

Engine Cooling - TDV6 2.7L Diesel -

Fluids and Capacities

Item	Specification
* Anti-freeze	Havoline Extended Life Coolant (XLC) or any ethylene glycol based anti-freeze containing no methanol with only Organic Acid Technology (OAT) corrosion inhibitors
Anti-freeze concentration - Will provide frost protection to -40°C (-40°F)	50%
Specific gravity of coolant at 20°C (68°F), to protect against frost down to -40°C (-40°F)	1.068
Amount of anti-freeze to use for 50 % concentration:	
Without rear passenger compartment heater or fuel burning heater	4.7 litres (8.25 pints) (4.9 US quarts)
With rear passenger compartment heater but without fuel burning heater	6.0 litres (10.6 pints) (6.4 US quarts)
Without rear passenger compartment heater but with fuel burning heater	5.1 litres (9.1 pints) (5.4 US quarts)
With rear passenger compartment heater and fuel burning heater	6.5 litres (11.5 pints) (6.9 US quarts)



CAUTION: * No other anti-freeze should be used with Havoline Extended Life Coolant.

Capacity

Item	Capacity
Without rear passenger compartment heater or fuel burning heater	9.4 litres (16.5 pints) (9.9 US quarts)
With rear passenger compartment heater but without fuel burning heater	12.15 litres (21.4 pints) (12.8 US quarts)
Without rear passenger compartment heater but with fuel burning heater	10.35 litres (18.2 pints) (10.9 US pints)
With rear passenger compartment heater and fuel burning heater	13.1 litres (23.0 pints) (13.8 US quarts)

General Specifications

Item	Specification
Cooling system type	Pressurised, thermostatically controlled with remote header tank
Radiator	Cross flow with integral transmission fluid and charge air coolers
Expansion tank	Remote - fitted with a bleed screw and low coolant level sensor
Pressure cap rating	110 kPa (1.1 bar) (16 lbf/in ²)
Thermostat:	
Starts to open	88° C (190° F)
Fully open	95° C (203° F)
Cooling fan	Engine driven, viscous coupled with electronic control
Cooling fan diameter	500 mm (19.6 in)
Direction of rotation	Clockwise when viewed from front of engine
Coolant pump	Centrifugal flow impellor, belt driven from crankshaft

Torque Specifications

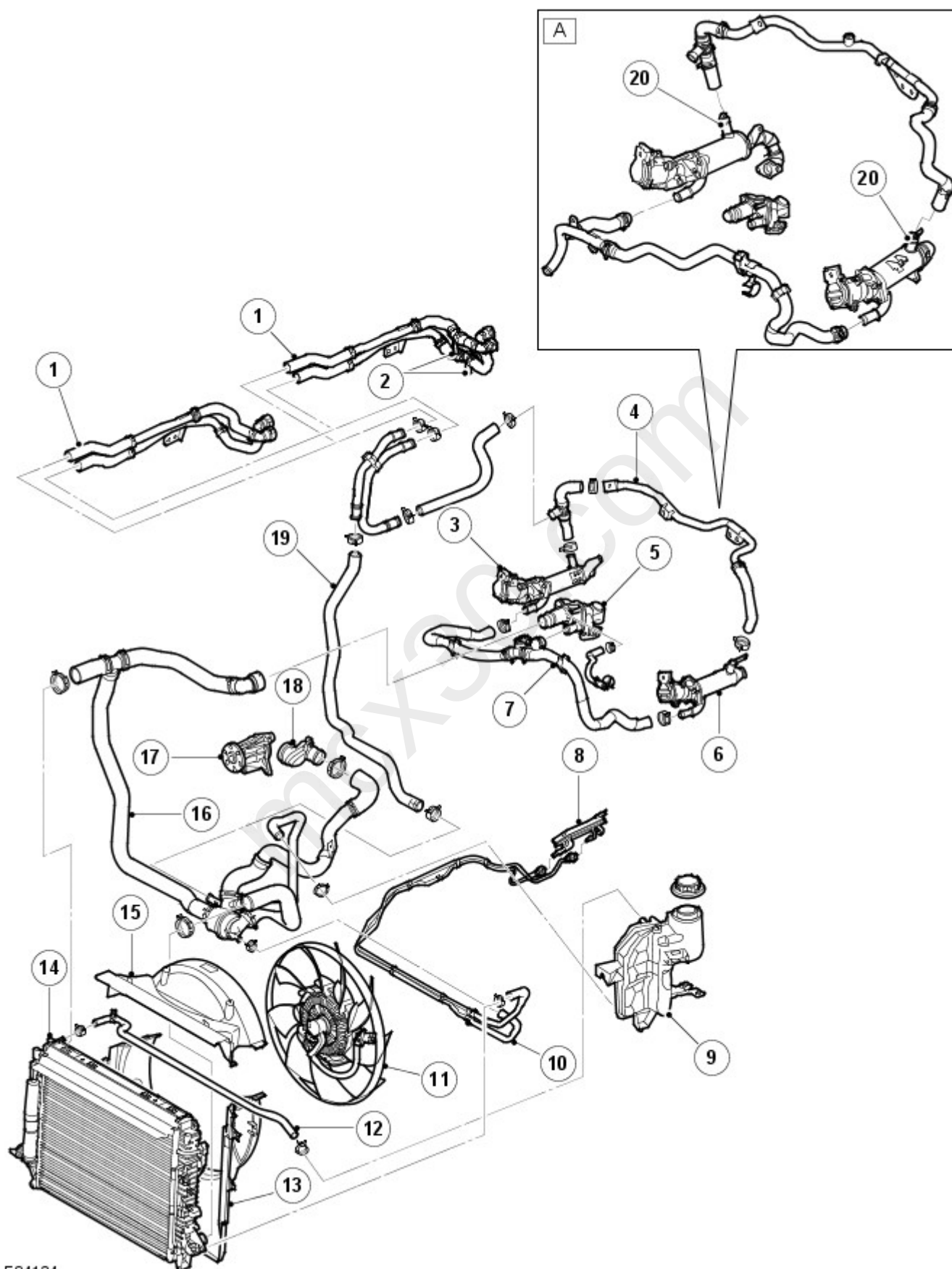
Description	Nm	lb-ft
Coolant expansion tank bolts	10	7
Radiator access panel	10	7
Coolant pump bolts	10	7
Coolant pump pulley bolts	25	18
Radiator securing bolts	25	18
Air Conditioning (A/C) condenser bolts	6	4
Charge air outlet hose clip	10	7
Charge air inlet hose clip	10	7
Cooling fan to viscous coupling bolts	10	7
* Cooling fan assembly	65	48
Coolant bleed screw(s)	3	2

* **Note:** Left-hand thread

Engine Cooling - TDV6 2.7L Diesel - Engine Cooling

Description and Operation

Cooling System Component Layout – Manual Gearbox Without Fuel Burning Heater (FBH)



E84134

Item	Part Number	Description
A	-	2007 model year onwards

1	-	Heater hose, in and out
2	-	Heater hose, in and out, for vehicles with rear heater (optional)
3	-	EGR valve
4	-	Hose, EGR
5	-	Water outlet assembly
6	-	EGR valve
7	-	Hose, EGR inlet
8	-	Fuel cooler
9	-	Expansion tank
10	-	Hose, fuel cooler
11	-	Cooling fan
12	-	Hose, radiator to expansion tank
13	-	Shroud, lower
14	-	Radiator
15	-	Shroud, upper
16	-	Hose and thermostat assembly
17	-	Water pump
18	-	Water inlet connector
19	-	Heater hose, thermostat
20	-	EGR thermostat, 2 off (2007 model year onwards)

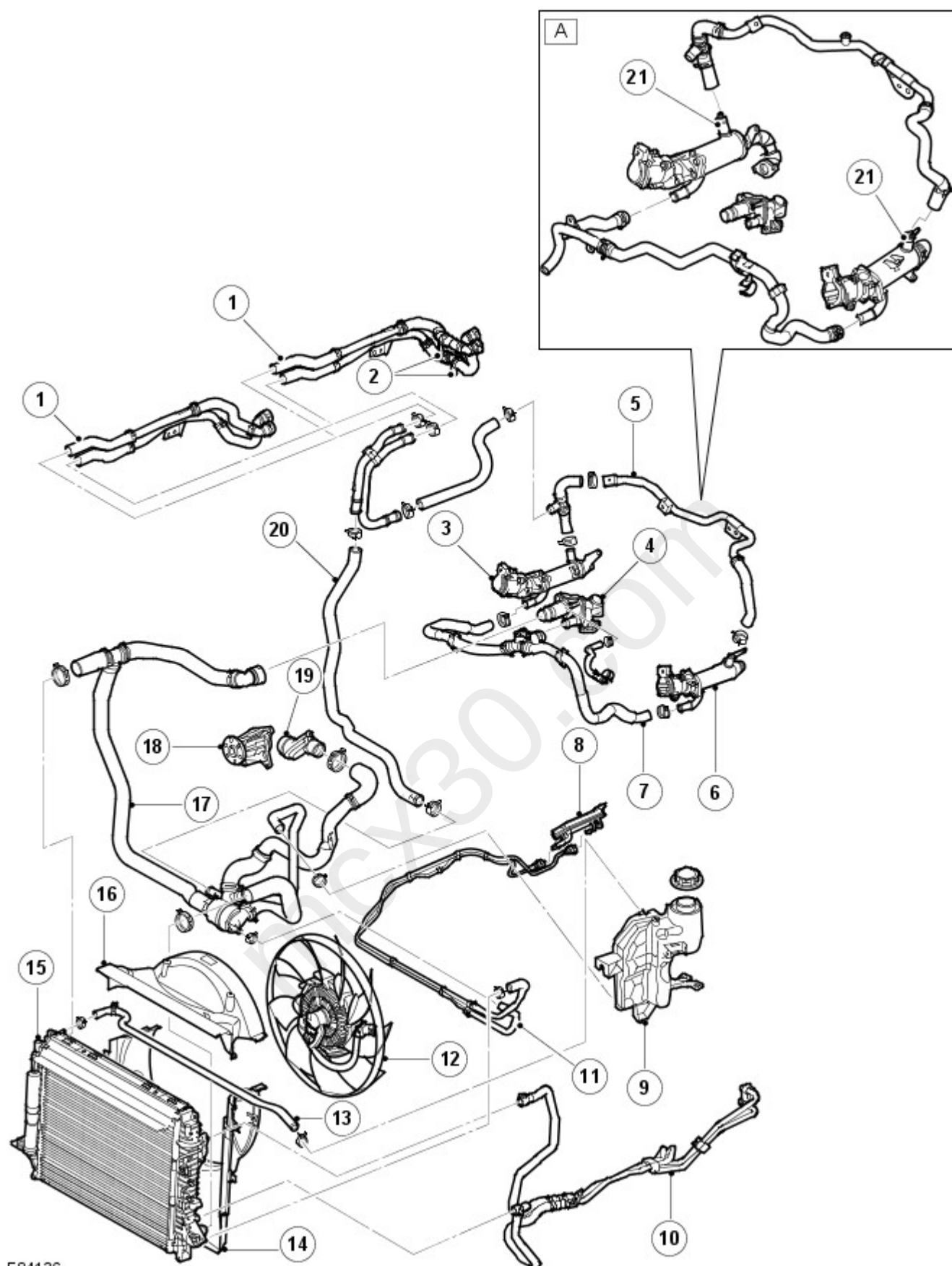
Cooling System Component Layout – Manual Gearbox, With FBH

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8	-	FBH
9	-	Fuel cooler
10	-	Expansion tank
11	-	Hose, fuel cooler
12	-	Cooling fan
13	-	Hose, radiator to expansion tank
14	-	Shroud, lower
15	-	Radiator
16	-	Shroud, upper
17	-	Hose and thermostat assembly
18	-	Water pump
19	-	Water inlet connector
20	-	FBH hose, in and out
21	-	EGR thermostat, 2 off (2007 model year onwards)

Cooling System Component Layout – Automatic Gearbox Without FBH

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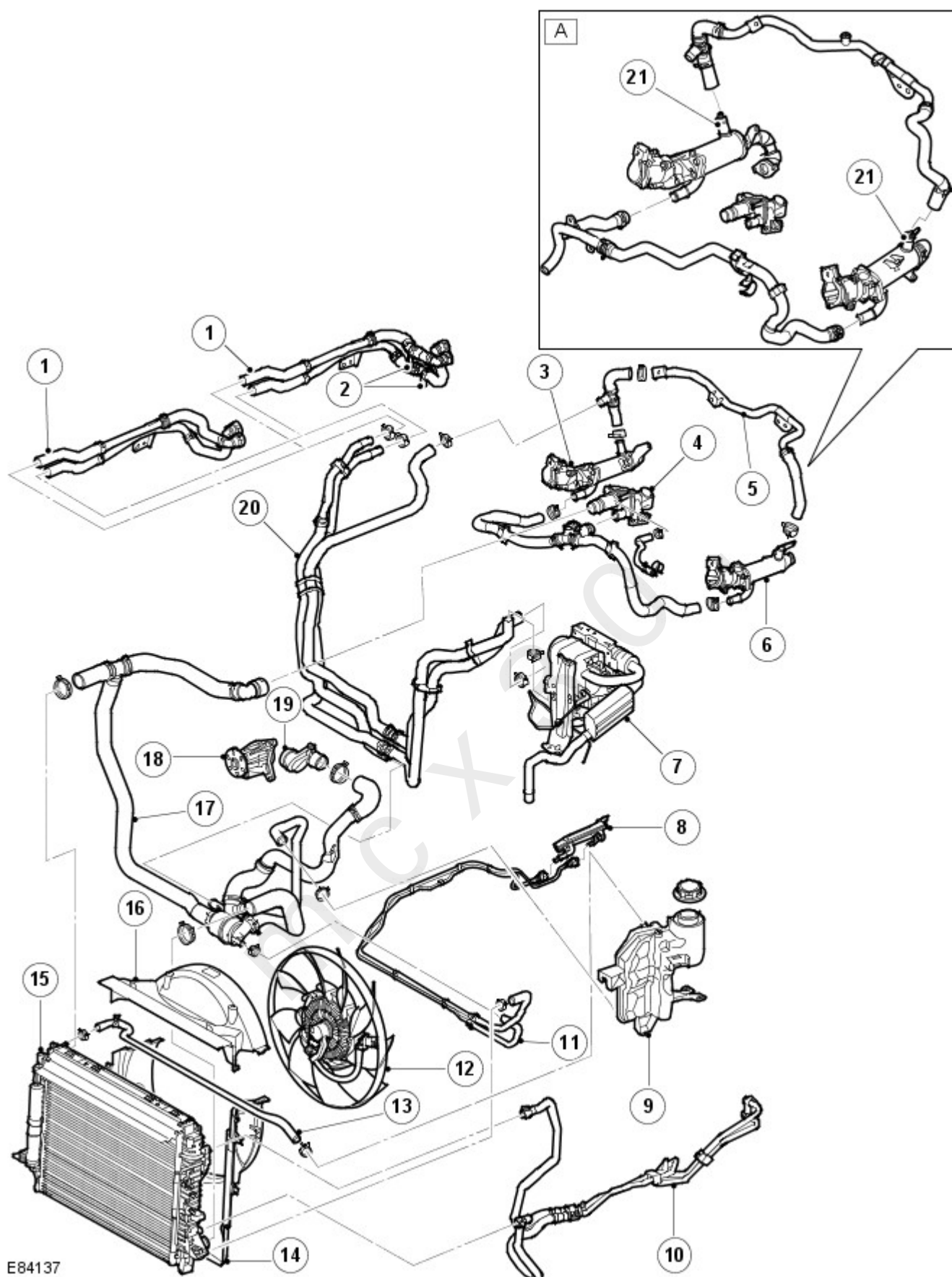
E84136

Item	Part Number	Description
A	-	2007 model year onwards
1	-	Heater hose, in and out
2	-	Connections for rear heater (optional)
3	-	EGR valve
4	-	Water outlet assembly
5	-	Hose, EGR
6	-	EGR valve
7	-	Hose, EGR inlet

8	-	Fuel cooler
9	-	Expansion tank
10	-	Transmission oil cooler pipes
11	-	Hose, fuel cooler
12	-	Cooling fan
13	-	Hose, radiator to expansion tank
14	-	Shroud, lower
15	-	Radiator
16	-	Shroud, upper
17	-	Hose and thermostat assembly
18	-	Water pump
19	-	Water inlet connector
20	-	Heater hose, thermostat
21	-	EGR thermostat, 2 off (2007 model year onwards)

Cooling System Component Layout – Automatic Gearbox, With FBH

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E84137

Item	Part Number	Description
A	-	2007 model year onwards
1	-	Heater hose, in and out
2	-	Connections for rear heater (optional)
3	-	EGR valve
4	-	Water outlet assembly
5	-	Hose, EGR
6	-	EGR valve
7	-	FBH

8	-	Fuel cooler
9	-	Expansion tank
10	-	Transmission oil cooler pipes
11	-	Hose, fuel cooler
12	-	Cooling fan
13	-	Hose, radiator to expansion tank
14	-	Shroud, lower
15	-	Radiator
16	-	Shroud, upper
17	-	Hose and thermostat assembly
18	-	Water pump
19	-	Water inlet connector
20	-	FBH hose, in and out
21	-	EGR thermostat, 2 off (2007 model year onwards)

GENERAL

The cooling system employed is of the pressure relief by-pass type, which allows coolant to circulate around the engine and the heater circuit while the thermostat main valve is closed. The primary function of the cooling system is to maintain the engine within an optimum temperature range under changing ambient and engine operating conditions. Secondary functions are to provide heating for the passenger compartment and cooling for the transmission fluid and engine oil.

The cooling system comprises:

- A radiator
- An intercooler
- A passenger compartment heater matrix
- Two fuel coolers
- Two Exhaust Gas Recirculation (EGR) coolers
- A Fuel Burning Heater (FBH) (Market dependant)
- A coolant pump
- A Pressure Relief Thermostat (PRT)
- An expansion tank
- An electro-viscous fan
- Connecting hoses and pipes.

ENGINE COOLING SYSTEM

The coolant is circulated by a centrifugal type pump mounted on the front of the engine and driven by the ancillary drive 'polyvee' belt. The coolant pump circulates coolant around the cylinder block and cylinder heads via a chamber located in the 'vee' of the engine. Some of the coolant flow is diverted through the integrated fuel and engine oil coolers. Having passed through the engine and oil coolers, the coolant returns to the thermostat housing via the by-pass pipe. Coolant also circulates through the EGR coolers to the heater matrix and returns to the engine side of the PRT.

On vehicles fitted with FBH, the coolant circulates through the EGR coolers to the FBH unit (whether active or not) and then on to the heater matrix. The coolant then returns to the engine side of the PRT.

On vehicles from 2007 model year, there is a thermostat located in each EGR cooler outlet spigot. These thermostats control coolant flow through the EGR coolers benefitting both engine emissions and engine/heater warm-up.

The PRT housing contains a normal thermostat, which is positioned such that the wax's temperature is controlled by both the coolant from the radiator and the bypass. This results in the thermostat being able to vary its opening temperature dependant on ambient conditions. The PRT also contains a sprung loaded valve, which limits the amount flow using the bypass. This means that the engine can run without coolant flowing through the bypass temporarily, to improve heater performance.

The radiator is a cross flow type with an aluminium matrix and has a drain tap on the lower RH rear face. The lower radiator mountings are located part way up the end tanks. The mountings are fitted with rubber bushes, which sit on the upper chassis rails. The radiator upper is mounted by pins, which are pushed through rubber bushes mounted in the Front End Carrier (FEC) above the radiator.

The intercooler is attached to the bottom of the radiator by two pins, which locate into fittings in the radiator end tanks.

The radiator top hose is connected to the PRT by the bypass hose and the bottom hose is directly connected to the outlet side of the thermostat housing.

The expansion tank is fitted forward of the LH suspension turret in the engine compartment. The expansion tank allows for the expansion of the coolant as the engine gets hot and also supplies the engine with coolant as the coolant in the engine contracts. The tank also allows any air trapped in the coolant to be removed.

The liquid cooled transmission fluid cooler (automatic models only) is mounted in the cold side radiator end tank. It is positioned in the middle of the LH end tank.

The 2nd fuel cooler is fed from the cold side end tank of the radiator from a sub cooled section and returns into the PRT housing on the radiator side.

On vehicles fitted with a FBH, the unit is located forward of the LH suspension turret. Coolant flows through the FBH whether it is active or not. The exhaust from the burner is vented into the front LH wheel arch. For additional information, refer to: Auxiliary Heater (412-02B Auxiliary Heating, Description and Operation).

For additional airflow through the radiator matrix, particularly when the vehicle is stationary, there is an engine driven electro-viscous fan unit fitted to the rear of the radiator. The fan is used for engine cooling and for Air Conditioning (A/C) system cooling. This unit functions as a normal viscous fan, but with electronic control over the level engagement of the clutch. The Engine Control Module (ECM), which determines the required fan speed, controls the level of clutch

engagement. The ECM determines engagement based on the coolant, charge air, ambient and transmission oil temperatures and the A/C pressure. The fan is mounted using a left hand thread.

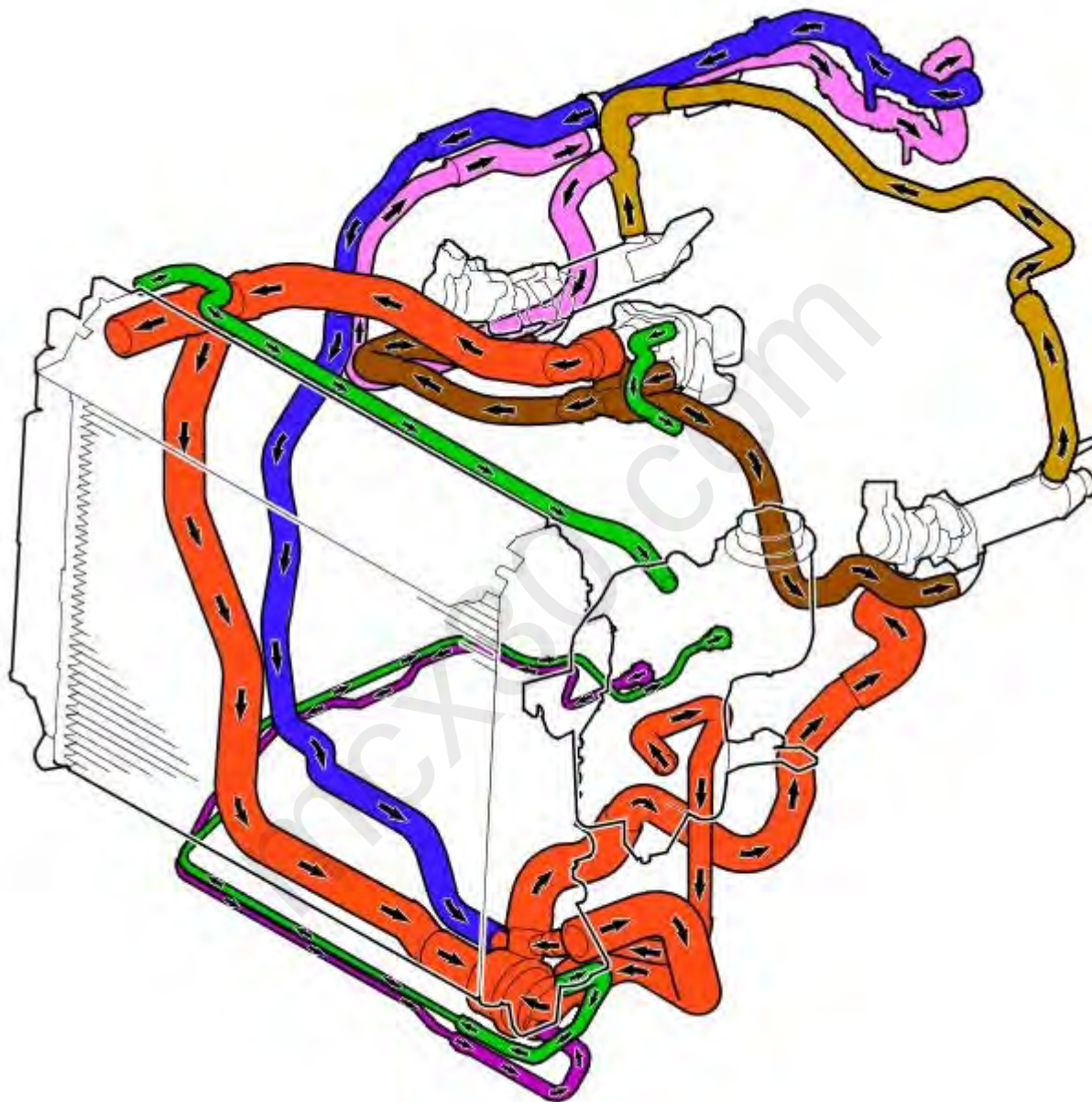
The viscous fan unit is electronically controlled by the ECM to optimise fan speed for all operating conditions.

- NOTE: If the electrical connections to the viscous fan are disconnected the fan will 'idle' and overheating may result. The ECM stores the appropriate fault codes in this case.

ENGINE COOLING SYSTEM OPERATION

Cooling System Coolant Flow – Manual Gearbox Without FBH

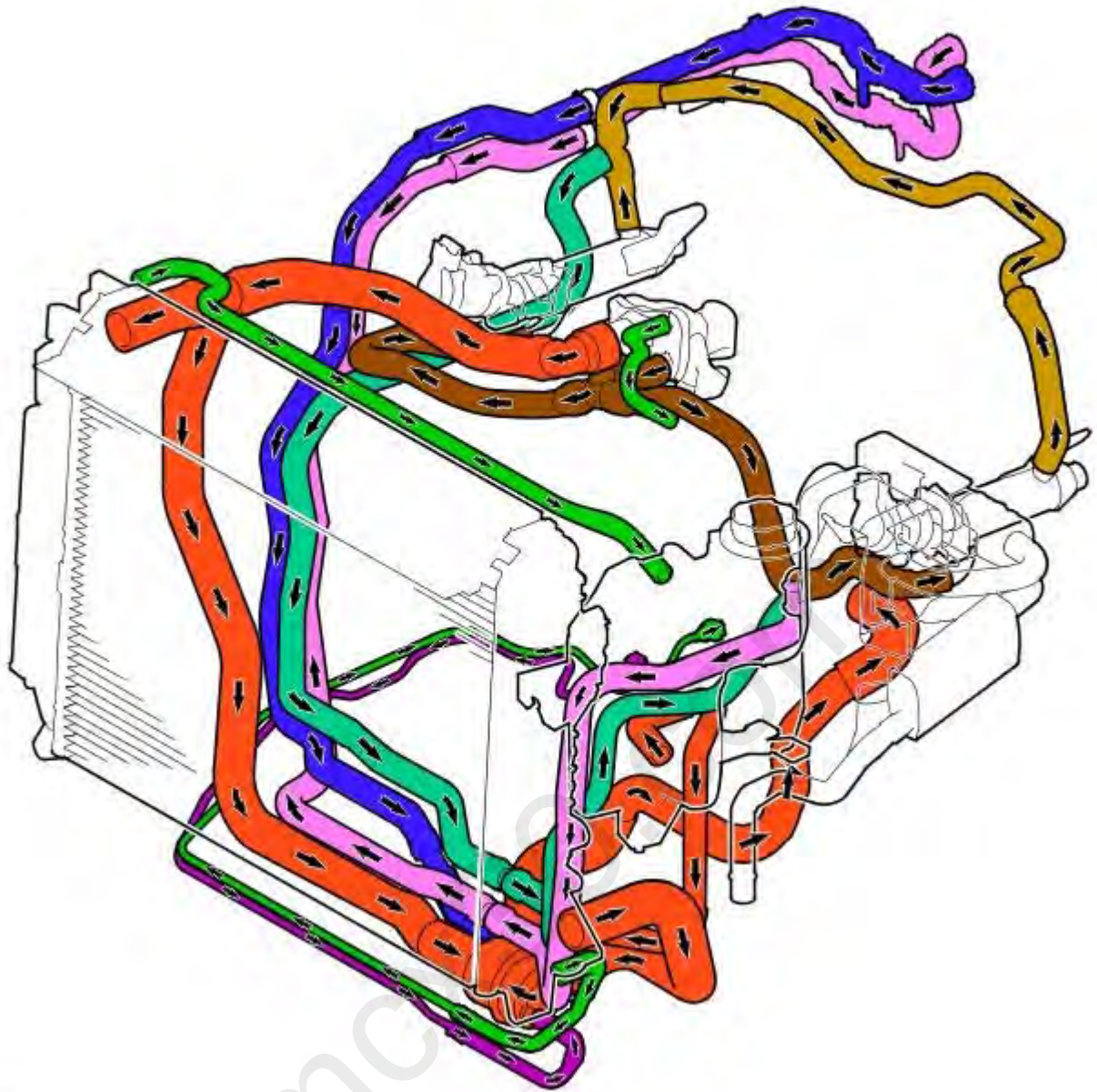
- NOTE: Pre-2007 model year shown, 2007 model year onwards similar



E43016

Cooling System Coolant Flow – Manual Gearbox With FBH

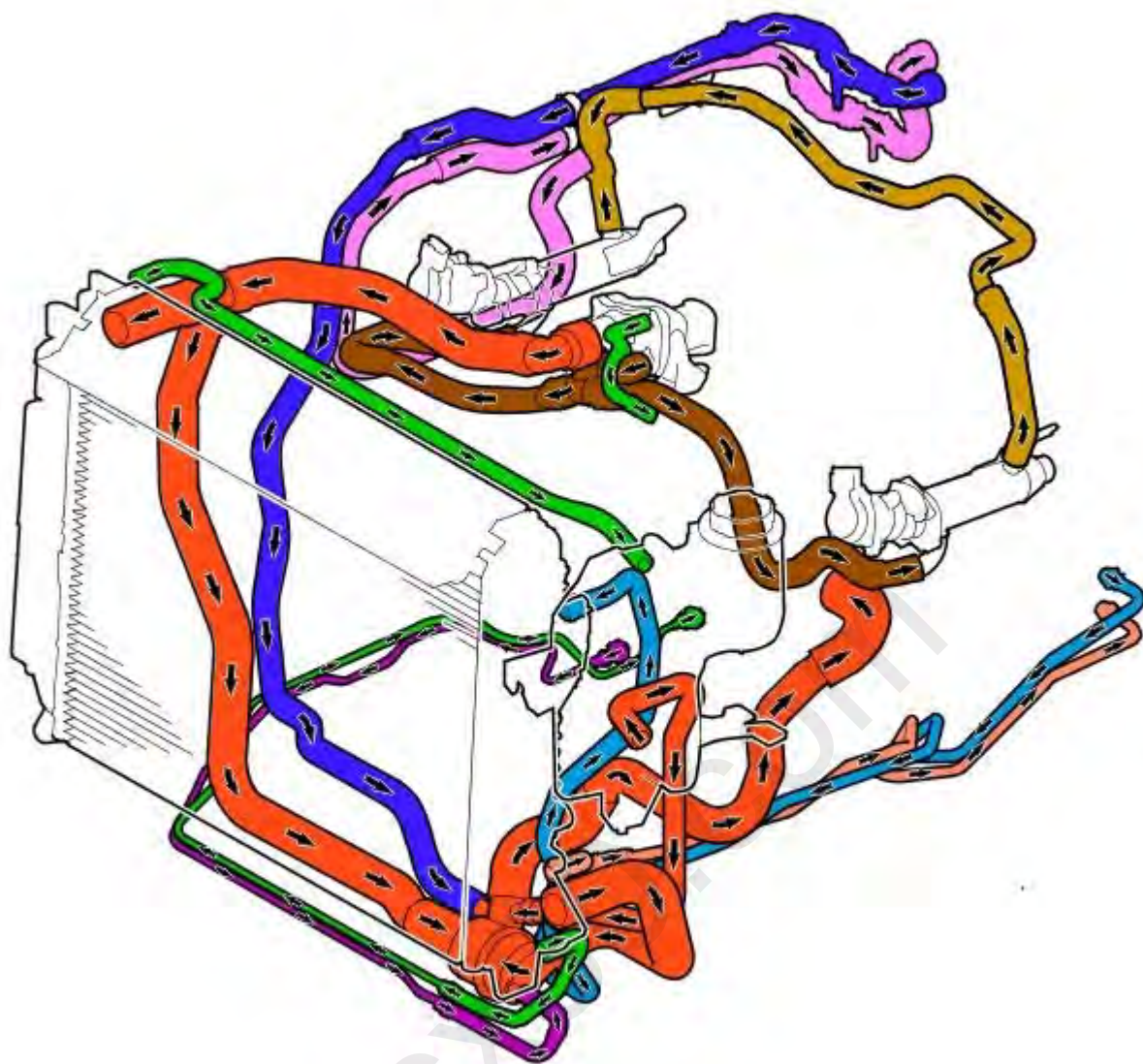
- NOTE: Pre-2007 model year shown, 2007 model year onwards similar



E43017

Cooling System Coolant Flow – Automatic Gearbox Without FBH

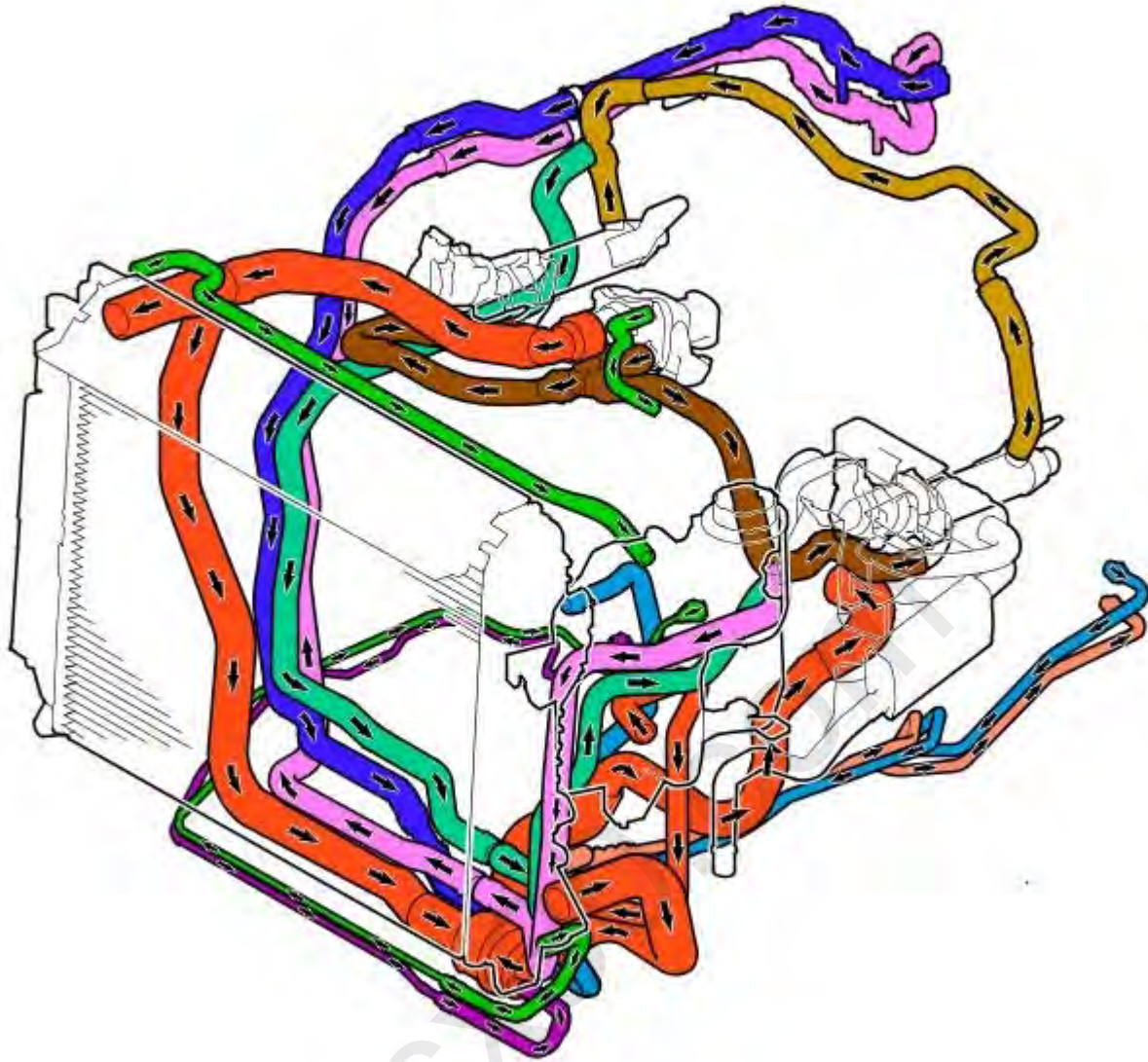
- NOTE: Pre-2007 model year shown, 2007 model year onwards similar



E43018

Cooling System Coolant Flow – Automatic Gearbox With FBH

- NOTE: Pre-2007 model year shown, 2007 model year onwards similar



E 43019

When the engine is running the coolant pump is driven by the ancillary drive belt. This forces coolant to circulate around the engine and heater, while the thermostat and bypass valve are shut. As the temperature and pressure increases the bypass valve is forced open allowing coolant to circulate through the bypass valve. When the temperature reaches 82°C (180°F) the main thermostat begins to open, allowing coolant to circulate through the main radiator. As the thermostat progressively opens (fully open at 95°C (203°F)), the bypass valve progressively closes forcing any coolant through the heater or radiator. Once coolant is allowed to circulate through the radiator, the transmission fluid (automatic models only) and fuel coolers begin to receive coolant flow.

The increased coolant volume, created by heat expansion, is directed to the expansion tank through a bleed hose from the top of the radiator. The expansion tank has an outlet hose which is connected into the coolant circuit. This outlet hose returns the coolant to the system when the engine cools.

Coolant flows through the radiator from the top right hand tank to the bottom left hand tank and is cooled by air passing through the matrix. The temperature of the cooling system is monitored by the ECM via the Engine Coolant temperature (ECT) sensor located in the cylinder head. The ECM uses signals from this sensor to control the cooling fan operation and adjust fuelling according to engine temperature.

For additional information, refer to: Electronic Engine Controls (303-14C Electronic Engine Controls - 2.7L Diesel, Description and Operation).

To control the cooling fan, the ECM sends a Pulse Width Modulated (PWM) signal to the cooling fan module (integral to the ECM). The frequency of the PWM signal is used by the cooling fan module to determine the output voltage supplied to the fan motor.

The ECM varies the duty cycle of the PWM signal between 0 and 100% to vary the fan speed. If the PWM signal is outside the 0 to 100% range, the cooling fan module interprets the signal as an open or short circuit and runs the fans at maximum speed to ensure the engine and gearbox do not overheat.

The ECM operates the fan in response to inputs from the ECT sensor, the transmission oil temperature sensor, the charge air temperature sensor, the A/C switch and the A/C pressure sensor.

For additional information, refer to: Air Conditioning (412-03A Air Conditioning - 4.0L, Description and Operation).

The speed of the cooling fan is also influenced by vehicle road speed. The ECM adjusts the speed of the cooling fans, to compensate for the ram effect of vehicle speed, using the Controller Area Network (CAN) road speed signal received from the Anti-lock Braking System (ABS) module.

Pressure Relief Thermostat (PRT)

The thermostat is exposed to 85% hot coolant from the engine on one side and 15% cold coolant returning from the radiator bottom hose on the other side. This allows the thermostat to react to the ambient conditions and provide coolant control for both winter and summer use. Hot coolant from the engine passes via holes in the by-pass flow valve into a tube which surrounds 85% of the thermostat sensitive area. Cold coolant from the radiator conducts through the remaining 15% of the sensitive area. In cold ambient conditions, the engine temperature is raised by approximately 10°C (50°F) to compensate for the heat loss of 15% exposure to the cold coolant returning from the bottom hose. This improves heater performance and engine warm-up.

The by-pass flow valve is held closed by a light spring and operates to further assist engine and heater warm-up. When the main valve is closed and the engine speed is at idle, the coolant pump does not produce sufficient flow and pressure to overcome the spring and open the valve. In this condition the valve prevents coolant circulating through the by-pass circuit and directs coolant through the heater matrix only. This provides a higher flow of coolant through the heater matrix improving passenger comfort in cold conditions.

When the engine speed increases above idle, the coolant pump produces a greater flow and pressure than the heater circuit can accommodate. The build up of pressure acts on the flow valve, overcoming the spring pressure, opening the valve and relieving the pressure in the heater circuit. The valve then modulates to provide maximum coolant flow through the heater matrix and allowing excess coolant to flow into the by-pass circuit to provide the engine's cooling requirements at higher engine speeds. The thermostat then regulates the flow through the radiator to maintain the engine at the optimum temperature. Maximum opening of the thermostat, and therefore maximum flow through the radiator, occurs if the coolant temperature reaches 95°C (203°F).

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Engine Cooling - TDV6 2.7L Diesel - Engine Cooling

Diagnosis and Testing

Principle of Operation

For a detailed description of the engine cooling system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to:

Engine Cooling (303-03 Engine Cooling - 2.7L Diesel, Description and Operation),
[Engine Cooling](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Description and Operation).

Inspection and Verification



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

Visual Inspection

Mechanical	Electrical
● Coolant leaks ● Coolant Hoses ● Coolant expansion tank ● Radiator ● Heater core ● Accessory drive belt ● Viscous fan	● Fuses ● Harnesses ● Loose or corroded connector(s) ● Engine Coolant Temperature (ECT) sensor

3. **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. **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
Coolant loss	● Hoses ● Hose connections ● Radiator ● Water pump ● Heater core ● Gaskets ● Engine casting cracks ● Engine block core plugs	Carry out a visual inspection. If there are no obvious leaks, carry out a cooling system pressure test. Rectify any leaks as necessary.
Overheating	● Low/Contaminated coolant ● Thermostat ● Viscous fan ● ECT sensor ● Restricted air flow over the radiator	Check the coolant level and condition. Carry out a cooling system pressure test. Rectify any leaks as necessary. Check the thermostat and rectify as necessary. Check the viscous fan operation, make sure the viscous fan rotates freely. Check for obstructions to the air flow over the radiator. Rectify as necessary.
Engine not reaching normal temperature	● Thermostat ● Viscous fan ● Thermostat ● Electric fan ● Fan speed module	Check the thermostat operation. Check the viscous fan operation, make sure the viscous fan is not seized. Rectify as necessary.

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).

Engine Cooling - TDV6 2.7L Diesel - Cooling System Draining, Filling and Bleeding

General Procedures

All vehicles

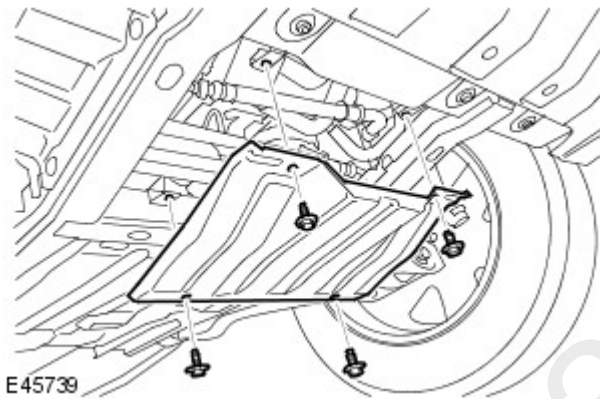
1. Position the vehicle on a lift.
2. Set the heater controls to maximum.
3. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
4. Remove the engine cover.
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Ornamentation, Removal and Installation).

5.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Remove the coolant expansion tank cap.

6. Remove the radiator access panel.

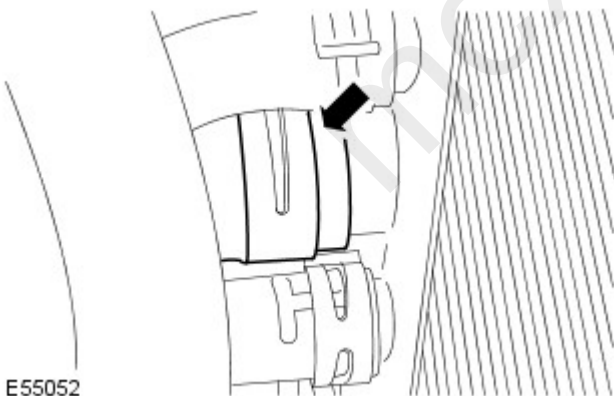
- Remove the 4 bolts.



7. Position a container to collect the fluid.

8.  **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

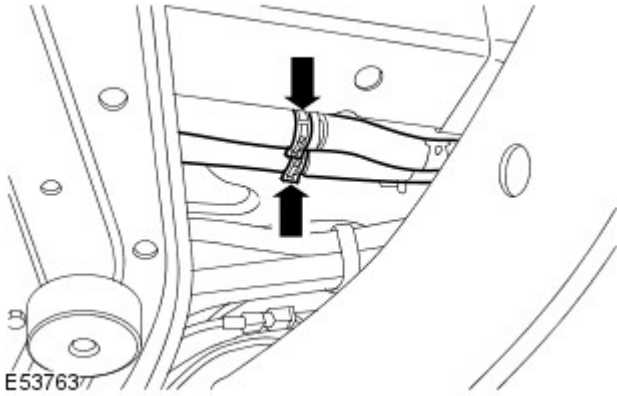
Release the clip and disconnect the radiator lower hose, allow the coolant to drain.



9. Remove the container.

Vehicles with auxiliary climate control

10. Remove the spare wheel and tire.
 - Remove the tool kit.
 - Access the winch.
11. Position a container to collect the fluid.



12. Disconnect the rear heater coolant hoses.

- Release the 2 clips.
- Allow the coolant to drain.

13. Remove the container.

14. Connect the rear heater coolant hoses.

- Secure the two clips.

15. Install the spare wheel and tire.

- Stow the tool kit.

All vehicles

16. Connect and secure the radiator lower hose.

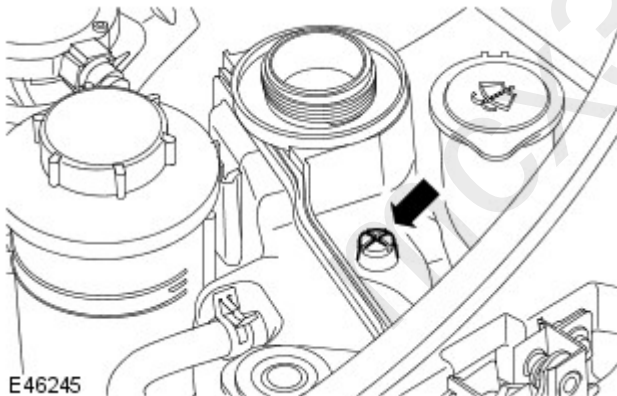
- Secure with the clip.

17. Connect the battery ground cable.

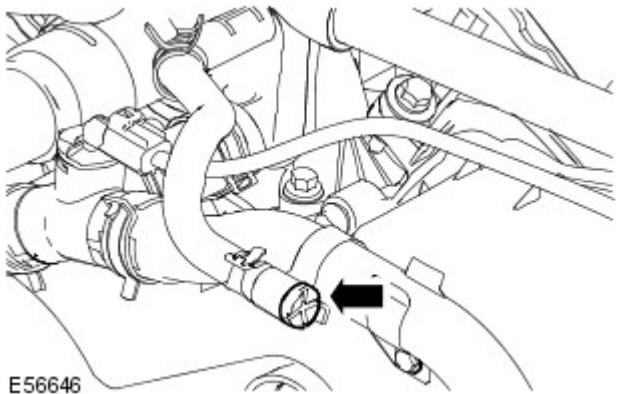
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

18. Connect exhaust extraction hoses to the tail pipes.

19. Loosen the coolant expansion tank bleed screw.



20. Loosen the cylinder head bleed hose bleed screw.



21. Refill the cooling system.

22. Tighten the bleed screws to 14 Nm (10 lb.ft).

23. Fill the cooling system, keeping coolant to the upper level mark of the expansion tank, until a steady stream of coolant is seen returning to the tank.

24. NOTE: When the coolant bleed is complete and prior to installing the expansion tank cap, top up the expansion tank to 30mm above the maximum level.

Install the coolant expansion tank cap.

25. ⚠ WARNING: Release the cooling system pressure by slowly turning the expansion tank cap a quarter of a turn. Cover the expansion tank cap with a thick cloth to prevent the possibility of scalding. Failure to follow this instruction may result in personal injury.

Start and run the engine.

- Hold the engine speed at 3,000 RPM for one minute.
- Return the engine to idle for five minutes.
- Hold the engine speed at 3,000 RPM for one minute.
- Run the engine until the thermostat opens.
- Remove coolant expansion tank cap, allow float to settle and top-up coolant if required. Install cap.

26. Switch the engine off and allow to cool.

27. Install the engine cover.

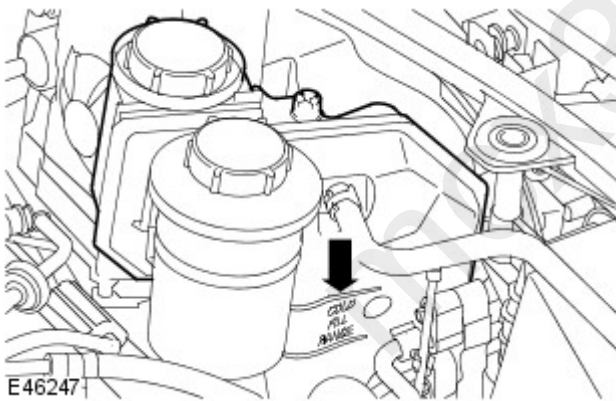
For additional information, refer to: [Engine Cover - 2.7L V6 - TdV6](#) (501-05 Interior Trim and Oramentation, Removal and Installation).

28. Clean any remaining coolant from the chassis and surrounding area.

29. Install the radiator access panel.

- Tighten the 4 bolts to 10 Nm (7 lb.ft).

30. Check and top-up the coolant if required.



Engine Cooling - TDV6 2.7L Diesel - Cooling System Draining and Vacuum

Filling

General Procedures

WARNING: To avoid having scalding hot coolant or steam blowing out of the cooling system, use extreme care when removing the coolant pressure cap from a hot cooling system. Wait until the engine has cooled, then wrap a thick cloth around the coolant pressure cap and turn it slowly until the pressure begins to release. Step back while the pressure is released from the system. When certain all the pressure has been released (still with a cloth) turn and remove the coolant pressure cap from the coolant expansion tank. Failure to follow these instructions may result in personal injury.

• CAUTIONS:

WARNING: The engine cooling system must be maintained with the correct concentration and type of anti-freeze solution to prevent corrosion and frost damage. Failure to follow this instruction may result in damage to the engine.

WARNING: Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

1. Set the heater controls to maximum HOT.

WARNING: Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

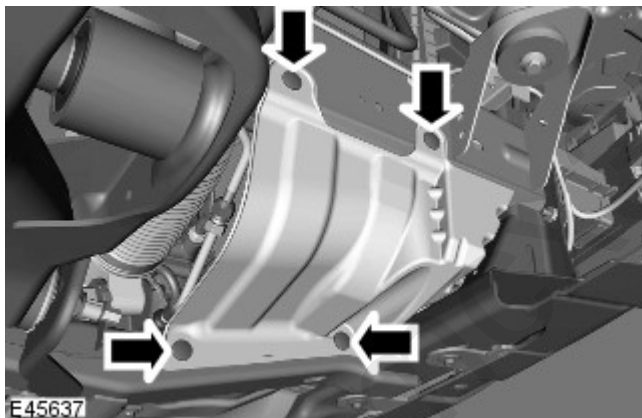
Remove the coolant expansion tank cap.

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.

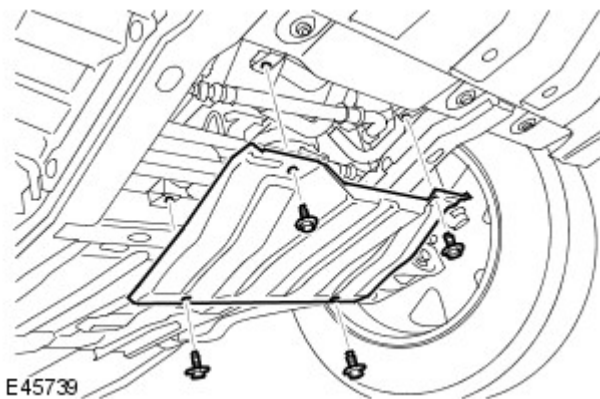
4. Remove the front LH splash shield.

- Remove the 4 clips.

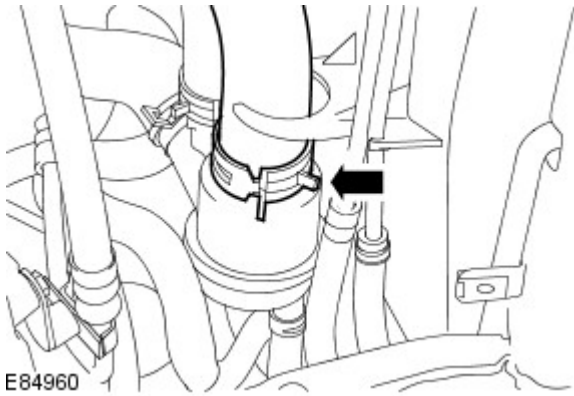


5. Remove the radiator access panel.

- Remove the 4 bolts.

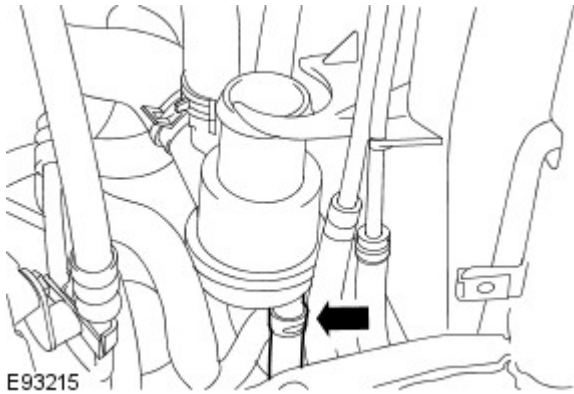


6. Position a container to collect the fluid.



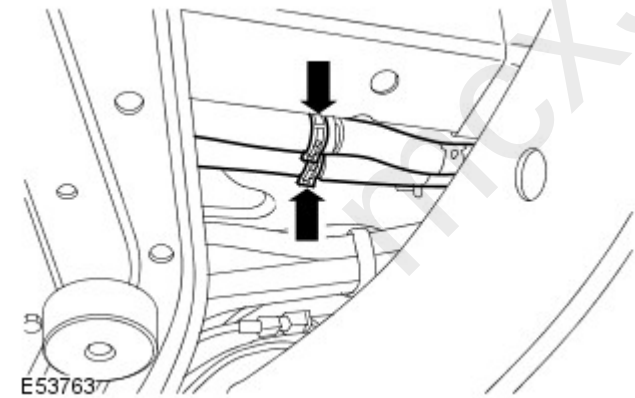
7. Disconnect the coolant hose from the thermostat.

- Release the clip.
- Allow the coolant to drain.



8. Disconnect the coolant hose from the thermostat.

- Release the clip.
- Allow the coolant to drain.



9. Remove the spare wheel and tire.

- Remove the tool kit.
- Access the winch.

10. Position a container to collect the fluid.

11. Disconnect the rear heater coolant hoses.

- Release the 2 clips.
- Allow the coolant to drain.

12. Connect the rear heater coolant hoses.

- Secure the clips.

13. Install the spare wheel and tire.

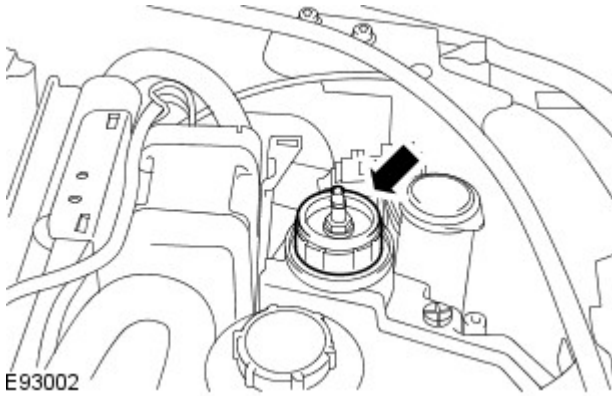
- Stow the tool kit.

14. Connect the thermostat housing coolant hoses.

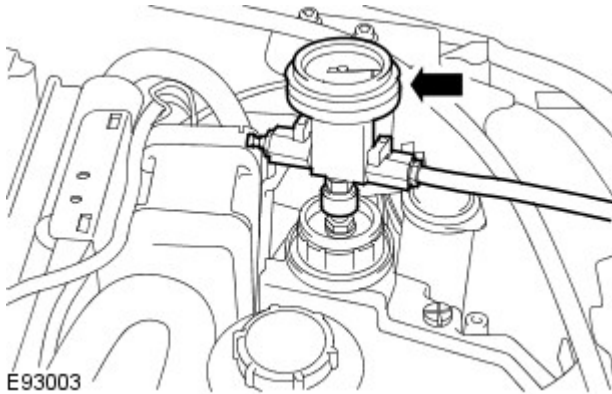
- Secure with the clip.

15. Prepare a sufficient amount of coolant to the specified concentration.

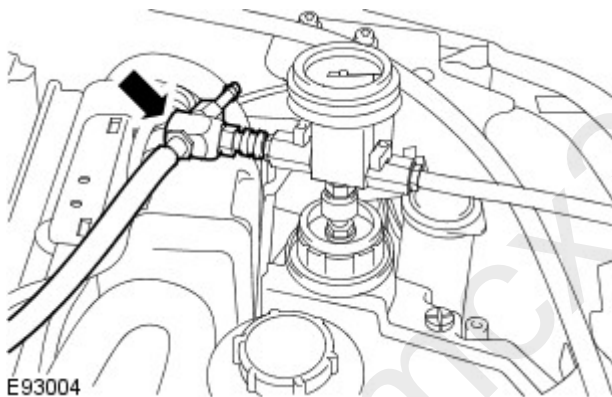
- 16.** Install the cooling system vacuum refill adaptor to the expansion tank.



- 17.** Install the vacuum filler gauge to the cooling system vacuum refill adaptor.



- 18.** Install the venturi tube assembly to the vacuum filler gauge.

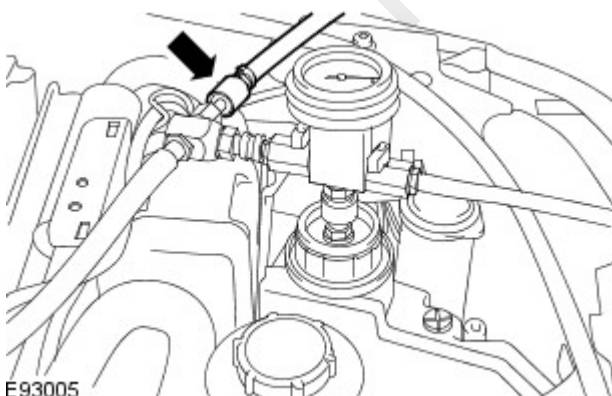


- 19.** NOTE: Make sure both valves on gauge assembly are in the closed position.

- NOTE: The coolant vacuum fill tool needs an air pressure of 6 to 8 bar (87 to 116 psi) to operate correctly.

- NOTE: Small diameter or long airlines may restrict airflow to the coolant vacuum fill tool.

Connect a regulated compressed air supply to the venturi tube assembly.

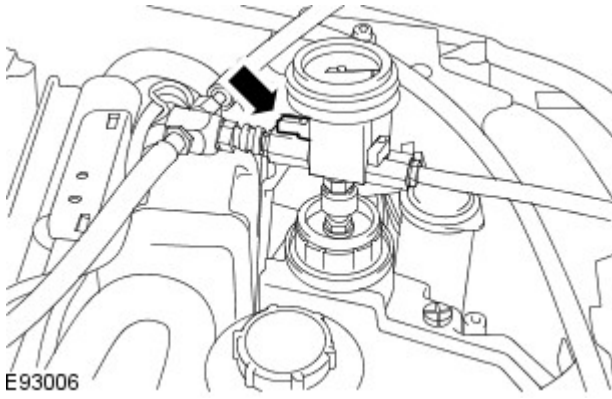


- 20.** NOTE: Make sure air cannot enter the hose.

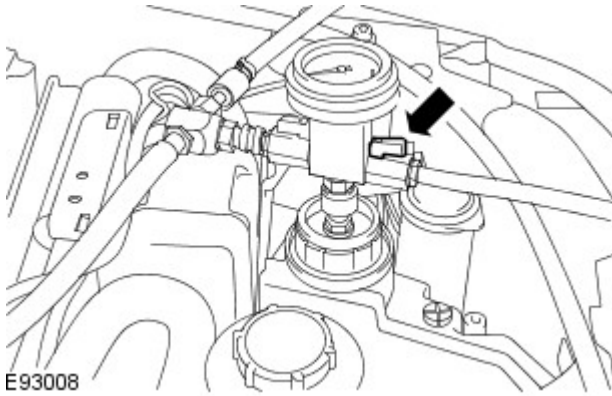
Position the coolant pick-up pipe into a container of clean coolant.

- 21.** Position the evacuated air hose into a container.

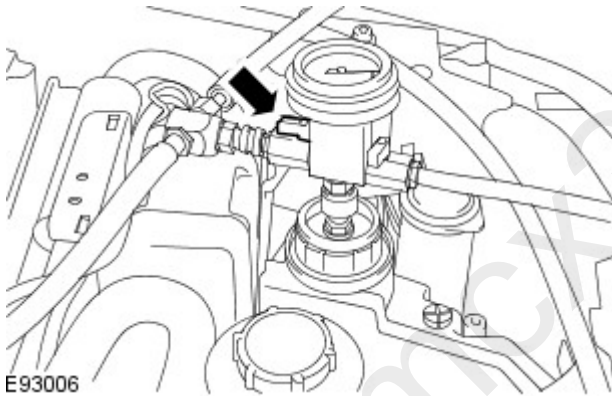
22. Open the air supply valve.



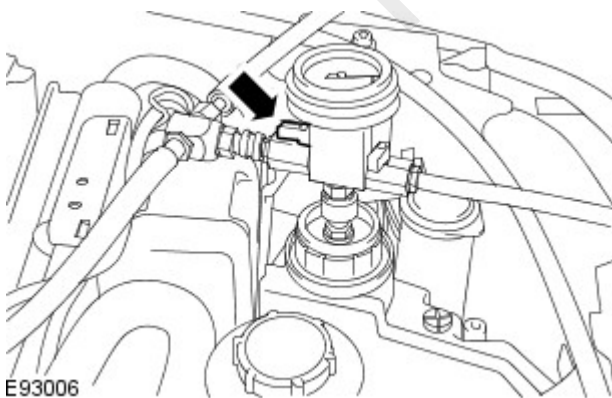
23. Open the coolant supply valve for 2 seconds to prime the coolant supply hose.

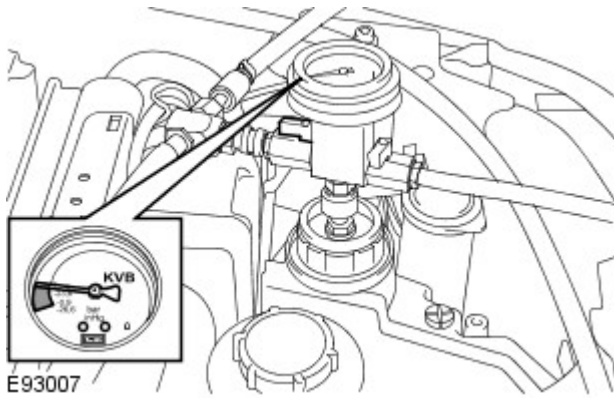


24. Apply air pressure progressively until the arrow on the vacuum filler gauge reaches the green segment.



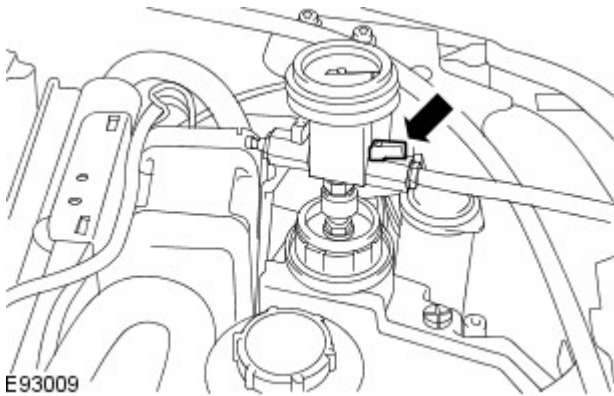
25. Close the air supply valve.





26. Allow one minute to check the vacuum is held.

- Disconnect the compressed air supply.



27. NOTE: Close the coolant supply valve when the coolant expansion tank MAX mark is reached or coolant movement has ceased.

Open the coolant supply valve and allow the coolant to be drawn into the system.

28. Remove the vacuum filler gauge and cooling system vacuum refill adaptor assembly.

29. Connect exhaust extraction hoses to the tail pipes.

30. Check and top-up the coolant if required.

31. Install the coolant expansion tank cap.

32. Start and run the engine.

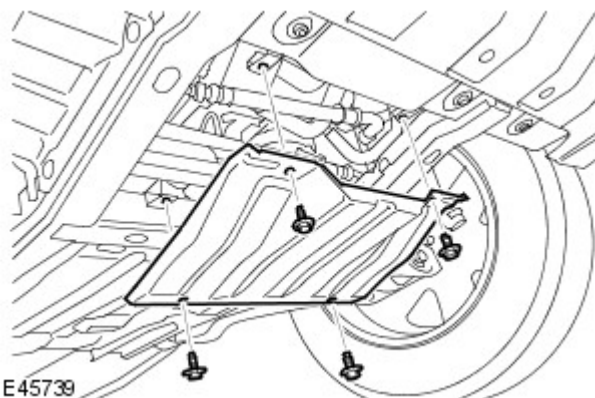
- Hold the engine speed at 3,000 RPM for one minute.
- Return the engine to idle for five minutes.
- Hold the engine speed at 3,000 RPM for one minute.
- Run the engine until the thermostat opens.

33. Switch the engine off and allow to cool.

34. Clean any spilt coolant from the vehicle.

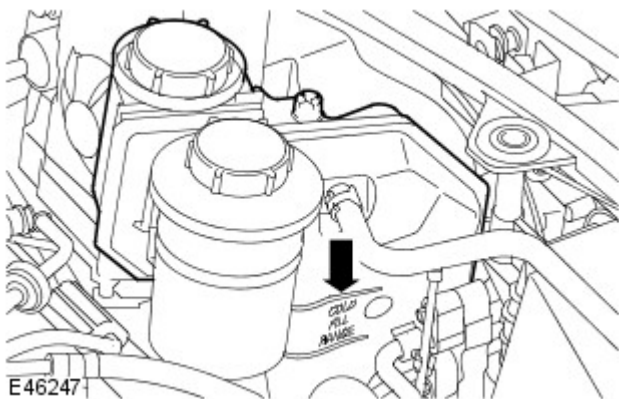
35. Install the radiator access panel.

- Tighten the 4 bolts to 10 Nm (7 lb.ft).



36. Install the front LH splash shield.

- Install the clips.



37.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Check and top-up the coolant if required.

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Engine Cooling - TDV6 2.7L Diesel - Cooling System Pressure Test

General Procedures

• **NOTE:** The following procedure will enable the cooling system to be pressure tested for condition and leaks. Stage 1 will check the expansion tank cap register seal and the cap for leaks. Stage 2 will check the entire cooling system.

• **NOTE:** It will be necessary to use the cooling system test kit, Part Number LR-218, which is available under the equipment programme.

1. Examine the coolant hoses for signs of cracking, distortion and security of the hose connections.

2.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

Disconnect the coolant expansion tank bleed hose.

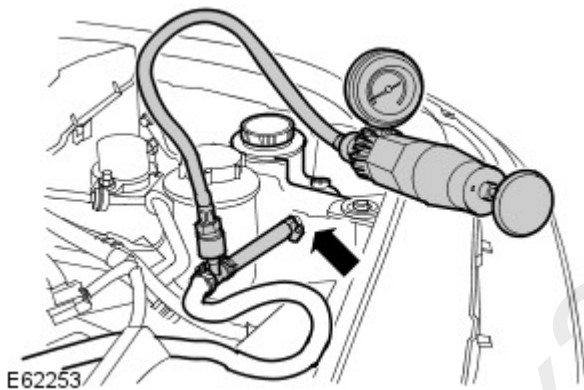
- Release the clip.

3. Install the 'T' piece adaptor (part of the cooling system test kit) between the coolant expansion tank and the coolant bleed hose.

- Secure with the 2 clips.

4. Install the coolant pressure pump assembly.

- Connect to the 'T' piece.



5. Pressurize the cooling system.

- Slowly pressurize the cooling system to 1.0 bar (100 kPa) (14.5 psi).
- Check the pressure remains above 0.9 bar (90 kPa) (13 psi) after waiting for 30 seconds.
- During the pressure drop check, listen for a hissing noise from the expansion tank cap.

6. **NOTE:** If the coolant expansion tank cap is found to be leaking, replace the cap.

Depressurize the cooling system.

- Disconnect the 'T' piece.
- Connect the coolant expansion tank bleed hose.
- Secure the clip.

7.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, allow the vehicle cooling system to cool prior to carrying out this procedure.

Remove the coolant expansion tank cap.

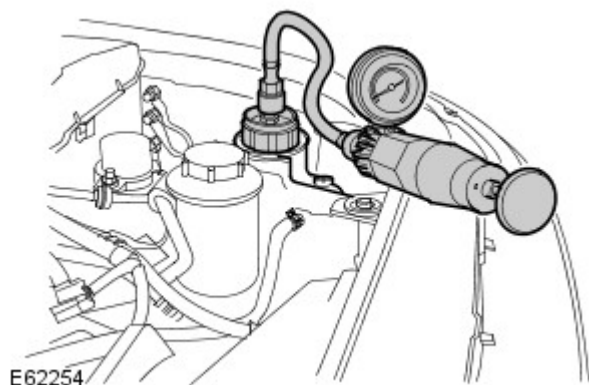
8. **NOTE:** This adaptor is part of the cooling system test kit.

Install adaptor K83 to the coolant expansion tank.

- Clean the component mating faces.
- Lubricate the seal.

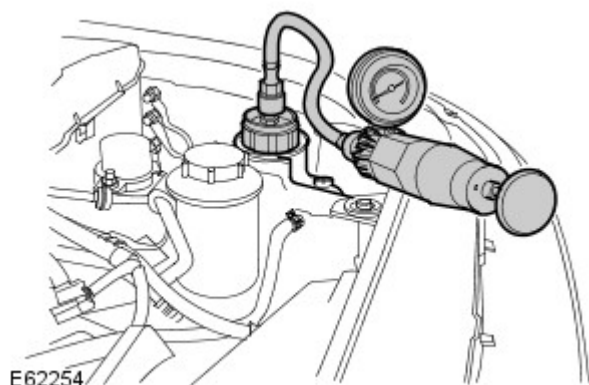
9. Install the coolant pressure pump assembly.

- Slowly pressurize the cooling system to 1.5 bar (150kPa) (22 psi), check the pressure over a 5 minute period. A small pressure decay of approximately 0.15 bar (15 »kPa) (1 psi) over the first minute is normal, as the air in the expansion tank cools.
- If the pressure continues to drop after the initial tolerance, there is a coolant leak.



10. Depressurize and remove the pressure pump and gauge.

- Install the coolant expansion tank cap.



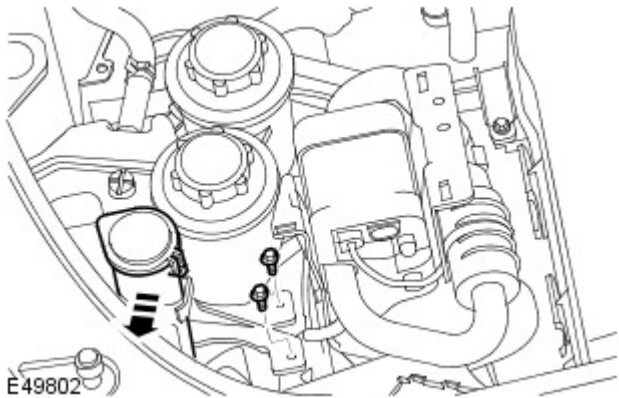
Engine Cooling - TDV6 2.7L Diesel - Coolant Expansion Tank

Removal and Installation

Removal

1. Remove the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
2. Release the windshield washer reservoir filler neck.
3. Release the coolant expansion tank.

- Remove the 2 bolts.



4. Release the power steering fluid reservoir.

5.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

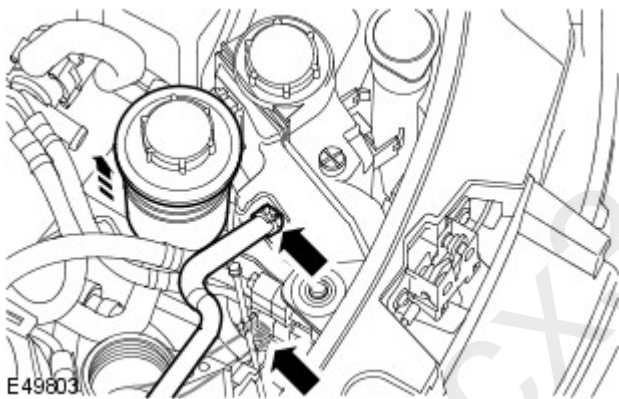
 **CAUTION:** Engine coolant will damage the paint finished surfaces. If spilt, immediately remove the coolant and clean the area with water.

Disconnect the 2 hoses from the coolant expansion tank.

- Position an absorbent cloth to collect fluid spillage.
- Position a container to collect the fluid.
- Clamp the hoses
- Release the 2 clips.

6. Remove the coolant expansion tank.

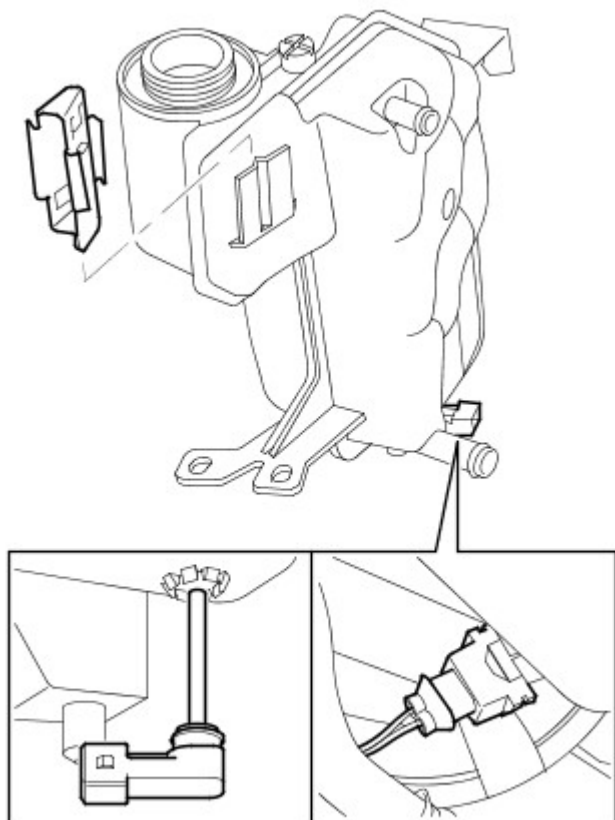
- Disconnect the coolant low level sensor electrical connector.



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

Remove the coolant low level sensor.

- Remove the coolant expansion tank support bracket.



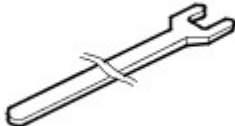
E47510

Installation

1. Install the bracket.
2. Install the coolant low level sensor.
3. Install the coolant expansion tank.
 - Connect the coolant low level sensor electrical connector.
4. Connect the coolant hoses to the expansion tank.
 - Secure with the clips.
5. Top-up the coolant.
 - Loosen the coolant expansion tank bleed screw.
 - Fill the coolant expansion tank until coolant emerges from the cooling system air bleed screw.
 - Remove the hose clamps.
 - Tighten the bleed screw to 8 Nm (6 lb.ft).
6. Secure the coolant expansion tank.
 - Tighten the bolts to 10 Nm (7 lb.ft).
7. Check and top-up the coolant.
 - Install the coolant expansion tank pressure cap.
8. Secure the power steering fluid reservoir.
 - Attach to the mounting bracket.
9. Secure the windshield washer reservoir filler neck.
 - Locate in clip.
10. Install the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).

Engine Cooling - TDV6 2.7L Diesel - Cooling Fan

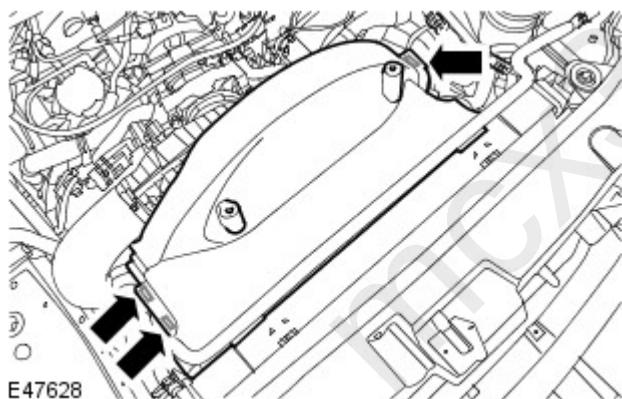
Removal and Installation

Special Tool(s)	
 303-1142 E46076	Viscous coupling spanner 303-905 (LRT-12-094)
 303-1143 E55382	Viscous coupling pulley retaining tool 303-1143

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 air cleaner assembly.
For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).
3. Remove the cooling fan shroud.

- Release the coolant hose.
- Release the 3 clips.



4. **NOTE: The thread is left handed.**

Remove the cooling fan assembly.

- Disconnect the electrical connector.
- Use the special tools.





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

Remove the viscous coupling.

- Remove the 4 bolts.

Installation

1. Install the viscous coupling.

- Clean the component mating faces.
- Tighten the bolts to 10 Nm (7 lb.ft).

2. Install the cooling fan assembly.

- Clean the component mating faces.
- Tighten the cooling fan assembly to 65 Nm (48 lb.ft).
- Connect the electrical connector.

3. Install the cooling fan shroud.

4. Install the air cleaner assembly.

For additional information, refer to: [Air Cleaner](#) (303-12A Intake Air Distribution and Filtering - TDV6 2.7L Diesel, Removal and Installation).

5. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

Engine Cooling - TDV6 2.7L Diesel - Cooling Fan Shroud

Removal and Installation

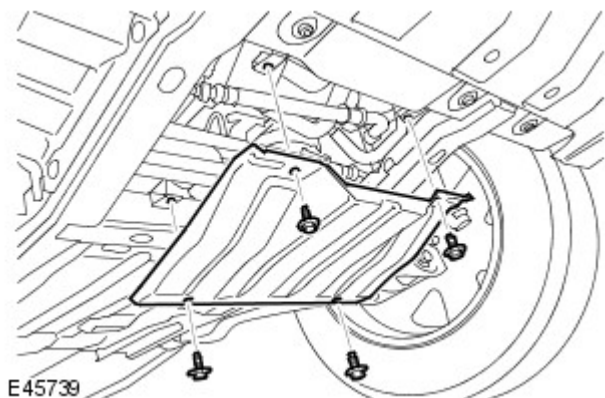
Removal

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

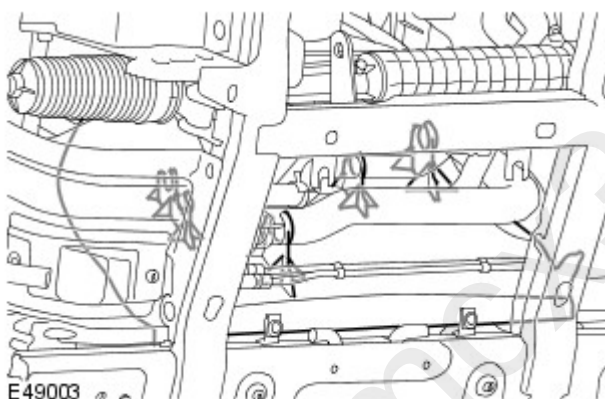
Raise and support the vehicle.

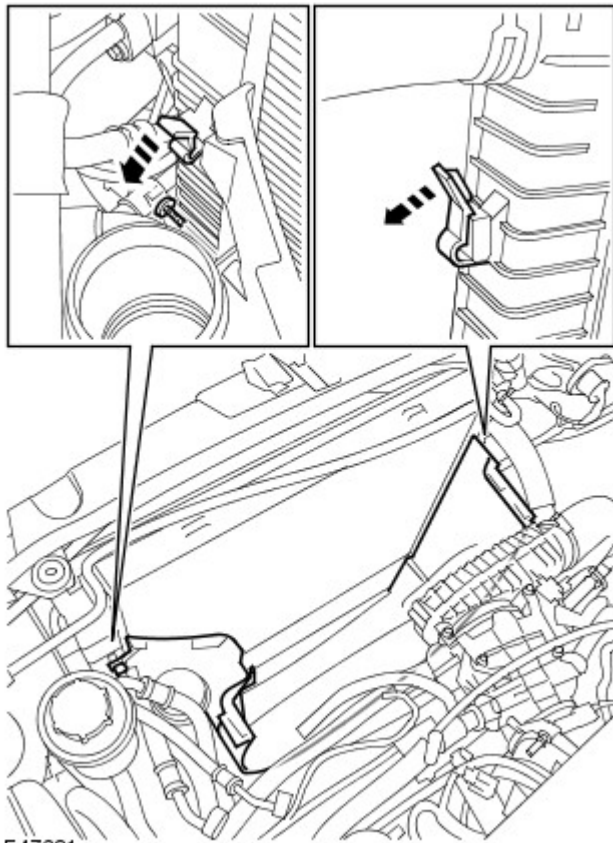
2. Remove the cooling fan assembly.
For additional information, refer to: [Cooling Fan](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
3. Remove the radiator access panel.

- Remove the 4 bolts.



4. Release the coolant pipes and hoses from the lower shroud.





E47631

5. Remove the cooling fan lower shroud.

- Release the 2 clips.
- Remove the screw.

Installation

1. Install the cooling fan lower shroud.

- Tighten the screw.
- Secure with the clips.

2. Install the coolant pipes and hoses to the lower shroud.

3. Install the radiator access panel.

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

4. Install the cooling fan assembly.

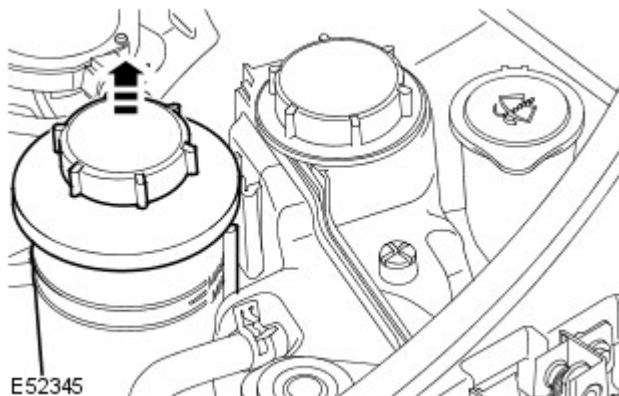
For additional information, refer to: [Cooling Fan](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).

Engine Cooling - TDV6 2.7L Diesel - Engine Coolant Level Switch

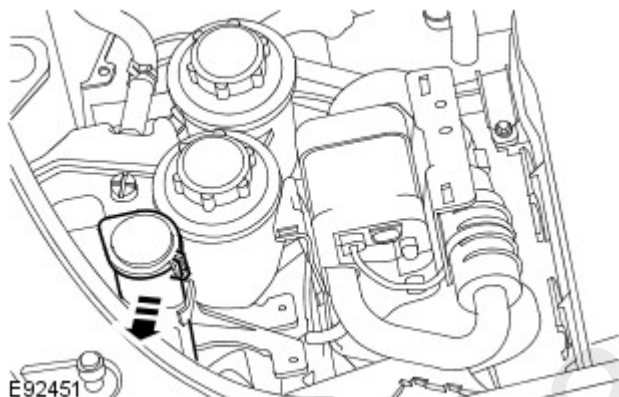
Removal and Installation

Removal

1. Release the power steering fluid reservoir from the bracket.

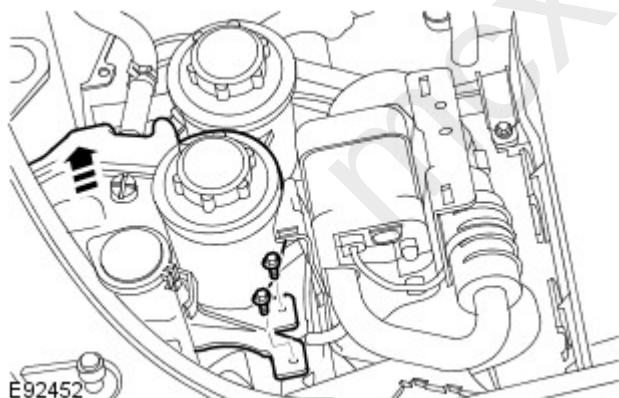


2. Release the windshield washer reservoir filler neck.



3. Reposition the coolant expansion tank.

- Remove the 2 bolts.



4. Remove the engine coolant level switch.

Installation

1. Disconnect the engine coolant level switch electrical connector. **NOTE:** A click can be heard when the engine coolant level switch is correctly installed.

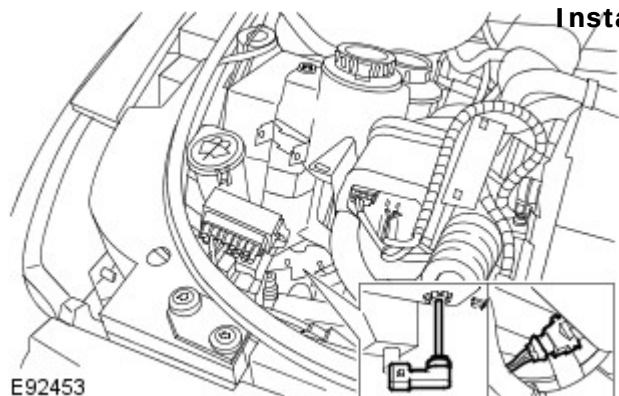
Install the engine coolant level switch.

- Connect the engine coolant level switch electrical connector.

3. Secure the windshield washer reservoir filler neck.
2. **CAUTION:** Make sure that the component is correctly located on the locating pegs.

Secure the coolant expansion tank.

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



Engine Cooling - TDV6 2.7L Diesel - Radiator

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. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).

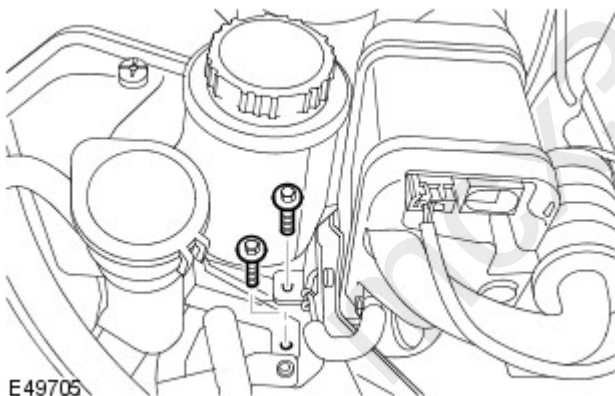
3.  **WARNING:** Since injury such as scalding could be caused by escaping steam or coolant, do not remove the filler cap from the coolant expansion tank while the system is hot.

Drain the cooling system.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).

4. Remove the cooling fan lower shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
5. Remove the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
6. Remove the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
7. Release the coolant expansion tank.

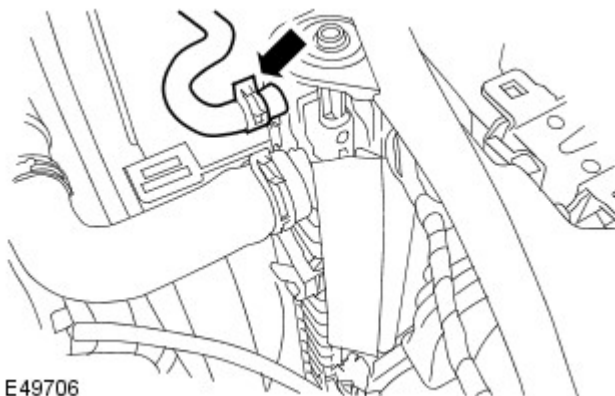
- Remove the 2 bolts.



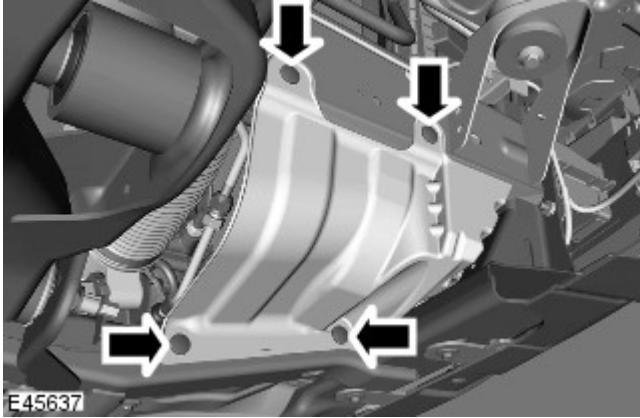
E49705

8. Disconnect the radiator bleed hose.

- Release the clip.



E49706



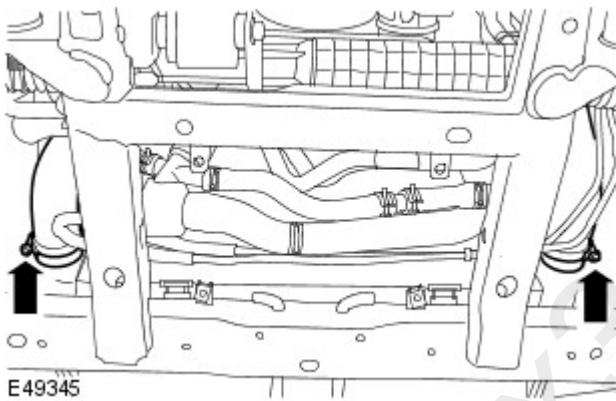
9. Remove the front RH splash shield.

- Remove the 4 retaining clips.

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

Disconnect the charge air cooler inlet hose.

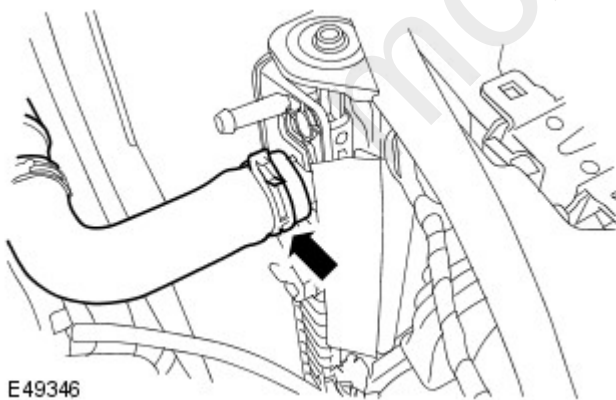
- Loosen the clip.
- Tie aside.



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

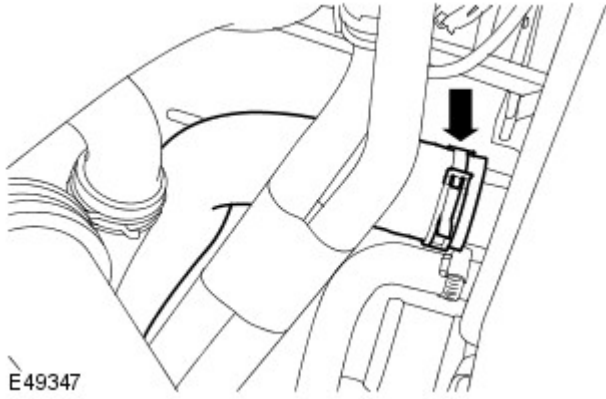
Disconnect the charge air cooler outlet hose.

- Loosen the clip.
- Tie aside.



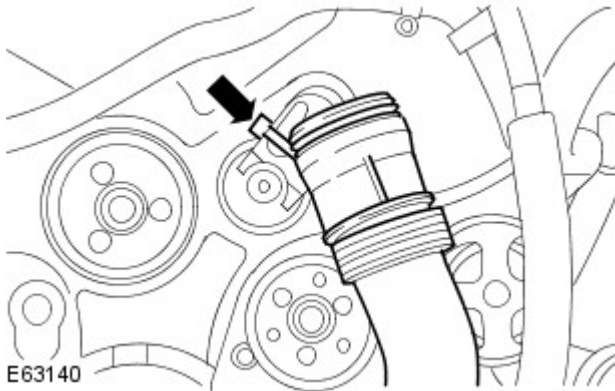
12. Disconnect the radiator upper hose.

- Release the clip.
- Tie aside.



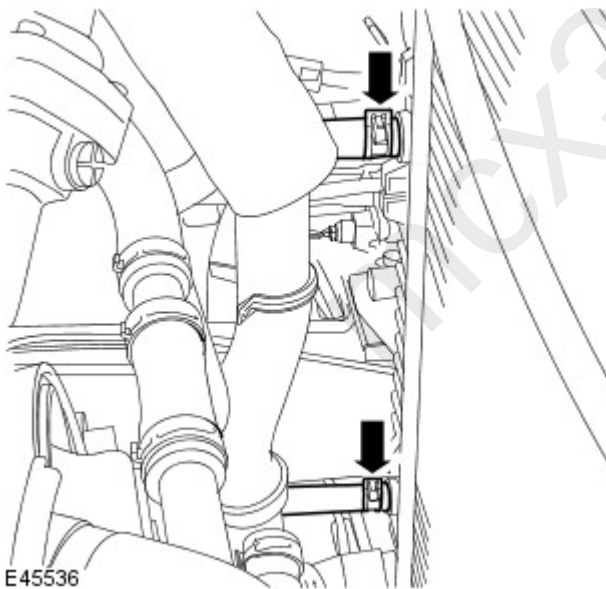
13. Disconnect the radiator lower hose.

- Release the clip.
- Tie aside.



14. Tie the engine air intake duct towards the engine.

Vehicles with automatic transmission



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

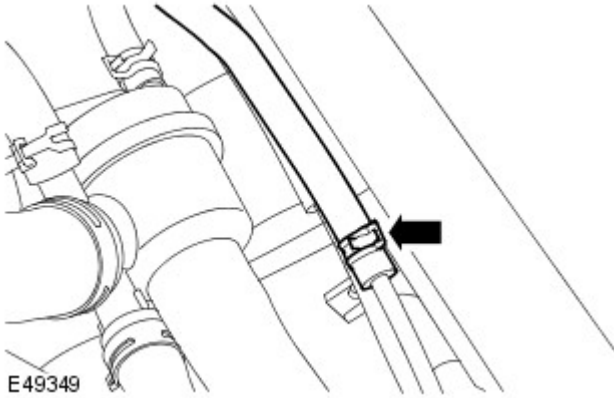
Disconnect the 2 transmission fluid cooler pipes.

- Release the clips.
- Position a container to collect the fluid spillage.
- Tie aside.

All vehicles

16. Disconnect the fuel cooler line.

- Release the clip.

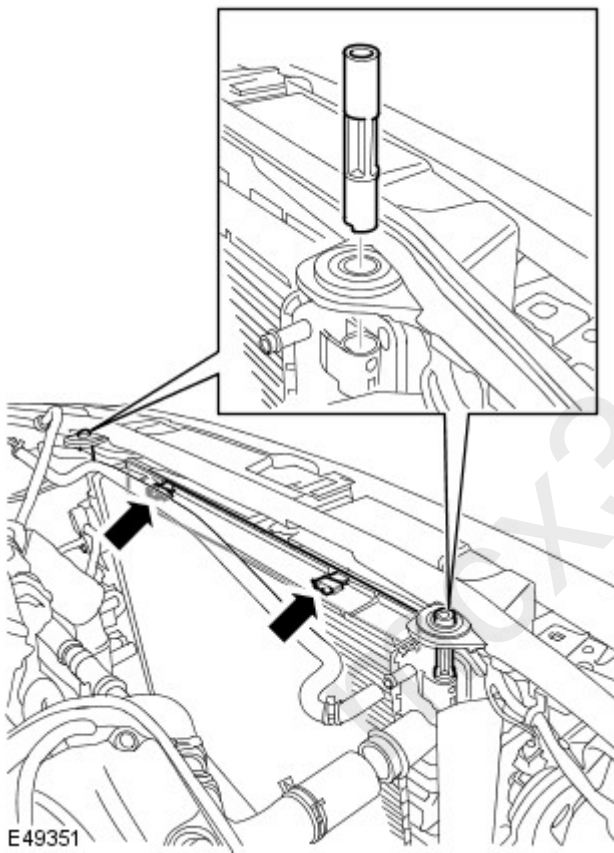


17. Remove the radiator securing pegs.

- Release the clips.

18. Remove the radiator upper deflector.

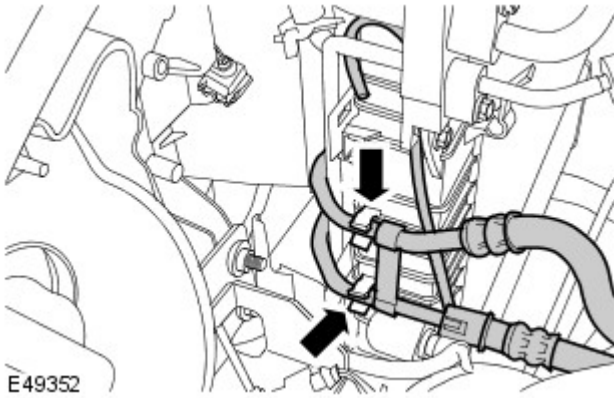
- Release the 2 clips.



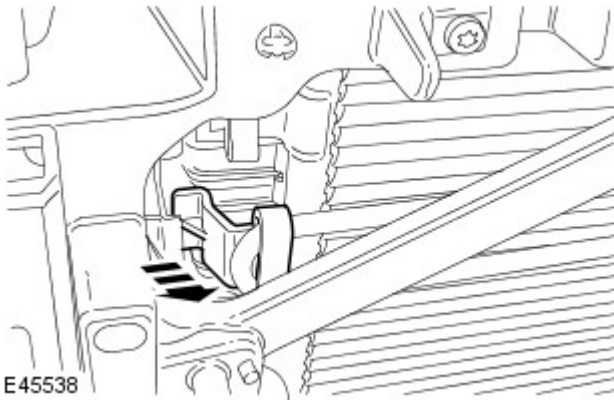
19. Release the power steering fluid cooler.

- Release the 2 clips.
- Tie the line aside.

20. Release the front differential breather line.

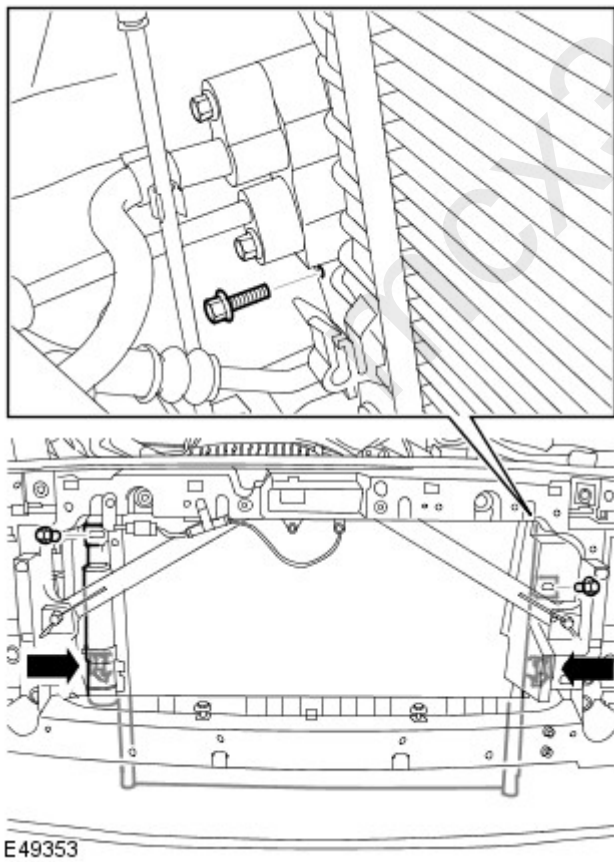


21. Remove the power steering fluid cooler line retaining clip.



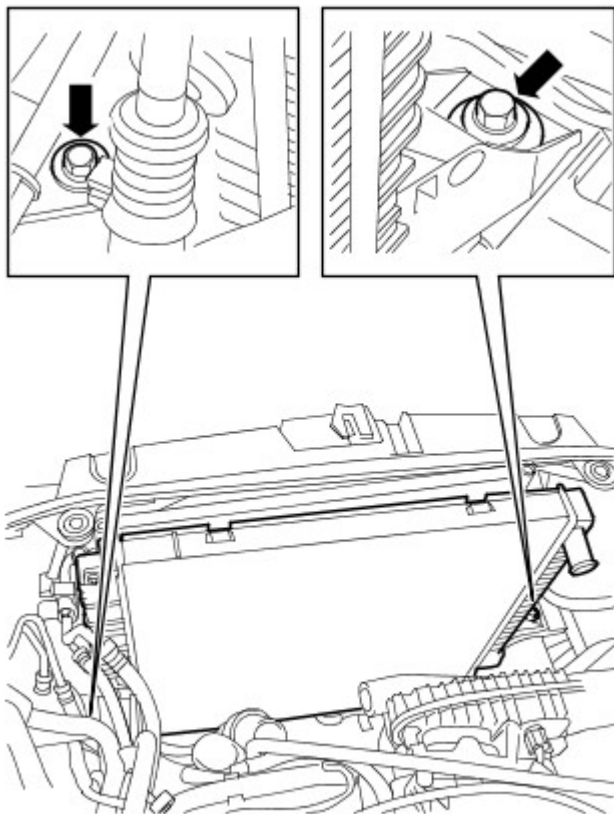
22. Release the A/C condenser.

- Remove the 3 bolts.
- Release the 2 clips.



23. Release the radiator.

- Remove the 2 bolts.
- Lift the radiator clear of its mountings.

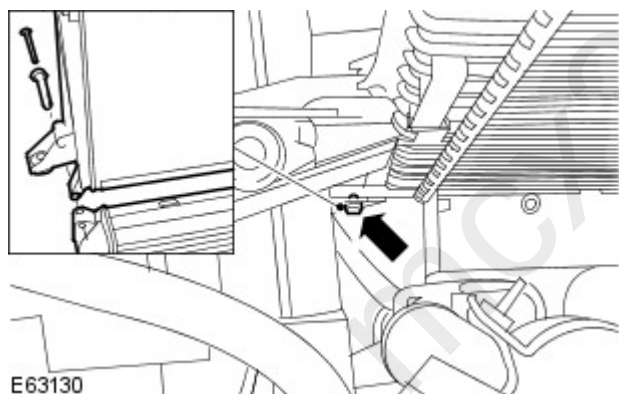


E49354

24. Tie the A/C condenser forwards, clear of the radiator.

25. NOTE: Left-hand shown, right-hand similar.

Remove the 2 clips retaining the radiator to the charge air cooler.



E63130

26. ⚠ CAUTION: Protect the radiator during this operation.

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

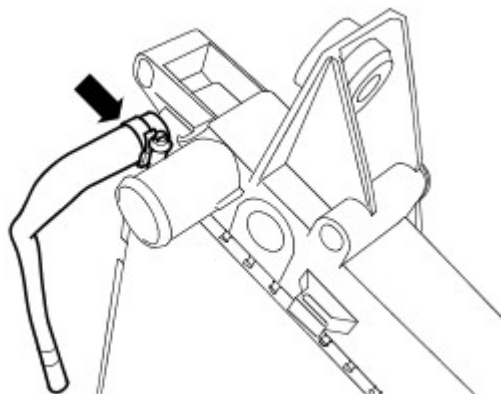
Carefully remove the radiator.

27. NOTE: Note the fitted position.

28. Remove the radiator lower deflector.

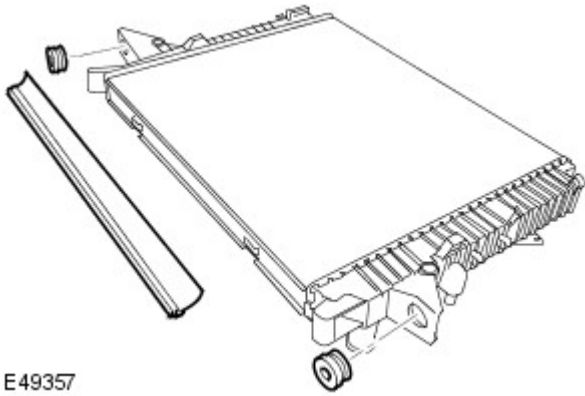
Remove the fuel cooler hose.

- Loosen the clip.



E49356

29. Remove the radiator rubber insulators.



E49357

Installation

All vehicles

1. Install the rubber insulators.
2. Install the radiator lower deflector.
3. Install the fuel cooler hose.
 - Tighten the clip.
4.  **CAUTION:** Protect the radiator during this operation.
Carefully install the radiator.
5. Install the 2 clips, to retain the charge air cooler to the radiator.
6. Position the radiator.
 - Lift the radiator onto its mountings.
 - Tighten the bolts to 25 Nm (18 lb.ft).
7. Attach the A/C condenser.
 - Remove and discard the 2 cable ties.
 - Lift it into the clips.
 - Tighten the bolt to 6 Nm (4 lb.ft).
8. Position the front differential breather line.
9. Attach the power steering fluid cooler.
 - Secure into the 3 clips.
10. Install the radiator upper deflector.
11. Install the radiator securing pegs.
12. Connect the fuel cooler line.
 - Secure with the clip.

Vehicles with automatic transmission

13. Connect the transmission fluid cooler coolant hoses.
 - Install the clips.

All vehicles

14. Install the radiator lower hose.
 - Secure with the clip.
15. Release the air intake duct.
 - Remove and discard the cable tie.
16. Connect the radiator upper hose.

- Remove and discard the cable tie.
 - Secure with the clip.
- 17.** Connect the radiator lower hose.
- Remove and discard the cable tie.
 - Secure with the clip.
- 18.** Connect the charge air outlet hose.
- Tighten the clip to 10 Nm (7 lb.ft).
- 19.** Connect the charge air inlet hose.
- Tighten the clip to 10 Nm (7 lb.ft).
- 20.** Install the front RH splash shield.
- Install the four clips.
- 21.** Secure the coolant expansion tank.
- Tighten the two retaining bolts to 10 Nm (7 lb.ft).
- 22.** Connect the radiator bleed hose.
- Secure with the clip.
- 23.** Install the LH headlamp assembly.
For additional information, refer to: [Headlamp Assembly](#) (417-01 Exterior Lighting, Removal and Installation).
- 24.** Install the radiator grille.
For additional information, refer to: [Radiator Grille](#) (501-08 Exterior Trim and Ornamentation, Removal and Installation).
- 25.** Install the cooling fan lower shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
- 26.** Connect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
- 27.** Refill the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).

Vehicles with automatic transmission

- 28.** Check automatic transmission fluid level.

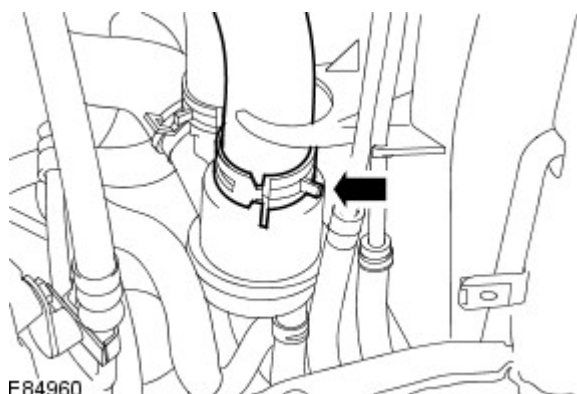
Engine Cooling - TDV6 2.7L Diesel - Thermostat

Removal and Installation

Removal

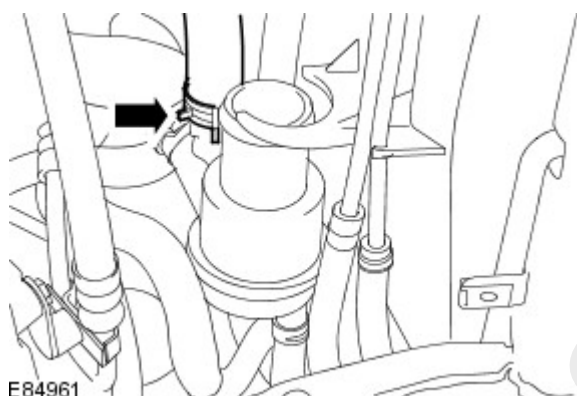
1. Drain the cooling system.
2. Position a container to collect the fluid spillage.
3. Disconnect the radiator upper hose from the thermostat.

- Release the clip.



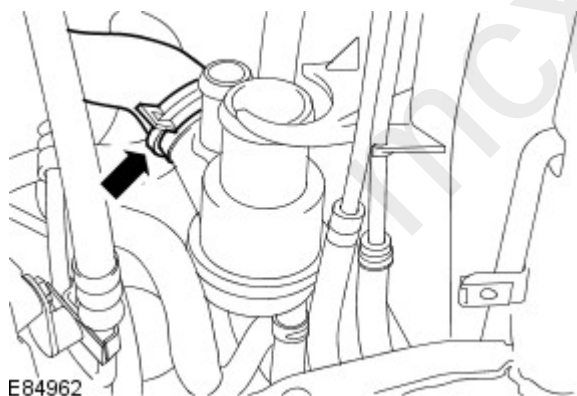
4. Disconnect the heater hose from the thermostat.

- Release from the clip.



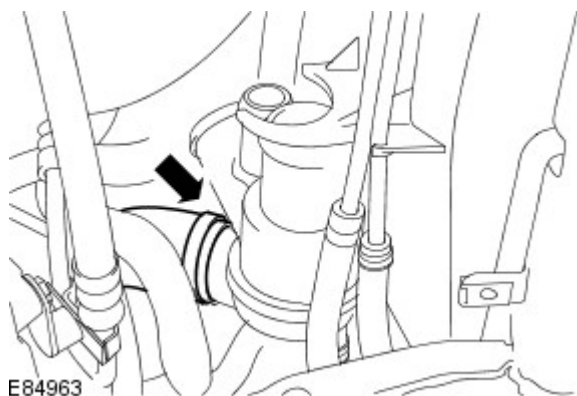
5. Disconnect the engine inlet hose from the thermostat.

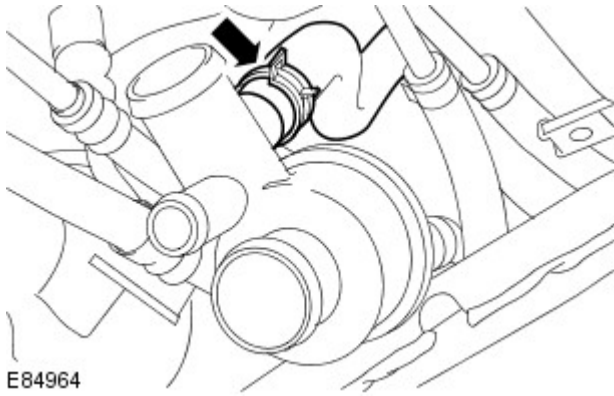
- Release the clip.



6. Disconnect the radiator lower hose from the thermostat.

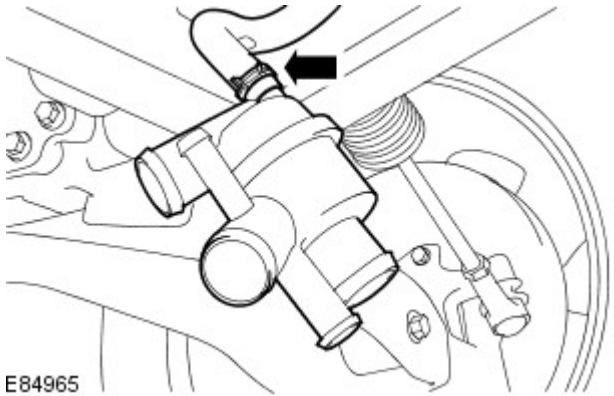
- Release the clip.





7. Disconnect the coolant expansion tank hose from the thermostat.

- Release the clip.



8. Remove the thermostat.

- Disconnect the coolant hose from the thermostat.

9. Remove the container.

Installation

1. Install the thermostat.

- Connect the coolant hose to the thermostat.
- Secure with the clip.

2. Connect the coolant expansion tank hose to the thermostat.

- Secure with the clip.

3. Connect the radiator lower hose to the thermostat.

- Secure with the clip.

4. Connect the engine inlet hose to the thermostat.

- Secure with the clip.

5. Connect the heater hose to the thermostat.

- Secure with the clip.

6. Connect the radiator upper hose to the thermostat.

- Secure with the clip.
- Position the radiator upper hose to the cooling fan shroud.

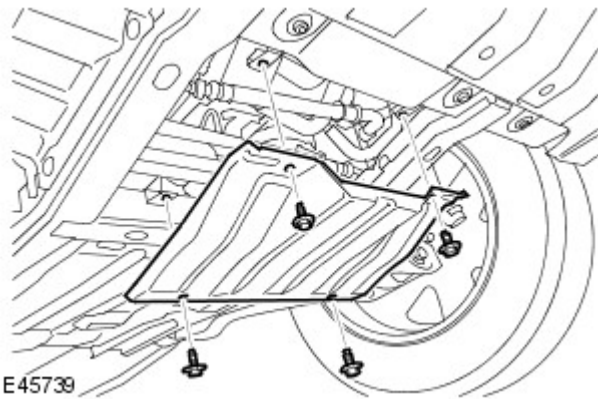
7. Refill and bleed the cooling system.

Engine Cooling - TDV6 2.7L Diesel - Thermostat Housing

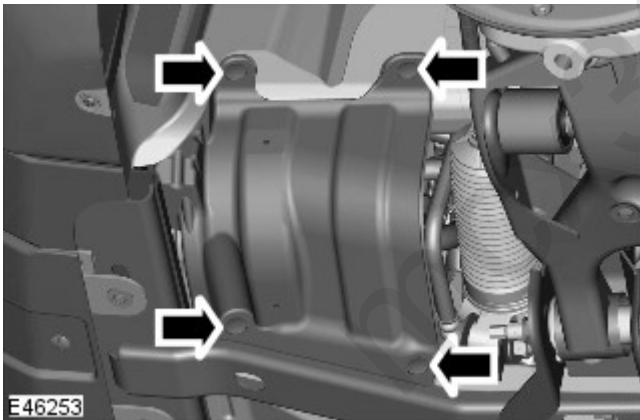
Removal and Installation

Removal

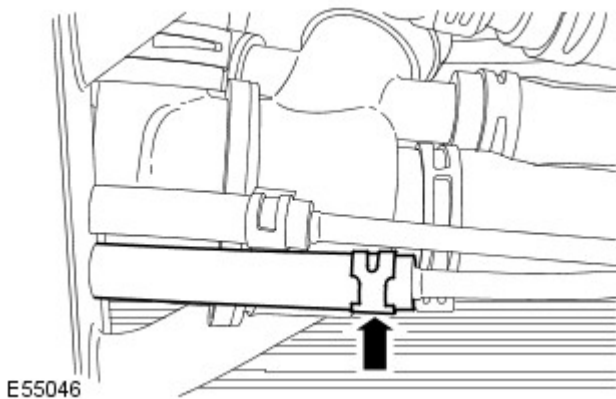
1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).
3. Remove the cooling fan shroud.
For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
4. Remove the radiator access panel.
 - Remove the four retaining bolts.



5. Remove the front LH splash shield.
 - Remove the four clips.

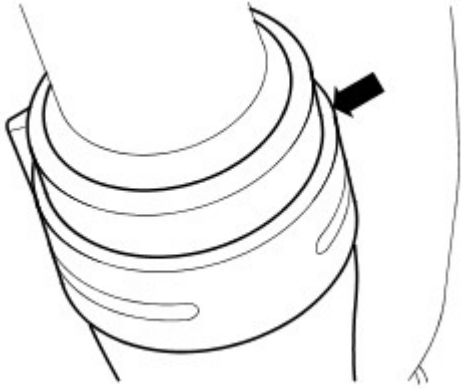


6. Disconnect the fuel cooler return hose from the thermostat.
 - Release the clip.



7. Disconnect the heater return hose from the heater return pipe.

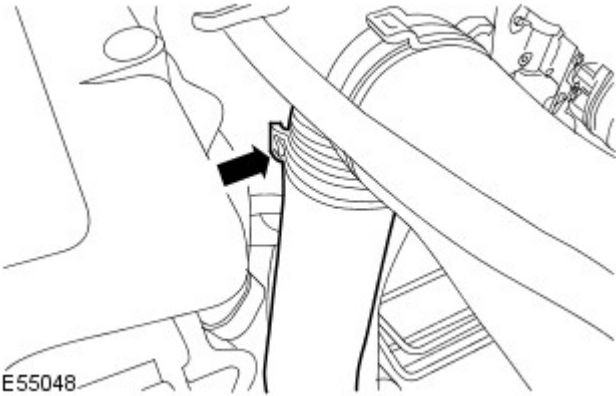
- Release from the clip.



E55056

8. Disconnect the thermostat to top hose 'T' piece hose.

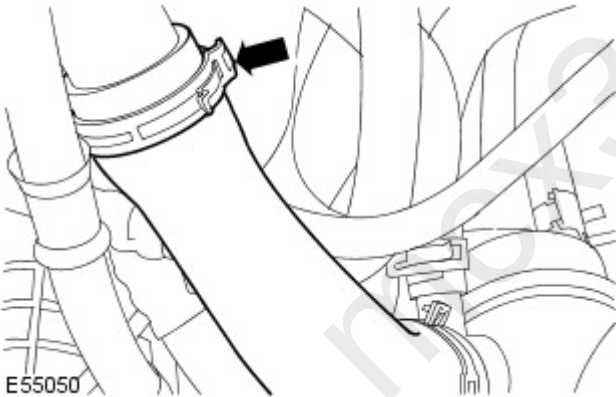
- Release from the clip.



E55048

9. Disconnect the thermostat hose from the engine coolant rail.

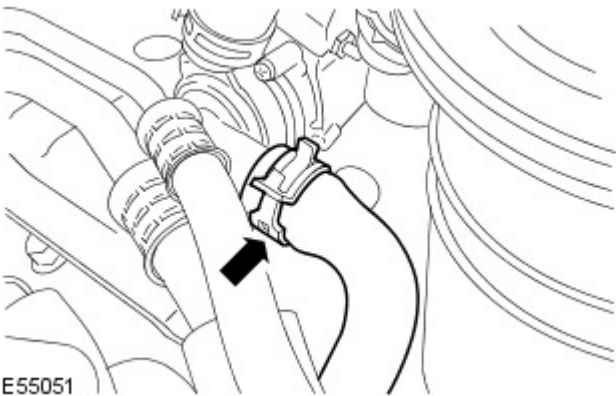
- Release the clip.



E55050

10. Disconnect the thermostat to fuel fired heater hose from the fuel fired heater.

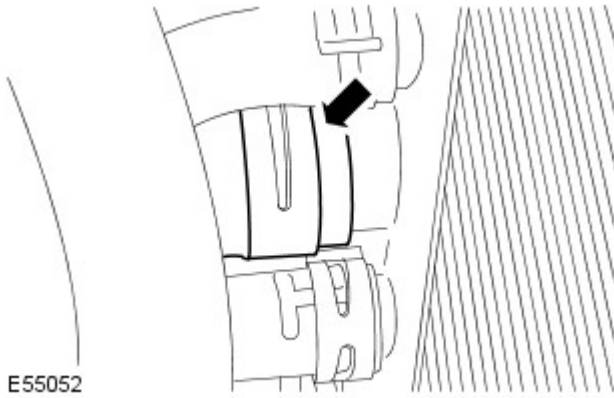
- Release the clip.



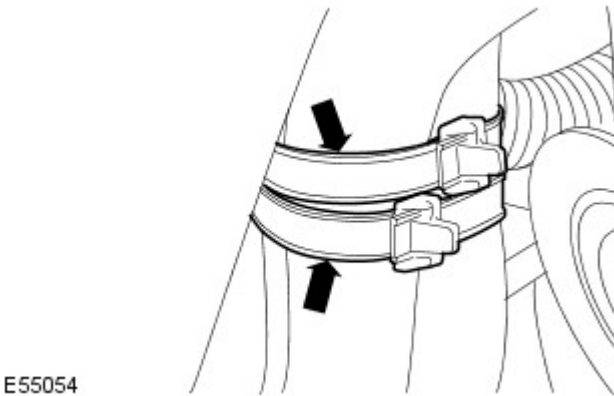
E55051

11. Disconnect the radiator lower hose from the radiator.

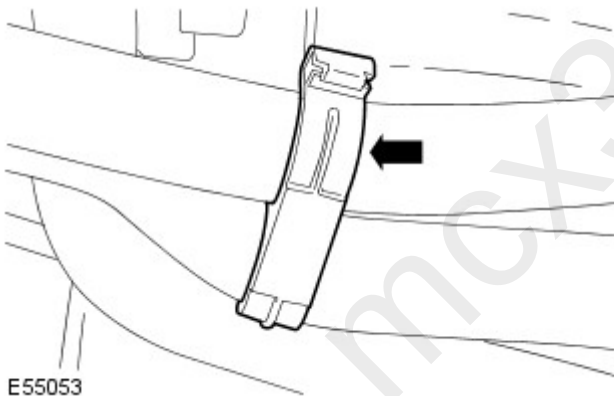
- Release the clip.



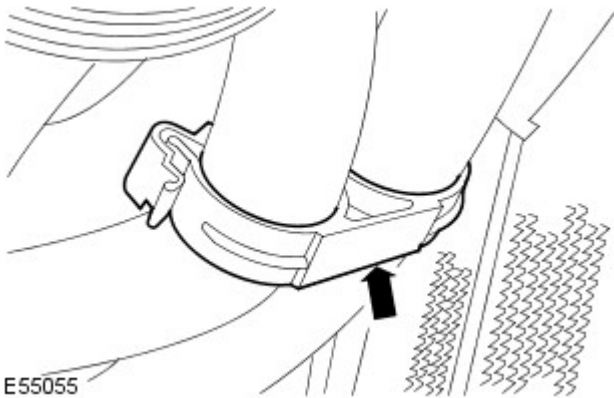
12. Release the securing straps.



13. Release the coolant hose retaining clip.



14. Release the coolant hose retaining clip.



15. Remove the thermostat and hose assembly.

Installation

1. Install the thermostat and hose assembly.

2. Install the coolant hose retaining clip.
3. Install the coolant hose retaining clip.
4. Install the securing straps.
5. Connect the radiator lower hose to the radiator.
6. Connect the thermostat to fuel fired heater hose to the fuel fired heater.
7. Connect the thermostat hose to the engine coolant rail.
8. Connect the thermostat to top hose 'T' piece hose.
9. Connect the heater return hose to the heater return pipe.
10. Connect the fuel cooler return hose to the thermostat.
11. Install the front LH splash shield.
 - Install the four clips.
12. Install the radiator access panel.
 - Install the four retaining bolts.
13. Install the cooling fan shroud.

For additional information, refer to: [Cooling Fan Shroud](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, Removal and Installation).
14. Connect the battery ground cable.

For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
15. Refill and bleed the cooling system.

For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).

Engine Cooling - TDV6 2.7L Diesel - Coolant Pump

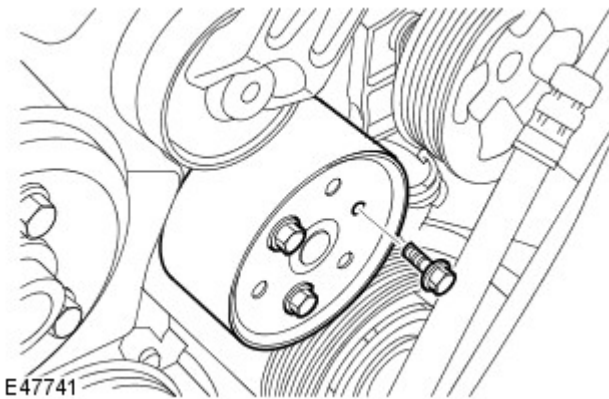
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).
3. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
4. **NOTE: Loosen the bolts prior to removing the accessory drive belt.**

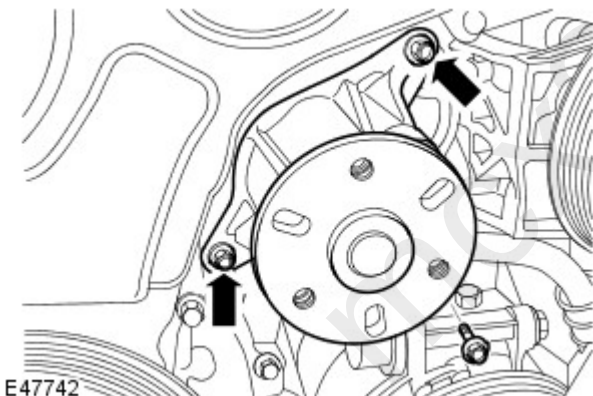
Remove the coolant pump pulley.

- Remove the 3 bolts.



5. Remove the coolant pump.

- Remove the 3 bolts.
- Discard the O-ring seal.



Installation

1. Install the coolant pump.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Install the coolant pump pulley.
 - Clean the components.
 - Tighten the bolts to 25 Nm (18 lb.ft).
3. Install the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
4. Refill and bleed the cooling system.
For additional information, refer to: [Cooling System Draining, Filling and Bleeding](#) (303-03A Engine Cooling - TDV6 2.7L Diesel, General Procedures).

Diesel, General Procedures).

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Engine Cooling - TDV6 2.7L Diesel - Water Pump

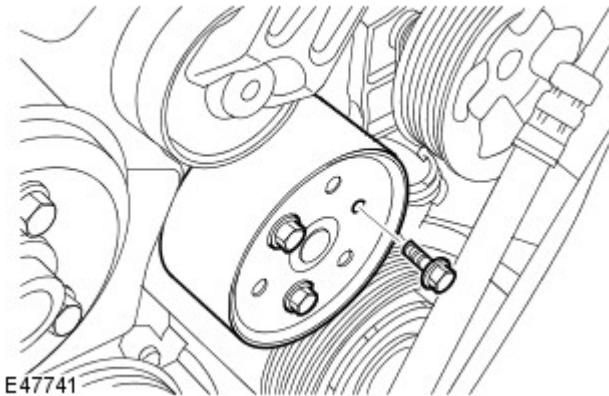
Removal and Installation

Removal

1. Disconnect the battery ground cable.
For additional information, refer to: [Specifications](#) (414-00 Battery and Charging System - General Information, Specifications).
2. Drain the cooling system.
For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).
3. Remove the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
4. **NOTE:** Loosen the bolts prior to removing the accessory drive belt.

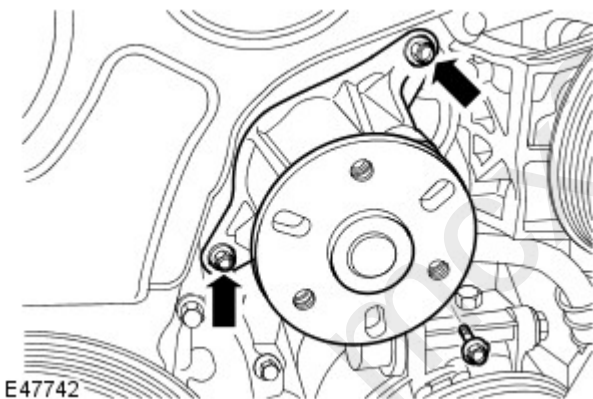
Remove the coolant pump pulley.

- Remove the 3 bolts.



5. Remove the coolant pump.

- Remove the 3 bolts.
- Discard the O-ring seal.



Installation

1. Install the coolant pump.
 - Clean the component mating faces.
 - Install a new O-ring seal.
 - Tighten the bolts to 10 Nm (7 lb.ft).
2. Install the coolant pump pulley.
 - Clean the components.
 - Tighten the bolts to 25 Nm (18 lb.ft).
3. Install the accessory drive belt.
For additional information, refer to: [Accessory Drive Belt](#) (303-05A Accessory Drive - TDV6 2.7L Diesel, Removal and Installation).
4. Refill and bleed the cooling system.
For additional information, refer to: Cooling System Draining, Filling and Bleeding (303-03, General Procedures).

