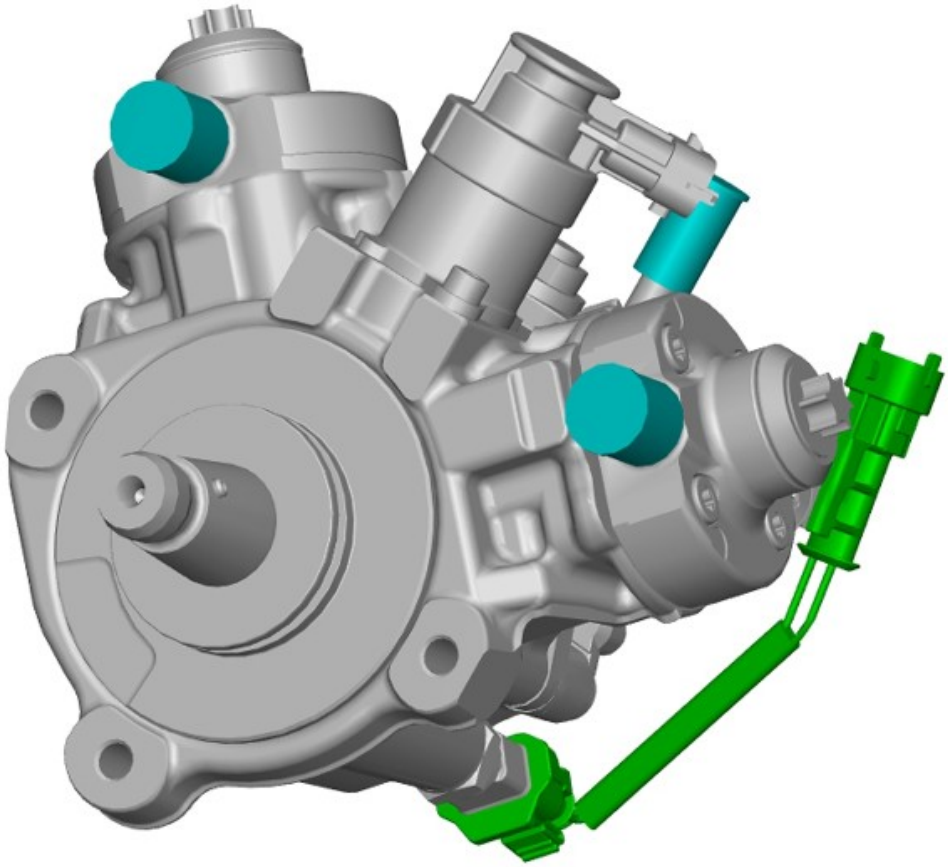


E108848

The HP pump is a 2 piston radial plunger pump. The pump has the ability to produce a maximum pressure of 2000 bar (29007 lbf/in^2). The housing is cast from iron, the flange is cast from aluminum.

The HP pump is driven from the LH cylinder bank exhaust camshaft via a toothed belt. The drive from the belt rotates a cam within the pump which operate a plunger within each pumping element. A procedure and special tools are required for pump or belt replacement to time the pump.

The high-pressure pump comprises 2 high pressure pumping elements, a volume control valve, an internal transfer pump and a fuel temperature sensor.

The fuel is delivered to the internal transfer pump via the external fuel filter and an electric fuel pump which is located in the fuel tank.

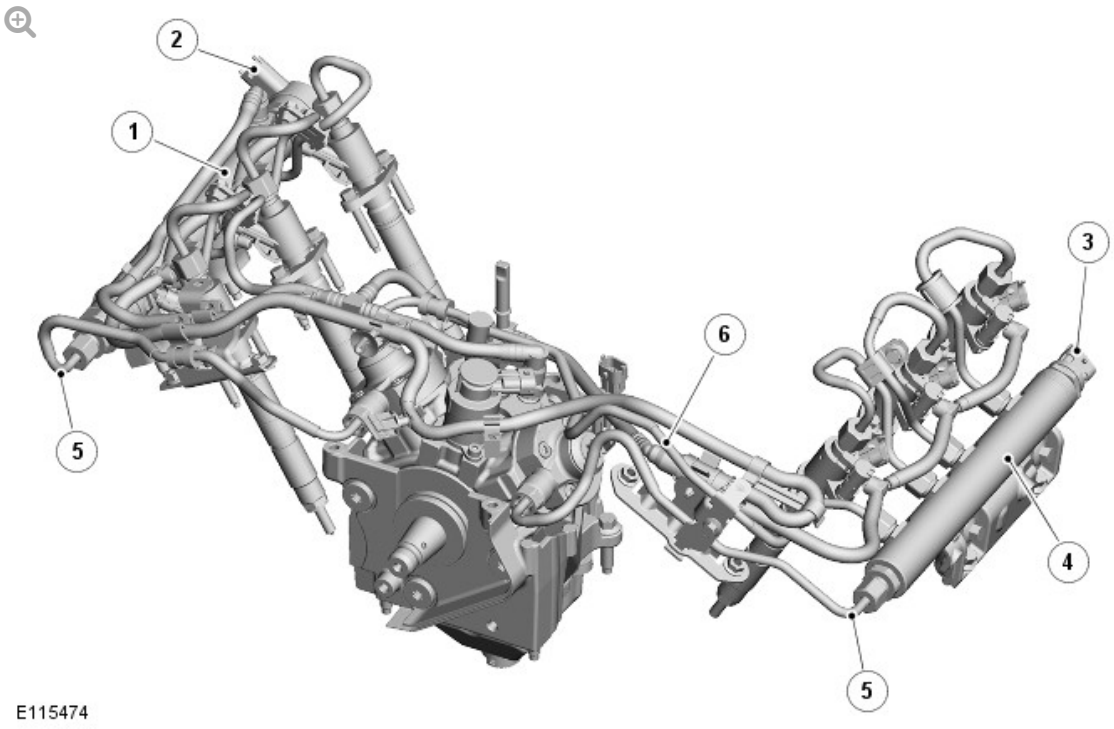
The volume control valve is mounted on the high-pressure pump, and located in the feed port between the high pressure pump elements and the internal transfer pump. The volume control valve is a variable position solenoid-operated valve that is controlled by the ECM. The volume control valve determines the amount of fuel that is delivered from the internal transfer pump to the HP pumping elements. When there is no signal to the volume control valve, the valve is closed and there is no fuel delivery.

The fuel from the internal transfer pump is passed to the HP pumping elements at a constant pressure known as transfer pressure. The transfer pressure is controlled by an internal pressure relief valve. Once the fuel enters each of the HP pump elements the pressure rises rapidly, with each element providing a HP supply to one of the fuel rails. The high pressure is controlled by the high pressure regulator valve and the fuel rail pressure sensor.

A controlled amount of fuel is allowed to leak-off from the internal transfer pump. This fuel is delivered to the pump internal components to provide cooling and lubrication and is passed back the fuel filter via the LP feed line.

The pressure control valve is located in one of the fuel rails. The fuel pressure is monitored by a pressure sensor located in the other fuel rail. The ECM controls the pressure control valve using the received signals from the pressure sensor. Reducing the pressure in the fuel rails via the pressure control valve results in fuel returning from the fuel rails to the LP fuel return to the fuel filter.

The fuel temperature sensor is located on the rear of the HP pump. It measures the fuel temperature in the low-pressure side of the HP pump. The ECM continually monitors this signal to determine the fuel temperature to prevent overheating of the fuel system. The ECM will also make fine adjustments to fuel injection quantity to adjust for fuel temperature.



1	LH fuel rail
2	Fuel pressure control valve
3	Fuel pressure sensor
4	RH (right-hand) fuel rail
5	HP fuel connection from HP pump
6	Fuel rail balance pipe

The fuel rails are steel fabrications and are similar in their construction. Two fuel rails are used with each rail supplying high pressure fuel to 3 fuel injectors.

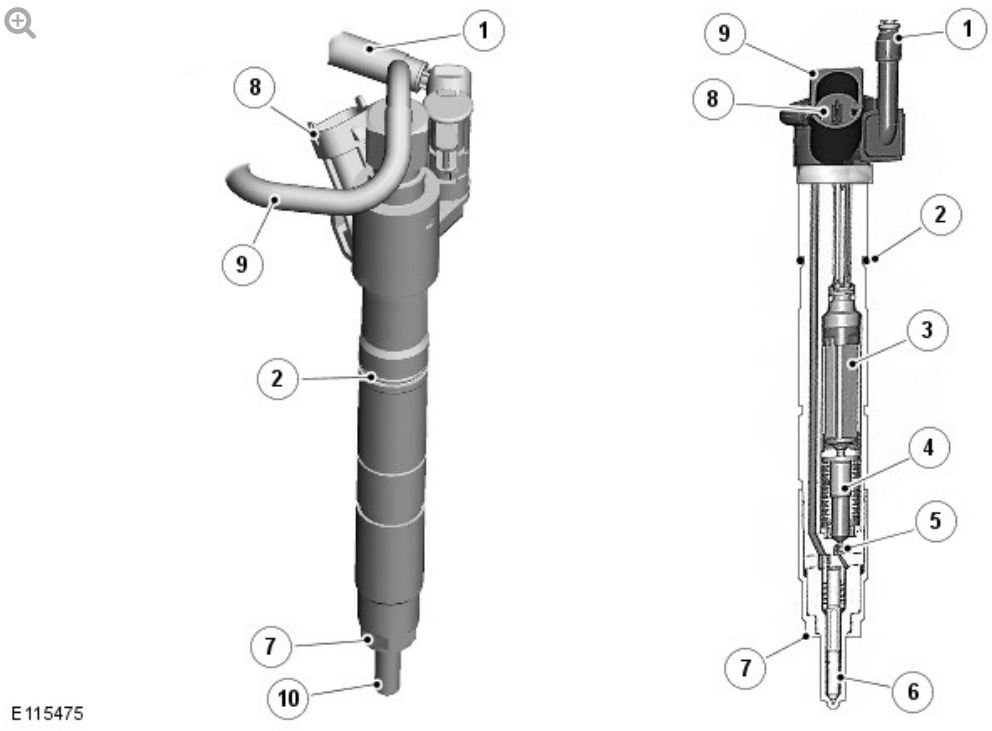
Each rail has 5 threaded connections which provide for the attachment of the high pressure fuel supply from the HP pump, the balance pipe and connections for the 3 injectors supplied with fuel from that rail.

The fuel pressure in the rails is detected by a fuel pressure sensor which is located in the end of the RH rail. The LH rail houses a pressure control valve.

The ECM controls the pressure control valve using signals from the pressure sensor.

The fuel rail pressure sensor is a piezo-resistive type sensor containing an actuating diaphragm. Deflection of the diaphragm provides a proportional signal (output) voltage to the ECM, dependant on the fuel pressure within the fuel rail.

Both rails are connected together with a balance pipe which ensures the pressure in both rails is equal, even though each rail is supplied from a different pumping element in the HP pump.



1	Fuel return
2	O-ring seal
3	Piezo stack actuator
4	Hydraulic coupler
5	Control valve

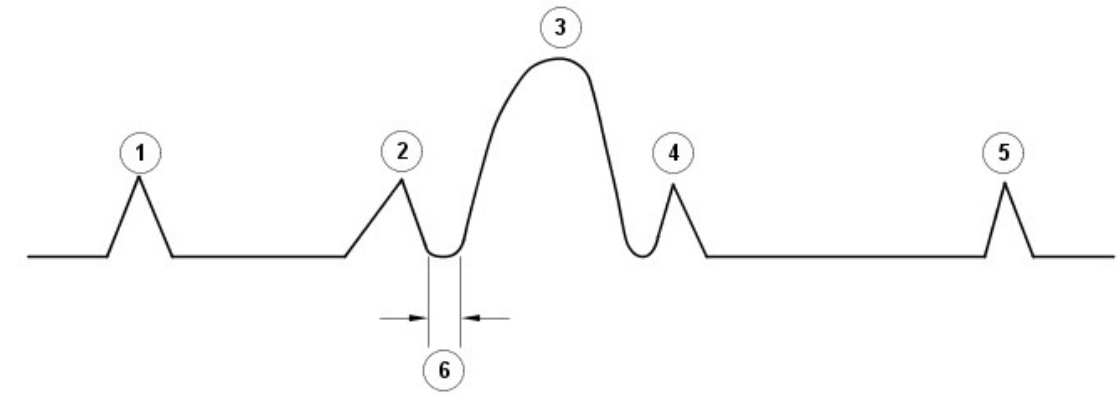
6	Nozzle body
7	Copper sealing washer
8	Electrical connector
9	High pressure feed
10	Nozzle

Six fuel injectors are used in the fuel system. A piezo actuator in each injector is electronically controlled by the ECM to operate the injector in response to engine speed and load conditions.

Each injector has an electrical connector which connects the injector to the engine harness. A fuel connection on the top of the injector provides for the high pressure fuel inlet from the HP pump. A second fuel connection allows fuel leakage within the injector to return to the HP pump.

Each injector is located in a machined hole in the cylinder head and is sealed in the cylinder head with a copper sealing washer and an O-ring seal. The injector is retained in the cylinder head with a clamp plate and 2 bolts. If an injector is removed or replaced, a new copper sealing washer and a clamp plate must be used when refitting the injector.

The injector can operate up to 5 times during one combustion cycle depending on engine speed and load. The injection sequence can occur as follows:



Pilot injection - occurs before the main injection and improves fuel and air mixing

Pre-injection - shortens the main injection's ignition delay and therefore reduces the generation of nitrous oxides

Main injection - delivers the required engine torque

After injection - occurs after the Main injection and assists the re-burn of any remaining particulate matter

Post injection - helps manage the temperature of the exhaust gas for more effective exhaust-gas after-treatment

Injection delay 0.4 ms.

Each injector is calibrated to the ECM and applicable the cylinder to which it is fitted. Therefore, if an injector is removed it must be refitted to the cylinder from which it was removed. If a new injector is fitted, a calibration routine using a Jaguar approved diagnostic system must be performed to calibrate the injector unique code to the ECM.

The operating voltage of the injector is between 110 and 163 volts depending on engine speed and load and care must be taken when working in the vicinity of the injectors. The voltage increases linearly from 200 to 2000 bar (2900 to 29007 lbf/in^2).

Each injector has an electrical resistance value of between 150 - 250 kOhms.

Each injector operation is controlled by a charge and discharge cycle allowing energy to dissipate in, and recover from the injector. Never disconnect the wiring connection when the engine is running. The injector can remain open thus causing engine damage.

FUEL CHARGING AND CONTROLS - TDV6 3.0L DIESEL

PRINCIPLES OF OPERATION

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section in the workshop manual. REFER to: (303-04A Fuel Charging and Controls - TDV6 3.0L Diesel)

Fuel Charging and Controls (Description and Operation),
Fuel Charging and Controls (Description and Operation),
Fuel Charging and Controls (Description and Operation).

INSPECTION AND VERIFICATION

- Do **NOT** carry out any work on the fuel system with the engine running. The fuel pressure within the system can be as high as 2000 bar (29,008 lb/in^2). Failure to follow this instruction may result in personal injury.
- Eye protection must be worn at all times when working on or near any fuel related components. Failure to follow this instruction may result in personal injury.
- This procedure involves fuel handling. Be prepared for fuel spillage at all times and always observe fuel handling precautions. Failure to follow this instruction may result in personal injury.
- After carrying out repairs, the fuel system must be checked visually for leaks. This should be done after the engine has been run, but with the engine switched **OFF**. Failure to follow this instruction may result in personal injury.
- If taken internally, **DO NOT** induce vomiting. Seek immediate medical attention. Failure to follow this instruction may result in personal injury.
- If fuel contacts the eyes, flush the eyes with cold water or eyewash solution and seek medical attention. Failure to follow this instruction may result in personal injury.
- Wash hands thoroughly after handling, as prolonged contact may cause irritation. Should irritation develop, seek medical attention. Failure to follow this instruction may result in personal injury.

- Before disconnecting any part of the system, it is imperative that all dust, dirt and debris is removed from around components to prevent ingress of foreign matter into the fuel system. Failure to follow this

instruction may result in damage to the vehicle.

- The fuel pipes between the injectors and the rail must be discarded after each use, and new pipes installed. Failure to follow this instruction may result in damage to the vehicle.
- It is essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in damage to the vehicle.
- Make sure that the workshop area in which the vehicle is being worked on is as clean and dust-free as possible. Areas in which work on clutches, brakes or where welding or machining are carried out are not suitable in view of the risk of contamination to the fuel system. Failure to follow this instruction may result in damage to the vehicle.
- Make sure that any protective clothing worn is clean and made from lint-free non-flocking material. Failure to follow this instruction may result in damage to the vehicle.
- Make sure that any protective gloves worn are new and are of the non-powdered latex type. Failure to follow this instruction may result in damage to the vehicle.
- Make sure that clean, non-plated tools are used. Clean tools using a new brush that will not lose it's bristles and fresh cleaning fluid prior to starting work on the vehicle. Failure to follow this instruction may result in damage to the vehicle.
- Use a steel-topped work bench and cover it with clean, lint-free, non-flocking material. Failure to follow this instruction may result in damage to the vehicle.
- Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

- When performing voltage or resistance tests, always use a digital multimeter (DMM) accurate to 3 decimal places, and with an up-to-date calibration certificate. When testing resistance, always take the resistance of the DMM leads into account.
- Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

Verify the customer concern.

Visually inspect for obvious signs of mechanical or electrical damage.

▪ Fuel level ▪ Contaminated fuel ▪ Fuel supply line(s) ▪ Fuel return line(s) ▪ High-pressure fuel supply line(s) ▪ Fuel tank filler pipe ▪ Fuel leak(s) ▪ Fuel tank ▪ Fuel filler cap ▪ Fuel filter ▪ Push connect fittings ▪ Fuel rail ▪ Fuel injection pump ▪ Exhaust Gas Recirculation (EGR) system	▪ Glow plug indicator ▪ Inertia fuel shutoff (IFS) switch ▪ Fuel pump module ▪ Sensor(s) ▪ Engine Control Module (ECM) ▪ Fuel volume control valve (FVCV) ▪ Fuel pressure control valve (FPCV) ▪ Fuel rail pressure (FRP) sensor ▪ Fuel temperature sensor ▪ Fuel injector(s) ▪ Exhaust Gas Recirculation (EGR) system

If an obvious cause for an observed or reported condition is found,

correct the cause (if possible) before proceeding to the symptom chart.

If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

SYMPTOM CHART

Engine cranks, but does not start	▪ Inertia fuel shutoff switch ▪ Low/Contaminated fuel ▪ Air leakage ▪ Low-pressure fuel system fault ▪ Fuel pump module (lift pump) fault ▪ Blocked fuel filter ▪ Fuel volume regulator blocked/contaminated ▪ Fuel pressure control valve blocked/contaminated ▪ Fuel pump fault ▪ Crankshaft Position (CKP) sensor	Check that the inertia switch has not tripped. Check the fuel level and condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump. Check the crankshaft position sensor circuits. Refer to the electrical guides.
Difficult to start	▪ Glow plug system fault (very cold conditions) ▪ Low/Contaminated fuel ▪ Air leakage ▪ Fuel pump module (lift pump) fault ▪ Low-pressure fuel system fault ▪ Blocked fuel filter	Check the glow plug circuits. Refer to the electrical guides. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the lift pump operation, check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Carry out EGR valve checks.

	▪ Fuel volume control valve blocked/contaminated ▪ Fuel pressure control valve blocked/contaminated ▪ Exhaust gas recirculation (EGR) valve(s) fault	
Rough idle	▪ Intake air system fault ▪ Low/Contaminated fuel ▪ Low-pressure fuel system fault ▪ Blocked fuel filter ▪ Fuel volume control valve blocked/contaminated ▪ Fuel pressure control valve blocked/contaminated ▪ Exhaust gas recirculation (EGR) valve(s) fault	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the low-pressure fuel system for leaks/damage. Check the fuel filter, check for DTCs indicating a fuel volume or pressure control valve fault. Carry out EGR valve checks.
Lack of power when accelerating	▪ Intake air system fault ▪ Restricted exhaust system ▪ Low fuel pressure ▪ Exhaust gas recirculation (EGR) valve(s) fault ▪ Turbocharger actuator fault	Check the intake air system for leakage or restriction. Check for a blockage/restriction in the exhaust system, install new components as necessary. Check for DTCs indicating a fuel pressure fault. Carry out EGR valve checks. Carry out turbocharger actuator checks.
Engine stops/stalls	▪ Air leakage ▪ Low/Contaminated fuel ▪ Low-pressure fuel system fault	Check the intake air system for leaks. Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the fuel system for leaks/damage: Check for DTCs indicating a fuel volume or pressure

	▪ High pressure fuel leak ▪ Fuel volume control valve blocked/contaminated ▪ Fuel pressure control valve blocked/contaminated ▪ Exhaust gas recirculation (EGR) valve fault	control valve fault. Carry out EGR valve checks.
Engine judders	▪ Low/Contaminated fuel ▪ Air ingress ▪ Low-pressure fuel system fault ▪ Fuel metering valve blocked/contaminated ▪ Fuel volume control valve blocked/contaminated ▪ Fuel pressure control valve blocked/contaminated ▪ High pressure fuel leak ▪ Fuel pump fault	Check the fuel level/condition. Draw off approximately 1 ltr (2.11 pints) of fuel and allow to stand for 1 minute. Check to make sure there is no separation of the fuel indicating water or other liquid in the fuel. Check the intake air system for leaks. Check the low-pressure fuel system for leaks/damage. Check the high pressure fuel system for leaks, check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel pump.
Excessive fuel consumption	▪ Low-pressure fuel system fault ▪ Fuel volume control valve blocked/contaminated ▪ Fuel pressure control valve blocked/contaminated ▪ Fuel temperature sensor leak ▪ High pressure fuel leak ▪ Injector(s) fault	Check the low-pressure fuel system for leaks/damage. Check for DTCs indicating a fuel volume or pressure control valve fault. Check the fuel temperature sensor, fuel pump, etc for leaks. Check for injector DTCs. Carry out EGR valve checks.

	▪ Exhaust gas recirculation (EGR) valve(s) fault	

DTC INDEX

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.
REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Engine Control Module 3.0L Tdv6 (PCM) (100-00 General Information, Description and Operation).

FUEL CHARGING AND CONTROLS - TDV6 3.0L DIESEL

A = refer to procedure for the correct torque sequence.

Wiring harness bracket to left-hand cylinder head retaining bolts	23	16	-
Fuel injection pump retaining bolts	23	16	-
Fuel injection pump bracket retaining bolts	3	-	27
Fuel injection pump bracket(s) to cylinder head retaining bolts	10	7	-
Turbocharger heat shield(s) retaining bolts	10	7	-
Fuel injection pump sprocket retaining bolt	50	37	-
Fuel injection pump belt rear cover retaining bolts	9	-	80
Rear end accessory drive (READ) pulley hub retaining bolt	A	-	-
Fuel injection pump belt tensioner retaining bolt	23	16	-
READ pulley retaining bolts	A	-	-
Wiring harness and coolant pipe retaining bracket bolts	10	7	-
Fuel injector retaining bolts	9	-	80
High-pressure fuel line bracket retaining bolts	10	7	-

Fuel rail retaining bolts	24	18	-
High-pressure fuel line union nuts	A	-	-
Fuel rail supply tube union nuts	A	-	-
Fuel crossover line union nuts	A	-	-
Exhaust gas recirculation (EGR) valve retaining bolts	10	7	-
Intake air shutoff throttle elbow retaining bolt	10	7	-
Intake air shutoff throttle retaining stud	10	7	-

FUEL CHARGING AND CONTROLS - TURBOCHARGER - TDV6 3.0L DIESEL

FIXED VANE TURBOCHARGER ACTUATOR [G1271878]

REMOVAL

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

All vehicles

1.

Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

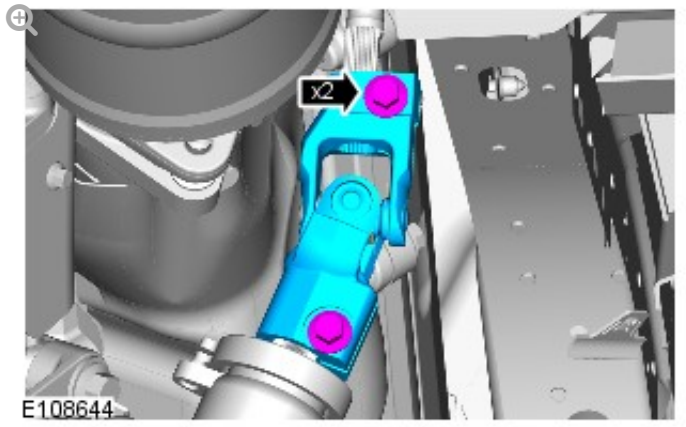
2. Refer to: Air Deflector (501-02 Front End Body Panels, Removal and

Installation).

	Right-hand drive vehicles

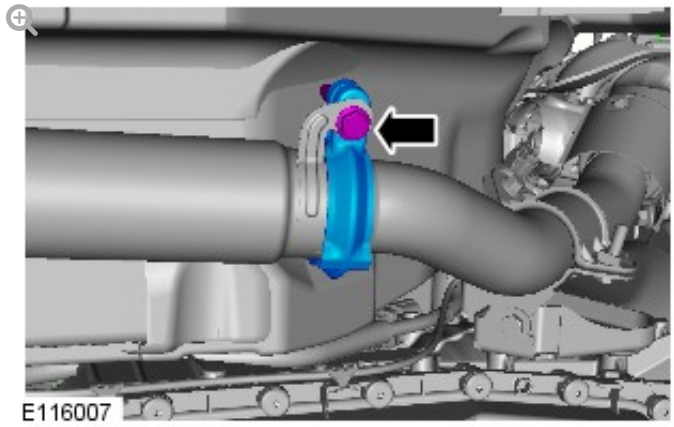
3.

Discard the bolts.

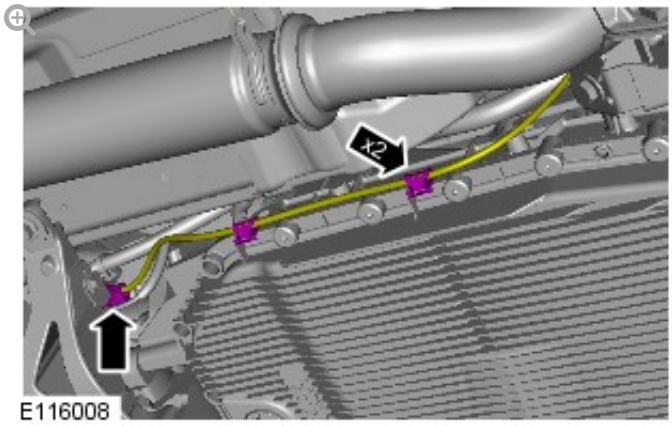


	All vehicles

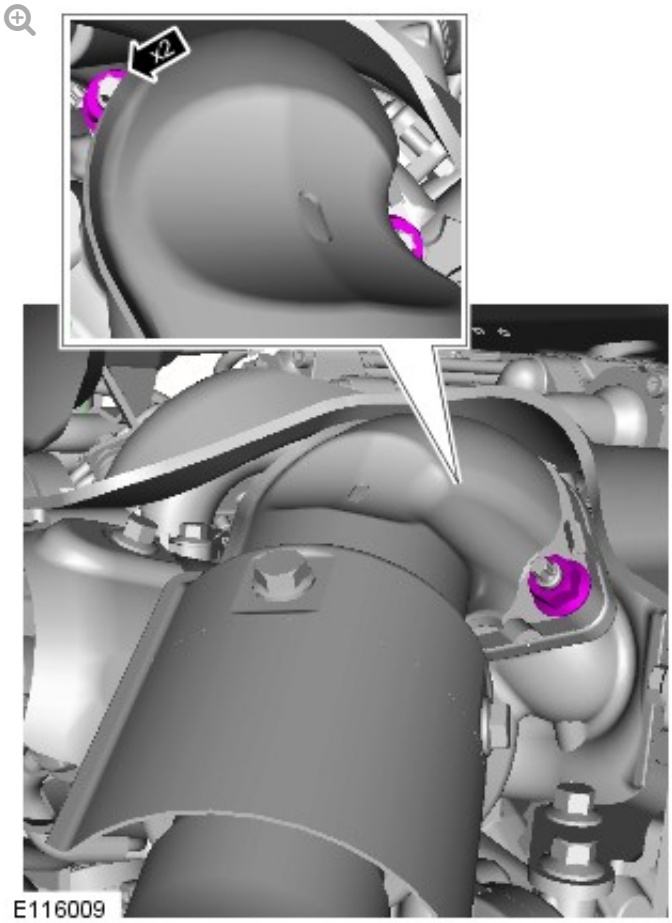
4.



5.

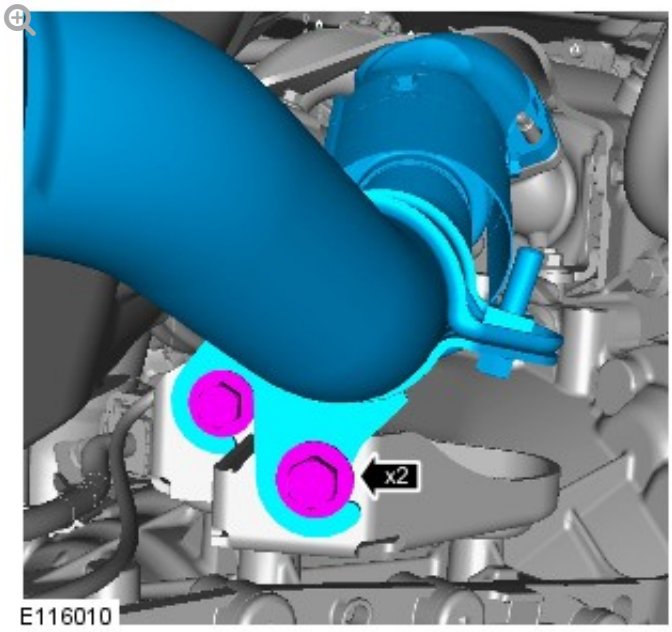


6.



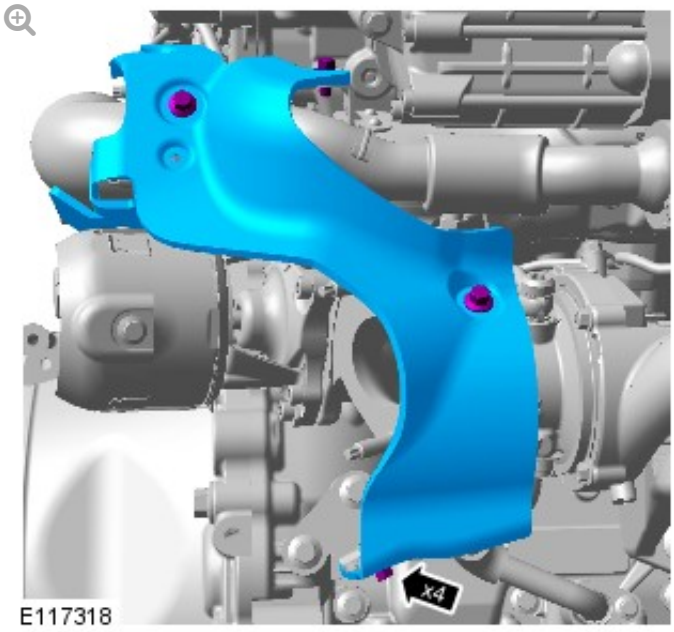
7.

Remove and discard the gasket.

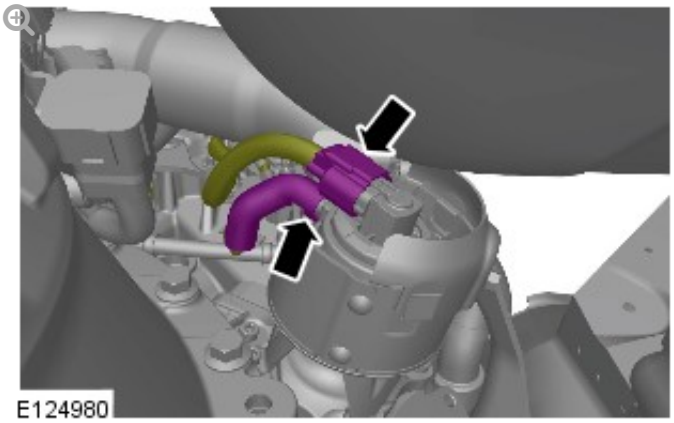


8.

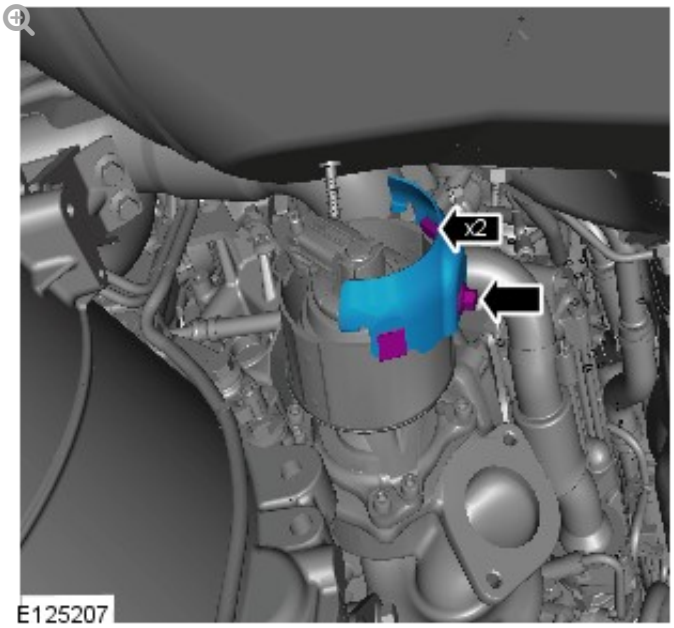
Engine shown removed for clarity.



9.

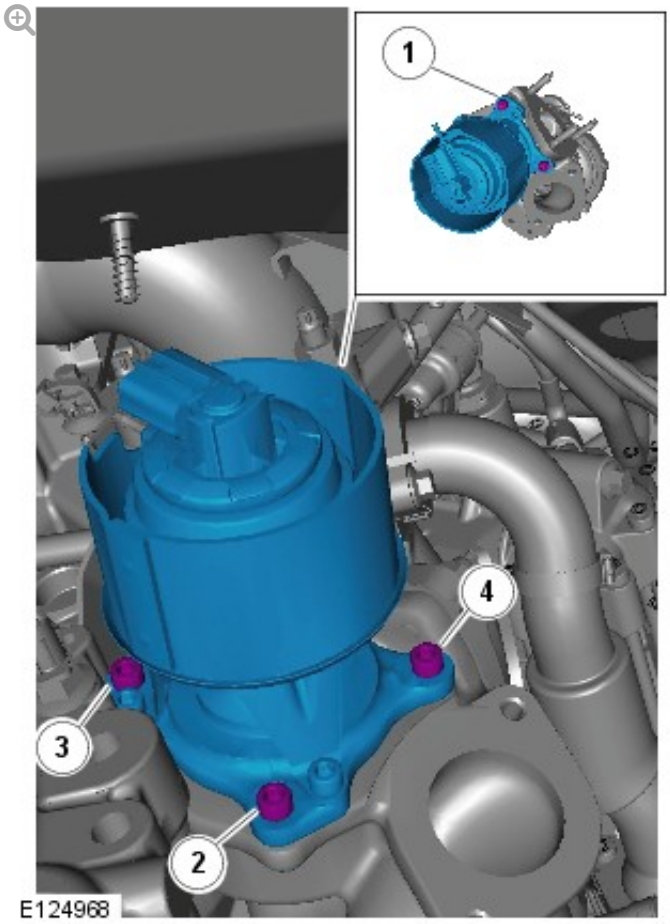


10.



11.

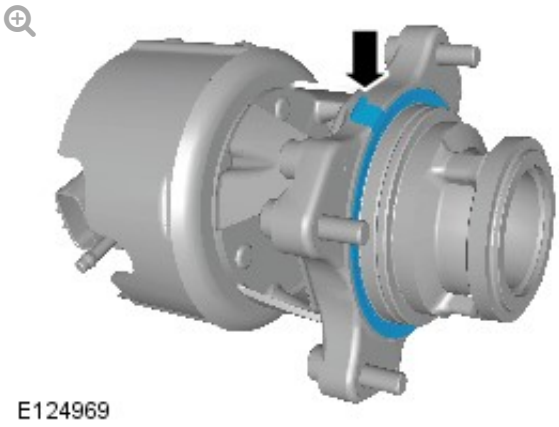
- Remove the Torx screws evenly and progressively.
- Make sure component mating faces are not damaged during removal.



Using a suitable 130mm T30 Torx socket, remove the retaining bolts.

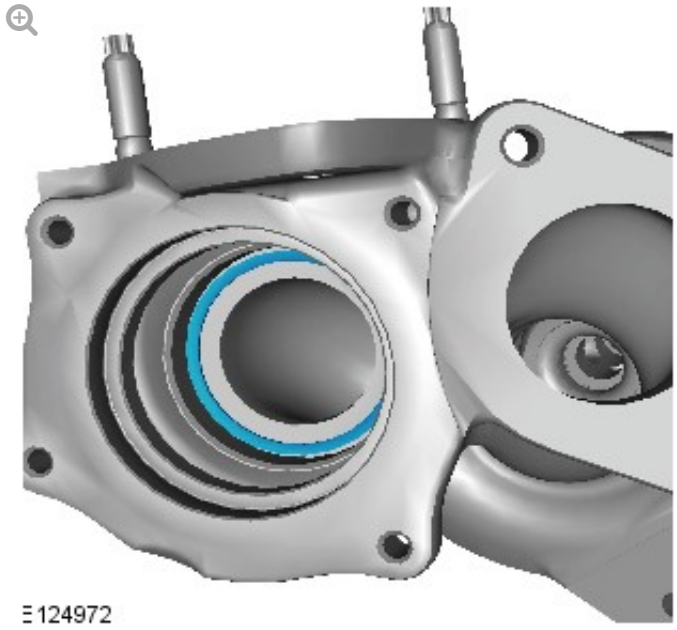
12.

- Make a note of the orientation of the gasket tang.
- Remove and discard the gasket using the gasket tang.



13.

- Remove and discard the gasket.
- Turbocharger shown removed for clarity.



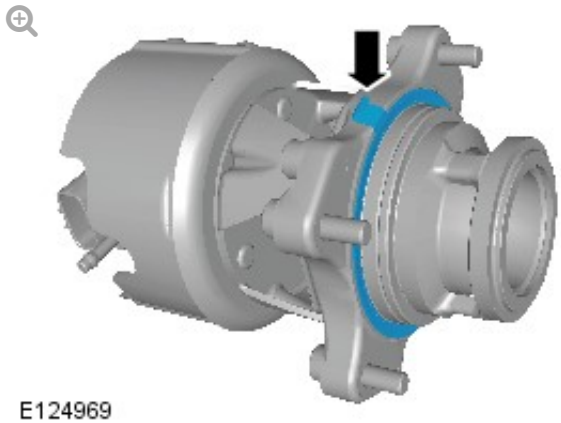
INSTALLATION

All vehicles

1.

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

- Install a new gasket.
- Make sure that the gasket tang is installed in the correct orientation as noted in the removal step.

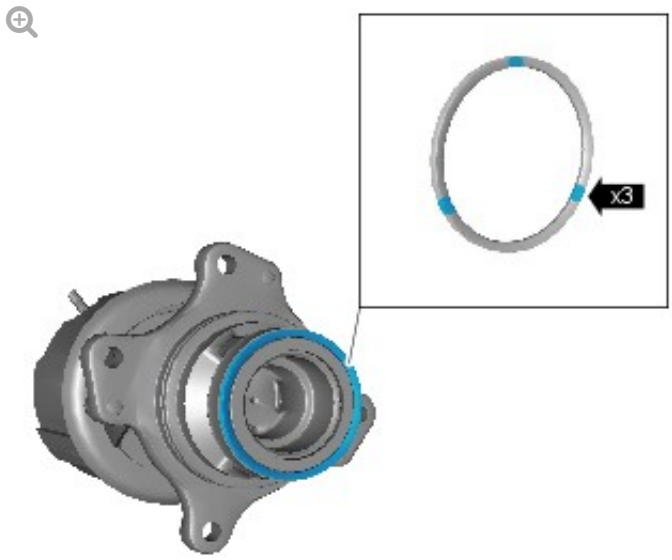


E124969

2.

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

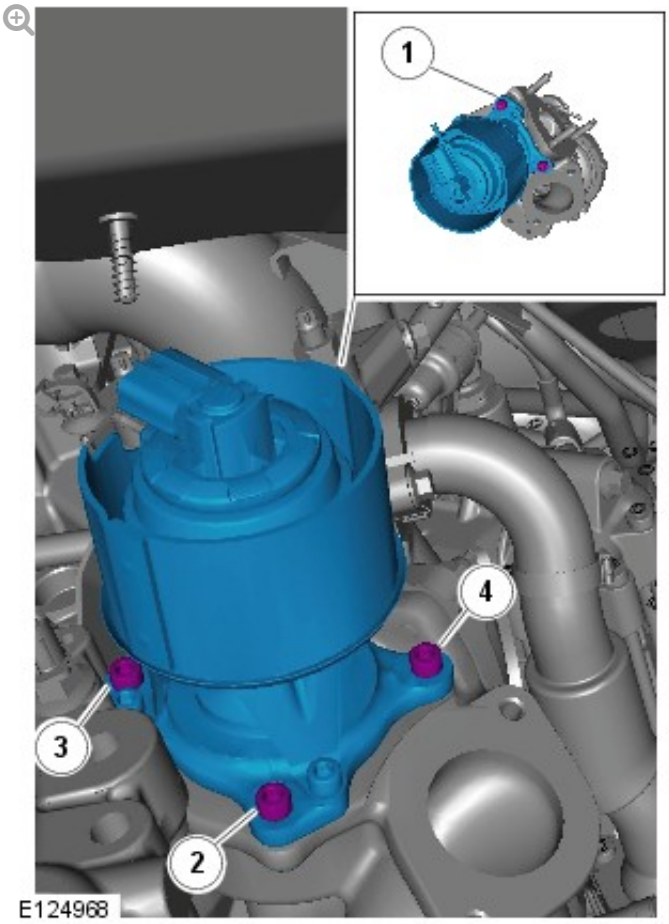
- Install a new gasket.
- Apply a small amount of grease in the areas indicated to allow the gasket to remain in the position for installation.



E124970

3.

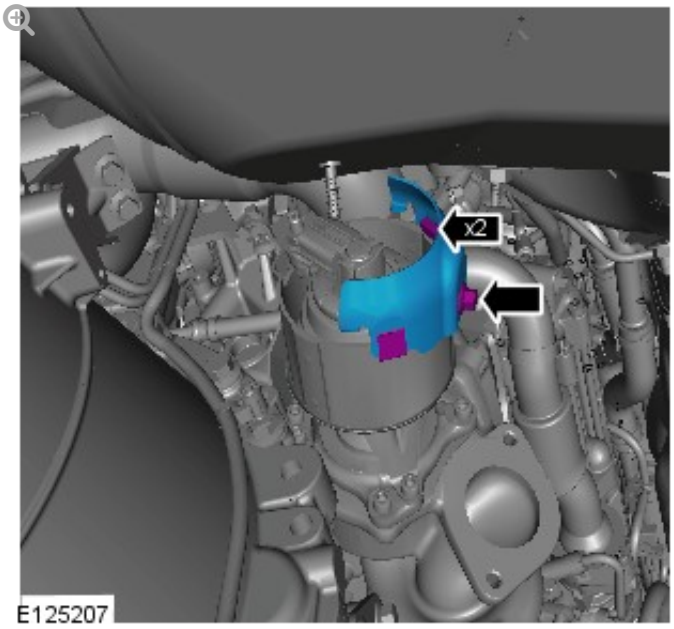
- Install all the bolts finger tight before final tightening.
- Tighten the Torx screws evenly and progressively.



Using a suitable 130mm T30 Torx socket, Install the retaining bolts.

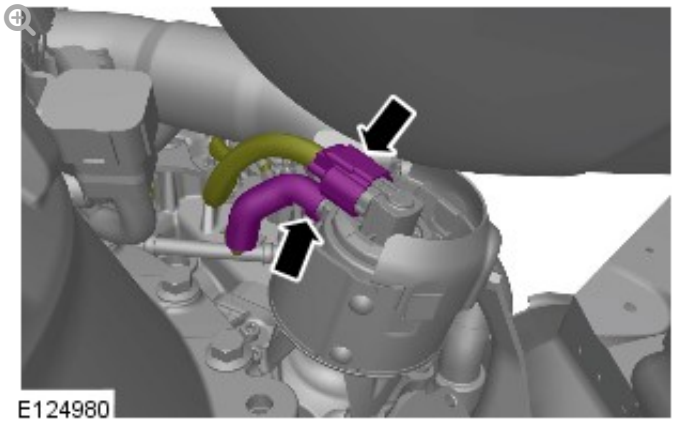
Torque: **12 Nm**

4.



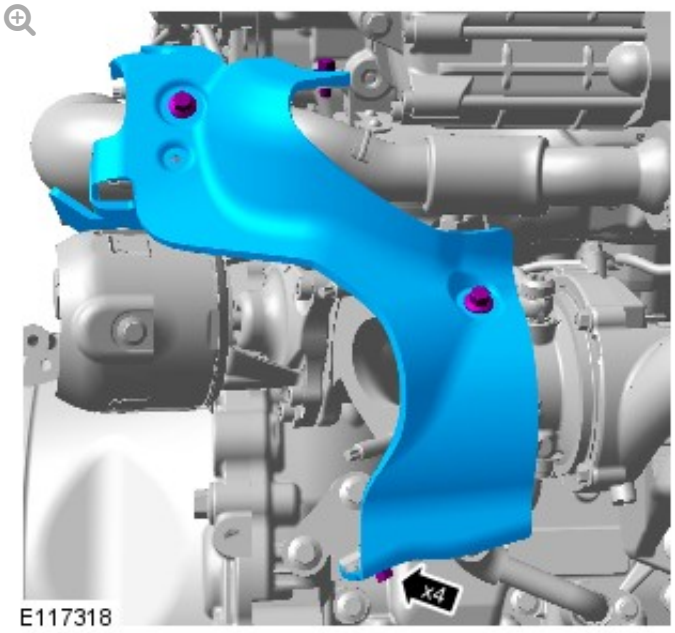
Torque: **9 Nm**

5.



6.

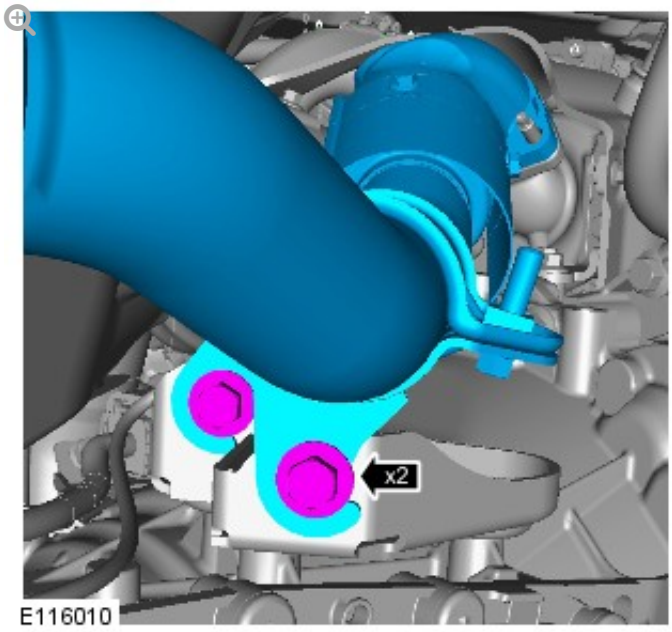
Engine shown removed for clarity.



Torque: **9 Nm**

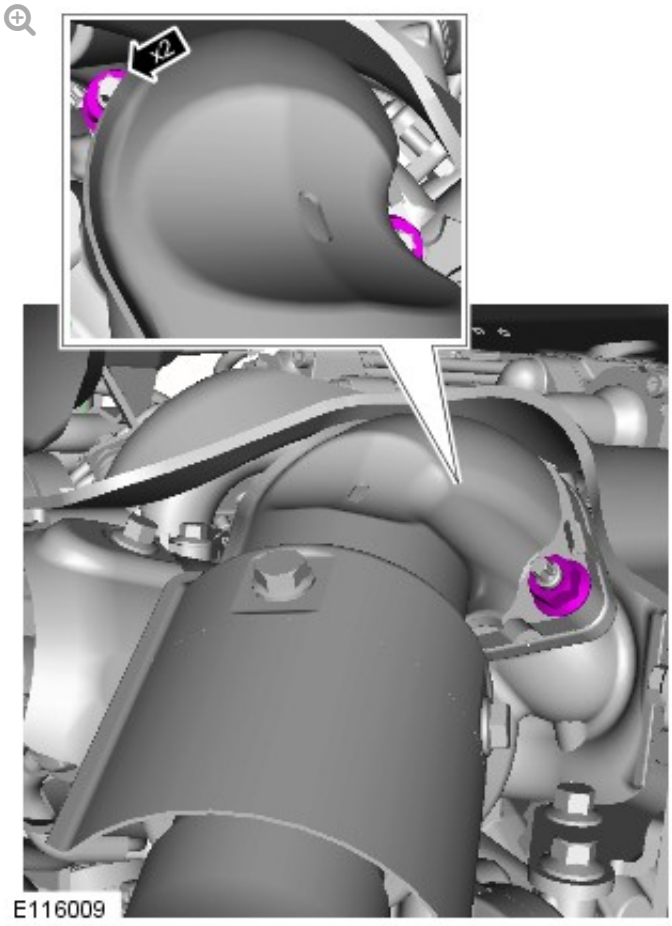
7.

Install a new gasket.



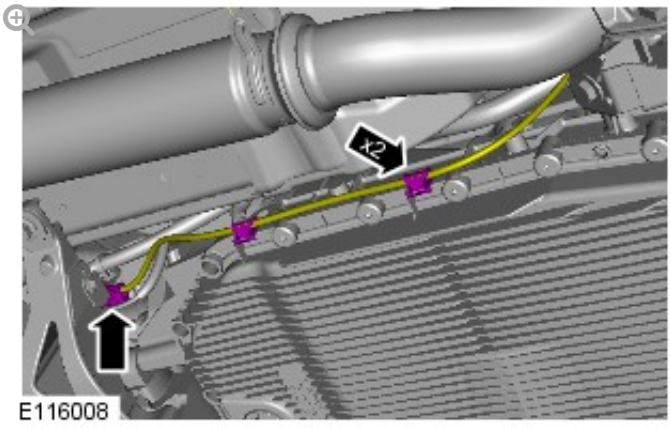
Torque: **25 Nm**

8.

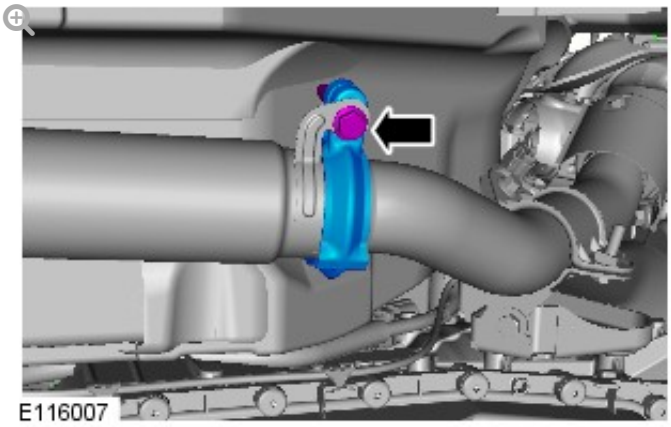


Torque: **22 Nm**

9.



10.

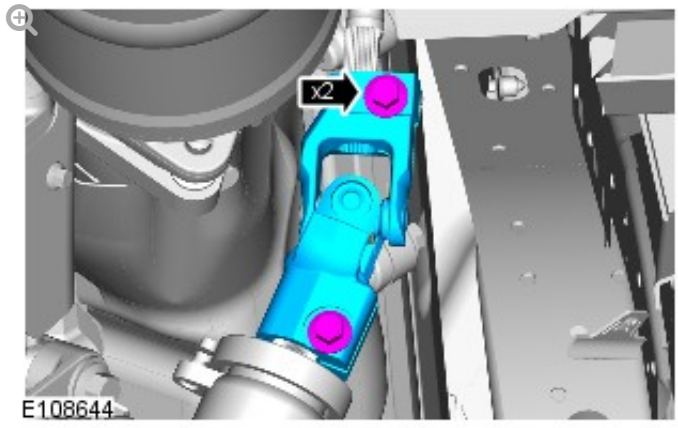


Torque: **11 Nm**

ℹ	Right-hand drive vehicles

11.

Make sure that new bolts are installed.



Torque: **30 Nm**

	All vehicles

12. Refer to: Air Deflector (501-02 Front End Body Panels, Removal and Installation).

13. If a new fixed vane turbocharger actuator is installed, carry out the reset procedure for the fixed vane turbocharger actuator using approved diagnostic tool.

FUEL CHARGING AND CONTROLS - TURBOCHARGER - TDV6 3.0L DIESEL

LEFT TURBOCHARGER [G1271875]

REMOVAL

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

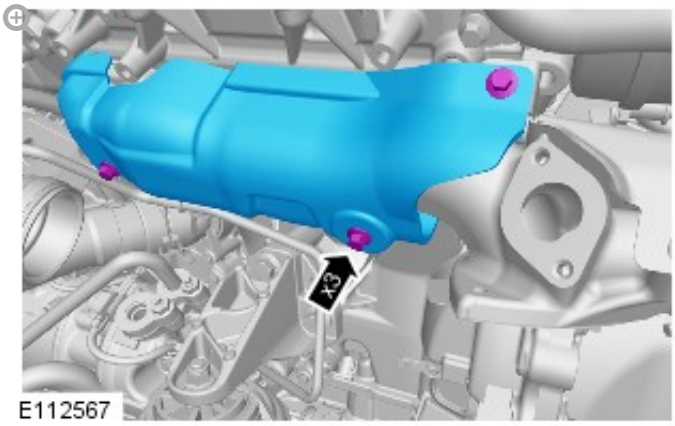
Some variation in the illustrations may occur, but the essential information is always correct.

All vehicles

1. Refer to: Catalytic Converter (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).

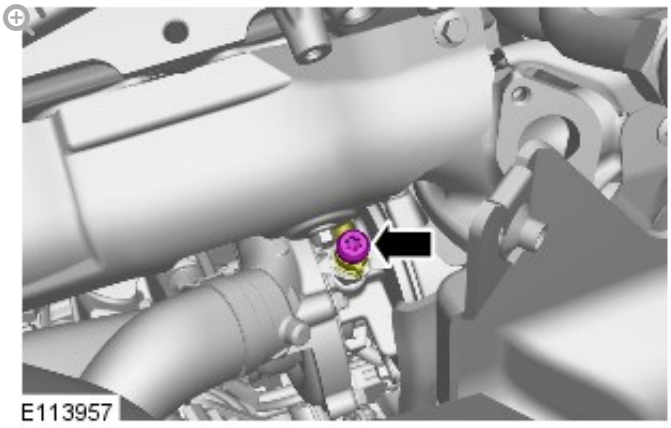
2. Refer to: Left Exhaust Gas Recirculation Valve (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

3.

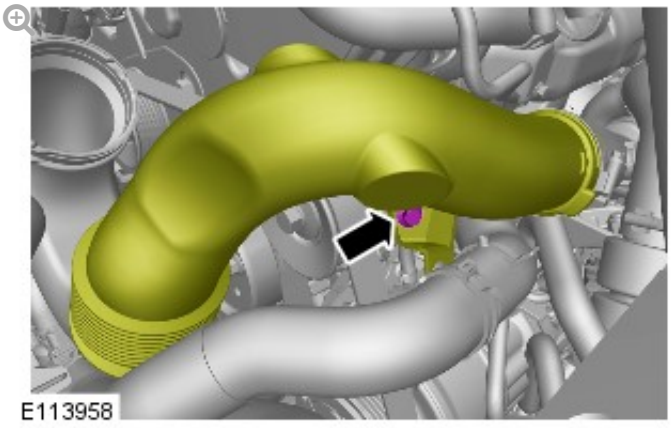


4.

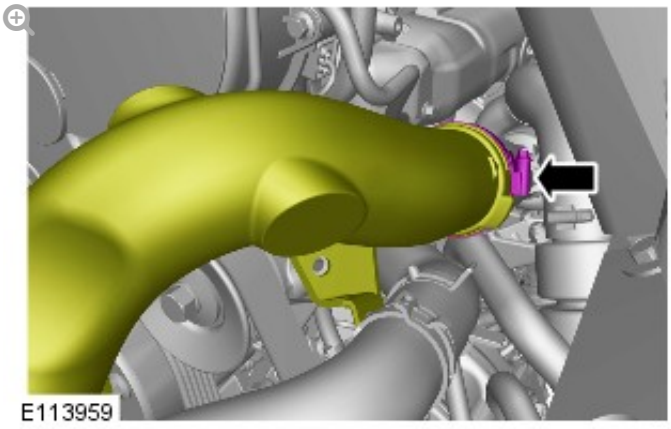
Discard the sealing washers.



5.



6.



7.

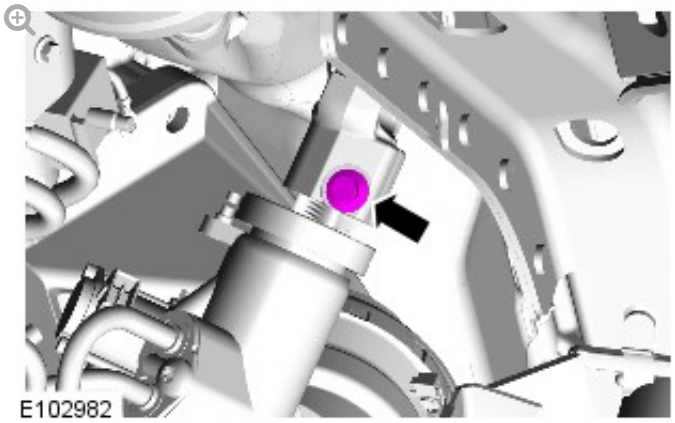
Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

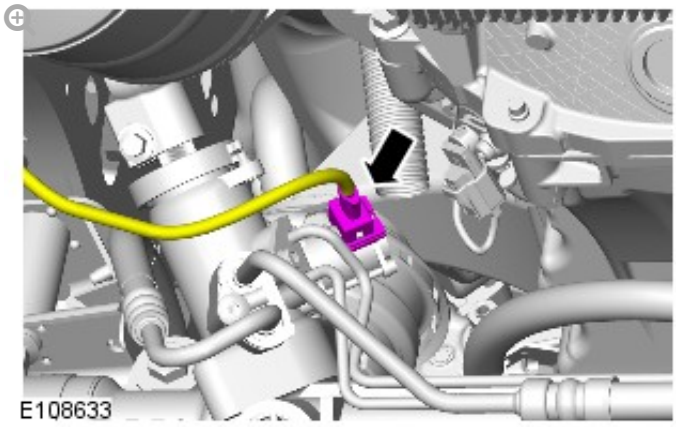
	Left-hand drive vehicles

8.

Make sure that the road wheels are in the straight ahead position.

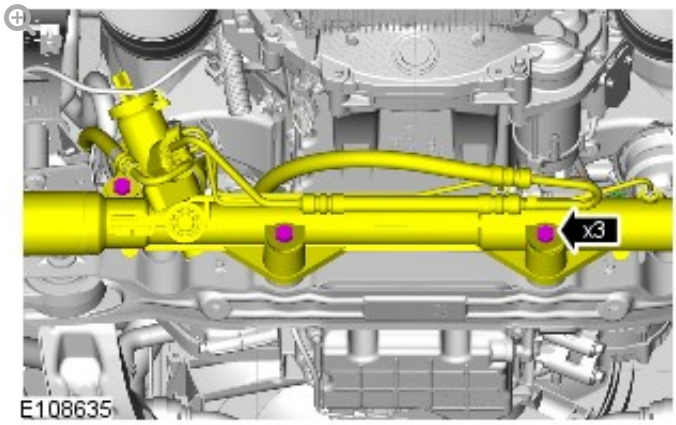


9.



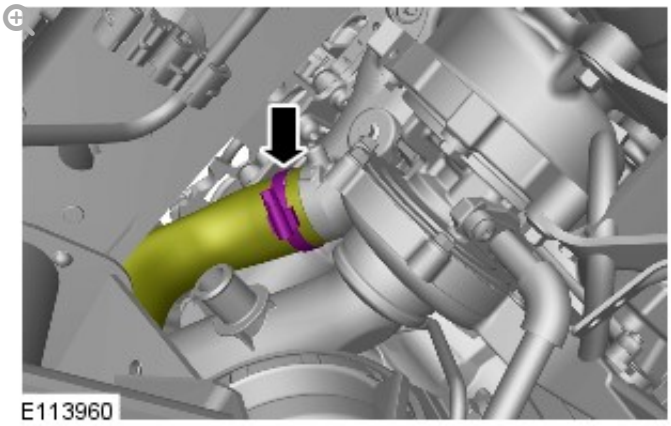
10.

Make sure to support the steering gear.



All vehicles

11.



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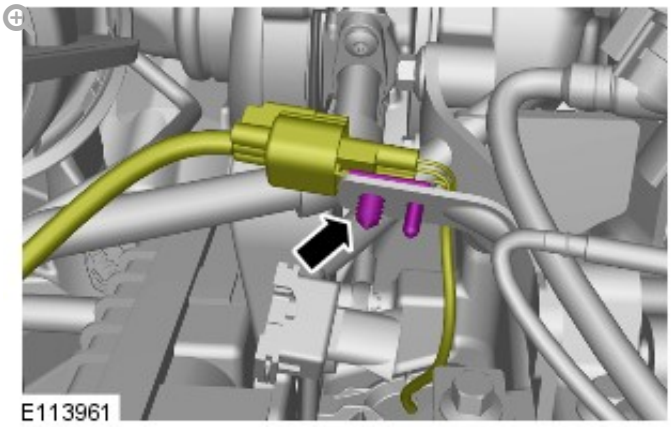
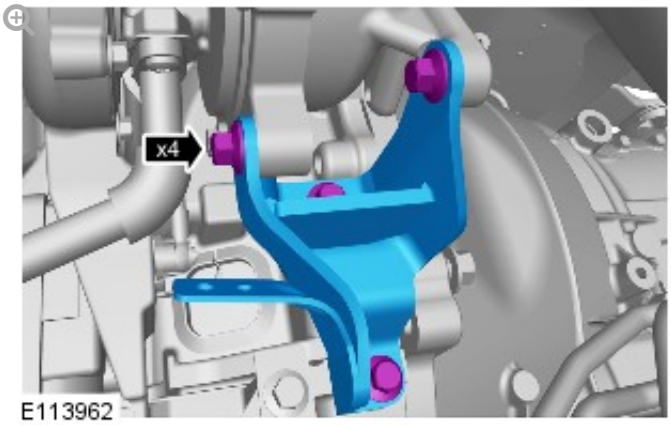
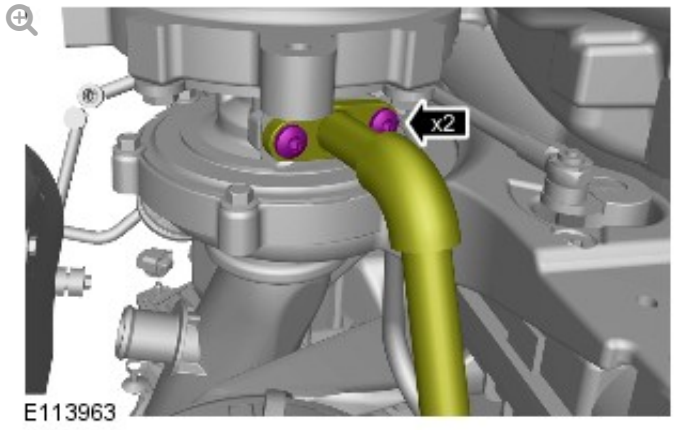


13.



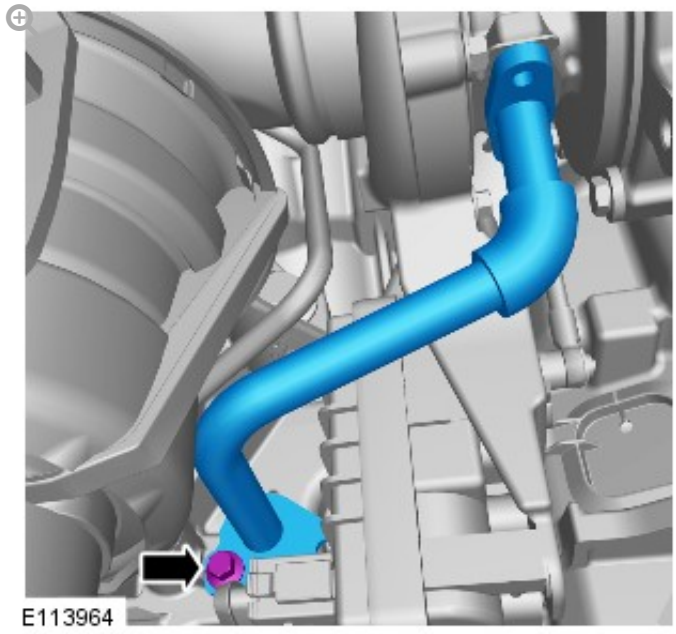
14.

Discard the gasket.



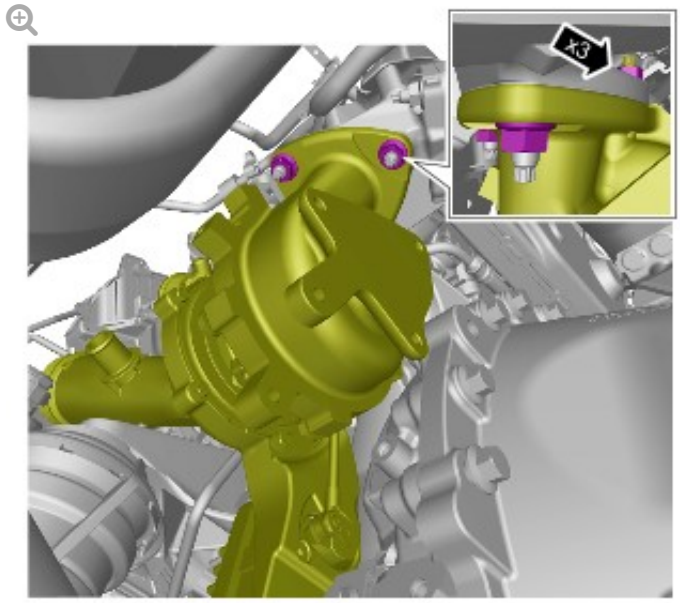
15.

Discard the seal.



16.

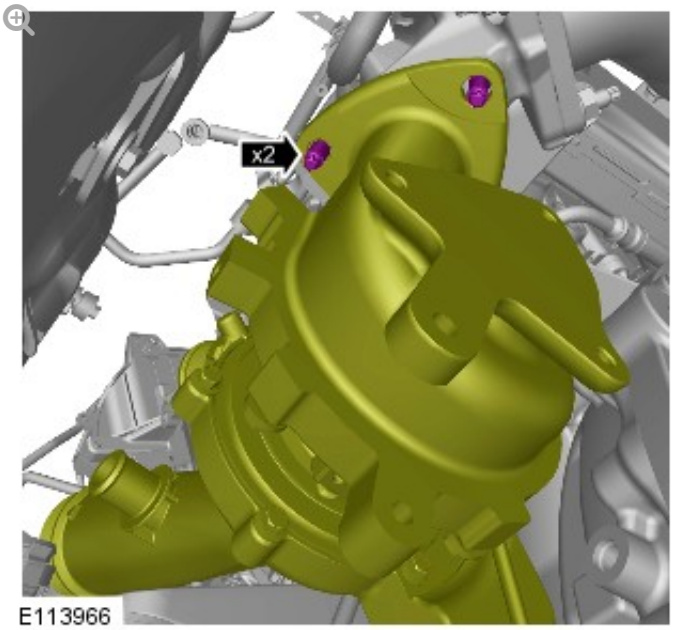
Discard the nuts.



E113965

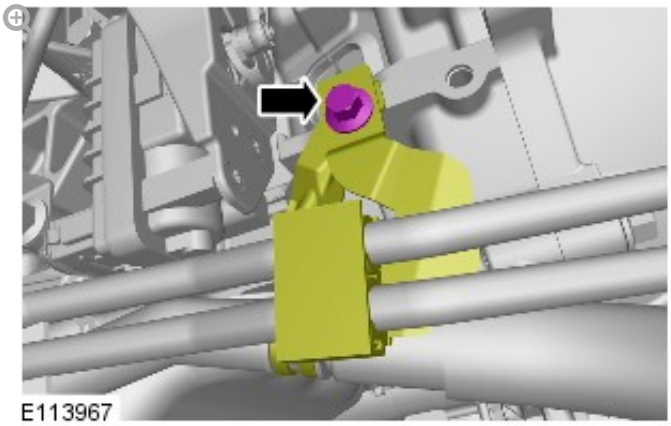
17.

Discard the studs.

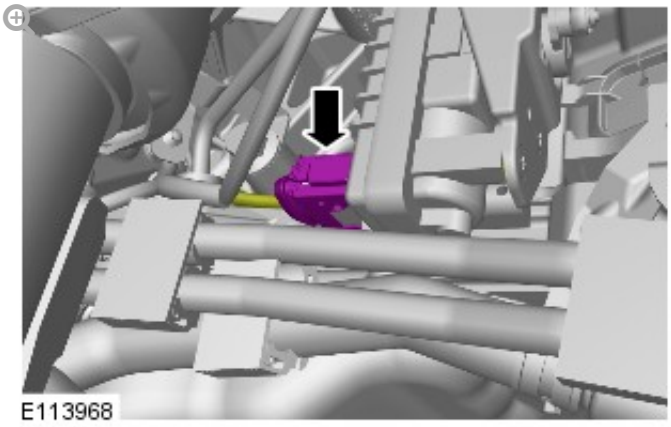


E113966

18.

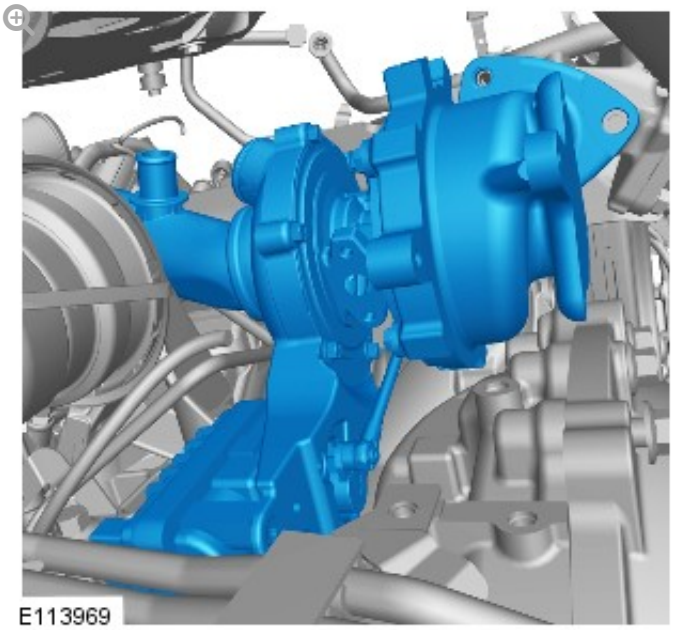

E113967

19.

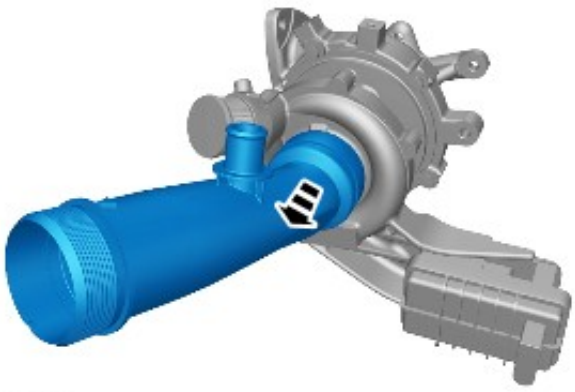

E113968

- Position the turbocharger to one side.

20.

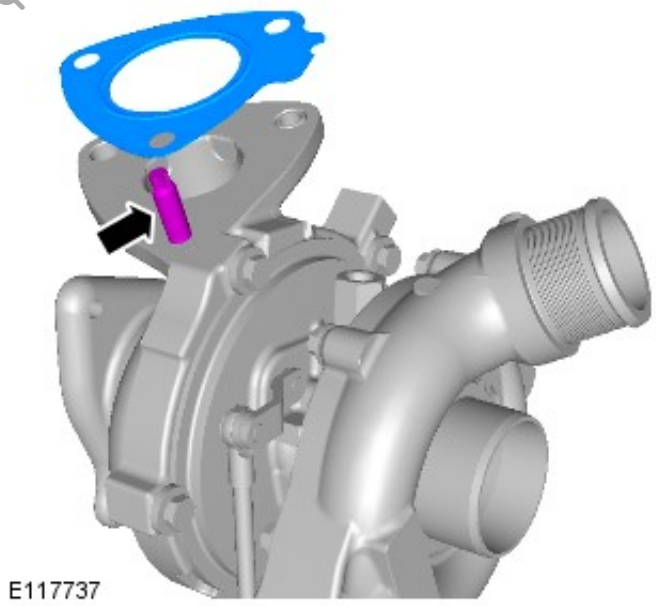

E113969

21.


E113970

- Do not disassemble further if removed for access only

22.

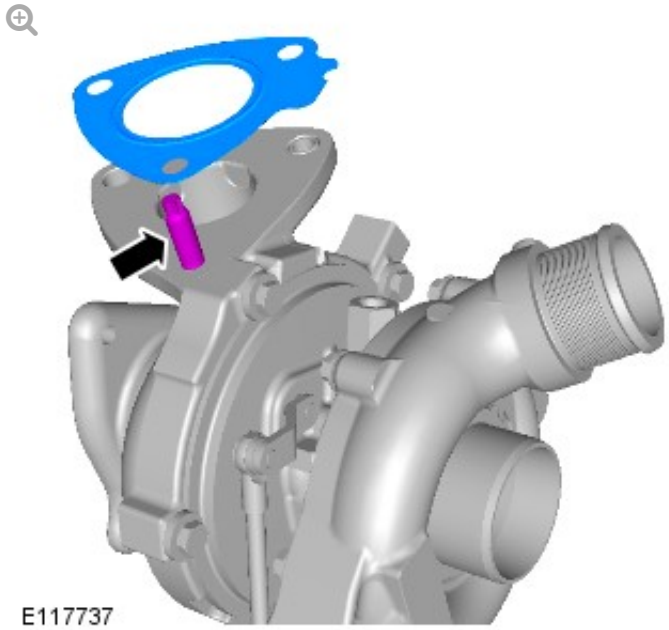


INSTALLATION

All vehicles

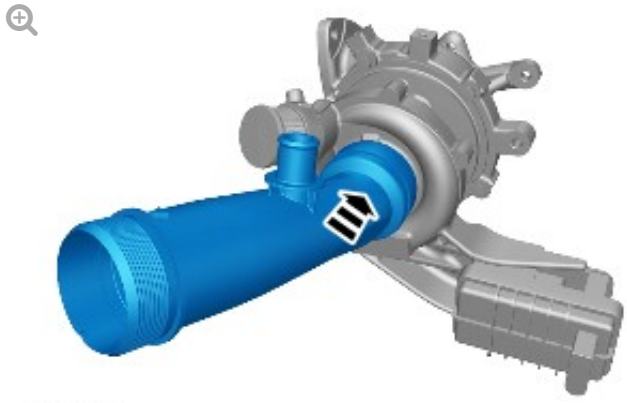
1.

- Install new studs.
- Check the turbocharger and exhaust manifold mating faces for distortion.
- Install a new turbocharger to exhaust manifold gasket every time the turbocharger is removed.
- Make sure that the mating faces are clean and free of corrosion and foreign material.

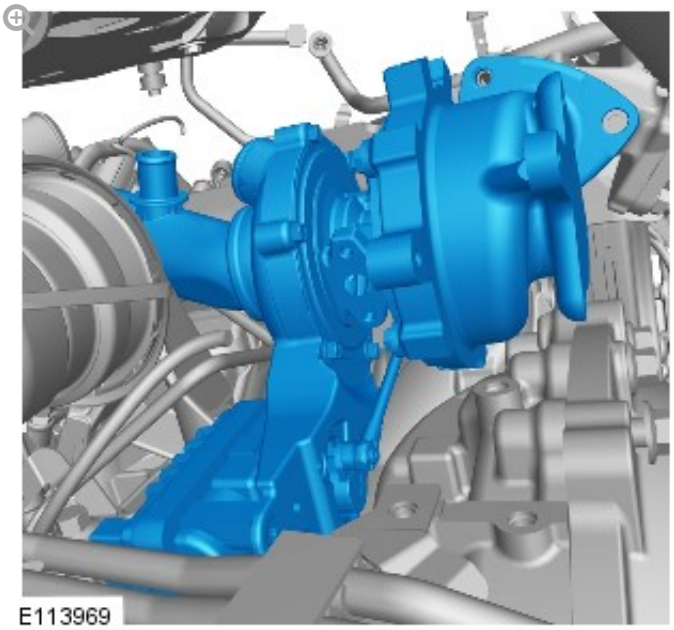

E117737

Torque: **13 Nm**

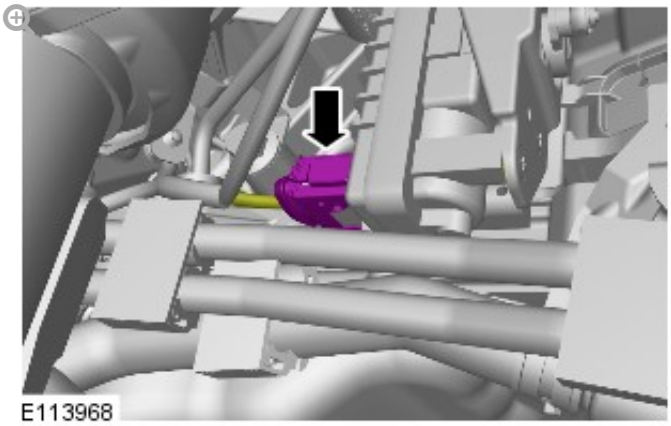
2.


E116713

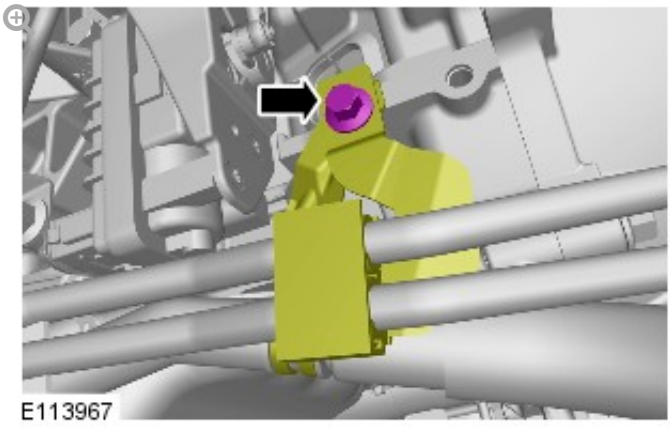
3.



4.



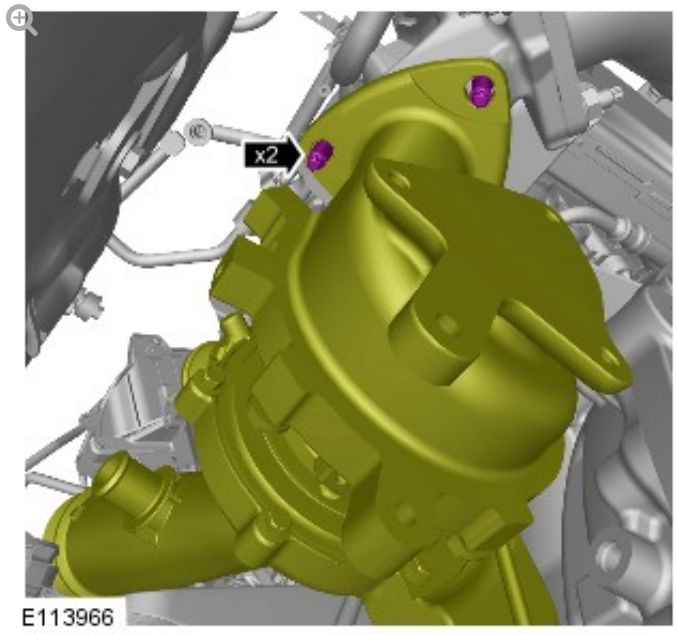
5.



Torque: **10 Nm**

6.

Install new studs.

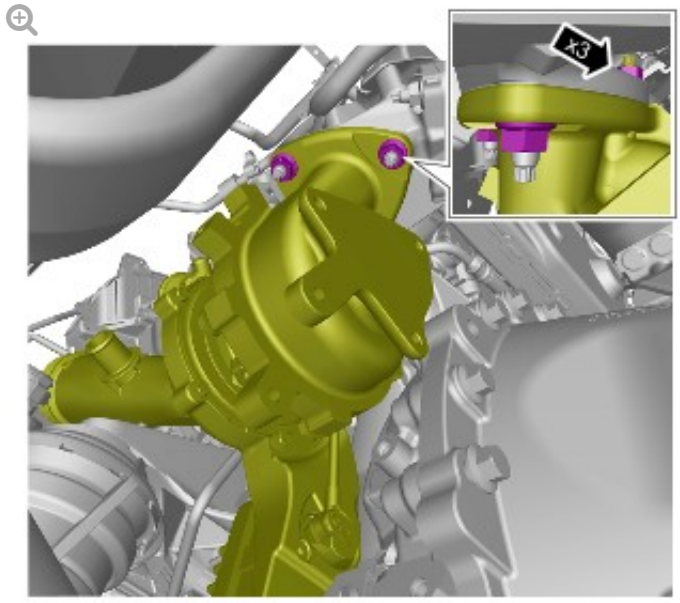


Torque: **13 Nm**

7.

Make sure that new nuts are installed.

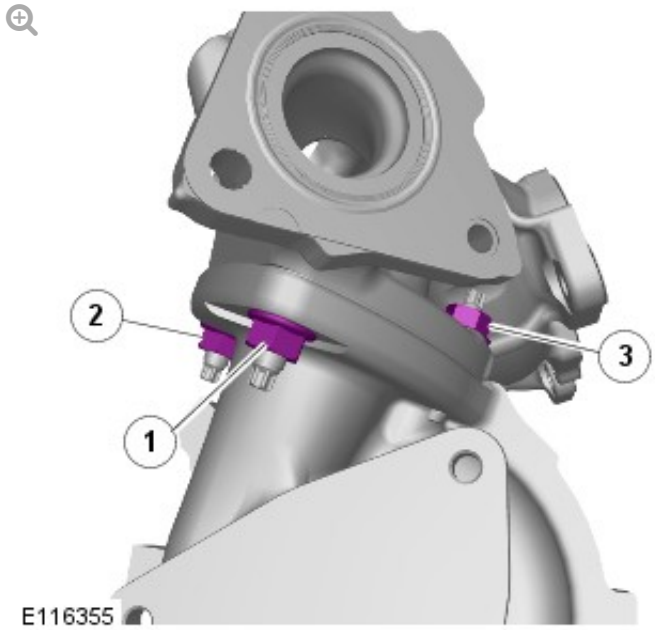
Only tighten the nut finger tight at this stage.



E113965

8.

- Tighten the bolts in the indicated sequence.
- Engine shown removed for clarity.

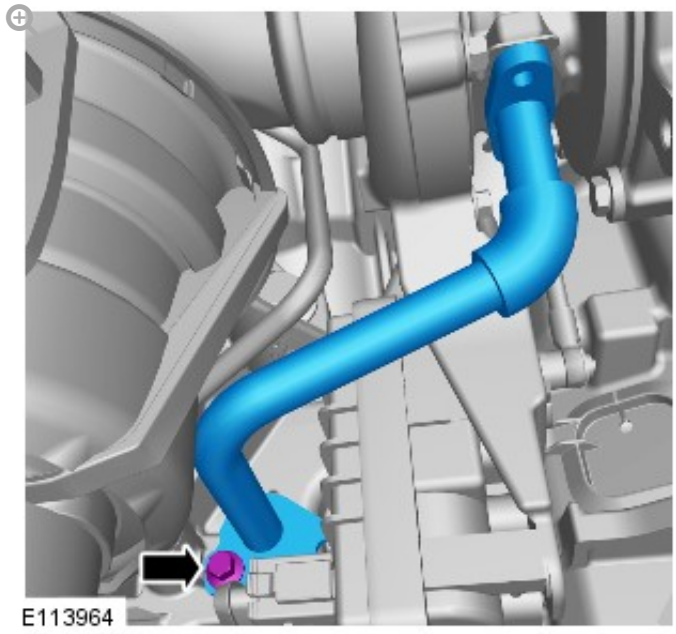


E116355

Torque: **24 Nm**

9.

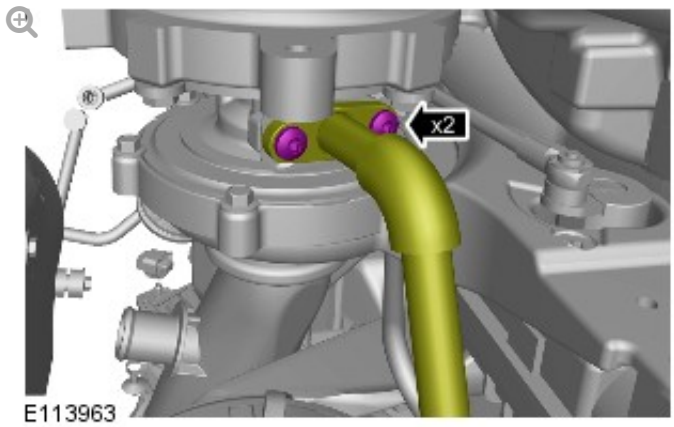
Install a new seal.



Torque: **10 Nm**

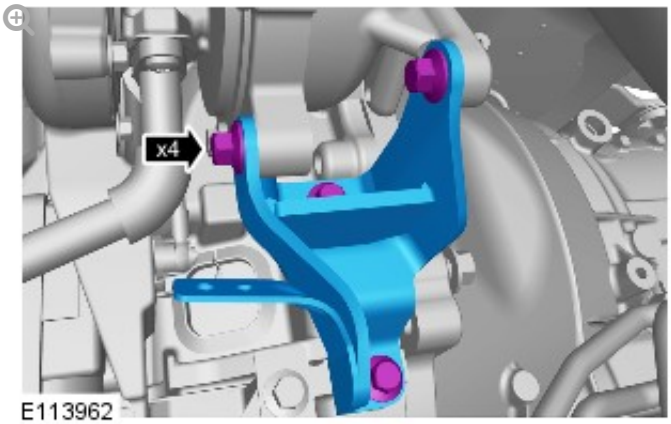
10.

Install a new gasket.



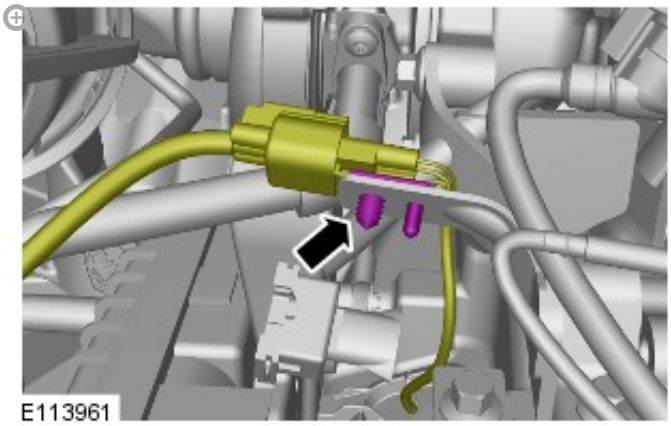
Torque: **10 Nm**

11.

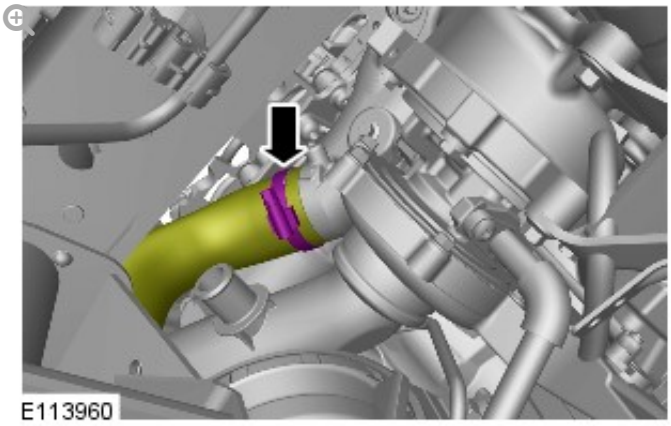


Torque: **24 Nm**

12.



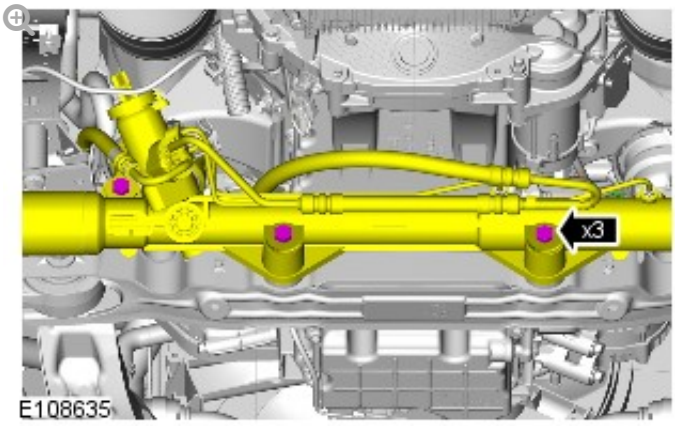
13.



Torque: **7 Nm**

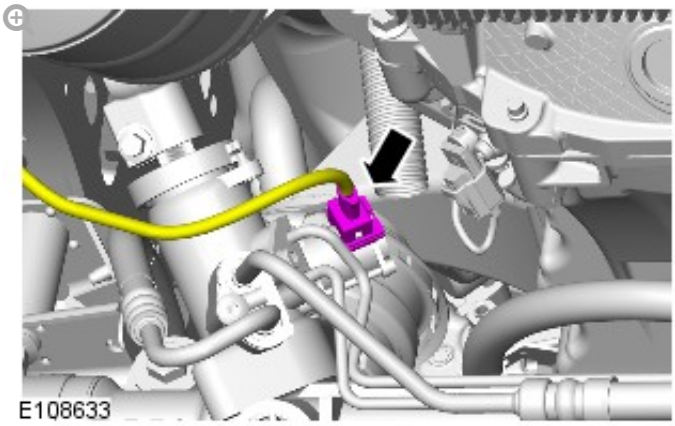
	Left-hand drive vehicles

14.



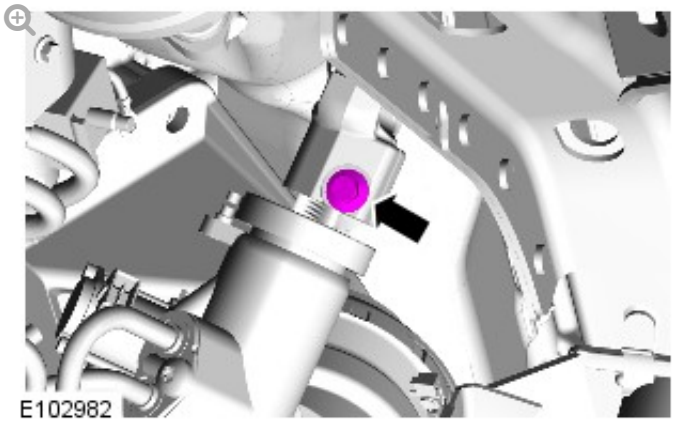
Torque: **100 Nm**

15.



16.

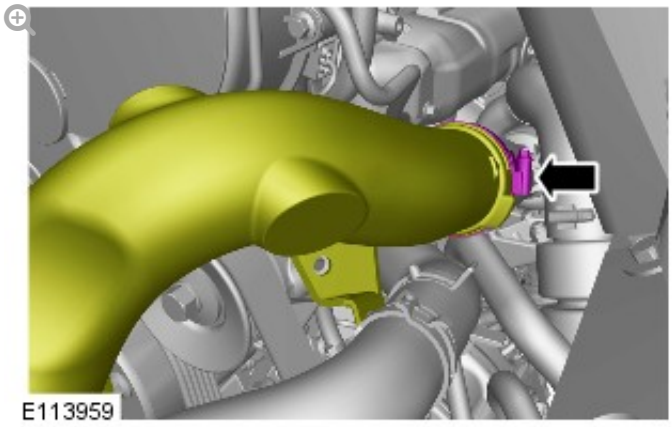
Make sure that the road wheels are in the straight ahead position.



Torque: **35 Nm**

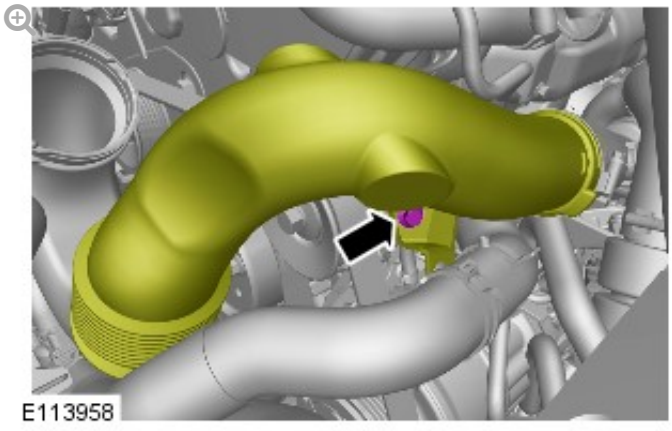
All vehicles

17.



Torque: **7 Nm**

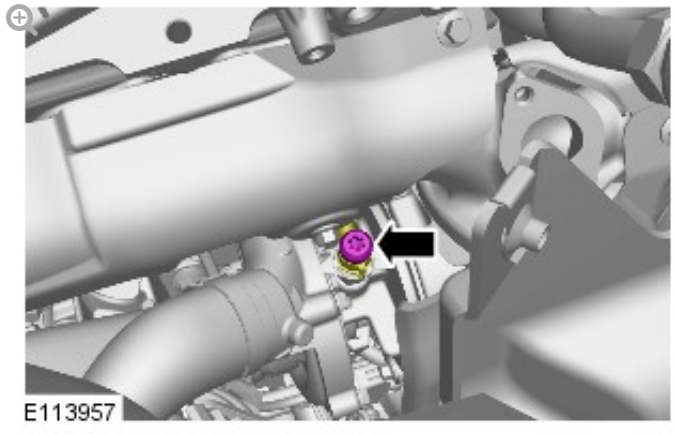
18.



Torque: **10 Nm**

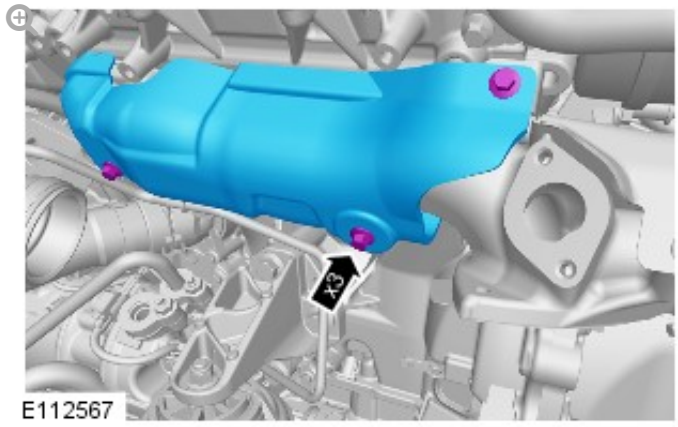
19.

> Make sure that a new sealing washer is installed.



Torque: **30 Nm**

20.



Torque: **10 Nm**

21. Refer to: Left Exhaust Gas Recirculation Valve (303-08A Engine Emission Control - TDV6 3.0L Diesel, Removal and Installation).

22. Refer to: Catalytic Converter (309-00A Exhaust System - TDV6 3.0L Diesel, Removal and Installation).