FUEL CHARGING AND CONTROLS - TURBOCHARGER - TDV6 3.0L DIESEL

RIGHT TURBOCHARGER [G1271876]

REMOVAL

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

1.

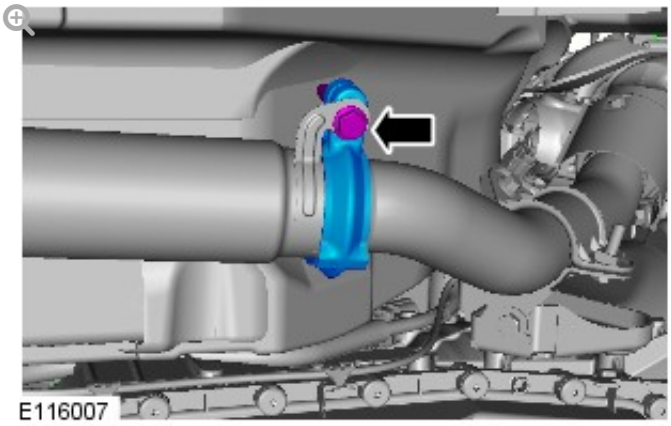
Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

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

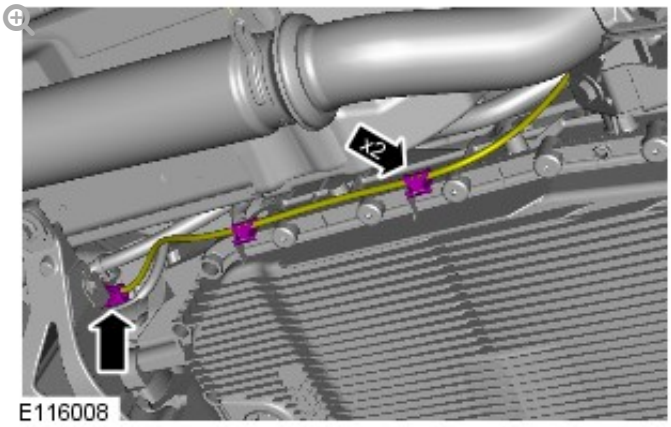
3. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

4.



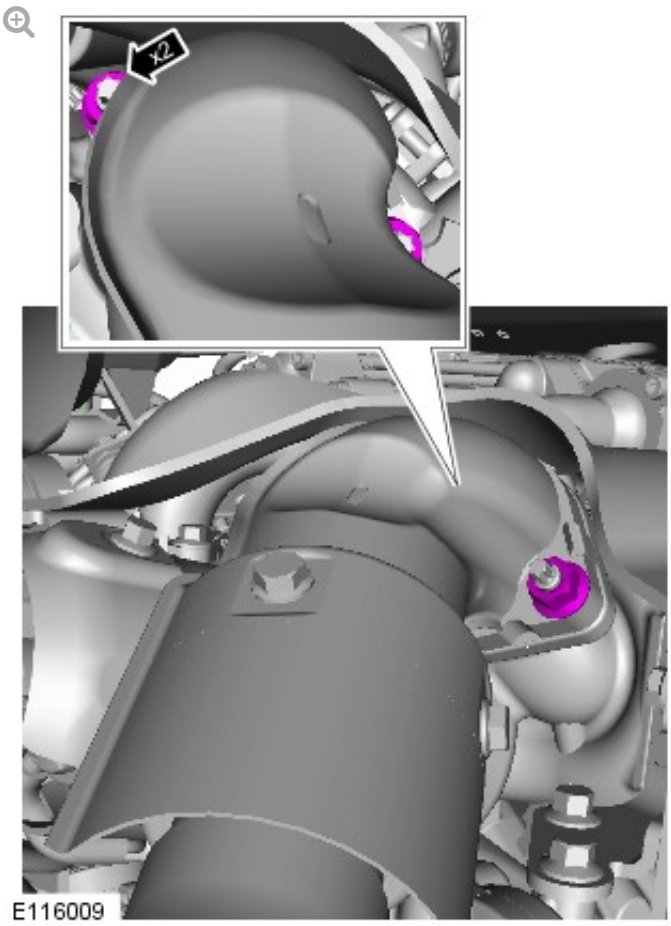
E116007

5.



E116008

6.



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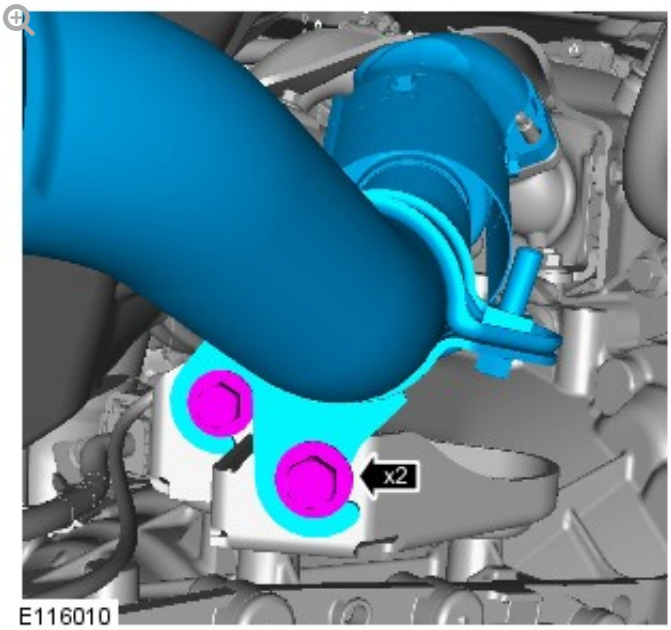
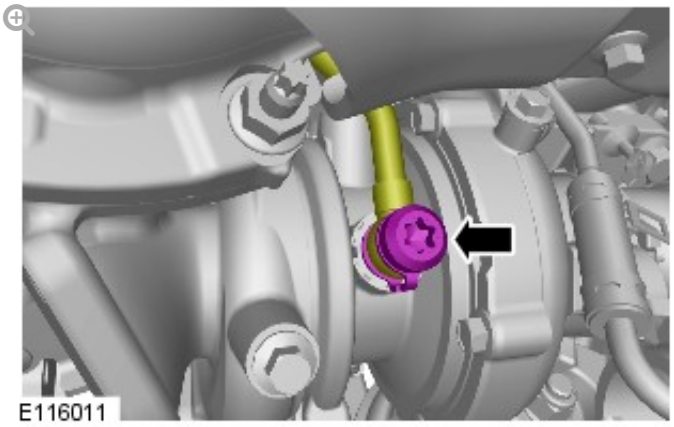
7.



E116010

8.

Discard the sealing washers.



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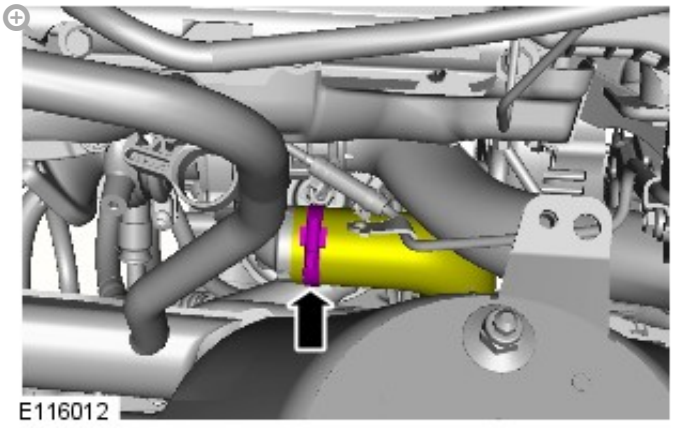

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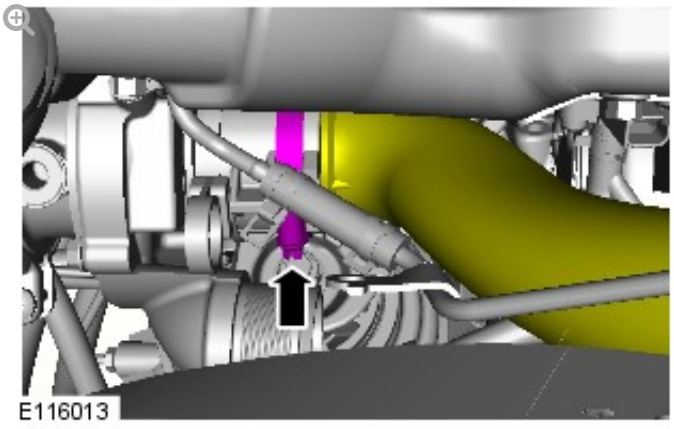

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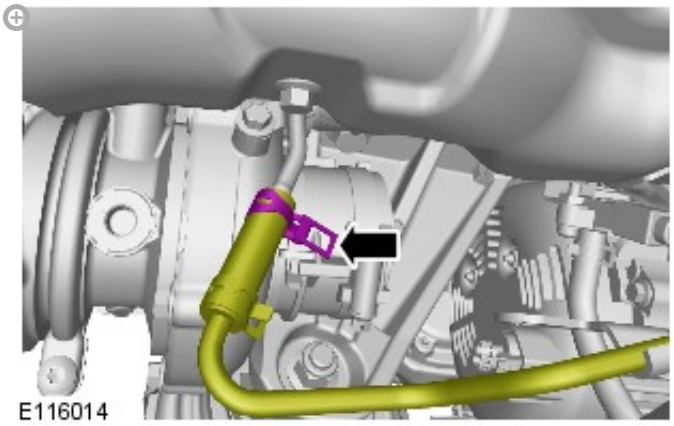

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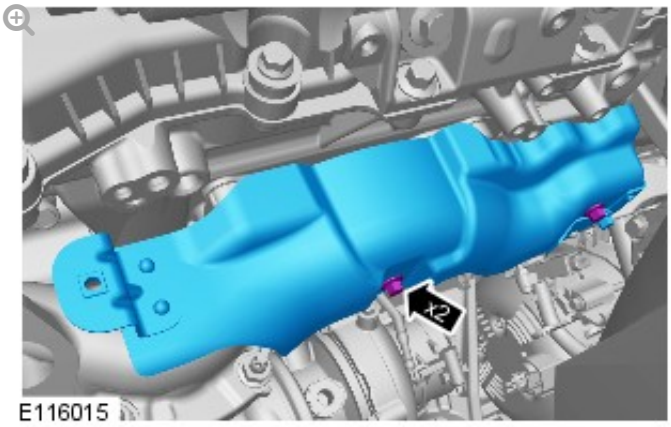

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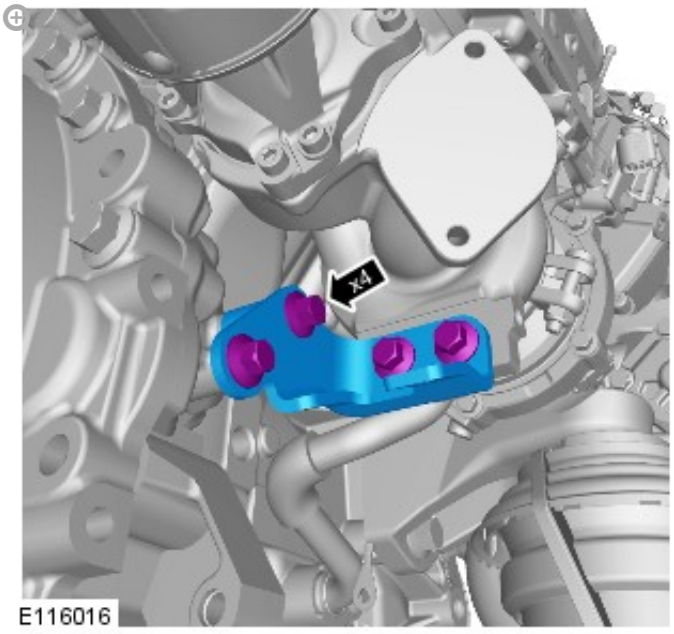
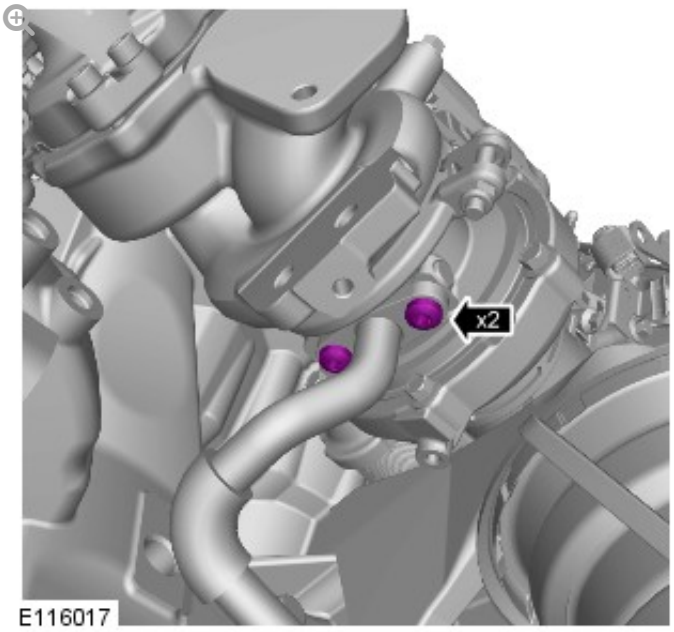


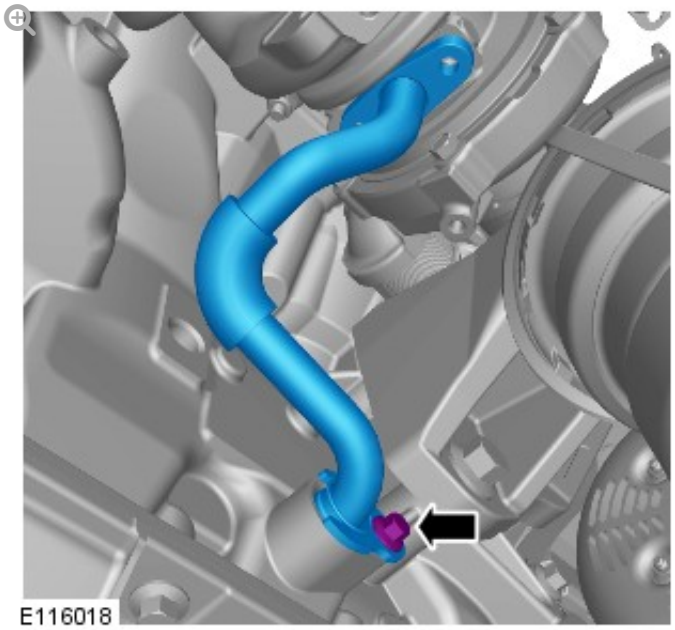
14.

Discard the gasket.



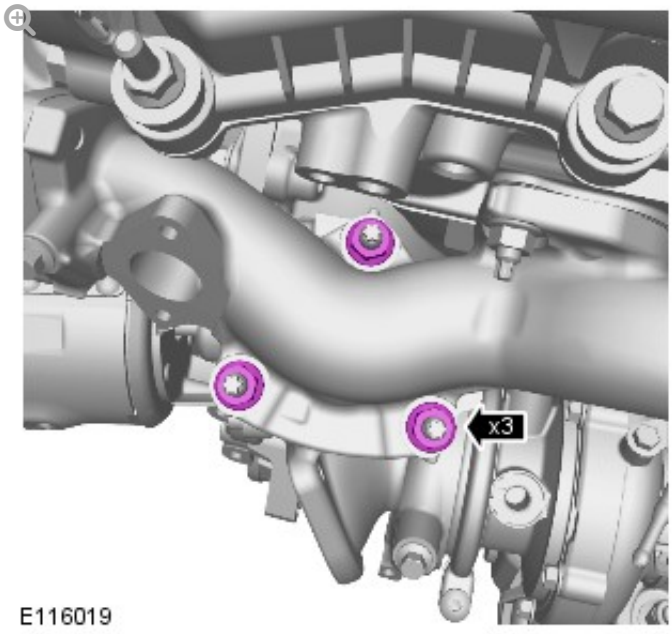
15.

Discard the seal.



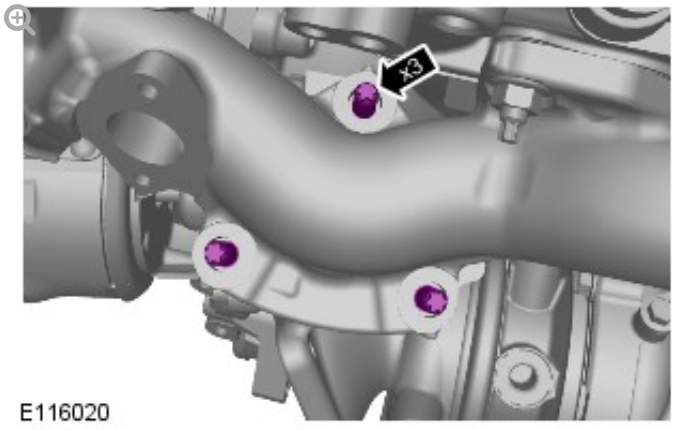
16.

Discard the nuts.



17.

Discard the studs.



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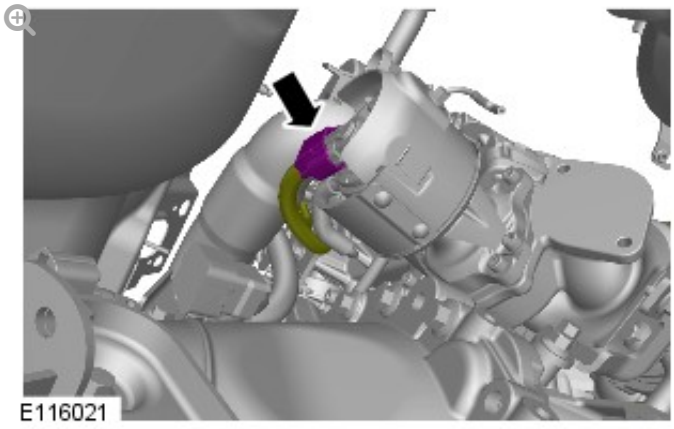
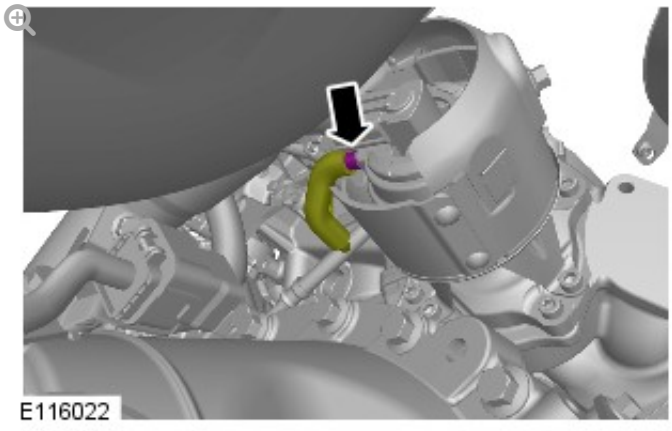


- Reposition the turbocharger.

19.



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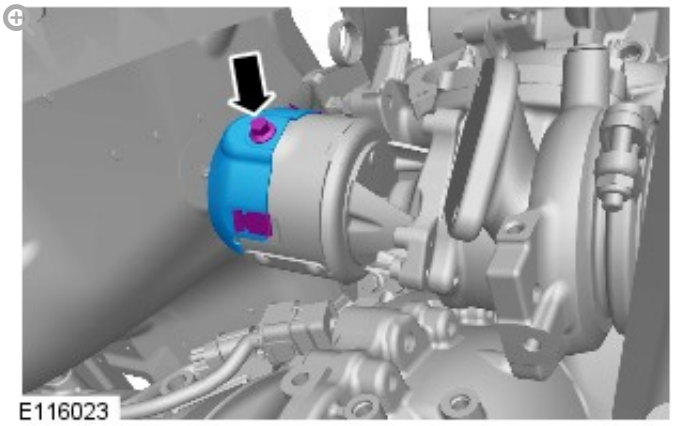
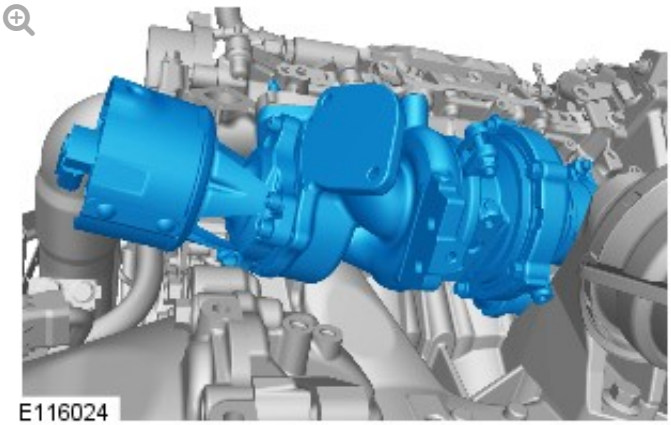


21.

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



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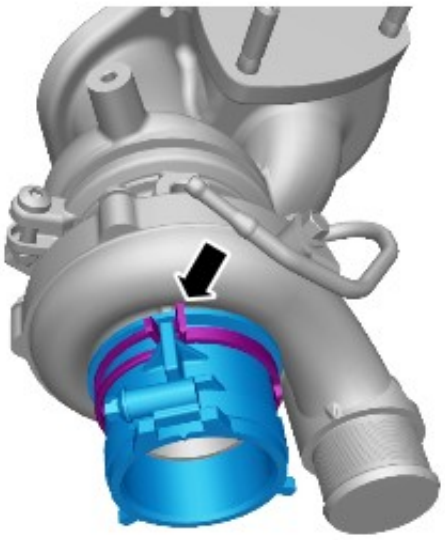
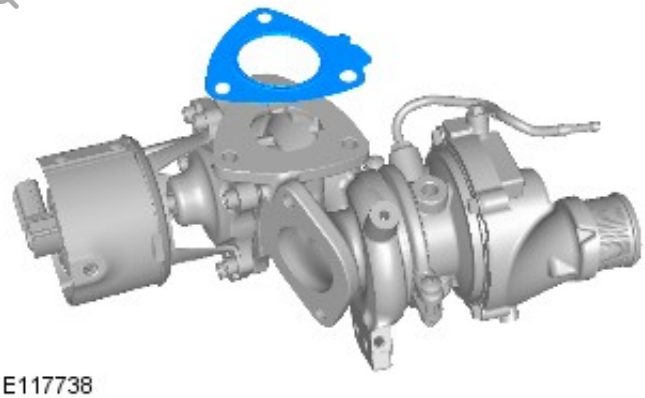


E116025

23.

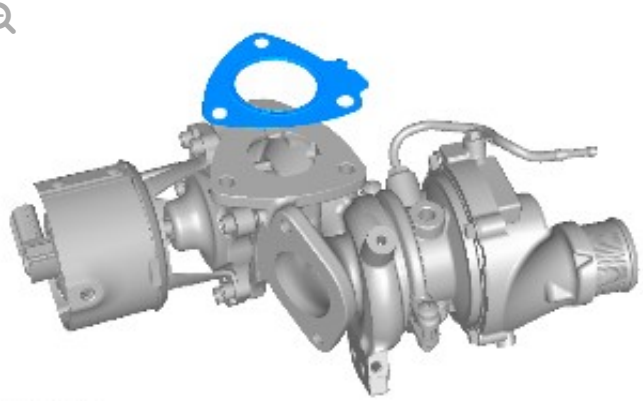


E117738

INSTALLATION

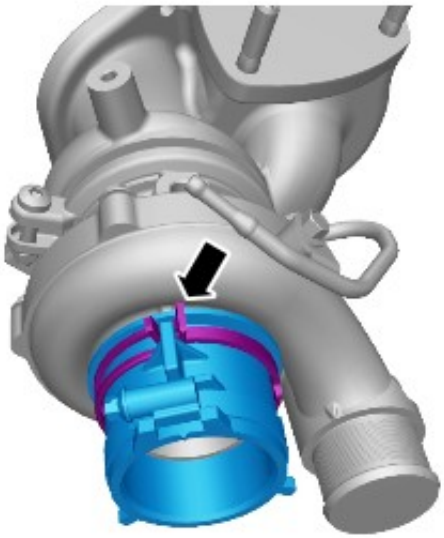
1.

- 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.



E117738

2.



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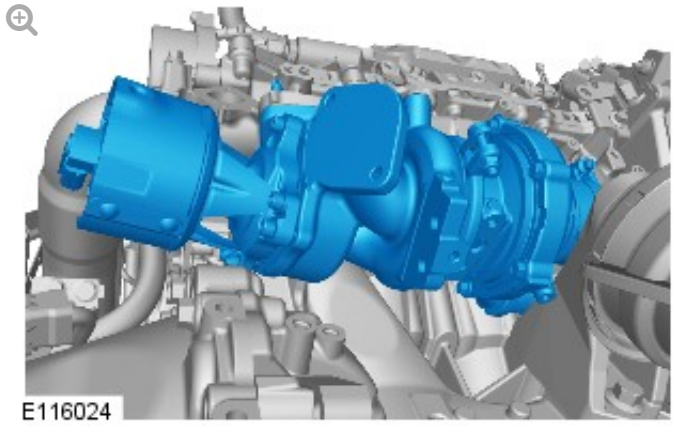

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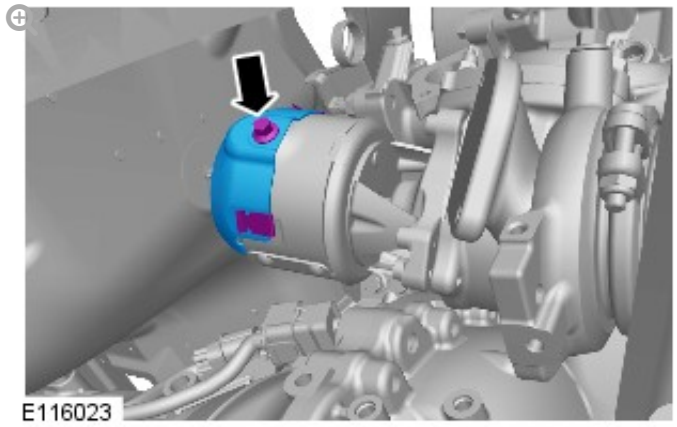
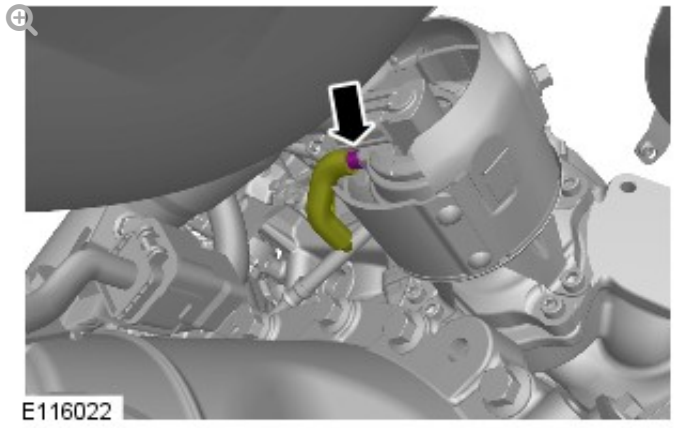


Torque: **10 Nm**

5.



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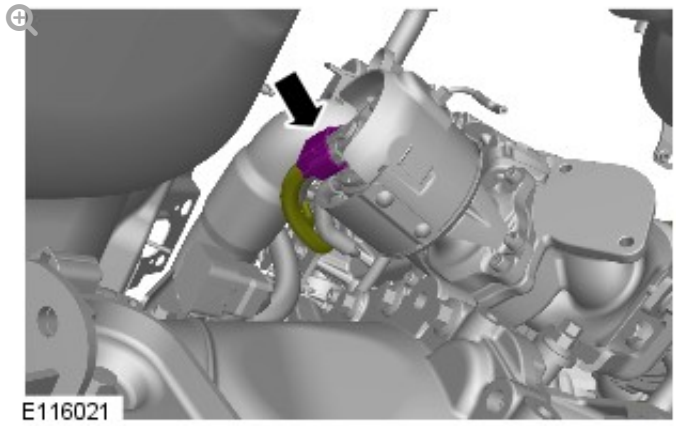
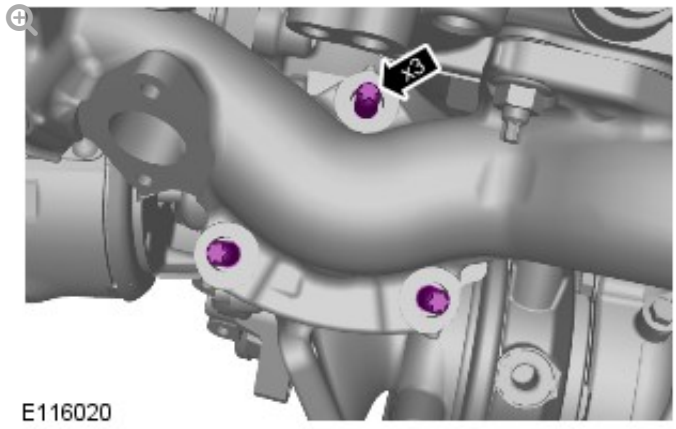


7.

Install new studs.

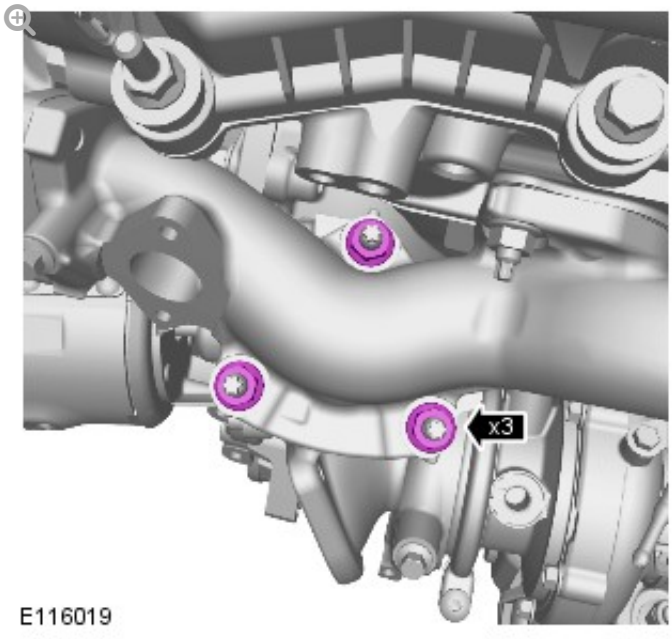


Torque: **13 Nm**

8.

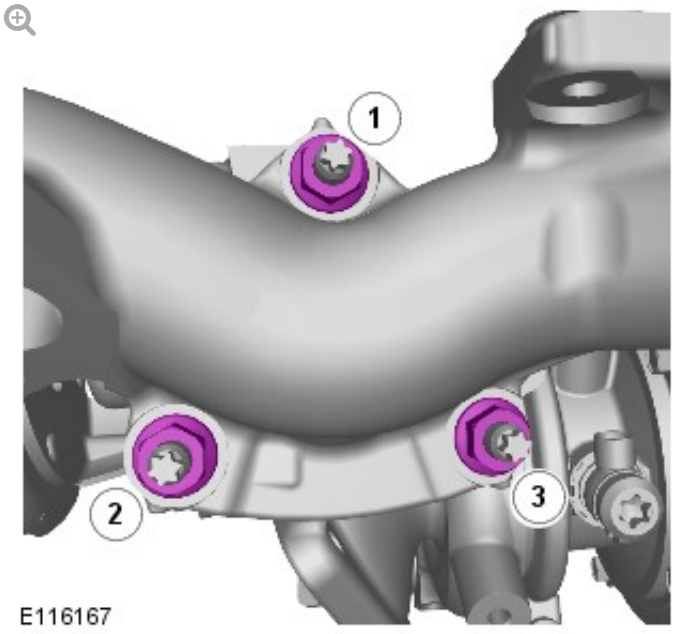
Make sure that new nuts are installed.

Only tighten the nut finger tight at this stage.



9.

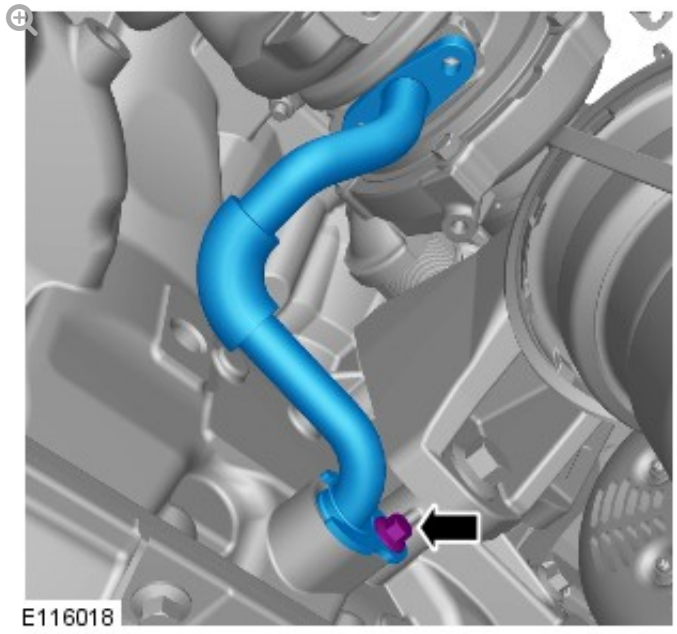
Tighten the bolts in the indicated sequence.



Torque: **24 Nm**

10.

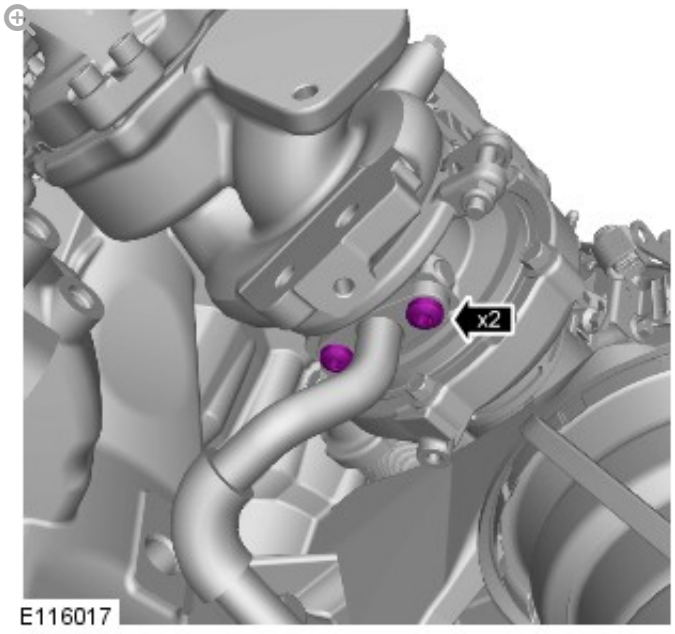
Install a new seal.



Torque: **10 Nm**

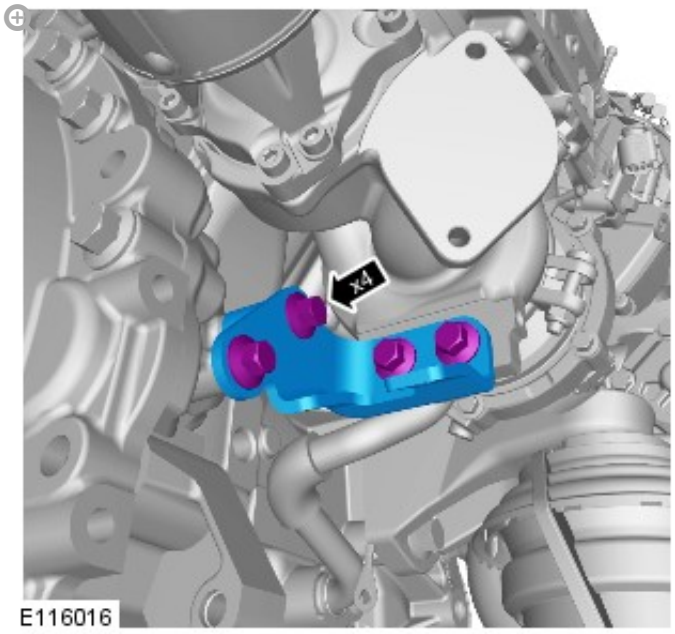
11.

Install a new gasket.



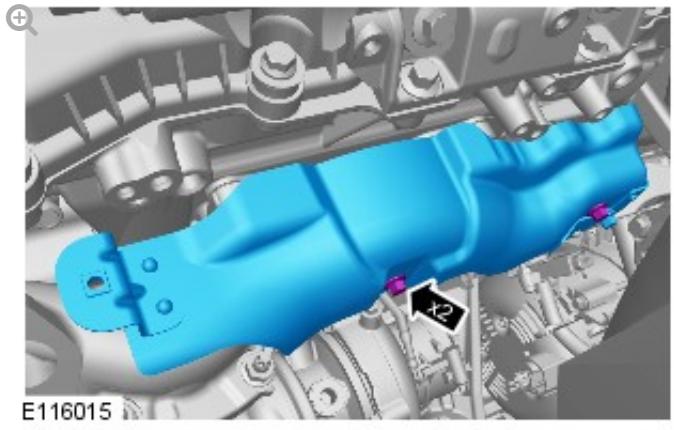
Torque: **10 Nm**

12.



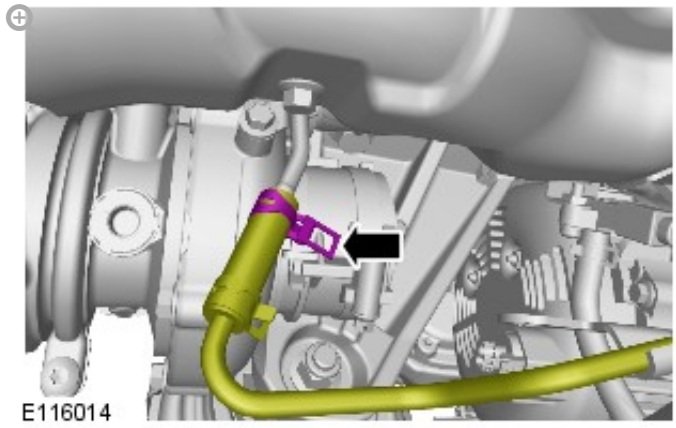
Torque: **33 Nm**

13.

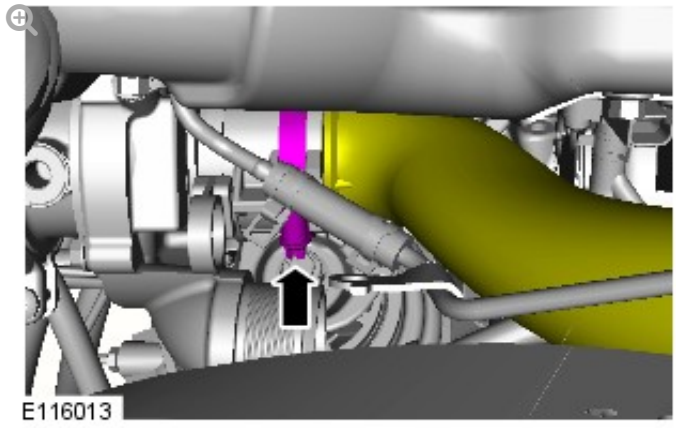


Torque: **10 Nm**

14.

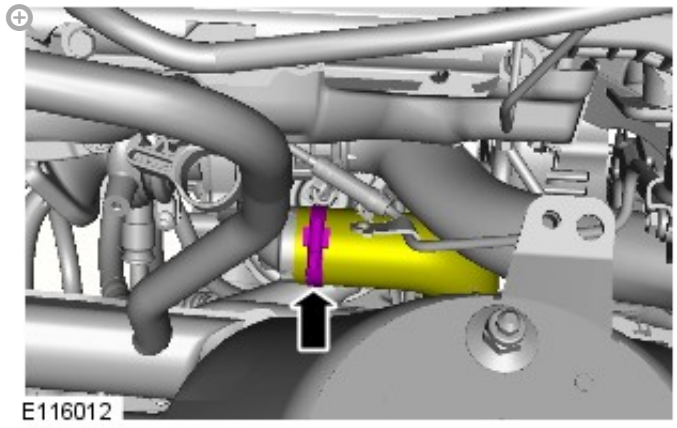


15.



Torque: **7 Nm**

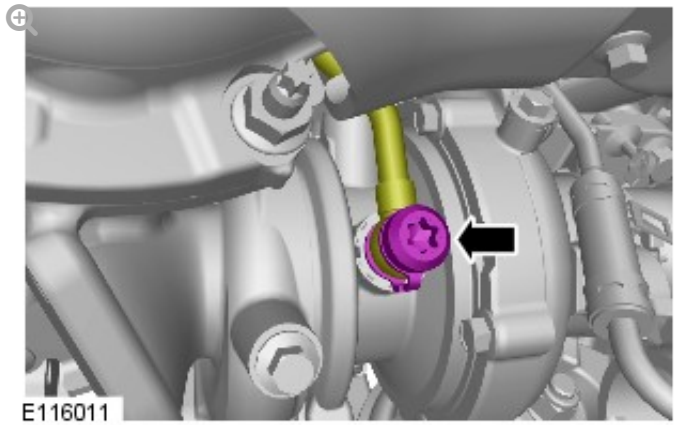
16.



Torque: **7 Nm**

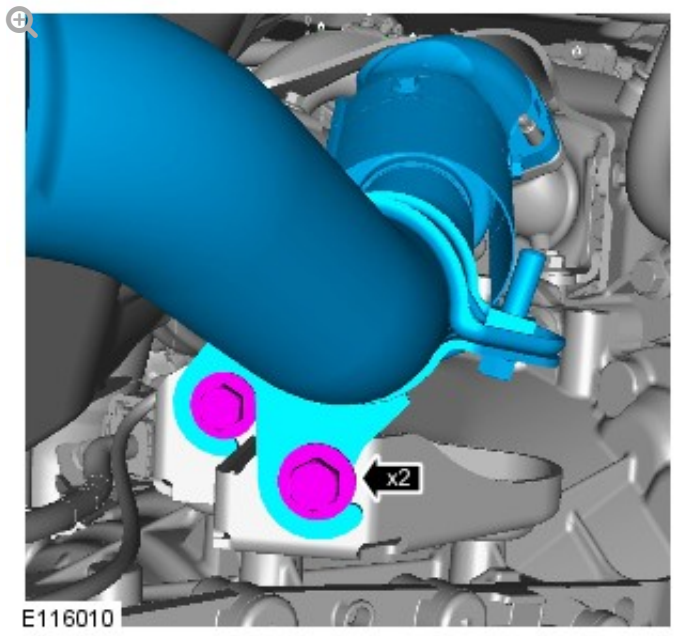
17.

Install a new seal.



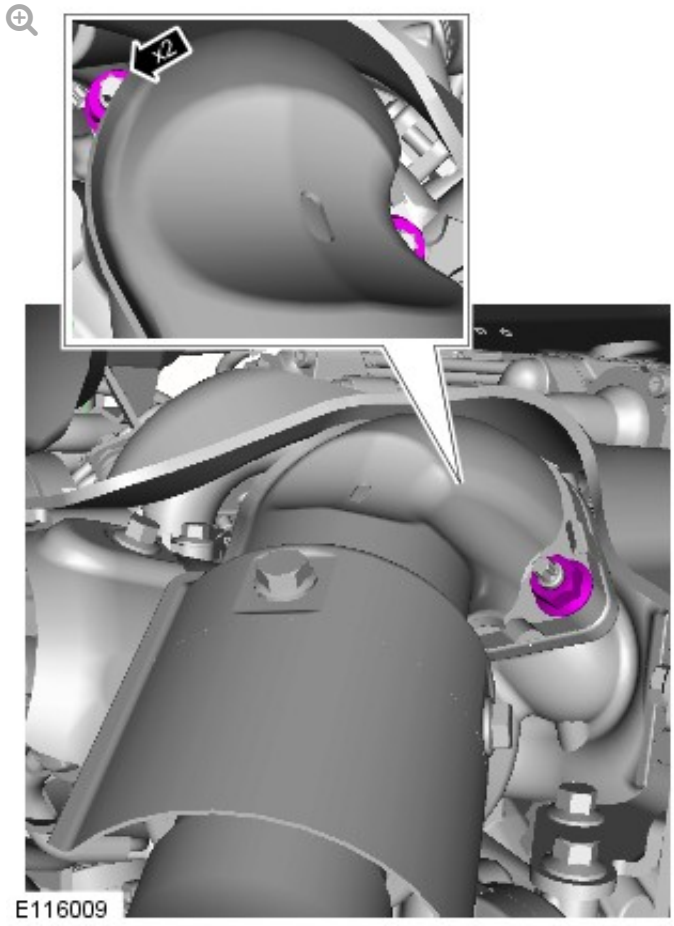
Torque: **30 Nm**

18.



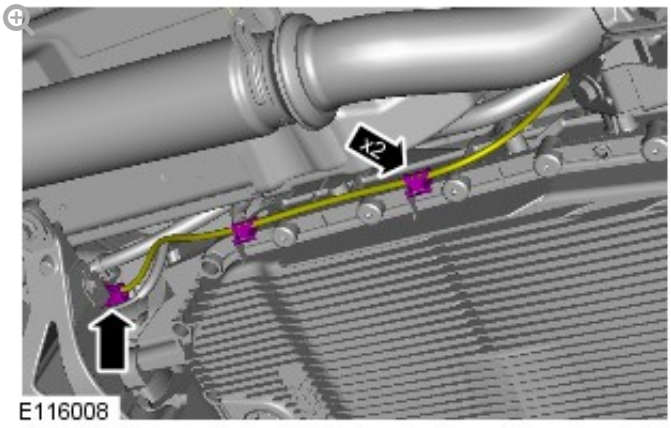
Torque: **25 Nm**

19.



Torque: **22 Nm**

20.



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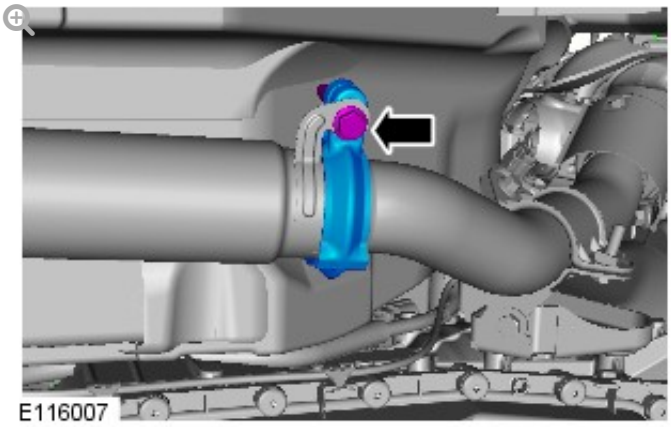


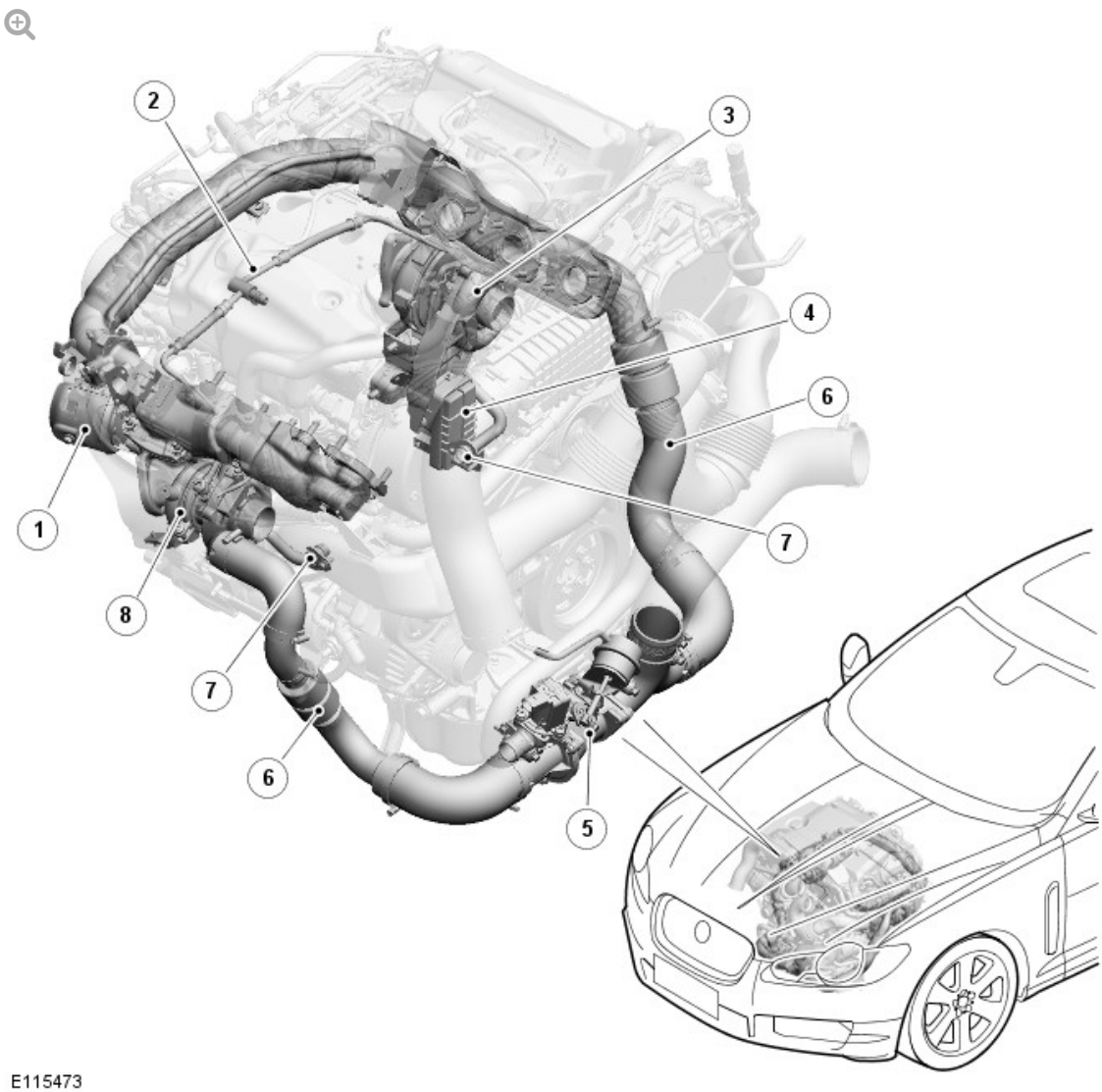
Torque: **11 Nm**

22. Refer to: Starter Motor (303-06A Starting System - TDV6 3.0L Diesel, Removal and Installation).

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

FUEL CHARGING AND CONTROLS - TURBOCHARGER - TDV6 3.0L DIESEL

TURBOCHARGER - COMPONENT LOCATION [G1088896]



1	Secondary turbocharger turbine shut-off valve
2	Turbocharger oil supply
3	Primary turbocharger (variable vane)
4	Primary turbocharger control module (variable vane actuator)
5	Secondary turbocharger recirculation valve and shut-off valve
6	Charge air tube
7	Turbocharger oil drain
8	Secondary turbocharger (fixed vane)

TURBOCHARGER - OVERVIEW [G1088897]

INTRODUCTION

The 3.0L V6 diesel engine uses two turbochargers; a fixed vane type (secondary) and a variable vane (primary) type. The fixed vane turbocharger is fitted to the RH (right-hand) cylinder bank and the variable vane turbocharger is fitted to the LH (left-hand) cylinder bank.

Both turbochargers are used in a parallel sequential turbocharging system which enables the engine to achieve quick throttle response at low engine speeds and efficient use of exhaust gas energy at high engine speeds.

The variable vane turbocharger has an ECM (engine control module) controlled electronic rotary actuator. The rotary actuator adjusts the turbine vanes to optimize the exhaust gas flow and velocity onto the turbine wheel to maintain the required boost pressure.

The parallel sequential turbocharging system comprises the two turbochargers and the ECM. The primary variable nozzle turbine operates through the entire engine speed range but is at its most efficient at engine speeds of up to 2800 rpm. At engine speeds above 2800 rpm under load, the fixed vane secondary turbine comes into operation, with both of the turbochargers now running in a parallel bi-turbo mode.

TURBOCHARGER - SYSTEM OPERATION AND COMPONENT DESCRIPTION

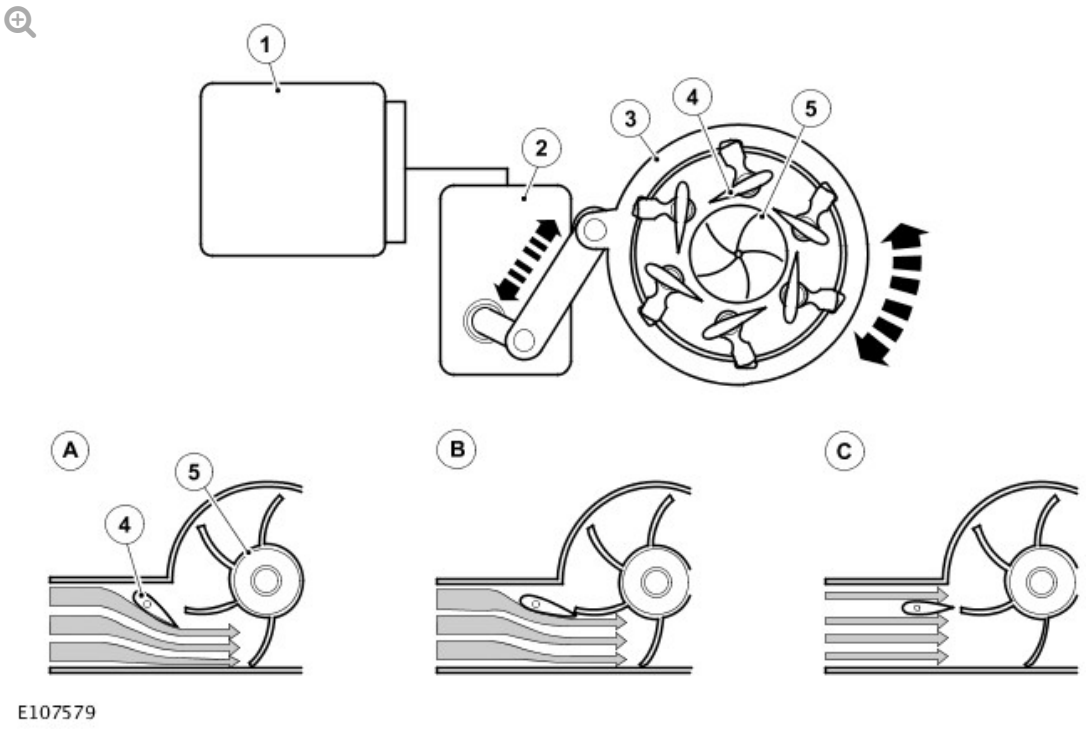
[G1088898]

SYSTEM OPERATION

TURBOCHARGERS

The turbine wheel of the turbocharger uses the engine's exhaust gasses to drive the compressor wheel. The compressor wheel draws in fresh air which is supplied to the engine cylinders in a compressed form.

The primary variable vane turbocharger allows the optimum inlet geometry (inlet area and flow angle) to be used over a wide range of engine operating conditions. This allows a rapid speed of response and higher boost pressures at low engine speeds. The variable vane angle determines both the inlet area as well as the flow angle, as controlled by the ECM (engine control module). The variable vanes allow efficient use of the exhaust gas energy which in turn improves turbocharger and engine efficiency.



A	Low engine speed
B	Intermediate engine speed
C	High engine speed
1	ECM
2	Electronic rotary actuator
3	Turbine housing
4	Variable vanes
5	Compressor wheel

The variable vanes in the primary turbocharger are controlled by the ECM. The ECM controls a rotary electronic actuator attached to the primary turbocharger which is used to adjust the pitch angle of the vanes by rotating the turbine housing. The electronic rotary actuator also provides the ECM with a feedback signal to determine the pitch angle of the vanes.

The variable vanes in the primary turbocharger improve the exhaust gas power transfer to the turbine wheel which in turn drives the compressor

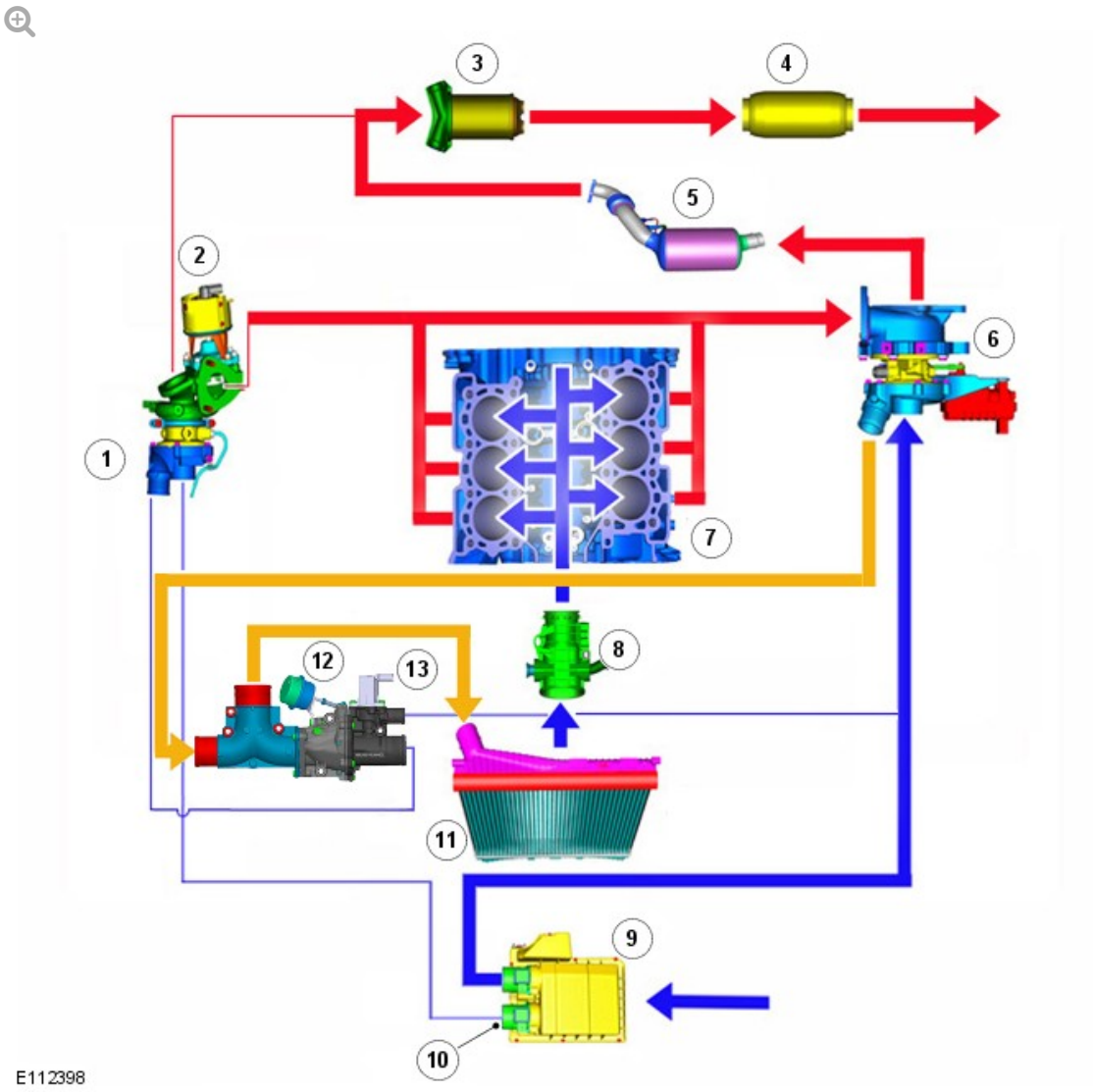
wheel. At low engine speeds this greatly assists the increase in turbocharger boost pressure.

As engine speed, and therefore the exhaust gas velocity, increases, the vanes are opened. The amount of opening is determined by the ECM to ensure that the power transfer from the turbine wheel to the compressor wheel is within the turbocharger speed and boost pressure requirements.

At high engine speed and exhaust gas flow, the ECM increases the vane opening to avoid overspeed of the turbines and provide a smooth high speed operation. At this point the dual mode boosting system comes into affect by utilizing the secondary (fixed vane) turbocharger.

The dual mode boosting system comprises two turbochargers and software within the ECM. The two turbochargers can operate in two modes; mono turbocharger operation or bi-turbocharger operation.

Mono Turbocharger Operation



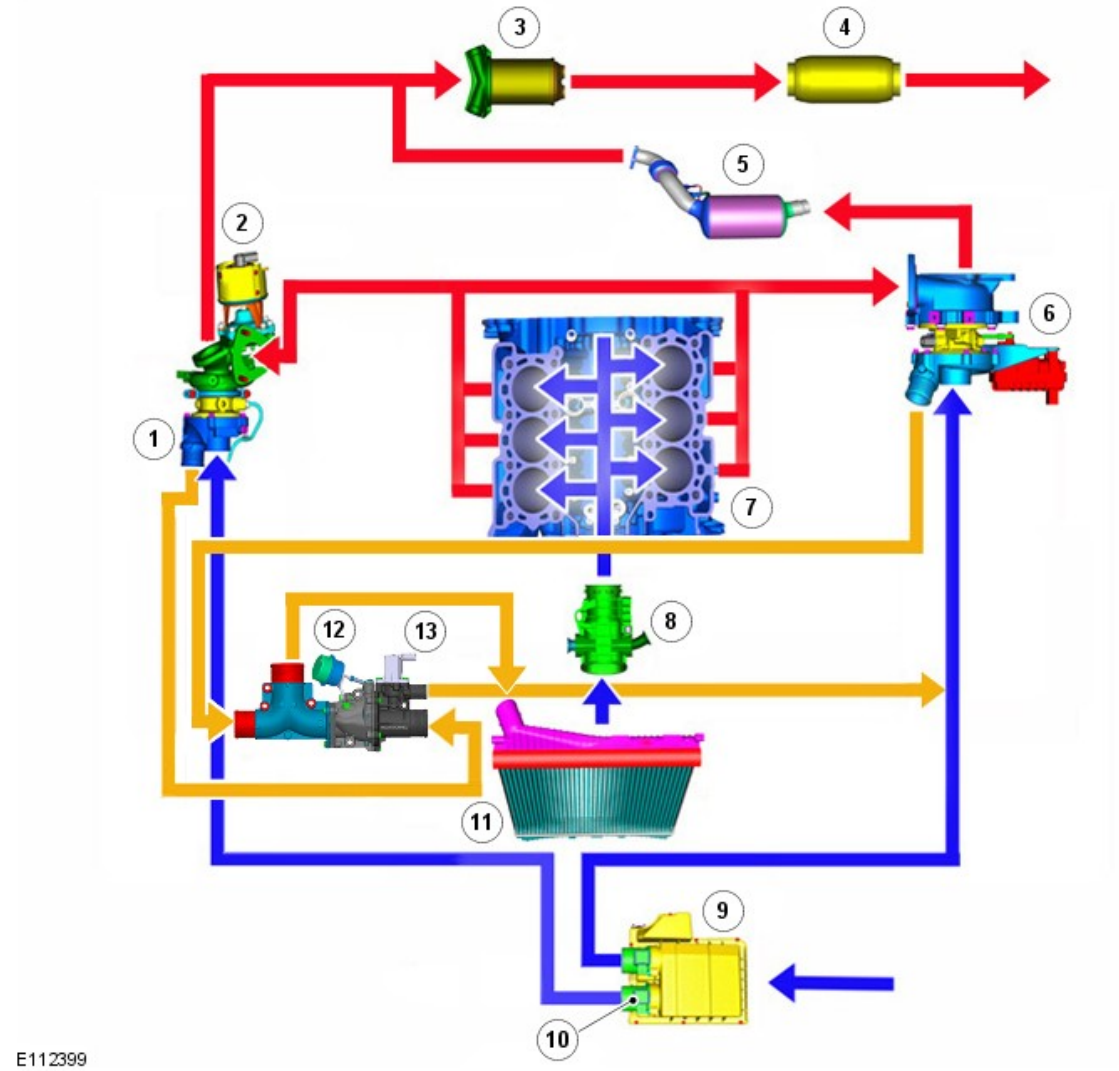
1	Fixed vane turbine
2	Turbine shut-off valve
3	Diesel Particulate Filter (DPF)
4	Flexible center resonators
5	Catalytic Converter
6	Variable vane turbocharger
7	Engine
8	Throttle
9	Air filter
10	MAF (mass air flow) meter

11	Charge air cooler
12	Compressor shut-off valve
13	Recirculation valve

Fresh air is drawn through the air filter and the MAF meter to the primary turbocharger compressor. The compressed air is then passed through the charge air cooler and into the engine.

The turbine shut-off valve on the secondary turbocharger is closed and therefore exhaust gasses are unable to operate the secondary turbocharger turbine. In this condition all turbocharging boost pressure is produced by the primary turbocharger.

Bi-Turbocharger Switching Operation

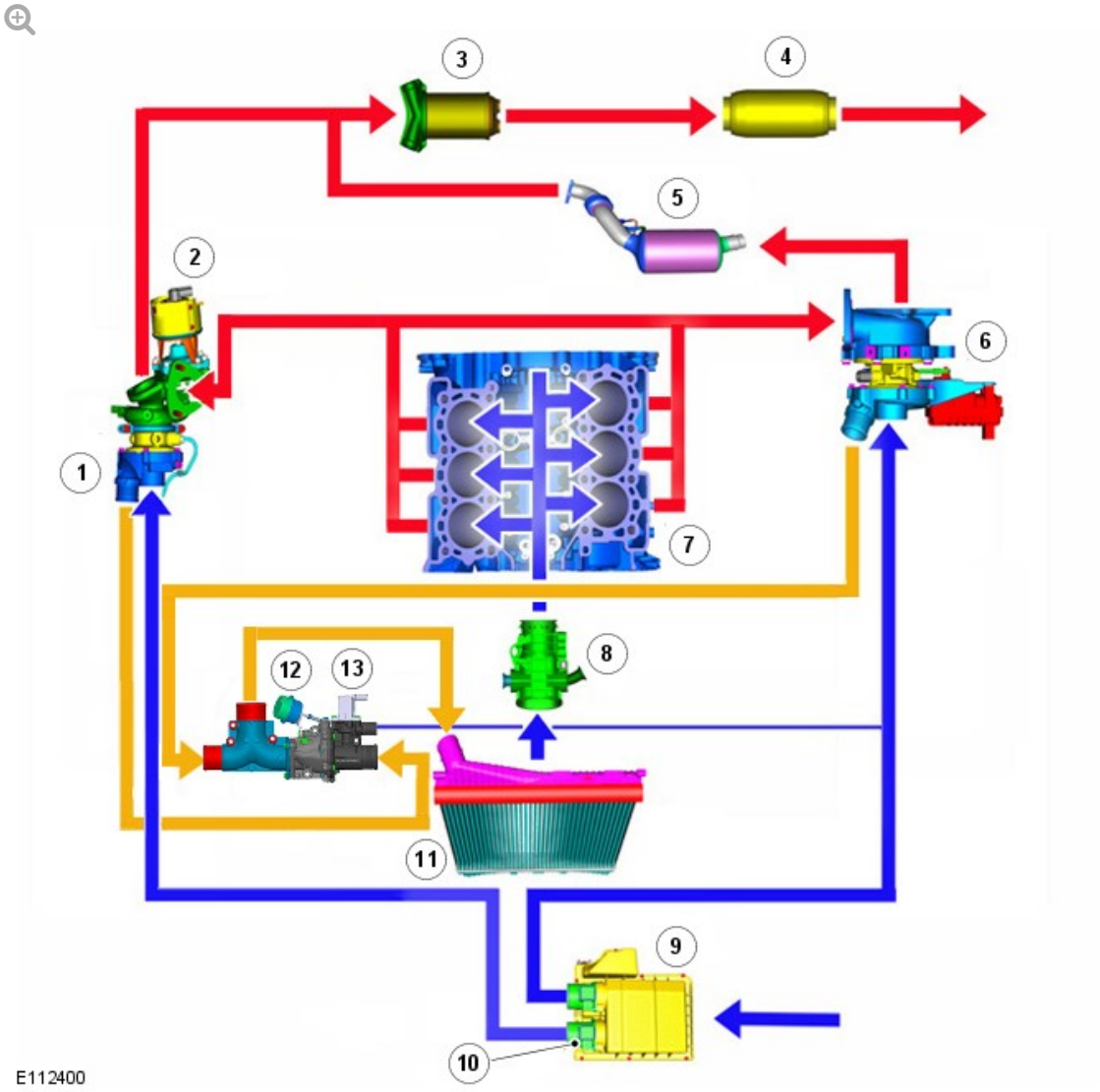


1	Fixed vane turbine
2	Turbine shut-off valve
3	Diesel Particulate Filter (DPF)
4	Flexible center resonators
5	Catalytic Converter
6	Variable vane turbocharger
7	Engine
8	Throttle
9	Air filter
10	MAF meter

11	Charge air cooler
12	Compressor shut-off valve
13	Recirculation valve

When the engine operating parameters approach the limits (approximately 2800 rpm under load) of the primary turbocharger, dual mode boosting control software within the ECM begins the switch to parallel bi-turbocharger operation. The secondary turbocharger is brought into operation by the opening of the turbine shut-off valve which allows exhaust gasses to flow through the turbine.

Initially, the secondary turbocharger does not produce a boost pressure to equal that of the primary turbocharger. Therefore, the initial boost pressure from the secondary turbocharger is fed via the recirculation valve into the clean air inlet for the primary turbocharger. As the secondary turbocharger boost pressure output increases, the recirculation valve is then closed and the compressor shut-off valve opened to increase the boost pressure from the secondary turbocharger which is directed into the charge air cooler.



1	Fixed vane turbine
2	Turbine shut-off valve
3	Diesel Particulate Filter (DPF)
4	Flexible center resonators
5	Catalytic Converter
6	Variable vane turbocharger
7	Engine
8	Throttle
9	Air filter
10	MAF meter

11	Charge air cooler
12	Compressor shut-off valve
13	Recirculation valve

When the secondary turbocharger has reached the required operating parameters, the recirculation valve is closed and the compressor shut-off valve is opened. The ECM will maintain the engine operating in bi-turbocharger operation with both primary and secondary turbochargers contributing to the air charge induction. When the dual mode boosting software determines that the engine operating parameters no longer require the use of dual mode boosting, the system switches back to mono turbocharger operation.

If the engine idles for more than 3 minutes, the secondary turbocharger is actuated to ensure correct lubrication. This is achieved by pressurizing the turbine shaft bearing cavities through a pipe, which is connected to the air intake system and periodically opening the turbine shut-off valve to operate the turbocharger.

> Ensure both ends of the pipe are securely connected to the secondary turbo and the air intake system to prevent damage to the turbo components.

COMPONENT DESCRIPTION

Each turbocharger consists of two turbo elements, a turbine wheel and compressor wheel, enclosed separately in cast housings and mounted on a common shaft, which rotates in two semi-floating bearings.

VARIABLE VANE TURBOCHARGER [PRIMARY]

The variable vane turbocharger is attached to the LH (left-hand) exhaust manifold and secured to 3 studs on a flange on the manifold with nuts. On production, no gasket is used to seal the joint between turbocharger and the manifold. In-service vehicles will require a service gasket to be fitted if the joint between the turbocharger and the manifold is disturbed.

A second flange on the turbocharger has 3 integral studs and provides for the attachment of the LH catalytic converter inlet pipe. Three nuts secure the inlet pipe to the flange studs and a gasket seals the joint between the components.

The compressor end of the turbocharger has two hose connections. The central connection provides a clean air supply from the air filter to the compressor. The second connection on the outside of the housing provides for a pipe connection from the turbocharger to the charge air cooler

The turbocharger is a conventional design with both the turbine wheel and the compressor wheel sharing a common shaft which is supported on bearings. The turbocharger receives an engine oil feed via a pipe from the cylinder block. The pipe supplies both turbochargers with an oil supply for lubrication purposes. An oil drain pipe from the turbocharger allows oil to drain from the turbocharger into the cylinder block.

An integral bracket houses the variable vane electronic rotary actuator. The rotary actuator is connected to an eccentric lever which moves the turbine housing to adjust the position of the vanes. When the rotary actuator operates a boss is rotated, which in turn moves the lever and changes rotary motion into linear motion. The lever is connected to the outside of the turbine housing and the linear motion is converted back to rotary motion of the housing. Operation of the electronic rotary actuator is controlled by the ECM.

FIXED VANE TURBOCHARGER [SECONDARY]

The fixed vane turbocharger is attached to the RH (right-hand) exhaust

manifold and is secured to 3 studs on a flange on the manifold with nuts. On production, no gasket is used to seal the joint between turbocharger and the manifold. In-service vehicles will require a service gasket to be fitted if the joint between the turbocharger and the manifold is disturbed.

A second flange on the turbocharger has 2 integral studs and provides for the attachment of the RH exhaust system downpipe. Two nuts secure the downpipe to the flange studs and a gasket seals the joint between the downpipe and the turbocharger.

The compressor end of the turbocharger has two hose connections; the central connection provides the clean air supply from the air filter. The second connection on the outside of the turbocharger housing allows the connection from the turbocharger to the charge air cooler

Attached to the rear of the turbocharger is a turbine shut-off valve. The valve is vacuum operated and electronically controlled by the ECM. The valve is closed when the system is operating in mono-turbocharger mode, diverting exhaust gasses from the RH exhaust manifold, via the exhaust cross-over duct to the LH exhaust manifold. When bi-turbocharger operation is required, the ECM electronically operates the valve allow vacuum to open the shut-off valve allowing exhaust gasses from the RH exhaust manifold to drive the turbine of the fixed vane turbocharger.

FUEL CHARGING AND CONTROLS - TURBOCHARGER - TDV6 3.0L DIESEL

TURBOCHARGER BYPASS VALVE [G1271877]

REMOVAL

- Some variation in the illustrations may occur, but the essential information is always correct.
- Removal steps in this procedure may contain installation details.

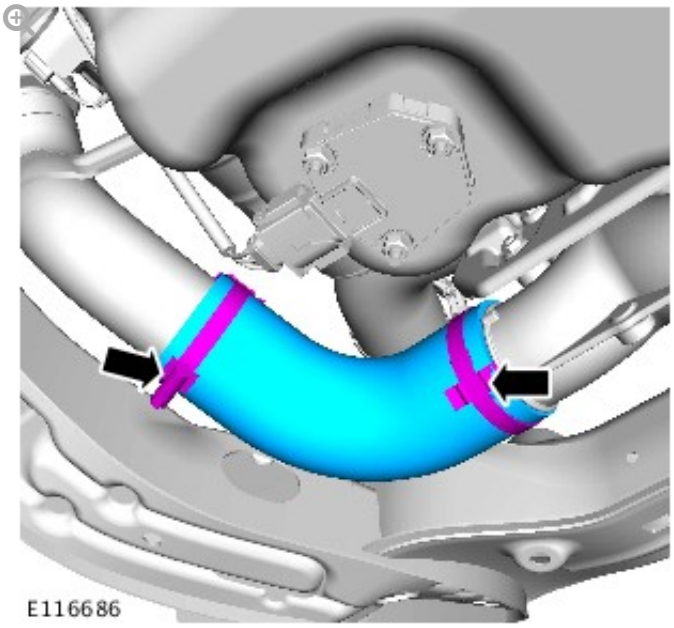
1.

Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

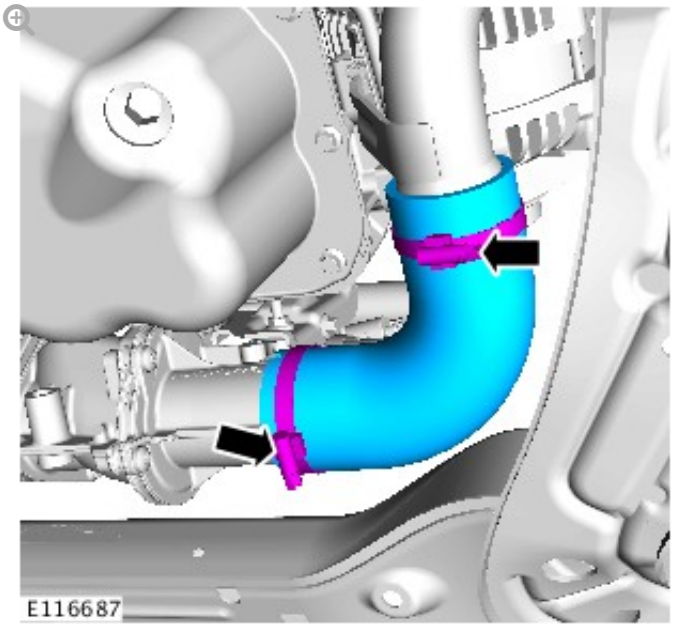
2. Refer to: Air Deflector (501-02 Front End Body Panels, Removal and Installation).

3.



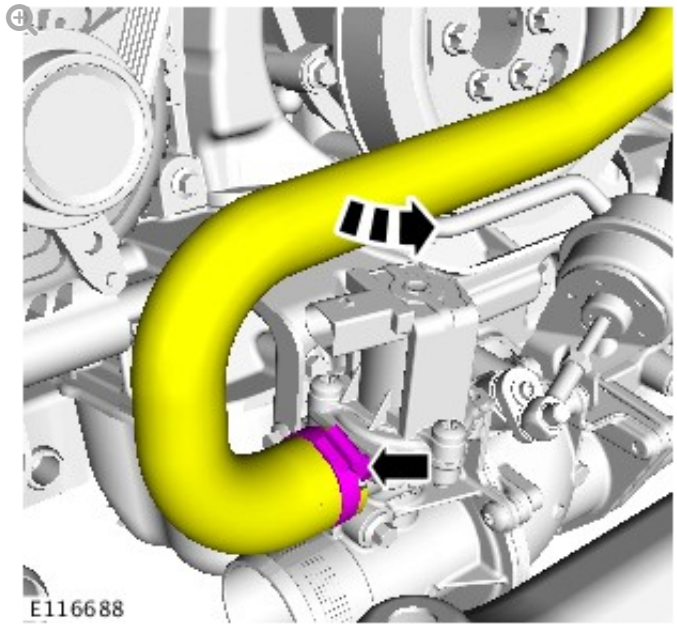
Torque: **7 Nm**

4.



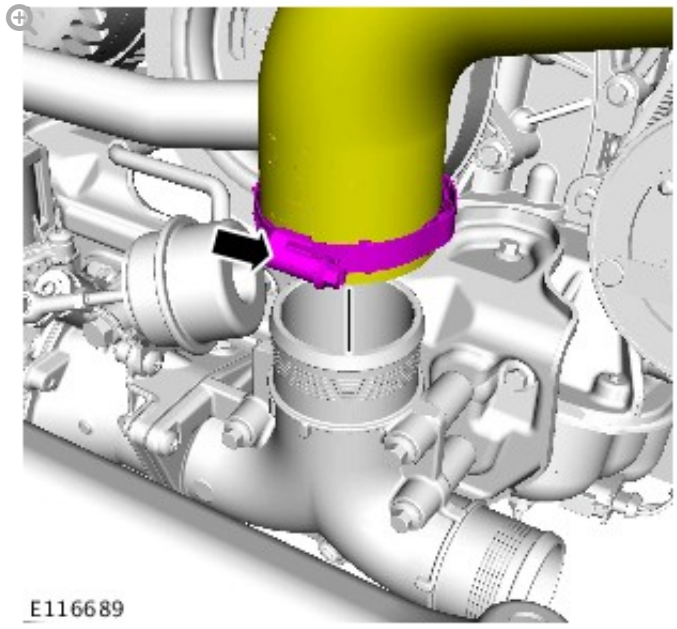
Torque: **7 Nm**

5.



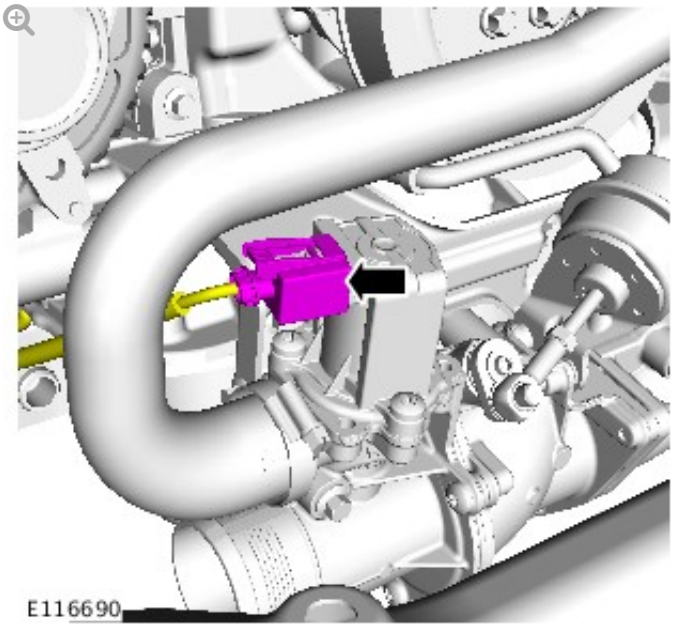
Torque: **7 Nm**

6.



Torque: **7 Nm**

7.



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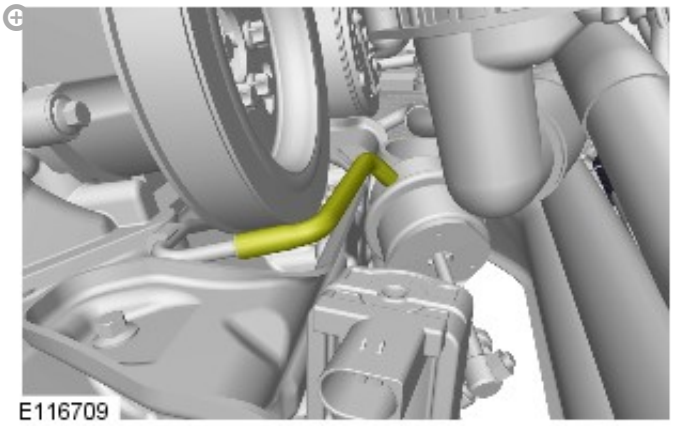
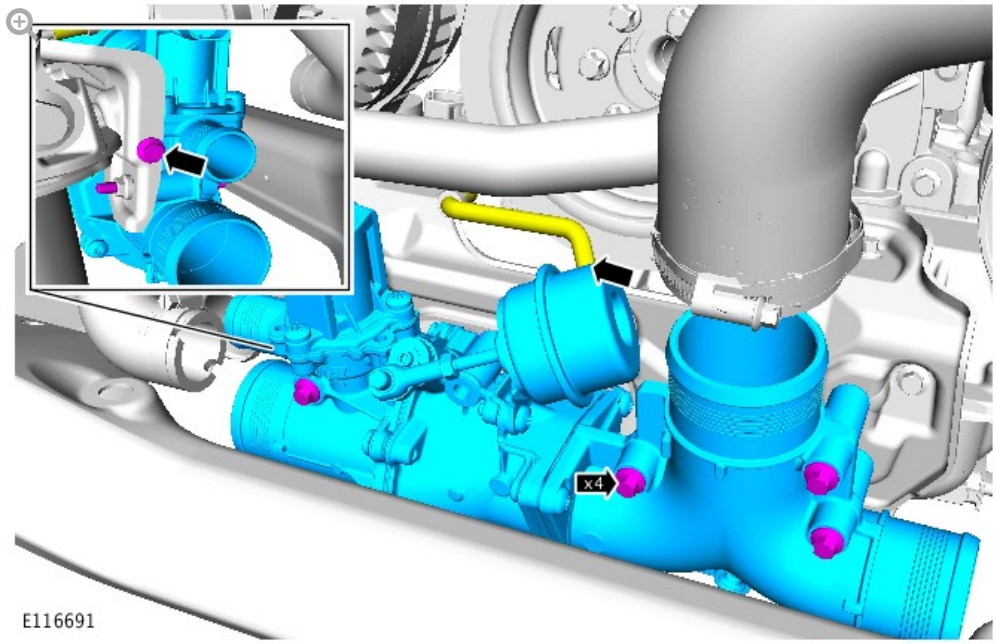


9.



Torque: **10 Nm**

INSTALLATION

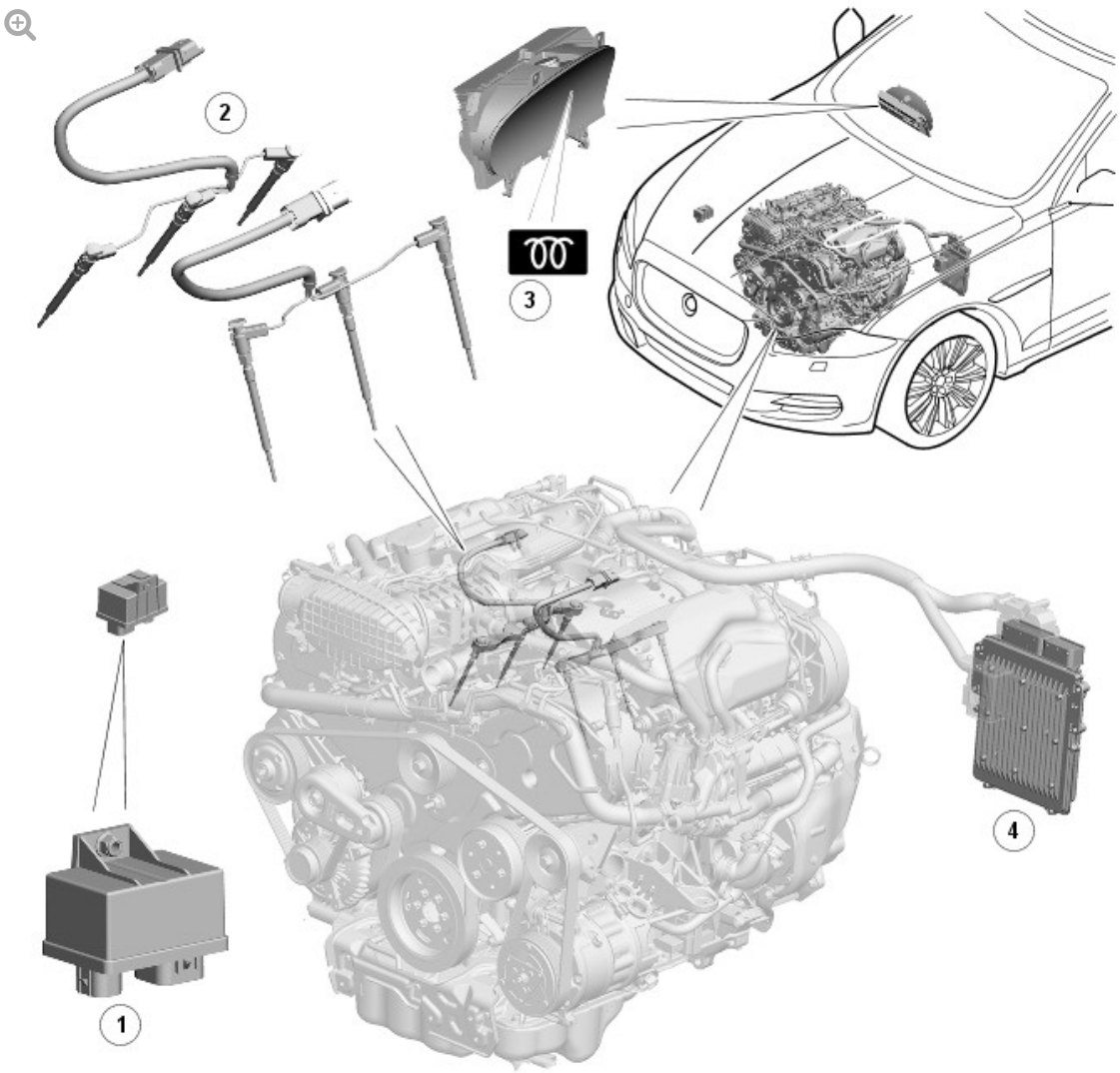
1. To install, reverse the removal procedure.

FUEL CHARGING AND CONTROLS - TURBOCHARGER - TDV6 3.0L DIESEL

Exhaust manifold threaded stud	13	10	-
Exhaust manifold retaining nuts	24	18	-
Turbocharger oil return tube to turbocharger retaining bolt	9	-	80
Turbocharger oil return tube to engine retaining bolt	9	-	80
Turbocharger bracket retaining bolts	23	17	-
Turbocharger to exhaust manifold retaining nuts	24	18	-
Turbocharger bypass valve retaining bolt	10	7	88
Exhaust manifold heatshield retaining bolt	11	8	-
Exhaust heatshield retaining bolt	9	-	80
Exhaust heatshield retaining nut	10	7	88
Turbocharger oil supply tube retaining bolt	9	-	80
Turbocharger oil supply tube union bolt	30	22	-
Exhaust gas recirculation (EGR) valve retaining bolts	9	-	80
EGR valve tube to exhaust manifold retaining bolts	9	-	80

GLOW PLUG SYSTEM - TDV6 3.0L DIESEL

GLOW PLUG SYSTEM - COMPONENT LOCATION [G962934]



1	Glow plug module
2	Glow plugs
3	Glow plug warning lamp
4	ECM (engine control module)

GLOW PLUG SYSTEM - TDV6 3.0L DIESEL

GLOW PLUG SYSTEM - OVERVIEW [G970189]

OVERVIEW

The glow plug system has a glow plug installed in the inlet side of each cylinder. The glow plugs heat the combustion chambers before and during cranking, to aid cold starting, and after the engine starts to reduce emissions and engine noise when idling with a cold engine.

The glow plugs are connected for each bank by a common harness which is connected into the main engine harness. The harness for each bank connects into a connector block which attaches to each of the glow plugs for that bank. The glow plugs are connected directly to the glow plug module which is controlled by glow plug software contained within the ECM (engine control module).

Each glow plug is a tubular heating element which contains a spiral filament encased in magnesium oxide powder. At the tip of the tubular heating element is the heater coil. Behind the heater coil, and connected in series, is a control coil. The control coil regulates the current to the heater coil to safeguard against overheating.

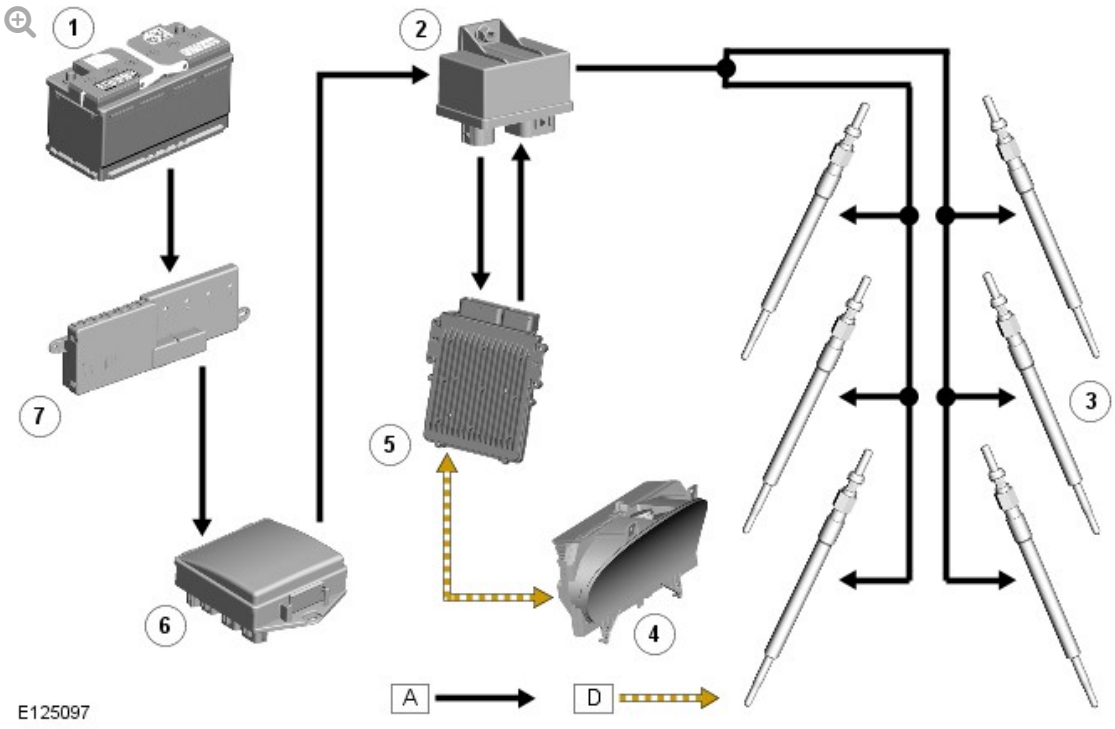
GLOW PLUG SYSTEM - TDV6 3.0L DIESEL

GLOW PLUG SYSTEM - SYSTEM OPERATION AND COMPONENT DESCRIPTION

[G970190]

CONTROL DIAGRAM

A = Hardwired; **D** = HS CAN (controller area network)



1	Battery
2	Glow plug module
3	Glow plug (6 off)
4	Instrument cluster
5	Engine Control Module (ECM)
6	Engine Junction Box (EJB) - (100A Midi-Fuse)
7	Battery Junction Box (BJB) - (250A Megafuse)

SYSTEM OPERATION

SYSTEM OPERATION

There are three phases of glow plug heating:

- Pre heating

- Crank heating
- Post heating

The ECM (engine control module) determines the heating times from the ECT (engine coolant temperature). The lower the ECT, the longer the heating times.

When the ignition is switched to power mode 9 (engine crank), the ECM calculates any required heating times and, if heating is required, energizes the glow plug relay in the BJB (battery junction box). The glow plug relay supplies an ignition power supply to the glow plug module. The glow plug module is controlled by the ECM which determines the pre-heat time required. The module then supplies power to each of the glow plugs for the required time.

When pre-heating is required, the ECM also sends a message to the instrument cluster, on the high speed CAN, to request illumination of the glow plug indicator. The glow plug indicator remains illuminated for the duration of the pre heating phase, or until the ignition is switched to crank, whichever occurs first. If required, the ECM keeps the glow plug module energized during cranking and for the duration of any post heating phase.

The ECM monitors the drive circuit of the glow plug module, via a direct diagnostic connection with the module, for plausibility of operation, continuity, and short and open circuits. If a fault is detected, the glow plug module passes the fault information to the ECM, which stores a related fault code and permanently illuminates the glow plug indicator while the ignition is in power mode 9.

PRE HEATING

Pre-heat is the length of time the glow plugs operate prior to engine cranking. The ECM controls the pre-heat time based on ECT sensor output and battery voltage. If the ECT sensor fails, the ECM will use the IAT (intake air temperature) sensor value as a default value. The pre-heat duration is extended if the coolant temperature is low and the battery is not fully charged.