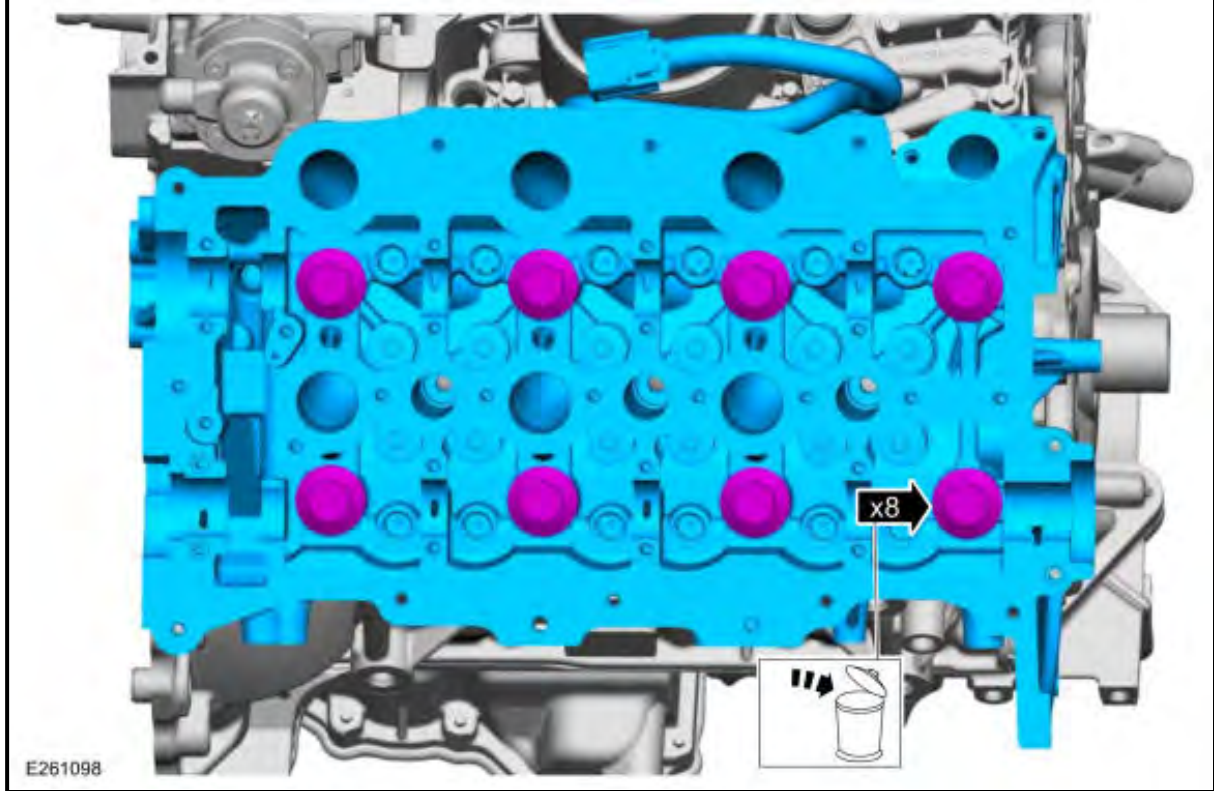
163. Inspect the hydraulic lash adjuster and roller follower for damage. If any damage is found, inspect the camshaft lobes and valves for damage. Replace damaged components as necessary.



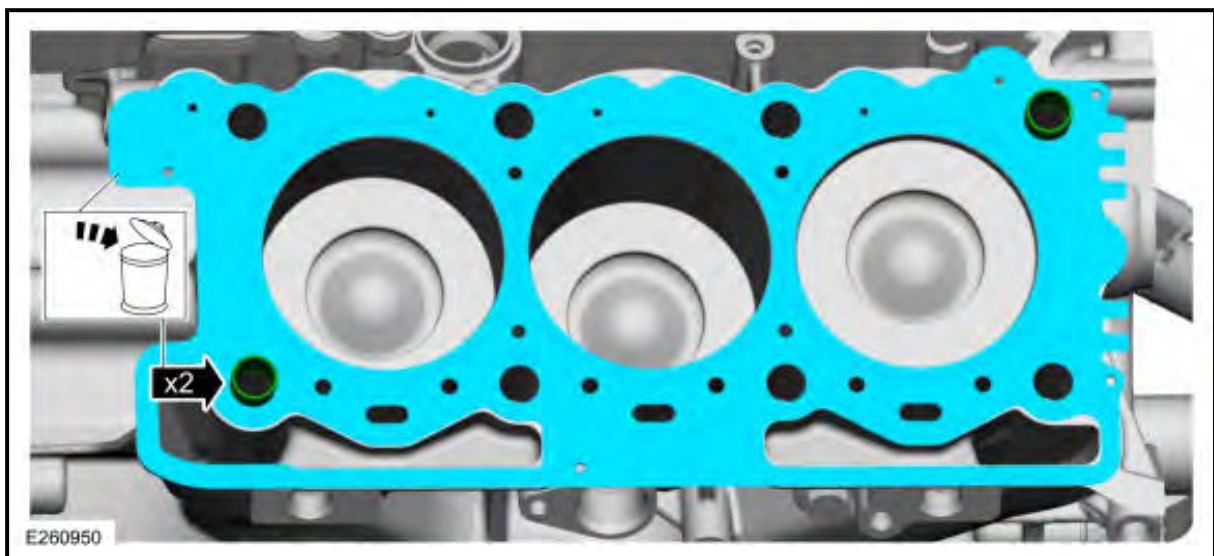


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164. **NOTE:** Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may 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:** The glow plugs protrude past the lower face of the cylinder head, any impact on the tip of the glow plug may result in glow plug damage.
- NOTE:** The cylinder head bolts must be discarded and new bolts must be installed. They are tighten-to-yield designed and cannot be reused.
- Remove and discard the bolts from the RH cylinder head.
  - Remove the cylinder head.



165. Remove and discard the RH cylinder head gasket and the cylinder head dowels.



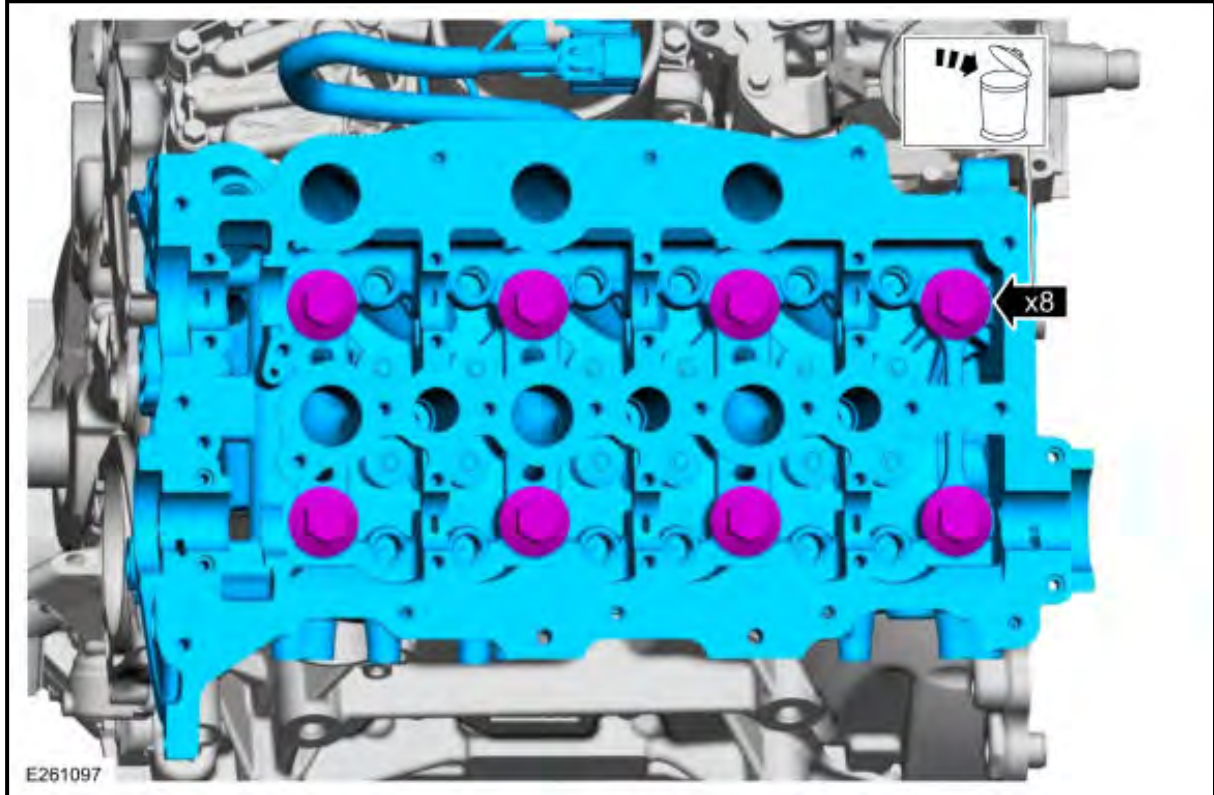
166. **NOTE:** Place clean shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.

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

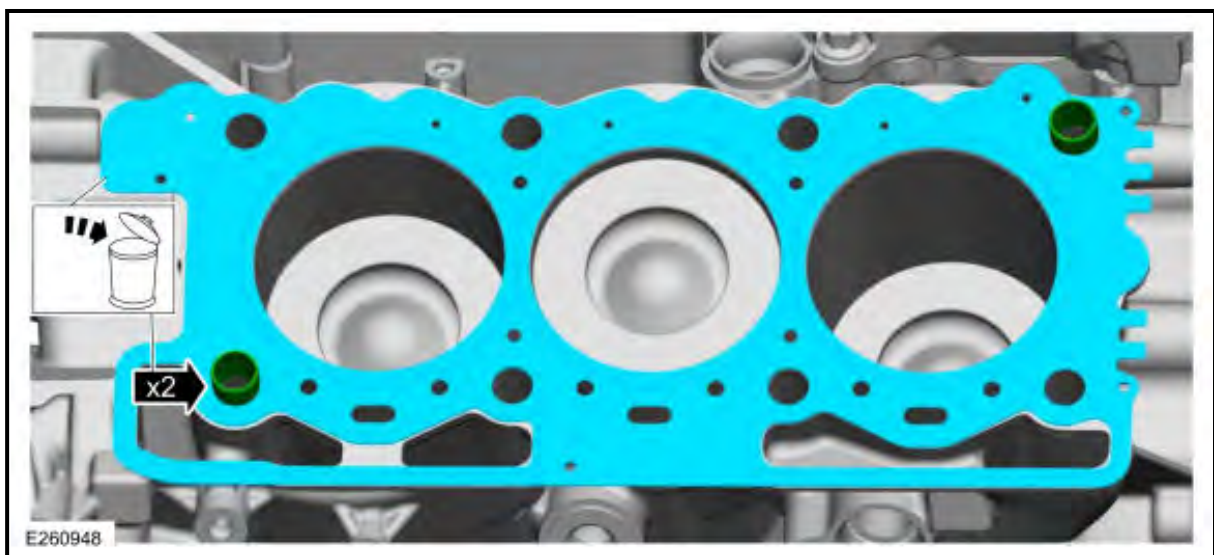
**NOTE:** The glow plugs protrude past the lower face of the cylinder head, any impact on the tip of the glow plug may result in glow plug damage.

**NOTE:** The cylinder head bolts must be discarded and new bolts must be installed. They are tighten-to-yield designed and cannot be reused.

- Remove and discard the bolts from the LH cylinder head.
- Remove the cylinder head.



167. Remove and discard the LH cylinder head gasket and the cylinder head dowels.



168. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. Use a plastic scraping tool to remove all traces of the head gasket.

**NOTE:** Observe all warnings or cautions and follow all application directions contained on the packaging.

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

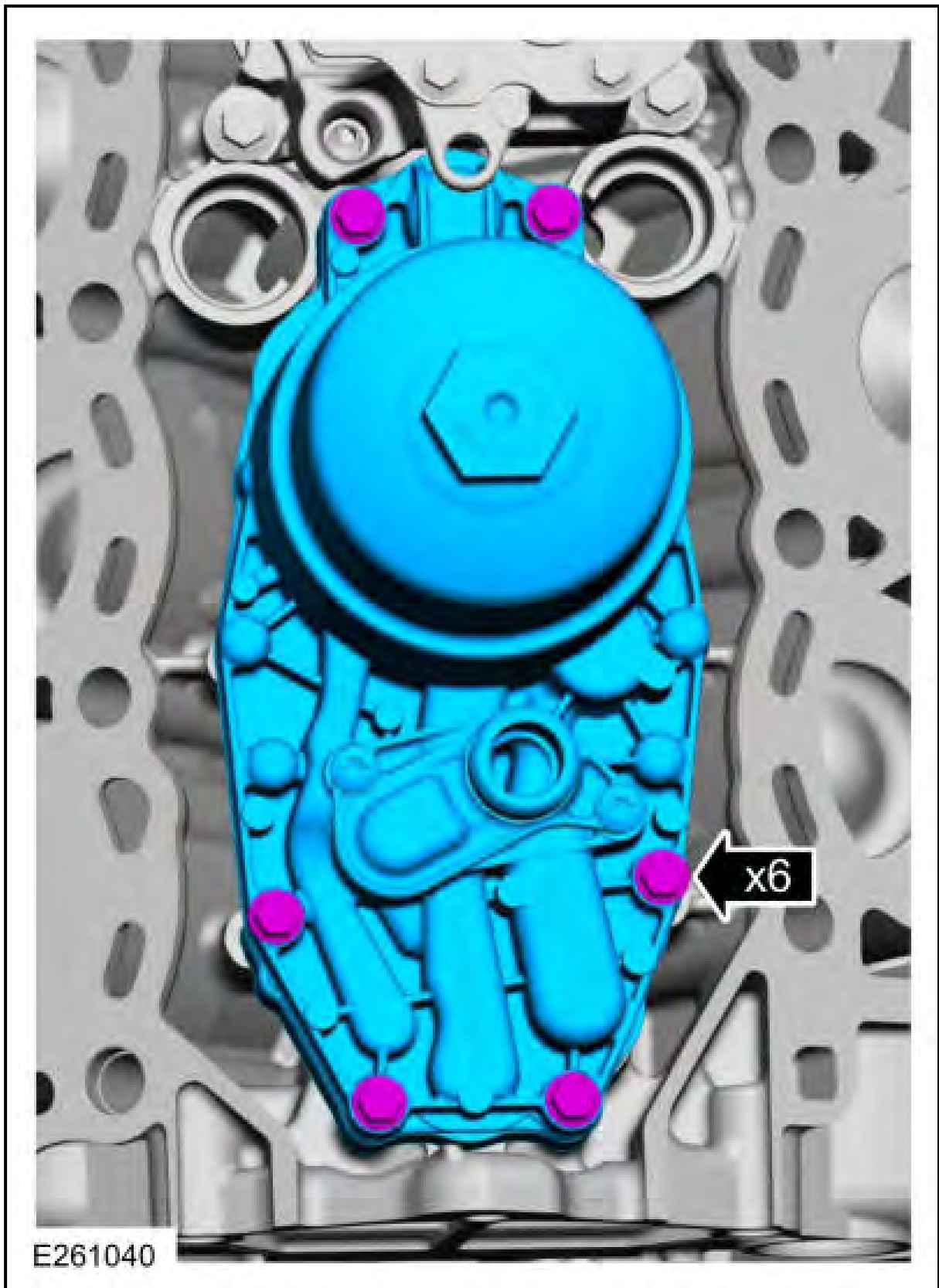
Material: Motorcraft <sup>Â</sup> Metal Surface Prep Wipes / ZC-31-B

Material: Motorcraft <sup>Â</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B

169. Check the cylinder head distortion. Refer to: [Cylinder Head Distortion](#) .

170. **NOTE:** In the event of catastrophic engine failure, always install a new oil cooler assembly. Foreign material cannot be removed from the oil cooler and engine damage may occur.

Remove the bolts and the oil cooler.

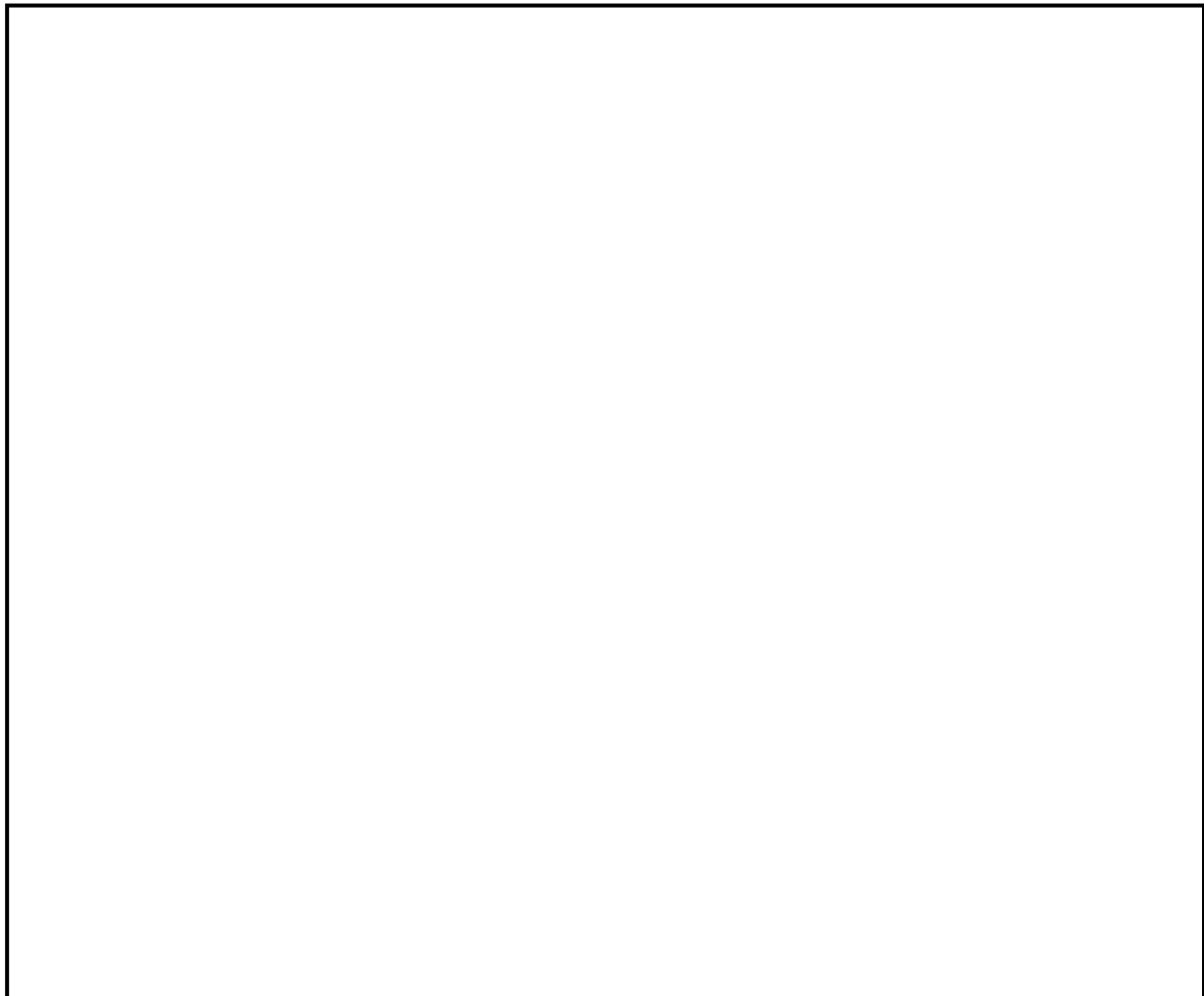


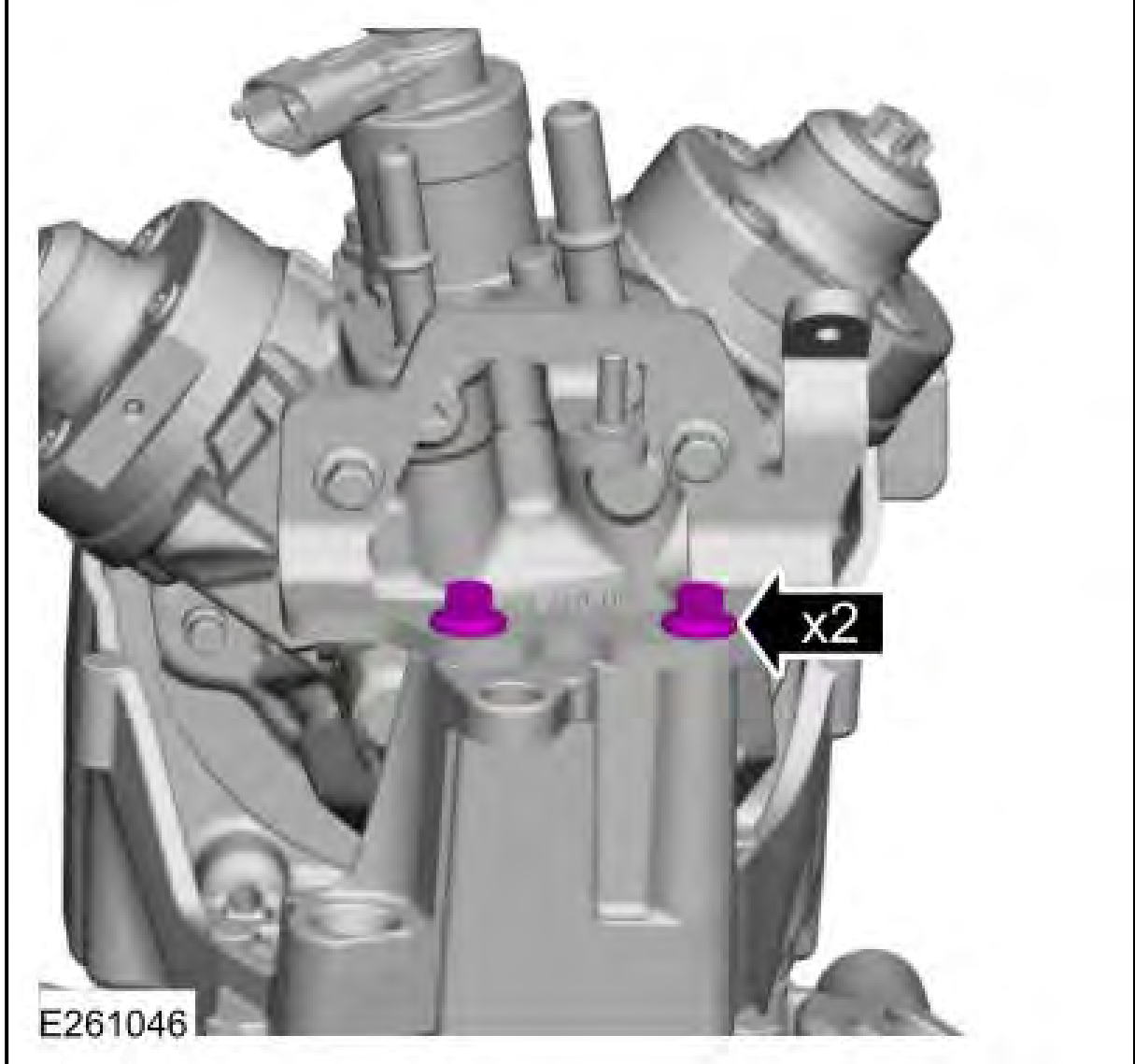
171. Remove and discard the oil cooler O-rings.



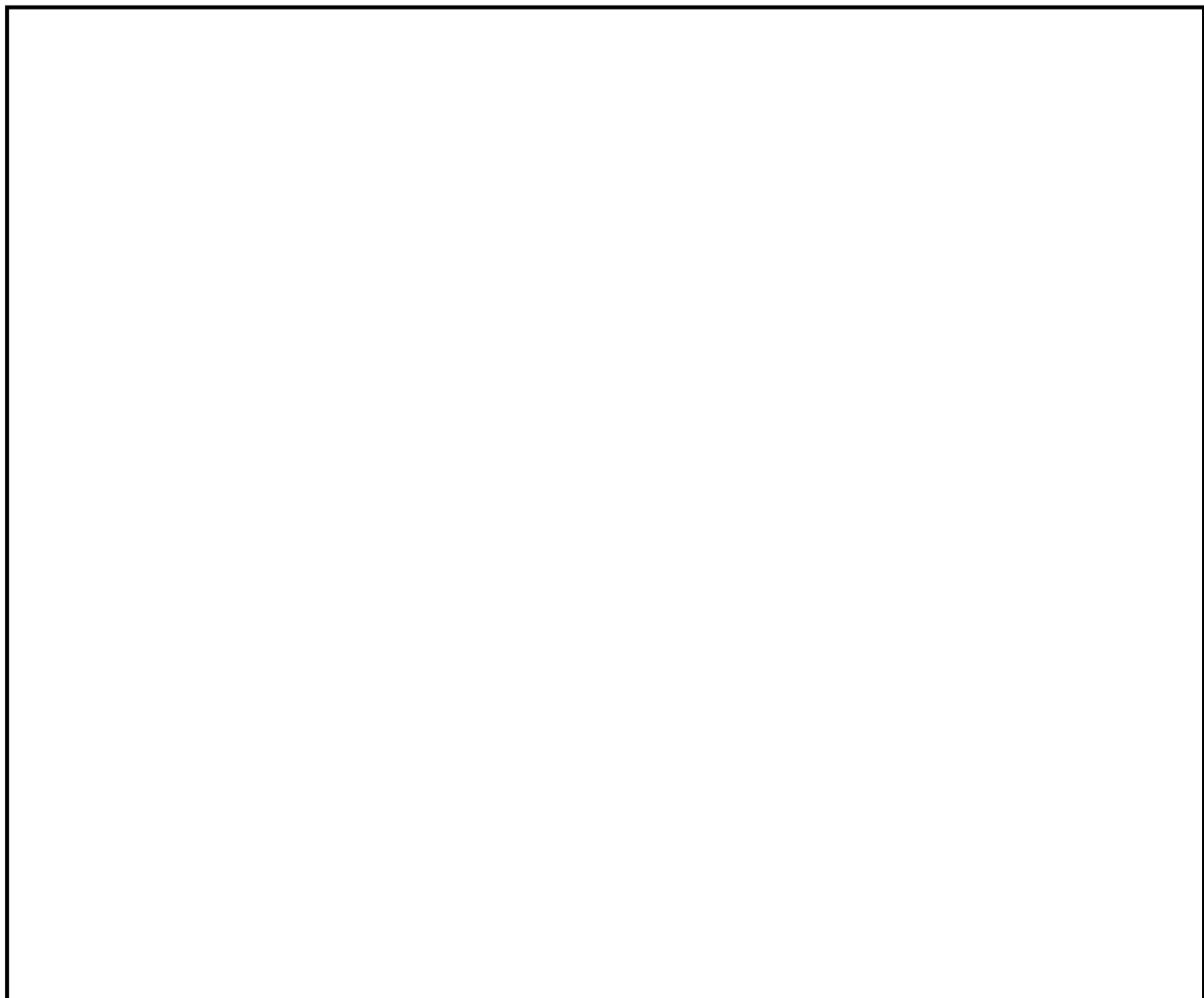


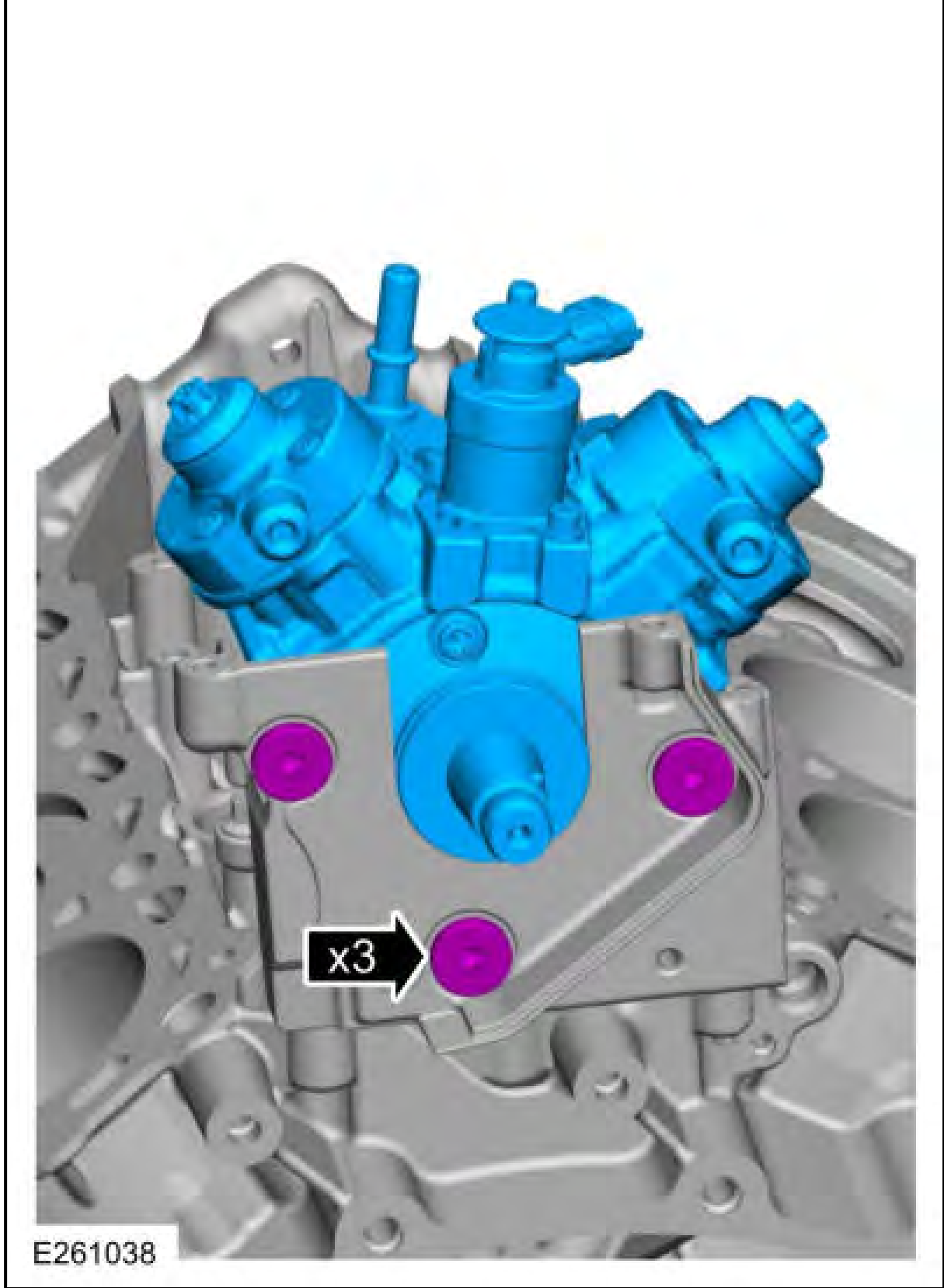
172. Remove the bolts for the fuel injection pump bracket.





173. Remove the bolts and the fuel injection pump.

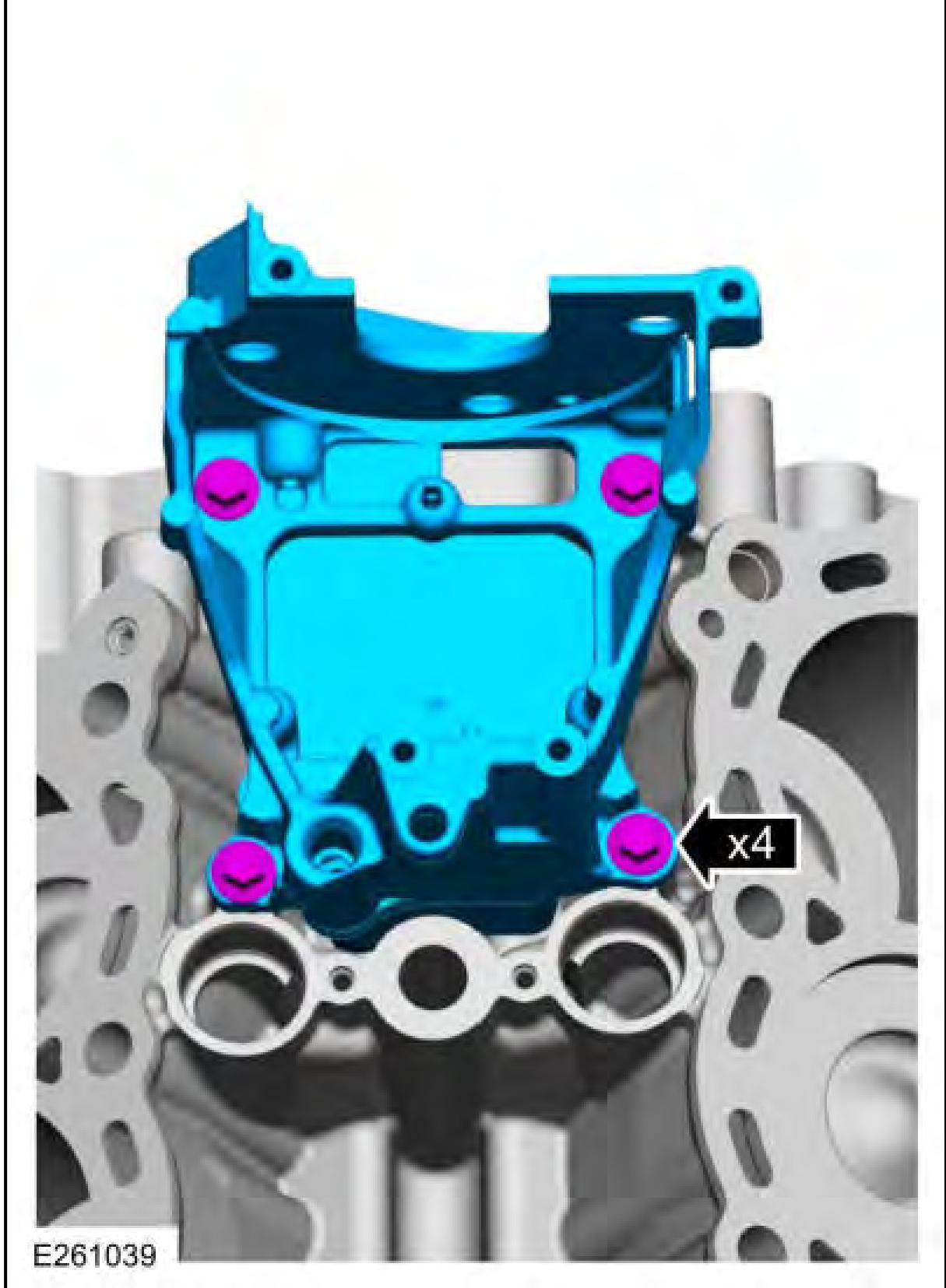




174. Remove the bolts and the fuel injection pump mounting bracket.

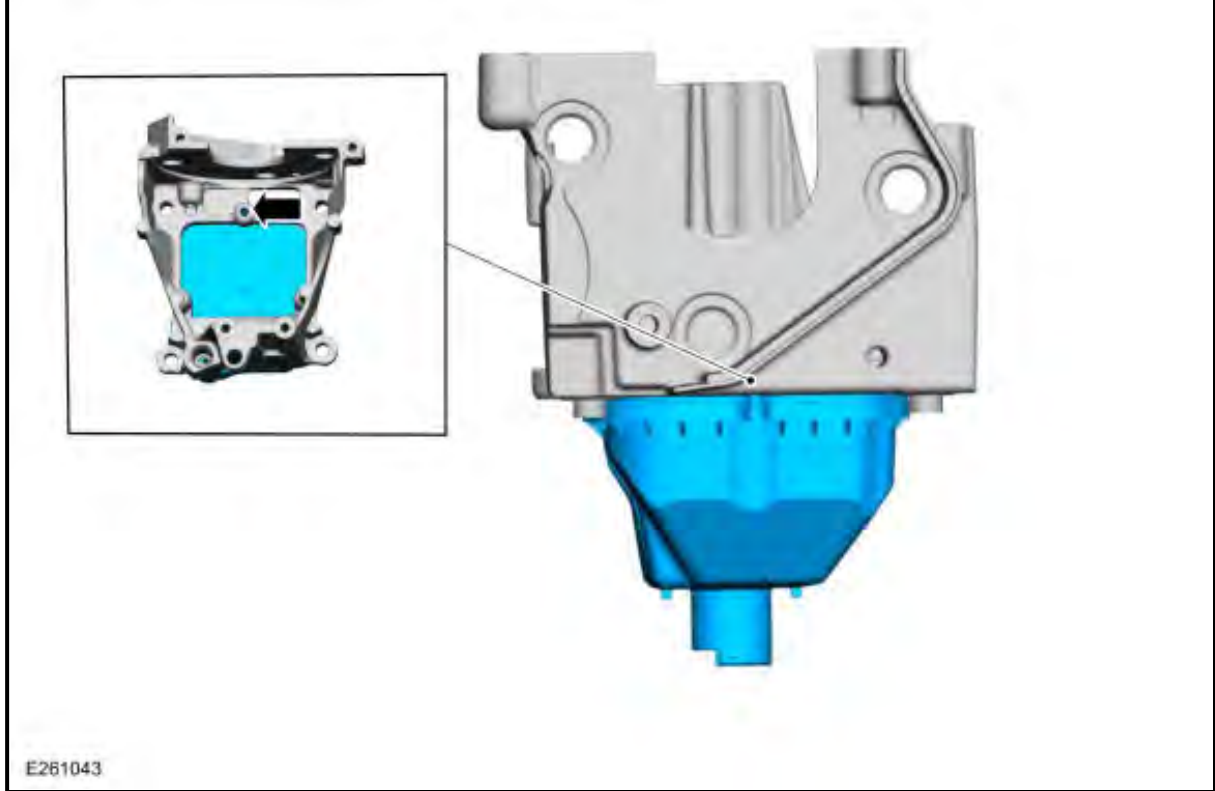




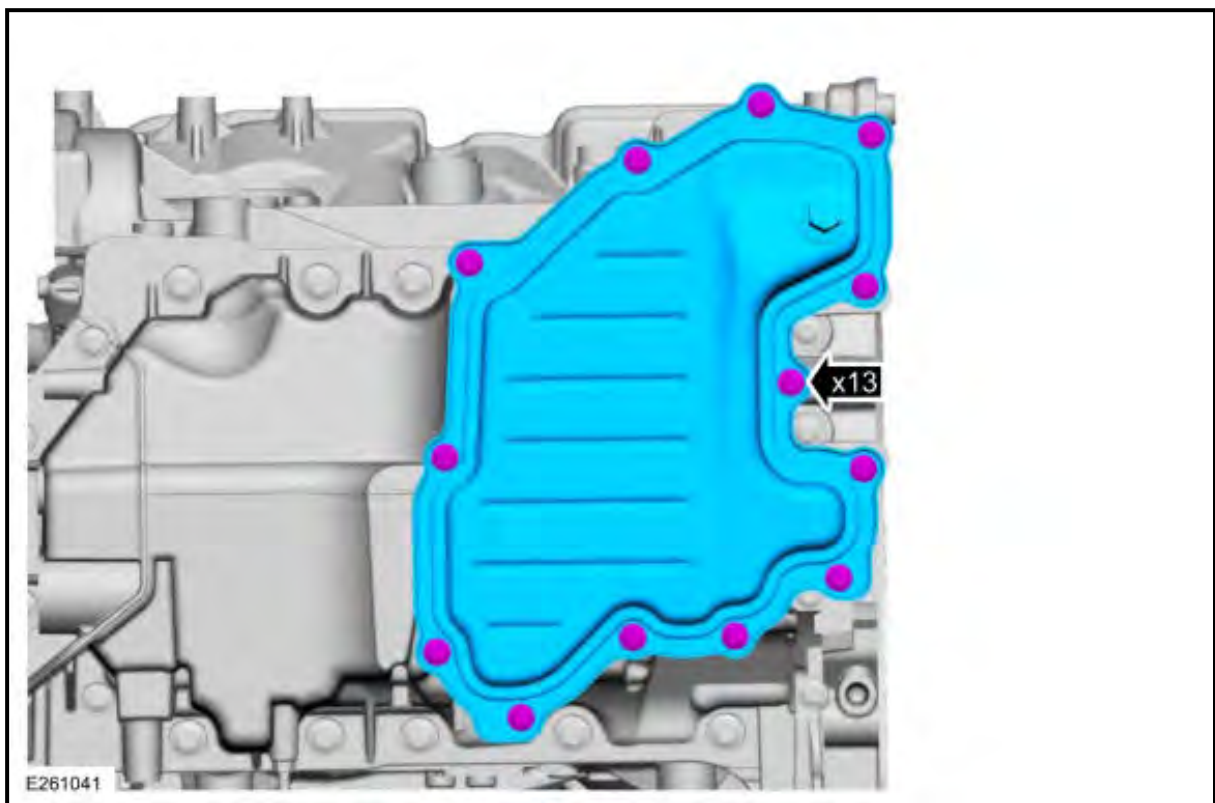


175. If necessary, remove the lower CCV (crankcase vent) separator.





176. Remove the oil pan bolts and the oil pan.



177. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.

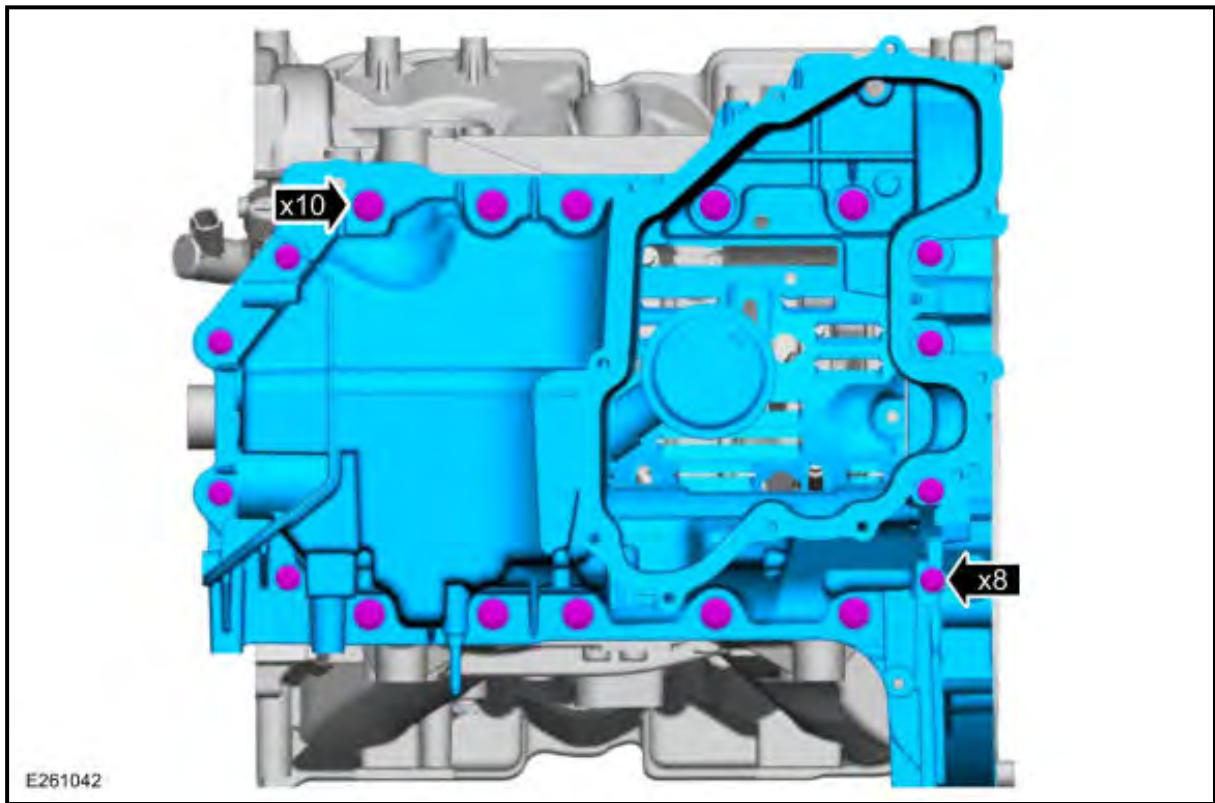
Make sure that the mating faces of the oil pan are clean and free of foreign material. Refer to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

Material: Motorcraft <sup>®</sup> Silicone Gasket Remover / ZC-30-A

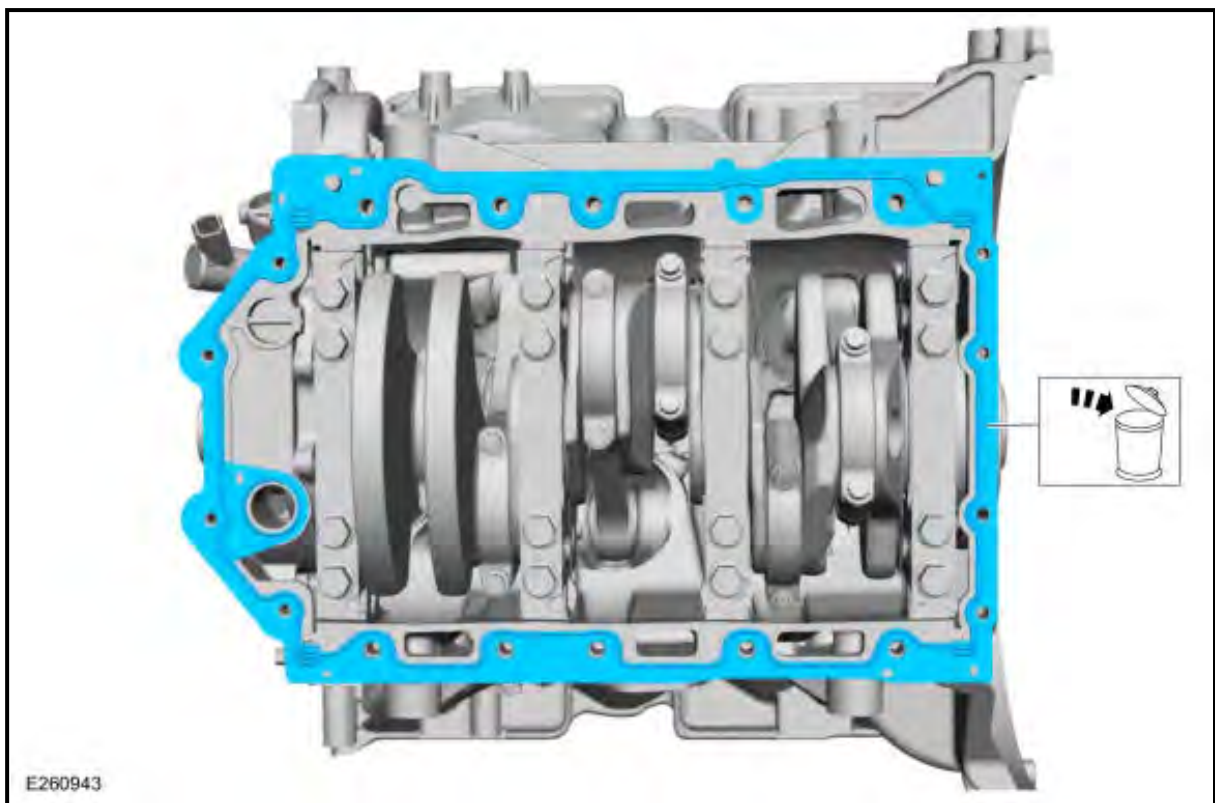
Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B

178. Remove the bolts and the engine block skirt stiffener.



179. Remove and discard the engine block skirt stiffener gasket.



180. Remove the engine block skirt stiffener alignment dowels.





181. **NOTE:** Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges, which make leak paths. Use a plastic scraping tool to remove traces of sealant.

Make sure that the mating faces of the engine block skirt stiffener are clean and free of foreign material. Refer to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

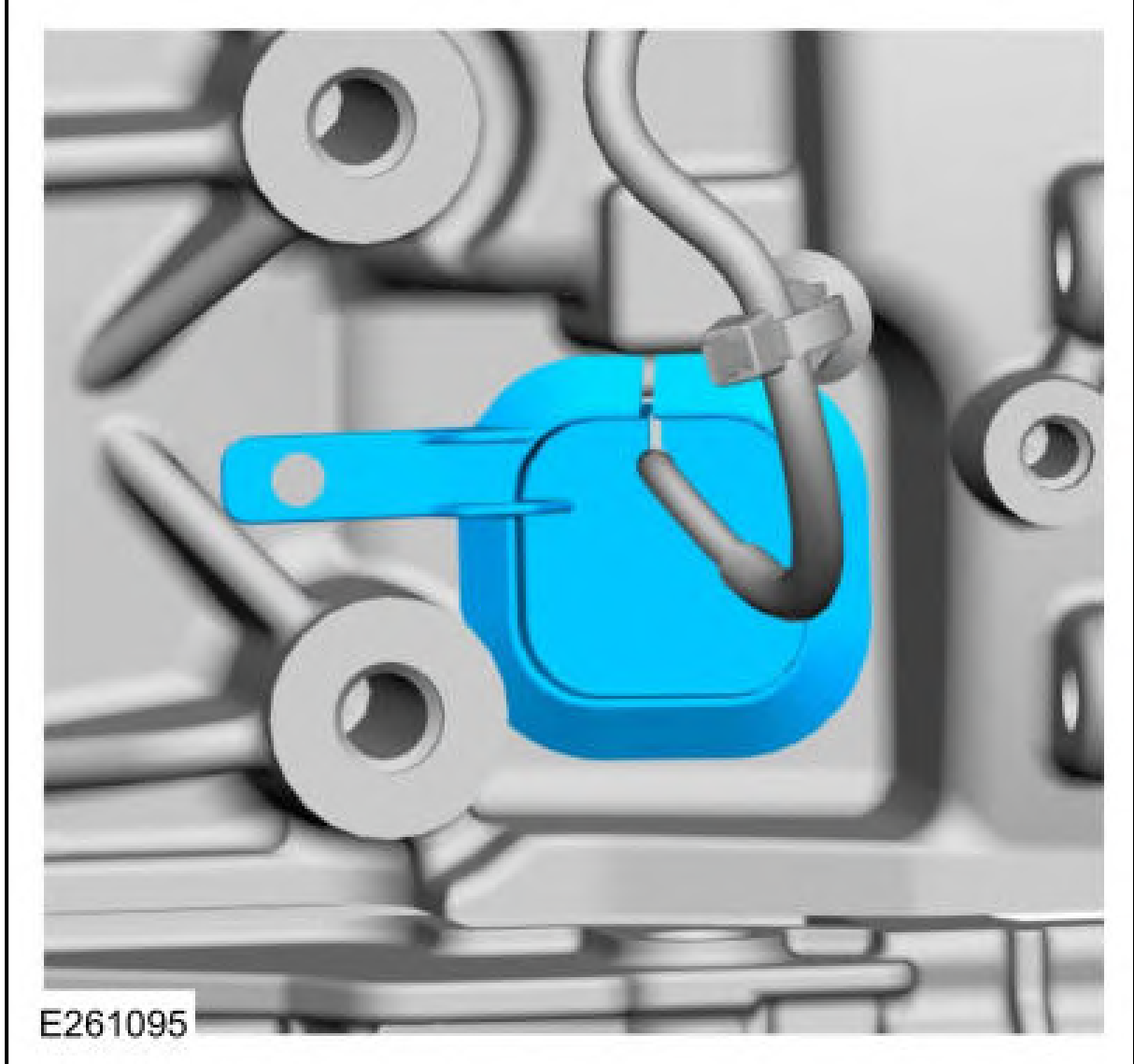
Material: Motorcraft <sup>Â</sup> Silicone Gasket Remover / ZC-30-A

Material: Motorcraft <sup>Â</sup> Metal Surface Prep Wipes / ZC-31-B

Material: Motorcraft <sup>Â</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B

182. Remove the CKP sensor cover.

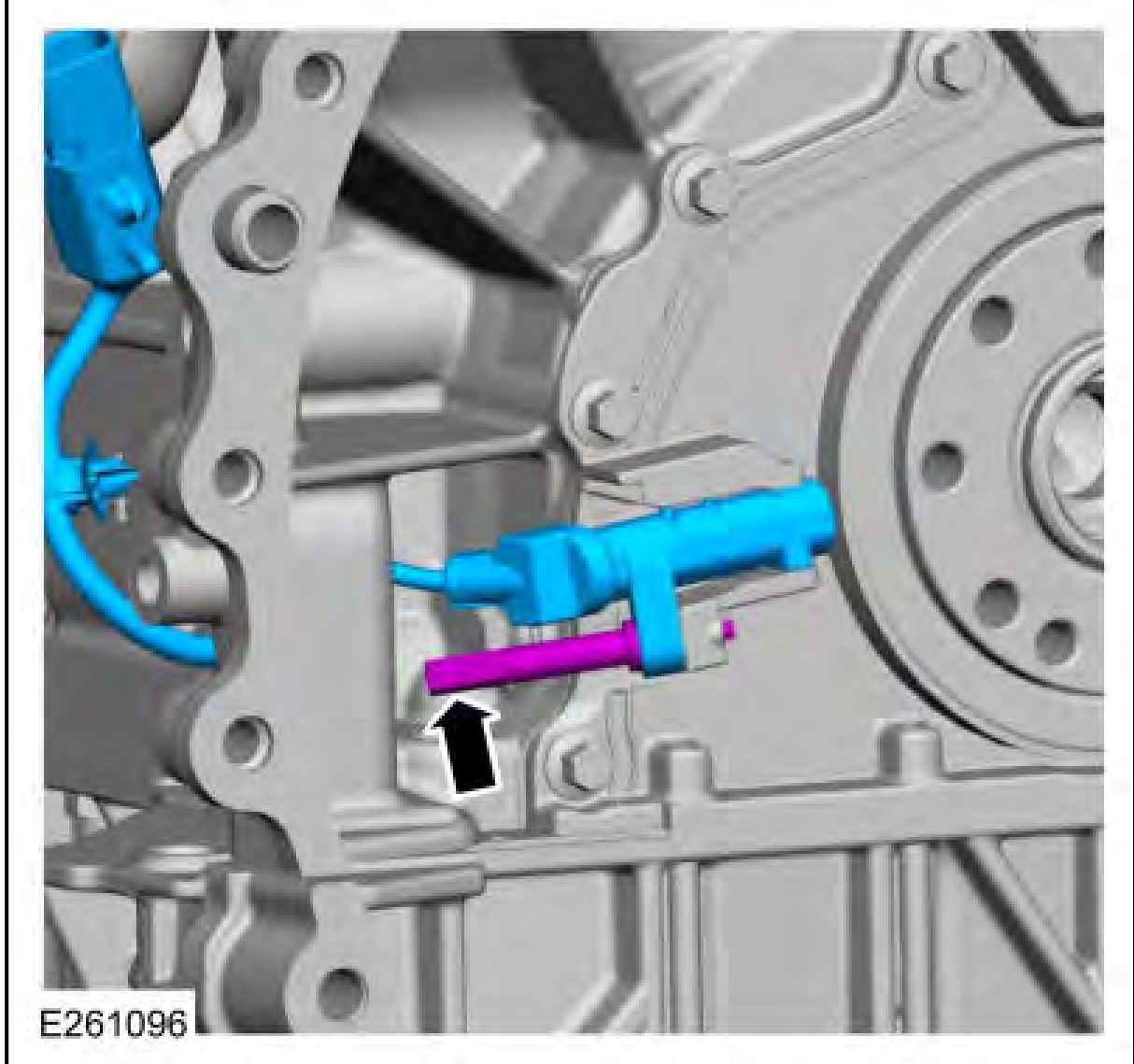




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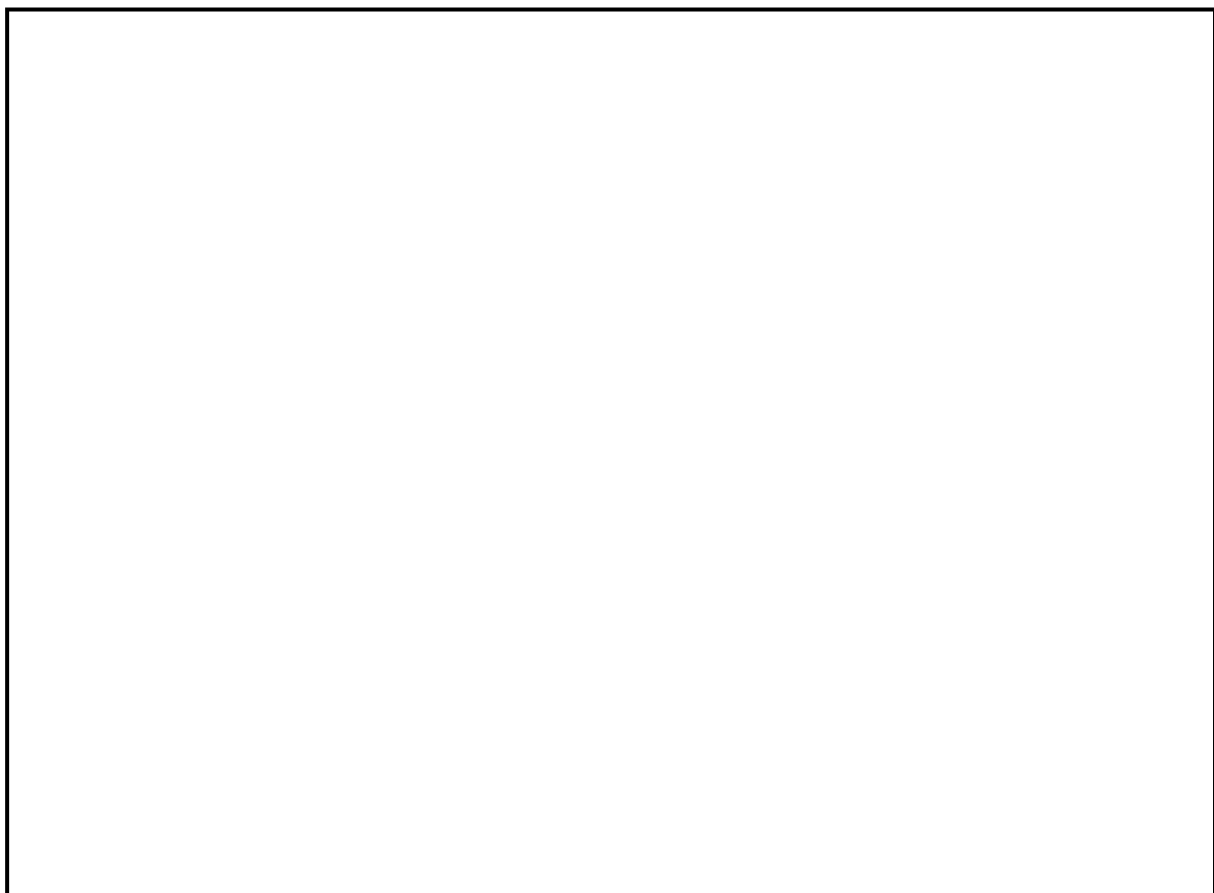
183. Remove the retainer and the CKP sensor.

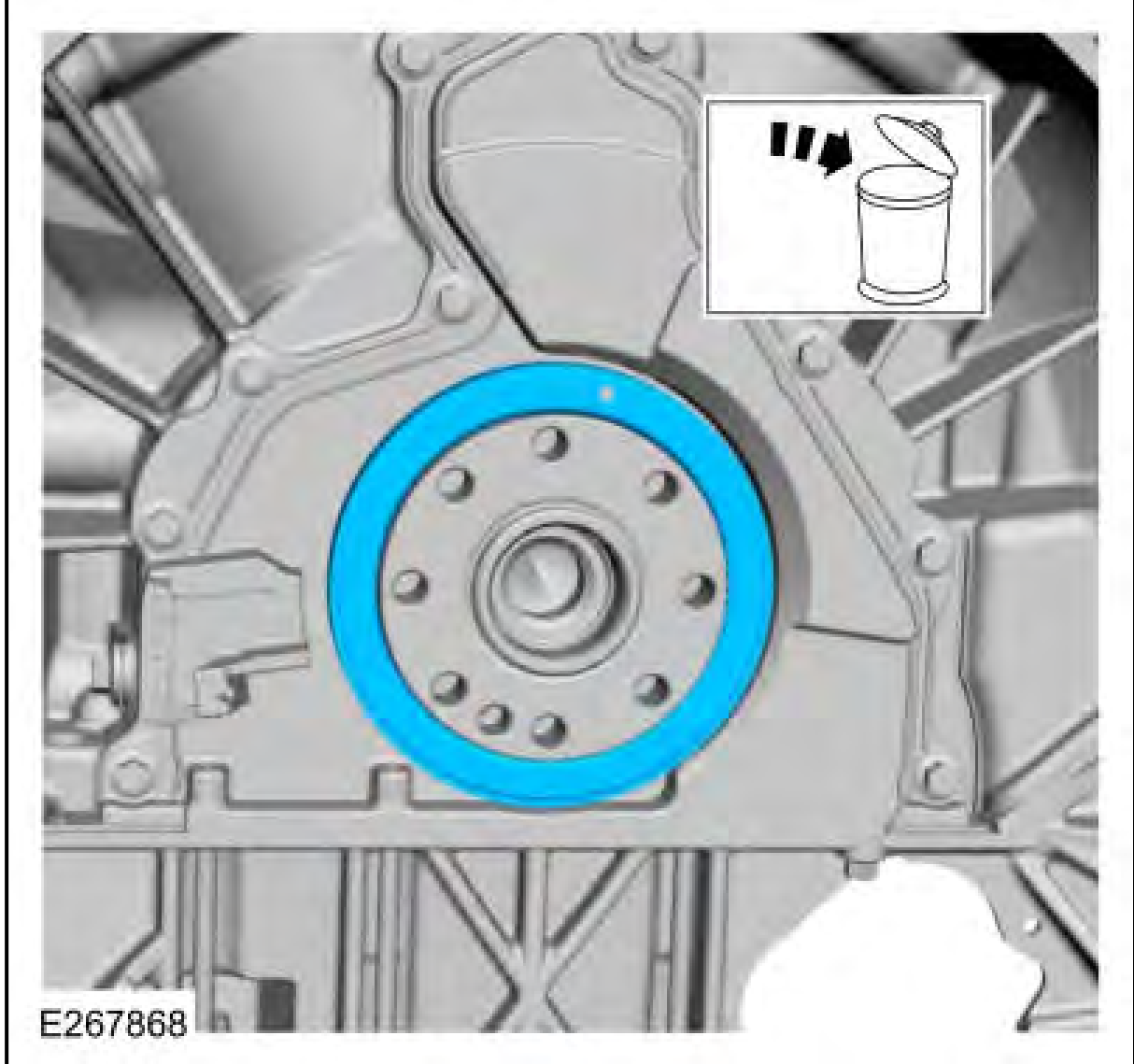




184. **NOTE:** Care must be taken not to damage the crankshaft sealing surface when removing the crankshaft trigger wheel.

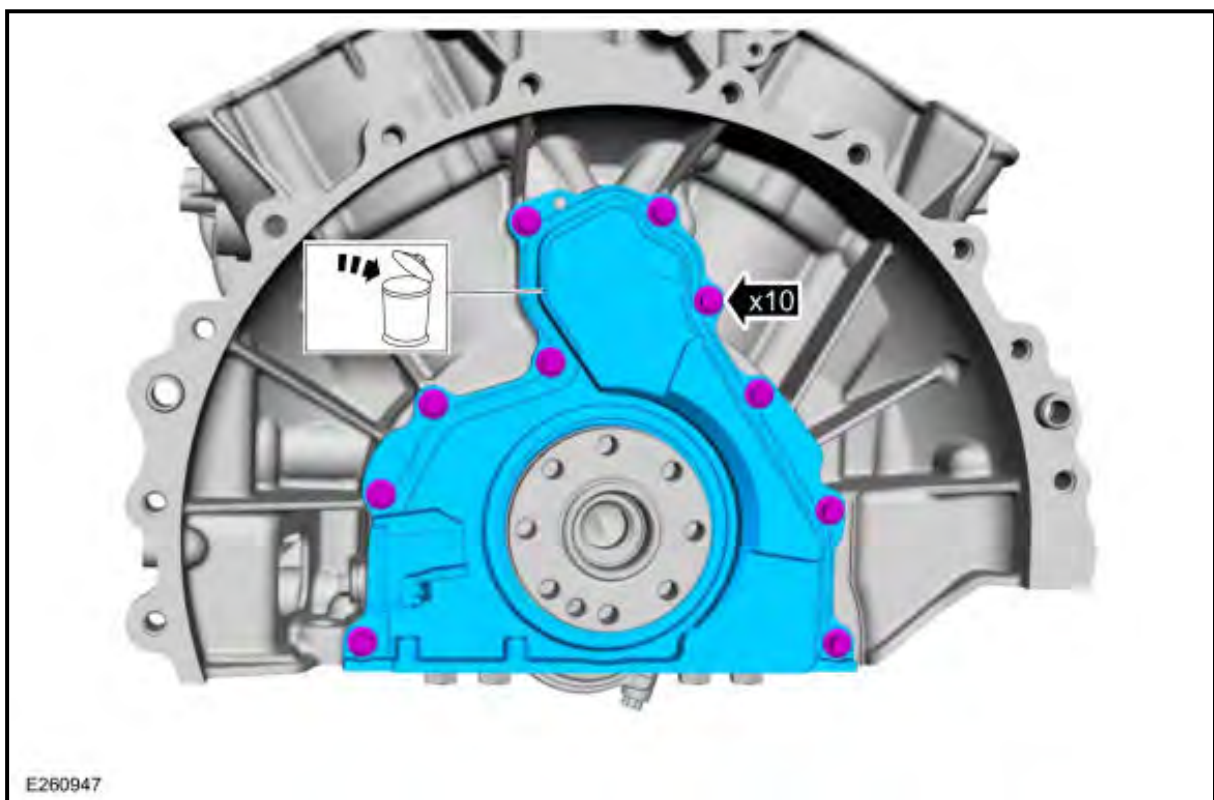
Remove and discard the CKP timing trigger wheel.



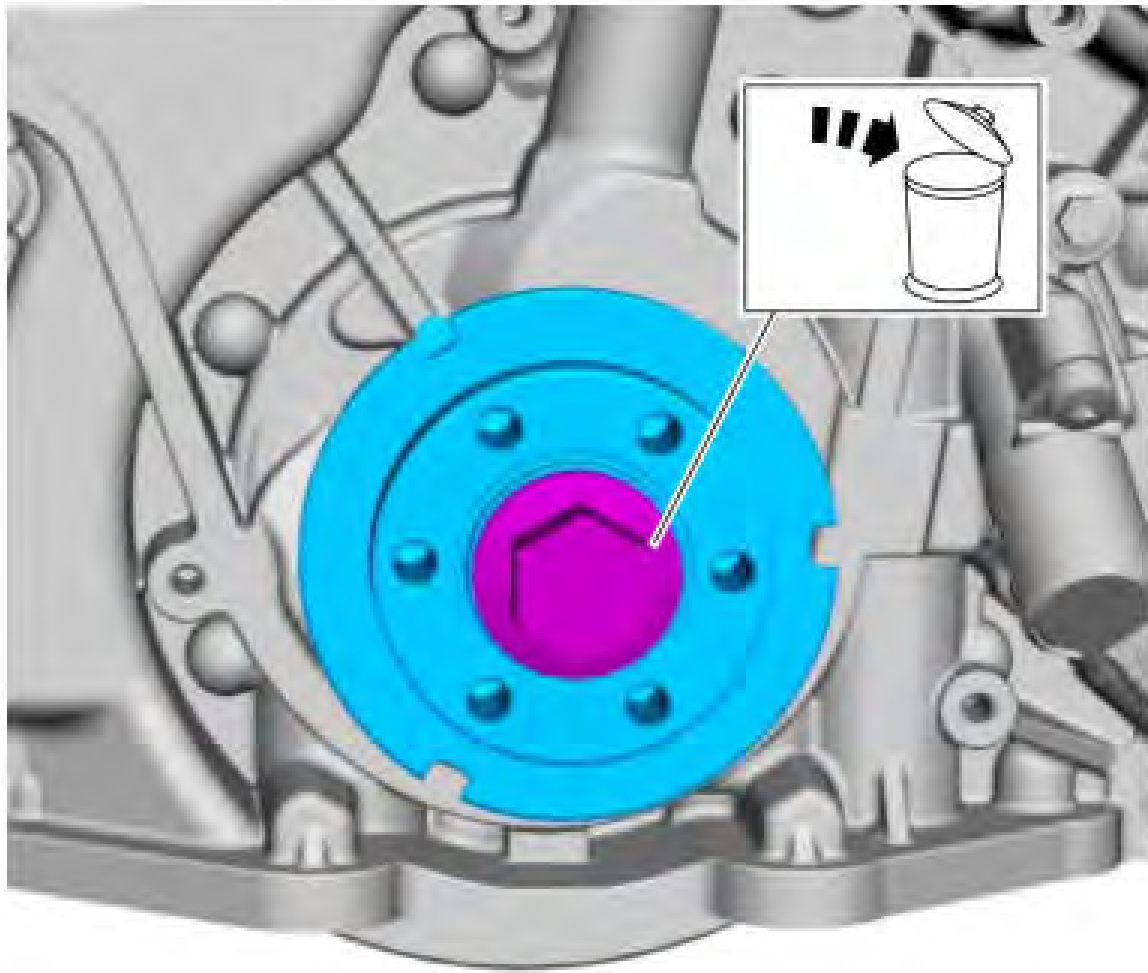


185.

- Remove the bolts and the crankshaft rear seal retainer.
- Discard the crankshaft rear seal retainer.



186. Remove the bolt and the crankshaft sprocket. Discard the bolt.

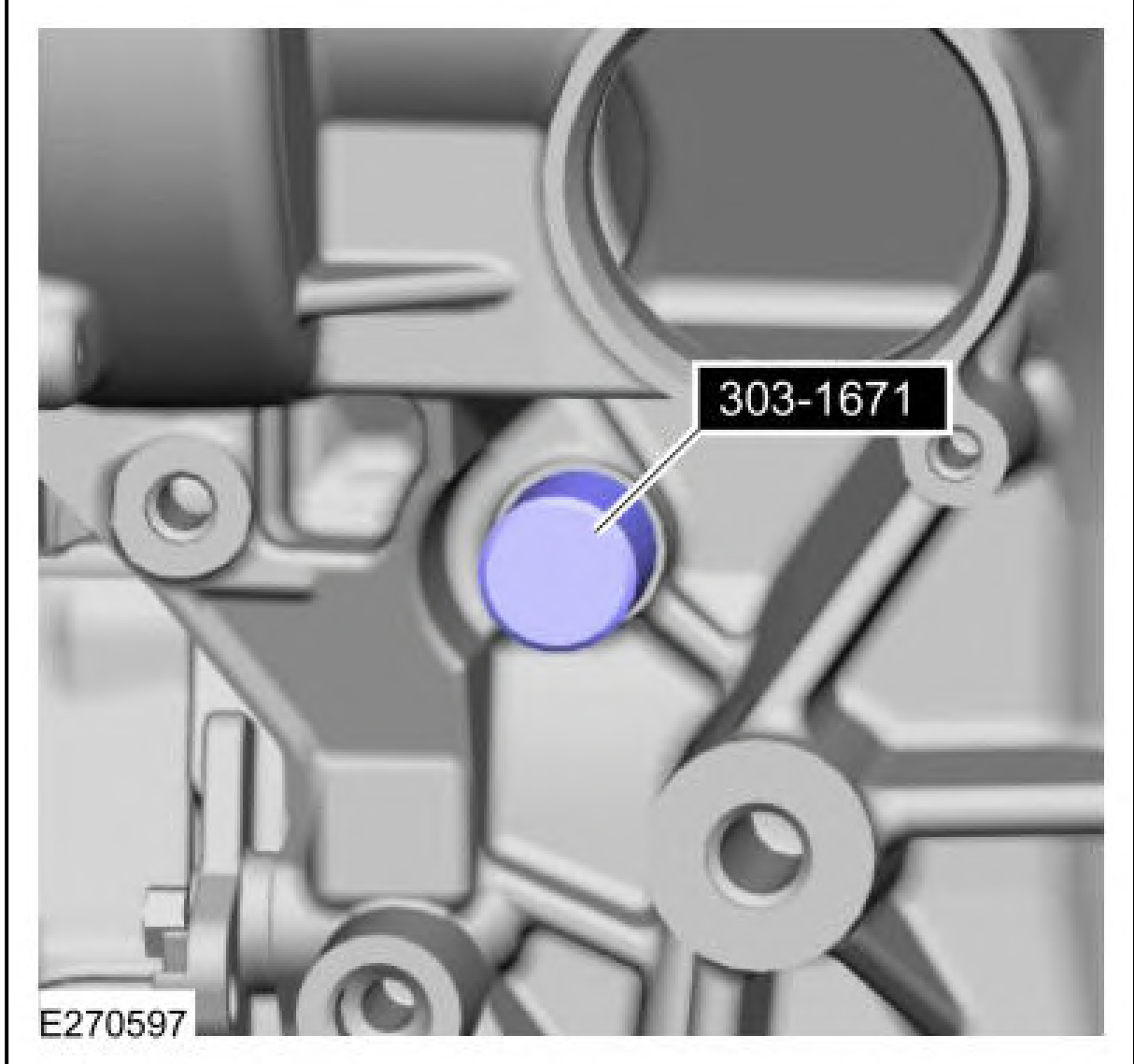


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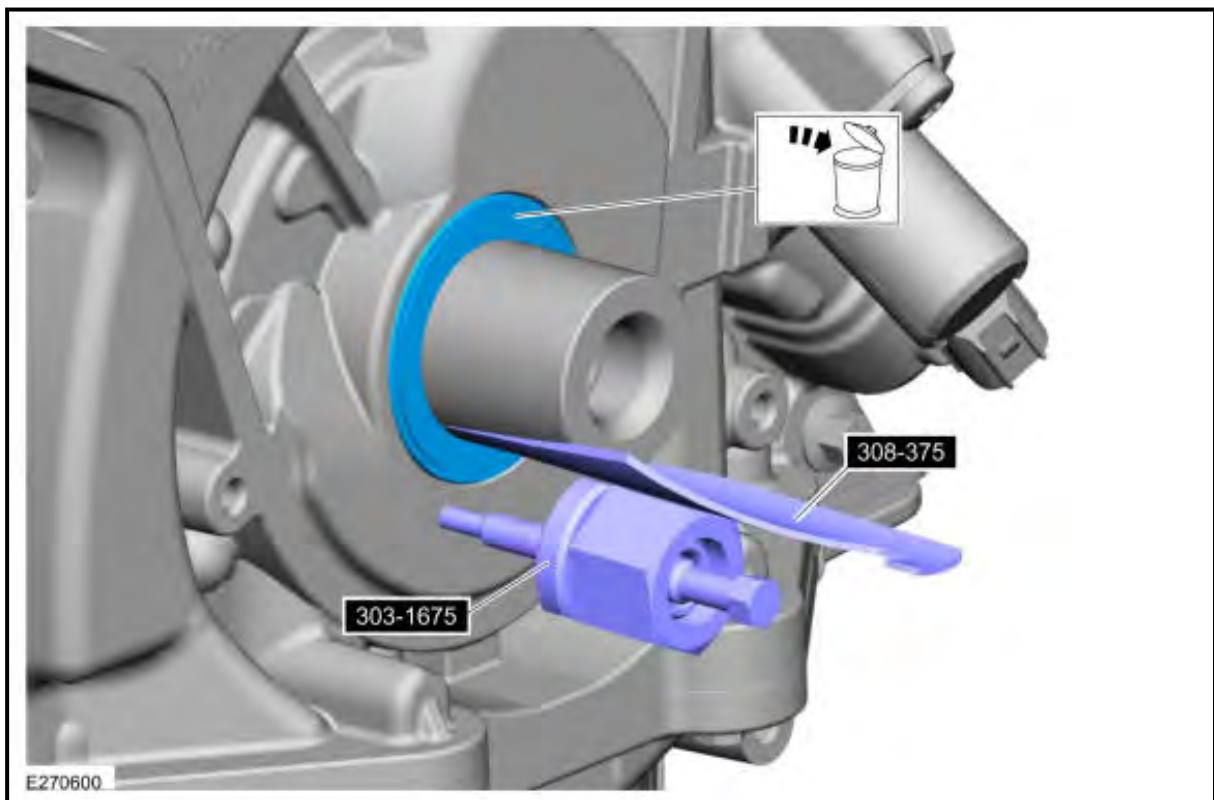
187. Remove Special Service Tool: 303-1671 Pin, Locking Crankshaft.



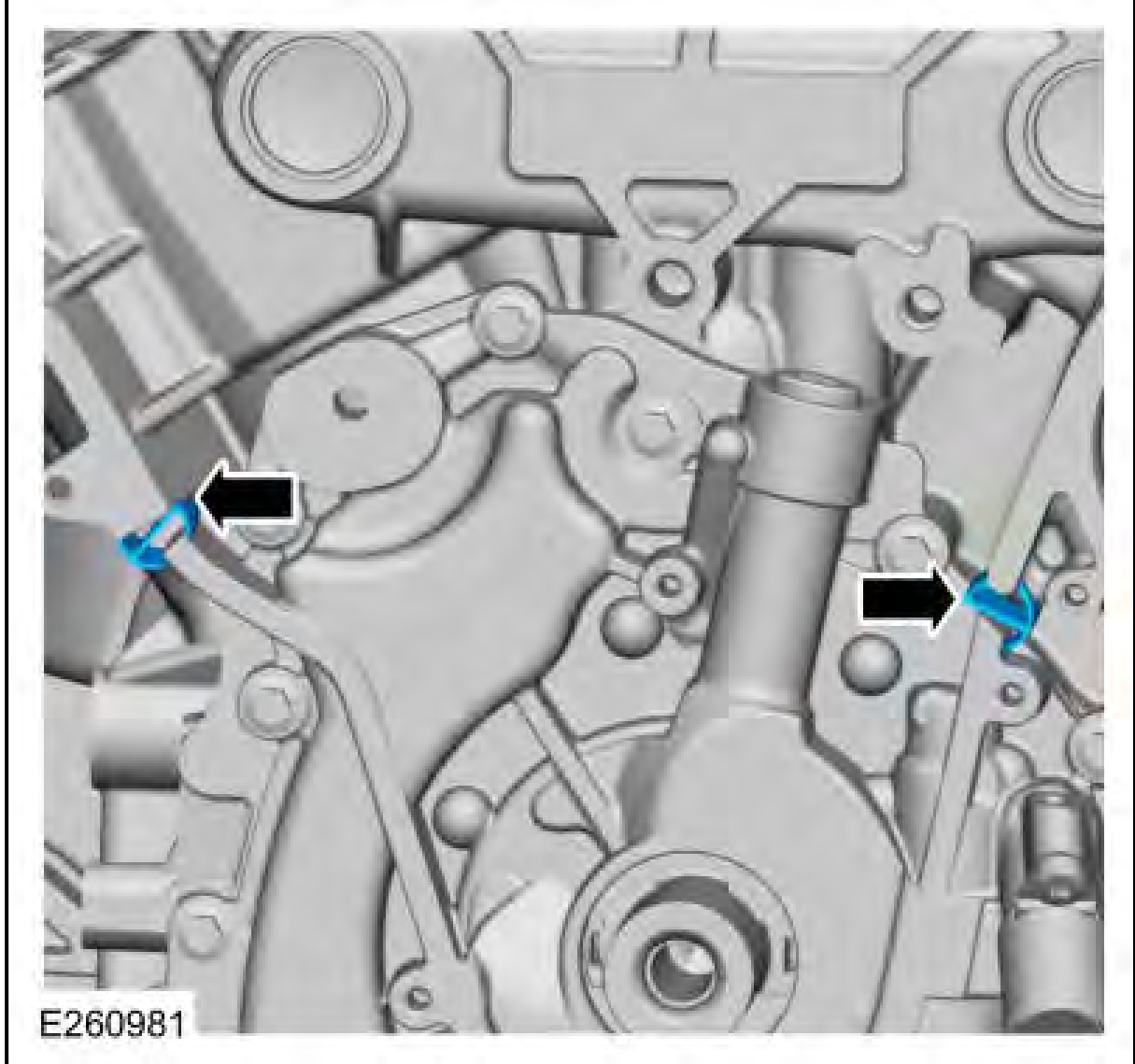




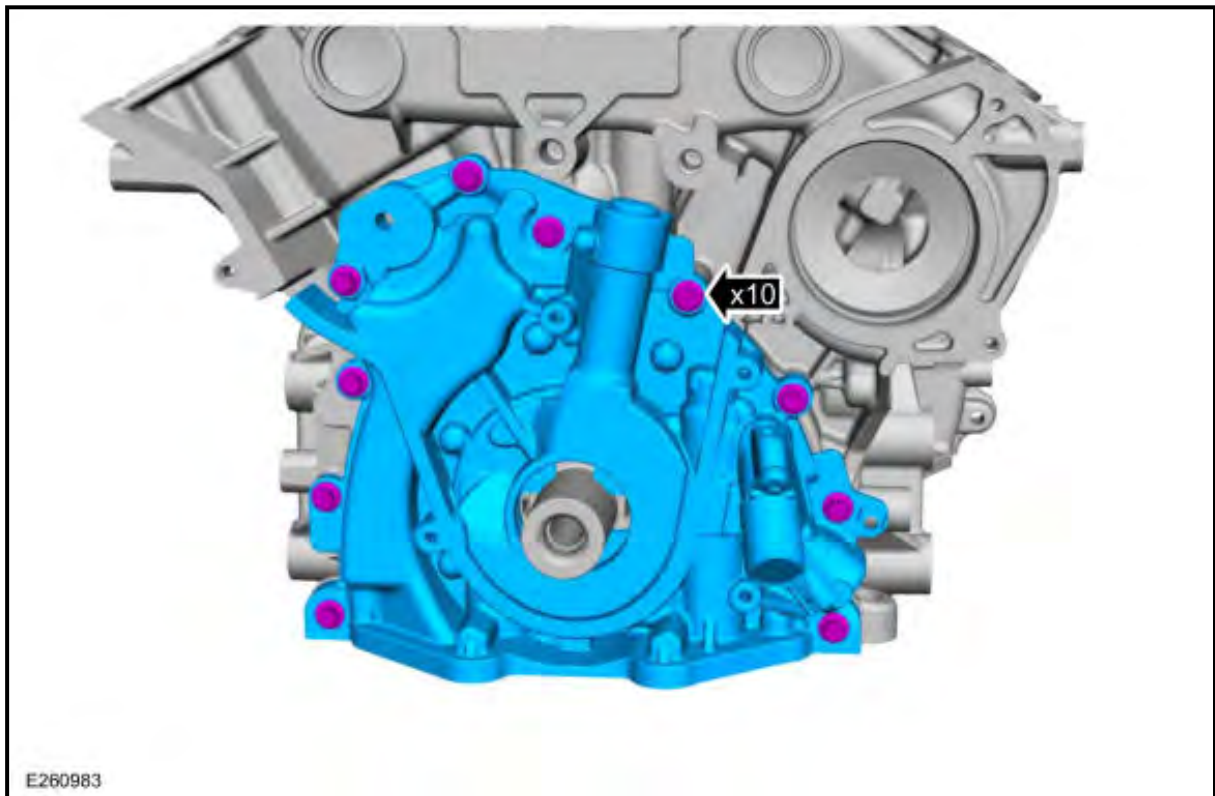
188. Using the special tools, remove and discard the crankshaft front oil seal. Use Special Service Tool: 303-1675 Adapter, Seal Remover., 308-375 Remover, Input Shaft Seal.



189. Remove the oil pump inserts.

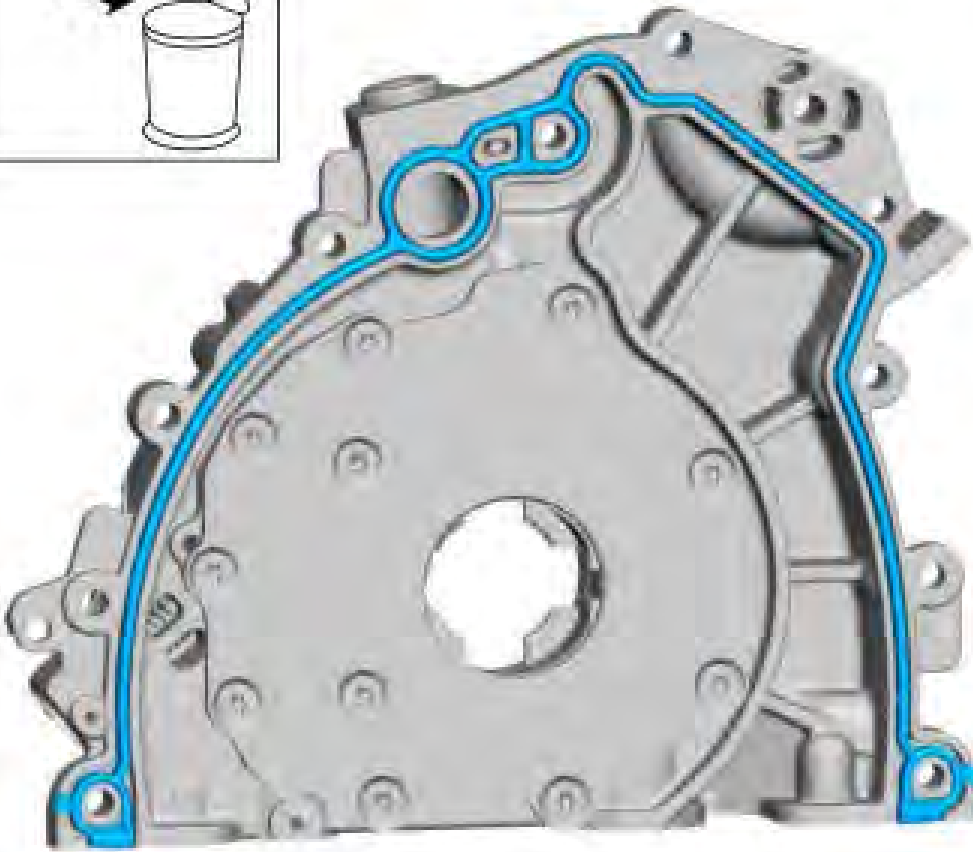
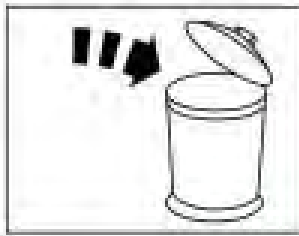


190. Remove the bolts and the oil pump.



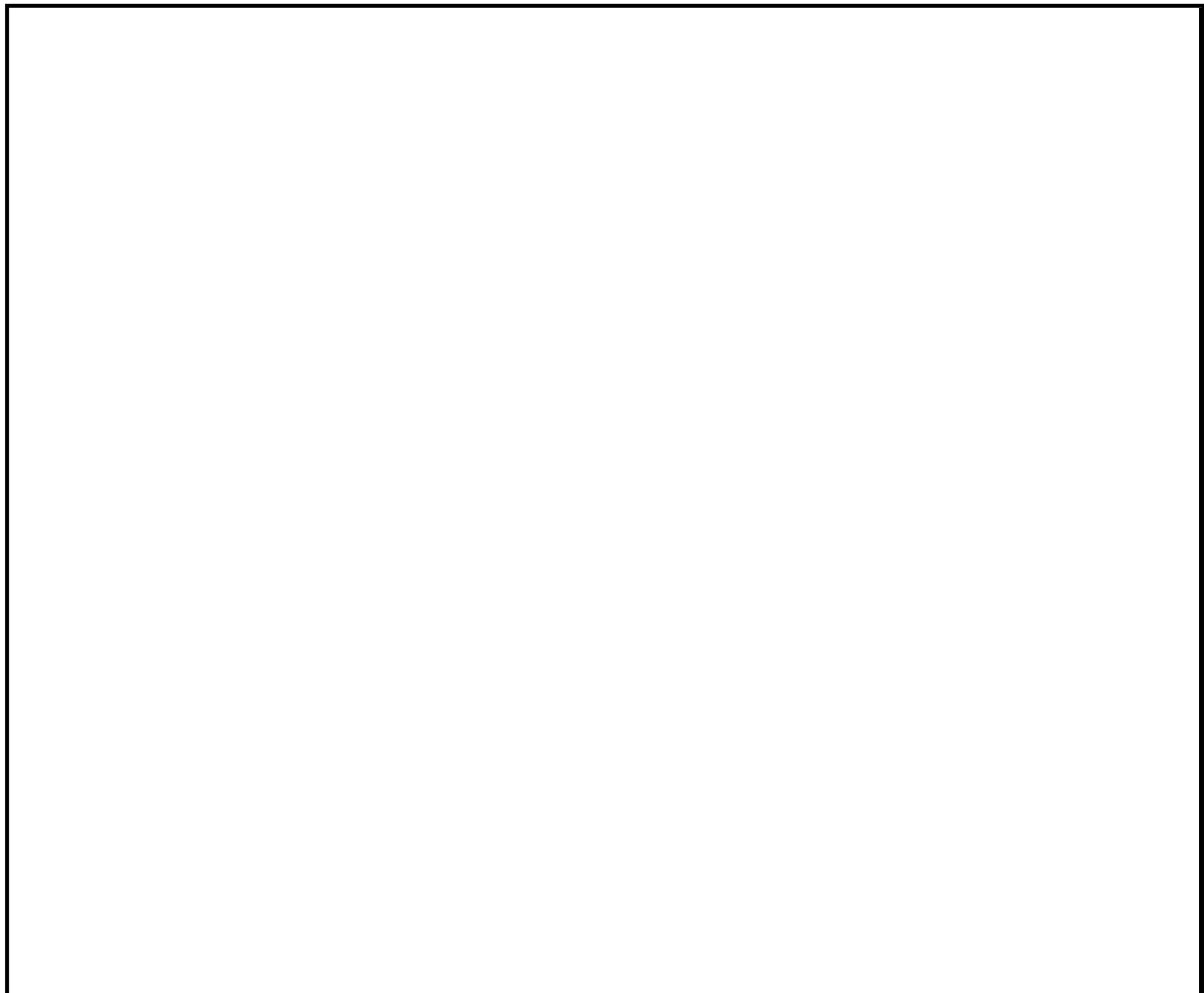
191. Remove and discard the oil pump gasket.

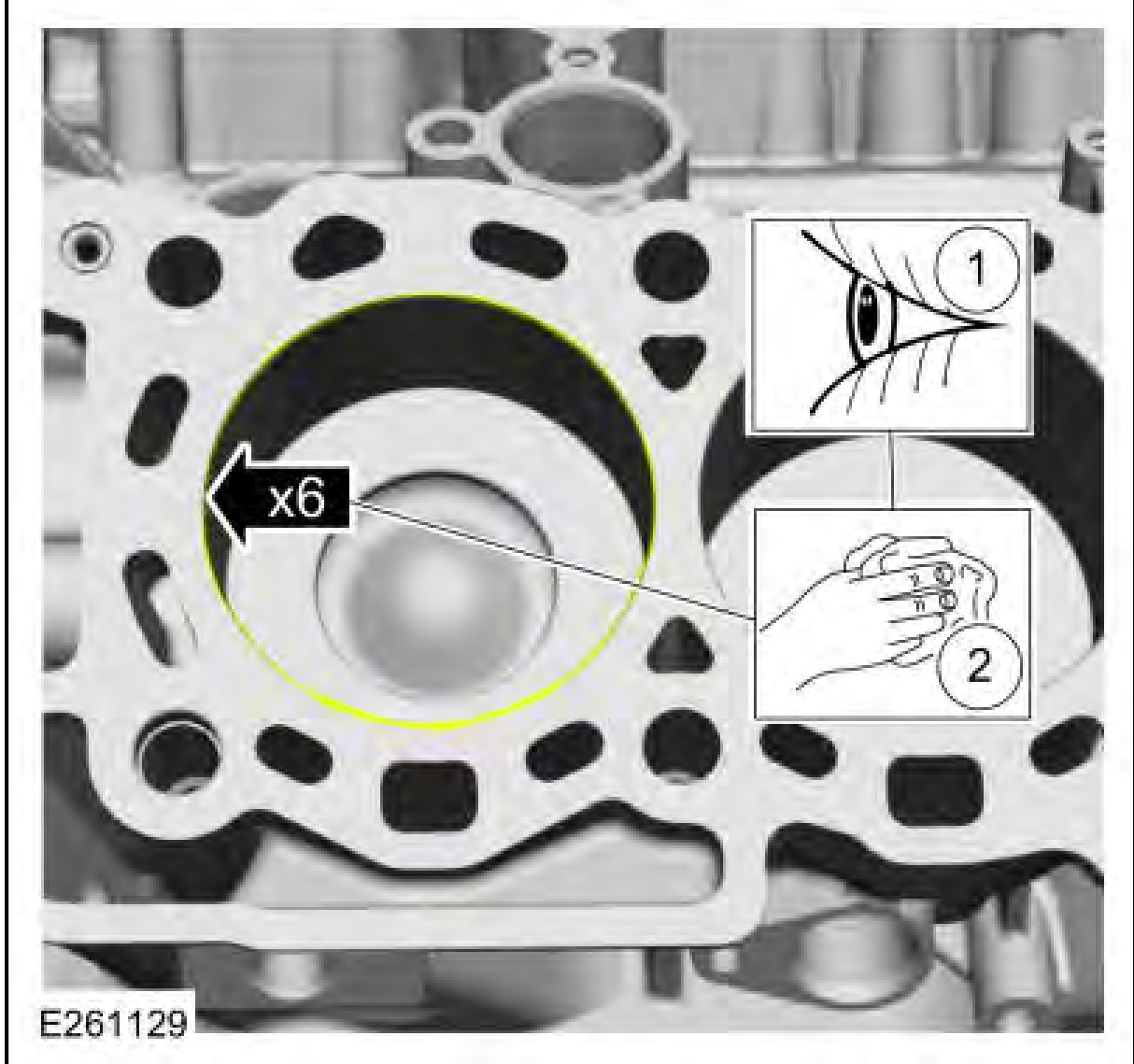




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192. Inspect and clean the specified component with a abrasive pad.



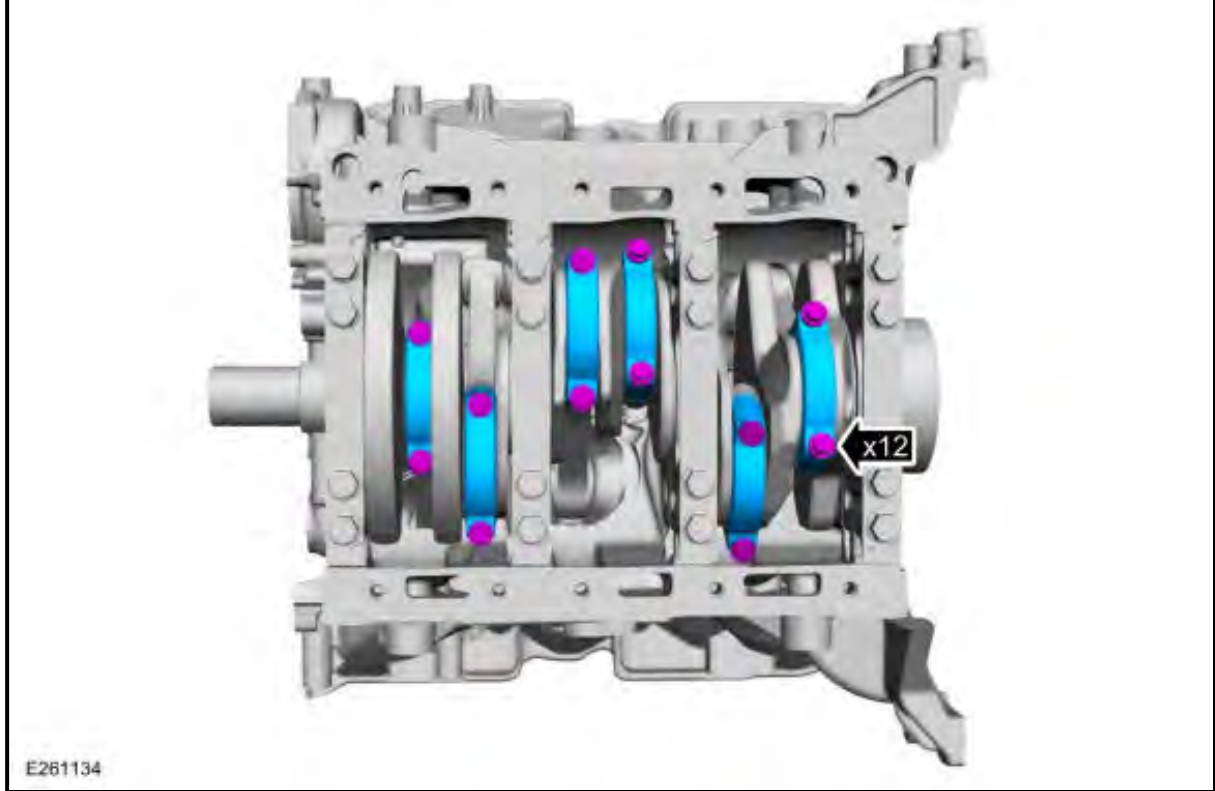


193. **NOTE:** The connecting rod cap bolts are a torque-to-yield design. The original connecting rod cap bolts will be used when measuring the connecting rod large end bore during assembly. The connecting rod cap bolts will be discarded after measurement.

**NOTE:** Clearly mark the position and orientation of the connecting rods, connecting rod caps and connecting rod bearings for reassembly.

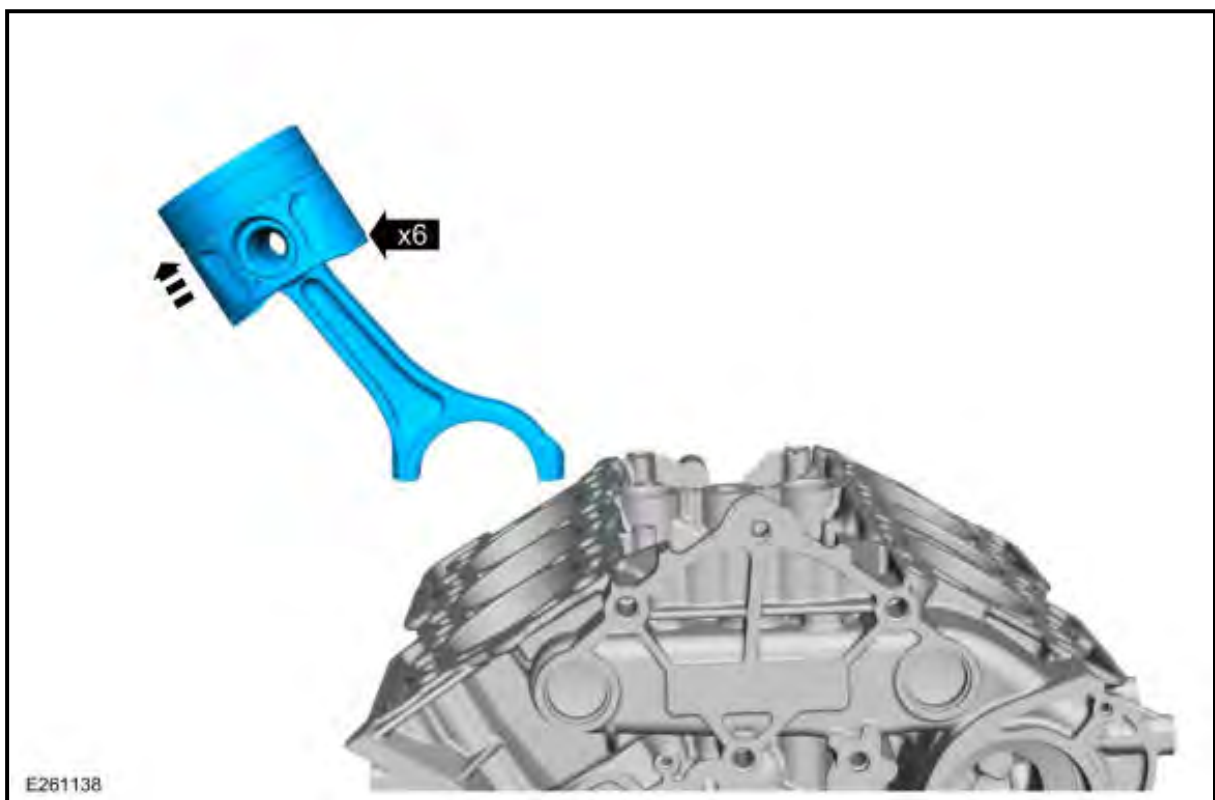
Remove the connecting rod cap bolts and caps.





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

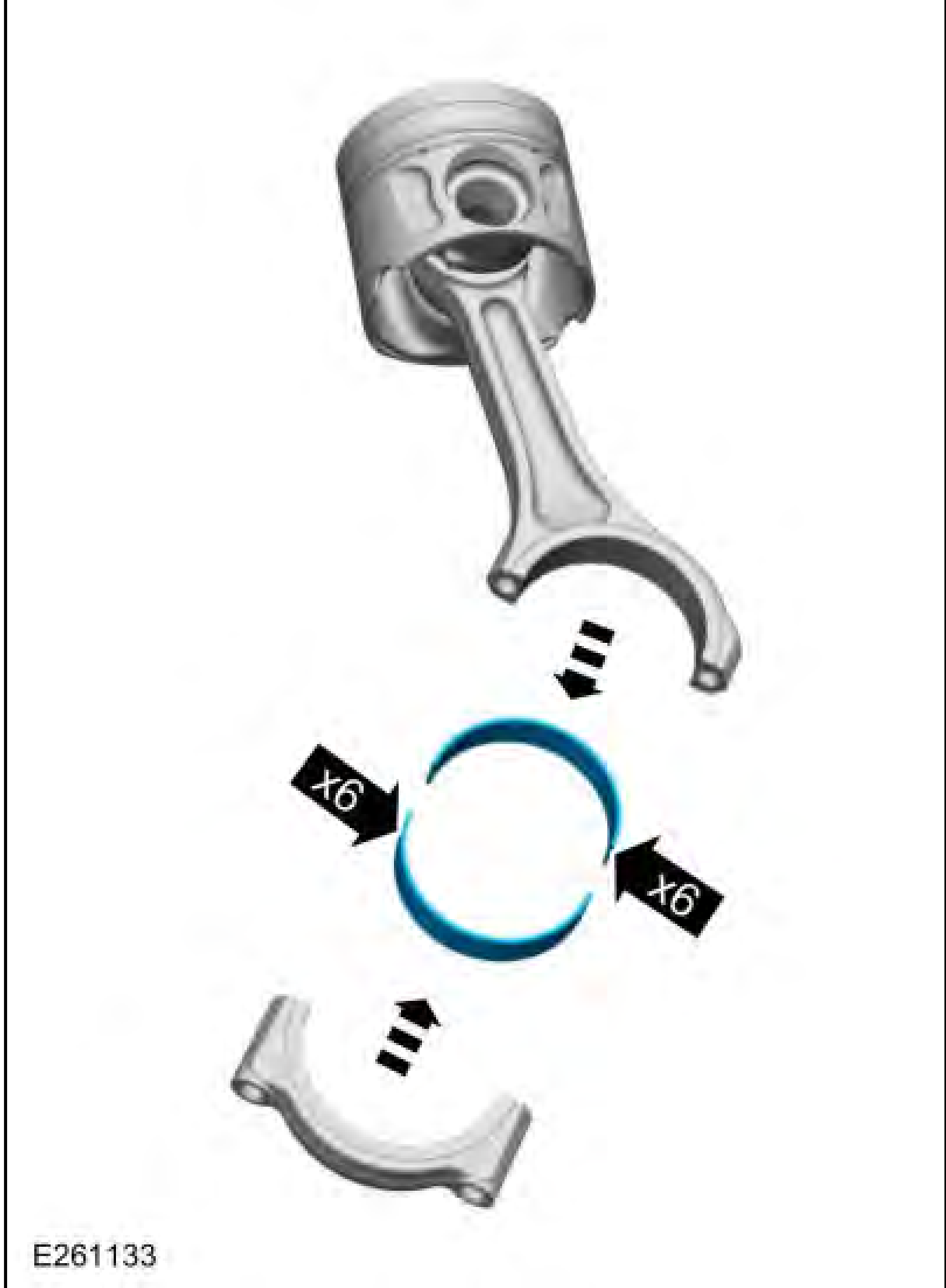
Remove the piston/rod assembly from the engine block.



195. **NOTE:** If the connecting rod bearings are being reused, mark them for correct position and orientation for reassembly.

Remove the bearings from the connecting rods.

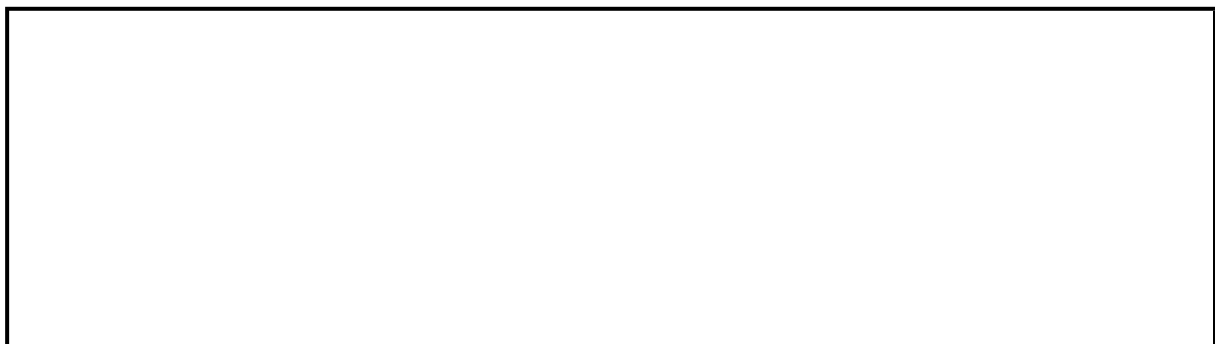


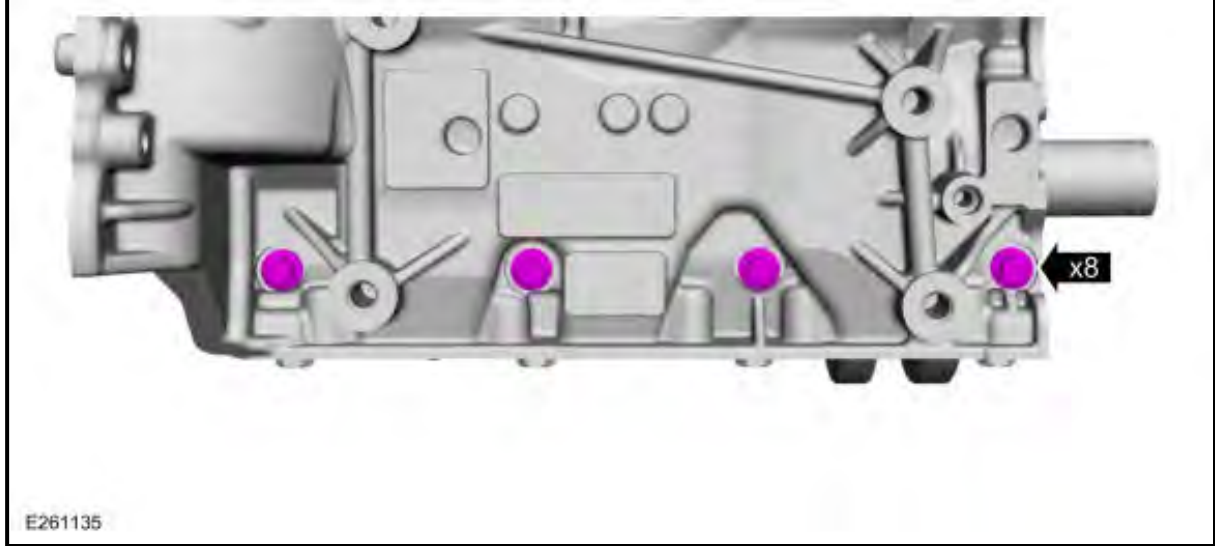


196. Inspect the pistons. Refer to: [Piston Inspection](#) .

197. **NOTE:**        **RH side shown, LH similar.**

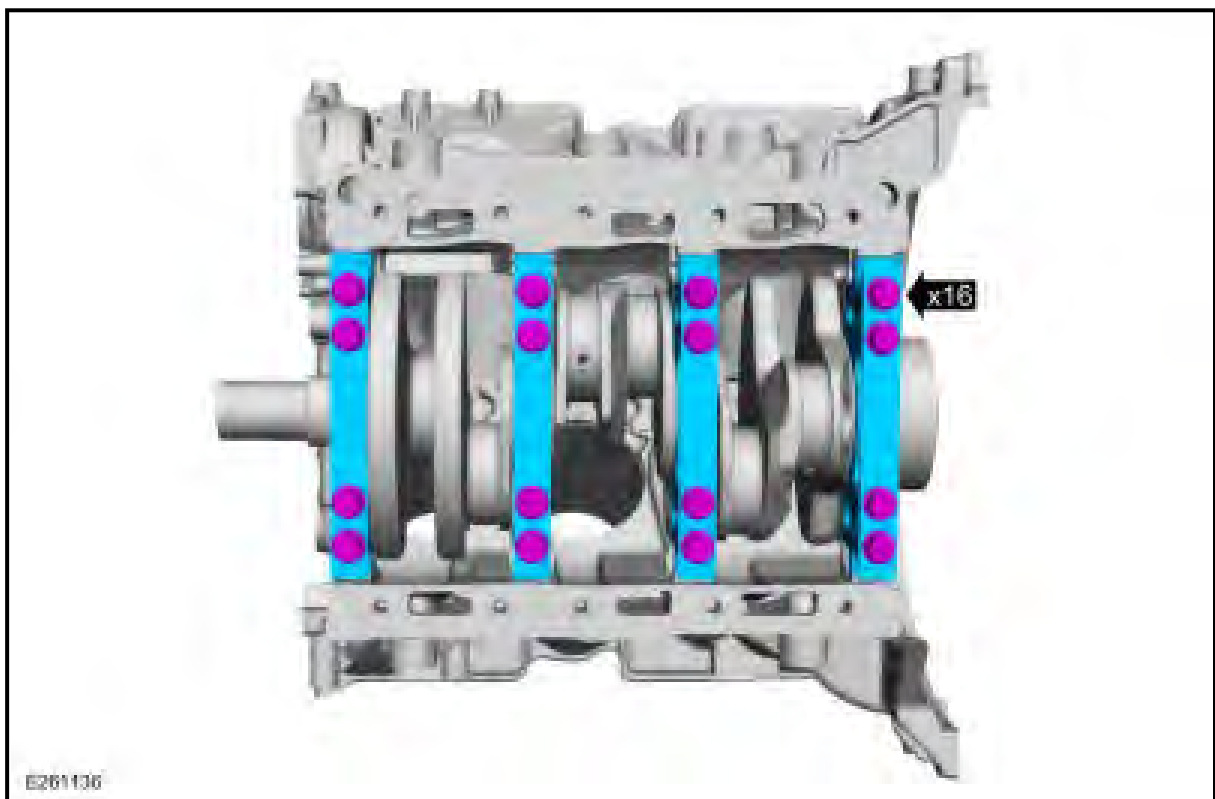
Remove the side bolts.





198. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

Remove the bolts and the main bearing caps.



199. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

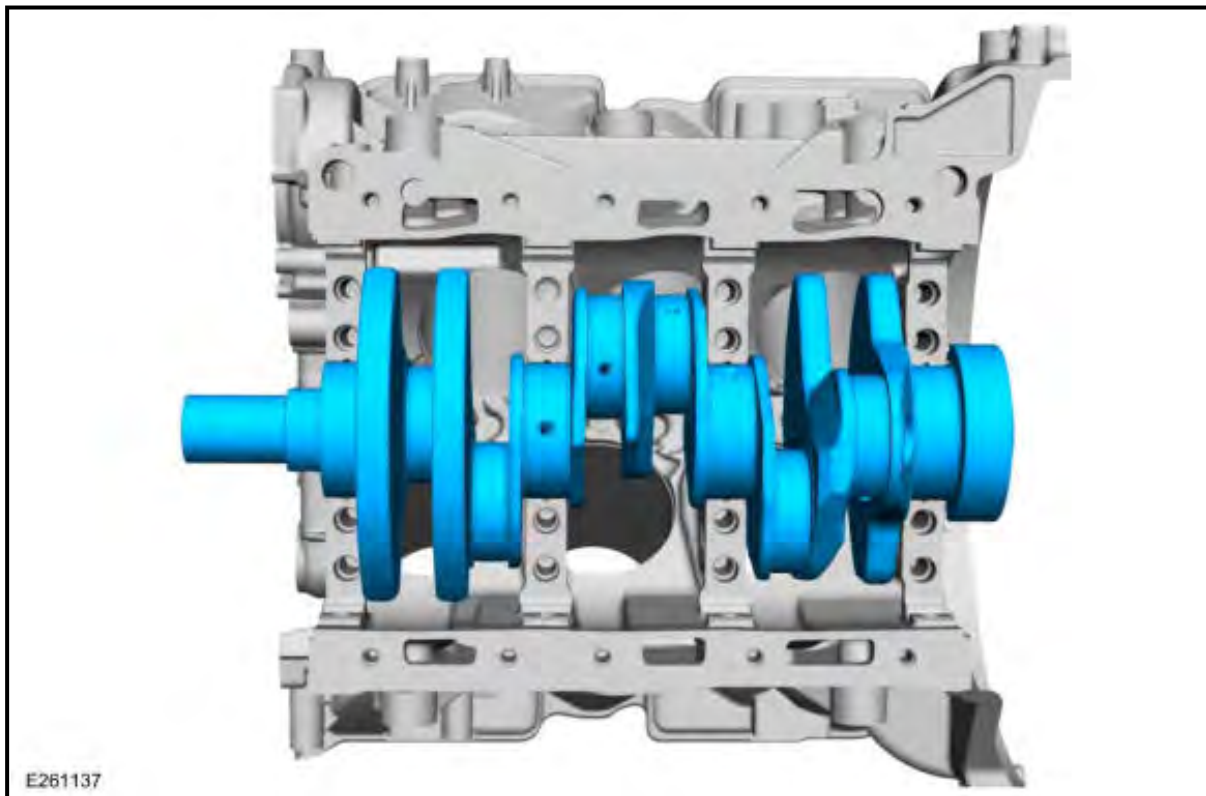
Remove the crankshaft main bearings from the main bearing caps.





E261132

200. Remove the crankshaft.



E261137

201. **NOTE:** If the main bearings are being reused, mark them for correct position and orientation for reassembly.

Remove the crankshaft main bearings from the cylinder block.





202. Remove the bolts and the piston cooling jets.



203. **NOTE:** Place clean, lint-free shop towels over exposed engine cavities. Carefully remove the towels so foreign material is not dropped into the engine. Any foreign material (including any material created while cleaning gasket surfaces) that enters the oil passages or the oil pan, may cause engine failure.

**NOTE:** Do not use wire brushes, power abrasive discs or 3M™ Roloc Â® Bristle Disk (2-in white part number 07528) to clean the sealing surfaces. These tools cause scratches and gouges that make leak paths. They also cause contamination that will cause premature engine failure. Remove all traces of the gasket.

Make sure that the mating faces of the cylinder block are clean and free of foreign material. Refer to: [RTV Sealing Surface Cleaning and Preparation](#) . Use the General Equipment: Plastic Scraper

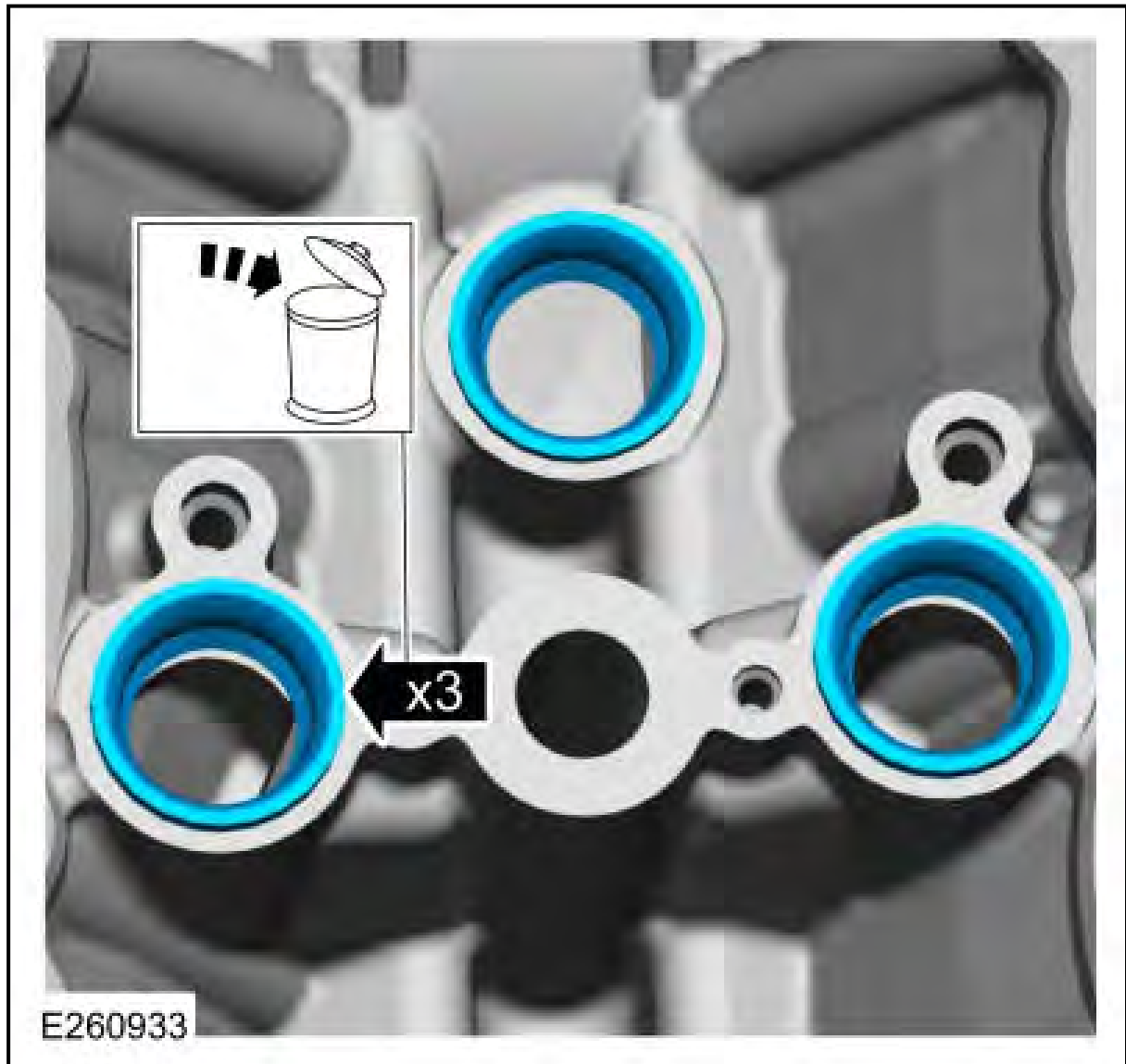
Material: Motorcraft <sup>®</sup> Silicone Gasket Remover / ZC-30-A

Material: Motorcraft <sup>®</sup> Metal Surface Prep Wipes / ZC-31-B

Material: Motorcraft <sup>®</sup> Metal Brake Parts Cleaner / PM-4-A, PM-4-B

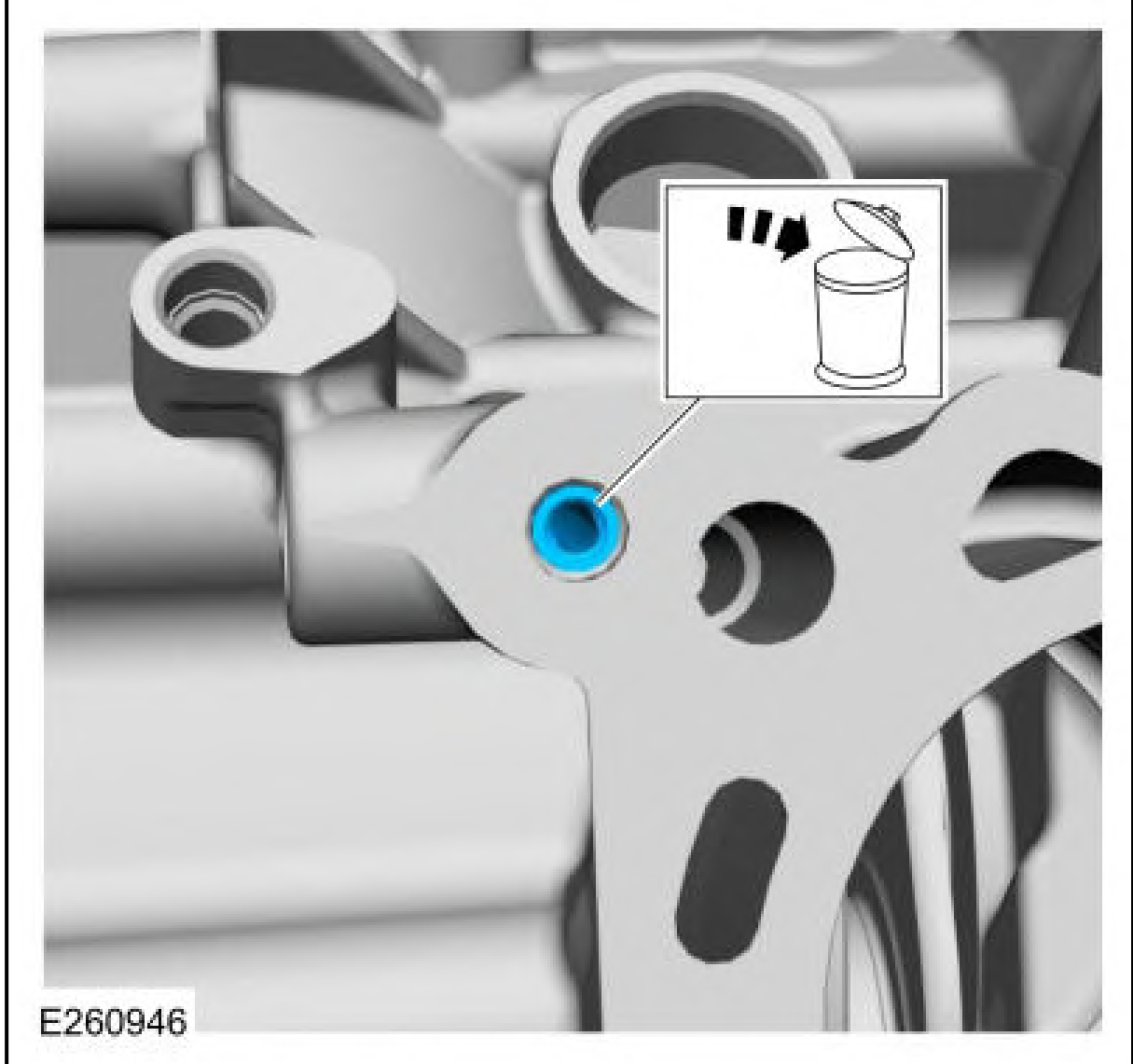
204. Check the cylinder block distortion. Refer to: [Cylinder Block Distortion](#) .

205. Remove and discard the CCV gaskets.

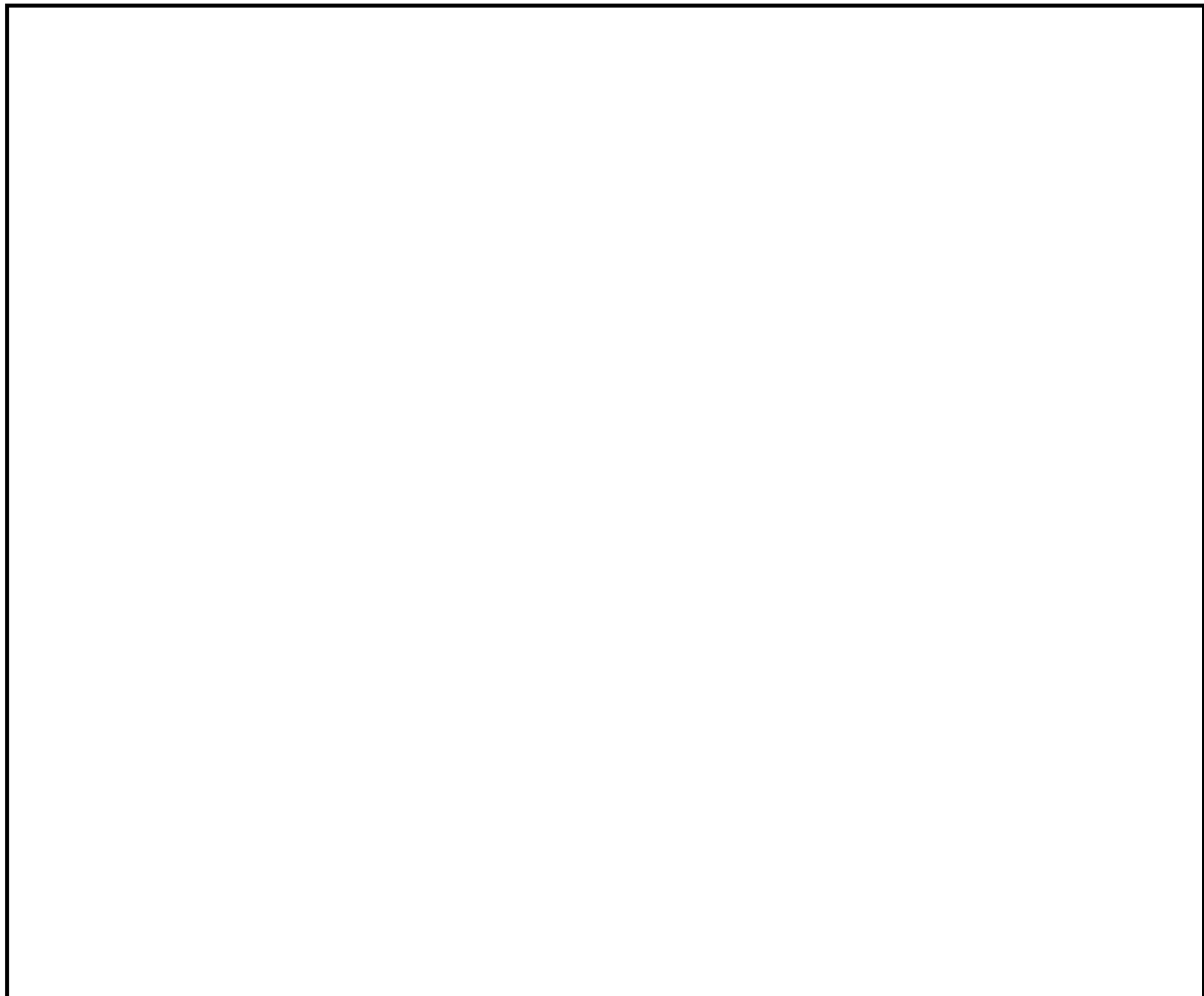


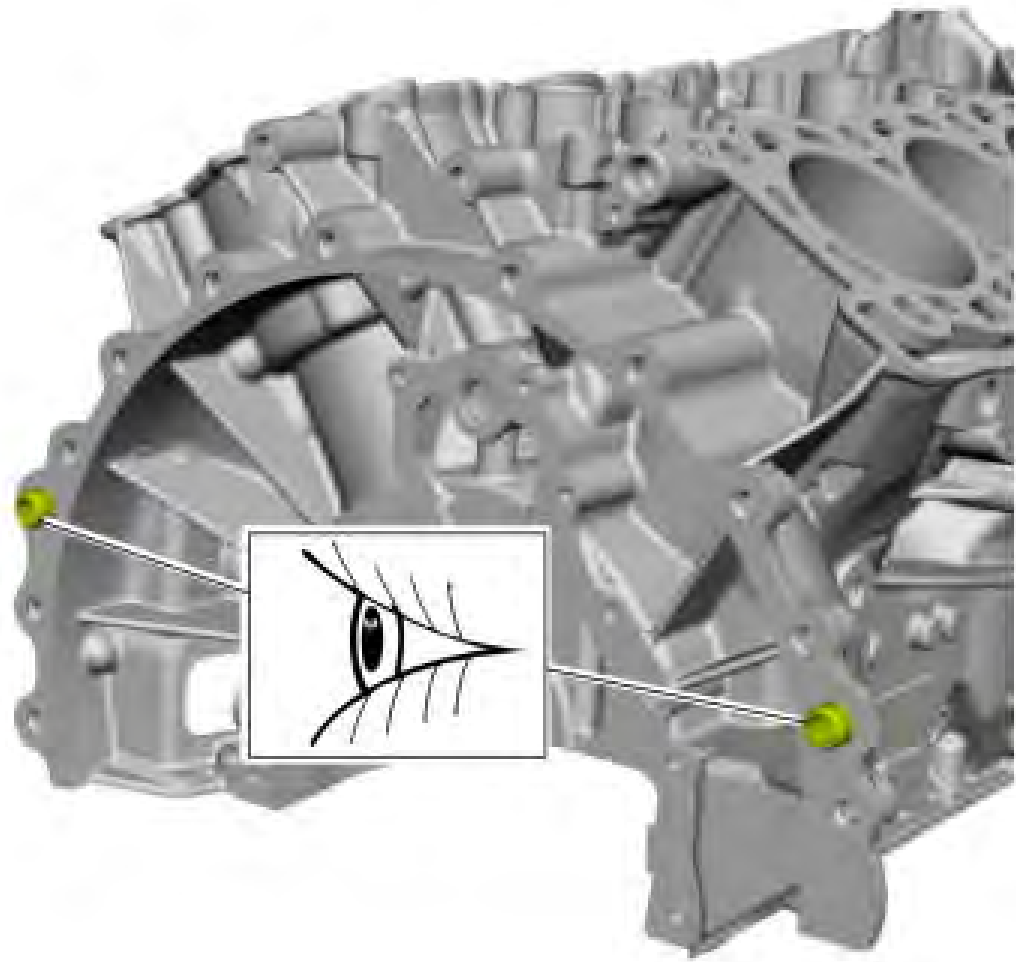
206. Remove and discard the engine oil filter.





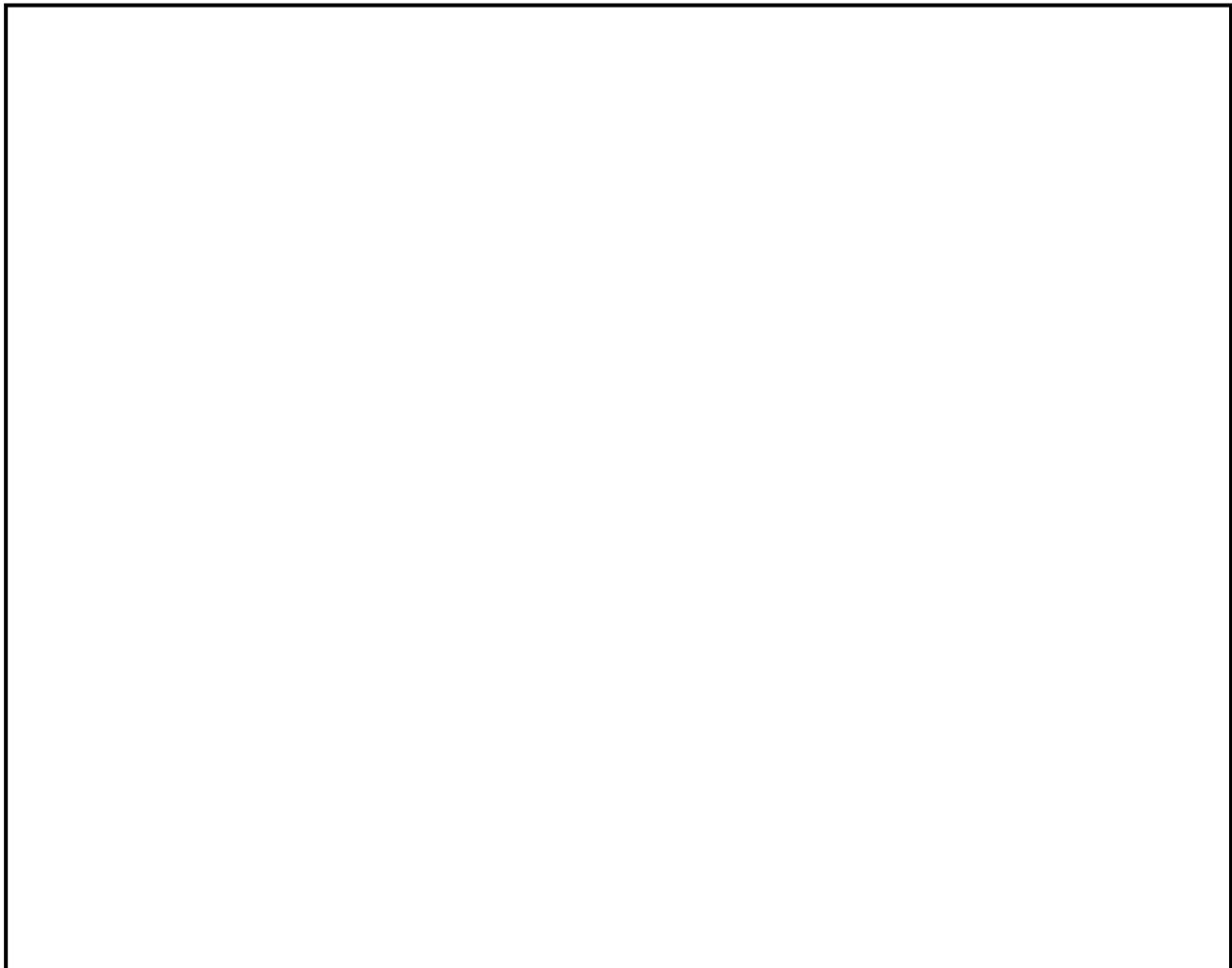
207. Inspect the engine alignment dowels, replace if necessary.

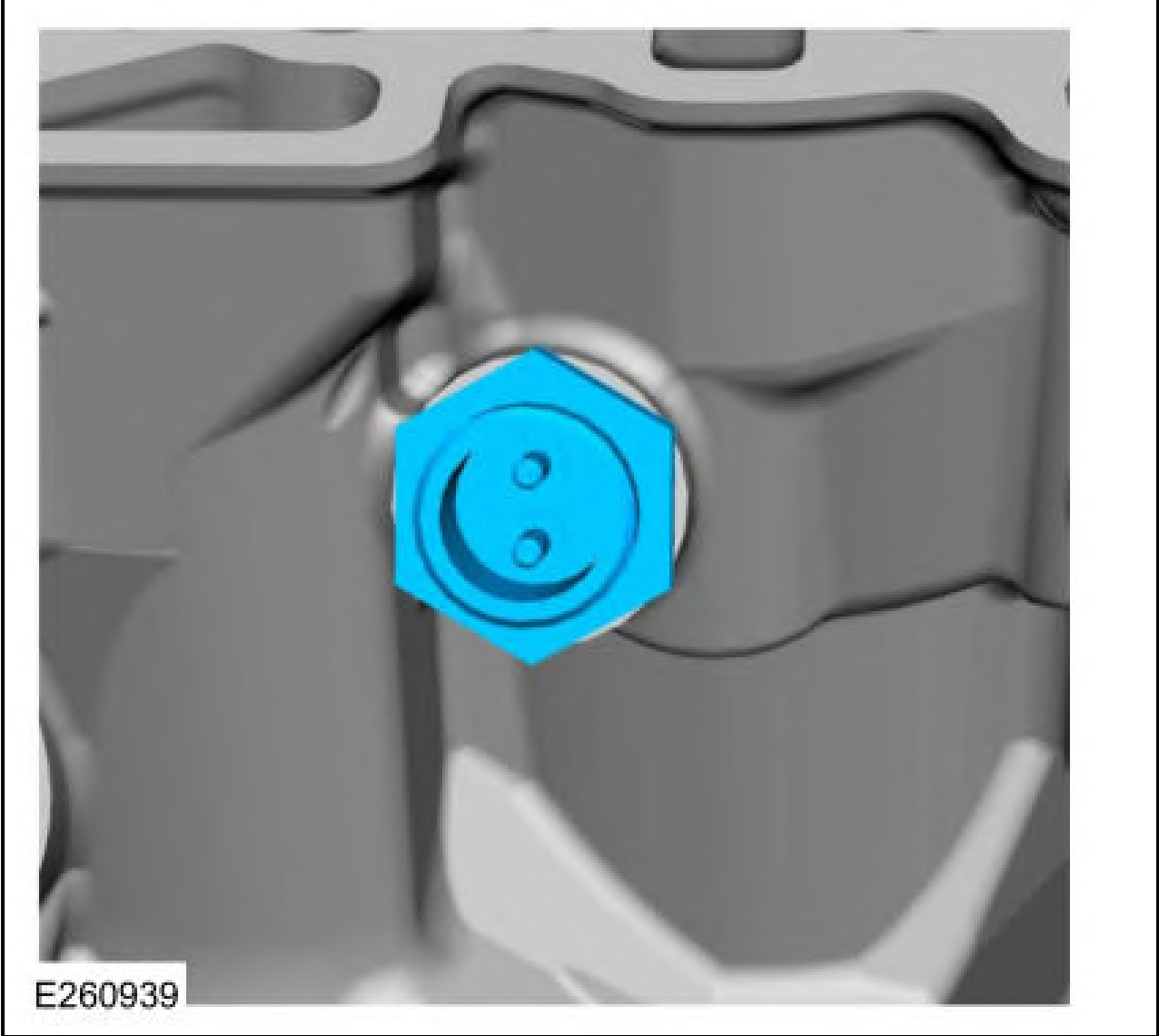




E260979

208. If equipped. Remove the block heater.





## DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

### CYLINDER HEAD

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

Base Part Number: 6051

#### Special Tool(s) / General Equipment

|  |  |
|--|--|
|  | <b>303-1249 Valve Spring CompressorTKIT-2006UF-FLMTKIT-2006UF-ROW</b>  |
|  | 303-1516 Compressor, Valve Spring  |
|  | 303-300 (T87C-6565-A) Set, Valve Spring CompressorTKIT-1988-FESTIVAT88C-1000-STTKIT-1988-TRACERTKIT-2009TC-F |
|  | 303-350 (T89P-6565-A) Compressor, Valve SpringTKIT-1990-LMHTKIT-1989-FTKIT-1989-FMTKIT-1989-FLM              |

#### Materials

| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> Multi-Purpose Grease SprayXL-5-A | ESB-M1C93-B   |

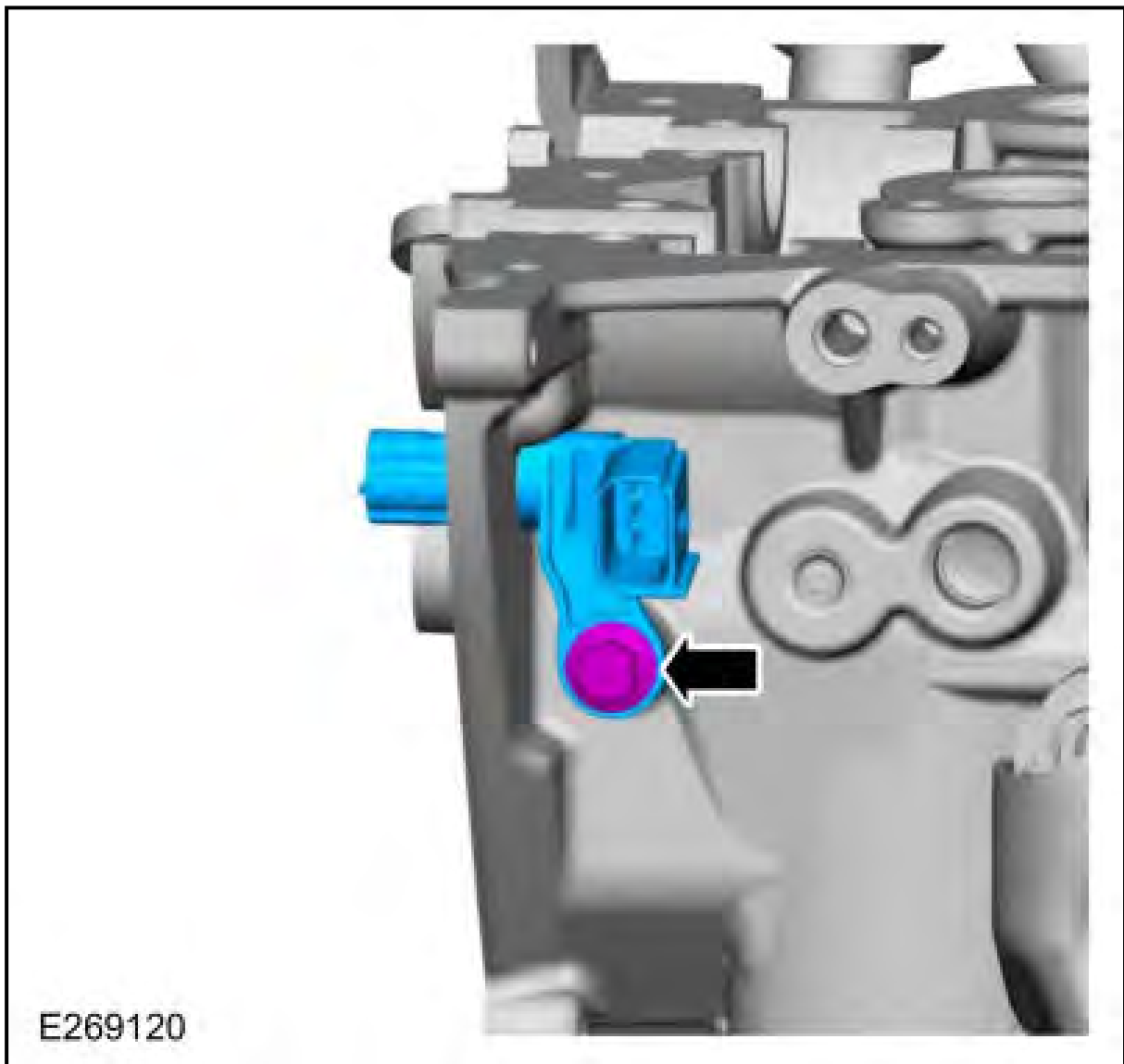
| Name   | Specification |
|--|---------------|
| Motorcraft $\hat{A}$ ® Thread Sealant with PTFETA-24-B             | WSK-M2G350-A2 |
| Motorcraft $\hat{A}$ ® SAE 5W-30 F-150 Diesel Motor OilXO-5W30-QFA | WSS-M2C214-B1 |

## 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:** The glow plugs protrude past the lower face of the cylinder head, any impact on the tip of the glow plug may result in glow plug damage.

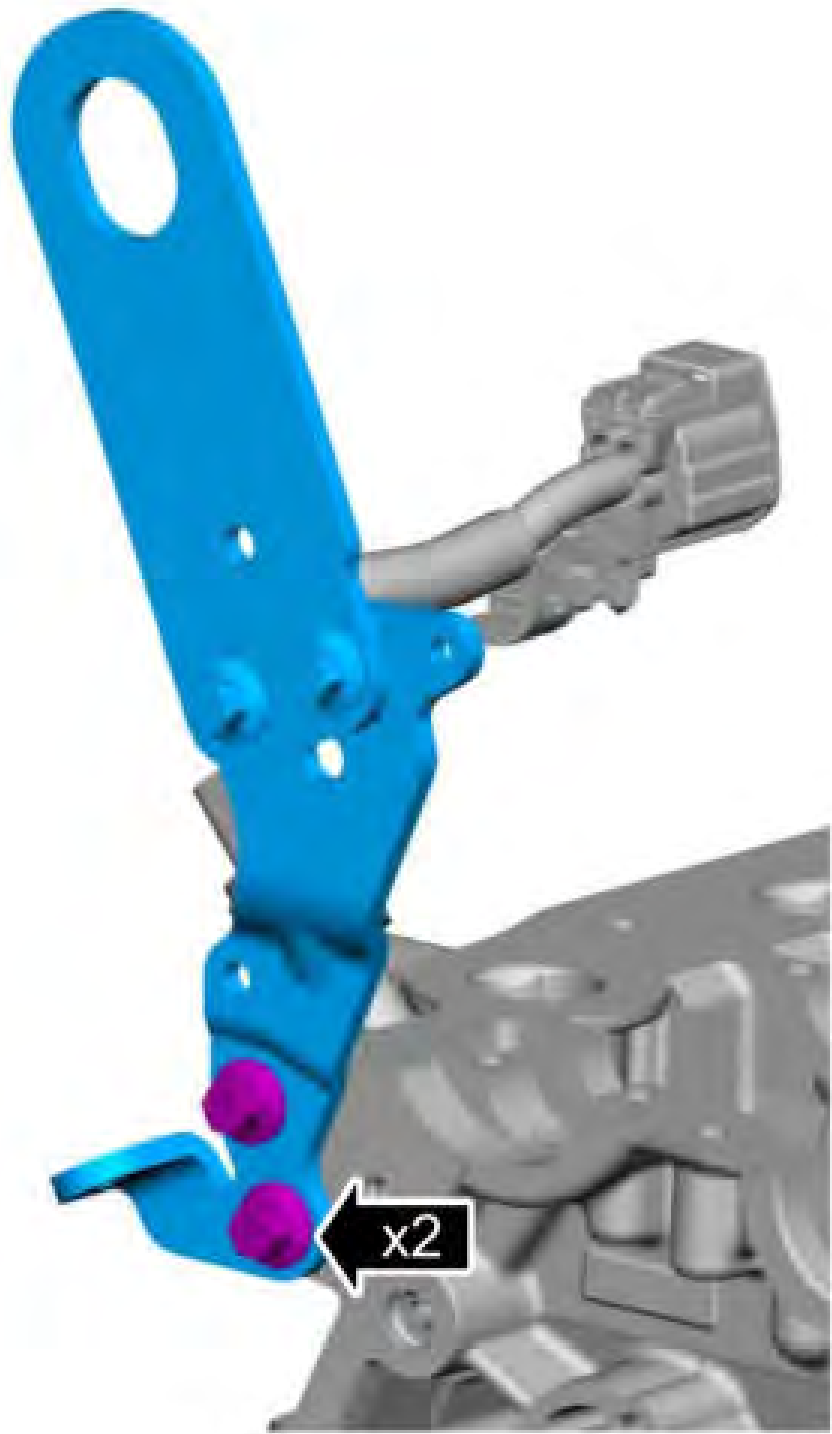
### LH cylinder head

1. Remove the bolt and the CMP sensor.



2. Remove the bolts and the front lifting eye.

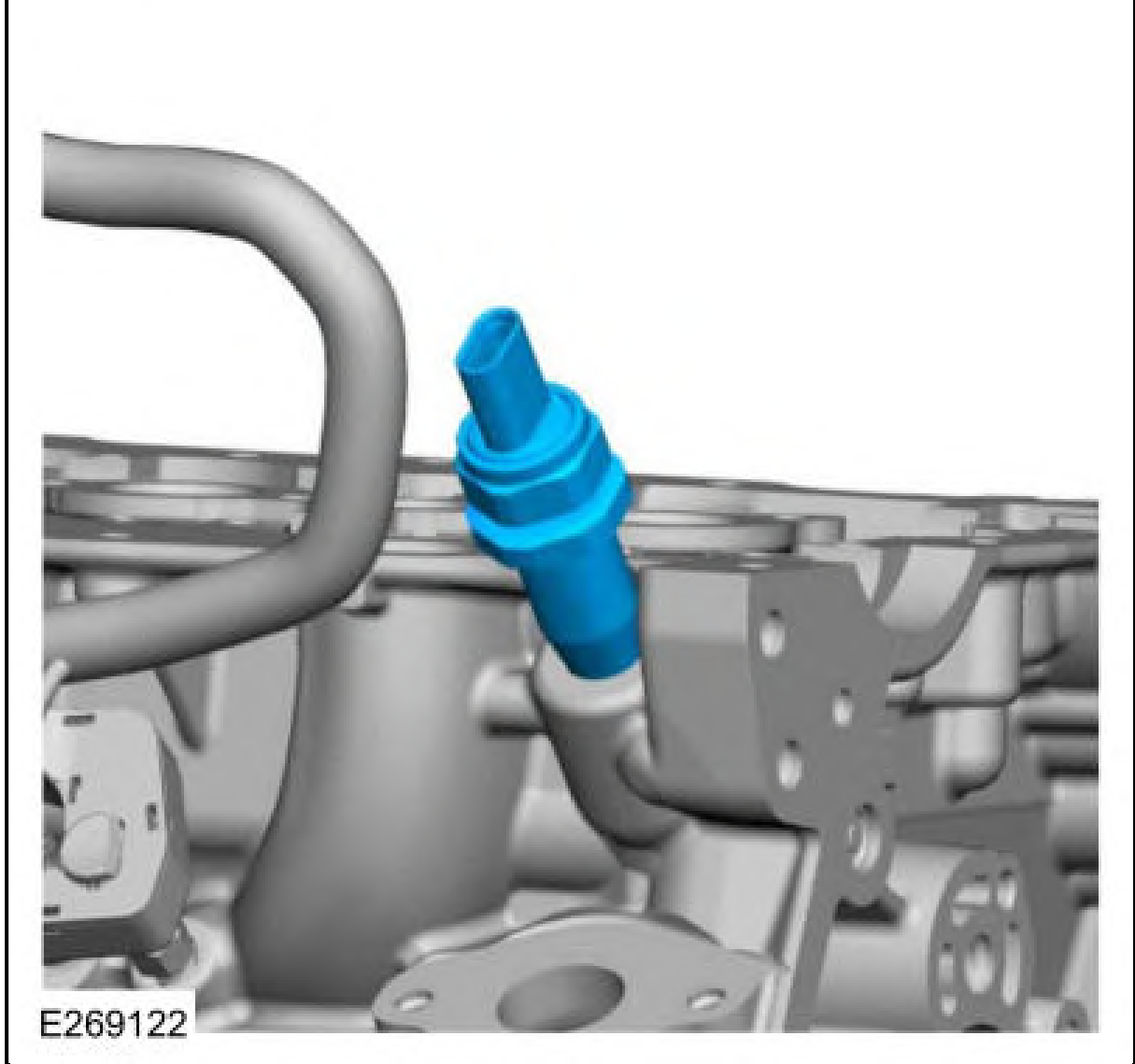




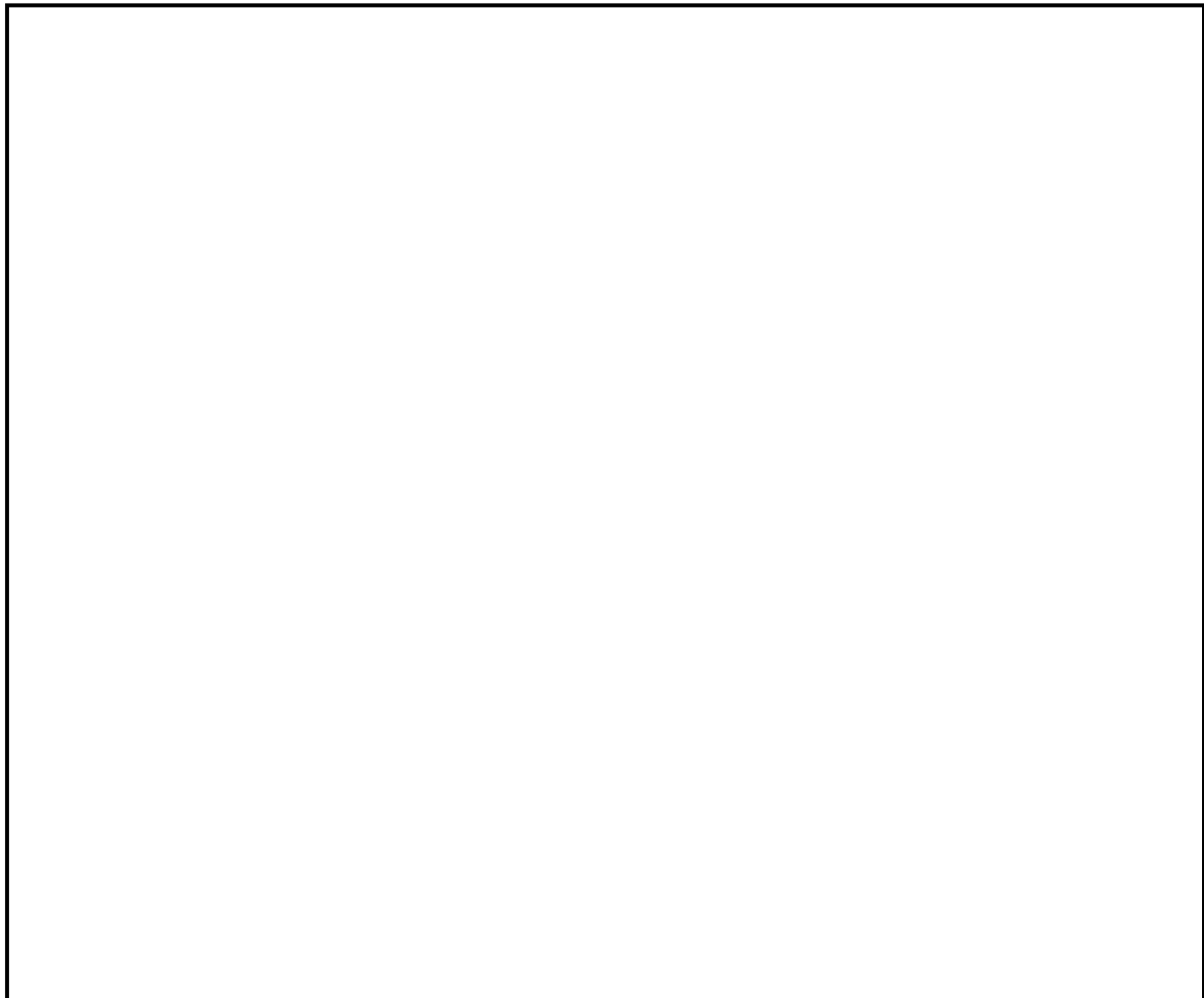
E269121

3. Remove the EOP sensor.

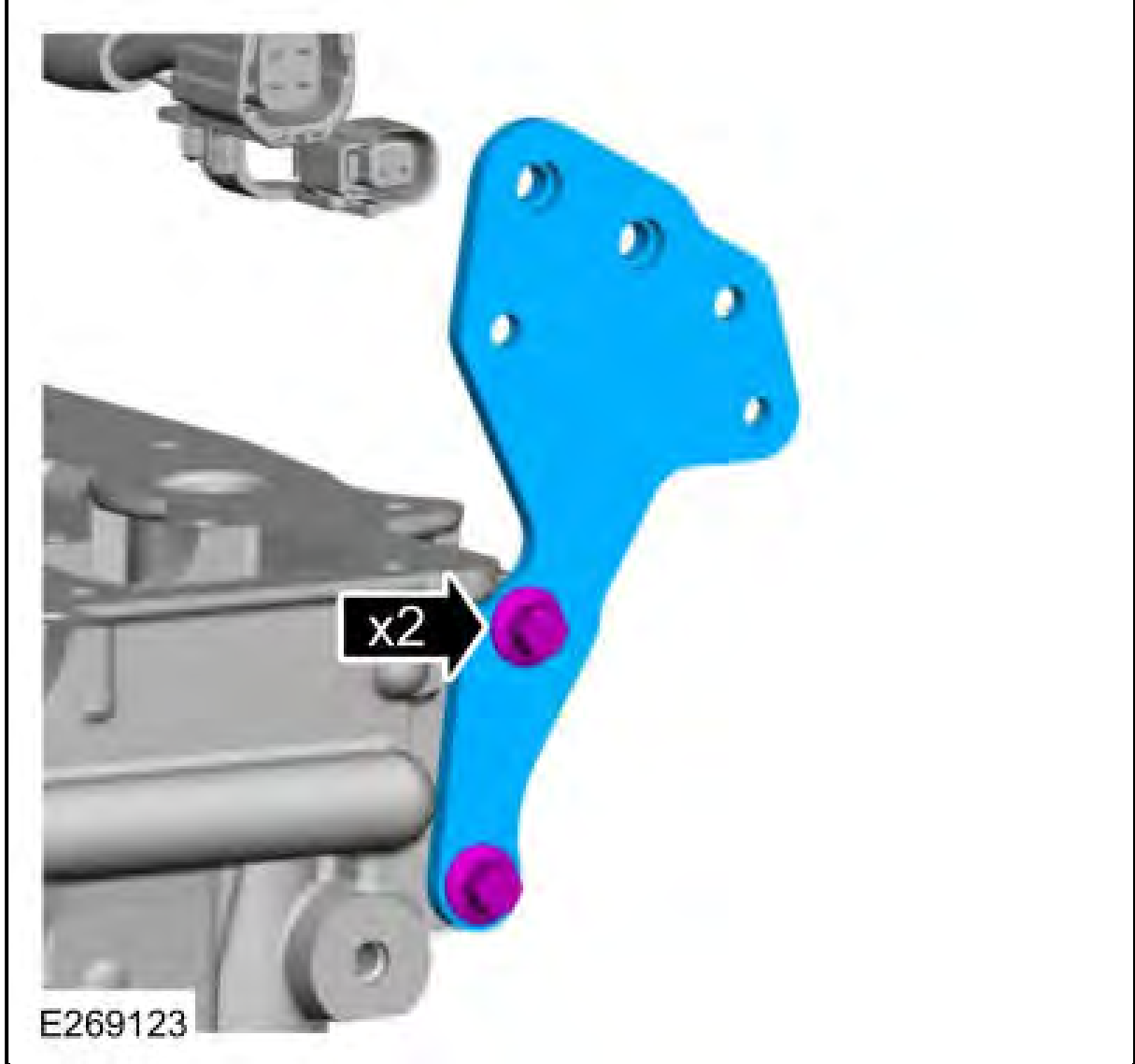




4. Remove the bolts and the rear lifting eye.



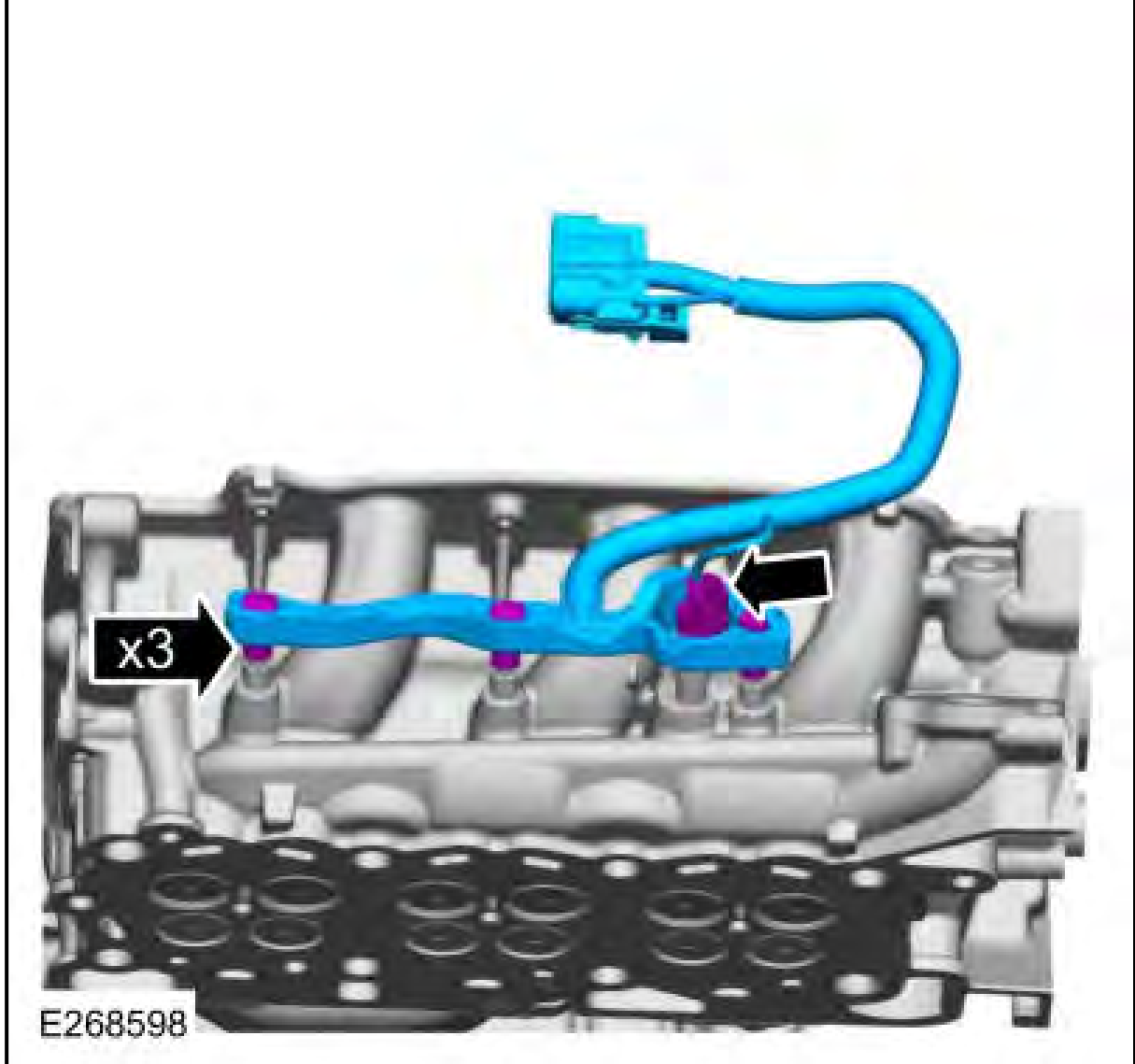




5.

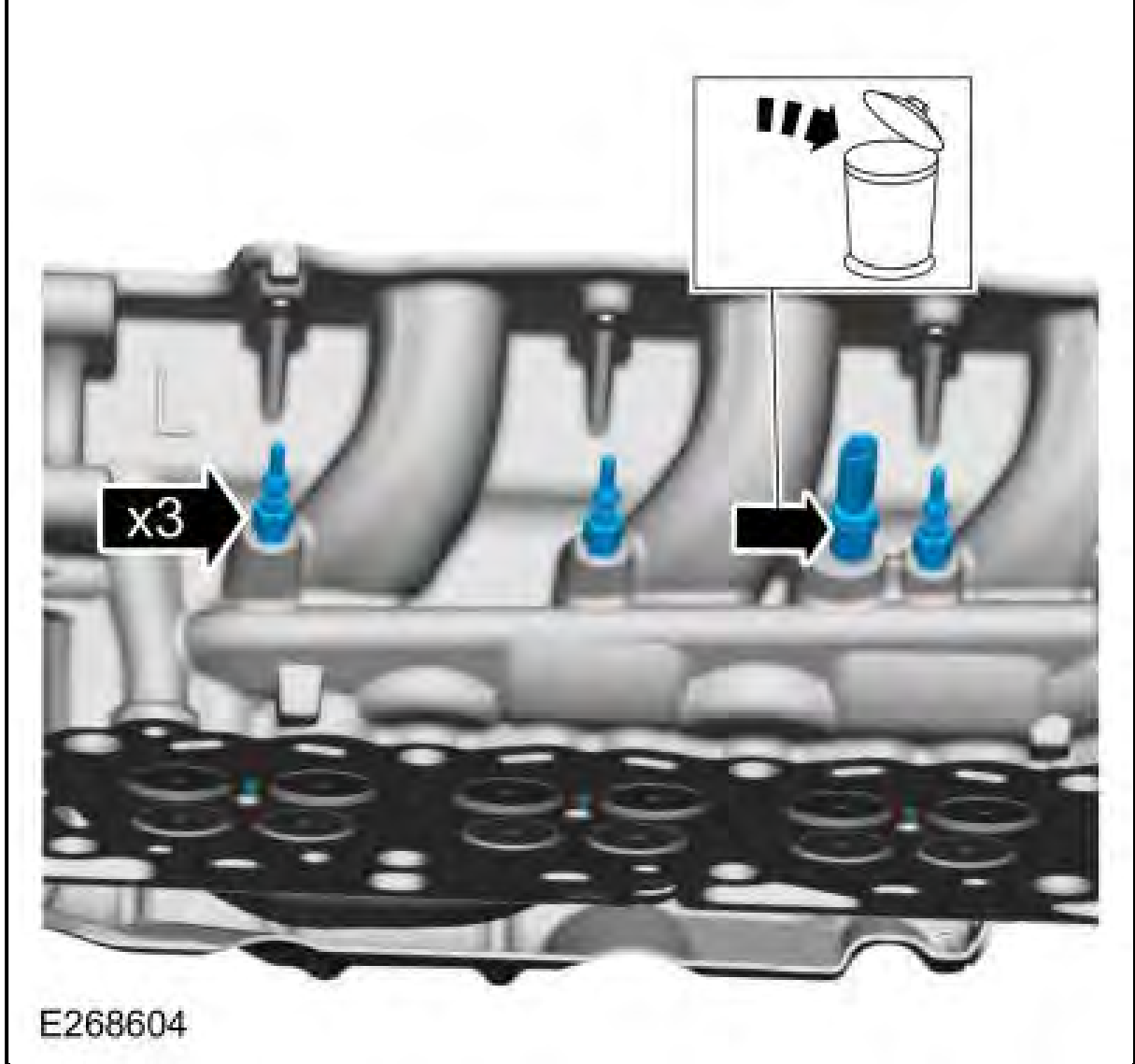
- Disconnect the CHT electrical connector.
- Disconnect and remove the LH glow plug harness.





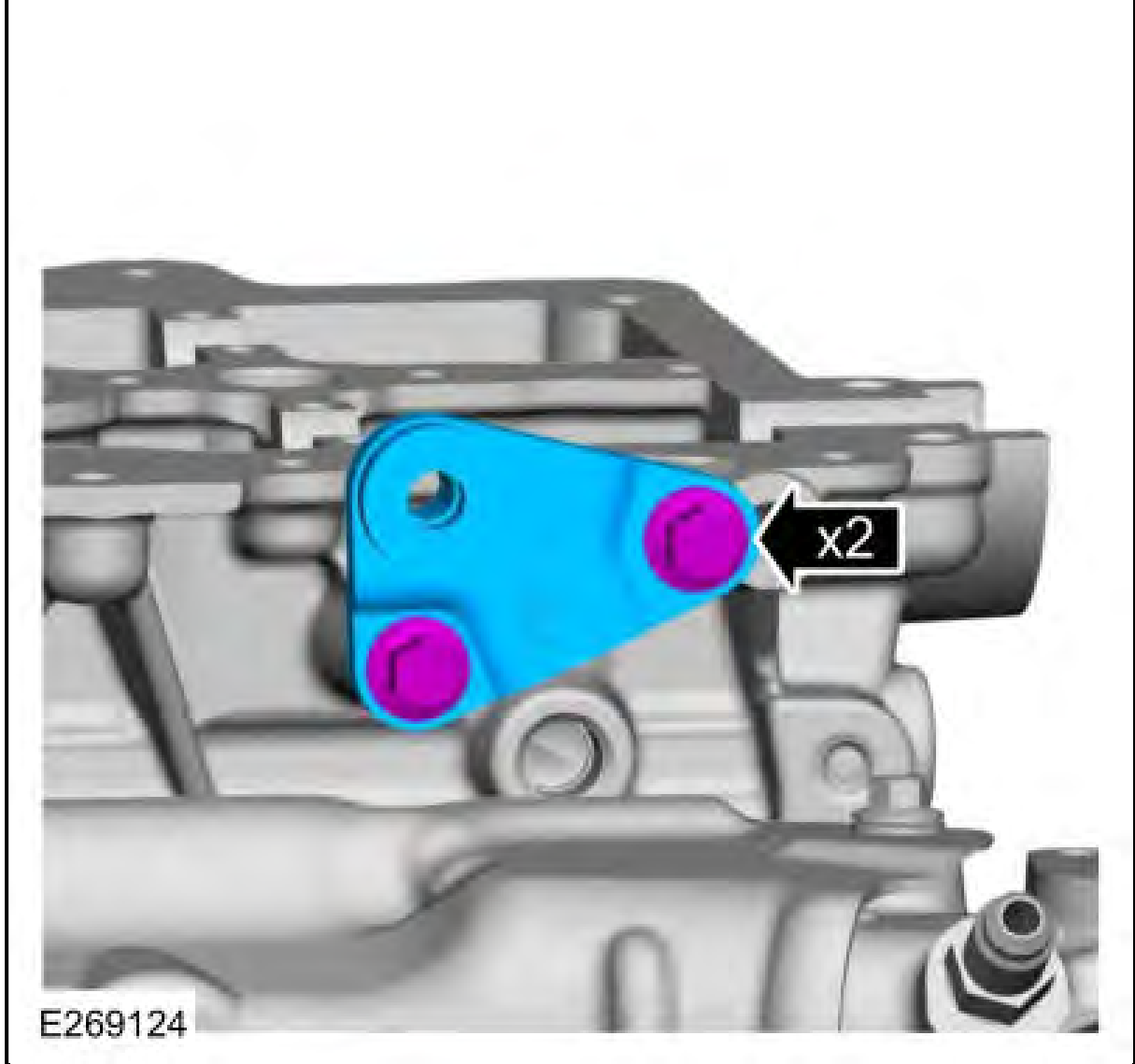
6.
  - Remove and discard the CHT sensor.
  - Remove the LH glow plugs.



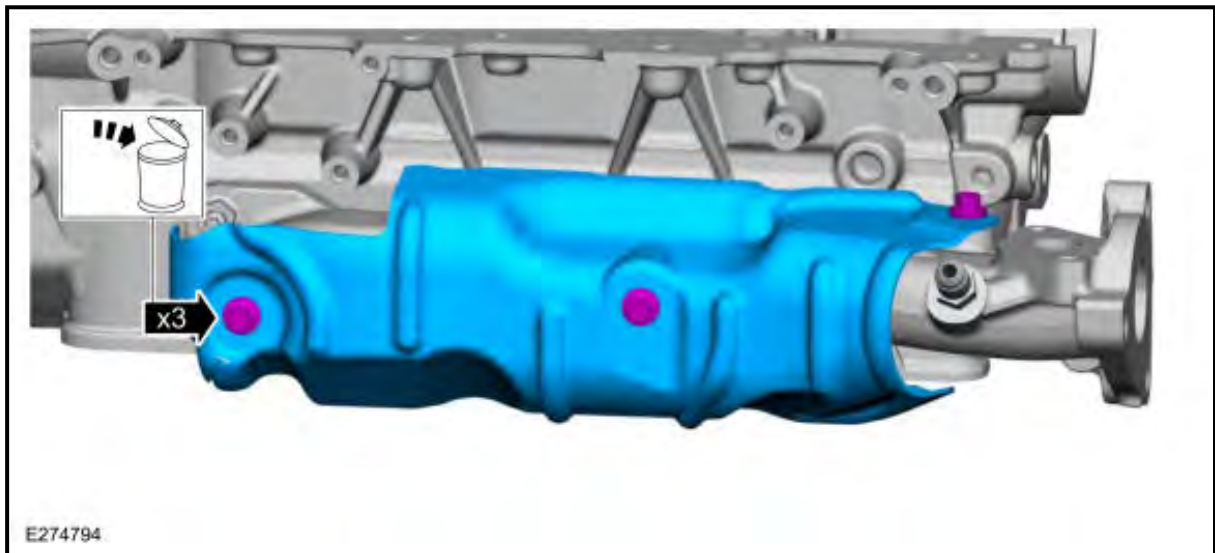


7. Remove the bolts and the EGR cooler bracket.



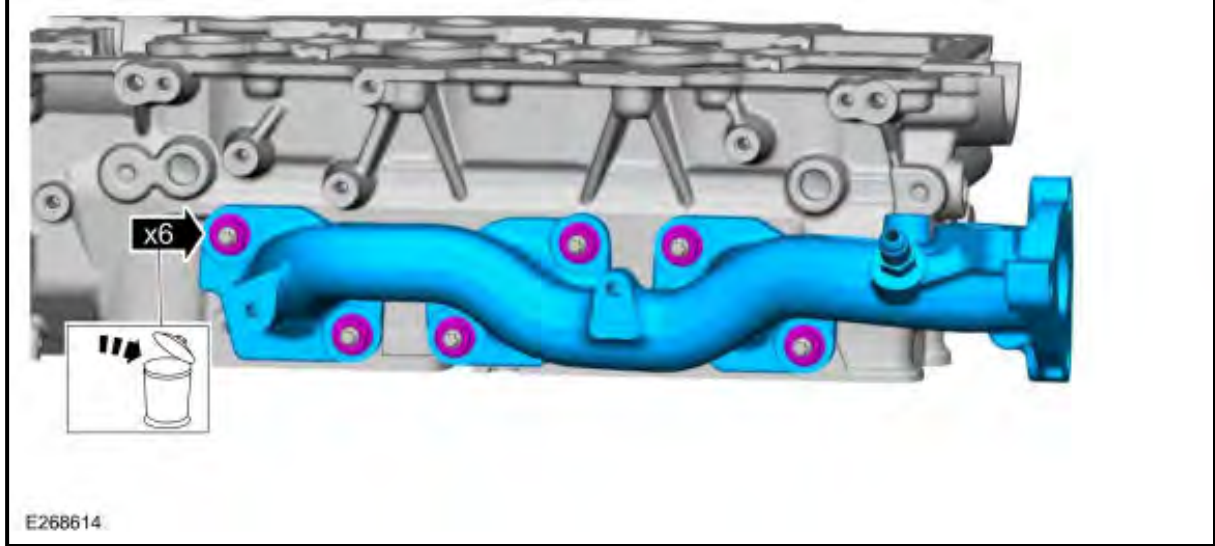


8. Remove the bolts and the LH exhaust manifold heat shield. Discard the bolts.



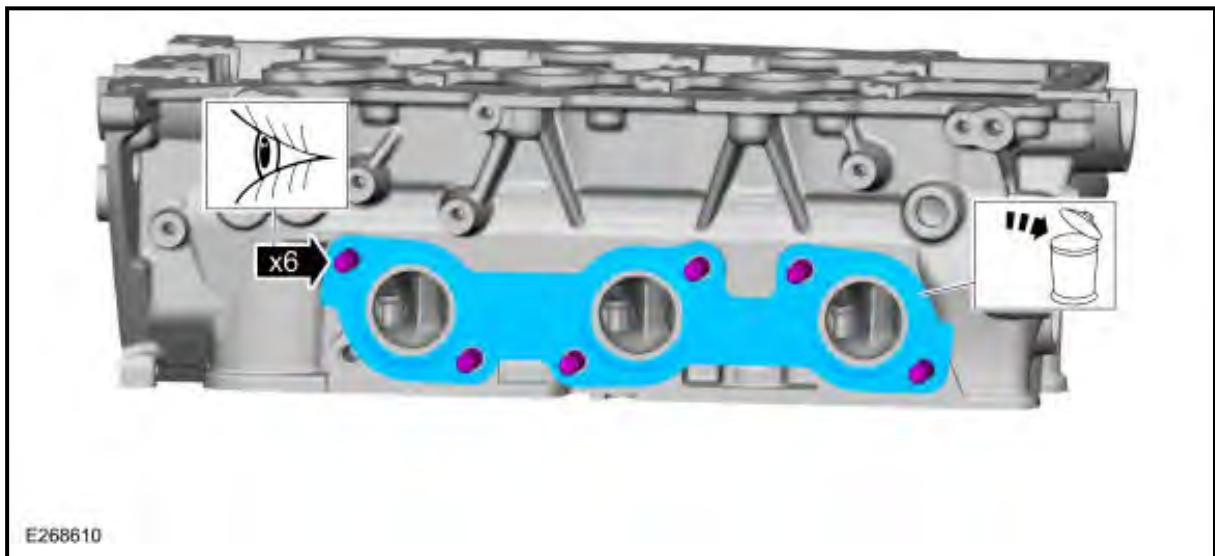
9. Remove the nuts and the LH exhaust manifold. Discard the nuts.





10.

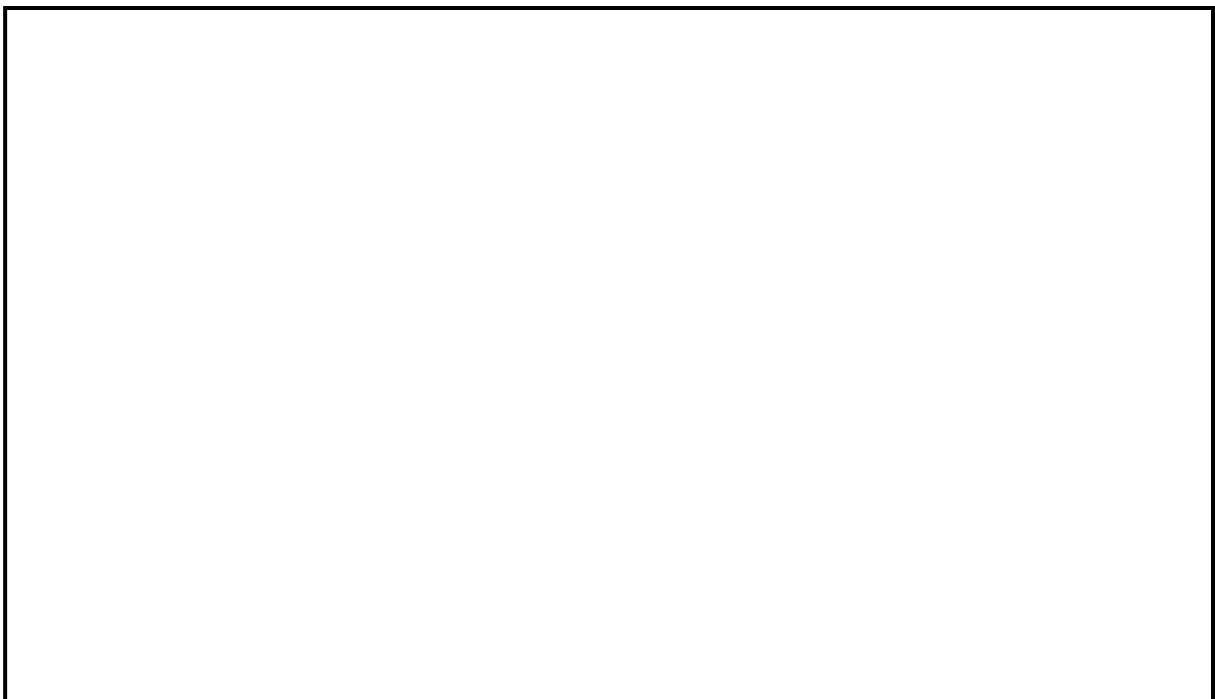
- Remove and discard the LH exhaust manifold gasket.
- Inspect the exhaust manifold studs. Replace as necessary.

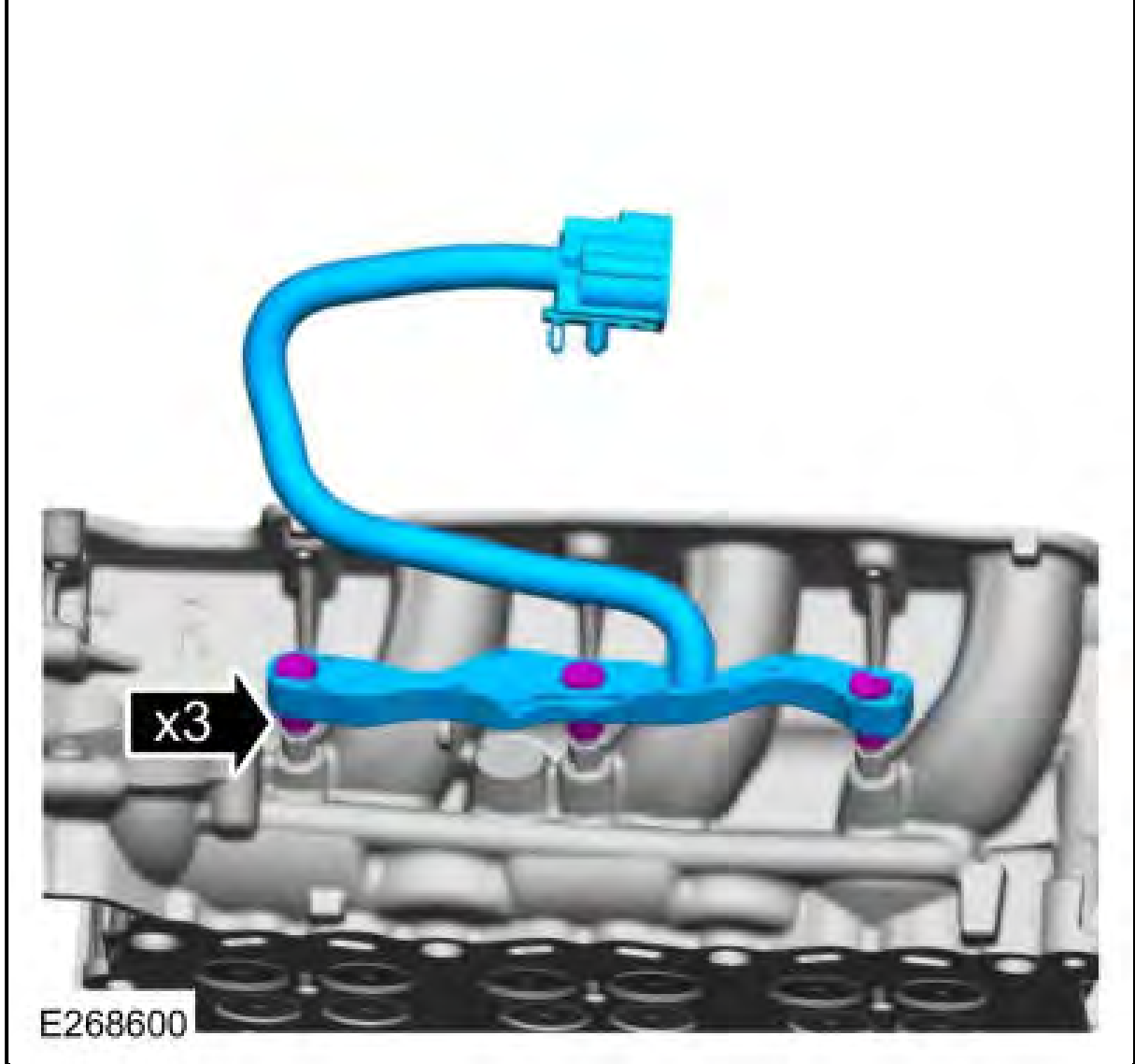


11. Clean and inspect the exhaust manifold. Refer to: [Exhaust Manifold Cleaning and Inspection](#) .

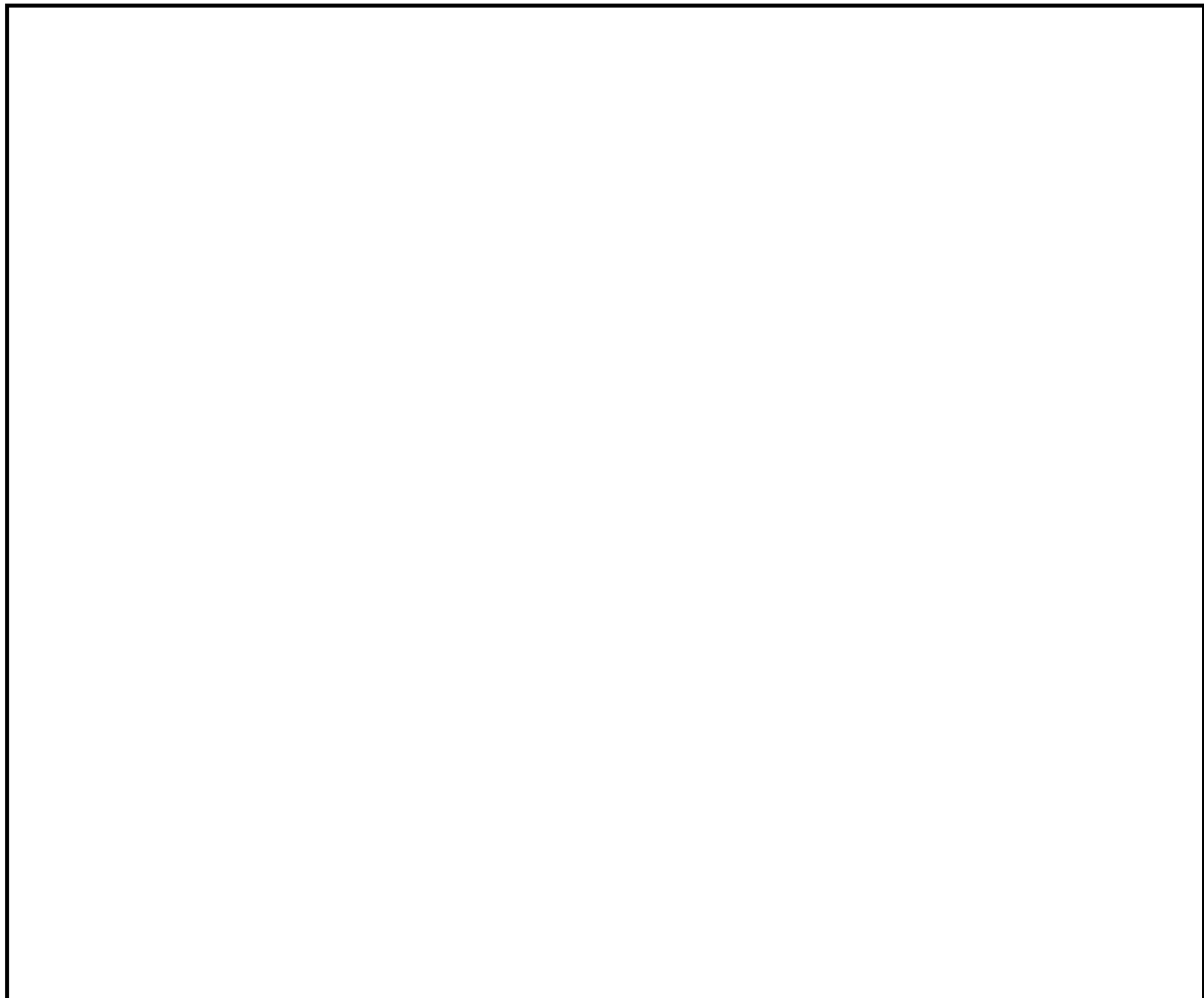
### **RH cylinder head**

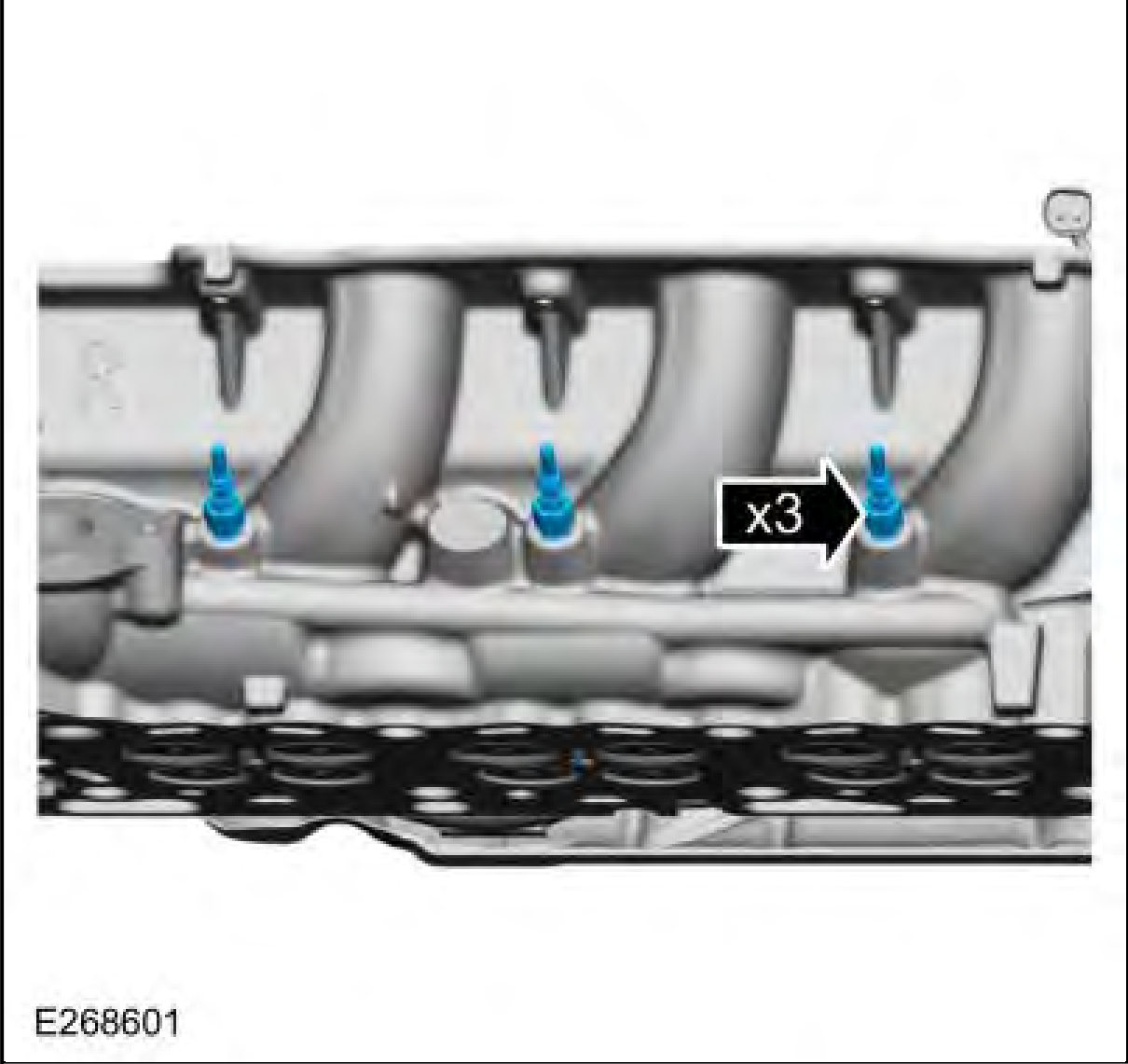
12. Disconnect and remove the RH glow plug harness.





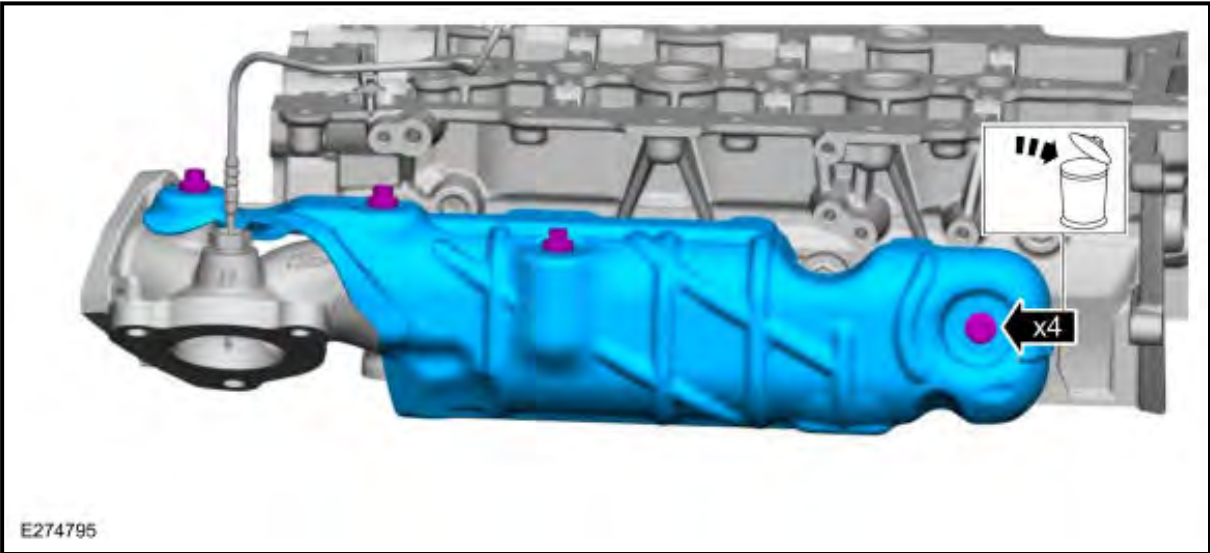
13. Remove the RH glow plugs.





E268601

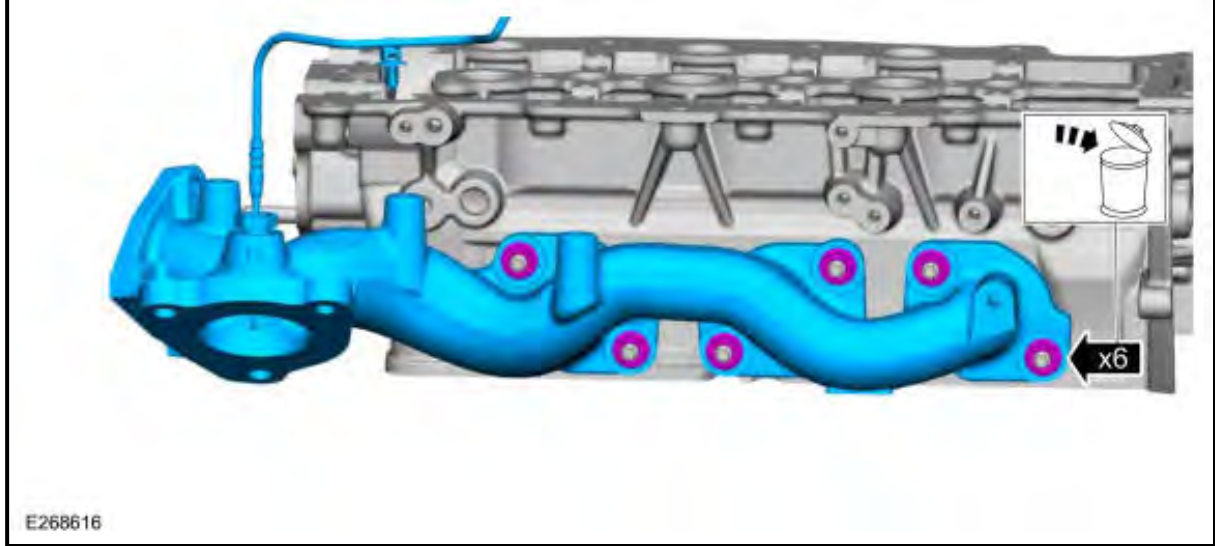
14. Remove the bolts and the RH exhaust manifold heat shield. Discard the bolts.



E274795

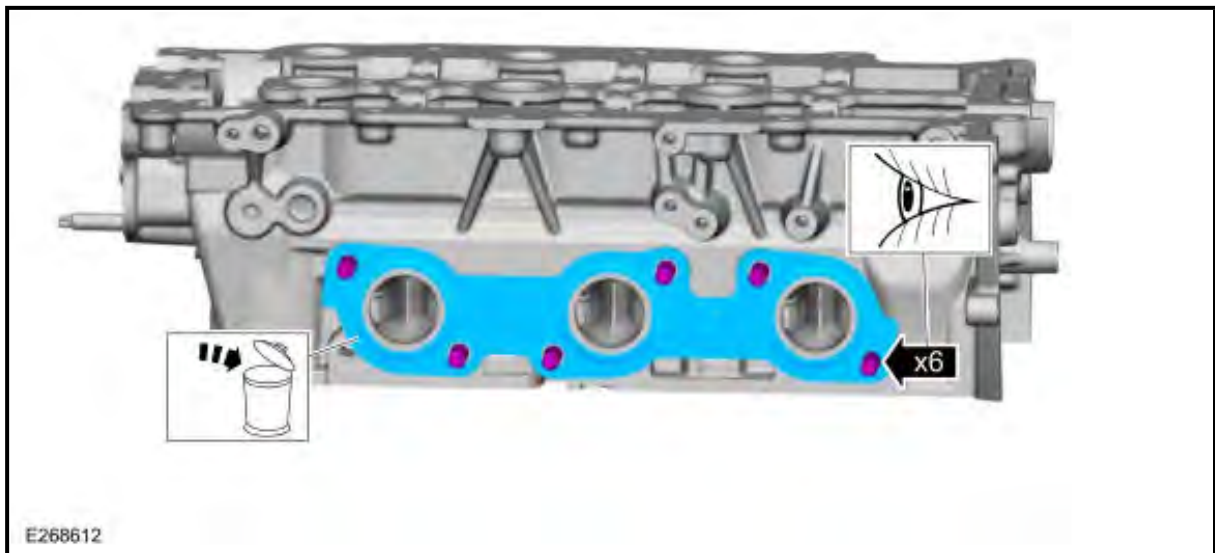
15. Remove the nuts and the RH exhaust manifold. Discard the nuts.





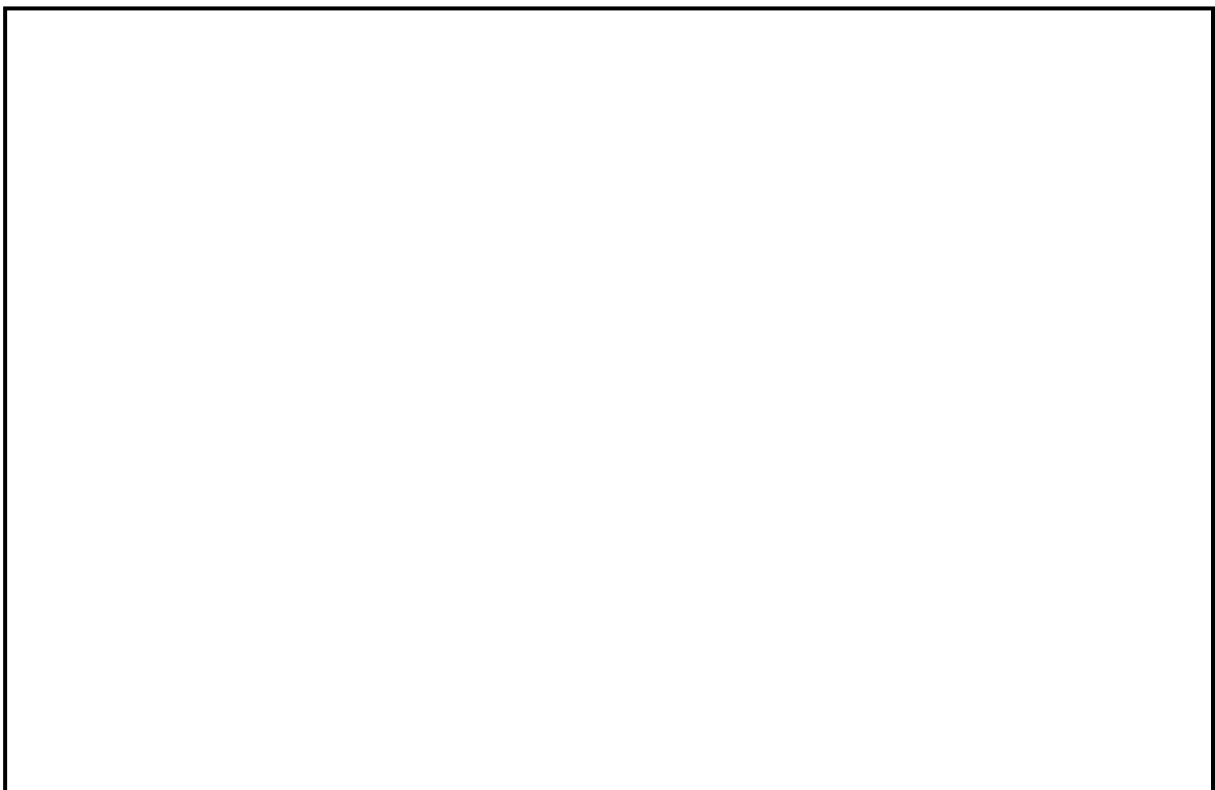
16.

- Remove and discard the RH exhaust manifold gasket.
- Inspect the exhaust manifold studs. Replace as necessary.

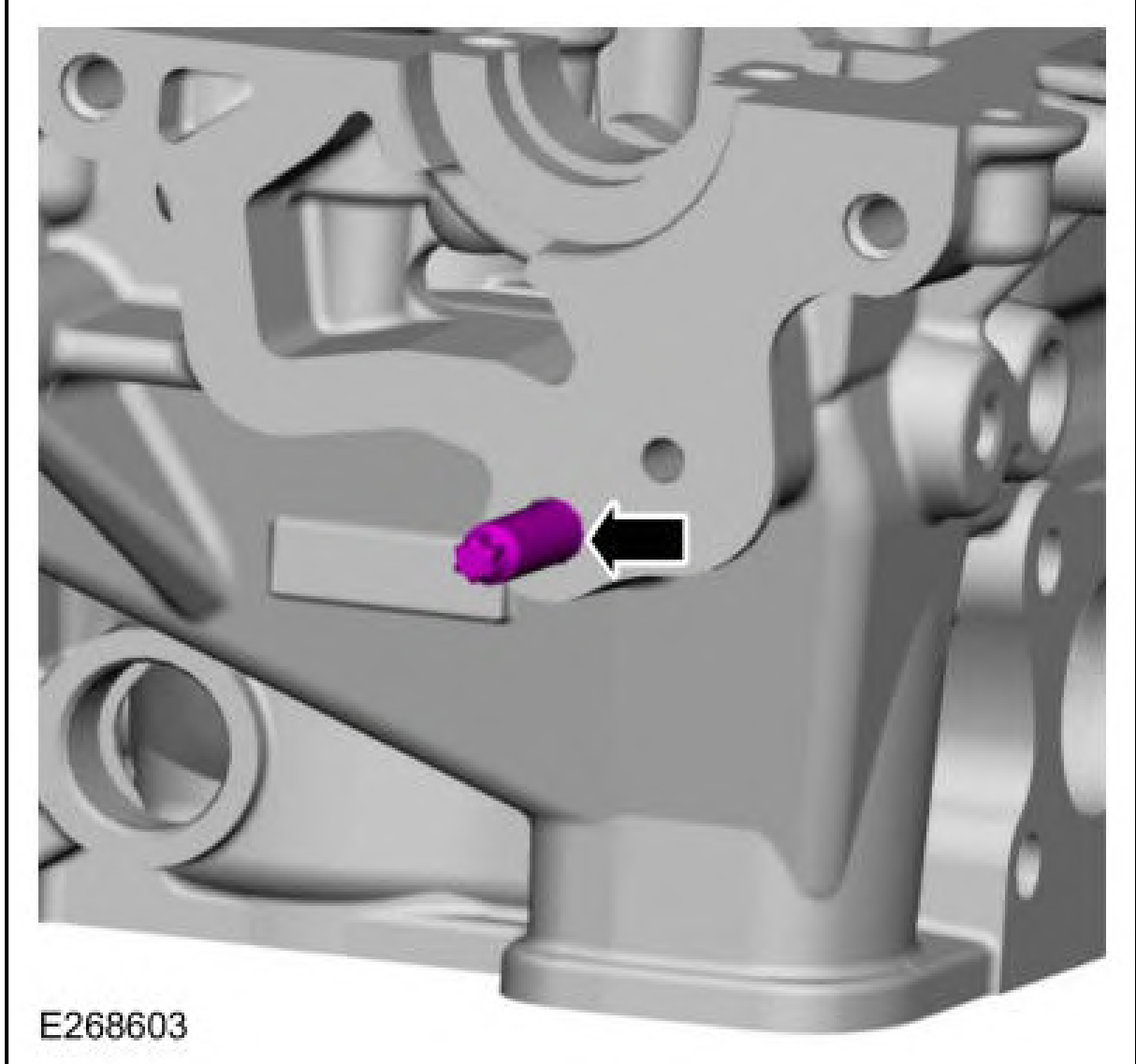


17. Clean and inspect the exhaust manifold. Refer to: [Exhaust Manifold Cleaning and Inspection](#) .

18. Remove the vacuum pump stud.







All cylinder heads

19. **NOTE:** LH shown, RH similar.

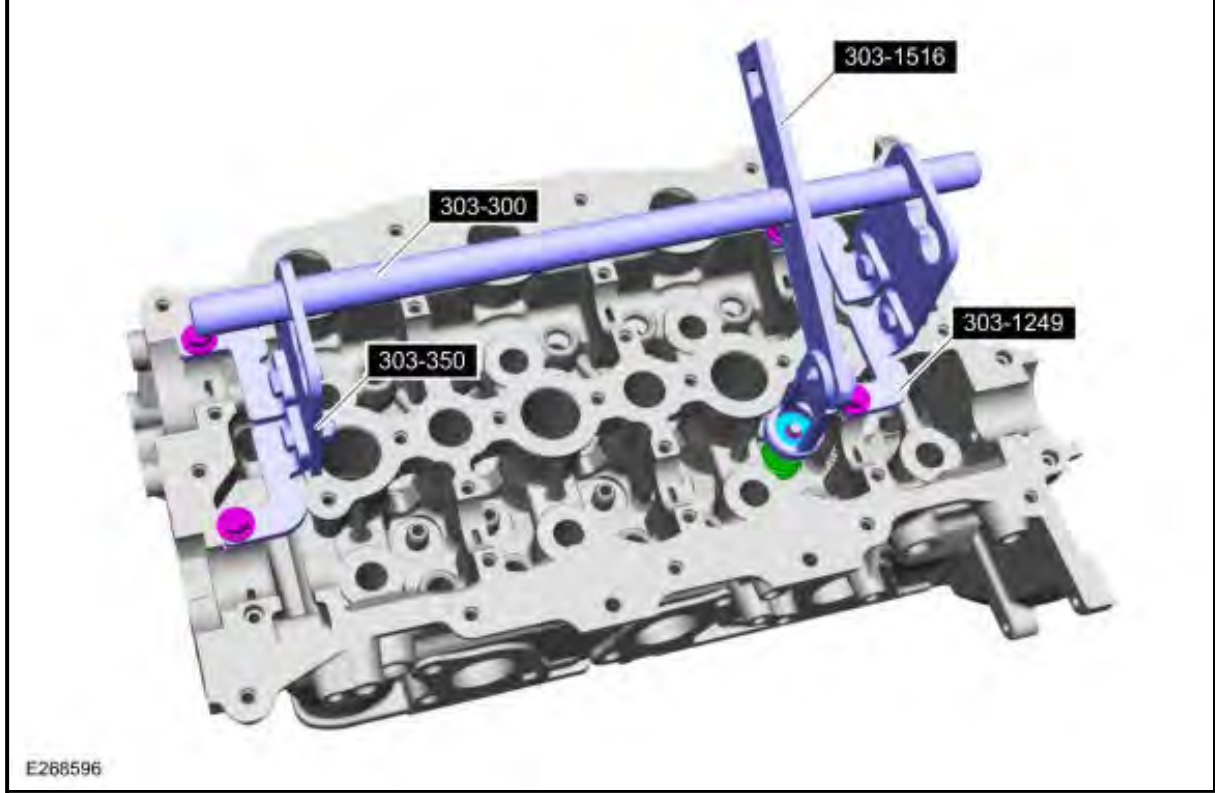
**NOTE:** If the components are to be reinstalled, they must be installed in the same positions. Mark the components for installation into their original locations.

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

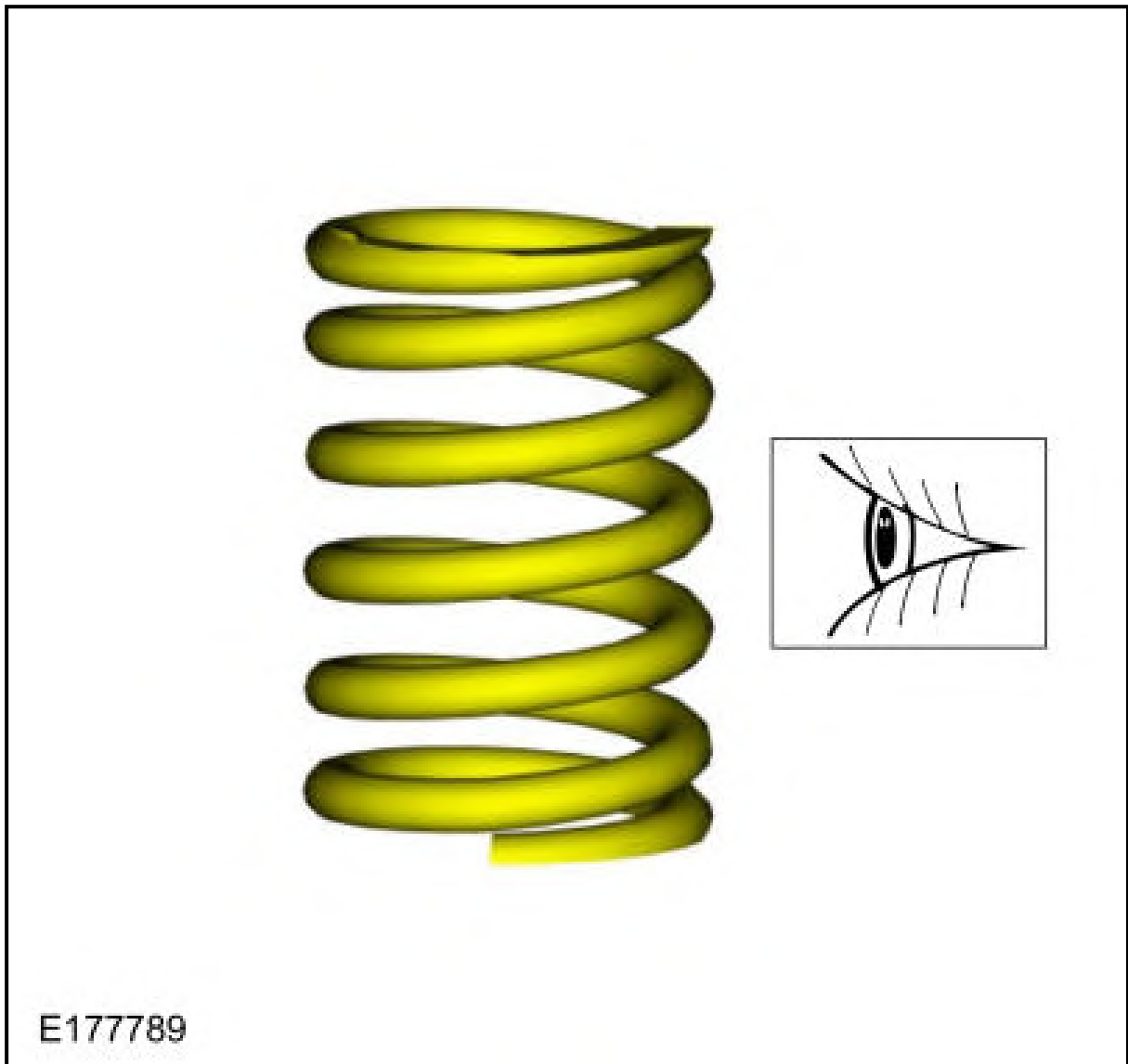
Using the special tools, remove the valve collet, valve spring retainer and the valve spring. Use Special Service Tool: 303-300 (T87C-6565-A) Set, Valve Spring Compressor., 303-350 (T89P-6565-A) Compressor, Valve Spring., 303-1249 Valve Spring Compressor., 303-1516 Compressor, Valve Spring.

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





20. Inspect and install new parts as necessary.

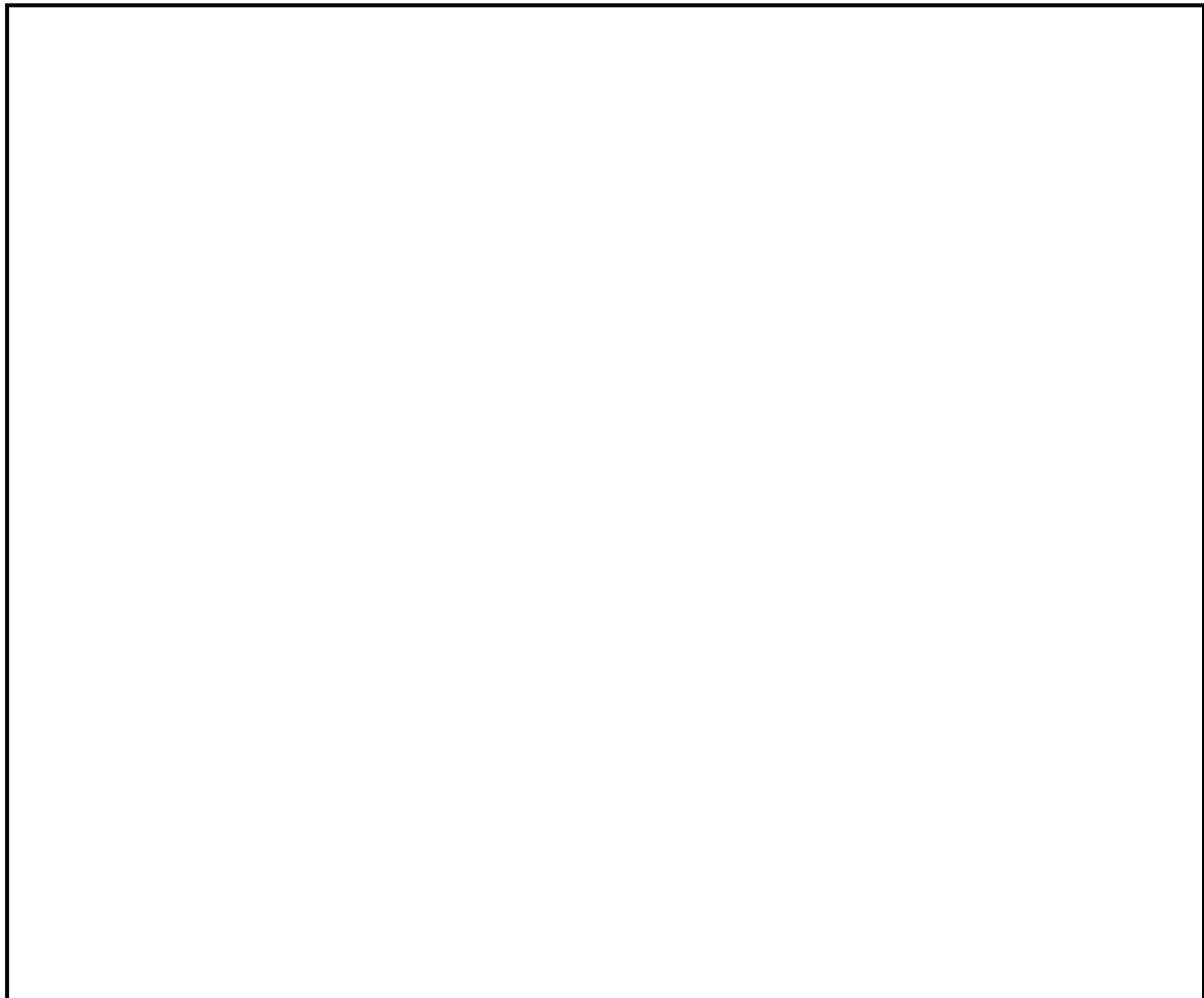


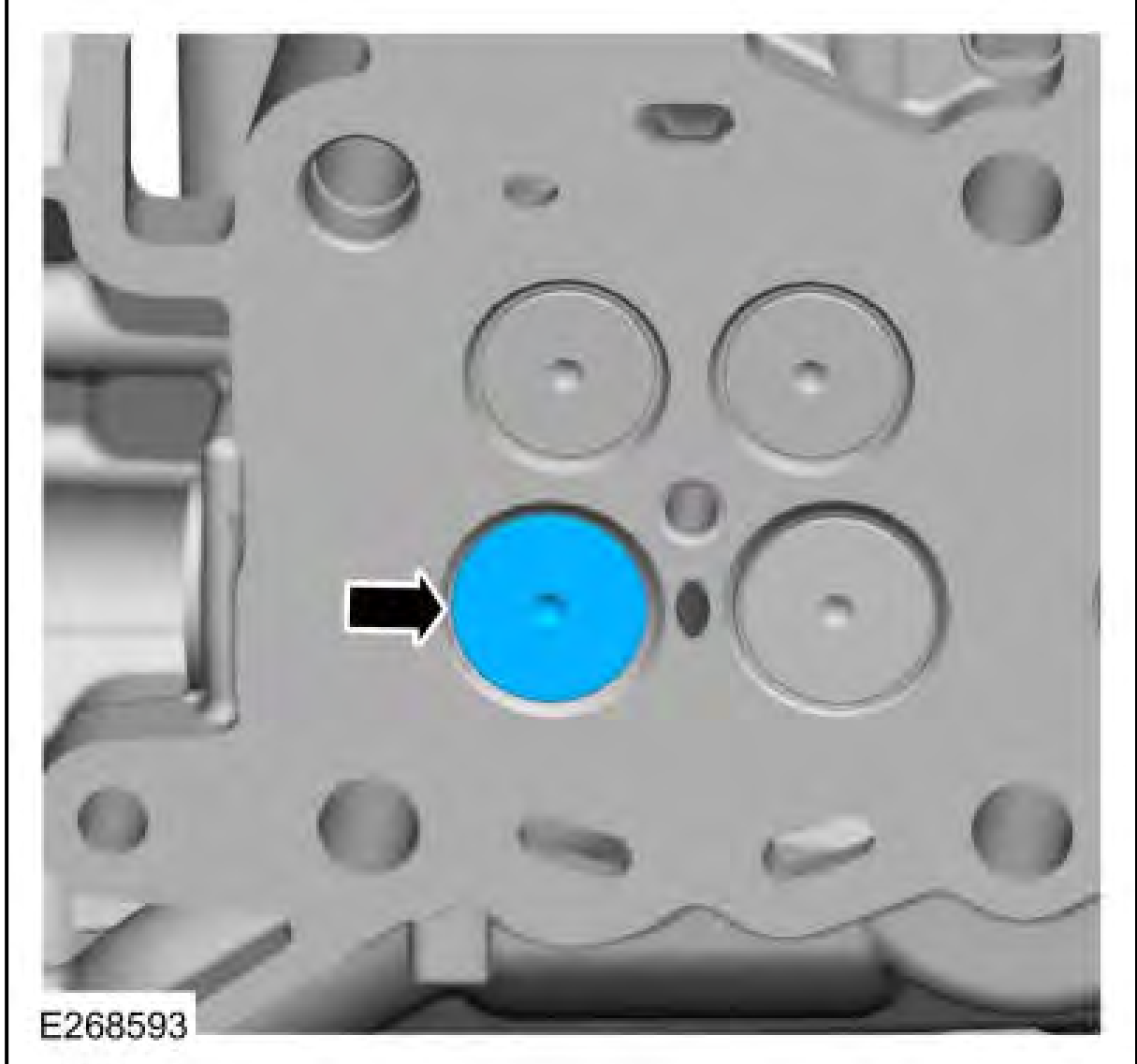
21. **NOTE:** Use commercially available valve stem seal pliers.

Remove and discard the valve stem seal.



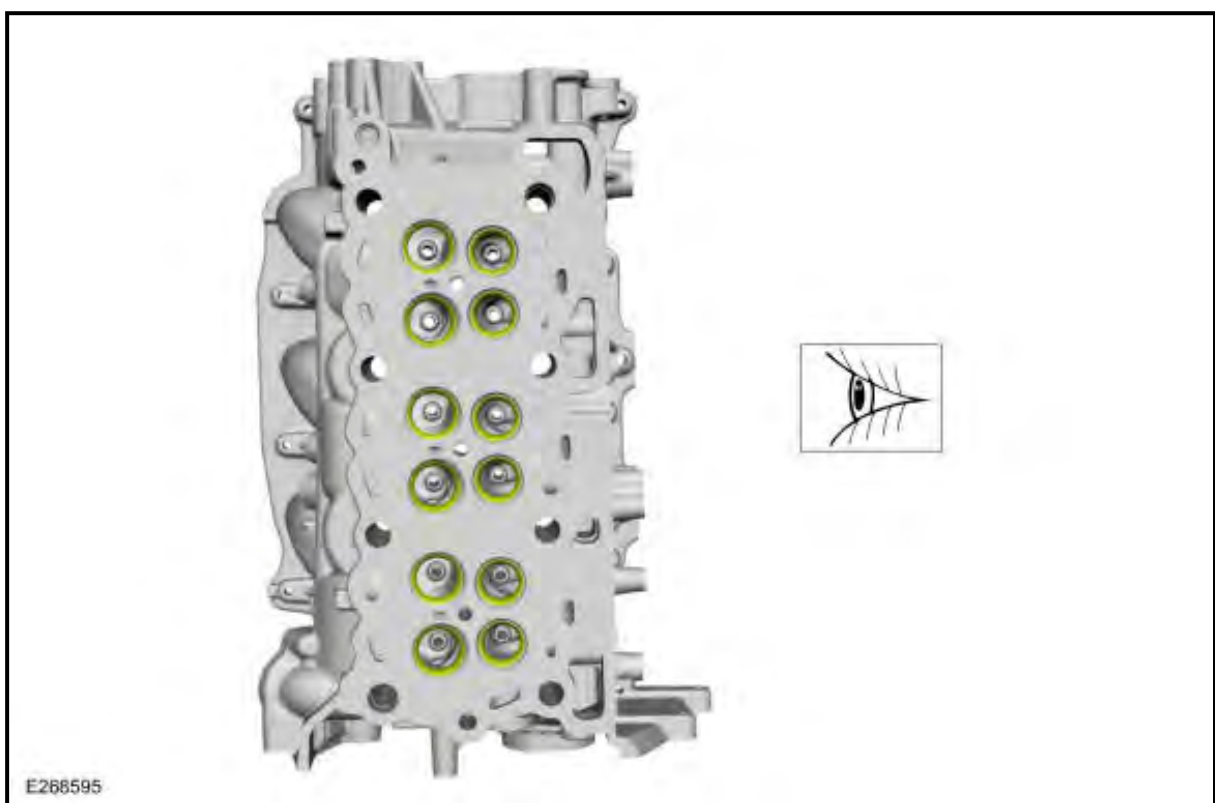
22. Remove the valve from the cylinder head.





23. Repeat the previous 3 steps for each valve.

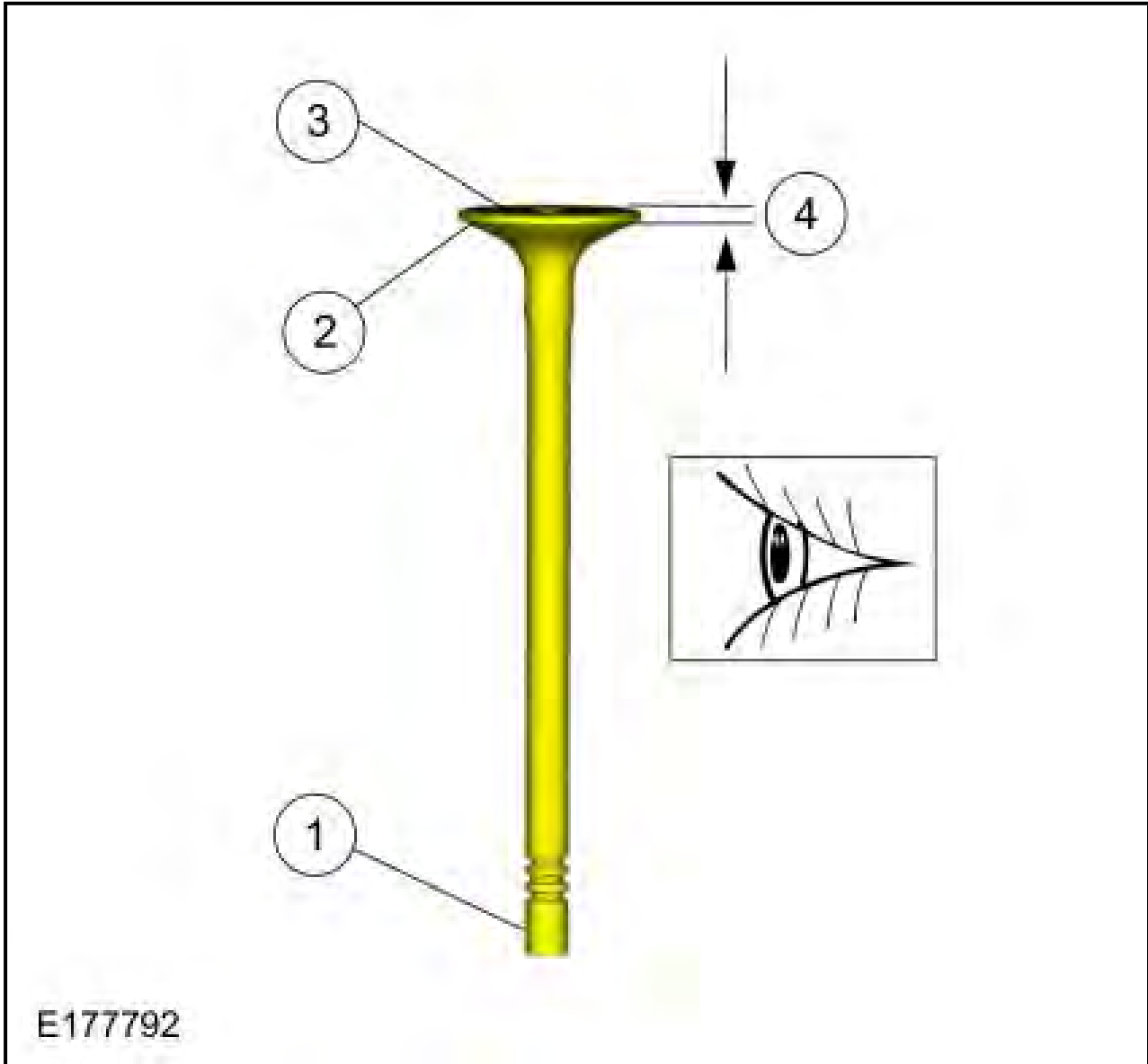
24. Inspect the intake and exhaust valve guides and valve seats.



25.

1. Inspect the following valve areas: 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.
- Install new parts as necessary.



## ASSEMBLY

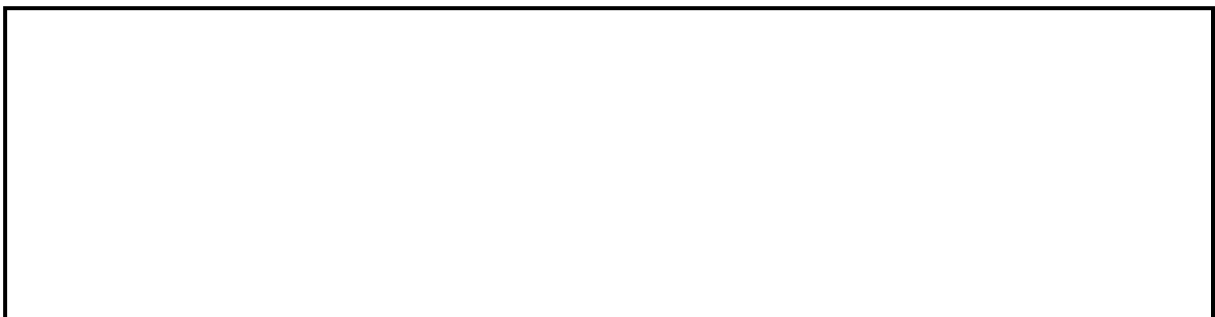
### All cylinder heads

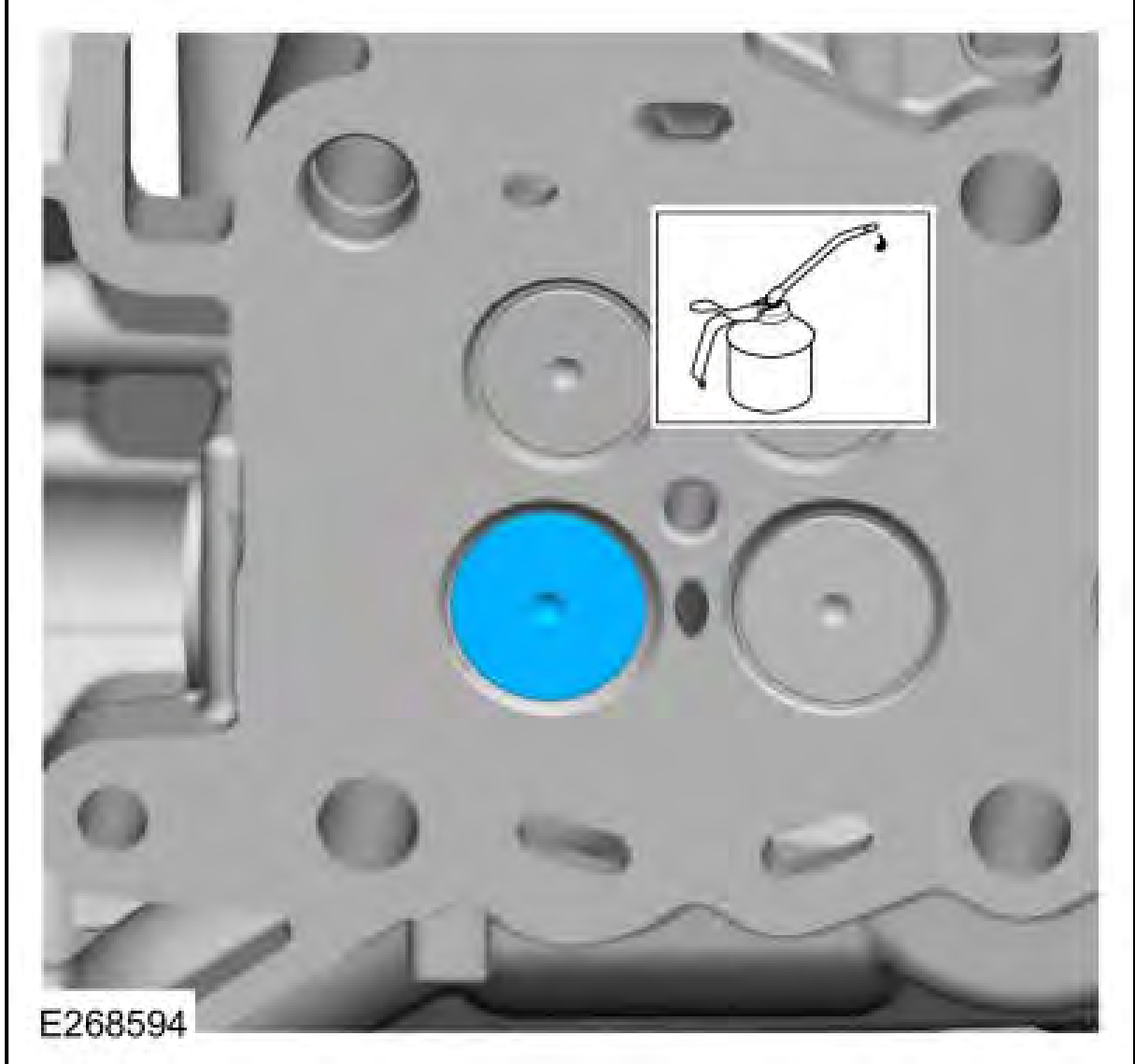
1. **NOTE:** If installing the original valves, make sure the valves are installed in the same position from which they were removed. Coat the valve stems with clean engine oil.

Lubricate with clean engine oil and install the valve in the cylinder head.

Material

: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)



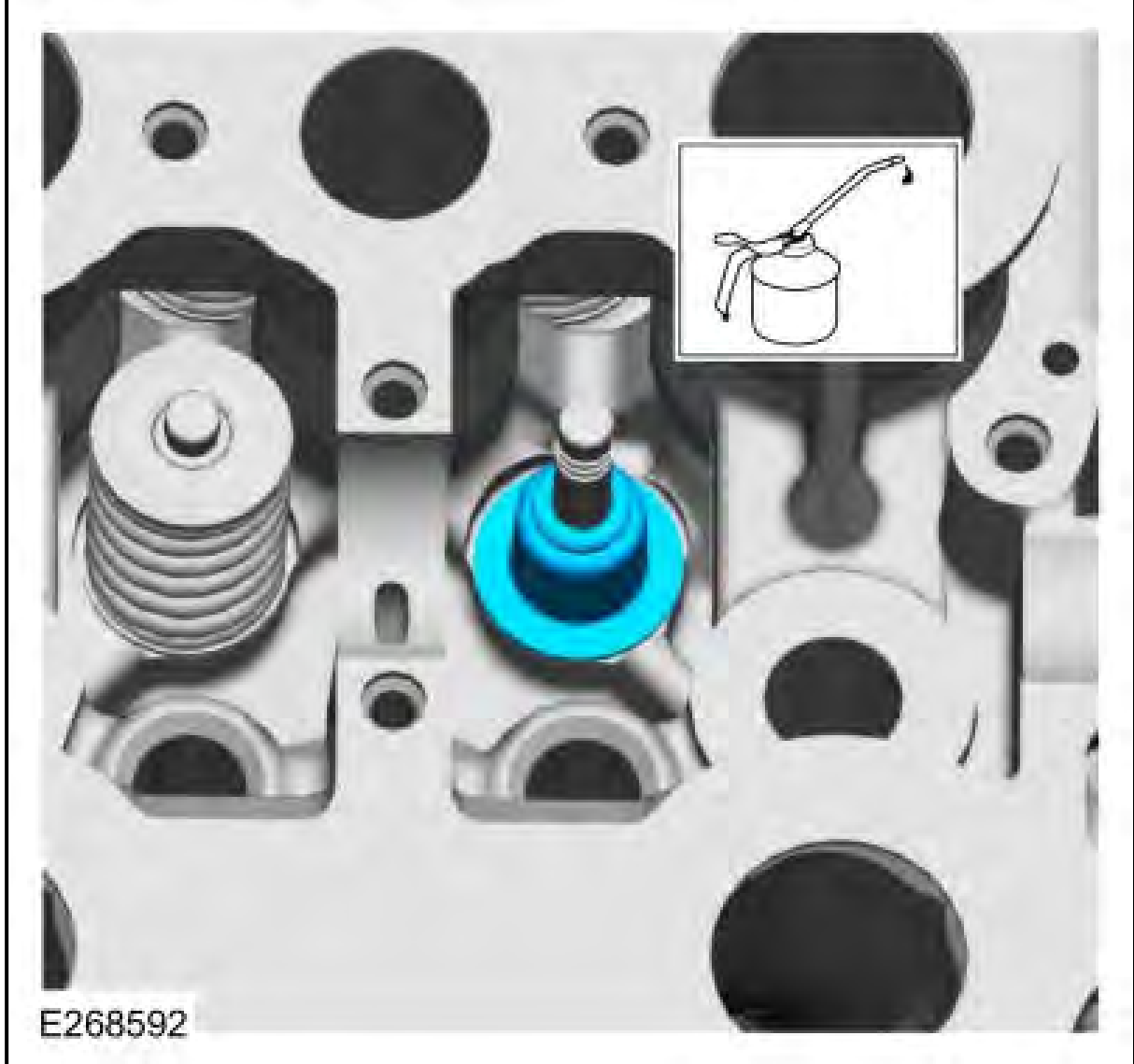


2. **NOTE:** Use commercially available valve stem seal pliers.

Lubricate with clean engine oil and install the valve seal.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

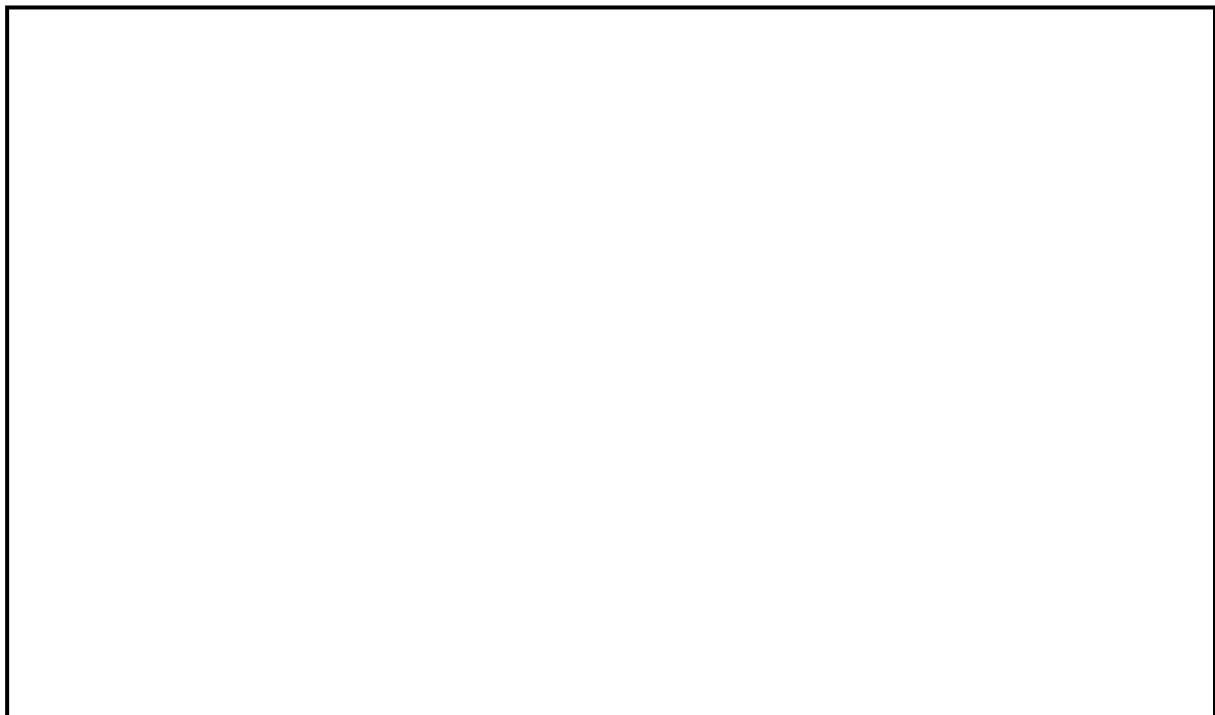


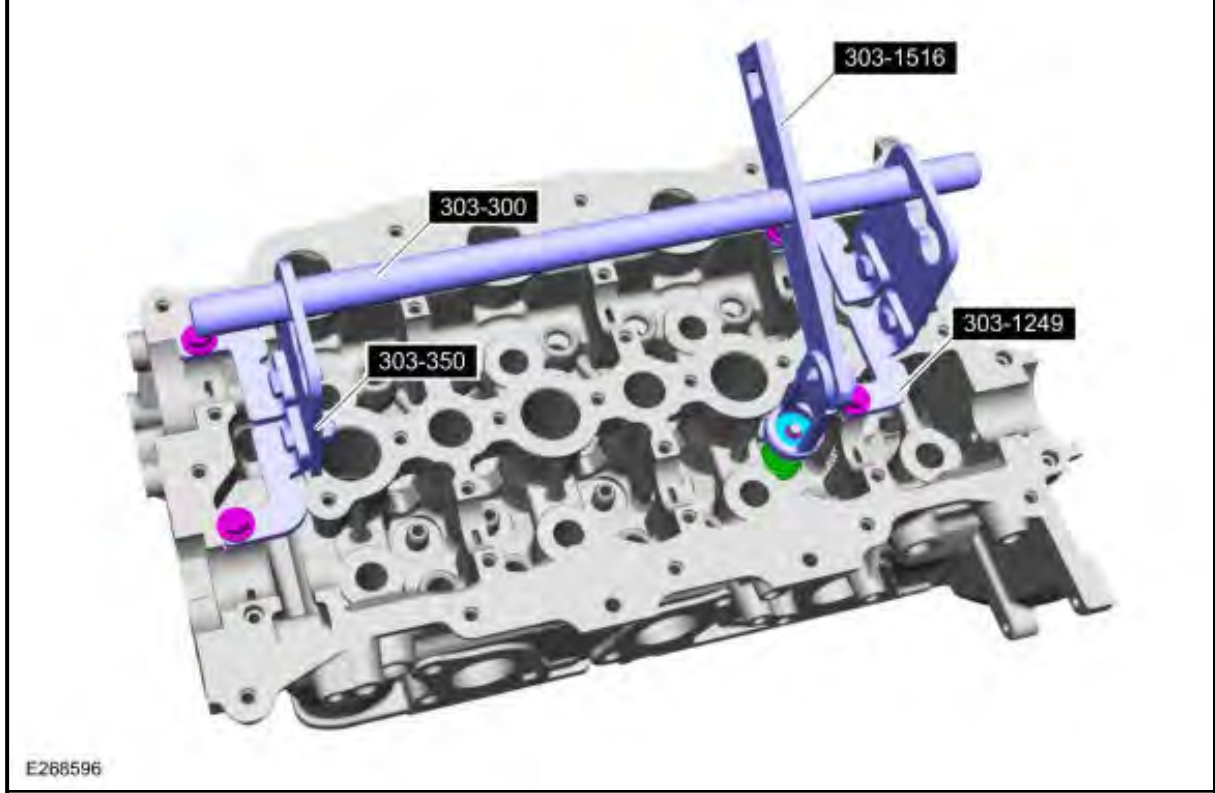


3. **NOTE:** Use a small screwdriver and multi-purpose grease to install the valve collets. Check the seating of the valve collets.

Using the special tools, install the valve spring, valve spring retainer and the valve collet. Use Special Service Tool: 303-300 (T87C-6565-A) Set, Valve Spring Compressor., 303-350 (T89P-6565-A) Compressor, Valve Spring., 303-1249 Valve Spring Compressor., 303-1516 Compressor, Valve Spring.

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



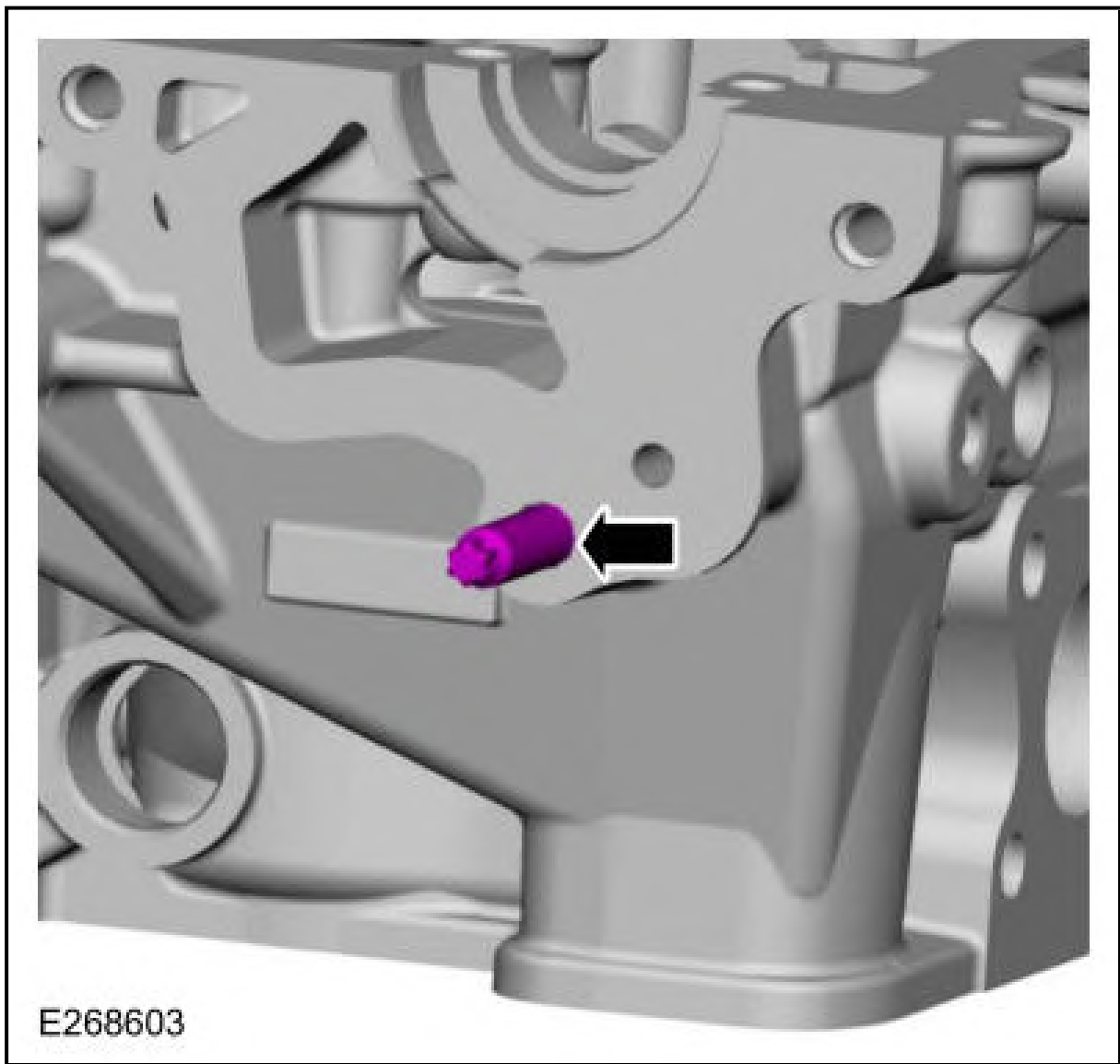


4. Repeat the previous 3 steps for each valve.

#### **RH cylinder head**

5. Install the vacuum pump stud.

Torque: 115 lb.in (13 Nm)



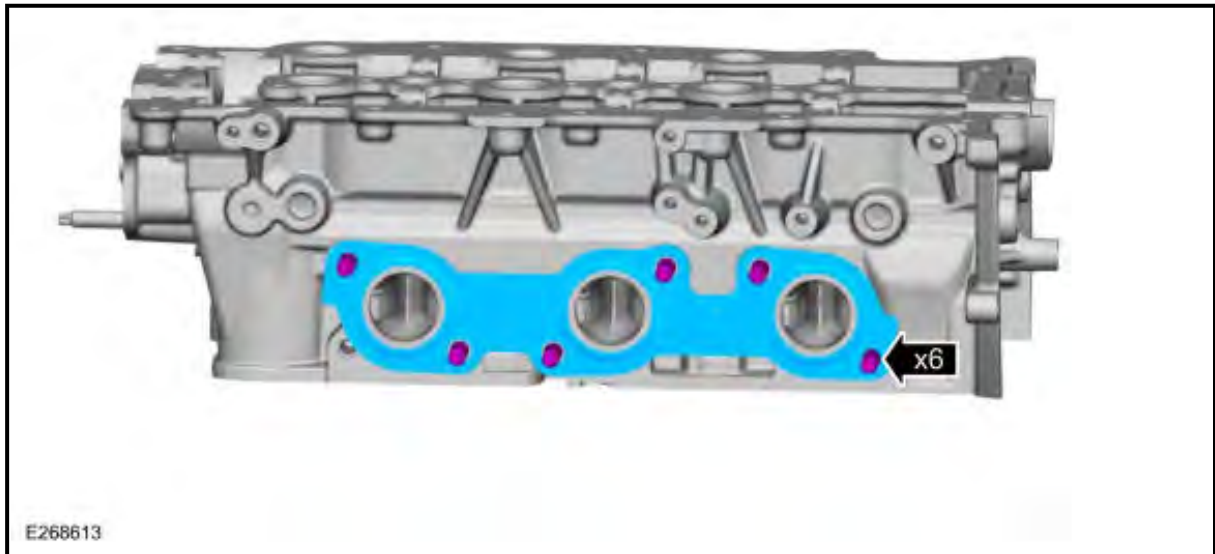


6.

- Install the exhaust manifold studs as needed.

Torque: 115 lb.in (13 Nm)

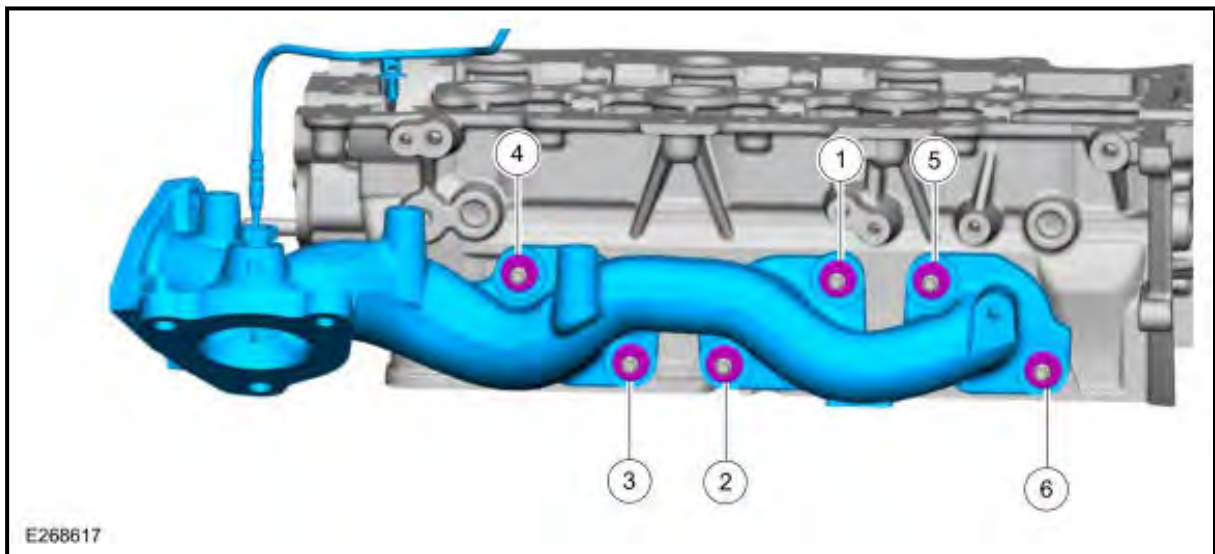
- Install the RH exhaust manifold gasket.



7. Install the RH exhaust manifold and the nuts.

Torque

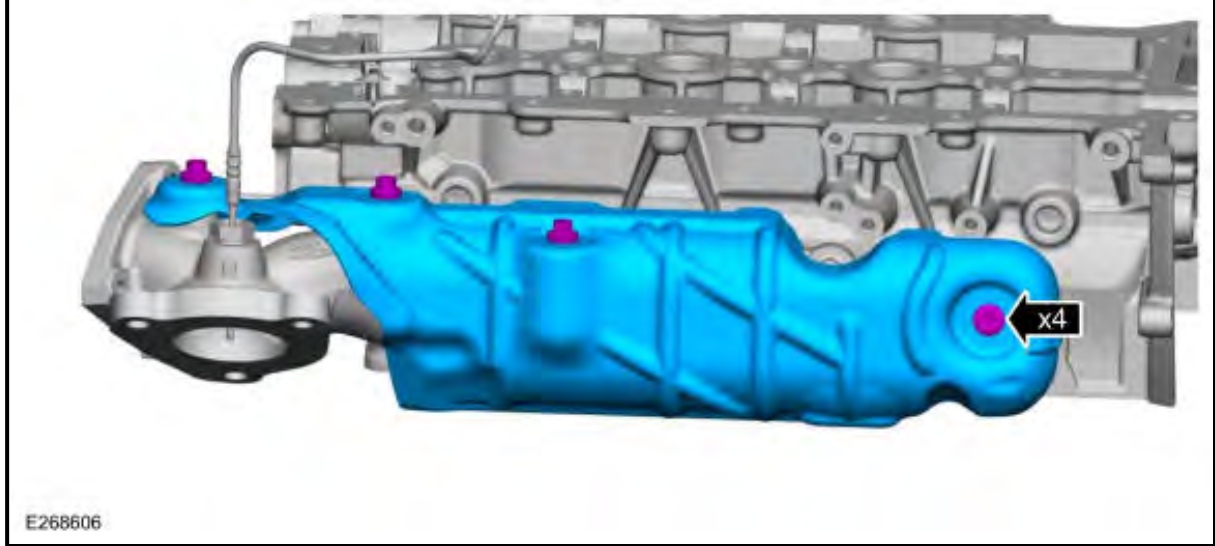
:Tighten the nuts in the sequence shown to : 21 lb.ft (28 Nm)Tighten the nuts in the following order 1, 2, 3, 5, 1, 2 to : 21 lb.ft (28 Nm)



8. Install the RH exhaust manifold heat shield and the bolts.

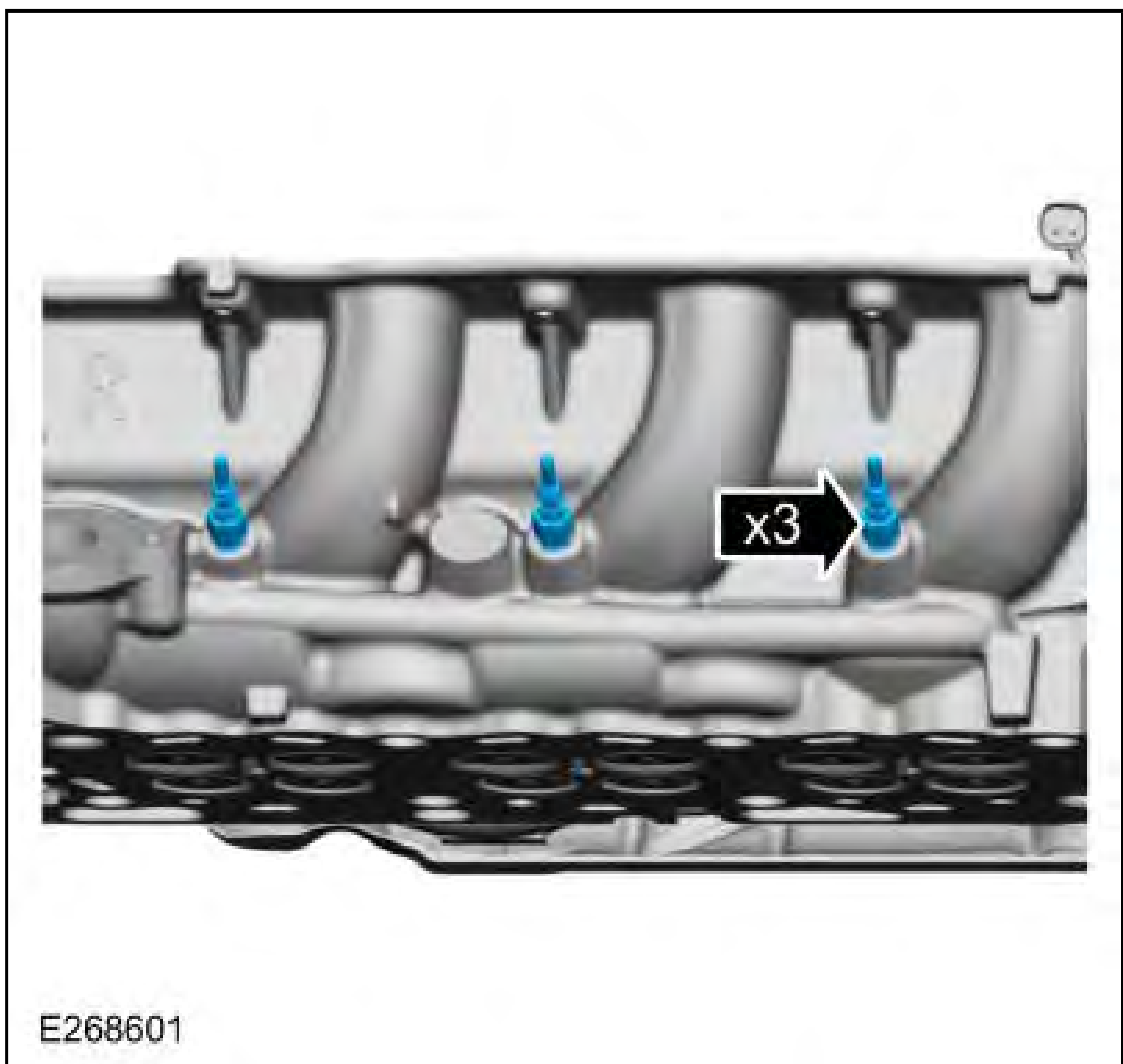
Torque: 97 lb.in (11 Nm)





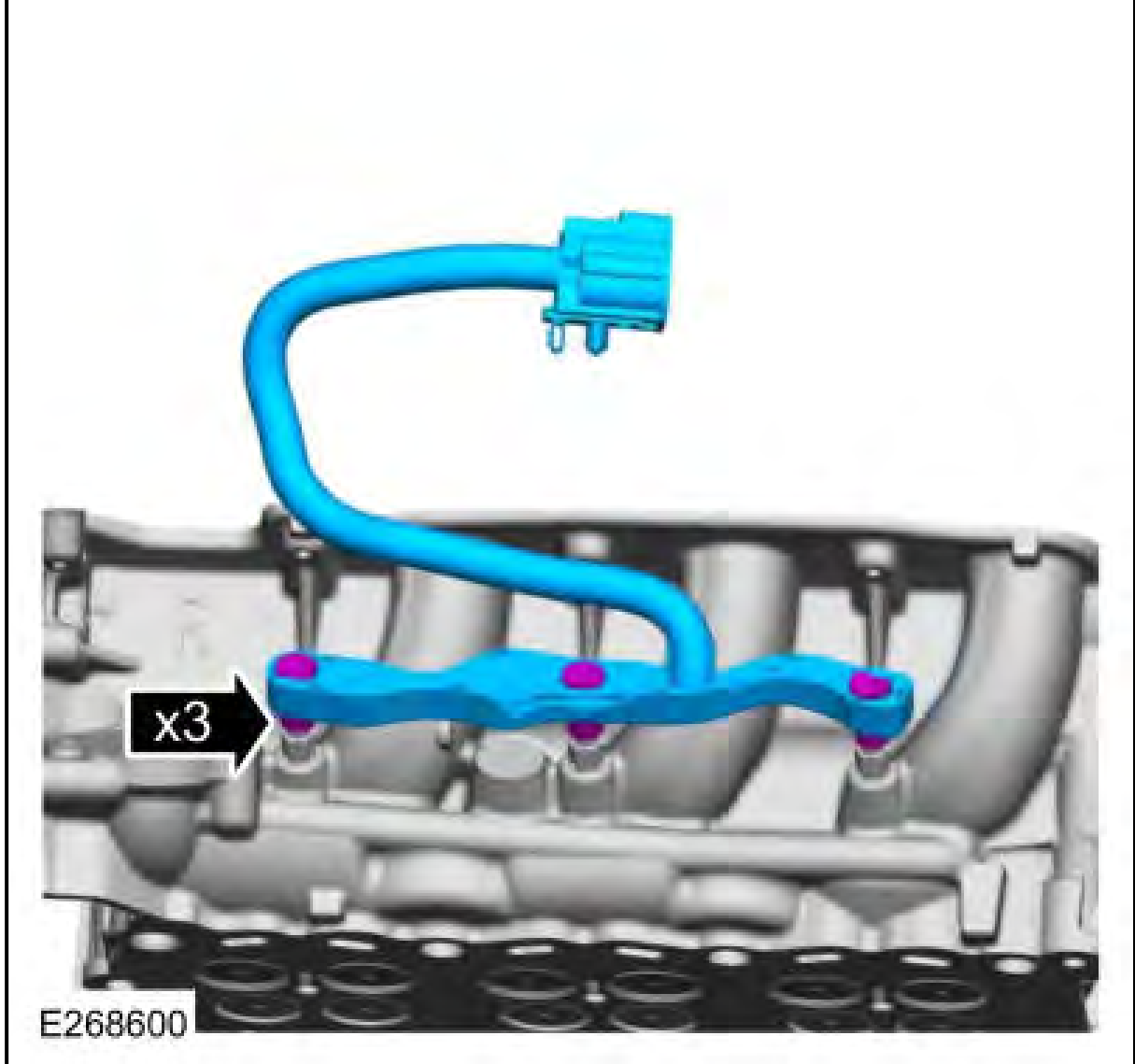
9. Install the RH glow plugs.

Torque: 97 lb.in (11 Nm)



10. Install the RH glow plug harness.





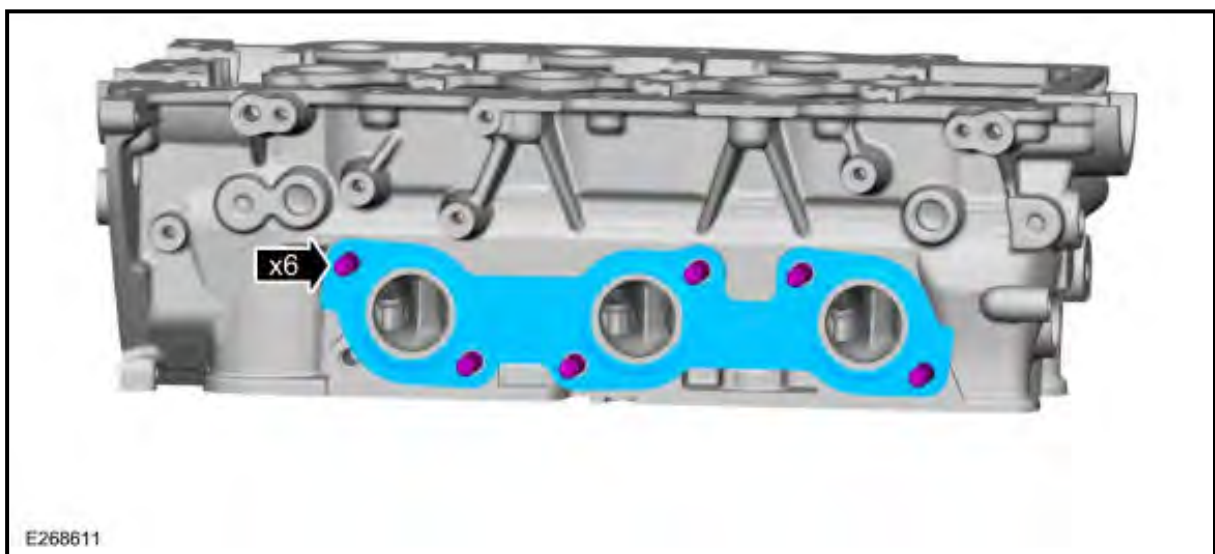
### LH cylinder head

11.

- Install the exhaust manifold studs as needed.

Torque: 115 lb.in (13 Nm)

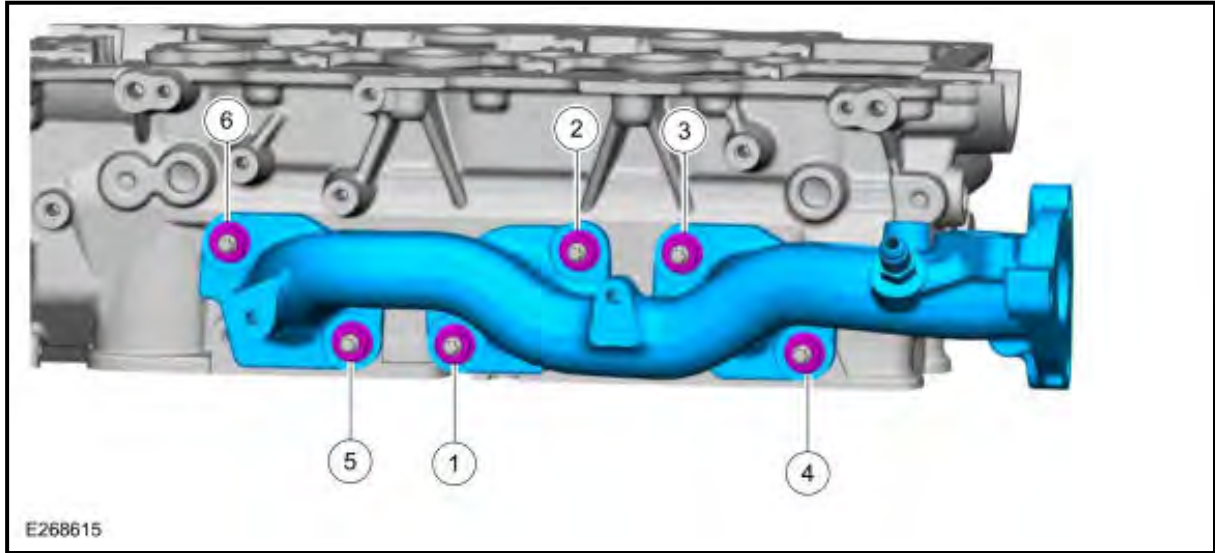
- Install the LH exhaust manifold gasket.



12. Install the LH exhaust manifold and the nuts.

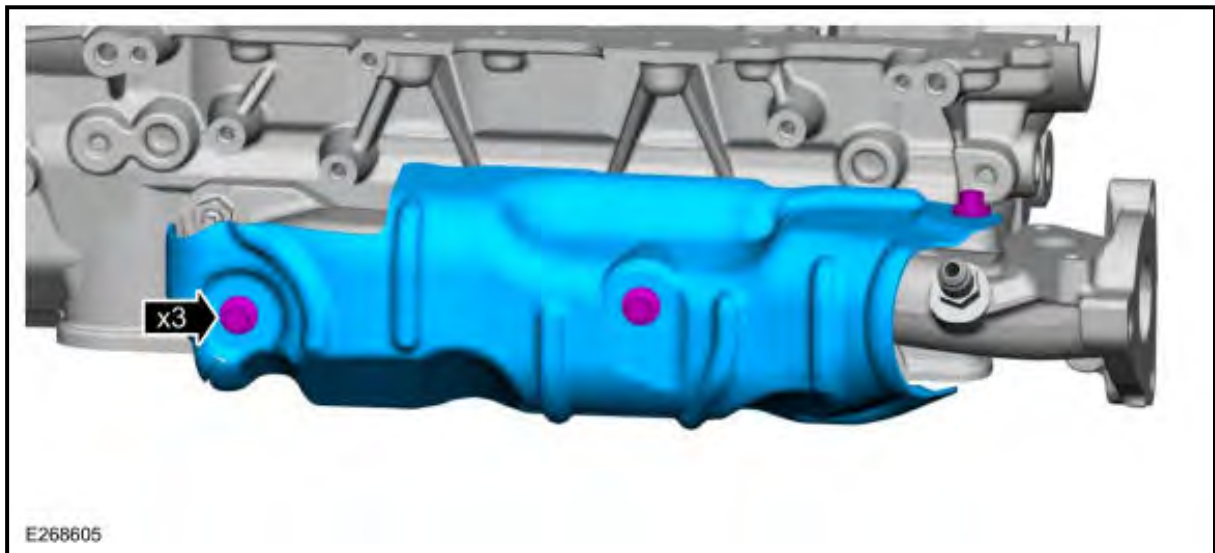
Torque

:Tighten the nuts in the sequence shown to: : 21 lb.ft (28 Nm) Tighten the nuts in the following order 1, 2, 3, 5, 1, 2 to: : 21 lb.ft (28 Nm)



13. Install the LH exhaust manifold heat shield and the bolts.

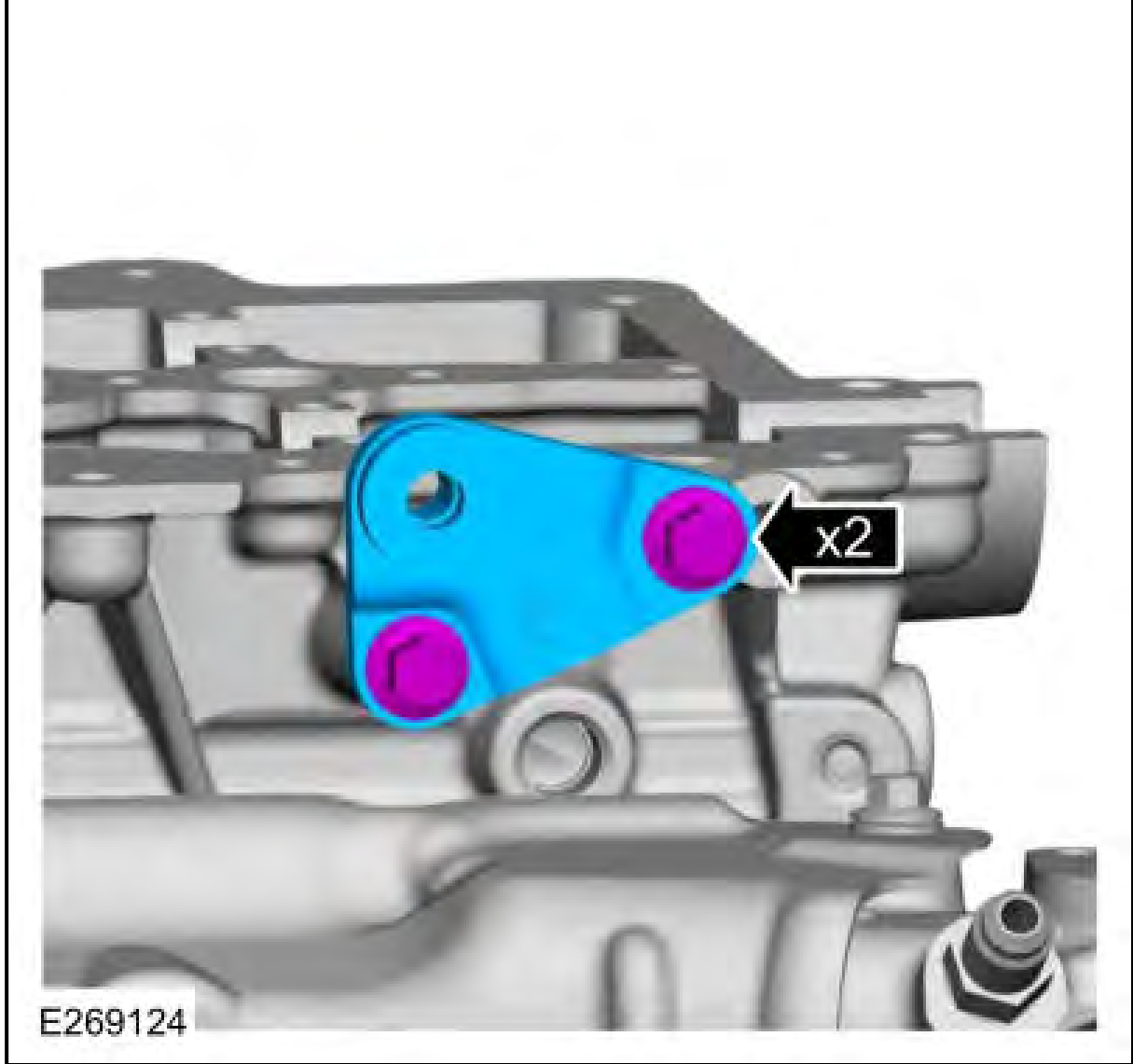
Torque: 97 lb.in (11 Nm)



14. Install the EGR cooler bracket and the bolts.

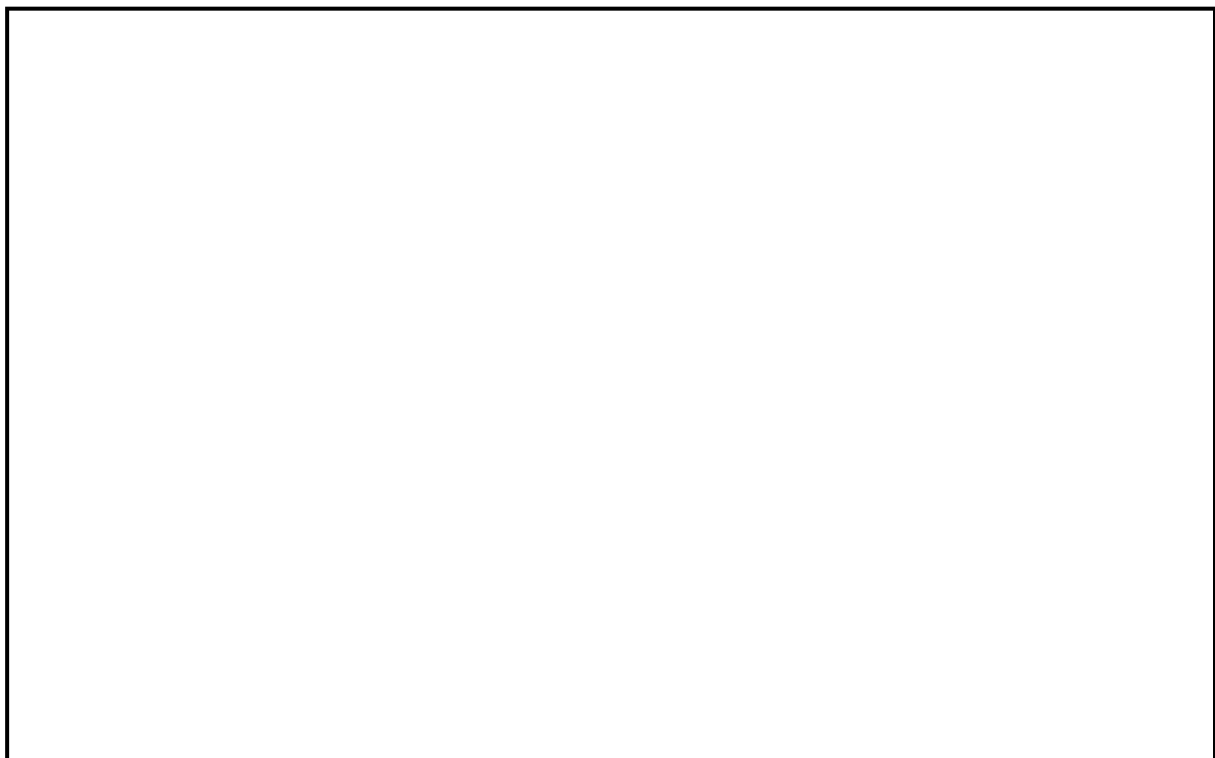
Torque: 89 lb.in (10 Nm)

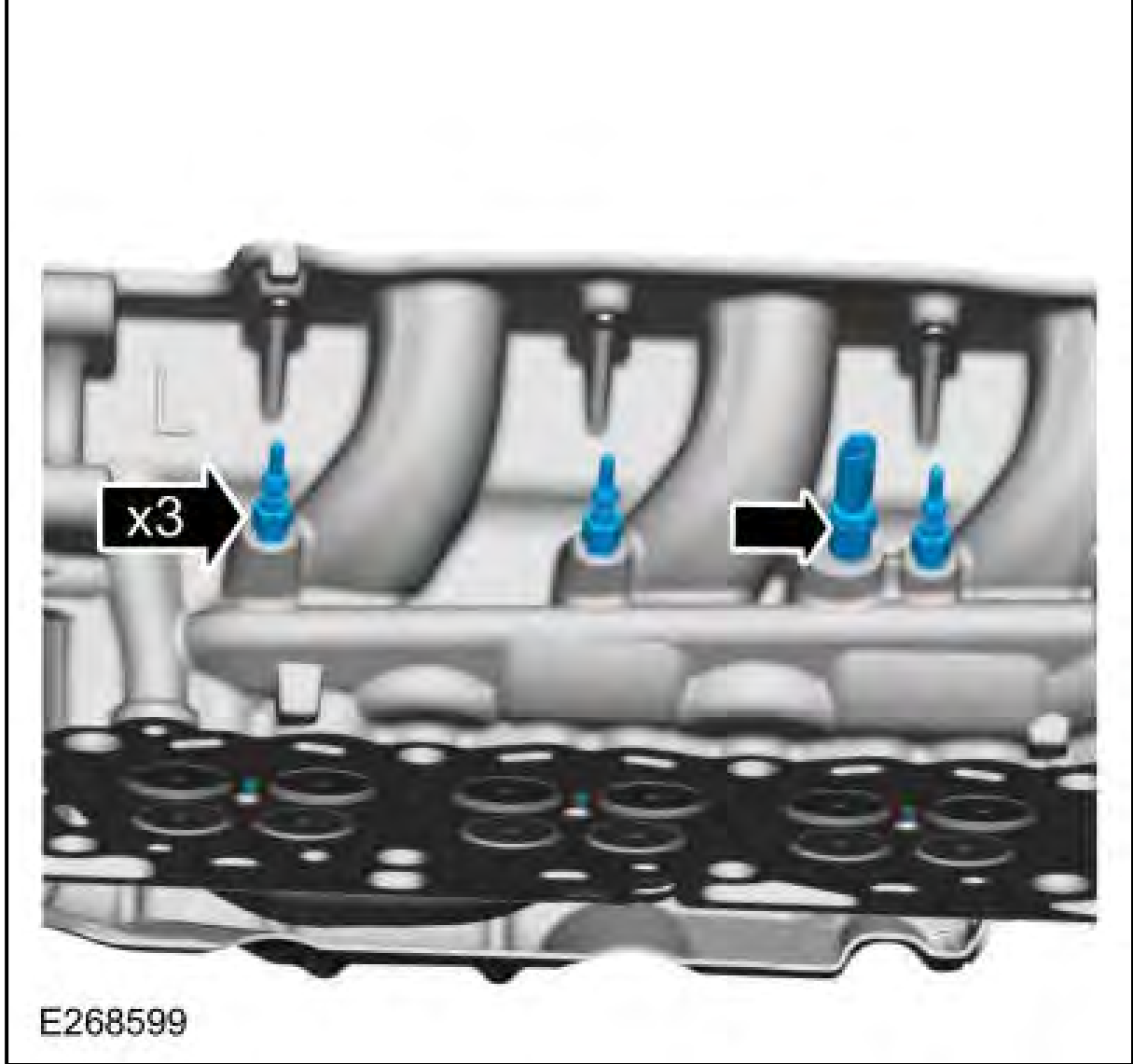




15.

- Install the new CHT sensor.  
Torque: 97 lb.in (11 Nm)
- Install the LH glow plugs.  
Torque: 97 lb.in (11 Nm)

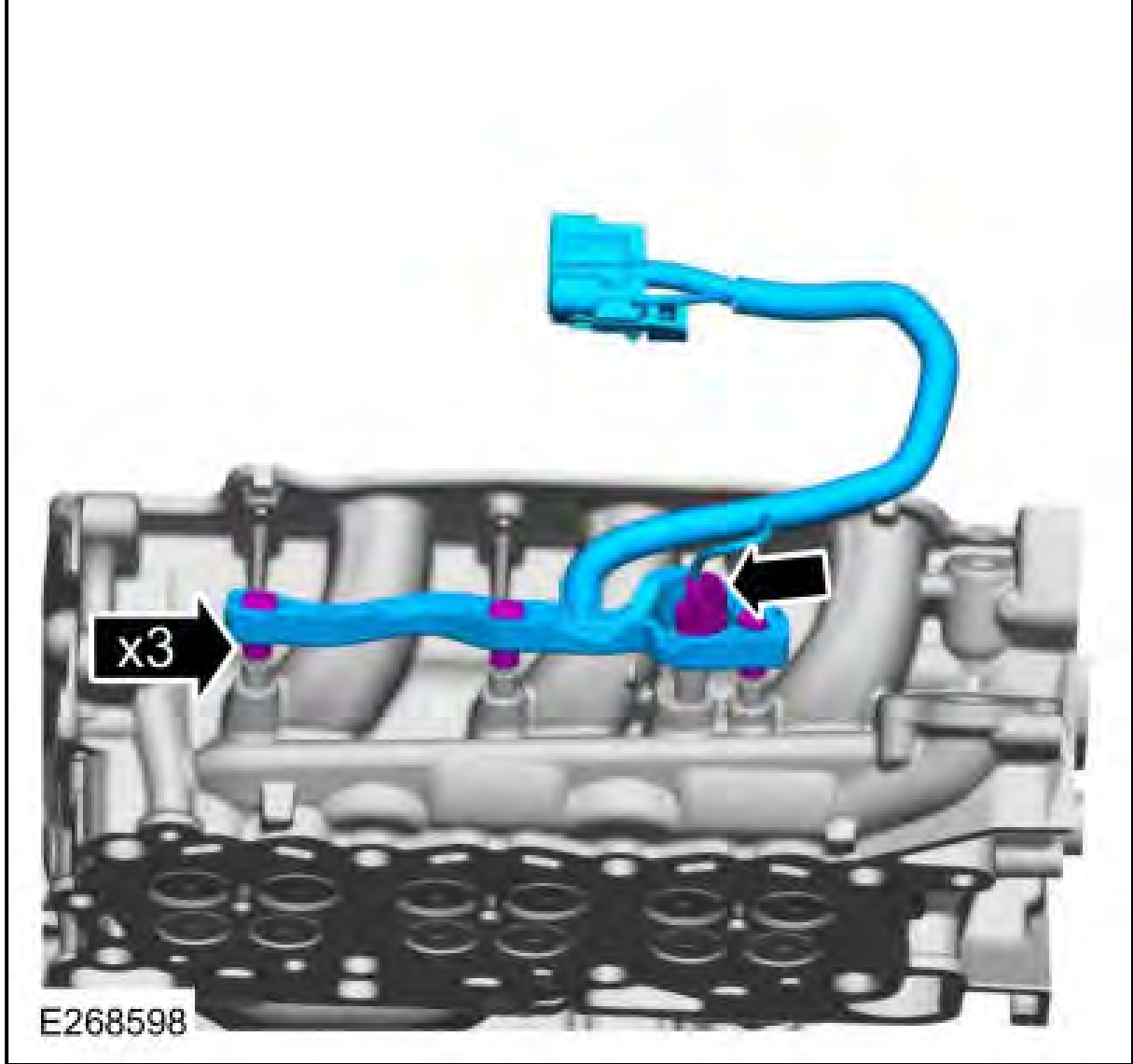




16.

- Install the LH glow plug harness.
- Connect the CHT electrical connector.

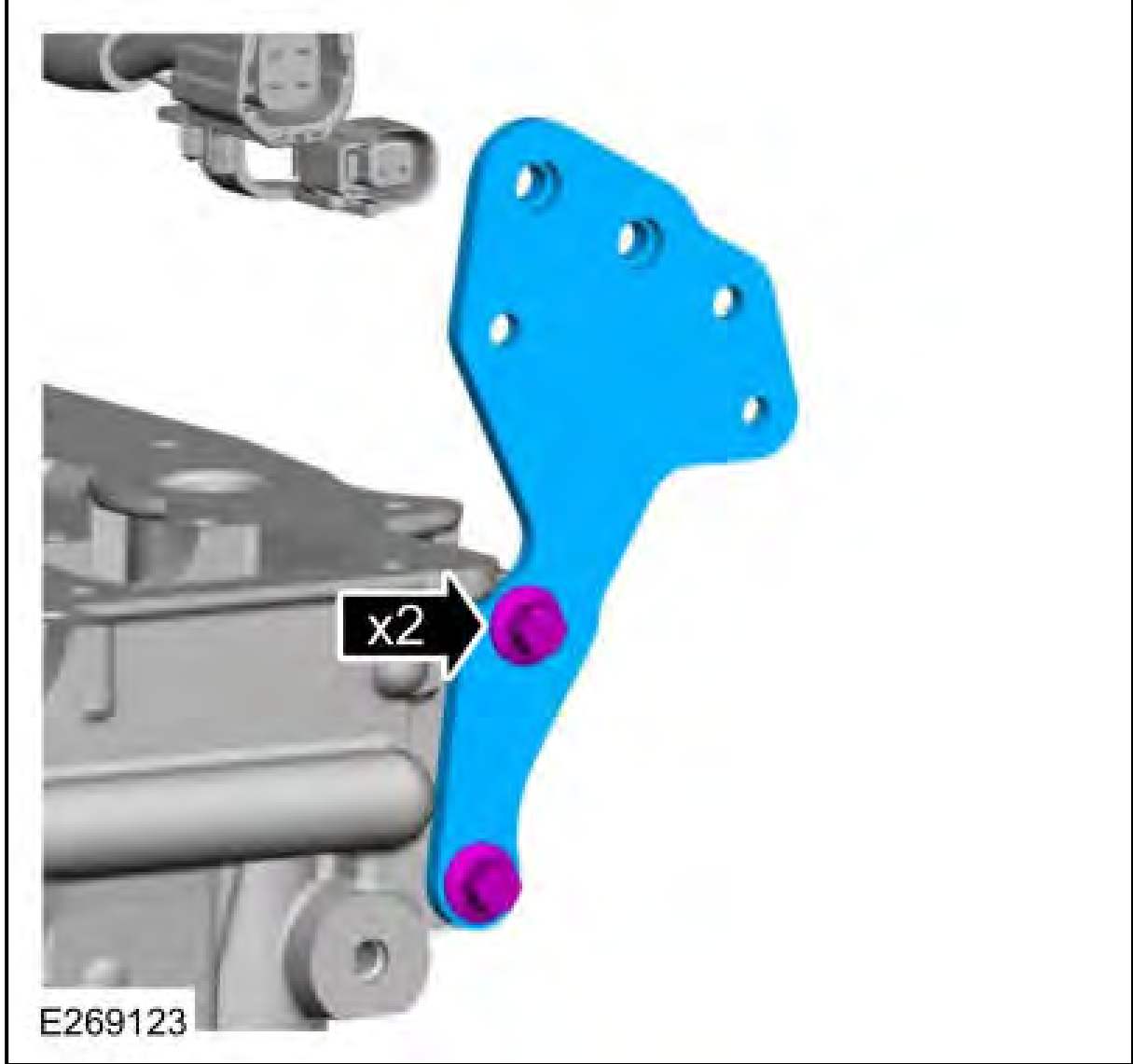




17. Install the rear lifting eye and the bolts.

Torque: 17 lb.ft (23 Nm)





18. **NOTE:** If the EOP sensor is to be reused, apply thread sealant.

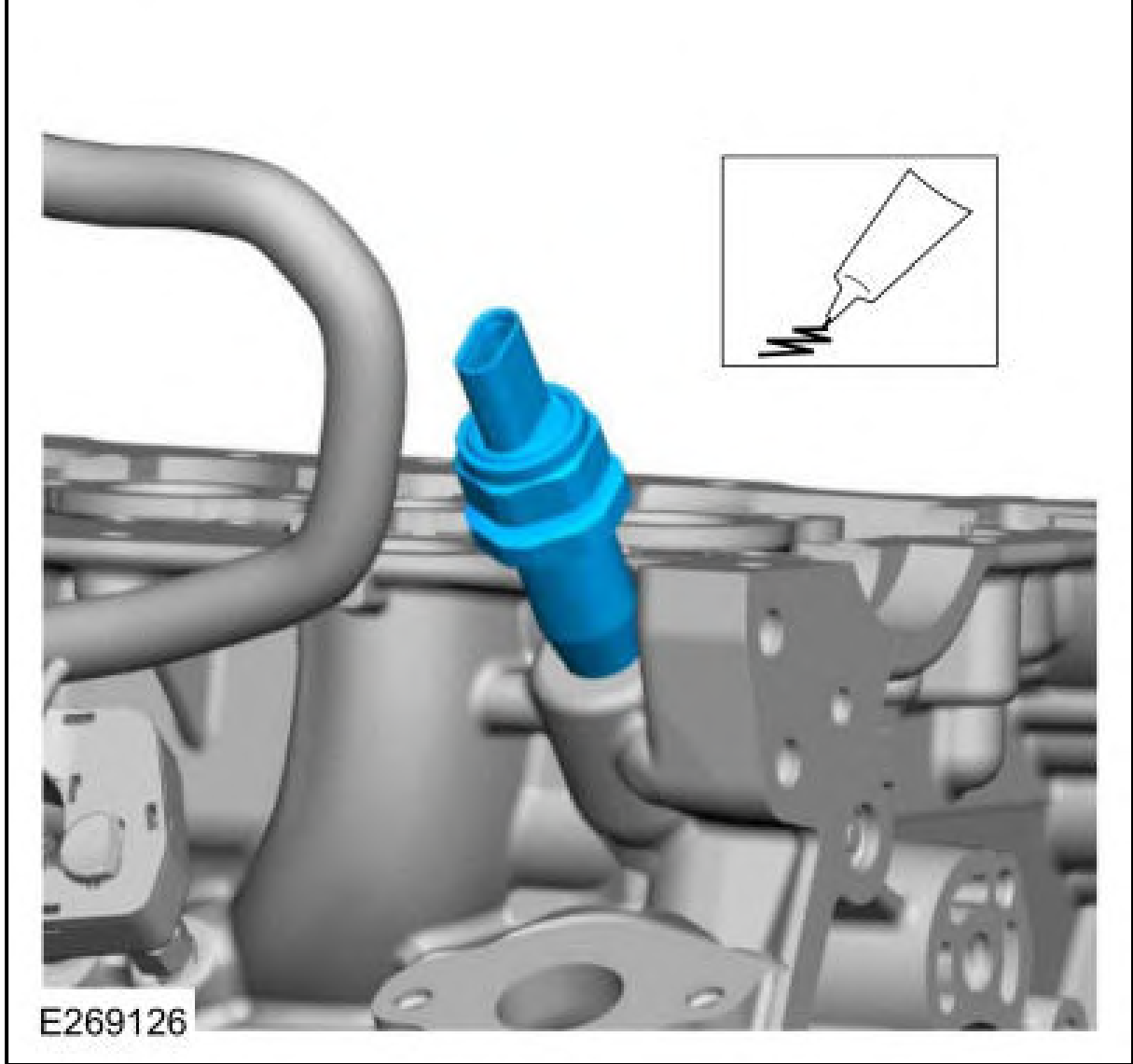
Install the EOP sensor.

Material: Motorcraft <sup>®</sup> Thread Sealant with PTFE / TA-24-B (WSK-M2G350-A2)

Torque: 159 lb.in (18 Nm)

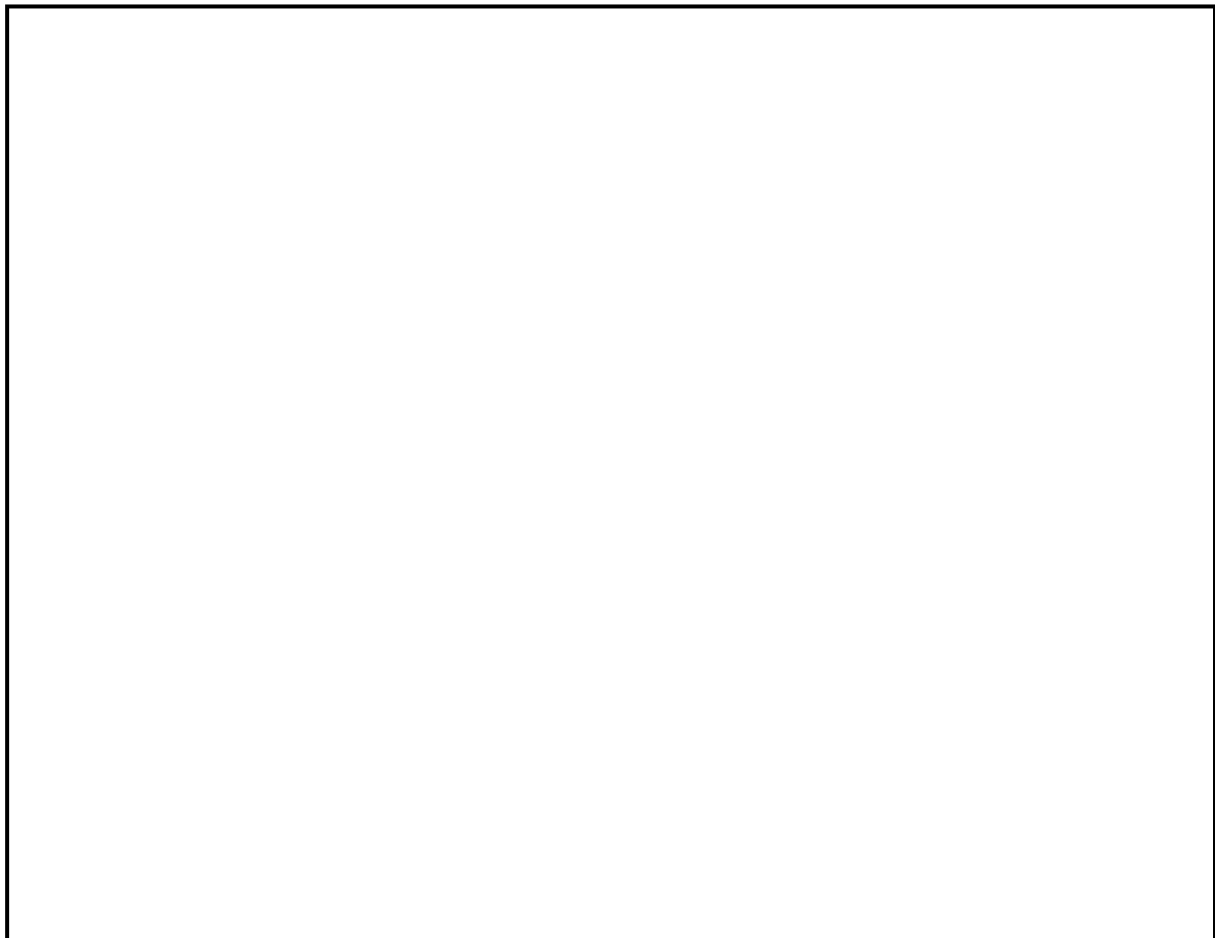


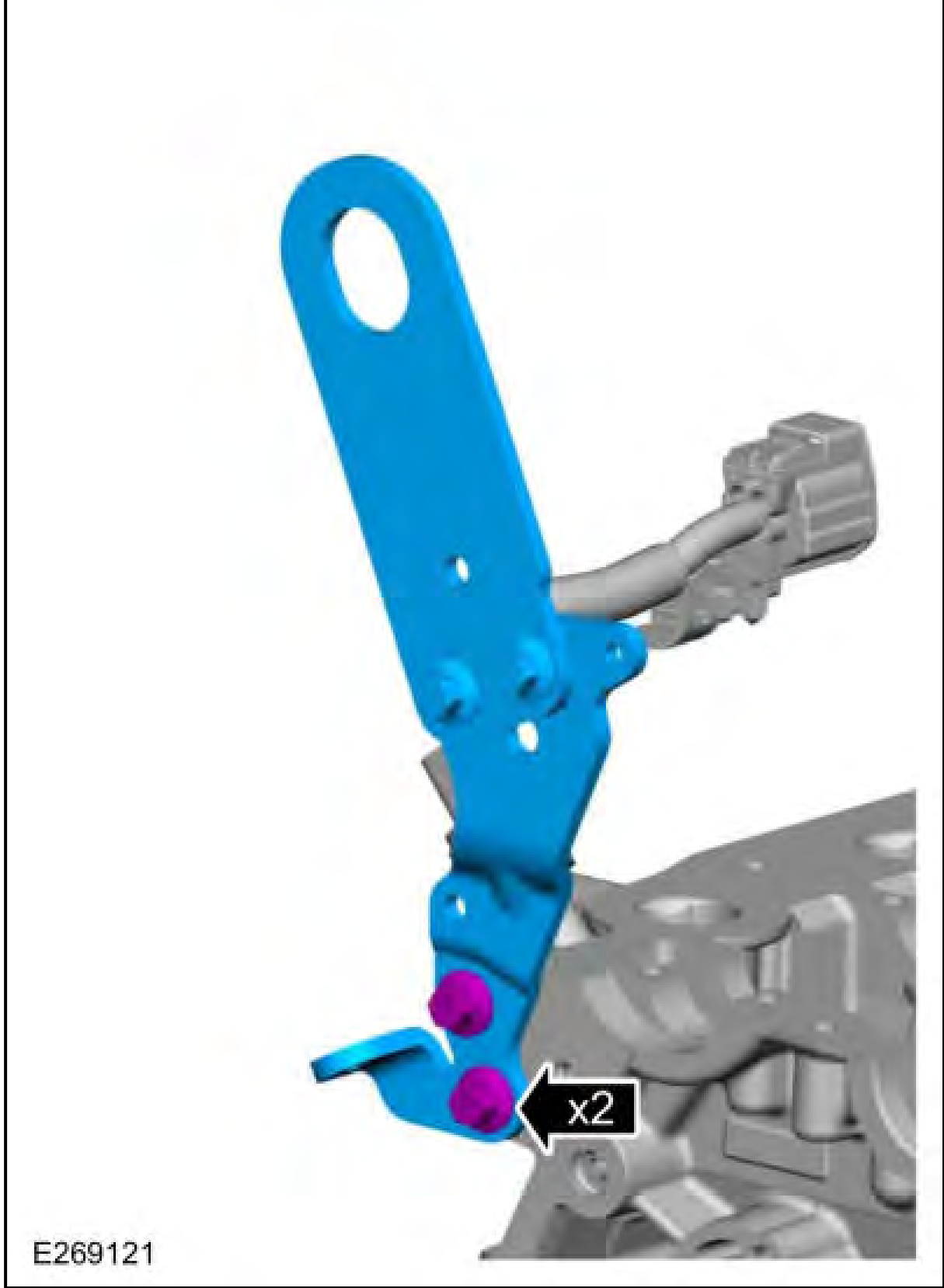




19. Install the front lifting eye and the bolts.

Torque: 17 lb.ft (23 Nm)

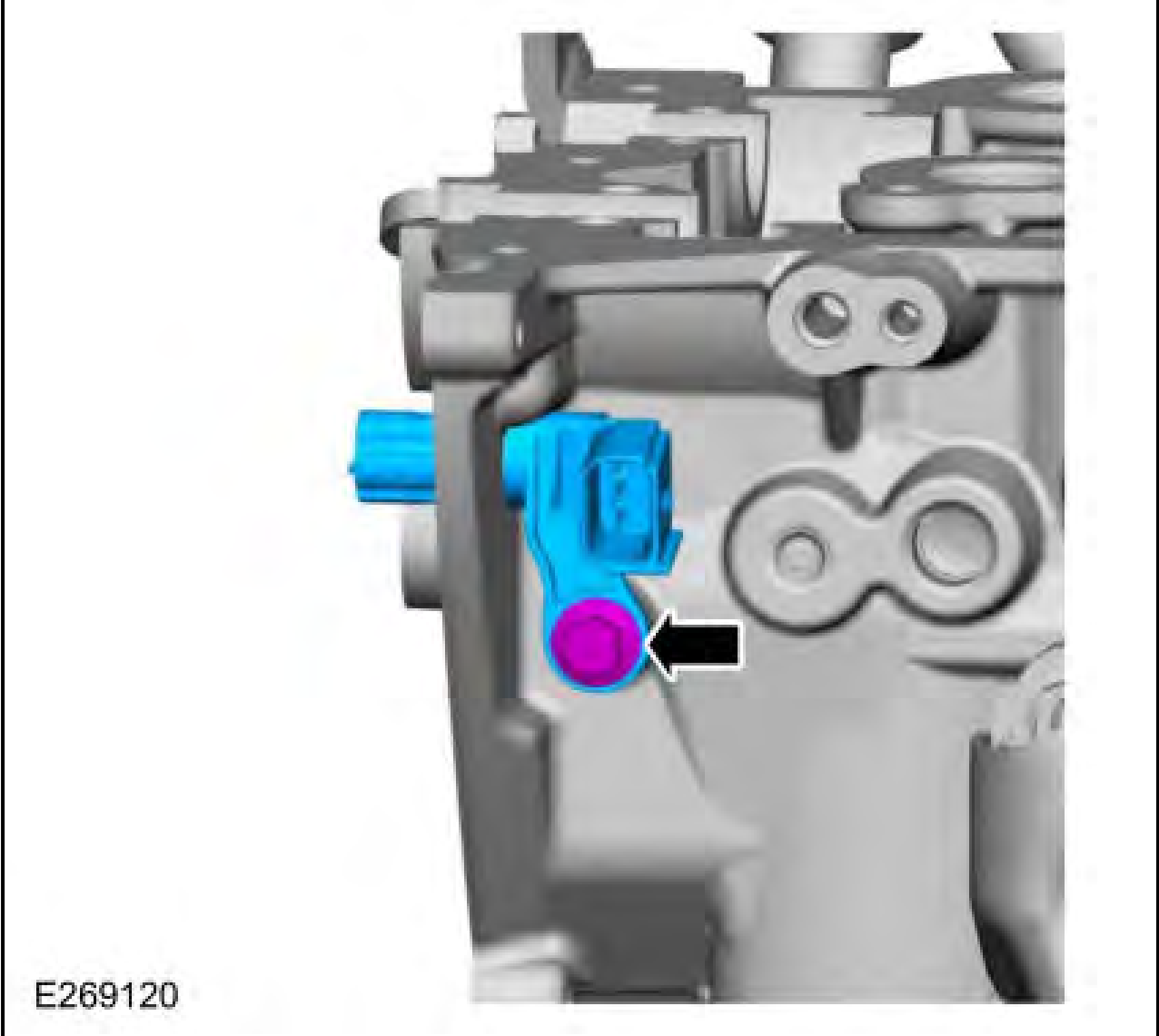




20. Install the CMP sensor and the bolt.

Torque: 89 lb.in (10 Nm)





## PISTON

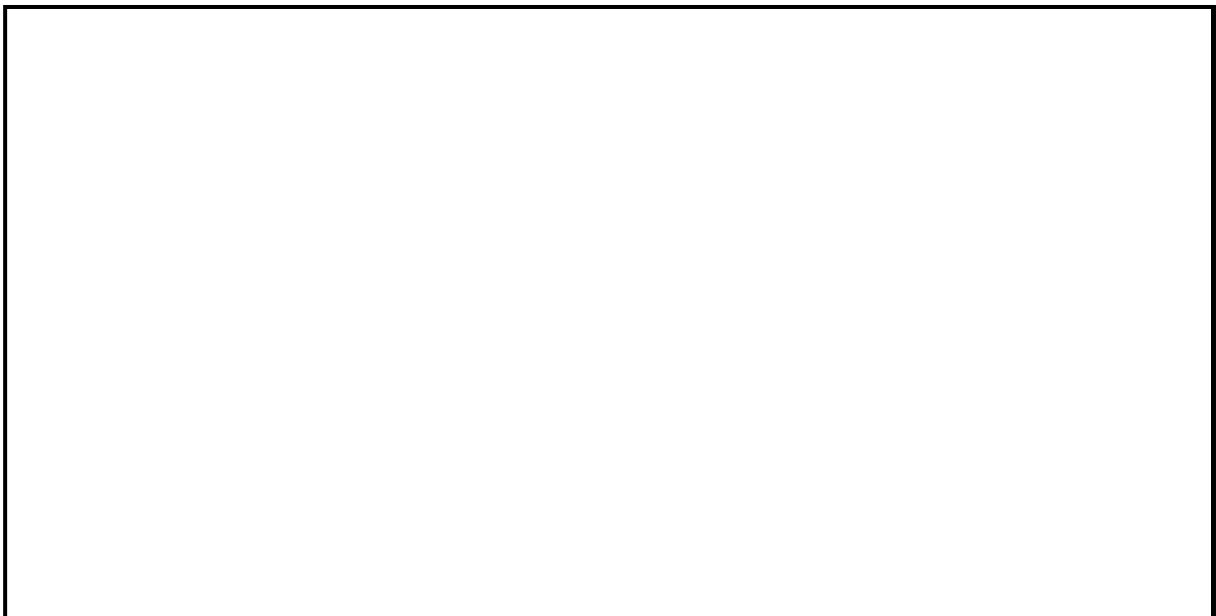
For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

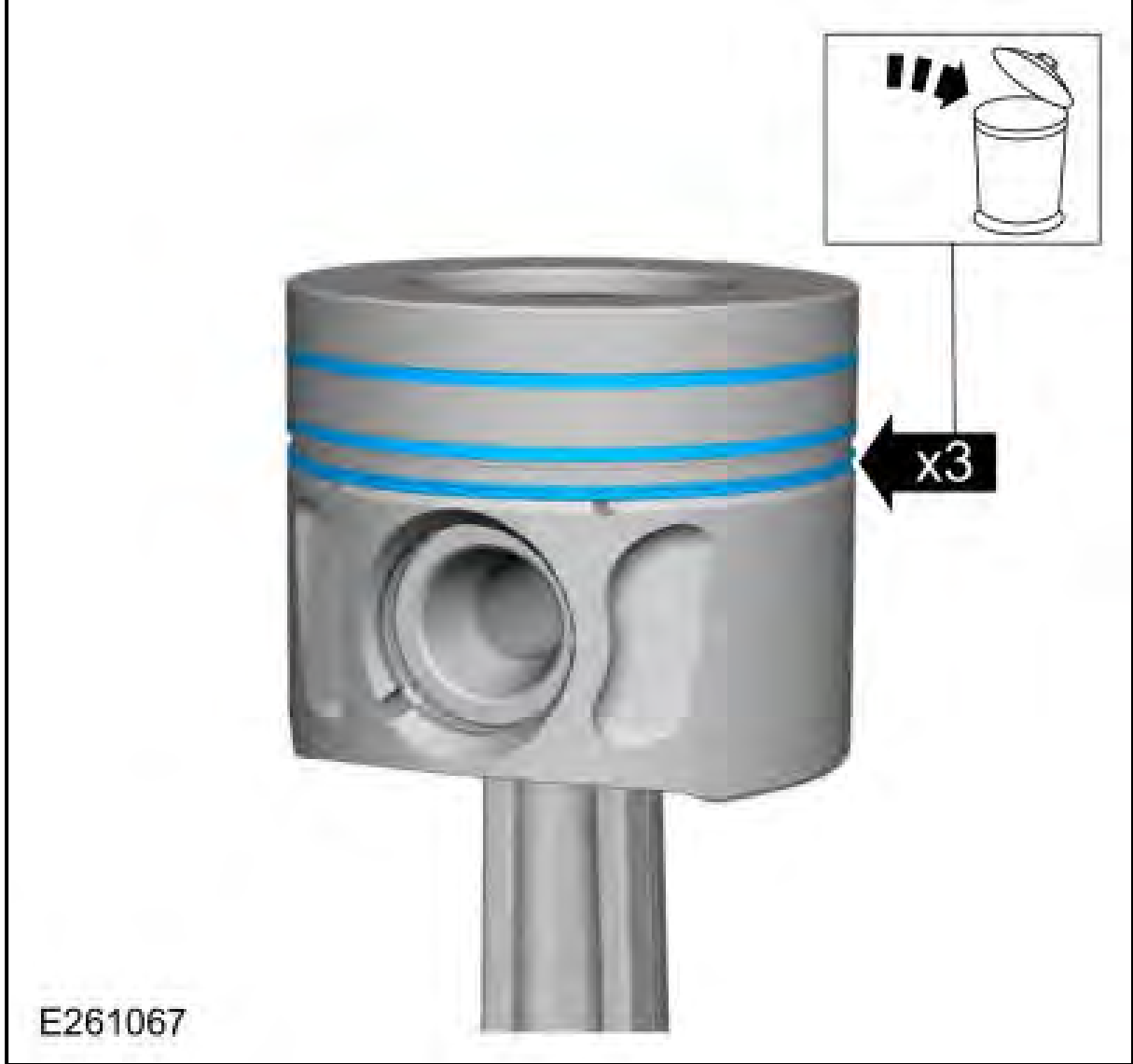
### Materials

| Name  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor OilXO-5W30-QFA | WSS-M2C214-B1 |

### DISASSEMBLY

1. Remove the piston rings and discard.

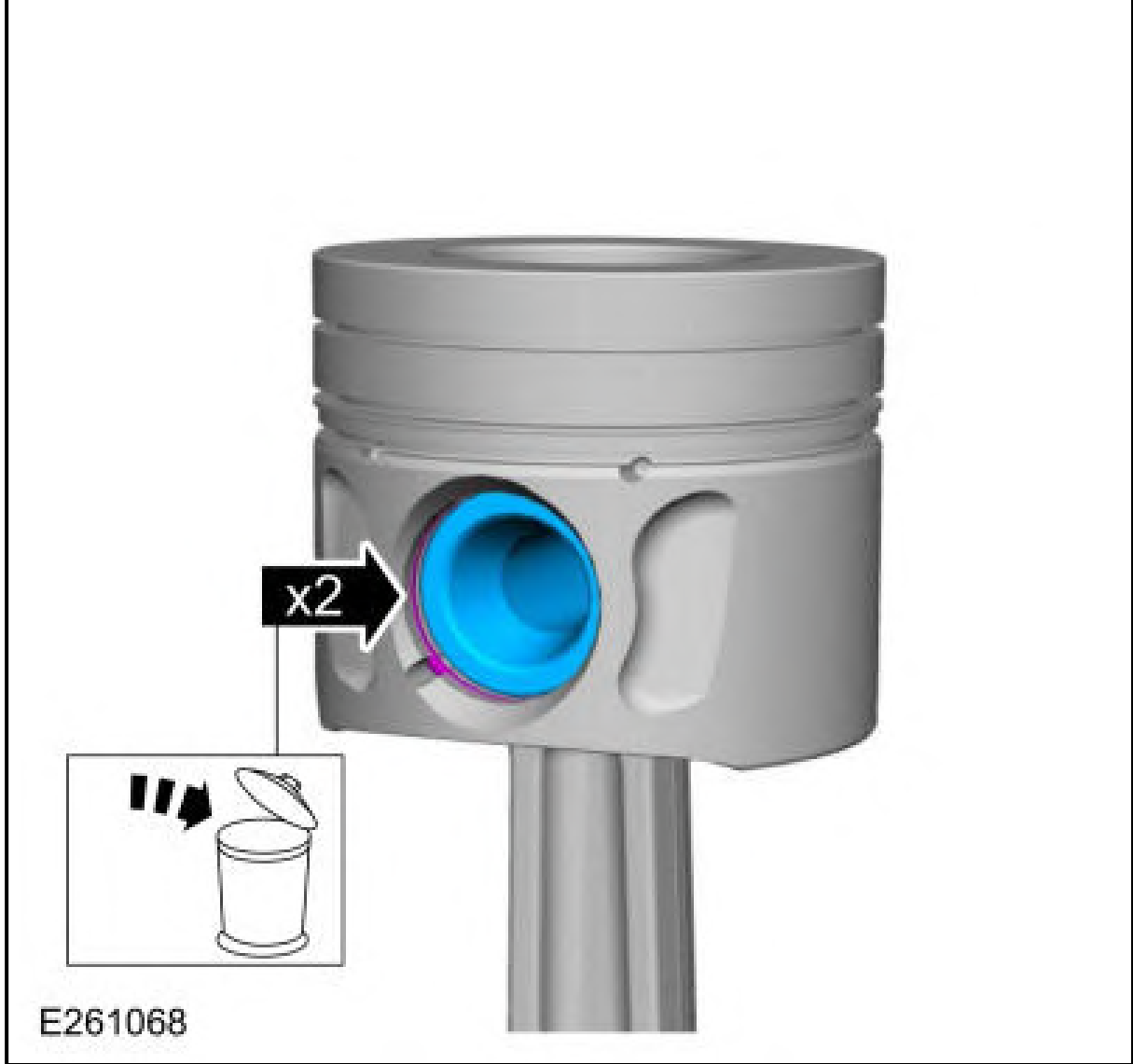




2.

- Remove the piston pin retainers and discard.
- Remove the piston pin.

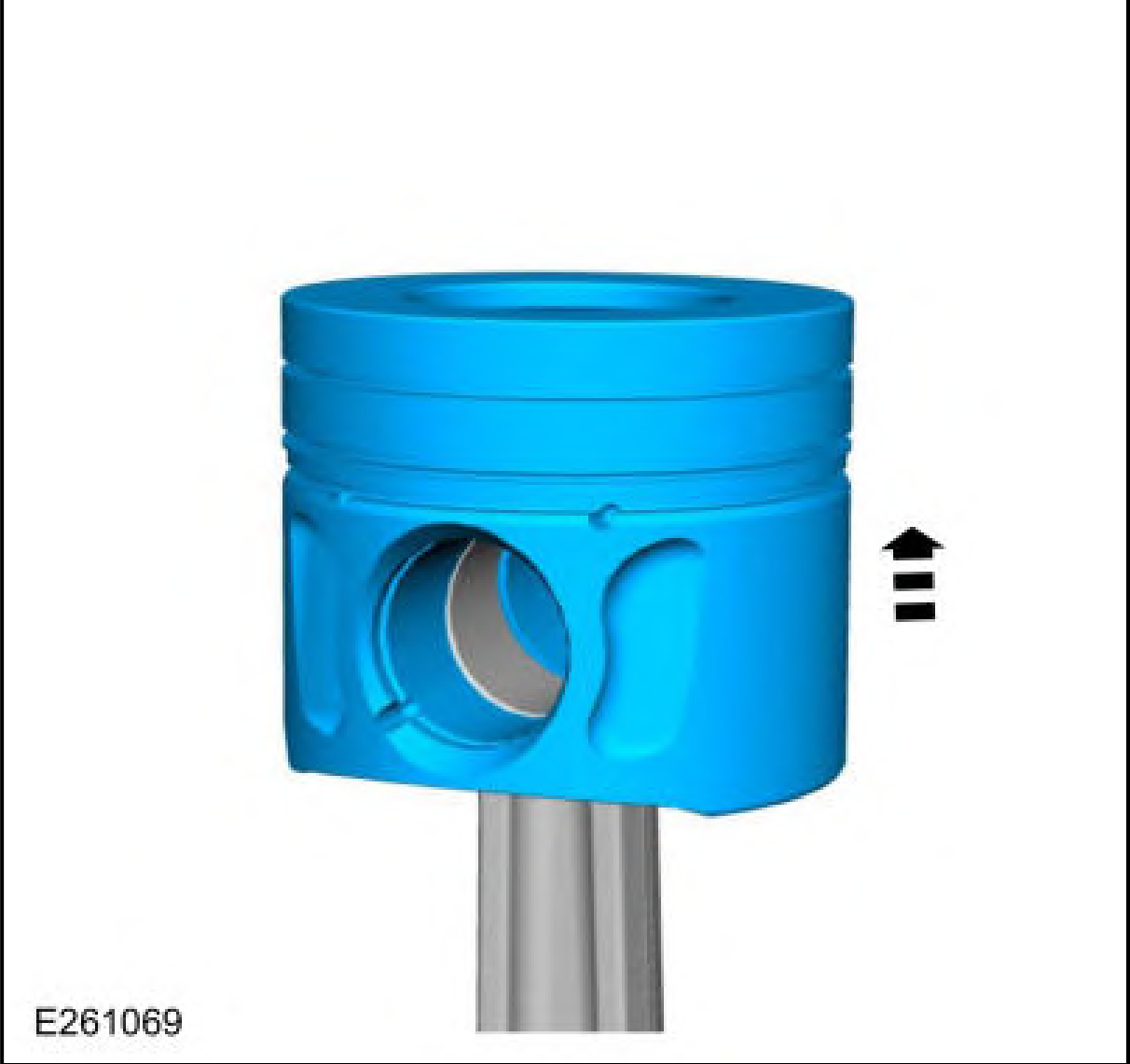




3. **NOTE:** If the piston and connecting rod are to be reinstalled, they must be assembled in the same orientation. Mark the piston orientation to the connecting rod for reassembly.

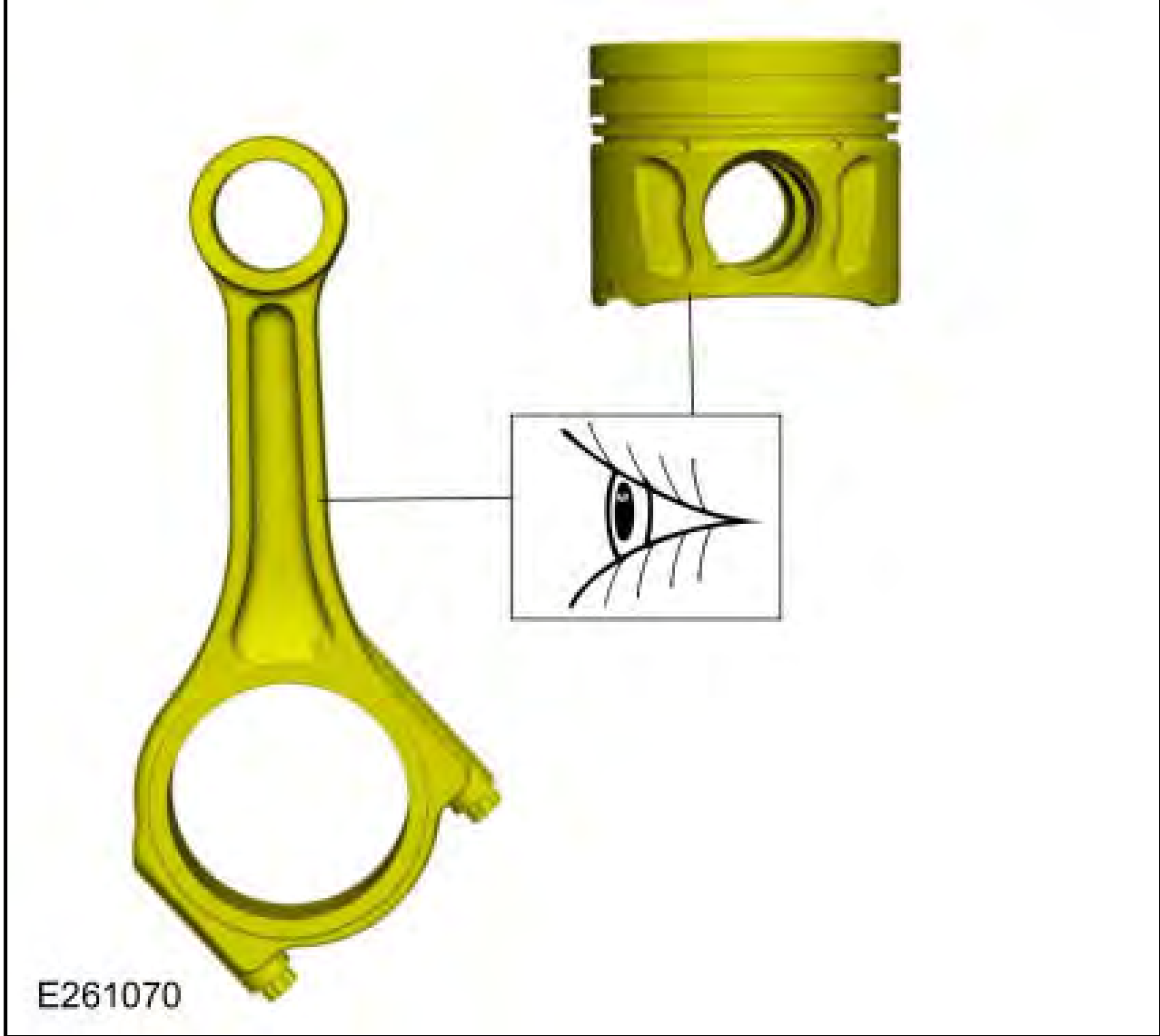
Remove the piston from the connecting rod.





4. Inspect the piston and connecting rod. Refer to: [Piston Inspection](#) .

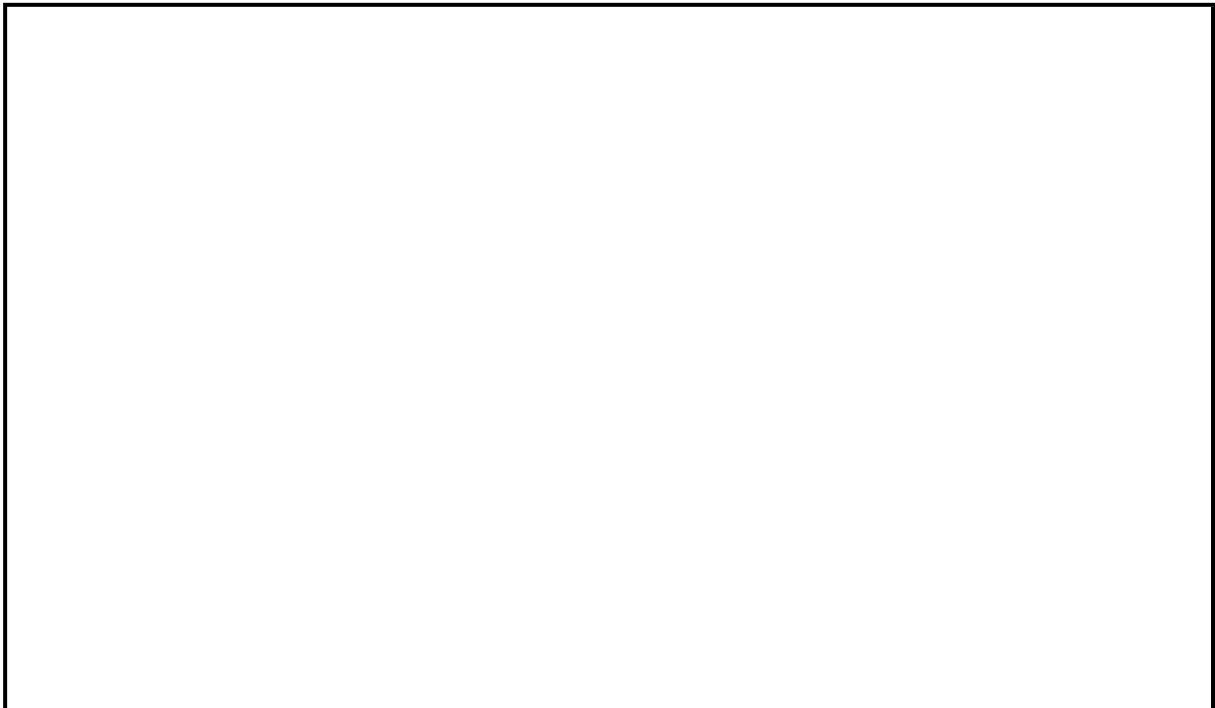


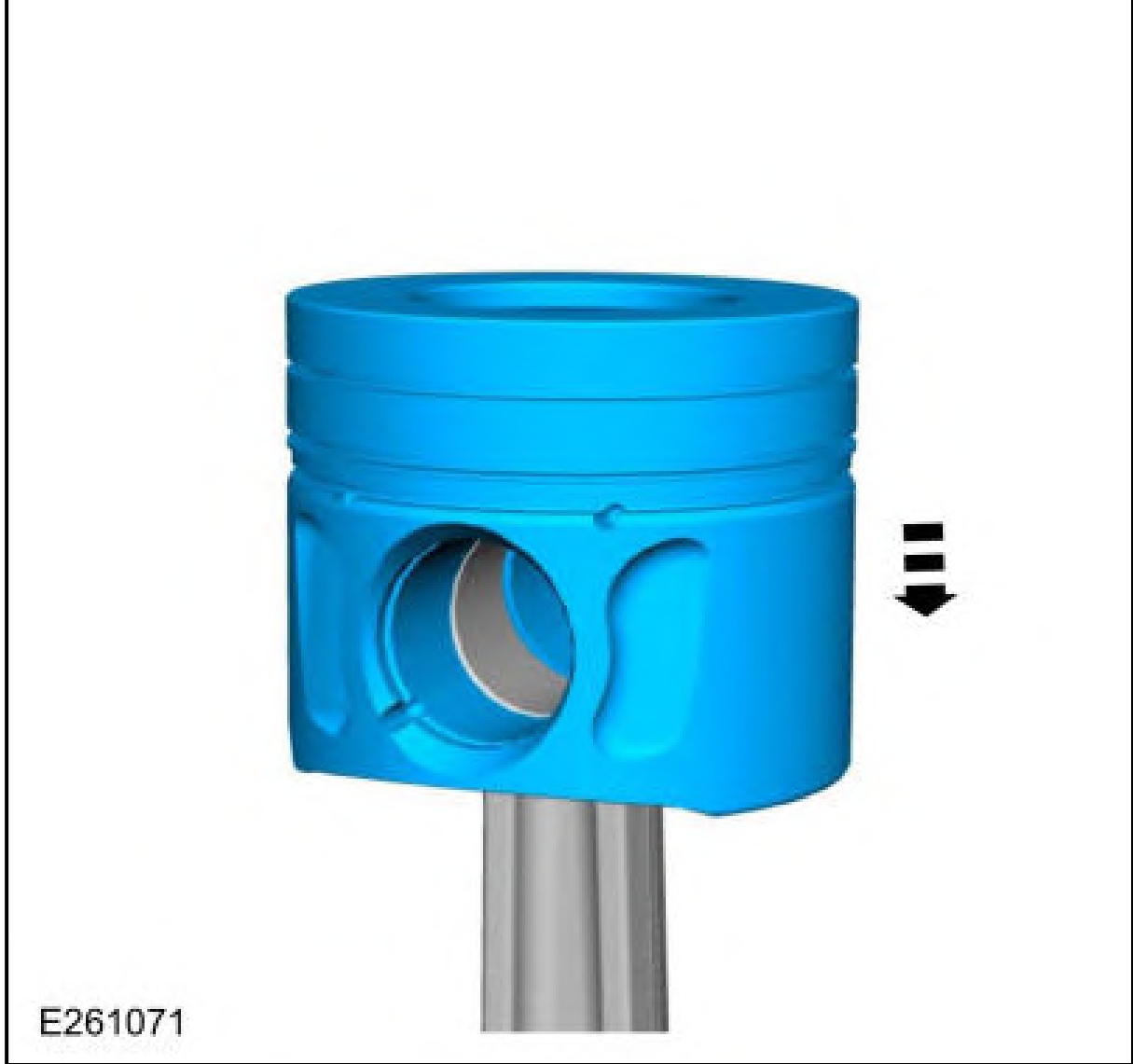


### ASSEMBLY

- NOTE:** Align the piston-to-connecting rod orientation marks made during disassembly.
  
- NOTE:** If installing a new piston, install with the arrow towards the front of the engine.

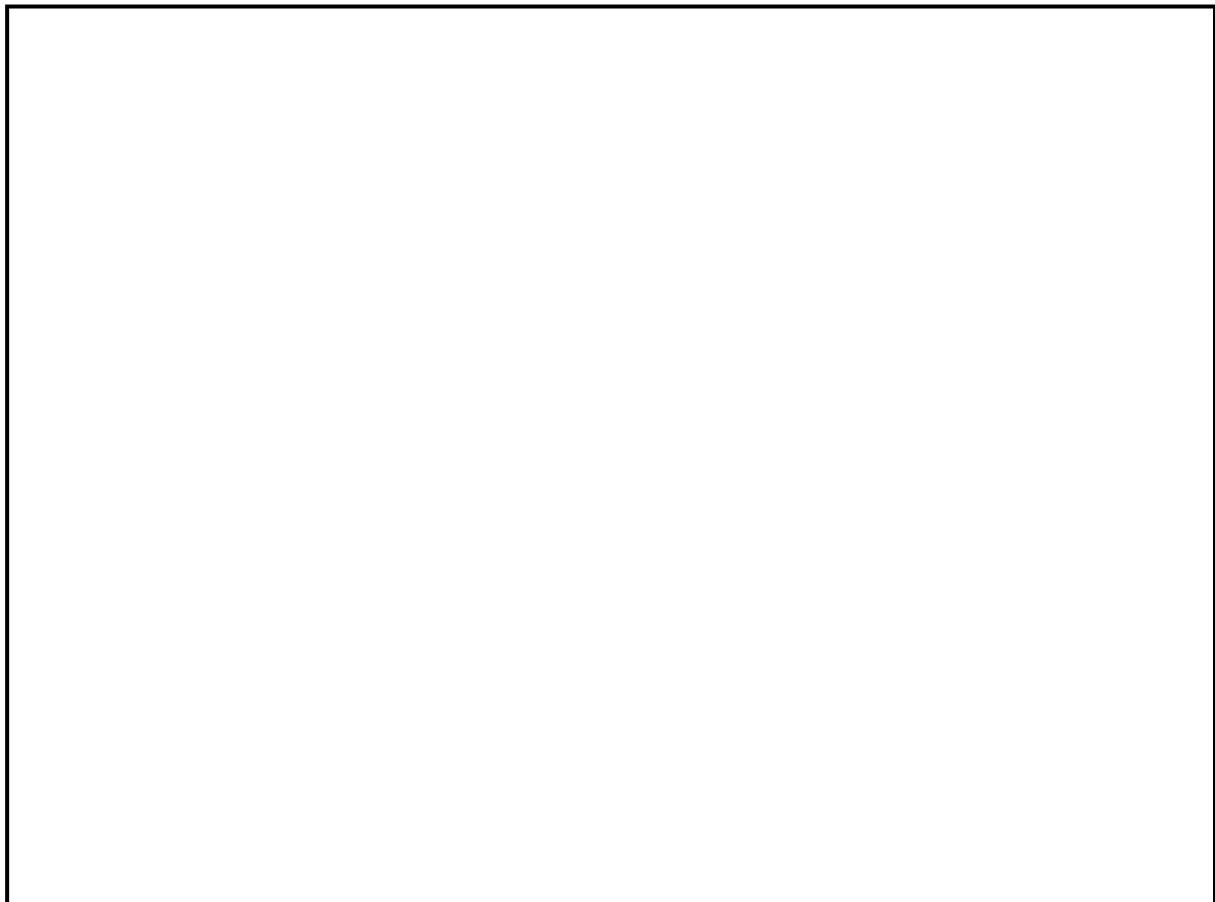
Install the piston to the connecting rod.





2. Lubricate with clean engine oil and install the piston pin.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

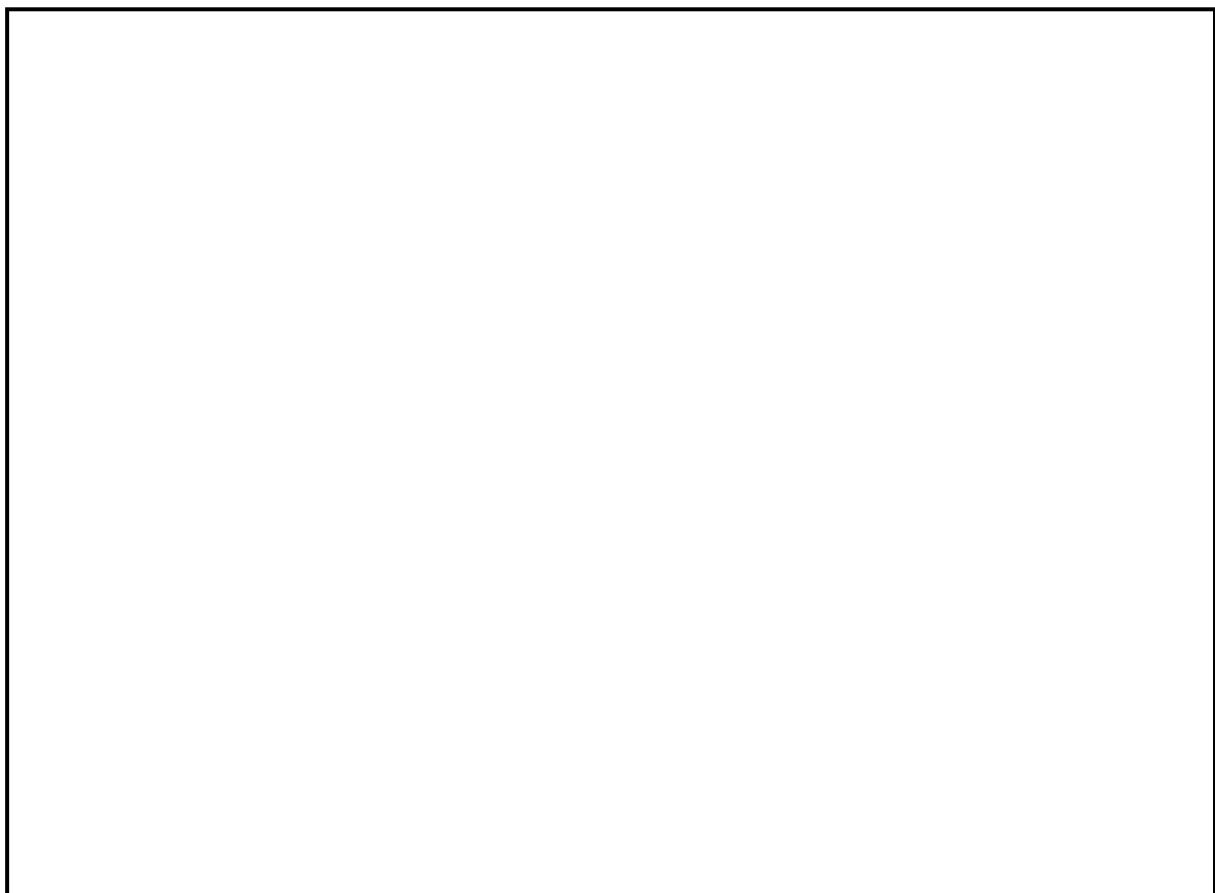






- NOTE:** The piston pin retaining clip gap orientation must be toward the top of the piston.

Install the piston pin retainers.



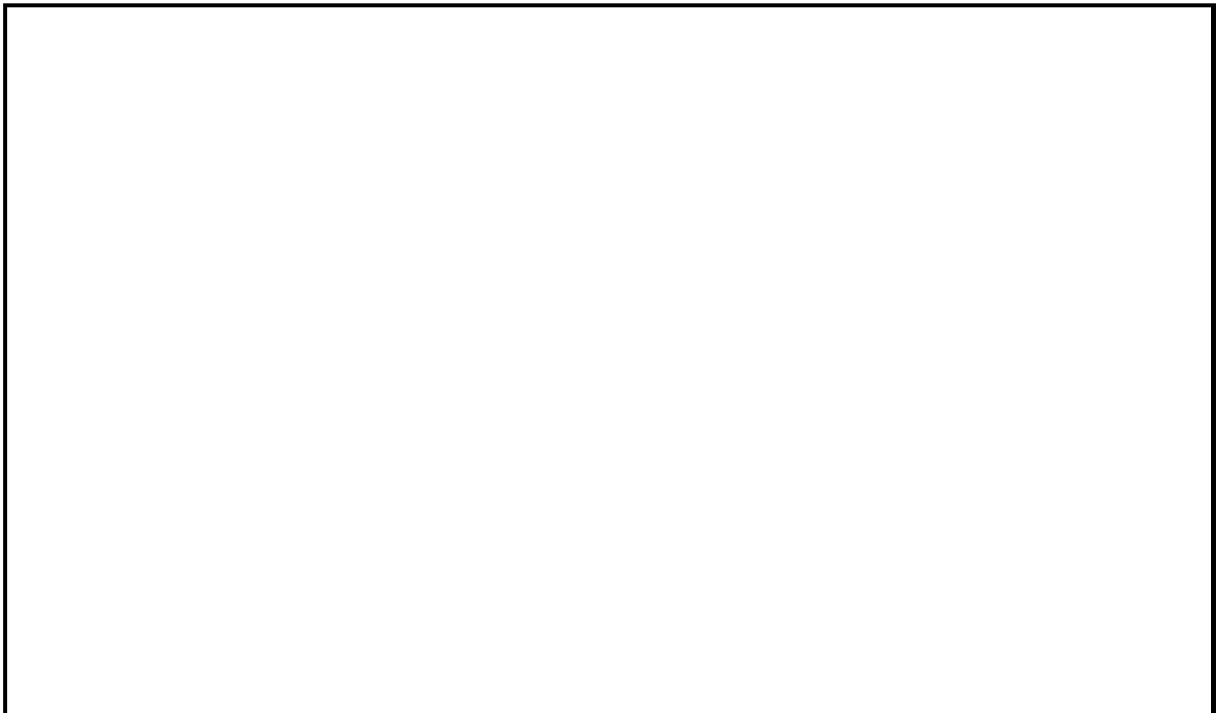


E261073

4. **NOTE:** The upper compression ring has a yellow paint mark on the running surface. The lower compression ring has a white paint mark on the running surface. The piston oil control ring has a green paint mark on the running surface.

Lubricate with clean engine oil and install the piston rings.

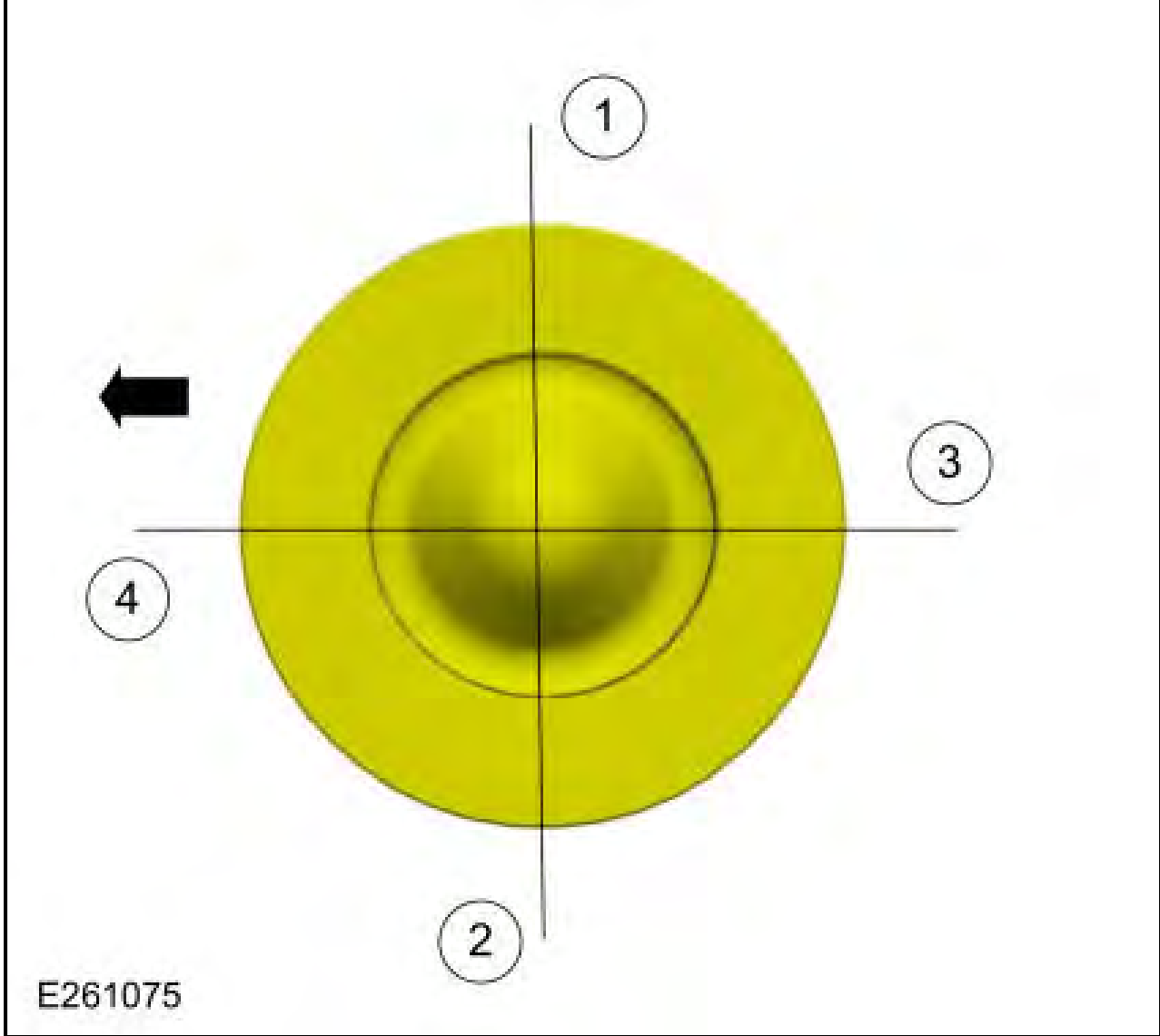
Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)





5. **NOTE:** The arrow on the top of the piston indicates the front of the engine.

1. Upper compression ring gap location
2. Lower compression ring gap location
3. Piston oil control ring gap location
4. Piston oil control ring gap location



## ASSEMBLY

### ENGINE

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

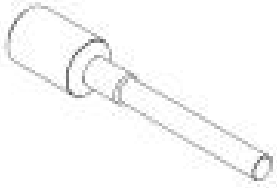
Base Part Number: 6L084

### Special Tool(s) / General Equipment

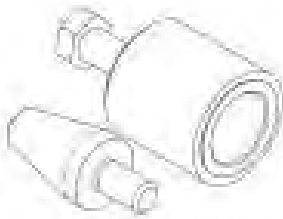
|                |   |
|----------------|---|
| <p>E138373</p> | <p><b>100-002 (TOOL-4201-C) Holding Fixture with Dial Indicator Gauge</b></p> |
| <p>E274086</p> | <p>303-1670 Pins, Camshaft Locking</p>  |



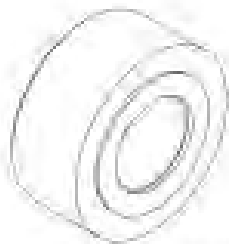
100-002 (TOOL-4201-C) Holding Fixture with Dial Indicator Gauge



303-1671 Pin, Locking Crankshaft



303-1672 Installer, Crankshaft Seal



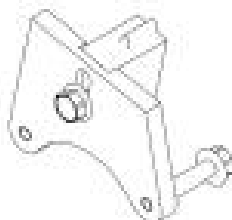
303-1673 Installer, Camshaft Seal




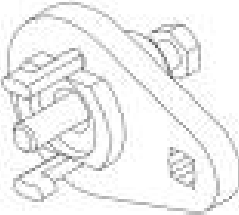

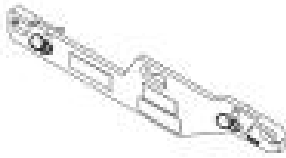
303-1674 Tool, Holding Camshaft Sprocket



303-1676 Installer, Crankshaft Position Sensor Ring



303-1677 Locking Tool, Flywheel

|   |  |
|---|--|
|  <p>E139373</p>       | <p><b>100-002 (TOOL-4201-C)Holding Fixture with Dial Indicator Gauge</b></p> |
|  <p>E274094</p>      | <p>303-1678Remover, Fuel Pump Pulley Holding Tool</p>                        |
|  <p>E274095</p>      | <p>303-1679Timing Tool, Fuel Pump Rear Access</p>                            |
|  <p>E274098</p>     | <p>303-1681Spreader Bar</p>  |
| <p>Floor Crane<br/>Mounting Stand<br/>Hose Clamp<br/>Remover/Installer<br/>Piston Ring Compressor</p> |  |

**Materials**

| Name   | Specification  |
|--|----------------|
| Motorcraft <sup>®</sup> Thread Sealant with PTFETA-24-B              | WSK-M2G350-A2  |
| Motorcraft <sup>®</sup> High Performance Engine RTV SiliconeTA-357   | WSE-M4G323-A6  |
| Flange SealantCU7Z-19B508-A  | WSS-M2G348-A11 |
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor OilXO-5W30-QFA  | WSS-M2C214-B1  |
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/CoolantVC-3-B | WSS-M97B44-D   |

**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, may cause engine failure.

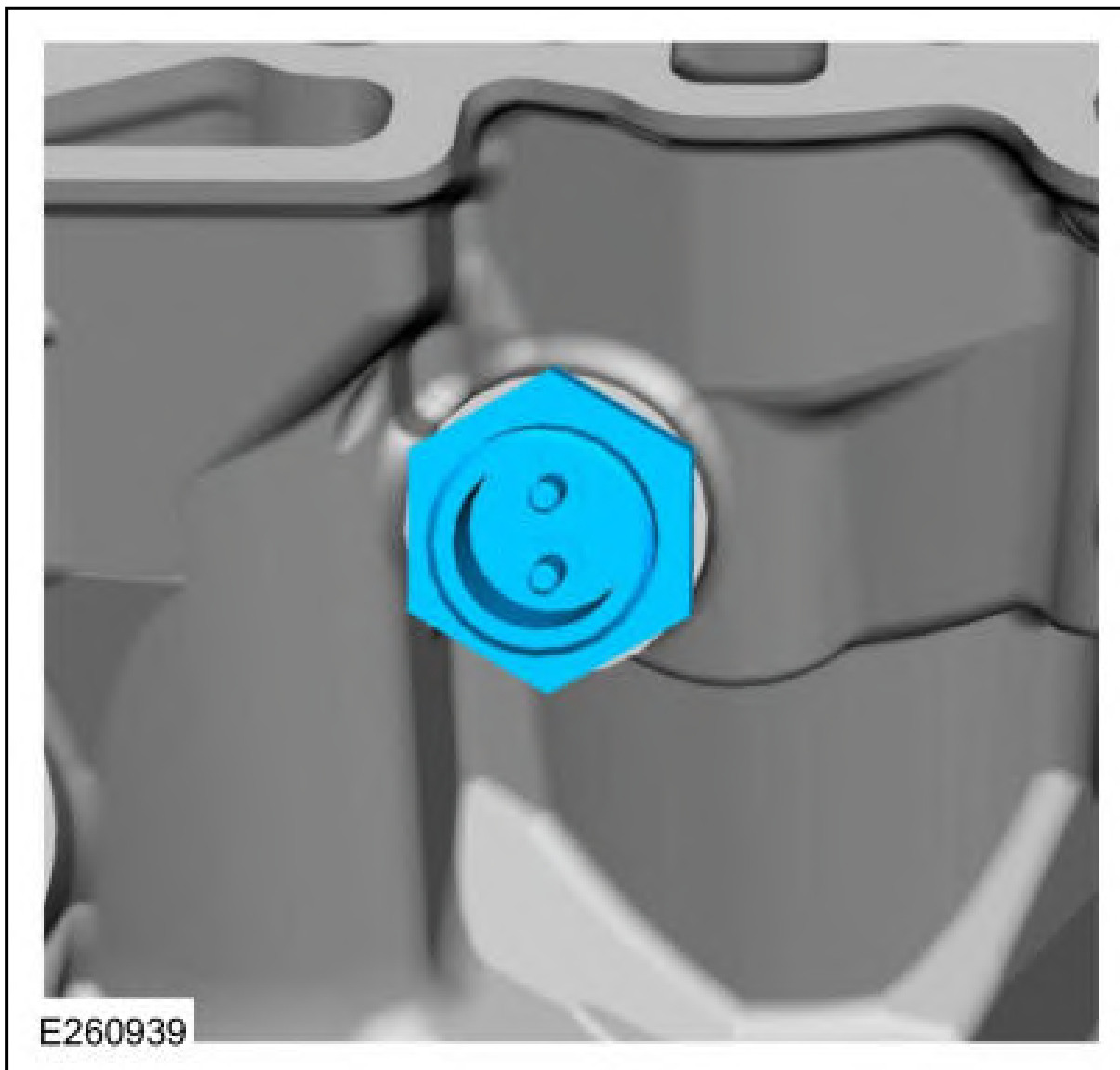
**NOTE:** This procedure assumes the engine will be installed using the recommended body off engine installation procedure. If it will be necessary to install the engine using the alternate body on engine installation procedure, some of the components in this procedure should not be installed at this time. Refer to Engine - Body On in this section.

**NOTE:** Assembly of the engine requires various inspections/measurements of the engine components. These inspections/measurements will aid in determining if the engine components will require replacement. Refer to Section 303-00.

**NOTE:** Refer to the exploded view under the Engine Component View in the Description and Operation.

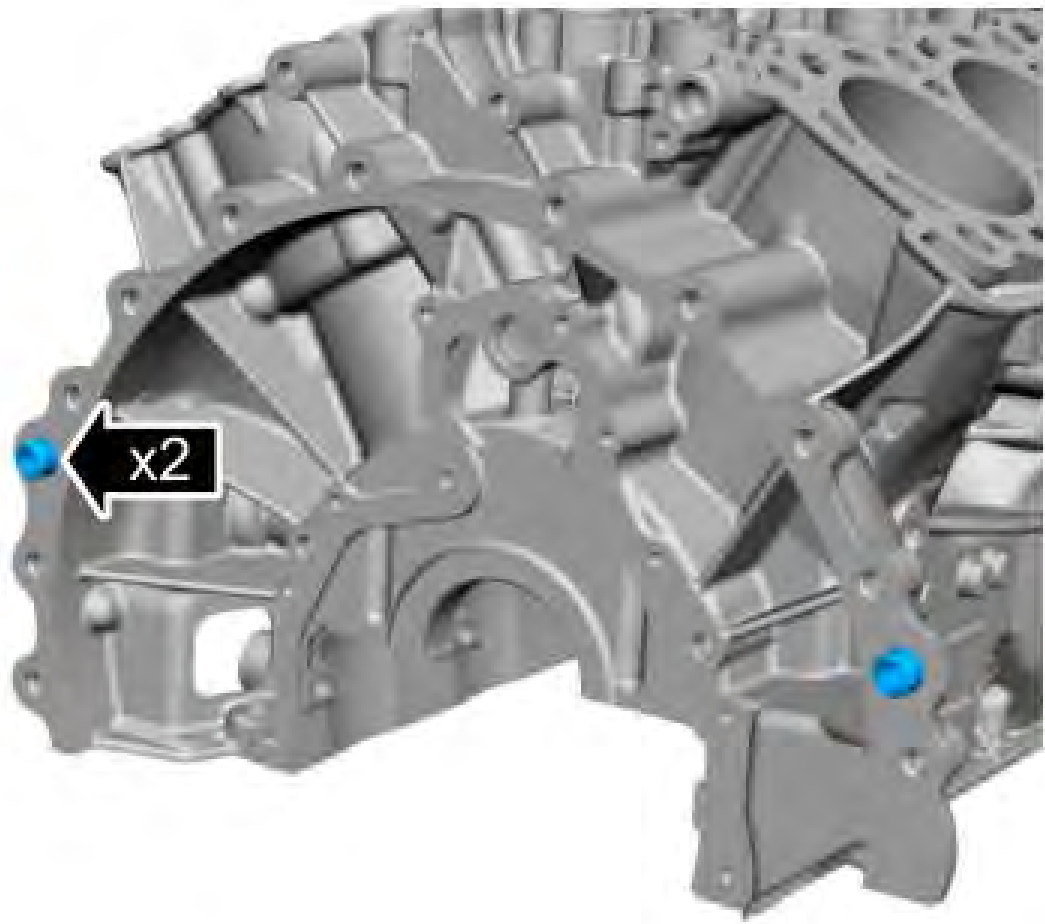
1. If equipped. Install the block heater.

Torque: 41 lb.ft (55 Nm)



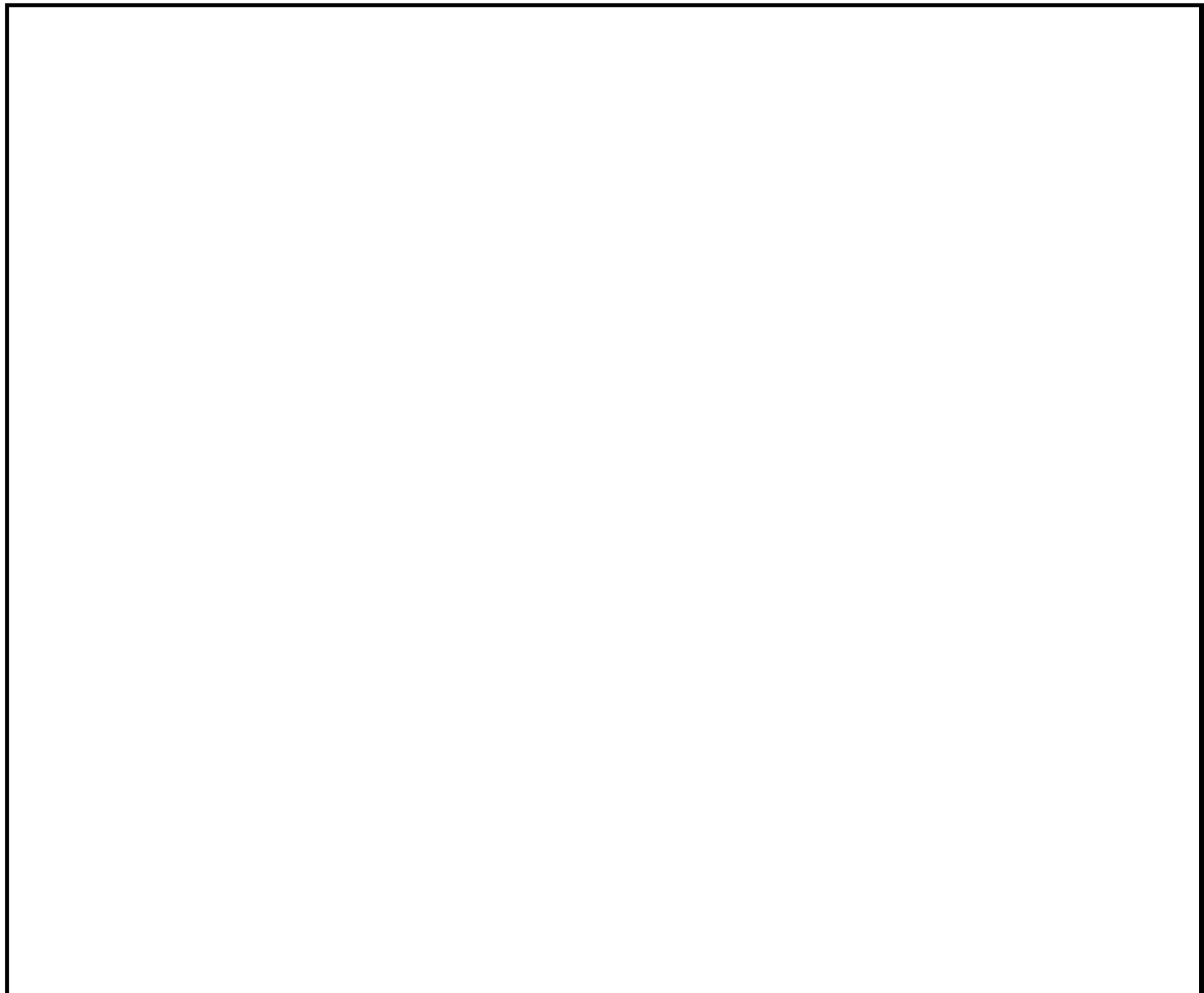
2. If removed. Install the cylinder block to flywheel housing dowels.





E261498

3. Install the engine oil filter.

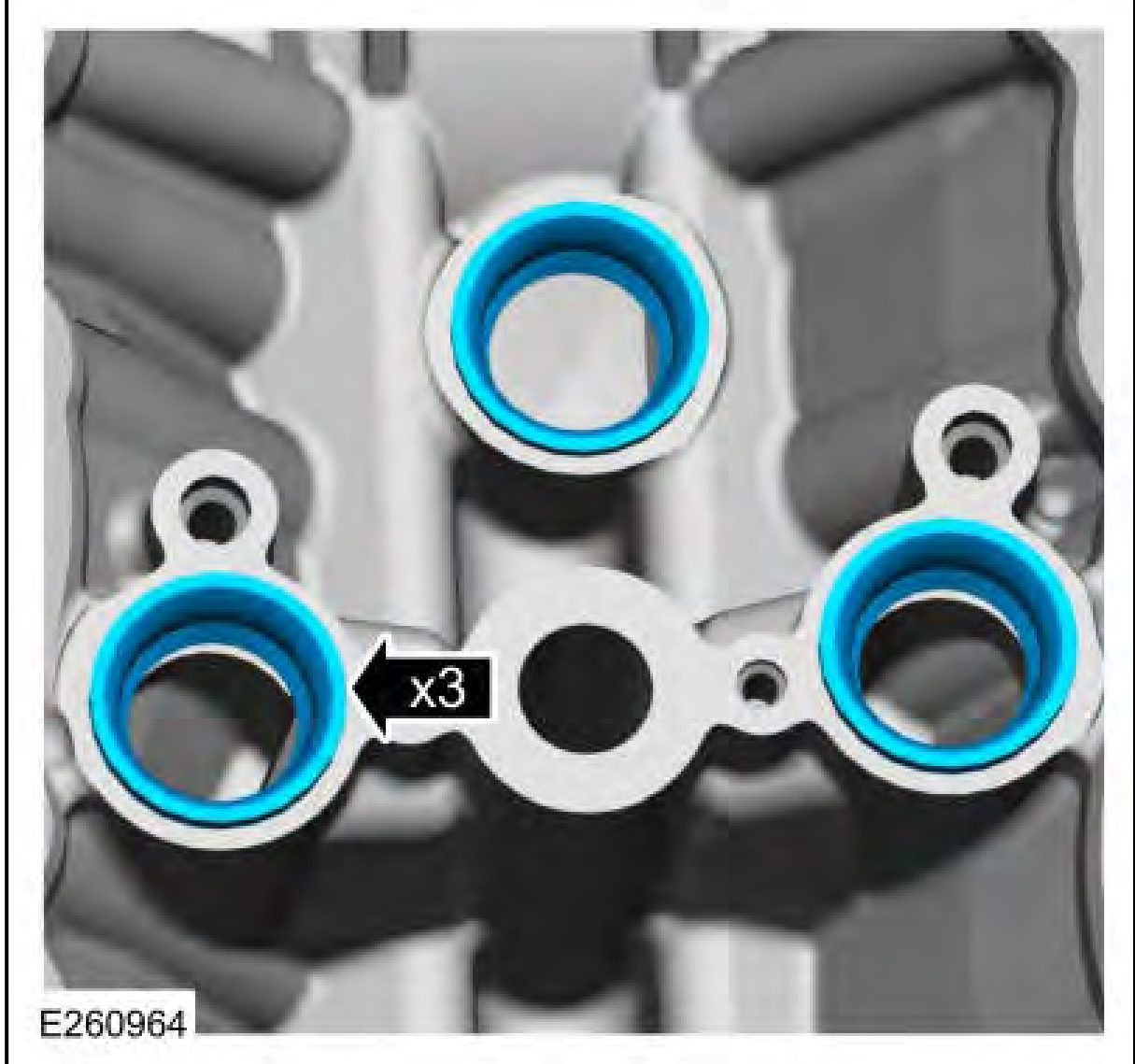






4. Install the crankcase vent gaskets.





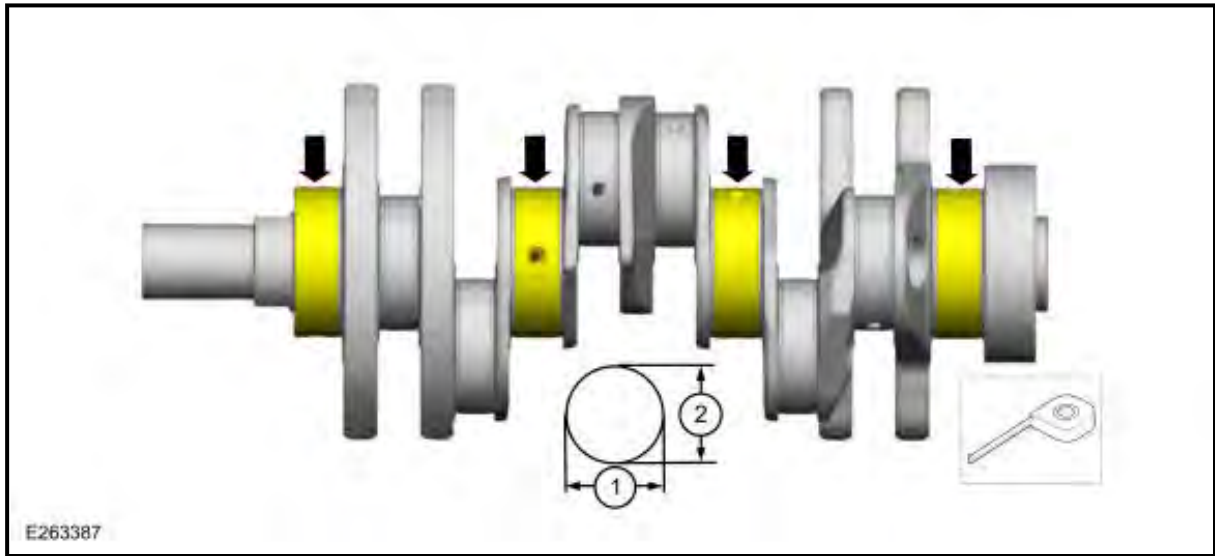
5. Install the piston cooling jets and bolts.

Torque: 89 lb.in (10 Nm)



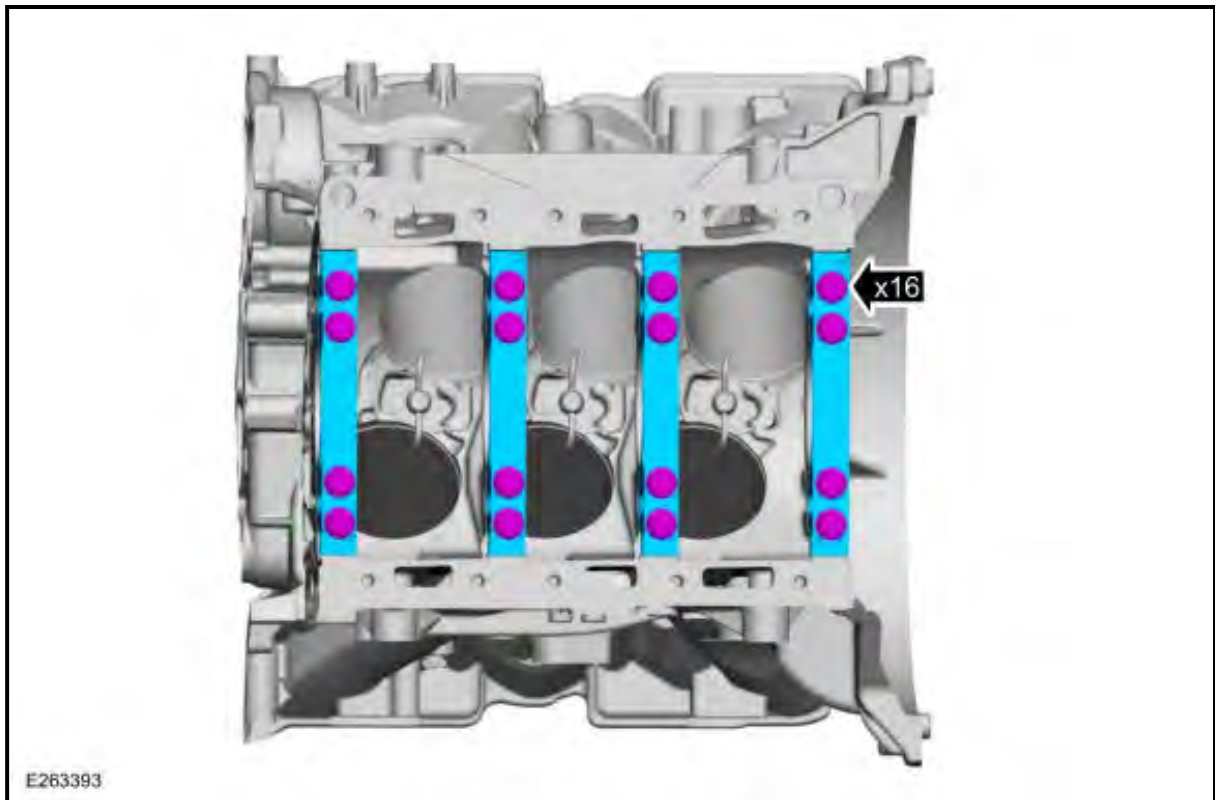
6. Measure the length or distance in two directions.

- Record the smallest measurement for each crankshaft main bearing journal.



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

Install the main bearing caps and the bolts.

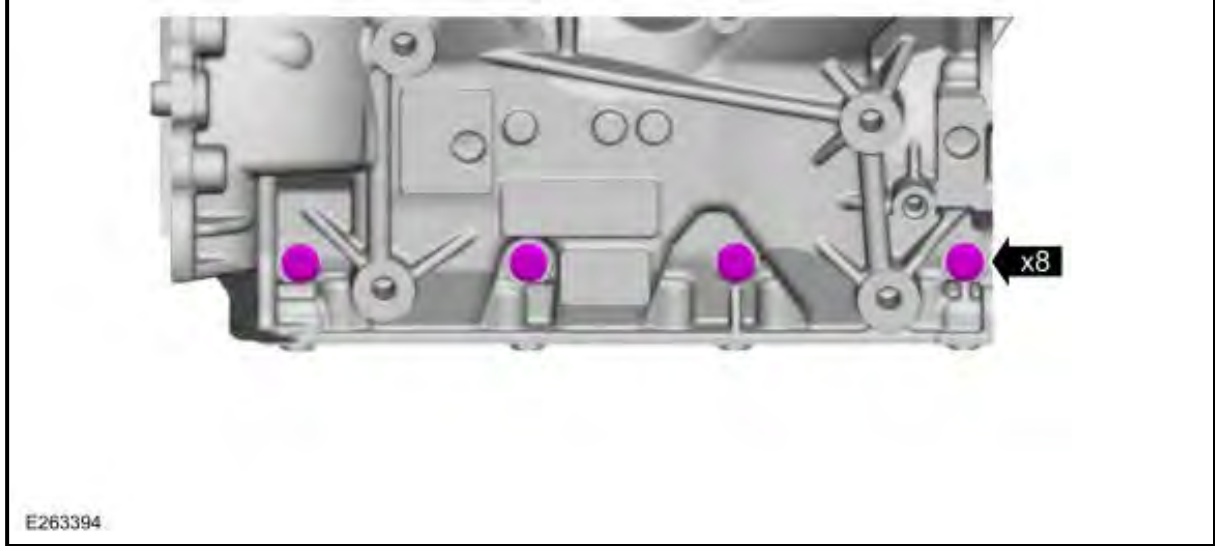


8. **NOTE:** Only tighten the bolts finger tight at this stage.

**NOTE:** RH side shown, LH side similar.

Install the main bearing cap side bolts.

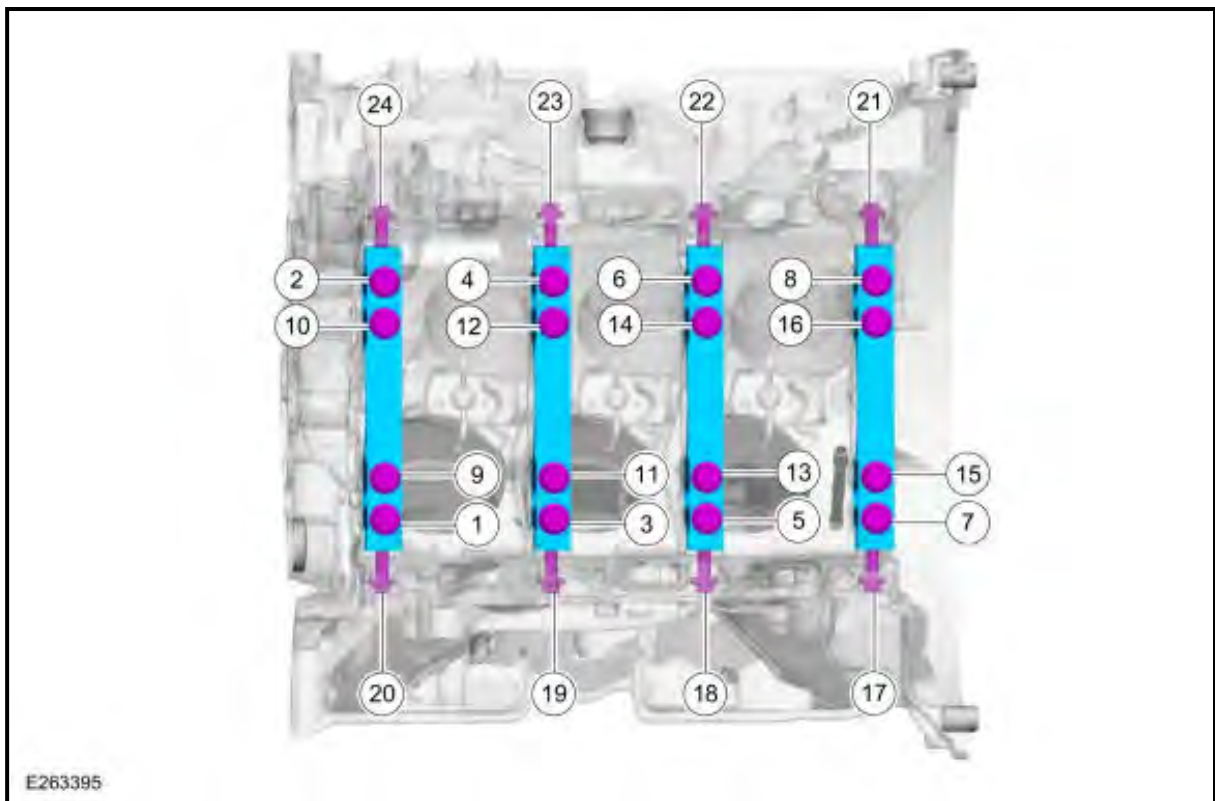




9. Tighten the main bearing bolts.

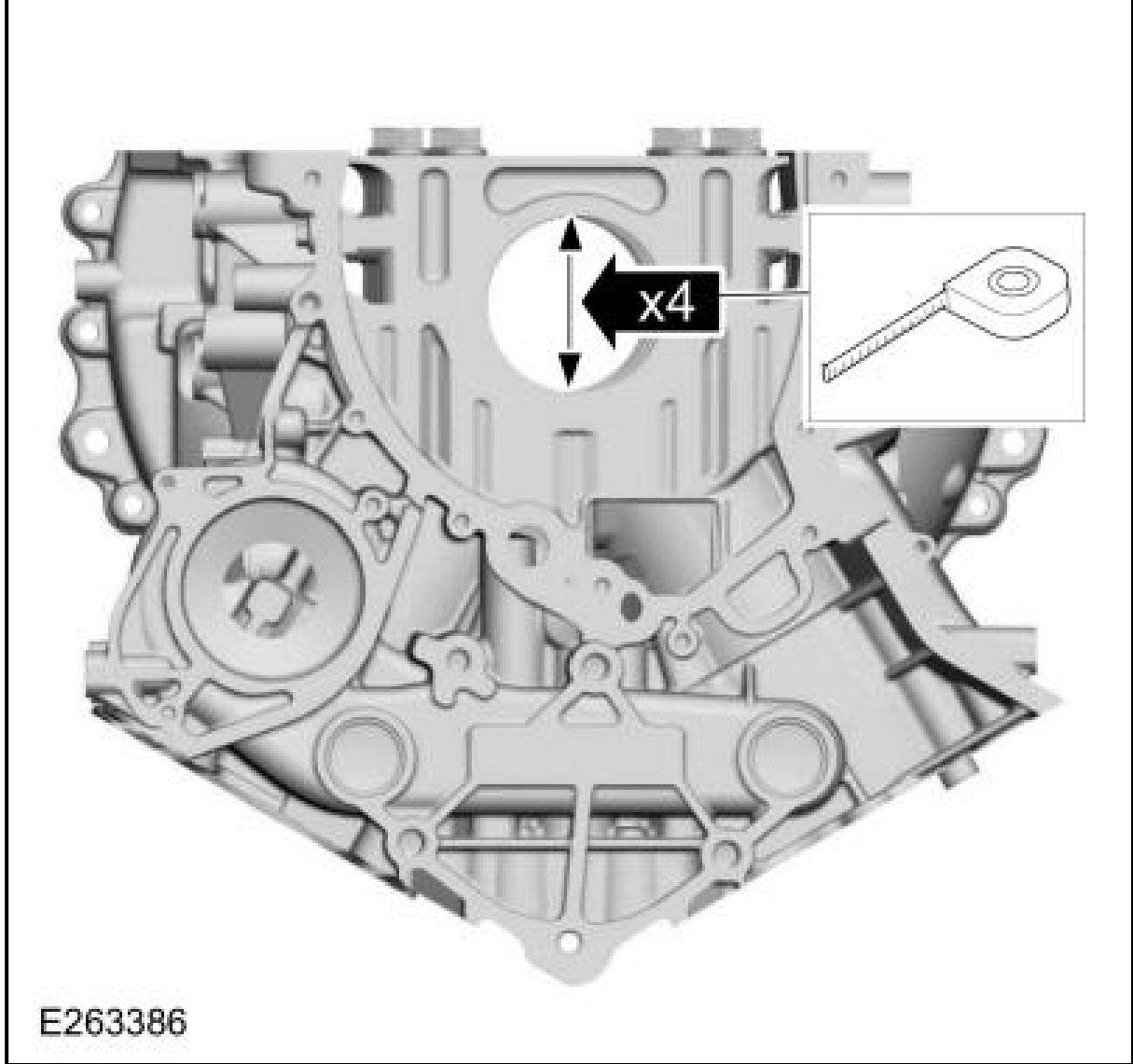
### Torque

- Stage 1: Tighten bolts 1 thru 16 to : 30 lb.ft (40 Nm)
- Stage 2: Tighten bolts 1 thru 16 to : 66 lb.ft (90 Nm)
- Stage 3: Tighten bolts 1 thru 16, an additional : 45  $\hat{A}^\circ$
- Stage 4: Tighten bolts 1 thru 16, a second time, an additional : 45  $\hat{A}^\circ$
- Stage 5: Tighten bolts 17 thru 24 to : 124 lb.in (14 Nm)
- Stage 6: Tighten bolts 17 thru 24, an additional : 45  $\hat{A}^\circ$



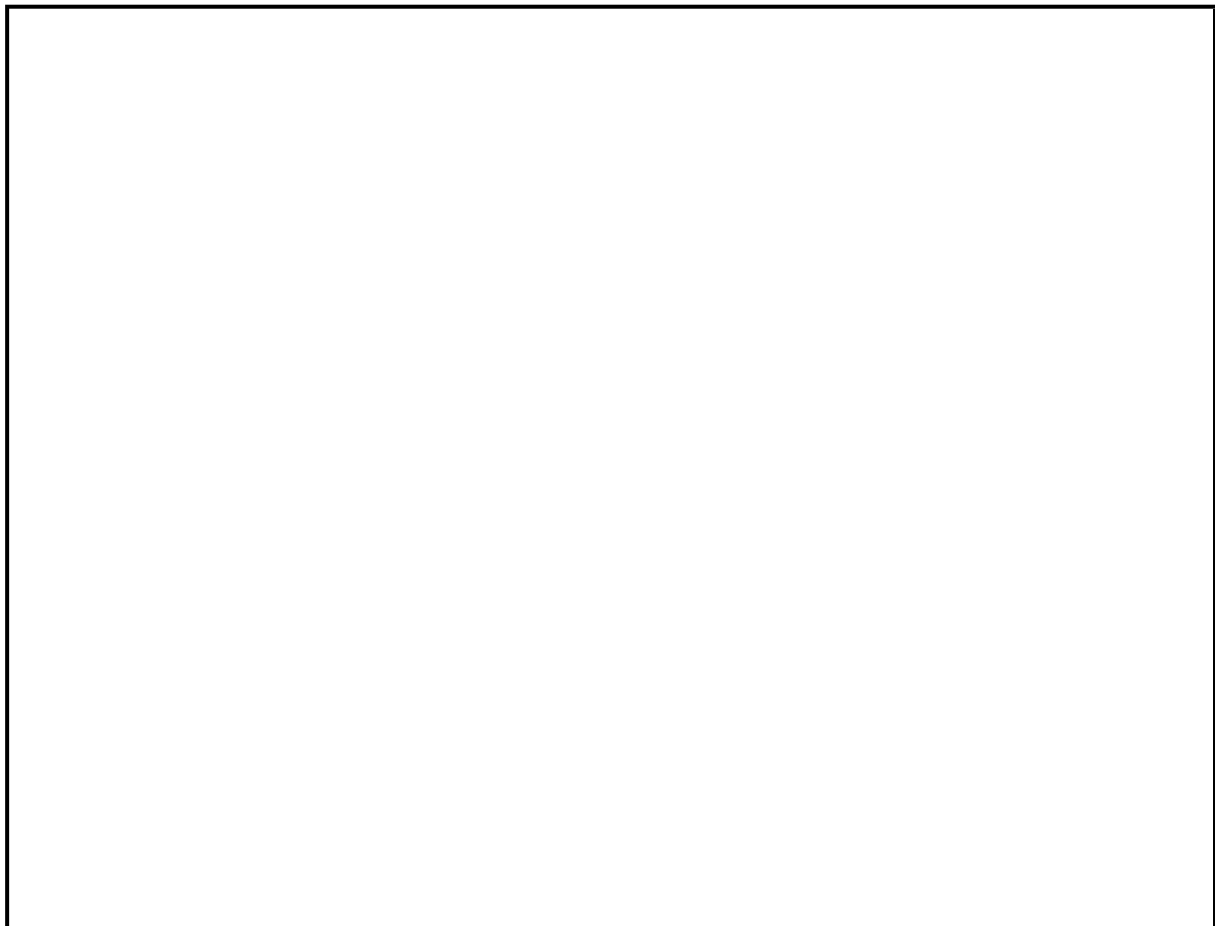
10. Measure each crankshaft block main bearing bore diameter.





11. **NOTE:** This chart is continued in the next step.

Using the chart, select the crankshaft main bearings.



| BEARING |            |       |       |              |
|---------|------------|-------|-------|--------------|
|         | I.D. COLOR | MIN   | MAX   | PART NO.     |
| GRADE 1 | RED        | 2.484 | 2.491 | JL3Q-6338-CA |
| GRADE 2 | YELLOW     | 2.491 | 2.498 | JL3Q-6338-BA |
| GRADE 3 | BLUE       | 2.498 | 2.505 | JL3Q-6338-AA |

| MAXIMUM / MINIMUM OIL CLEARANCE (INCLUDING HOUSING SWELL) |        |        |        |        |        |        |        |        |        |        |        |       |       |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|
| BLOCK DIAMETER  |        |        |        |        |        |        |        |        |        |        |        |       |       |
|   |        | 75.000 | 75.001 | 75.002 | 75.003 | 75.004 | 75.005 | 75.006 | 75.007 | 75.008 | 75.009 |       |       |
|   |        | 000    | 001    | 002    | 003    | 004    | 005    | 006    | 007    | 008    | 009    |       |       |
| SHAFT DIAMETER  | 69.970 | A      | MIN    | 0.062  | 0.063  | 0.064  | 0.065  | 0.066  | 0.067  | 0.068  | 0.065  | 0.056 | 0.057 |
|   |        |        | MAX    | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.041  | 0.042 | 0.043 |
|   | 69.971 | B      | MIN    | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066  | 0.067  | 0.068  | 0.055 | 0.056 |
|   |        |        | MAX    | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.041 | 0.042 |
|   | 69.972 | C      | MIN    | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066  | 0.067  | 0.068 | 0.055 |
|   |        |        | MAX    | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054 | 0.041 |
|   | 69.973 | D      | MIN    | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066  | 0.067 | 0.068 |
|   |        |        | MAX    | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053 | 0.054 |
|   | 69.974 | E      | MIN    | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066 | 0.067 |
|   |        |        | MAX    | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052 | 0.053 |
|   | 69.975 | F      | MIN    | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065 | 0.066 |
|   |        |        | MAX    | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051 | 0.052 |
|   | 69.976 | G      | MIN    | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064 | 0.065 |
|   |        |        | MAX    | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050 | 0.051 |
|   | 69.977 | H      | MIN    | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063 | 0.064 |
|   |        |        | MAX    | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049 | 0.050 |
|   | 69.978 | I      | MIN    | 0.054  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062 | 0.063 |
|   |        |        | MAX    | 0.039  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048 | 0.049 |
|   | 69.979 | J      | MIN    | 0.053  | 0.054  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061 | 0.062 |
|   |        |        | MAX    | 0.038  | 0.039  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047 | 0.048 |
| 69.980  | K      | MIN    | 0.052  | 0.053  | 0.054  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061 |       |
|   |        | MAX    | 0.037  | 0.038  | 0.039  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047 |       |
| 69.981  | L      | MIN    | 0.051  | 0.052  | 0.053  | 0.054  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060 |       |
|   |        | MAX    | 0.036  | 0.037  | 0.038  | 0.039  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046 |       |
| 69.982  | M      | MIN    | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059 |       |
|   |        | MAX    | 0.035  | 0.036  | 0.037  | 0.038  | 0.039  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045 |       |
| 69.983  | N      | MIN    | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.055  | 0.056  | 0.057  | 0.058 |       |
|   |        | MAX    | 0.034  | 0.035  | 0.036  | 0.037  | 0.038  | 0.039  | 0.041  | 0.042  | 0.043  | 0.044 |       |
| 69.984  | O      | MIN    | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.055  | 0.056  | 0.057 |       |
|   |        | MAX    | 0.033  | 0.034  | 0.035  | 0.036  | 0.037  | 0.038  | 0.039  | 0.041  | 0.042  | 0.043 |       |
| 69.985  | P      | MIN    | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.055  | 0.056 |       |
|   |        | MAX    | 0.032  | 0.033  | 0.034  | 0.035  | 0.036  | 0.037  | 0.038  | 0.039  | 0.041  | 0.042 |       |
| 69.986  | Q      | MIN    | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.055 |       |
|   |        | MAX    | 0.031  | 0.032  | 0.033  | 0.034  | 0.035  | 0.036  | 0.037  | 0.038  | 0.039  | 0.041 |       |
| 69.987  | R      | MIN    | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054 |       |
|   |        | MAX    | 0.030  | 0.031  | 0.032  | 0.033  | 0.034  | 0.035  | 0.036  | 0.037  | 0.038  | 0.039 |       |
| 69.988  | S      | MIN    | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053 |       |
|   |        | MAX    | 0.029  | 0.030  | 0.031  | 0.032  | 0.033  | 0.034  | 0.035  | 0.036  | 0.037  | 0.038 |       |
| 69.989  | T      | MIN    | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052 |       |
|   |        | MAX    | 0.028  | 0.029  | 0.030  | 0.031  | 0.032  | 0.033  | 0.034  | 0.035  | 0.036  | 0.037 |       |
| 69.990  | U      | MIN    | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051 |       |
|   |        | MAX    | 0.027  | 0.028  | 0.029  | 0.030  | 0.031  | 0.032  | 0.033  | 0.034  | 0.035  | 0.036 |       |

BLUE  
GRADE 3

YELLOW  
GRADE 2

RED  
GRADE 1

|                |        | MAXIMUM / MINIMUM OIL CLEARANCE (INCLUDING HOUSING SWELL) |        |        |        |        |        |        |        |        |        |        |       |       |
|----------------|--------|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|
|                |        | BLOCK DIAMETER  |        |        |        |        |        |        |        |        |        |        |       |       |
|                |        | 75.010  | 75.011 | 75.012 | 75.013 | 75.014 | 75.015 | 75.016 | 75.017 | 75.018 | 75.019 | 75.020 |       |       |
|                |        | 010   | 011    | 012    | 013    | 014    | 015    | 016    | 017    | 018    | 019    | 020    |       |       |
| SHAFT DIAMETER | 69.970 | A   | MIN    | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066  | 0.067 | 0.068 |
|                |        | MAX   | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054 |       |
|                | 69.971 | B   | MIN    | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066 | 0.067 |
|                |        | MAX   | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053 |       |
|                | 69.972 | C   | MIN    | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065 | 0.066 |
|                |        | MAX   | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052 |       |
|                | 69.973 | D   | MIN    | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064 | 0.065 |
|                |        | MAX   | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051 |       |
|                | 69.974 | E   | MIN    | 0.068  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063 | 0.064 |
|                |        | MAX   | 0.054  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050 |       |
|                | 69.975 | F   | MIN    | 0.067  | 0.068  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062 | 0.063 |
|                |        | MAX   | 0.053  | 0.054  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049 |       |
|                | 69.976 | G   | MIN    | 0.066  | 0.067  | 0.068  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061 | 0.062 |
|                |        | MAX   | 0.052  | 0.053  | 0.054  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048 |       |
|                | 69.977 | H   | MIN    | 0.065  | 0.066  | 0.067  | 0.068  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060 | 0.061 |
|                |        | MAX   | 0.051  | 0.052  | 0.053  | 0.054  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047 |       |
|                | 69.978 | I   | MIN    | 0.064  | 0.065  | 0.066  | 0.067  | 0.068  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059 | 0.060 |
|                |        | MAX   | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046 |       |
|                | 69.979 | J   | MIN    | 0.063  | 0.064  | 0.065  | 0.066  | 0.067  | 0.068  | 0.055  | 0.056  | 0.057  | 0.058 | 0.059 |
|                |        | MAX   | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045 |       |
| 69.980         | K      | MIN   | 0.062  | 0.063  | 0.064  | 0.065  | 0.066  | 0.067  | 0.068  | 0.055  | 0.056  | 0.057  | 0.058 |       |
|                | MAX    | 0.048   | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.041  | 0.042  | 0.043  | 0.044  |       |       |
| 69.981         | L      | MIN   | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066  | 0.067  | 0.068  | 0.055  | 0.056  | 0.057 |       |
|                | MAX    | 0.047   | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.041  | 0.042  | 0.043  |       |       |
| 69.982         | M      | MIN   | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066  | 0.067  | 0.068  | 0.055  | 0.056 |       |
|                | MAX    | 0.046   | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.041  | 0.042  |       |       |
| 69.983         | N      | MIN   | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066  | 0.067  | 0.068  | 0.055 |       |
|                | MAX    | 0.045   | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  | 0.041  |       |       |
| 69.984         | O      | MIN   | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066  | 0.067  | 0.068 |       |
|                | MAX    | 0.044   | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  | 0.054  |       |       |
| 69.985         | P      | MIN   | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066  | 0.067 |       |
|                | MAX    | 0.043   | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  | 0.053  |       |       |
| 69.986         | Q      | MIN   | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065  | 0.066 |       |
|                | MAX    | 0.042   | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  | 0.052  |       |       |
| 69.987         | R      | MIN   | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064  | 0.065 |       |
|                | MAX    | 0.041   | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  | 0.051  |       |       |
| 69.988         | S      | MIN   | 0.068  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063  | 0.064 |       |
|                | MAX    | 0.054   | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  | 0.050  |       |       |
| 69.989         | T      | MIN   | 0.067  | 0.068  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062  | 0.063 |       |
|                | MAX    | 0.053   | 0.054  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  | 0.049  |       |       |
| 69.990         | U      | MIN   | 0.066  | 0.067  | 0.068  | 0.055  | 0.056  | 0.057  | 0.058  | 0.059  | 0.060  | 0.061  | 0.062 |       |
|                | MAX    | 0.052   | 0.053  | 0.054  | 0.041  | 0.042  | 0.043  | 0.044  | 0.045  | 0.046  | 0.047  | 0.048  |       |       |

BLUE GRADE 3

RED GRADE 1

YELLOW GRADE 2

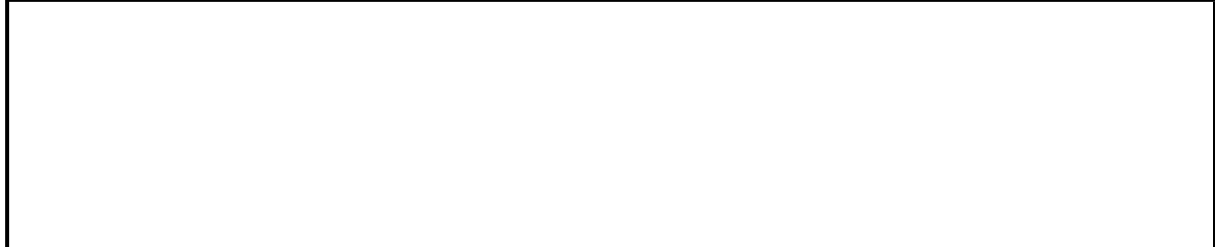
E271958

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

Using the original connecting rod cap bolts, install the connecting rod caps and bolts.

**Torque**

- :Stage 1: 177 lb.in (20 Nm)
- Stage 2: 22 lb.ft (30 Nm)
- Stage 3: 90 Å°



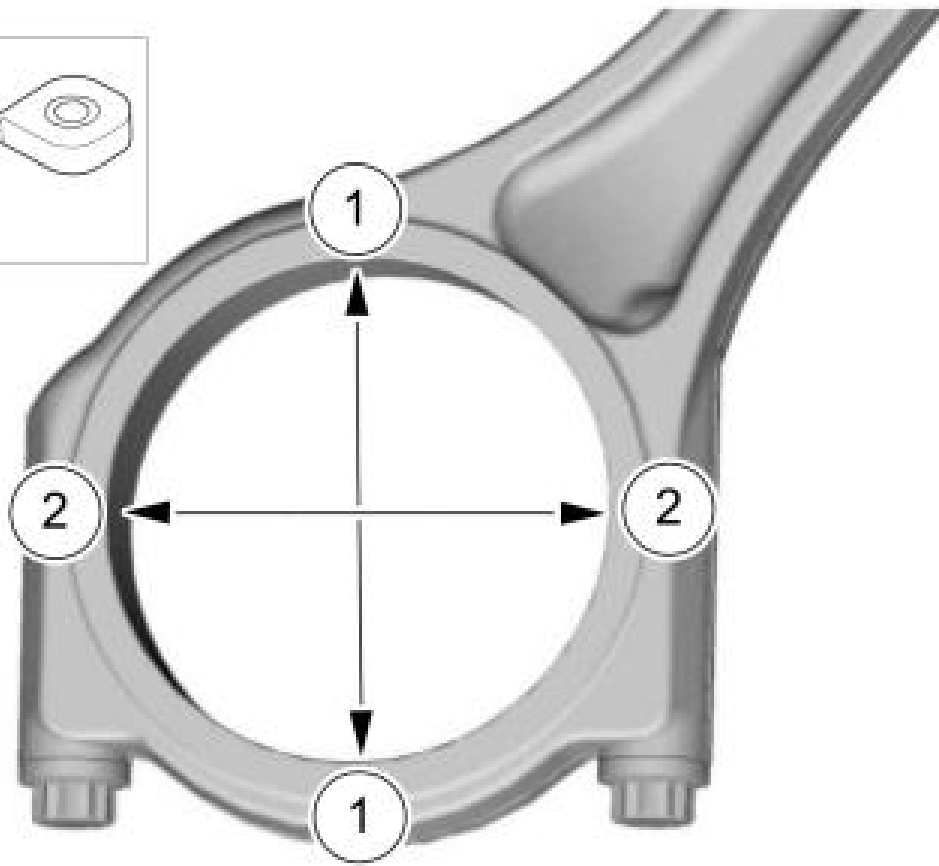
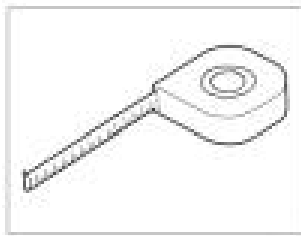


E263392

13. Measure the connecting rod large end bore in 2 directions.







E263389

14. Remove the bolts and the connecting rod caps. Discard the bolts.

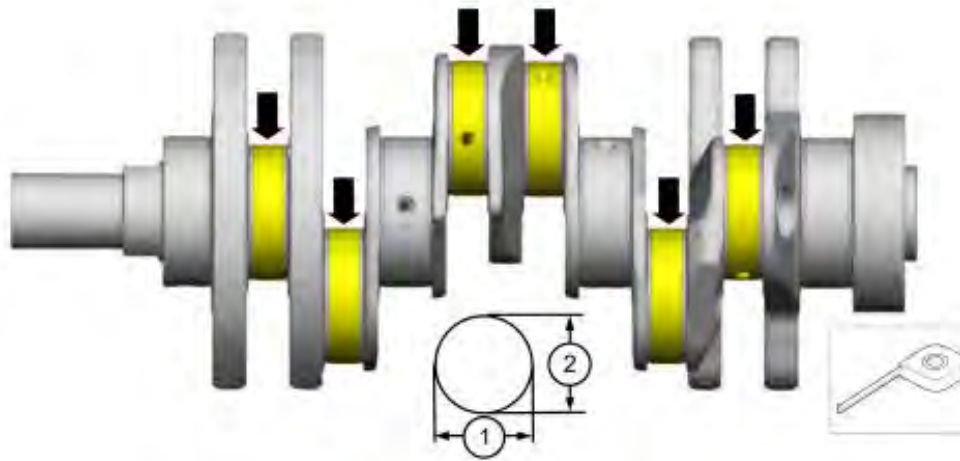




15. Measure the length or distance in two directions.

- Record the smallest measurement for each crankshaft main bearing journal.

|  |
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|  |
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E263388

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

| UPPER BEARING |            |       |       |              |
|---------------|------------|-------|-------|--------------|
|               | I.D. COLOR | MIN   | MAX   | PART NO.     |
| GRADE 1       | RED        | 1.488 | 1.498 | JL3Q-6311-AA |
| GRADE 2       | YELLOW     | 1.498 | 1.508 | JL3Q-6311-BA |
| GRADE 3       | BLUE       | 1.508 | 1.518 | JL3Q-6311-CA |

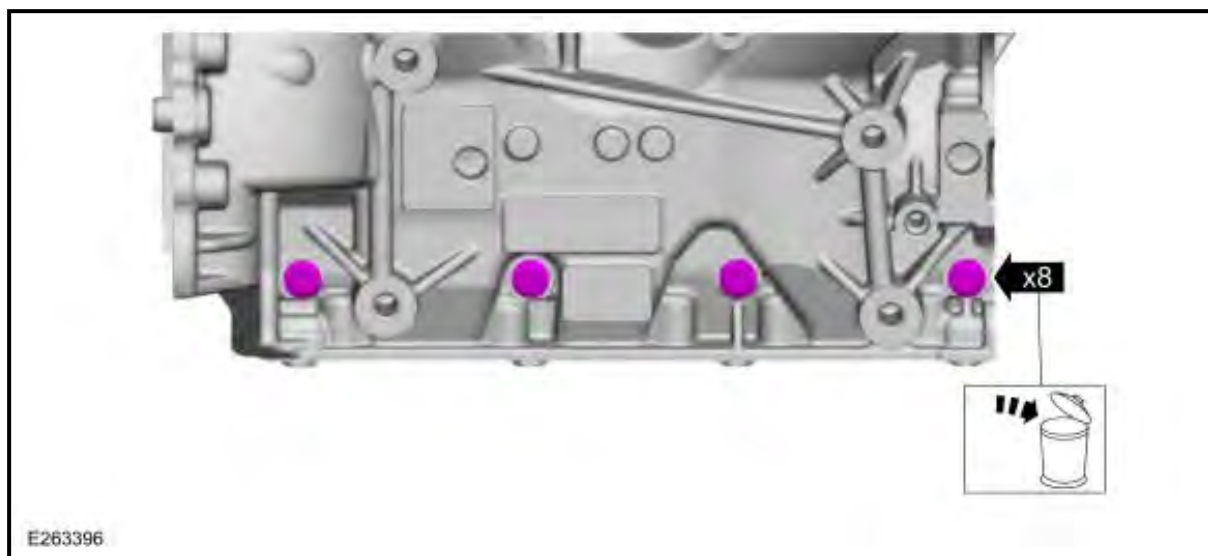
| LOWER BEARING |            |       |       |              |
|---------------|------------|-------|-------|--------------|
|               | I.D. COLOR | MIN   | MAX   | PART NO.     |
| GRADE 1       | RED        | 1.486 | 1.492 | JL3Q-6311-DA |
| GRADE 2       | YELLOW     | 1.492 | 1.498 | JL3Q-6311-EA |
| GRADE 3       | BLUE       | 1.498 | 1.504 | JL3Q-6311-FA |

| MAXIMUM / MINIMUM OIL CLEARANCE (INCLUDING HOUSING SWELL) |     |                         |               |               |               |               |               |               |               |               |               |               |               |               |               |       |
|---|-----|-------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|-------|
|   |     | CONNECTING ROD DIAMETER |               |               |               |               |               |               |               |               |               |               |               |               |               |       |
|   |     | 66.000<br>000           | 66.001<br>001 | 66.002<br>002 | 66.003<br>003 | 66.004<br>004 | 66.005<br>005 | 66.006<br>006 | 66.007<br>007 | 66.008<br>008 | 66.009<br>009 | 66.010<br>010 | 66.011<br>011 | 66.012<br>012 | 66.013<br>013 |       |
| 62.958  | A   | MIN                     | 0.073         | 0.074         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074         | 0.075         | 0.076 |
|   | MAX | 0.057                   | 0.058         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.059         | 0.060         |       |
| 62.959  | B   | MIN                     | 0.072         | 0.073         | 0.074         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074         | 0.075 |
|   | MAX | 0.056                   | 0.057         | 0.058         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.059         | 0.060 |
| 62.960  | C   | MIN                     | 0.071         | 0.072         | 0.073         | 0.074         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074 |
|   | MAX | 0.055                   | 0.056         | 0.057         | 0.058         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.059 |
| 62.961  | D   | MIN                     | 0.070         | 0.071         | 0.072         | 0.073         | 0.074         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073 |
|   | MAX | 0.054                   | 0.055         | 0.056         | 0.057         | 0.058         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058 |
| 62.962  | E   | MIN                     | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072 |
|   | MAX | 0.053                   | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057 |
| 62.963  | F   | MIN                     | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071 |
|   | MAX | 0.052                   | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056 |
| 62.964  | G   | MIN                     | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070 |
|   | MAX | 0.051                   | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055 |
| 62.965  | H   | MIN                     | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069 |
|   | MAX | 0.050                   | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054 |
| 62.966  | I   | MIN                     | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074         | 0.065         | 0.066         | 0.067         | 0.068 |
|   | MAX | 0.049                   | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053 |
| 62.967  | J   | MIN                     | 0.064         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074         | 0.065         | 0.066         | 0.067 |
|   | MAX | 0.048                   | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.049         | 0.050         | 0.051         | 0.052 |
| 62.968  | K   | MIN                     | 0.063         | 0.064         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074         | 0.065         | 0.066 |
|   | MAX | 0.047                   | 0.048         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.049         | 0.050         | 0.051 |
| 62.969  | L   | MIN                     | 0.062         | 0.063         | 0.064         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074         | 0.065 |
|   | MAX | 0.046                   | 0.047         | 0.048         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.059         | 0.060 |
| 62.970  | M   | MIN                     | 0.061         | 0.062         | 0.063         | 0.064         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073         | 0.074 |
|   | MAX | 0.045                   | 0.046         | 0.047         | 0.048         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.059 |
| 62.971  | N   | MIN                     | 0.060         | 0.061         | 0.062         | 0.063         | 0.064         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072         | 0.073 |
|   | MAX | 0.044                   | 0.045         | 0.046         | 0.047         | 0.048         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058 |
| 62.972  | O   | MIN                     | 0.059         | 0.060         | 0.061         | 0.062         | 0.063         | 0.064         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071         | 0.072 |
|   | MAX | 0.043                   | 0.044         | 0.045         | 0.046         | 0.047         | 0.048         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056         | 0.057 |
| 62.973  | P   | MIN                     | 0.058         | 0.059         | 0.060         | 0.061         | 0.062         | 0.063         | 0.064         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070         | 0.071 |
|   | MAX | 0.042                   | 0.043         | 0.044         | 0.045         | 0.046         | 0.047         | 0.048         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055         | 0.056 |
| 62.974  | Q   | MIN                     | 0.057         | 0.058         | 0.059         | 0.060         | 0.061         | 0.062         | 0.063         | 0.064         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069         | 0.070 |
|   | MAX | 0.041                   | 0.042         | 0.043         | 0.044         | 0.045         | 0.046         | 0.047         | 0.048         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054         | 0.055 |
| 62.975  | R   | MIN                     | 0.056         | 0.057         | 0.058         | 0.059         | 0.060         | 0.061         | 0.062         | 0.063         | 0.064         | 0.065         | 0.066         | 0.067         | 0.068         | 0.069 |
|   | MAX | 0.040                   | 0.041         | 0.042         | 0.043         | 0.044         | 0.045         | 0.046         | 0.047         | 0.048         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053         | 0.054 |
| 62.976  | S   | MIN                     | 0.055         | 0.056         | 0.057         | 0.058         | 0.059         | 0.060         | 0.061         | 0.062         | 0.063         | 0.064         | 0.065         | 0.066         | 0.067         | 0.068 |
|   | MAX | 0.039                   | 0.040         | 0.041         | 0.042         | 0.043         | 0.044         | 0.045         | 0.046         | 0.047         | 0.048         | 0.049         | 0.050         | 0.051         | 0.052         | 0.053 |
| 62.977  | T   | MIN                     | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.059         | 0.060         | 0.061         | 0.062         | 0.063         | 0.064         | 0.065         | 0.066         | 0.067 |
|   | MAX | 0.038                   | 0.039         | 0.040         | 0.041         | 0.042         | 0.043         | 0.044         | 0.045         | 0.046         | 0.047         | 0.048         | 0.049         | 0.050         | 0.051         | 0.052 |
| 62.978  | U   | MIN                     | 0.053         | 0.054         | 0.055         | 0.056         | 0.057         | 0.058         | 0.059         | 0.060         | 0.061         | 0.062         | 0.063         | 0.064         | 0.065         | 0.066 |
|   | MAX | 0.037                   | 0.038         | 0.039         | 0.040         | 0.041         | 0.042         | 0.043         | 0.044         | 0.045         | 0.046         | 0.047         | 0.048         | 0.049         | 0.050         | 0.051 |

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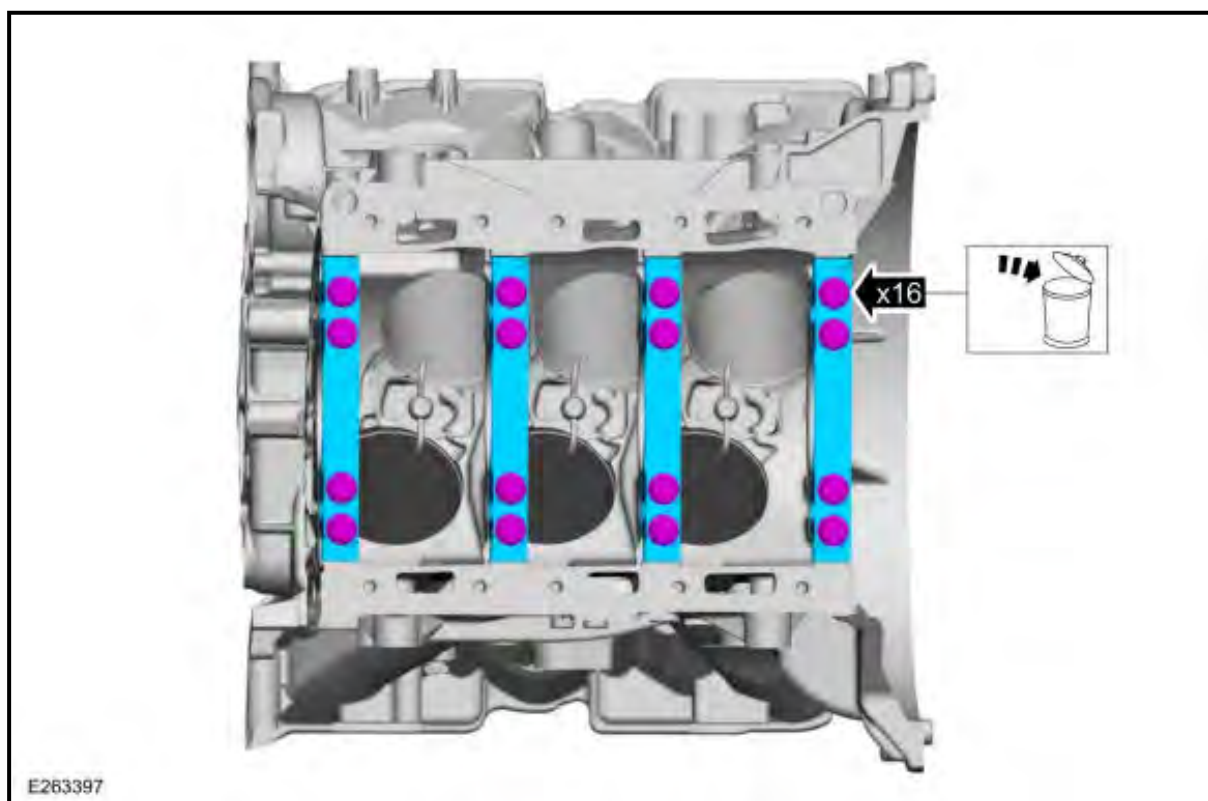
17. **NOTE:** RH side shown, LH side similar.

Remove and discard the main bearing cap side bolts.



18. Remove the bolts and the main bearing caps.

- Discard the bolts.

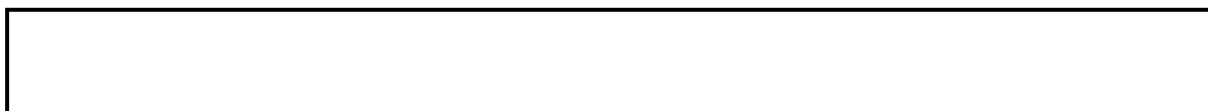


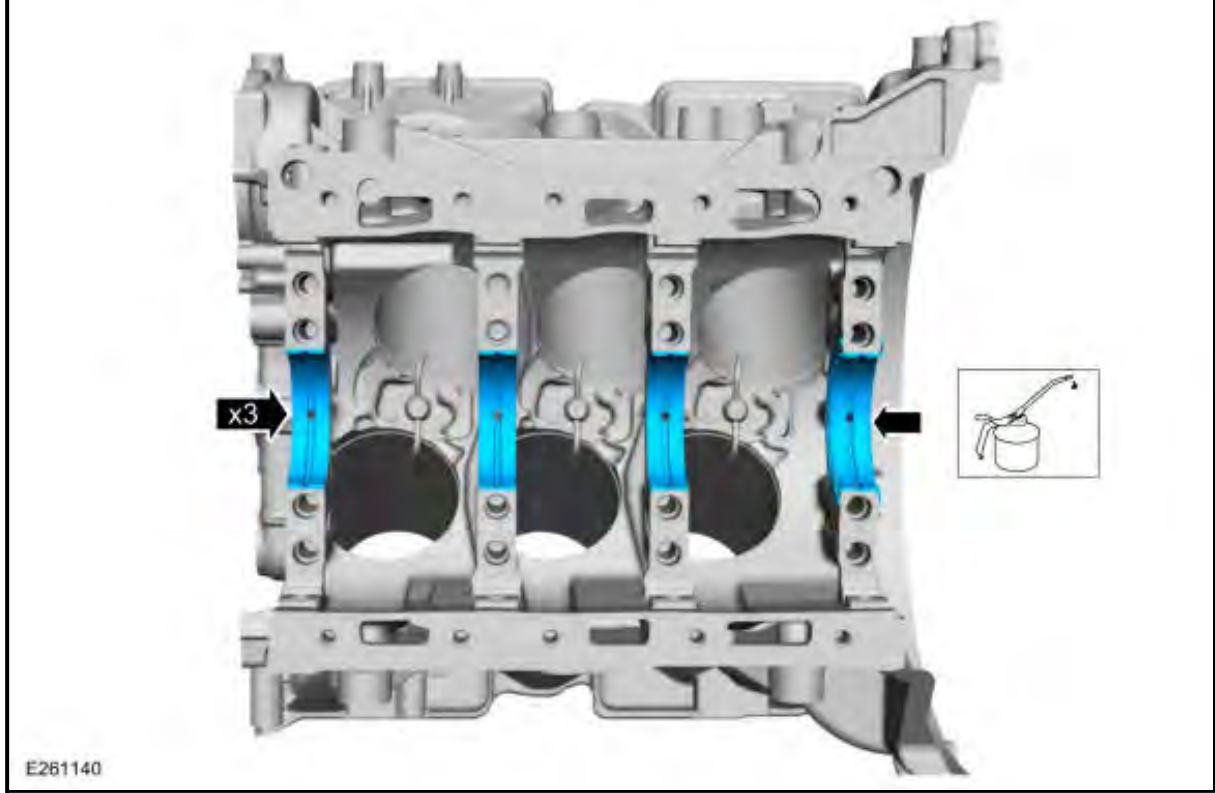
19. **NOTE:** Before assembling the cylinder block, all sealing surfaces must be free of chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

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

Install the upper crankshaft bearings and lubricate.

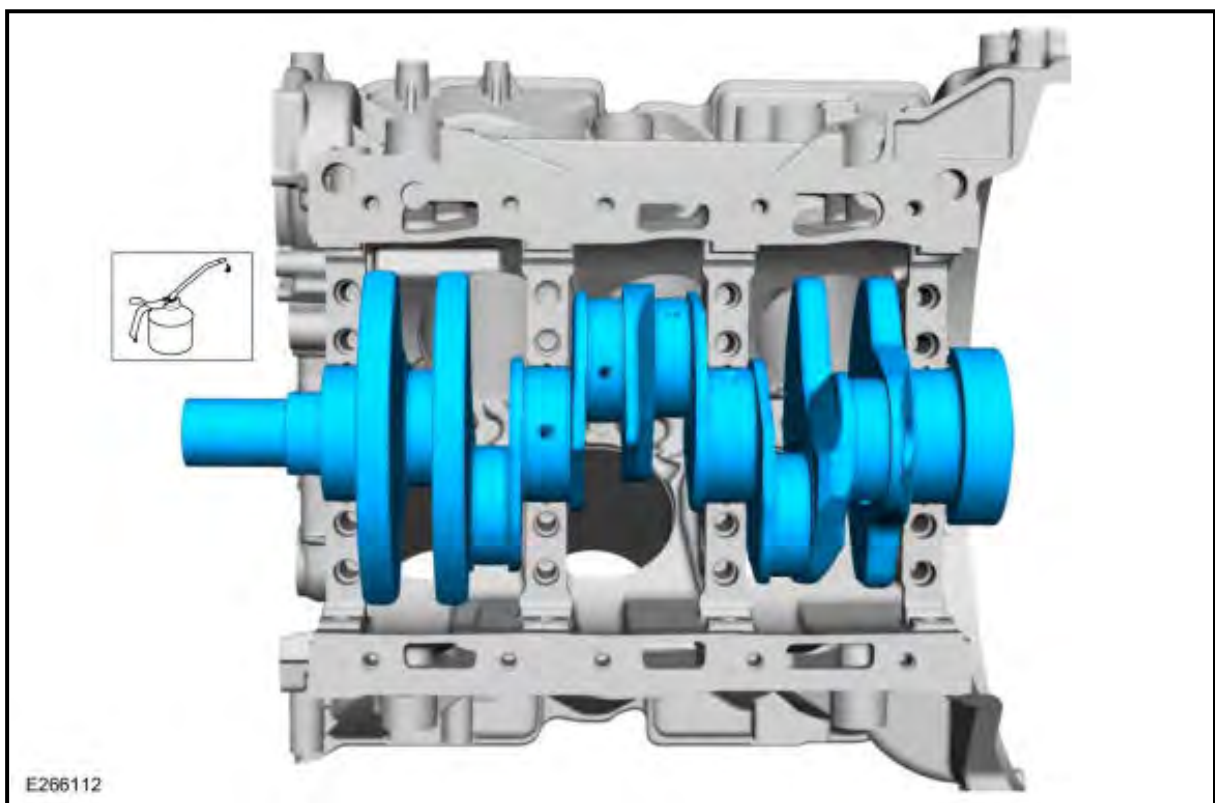
Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)





20. Lubricate with clean engine oil and install the crankshaft.

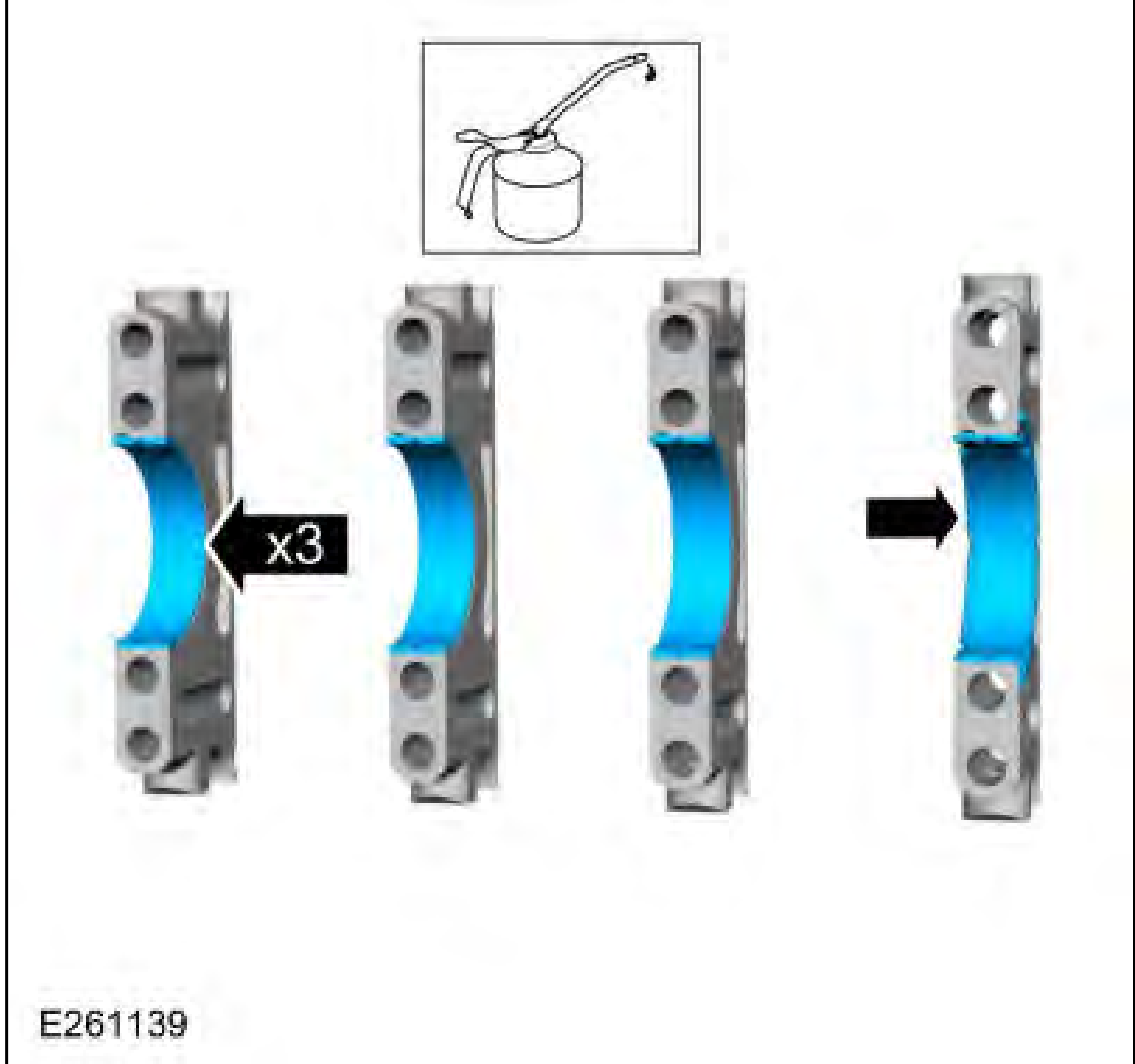
Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)



21. Lubricate the crankshaft lower main bearings with clean engine oil and install them into the main bearing caps. Check seating and squareness of the bearings to make sure of proper seating in caps.

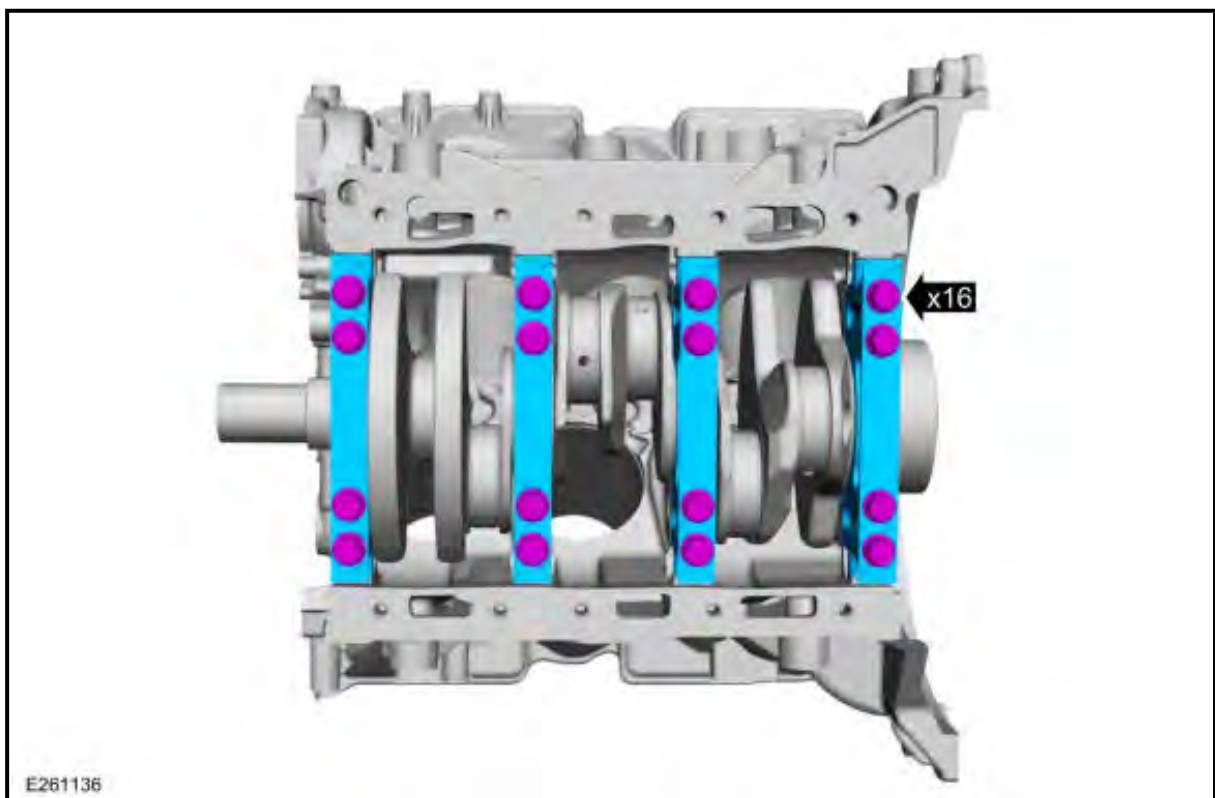
Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)





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

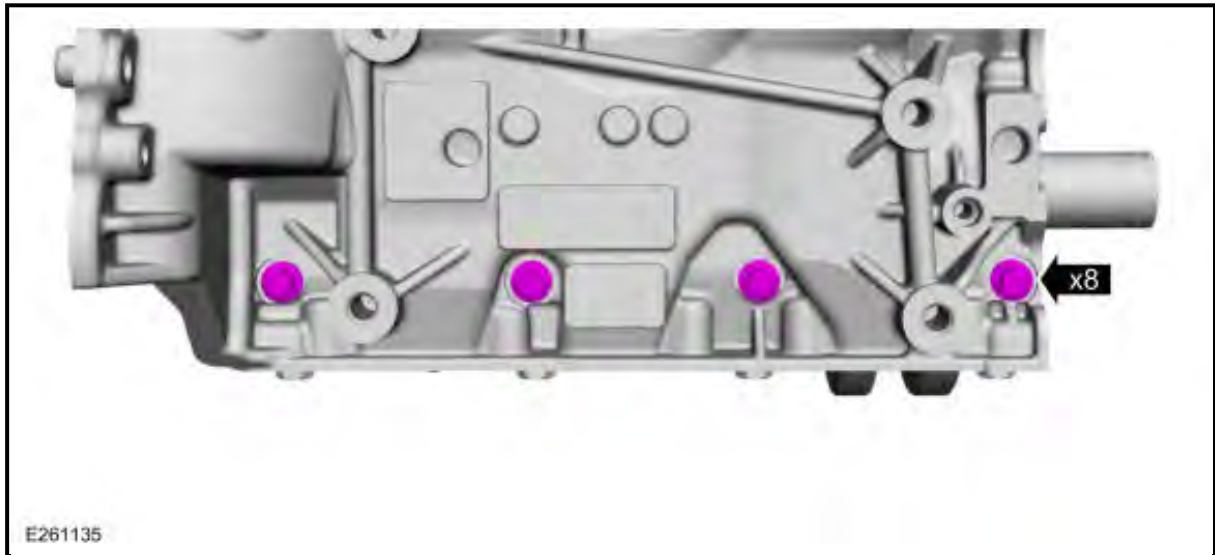
Install the main bearing caps and the bolts.



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

**NOTE:** RH side shown, LH side similar.

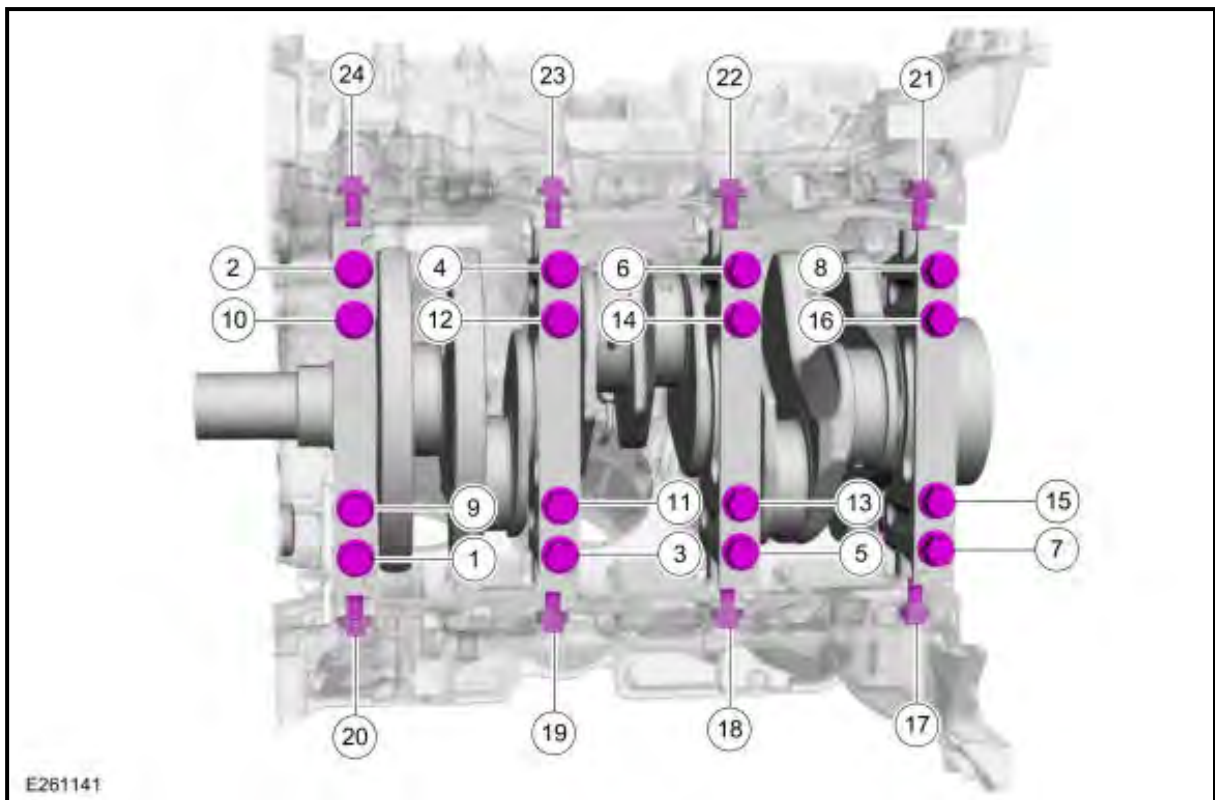
Install the main bearing cap side bolts.



24. Tighten the main bearing bolts.

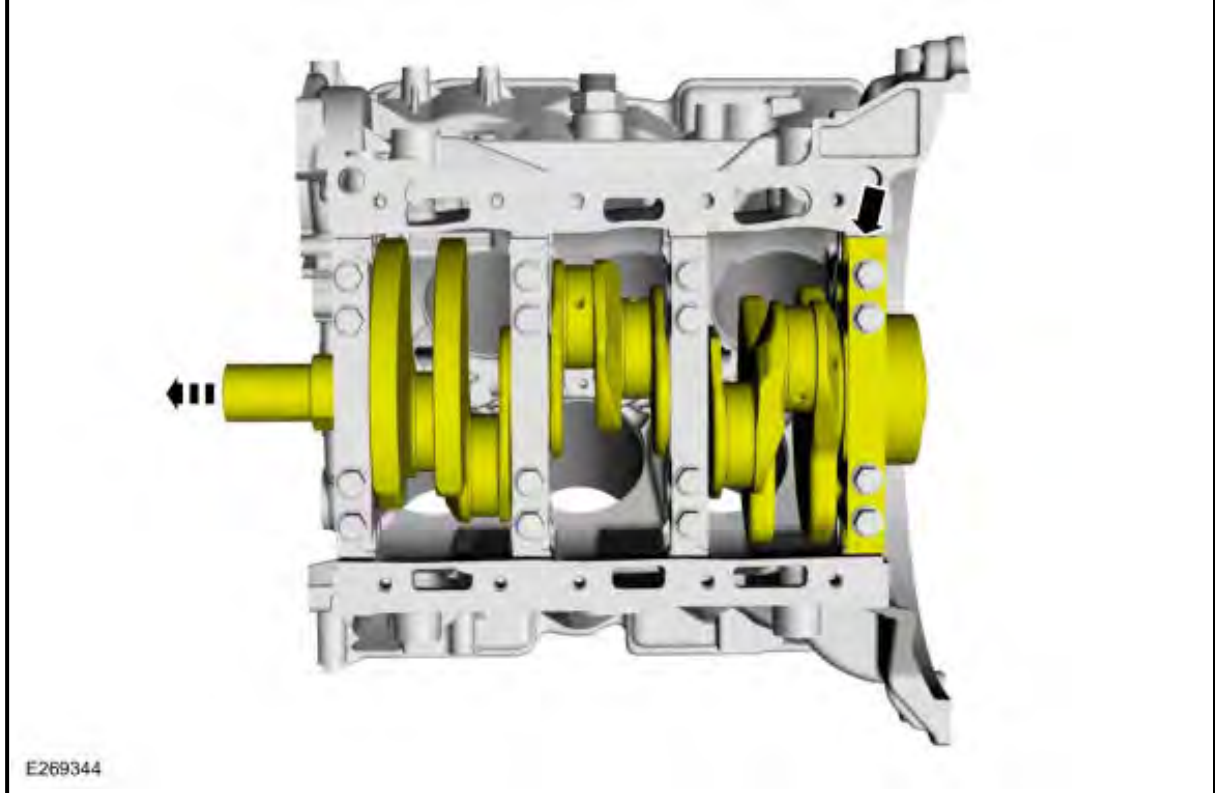
### Torque

- Stage 1: Tighten bolts 1 thru 6 and 9 thru 14 to : 30 lb.ft (40 Nm)
- Stage 2: Tighten bolts 1 thru 6 and 9 thru 14 to : 66 lb.ft (90 Nm)
- Stage 3: Tighten bolts 1 thru 6 and 9 thru 14, an additional : 45 Å°
- Stage 4: Tighten bolts 1 thru 6 and 9 thru 14, a second time, an additional : 45 Å°



25. Push the crankshaft forward to the front of the engine to align the thrust bearings to the cylinder block.

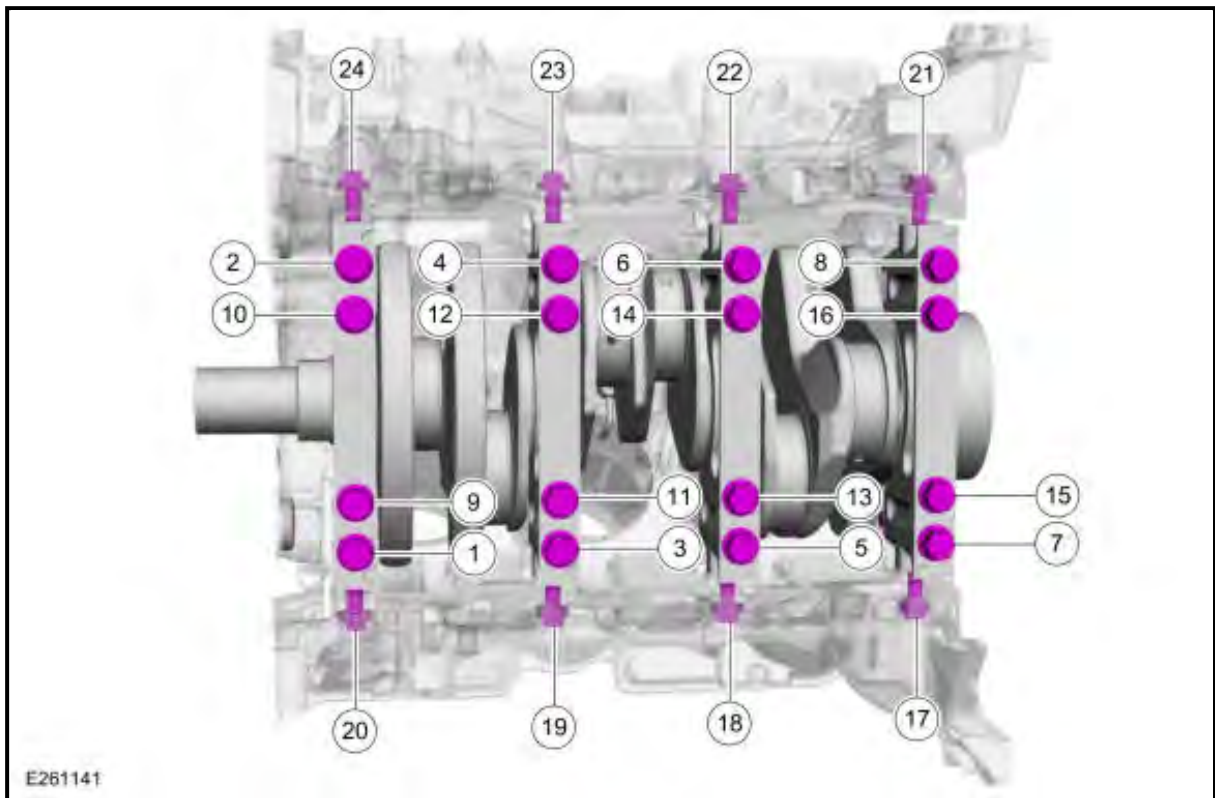




26. Tighten the main bearing bolts.

### Torque

- :Stage 1: Tighten bolts 15&16 and 7&8 to : 30 lb.ft (40 Nm)
- Stage 2: Tighten bolts 15&16 and 7&8 to : 66 lb.ft (90 Nm)
- Stage 3: Tighten bolts 15&16 and 7&8, an additional : 45 Å°
- Stage 4: Tighten bolts 15&16 and 7&8, a second time, an additional : 45 Å°
- Stage 5: Tighten bolts 17 thru 24 to : 124 lb.in (14 Nm)
- Stage 6: Tighten bolts 17 thru 24, an additional : 45 Å°

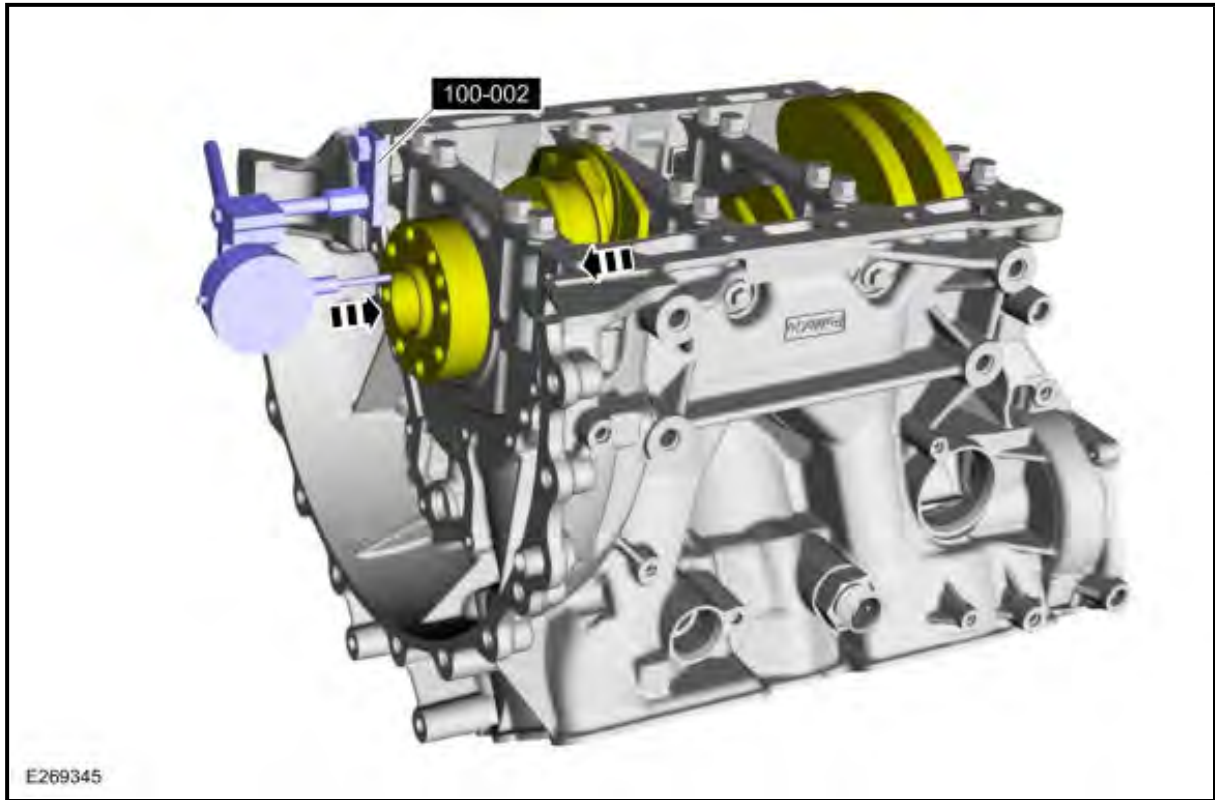


27.

- Position the crankshaft to the rear of the cylinder block. Use Special Service Tool: 100-002 (TOOL-4201-C) Holding Fixture with Dial Indicator Gauge.



- Zero the Dial Indicator Gauge.
- Move the crankshaft to the front of the cylinder block. Measure and record the crankshaft end play. Refer to: [Specifications](#) .

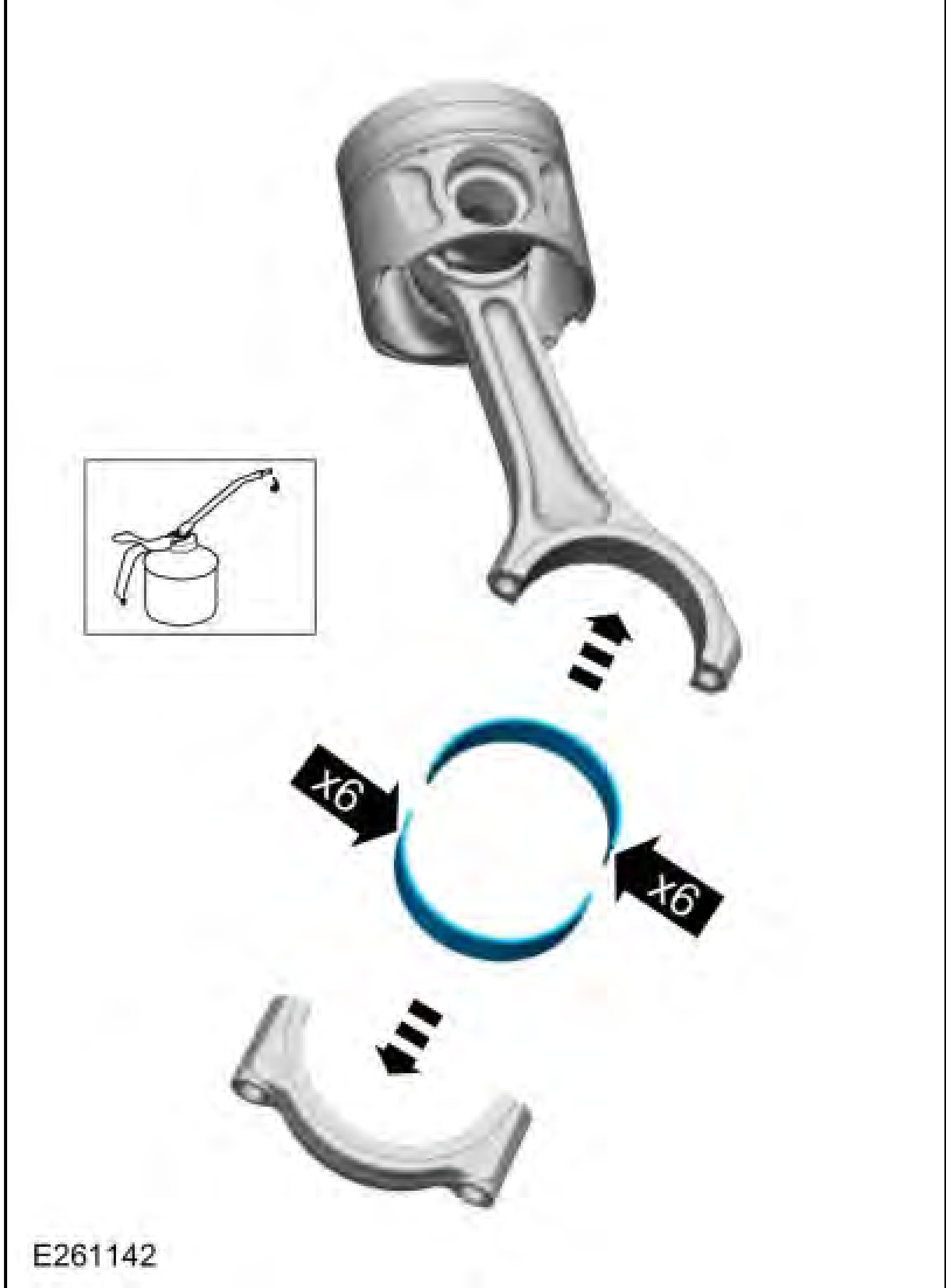


28. **NOTE:** If reusing the connecting rod bearings, install them in their original positions and orientation as noted during disassembly.

Install the connecting rod bearings and lubricate.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

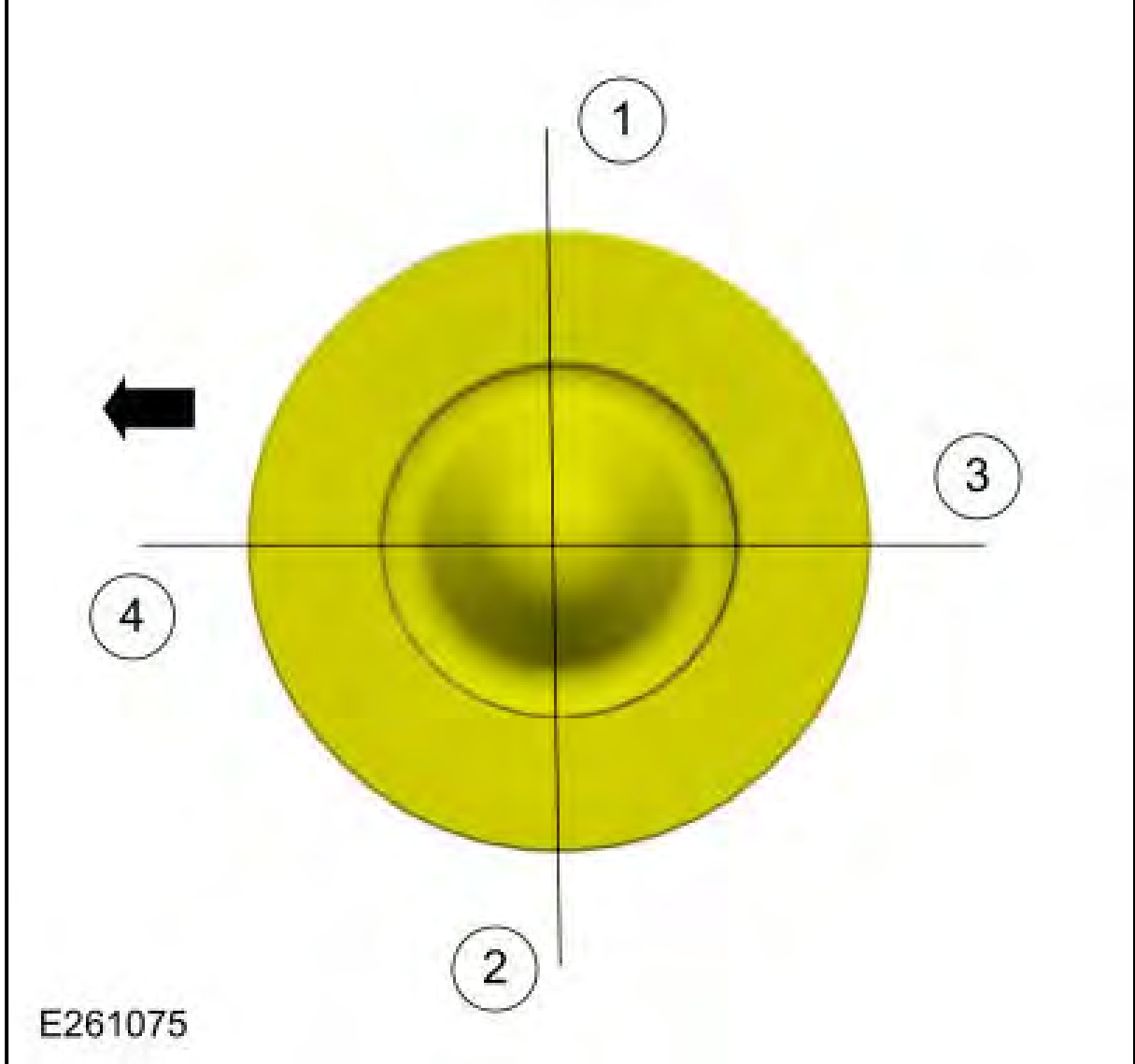




29. **NOTE:** The arrow on the top of the piston indicates the front of the engine.

1. Upper compression ring gap location
2. Lower compression ring gap location.
3. Piston oil control ring gap location.
4. Piston oil control ring gap location.



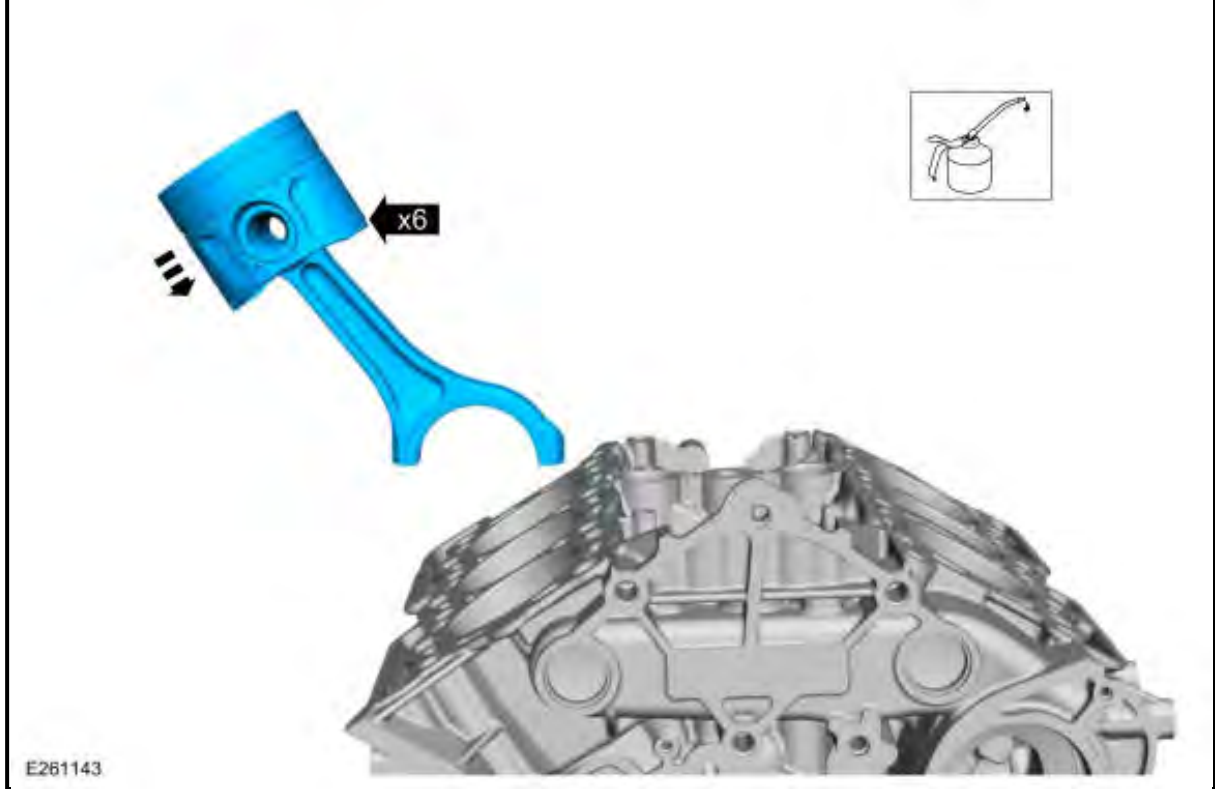


30. **NOTE:** Be sure not to scratch the cylinder wall or crankshaft journal with the connecting rod. Be sure not to damage or bend the piston oil cooling jets when seating the connecting rod on the crankshaft journal. Push the piston down until the connecting rod bearing seats on the crankshaft journal.
- NOTE:** Lubricate the pistons, piston rings, connecting rod bearings and the entire cylinder bores with clean engine oil.
- NOTE:** If the piston and or connecting rod are being installed new, the piston rod orientation marks and the arrow on the top of the dome of the piston should be facing toward the front of the engine block.
- NOTE:** If the piston and connecting rod are to be reinstalled, they must be installed in the same orientation as disassembled.

Using the Piston Ring Compressor, install the piston and connecting rod assemblies. Repeat until all 6 piston assemblies are installed. Use the General Equipment: Piston Ring Compressor

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)





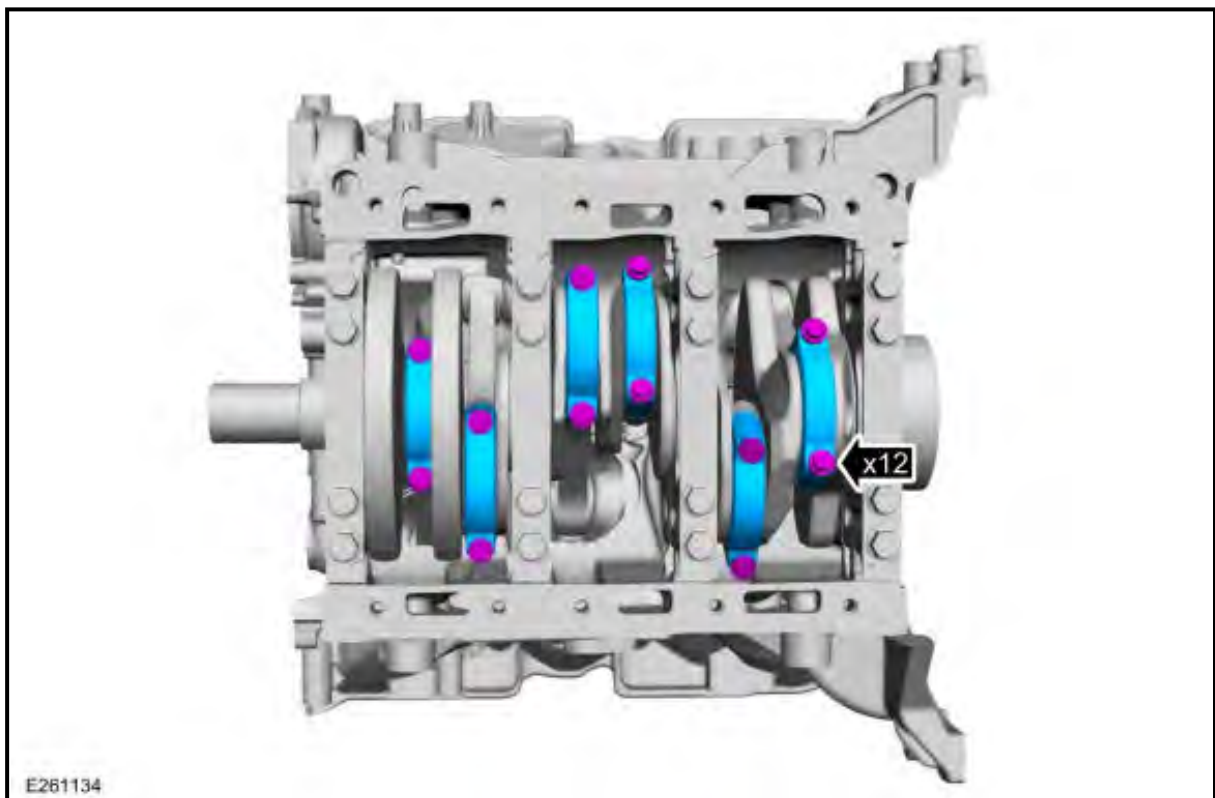
31. **NOTE:** The rod cap installation must keep the same orientation as marked during disassembly or engine damage may occur.

**NOTE:** After installation of each piston, connecting rod, rod cap and bolts, rotate the crankshaft to verify smooth operation.

Install the connecting rod cap and the new bolts.

#### Torque

- :Stage 1: 177 lb.in (20 Nm)
- Stage 2: 22 lb.ft (30 Nm)
- Stage 3: 90 Â°



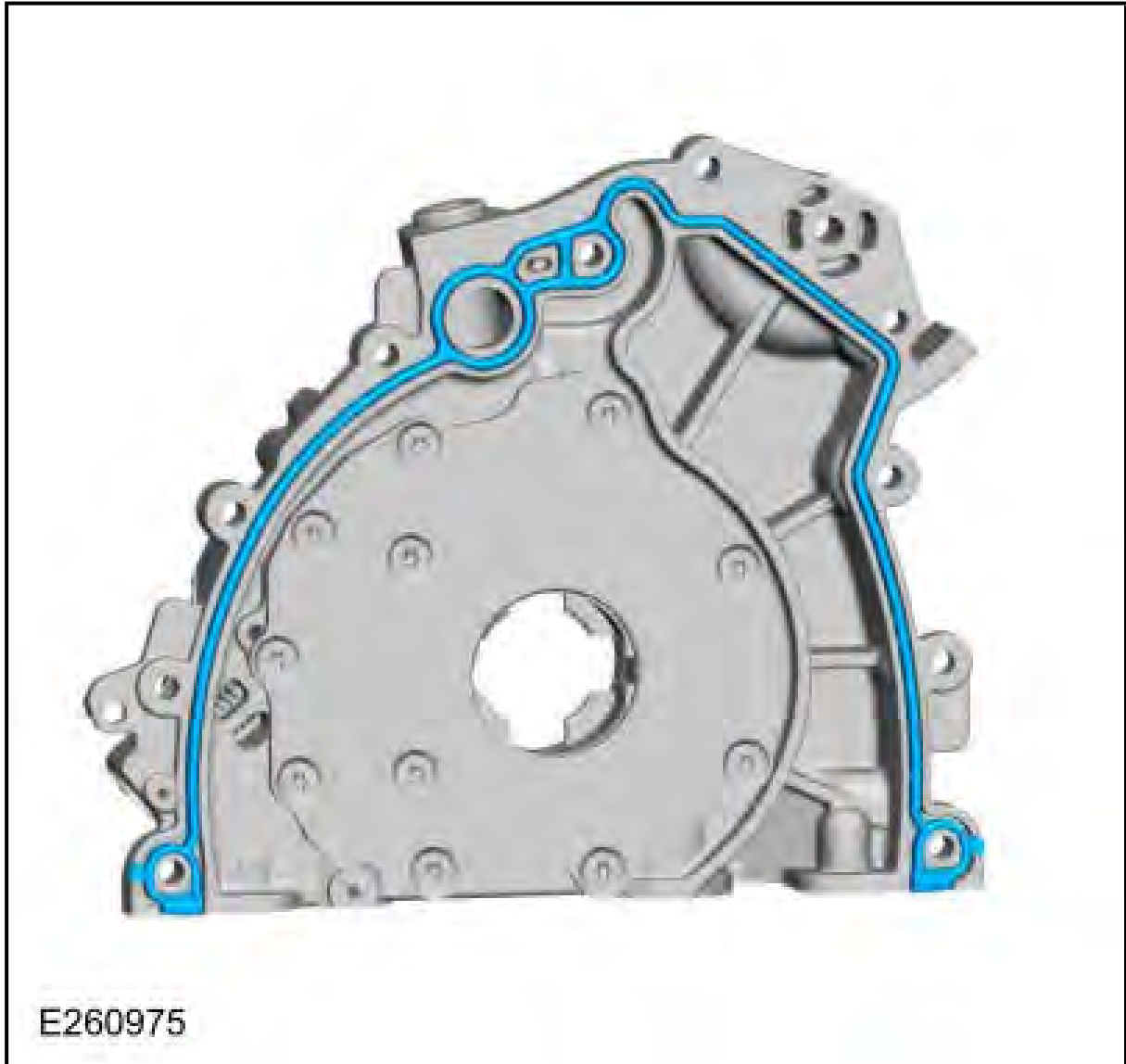
32. **NOTE:** Only rotate the oil pump in the clockwise direction when viewed

**from the front. Counter clockwise rotation will cause damage to the oil pump assembly.**

Prime the oil pump. Add 2 tablespoons of clean engine oil to the oil pump and rotate the oil pump by hand.

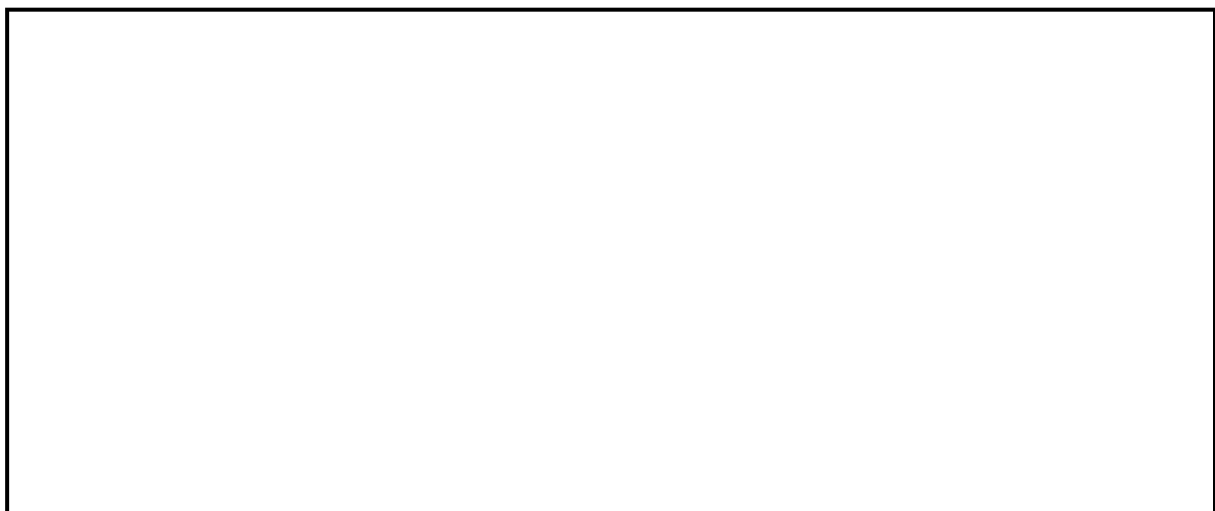
Material: Motorcraft  $\hat{A}$ ® SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

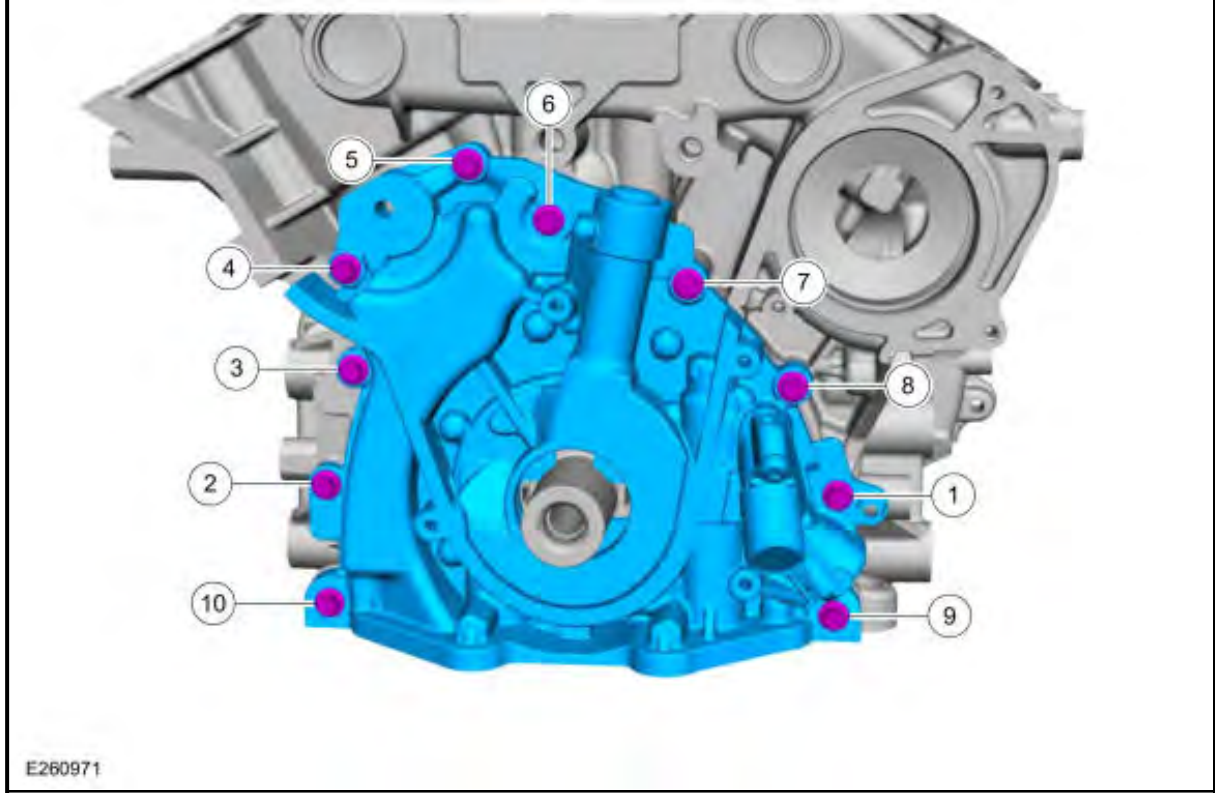
33. Install a new oil pump gasket.



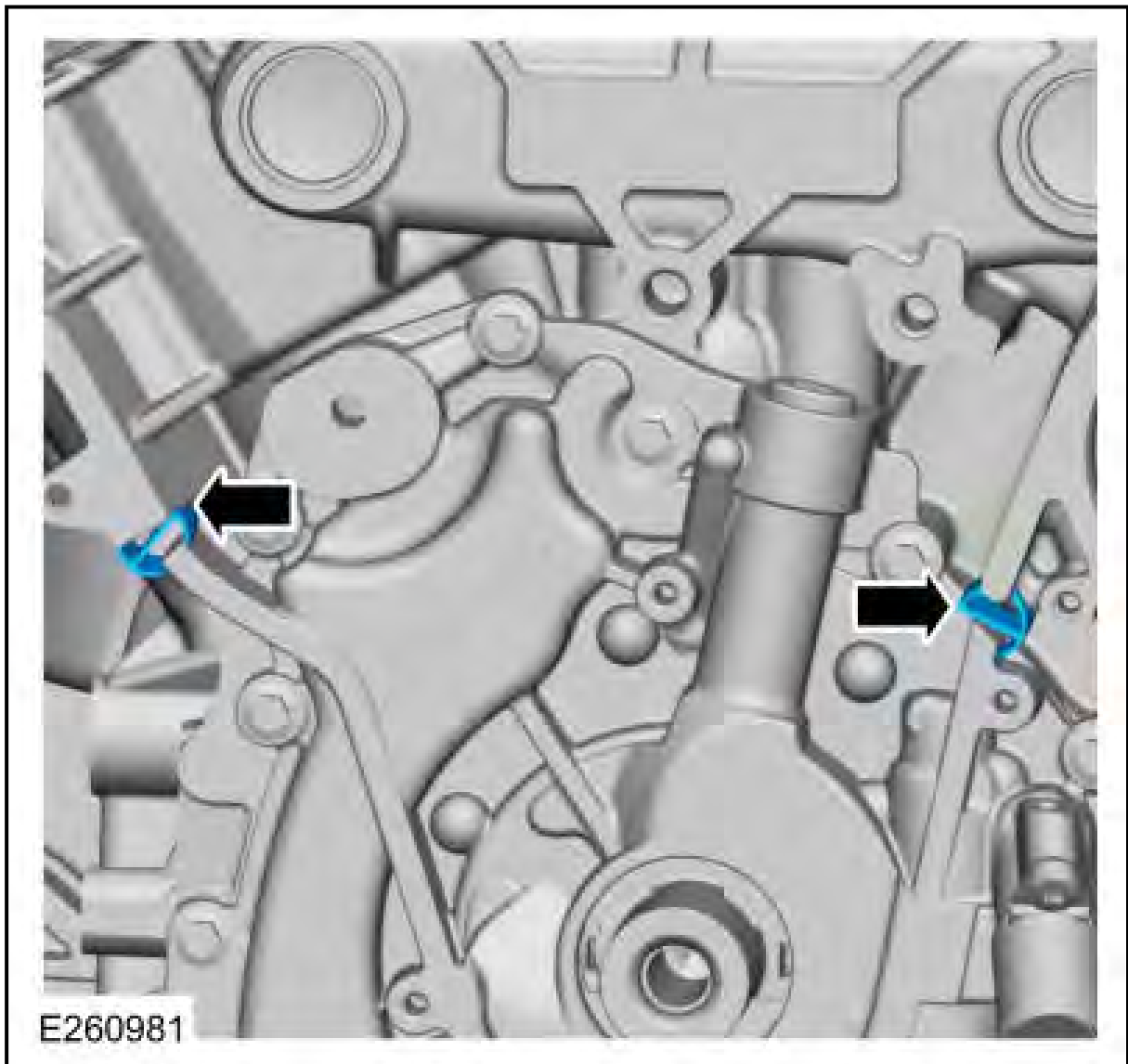
34. Install the oil pump and the bolts.

Torque: Torque all bolts to : 89 lb.in (10 Nm) Tighten bolts 1, 2 and 3 a second time to: : 89 lb.in (10 Nm)



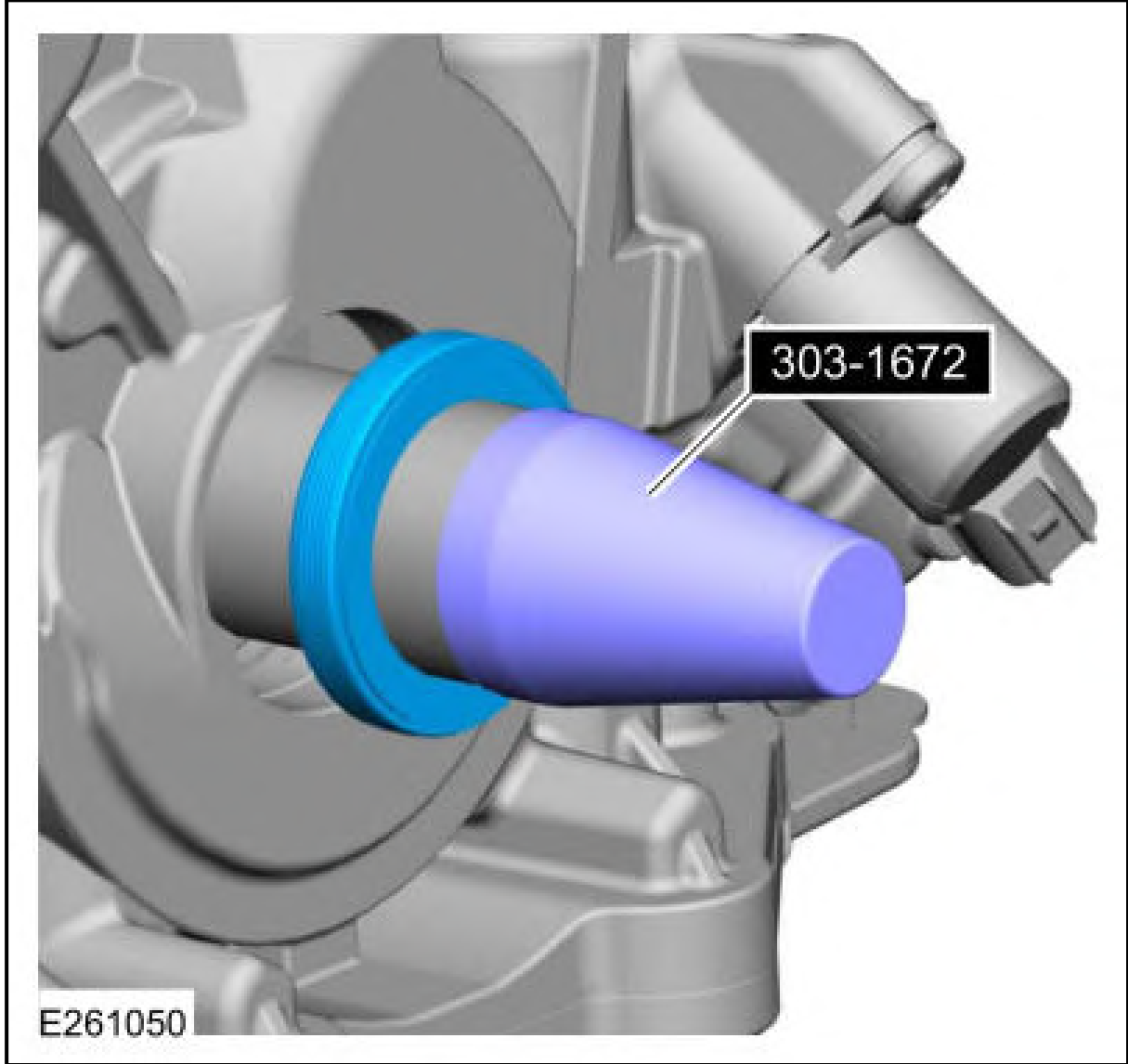


35. Install the oil pump body-to-cylinder block seals.

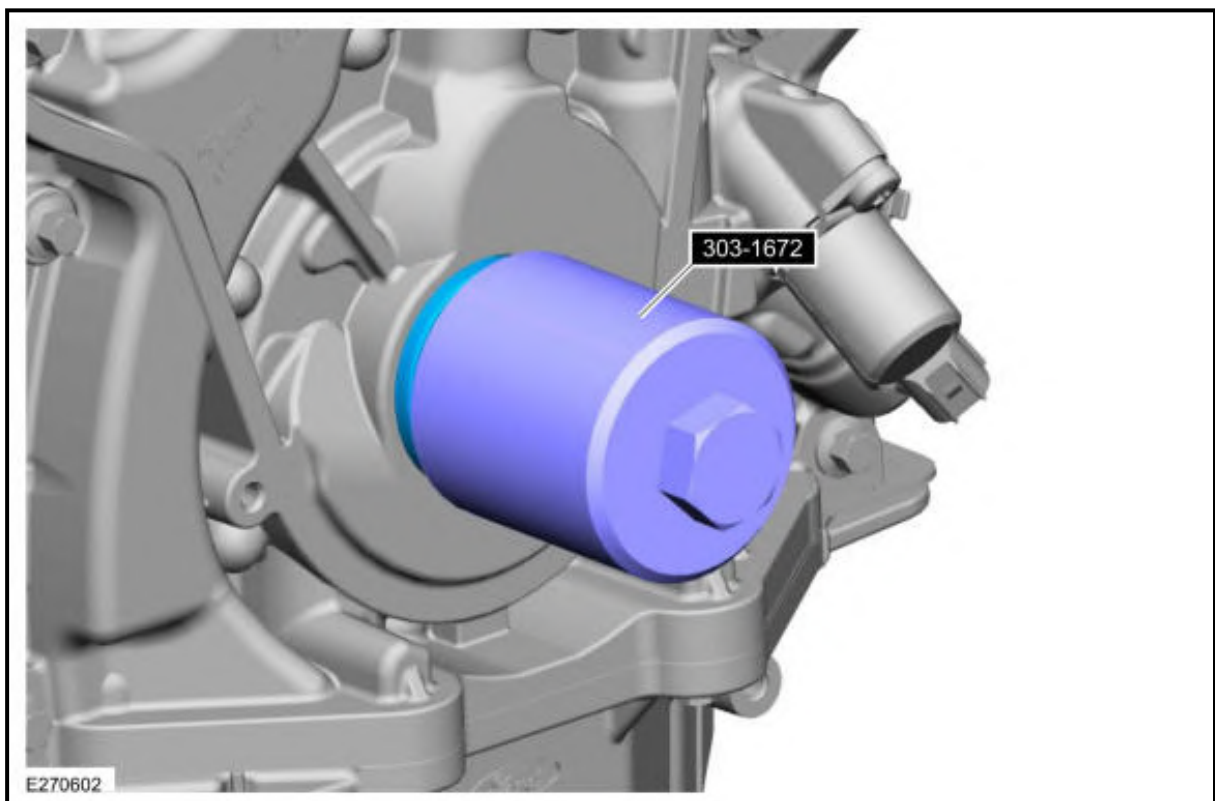


36. **NOTE:** Rotate the seal as the seal is being installed on the crankshaft.

Using the special tool, position the crankshaft front seal on the crankshaft. Use Special Service Tool: 303-1672 Installer, Crankshaft Seal.



37. Using the special tool, install the crankshaft front seal. Use Special Service Tool: 303-1672 Installer, Crankshaft Seal.

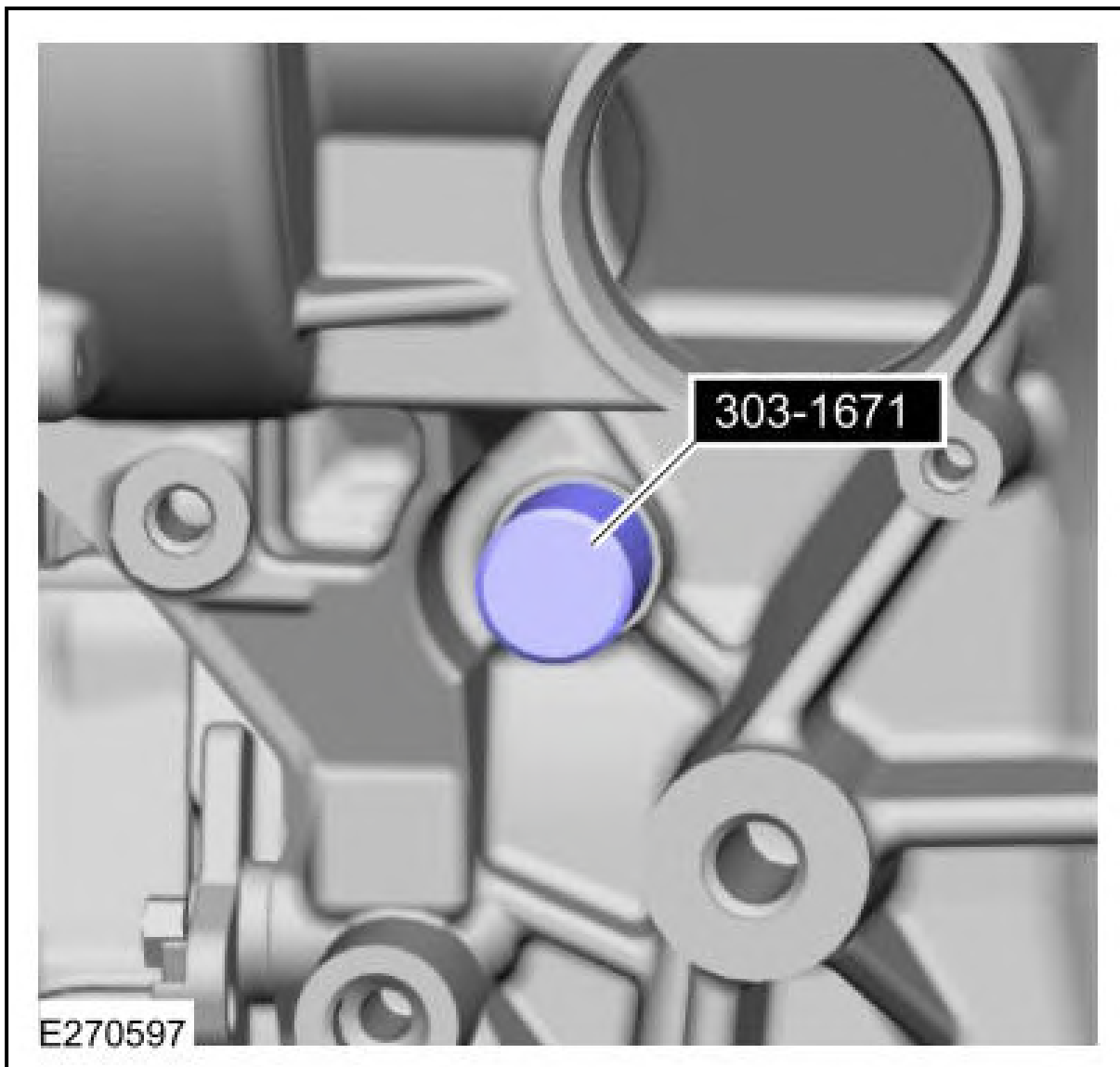


38. Install special tool.

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

**NOTE:** The Locking Crankshaft Pin must be bottomed out against the cylinder block.

Rotate the crankshaft clockwise so the crankshaft contacts the locking crankshaft pin. Use Special Service Tool: 303-1671 Pin, Locking Crankshaft.



39. **NOTE:** Align the crankshaft sprocket tab with the rib of the oil pump.

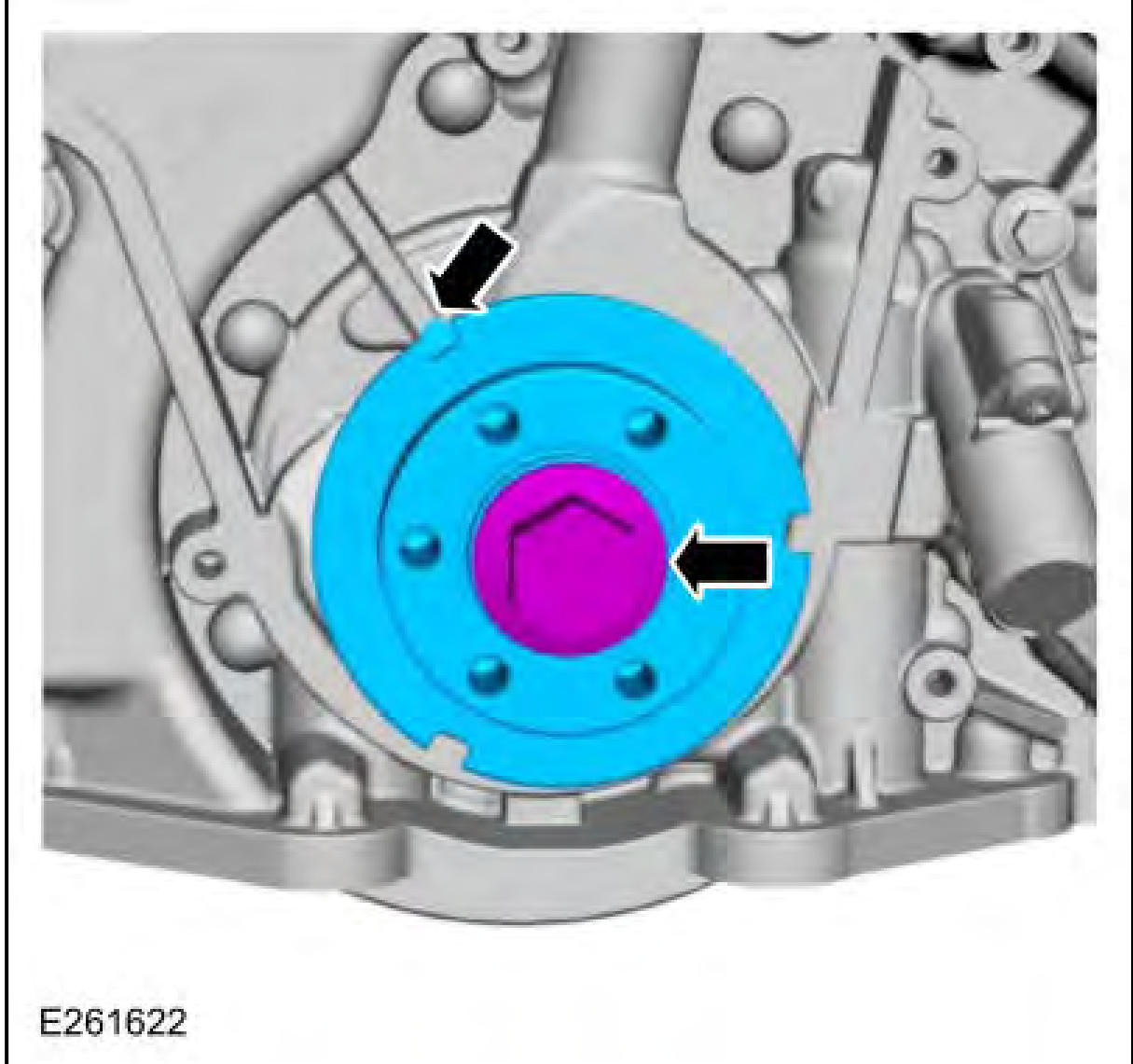
**NOTE:** Final torque will be done after the engine is off the mounting stand.

Install the crankshaft sprocket and the bolt.

Torque: 74 lb.ft (100 Nm)

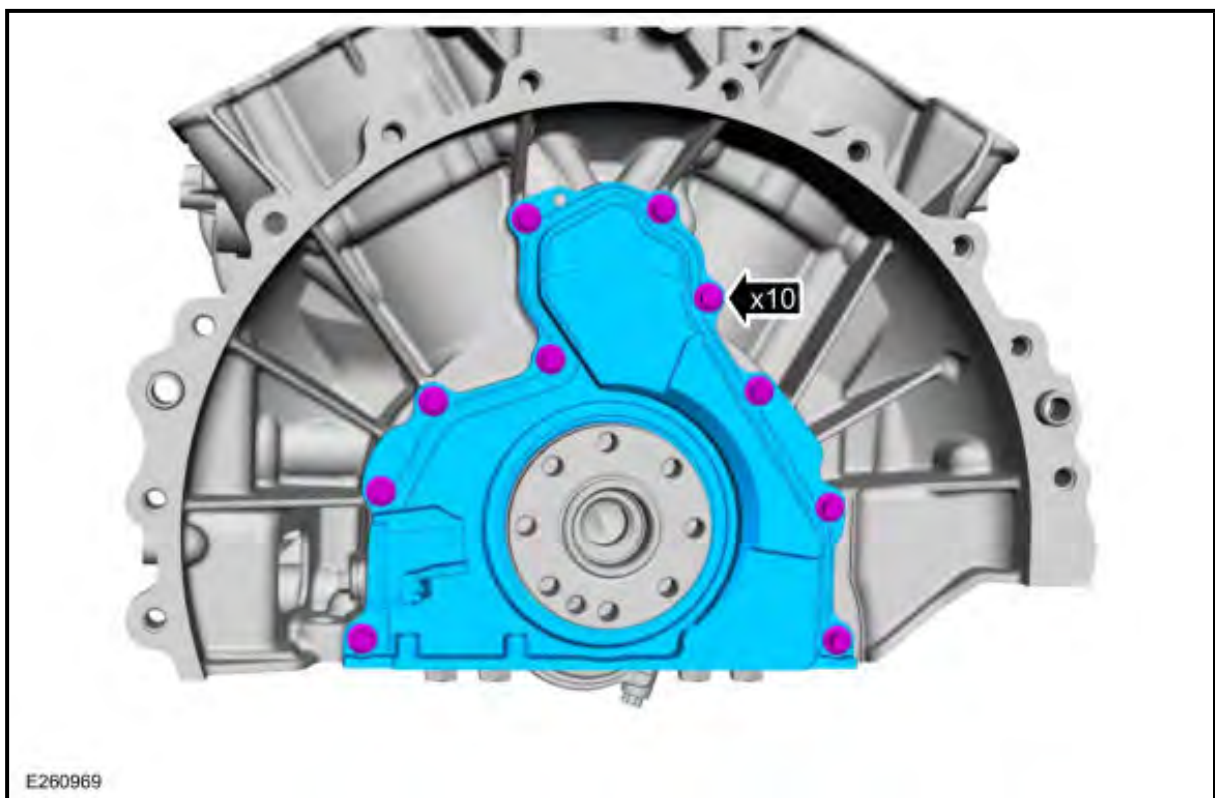






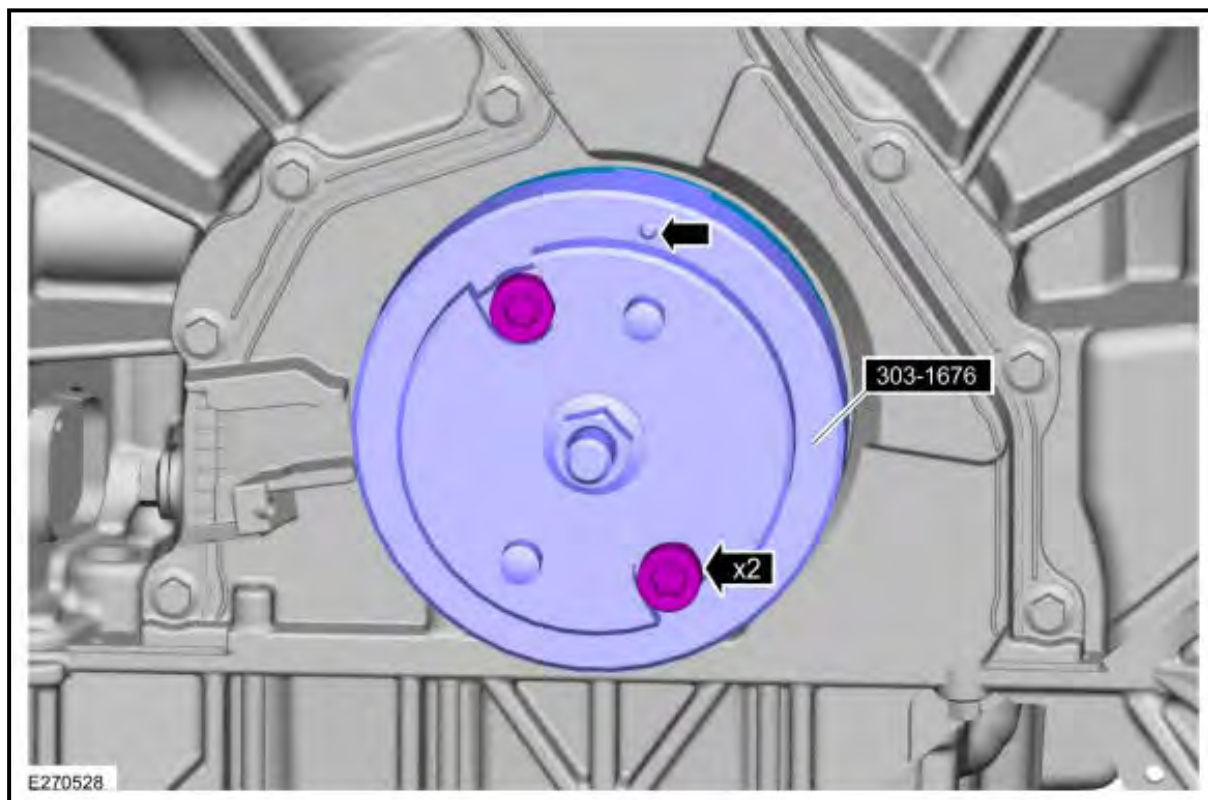
40. Install the crankshaft rear seal retainer and the bolts.

Torque: 89 lb.in (10 Nm)



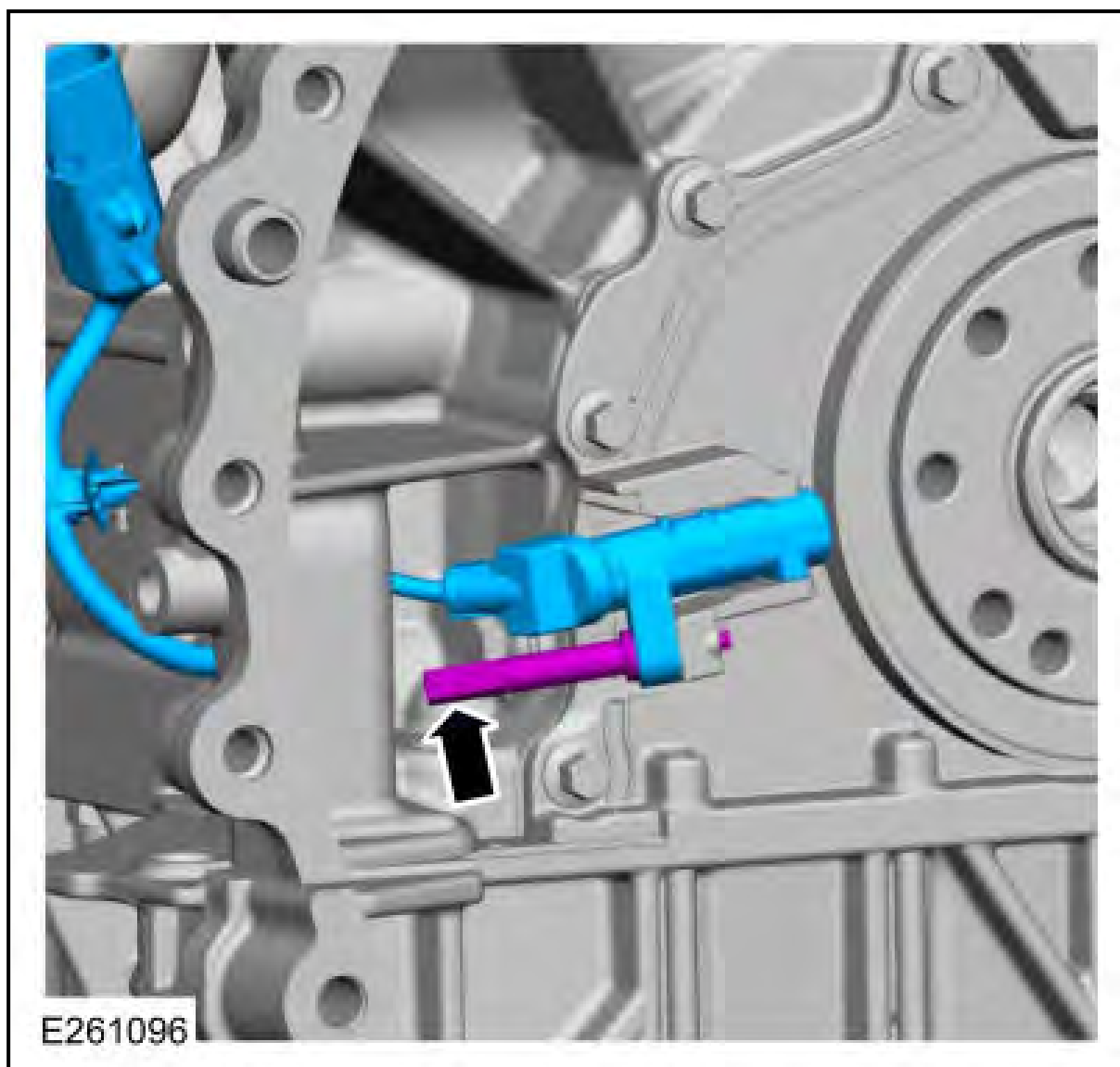
41. **NOTE:** Make sure that the locating pin on the special tool is aligned with the crankshaft timing trigger wheel hole.

Using the special tool, install the crankshaft timing trigger wheel. Use Special Service Tool: 303-1676 Installer, Crankshaft Position Sensor Ring.

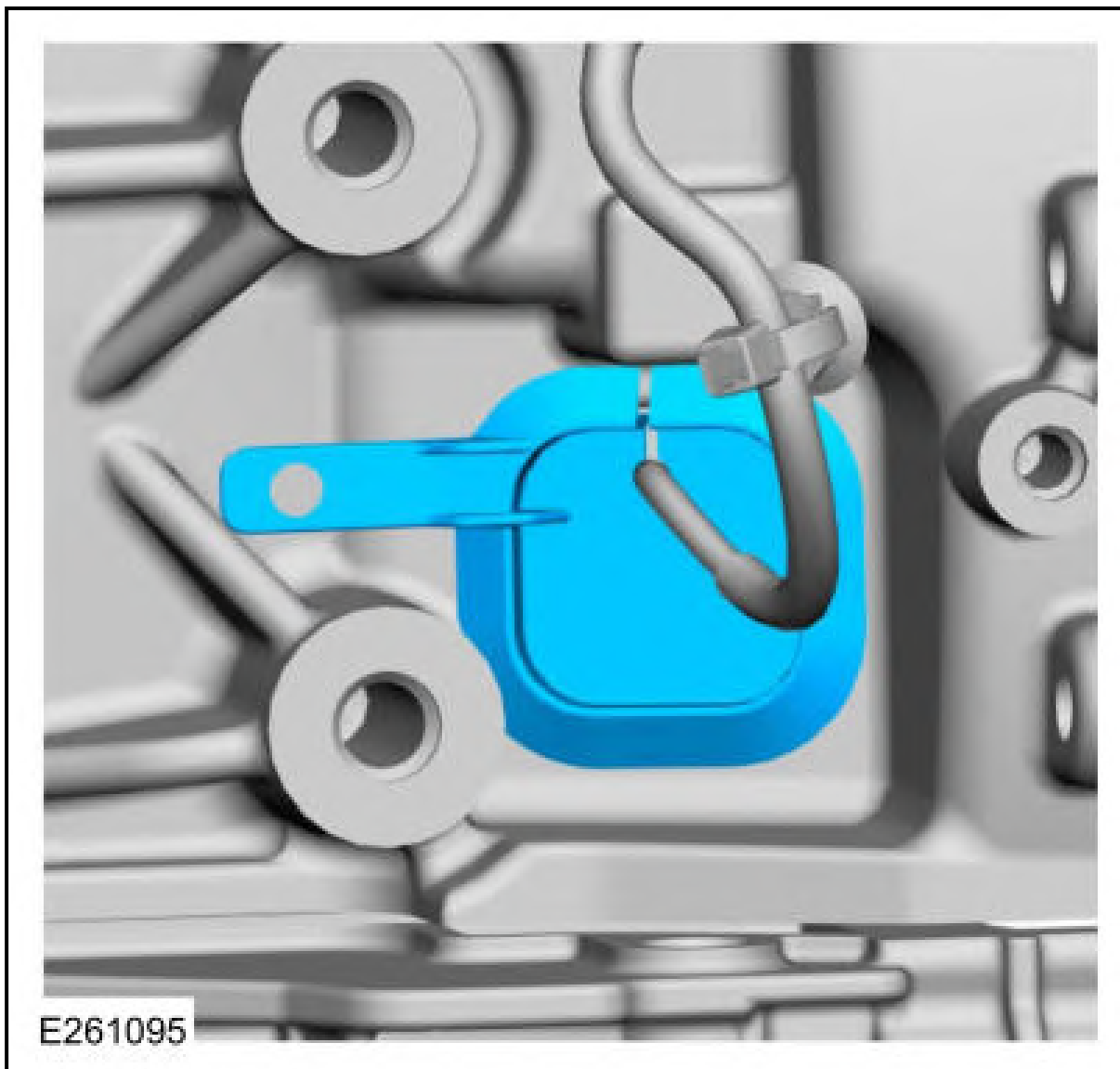


42. Install the CKP sensor and bolt.

Torque: 44 lb.in (5 Nm)



43. Install the CKP sensor cover.



44. Install the engine block skirt stiffener alignment dowels.

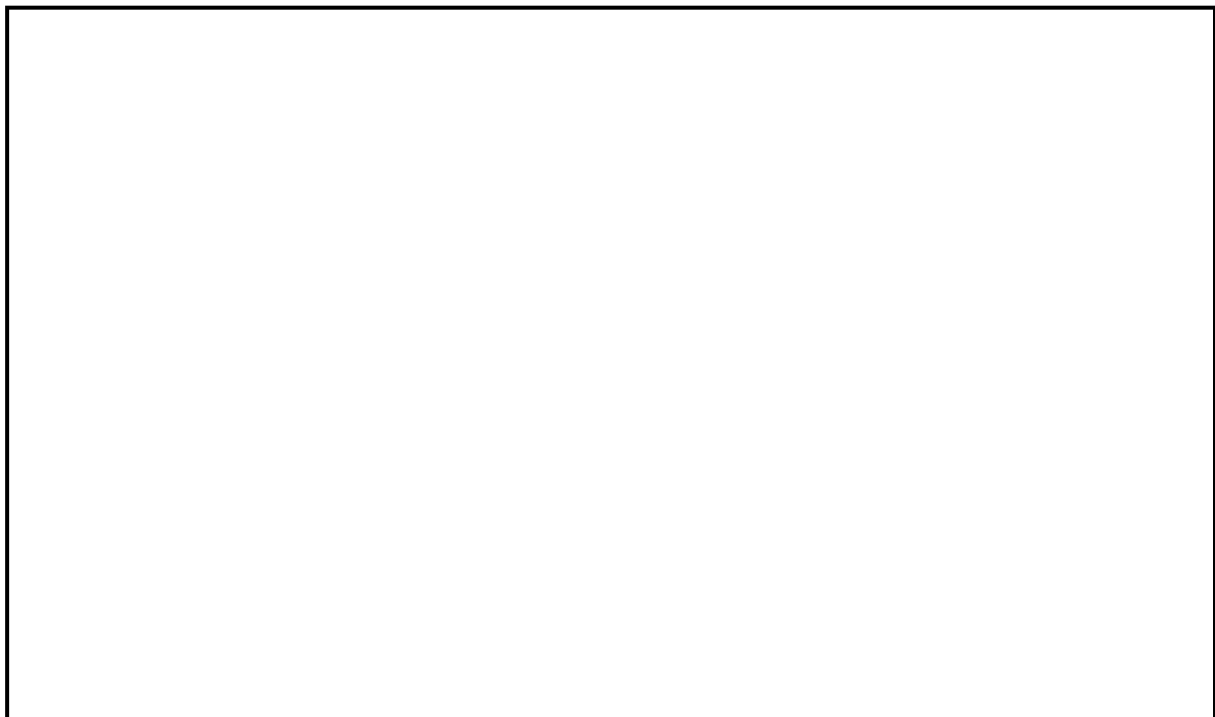


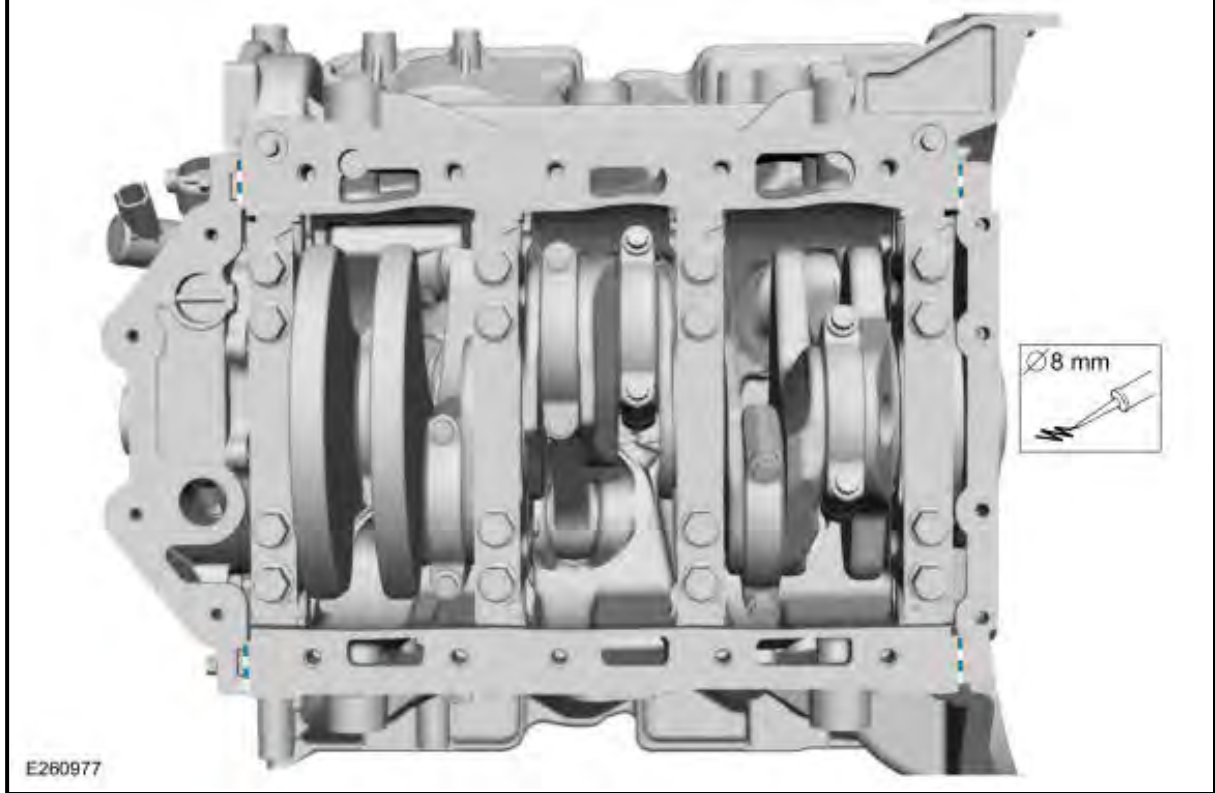


45. **NOTE:** The engine block skirt stiffener and the bolts must be installed with 4 minutes of sealant application. Final tightening of the engine block skirt stiffener bolts must be carried out within 60 minutes of sealant application.

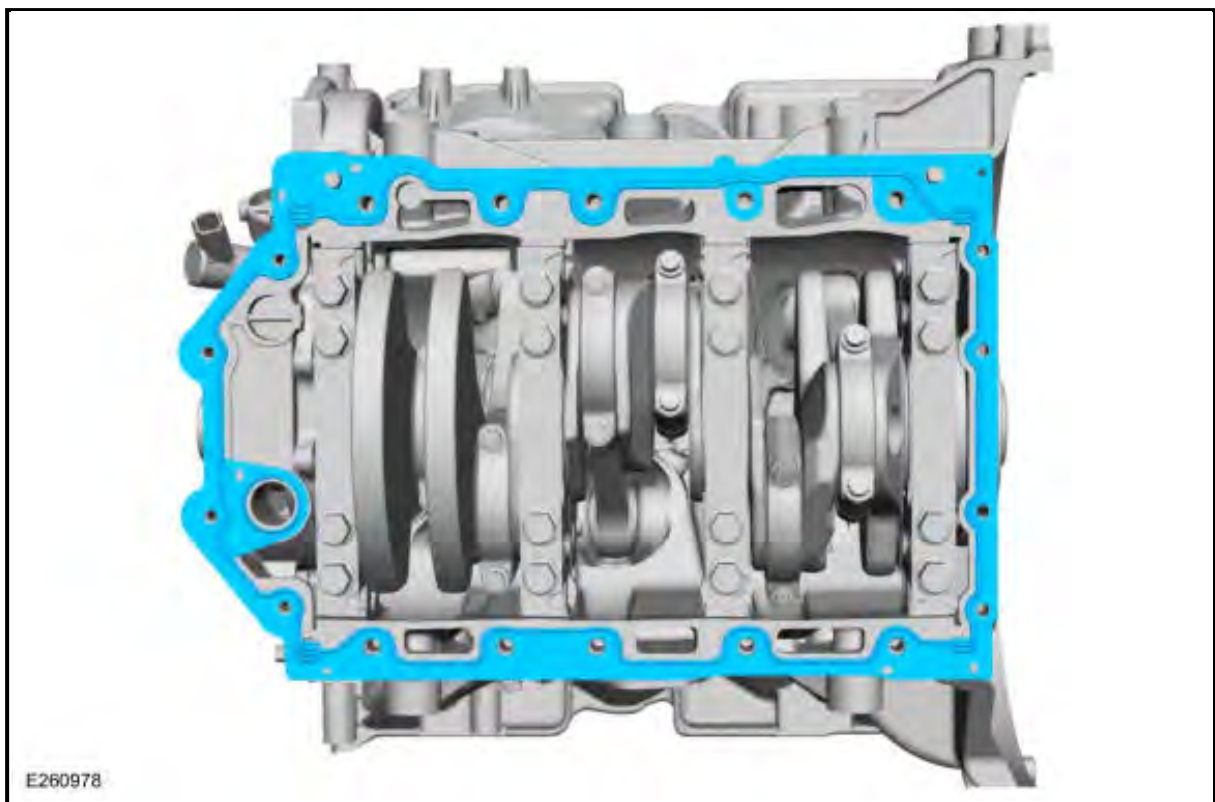
Apply a 8.0 mm bead of Motorcraft <sup>®</sup> High Performance Engine RTV Silicone to the engine block T-joints.

Material: Motorcraft <sup>®</sup> High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)





46. Install a new engine block skirt stiffener gasket.

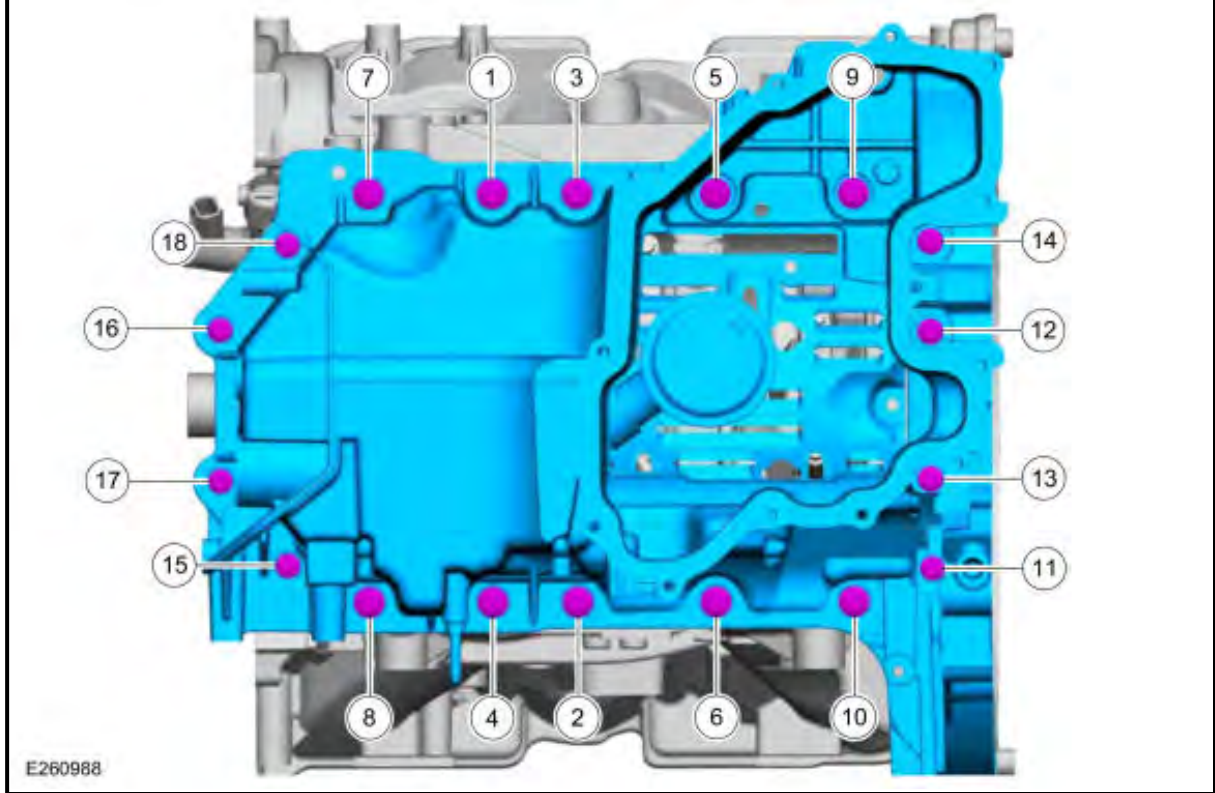


47. Install the engine block skirt stiffener and the bolts.

### Torque

- :Stage 1: 18 lb.in (2 Nm)
- Stage 2: 89 lb.in (10 Nm)

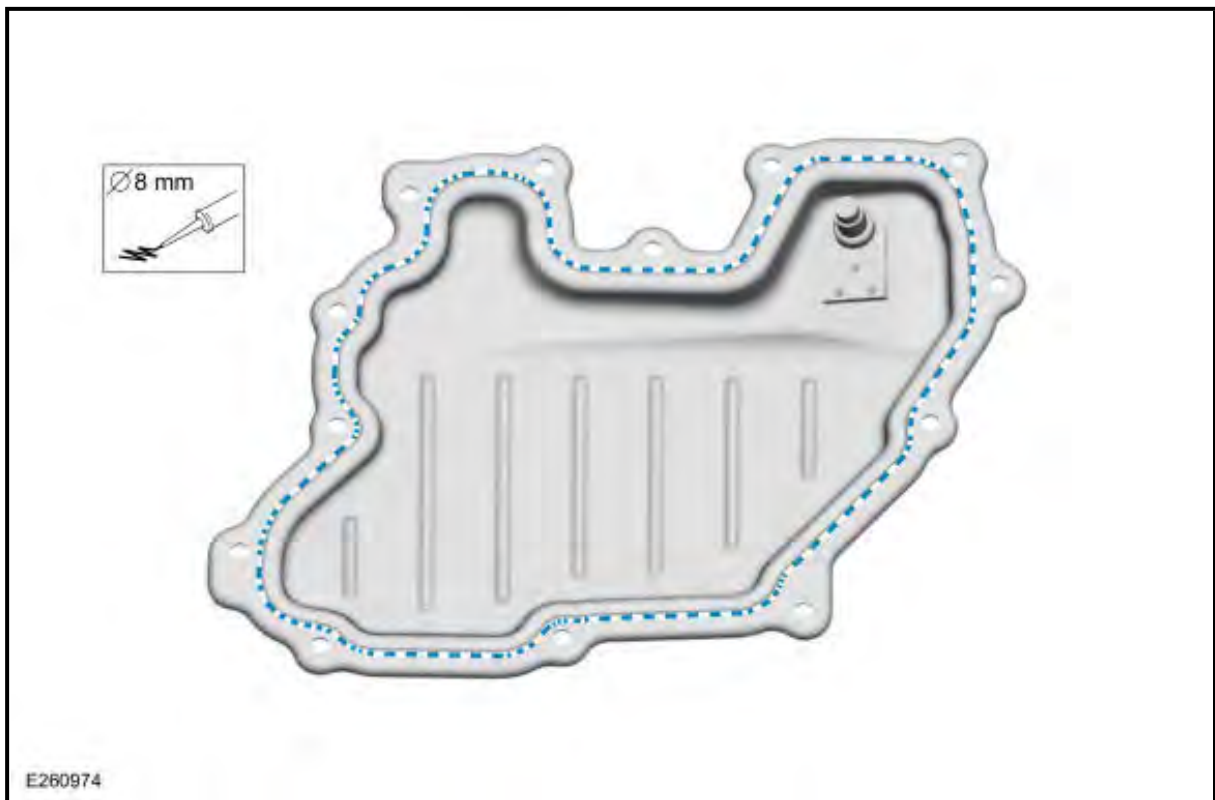




48. **NOTE:** Failure to use Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

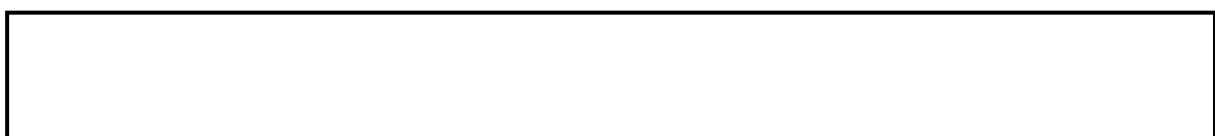
Apply a 8 mm bead of Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone to the sealing surface of the oil pan.

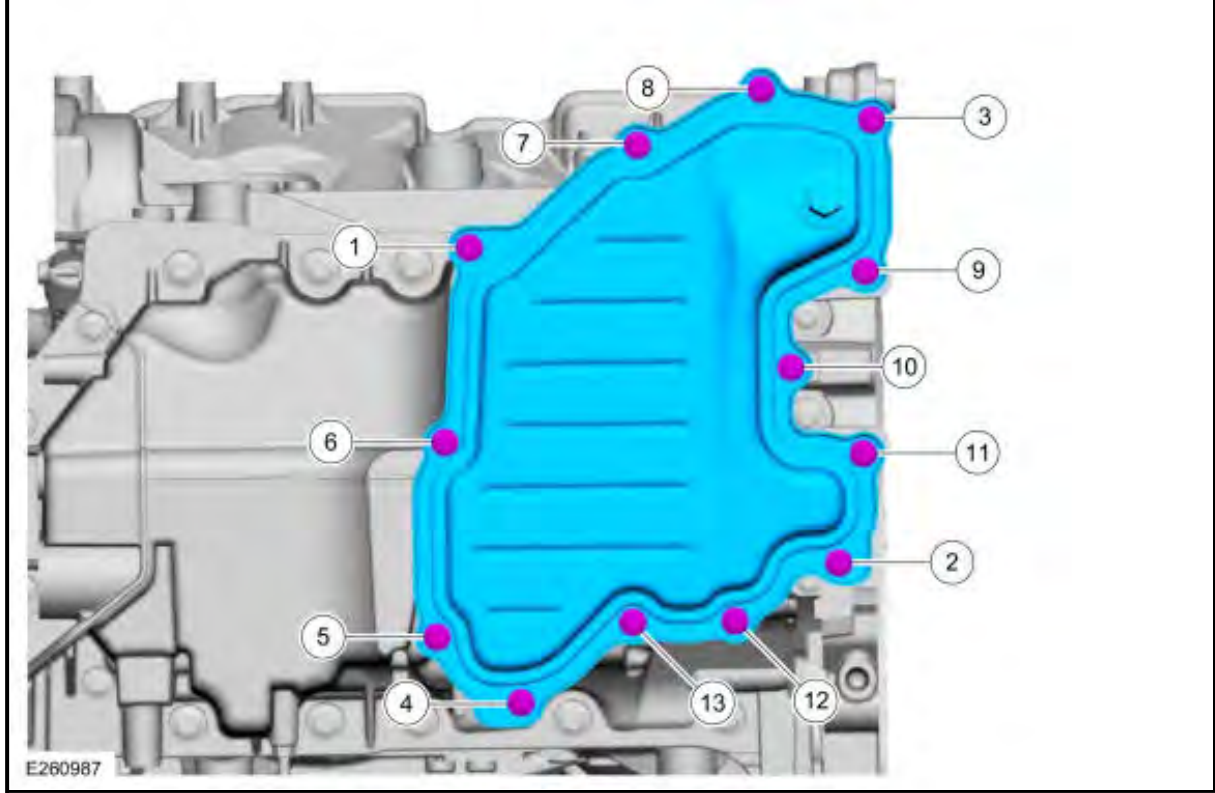
Material: Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



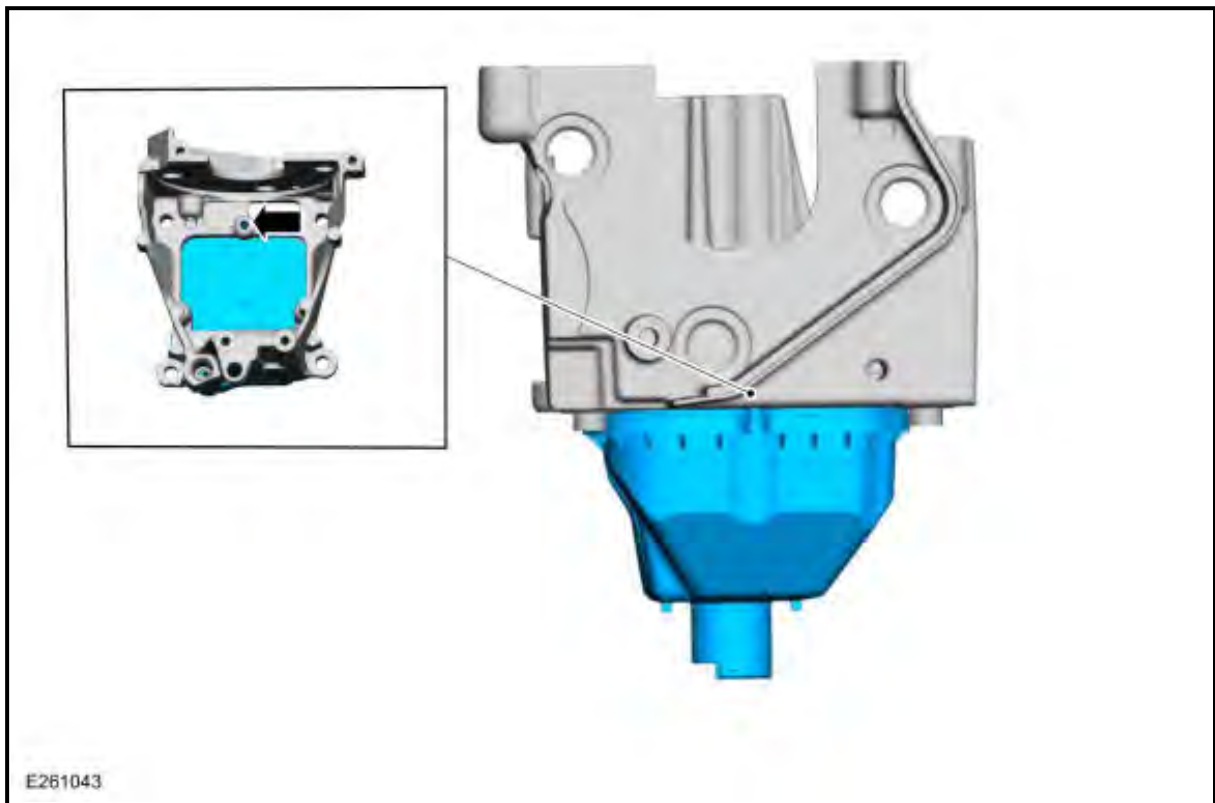
49. Install the oil pan and the bolts.

Torque: 89 lb.in (10 Nm)





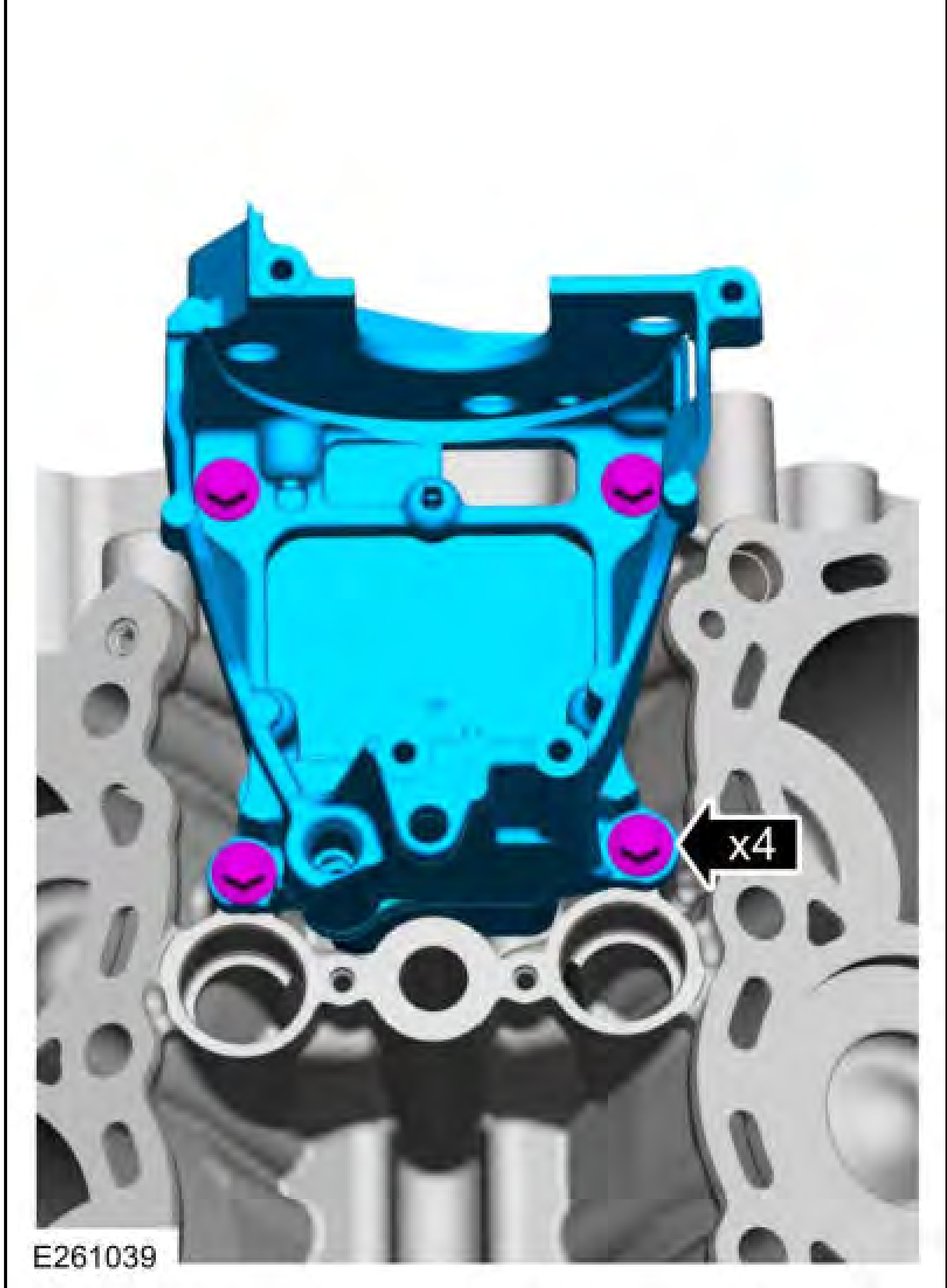
50. If removed, install the CCV (crankcase vent) separator to the fuel injection pump mounting bracket.



51. Install the fuel injection pump mounting bracket and the bolts.

Torque: 17 lb.ft (23 Nm)



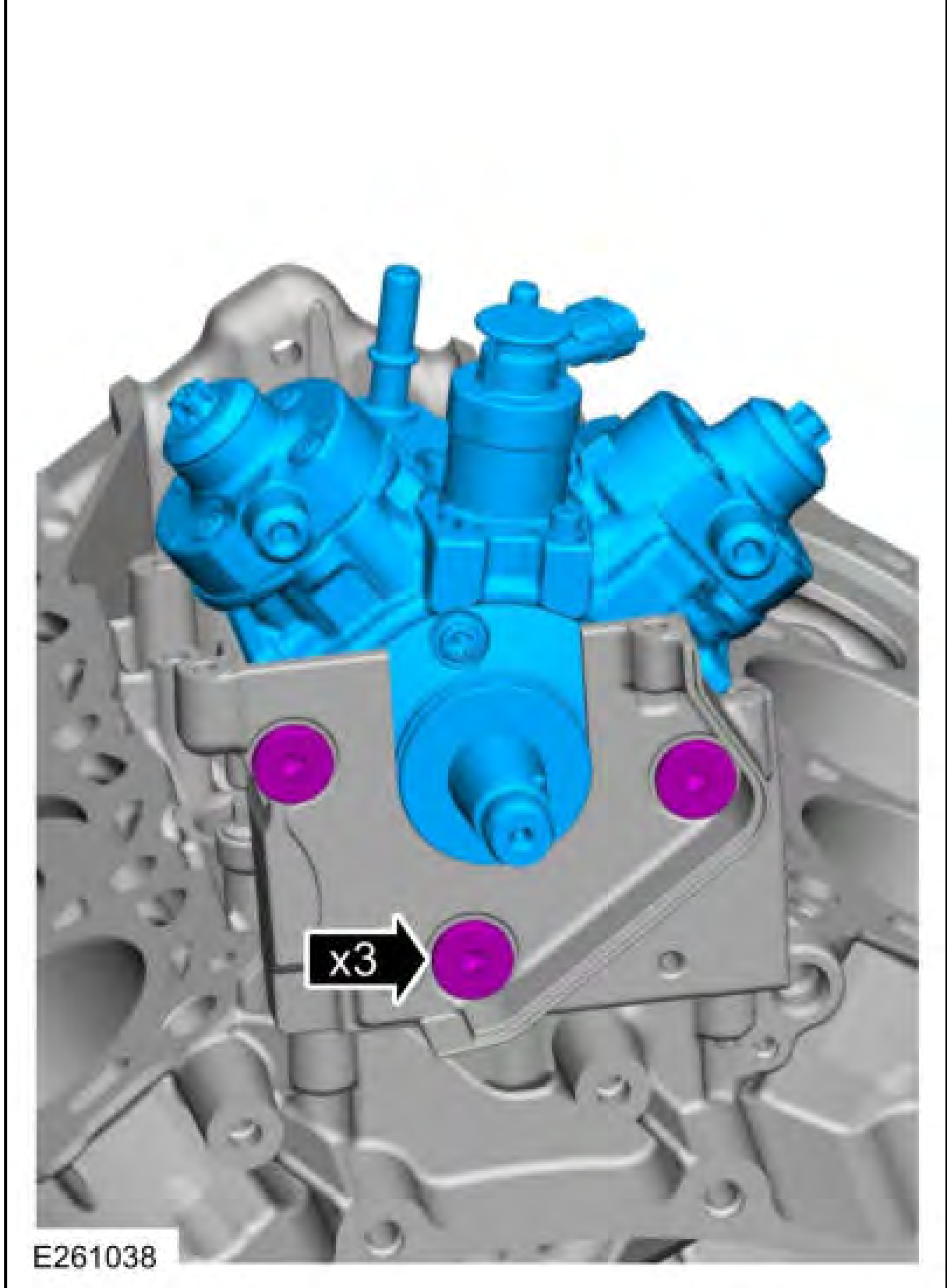


52. Install the fuel injection pump and the bolts.

Torque: 17 lb.ft (23 Nm)

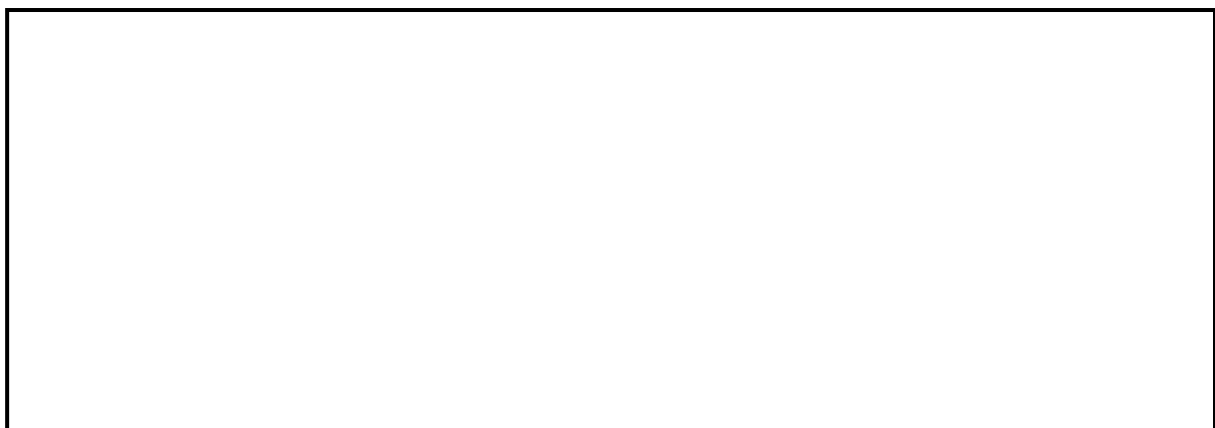


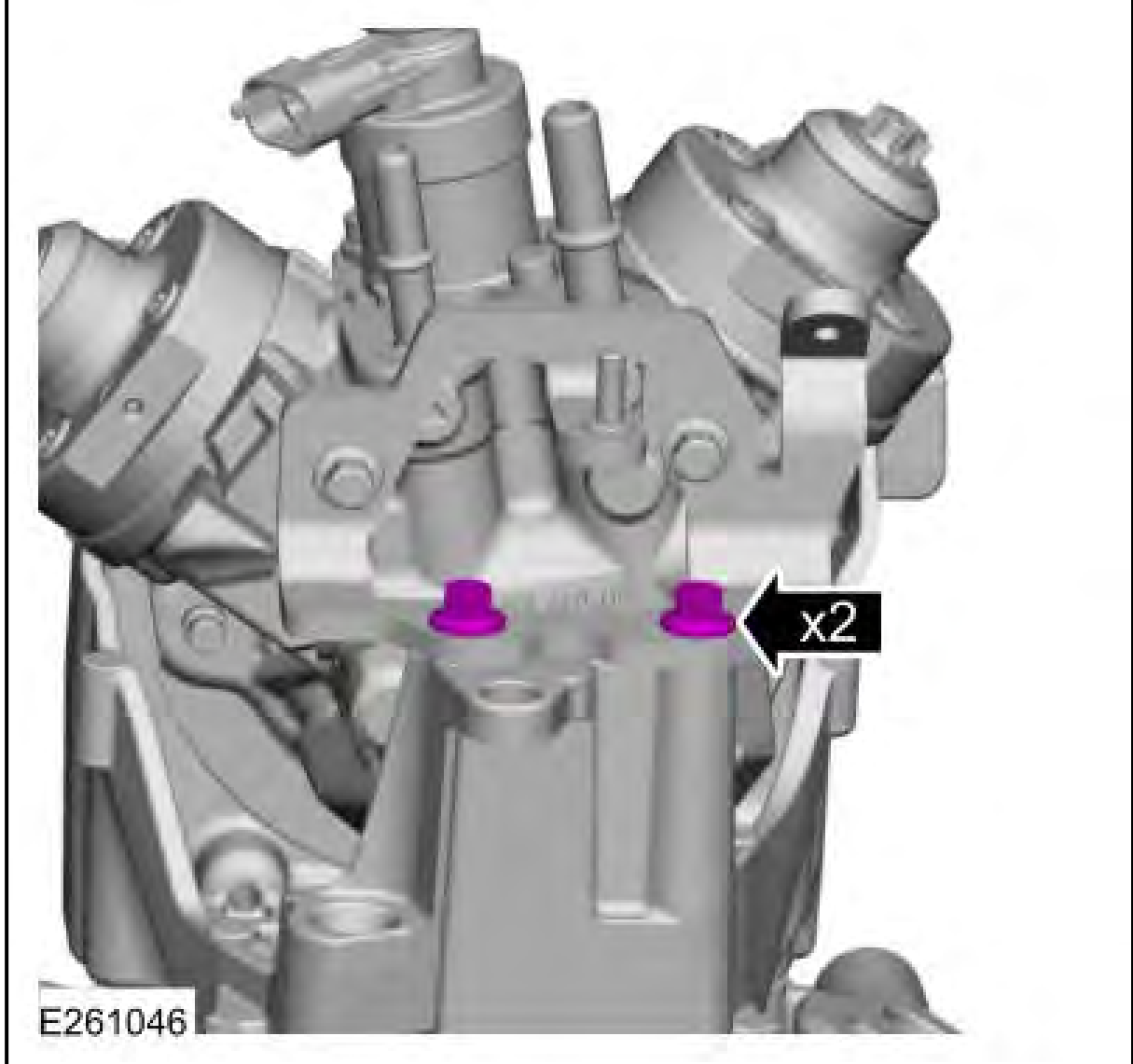




53. Install the fuel injection pump bolts.

Torque: 89 lb.in (10 Nm)





54. Install the oil cooler O-rings.



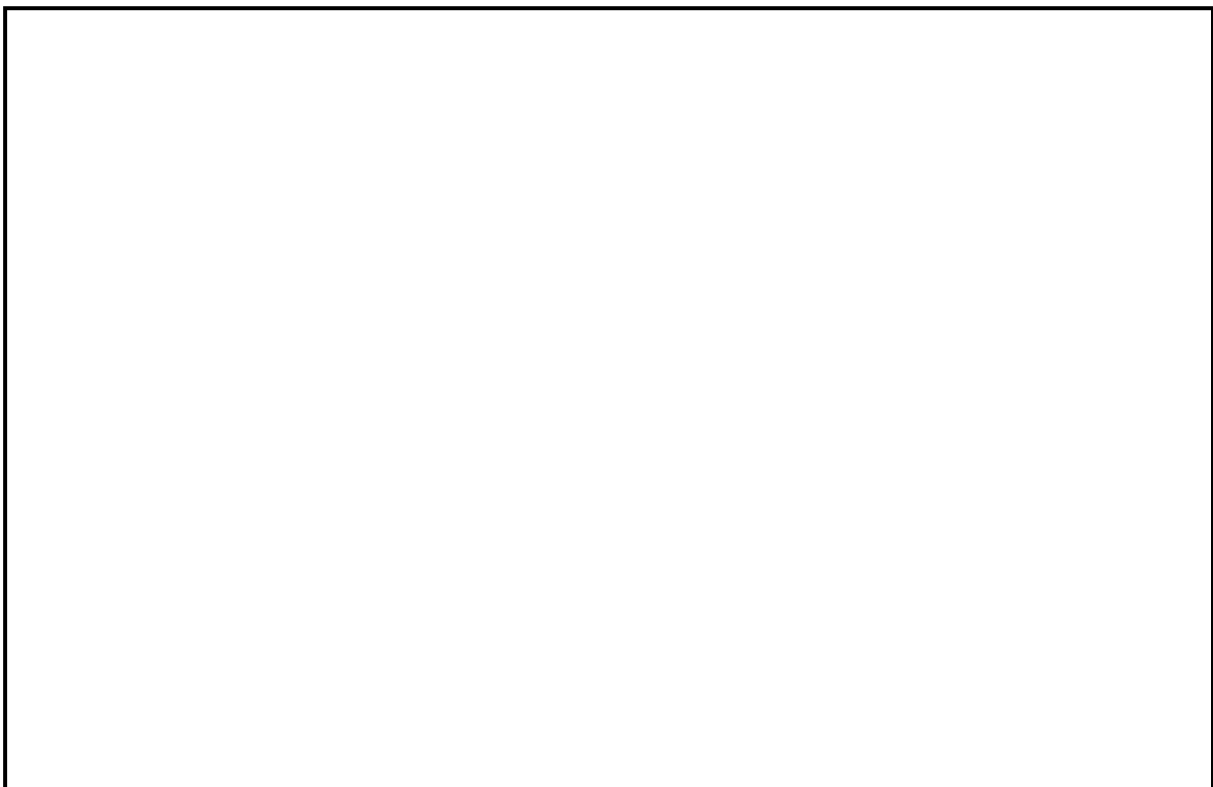


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55. **NOTE:** In the event of catastrophic engine failure, always install a new oil cooler assembly. Foreign material cannot be removed from the oil cooler and engine damage may occur.

Install the oil cooler and the bolts.

Torque: 89 lb.in (10 Nm)

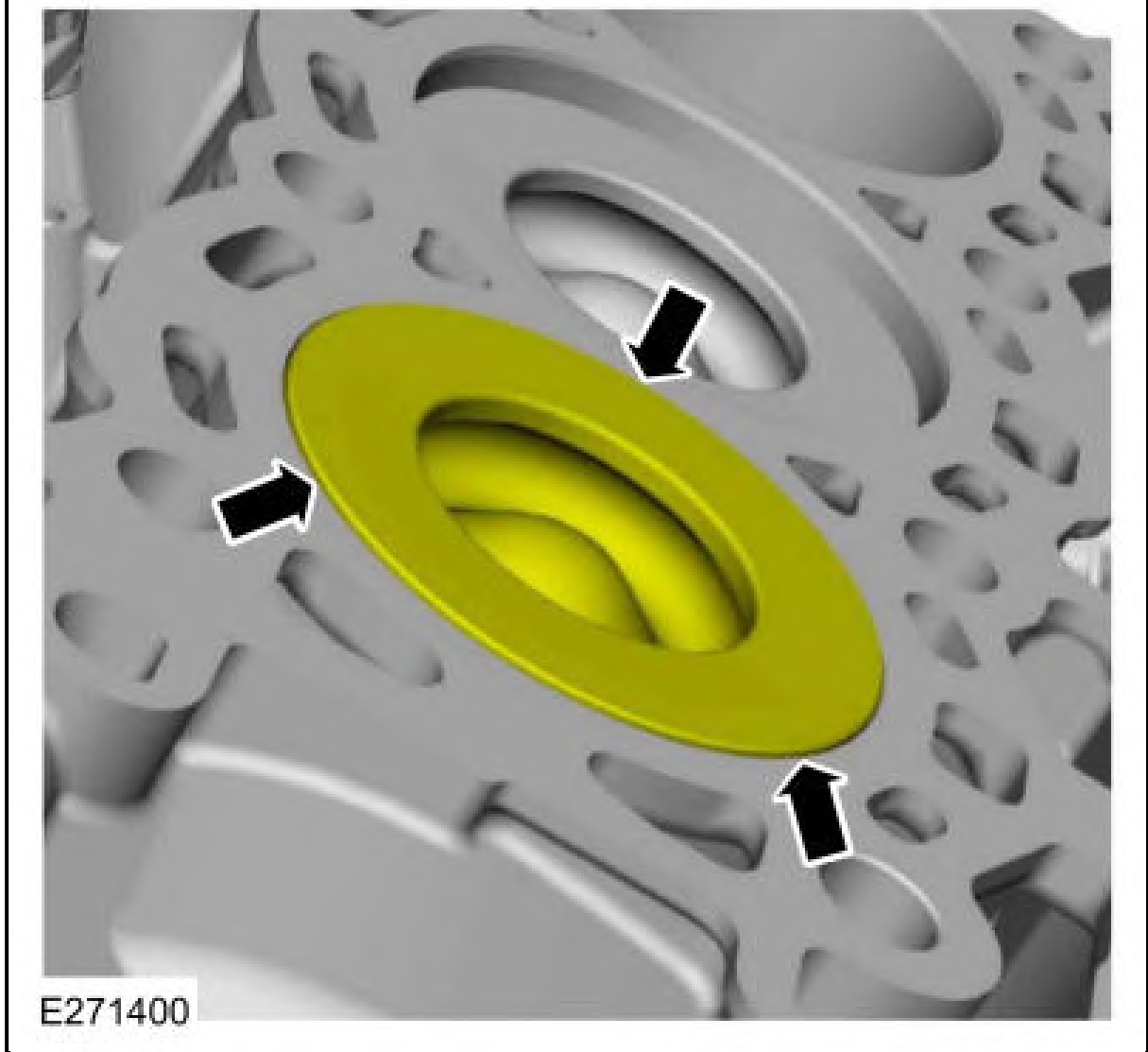




56. **NOTE:** Measure the piston protrusion of each cylinder at TDC.

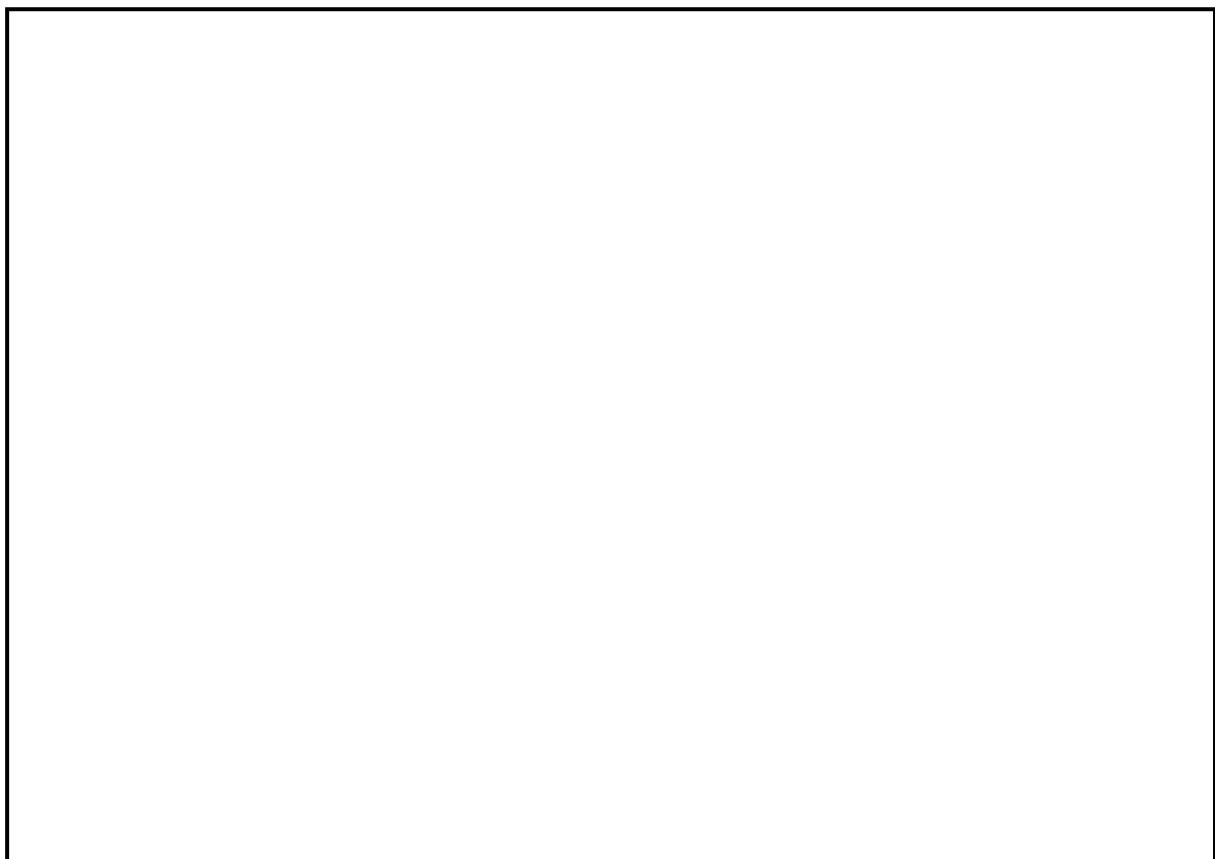
Measure the LH distance between the piston crown and the cylinder block at the points indicated.

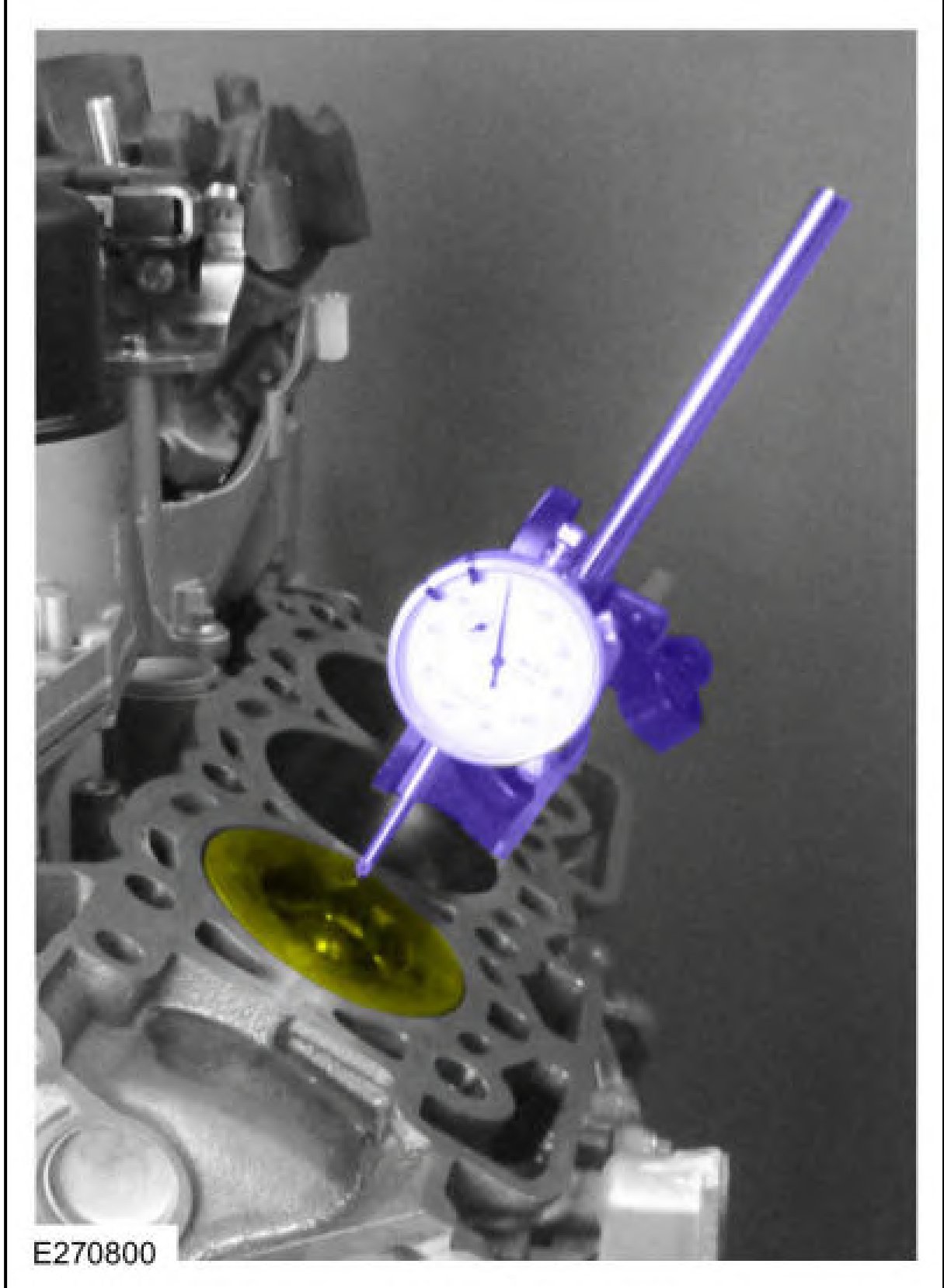




57. **NOTE:** The largest measurement determines the choice of the cylinder head gasket.

Using a commercially available dial indicator, check the piston protrusion. Refer to: [Specifications](#)





58. Install the LH cylinder head dowels and head gasket.





59. **NOTE:** Using too much engine oil on the threads of the cylinder head bolts may cause damage to the threads and poor sealing. Using anti-seize compounds, grease or any other lubricants other than engine oil on the cylinder head bolt threads may affect the true torque value of the bolts.

**NOTE:** The glow plugs protrude past the lower face of the cylinder head, any impact on the tip of the glow plug may result in glow plug damage.

**NOTE:** Lightly lubricate the new cylinder head bolt threads and flanges with clean engine oil.

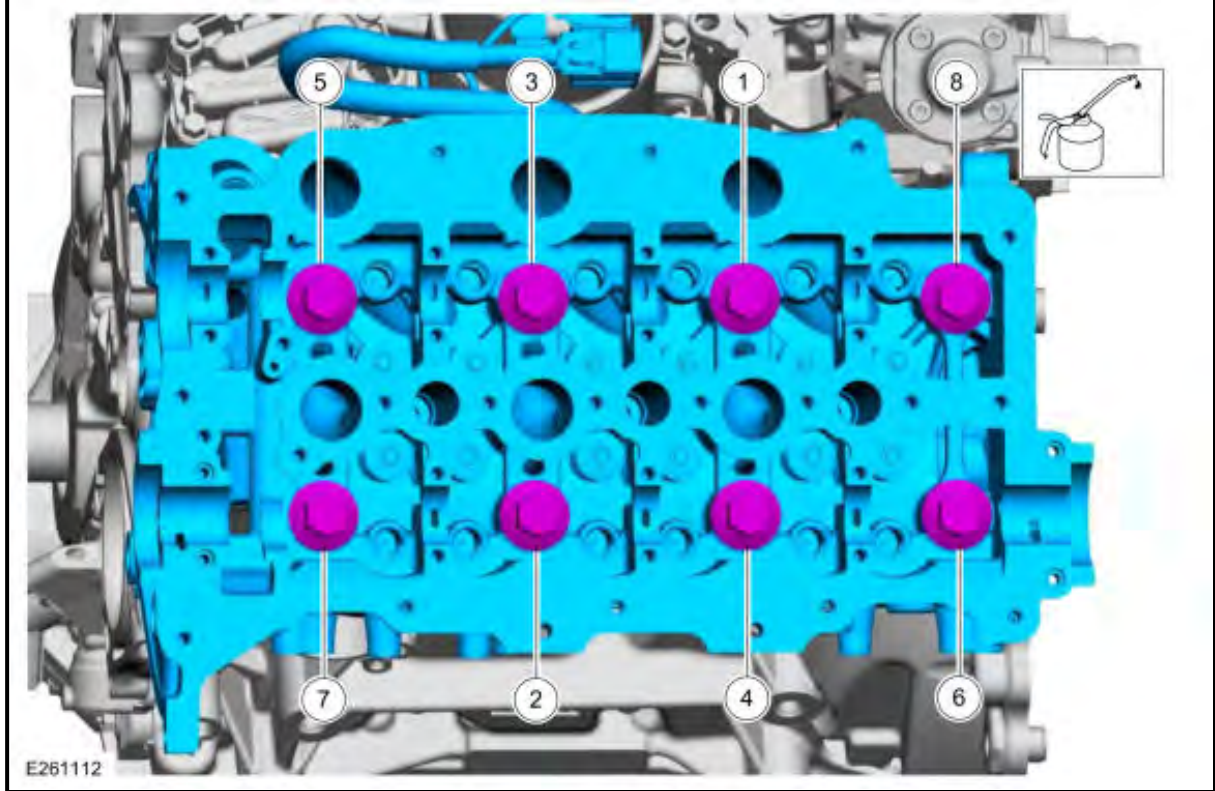
Install the LH cylinder head and the new bolts.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

### Torque

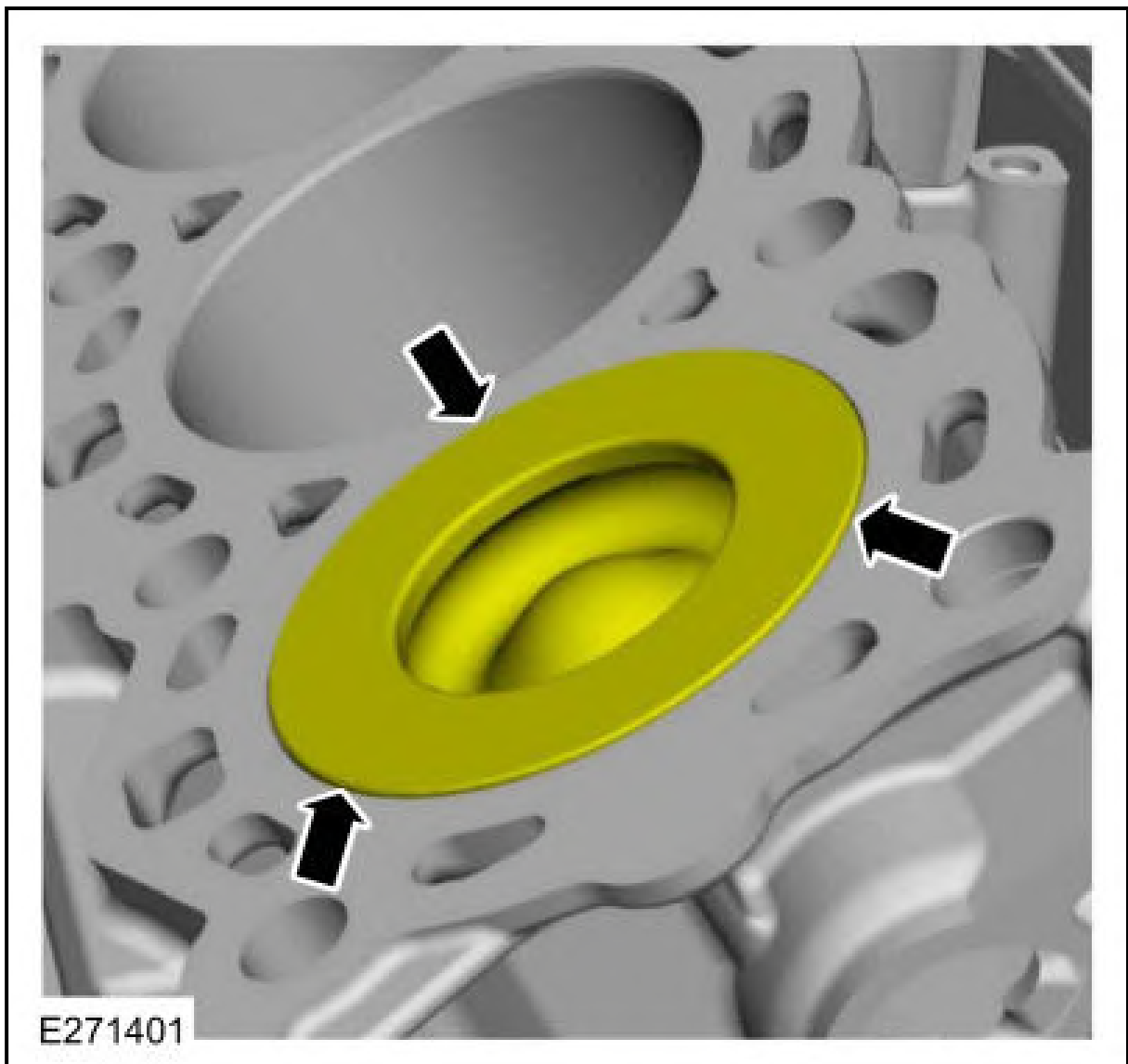
- :Stage 1: 177 lb.in (20 Nm)
- Stage 2: 30 lb.ft (40 Nm)
- Stage 3: 59 lb.ft (80 Nm)
- Stage 4: 180  $\hat{A}$ °





60. **NOTE:** Measure the piston protrusion of each cylinder at TDC.

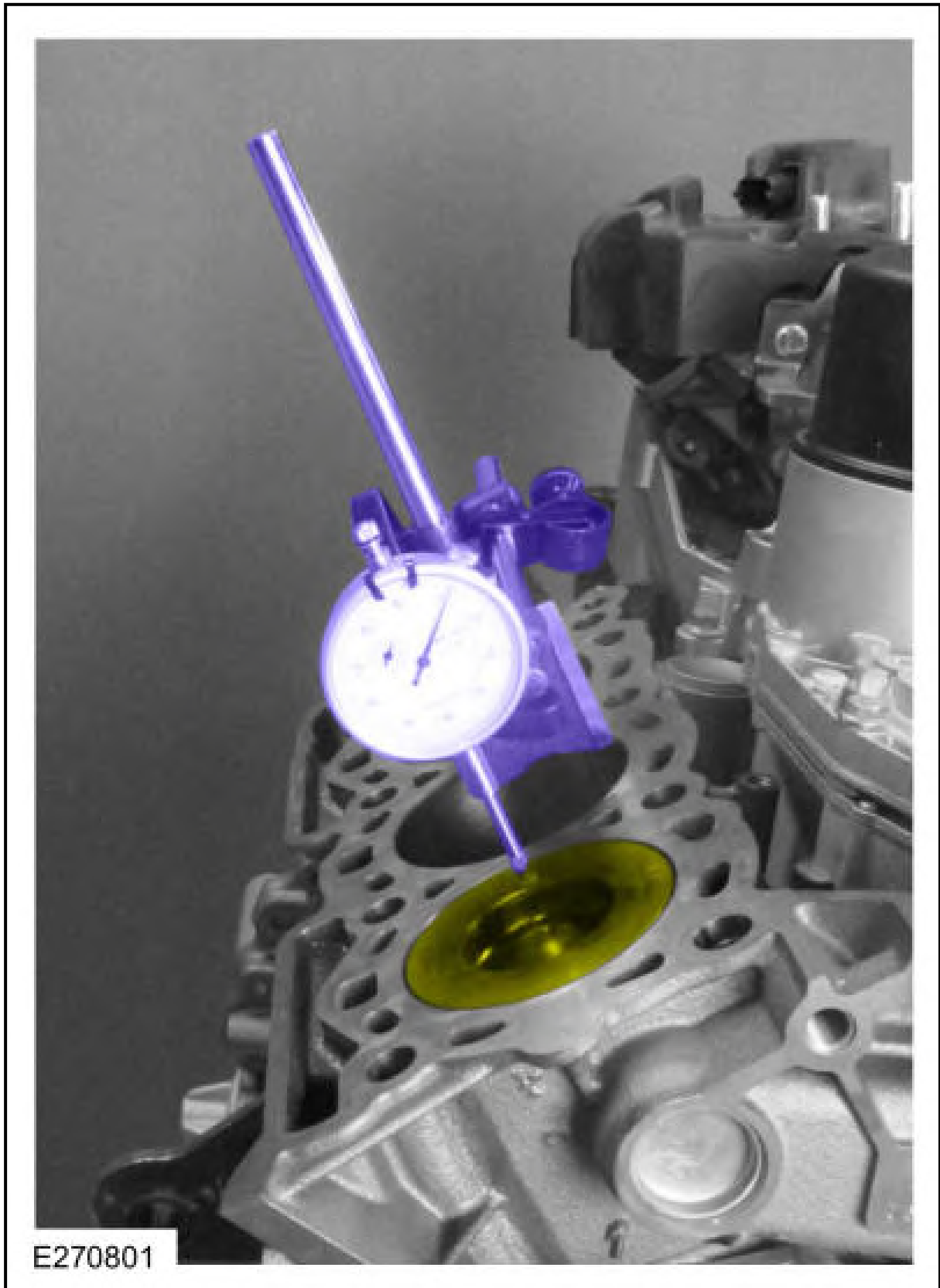
Measure the RH distance between the piston crown and the cylinder block at the points indicated.



61. **NOTE:** The largest measurement determines the choice of the cylinder head gasket.

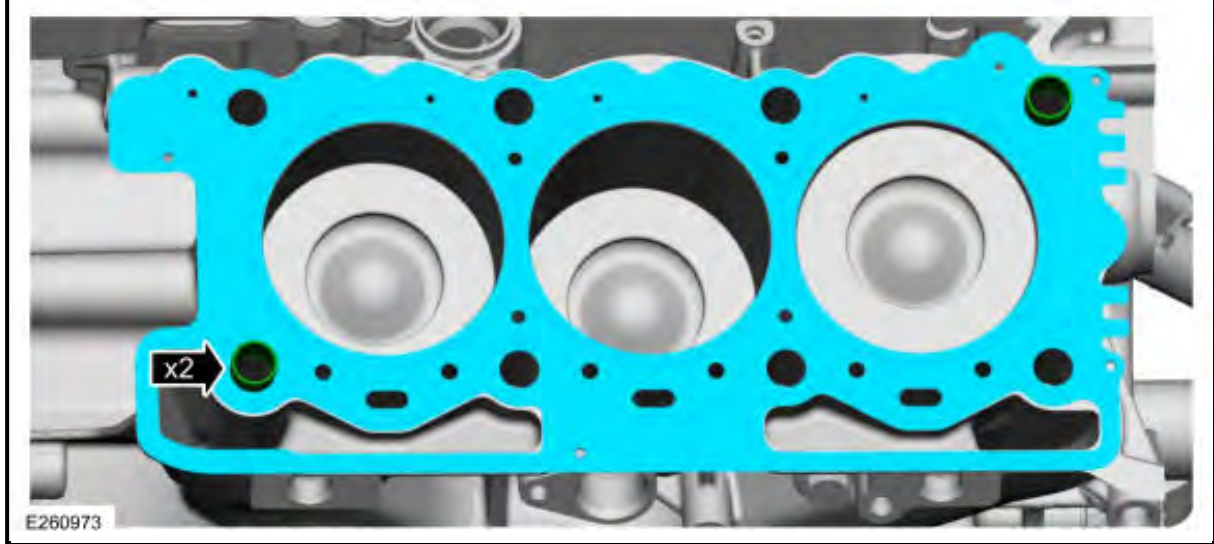


Using a commercially available dial indicator, check the piston protrusion. Refer to: [Specifications](#)



62. Install the RH cylinder head dowels and head gasket.





63. **NOTE:** Using too much engine oil on the threads of the cylinder head bolts may cause damage to the threads and poor sealing. Using anti-seize compounds, grease or any other lubricants other than engine oil on the cylinder head bolt threads may affect the true torque value of the bolts.

**NOTE:** The glow plugs protrude past the lower face of the cylinder head, any impact on the tip of the glow plug may result in glow plug damage.

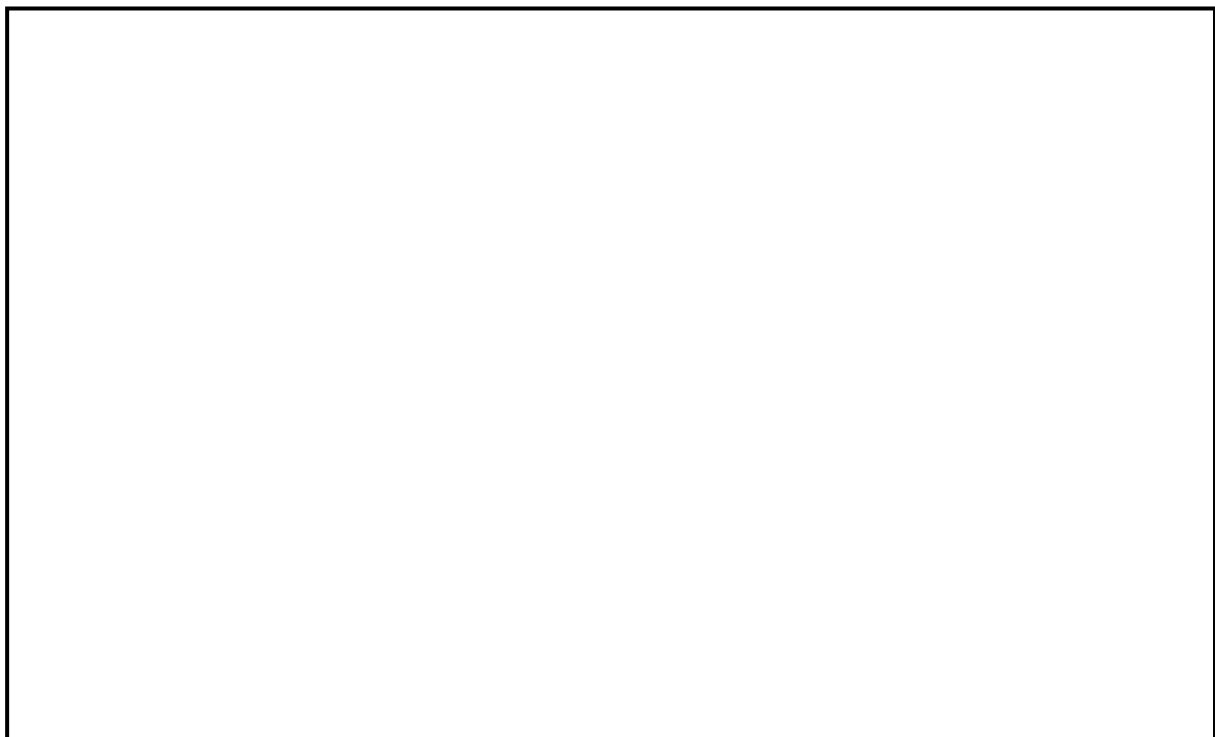
**NOTE:** Lightly lubricate the new cylinder head bolt threads and flanges with clean engine oil.

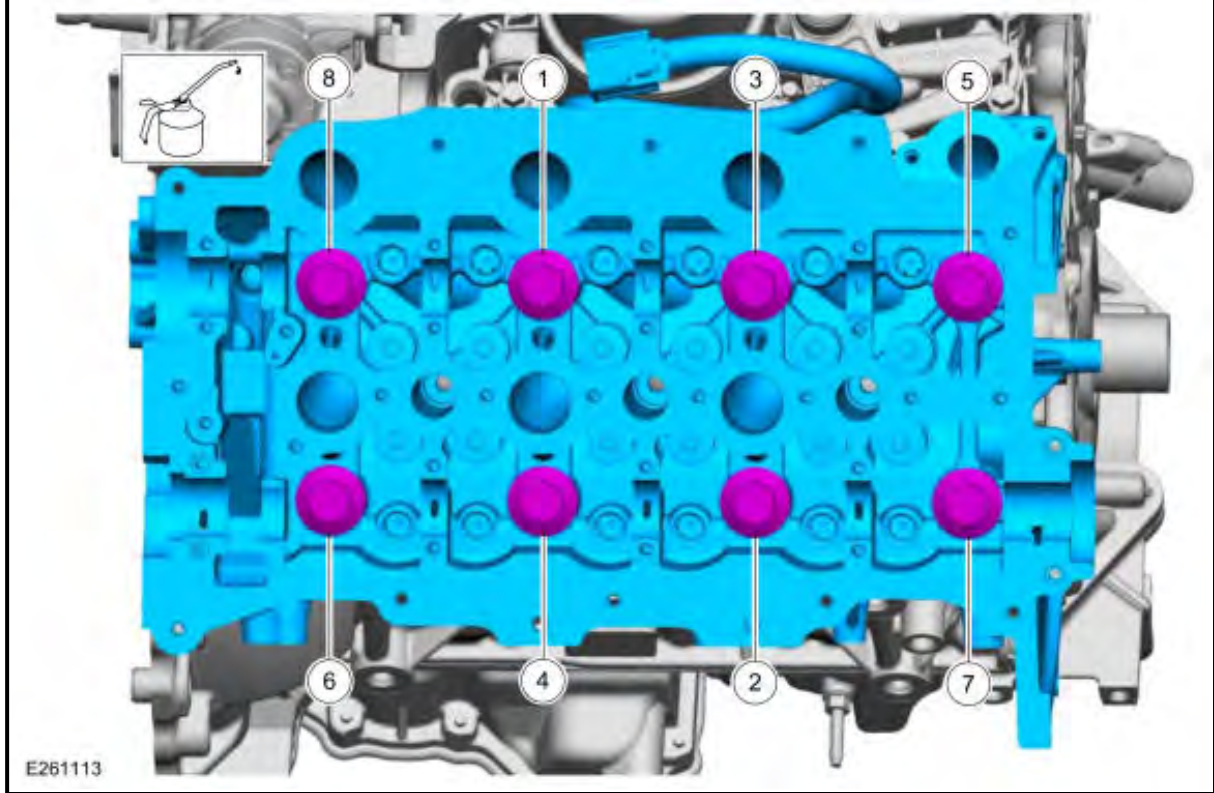
Install the RH cylinder head and the new bolts.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

### Torque

- :Stage 1: 177 lb.in (20 Nm)
- Stage 2: 30 lb.ft (40 Nm)
- Stage 3: 59 lb.ft (80 Nm)
- Stage 4: 180  $\hat{A}$ <sup>o</sup>



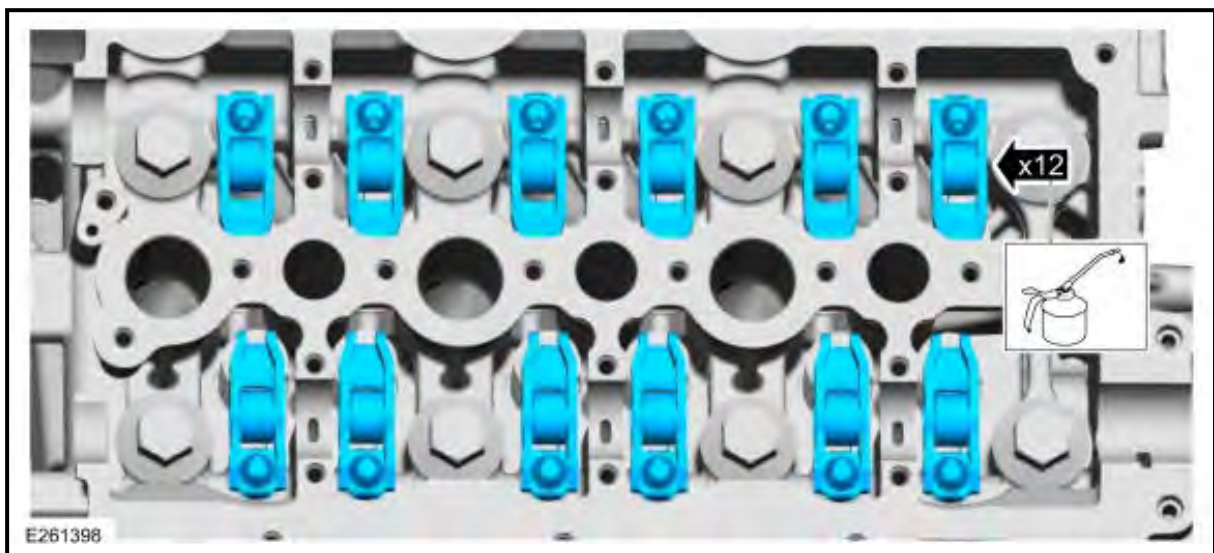


64. **NOTE:** If the original hydraulic lash adjusters and roller followers are to be reinstalled, they must be installed in their original locations.

1. Lubricate the RH hydraulic lash adjusters and roller followers with clean engine oil.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

2. Install the hydraulic lash adjusters and roller followers.



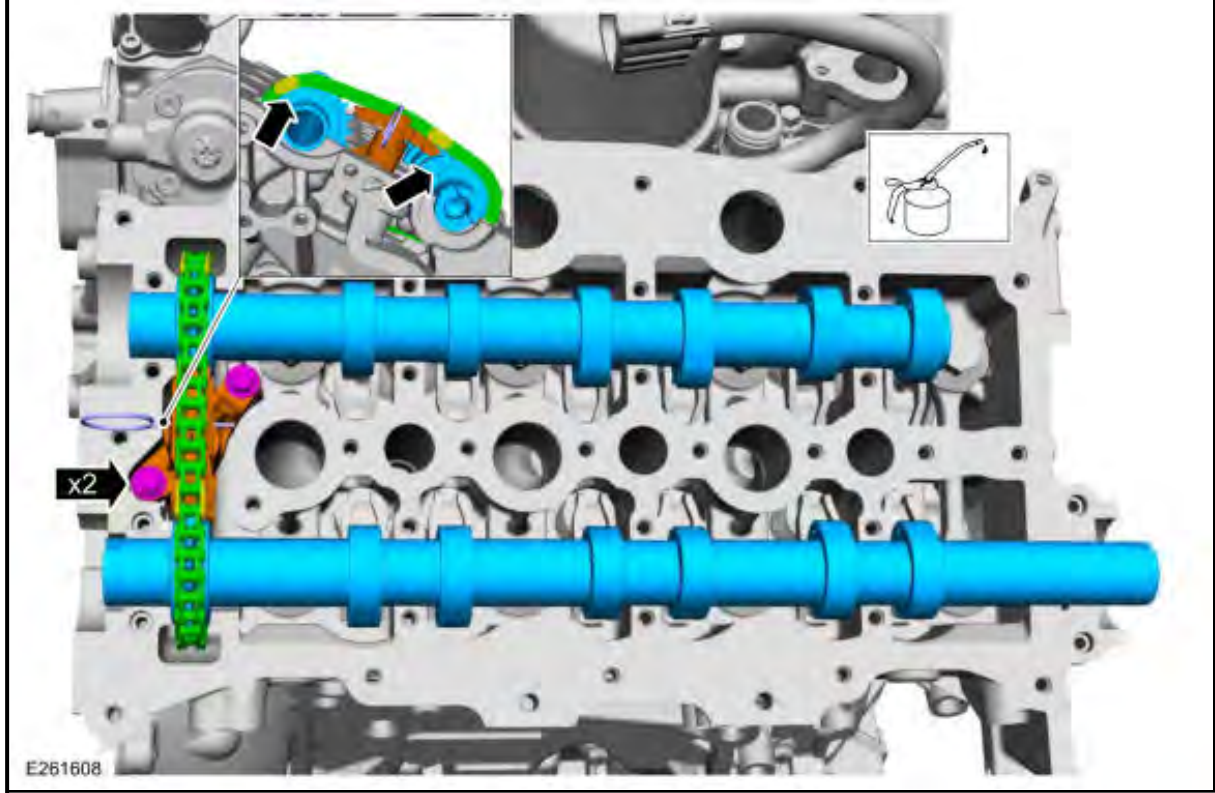
65. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

**NOTE:** Align the timing marks on the camshafts with the timing marks on the secondary timing chain.

Install the RH camshafts, camshaft chain, secondary timing chain tensioner and the bolts.

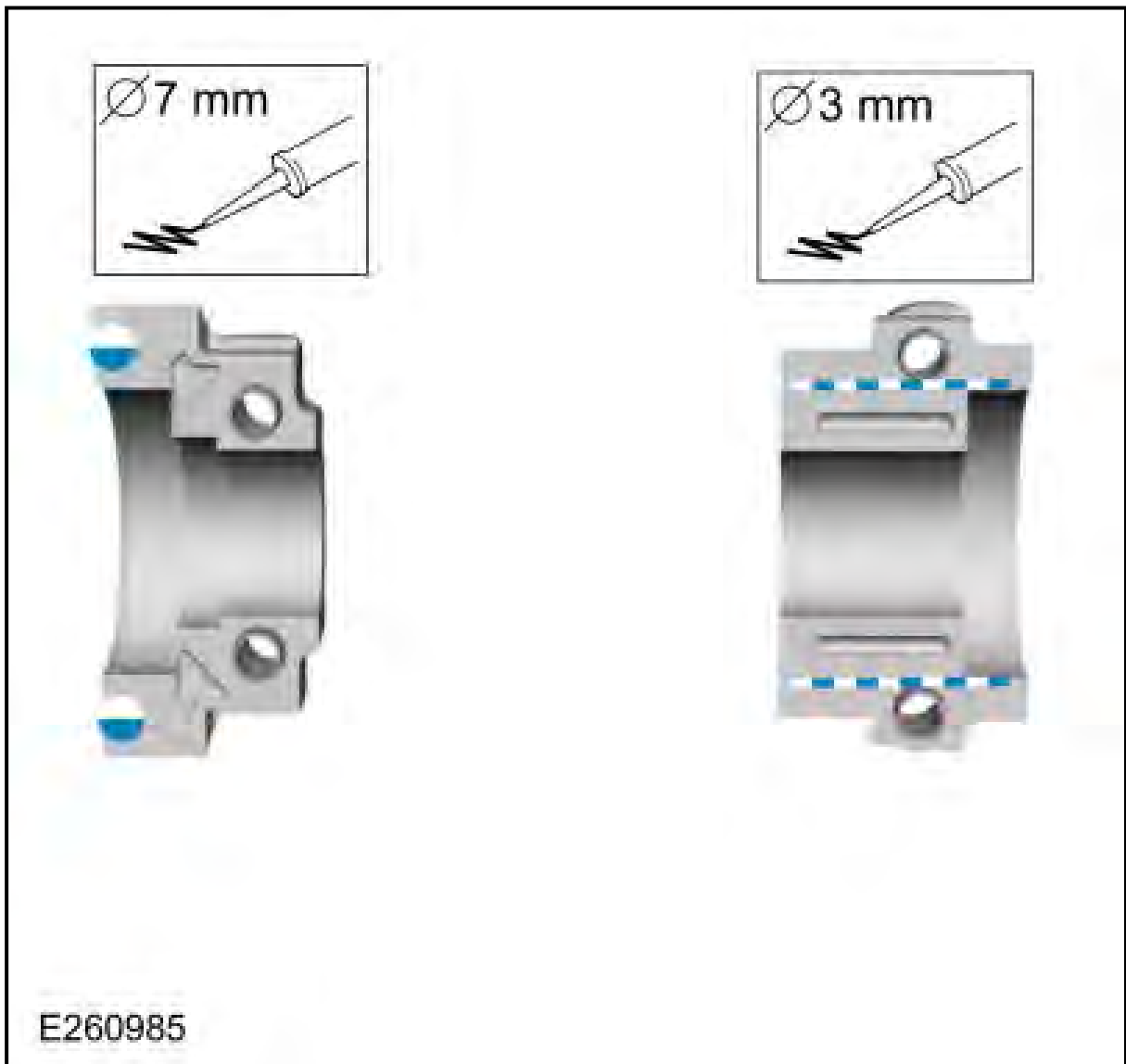
Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque: 89 lb.in (10 Nm)



66. Apply sealer to the RH bearing caps.

Material: Flange Sealant / CU7Z-19B508-A (WSS-M2G348-A11)



67. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

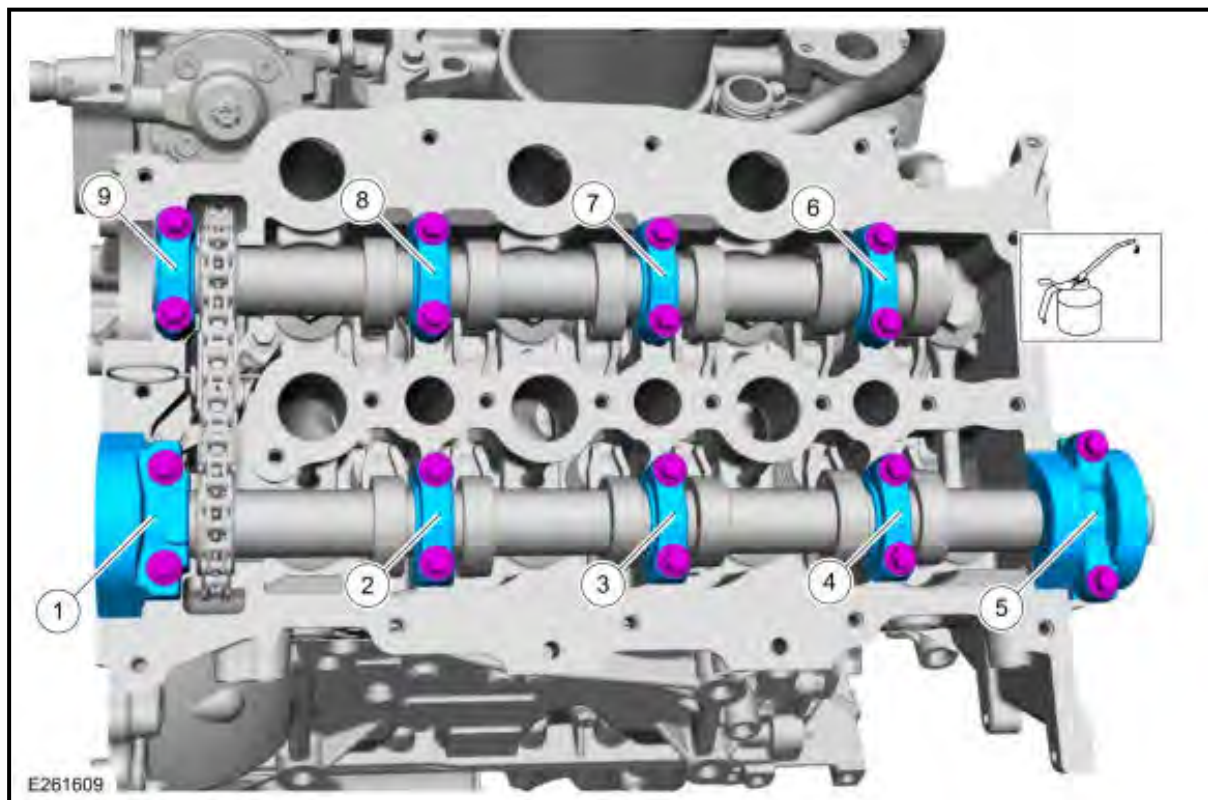
**NOTE:** Tighten the camshaft bearing cap bolts one turn at a time.

Apply clean engine oil to the camshaft bearing caps. Install camshaft bearing caps and the bolts.

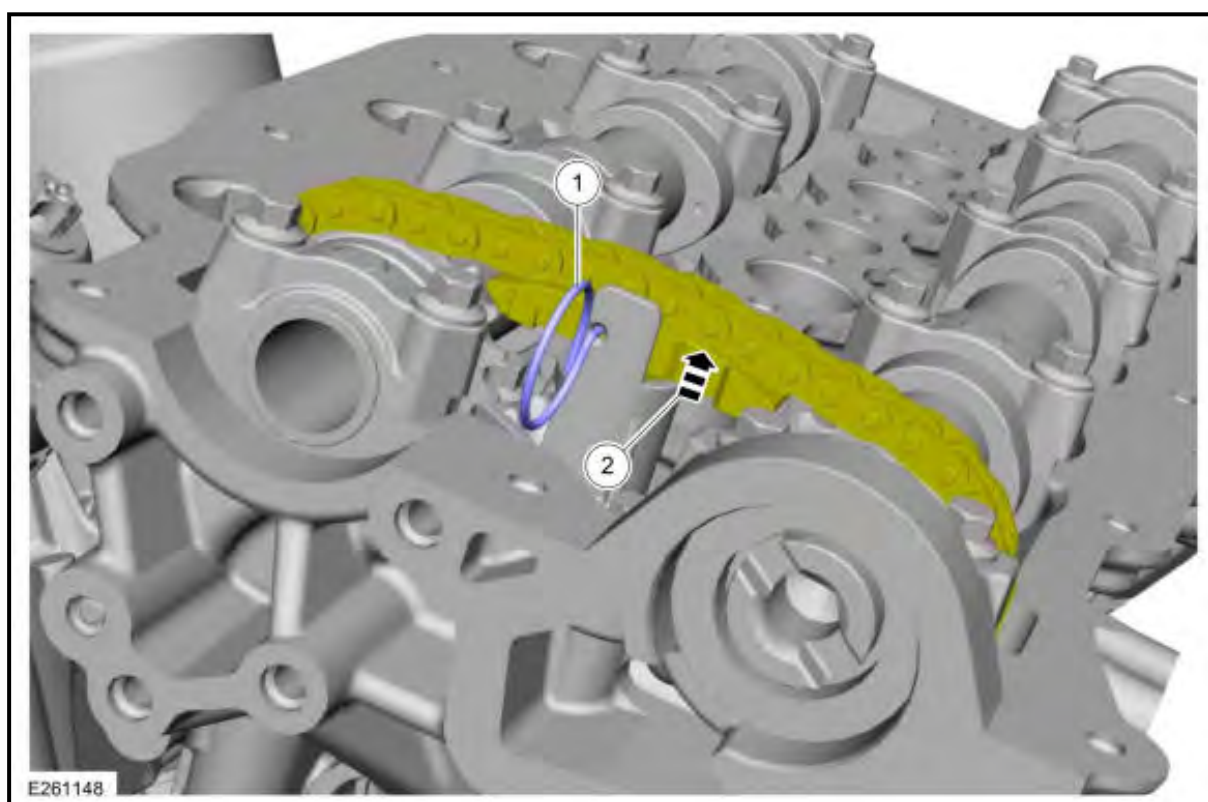
Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

### Torque

- Stage 1: 9 lb.in (1 Nm)
- Stage 2: 44 lb.in (5 Nm)
- Stage 3: 89 lb.in (10 Nm)



68. Remove the retaining pin.



69. **NOTE:** If the original hydraulic lash adjusters and roller followers are to be reinstalled, they must be installed in their original locations.

1. Lubricate the LH hydraulic lash adjusters and roller followers with clean engine oil.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

2. Install the hydraulic lash adjusters and roller followers.



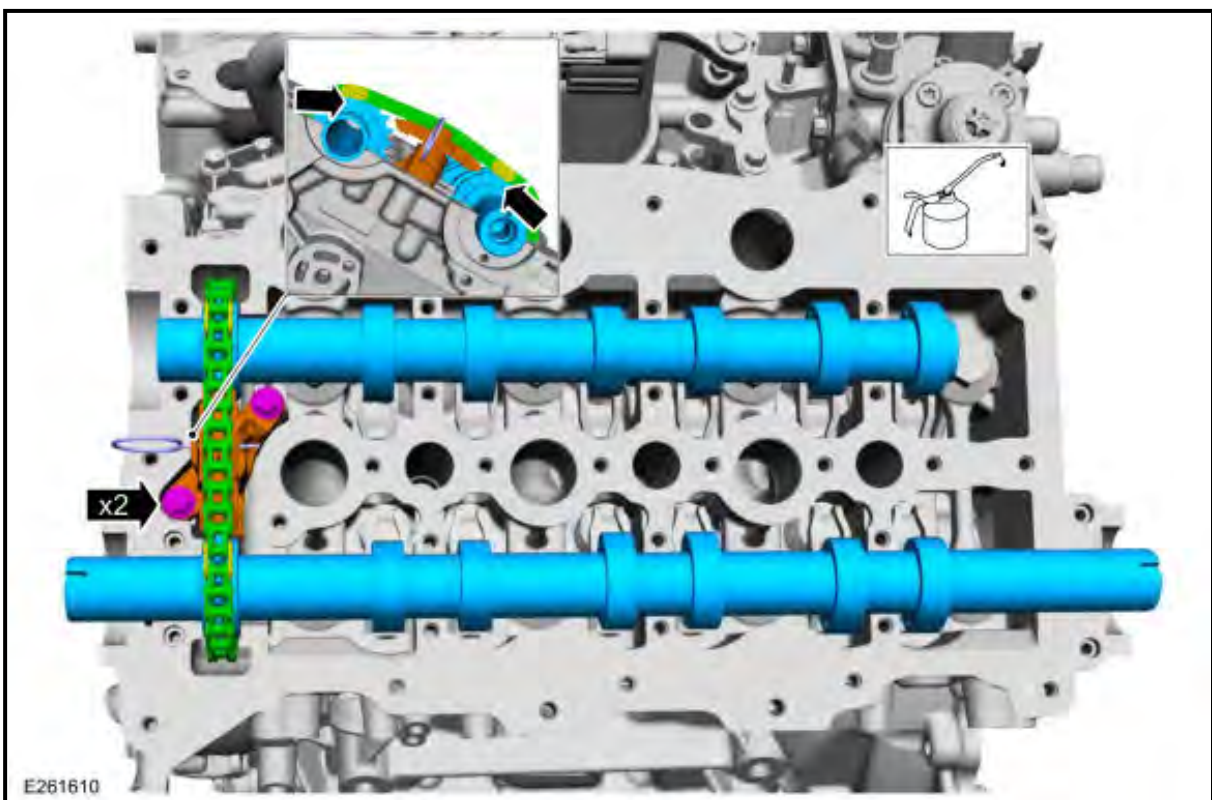
70. **NOTE:** Coat the camshafts with clean engine oil prior to installation.

**NOTE:** Align the timing marks on the camshafts with the timing marks on the secondary timing chain.

Install the LH camshafts, camshaft chain, secondary timing chain tensioner and the bolts.

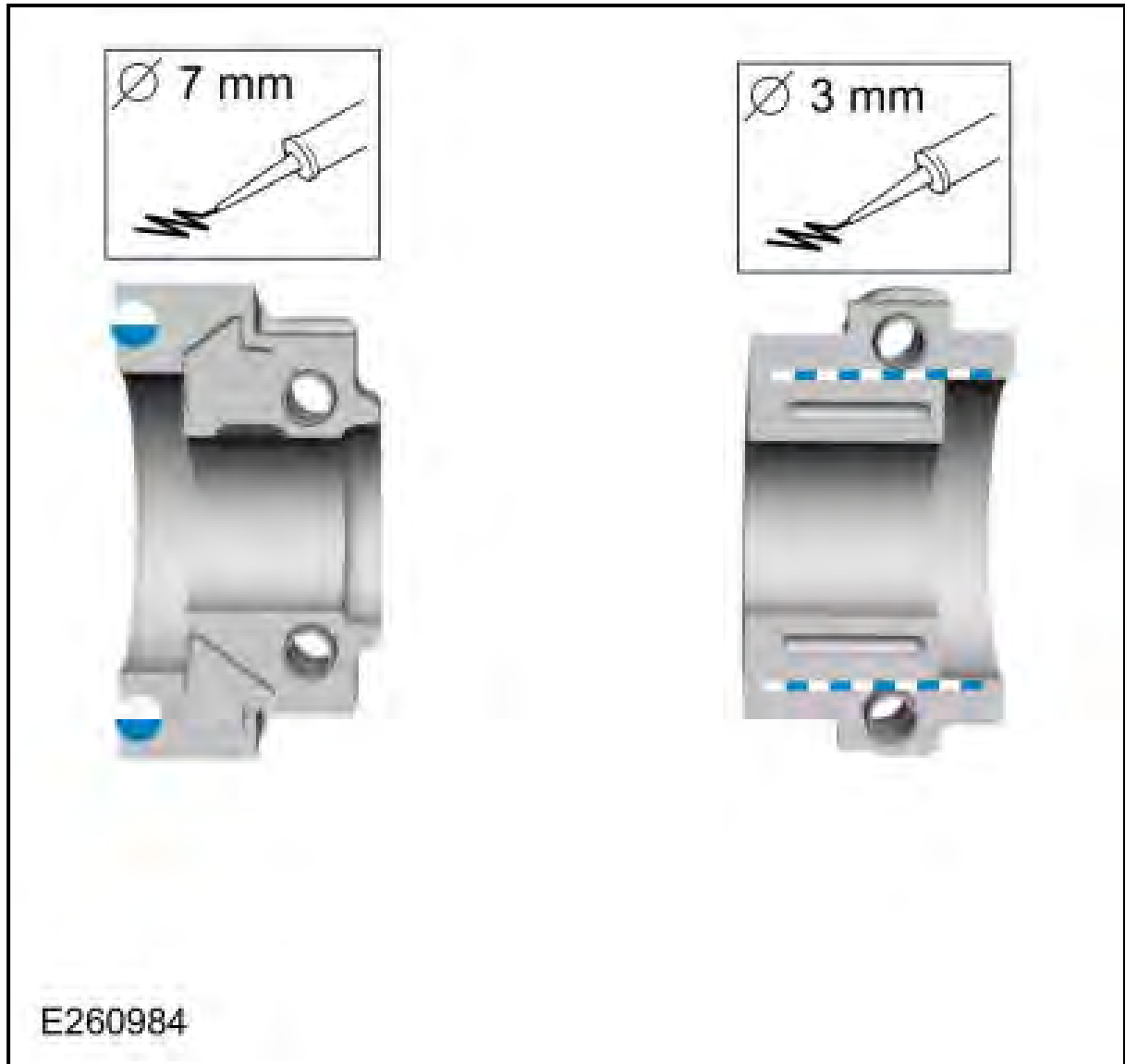
Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque: 89 lb.in (10 Nm)



71. Apply sealer to the LH bearing caps.

Material: Flange Sealant / CU7Z-19B508-A (WSS-M2G348-A11)



72. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

**NOTE:** Tighten the camshaft bearing cap bolts one turn at a time.

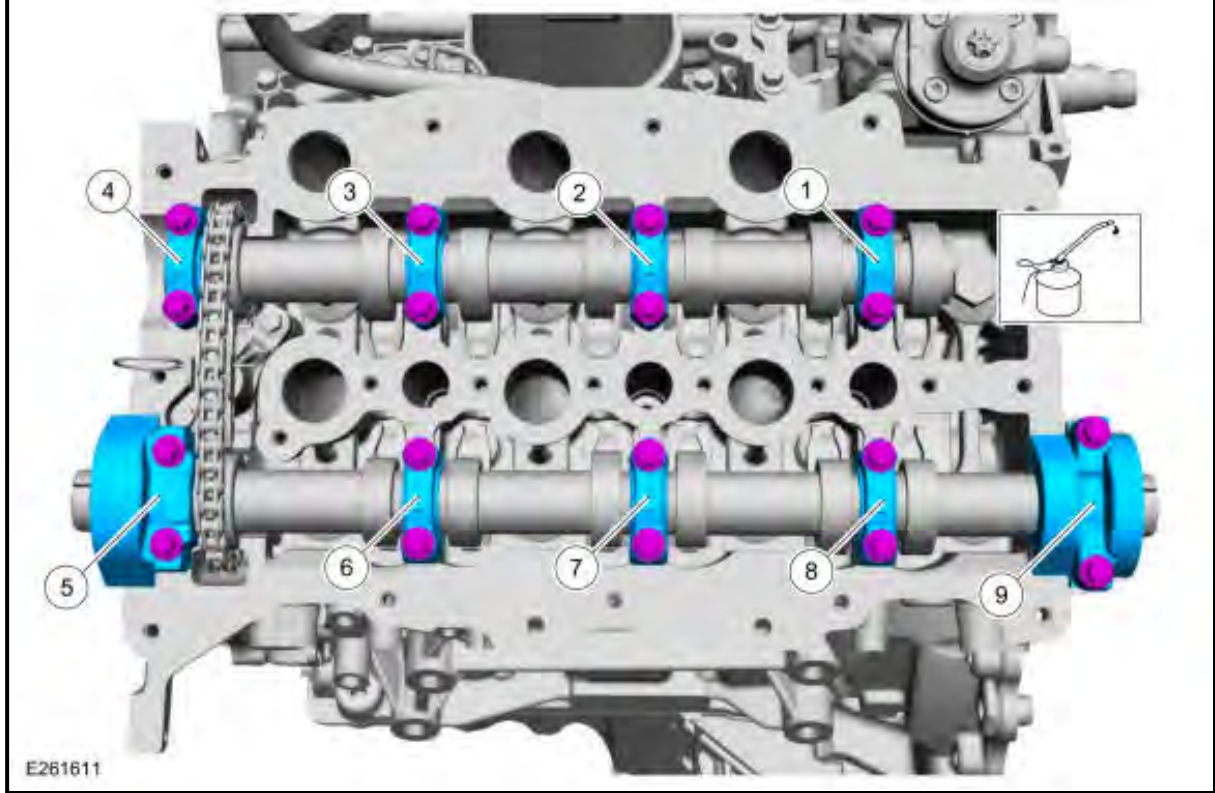
Apply clean engine oil to the camshaft bearing caps. Install camshaft bearing caps and the bolts.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

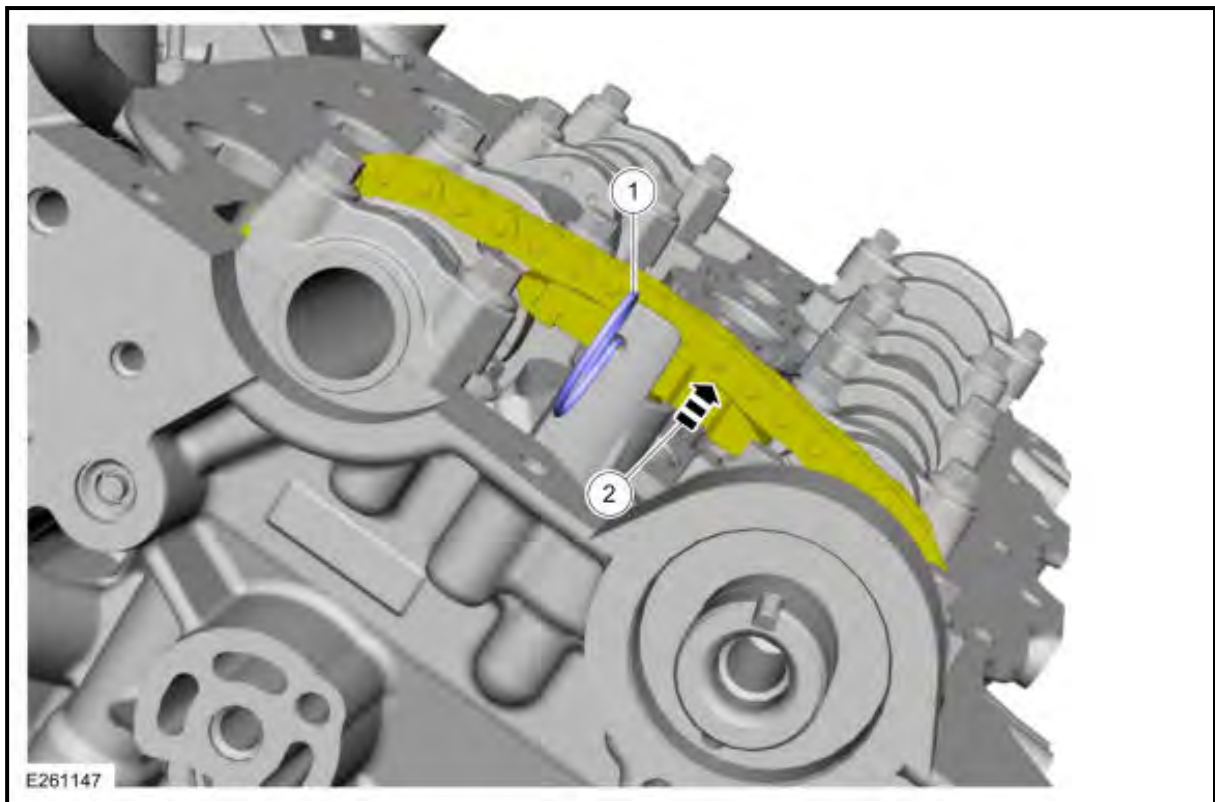
### Torque

- :Stage 1: 9 lb.in (1 Nm)
- Stage 2: 44 lb.in (5 Nm)
- Stage 3: 89 lb.in (10 Nm)



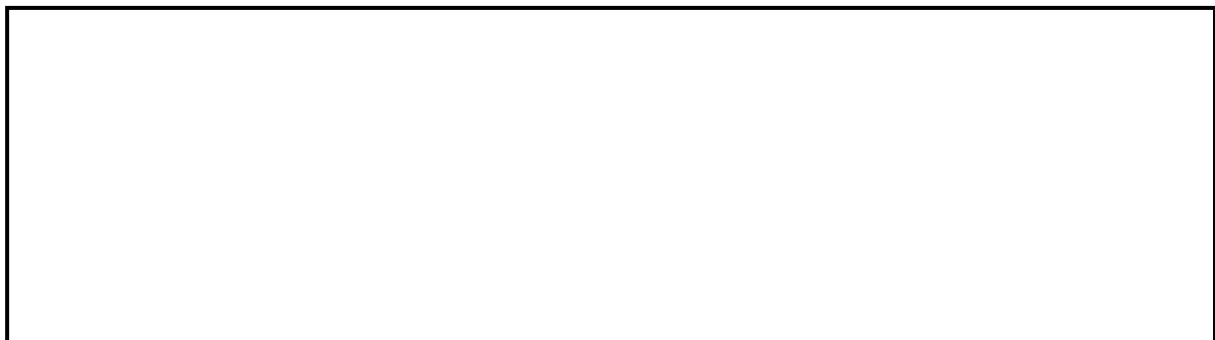


73. Remove the retaining pin.

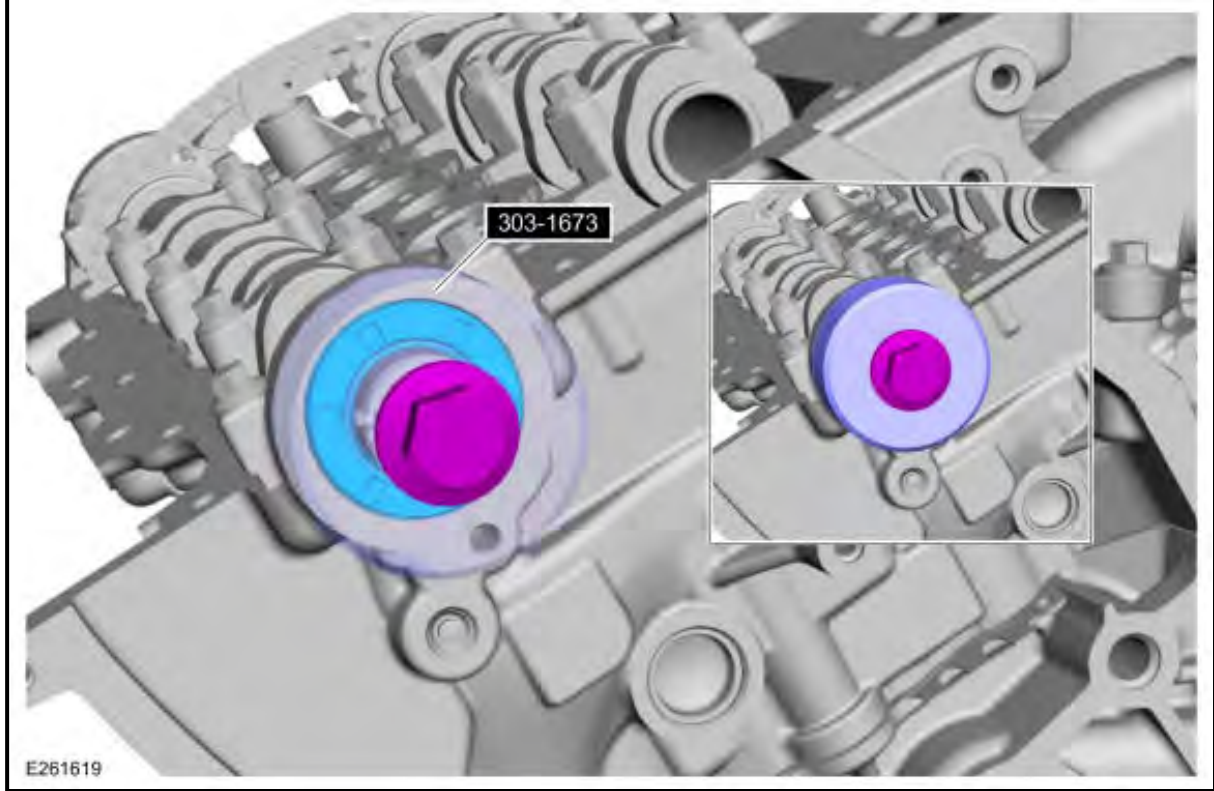


74. **NOTE:** Right side shown, left side front and rear similar.

Using the special tool, install the camshaft seals. Use Special Service Tool: 303-1673 Installer, Camshaft Seal.





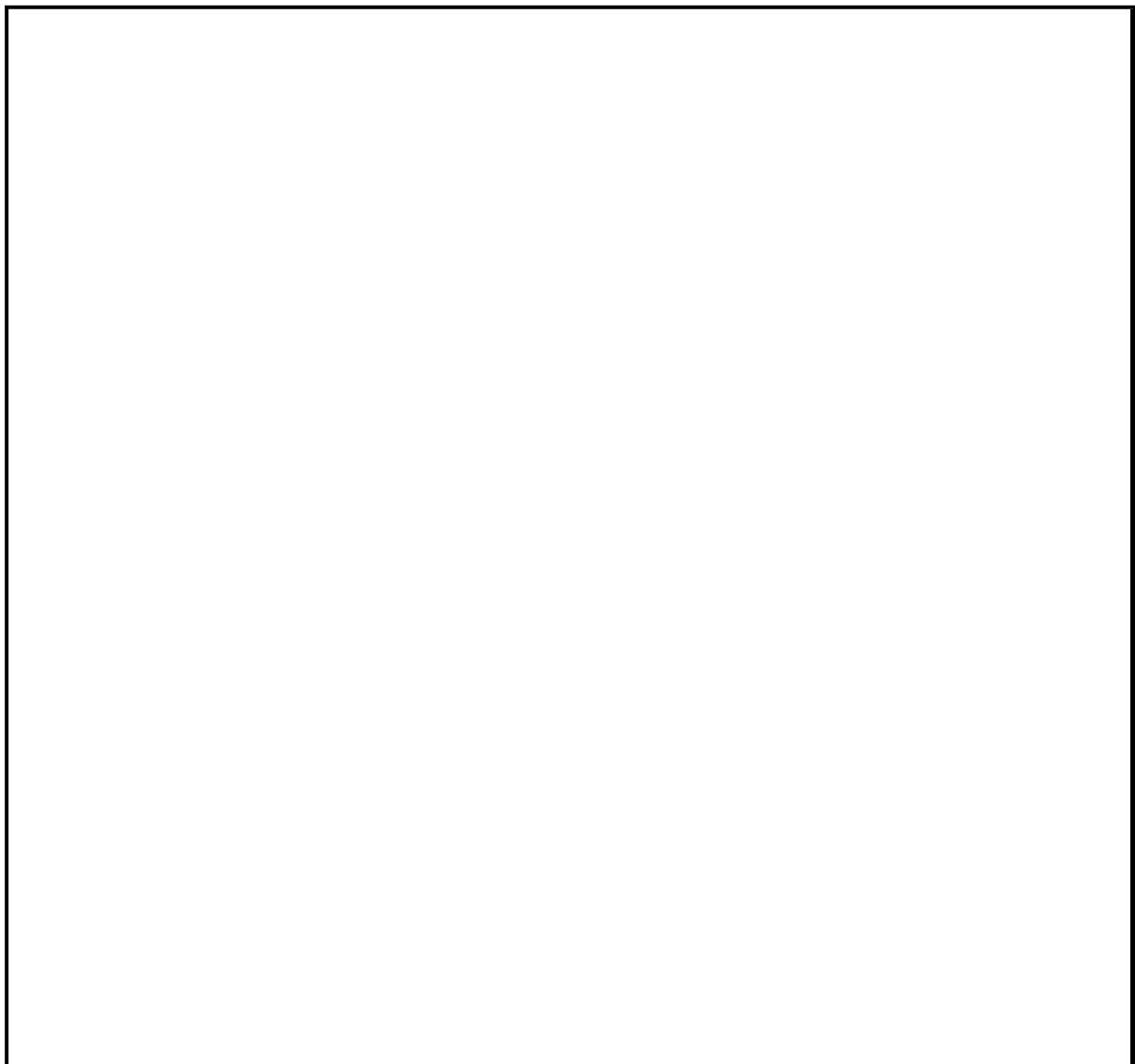


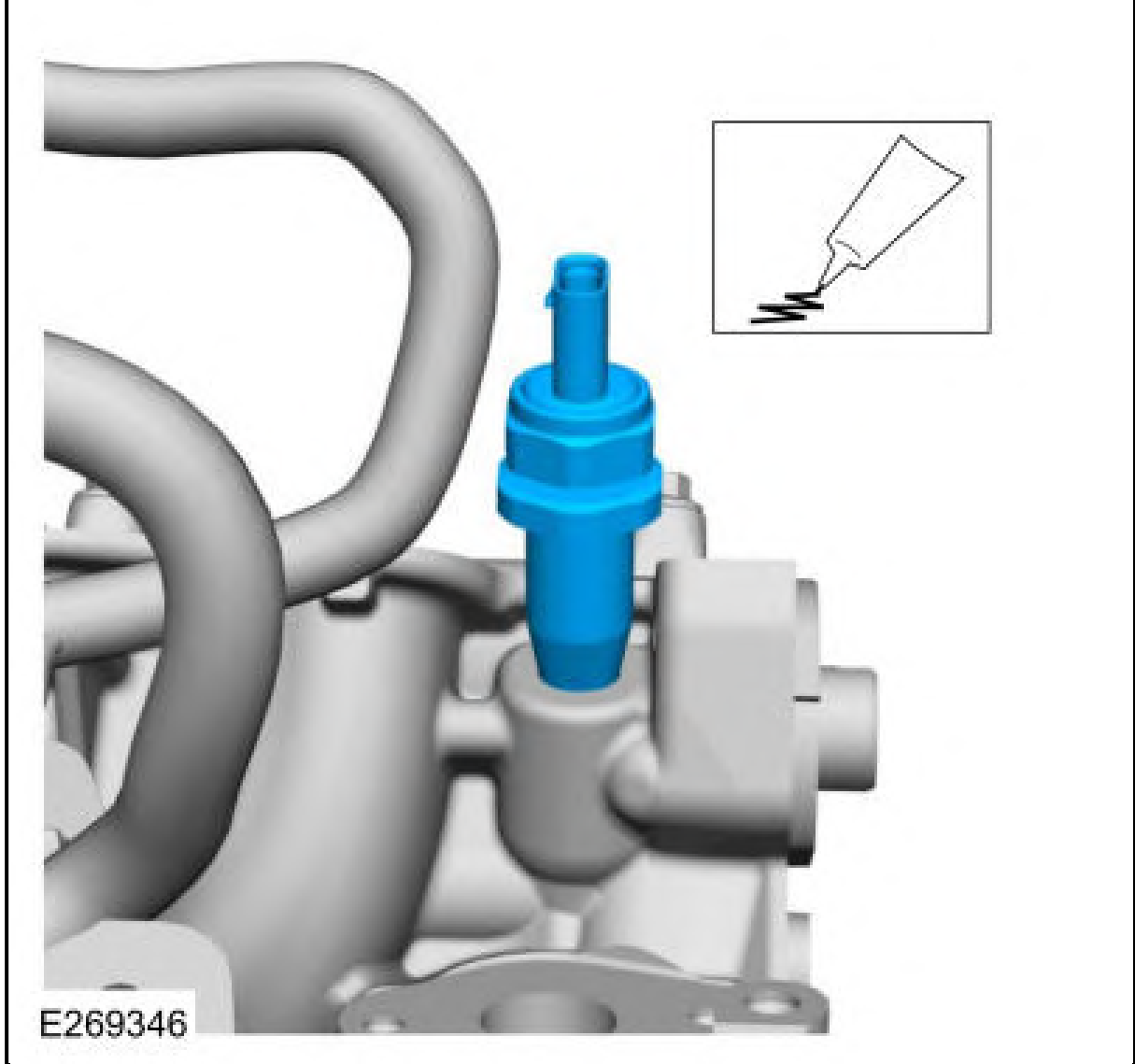
75. **NOTE:** If the EOP sensor is to be reused, apply thread sealant.

Install the EOP sensor.

Material: Motorcraft <sup>®</sup> Thread Sealant with PTFE / TA-24-B (WSK-M2G350-A2)

Torque: 159 lb.in (18 Nm)



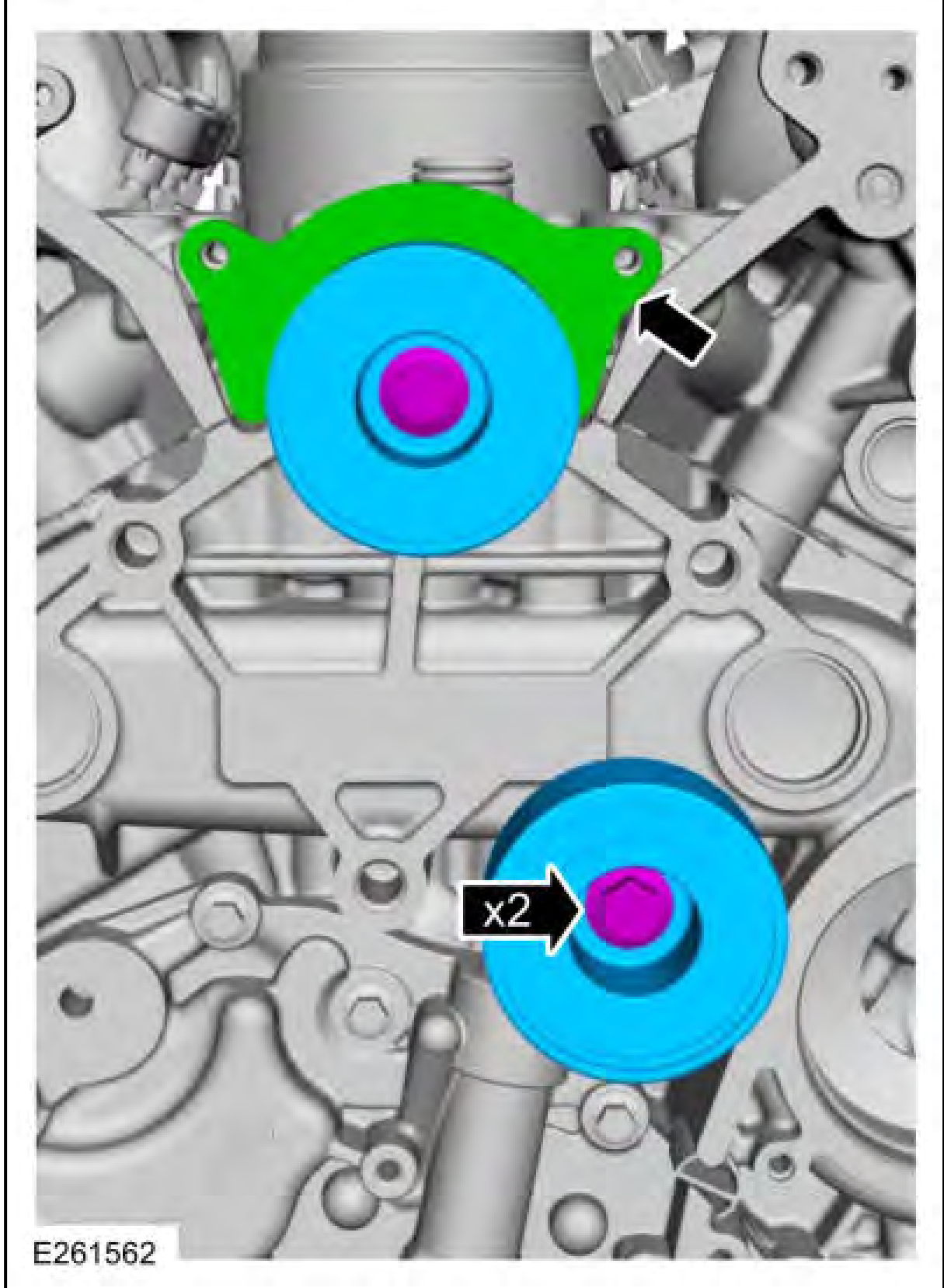


76. Install the dust shield. Install the timing belt idler pulleys and the bolts.

Torque

:Stage 1: 177 lb.in (20 Nm) Stage 2: 45 Å°





77. Install the coolant outlet connector gaskets.





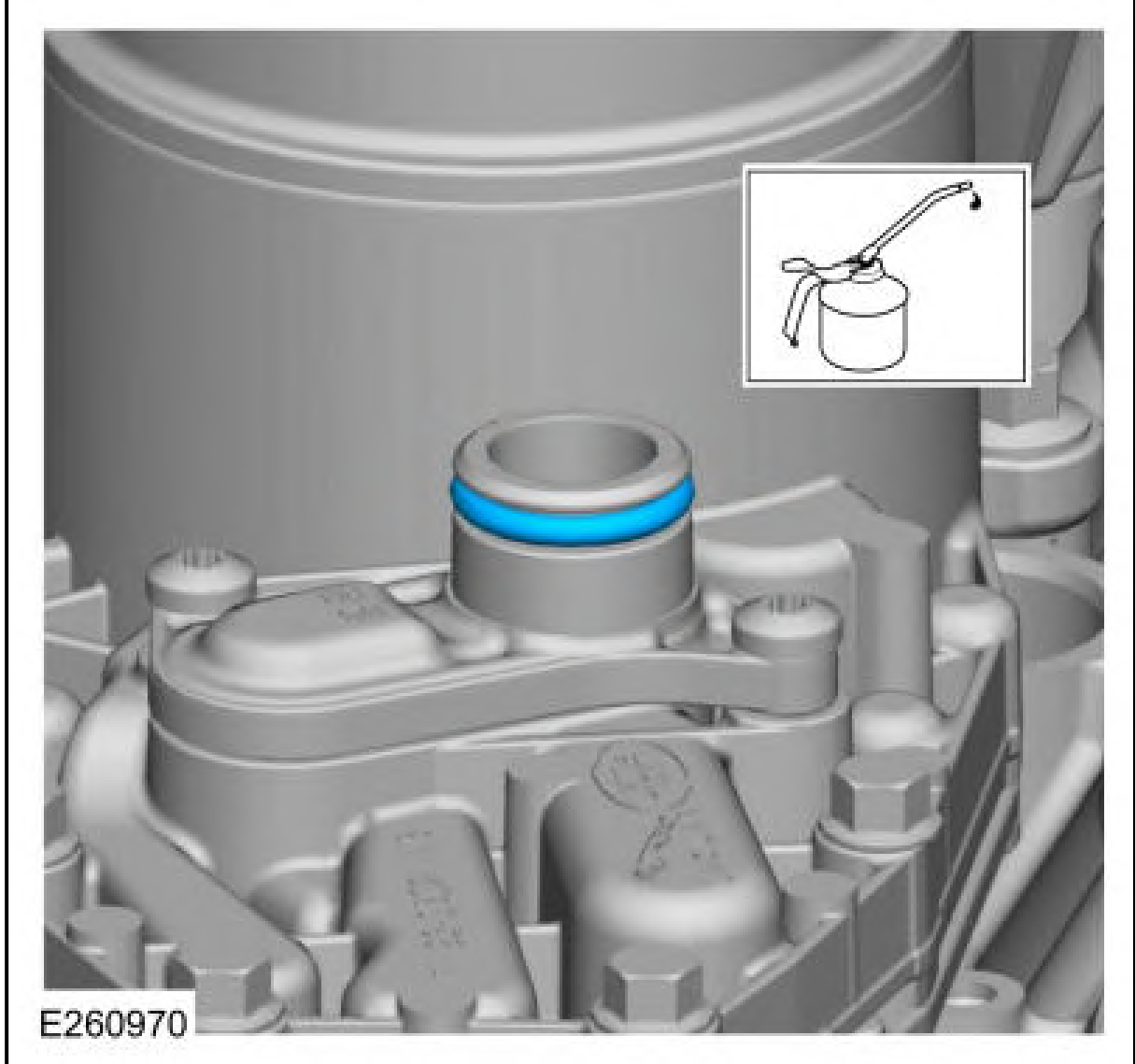
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78. Install the oil cooler O-ring and lubricate.

Material

: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

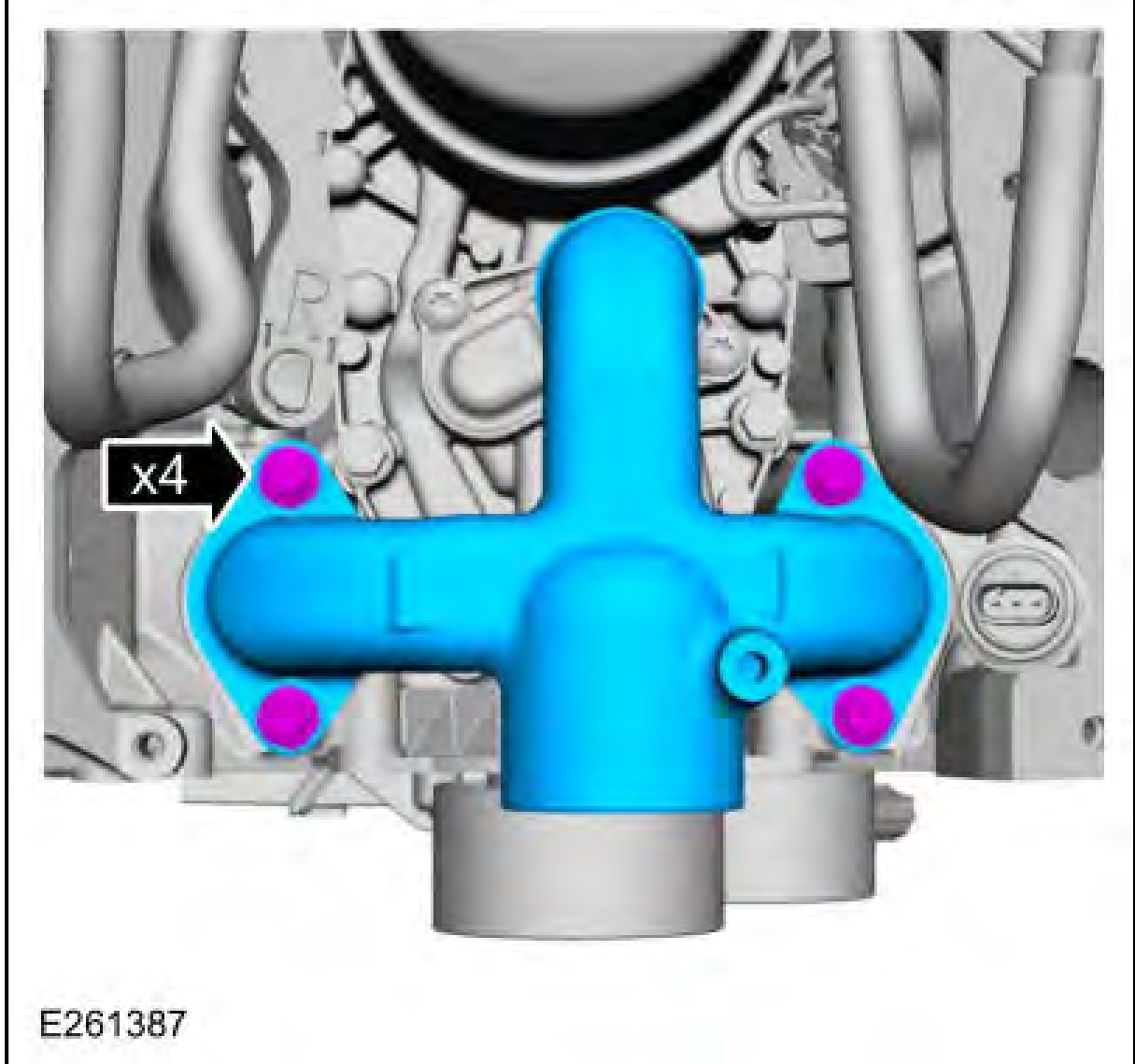




79. Install the coolant outlet connector and the bolts.

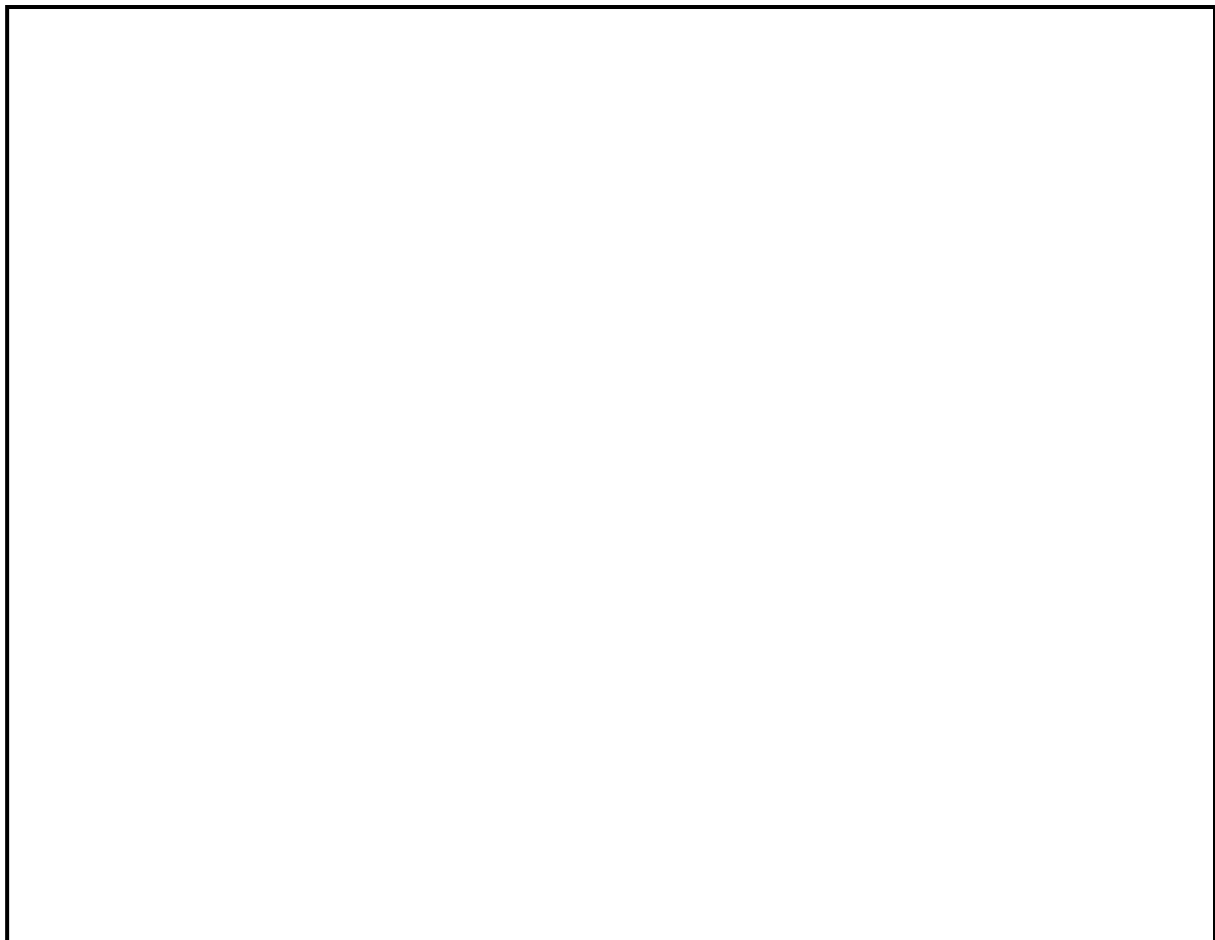
Torque: 89 lb.in (10 Nm)





80. Install the coolant pump O-ring and lubricate.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

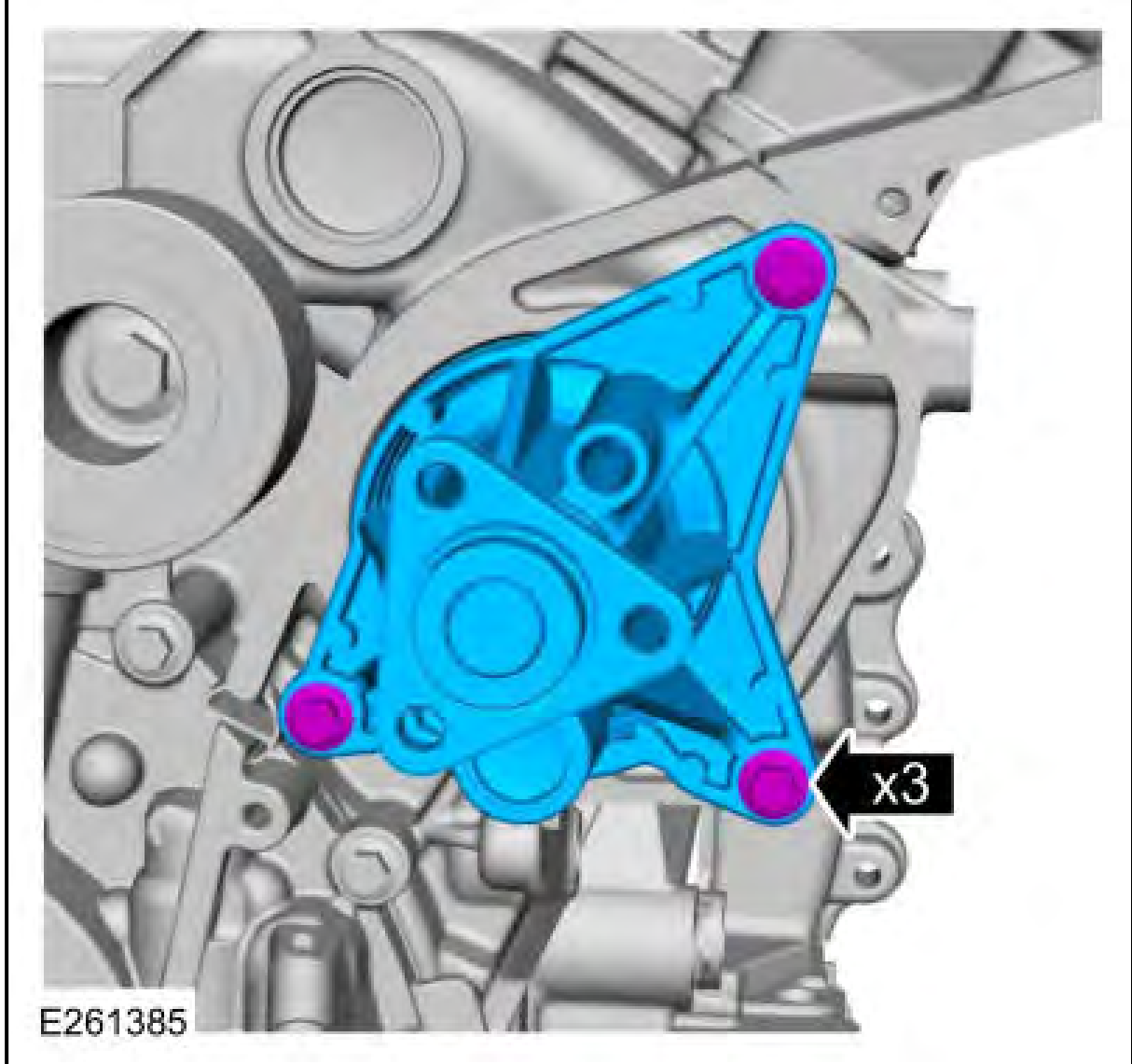




81. Install the coolant pump and the bolts.

Torque: 89 lb.in (10 Nm)



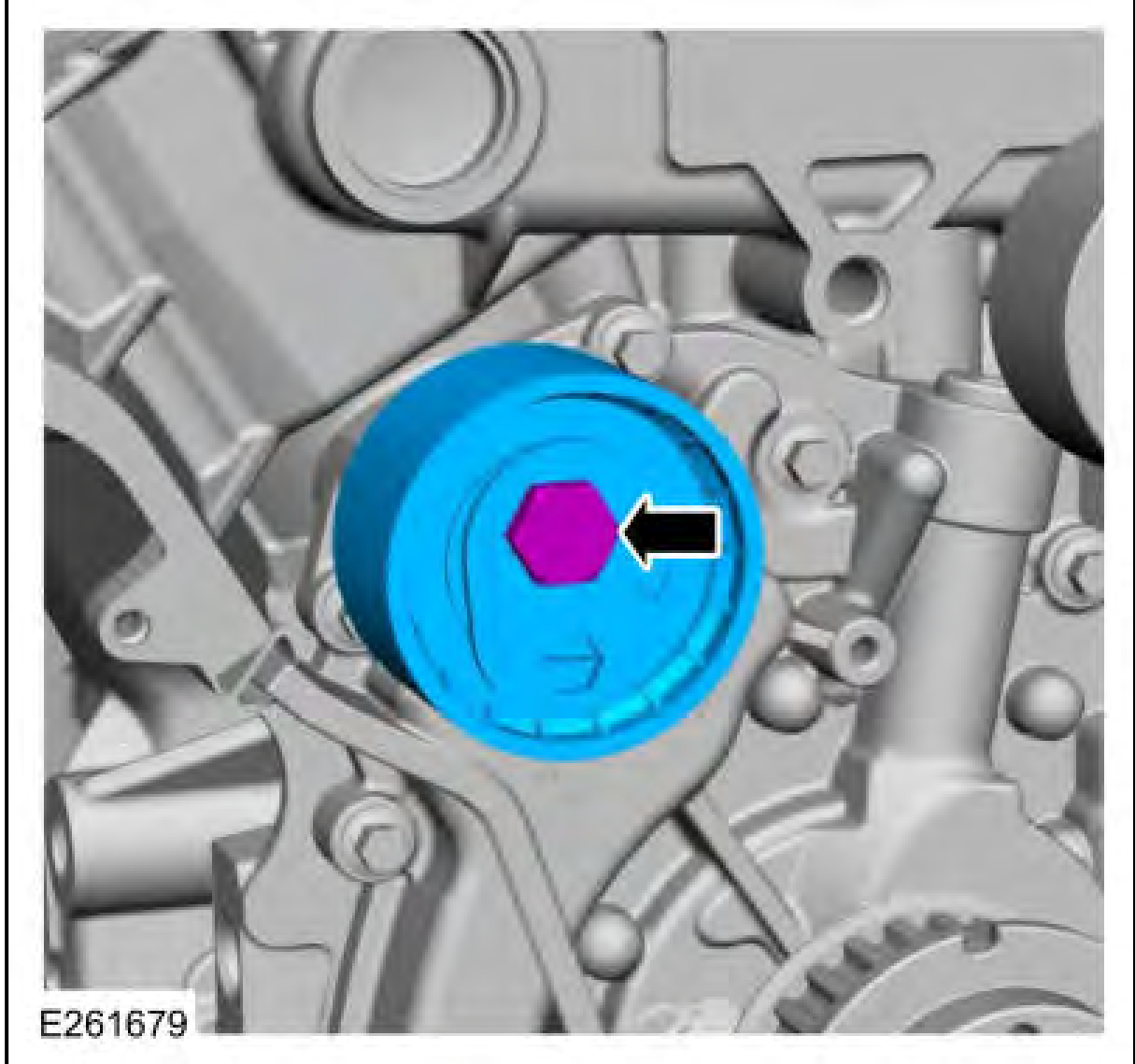


82. **NOTE:** Only tighten the bolts finger tight at this stage.

Install the timing belt tensioner and the bolt.







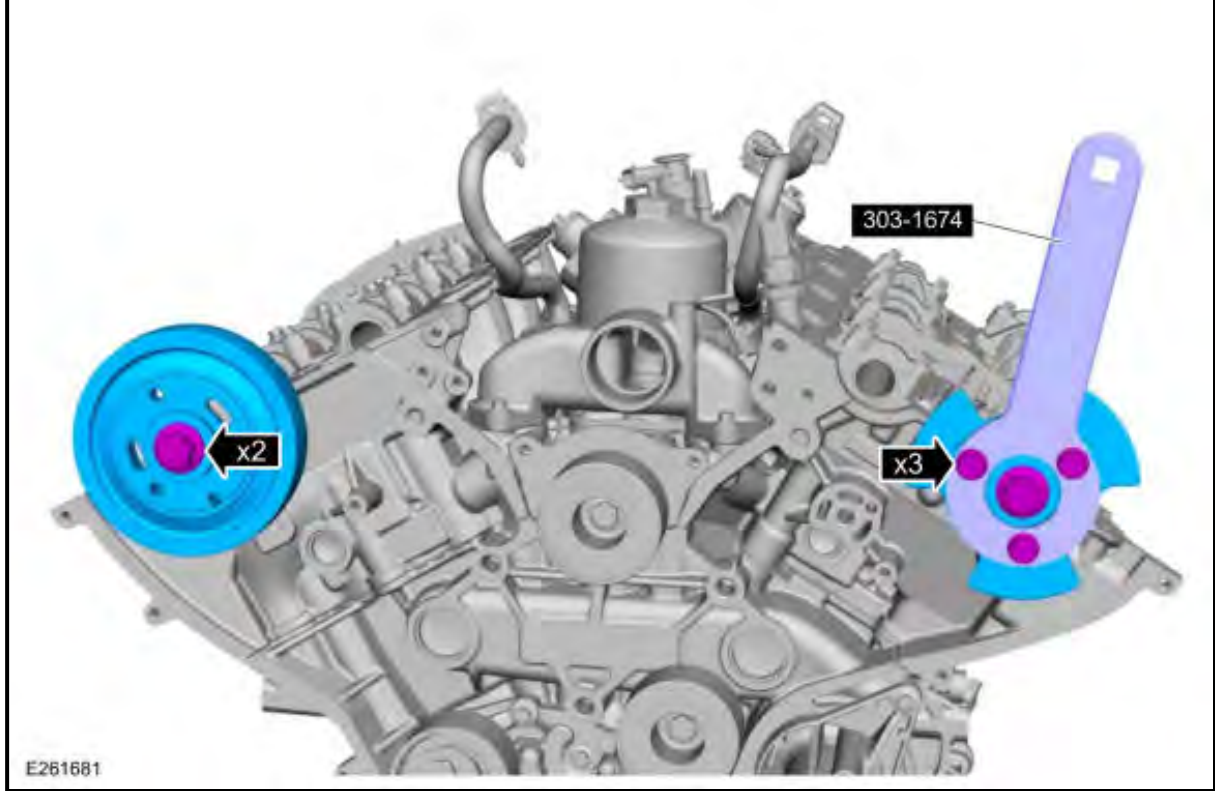
83. **NOTE:** Use the original bolts for the special tool.

Using the special tool, install the camshaft gear hubs and bolts. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.

Torque

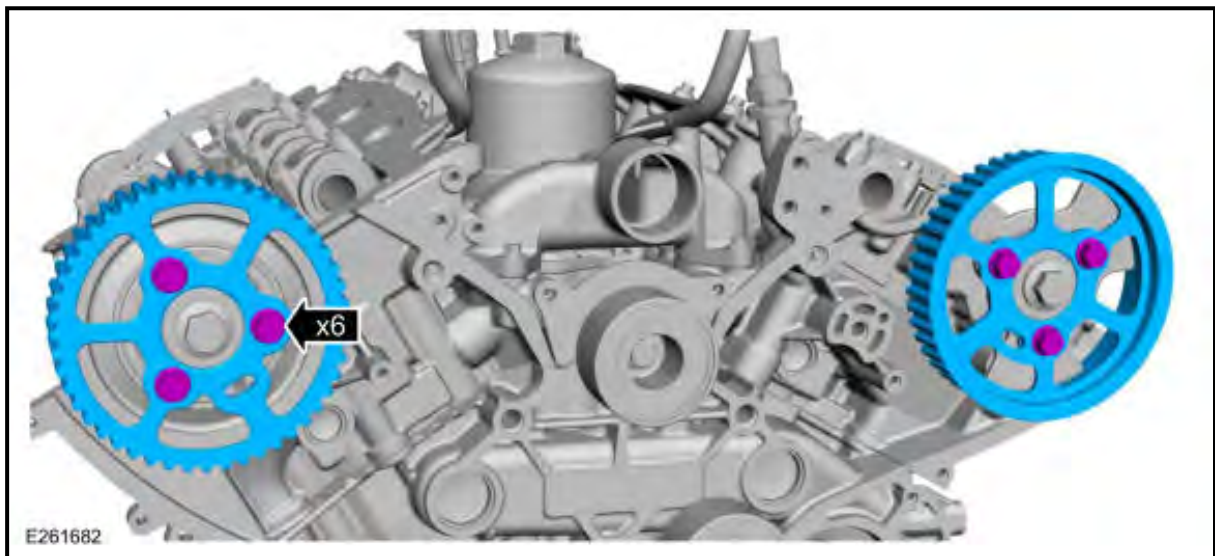
: Stage 1: 59 lb.ft (80 Nm) Stage 2: 80 Å°



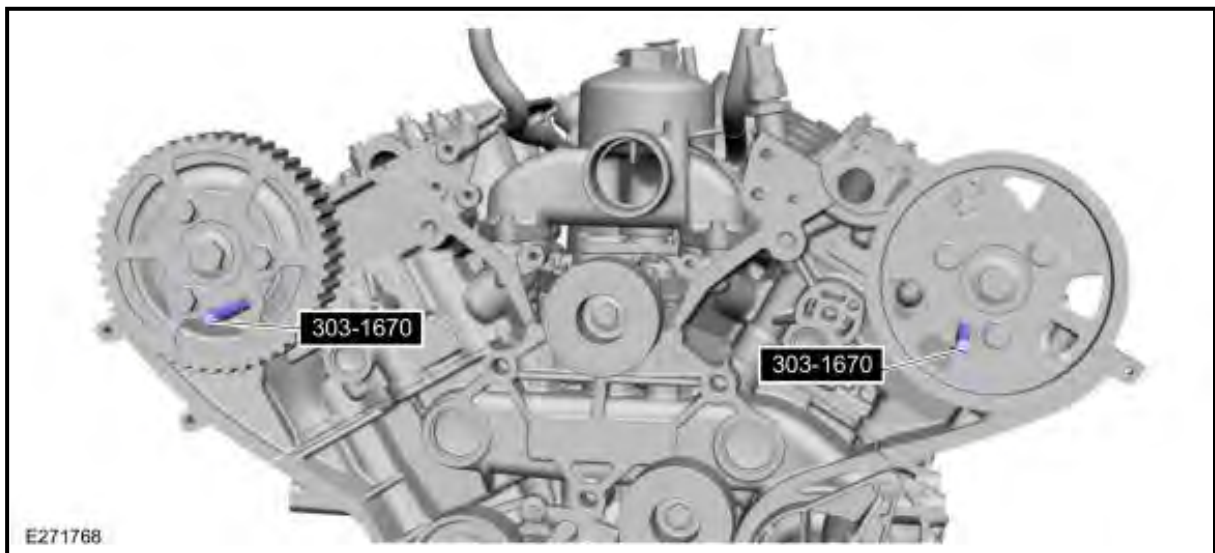


84. **NOTE:** Only tighten the bolts finger tight at this stage.

Install the camshaft pulleys and the bolts.



85. Install Special Service Tool: 303-1670 Pins, Camshaft Locking.



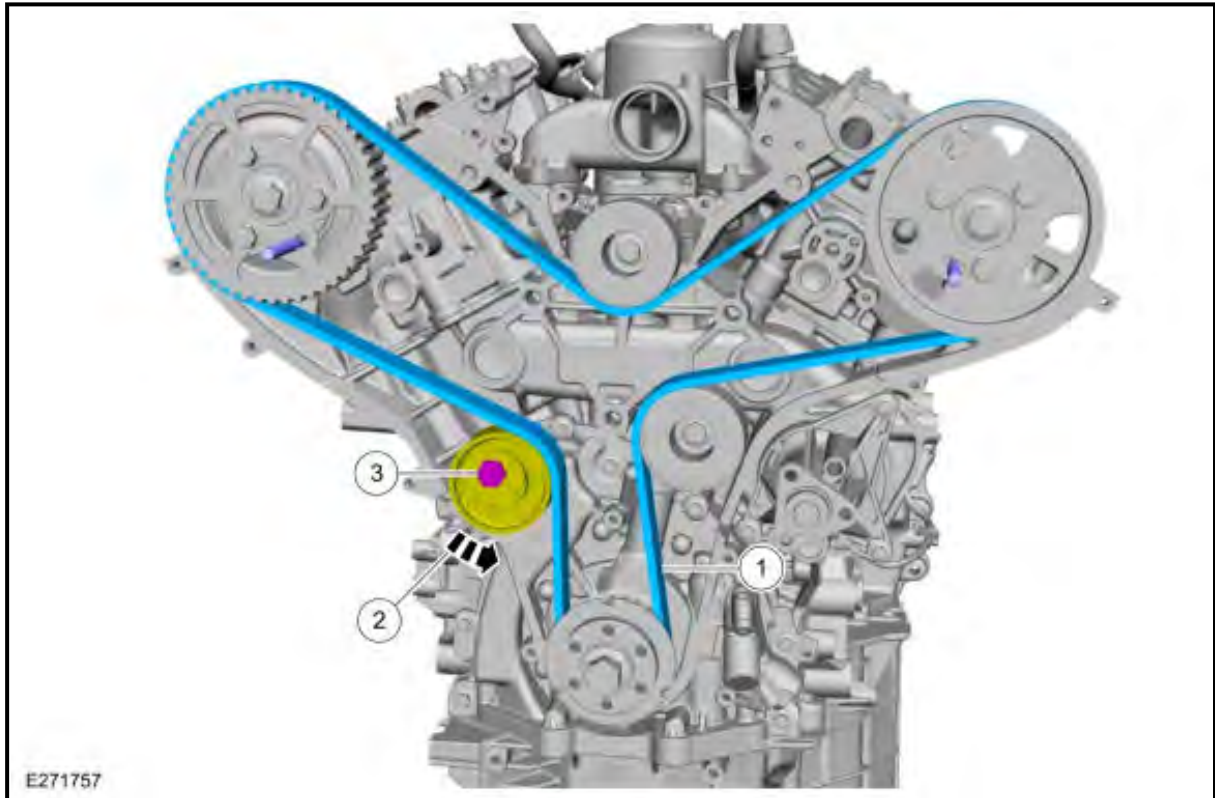
86. **NOTE:** Make sure that a new component is installed.

**NOTE:** It may be necessary to rotate the camshaft pulleys slightly to ensure the bolts are not at the end of the slots.

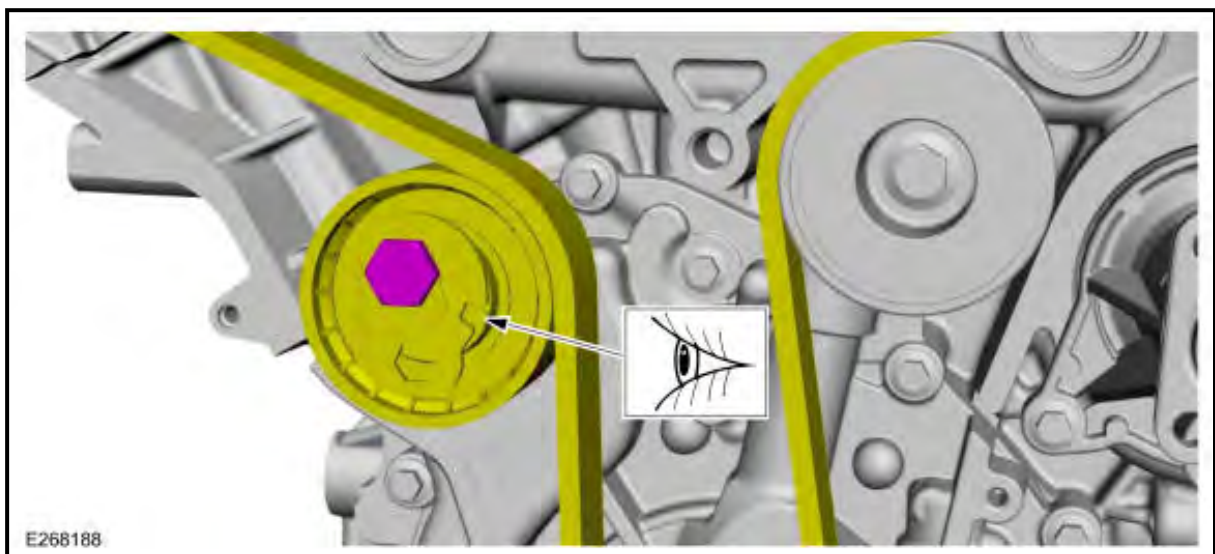
1. Install the timing belt.
2. Rotate the timing belt tensioner.
3. Tighten the timing belt tensioner bolt.

Torque

:Stage 1: 177 lb.in (20 Nm) Stage 2: 45 Å°

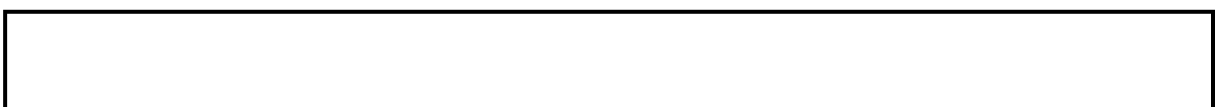


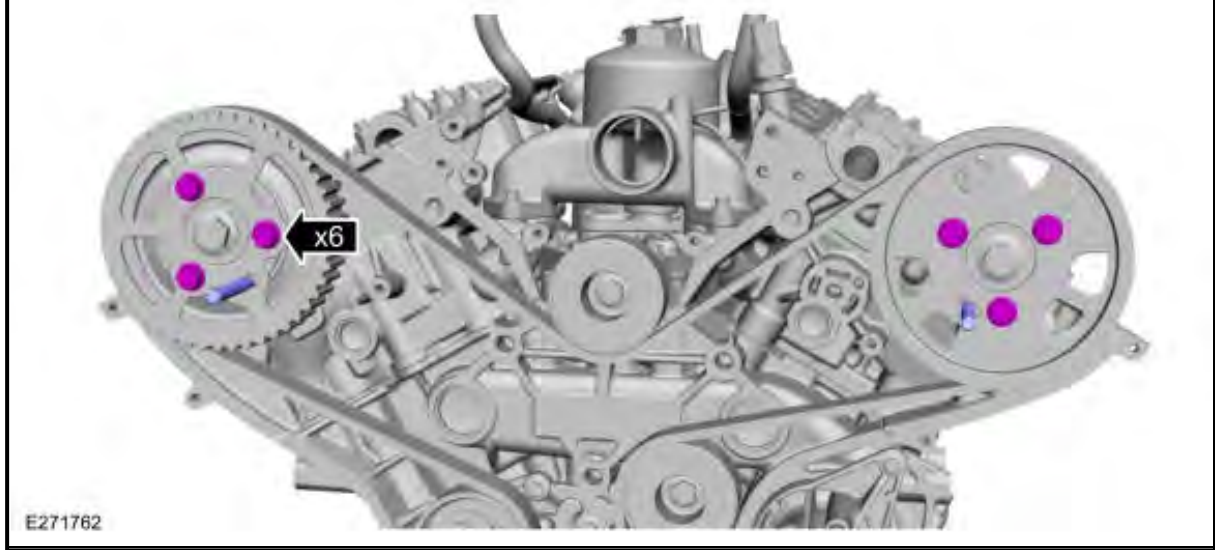
87. If the timing belt tensioner pointer is not visible in the window, the timing belt tensioning step must be repeated.



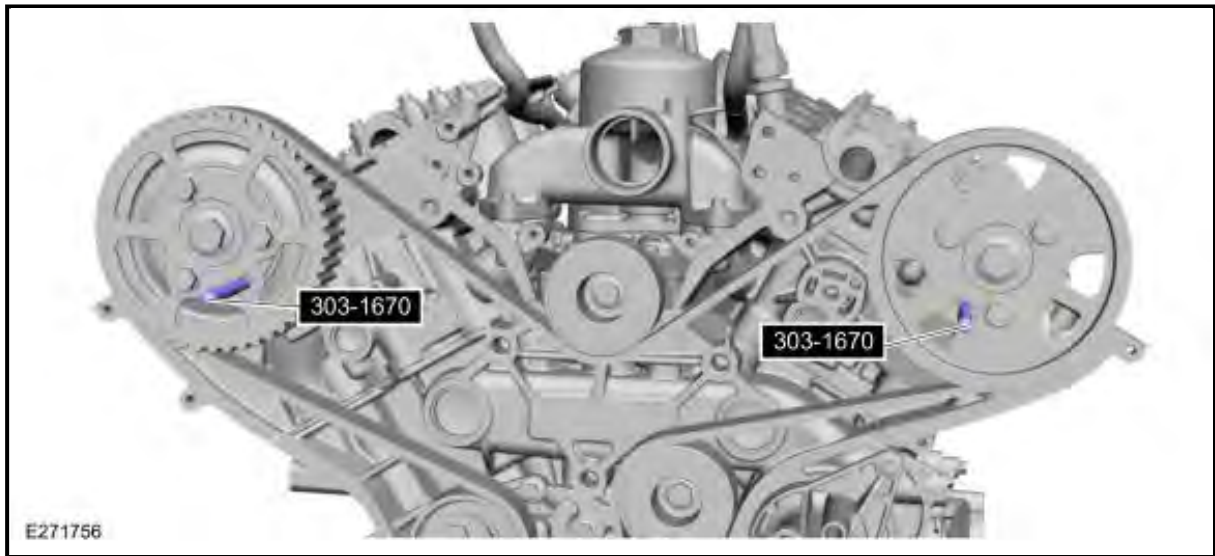
88. Tighten the camshaft pulley bolts.

Torque: 17 lb.ft (23 Nm)



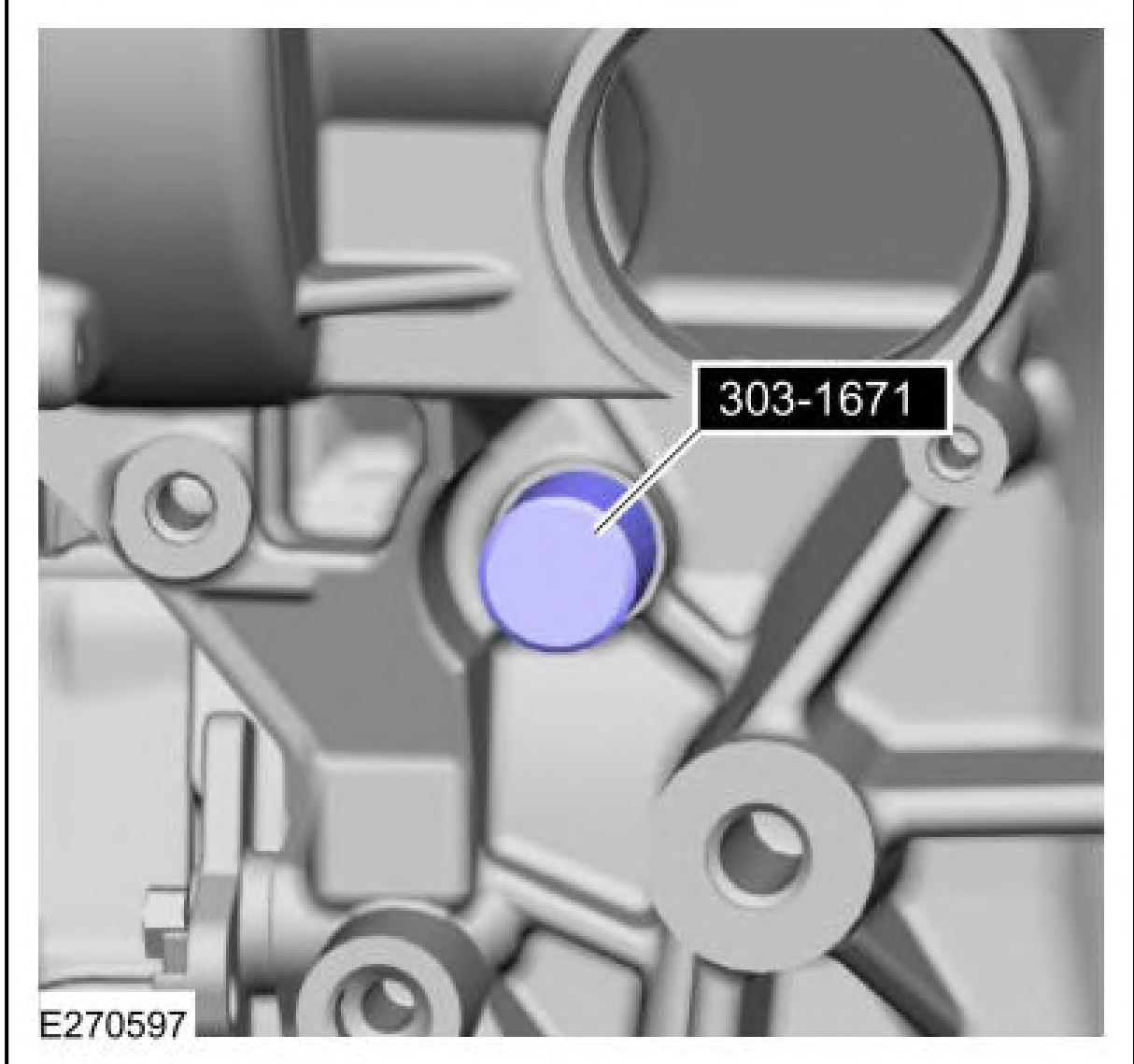


89. Remove Special Service Tool: 303-1670 Pins, Camshaft Locking.



90. Remove Special Service Tool: 303-1671 Pin, Locking Crankshaft.





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

This step is to verify that the timing is correct. Rotate the engine  $1 \frac{7}{8}$  revolutions.

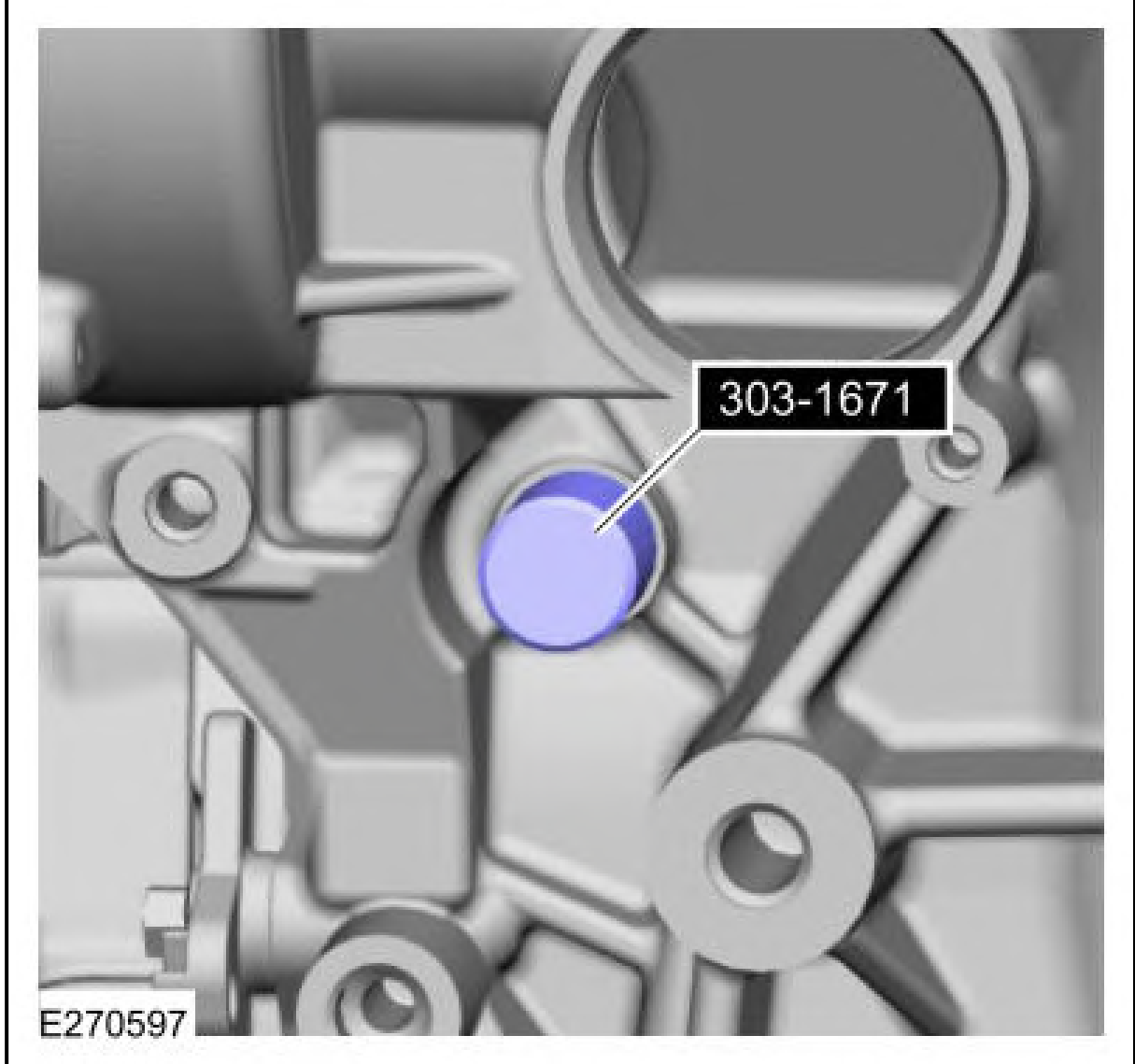
92. Install special tool.

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

**NOTE:** The Locking Crankshaft Pin must be bottomed out against the cylinder block.

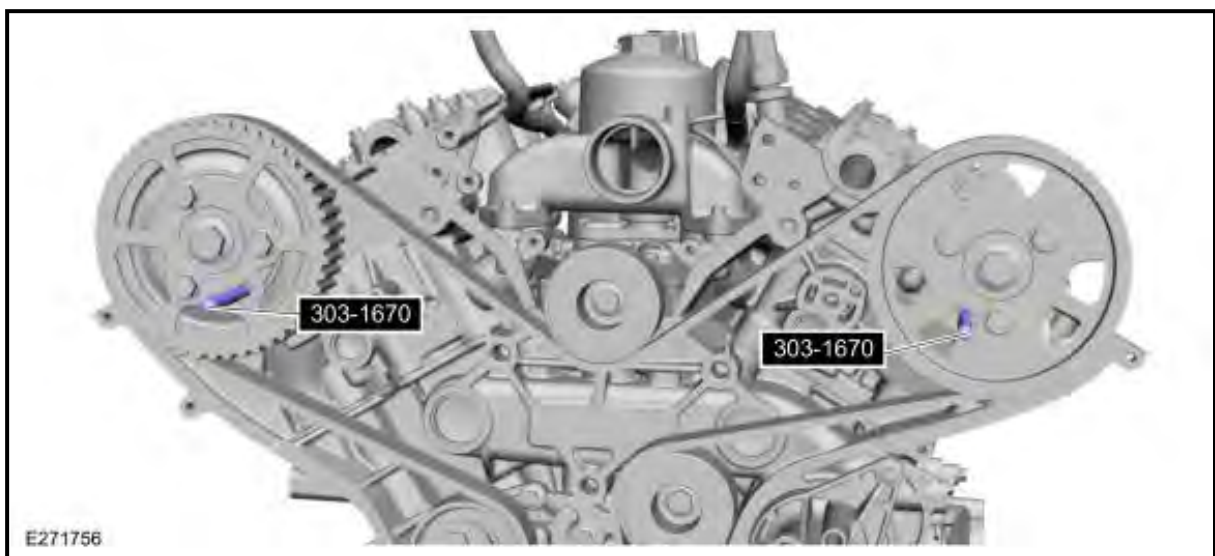
Rotate the crankshaft clockwise so the crankshaft contacts the locking crankshaft pin. Use Special Service Tool: 303-1671 Pin, Locking Crankshaft.





93. **NOTE:** The special tool can only be installed if the valve timing is correct.

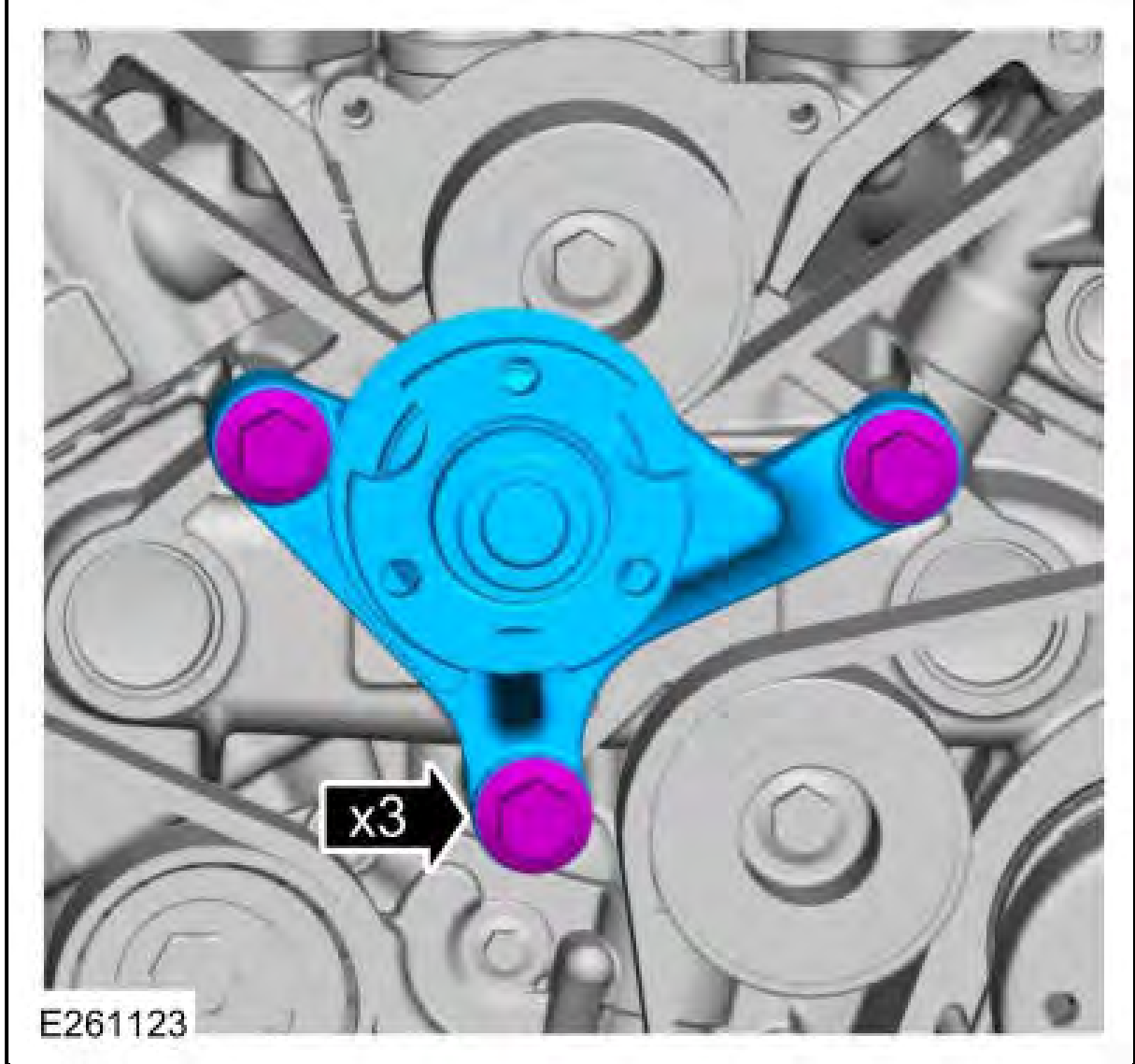
If the special tools do not install correctly, repeat the timing belt installation steps. Install Special Service Tool: 303-1670 Pins, Camshaft Locking.



94. Install the fan drive and the bolts.

Torque: 61 lb.ft (83 Nm)

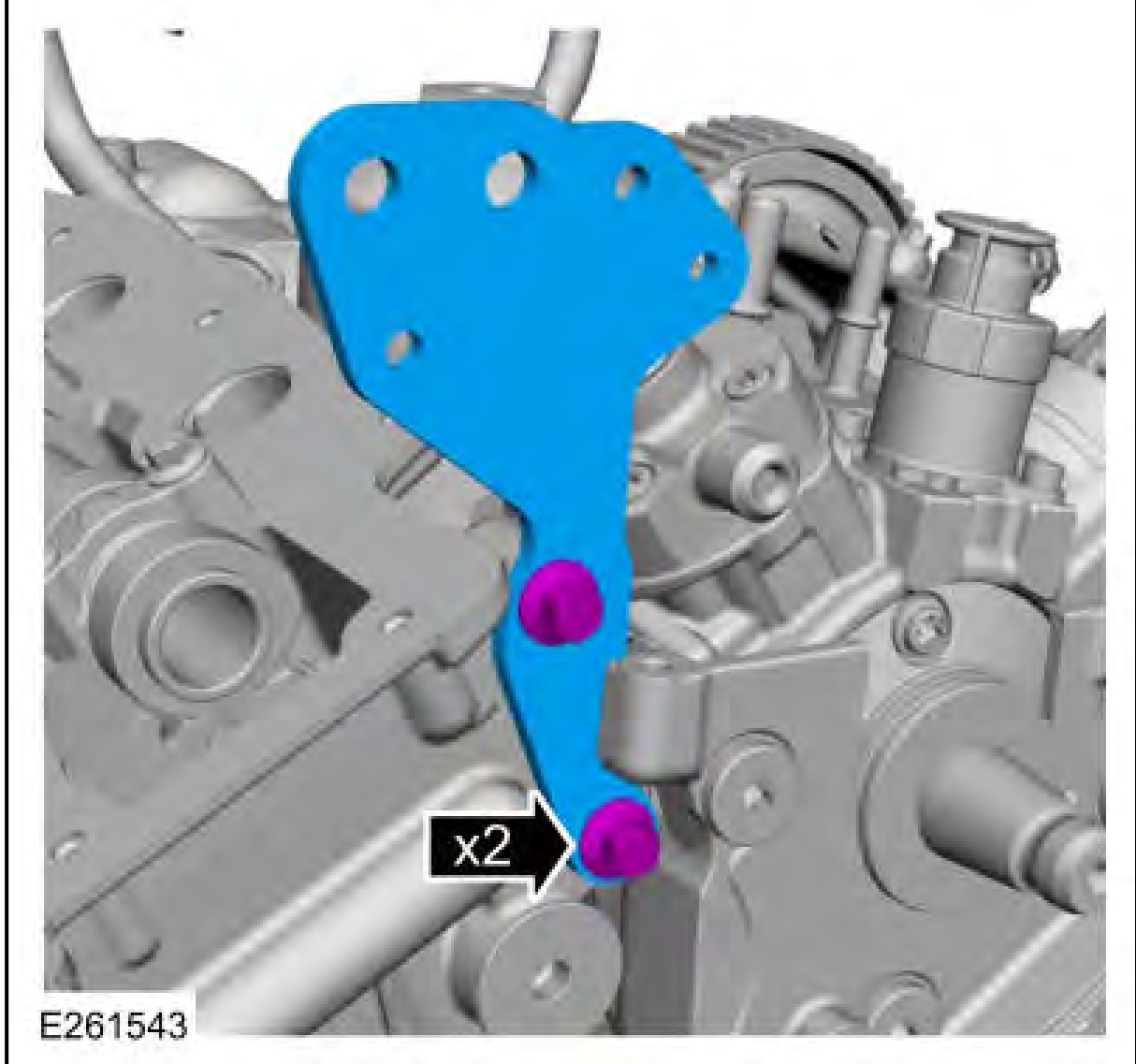




95. Install the rear engine cover lifting bracket.

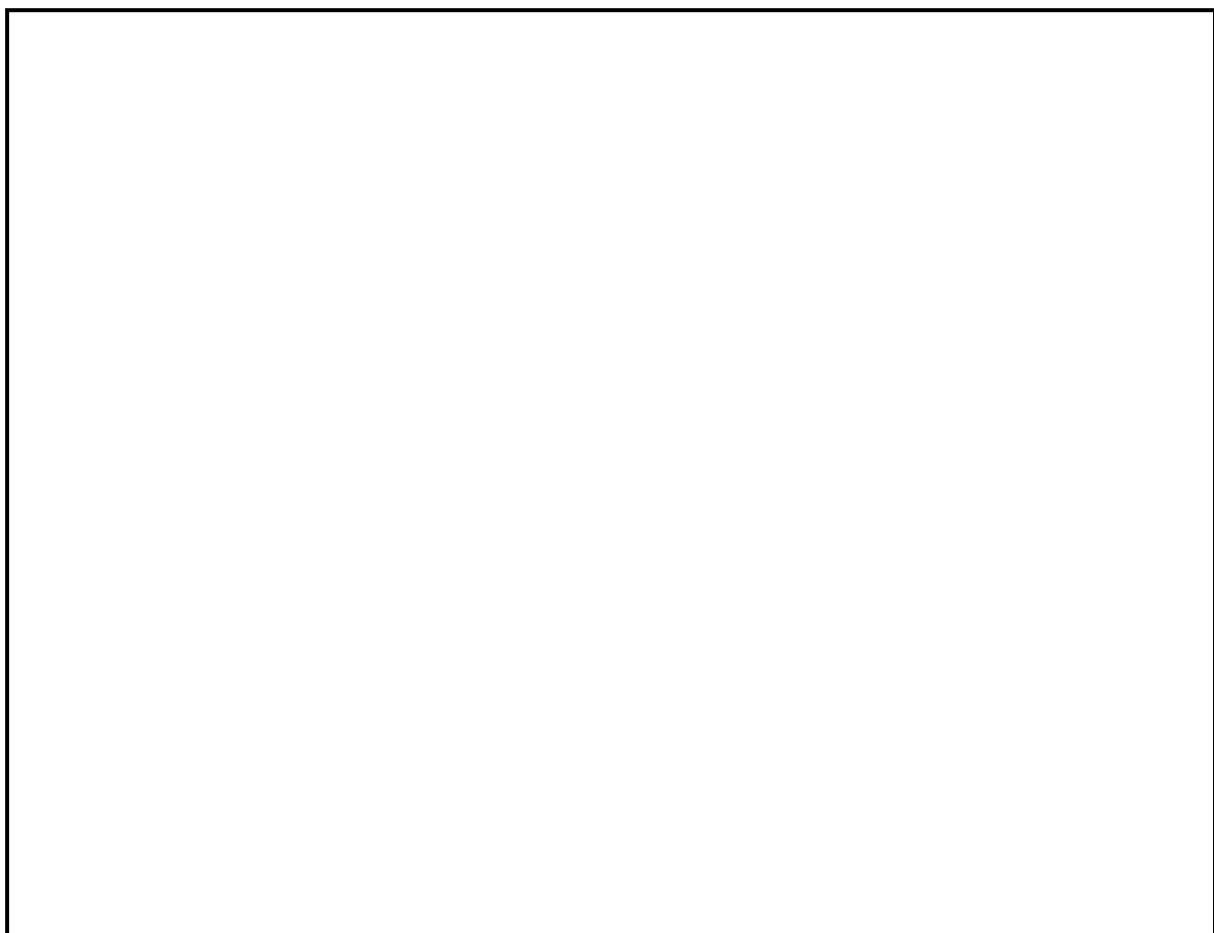
Torque: 17 lb.ft (23 Nm)



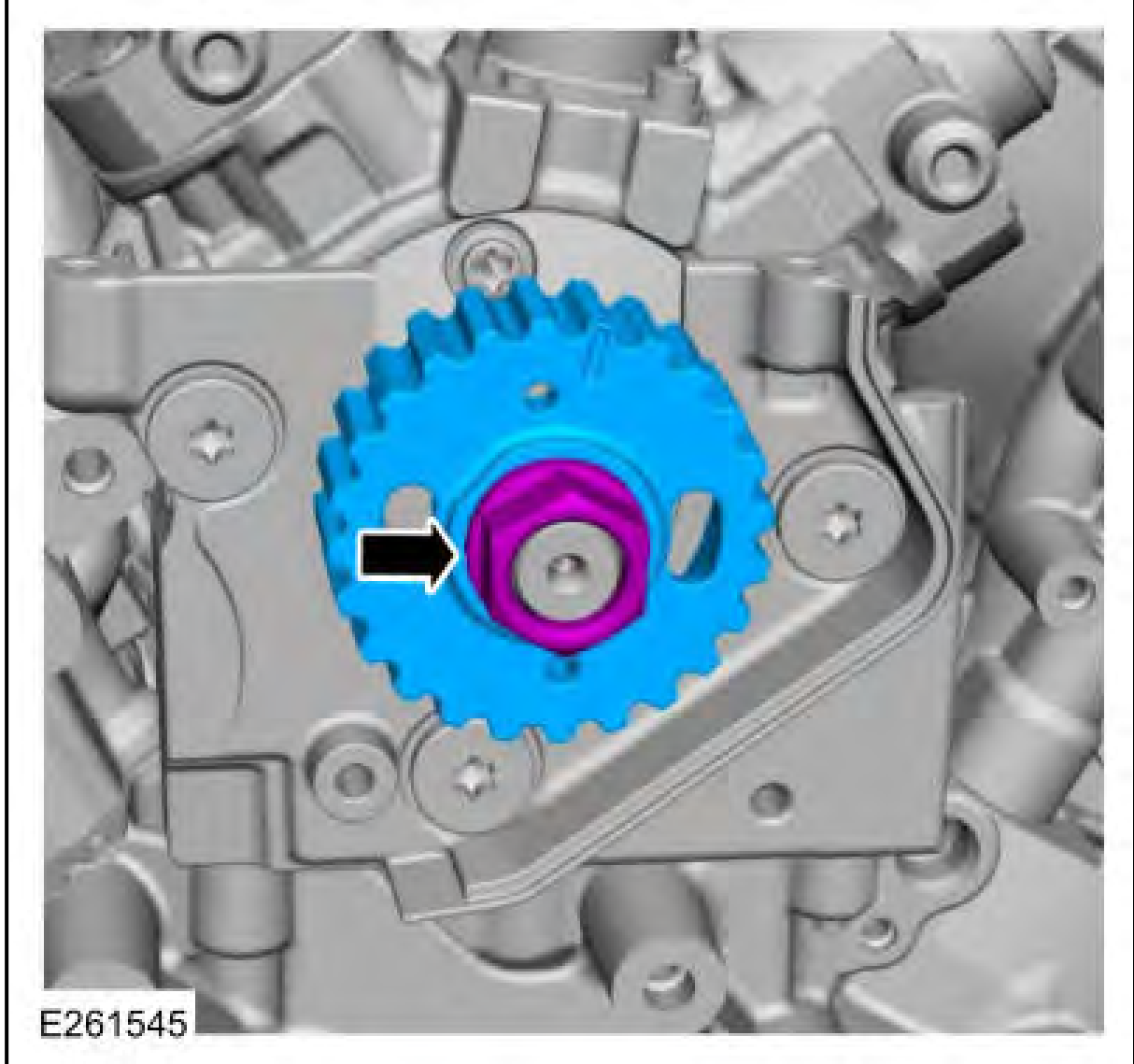


96. **NOTE:** Only tighten the nut finger tight at this stage.

Install the fuel injection pump pulley and nut.

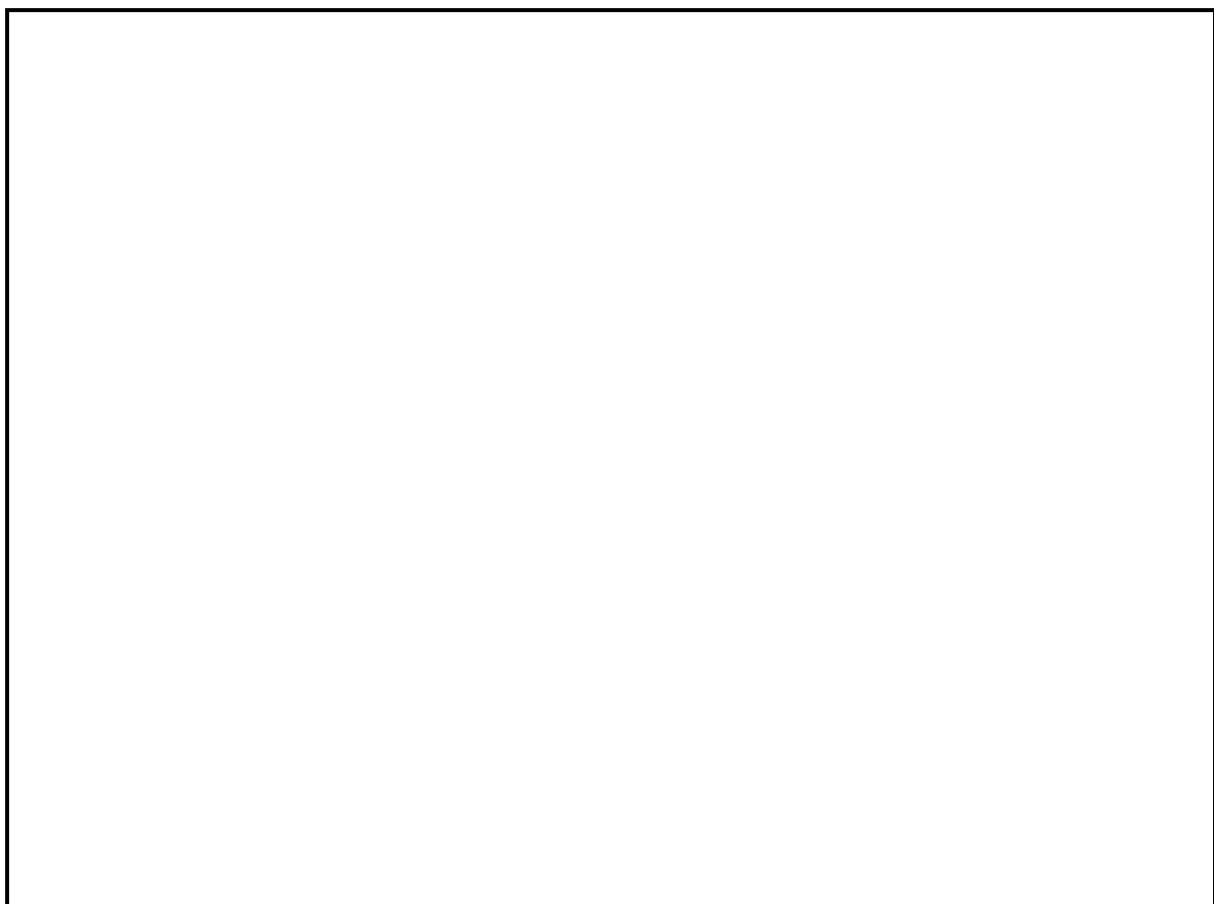


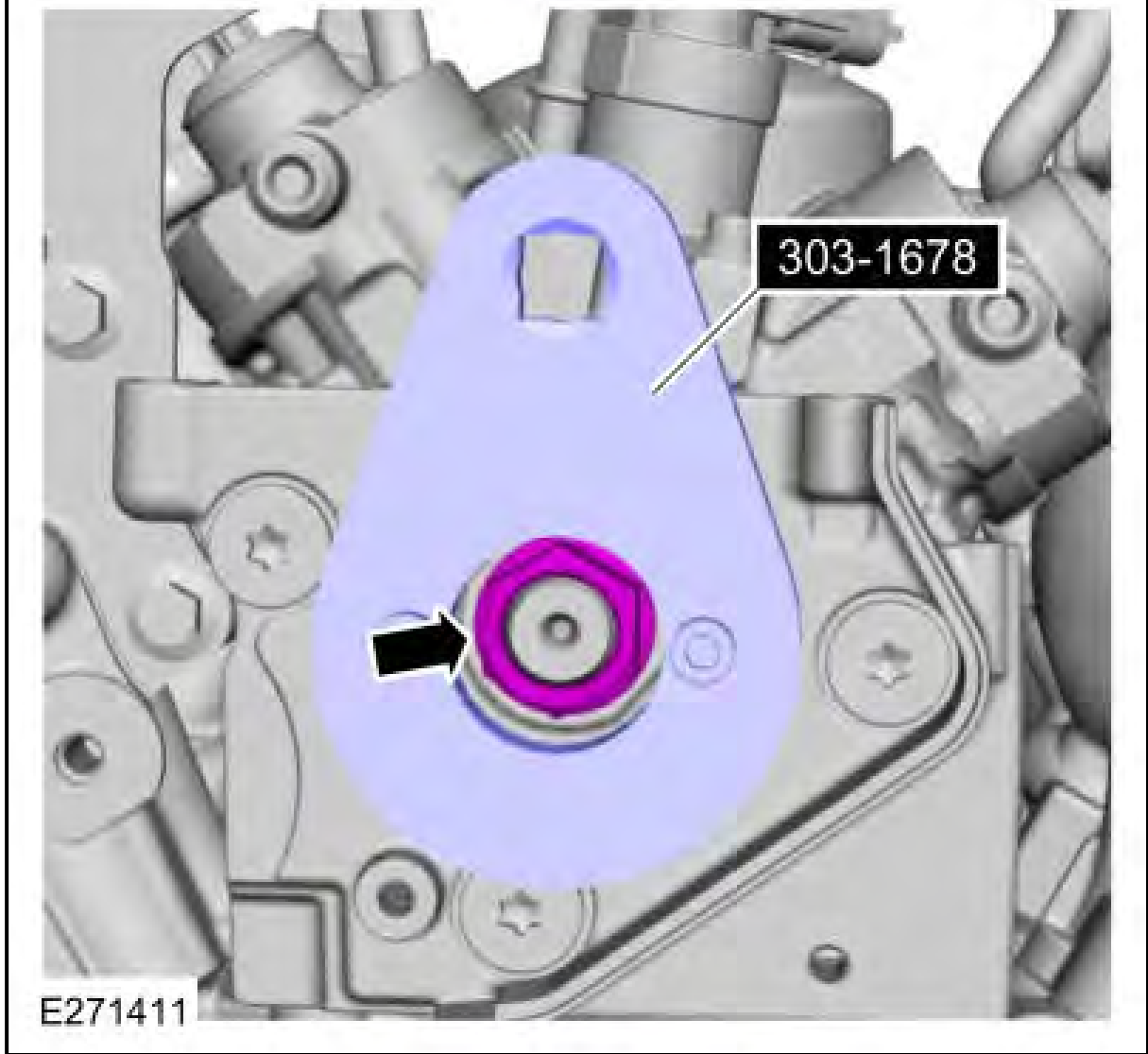




97. Using the special tool, tighten the fuel injection pump nut. Use Special Service Tool: 303-1678 Remover, Fuel Pump Pulley Holding Tool.

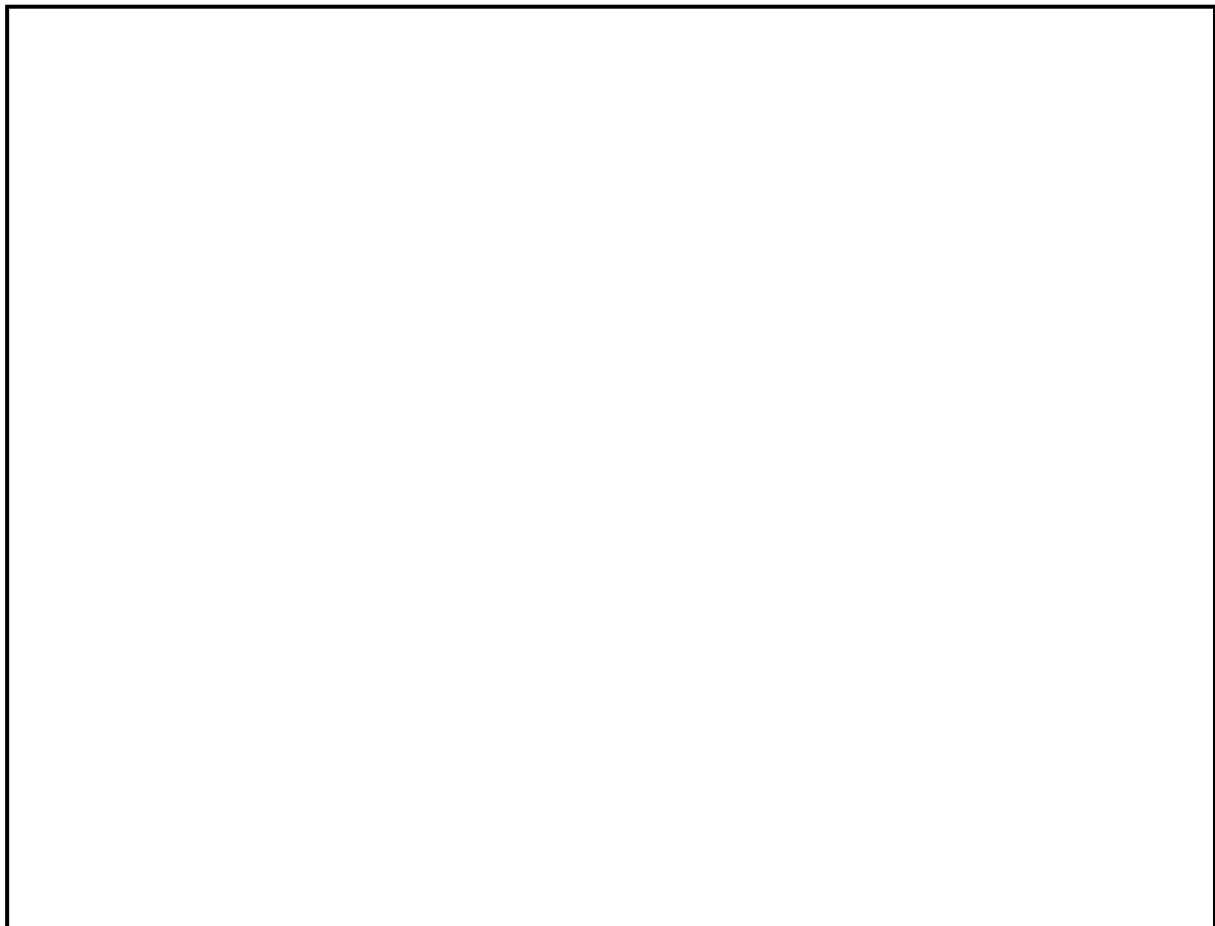
Torque: 37 lb.ft (50 Nm)

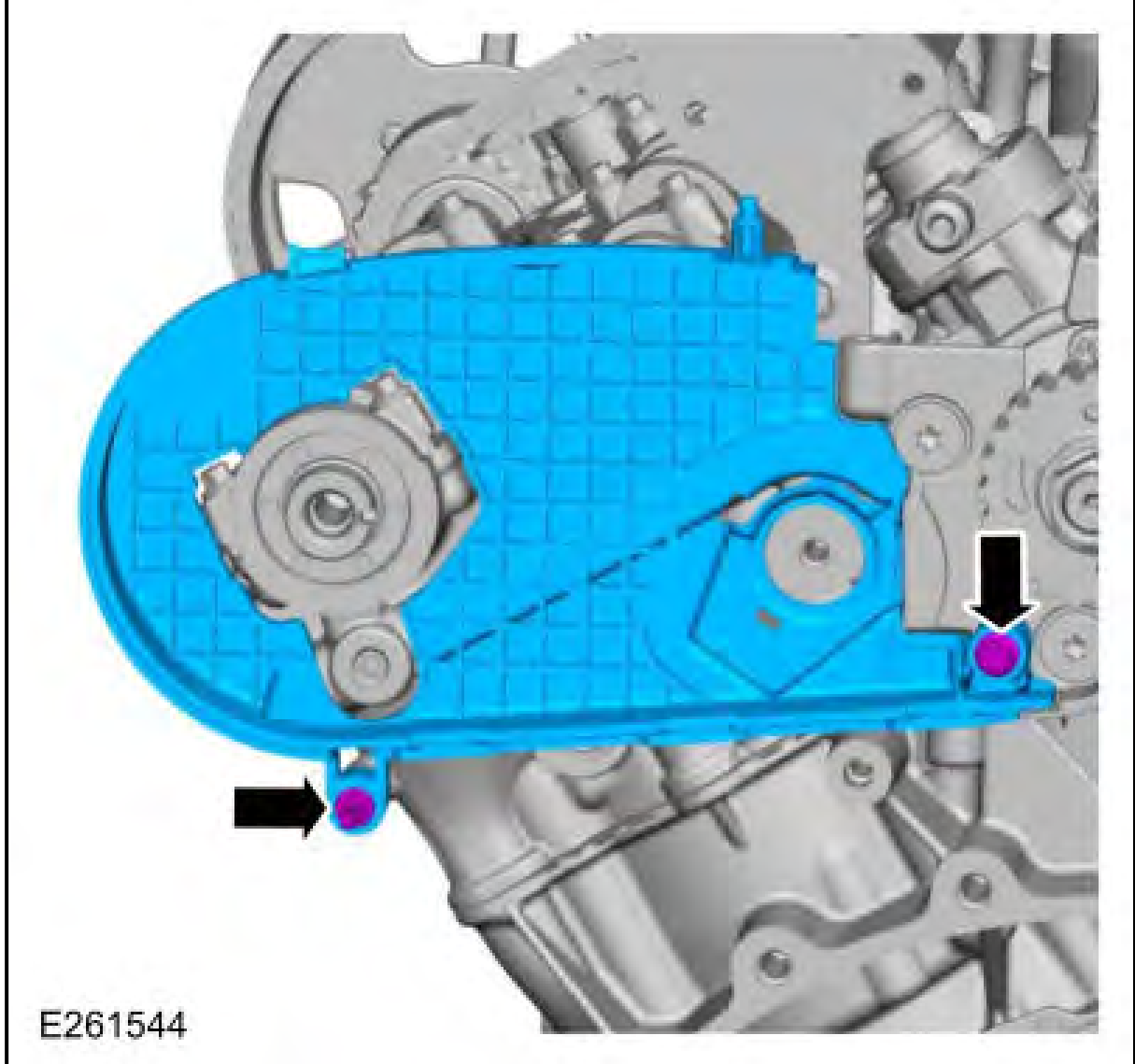




98. **NOTE:** Only tighten the bolts finger tight at this stage.

Install the accessory drive cover.





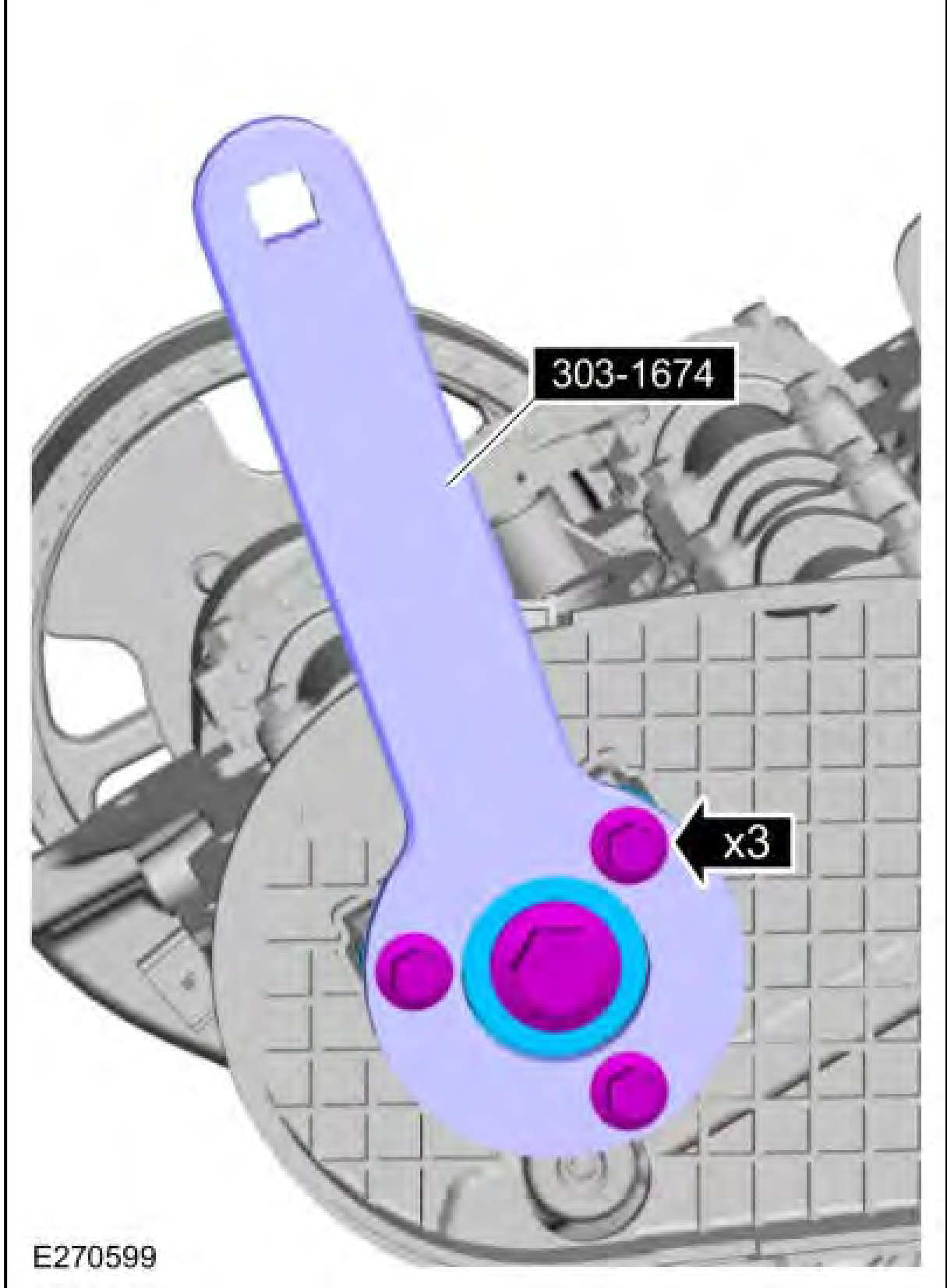
99. **NOTE:** Use the original bolts for the special tool.

Using the special tool, install the camshaft gear hub and the bolt. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.

Torque

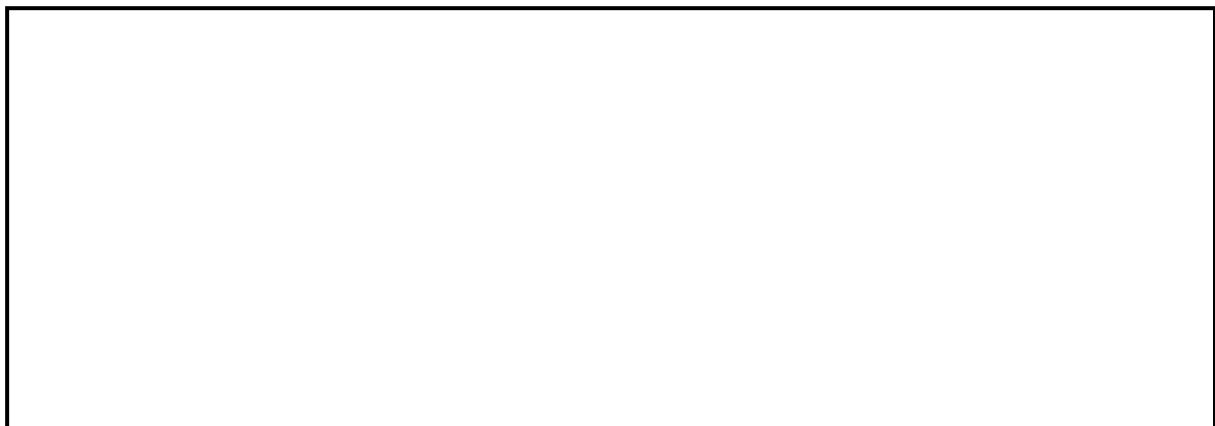
:Stage 1: 59 lb.ft (80 Nm) Stage 2: 80 Å°

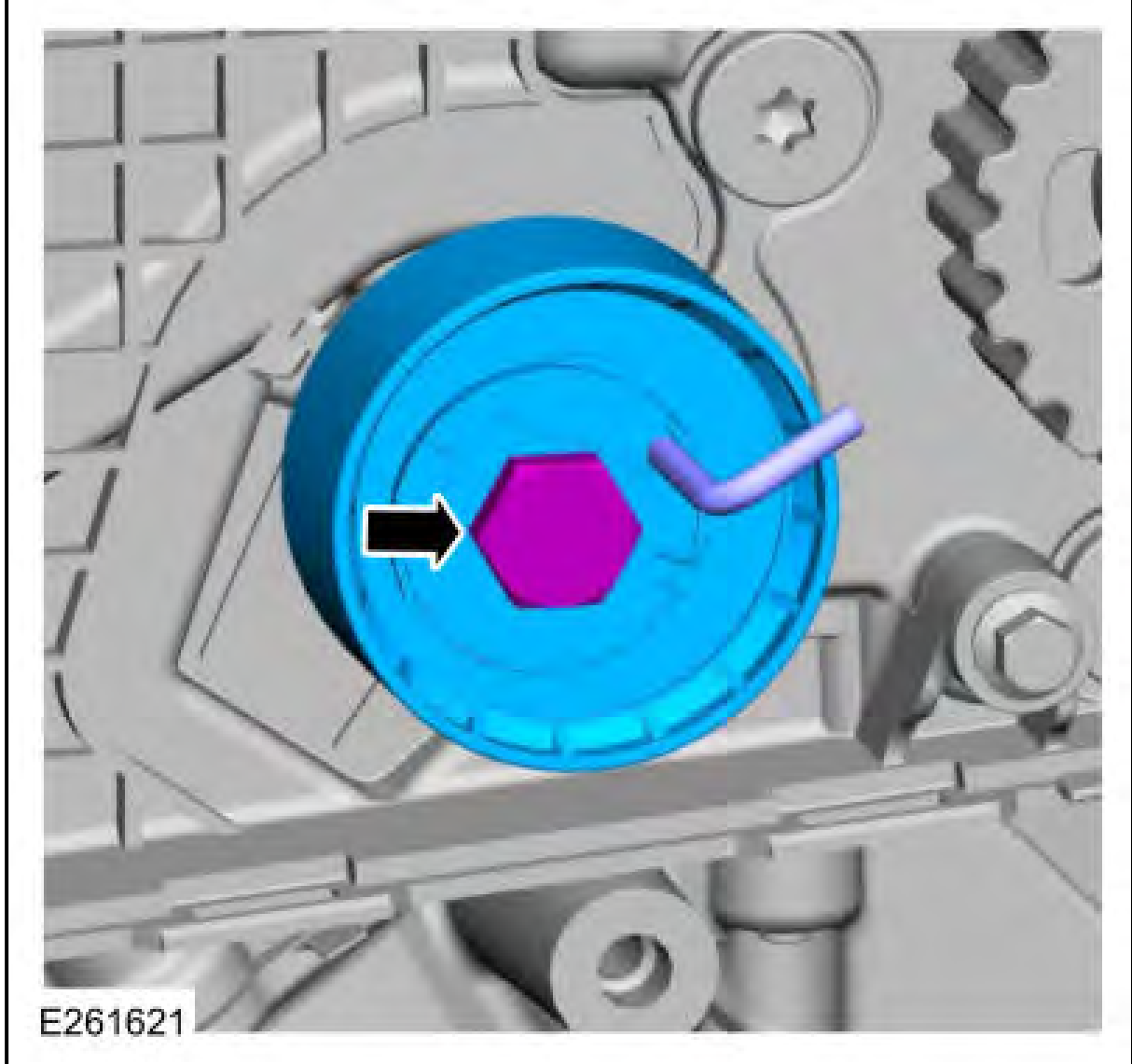




100. Install the READ belt tensioner and the bolt.

Torque: 17 lb.ft (23 Nm)



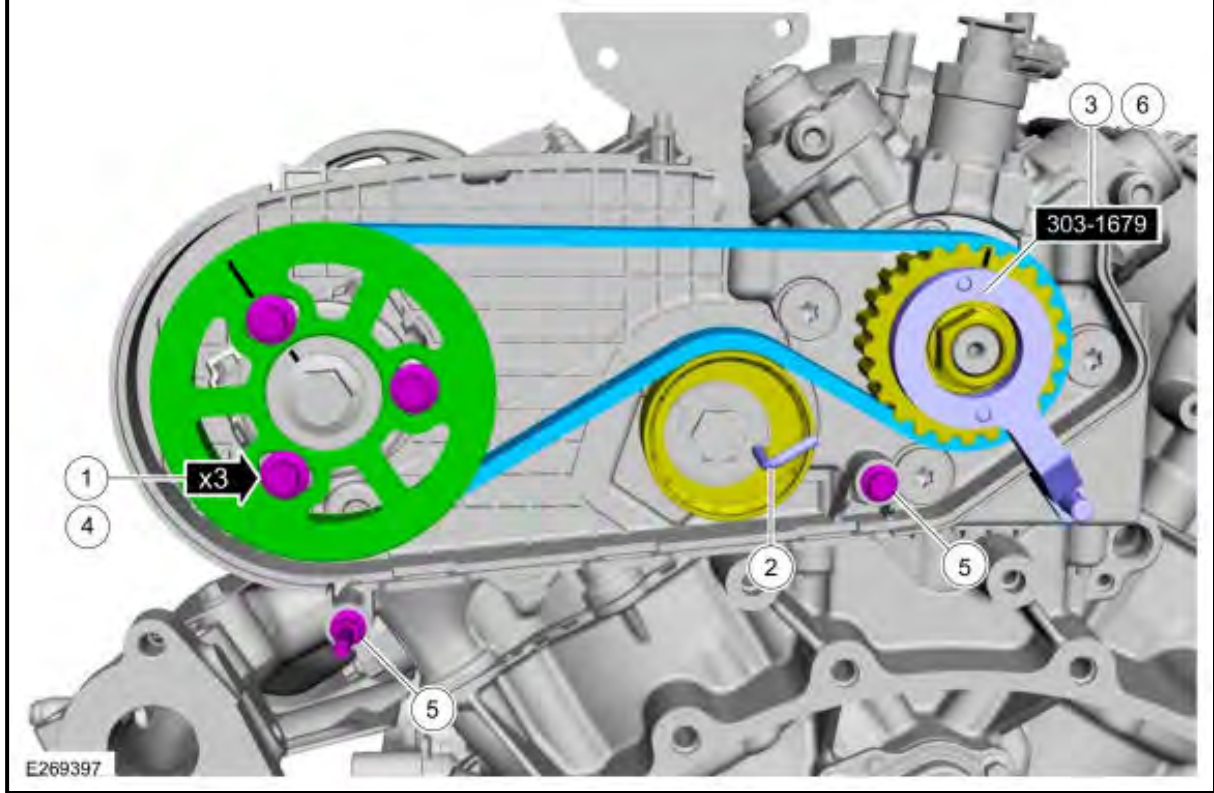


101.

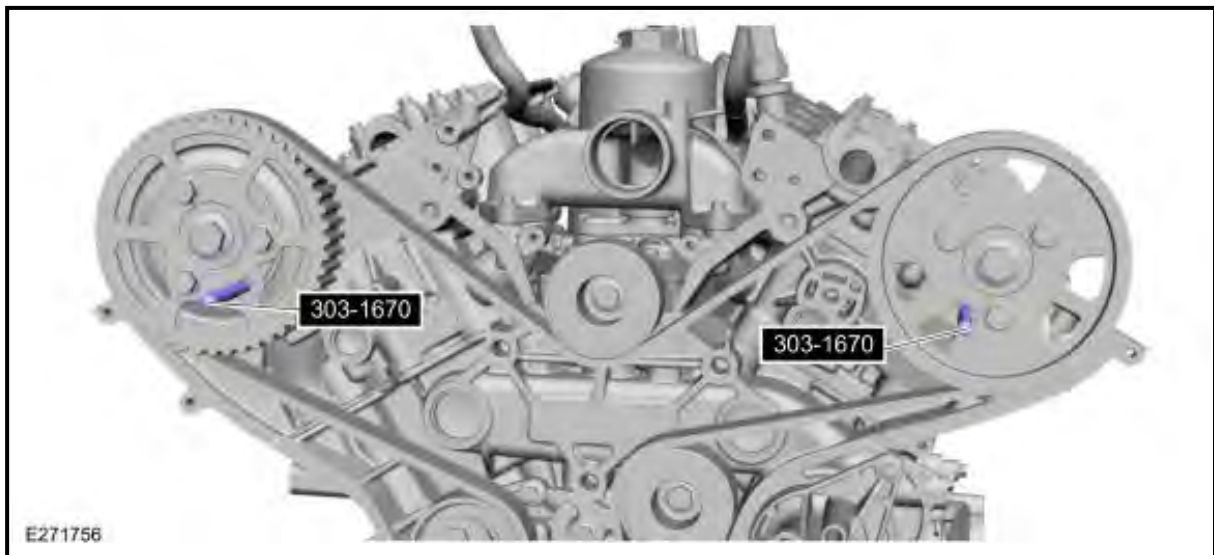
1. **NOTE:** Make sure that the installation marks are aligned.  
**NOTE:** It may be necessary to rotate the camshaft pulley slightly to ensure the bolts are not at the end of the slots.  
**NOTE:** Install the camshaft pulley with the timing mark on the camshaft drive.  
**NOTE:** Only tighten the bolts finger tight at this stage.

Install the READ belt, the camshaft pulley and the bolts.

2. Remove the pin from the READ belt tensioner.
3. Install Special Service Tool: 303-1679 Timing Tool, Fuel Pump Rear Access.
4. Tighten the bolts for the camshaft pulley.  
Torque: 17 lb.ft (23 Nm)
5. Tighten the bolts for the accessory drive cover.  
Torque: 89 lb.in (10 Nm)
6. Remove Special Service Tool: 303-1679 Timing Tool, Fuel Pump Rear Access.

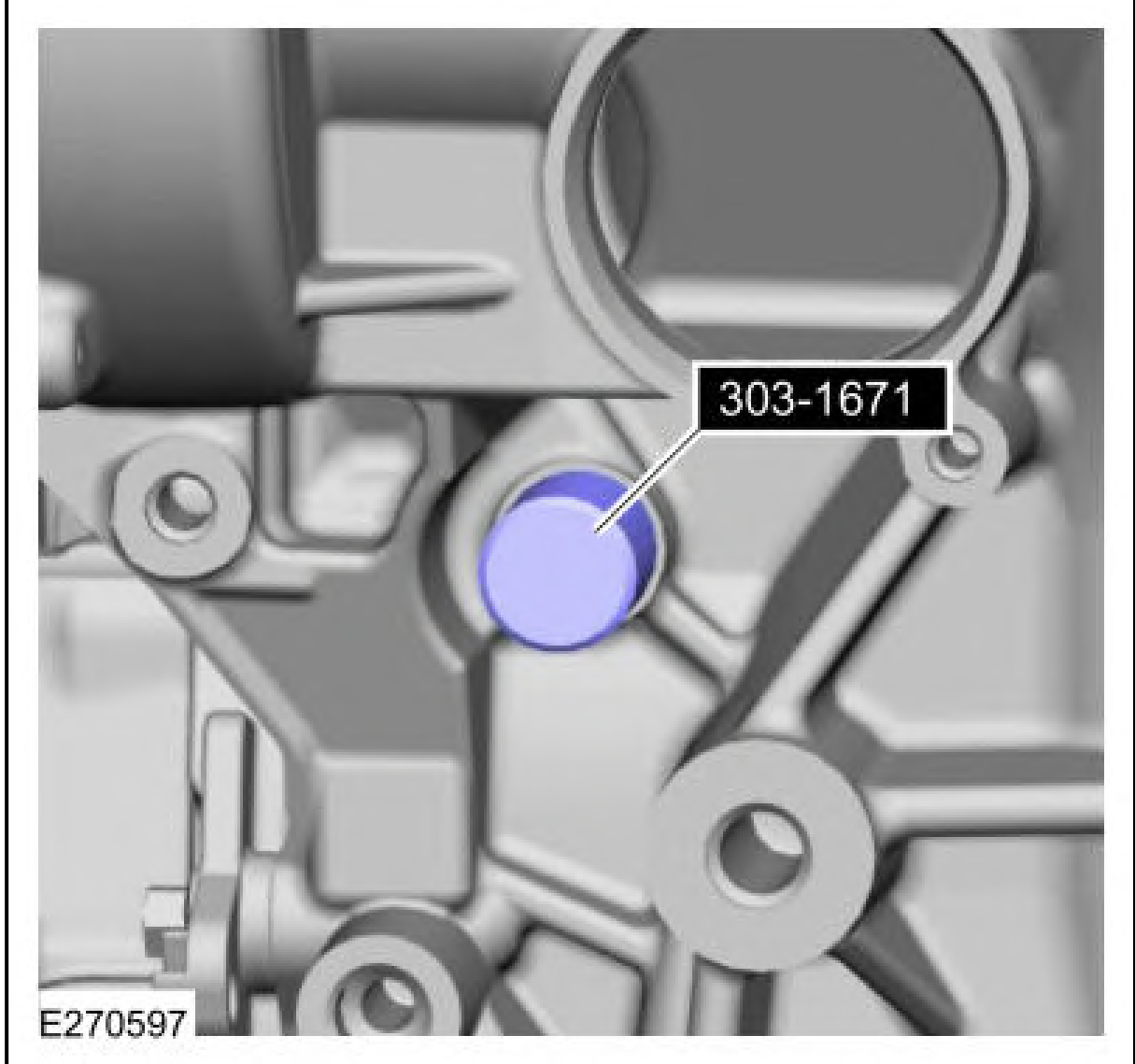


102. Remove Special Service Tool: 303-1670 Pins, Camshaft Locking.



103. Remove Special Service Tool: 303-1671 Pin, Locking Crankshaft.

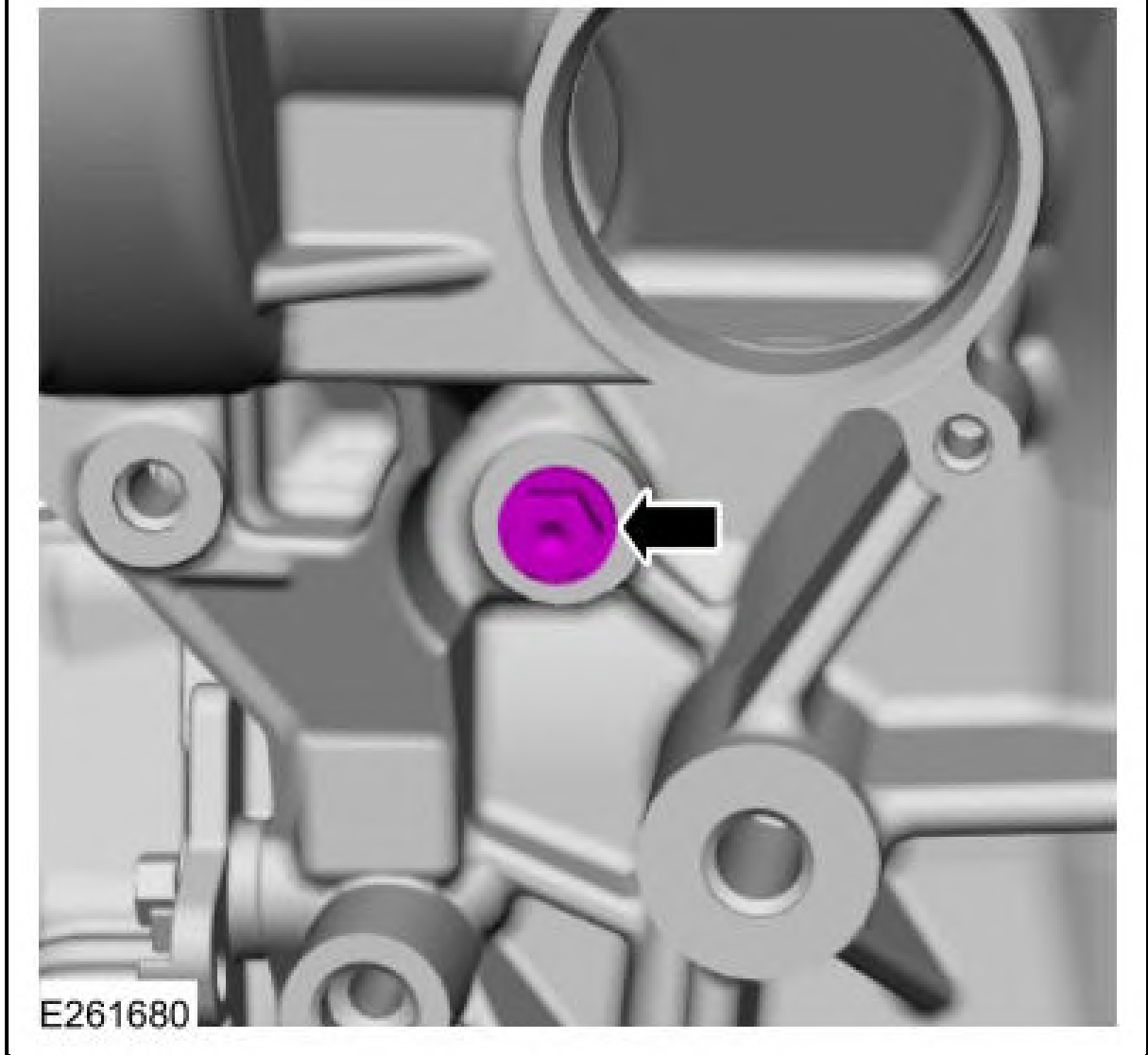




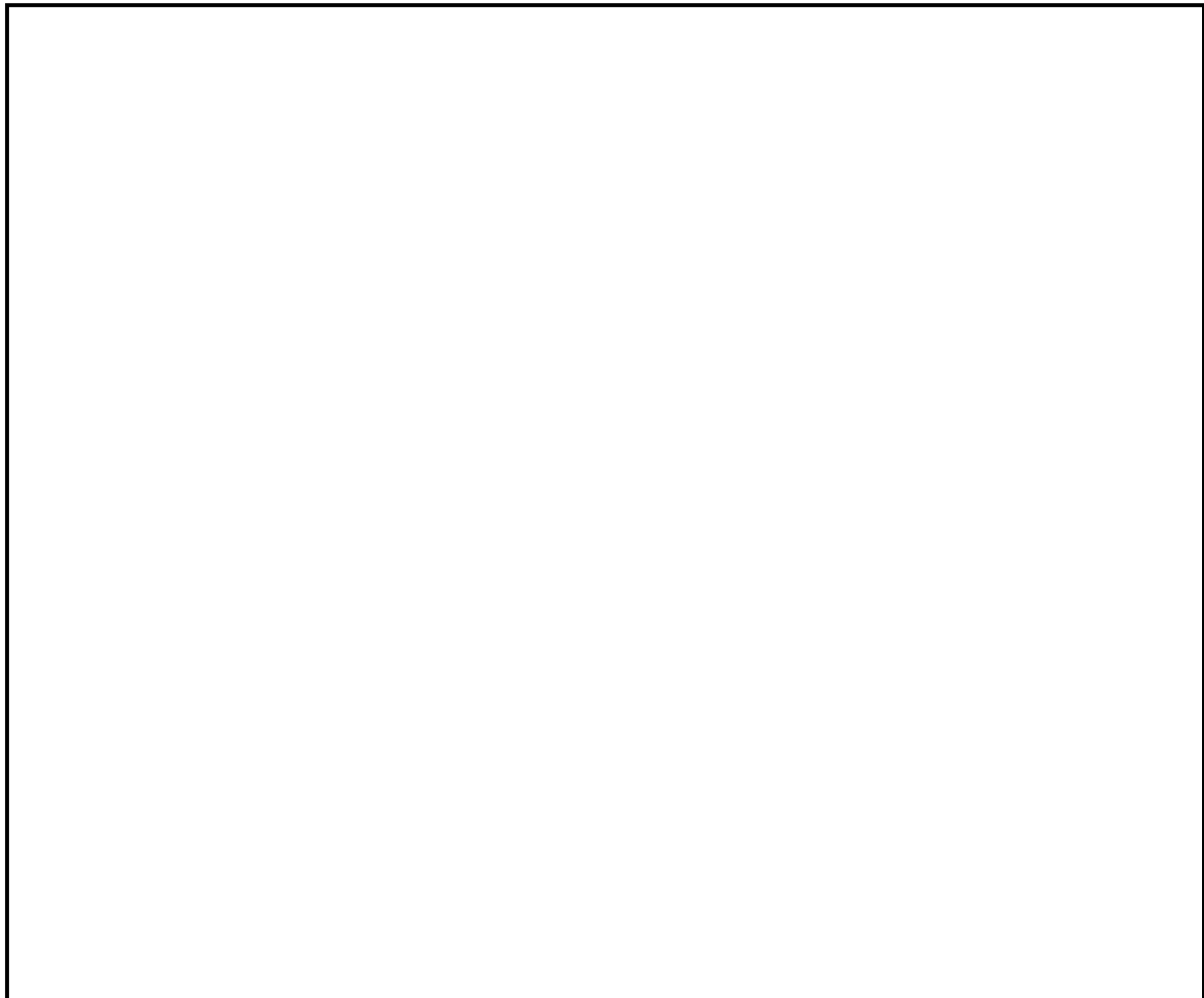
104. Install the timing pin bolt.

Torque: 17 lb.ft (23 Nm)

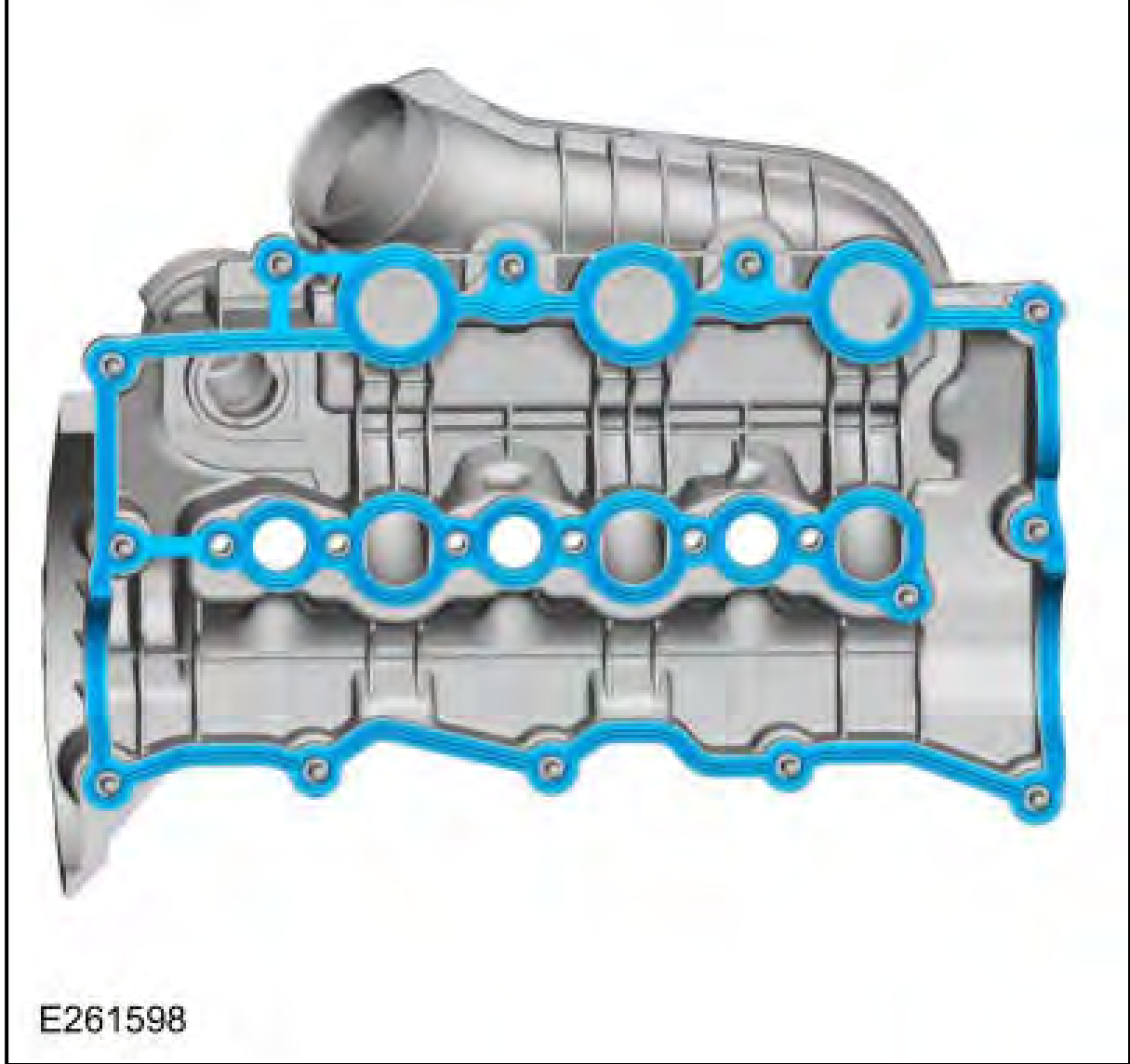




105. Install the RH valve cover gasket.



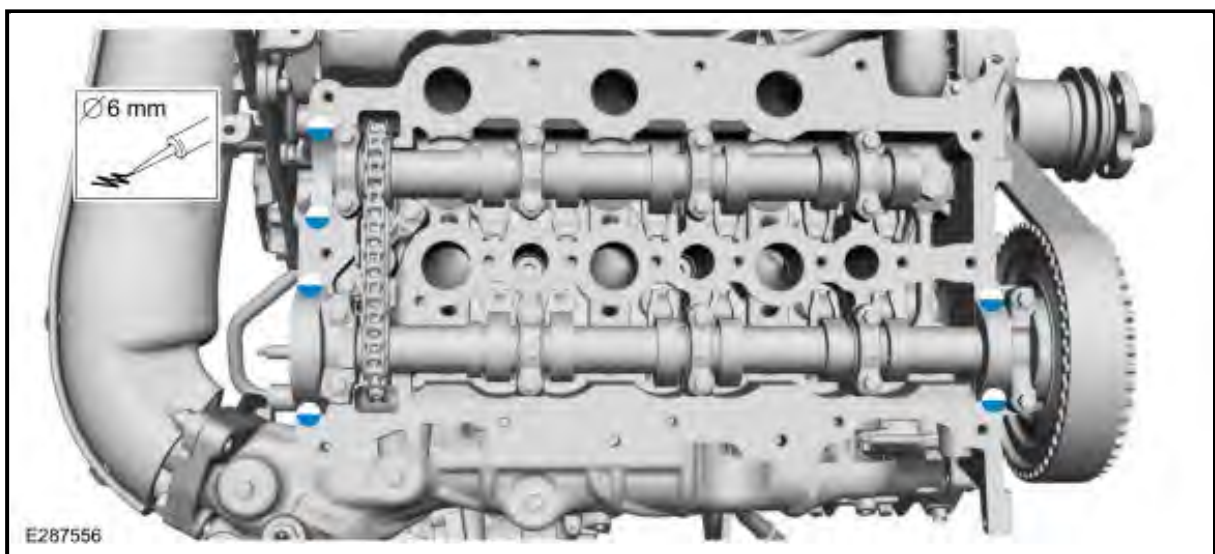




106. **NOTE:** If the valve cover is not installed and the fasteners tightened within 10 minutes, the sealant must be removed and the sealing area cleaned.

Apply an 6 mm dot of Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone to the locations shown.

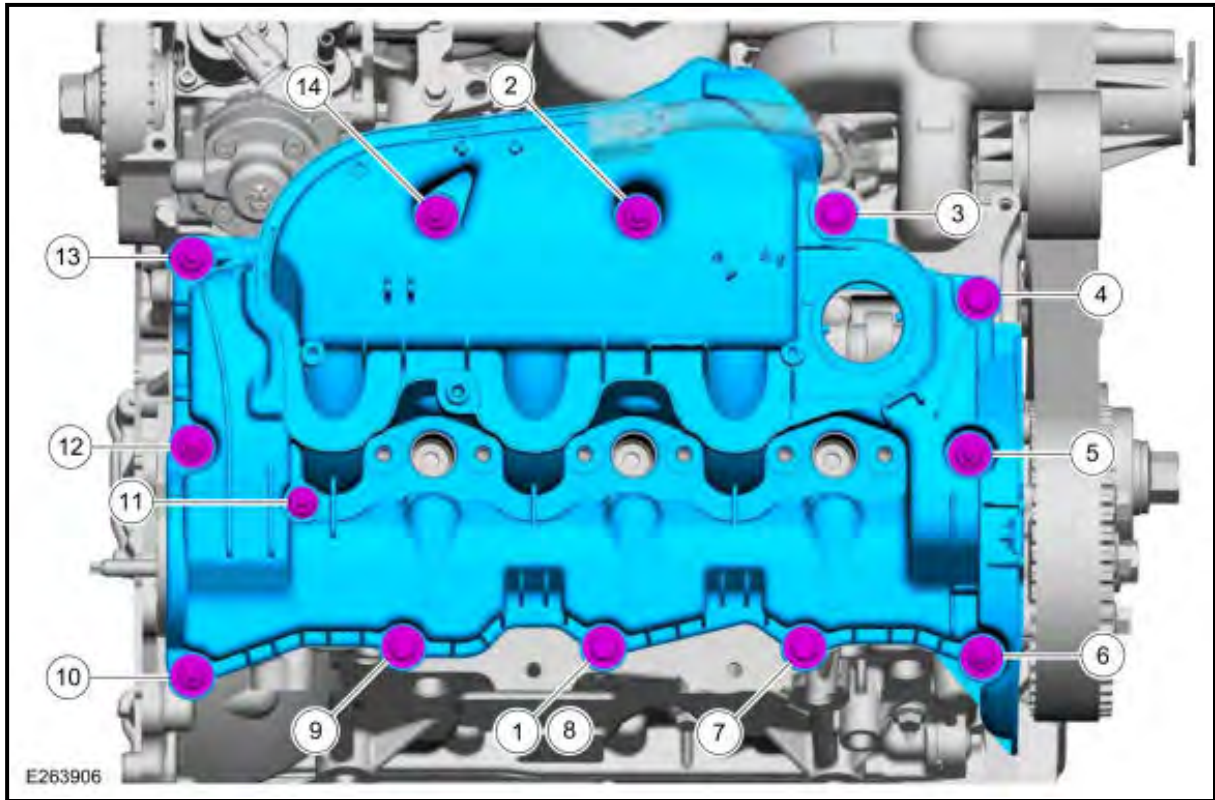
Material: Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



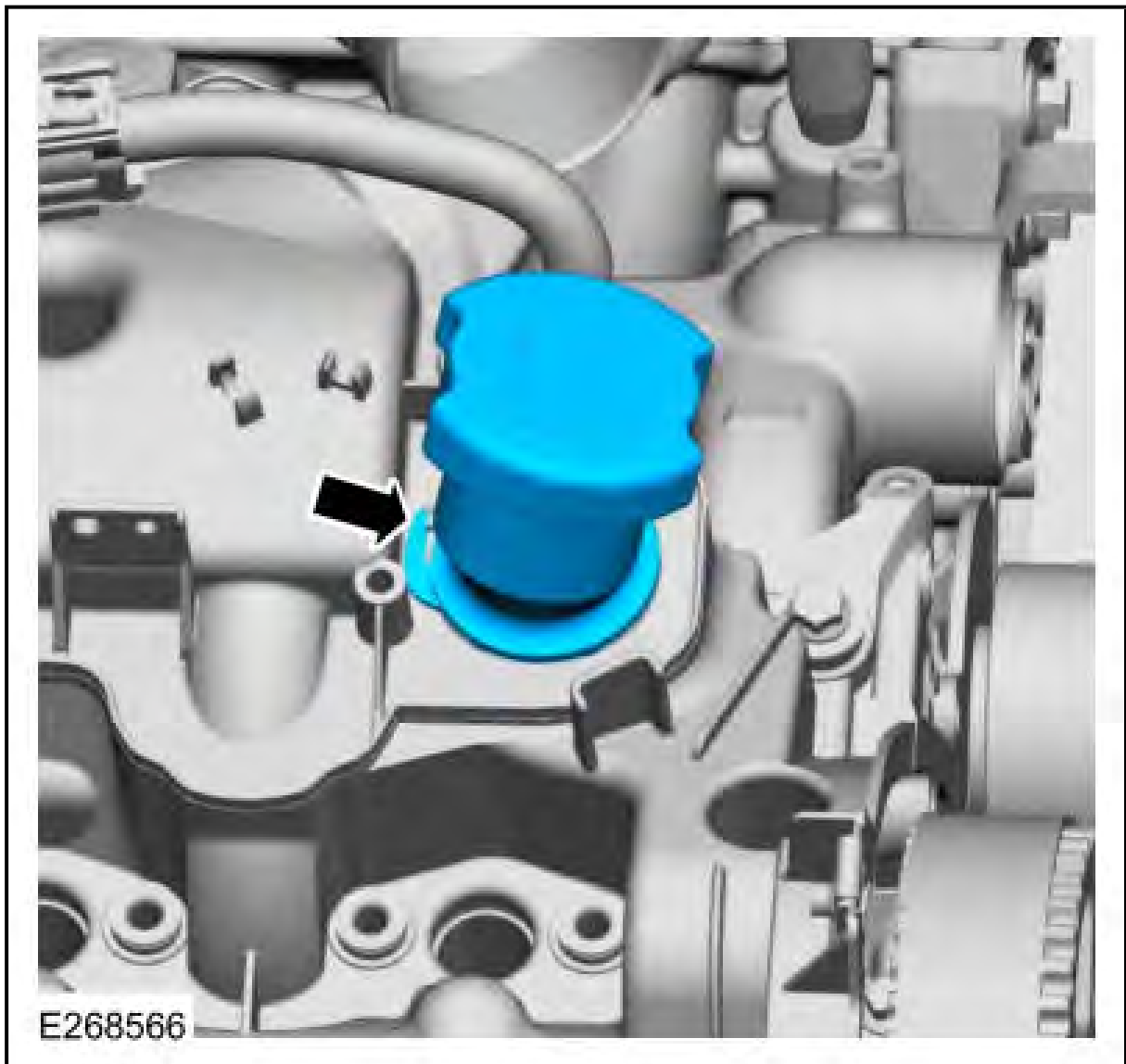
107. Install the RH valve cover and tighten the fasteners.

**Torque**

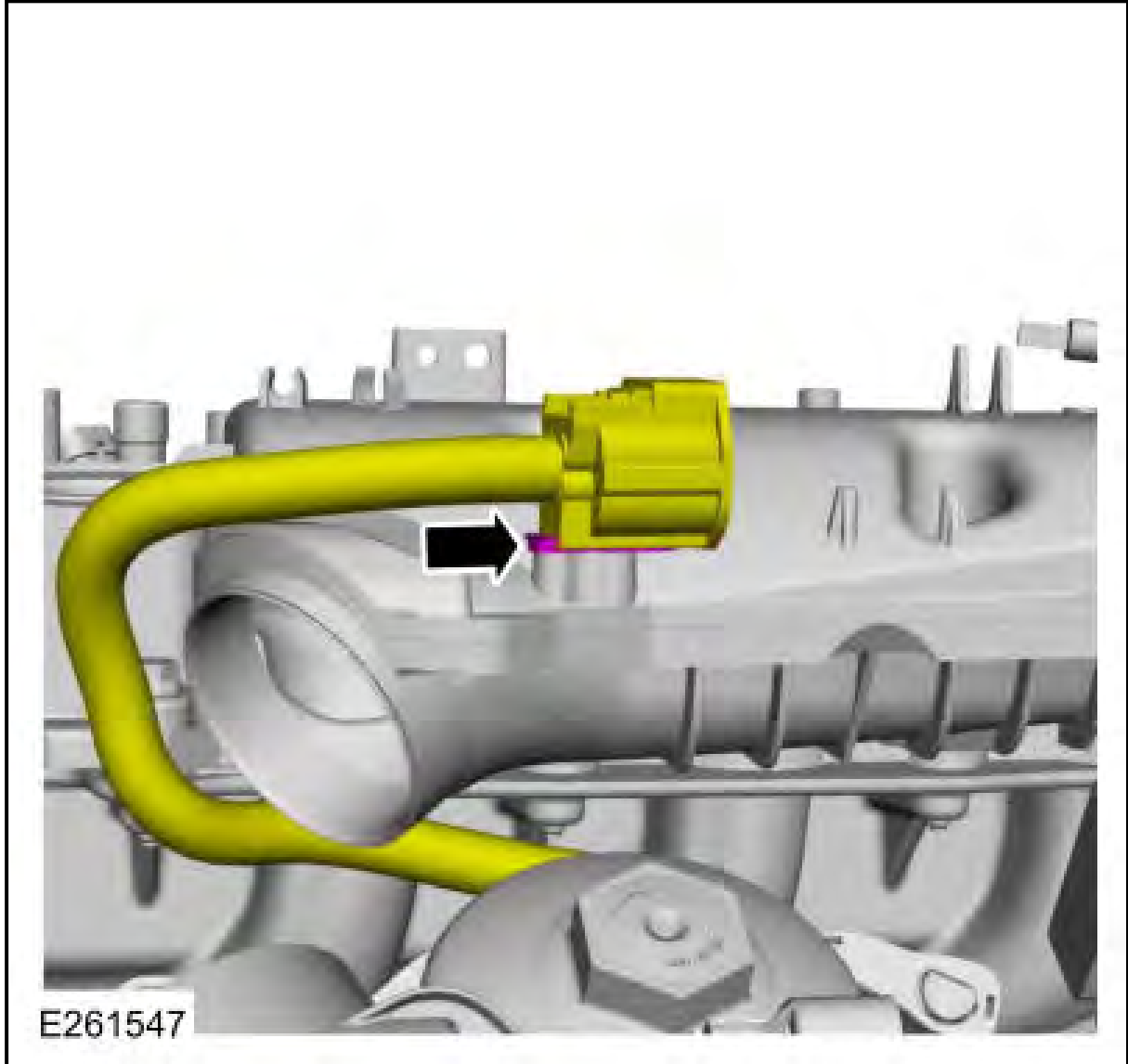
- :Stage 1: Tighten bolt number 1 to : 9 lb.in (1 Nm)
- Stage 2: Tighten bolts 2 thru 14 to : 89 lb.in (10 Nm)



108. Install the oil fill cap assembly.



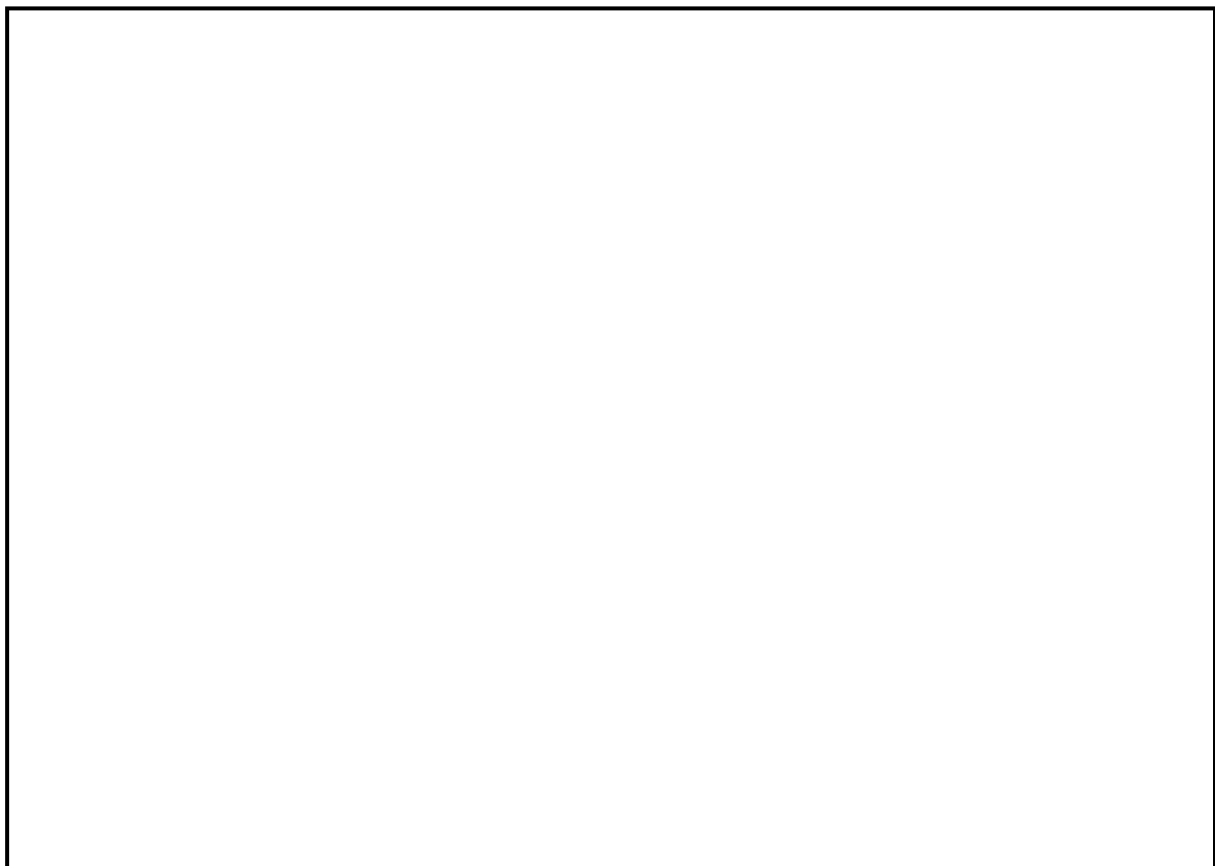
109. Connect the RH glow plug electrical connector.

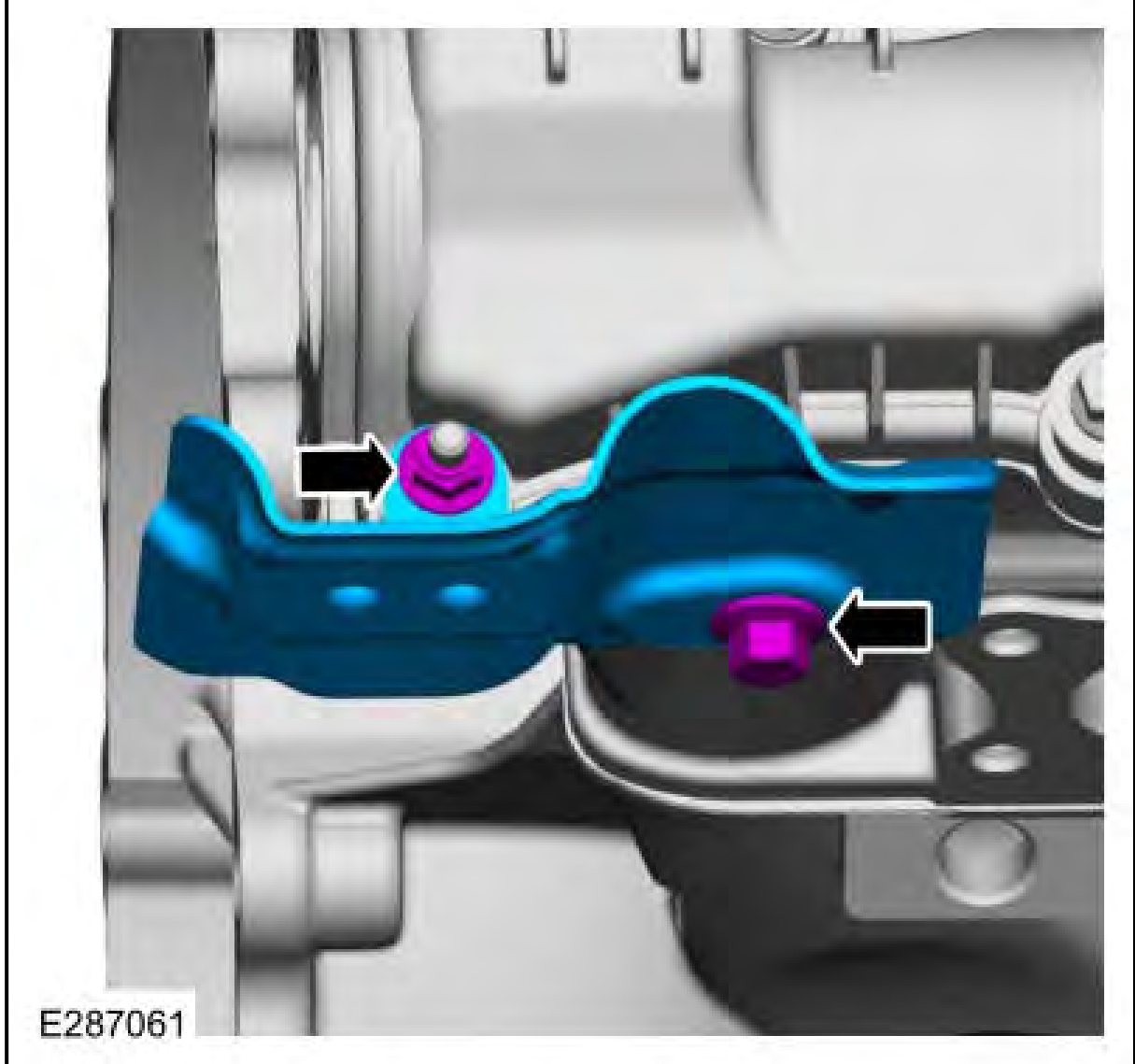


110. Install the turbocharger heat shield, the nut and the bolt.

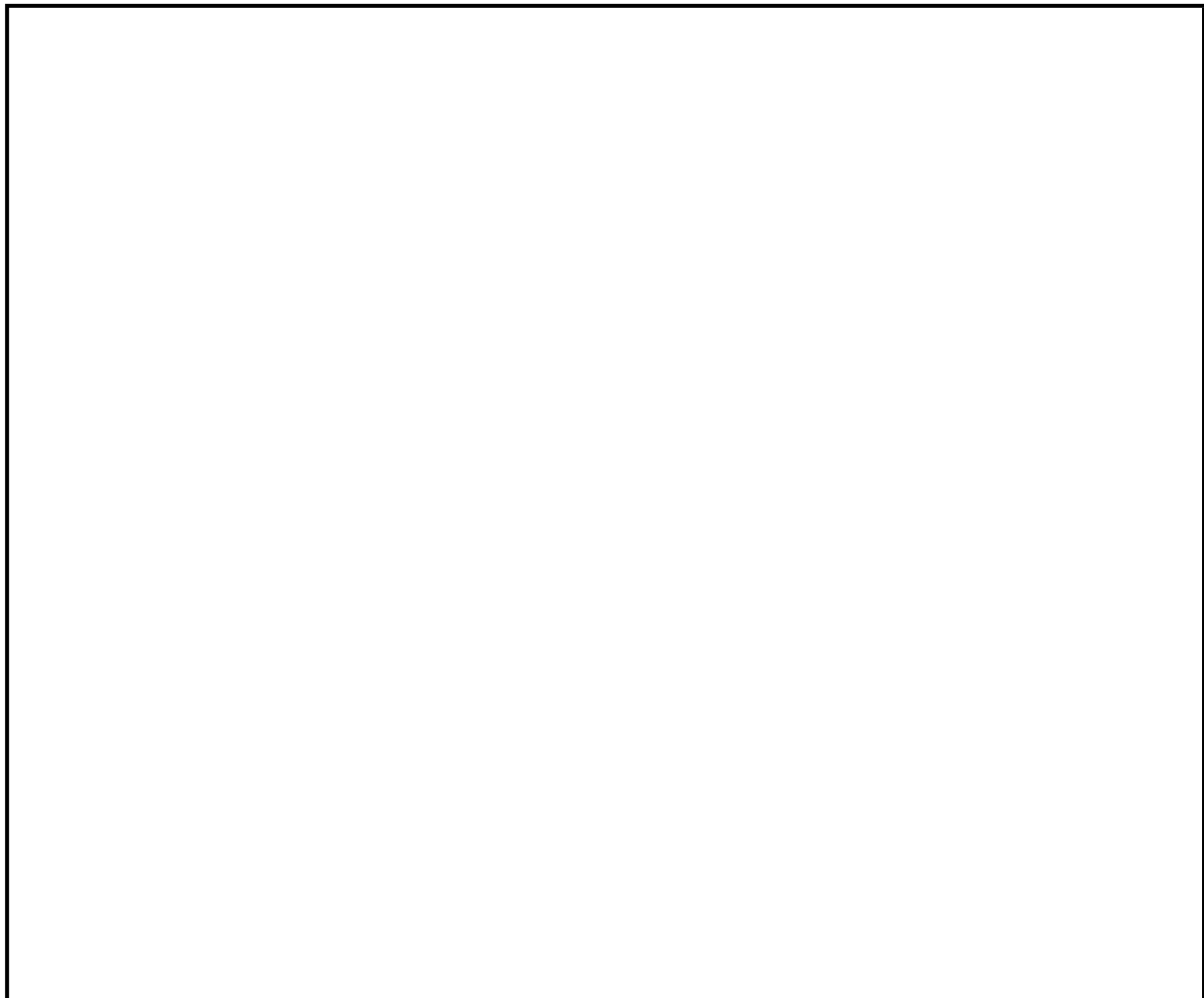
Torque

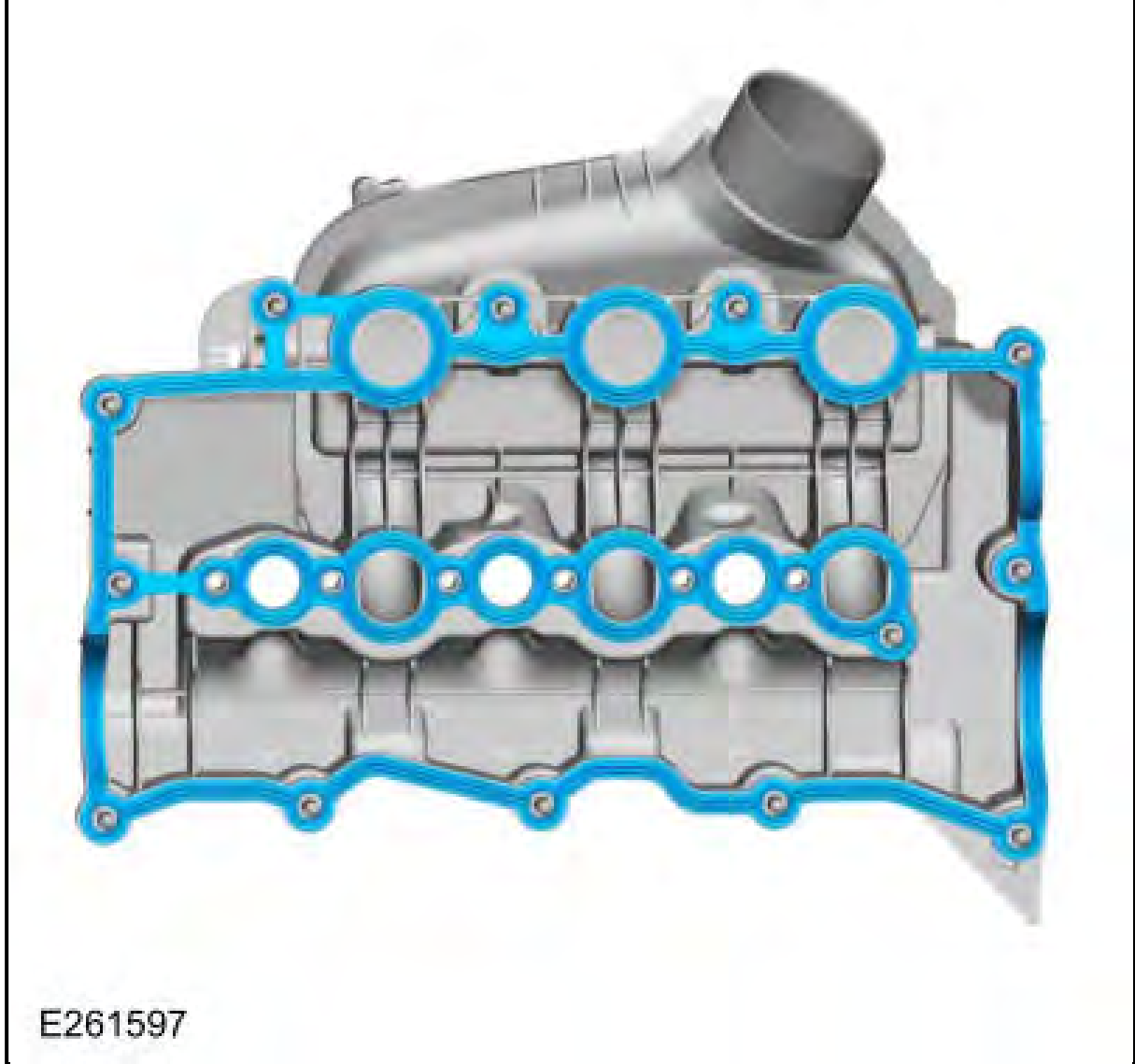
:Nut : 53 lb.in (6 Nm) Bolt : 18 lb.ft (24 Nm)





111. Install the LH valve cover gasket.

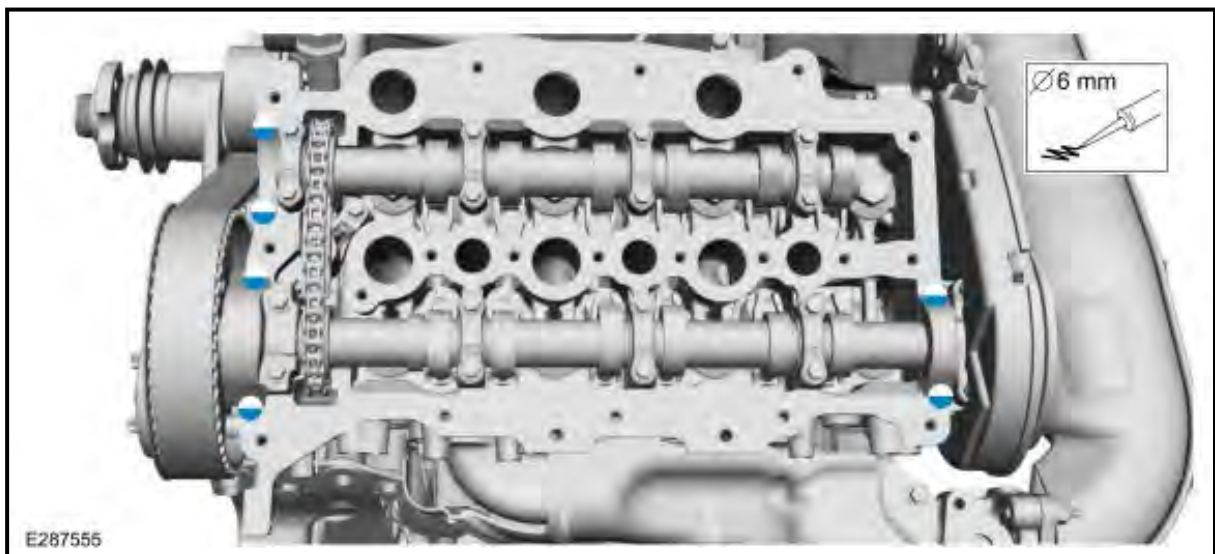




112. **NOTE:** If the valve cover is not installed and the fasteners tightened within 10 minutes, the sealant must be removed and the sealing area cleaned.

Apply an 6 mm dot of Motorcraft  $\hat{\text{A}}$ ® High Performance Engine RTV Silicone to the locations shown.

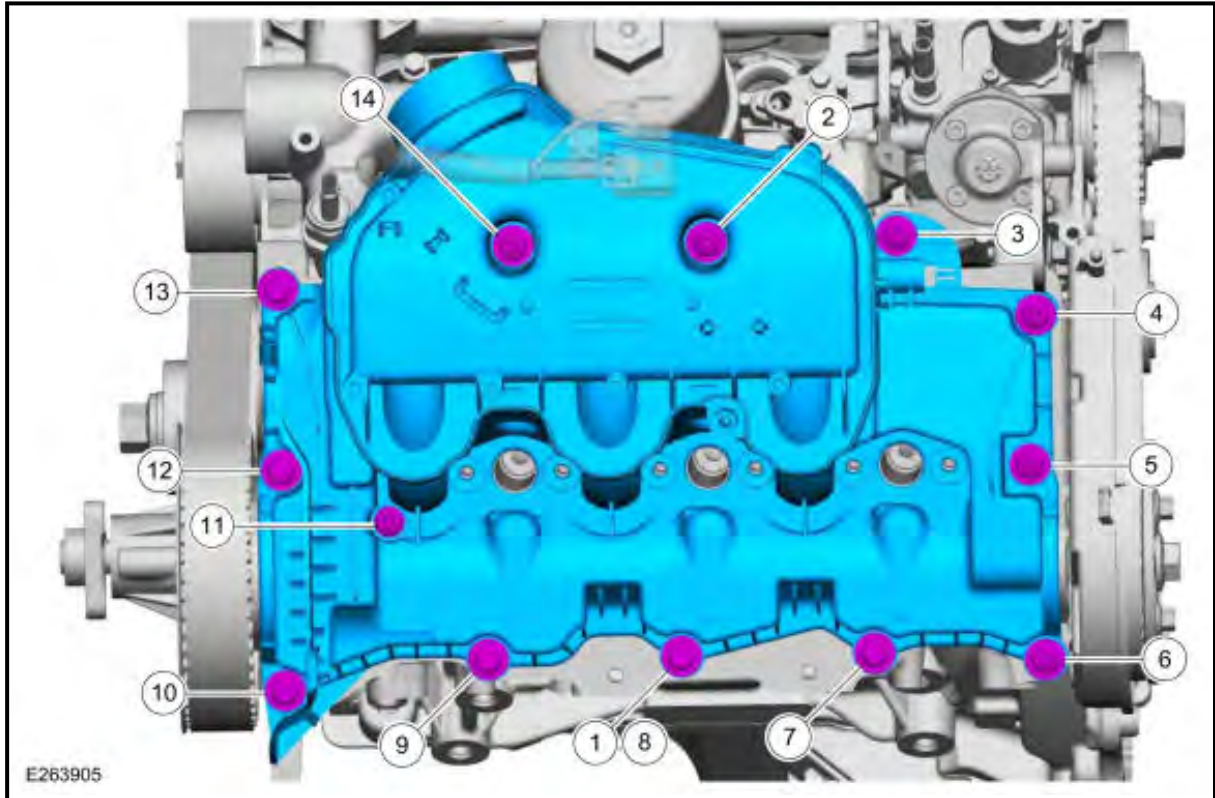
Material: Motorcraft  $\hat{\text{A}}$ ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



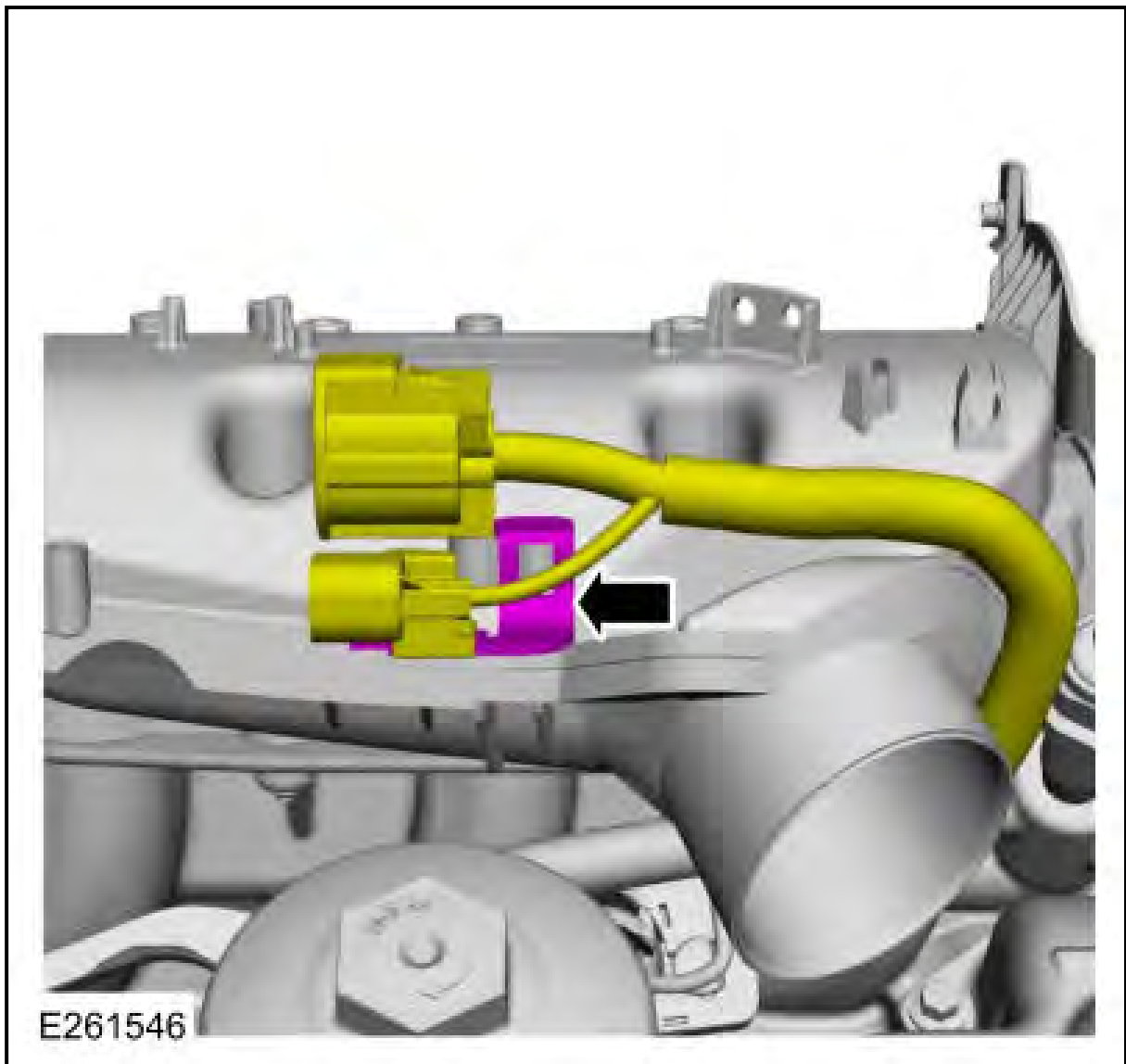
113. Install the LH valve cover and tighten the fasteners.

**Torque**

- :Stage 1: Tighten bolt number 1 to : 9 lb.in (1 Nm)
- Stage 2: Tighten bolts 2 thru 14 to : 89 lb.in (10 Nm)

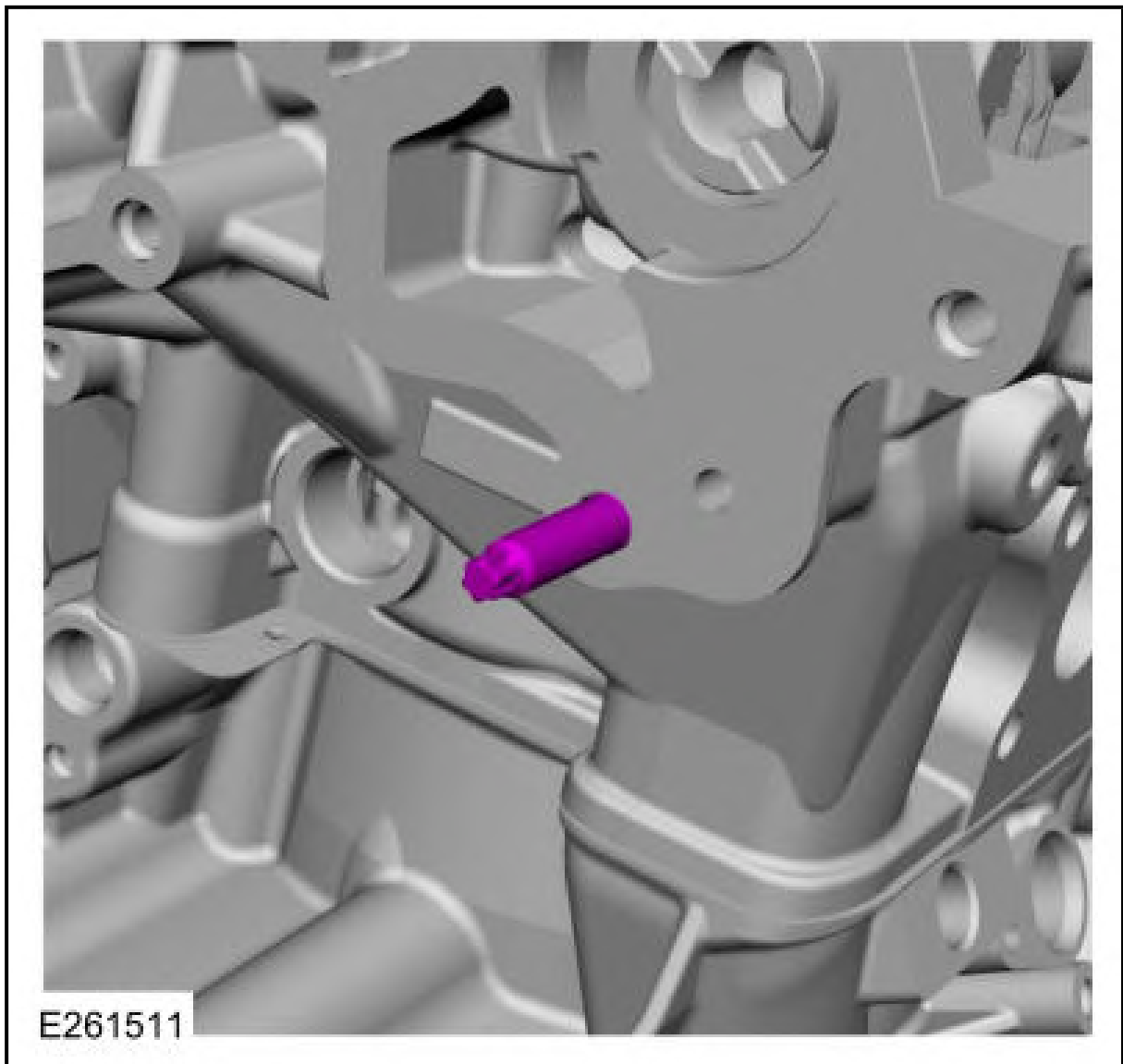


114. Connect the LH glow plug electrical connector.



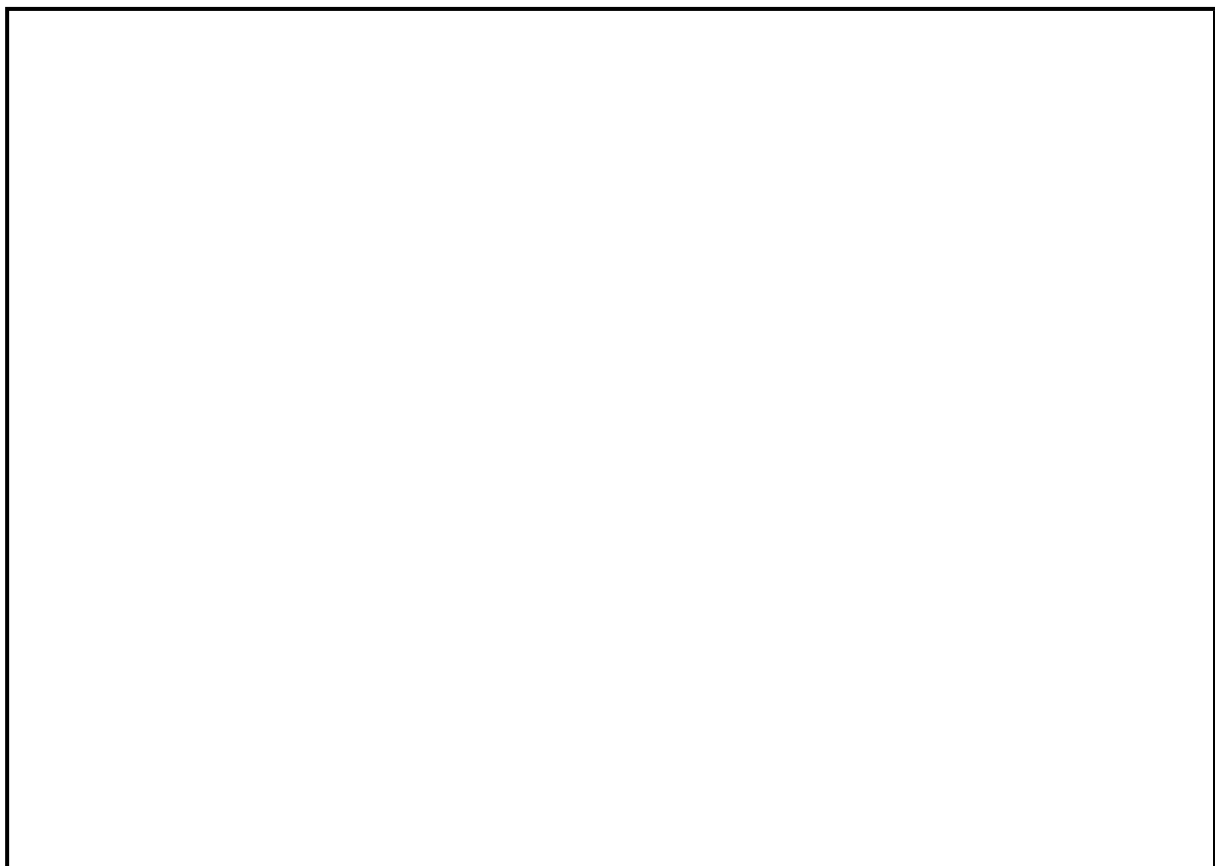
115. Install the vacuum pump stud.

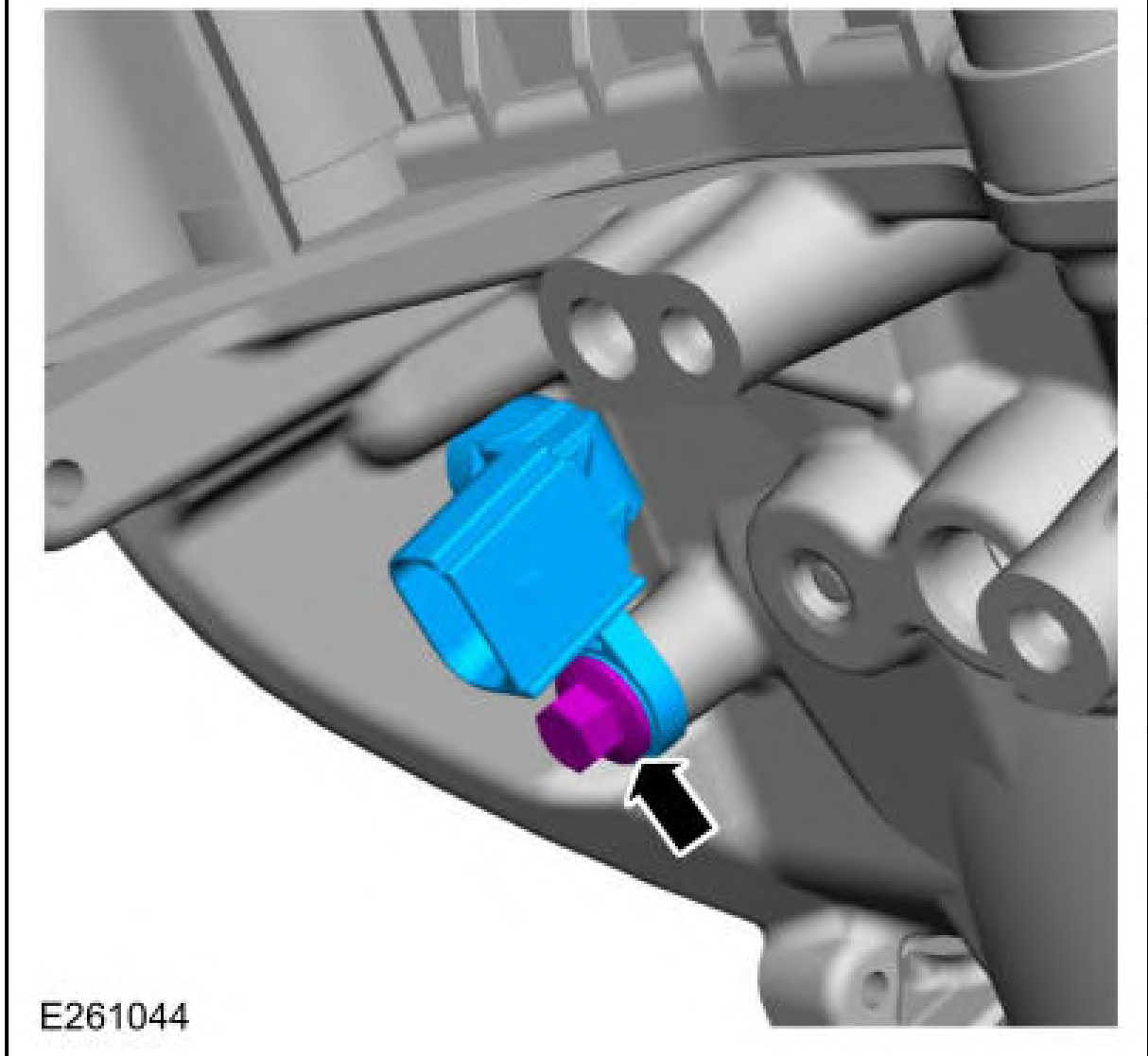
Torque: 115 lb.in (13 Nm)



116. Install the CMP sensor and the bolt.

Torque: 89 lb.in (10 Nm)



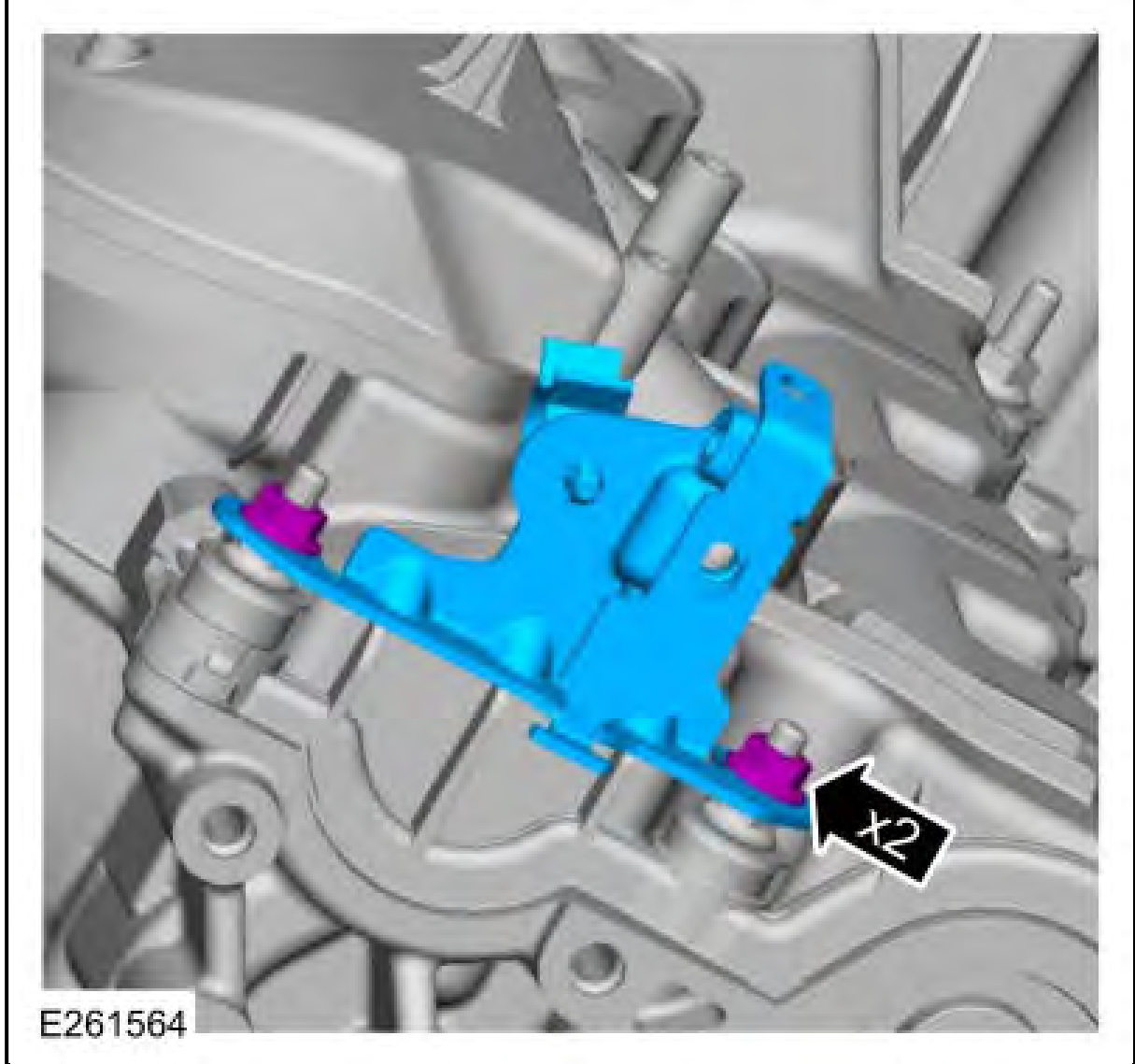


117. Install the RH fuel tube bracket and the nuts.

Torque: 89 lb.in (10 Nm)



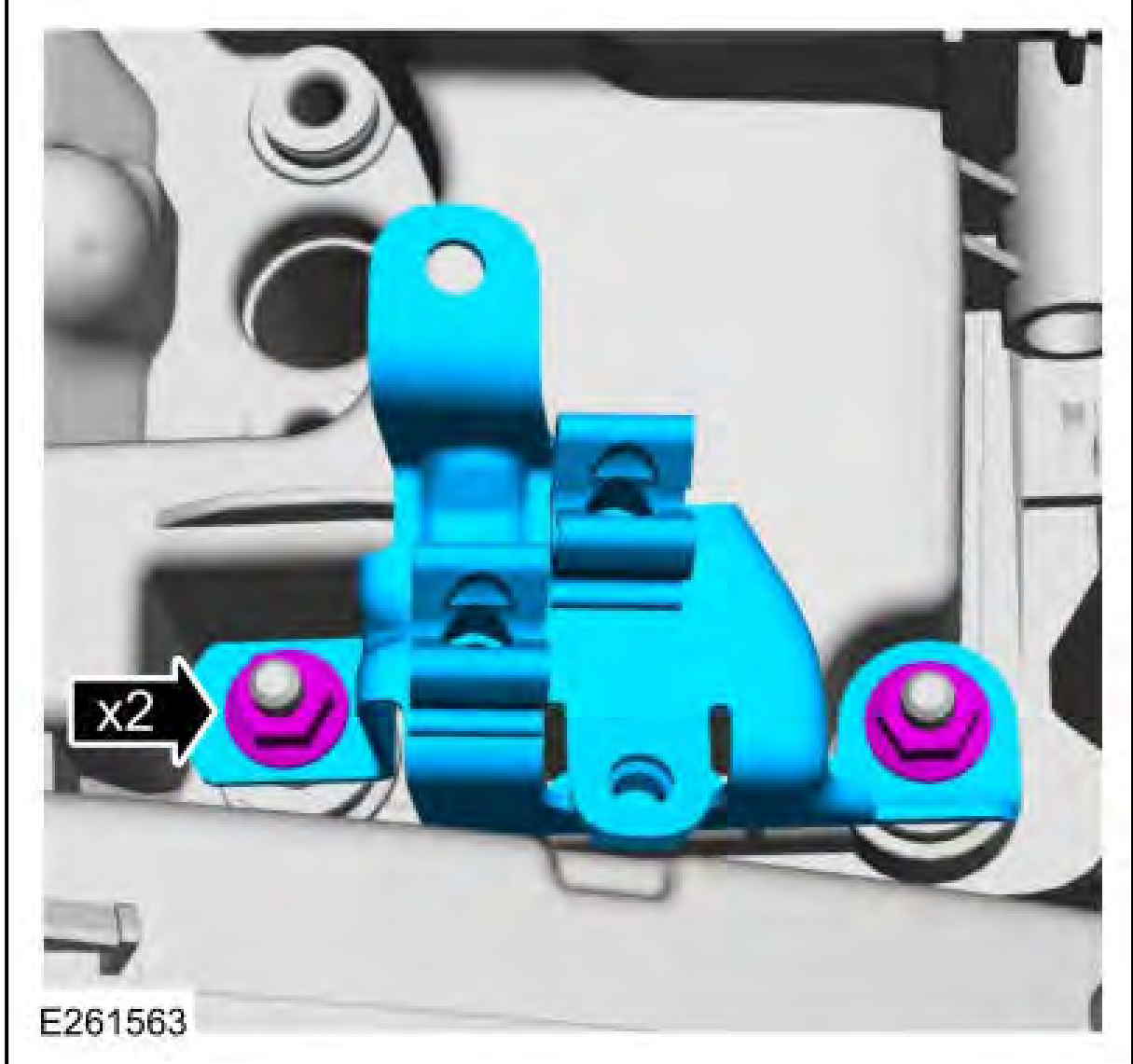




118. Install the LH fuel tube bracket and the nuts.

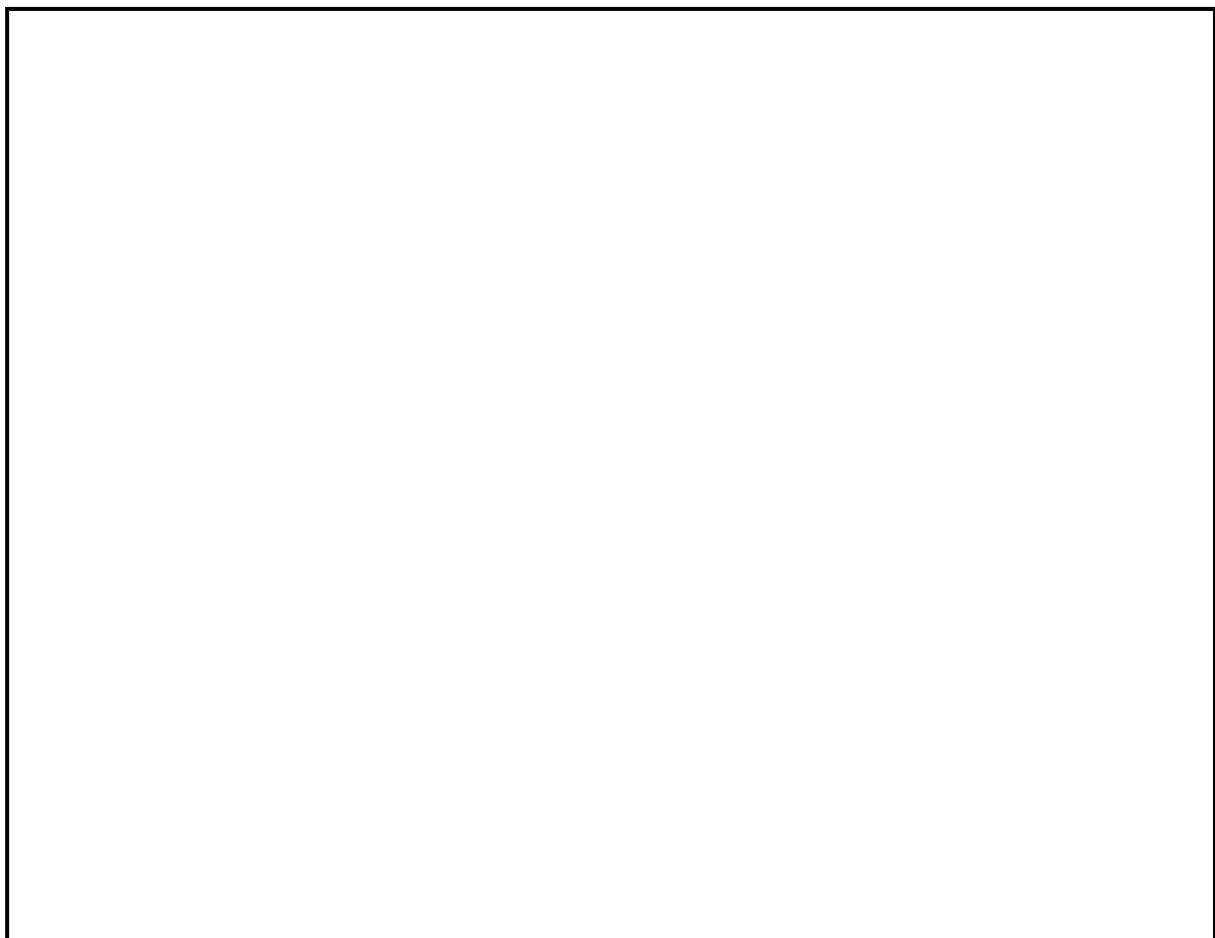
Torque: 89 lb.in (10 Nm)

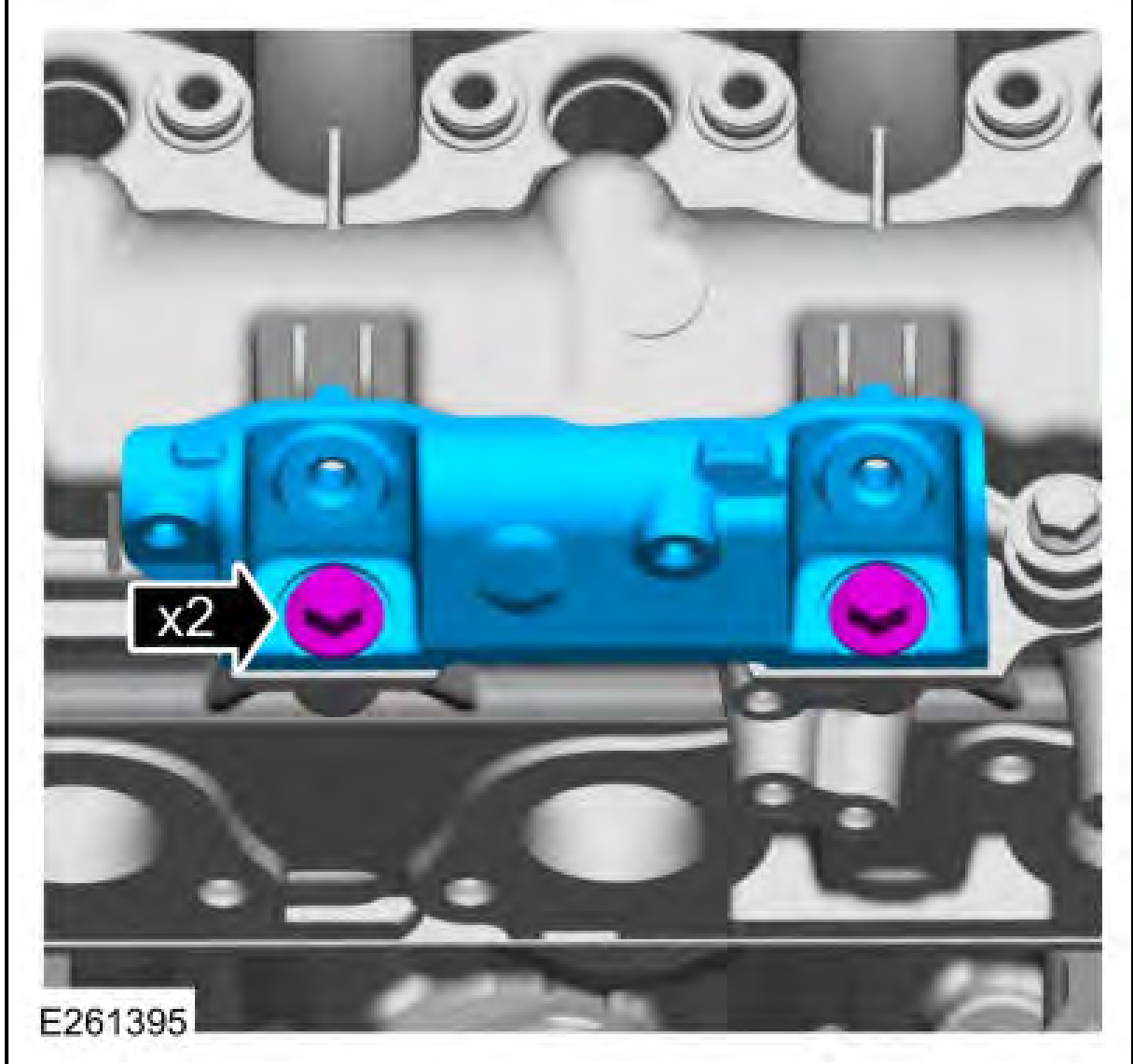




119. Install the RH fuel rail bracket and the bolts.

Torque: 17 lb.ft (23 Nm)

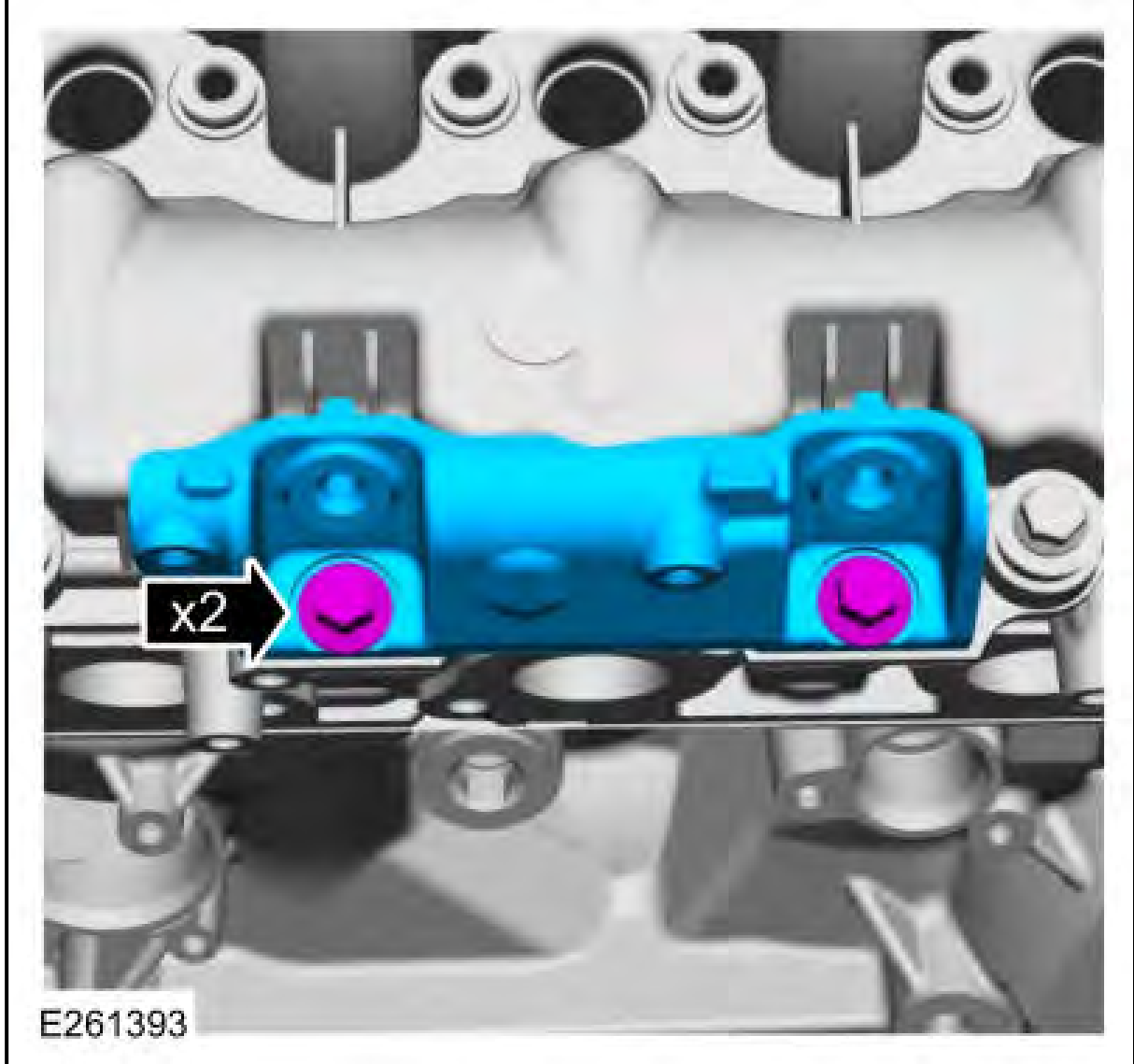




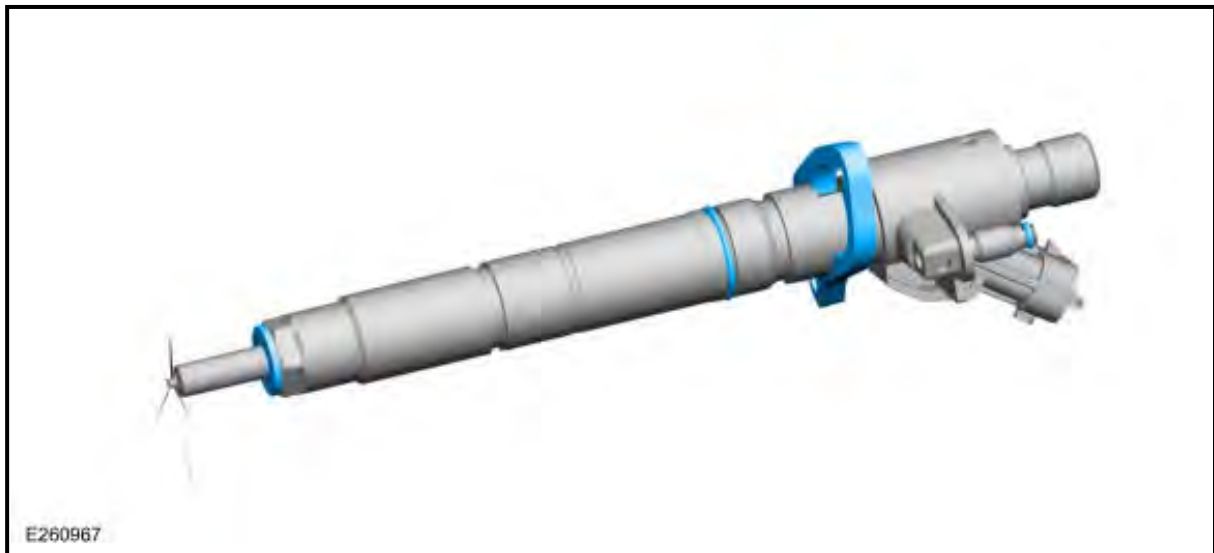
120. Install the LH fuel rail bracket and the bolts.

Torque: 17 lb.ft (23 Nm)





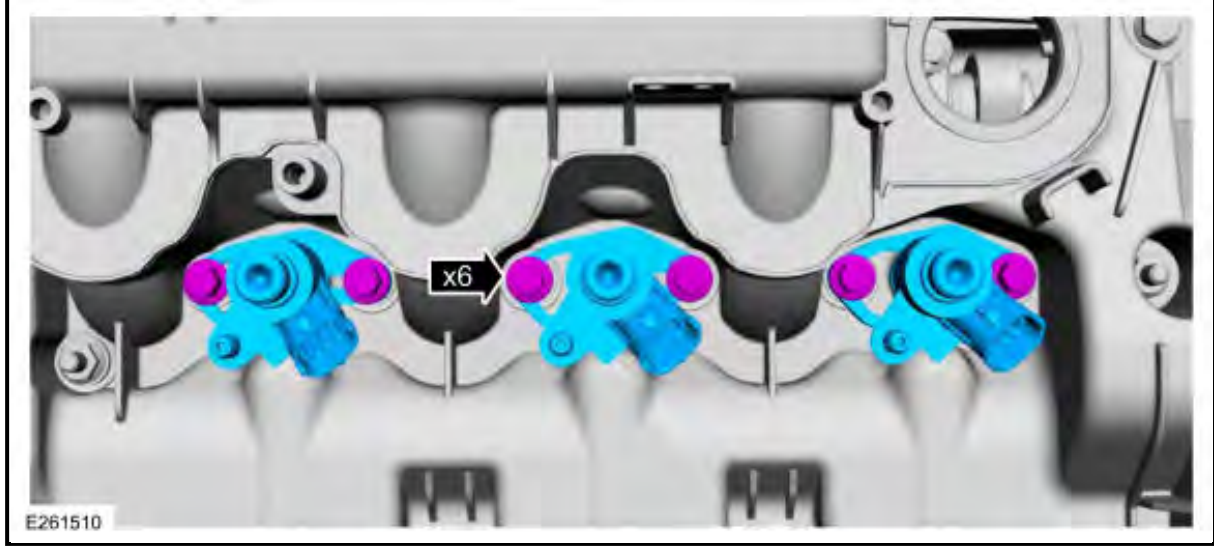
121. Install the sealing washer, the O-rings and the fuel injector hold down.



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

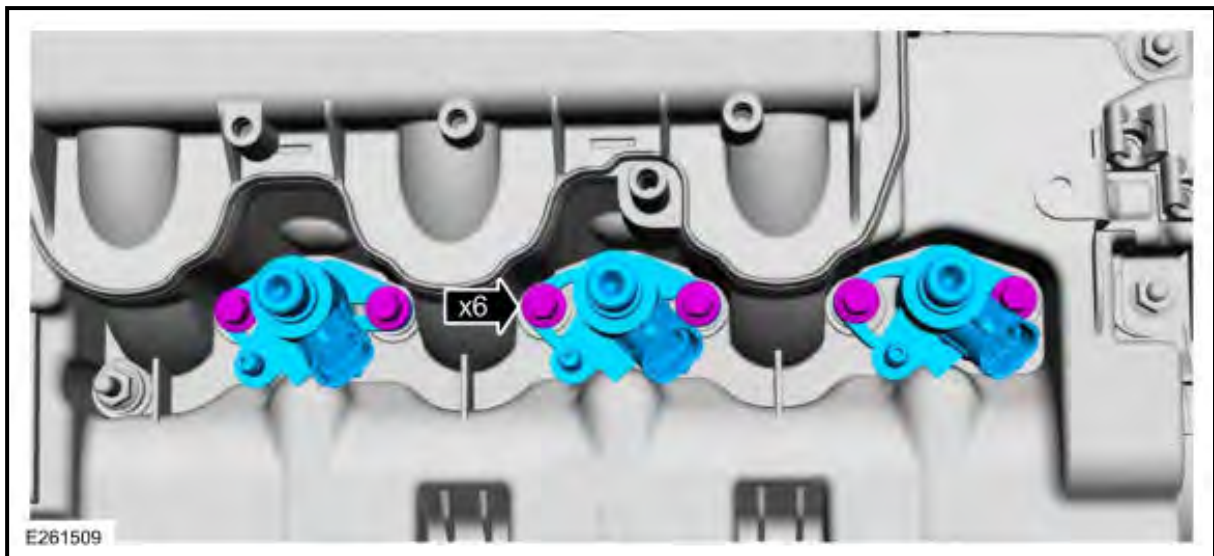
Install the RH fuel injectors and bolts.



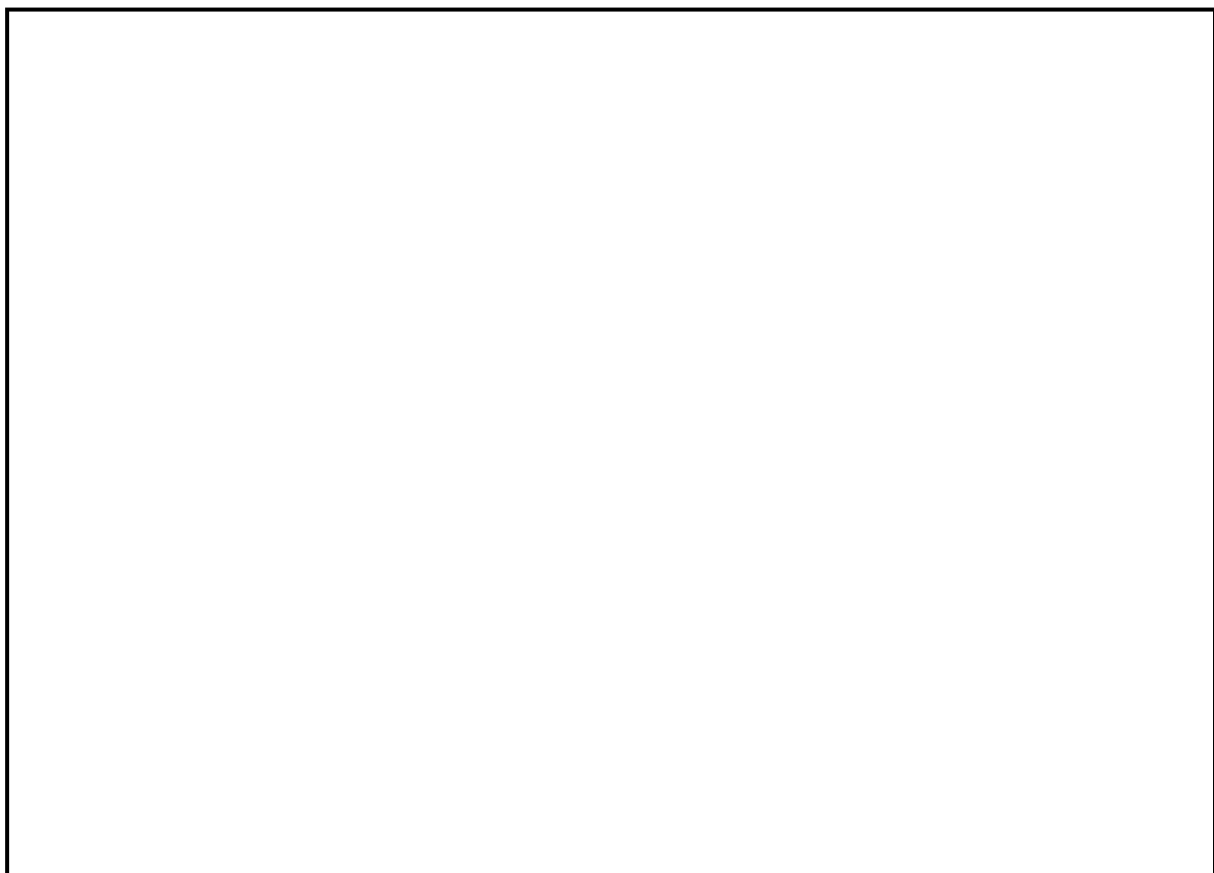


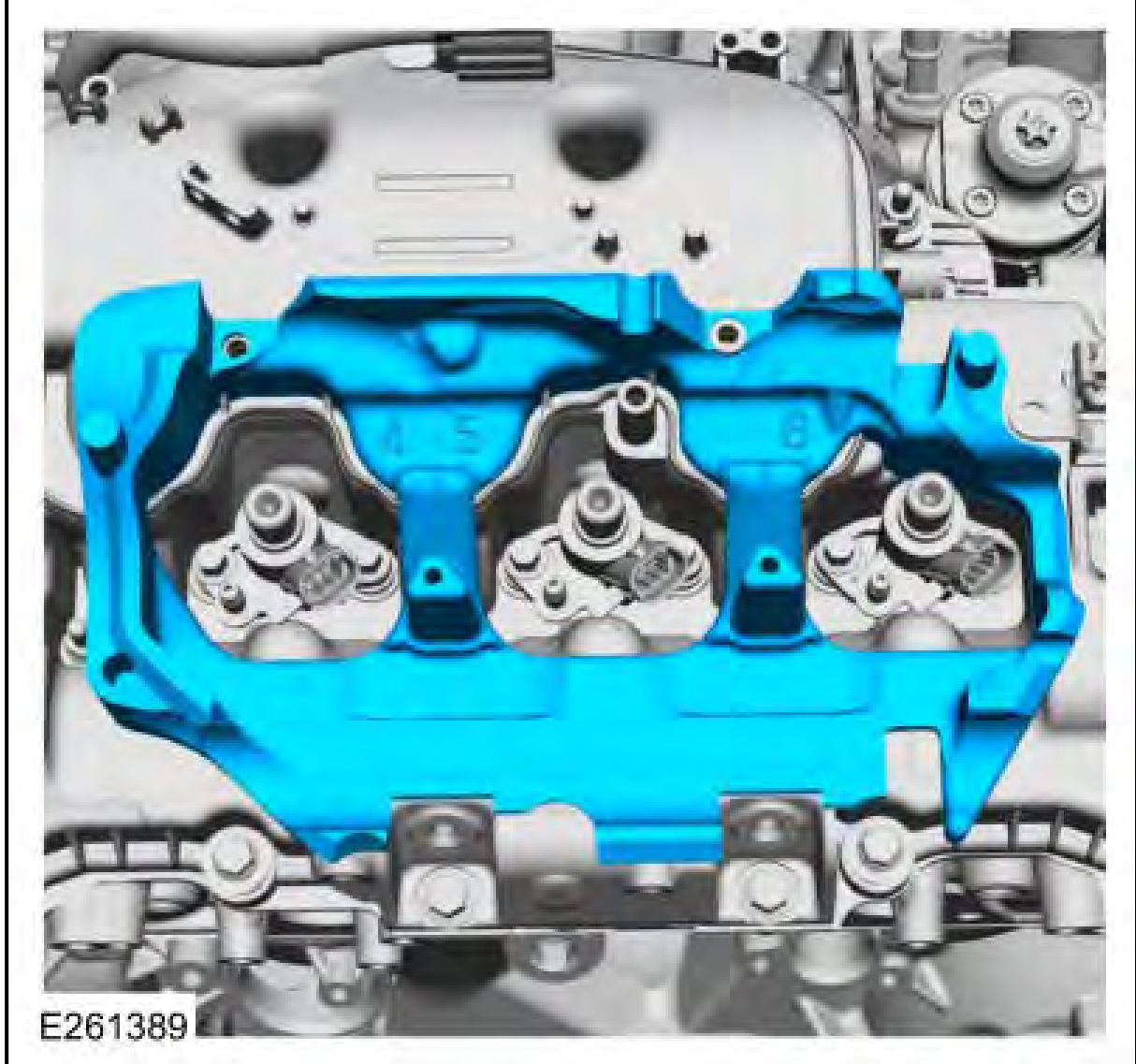
123. **NOTE:** Only tighten the bolts finger tight at this stage.

Install the LH fuel injectors and bolts.



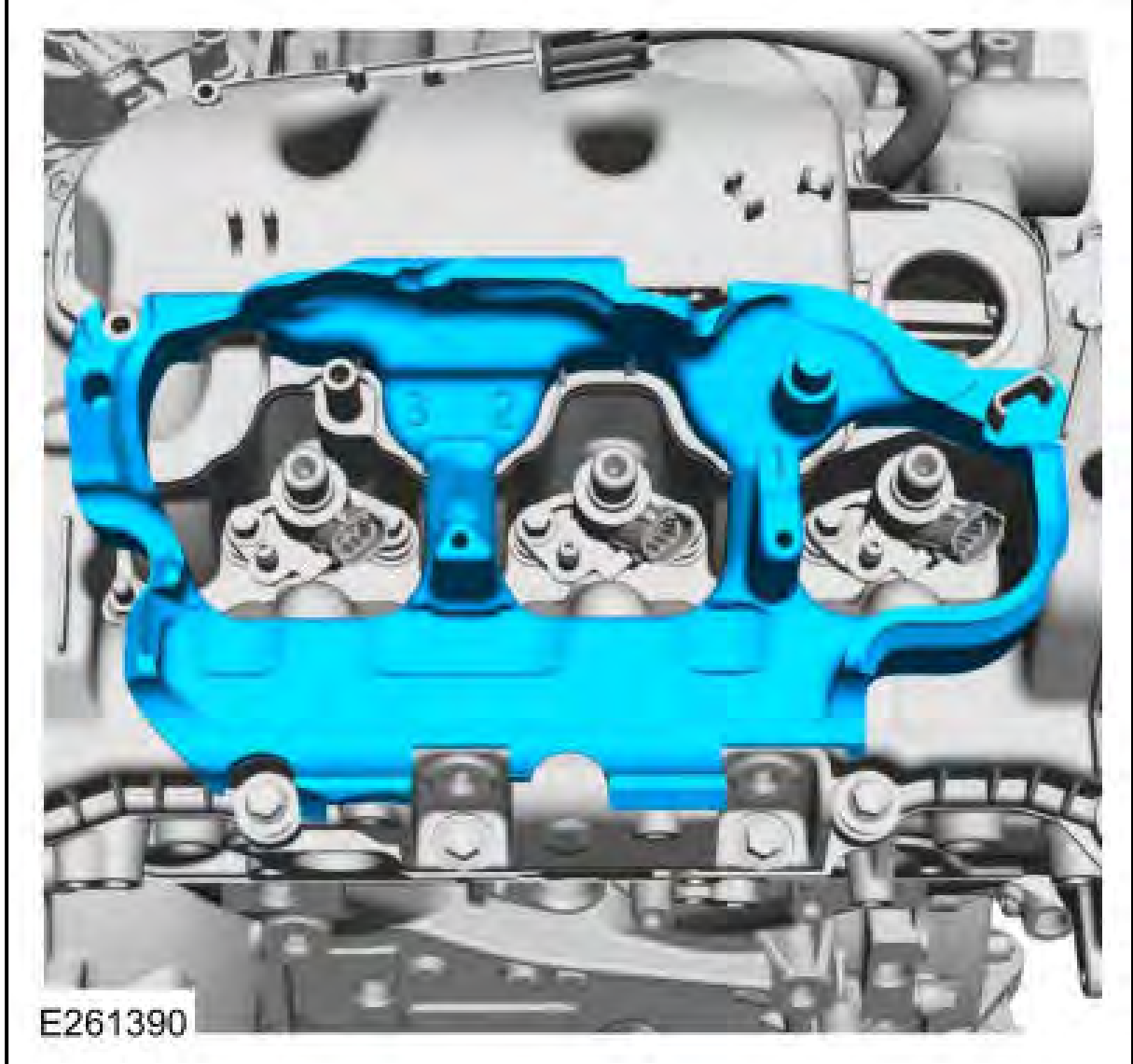
124. Install the LH fuel injector noise insulator.



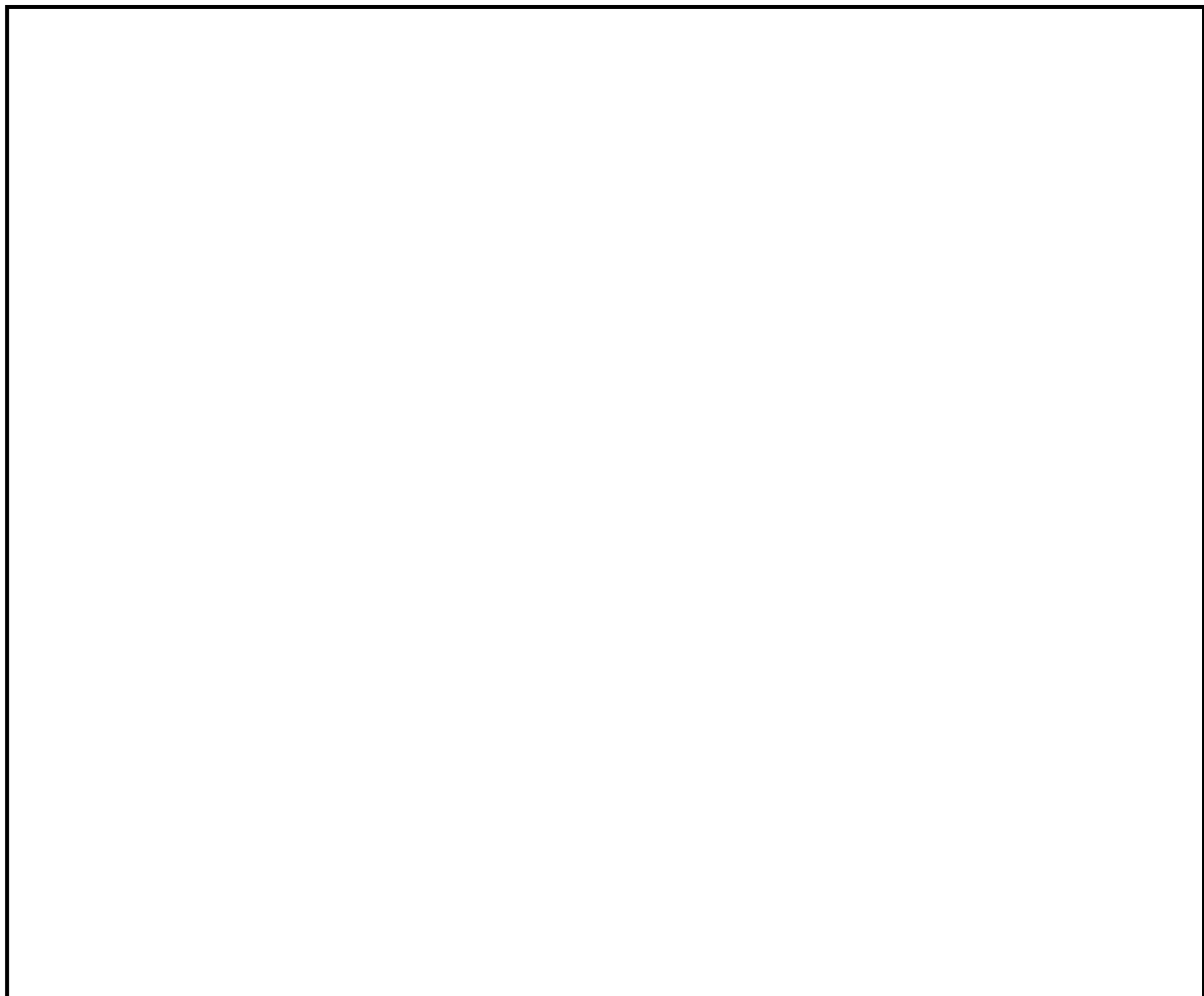


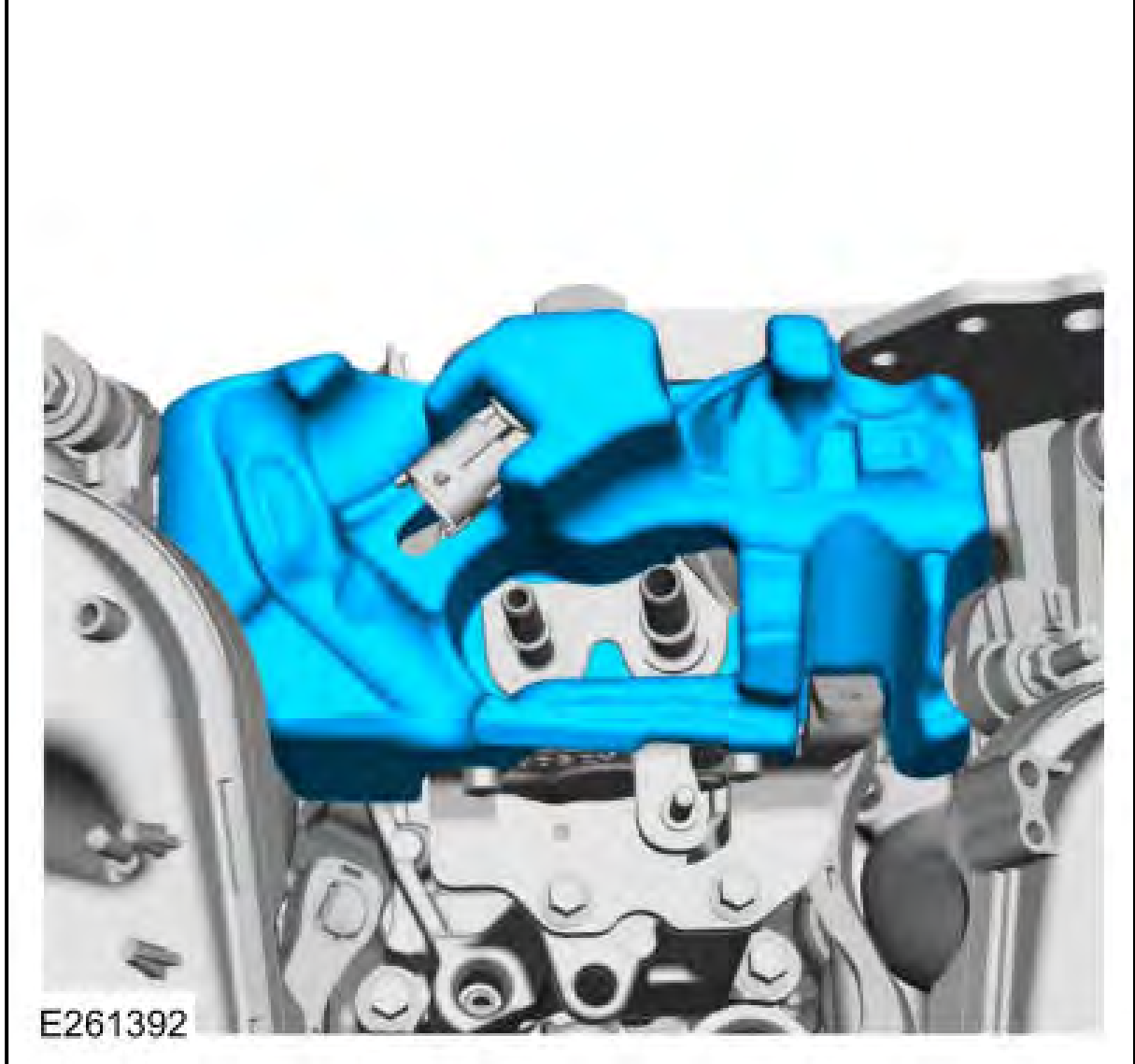
125. Install the RH fuel injector noise insulator.





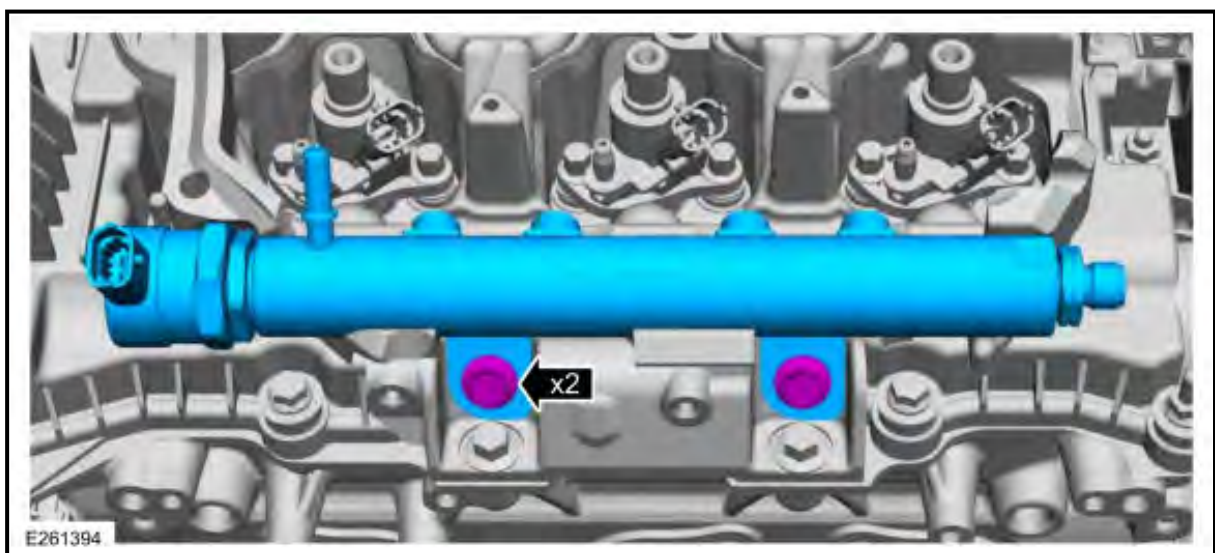
126. Install the fuel injection pump noise insulator.





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

Install the LH fuel rail and the bolts.

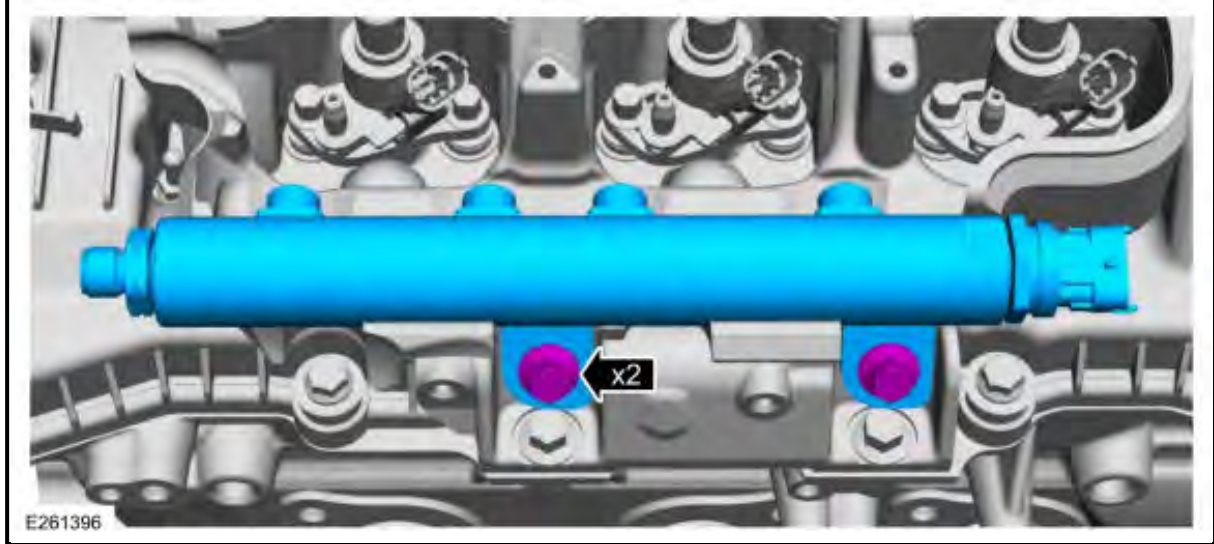


128. **NOTE:** Only tighten the bolts finger tight at this stage.

Install the RH fuel rail and the bolts.

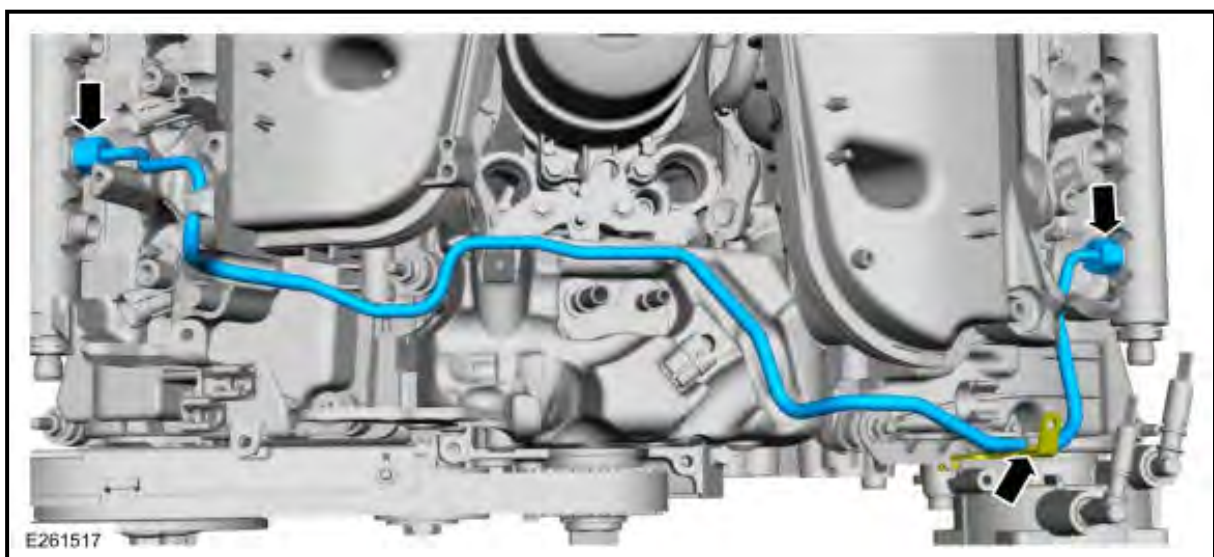






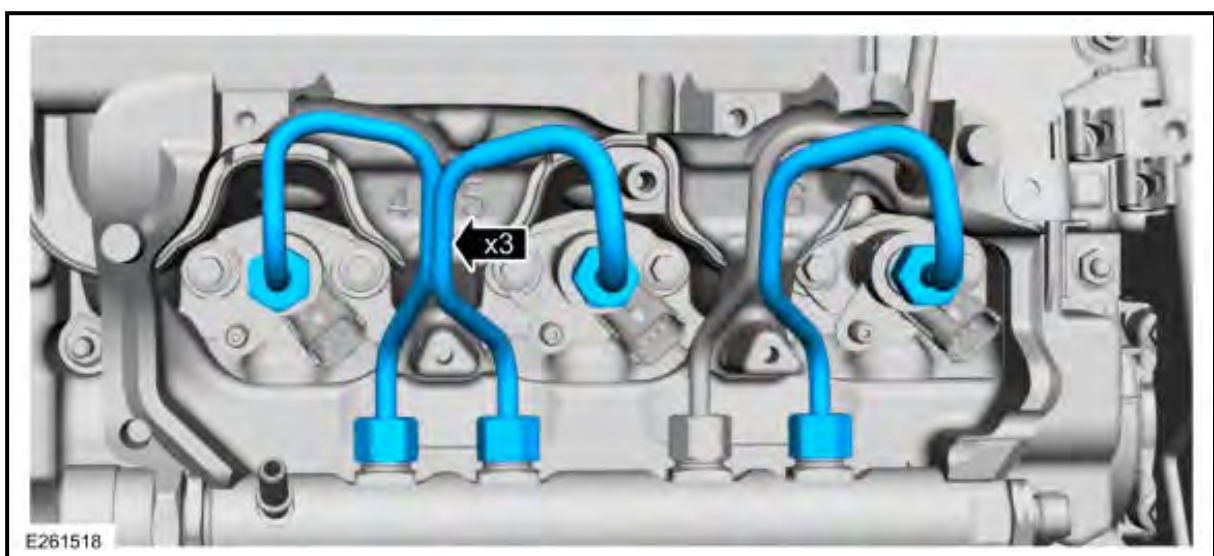
129. **NOTE:** The component must be installed by hand before final tightening.

Install the fuel injection pump balance tube.



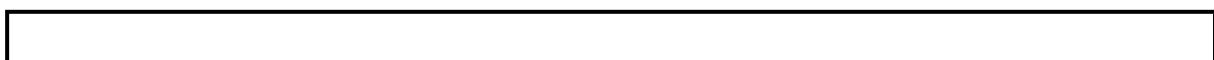
130. **NOTE:** The component must be installed by hand before final tightening.

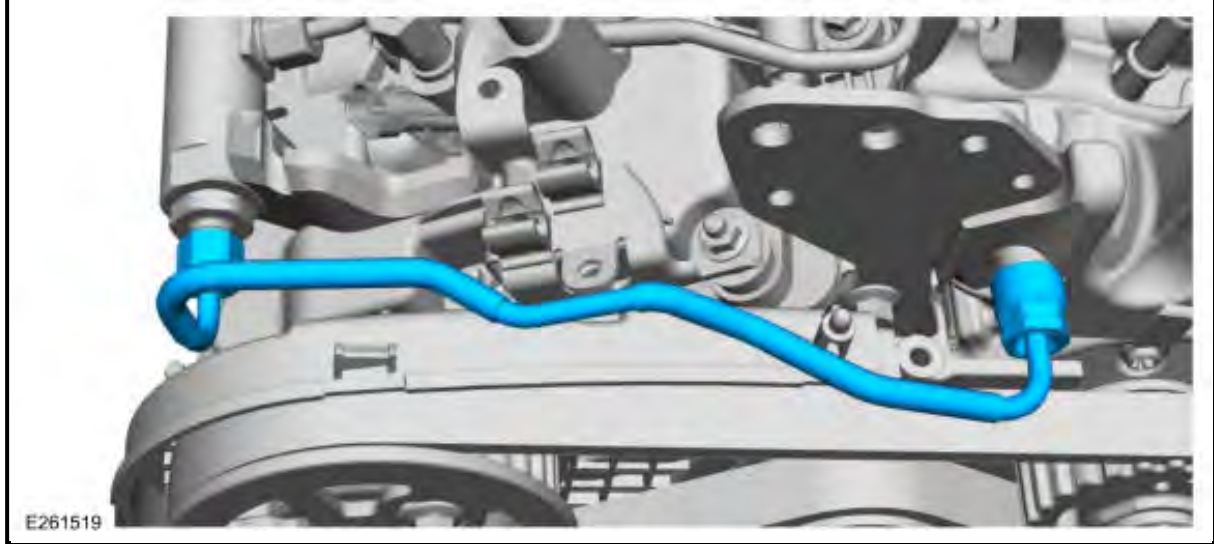
Install the LH fuel injector supply tubes.



131. **NOTE:** The component must be installed by hand before final tightening.

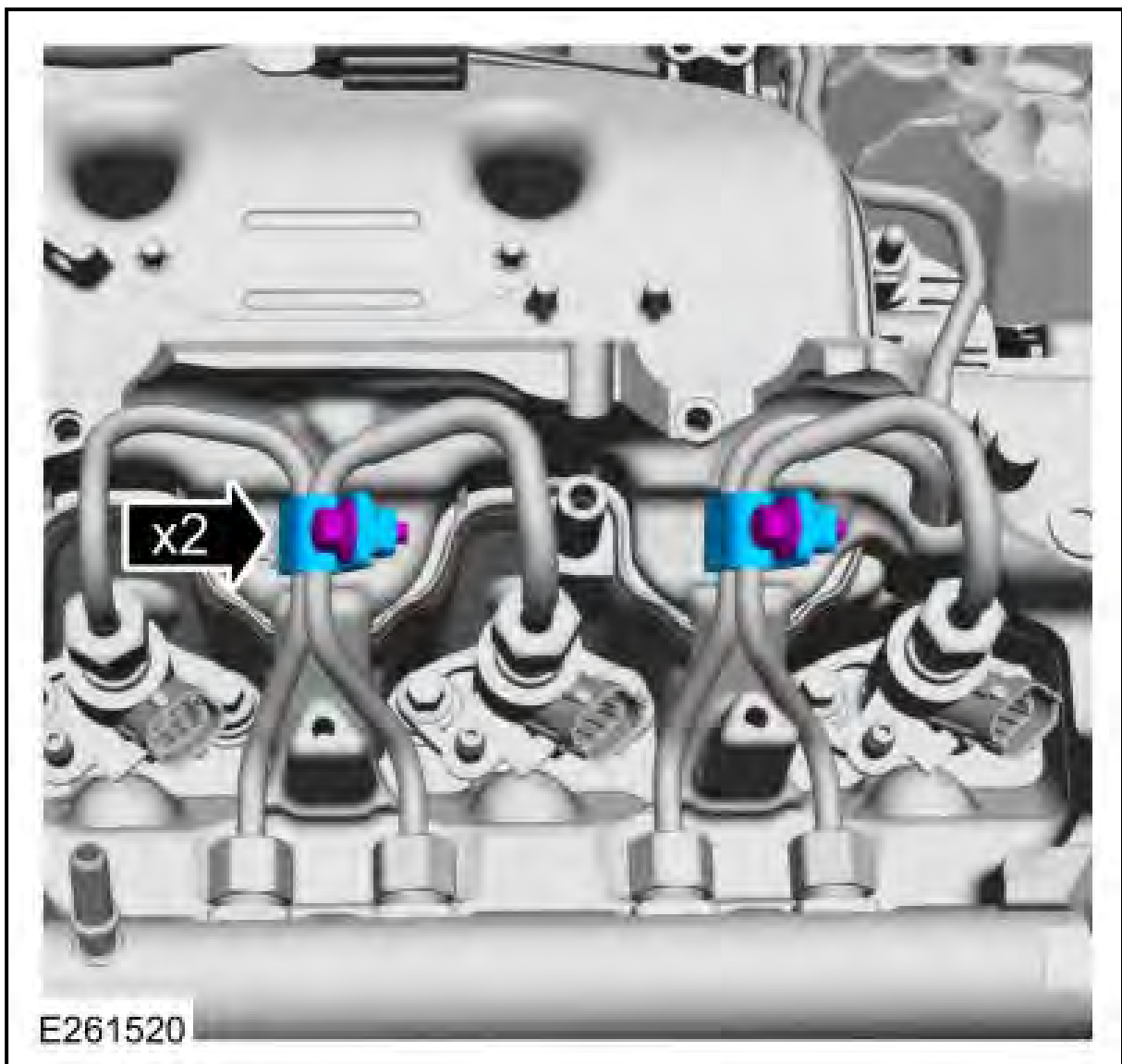
Install the LH fuel rail supply tube.





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

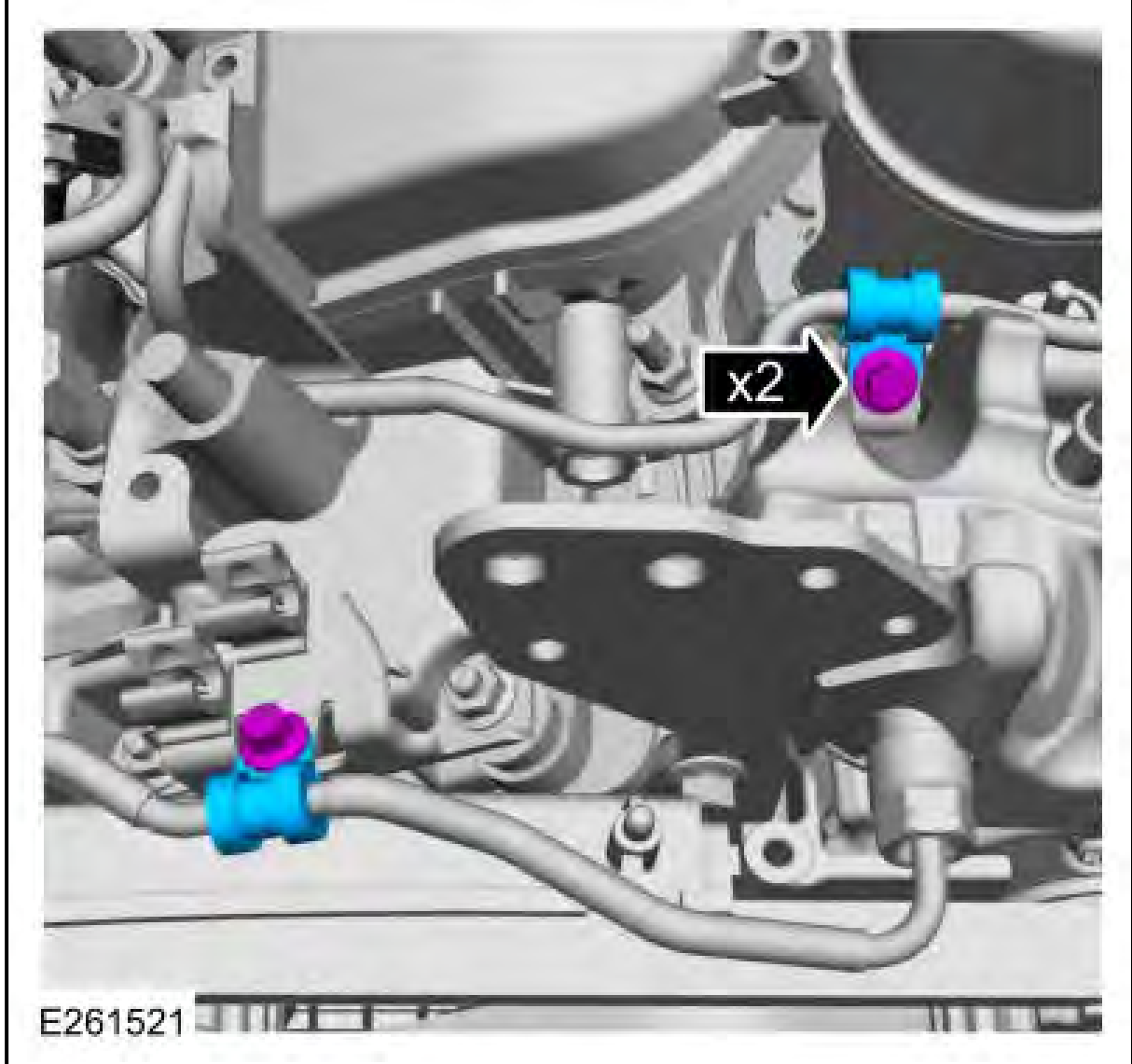
Install the LH fuel injector supply tube clamps.



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

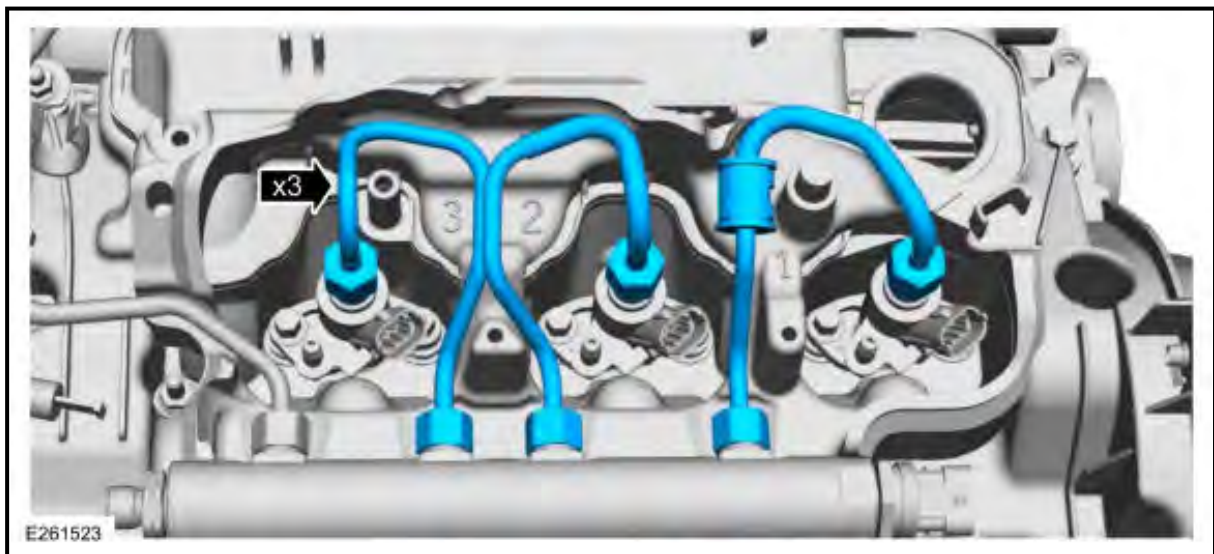
Install the fuel tube clamps and the bolts.





134. **NOTE:** The component must be installed by hand before final tightening.

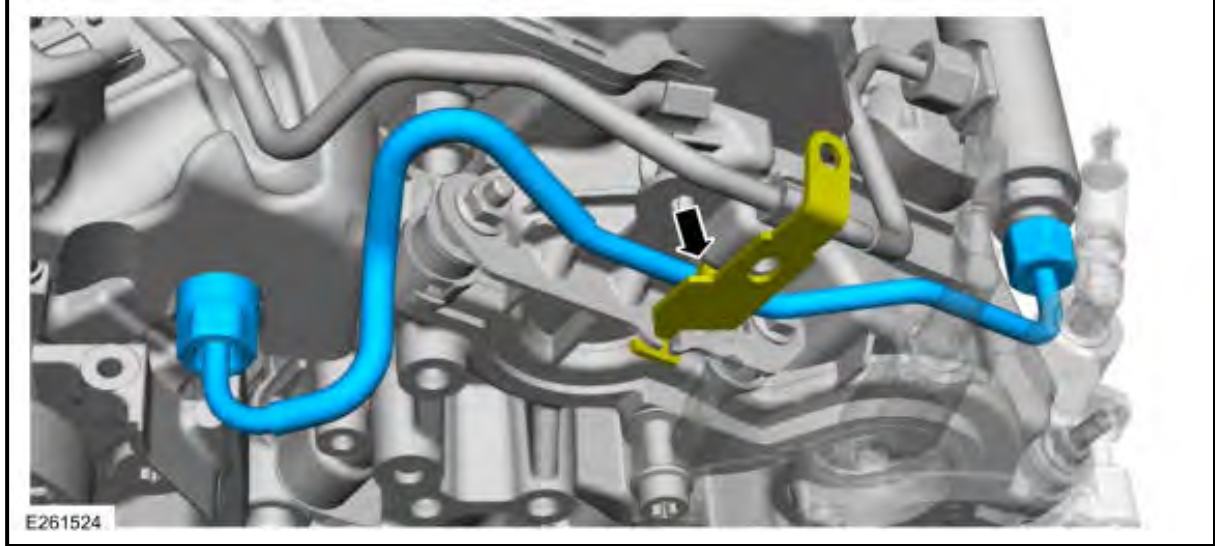
Install the RH fuel injector supply tubes.



135. **NOTE:** The component must be installed by hand before final tightening.

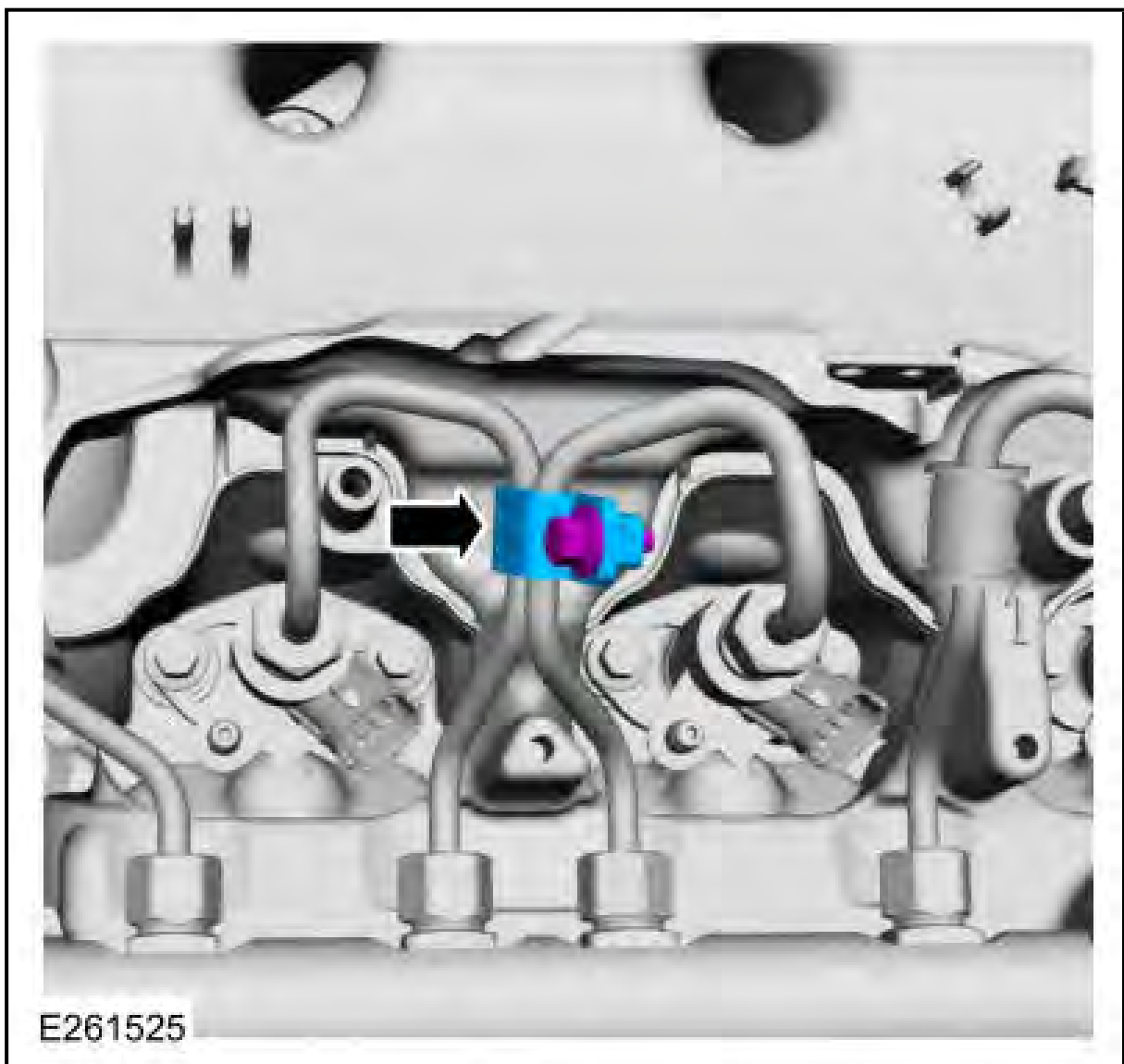
Install the RH fuel rail supply tube.





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

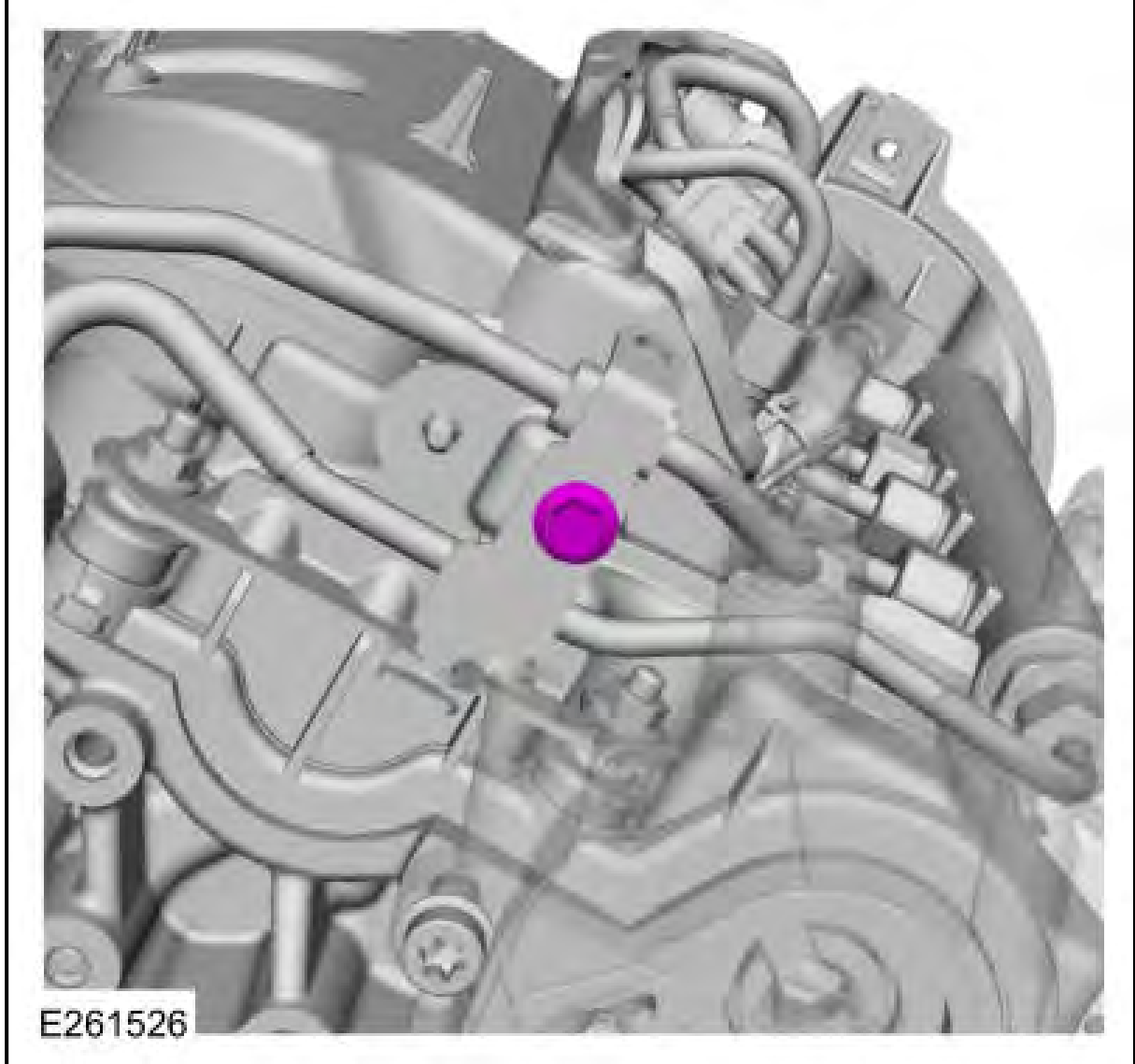
Install the RH fuel injector supply tube clamp.



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

Install the fuel tube bracket bolt.





138.

1. Tighten the fuel tube clamp bolts.

Torque: 89 lb.in (10 Nm)

2. **NOTE:**       **Tighten the fuel injector hold down bolts evenly.**

Tighten the fuel injector hold down bolts.

Torque: 89 lb.in (10 Nm)

3. Tighten the fuel rail bolts.

Torque: 17 lb.ft (23 Nm)

4. Tighten the fuel injector supply tubes.

#### **Torque**

- :Stage 1: Tighten at the fuel rail: 89 lb.in (10 Nm)
- Stage 2: Tighten at the fuel injector: 89 lb.in (10 Nm)
- Stage 3: Tighten at the fuel rail: 142 lb.in (16 Nm)
- Stage 4: Tighten at the fuel injector: 142 lb.in (16 Nm)
- Stage 5: Tighten at the fuel rail: 50 Å°
- Stage 6: Tighten at the fuel injector: 50 Å°

5. Tighten the fuel injection pump balance tube.

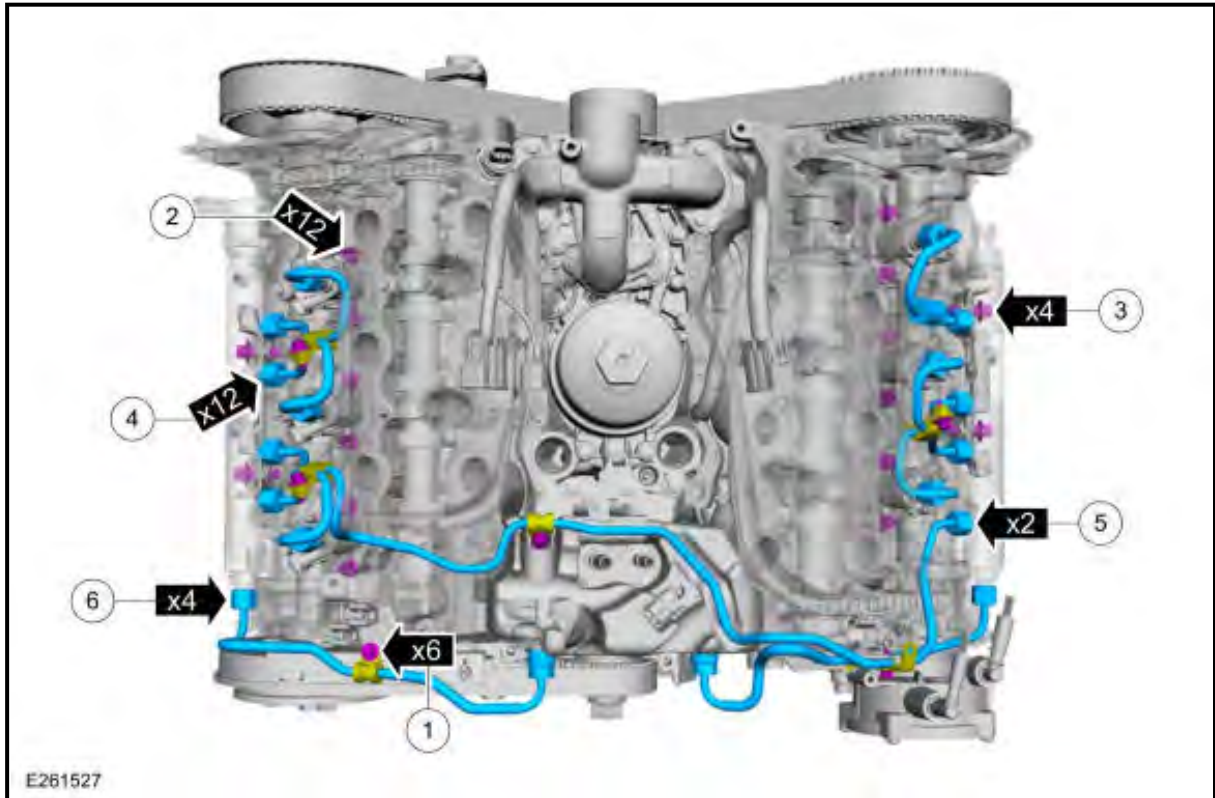
#### **Torque**

- :Stage 1: 89 lb.in (10 Nm)
- Stage 2: 142 lb.in (16 Nm)
- Stage 3: 50 Å°

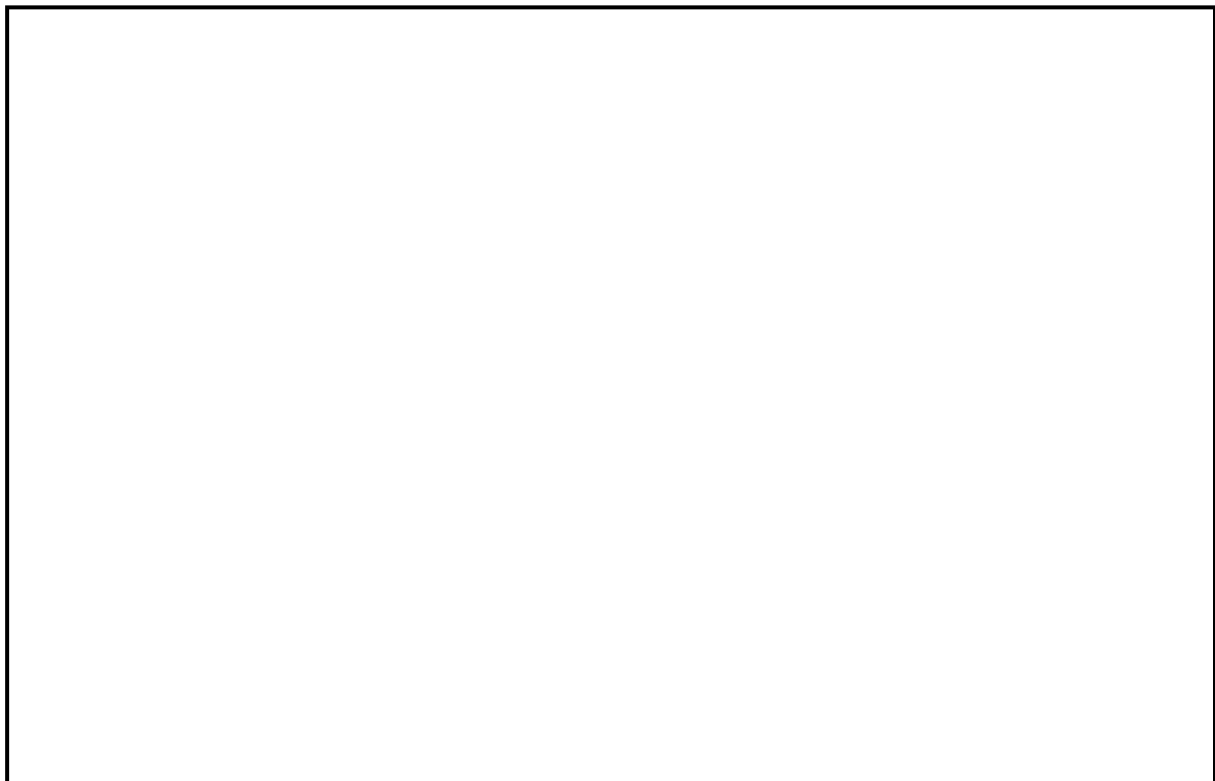
6. Tighten the fuel rail supply tubes.

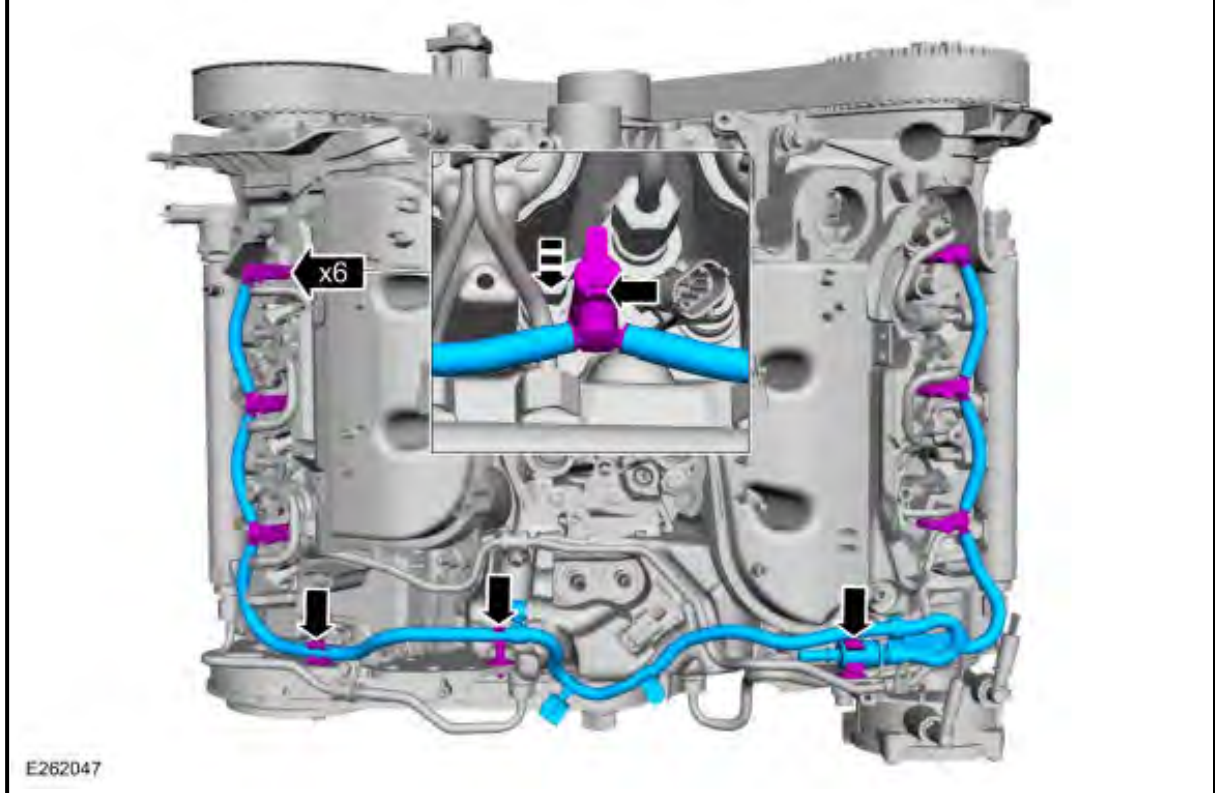
### Torque

- :Stage 1: Tighten at the fuel rail: 89 lb.in (10 Nm)
- Stage 2: Tighten at the fuel injection pump: 89 lb.in (10 Nm)
- Stage 3: Tighten at the fuel rail: 142 lb.in (16 Nm)
- Stage 4: Tighten at the fuel injection pump: 142 lb.in (16 Nm)
- Stage 5: Tighten at the fuel rail: 50 Å°
- Stage 6: Tighten at the fuel injection pump: 50 Å°



139. Install the fuel return hose assembly.

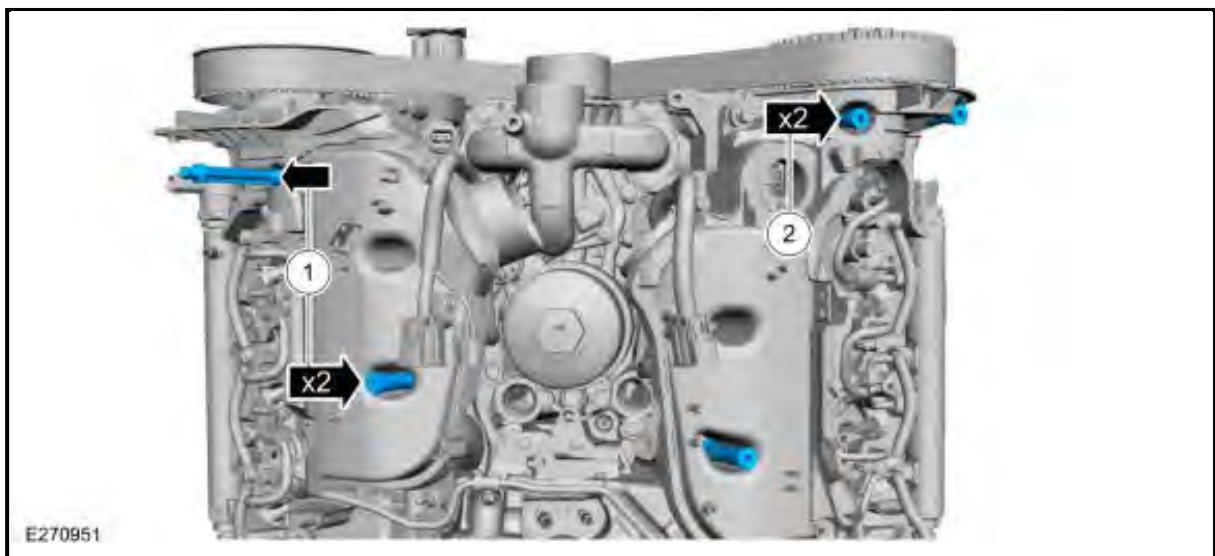




140. Install the engine cover stud assemblies.

Torque

:1 : 44 lb.in (5 Nm) 2 : 62 lb.in (7 Nm)



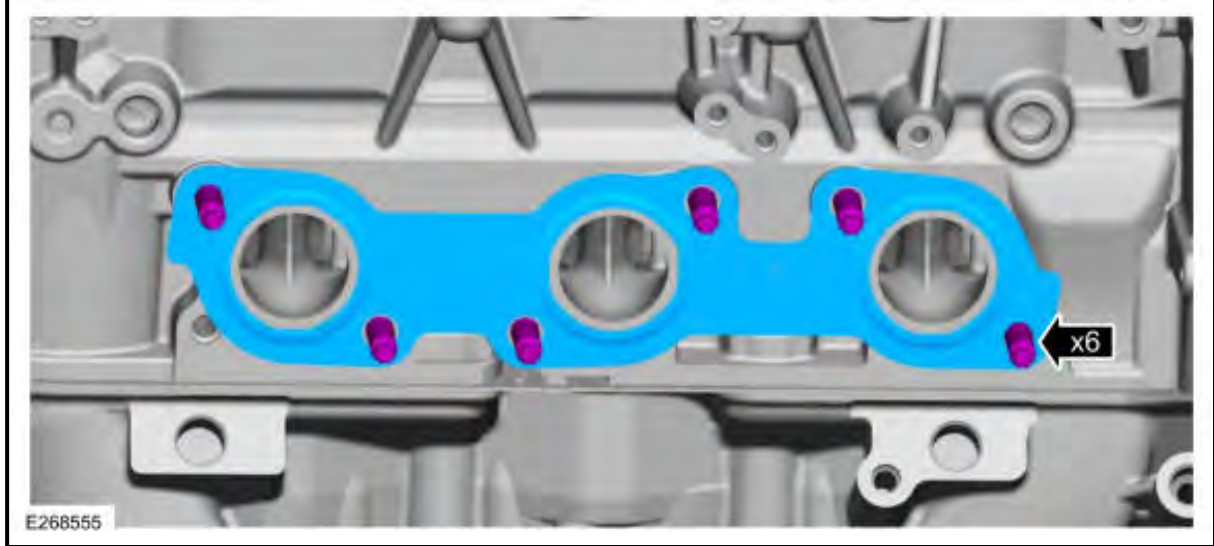
141.

- Install the RH exhaust manifold studs as needed.

Torque: 115 lb.in (13 Nm)

- Install the new RH exhaust manifold gasket.

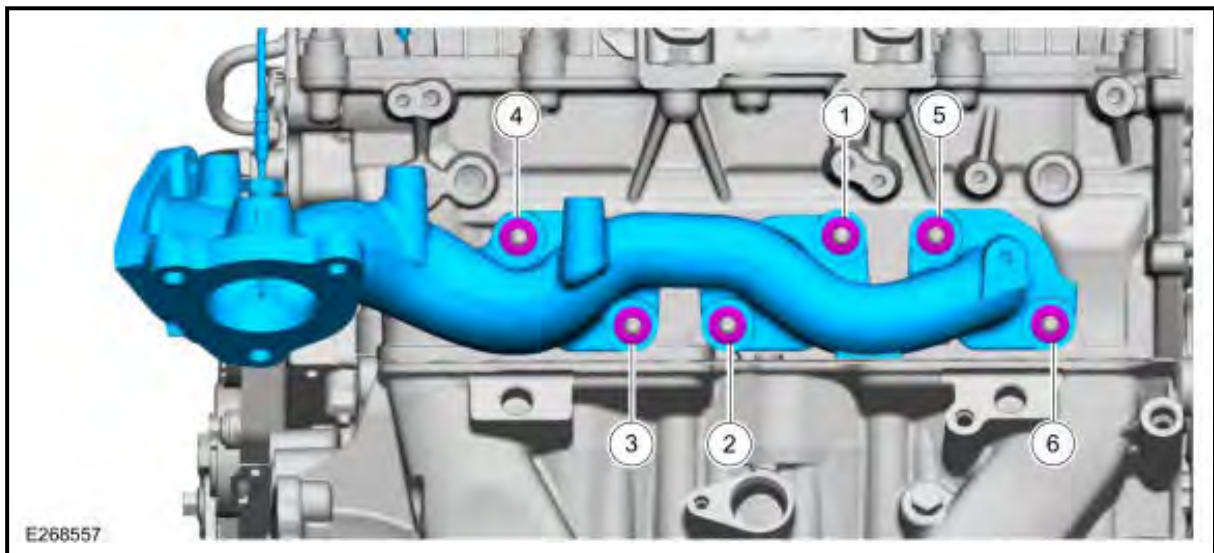




142. Install the RH exhaust manifold and the nuts.

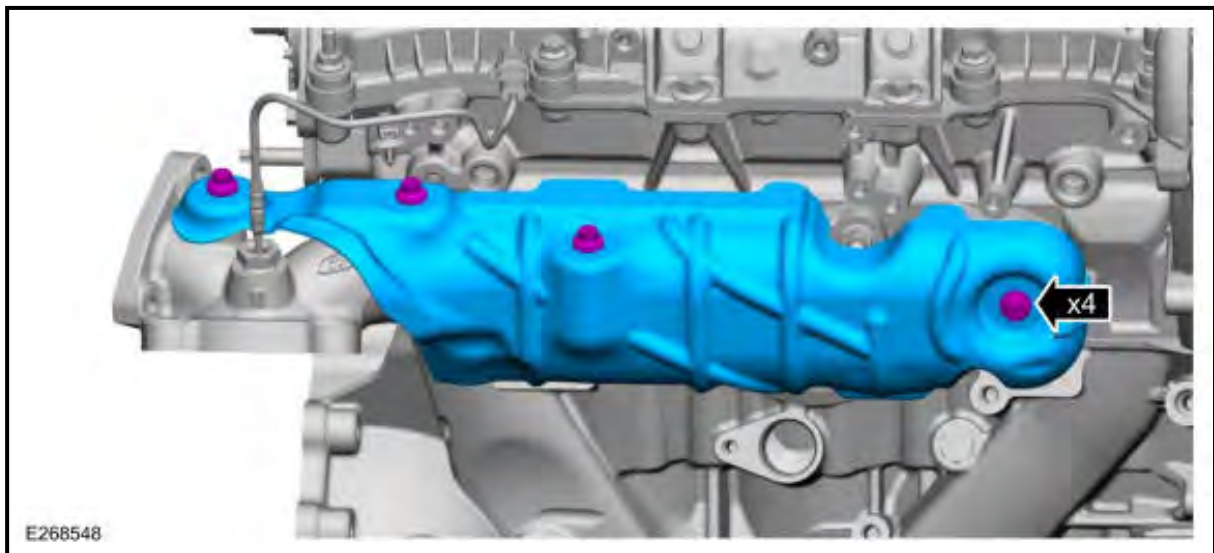
Torque

:Tighten the nuts in the sequence shown to: : 21 lb.ft (28 Nm) Tighten the nuts in the following order 1, 2, 3, 5, 1, 2 to: : 21 lb.ft (28 Nm)



143. Install the RH exhaust manifold heat shield and the bolts.

Torque: 97 lb.in (11 Nm)



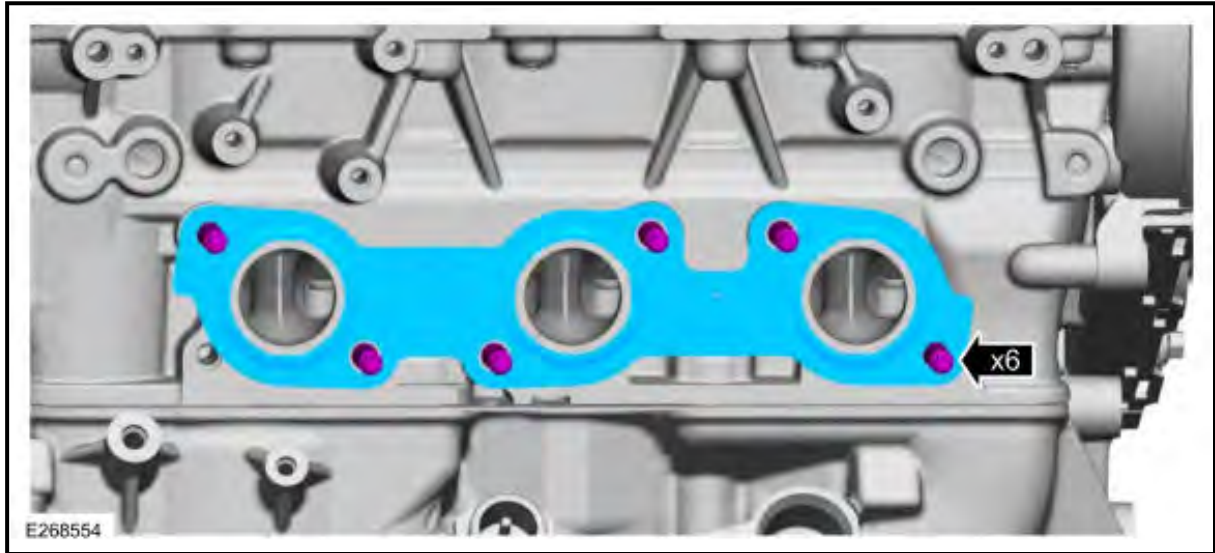
144.

- Install the LH exhaust manifold studs as needed.



Torque: 115 lb.in (13 Nm)

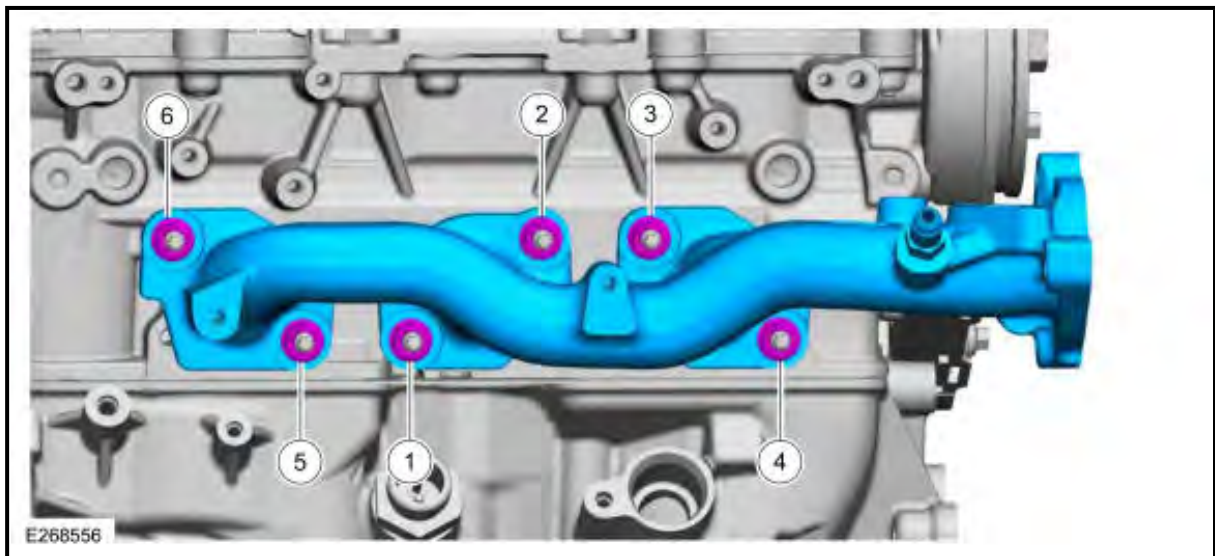
- Install the new LH exhaust manifold gasket.



145. Install the LH exhaust manifold and the nuts.

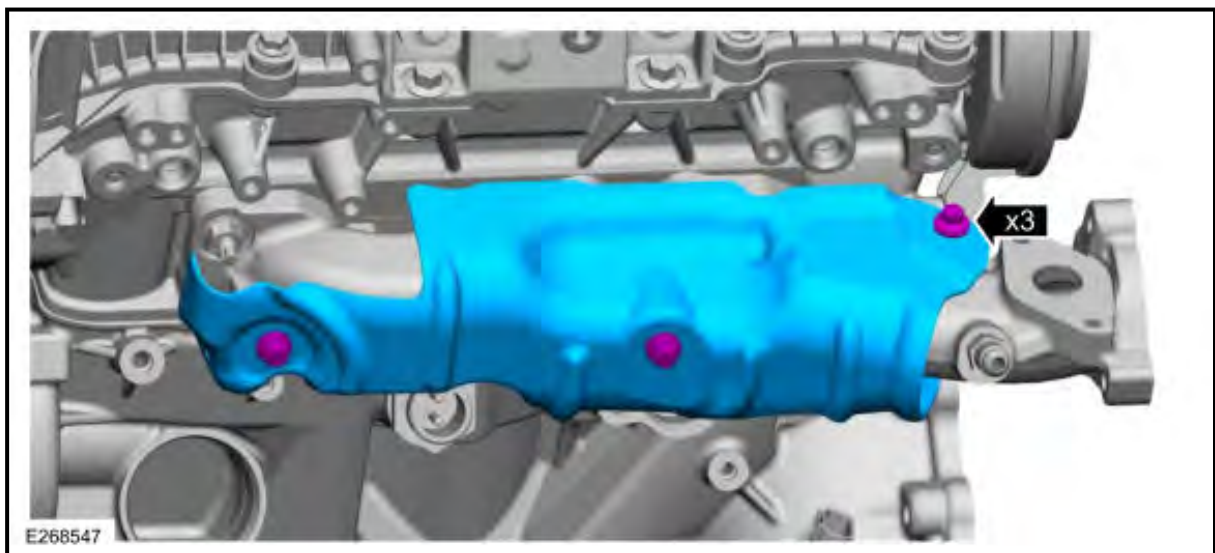
Torque

:Tighten the nuts in the sequence shown to: : 21 lb.ft (28 Nm) Tighten the nuts in the following order 1, 2, 3, 5, 1, 2 to: : 21 lb.ft (28 Nm)



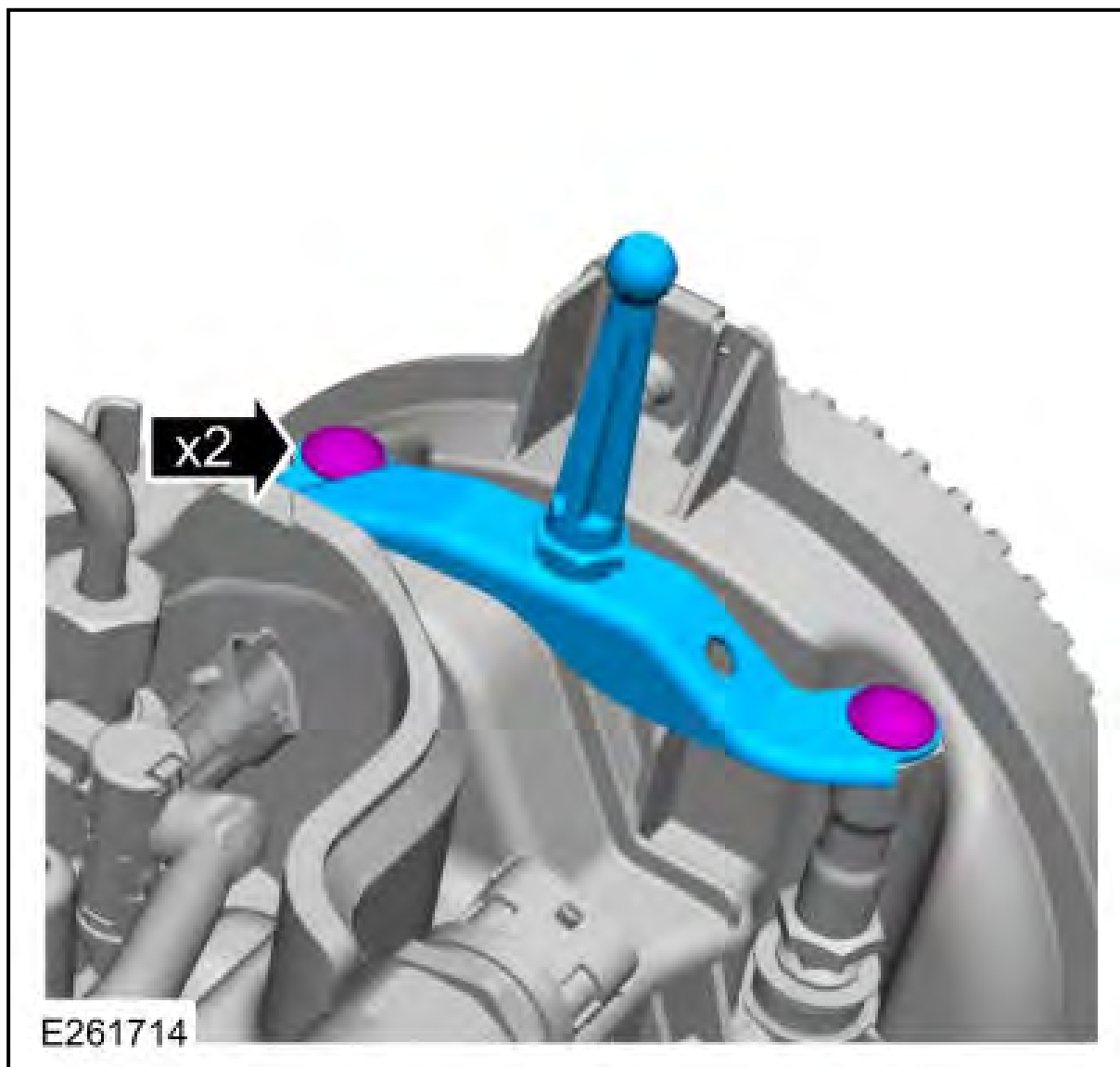
146. Install the LH exhaust manifold heat shield and the bolts.

Torque: 97 lb.in (11 Nm)



147. Install the engine support bracket and the retainers.

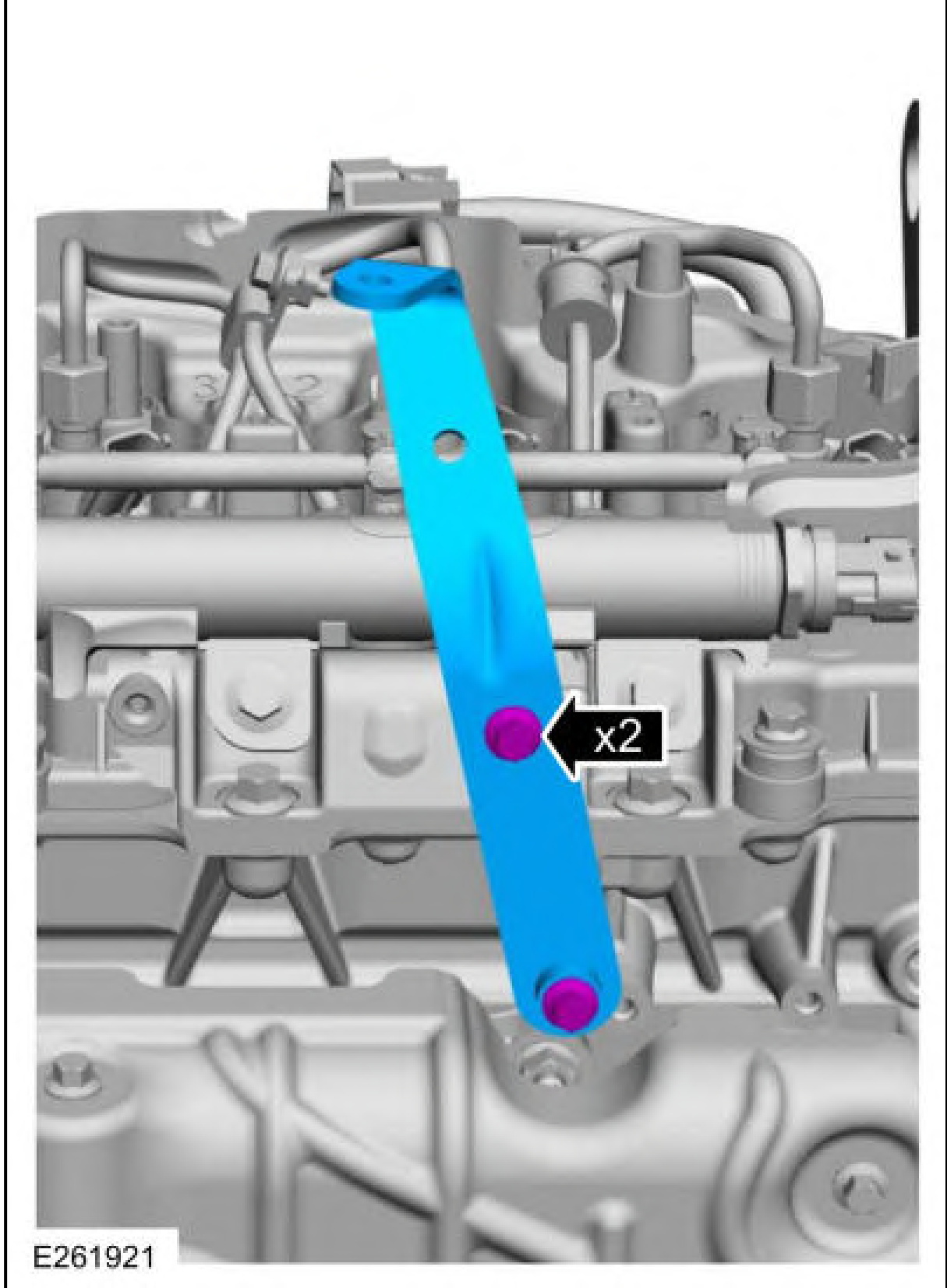
Torque: 62 lb.in (7 Nm)



148. Install the heater hose support bracket and the bolts.

Torque: 89 lb.in (10 Nm)

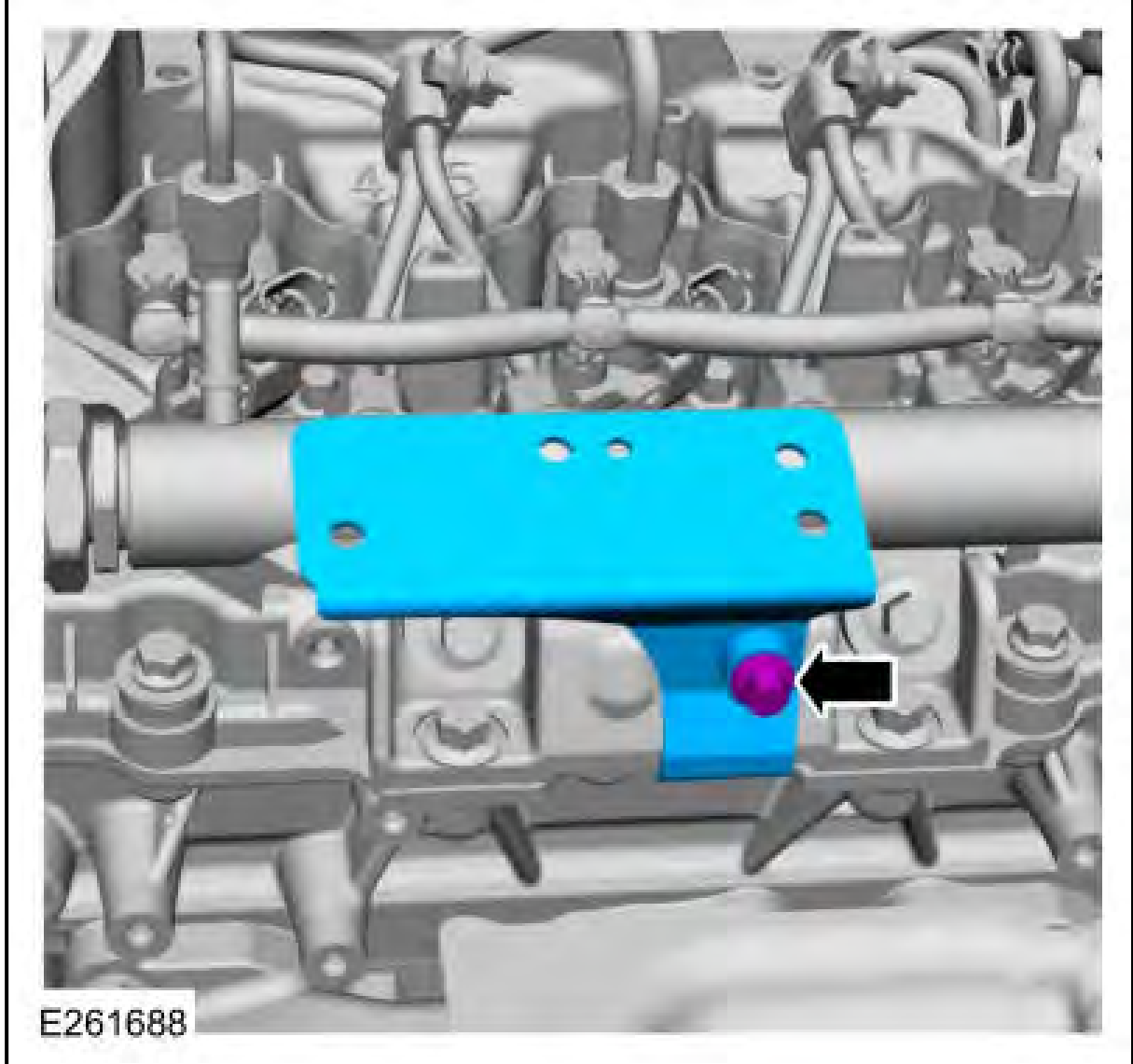




149. Install the wire harness bracket and the bolt.

Torque: 89 lb.in (10 Nm)

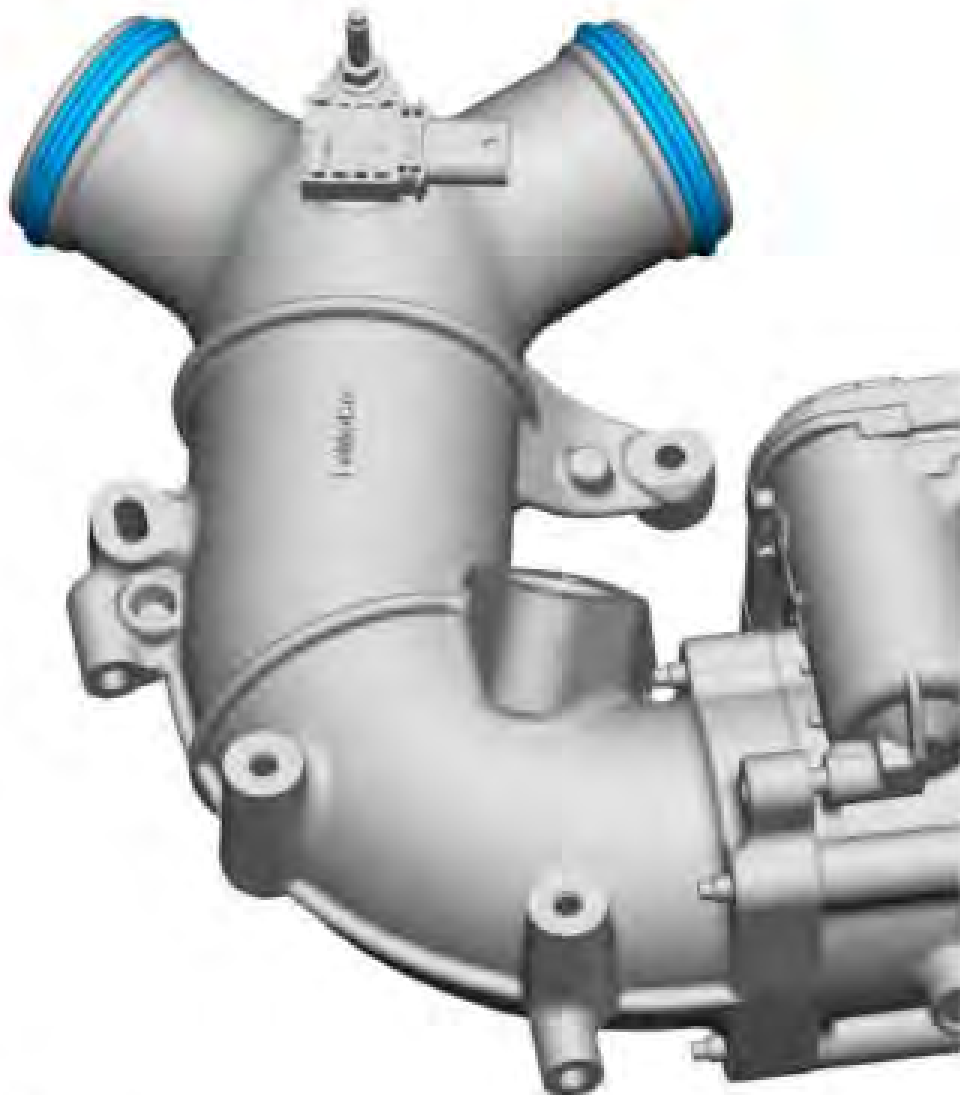
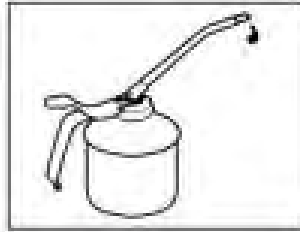




150. Install new gaskets on the intake manifold. Lubricate the gaskets with clean engine oil.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)





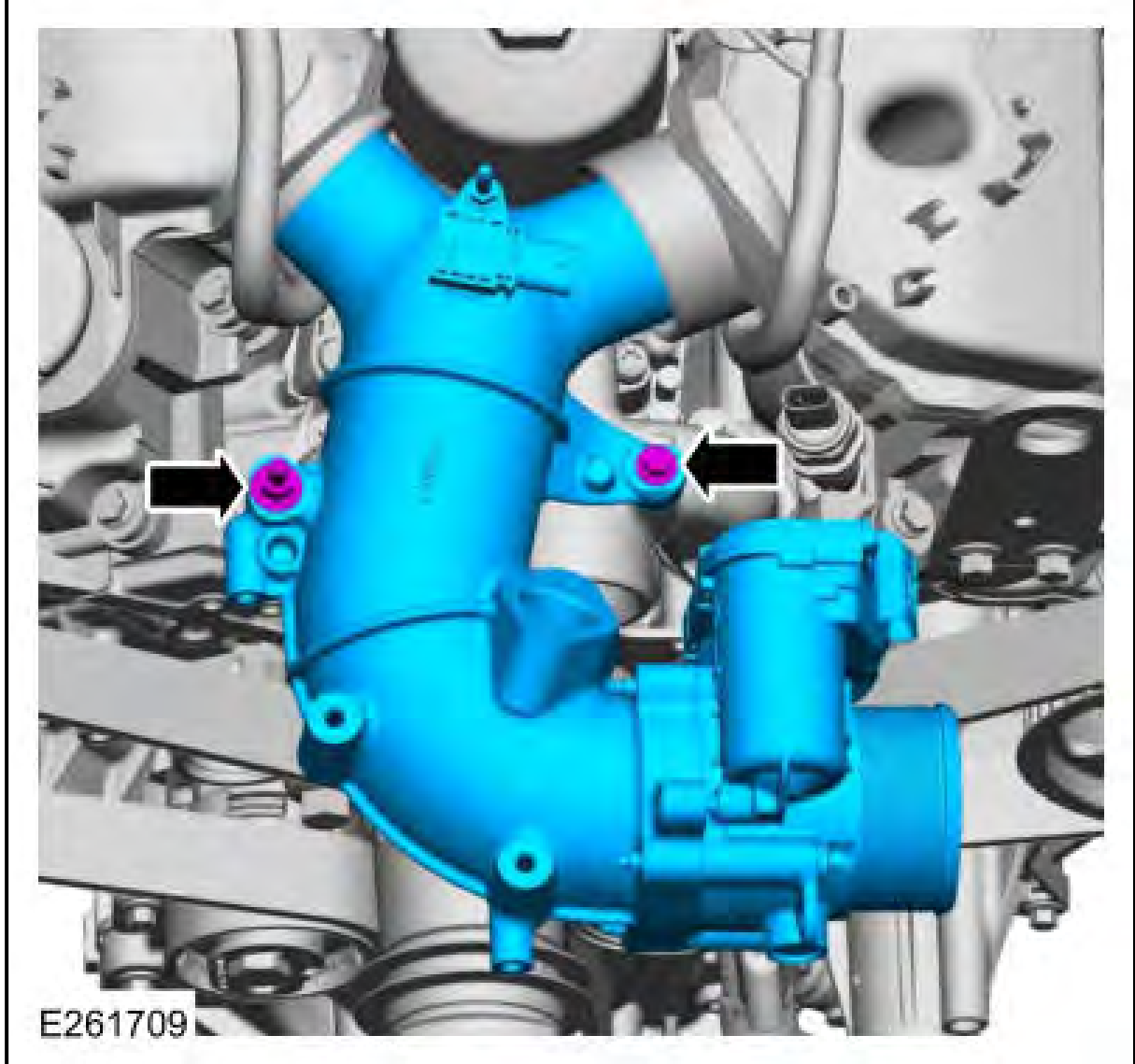
E261599

151. **NOTE:** Install the intake manifold into the LH valve cover, then into the RH valve cover.

Install the intake manifold, the stud bolt and the bolt.

Torque: 89 lb.in (10 Nm)

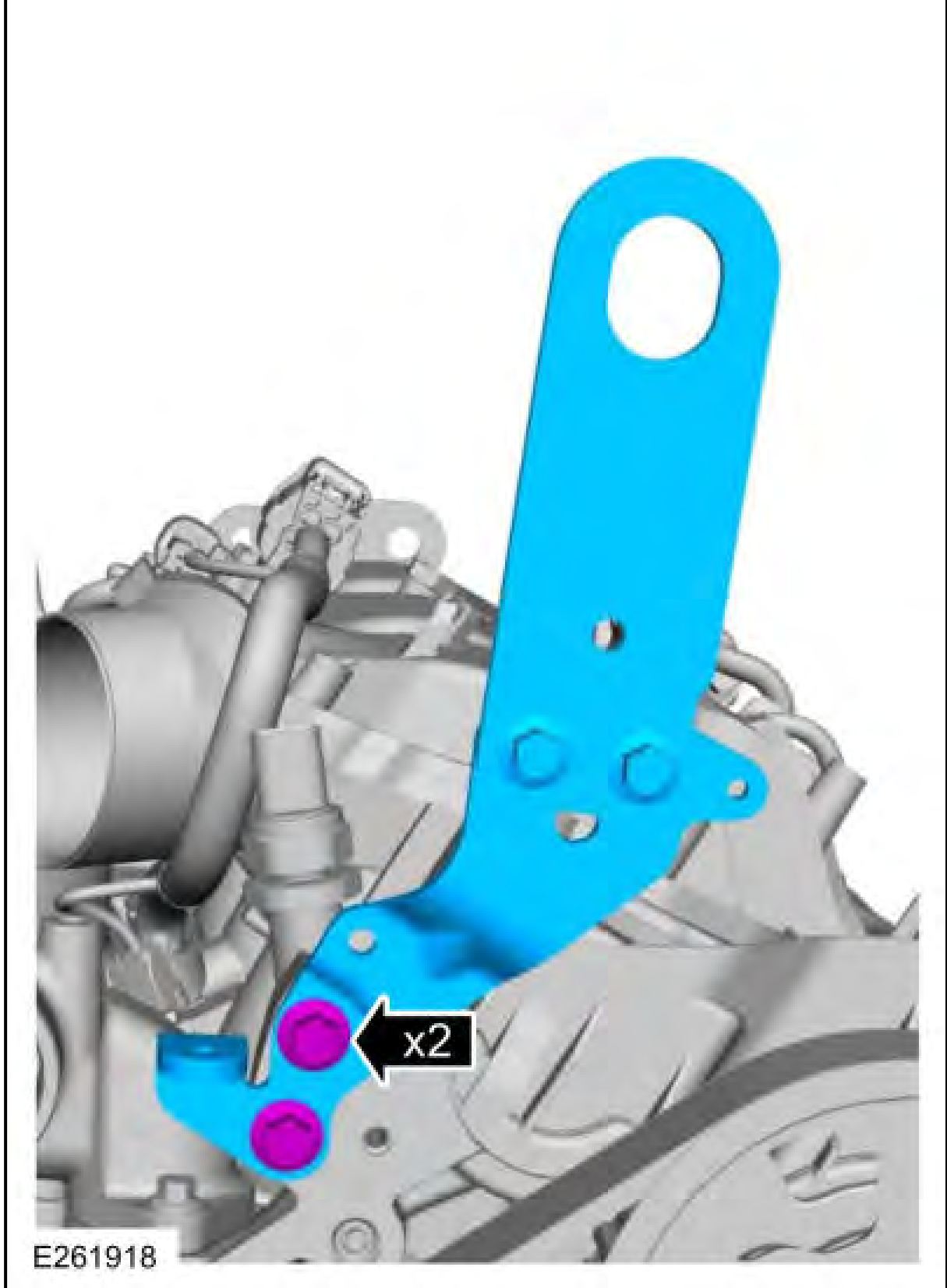




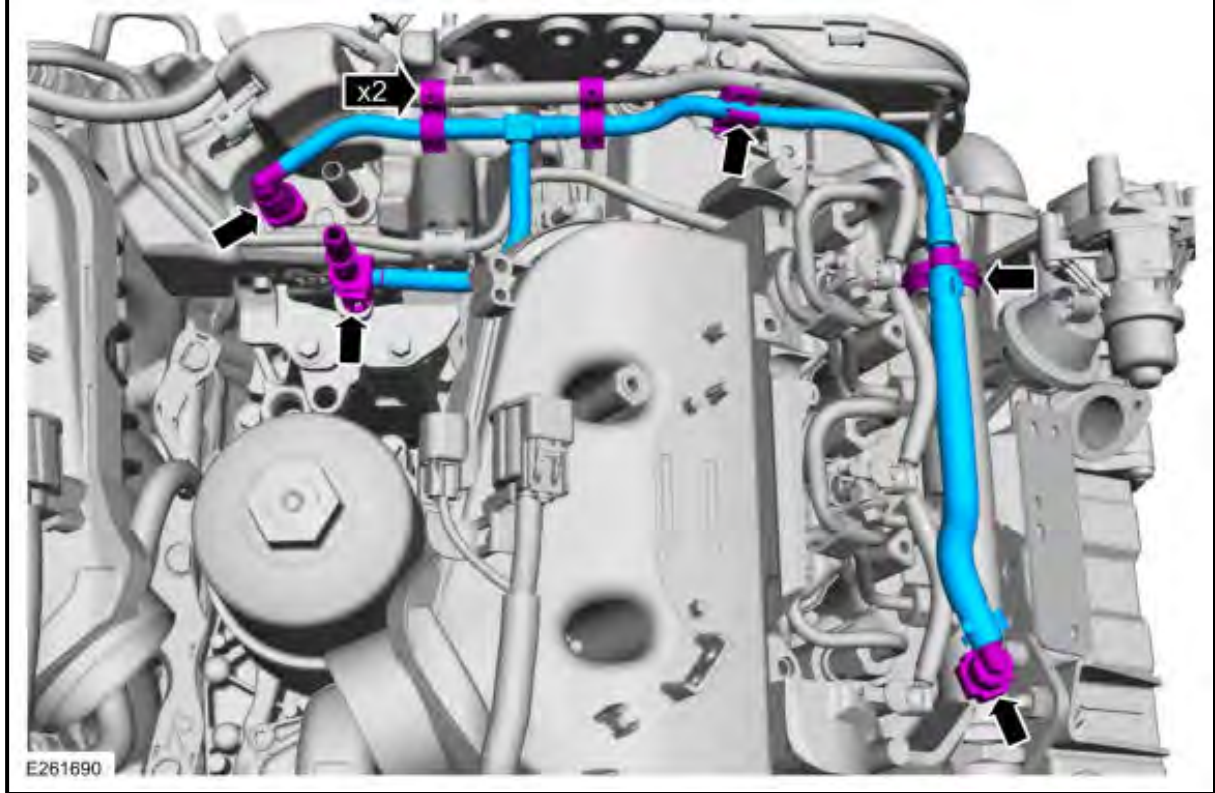
152. Install the front engine lifting eye and the bolts.

Torque: 17 lb.ft (23 Nm)

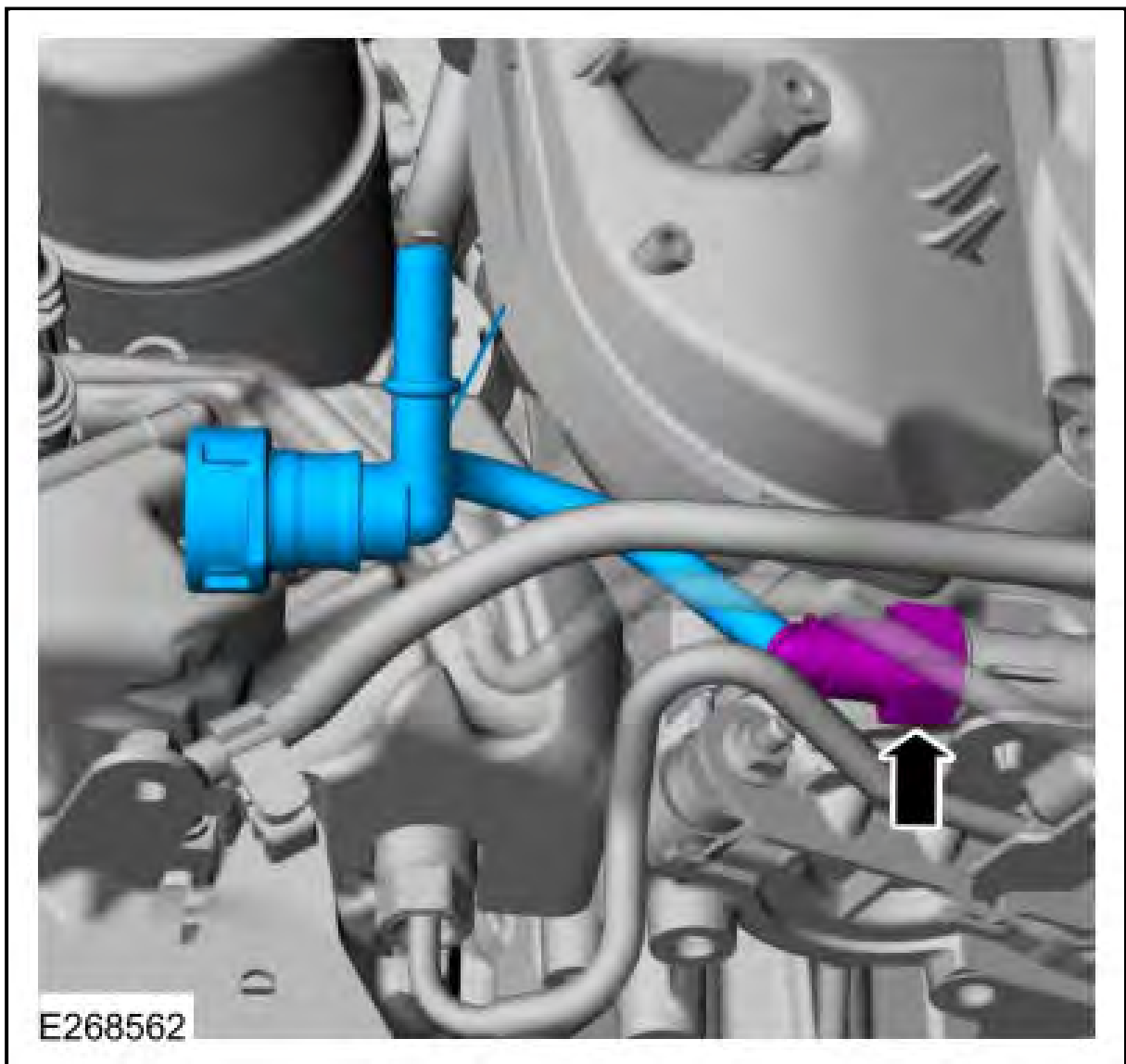




153. Install the fuel return tube assembly. Refer to: [Quick Release Coupling](#) .



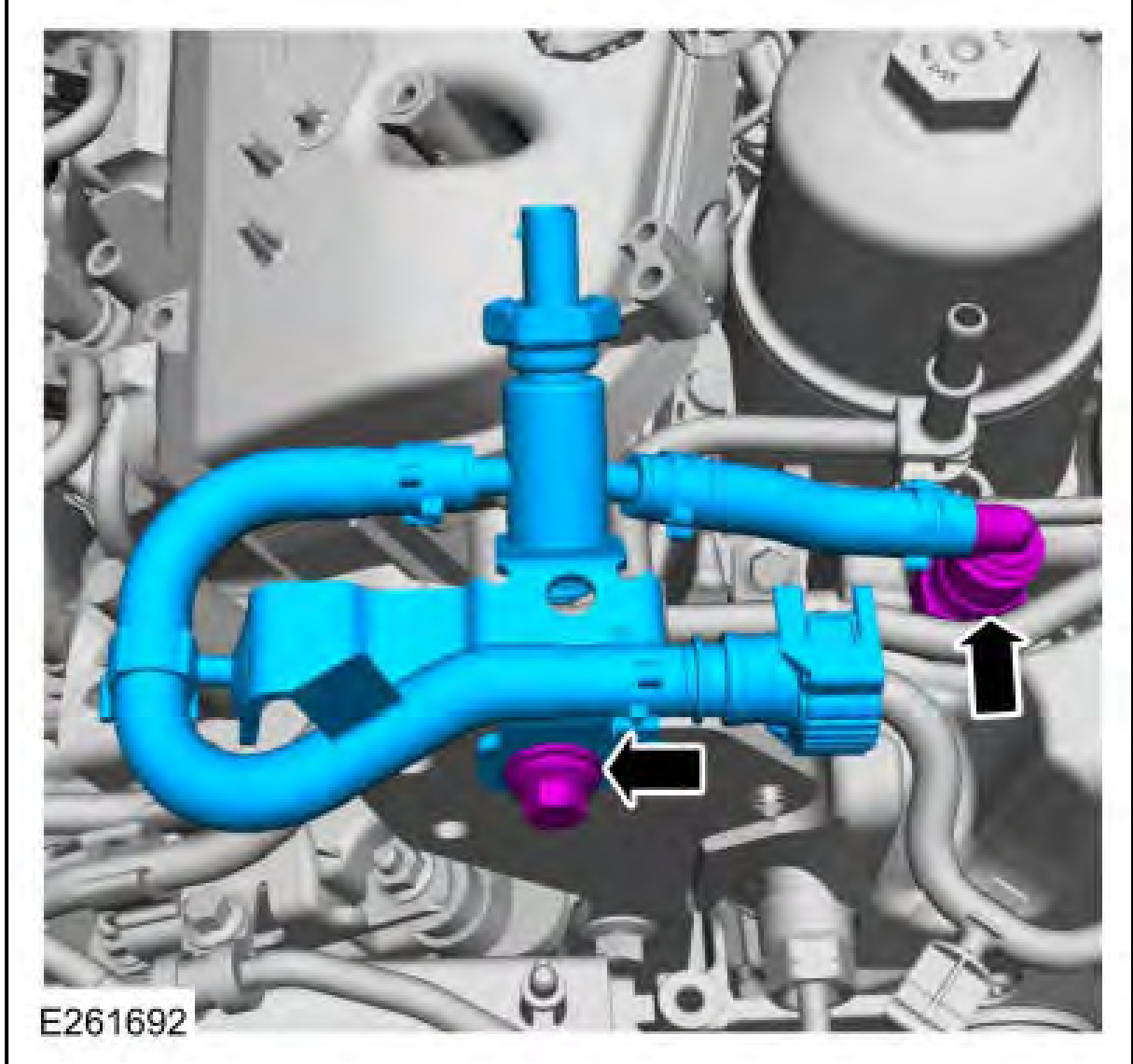
154. Install the fuel supply tube. Refer to: [Quick Release Coupling](#) .



155. Install the fuel supply tube and the bolt. Refer to: [Quick Release Coupling](#) .

Torque: 17 lb.ft (23 Nm)

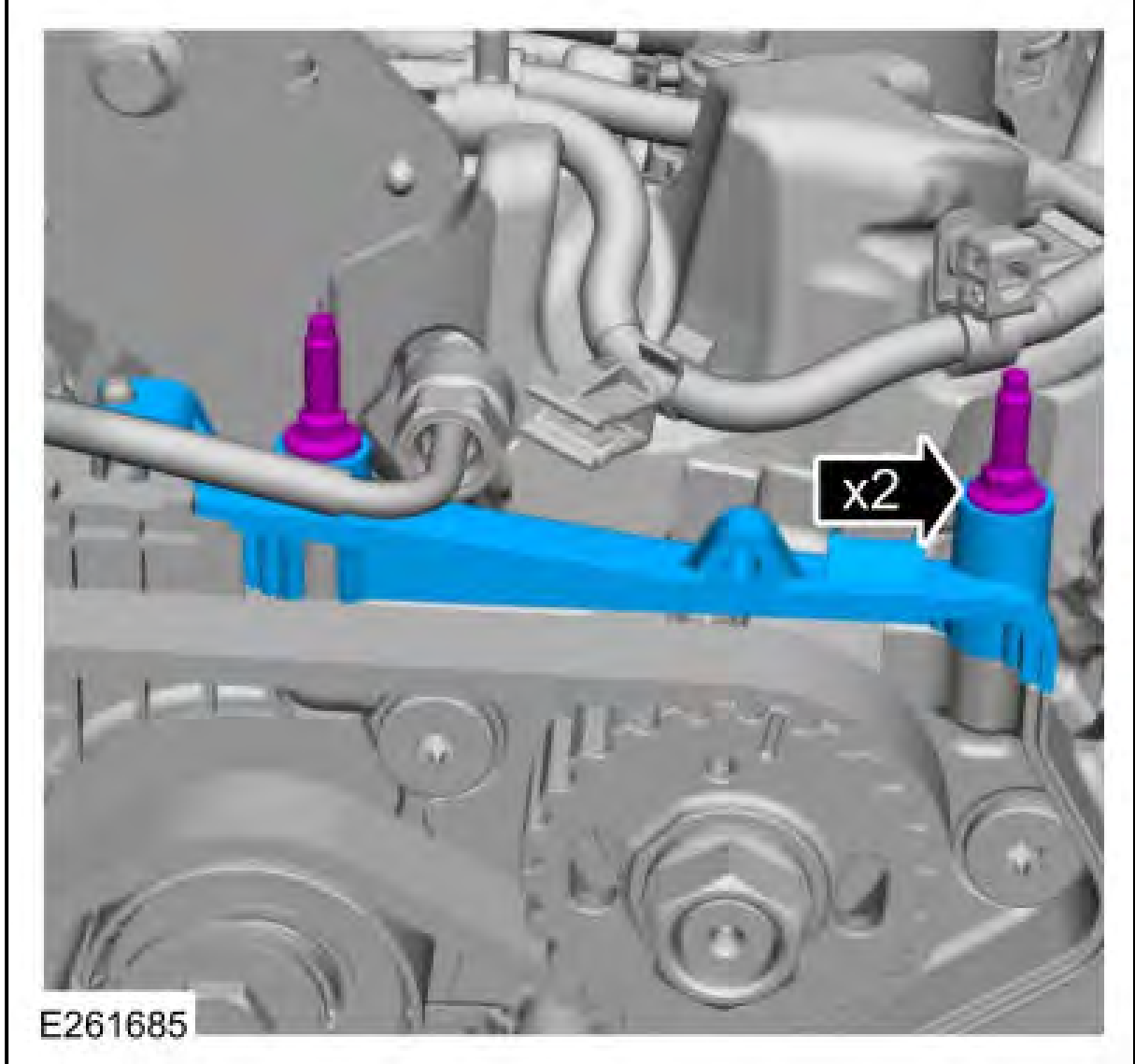




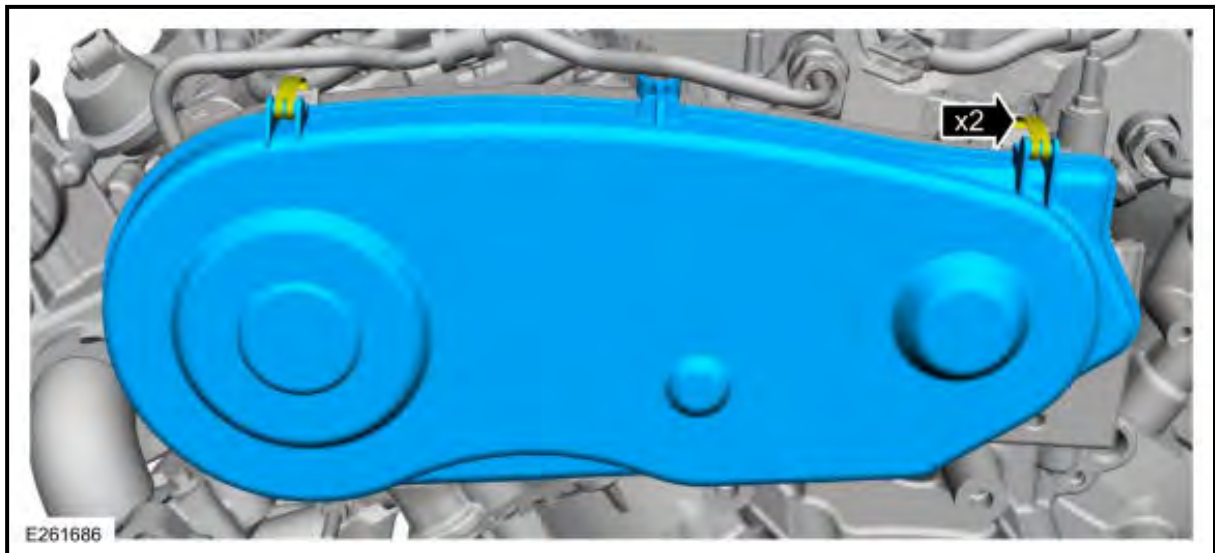
156. Install the accessory drive cover and the stud bolts.

Torque: 89 lb.in (10 Nm)





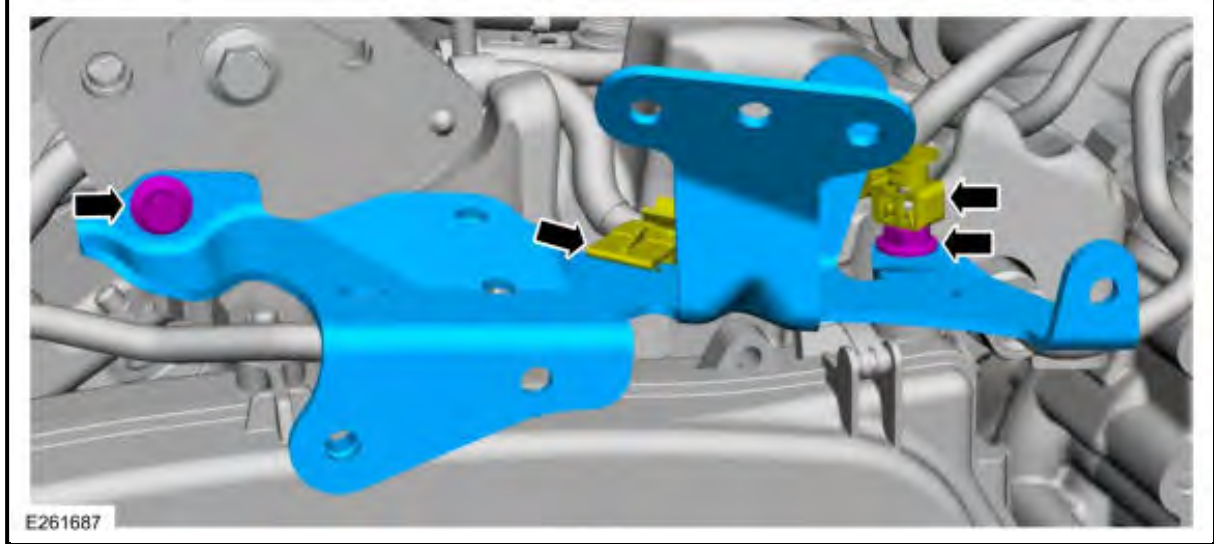
157. Install the accessory drive cover.



158. Install the wiring harness bracket, the nut and the bolt. Connect the retainers.

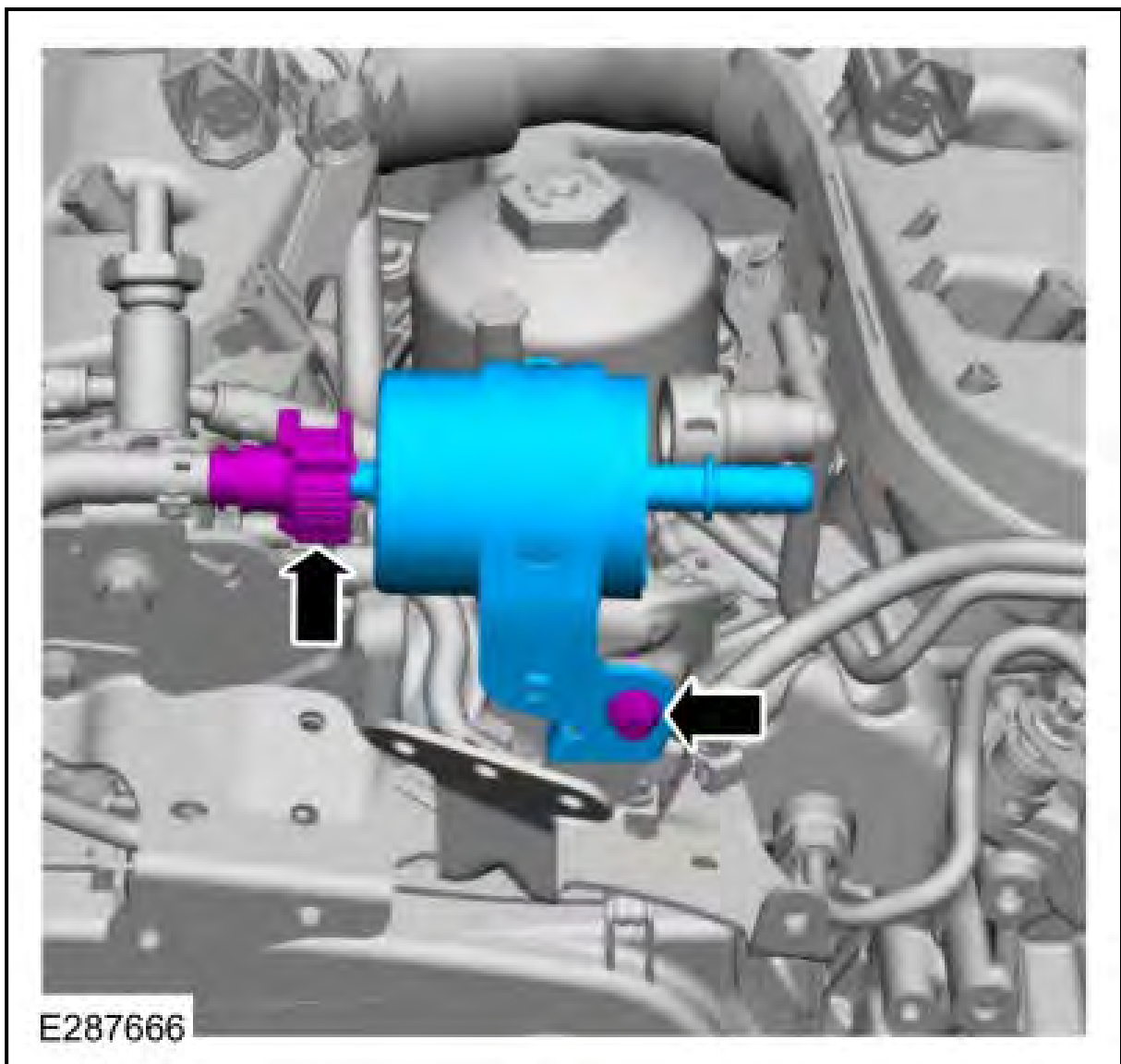
Torque: 89 lb.in (10 Nm)





159. Install the secondary fuel filter and the bolt. Connect the fuel line. Refer to: [Quick Release Coupling](#) .

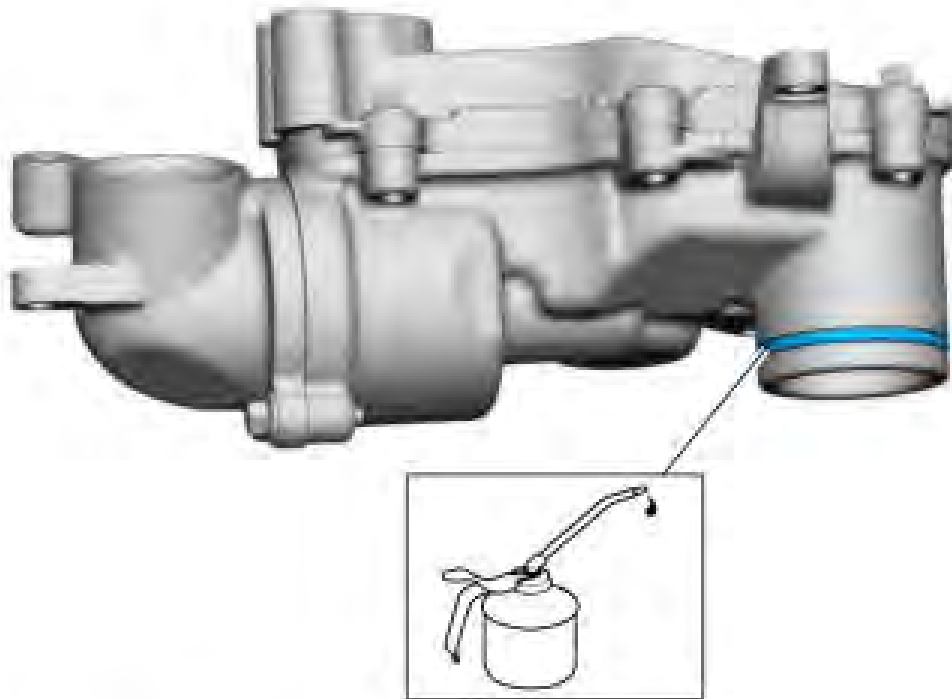
Torque: 89 lb.in (10 Nm)



160. Install a new O-ring seal and lubricate.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

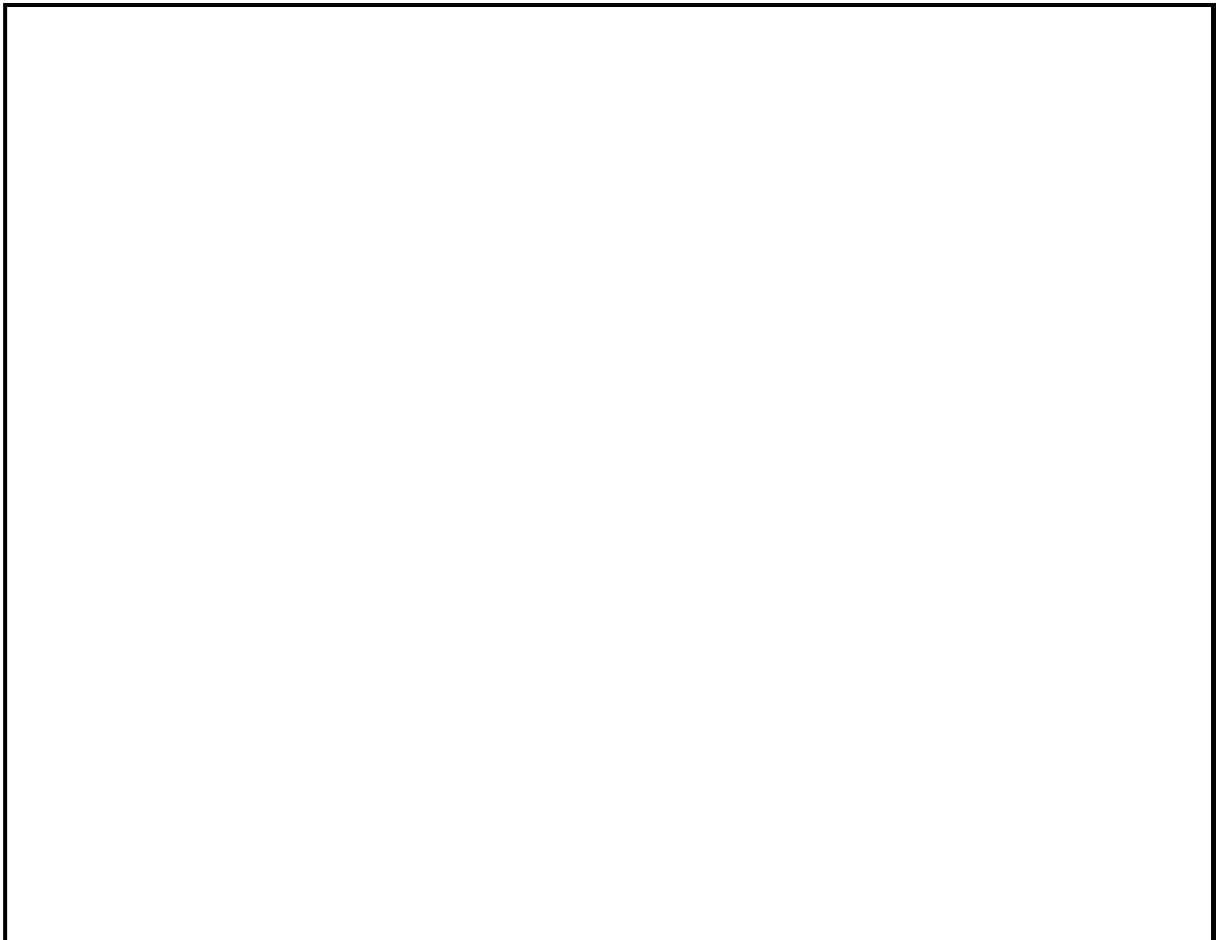


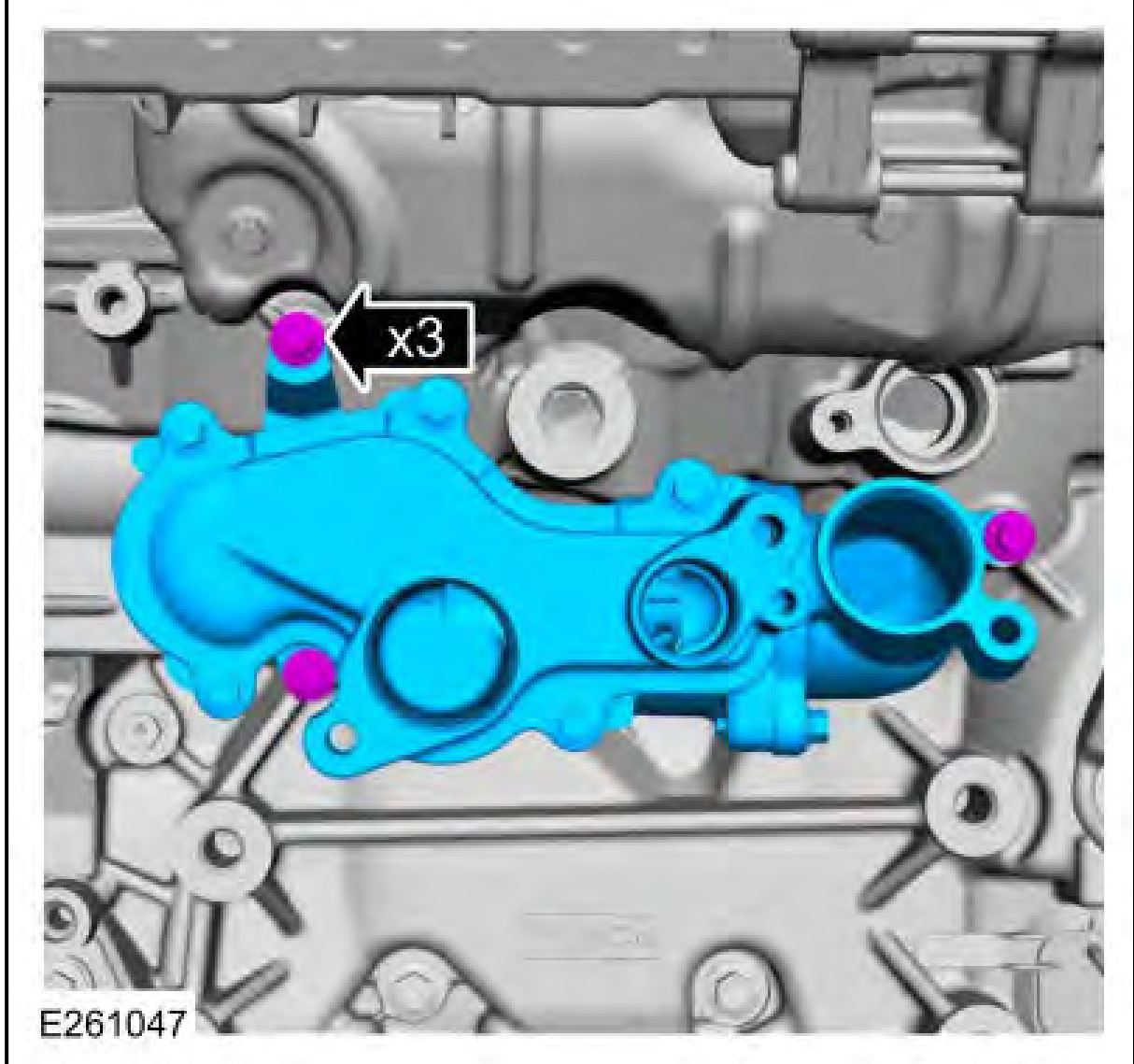


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161. Install the coolant inlet connector and the bolts.

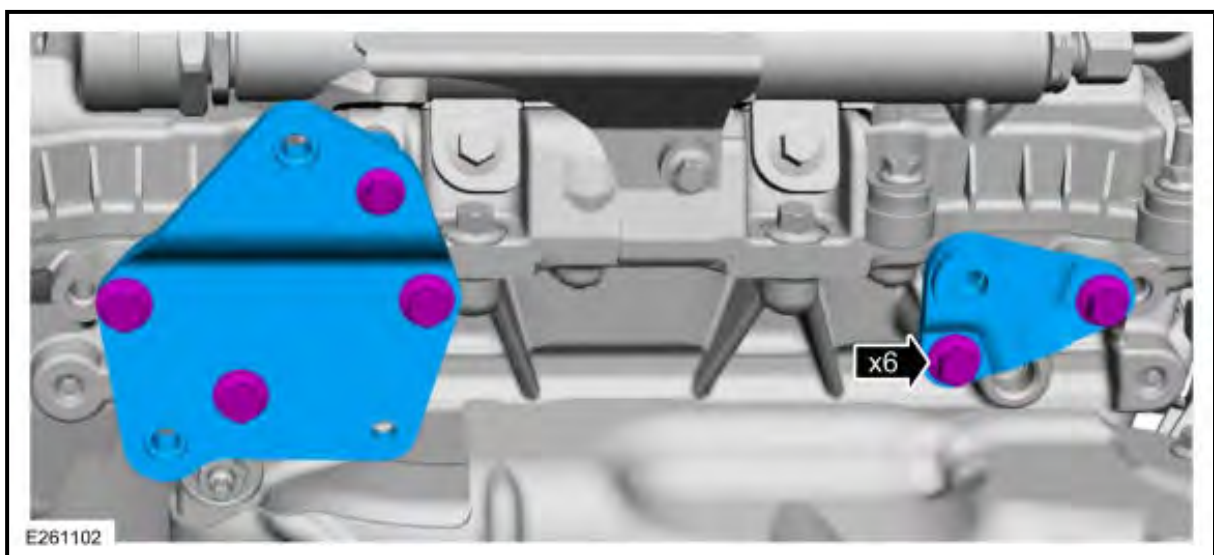
Torque: 89 lb.in (10 Nm)





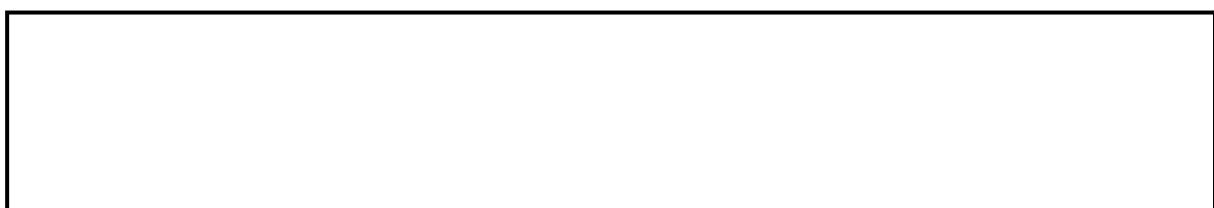
162. Install the EGR cooler brackets and the bolts.

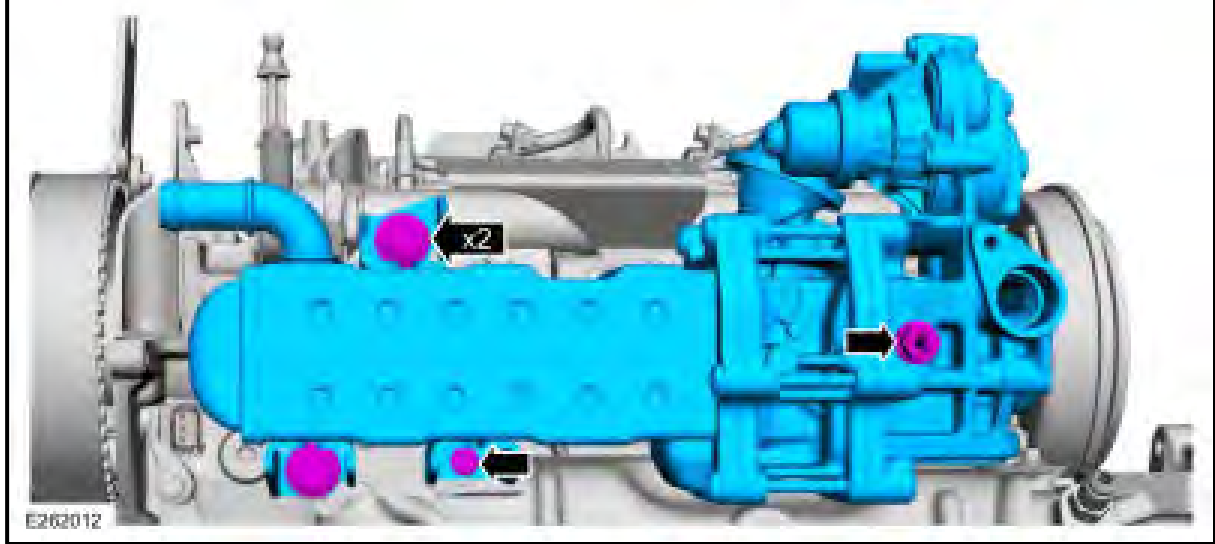
Torque: 89 lb.in (10 Nm)



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

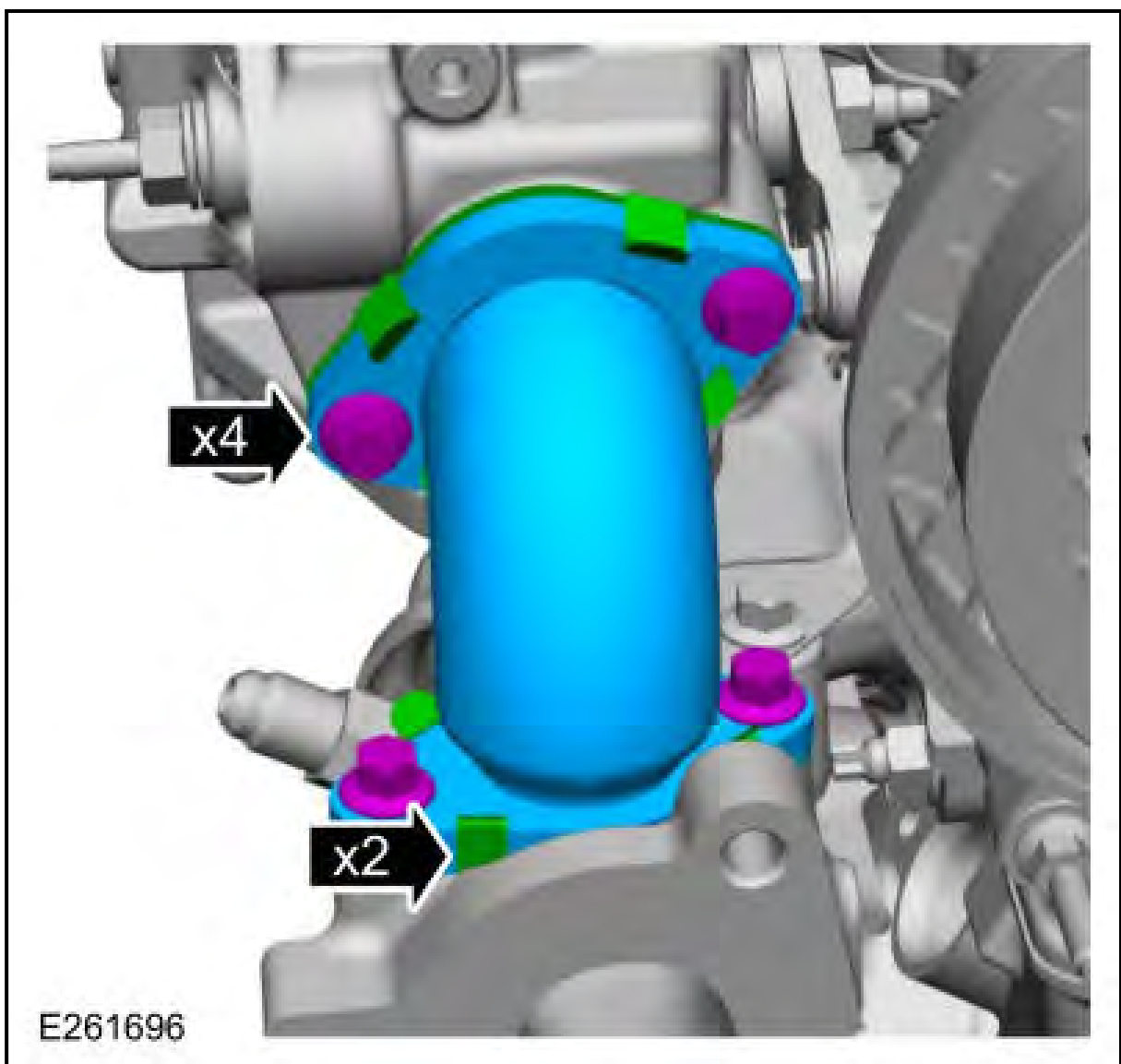
Install the EGR cooler and the bolts.





164. Using new gaskets, install the EGR cooler-to-exhaust manifold pipe and the bolts.

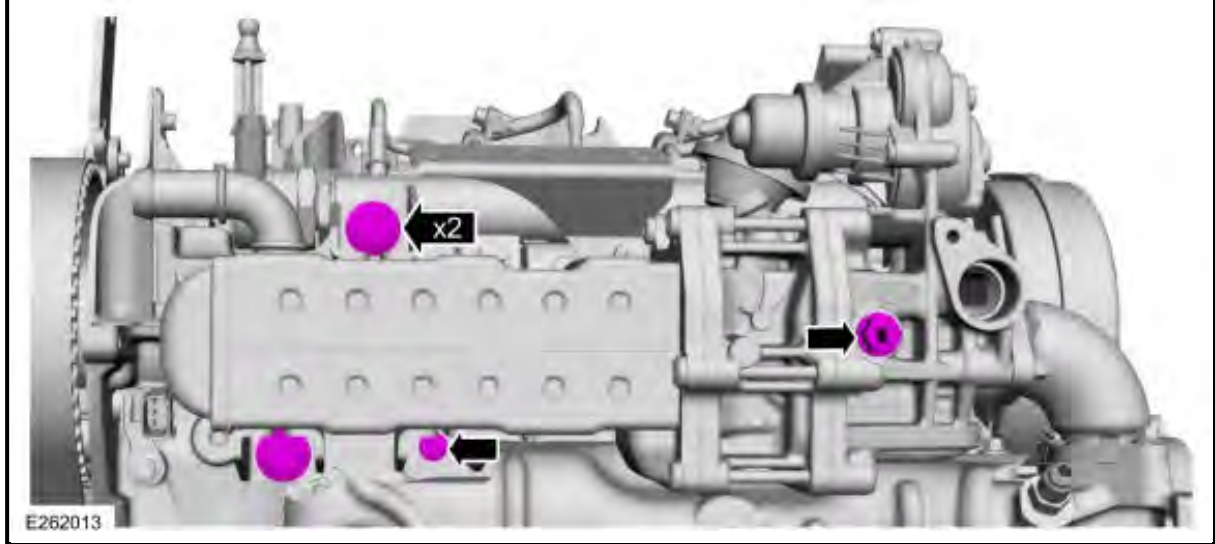
Torque: 89 lb.in (10 Nm)



165. Tighten the EGR cooler bolts.

Torque

:M6 bolt: 89 lb.in (10 Nm) M8 bolt: 17 lb.ft (23 Nm)



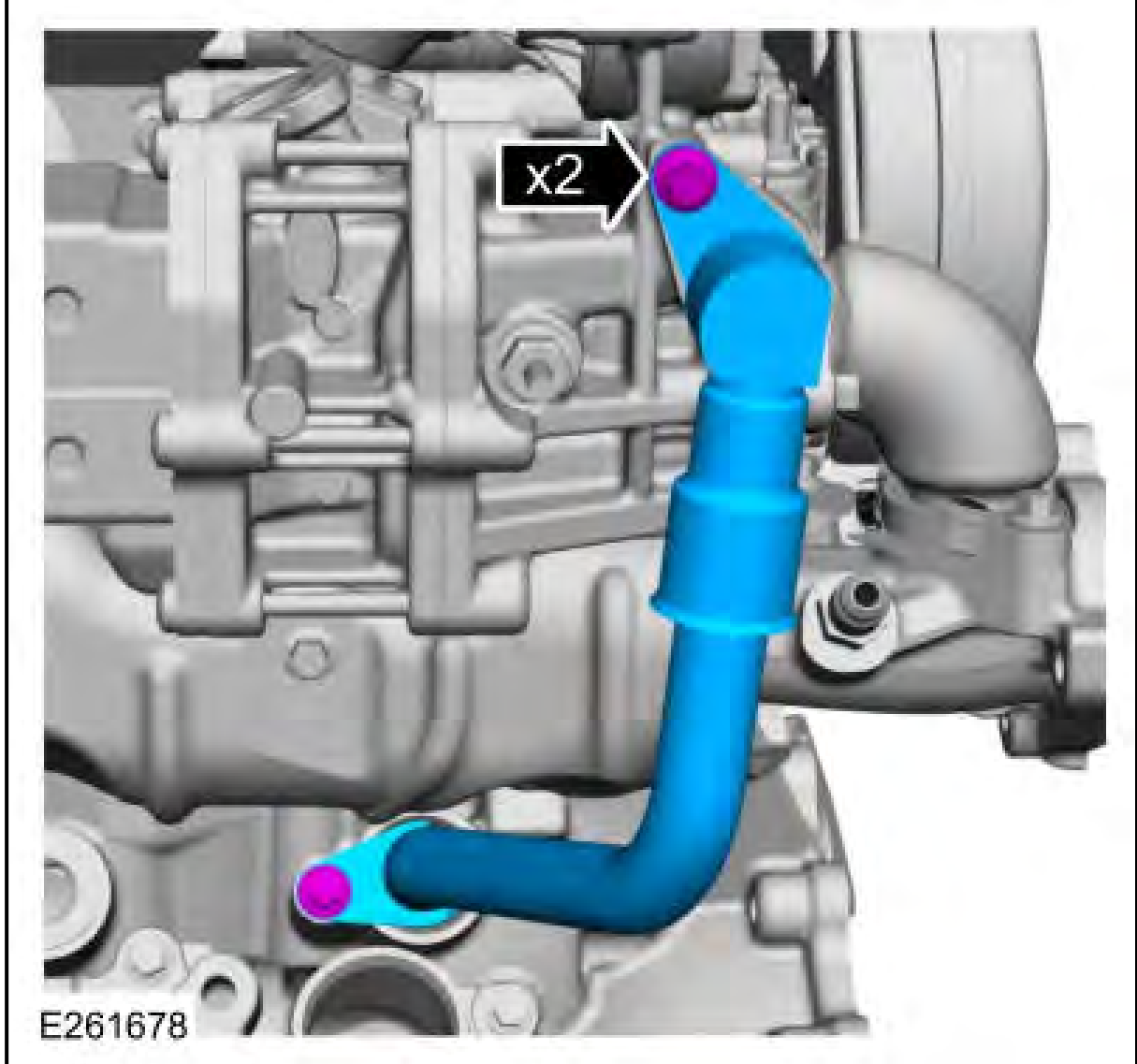
166. Install O-rings on the EGR cooler coolant tube and lubricate.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)



167. Install the EGR cooler coolant tube and the bolts.

Torque: 89 lb.in (10 Nm)



168. **NOTE:** Lubricate the O-ring seal prior to installing the oil level indicator tube.

- Install the oil level indicator tube, the stud bolt and the bolt.

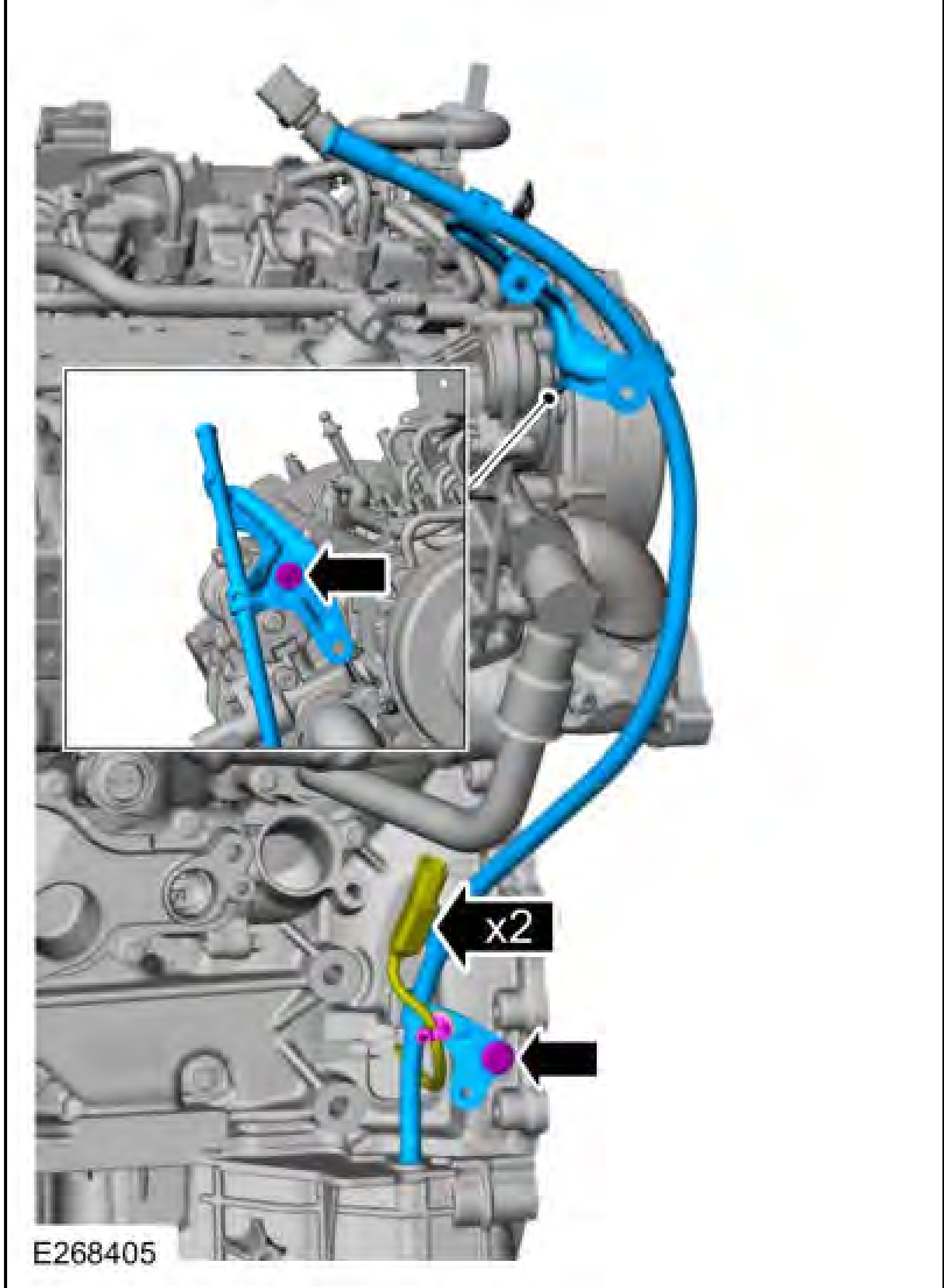
Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque

:M6 stud bolt: 89 lb.in (10 Nm) M8 bolt: 17 lb.ft (23 Nm)

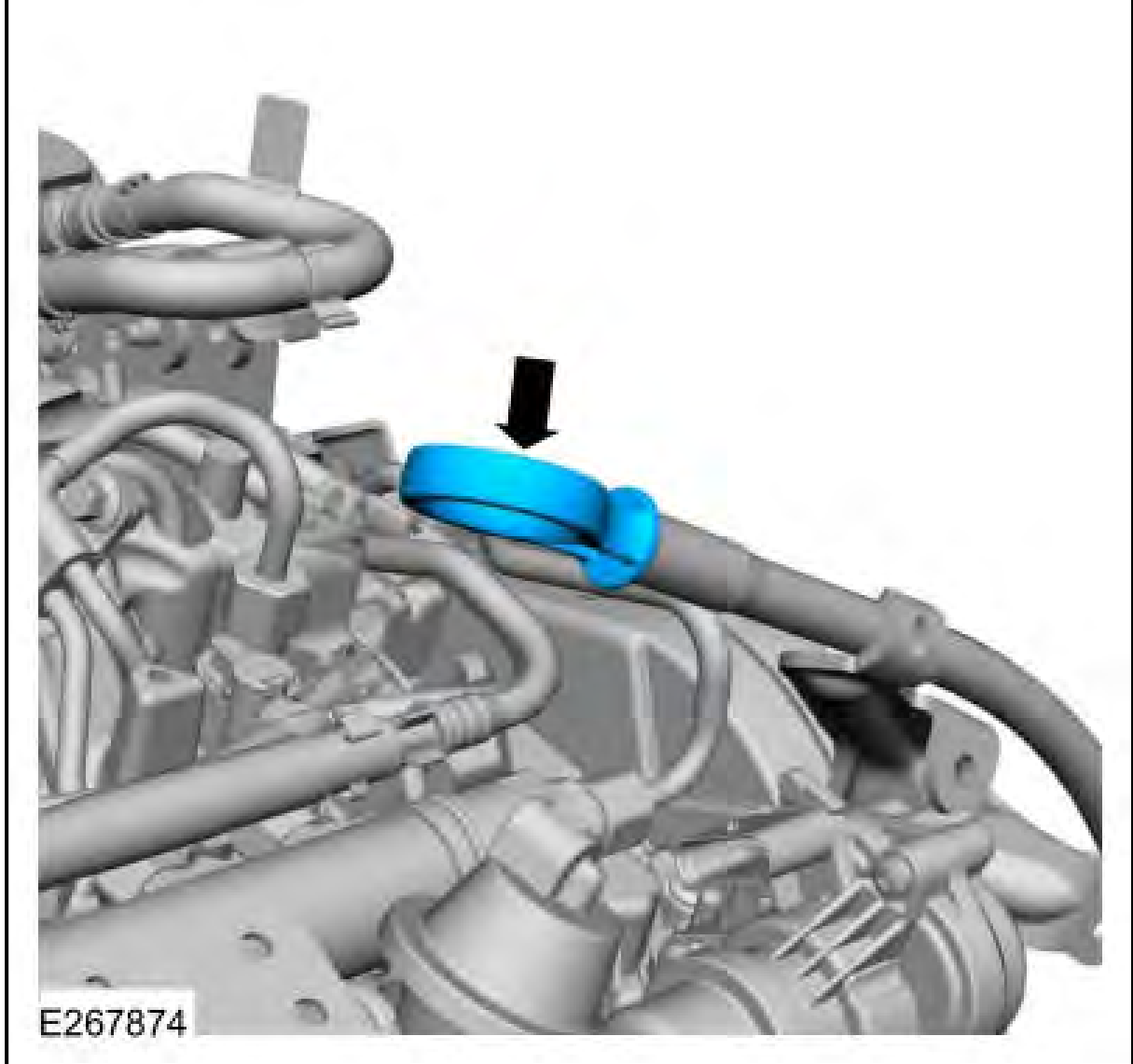
- Connect the wire retainers to the oil level indicator tube.





169. Install the oil level indicator.

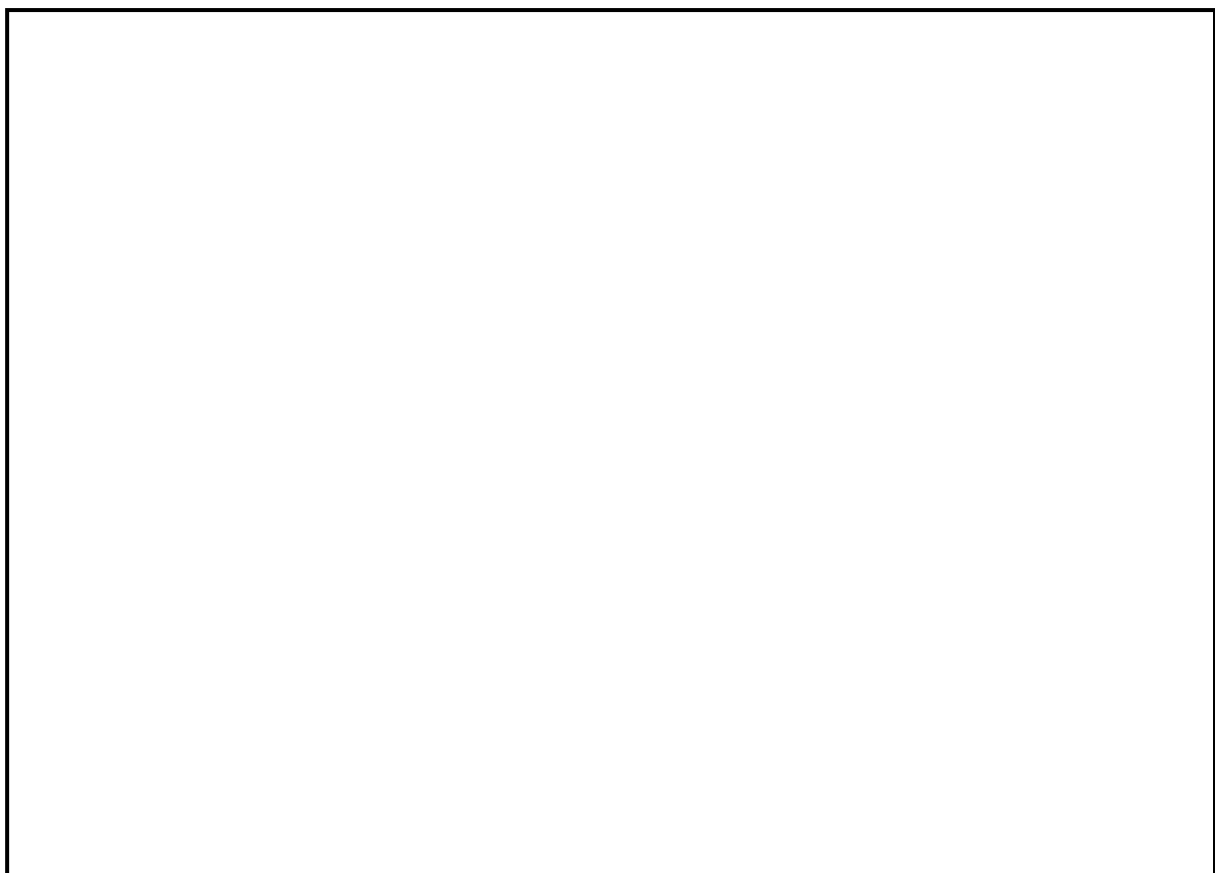


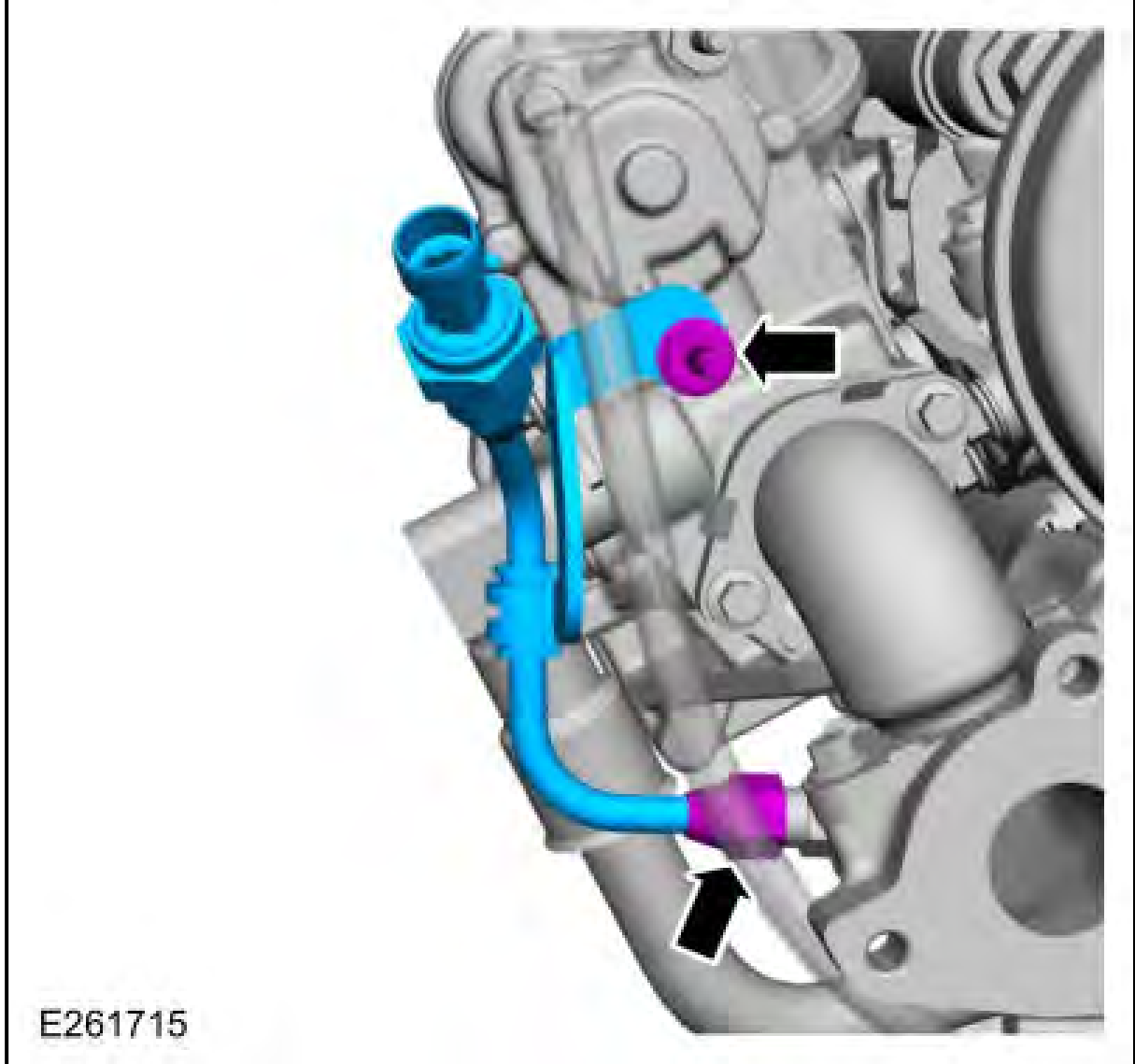


170. Install the EP (exhaust pressure) sensor tube and hand start the tube nut. Install the stud bolt.

Torque

:M6 stud bolt: 89 lb.in (10 Nm) Tube nut : 177 lb.in (20 Nm)

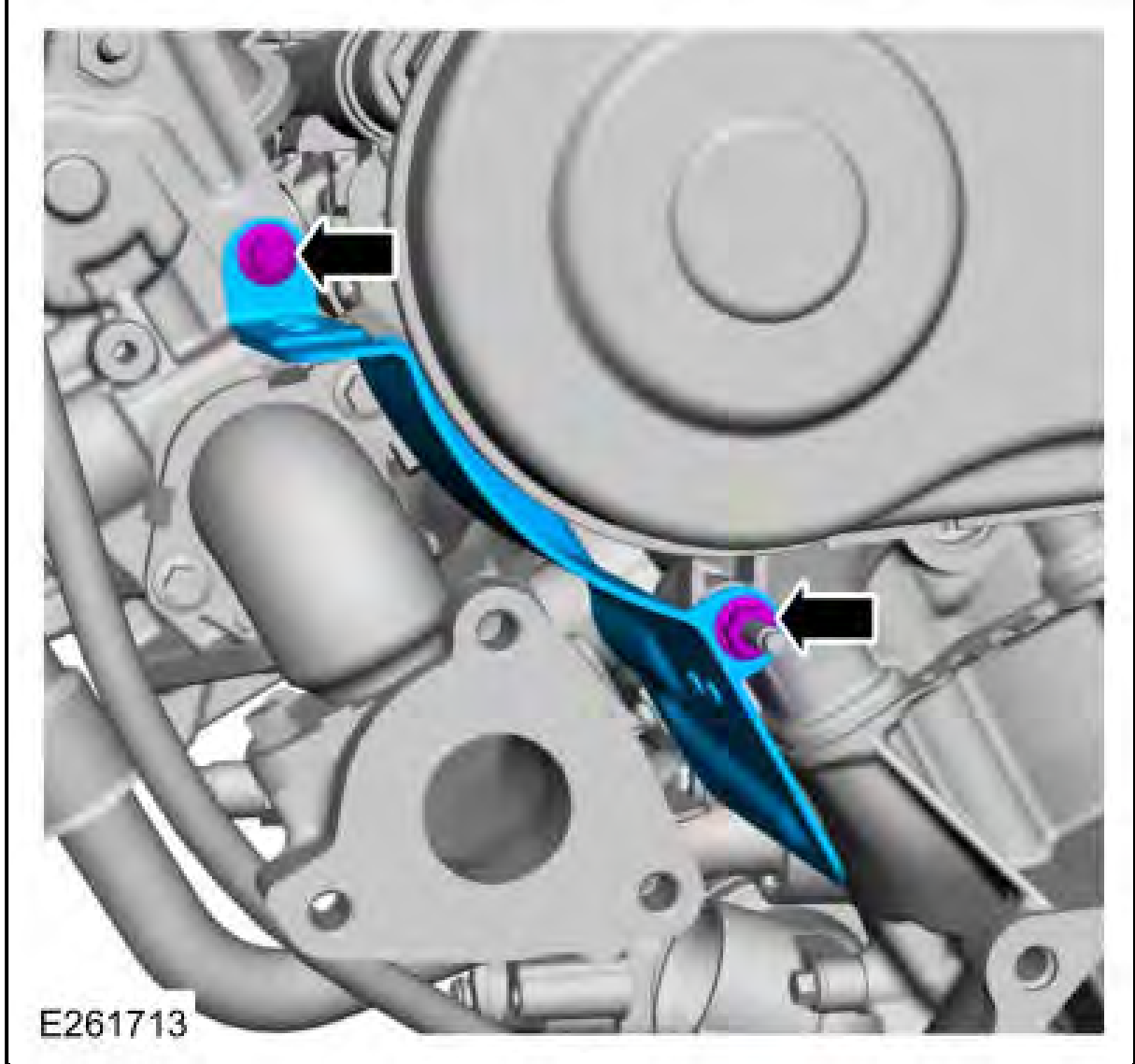




171. Install the LH exhaust manifold shield, the nut and the bolt.

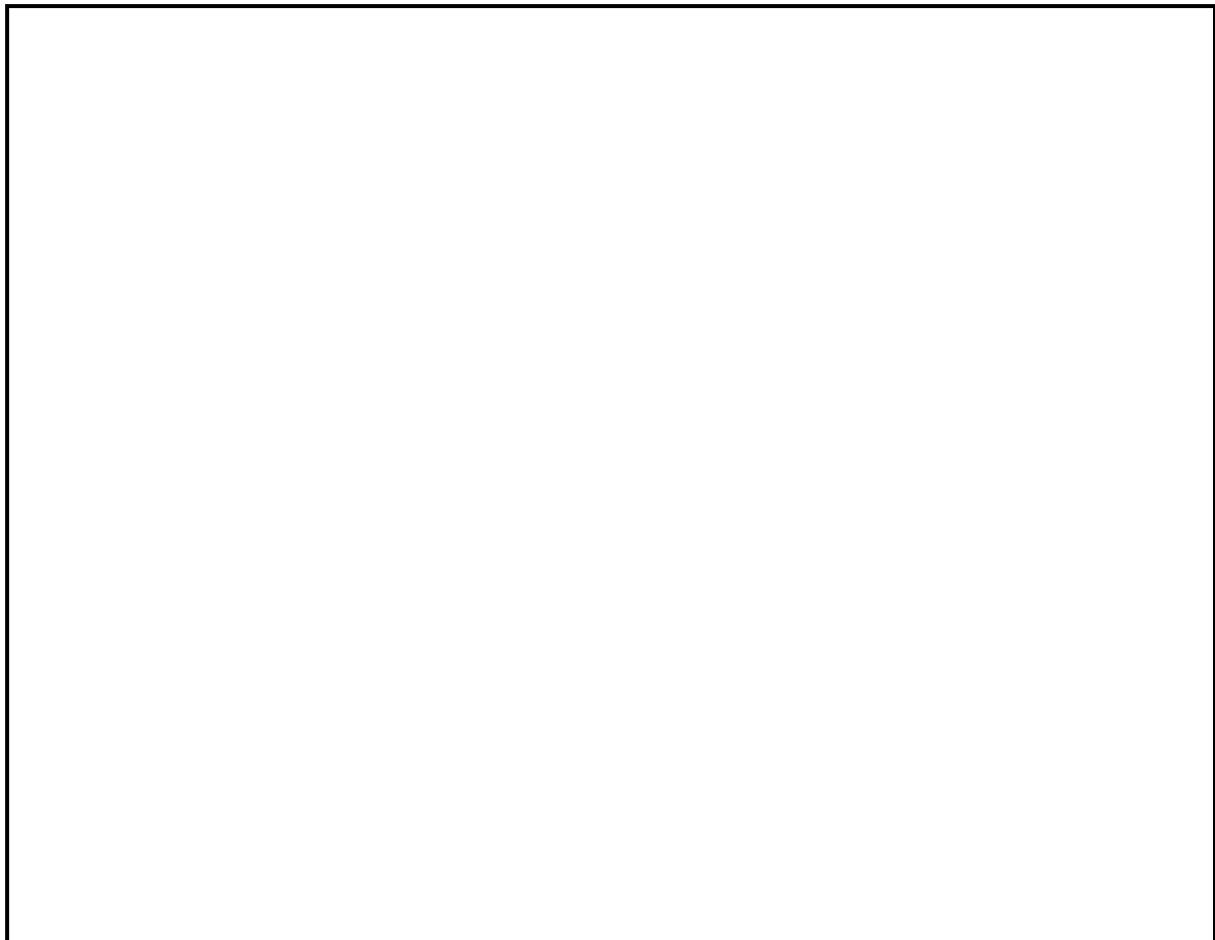
Torque: 89 lb.in (10 Nm)

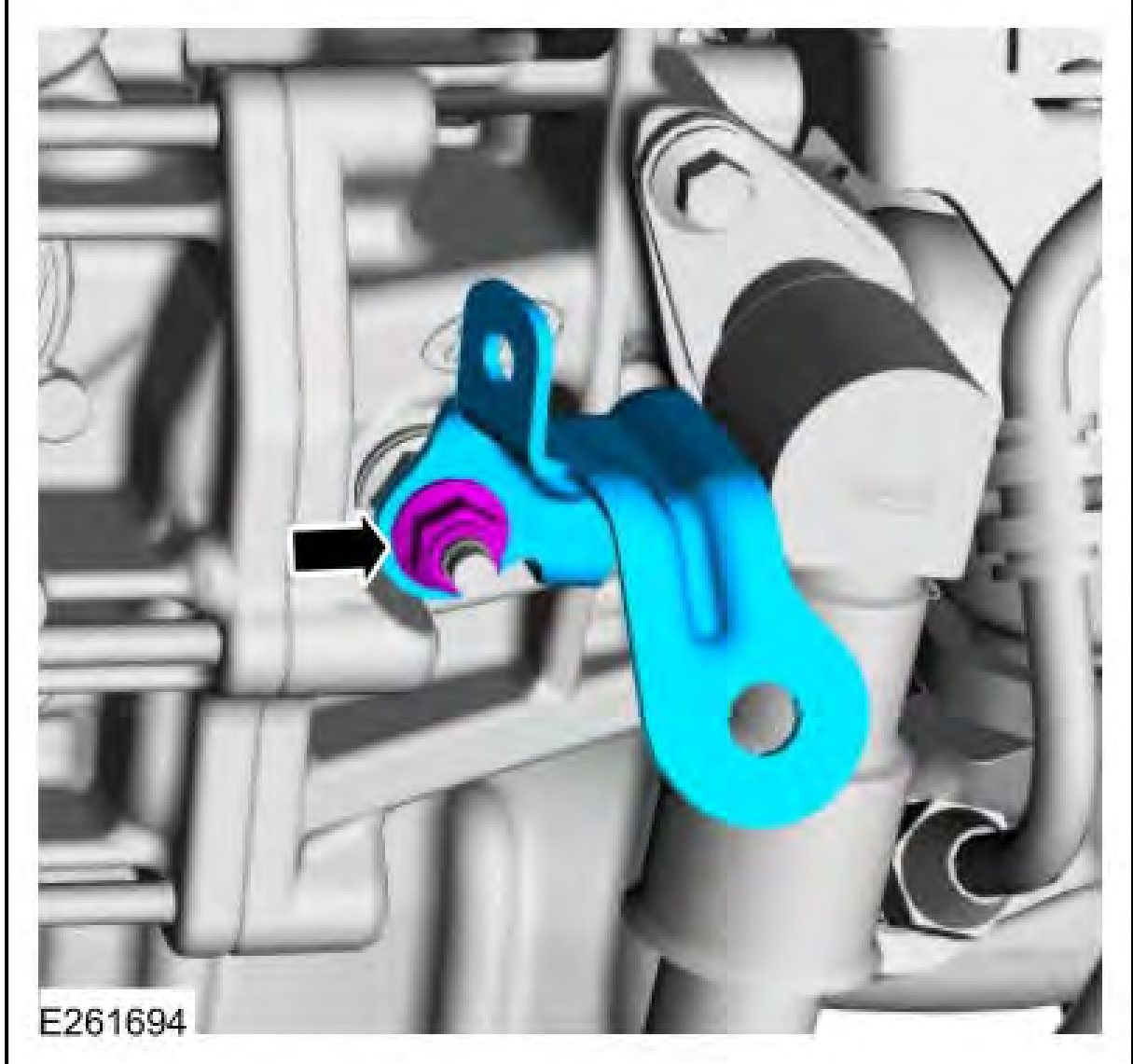




172. Install the fuel tube front support bracket and the nut.

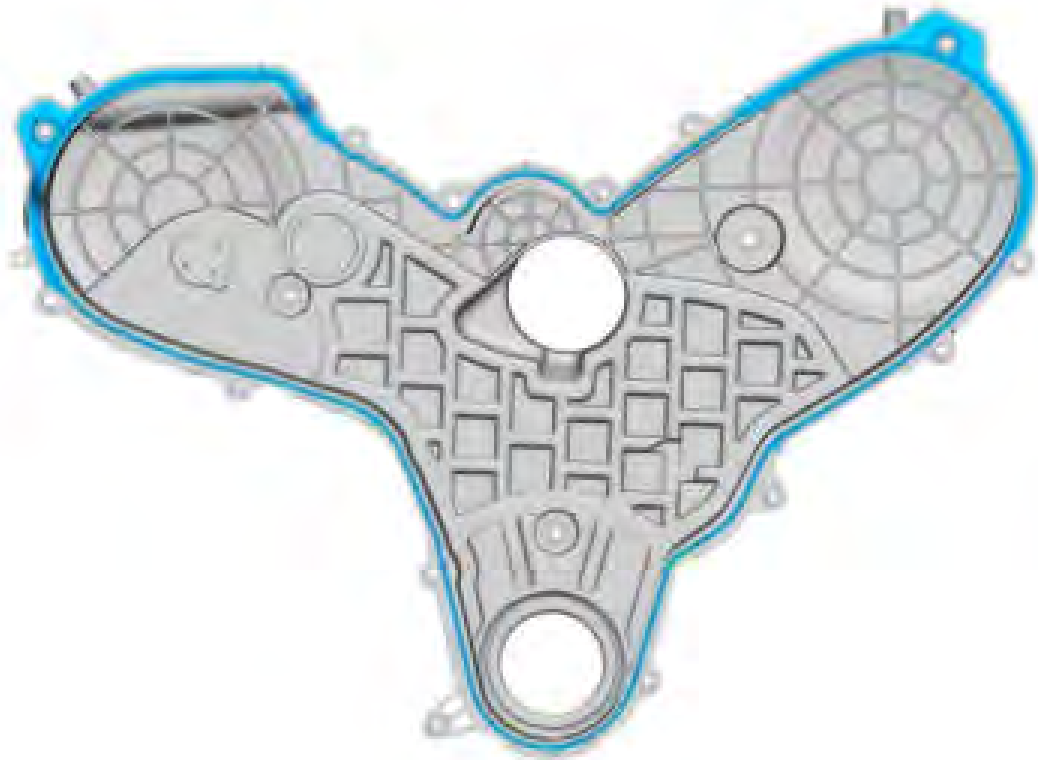
Torque: 89 lb.in (10 Nm)





173. Install a new timing belt cover gasket.

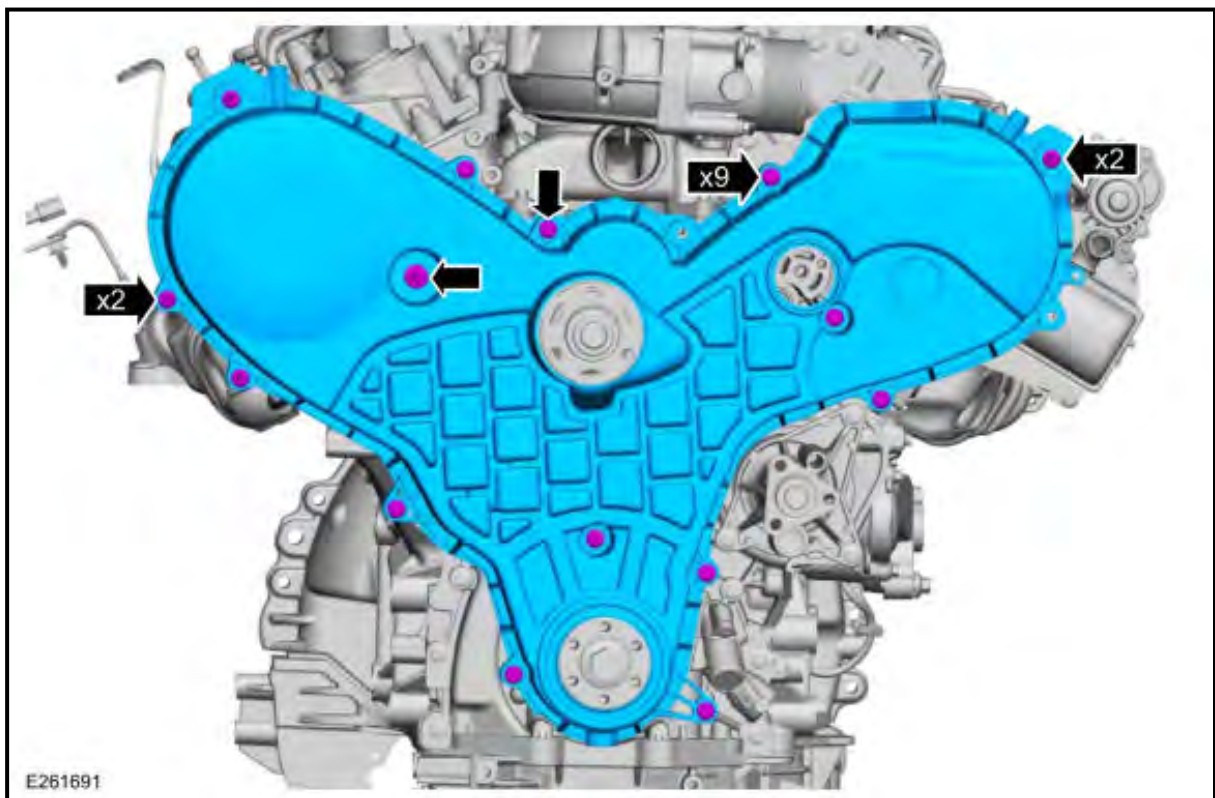




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174. Install the timing belt cover, the stud bolts and the bolts.

Torque: 89 lb.in (10 Nm)



175.

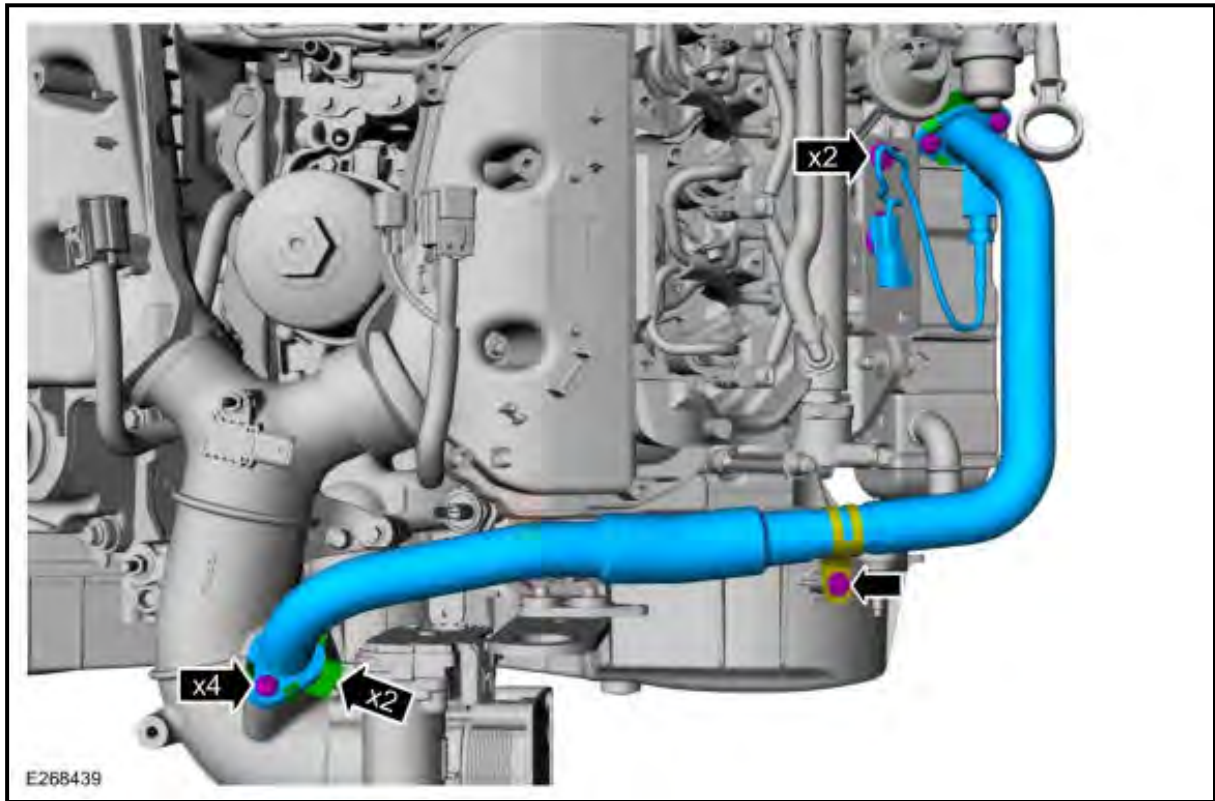
- Using new gaskets, install the EGR outlet tube and the bolts.

Torque: 89 lb.in (10 Nm)

- Install the retainer in the timing belt cover.

Torque: 31 lb.in (3.5 Nm)

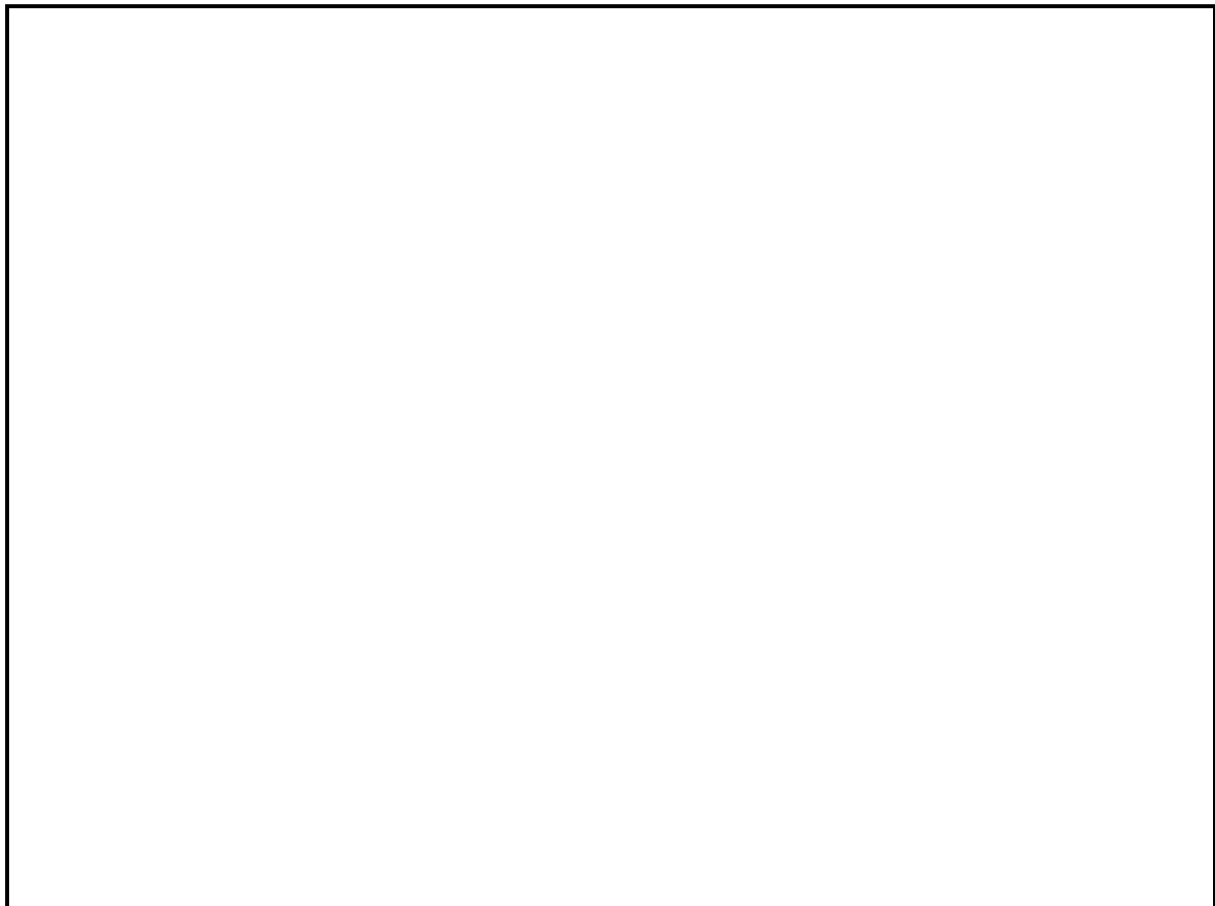
- Connect the wire retainers.

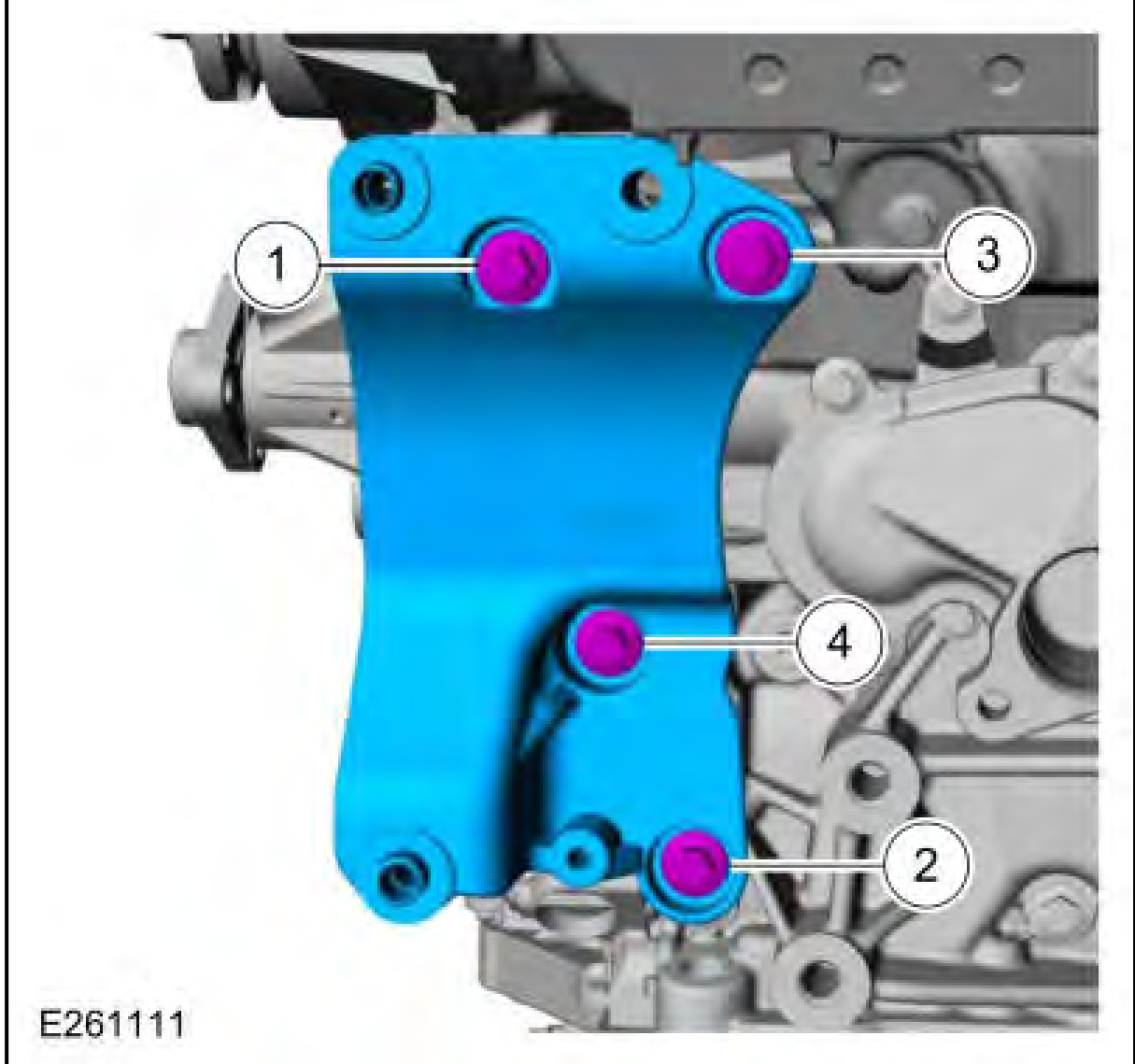


176. Install the generator mounting bracket and the bolts.

Torque

:Install and tighten bolts 1 and 2 to : 17 lb.ft (23 Nm) Install and tighten bolts 3 and 4 to : 17 lb.ft (23 Nm)





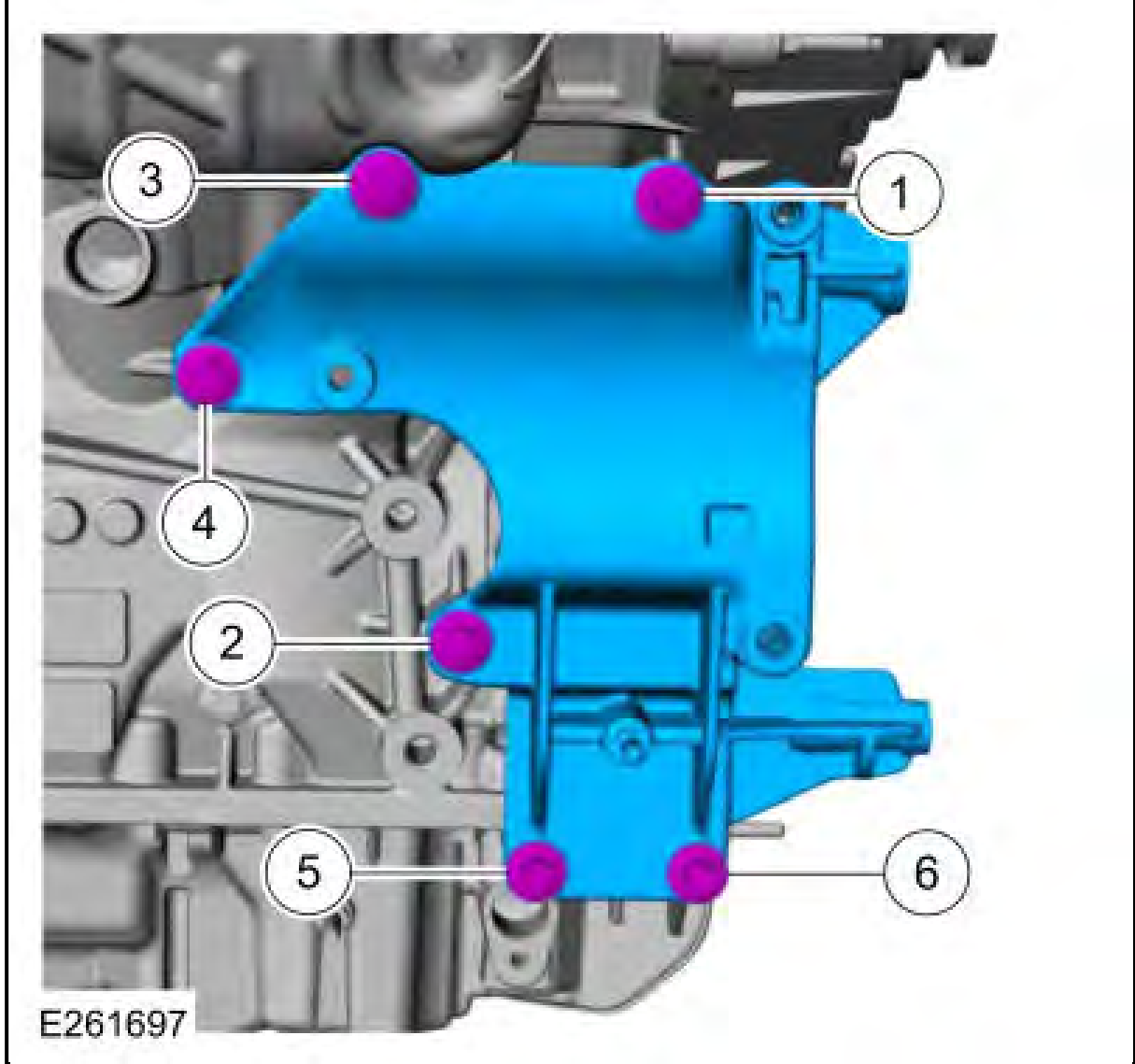
177. Install the A/C mounting bracket and the bolts.

Torque

:Install and tighten bolts 1 and 2 to: : 17 lb.ft (23 Nm)Install and tighten bolts 3 and 4 to: : 17 lb.ft (23 Nm)Install and tighten bolts 5 and 6 to: : 17 lb.ft (23 Nm)



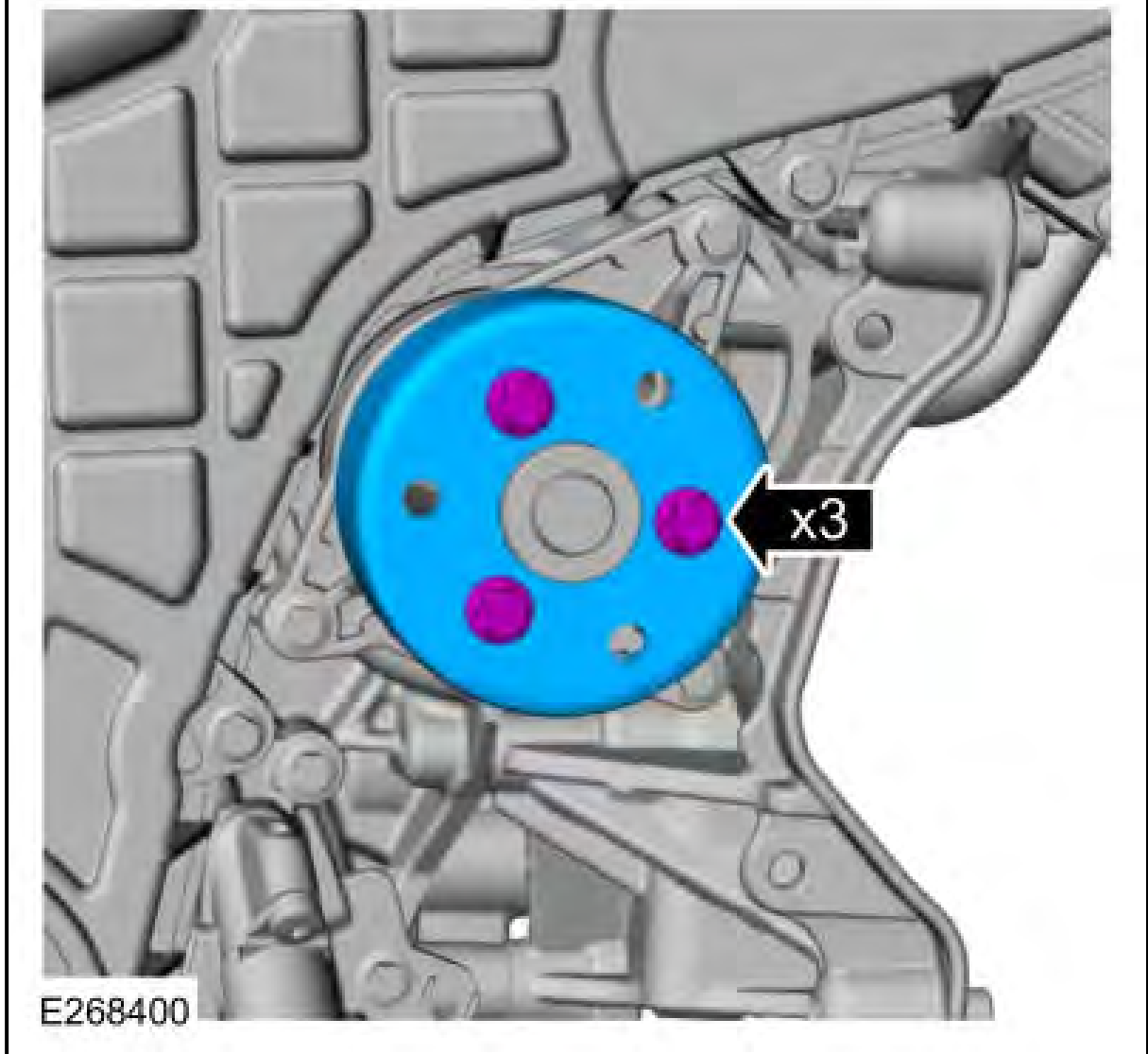




178. Install the coolant pump pulley and the bolts.

Torque: 18 lb.ft (25 Nm)

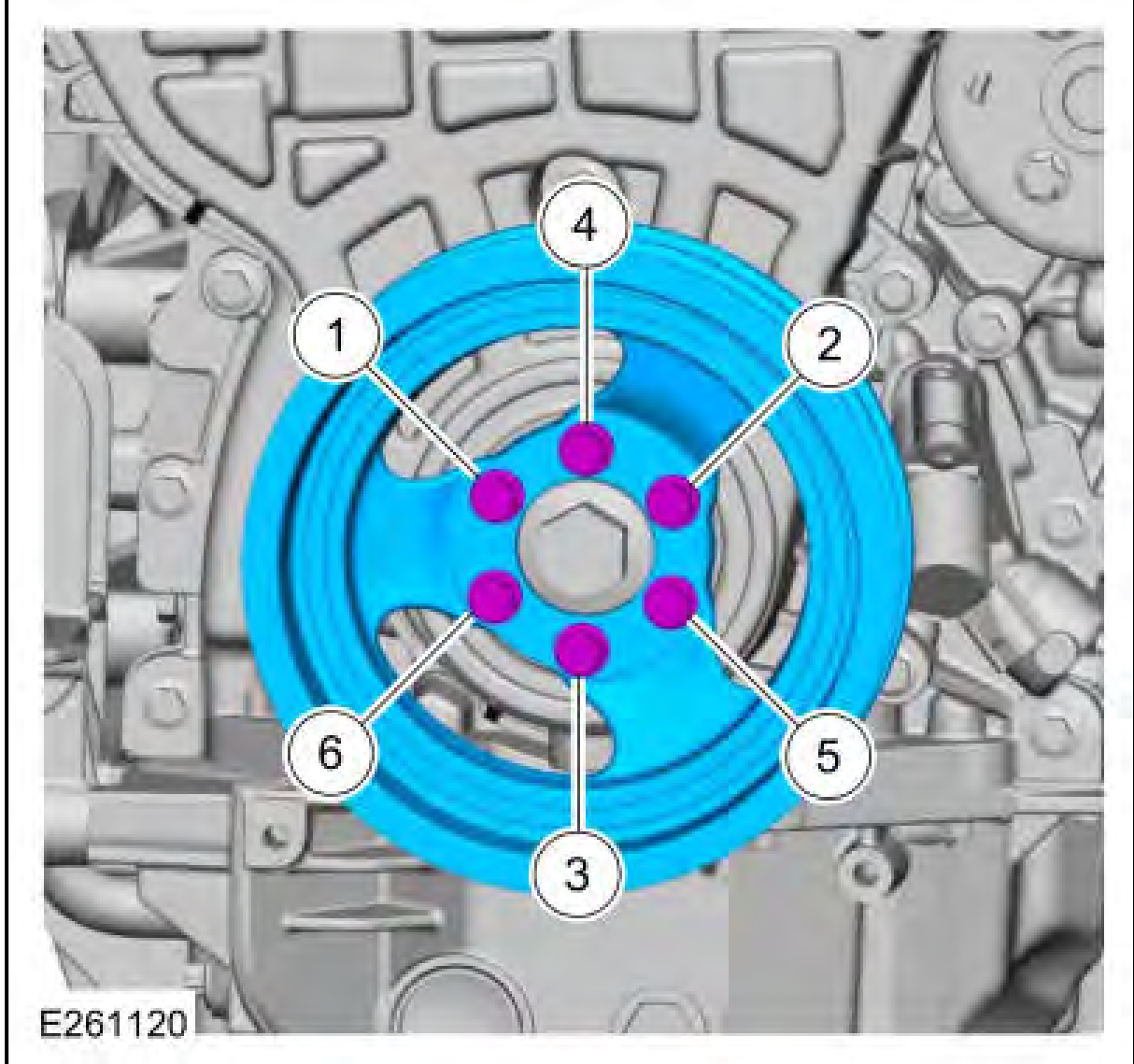




179. Install the crankshaft vibration damper and the bolts.

Torque: 18 lb.ft (25 Nm)

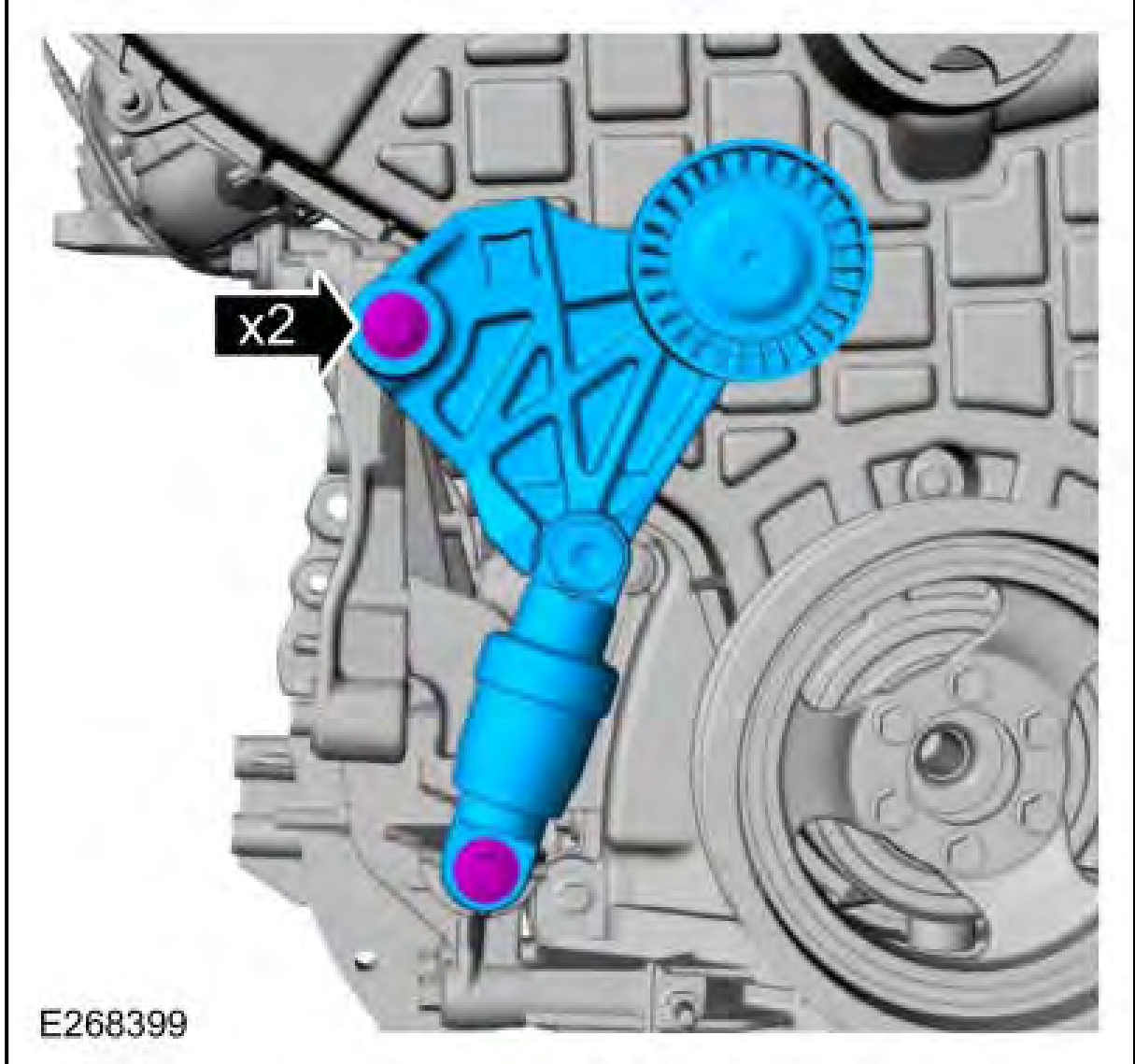




180. Install the accessory drive belt tensioner and the bolts.

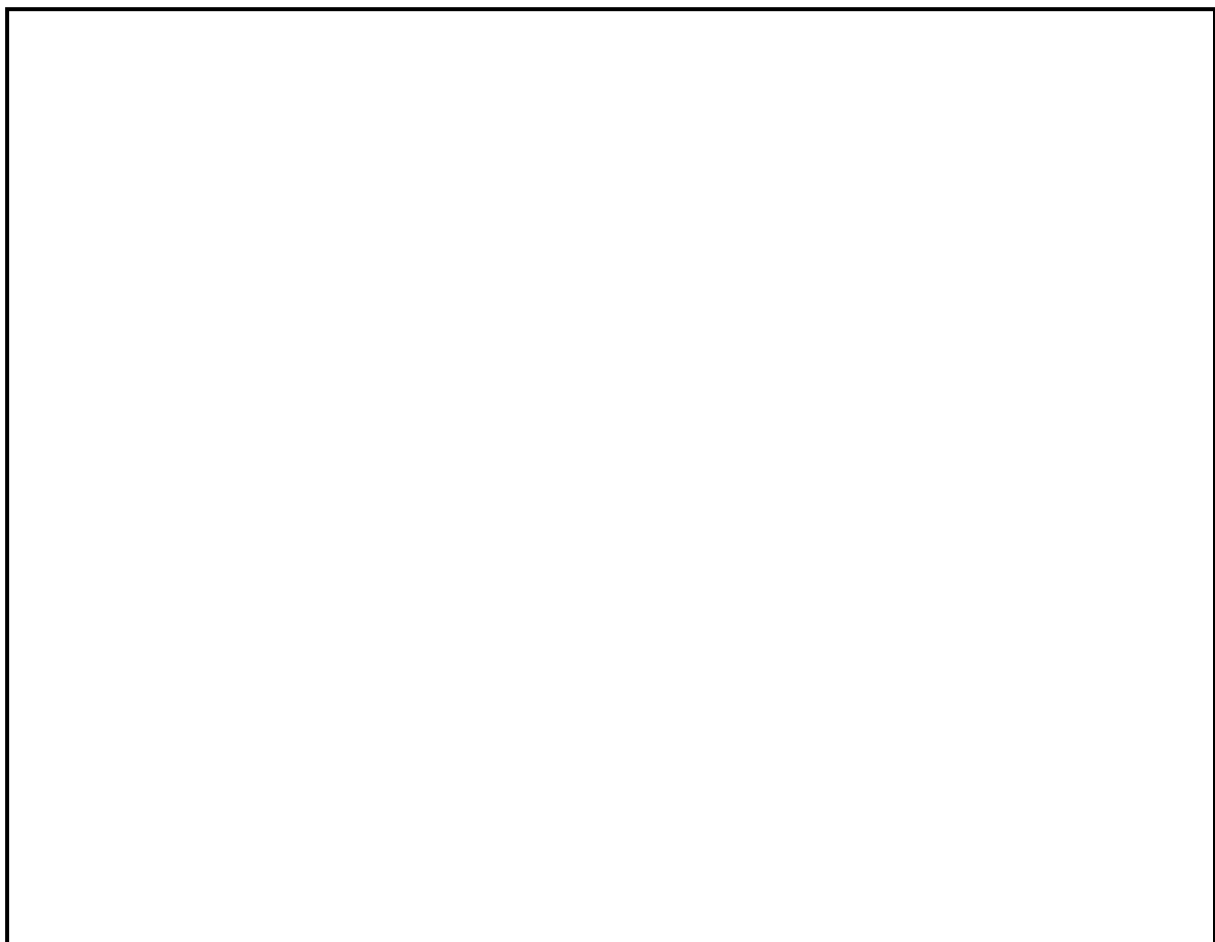
Torque: 18 lb.ft (25 Nm)

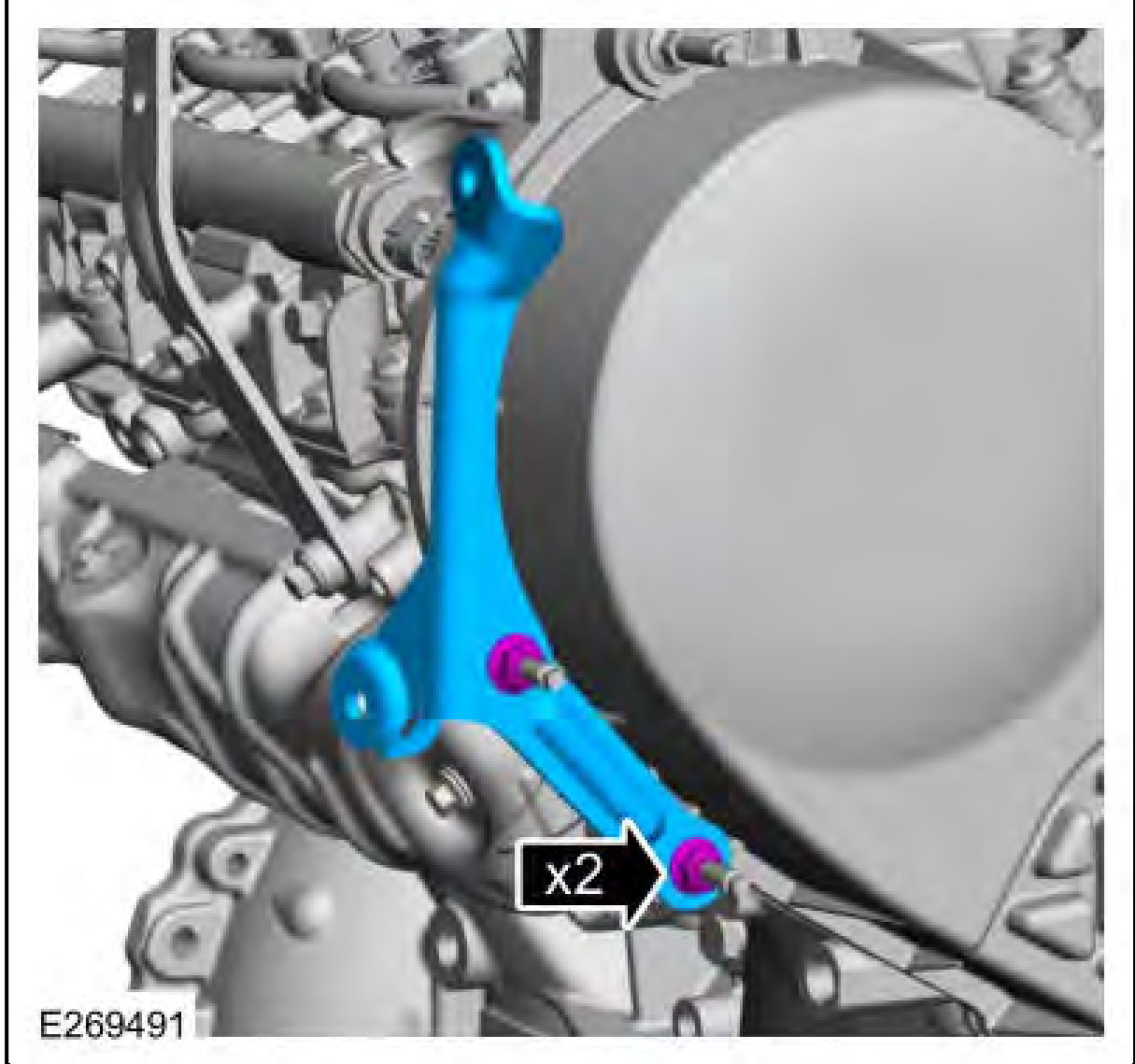




181. Install the CAC bracket and the nuts.

Torque: 53 lb.in (6 Nm)

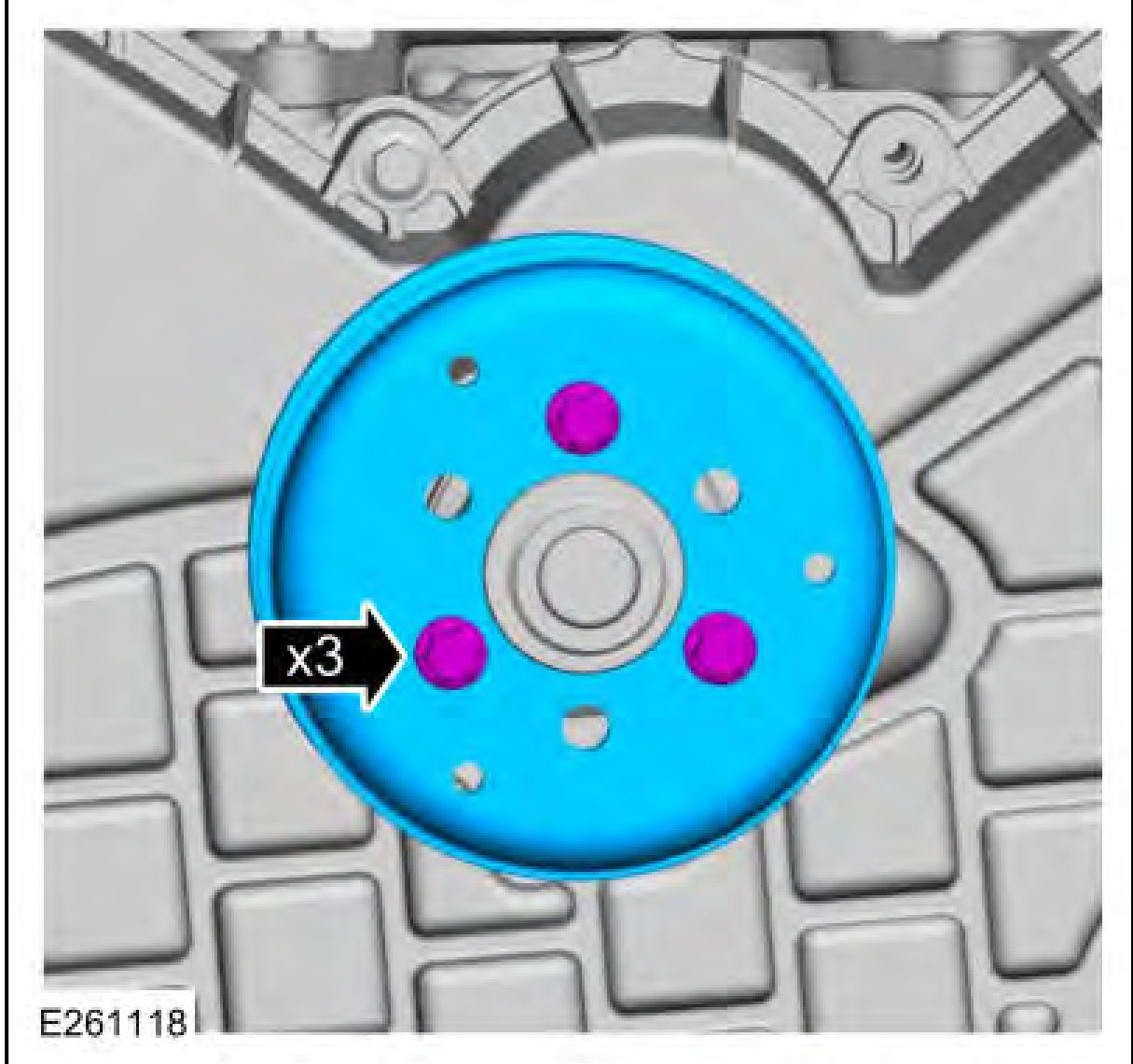




182. Install the fan pulley and the bolts.

Torque: 18 lb.ft (25 Nm)

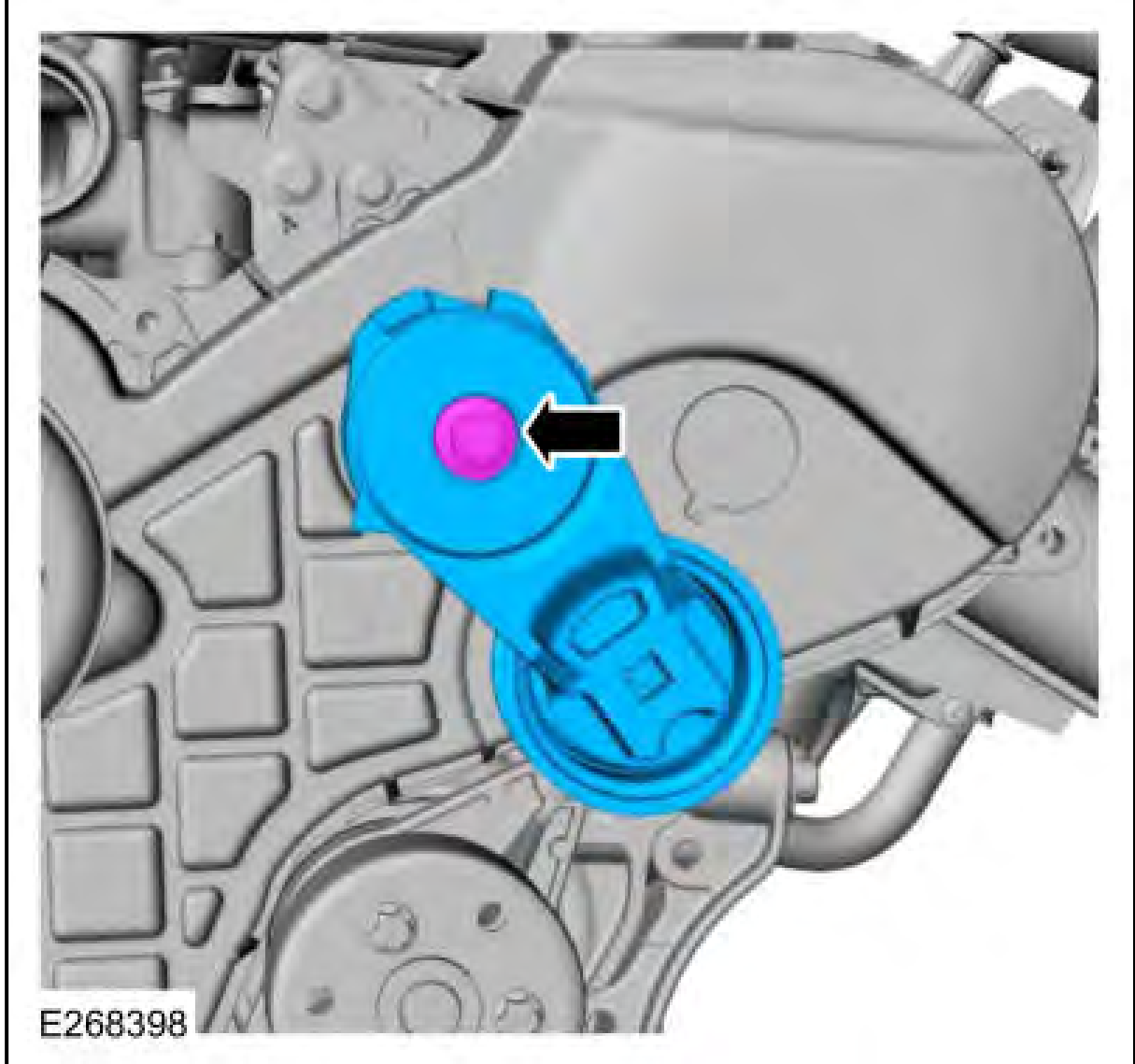




183. Install the accessory drive belt tensioner and the bolt.

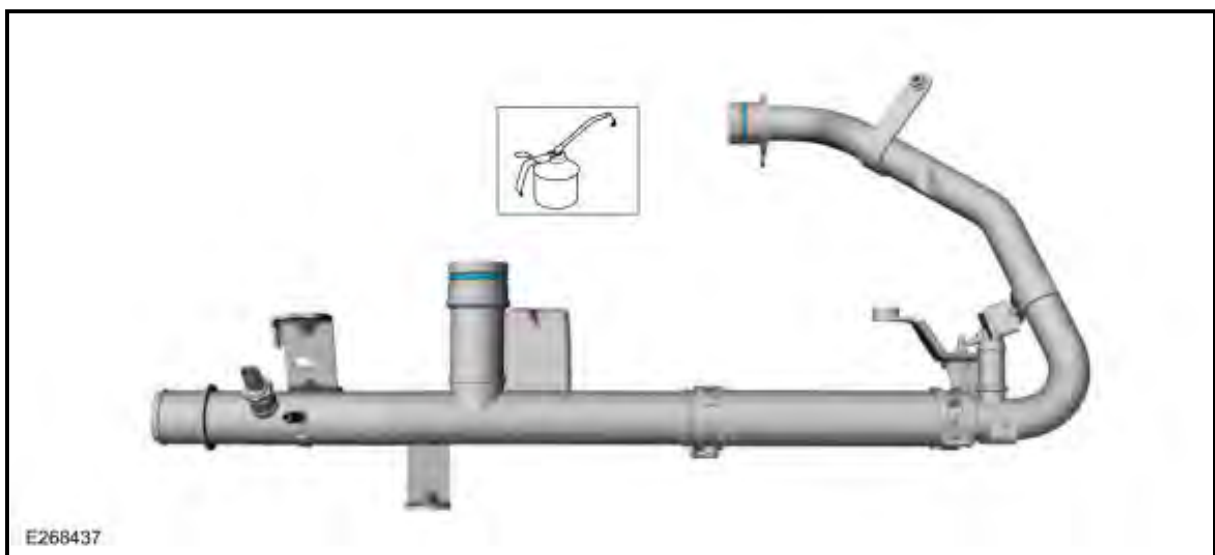
Torque: 35 lb.ft (48 Nm)





184. Install the coolant tube assembly O-rings and lubricate.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

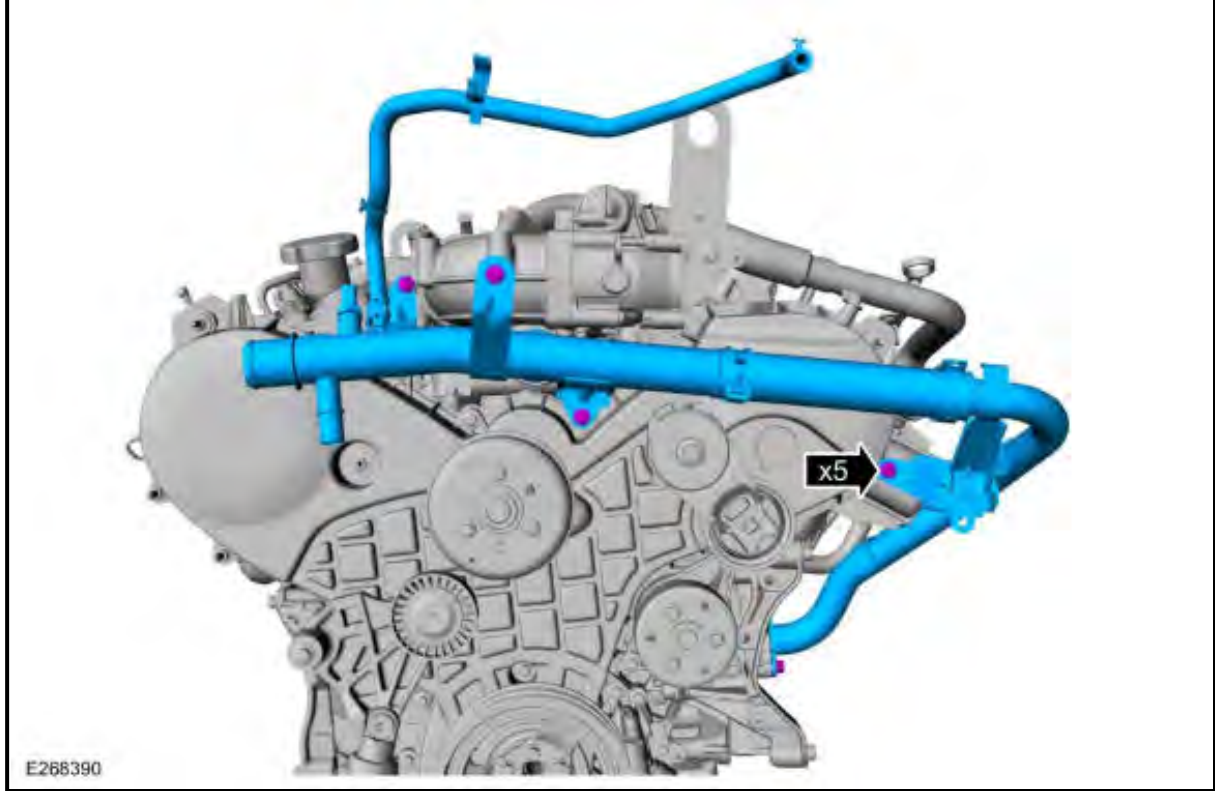


185. Install the coolant tube assembly and the bolts.

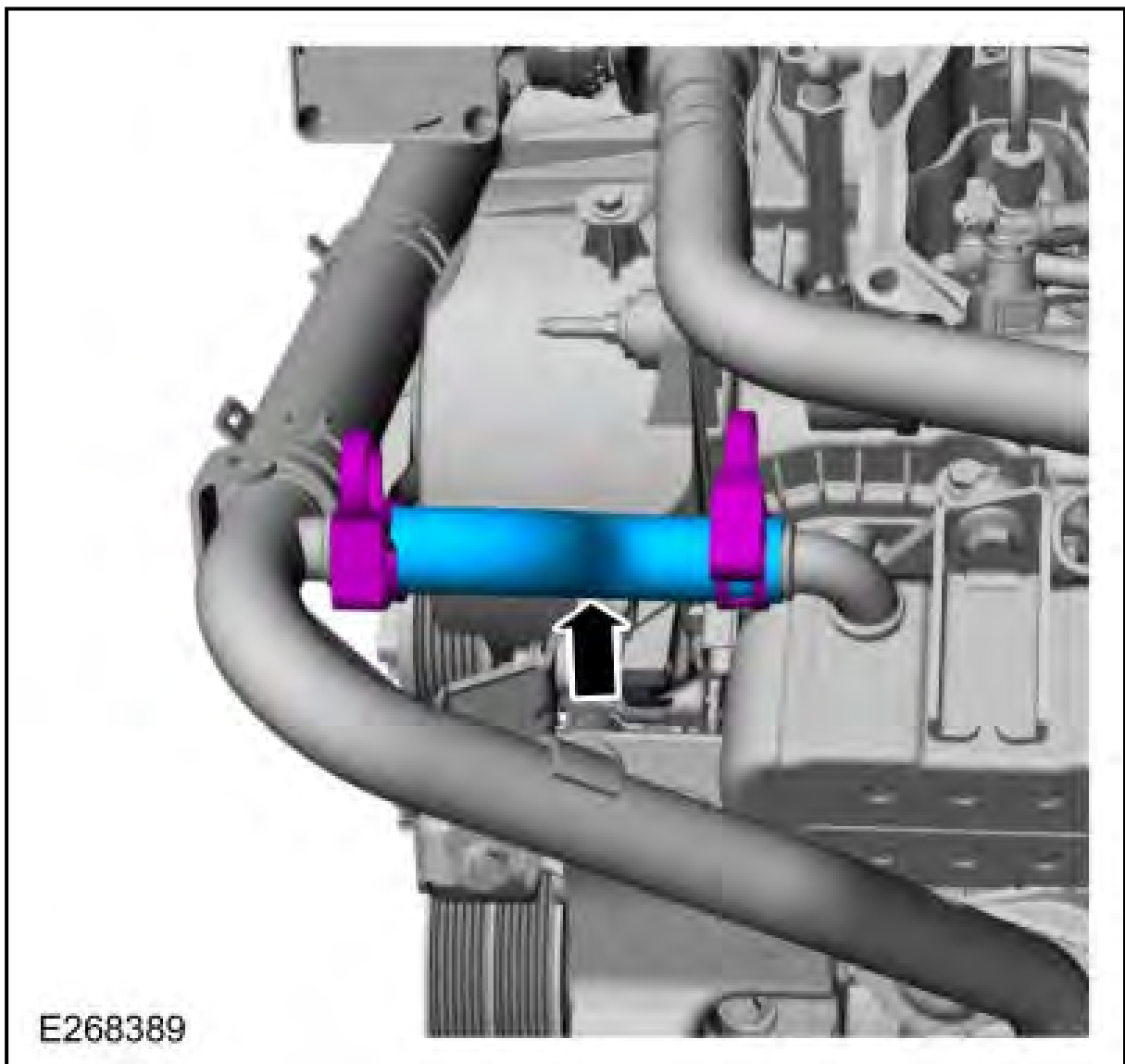
Torque

:M6 bolt: 89 lb.in (10 Nm) M8 bolt: 18 lb.ft (25 Nm)





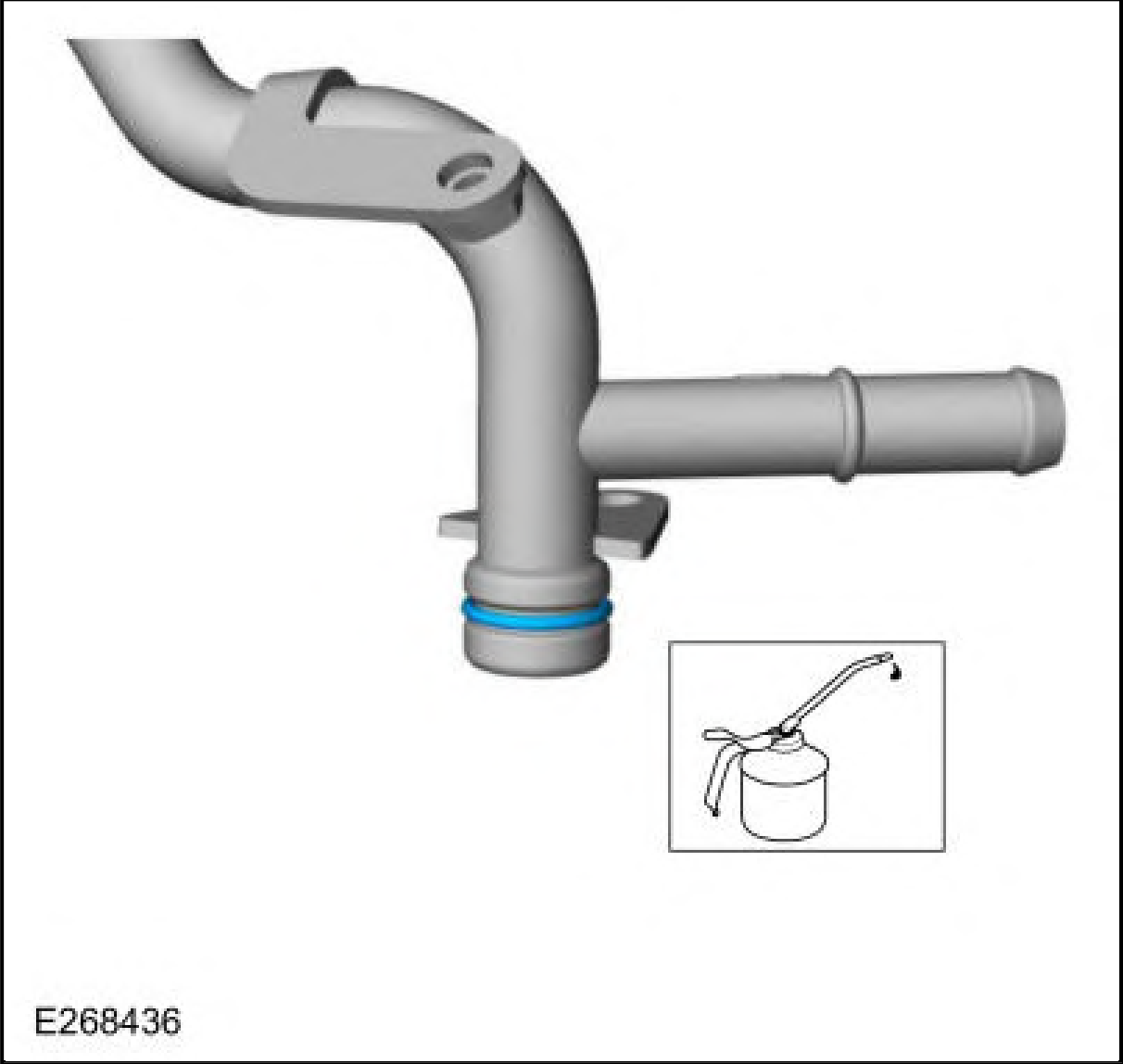
186. Install the EGR cooler coolant hose and the clamps. Use the General Equipment: Hose Clamp Remover/Installer



187. Install the coolant tube O-ring seal and lubricate.

Material: Motorcraft  $\hat{A}$ ® Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)



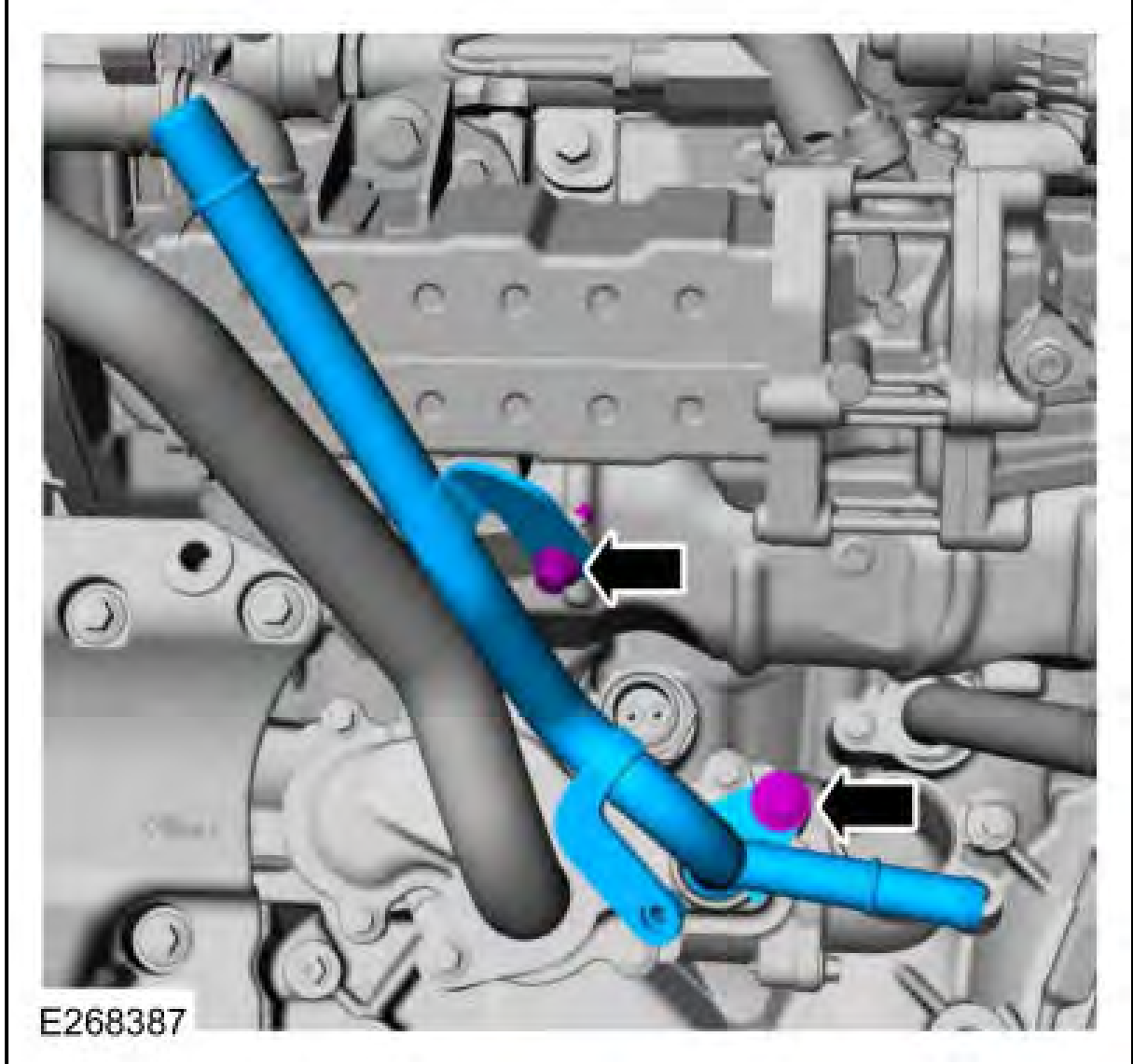


188. Install the coolant tube and the bolts.

Torque

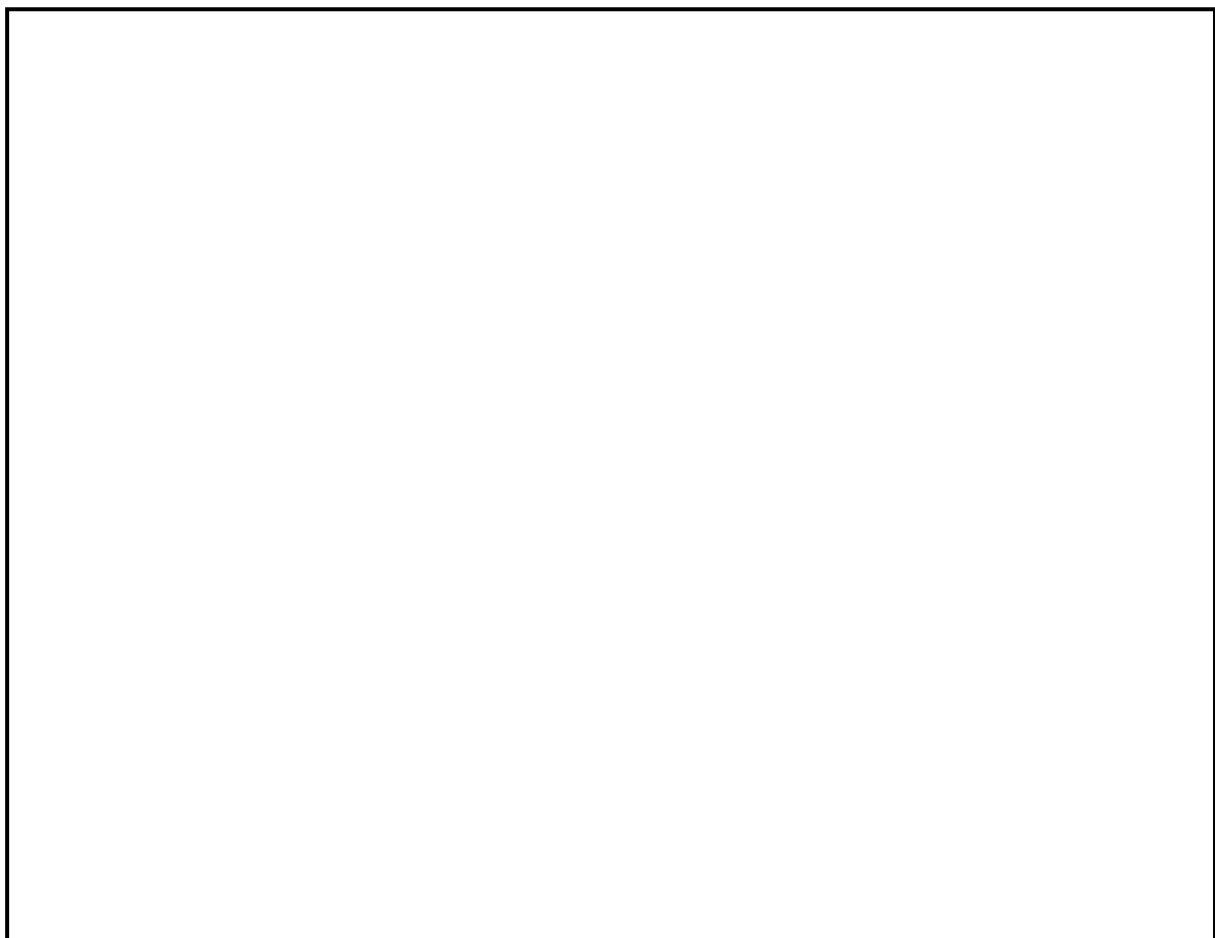
:M6 bolt: 71 lb.in (8 Nm) M8 bolt: 18 lb.ft (25 Nm)

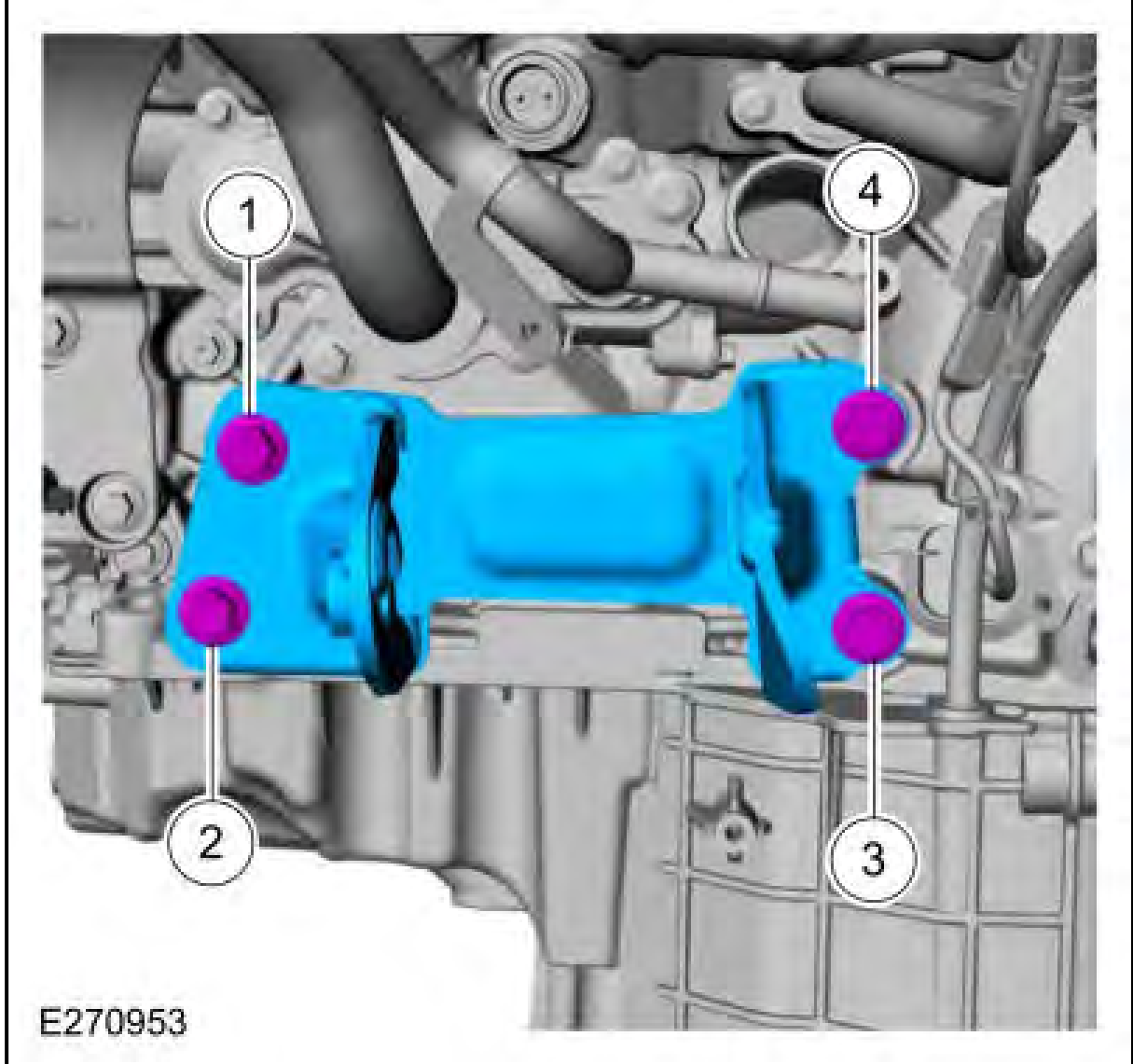




189. Install the LH engine mount bracket and the bolts.

Torque: 76 lb.ft (103 Nm)

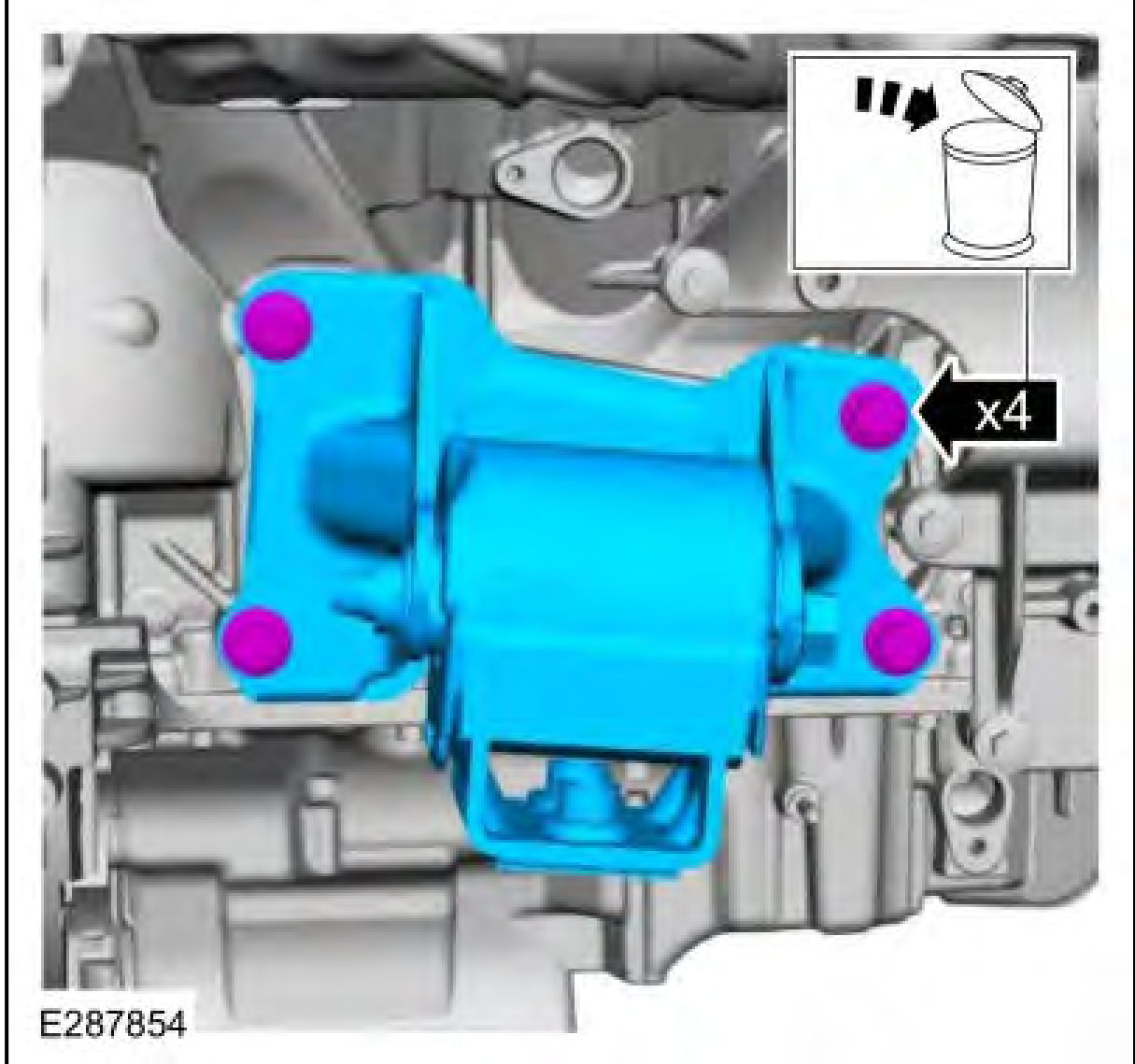




190. Install the RH engine mount bracket and the bolts.

Torque: 85 lb.ft (115 Nm)

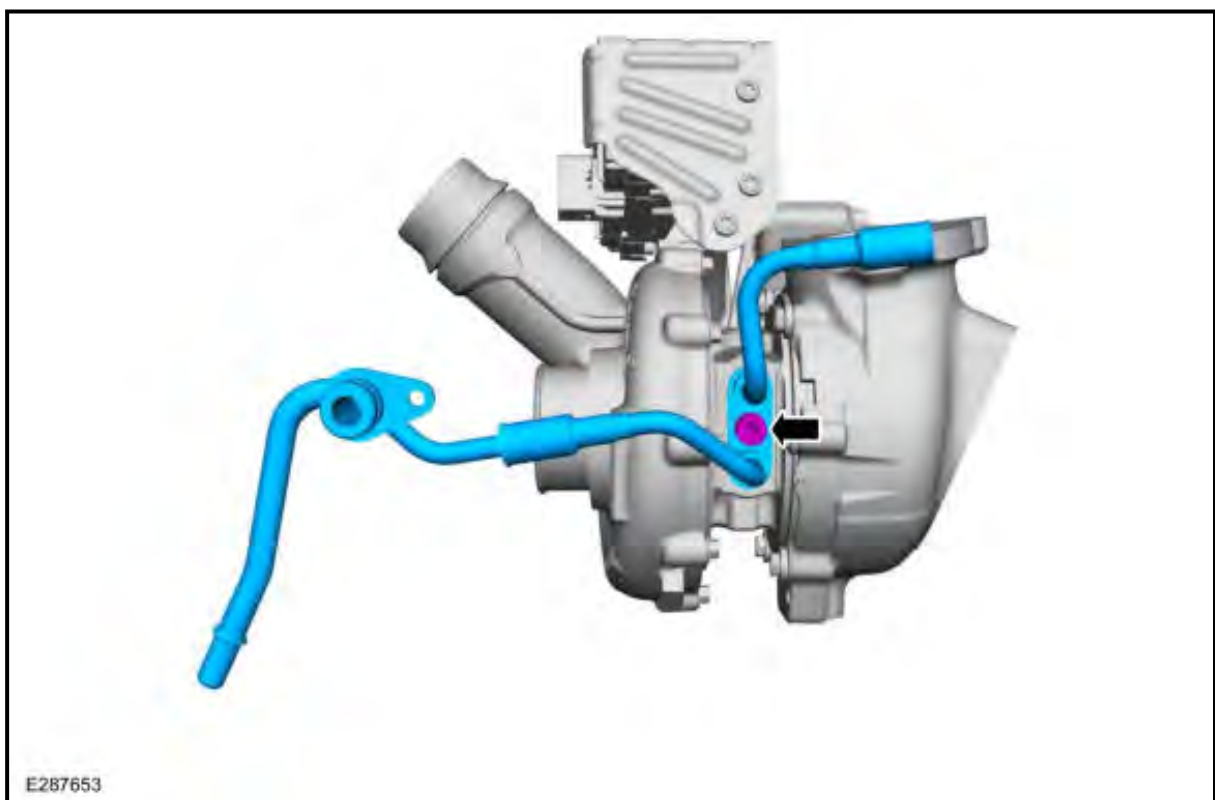




191. Lubricate the O-ring seals with clean engine coolant. Install the new turbocharger coolant tube manifold and the bolt.

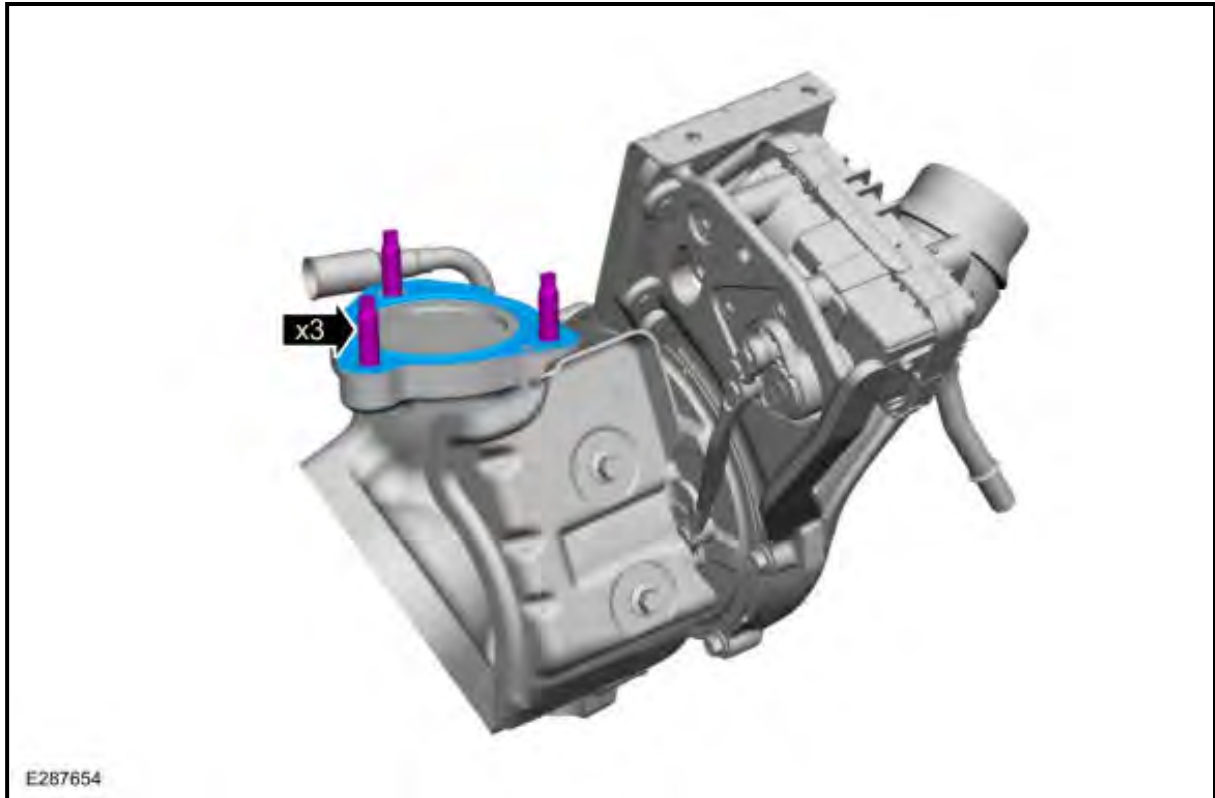
Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

Torque: 89 lb.in (10 Nm)



192. Install the turbocharger studs and the gasket.

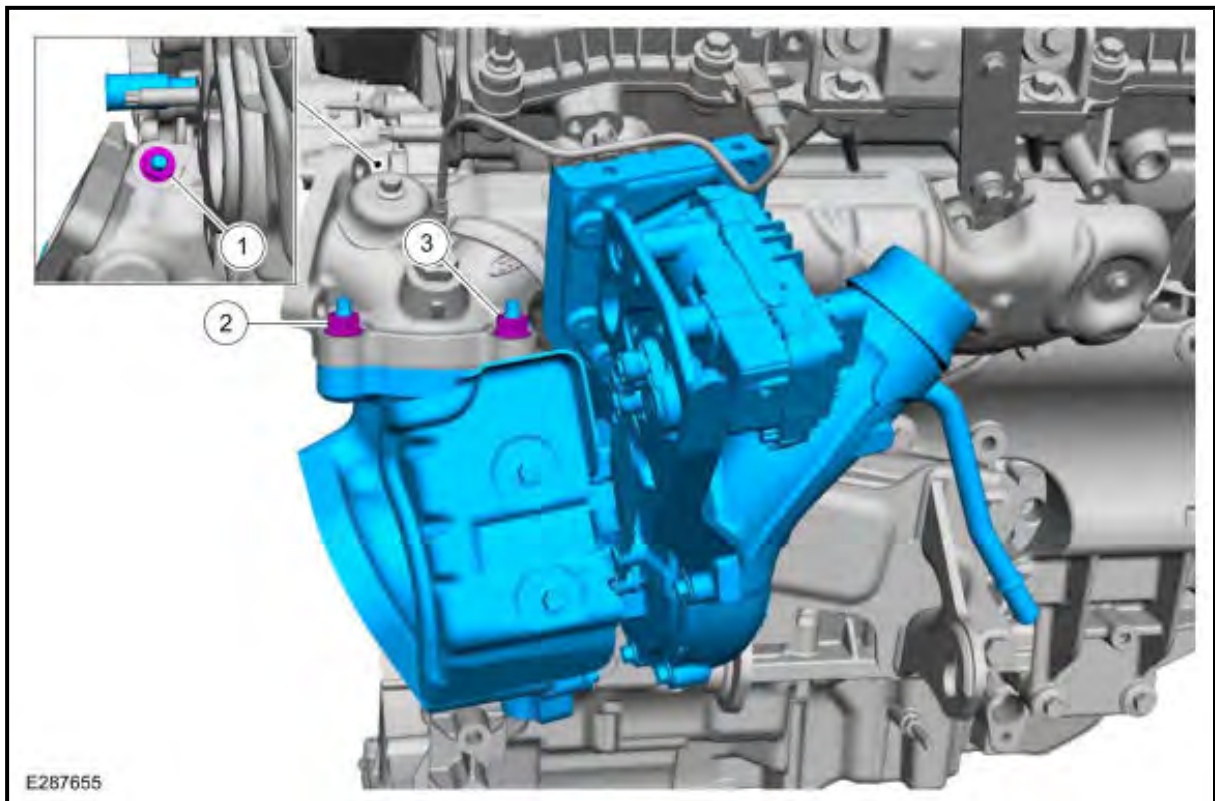
Torque: 115 lb.in (13 Nm)



193. Install the turbocharger and the nuts.

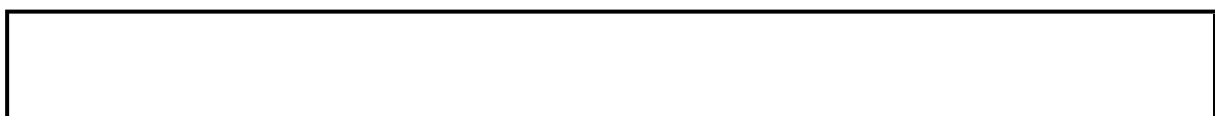
Torque

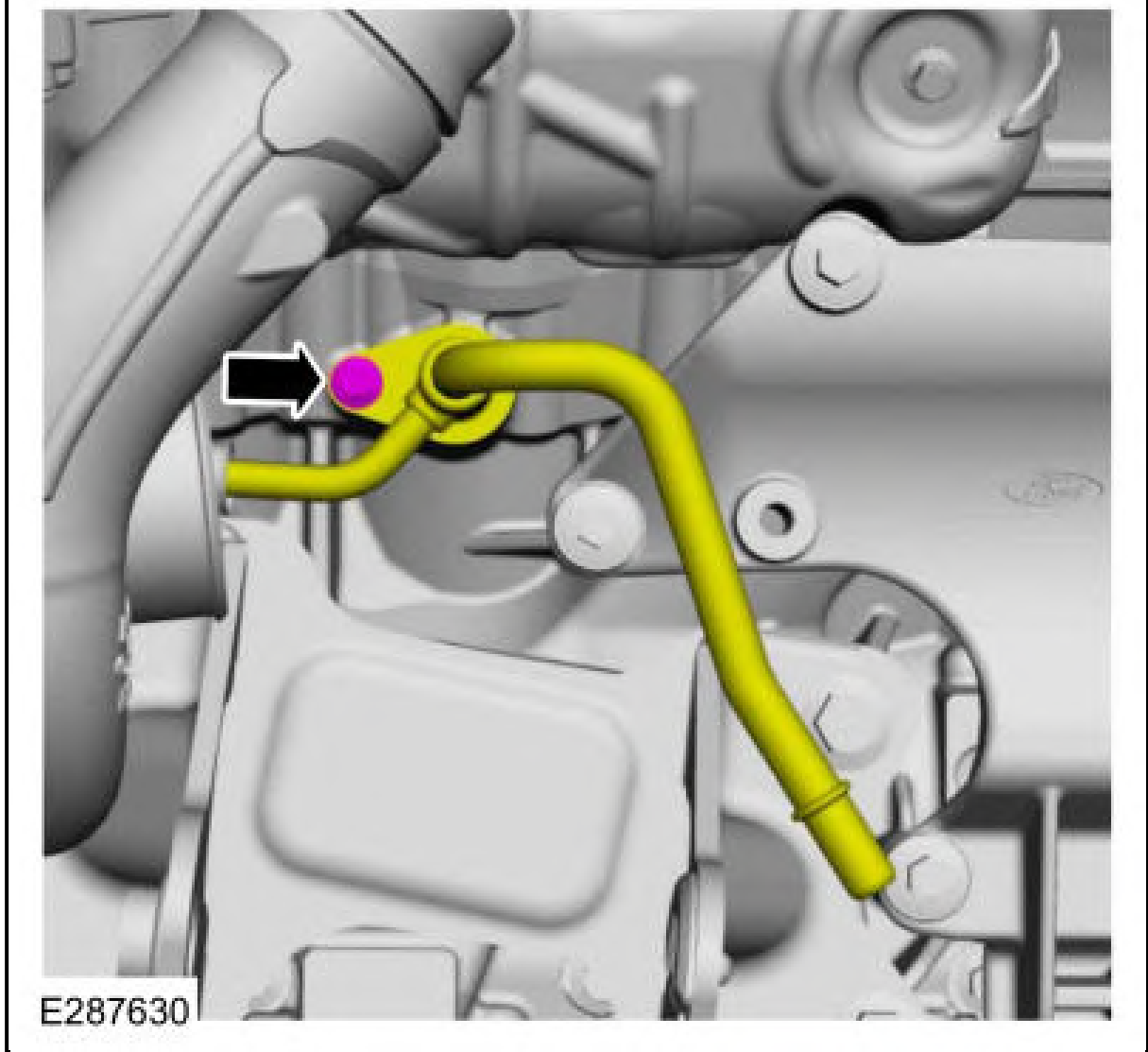
:Stage 1: 89 lb.in (10 Nm) Stage 2: 18 lb.ft (24 Nm)



194. Position back the turbocharger coolant supply tube into the engine and install the bolt.

Torque: 89 lb.in (10 Nm)



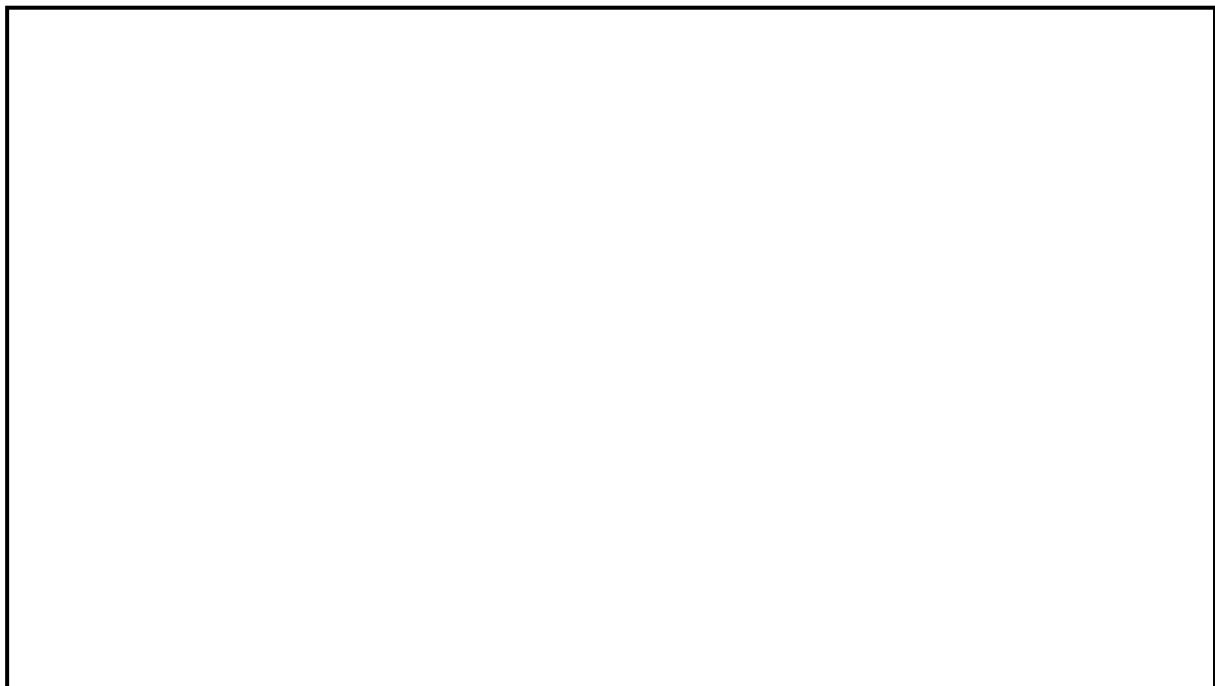


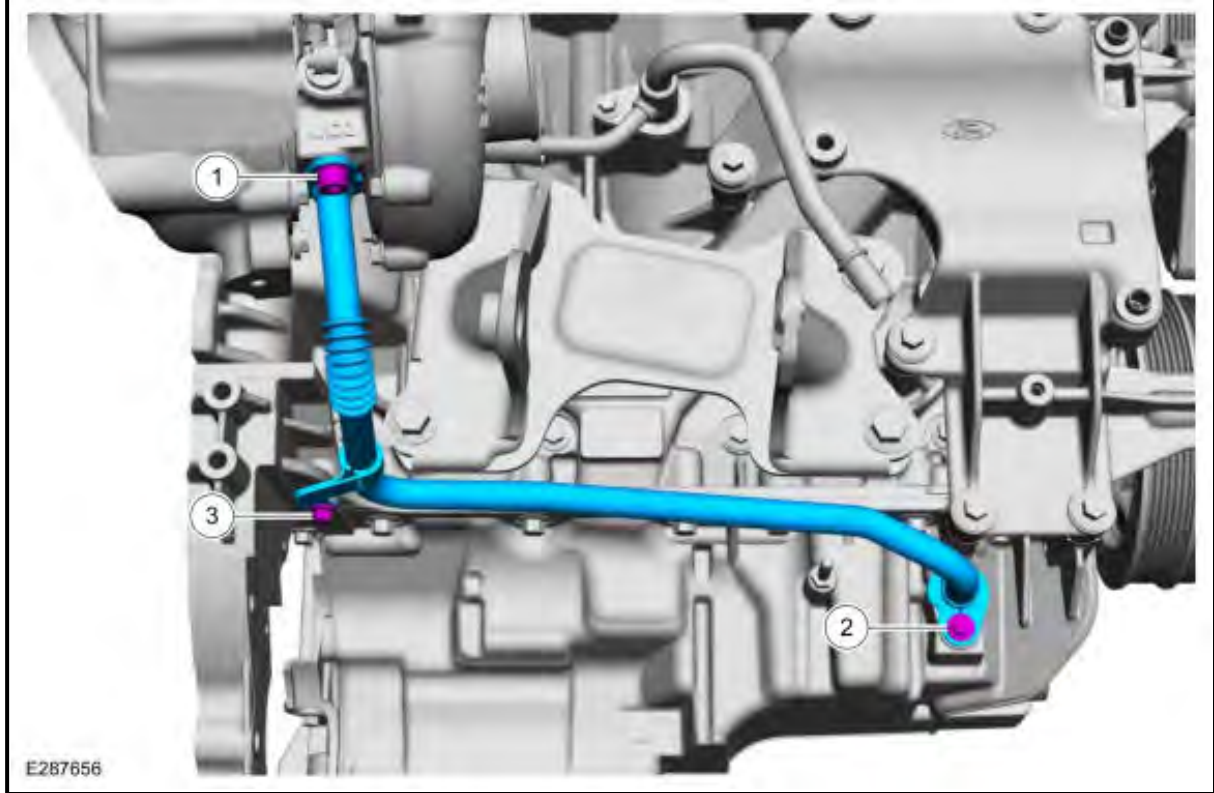
195. **NOTE:** Fully seat the turbocharger oil return tube O-rings into the turbocharger and engine bore holes prior to fastener tightening.

Lubricate the turbocharger oil return tube with clean engine oil. Install the turbocharger oil return tube and the bolts.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque: 89 lb.in (10 Nm)



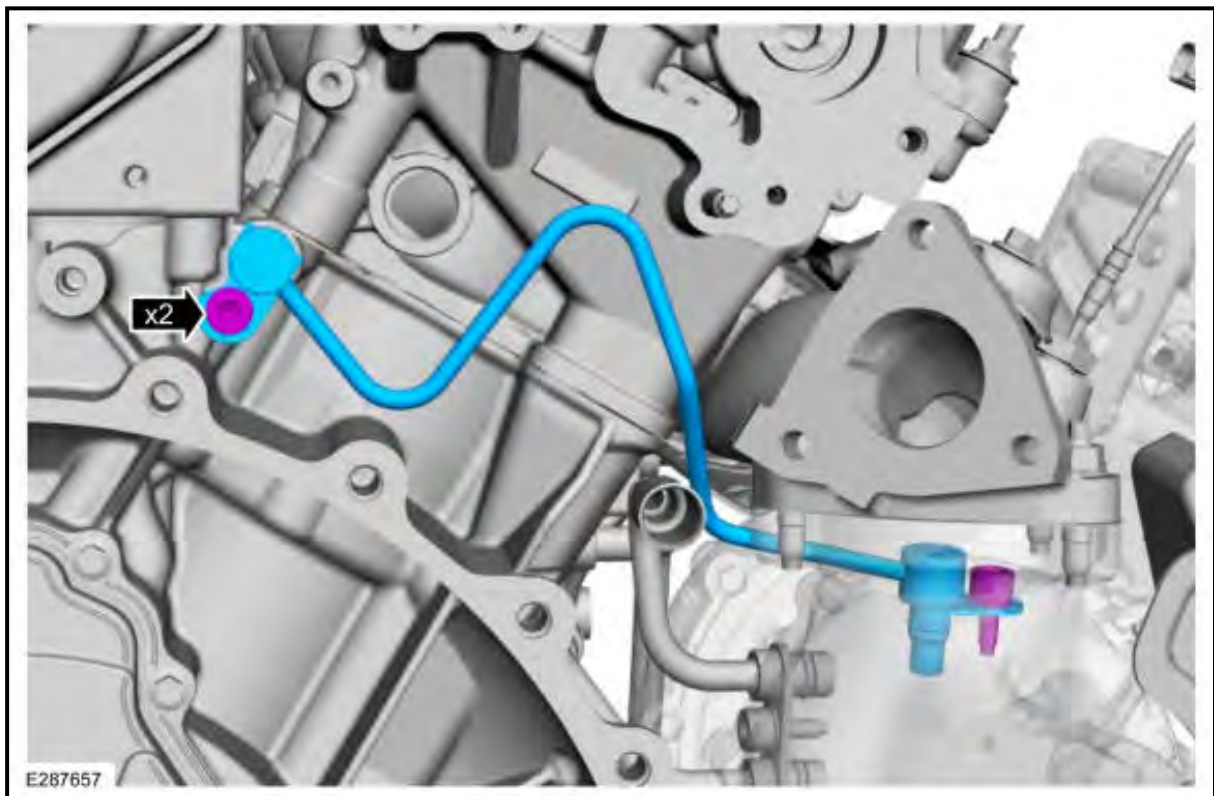


196. **NOTE:** Fully seat the turbocharger oil supply tube O-rings into the turbocharger and engine bore holes prior to fastener tightening.

Lubricate the turbocharger oil supply tube O-rings with clean engine oil. Install the turbocharger oil supply tube and the bolts.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque: 89 lb.in (10 Nm)



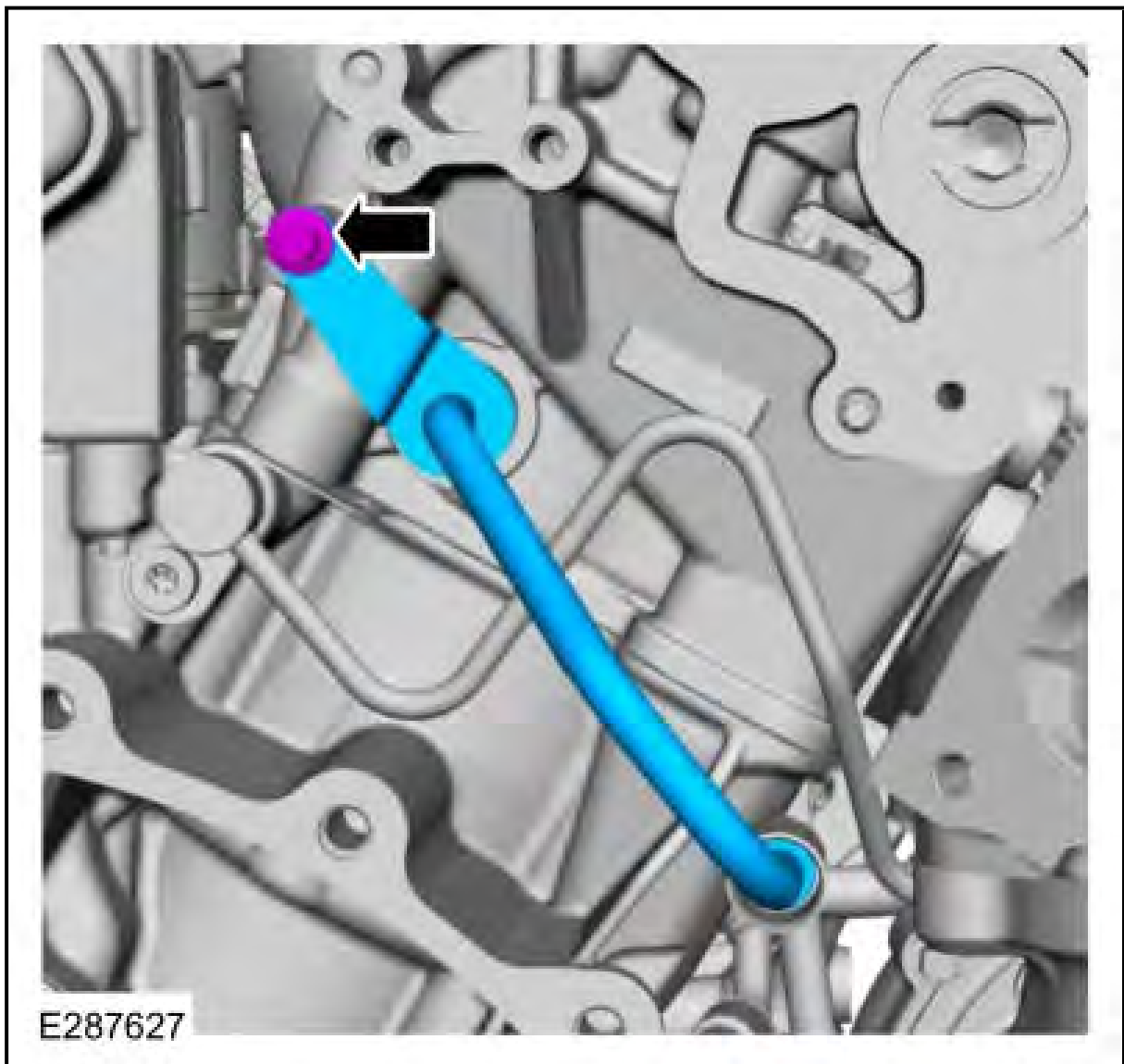
197. Install a new turbocharger coolant return tube O-ring seal. Lubricate the new O-ring seal and the tube sealing surface with clean engine coolant.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)



198. Install the coolant return tube and the bolt.

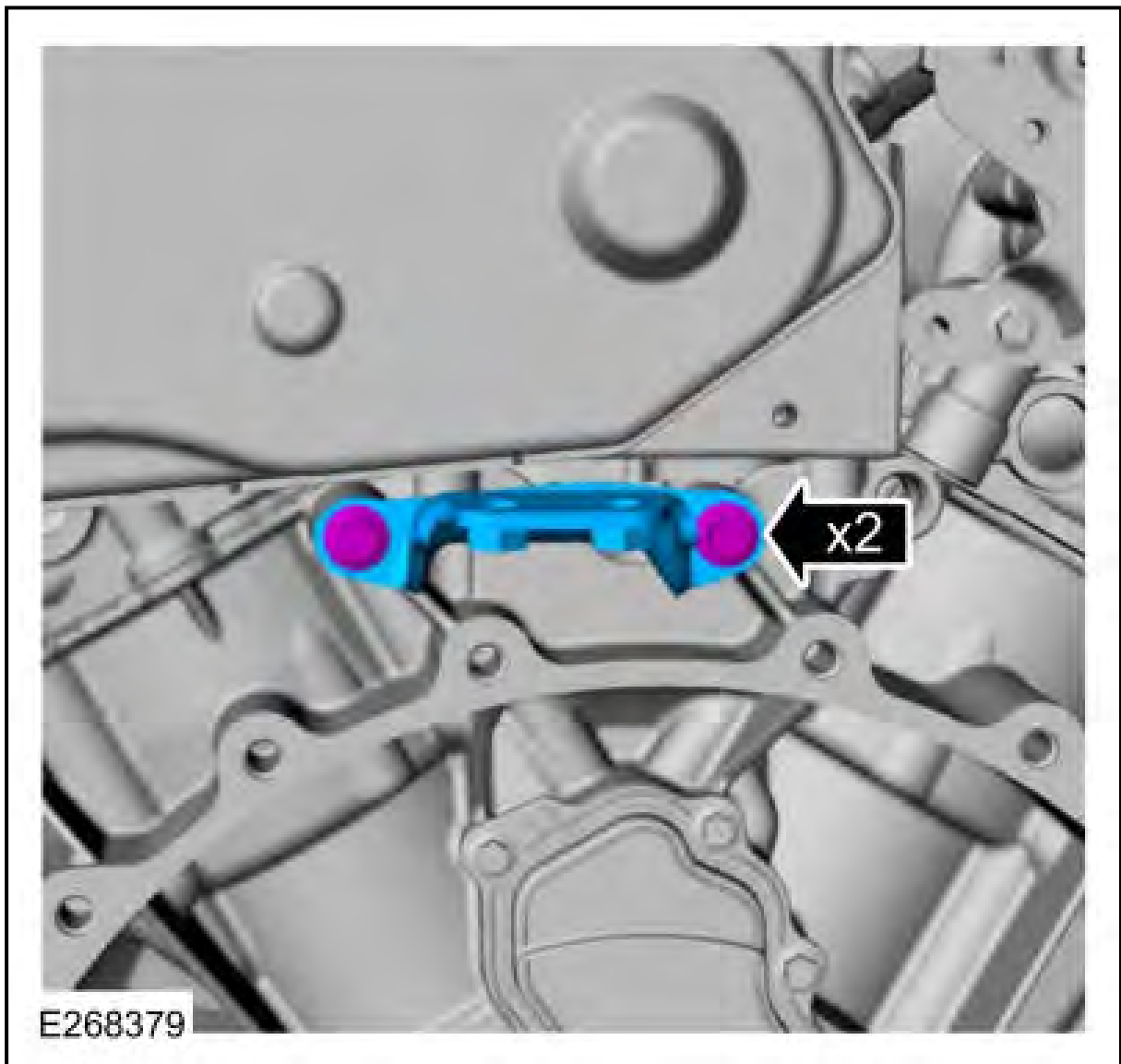
Torque: 89 lb.in (10 Nm)



199. Install the exhaust crossover pipe bracket and the bolts.

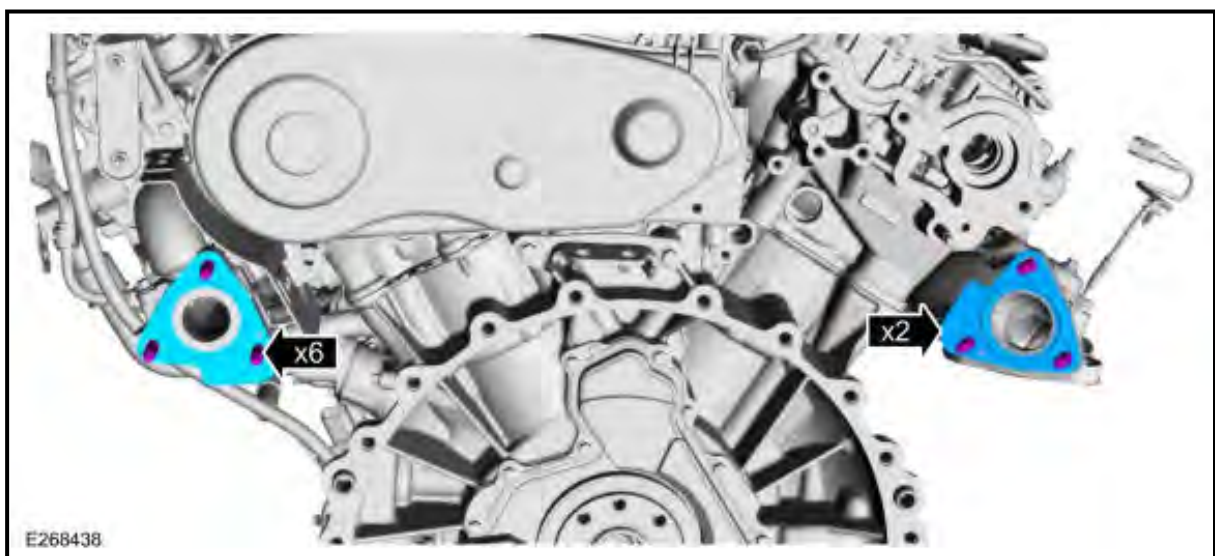


Torque: 17 lb.ft (23 Nm)



200. Install the studs and the exhaust crossover pipe gaskets.

Torque: 115 lb.in (13 Nm)

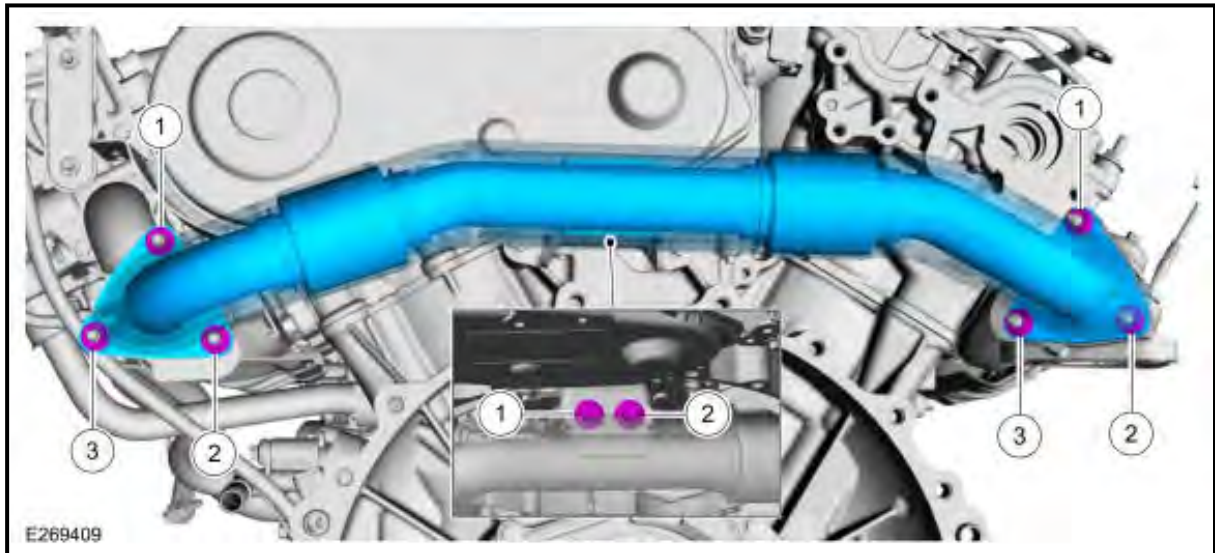


201. **NOTE:** If any snaps become undone on the exhaust crossover pipe wrap. Install a new exhaust crossover pipe wrap.

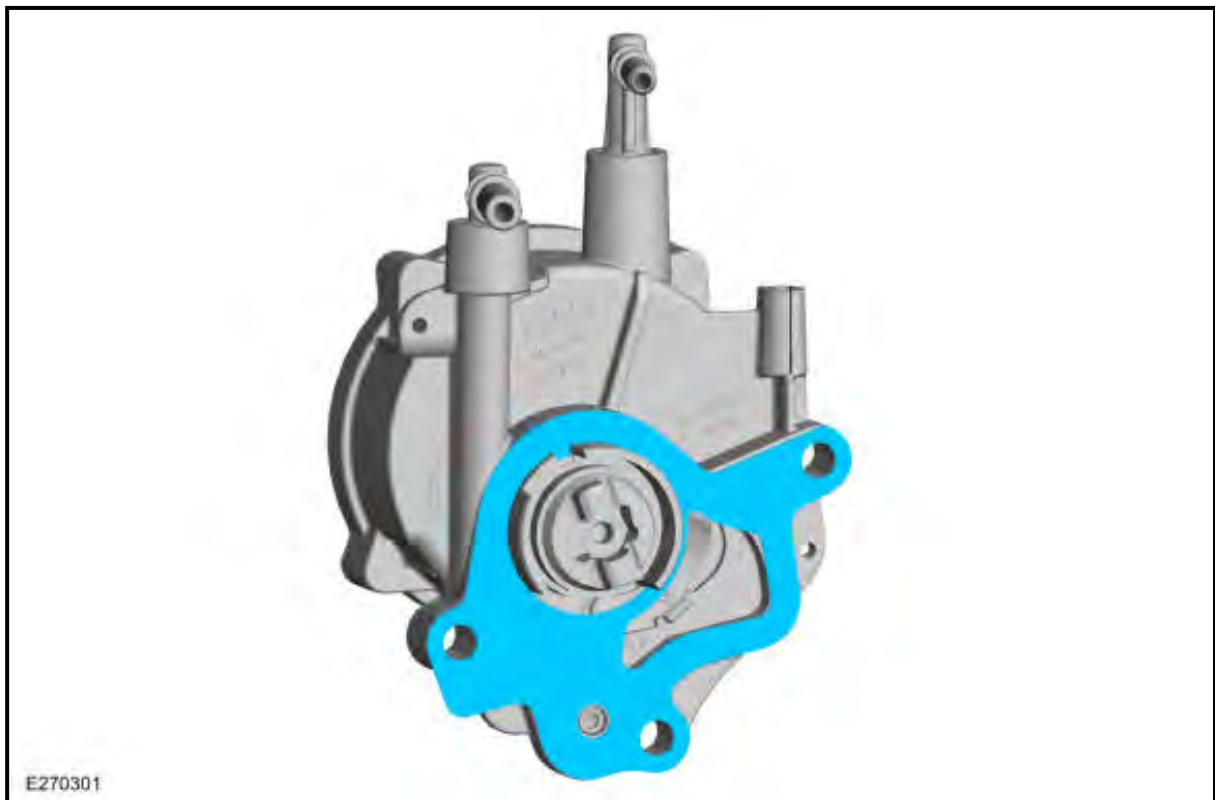
Install the exhaust crossover pipe, the nuts and the bolts.

- Hand start the RH exhaust manifold nuts.

- Hand start the LH exhaust manifold nuts.
- Hand start the exhaust crossover pipe bracket bolts.
- Tighten the RH exhaust manifold nuts in the following sequence: 1, 2, 3, 1, 2.  
Torque: 18 lb.ft (24 Nm)
- Tighten the LH exhaust manifold nuts in the following sequence: 1, 2, 3, 1, 2.  
Torque: 18 lb.ft (24 Nm)
- Tighten the exhaust crossover pipe bracket bolts in the sequence shown.  
Torque: 18 lb.ft (24 Nm)



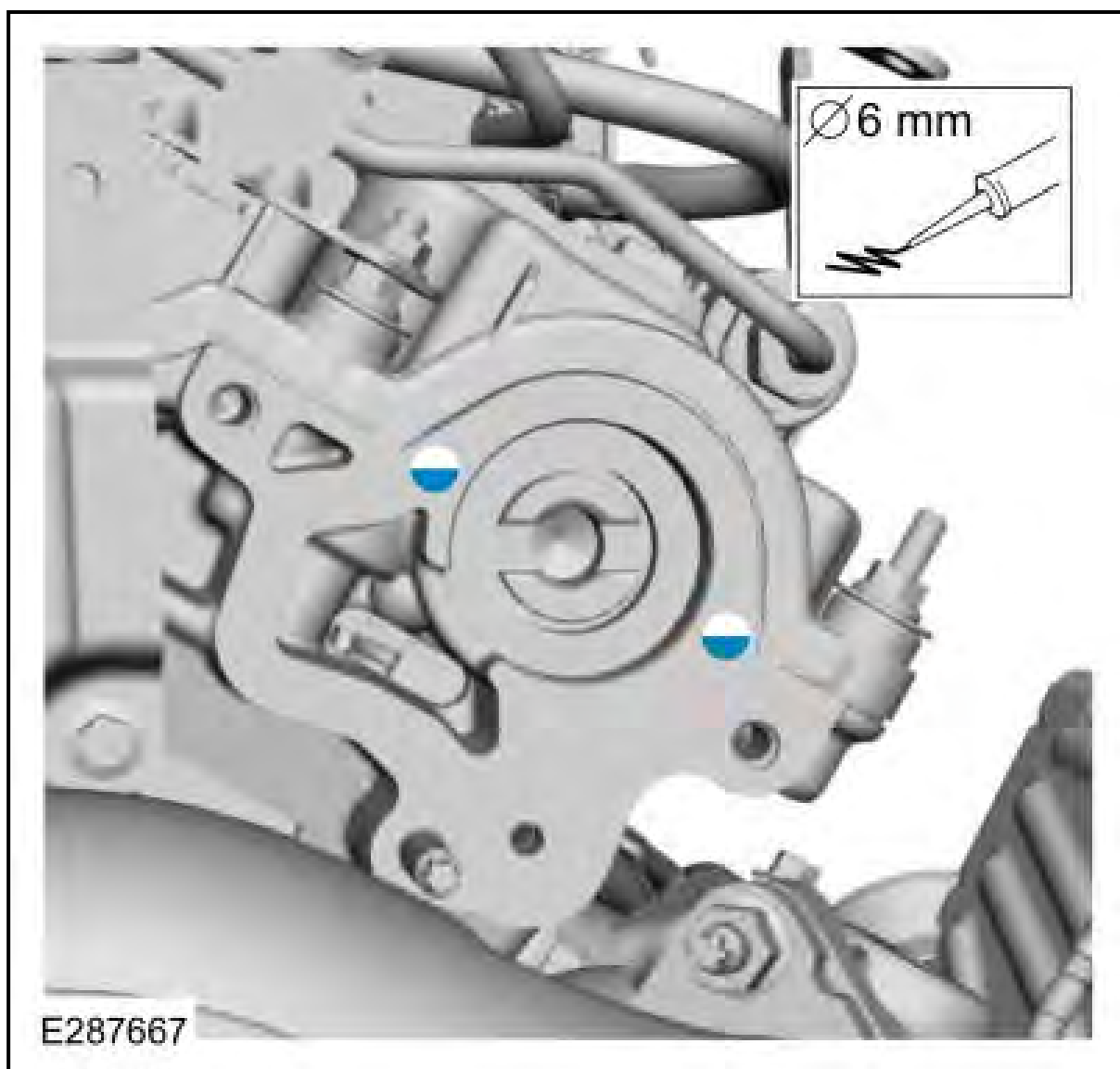
202. Install the vacuum pump gasket.



203. **NOTE:** If the vacuum pump is not installed and the fasteners tightened within 10 minutes, the sealant must be removed and the sealing area cleaned.

Apply an 6 mm dot of Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone to the locations shown.

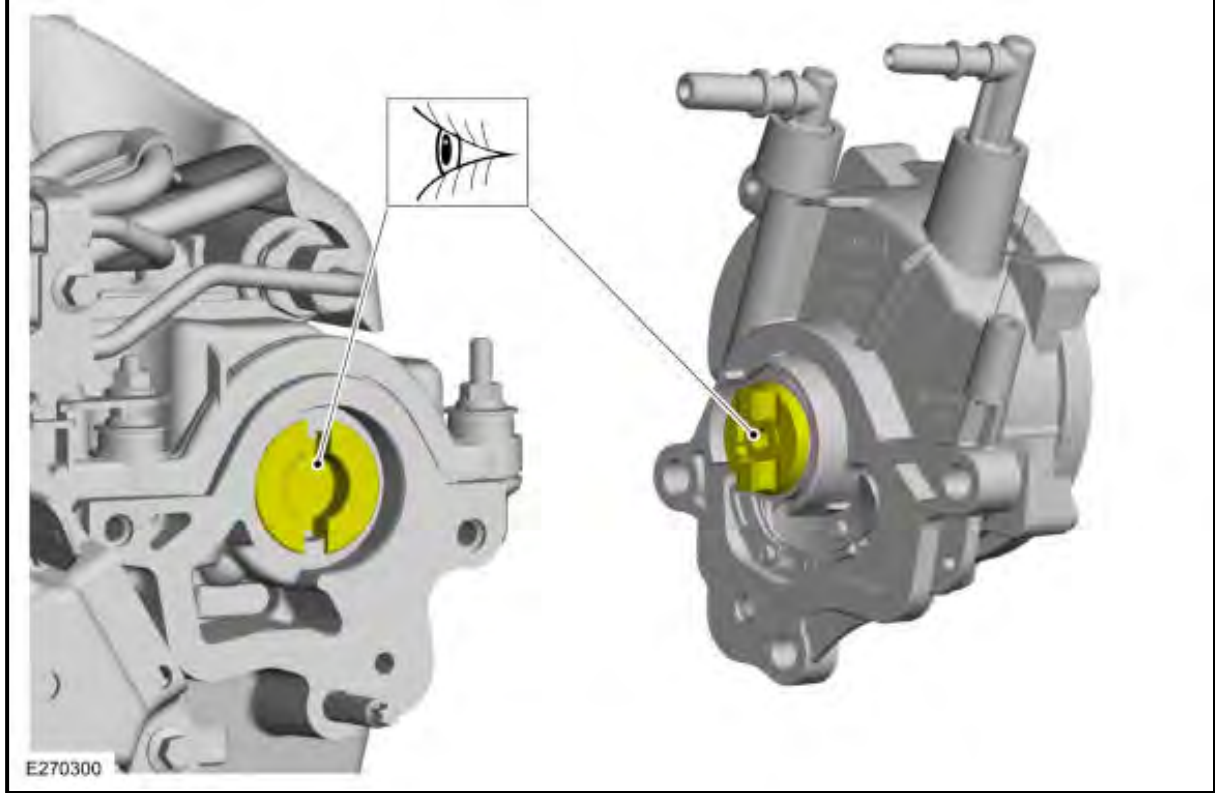
Material: Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



204. **NOTE:** Manually align the brake vacuum pump drive key with the camshaft slot before installation.

Align the brake vacuum pump drive key with the camshaft slot before installation.

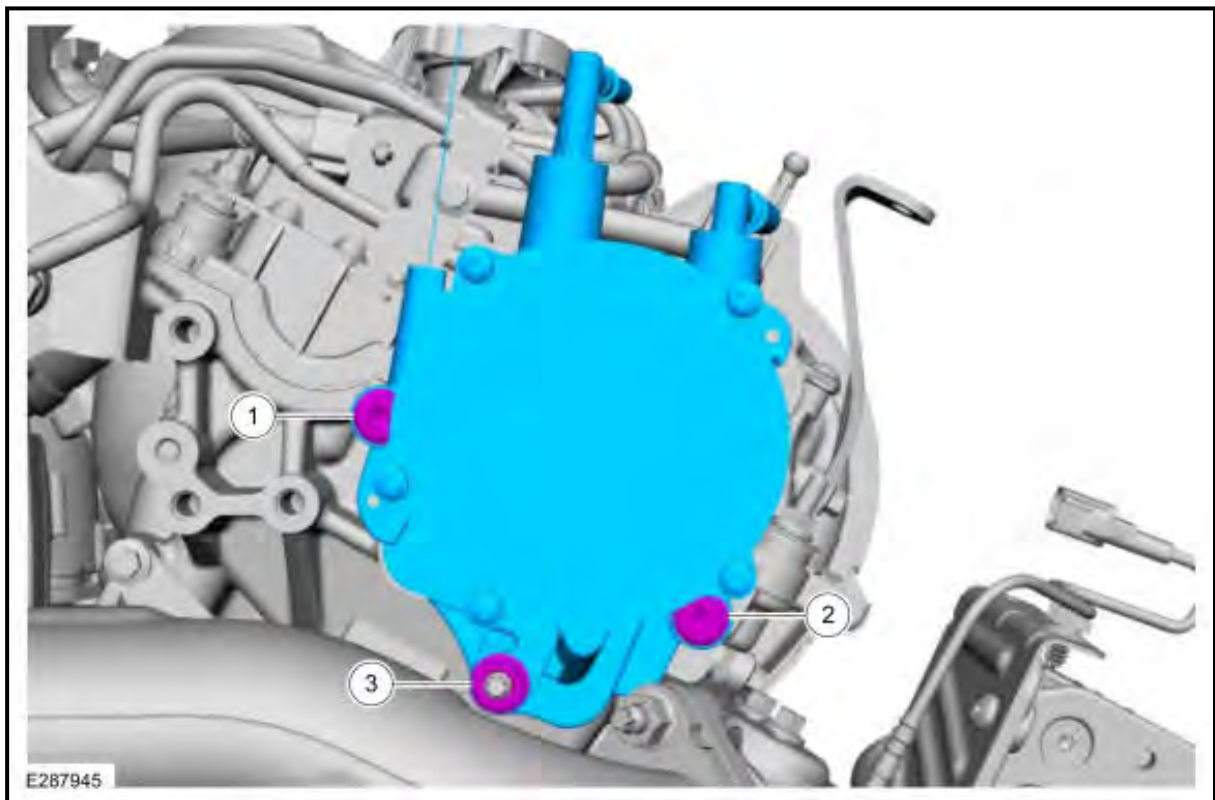




205. Install the vacuum pump and the retainers.

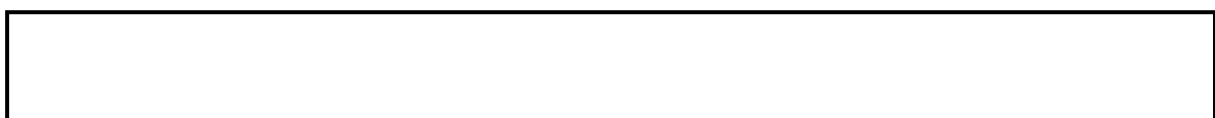
### Torque

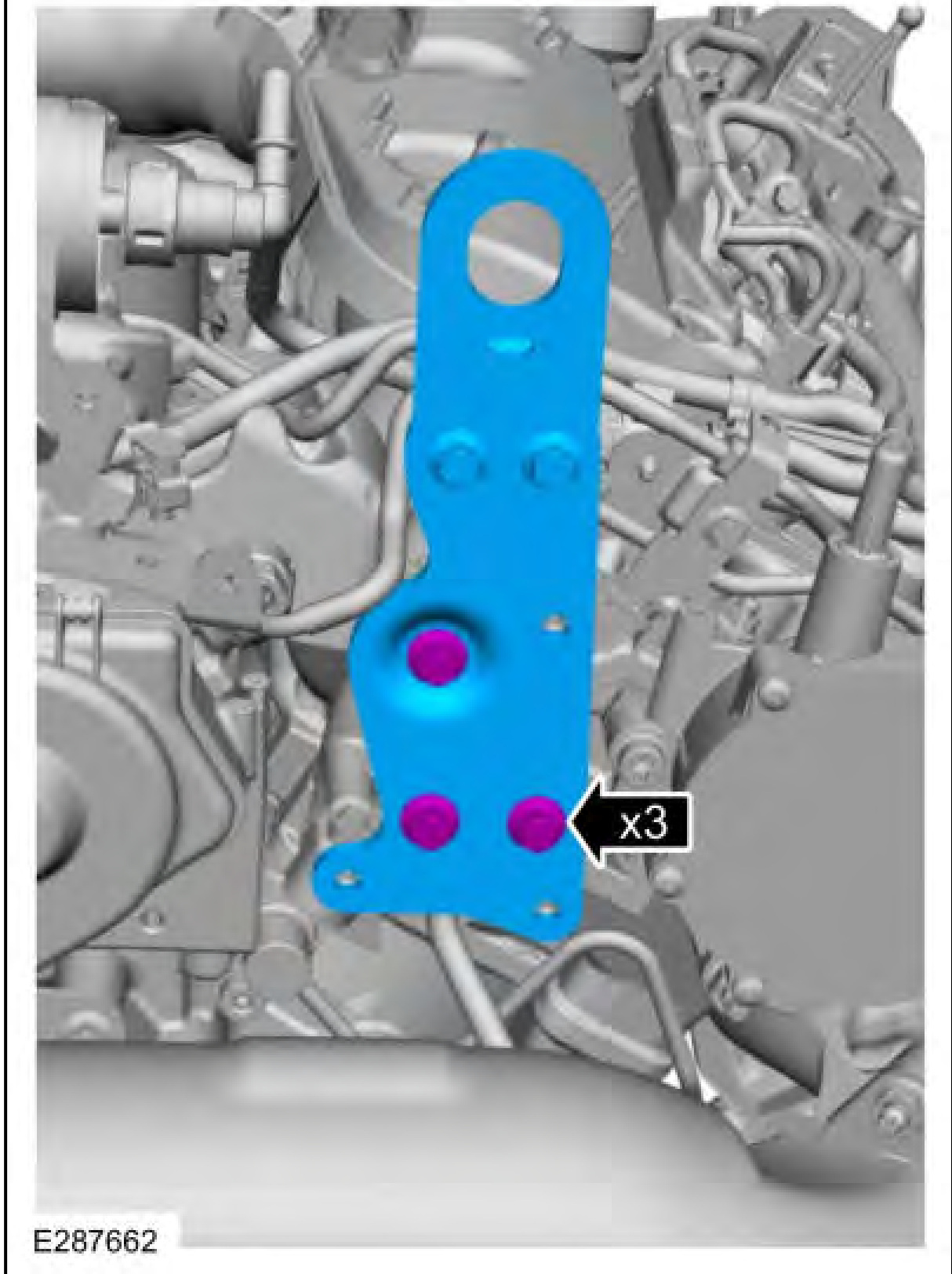
- :Stage 1: Tighten bolt number 1 to: : 17 lb.ft (23 Nm)
- Stage 2: Tighten bolt number 2 to: : 17 lb.ft (23 Nm)
- Stage 3: Tighten bolt number 1 a second time to: : 17 lb.ft (23 Nm)
- Stage 4: Tighten the nut number 3 to: : 17 lb.ft (23 Nm)



206. Install the lifting bracket and the bolts.

Torque: 17 lb.ft (23 Nm)

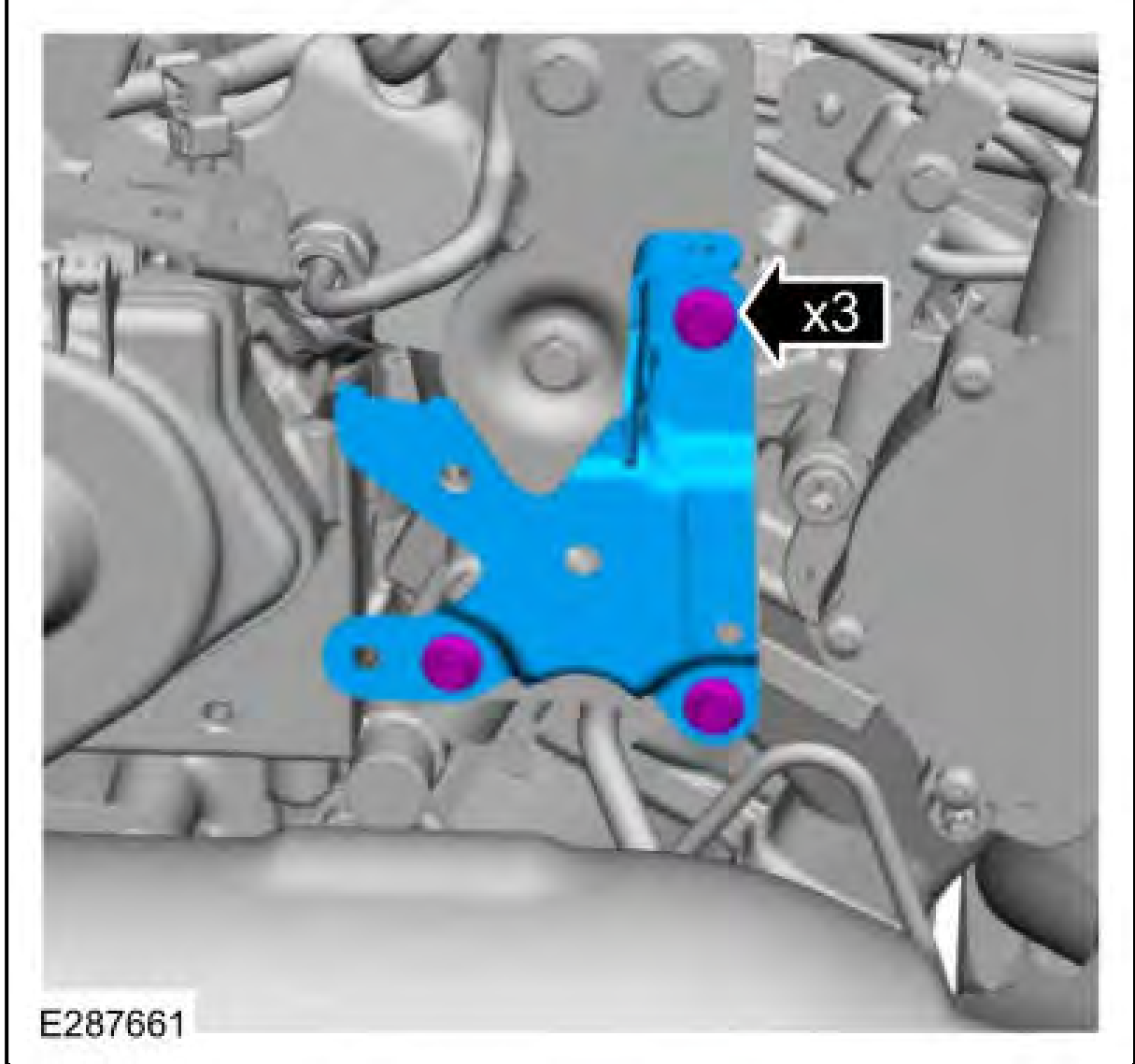




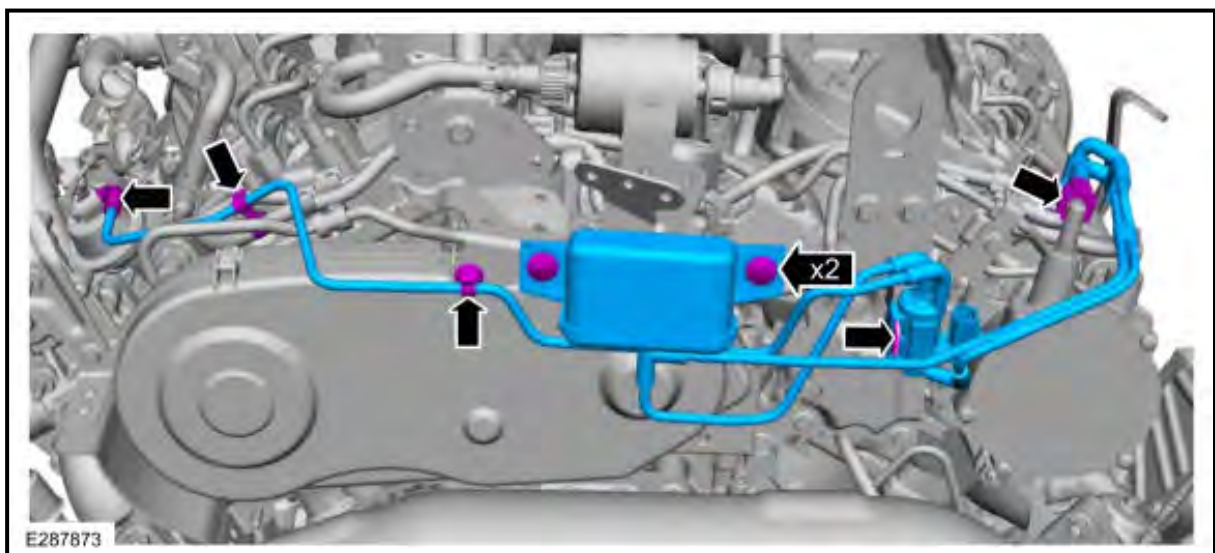
207. Install the valve bracket and the bolts.

Torque: 89 lb.in (10 Nm)





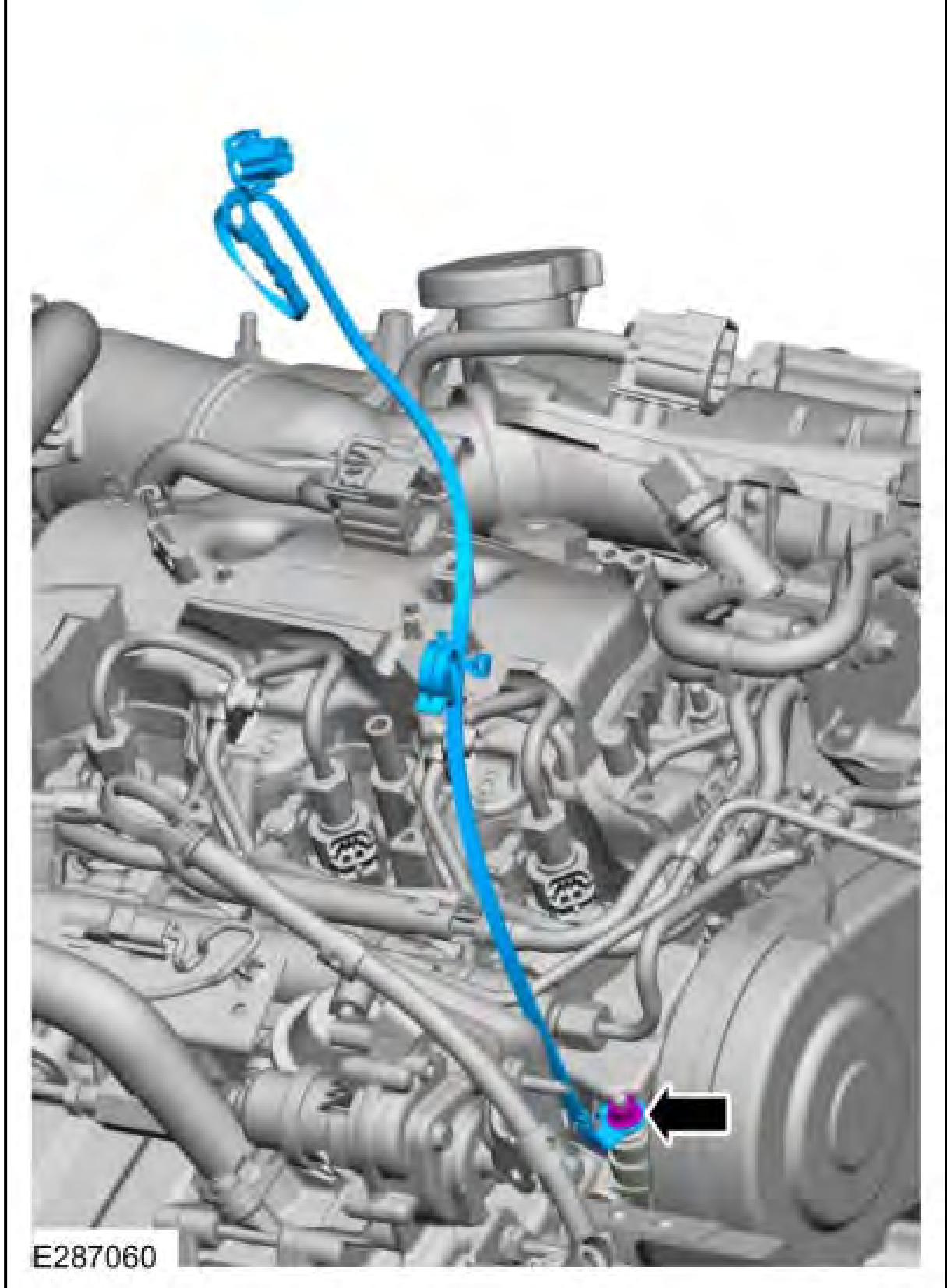
208. Install the vacuum hose assembly and the retainers. Connect the vacuum pump connector. Refer to: [Quick Release Coupling](#) .



209. Install the ground strap and the nut.

Torque: 80 lb.in (9 Nm)

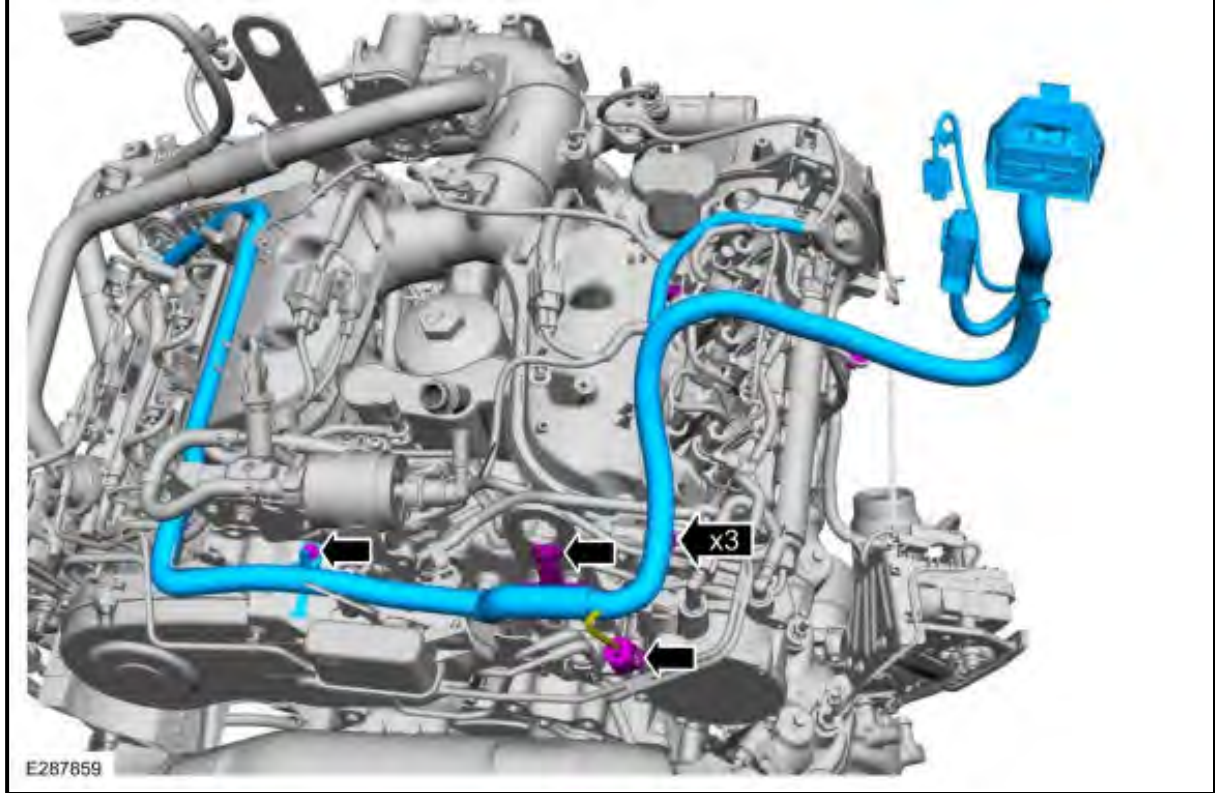




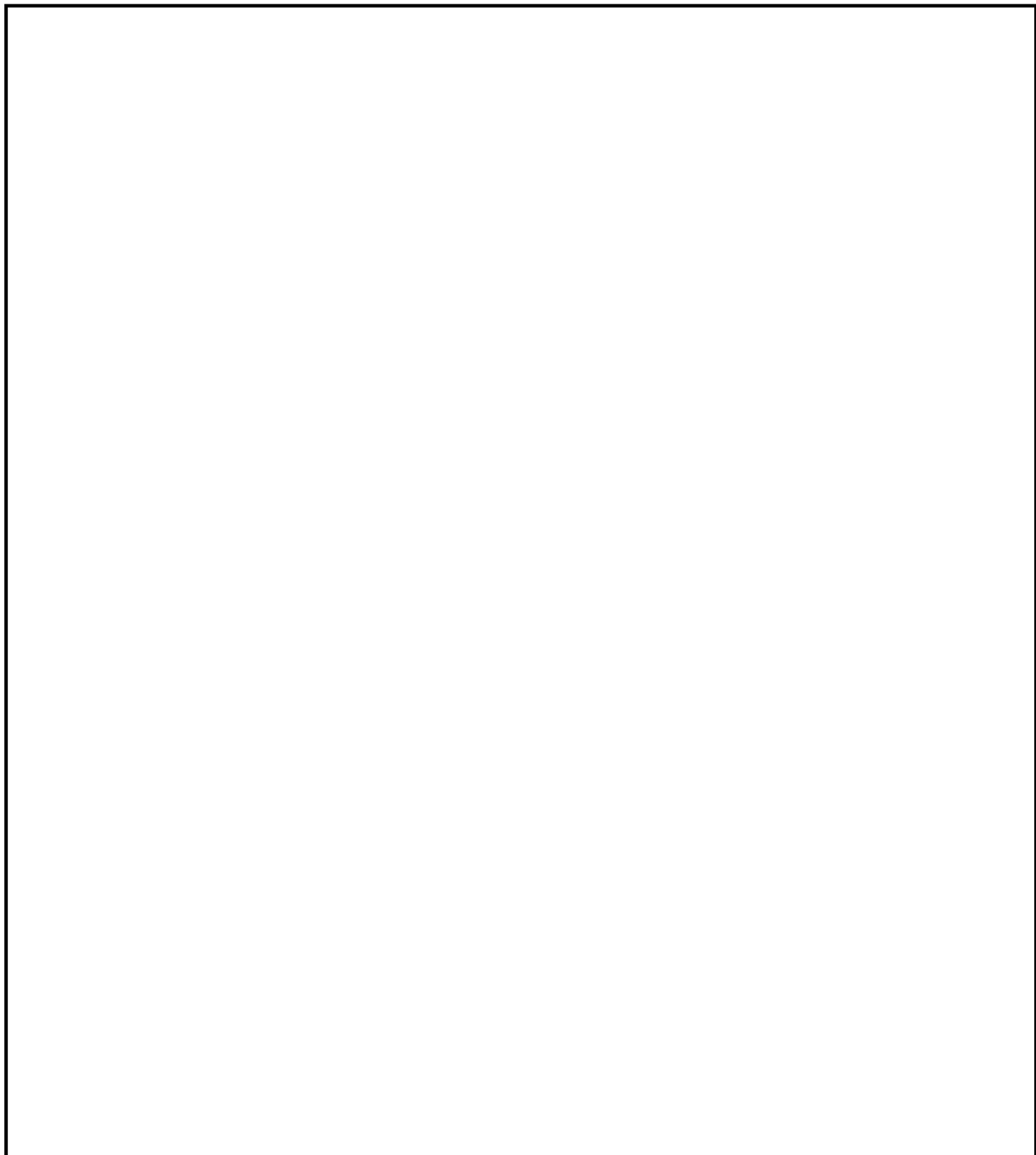
210. Position the engine wire harness on the engine and install the bolt. Connect the electrical wire retainers and the electrical connector.

Torque: 89 lb.in (10 Nm)

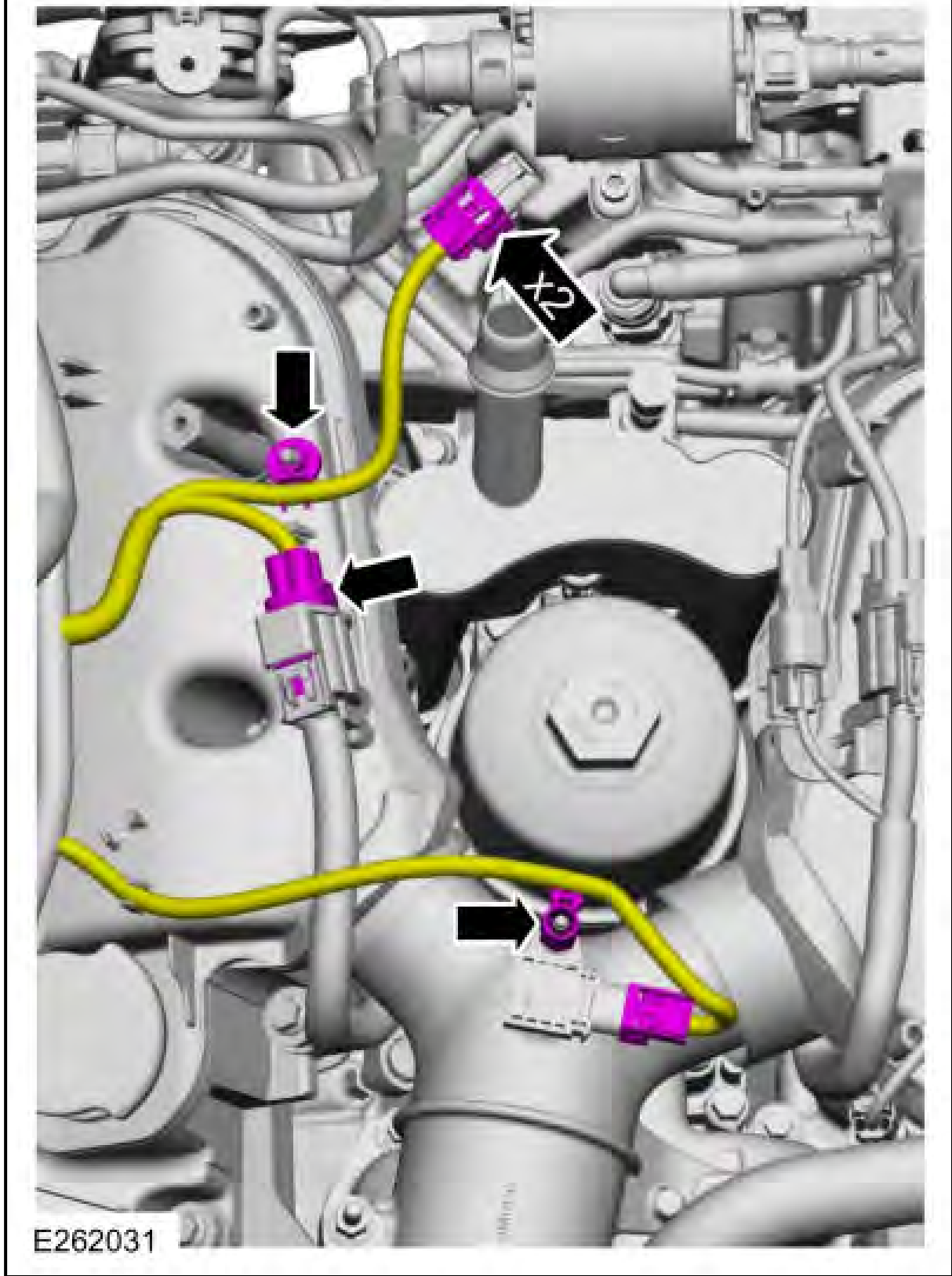




211. Connect the electrical connectors and the wire retainers.

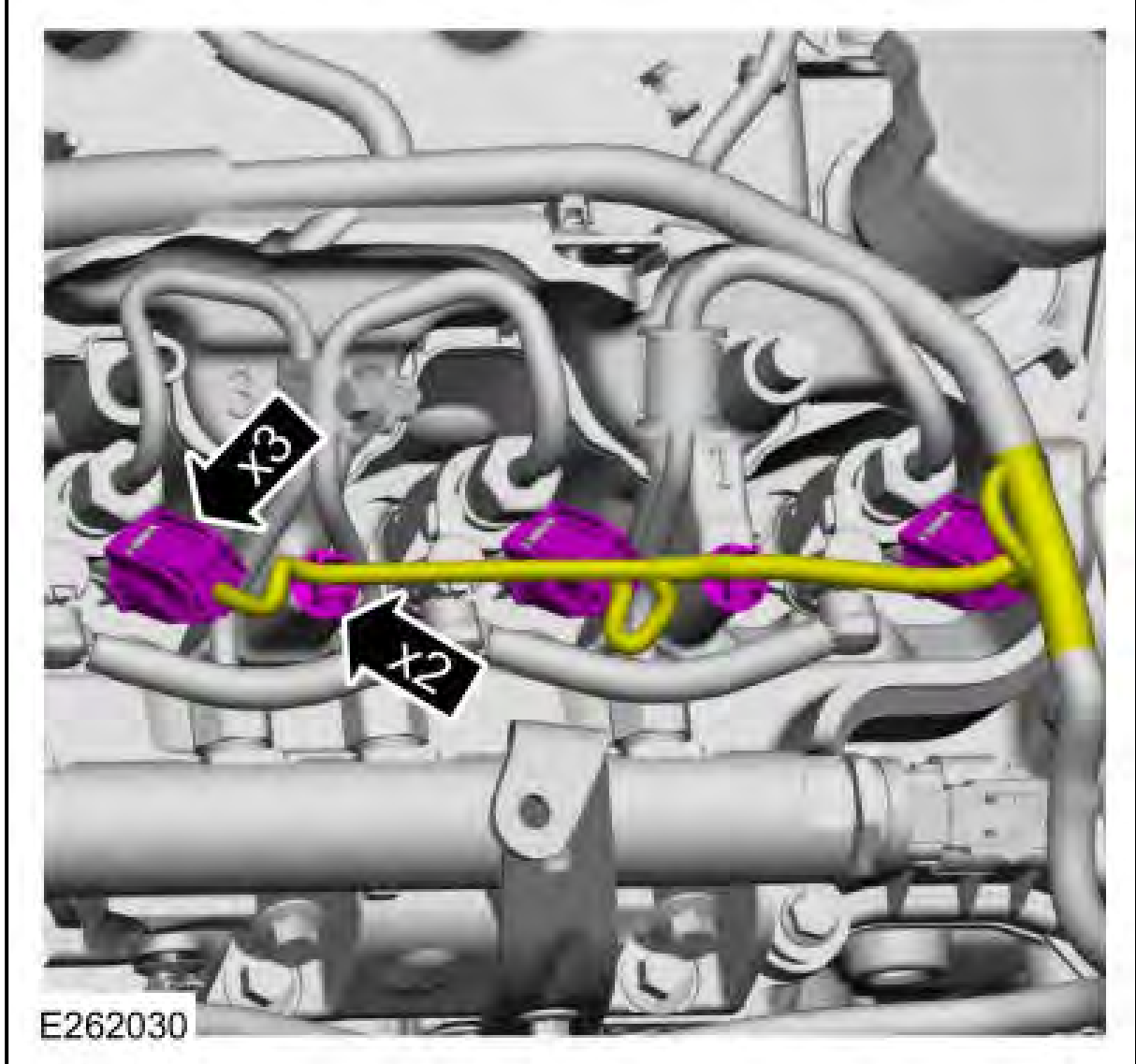




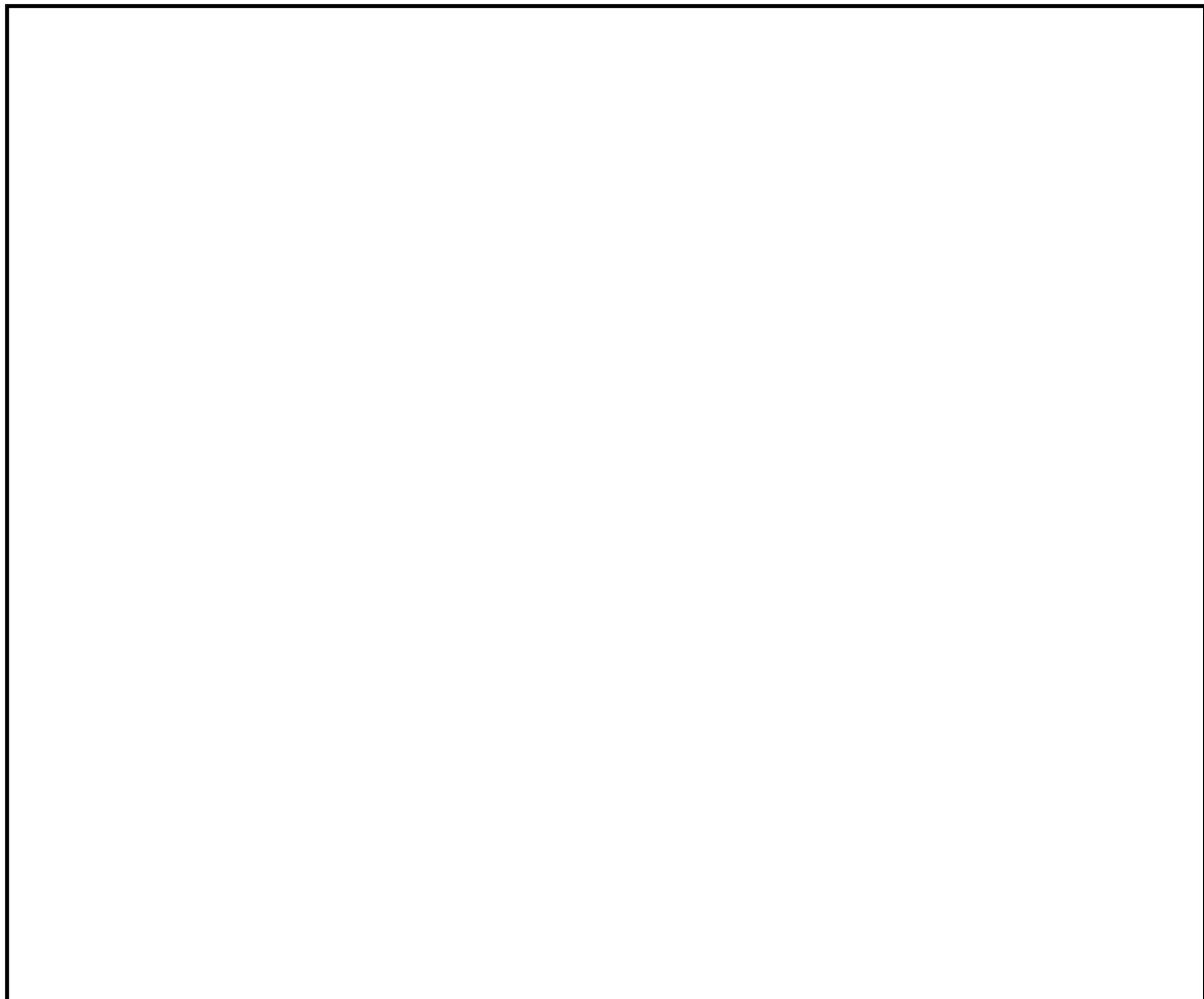


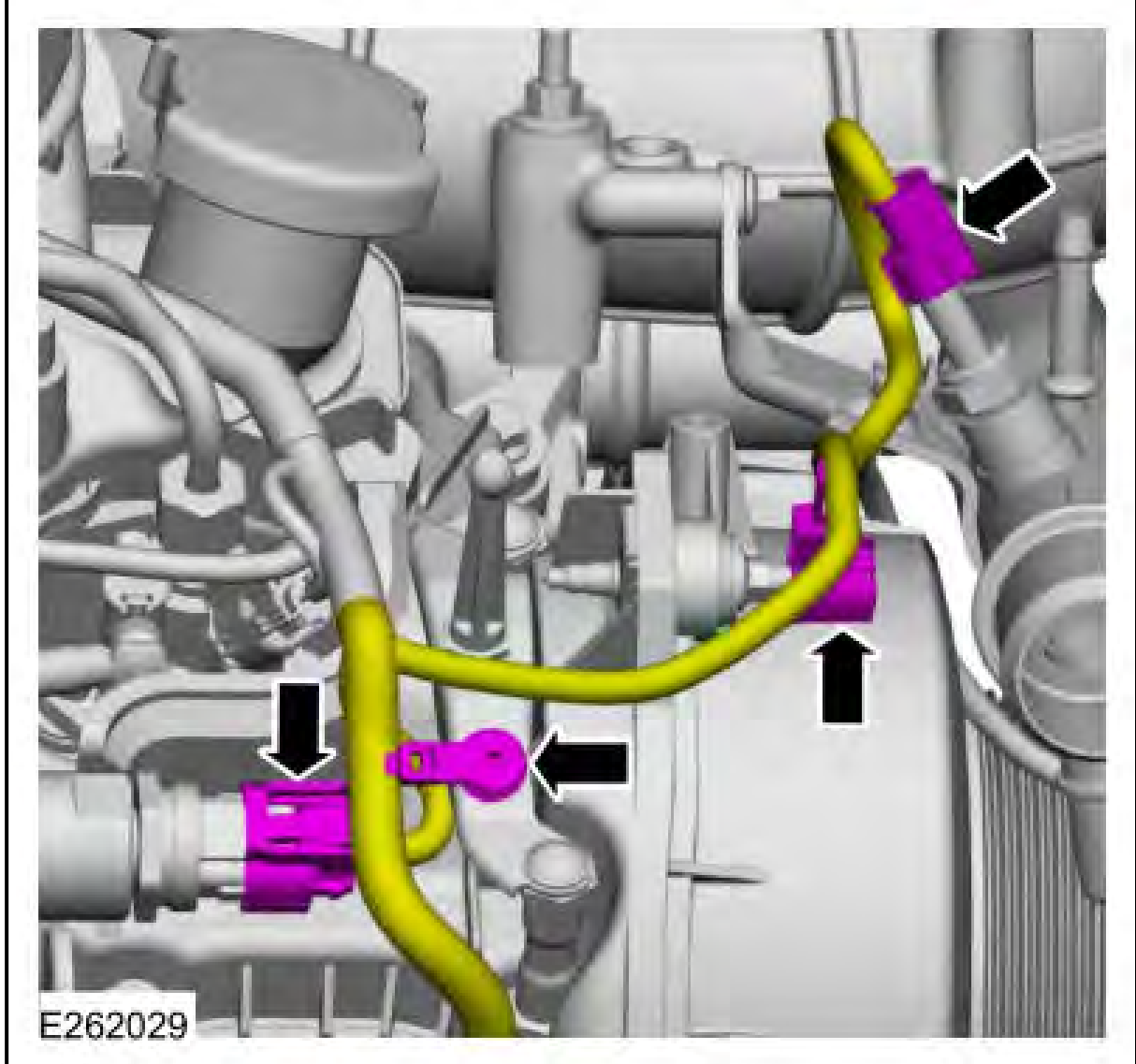
212. Connect the fuel injectors electrical connectors and the wire retainers.



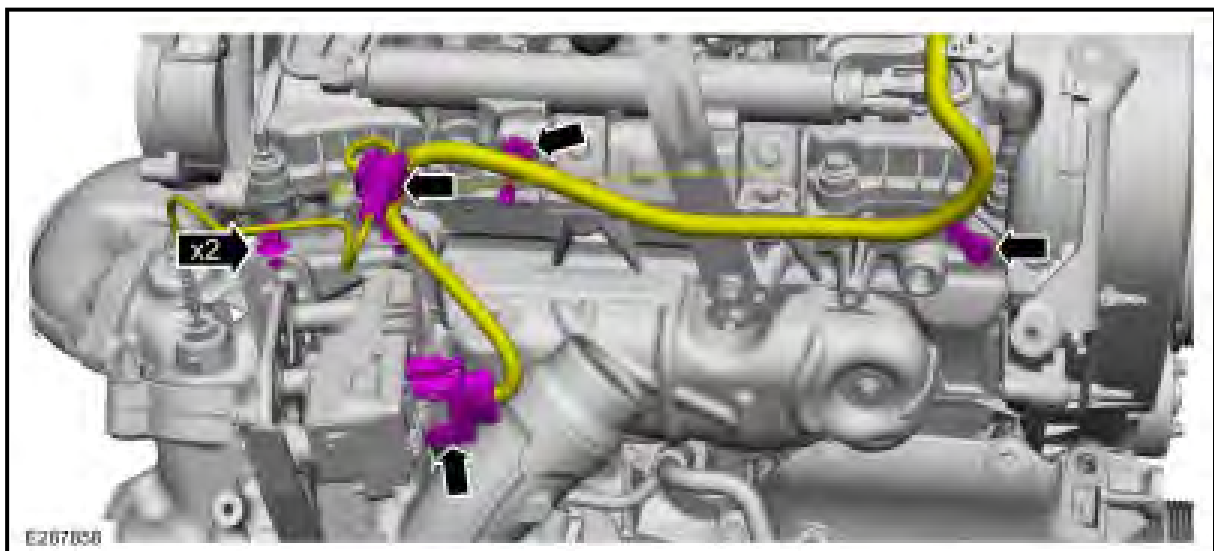


213. Connect the electrical connectors and the wire retainers.



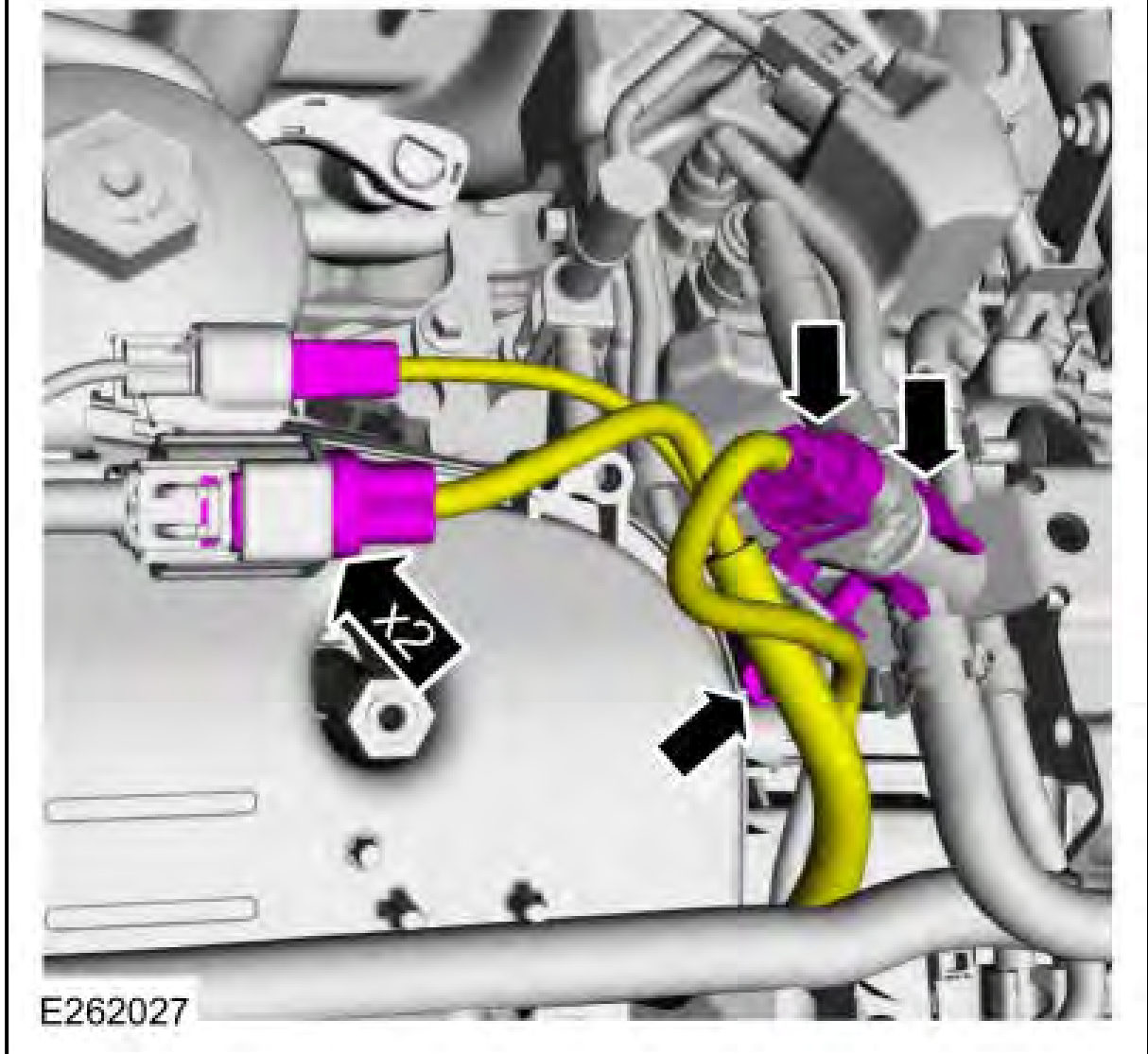


214. Connect the EGRT electrical connector and the wire retainers. Connect the turbocharger actuator electrical connector.



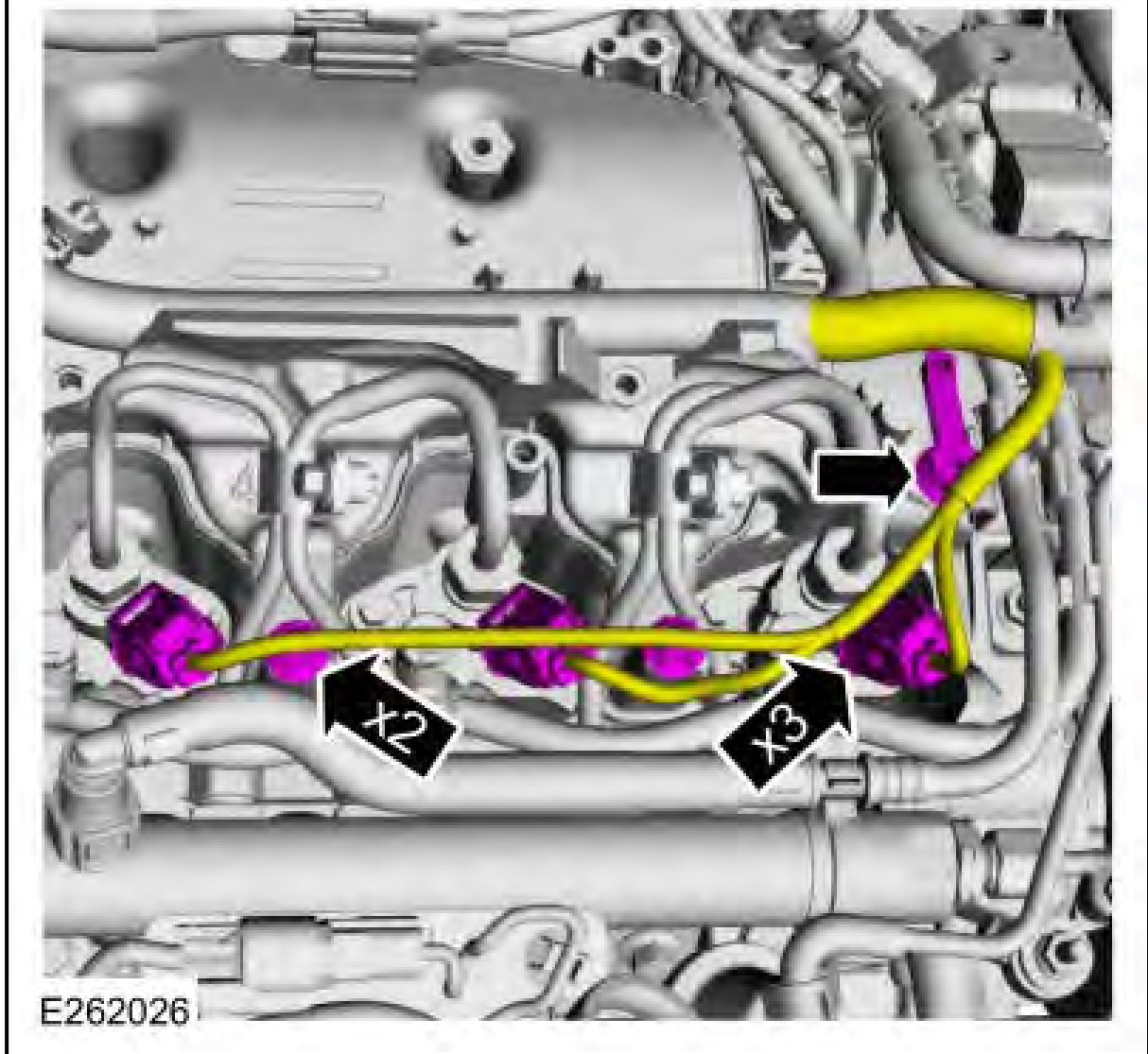
215. Connect the electrical connectors and the wire retainer.



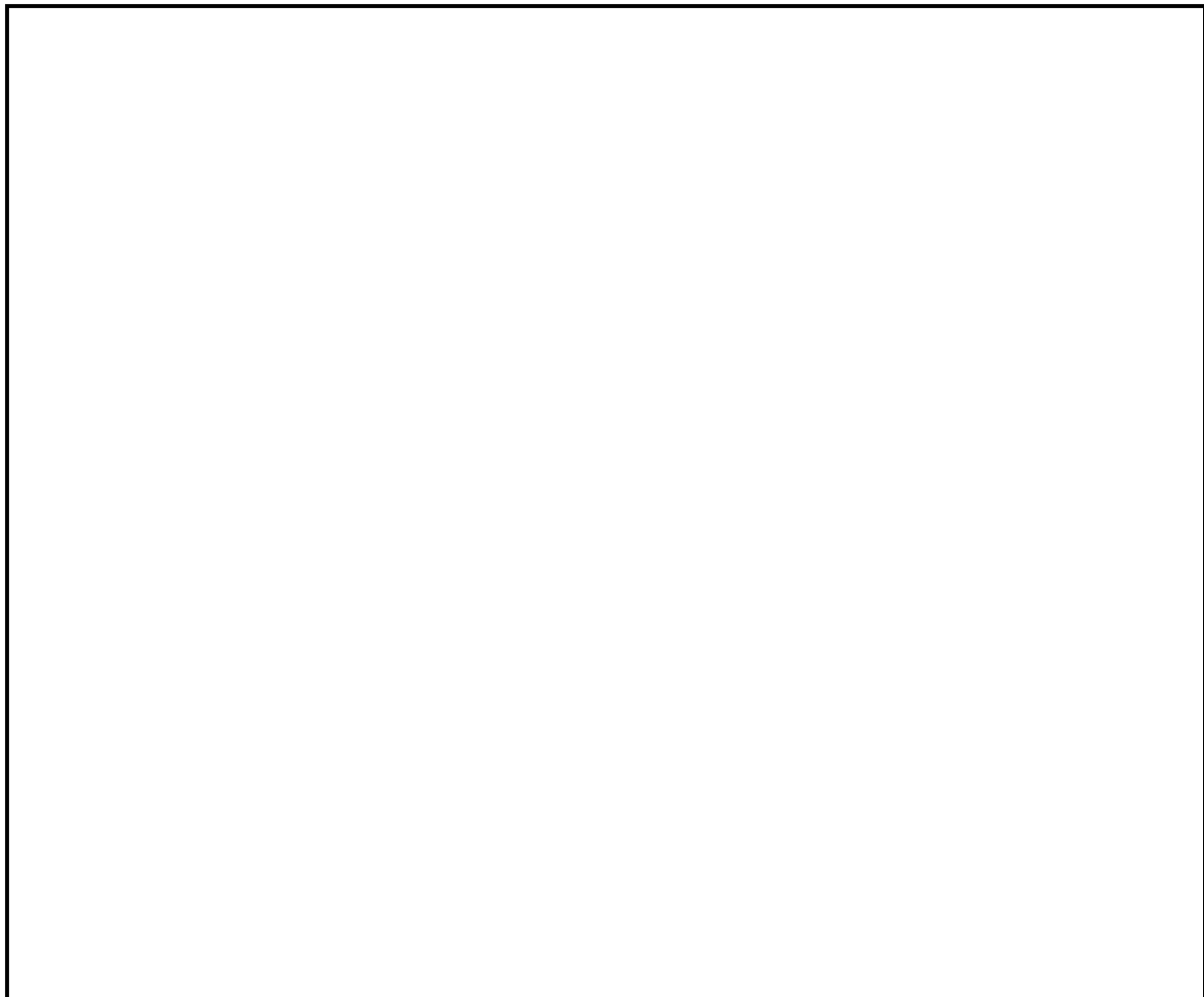


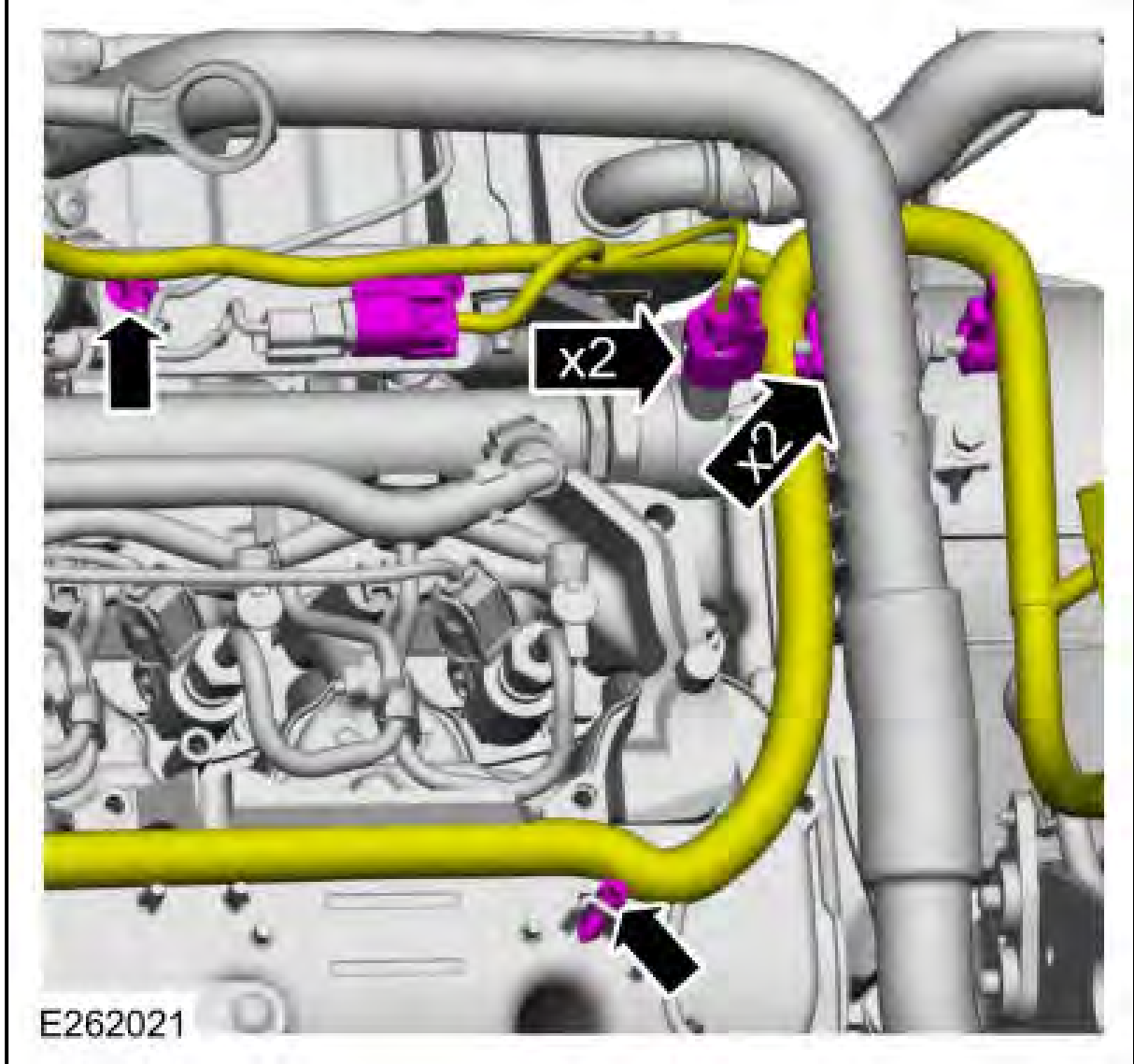
216. Connect the fuel injectors electrical connectors and the wire retainers.



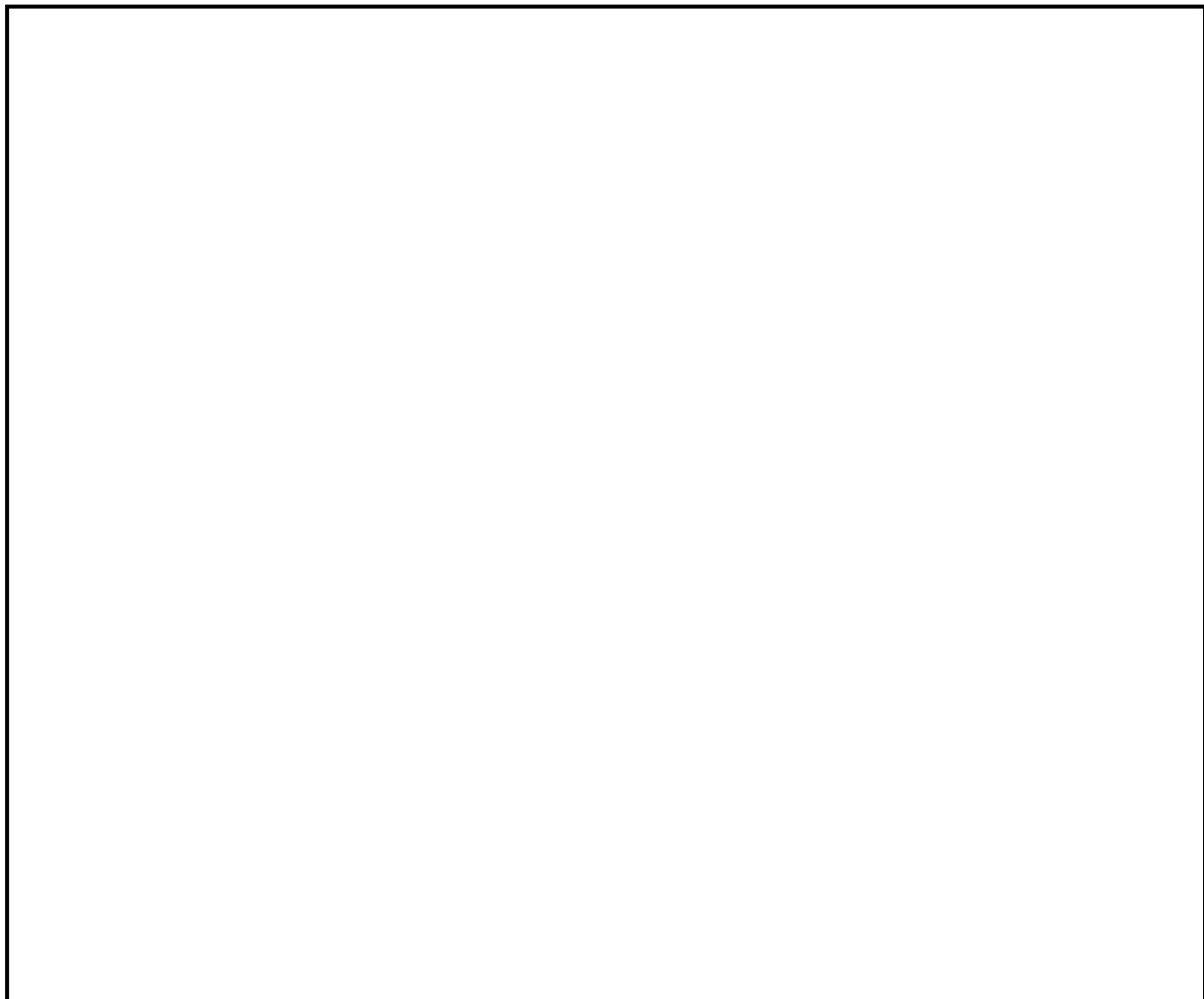


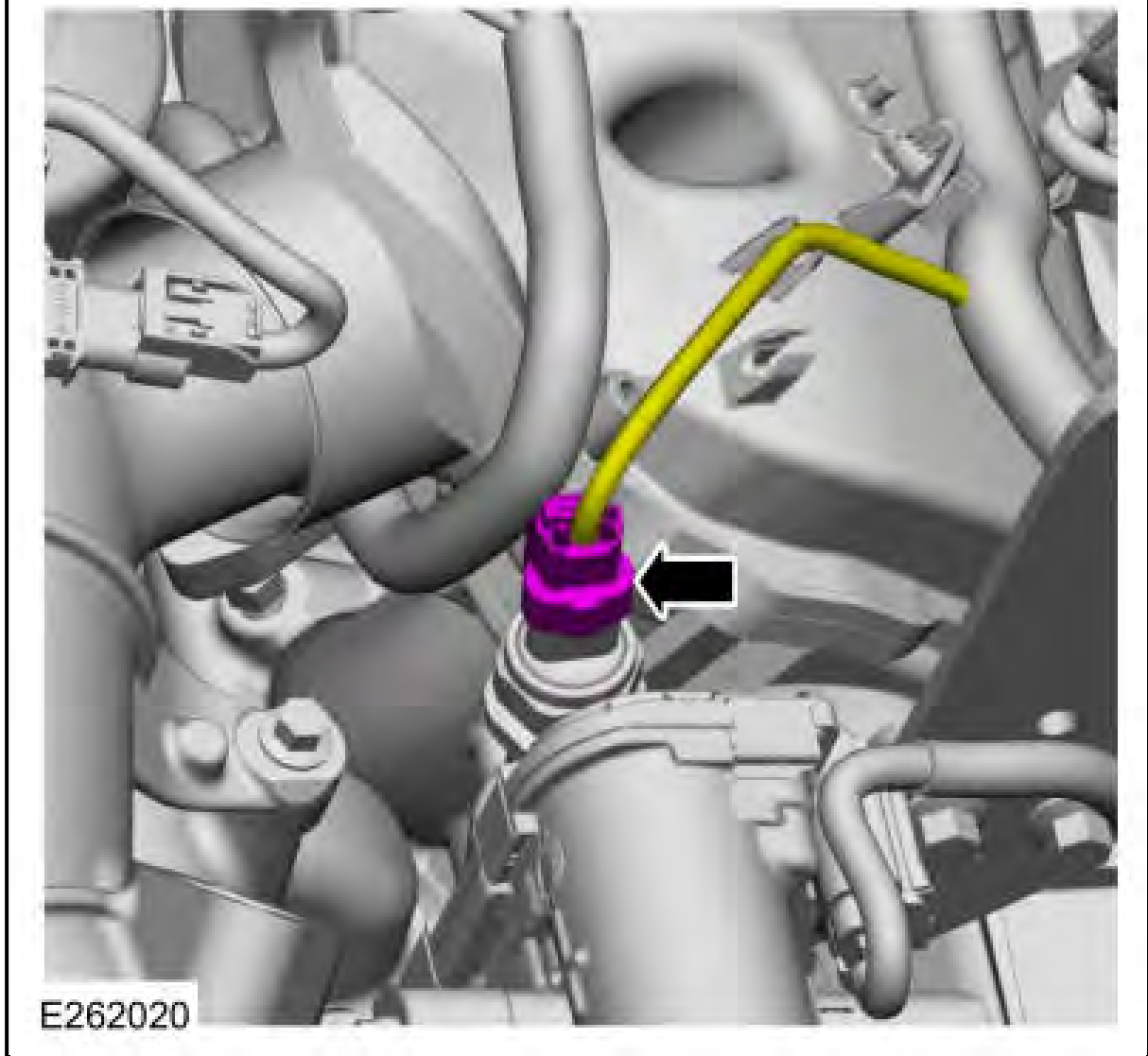
217. Connect the electrical connectors and the wire retainers.



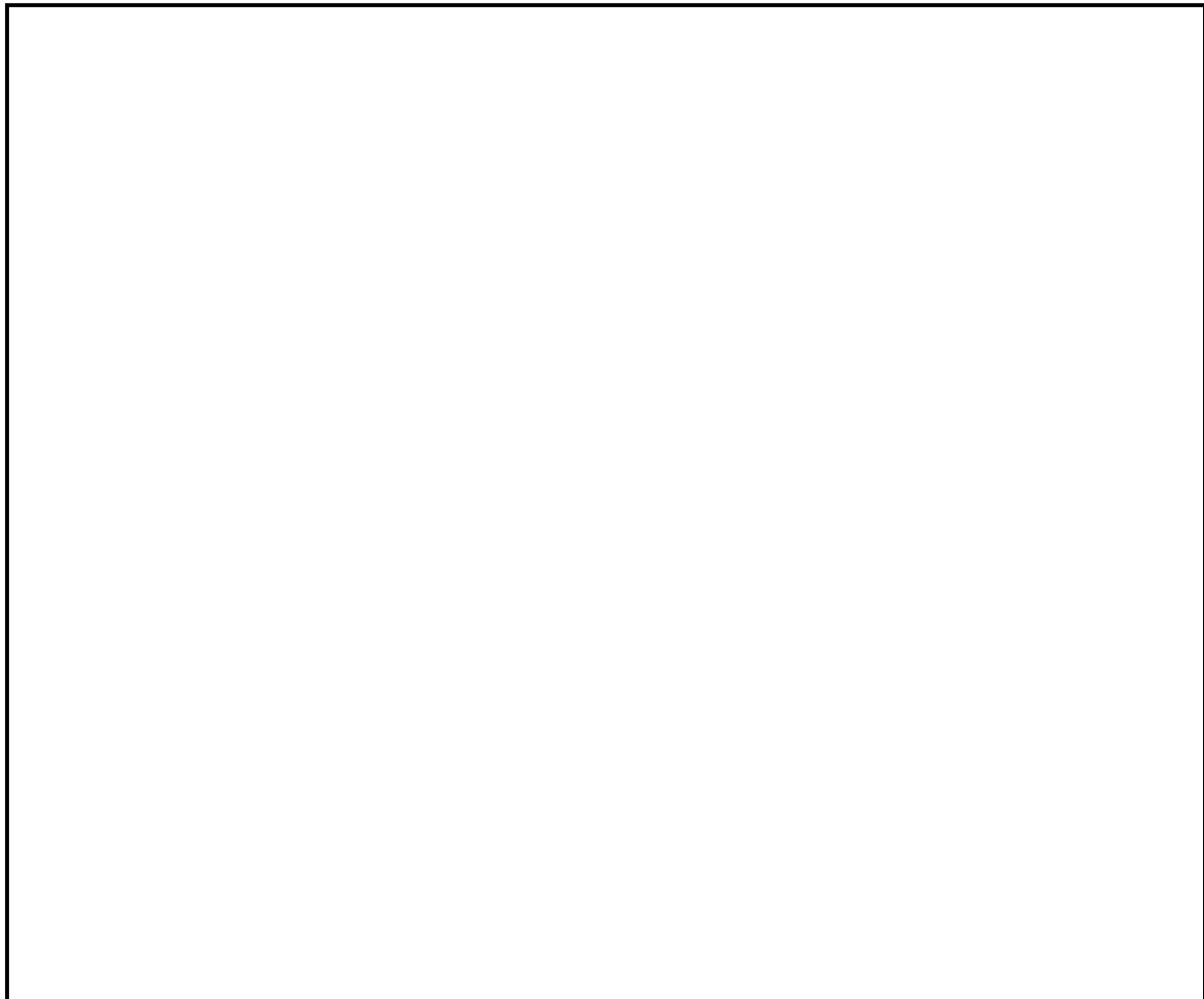


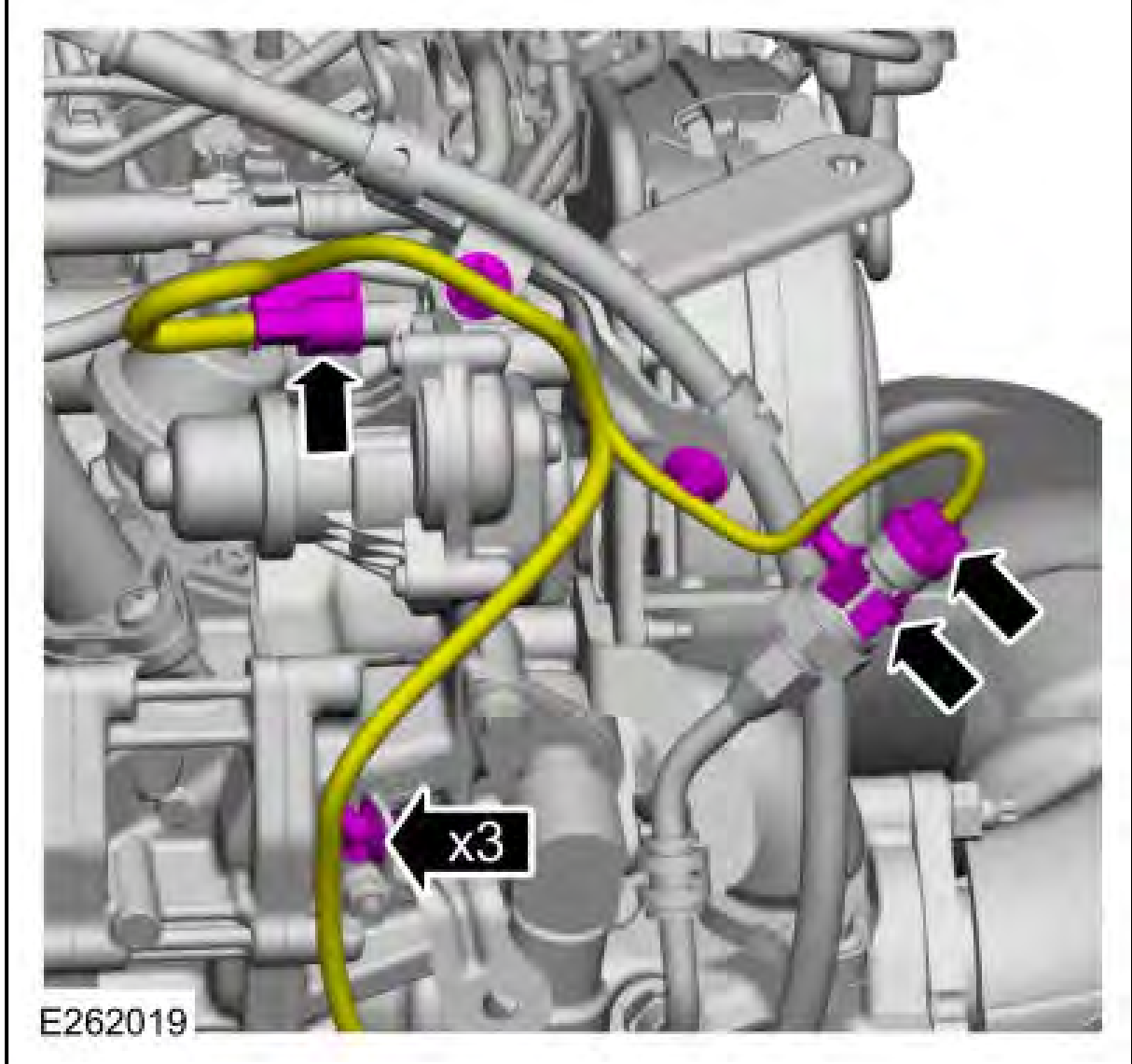
218. Connect the EOP sensor electrical connector.



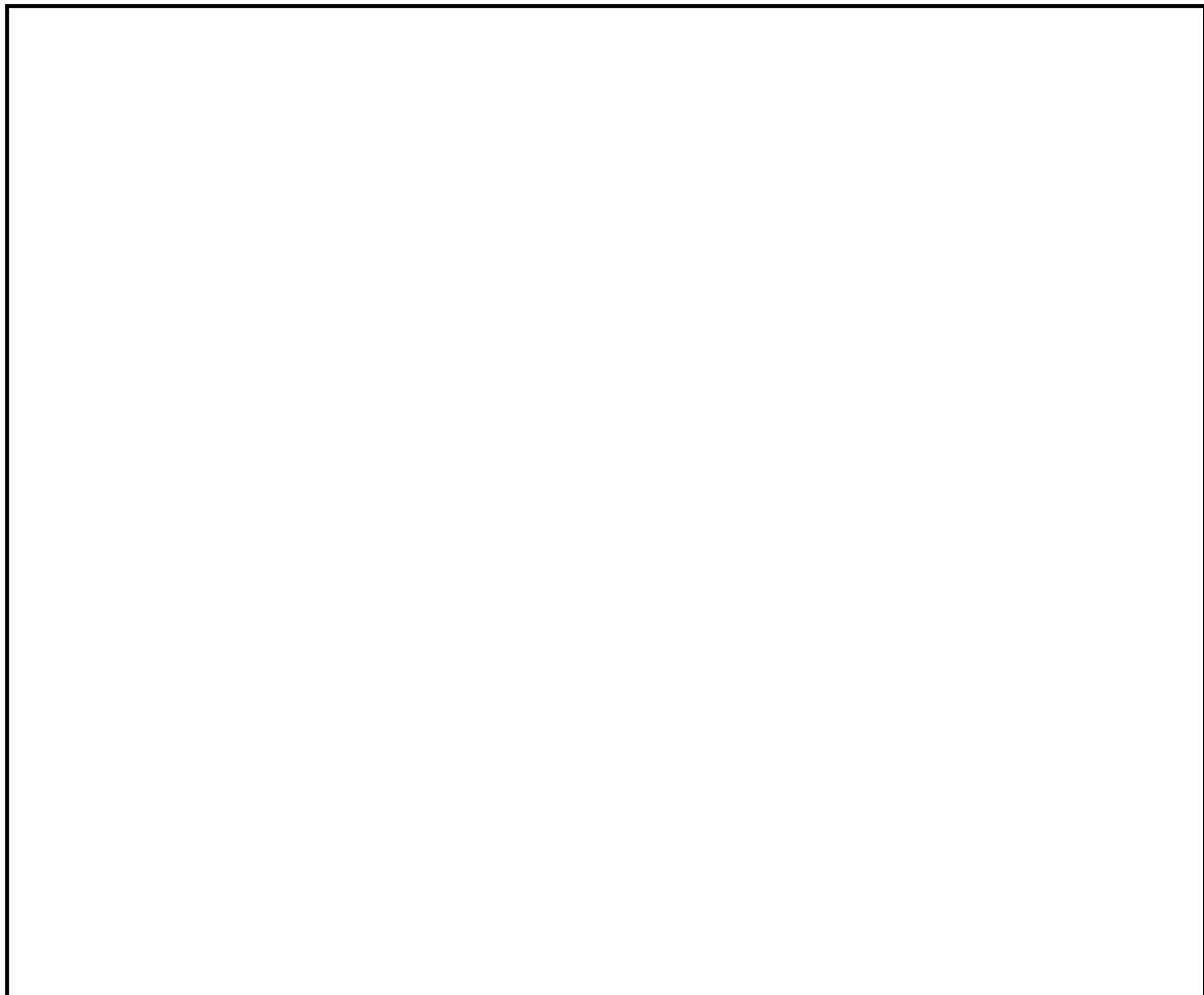


219. Connect the EGR valve and the EP sensor electrical connectors. Disconnect the wire retainers.

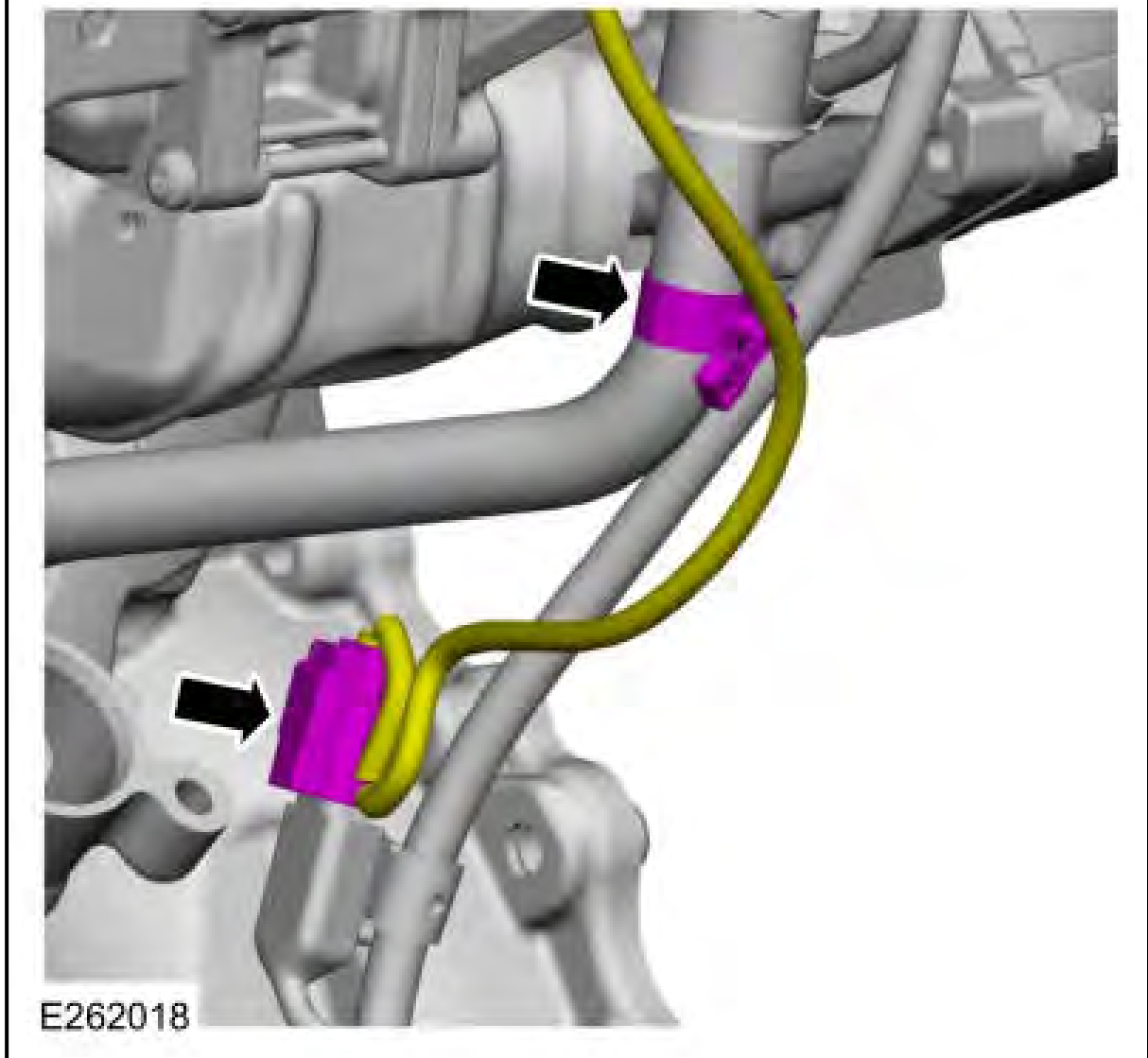




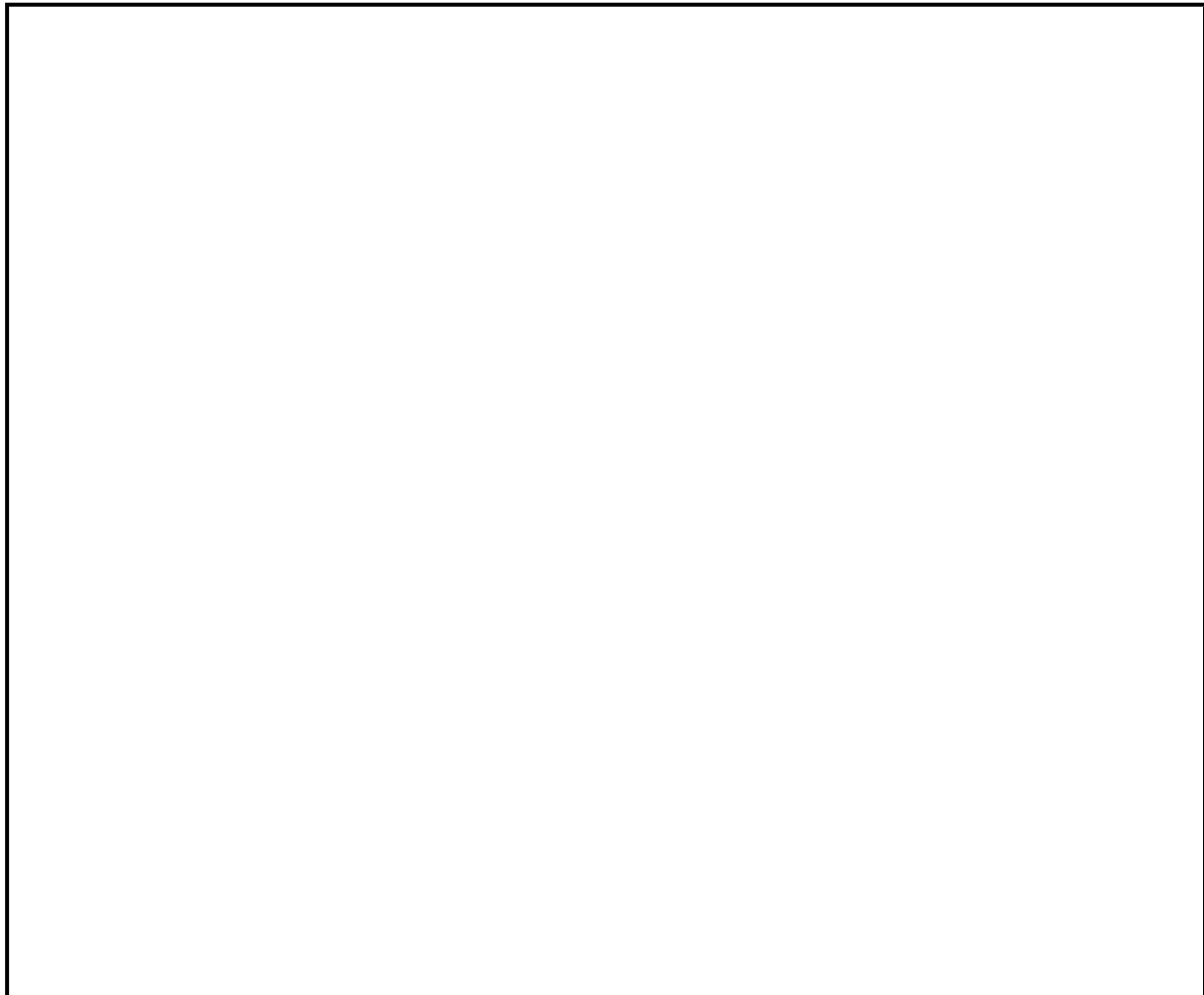
220. Connect the CKP electrical connector and the wire retainer.

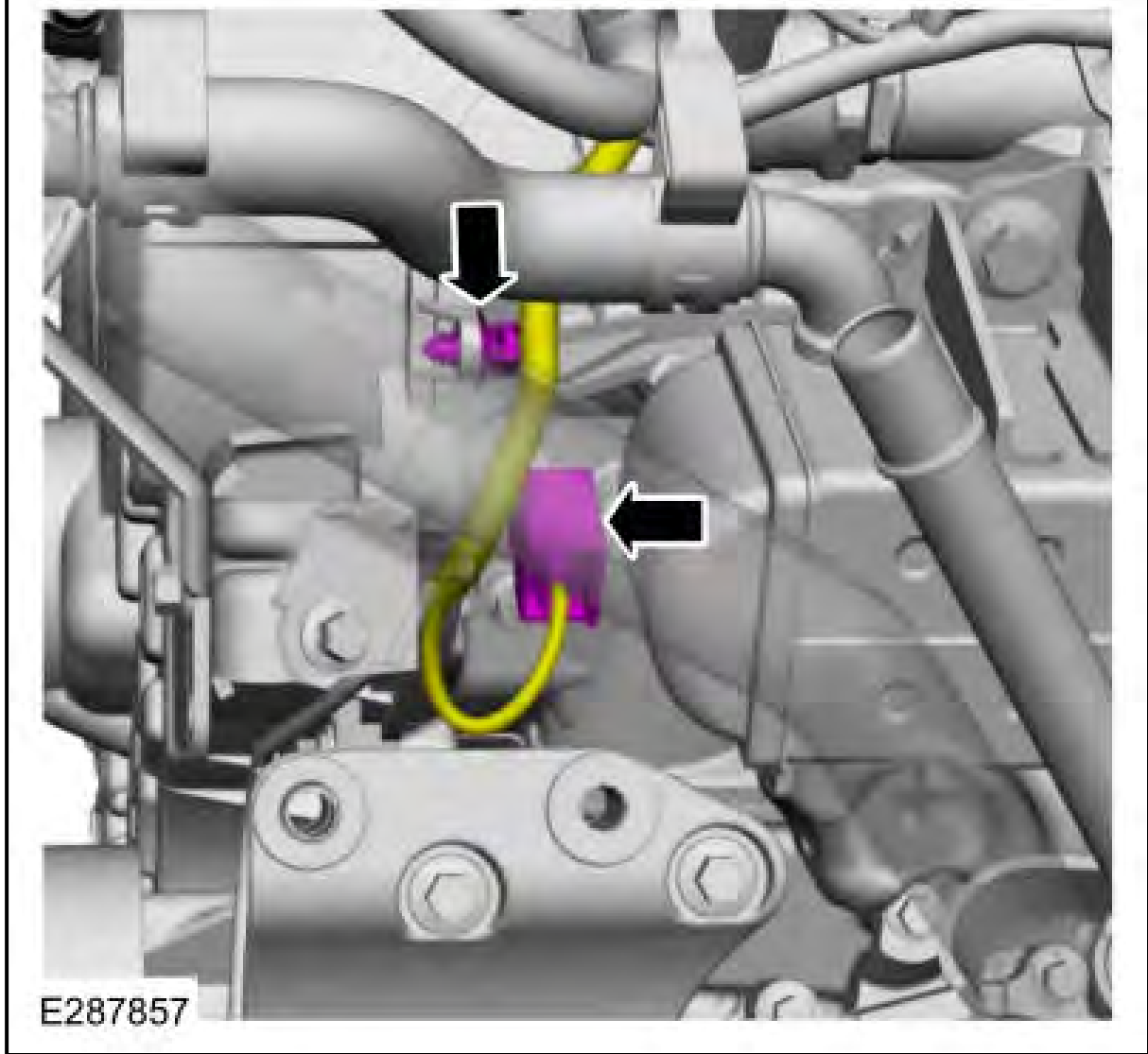




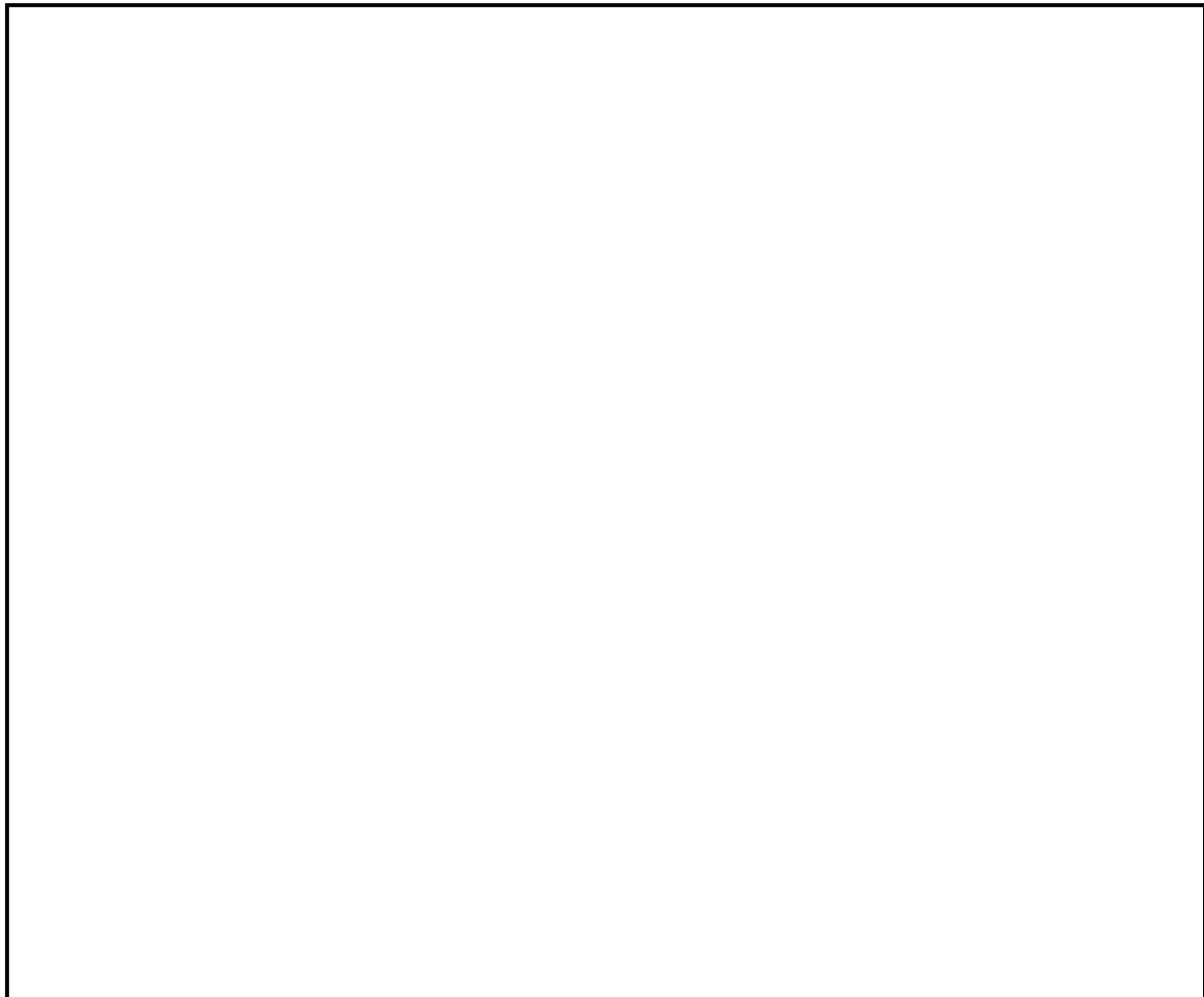


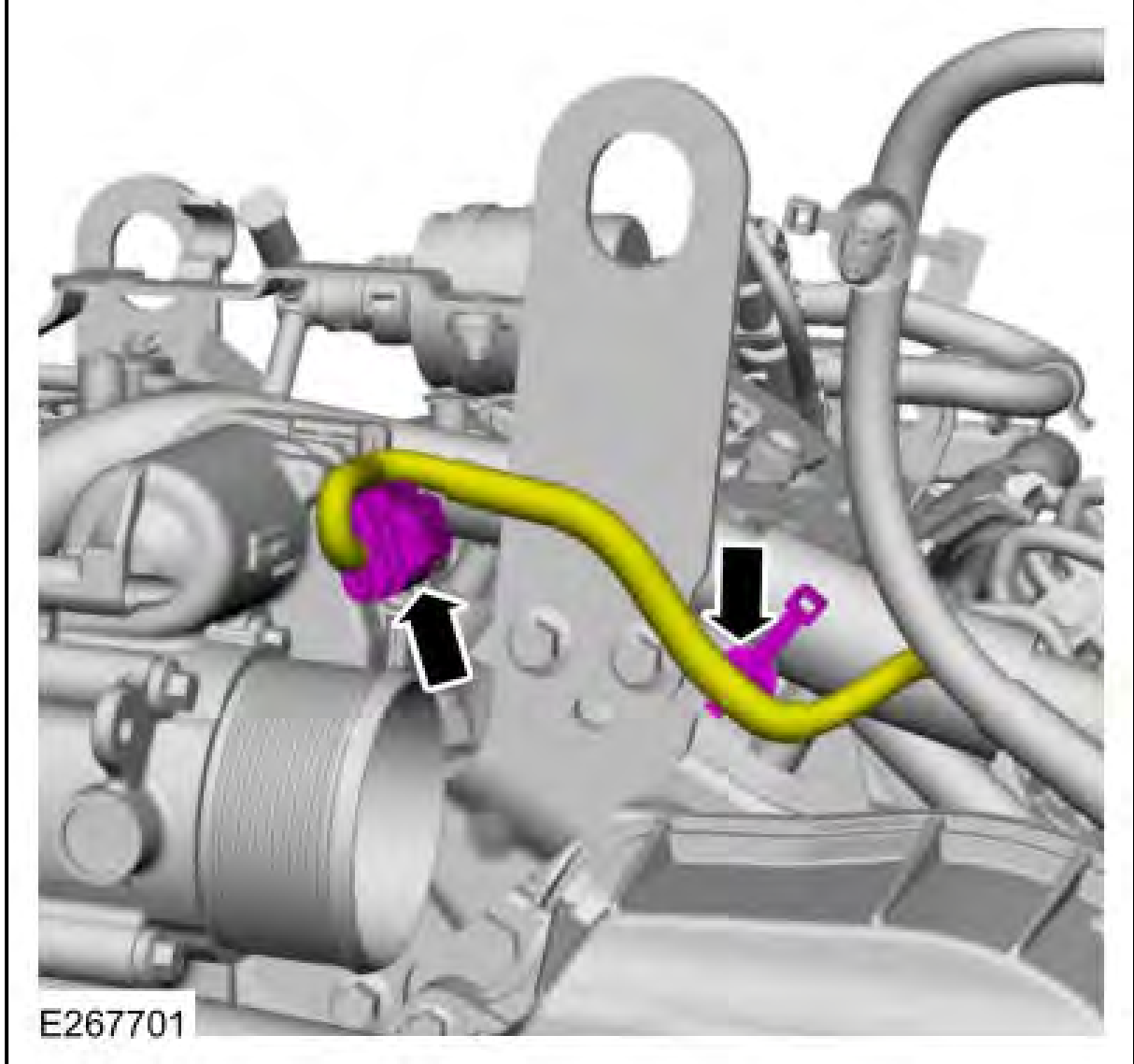
221. Connect the CMP electrical connector and the wire retainer.



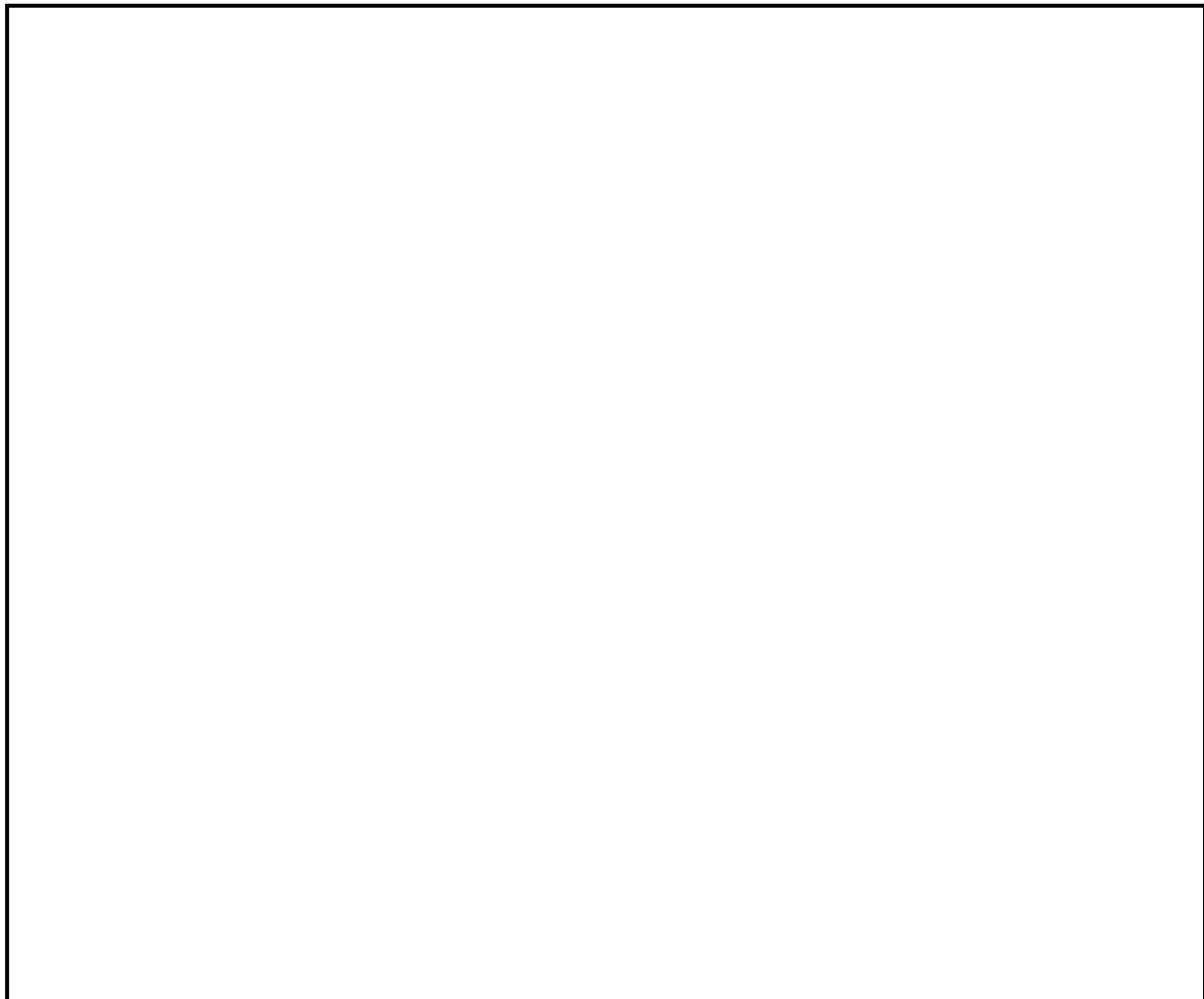


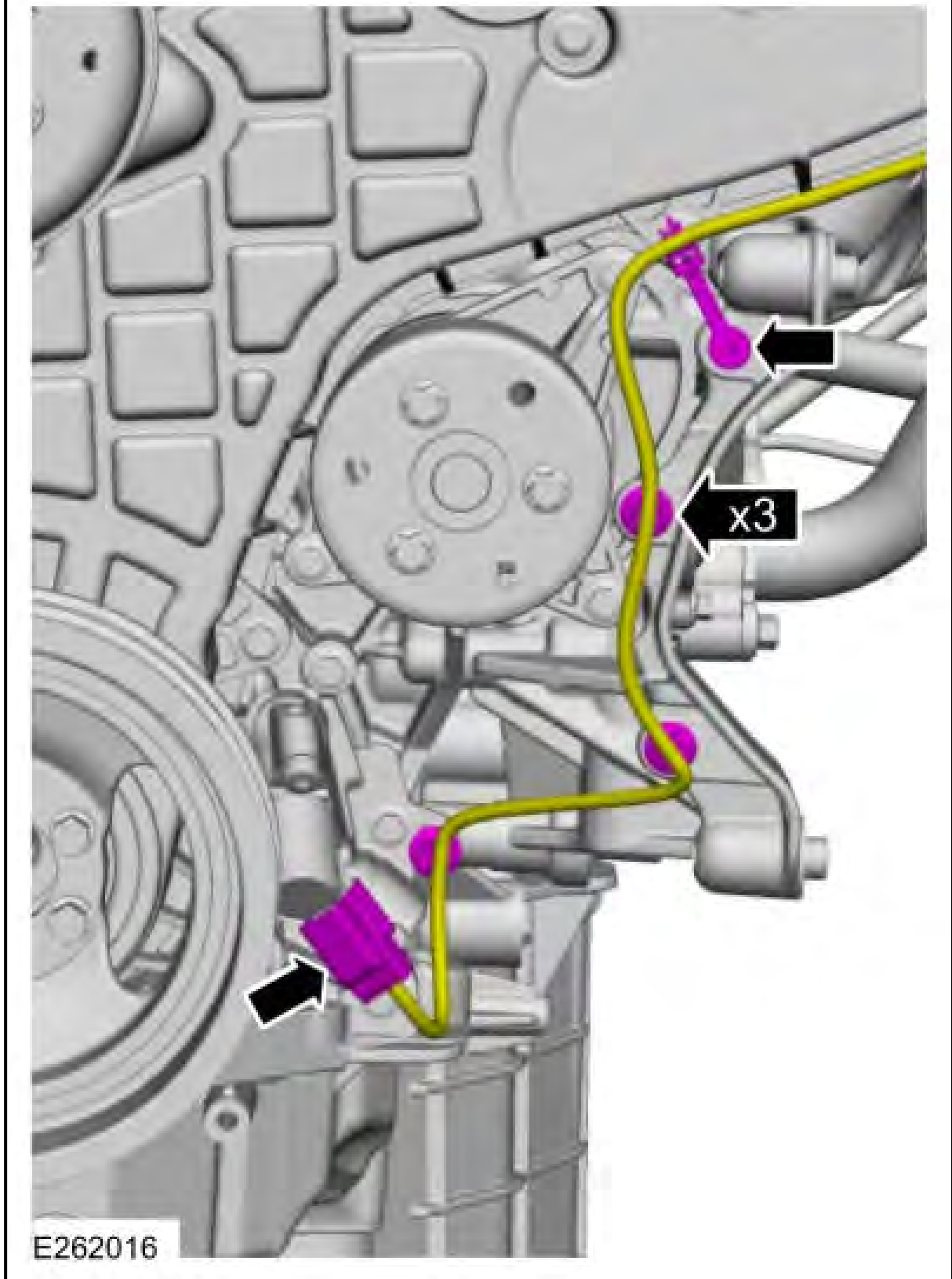
222. Connect the TB (throttle body) electrical connector and the wire retainer.



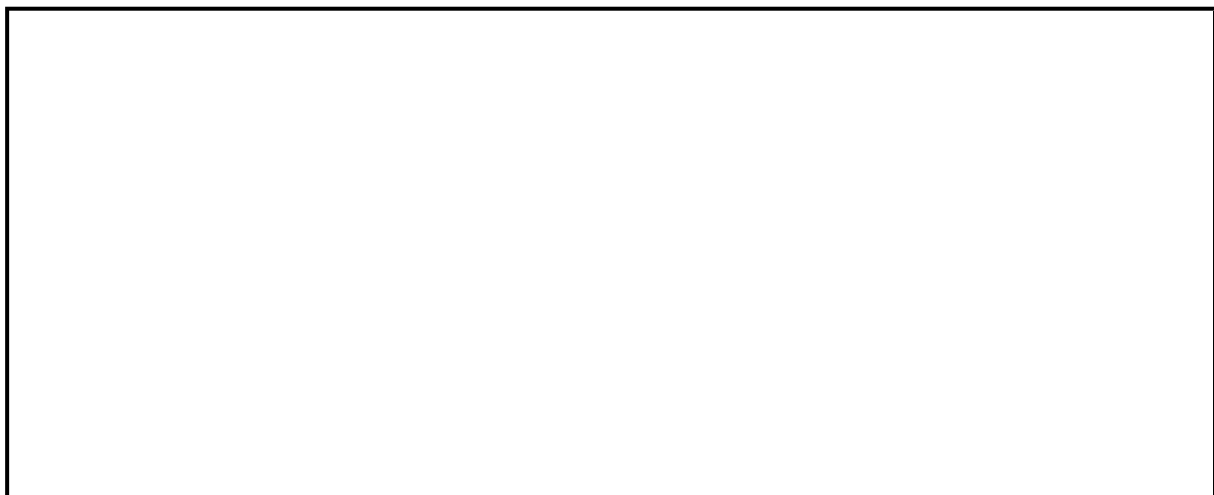


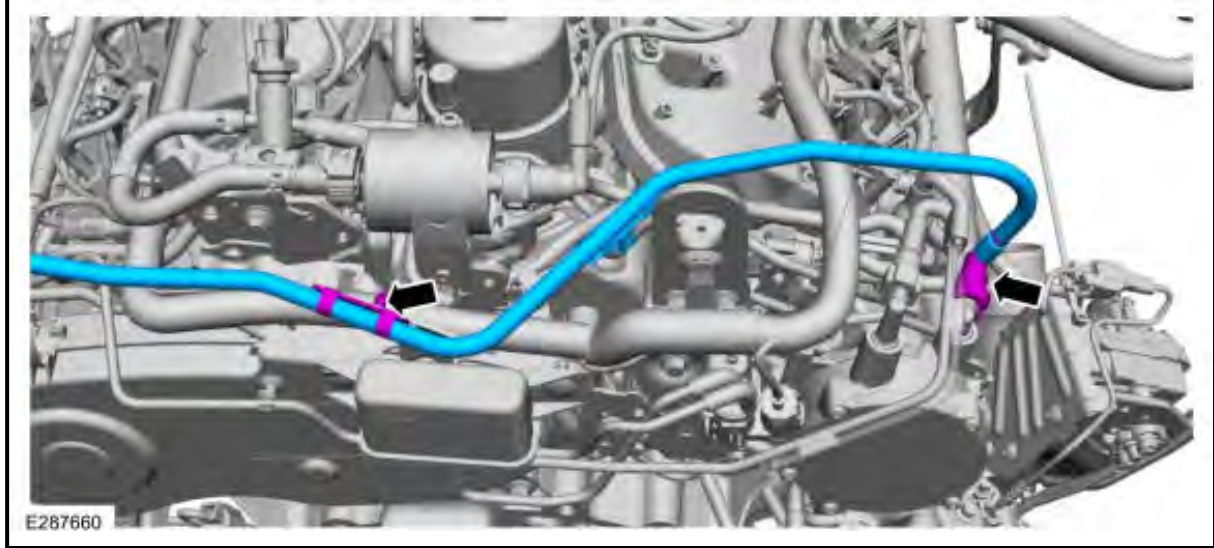
223. Connect the oil pump electrical connector and the wire retainers.



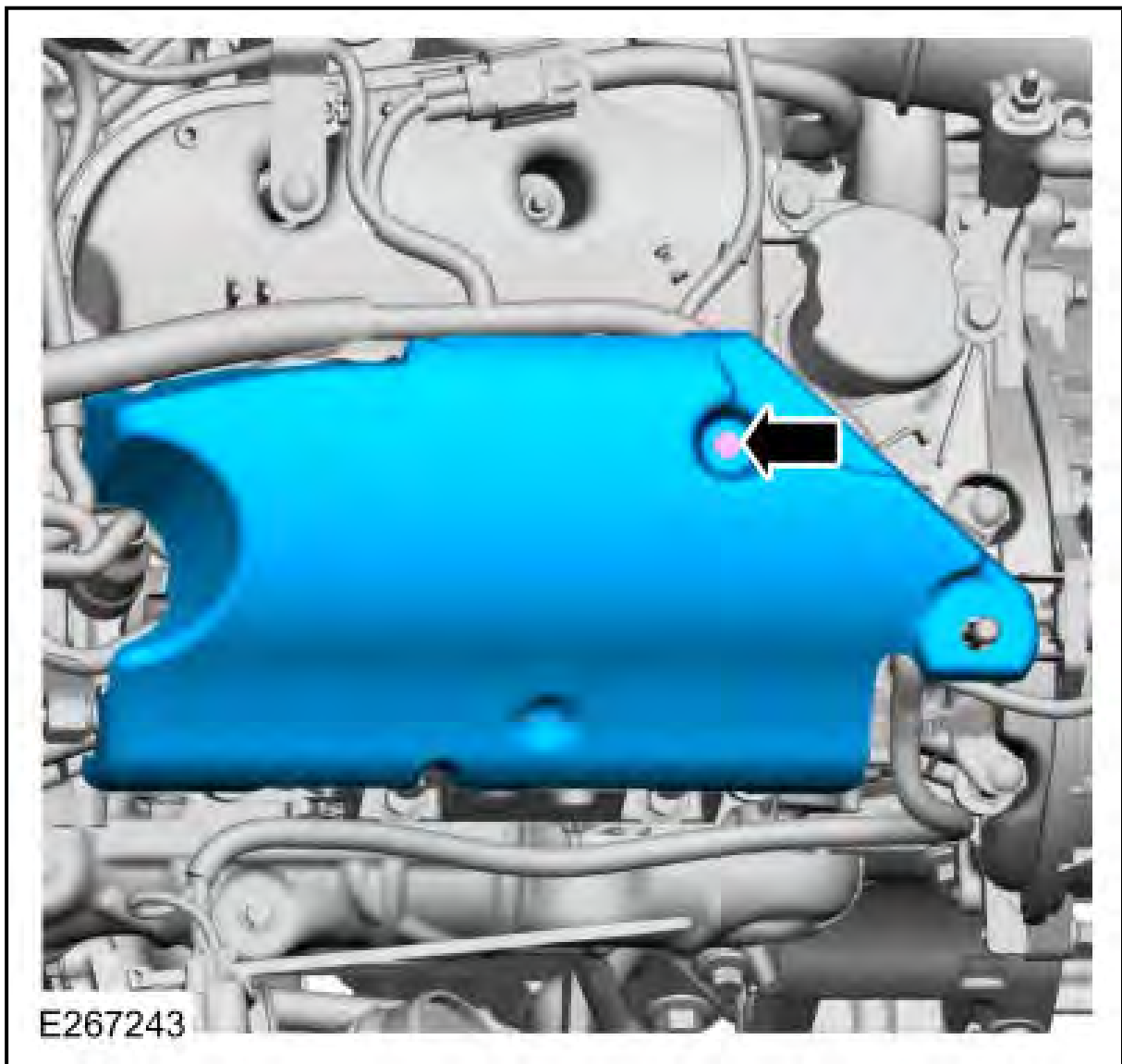


224. Install the brake vacuum hose and connect the retainer. Refer to: [Quick Release Coupling](#) .



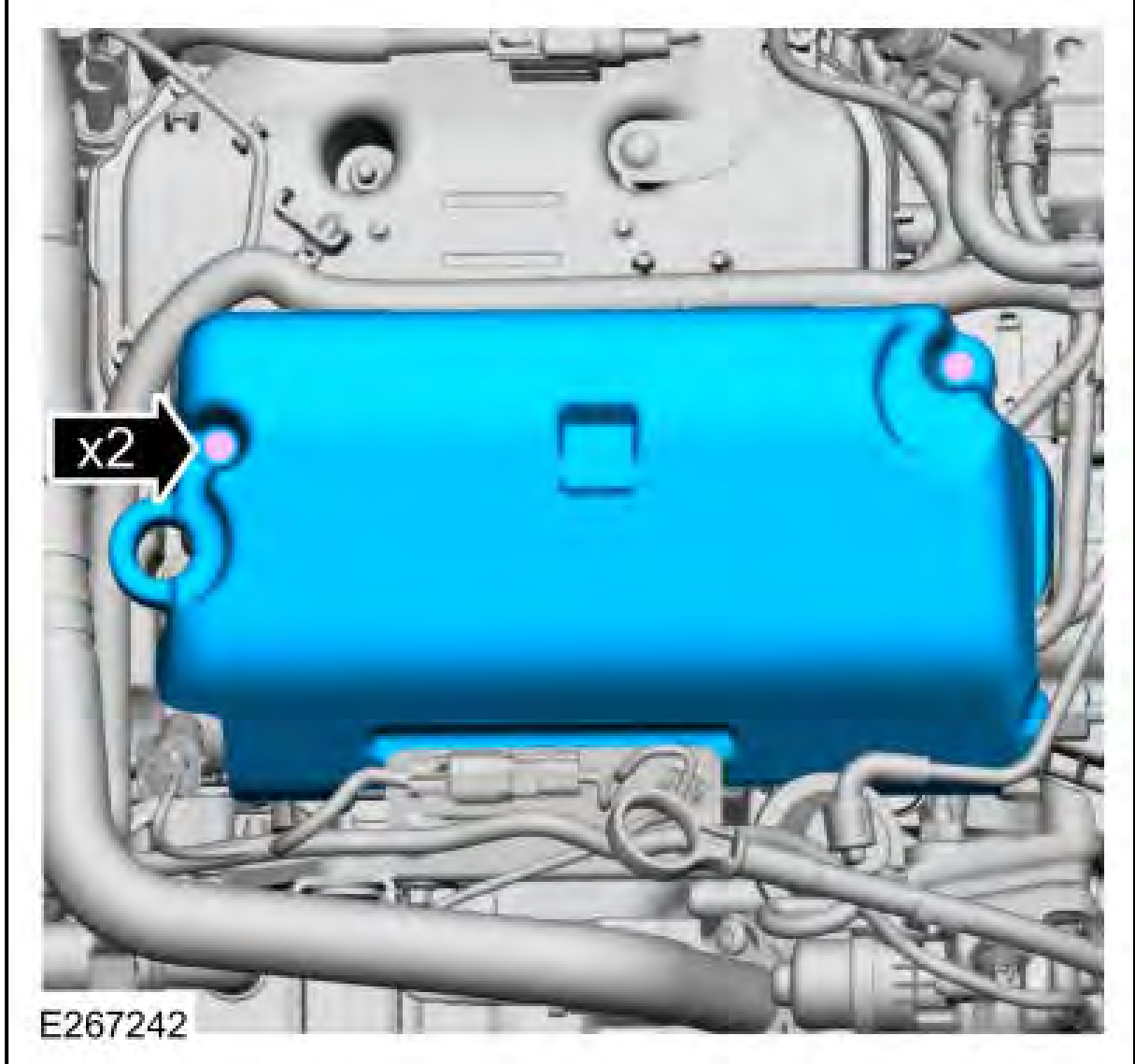


225. Remove the RH fuel injector noise insulator.



226. Install the LH fuel injector noise insulator.

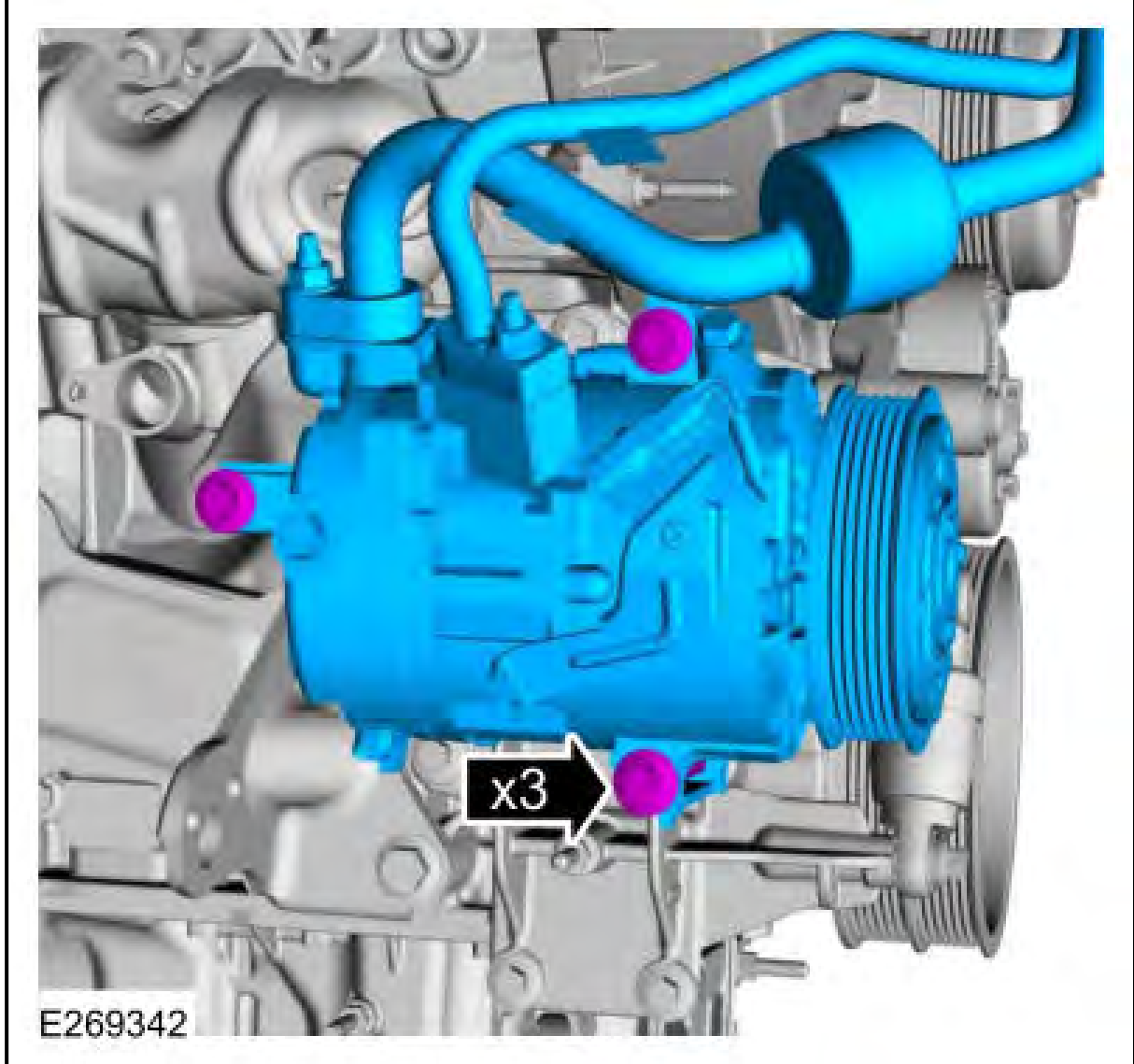




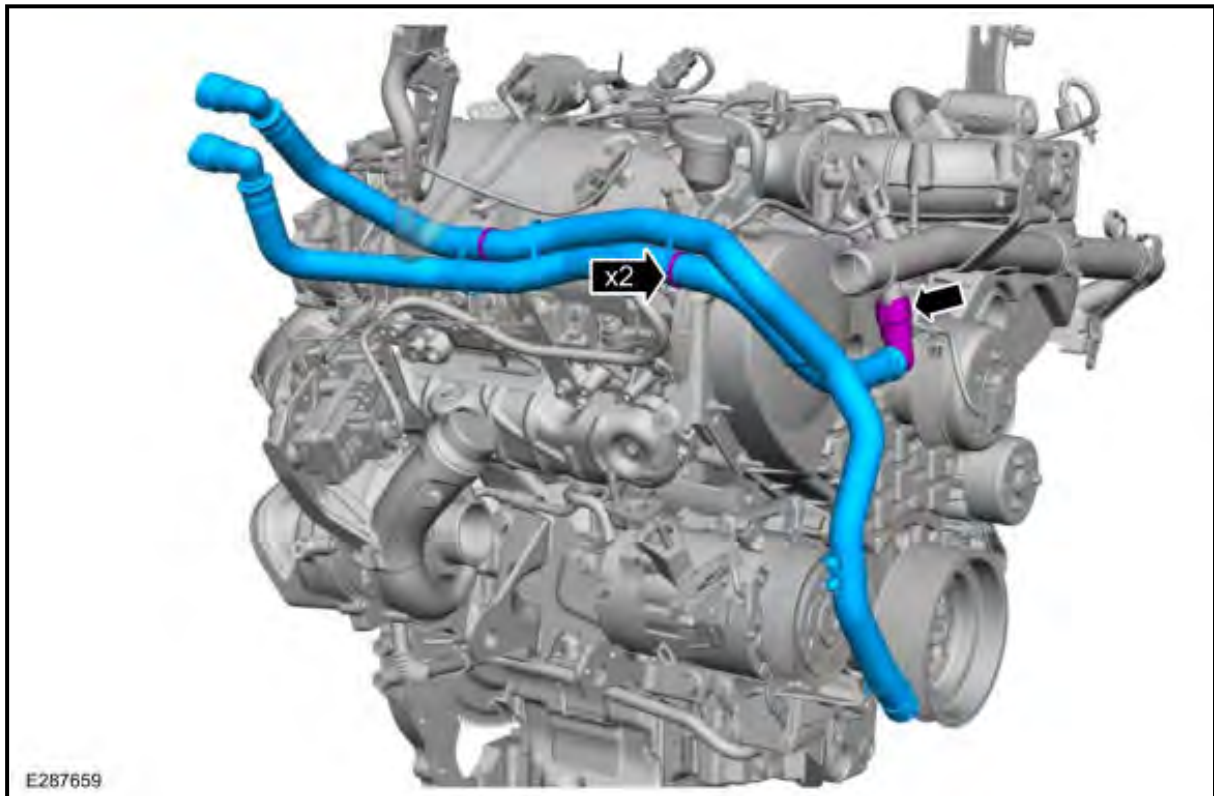
227. Install the A/C compressor and the bolts.

Torque: 18 lb.ft (25 Nm)



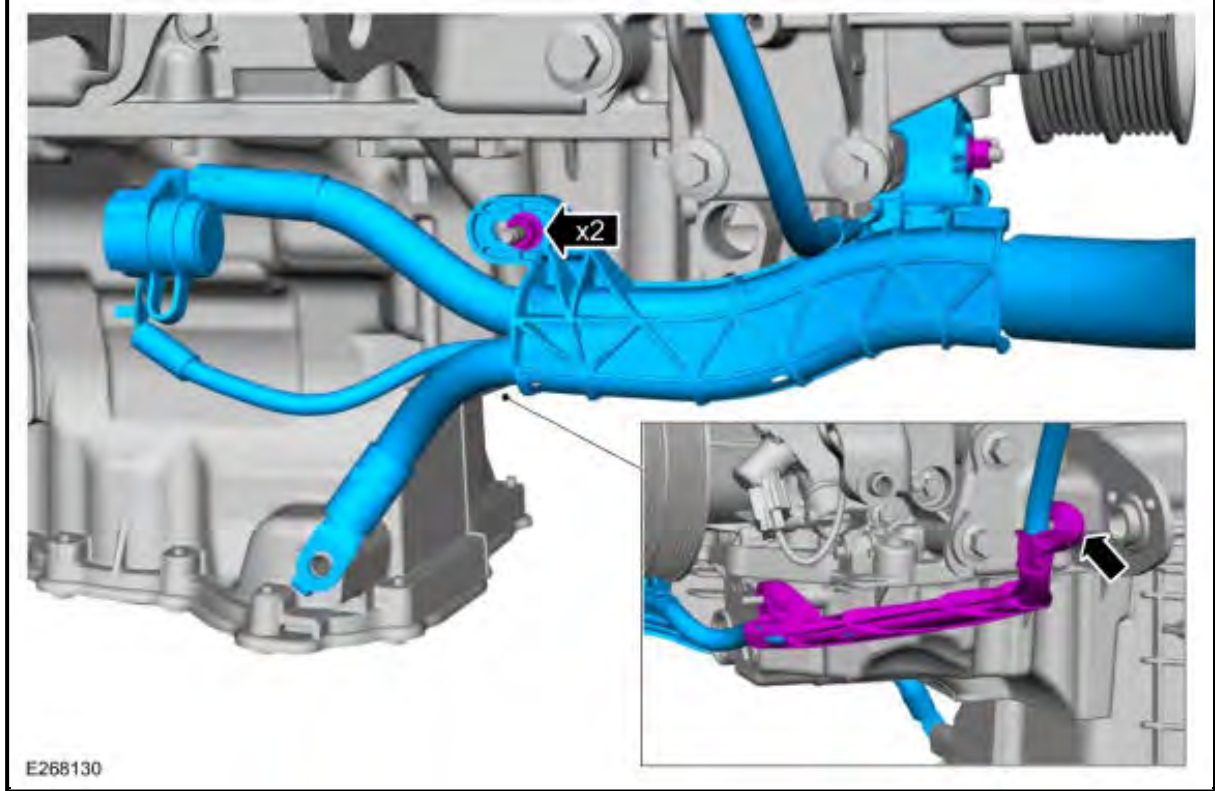


228. Install the coolant hoses and connect the coolant hose connector.



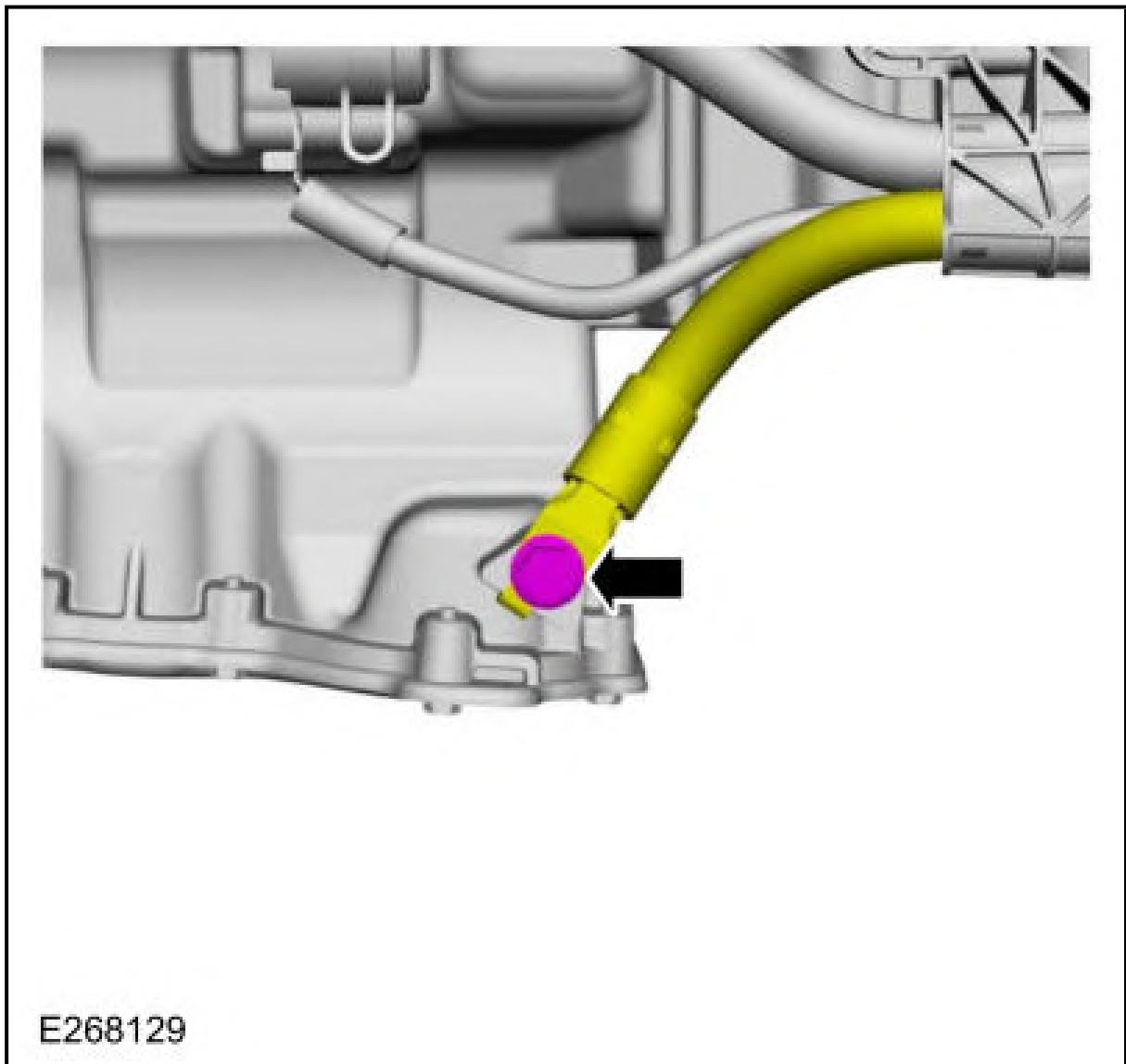
229. Install the battery cable harness and connect the wire harness retainer. Install the nuts.

Torque: 106 lb.in (12 Nm)



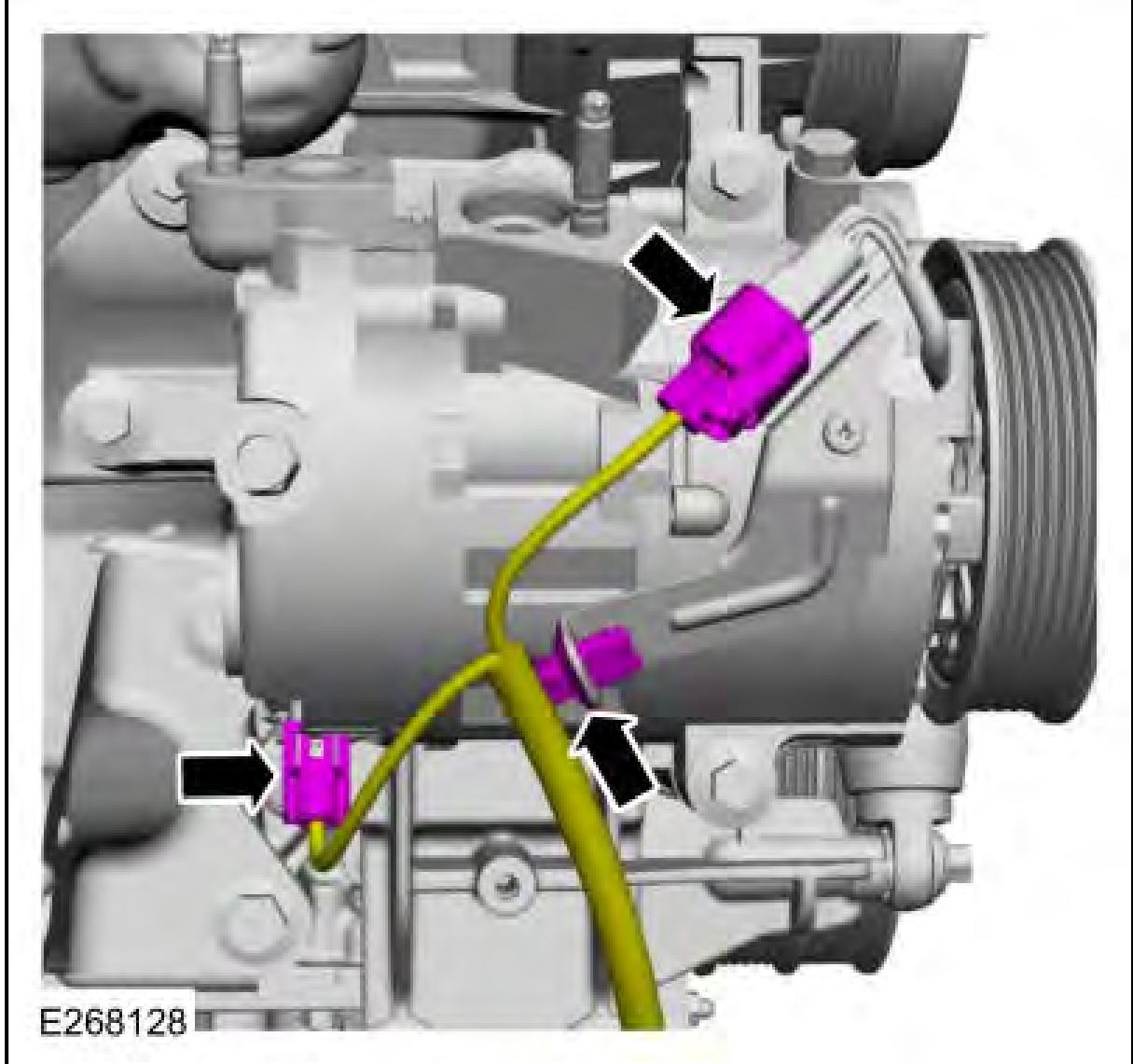
230. Install the ground cable bolt.

Torque: 18 lb.ft (25 Nm)



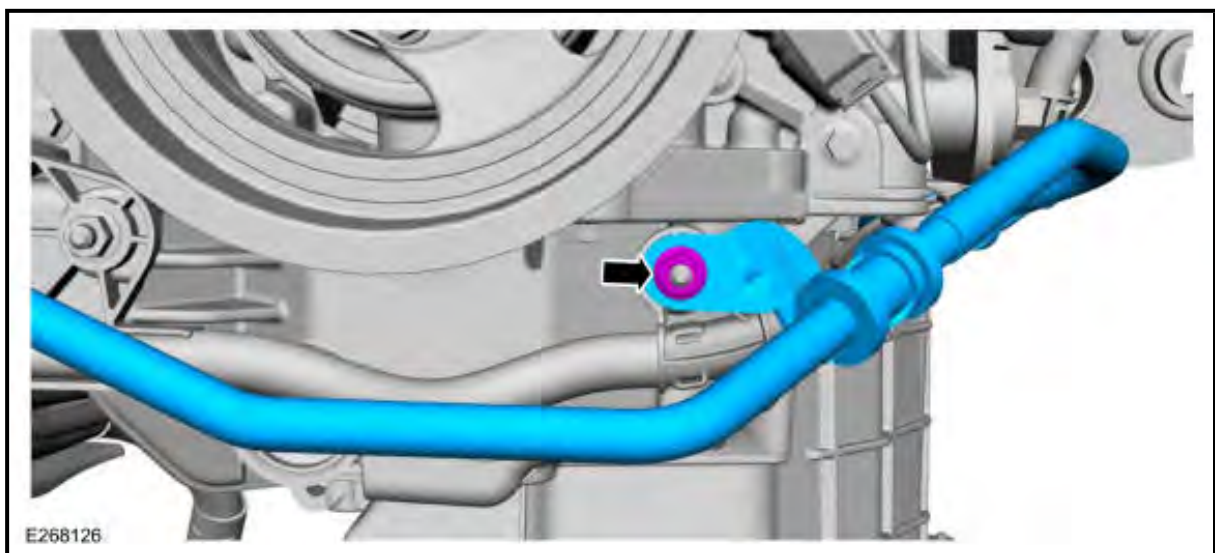
231. Connect the A/C electrical connectors and the wire retainer.





232. Install the coolant tube and the nut.

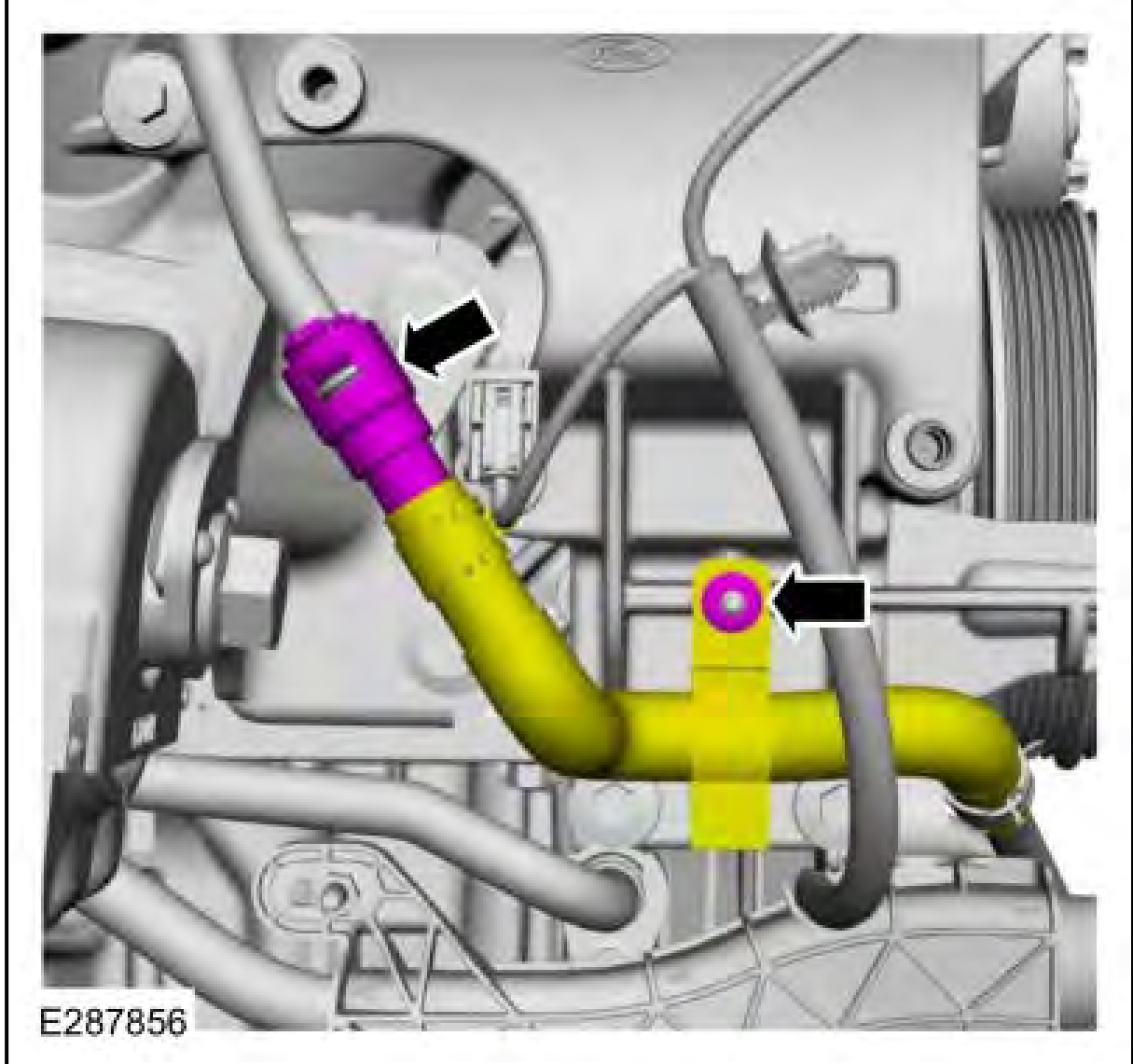
Torque: 106 lb.in (12 Nm)



233. Position back and connect the coolant hose. Install the nut for the coolant hose bracket.

Torque: 106 lb.in (12 Nm)

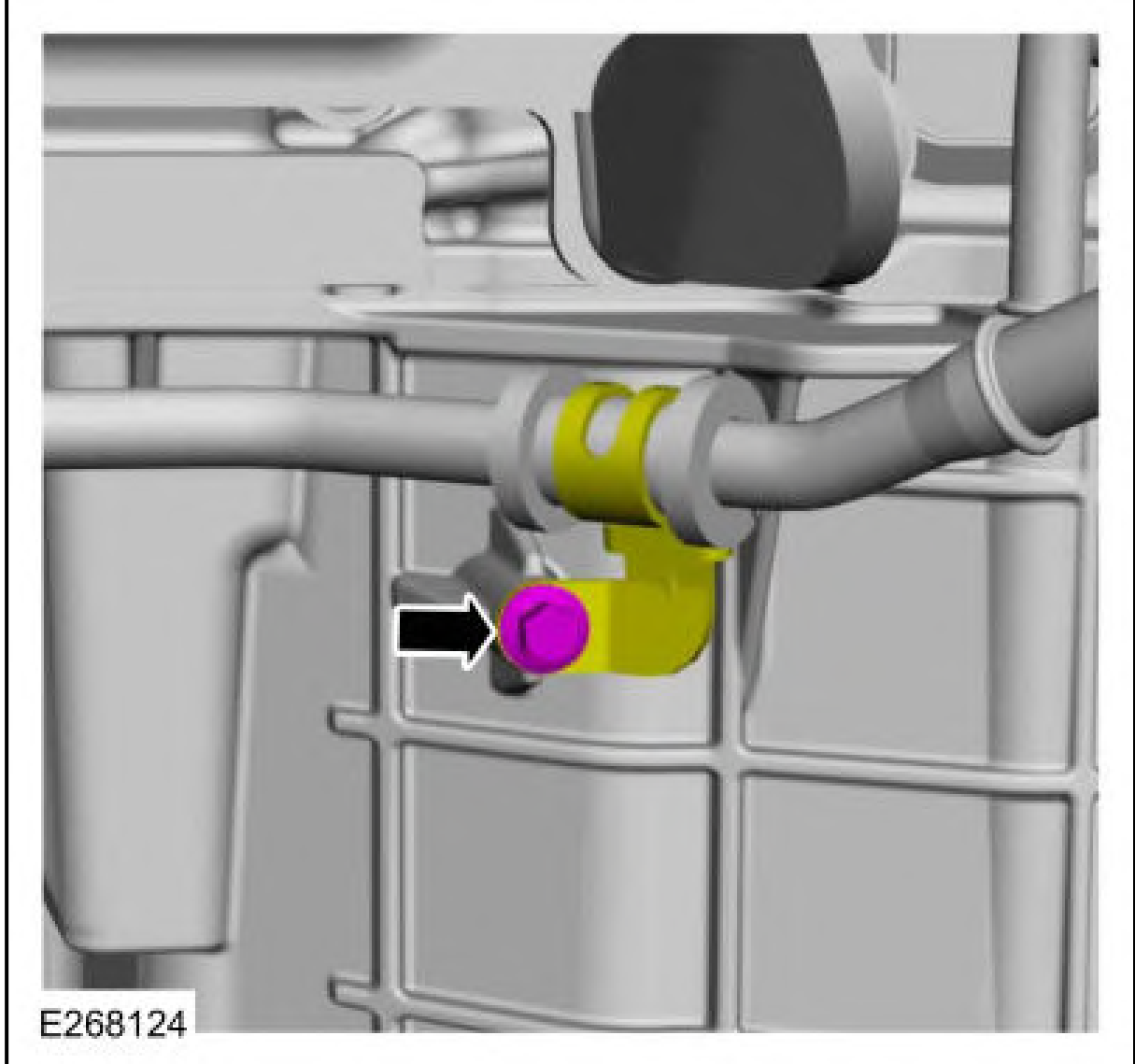




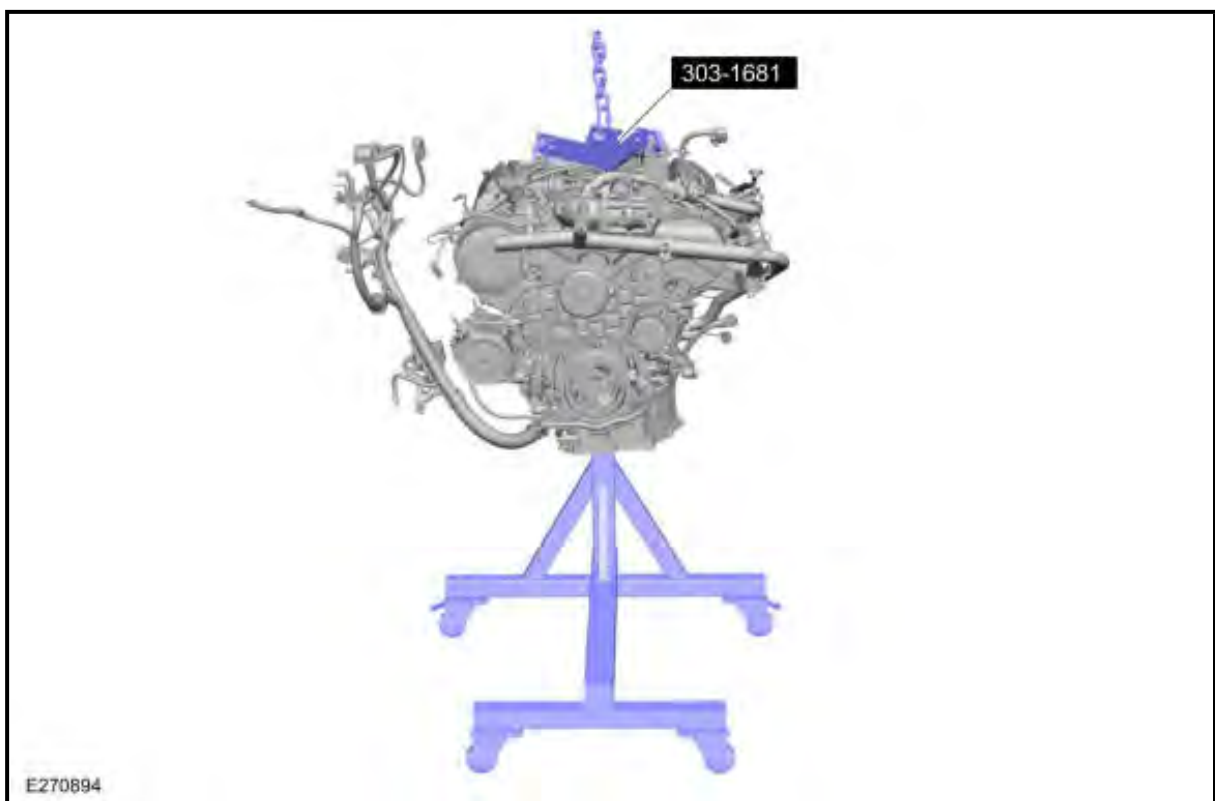
234. Install the bolt for the coolant tube.

Torque: 62 lb.in (7 Nm)

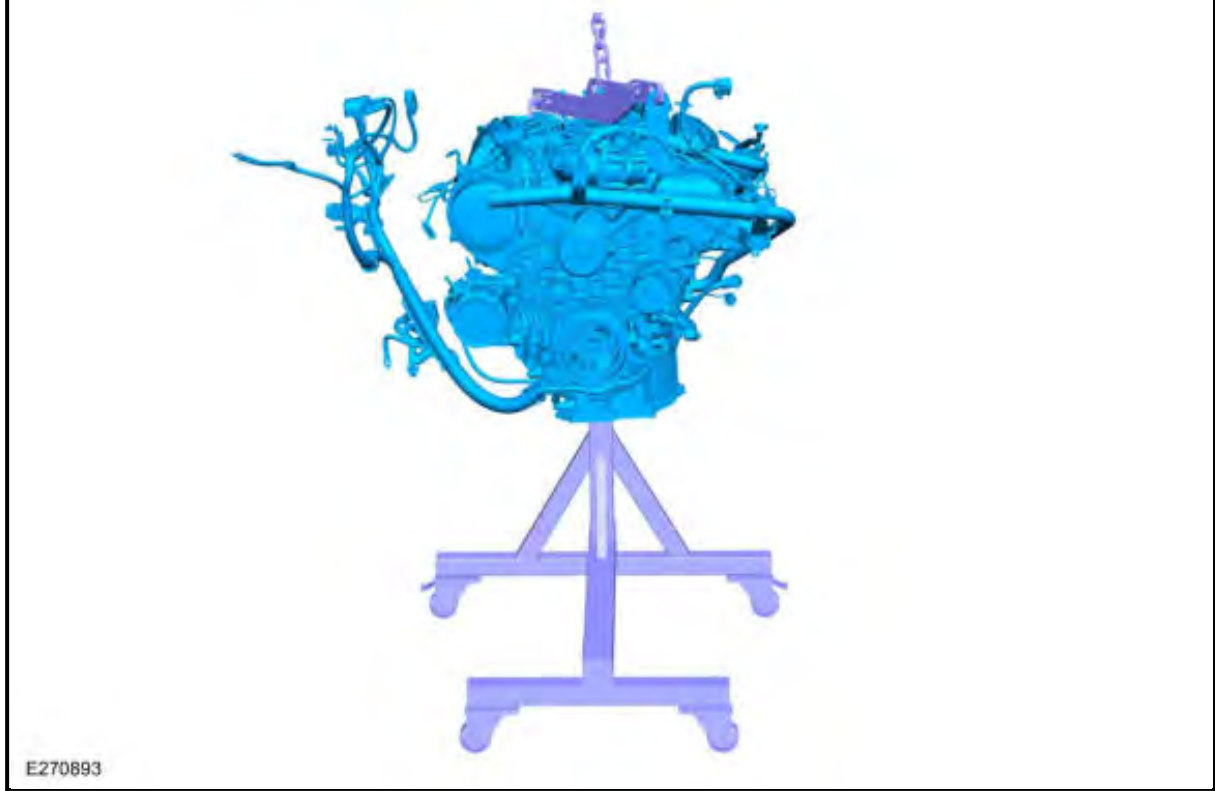




235. Install the floor crane and special tool. Use Special Service Tool: 303-1681 Spreader Bar. Use the General Equipment: Floor Crane



236. Using a floor crane, remove the engine from the mounting stand. Use the General Equipment: Floor Crane Use the General Equipment: Mounting Stand



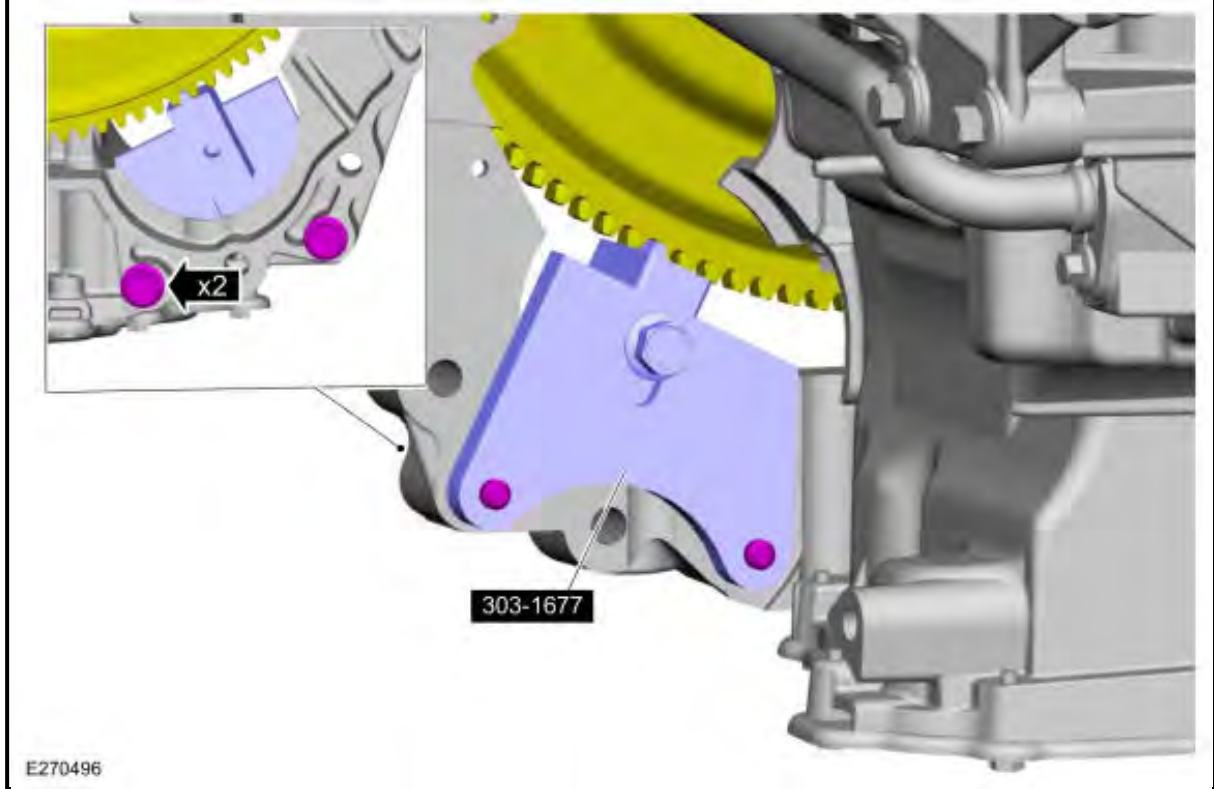
237. Install the flexplate and the bolts.



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

Install the special tool and the bolts. Use Special Service Tool: 303-1677 Locking Tool, Flywheel.

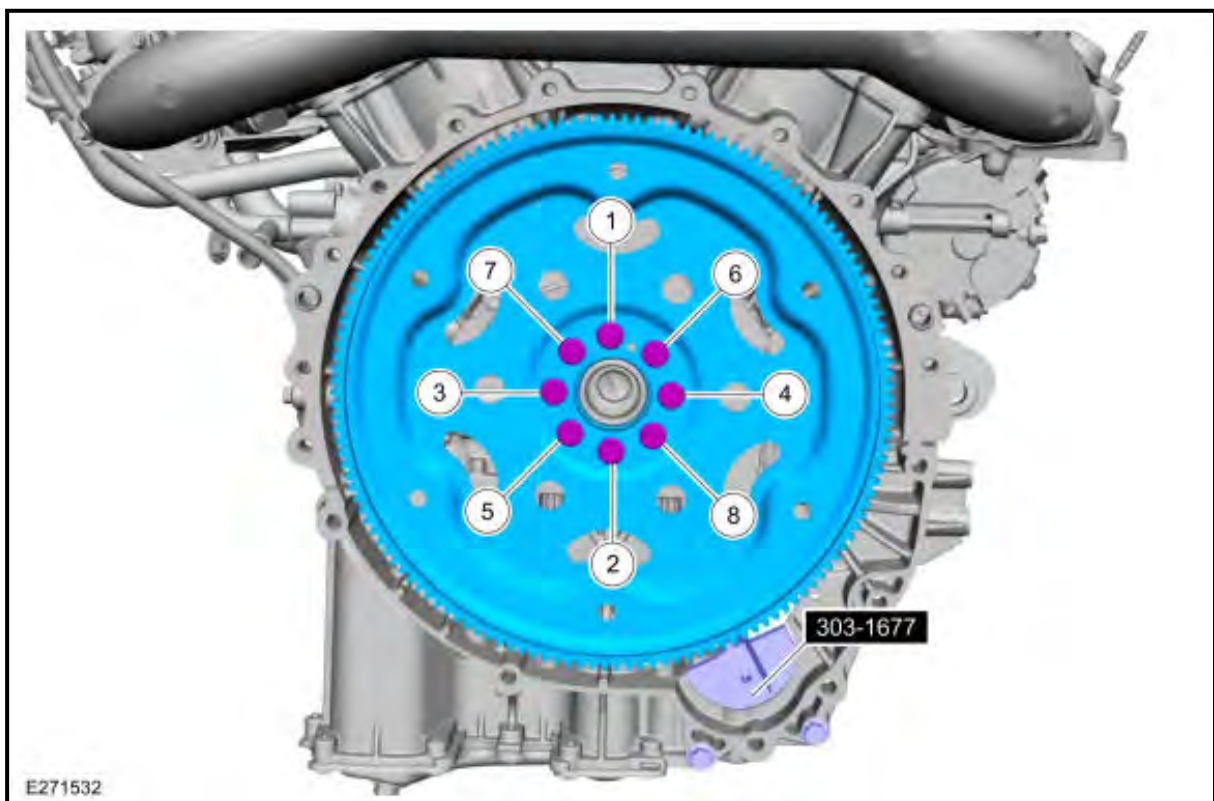




239. Tighten the flexplate bolts. Use Special Service Tool: 303-1677 Locking Tool, Flywheel.

Torque

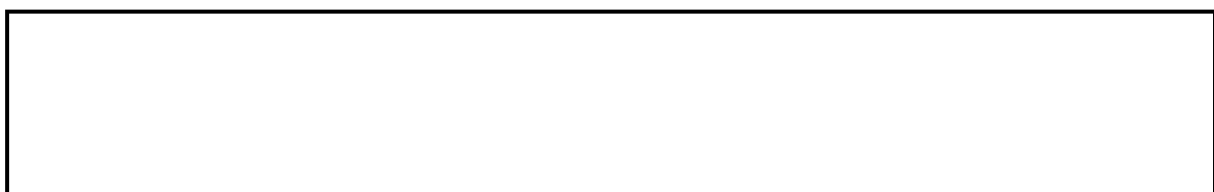
: Stage 1: 37 lb.ft (50 Nm) Stage 2: 45 Å° Stage 3: 45 Å°

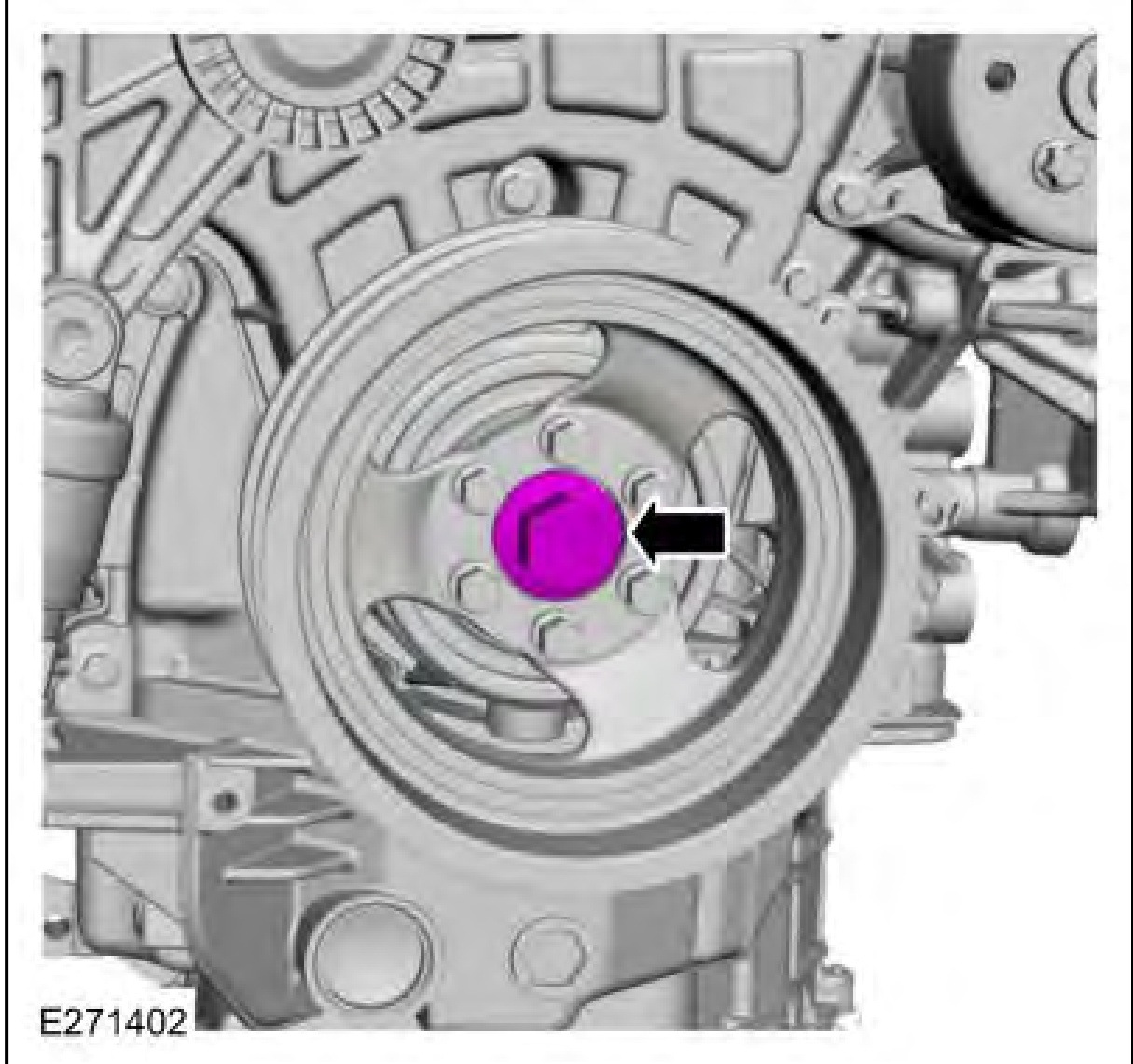


240. Final tighten the crankshaft bolt.

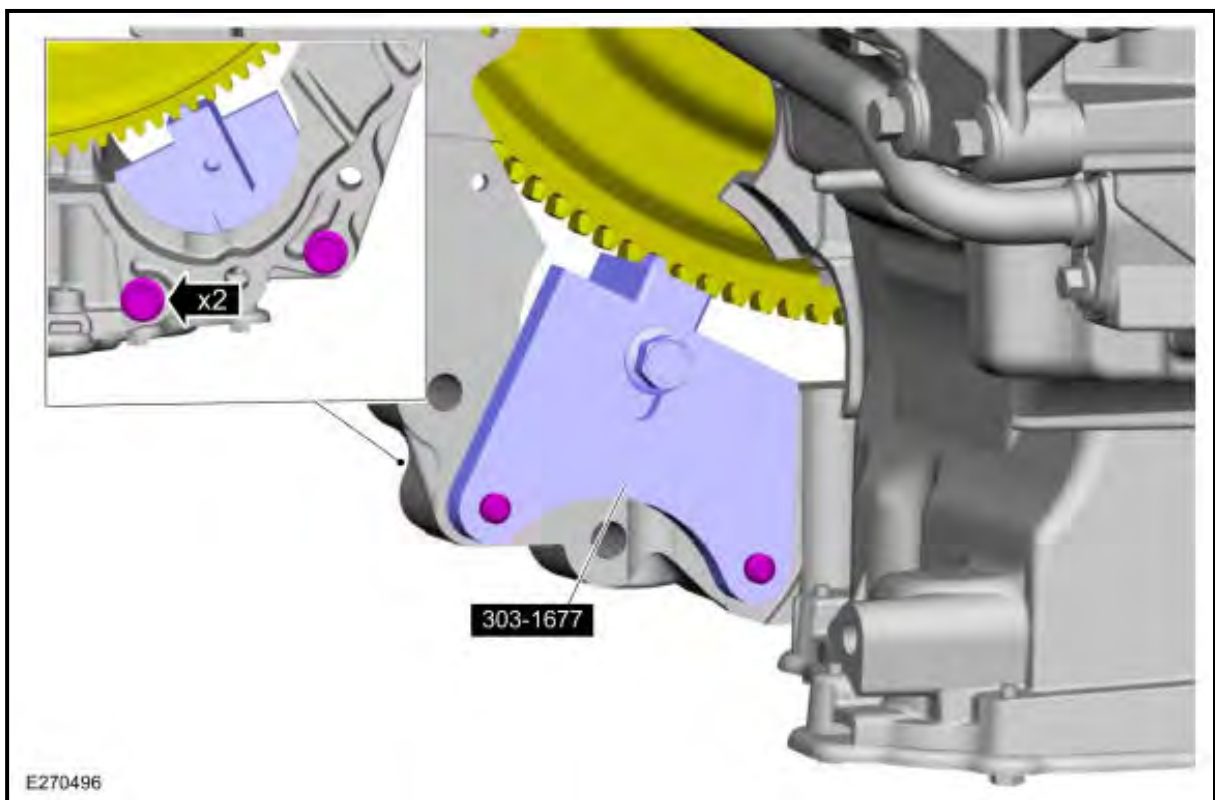
Torque

: Stage 1: 221 lb.ft (300 Nm) Stage 2: 90 Å°





241. Remove the bolts and the special tool. Use Special Service Tool: 303-1677 Locking Tool, Flywheel.




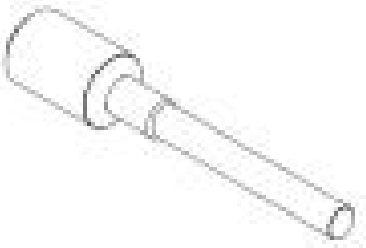
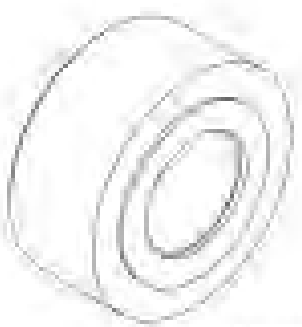


242. Install the engine. Refer to: [Engine - Body Off](#). Refer to: [Engine - Body On](#).

## INSTALLATION

**CYLINDER HEAD - BODY OFF - LH**

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

**Special Tool(s) / General Equipment**

|   |  |
|---|--|
|  <p><b>E274086</b></p>   | <p><b>303-1670 Pins, Camshaft Locking</b></p>      |
|  <p><b>E274087</b></p>   | <p>303-1671 Pin, Locking Crankshaft</p>            |
|  <p><b>E274089</b></p> | <p>303-1673 Installer, Camshaft Seal</p>           |
|  <p><b>E274090</b></p> | <p>303-1674 Tool, Holding Camshaft Sprocket</p>    |
|  <p><b>E274095</b></p> | <p>303-1679 Timing Tool, Fuel Pump Rear Access</p> |



303-1670 Pins, Camshaft Locking

E274086

Oil Drain Equipment

Hose Clamp Remover/Installer

## Materials

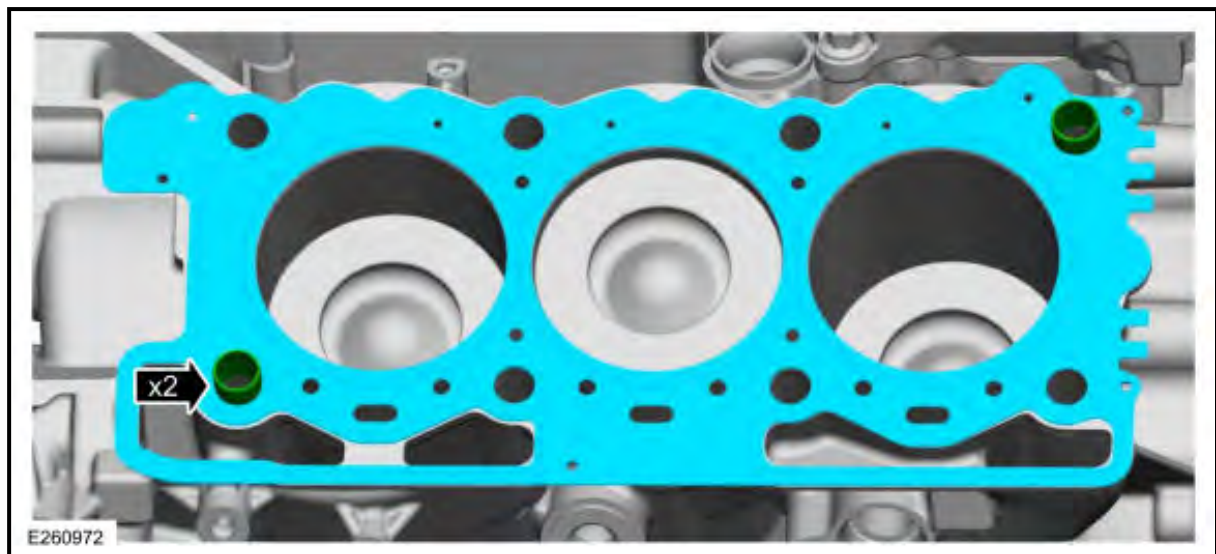
| Name  | Specification  |
|---|----------------|
| Motorcraft <sup>®</sup> High Performance Engine RTV Silicone TA-357   | WSE-M4G323-A6  |
| Flange Sealant CU7Z-19B508-A  | WSS-M2G348-A11 |
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA  | WSS-M2C214-B1  |
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant VC-3-B | WSS-M97B44-D   |

**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, may cause engine failure.

**NOTE:** It is recommended that this component be serviced with the vehicle body removed. If the body was not removed, refer to Cylinder Head - Body On in this section.

- NOTE:** Make sure that the same gasket thickness is reinstalled.

Install the LH cylinder head dowels and head gasket.



- NOTE:** Using too much engine oil on the threads of the cylinder head bolts may cause damage to the threads and poor sealing. Using anti-seize compounds, grease or any other lubricants other than engine oil on the cylinder head bolt threads may affect the true torque value of the bolts.

**NOTE:** The glow plugs protrude past the lower face of the cylinder head, any impact on the tip of the glow plug may result in glow plug



damage.

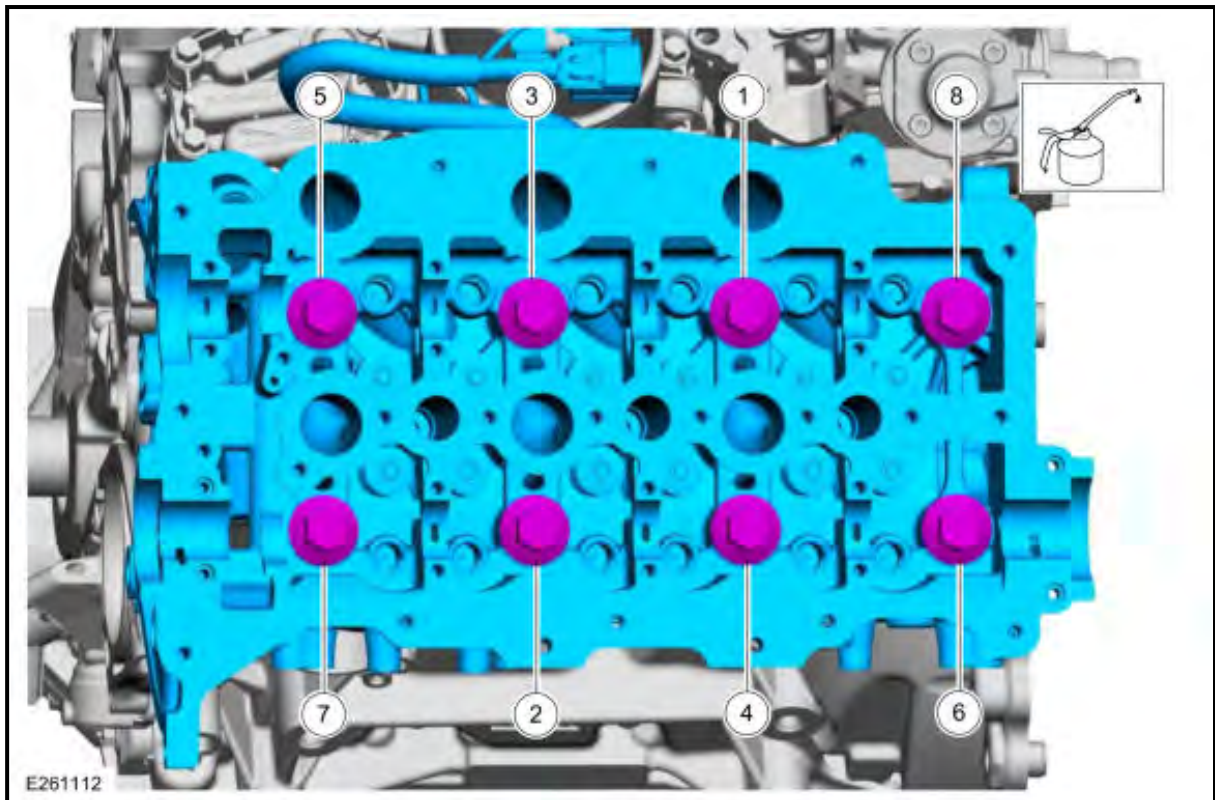
**NOTE:** Lightly lubricate the new cylinder head bolt threads and flanges with clean engine oil.

Install the LH cylinder head and the new bolts.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

### Torque

- :Stage 1: 177 lb.in (20 Nm)
- Stage 2: 30 lb.ft (40 Nm)
- Stage 3: 59 lb.ft (80 Nm)
- Stage 4: 180  $\hat{A}$ <sup>o</sup>

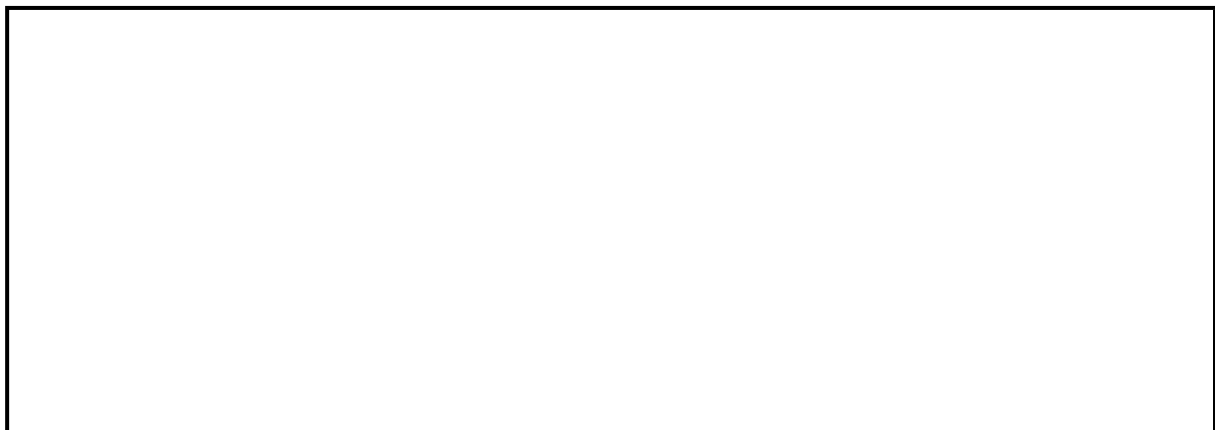


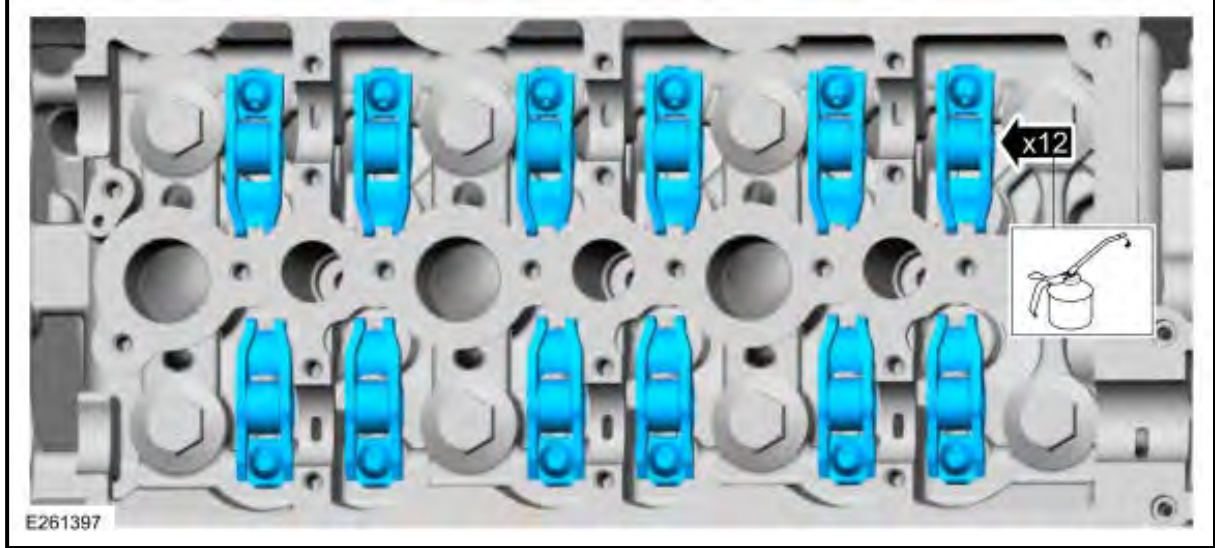
3. **NOTE:** If the original hydraulic lash adjusters and roller followers are to be reinstalled, they must be installed in their original locations.

1. Lubricate the LH hydraulic lash adjusters and roller followers with clean engine oil.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

2. Install the hydraulic lash adjusters and roller followers.





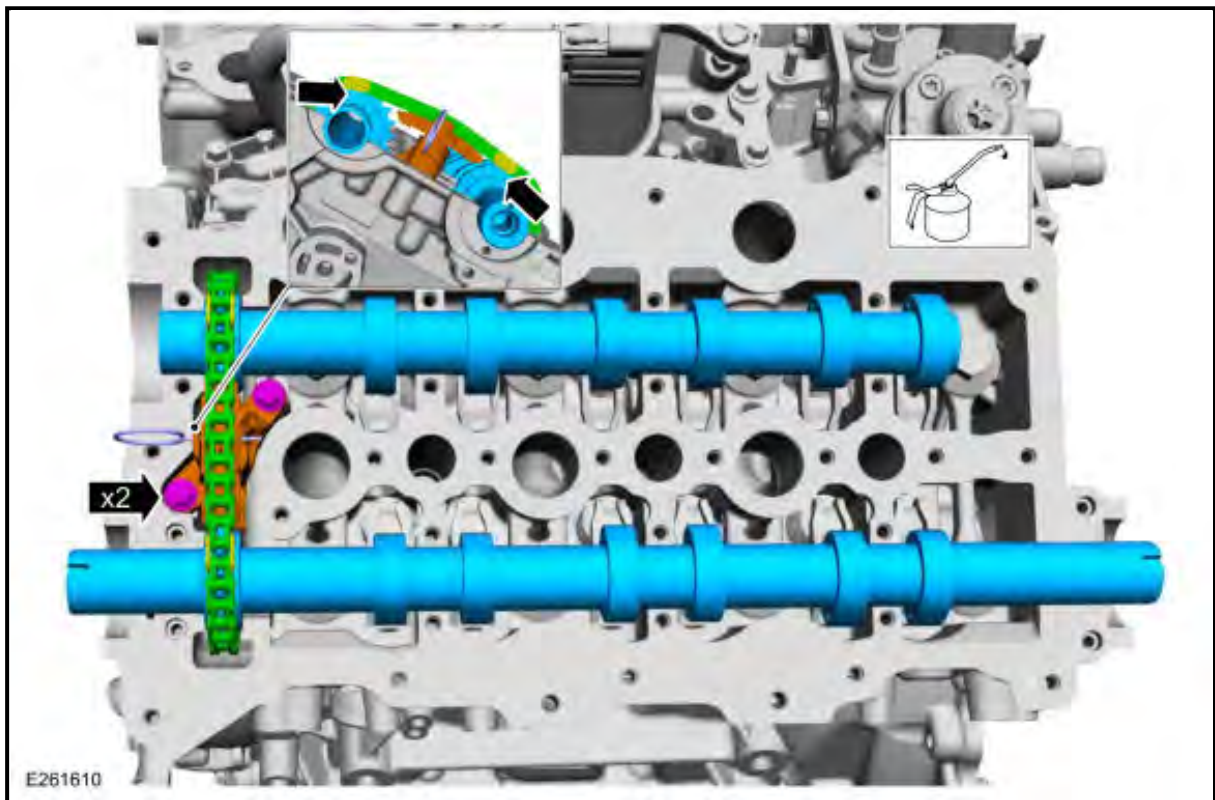
4. **NOTE:** Coat the camshafts with clean engine oil prior to installation.

**NOTE:** Align the timing marks on the camshafts with the timing marks on the secondary timing chain.

Install the LH camshafts, camshaft chain, secondary timing chain tensioner and the bolts.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

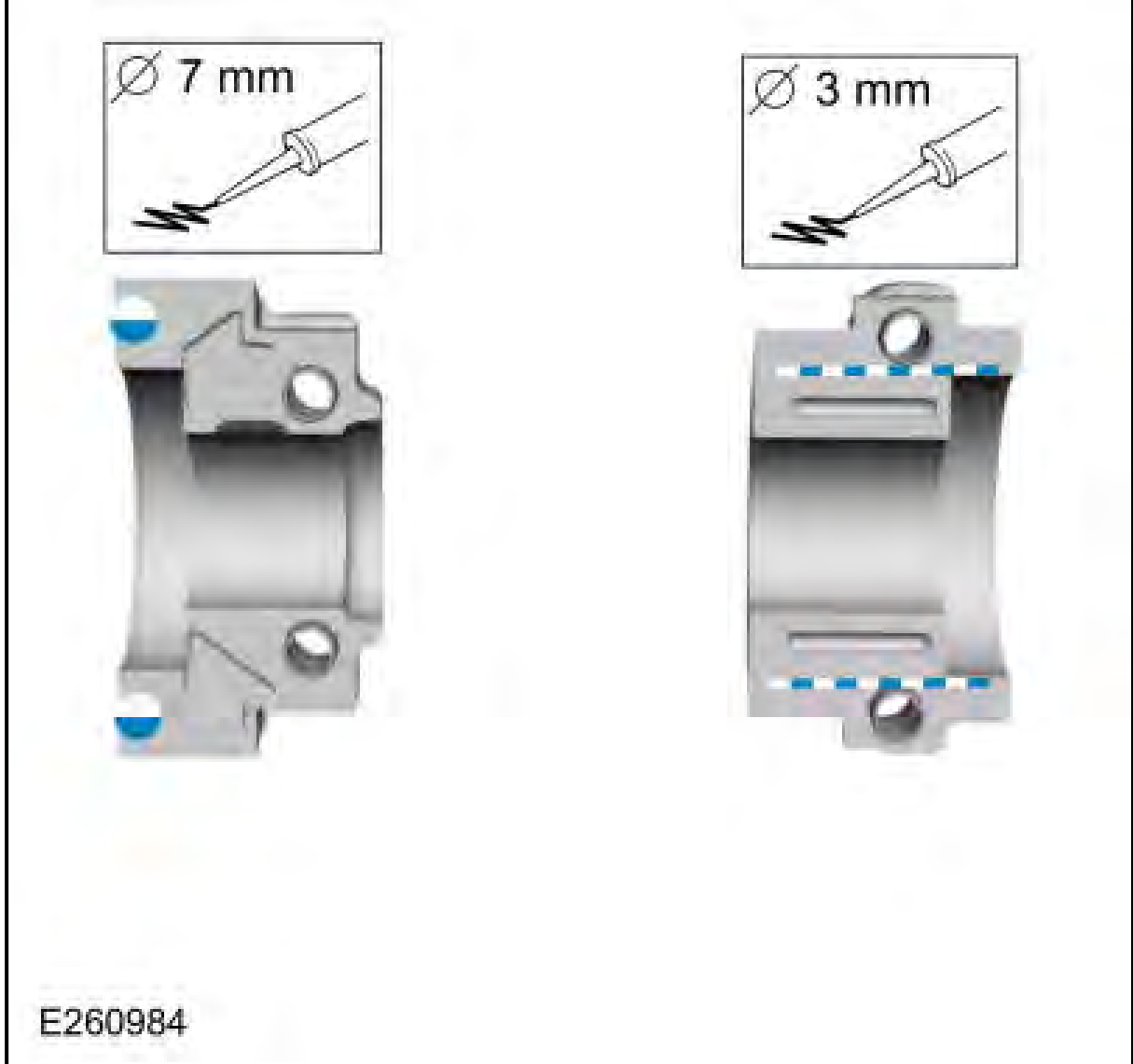
Torque: 89 lb.in (10 Nm)



5. Apply sealer to the LH bearing caps.

Material: Flange Sealant / CU7Z-19B508-A (WSS-M2G348-A11)





6. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

**NOTE:** Tighten the camshaft bearing cap bolts one turn at a time.

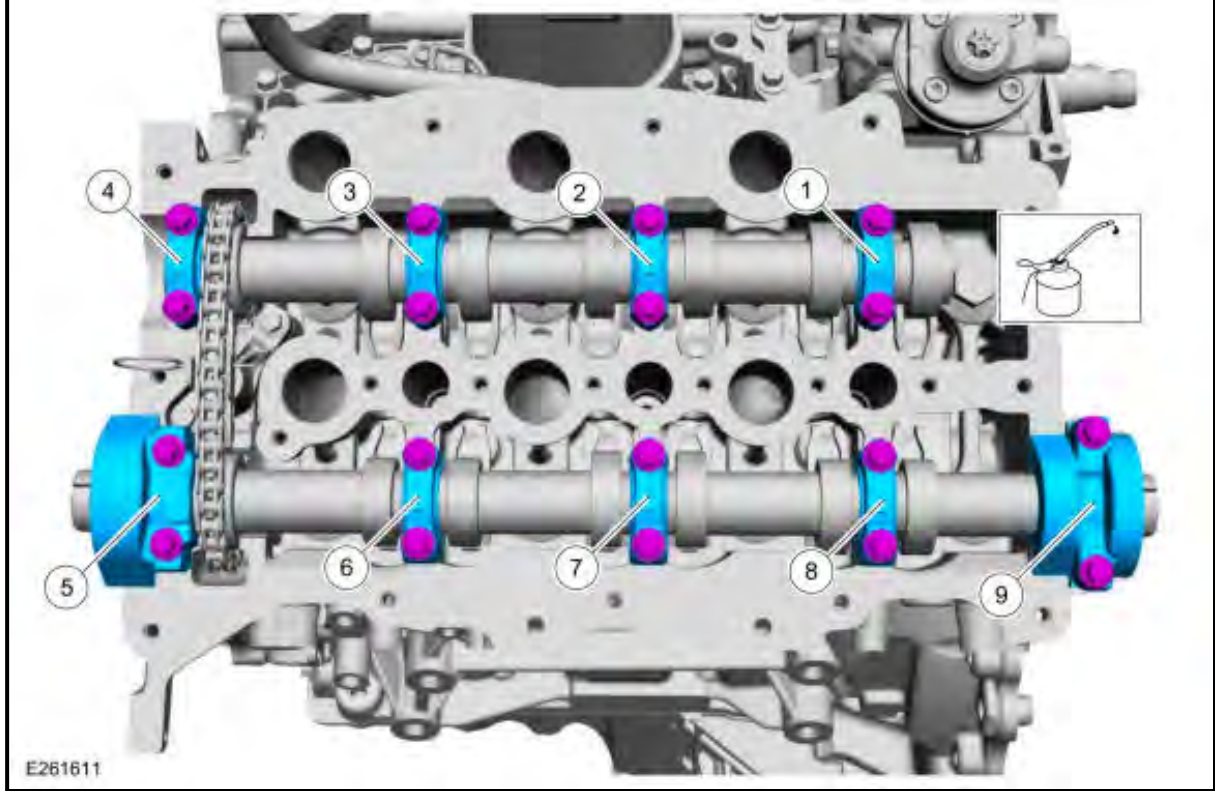
Apply clean engine oil to the camshaft bearing caps. Install camshaft bearing caps and the bolts.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

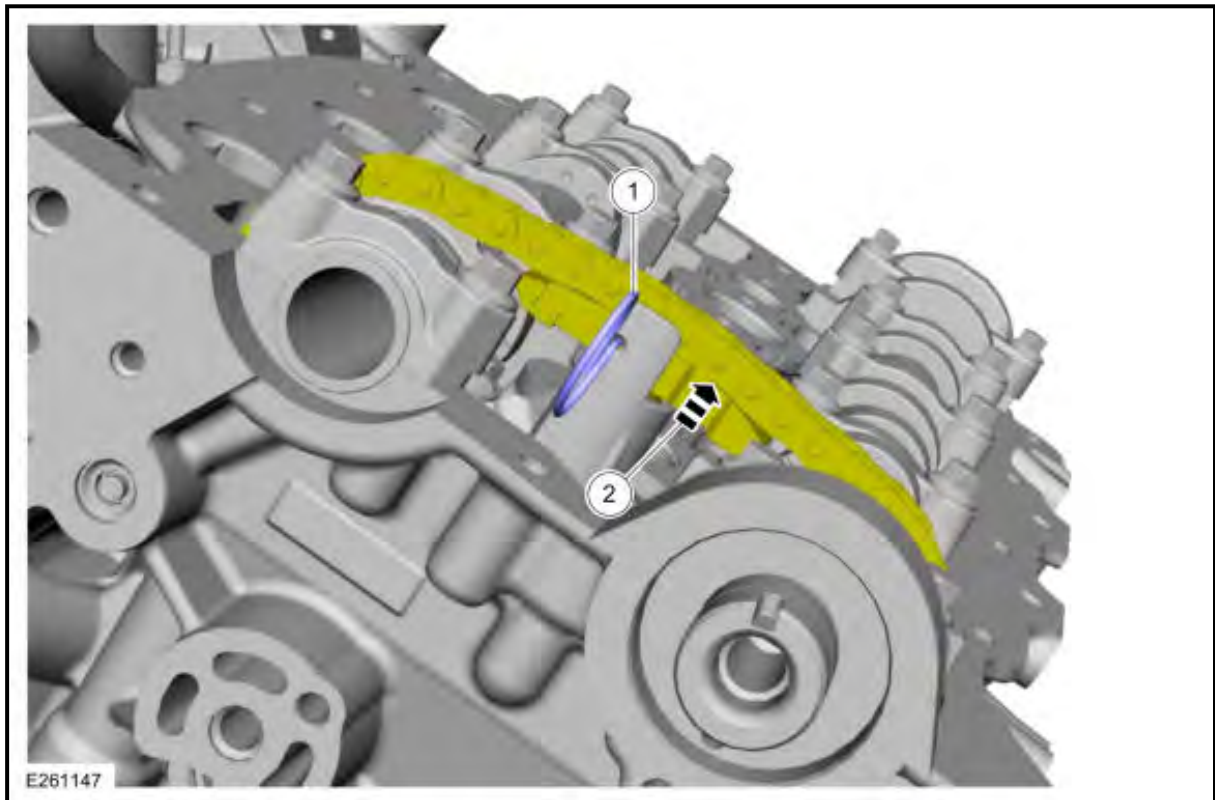
#### Torque

- :Stage 1: 9 lb.in (1 Nm)
- Stage 2: 44 lb.in (5 Nm)
- Stage 3: 89 lb.in (10 Nm)



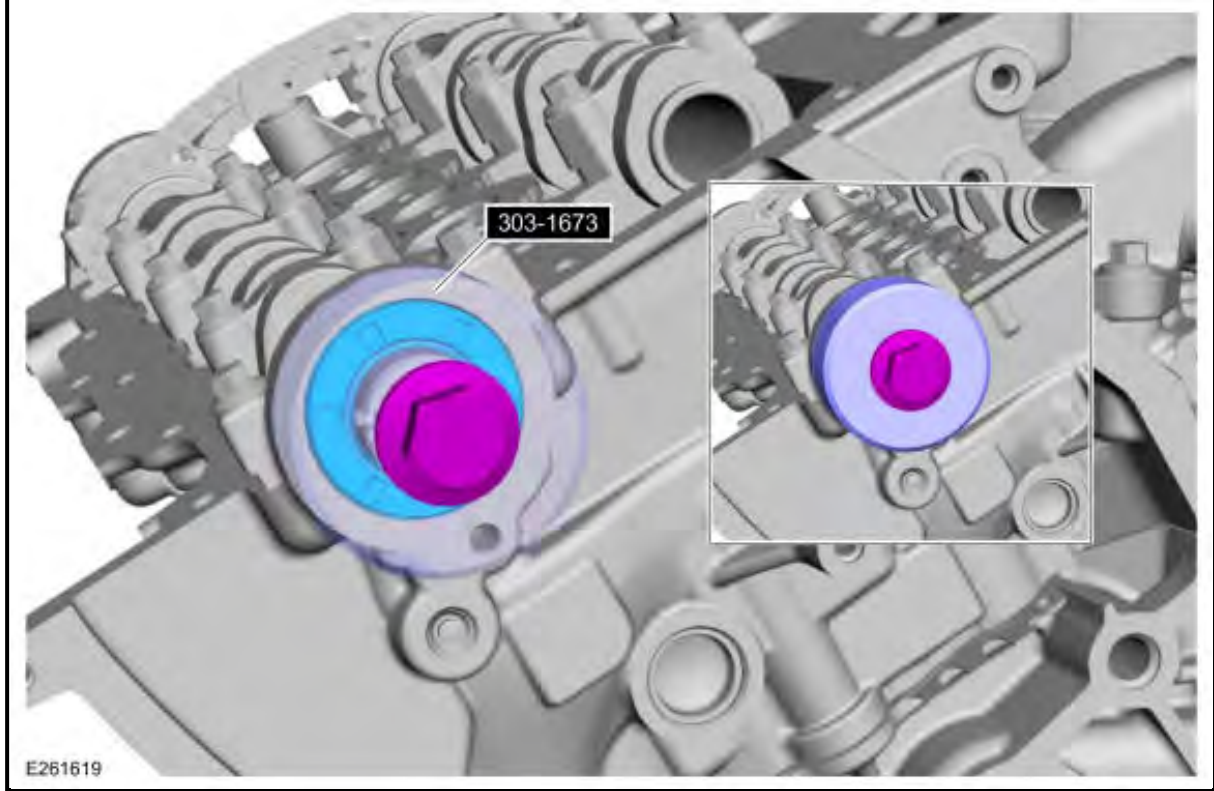


7. Remove the retaining pin.

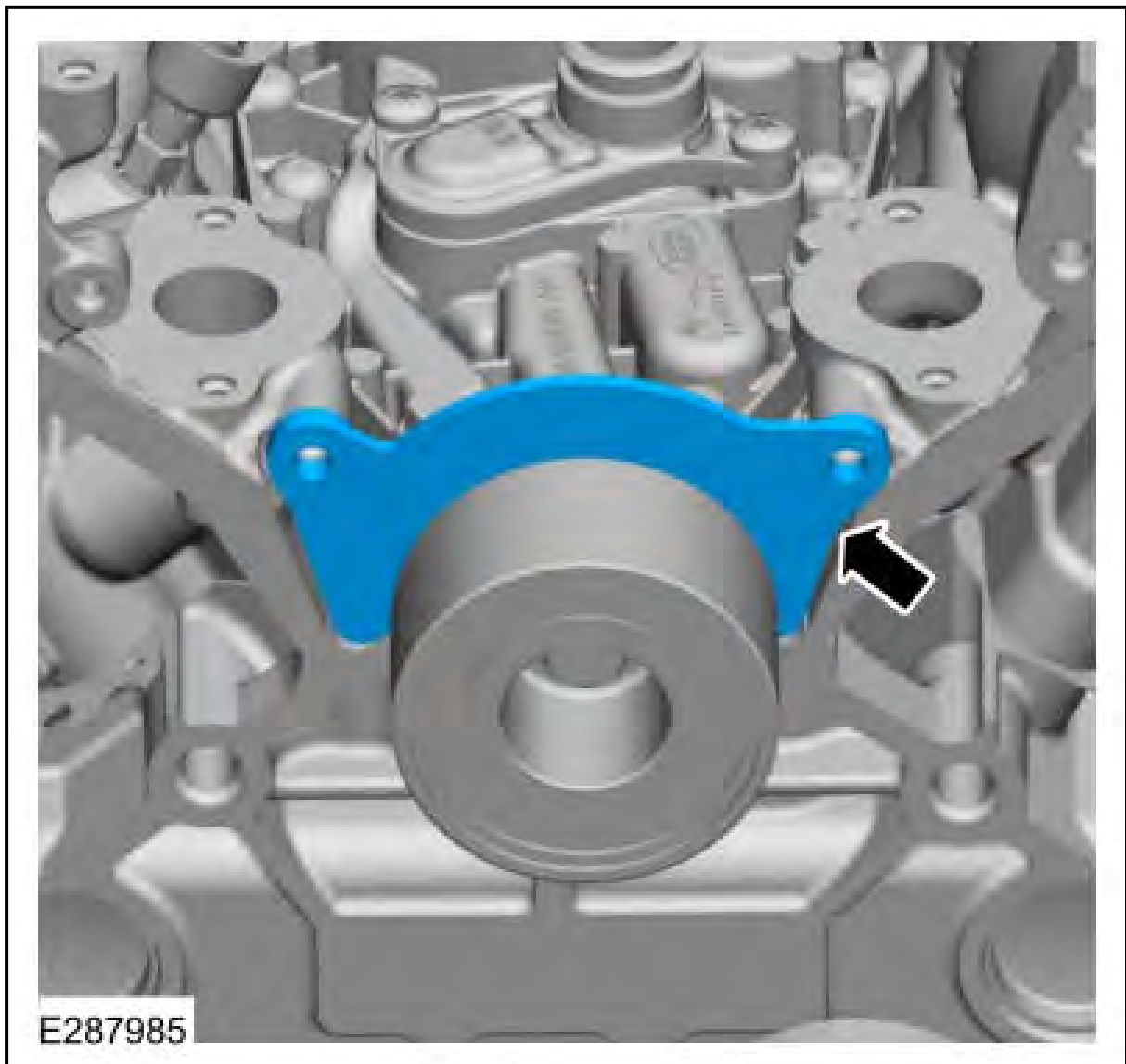


8. Using the special tool, install the camshaft seals. Use Special Service Tool: 303-1673 Installer, Camshaft Seal.





9. Install the dust shield.



10. Install the coolant outlet connector gaskets.

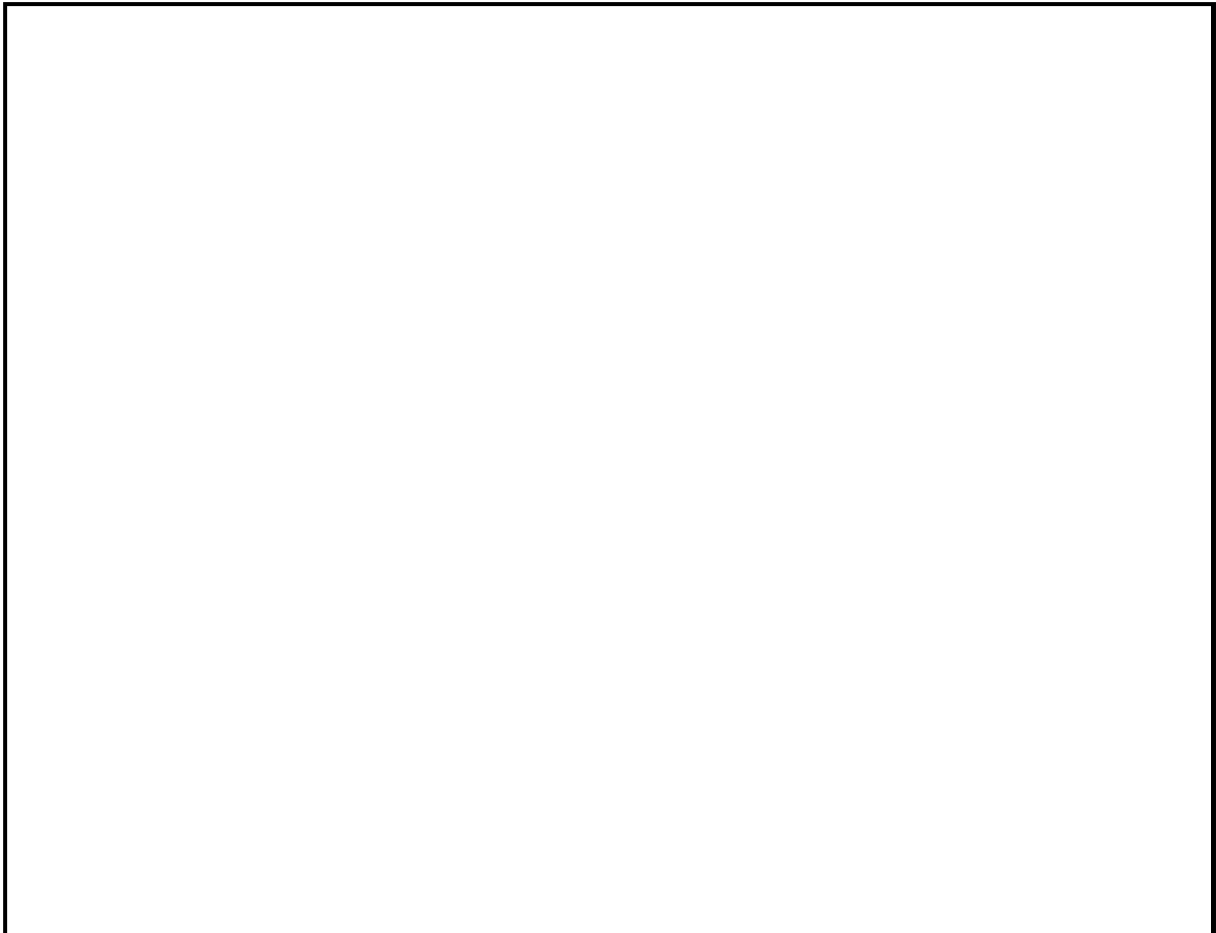


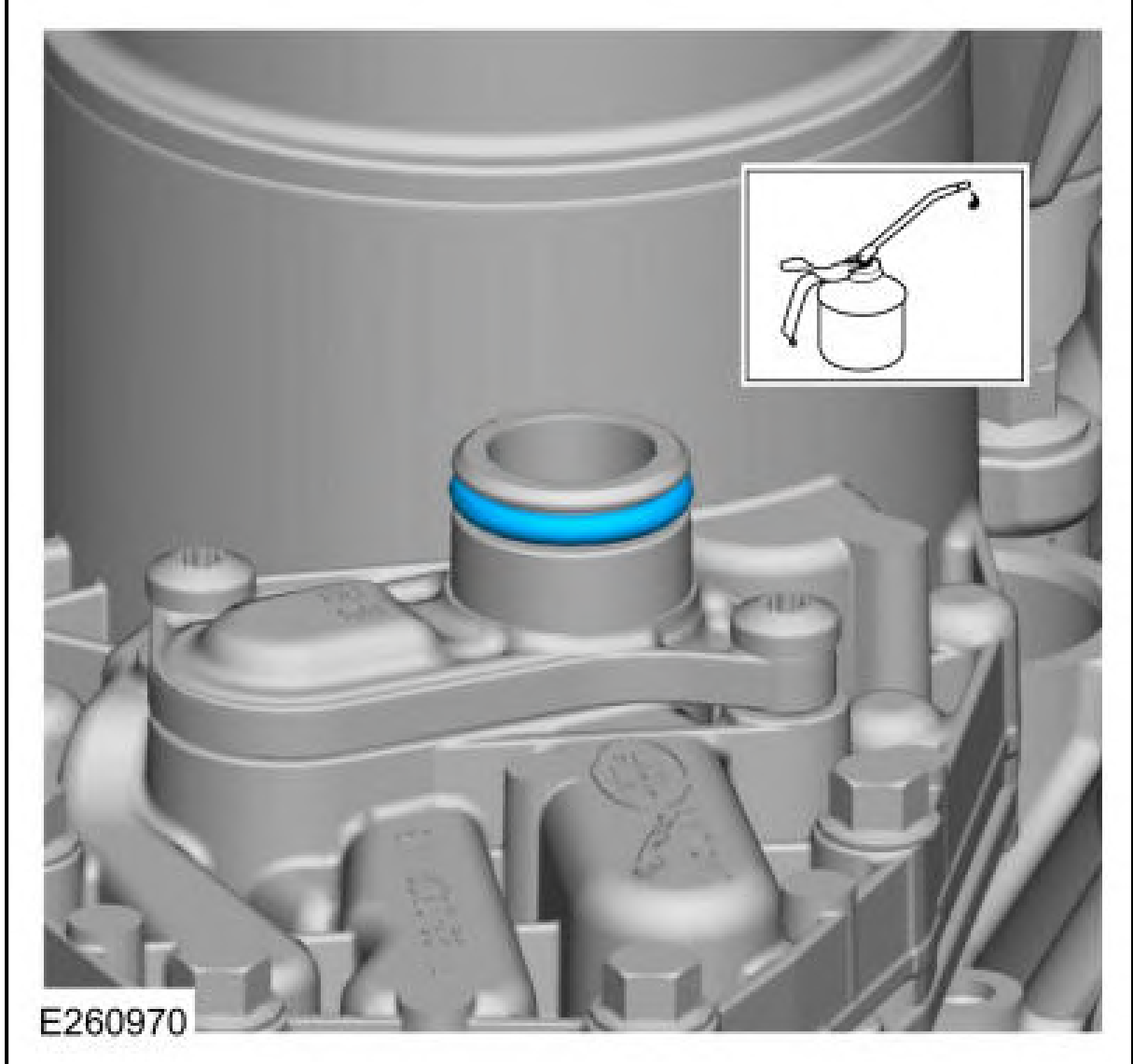


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11. Install the oil cooler O-ring and lubricate.

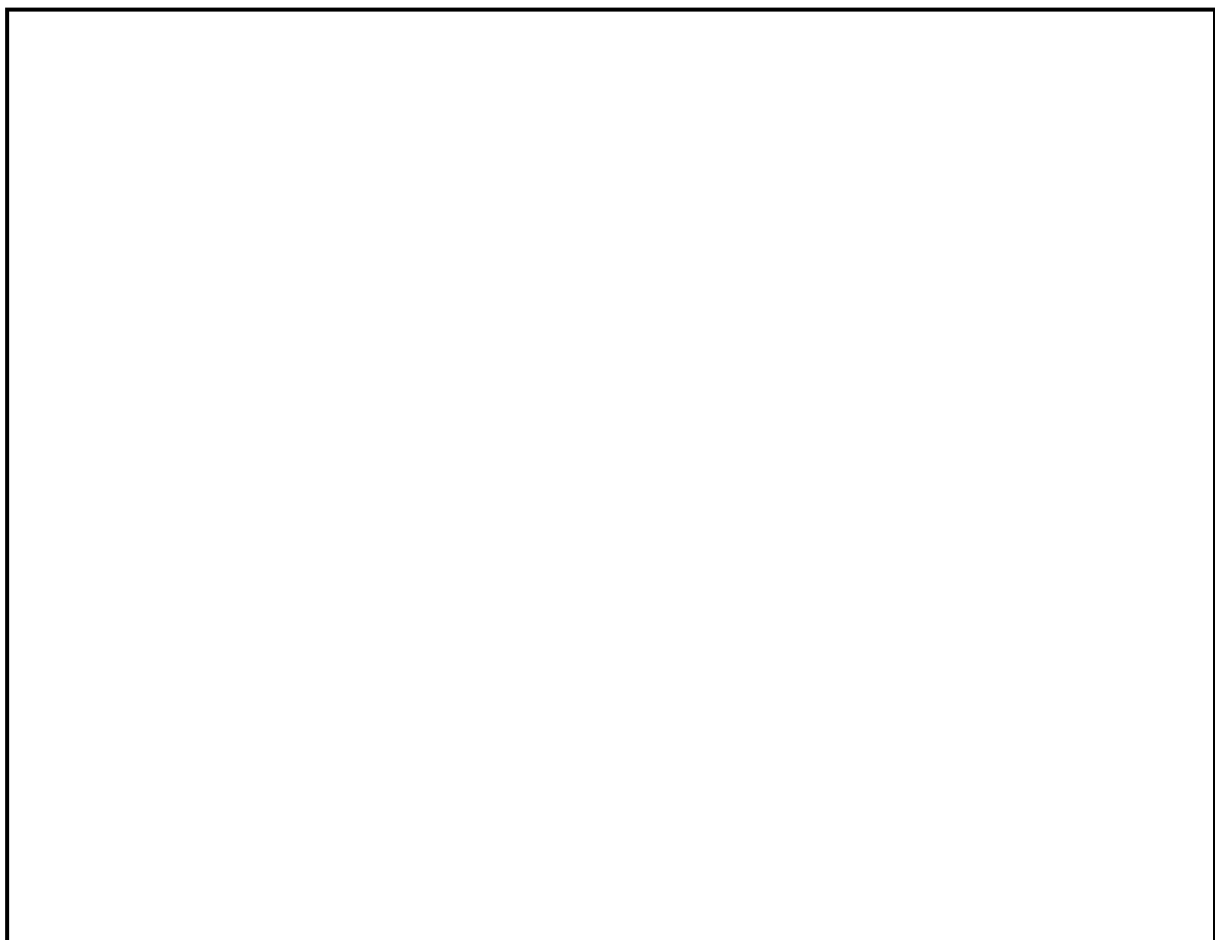
Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

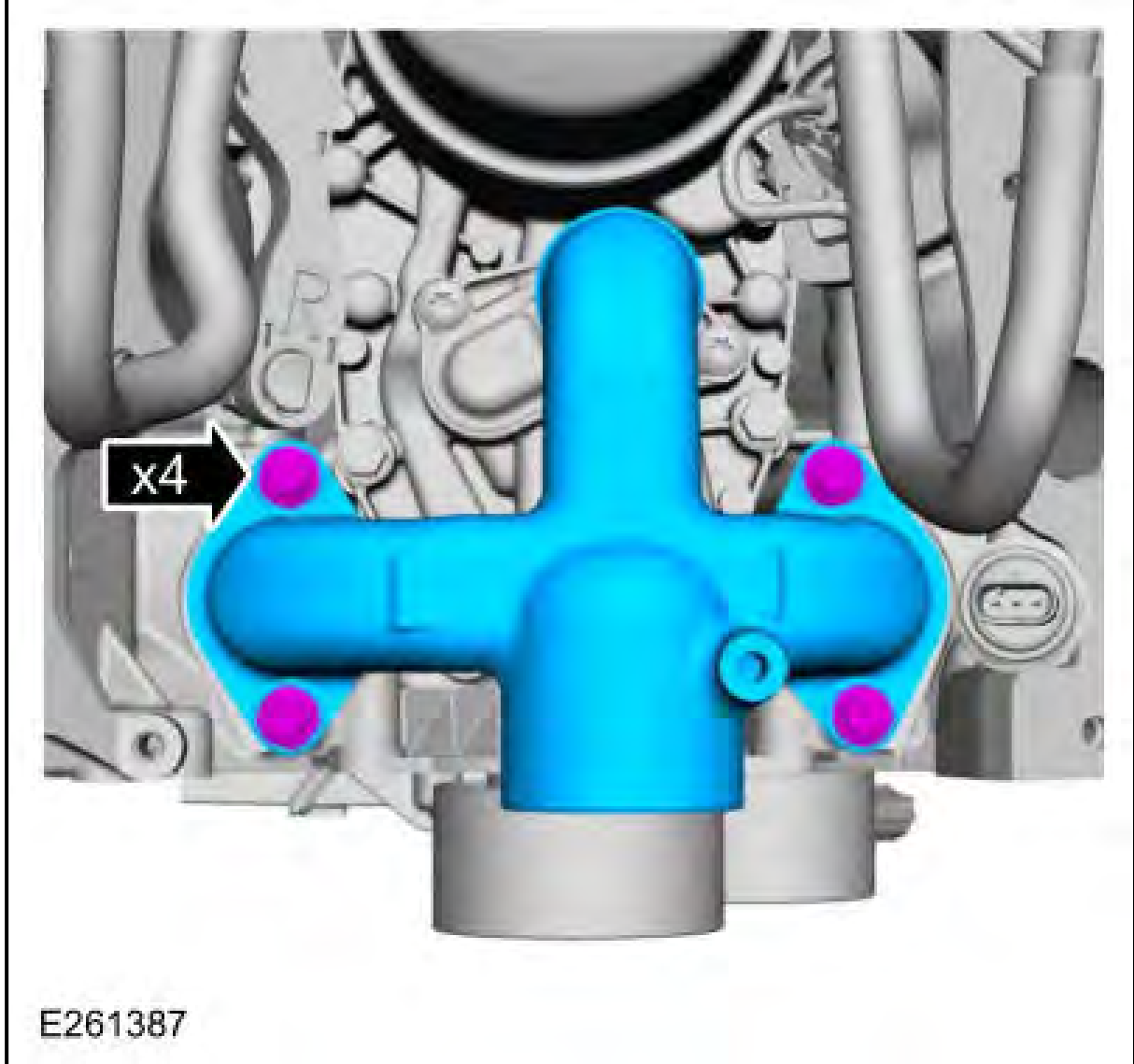




12. Install the coolant outlet connector and the bolts.

Torque: 89 lb.in (10 Nm)





13. **NOTE:** Use the original bolts for the special tool.

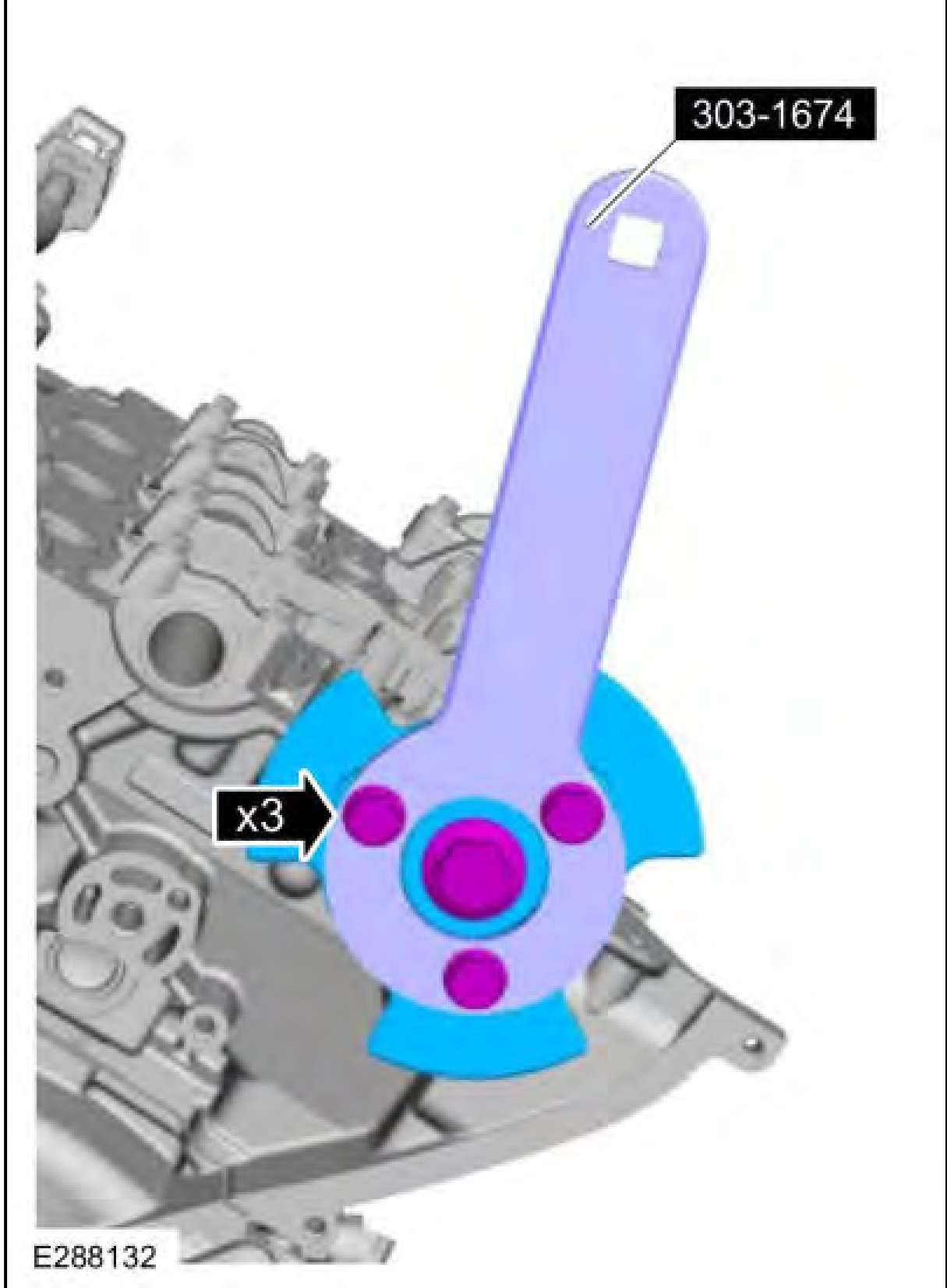
Using the special tool, install the LH camshaft gear hub and bolts. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.

Torque

: Stage 1: 59 lb.ft (80 Nm) Stage 2: 80 Å°







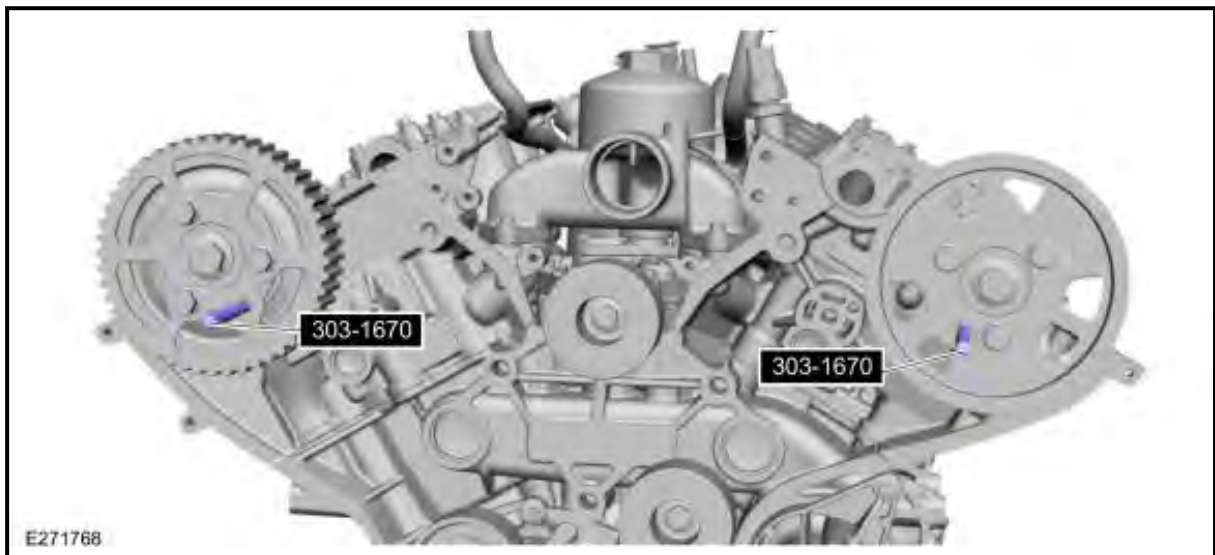
14. **NOTE:** Only tighten the bolts finger tight at this stage.

Install the LH camshaft pulleys and the bolts.





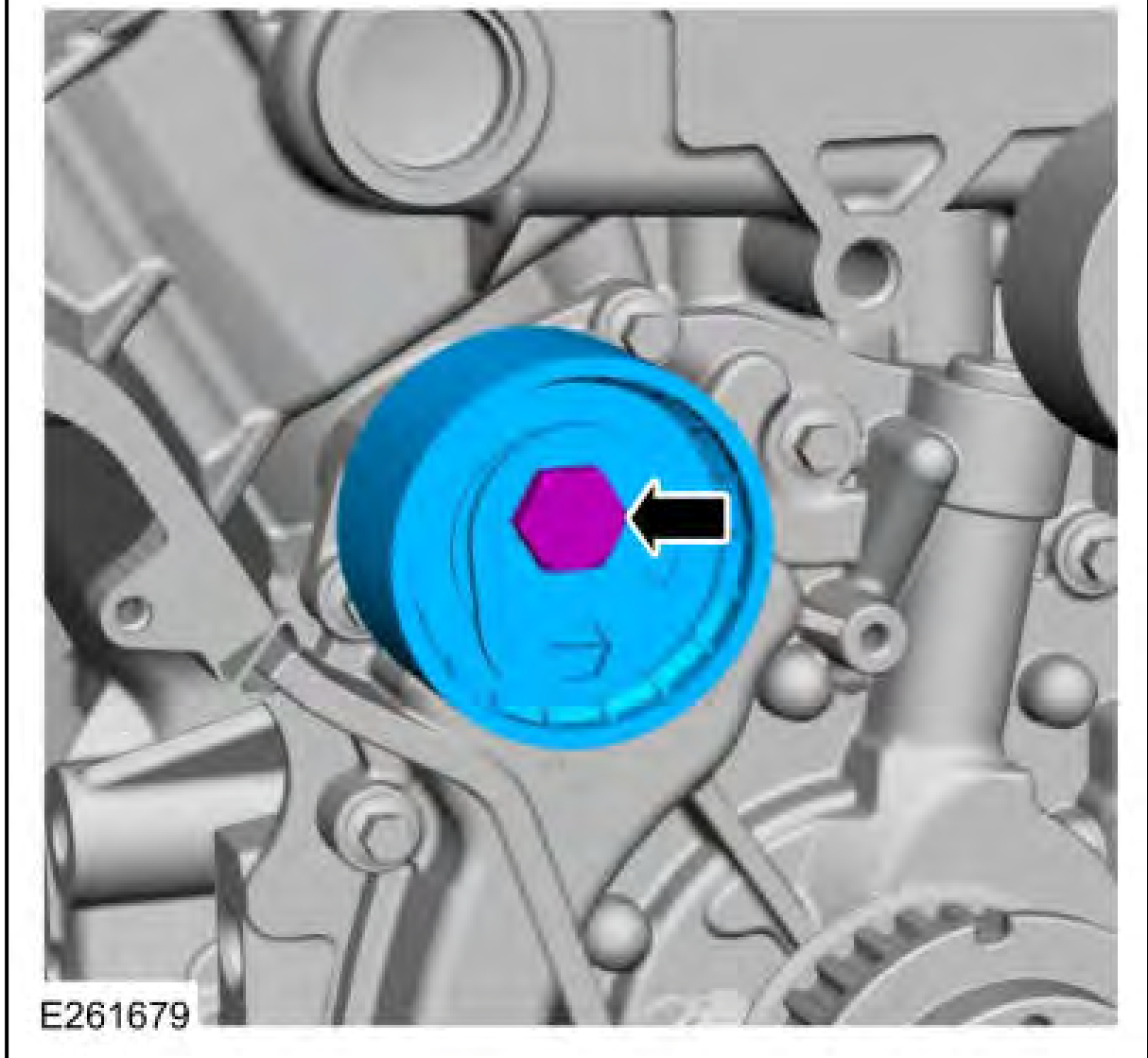
15. Install Special Service Tool: 303-1670 Pins, Camshaft Locking.



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

Install the timing belt tensioner and the bolt.





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

**NOTE:** Make sure that the crankshaft is against the Crankshaft Locking Pin.

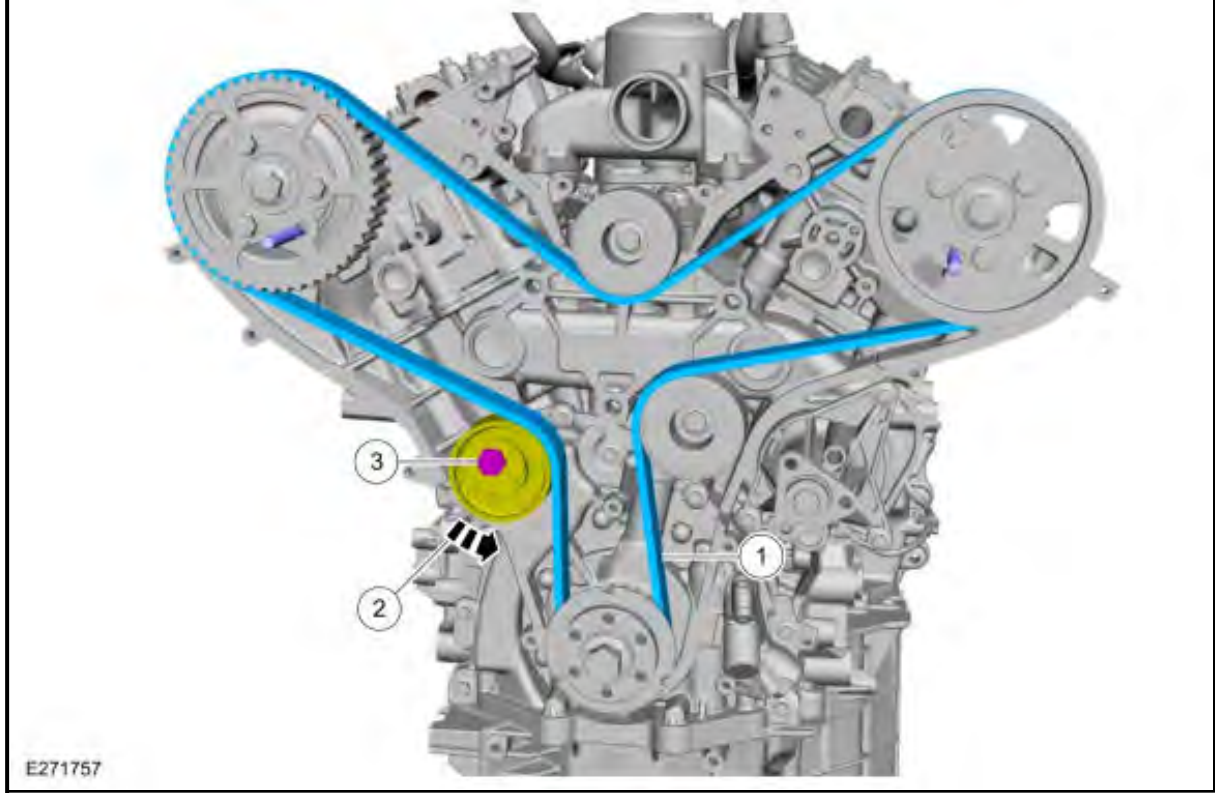
**NOTE:** It may be necessary to rotate the camshaft pulleys slightly to ensure the bolts are not at the end of the slots.

1. Install the timing belt.
2. Rotate the timing belt tensioner.
3. Tighten the timing belt tensioner bolt.

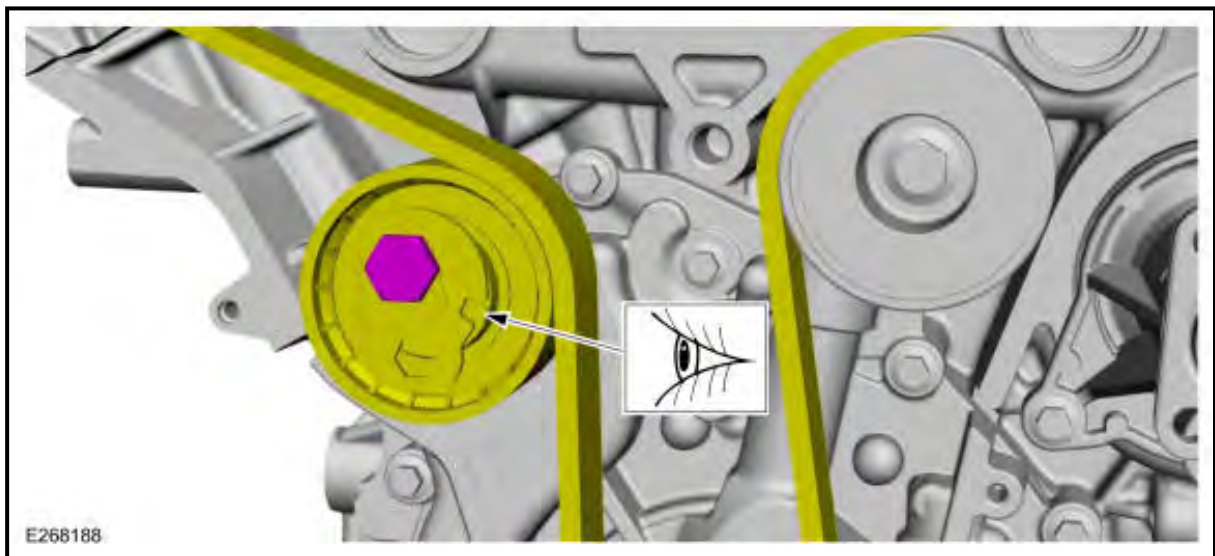
Torque

:Stage 1: 177 lb.in (20 Nm) Stage 2: 45 Å°



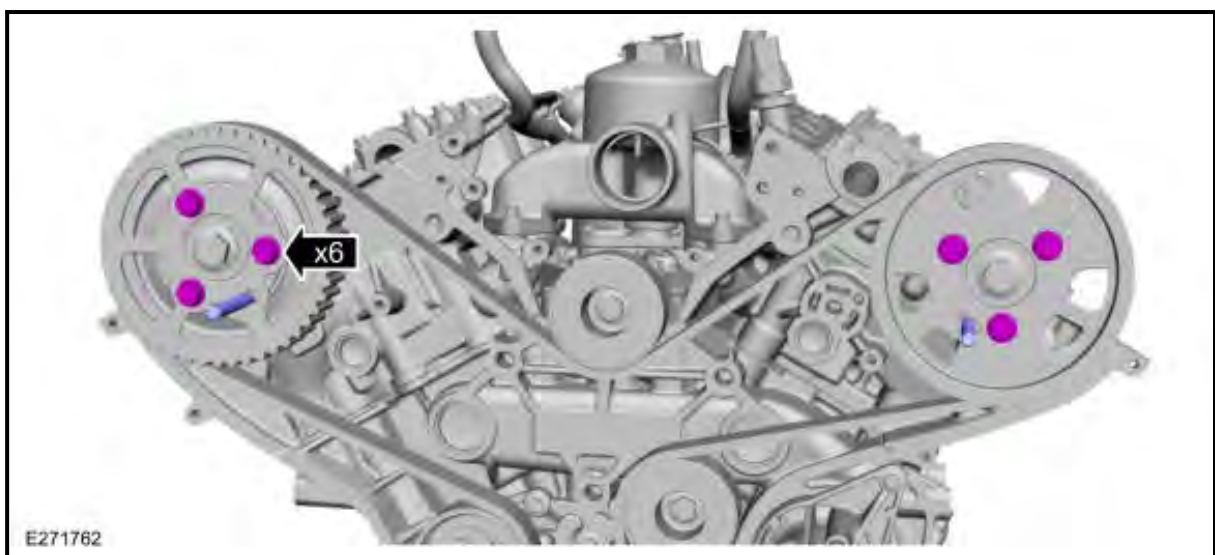


18. If the timing belt tensioner pointer is not visible in the window, the timing belt tensioning step must be repeated.

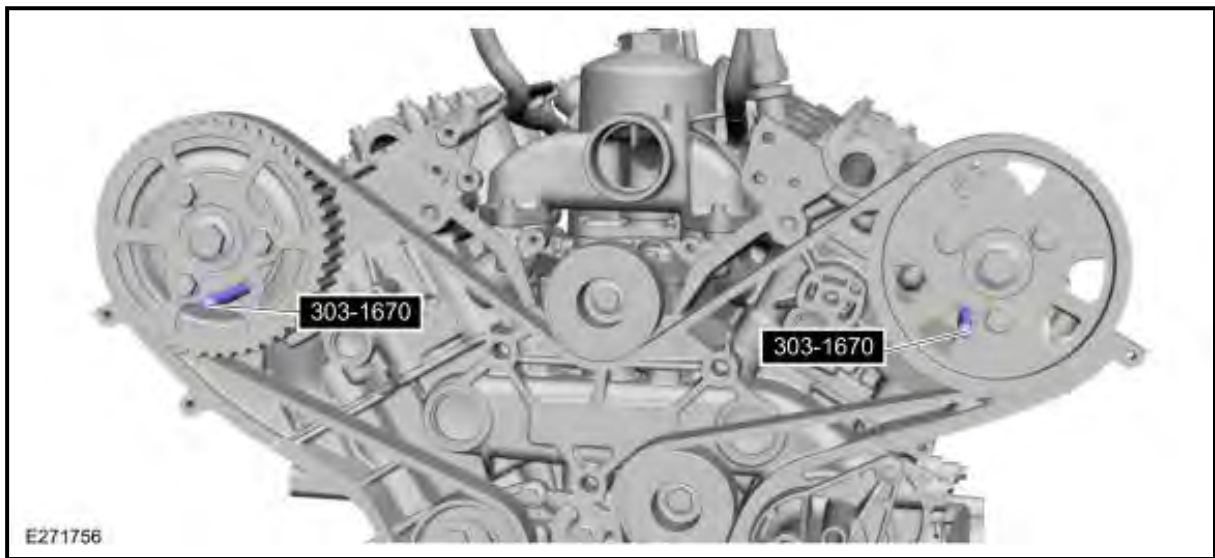


19. Tighten the camshaft pulley bolts.

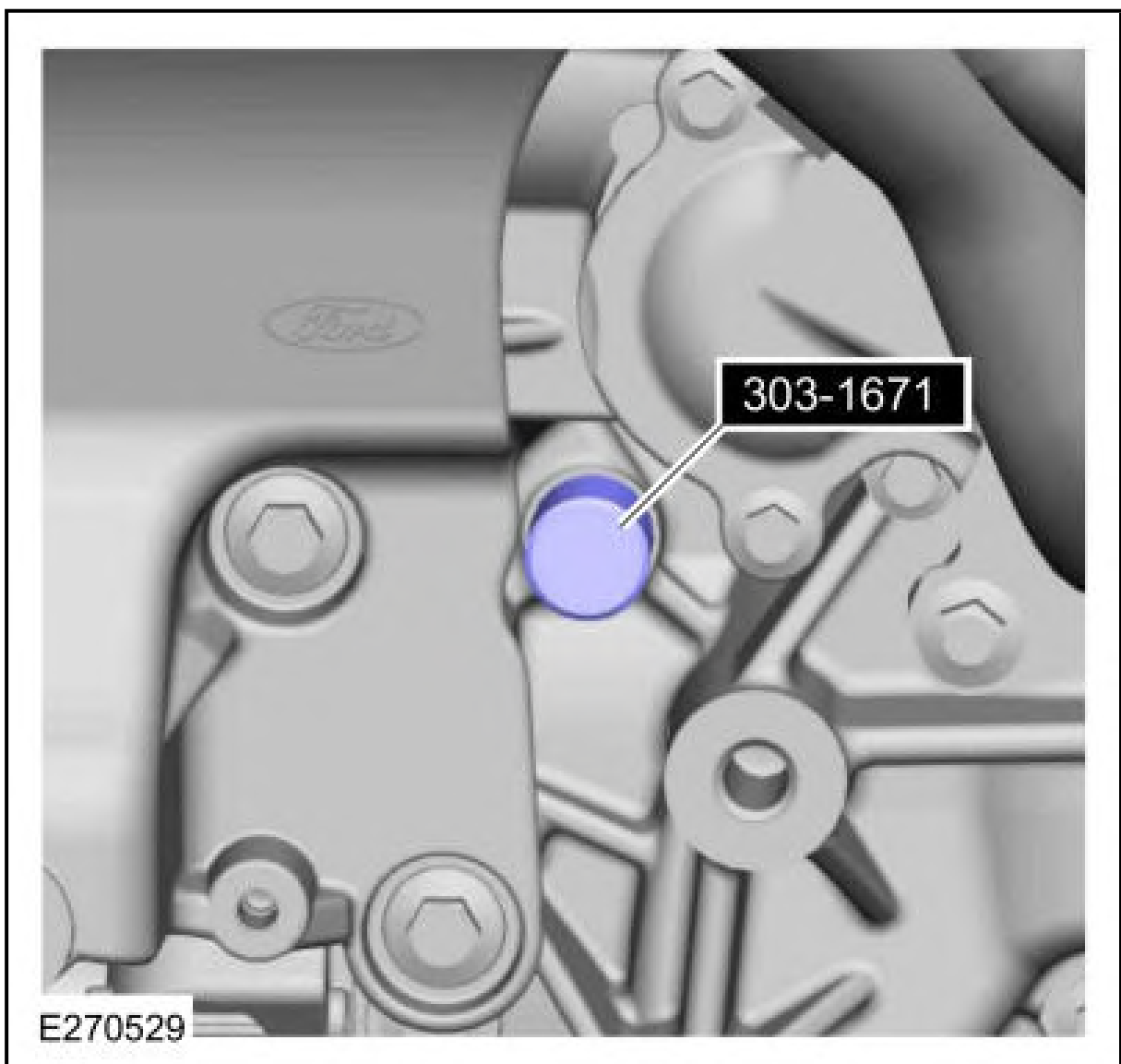
Torque: 17 lb.ft (23 Nm)



20. Remove Special Service Tool: 303-1670 Pins, Camshaft Locking.



21. Remove Special Service Tool: 303-1671 Pin, Locking Crankshaft.



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

This step is to verify that the timing is correct. Rotate the engine 1 7/8 revolutions.

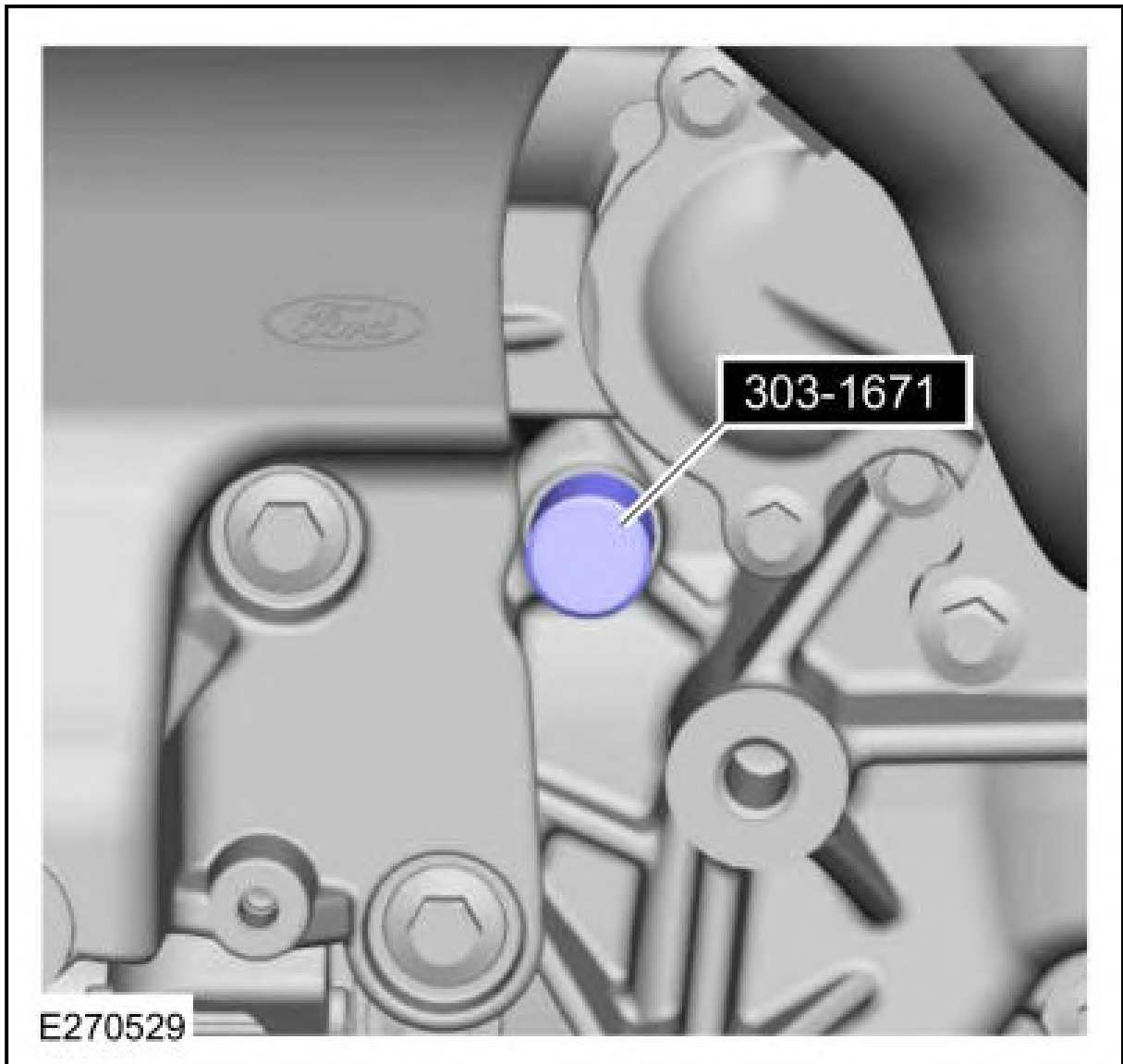
23. Install special tool.

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

**NOTE:** The Locking Crankshaft Pin must be bottomed out against the

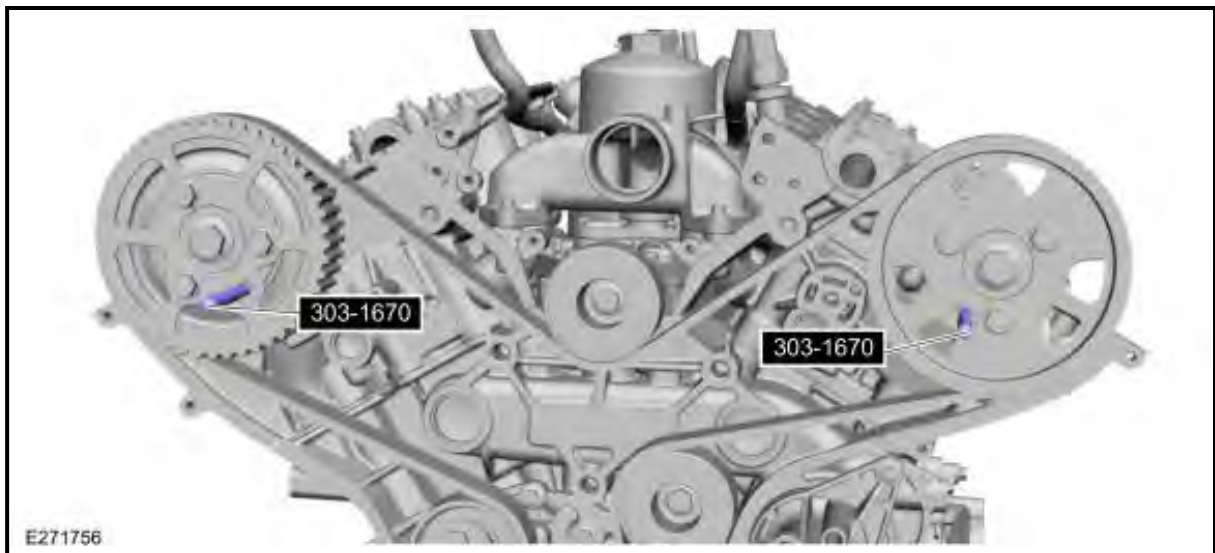
**cylinder block.**

Rotate the crankshaft clockwise so the crankshaft contacts the locking crankshaft pin. Use Special Service Tool: 303-1671 Pin, Locking Crankshaft.



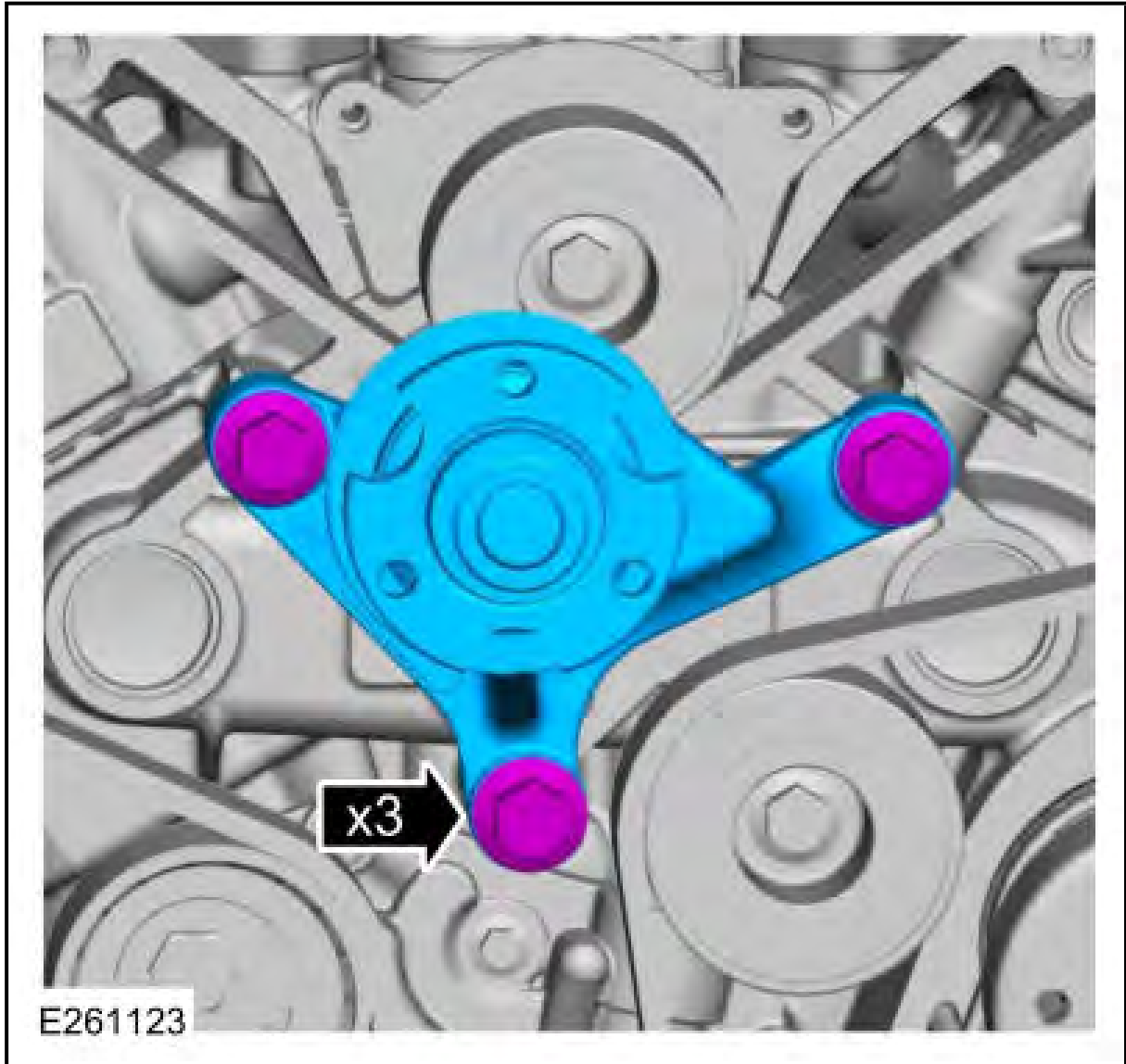
24. **NOTE:** The special tool can only be installed if the valve timing is correct.

If the special tools do not install correctly, repeat the timing belt installation steps. Install Special Service Tool: 303-1670 Pins, Camshaft Locking.



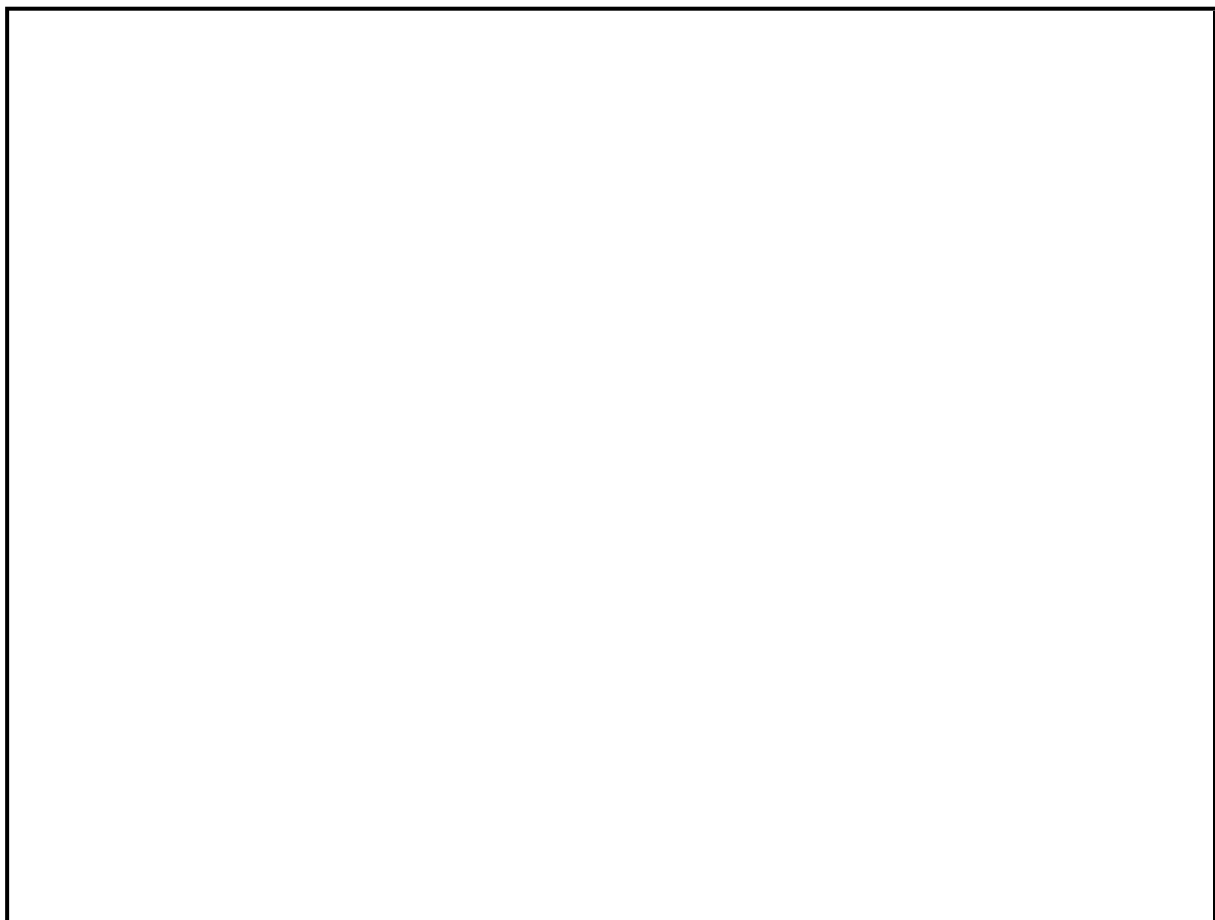
25. Install the fan drive and the bolts.

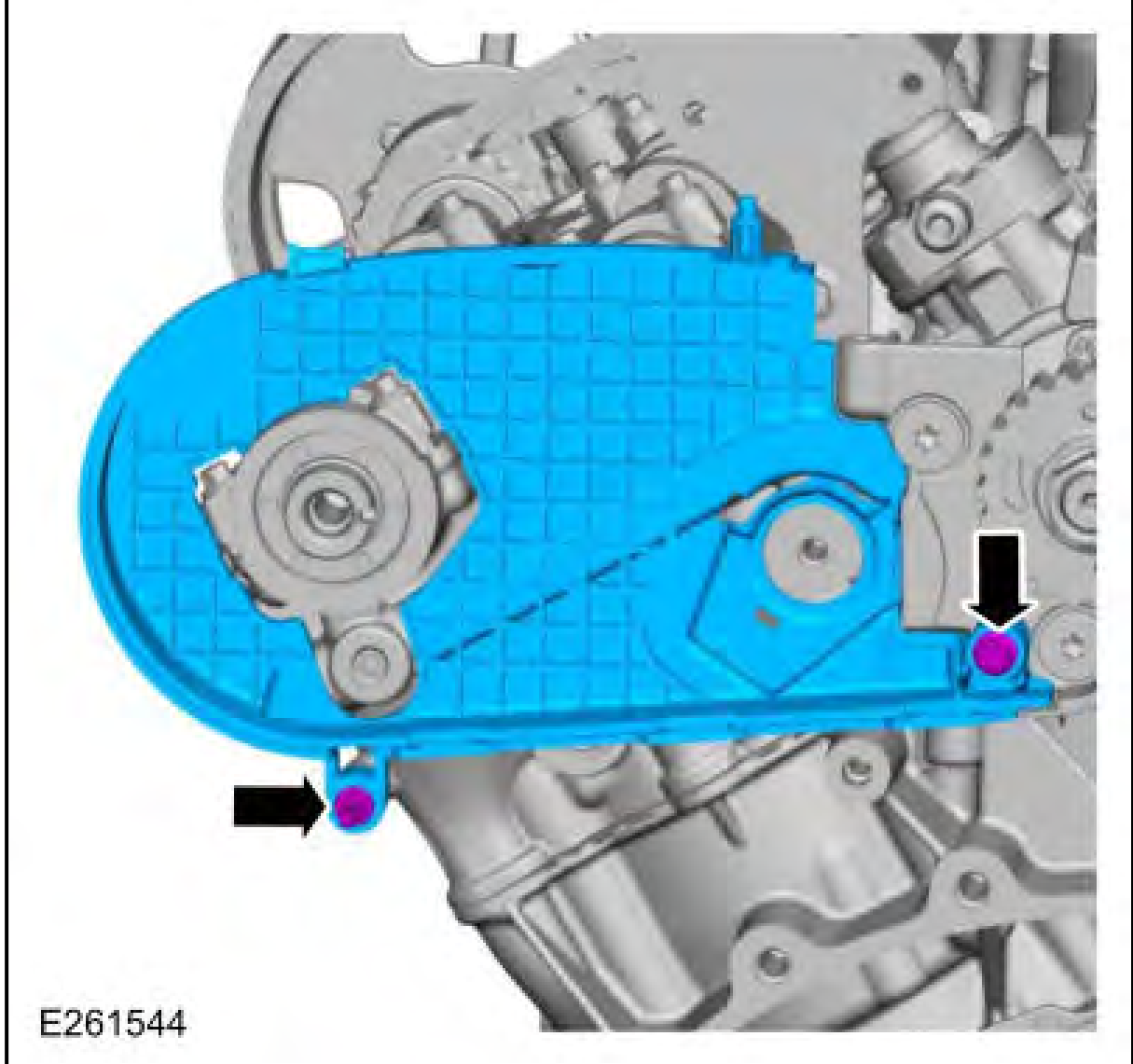
Torque: 61 lb.ft (83 Nm)



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

Install the accessory drive cover.



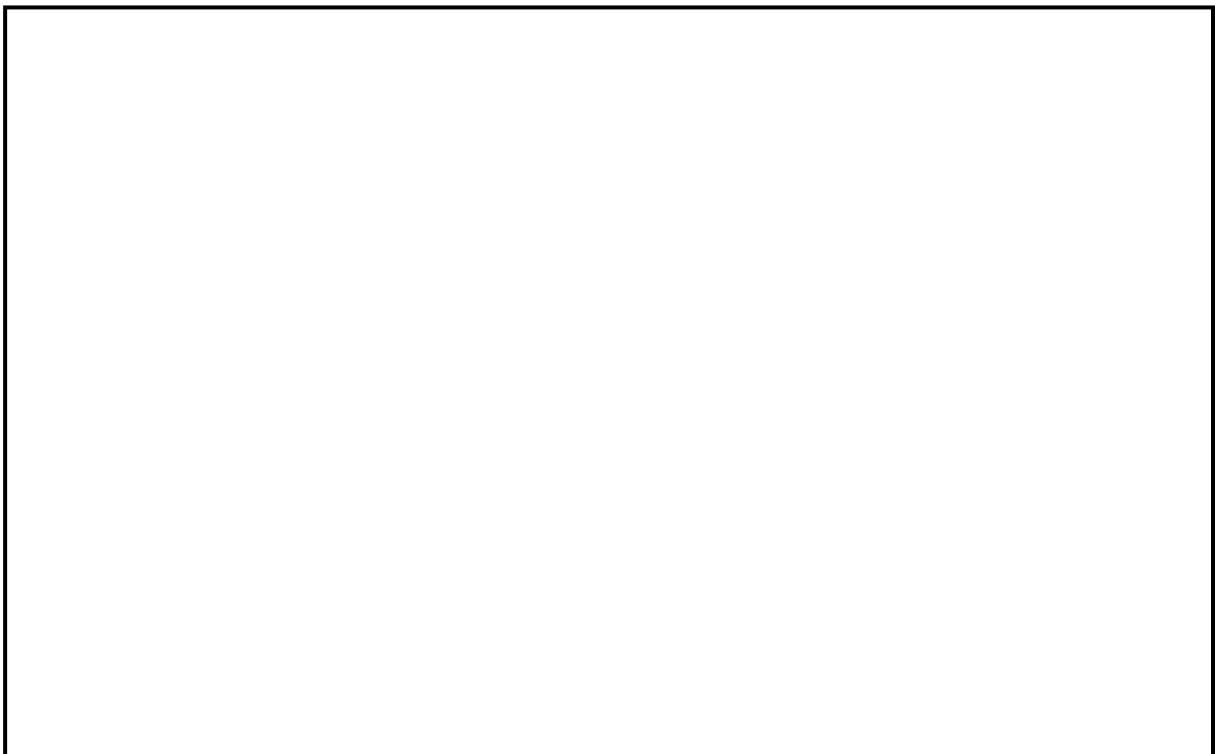


27. **NOTE:** Use the original bolts for the special tool.

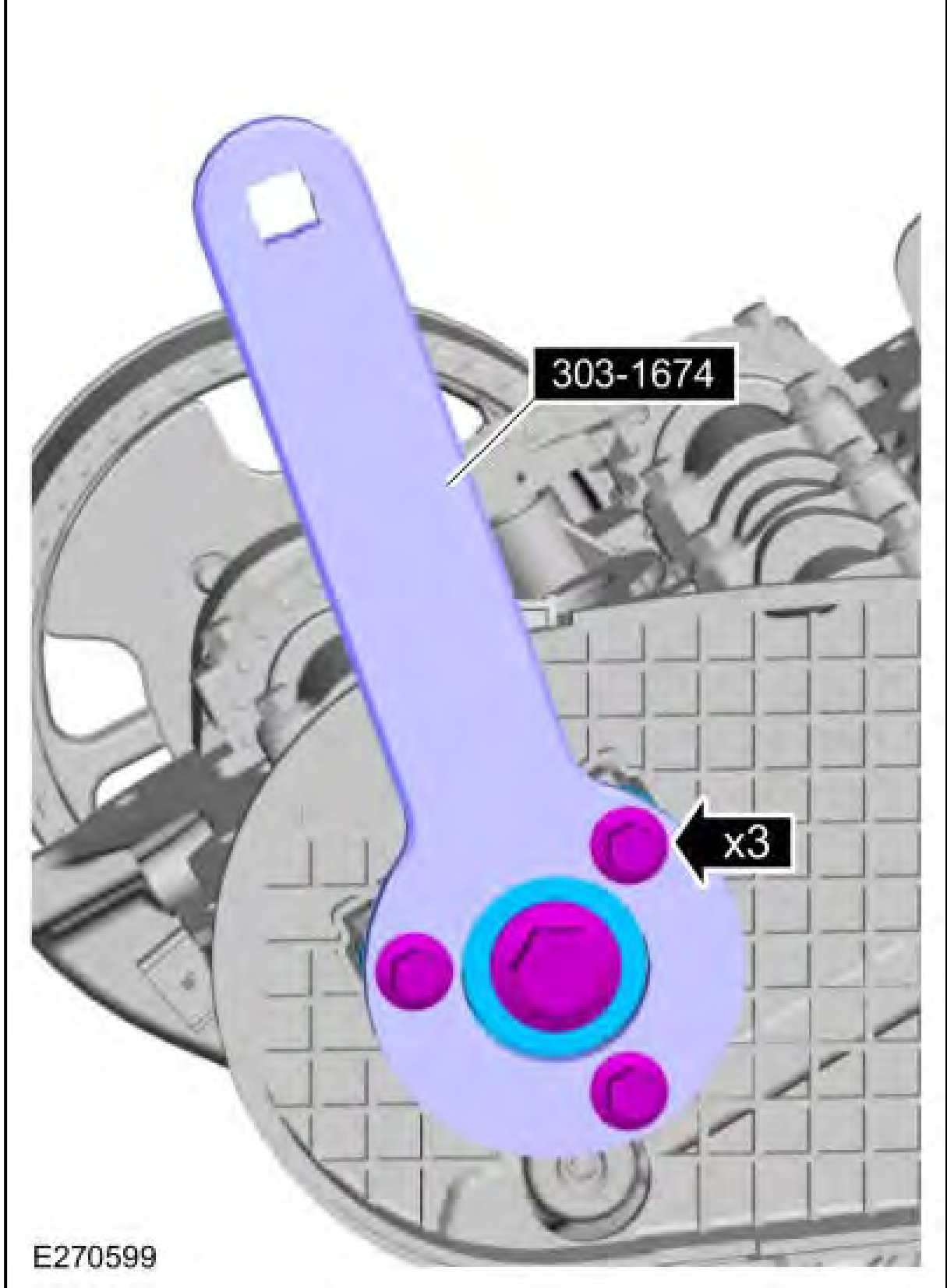
Using the special tool, install the camshaft gear hub and the bolt. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.

Torque

:Stage 1: 59 lb.ft (80 Nm) Stage 2: 80 Å°



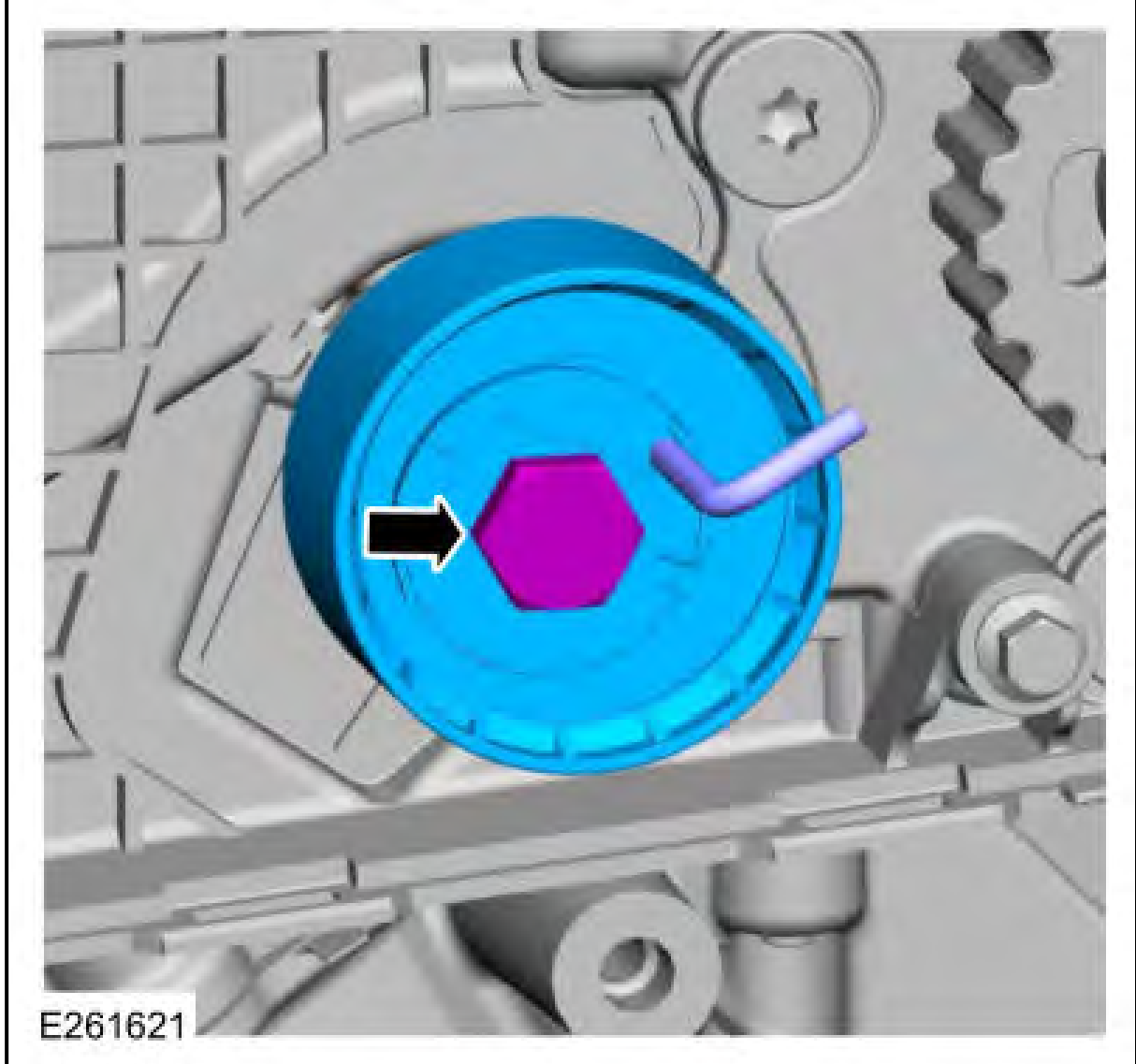




28. Install the READ belt tensioner and the bolt.

Torque: 17 lb.ft (23 Nm)



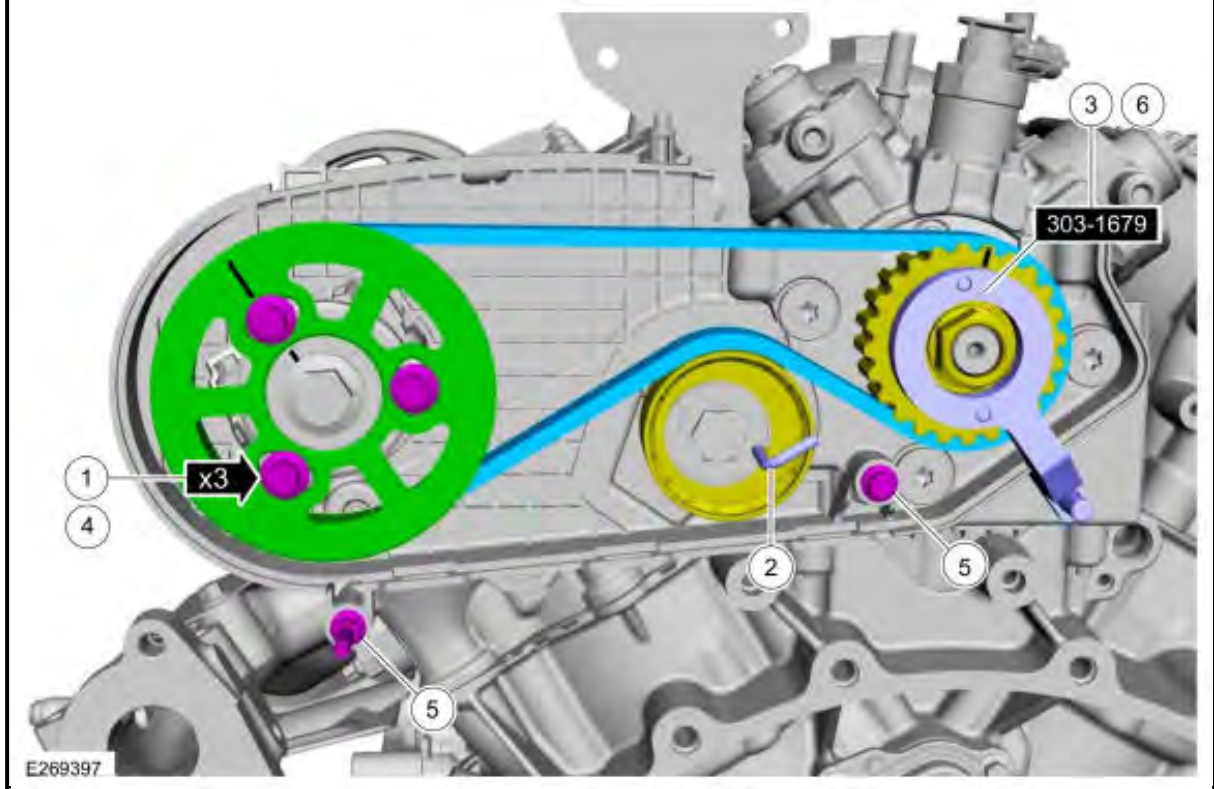


29.

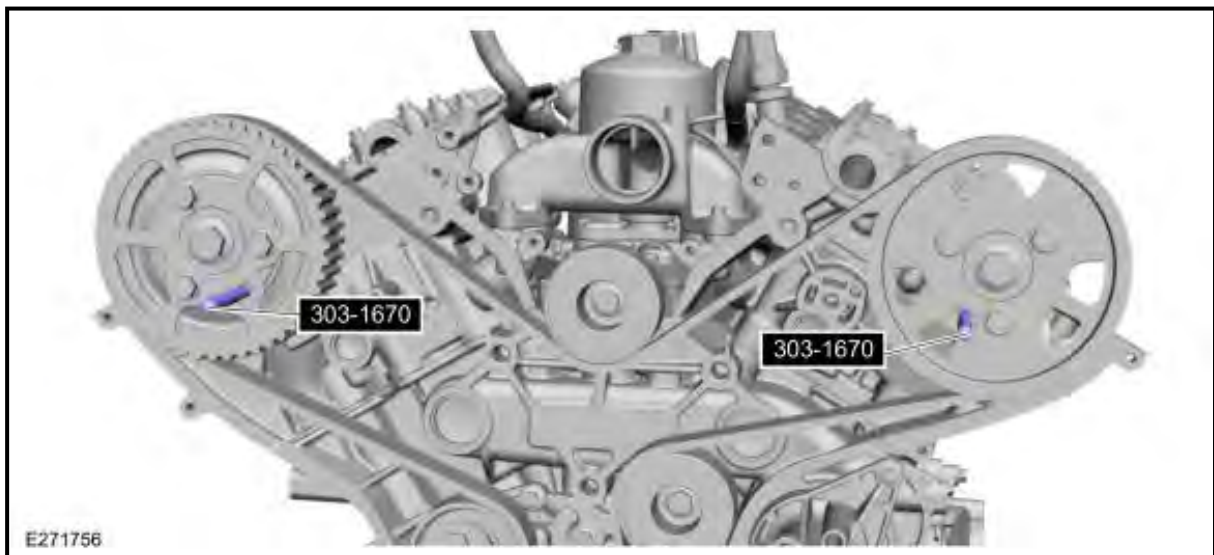
1. **NOTE:** Make sure that the installation marks are aligned.  
**NOTE:** It may be necessary to rotate the camshaft pulley slightly to ensure the bolts are not at the end of the slots.  
**NOTE:** Install the camshaft pulley with the timing mark on the camshaft drive.  
**NOTE:** Only tighten the bolts finger tight at this stage.

Install the READ belt, the camshaft pulley and the bolts.

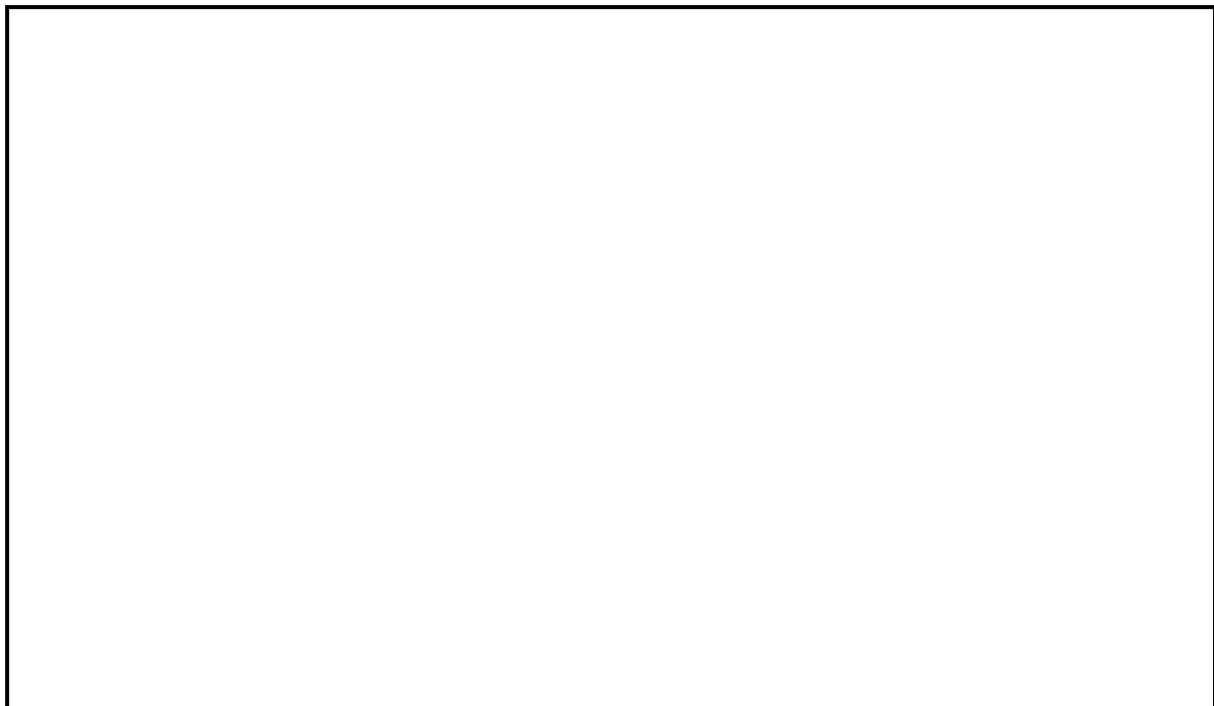
2. Remove the pin from the READ belt tensioner.
3. Install Special Service Tool: 303-1679 Timing Tool, Fuel Pump Rear Access.
4. Tighten the bolts for the camshaft pulley.  
Torque: 17 lb.ft (23 Nm)
5. Tighten the bolts for the accessory drive cover.  
Torque: 89 lb.in (10 Nm)
6. Remove Special Service Tool: 303-1679 Timing Tool, Fuel Pump Rear Access.

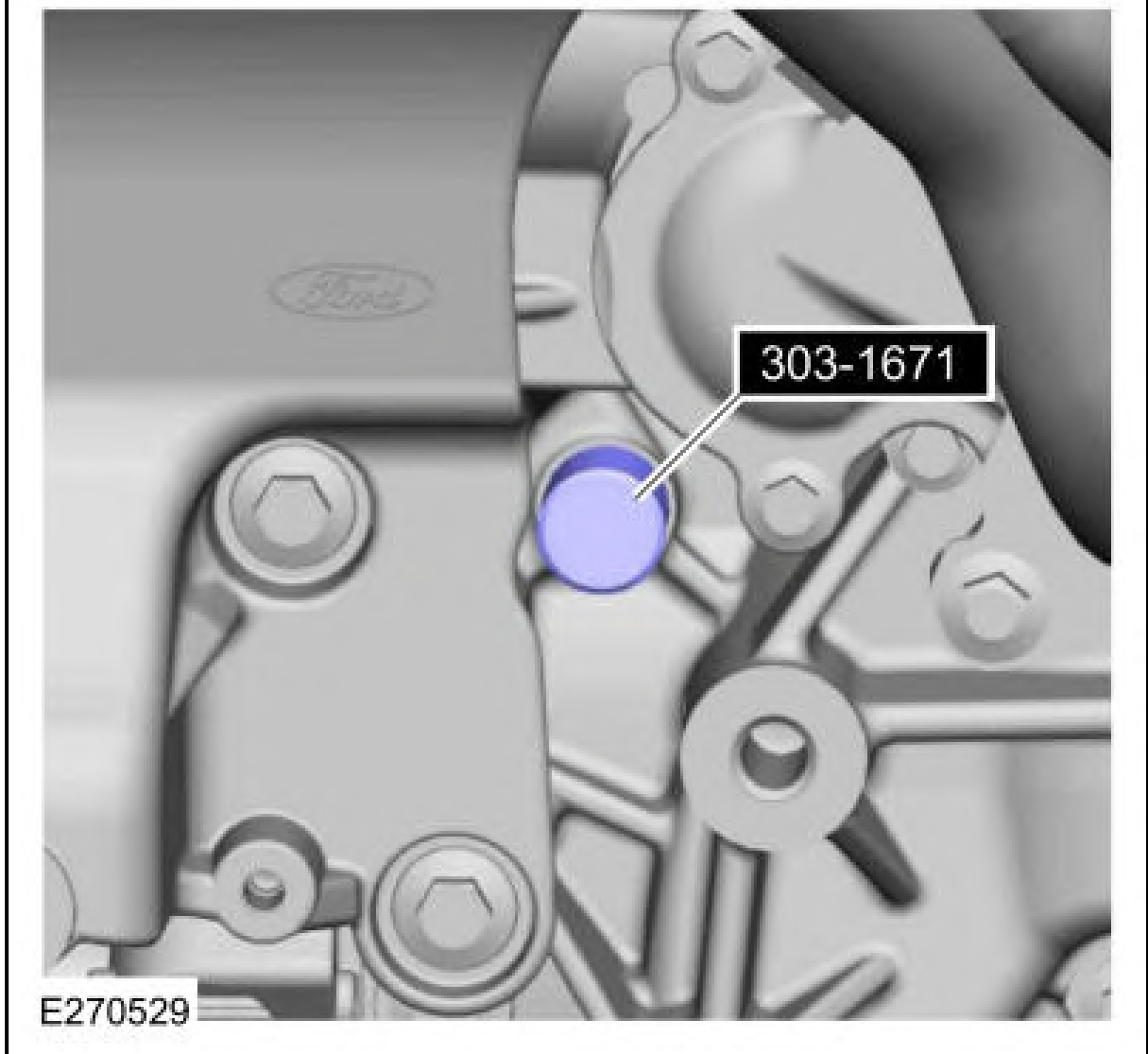


30. Remove Special Service Tool: 303-1670 Pins, Camshaft Locking.



31. Remove Special Service Tool: 303-1671 Pin, Locking Crankshaft.

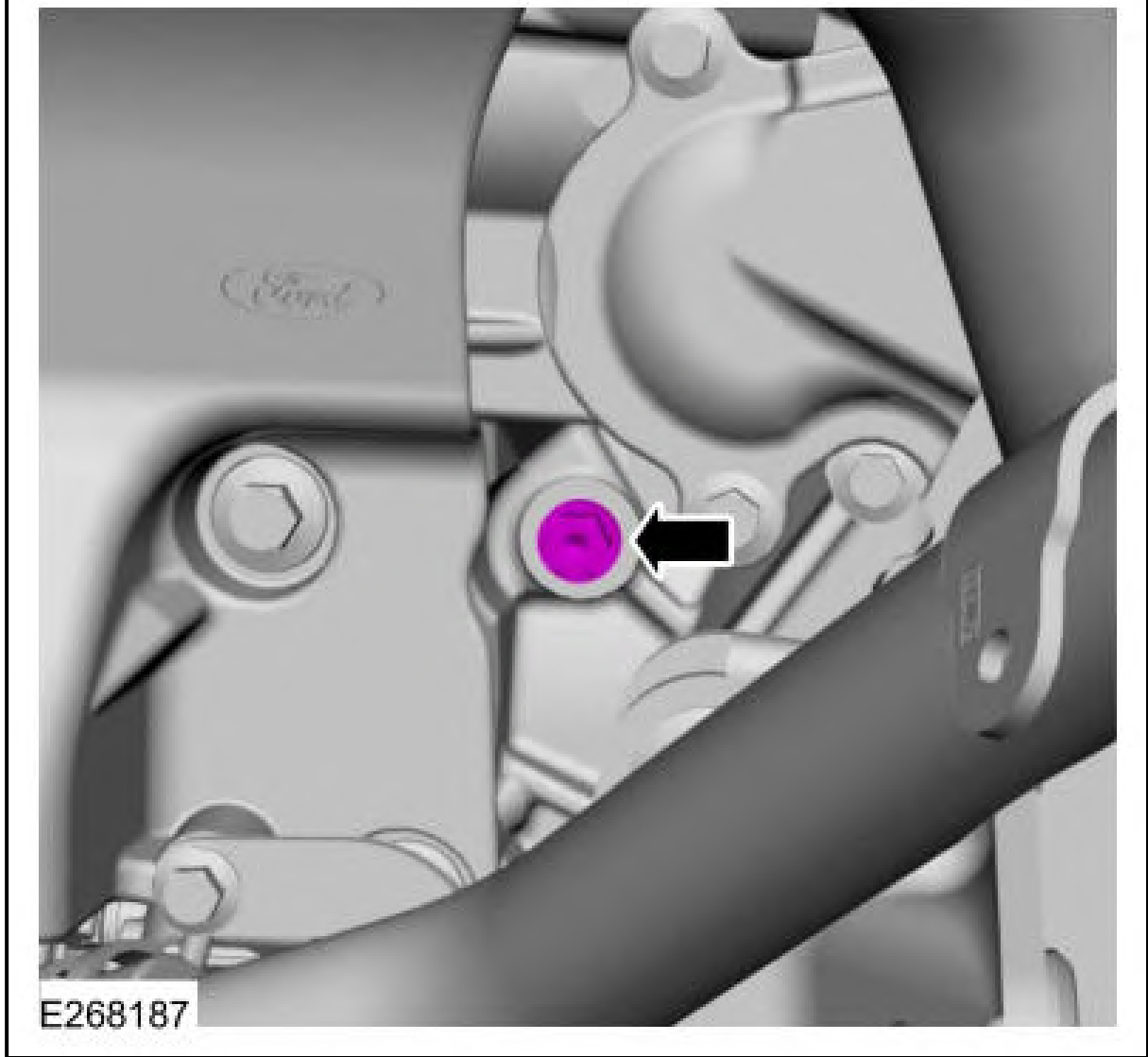




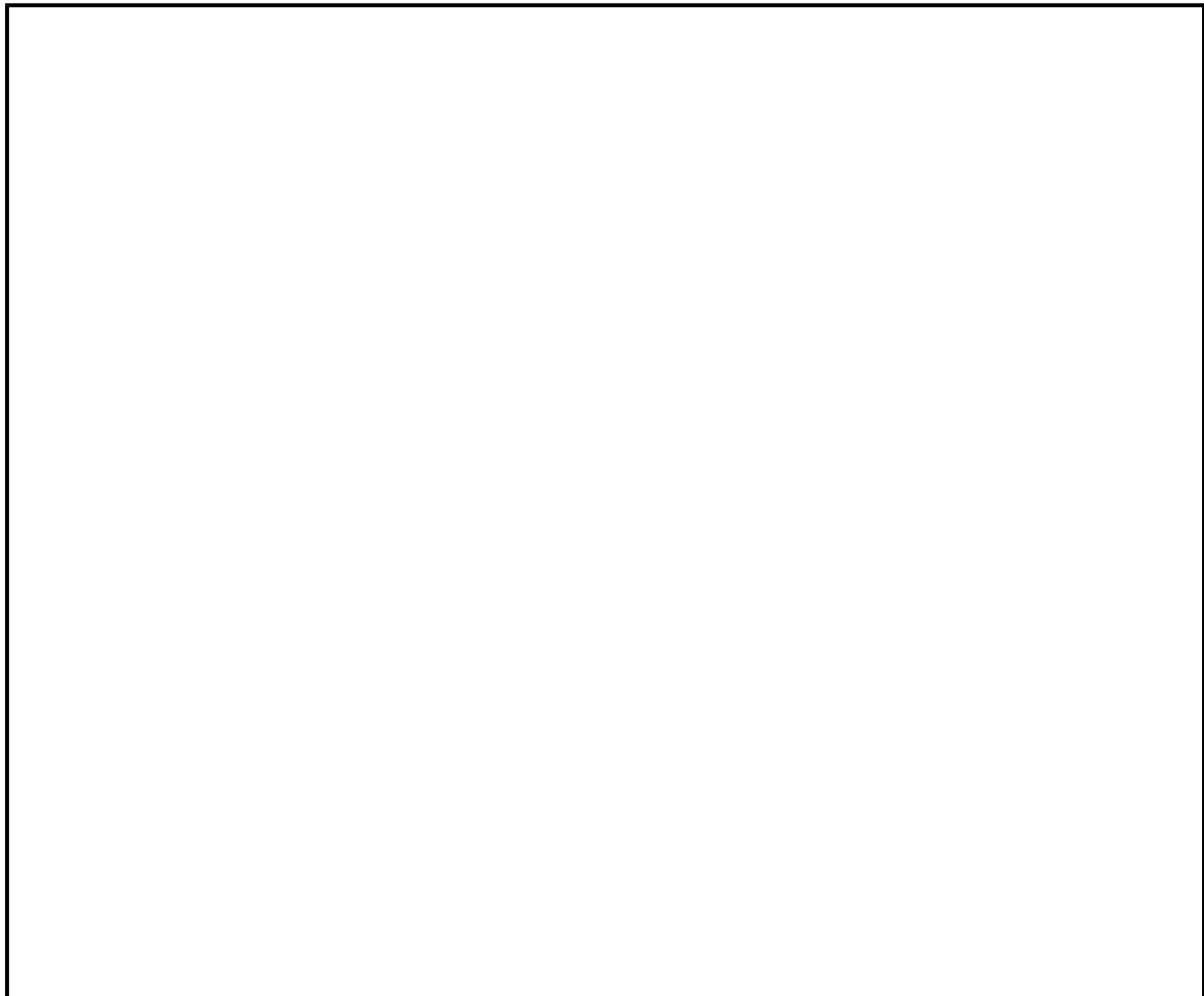
32. Install the timing pin bolt.

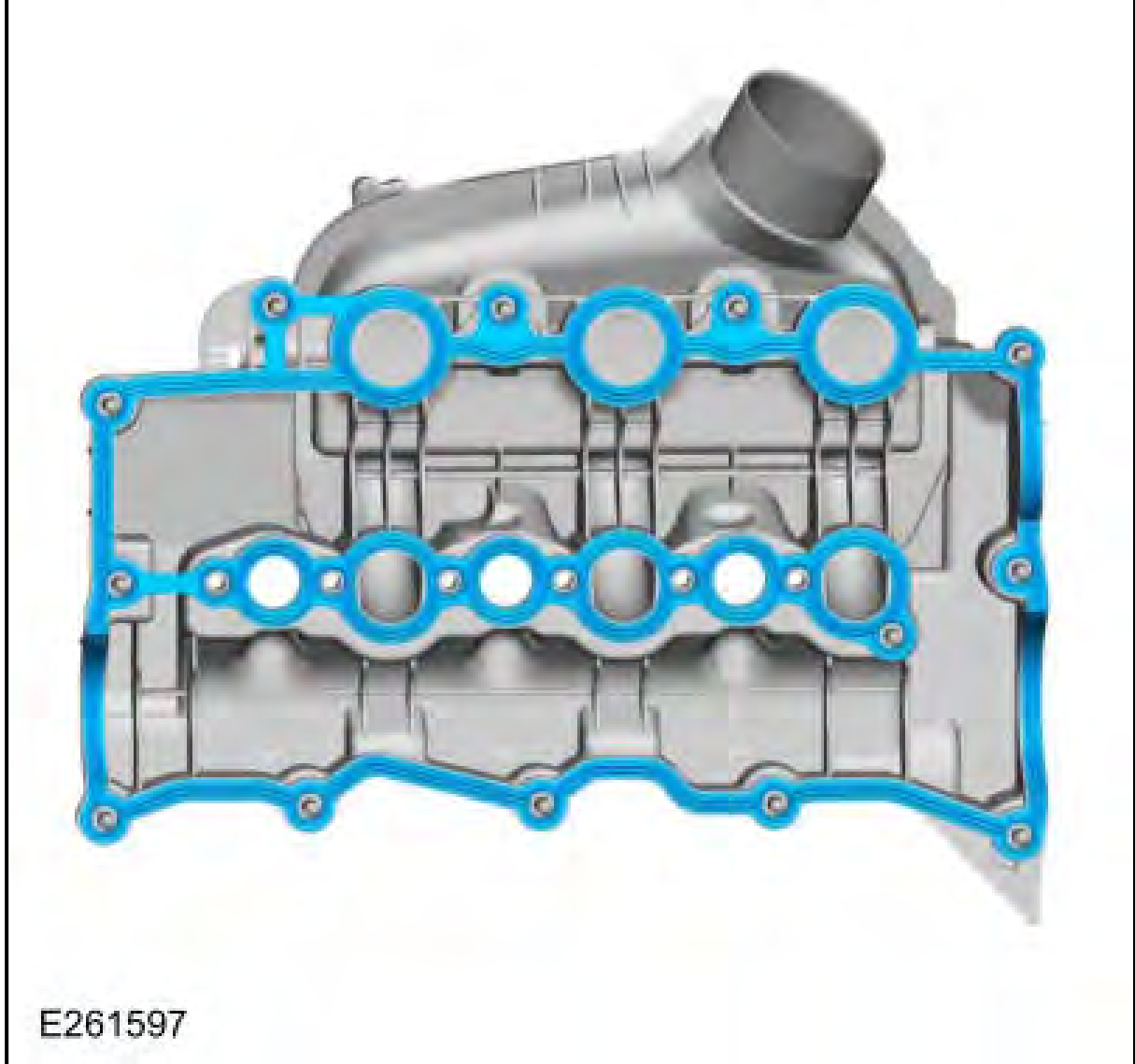
Torque: 17 lb.ft (23 Nm)





33. Install the LH valve cover gasket.

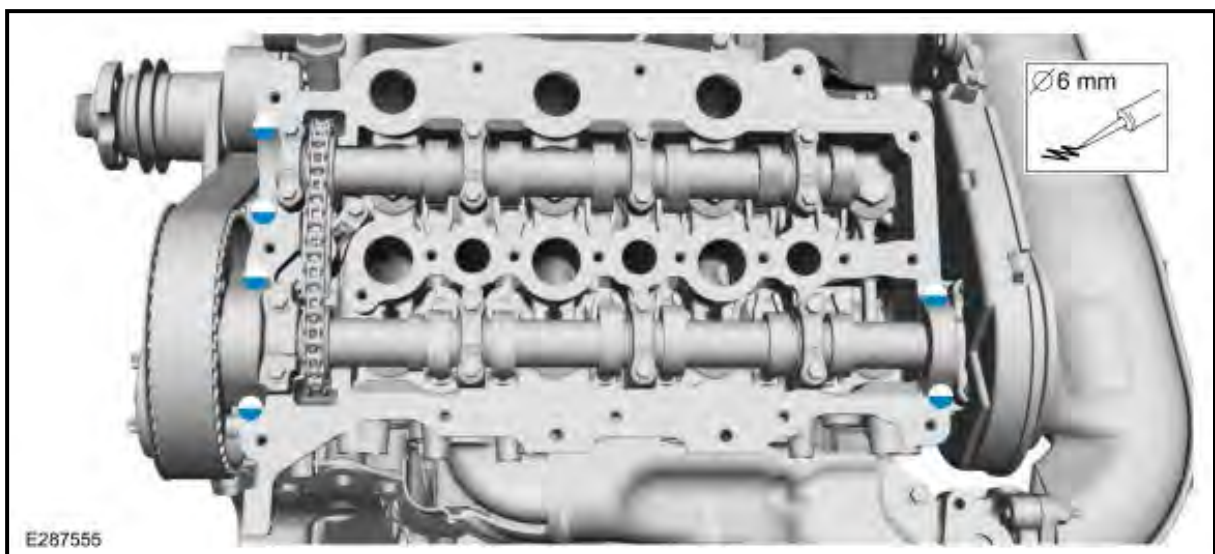




34. **NOTE:** If the valve cover is not installed and the fasteners tightened within 10 minutes, the sealant must be removed and the sealing area cleaned.

Apply an 6 mm dot of Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone to the locations shown.

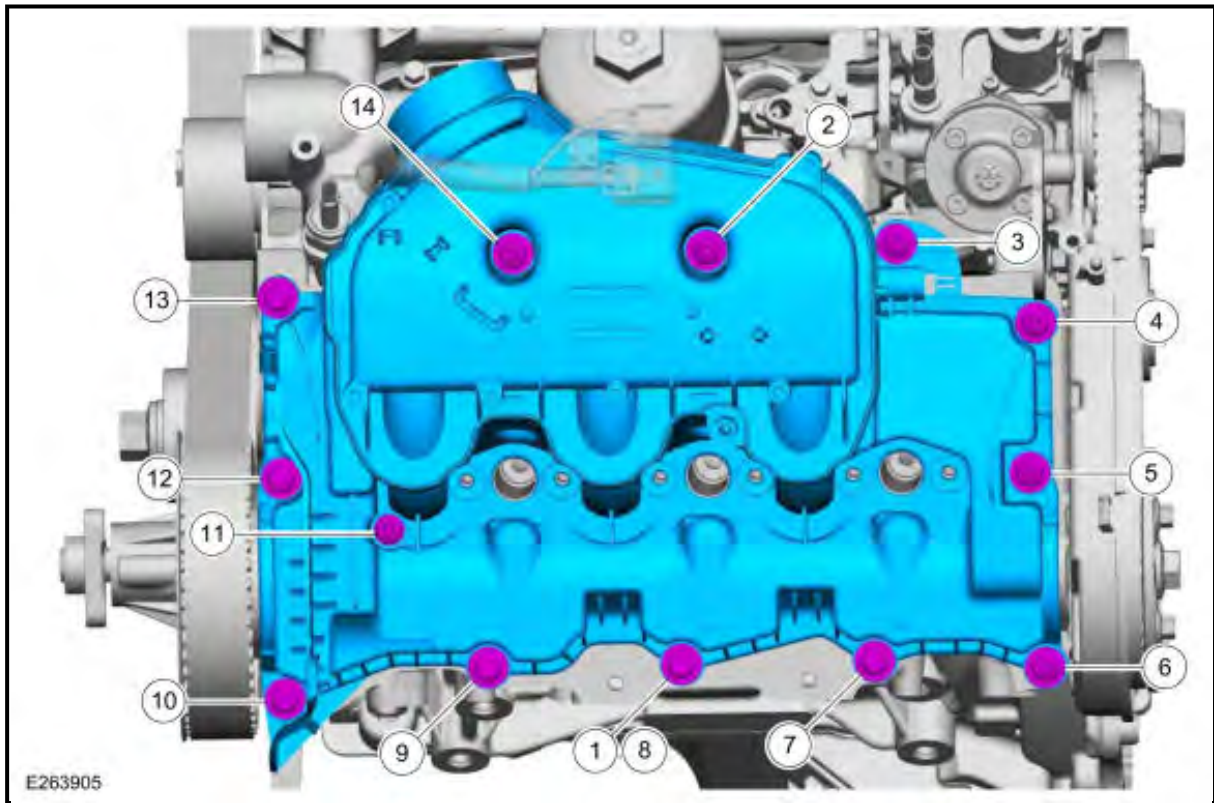
Material: Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



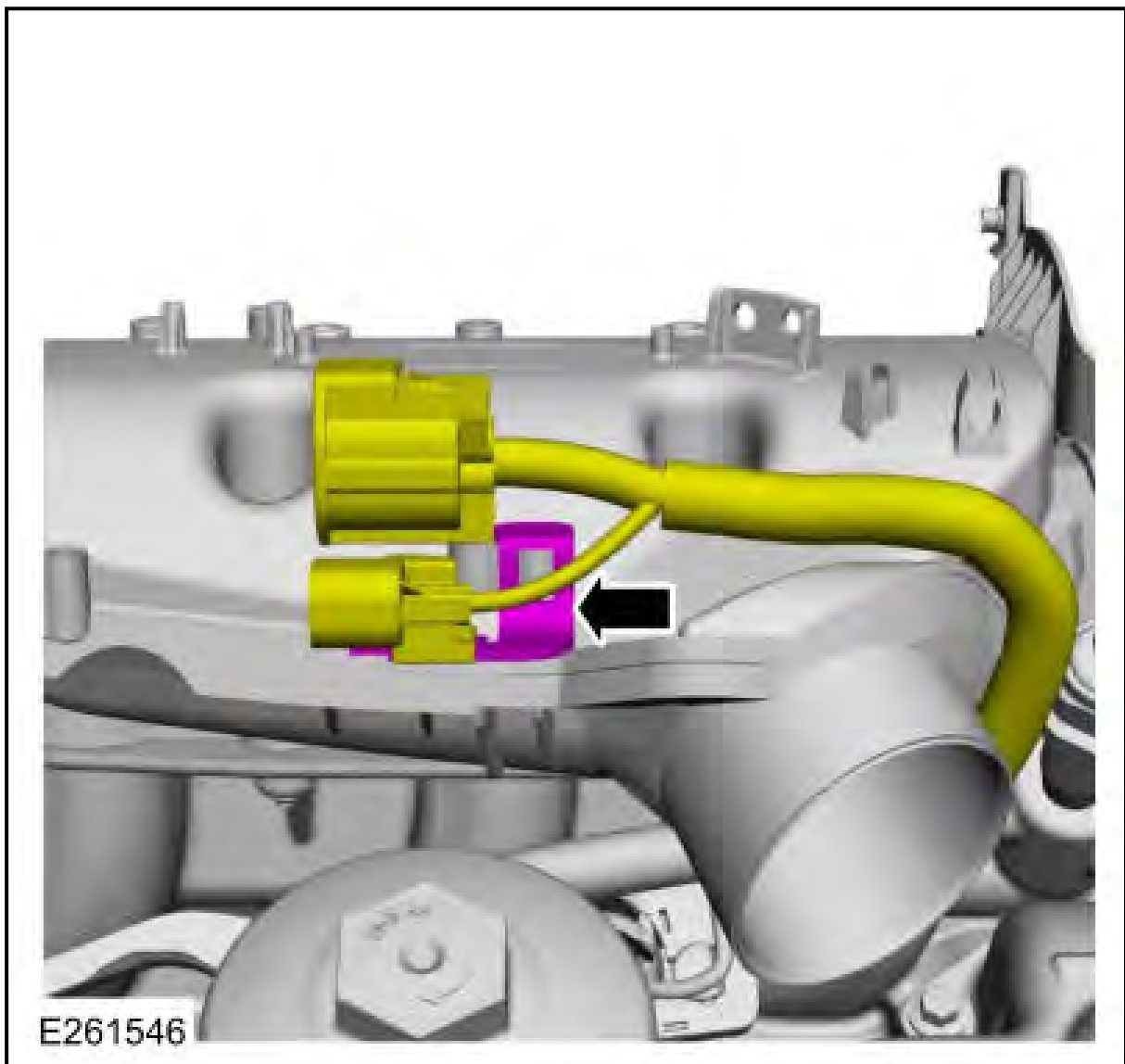
35. Install the LH valve cover and tighten the fasteners.

Torque

:Stage 1: Tighten bolt number 1 to : 9 lb.in (1 Nm) Stage 2: Tighten bolts 2 thru 14 to : 89 lb.in (10 Nm)

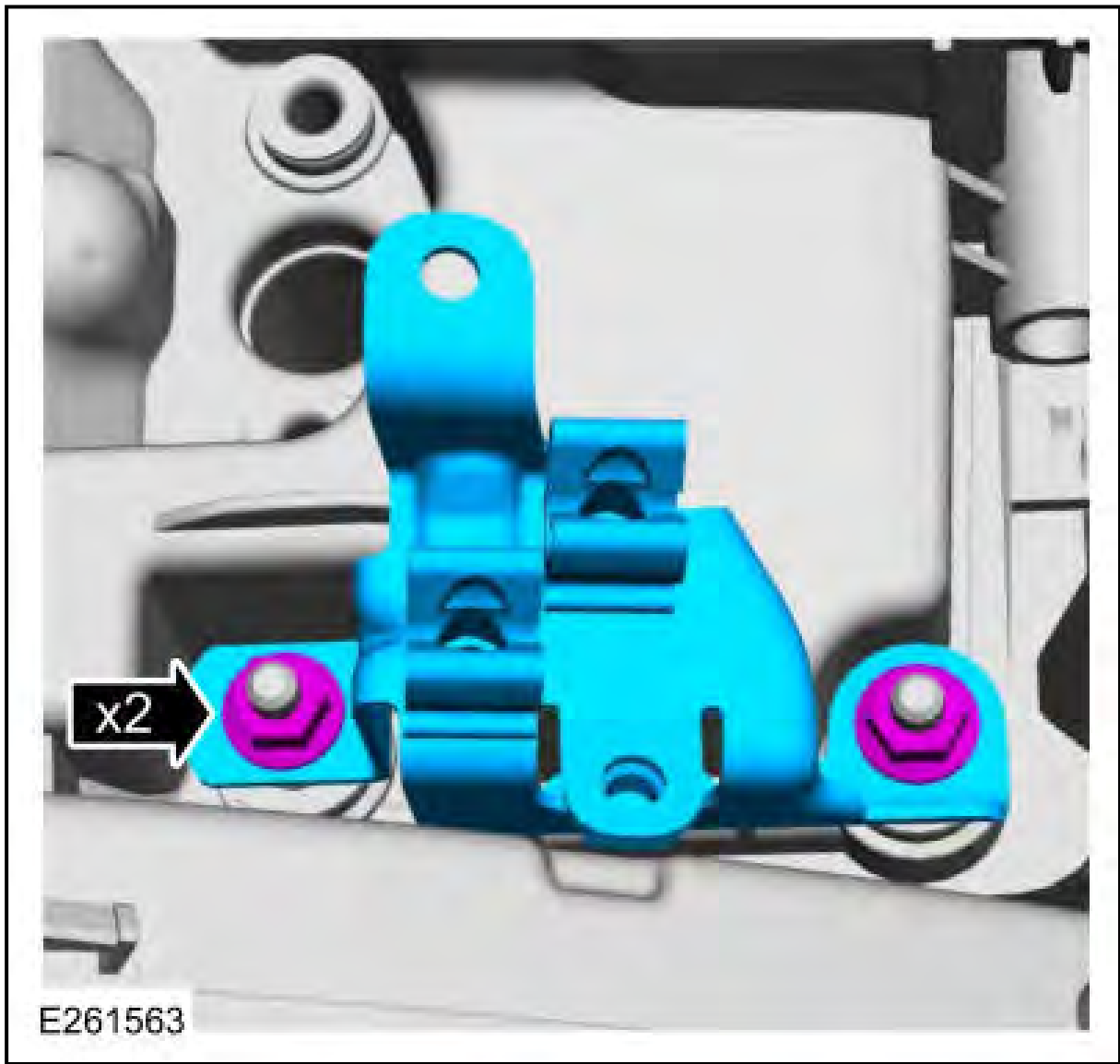


36. Connect the LH glow plug electrical connector.



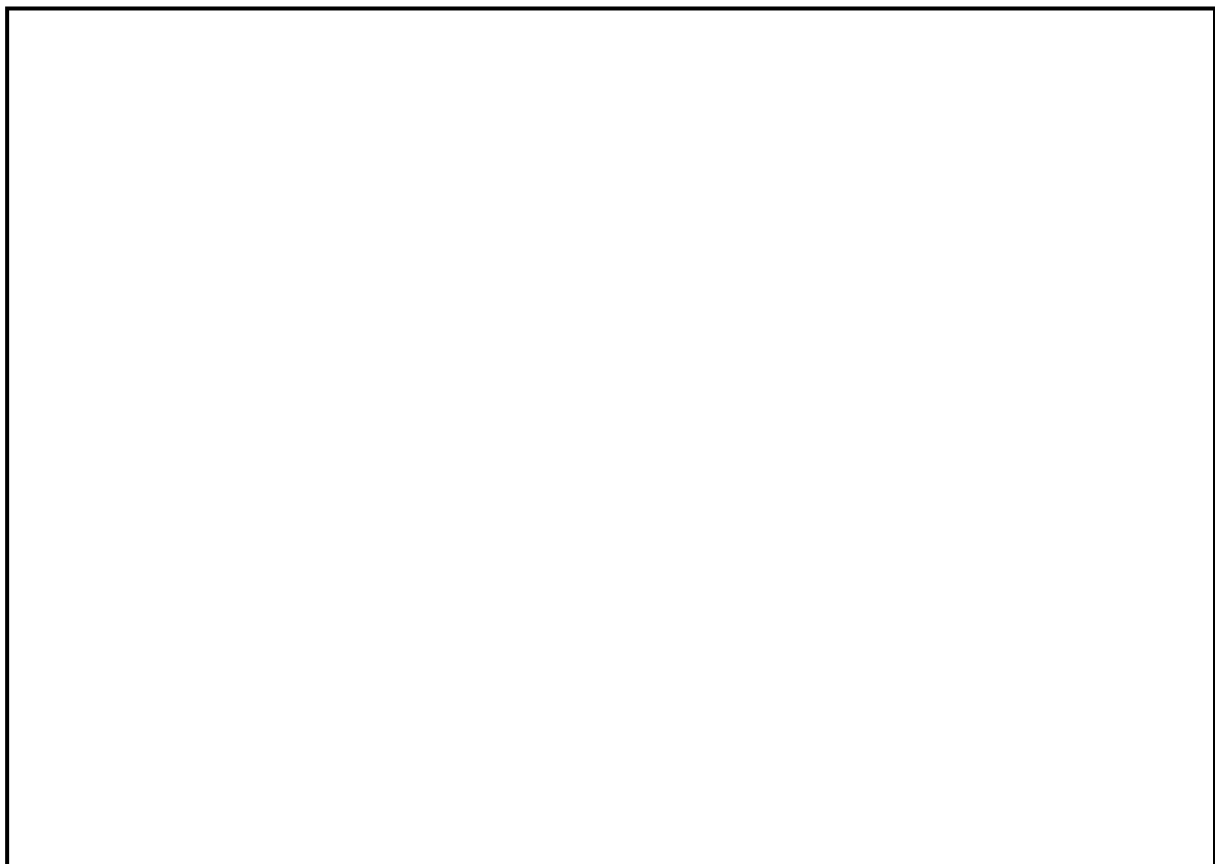
37. Install the LH fuel tube bracket and the nuts.

Torque: 89 lb.in (10 Nm)

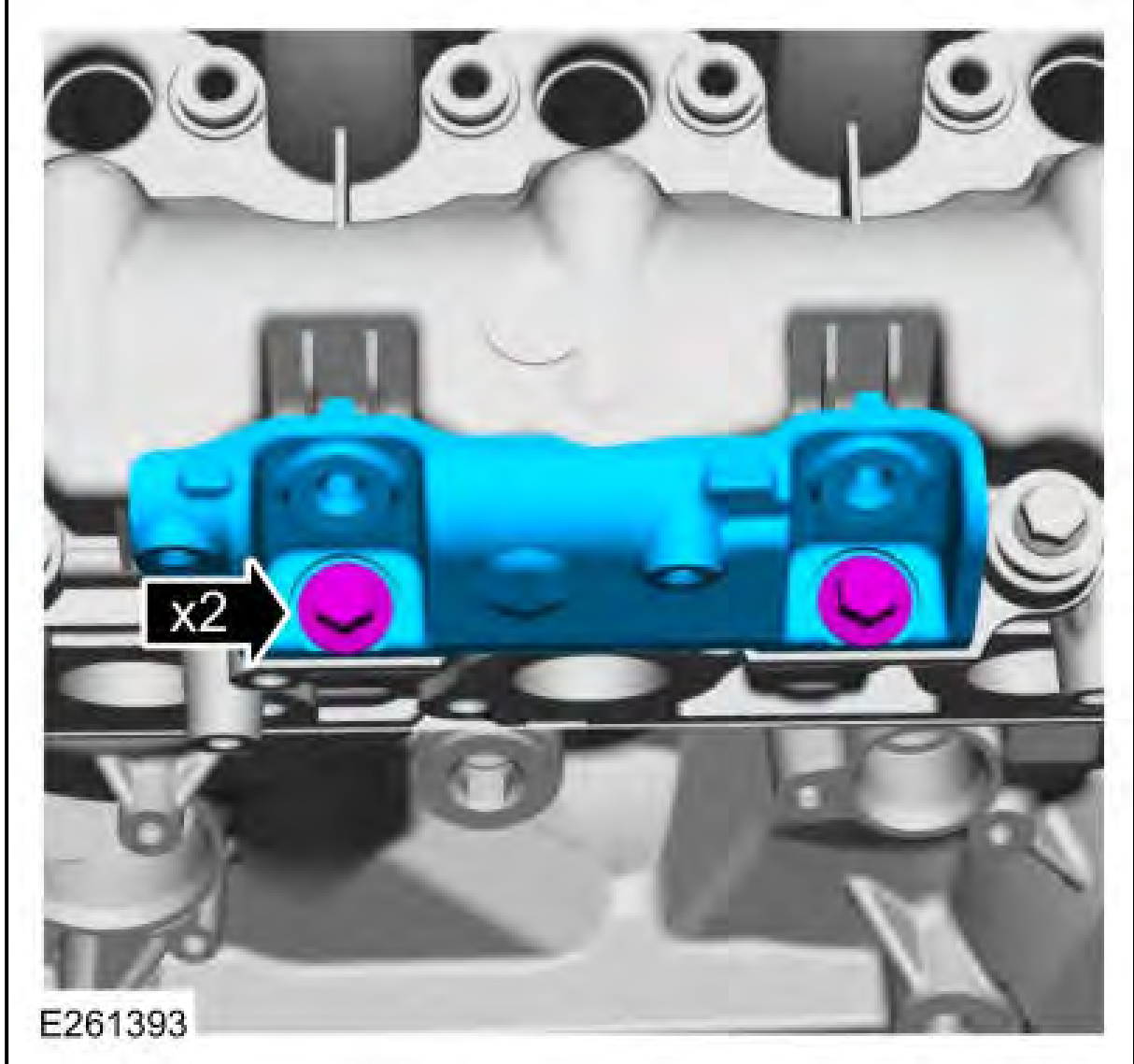


38. Install the LH fuel rail bracket and the bolts.

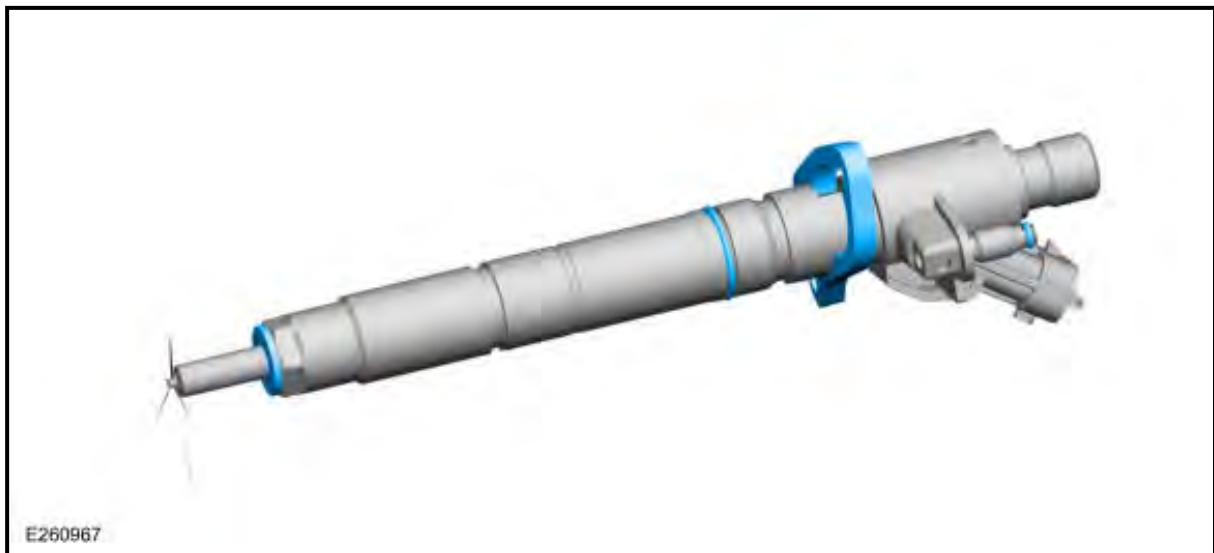
Torque: 17 lb.ft (23 Nm)







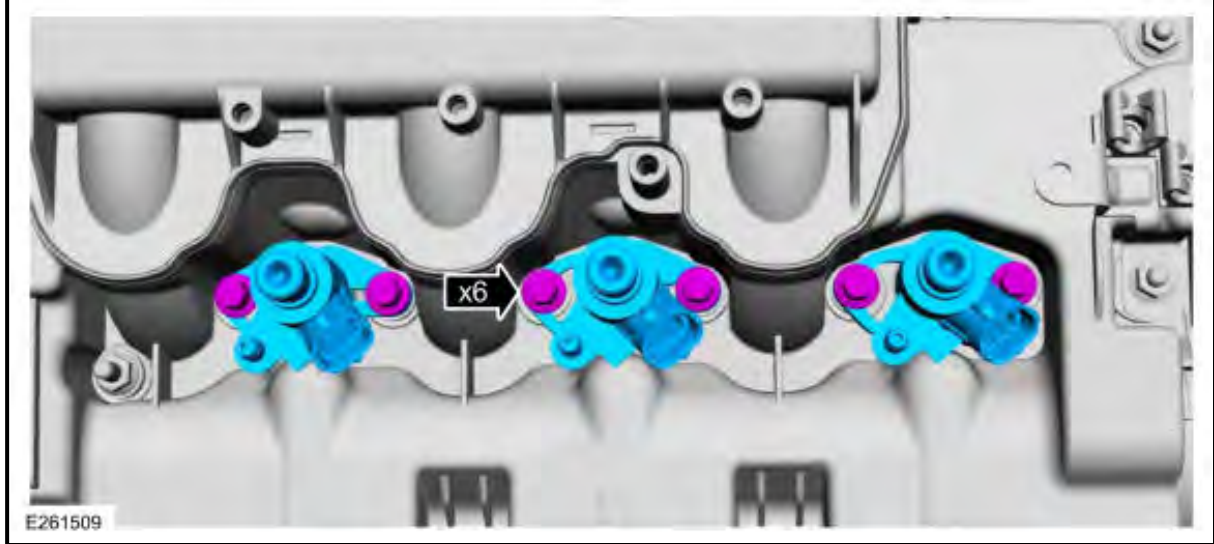
39. Install the sealing washer, the O-rings and the fuel injector hold down.



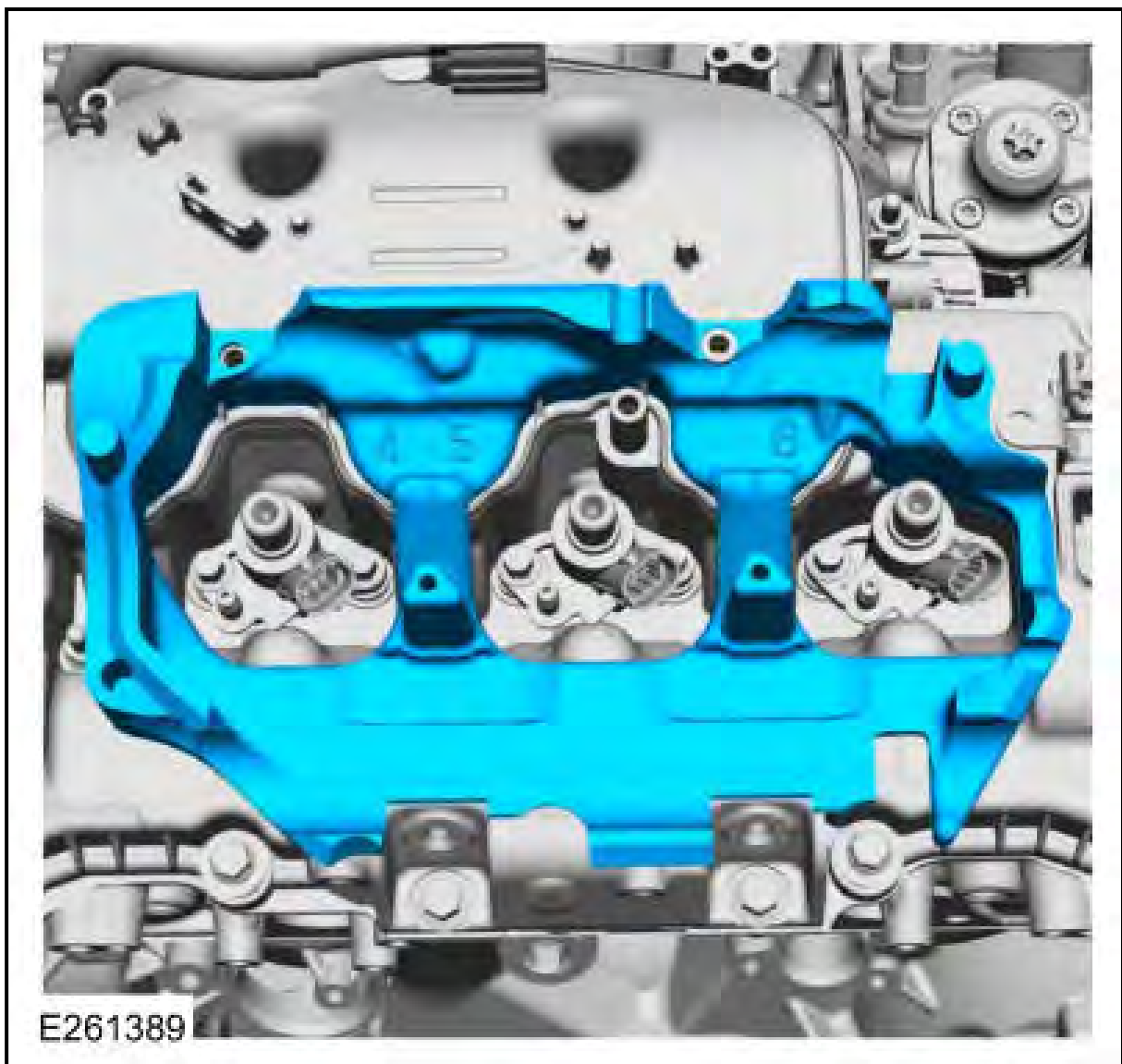
40. Install the LH fuel injectors and bolts.

Torque: 89 lb.in (10 Nm)





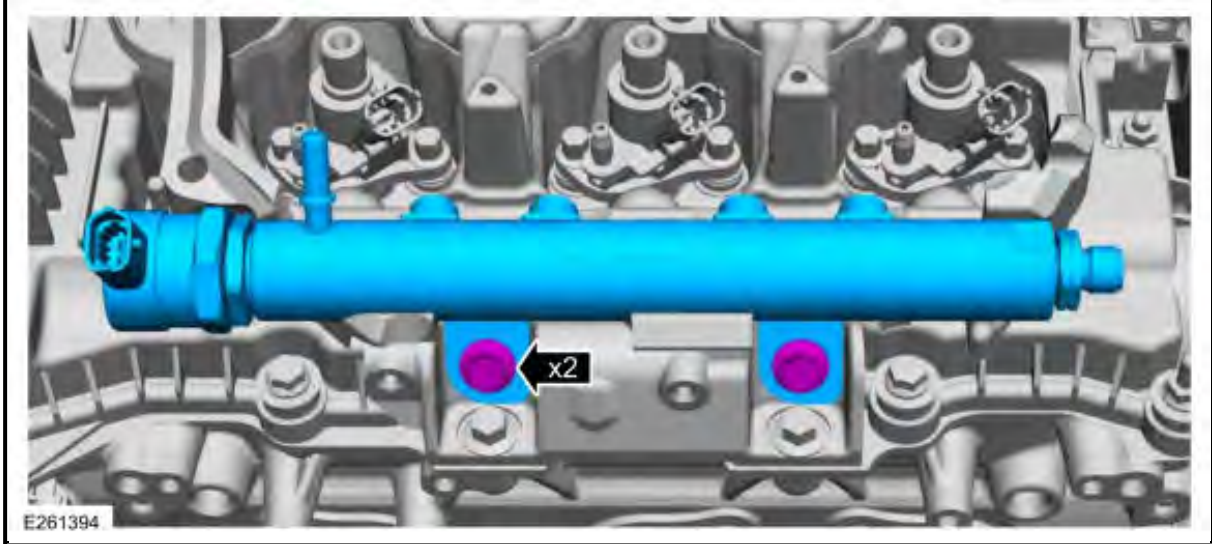
41. Install the LH fuel injector noise insulator.



42. Install the LH fuel rail and the bolts.

Torque: 17 lb.ft (23 Nm)



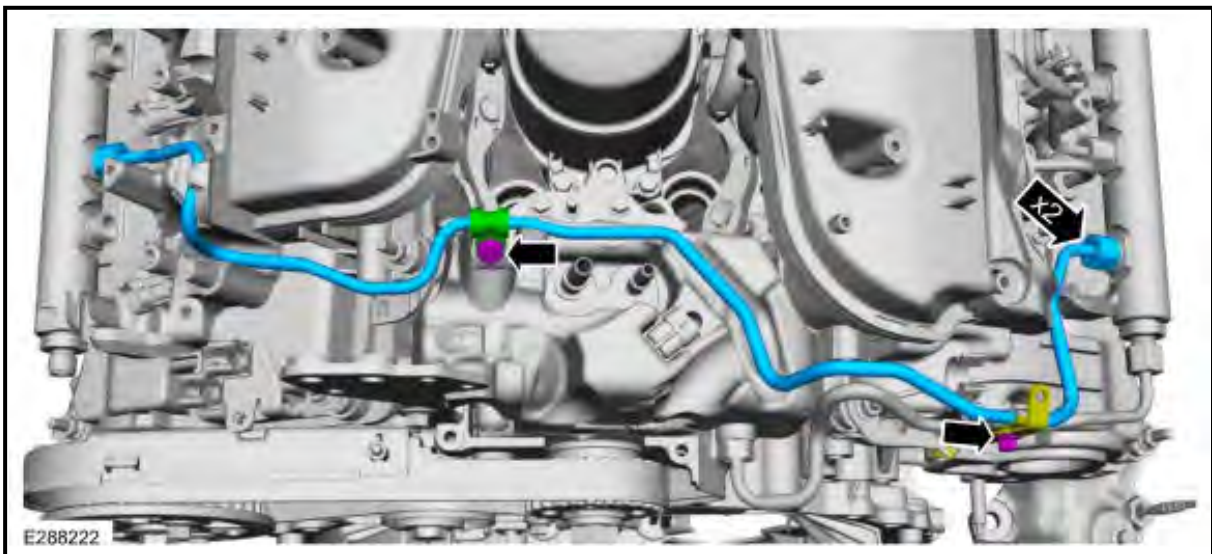


43. **NOTE:** The component must be installed by hand before final tightening.

Install the fuel injection pump balance tube, the clamp and the bolts.

#### Torque

- :Stage 1: Tighten the clamp bolts to: : 89 lb.in (10 Nm)
- Stage 2: Tighten the fuel injection pump balance tube to:: 89 lb.in (10 Nm)
- Stage 3: Tighten the fuel injection pump balance tube to:: 142 lb.in (16 Nm)
- Stage 4: Tighten the fuel injection pump balance tube to:: 50 Å°

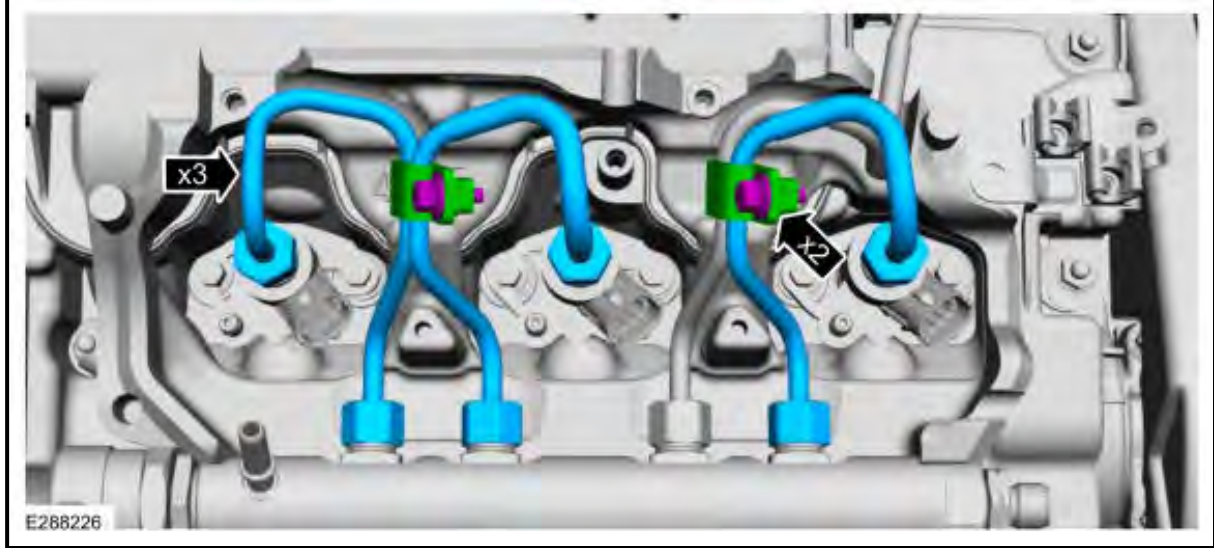


44. **NOTE:** The component must be installed by hand before final tightening.

Install the LH fuel injector supply tubes, the clamps and the bolts.

#### Torque

- :Stage 1: Tighten the clamp bolts to: : 89 lb.in (10 Nm)
- Stage 2: Tighten at the fuel rail to:: 89 lb.in (10 Nm)
- Stage 3: Tighten at the fuel injector to:: 89 lb.in (10 Nm)
- Stage 4: Tighten at the fuel rail to:: 142 lb.in (16 Nm)
- Stage 5: Tighten at the fuel injector to:: 142 lb.in (16 Nm)
- Stage 6: Tighten at the fuel rail to:: 50 Å°
- Stage 7: Tighten at the fuel injector to:: 50

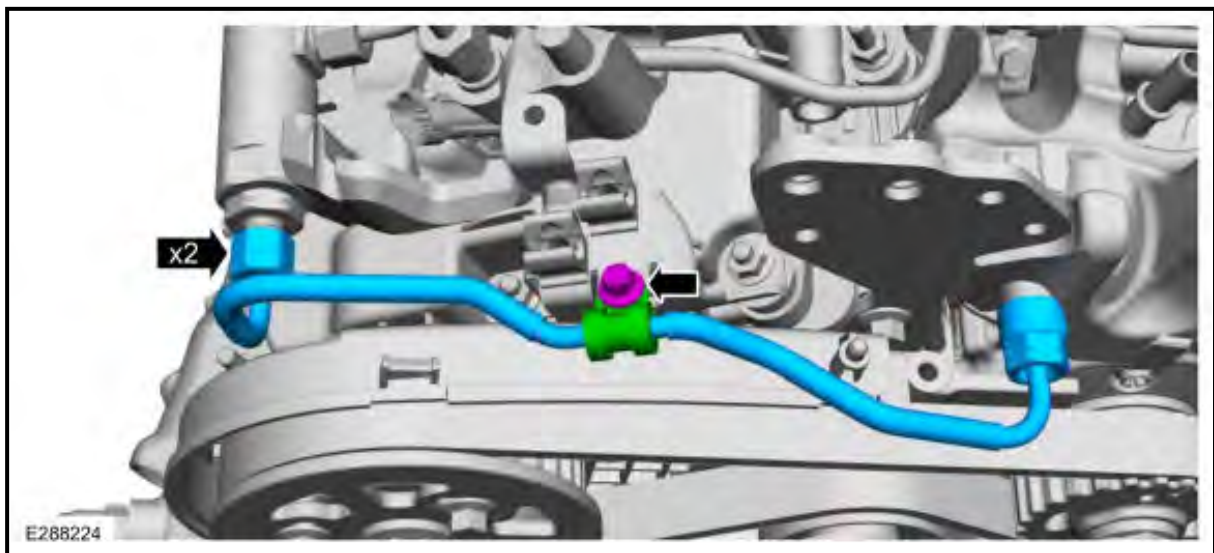


45. **NOTE:** The component must be installed by hand before final tightening.

Install the LH fuel rail supply tube, the clamp and the bolt.

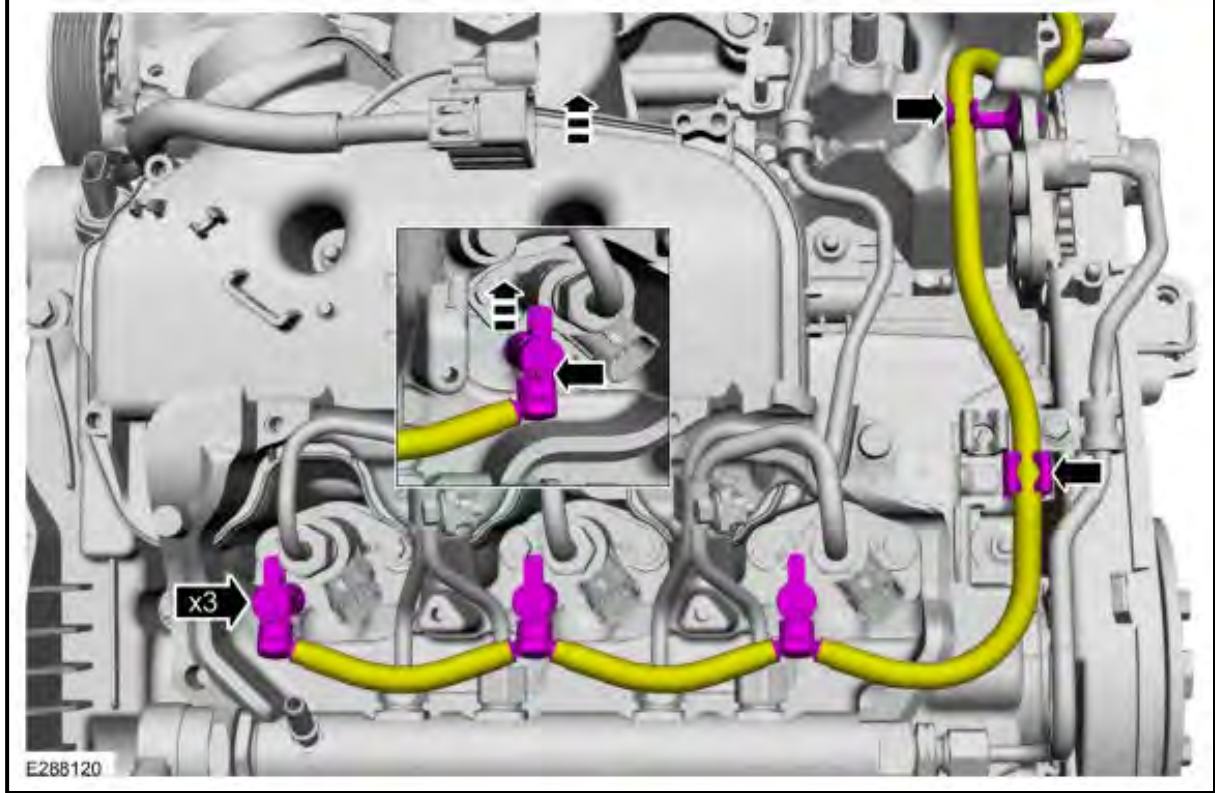
### Torque

- :Stage 1: Tighten the clamp bolt to: : 89 lb.in (10 Nm)
- Stage 2: Tighten at the fuel rail to:: 89 lb.in (10 Nm)
- Stage 3: Tighten at the fuel injection pump to:: 89 lb.in (10 Nm)
- Stage 4: Tighten at the fuel rail to:: 142 lb.in (16 Nm)
- Stage 5: Tighten at the fuel injection pump to:: 142 lb.in (16 Nm)
- Stage 6: Tighten at the fuel rail:: 50 Â°
- Stage 7: Tighten at the fuel injection pump:: 50 Â°



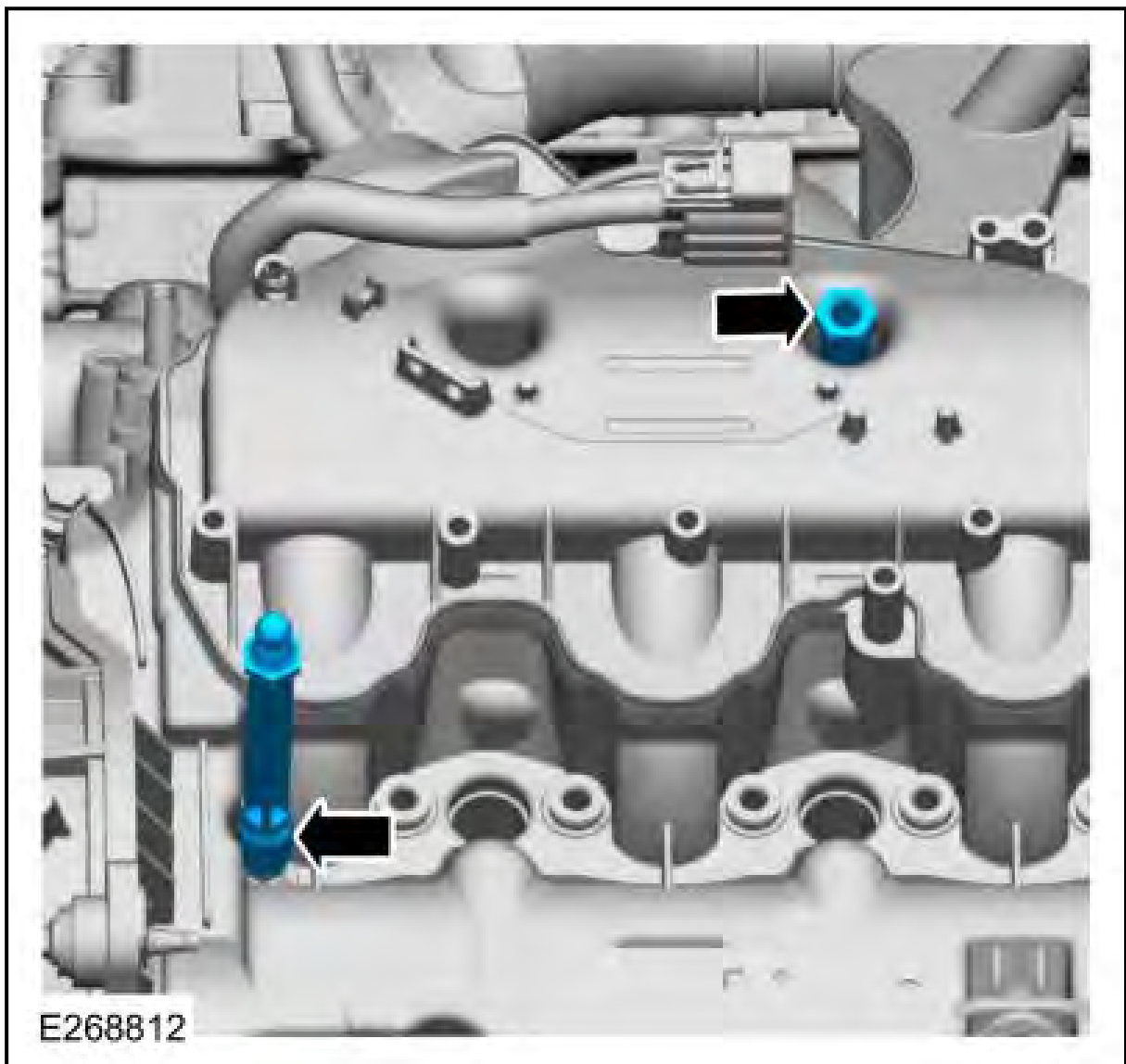
46. Position back and connect the LH fuel return hose assembly.





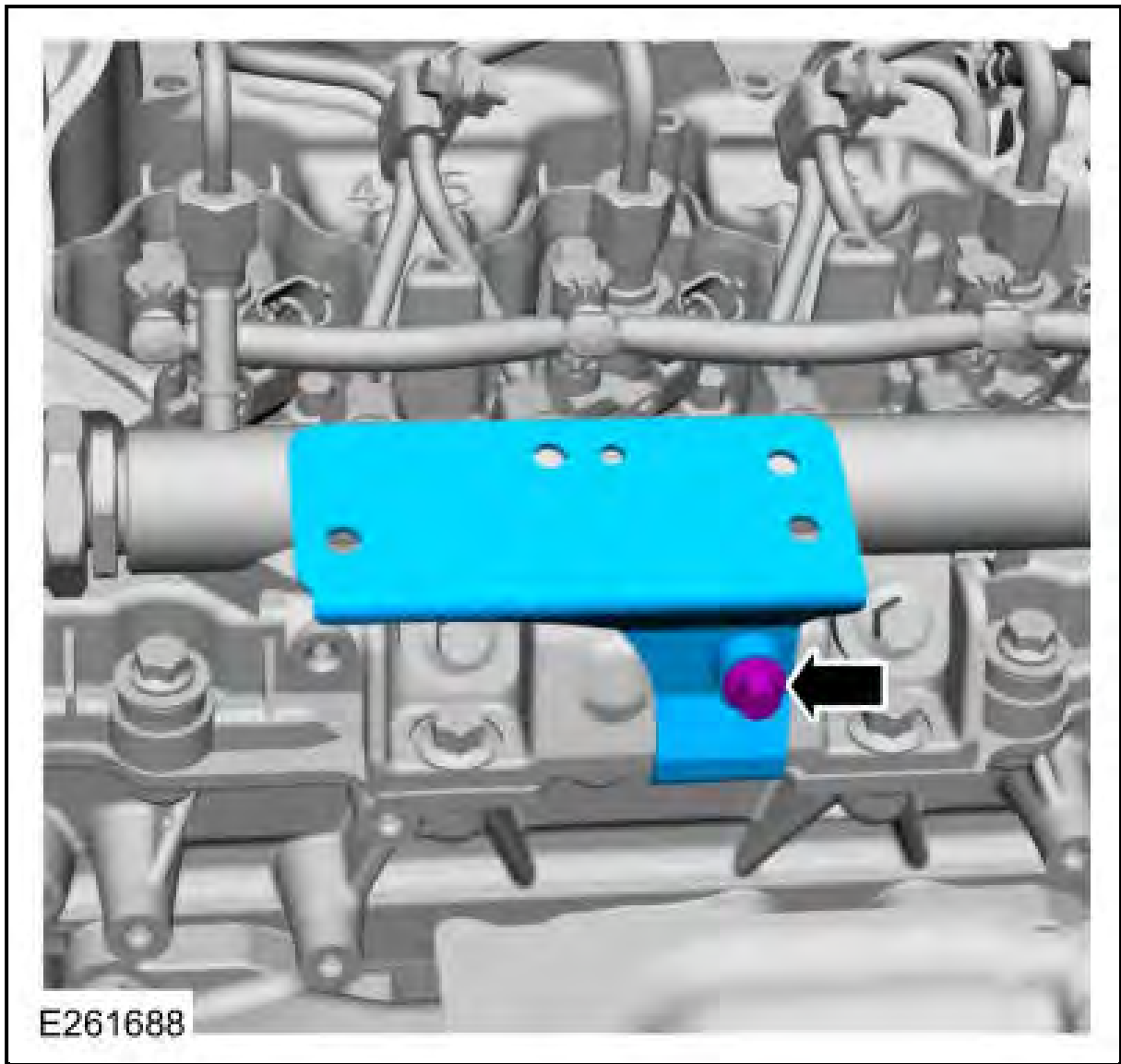
47. Install the LH engine cover stud assemblies.

Torque: 44 lb.in (5 Nm)



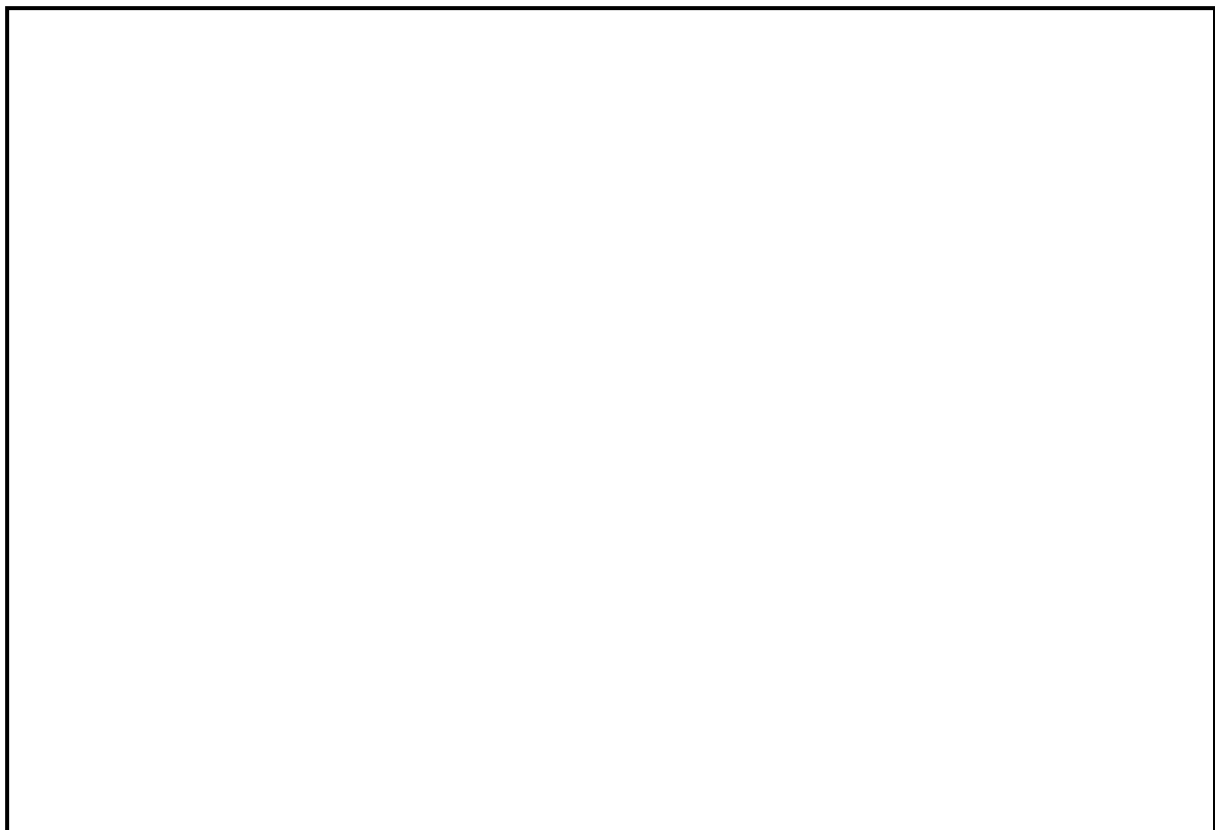
48. Install the wire harness bracket and the bolt.

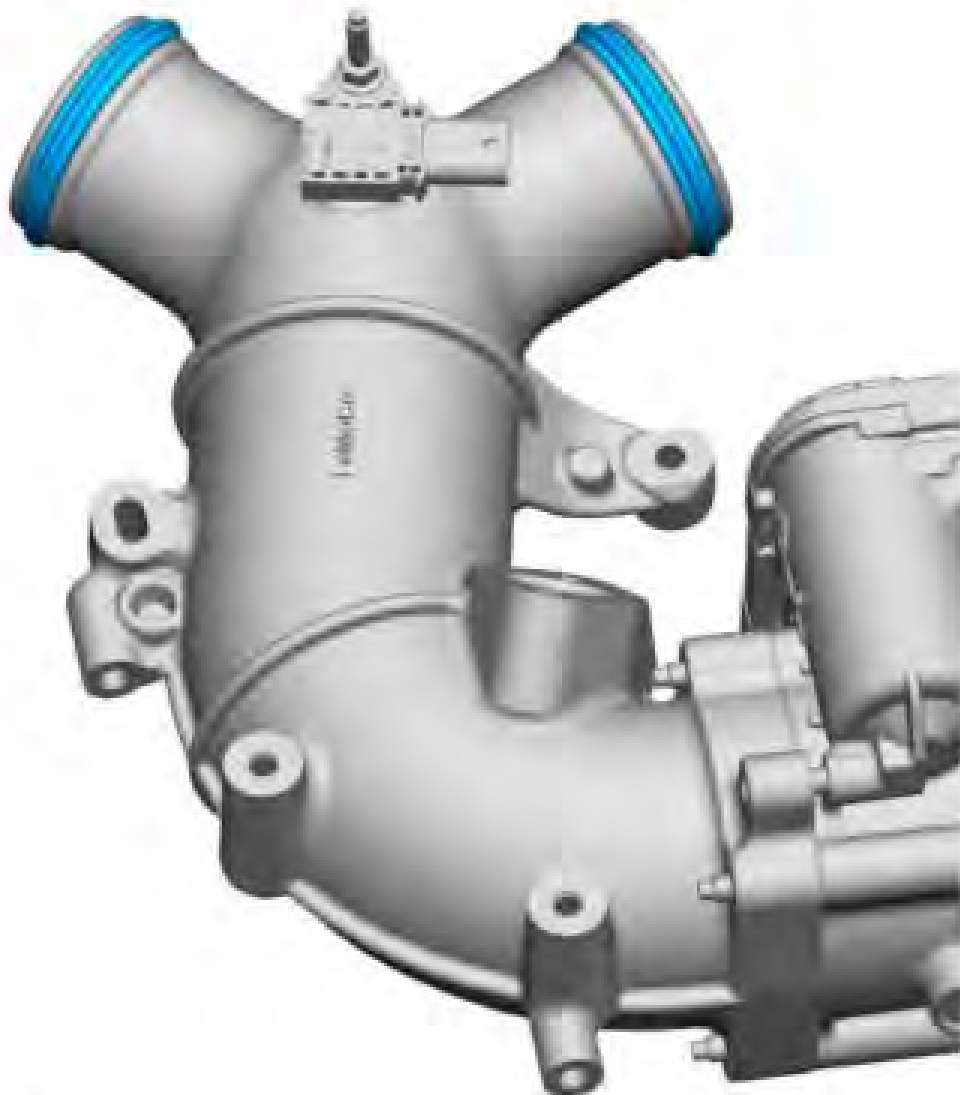
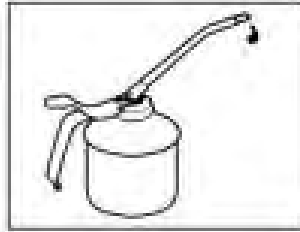
Torque: 89 lb.in (10 Nm)



49. Install new gaskets on the intake manifold. Lubricate the gaskets with clean engine oil.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)





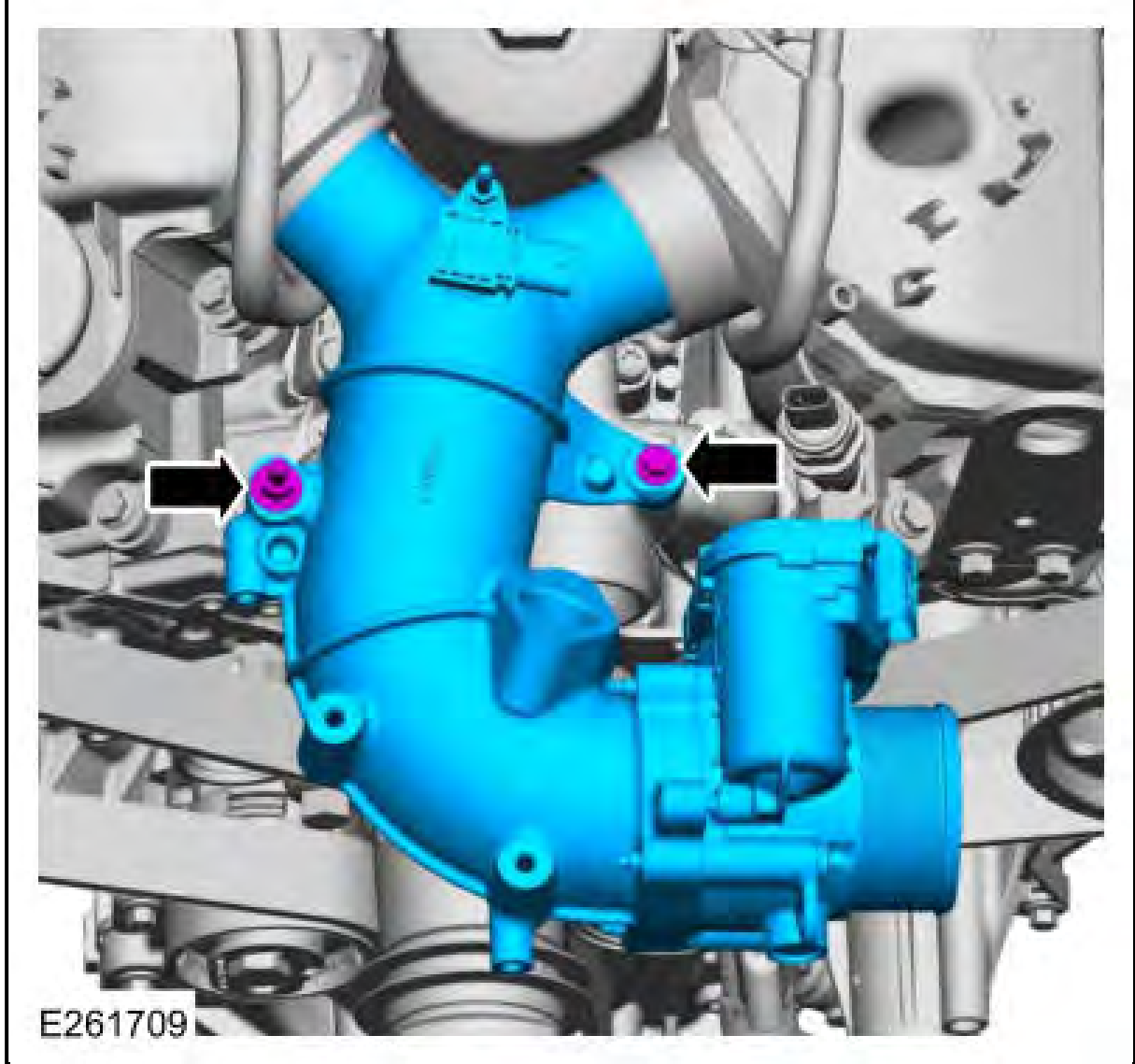
E261599

50. **NOTE:** Install the intake manifold into the LH valve cover, then into the RH valve cover.

Install the intake manifold, the stud bolt and the bolt.

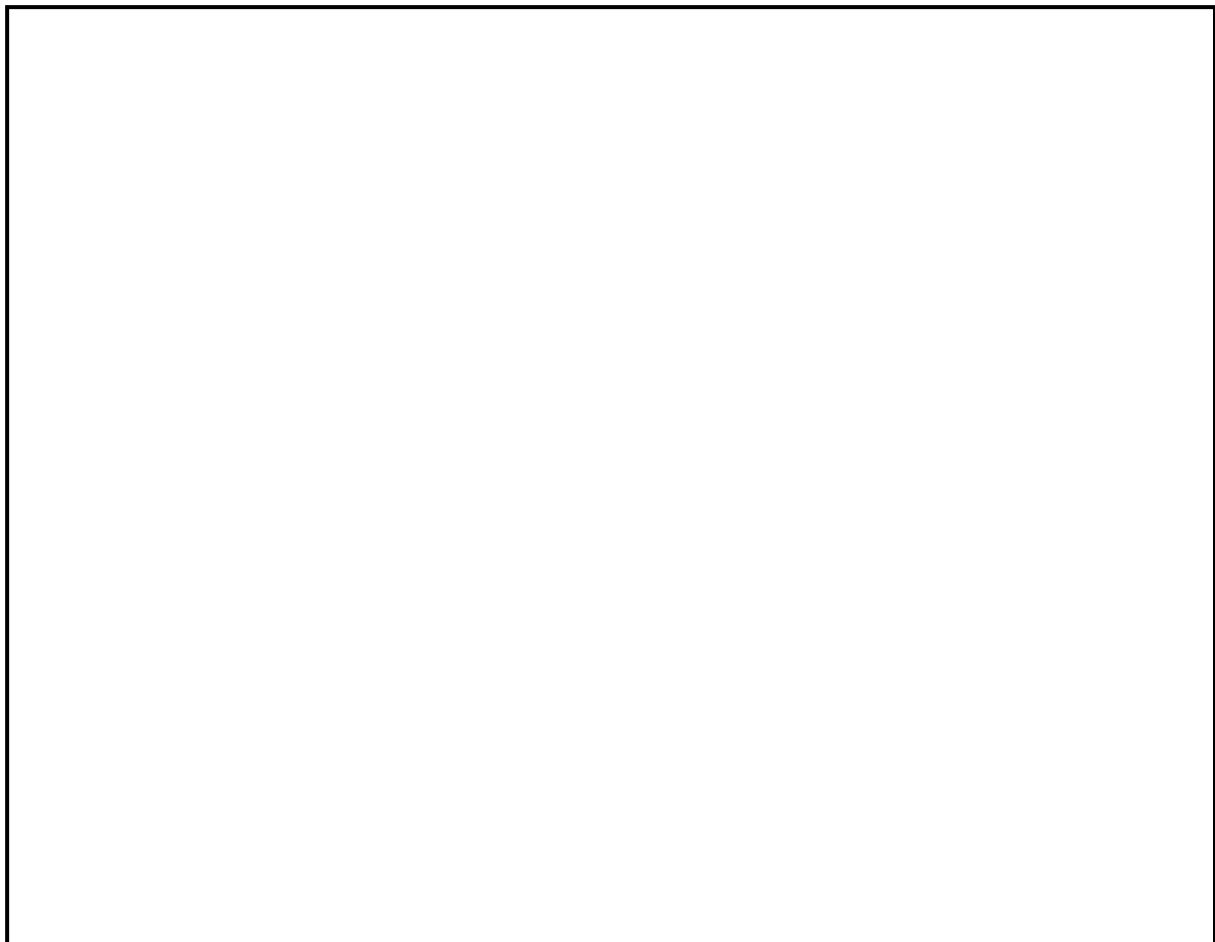
Torque: 89 lb.in (10 Nm)



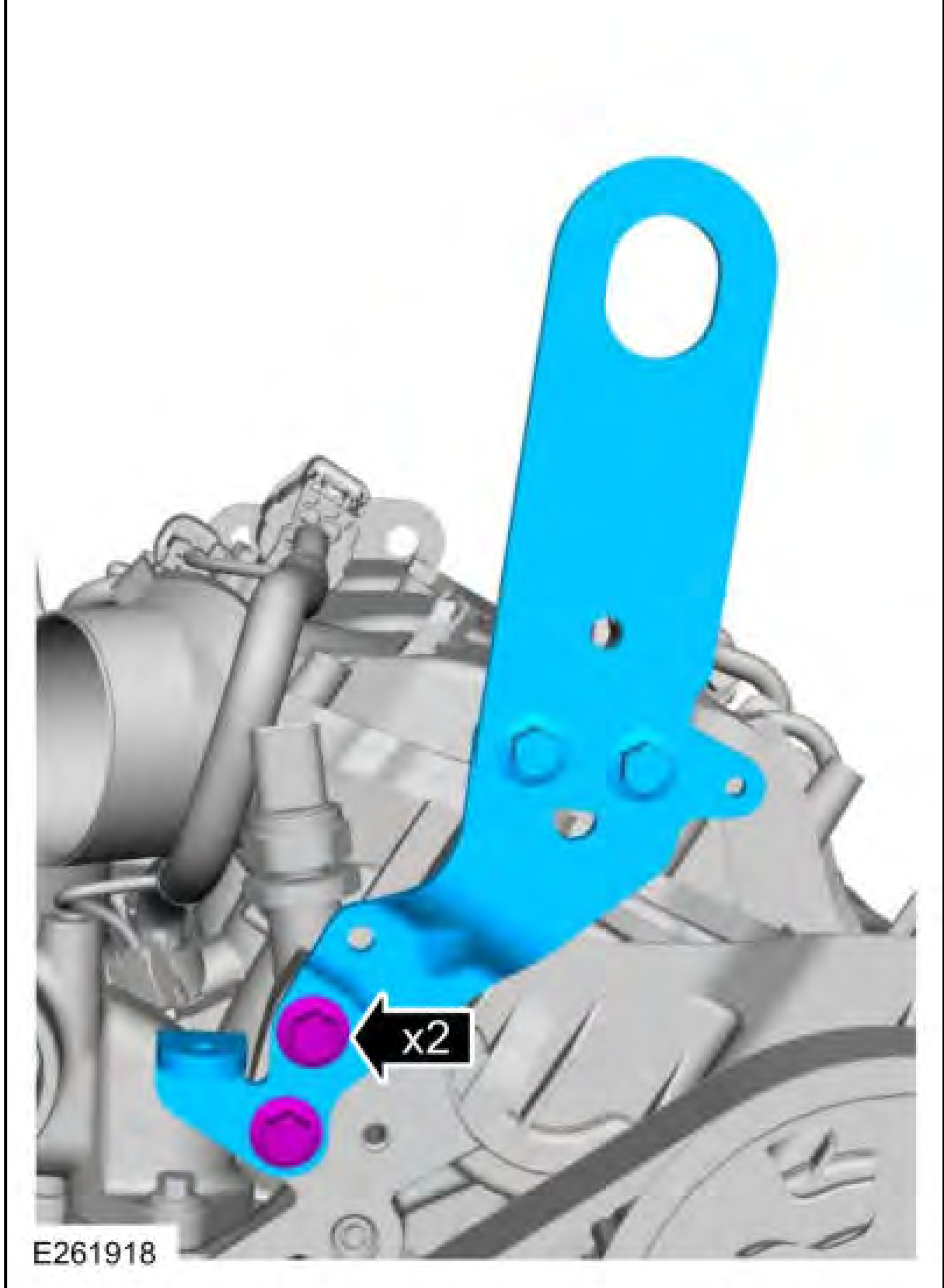


51. Install the front engine lifting eye and the bolts.

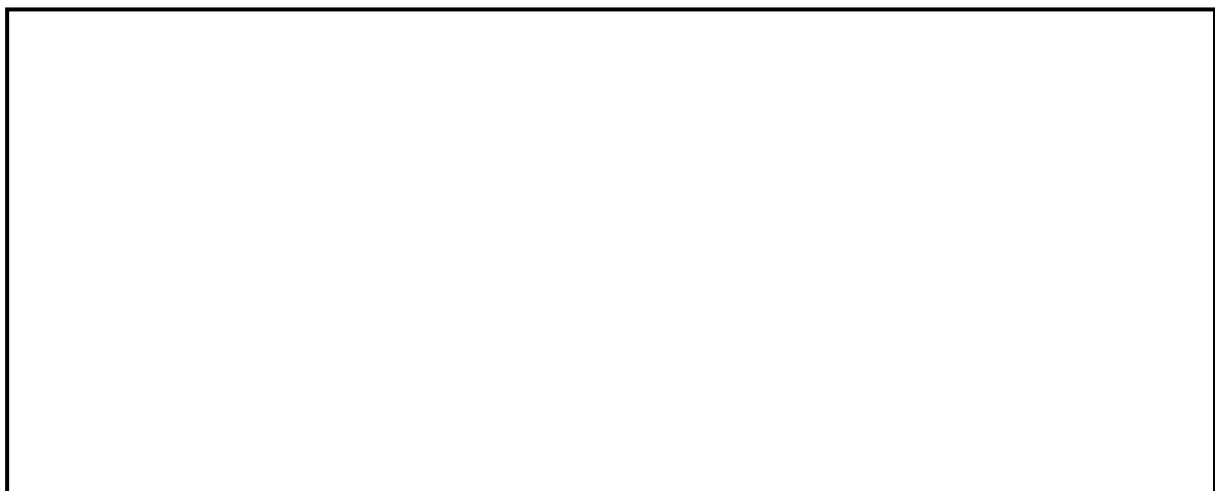
Torque: 17 lb.ft (23 Nm)

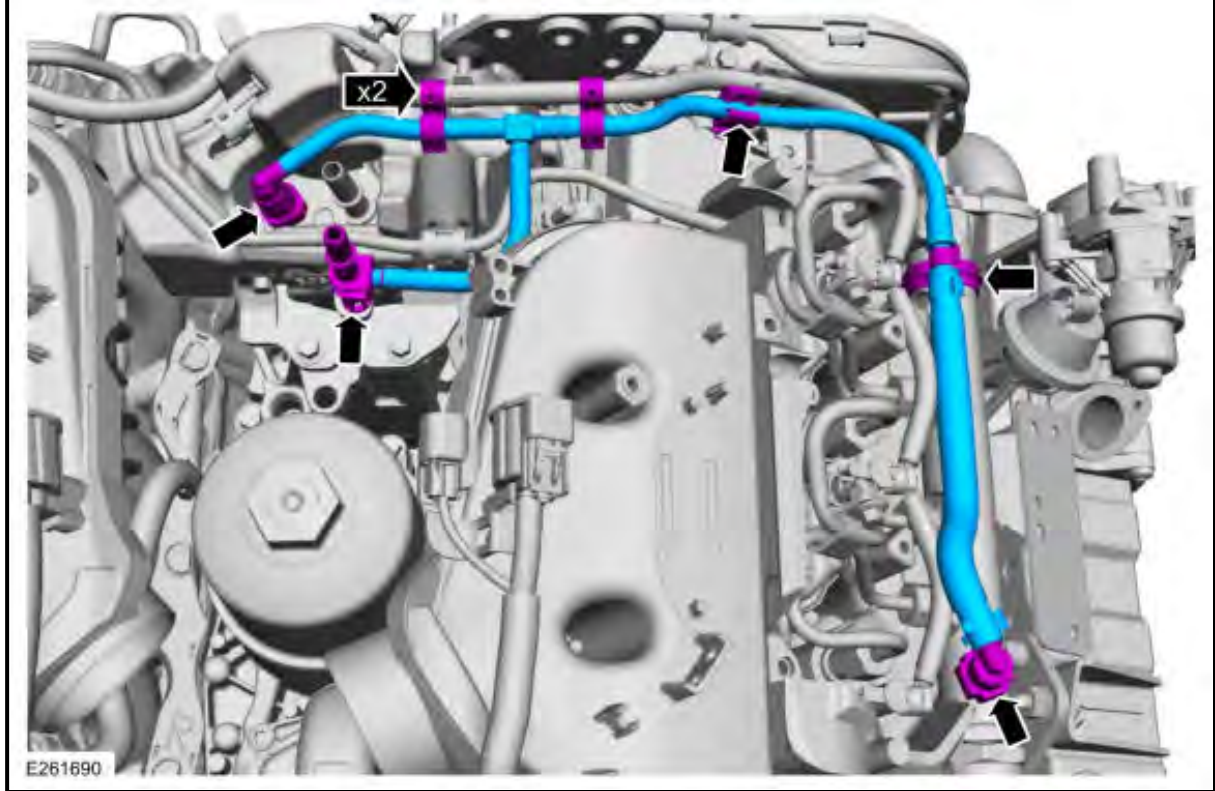






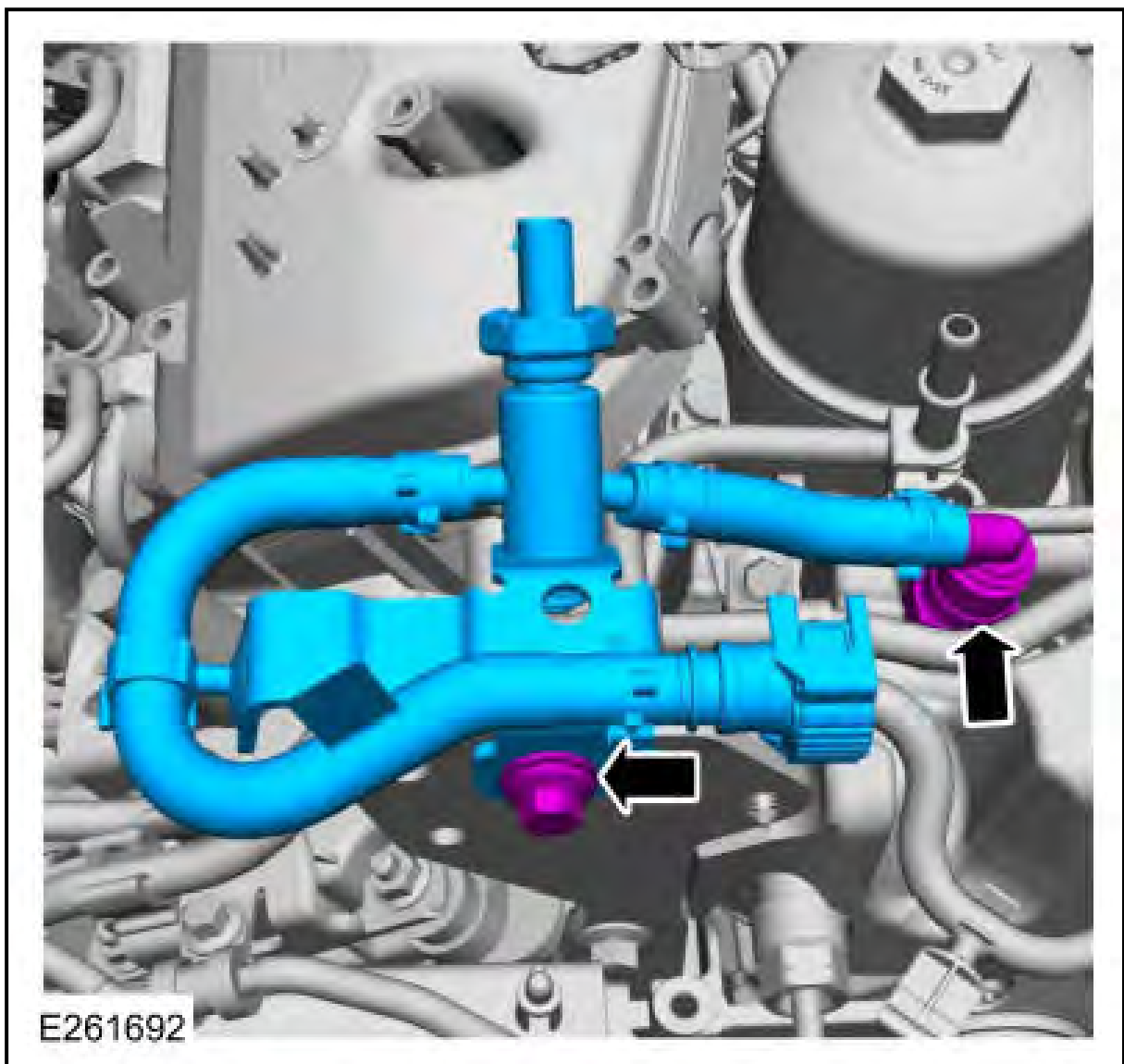
52. Install the fuel return tube assembly. Refer to: [Quick Release Coupling](#) .





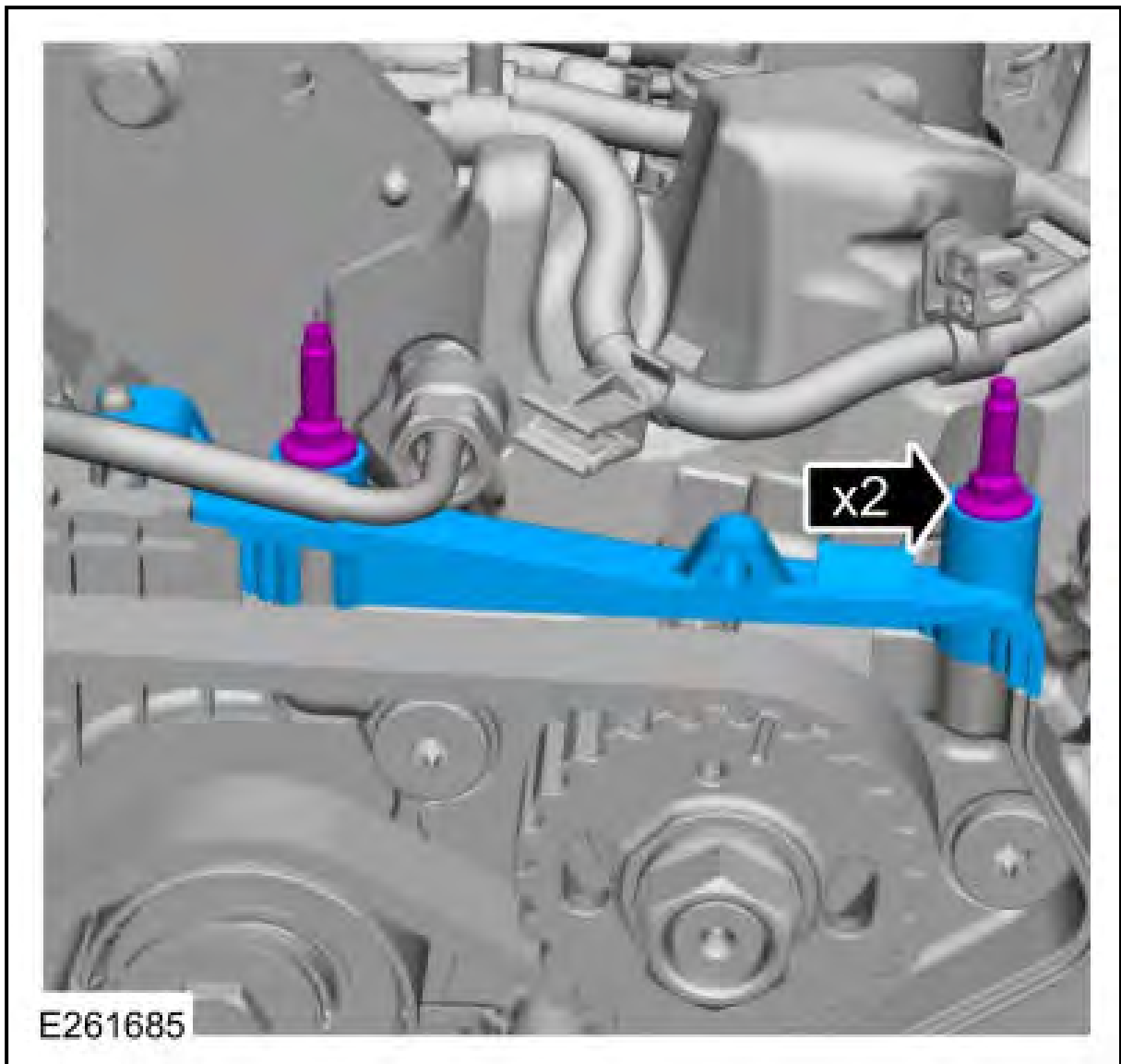
53. Install the fuel supply tube and the bolt. Refer to: [Quick Release Coupling](#) .

Torque: 17 lb.ft (23 Nm)

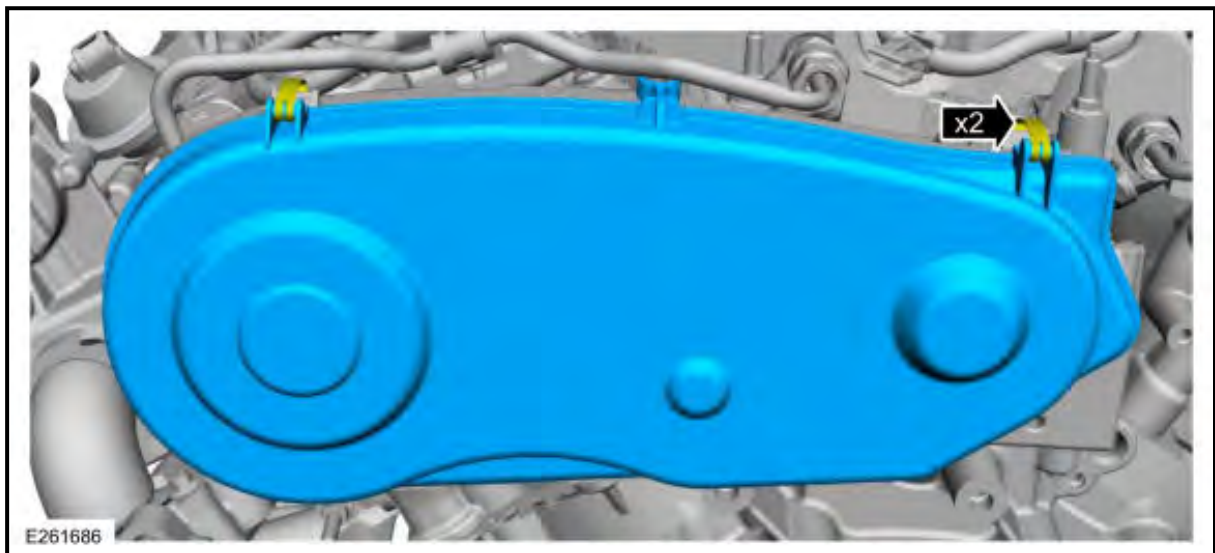


54. Install the accessory drive cover and the stud bolts.

Torque: 89 lb.in (10 Nm)



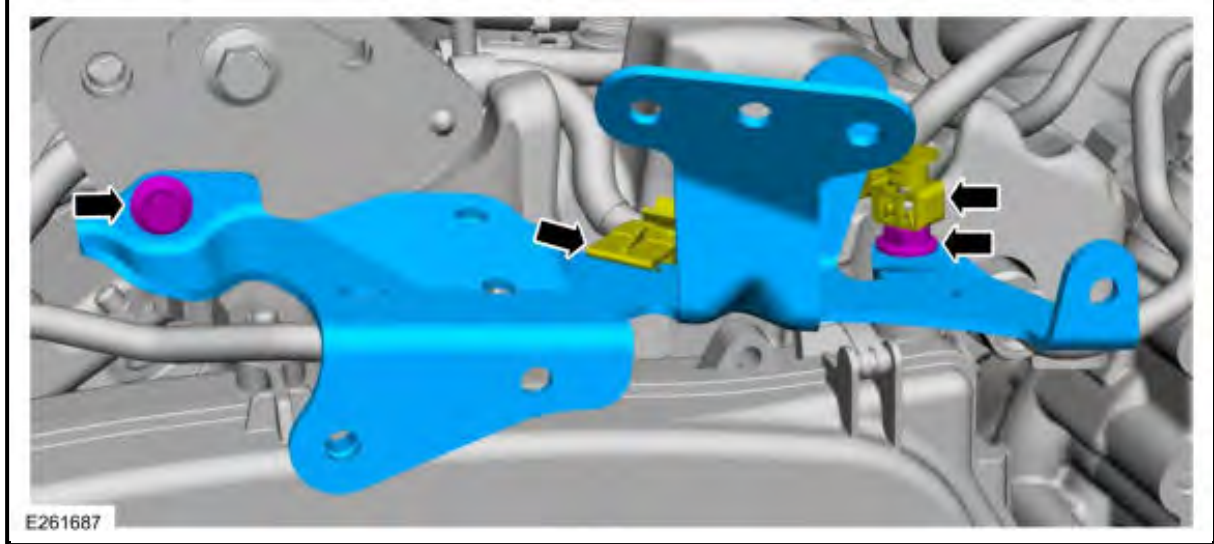
55. Install the accessory drive cover.



56. Install the wiring harness bracket, the nut and the bolt. Connect the retainers.

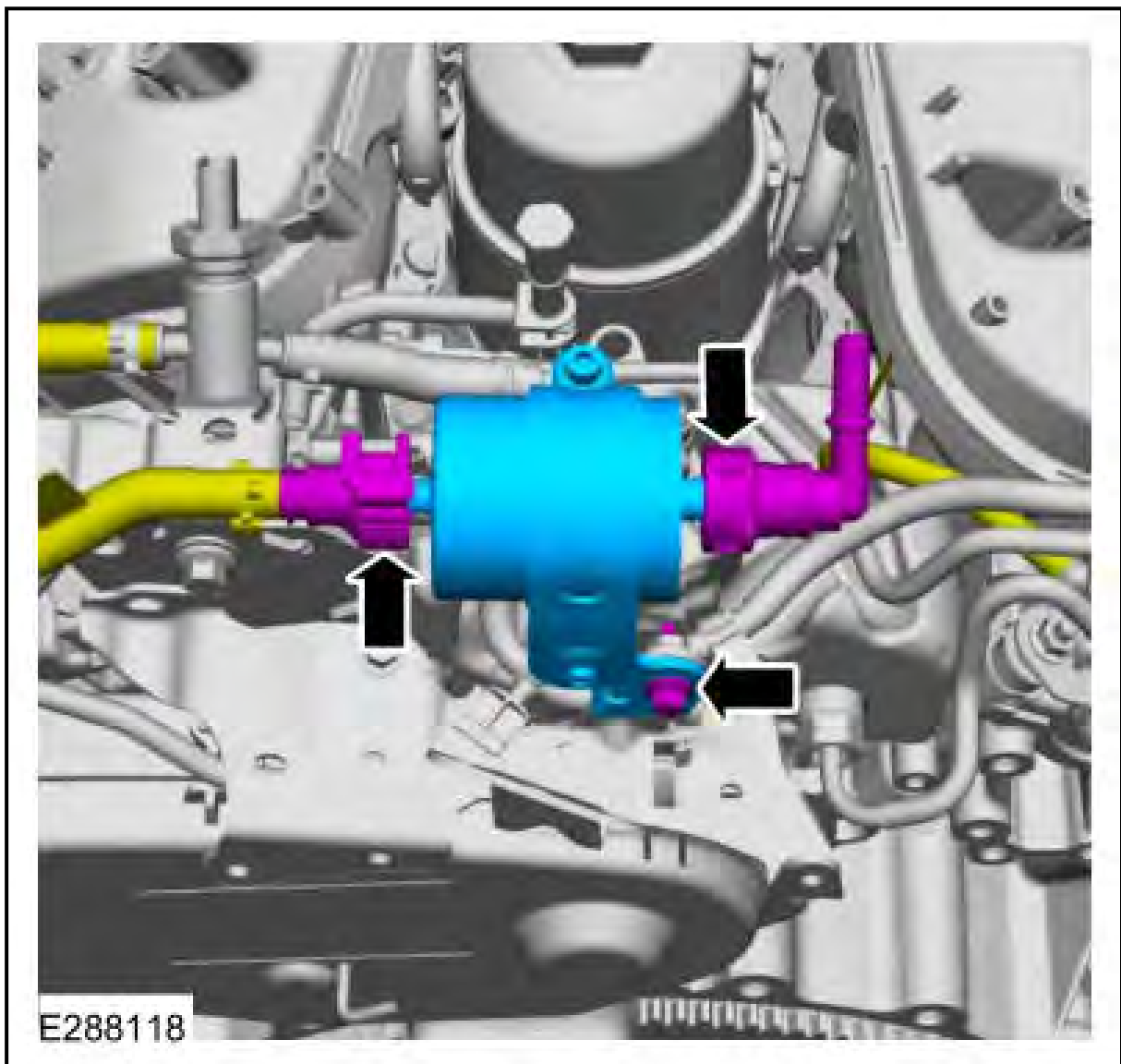
Torque: 89 lb.in (10 Nm)





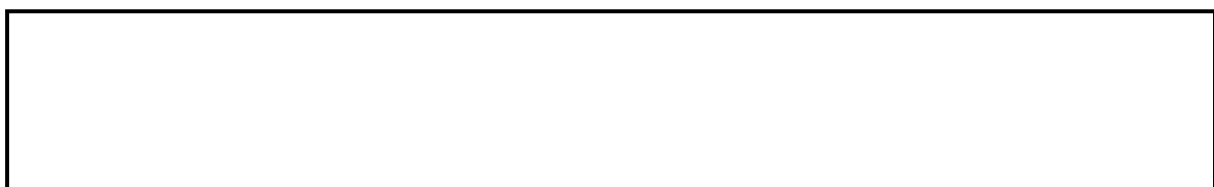
57. Install the secondary fuel filter and the bolt. Connect the fuel lines. Refer to: [Quick Release Coupling](#) .

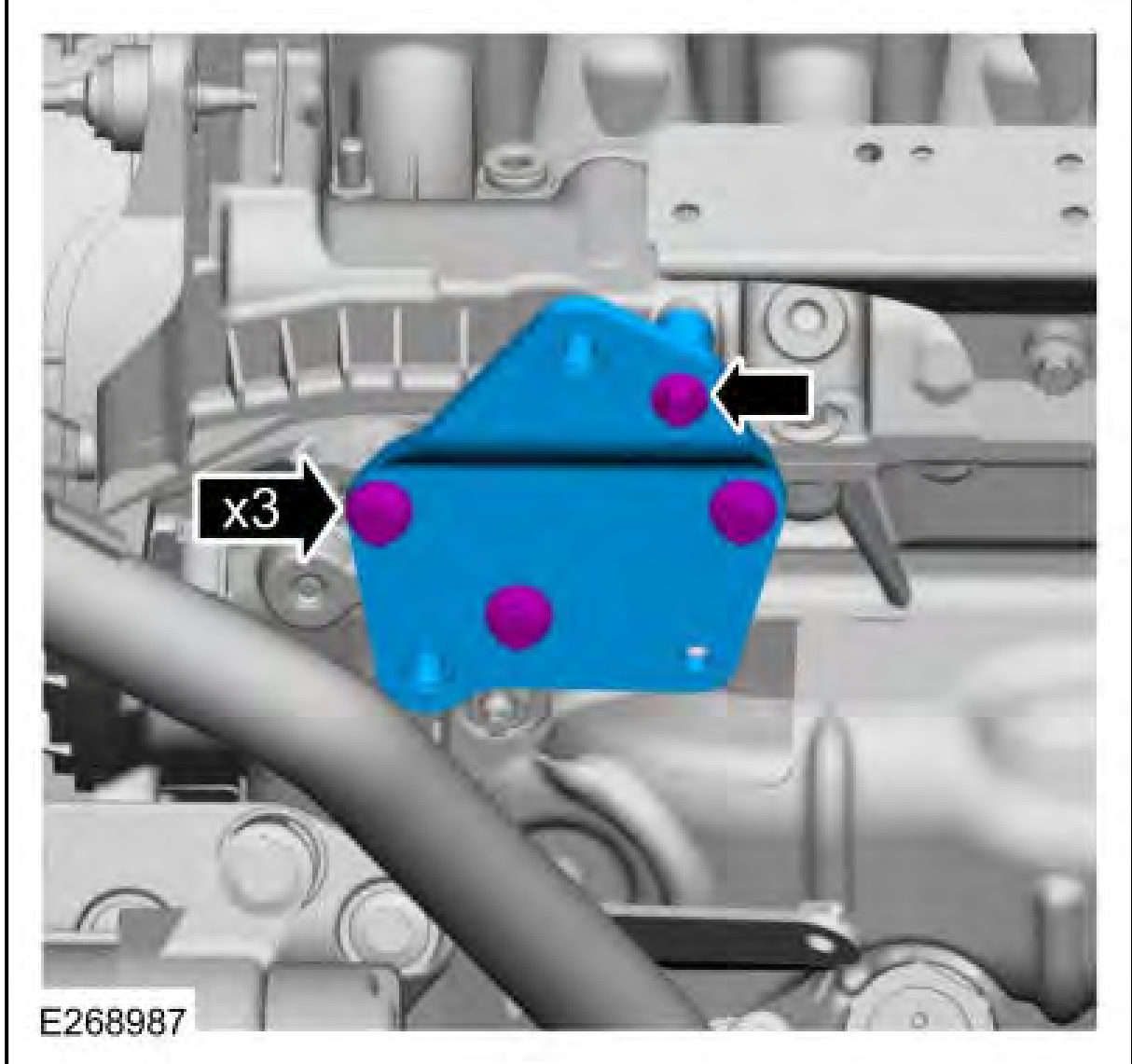
Torque: 89 lb.in (10 Nm)



58. Install the EGR cooler bracket and the bolts.

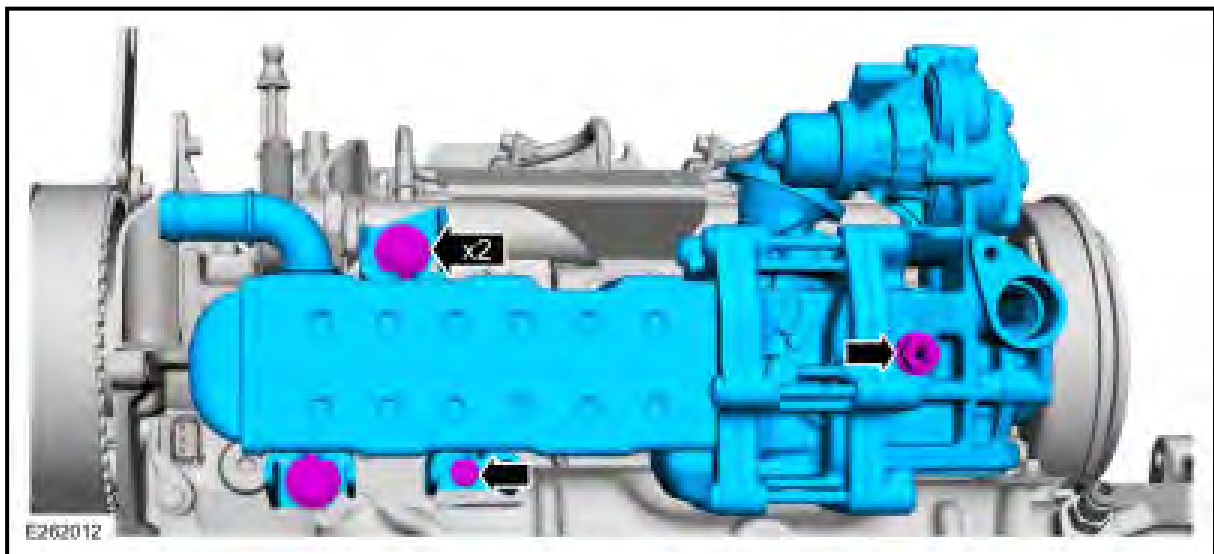
Torque: 89 lb.in (10 Nm)





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

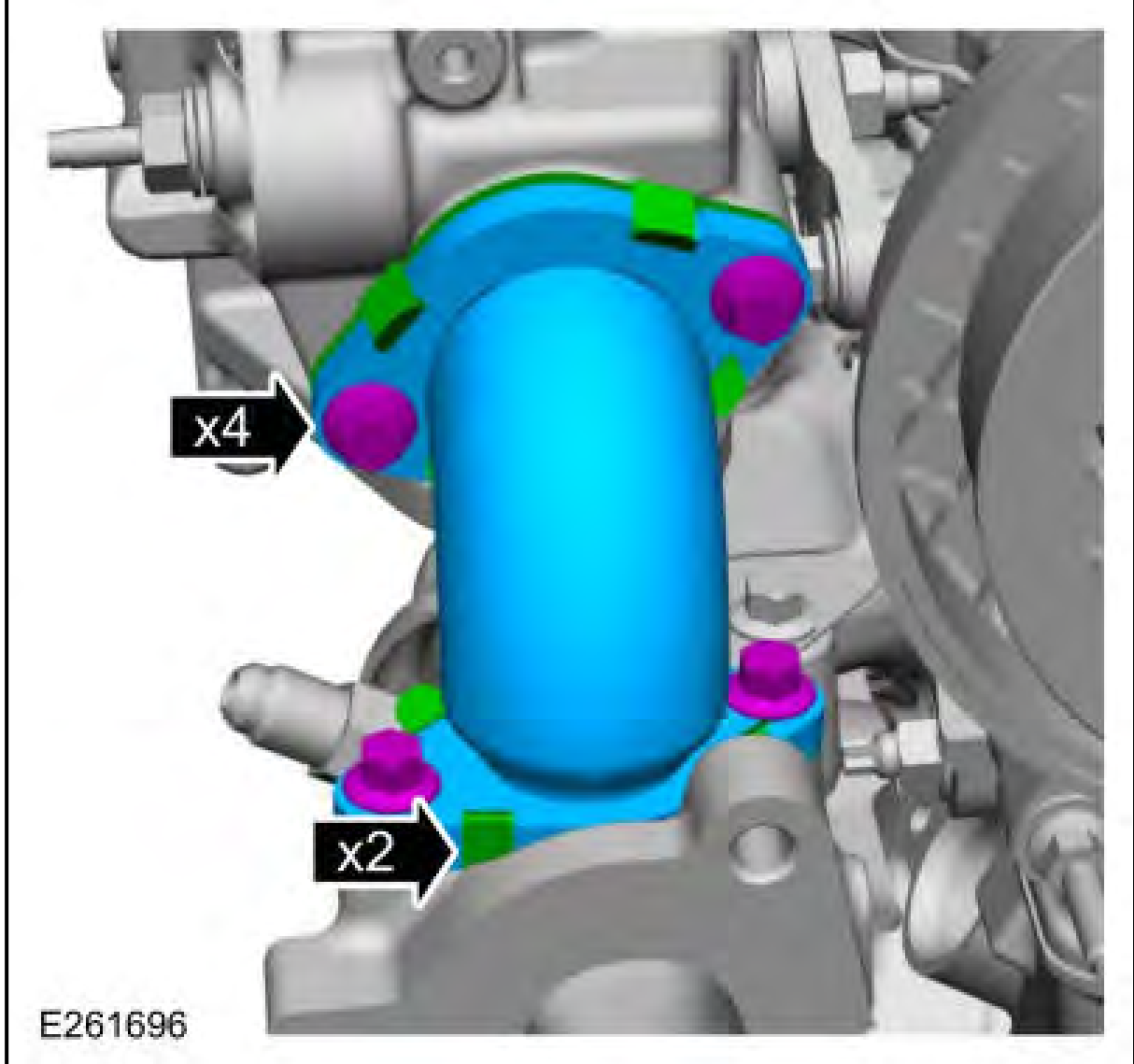
Install the EGR cooler and the bolts.



60. Using new gaskets, install the EGR cooler-to-exhaust manifold pipe and the bolts.

Torque: 89 lb.in (10 Nm)

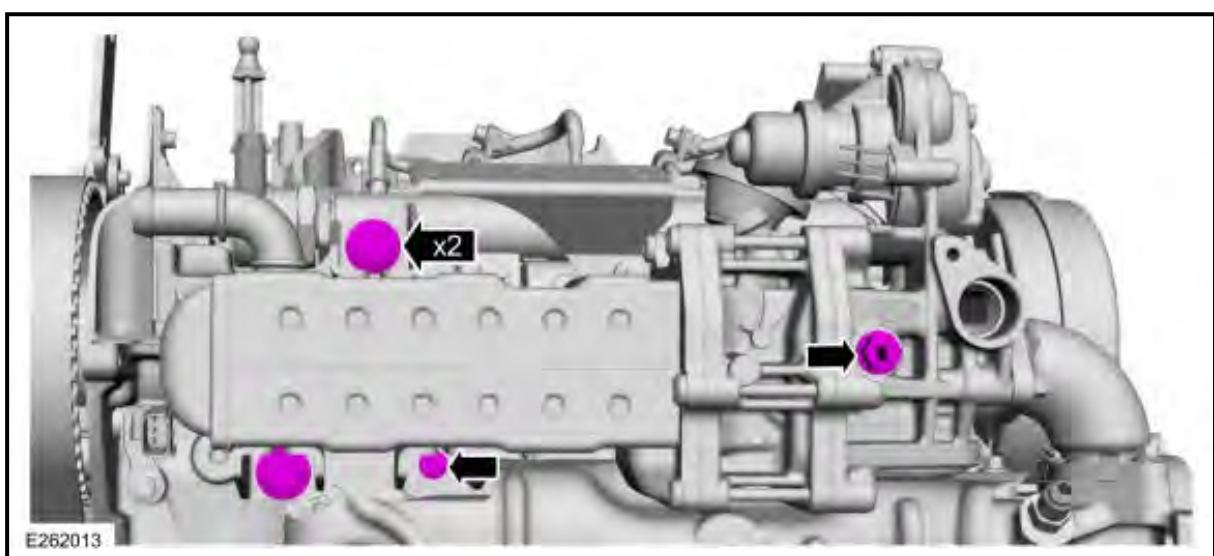




61. Tighten the EGR cooler bolts.

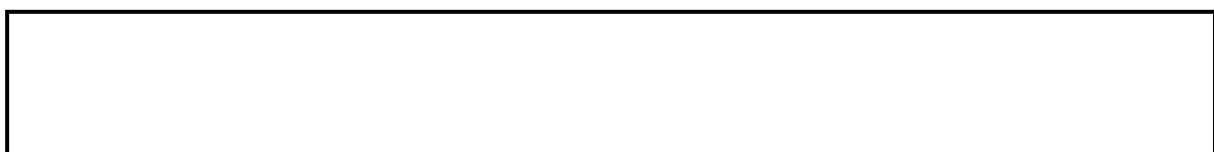
Torque

:M6 bolt: 89 lb.in (10 Nm) M8 bolt: 17 lb.ft (23 Nm)



62. Install O-rings on the EGR cooler coolant tube and lubricate.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

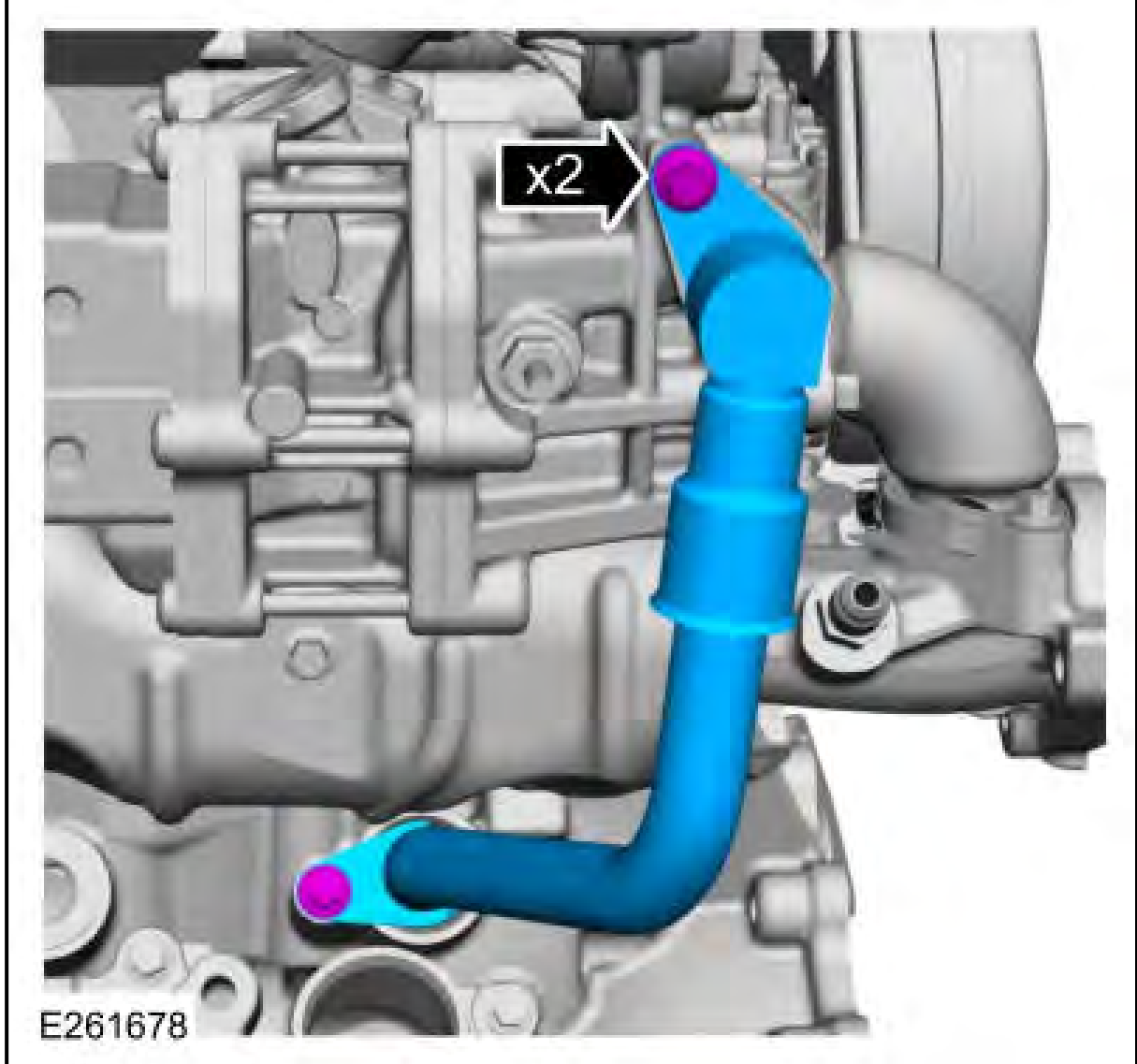




63. Install the EGR cooler coolant tube and the bolts.

Torque: 89 lb.in (10 Nm)





64. **NOTE:** Lubricate the O-ring seal prior to installing the oil level indicator tube.

- Install the oil level indicator tube, the stud bolt and the bolt.

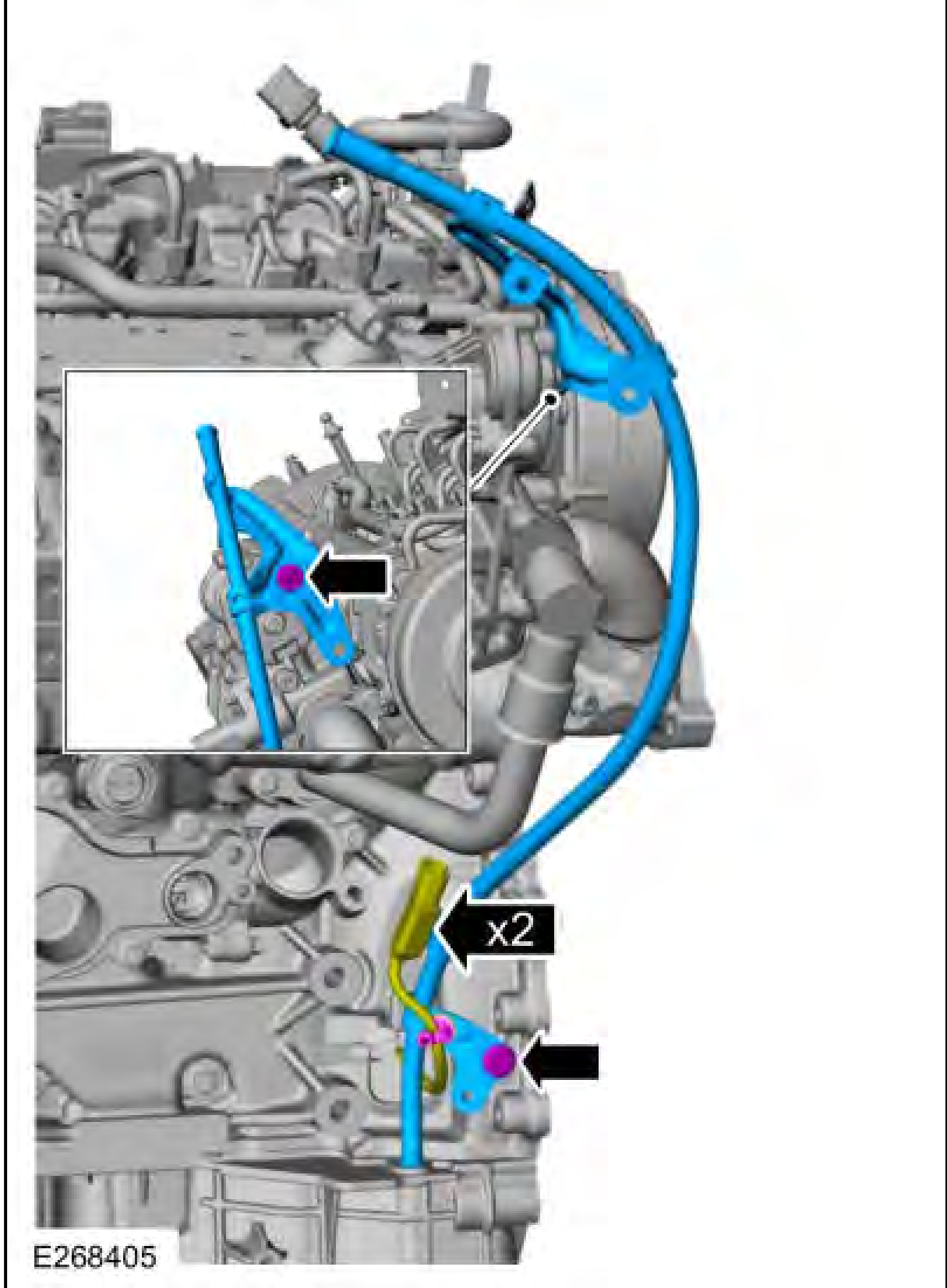
Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque

:M6 stud bolt: 89 lb.in (10 Nm) M8 bolt: 17 lb.ft (23 Nm)

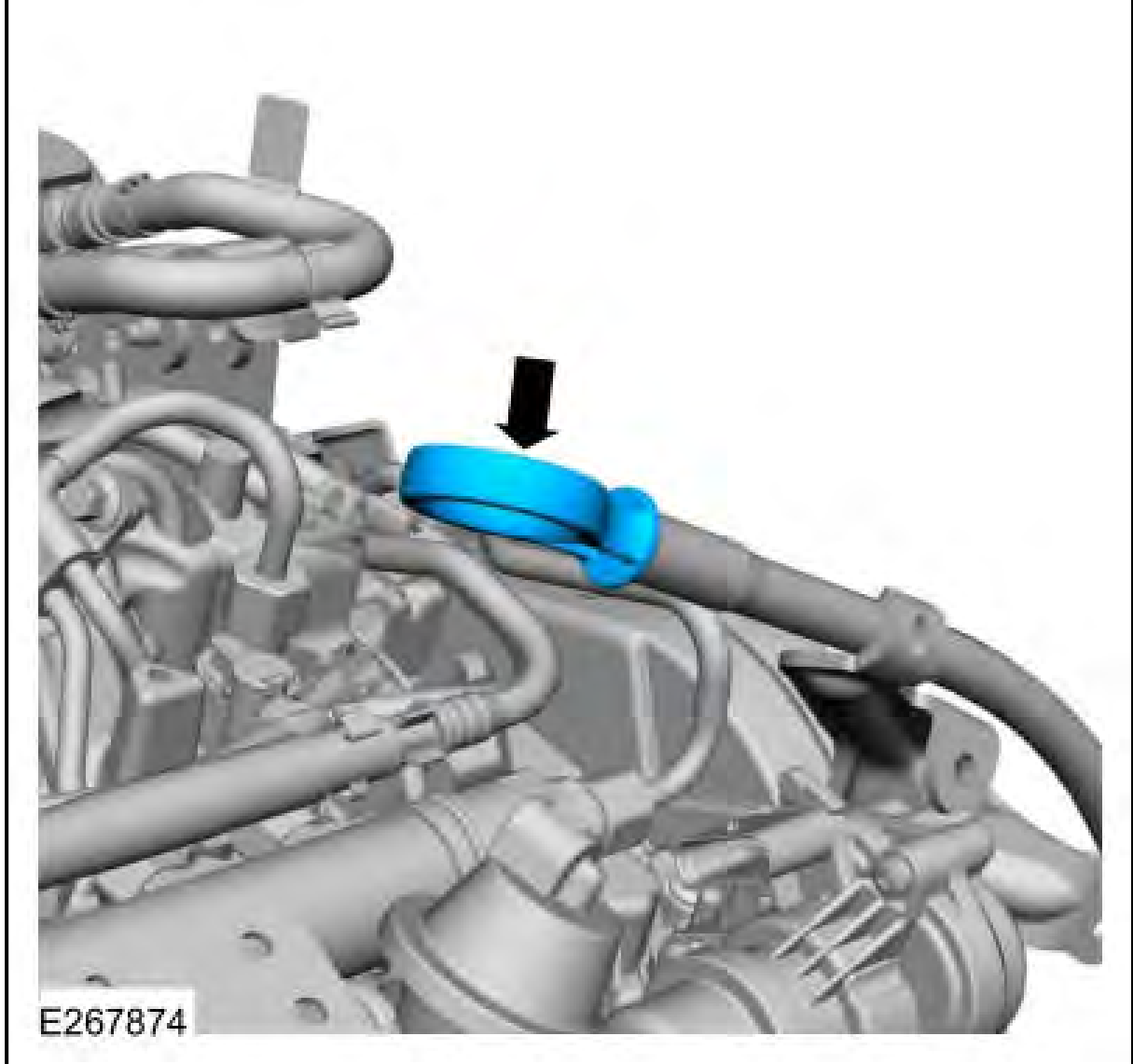
- Connect the wire retainers to the oil level indicator tube.





65. Install the oil level indicator.



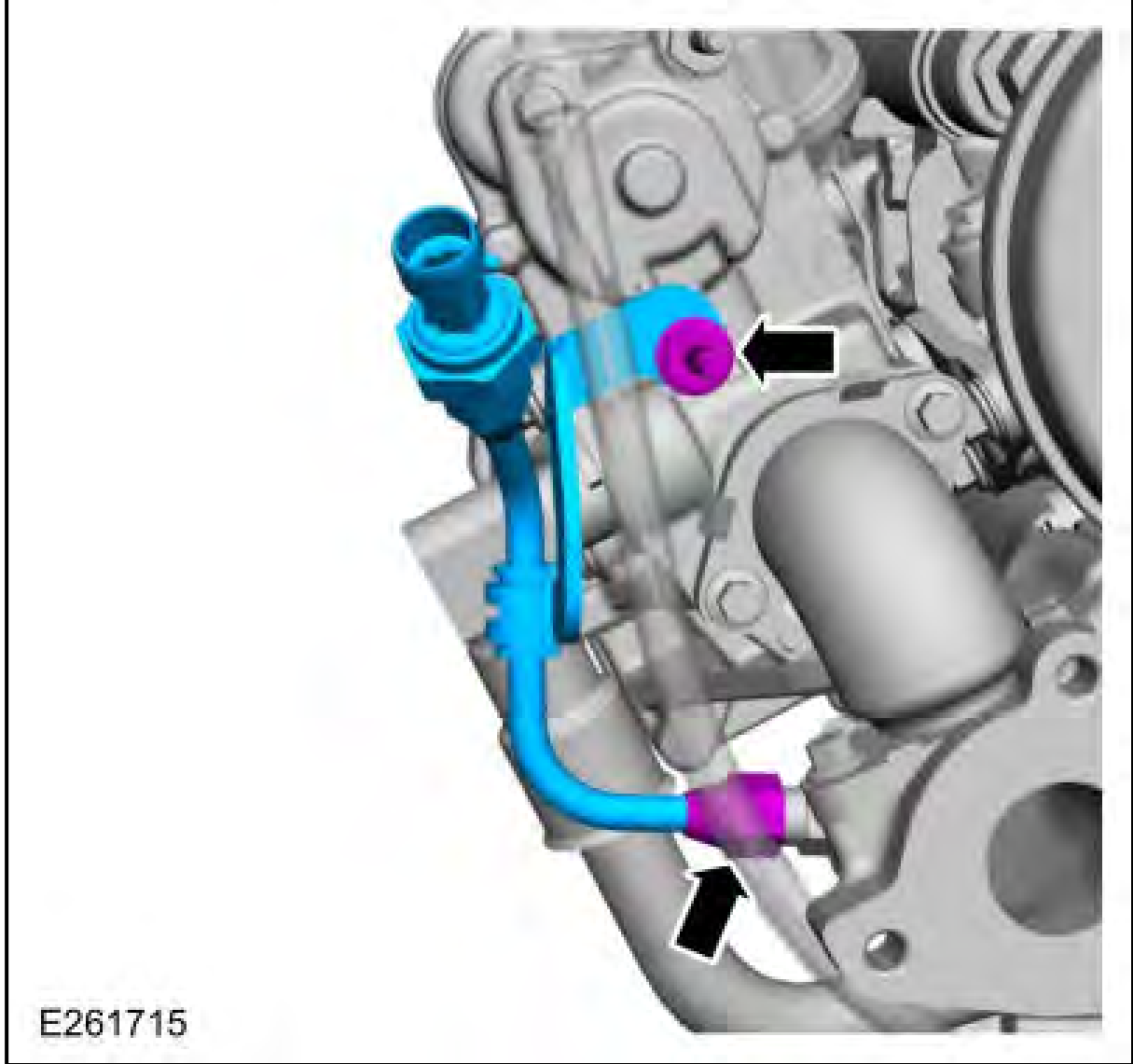


66. Install the EP (exhaust pressure) sensor tube and hand start the tube nut. Install the stud bolt.

Torque

:M6 stud bolt: 89 lb.in (10 Nm) Tube nut : 177 lb.in (20 Nm)

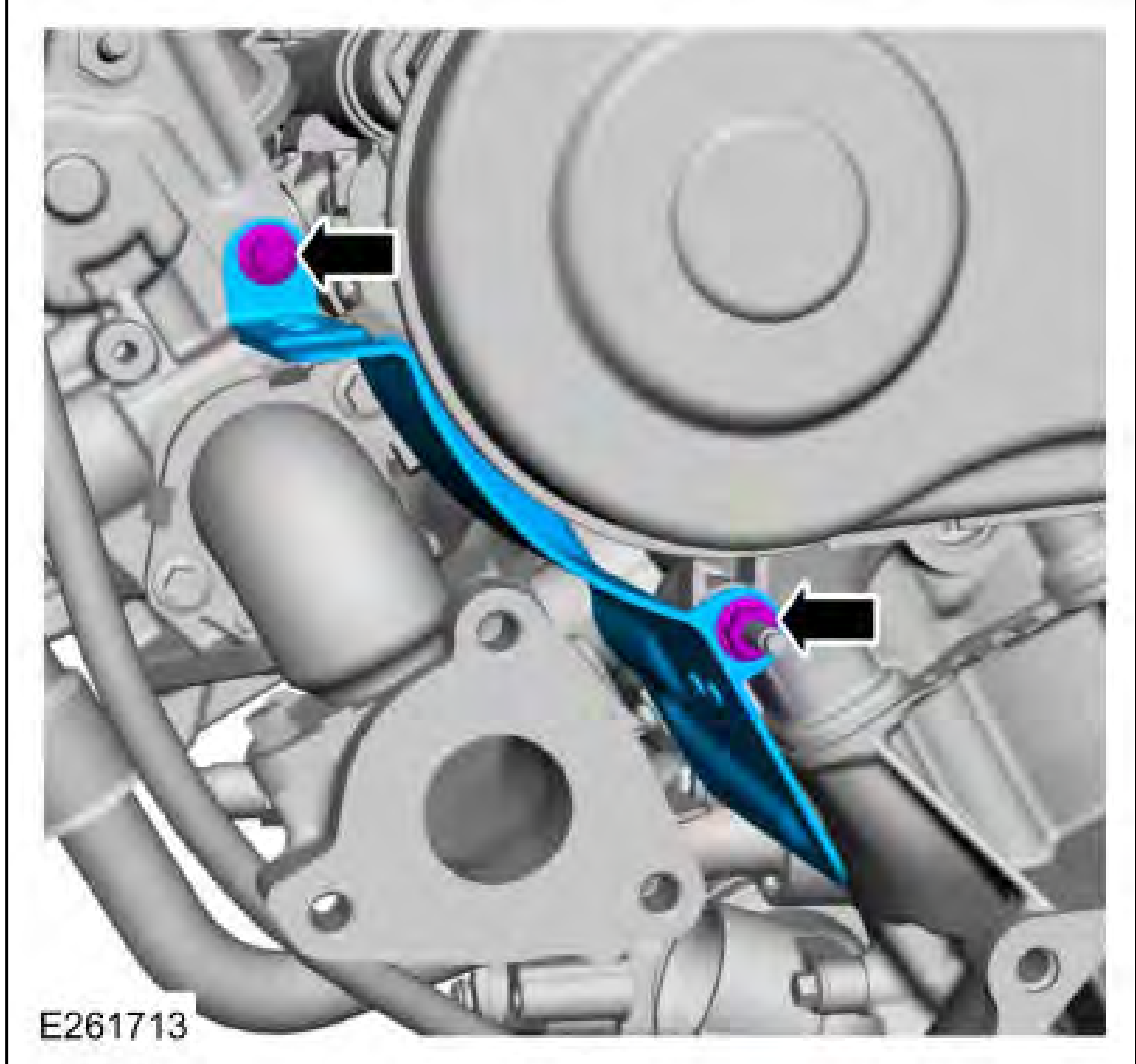




67. Install the LH exhaust manifold shield, the nut and the bolt.

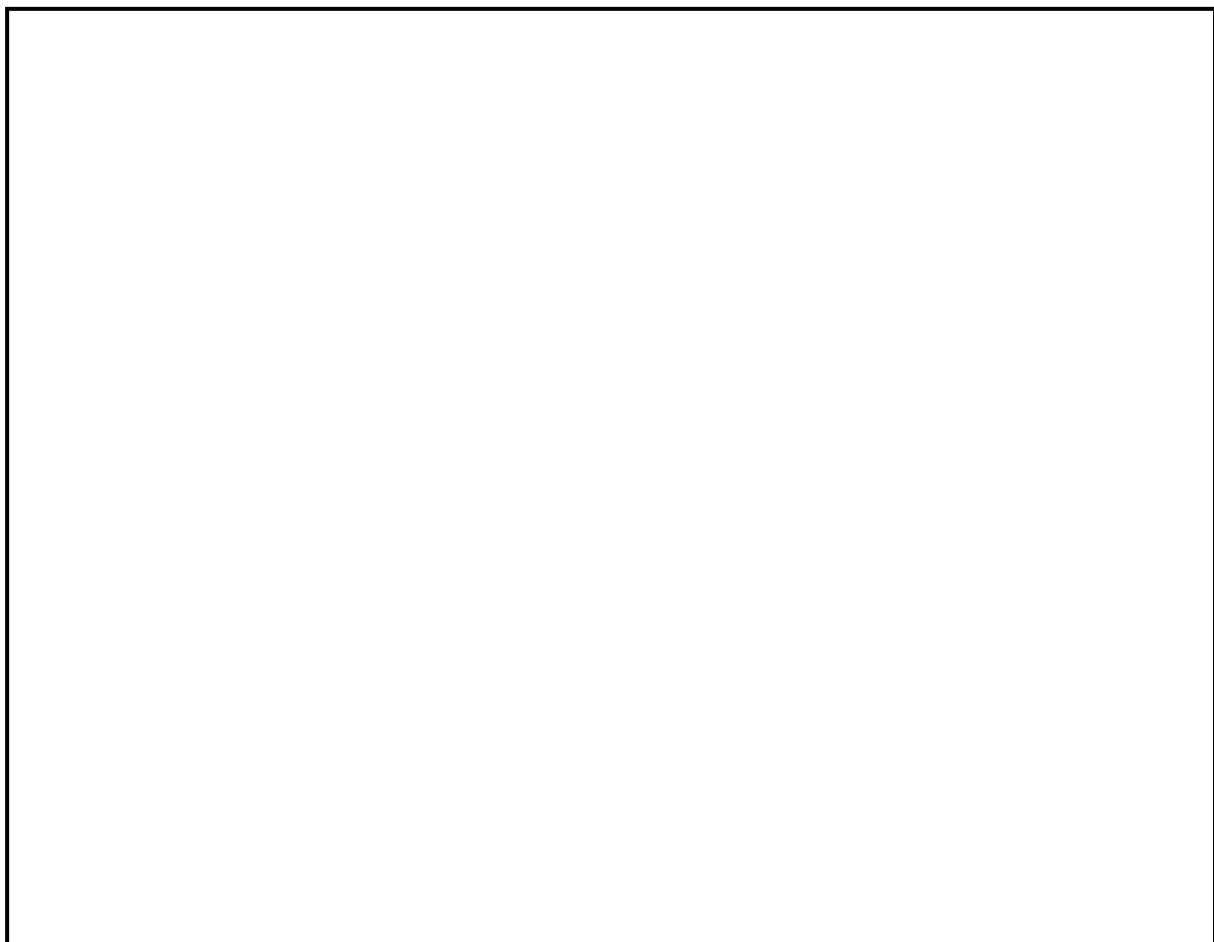
Torque: 89 lb.in (10 Nm)

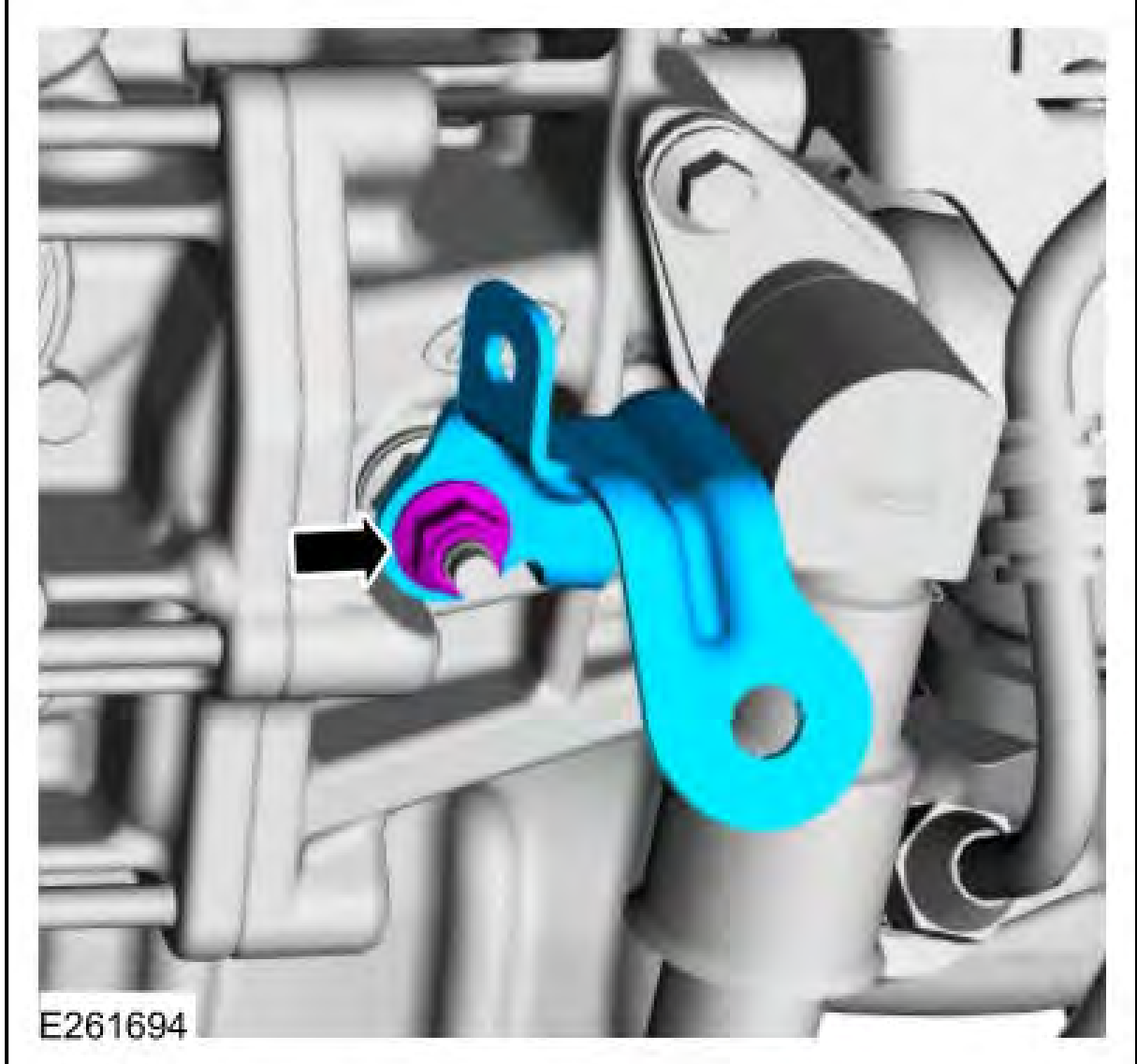




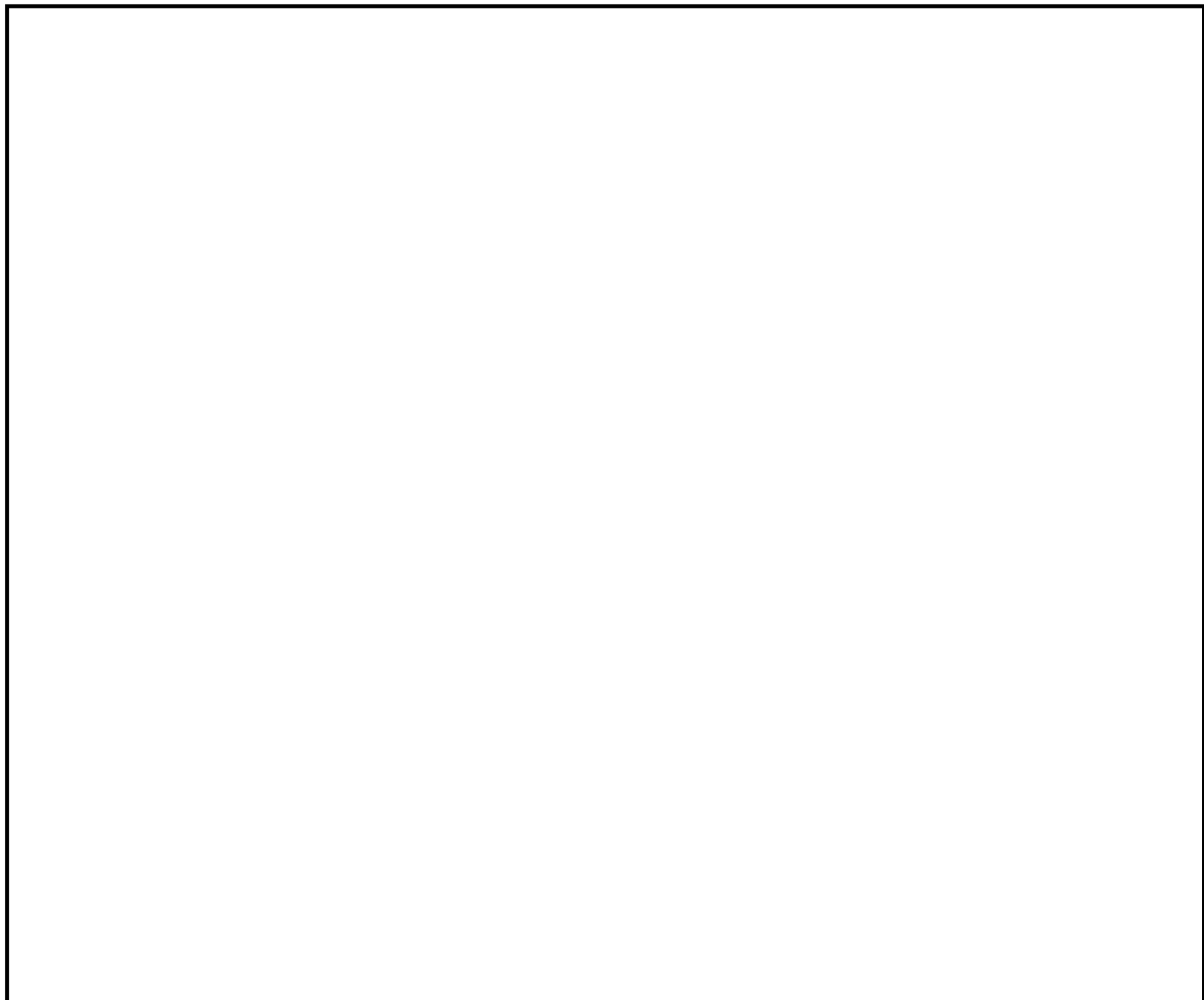
68. Install the fuel tube front support bracket and the nut.

Torque: 89 lb.in (10 Nm)





69. Install a new timing belt cover gasket.



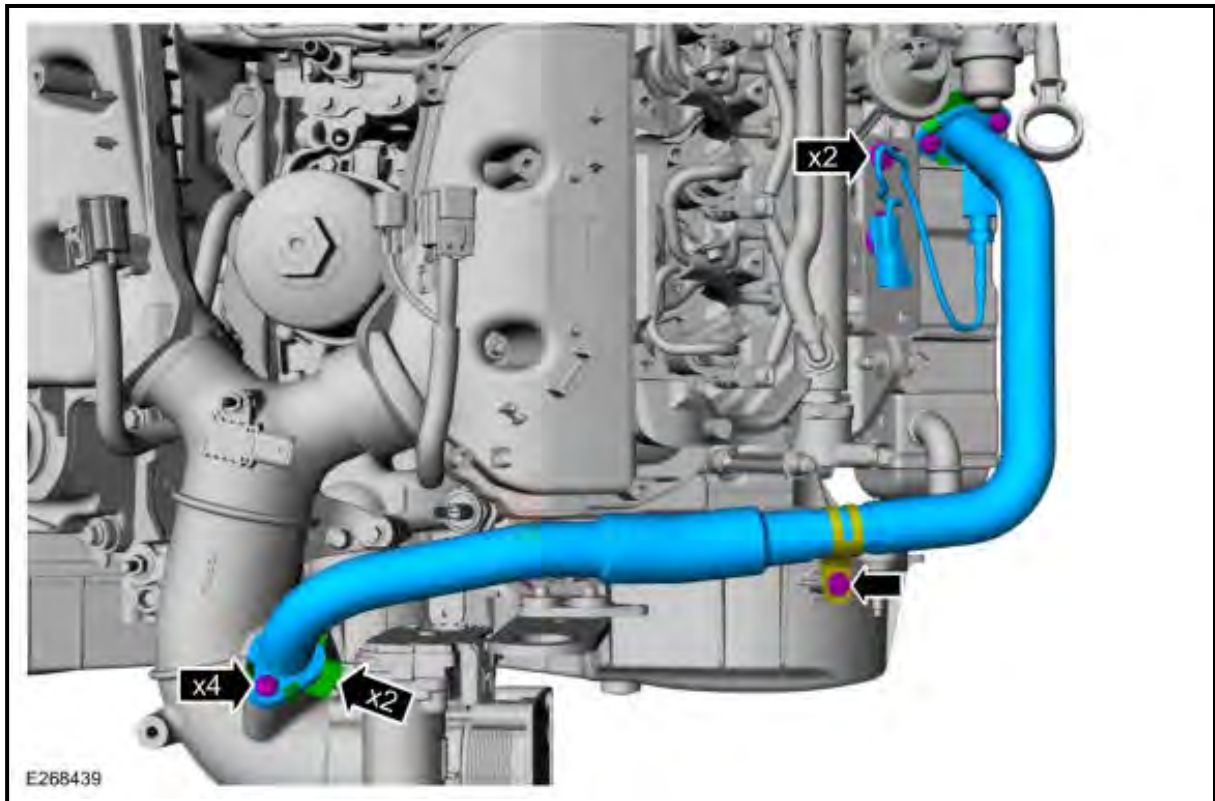


Torque: 89 lb.in (10 Nm)

- Install the retainer in the timing belt cover.

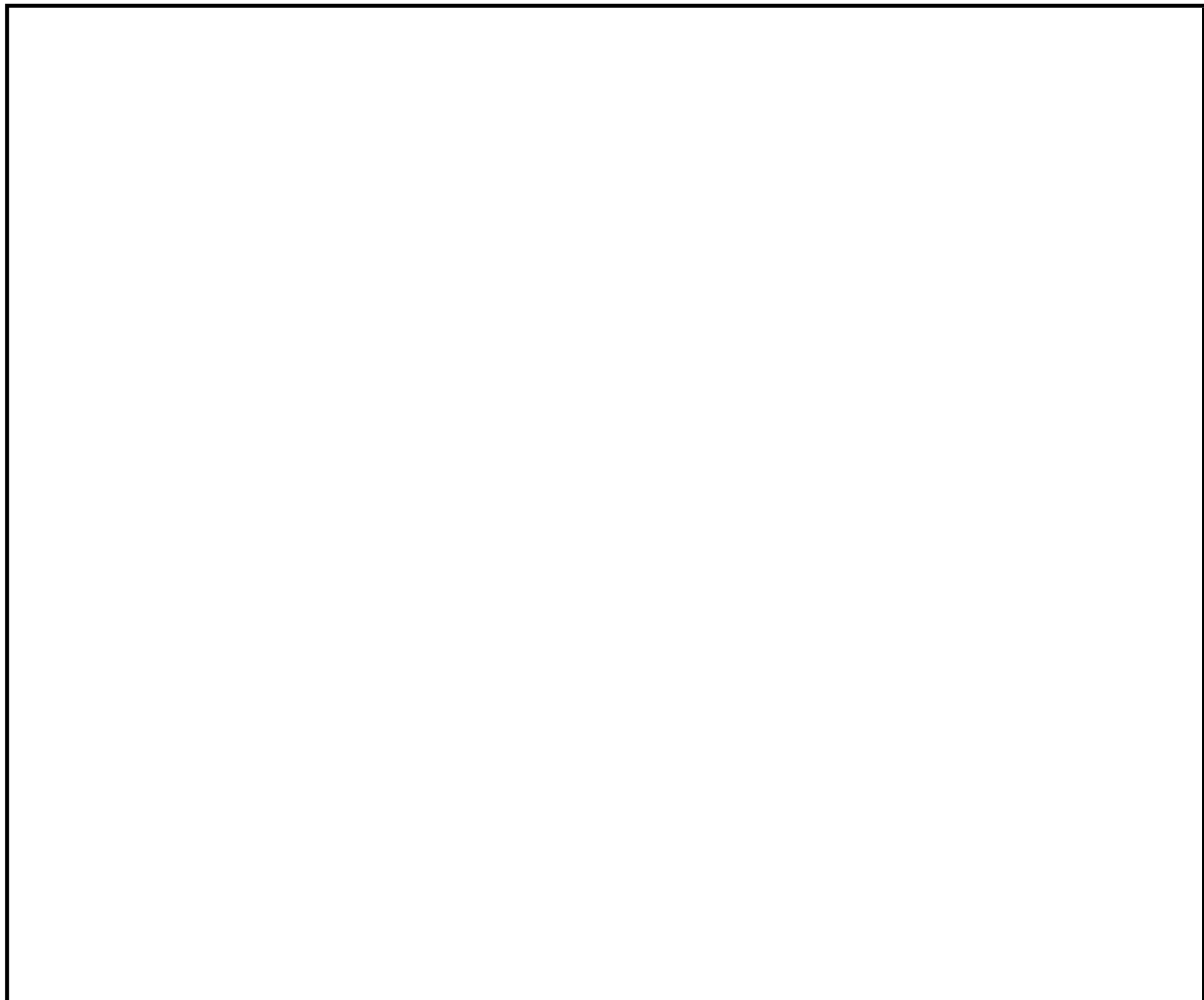
Torque: 31 lb.in (3.5 Nm)

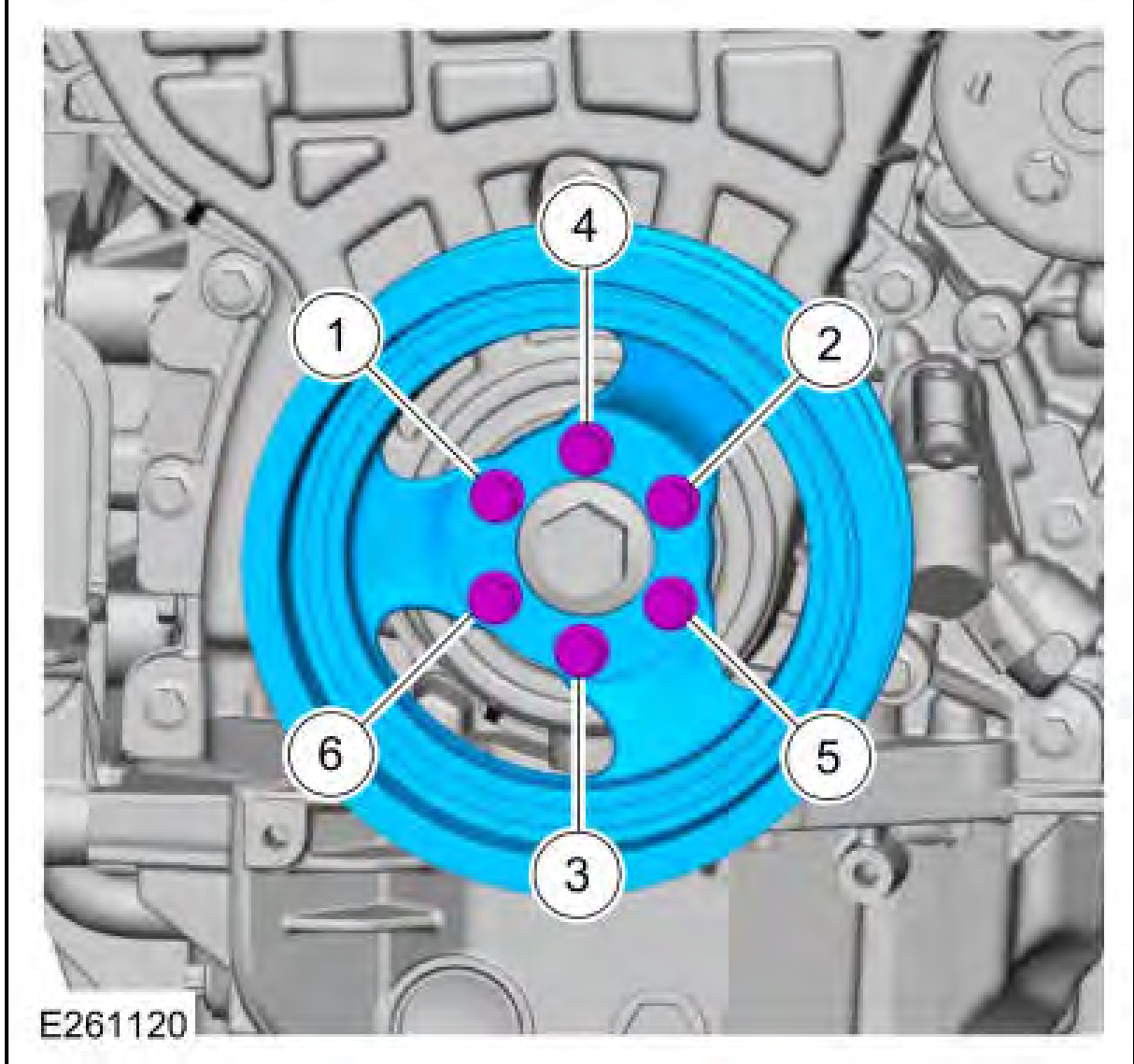
- Connect the wire retainers.



72. Install the crankshaft vibration damper and the bolts.

Torque: 18 lb.ft (25 Nm)



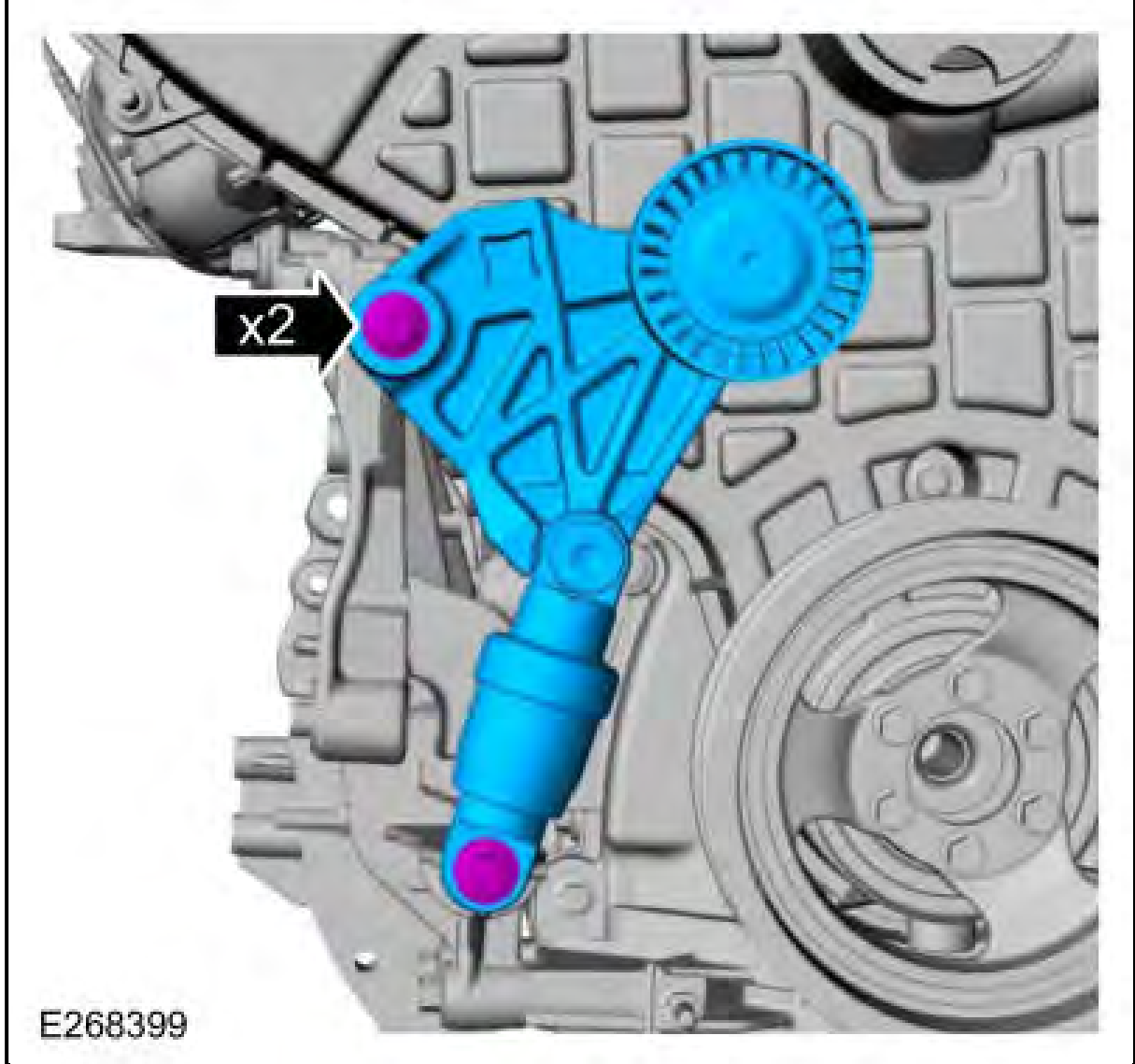


73. Install the accessory drive belt tensioner and the bolts.

Torque: 18 lb.ft (25 Nm)



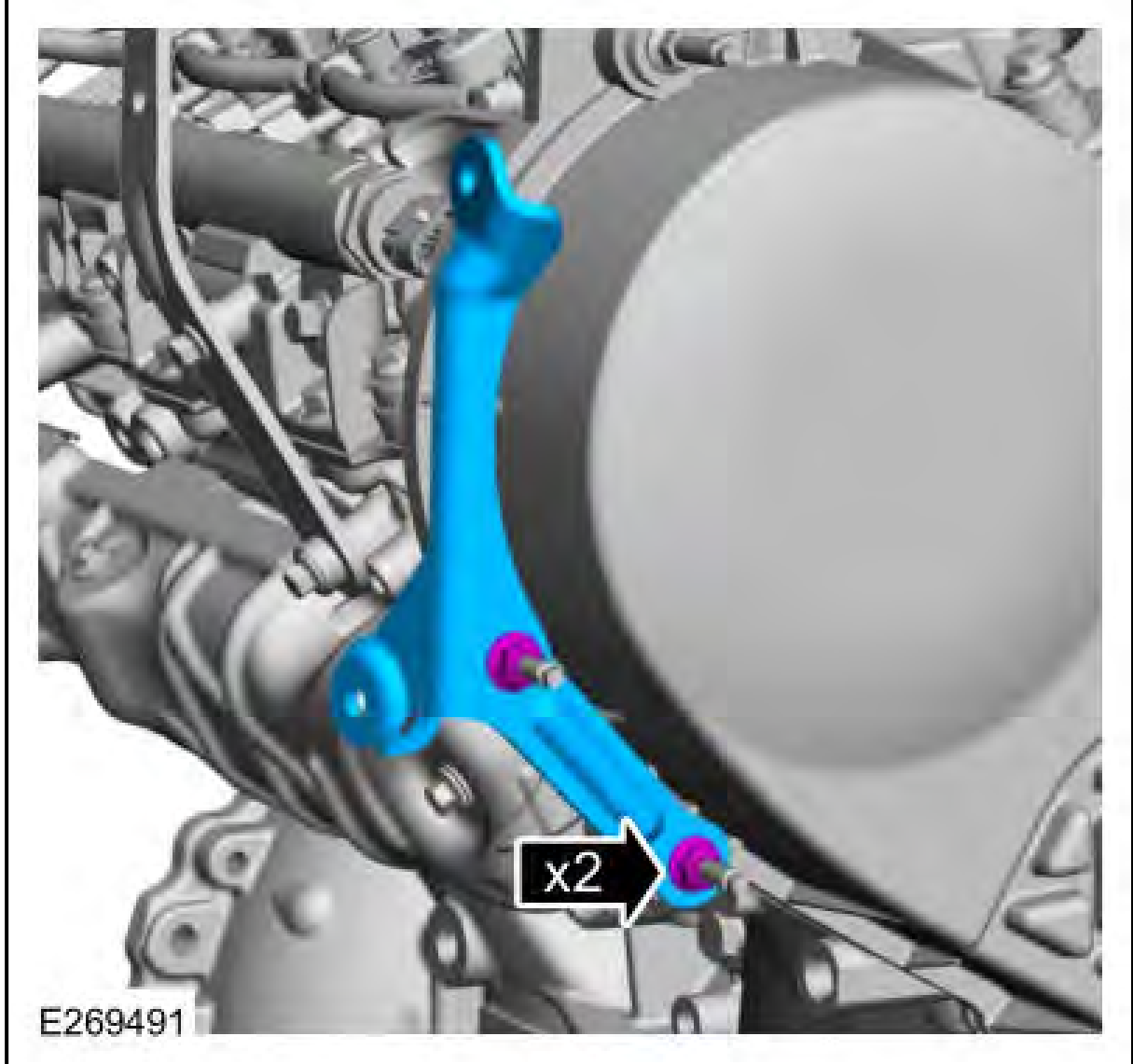




74. Install the CAC bracket and the nuts.

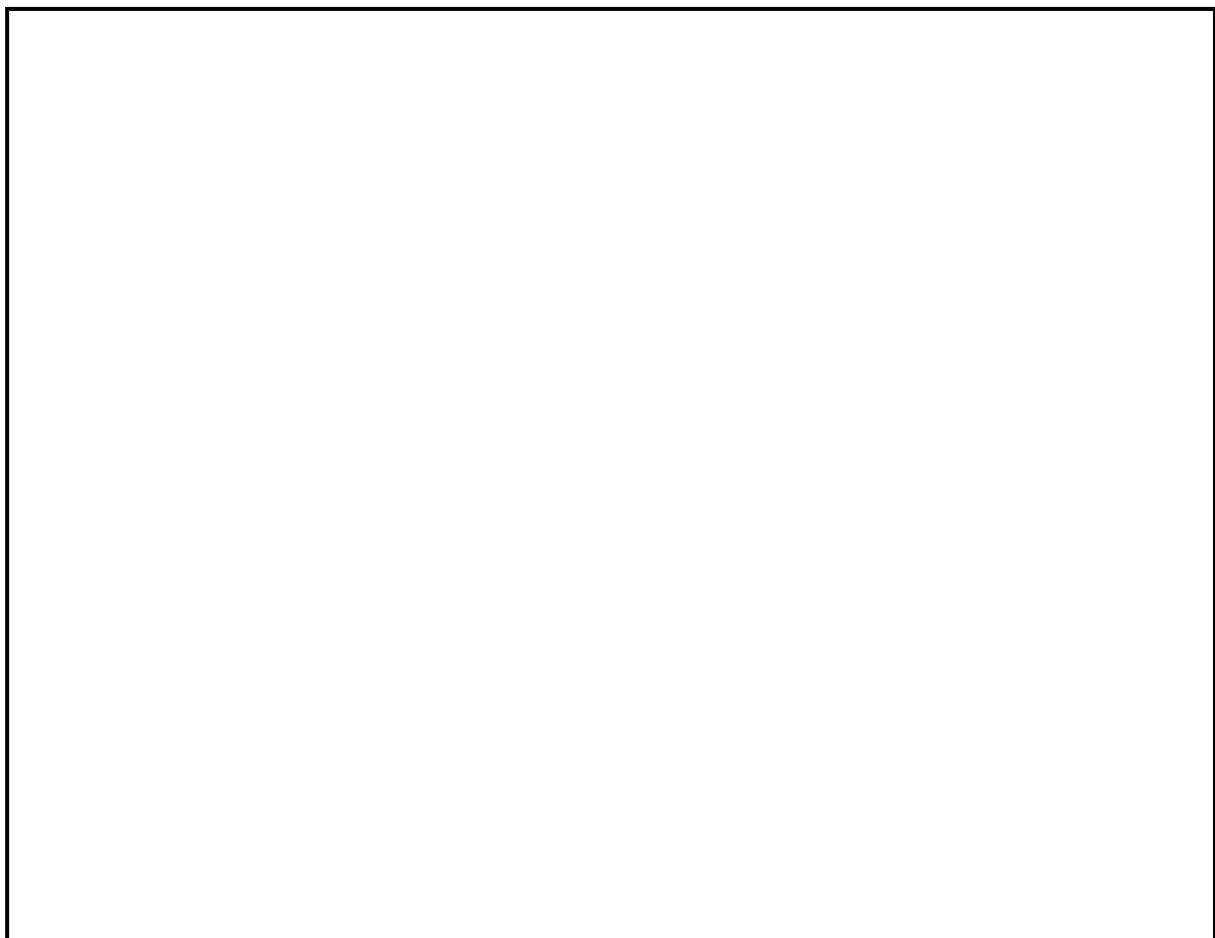
Torque: 53 lb.in (6 Nm)rrrrr

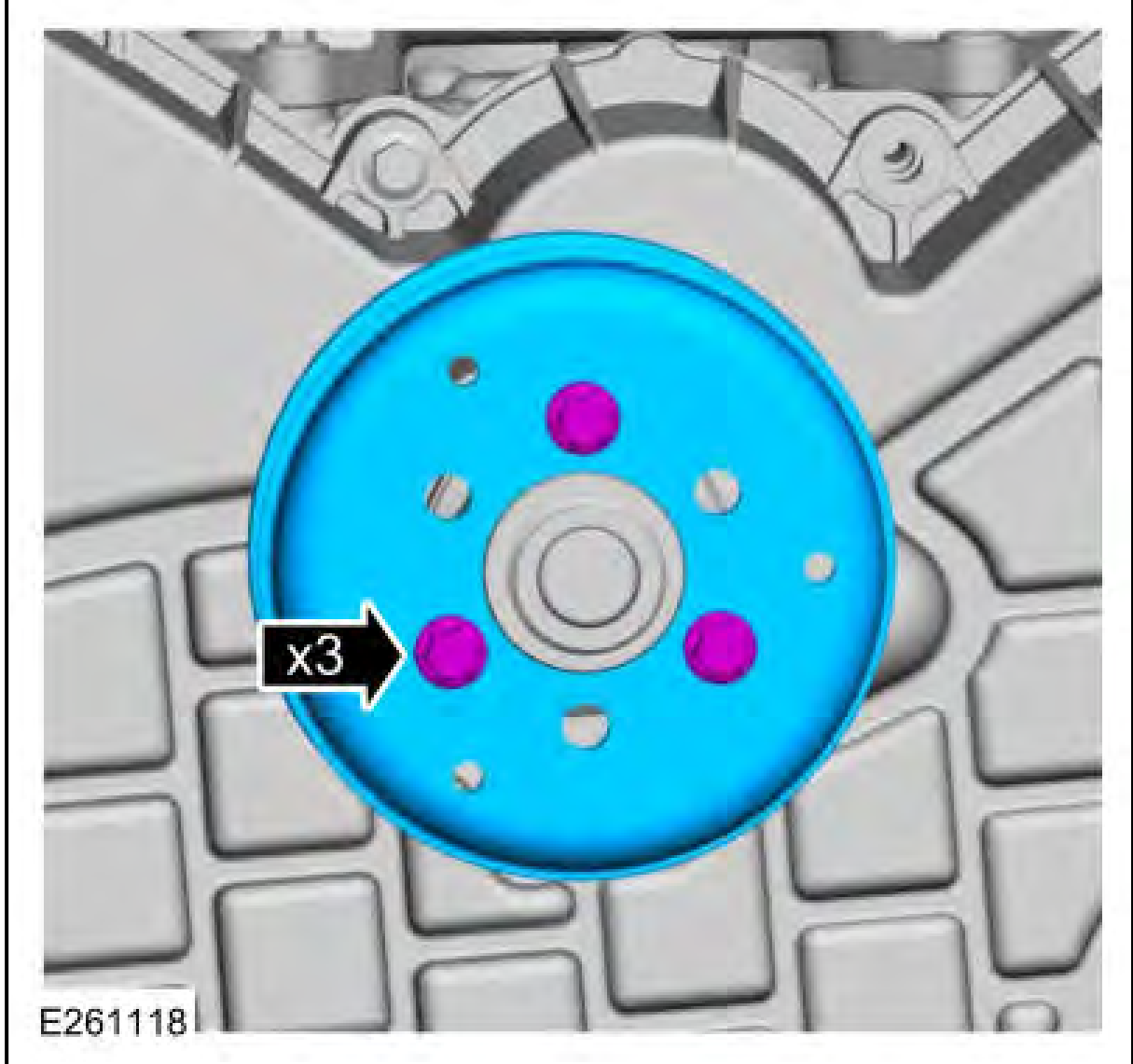




75. Install the fan pulley and the bolts.

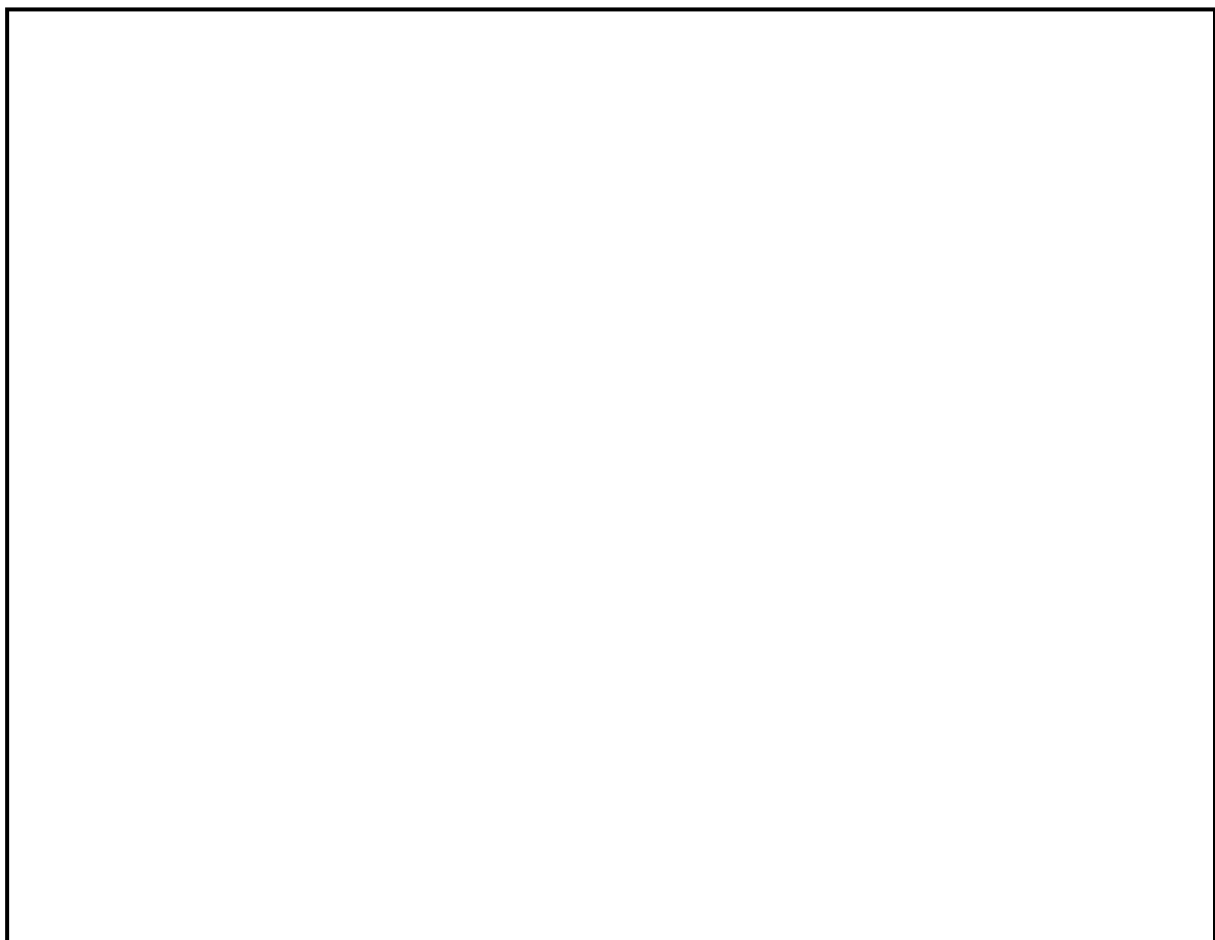
Torque: 18 lb.ft (25 Nm)

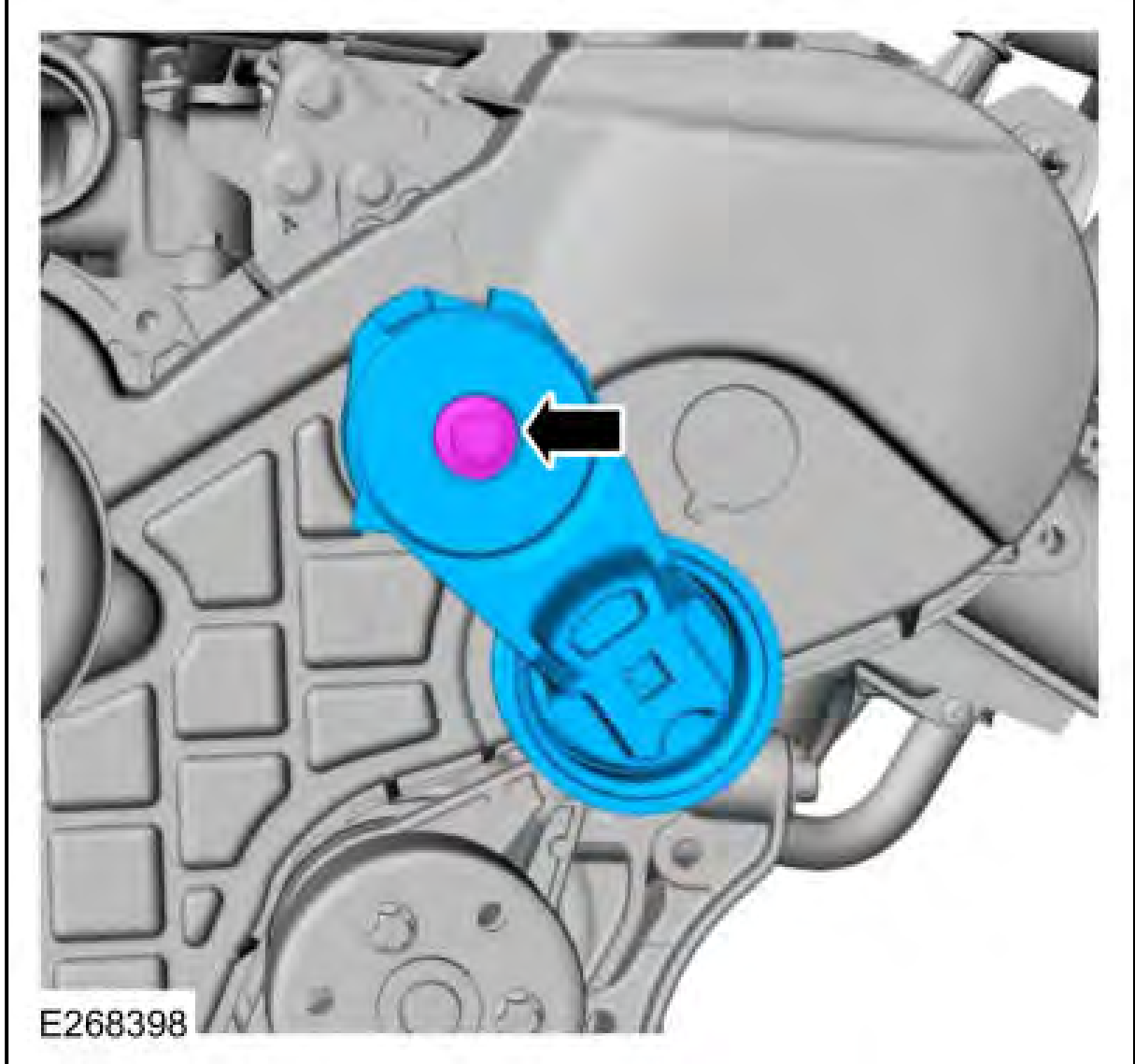




76. Install the accessory drive belt tensioner and the bolt.

Torque: 35 lb.ft (48 Nm)

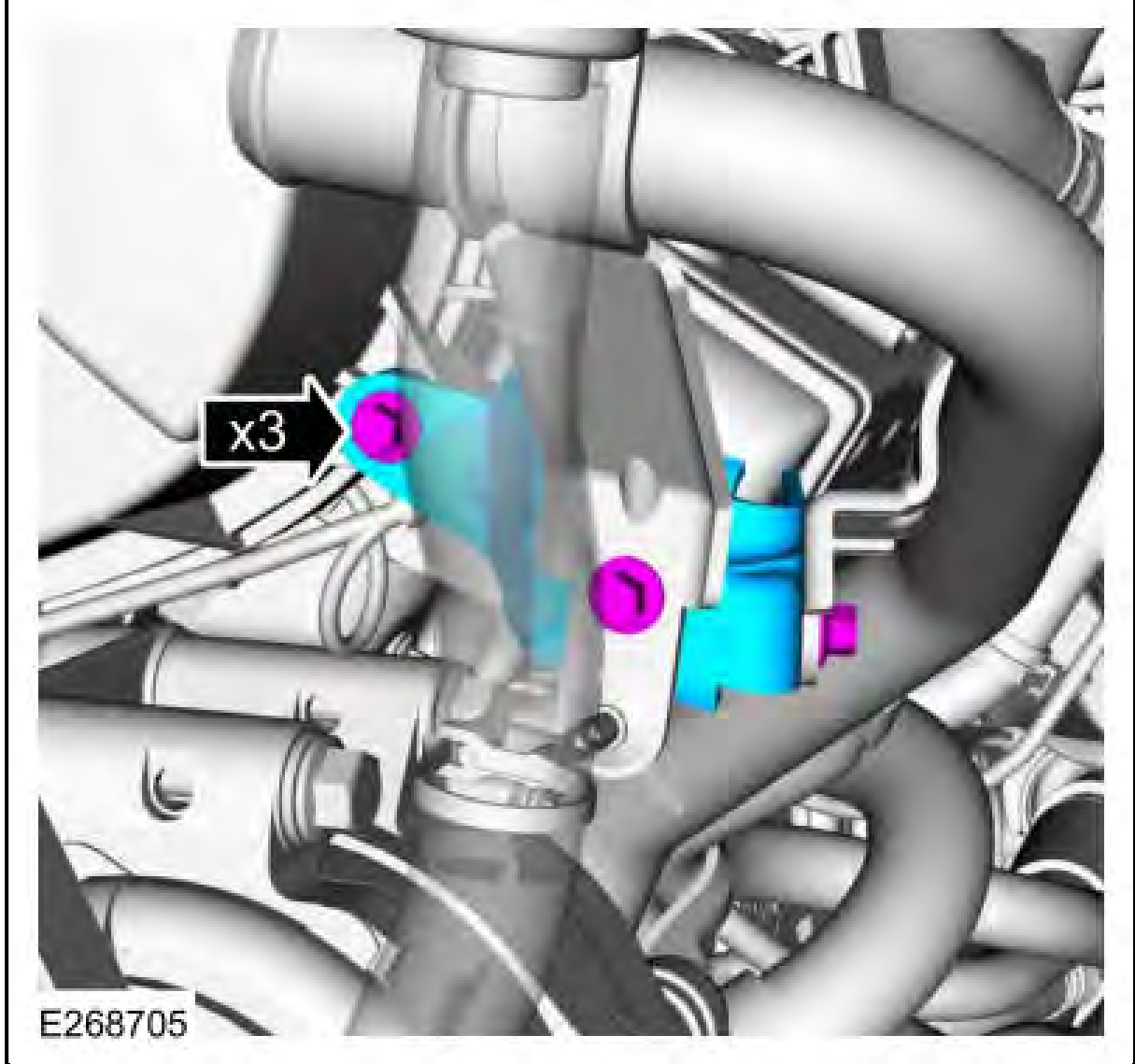




77. Install the coolant tube bracket and the bolts.

Torque: 89 lb.in (10 Nm)

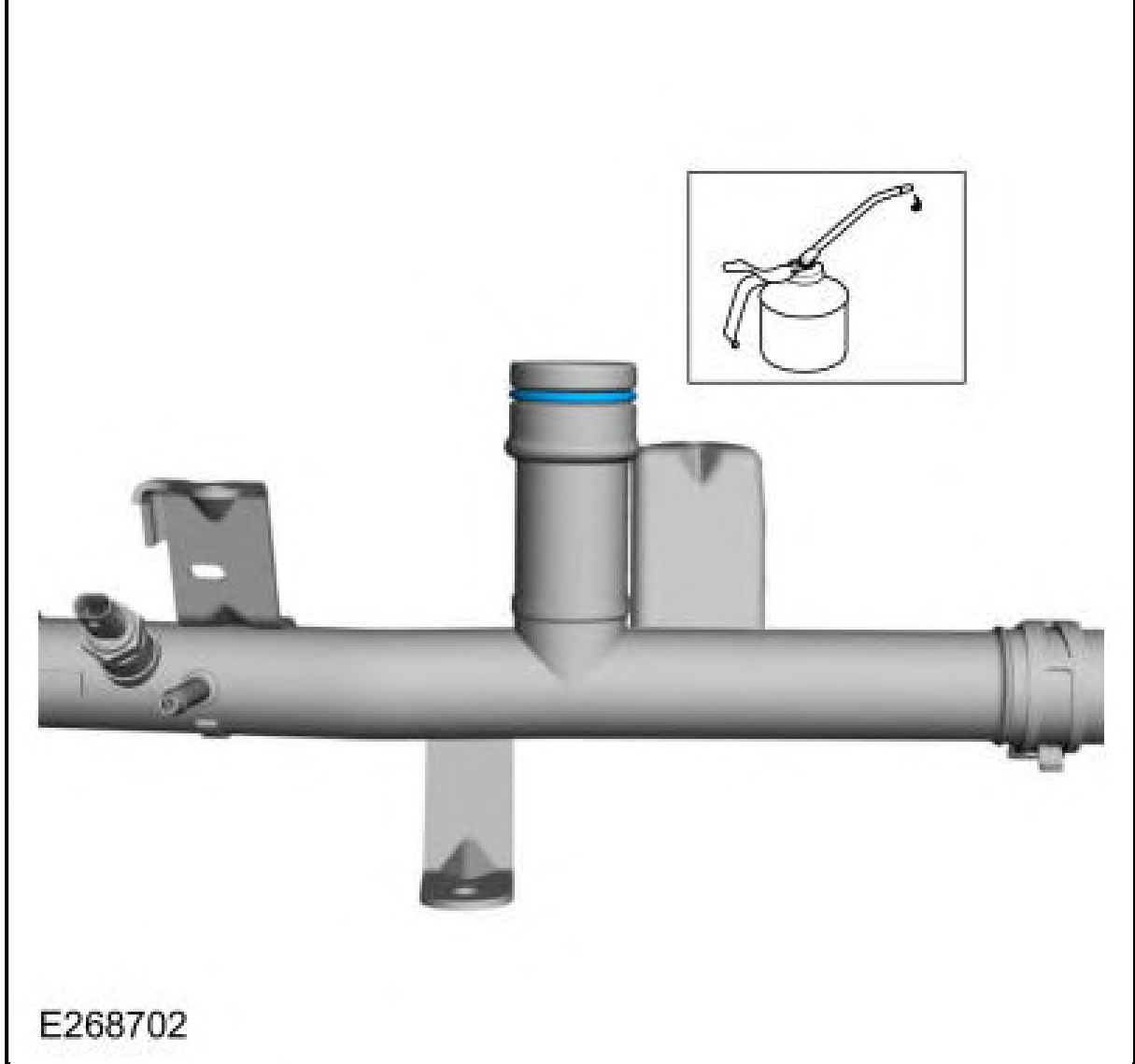




78. Install the coolant tube assembly O-ring and lubricate.

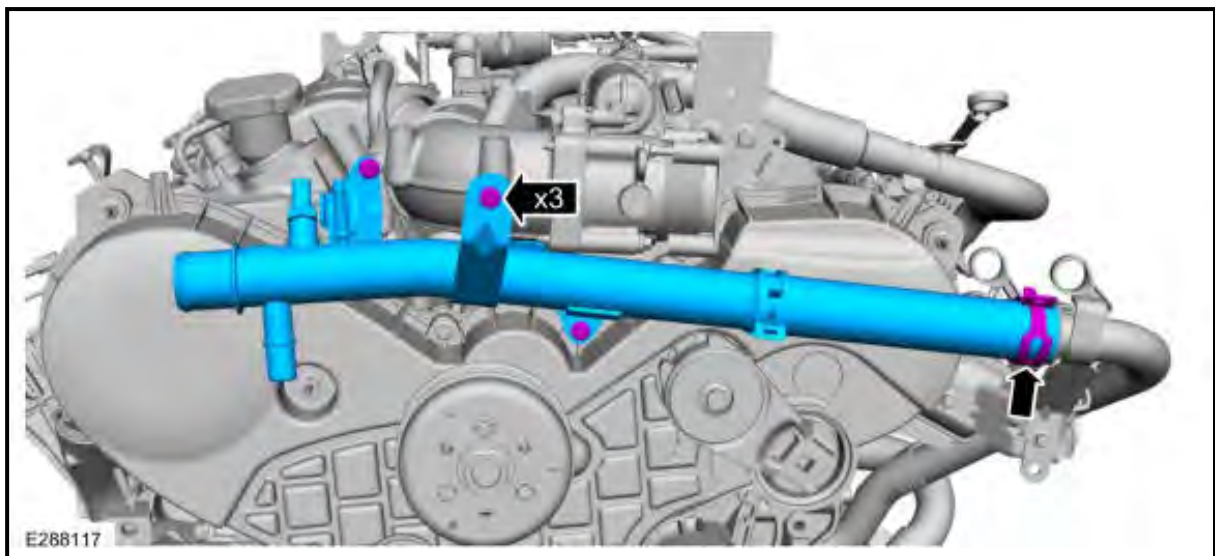
Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)





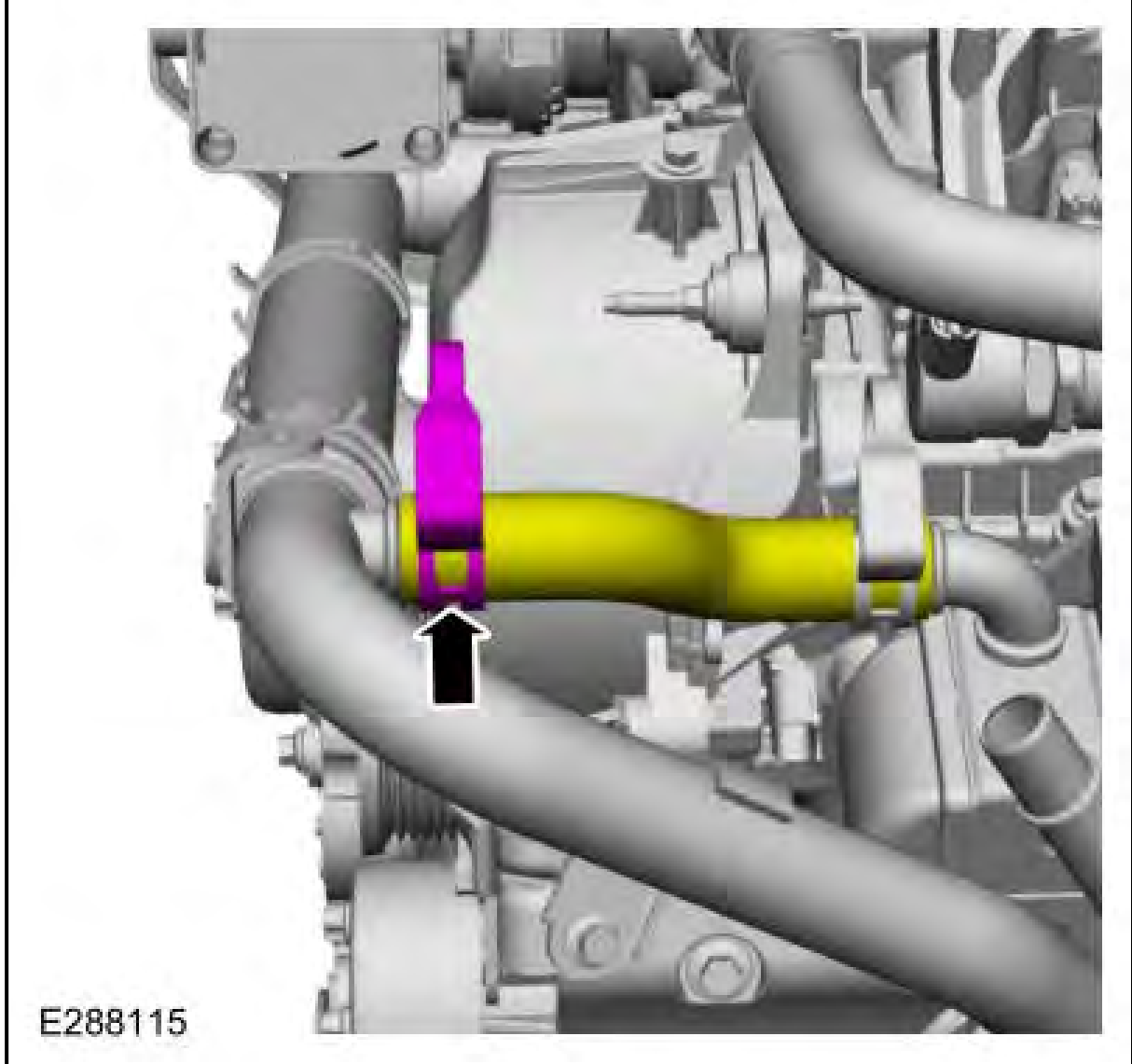
79. Install the coolant tube assembly and the bolts. Use the General Equipment: Hose Clamp Remover/Installer

Torque: 89 lb.in (10 Nm)



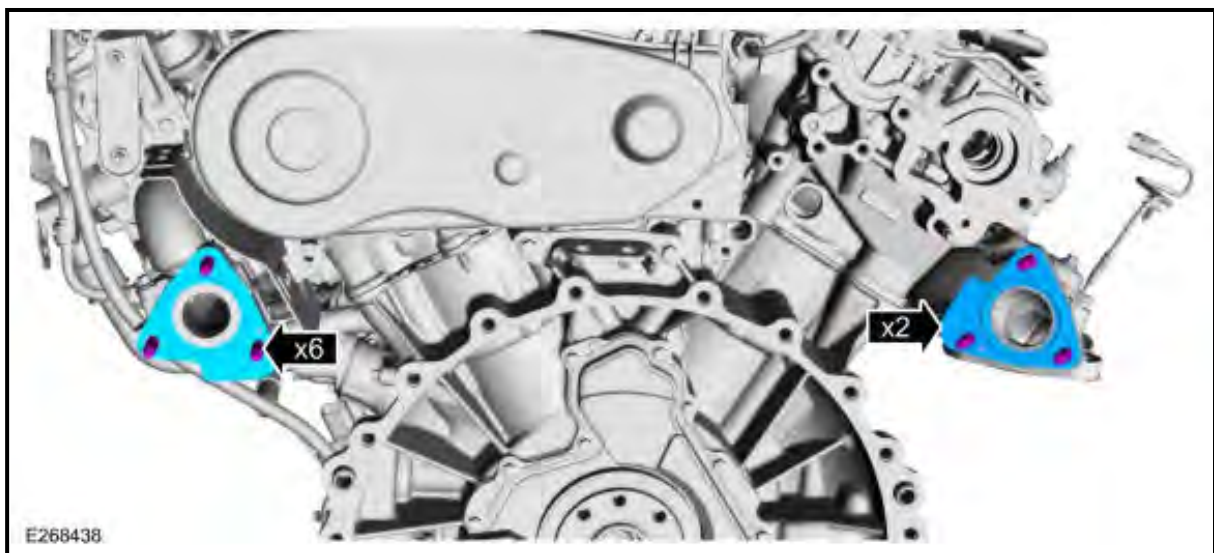
80. Position back the EGR cooler coolant hose and install the clamp. Use the General Equipment: Hose Clamp Remover/Installer





81. Install the studs and the exhaust crossover pipe gaskets.

Torque: 115 lb.in (13 Nm)

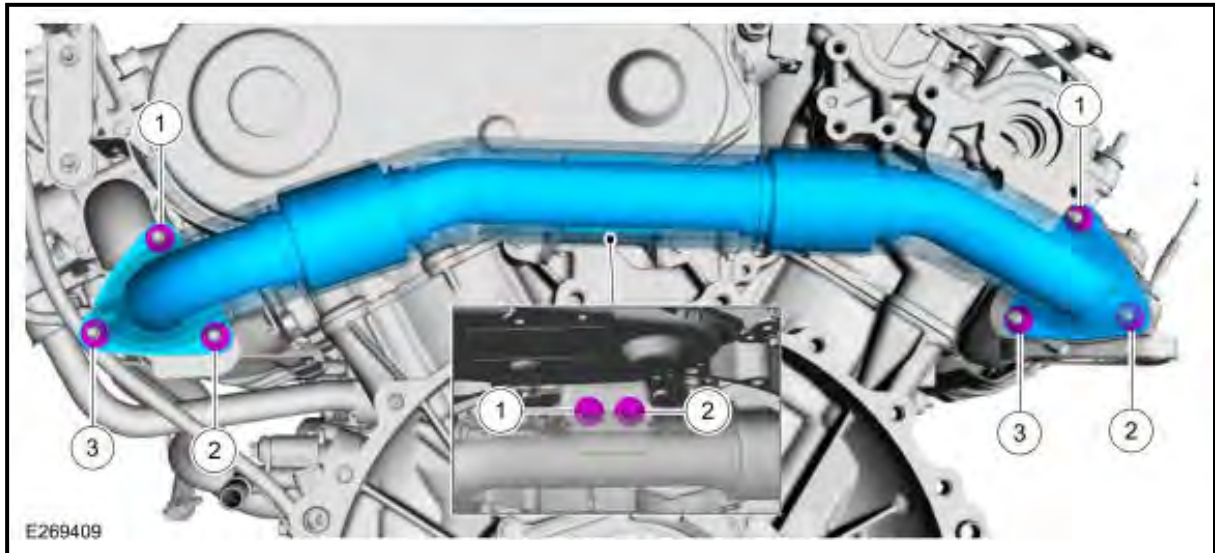


82. **NOTE:** If any snaps become undone on the exhaust crossover pipe wrap. Install a new exhaust crossover pipe wrap.

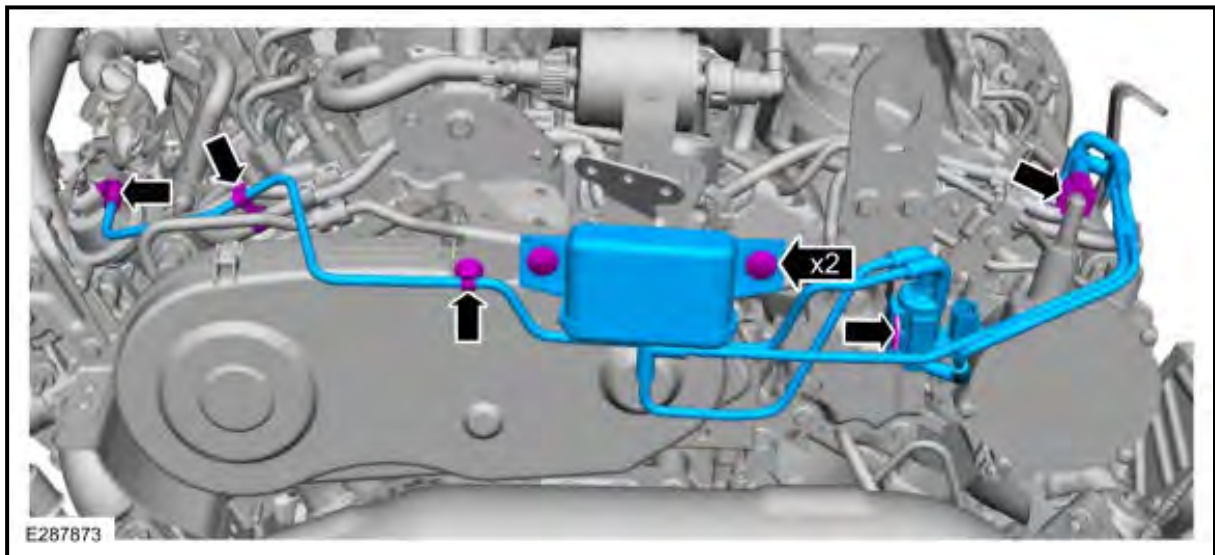
Install the exhaust crossover pipe, the nuts and the bolts.

- Hand start the RH exhaust manifold nuts.
- Hand start the LH exhaust manifold nuts.

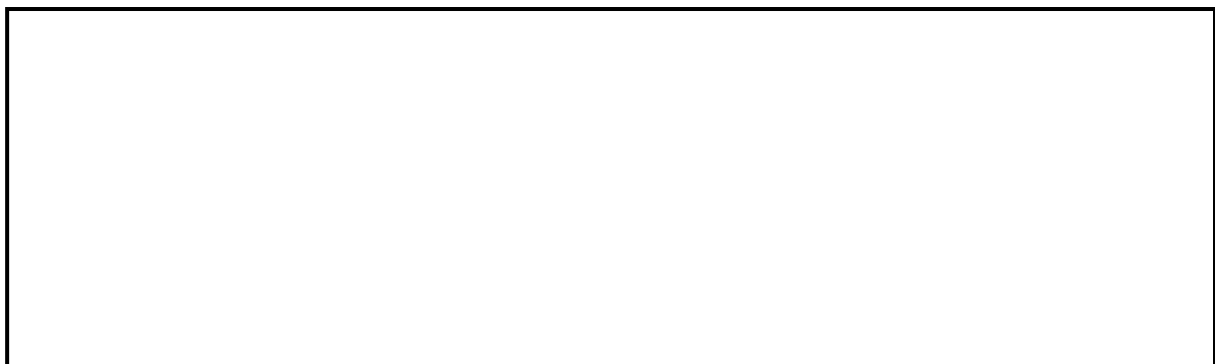
- Hand start the exhaust crossover pipe bracket bolts.
- Tighten the RH exhaust manifold nuts in the following sequence: 1, 2, 3, 1, 2.  
Torque: 18 lb.ft (24 Nm)
- Tighten the LH exhaust manifold nuts in the following sequence: 1, 2, 3, 1, 2.  
Torque: 18 lb.ft (24 Nm)
- Tighten the exhaust crossover pipe bracket bolts in the sequence shown.  
Torque: 18 lb.ft (24 Nm)



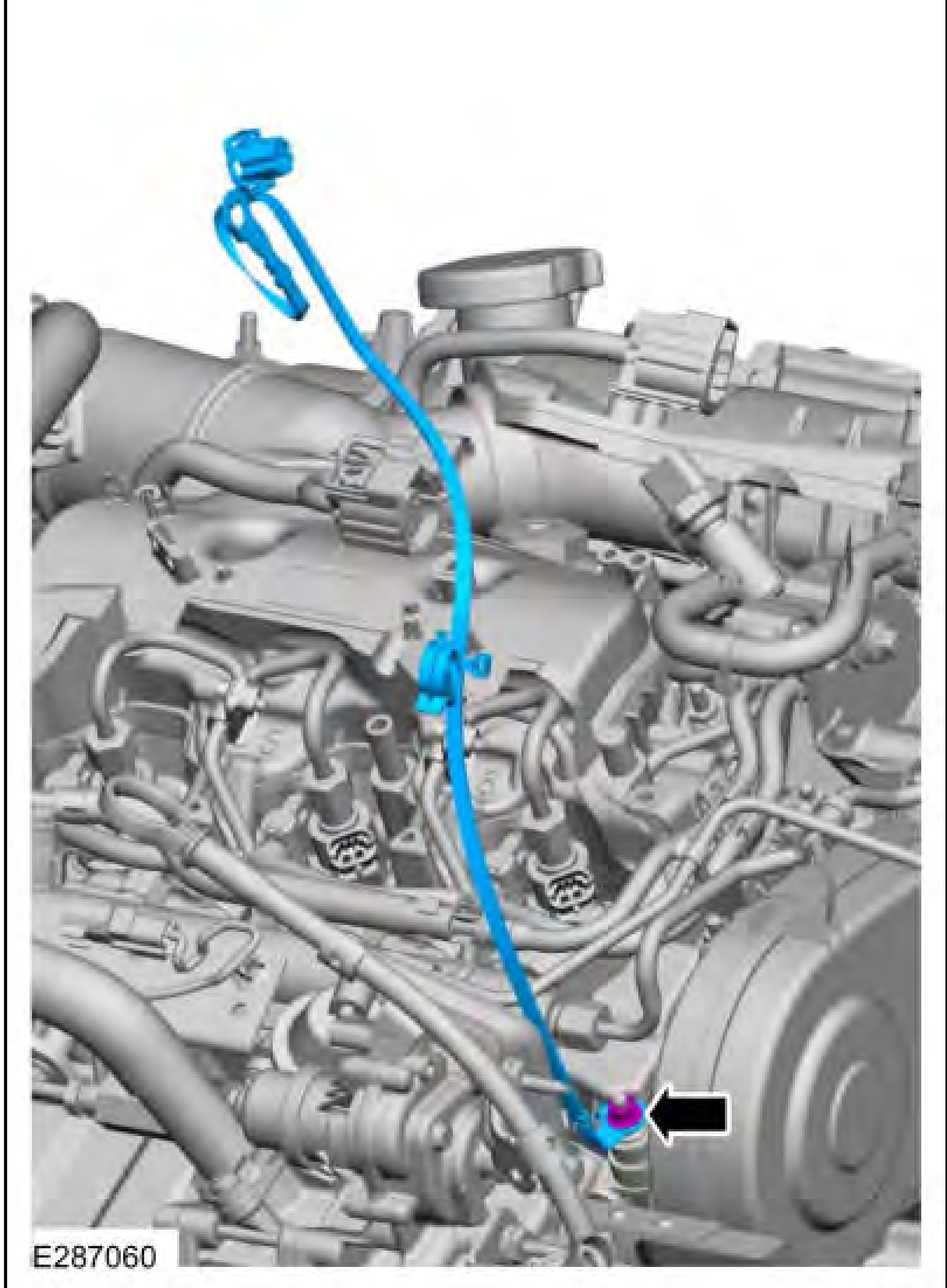
83. Install the vacuum hose assembly and the retainers. Connect the vacuum pump connector. Refer to: [Quick Release Coupling](#).



84. Install the ground strap and the nut.  
Torque: 80 lb.in (9 Nm)



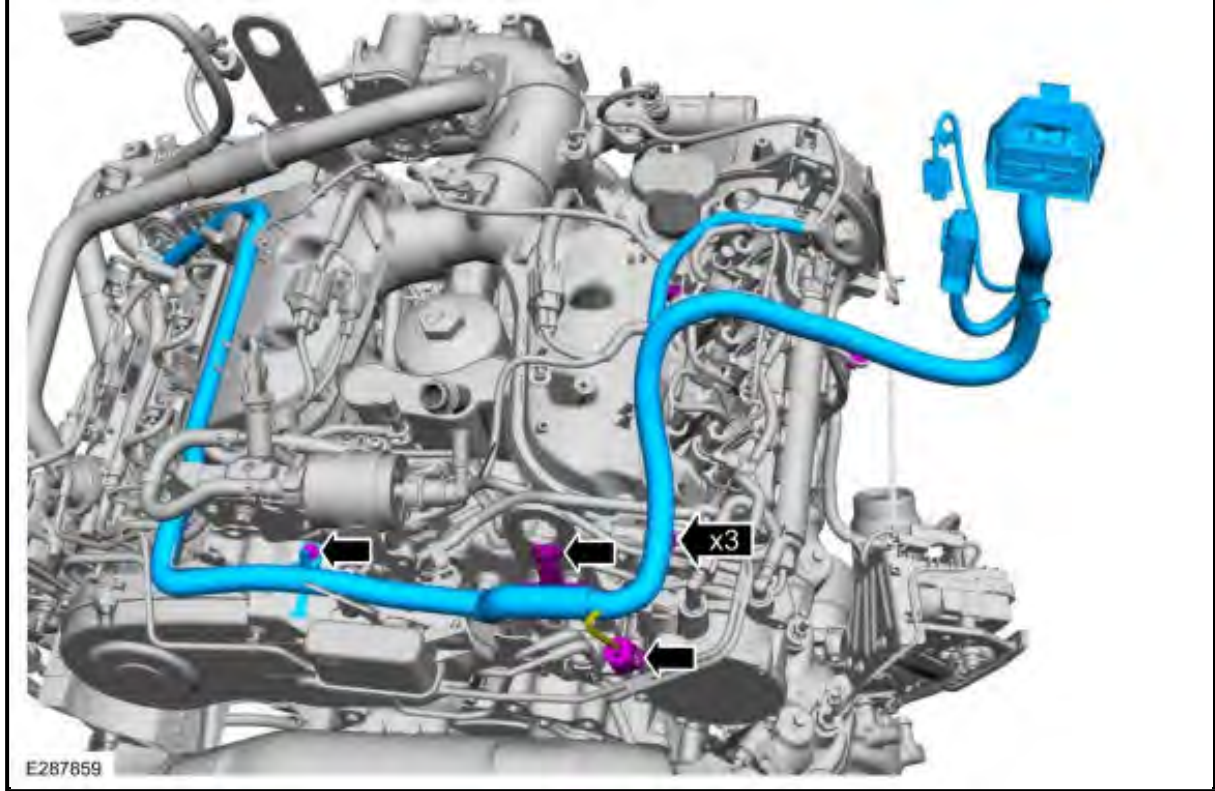




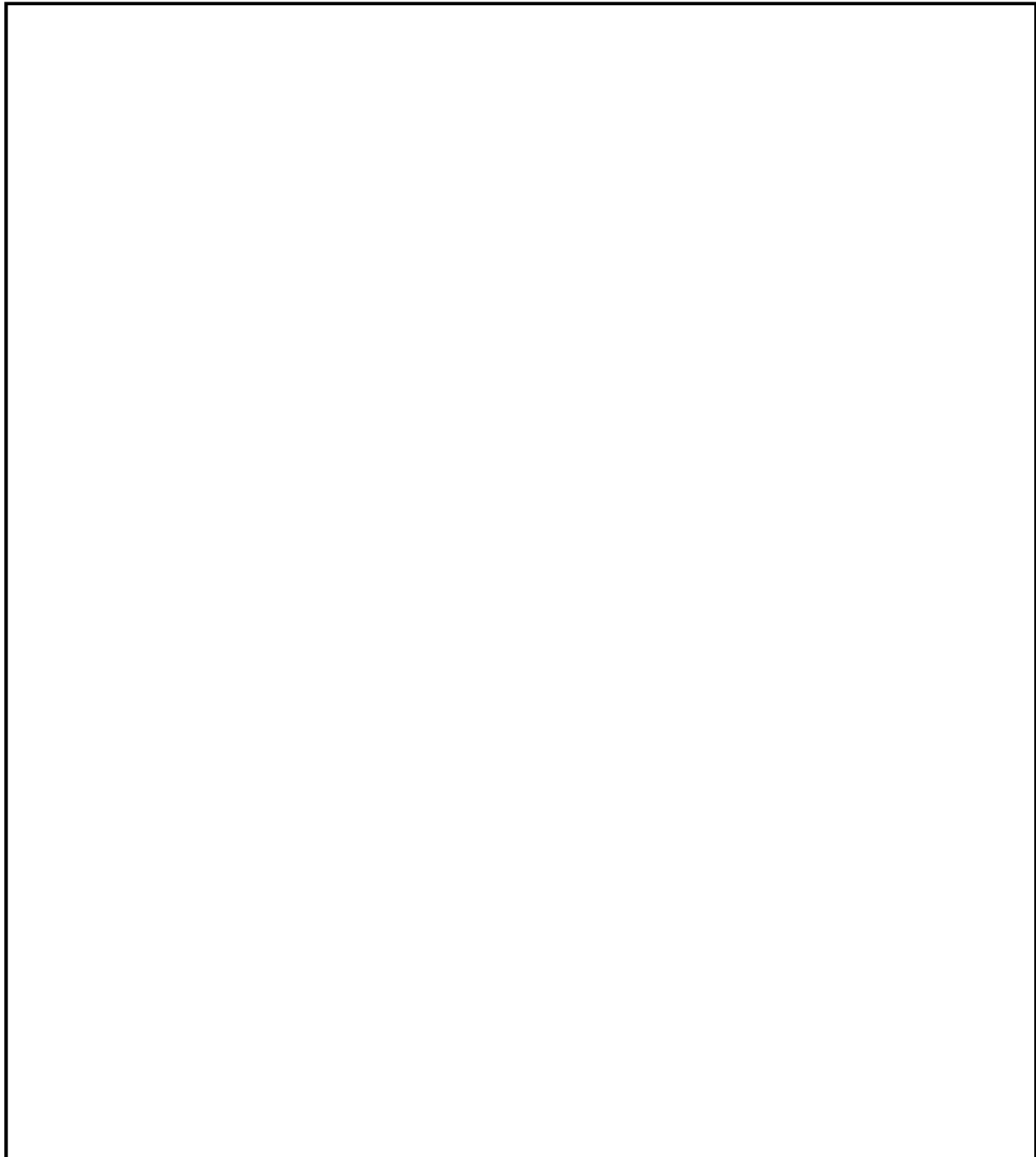
85. Position the engine wire harness on the engine and install the bolt. Connect the electrical wire retainers and the electrical connector.

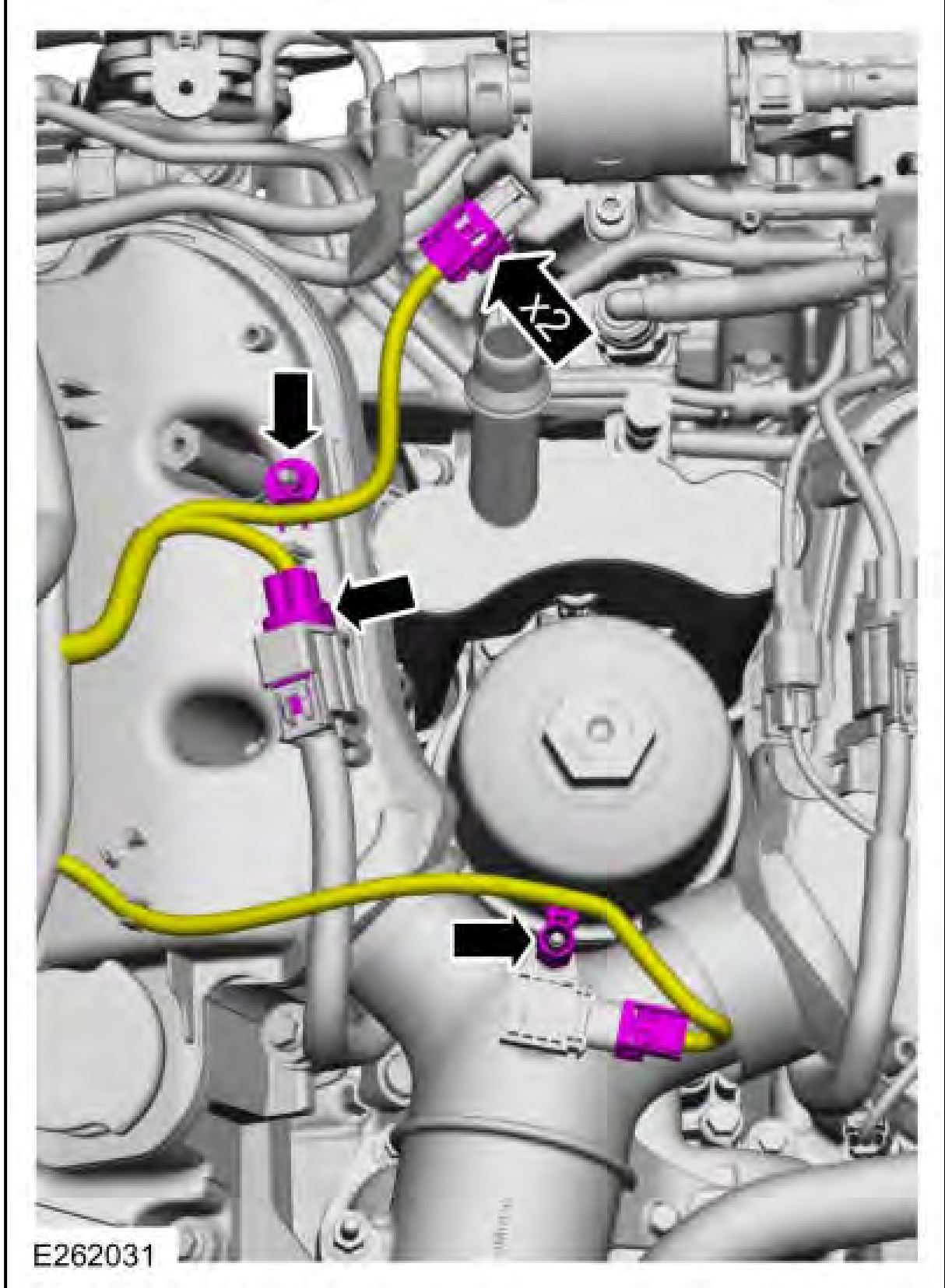
Torque: 89 lb.in (10 Nm)





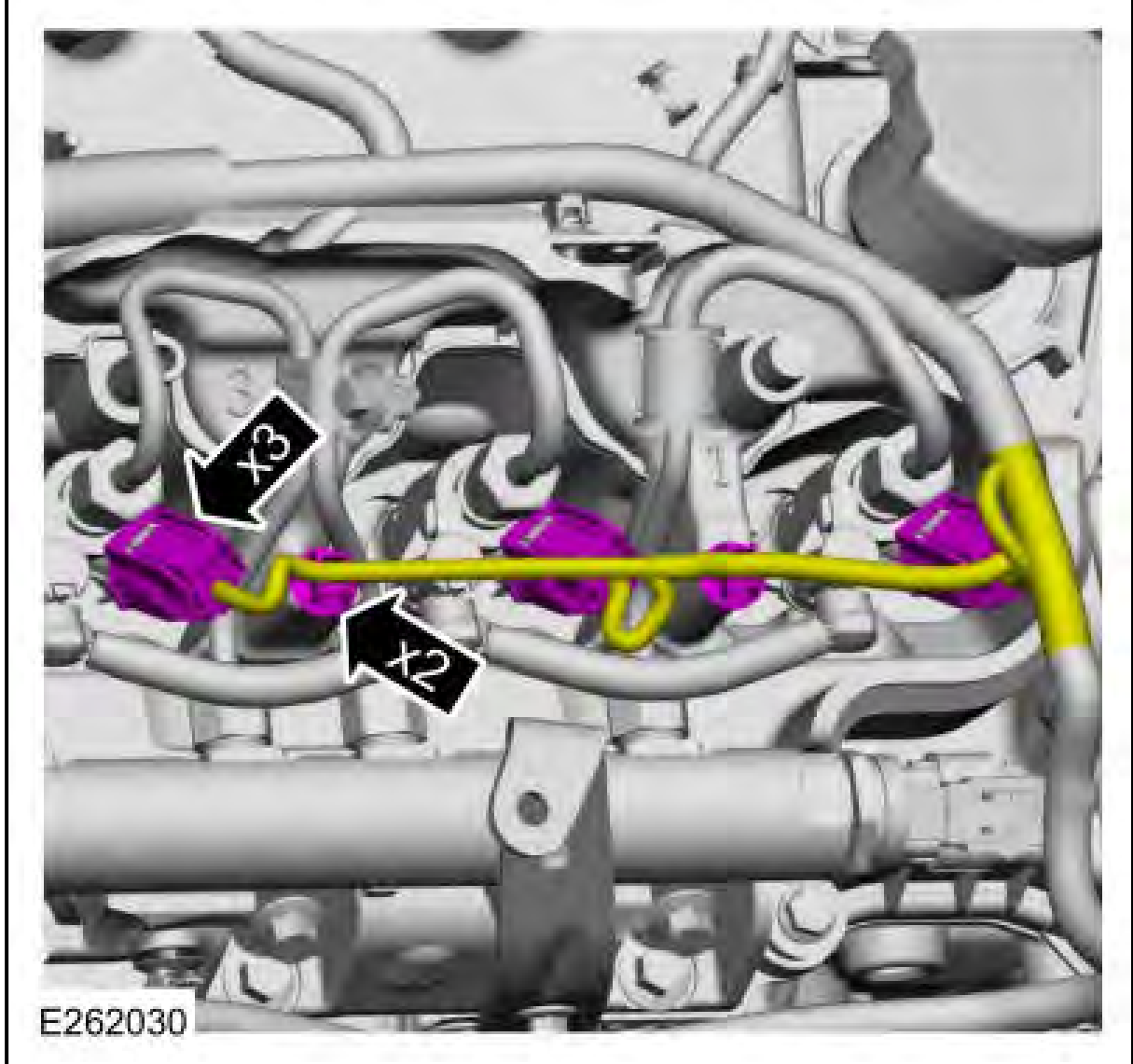
86. Connect the electrical connectors and the wire retainers.



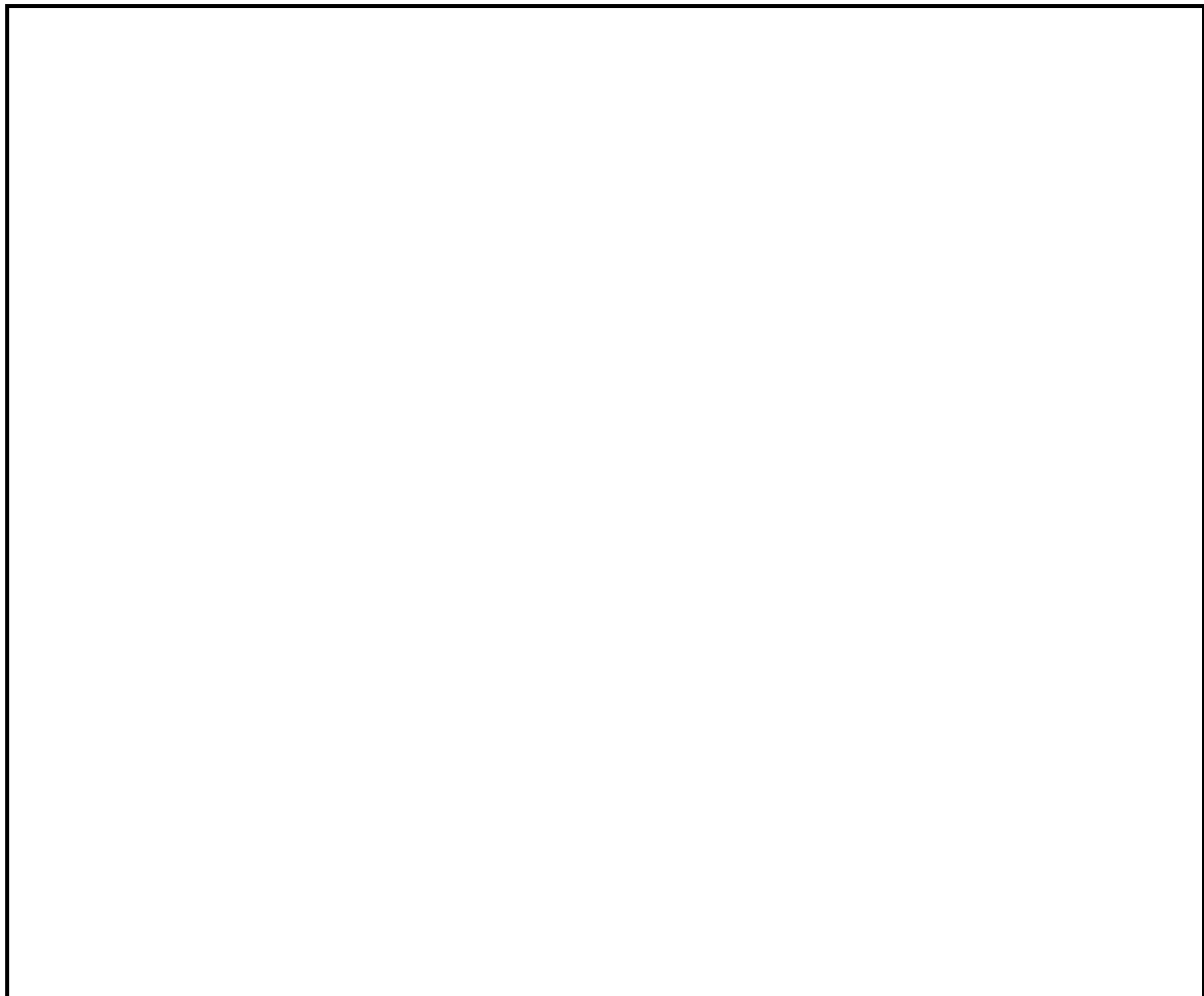


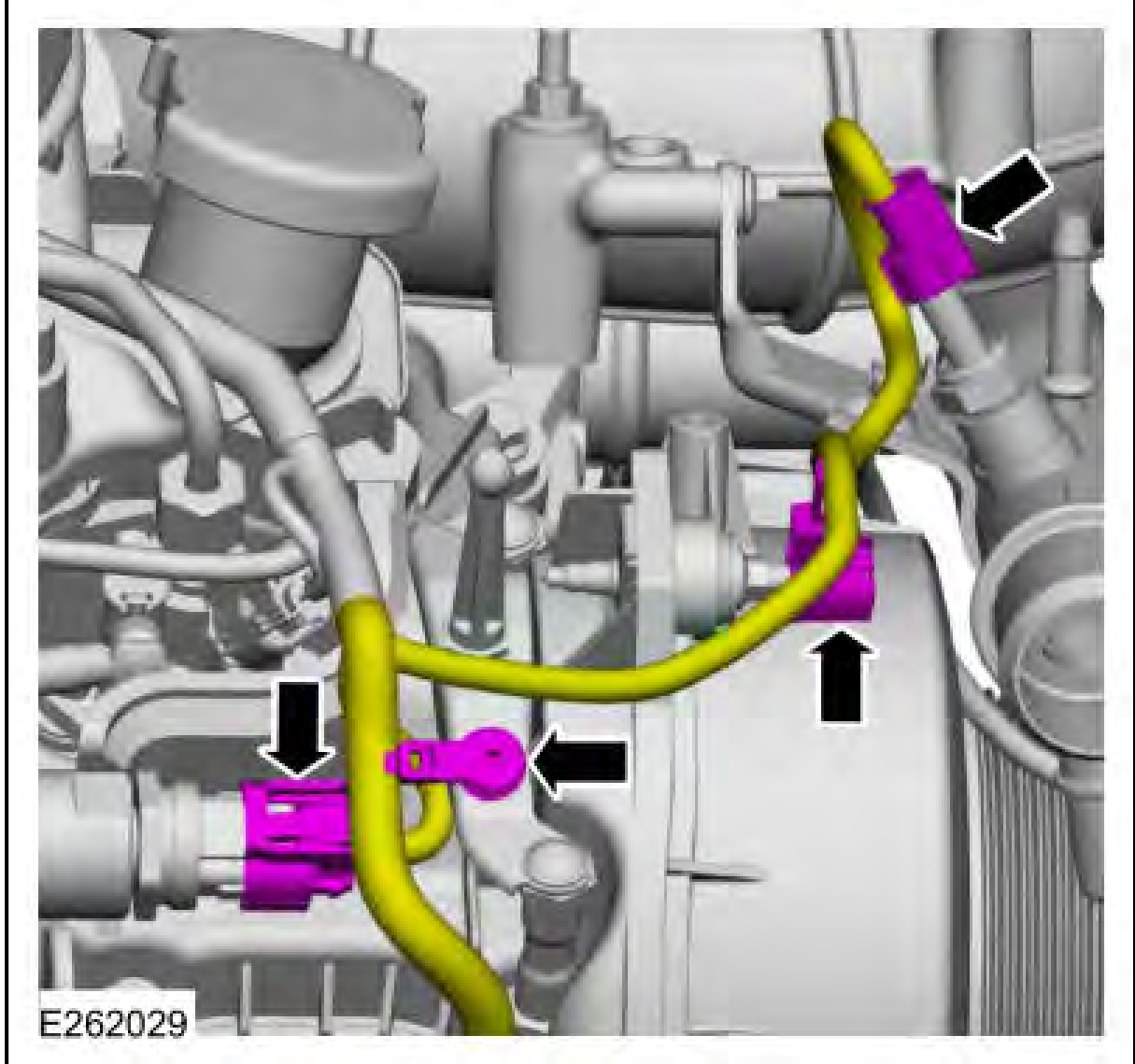
87. Connect the fuel injectors electrical connectors and the wire retainers.



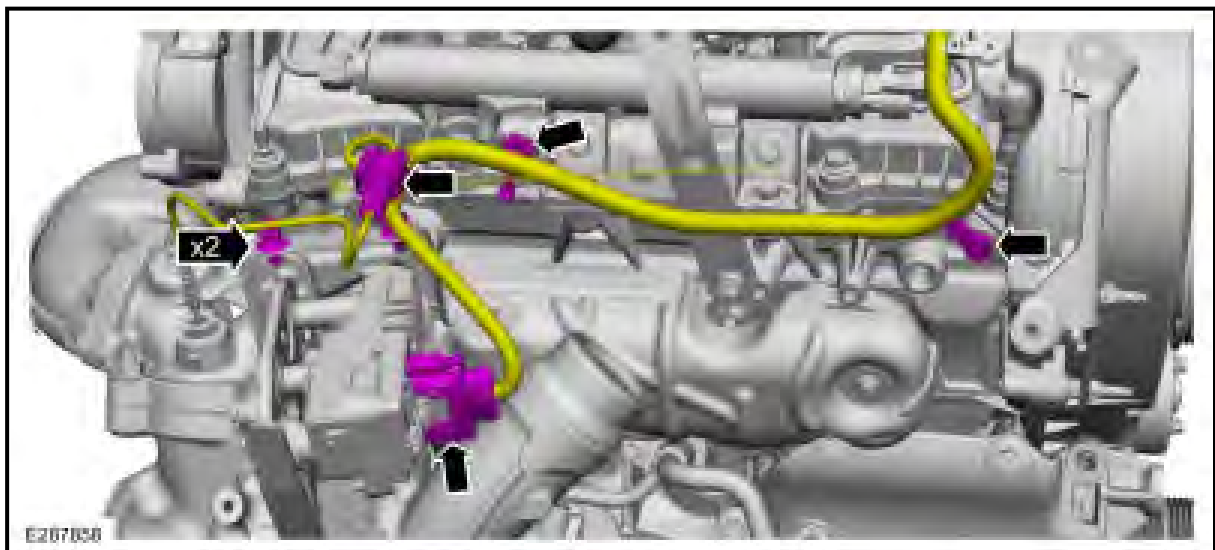


88. Connect the electrical connectors and the wire retainers.



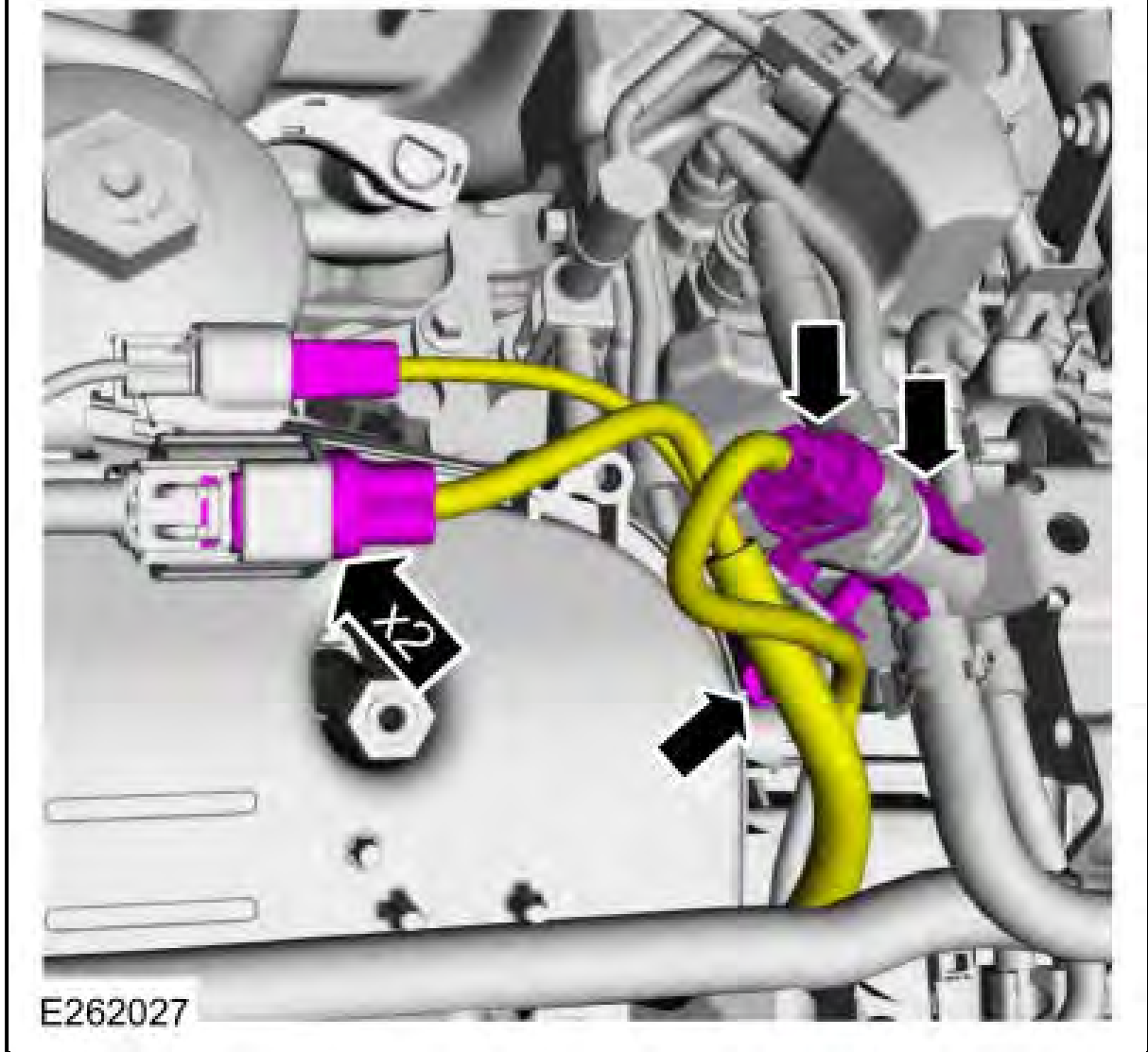


89. Connect the EGRT electrical connector and the wire retainers. Connect the turbocharger actuator electrical connector.

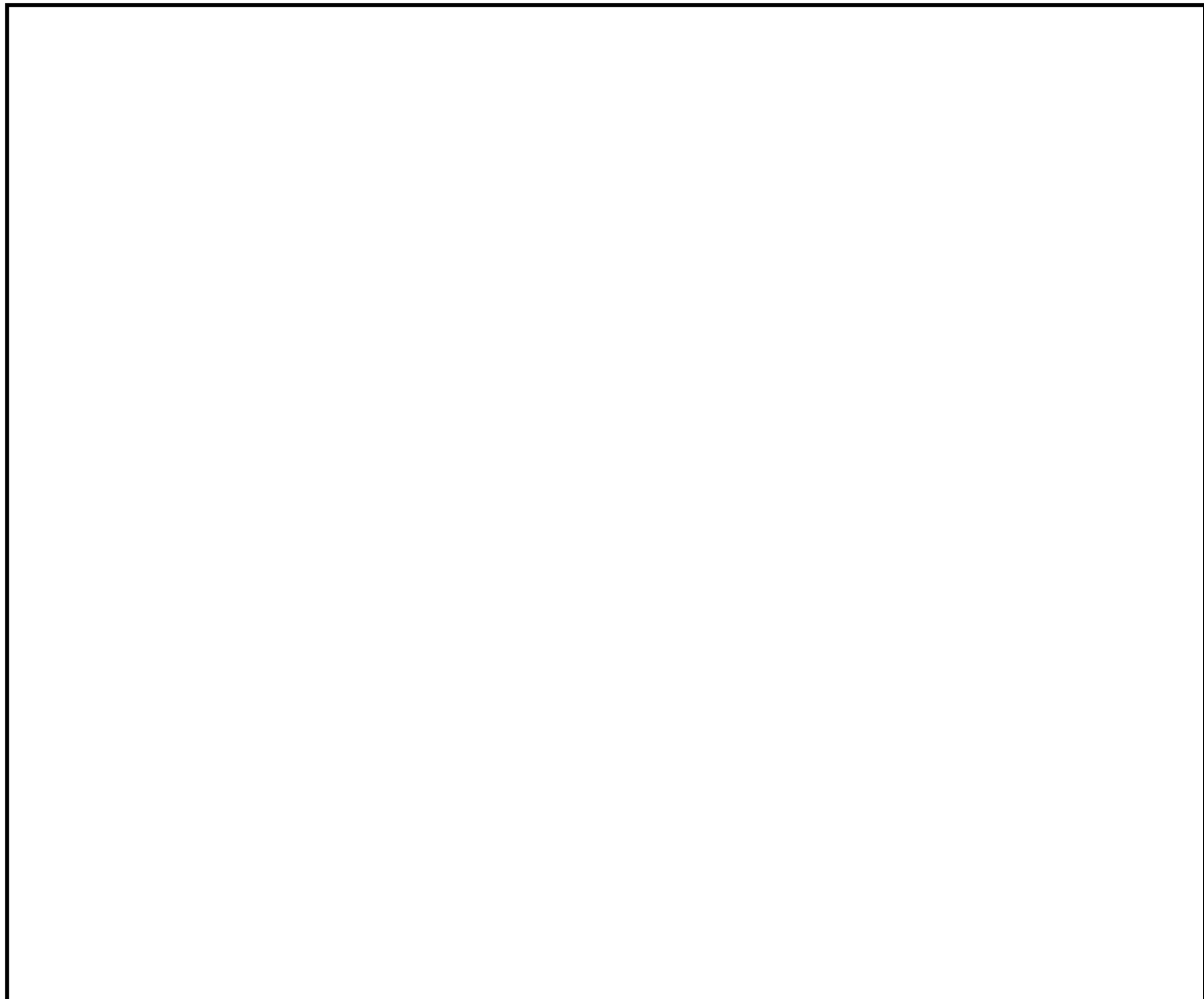


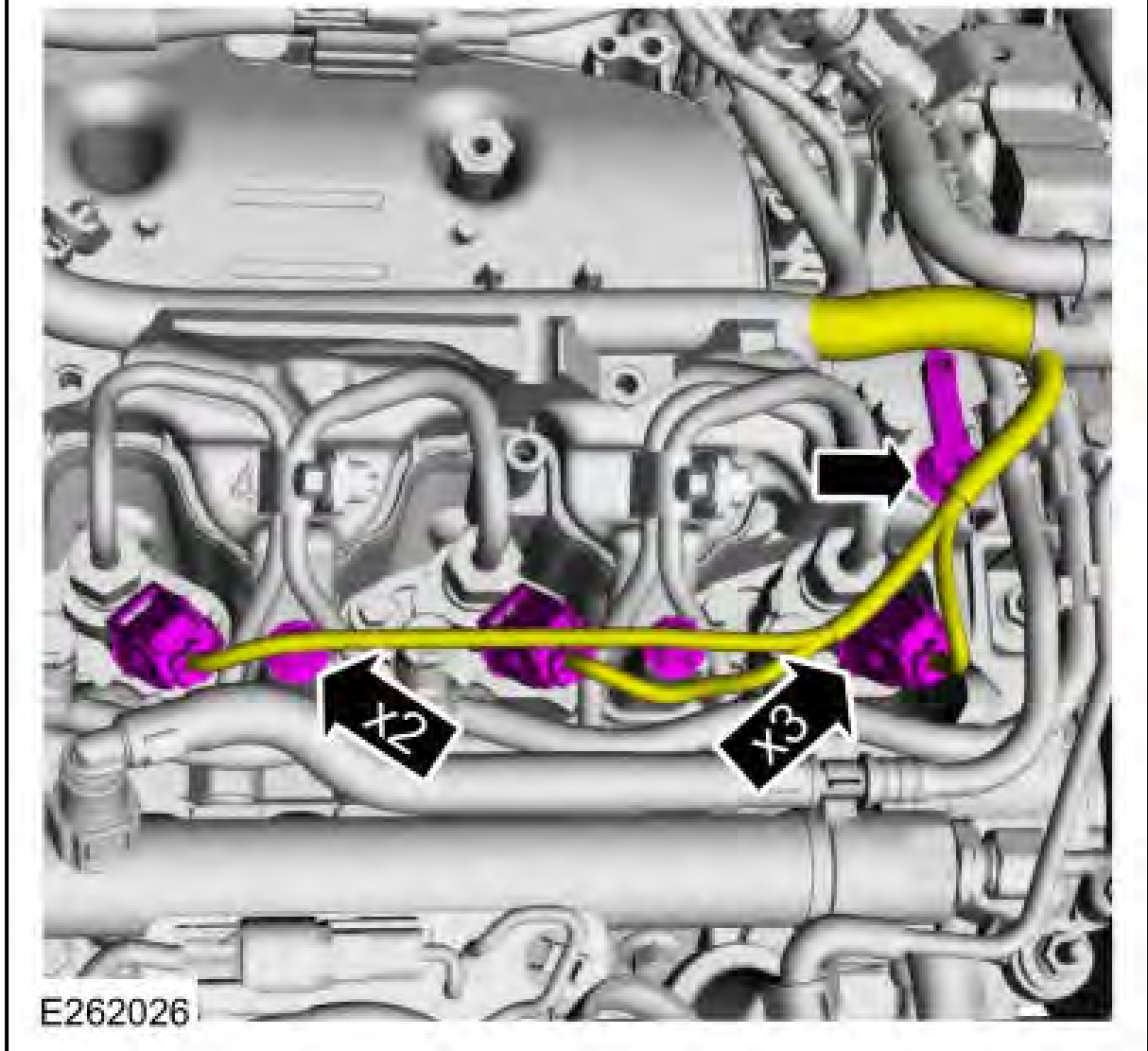
90. Connect the electrical connectors and the wire retainer.



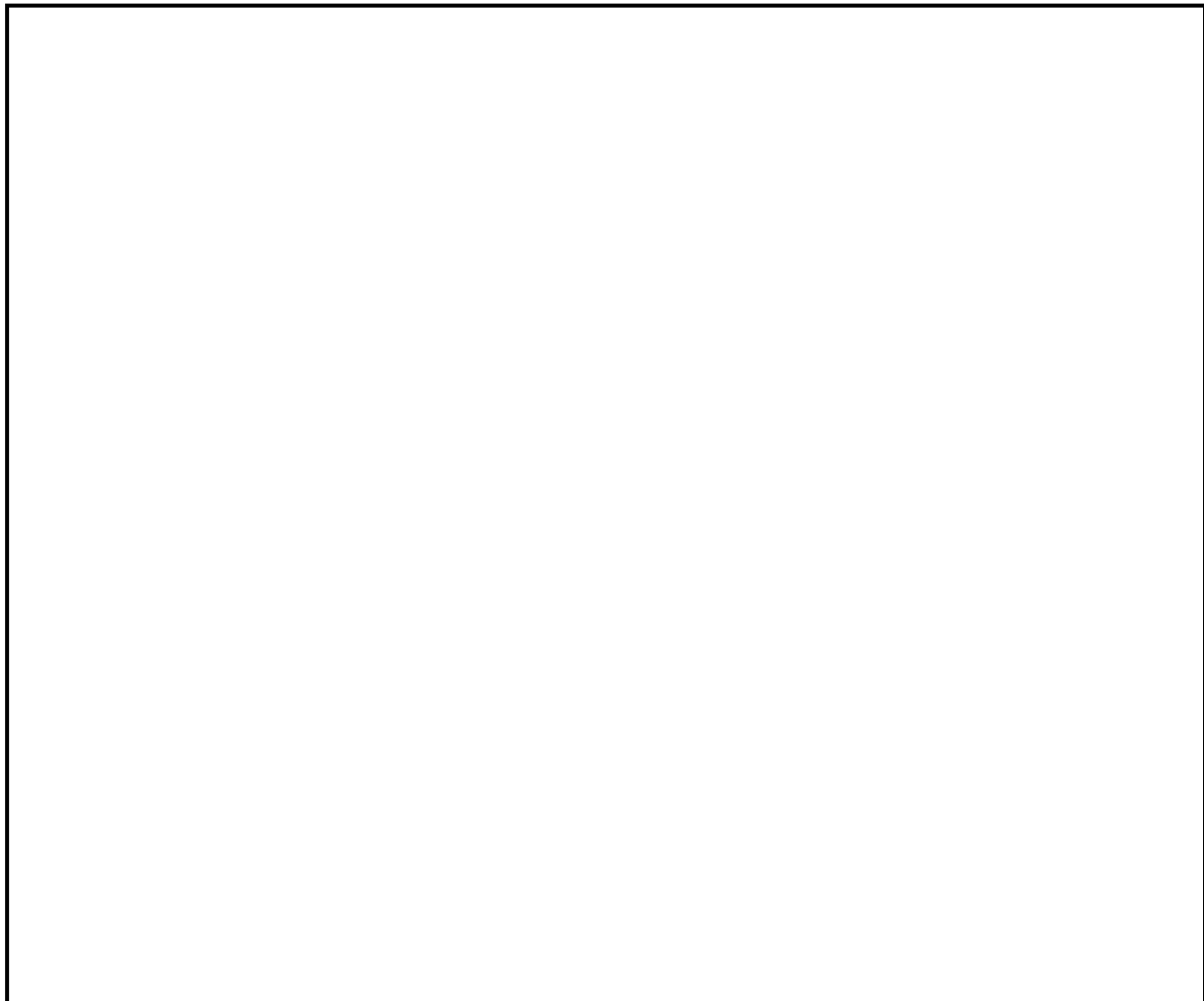


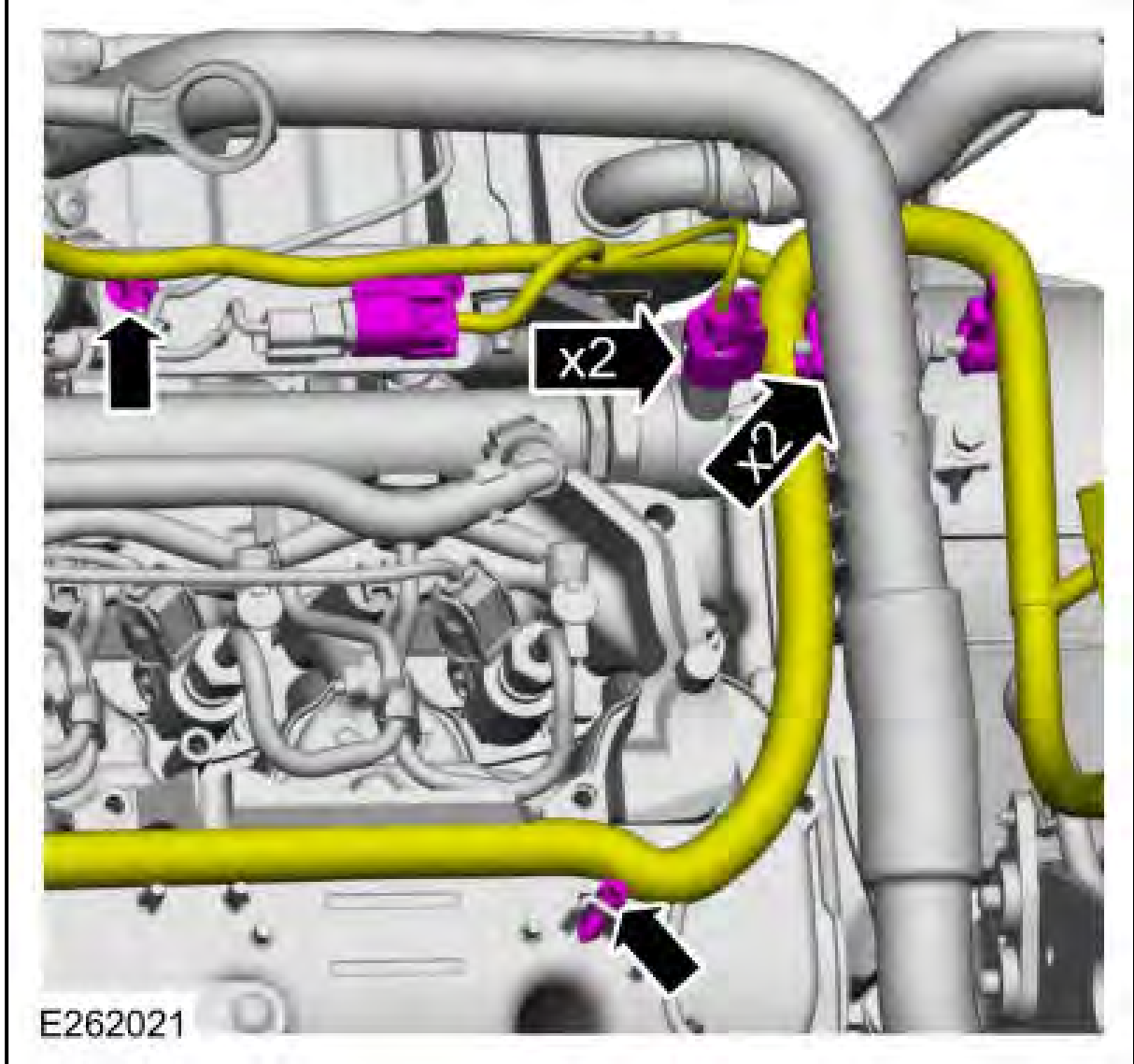
91. Connect the fuel injectors electrical connectors and the wire retainers.



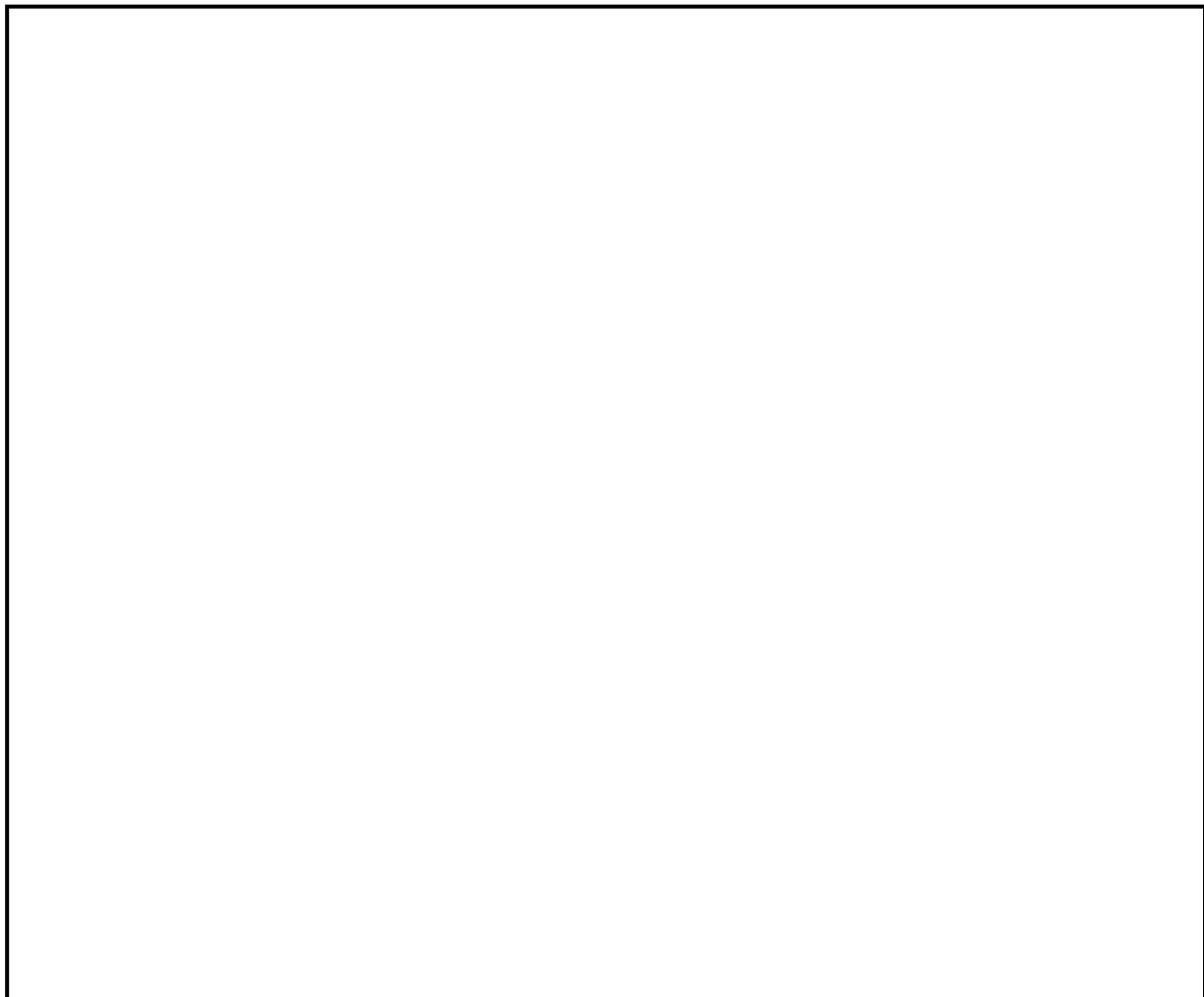


92. Connect the electrical connectors and the wire retainers.

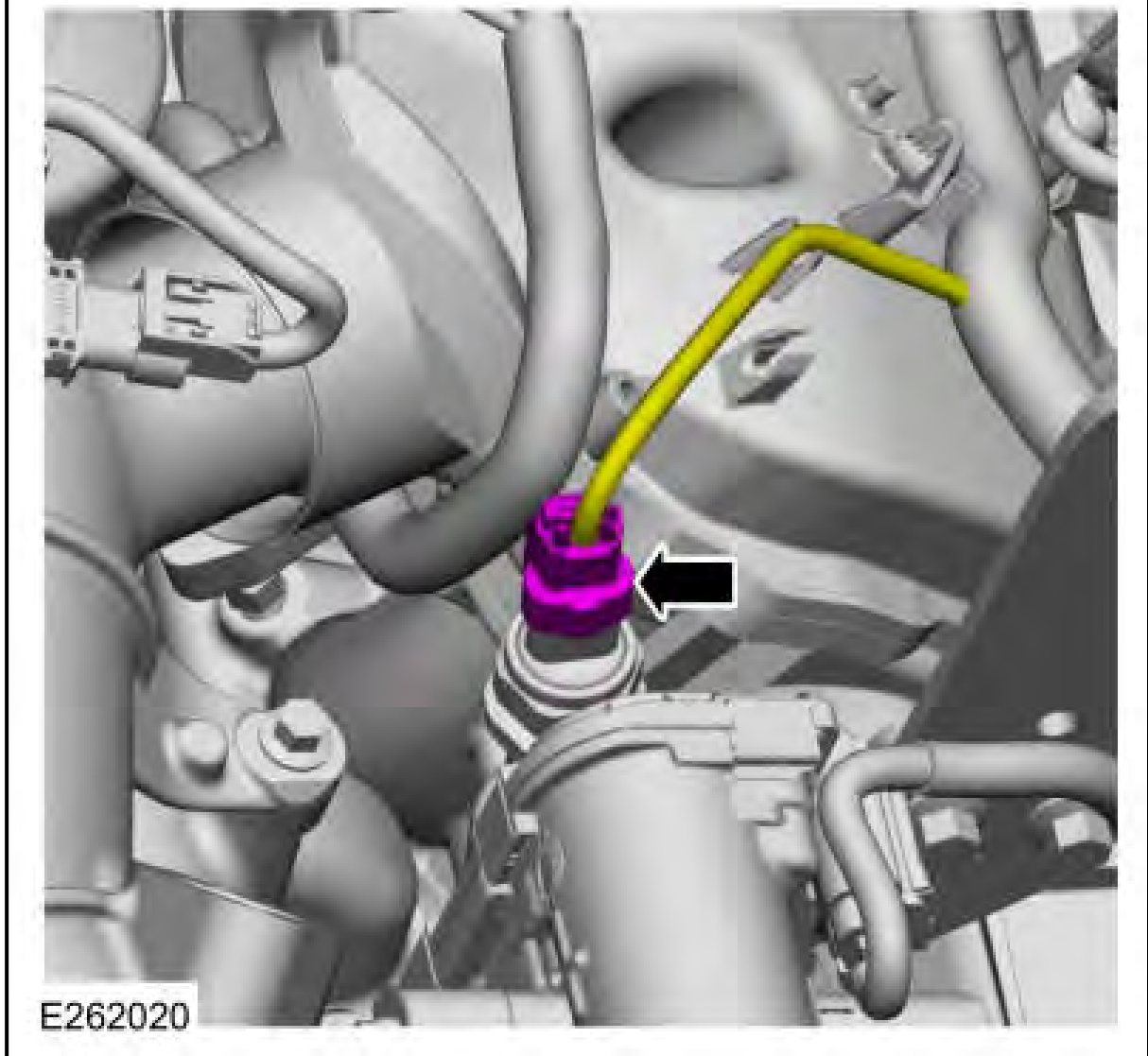




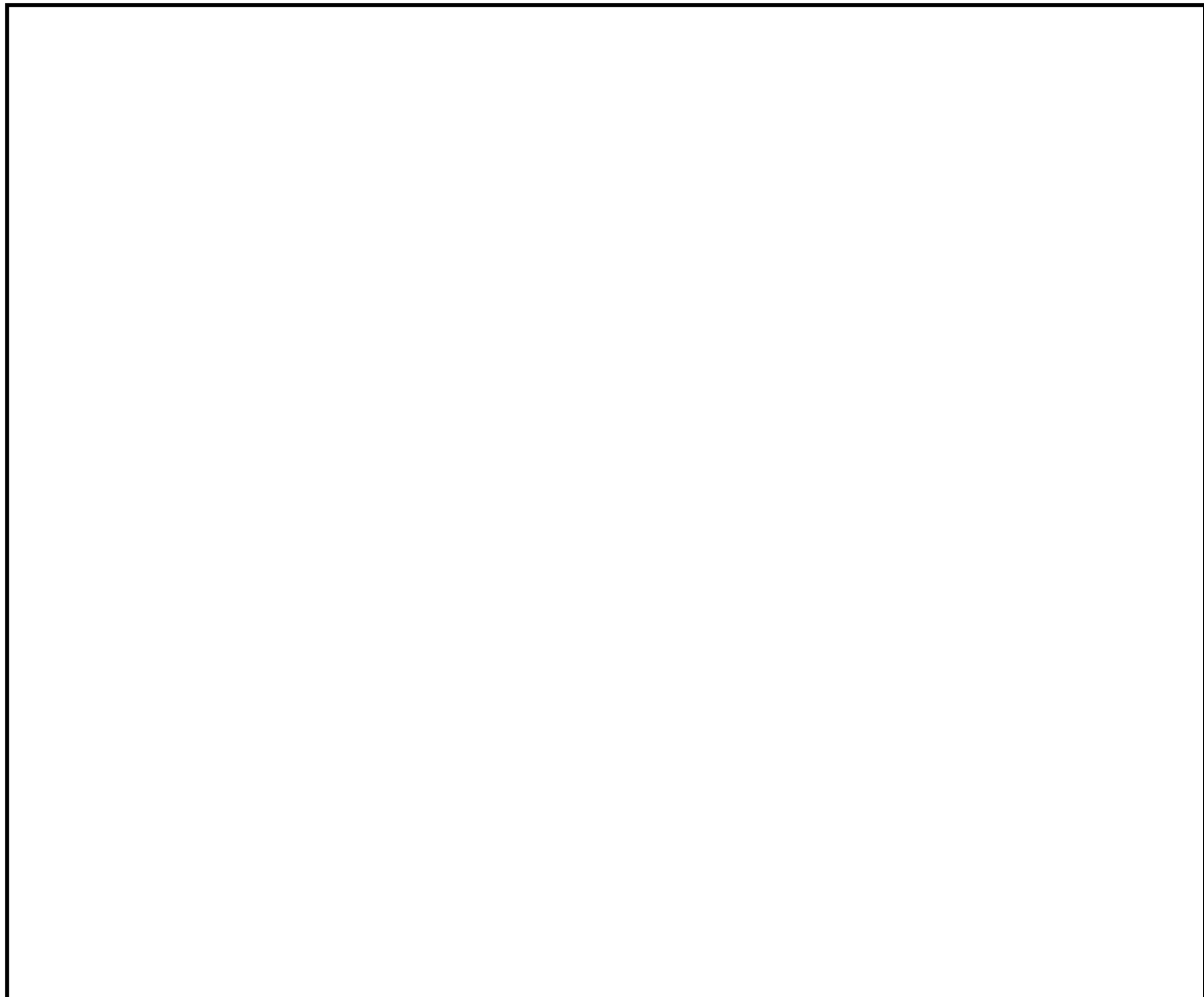
93. Connect the EOP sensor electrical connector.

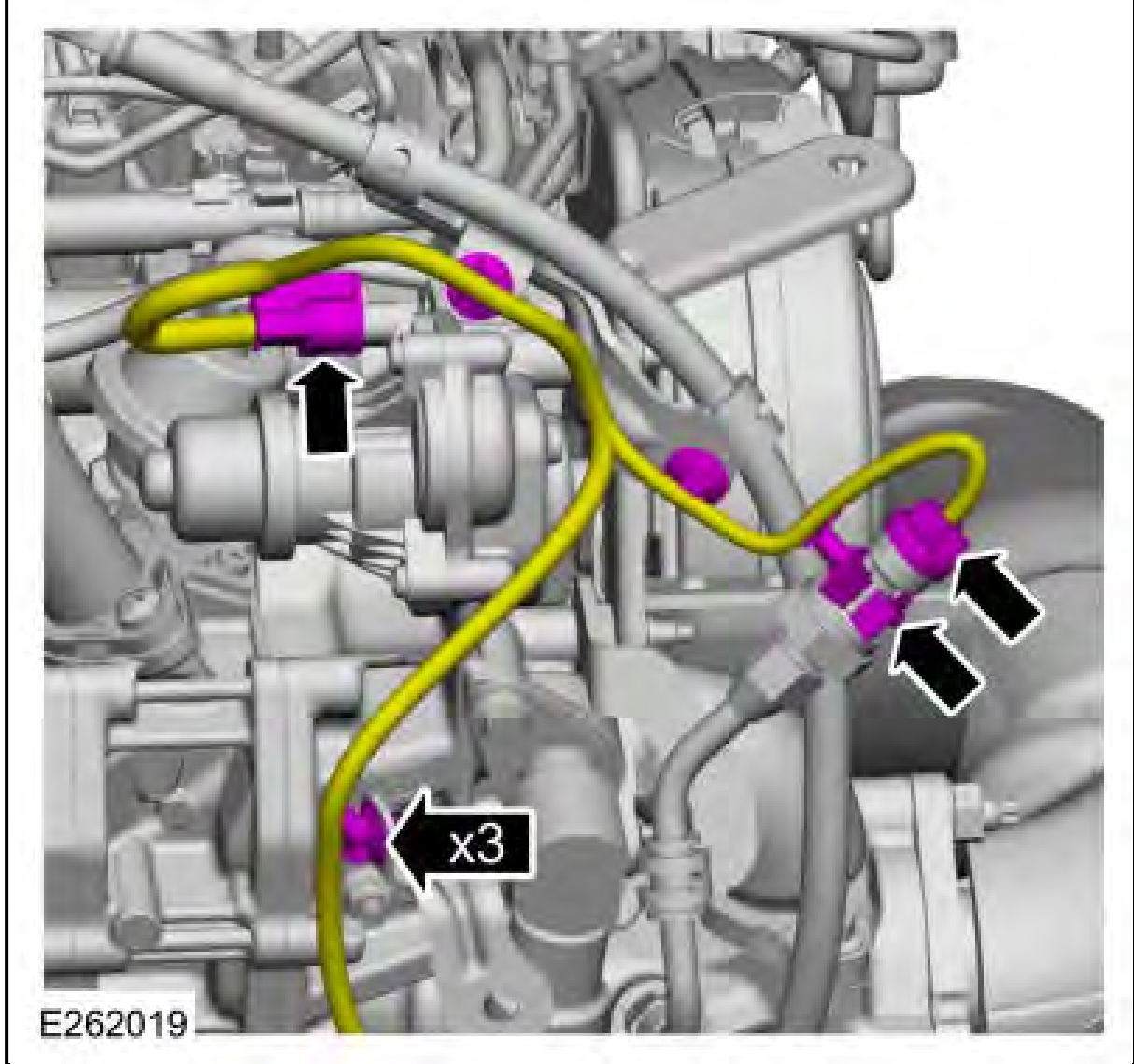




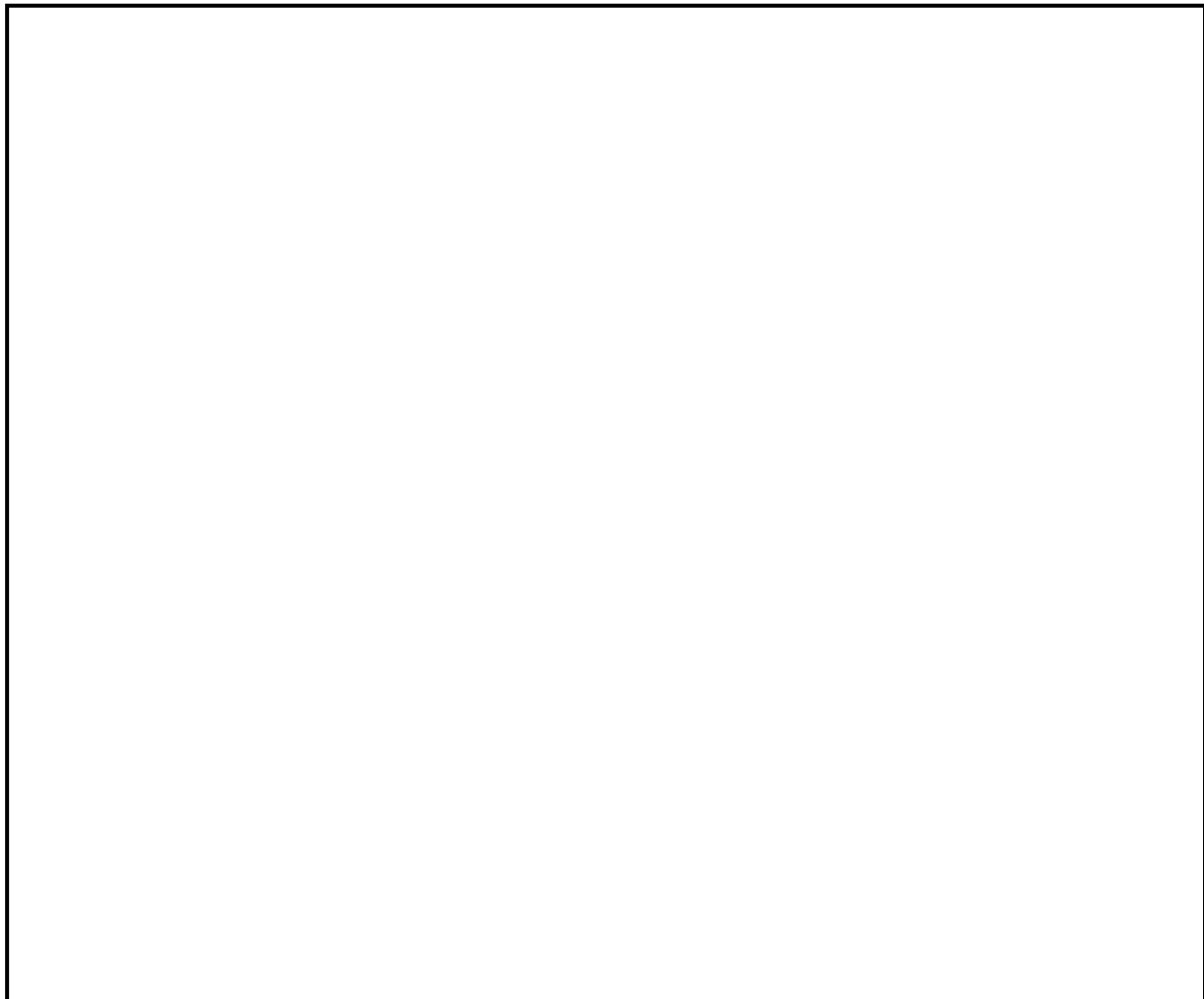


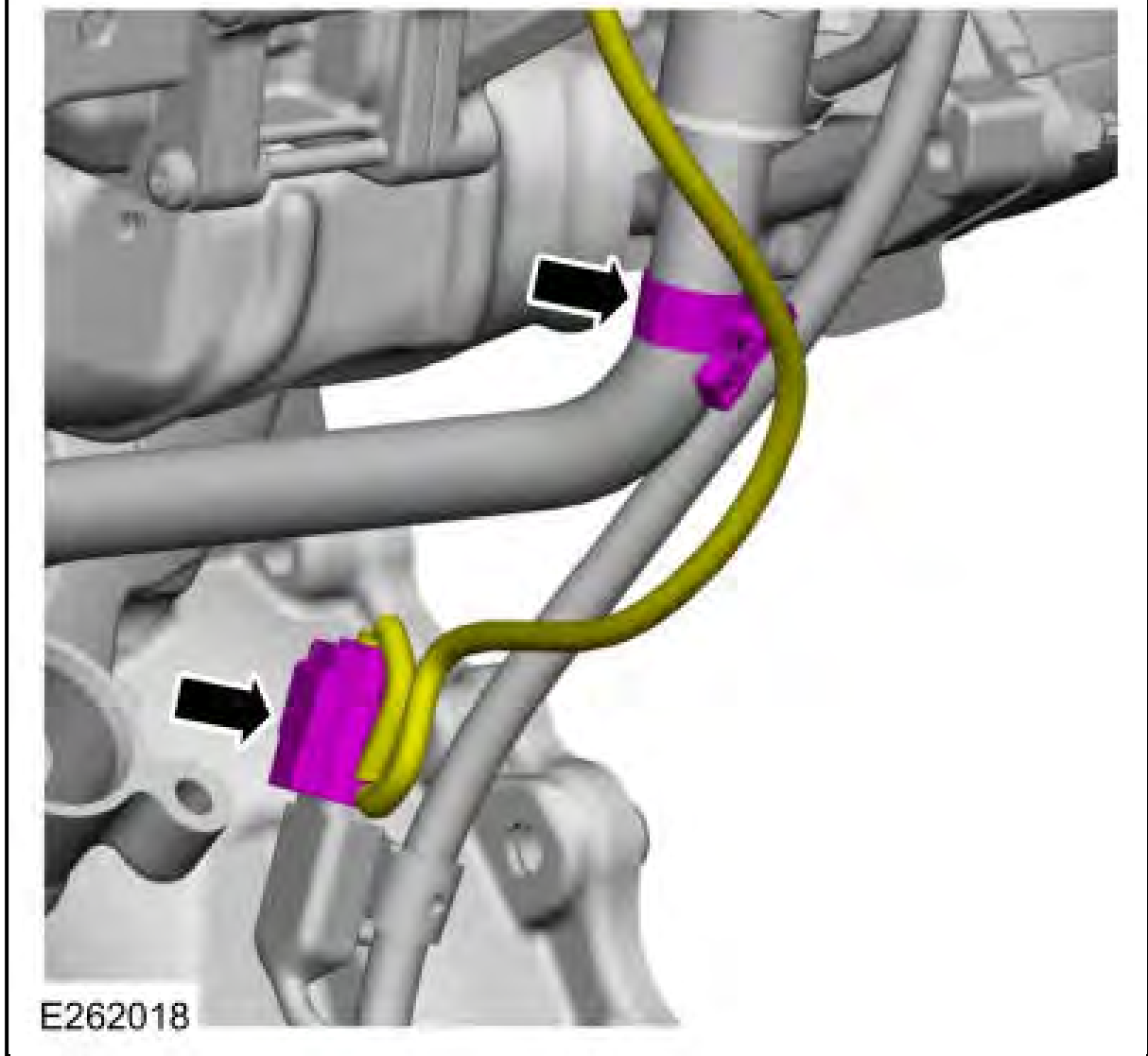
94. Connect the EGR valve and the EP sensor electrical connectors. Disconnect the wire retainers.



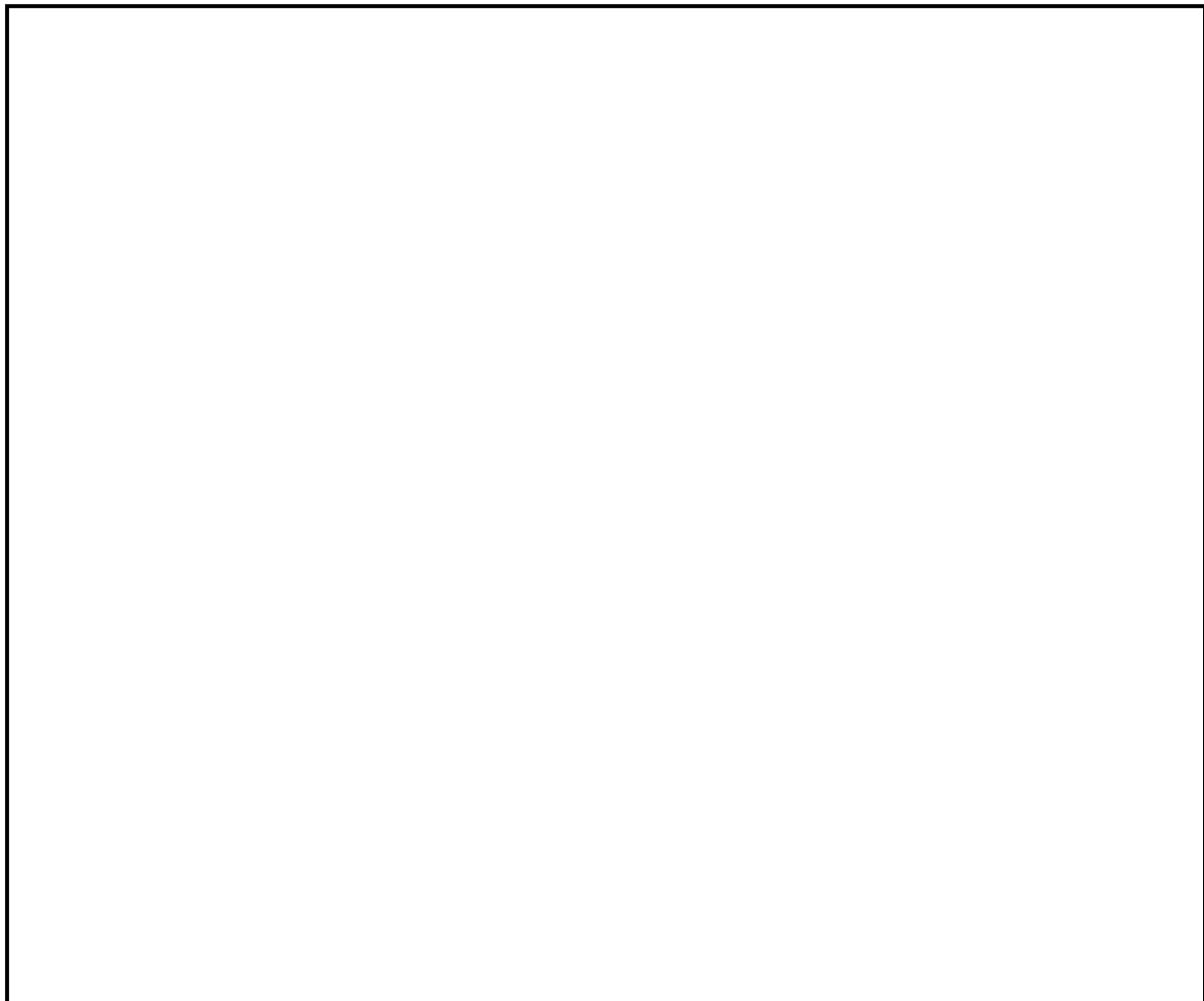


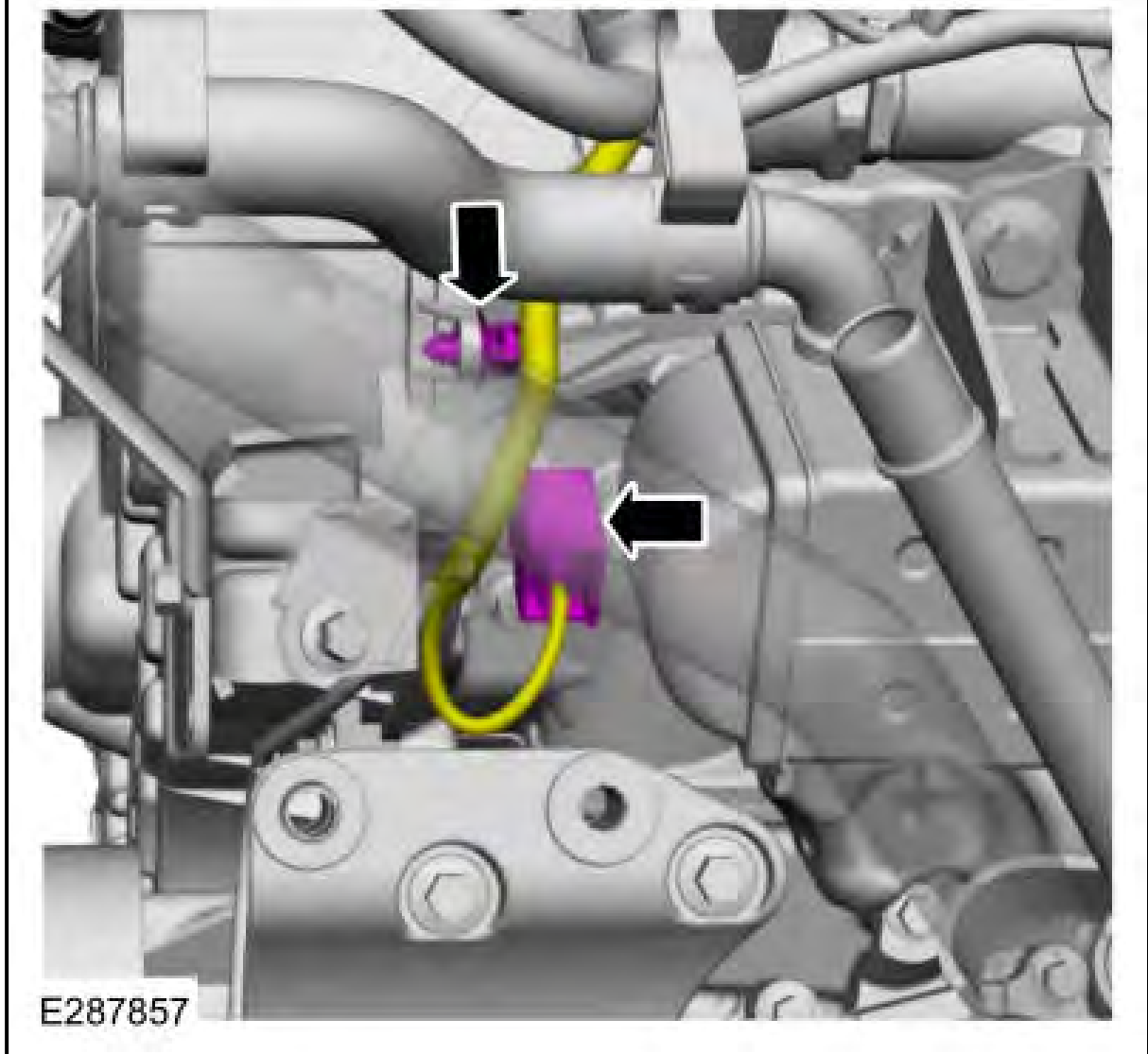
95. Connect the CKP electrical connector and the wire retainer.



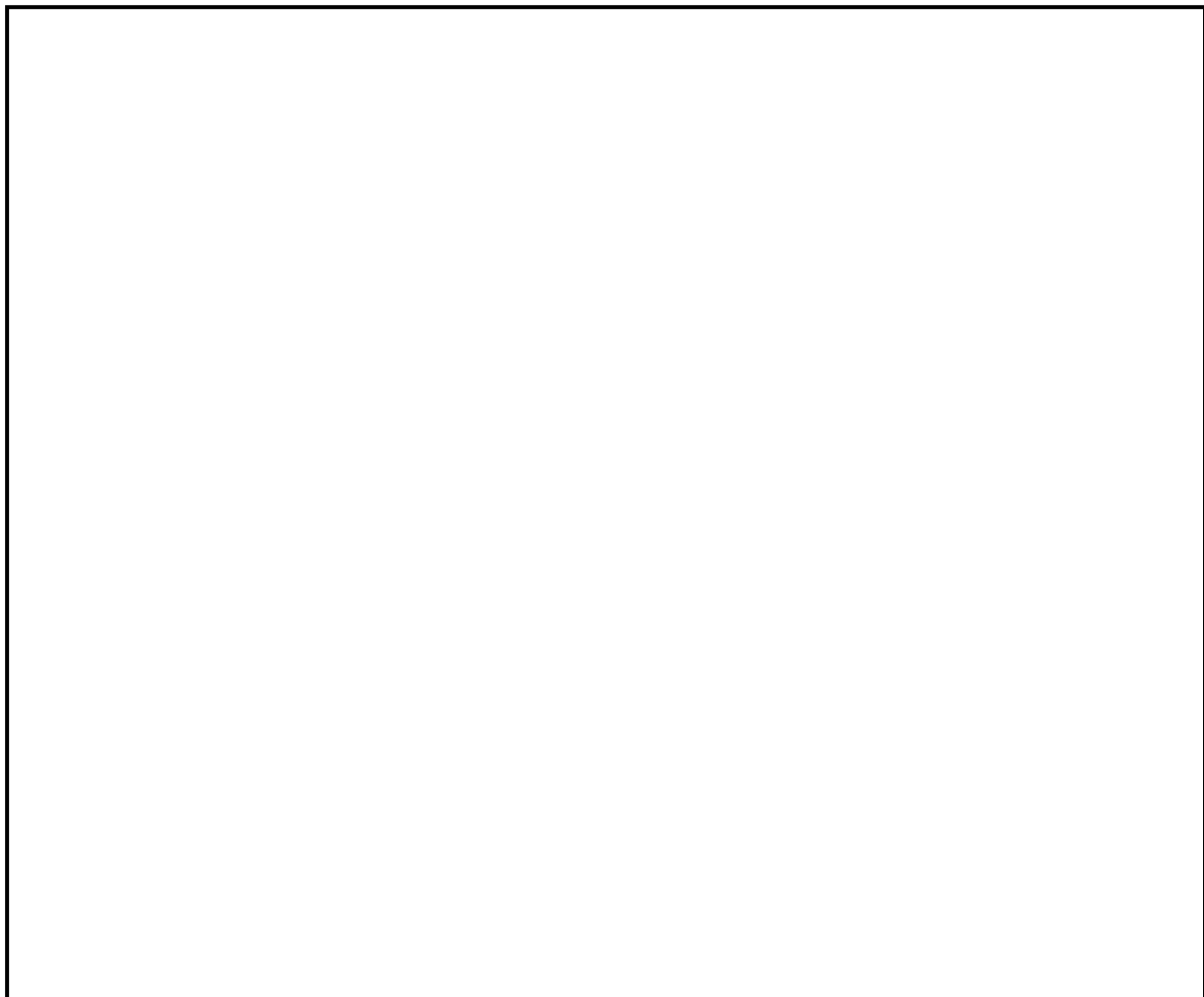


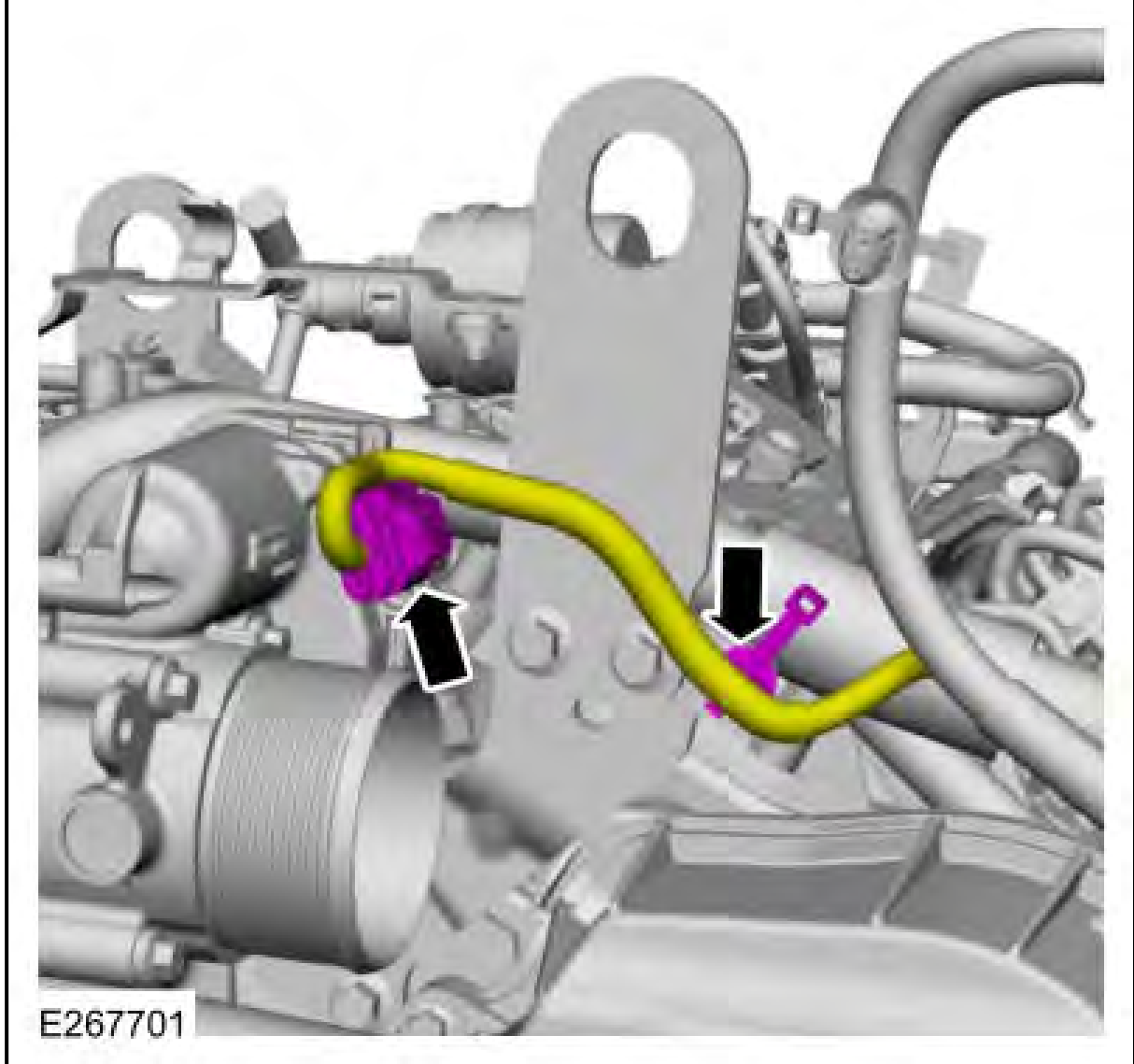
96. Connect the CMP electrical connector and the wire retainer.



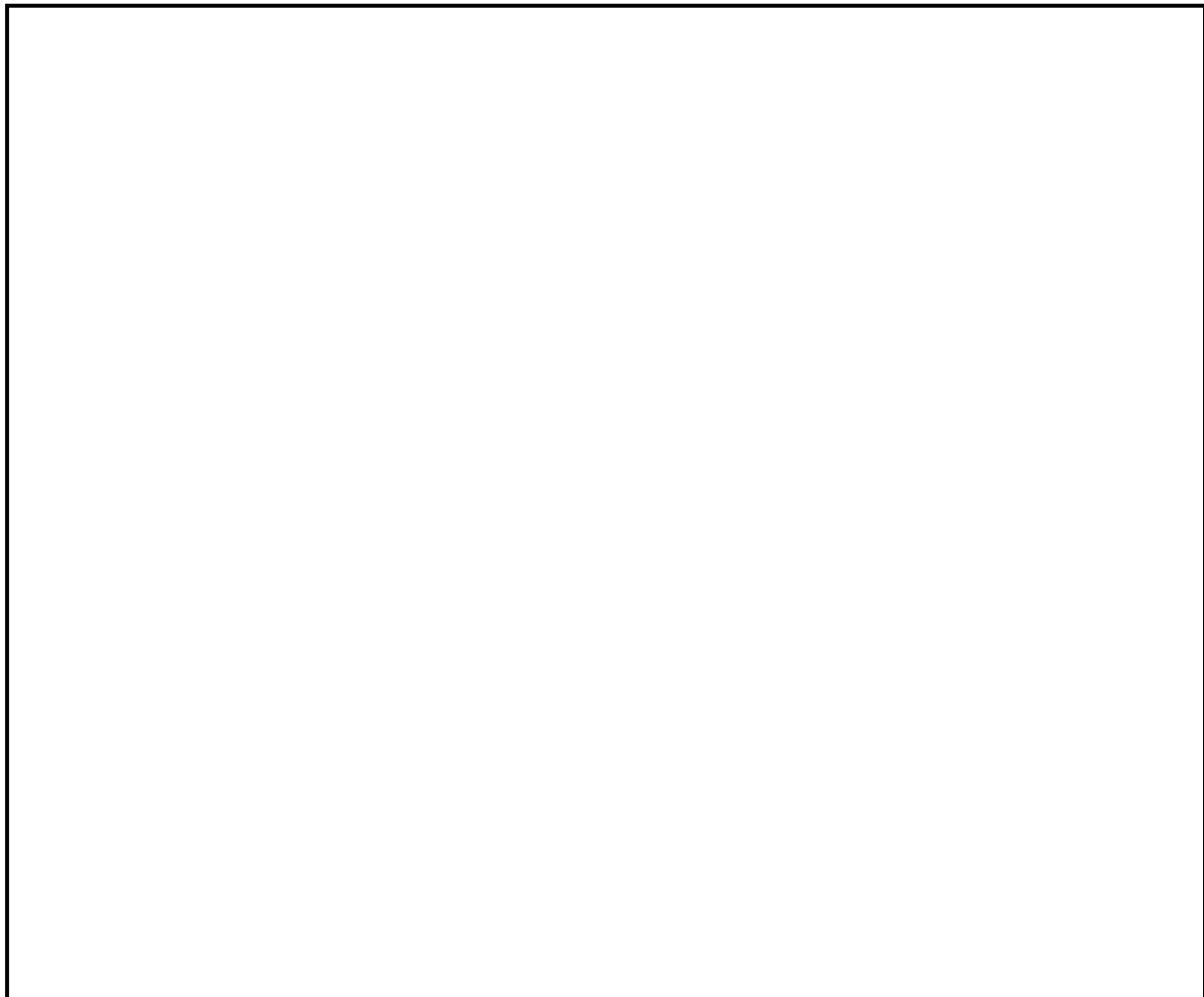


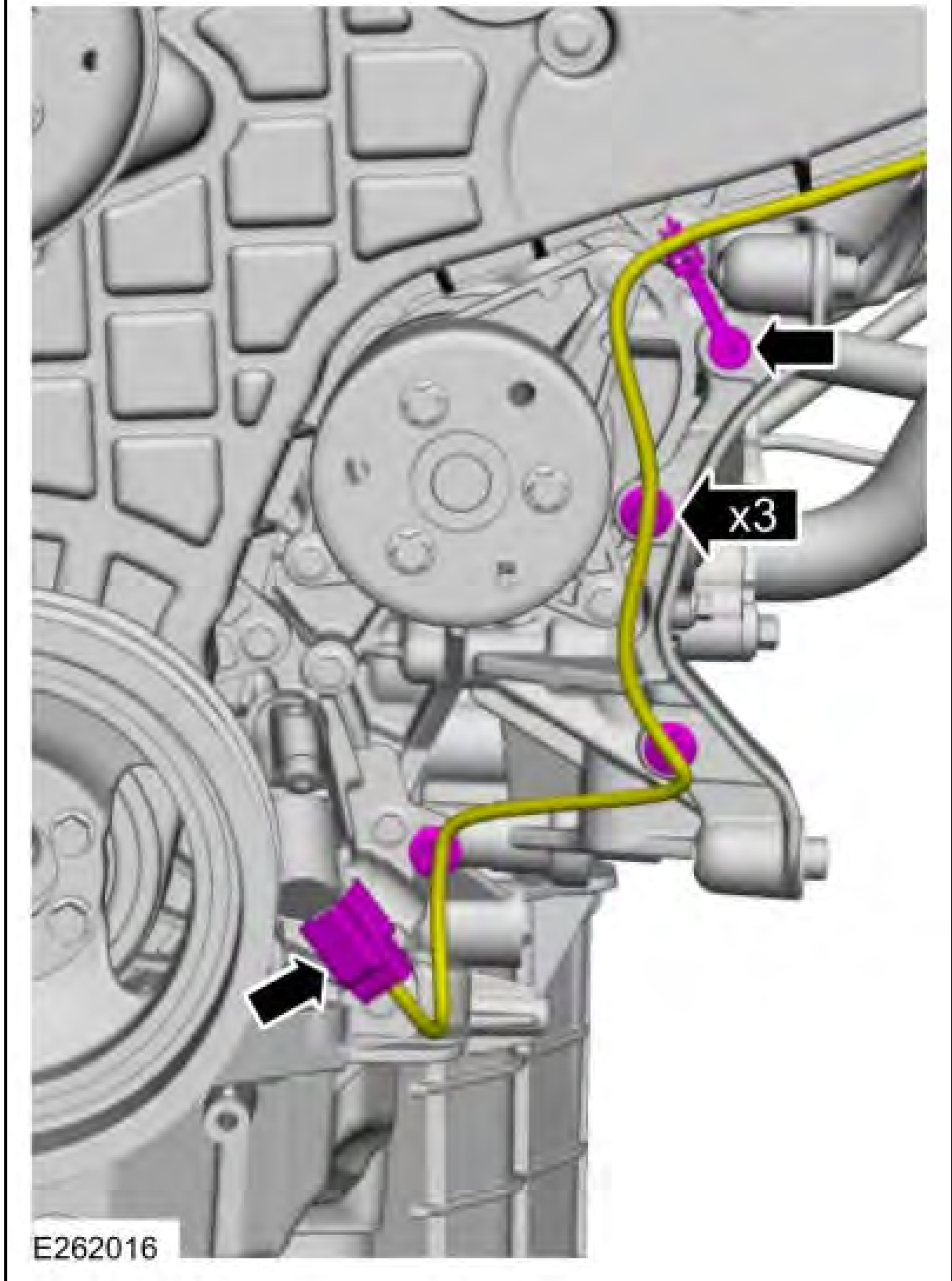
97. Connect the TB (throttle body) electrical connector and the wire retainer.





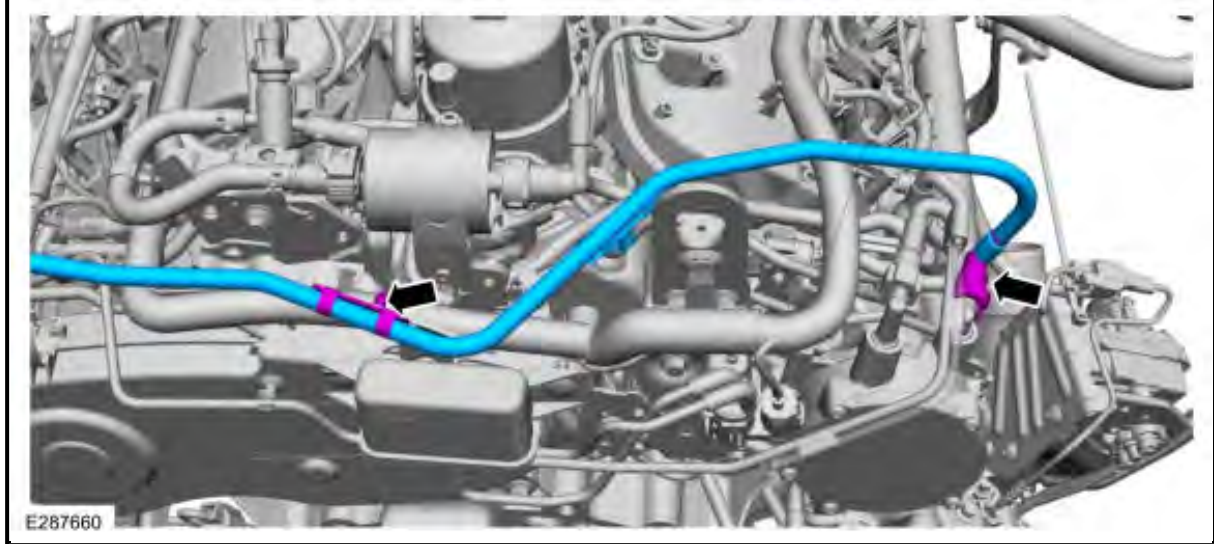
98. Connect the oil pump electrical connector and the wire retainers.



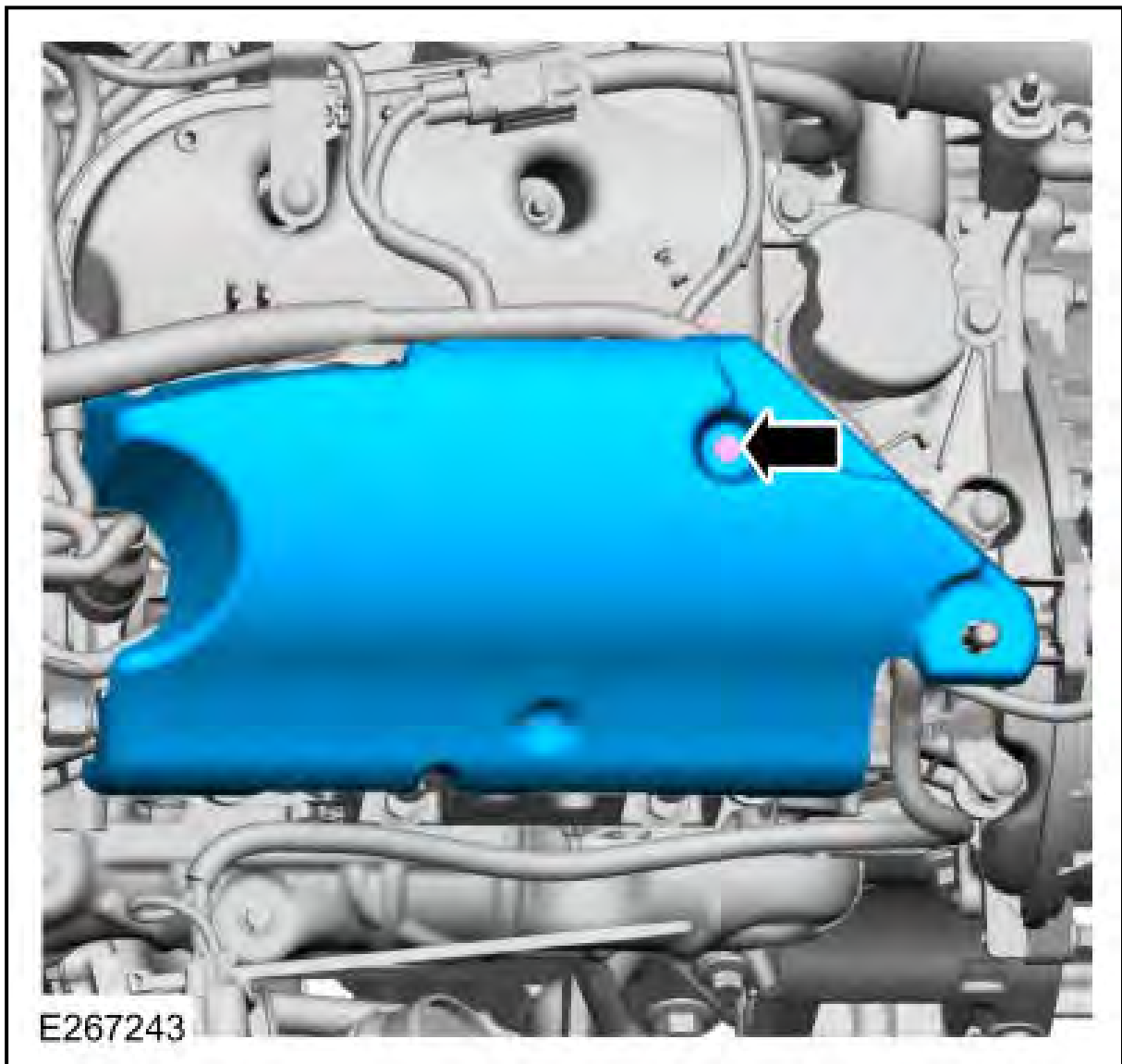


99. Install the brake vacuum hose and connect the retainer. Refer to: [Quick Release Coupling](#) .



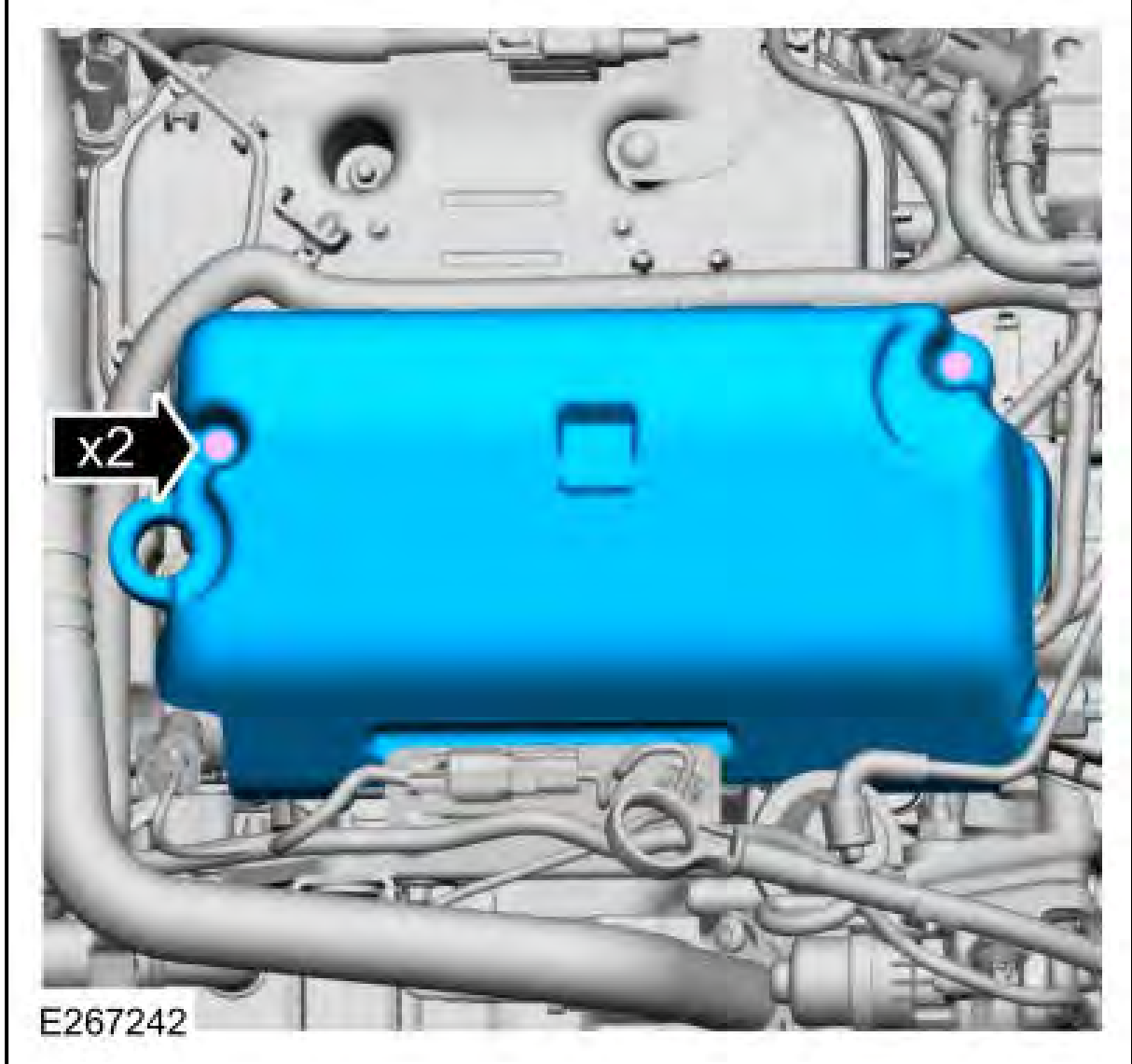


100. Remove the RH fuel injector noise insulator.

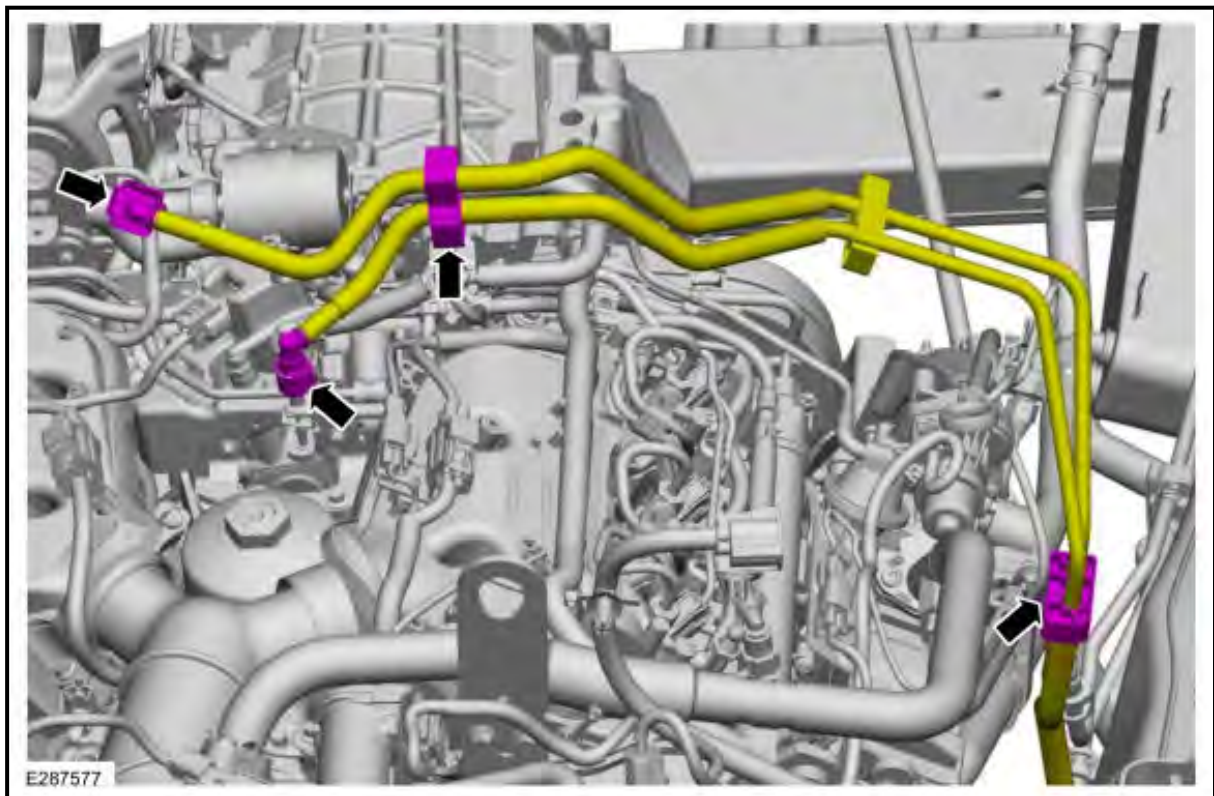


101. Install the LH fuel injector noise insulator.





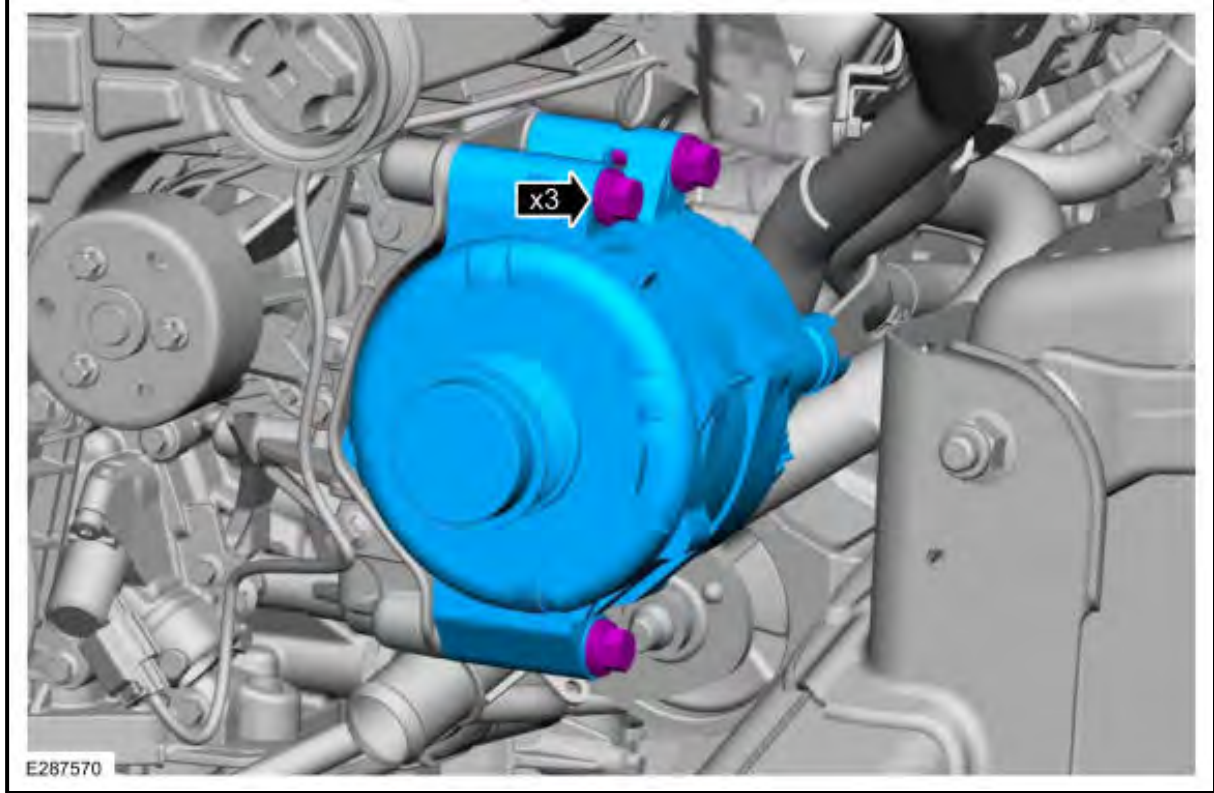
102. Position back and connect the fuel tubes. Refer to: [Quick Release Coupling](#) .



103. Install the generator and the bolts.

Torque: 35 lb.ft (48 Nm)

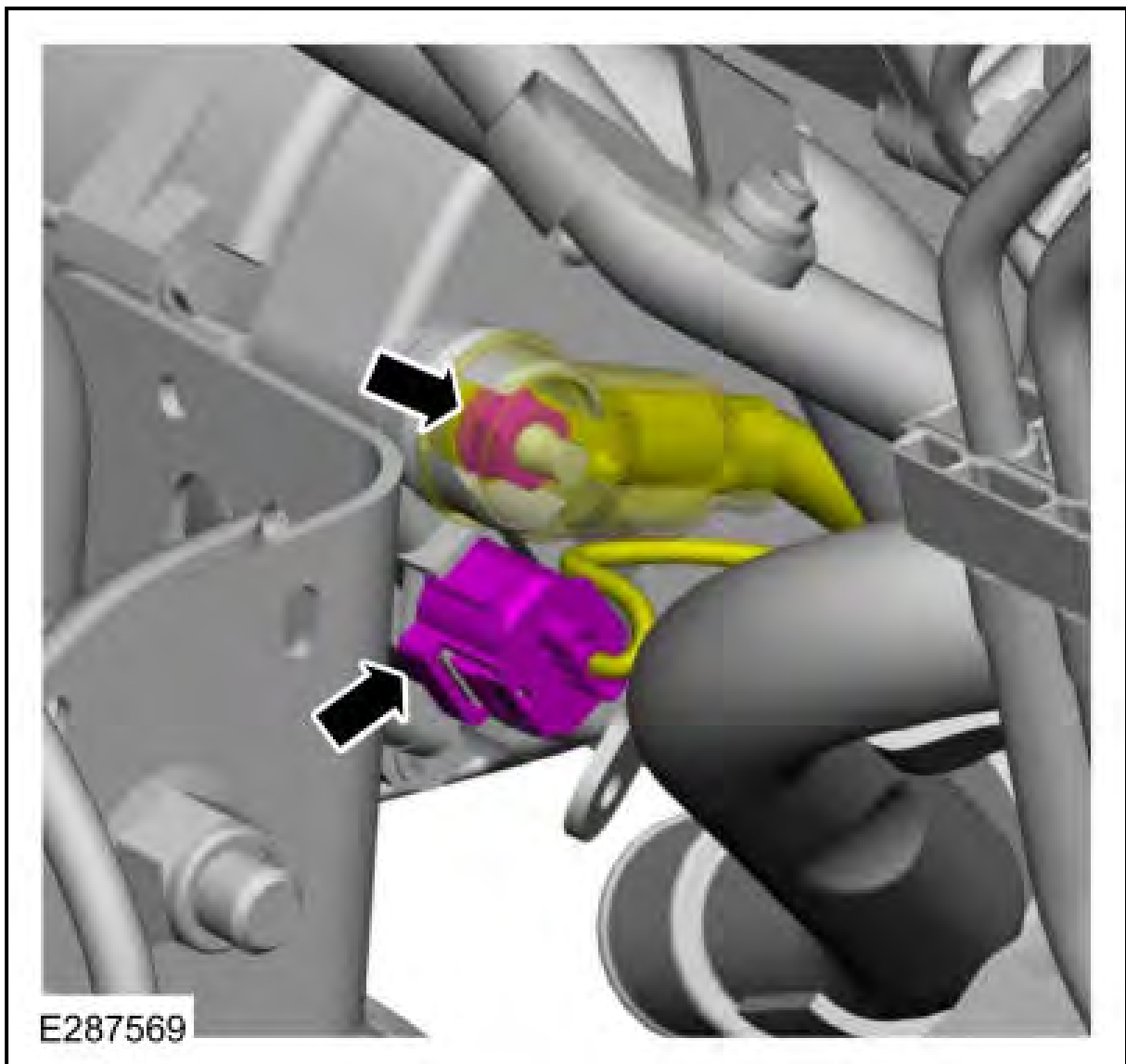




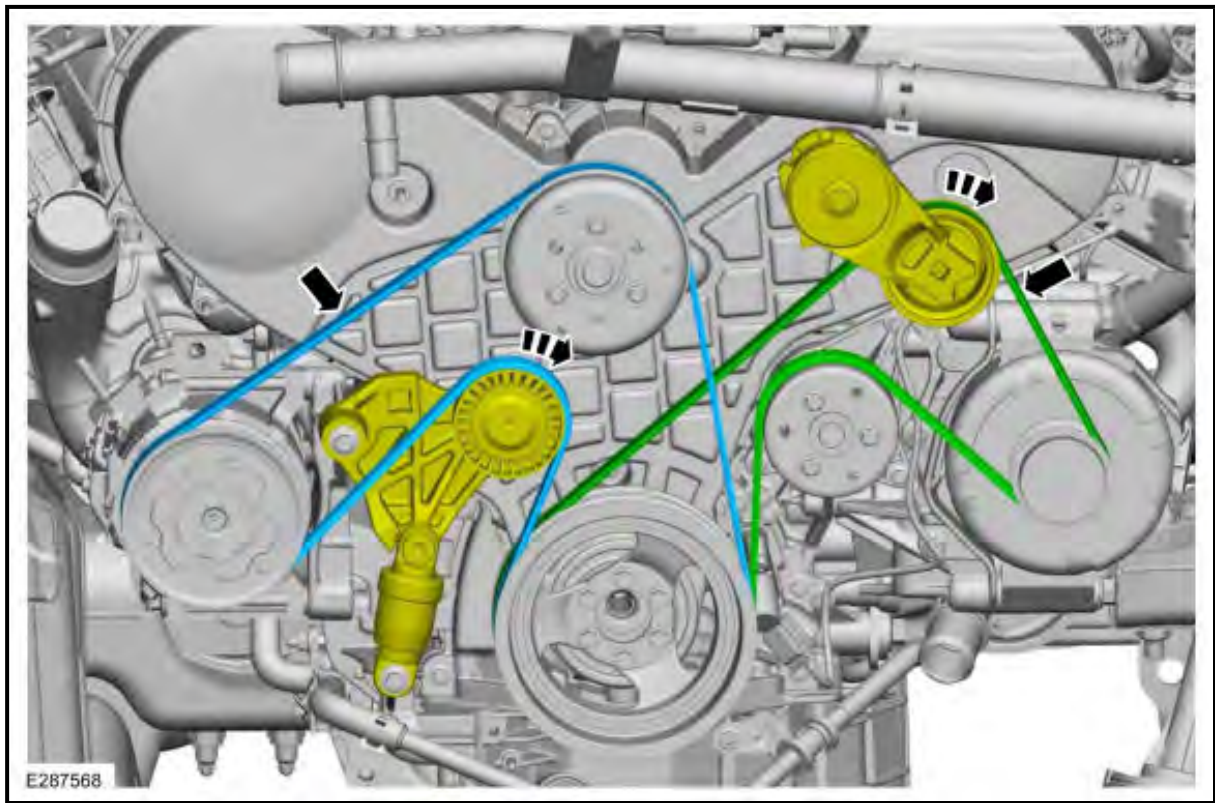
104. **NOTE:** When installing the B+ terminal nut to the generator, finger-start the nut before tightening or component damage may occur.

Connect the electrical connector and the generator output wire.

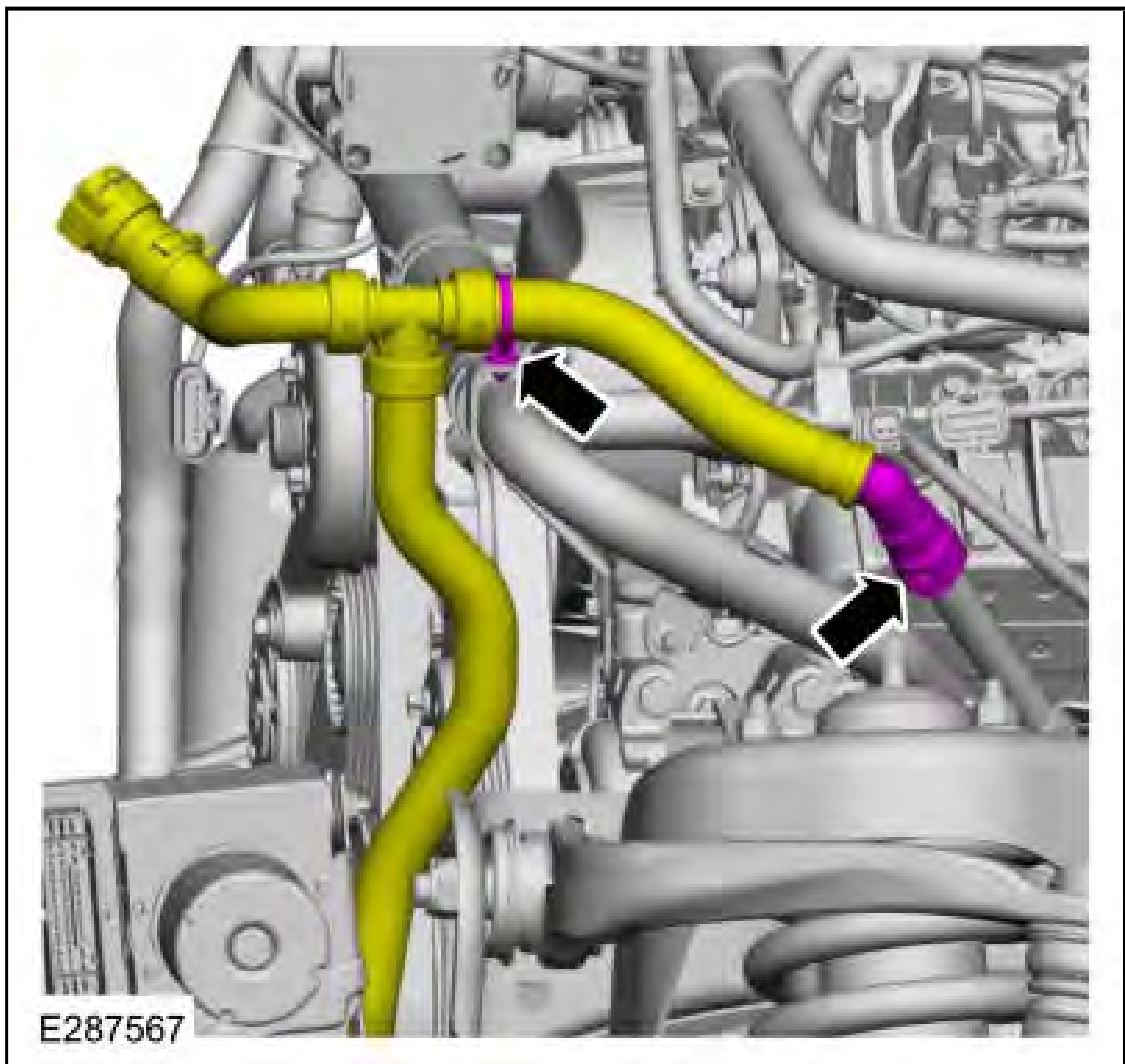
Torque: 159 lb.in (18 Nm)



105. Install the accessory drive belt and the A/C belt.

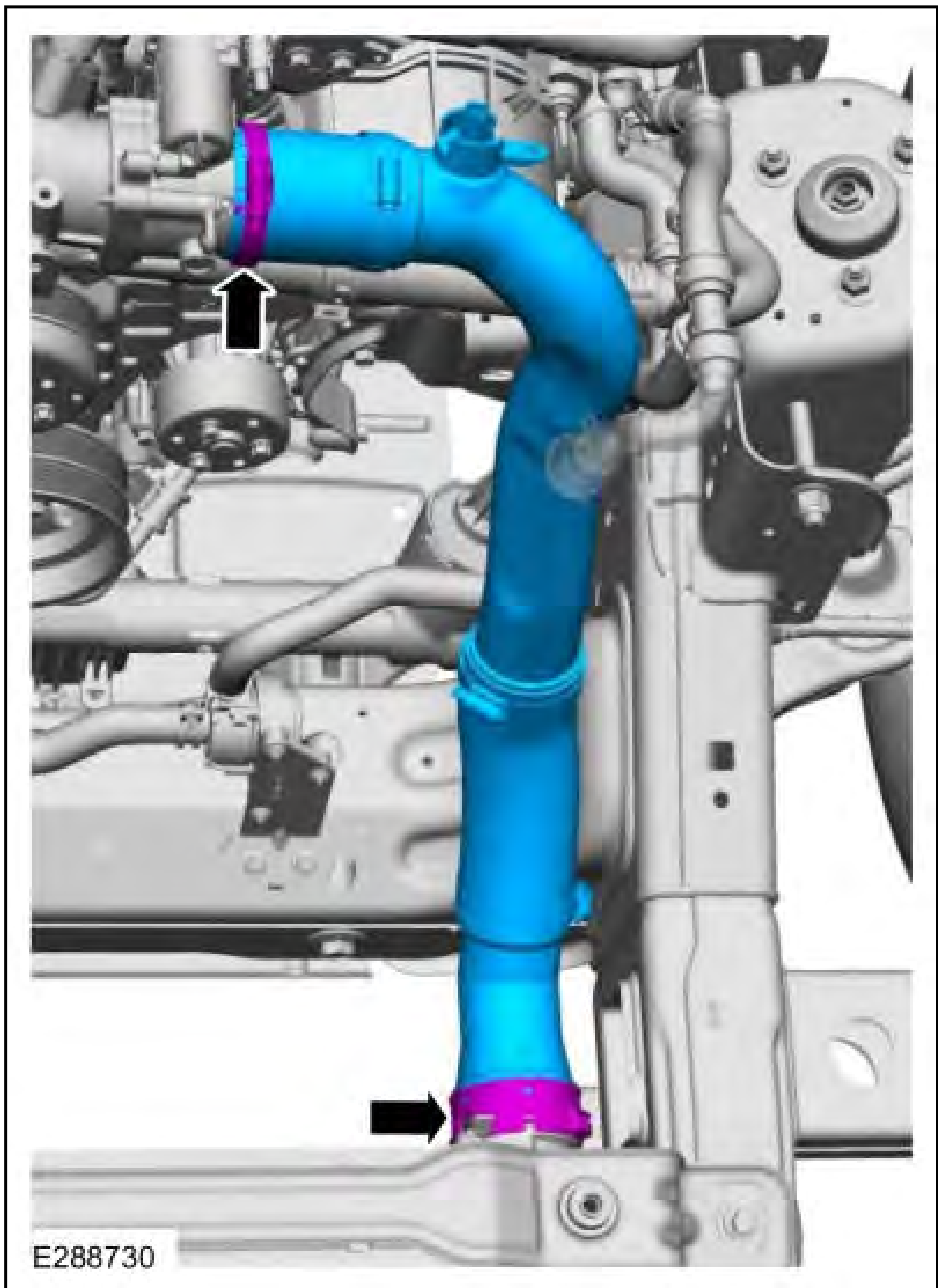


106. Connect the coolant hose connector and the retainer.

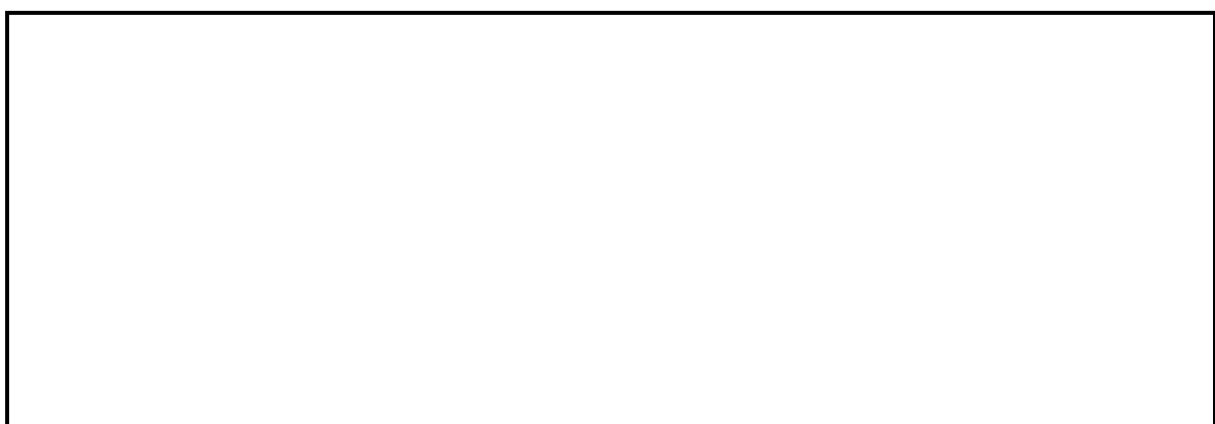


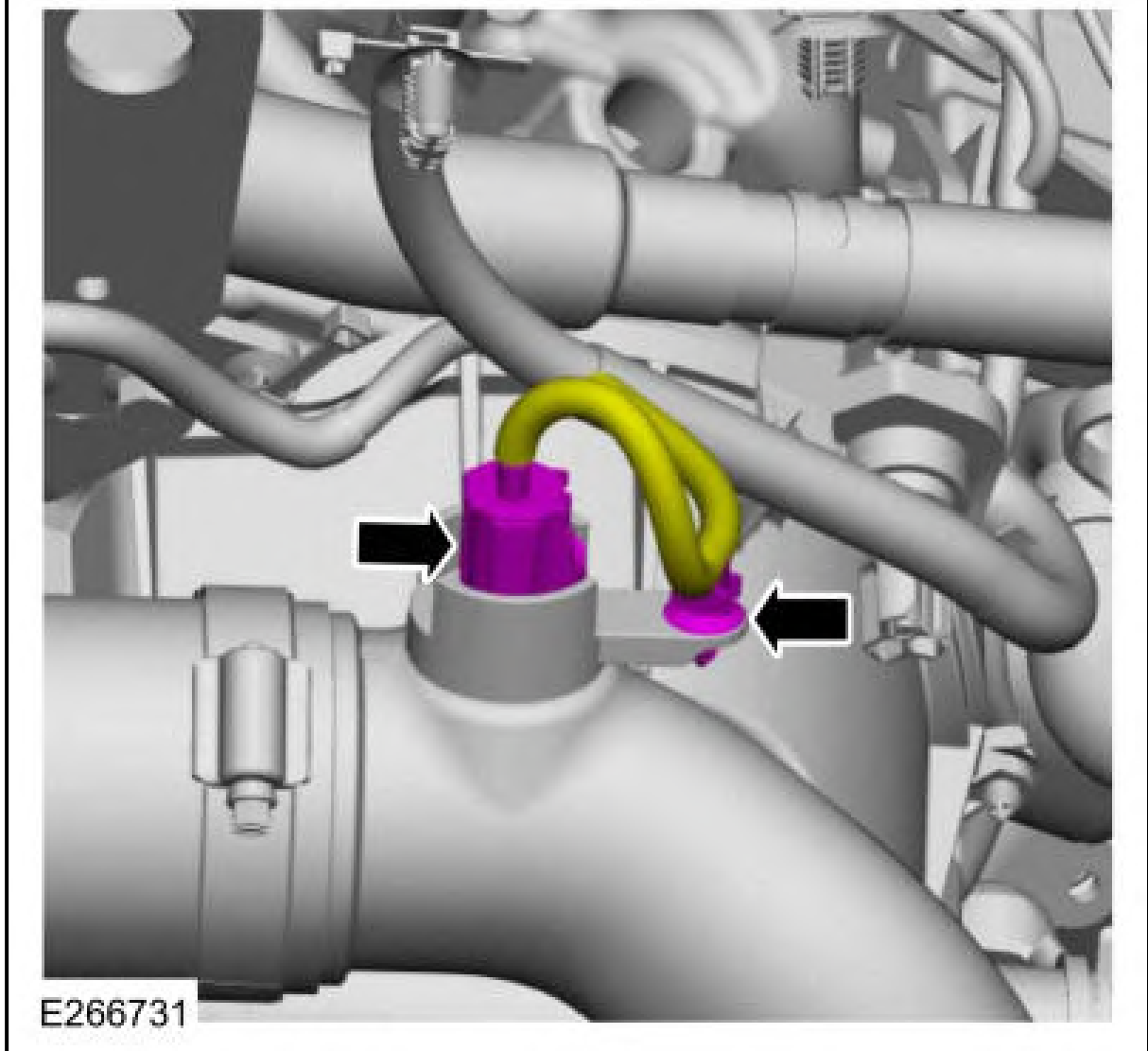
107. Inspect the turbocharger or engine air intake system components and clean, if necessary.

108. Install the LH CAC intake pipe and the clip. Tighten the clamp.

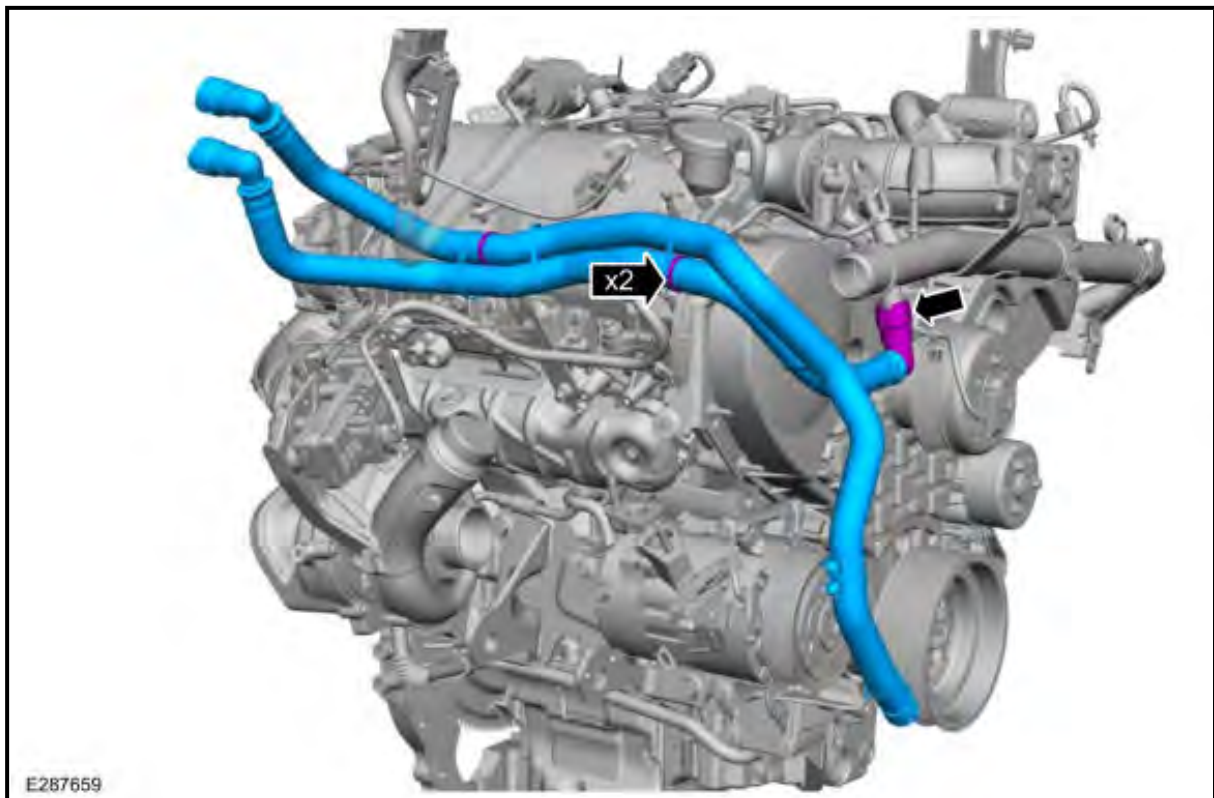


109. Connect the electrical connector and the wire retainer.

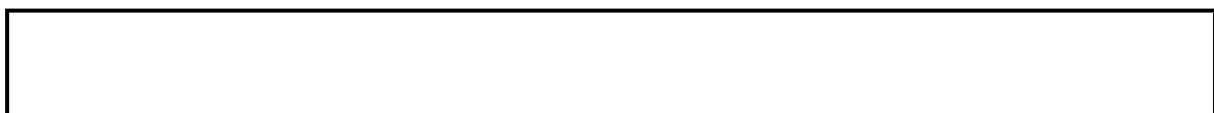


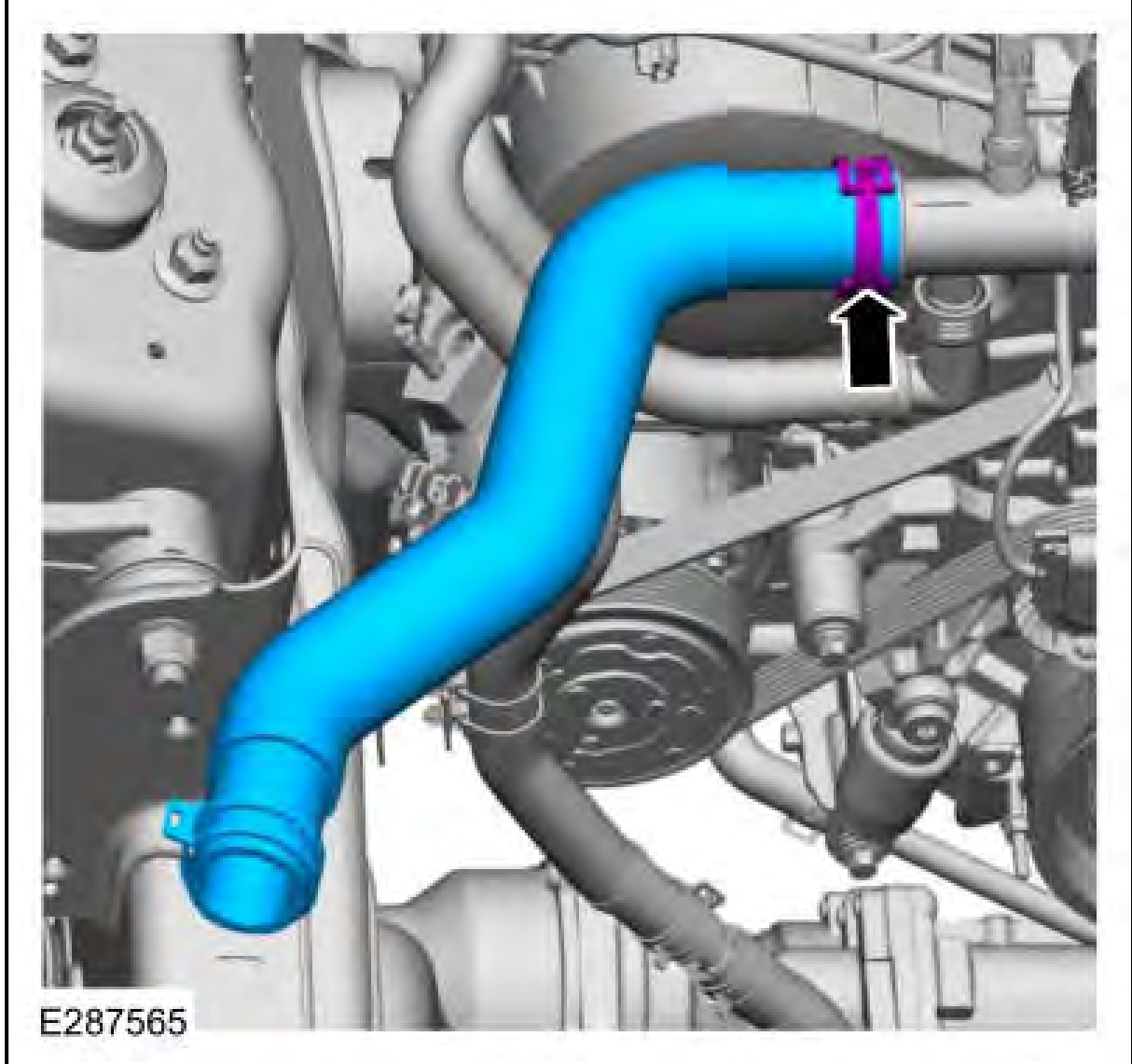


110. Install the coolant hoses and connect the coolant hose connector.



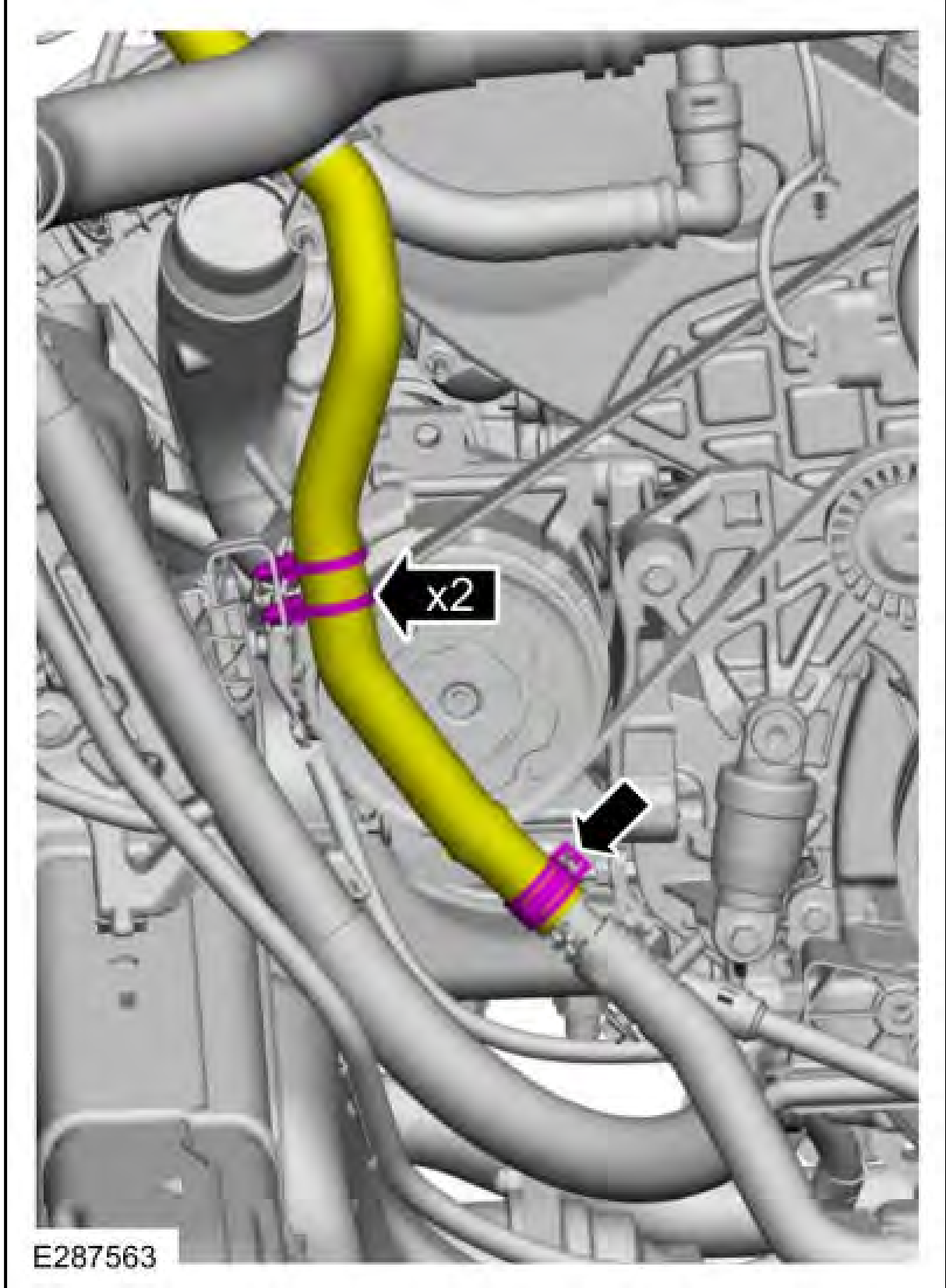
111. Install the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer





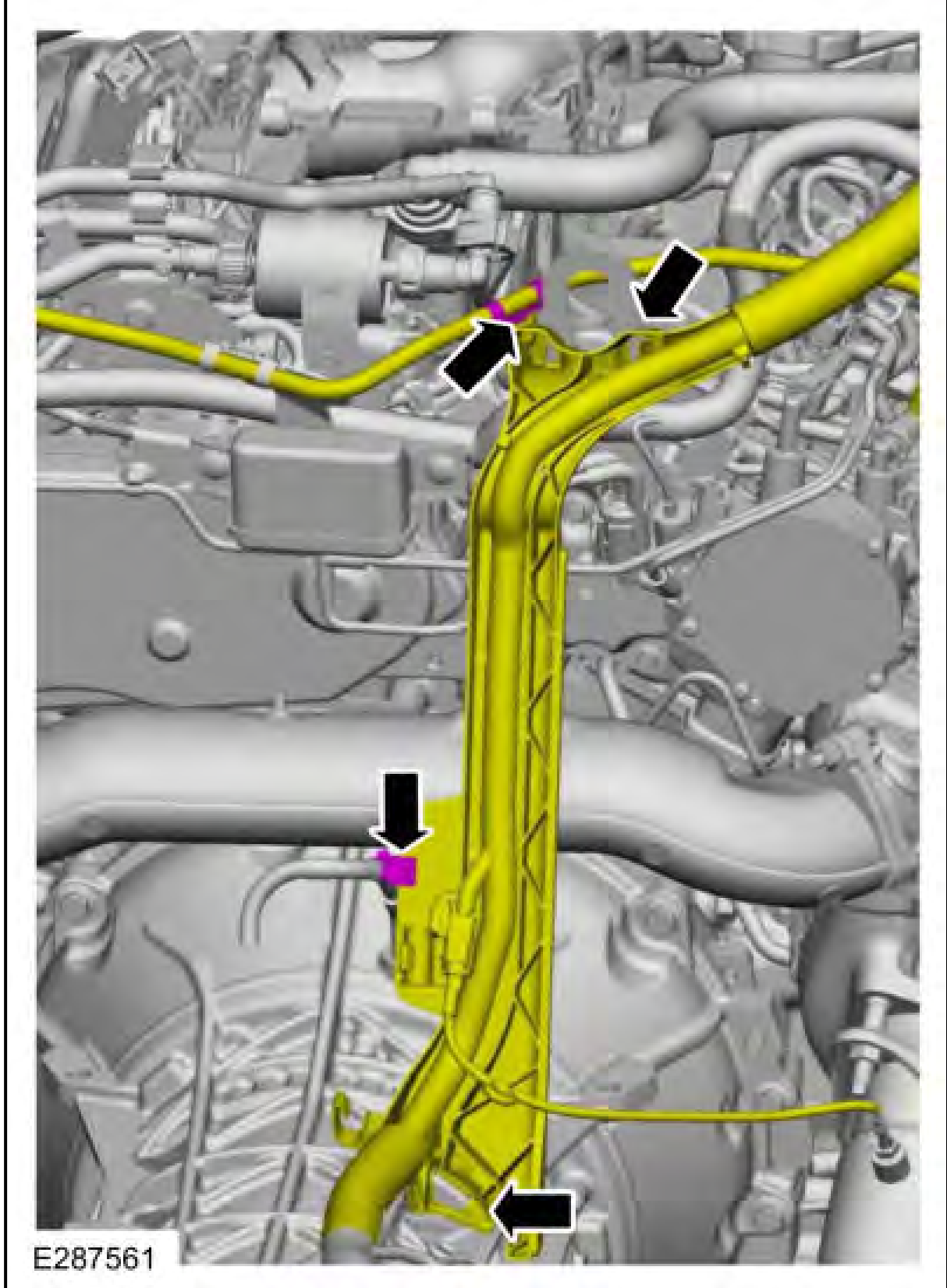
112. Position back the coolant hose and connect the retainers. Connect the coolant hose. Use the General Equipment: Hose Clamp Remover/Installer





113. Position back the wire harness housing. Connect the vacuum hose retainer and the transmission vent tube.

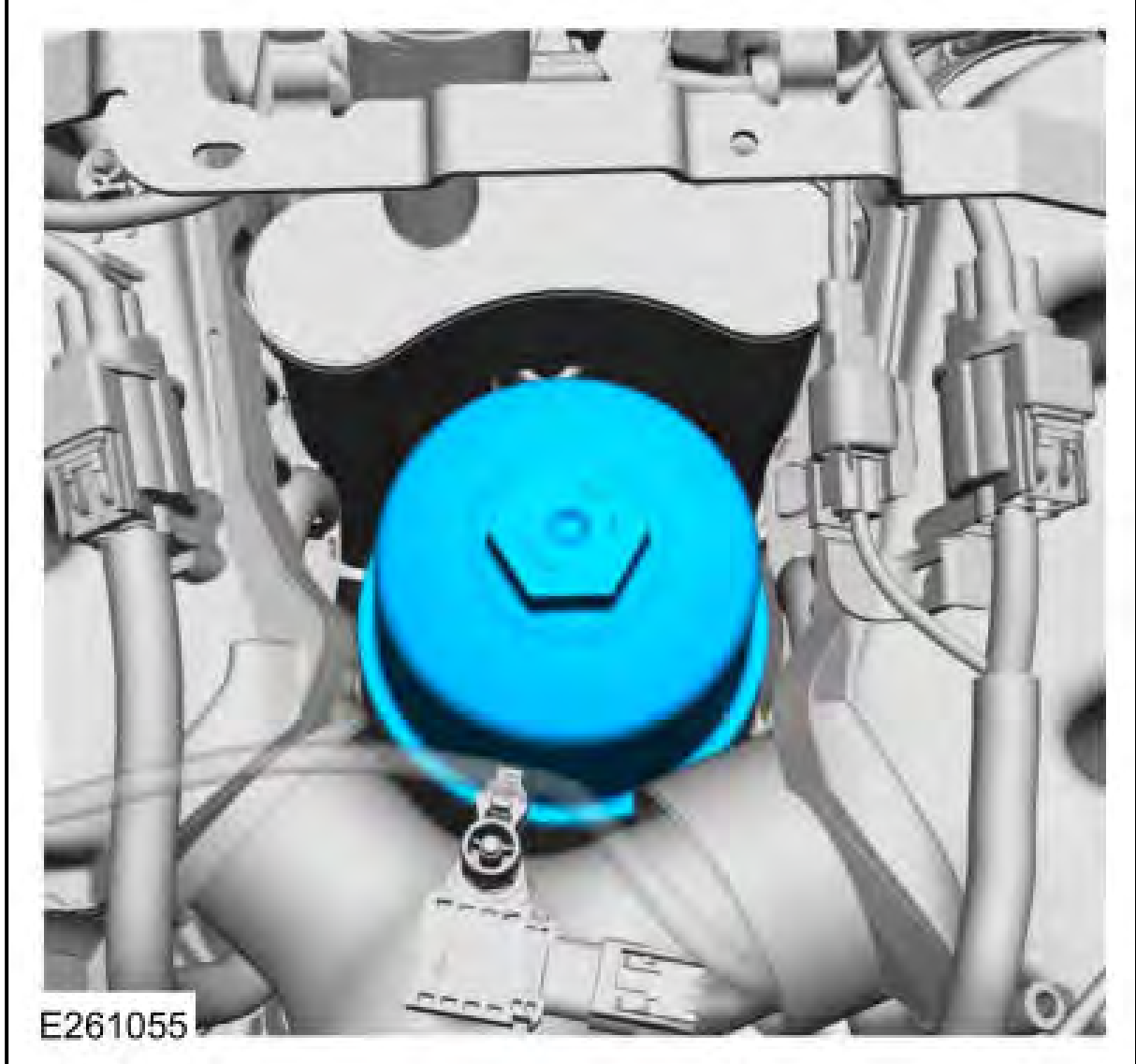




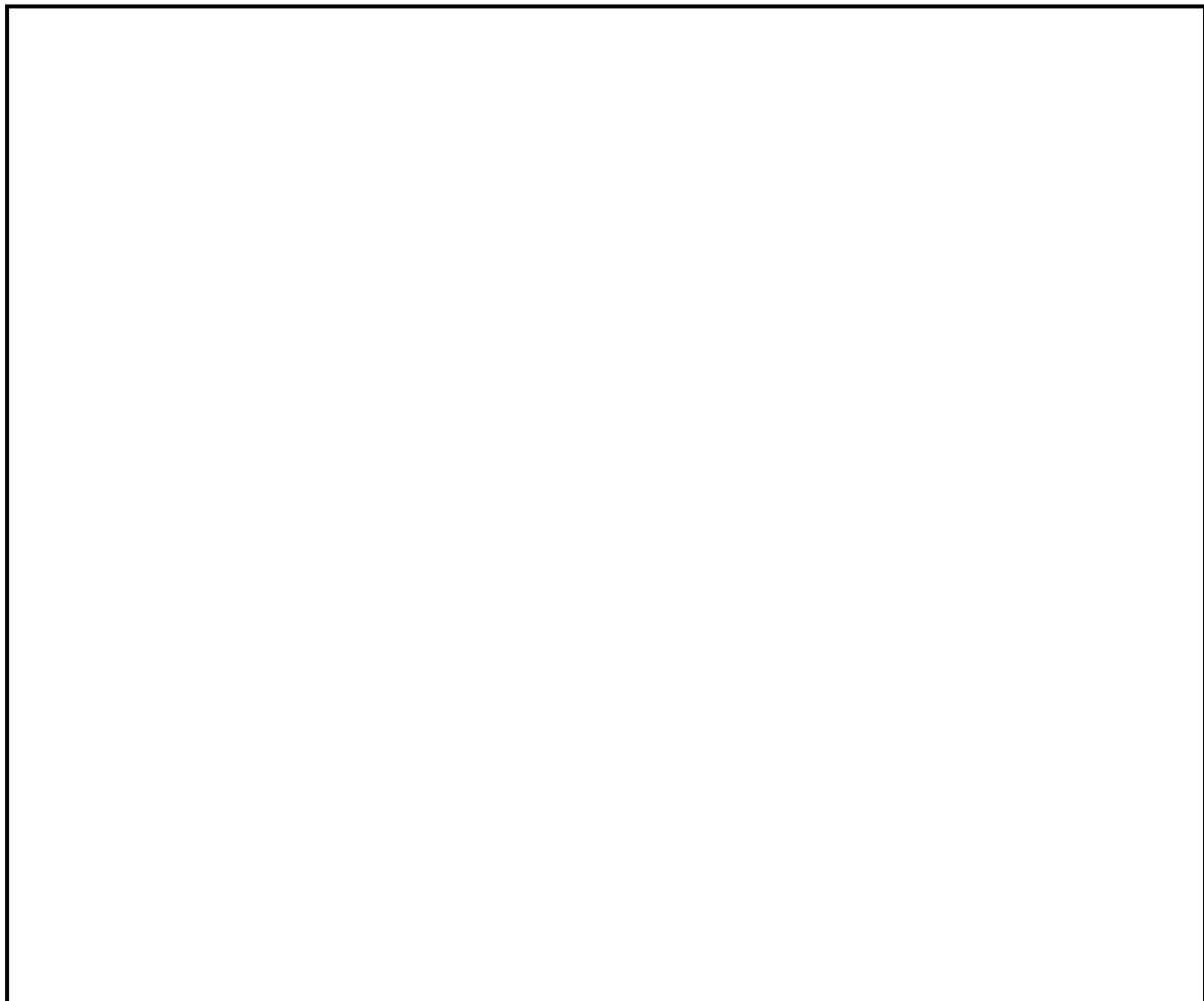
114. **NOTE:** The oil filter housing needs a minimum of 1 minute to allow the oil to drain out of the oil filter housing to minimise oil spillage.

Loosen the oil filter cap and let the oil filter housing drain. Remove the oil filter cap.

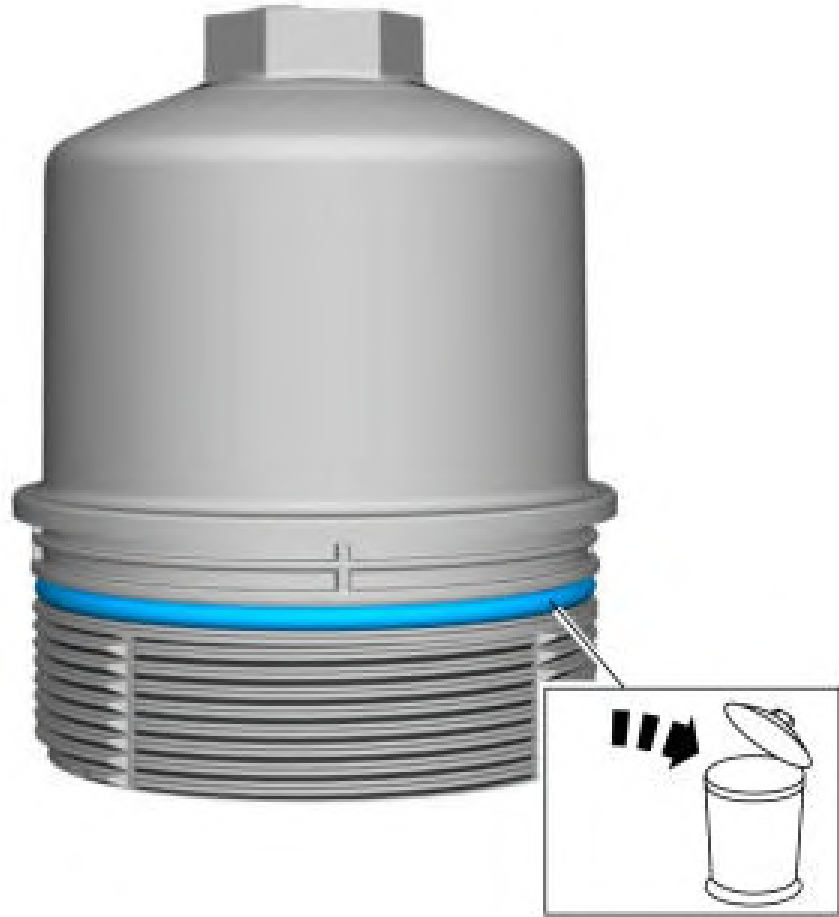




115. Remove and discard the oil filter cap O-ring seal.

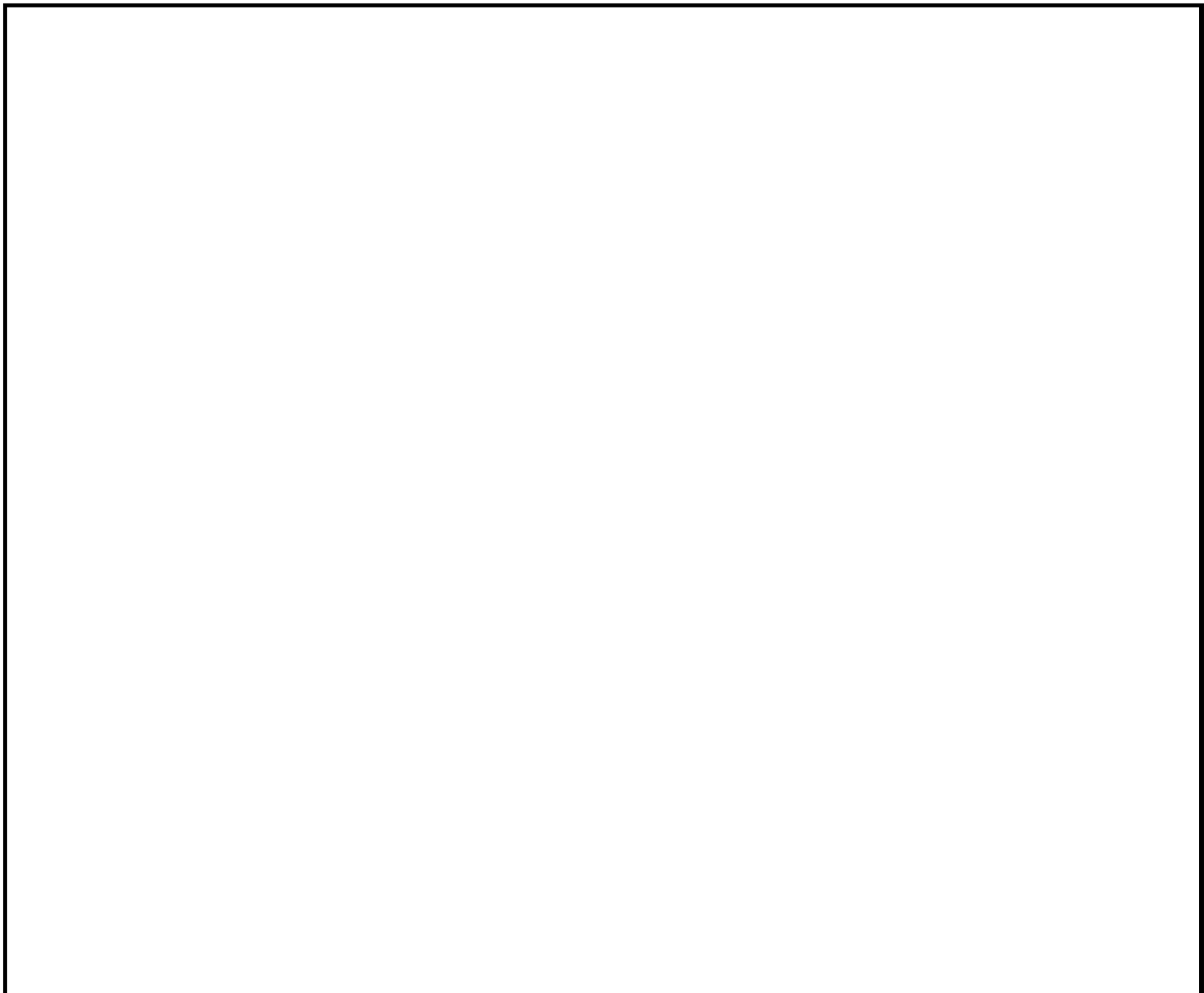


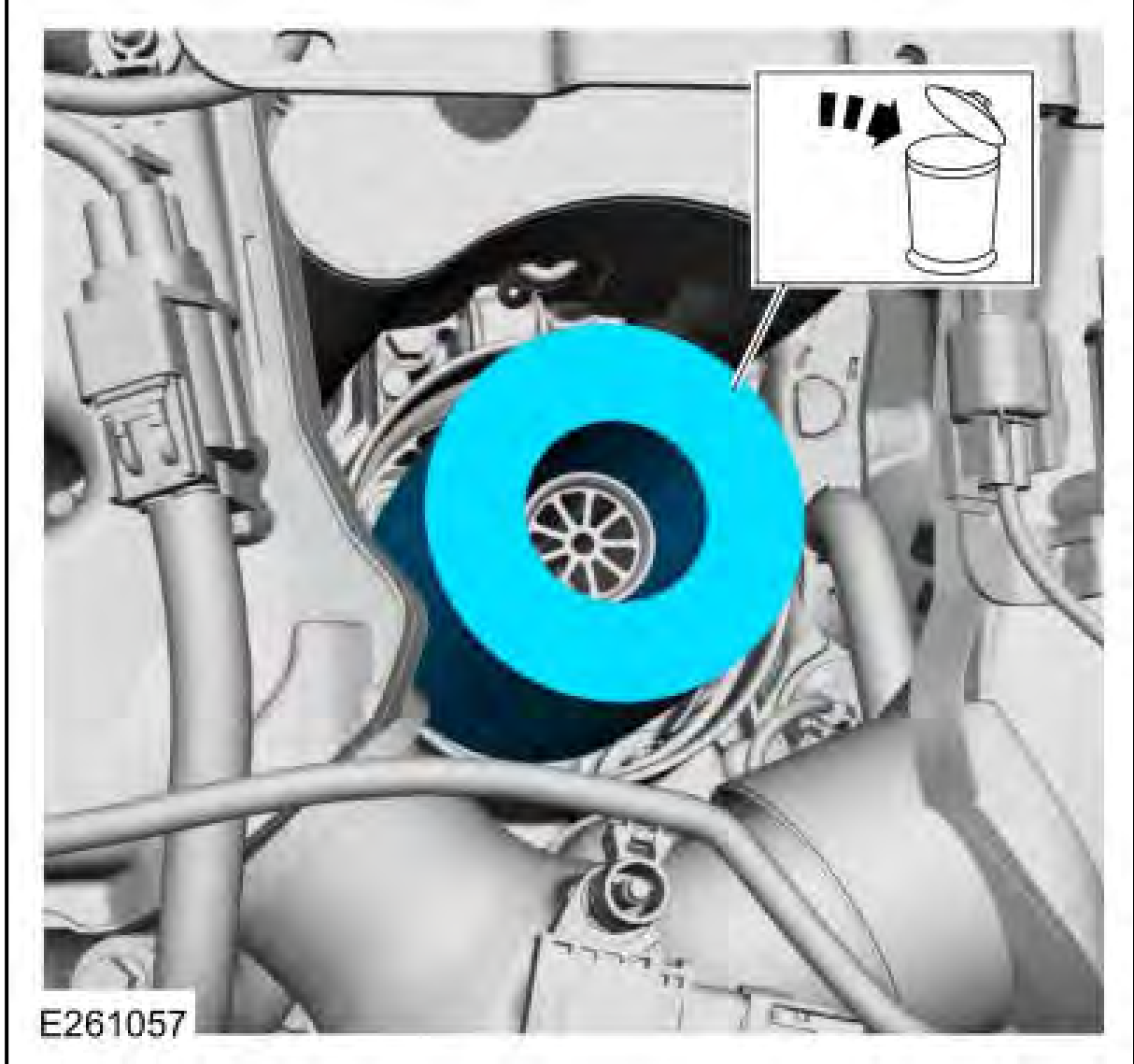




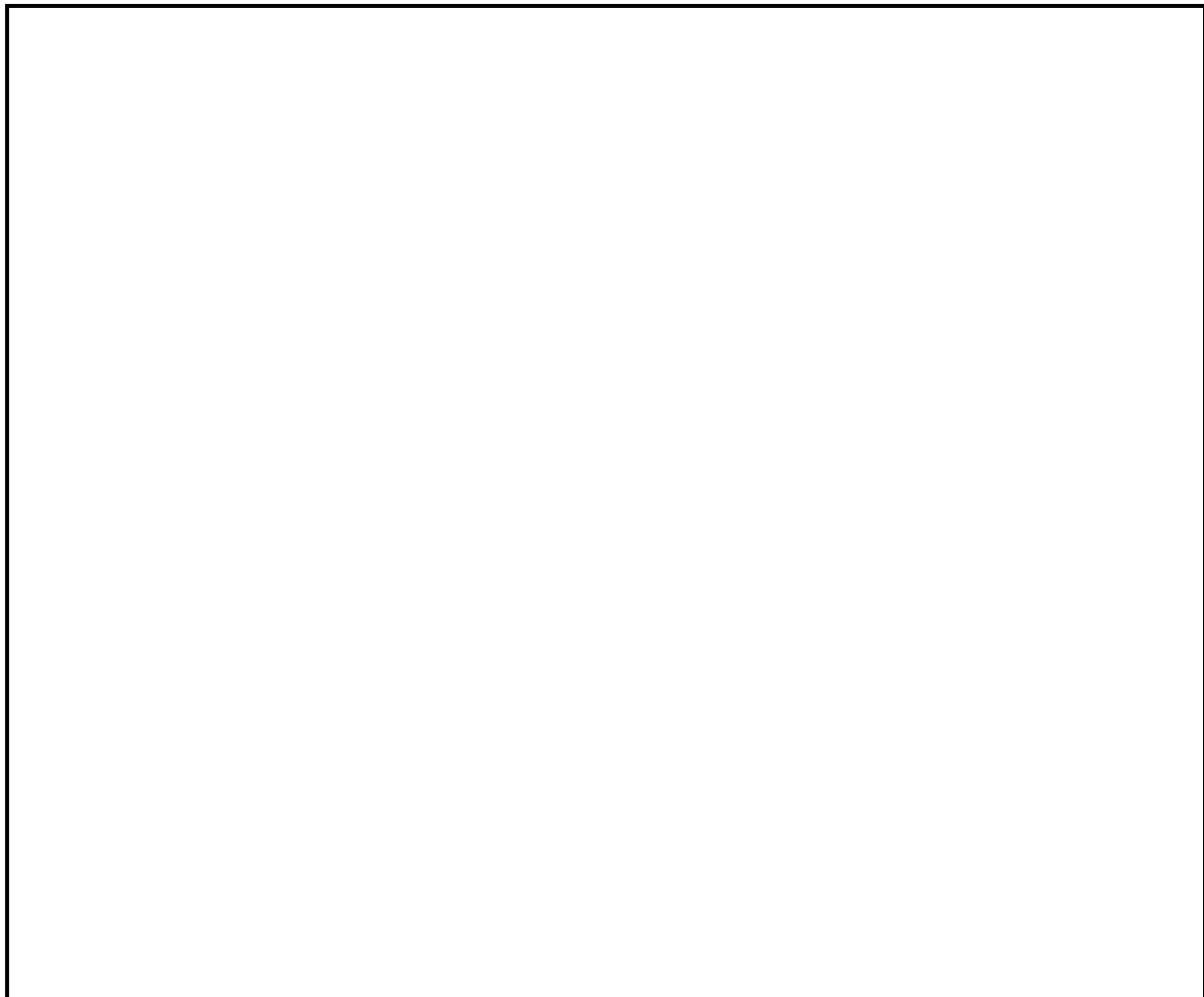
E261056

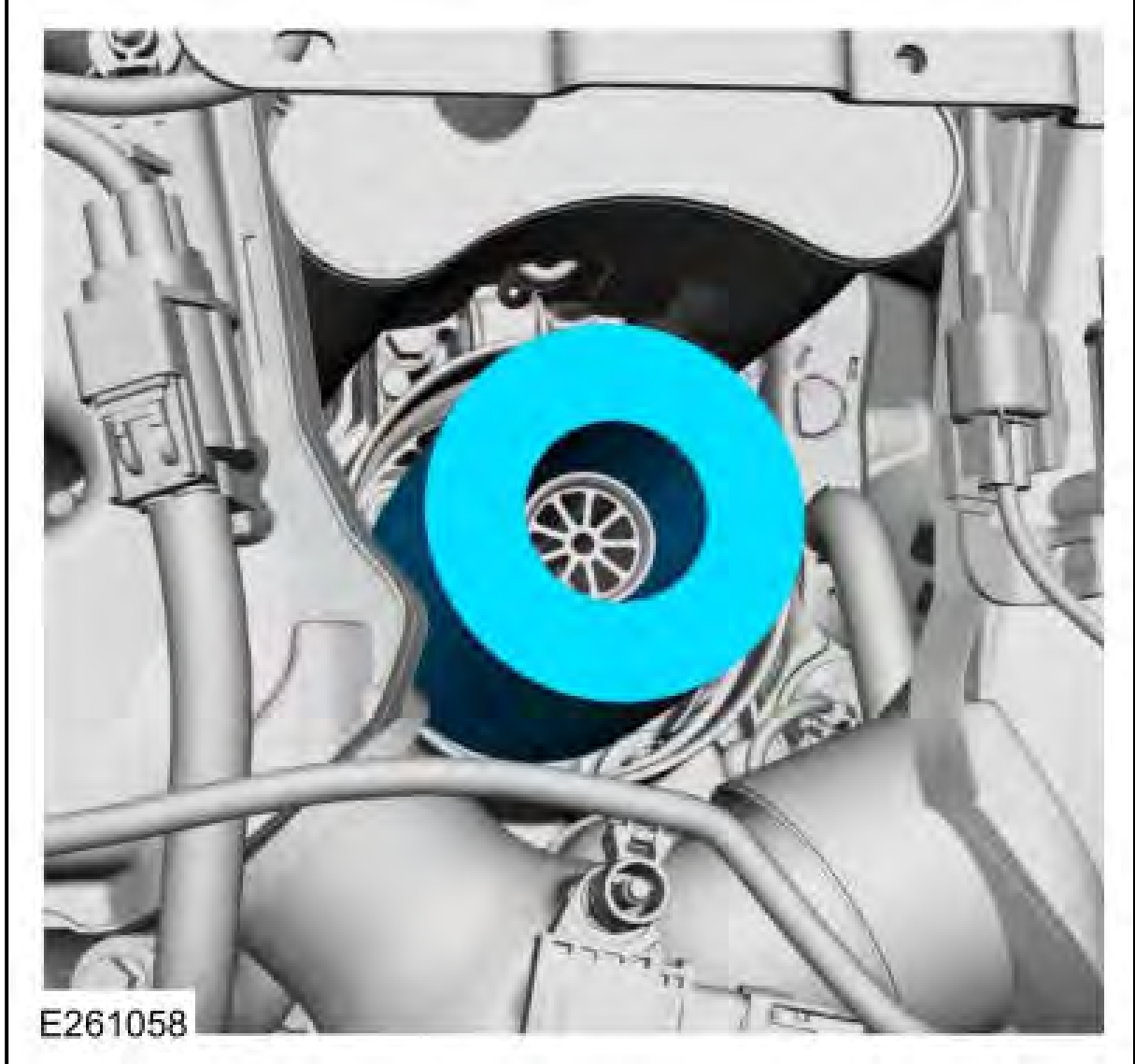
116. Remove and discard the oil filter. Use the General Equipment: Oil Drain Equipment





117. Install a new oil filter.

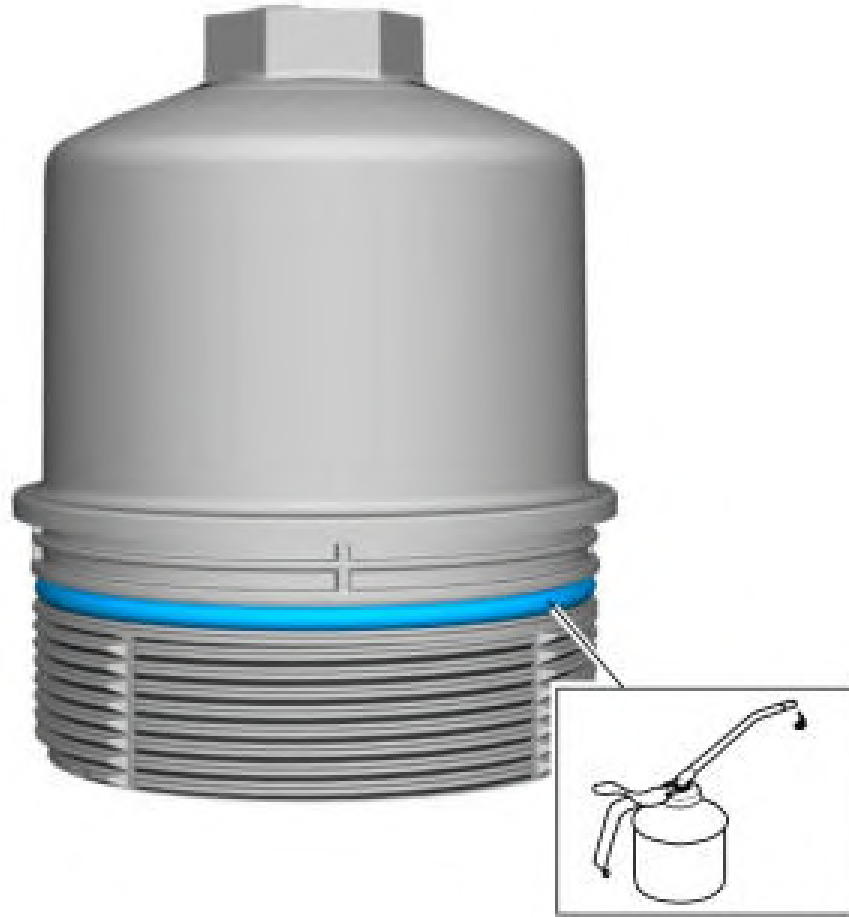




118. Install a new oil filter cap O-ring seal and lubricate.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

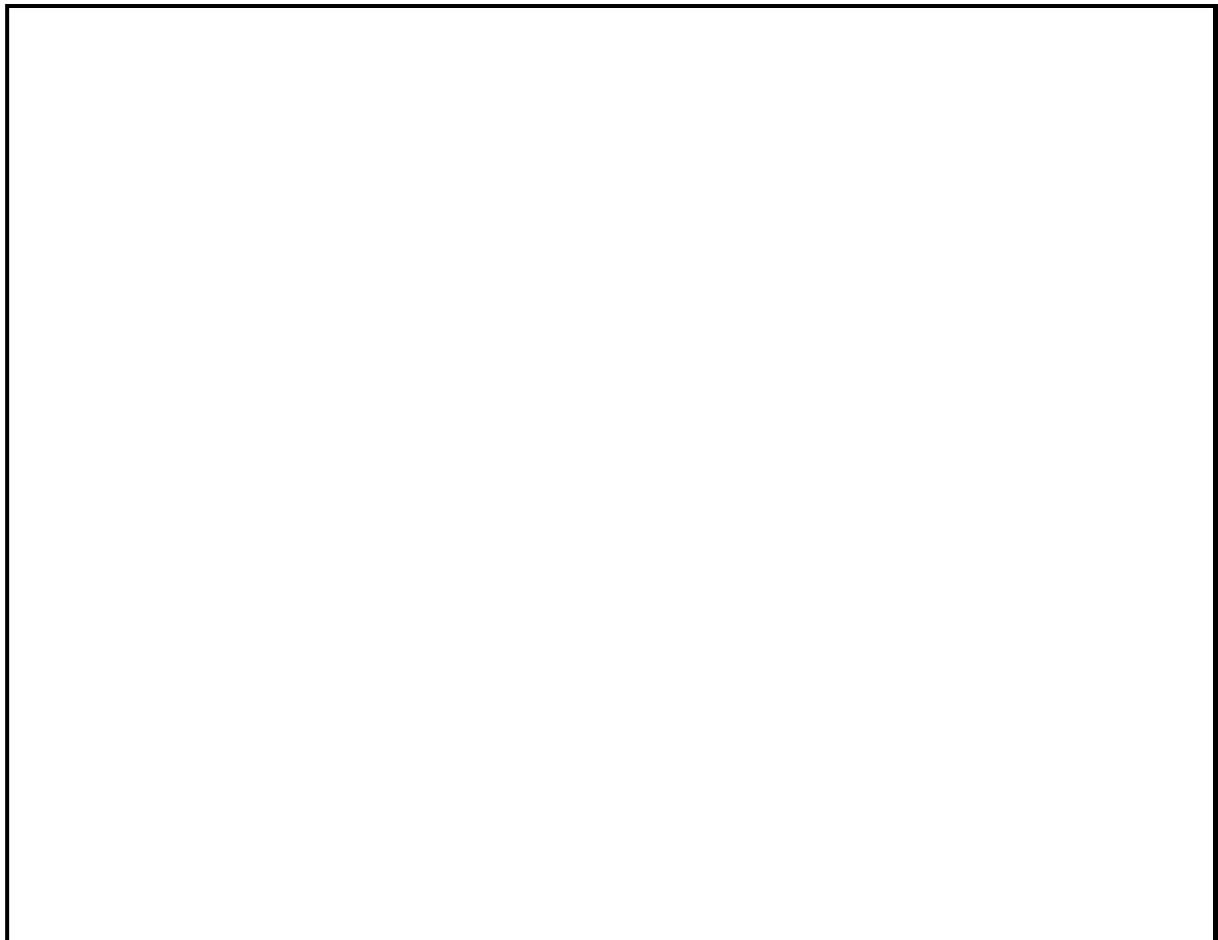


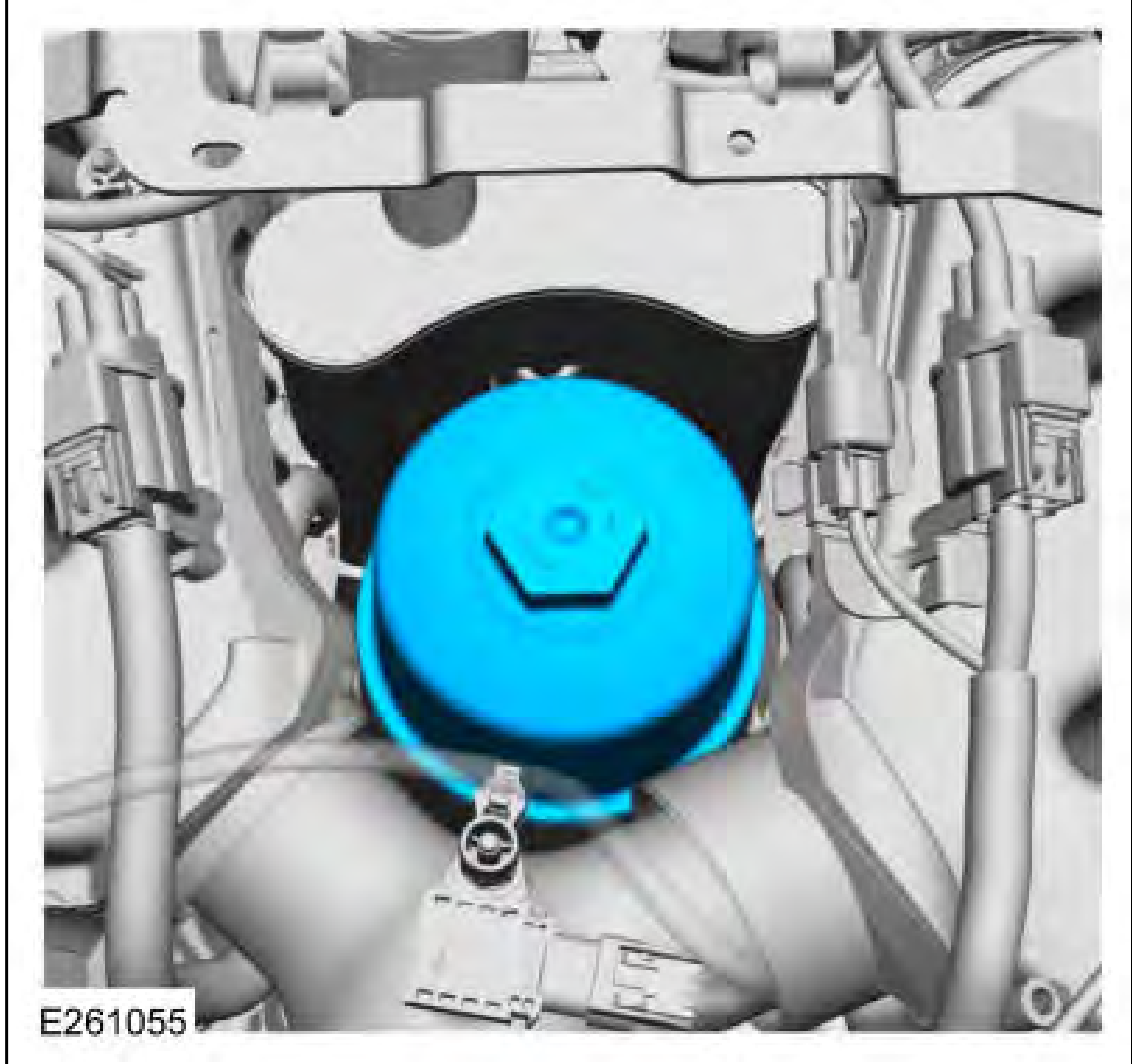


E261059

119. Install the oil filter cap.

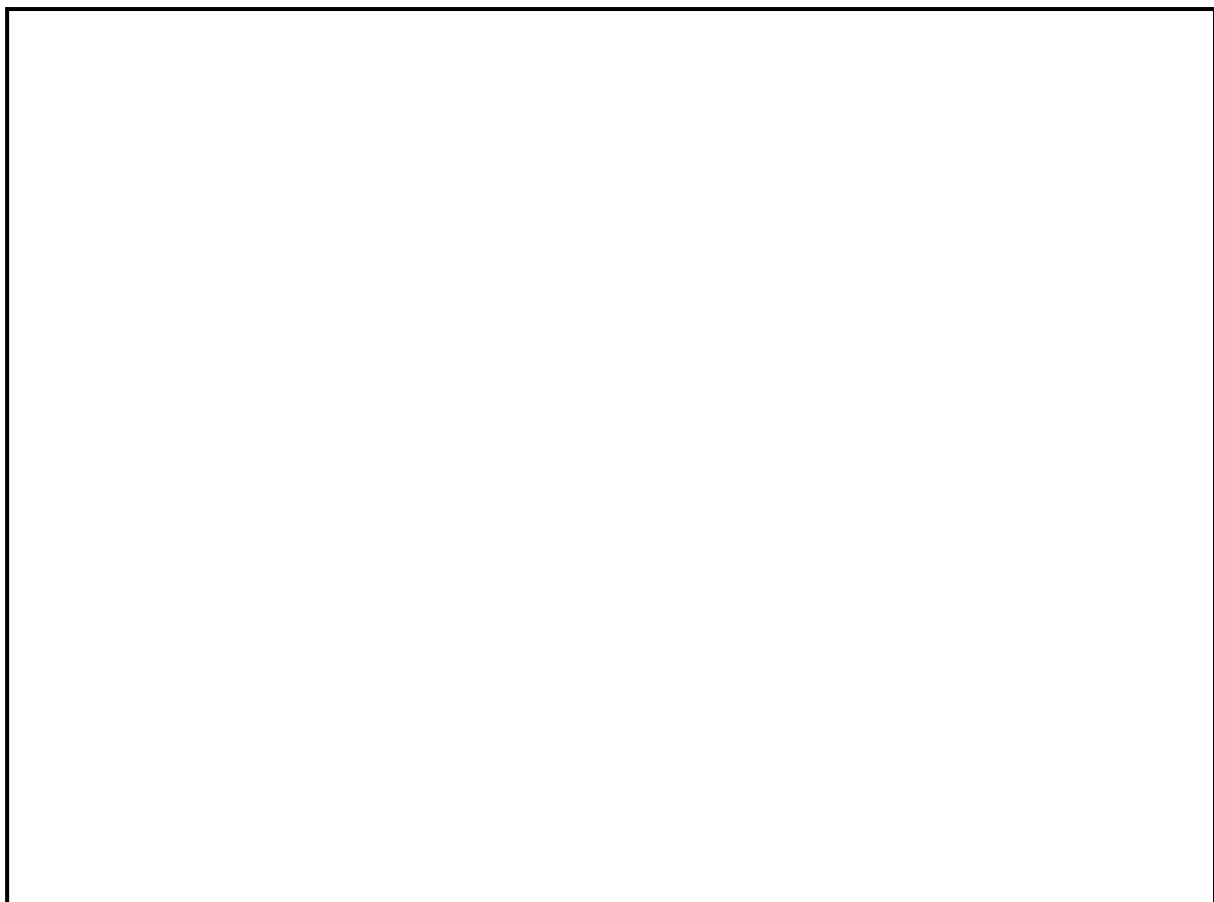
Torque: 18 lb.ft (25 Nm)

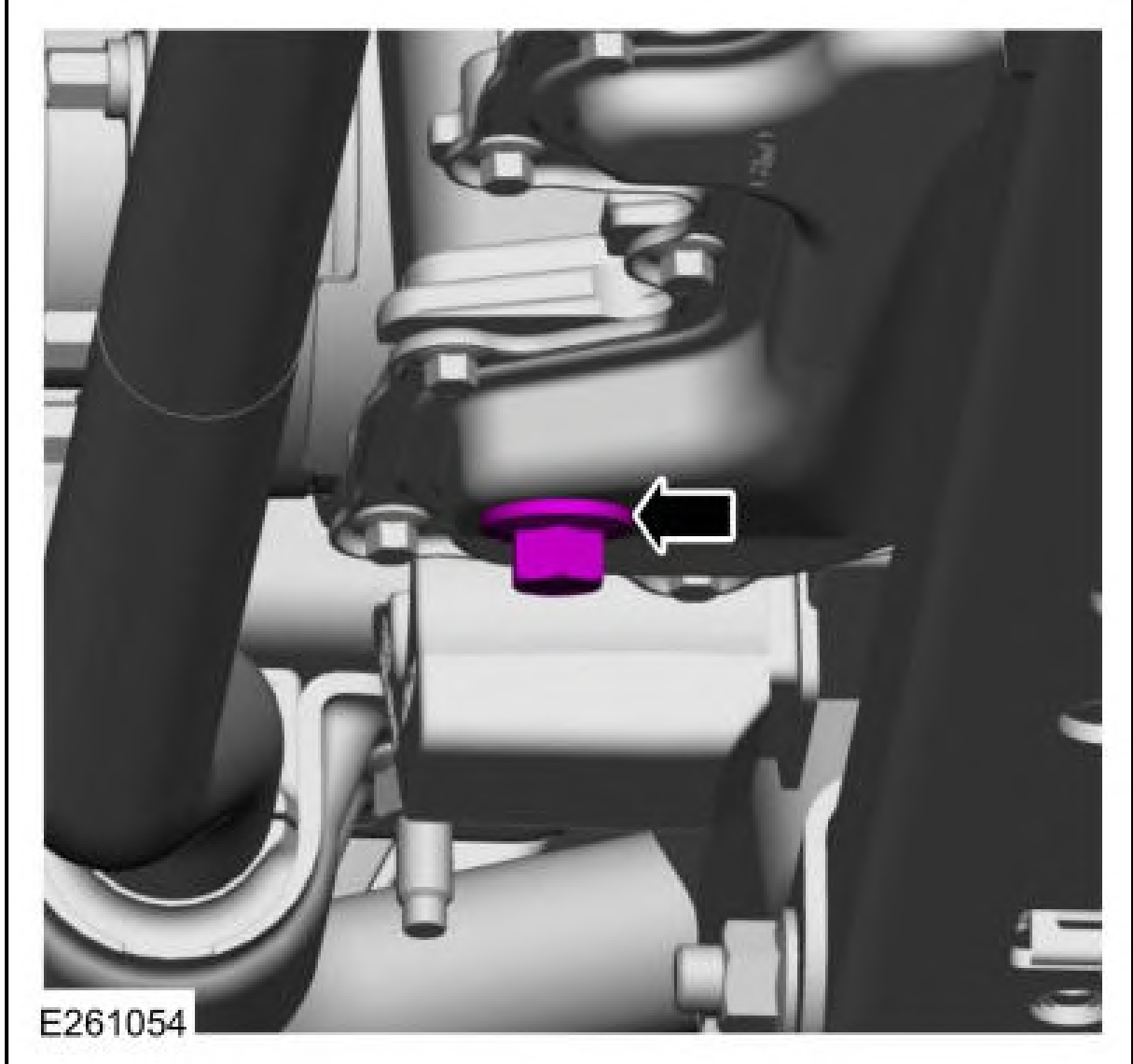




120. Remove the oil pan plug and drain the engine oil. Use the General Equipment: Oil Drain Equipment

Torque: 18 lb.ft (25 Nm)

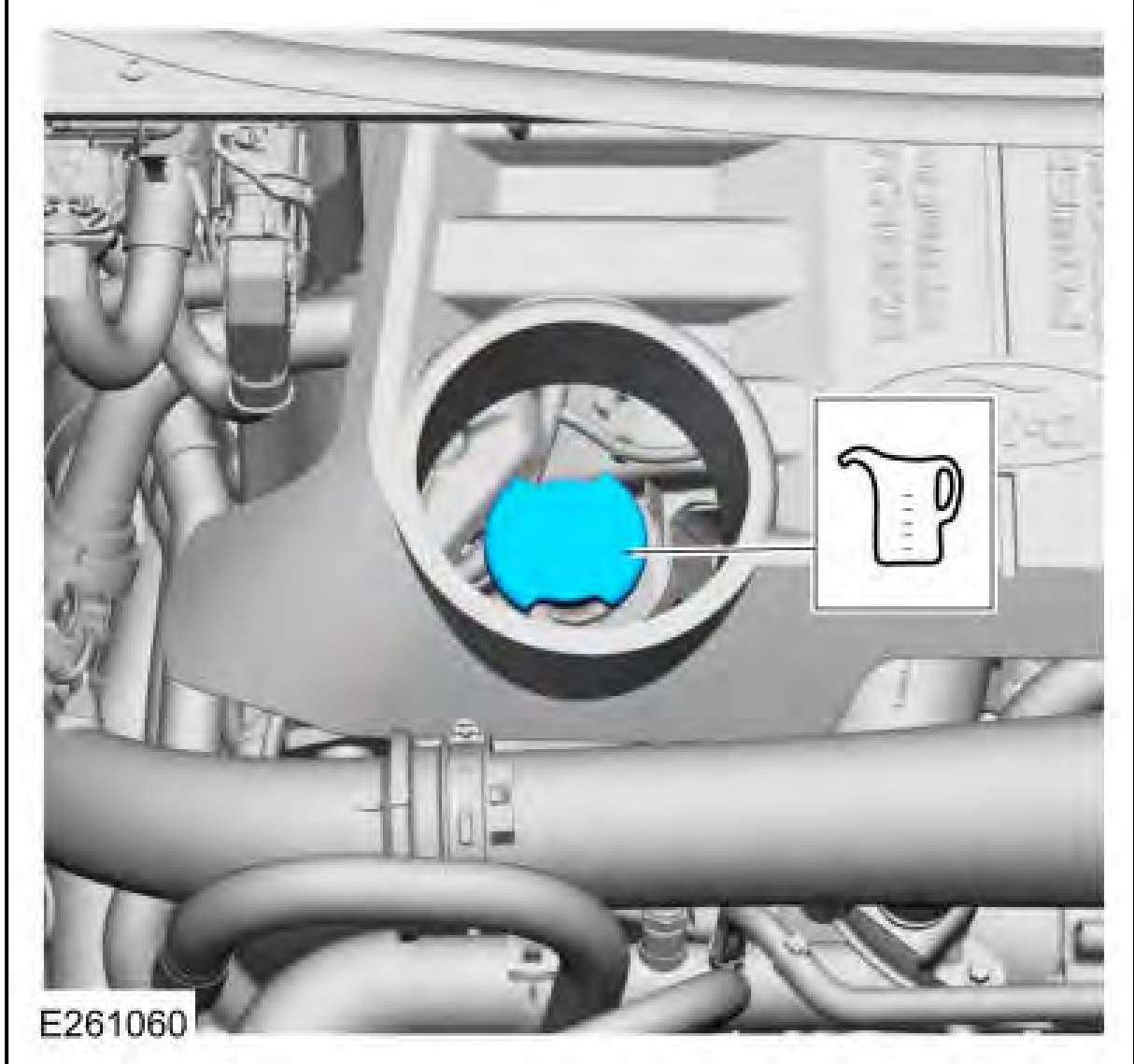




121. Fill the engine with clean engine oil. Refer to: [Specifications](#) .

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)





122. Remove the wheel chocks.

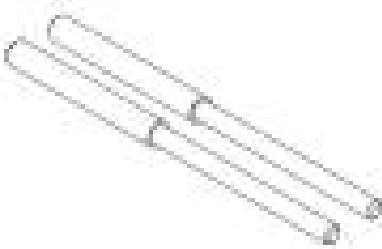
- Roll the chassis back to the markings on the floor.


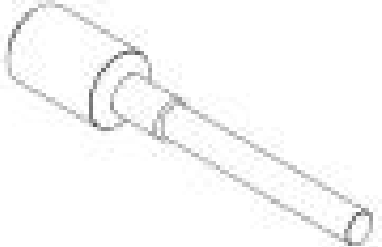
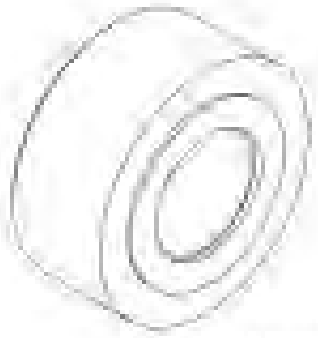

123. Install the body. Refer to: [Body - 3.0L Power Stroke Diesel](#) .

### **CYLINDER HEAD - BODY OFF - RH**

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

### **Special Tool(s) / General Equipment**

|  |   |
|--|---|
|  <p>E274086</p> | <p><b>303-1670 Pins, Camshaft Locking</b></p> |
|--|---|

|   |   |
|---|---|
|  <p style="text-align: center;"><b>E274086</b></p>    | <p><b>303-1670 Pins, Camshaft Locking</b></p>   |
|  <p style="text-align: center;"><b>E274087</b></p>   | <p>303-1671 Pin, Locking Crankshaft</p>         |
|  <p style="text-align: center;"><b>E274089</b></p>  | <p>303-1673 Installer, Camshaft Seal</p>        |
|  <p style="text-align: center;"><b>E274090</b></p> | <p>303-1674 Tool, Holding Camshaft Sprocket</p> |
| <p>Oil Drain Equipment<br/>Hose Clamp Remover/Installer</p>   |   |

**Materials**

| Name  | Specification  |
|---|----------------|
| Motorcraft <sup>®</sup> High Performance Engine RTV Silicone TA-357   | WSE-M4G323-A6  |
| Flange Sealant CU7Z-19B508-A  | WSS-M2G348-A11 |
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA  | WSS-M2C214-B1  |
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant VC-3-B | WSS-M97B44-D   |

**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, may cause engine failure.

**NOTE:** It is recommended that this component be serviced with the vehicle body removed. If the body was not removed, refer to Cylinder Head - Body On in this section.

1. **NOTE:** Make sure that the same gasket thickness is reinstalled.

Install the RH cylinder head dowels and head gasket.



2. **NOTE:** Using too much engine oil on the threads of the cylinder head bolts may cause damage to the threads and poor sealing. Using anti-seize compounds, grease or any other lubricants other than engine oil on the cylinder head bolt threads may affect the true torque value of the bolts.

**NOTE:** The glow plugs protrude past the lower face of the cylinder head, any impact on the tip of the glow plug may result in glow plug damage.

**NOTE:** Lightly lubricate the new cylinder head bolt threads and flanges with clean engine oil.

Install the RH cylinder head and the new bolts.

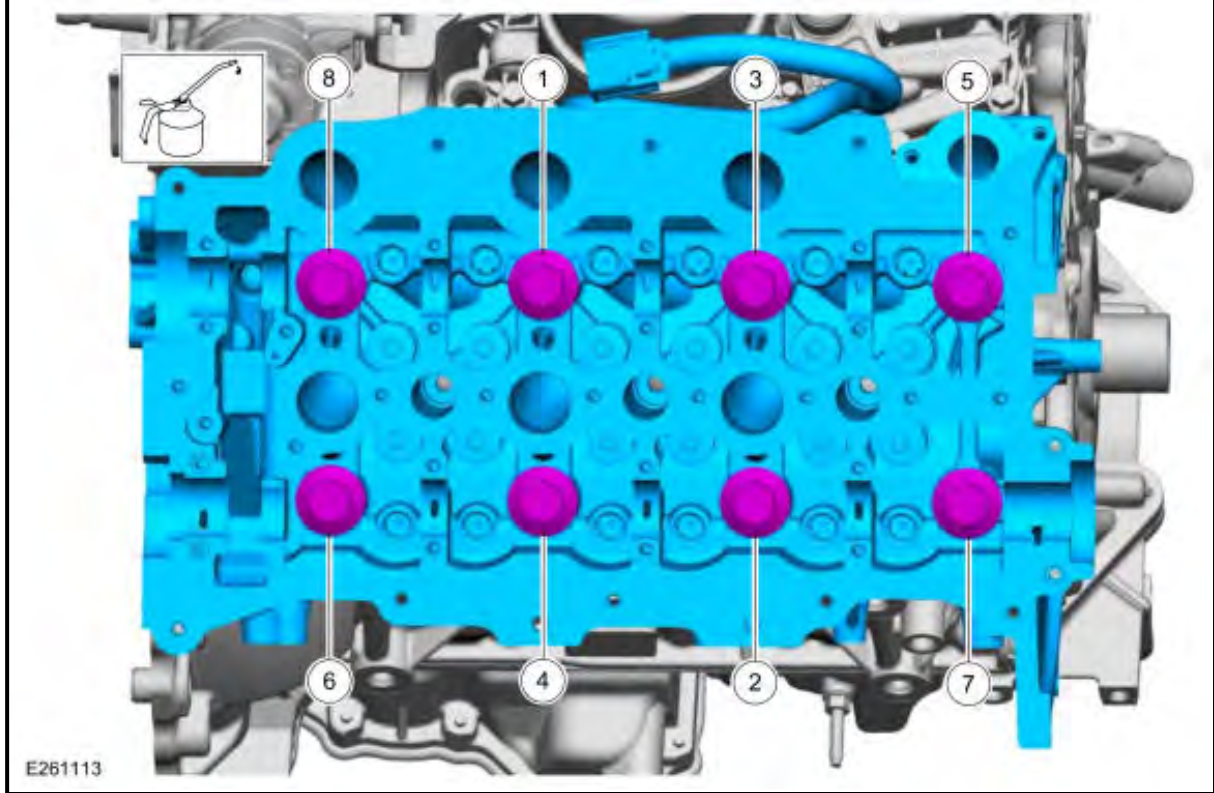
Material

: Motorcraft  $\hat{\text{A}}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque

:Stage 1: 177 lb.in (20 Nm)Stage 2: 30 lb.ft (40 Nm)Stage 3: 59 lb.ft (80 Nm)Stage 4: 180  $\hat{\text{A}}$





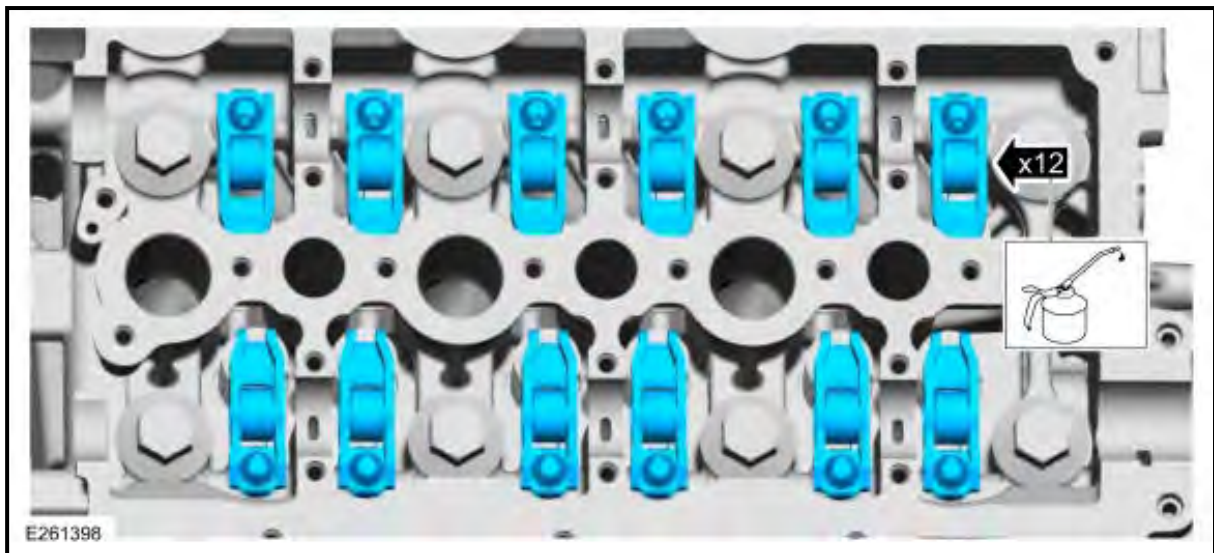
3. **NOTE:** If the original hydraulic lash adjusters and roller followers are to be reinstalled, they must be installed in their original locations.

1. Lubricate the RH hydraulic lash adjusters and roller followers with clean engine oil.

Material

: Motorcraft  $\hat{A}$ ® SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

2. Install the hydraulic lash adjusters and roller followers.



4. **NOTE:** Lubricate the camshafts with clean engine oil prior to installation.

**NOTE:** Align the timing marks on the camshafts with the timing marks on the secondary timing chain.

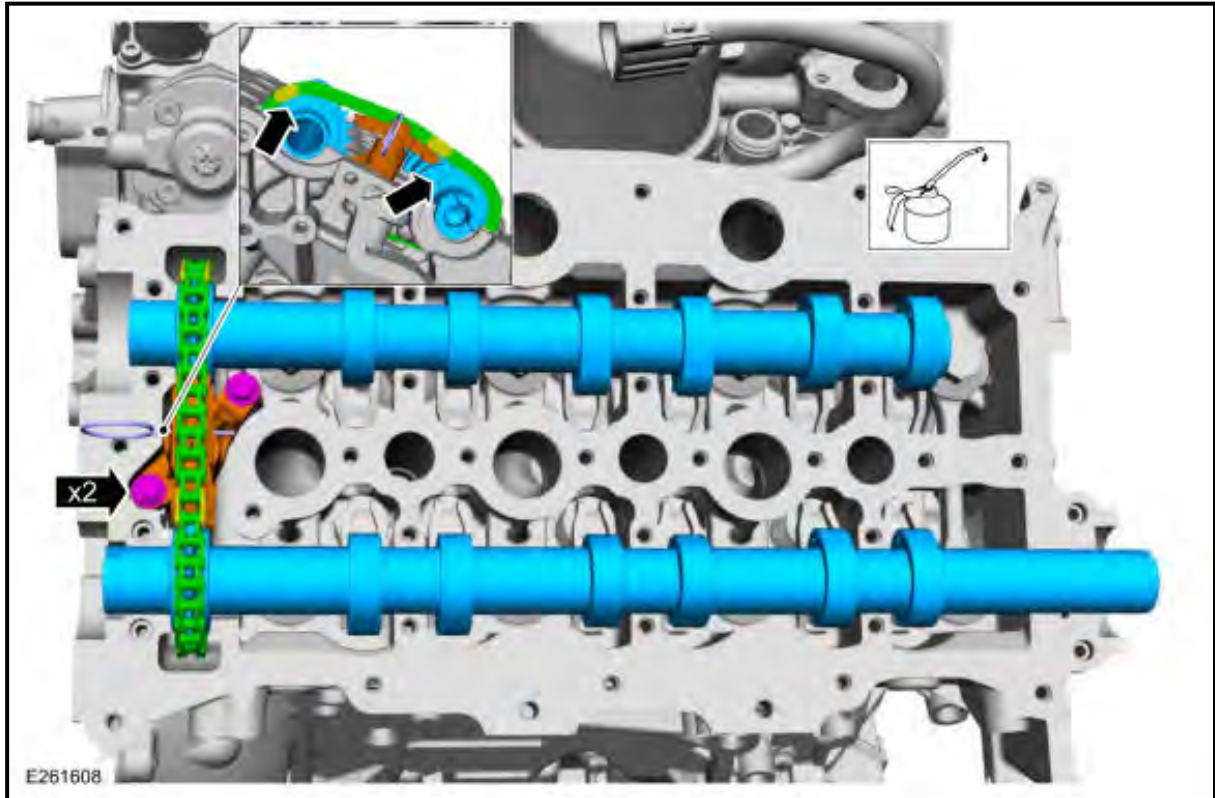
Install the RH camshafts, camshaft chain, secondary timing chain tensioner and the bolts.

Material

: Motorcraft  $\hat{A}$ ® SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque

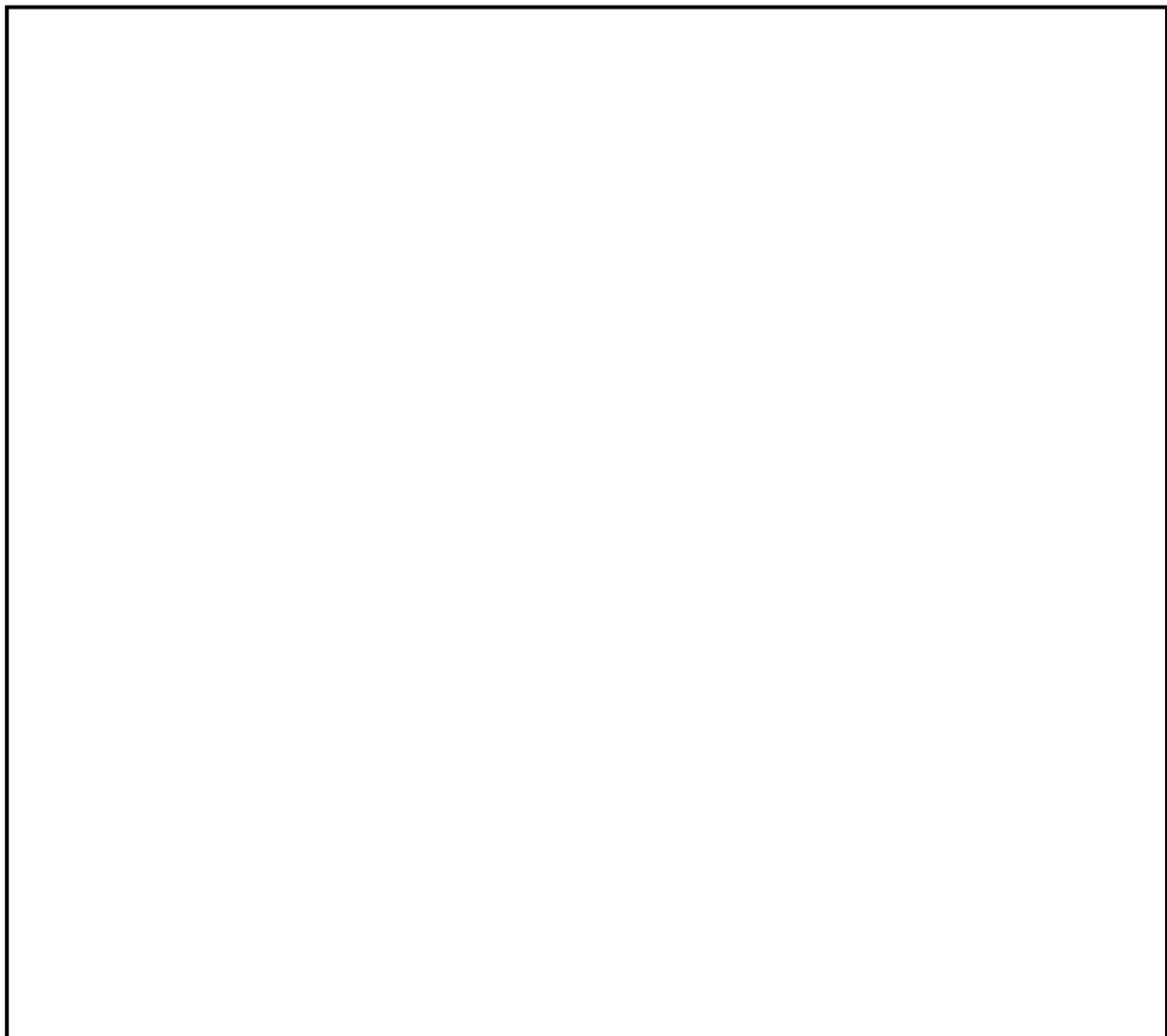
: 89 lb.in (10 Nm)

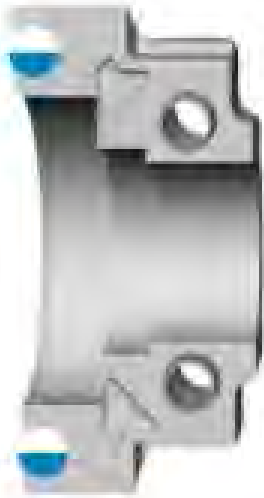
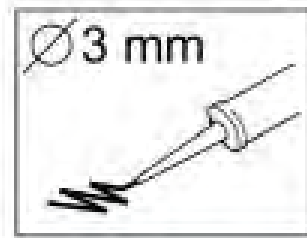
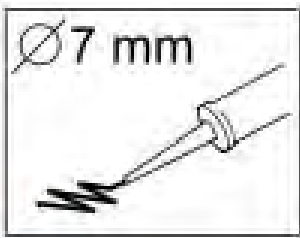


5. Apply sealer to the RH bearing caps.

Material

: Flange Sealant / CU7Z-19B508-A (WSS-M2G348-A11)





E260985

6. **NOTE:** Cylinder head camshaft bearing caps are numbered to verify that they are assembled in their original positions.

**NOTE:** Tighten the camshaft bearing cap bolts one turn at a time.

Apply clean engine oil to the camshaft bearing caps. Install camshaft bearing caps and the bolts.

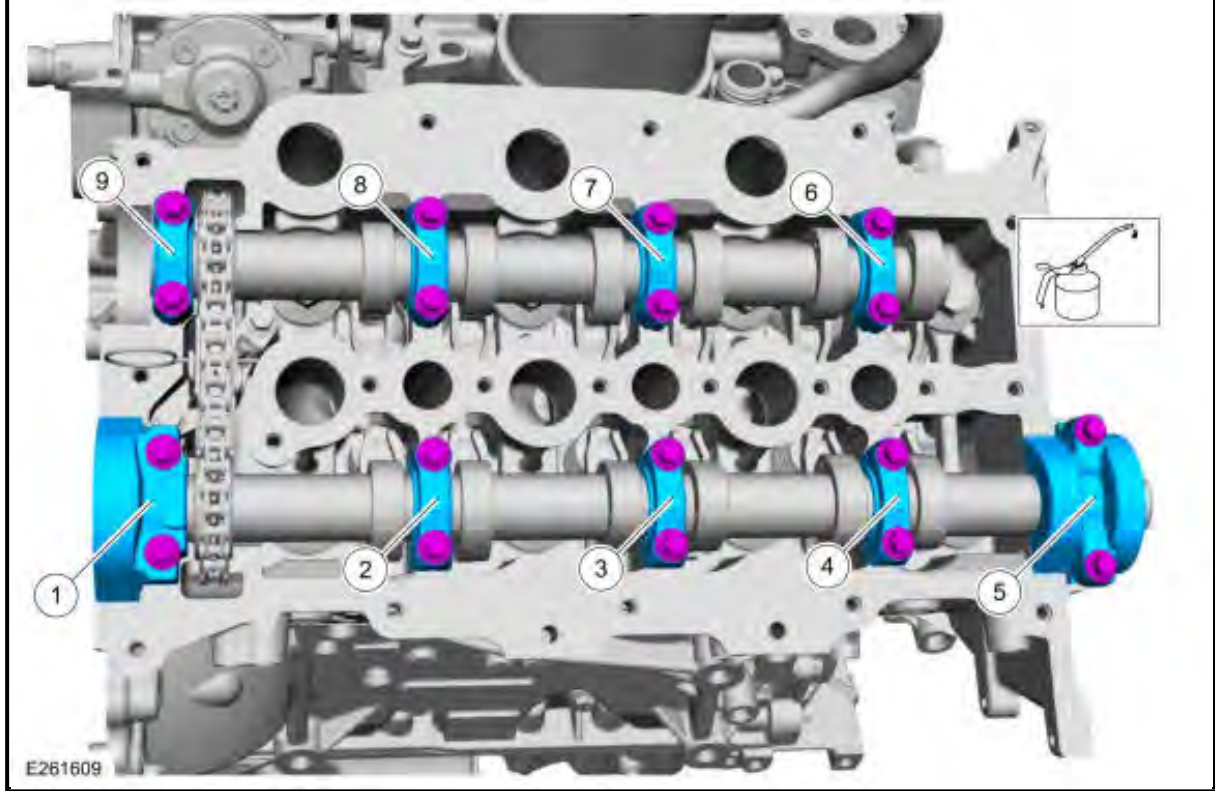
Material

: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

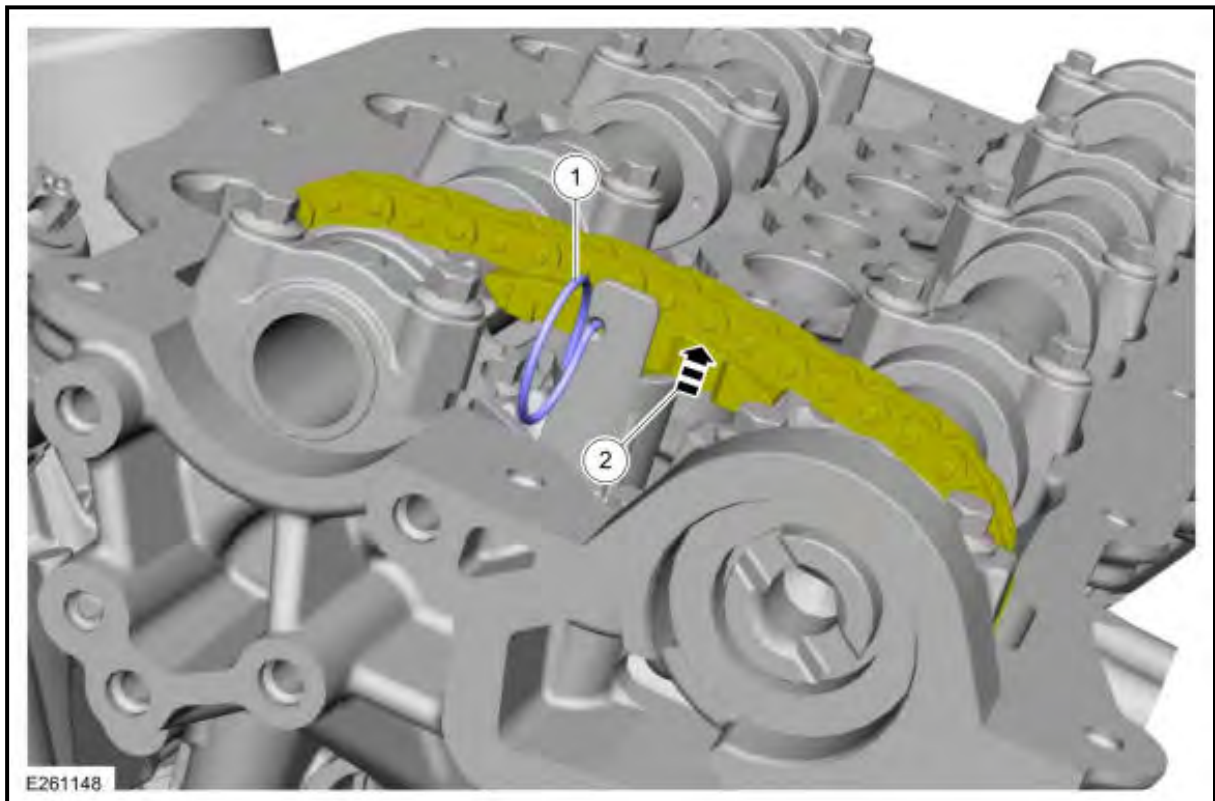
Torque

: Stage 1: 9 lb.in (1 Nm) Stage 2: 44 lb.in (5 Nm) Stage 3: 89 lb.in (10 Nm)

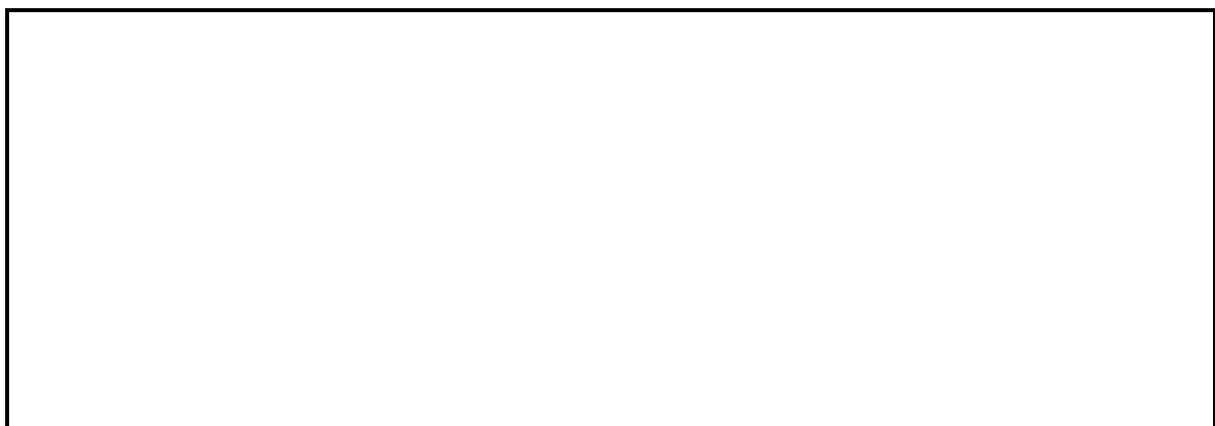


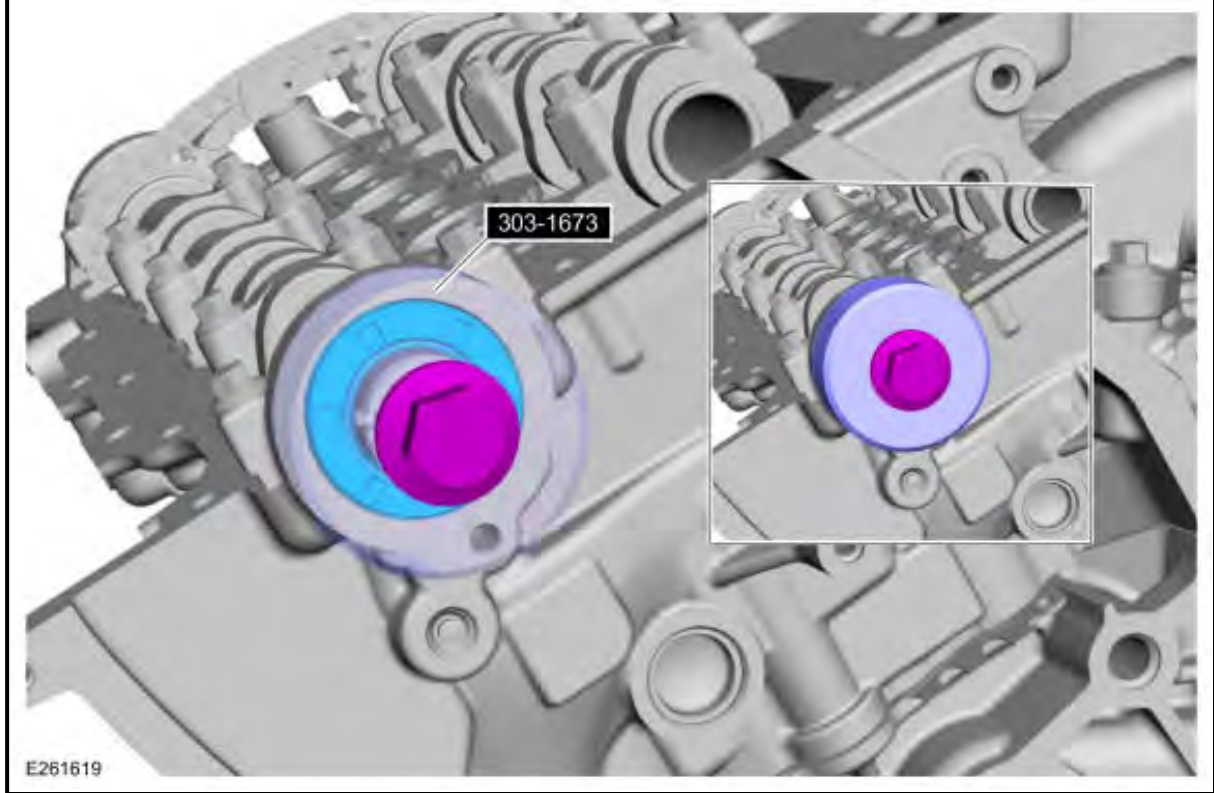


7. Remove the retaining pin.

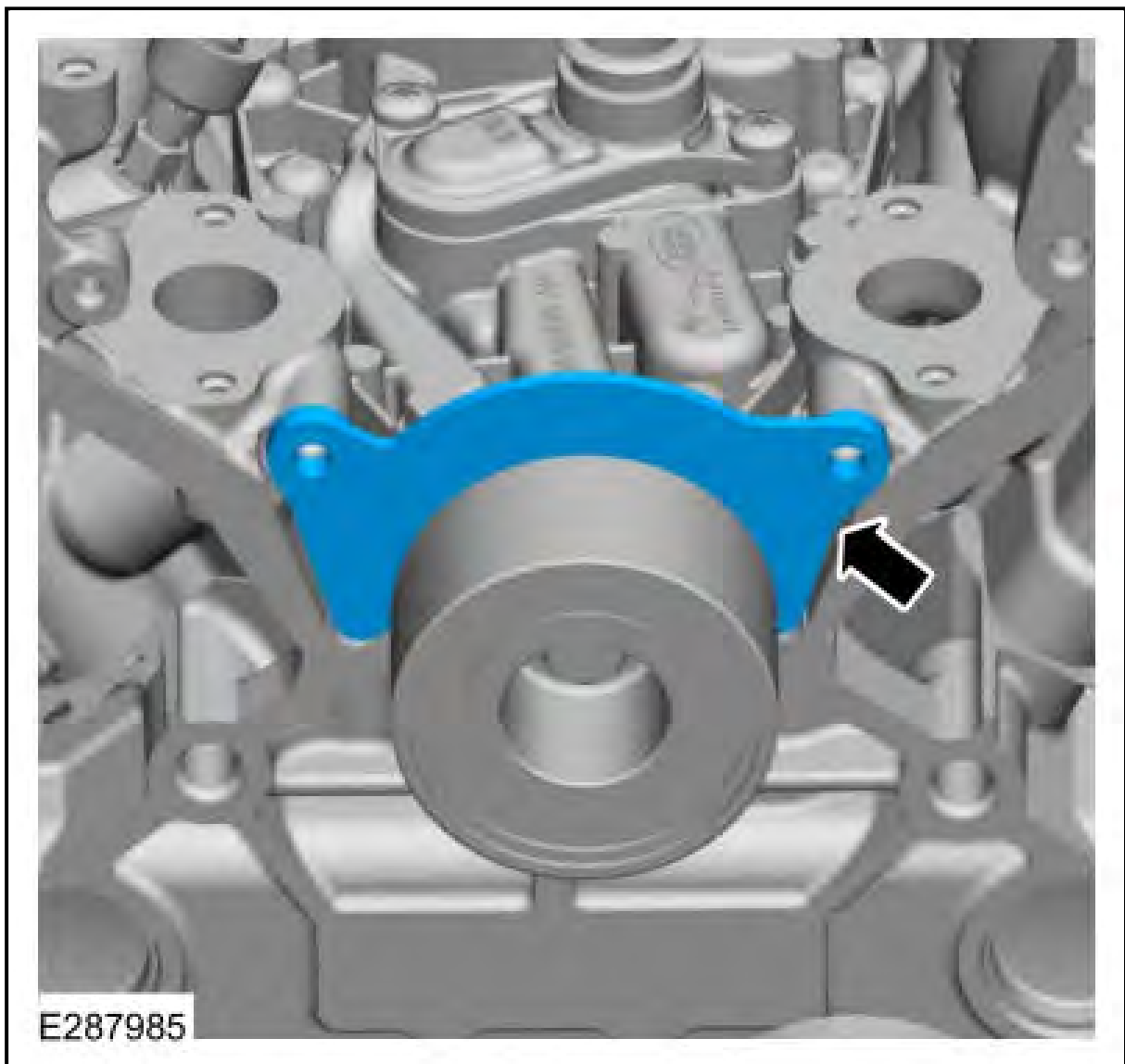


8. Using the special tool, install the camshaft seal. Use Special Service Tool: 303-1673 Installer, Camshaft Seal.





9. Install the dust shield.



10. Install the coolant outlet connector gaskets.





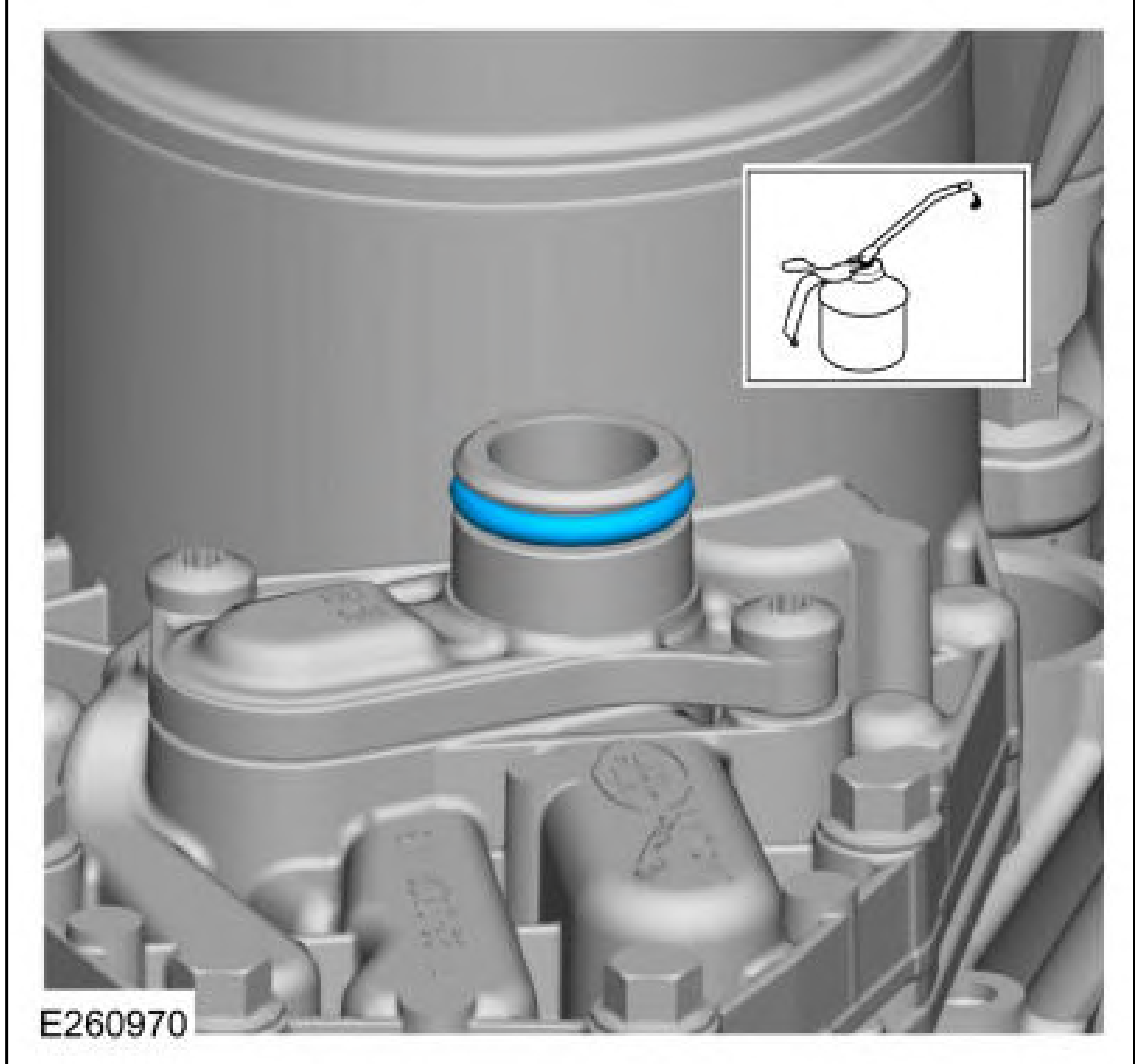
E261049

11. Install the oil cooler O-ring and lubricate.

Material

: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)





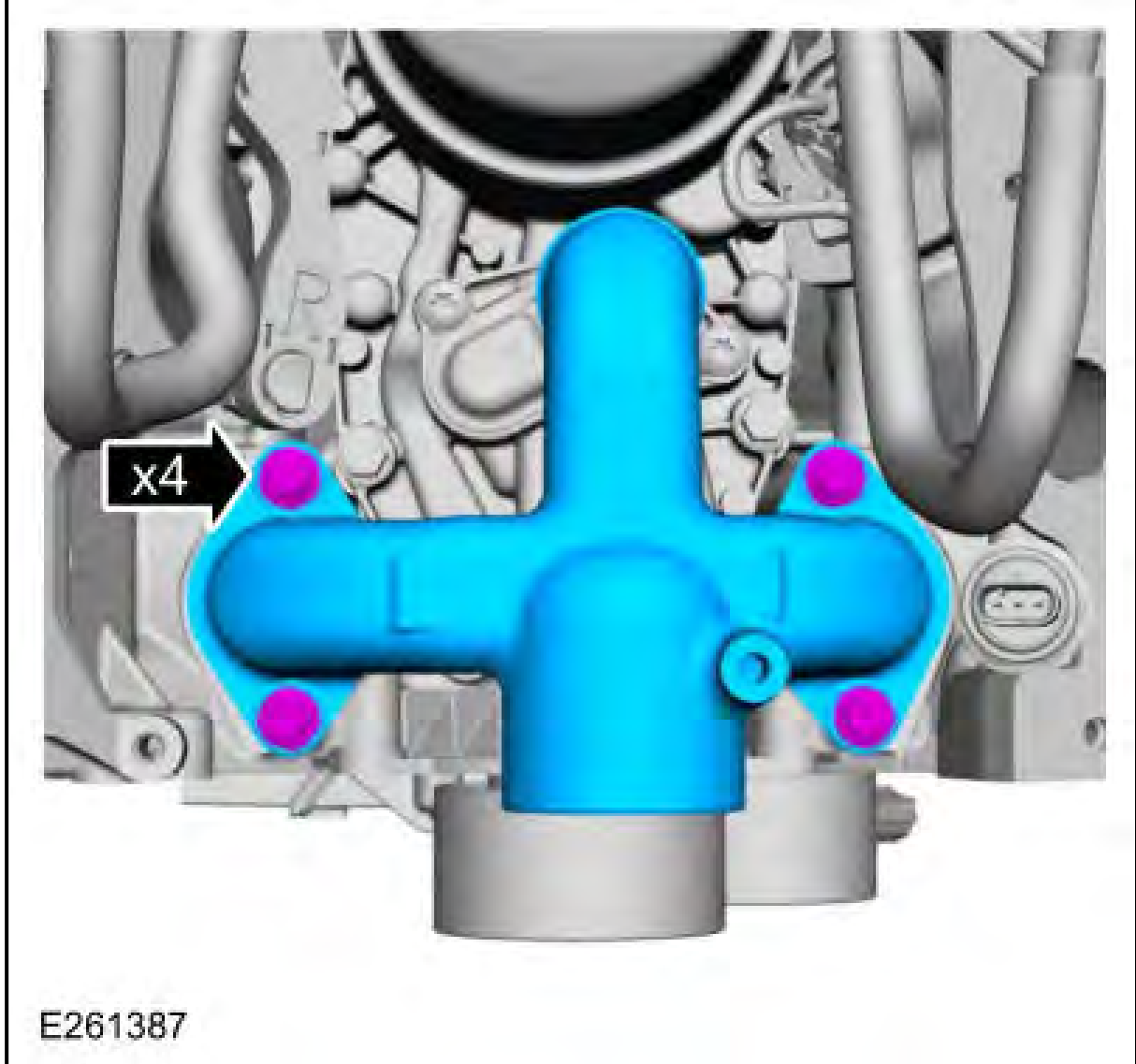
12. Install the coolant outlet connector and the bolts.

Torque

: 89 lb.in (10 Nm)





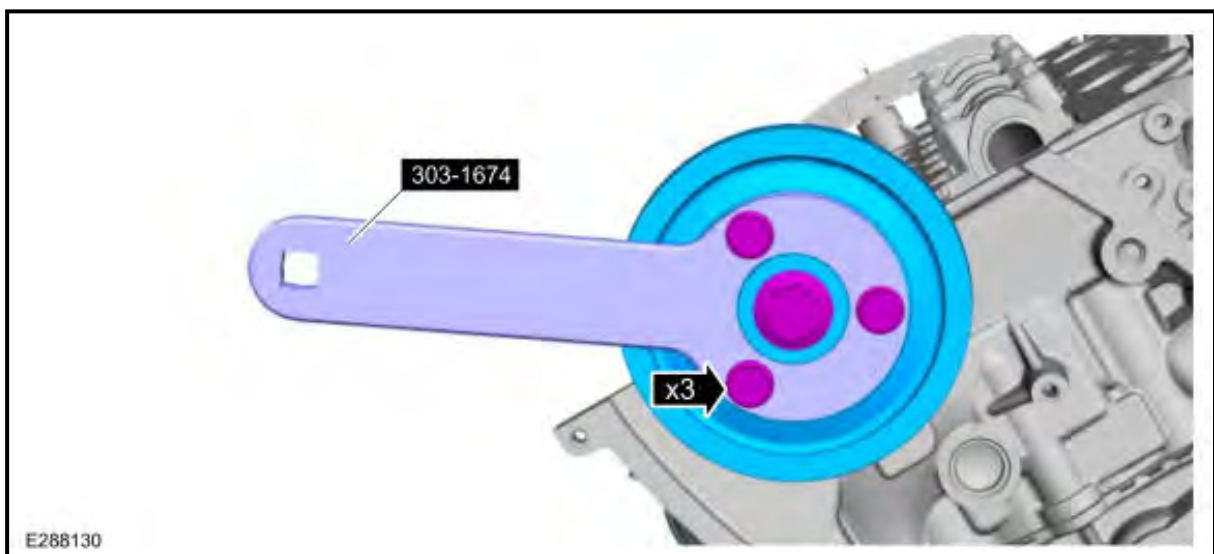


13. **NOTE:** Use the original bolts for the special tool.

Using the special tool, install the RH camshaft gear hub and bolts. Use Special Service Tool: 303-1674 Tool, Holding Camshaft Sprocket.

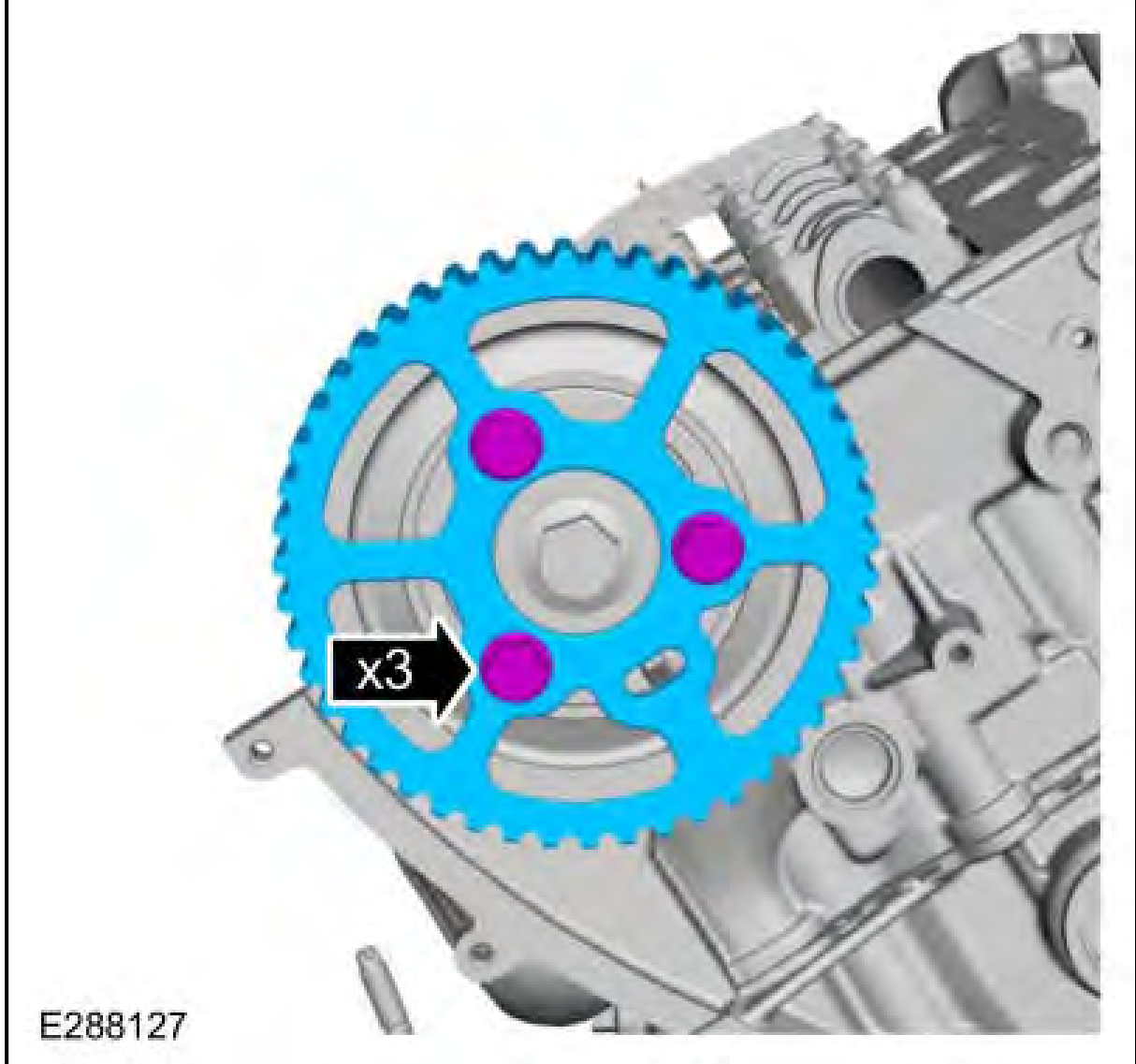
Torque

:Stage 1: 59 lb.ft (80 Nm) Stage 2: 80 Å°

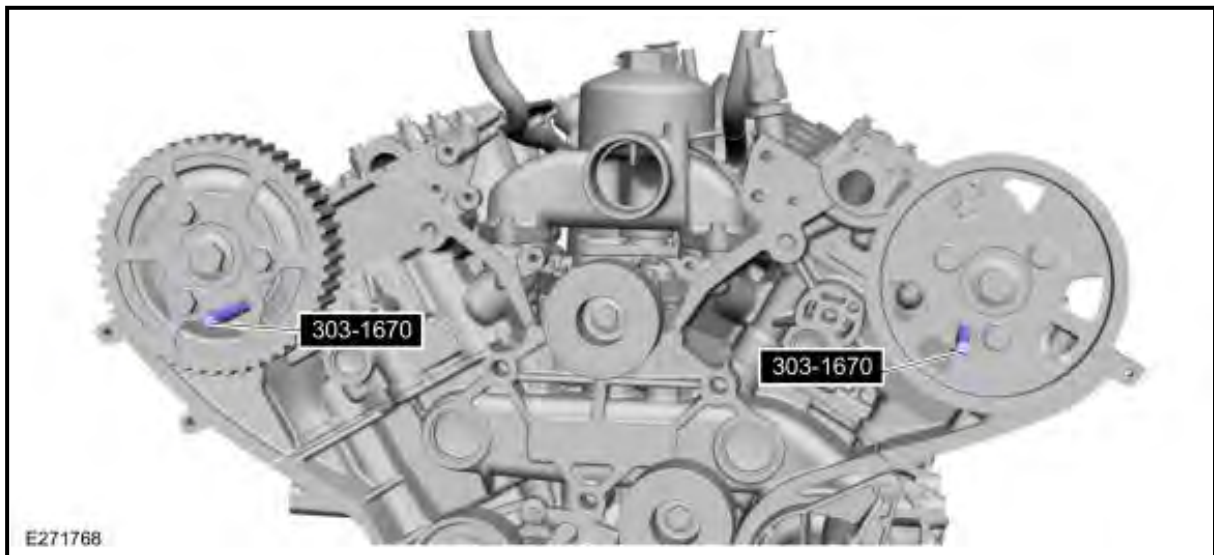


14. **NOTE:** Only tighten the bolts finger tight at this stage.

Install the RH camshaft pulley and the bolts.



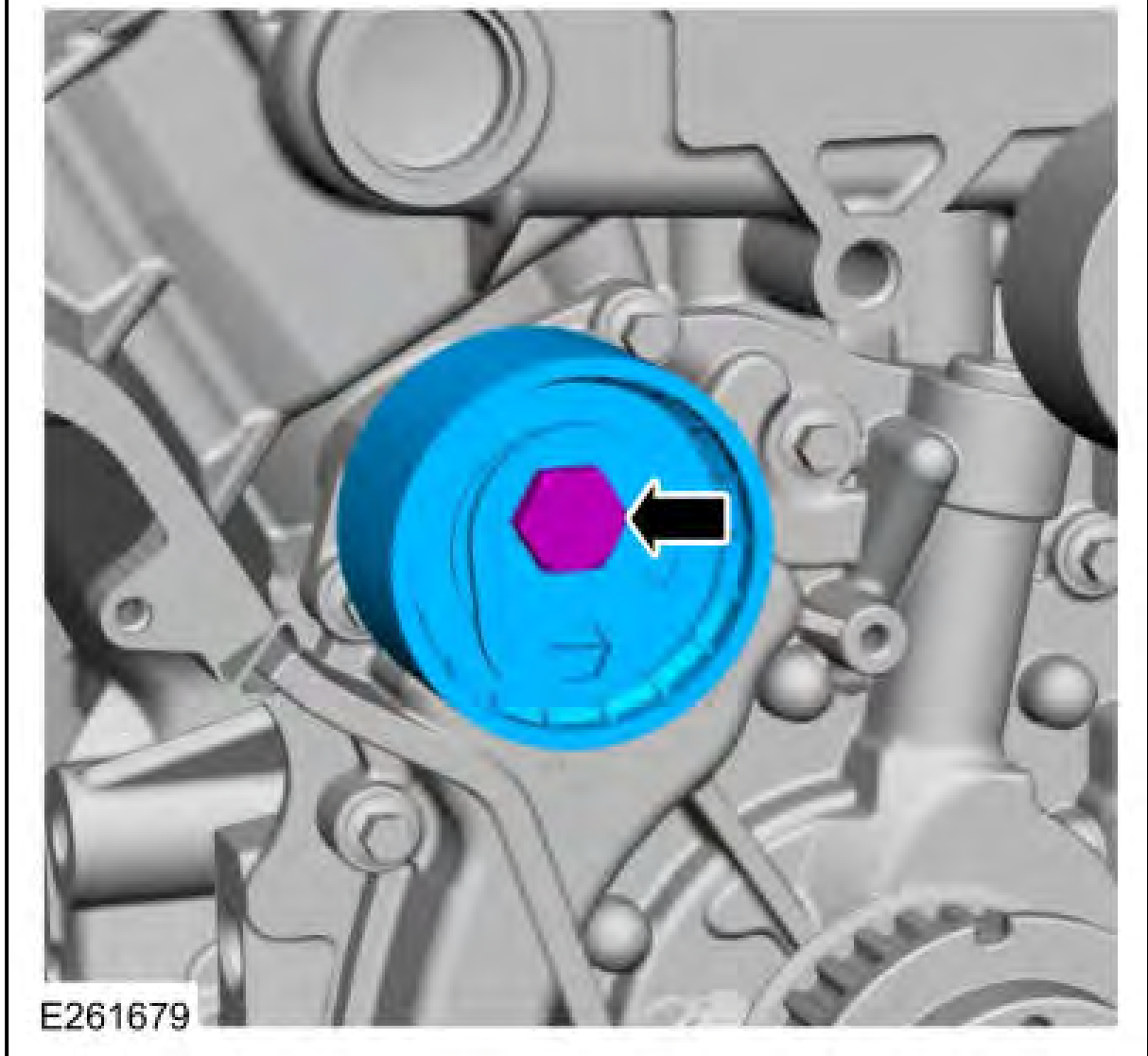
15. Install Special Service Tool: 303-1670 Pins, Camshaft Locking.



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

Install the timing belt tensioner and the bolt.





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

**NOTE:** Make sure that the crankshaft is against the Crankshaft Locking Pin.

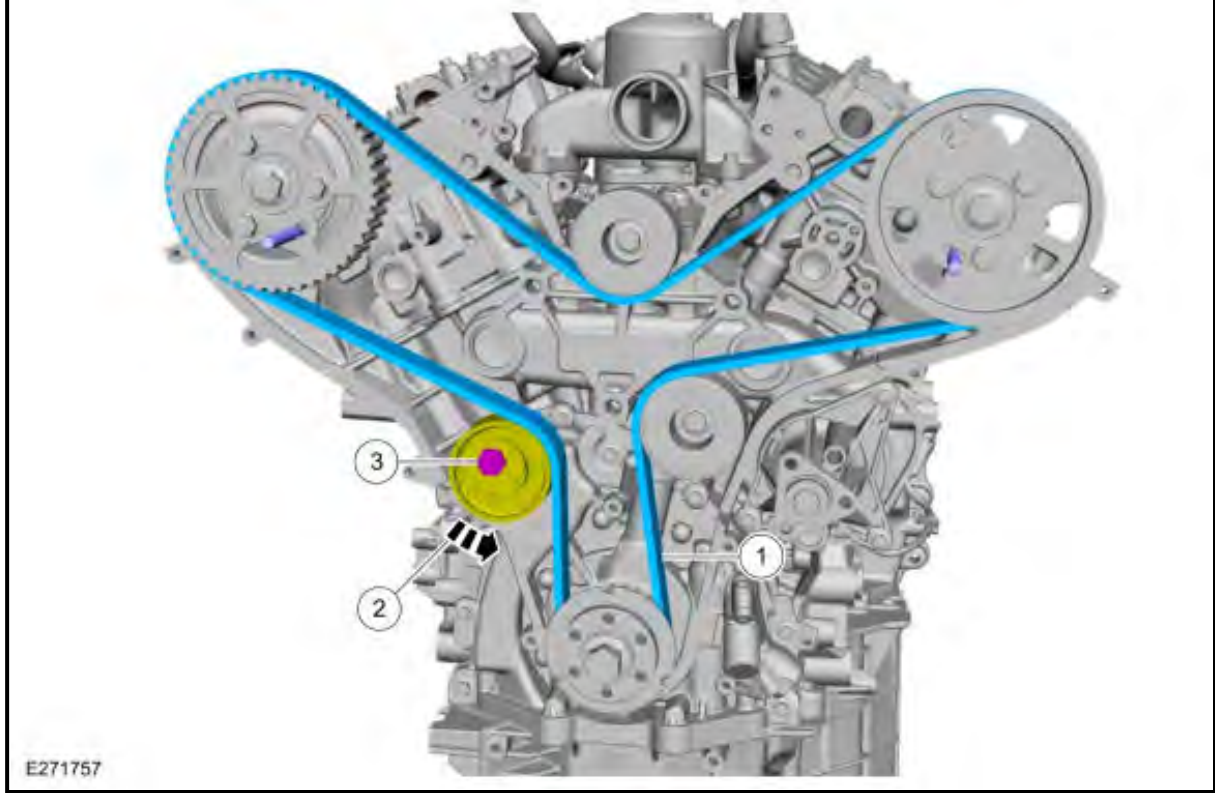
**NOTE:** It may be necessary to rotate the camshaft pulleys slightly to ensure the bolts are not at the end of the slots.

1. Install the timing belt.
2. Rotate the timing belt tensioner.
3. Tighten the timing belt tensioner bolt.

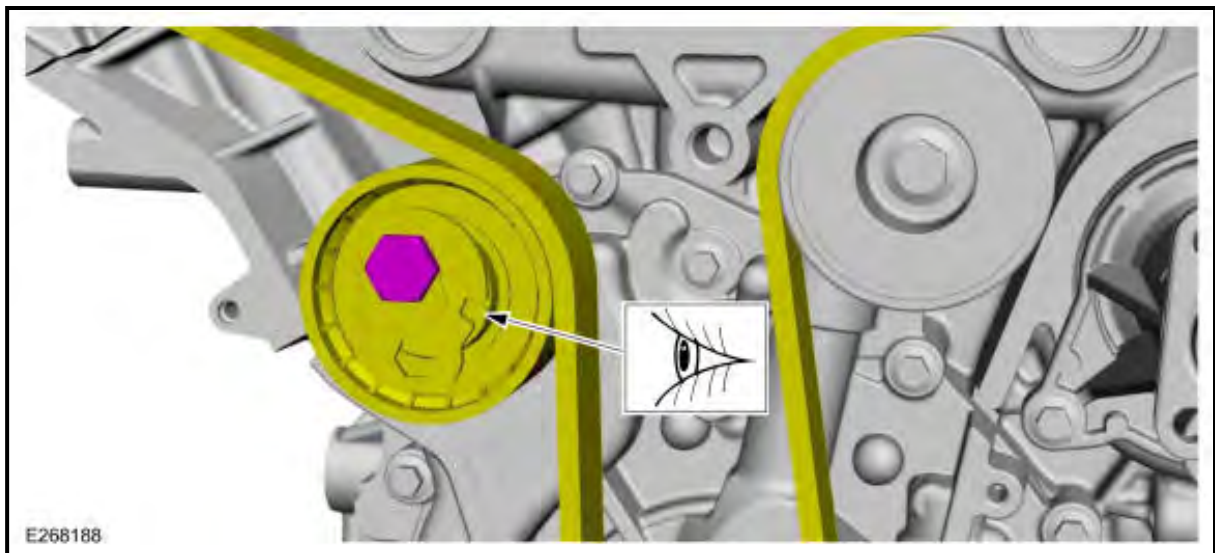
Torque

:Stage 1: 177 lb.in (20 Nm)Stage 2: 45 Å°





18. If the timing belt tensioner pointer is not visible in the window, the timing belt tensioning step must be repeated.

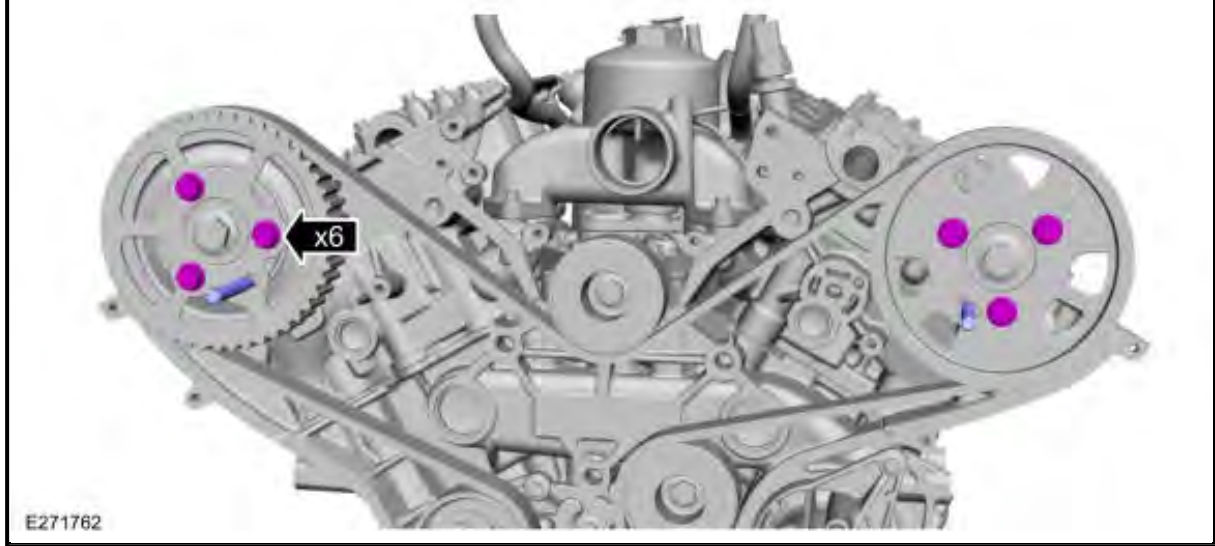


19. Tighten the camshaft pulley bolts.

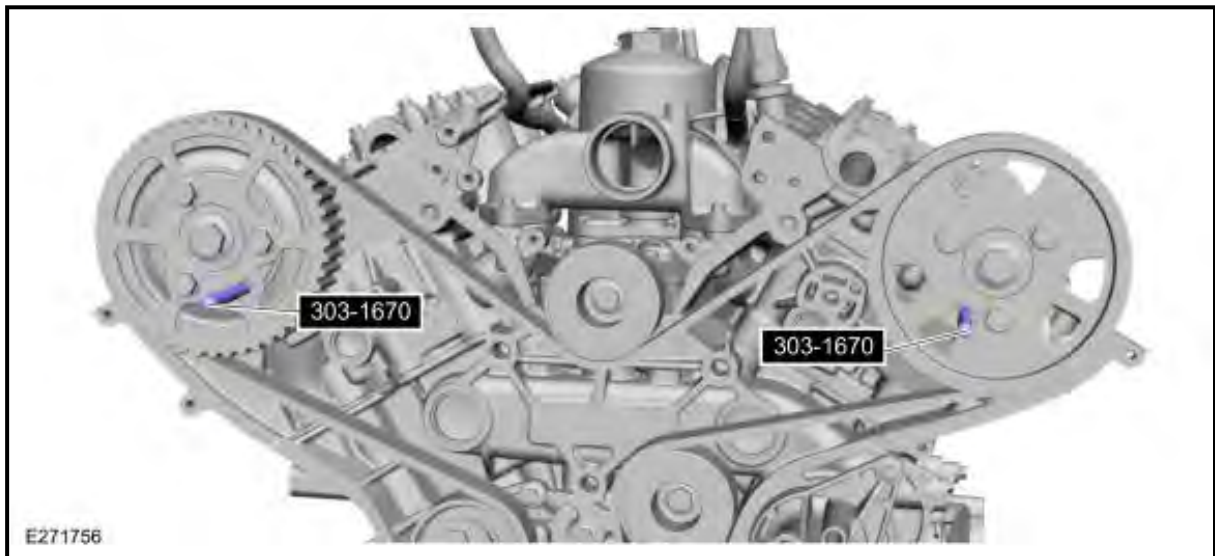
Torque

: 17 lb.ft (23 Nm)



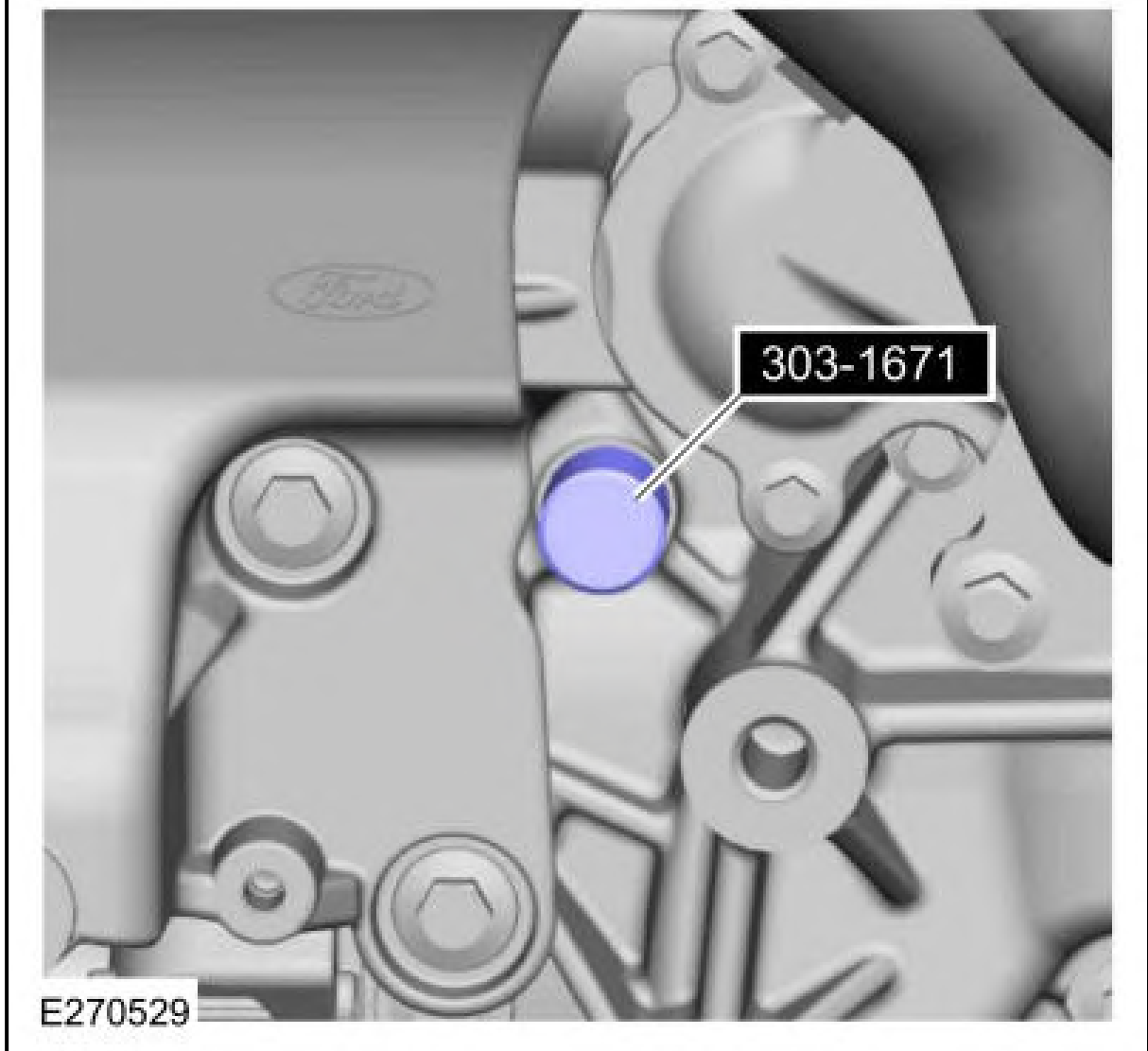


20. Remove Special Service Tool: 303-1670 Pins, Camshaft Locking.



21. Remove Special Service Tool: 303-1671 Pin, Locking Crankshaft.





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

This step is to verify that the timing is correct. Rotate the engine 1 7/8 revolutions.

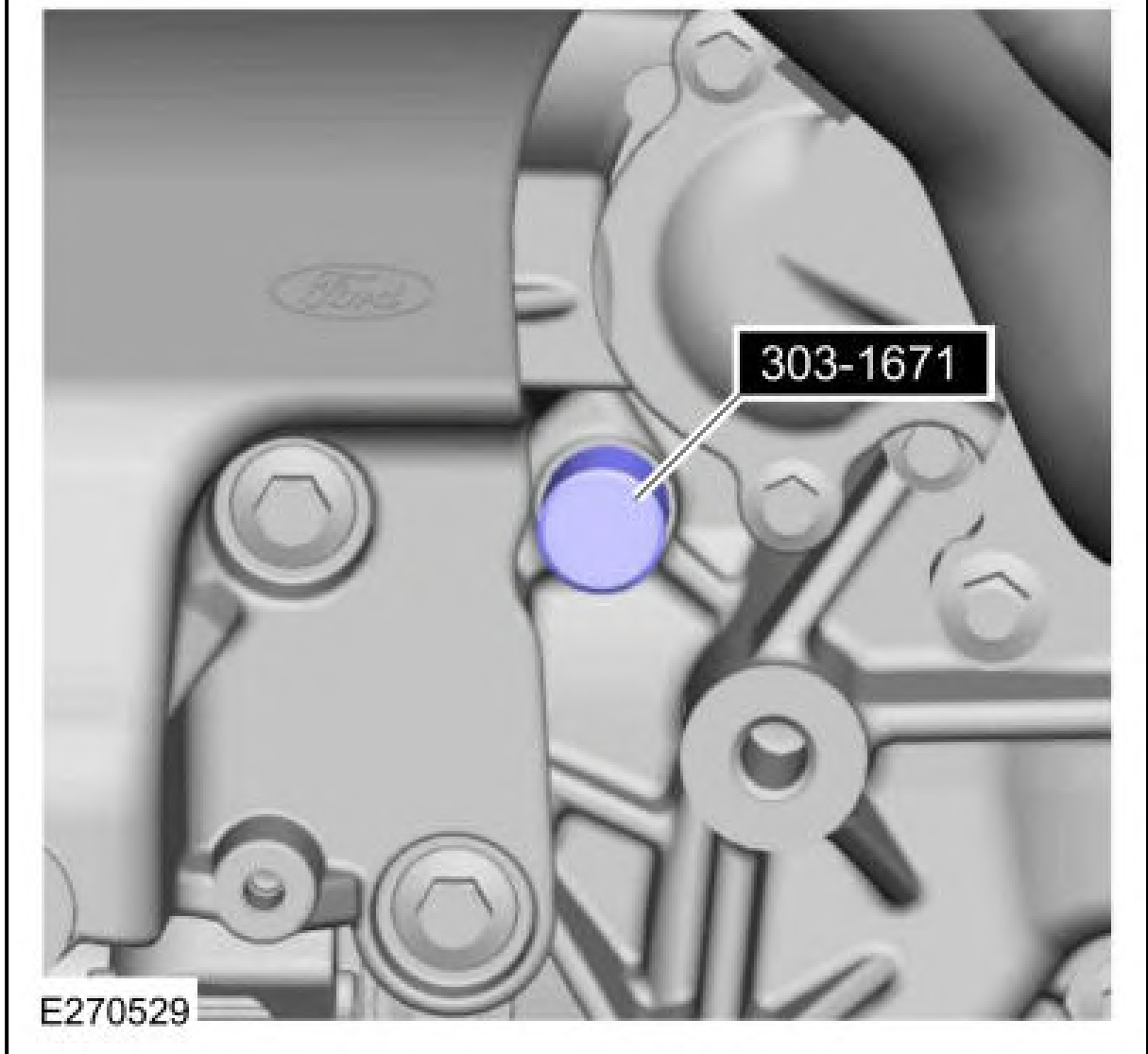
23. Install special tool.

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

**NOTE:** The Locking Crankshaft Pin must be bottomed out against the cylinder block.

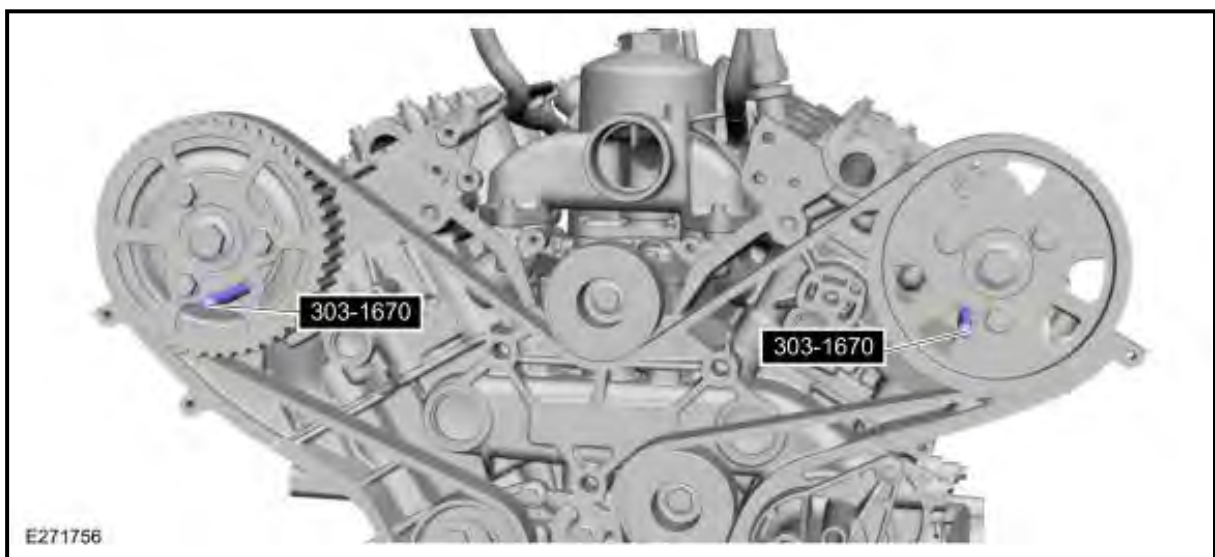
Rotate the crankshaft clockwise so the crankshaft contacts the locking crankshaft pin. Use Special Service Tool: 303-1671 Pin, Locking Crankshaft.





24. **NOTE:** The special tool can only be installed if the valve timing is correct.

If the special tools do not install correctly, repeat the timing belt installation steps. Install Special Service Tool: 303-1670 Pins, Camshaft Locking.

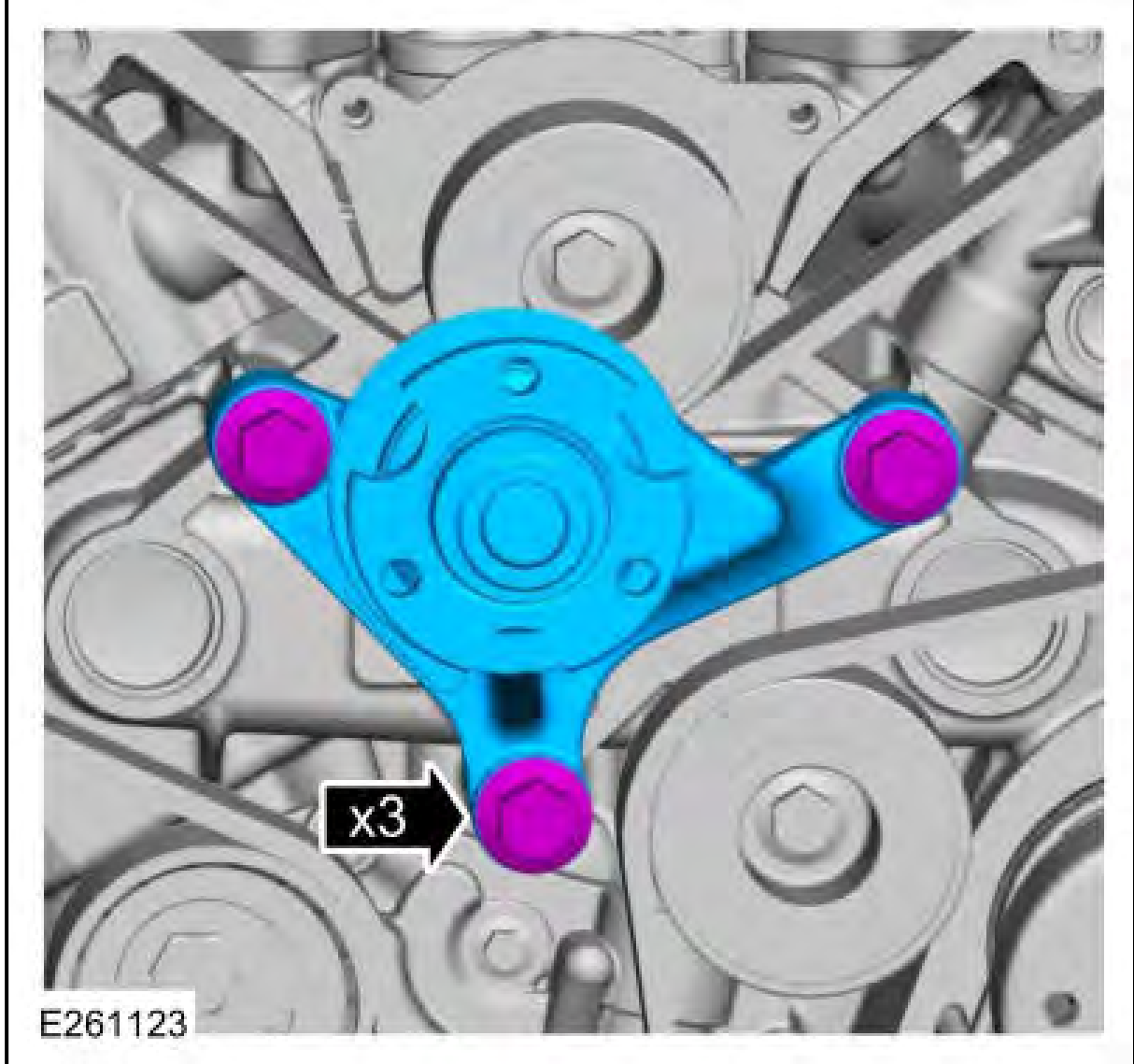


25. Install the fan drive and the bolts.

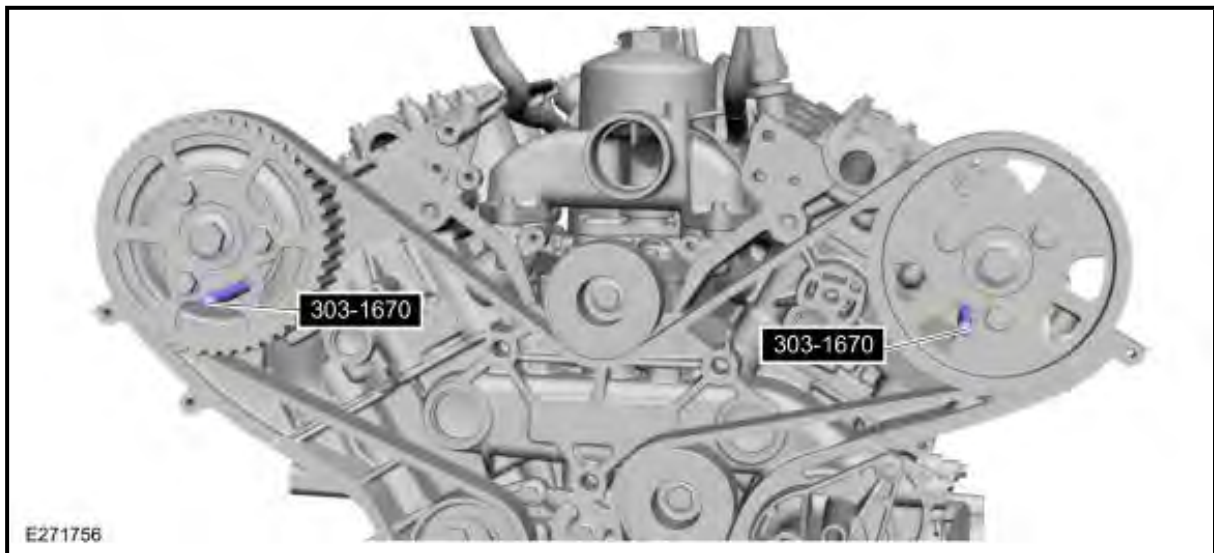
Torque

: 61 lb.ft (83 Nm)





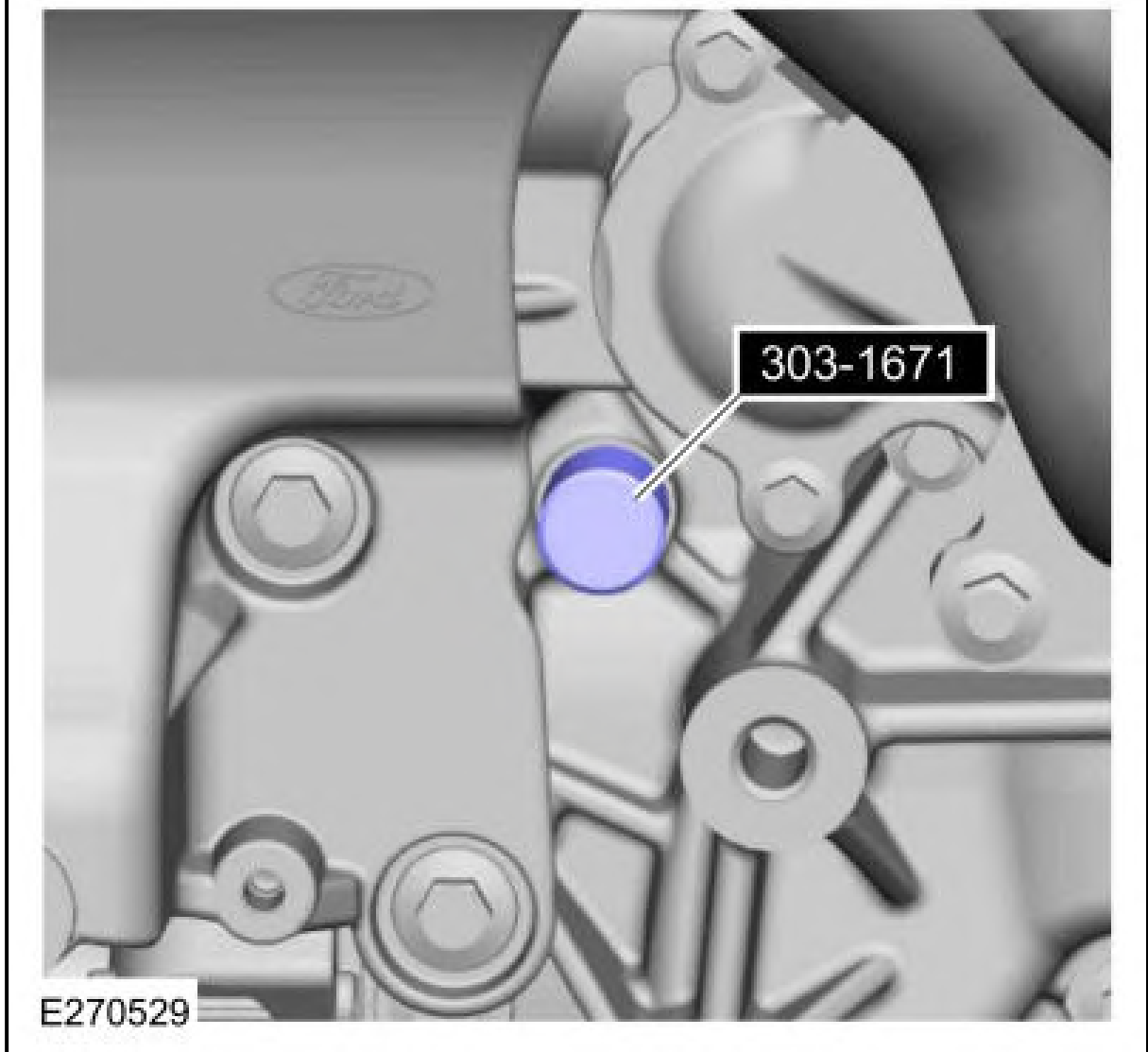
26. Remove Special Service Tool: 303-1670 Pins, Camshaft Locking.



27. Remove Special Service Tool: 303-1671 Pin, Locking Crankshaft.





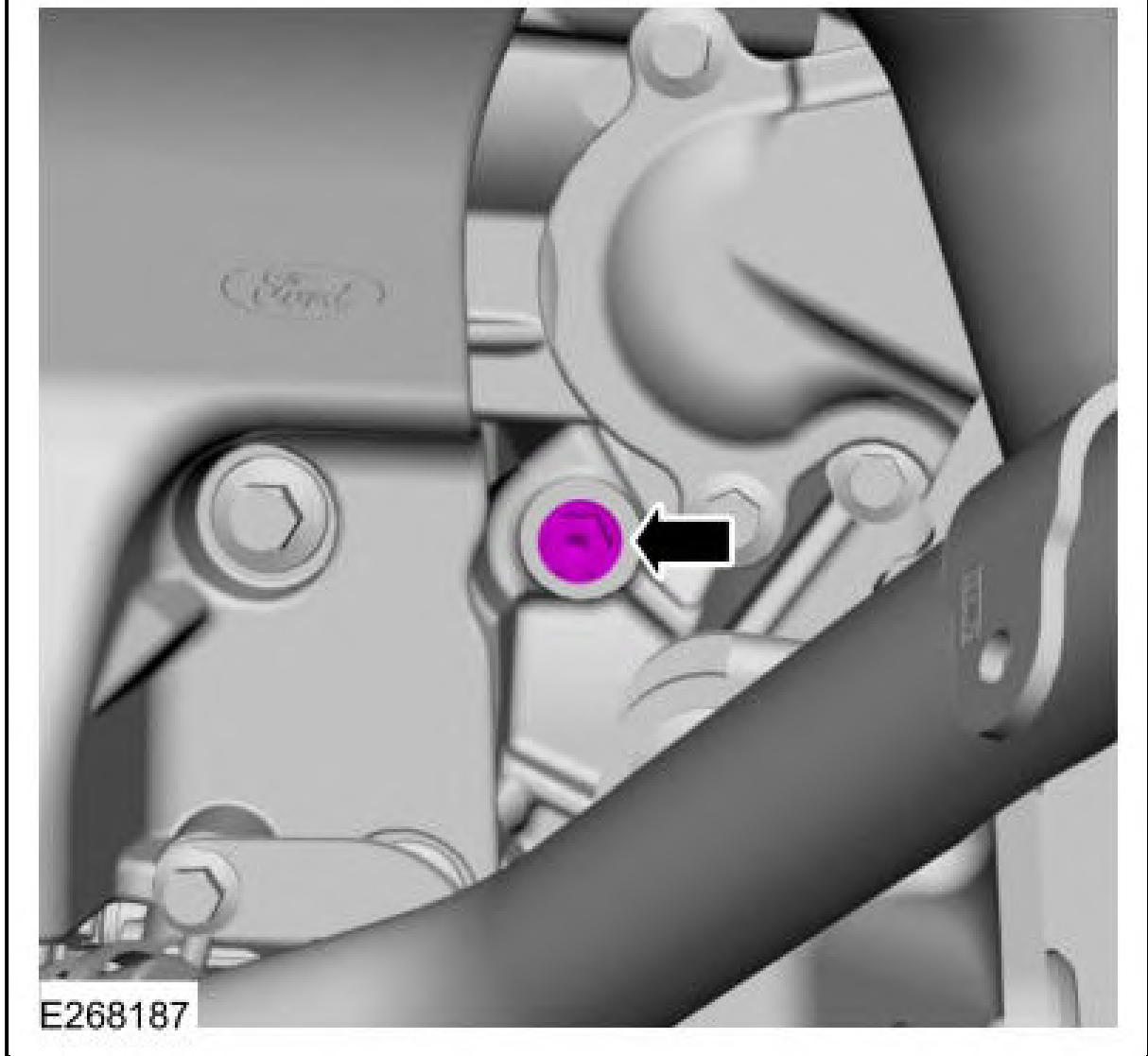


28. Install the timing pin bolt.

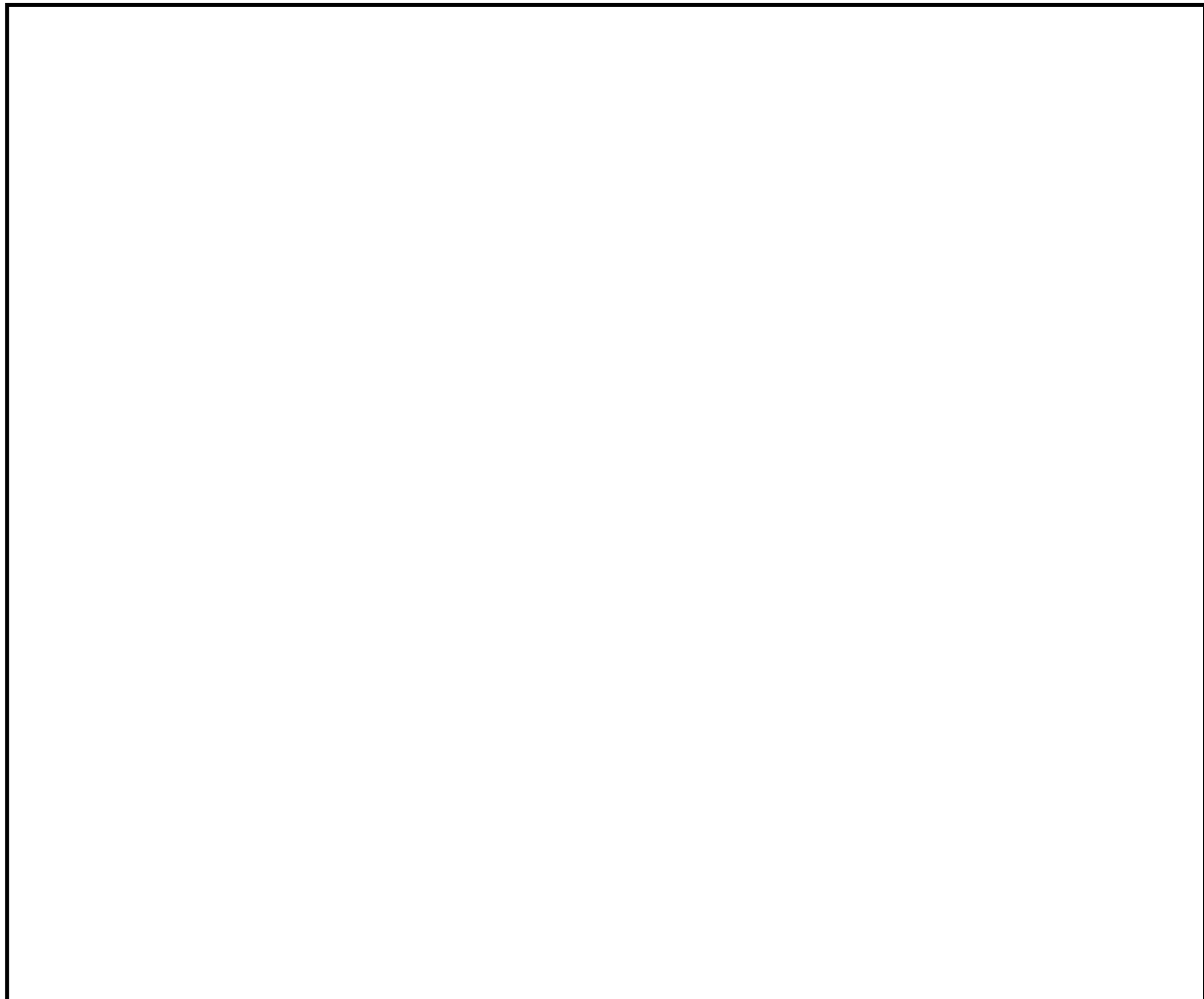
Torque

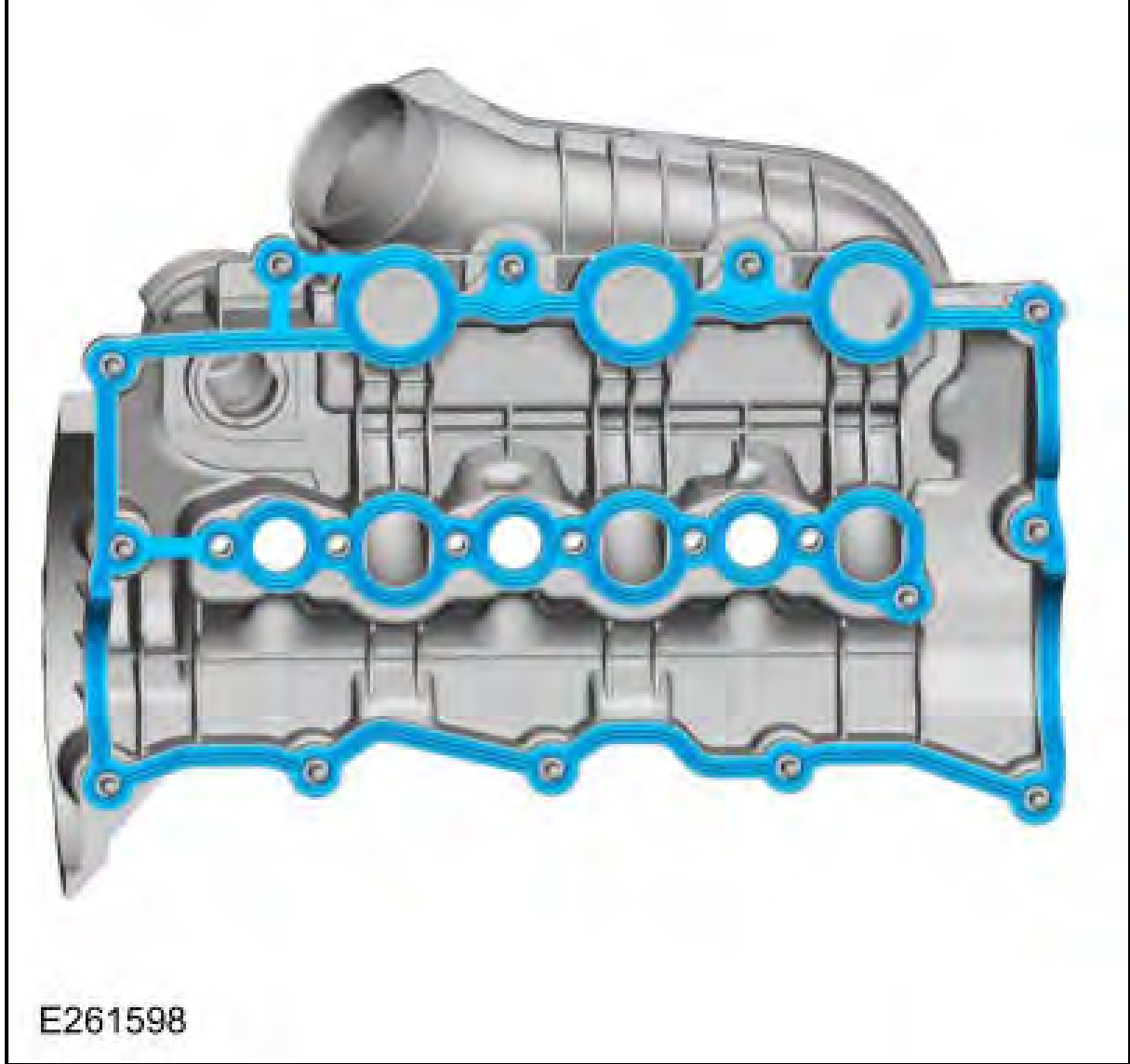
: 17 lb.ft (23 Nm)





29. Install the RH valve cover gasket.



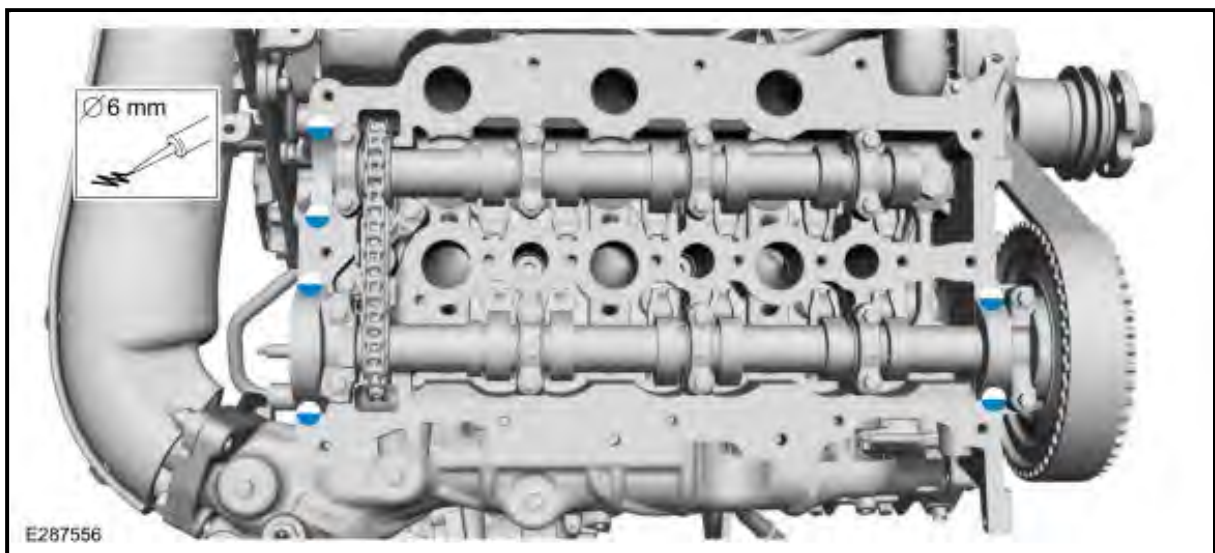


30. **NOTE:** If the valve cover is not installed and the fasteners tightened within 10 minutes, the sealant must be removed and the sealing area cleaned.

Apply an 6 mm dot of Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone to the locations shown.

Material

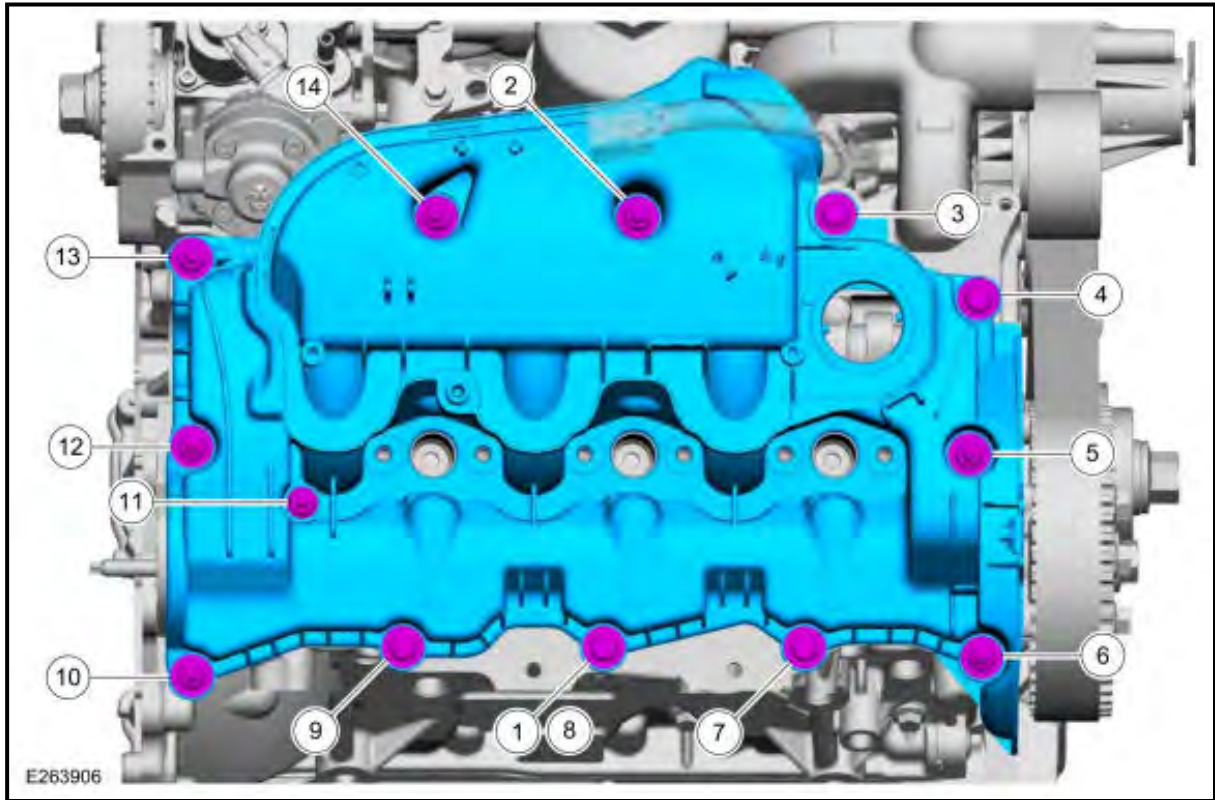
: Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



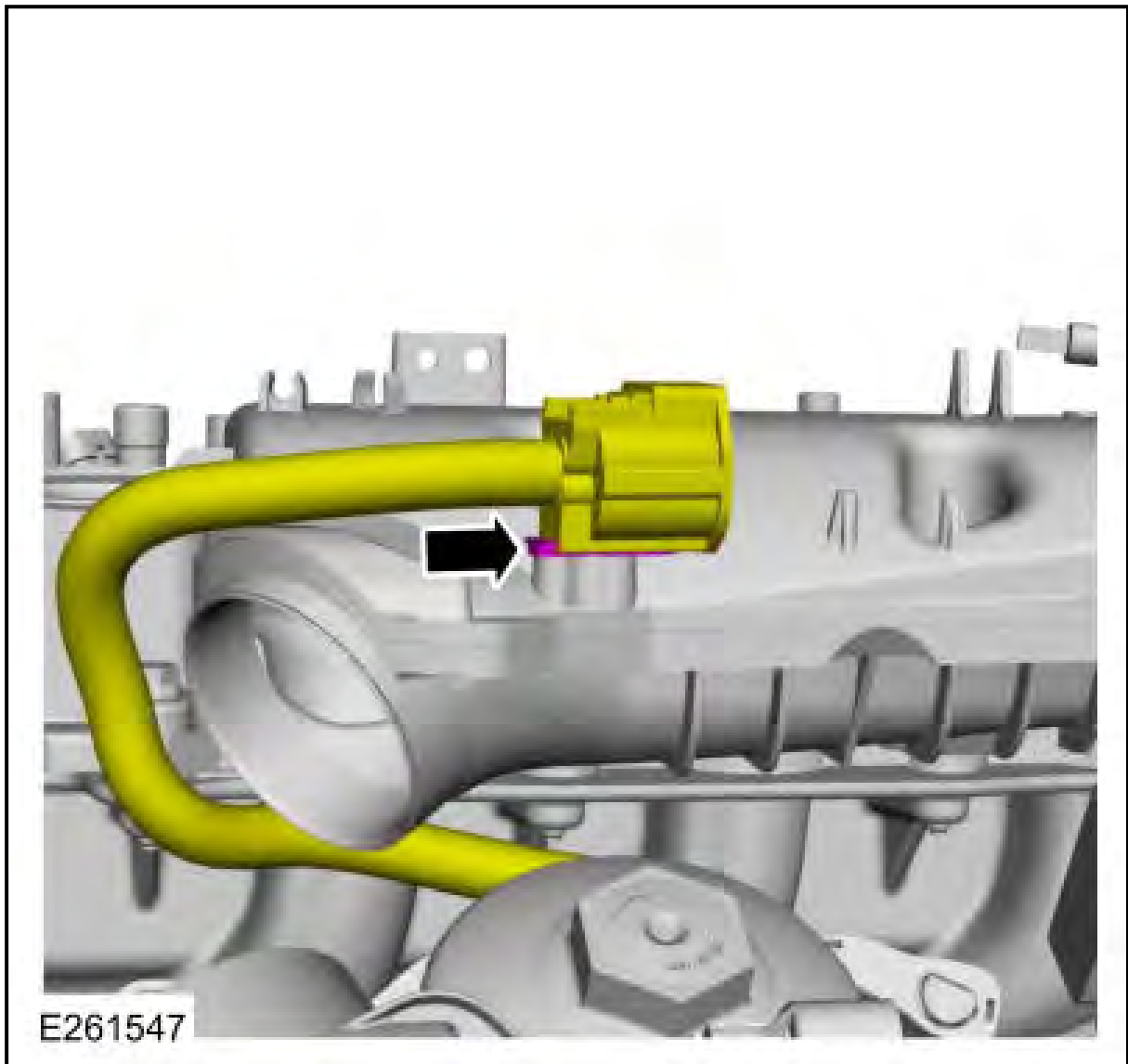
31. Install the RH valve cover and tighten the fasteners.

Torque

:Stage 1: Tighten bolt number 1 to : 9 lb.in (1 Nm)Stage 2: Tighten bolts 2 thru 14 to : 89 lb.in (10 Nm)



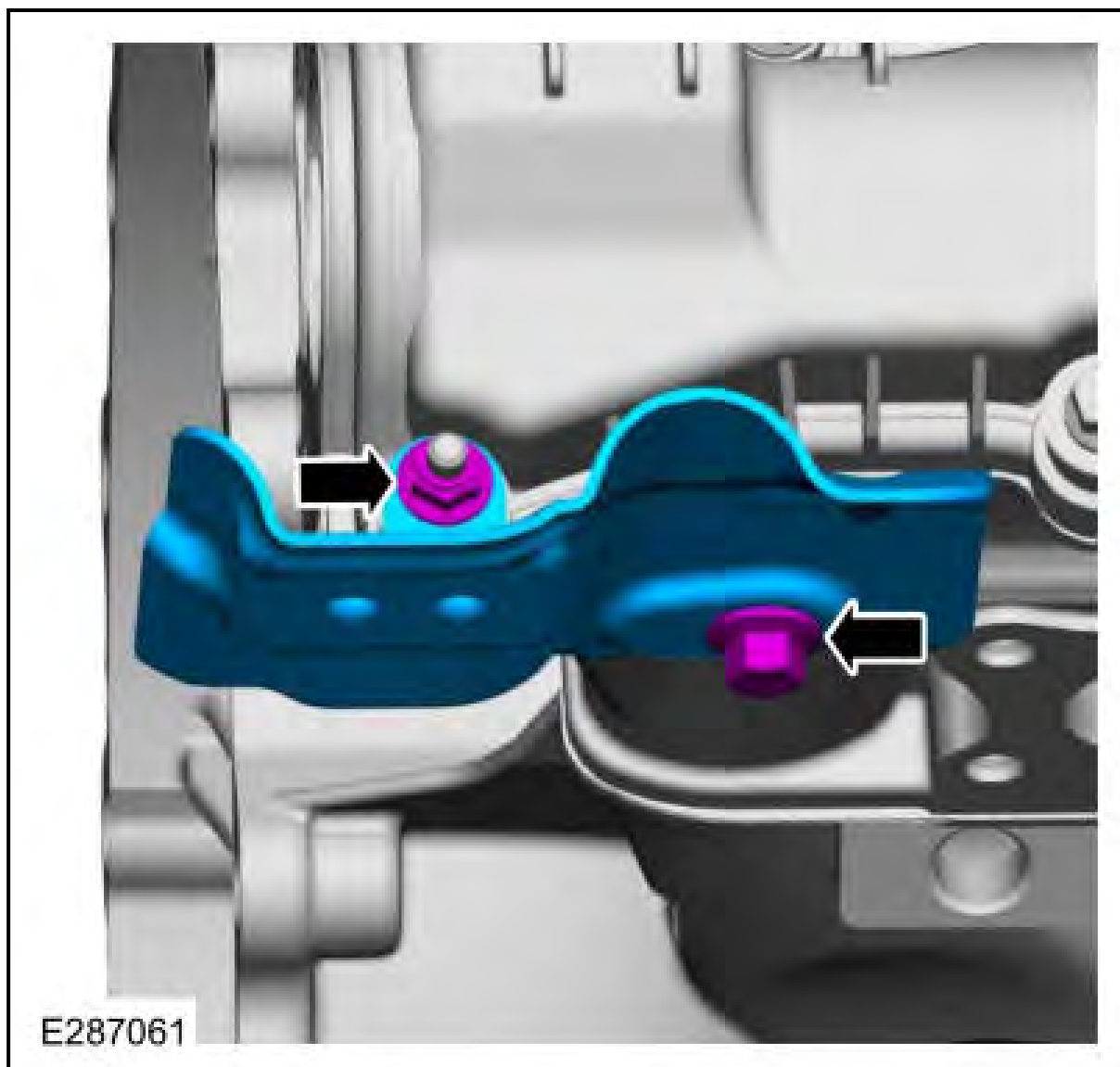
32. Connect the RH glow plug electrical connector.



33. Install the turbocharger heat shield, the nut and the bolt.

Torque

:Nut : 53 lb.in (6 Nm) Bolt : 18 lb.ft (24 Nm)

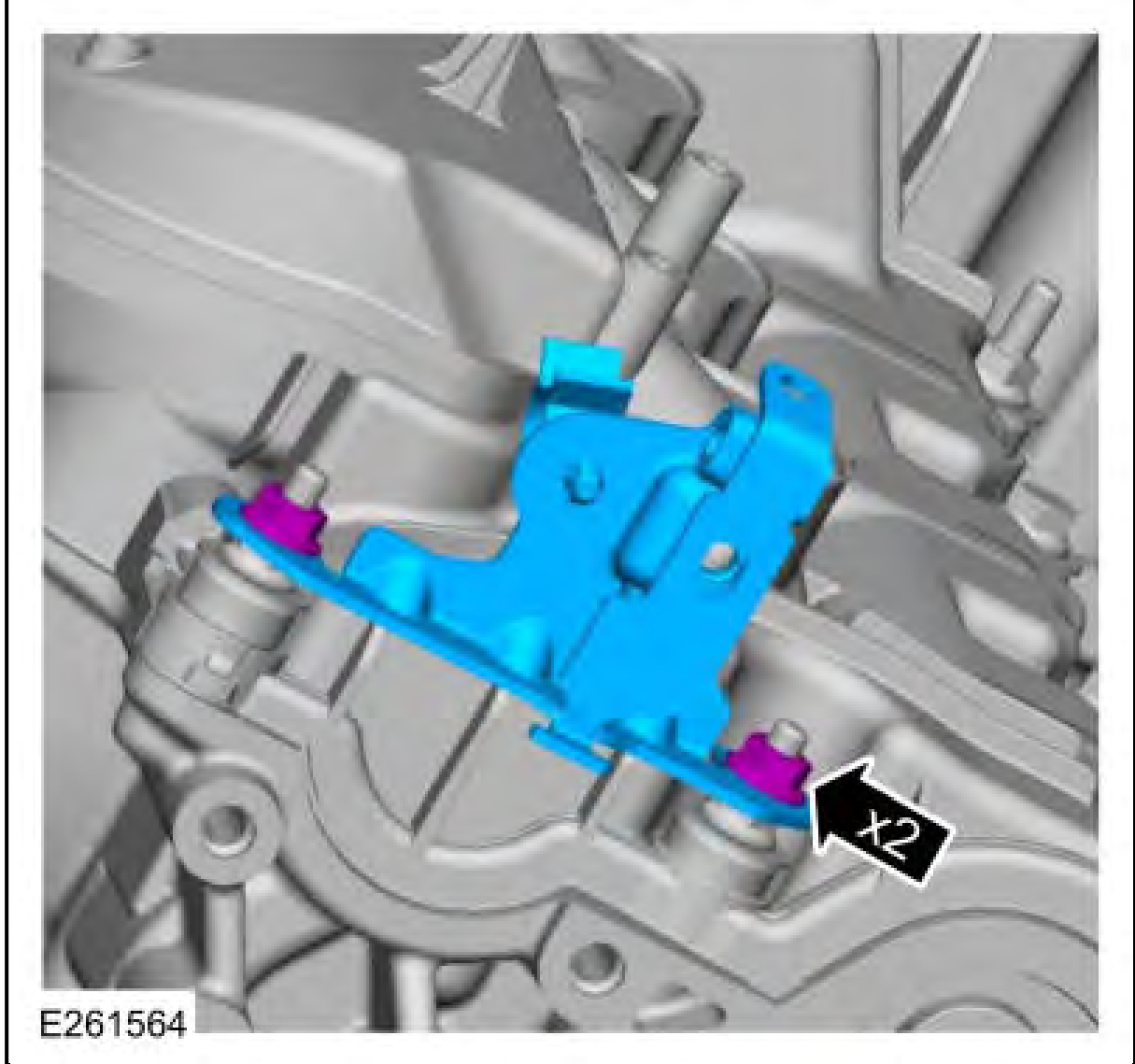


34. Install the RH fuel tube bracket and the nuts.

Torque

: 89 lb.in (10 Nm)

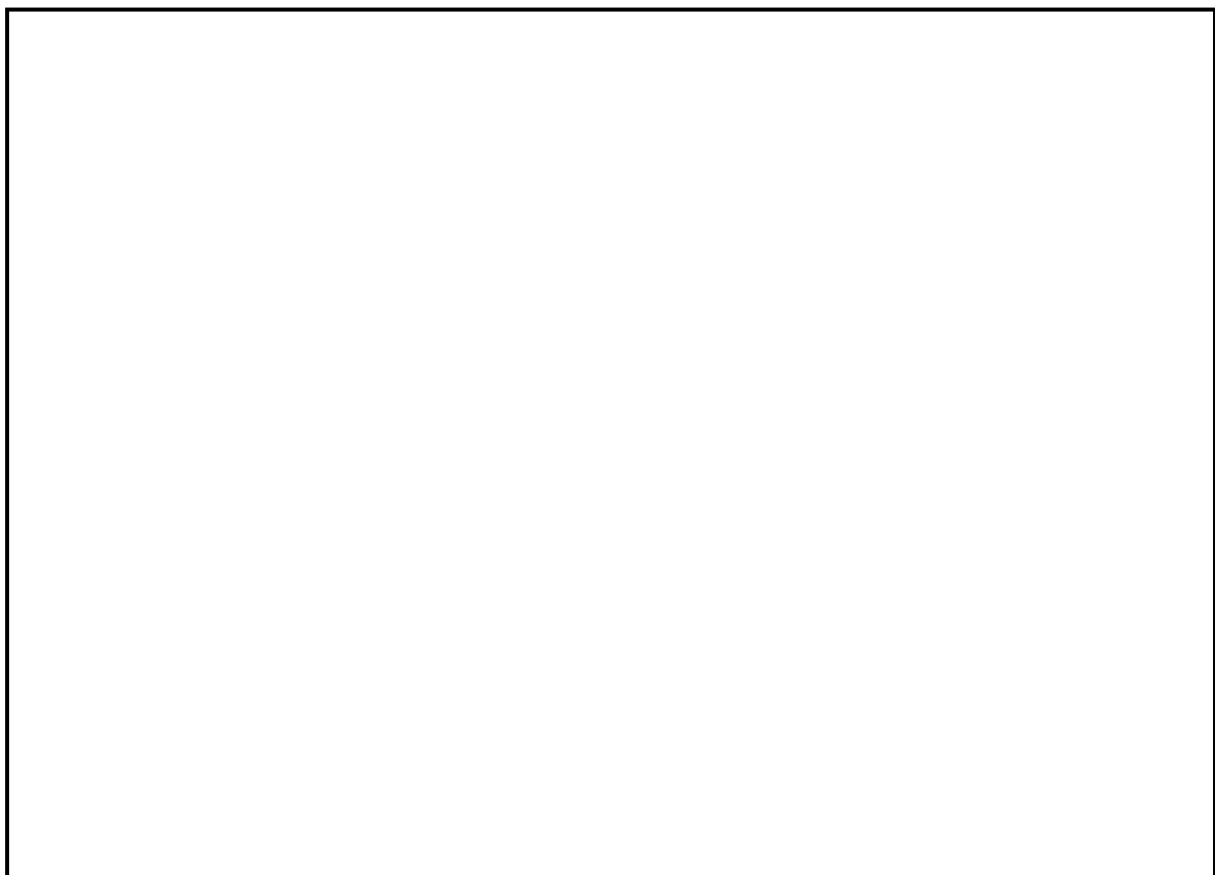


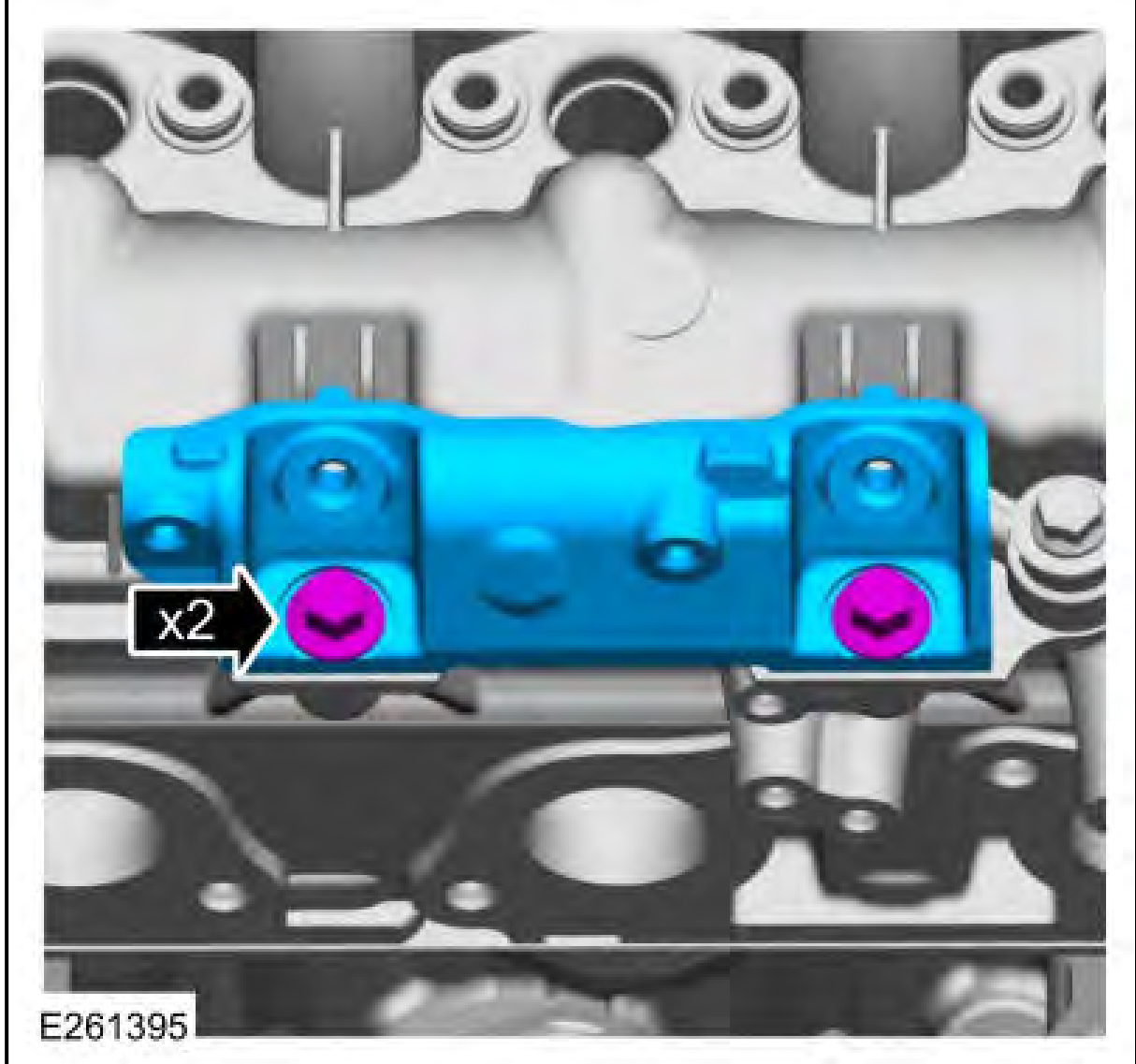


35. Install the RH fuel rail bracket and the bolts.

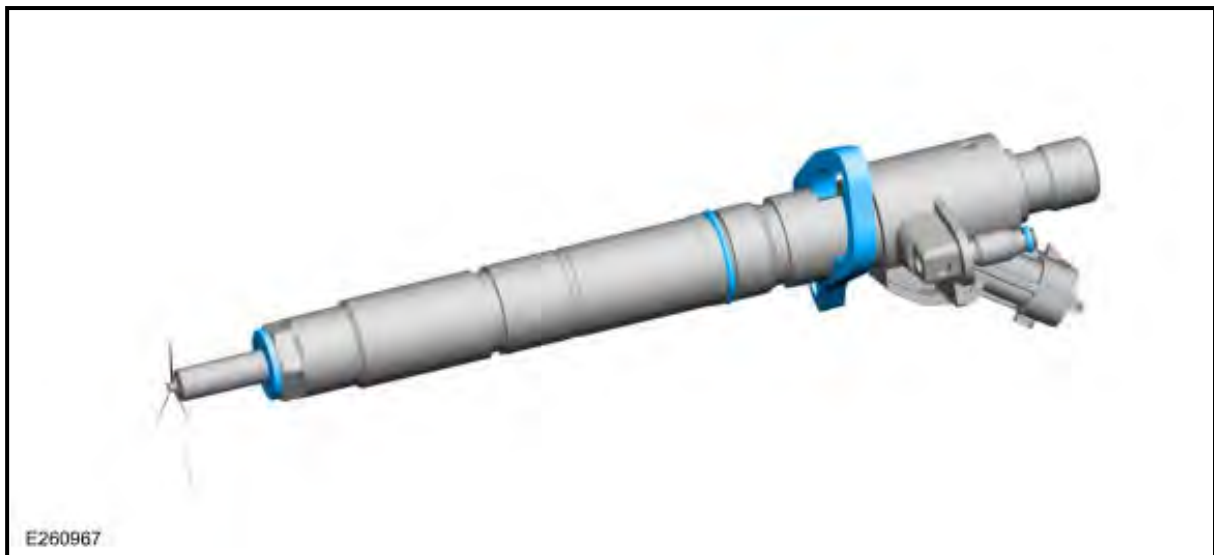
Torque

: 17 lb.ft (23 Nm)





36. Install the sealing washer, the O-rings and the fuel injector hold down.

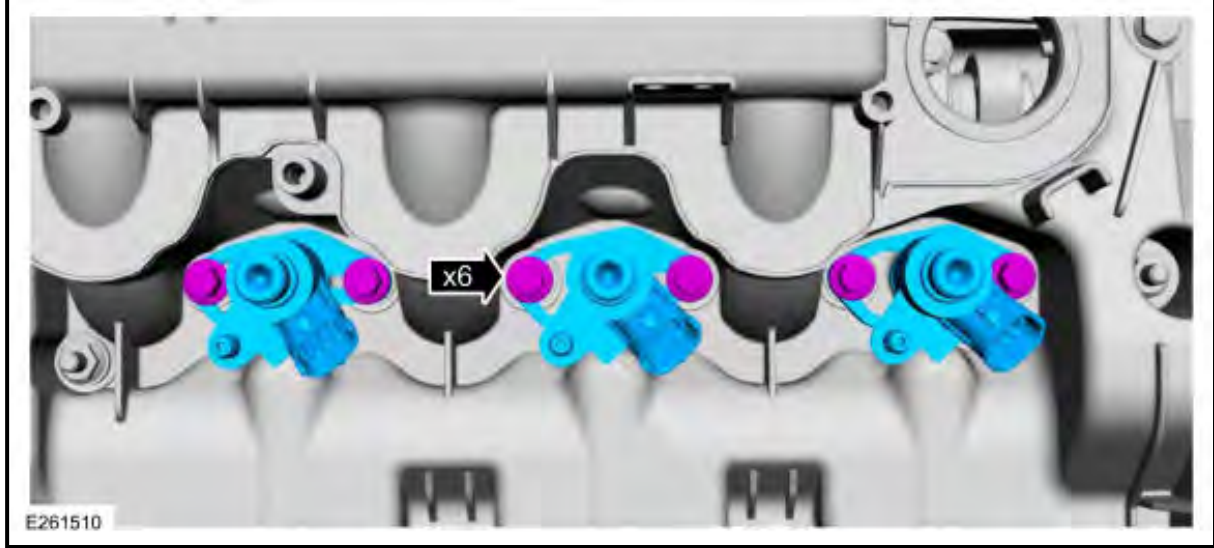


37. Install the RH fuel injectors and bolts.

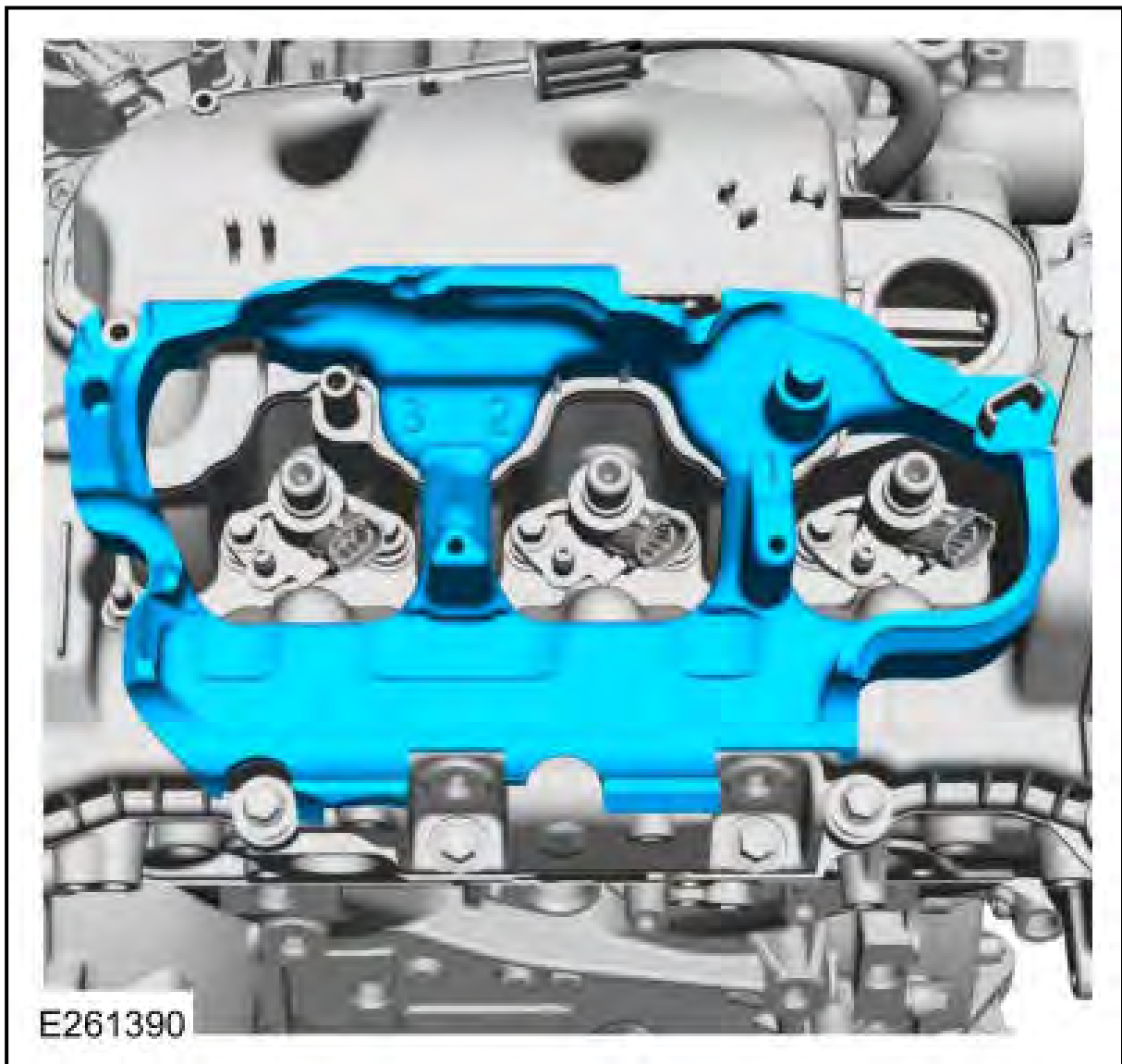
Torque

: 89 lb.in (10 Nm)





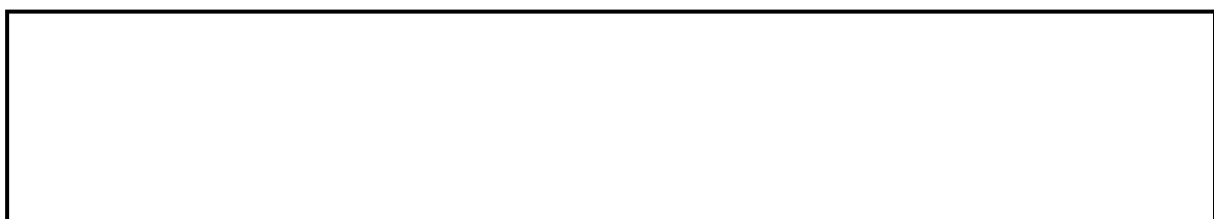
38. Install the RH fuel injector noise insulator.



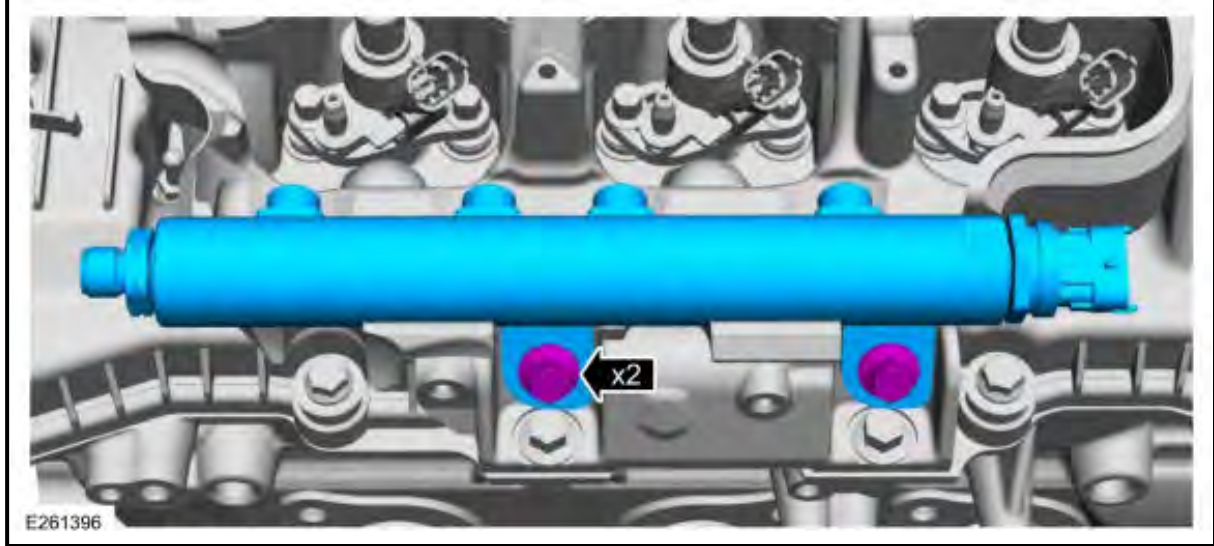
39. Install the RH fuel rail and the bolts.

Torque

: 17 lb.ft (23 Nm)





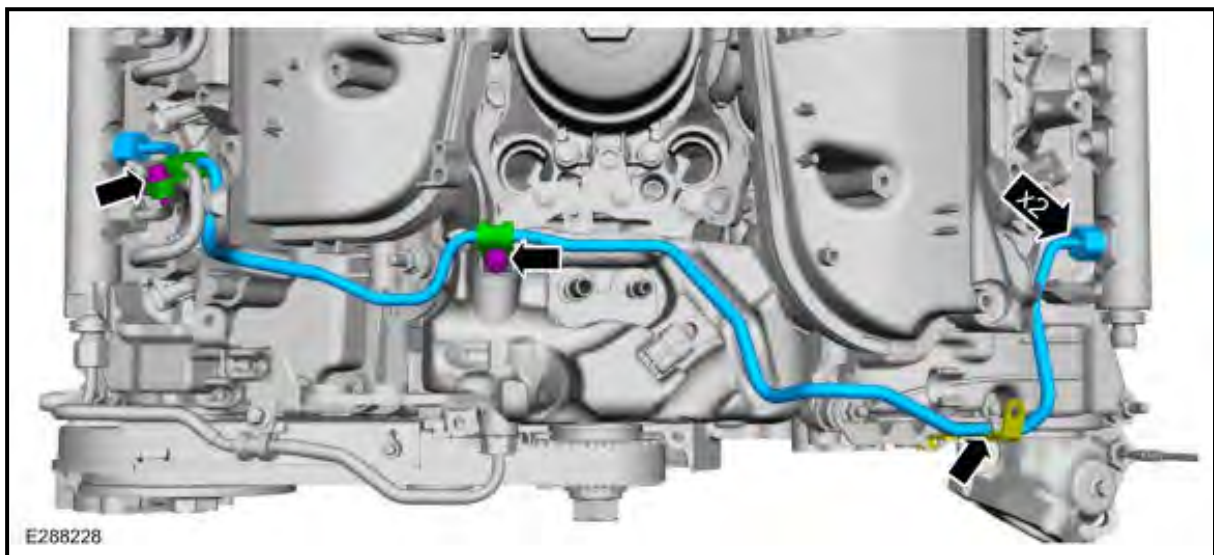


40. **NOTE:** The component must be installed by hand before final tightening.

Install the fuel injection pump balance tube, the clamps and the bolts.

Torque

:Stage 1: Tighten the clamp bolts to: : 89 lb.in (10 Nm)Stage 2: Tighten the fuel injection pump balance tube to:: 89 lb.in (10 Nm)Stage 3: Tighten the fuel injection pump balance tube to:: 142 lb.in (16 Nm)Stage 4: Tighten the fuel injection pump balance tube to:: 50 Å°

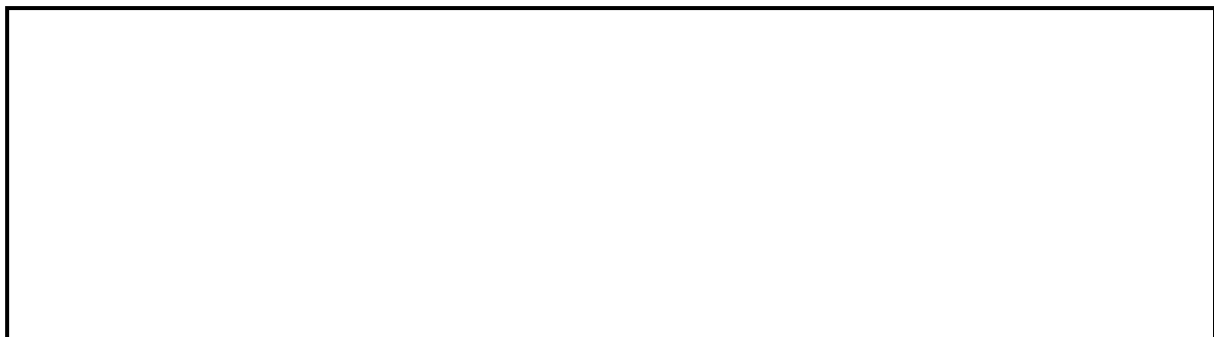


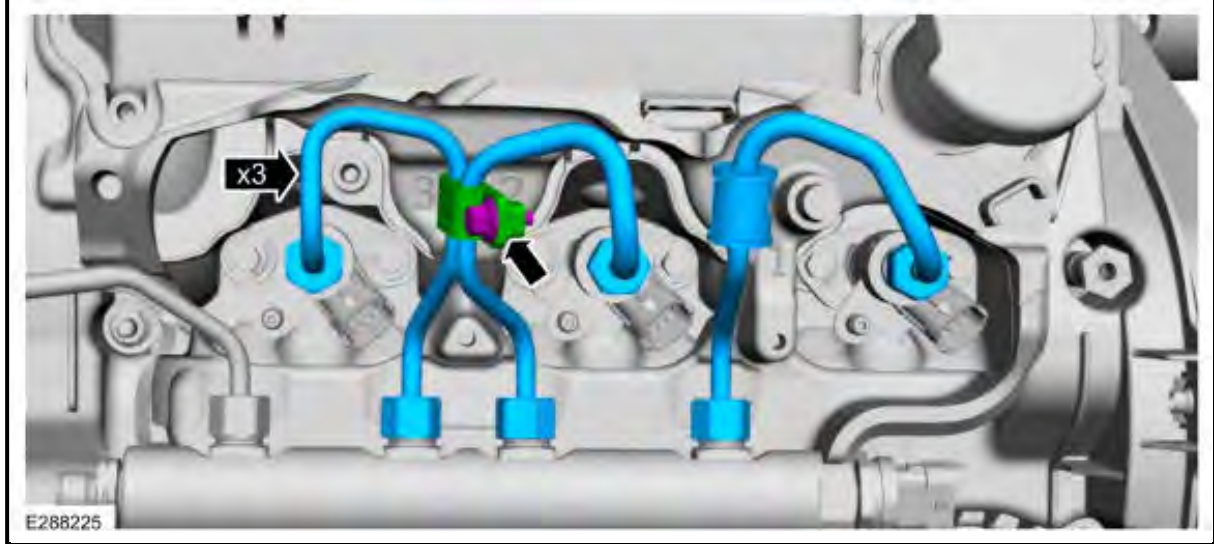
41. **NOTE:** The component must be installed by hand before final tightening.

Install the RH fuel injector supply tubes, the clamp and the bolt.

Torque

:Stage 1: Tighten the clamp bolt to: : 89 lb.in (10 Nm)Stage 2: Tighten at the fuel rail to:: 89 lb.in (10 Nm)Stage 3: Tighten at the fuel injector to:: 89 lb.in (10 Nm)Stage 4: Tighten at the fuel rail to:: 142 lb.in (16 Nm)Stage 5: Tighten at the fuel injector to:: 142 lb.in (16 Nm)Stage 6: Tighten at the fuel rail to:: 50 Å°Stage 7: Tighten at the fuel injector to:: 50 Å°



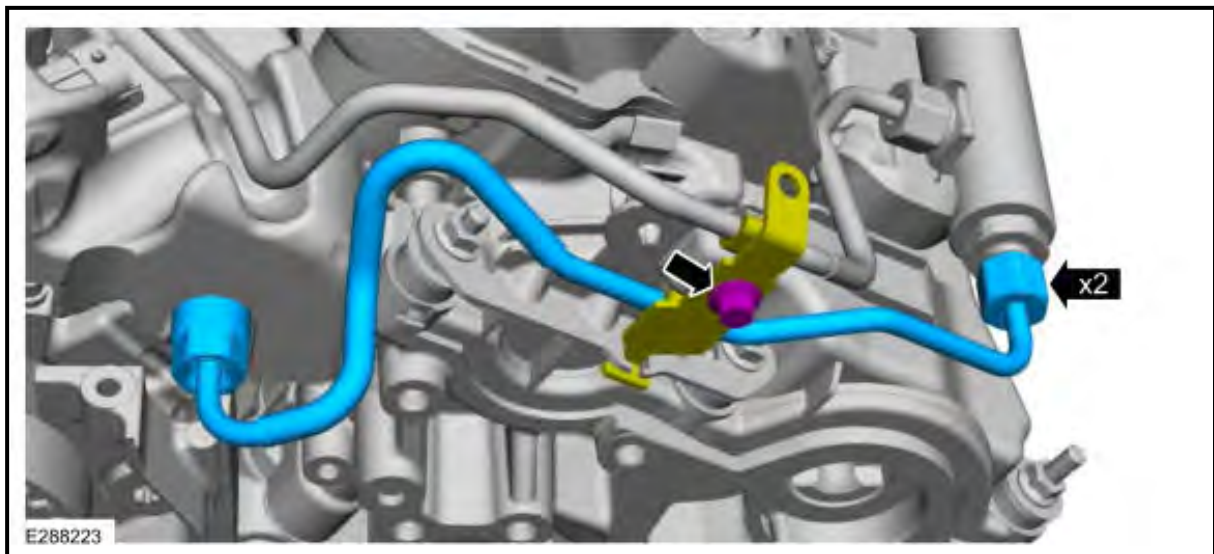


42. **NOTE:** The component must be installed by hand before final tightening.

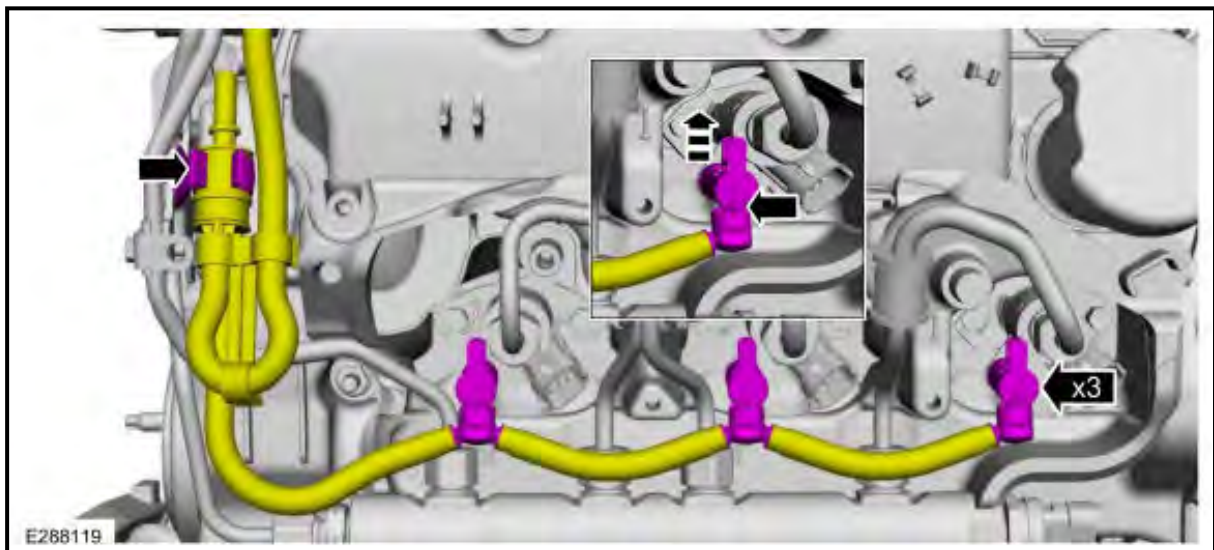
Install the RH fuel rail supply tube and the bolt.

Torque

:Stage 1: Tighten the clamp bolt to: : 89 lb.in (10 Nm)Stage 2: Tighten at the fuel rail to:: 89 lb.in (10 Nm)Stage 3: Tighten at the fuel injection pump to:: 89 lb.in (10 Nm)Stage 4: Tighten at the fuel rail to:: 142 lb.in (16 Nm)Stage 5: Tighten at the fuel injection pump to:: 142 lb.in (16 Nm)Stage 6: Tighten at the fuel rail:: 50 Å°Stage 7: Tighten at the fuel injection pump:: 50 Å°



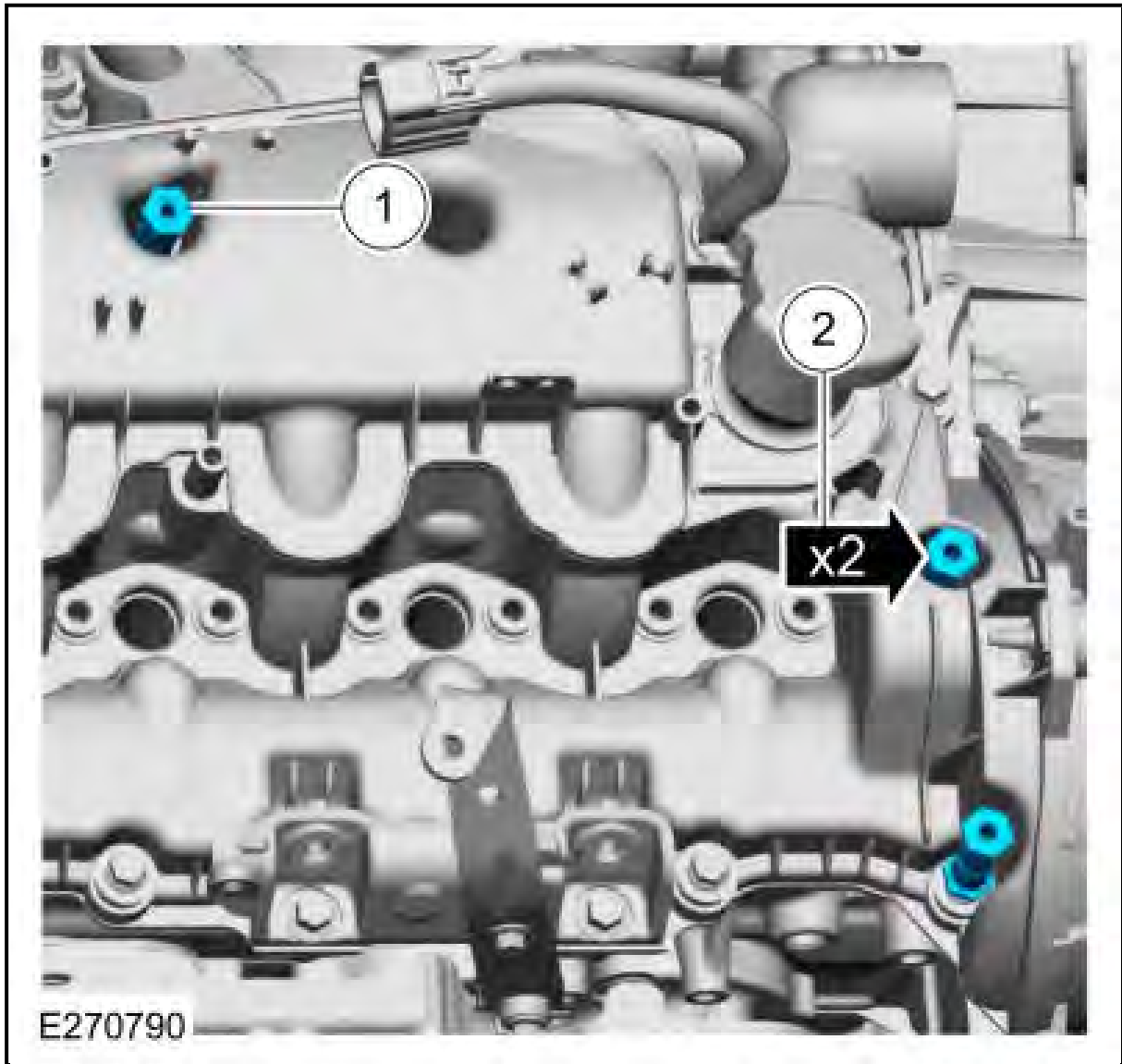
43. Position back and connect the RH fuel return hose assembly.



44. Install the RH engine cover stud assemblies.

Torque

: 1 : 44 lb.in (5 Nm) 2 : 62 lb.in (7 Nm)

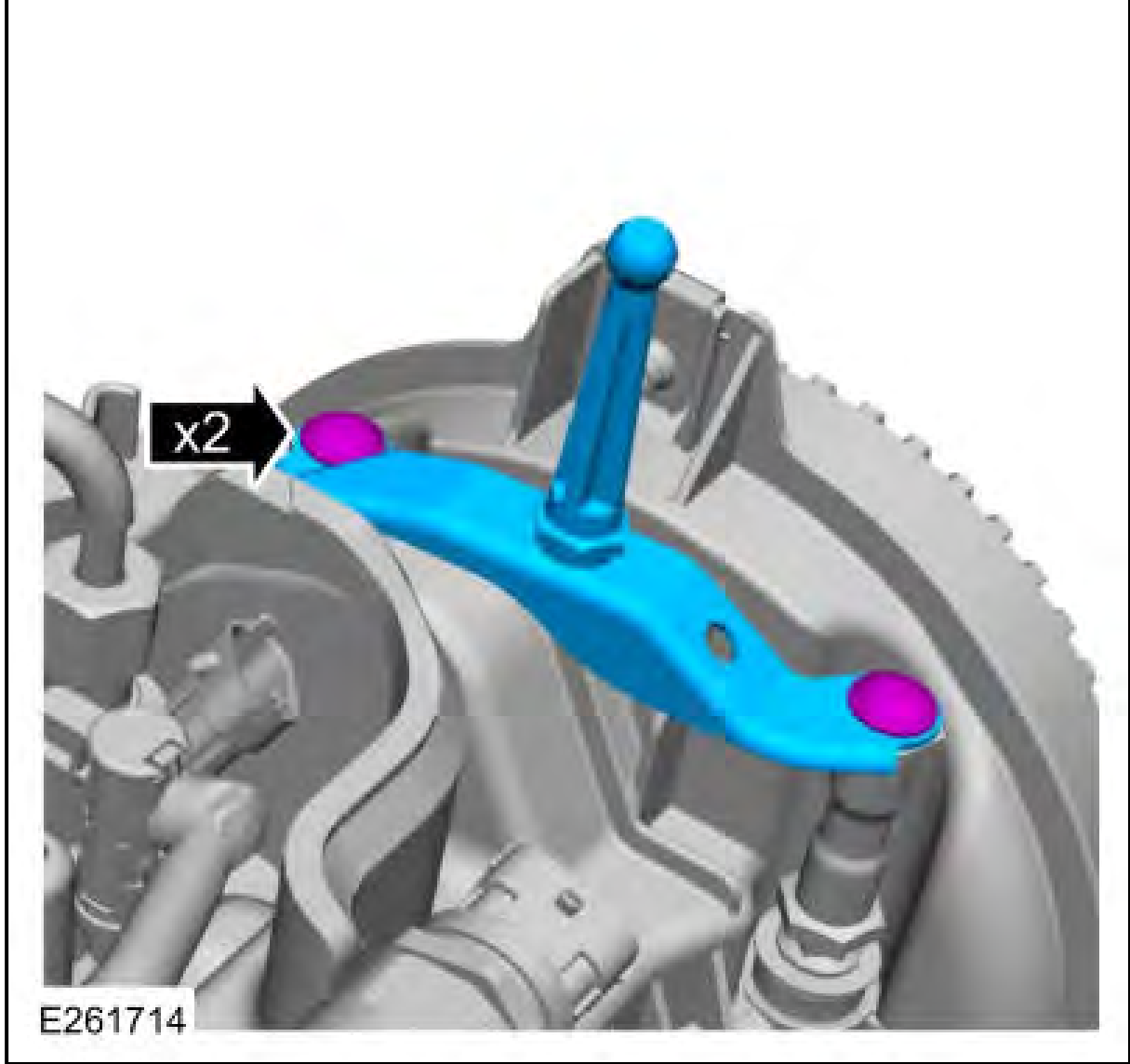


45. Install the engine support bracket and the retainers.

Torque

: 62 lb.in (7 Nm)

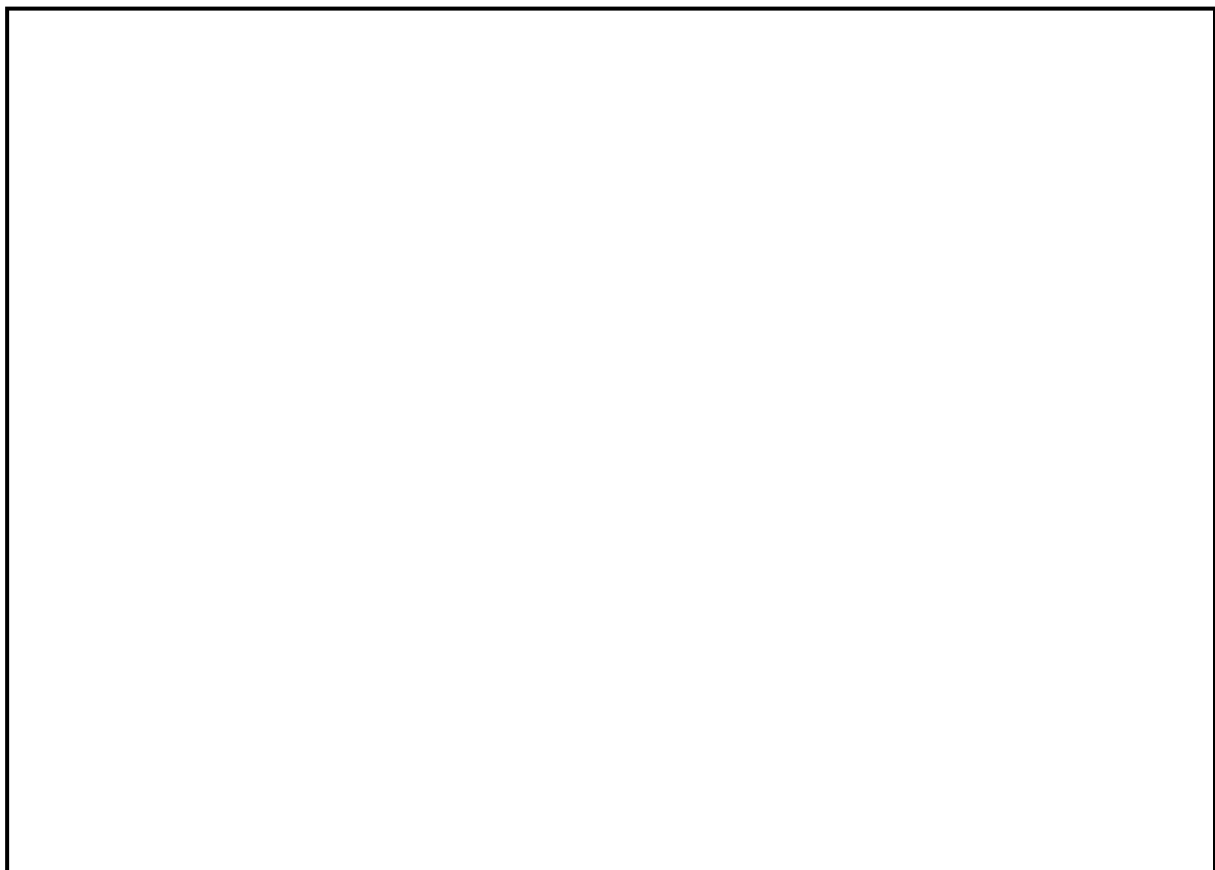


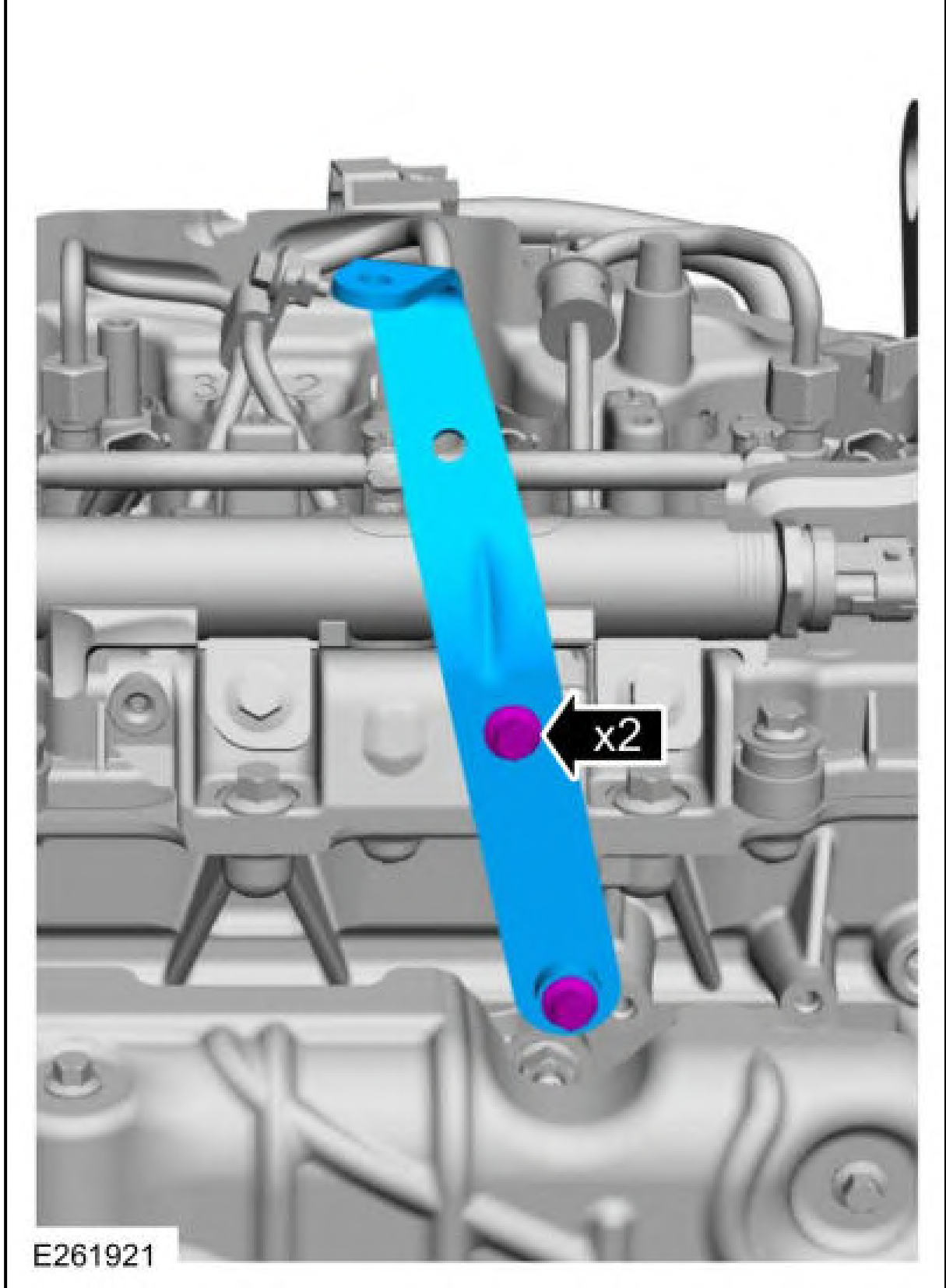


46. Install the heater hose support bracket and the bolts.

Torque

: 89 lb.in (10 Nm)



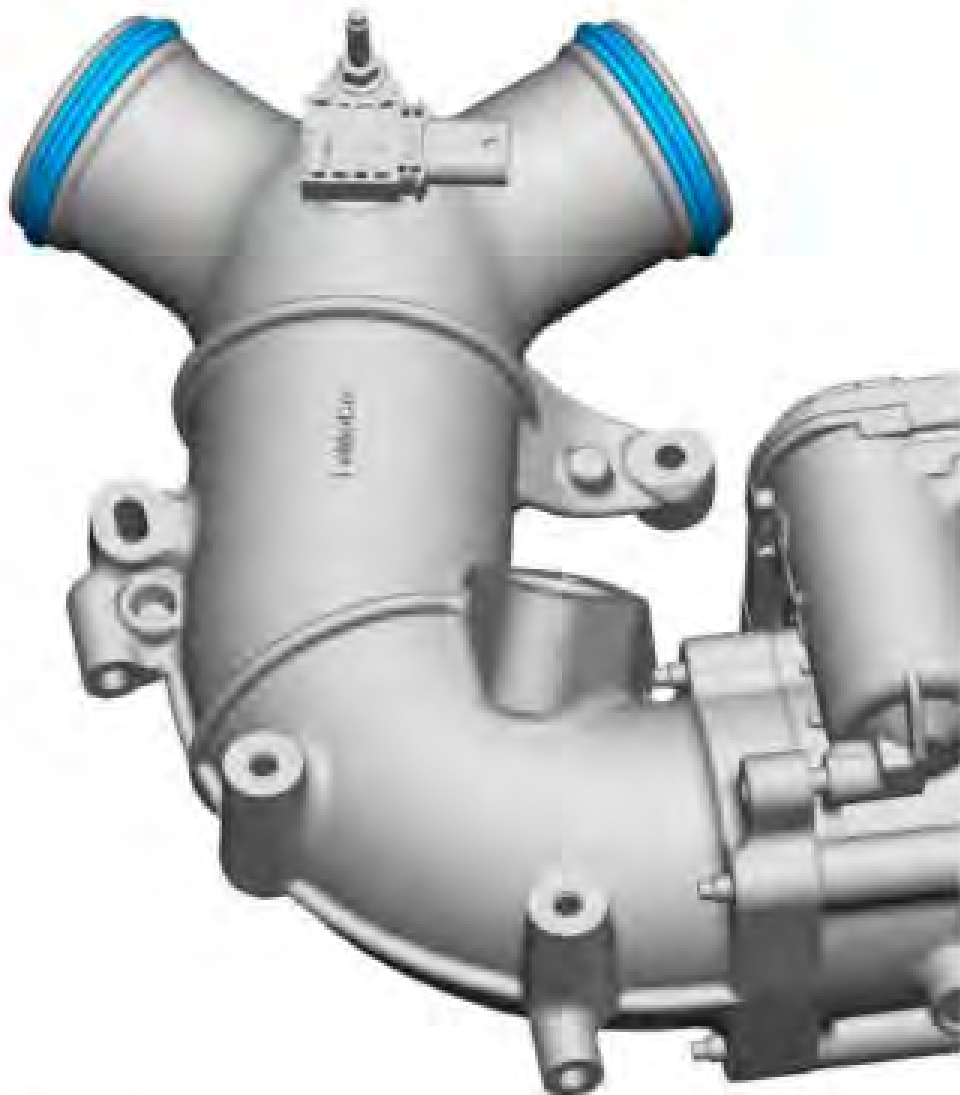
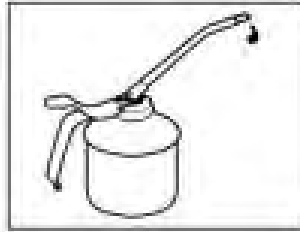


47. Install new gaskets on the intake manifold. Lubricate the gaskets with clean engine oil.

Material

: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)





E261599

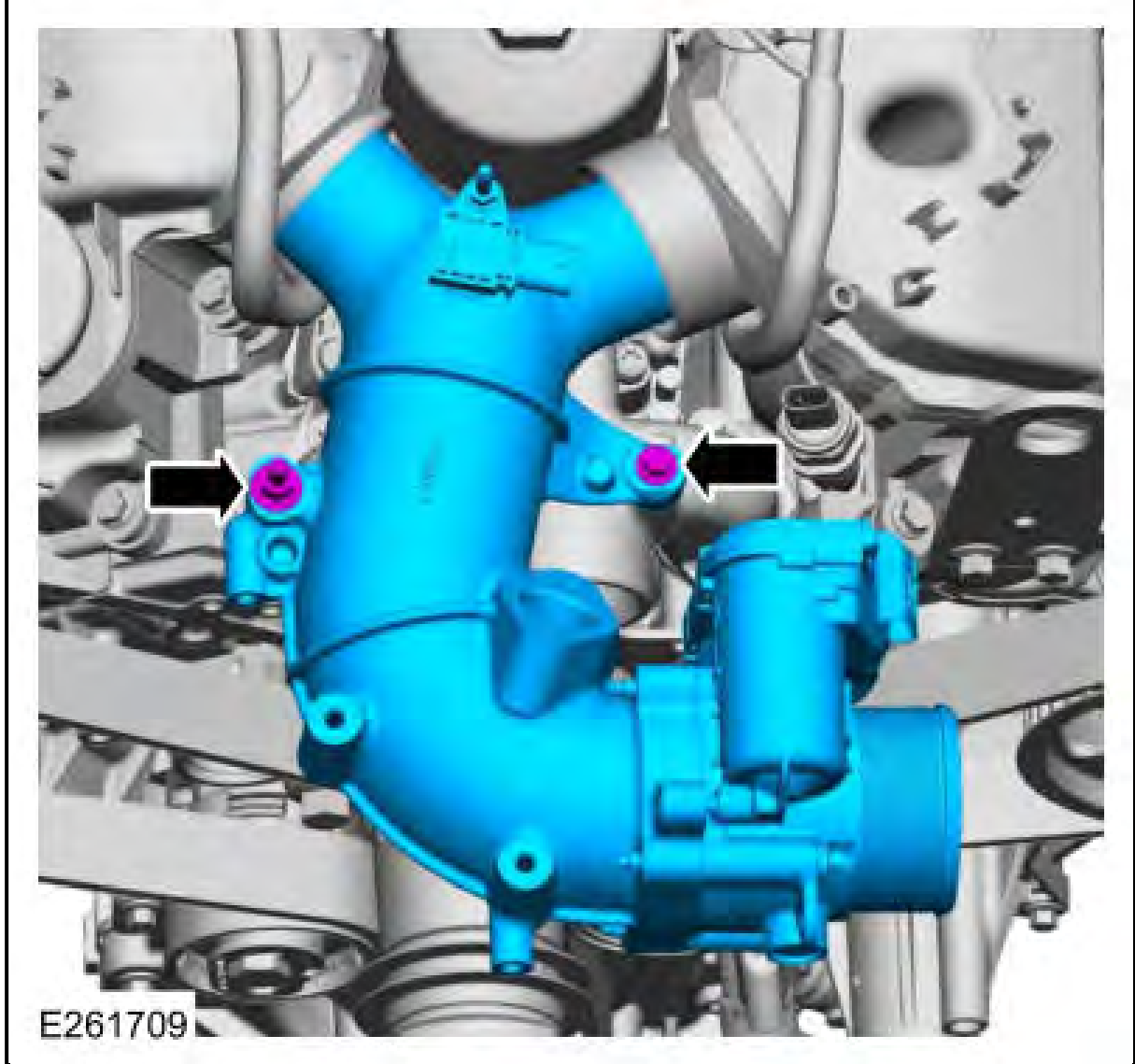
48. **NOTE:** Install the intake manifold into the LH valve cover, then into the RH valve cover.

Install the intake manifold, the stud bolt and the bolt.

Torque

: 89 lb.in (10 Nm)

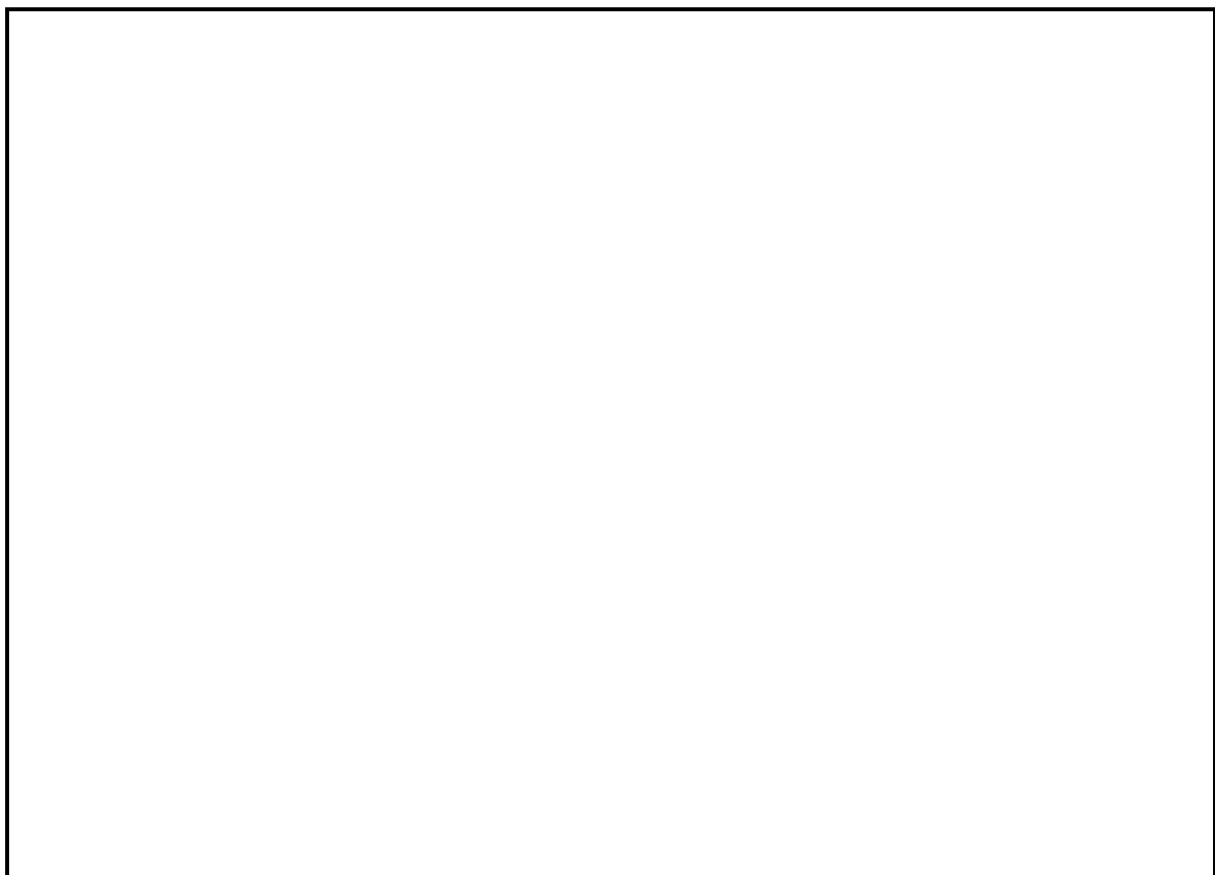


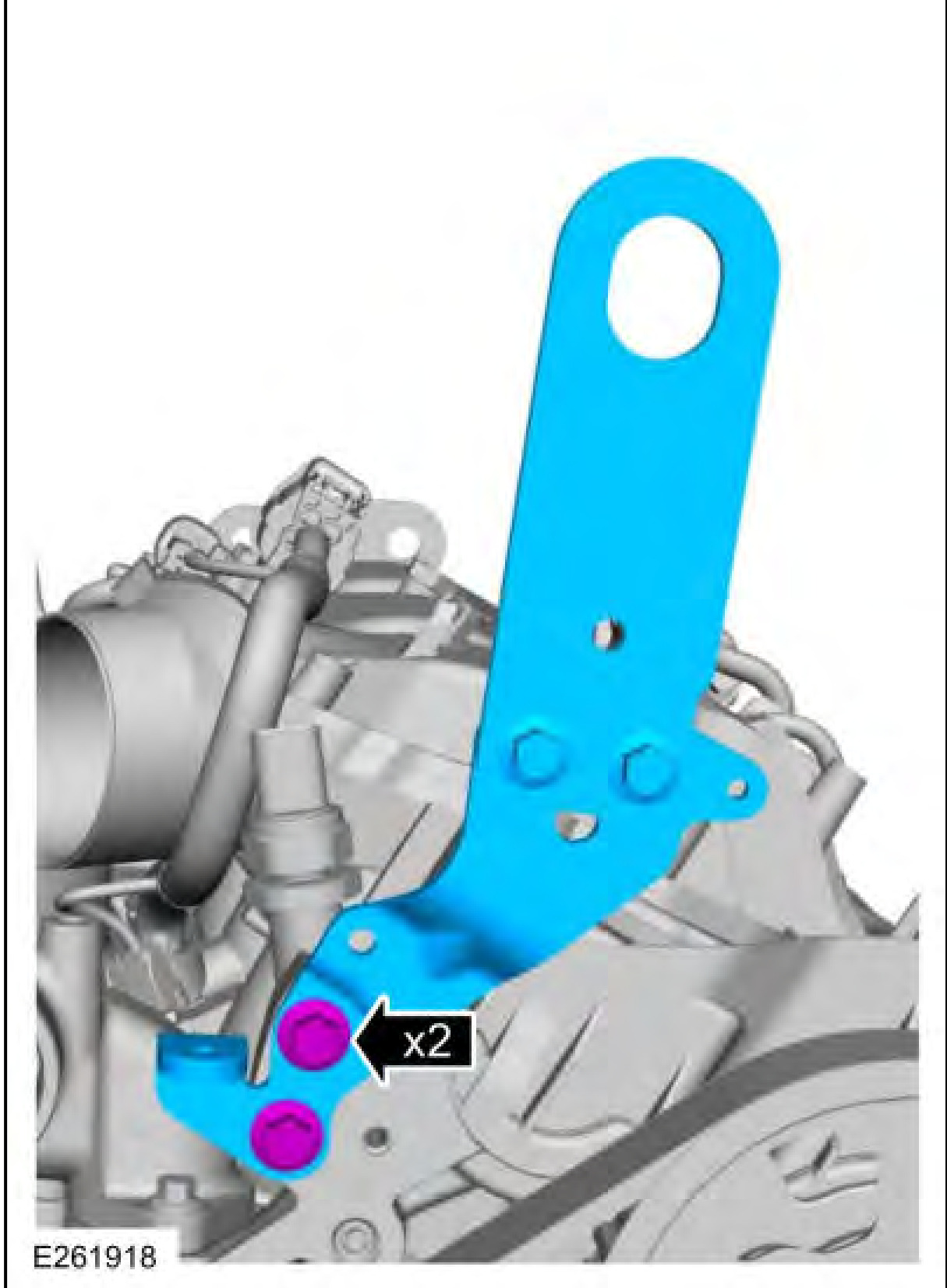


49. Install the front engine lifting eye and the bolts.

Torque

: 17 lb.ft (23 Nm)

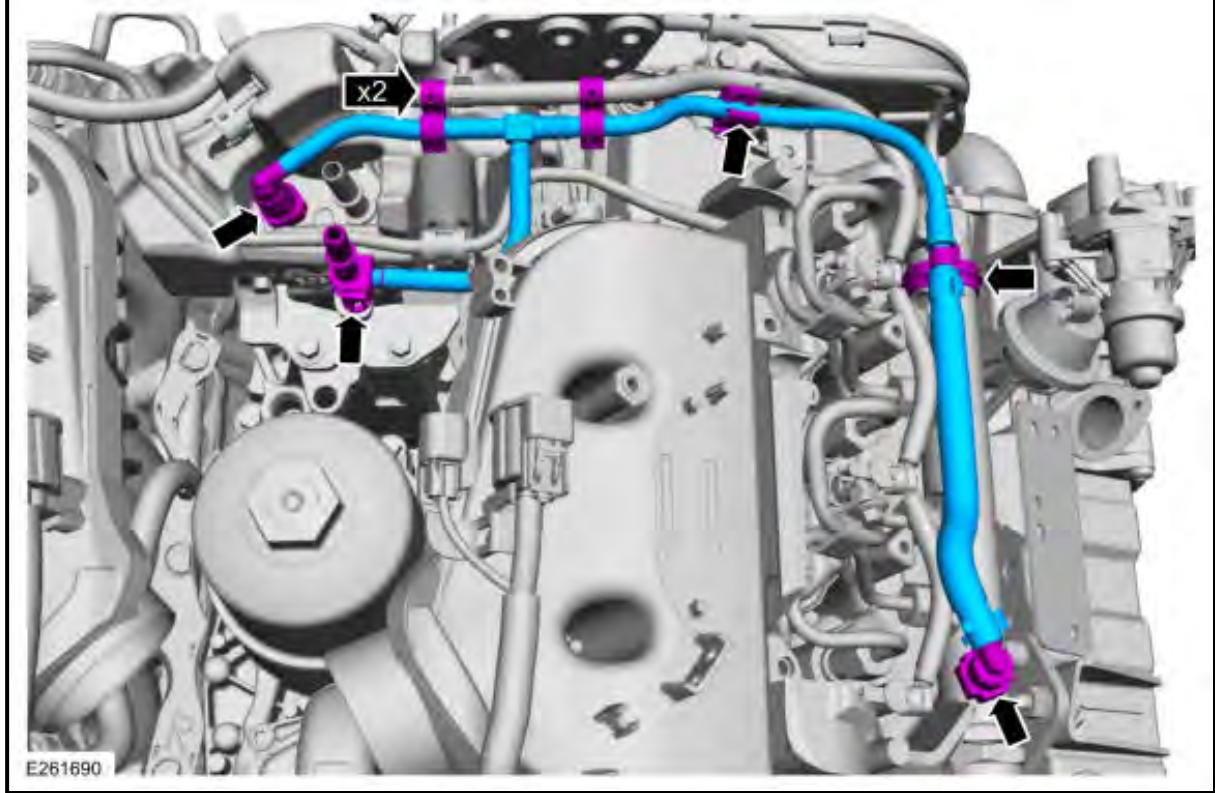




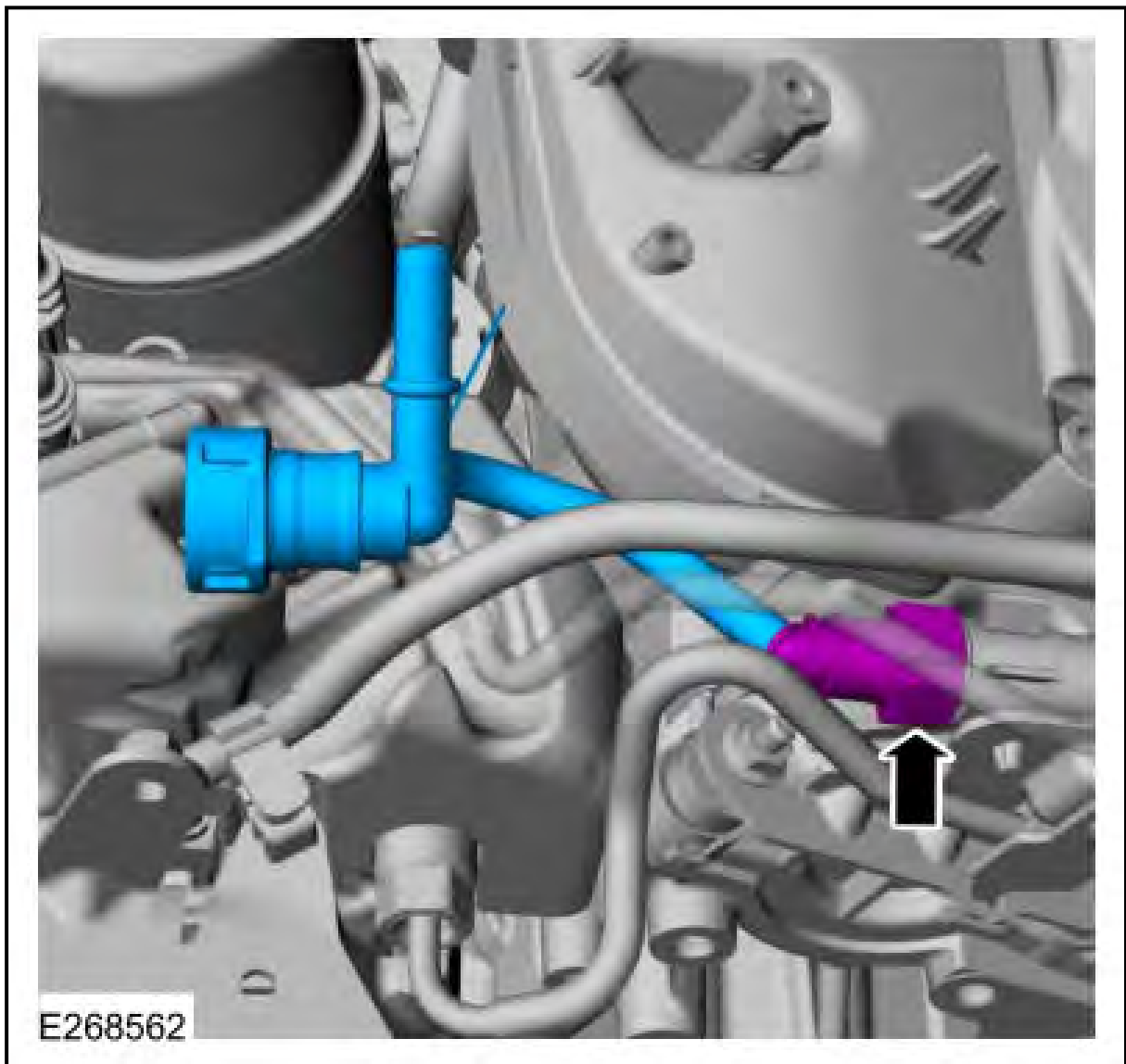
50. Install the fuel return tube assembly. Refer to: [Quick Release Coupling](#) .







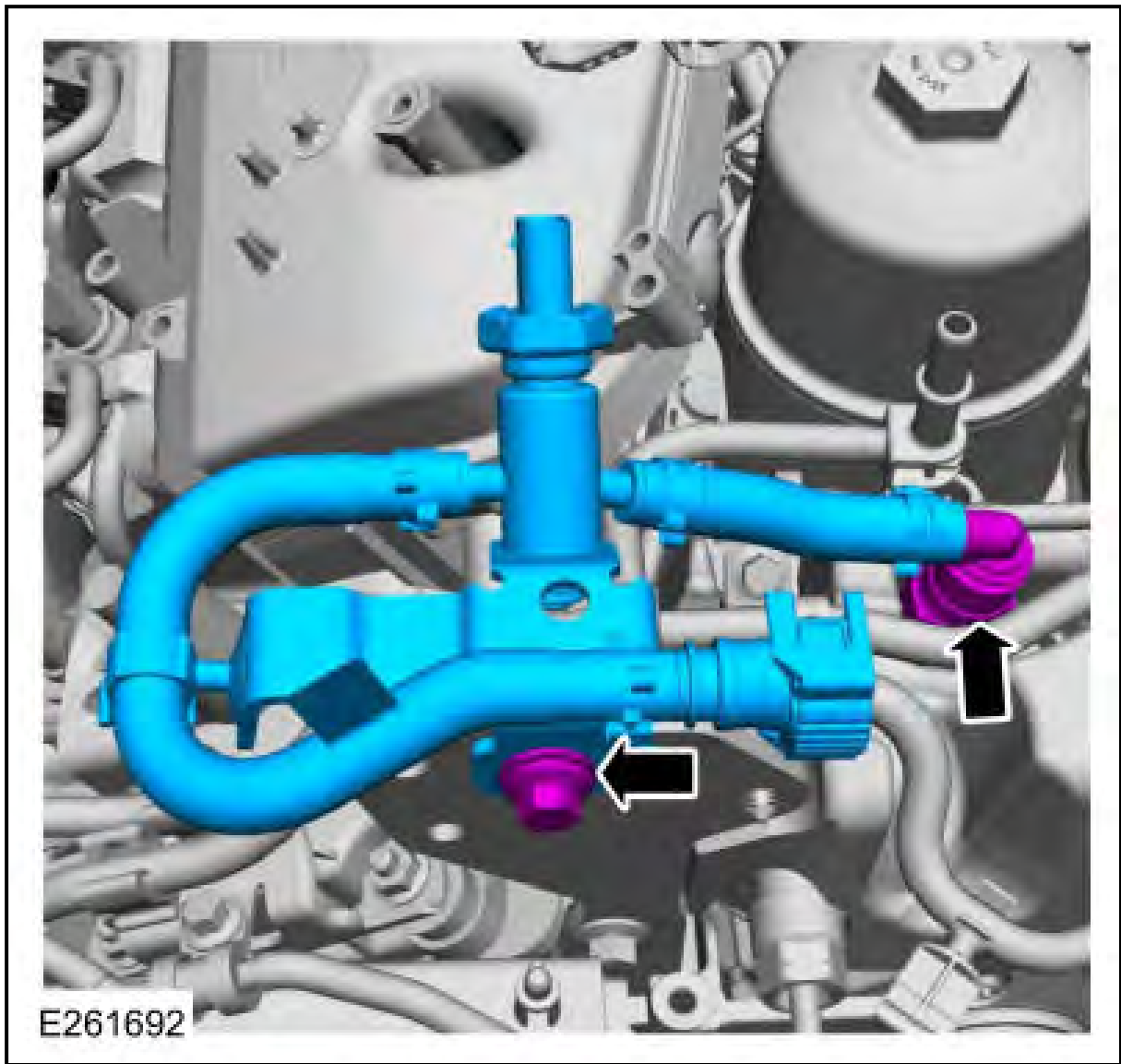
51. Install the fuel supply tube. Refer to: [Quick Release Coupling](#) .



52. Install the fuel supply tube and the bolt. Refer to: [Quick Release Coupling](#) .

Torque

: 17 lb.ft (23 Nm)

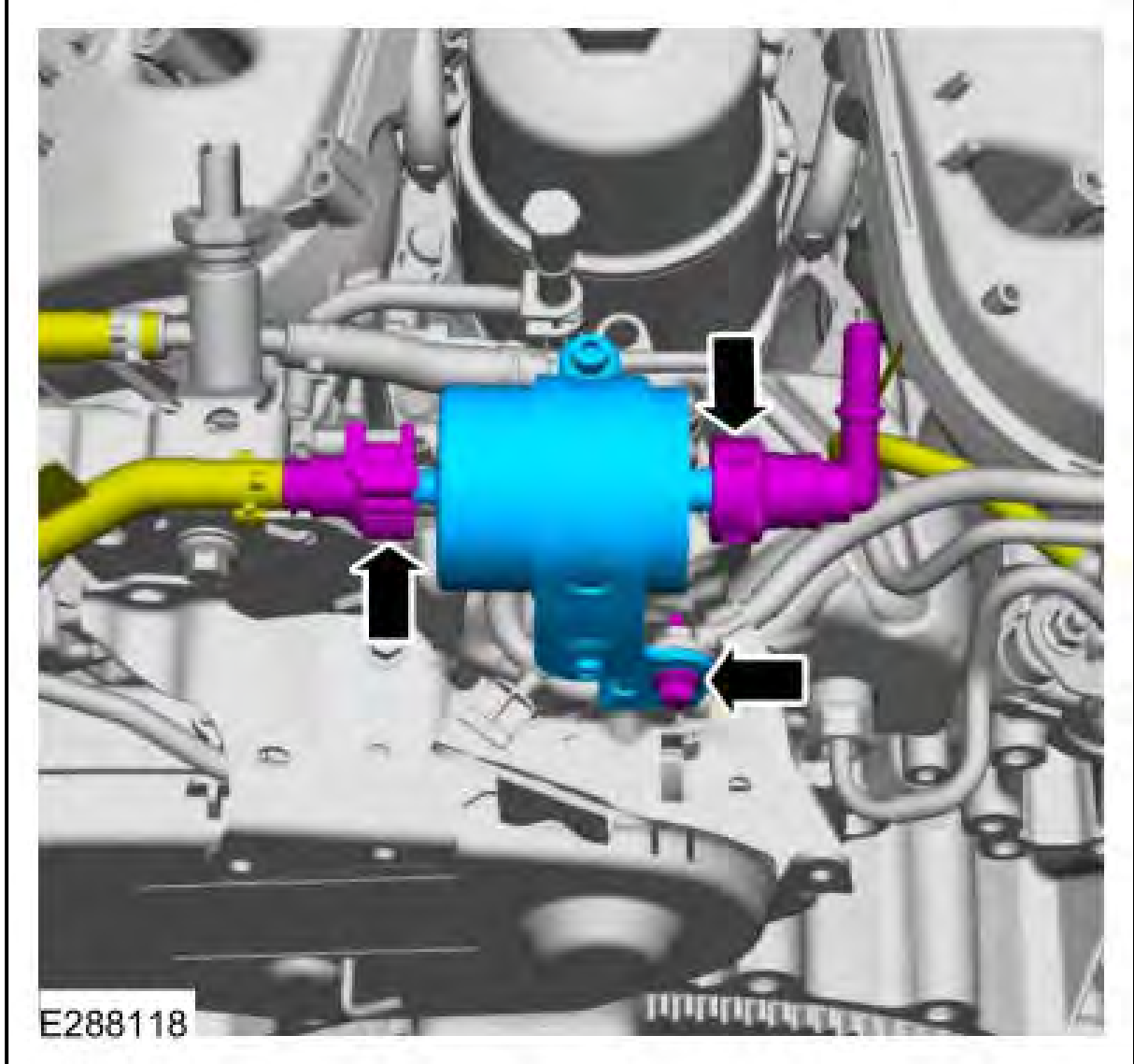


53. Install the secondary fuel filter and the bolt. Connect the fuel lines. Refer to: [Quick Release Coupling](#) .

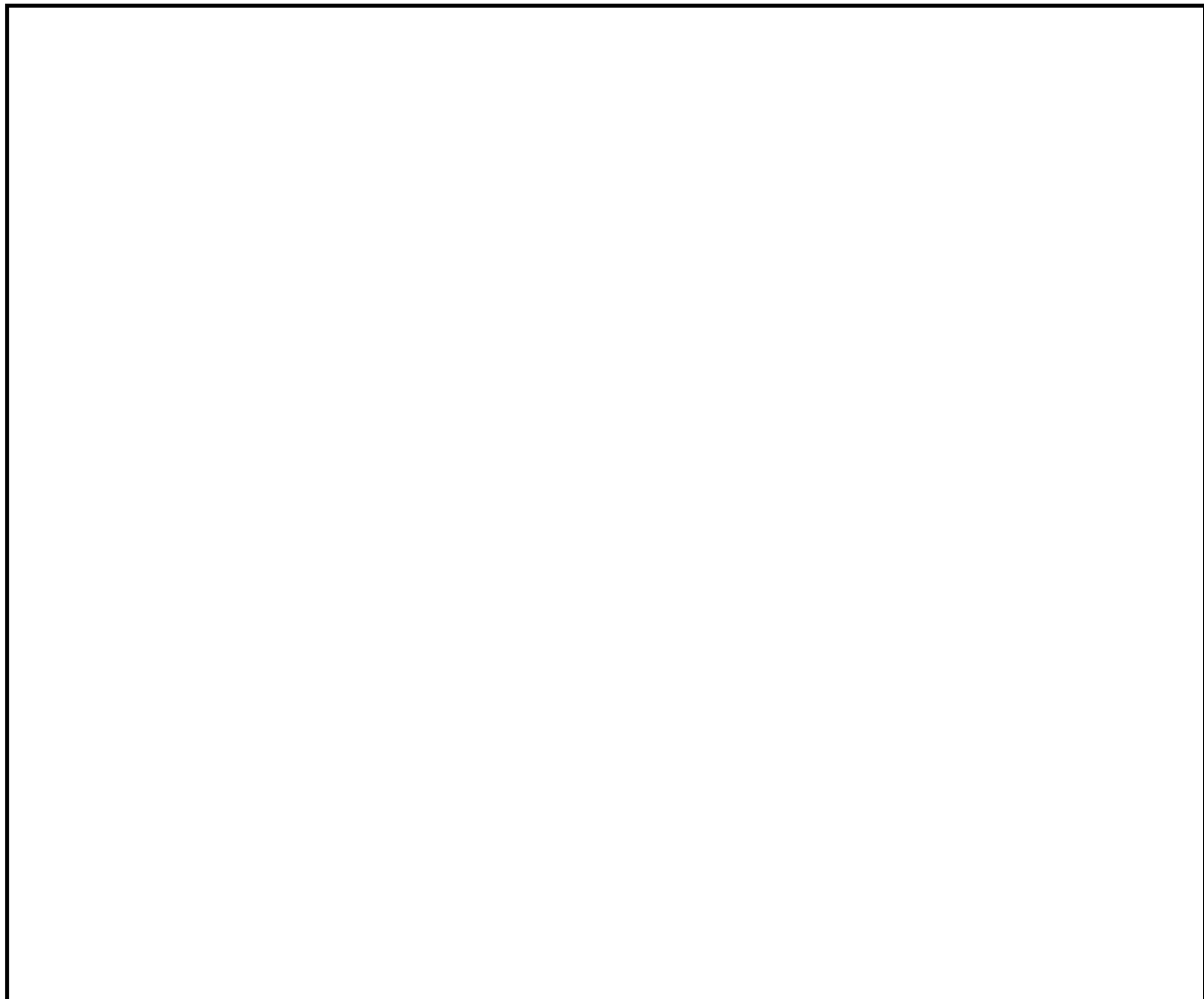
Torque

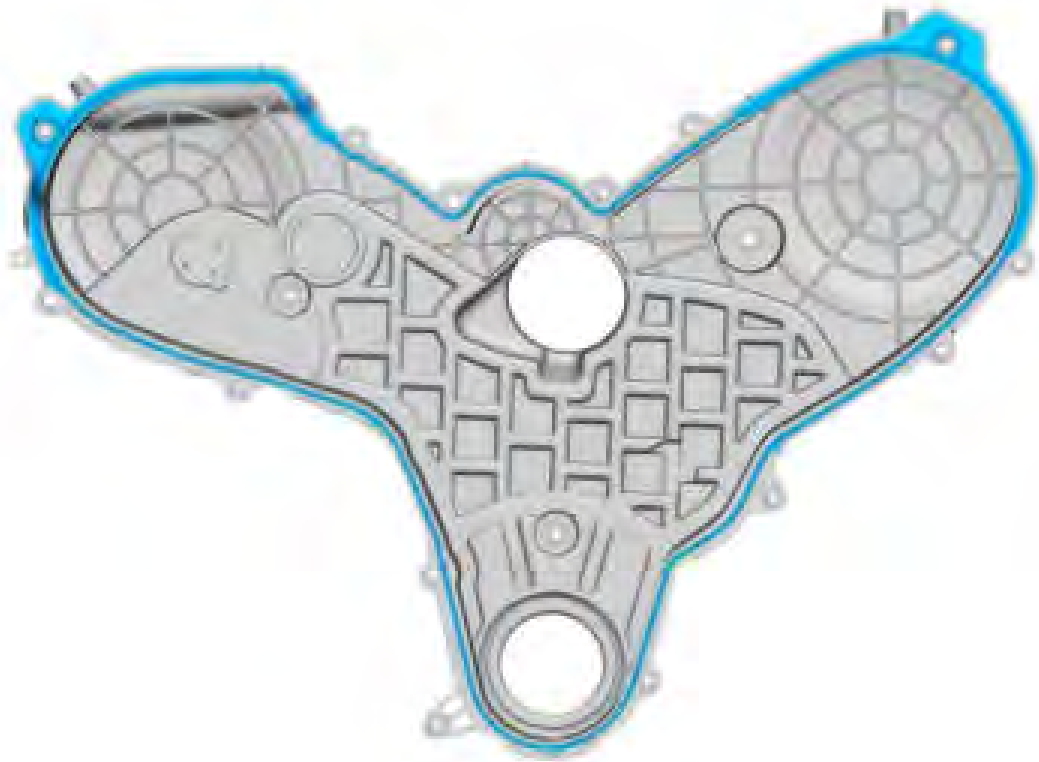
: 89 lb.in (10 Nm)





54. Install a new timing belt cover gasket.



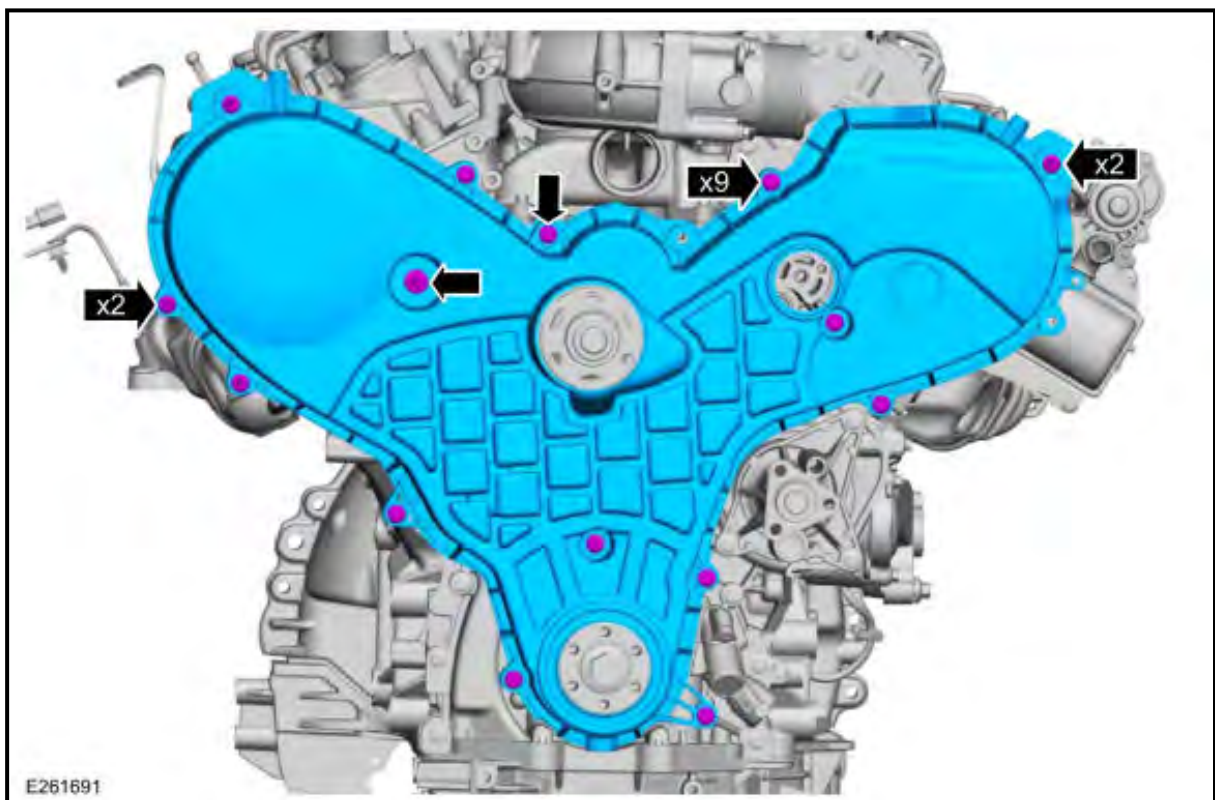


E261122

55. Install the timing belt cover, the stud bolts and the bolts.

Torque

: 89 lb.in (10 Nm)



E261691

56.

- Using new gaskets, install the EGR outlet tube and the bolts.

Torque

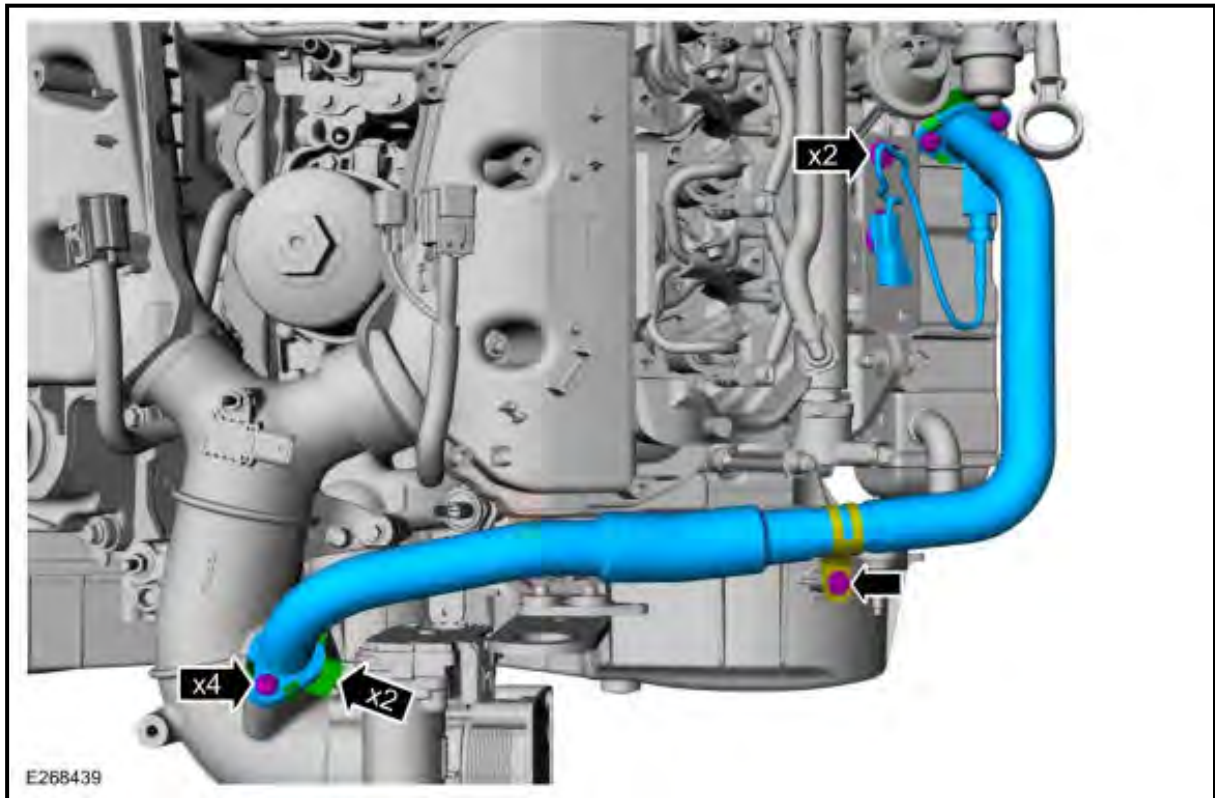
: 89 lb.in (10 Nm)

- Install the retainer in the timing belt cover.

Torque

: 31 lb.in (3.5 Nm)

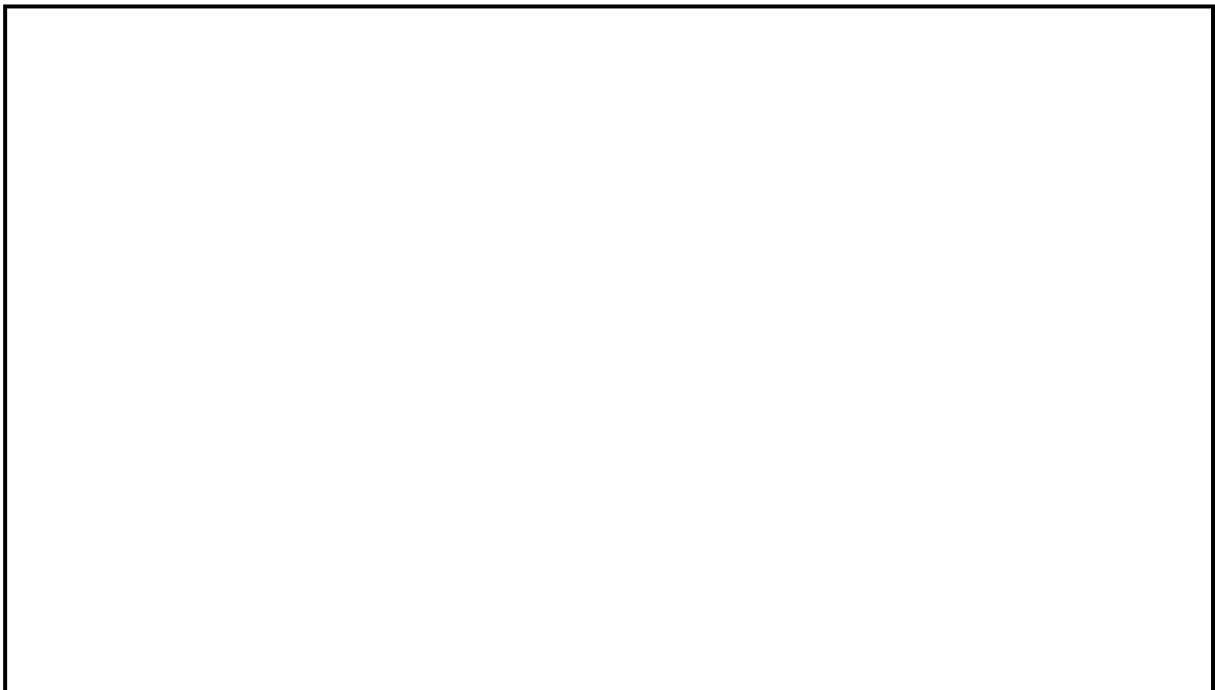
- Connect the wire retainers.

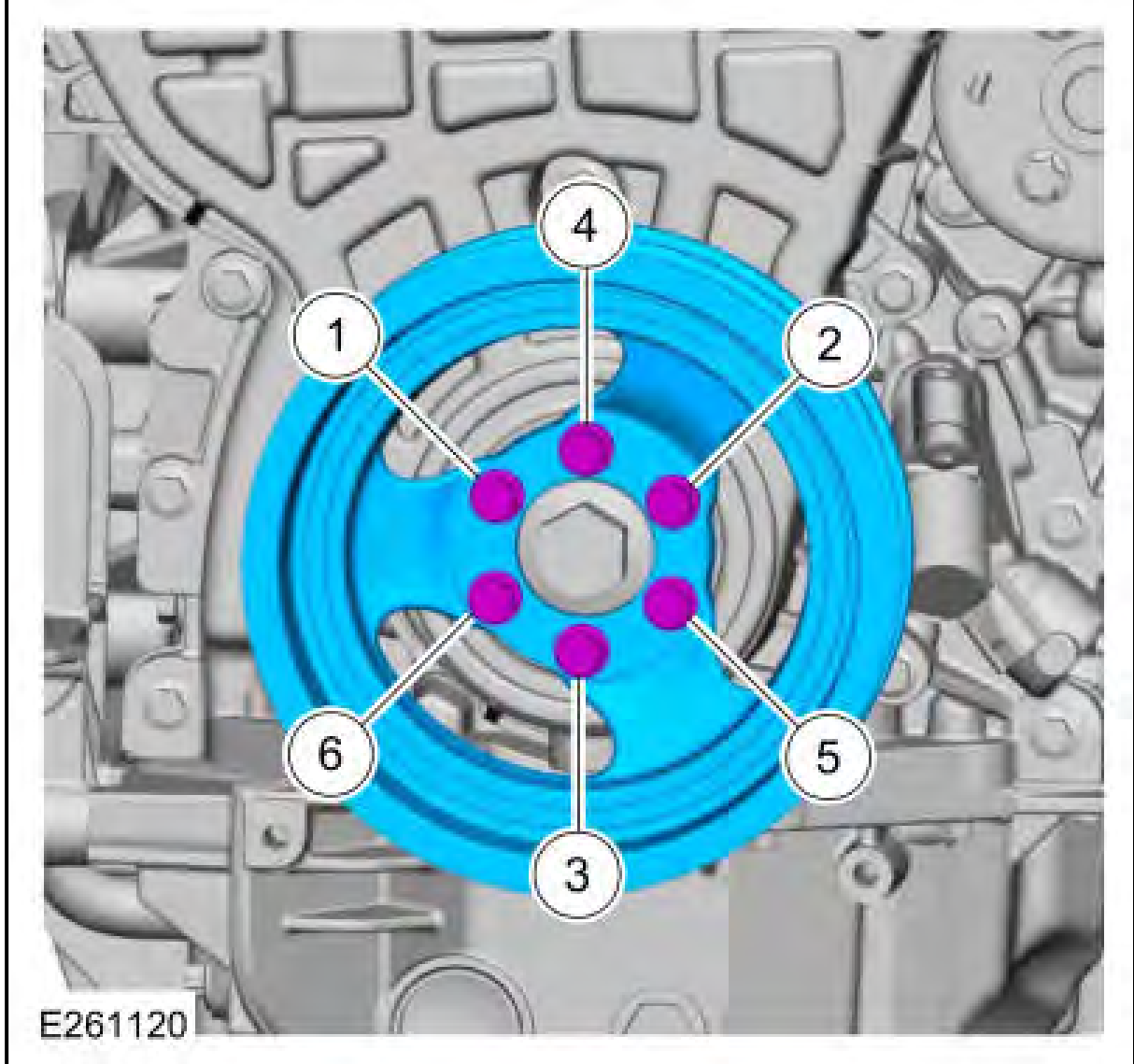


57. Install the crankshaft vibration damper and the bolts.

Torque

: 18 lb.ft (25 Nm)



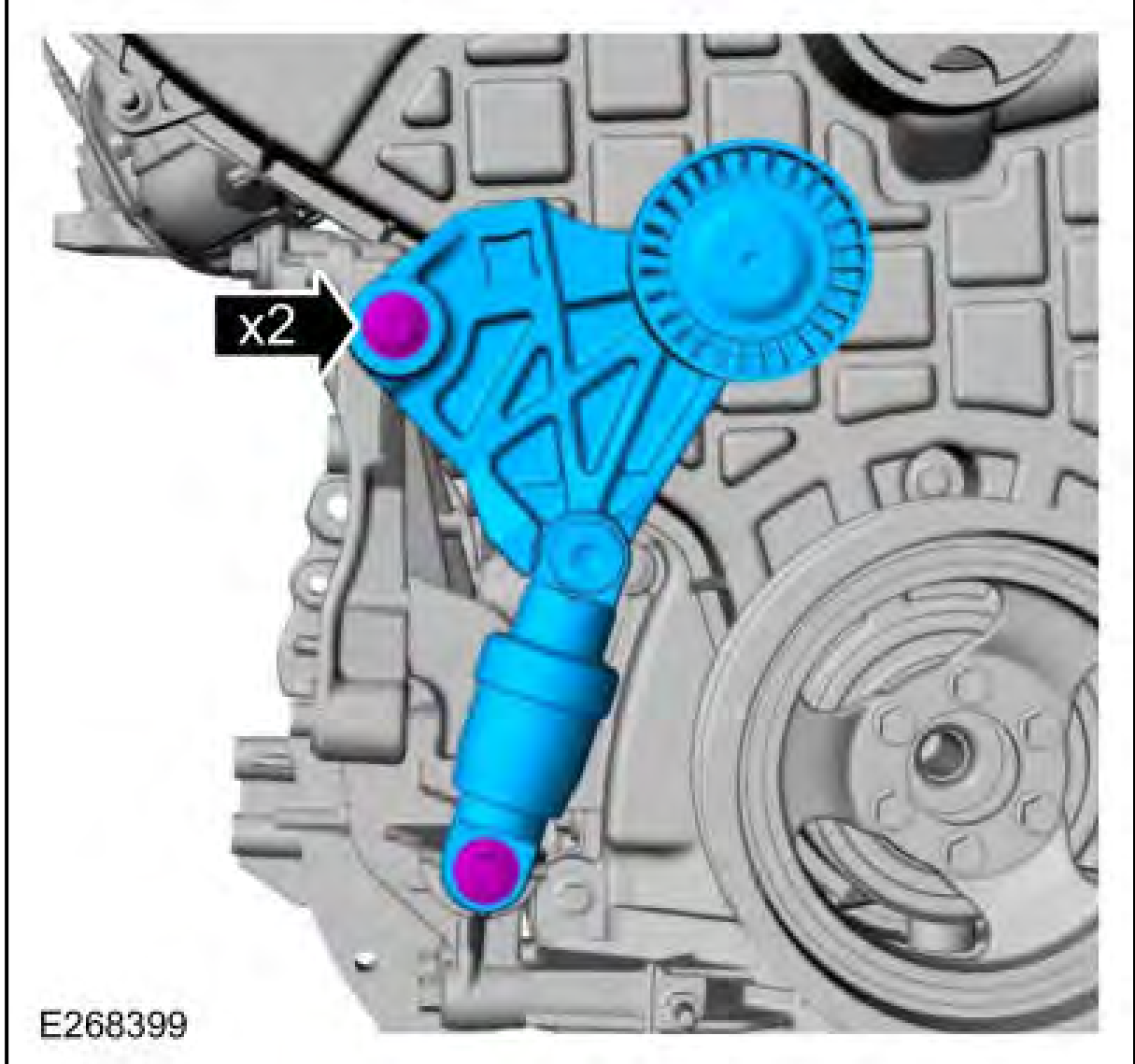


58. Install the accessory drive belt tensioner and the bolts.

Torque

: 18 lb.ft (25 Nm)

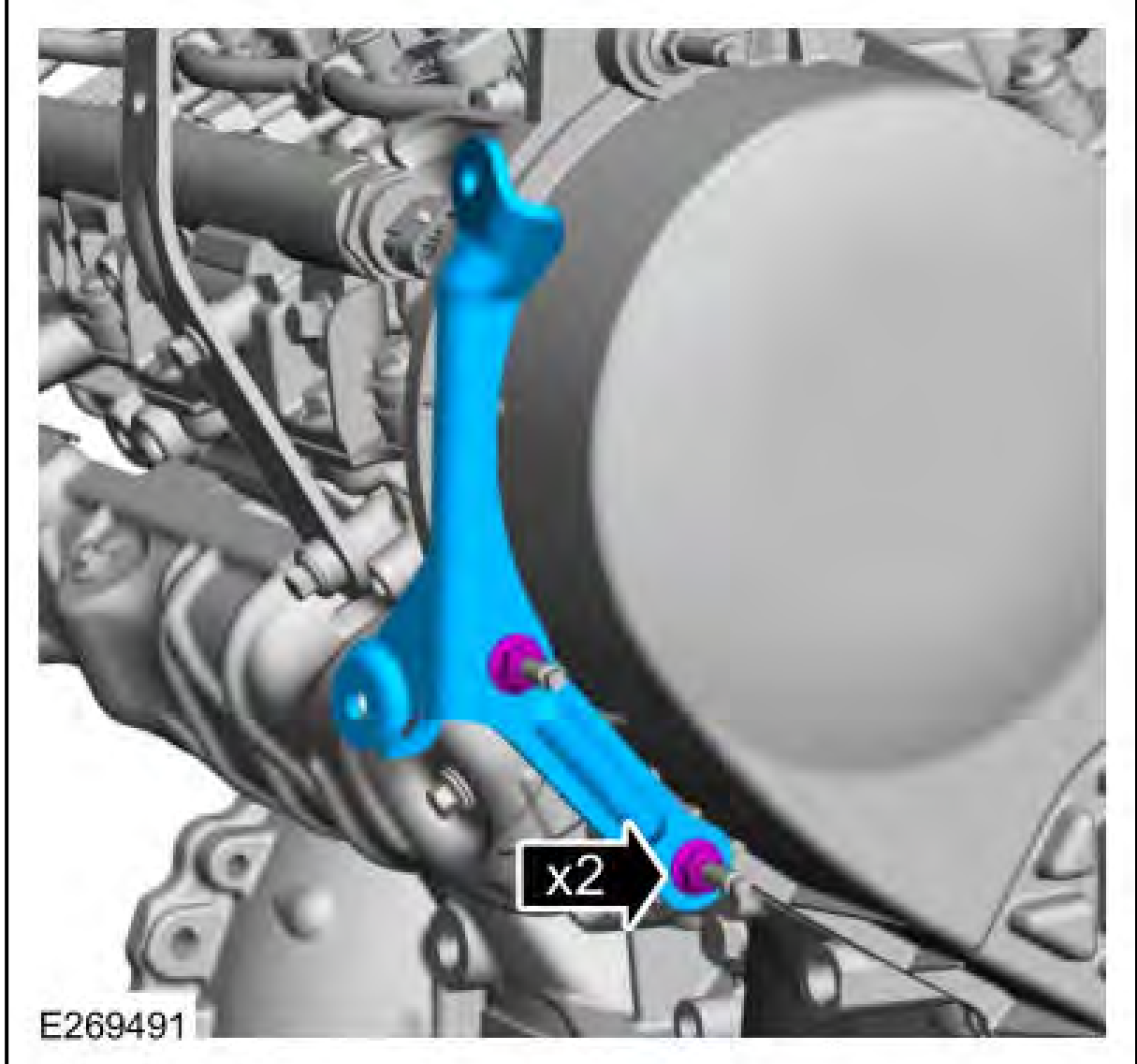




59. Install the CAC bracket and the nuts.

Torque

: 53 lb.in (6 Nm)



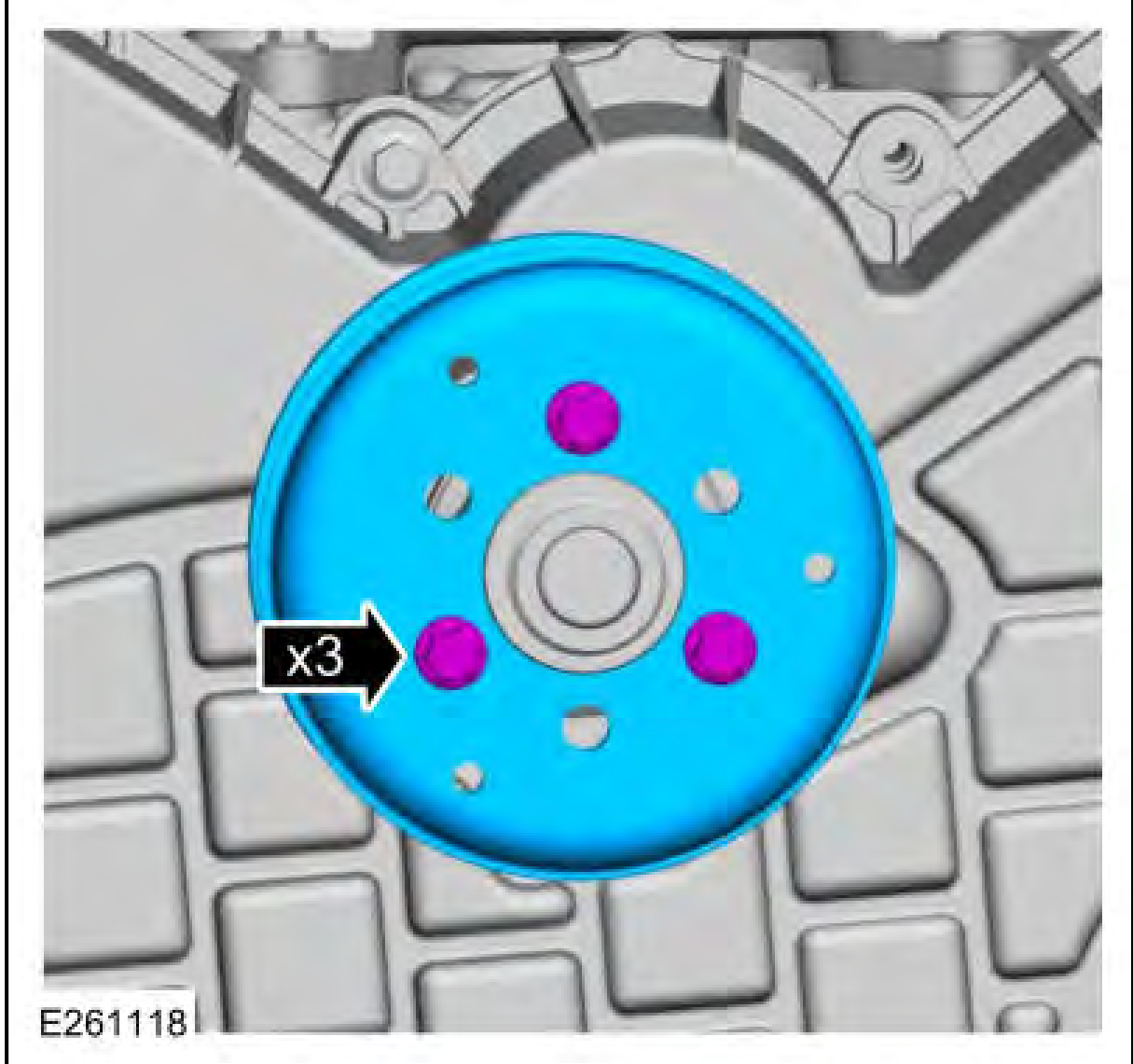
60. Install the fan pulley and the bolts.

Torque

: 18 lb.ft (25 Nm)



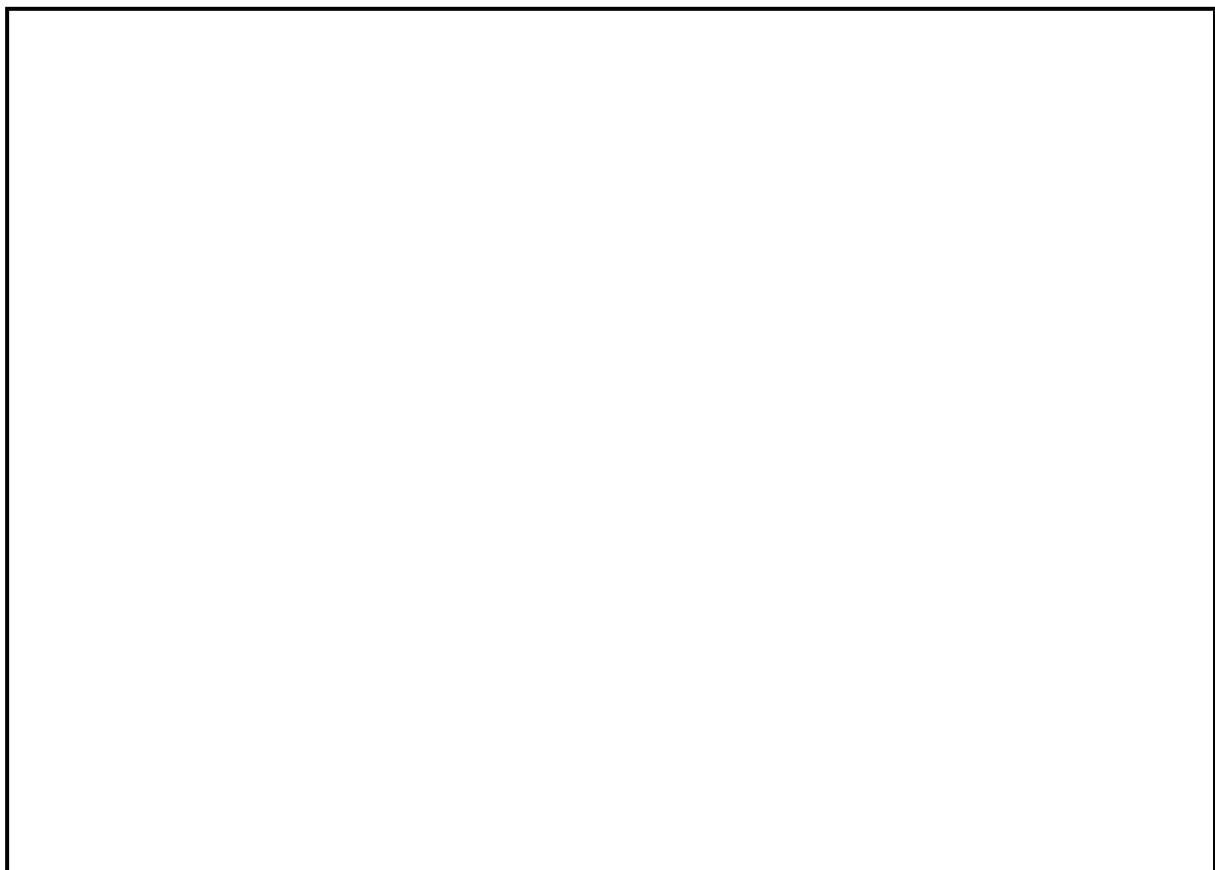


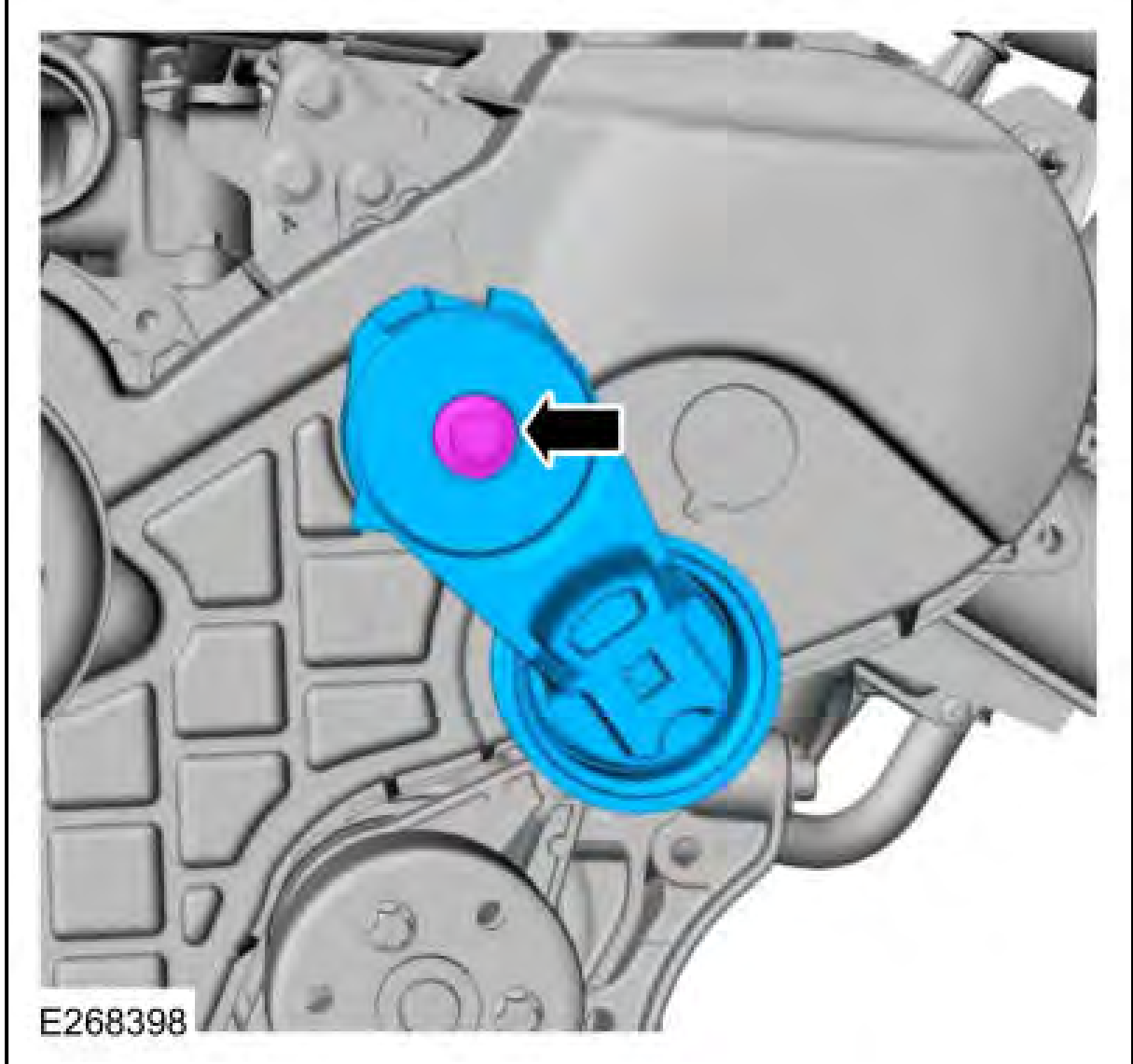


61. Install the accessory drive belt tensioner and the bolt.

Torque

: 35 lb.ft (48 Nm)

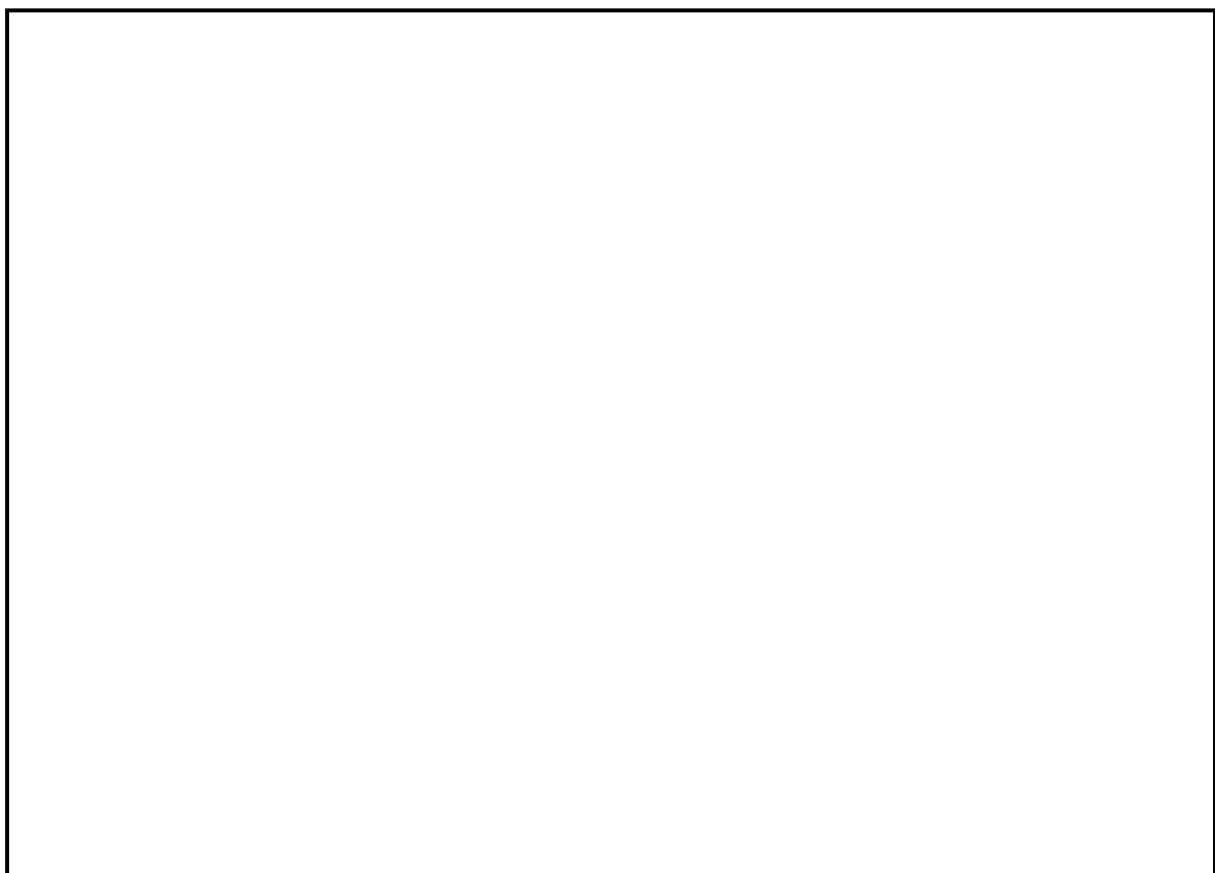


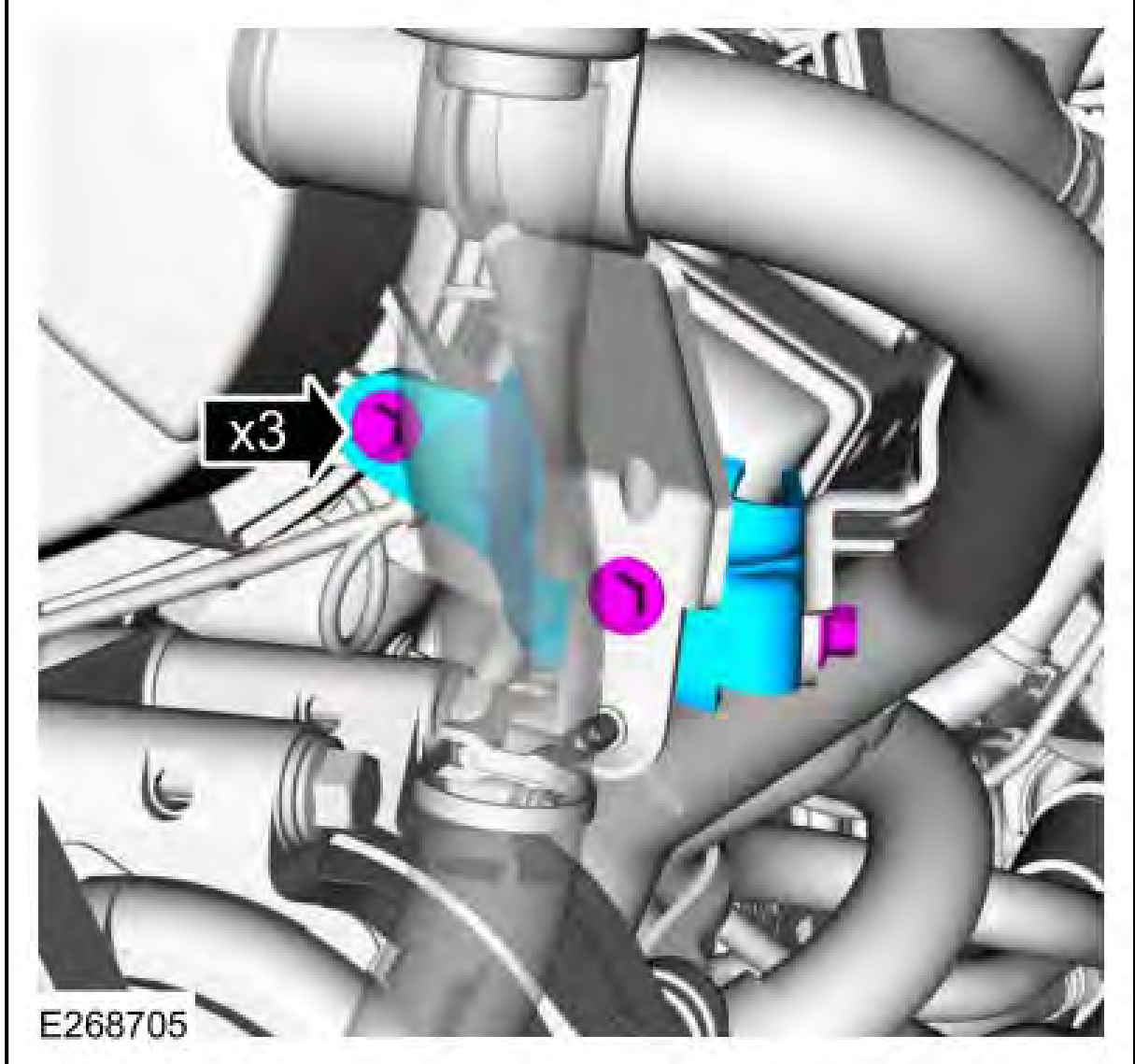


62. Install the coolant tube bracket and the bolts.

Torque

: 89 lb.in (10 Nm)



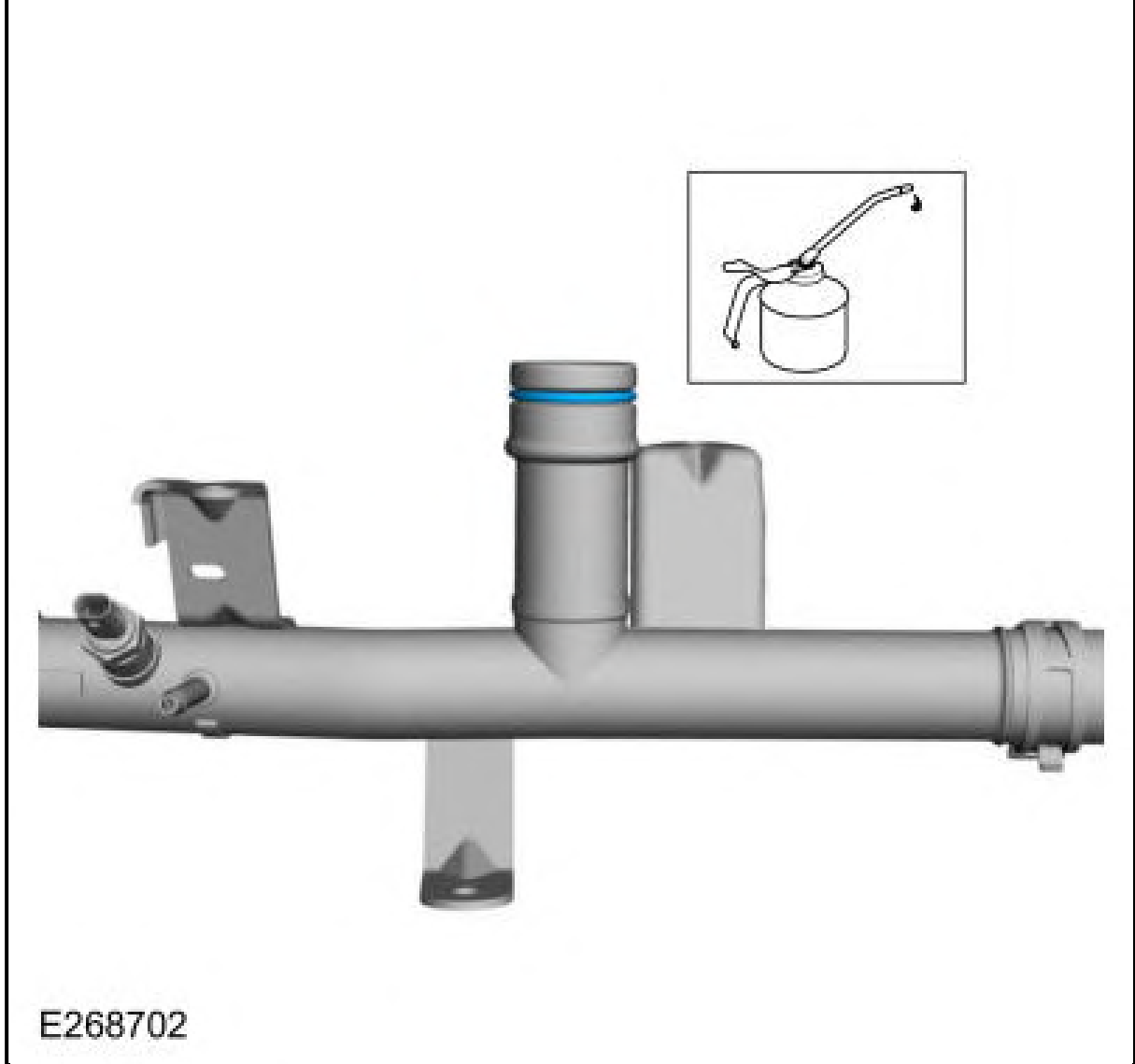


63. Install the coolant tube assembly O-ring and lubricate.

Material

: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

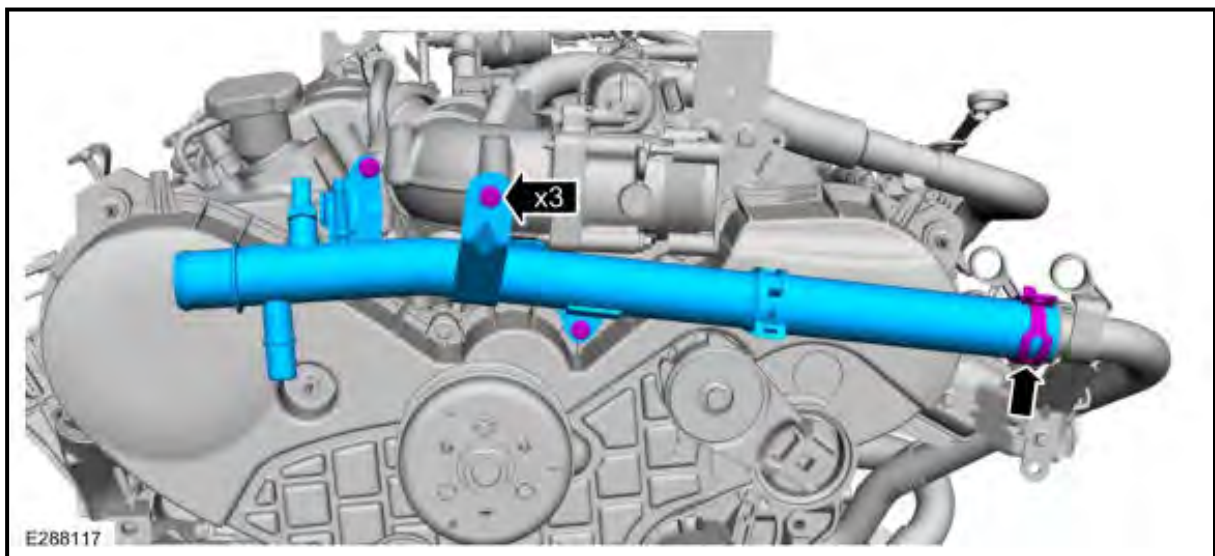




64. Install the coolant tube assembly and the bolts. Use the General Equipment: Hose Clamp Remover/Installer

Torque

: 89 lb.in (10 Nm)



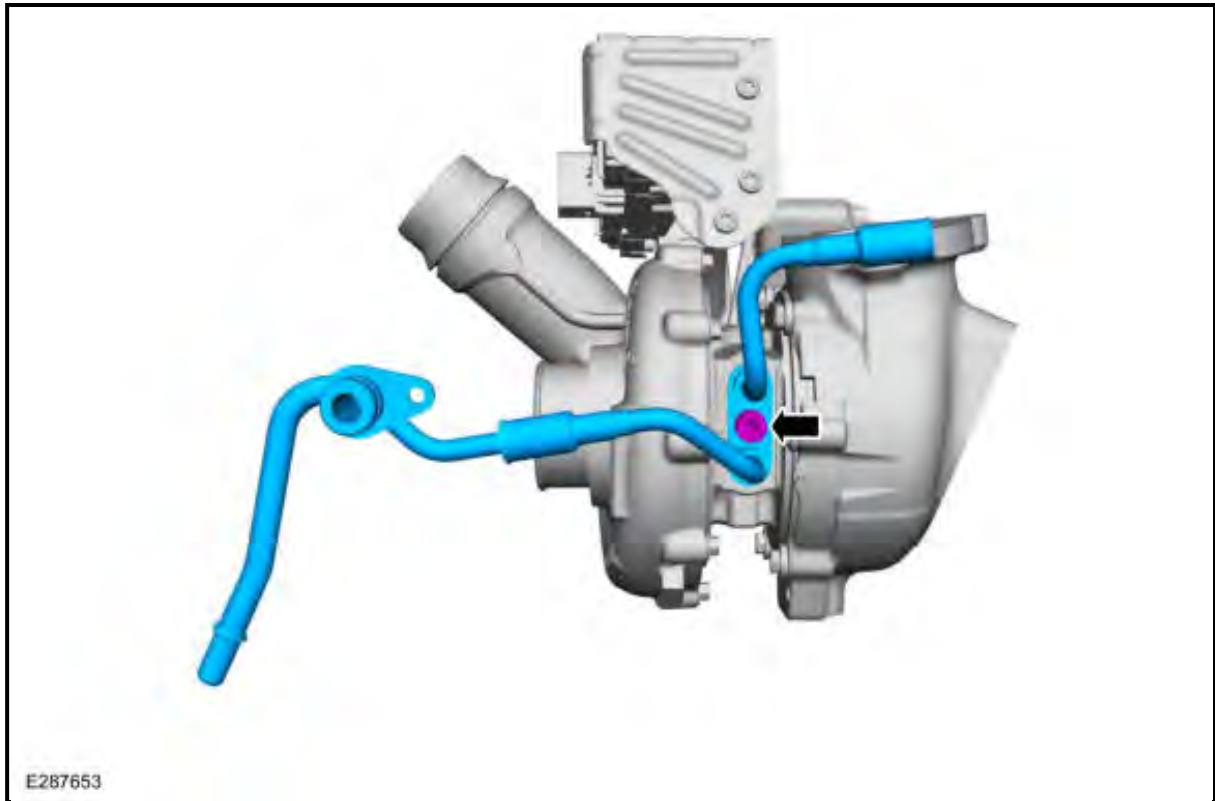
65. Lubricate the O-ring seals with clean engine coolant. Install the new turbocharger coolant tube manifold and the bolt.

Material

: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

Torque

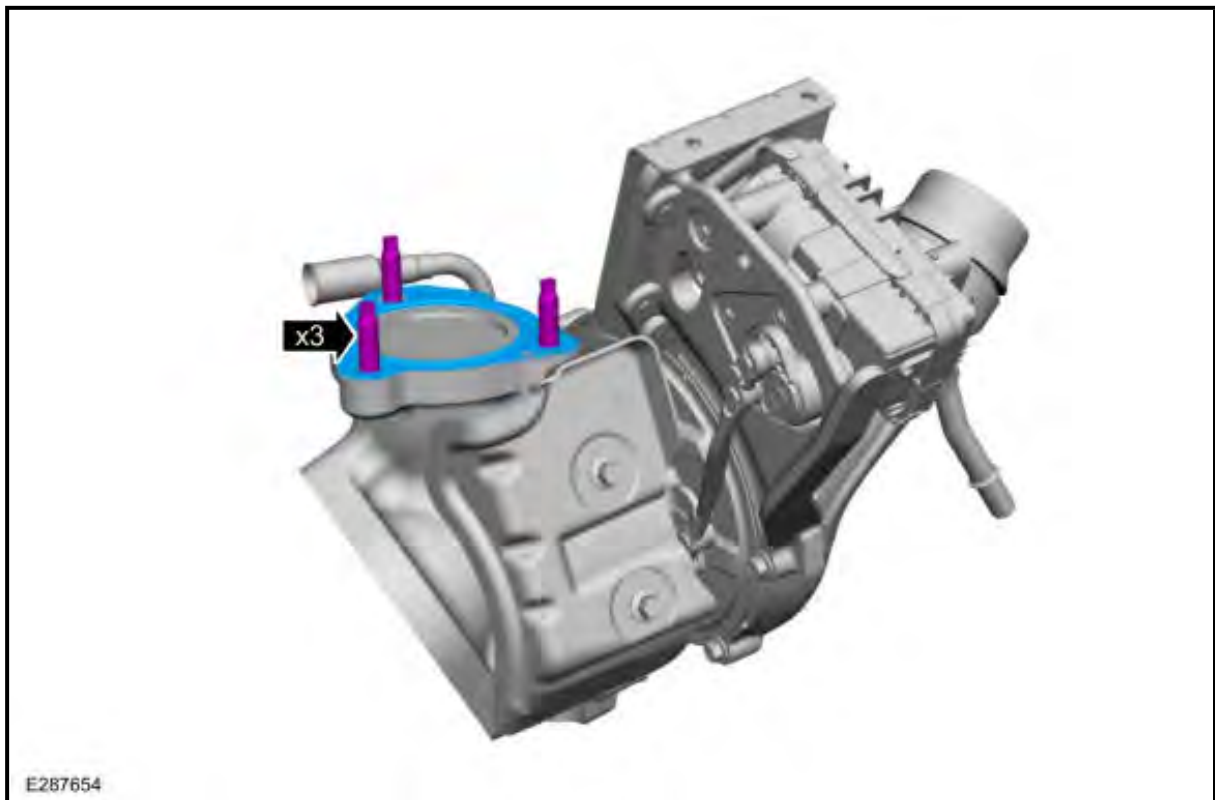
: 89 lb.in (10 Nm)



66. Install the turbocharger studs and the gasket.

Torque

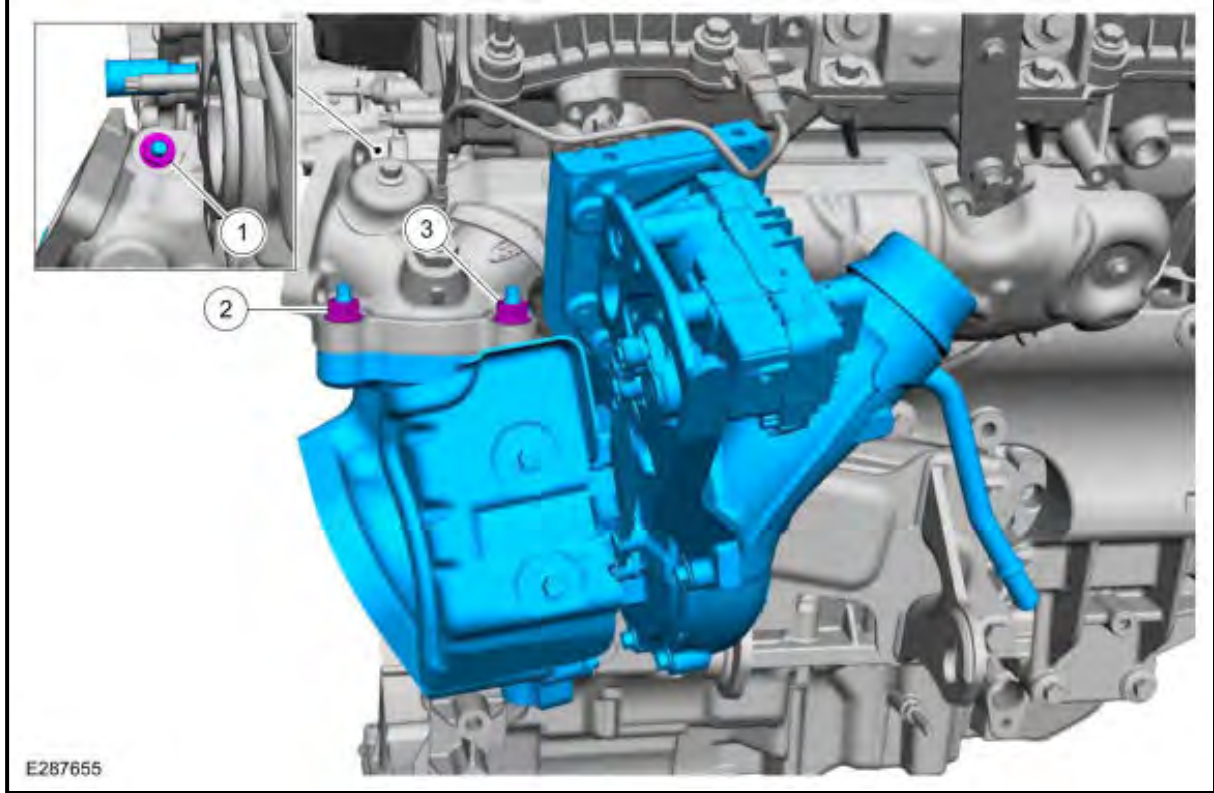
: 115 lb.in (13 Nm)



67. Install the turbocharger and the nuts.

Torque

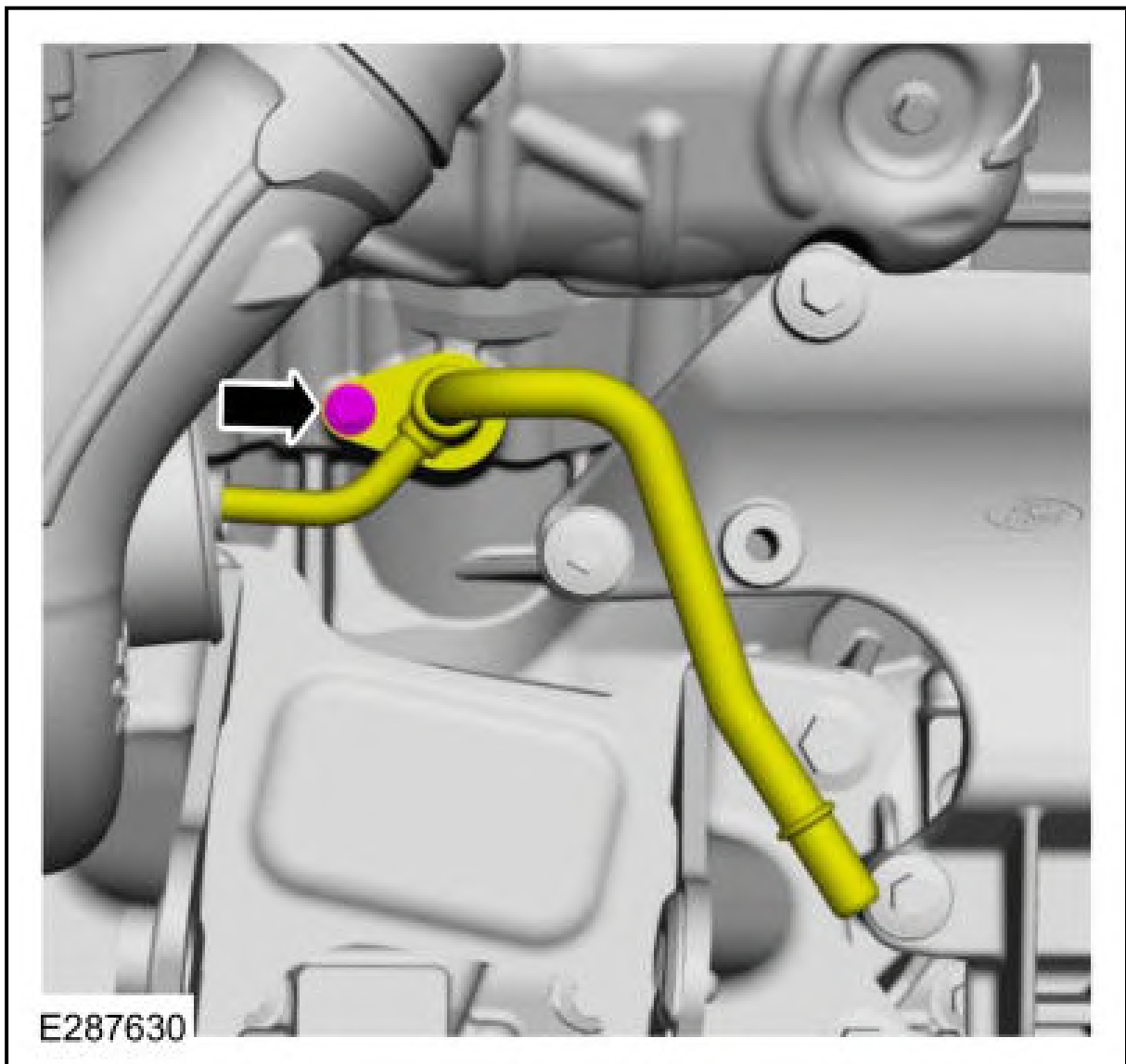
:Stage 1: 89 lb.in (10 Nm)Stage 2: 18 lb.ft (24 Nm)



68. Position back the turbocharger coolant supply tube into the engine and install the bolt.

Torque

: 89 lb.in (10 Nm)



69. **NOTE:** Fully seat the turbocharger oil supply tube O-rings into the turbocharger and engine bore holes prior to fastener tightening.

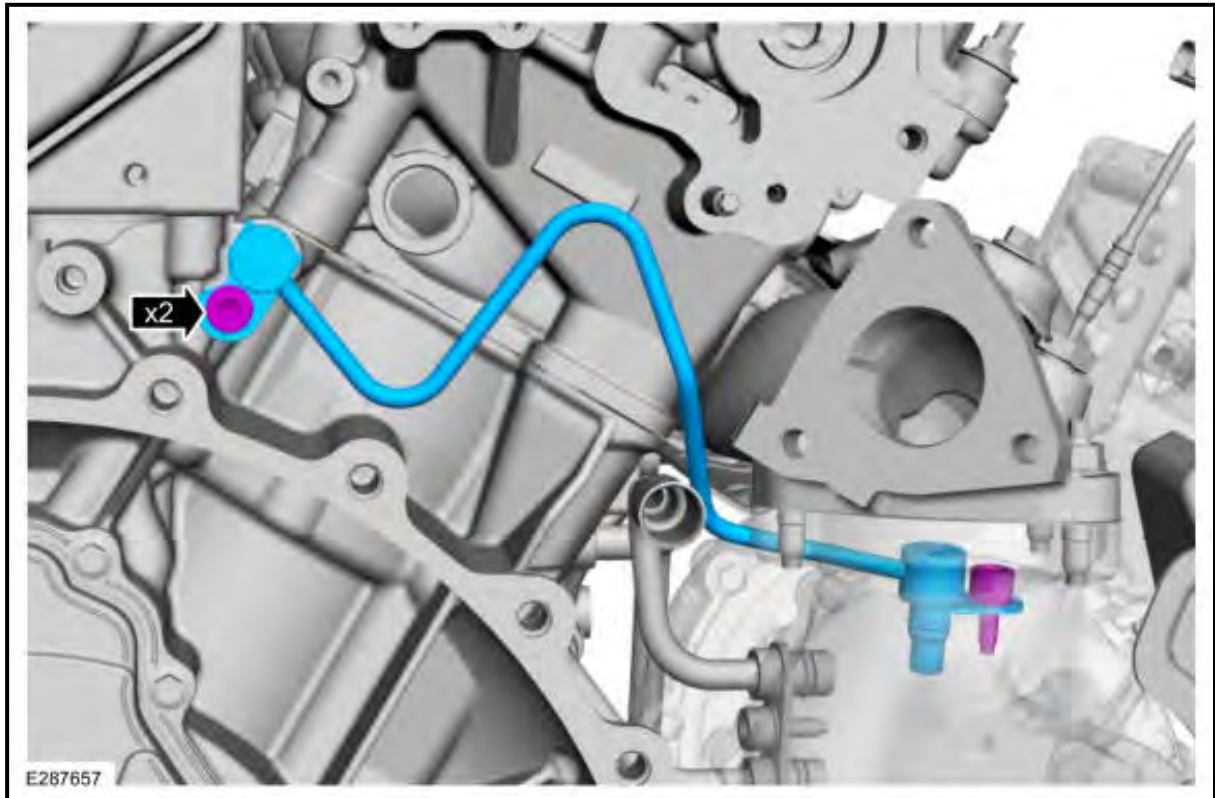
Lubricate the turbocharger oil supply tube O-rings with clean engine oil. Install the turbocharger oil supply tube and the bolts.

Material

: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque

: 89 lb.in (10 Nm)



70. Install a new turbocharger coolant return tube O-ring seal. Lubricate the new O-ring seal and the tube sealing surface with clean engine coolant.

Material

: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

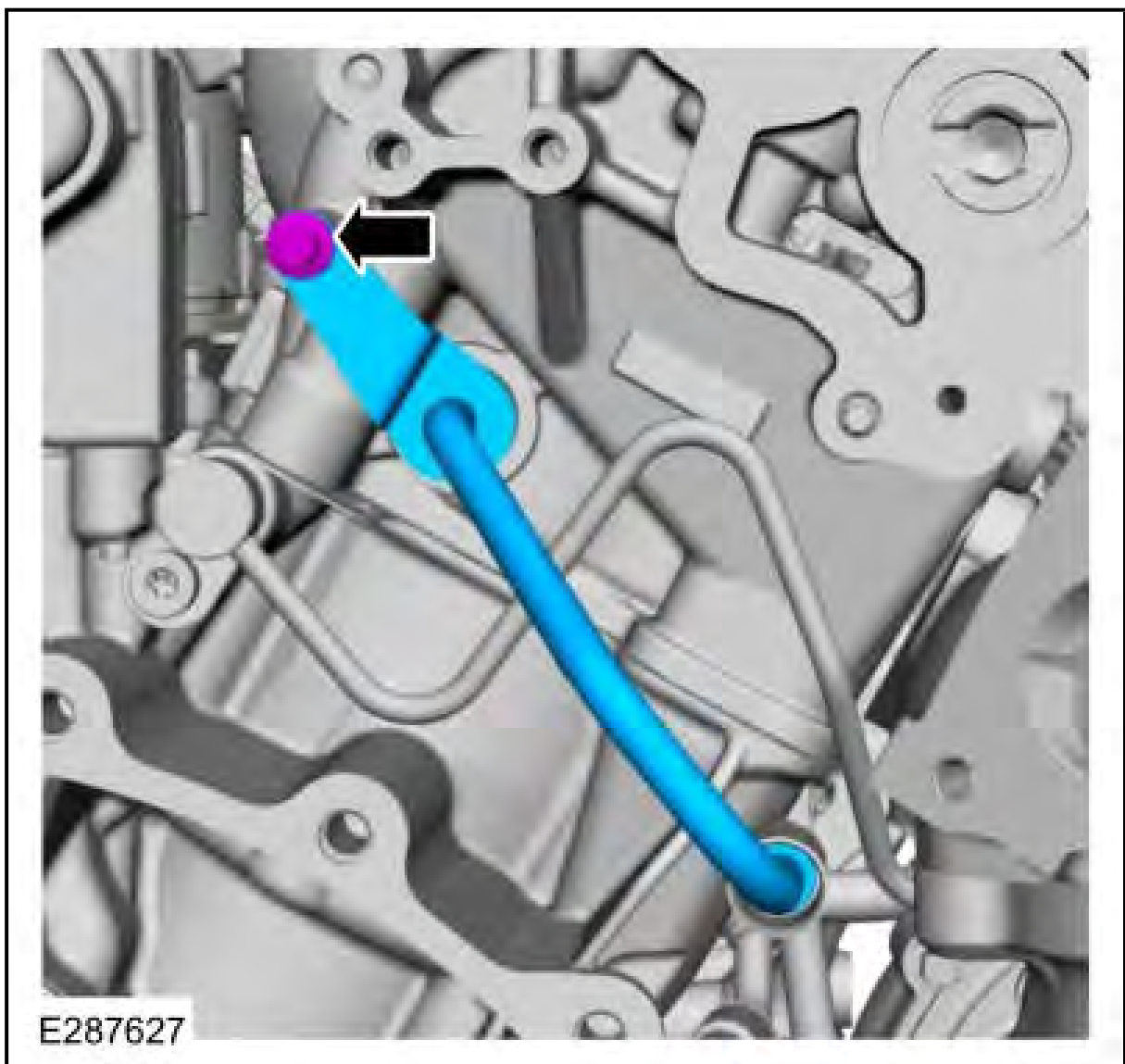




71. Install the coolant return tube and the bolt.

Torque

: 89 lb.in (10 Nm)

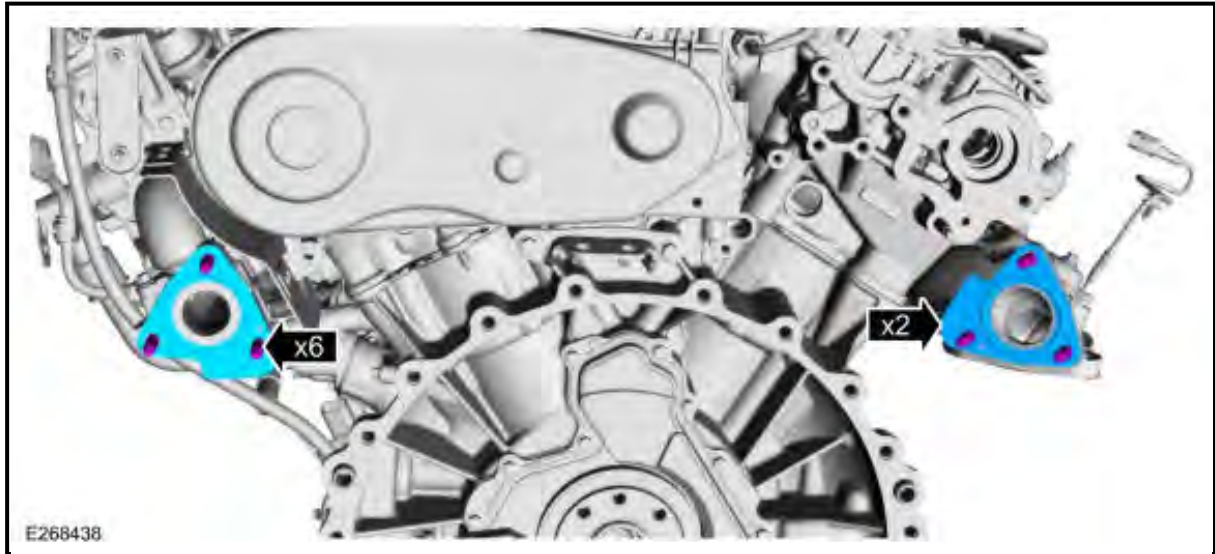




72. Install the studs and the exhaust crossover pipe gaskets.

Torque

: 115 lb.in (13 Nm)



73. **NOTE:** If any snaps become undone on the exhaust crossover pipe wrap. Install a new exhaust crossover pipe wrap.

Install the exhaust crossover pipe, the nuts and the bolts.

- Hand start the RH exhaust manifold nuts.
- Hand start the LH exhaust manifold nuts.
- Hand start the exhaust crossover pipe bracket bolts.
- Tighten the RH exhaust manifold nuts in the following sequence: 1, 2, 3, 1, 2.

Torque

: 18 lb.ft (24 Nm)

- Tighten the LH exhaust manifold nuts in the following sequence: 1, 2, 3, 1, 2.

Torque

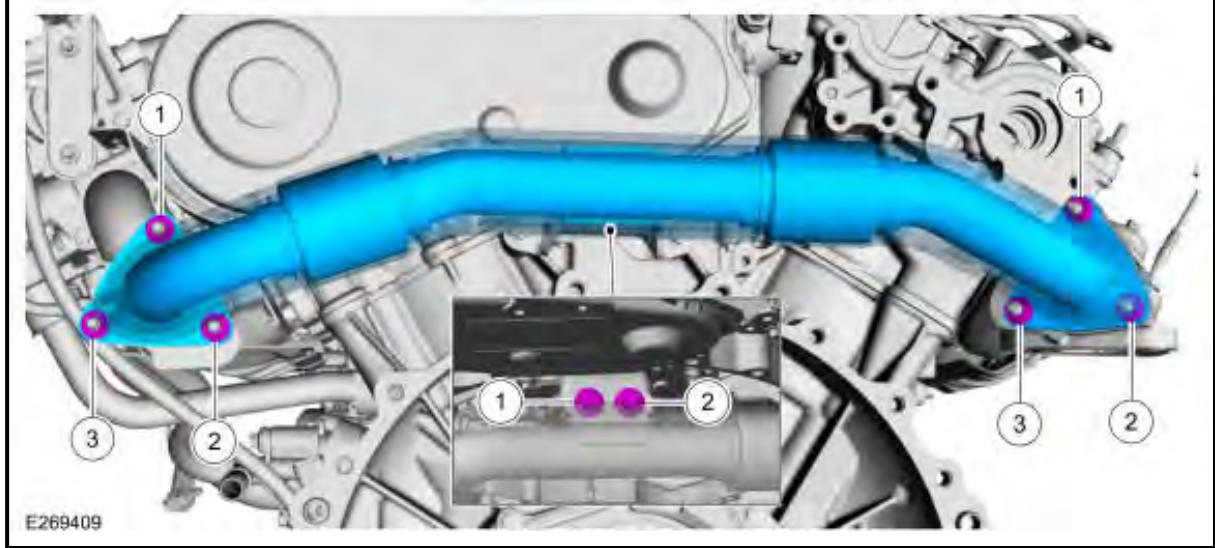
: 18 lb.ft (24 Nm)

- Tighten the exhaust crossover pipe bracket bolts in the sequence shown.

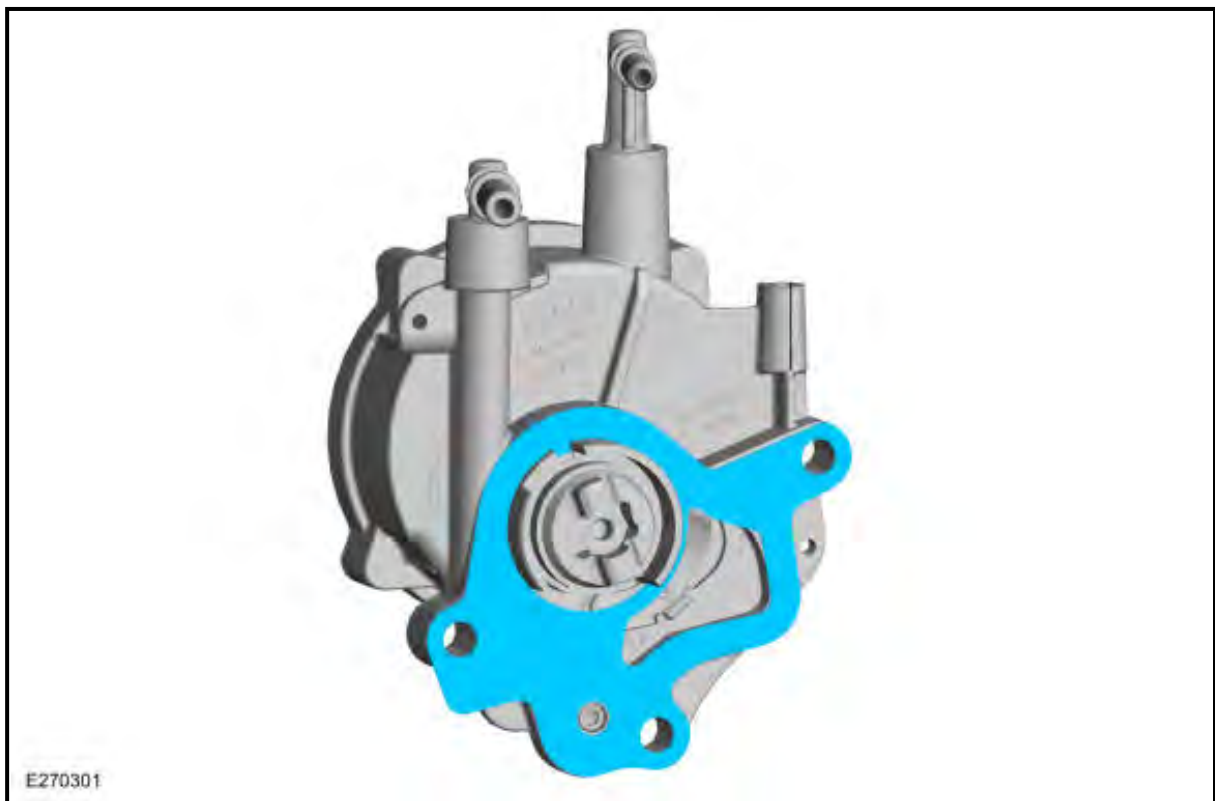
Torque

: 18 lb.ft (24 Nm)





74. Install the vacuum pump gasket.



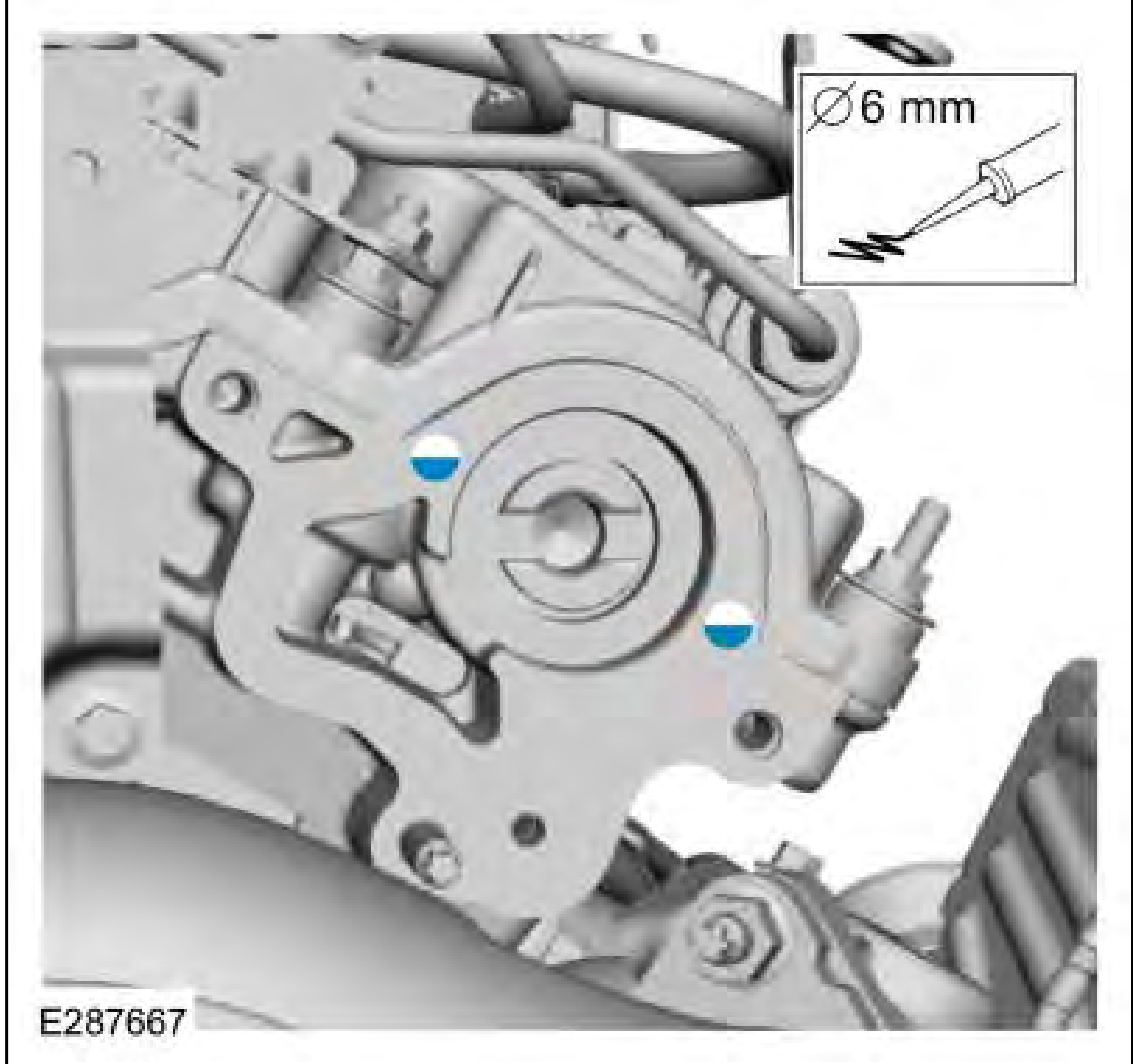
75. **NOTE:** If the vacuum pump is not installed and the fasteners tightened within 10 minutes, the sealant must be removed and the sealing area cleaned.

Apply an 6 mm dot of Motorcraft <sup>®</sup> High Performance Engine RTV Silicone to the locations shown.

Material

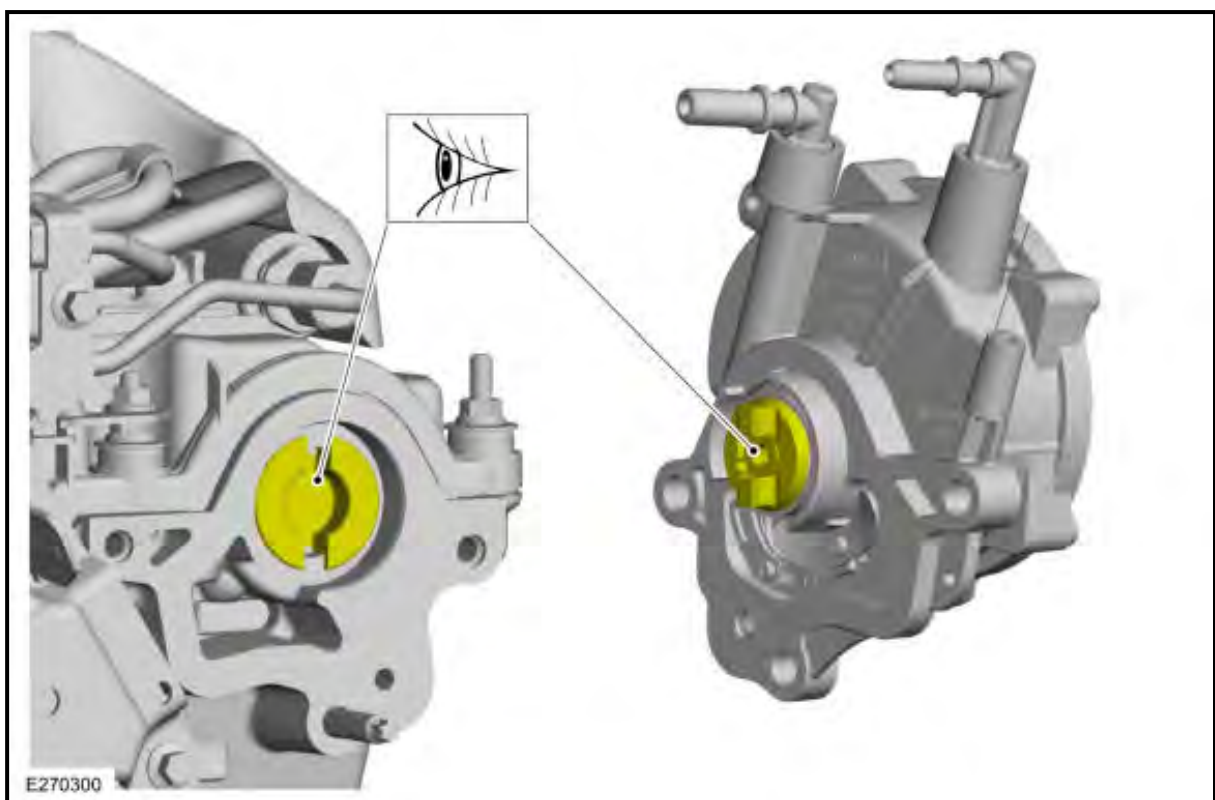
: Motorcraft <sup>®</sup> High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)





76. **NOTE:** Manually align the brake vacuum pump drive key with the camshaft slot before installation.

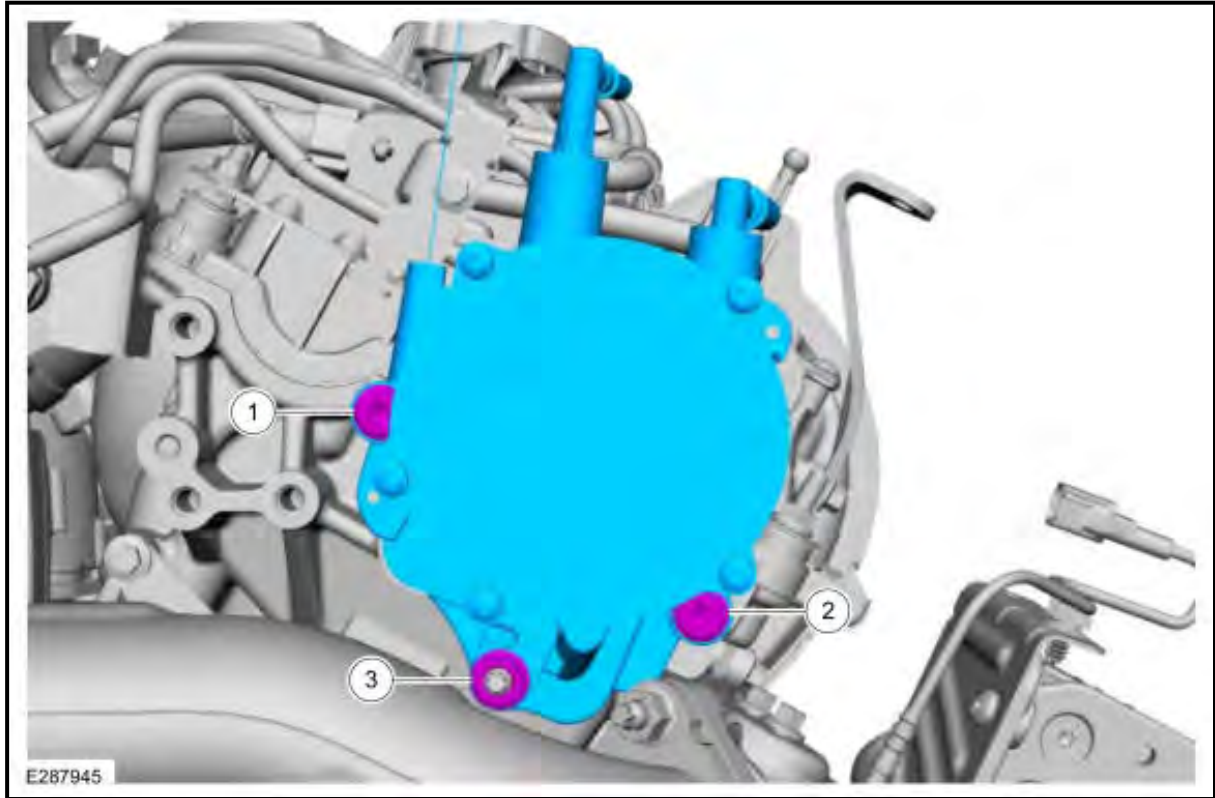
Align the brake vacuum pump drive key with the camshaft slot before installation.



77. Install the vacuum pump and the retainers.

Torque

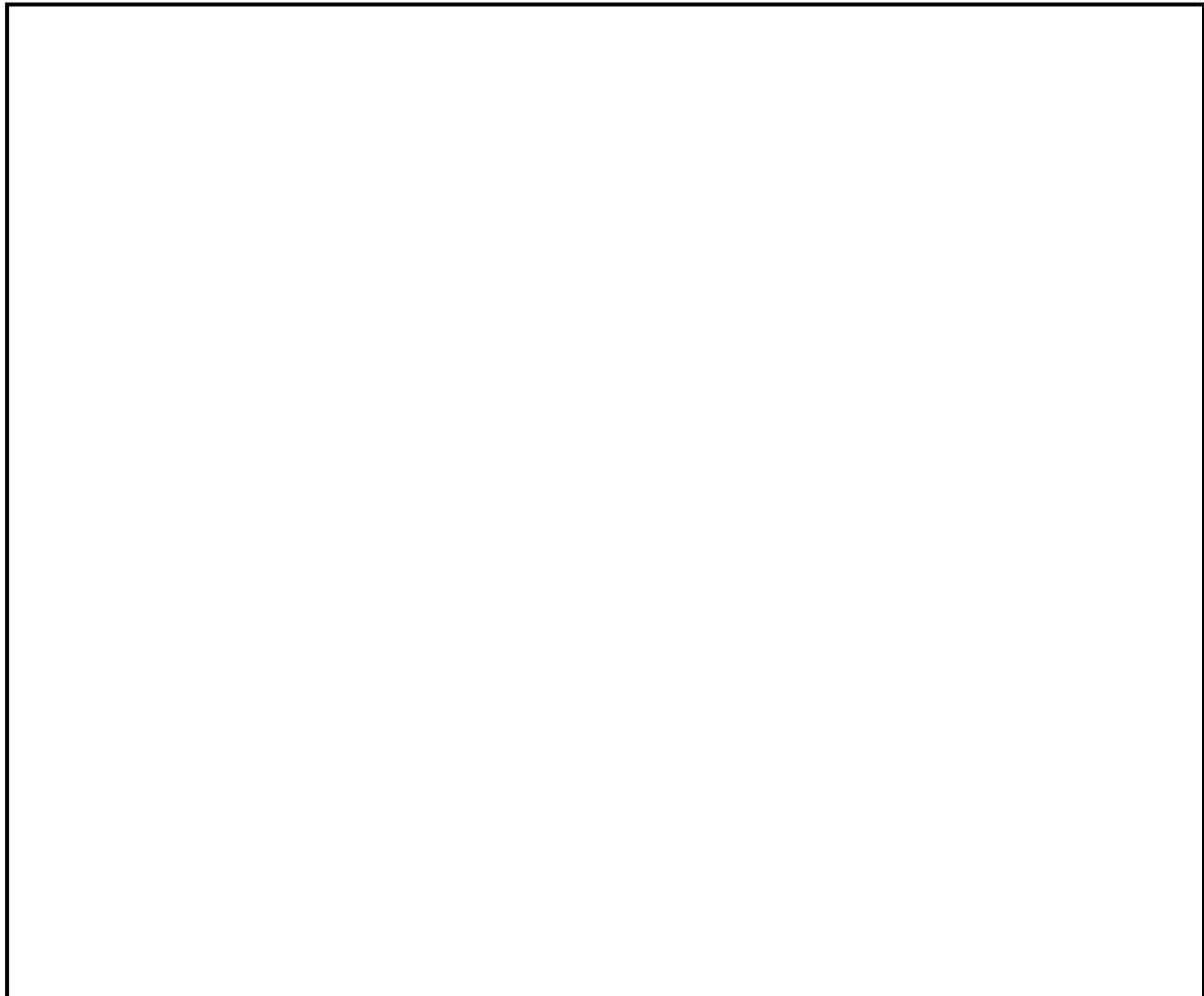
:Stage 1: Tighten bolt number 1 to: : 17 lb.ft (23 Nm)Stage 2: Tighten bolt number 2 to: : 17 lb.ft (23 Nm)Stage 3: Tighten bolt number 1 a second time to: : 17 lb.ft (23 Nm)Stage 4: Tighten the nut number 3 to: : 17 lb.ft (23 Nm)

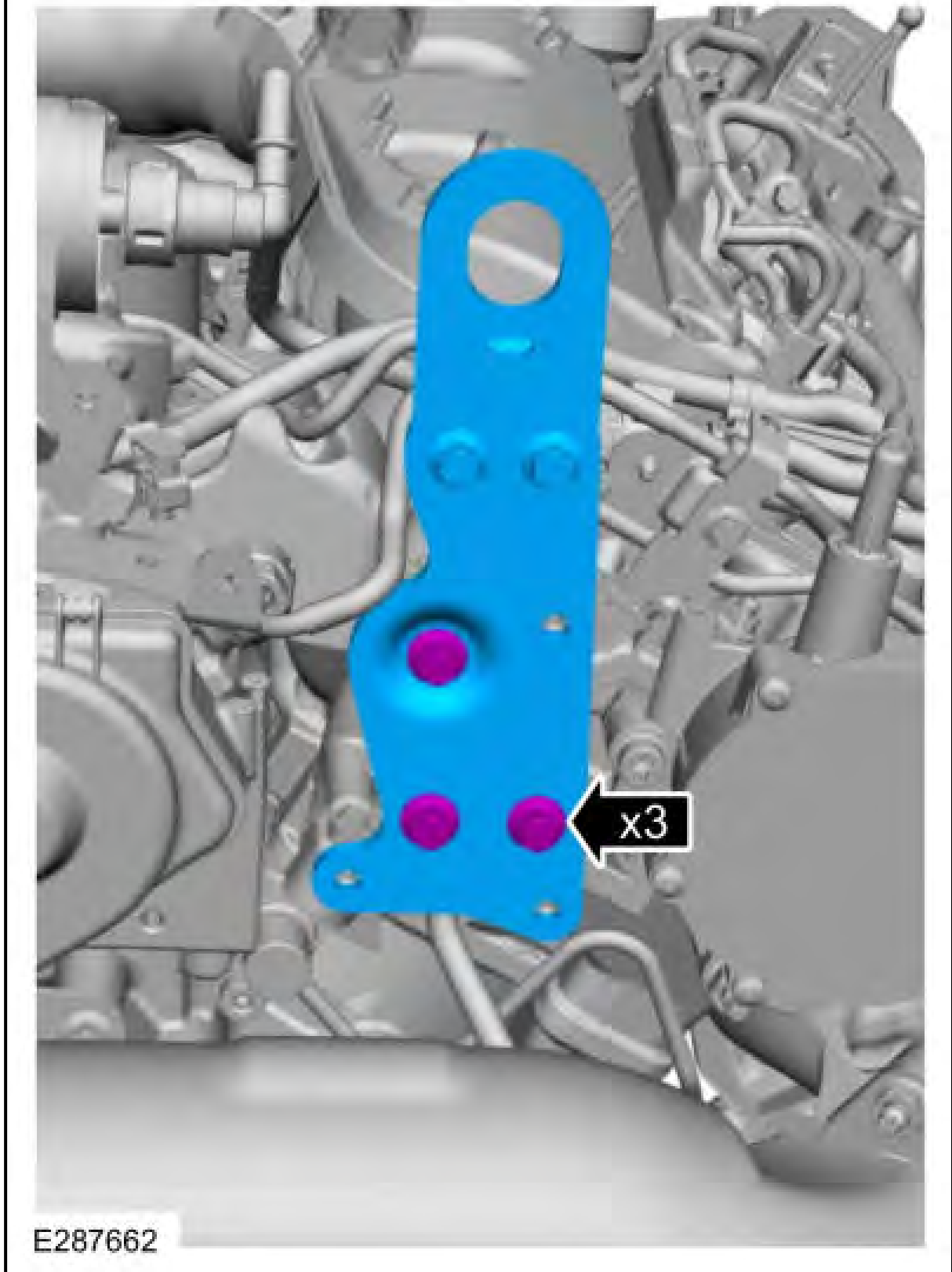


78. Install the lifting bracket and the bolts.

Torque

: 17 lb.ft (23 Nm)



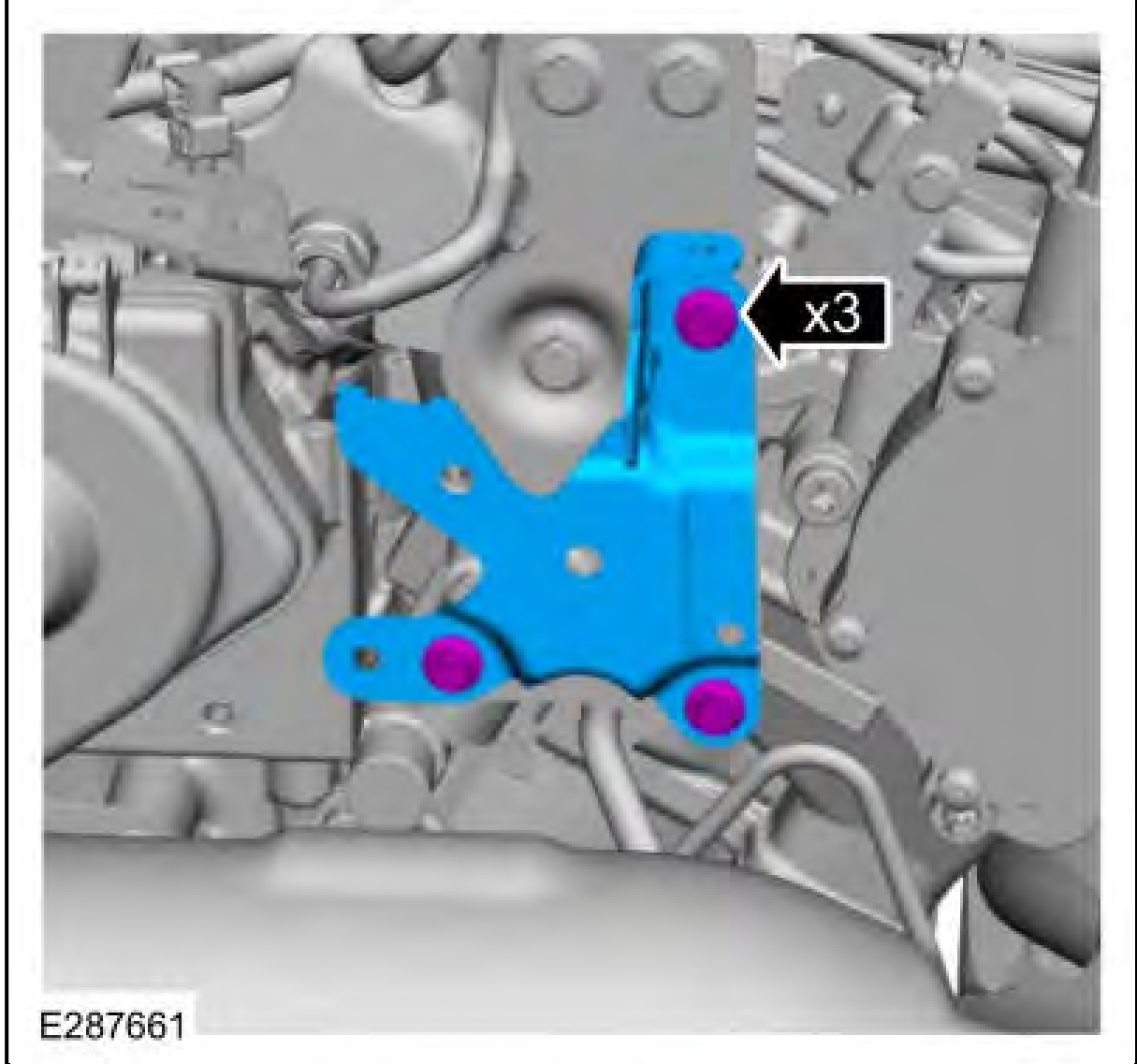


79. Install the valve bracket and the bolts.

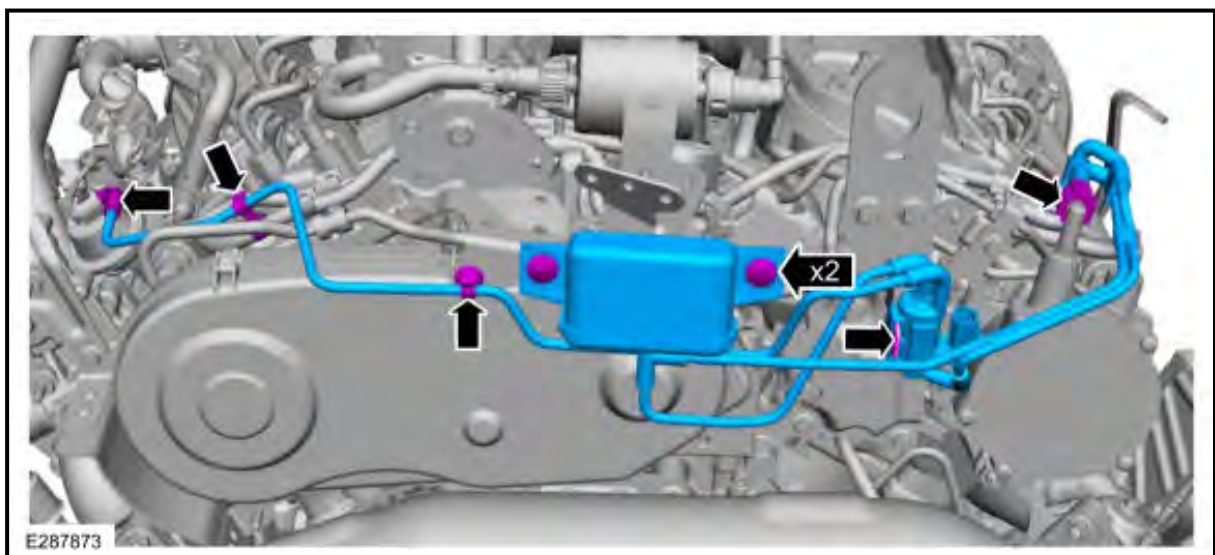
Torque

: 89 lb.in (10 Nm)





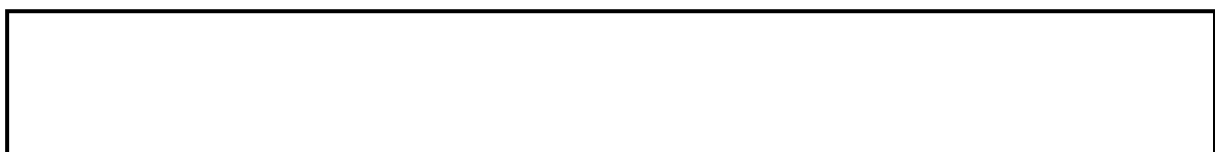
80. Install the vacuum hose assembly and the retainers. Connect the vacuum pump connector. Refer to: [Quick Release Coupling](#) .

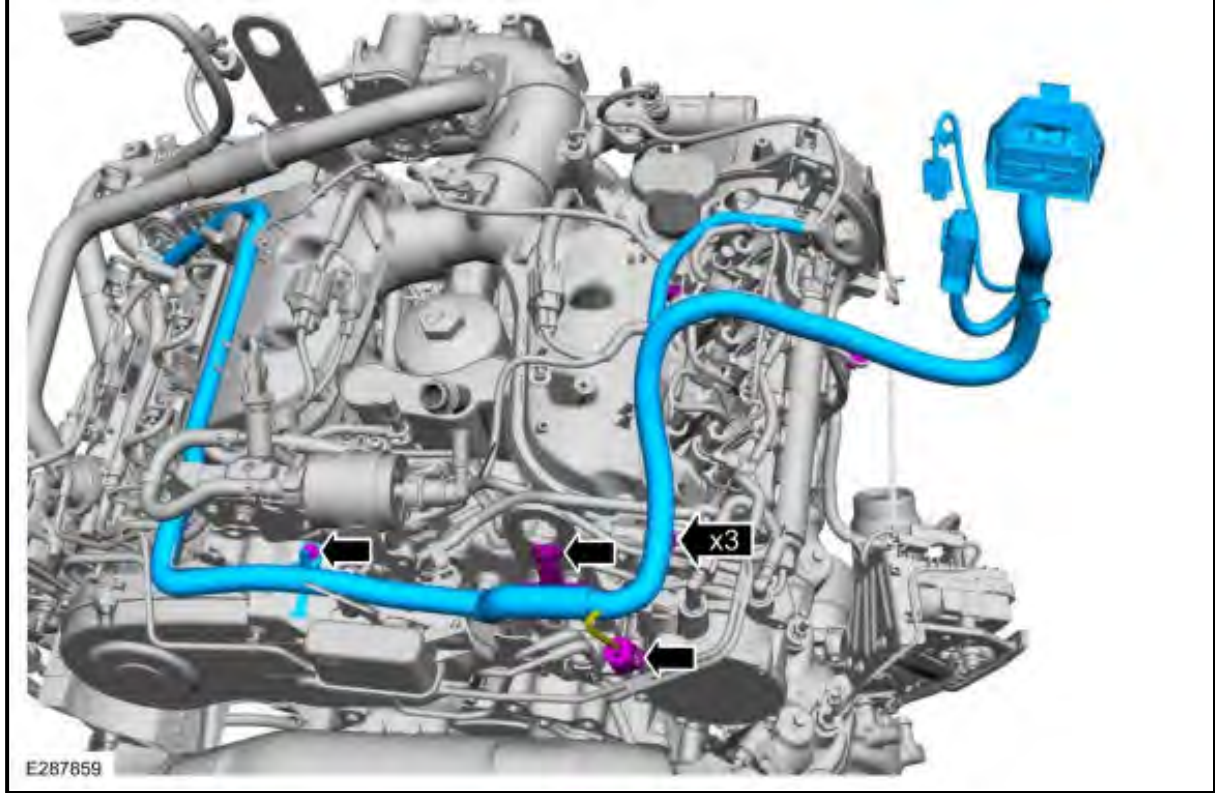


81. Position the engine wire harness on the engine and install the bolt. Connect the electrical wire retainers and the electrical connector.

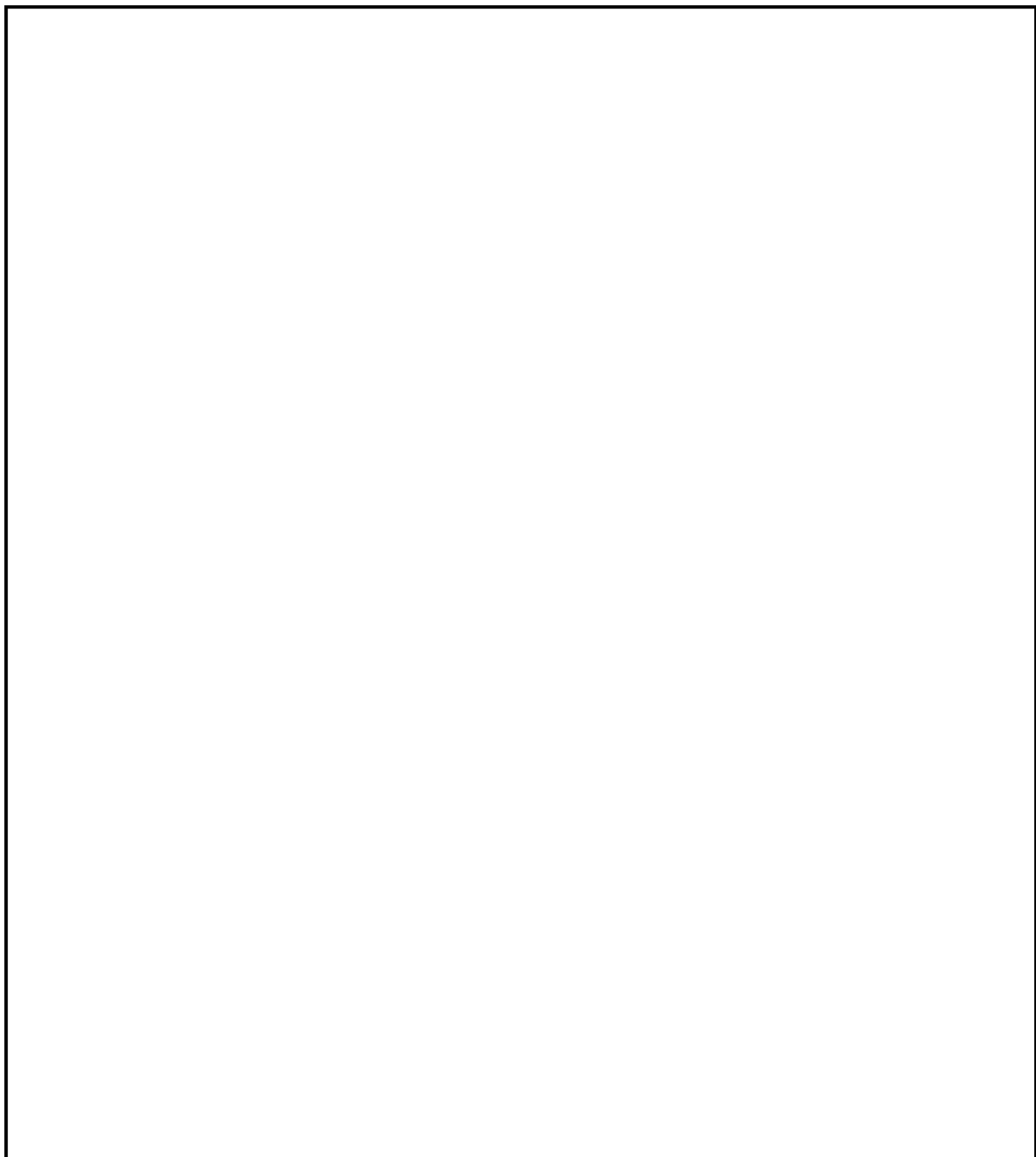
Torque

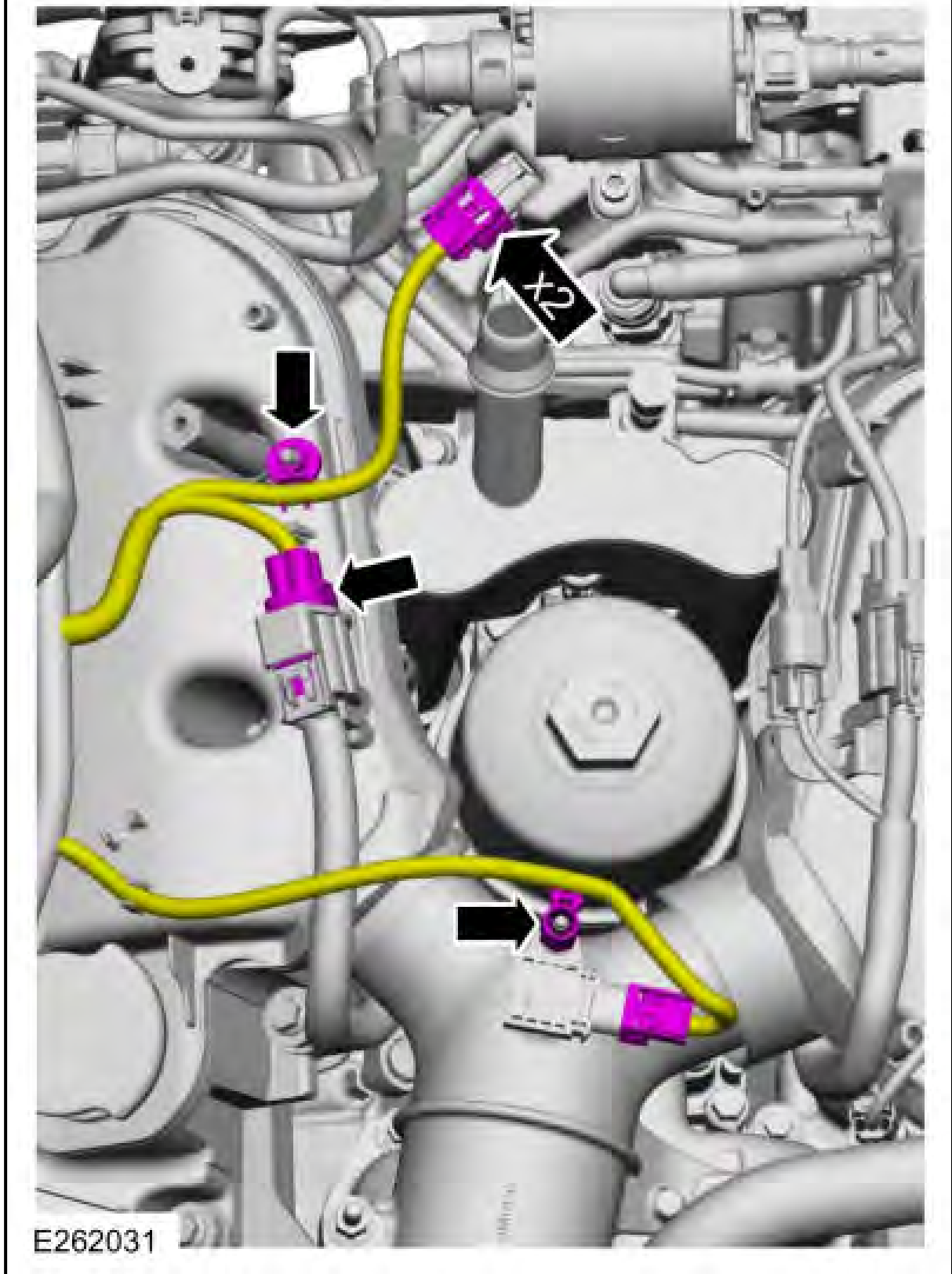
: 89 lb.in (10 Nm)





82. Connect the electrical connectors and the wire retainers.

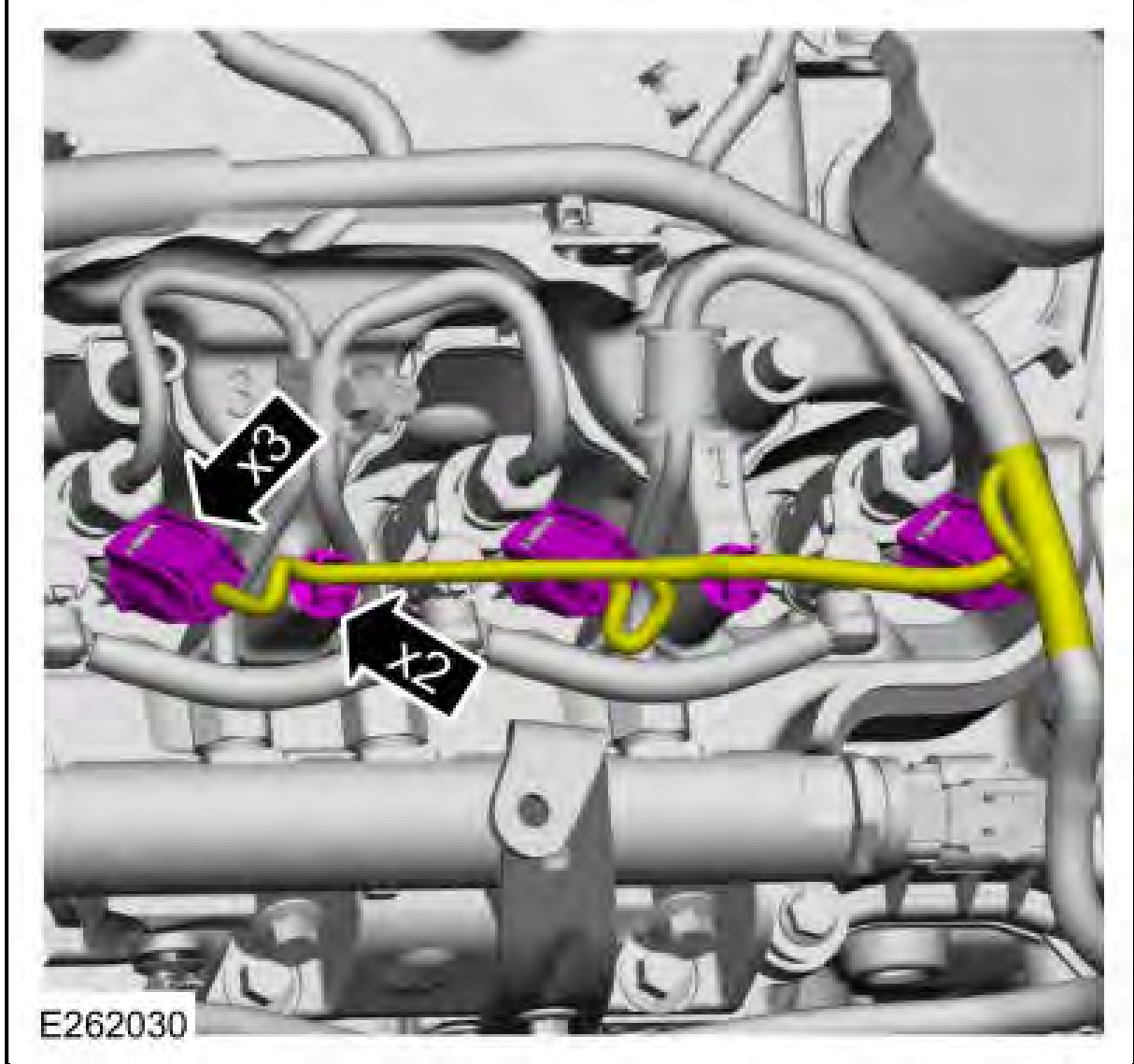




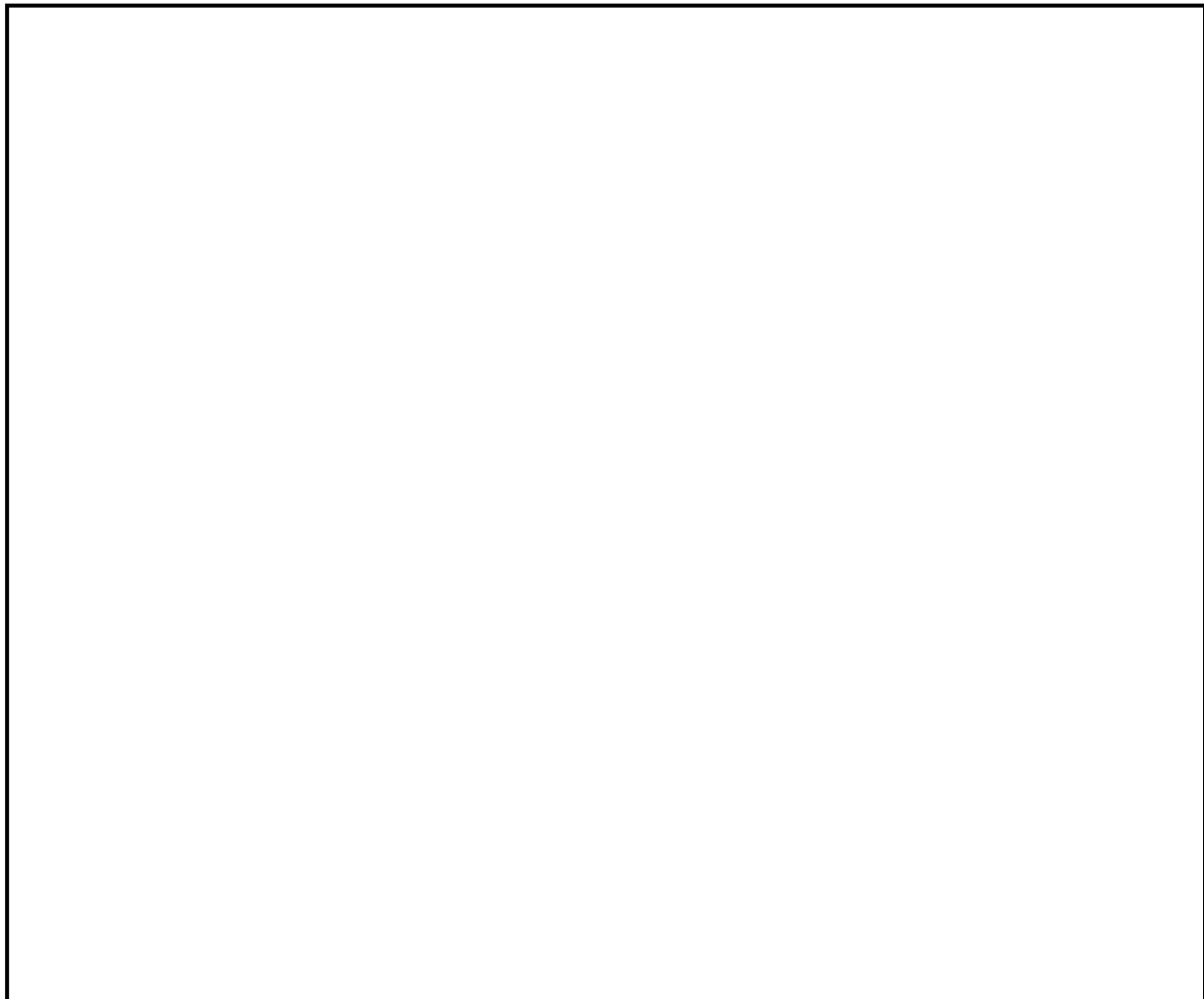
83. Connect the fuel injectors electrical connectors and the wire retainers.

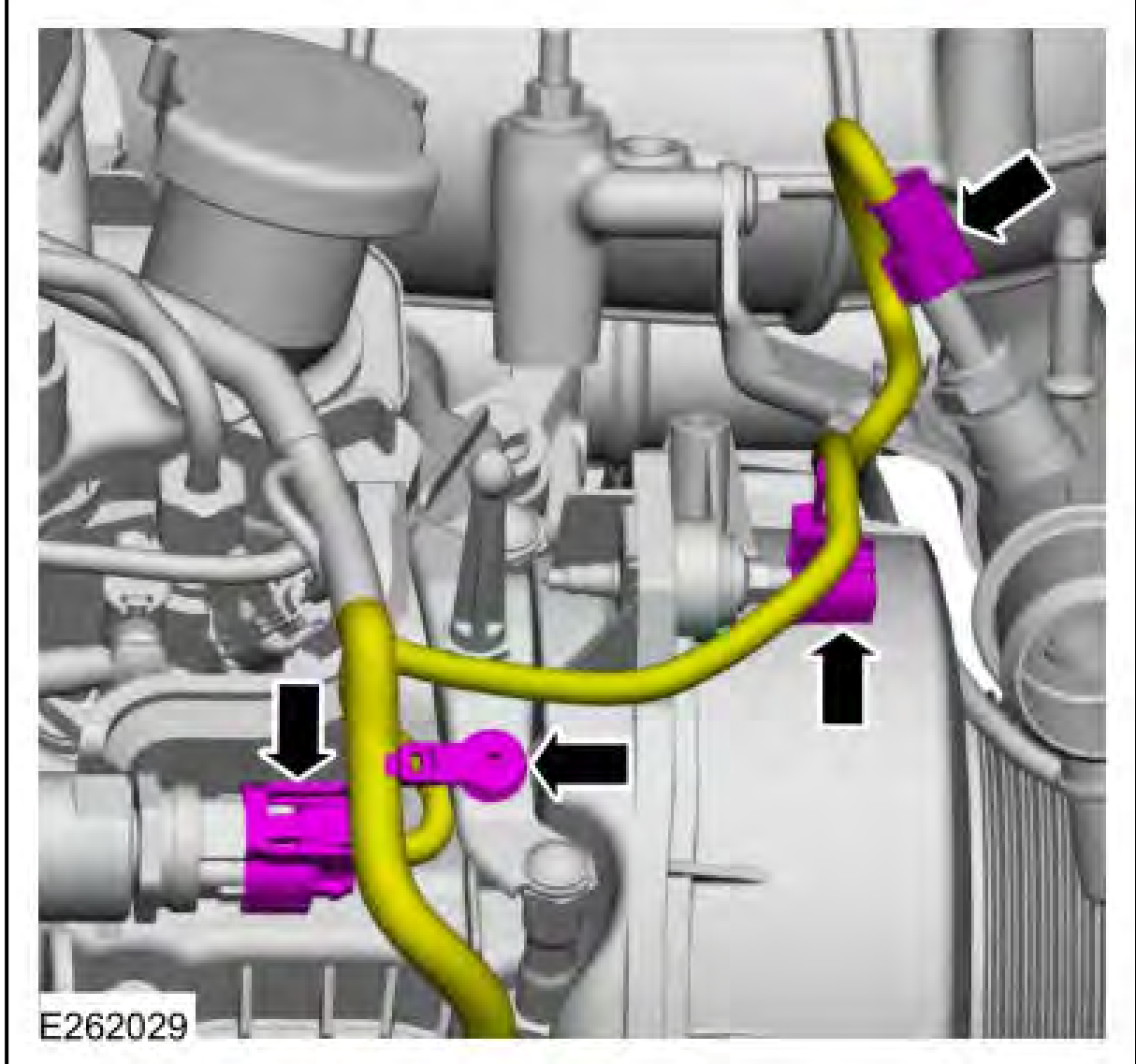




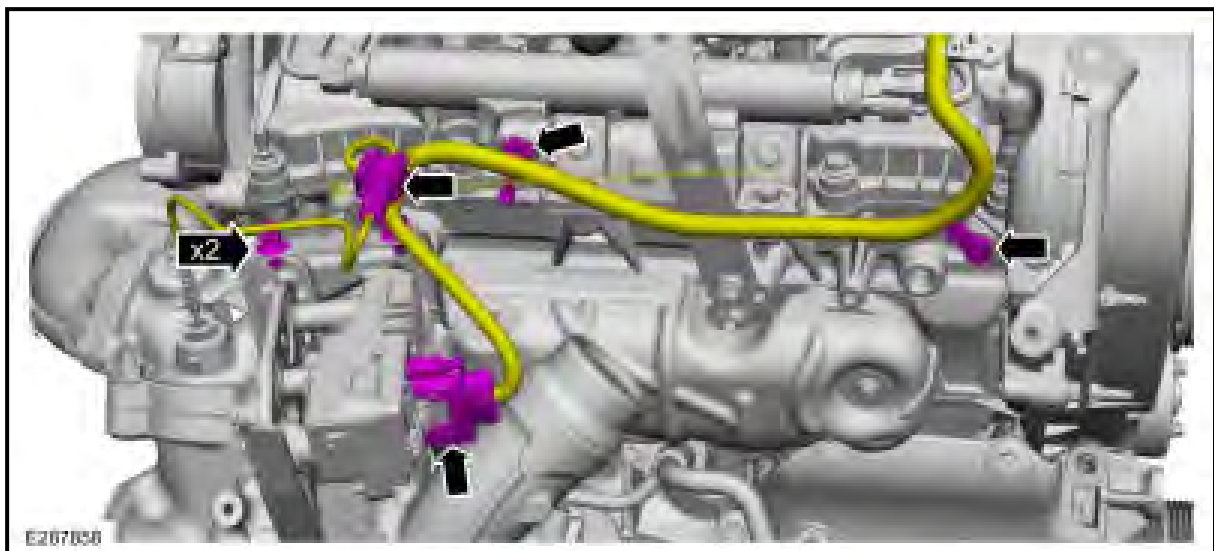


84. Connect the electrical connectors and the wire retainers.



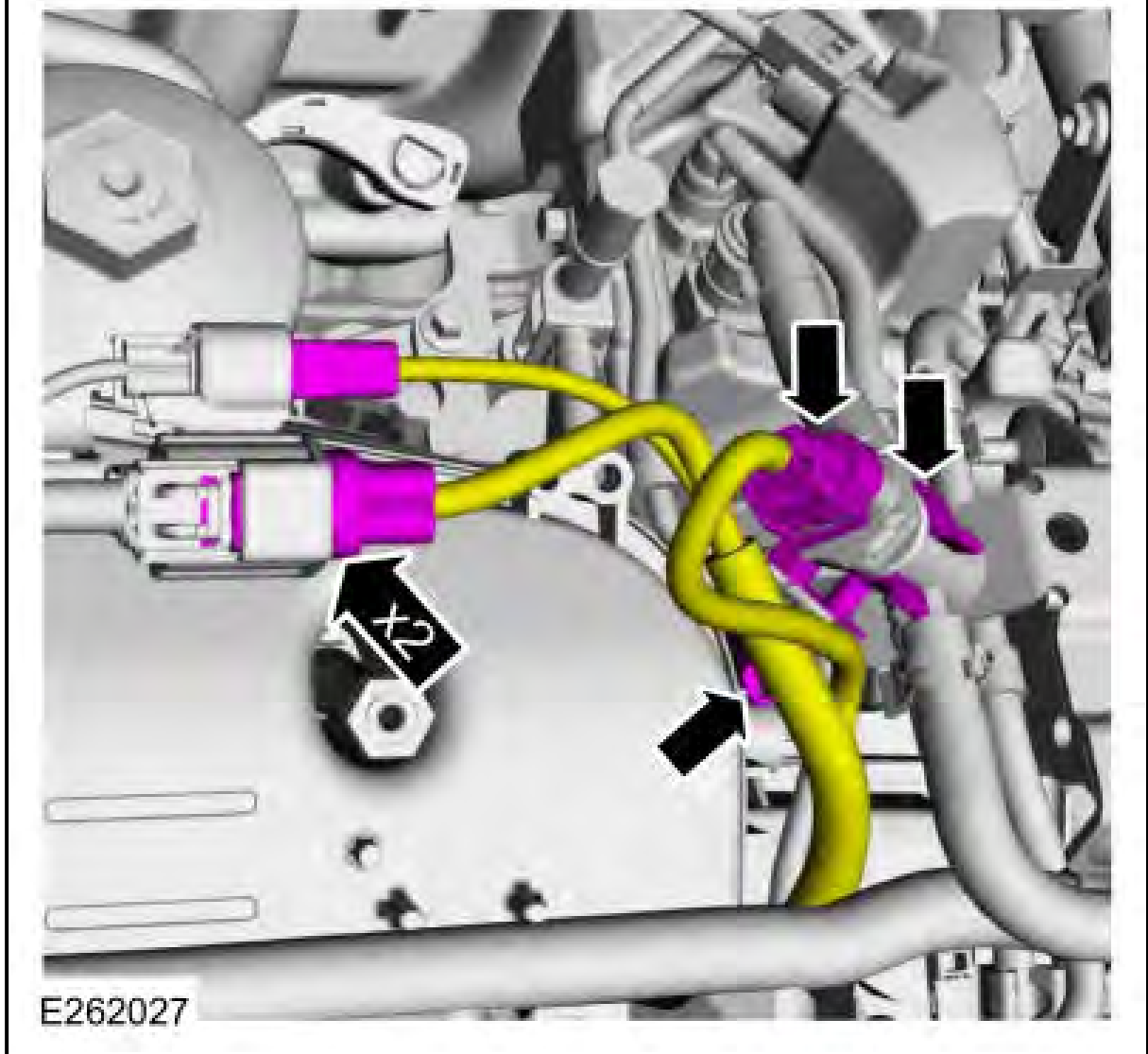


85. Connect the EGRT electrical connector and the wire retainers. Connect the turbocharger actuator electrical connector.

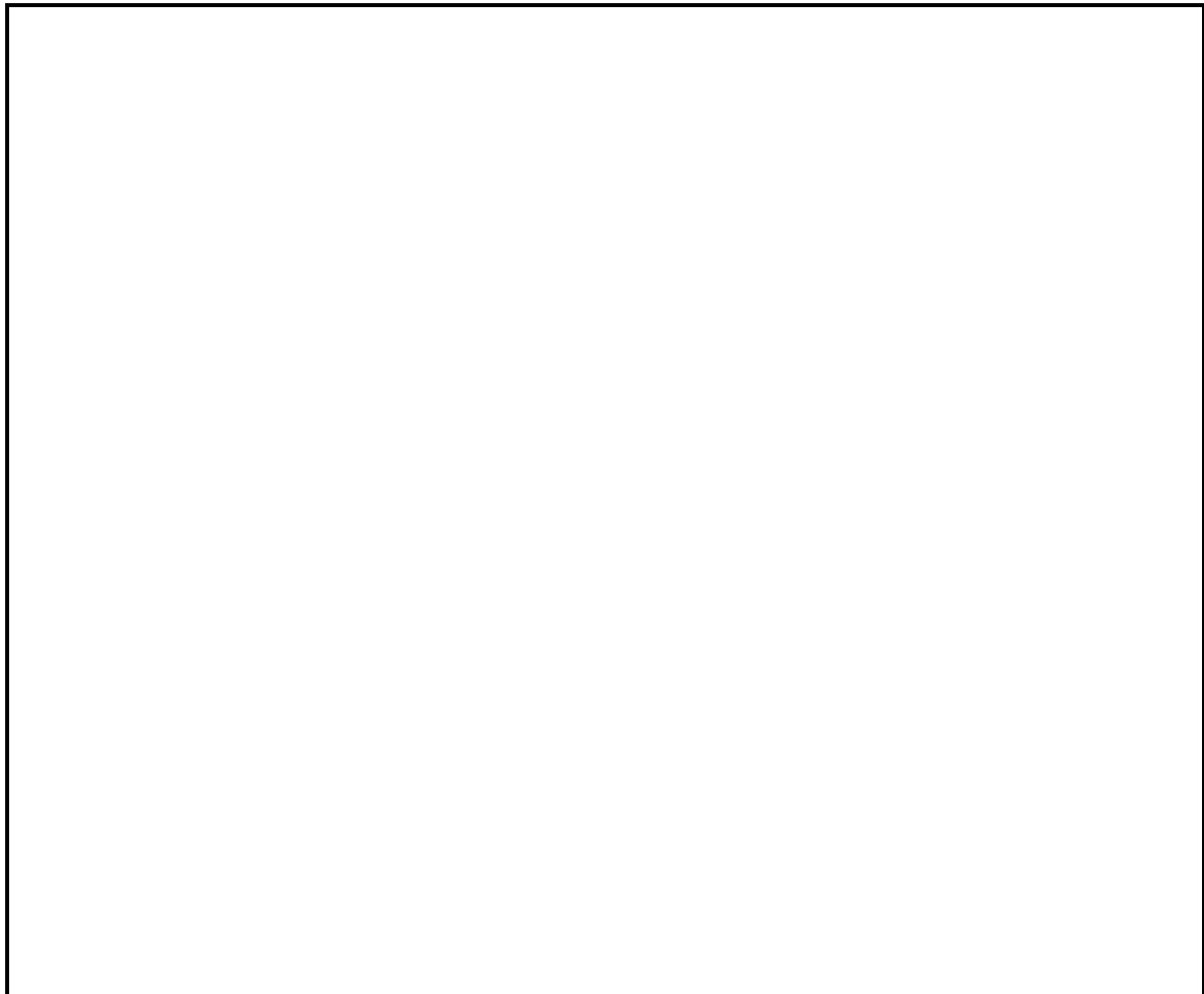


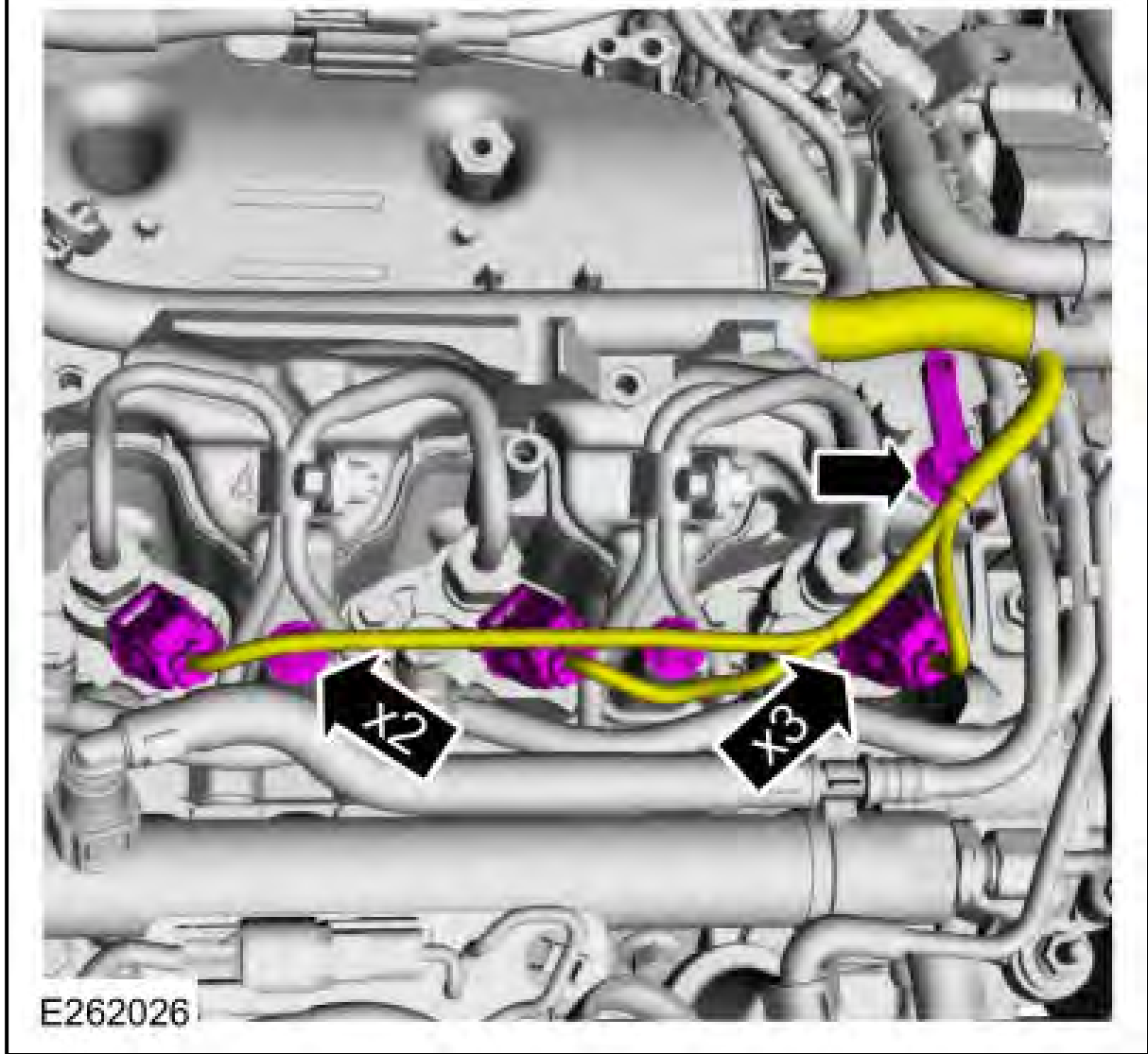
86. Connect the electrical connectors and the wire retainer.



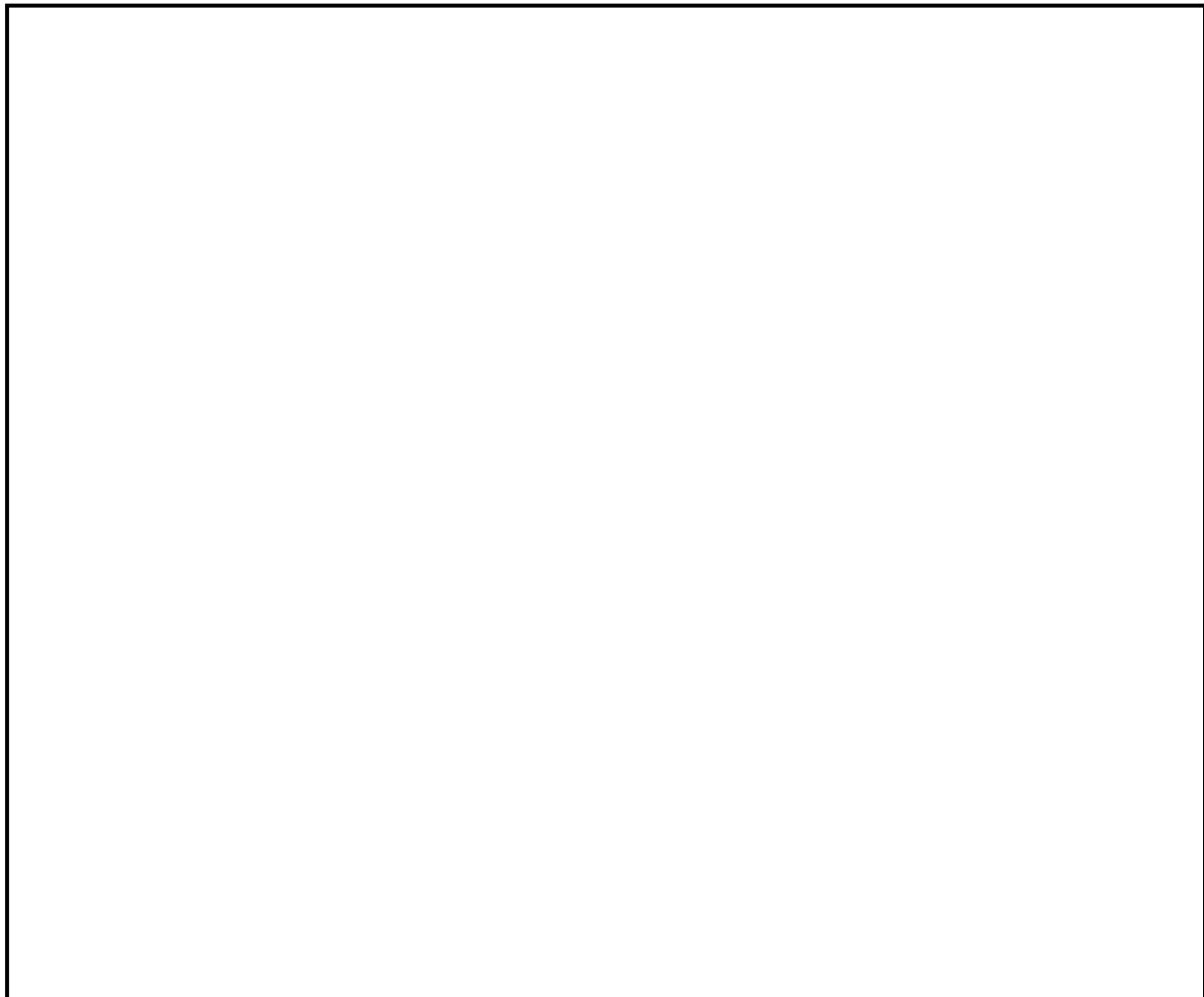


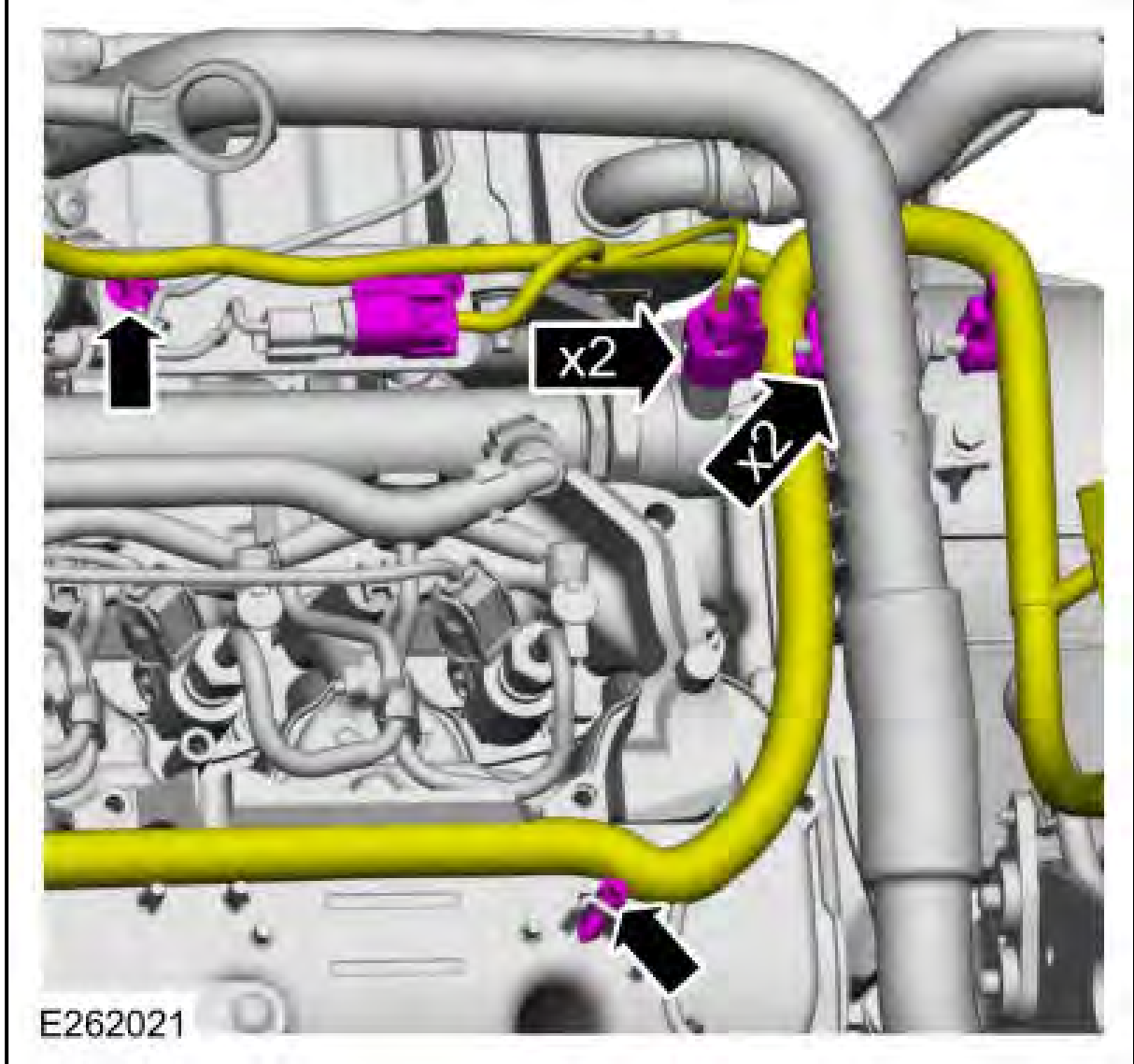
87. Connect the fuel injectors electrical connectors and the wire retainers.



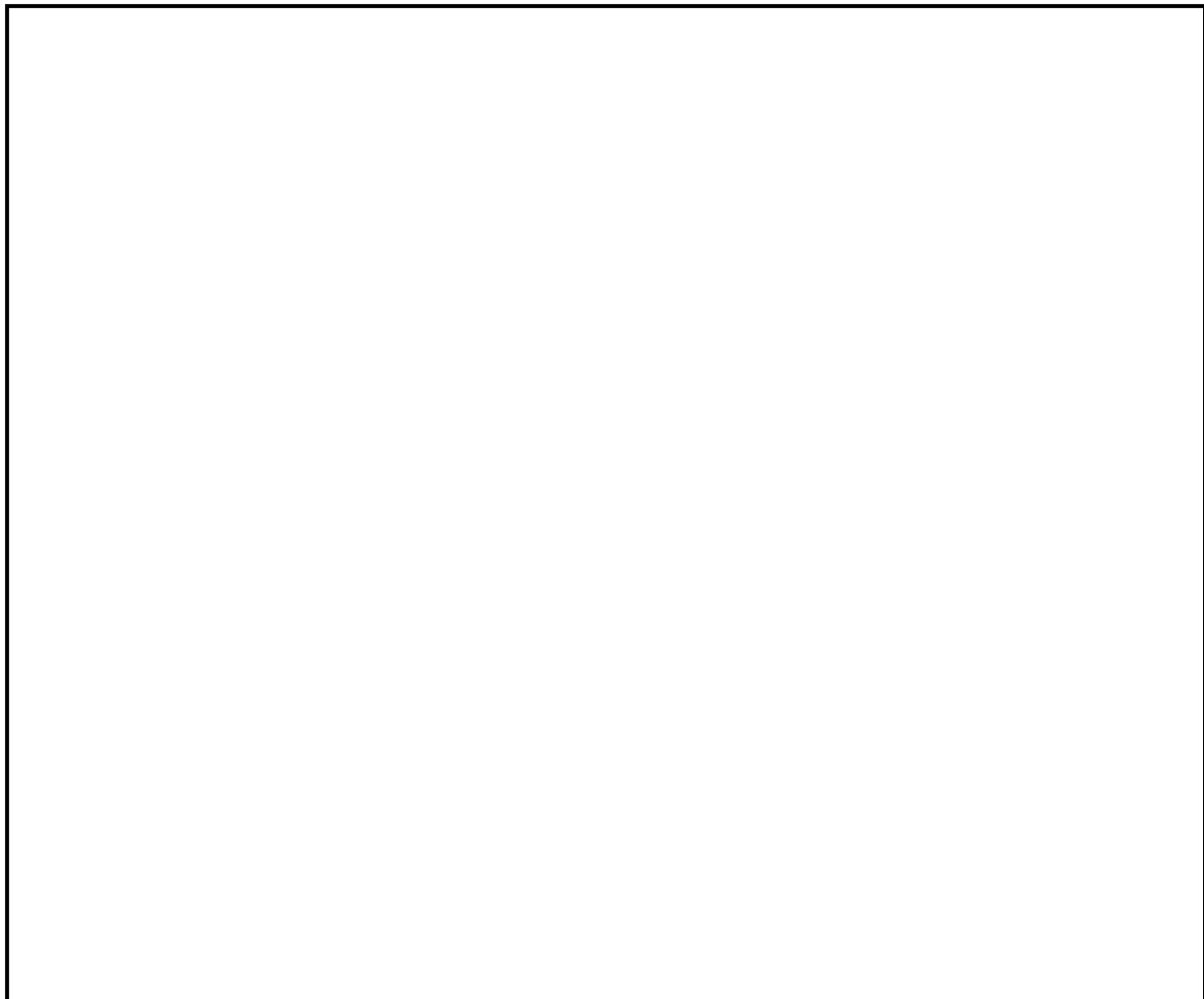


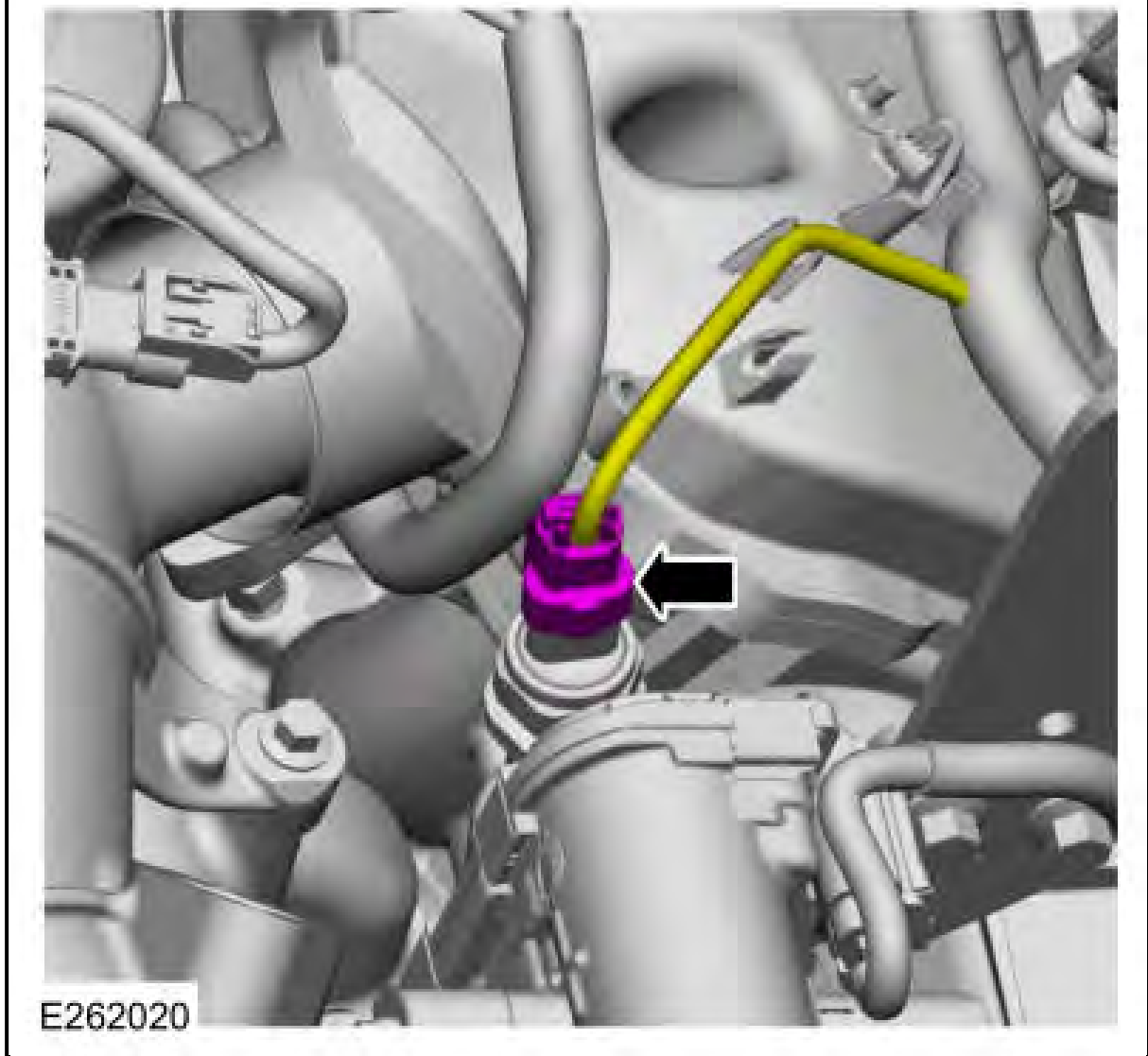
88. Connect the electrical connectors and the wire retainers.



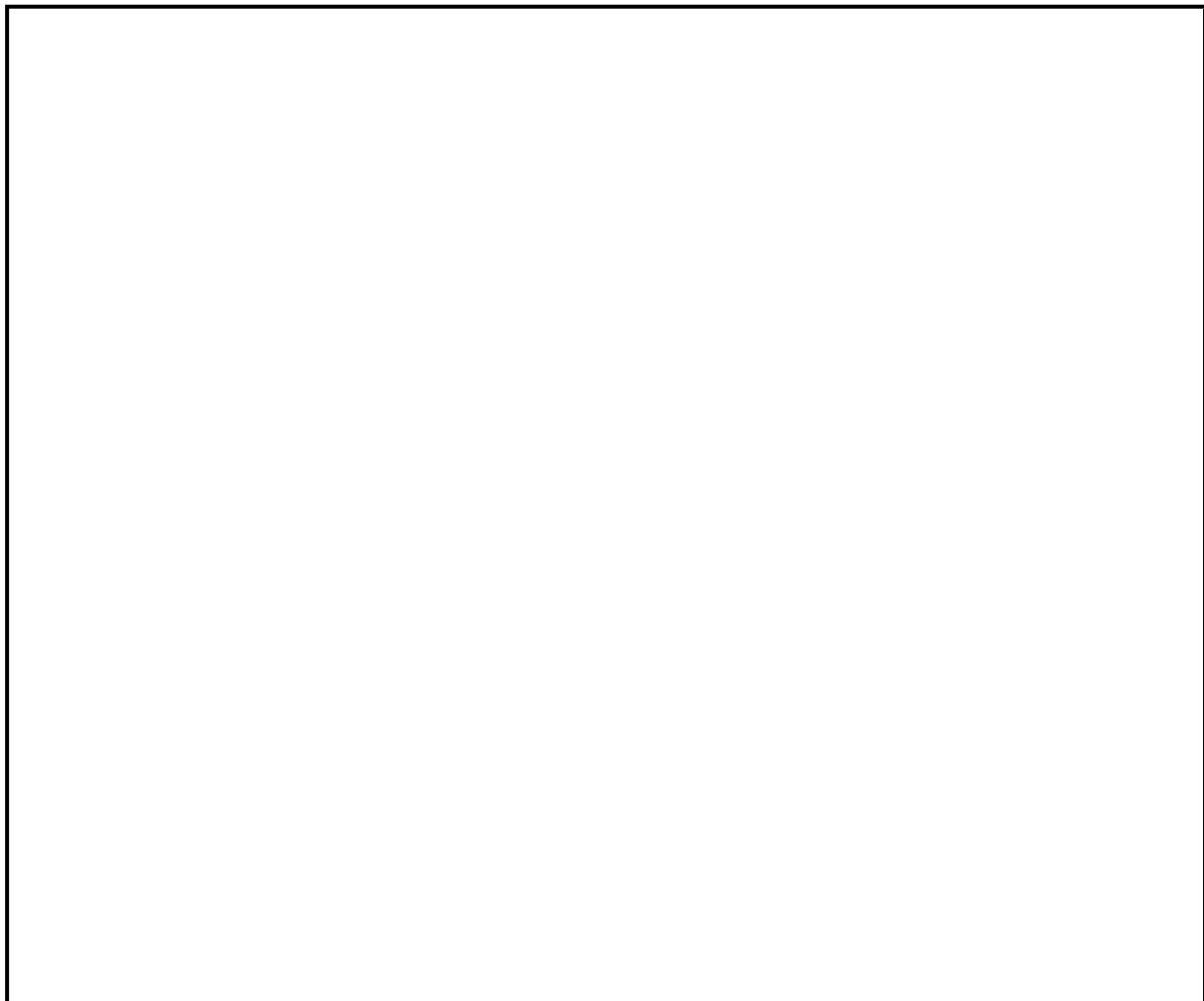


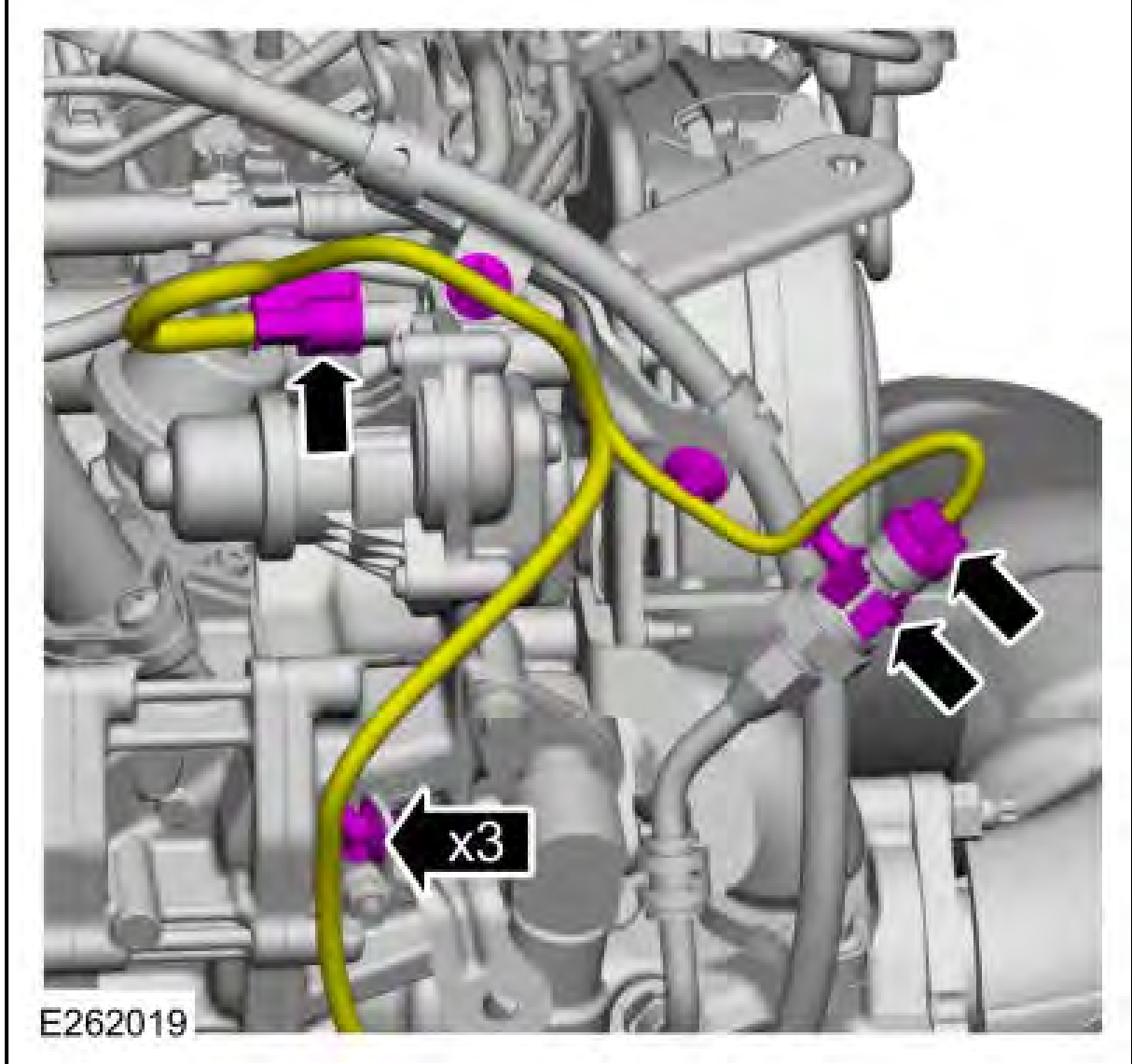
89. Connect the EOP sensor electrical connector.





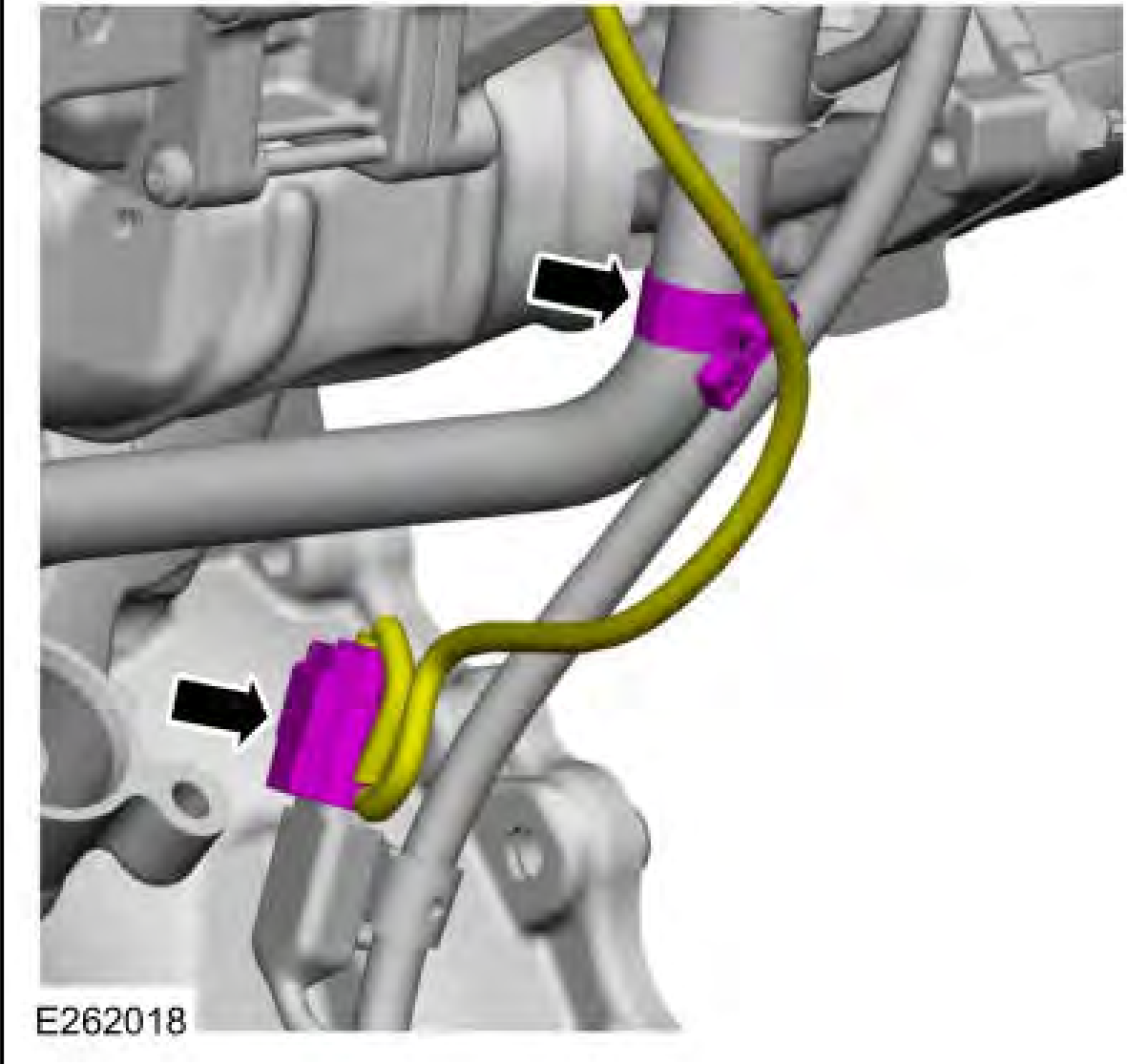
90. Connect the EGR valve and the EP sensor electrical connectors. Disconnect the wire retainers.



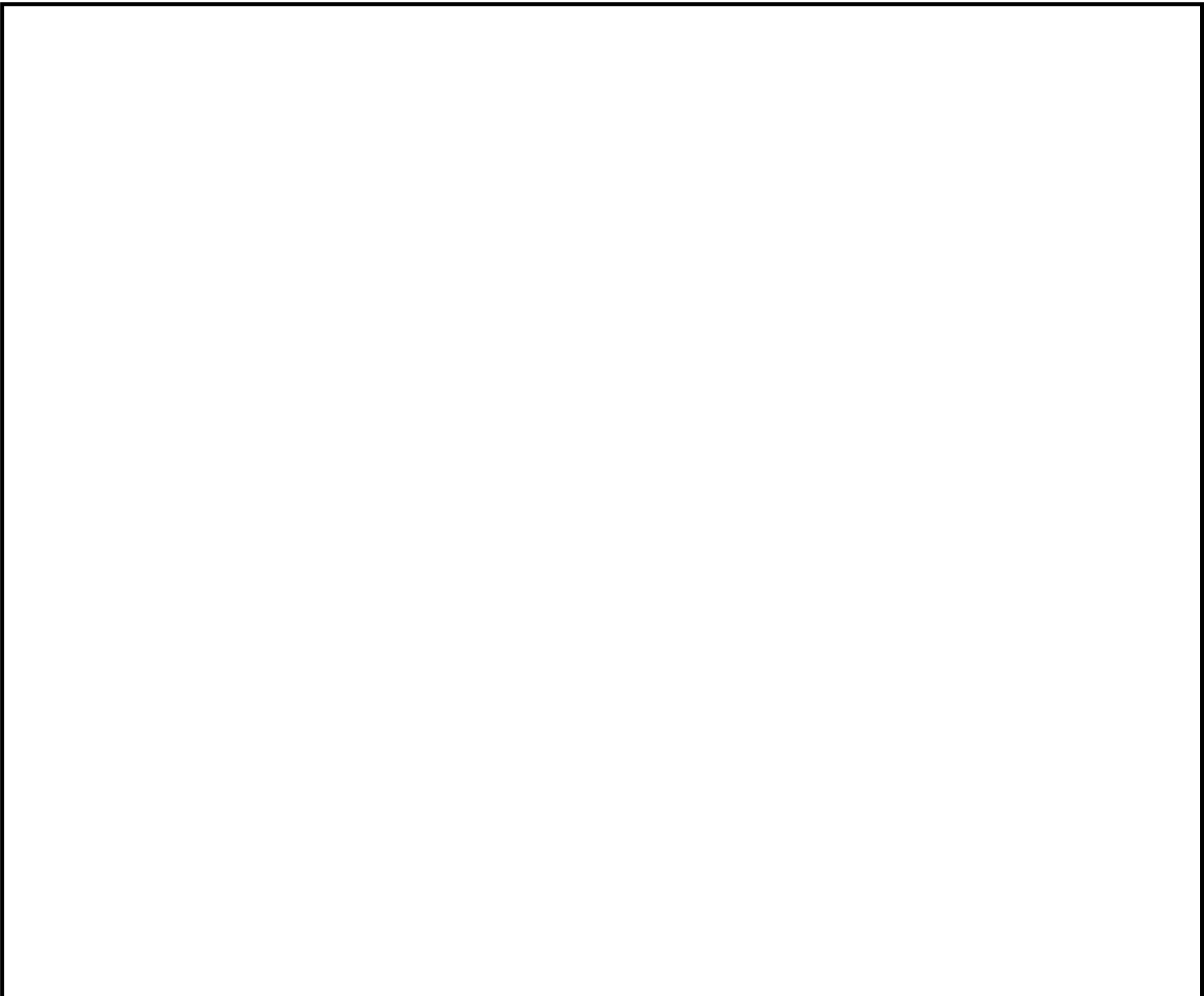


91. Connect the CKP electrical connector and the wire retainer.

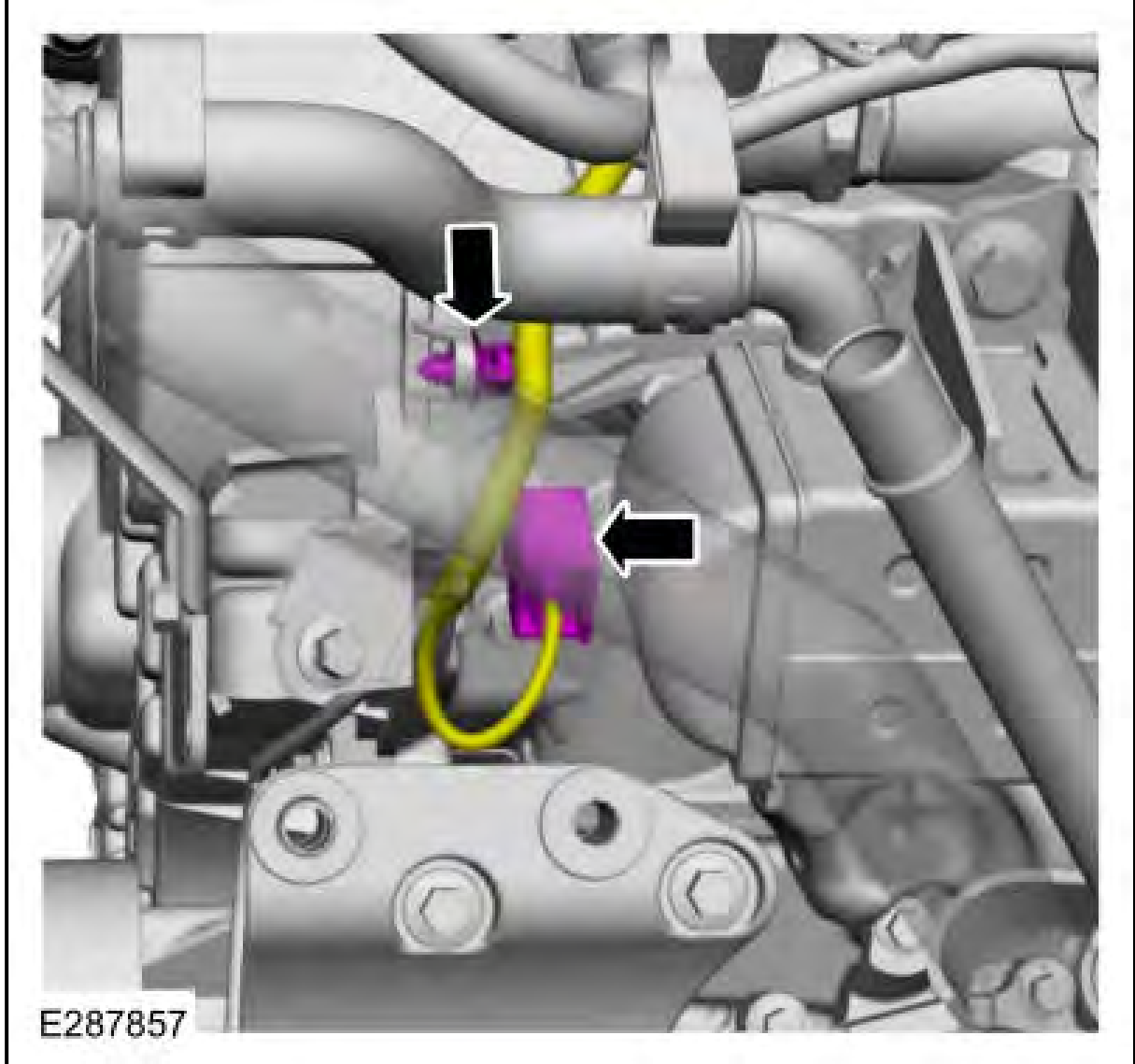




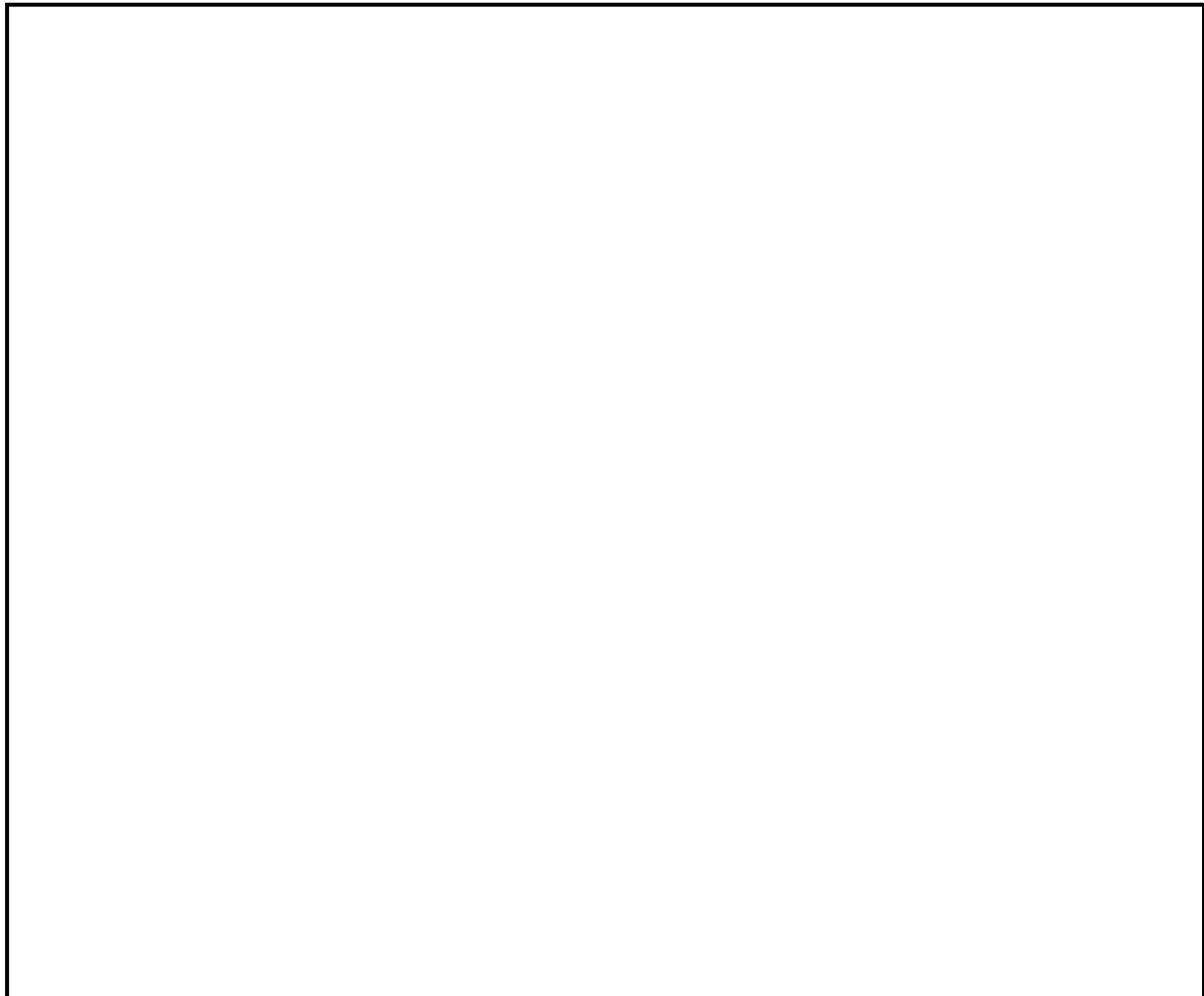
92. Connect the CMP electrical connector and the wire retainer.

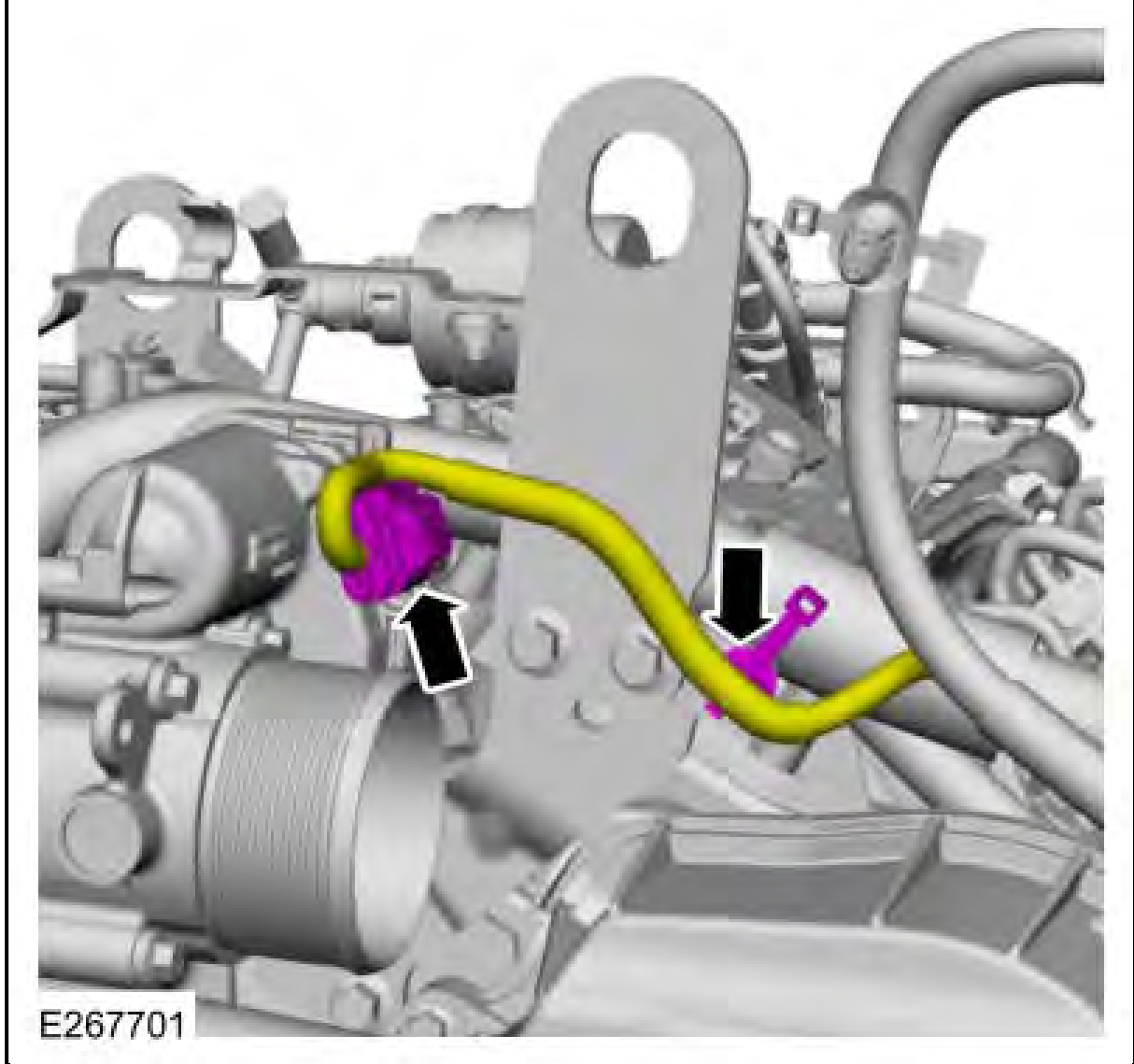




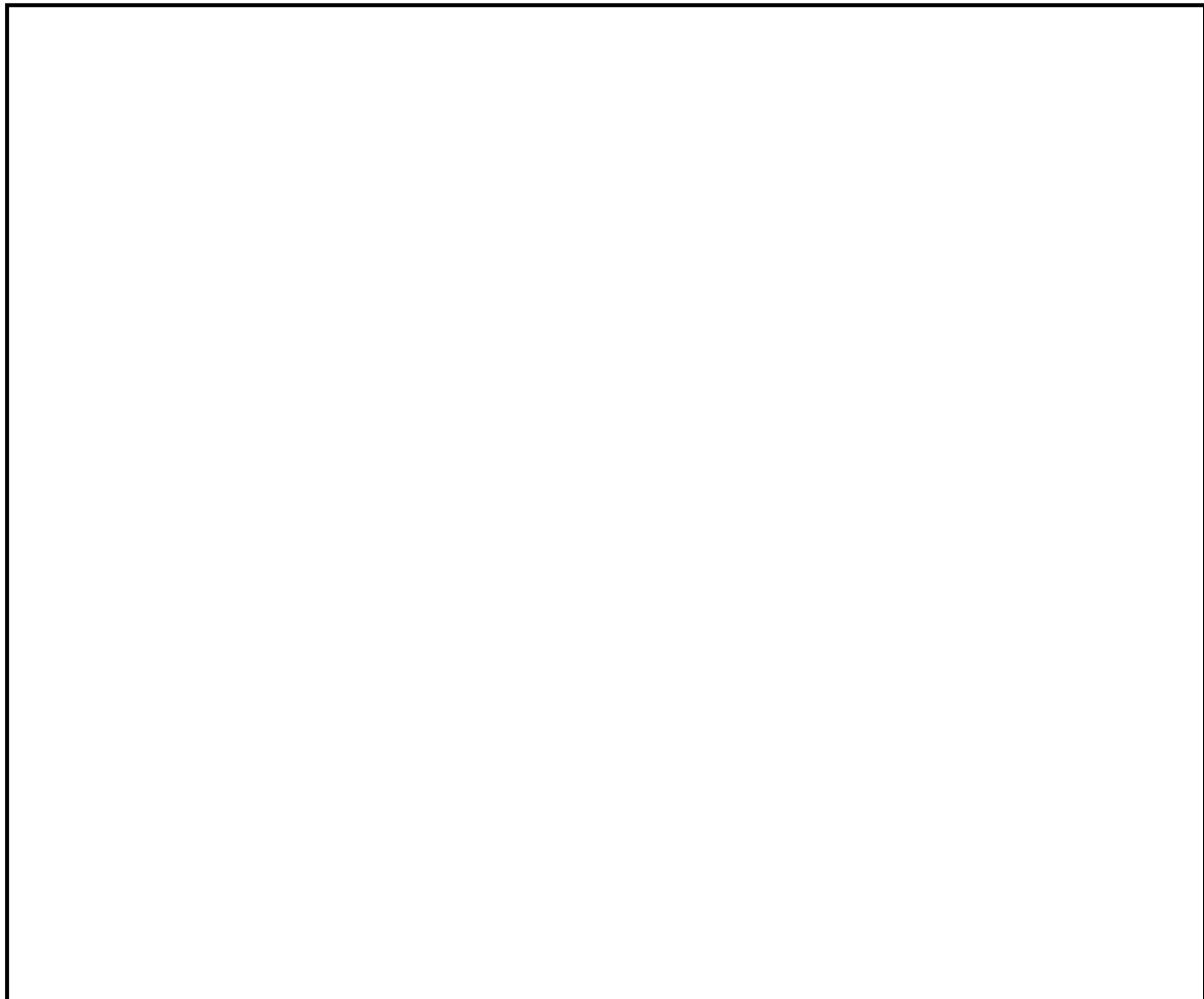


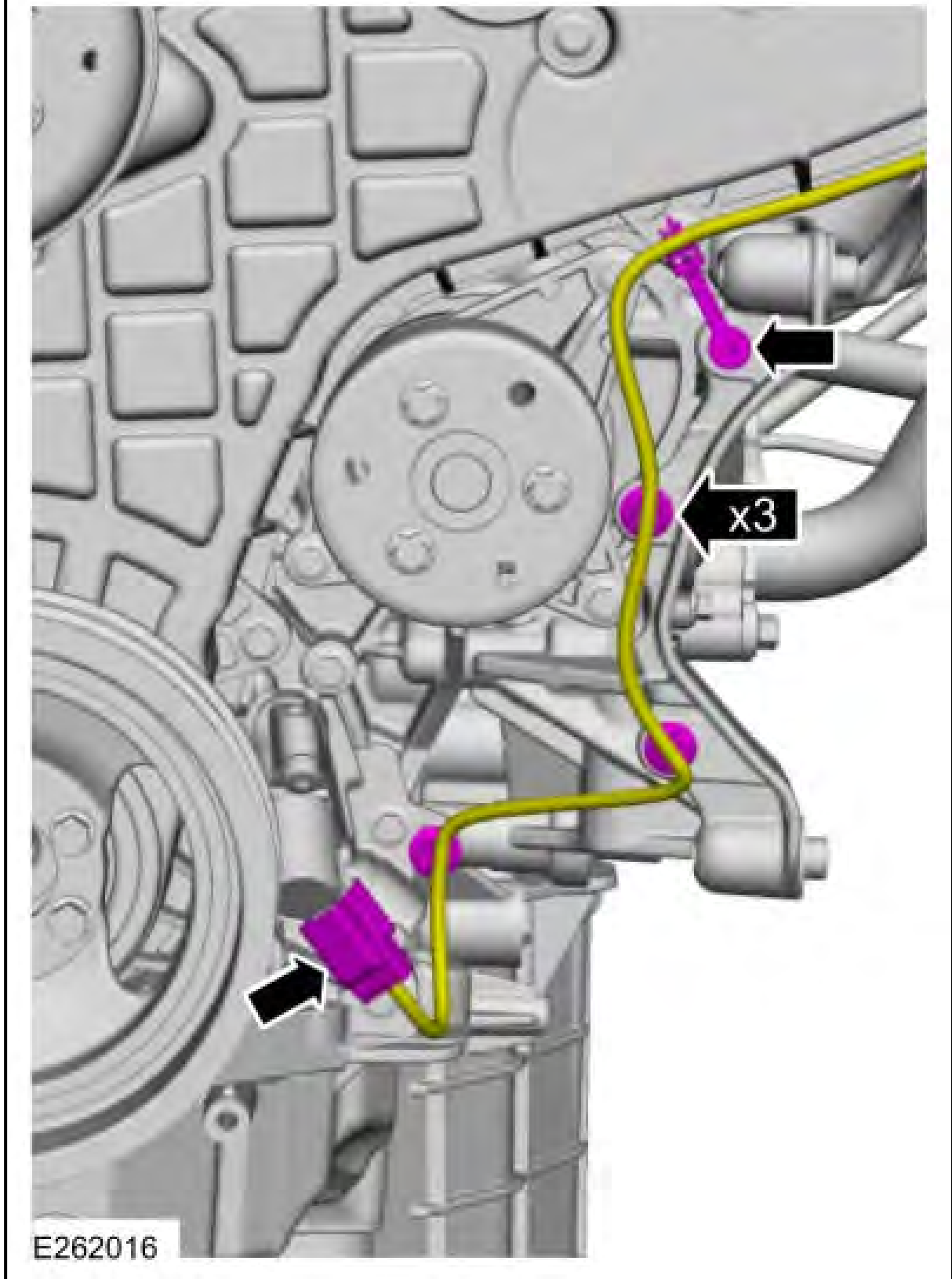
93. Connect the TB (throttle body) electrical connector and the wire retainer.





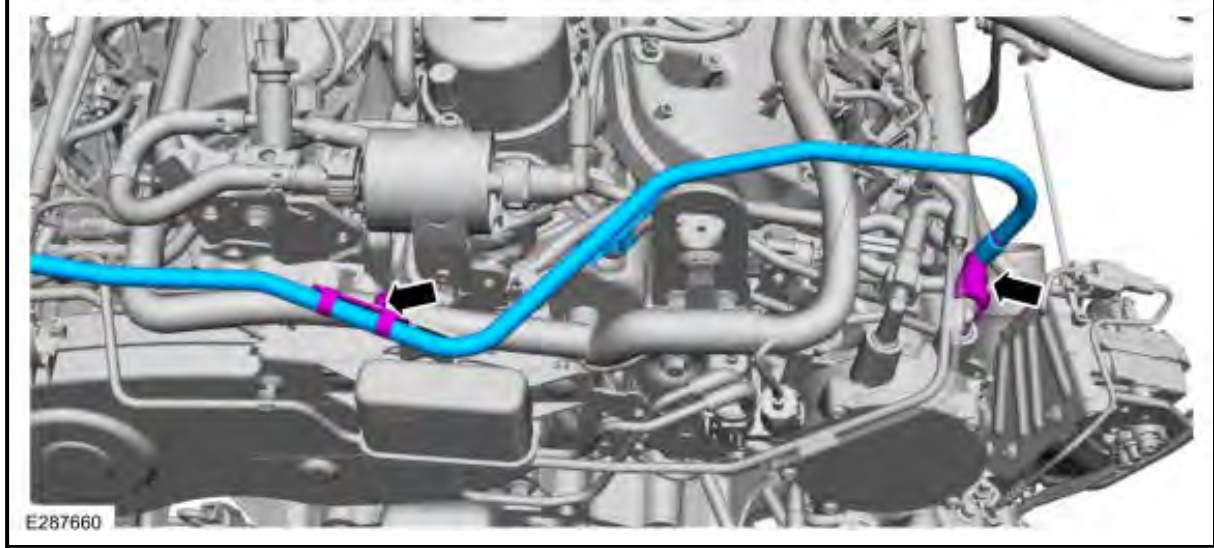
94. Connect the oil pump electrical connector and the wire retainers.



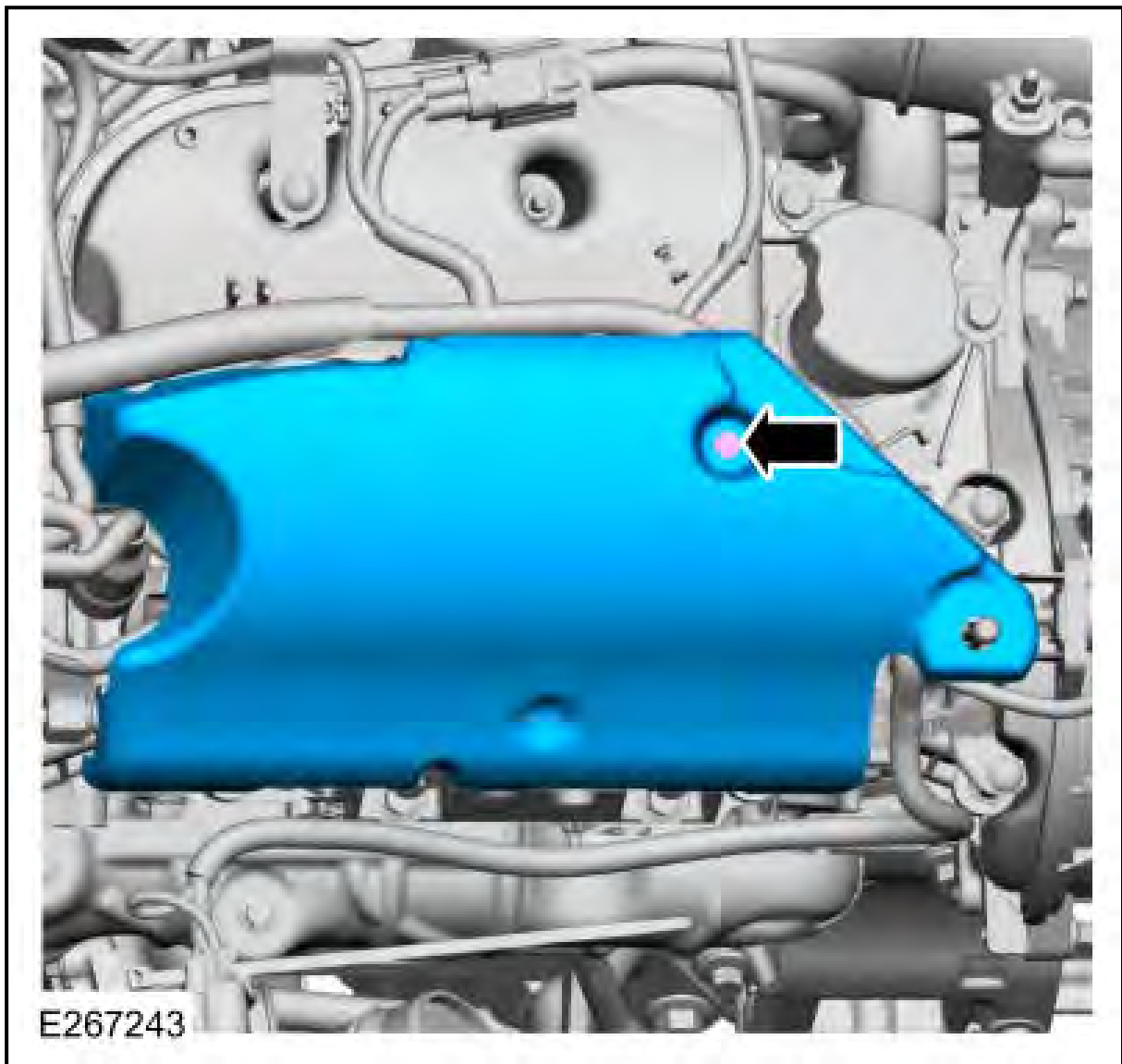


95. Install the brake vacuum hose and connect the retainer. Refer to: [Quick Release Coupling](#) .



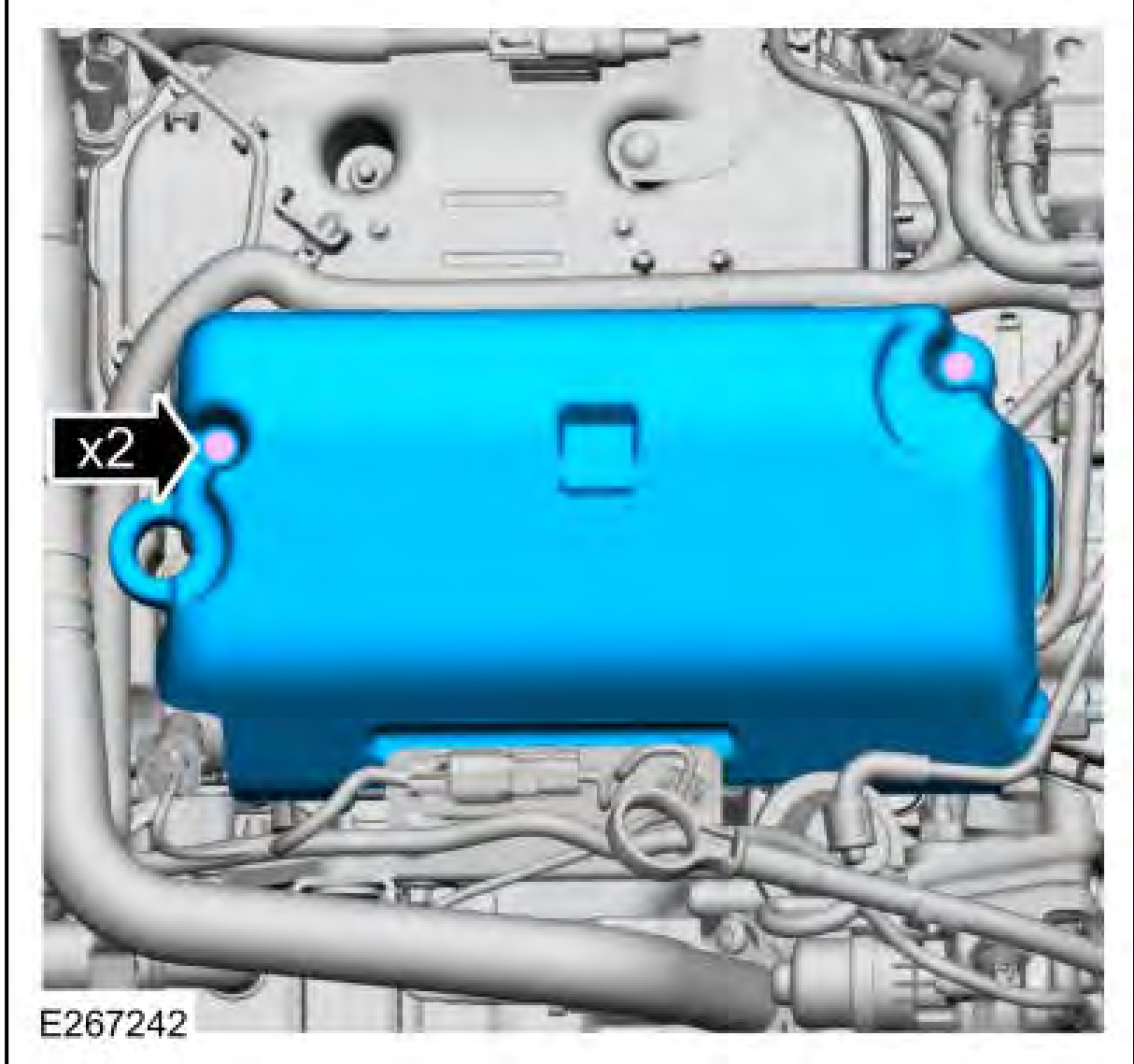


96. Remove the RH fuel injector noise insulator.

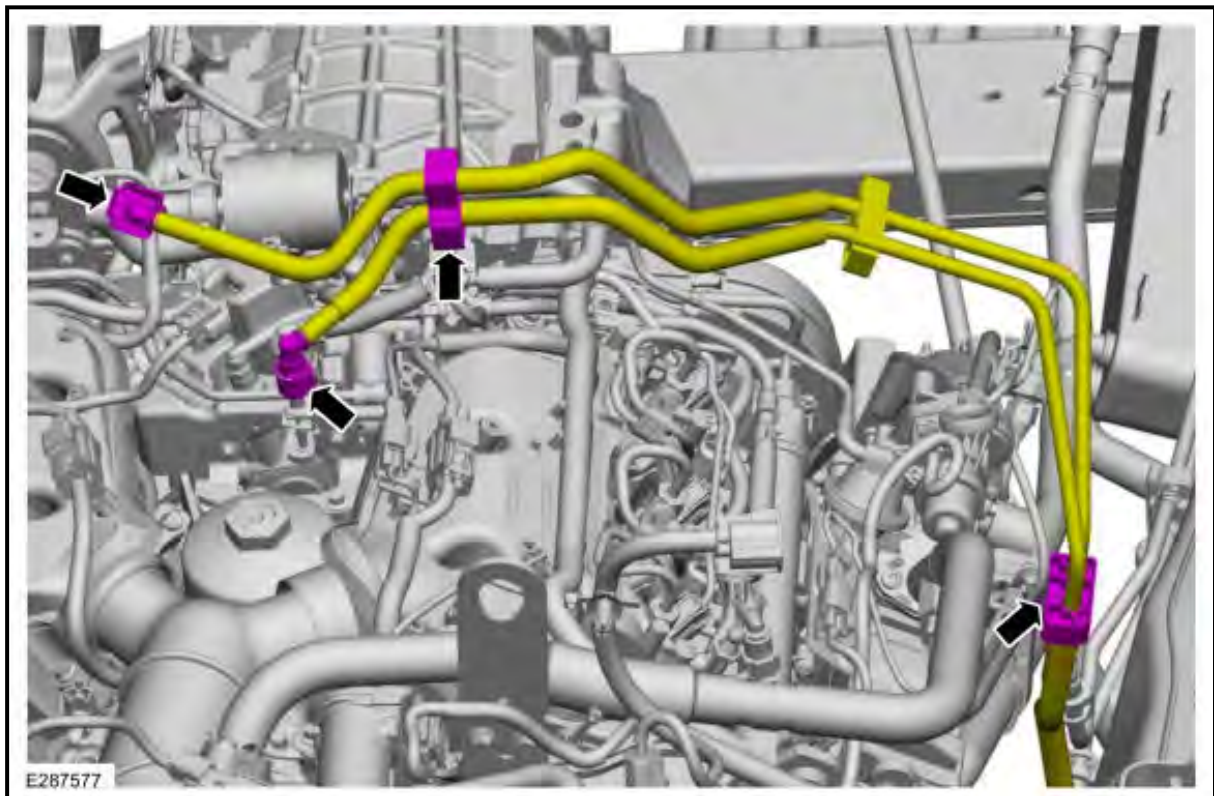


97. Install the LH fuel injector noise insulator.





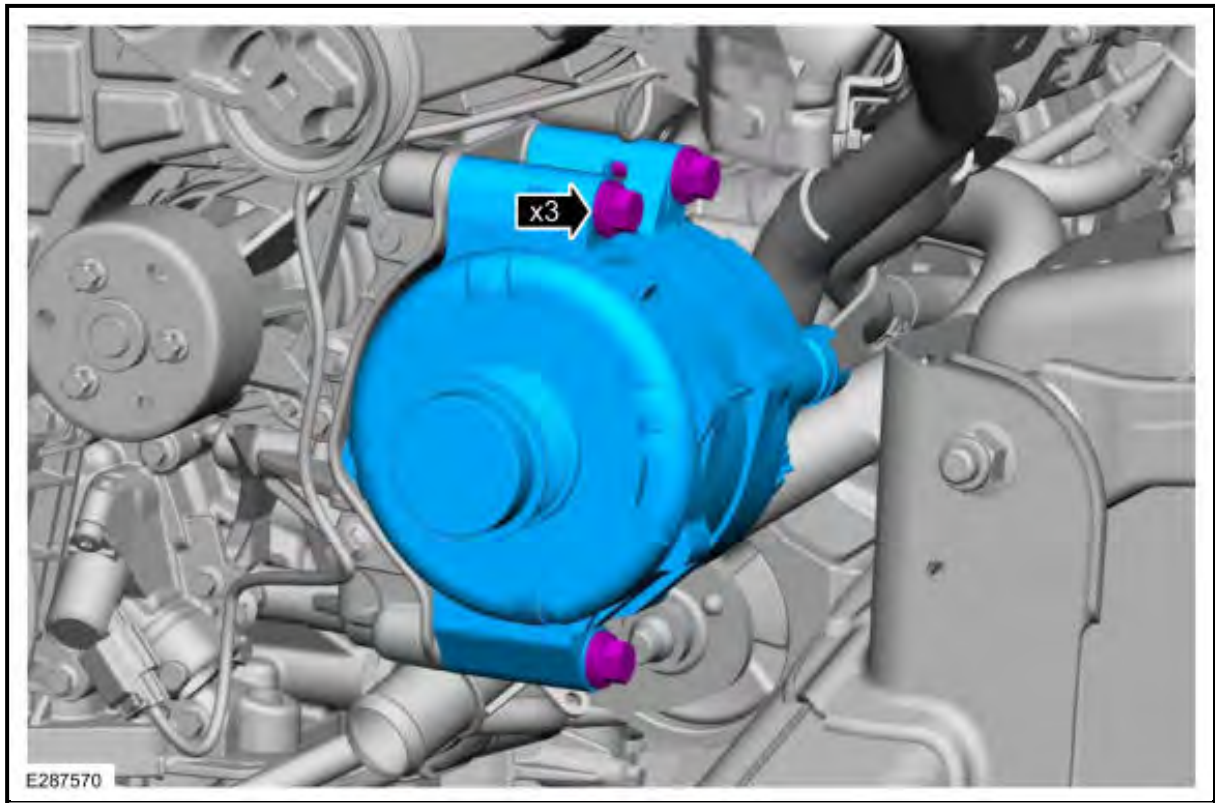
98. Position back and connect the fuel tubes. Refer to: [Quick Release Coupling](#) .



99. Install the generator and the bolts.

Torque

: 35 lb.ft (48 Nm)

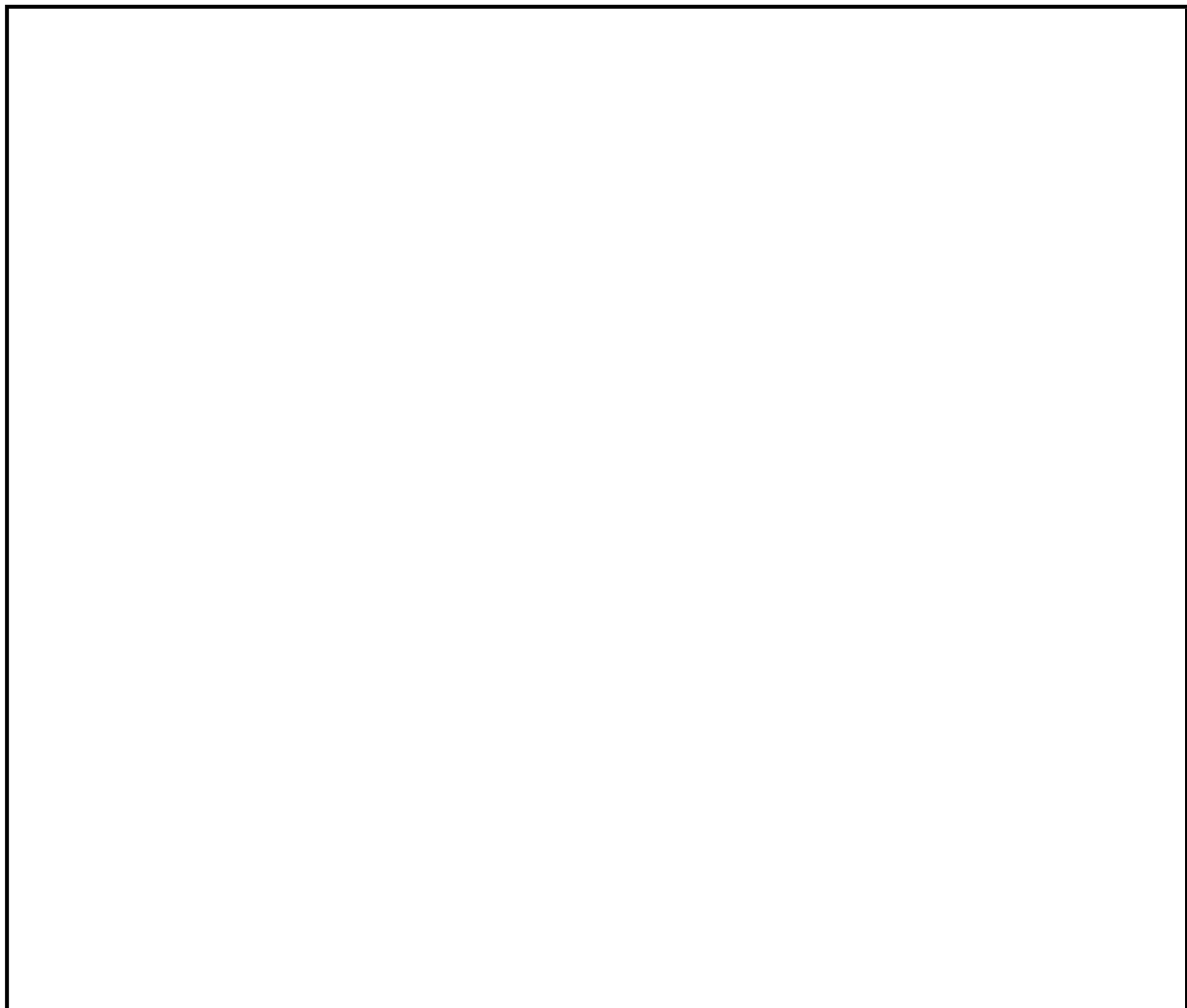


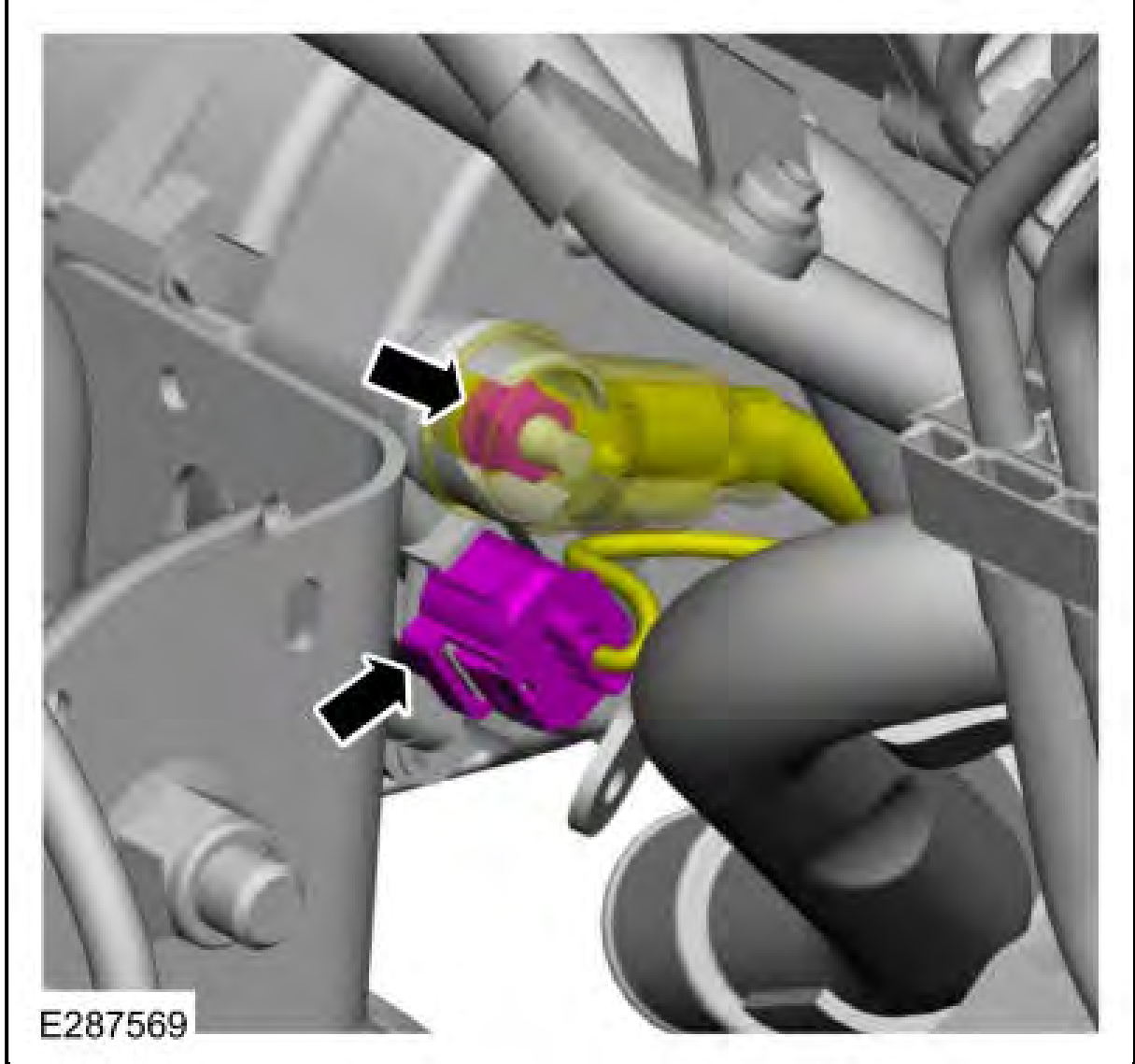
100. **NOTE:** When installing the B+ terminal nut to the generator, finger-start the nut before tightening or component damage may occur.

Connect the electrical connector and the generator output wire.

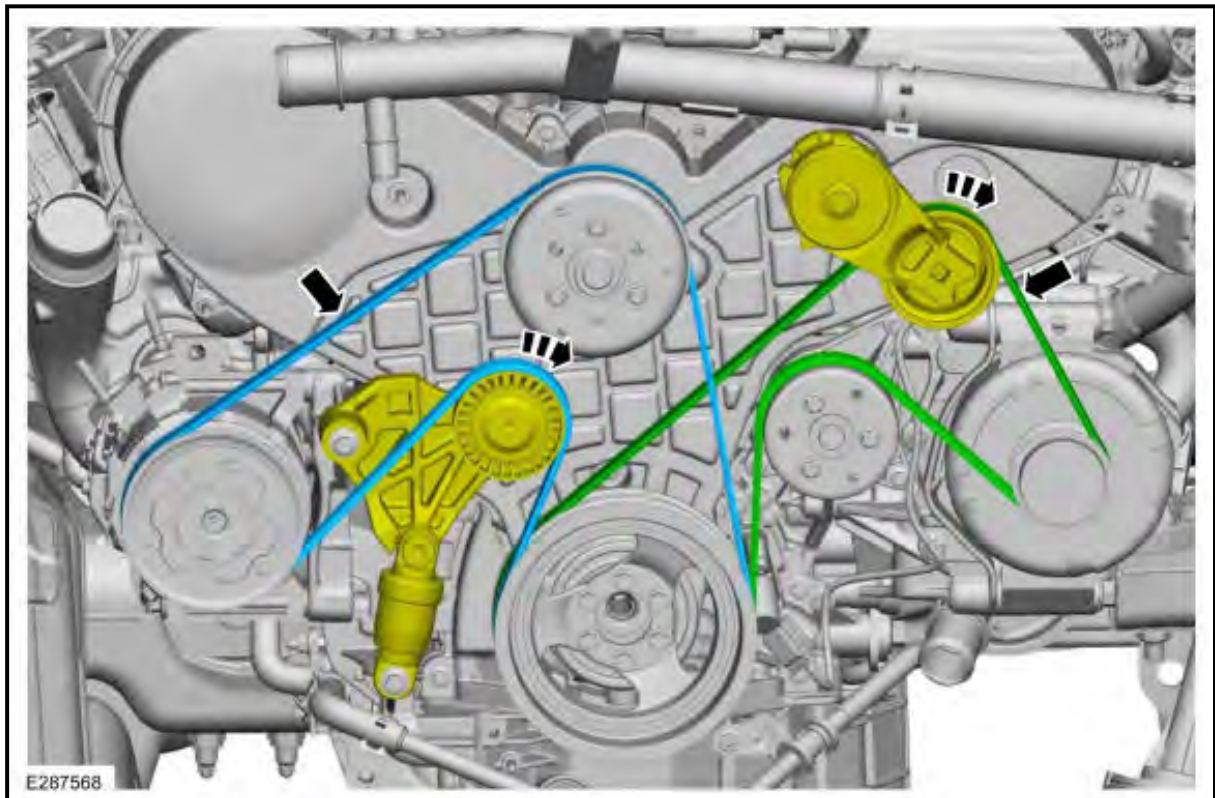
Torque

: 159 lb.in (18 Nm)



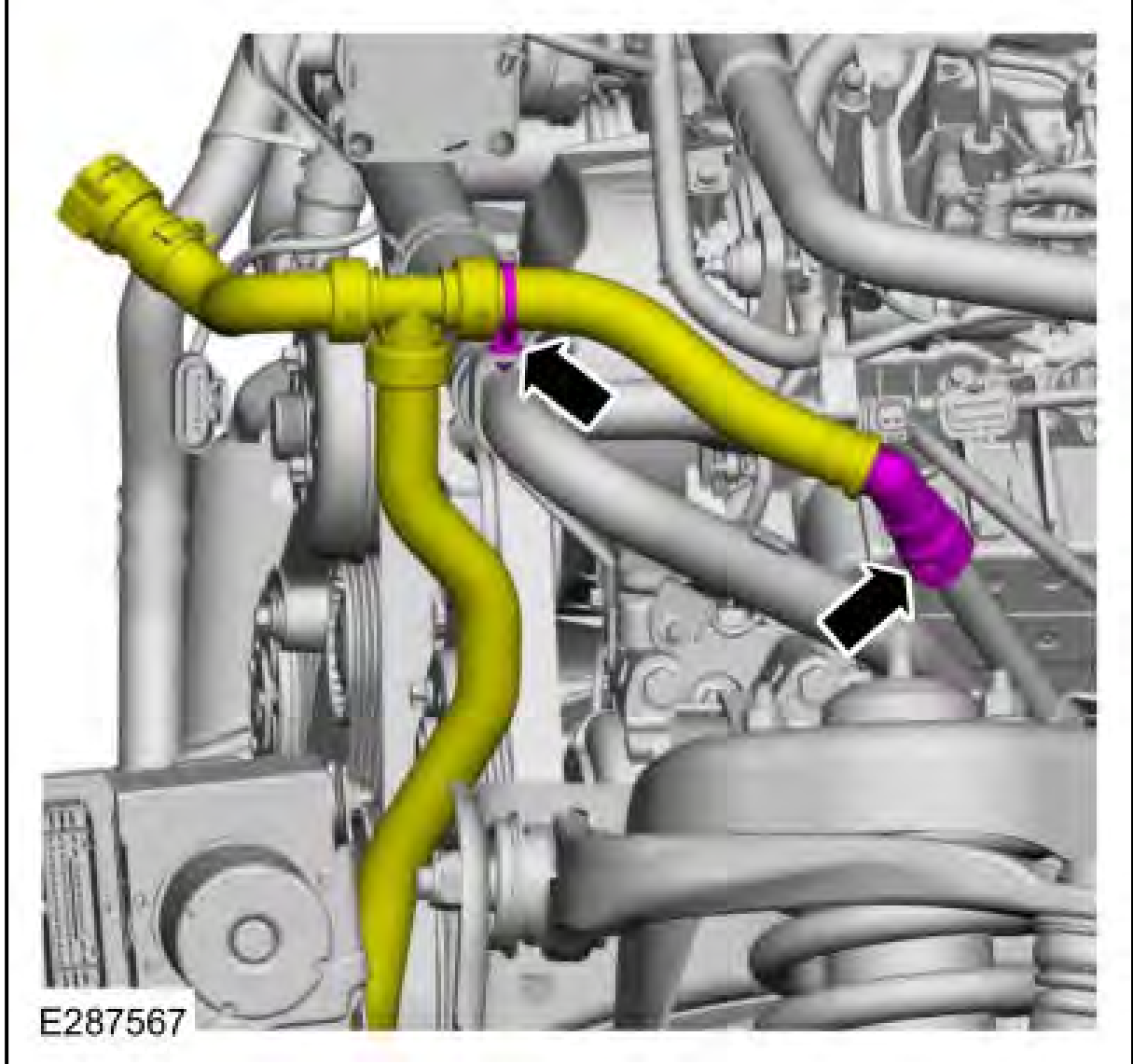


101. Install the accessory drive belt and the A/C belt.



102. Connect the coolant hose connector and the retainer.





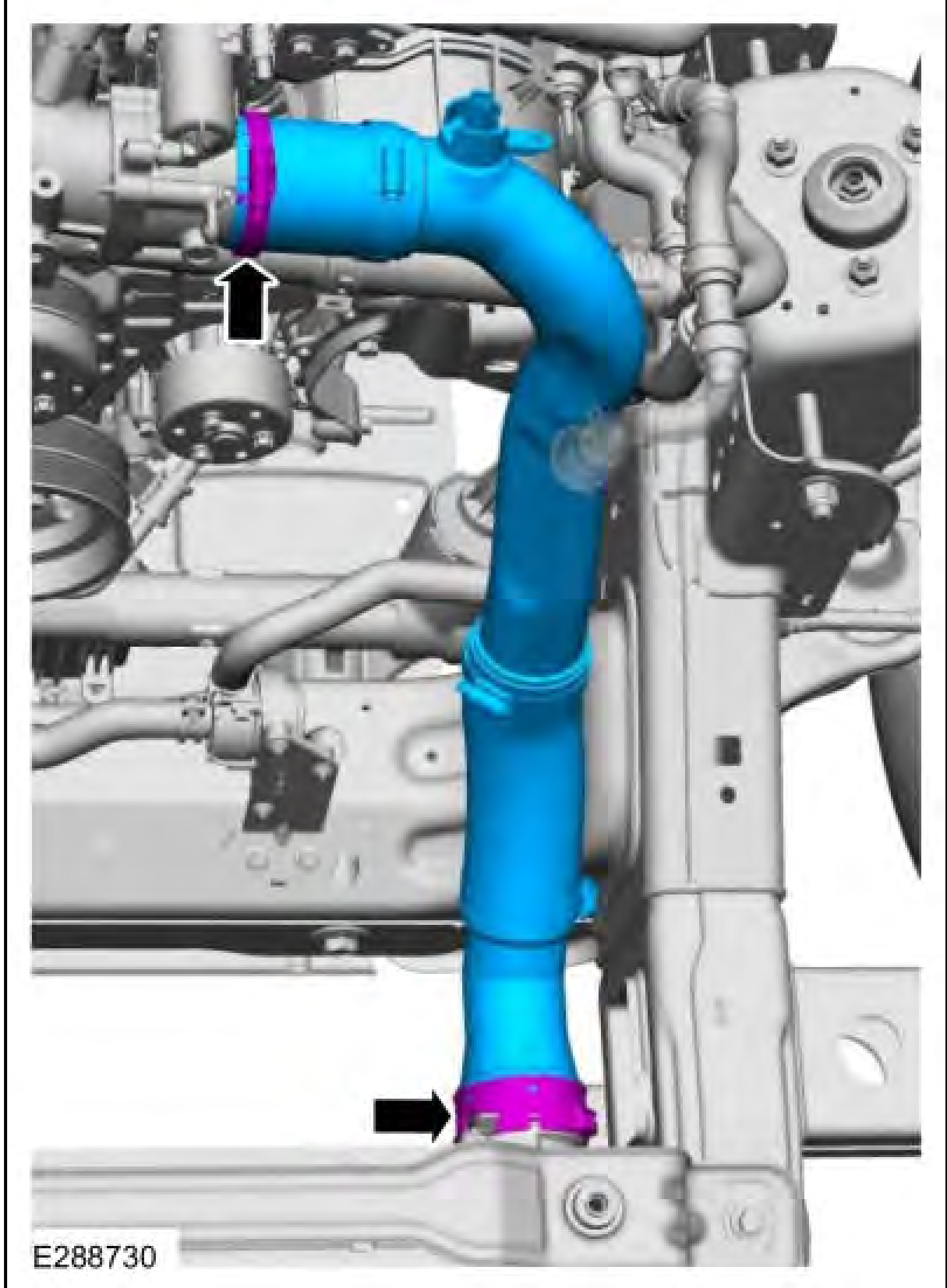
103. Inspect the turbocharger or engine air intake system components and clean, if necessary.
104. Install the LH CAC intake pipe and the clip. Tighten the clamp.

Torque

: 44 lb.in (5 Nm)

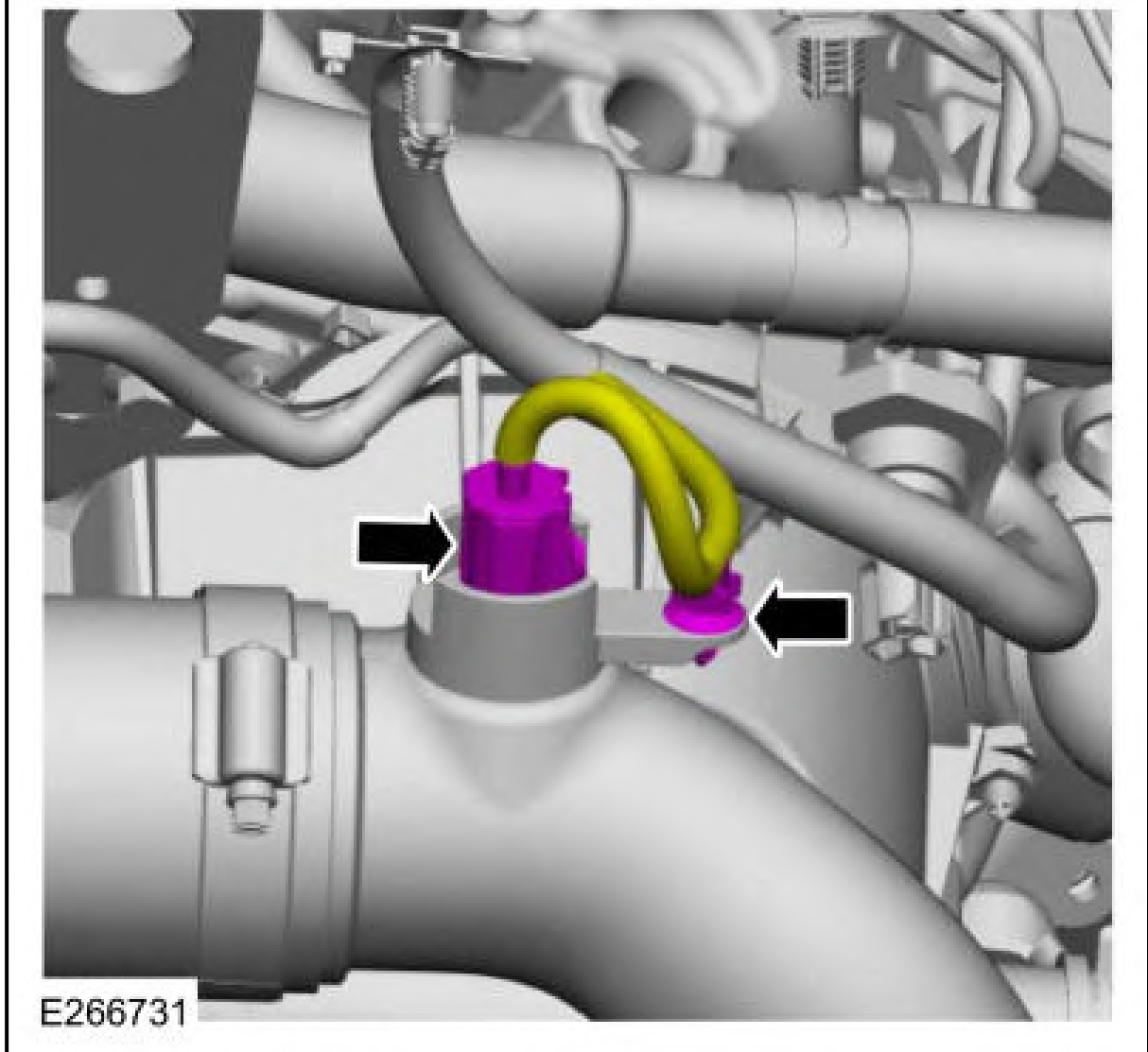




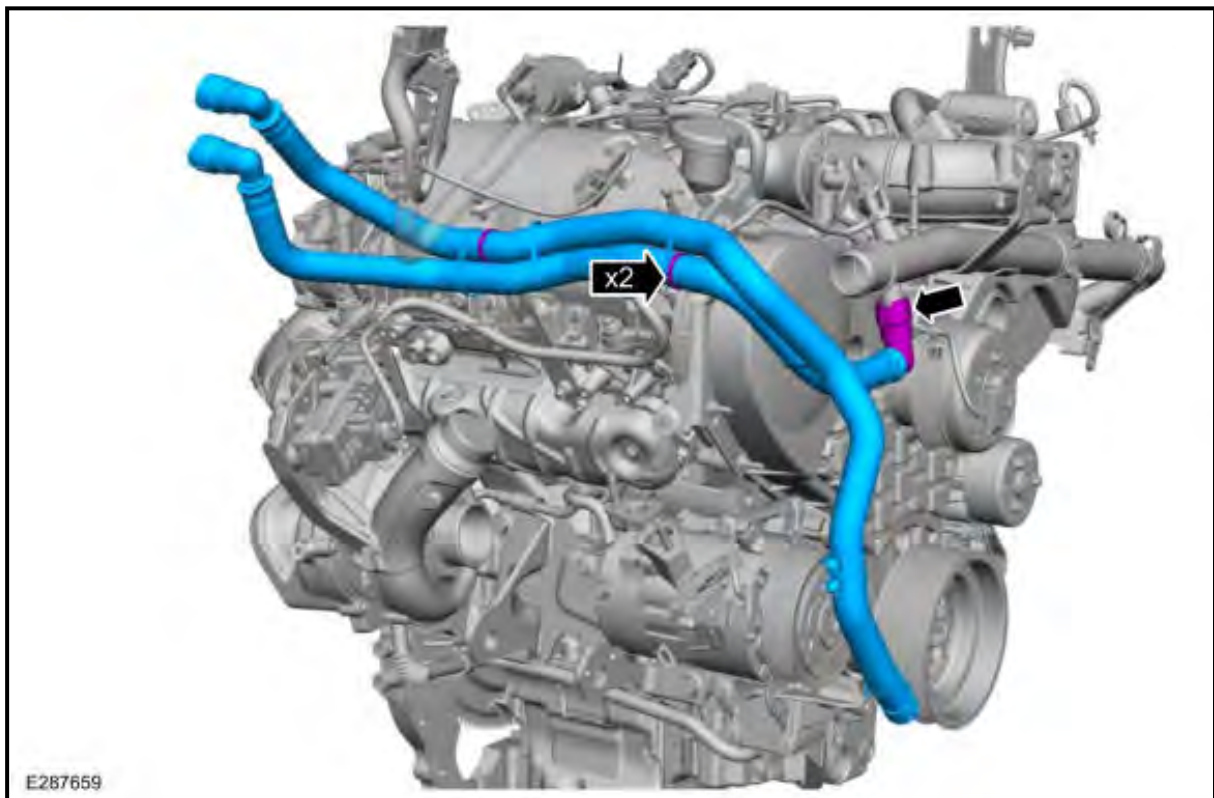


105. Connect the electrical connector and the wire retainer.

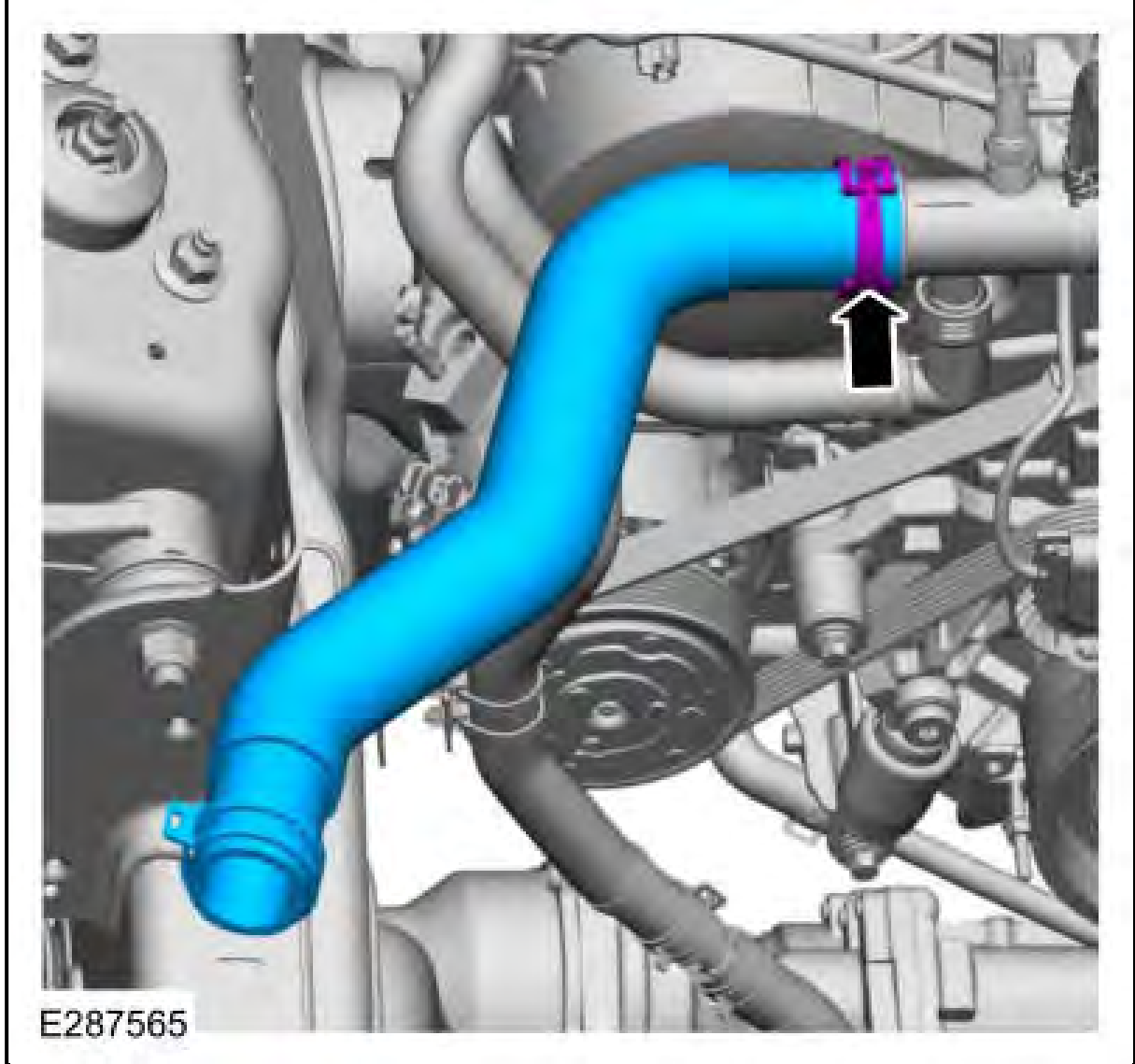




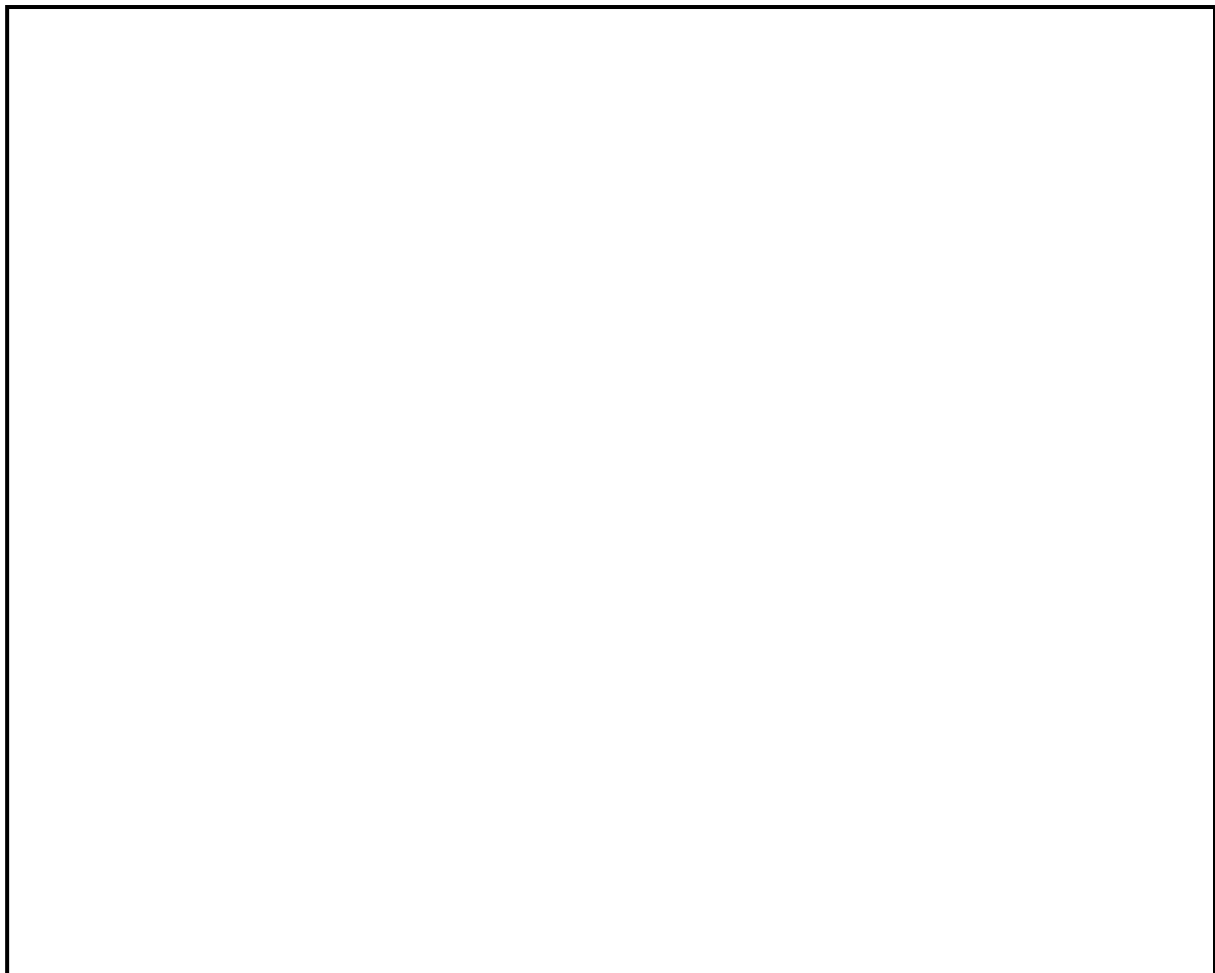
106. Install the coolant hoses and connect the coolant hose connector.

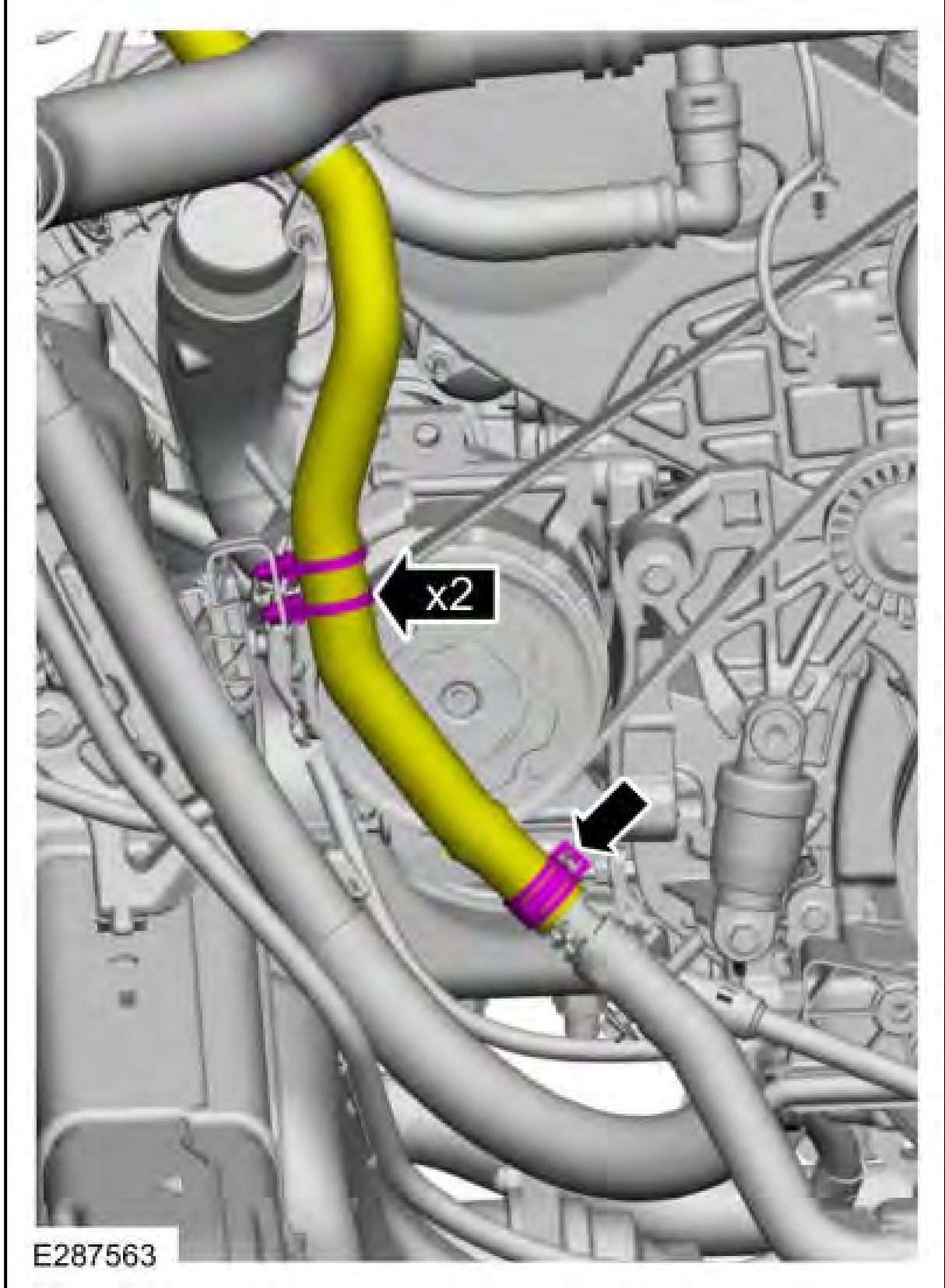


107. Install the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer



108. Position back the coolant hose and connect the retainers. Connect the coolant hose. Use the General Equipment: Hose Clamp Remover/Installer



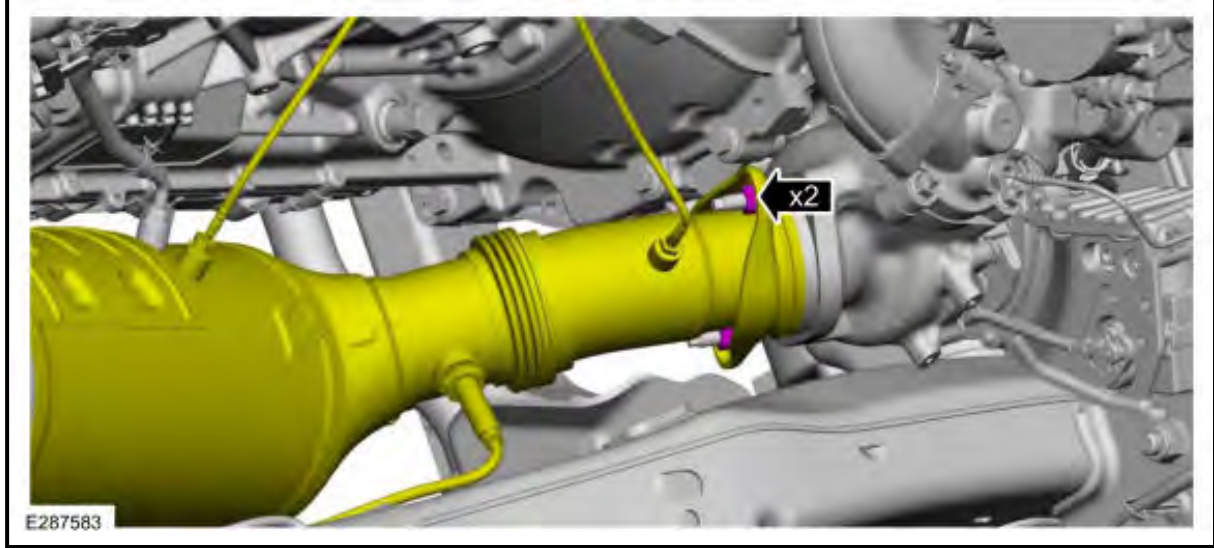


109. Position back the exhaust and install the nuts.

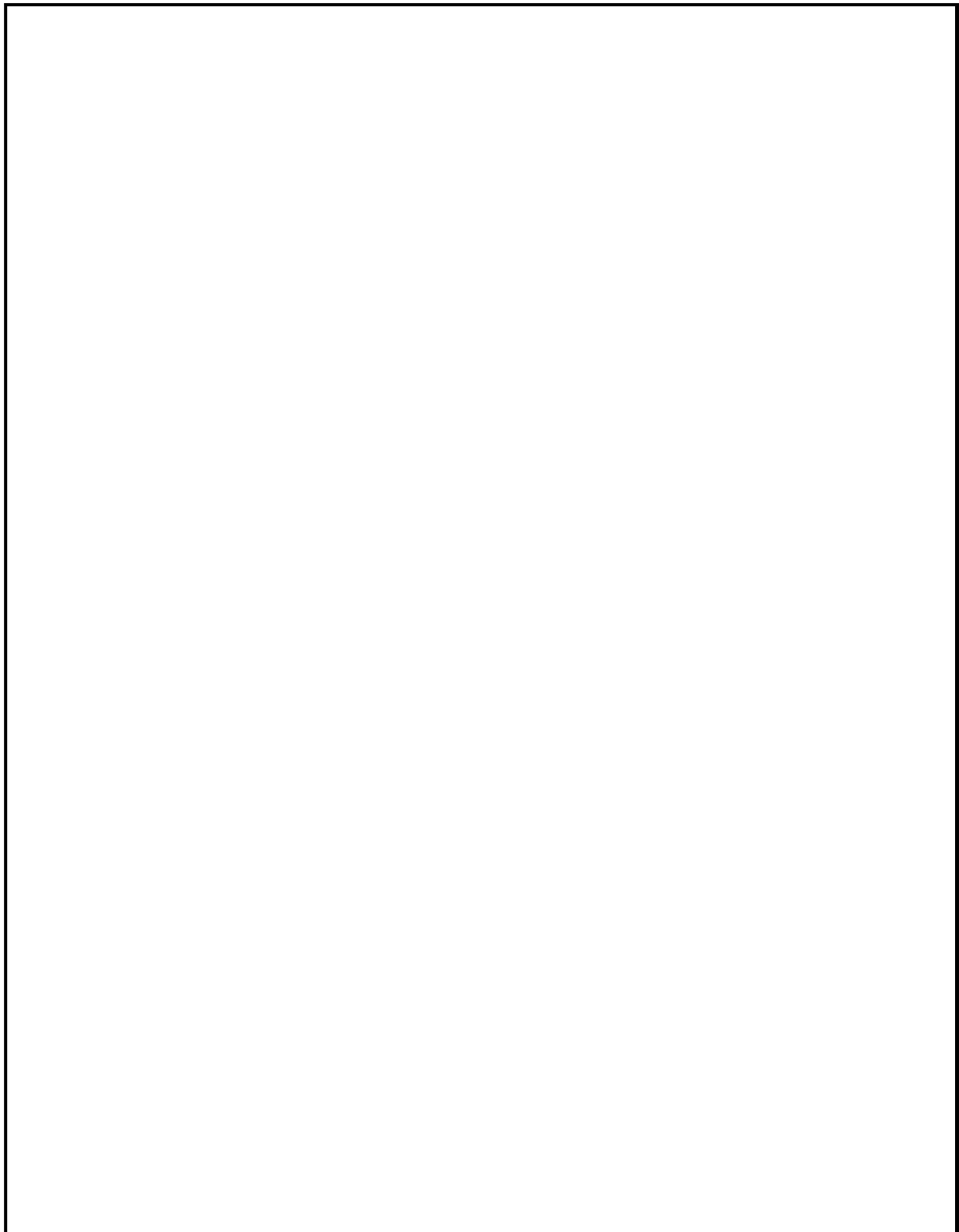
Torque

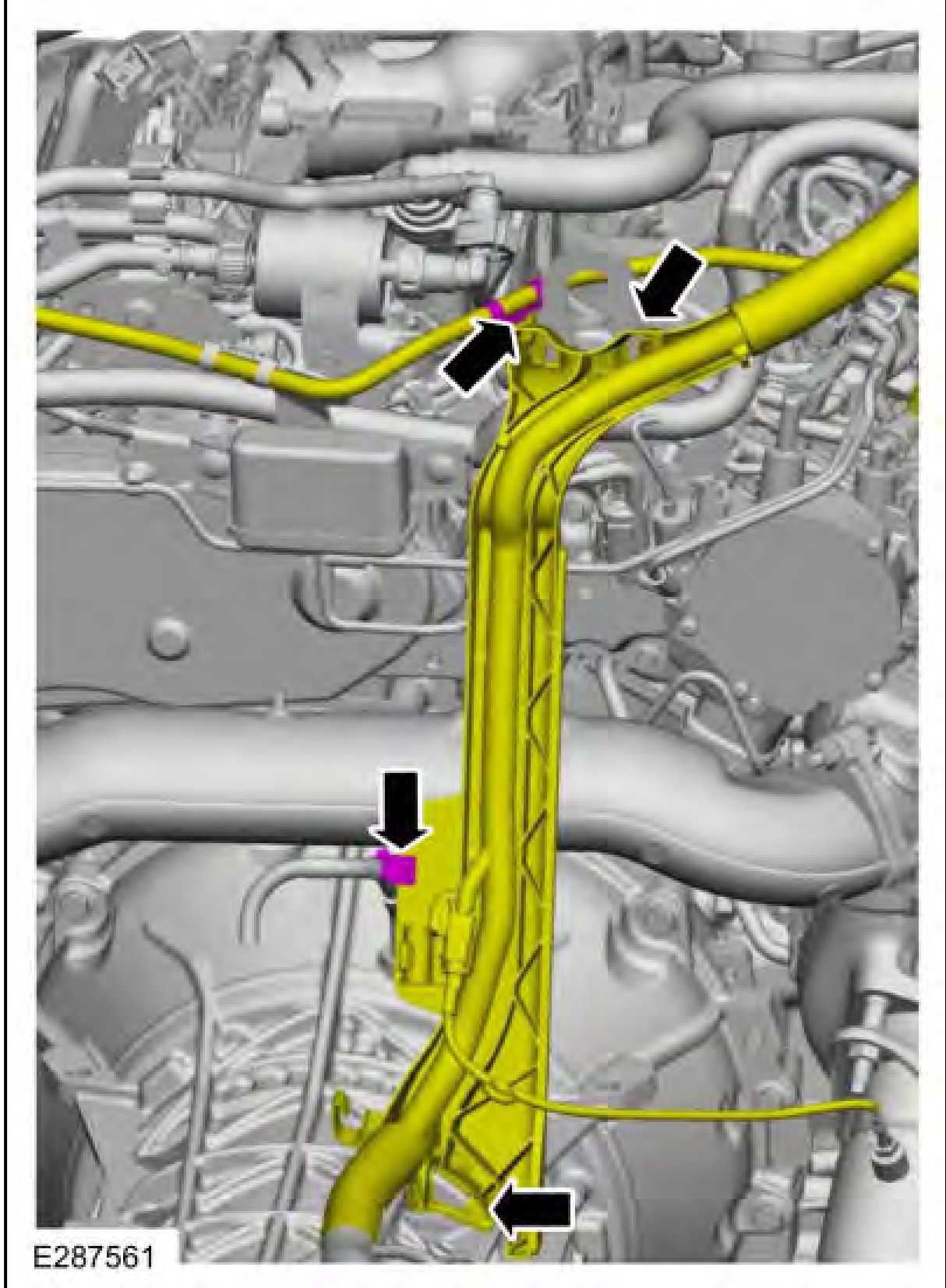
: 30 lb.ft (40 Nm)





110. Position back the wire harness housing. Connect the vacuum hose retainer and the transmission vent tube.

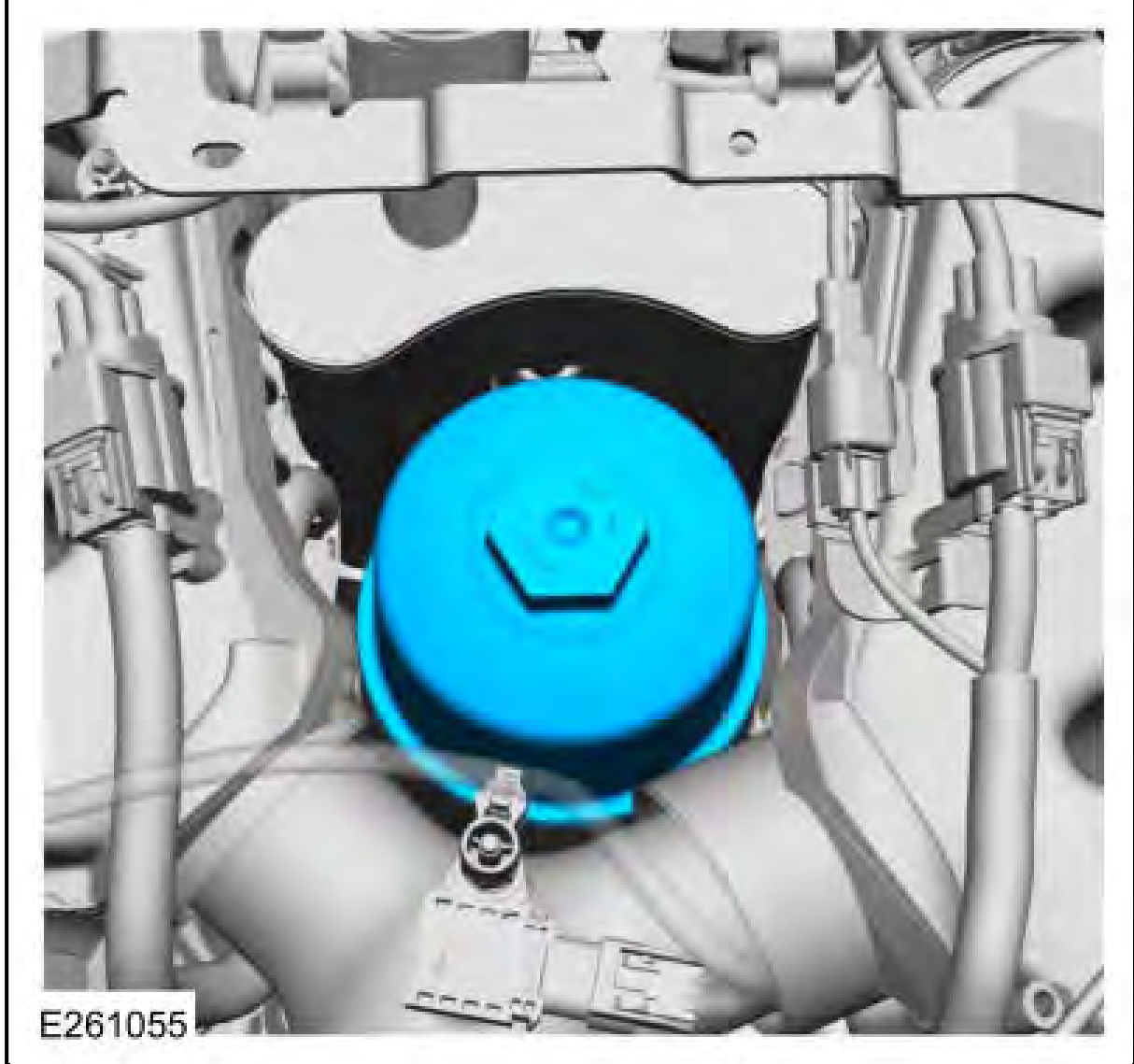




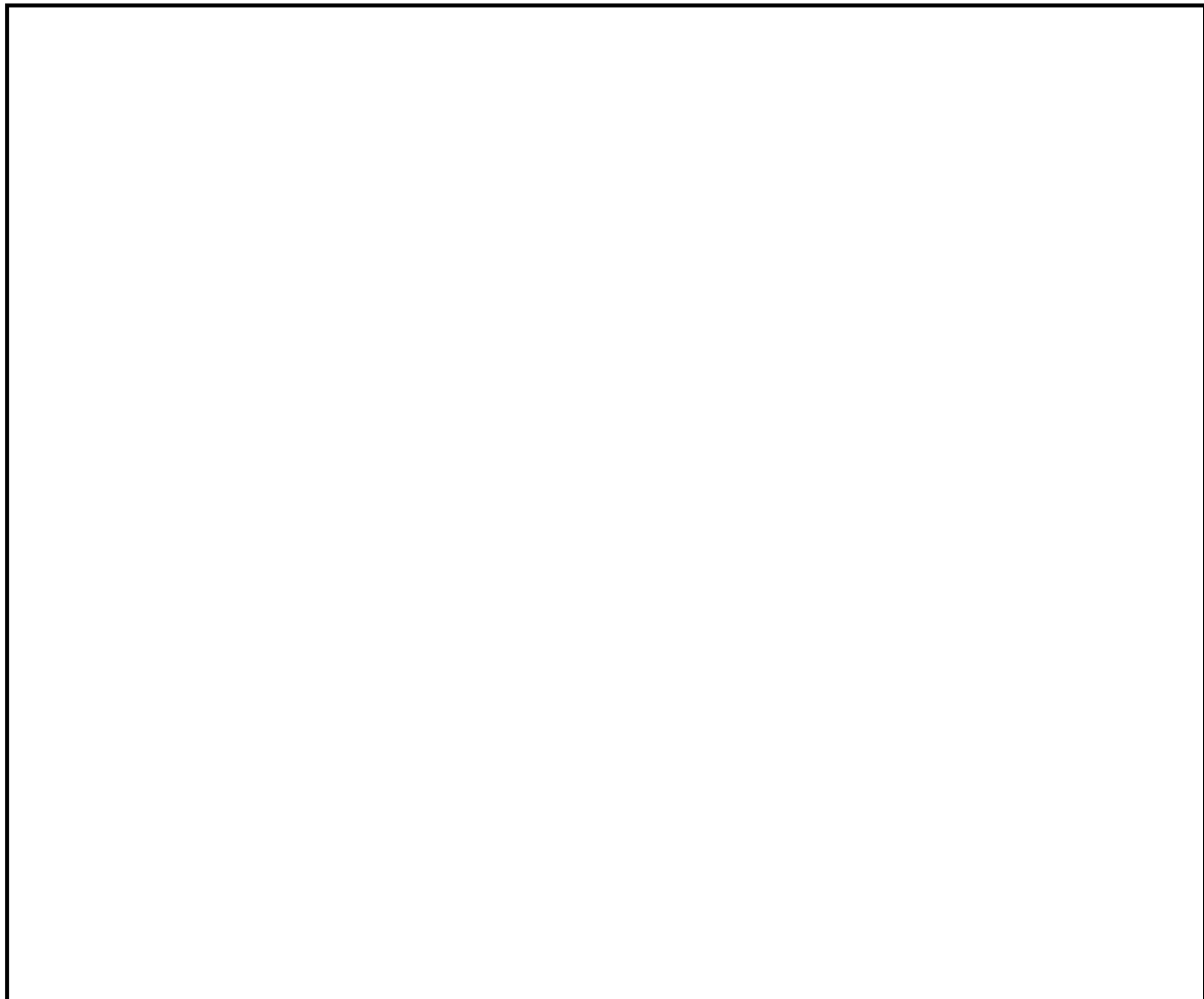
111. **NOTE:** The oil filter housing needs a minimum of 1 minute to allow the oil to drain out of the oil filter housing to minimise oil spillage.

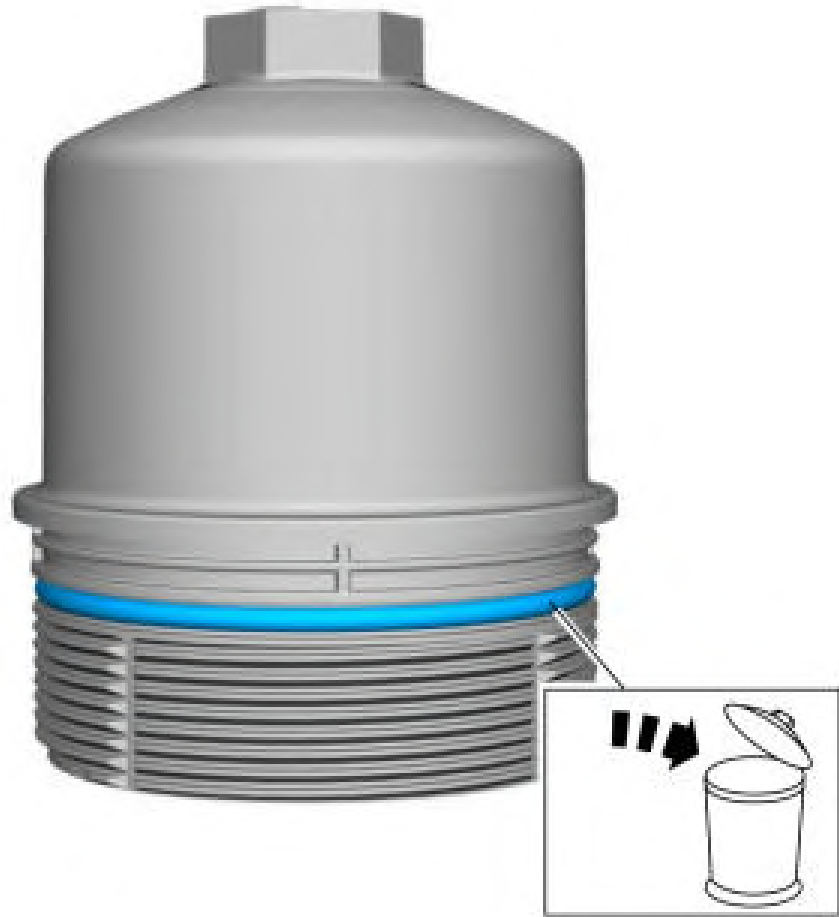
Loosen the oil filter cap and let the oil filter housing drain. Remove the oil filter cap.





112. Remove and discard the oil filter cap O-ring seal.



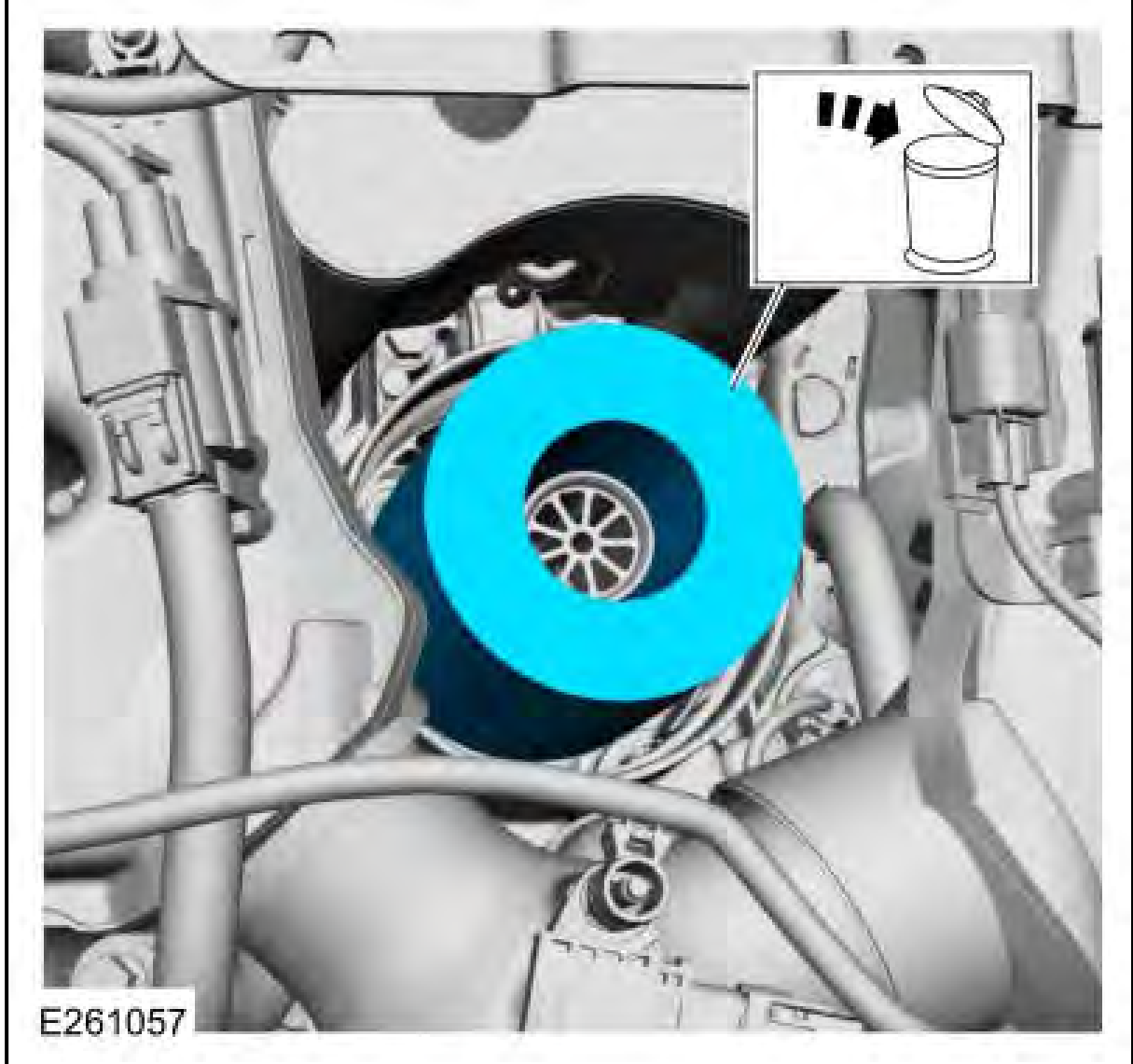


E261056

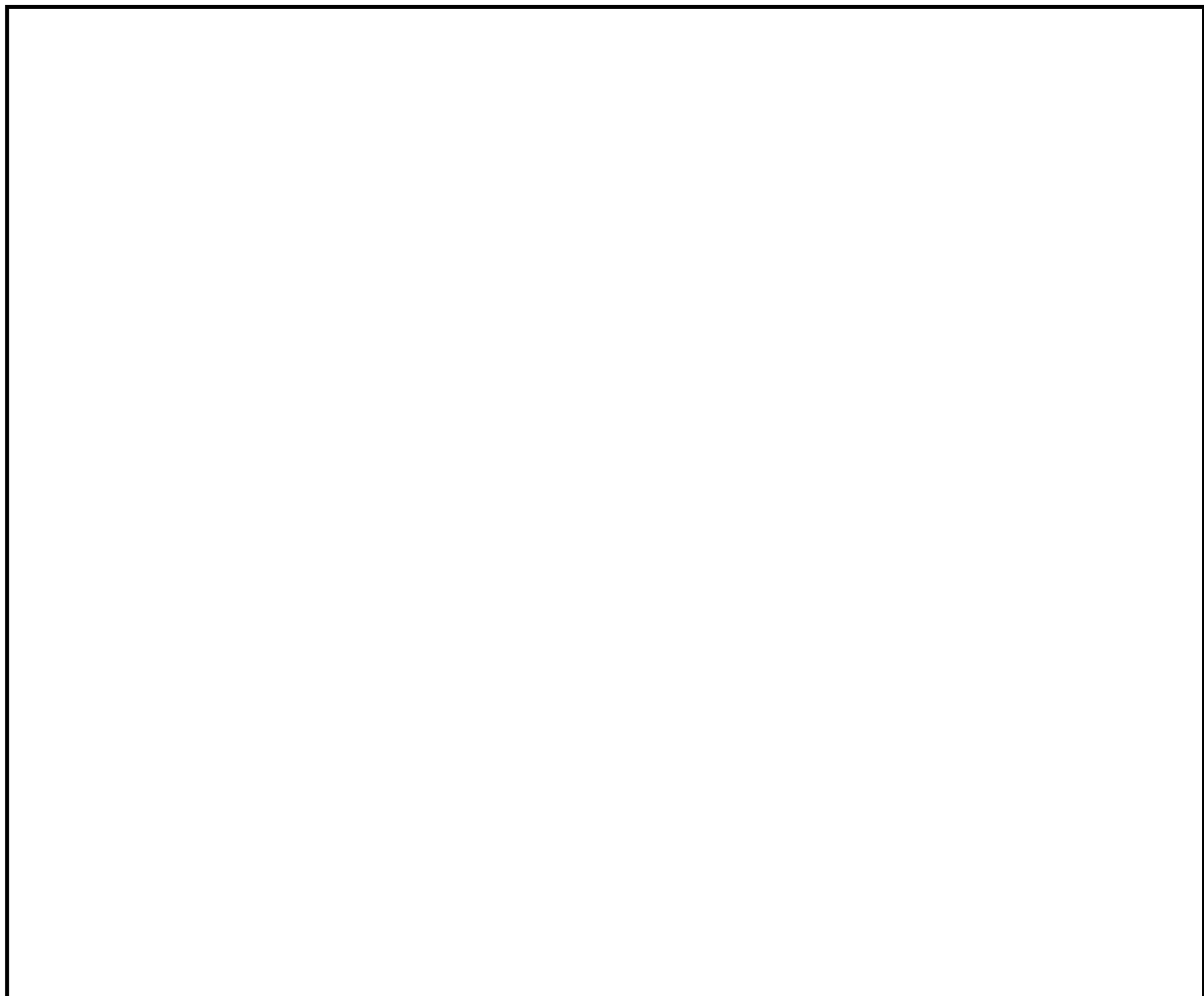
113. Remove and discard the oil filter. Use the General Equipment: Oil Drain Equipment

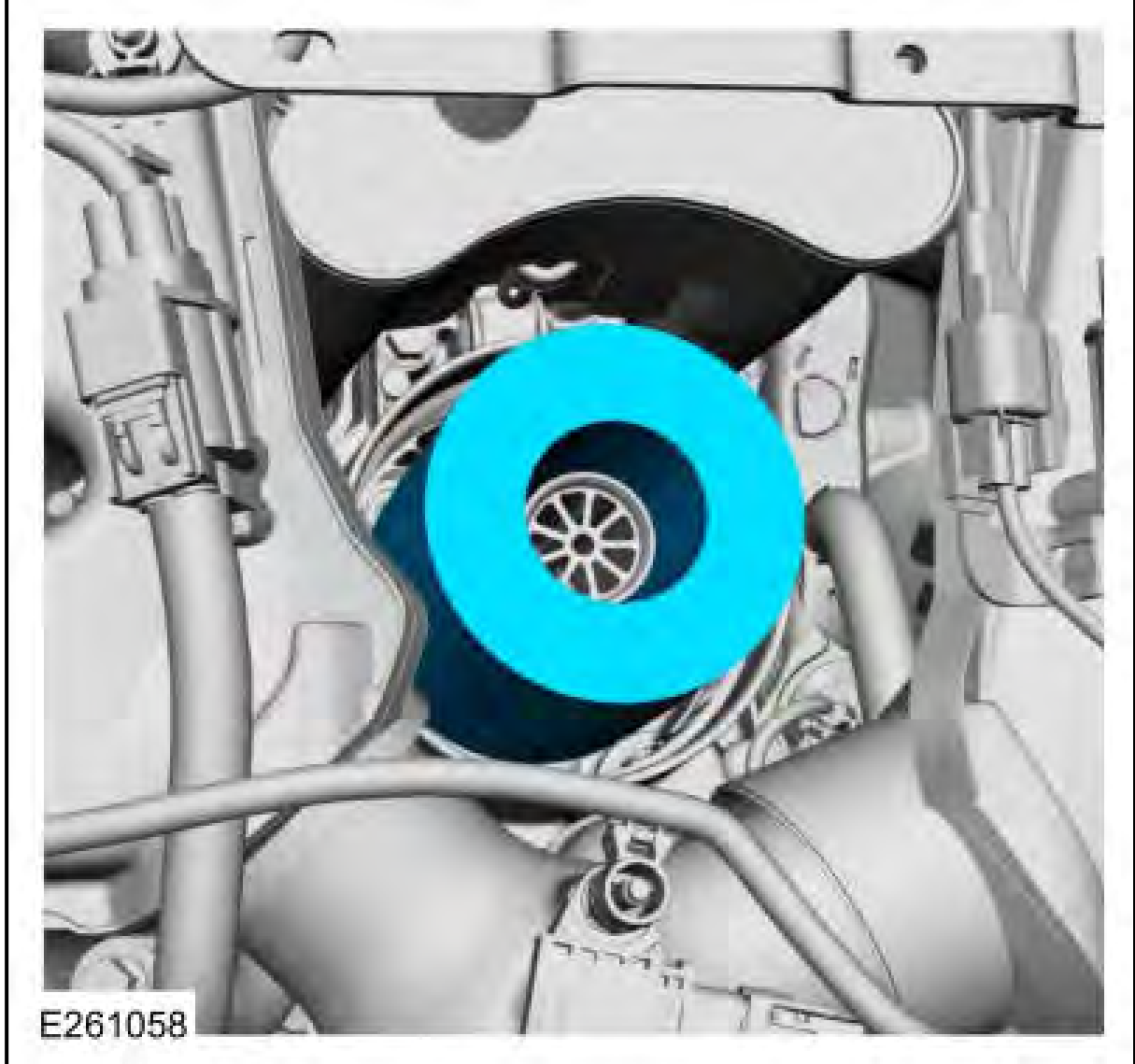






114. Install a new oil filter.

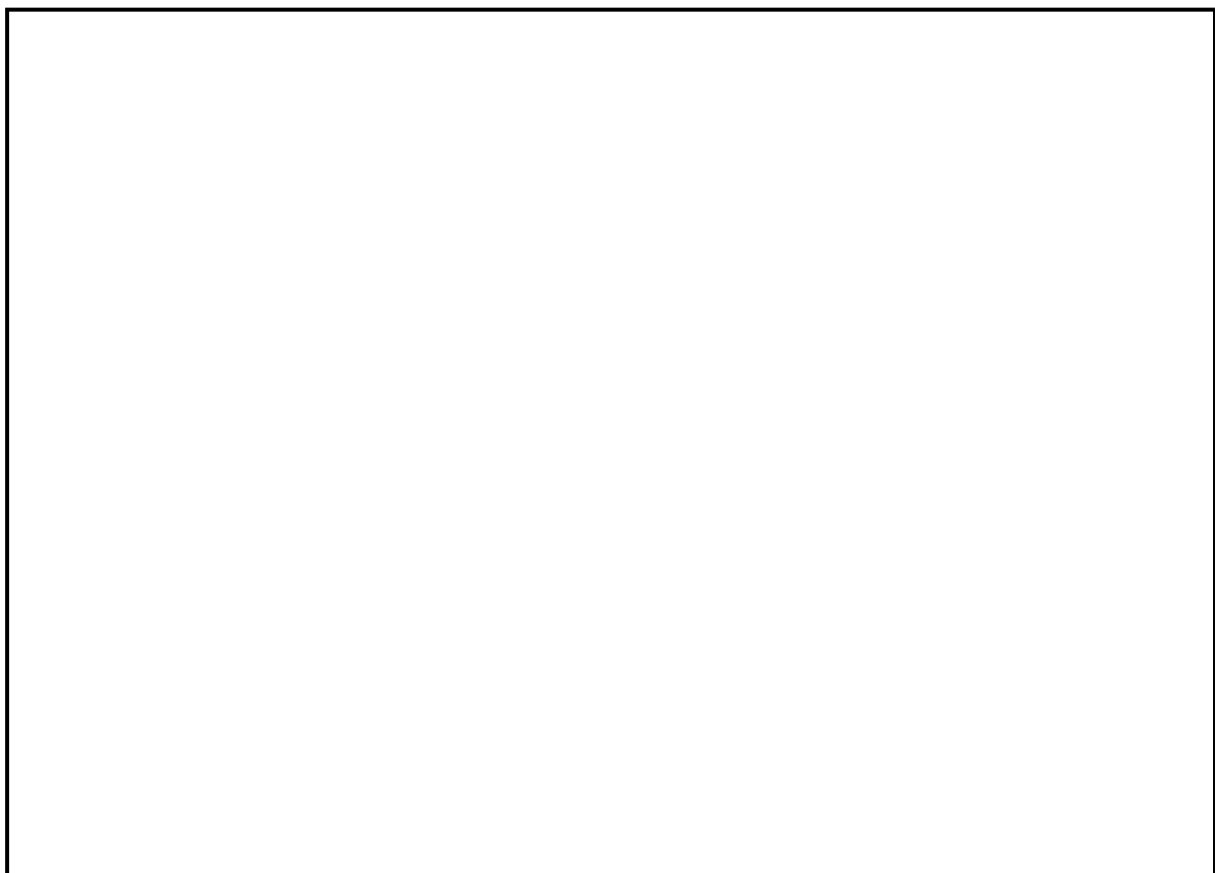


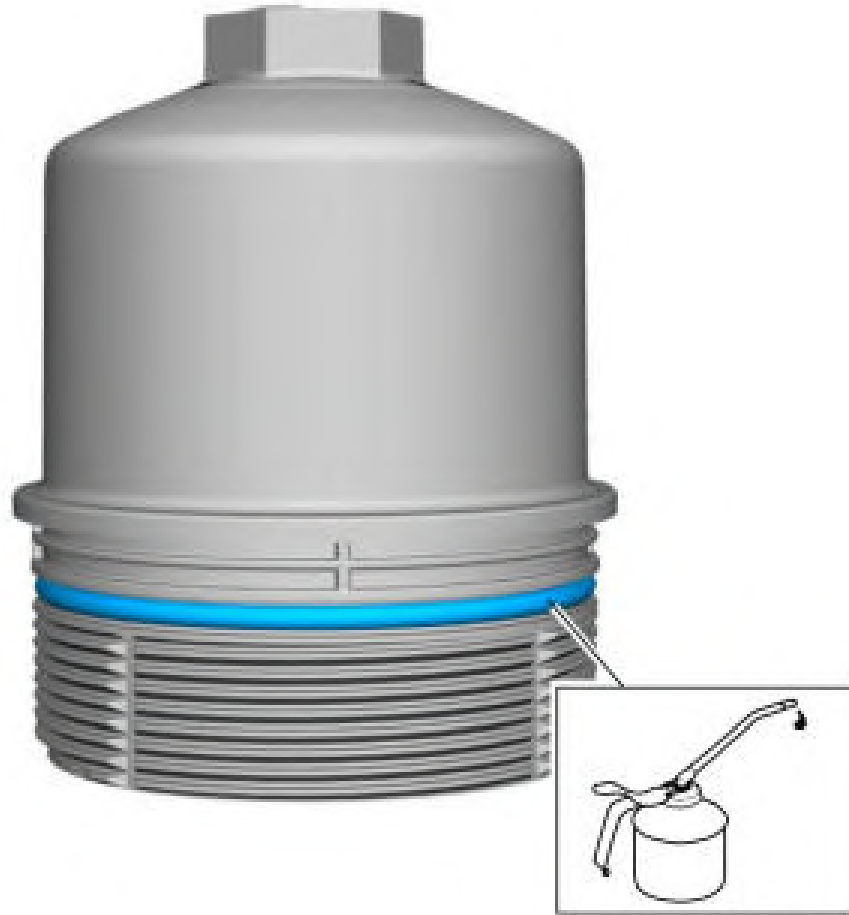


115. Install a new oil filter cap O-ring seal and lubricate.

Material

: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)



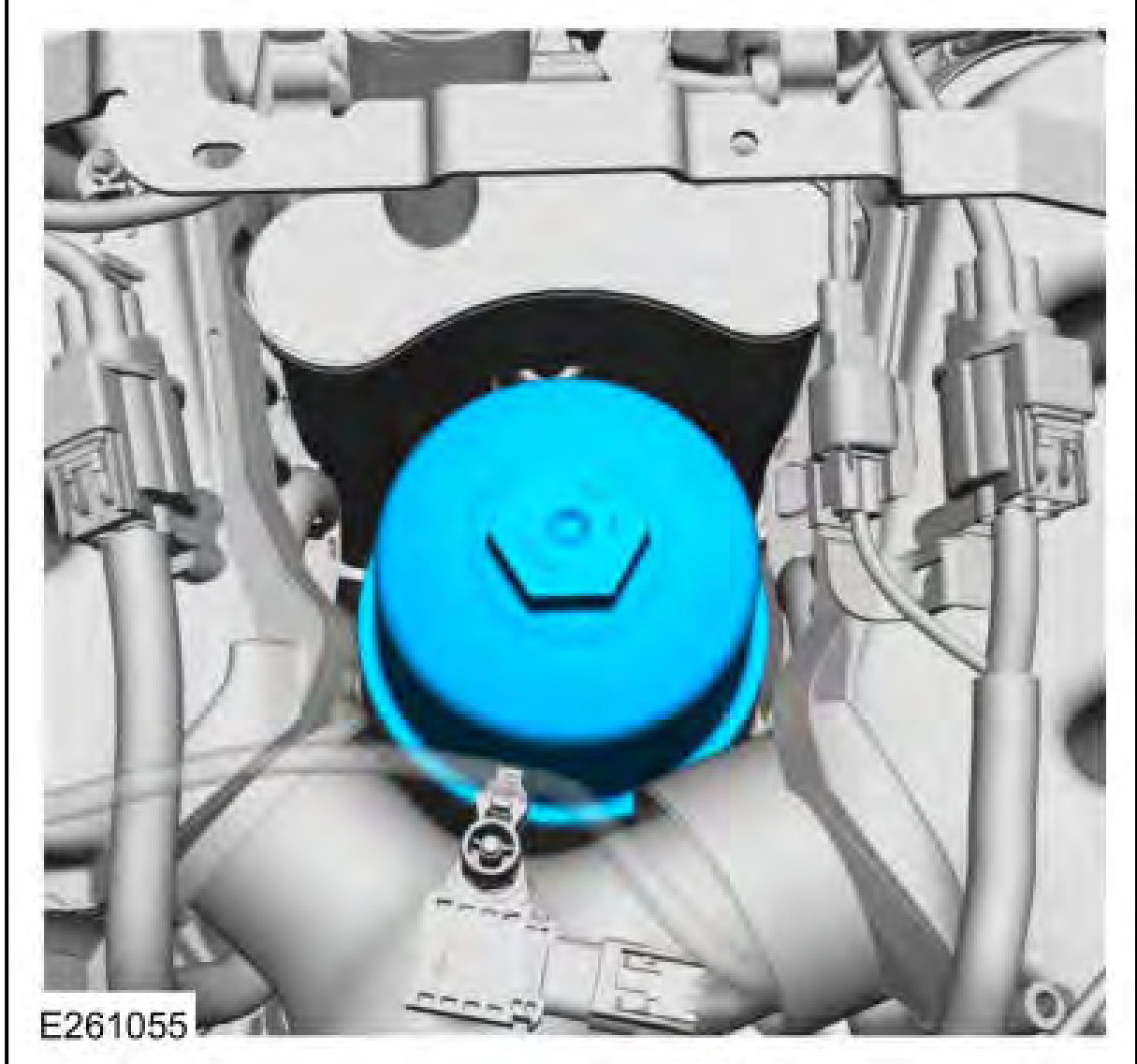


E261059

116. Install the oil filter cap.

Torque

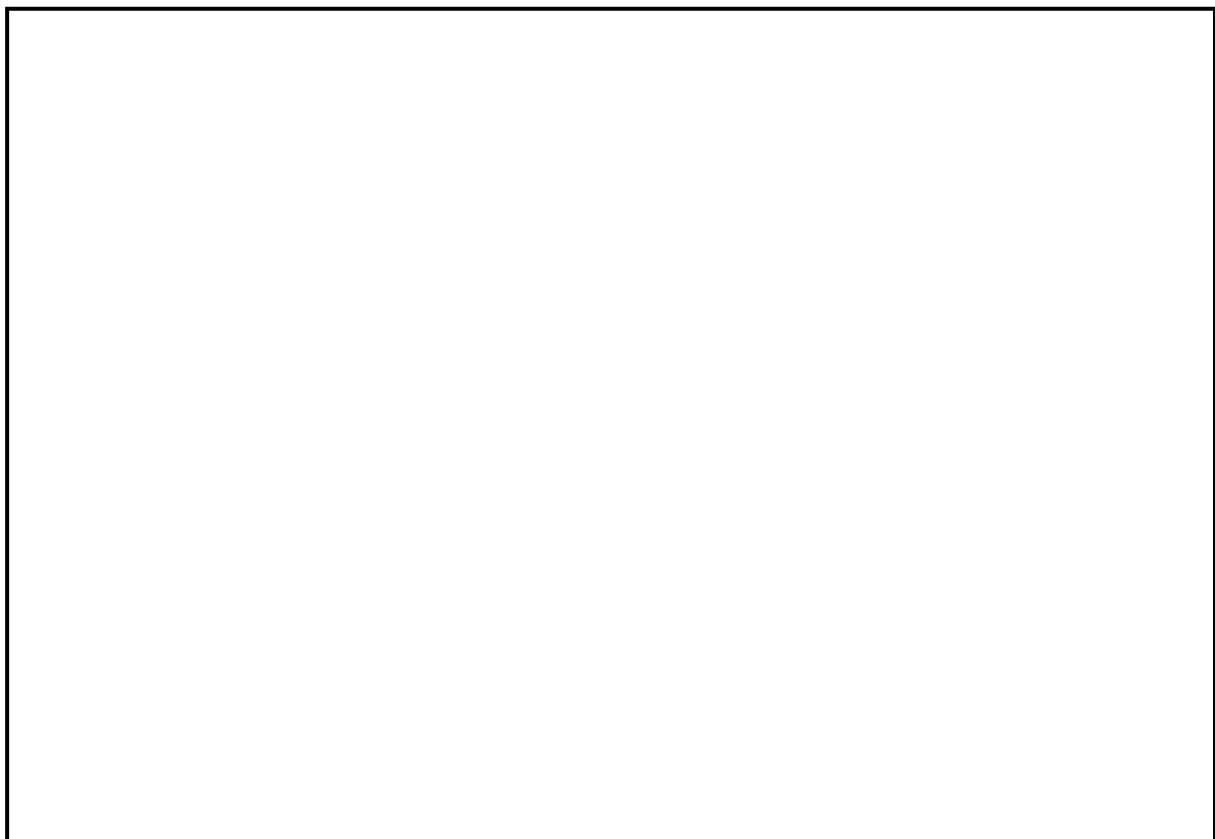
: 18 lb.ft (25 Nm)

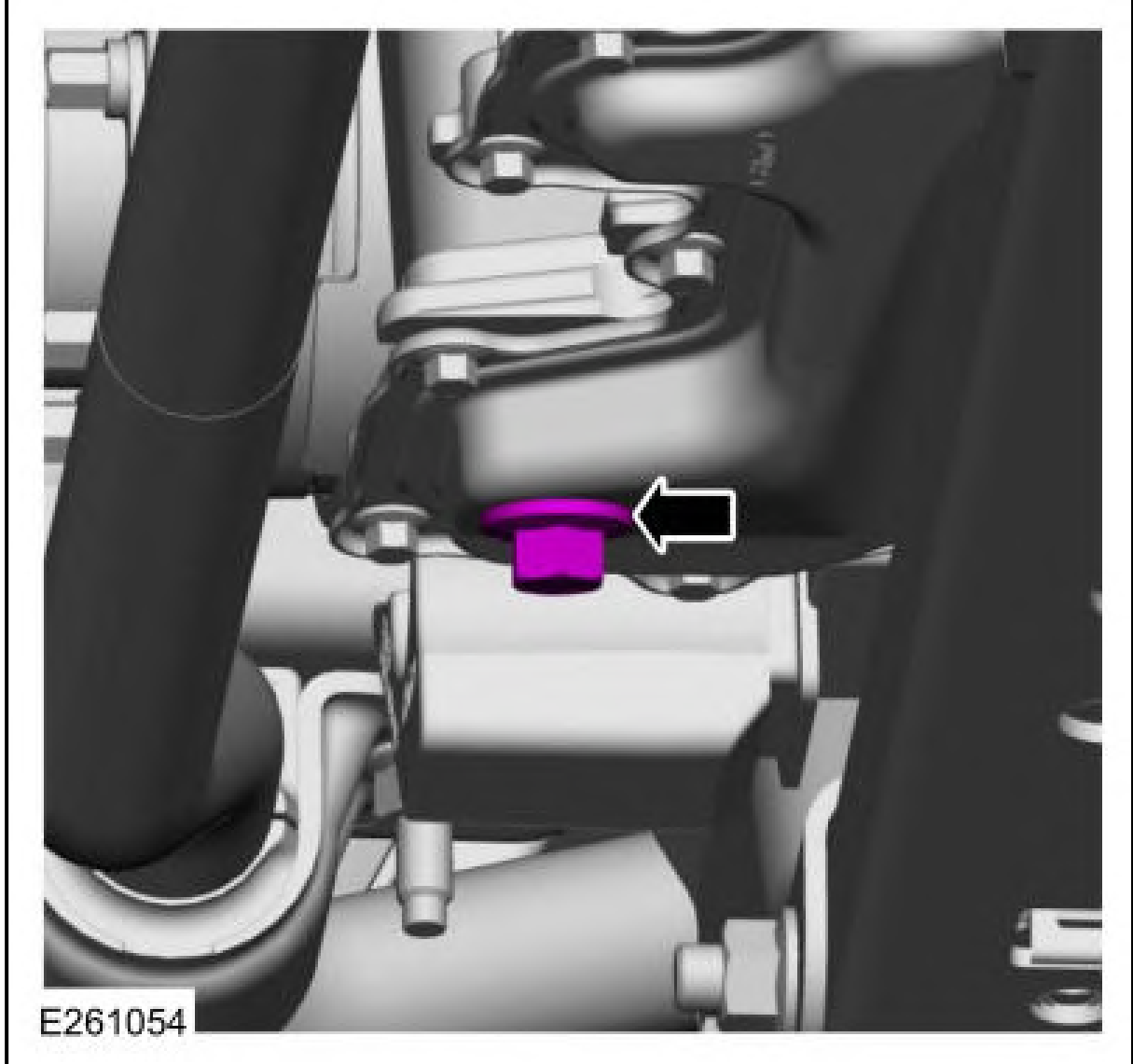


117. Remove the oil pan plug and drain the engine oil. Use the General Equipment: Oil Drain Equipment

Torque

: 18 lb.ft (25 Nm)

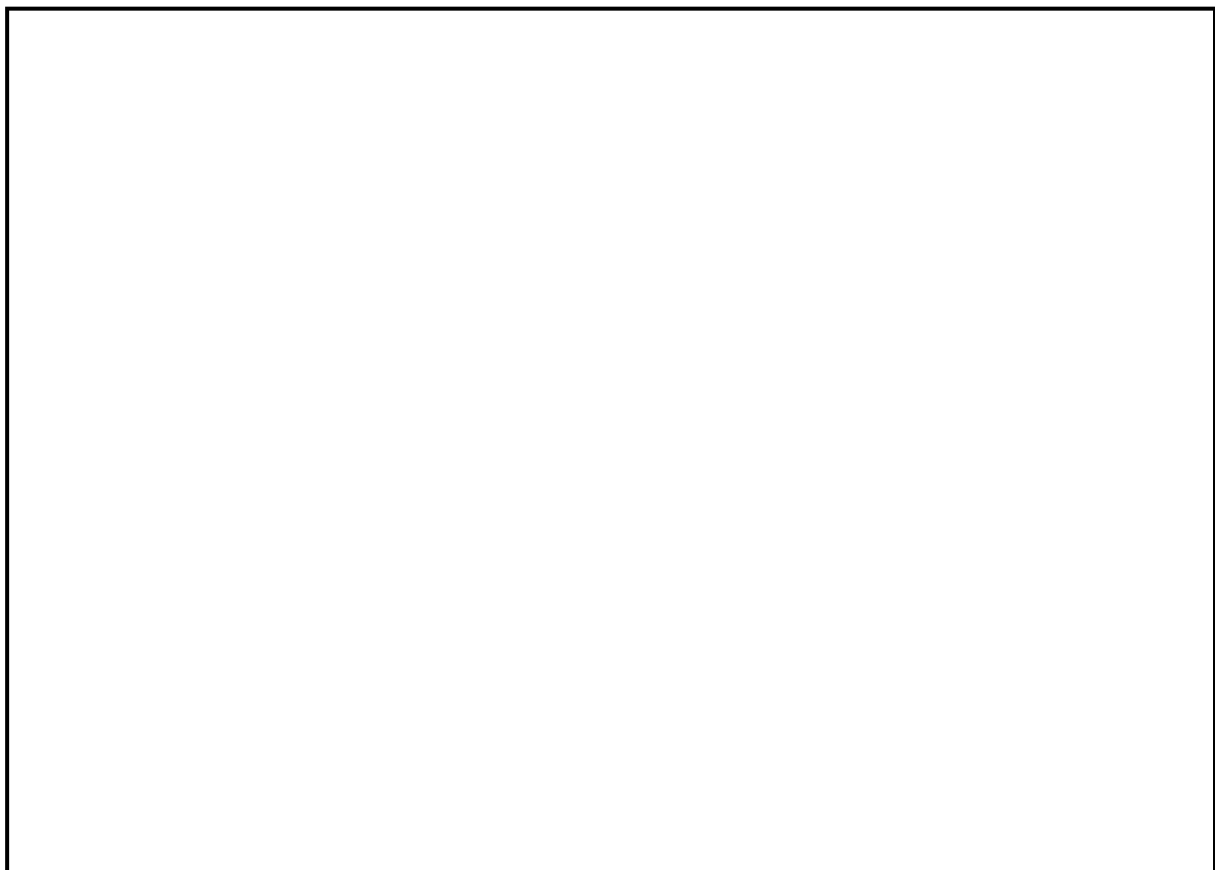


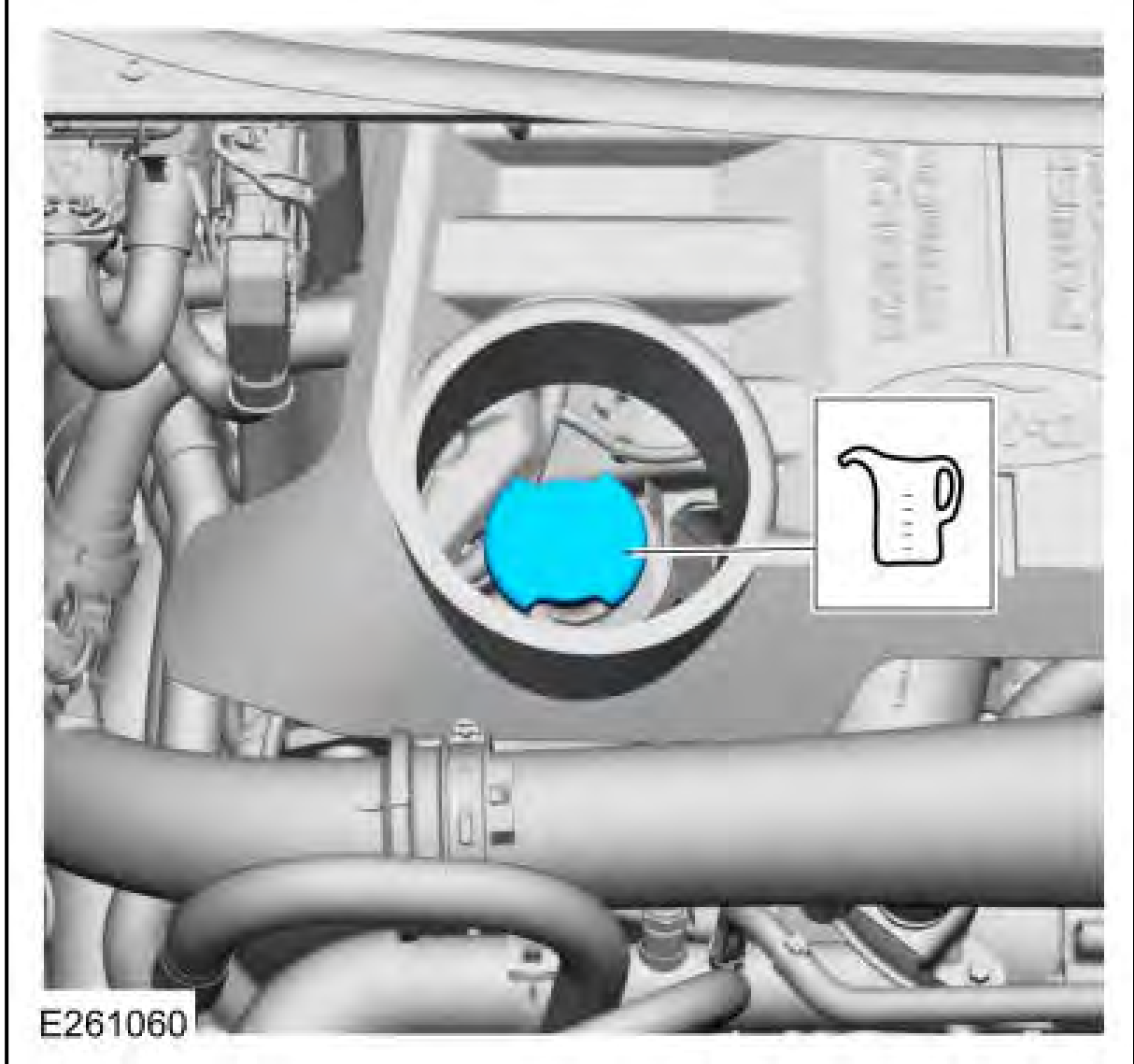


118. Fill the engine with clean engine oil. Refer to: [Specifications](#) .

Material

: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)





119. Remove the wheel chocks.

- Roll the chassis back to the markings on the floor.

120. Install the following items:

1. Install the body. Refer to: [Body - 3.0L Power Stroke Diesel](#) .
2. Install the turbocharger oil return tube. Refer to: [Turbocharger Oil Return Tube](#) .

## CYLINDER HEAD - BODY ON - LH

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

### Cylinder Head - Body On - LH

#### Special Tool(s) / General Equipment

|                            |
|----------------------------|
| <b>Oil Drain Equipment</b> |
|----------------------------|

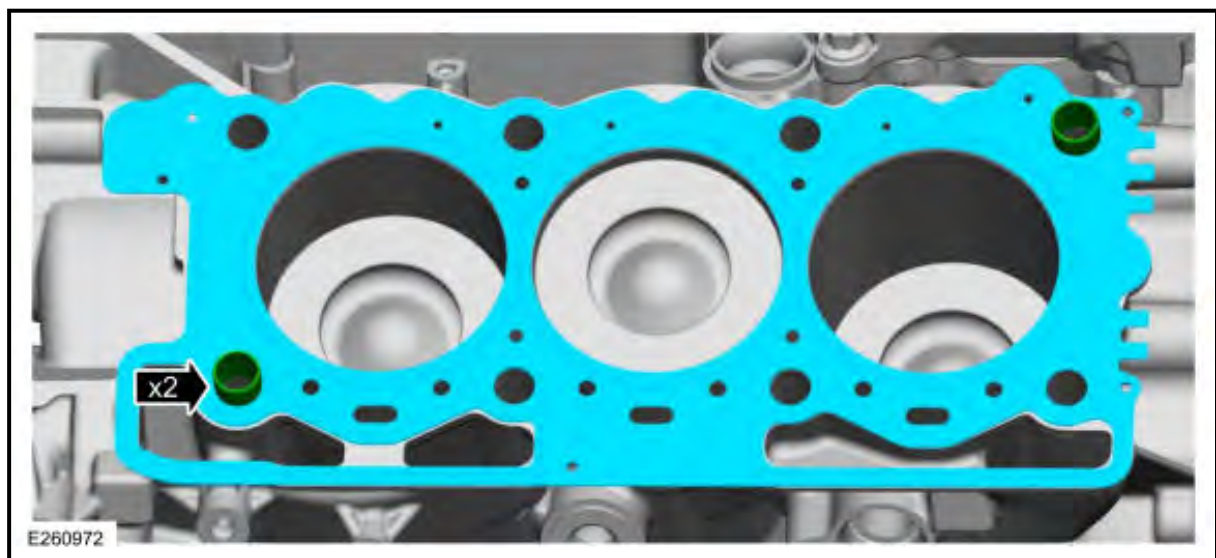
#### Materials

| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor OilXO-5W30-QFA  | WSS-M2C214-B1 |
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/CoolantVC-3-B | WSS-M97B44-D  |

**NOTE:** It is recommended that this component be serviced with the vehicle body removed. If the body was removed, refer to Cylinder Head - Body Off in this section.

1. **NOTE:** Make sure that the same gasket thickness is reinstalled.

Install the new cylinder head dowels and the LH cylinder head gasket.



2. **NOTE:** Using too much engine oil on the threads of the cylinder head bolts may cause damage to the threads and poor sealing. Using anti-seize compounds, grease or any other lubricants other than engine oil on the cylinder head bolt threads may affect the true torque value of the bolts.

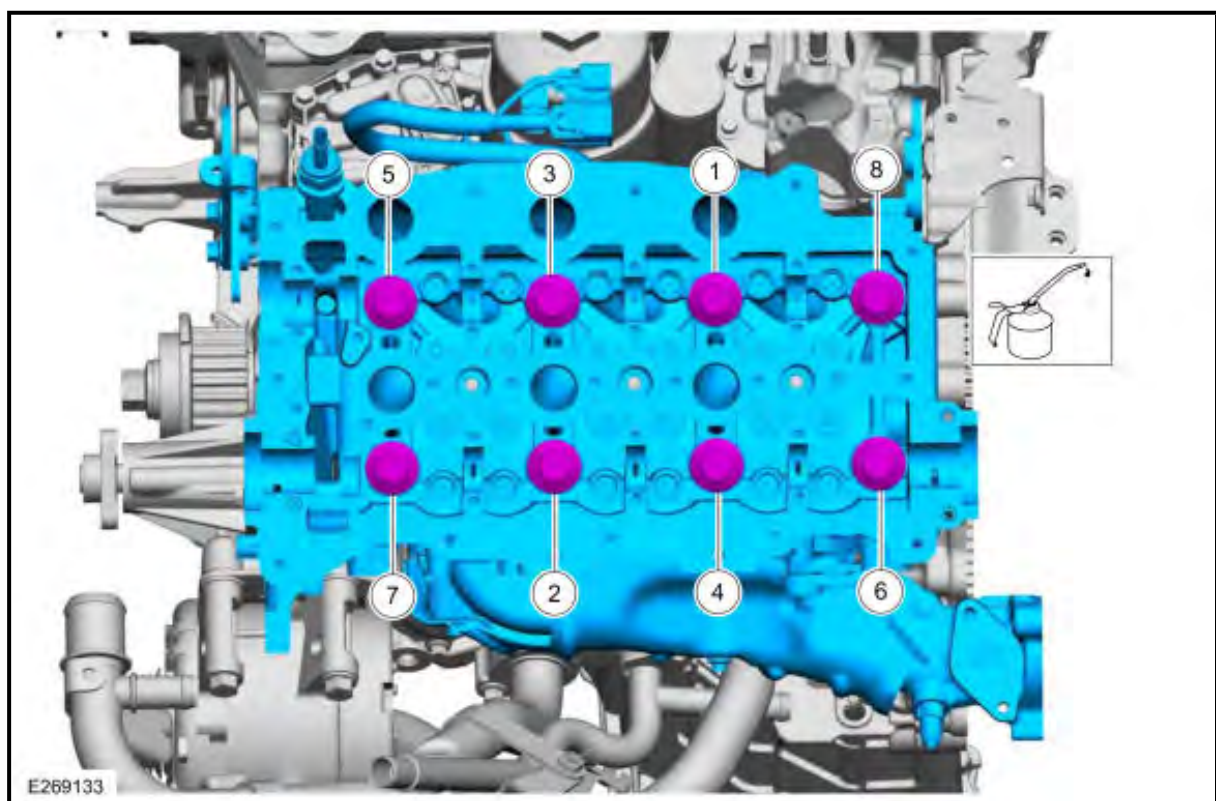
**NOTE:** Lightly lubricate the new cylinder head bolt threads and flanges with clean engine oil.

Install the LH cylinder head and the new bolts.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque

:Stage 1: 177 lb.in (20 Nm) Stage 2: 30 lb.ft (40 Nm) Stage 3: 59 lb.ft (80 Nm) Stage 4: 180  $\hat{A}$

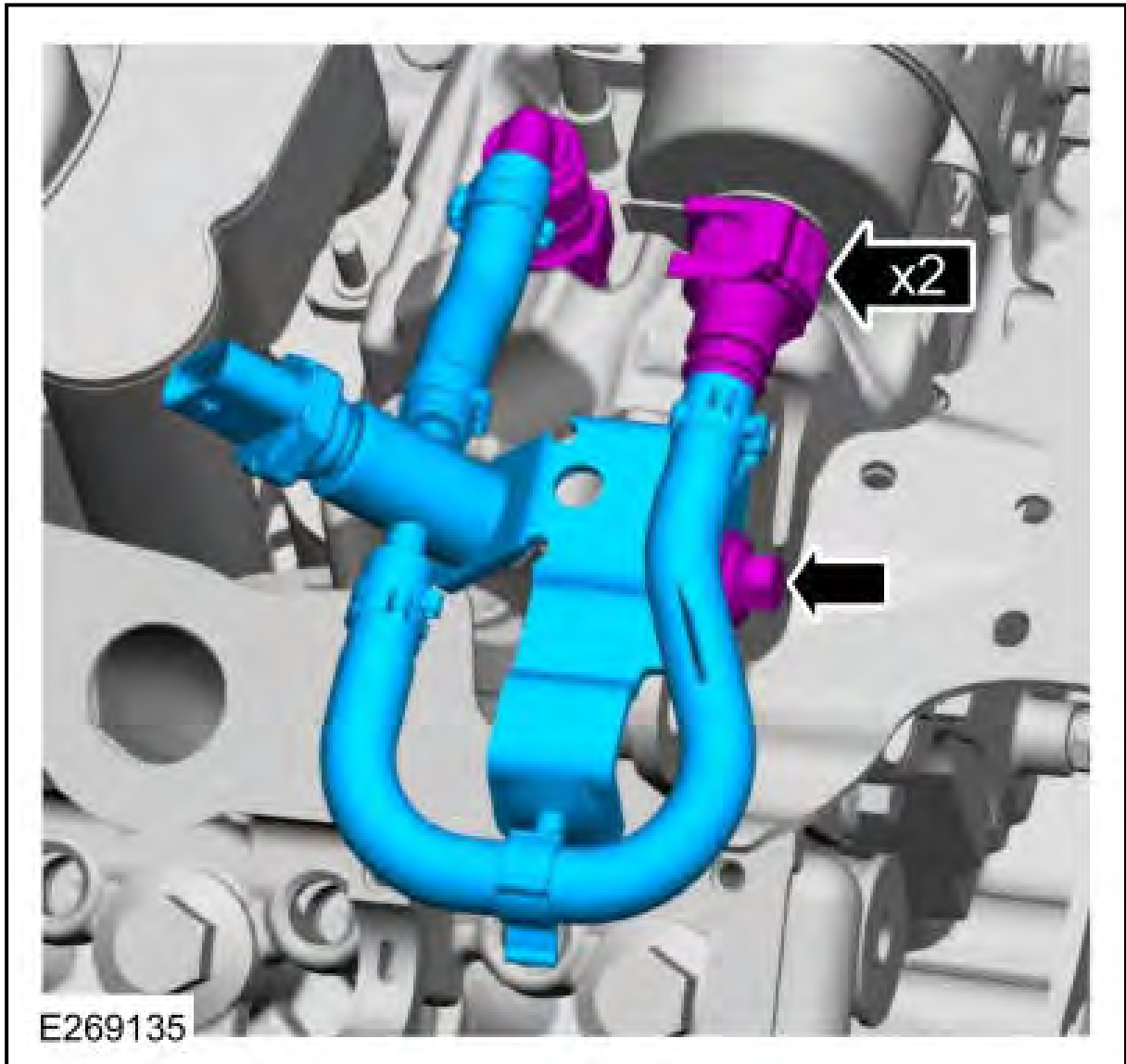


3.

- Install the fuel line assembly and the bolt.

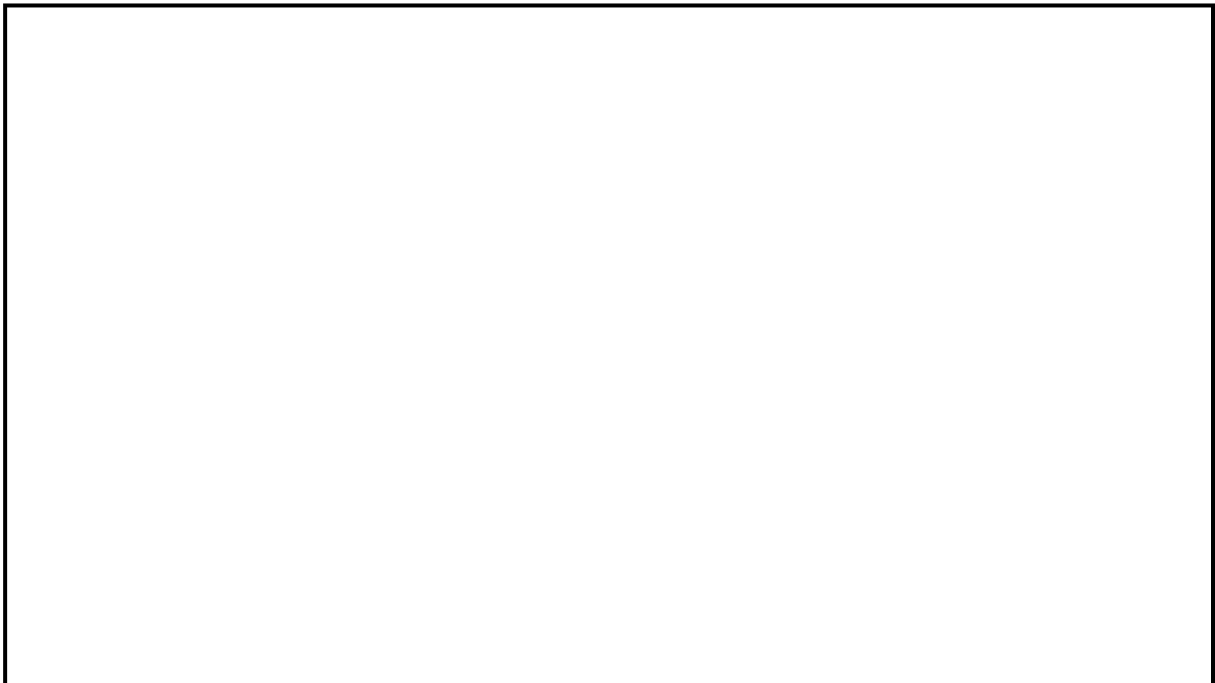
Torque: 17 lb.ft (23 Nm)

- Connect the fuel line connectors. Refer to: [Quick Release Coupling](#) .

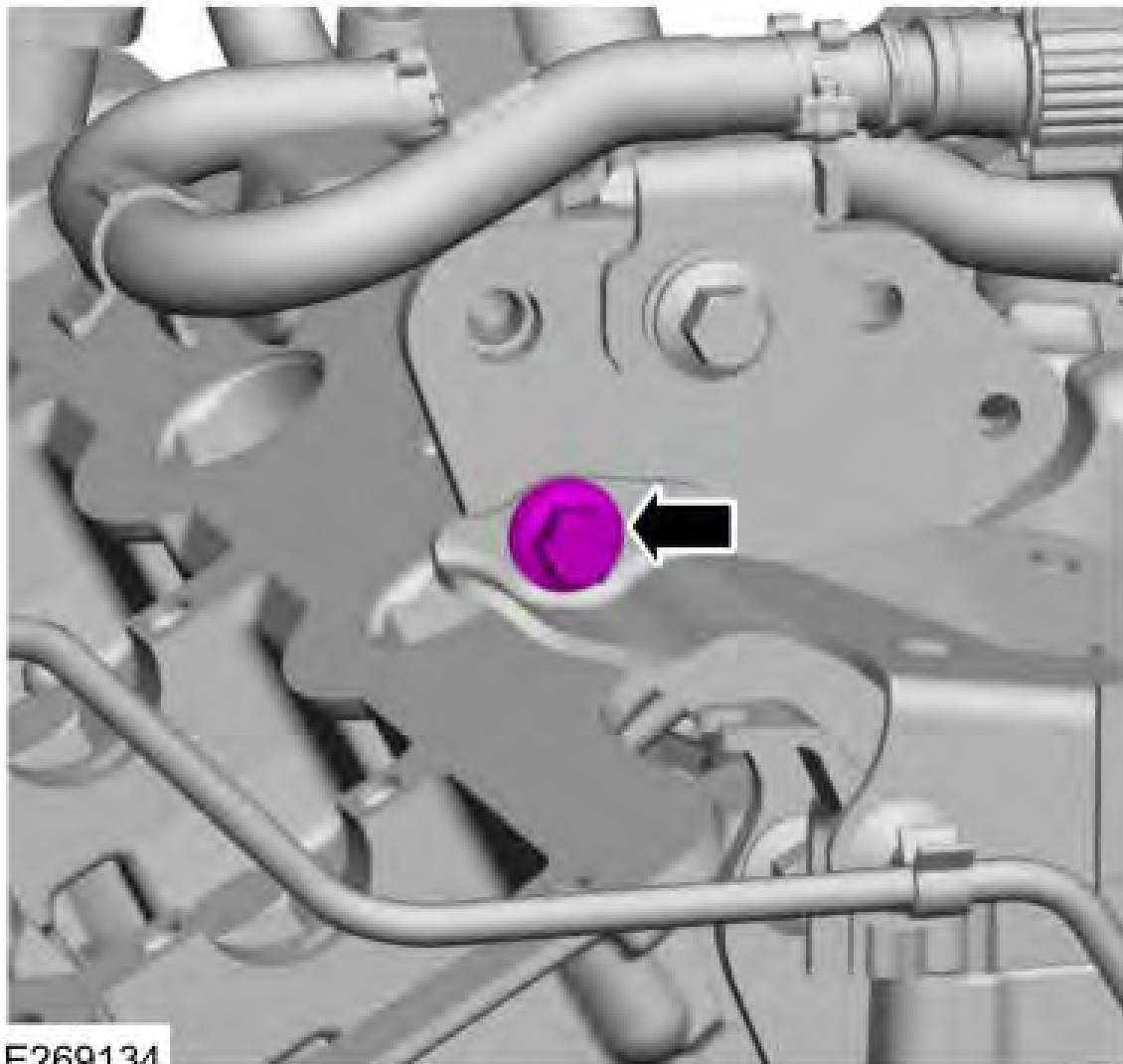


4. Remove the bolt from the bracket.

Torque: 89 lb.in (10 Nm)







E269134

5. Install the coolant outlet connector gaskets.

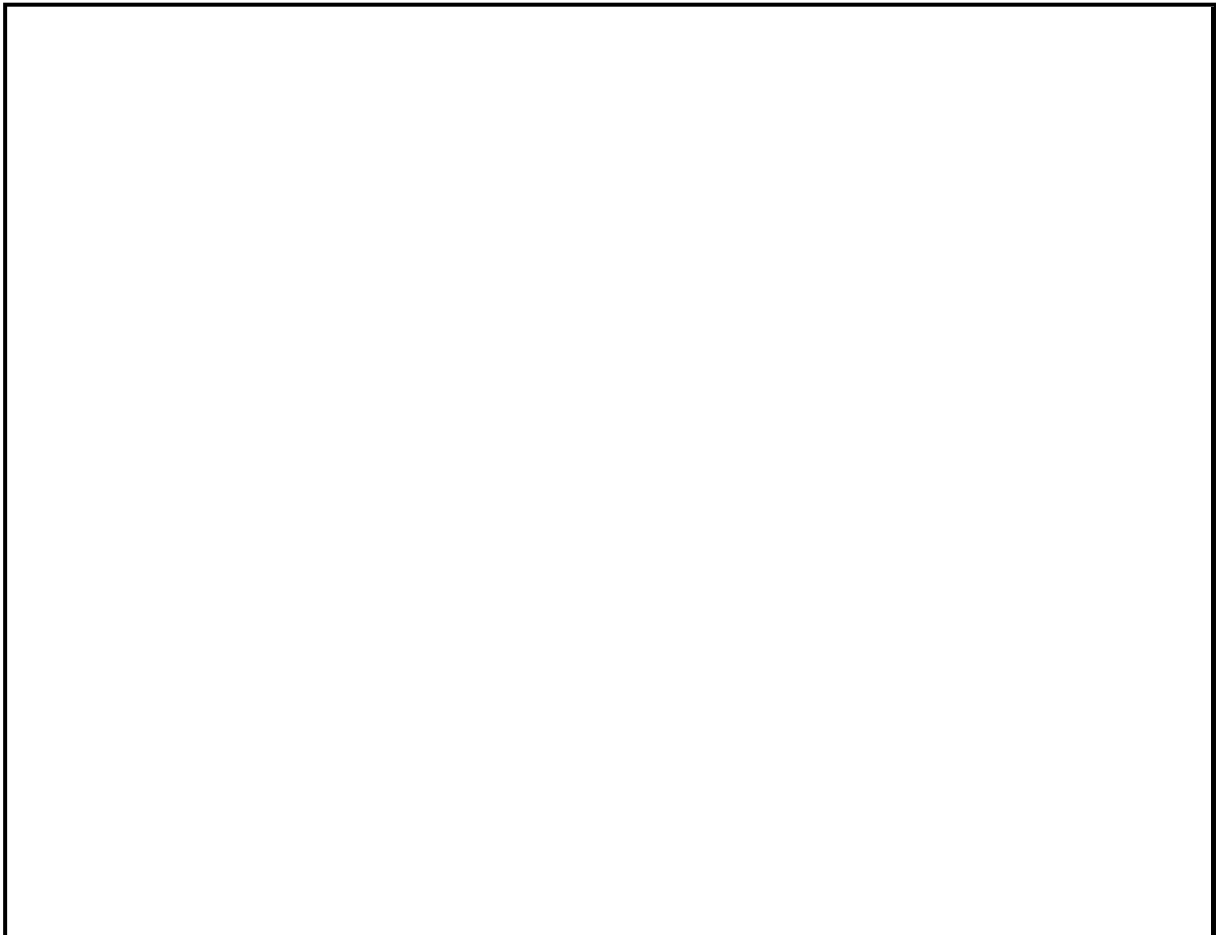


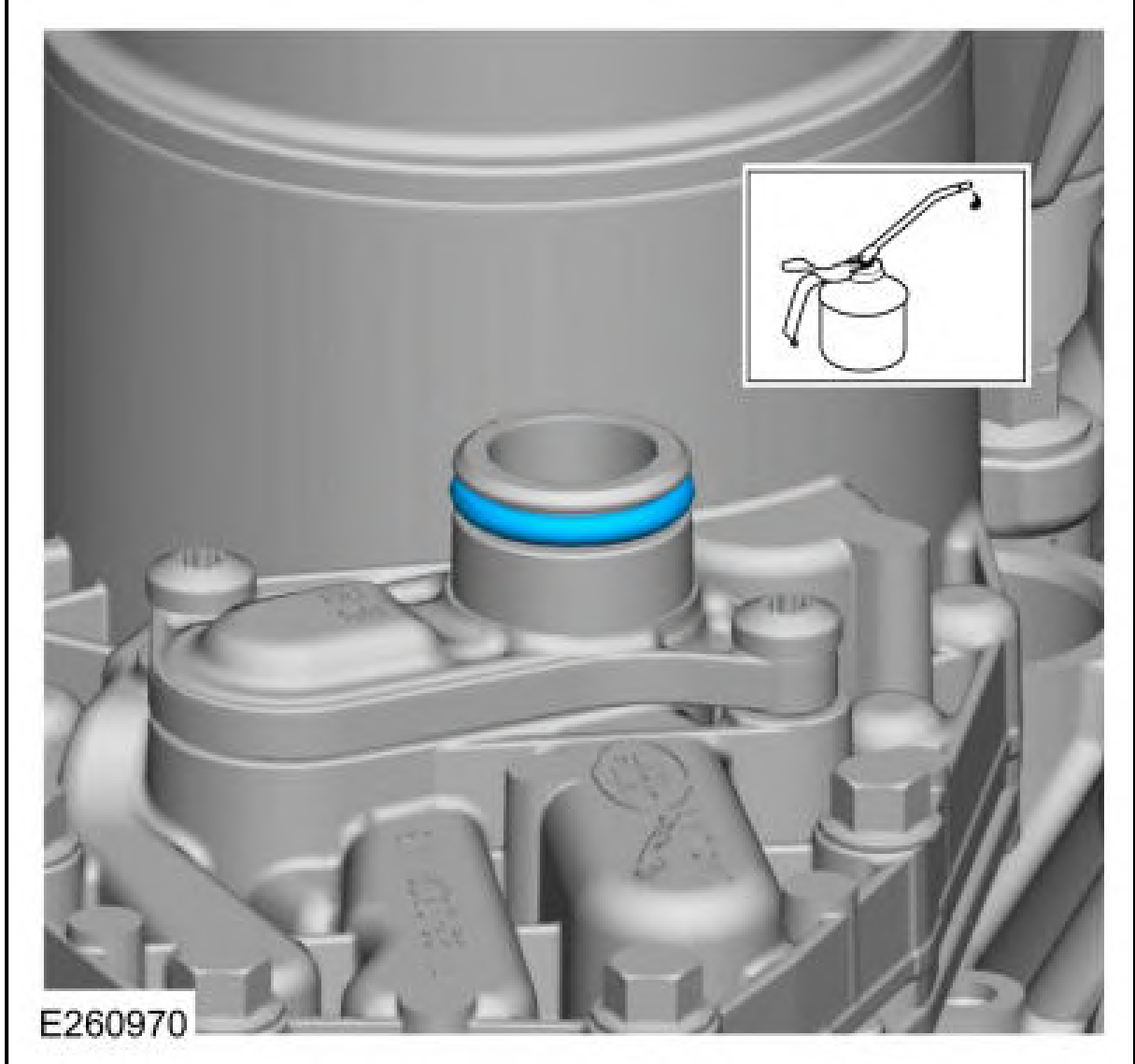


E261049

6. Install the oil cooler O-ring and lubricate.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

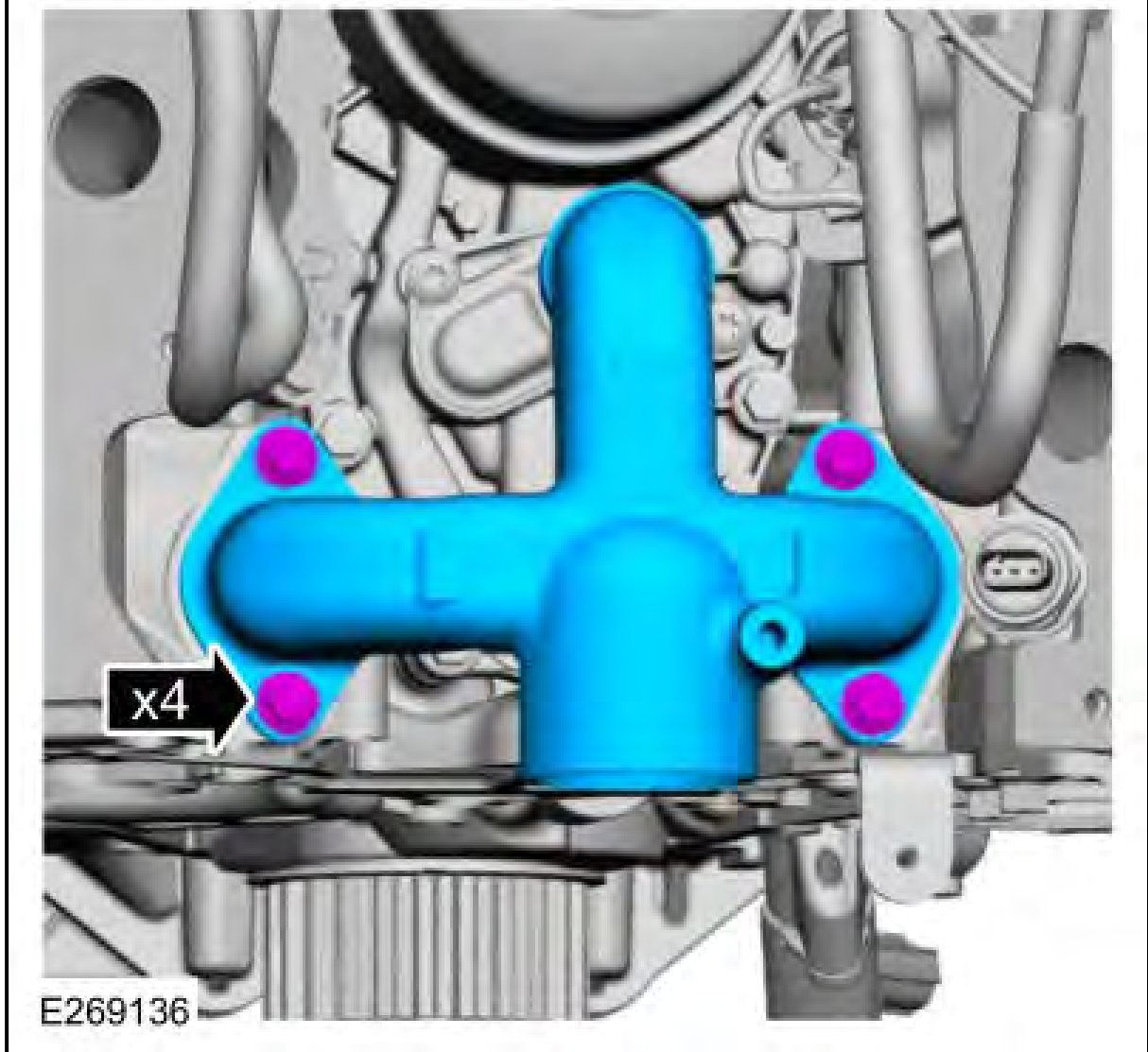




7. Install the coolant outlet connector and the bolts.

Torque: 89 lb.in (10 Nm)

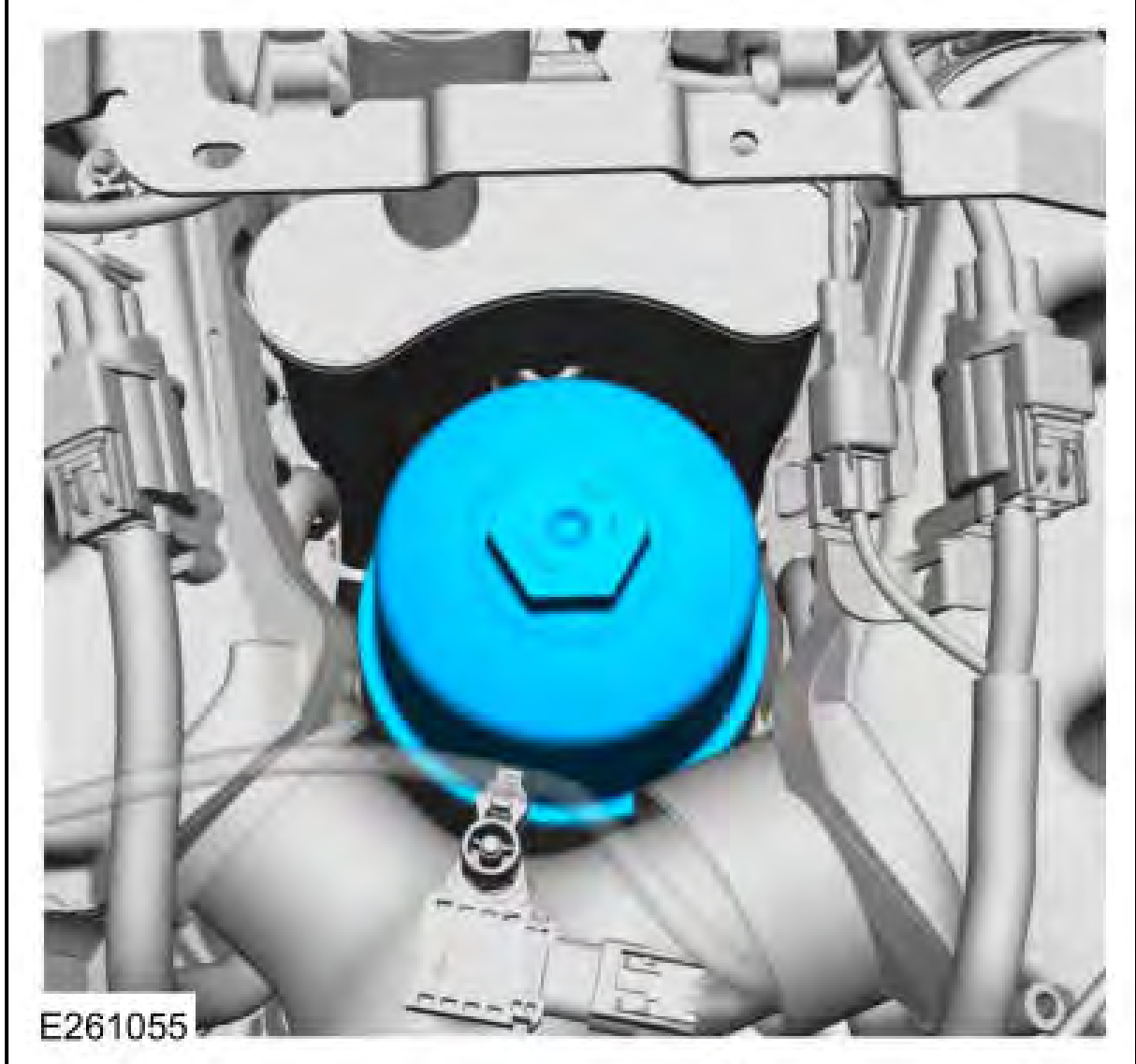




8. **NOTE:** The oil filter housing needs a minimum of 1 minute to allow the oil to drain out of the oil filter housing to minimise oil spillage.

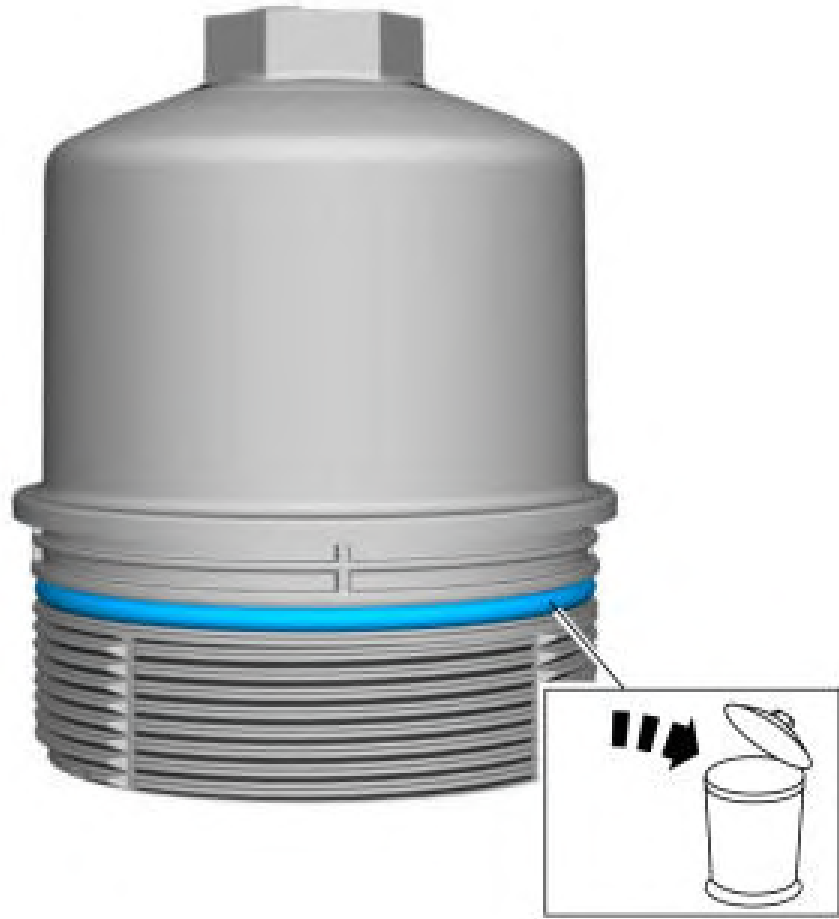
Loosen the oil filter cap and let the oil filter housing drain. Remove the oil filter cap.





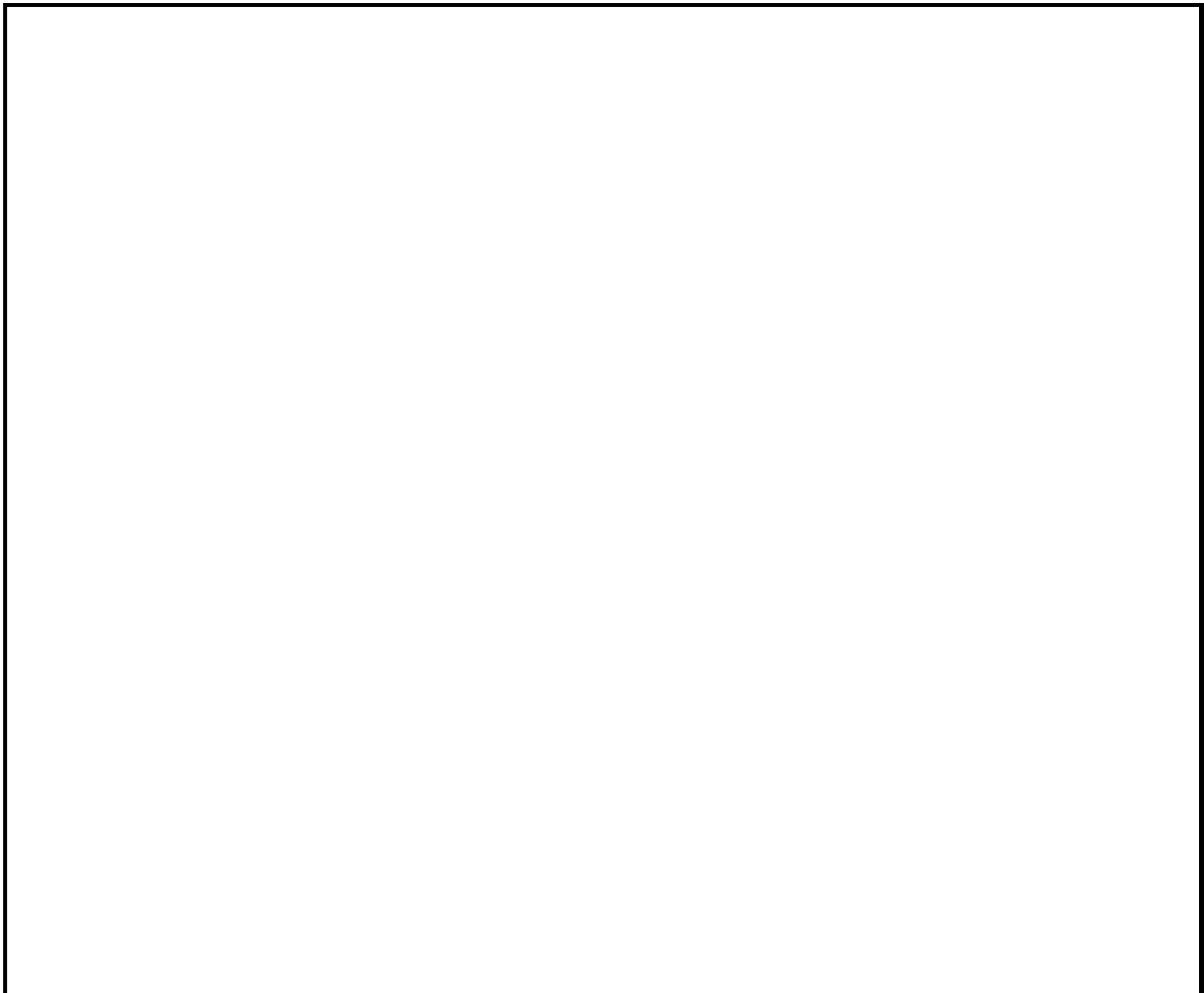
9. Remove and discard the oil filter cap O-ring seal.

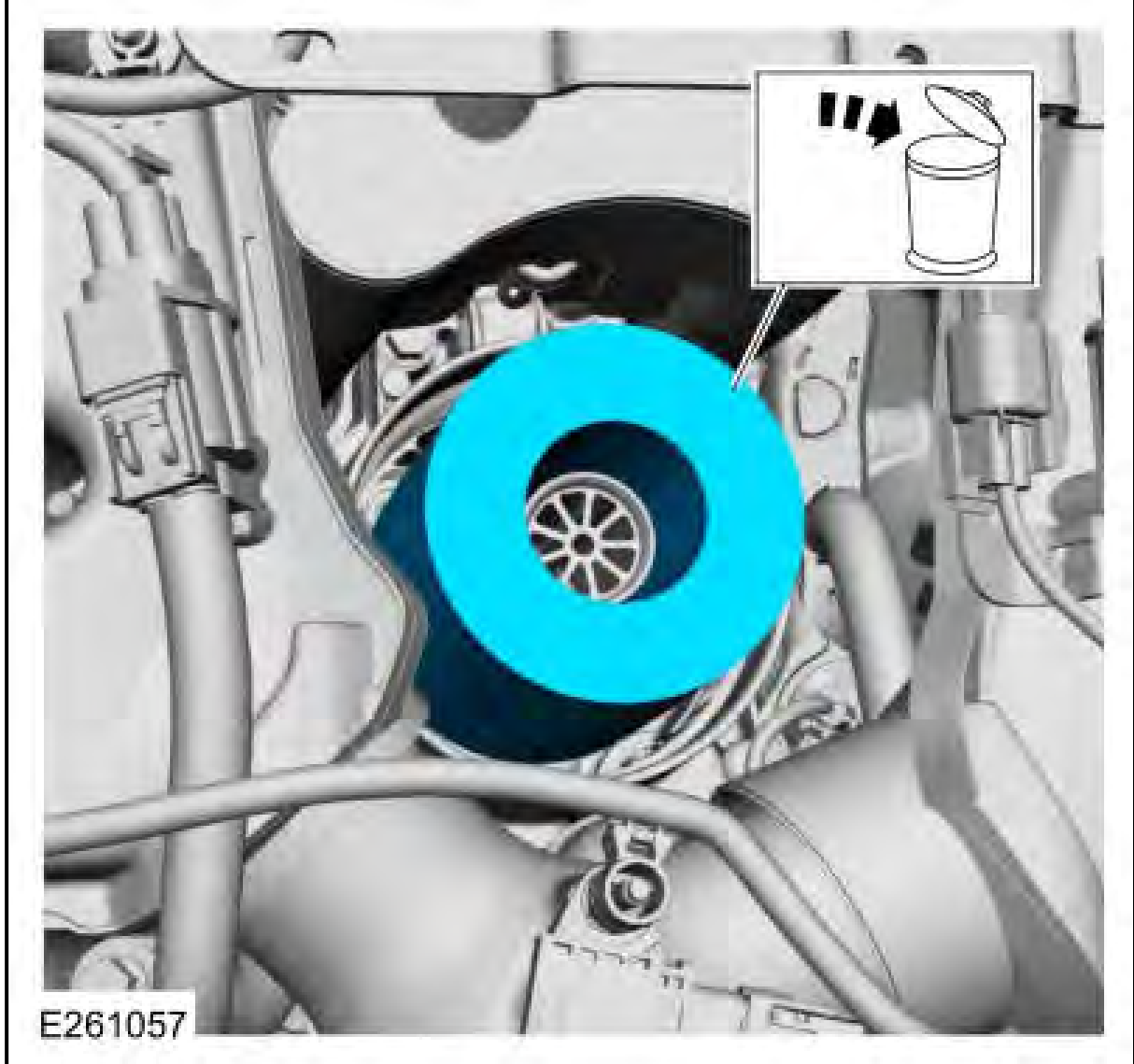




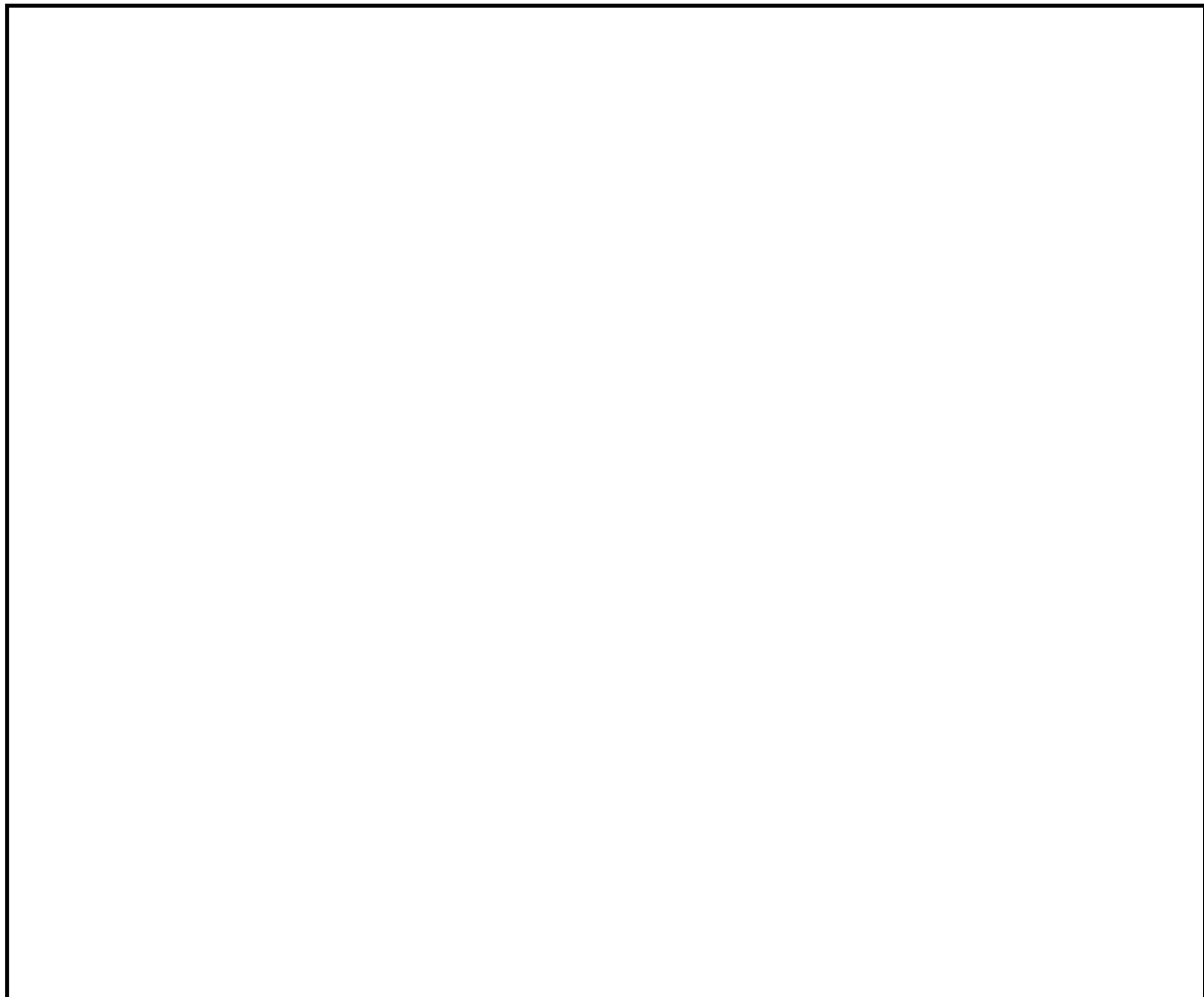
E261056

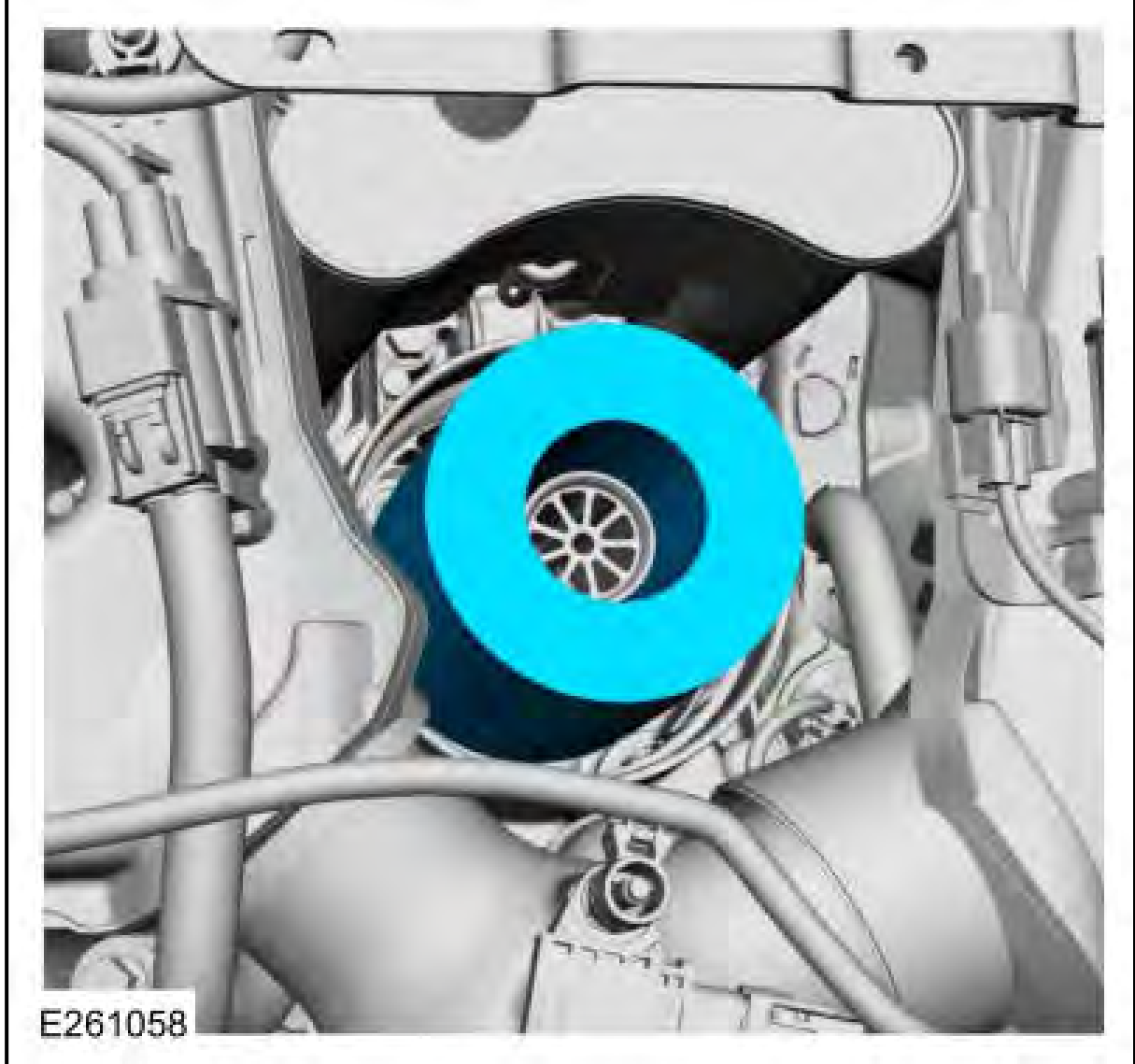
10. Remove and discard the oil filter. Use the General Equipment: Oil Drain Equipment





11. Install a new oil filter.





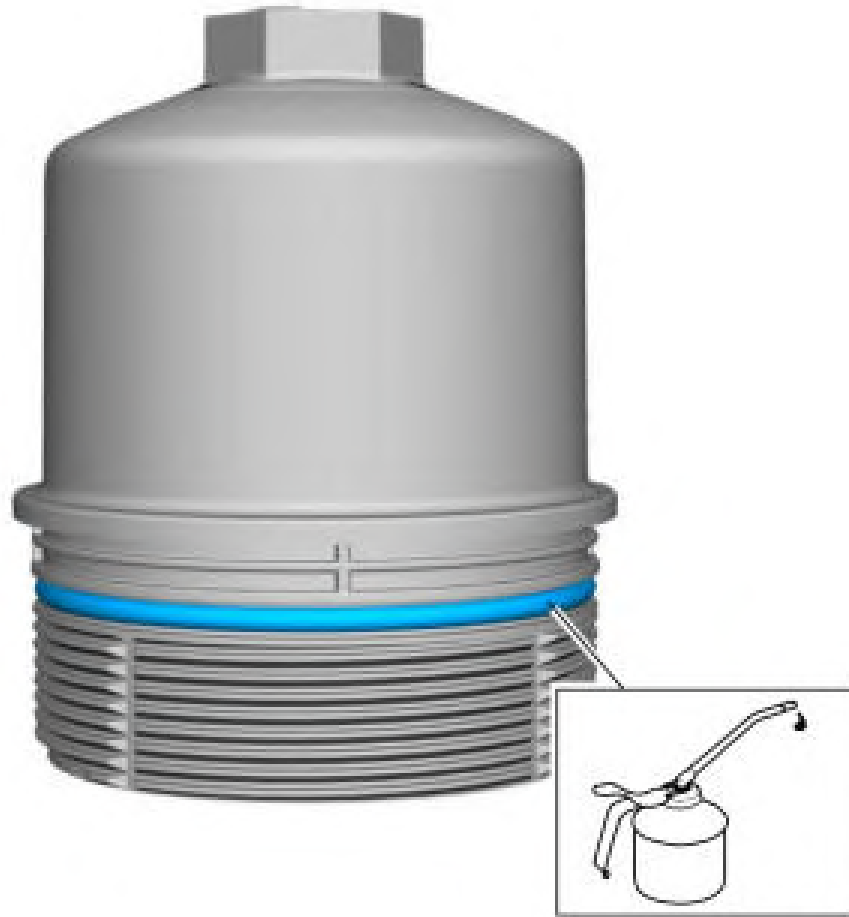
12. Install a new oil filter cap O-ring seal and lubricate.

Material

: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)



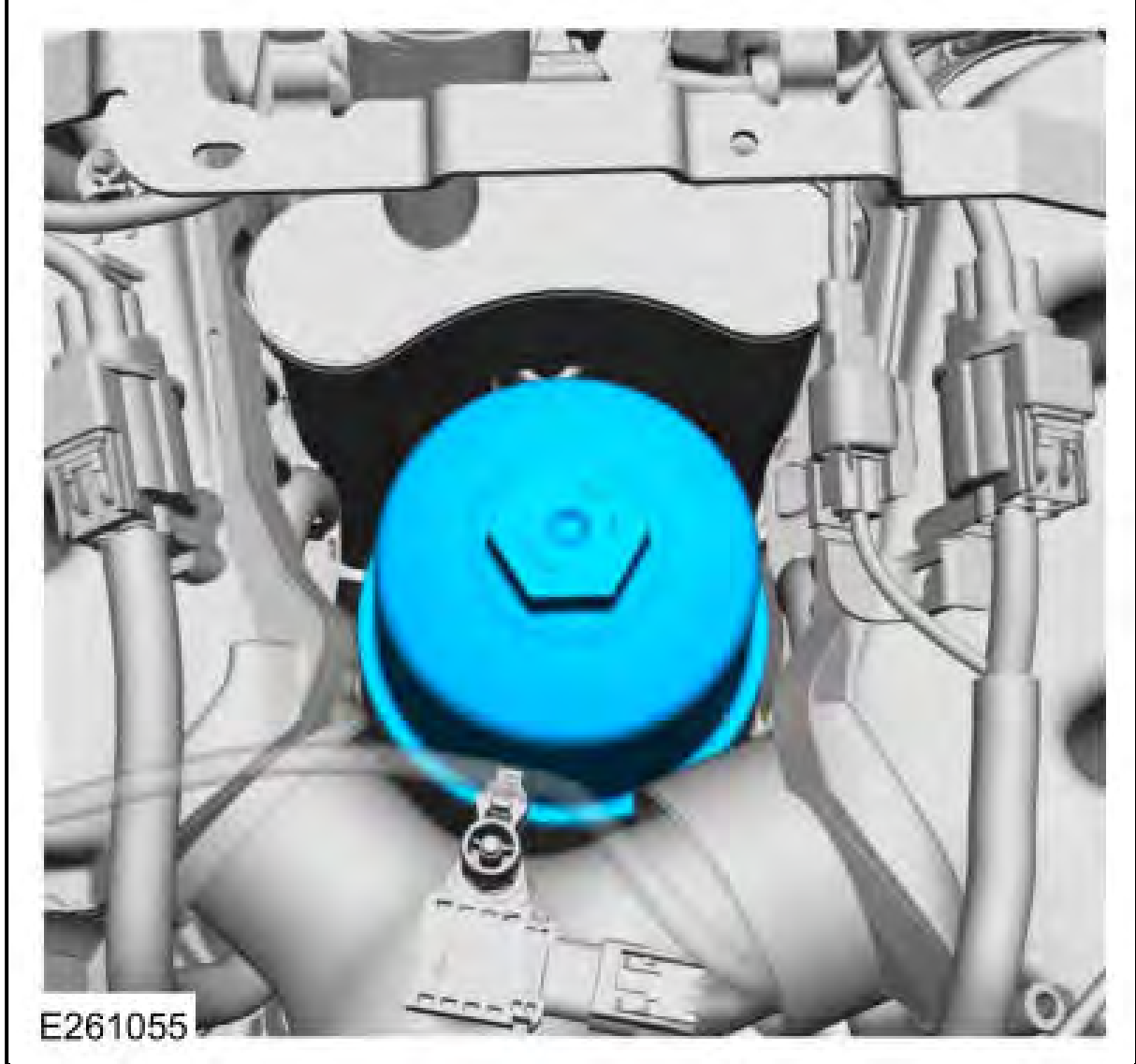




E261059

13. Install the oil filter cap.

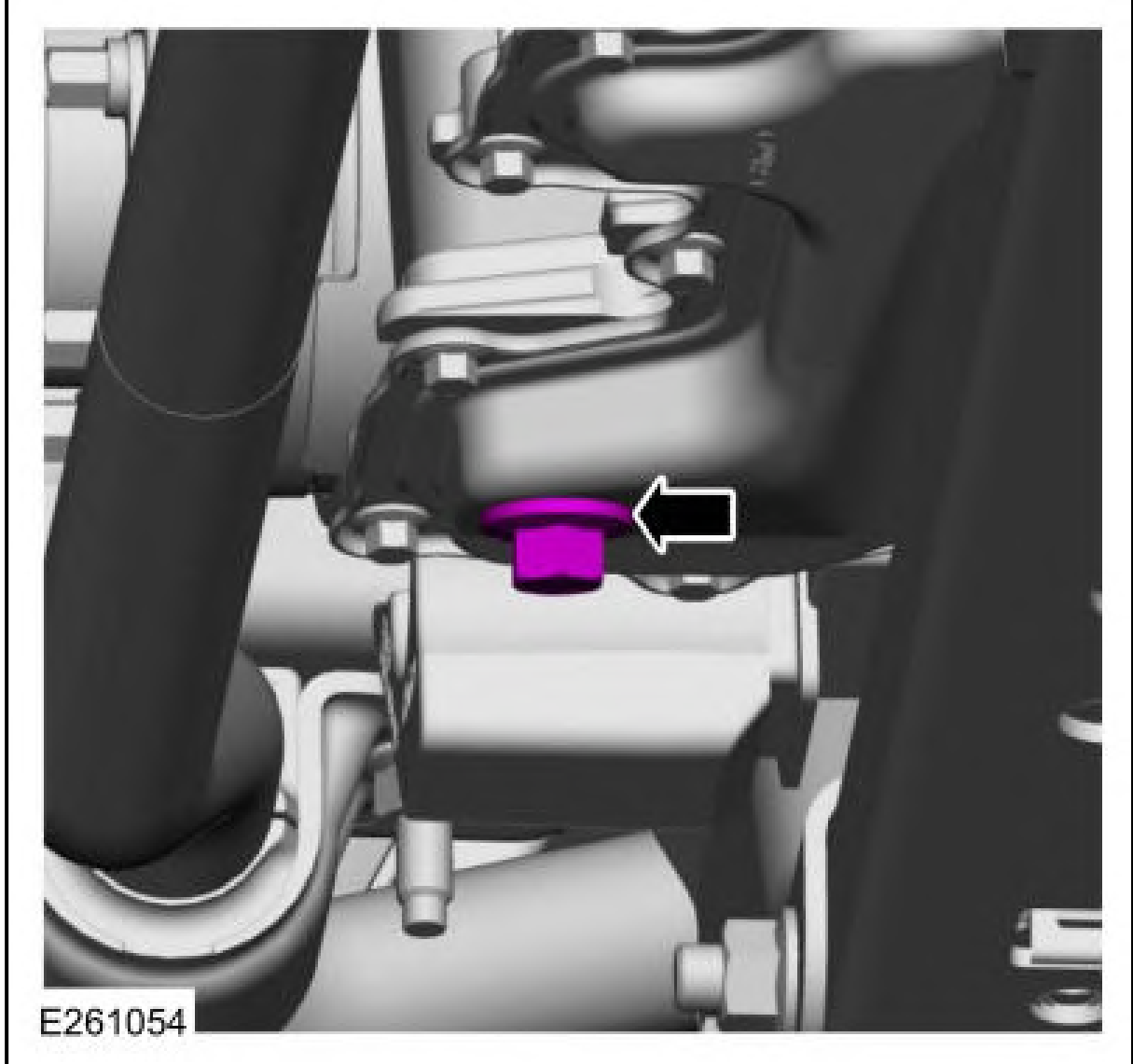
Torque: 18 lb.ft (25 Nm)



14. Remove the oil pan plug and drain the engine oil. Use the General Equipment: Oil Drain Equipment

Torque: 18 lb.ft (25 Nm)



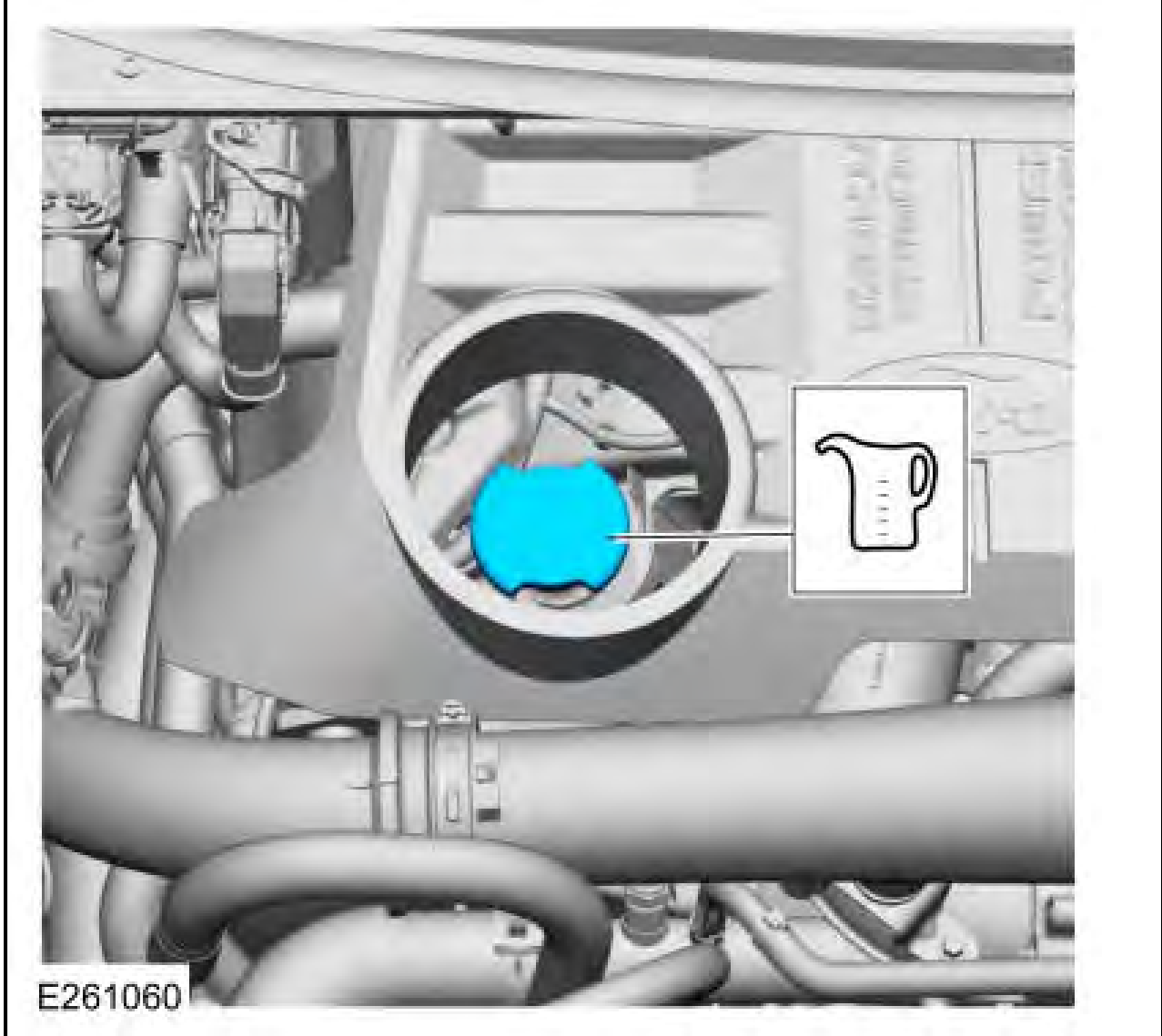


15. Install the following items:

1. Install the exhaust crossover pipe. Refer to: [Exhaust Crossover Pipe](#) .
2. Install the LH camshafts. Refer to: [Camshaft LH](#) .

16. Fill the engine with clean engine oil. Refer to: [Specifications](#) .

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)



## CYLINDER HEAD - BODY ON - RH

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#).

### Special Tool(s) / General Equipment

|                     |
|---------------------|
| Oil Drain Equipment |
|---------------------|

### Materials

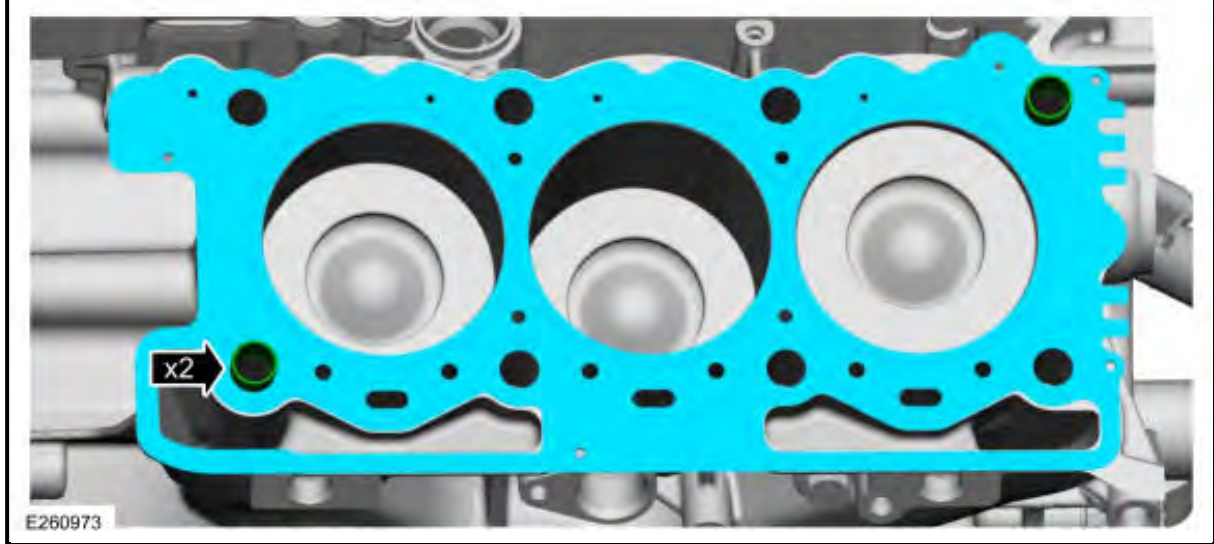
| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor OilXO-5W30-QFA  | WSS-M2C214-B1 |
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/CoolantVC-3-B | WSS-M97B44-D  |

**NOTE:** It is recommended that this component be serviced with the vehicle body removed. If the body was removed, refer to Cylinder Head - Body Off in this section.

- NOTE:** Make sure that the same gasket thickness is reinstalled.

Install the cylinder head dowels and the RH cylinder head gasket.





2. **NOTE:** Using too much engine oil on the threads of the cylinder head bolts may cause damage to the threads and poor sealing. Using anti-seize compounds, grease or any other lubricants other than engine oil on the cylinder head bolt threads may affect the true torque value of the bolts.

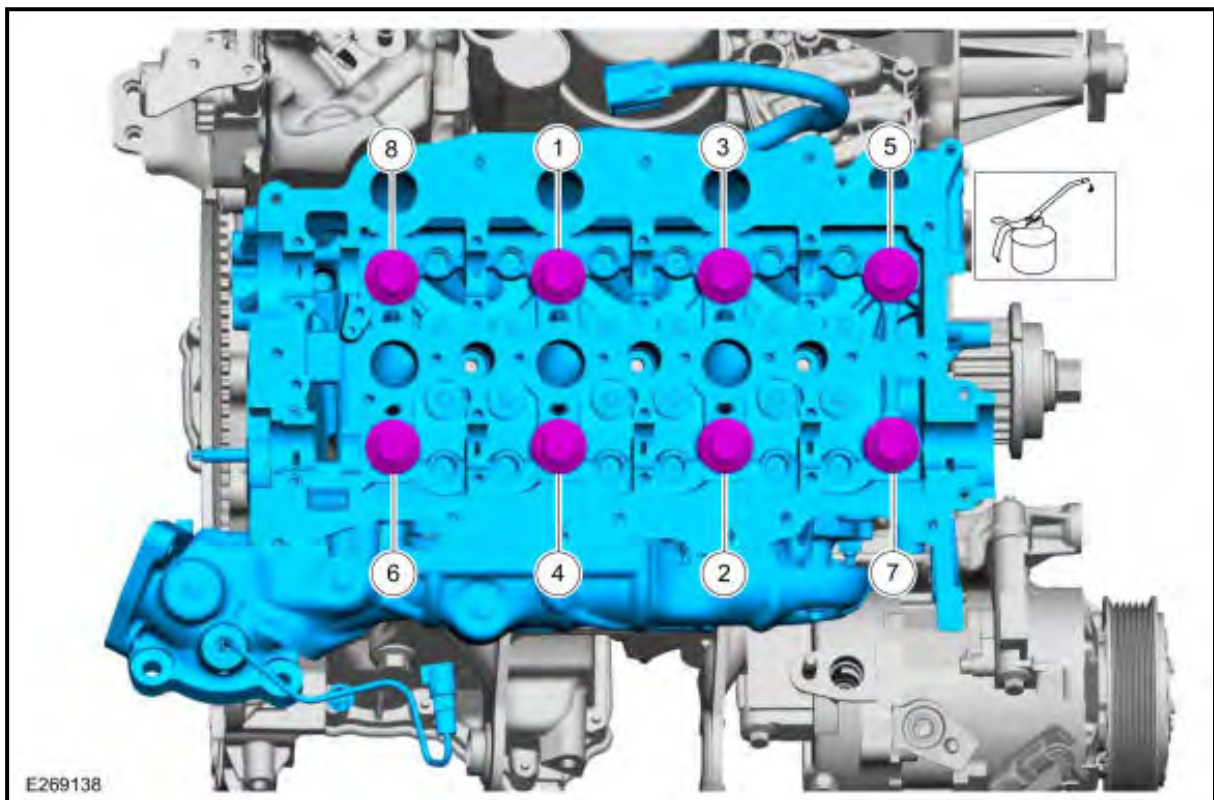
**NOTE:** Lightly lubricate the new cylinder head bolt threads and flanges with clean engine oil.

Install the RH cylinder head and the new bolts.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

Torque

:Stage 1: 177 lb.in (20 Nm) Stage 2: 30 lb.ft (40 Nm) Stage 3: 59 lb.ft (80 Nm) Stage 4: 180  $\hat{A}$



3. Install the coolant outlet connector gaskets.

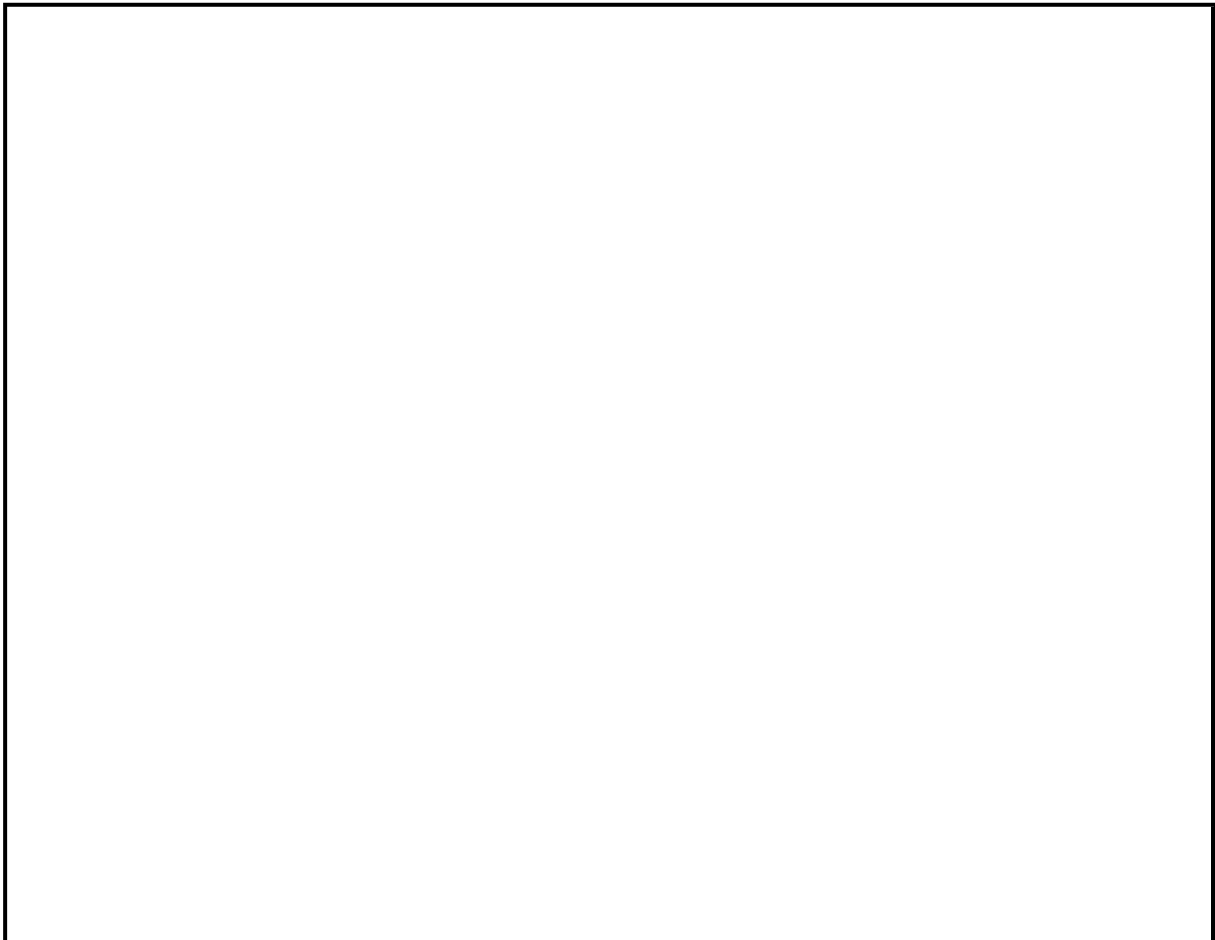


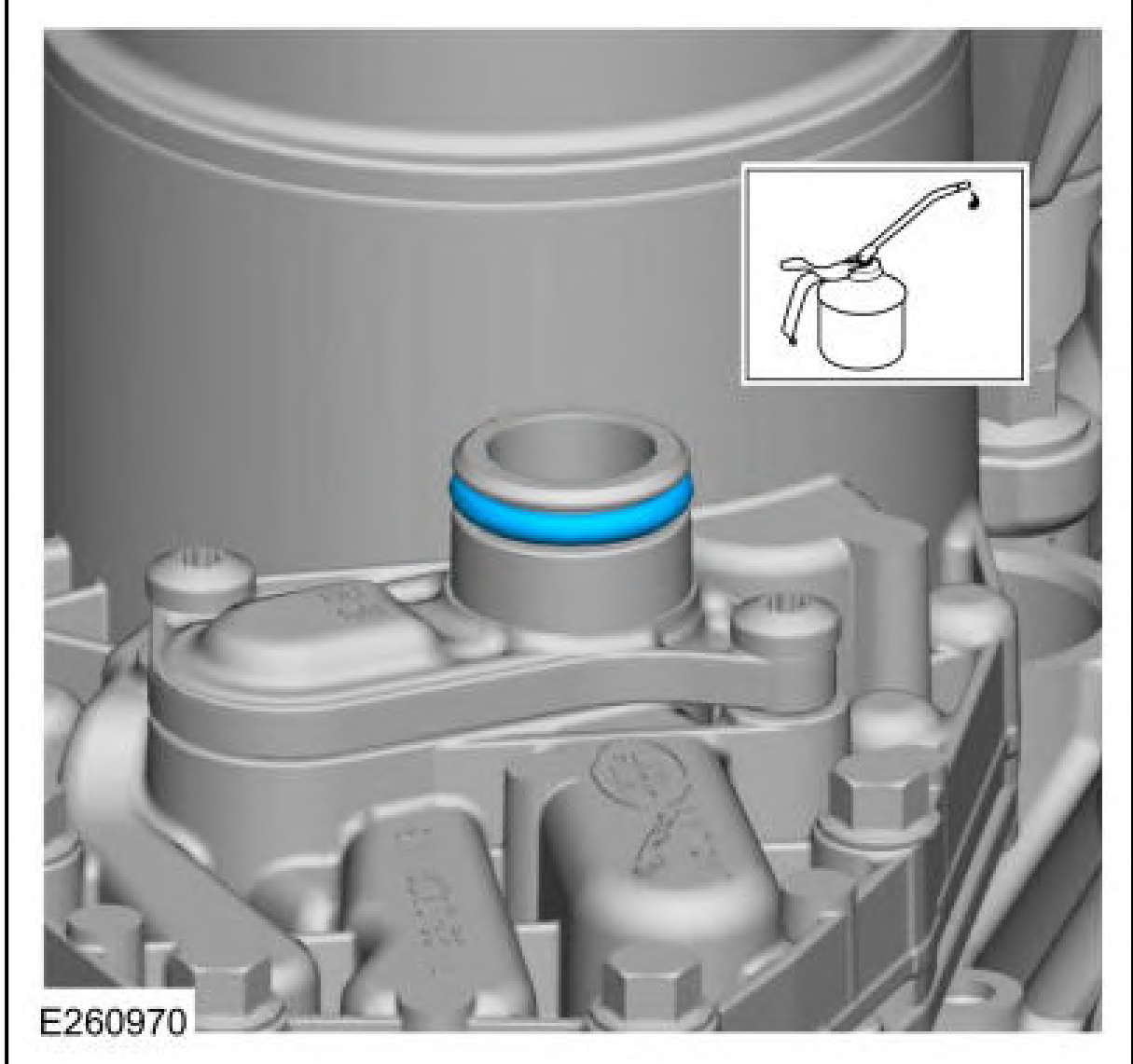


E261049

4. Install the oil cooler O-ring and lubricate.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

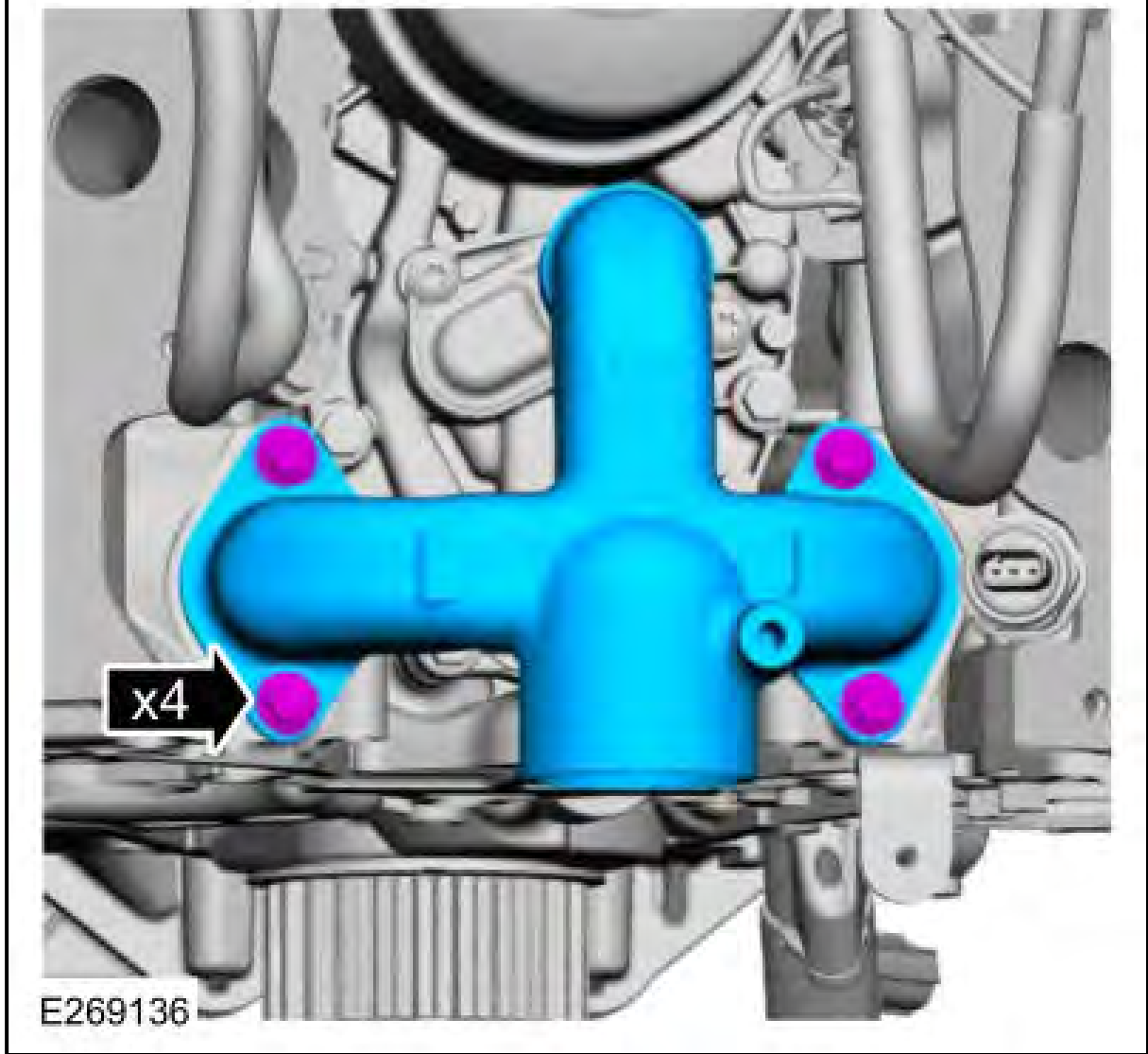




5. Install the coolant outlet connector and the bolts.

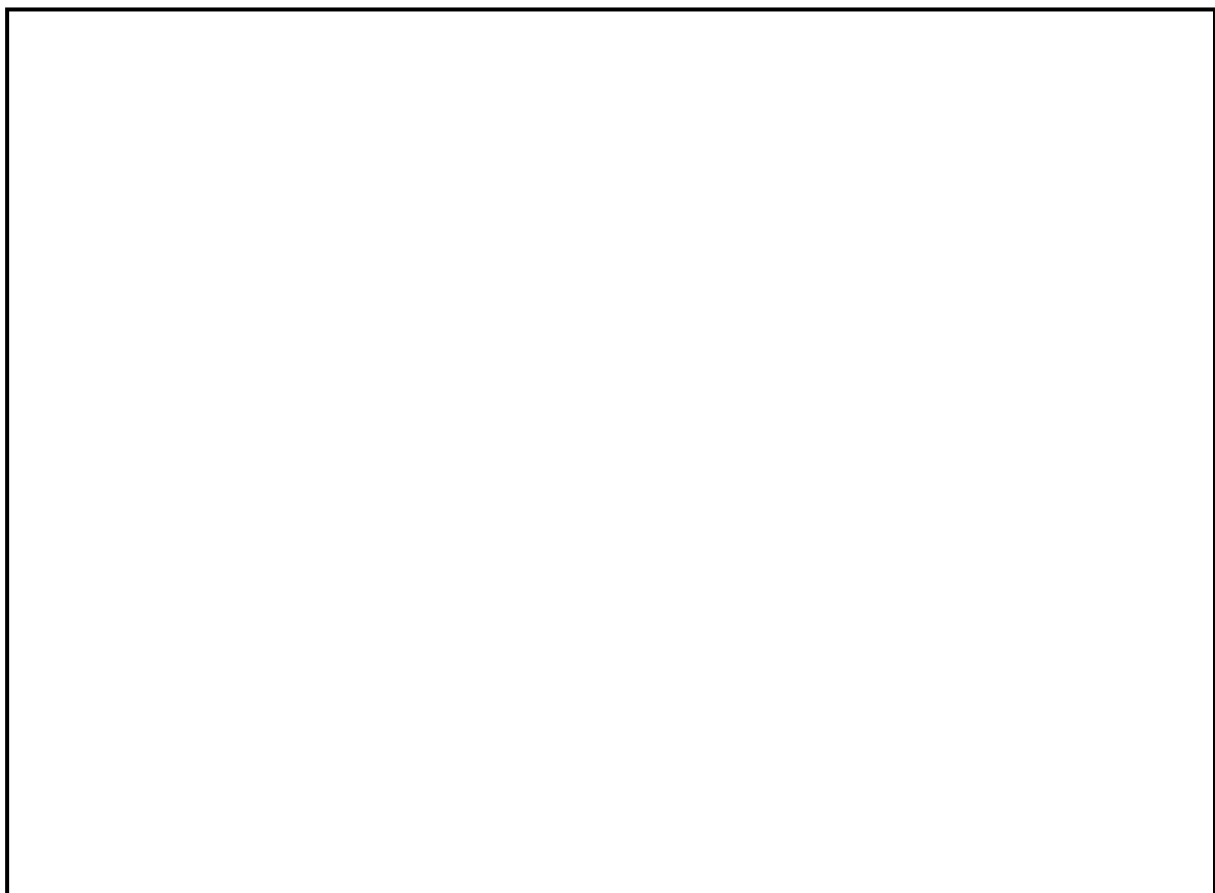
Torque: 89 lb.in (10 Nm)



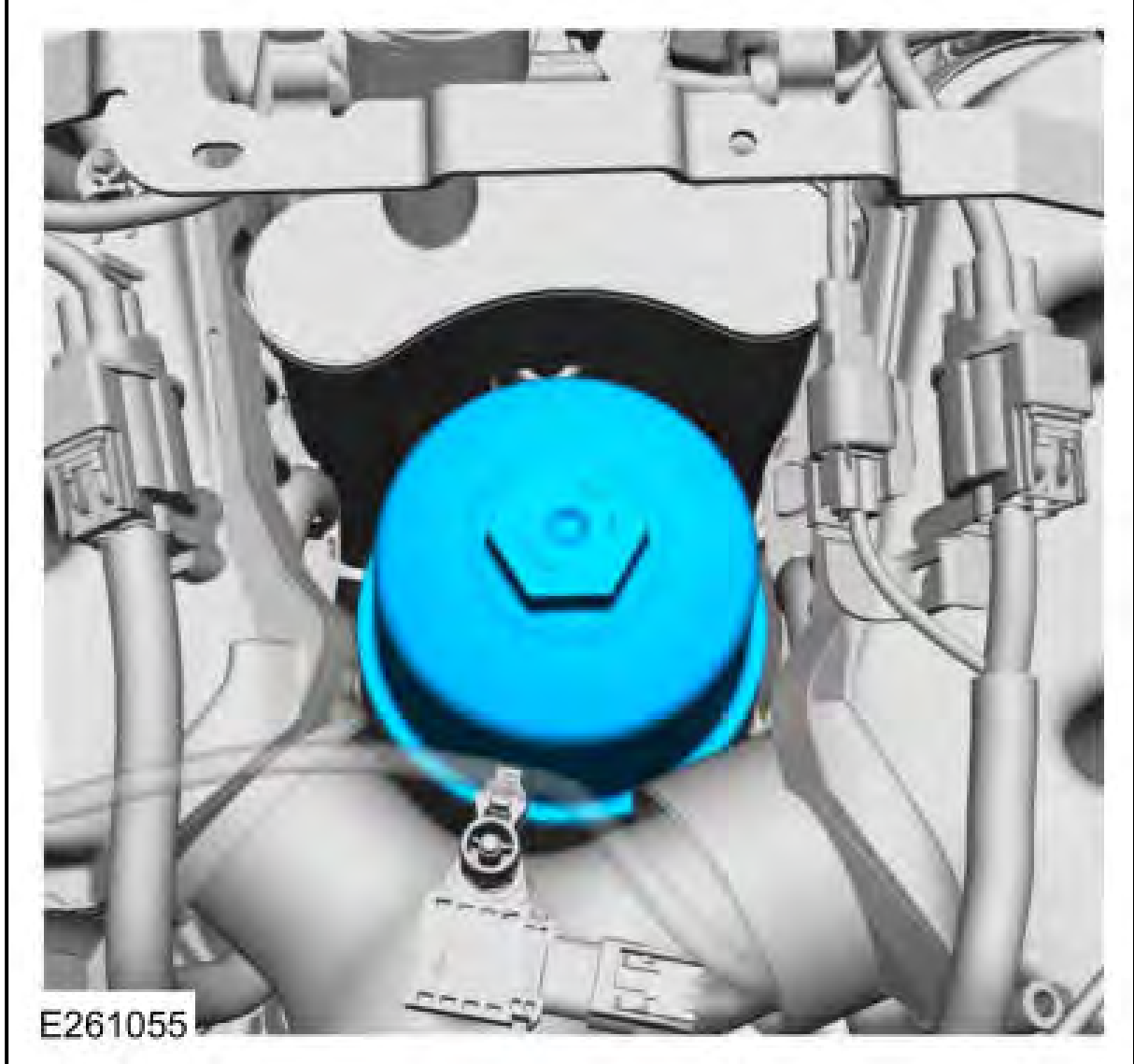


6. **NOTE:** The oil filter housing needs a minimum of 1 minute to allow the oil to drain out of the oil filter housing to minimise oil spillage.

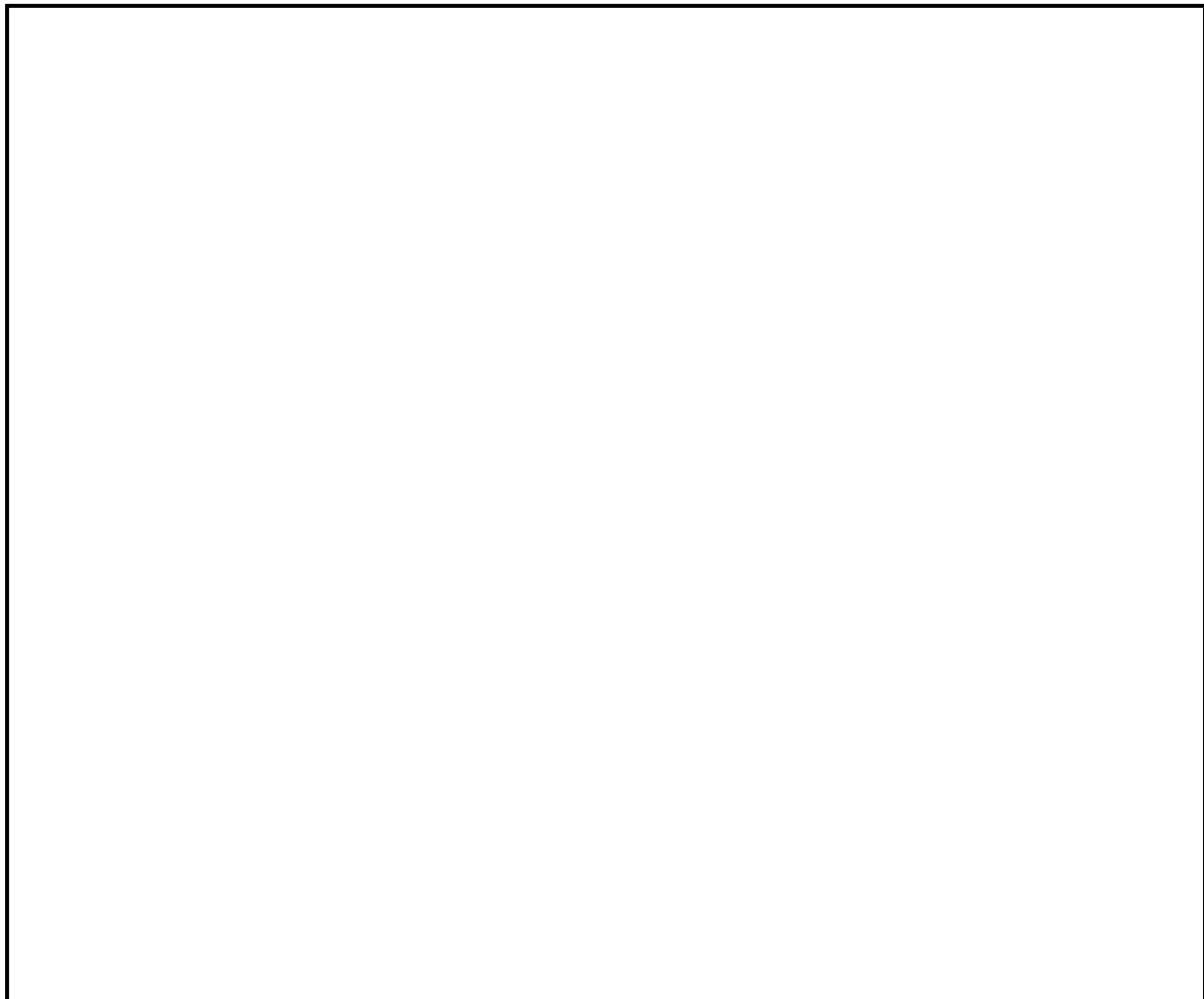
Loosen the oil filter cap and let the oil filter housing drain. Remove the oil filter cap.

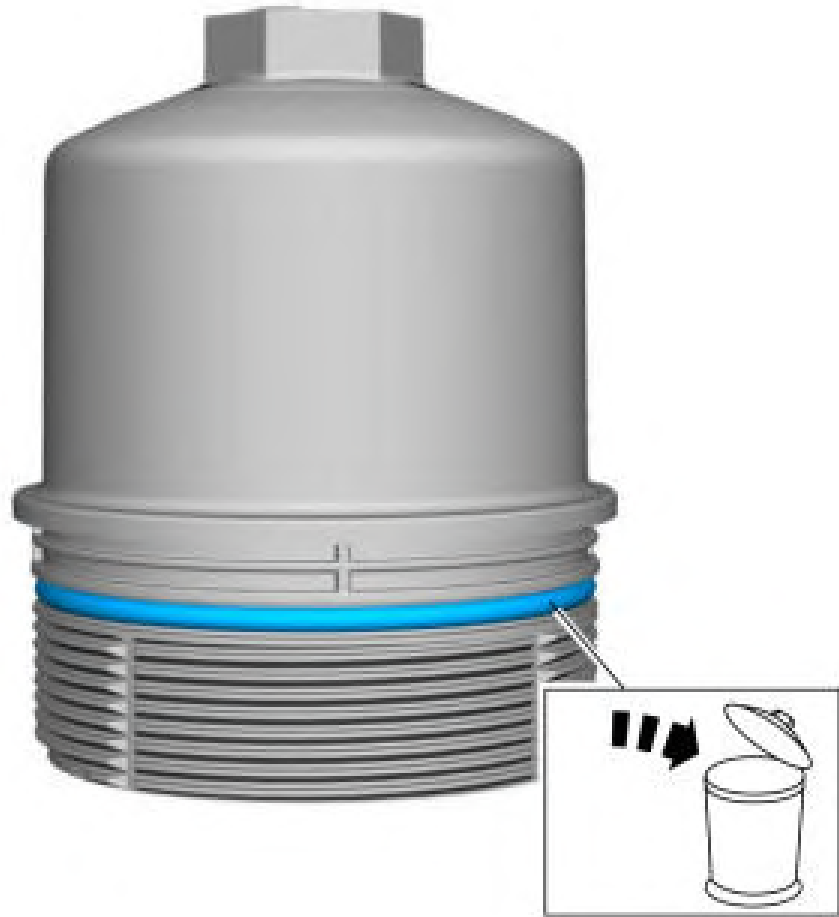






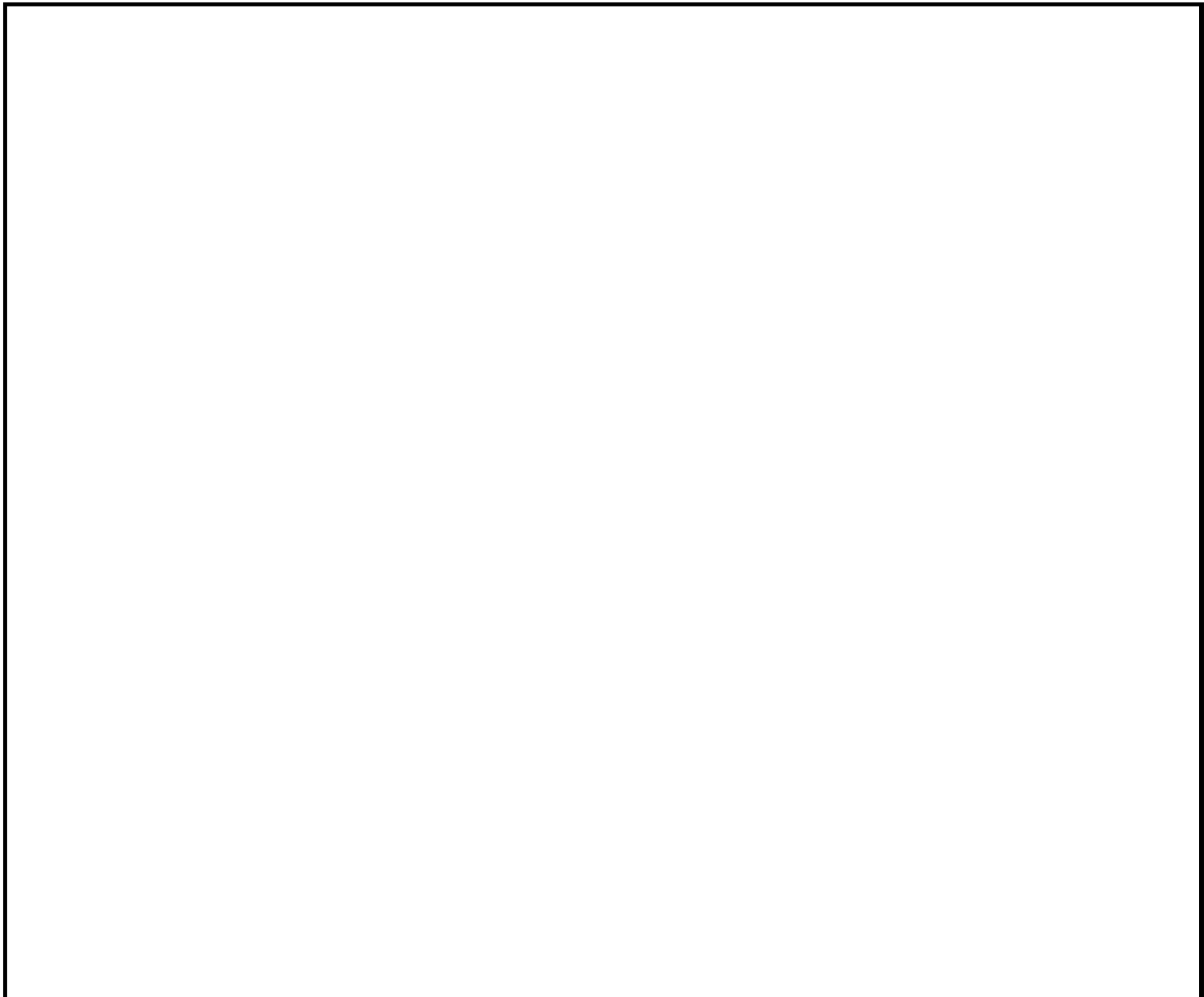
7. Remove and discard the oil filter cap O-ring seal.

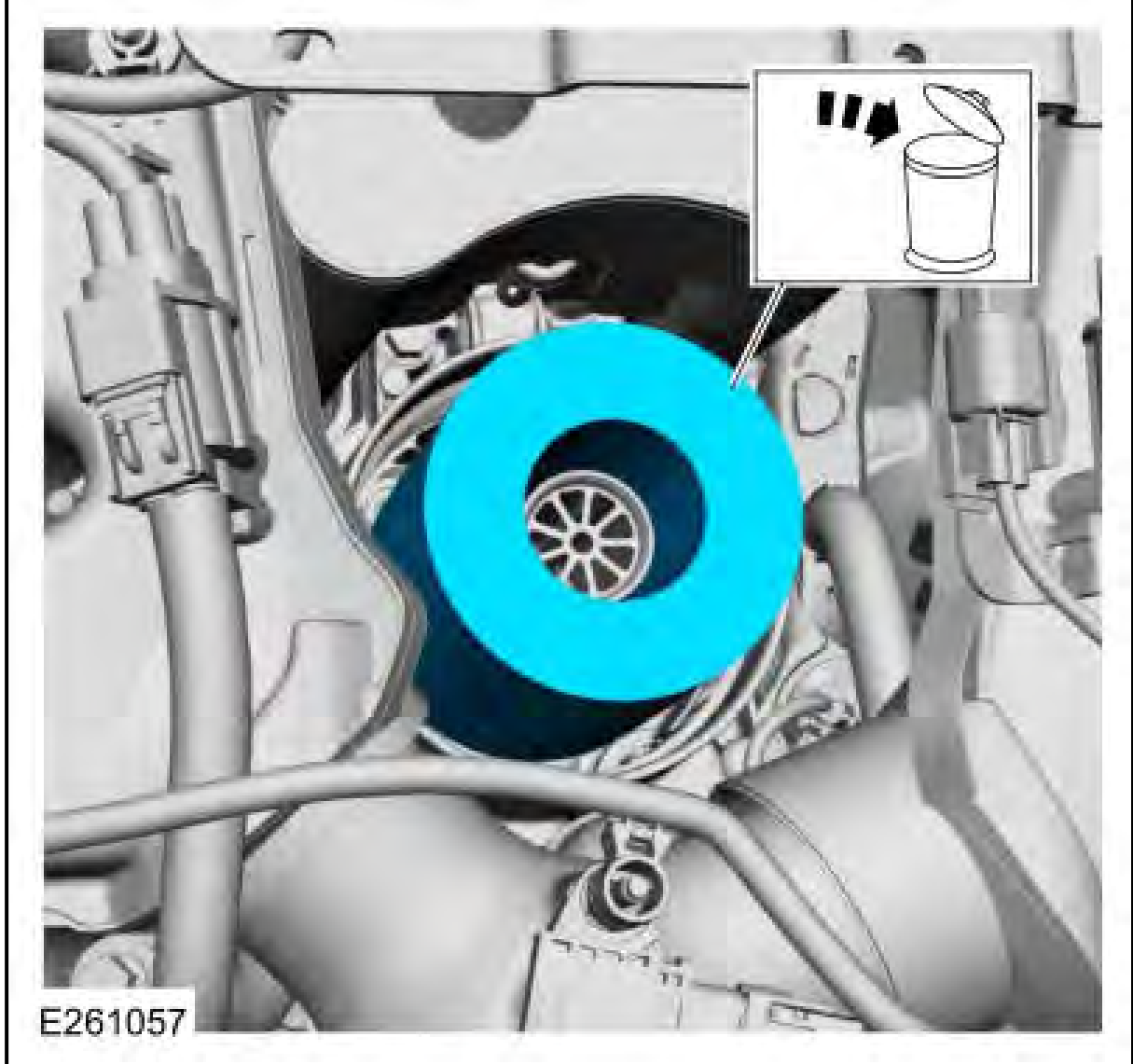




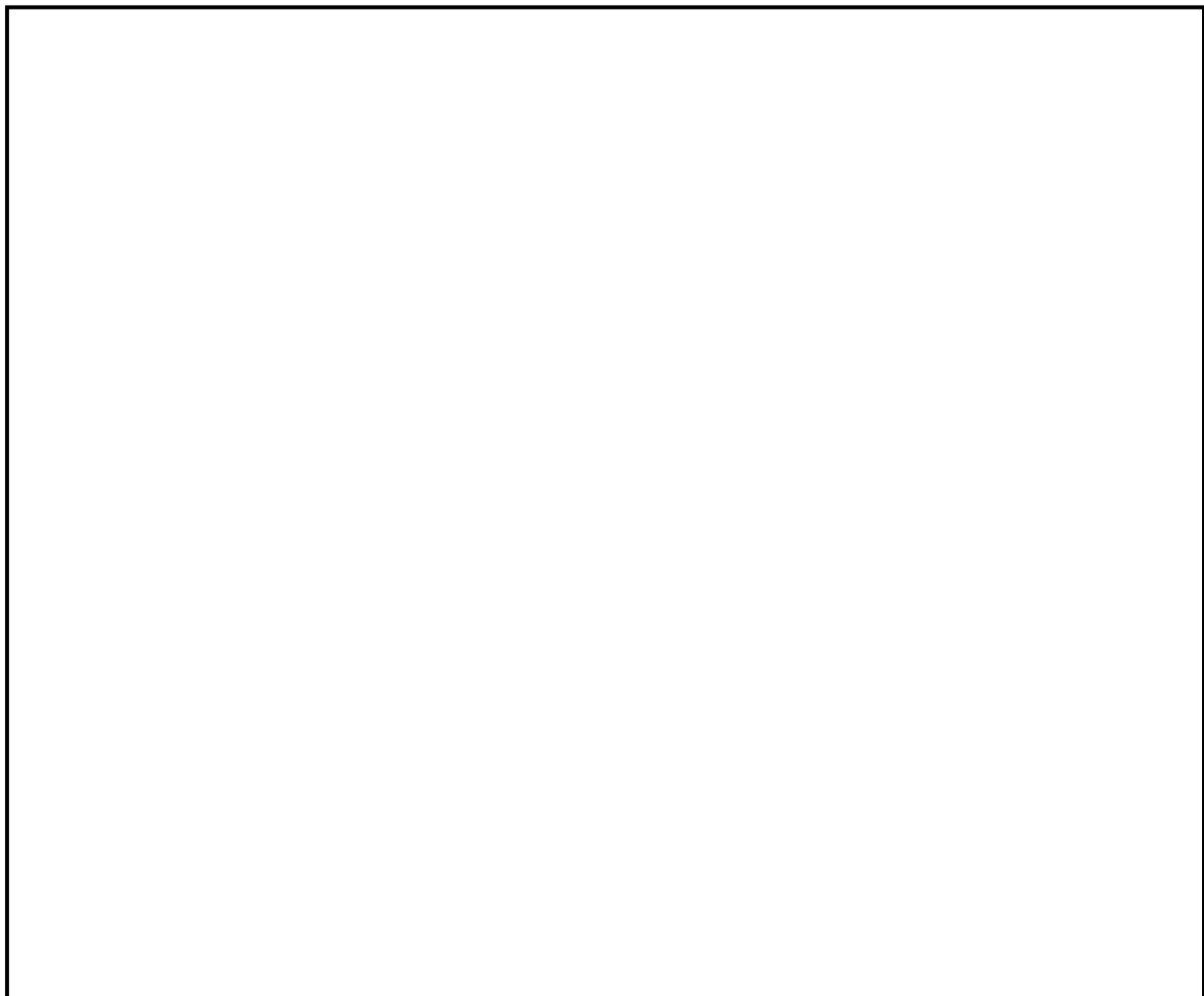
E261056

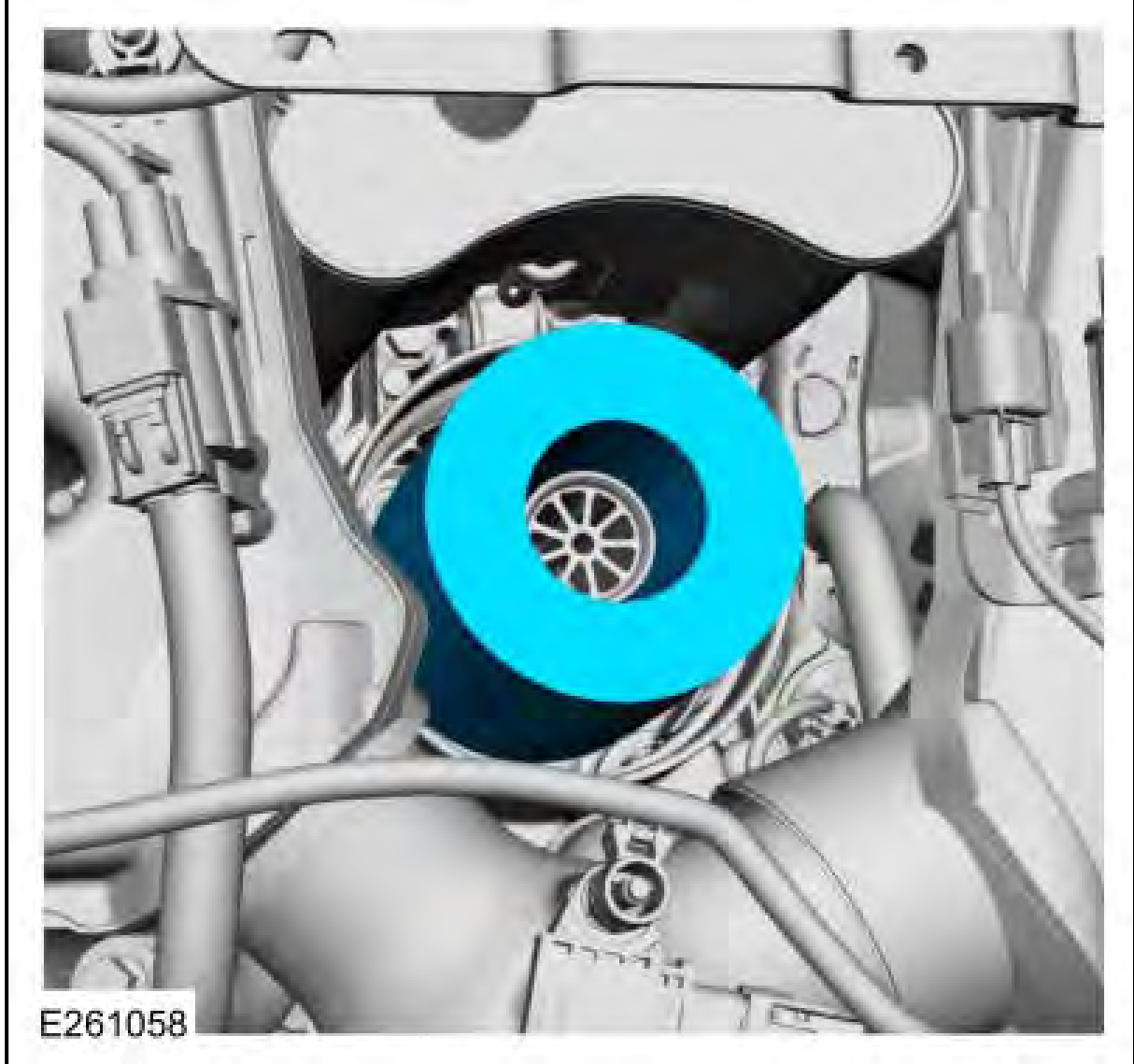
8. Remove and discard the oil filter. Use the General Equipment: Oil Drain Equipment





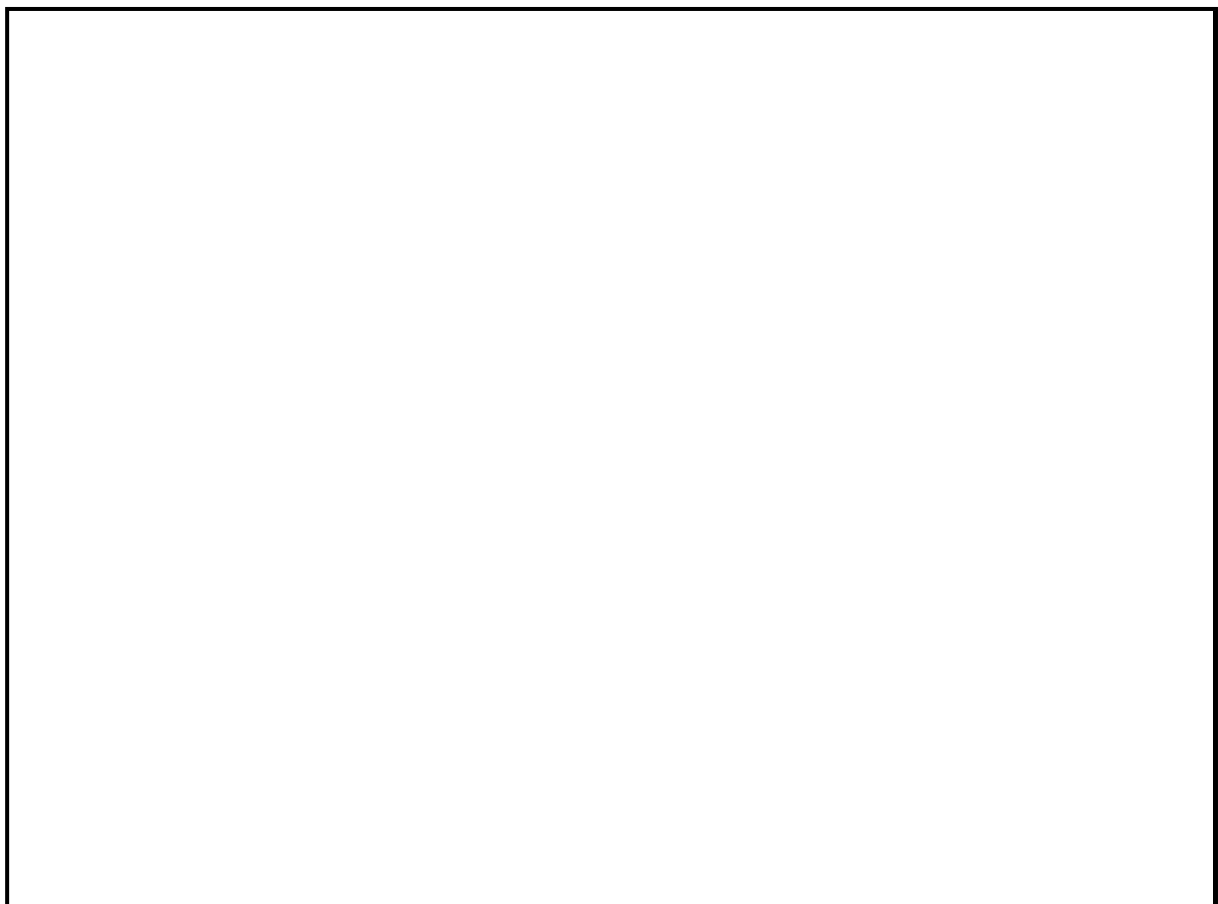
9. Install a new oil filter.

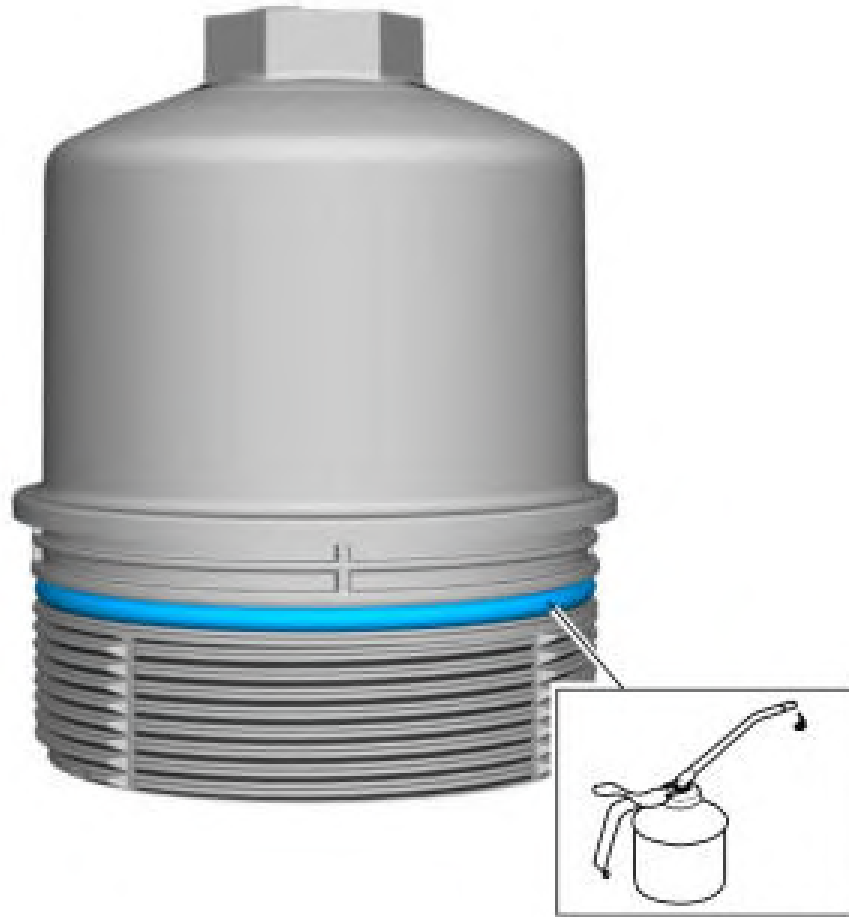




10. Install a new oil filter cap O-ring seal and lubricate.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)



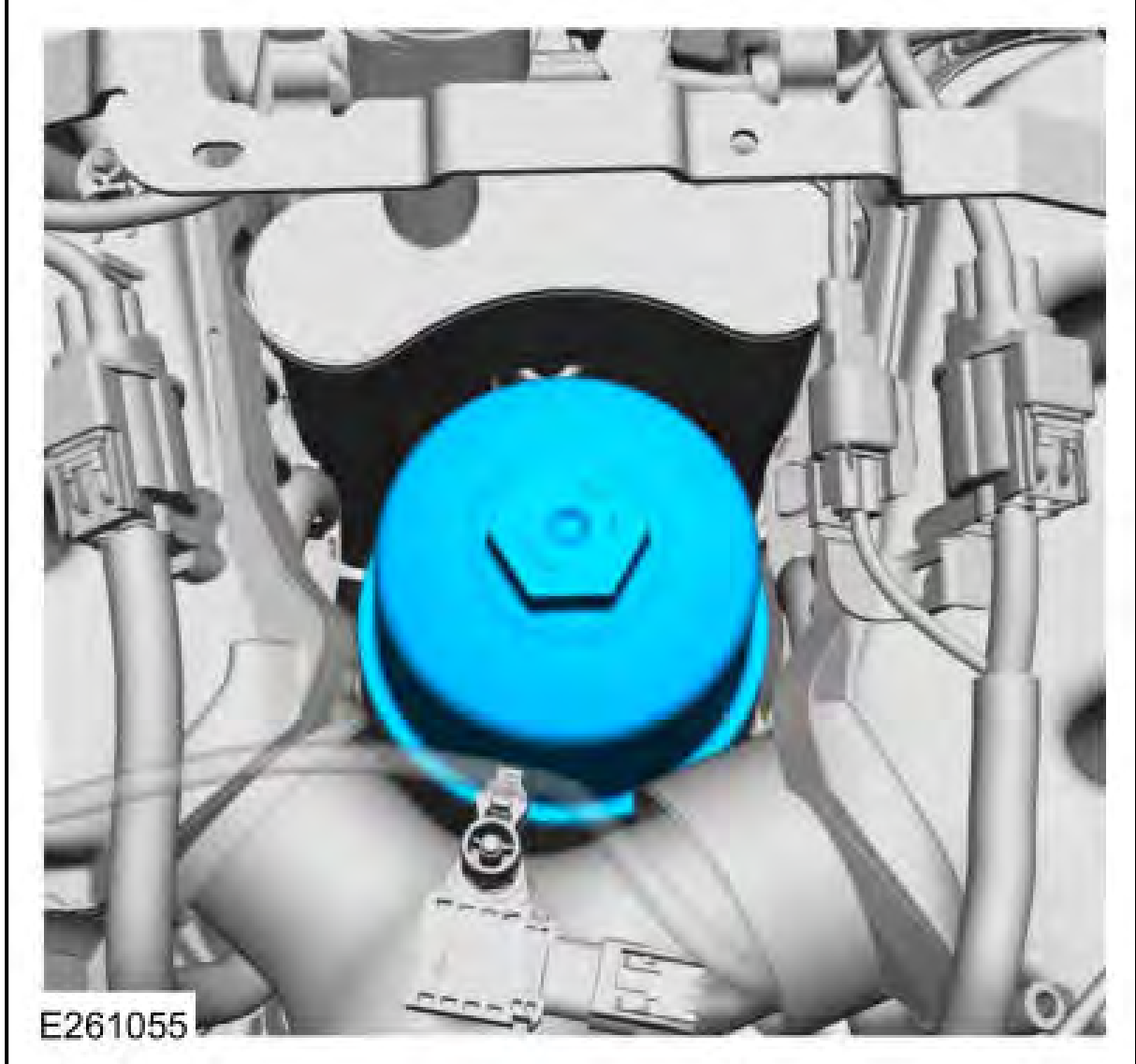


E261059

11. Install the oil filter cap.

Torque: 18 lb.ft (25 Nm)

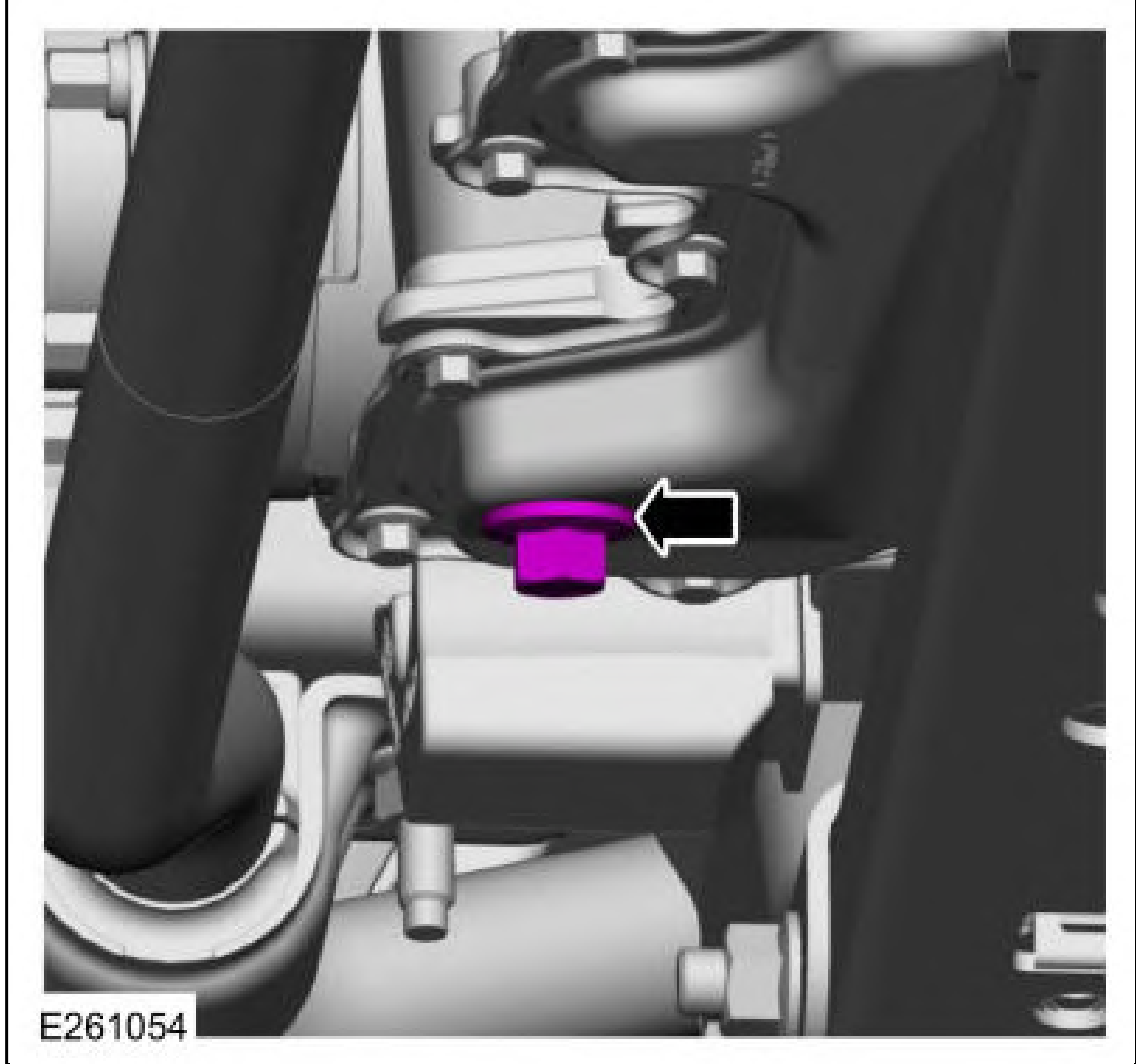




12. Remove the oil pan plug and drain the engine oil. Use the General Equipment: Oil Drain Equipment

Torque: 18 lb.ft (25 Nm)



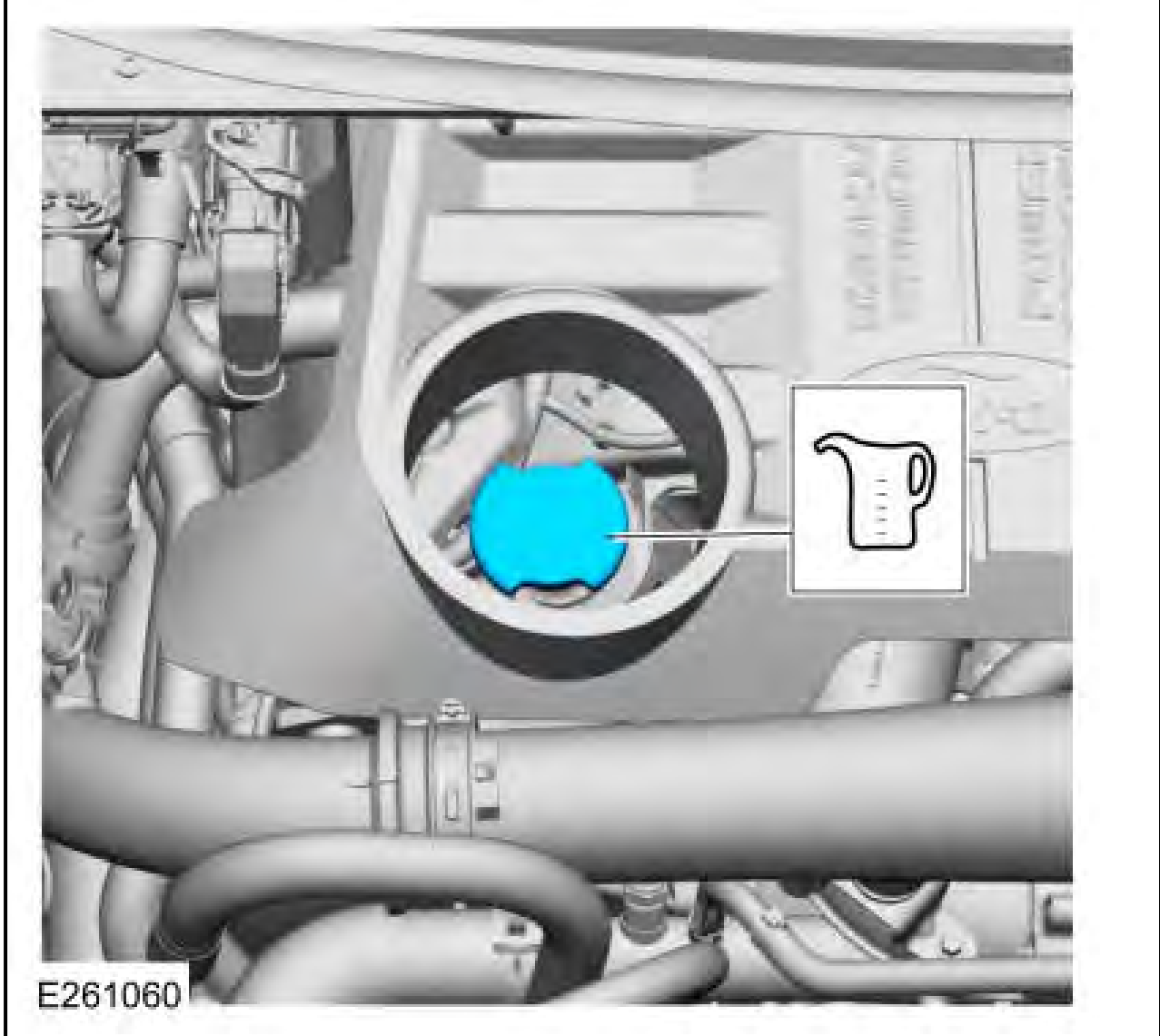


13. Install the following items:

1. Install the exhaust crossover pipe. Refer to: [Exhaust Crossover Pipe](#) .
2. Install the turbocharger. Refer to: [Turbocharger](#) .
3. Install the RH camshafts. Refer to: [Camshaft RH](#) .

14. Fill the engine with clean engine oil. Refer to: [Specifications](#) .


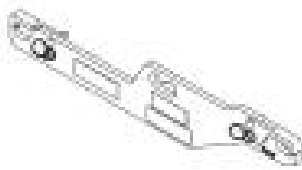
Material: Motorcraft  $\hat{A}$ ® SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)



**ENGINE BLOCK SKIRT STIFFENER**

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

**Special Tool(s) / General Equipment**

|  |  |
|--|--|
|  <p>E274093</p> | <p>303-1677 Locking Tool, Flywheel</p> |
|  <p>E274098</p> | <p>303-1681 Spreader Bar</p>           |
| <p>Floor Crane<br/>Mounting Stand</p>  |  |

**Materials**

|  |
|--|
|  |
|--|



| Name   | Specification |
|--|---------------|
| Motorcraft <sup>®</sup> High Performance Engine RTV Silicone TA-357  | WSE-M4G323-A6 |
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA | WSS-M2C214-B1 |

**NOTE:** Failure to use Motorcraft <sup>®</sup> High Performance Engine RTV Silicone may cause the engine oil to foam excessively and result in serious engine damage.

**NOTE:** This procedure assumes the engine will be installed using the recommended body off engine installation procedure. If it will be necessary to install the engine using the alternate body on engine installation procedure, some of the components in this procedure should not be installed at this time. Refer to Engine - Body Off in this section.

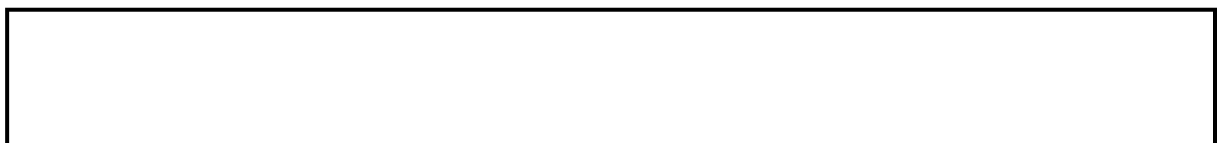
1. Install the engine block skirt stiffener alignment dowels.

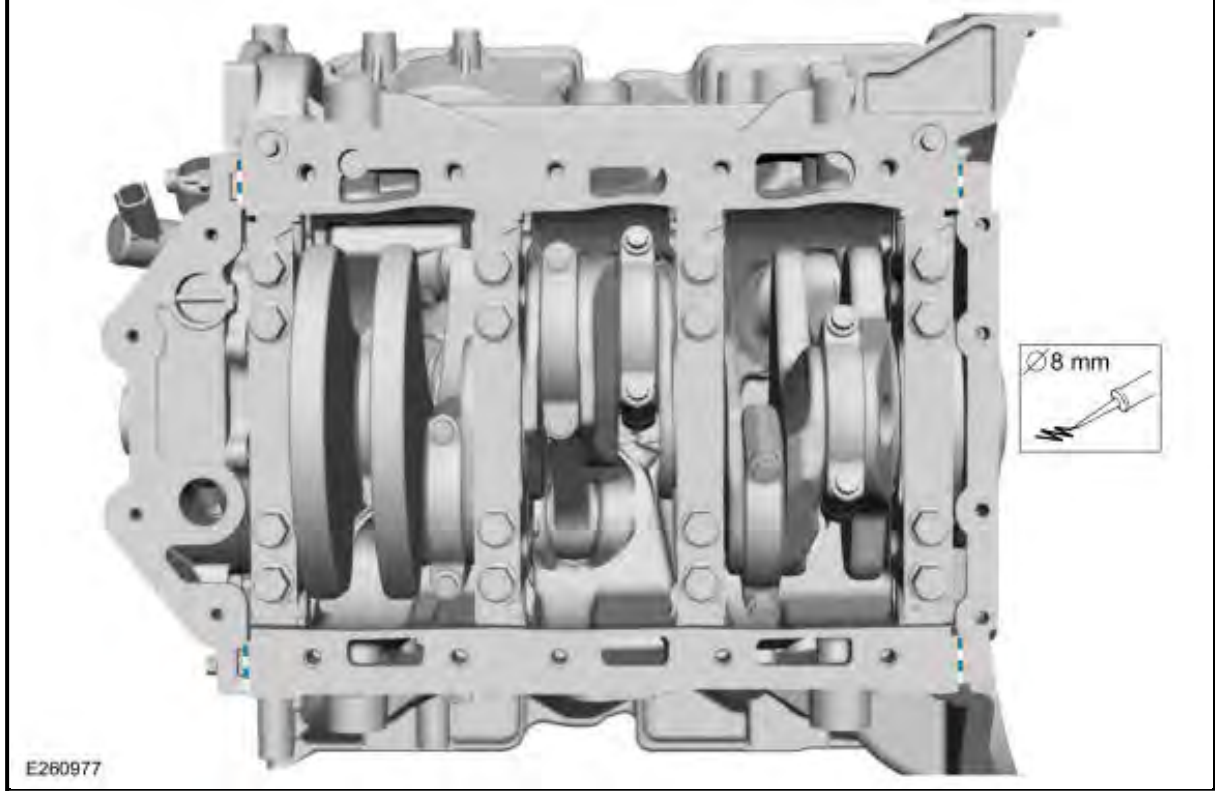


2. **NOTE:** The engine block skirt stiffener and the bolts must be installed within 4 minutes of sealant application. Final tightening of the oil pan bolts must be carried out within 60 minutes of sealant application.

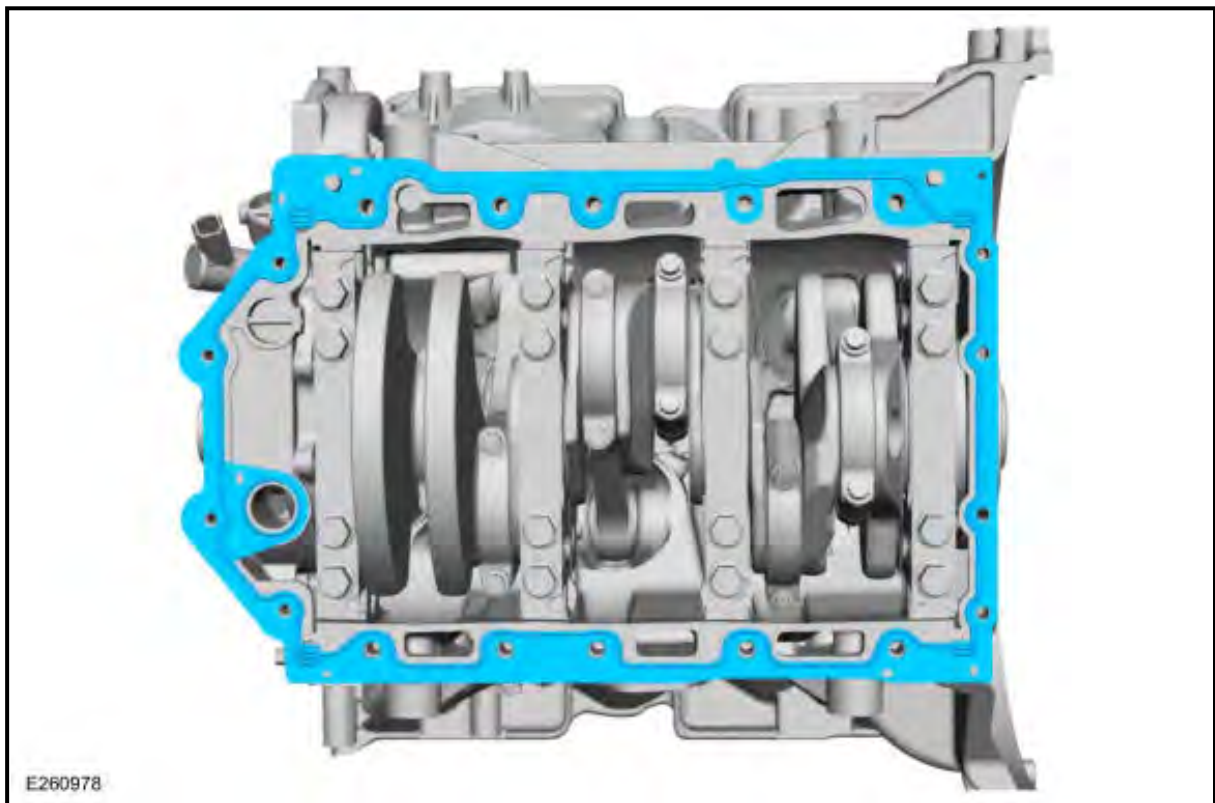
Apply a 8.0 mm bead of Motorcraft <sup>®</sup> High Performance Engine RTV Silicone to the T-joints.

Material: Motorcraft <sup>®</sup> High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)





3. Install a new engine block stiffener gasket.

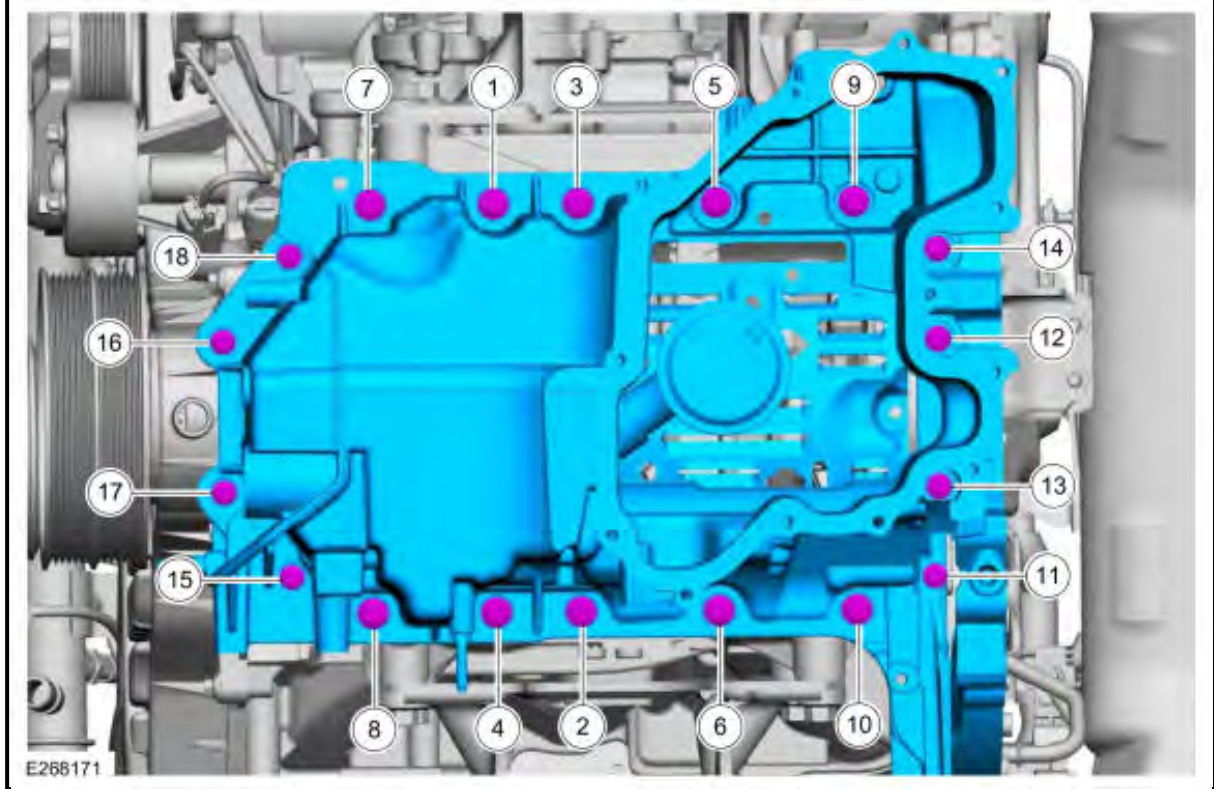


4. Remove the bolts and the engine block skirt stiffener.

Torque

:Stage 1: 18 lb.in (2 Nm) Stage 2: 89 lb.in (10 Nm)

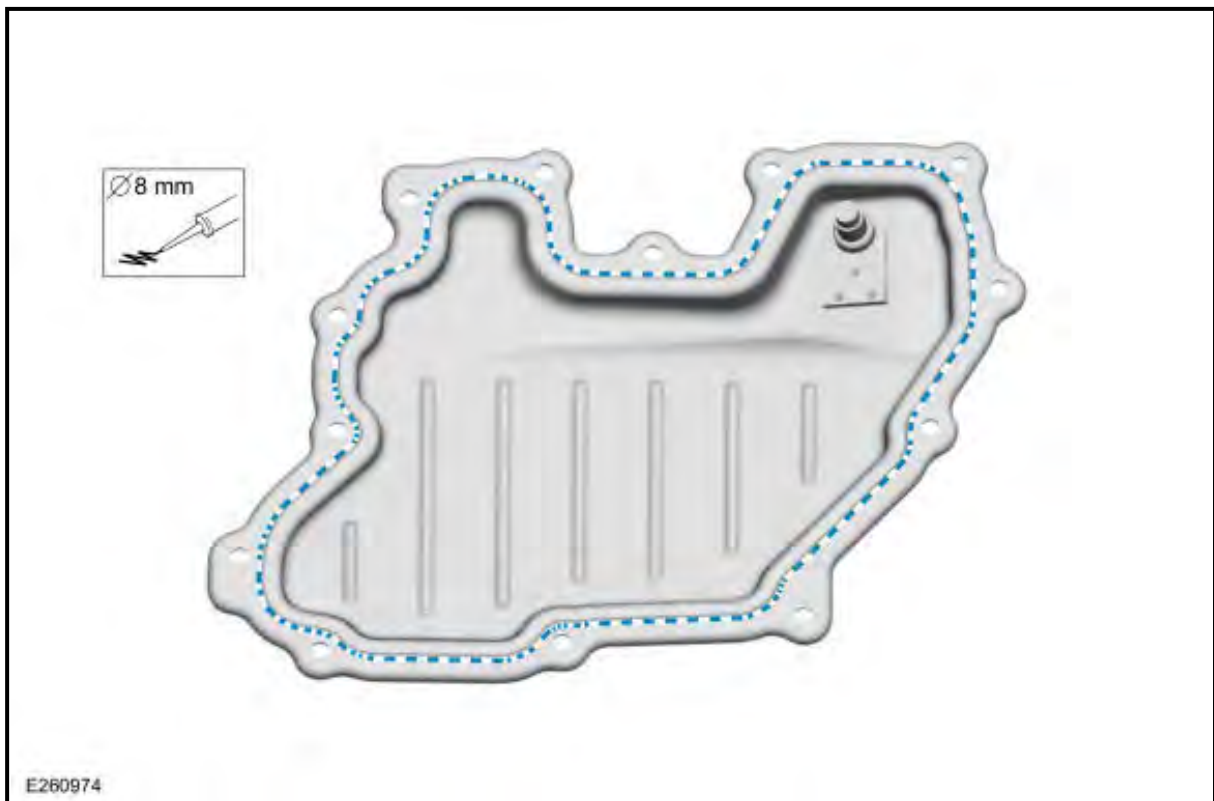




5. **NOTE:** The oil pan and the bolts must be installed within 4 minutes of sealant application. Final tightening of the oil pan bolts must be carried out within 60 minutes of sealant application.

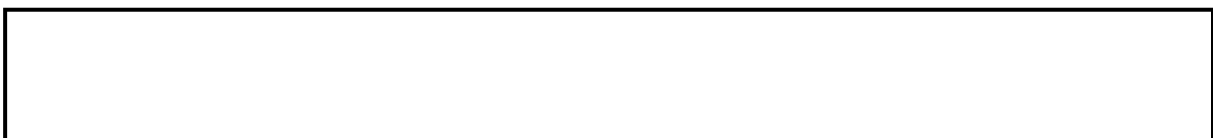
Apply a 8.0 mm bead of Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone to the sealing surface of the oil pan.

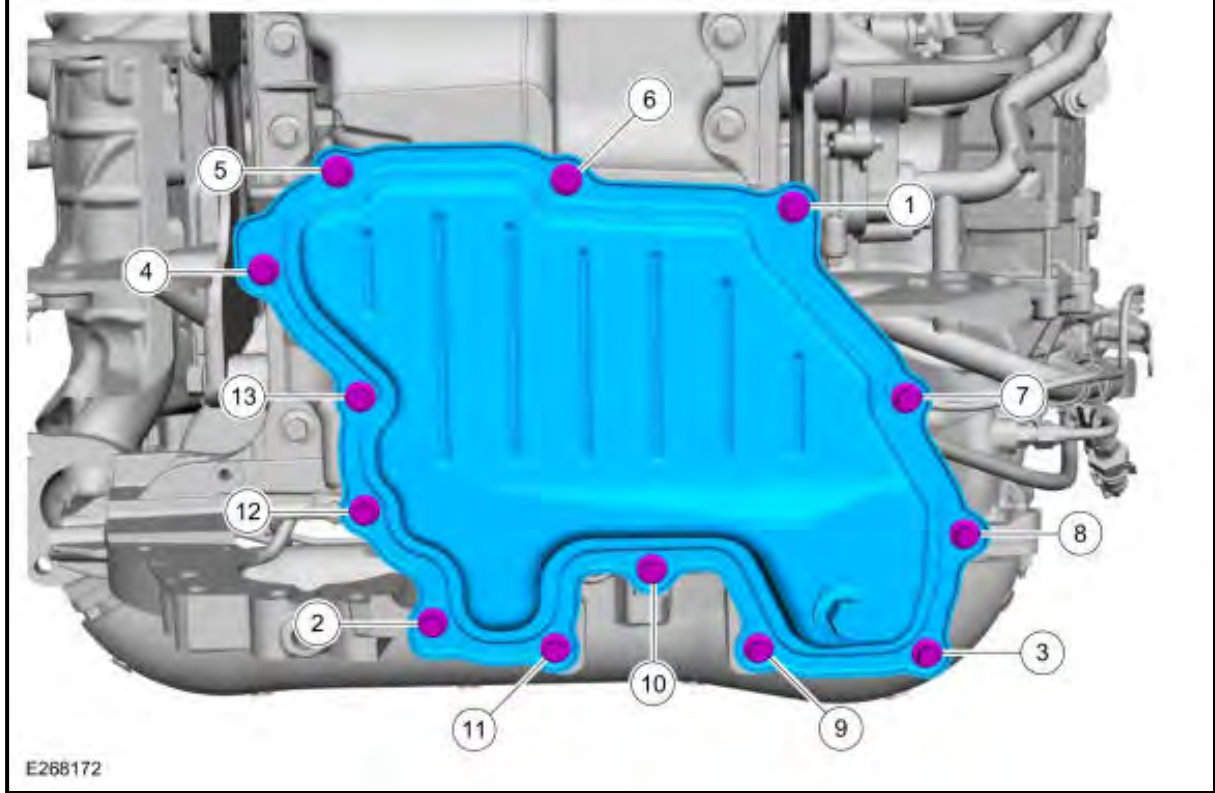
Material: Motorcraft  $\hat{A}$ ® High Performance Engine RTV Silicone / TA-357 (WSE-M4G323-A6)



6. Remove the bolts and the oil pan.

Torque: 89 lb.in (10 Nm)

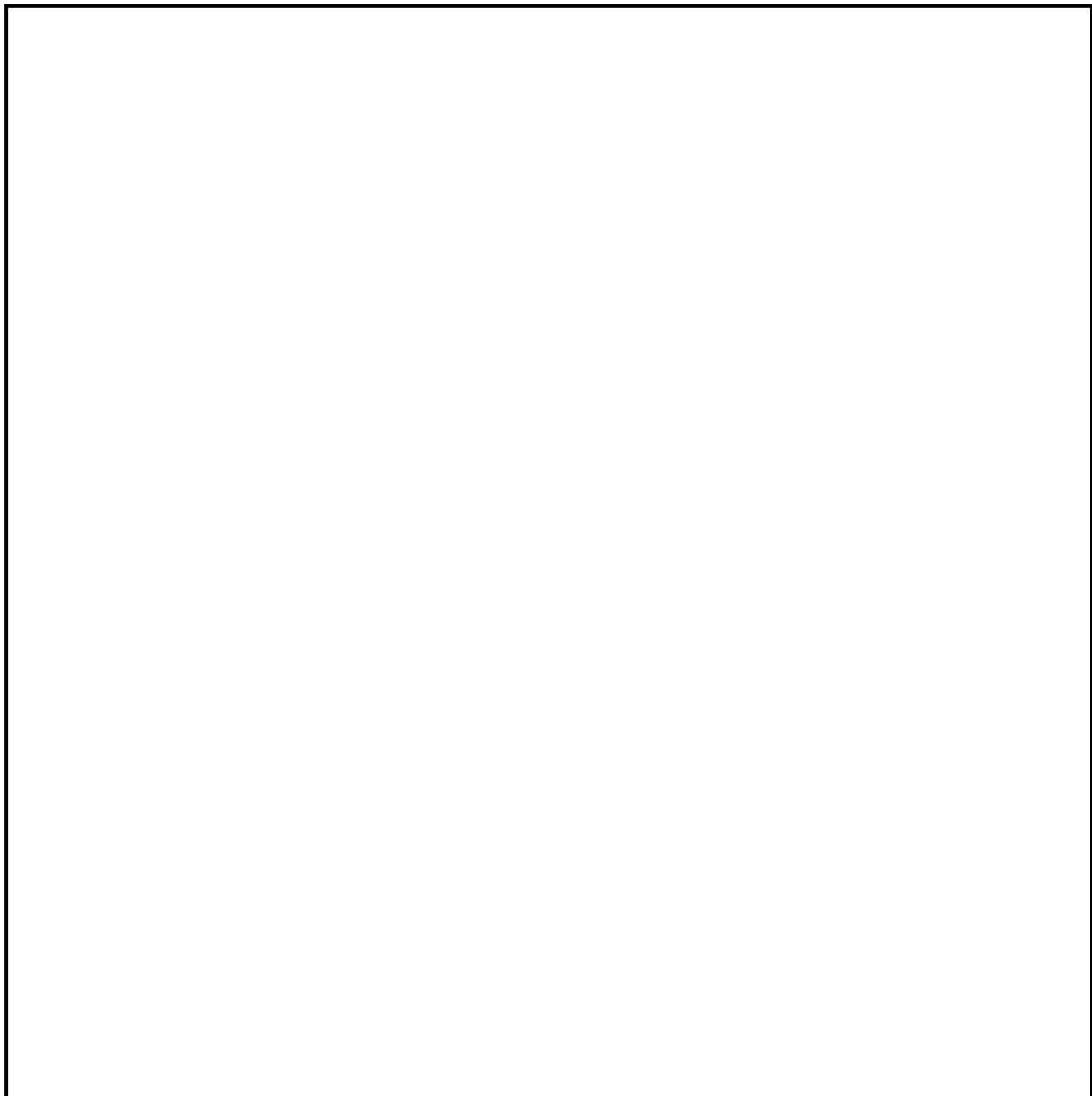


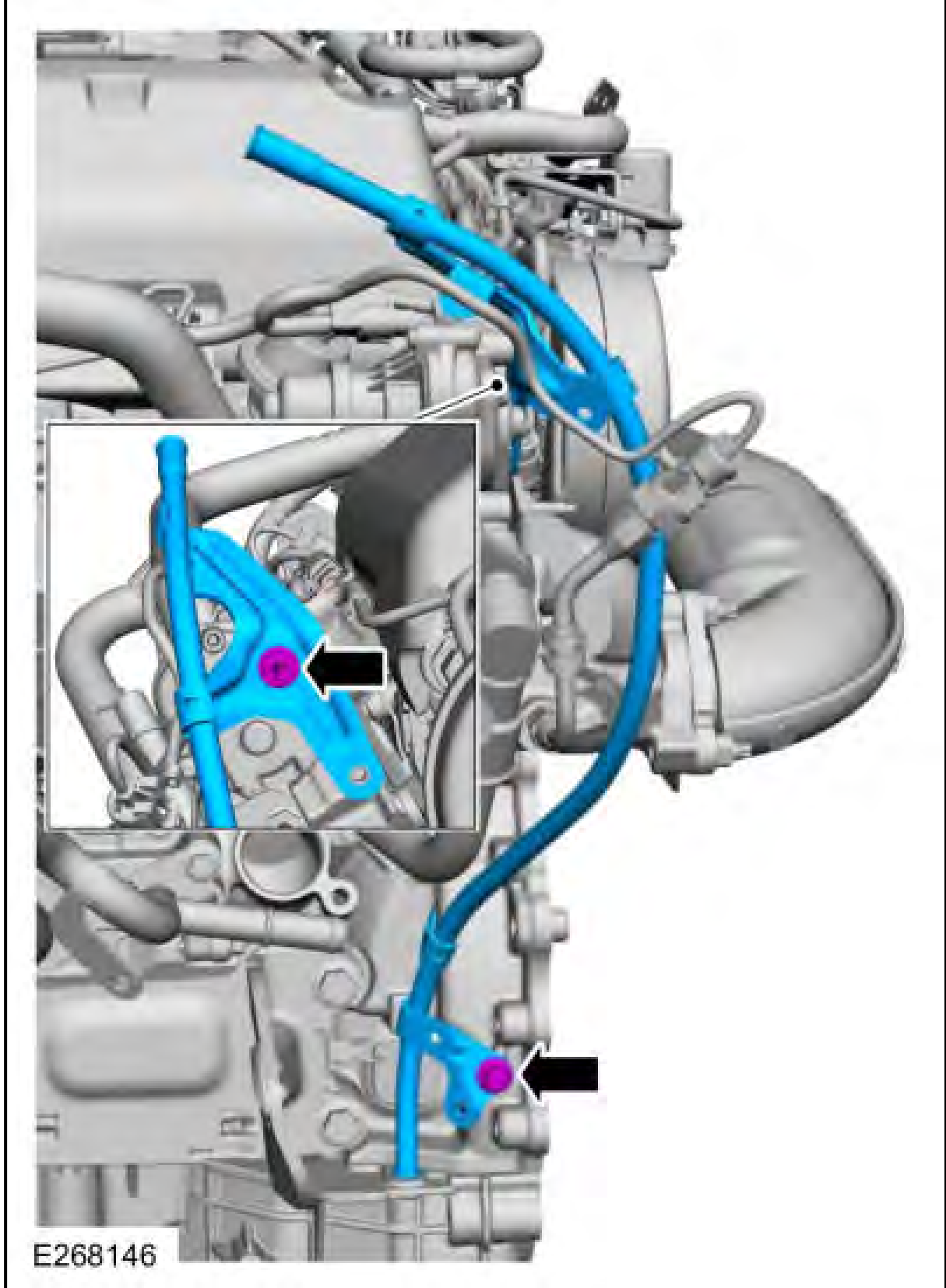


7. Install the oil level indicator, the stud bolt and the bolt.

Torque

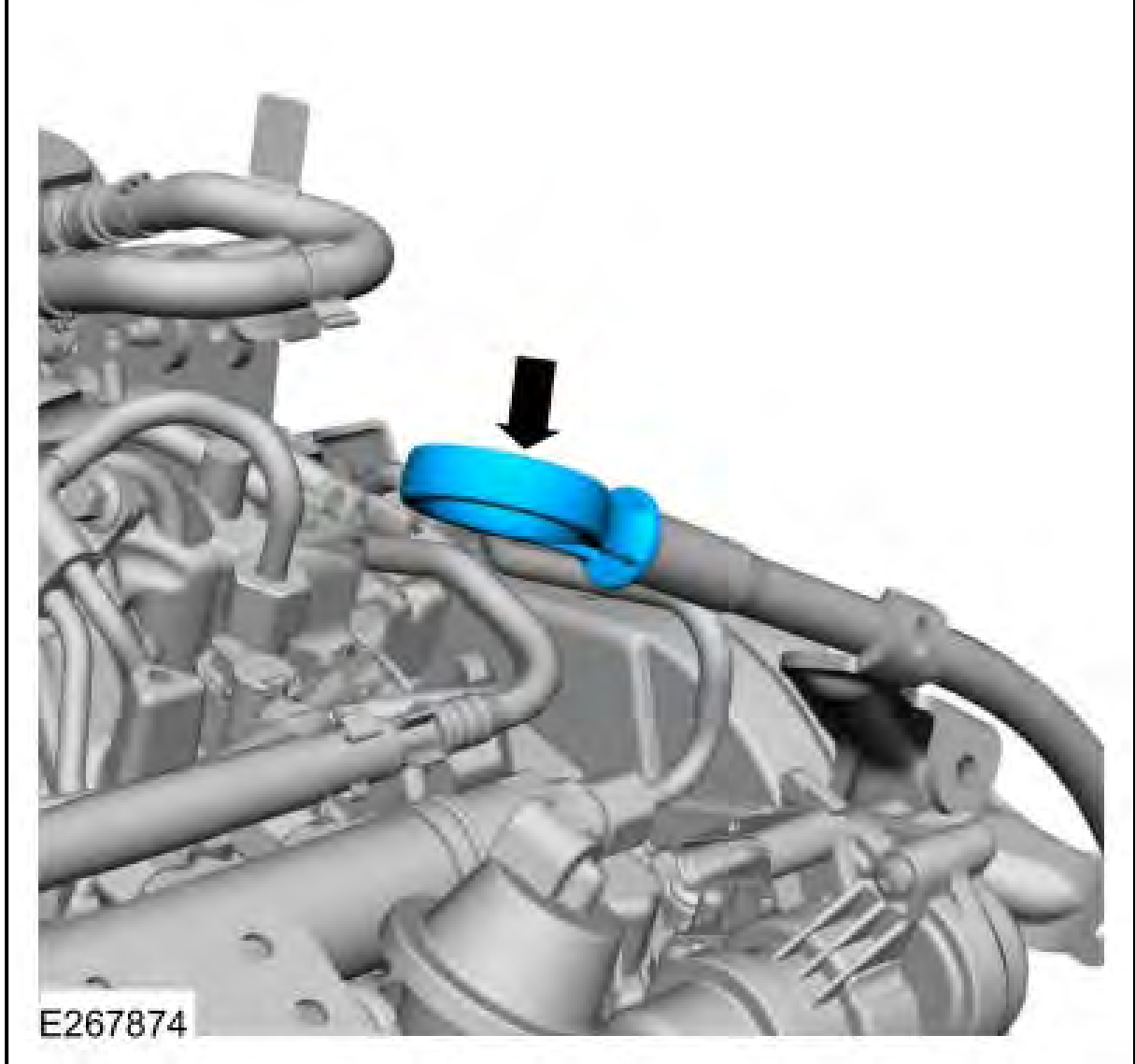
:Upper stud bolt : 89 lb.in (10 Nm) Lower bolt : 17 lb.ft (23 Nm)



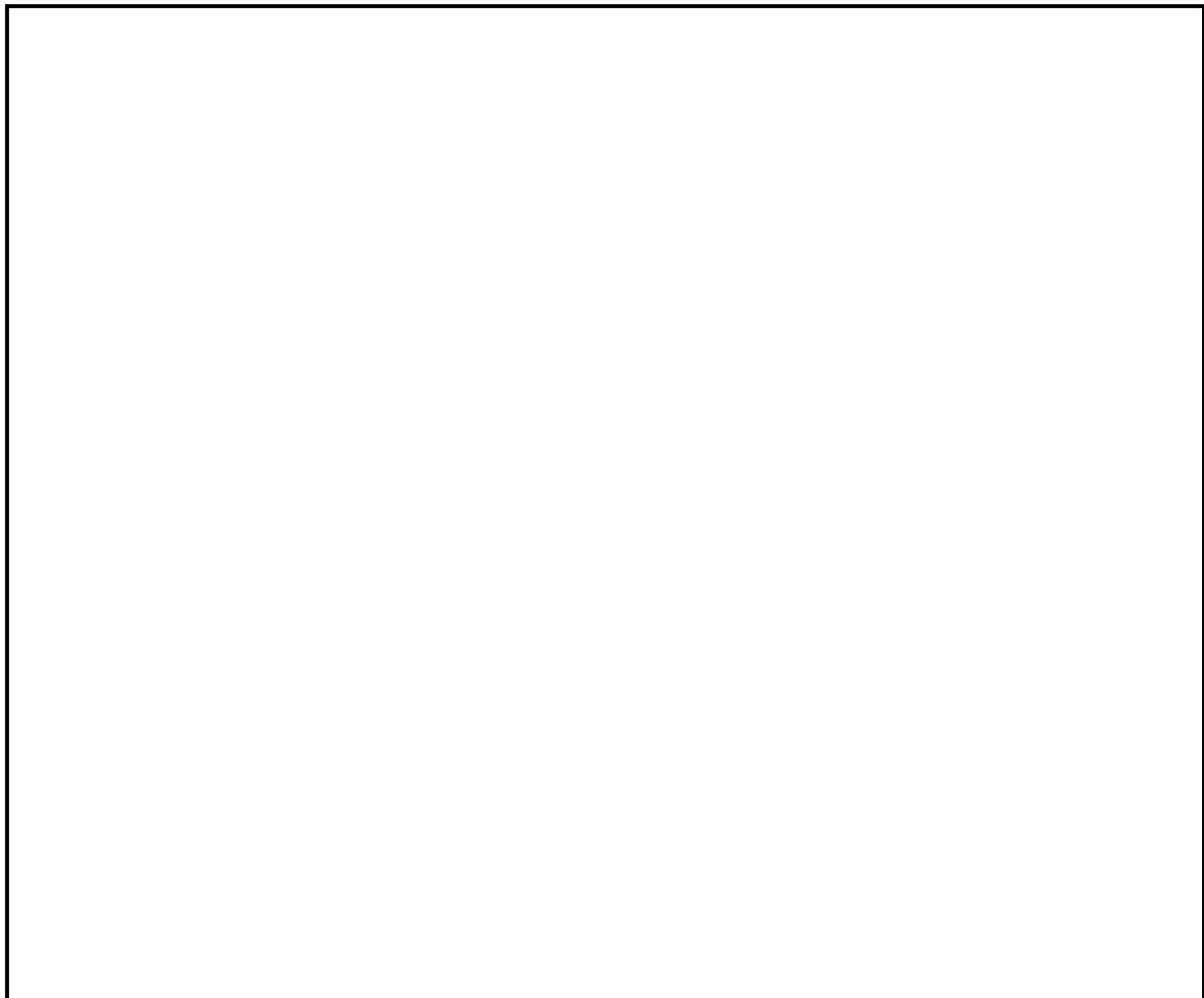


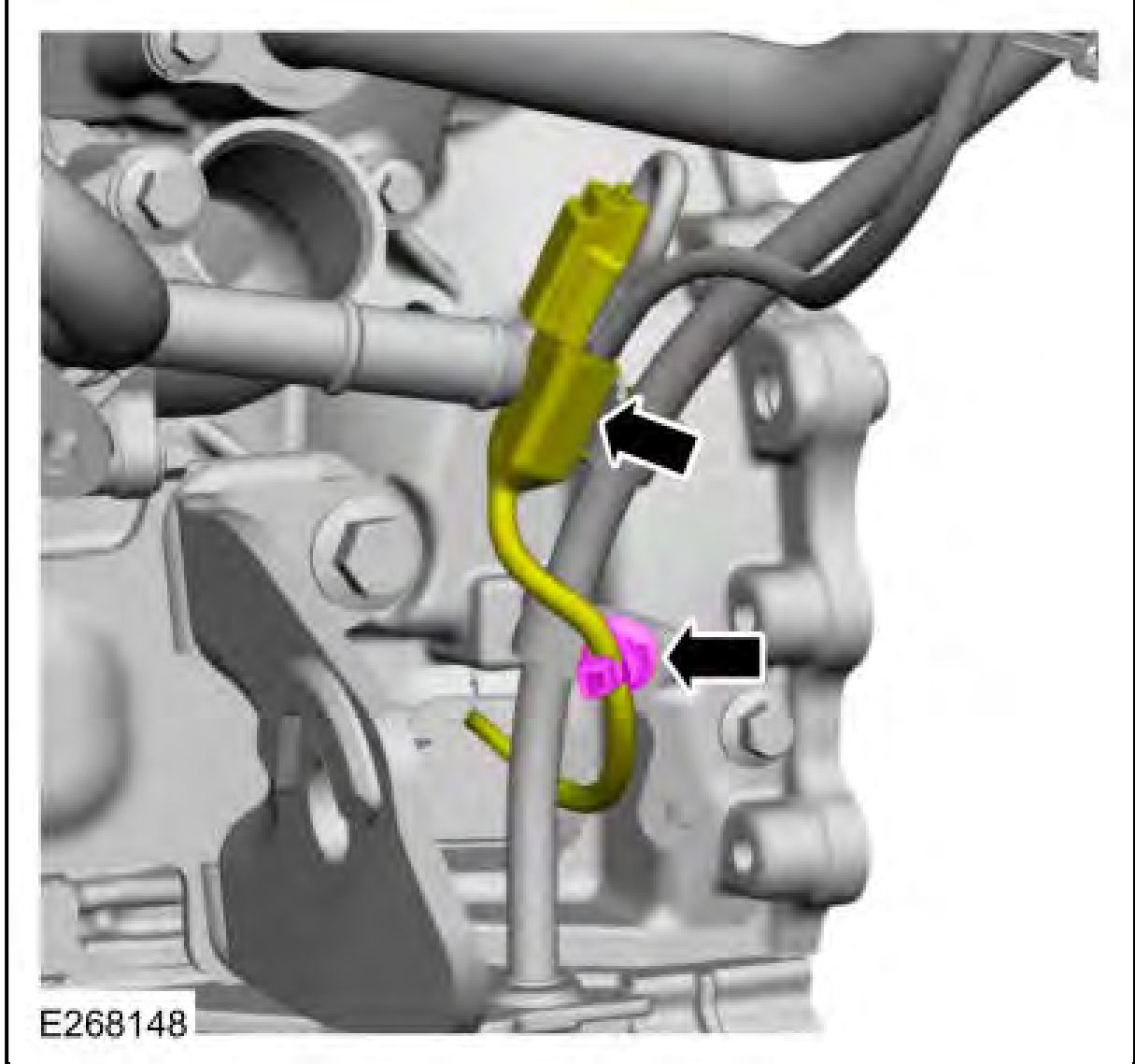
8. Remove the oil level indicator.





9. Connect the wire retainers to the oil level indicator tube.

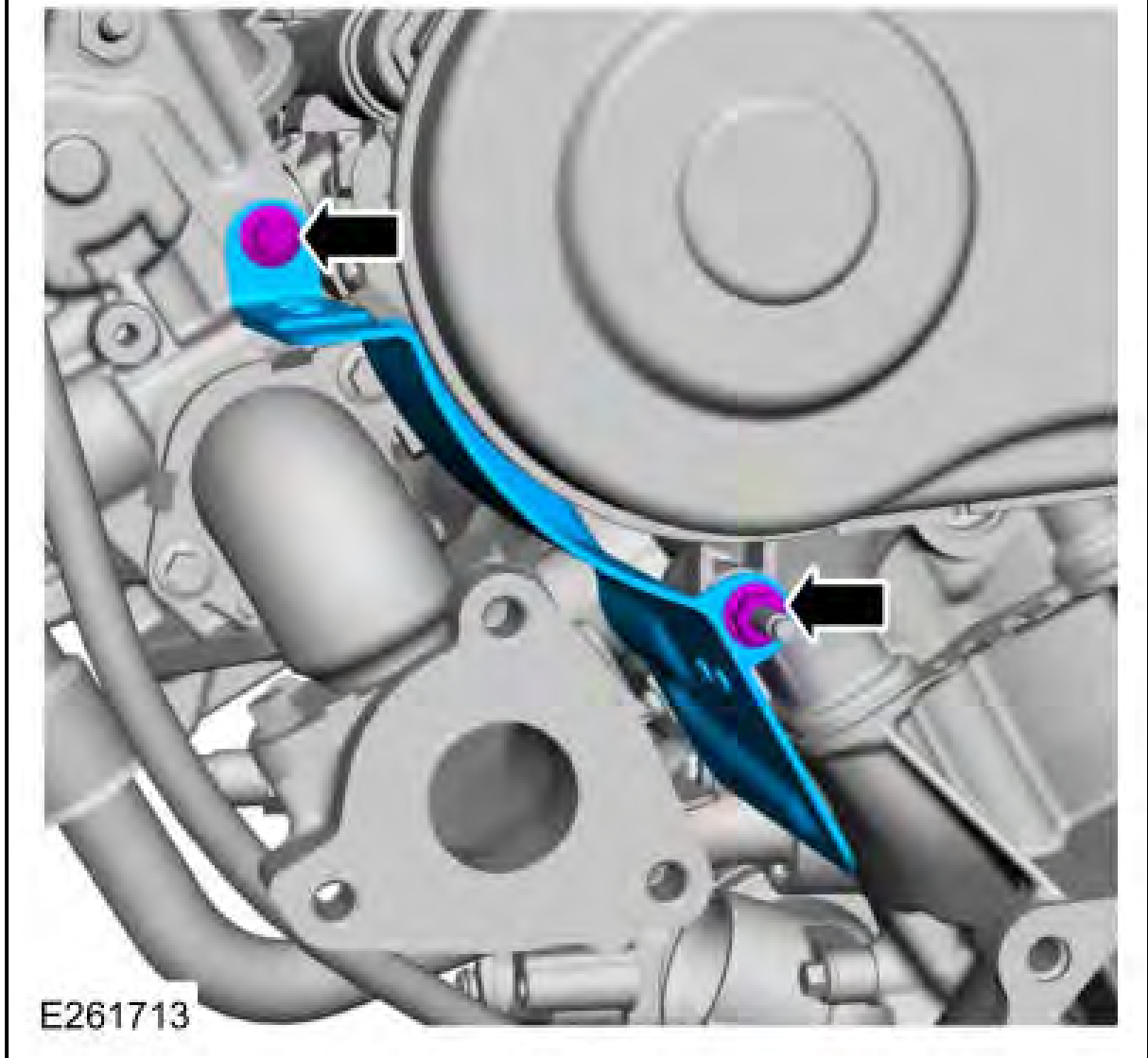




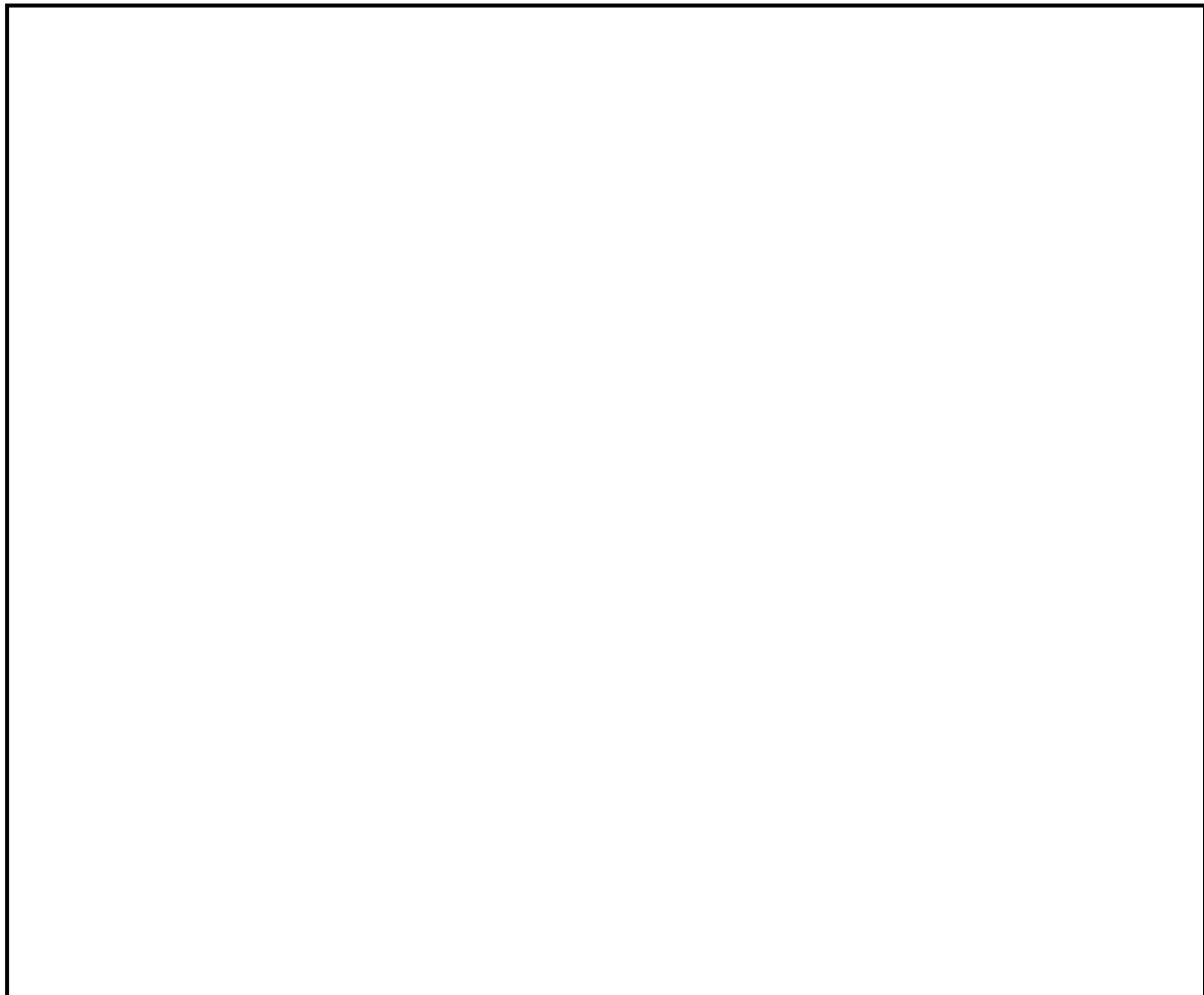
10. Install the heat shield, the nut and the bolt.

Torque: 89 lb.in (10 Nm)

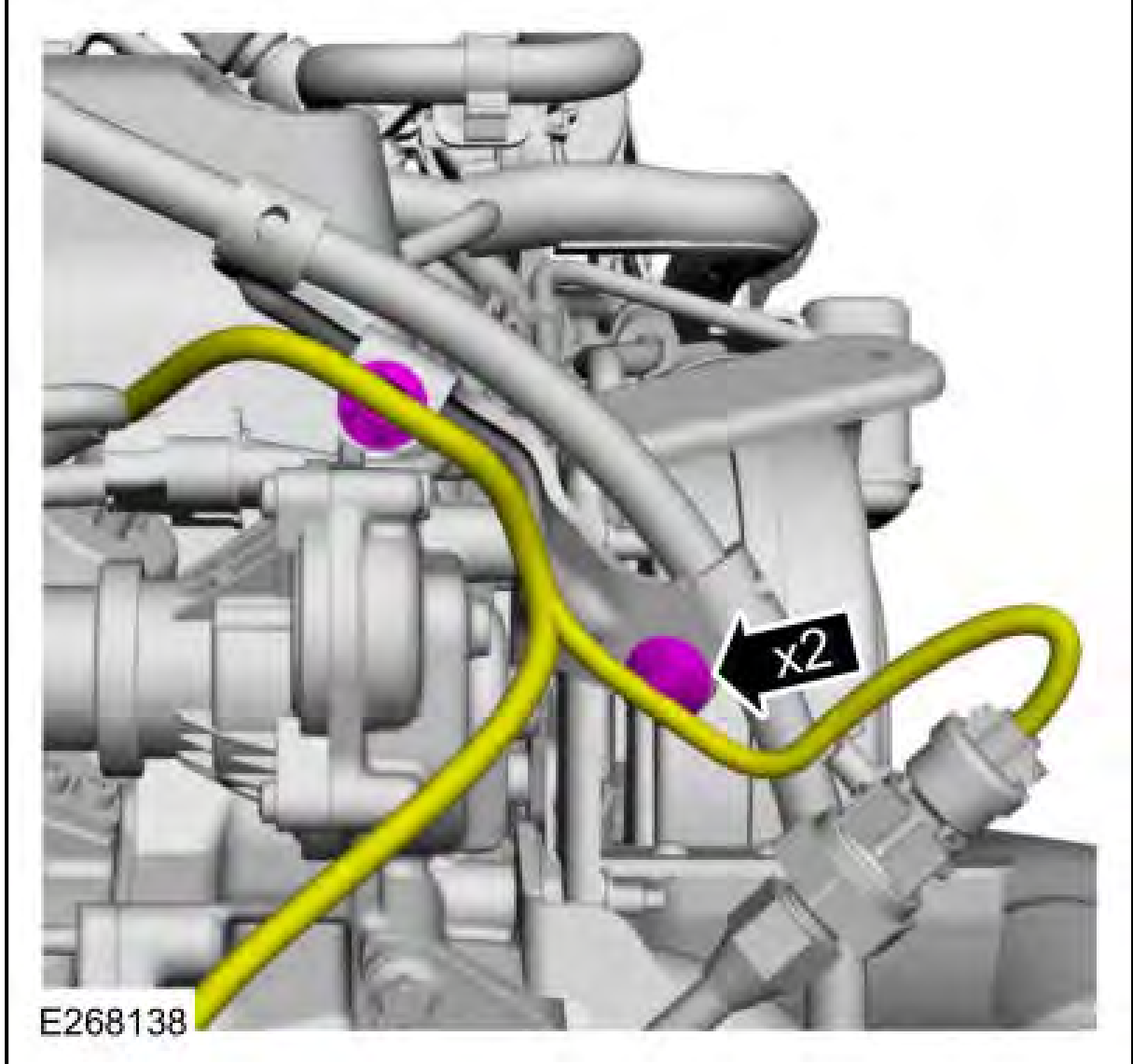




11. Connect the wire retainers to the oil level indicator.



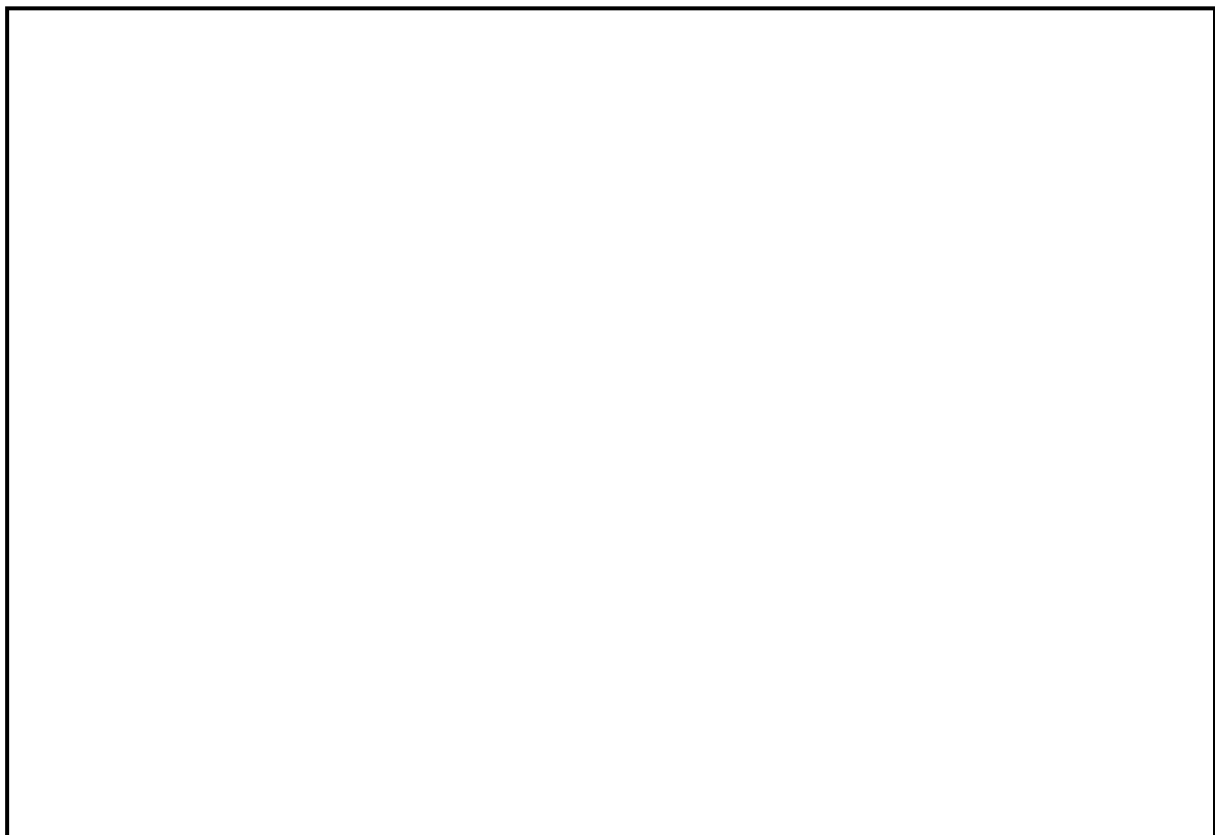


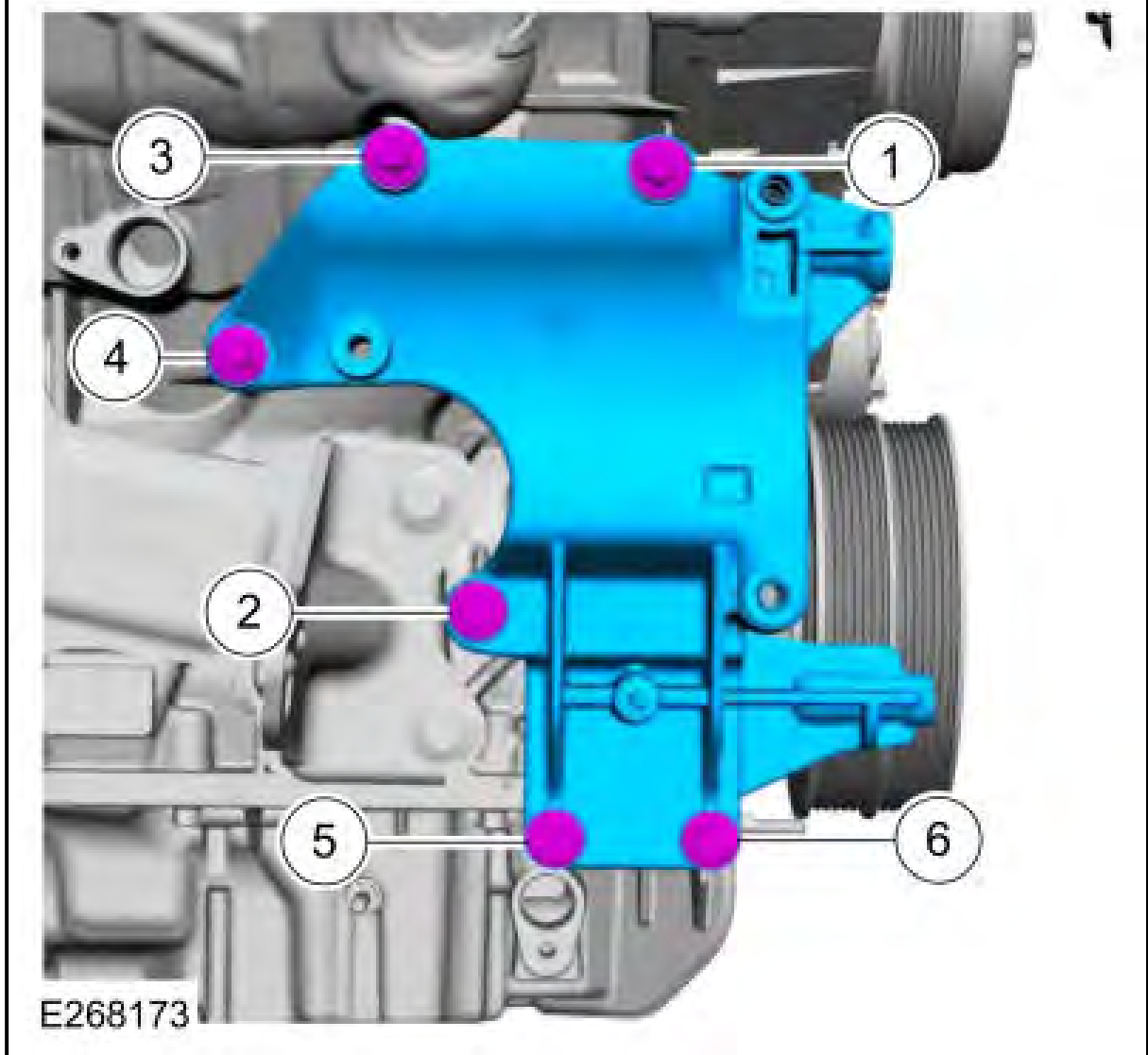


12. Install the A/C mounting bracket and the bolts.

Torque

:Install and tighten bolts 1 and 2 to: : 17 lb.ft (23 Nm)Install and tighten bolts 3 and 4 to: : 17 lb.ft (23 Nm)Install and tighten bolts 5 and 6 to: : 17 lb.ft (23 Nm)

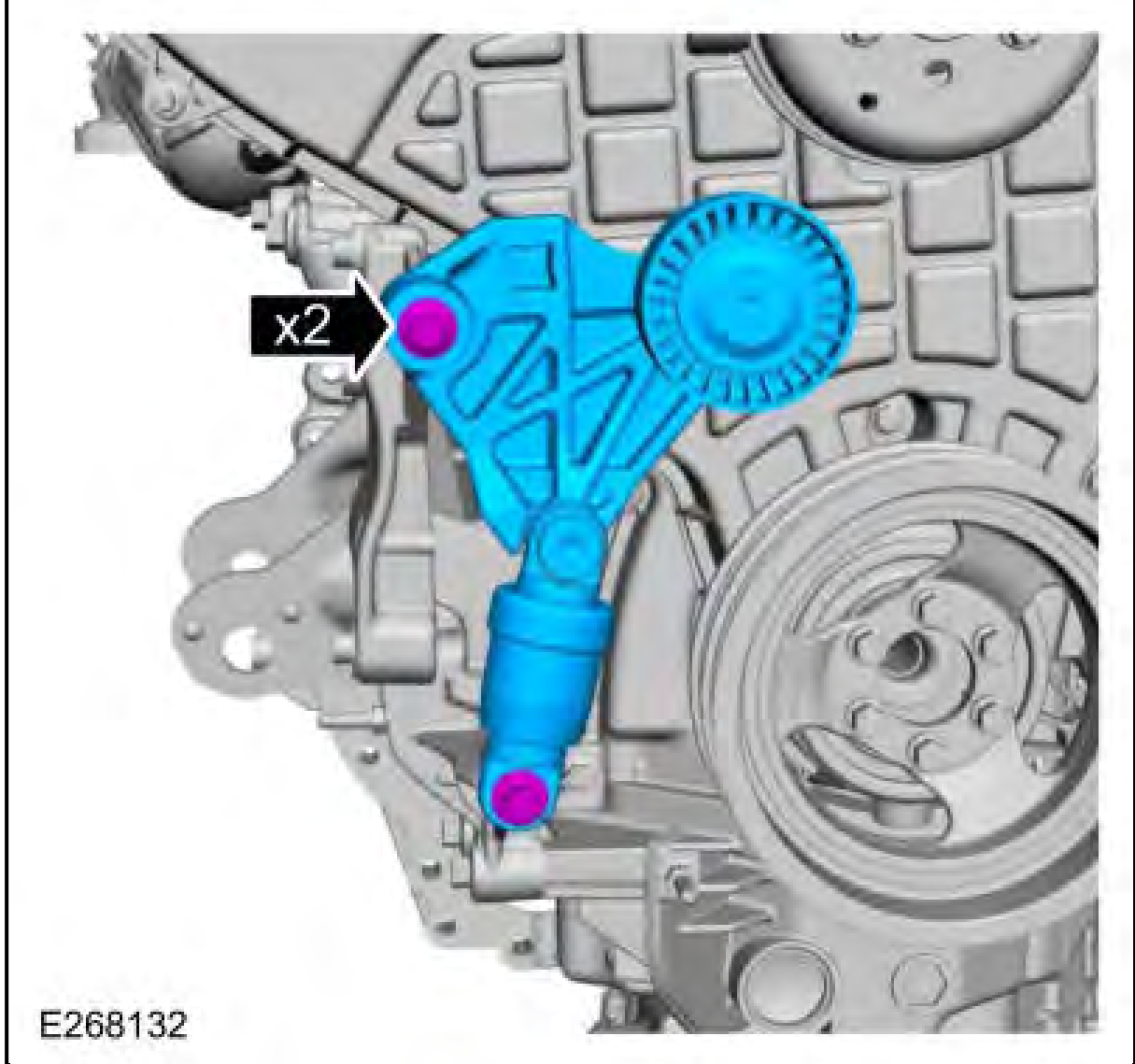




13. Install the accessory drive belt tensioner and the bolts.

Torque: 18 lb.ft (25 Nm)

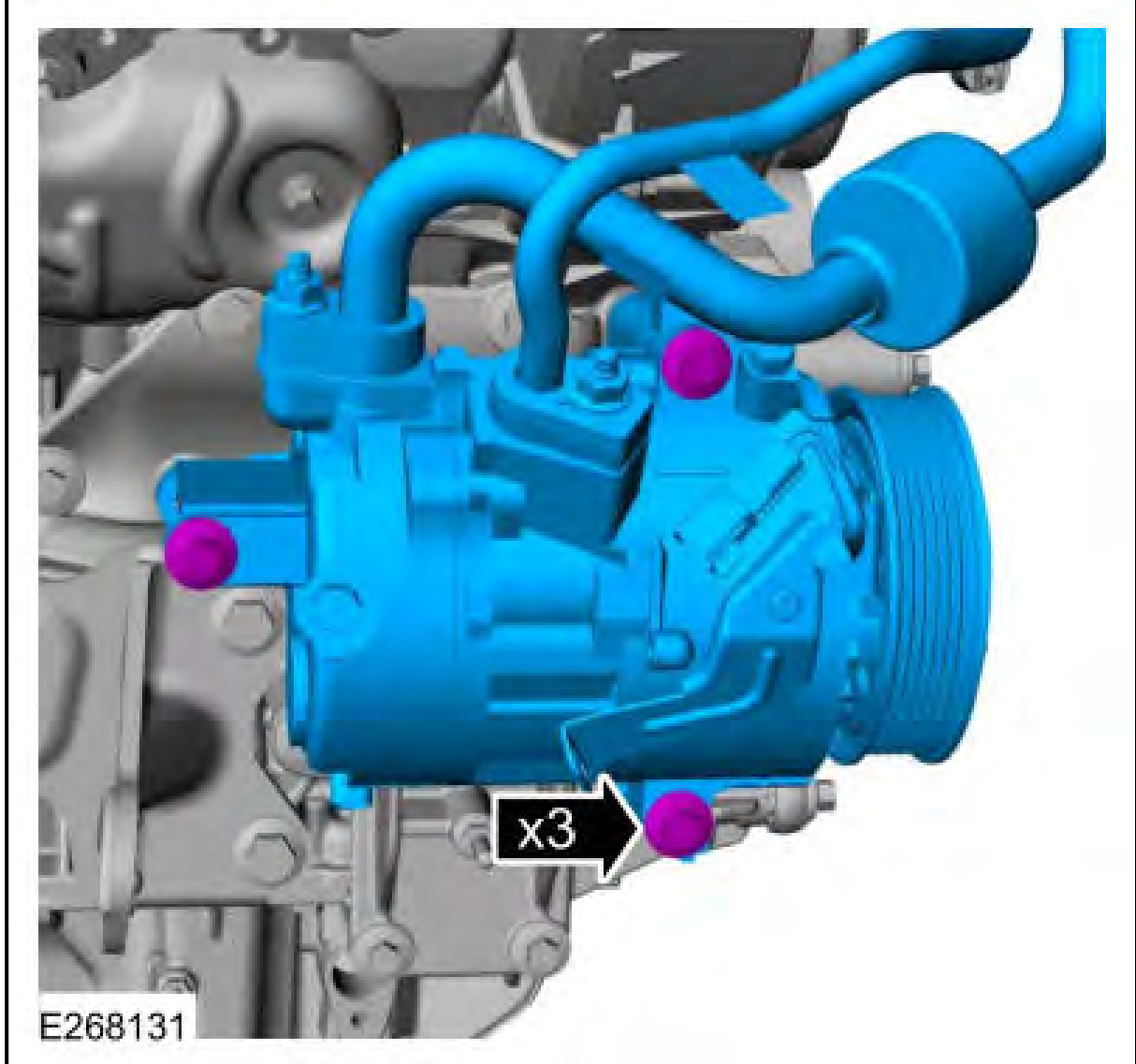




14. Install the A/C compressor and the bolts.

Torque: 18 lb.ft (25 Nm)





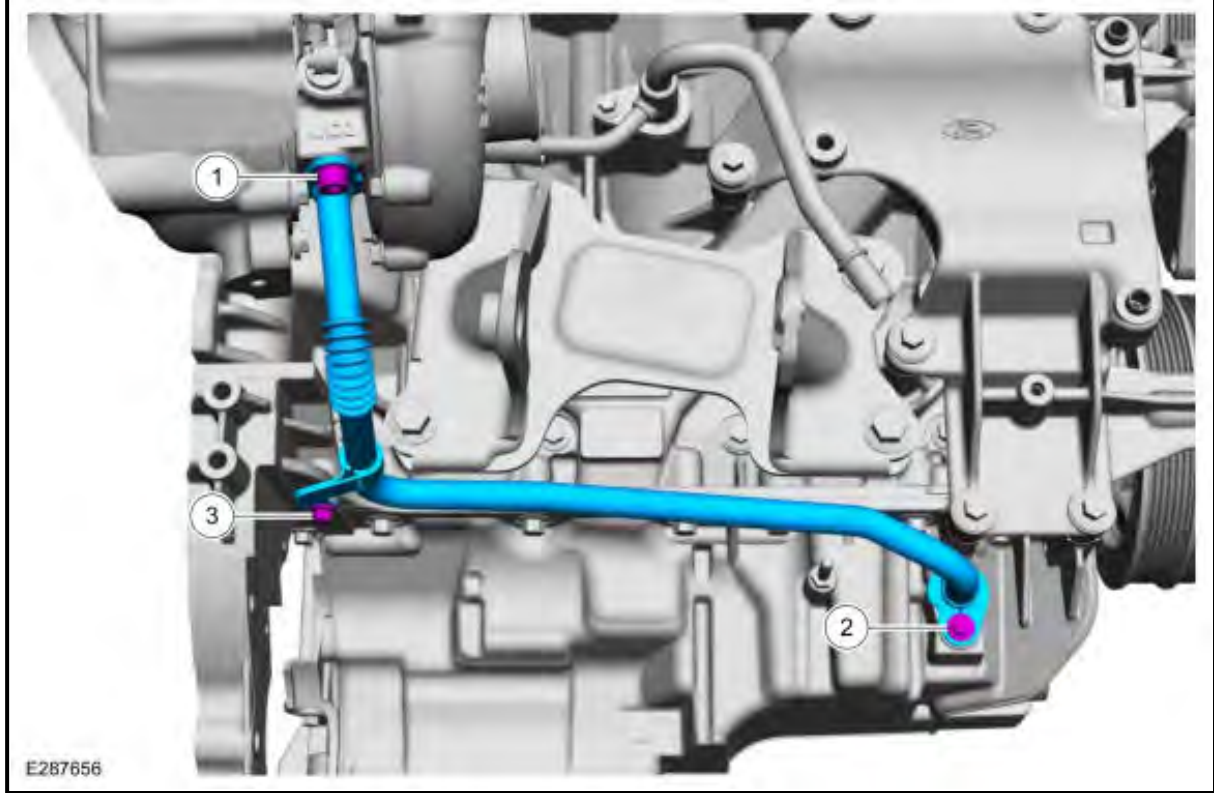
15. **NOTE:** Fully seat the turbocharger oil return tube O-rings into the turbocharger and engine bore holes prior to fastener tightening.

Lubricate the turbocharger oil return tube with clean engine oil. Install the turbocharger oil return tube and the bolts.

Material: Motorcraft  $\hat{A}$  SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

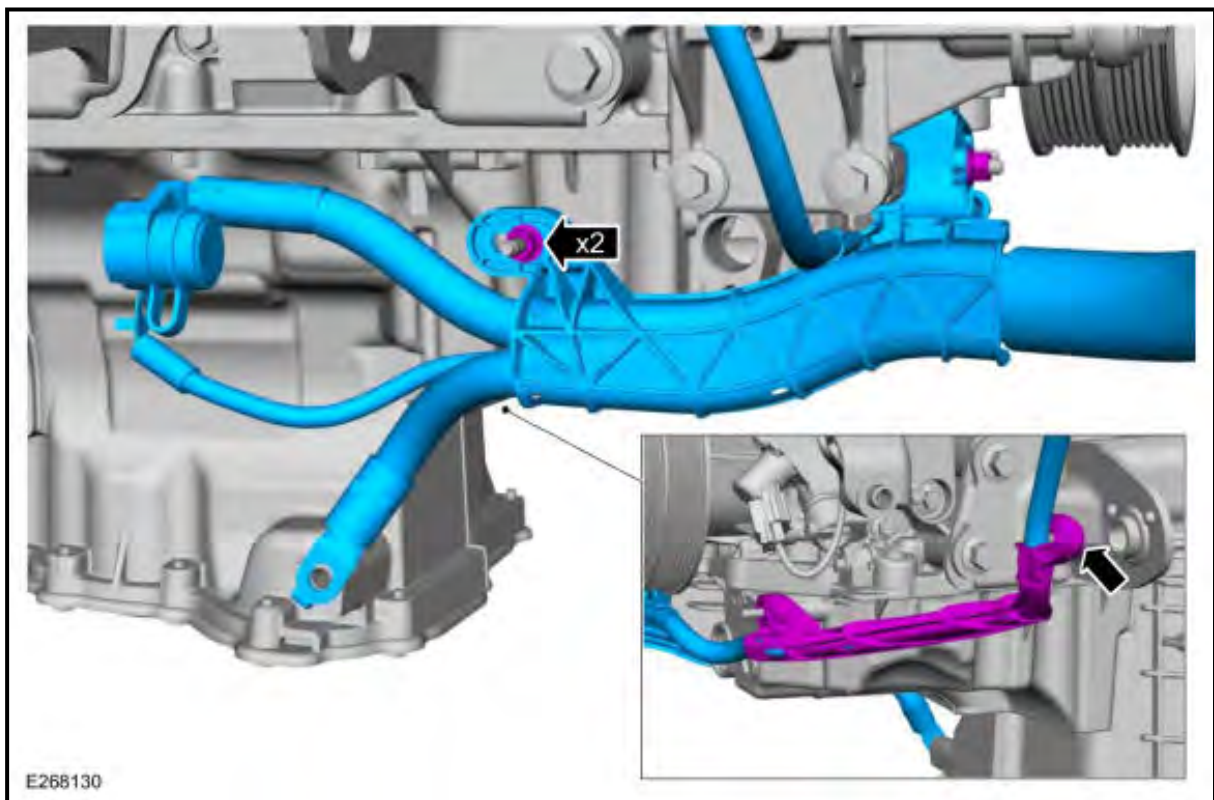
Torque: 89 lb.in (10 Nm)





16. Install the battery cable harness and connect the wire harness retainer. Install the nuts.

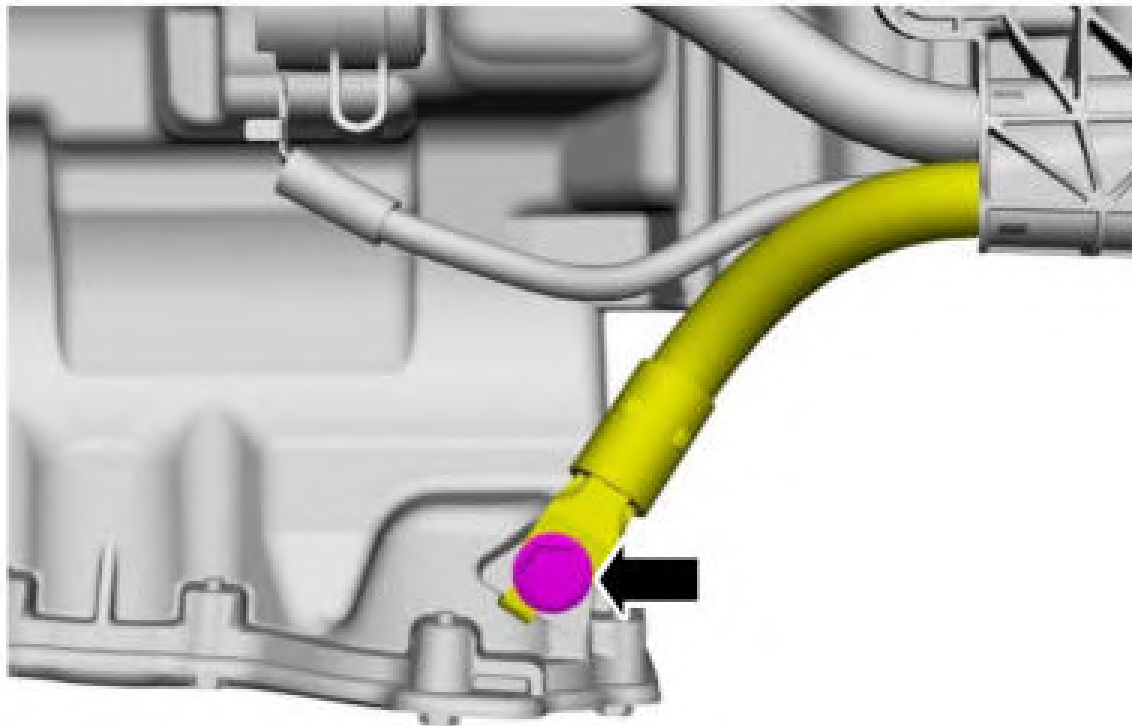
Torque: 106 lb.in (12 Nm)



17. Install the ground cable bolt.

Torque: 18 lb.ft (25 Nm)

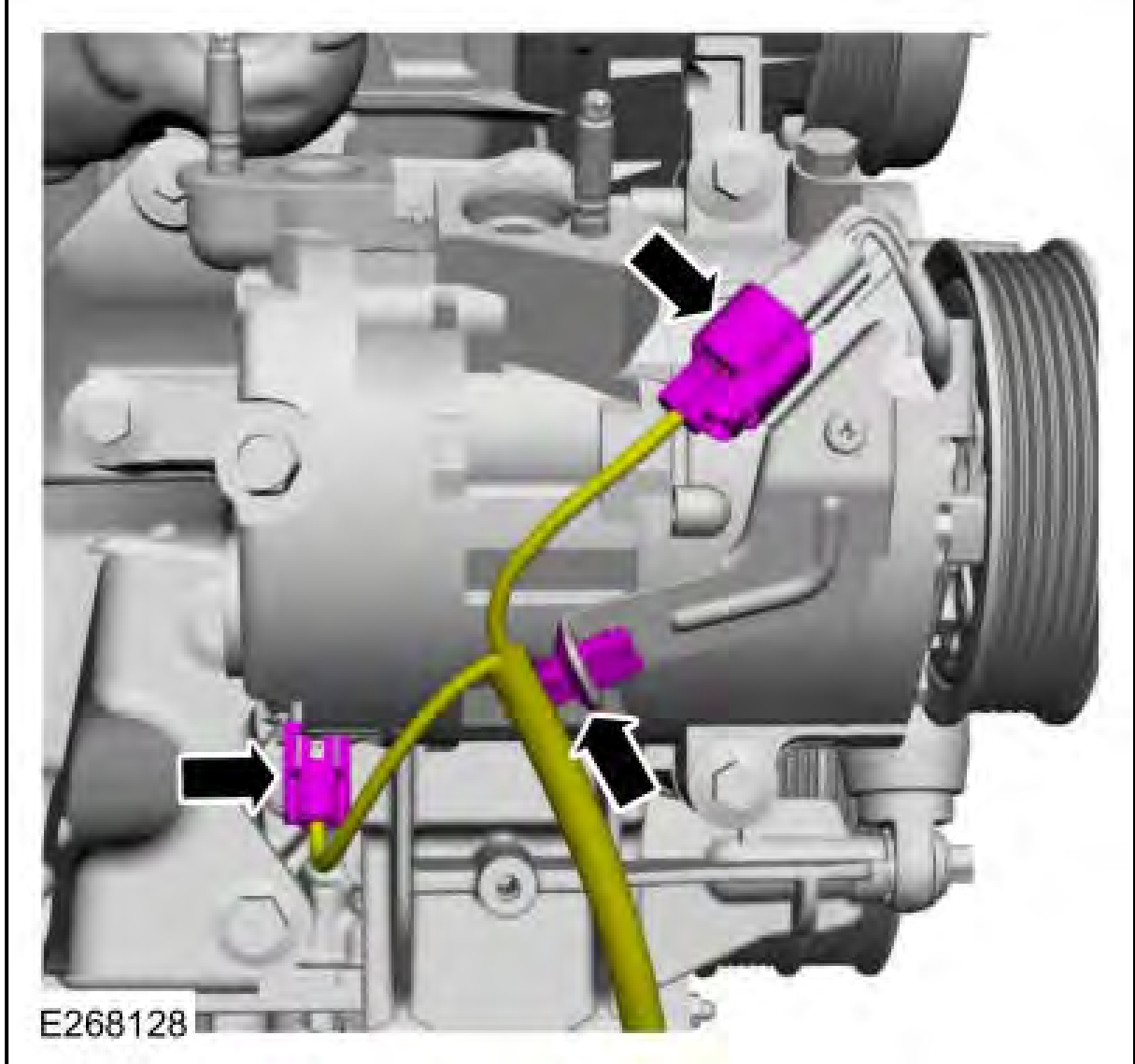




E268129

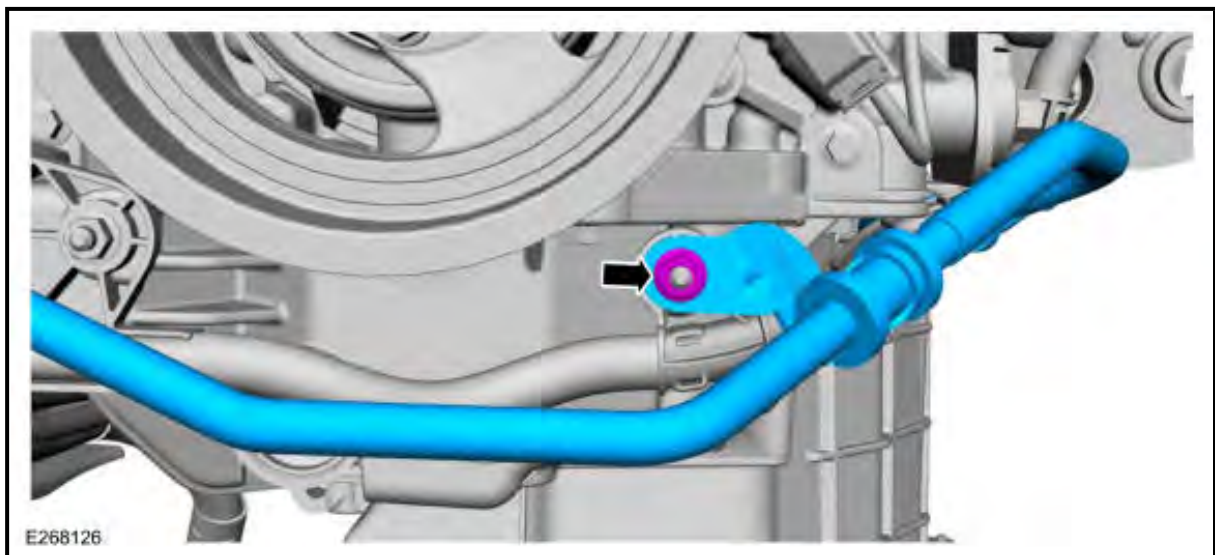
18. Connect the A/C electrical connectors and the wire retainer.





19. Install the coolant tube and the nut.

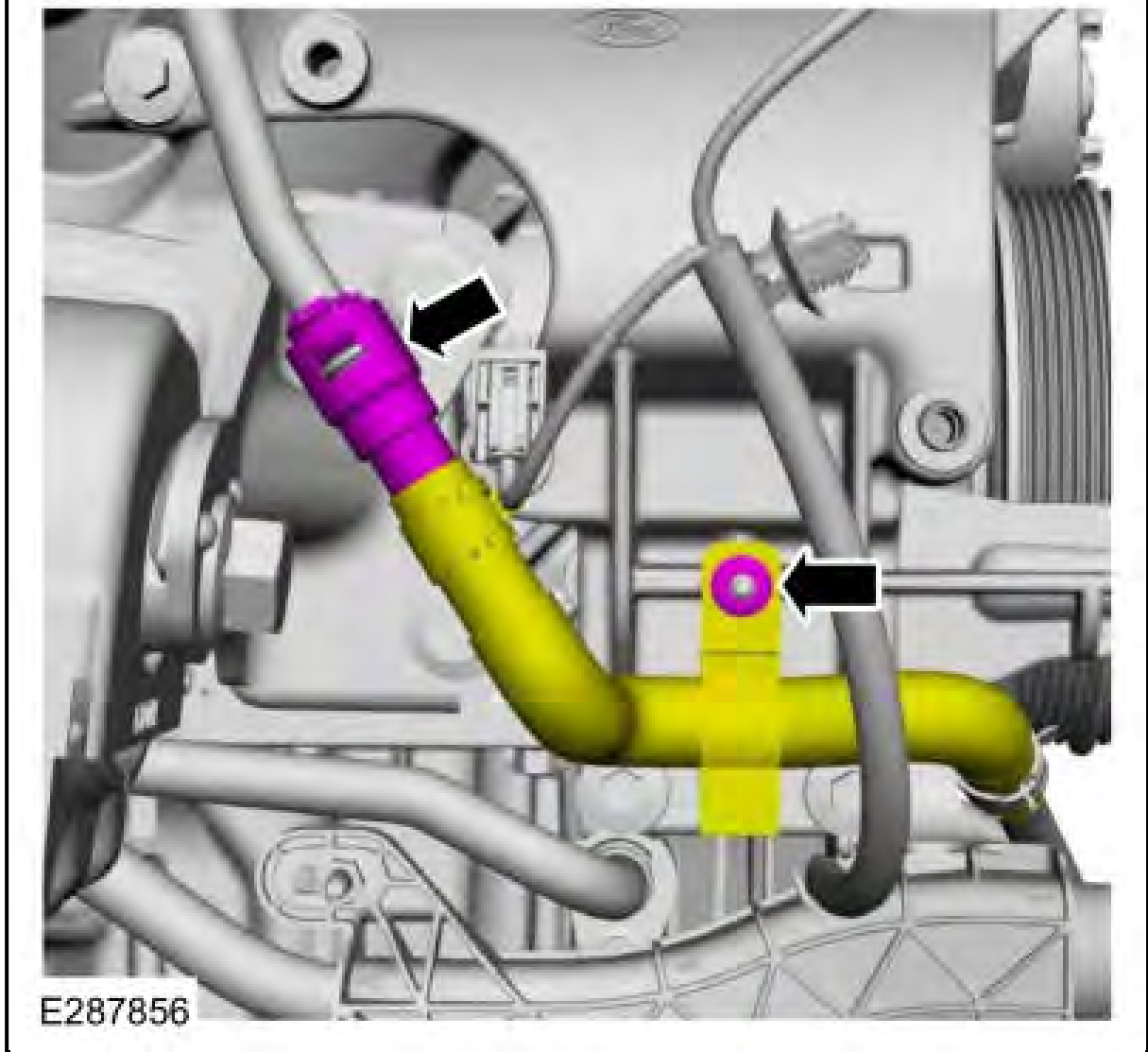
Torque: 106 lb.in (12 Nm)



20. Position back and connect the coolant hose. Install the nut for the coolant hose bracket.

Torque: 106 lb.in (12 Nm)



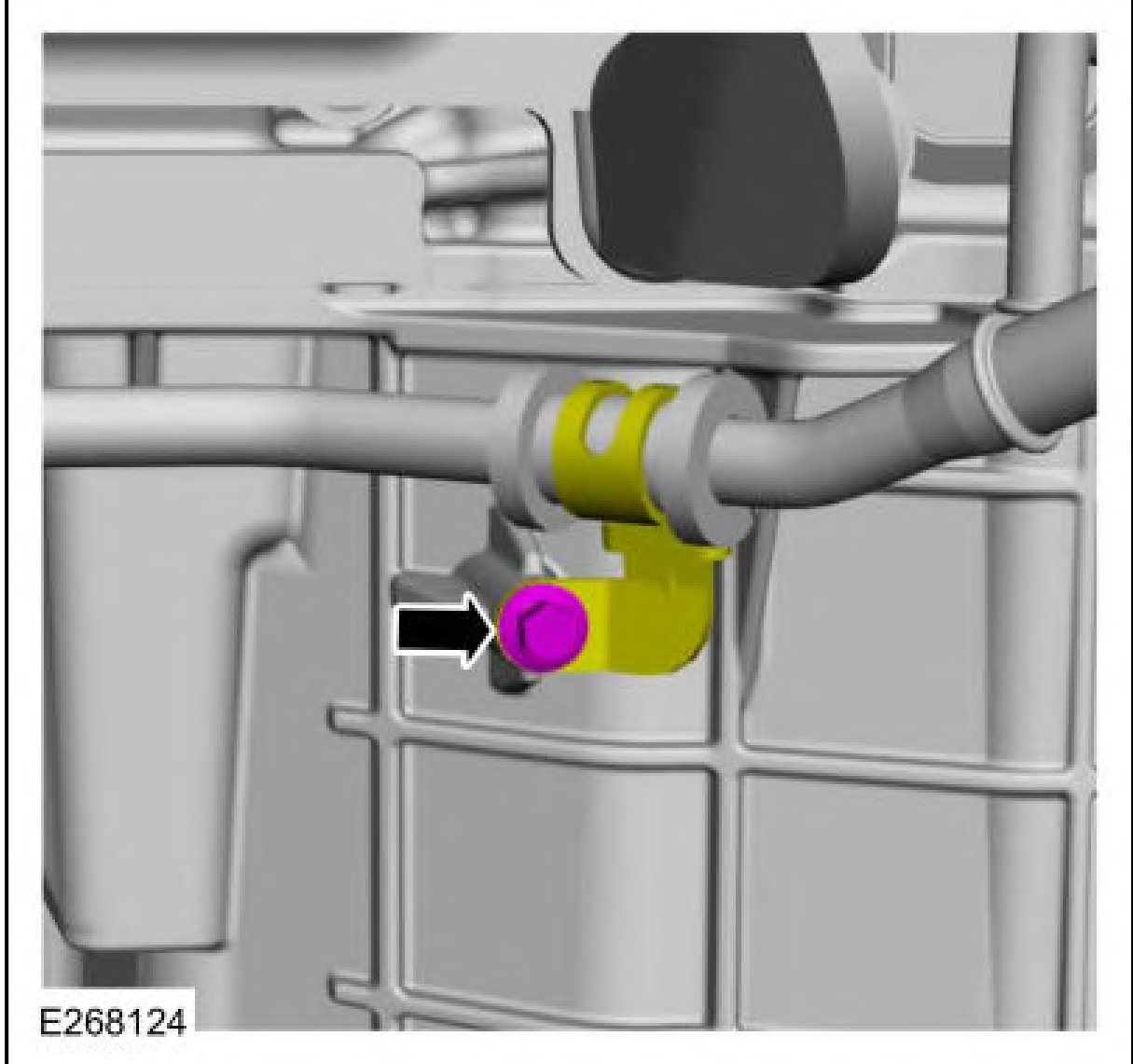


21. Install the bolt for the coolant tube.

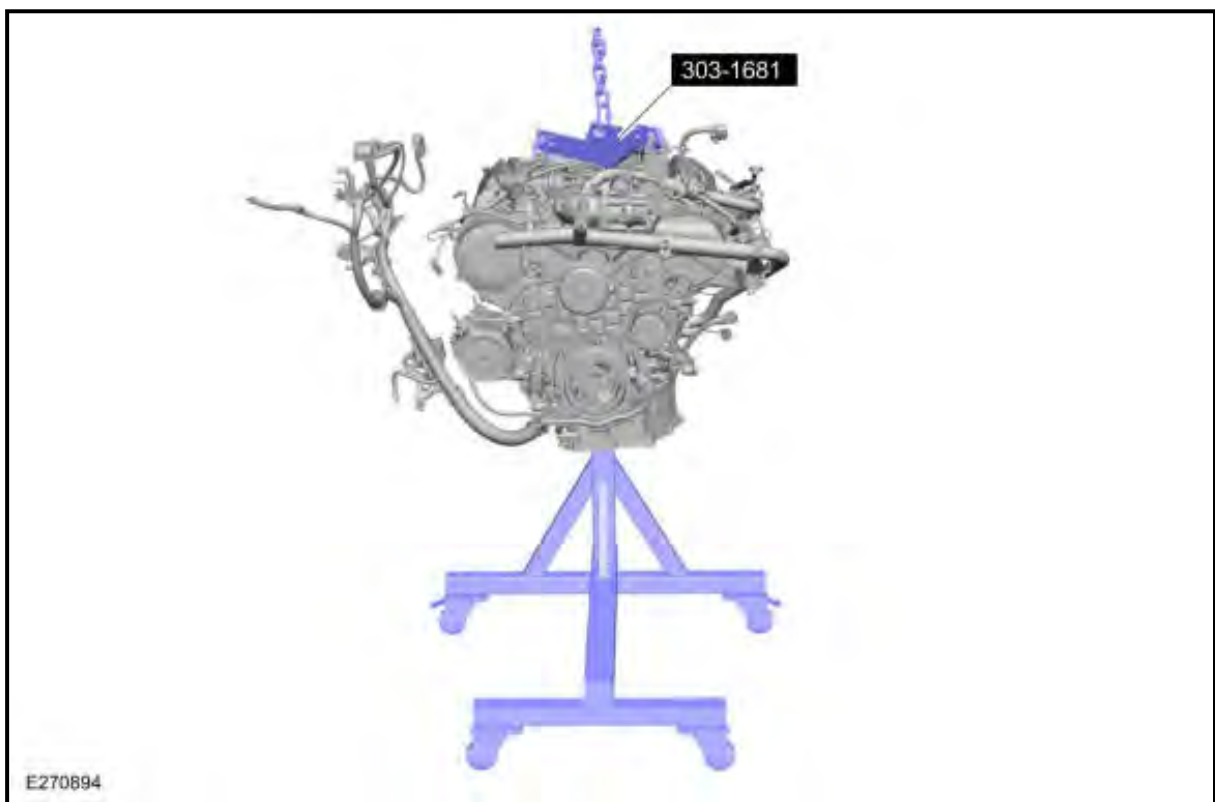
Torque: 62 lb.in (7 Nm)



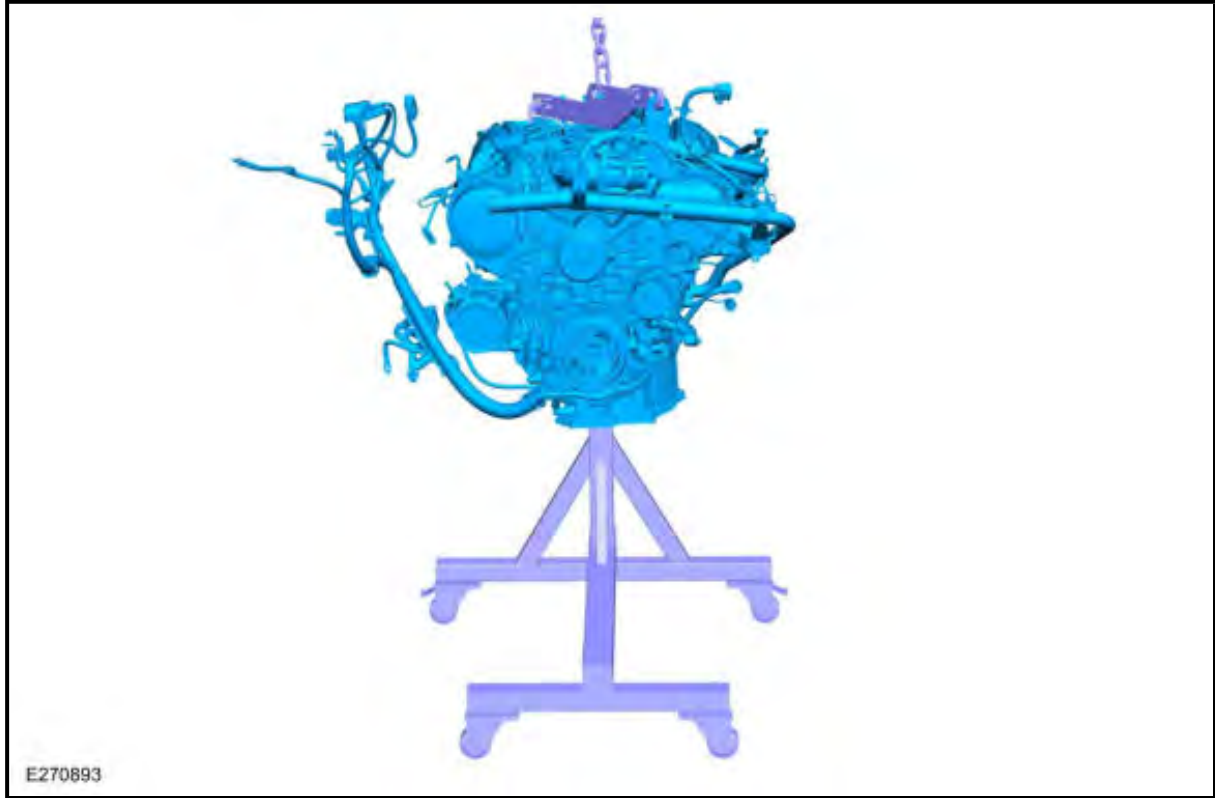




22. Install the floor crane and special tool. Use Special Service Tool: 303-1681 Spreader Bar. Use the General Equipment: Floor Crane



23. Using a floor crane and the special tool, remove the engine from the mounting stand. Use Special Service Tool: 303-1681 Spreader Bar. Use the General Equipment: Floor Crane Use the General Equipment: Mounting Stand



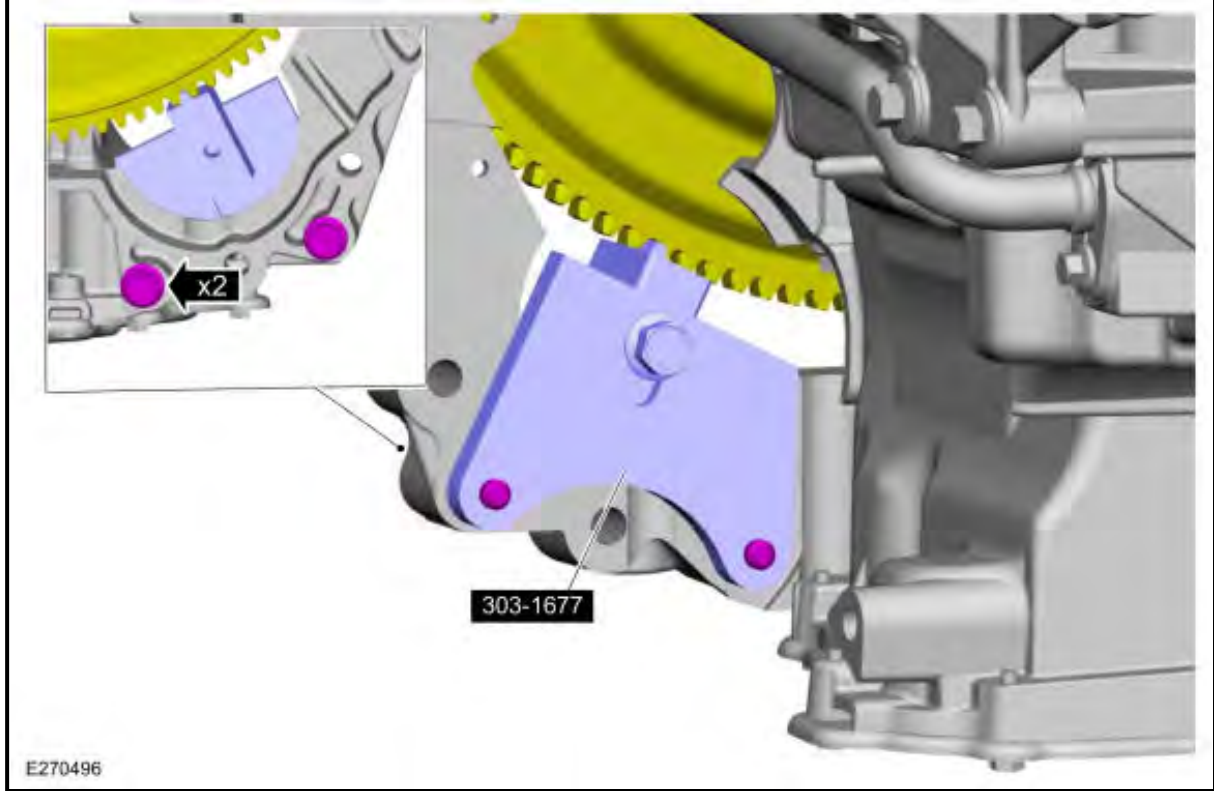
24. Install the flexplate and the bolts.



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

Install the special tool and the bolts. Use Special Service Tool: 303-1677 Locking Tool, Flywheel.

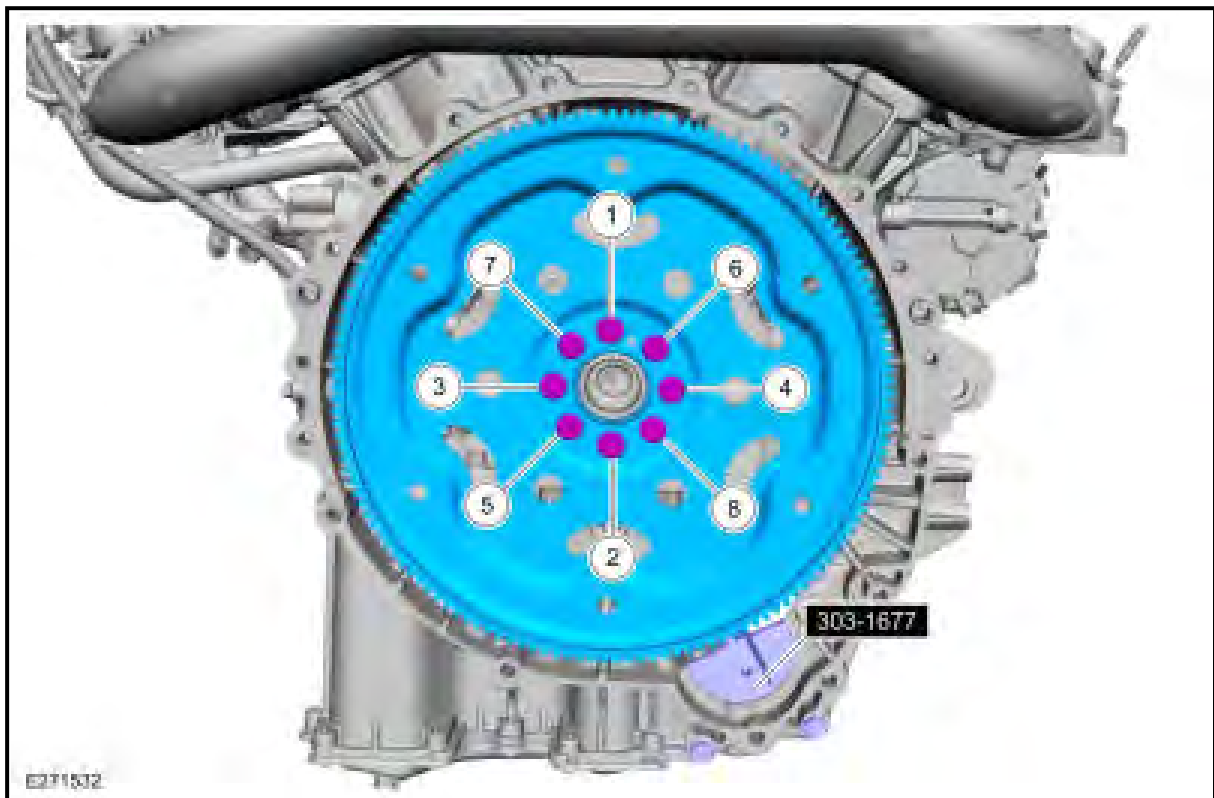




26. Tighten the flexplate bolts. Tighten in sequence shown. Use Special Service Tool: 303-1677 Locking Tool, Flywheel.

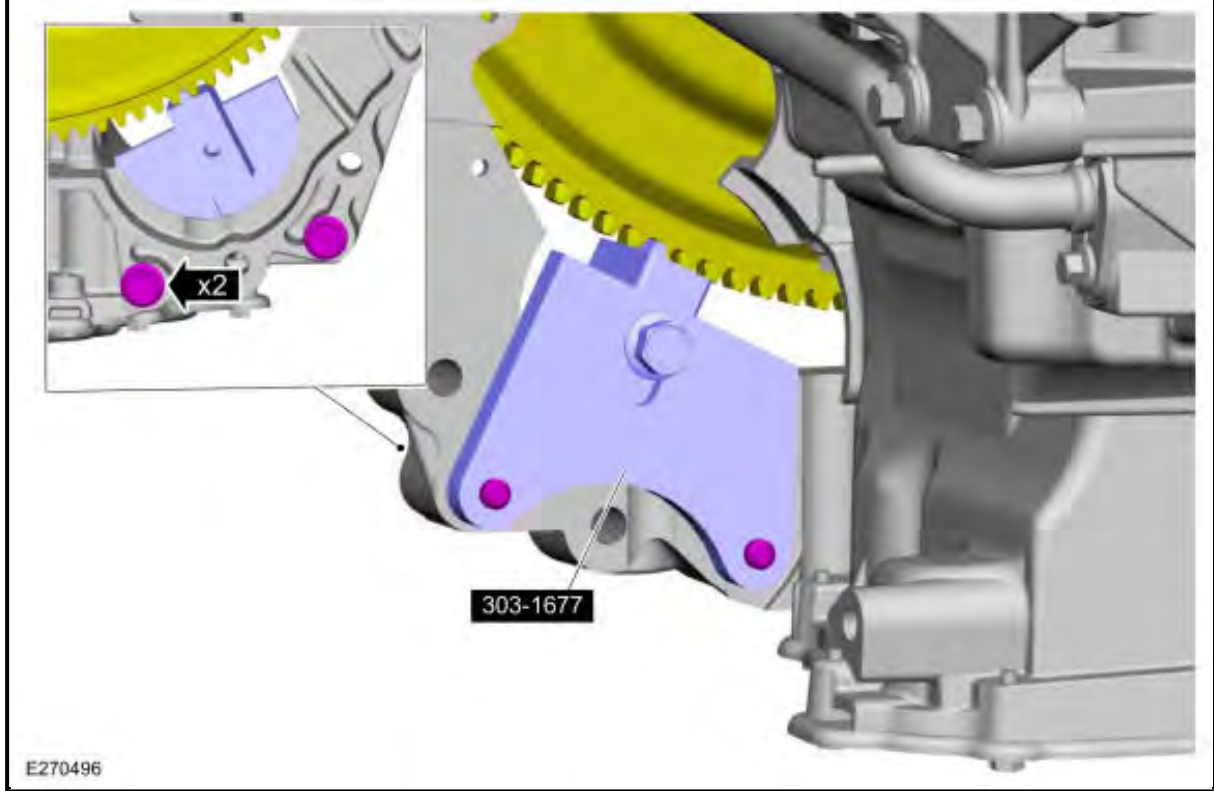
Torque

: Stage 1: 37 lb.ft (50 Nm) Stage 2: 45 Å° Stage 3: 45 Å°



27. Remove the bolts and the special tool. Use Special Service Tool: 303-1677 Locking Tool, Flywheel.



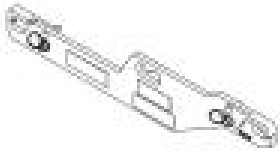
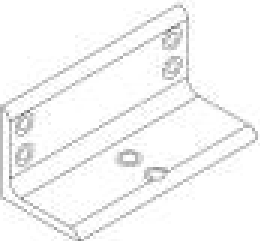


28. Install the engine into the vehicle. Refer to: [Engine - Body On](#). Refer to: [Engine - Body Off](#).

### ENGINE - BODY OFF

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#).

### Special Tool(s) / General Equipment

|  |  |
|--|--|
|  <p>E274098</p> | <p><b>303-1681</b> Spreader Bar</p>  |
|  <p>E216422</p> | <p>307-625 Fixture, Bench Mounting<br/>TKIT-2008ET-FLM<br/>TKIT-2008ET-ROW</p> |
| <p>Floor Crane</p> <p>Trolley Jack</p> <p>Hose Clamp Remover/Installer</p> <p>Wooden Block</p>     |  |

### Materials

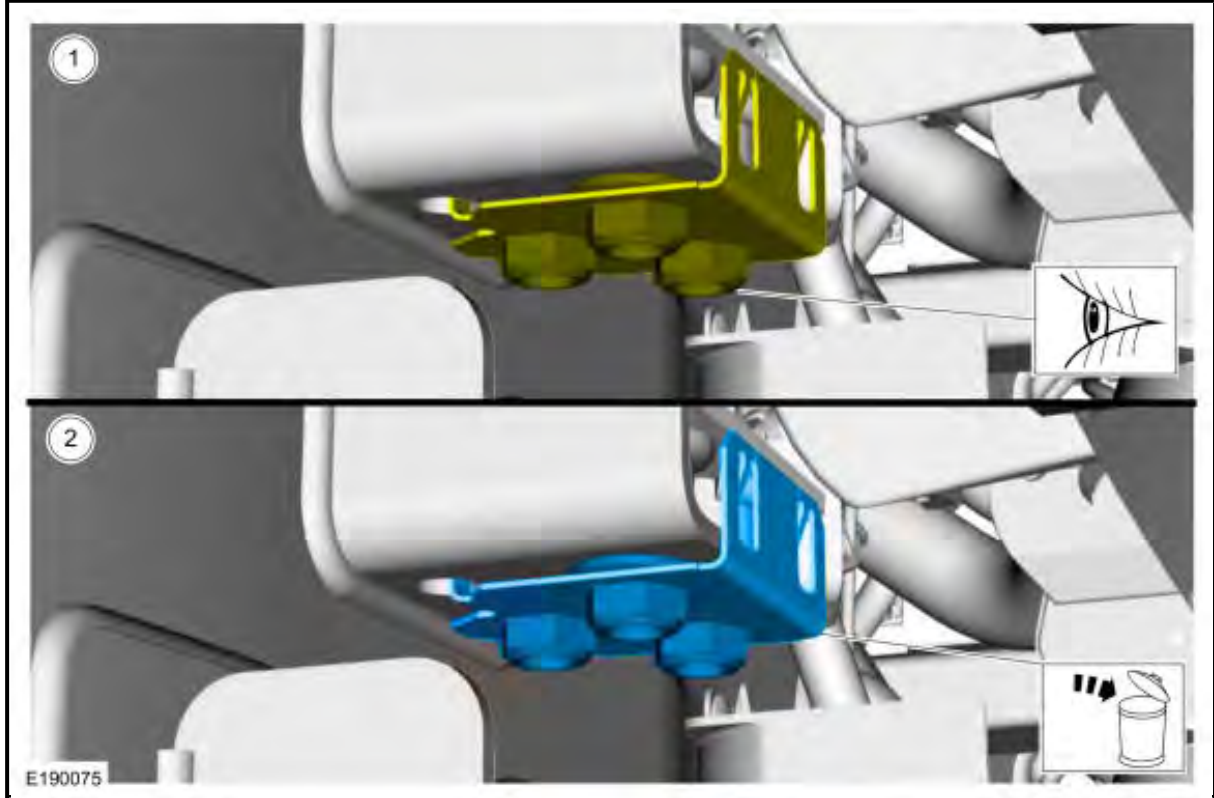
| Name  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> Multi-Purpose Grease Spray XL-5-A             | ESB-M1C93-B   |
| Motorcraft <sup>®</sup> Threadlock 262TA-26                           | WSK-M2G351-A6 |
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA  | WSS-M2C214-B1 |
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant VC-3-B | WSS-M97B44-D  |

**NOTE:**

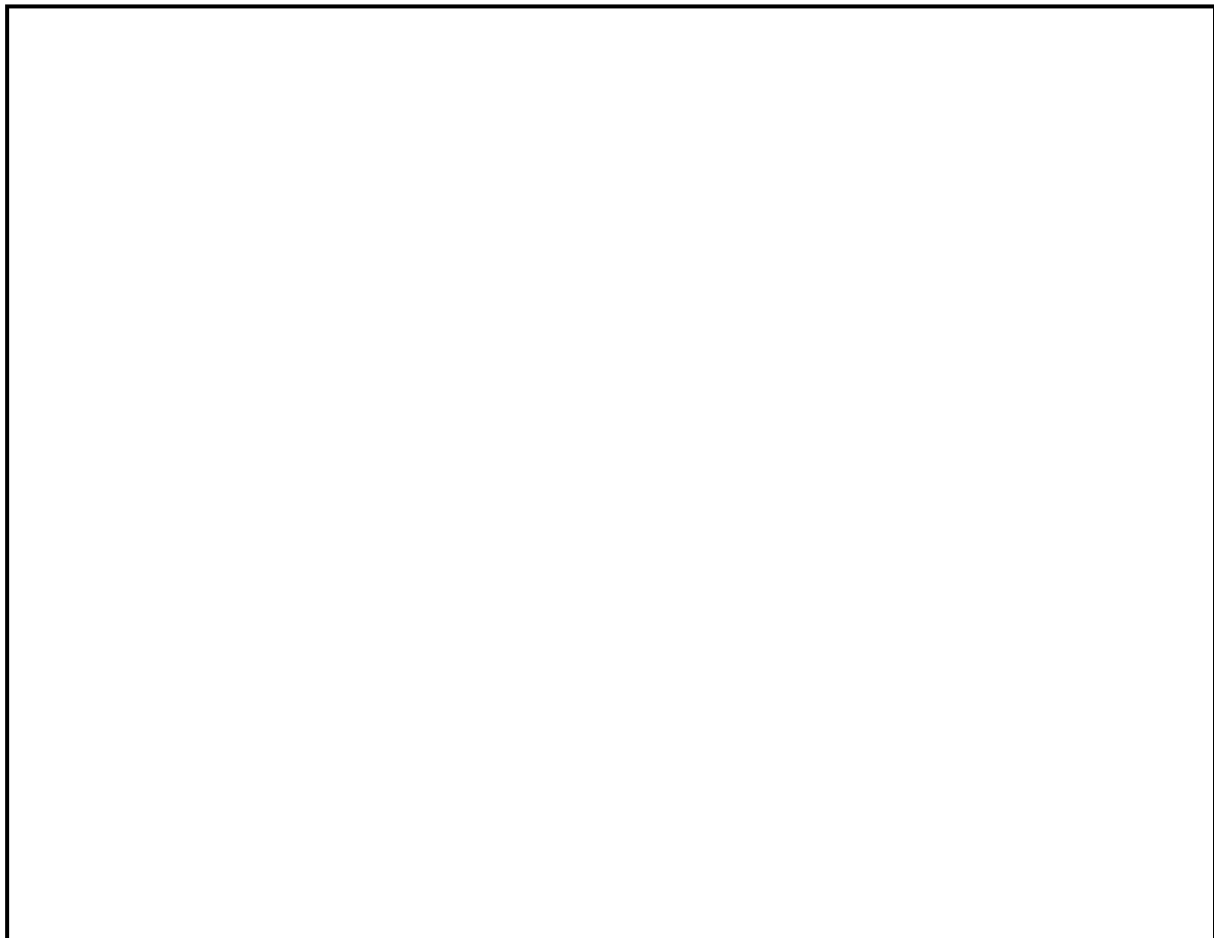
It is recommended that this component be serviced with the vehicle body removed. If the body cannot be removed, refer to Engine - Body On in this section.

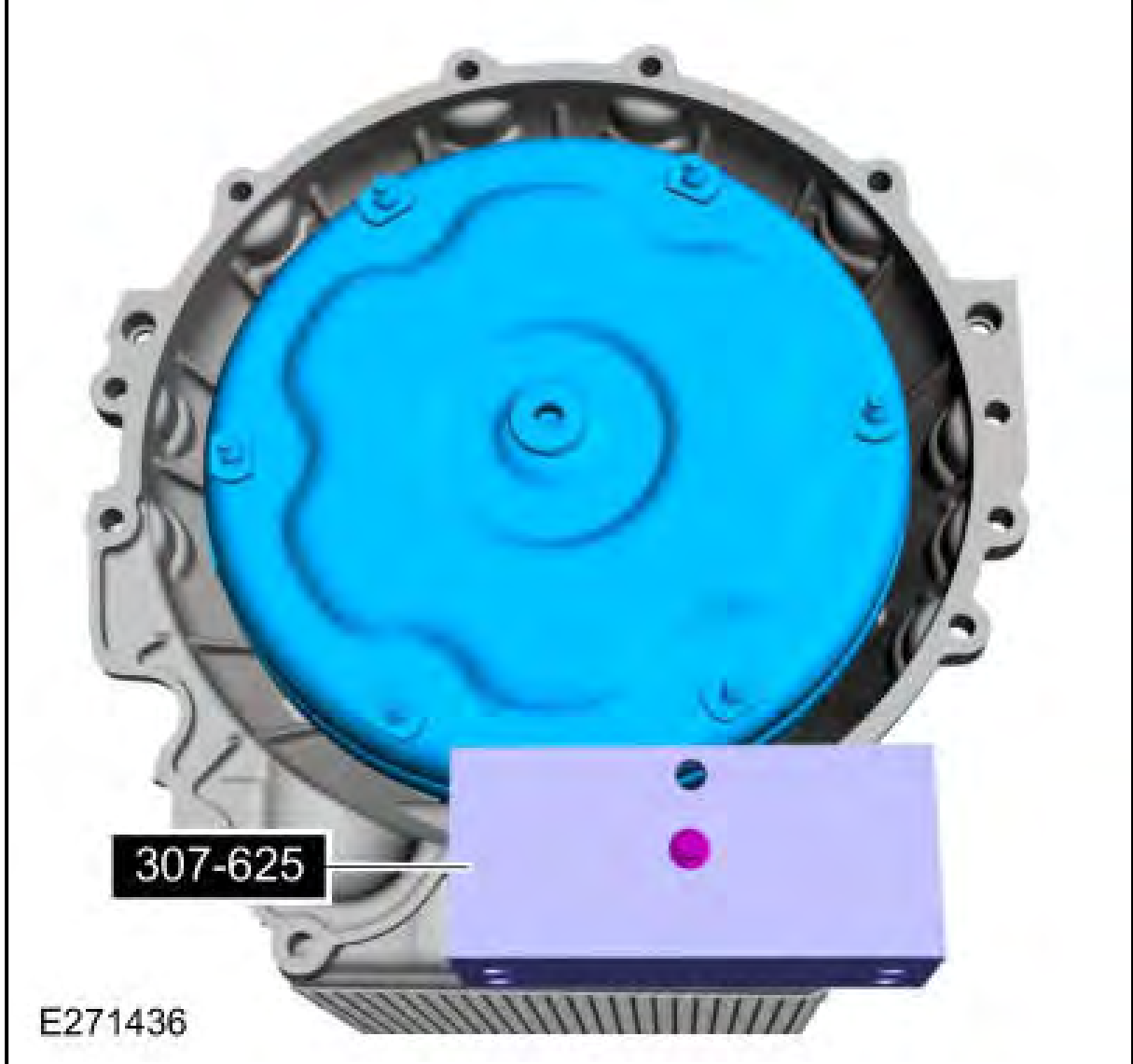
1.

1. Inspect the engine mount-to-frame nut plate for thread damage.
  2. If the nut plate is damaged, remove and discard the engine mount-to-frame nut plate.
- Clean the engine mount-to-frame mating surfaces of any dirt or foreign material prior to installation.



2. Remove Special Service Tool: 307-625 Fixture, Bench Mounting.

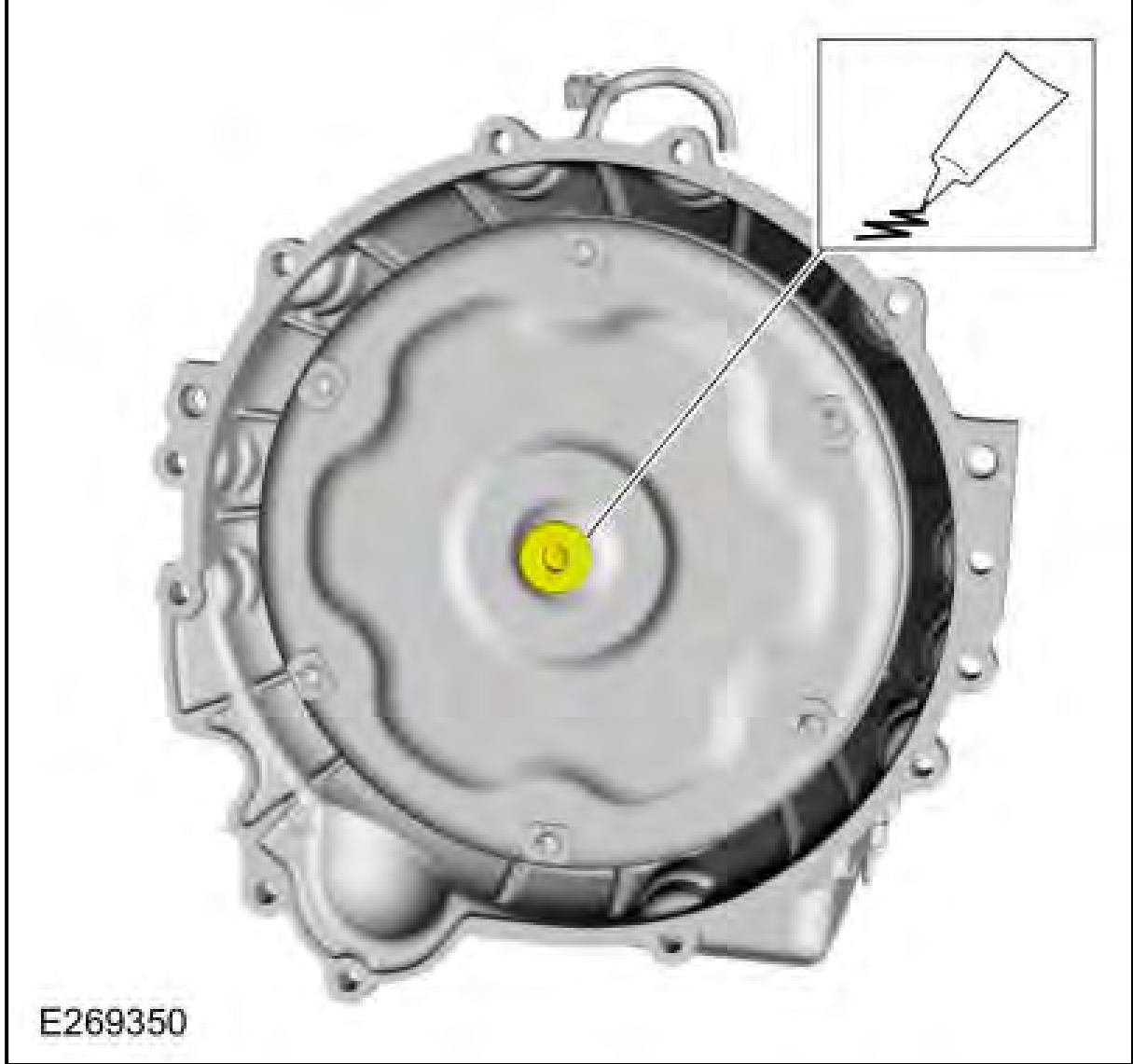




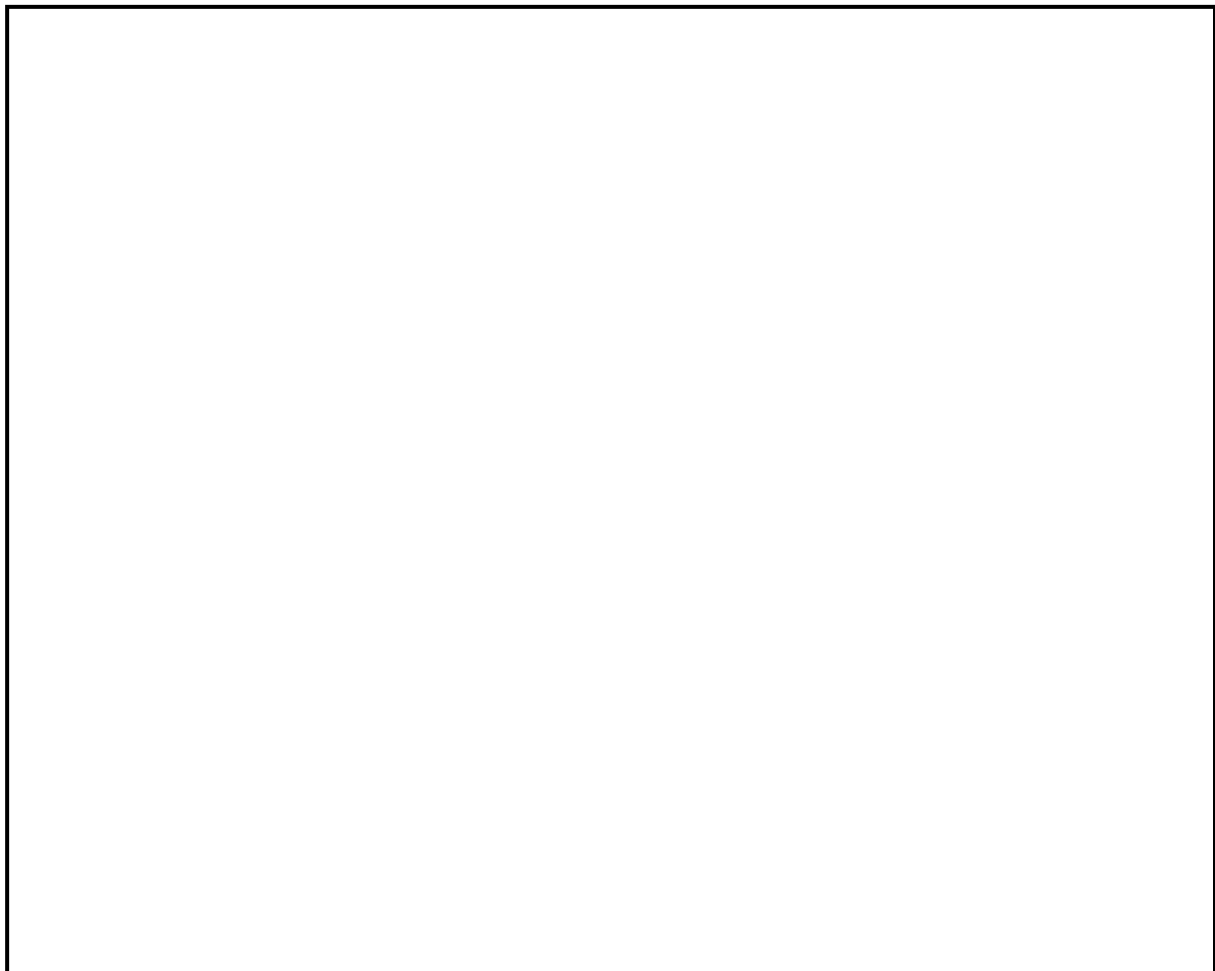
3. Lubricate the torque converter pilot hub with multi-purpose grease.

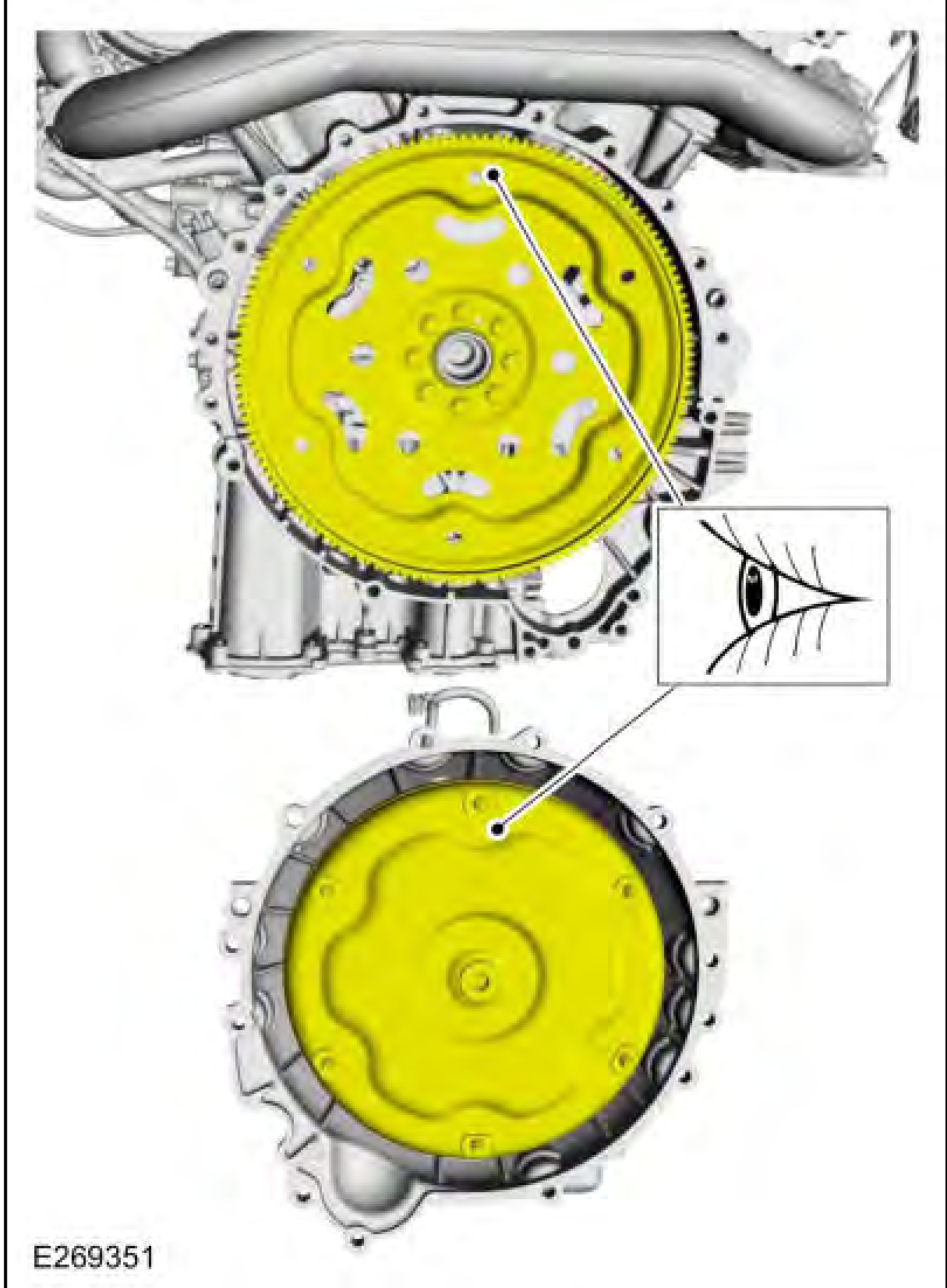
Material: Motorcraft <sup>®</sup> Multi-Purpose Grease Spray / XL-5-A (ESB-M1C93-B)





4. The paint dot on the torque converter need to be at 12 o'clock and the stud needs to be assembled with the corresponding flexplate hole that is closest to 12 o'clock.



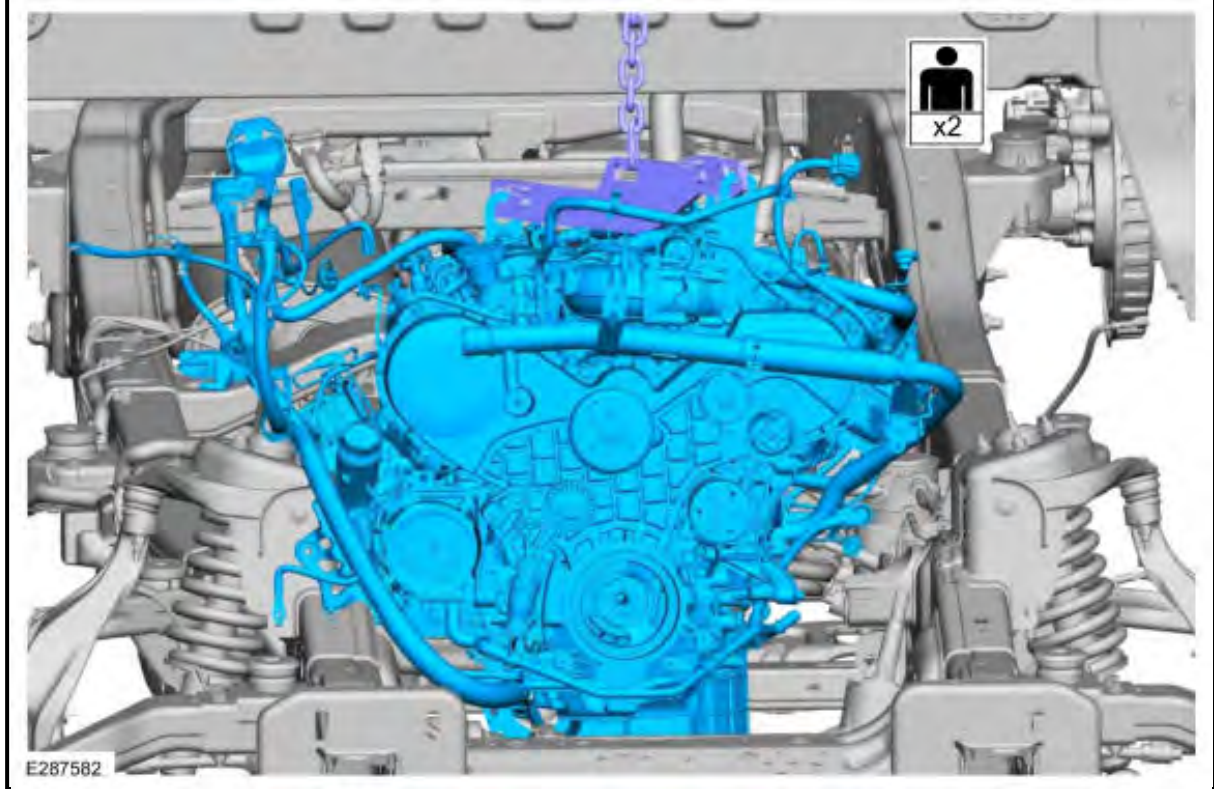


5. **NOTE:**      **The use of a ratchet strap may be needed to level the engine.**

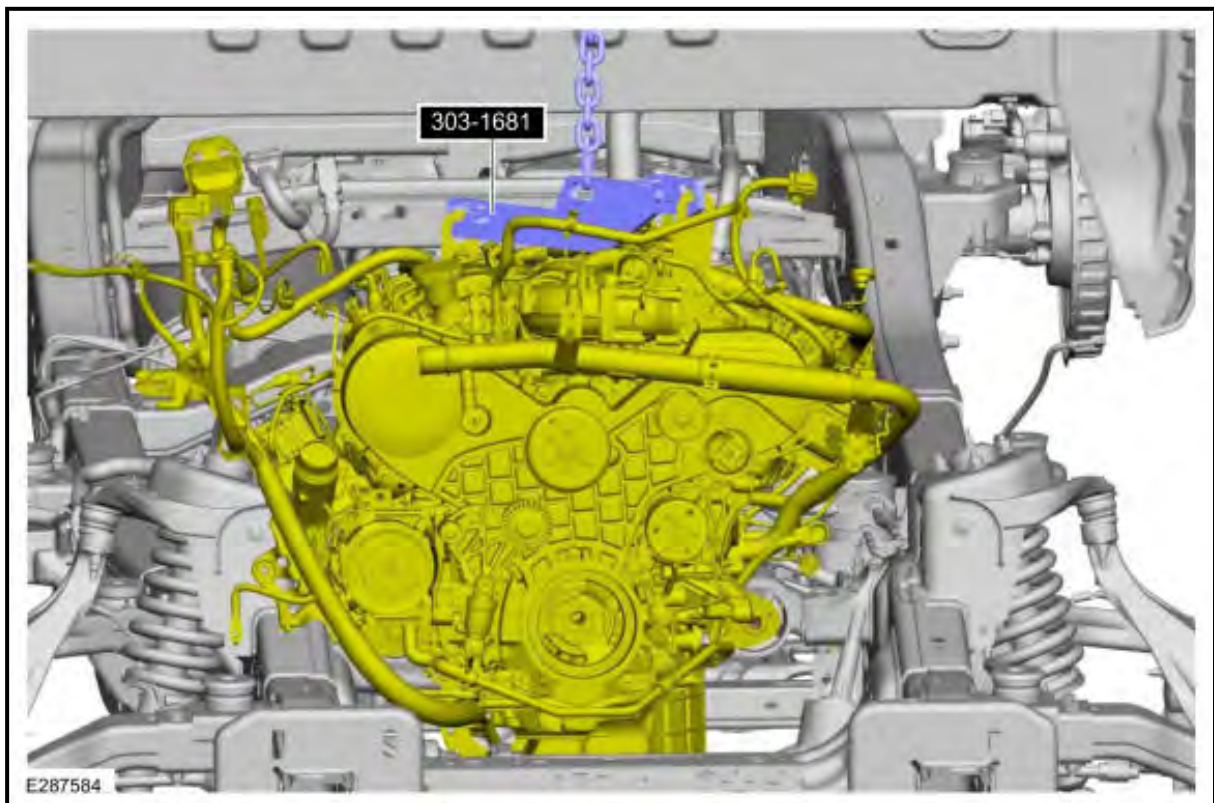
Using the floor crane and the spreader bar, install the engine. Use Special Service Tool: 303-1681 Spreader Bar. Use the General Equipment: Floor Crane







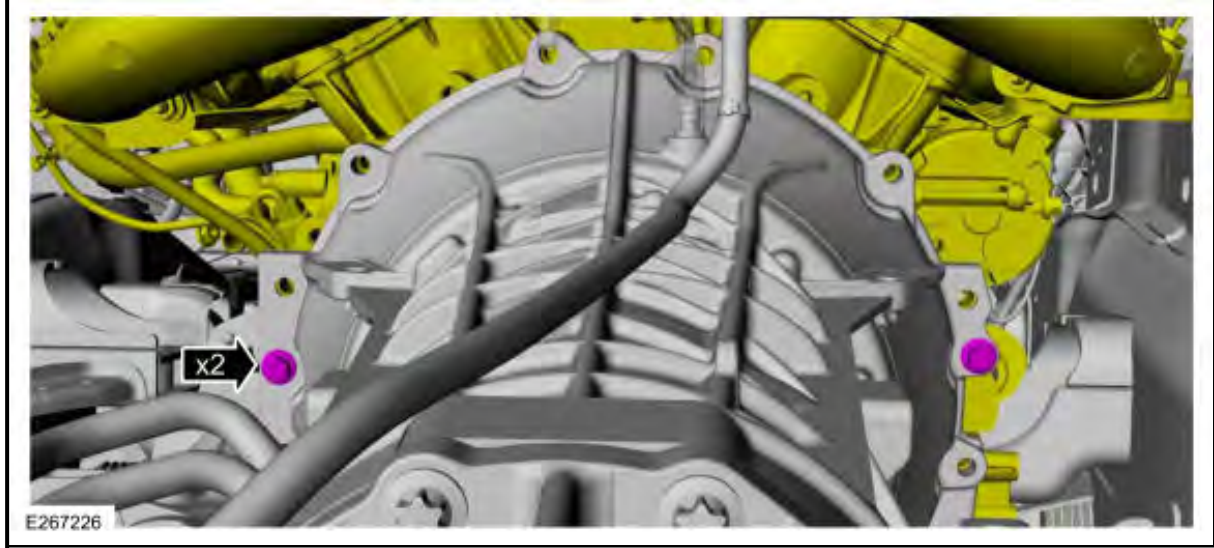
- Using the floor crane and the spreader bar, position the engine to the transmission. Use the General Equipment: Floor Crane



- Align the engine to the transmission and draw together using the bolts.

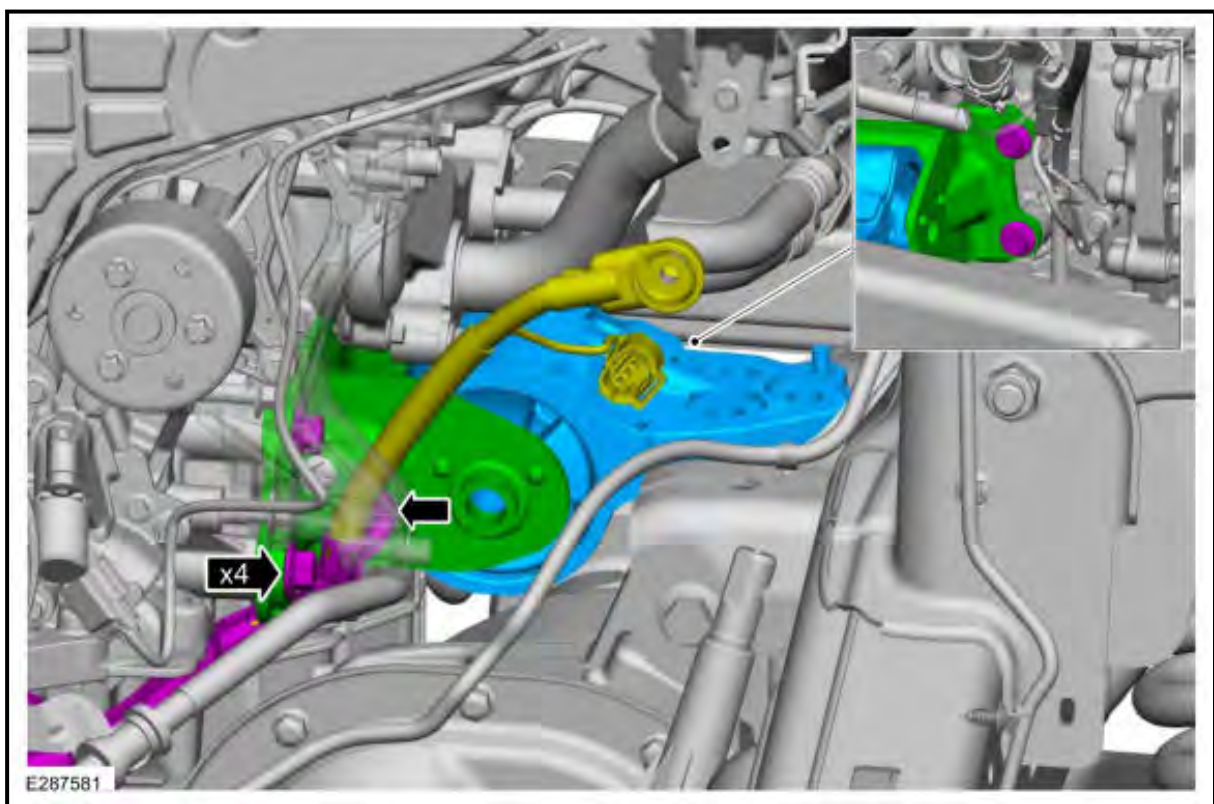
Torque: 35 lb.ft (48 Nm)





8. Install the LH engine mount. Install the engine mount bracket and the bolts.

Torque: 76 lb.ft (103 Nm)

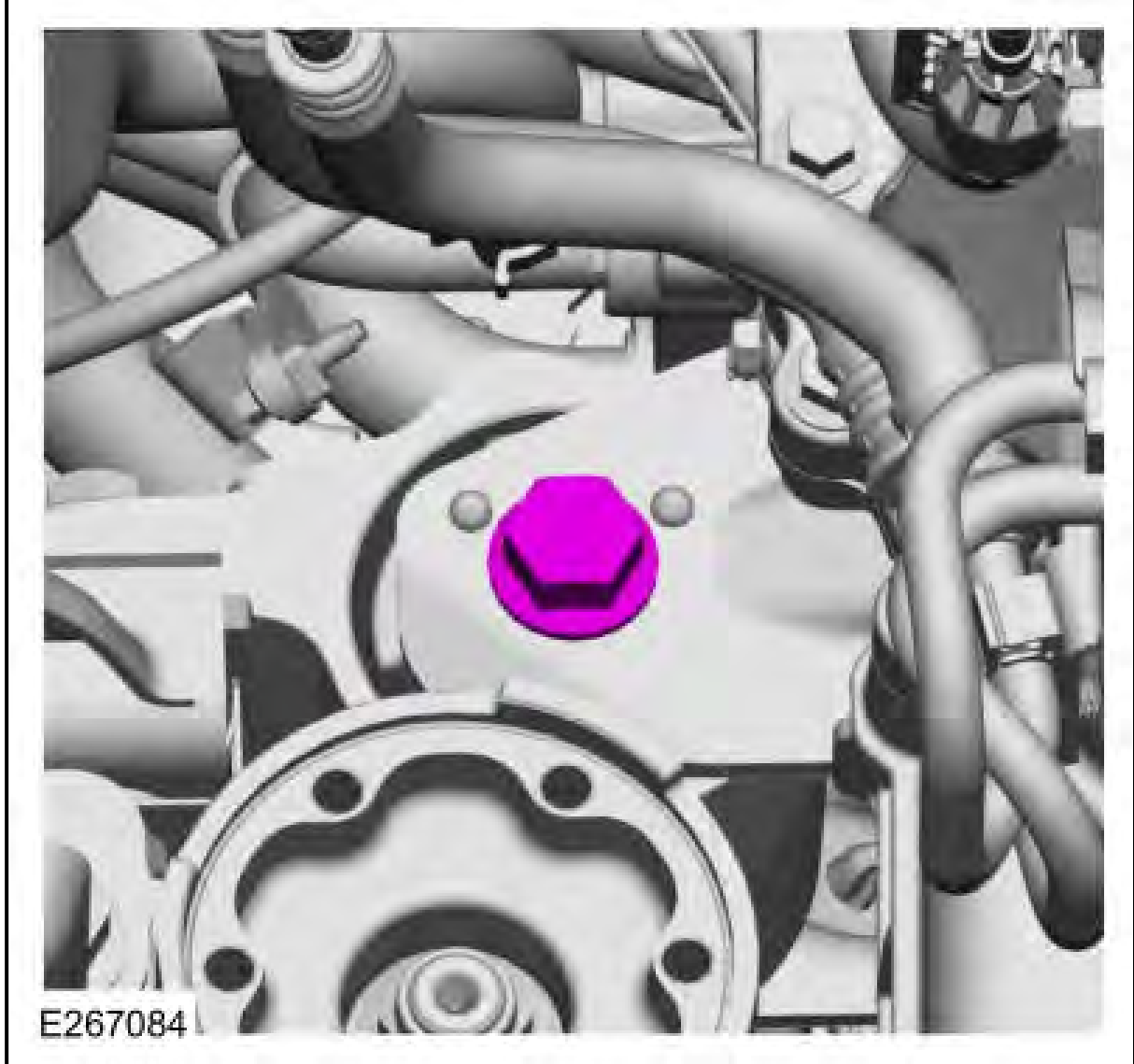


9. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

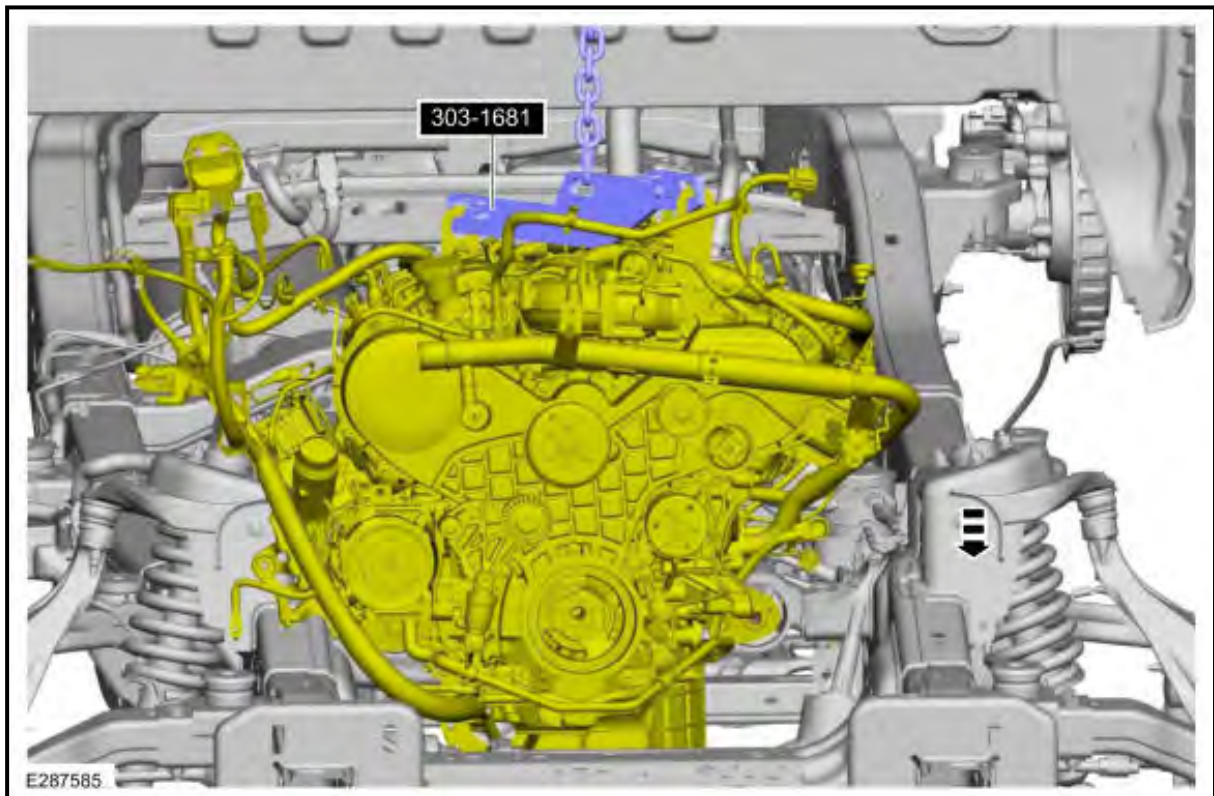
**NOTE:** Only tighten the bolt finger tight at this stage.

Install the LH engine mount thought bolt.





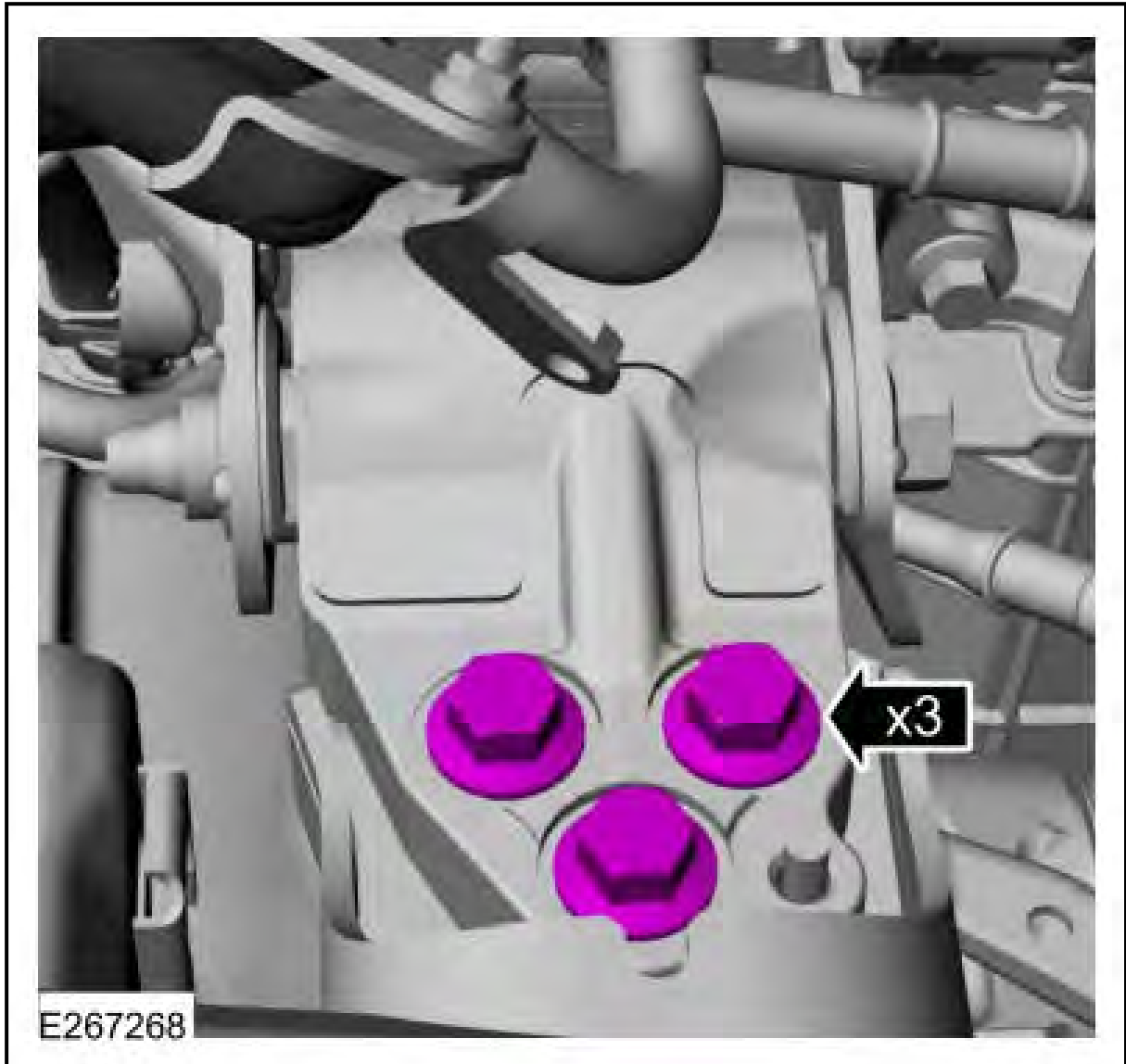
10. Using the floor crane, lower the engine. Use the General Equipment: Floor Crane



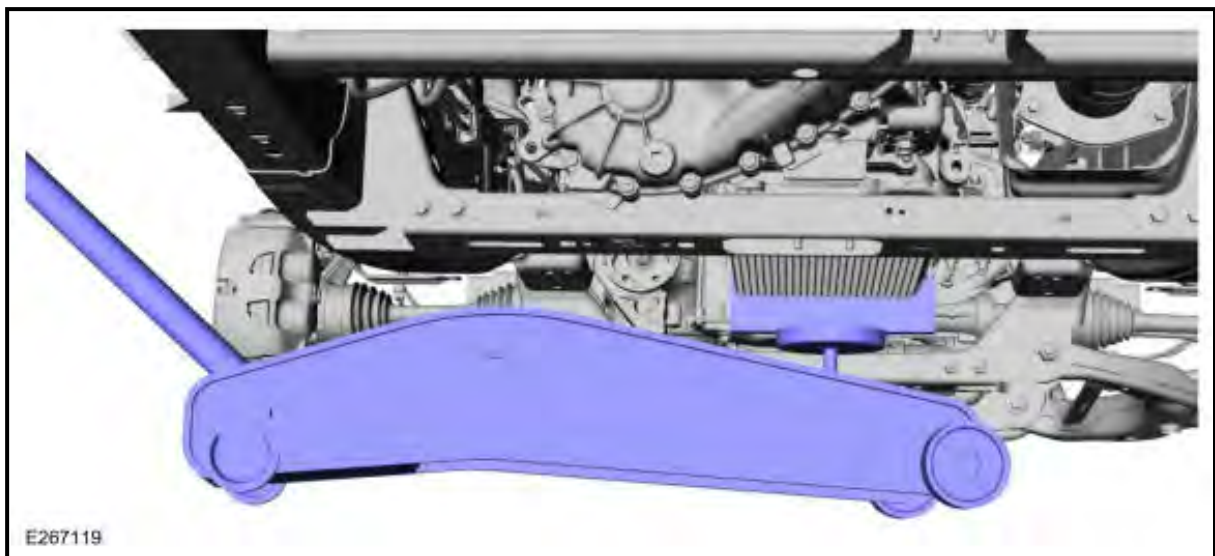
11. **NOTE:** Only use hand tools when loosening or tightening the engine mount-to-frame bolts or damage to the engine mount-to-frame nut plate can occur.

Install the new LH engine mount bolts.

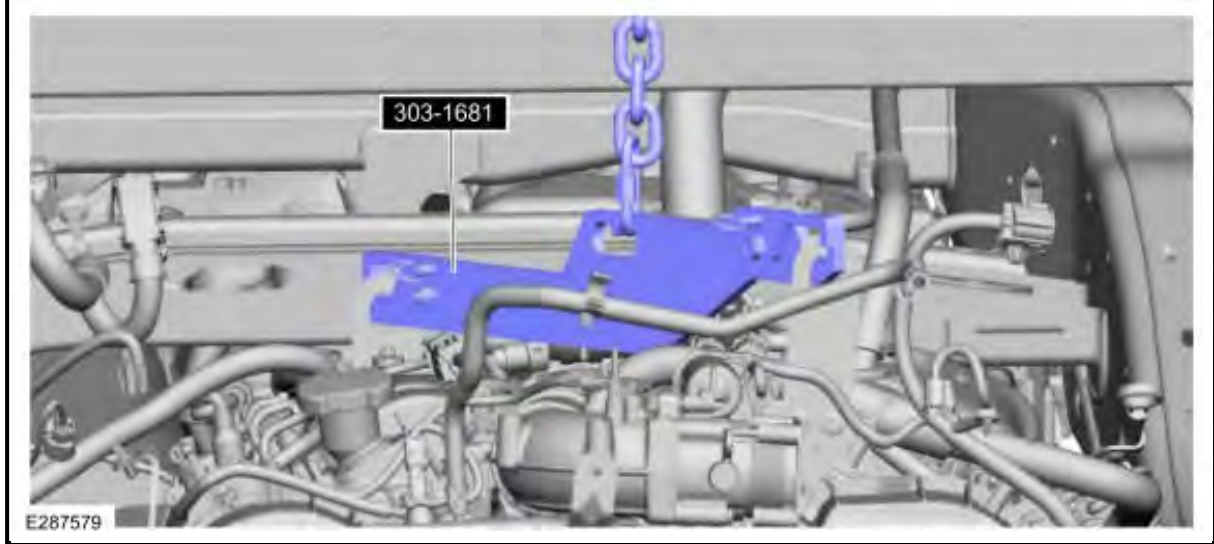
Torque: 129 lb.ft (175 Nm)



12. Remove the floor jack and the block of wood. Use the General Equipment: Trolley Jack Use the General Equipment: Wooden Block



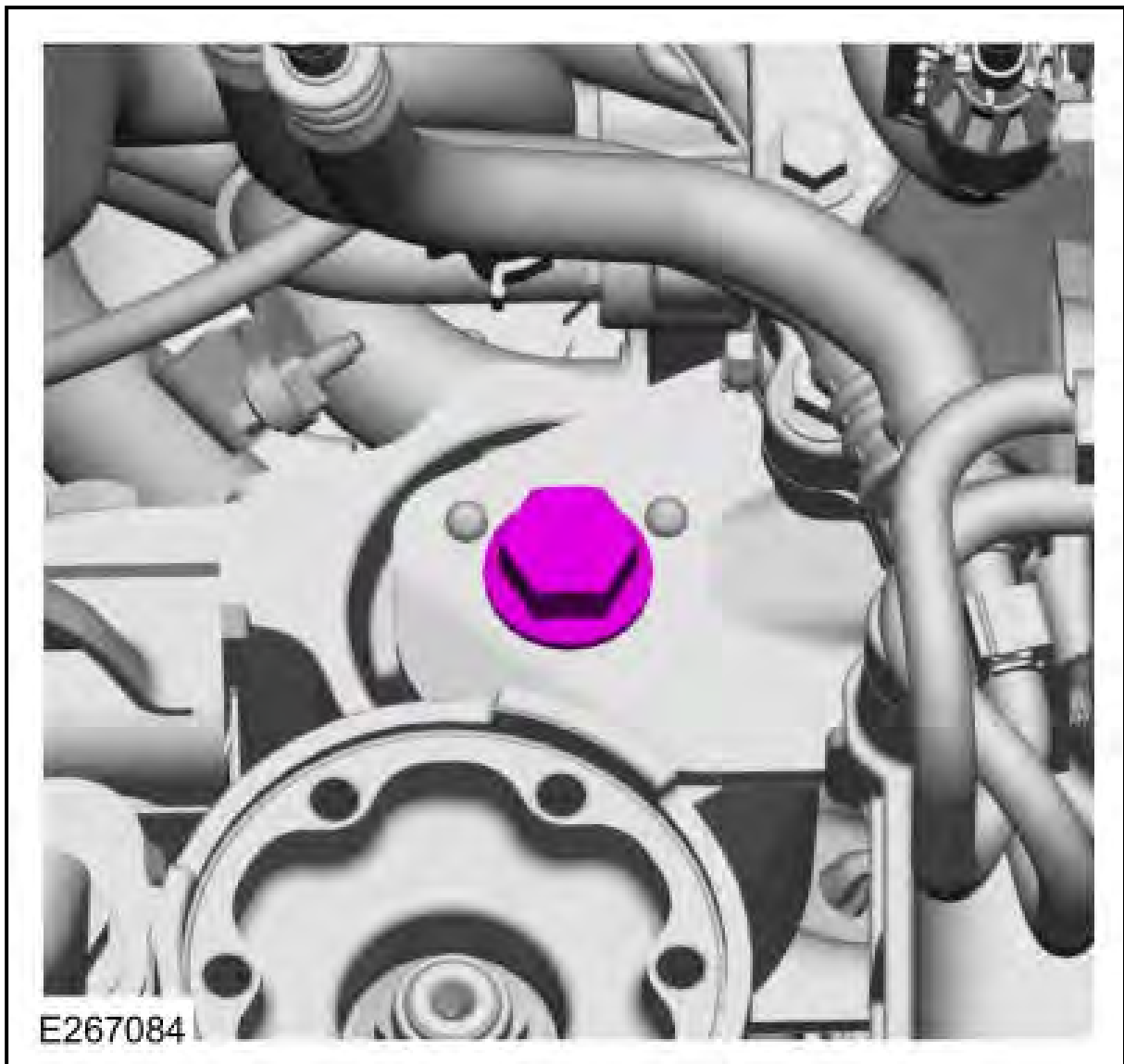
13. Remove the floor crane and the special tool. Use Special Service Tool: 303-1681 Spreader Bar. Use the General Equipment: Floor Crane



14. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

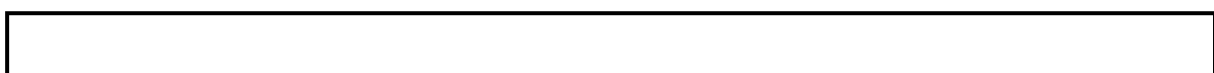
Tighten the LH engine mount through bolt.

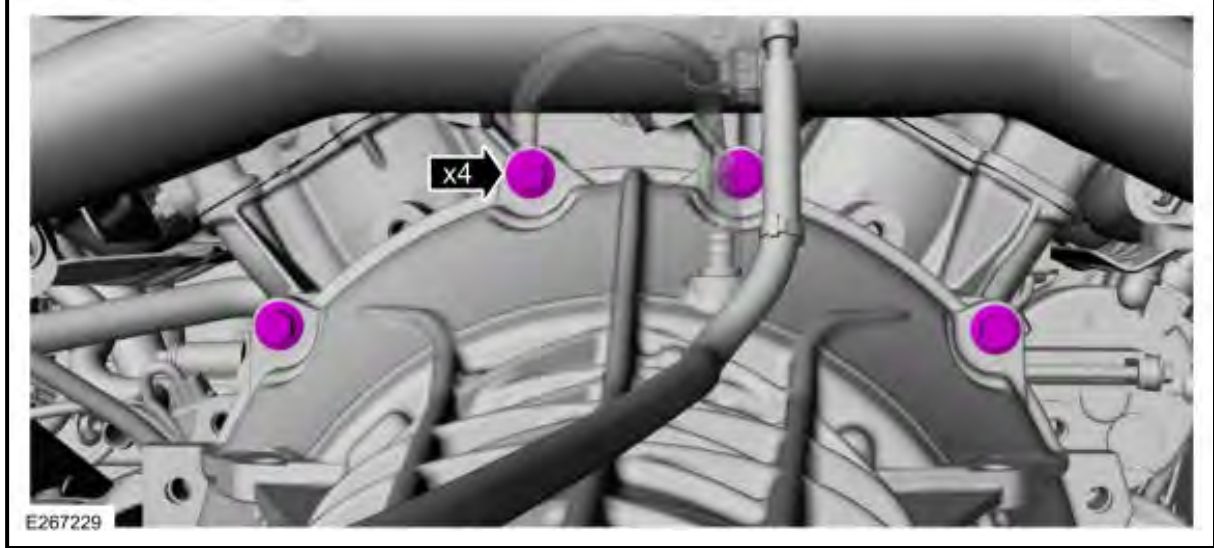
Torque: 258 lb.ft (350 Nm)



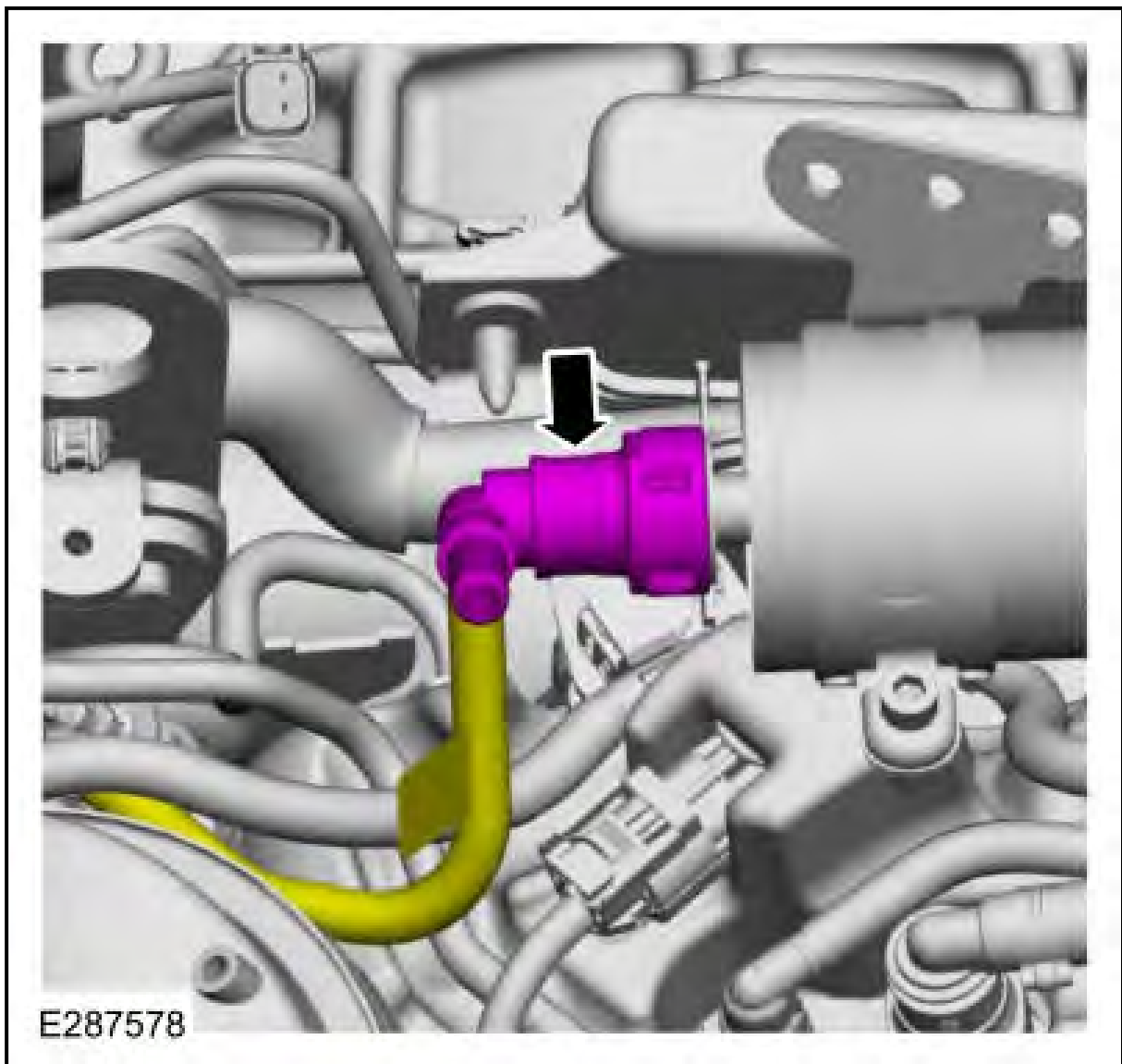
15. Install the upper bellhousing bolts.

Torque: 35 lb.ft (48 Nm)



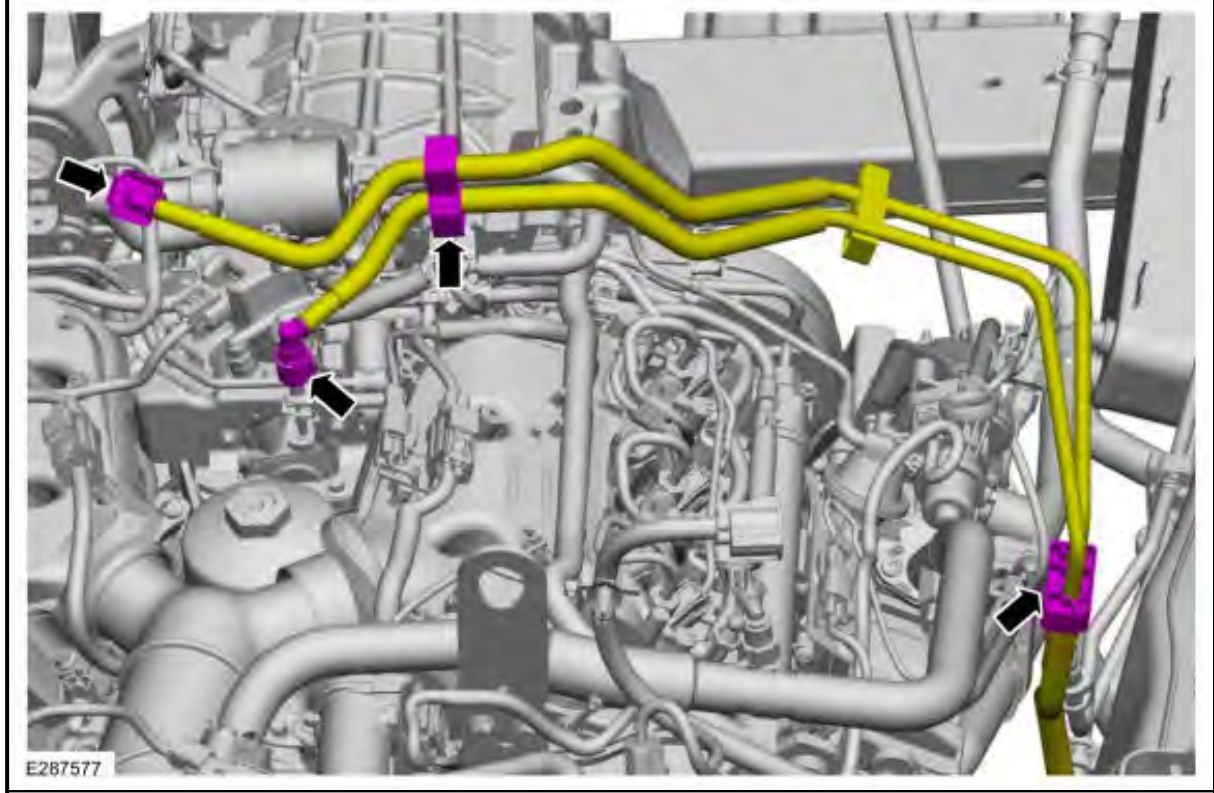


16. Connect the secondary fuel lines.Refer to: [Quick Release Coupling](#) .

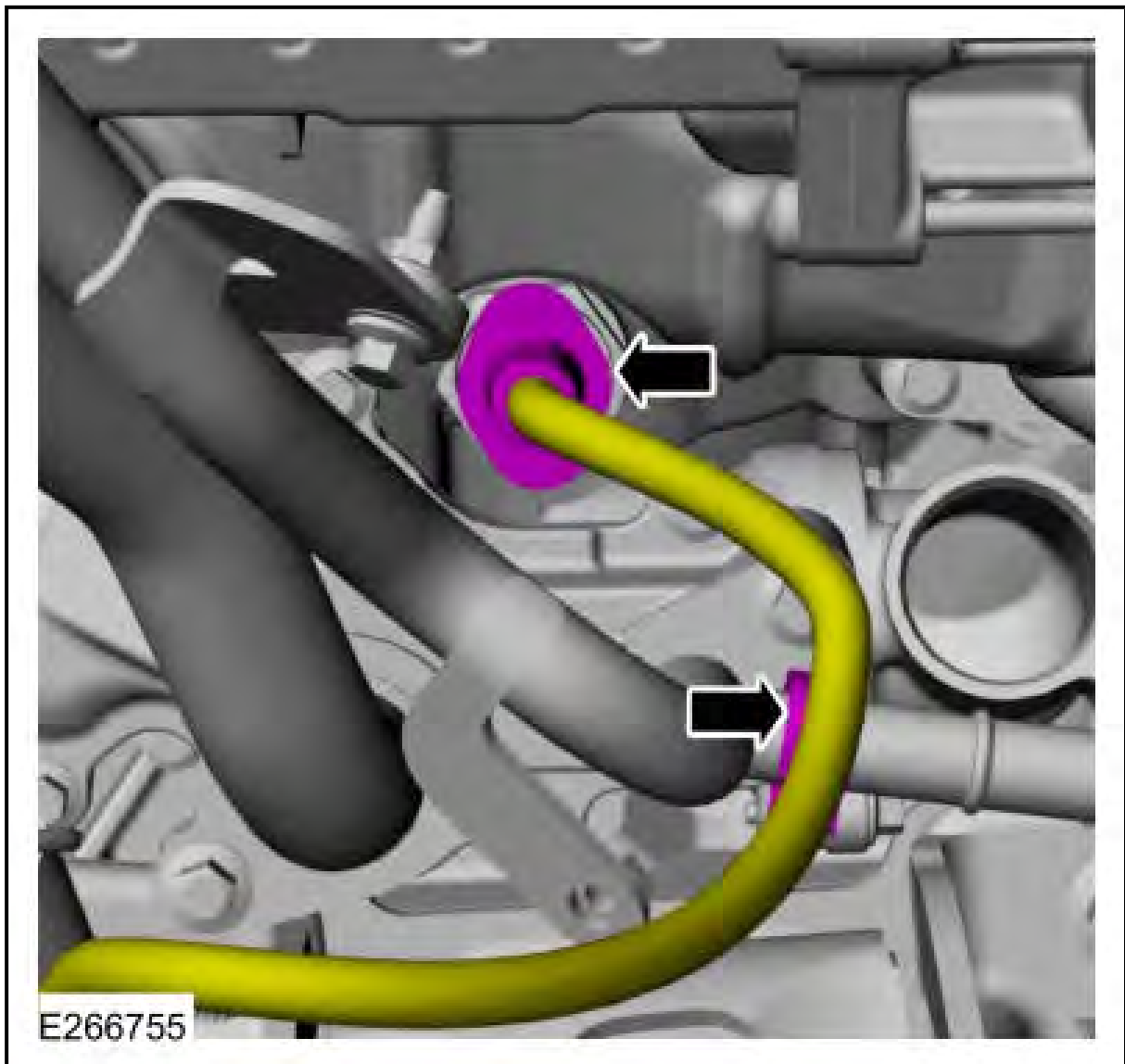


17. Position back and connect the fuel tubes.Refer to: [Quick Release Coupling](#) .



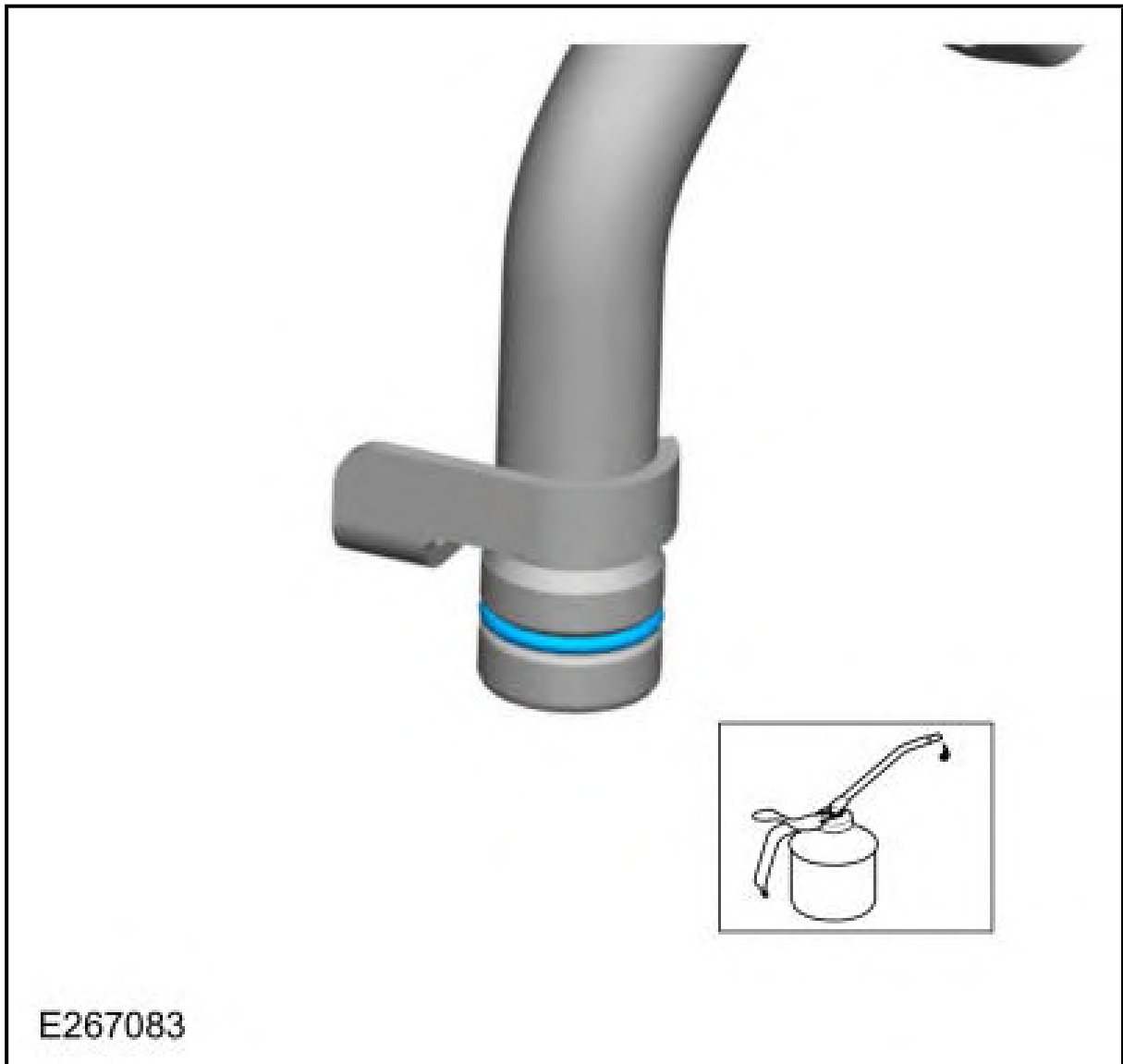


18. If equipped, connect the block heater electrical connector and the retainer.



19. Install a new O-ring seal on the lower radiator coolant tube. Apply coolant to the O-ring seal.

Material



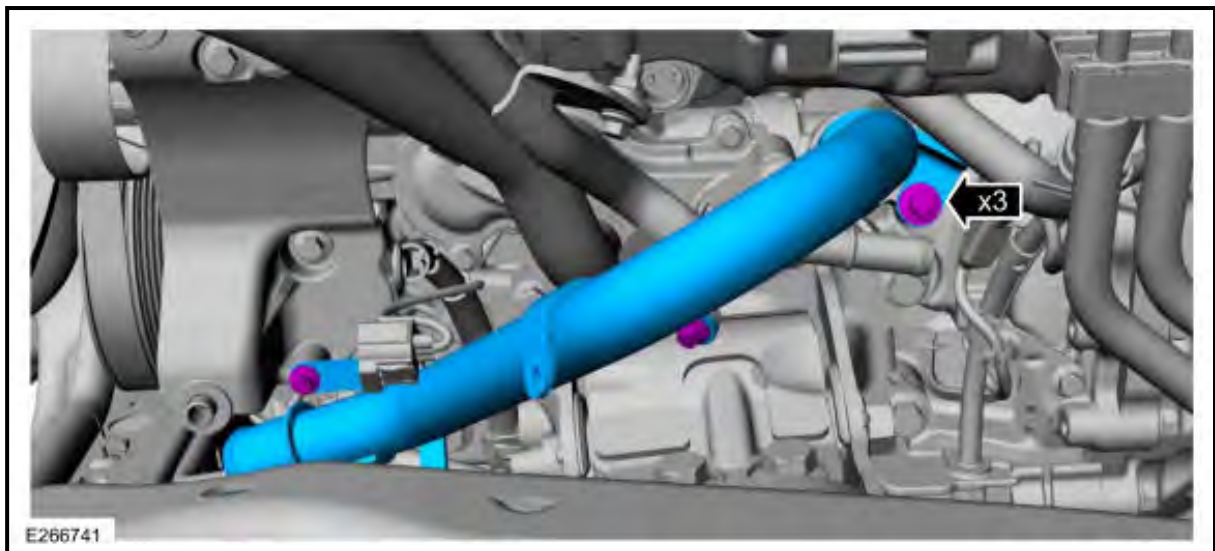
20. **NOTE:** Apply coolant to the coolant connector opening before installing the tube.

Install the lower radiator coolant tube and the bolts.

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

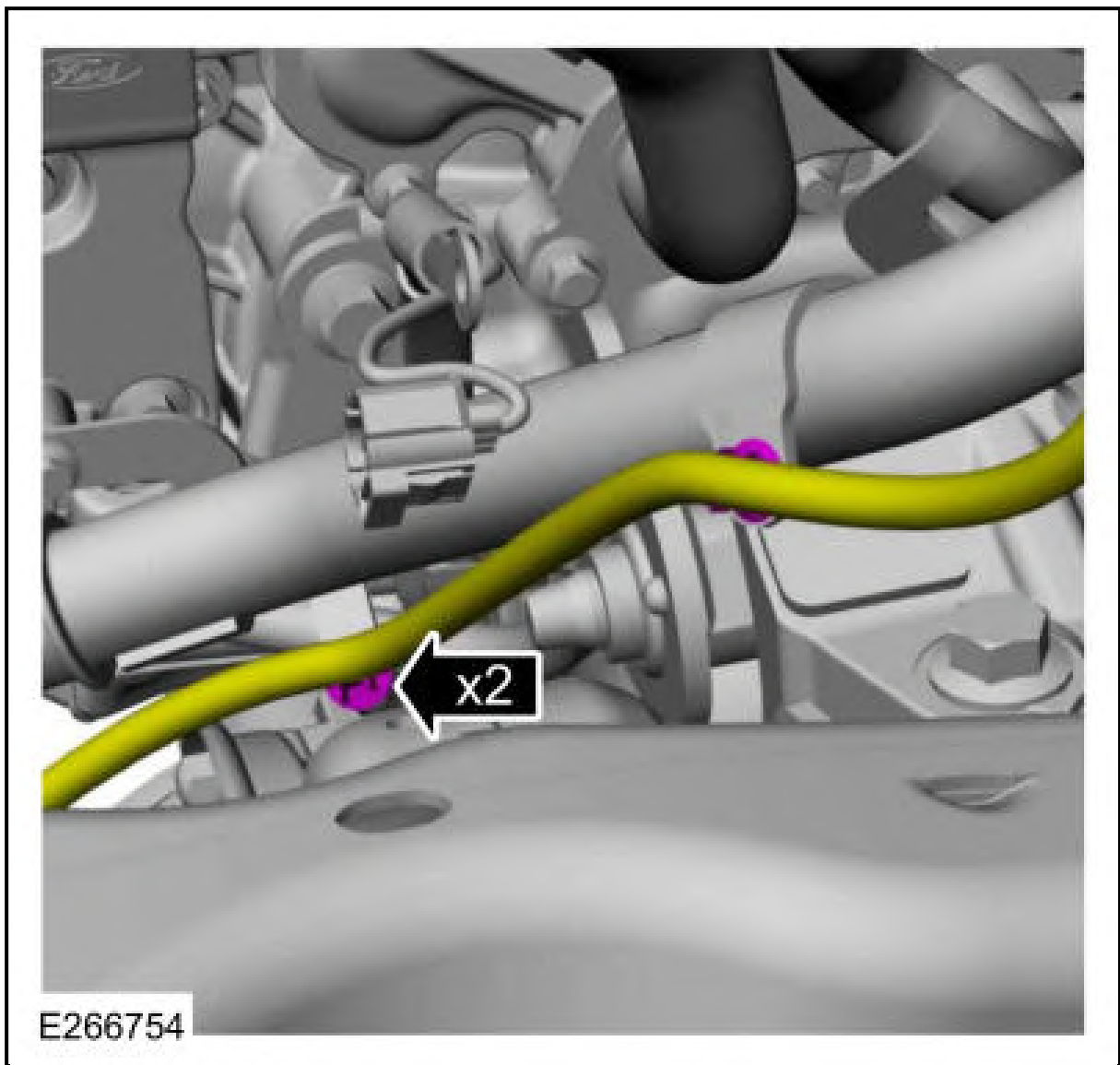
Torque

:M8 bolt : 18 lb.ft (25 Nm) M6 bolt : 71 lb.in (8 Nm)



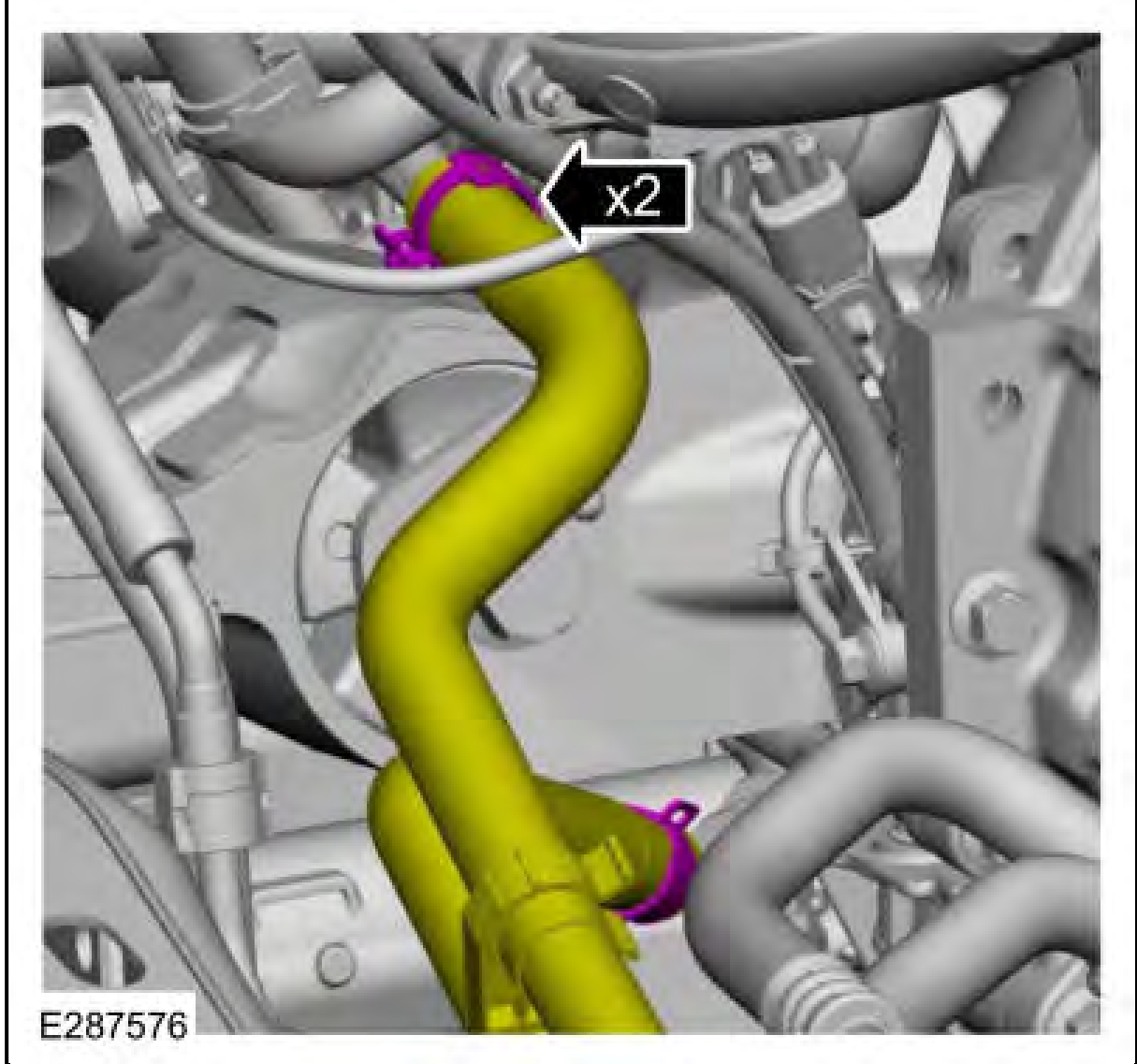


21. If equipped, connect the block heater cord retainers.



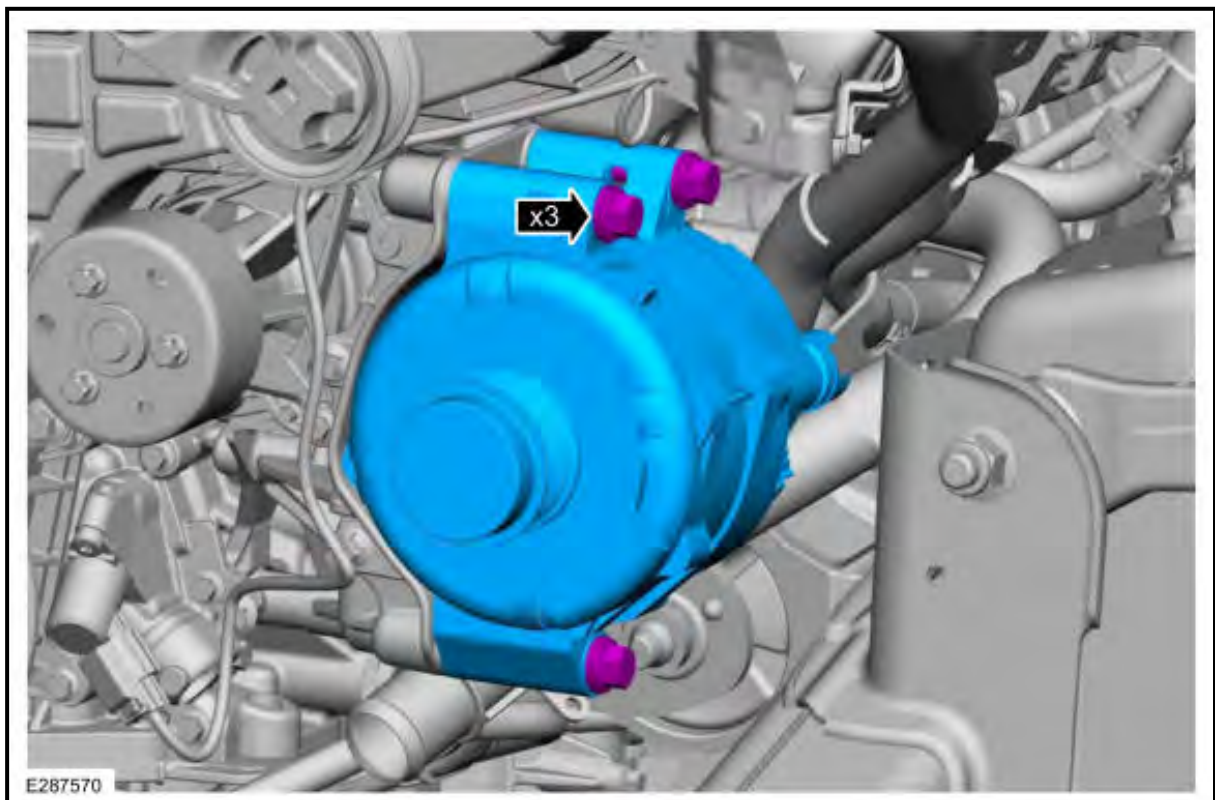
22. Position back and connect the coolant hoses. Use the General Equipment: Hose Clamp Remover/Installer





23. Install the generator and the bolts.

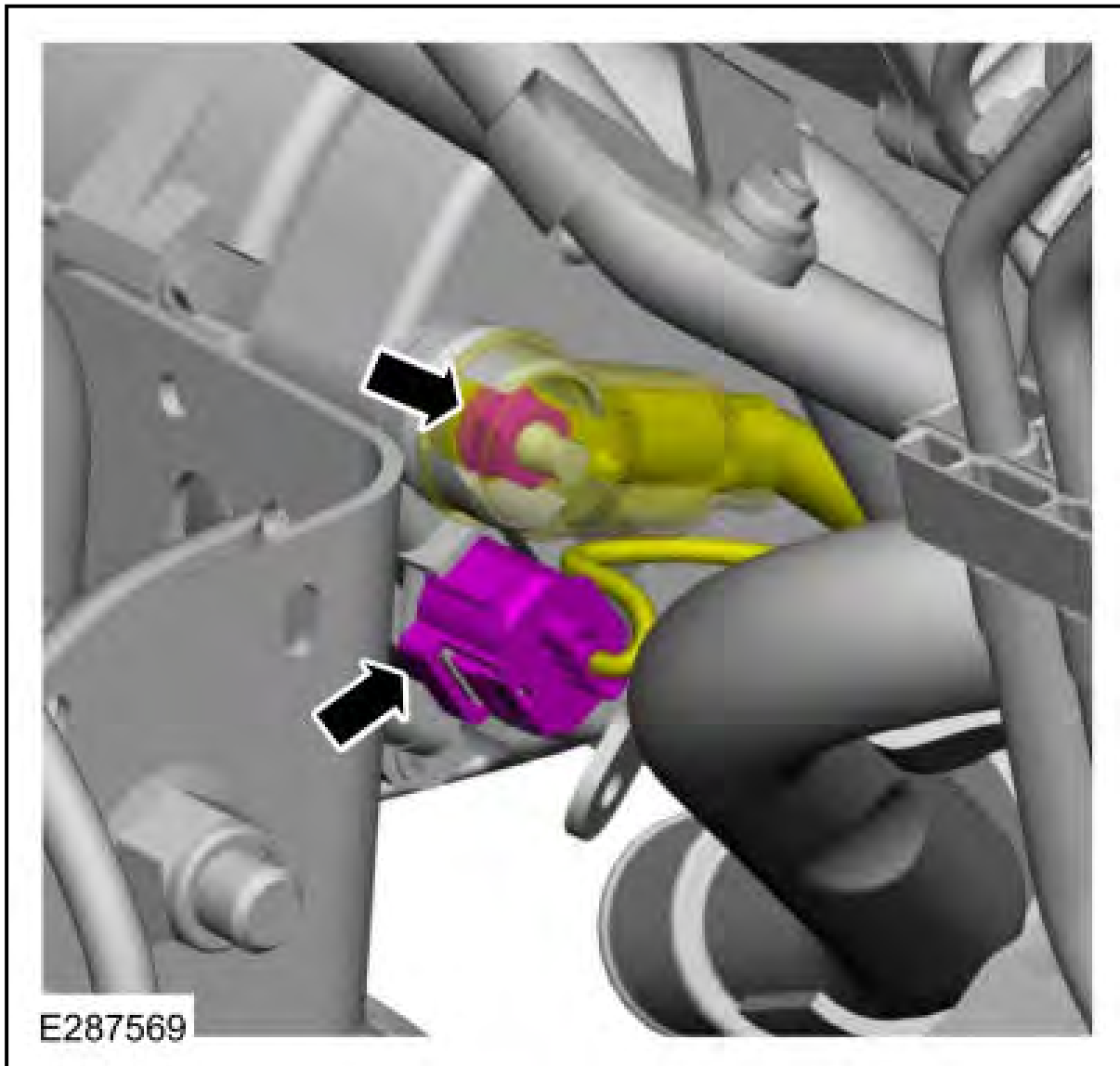
Torque: 35 lb.ft (48 Nm)



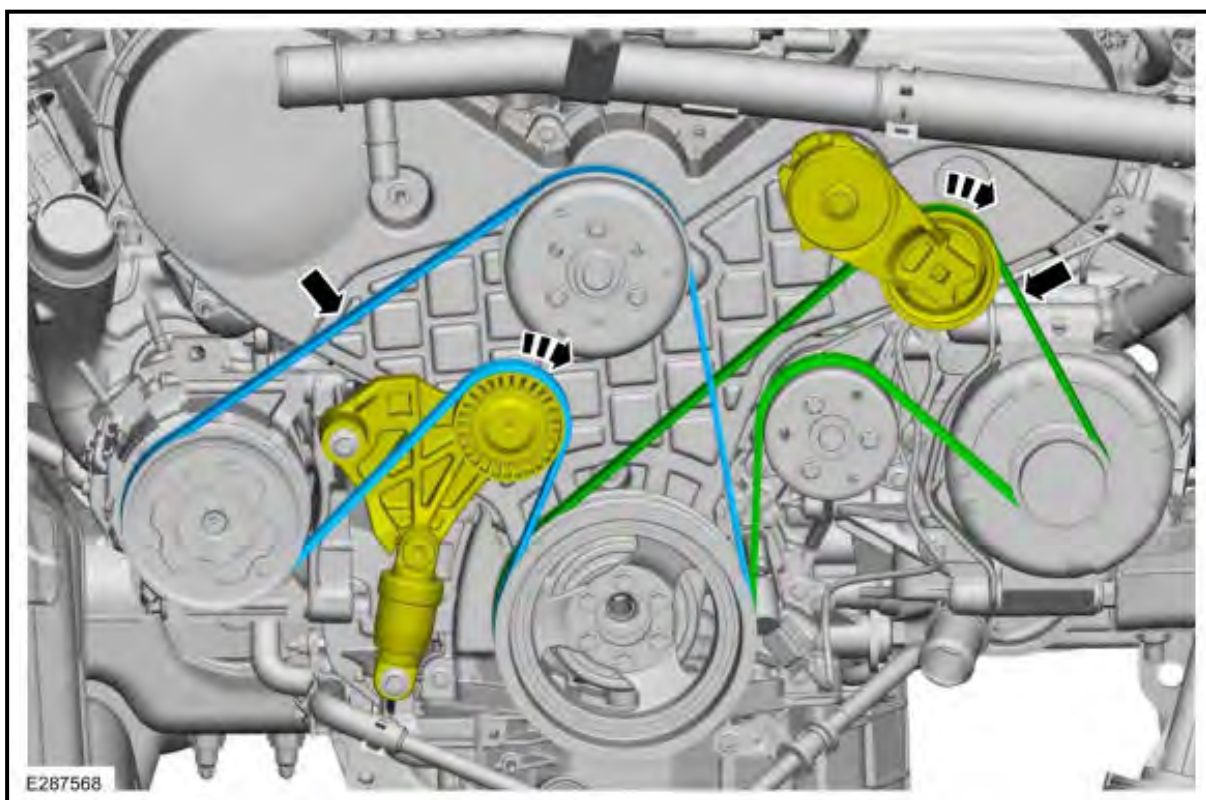
24. **NOTE:** When installing the B+ terminal nut to the generator, finger-start the nut before tightening or component damage may occur.

Connect the electrical connector and the generator output wire.

Torque: 159 lb.in (18 Nm)



25. Install the A/C belt and the accessory drive belt.

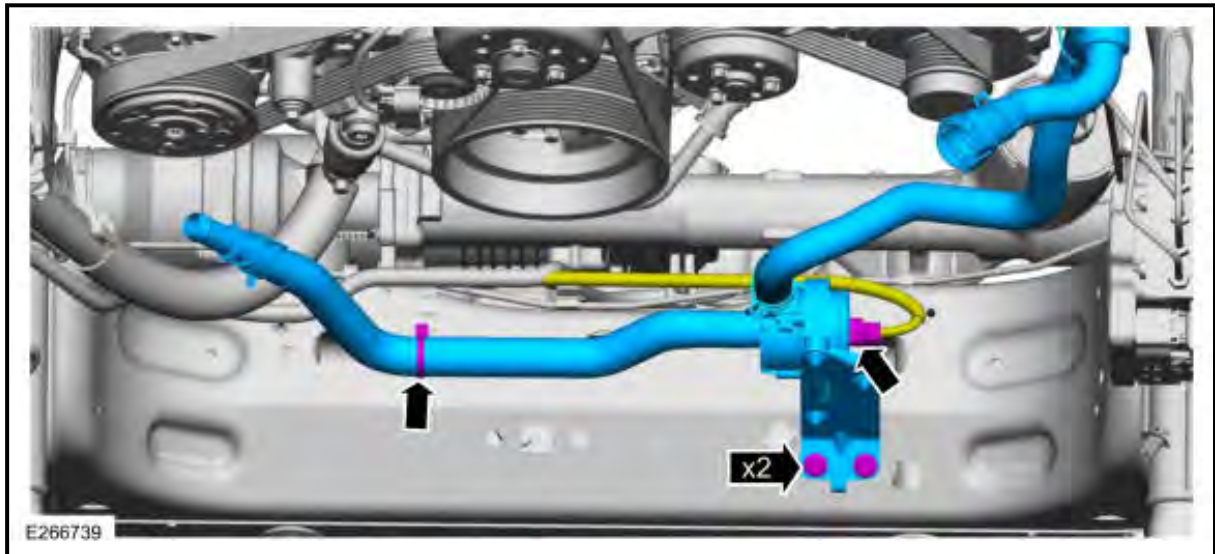


26.

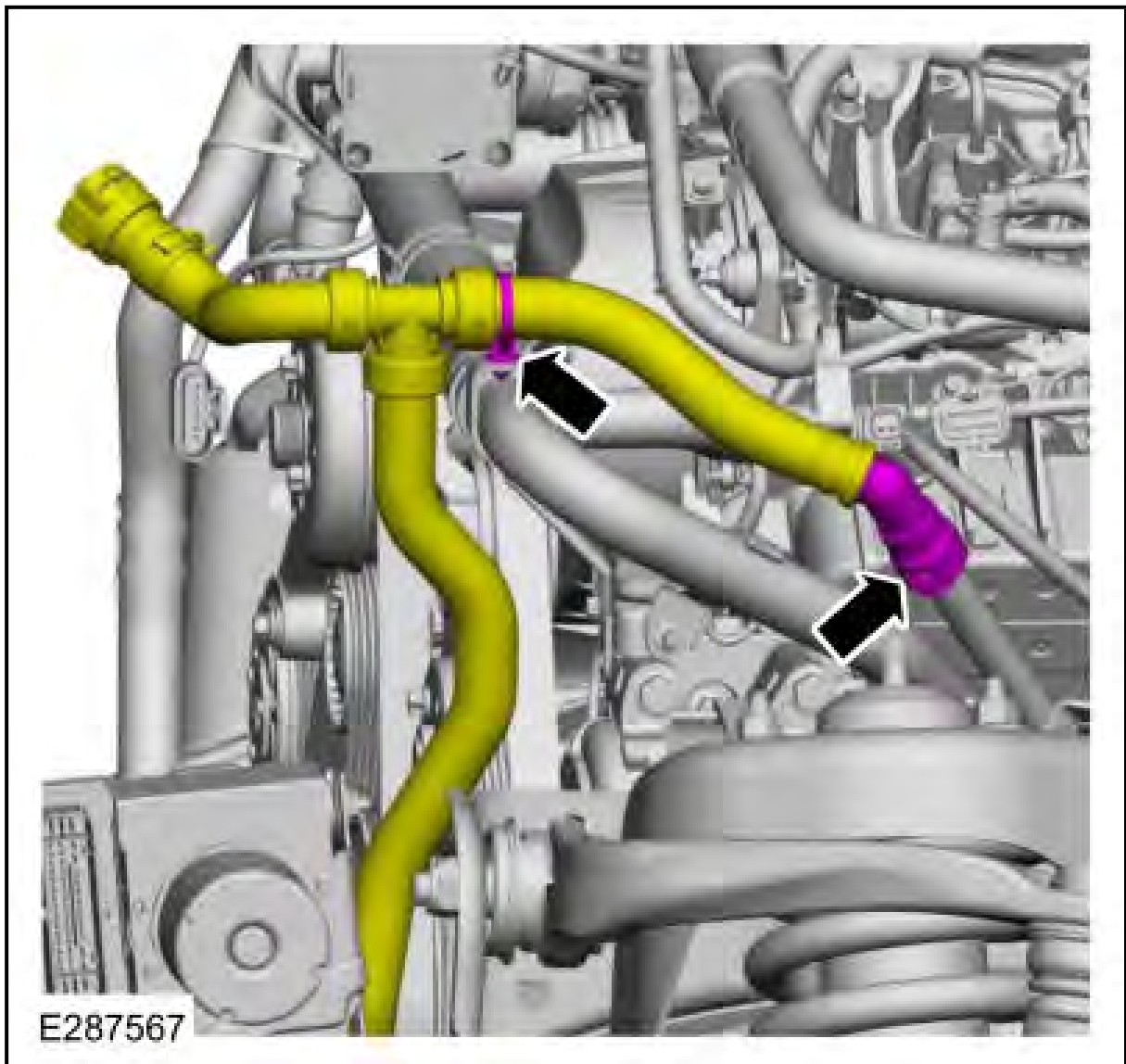
- Install the coolant pump and the bolts.

Torque: 177 lb.in (20 Nm)

- Connect the electrical connector and the coolant hose retainer.



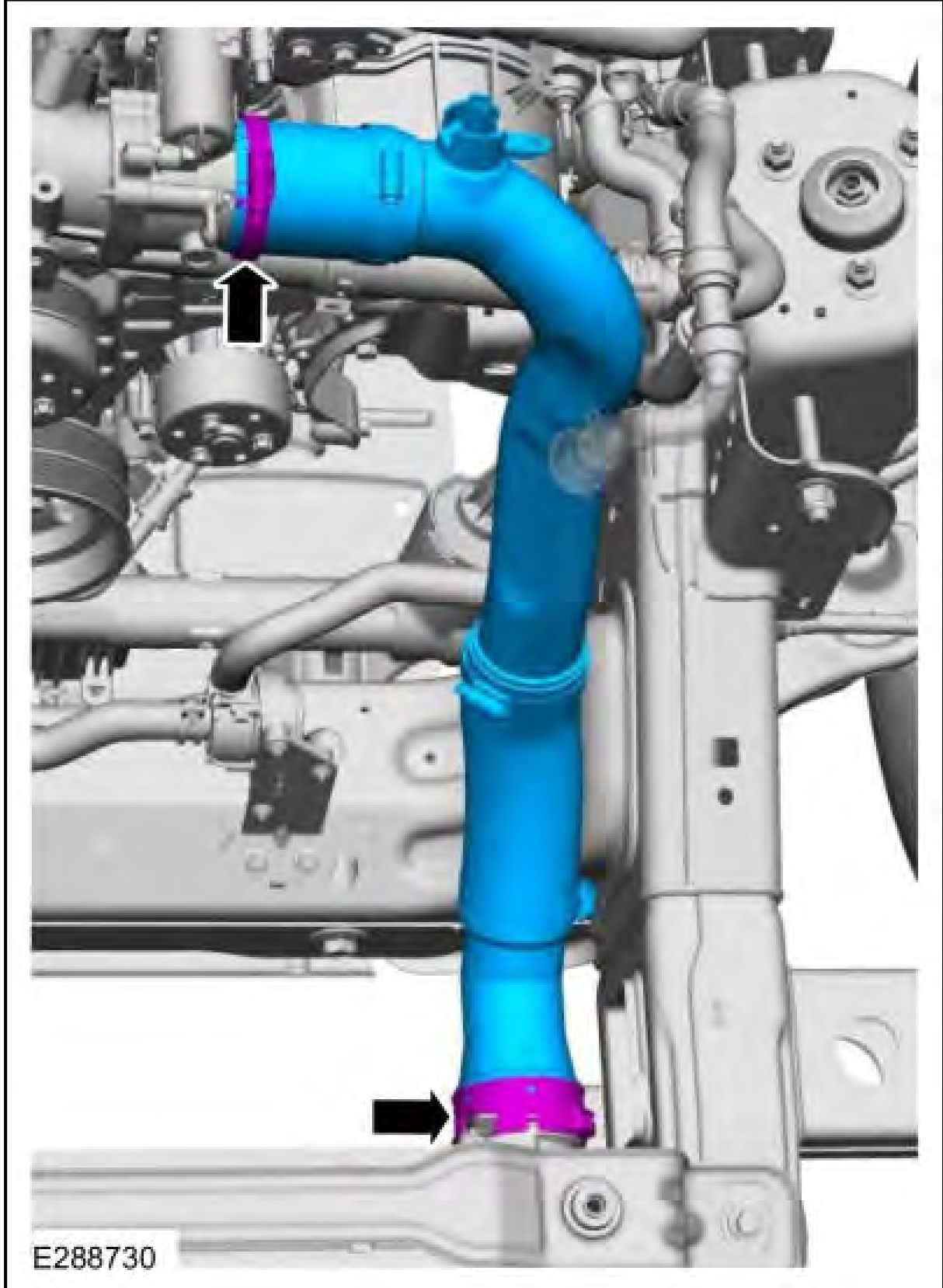
27. Connect the coolant hose connector and the retainer.



28. Inspect the turbocharger or engine air intake system components and clean, if necessary.

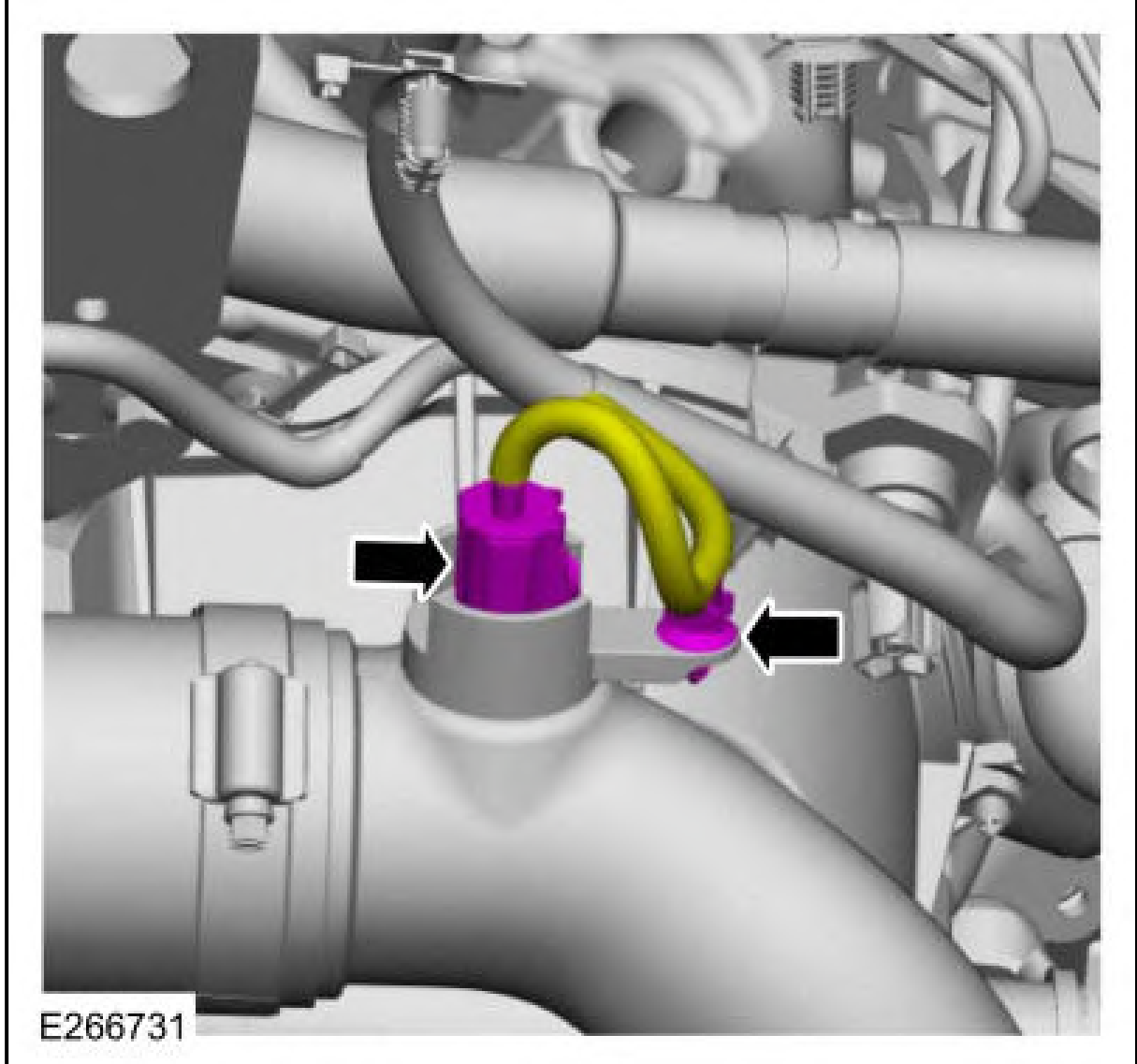
29. Install the LH CAC intake pipe and the clip. Tighten the clamp.

Torque: 44 lb.in (5 Nm)

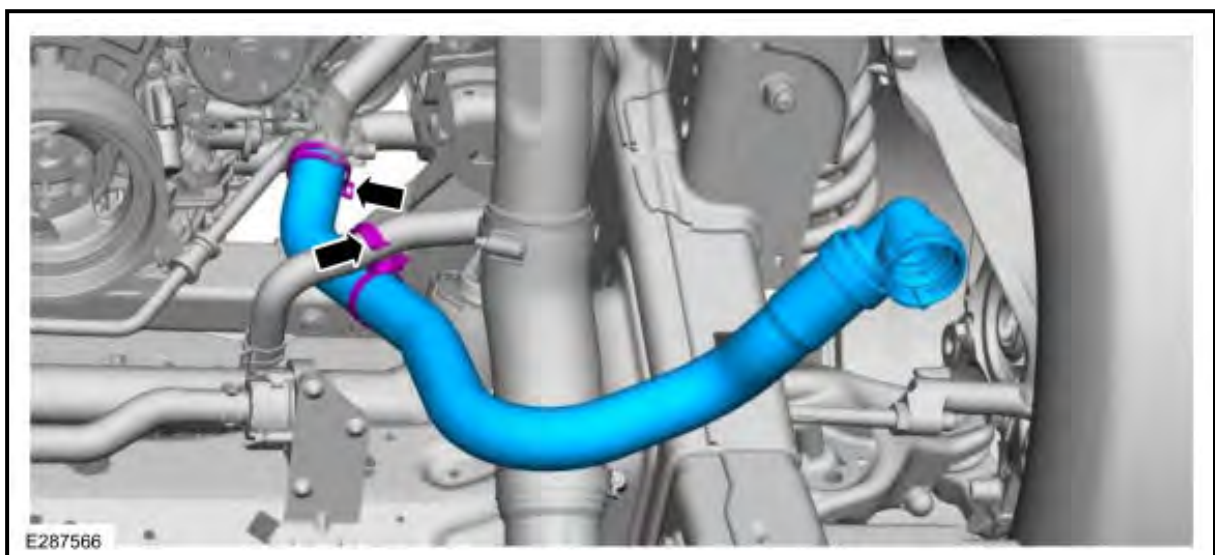


30. Connect the electrical connector and the wire retainer.



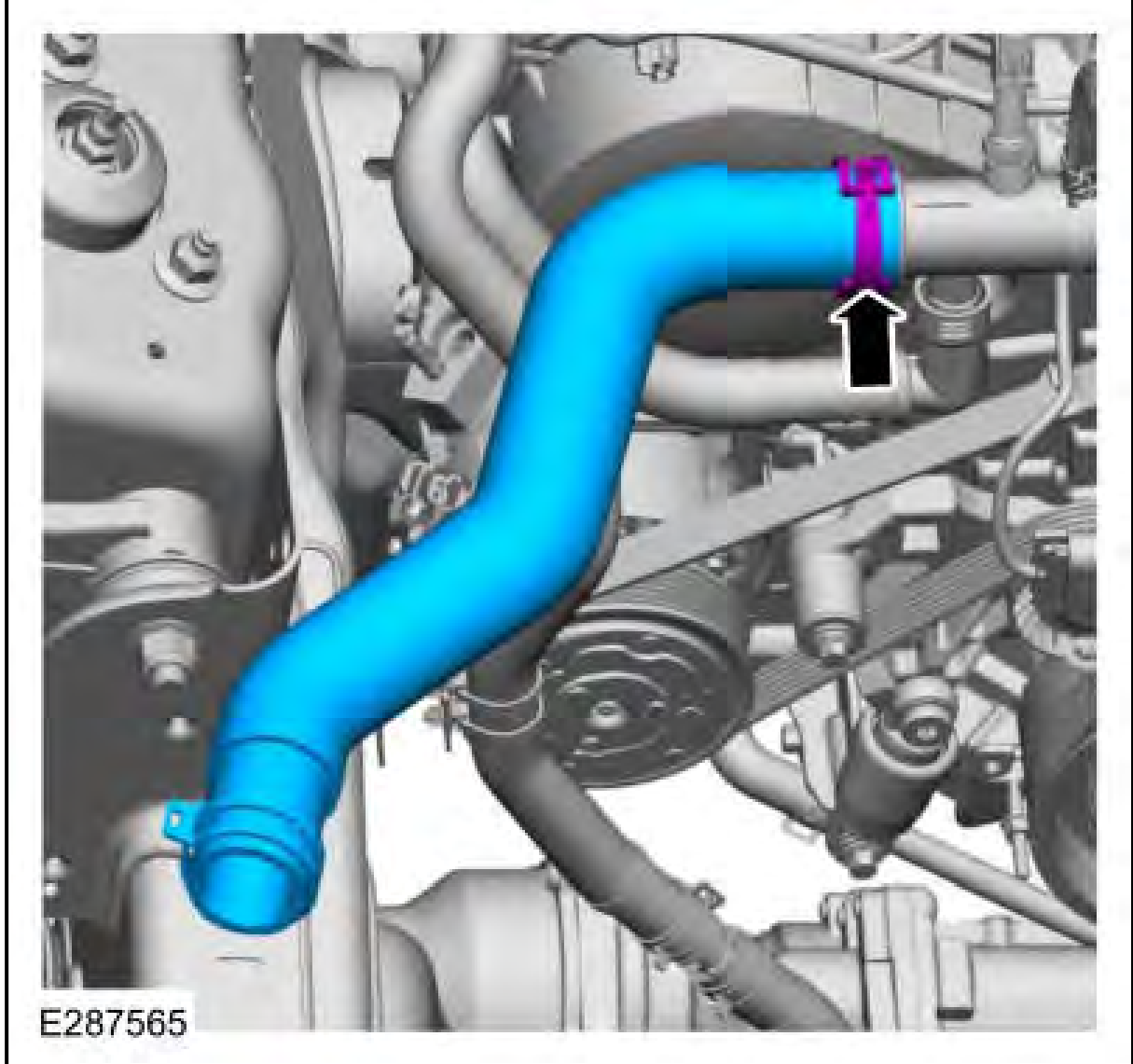


31. Install the lower radiator hose. Connect the retainer. Use the General Equipment: Hose Clamp Remover/Installer



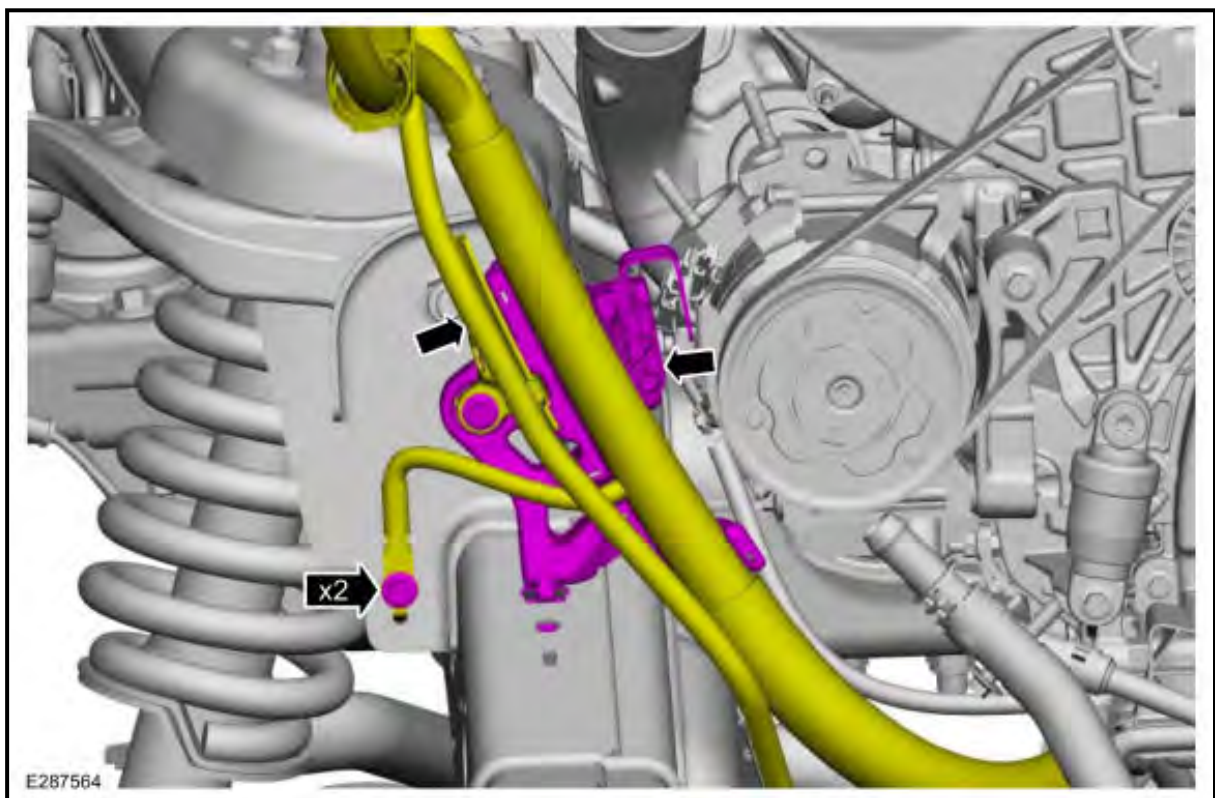
32. Install the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer



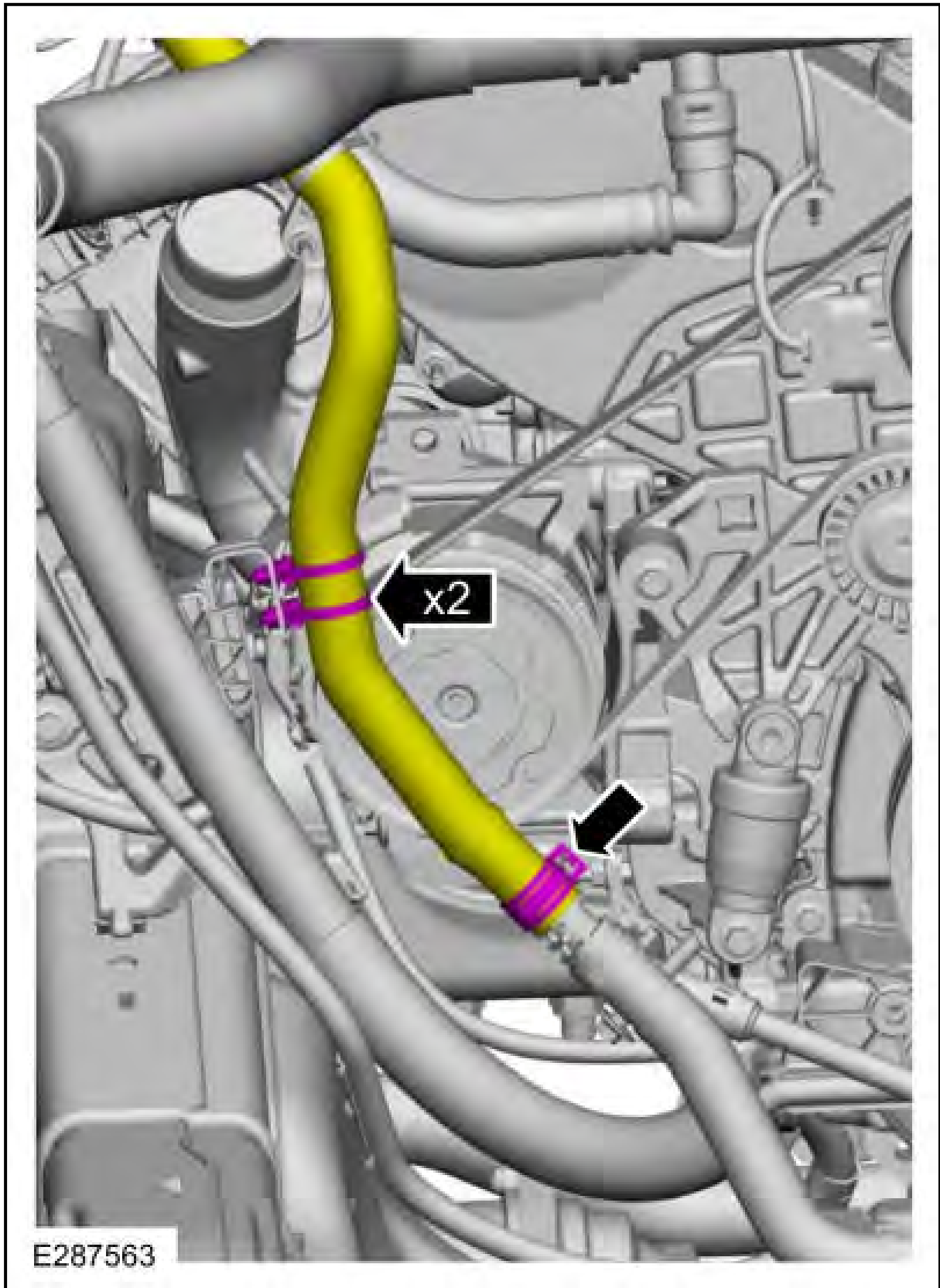


33. Position back the battery wire harness. Position back the power steering power cable and install the bolts.

Torque: 177 lb.in (20 Nm)



34. Position back the coolant hose and connect the retainers. Connect the coolant hose. Use the General Equipment: Hose Clamp Remover/Installer

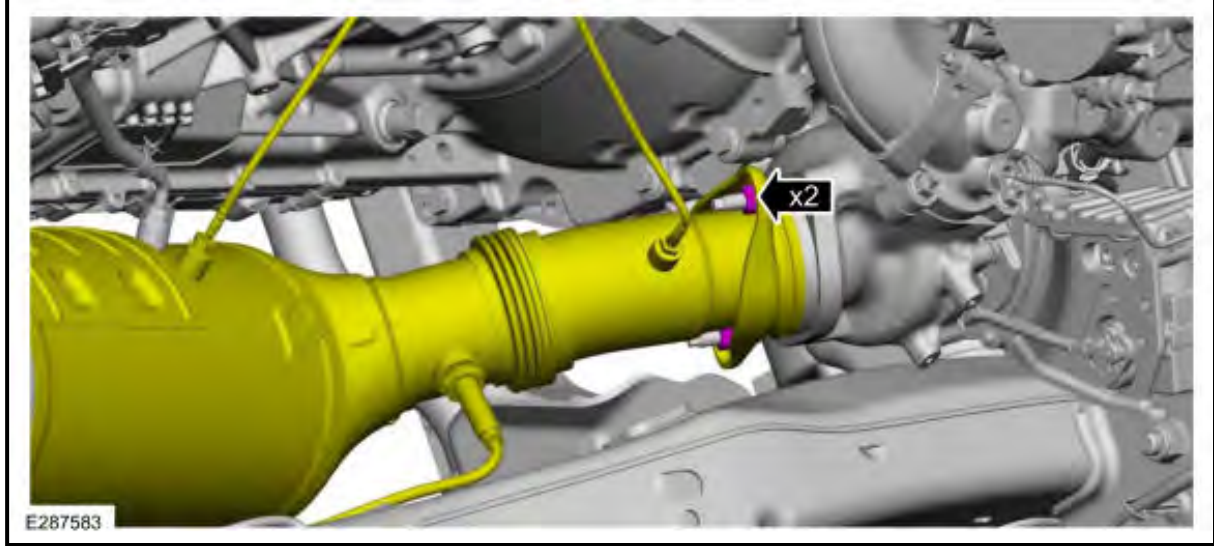


35. Position back the exhaust and install the nuts.

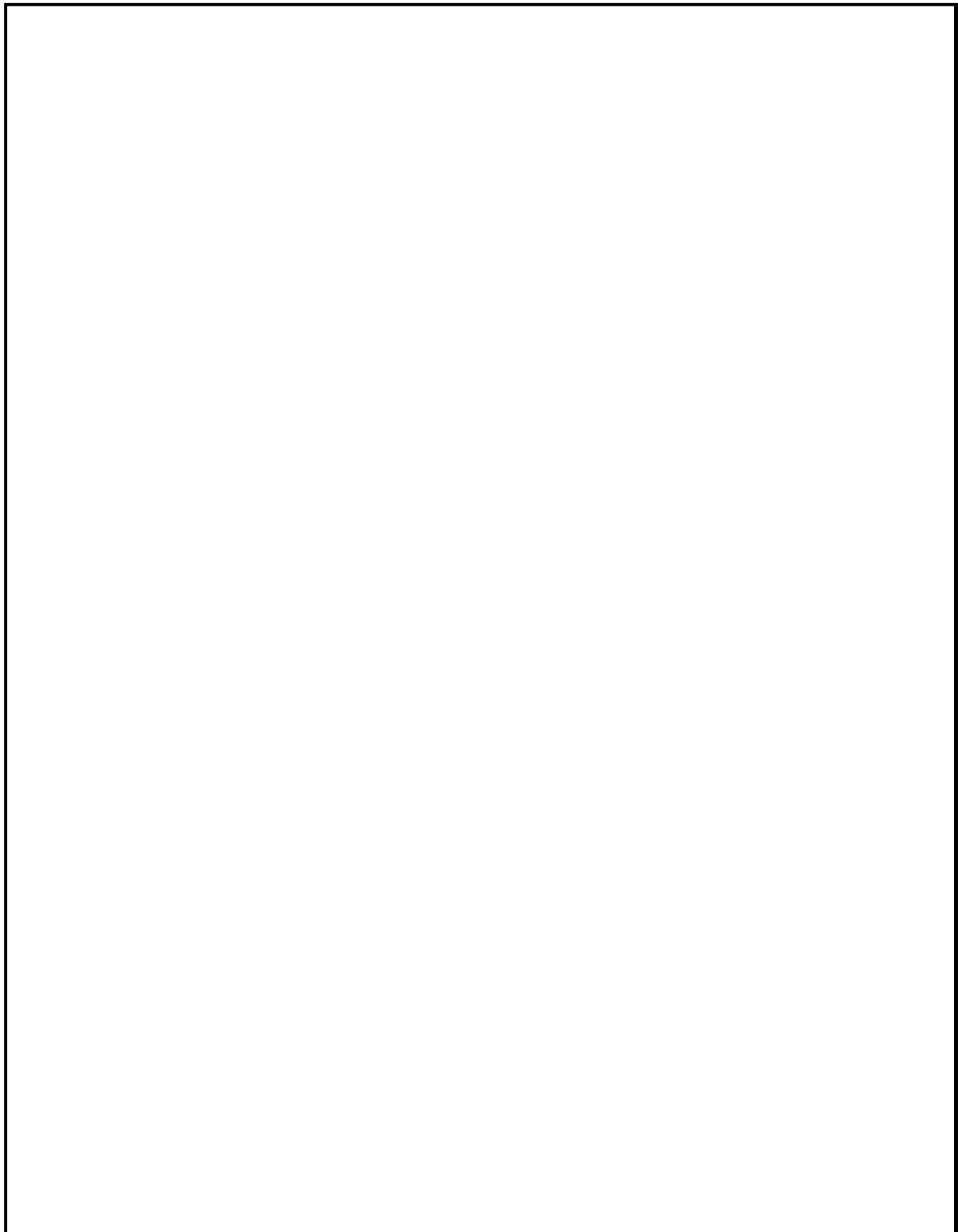
Torque: 30 lb.ft (40 Nm)

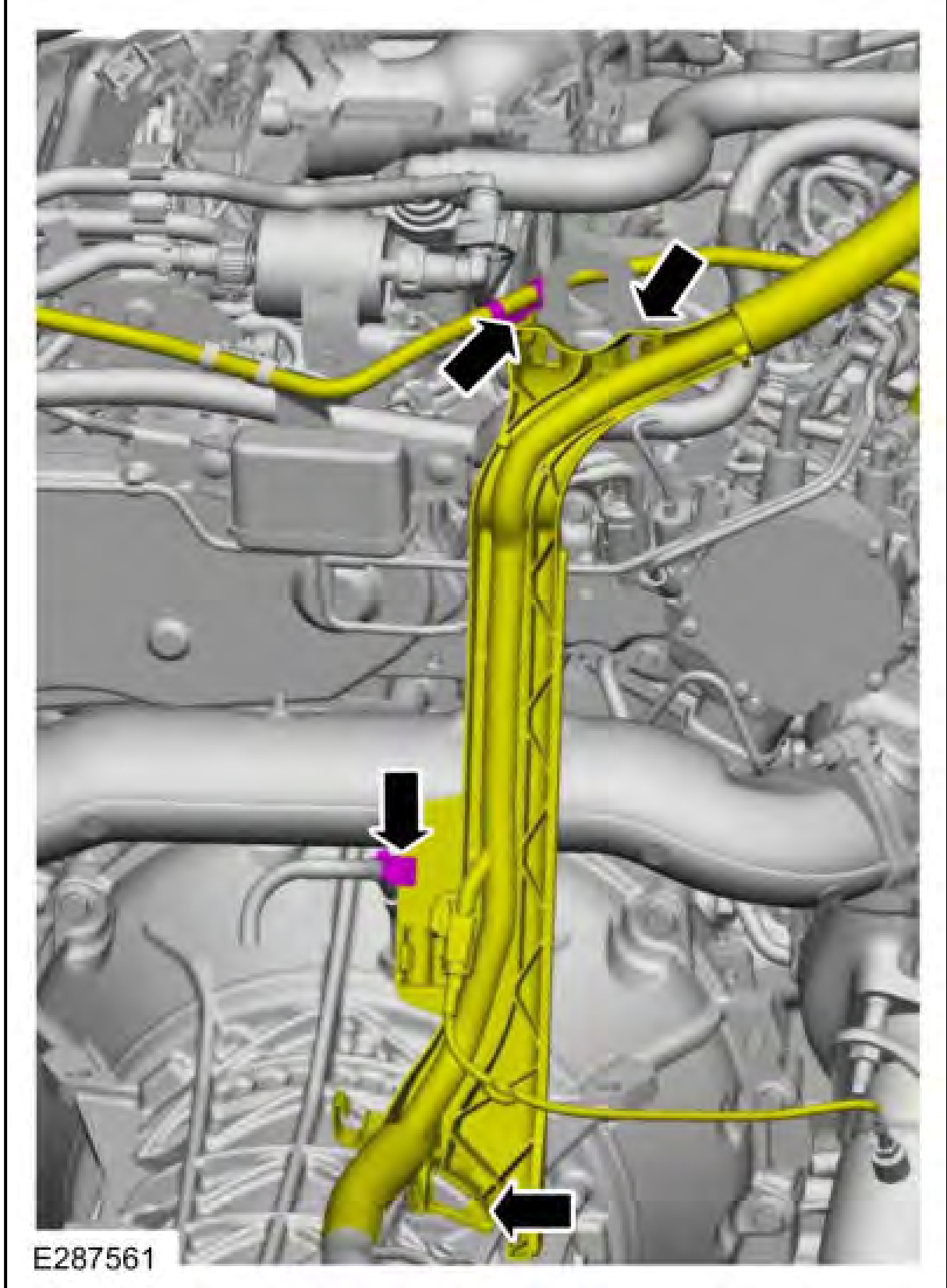






36. Position back the wire harness housing. Connect the vacuum hose retainer and the transmission vent tube.





37. Remove the wheel chocks.

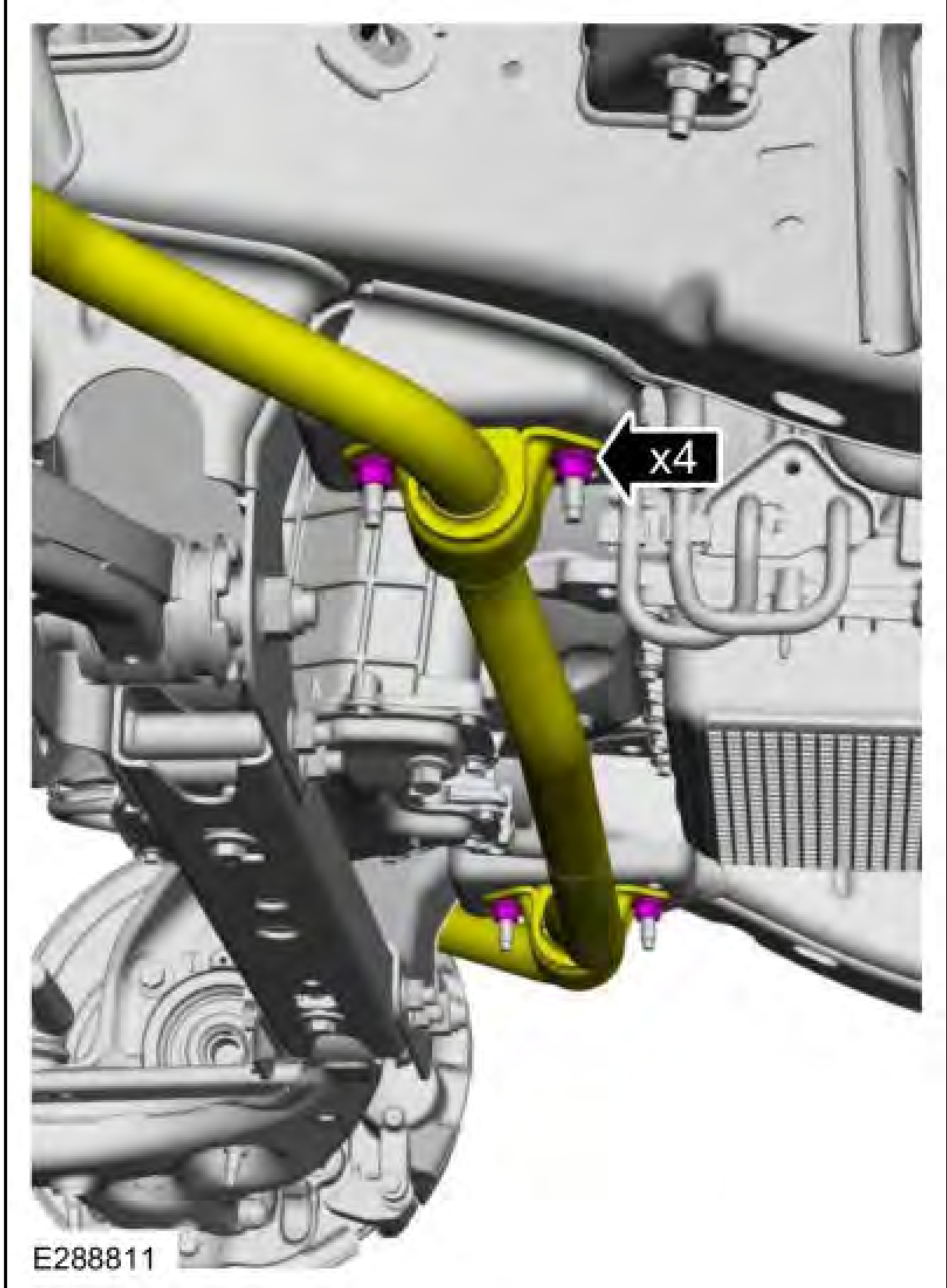
- Roll the chassis back to the markings on the floor.

38. Install the body. Refer to: [Body - 3.0L Power Stroke Diesel](#) .

39. Position the stabilizer bar and install the new nuts.

Torque: 41 lb.ft (55 Nm)





40. **NOTE:** Only use hand tools when installing the engine mount nuts and studs or damage to the engine mount can occur.

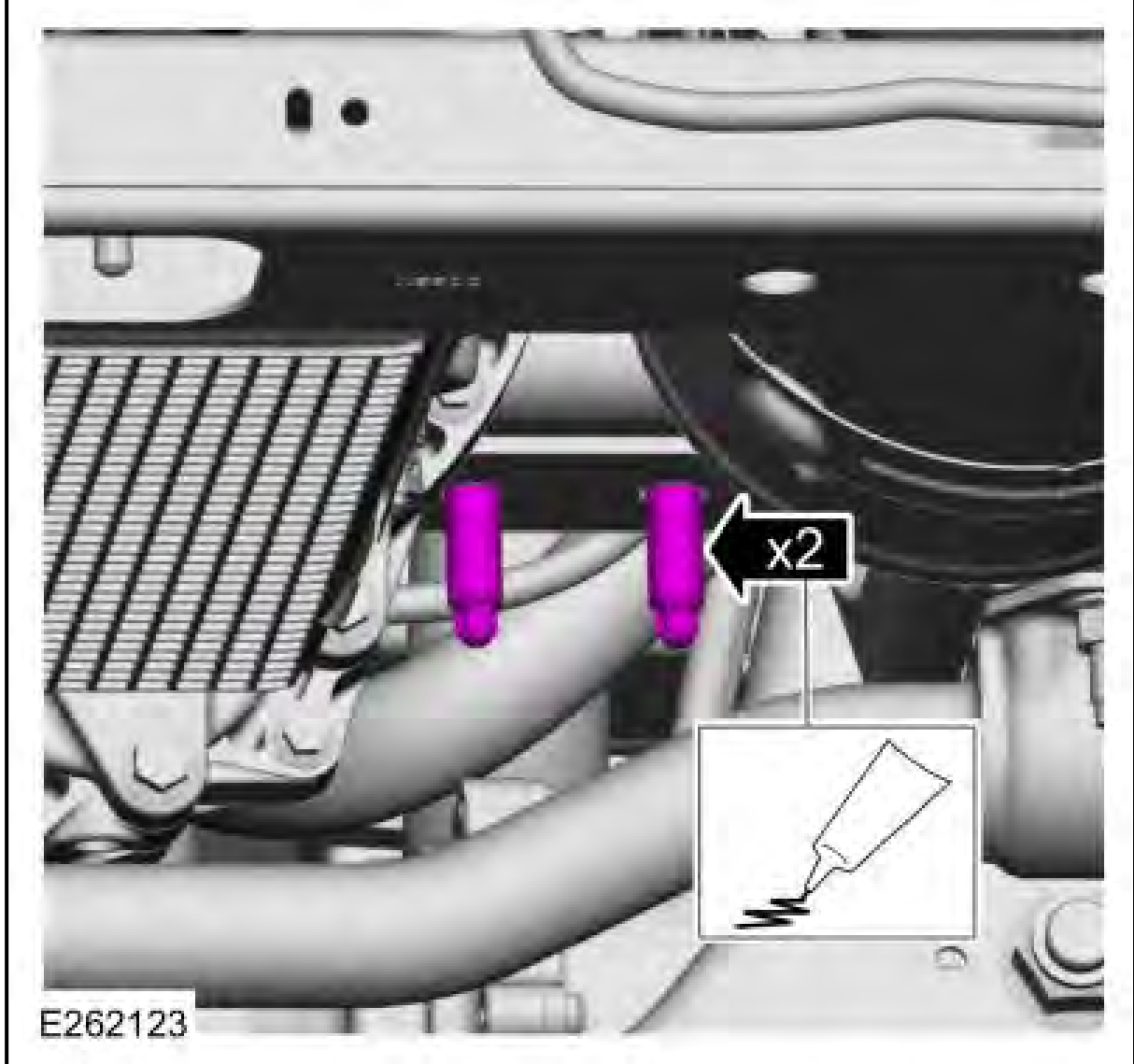
**NOTE:** Apply threadlock to the stud threads prior to installation.

Install the RH engine mount studs.

Material: Motorcraft <sup>®</sup> Threadlock 262 / TA-26 (WSK-M2G351-A6)

Torque: 22 lb.ft (30 Nm)

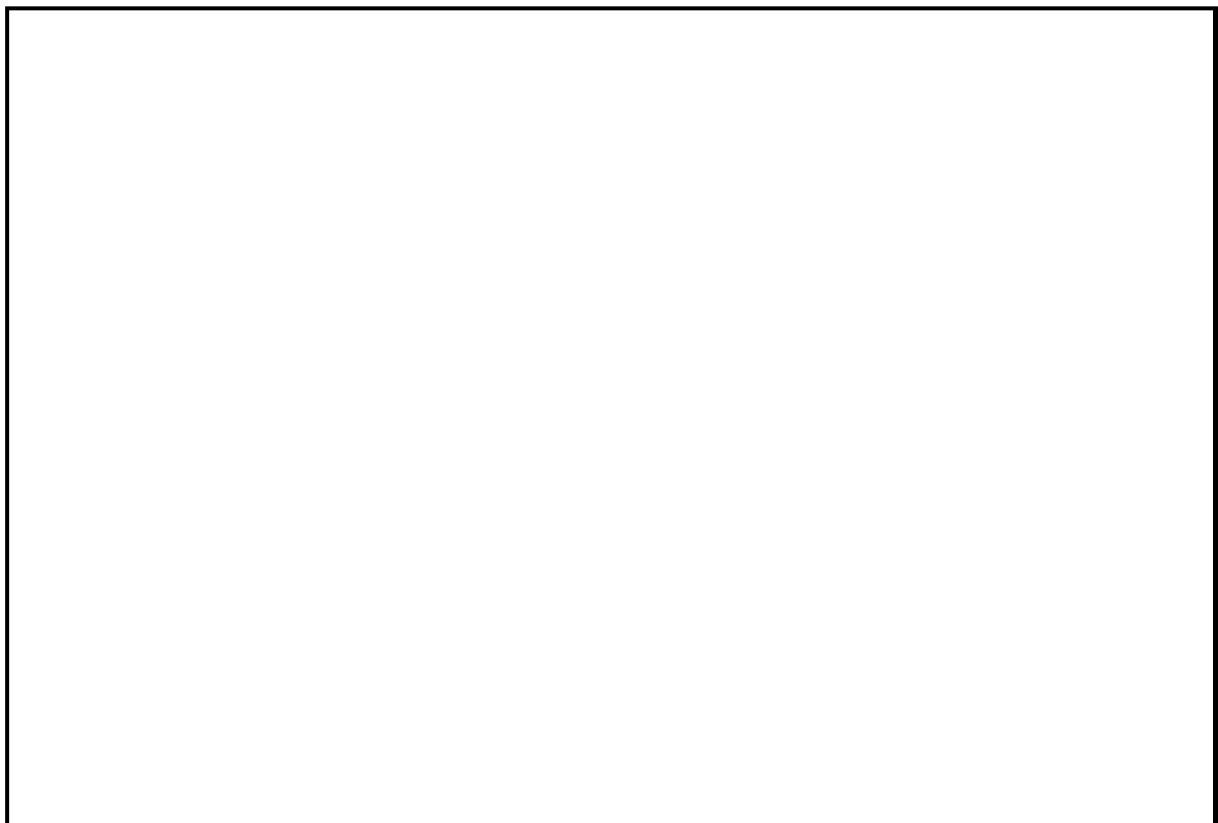


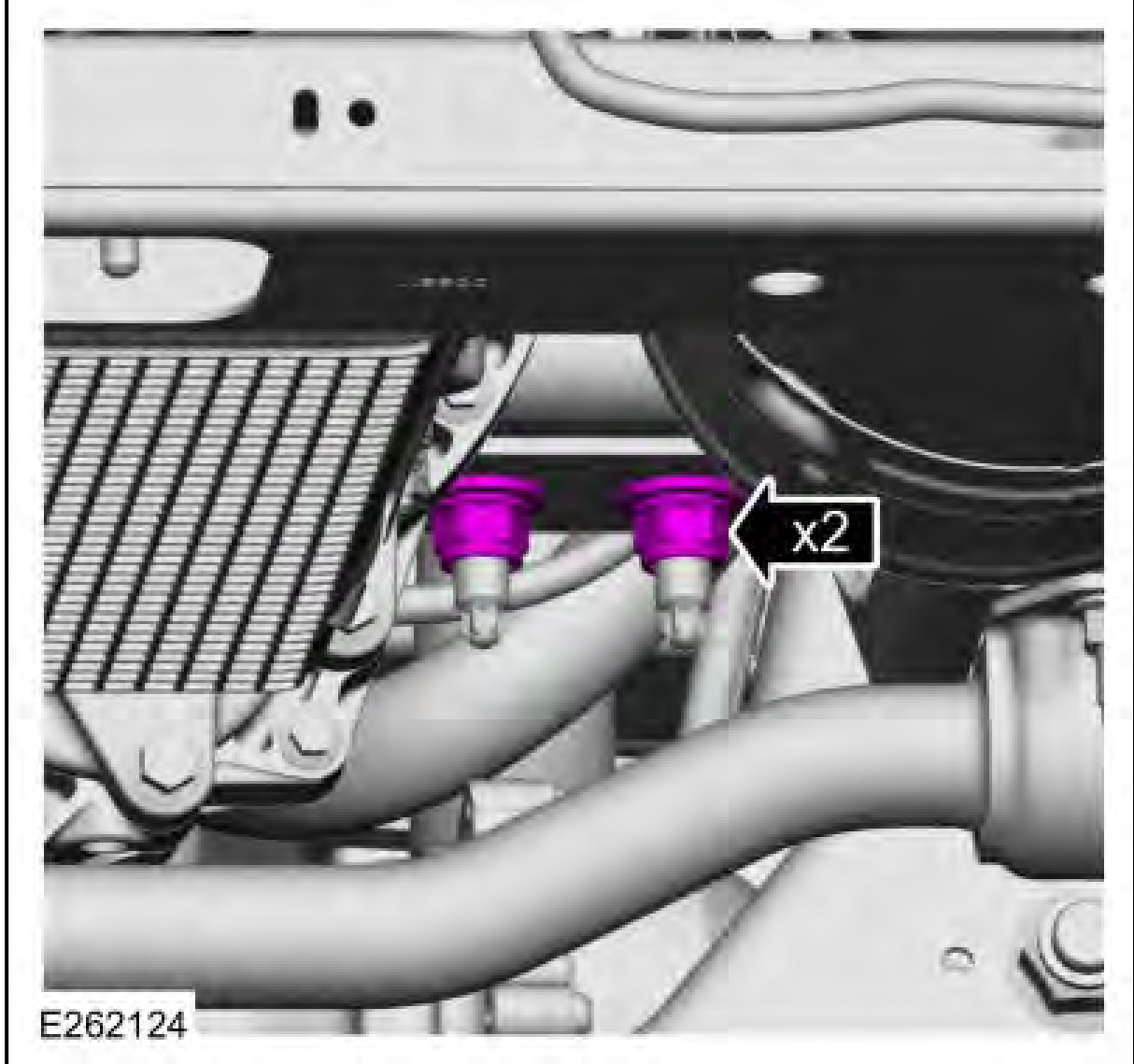


41. **NOTE:** Only use hand tools when installing the engine mount nuts and studs or damage to the engine mount can occur.

Install the new RH engine mount nuts.

Torque: 111 lb.ft (150 Nm)



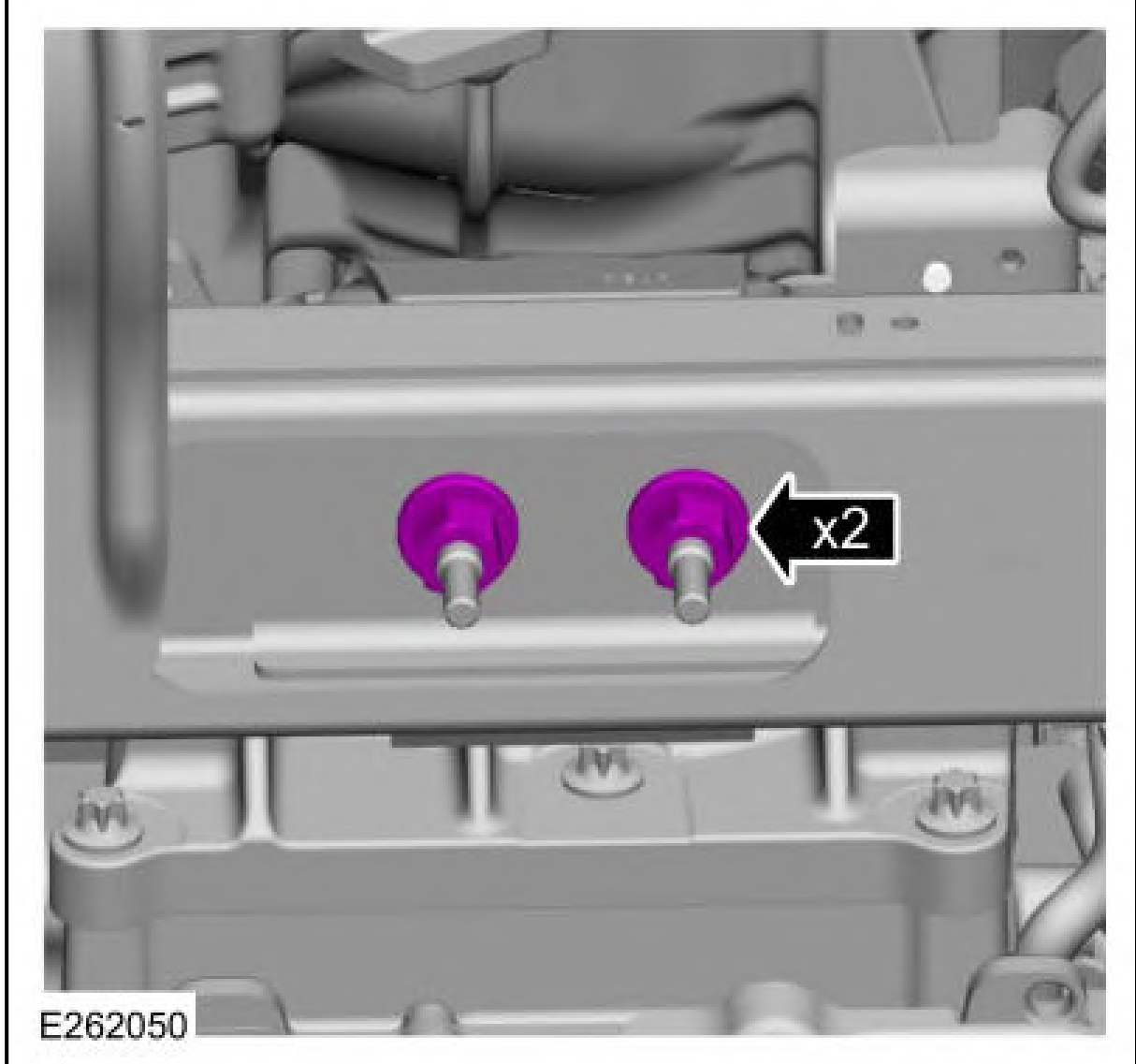


42. **NOTE:** Only use hand tools when loosening or tightening the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.

Remove and discard the transmission mount-to-crossmember nuts. Install new transmission mount-to-crossmember nuts.

Torque: 85 lb.ft (115 Nm)

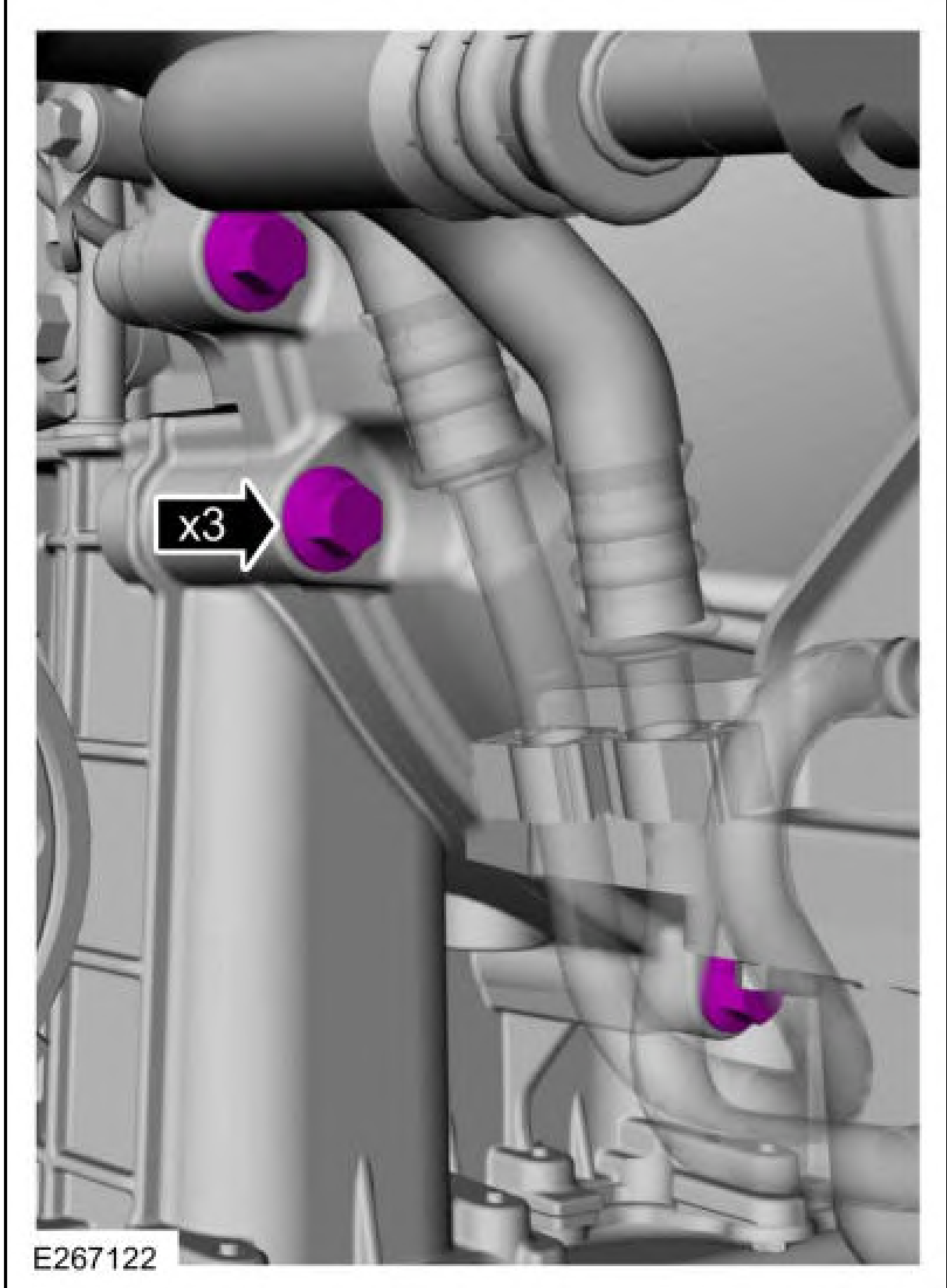




43. Install the LH side bellhousing bolts.

Torque: 35 lb.ft (48 Nm)

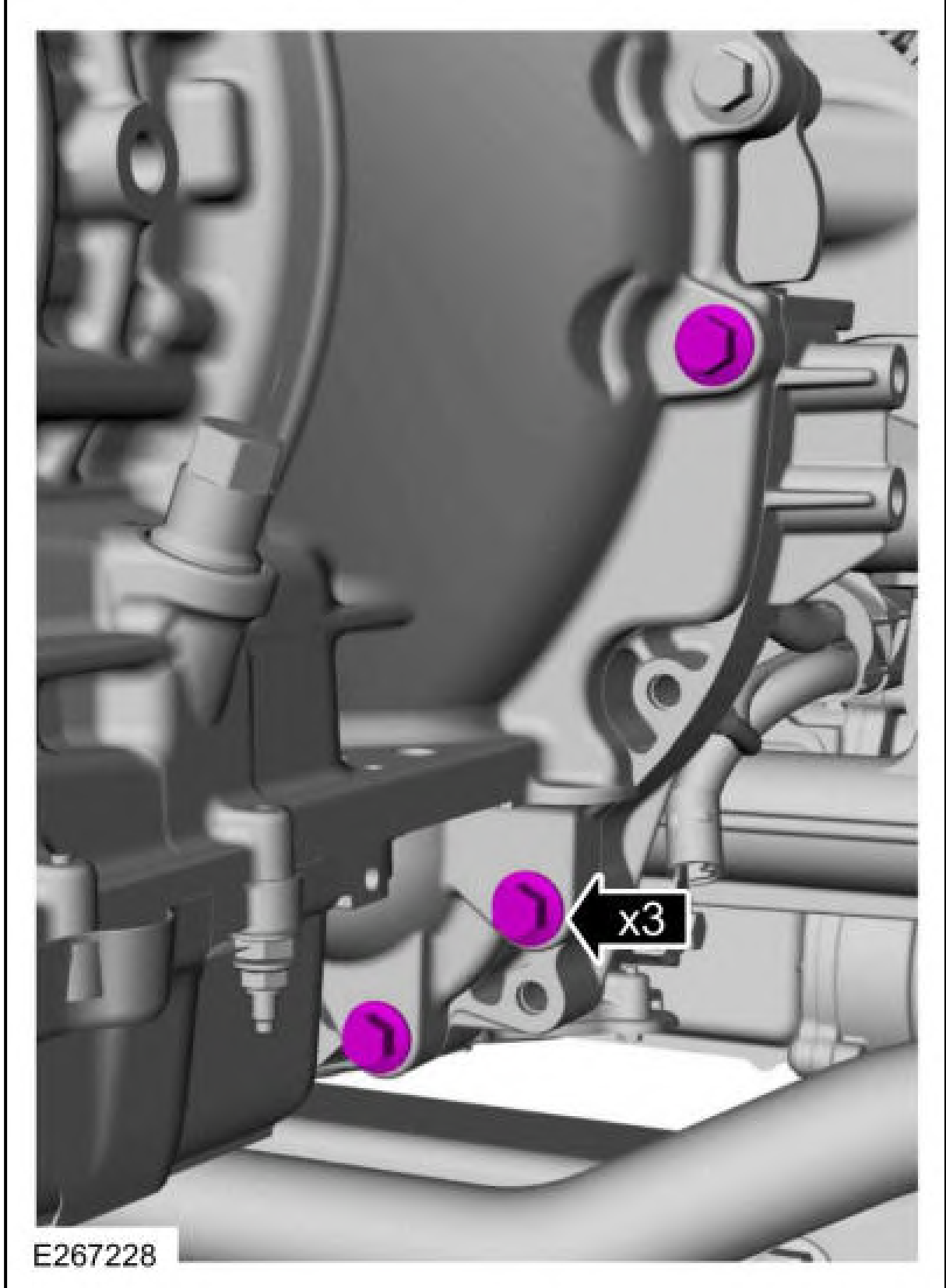




44. Install the RH side bellhousing bolt.

Torque: 35 lb.ft (48 Nm)





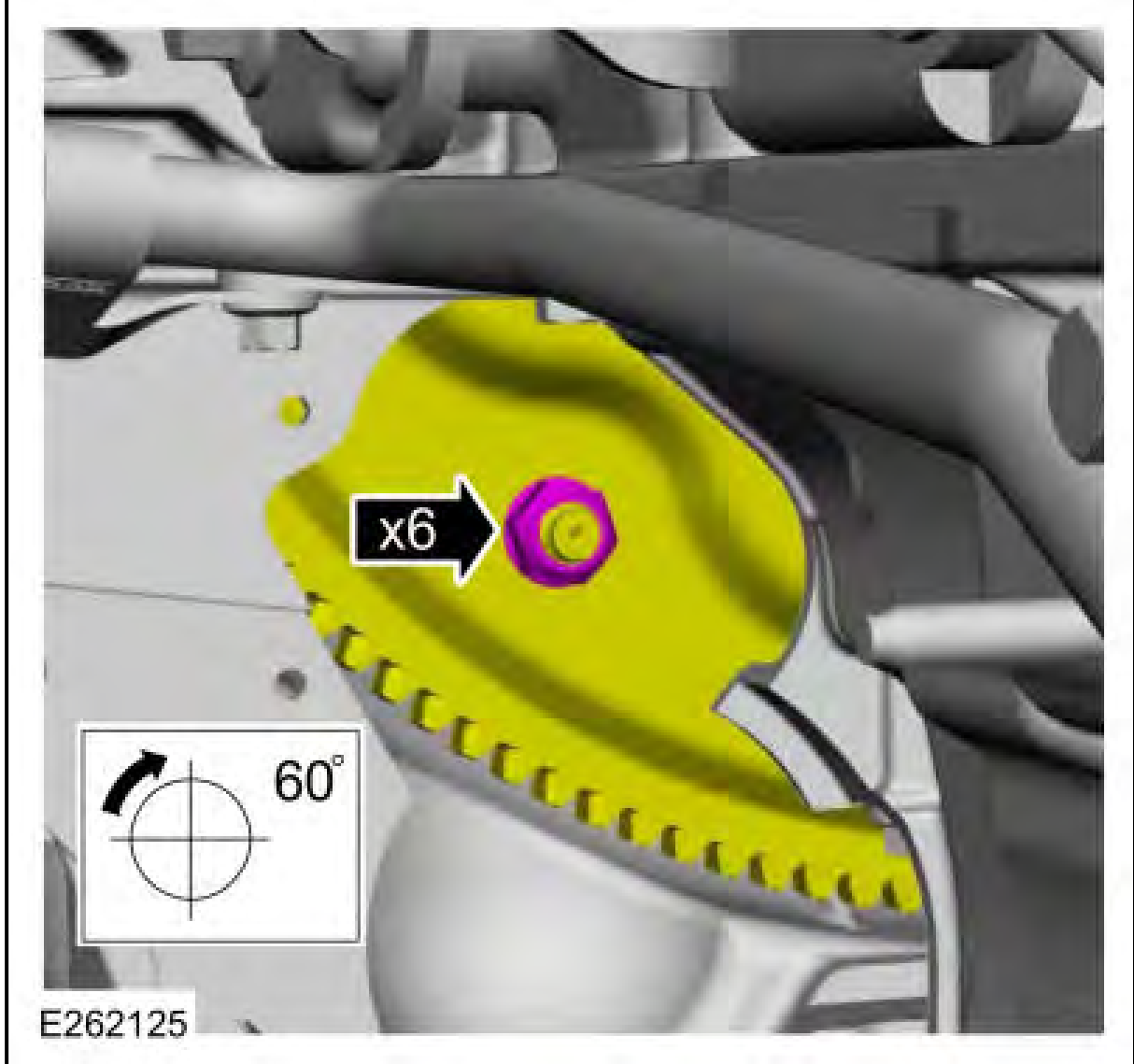
45. **NOTE:** Using the crankshaft pulley bolt, turn the engine clockwise.

Install new torque converter nuts.

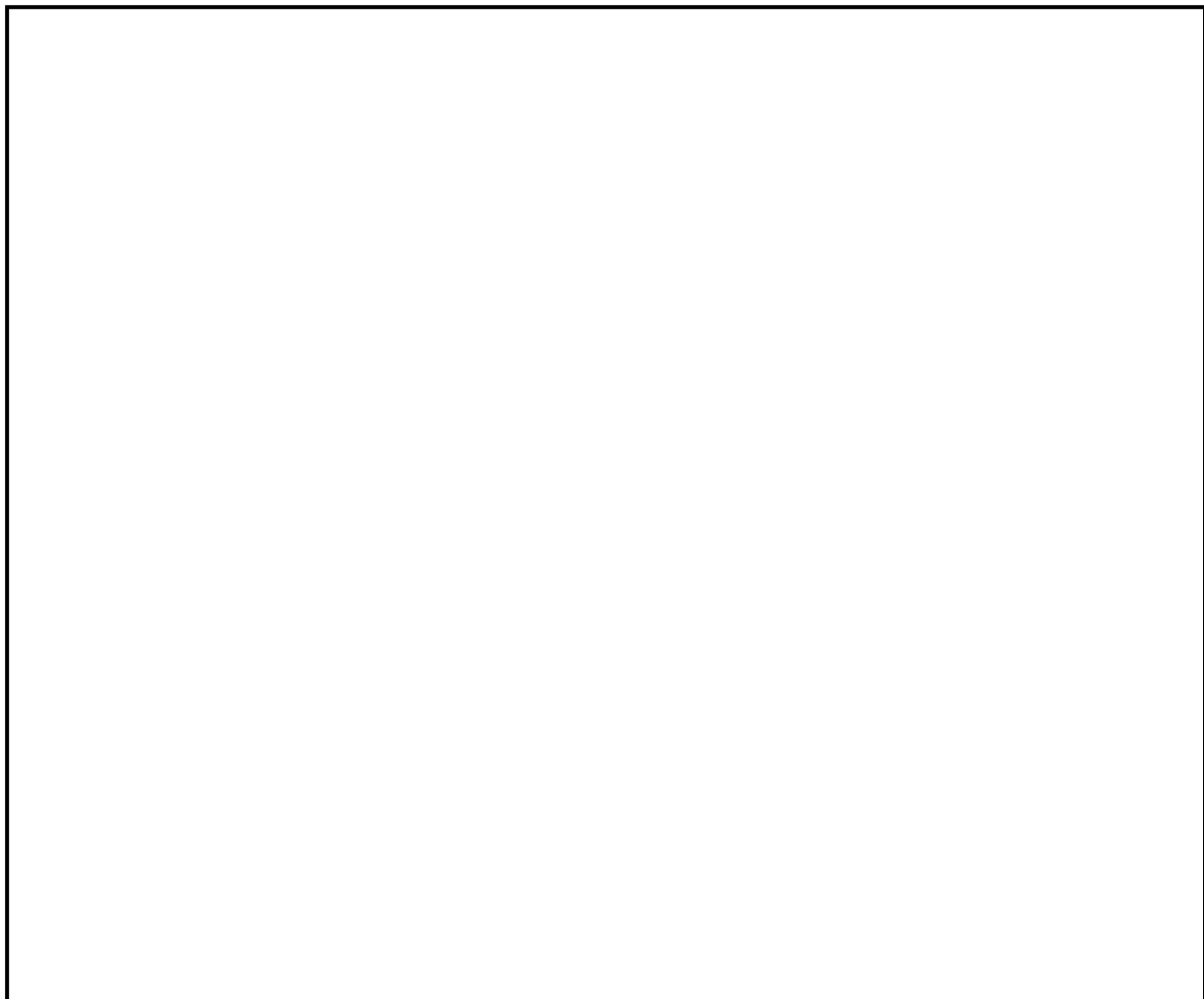
Torque: 35 lb.ft (48 Nm)

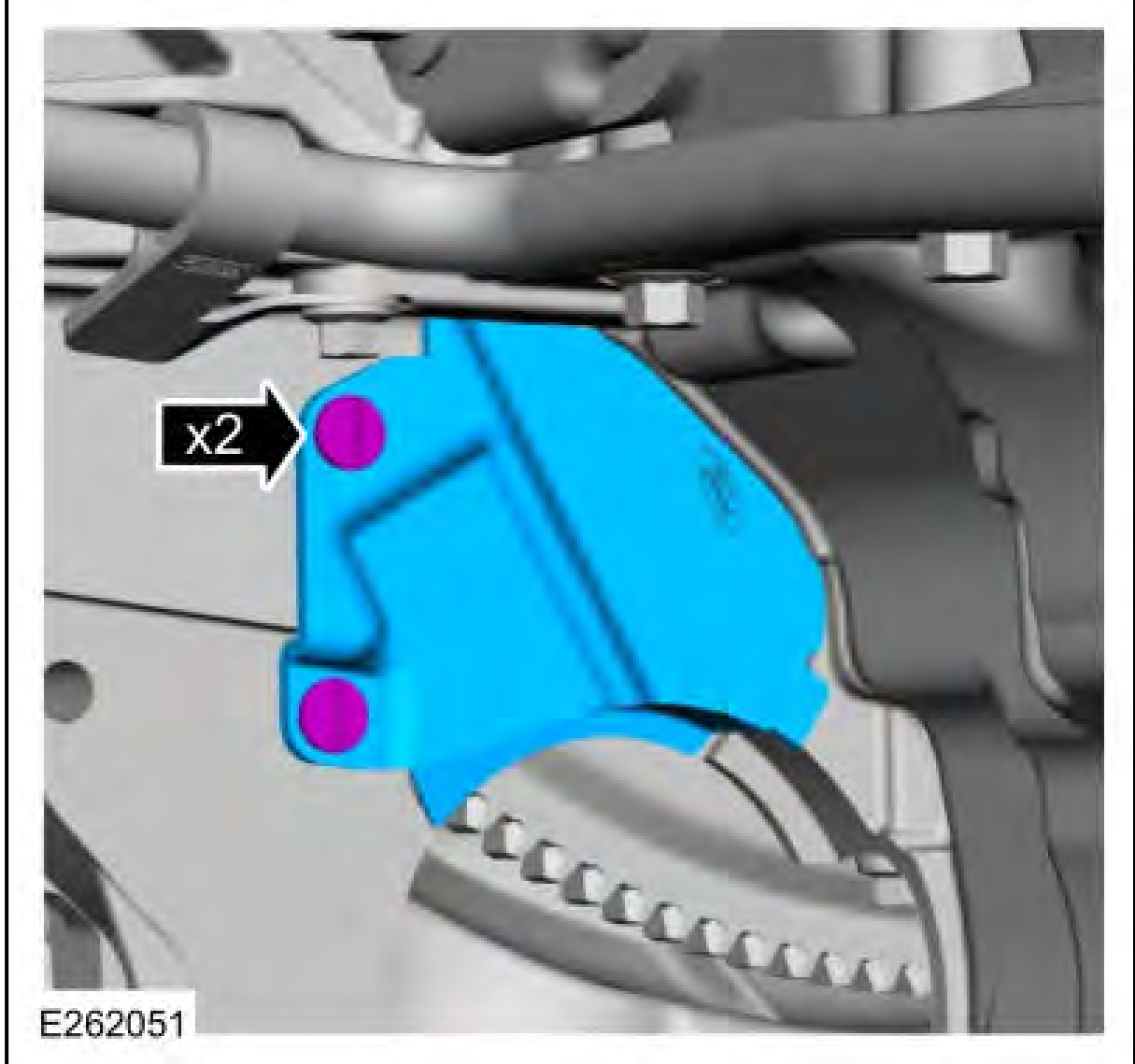






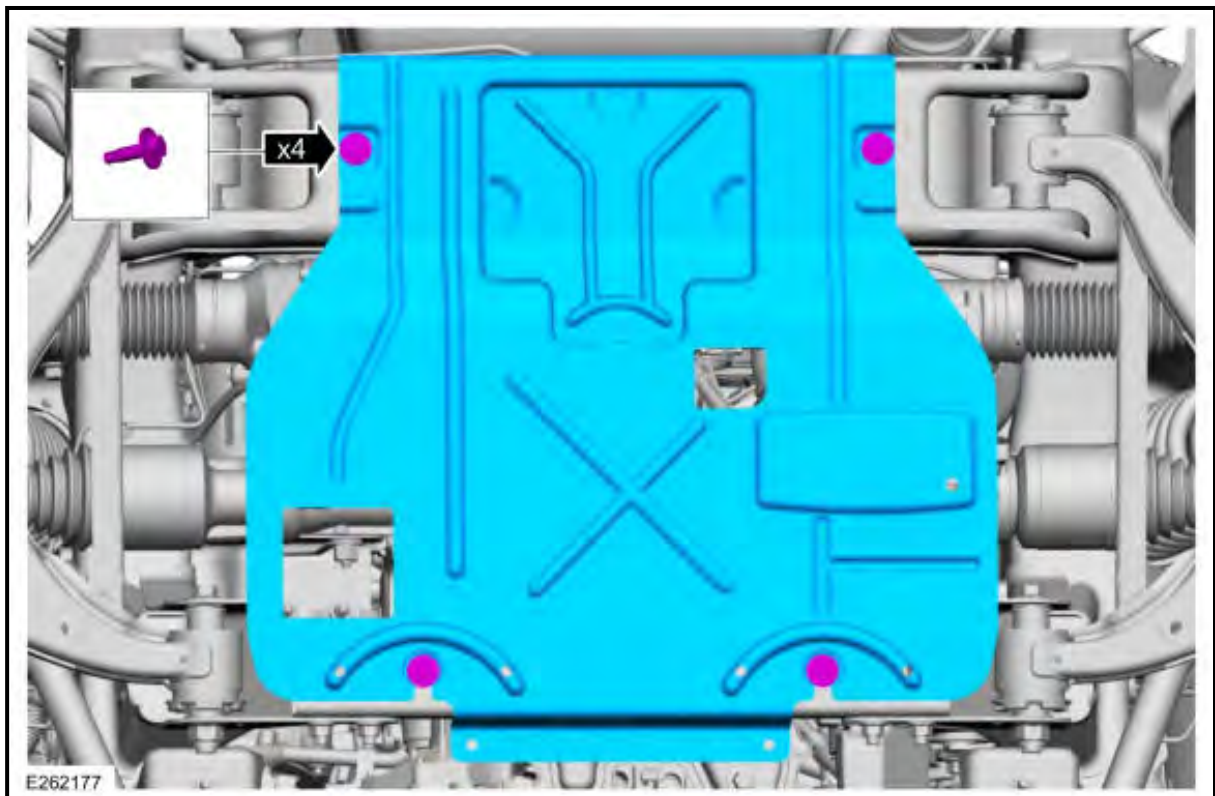
46. Install the access cover and the retainers.





47. Install the starter motor. Refer to: [Starter Motor](#) .
48. If equipped, Install the skid plate and the bolts.

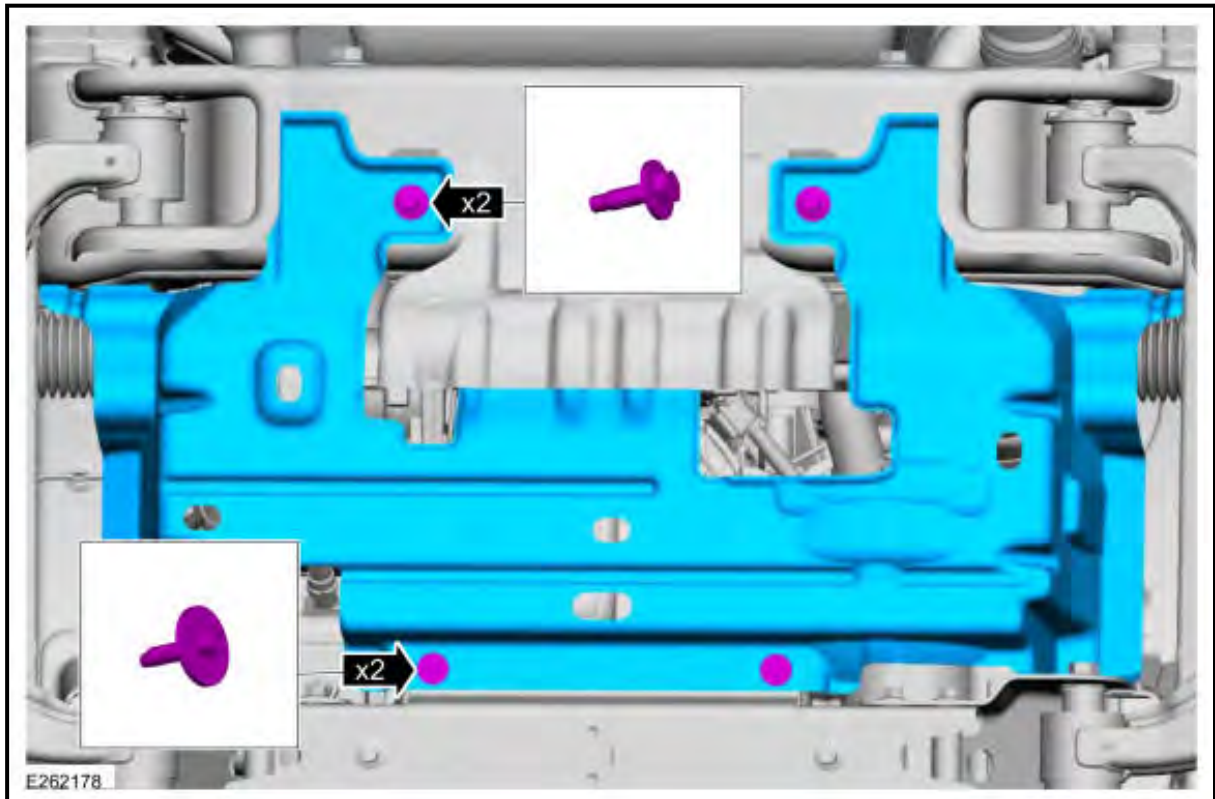
Torque: 30 lb.ft (40 Nm)



49. If equipped, install the underbody shield and the bolts.

Torque

:M8 bolt : 30 lb.ft (40 Nm) M6 bolt : 71 lb.in (8 Nm)



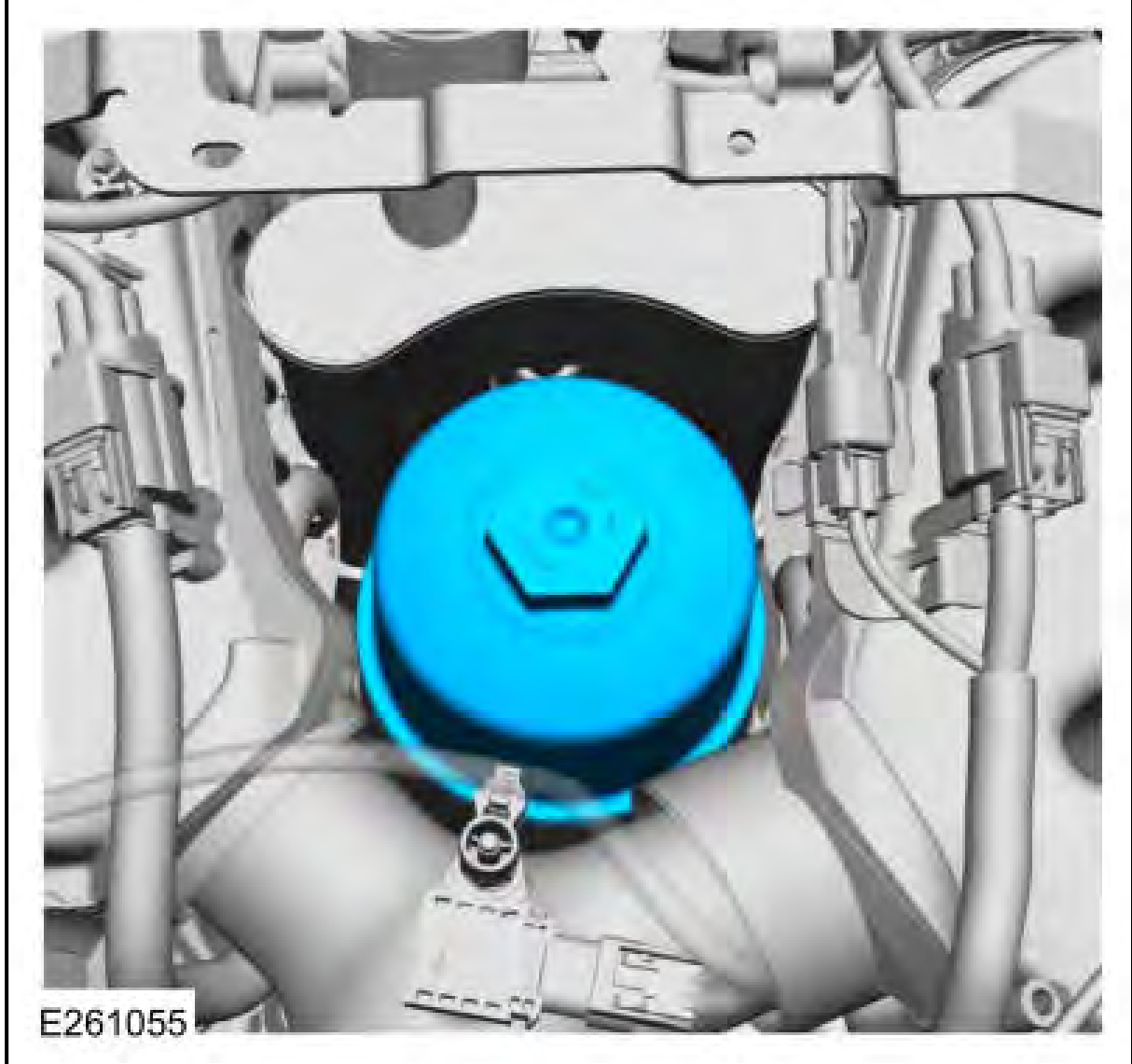
50. Install the transmission housing cover and the bolts. Install the retainer.

Torque: 71 lb.in (8 Nm)



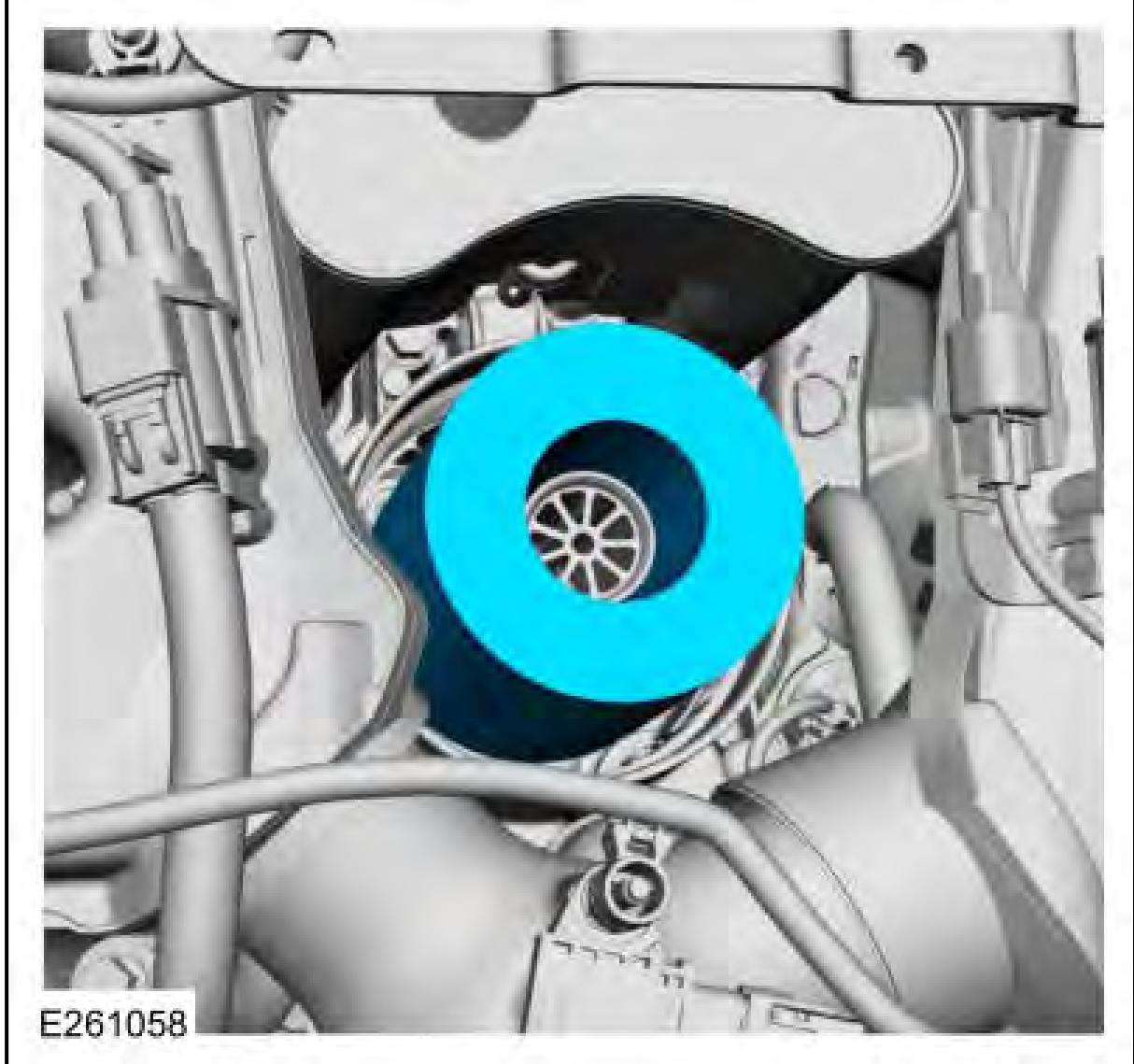
51. Remove the oil filter cap.





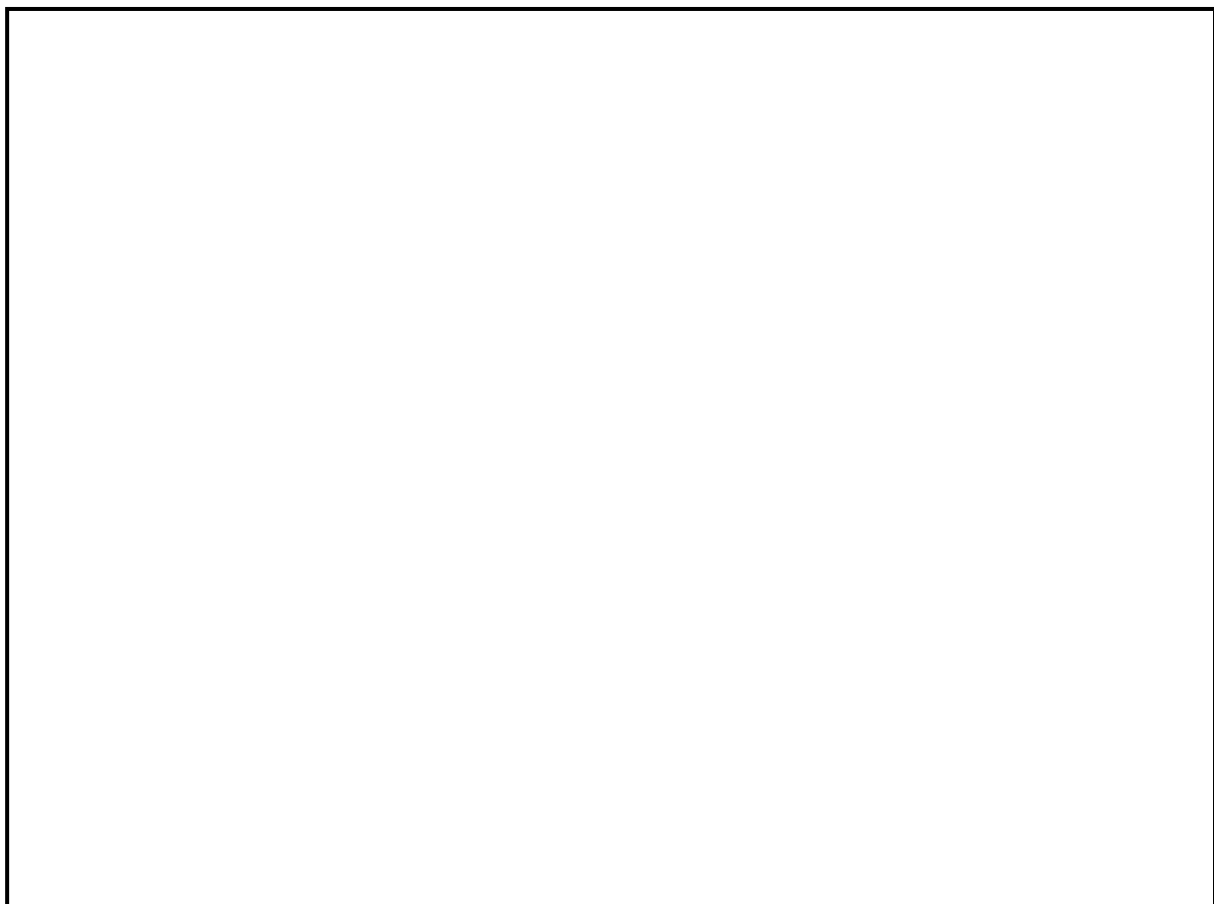
52. Install a new oil filter.

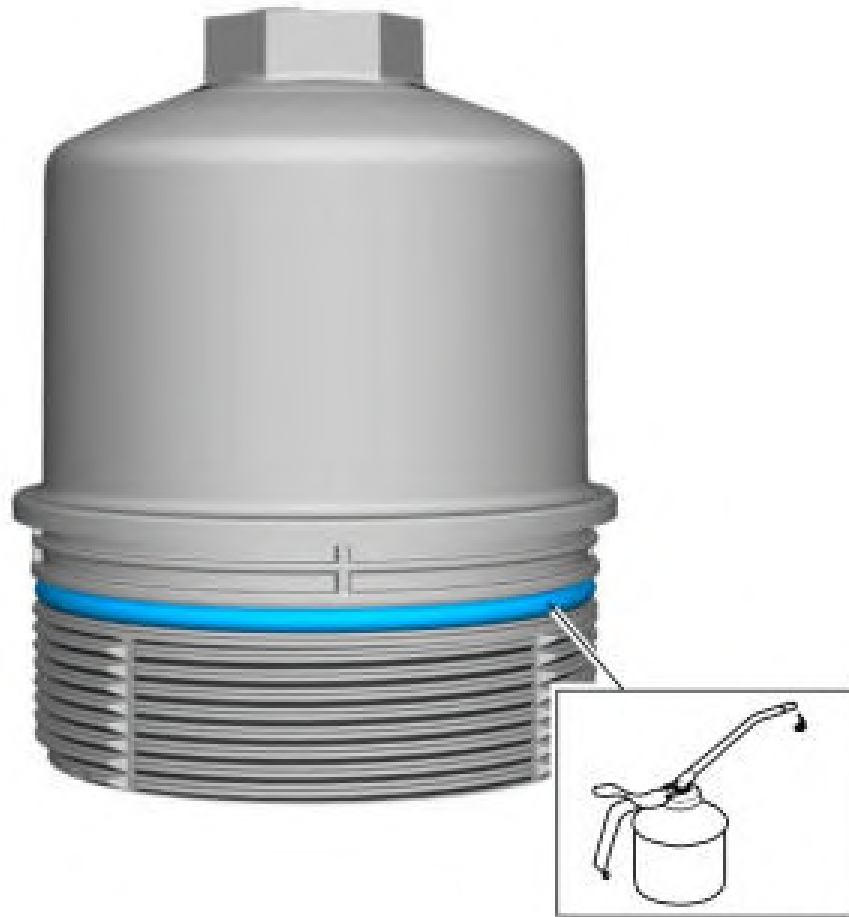




53. Install a new oil filter cap O-ring seal and lubricate.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

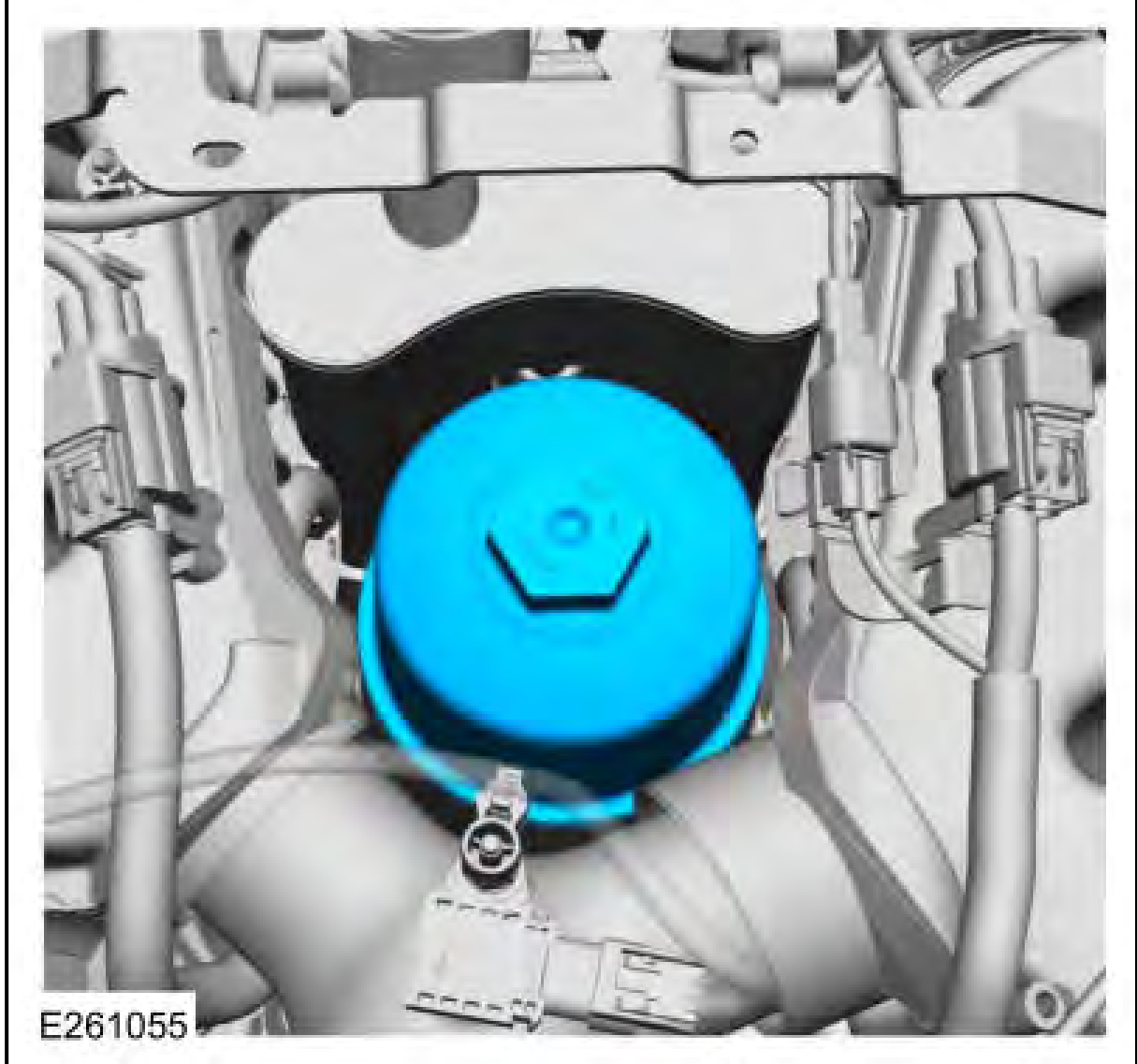




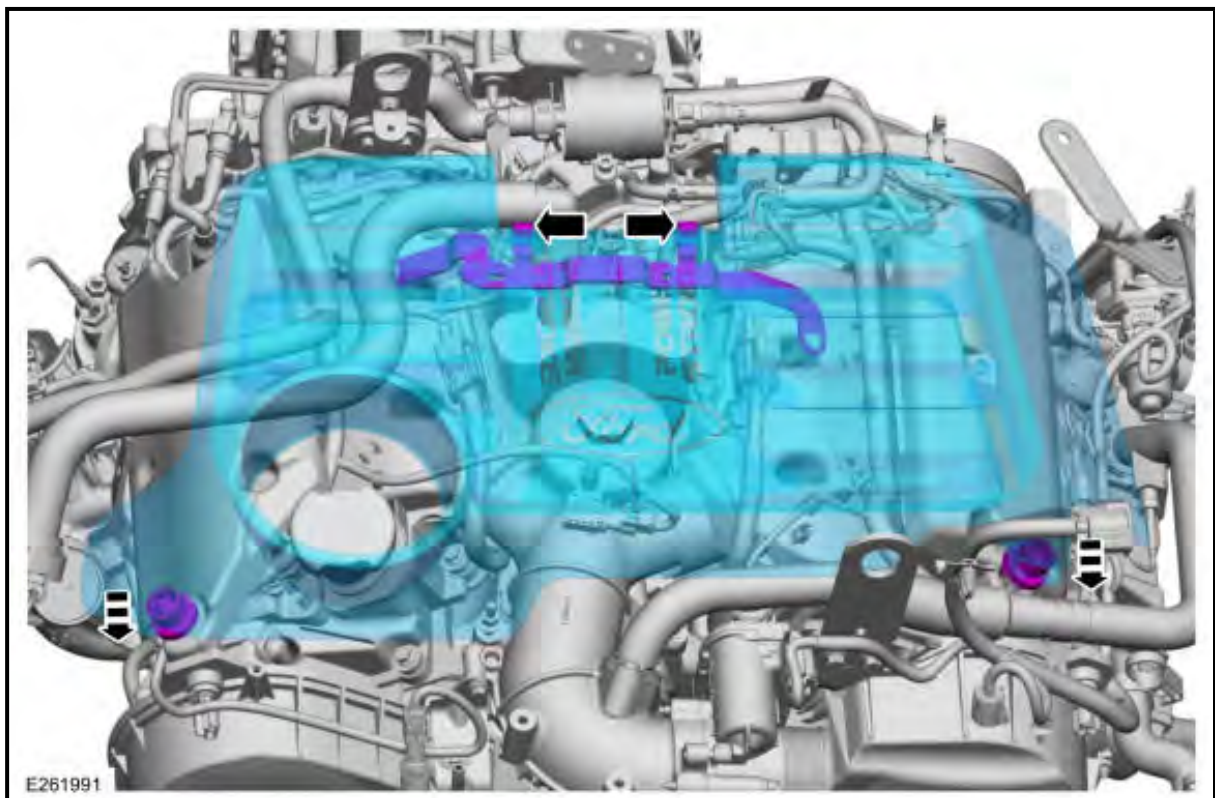
E261059

54. Install the oil filter cap.

Torque: 18 lb.ft (25 Nm)

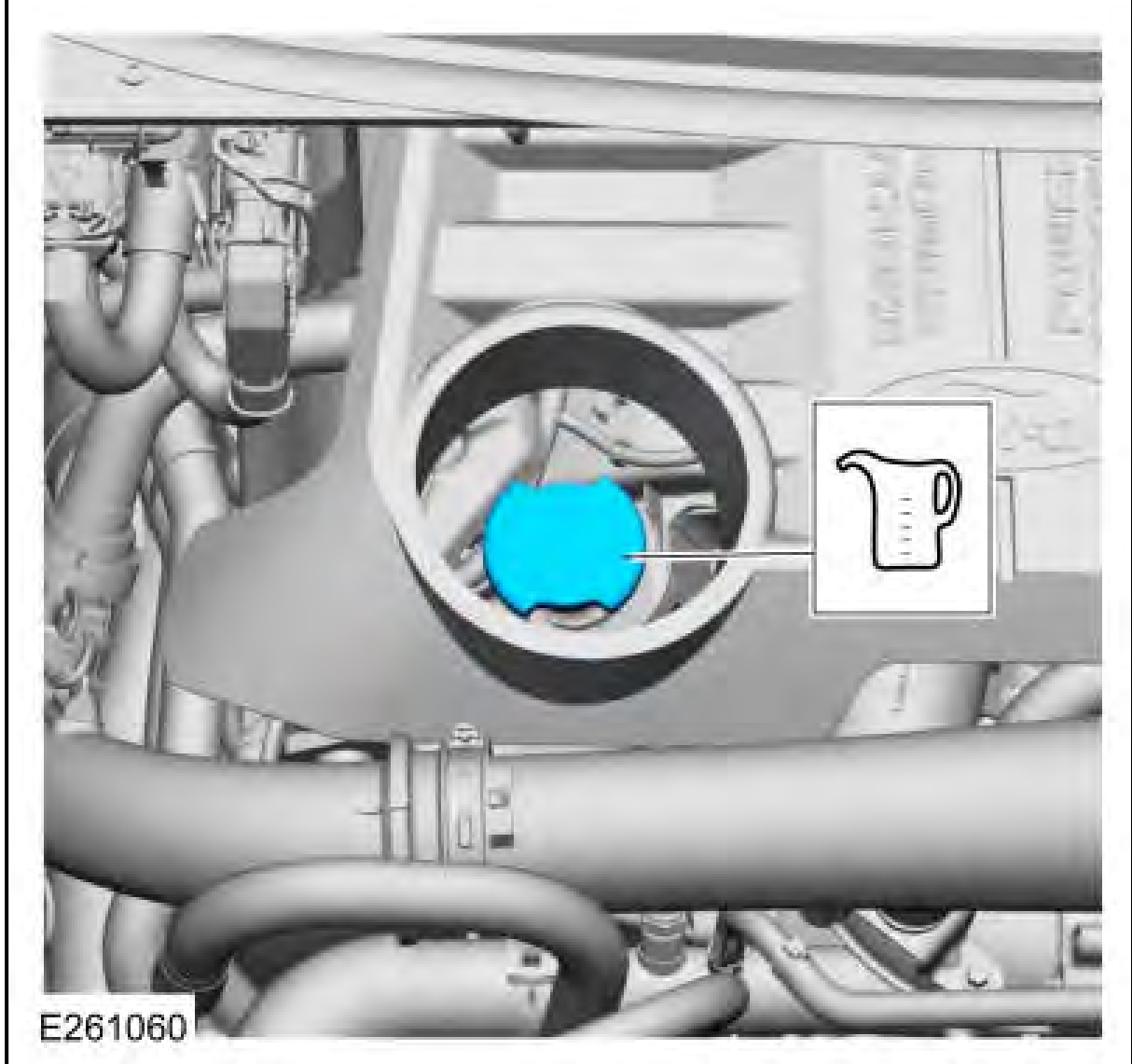


55. Install the engine appearance cover.



56. Fill the engine with clean engine oil. Refer to: [Specifications](#) .

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)



- 57. Connect the battery ground cable. Refer to: [Battery Disconnect and Connect](#) .
- 58. Bleed the fuel system. Refer to: [Fuel System Bleeding](#) .
- 59. Start and check the exhaust system for leaks.

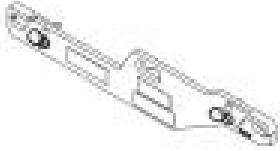
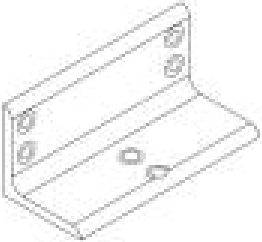
**ENGINE - BODY ON**

For more information on Ford Color Coded Illustrations refer to [OEM COLOR CODING](#) .

**Special Tool(s) / General Equipment**

|                |                              |
|----------------|------------------------------|
| <p>E274098</p> | <p>303-1681 Spreader Bar</p> |
| <p>E274099</p> | <p>303-1684 Lifting Eye</p>  |



|  |  |
|--|--|
|  <p>E274098</p>  | <p><b>303-1681 Spreader Bar</b></p>  |
|  <p>E216422</p> | <p>307-625 Fixture, Bench Mounting<br/>TKIT-2008ET-FLM<br/>TKIT-2008ET-ROW</p> |
| <p>Floor Crane<br/>Trolley Jack<br/>Hose Clamp<br/>Remover/Installer<br/>Wooden Block</p>        |  |

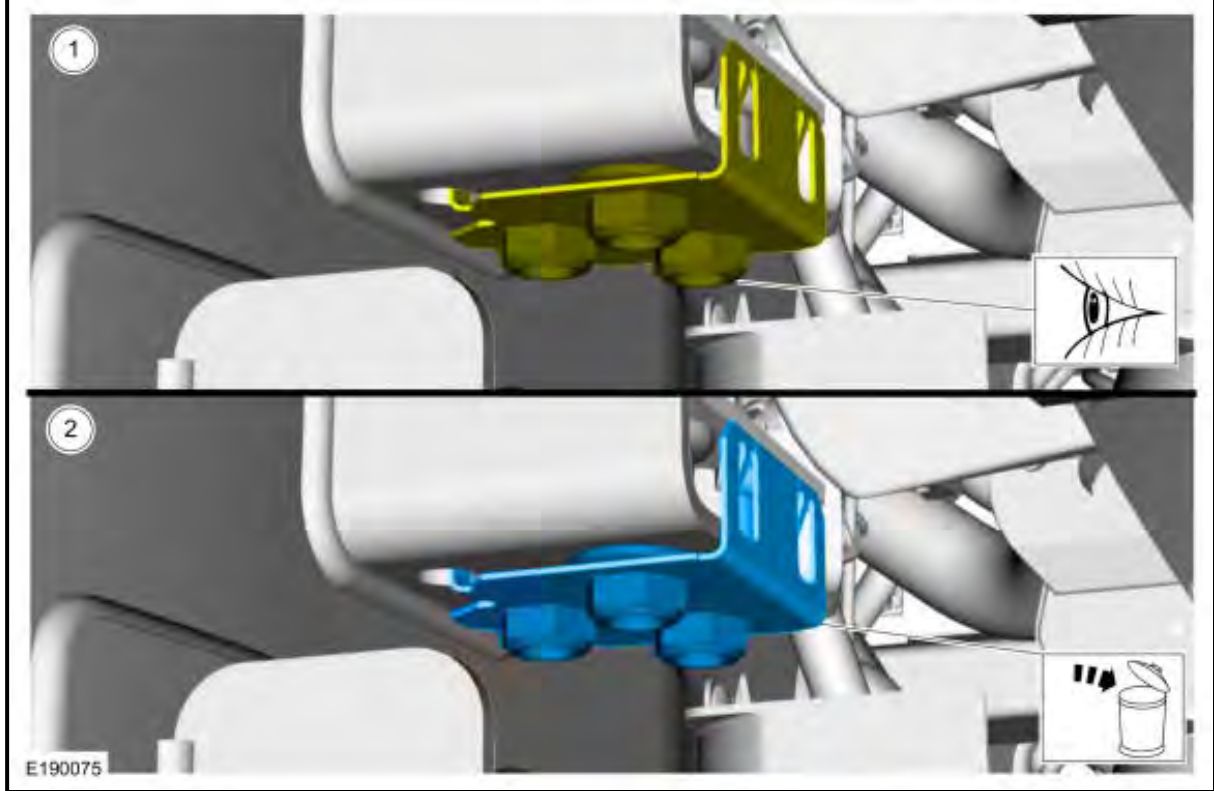
**Materials**

| Name  | Specification |
|---|---------------|
| Motorcraft <sup>®</sup> Multi-Purpose Grease Spray XL-5-A             | ESB-M1C93-B   |
| Motorcraft <sup>®</sup> Threadlock 262TA-26                           | WSK-M2G351-A6 |
| Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil XO-5W30-QFA  | WSS-M2C214-B1 |
| Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant VC-3-B | WSS-M97B44-D  |

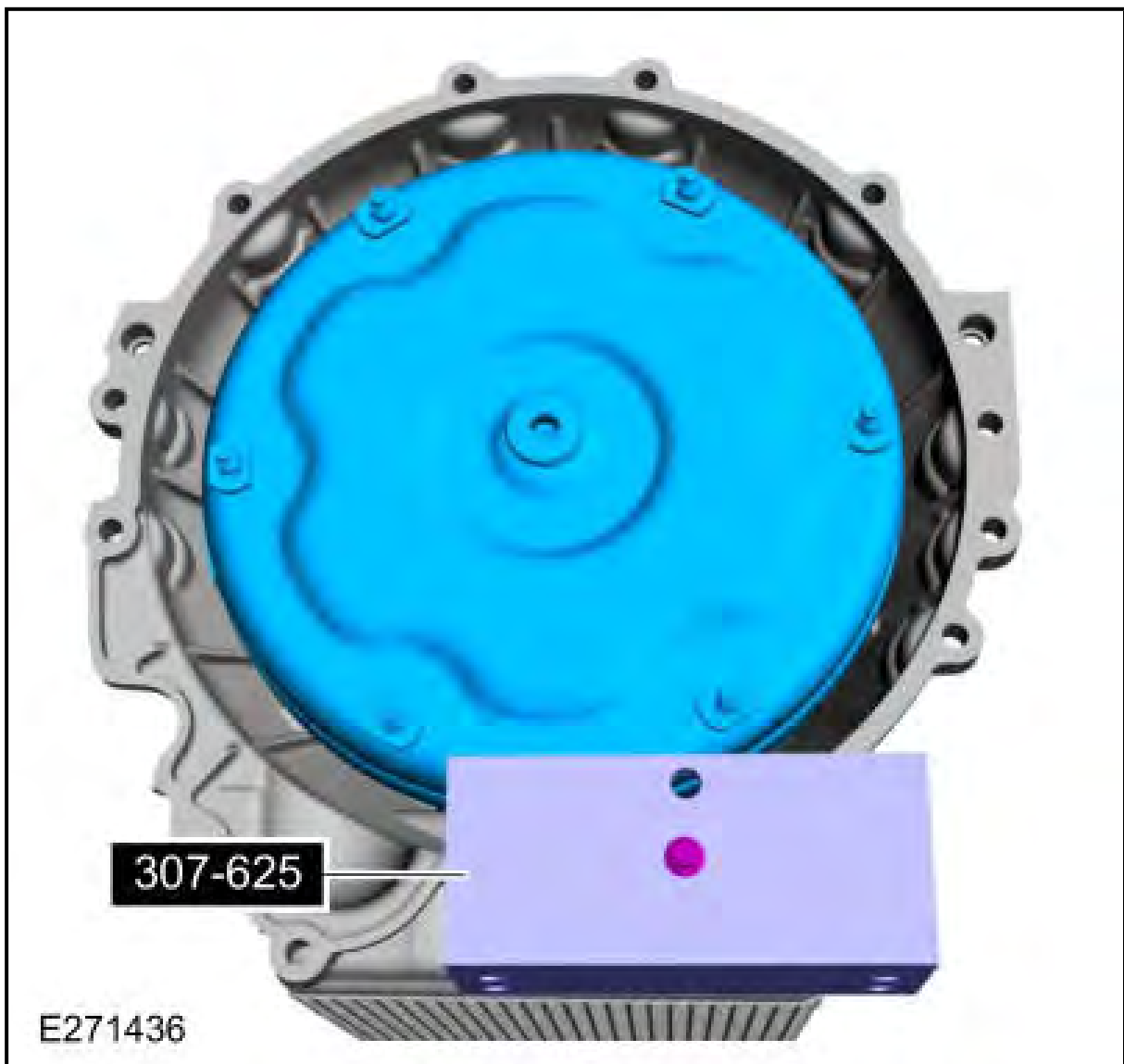
**NOTE:** It is recommended that this component be serviced with the vehicle body removed. If the body was removed, refer to Engine - Body Off in this section.

1.
  1. Inspect the engine mount-to-frame nut plate for thread damage.
  2. If the nut plate is damaged, remove and discard the engine mount-to-frame nut plate.
  - Clean the engine mount-to-frame mating surfaces of any dirt or foreign material prior to installation.



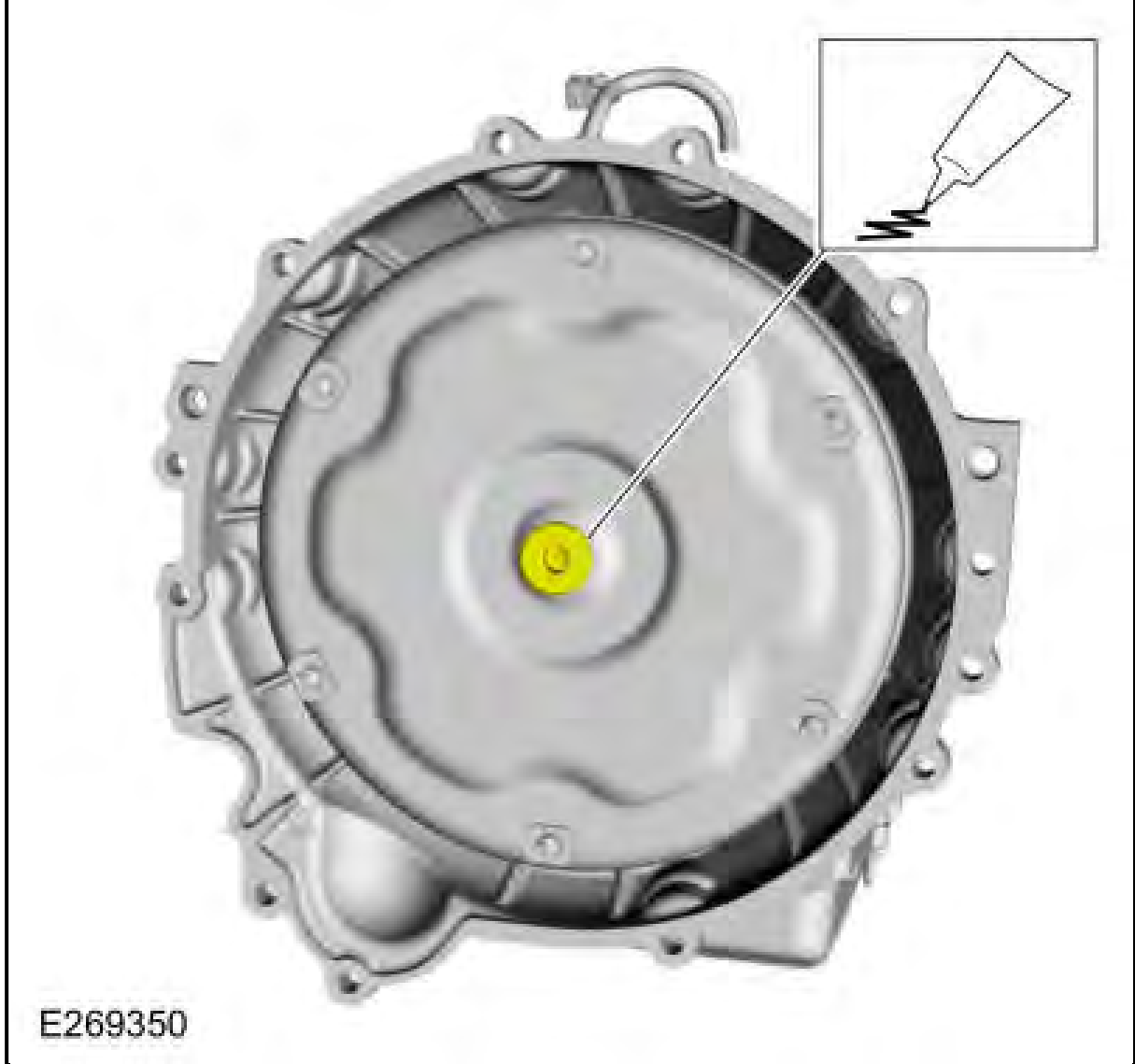


2. Remove Special Service Tool: 307-625 Fixture, Bench Mounting.



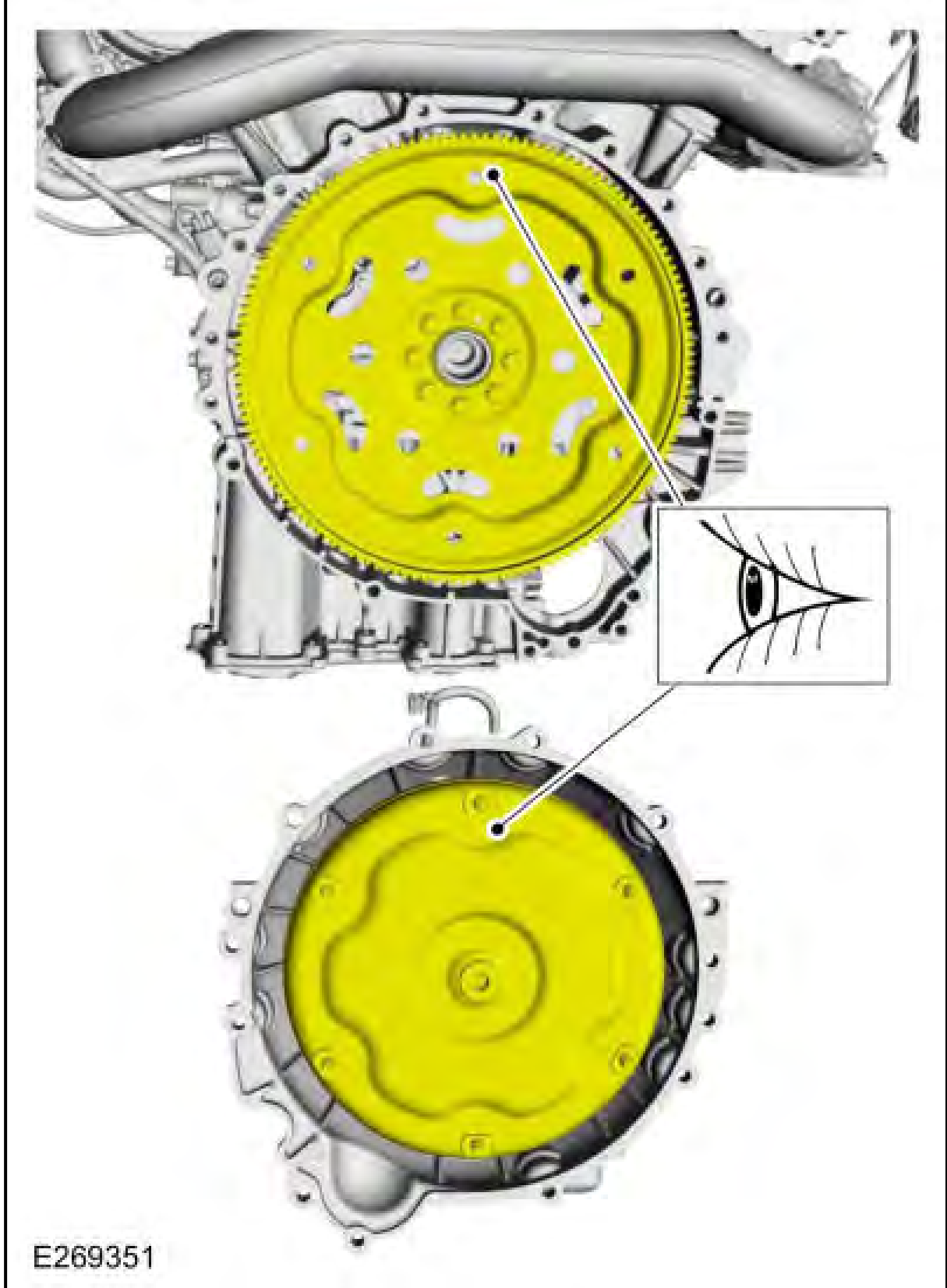
3. Lubricate the torque converter pilot hub with multi-purpose grease.

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



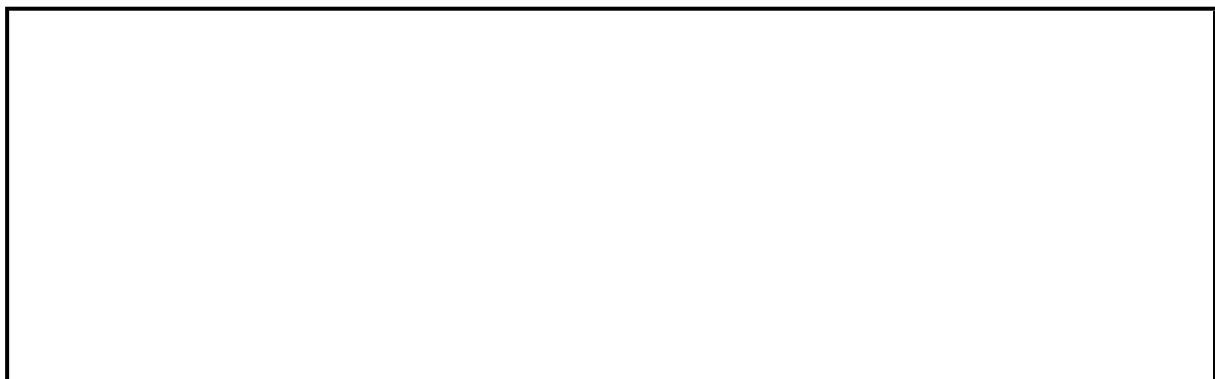
4. The paint dot on the torque converter need to be at 12 o'clock and the stud needs to be assembled with the corresponding flexplate hole that is closest to 12 o'clock.

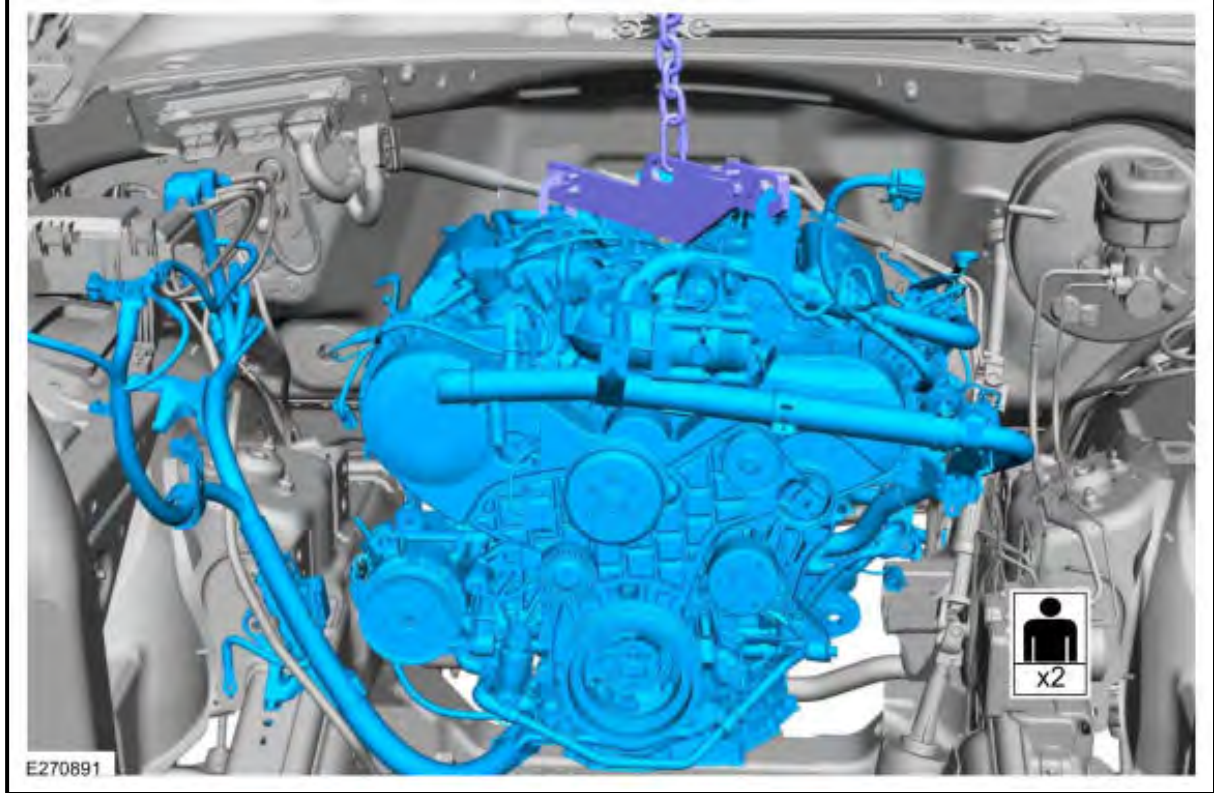




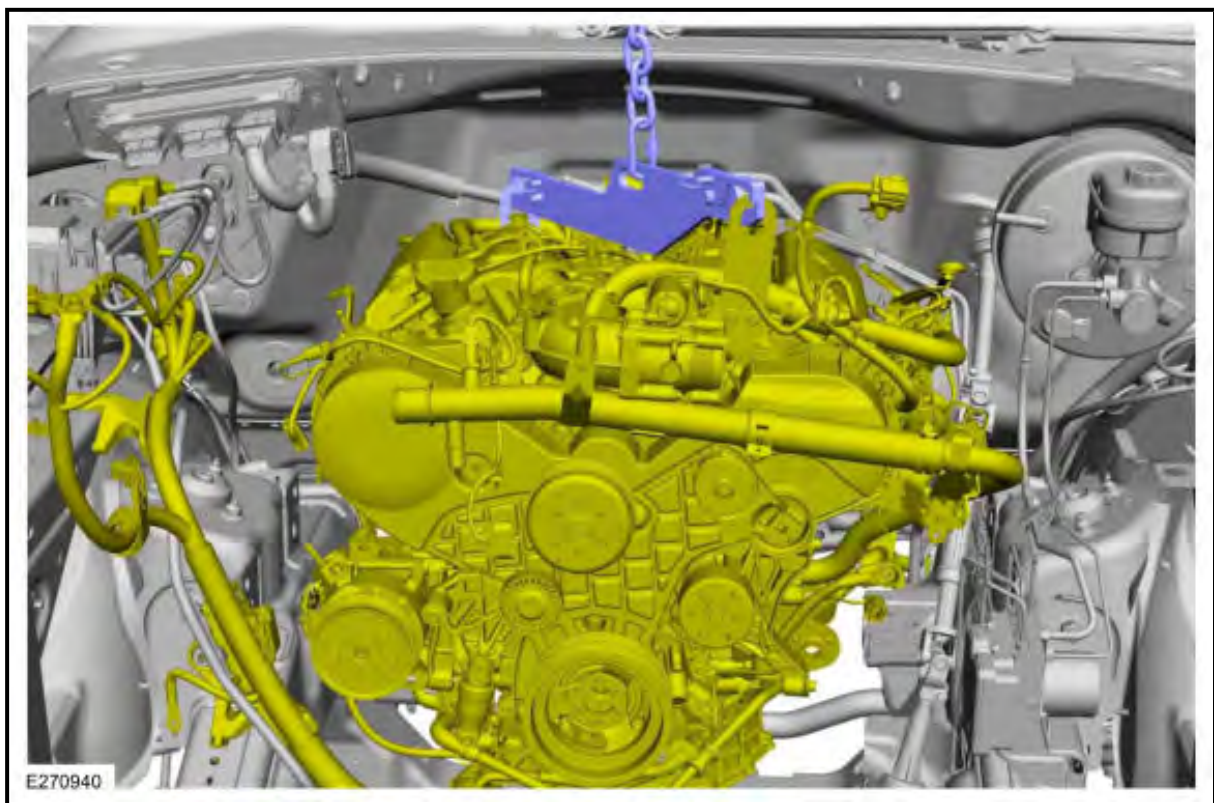
5. **NOTE:** The use of a ratchet strap may be needed to level the engine.

Using the floor crane and the spreader bar, install the engine. Use the General Equipment: Floor Crane





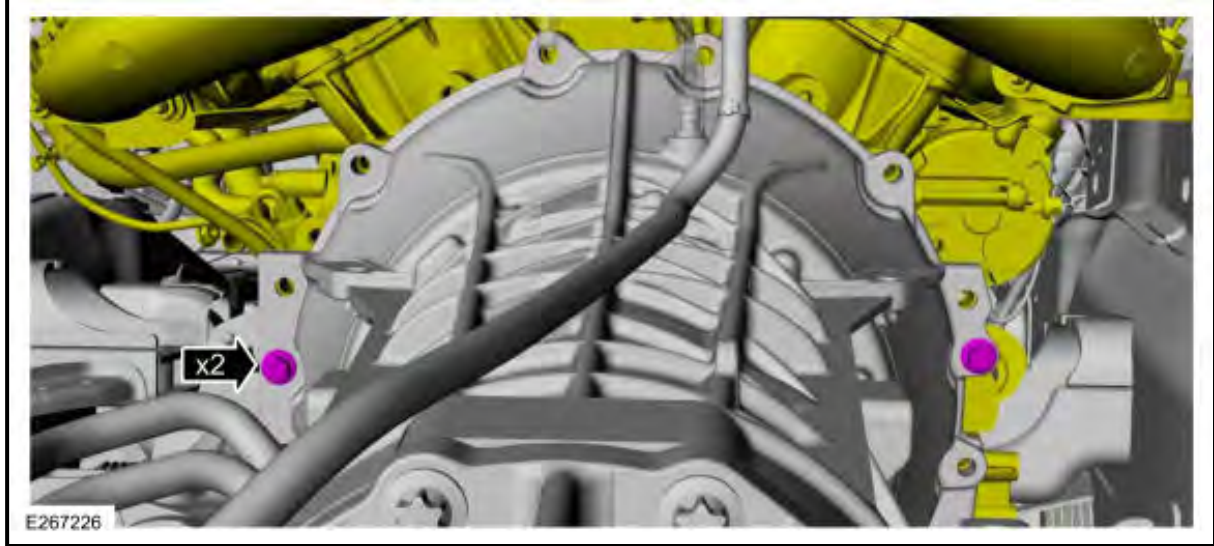
6. Using the floor crane and the spreader bar, position the engine to the transmission. Use the General Equipment: Floor Crane



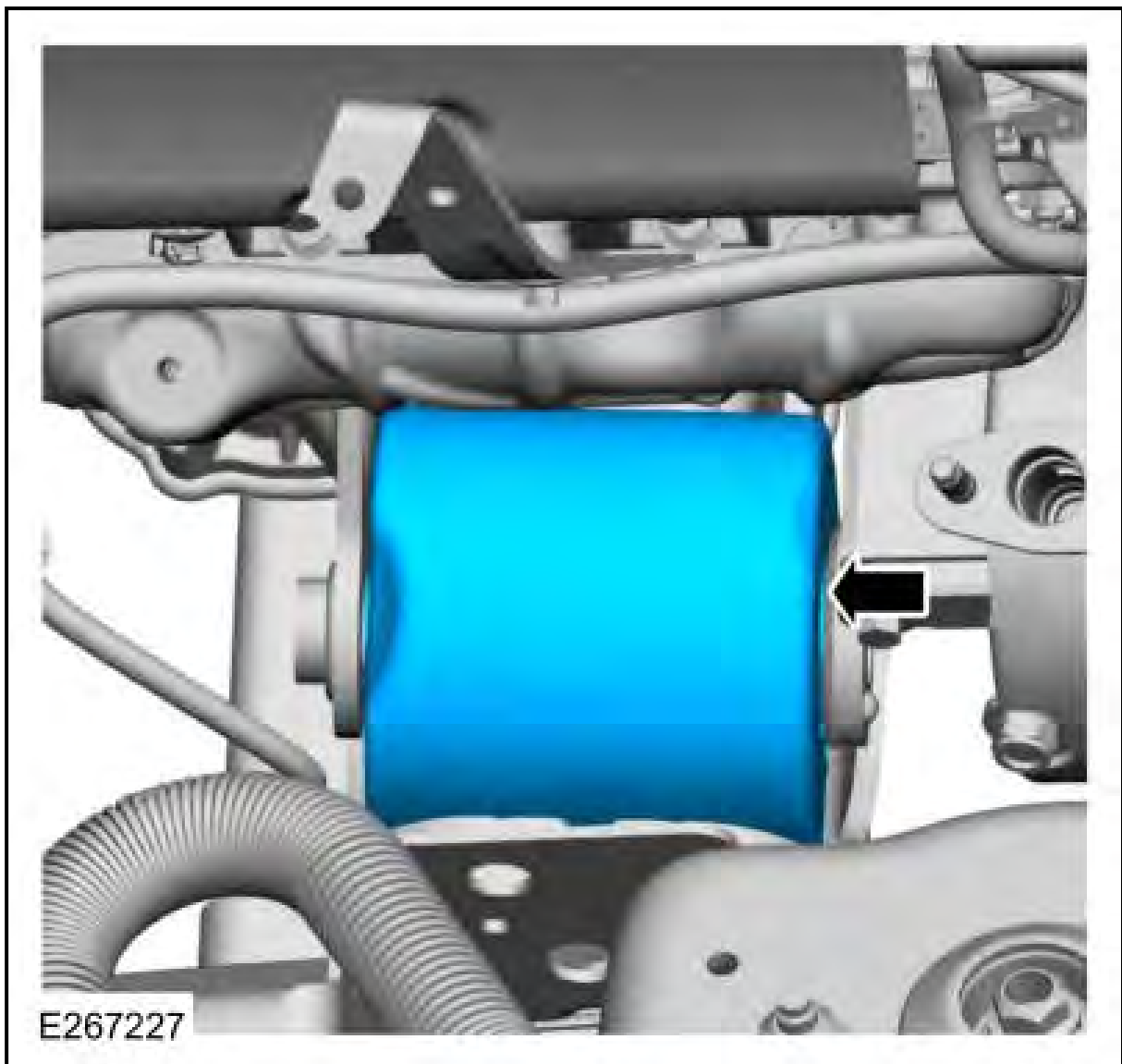
7. Align the engine to the transmission and draw together using the bolts.

Torque: 35 lb.ft (48 Nm)



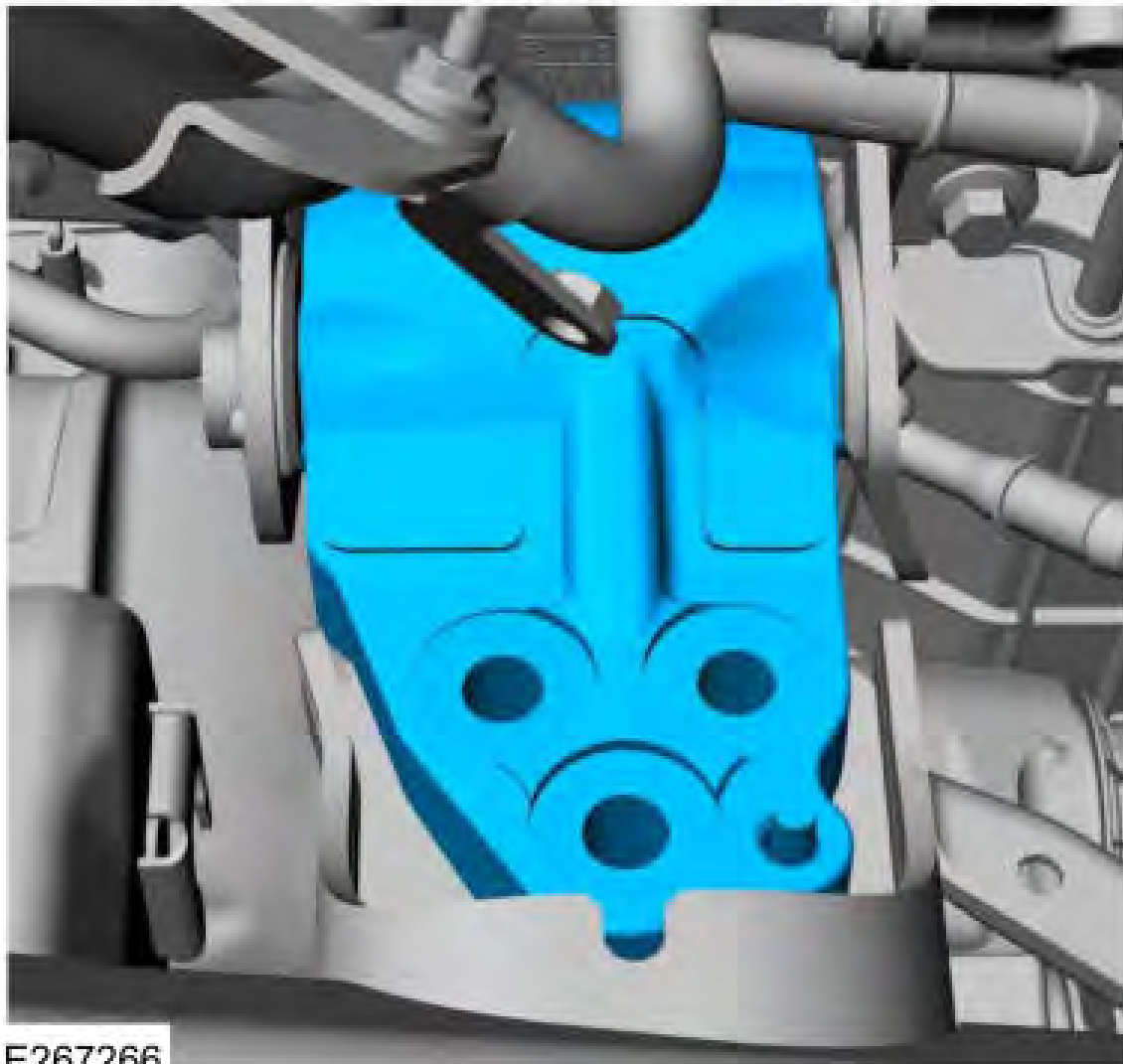


8. Install the RH engine mount.



9. Install the LH engine mount.





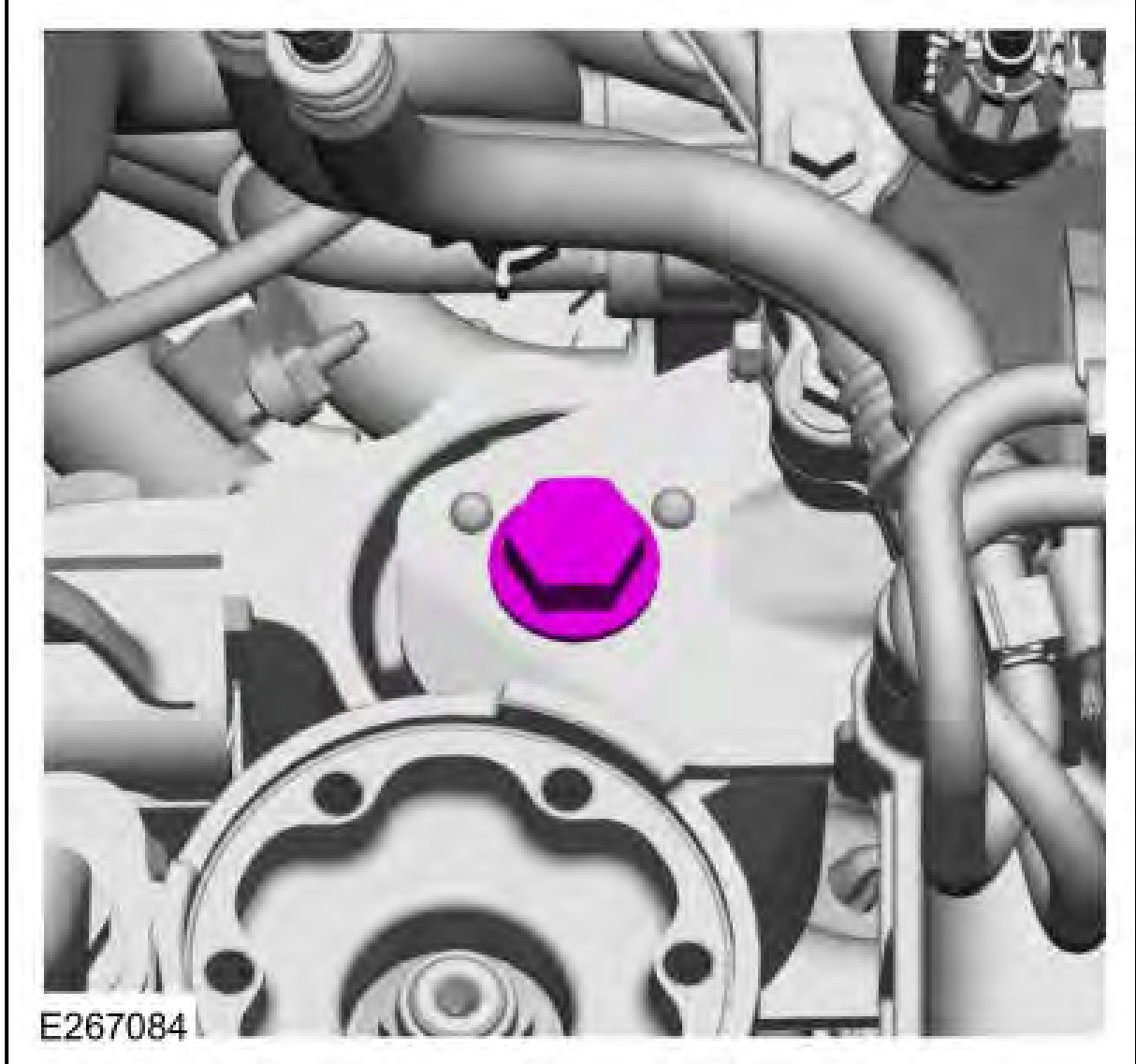
E267266

10. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

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

Install the LH engine mount thought bolt.

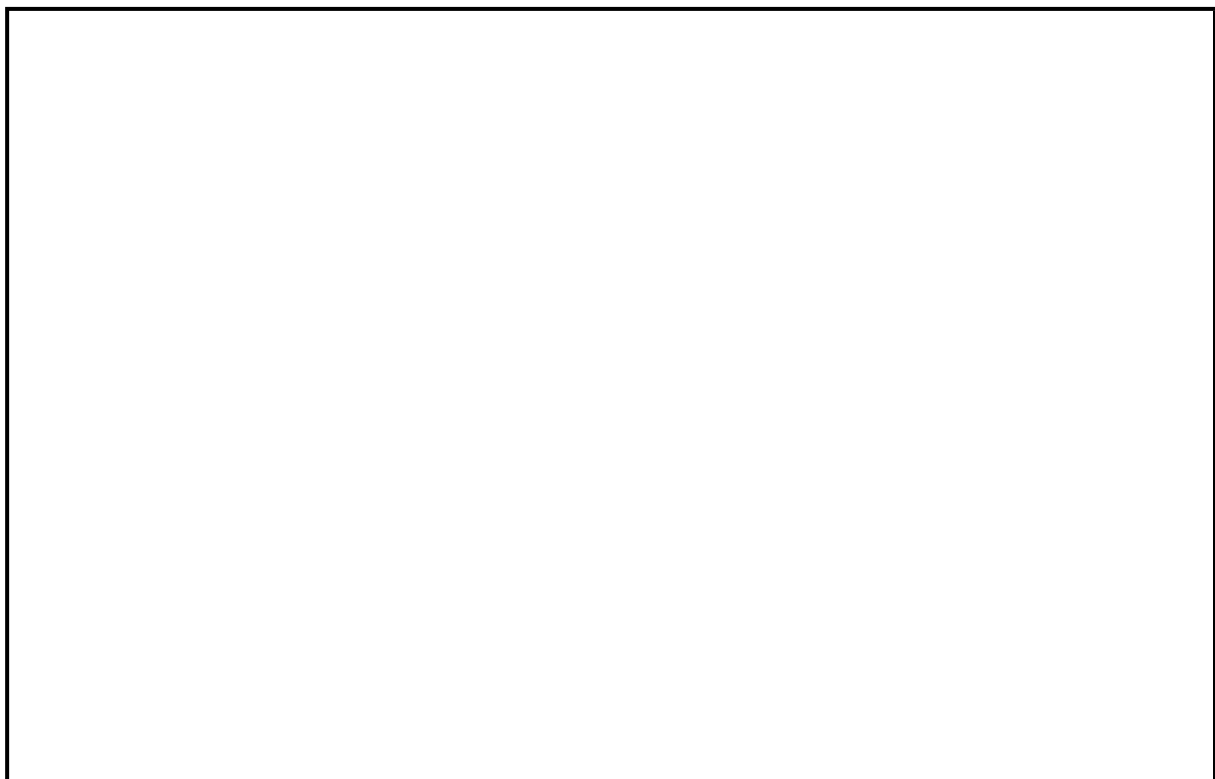




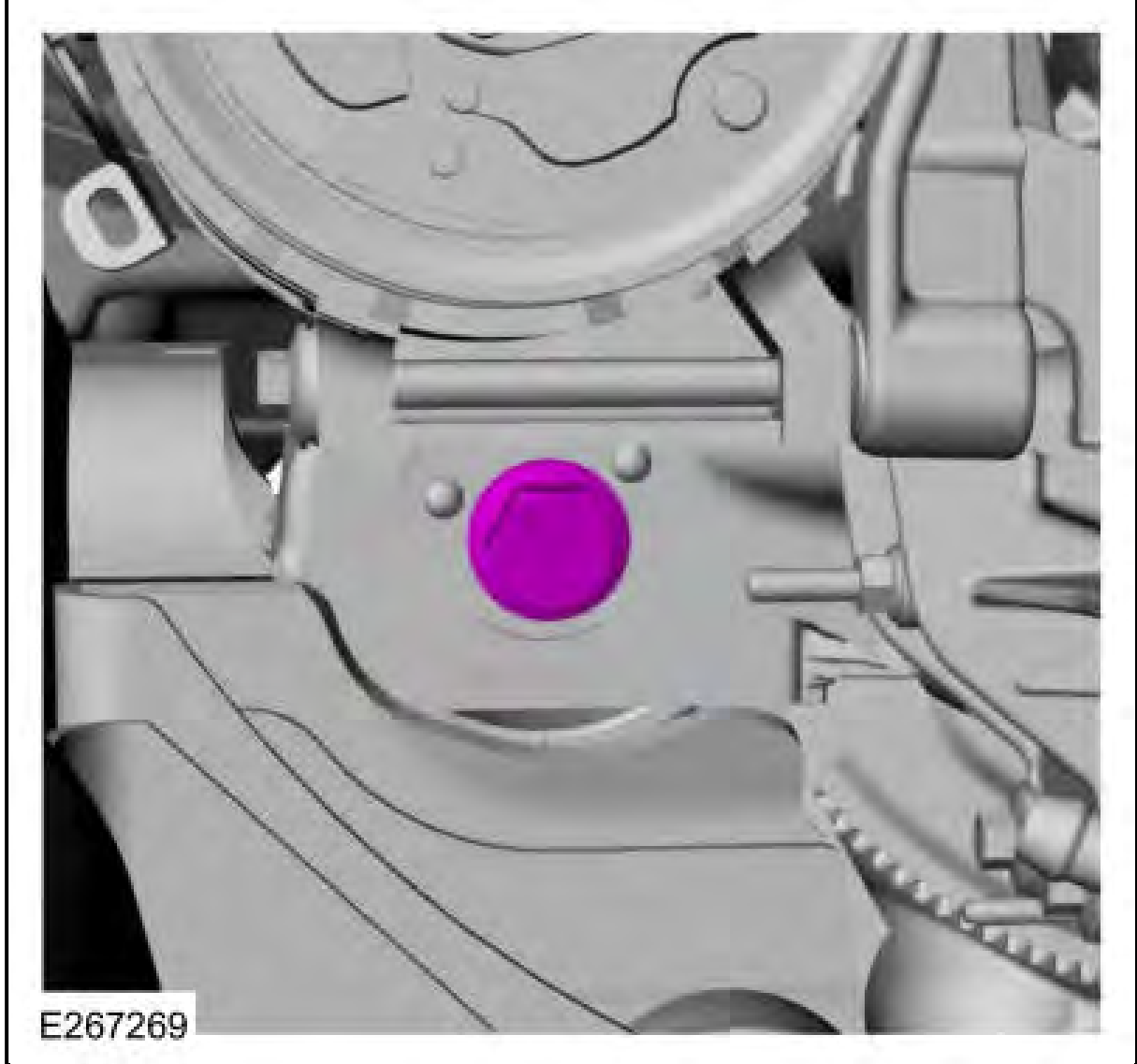
11. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

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

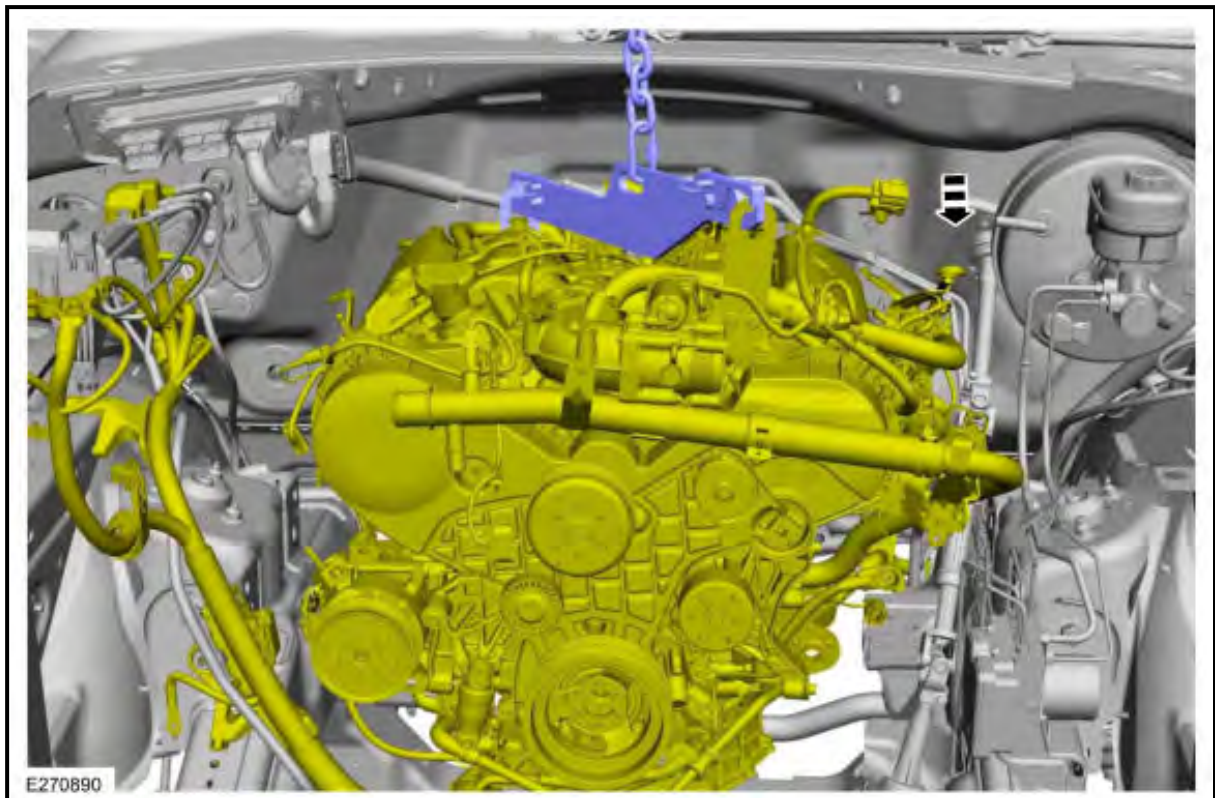
Install the new RH engine mount through bolt.







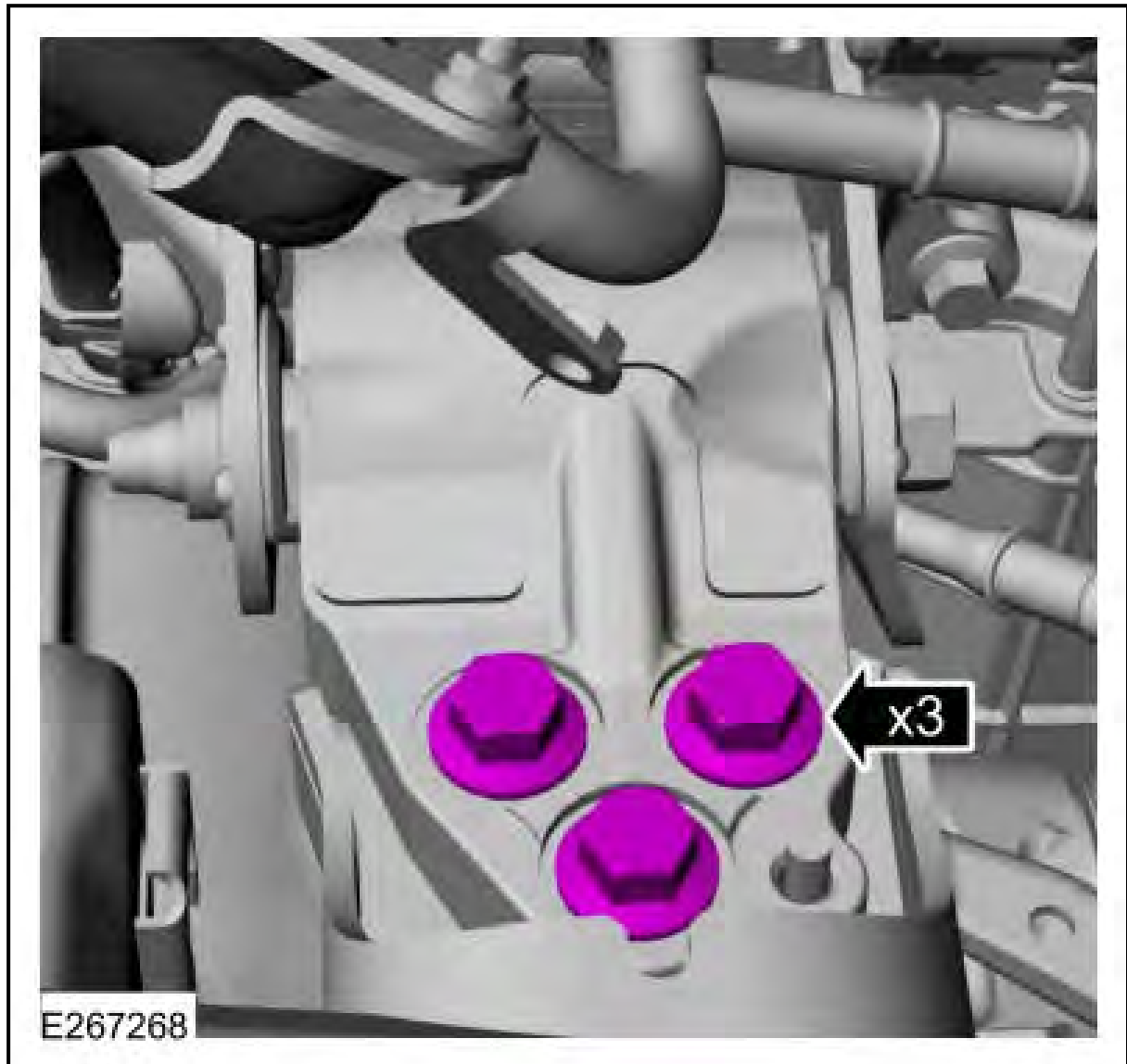
12. Using the floor crane, lower the engine. Use the General Equipment: Floor Crane



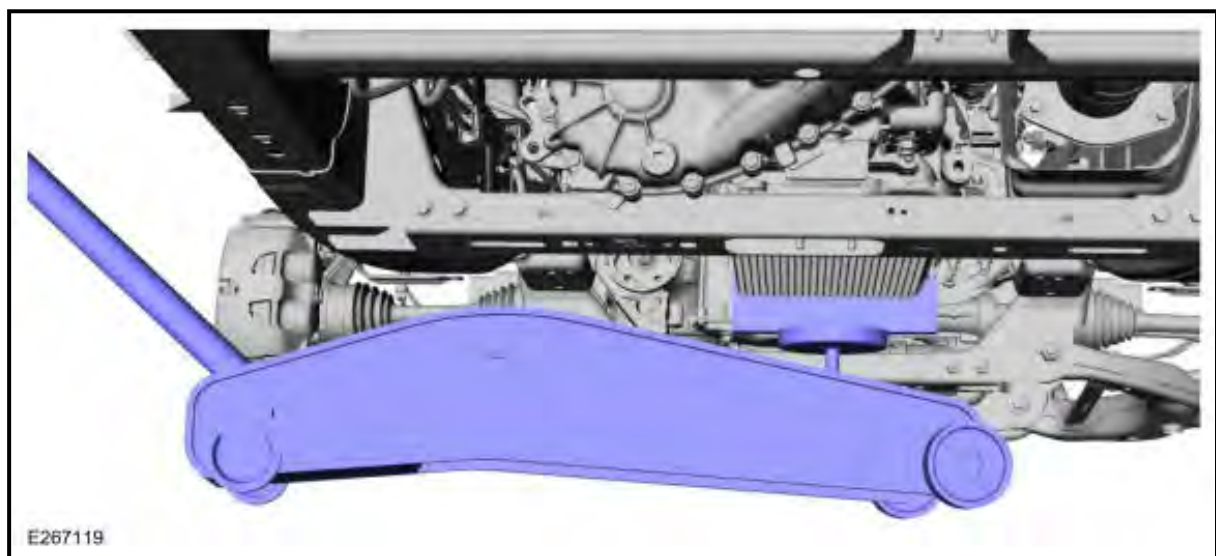
13. **NOTE:** Only use hand tools when loosening or tightening the engine mount-to-frame bolts or damage to the engine mount-to-frame nut plate can occur.

Install the new LH engine mount bolts.

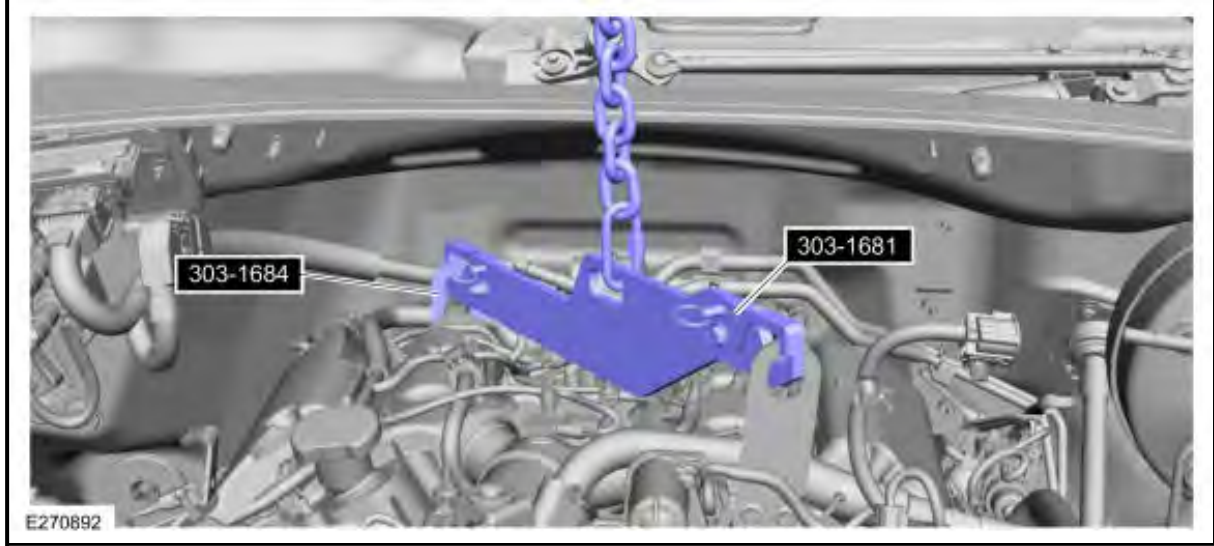
Torque: 129 lb.ft (175 Nm)



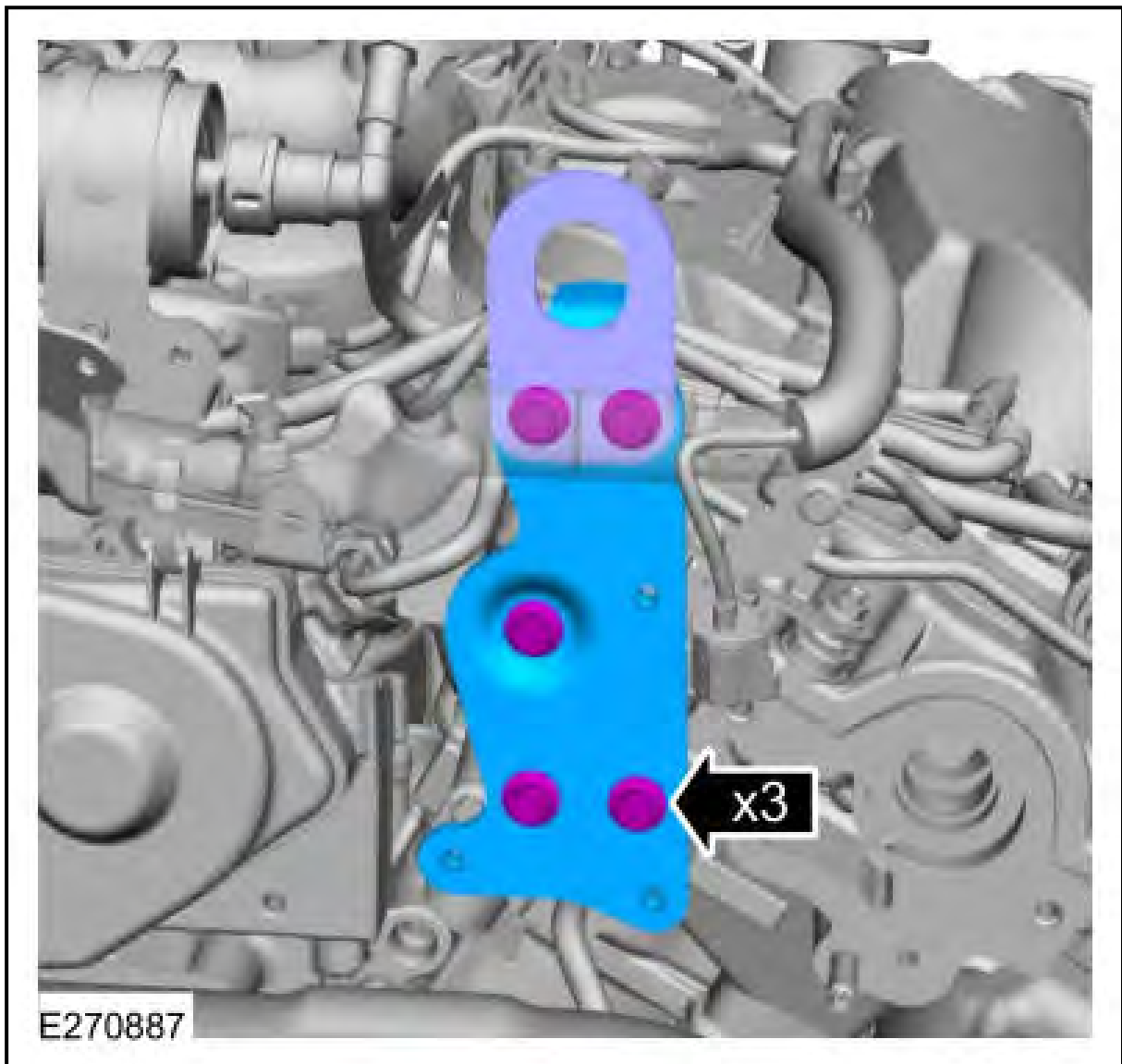
14. Remove the floor jack and the block of wood. Use the General Equipment: Trolley Jack Use the General Equipment: Wooden Block



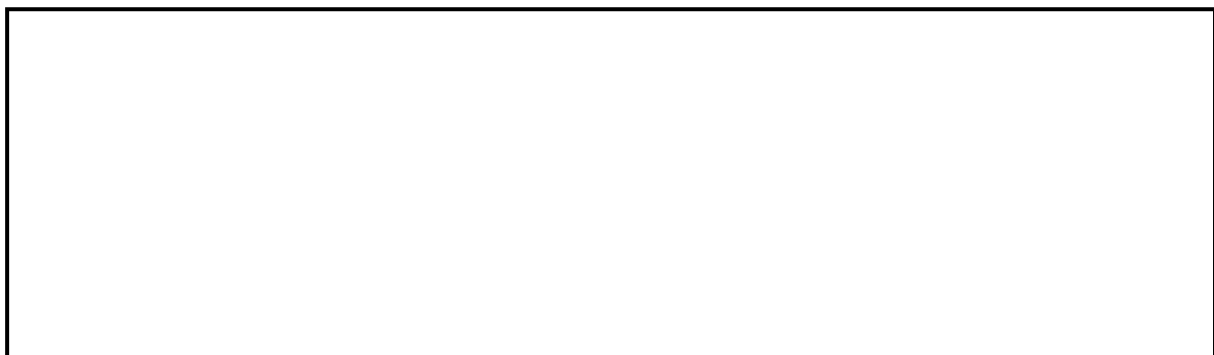
15. Remove the floor crane and the special tools. Use Special Service Tool: 303-1681 Spreader Bar., 303-1684 Lifting Eye. Use the General Equipment: Floor Crane



16. Remove the factory lifting eye with the special tool from the engine.



17. Remove the bolts and the special tool. Use Special Service Tool: 303-1684 Lifting Eye.





18. Install the upper lifting bracket and the bolts.

Torque: 17 lb.ft (23 Nm)

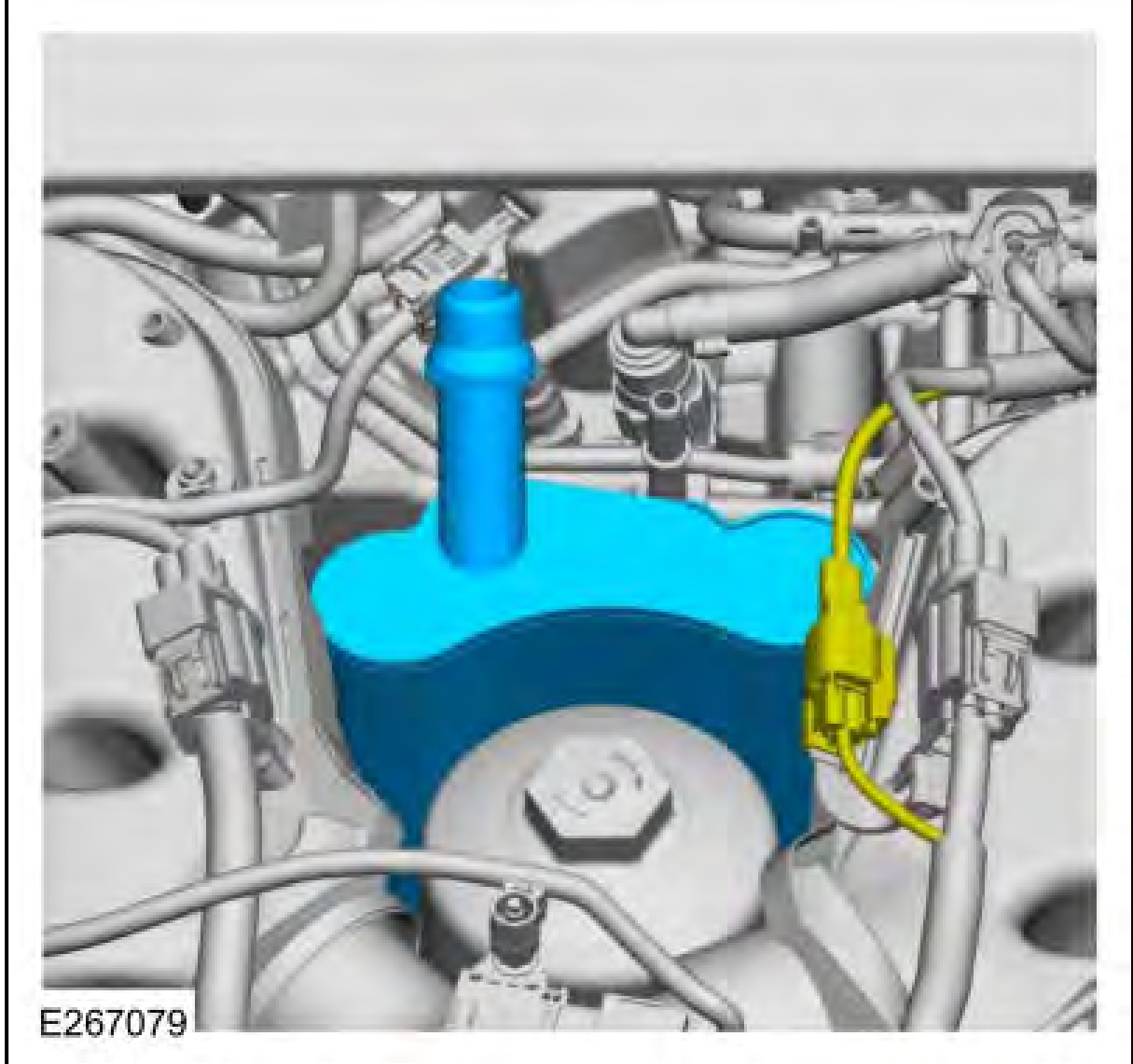




E270885

19. Install the crankcase vent oil separator. Position back the wiring.

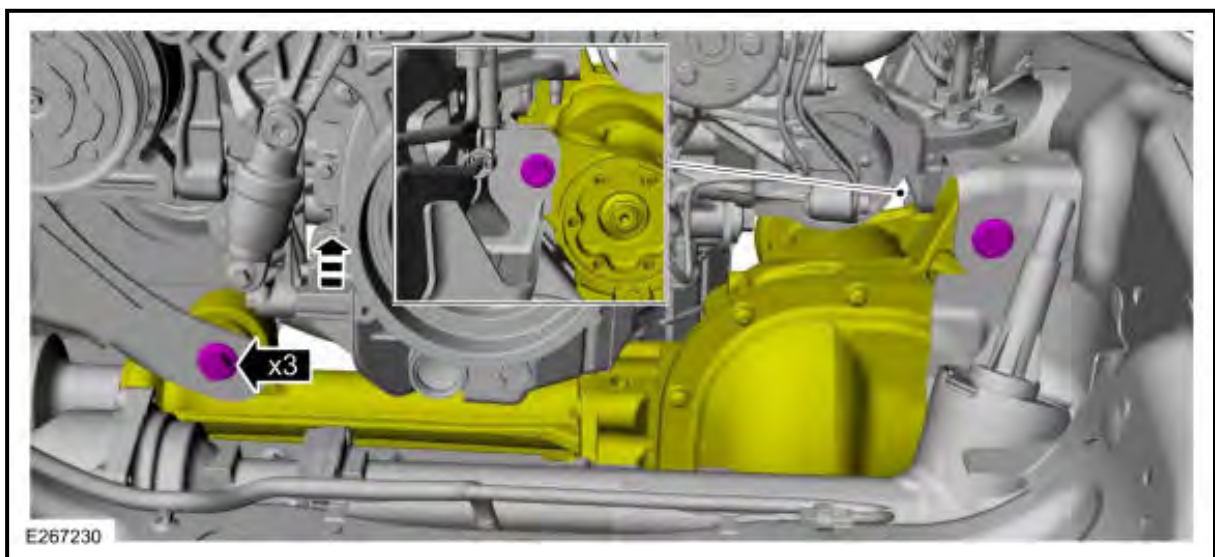




20. If equipped, using a floor jack, raise the front axle and install the bolts. Use the General Equipment: Trolley Jack

Torque

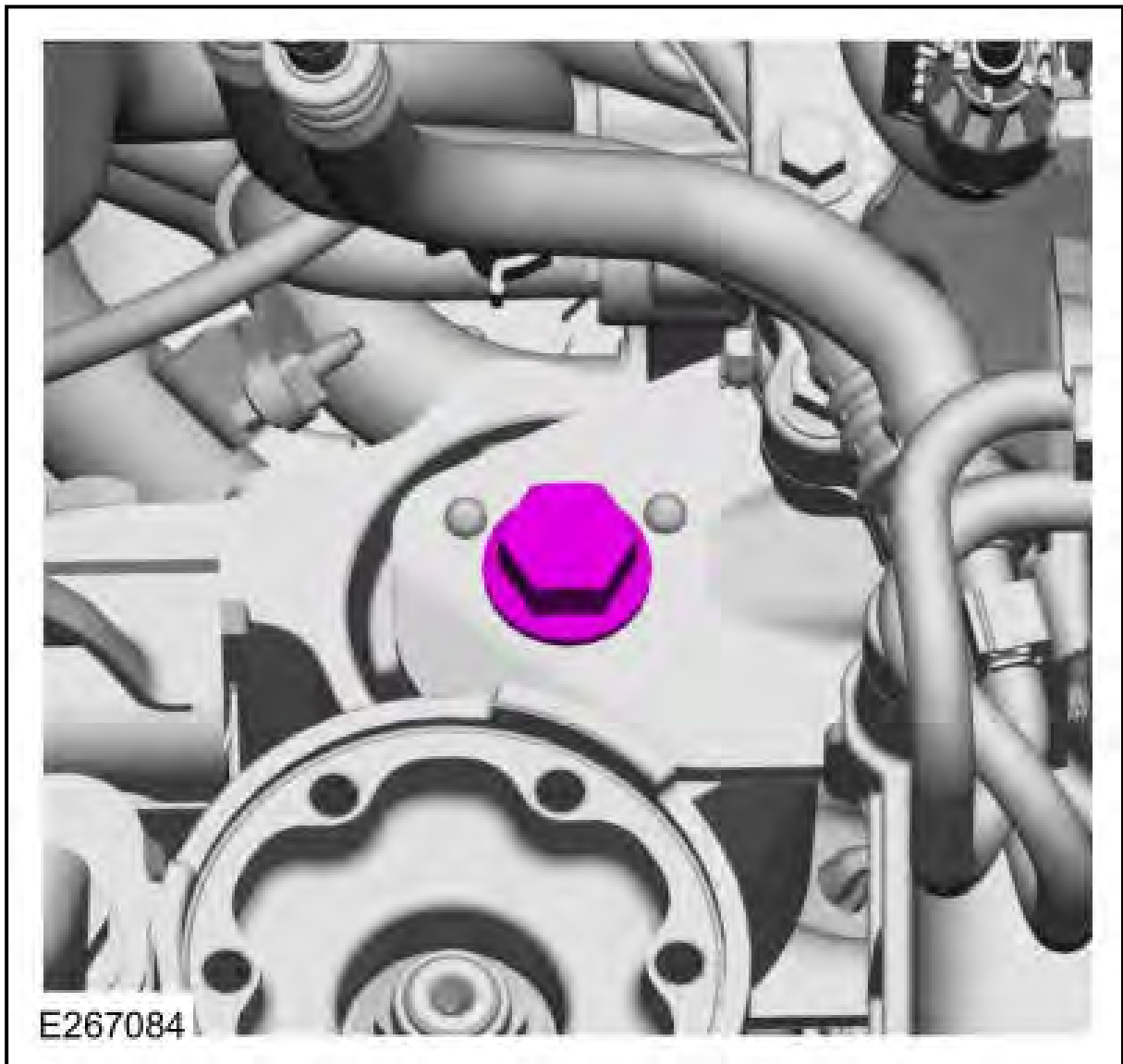
:Front bolts : 111 lb.ft (150 Nm) Back bolt : 129 lb.ft (175 Nm)



21. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

Tighten the LH engine mount through bolt.

Torque: 258 lb.ft (350 Nm)



22. **NOTE:** Only use hand tools when installing the engine mount nuts and studs or damage to the engine mount can occur.

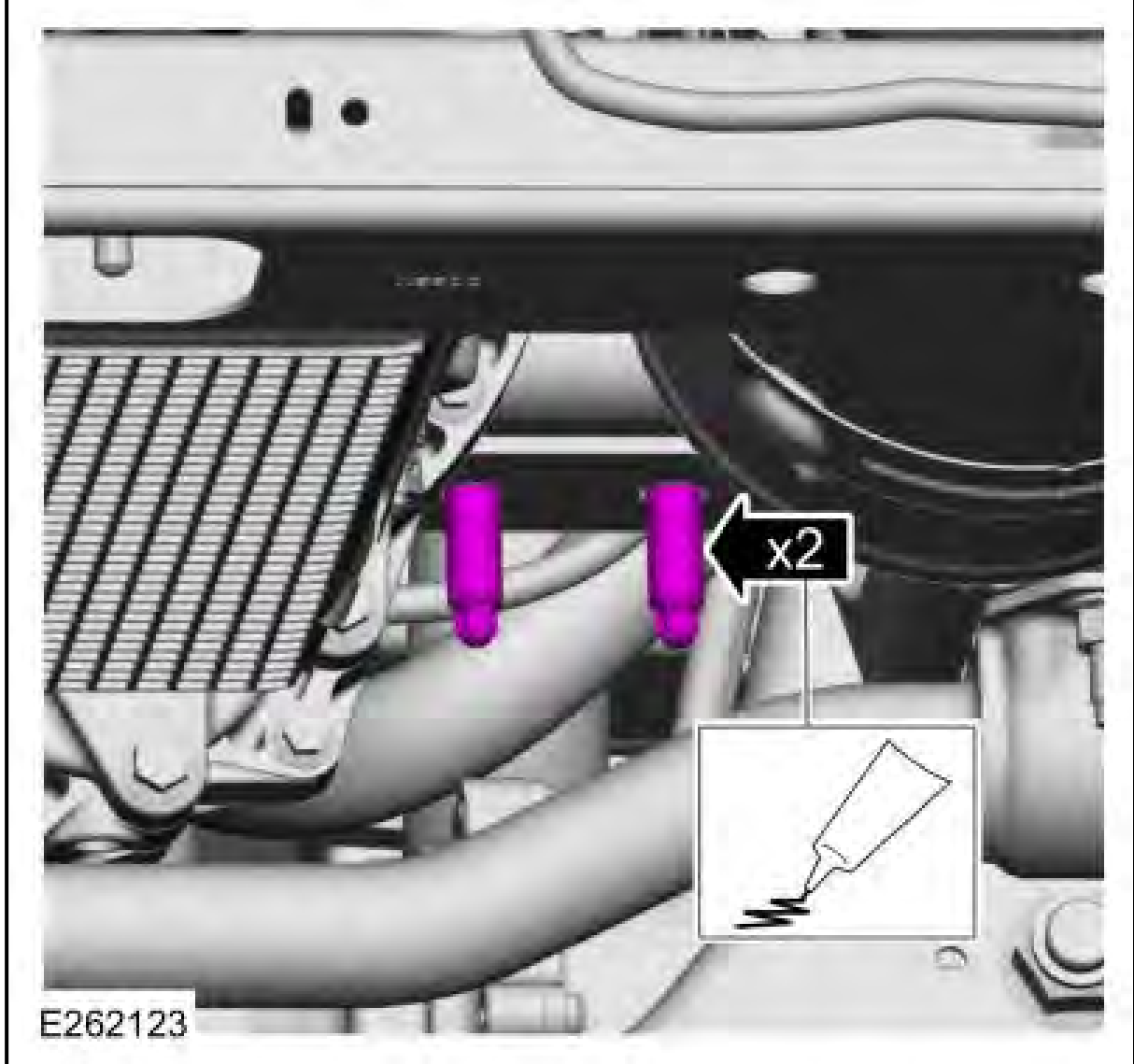
**NOTE:** Apply threadlock to the stud threads prior to installation.

Install the RH engine mount studs.

Material: Motorcraft <sup>®</sup> Threadlock 262 / TA-26 (WSK-M2G351-A6)

Torque: 22 lb.ft (30 Nm)

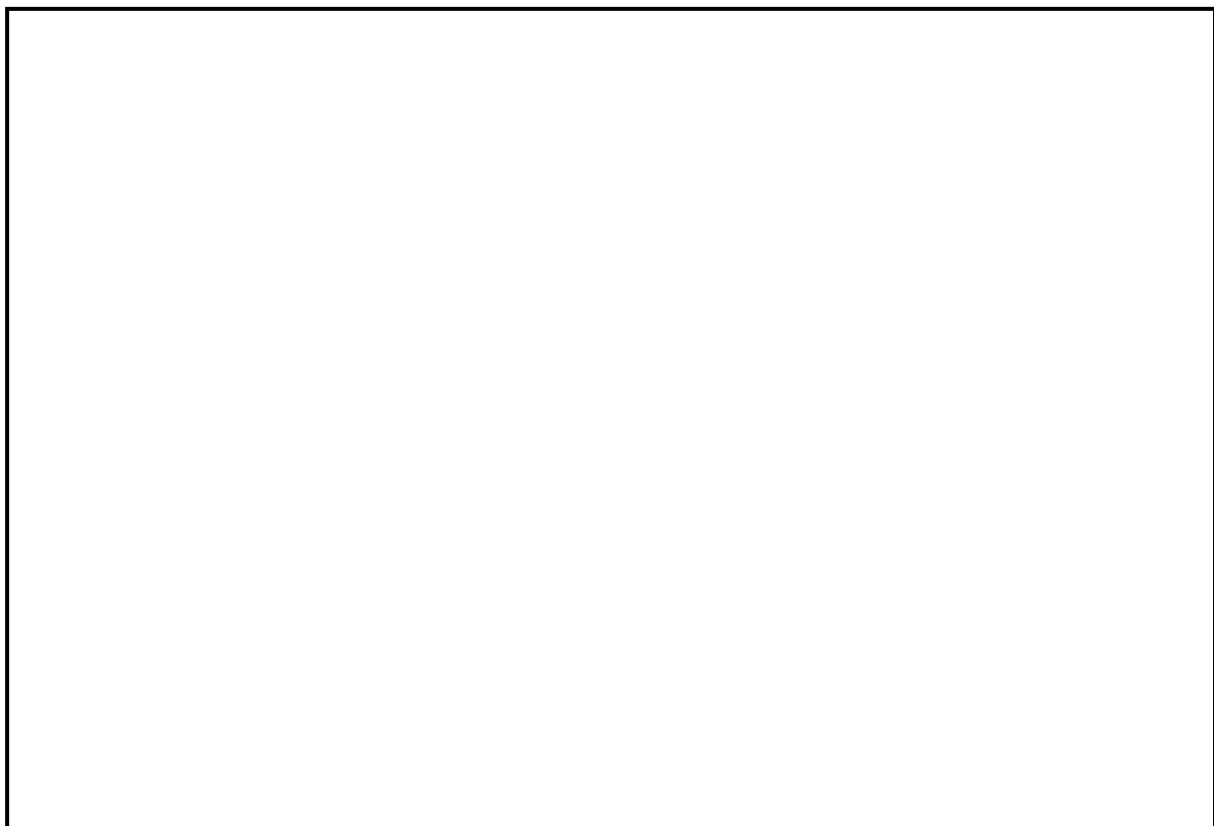




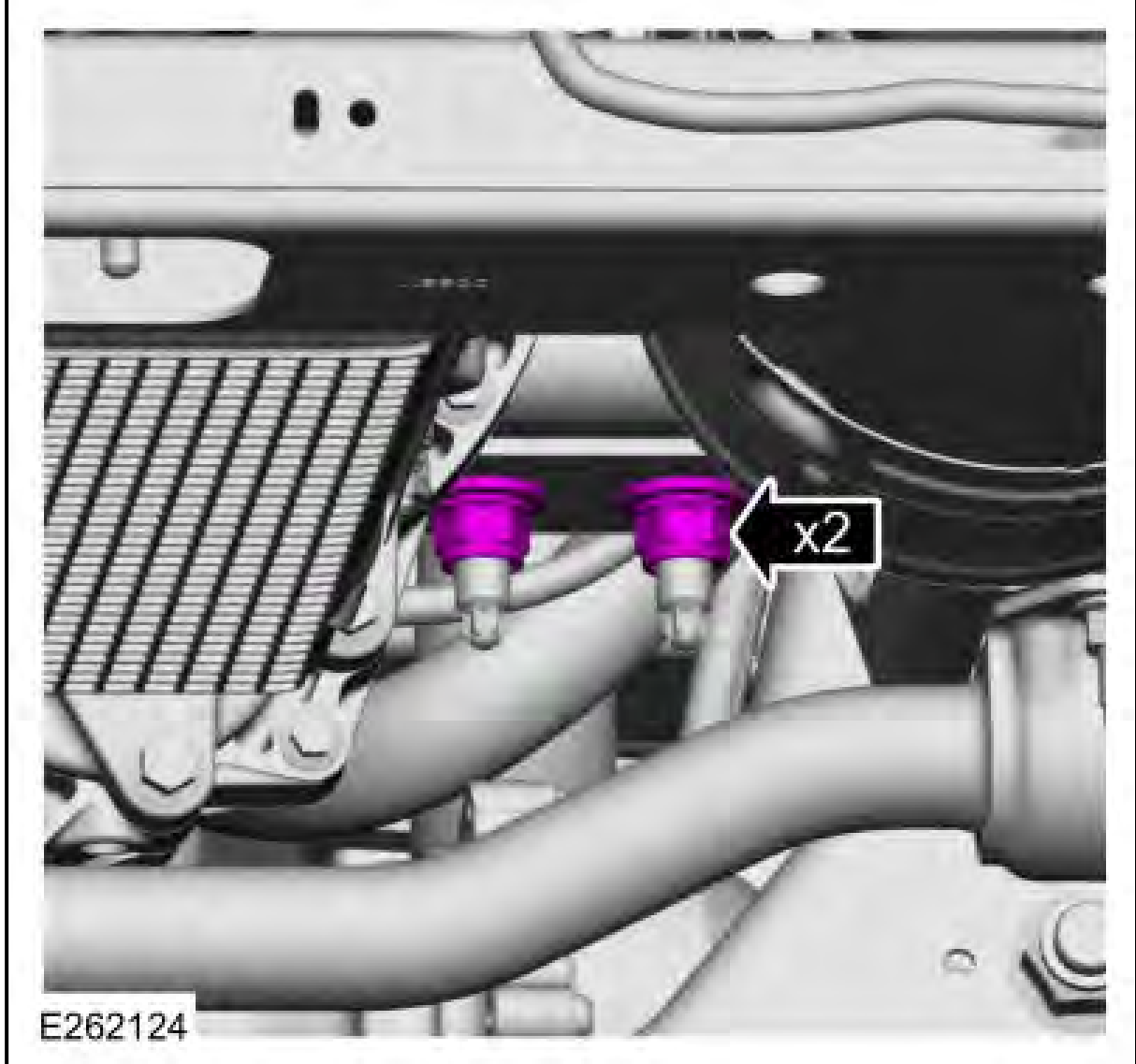
23. **NOTE:** Only use hand tools when installing the engine mount nuts and studs or damage to the engine mount can occur.

Install the new RH engine mount nuts.

Torque: 111 lb.ft (150 Nm)





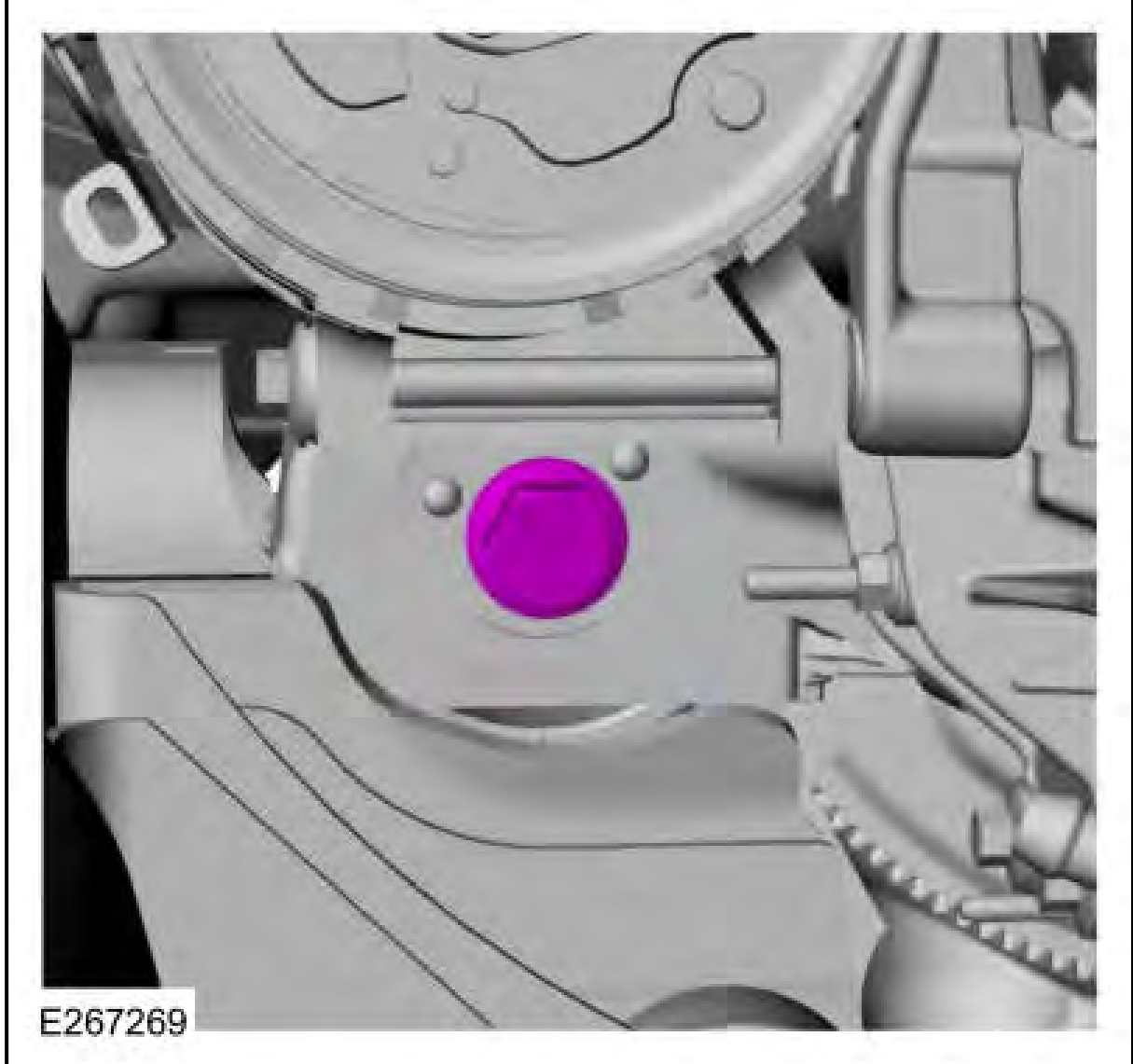


24. **NOTE:** Only use hand tools when loosening or tightening the engine mount through bolts or damage to the engine mount-to-cylinder block bracket can occur.

Tighten the RH engine mount through bolt.

Torque: 258 lb.ft (350 Nm)

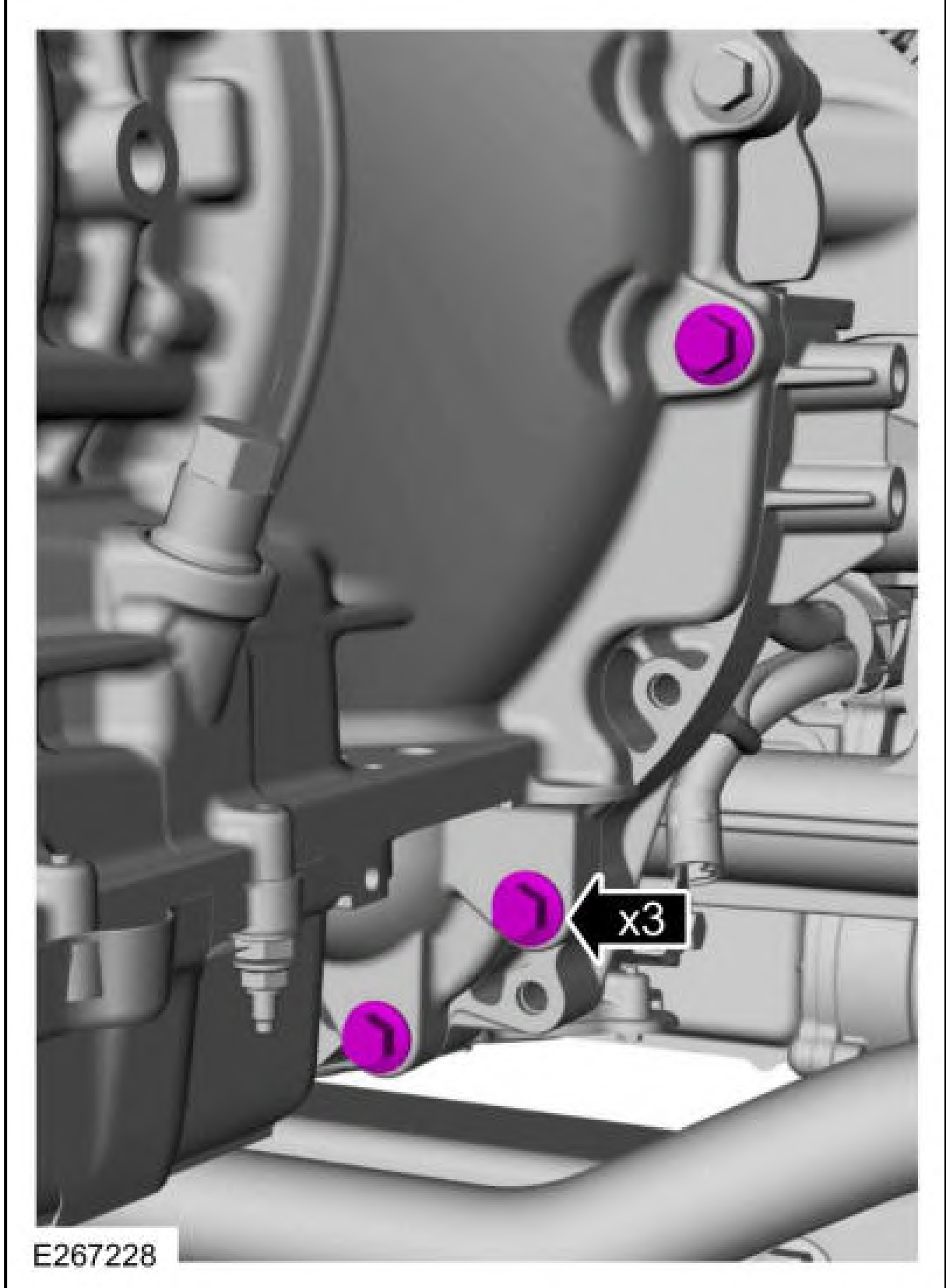




25. Install the RH side bellhousing bolt.

Torque: 35 lb.ft (48 Nm)

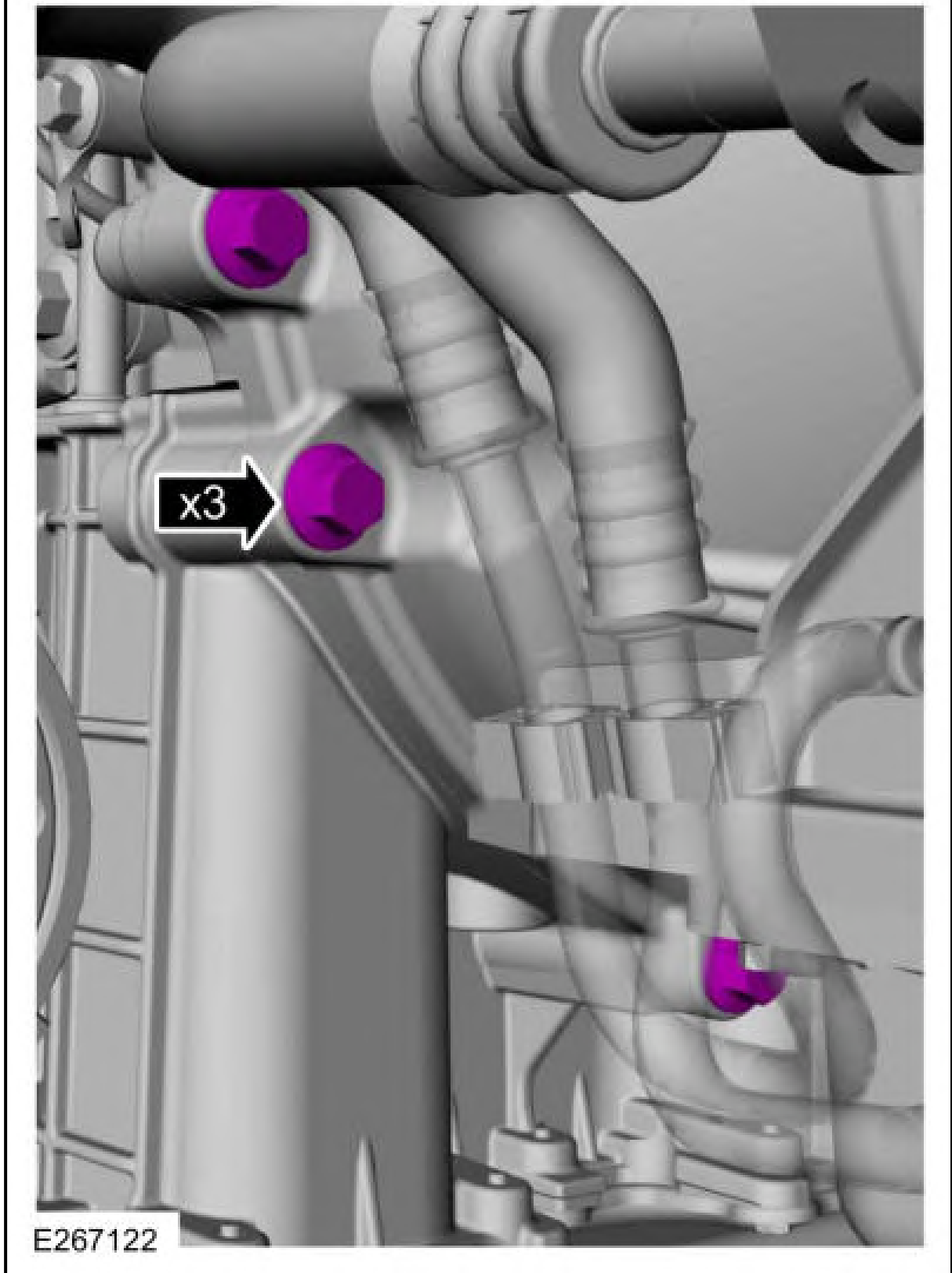




26. Install the LH side bellhousing bolts.

Torque: 35 lb.ft (48 Nm)

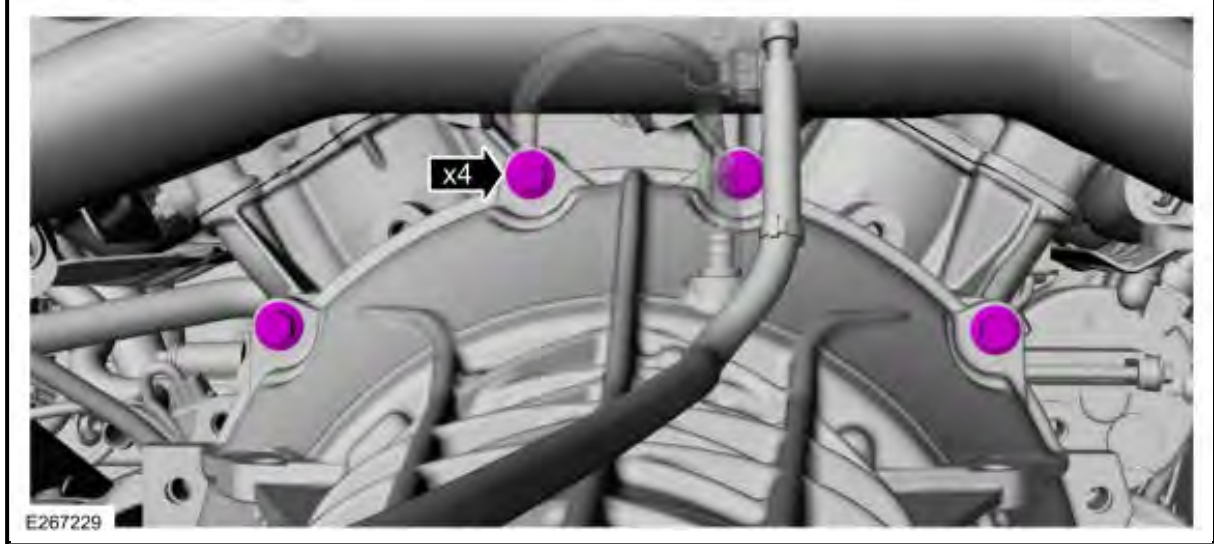




27. Install the upper bellhousing bolts.

Torque: 35 lb.ft (48 Nm)

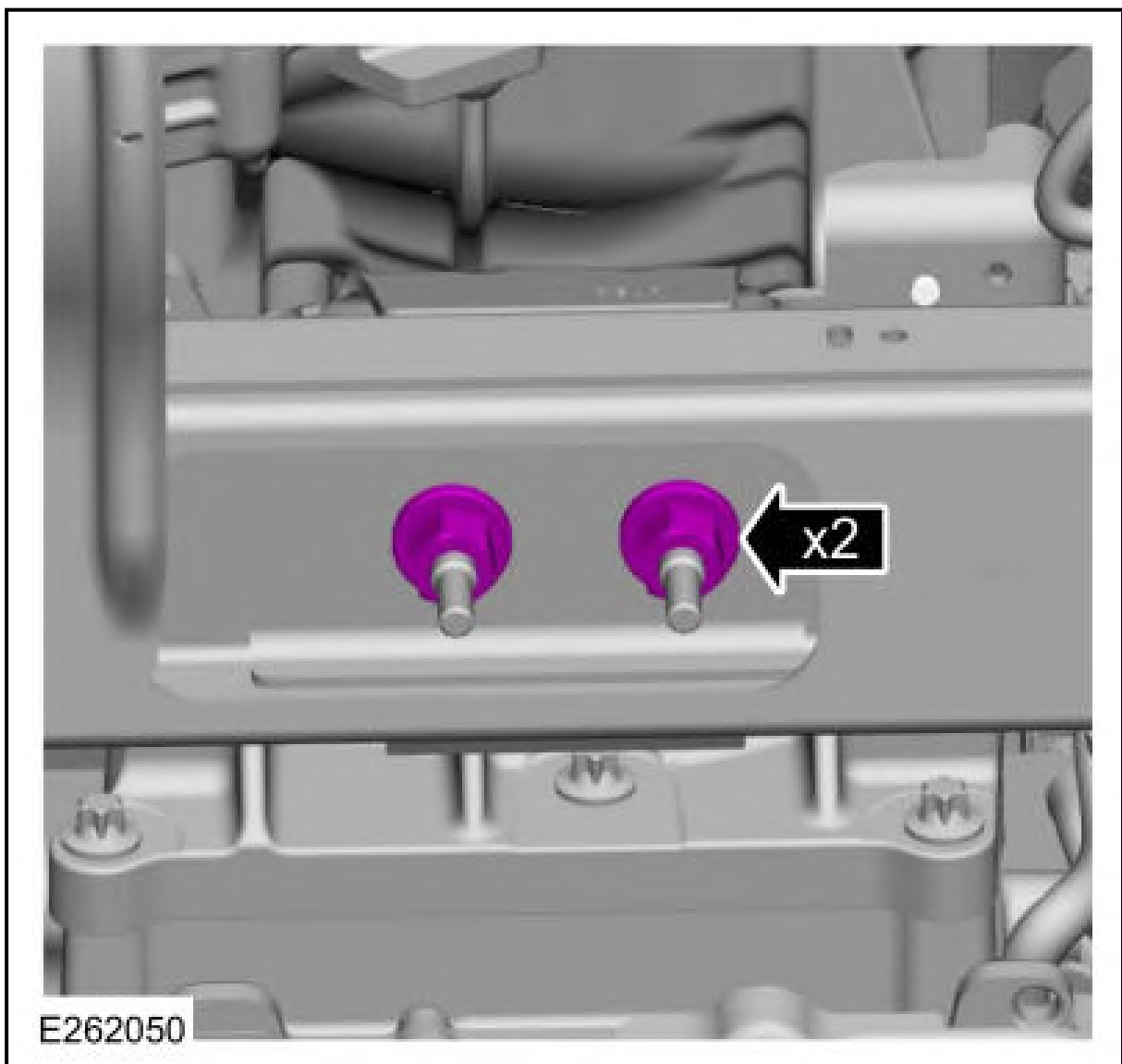




28. **NOTE:** Only use hand tools when loosening or tightening the transmission mount-to-crossmember nuts or damage to the transmission mount can occur.

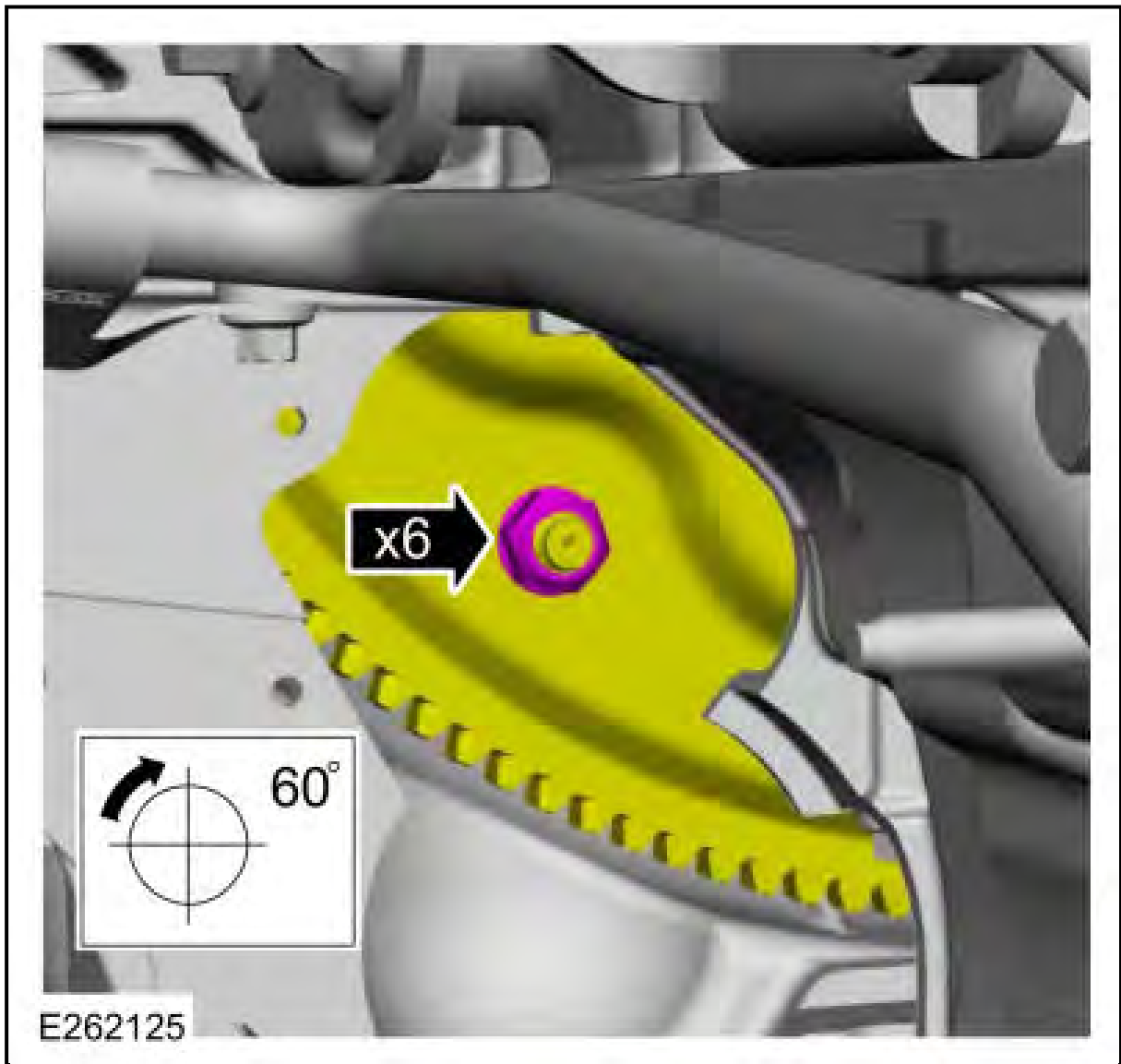
Remove and discard the transmission mount-to-crossmember nuts. Install new transmission mount-to-crossmember nuts.

Torque: 85 lb.ft (115 Nm)



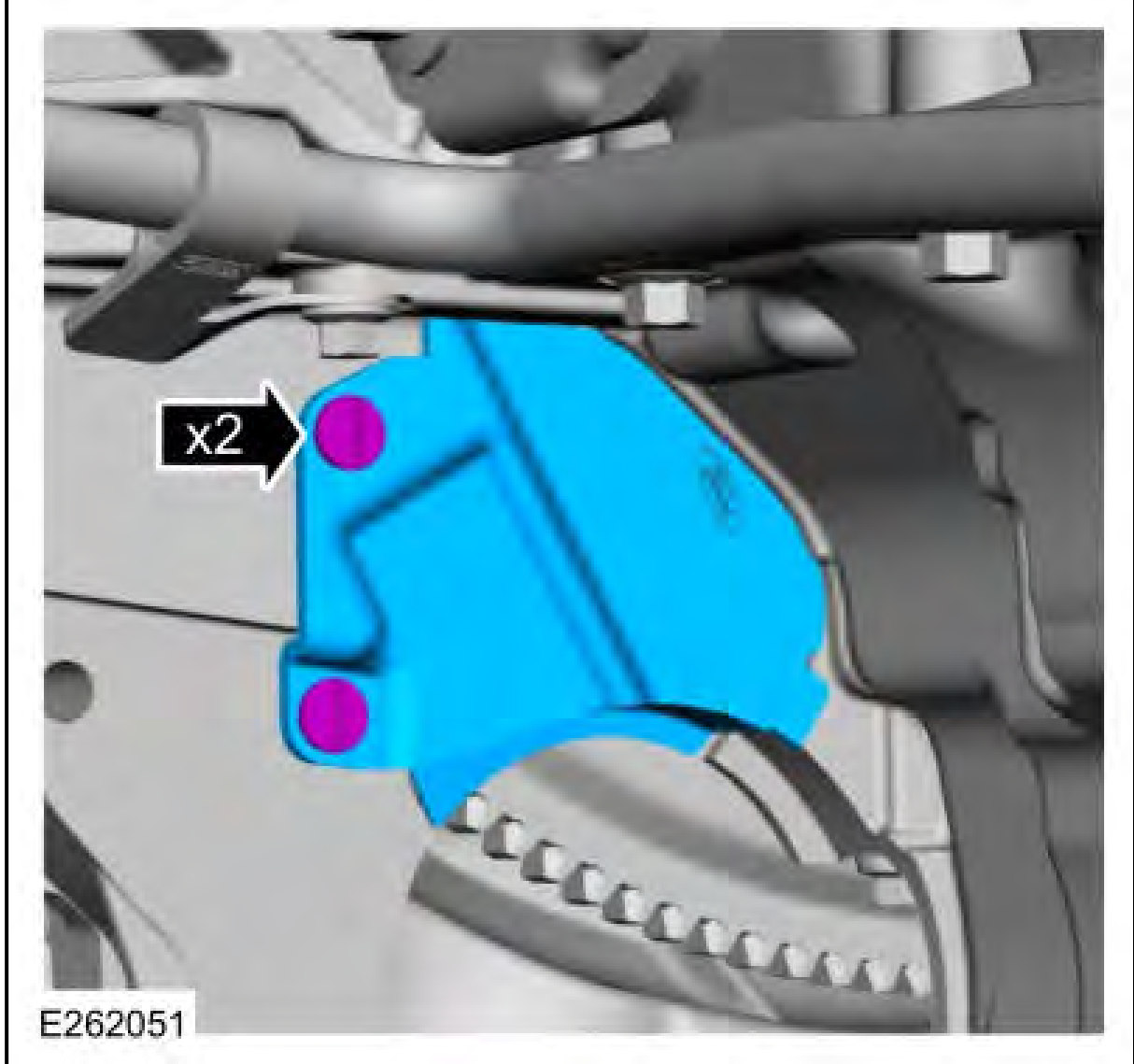
29. **NOTE:** Using the crankshaft pulley bolt, turn the engine clockwise.

Install new torque converter nuts.



30. Install the access cover and the retainers.





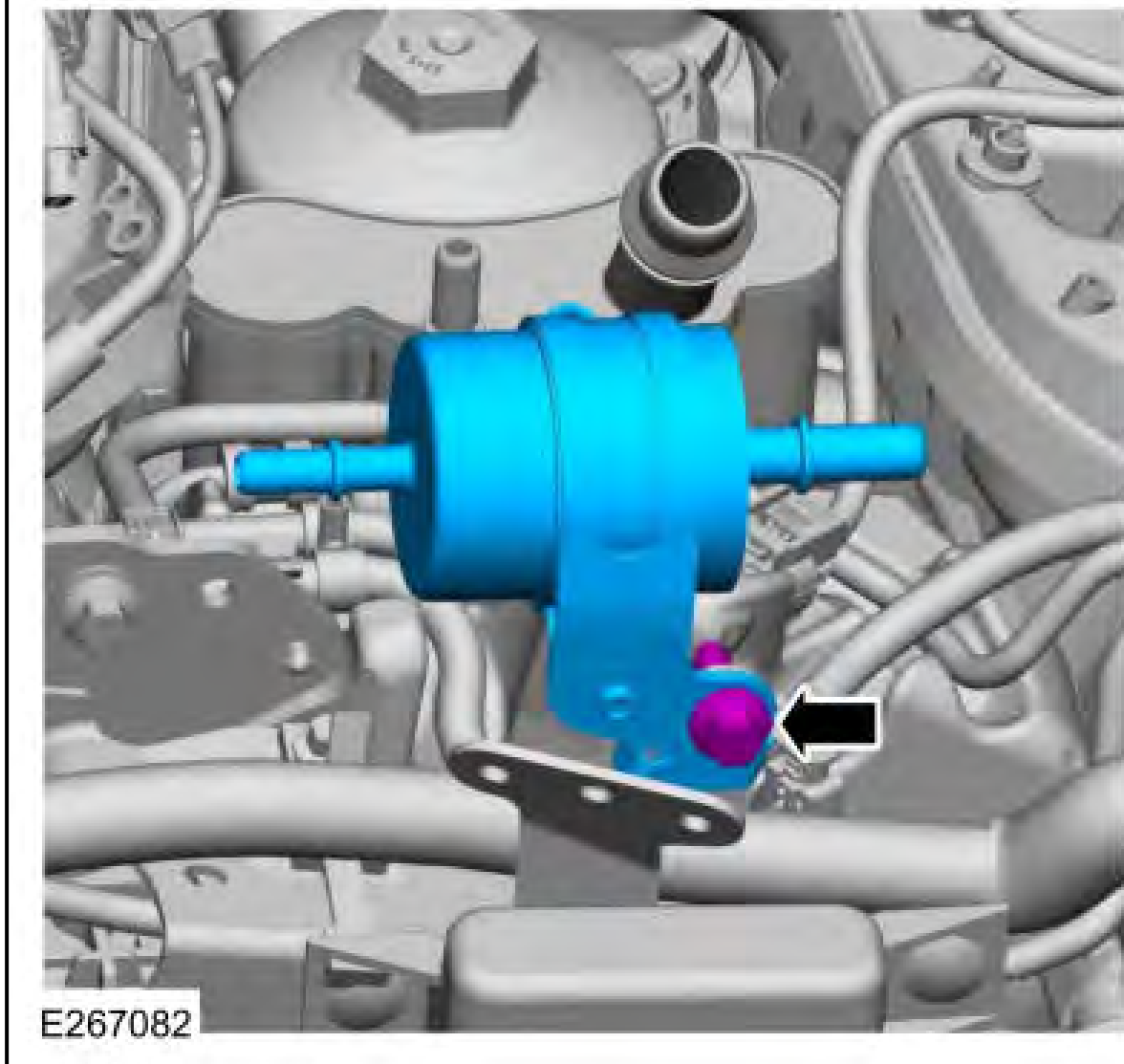
31. Install the following items:

1. Install the starter motor. Refer to: [Starter Motor](#) .
2. If equipped, install the front driveshaft. Refer to: [Front Driveshaft](#) .

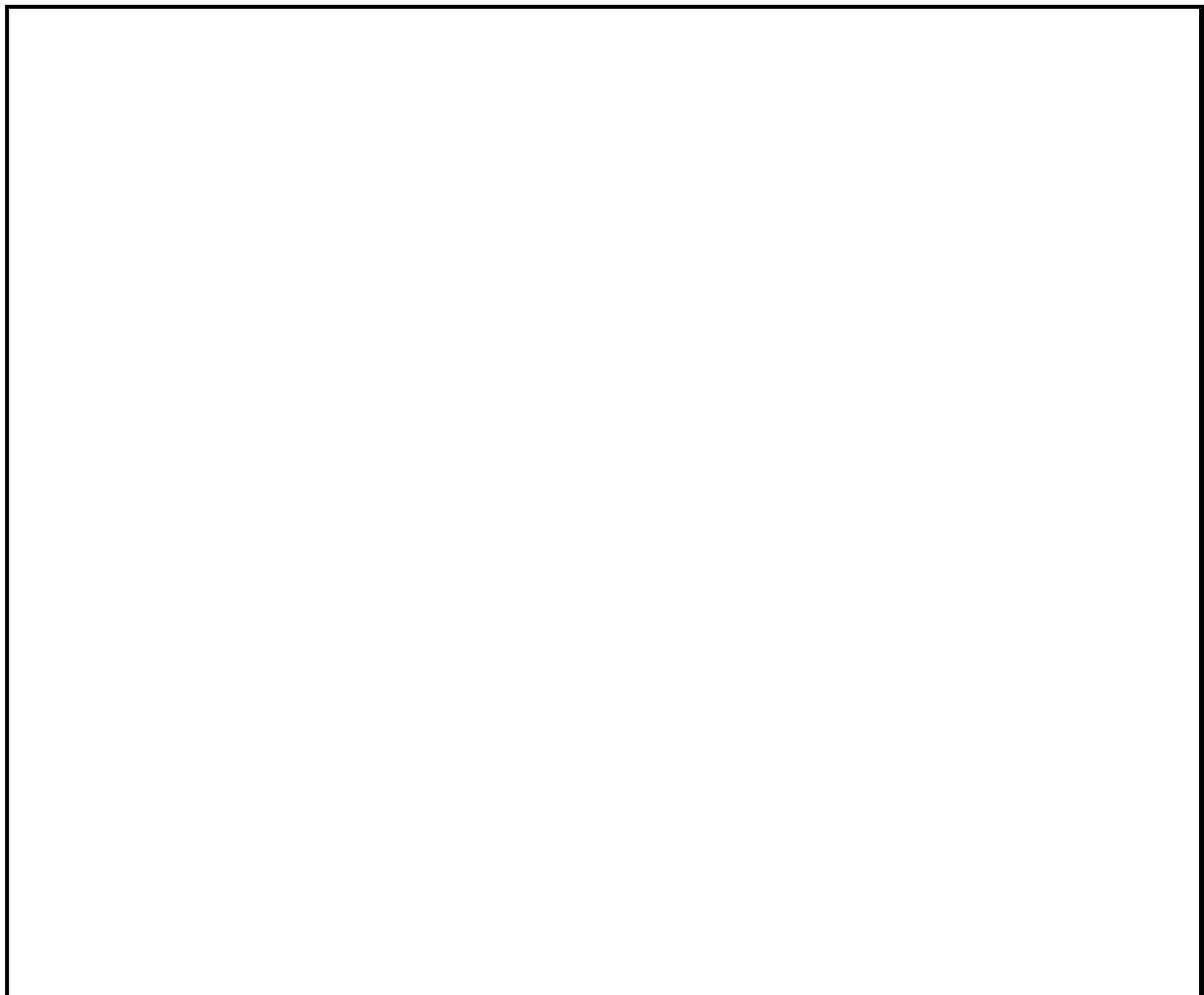
32. Install the secondary fuel filter and the bolt.

Torque: 89 lb.in (10 Nm)

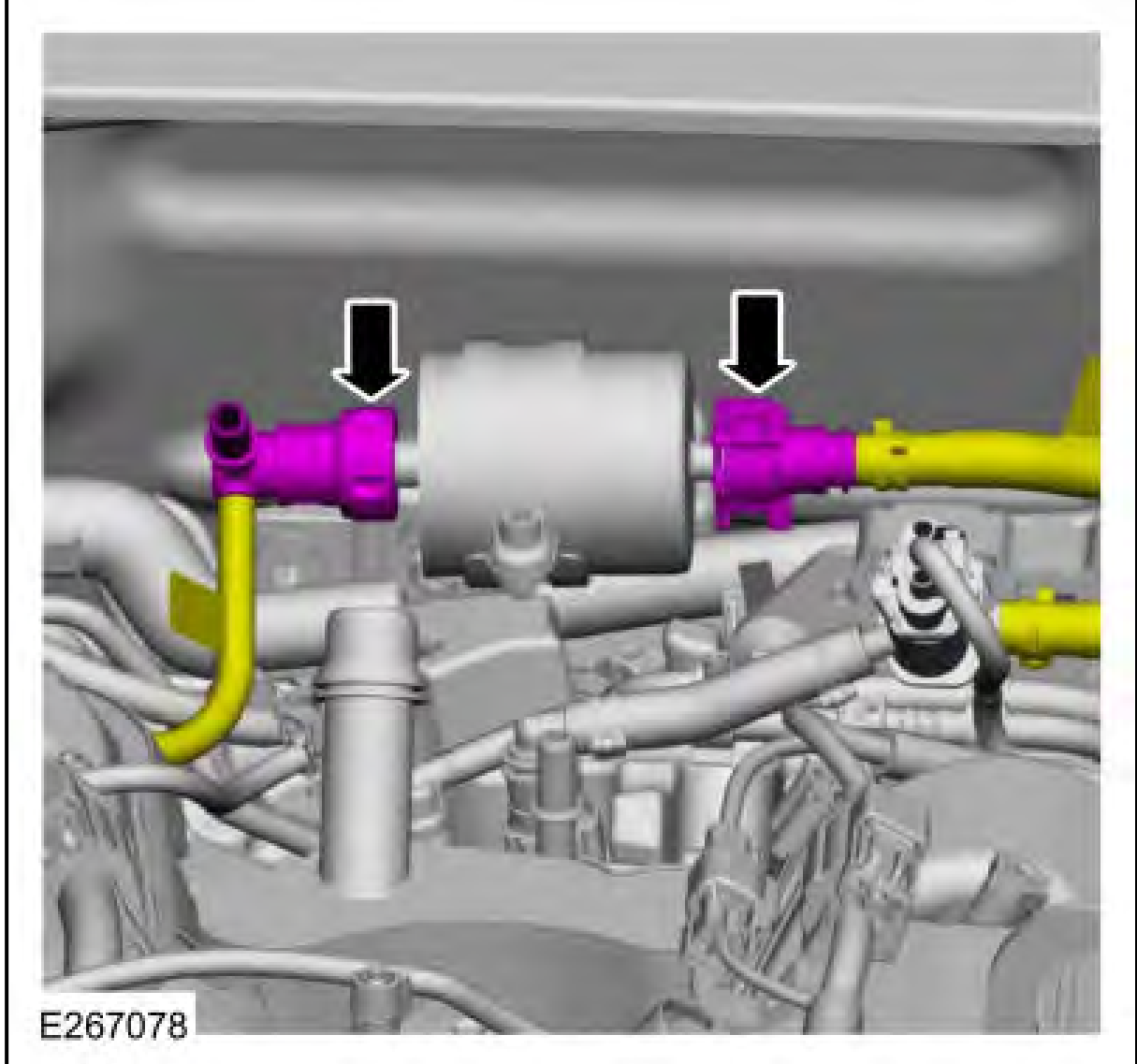




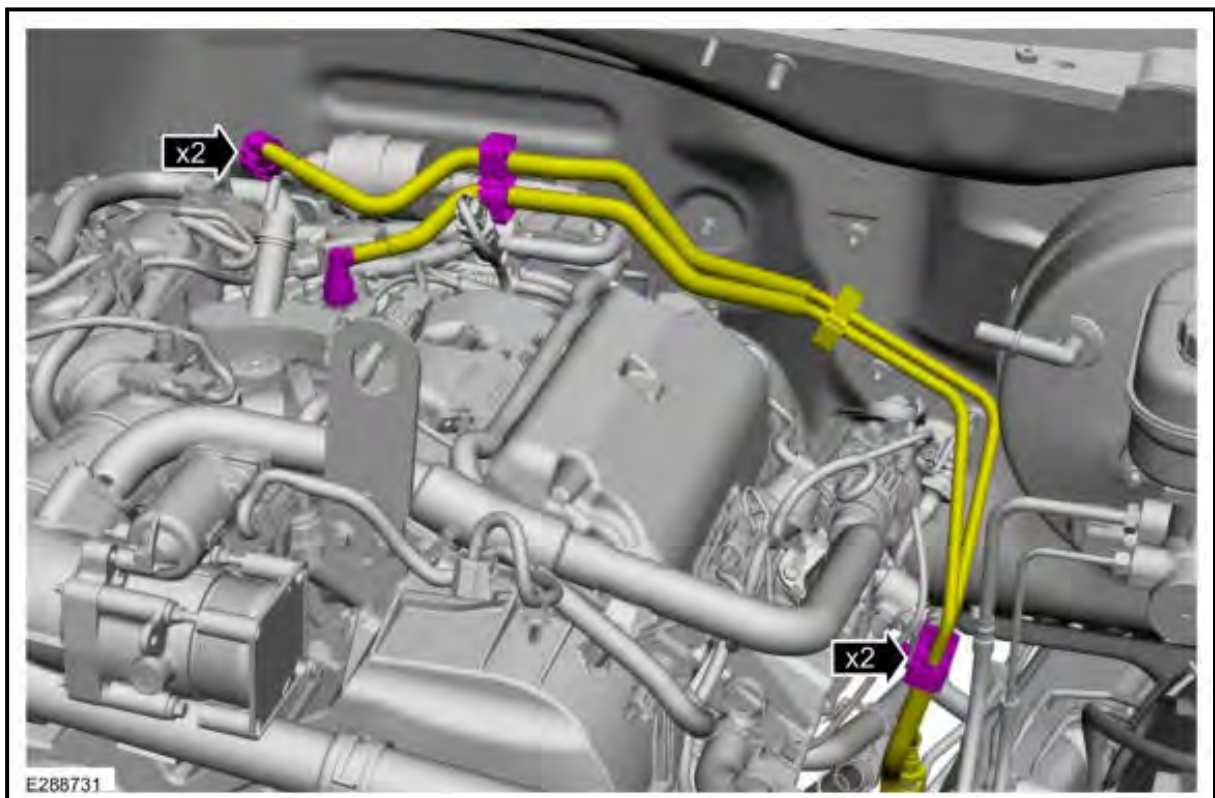
33. Connect the secondary fuel lines. Refer to: [Quick Release Coupling](#) .





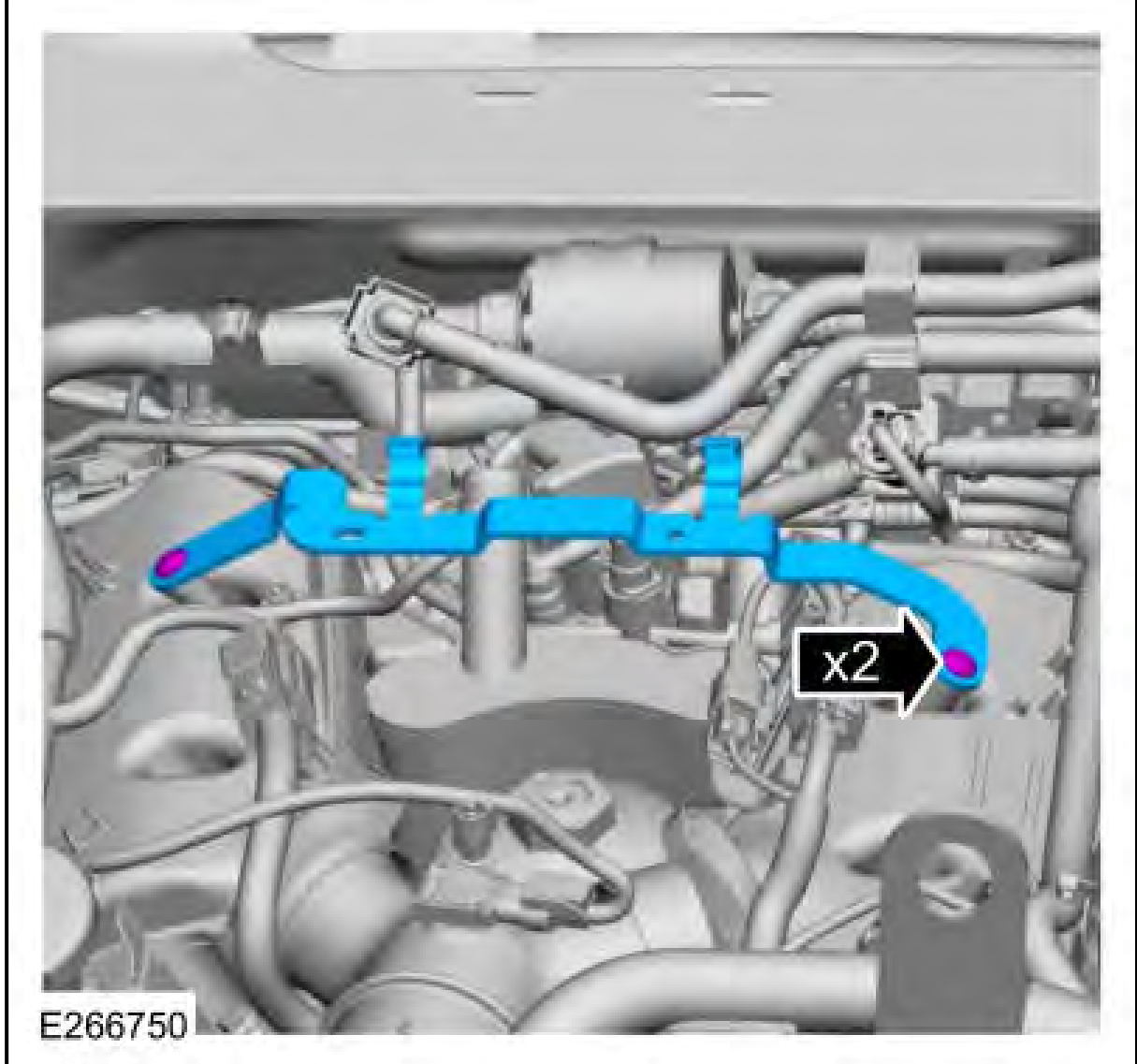


34. Position back and connect the fuel tubes. Refer to: [Quick Release Coupling](#) .

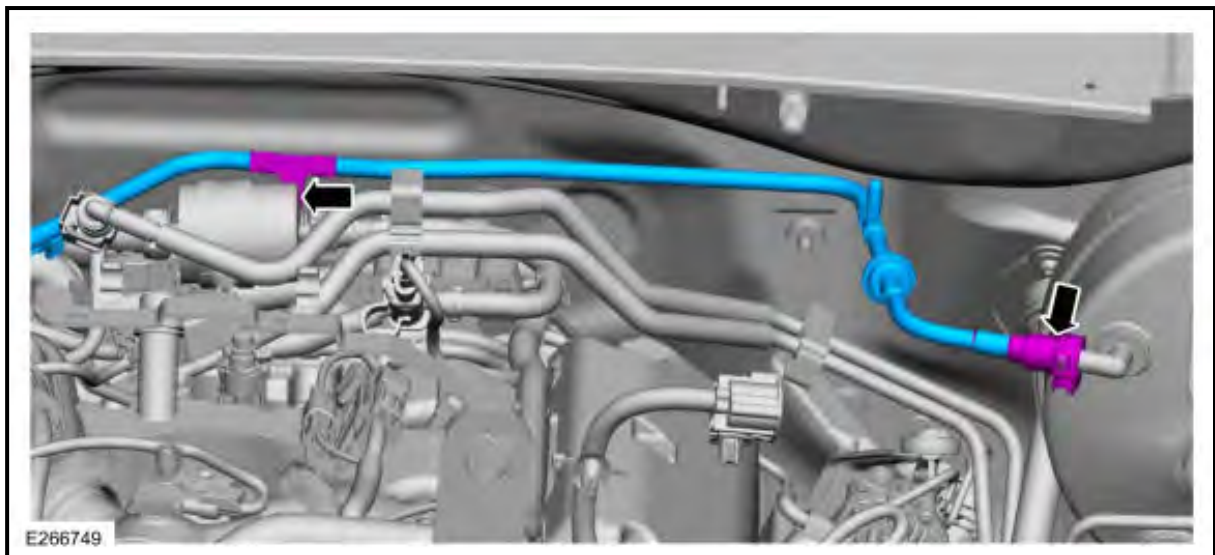


35. Install the engine appearance cover bracket and the retainers.

Torque: 44 lb.in (5 Nm)



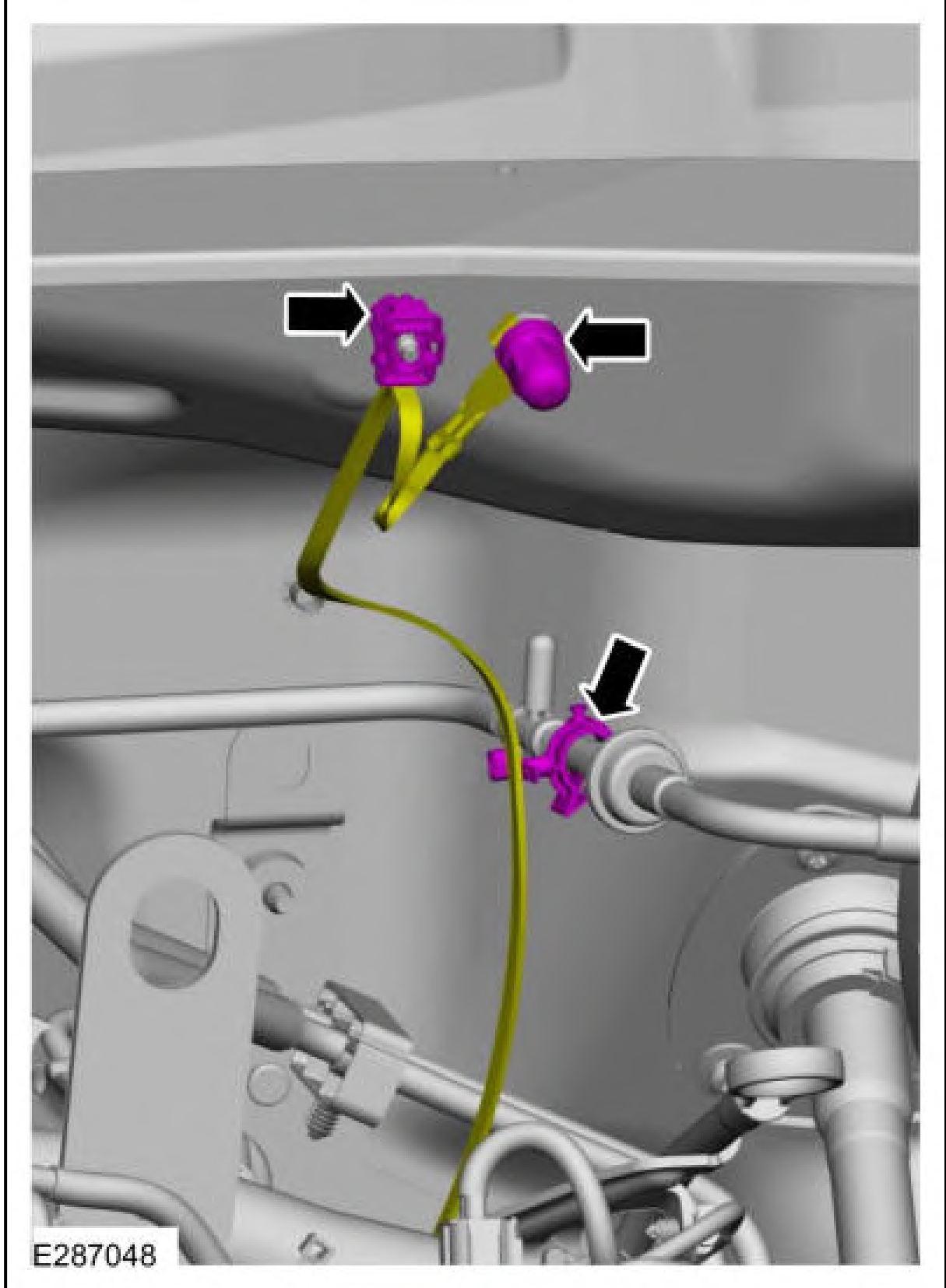
36. Install and connect the brake booster tube.



37. Install the ground strap and the nut. Connect the ground strap retainers.

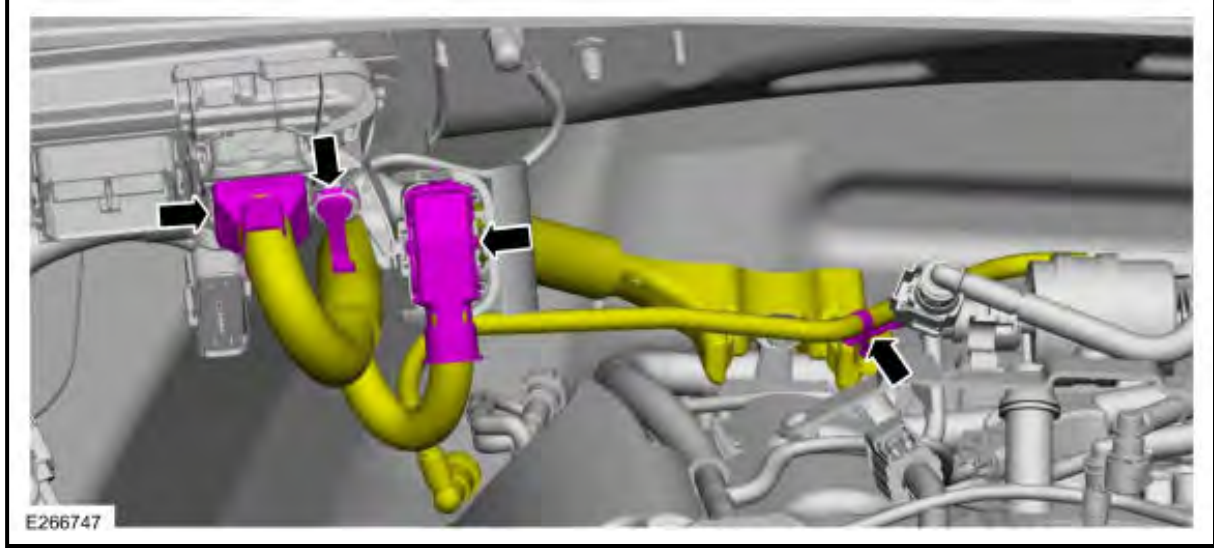
Torque: 80 lb.in (9 Nm)



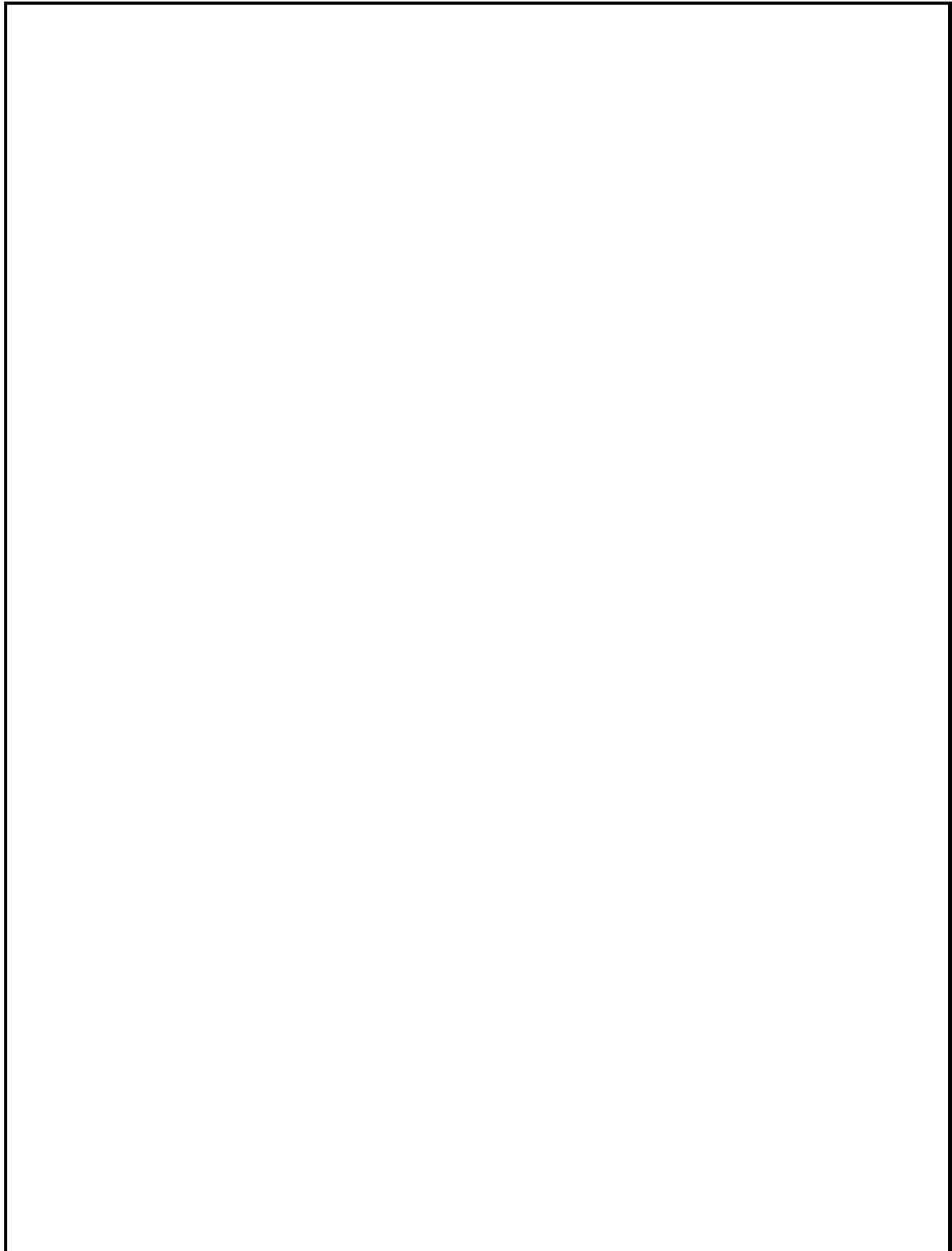


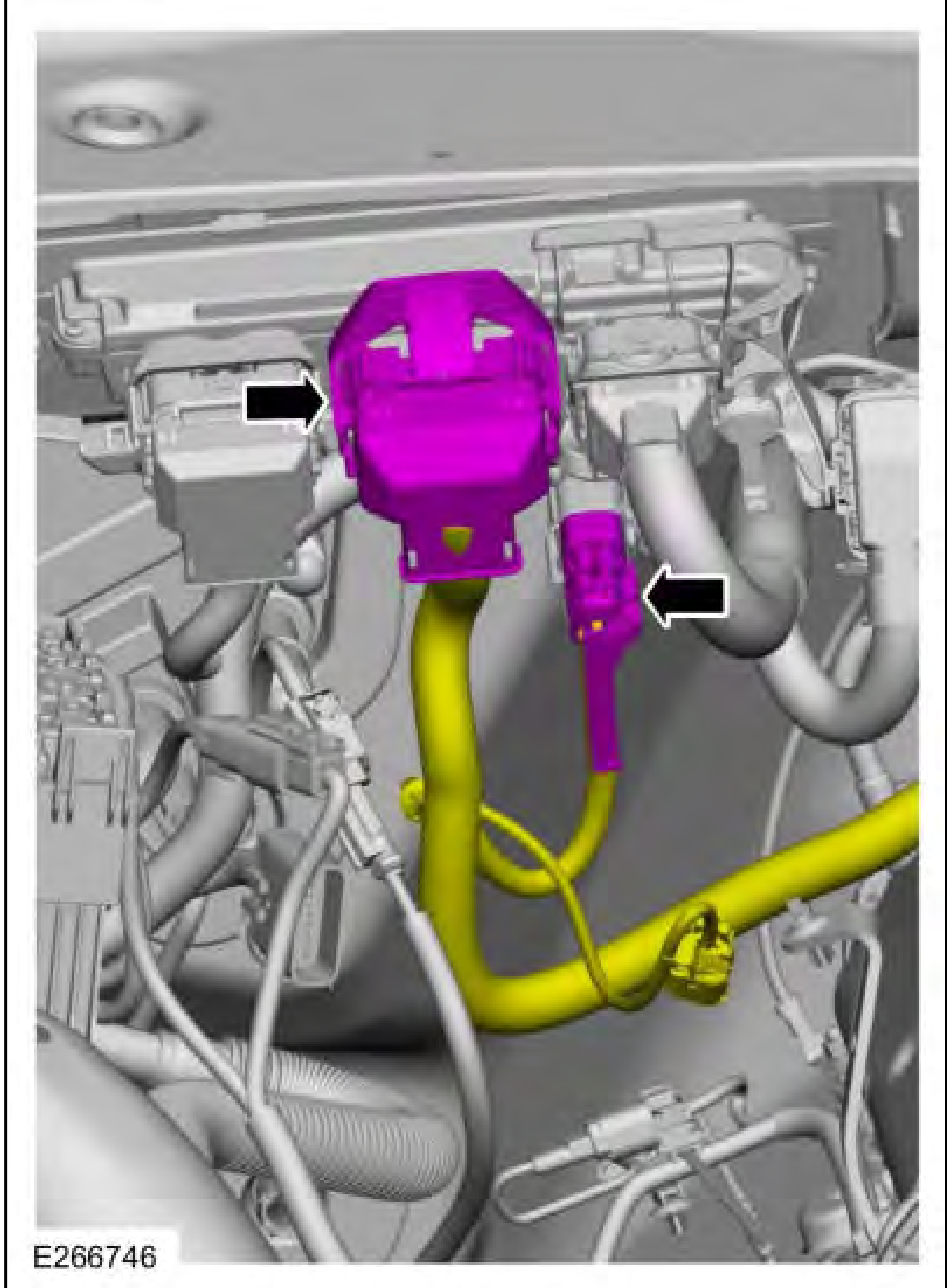
38. Position back the transmission wiring and connect the electrical connectors. Connect the wire harness retainers.





39. Connect the PCM electrical connector and the electrical connector.

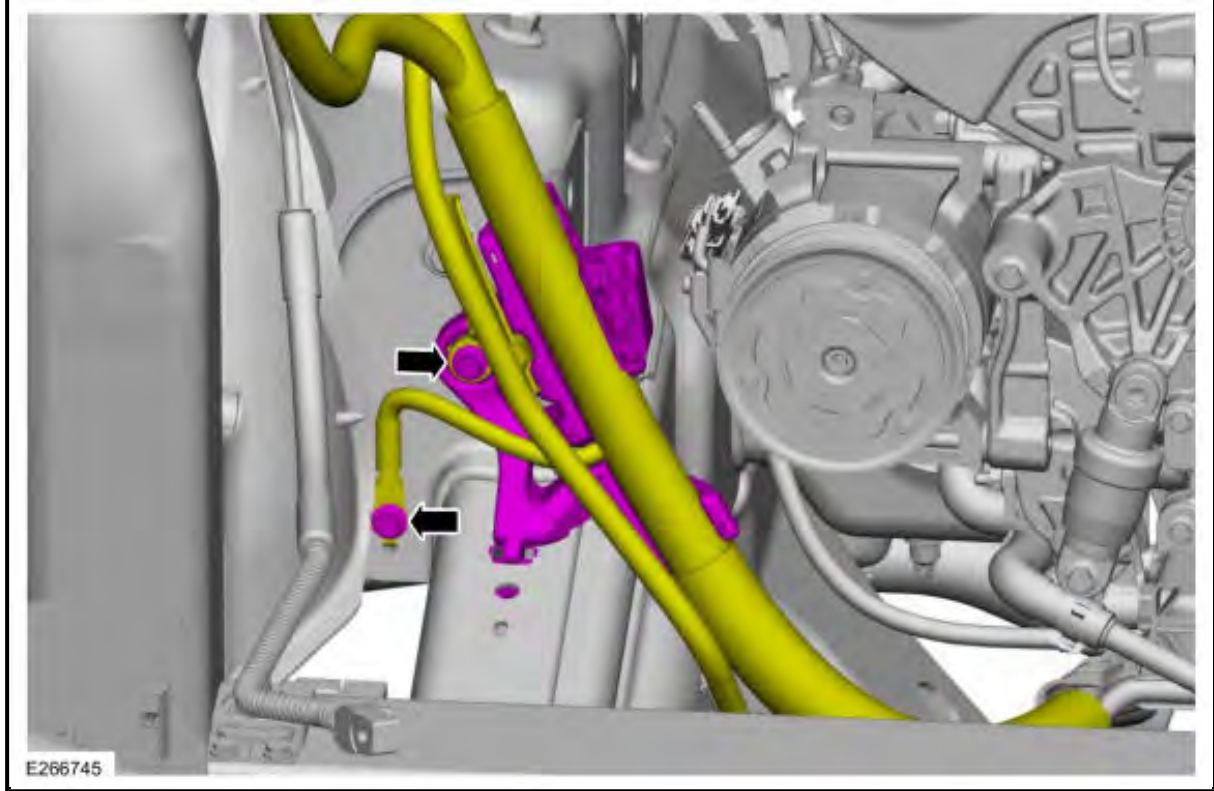




40. Position back and the battery wire harness and install the retainers.

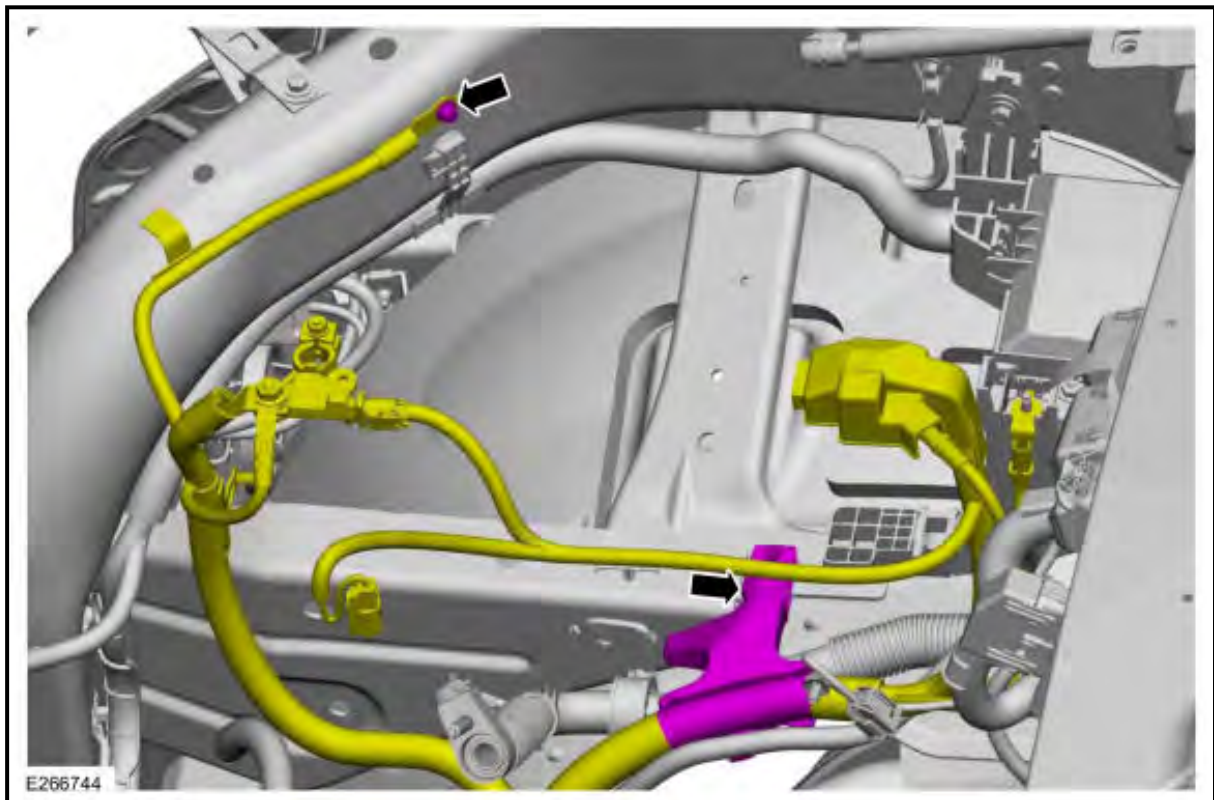
Torque: 177 lb.in (20 Nm)





41. Position back the battery wire harness and connect the wire retainer. Install the ground wire bolt.

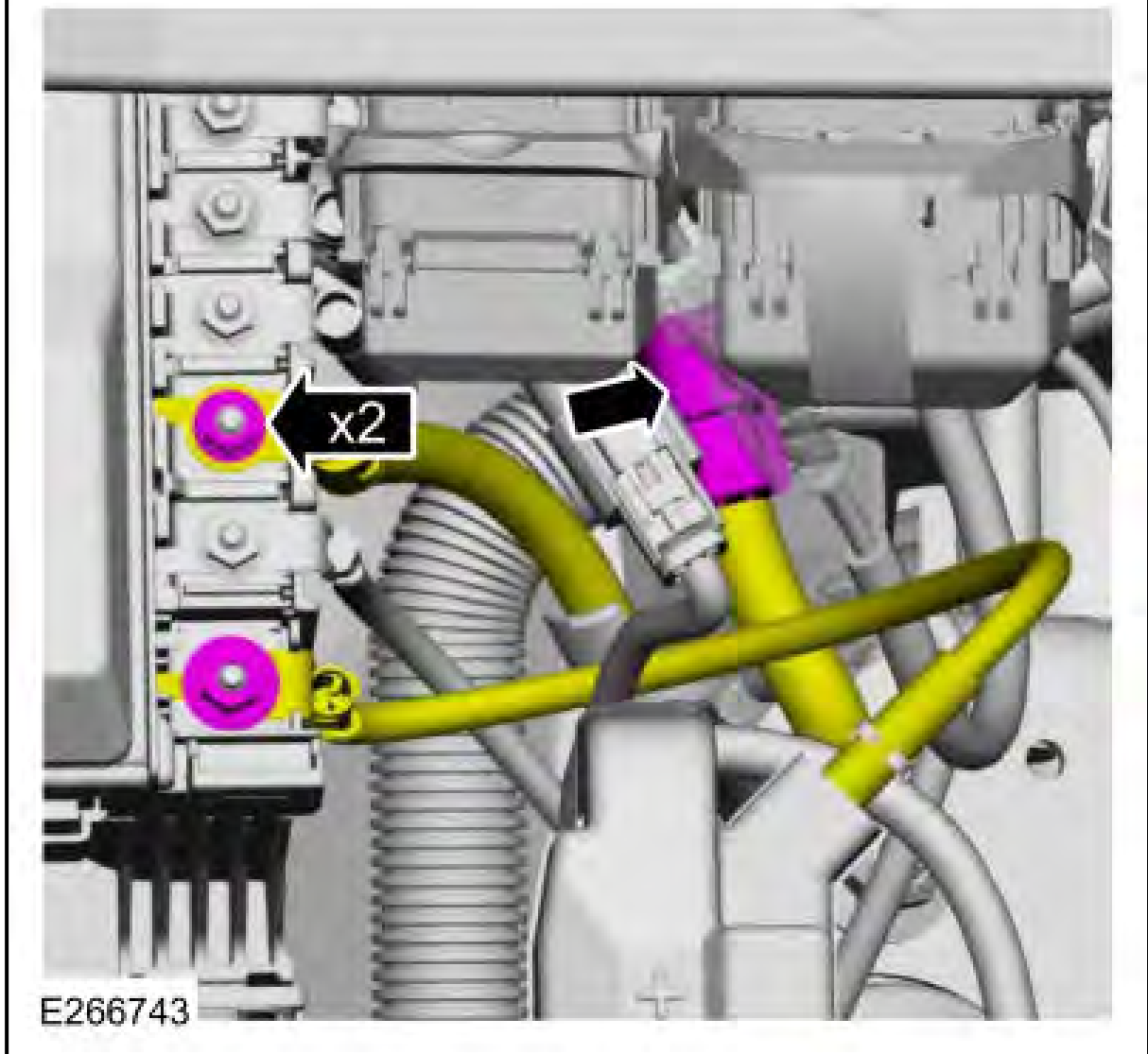
Torque: 80 lb.in (9 Nm)



42. Connect the electrical connector. Position back the battery wire harness and install the nuts.

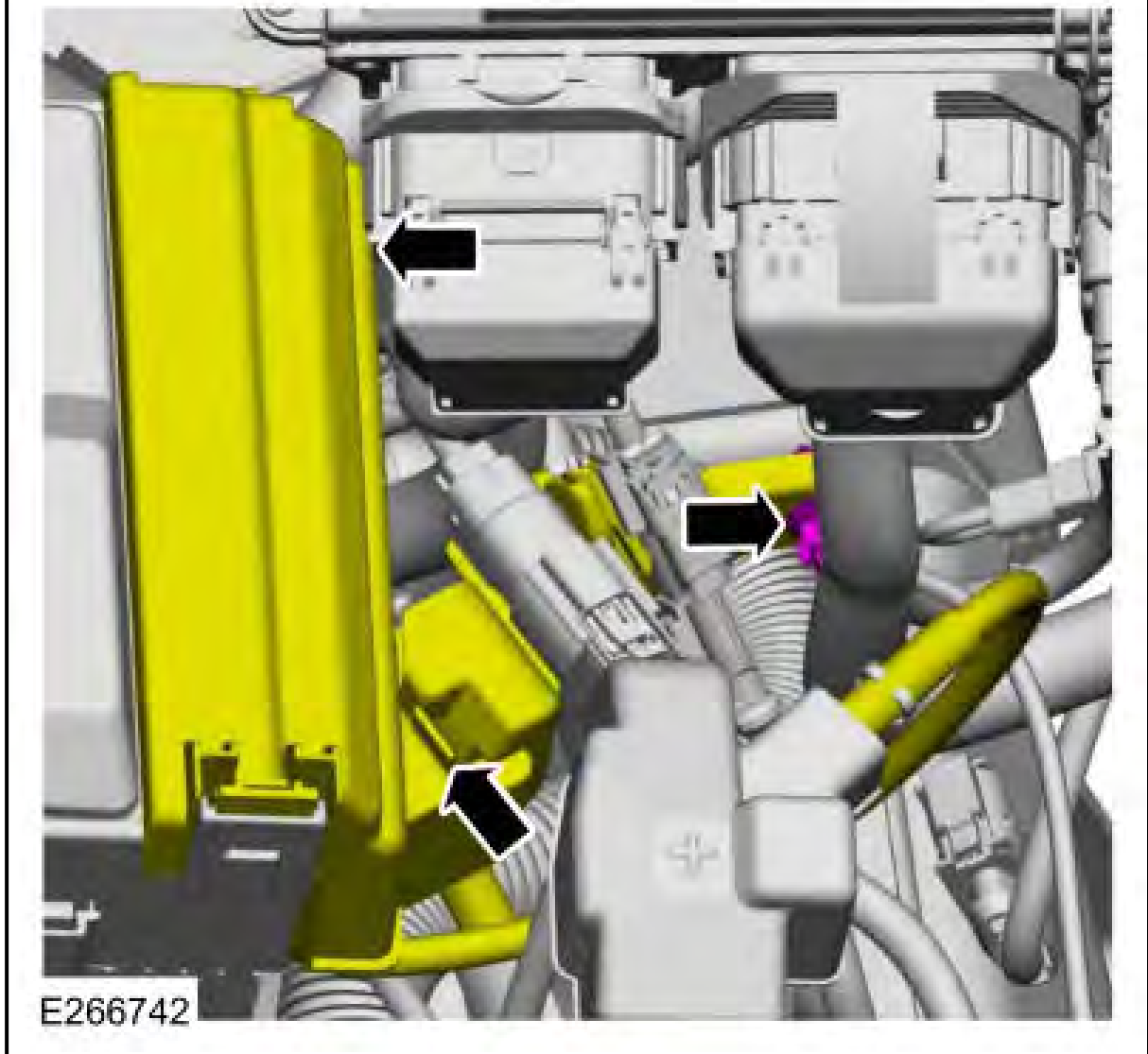
Torque: 80 lb.in (9 Nm)



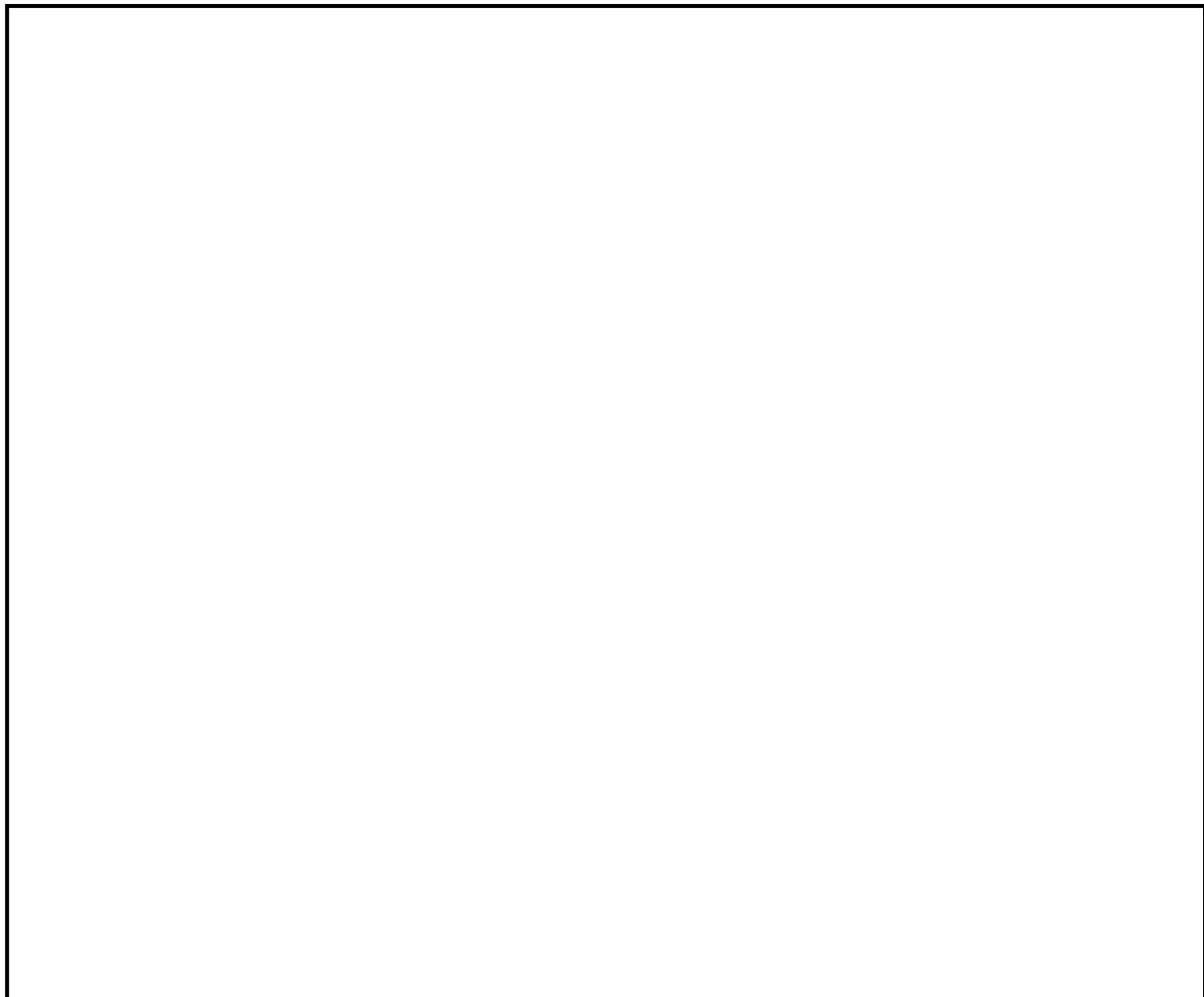


43. Install the power distribution box cover. Connect the retainer.

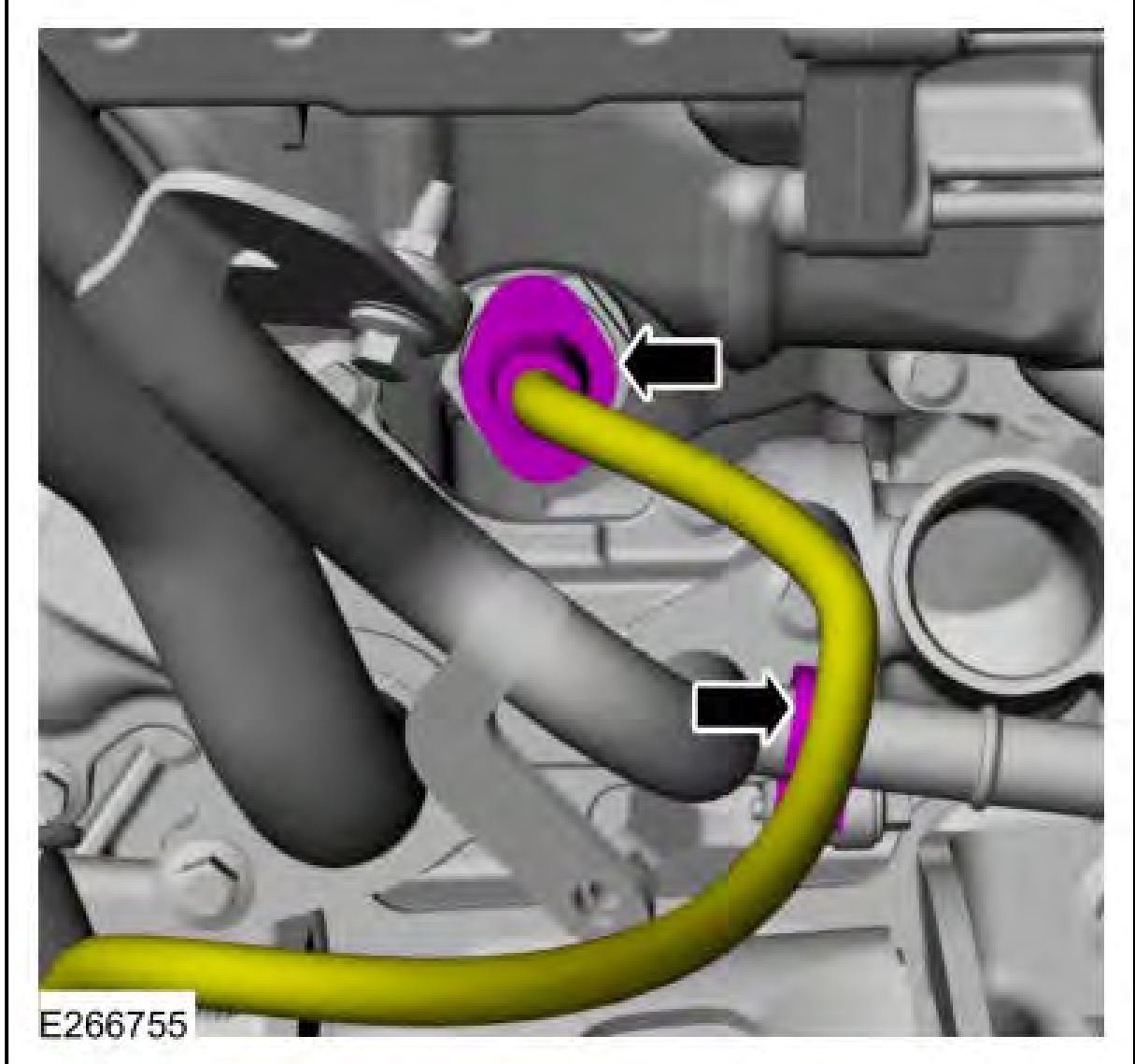




44. If equipped, connect the block heater electrical connector and the retainer.







45. Install a new O-ring seal on the lower radiator coolant tube. Apply coolant to the O-ring seal.

Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)





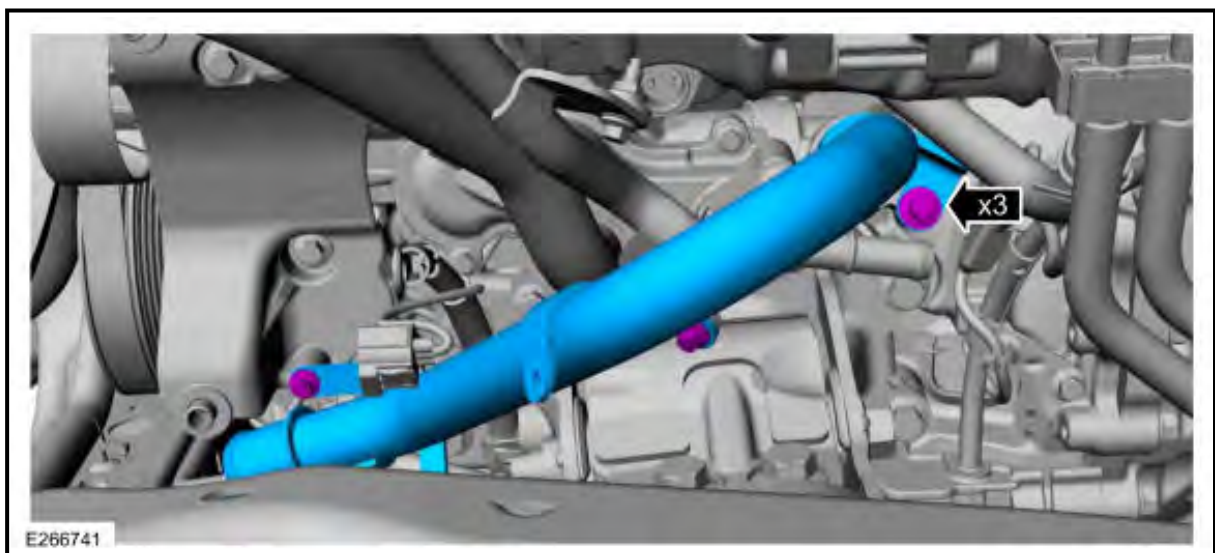
46. **NOTE:** Apply coolant to the coolant connector opening before installing the tube.

Install the lower radiator coolant tube and the bolts.

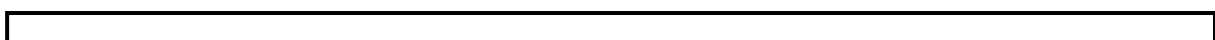
Material: Motorcraft <sup>®</sup> Orange Concentrated Antifreeze/Coolant / VC-3-B (WSS-M97B44-D)

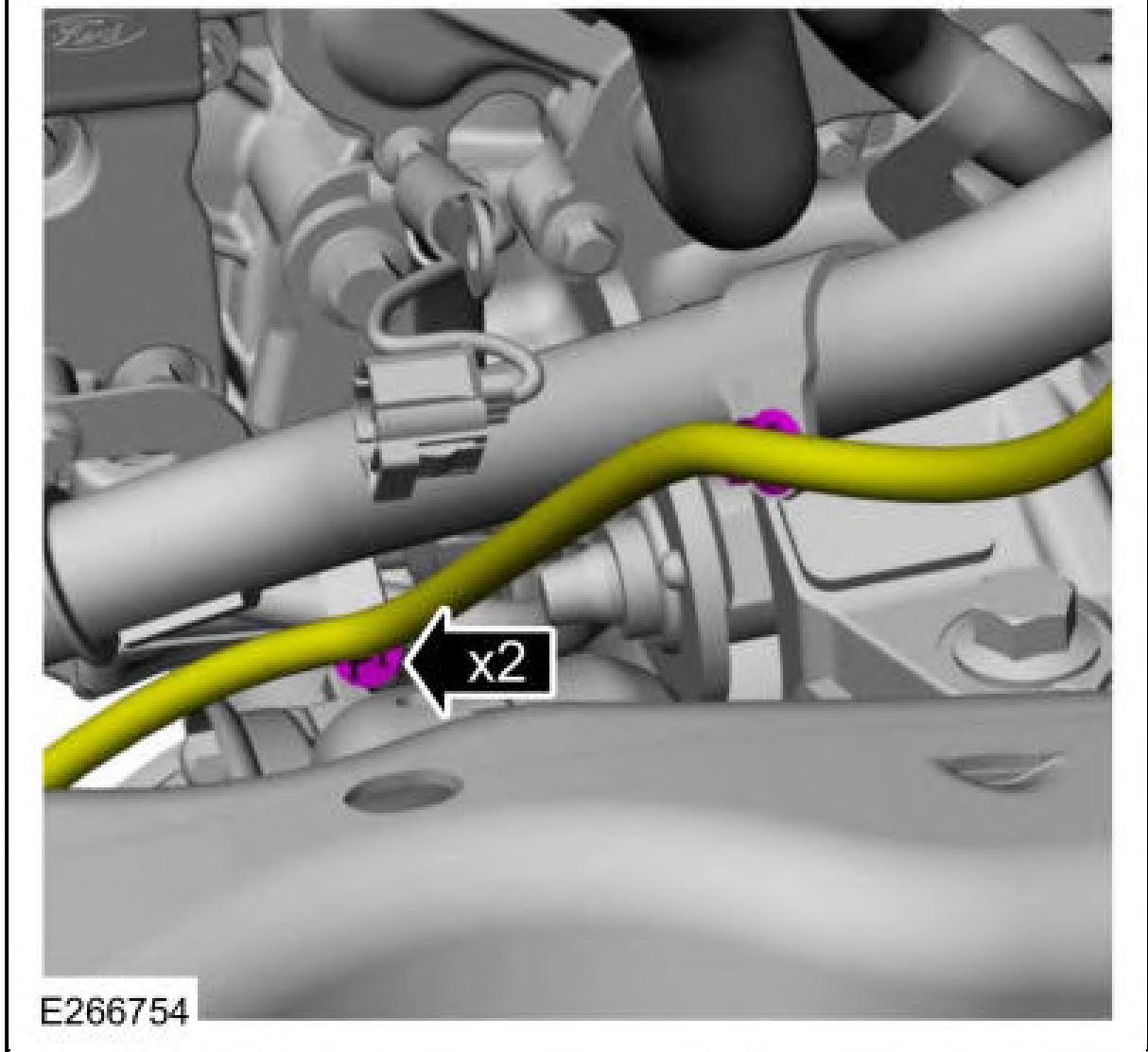
Torque

:M8 bolt : 18 lb.ft (25 Nm) M6 bolt : 71 lb.in (8 Nm)

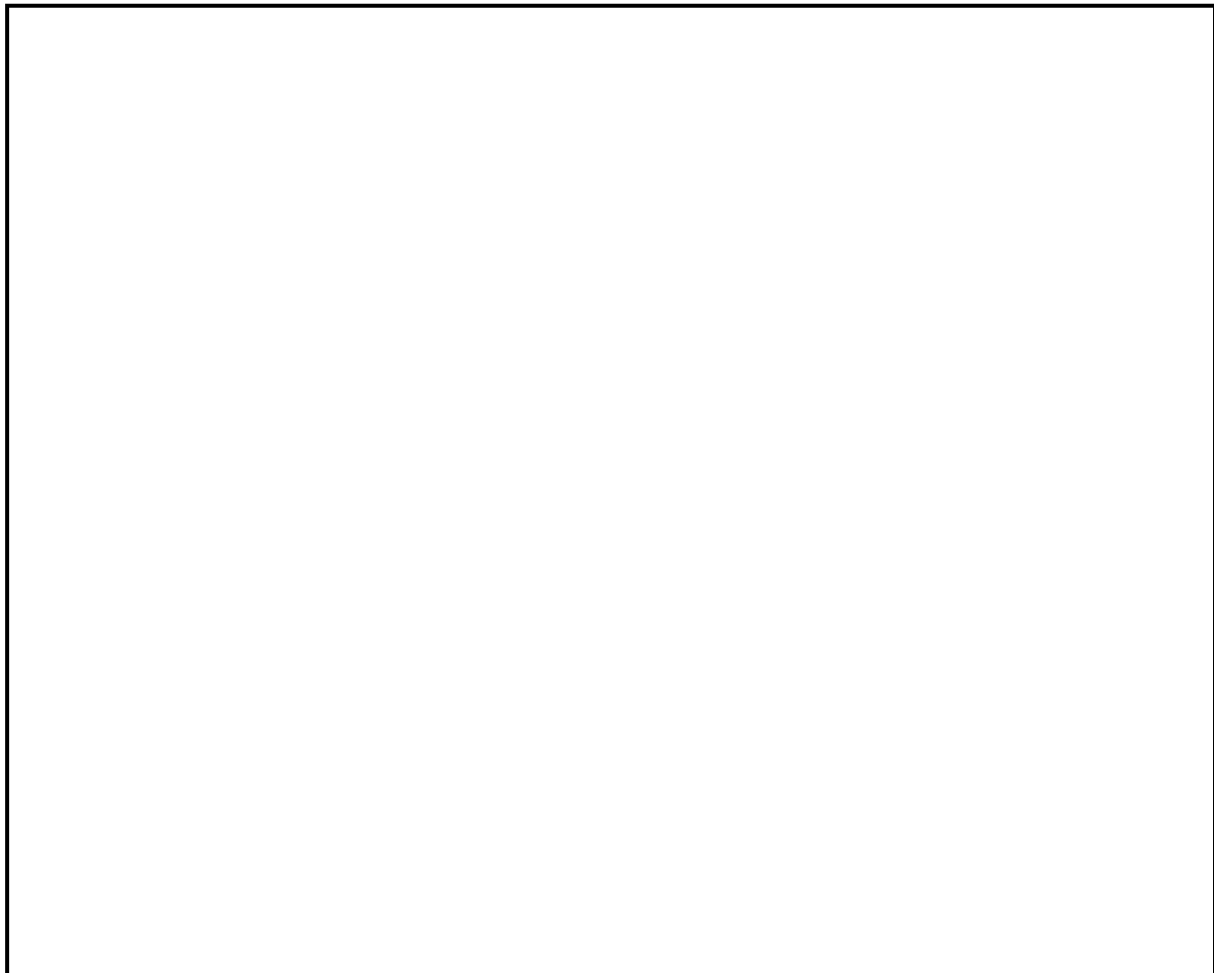


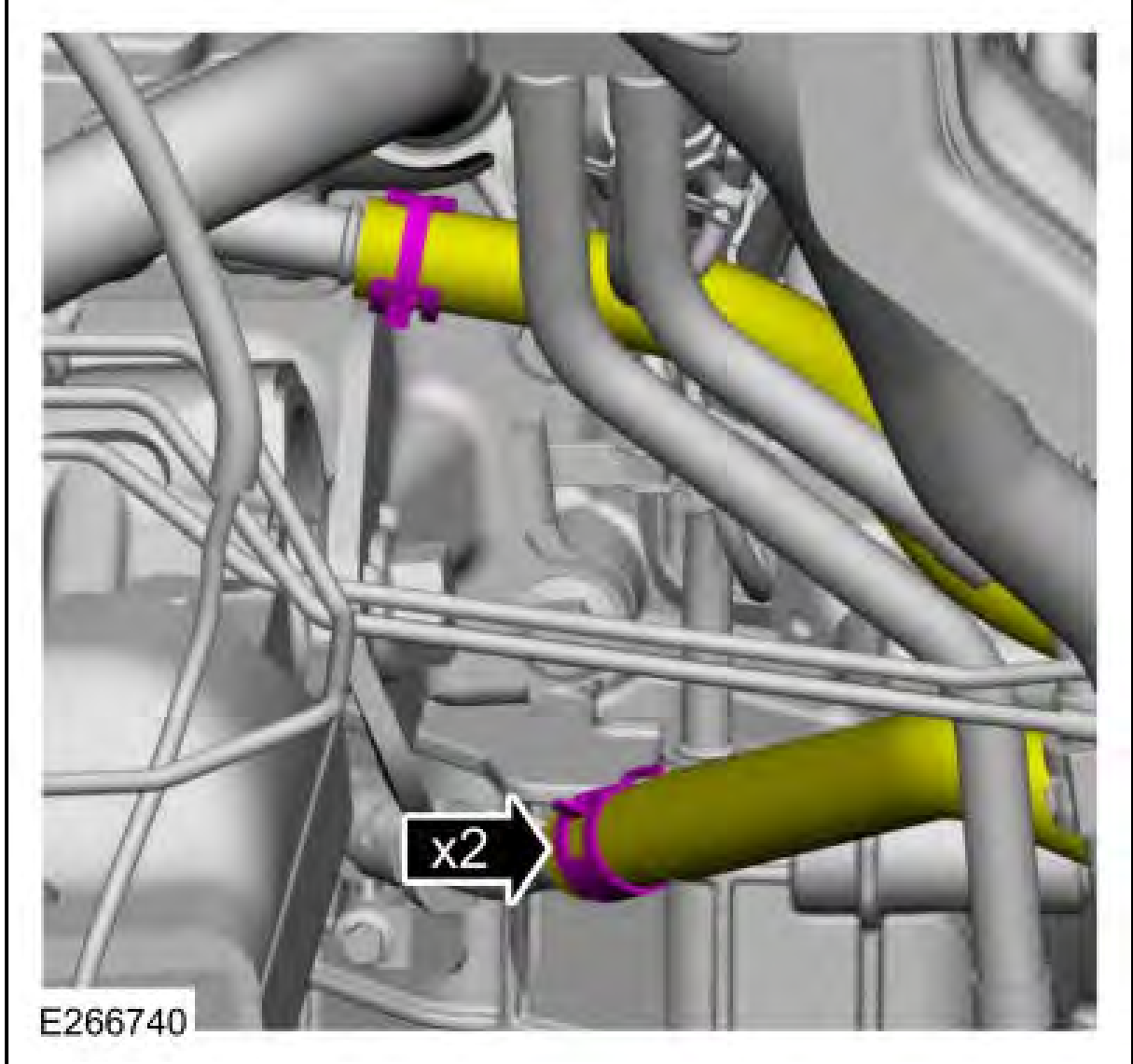
47. If equipped, connect the block heater cord retainers.





48. Position back and connect the coolant hoses. Use the General Equipment: Hose Clamp Remover/Installer





49. Install the following items:

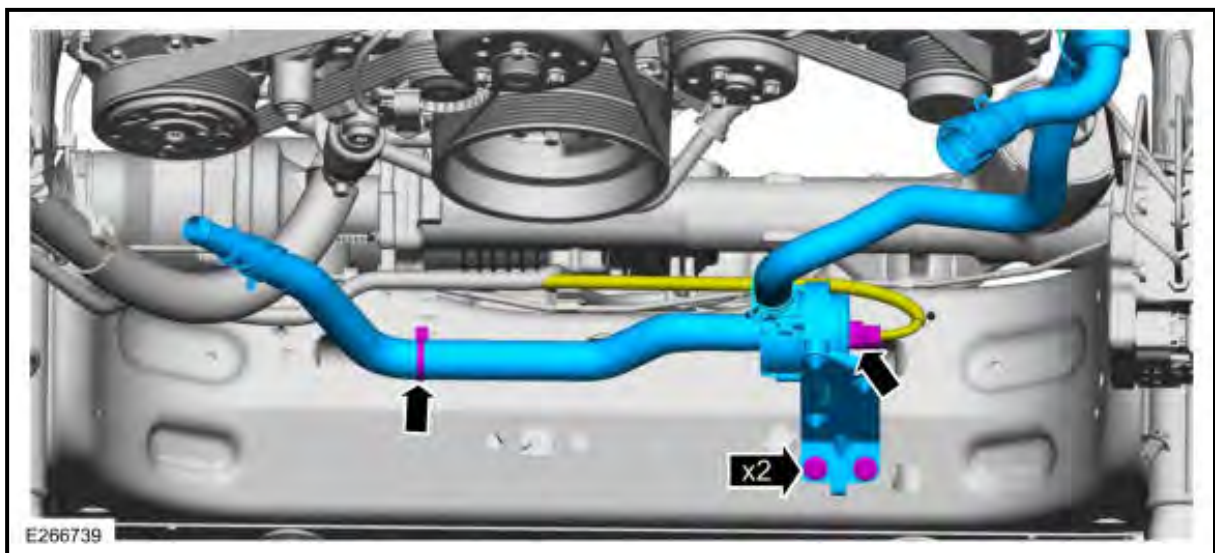
1. Install the generator. Refer to: [Generator - 3.0L Power Stroke Diesel](#) .
2. Install the cowl panel. Refer to: [Cowl Panel](#) .
3. Install the cowl panel grille. Refer to: [Cowl Panel Grille](#) .

50.

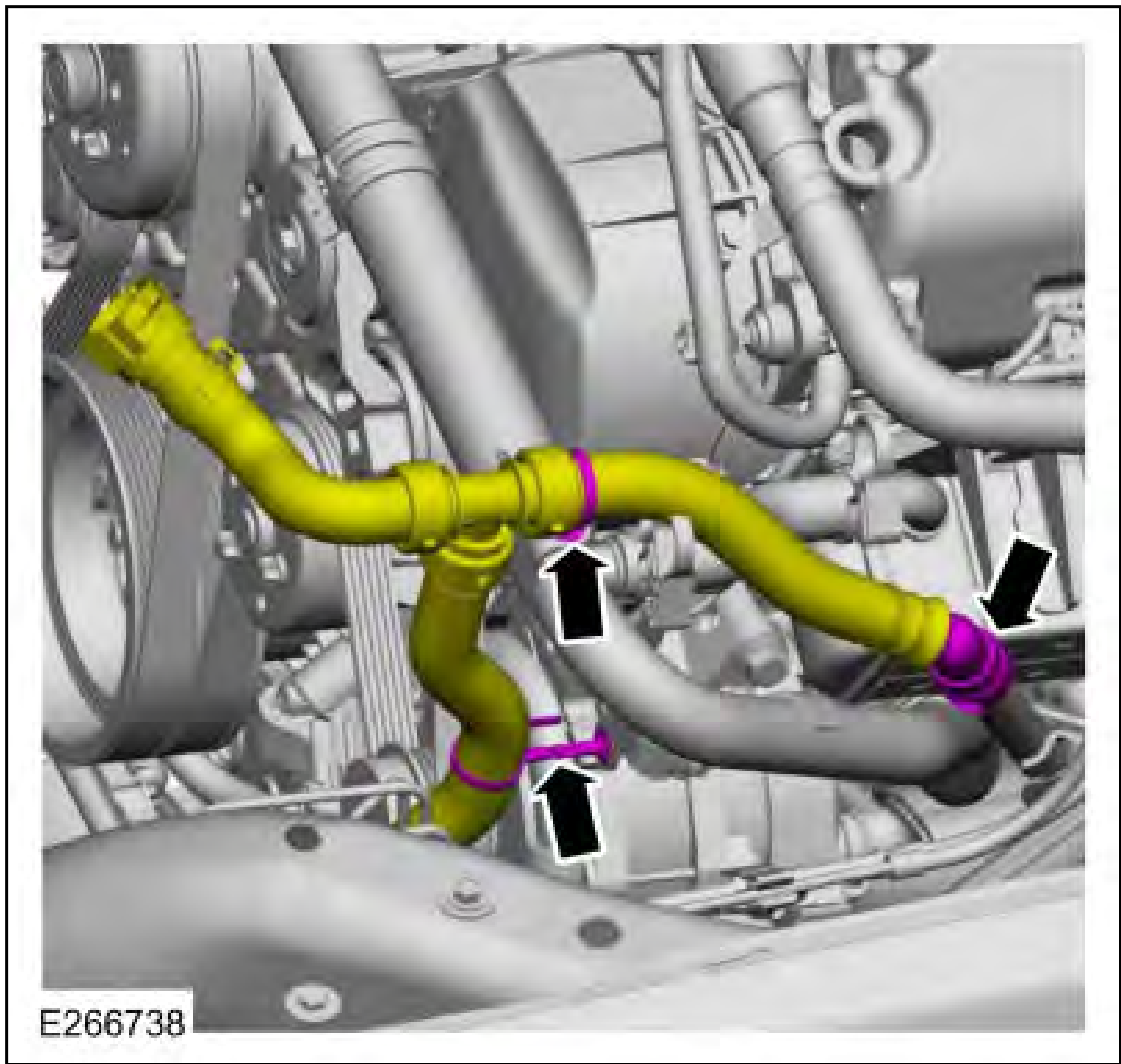
- Install the coolant pump and the bolts.

Torque: 177 lb.in (20 Nm)

- Connect the electrical connector and the coolant hose retainer.

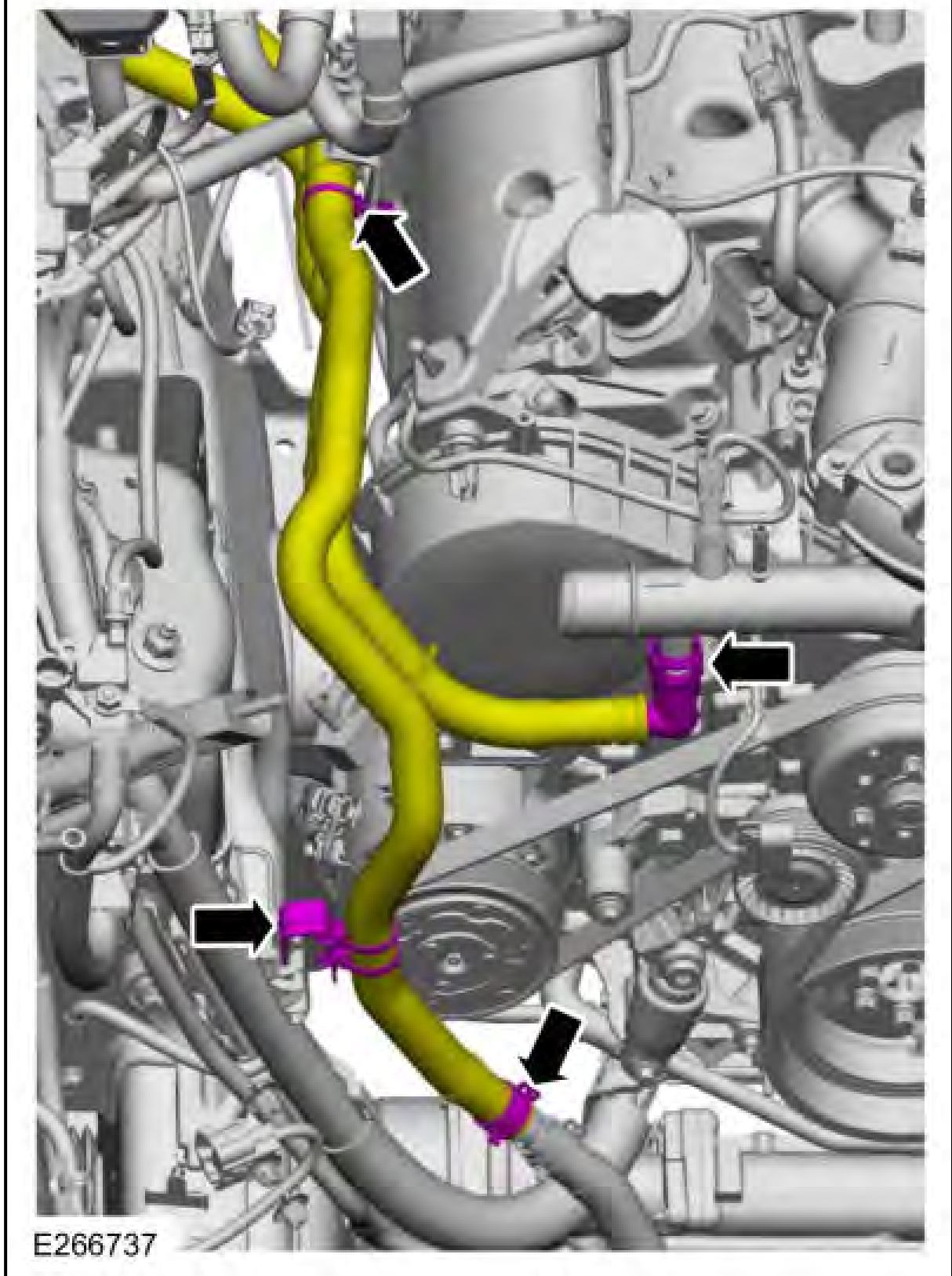


51. Connect the coolant hose connector and the retainers.



52. Connect the heater hoses and the retainers. Use the General Equipment: Hose Clamp Remover/Installer



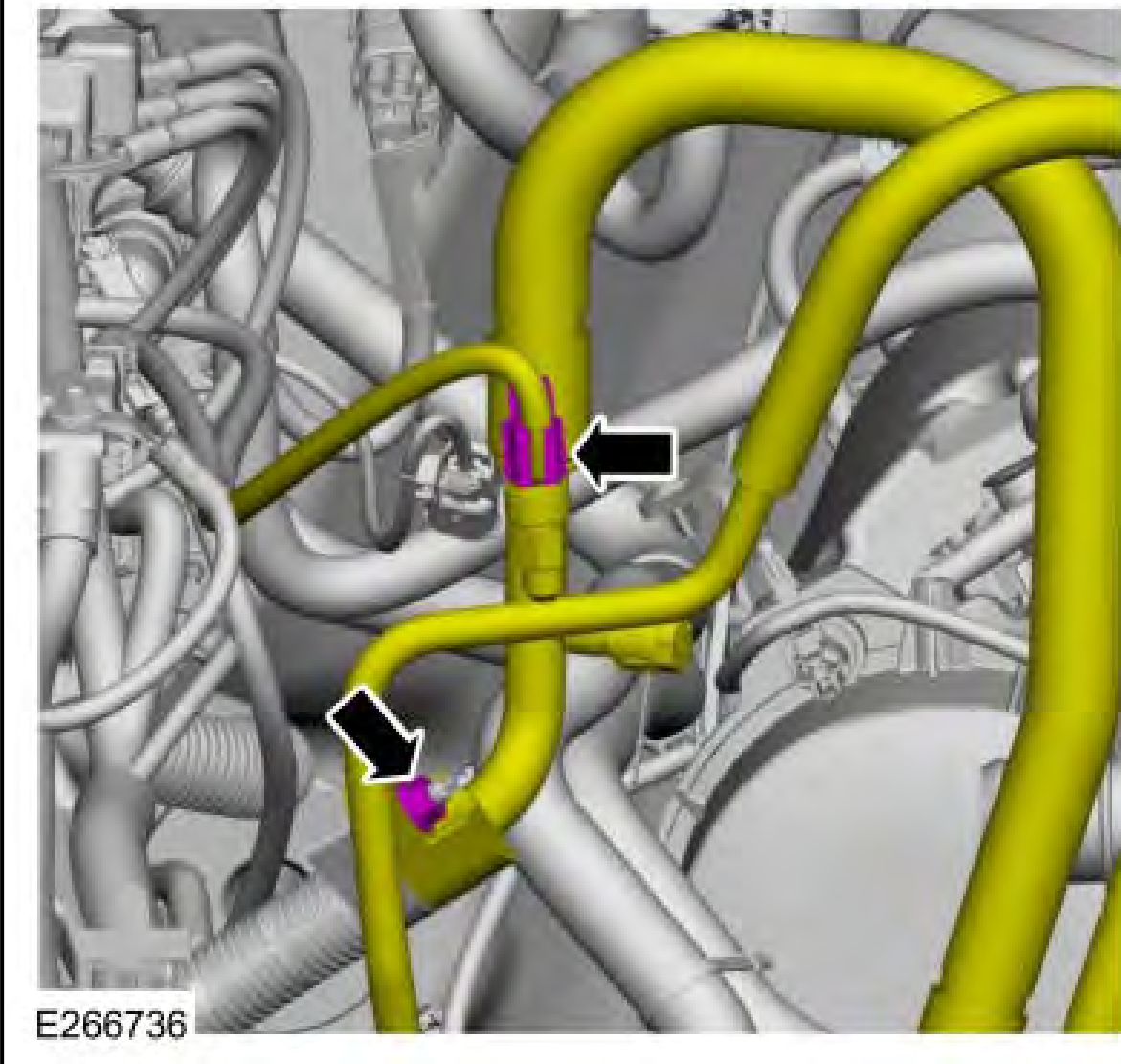


53.

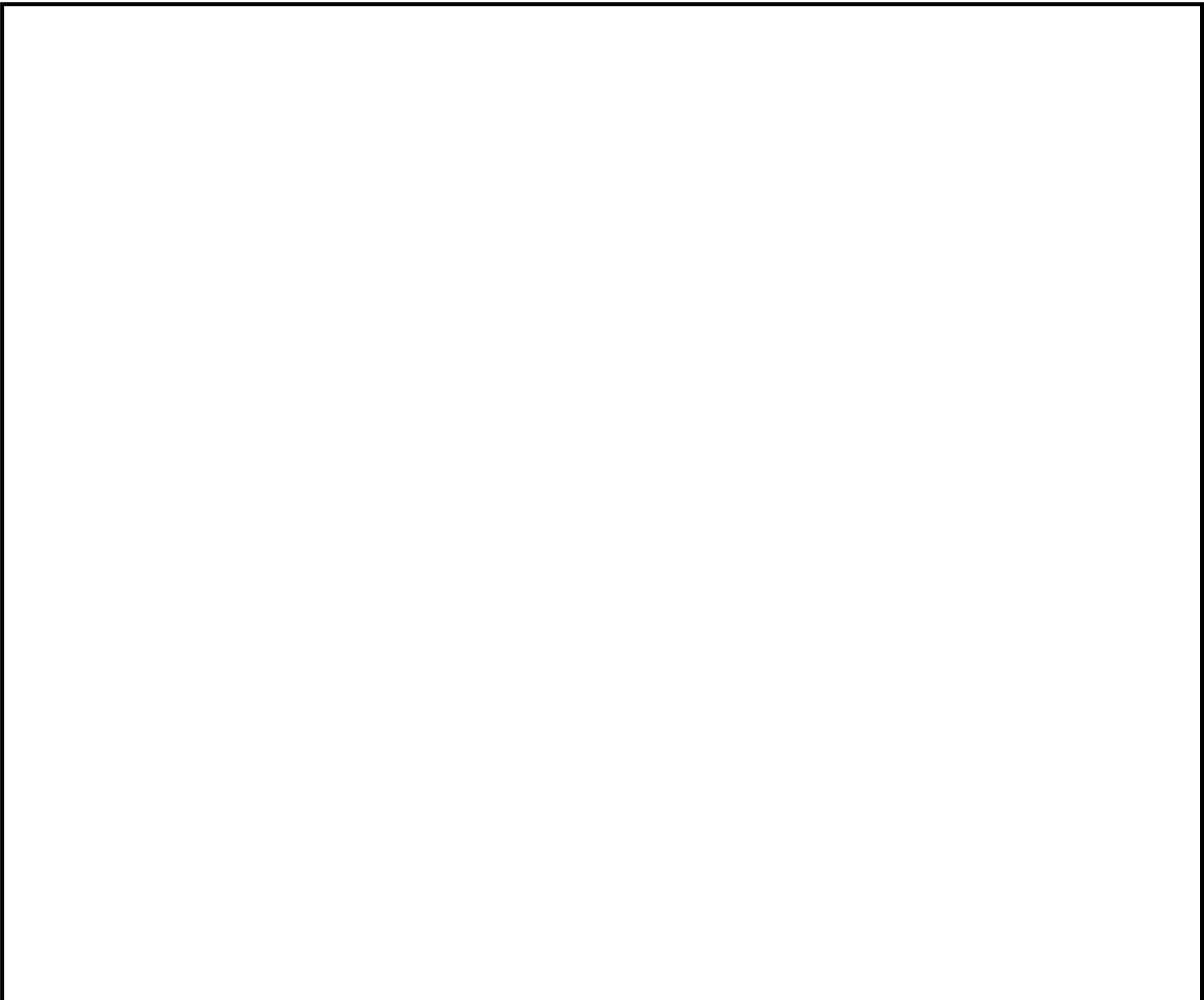
- Connect the A/C pressure transducer electrical connector.
- Install a new O-ring seal.
- Connect the A/C compressor inlet line and install the nut.

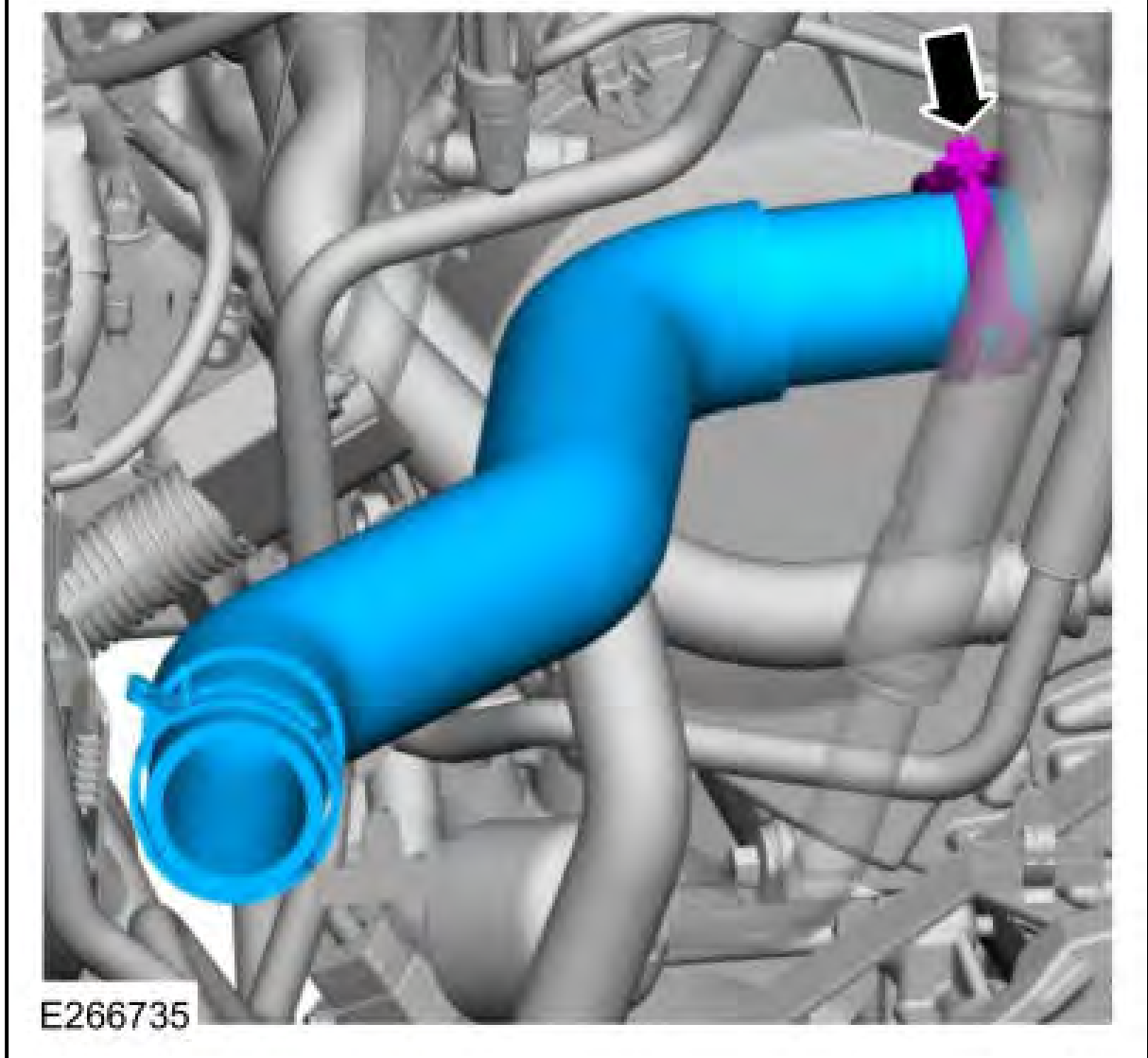
Torque: 133 lb.in (15 Nm)





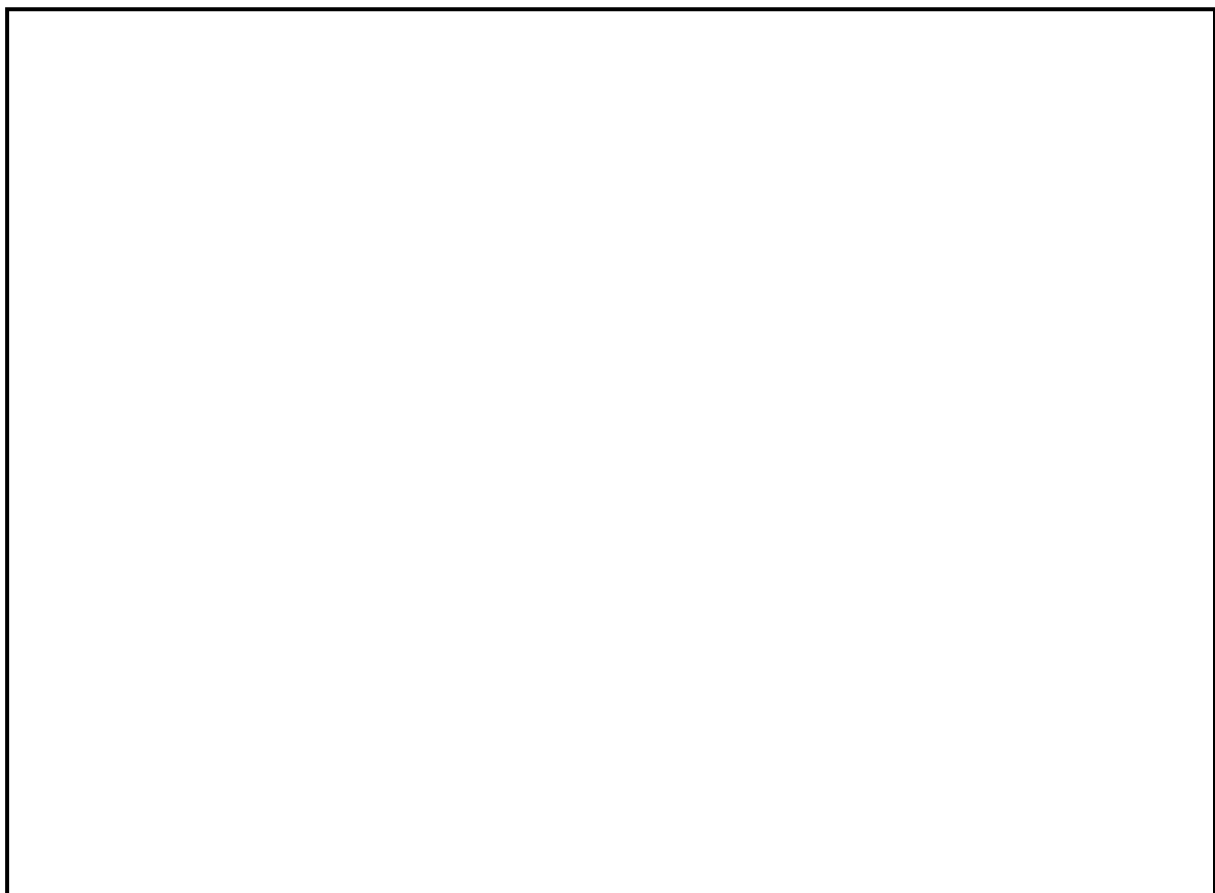
54. Install the upper radiator hose. Use the General Equipment: Hose Clamp Remover/Installer



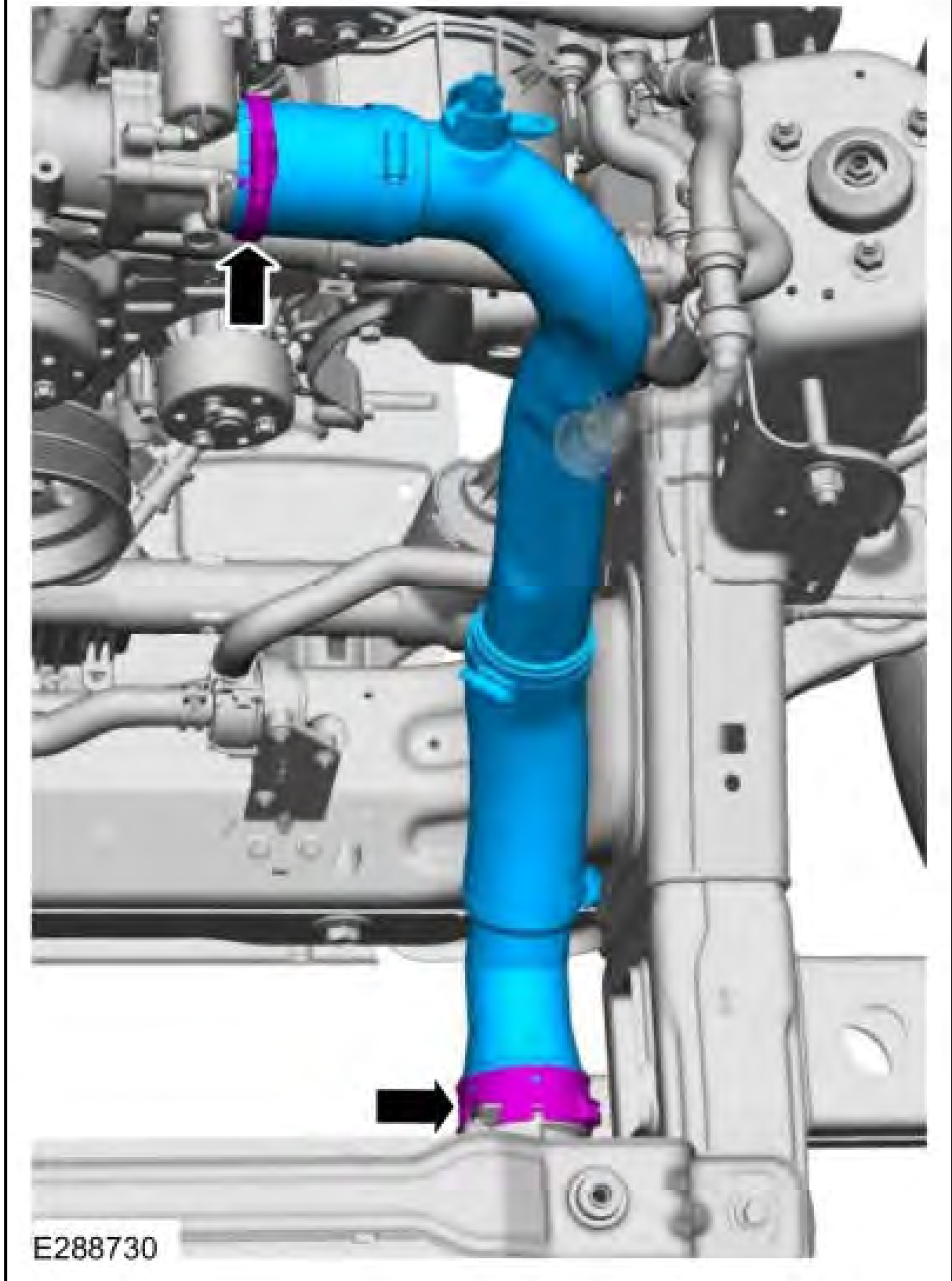


55. Inspect the turbocharger or engine air intake system components and clean, if necessary.
56. Install the LH CAC intake pipe and the clip. Tighten the clamp.

Torque: 44 lb.in (5 Nm)

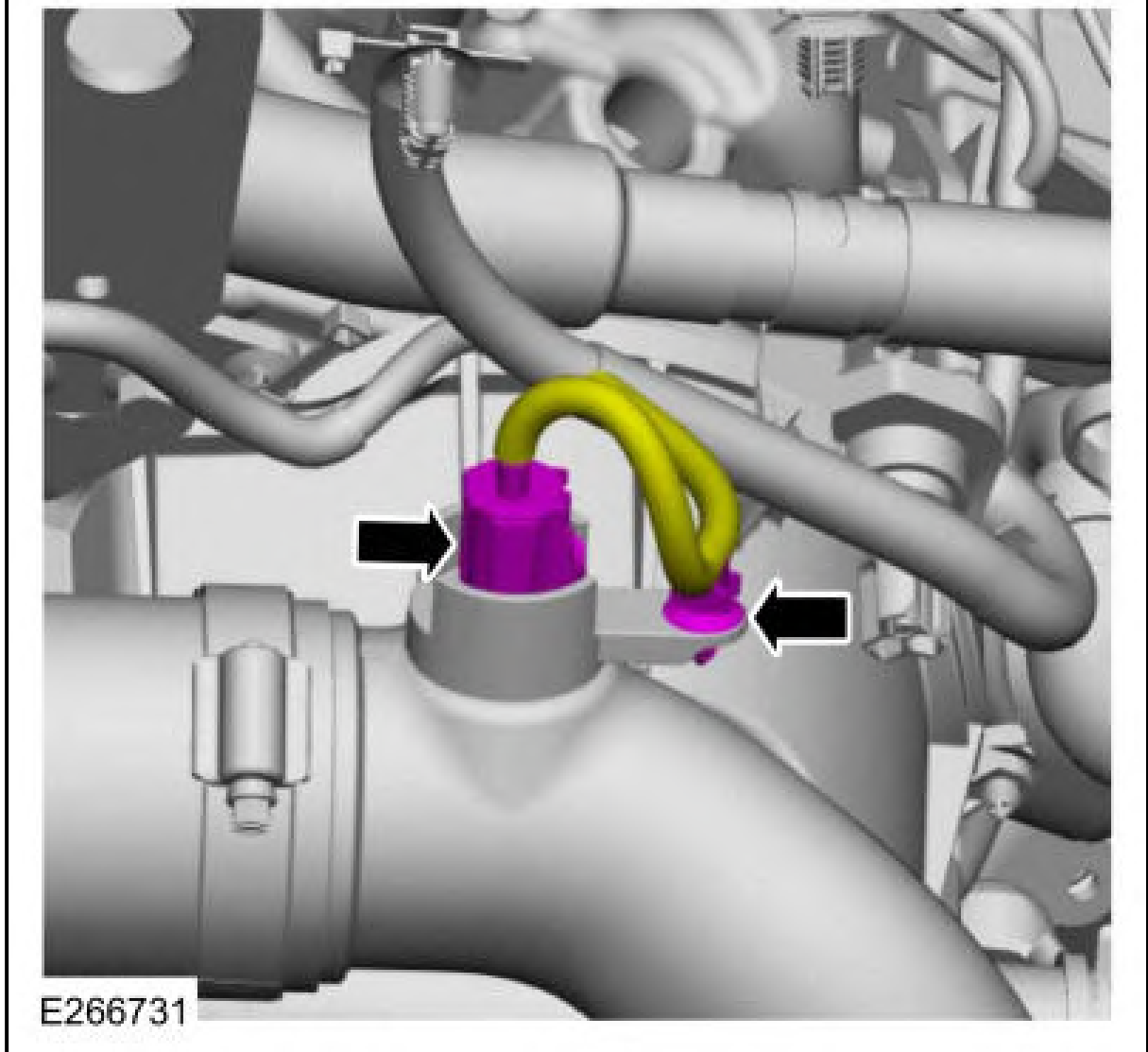




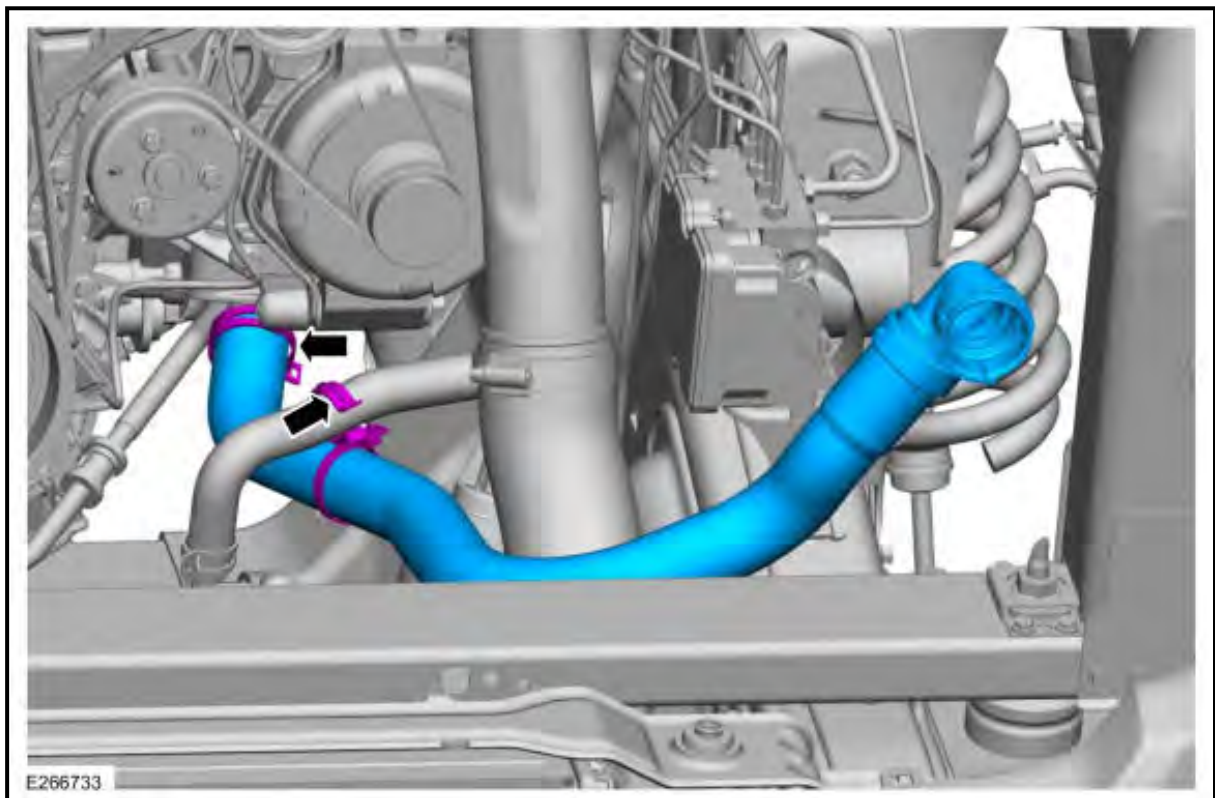


57. Connect the electrical connector and the wire retainer.

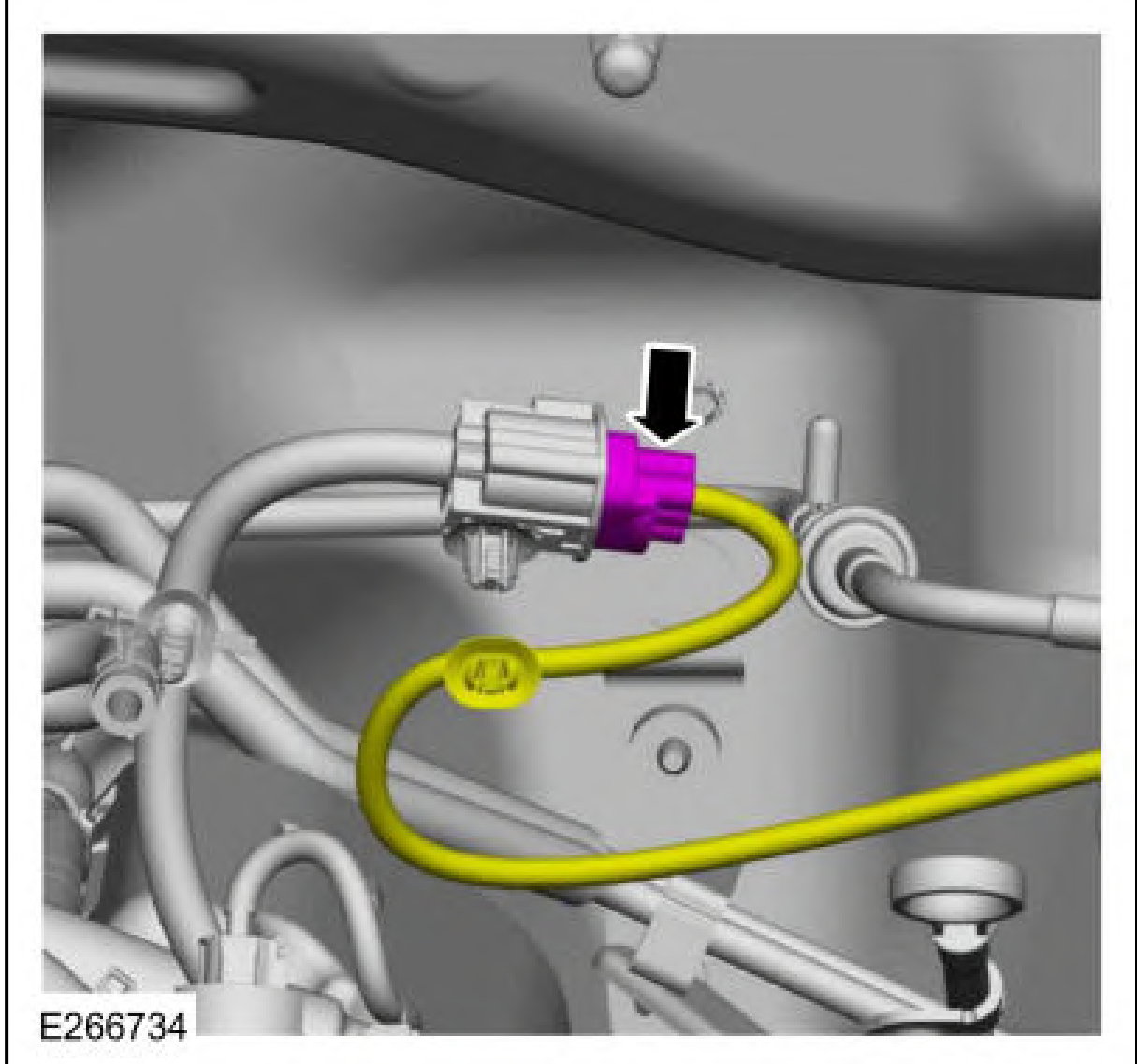




58. Install the lower radiator hose. Connect the retainer. Use the General Equipment: Hose Clamp Remover/Installer



59. Connect the electrical connector.



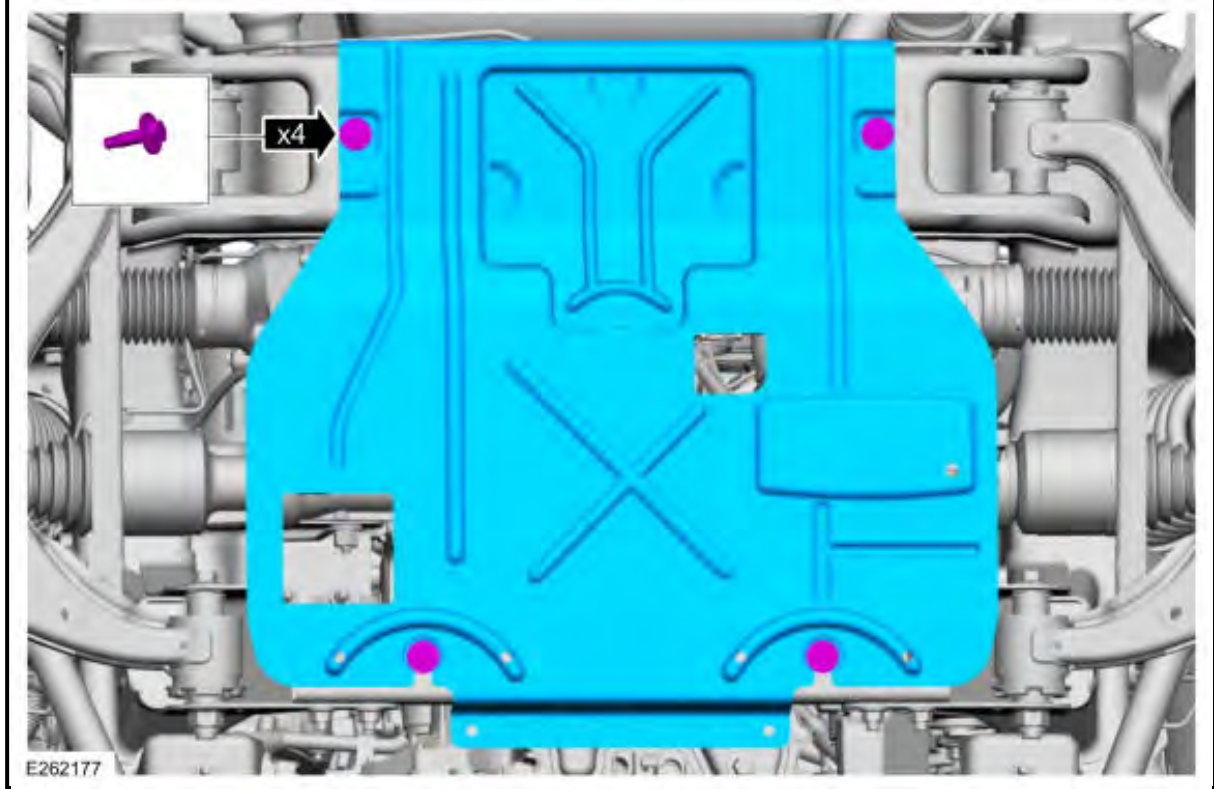
60. Install the following items:

1. Install the turbocharger. Refer to: [Turbocharger](#) .
2. Install the LH and the RH fender splash shield. Refer to: [Fender Splash Shield](#) .
3. Install the battery tray. Refer to: [Battery Tray](#) .
4. Install the air cleaner outlet pipe. Refer to: [Air Cleaner Outlet Pipe](#) .
5. Install the cooling module. Refer to: [Cooling Module](#) .
6. Install the degas bottle. Refer to: [Degas Bottle](#) .

61. If equipped, Install the skid plate and the bolts.

Torque: 30 lb.ft (40 Nm)

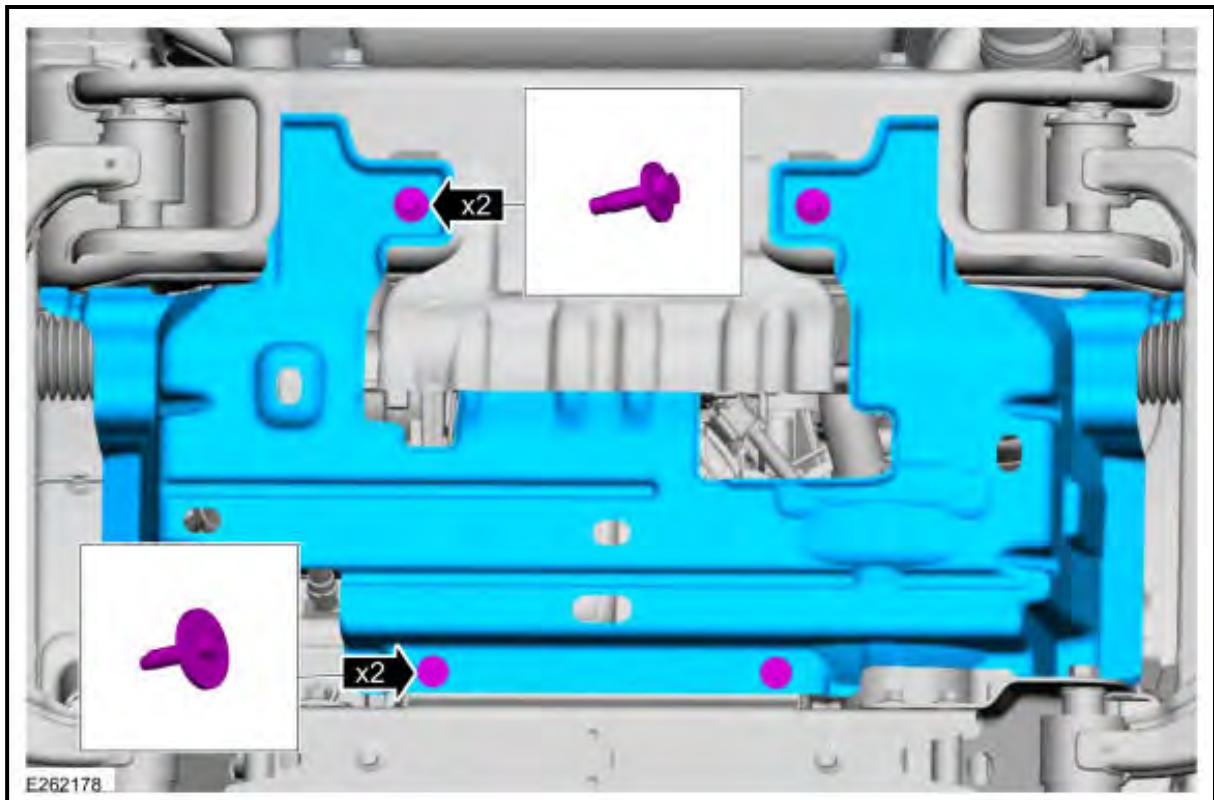




62. If equipped, install the underbody shield and the bolts.

Torque

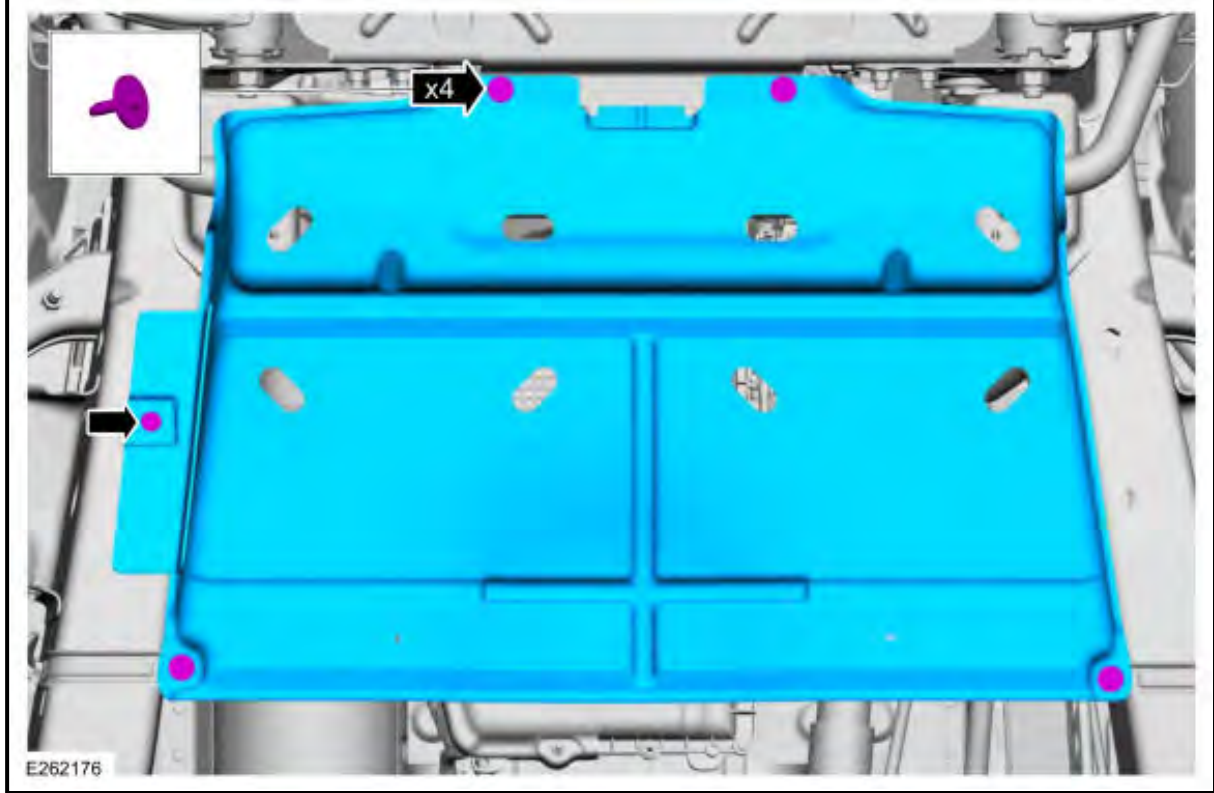
:M8 bolt : 30 lb.ft (40 Nm) M6 bolt : 71 lb.in (8 Nm)



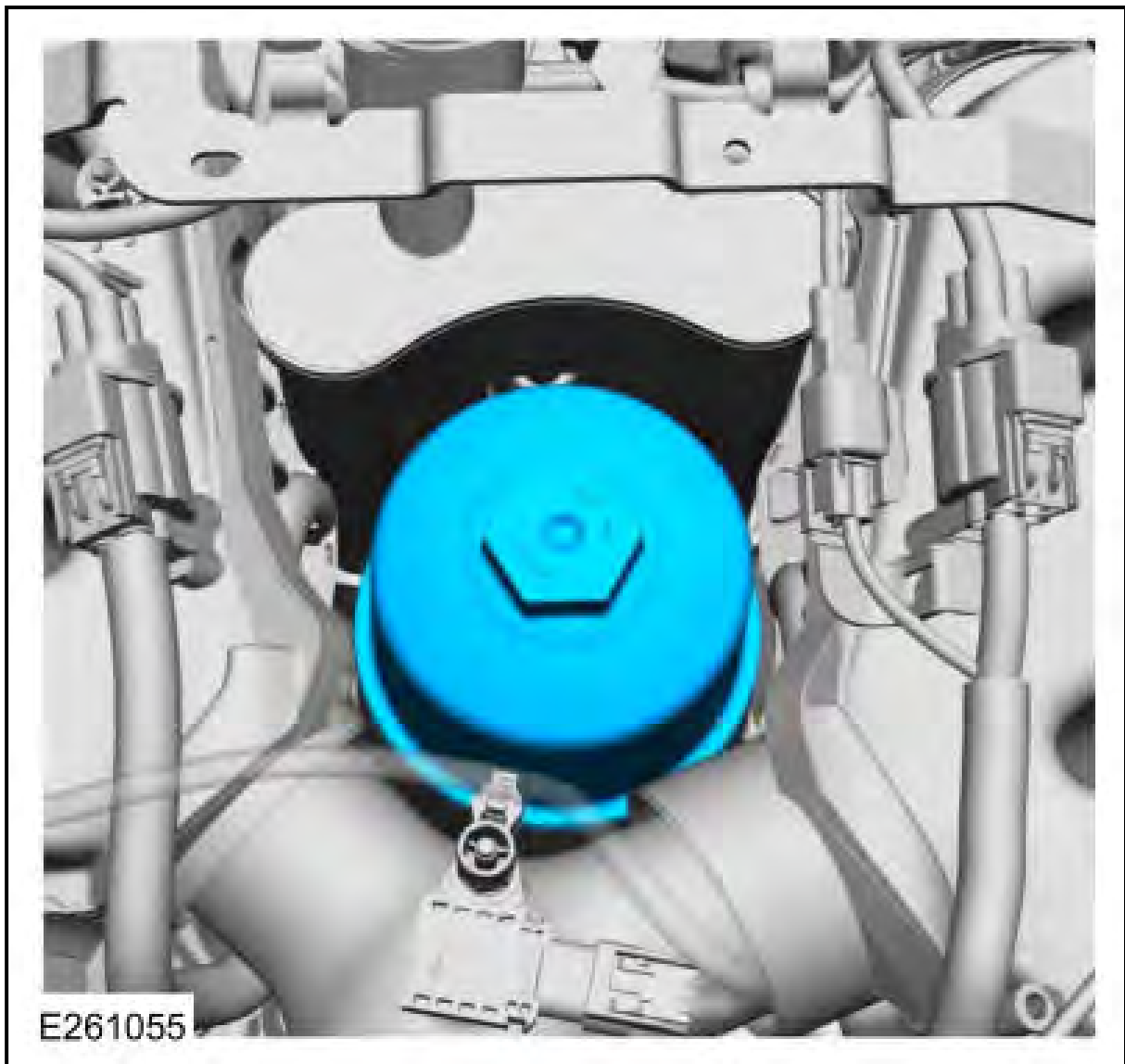
63. Install the transmission housing cover and the bolts. Install the retainer.

Torque: 71 lb.in (8 Nm)

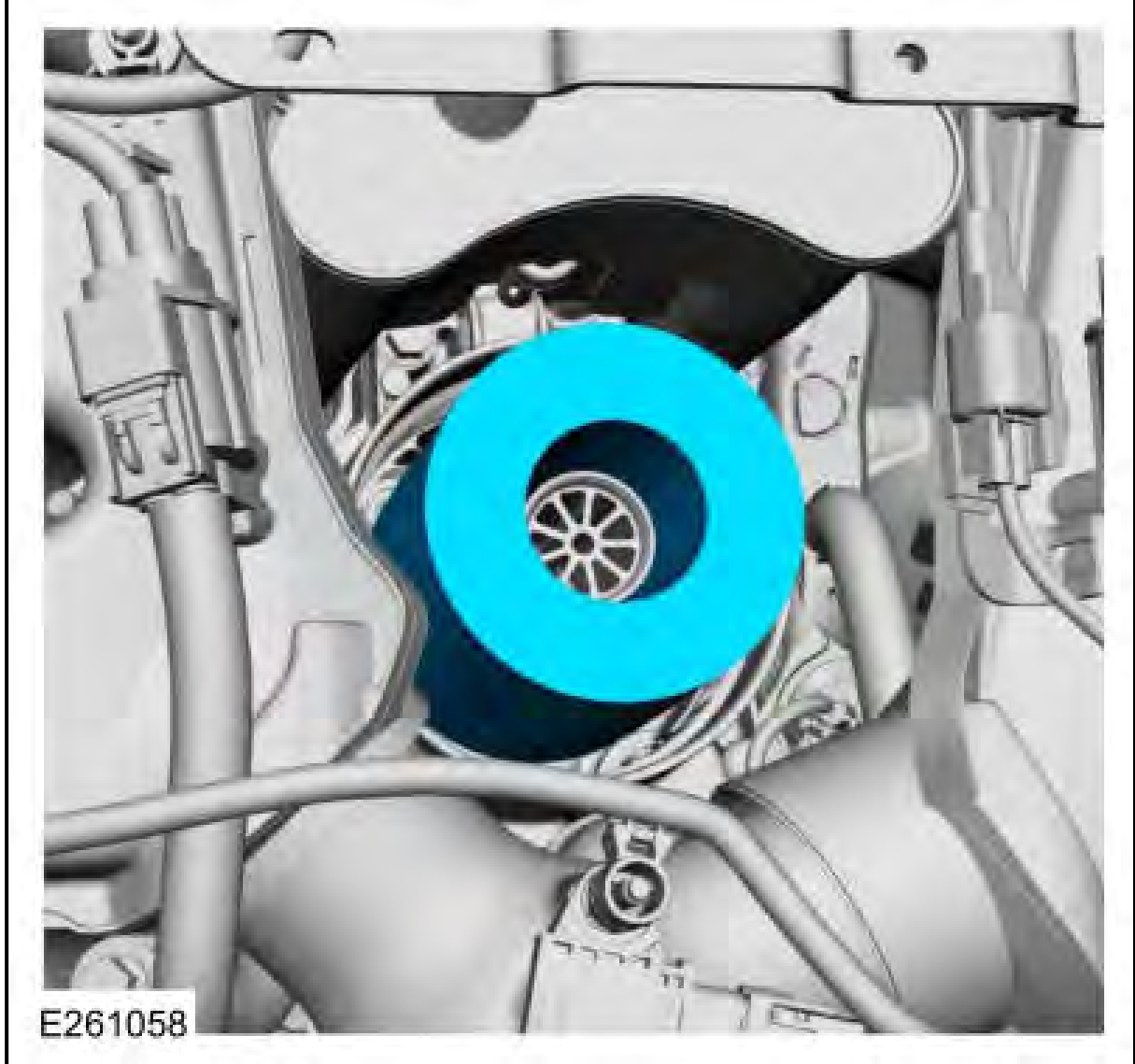




64. Remove the oil filter cap.



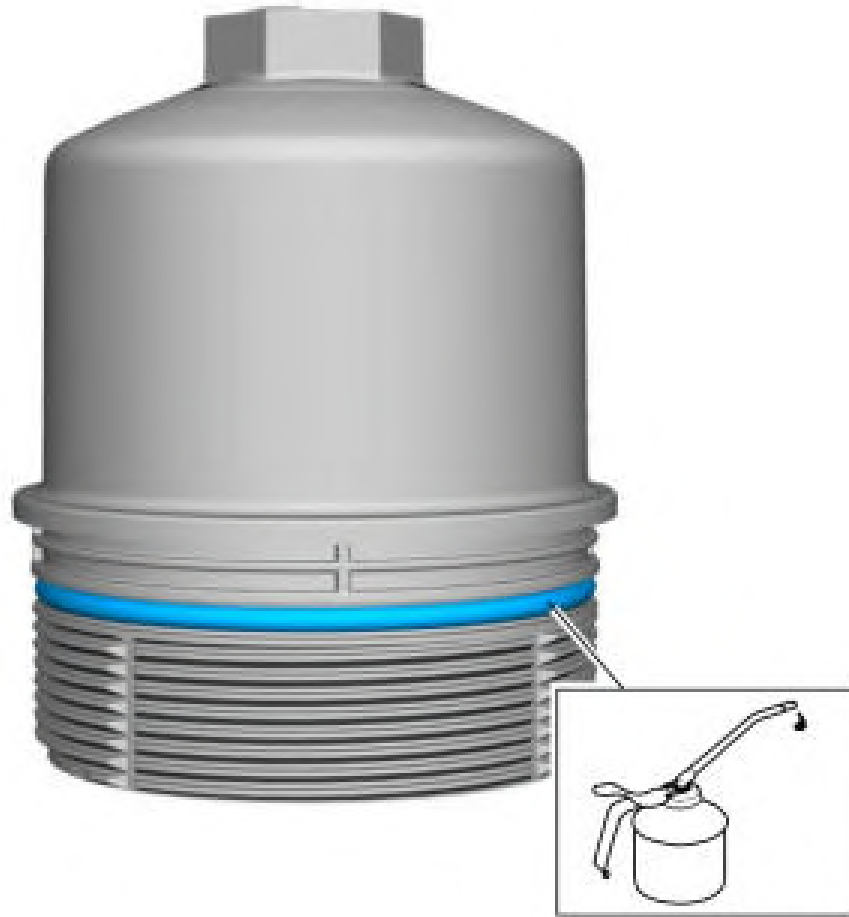
65. Install a new oil filter.



66. Install a new oil filter cap O-ring seal and lubricate.

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)

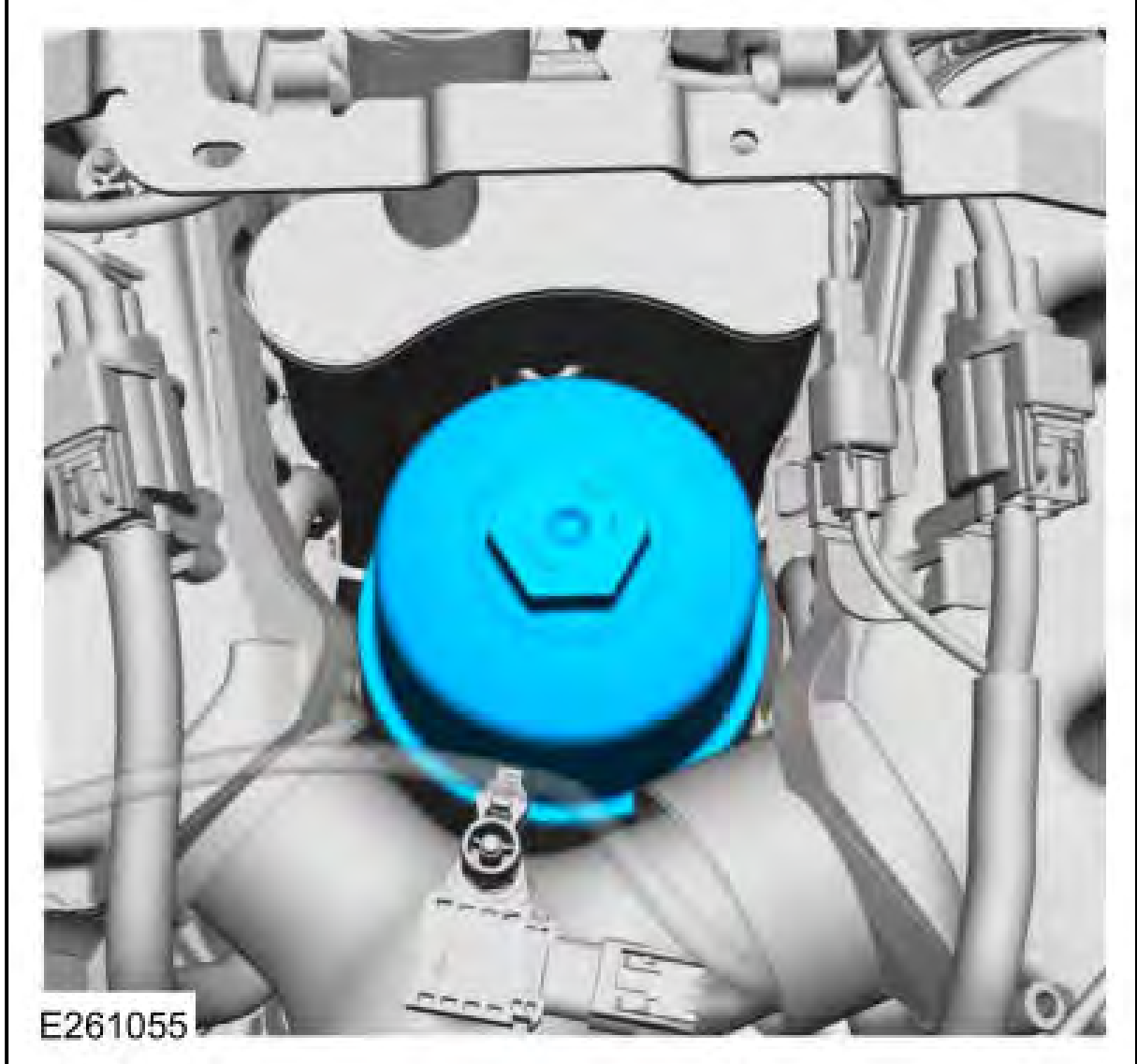




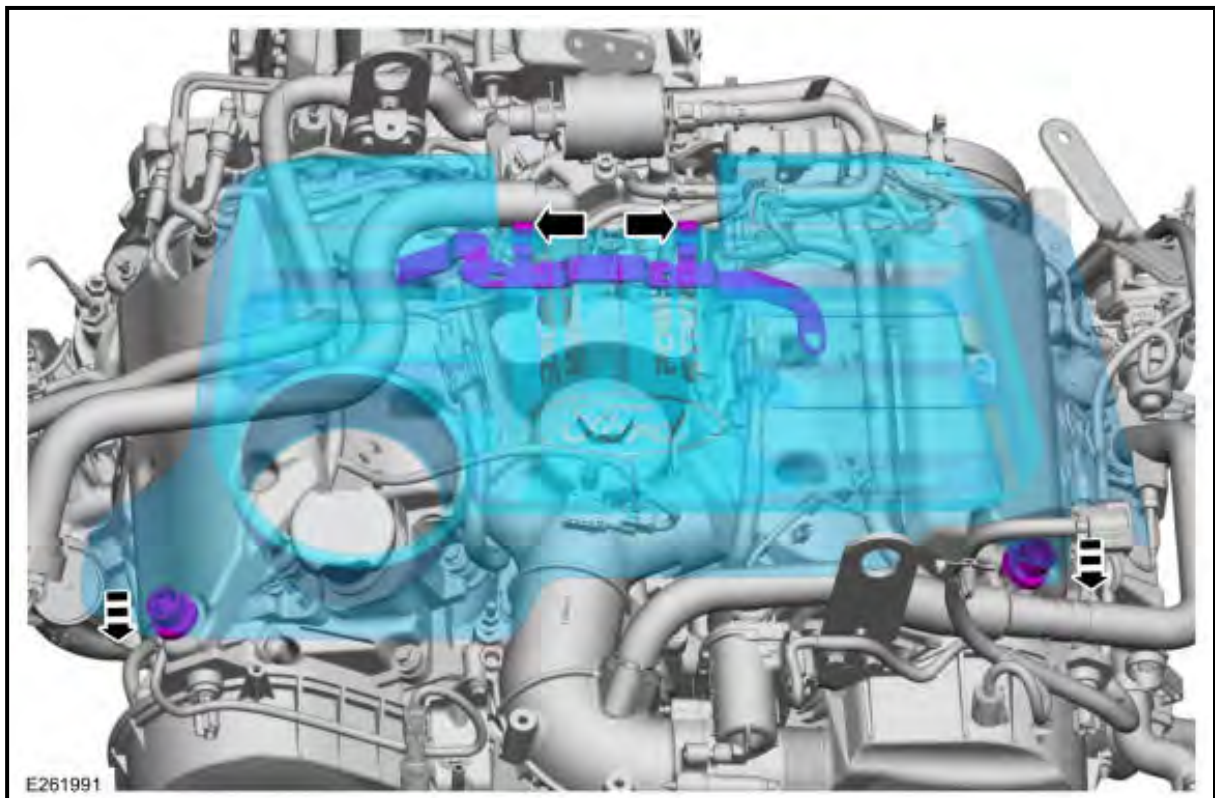
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67. Install the oil filter cap.

Torque: 18 lb.ft (25 Nm)



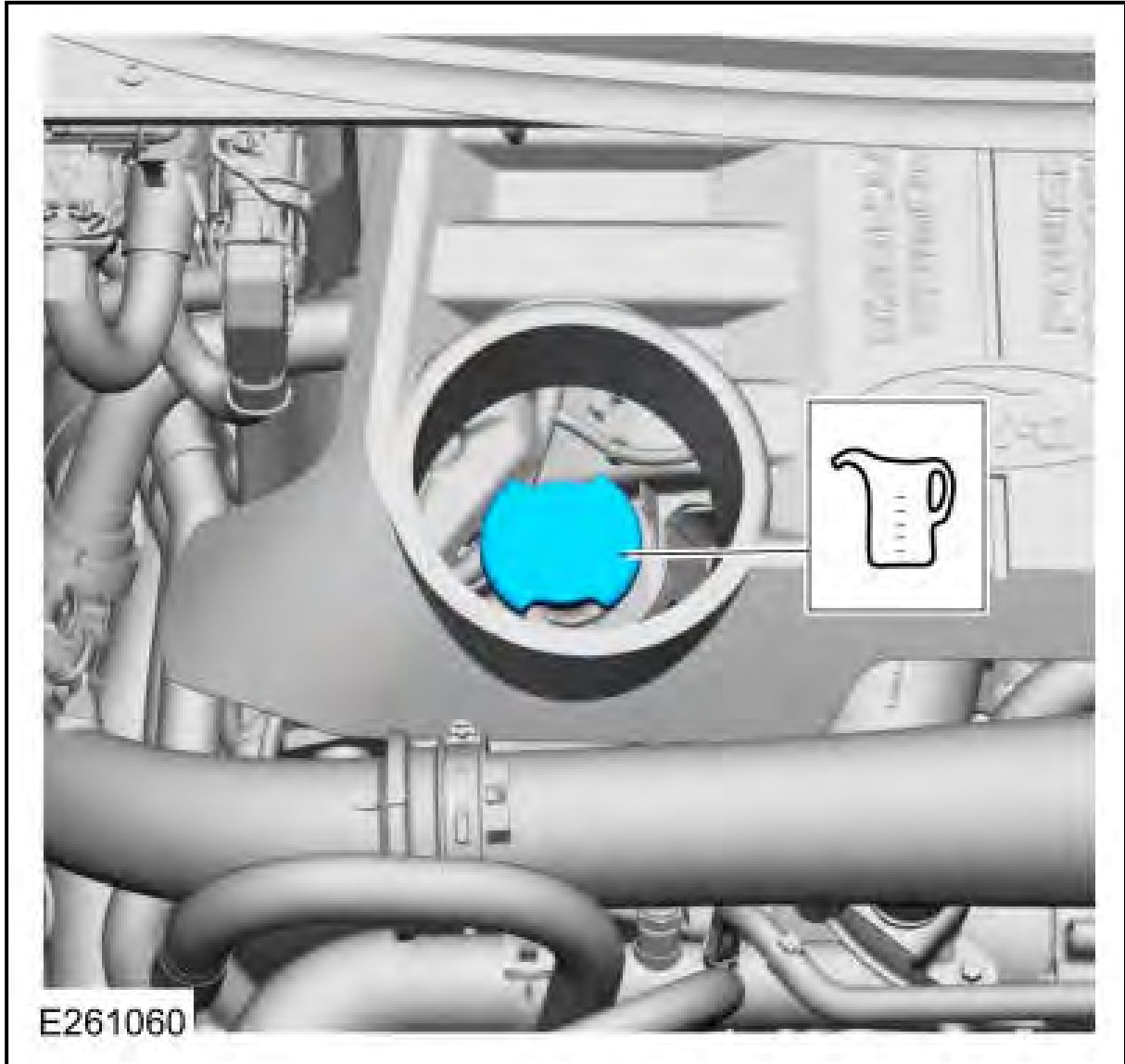
68. Install the engine appearance cover.



69. Fill the engine with clean engine oil. Refer to: [Specifications](#) .

Material: Motorcraft <sup>®</sup> SAE 5W-30 F-150 Diesel Motor Oil / XO-5W30-QFA (WSS-M2C214-B1)





70. Connect the battery ground cable. Refer to: [Battery Disconnect and Connect](#) .

71. Start and check the exhaust system for leaks.