

Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel -

Torque Specifications

Description	Nm	lb-ft
Oil supply tube union to turbocharger retaining bolt	30	22
Oil supply tube to cylinder block retaining bolt	10	7
Oil return tube to turbocharger retaining bolts	10	7
Oil return tube to cylinder block retaining bolt	10	7
Exhaust gas recirculation (EGR) valve to cylinder head retaining bolts	10	7
EGR cooler mount bracket retaining bolt	10	7
EGR valve tube to exhaust manifold retaining bolts	10	7
* Turbocharger to exhaust manifold retaining nuts	24	18
Turbocharger heatshield retaining bolts	10	7
* Exhaust manifold retaining studs	13	10
*+ Exhaust manifold retaining nuts	24	18
Differential mounting bracket heat shield bolts	10	7
Exhaust heat shield bolts	10	7
Exhaust heat shield nut	10	7
Oil level indicator tube retaining bolt	10	7
Turbocharger securing bracket stud	13	10
Turbocharger securing bracket bolts	32	24
Turbocharger to transmission support bracket nut	25	18
Turbocharger to transmission support bracket bolts	48	35

+ Nuts must be tightened in sequence

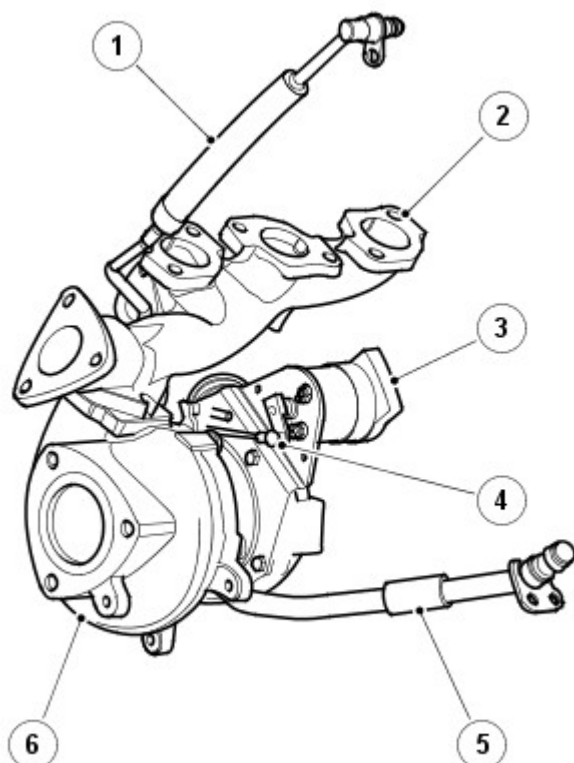
*** New nuts/studs must be installed**

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Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel -

Turbocharger

Description and Operation



E50590

Item	Part Number	Description
1	-	Oil feed pipe
2	-	LH exhaust manifold
3	-	Actuator motor
4	-	Actuator lever
5	-	Oil return pipe
6	-	Turbocharger

The variable vane turbocharger, fitted to the LH exhaust manifold of the TdV6 engine, makes it possible to vary the exhaust gas flow of the turbine, dependent on engine operation. This improves the power transfer to the turbine wheel and compressor, particularly at low engine speeds, thus increasing the boost pressure. The guide vanes are opened progressively as the engine speed increases so that the power transfer always remains in balance with the required charger speed and the required boost pressure level. Variable vanes facilitate better use of the exhaust gas energy so as to further improve the efficiency of the turbocharger and thus of the engine, compared to the more conventional 'wastegate control'.

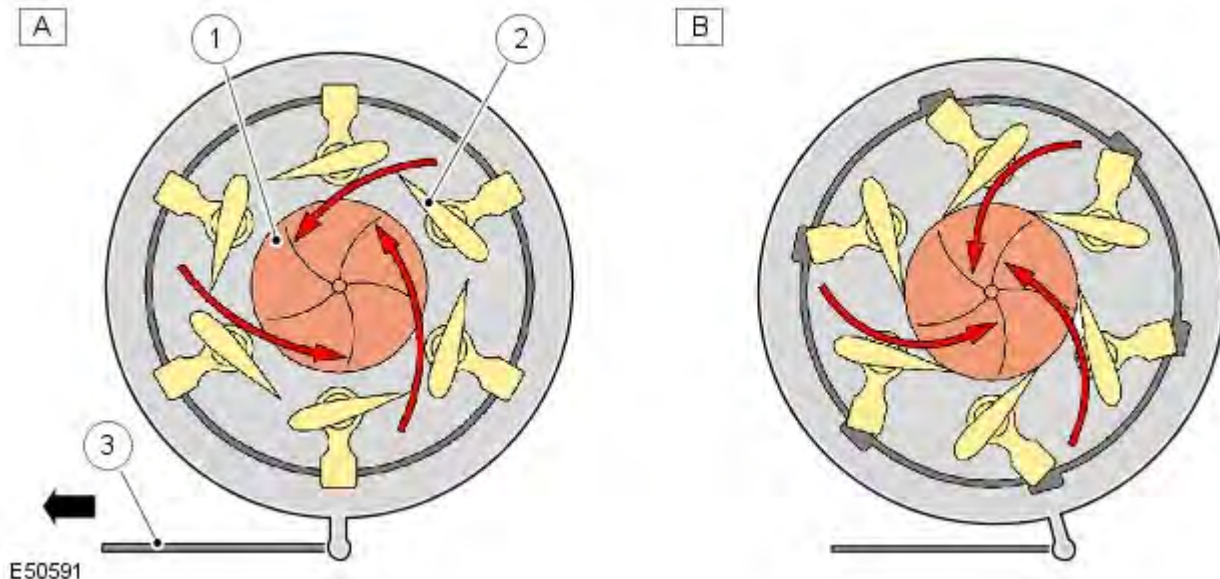
Advantages:

- High torque at both high and low engine speeds
- Continuous and optimum adjustment for all engine speeds
- No wastegate valve required, exhaust energy is better utilised, less back-pressure in conjunction with same compressor work
- Low thermal and mechanical load improves engine power output
- Low emissions
- Optimised fuel consumption over the entire engine speed range

The turbochargers construction is similar to the unit fitted to the Freelander Td4 engine. However, a stepper motor instead of a vacuum diaphragm electronically controls the variable vanes.

The DC rotary actuator motor operates a drive shaft. The drive shaft is connected to the vanes by an actuating lever. Adjustment of the vanes is achieved by moving the actuating lever. When the drive shaft is turned, a signal is created at the end of the drive shaft; this feedback signal is used to determine the angular position of the vanes. This information is transmitted to the Engine Control Module (ECM).

There is a temperature sensor in the control unit, which drives the stepper motor to a safe position (vanes fully opened) if the maximum temperature is exceeded. The ECM detects any malfunctions in the stepper motor and generates Diagnostic Trouble Codes (DTC).



Item	Part Number	Description
A	-	Closed (fast)
B	-	Open (slow), default position
1	-	Turbine
2	-	Vanes
3	-	Actuator lever

At low engine speeds, because of the flat setting of the vanes, the relatively low flow of exhaust gases are accelerated and routed in such a way that they meet the vanes of the turbine wheel at the outermost edge. Consequently, a high torque is produced at the turbine wheel, and a high turbine speed is therefore achieved.

At high engine speeds the vanes are progressively opened, so that a large flow of exhaust gas is delayed and is directed more and more towards the centre of the turbine wheel.

The torque at the turbine wheel is artificially lowered. In this way the turbine speed, and therefore the air quantity required by the engine, are matched to engine speed. Consequently, the boost pressure is approximately constant over the whole engine speed range.

The operating parameters are controlled electronically by the ECM using powertrain sensors and driver inputs. For additional information, refer to: [Electronic Engine Controls](#) (303-14A Electronic Engine Controls - TDV6 2.7L Diesel, Description and Operation).

The turbocharger is designed for fail safe operation. If a fault occurs regarding the control of the unit, the vanes default to the fully open position so as to produce minimum boost.

Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel -

Turbocharger

Diagnosis and Testing

Principles of Operation

For a detailed description of the fuel charging and controls system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



WARNING: The following tests may involve working in close proximity to hot components. Make sure adequate protection is used. Failure to follow this instruction may result in personal injury.



CAUTION: 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.

- **NOTE:** Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. Verify the customer concern.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
● Intake air system ● Hose(s)/hose connections ● General engine condition.	● Circuit(s) ● Engine control module (ECM) ● Electrical connections and harnesses

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. 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

Symptom	Possible Causes	Action
Poor performance	● Low/Contaminated fuel ● Restricted air intake system ● General engine condition ● Engine control module failure	Check the fuel level and condition. Check the air intake for restriction. Check the engine condition, compressions, etc. Refer to the relevant section of the workshop manual. Check for DTCs. Refer to the warranty policy and procedures manual if an engine control module is suspect.
No boost	● Electrical connections and harnesses ● Restricted air intake system ● Charge air cooler restricted/leaking ● Engine control module failure	Check the electrical connections and harnesses. Check the air intake for restriction/leakage (see visual inspection). Refer to the relevant section of the workshop manual. Refer to the warranty policy and procedures manual if an engine control module is suspect.

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 - TDV6 2.7L Diesel, DTC: Engine Control Module \(PCM\)](#) (100-00 General Information, Description and Operation).

Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel - Turbocharger

Removal and Installation

Removal

All vehicles

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

Raise and support the vehicle.

2. Open the hood.

Left-hand drive vehicles

3. **CAUTIONS:**



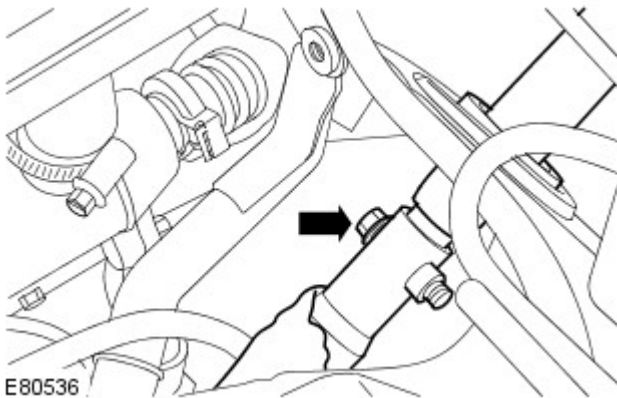
Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.



Make sure the steering is in the straight ahead position.

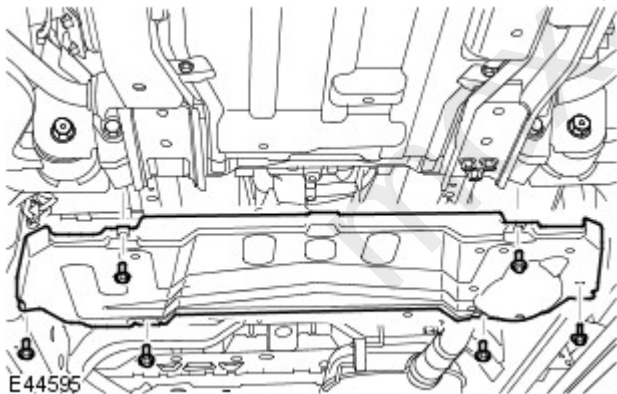
- **NOTE:** Note the fitted position.

Loosen the steering column lower shaft to steering column upper shaft bolt.



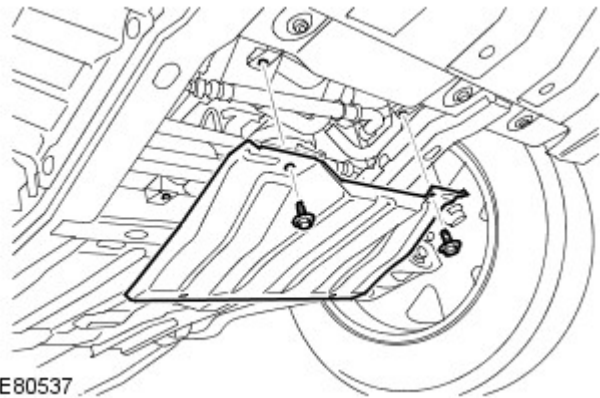
All vehicles

4. Remove the LH front wheel and tire.
5. Remove the transmission undershield.
 - Remove the 6 bolts.



6. Remove the engine undershield.
For additional information, refer to: [Engine Undershield](#) (501-02 Front End Body Panels, Removal and Installation).

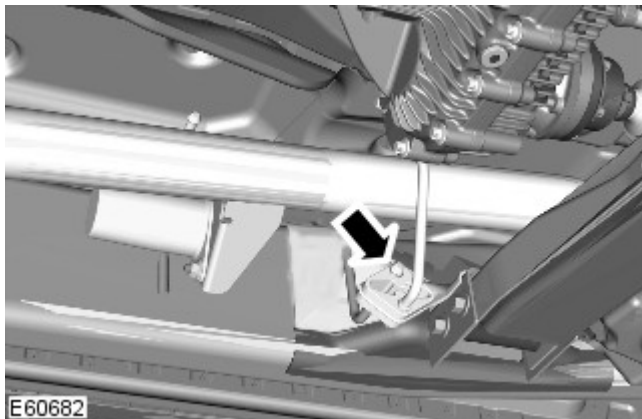
Left-hand drive vehicles



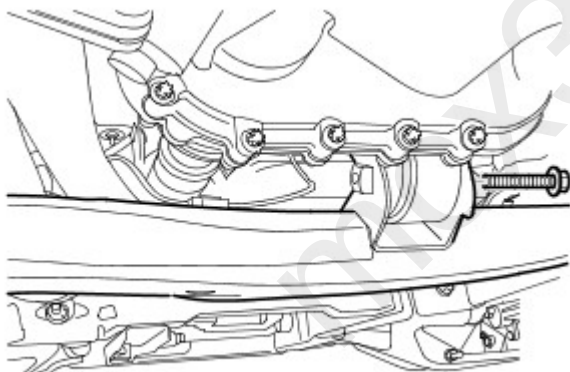
7. Remove the radiator access panel.

- Remove the 2 bolts.

All vehicles

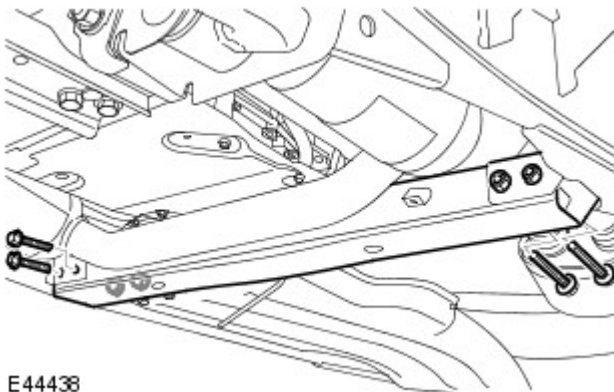


8. Release the downpipe catalytic converter support insulator.



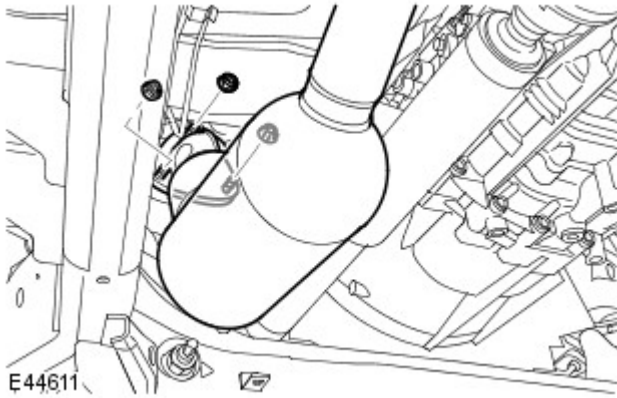
9. Remove the transmission support insulator through-bolt.

- Using a transmission jack, support the transmission.



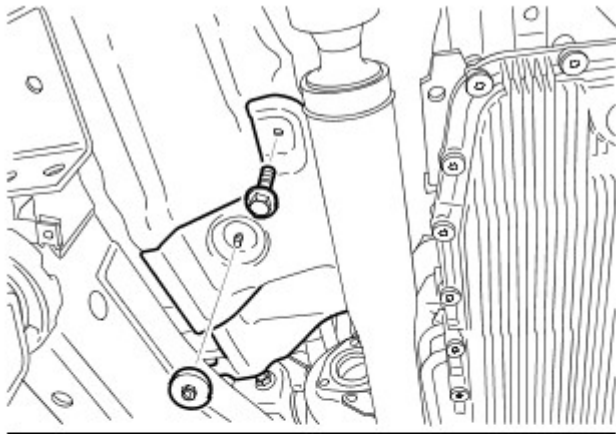
10. With assistance, remove the transmission support crossmember.

- Remove the 4 nuts and bolts.



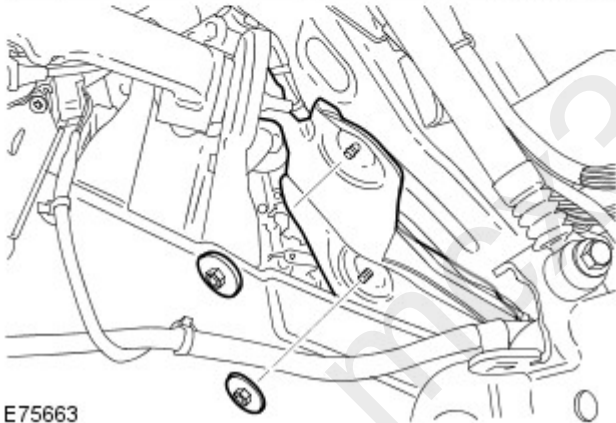
11. With assistance, remove the downpipe catalytic converter.

- Loosen the clamp.
- Remove and discard the 3 nuts.
- Remove and discard the gasket.



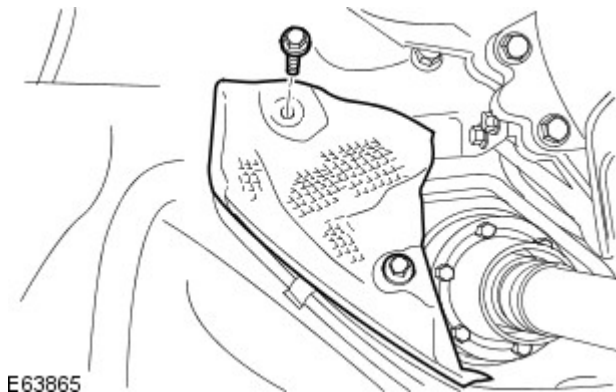
12. Remove the exhaust front heat shield.

- Remove the 3 nuts.
- Remove the bolt.



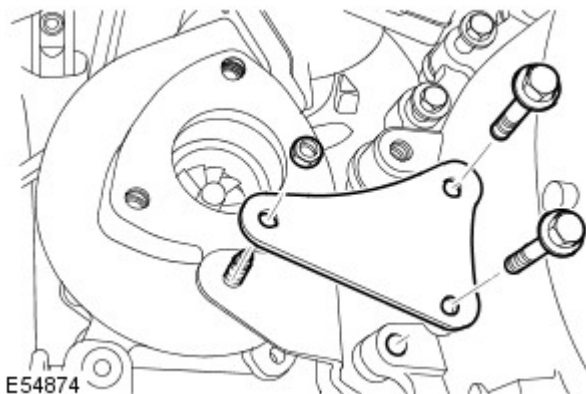
13. Install the transmission support crossmember.

- Install but do not fully tighten at this stage the 2 transmission support crossmember bolts.
- Install but do not fully tighten at this stage the transmission support insulator through-bolt.
- Remove the transmission jack.



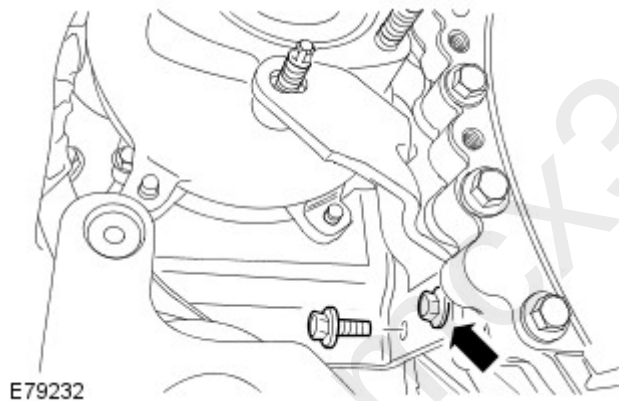
14. Remove the differential mounting bracket heat shield.

- Remove the 2 bolts.

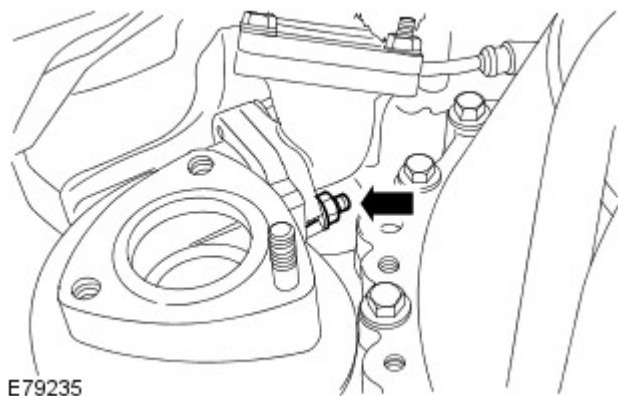


15. Remove the turbocharger support bracket.

- Remove the 2 bolts.
- Remove the nut.



16. Remove the 2 bolts from the turbocharger support bracket.



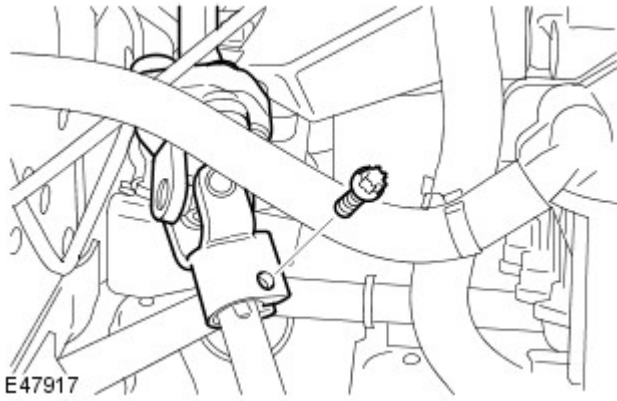
17. Loosen the turbocharger lower nut.

18. Remove the LH upper arm.
For additional information, refer to: [Upper Arm](#) (204-01 Front Suspension, Removal and Installation).

19. Turn the ignition key to position I.

- Turn the steering wheel until the head of the steering column lower shaft bolt can be seen through the LH wheel

arch.



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

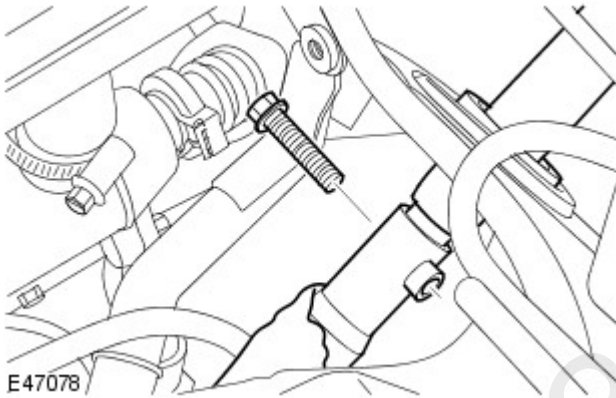
Remove and discard the steering column lower shaft bolt.

21. Turn the steering wheel to the straight ahead position.

- Remove the ignition key.

22. Remove the steering column lower shaft.

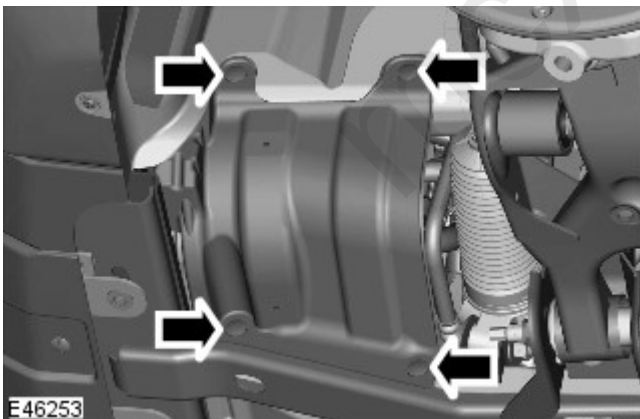
- Remove and discard the steering column lower shaft upper bolt.



All vehicles

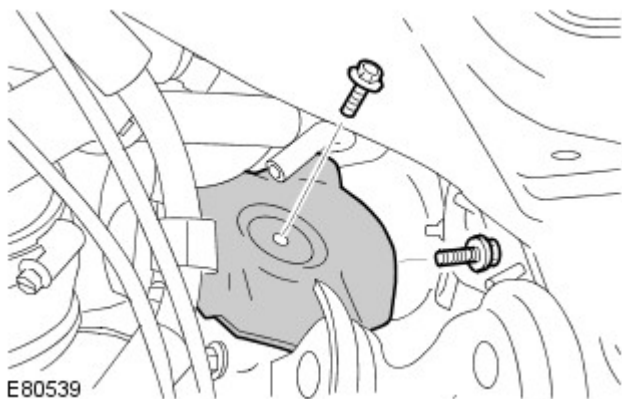
23. Remove the fender splash shield lower trim.

- Remove the 4 clips.



24. Remove the turbocharger heat shield.

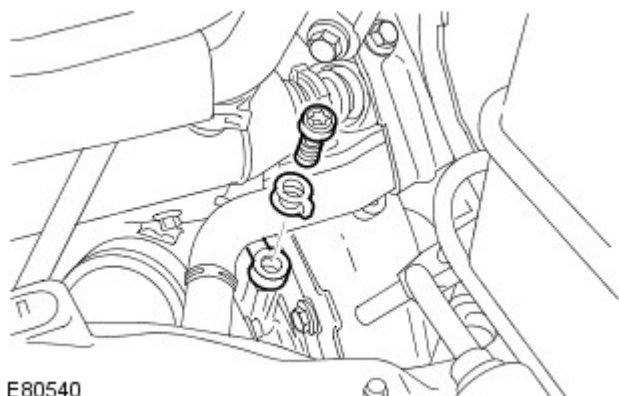
- Remove the 2 bolts.



25.  **CAUTION:** Always plug any open connections to prevent contamination.

Disconnect the turbocharger oil supply tube.

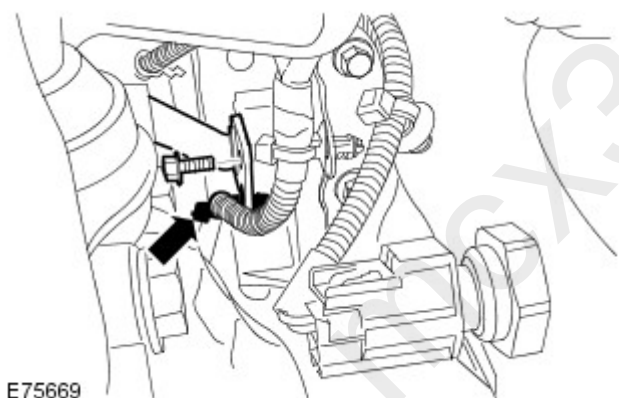
- Remove the turbocharger banjo bolt.
- Remove and discard the sealing washers.



26.  **CAUTION:** Always plug any open connections to prevent contamination.

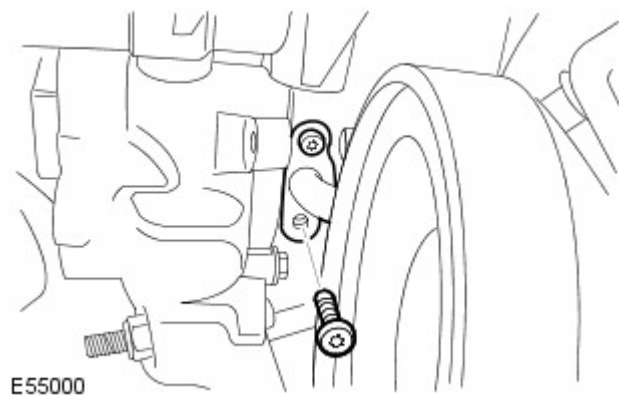
Remove the turbocharger oil return tube bolt.

- Release the wiring harness clip.



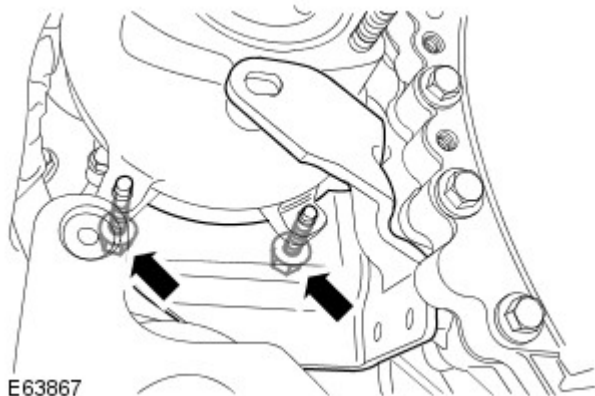
27. Remove the turbocharger oil return tube.

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

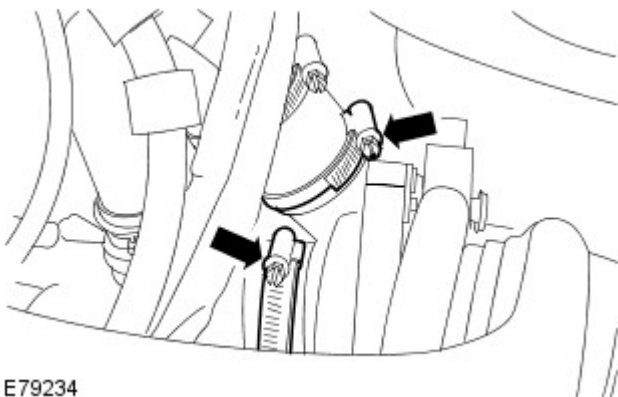


28. Remove the turbocharger support bracket.

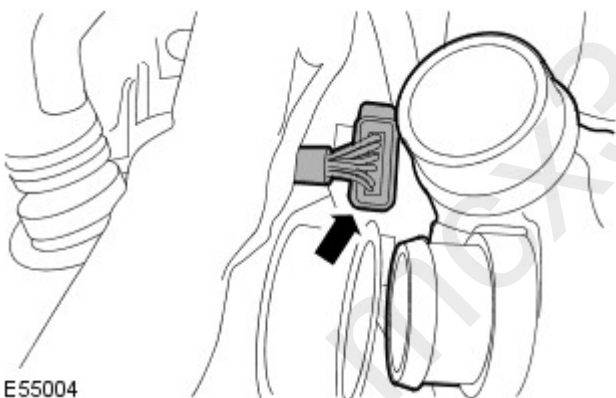
- Remove the 2 bolts.



29. Loosen the turbocharger intake and outlet pipe clips.



30. Disconnect the turbocharger electrical connector.



31.  **WARNING:** Eye protection must be worn.

• **CAUTIONS:**

 Make sure that only the turbocharger studs are drilled.

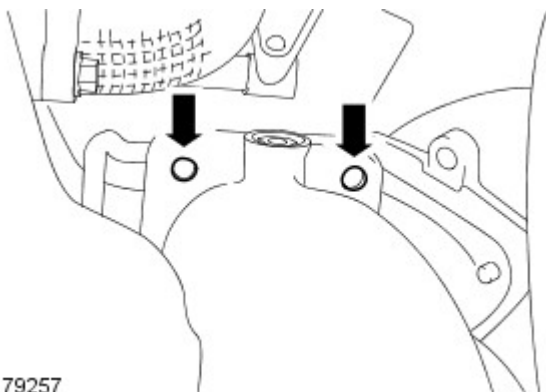
 Make sure that the depth of the drill does not exceed 14 mm (0.6 inch).

Carefully drill the turbocharger 2 upper studs.

- Center punch the turbocharger 2 upper studs.
- Drill a pilot hole in the center of the turbocharger studs progressively drill out the studs until a 8 mm (0.3 inch) hole is achieved.

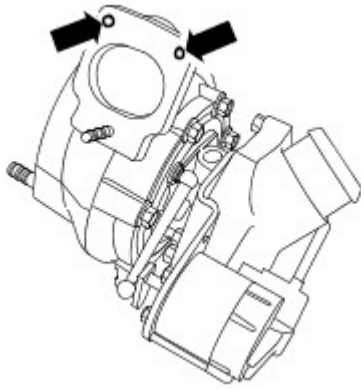
32. With assistance, remove the turbocharger.

- Loosen the turbocharger lower nut.



Installation

All vehicles



E55006

1. WARNINGS:



Eye protection must be worn.



Never direct a high-pressure nozzle at the skin as the high-pressure air may penetrate to the underlying tissue, and cause serious injury.



CAUTION: Always keep high-pressure equipment in good condition, and regularly maintained, particularly at joints and unions.

Drill two 8 mm (0.3 inches) holes in the turbocharger as shown.

- Clean the turbocharger and blow out with an air line.
2. Install a new stud to turbocharger lower hole.
 3. With assistance, install the turbocharger.
 - Clean the turbocharger mating faces.
 - Align the turbocharger intake and outlet pipes.
 4. With assistance, tighten the turbocharger upper nuts and bolts to 24 Nm (18 lb.ft).
 5. Tighten the turbocharger lower nut to 24 Nm (18 lb.ft).
 6. Connect the turbocharger electrical connector.
 7. Tighten the turbocharger intake and outlet pipe clips.
 8. Install the turbocharger support bracket.
 - Tighten the bolts to 23 Nm (17 lb.ft).
 9. Connect the turbocharger oil supply tube.
 - Install new sealing washers.
 - Tighten the turbocharger oil supply tube bolt to 30 Nm (22 lb.ft).
 10. Install the turbocharger heat shield.
 - Install the 2 bolts.
 11. Install the 2 turbocharger oil return tube bolts.
 - Install a new gasket.
 - Install a new O-ring seal.
 - Tighten the 2 bolts to 10 Nm (7 lb.ft).
 12. Install the turbocharger oil return tube bolt.
 - Attach the wiring harness clip.
 13. Install the fender splash shield lower trim.
 - Install the 4 clips.

Left-hand drive vehicles

14. Install the steering column lower shaft.
 - Connect the steering column lower shaft to the steering column upper shaft.
 - Connect the universal joint to the steering gear.
15. Install but do not fully tighten at this stage a new steering column lower shaft to steering column upper shaft bolt.

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

Turn the ignition key to position I.

- Turn the steering wheel until the steering column lower shaft bolt hole can be seen through the LH wheel arch.

17. Install the steering column lower shaft to steering gear bolt.

- Install a new bolt and tighten to 30 Nm (22 lb.ft).

18. Turn the steering wheel to the straight ahead position.

- Remove the ignition key.

19. Tighten the steering column lower shaft to steering column upper shaft bolt to 30 Nm (22 lb.ft).

All vehicles

20. Install the LH upper arm.

For additional information, refer to: [Upper Arm](#) (204-01 Front Suspension, Removal and Installation).

21. Install the 2 turbocharger support bracket bolts.

- Tighten the 2 bolts to 23 Nm (17 lb.ft).

22. Install the turbocharger support bracket.

- Install the turbocharger support bracket stud.
- Tighten the 2 bolts to 48 Nm (35 lb.ft).
- Tighten the nut to 25 Nm (18 lb.ft).

23. Install the differential mounting bracket heat shield.

- Install the 2 bolts and tighten to 10 Nm (7 lb.ft).

24. Remove the transmission support crossmember.

- Using a transmission jack, support the transmission.

25. Install the exhaust front heat shield.

- Install the 3 nuts.
- Install the bolt.

26. With assistance, install the downpipe catalytic converter.

- Install new studs and nuts.
- Install a new gasket.
- Tighten the downpipe catalytic converter nuts and clamp to 48 Nm (35 lb.ft).

27. Install the transmission support crossmember.

- Tighten the nuts and bolts to 90 Nm (66 lb.ft).
- Install the transmission support insulator through-bolt and tighten to 175 Nm (129 lb.ft).
- Remove the transmission jack.

28. Attach the downpipe catalytic converter hanger.

Left-hand drive vehicles

29. Install the radiator access panel.

- Tighten the 2 bolts to 10 Nm (7 lb.ft).

All vehicles

30. Install the engine undershield.

For additional information, refer to: [Engine Undershield](#)
(501-02 Front End Body Panels, Removal and Installation).

31. Install the transmission undershield.

- Tighten the bolts to 10 Nm (7 lb.ft).

32. Install the LH front wheel and tire.

- Tighten the wheel nuts to 140 Nm (103 lb.ft).

33. Check and top-up the engine oil.

34. Close the hood.

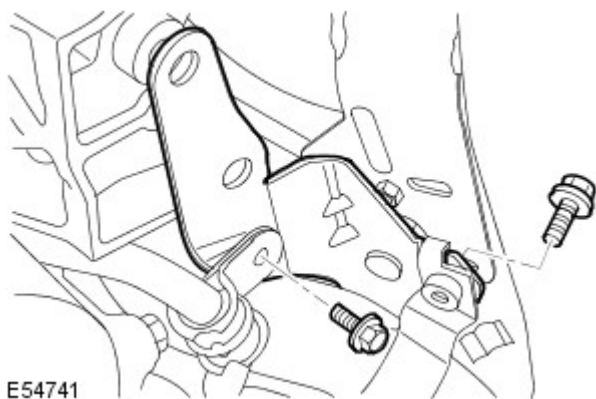
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Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel - Turbocharger Intake Tube

Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Remove the power steering pump.
For additional information, refer to: Power Steering Pump - 2.7L Diesel (211-02, Removal and Installation).
3. Remove the support bracket.
 - Remove the two retaining bolts.

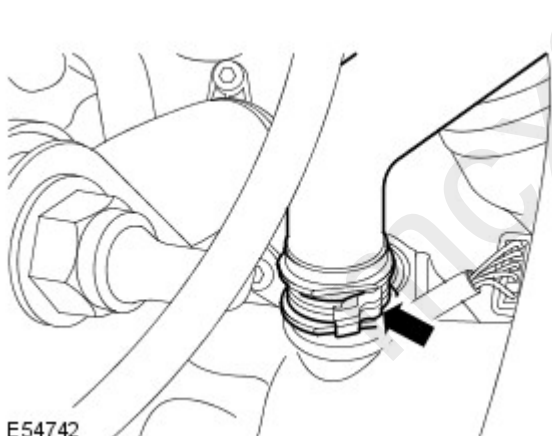


E54741

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

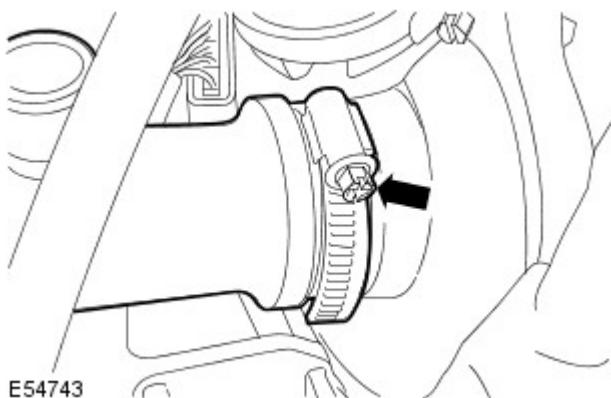
Raise the vehicle.

5. Disconnect the breather hose.
 - Release the clip.



E54742

6. Disconnect the turbocharger intake tube.
 - Loosen the clip.



E54743

7. Remove the charge air cooler intake pipe.

- With assistance, reposition the turbocharger intake tube.

8. With assistance, remove the turbocharger intake tube.

Installation

1. To install, reverse the removal procedure.

- Tighten the two retaining bolts to 10 Nm (7 lb.ft).

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Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel - Turbocharger Actuator Rod

Removal and Installation

Removal



CAUTION: Always plug any open connections to prevent contamination.

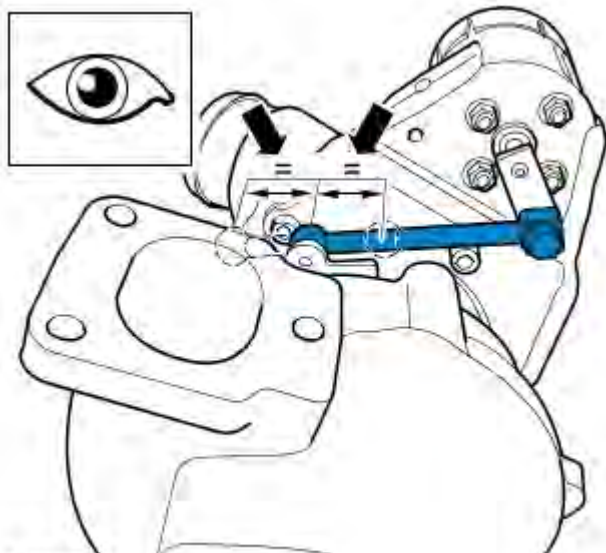
- **NOTE:** Some variation in the illustrations may occur, but the essential information is always correct.

1. Remove the turbocharger. For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel, Removal and Installation).



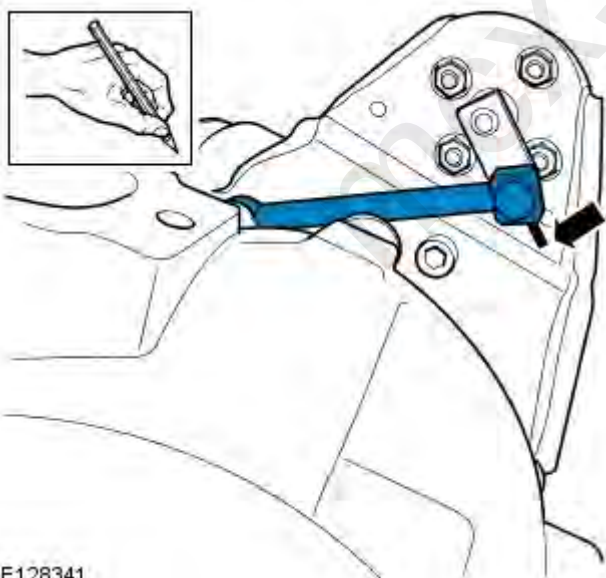
2. **CAUTION:** Make sure that no parts of the turbocharger actuator linkage are allowed to move beyond the normal operating limits. Failure to follow this instruction may result in damage to the vehicle.

Position the turbocharger actuator connecting rod to the mid point position.

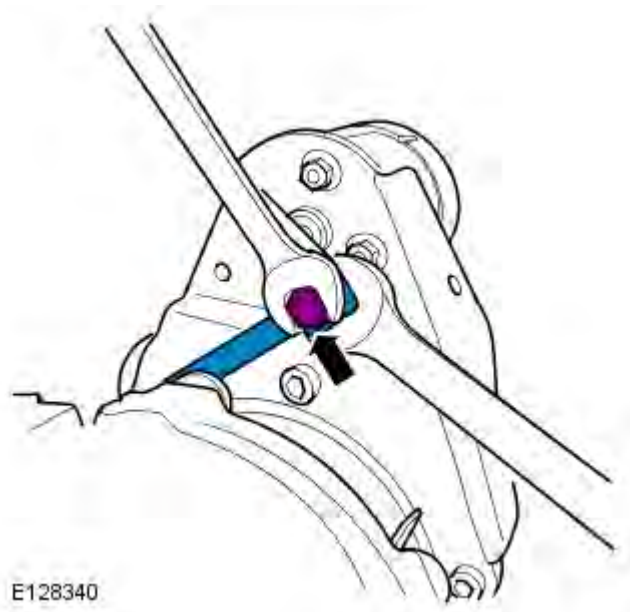


E128338

3. Using a suitable marker, mark the mid point position of the actuator arm.



E128341



4.  **CAUTION:** Make sure that two spanners are used to remove the bolt. Failure to follow this instruction may result in damage to the vehicle.

Remove the bolt.



5. Remove the turbocharger actuator connecting rod.

Installation

1. CAUTIONS:

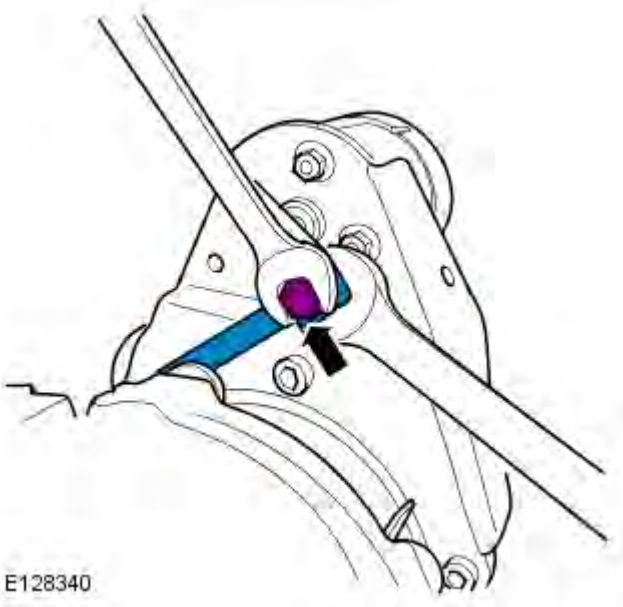
 Make sure that no parts of the turbocharger actuator linkage are allowed to move beyond the normal operating limits. Failure to follow this instruction may result in damage to the vehicle.

 Make sure that the marks are aligned. Failure to follow this instruction may result in damage to the vehicle.

 Make sure that two spanners are used to install the bolt. Failure to follow this instruction may result in damage to the vehicle.

To install, reverse the removal procedure.

2. Tighten the bolt to 5 Nm.



3. Install the turbocharger. For additional information, refer to: [Turbocharger](#) (303-04B Fuel Charging and Controls - Turbocharger - TDV6 2.7L Diesel, Removal and Installation).

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