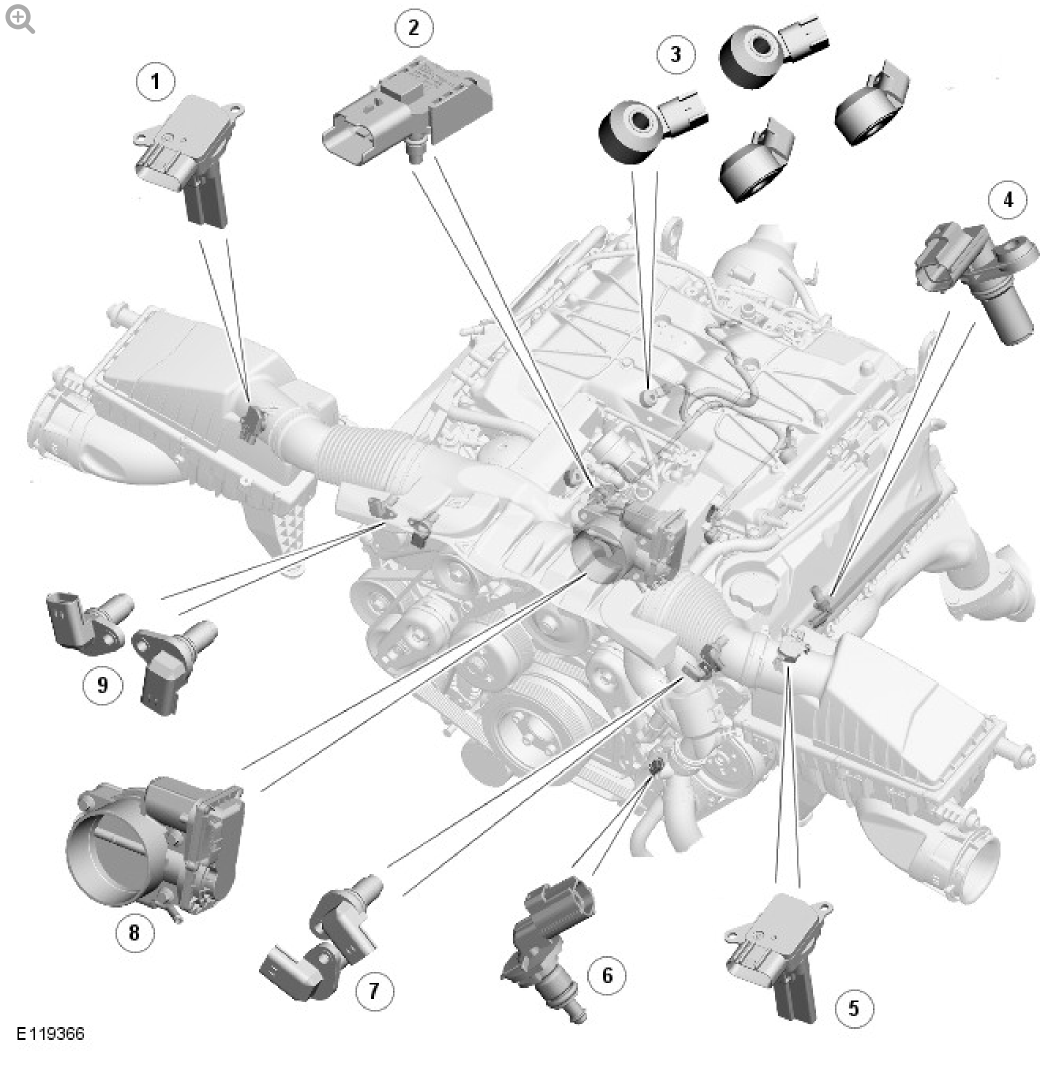
2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

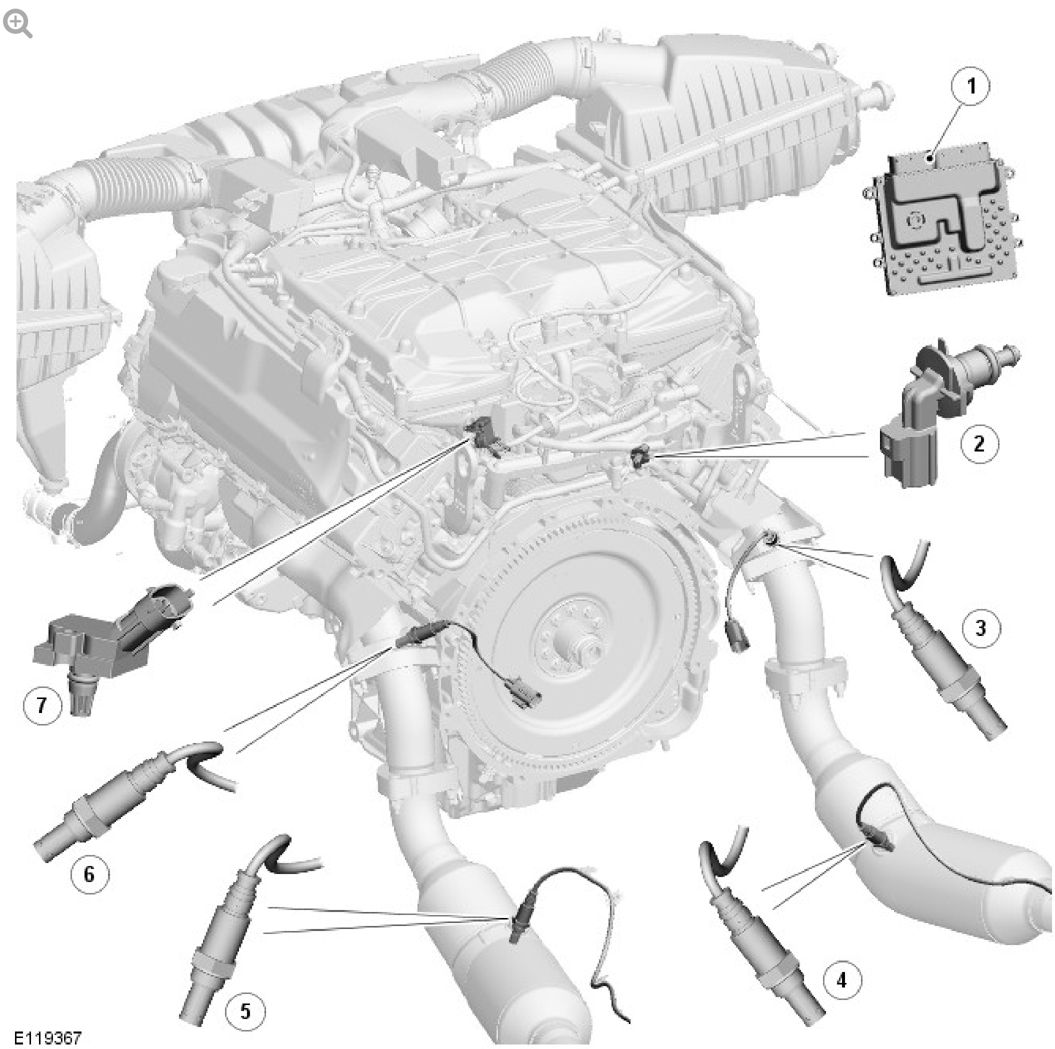
DESCRIPTION AND OPERATION

COMPONENT LOCATION - SHEET 1 OF 3



ITEM	DESCRIPTION
1	MAFT (mass air flow and temperature) sensor
2	MAP (manifold absolute pressure) sensor
3	Knock sensors
4	CKP (crankshaft position) sensor
5	MAFT sensor
6	ECT (engine coolant temperature) sensor (ECT 2)
7	CMP (camshaft position) sensors
8	Electronic throttle
9	CMP sensors

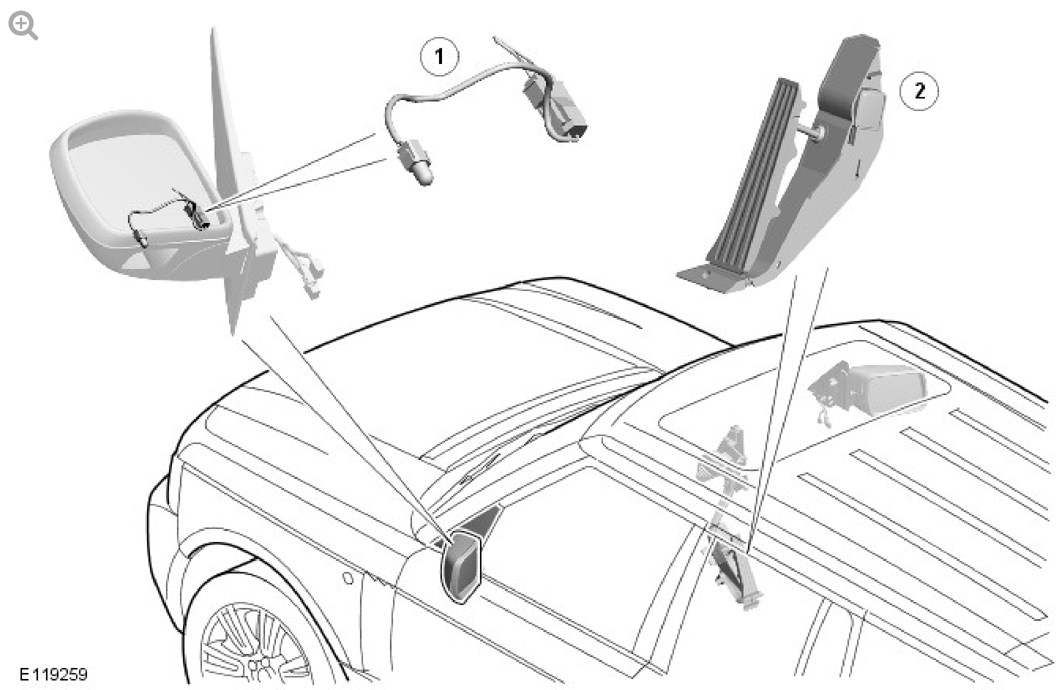
COMPONENT LOCATION - SHEET 2 OF 3



ITEM DESCRIPTION

ITEM	DESCRIPTION
1	ECM (engine control module)
2	ECT sensor (ECT 1)
3	Upstream HO2S (heated oxygen sensor)
4	Downstream HO2S
5	Downstream HO2S
6	Upstream HO2S
7	MAPT (manifold absolute pressure and temperature) sensor

COMPONENT LOCATION - SHEET 3 OF 3



ITEM	DESCRIPTION
1	AAT (ambient air temperature) sensor
2	APP (accelerator pedal position) sensor

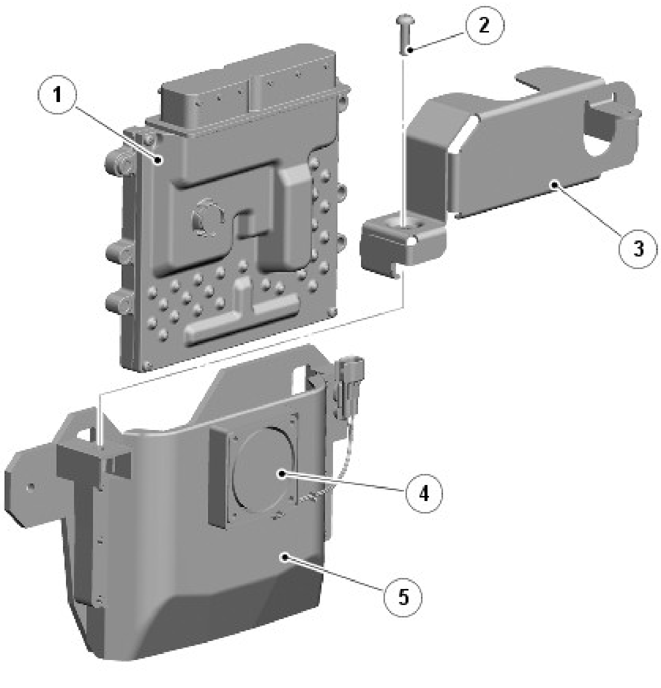
INTRODUCTION

The EEC (electronic engine control) system operates the engine to generate the output demanded by the accelerator pedal and loads imposed by other systems. The EEC system has an ECM (engine control module) that uses a torque-based strategy to evaluate inputs from sensors and other systems, then produces outputs to engine actuators to produce the required torque.

The EEC system controls the following:

- Charge air
- Fueling
- Ignition timing
- Valve timing
- Cylinder knock
- Idle speed
- Engine cooling fan
- Evaporative emissions
- On-board diagnostics
- Immobilization system interface
- Speed control.

ENGINE CONTROL MODULE



ITEM	DESCRIPTION
1	ECM
2	Screw
3	Cover
4	Cooling fan
5	ECM and cooling fan mounting bracket

The ECM is installed in the passenger side protective box in the engine compartment, on a bracket attached to the suspension housing. The bracket also contains an electric cooling fan. The ECM, which has an internal temperature sensor, controls the operation of the cooling fan. While the ignition is on, the cooling fan receives a power supply from the ECM relay in the EJB (engine junction box). When cooling is required, the ECM connects the cooling fan to ground.

The ECM has the capability of adapting its fuel and ignition control outputs in response to several sensor inputs.

The ECM receives inputs from the following:

- CKP (crankshaft position) sensor.
- CMP (camshaft position) sensors (4 off).
- ECT (engine coolant temperature) sensor.
- Knock sensors (4 off).
- MAP (manifold absolute pressure) sensor.
- MAFT (mass air flow and temperature) sensors (2 off).
- MAPT (manifold absolute pressure and temperature) sensor.
- Throttle position sensor.
- Heated oxygen sensors (4 off).
- APP (accelerator pedal position) sensor.
- Ambient air temperature sensor.
- FRP (fuel rail pressure) sensor.
  For additional information, refer to: Fuel Charging and Controls (303-04E

Fuel Charging and Controls - V8 S/C 5.0L Petrol, Description and Operation).

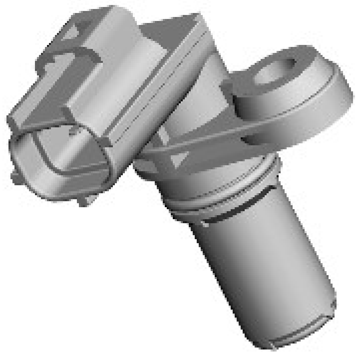
- Engine cooling fan.
  For additional information, refer to: Engine Cooling (303-03C Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).
- Stoplamp switch.
  For additional information, refer to: Anti-Lock Control - Traction Control (206-09A Anti-Lock Control - Traction Control, Description and Operation).
- Speed control cancel/suspend switch.
  For additional information, refer to: Speed Control (310-03C Speed Control - V8 5.0L Petrol/V8 S/C 5.0L Petrol, 5.0L, Description and Operation).
- Oil level and temperature sensor.
  For additional information, refer to: Engine (303-01D Engine - V8 S/C 5.0L Petrol, Description and Operation).
- Fuel LP (low pressure) sensor.
  For additional information, refer to: Fuel Tank and Lines (310-01C Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).
- Fuel pump driver module.
  For additional information, refer to: Fuel Tank and Lines (310-01C Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

The ECM provides outputs to the following:

- Electronic throttle.
- Main relay.
- Heaters elements of the heated oxygen sensors (4 off).
- Fuel injectors (8 off).
  For additional information, refer to: Fuel Charging and Controls (303-04E Fuel Charging and Controls - V8 S/C 5.0L Petrol, Description and Operation).
- Ignition coils (8 off)

- Ignition coils (8 off).
  For additional information, refer to: Engine Ignition (303-07A Engine Ignition - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).
- VCT (variable camshaft timing) solenoids (4 off).
  For additional information, refer to: Engine (303-01D Engine - V8 S/C 5.0L Petrol, Description and Operation).
- EVAP (evaporative emission) canister purge valve. For additional information, refer to 303-15: Evaporative Emissions - 5.0L, Description and Operation.
- Engine starter relay.
  For additional information, refer to: Starting System (303-06C Starting System - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).
- Engine cooling fan.
  For additional information, refer to: Engine Cooling (303-03C Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).
- Charge air coolant pump relay.
  For additional information, refer to: Supercharger Cooling (303-03D Supercharger Cooling, Description and Operation).
- Generator.
  For additional information, refer to: Generator (414-02C Generator and Regulator - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).
- HP fuel pumps.
  For additional information, refer to: Fuel Charging and Controls (303-04E Fuel Charging and Controls - V8 S/C 5.0L Petrol, Description and Operation).
- Fuel pump driver module.
  For additional information, refer to: Fuel Tank and Lines (310-01C Fuel Tank and Lines - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).
- DMTL (diagnostic module - tank leakage). For additional information, refer to 303-15: Evaporative Emissions - 5.0L, Description and Operation.

CRANKSHAFT POSITION SENSOR


E116086

The CKP sensor is an inductive sensor that allows the ECM to determine the angular position of the crankshaft and the engine speed.

The CKP sensor is installed in the rear left side of the sump body, in line with the engine drive plate. The sensor is secured with a single screw and sealed with an O-ring. A two pin electrical connector provides the interface with the engine harness.

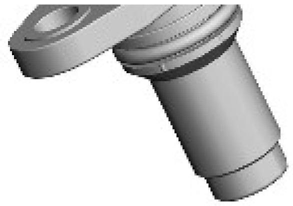
The head of the CKP sensor faces a reluctor ring pressed into the outer circumference of the engine drive plate. The reluctor ring has a 60 minus 2 tooth pattern. There are 58 teeth at 6° intervals, with two teeth removed to provide a reference point with a centerline that is 21° BTDC (before top dead center) on cylinder 1 of bank A.

If the CKP sensor fails, the ECM:

- Uses signals from the CMP sensors to determine the angular position of the crankshaft and the engine speed
- Adopts a limp home mode where engine speed is limited to a maximum of 3000 rev/min.

With a failed CKP sensor, engine starts will require a long crank time while the ECM determines the angular position of the crankshaft.

CAMSHAFT POSITION SENSORS



E116087

The CMP sensors are MRE (magneto resistive element) sensors that allow the ECM to determine the angular position of the camshafts. MRE sensors produce a digital output which allows the ECM to detect speeds down to zero.

The four CMP sensors are installed in the front upper timing covers, one for each camshaft.

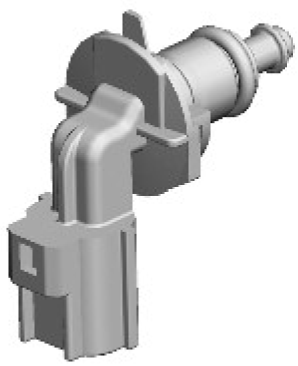
Each CMP sensor is secured with a single screw and sealed with an O-ring. On each CMP sensor, a three pin electrical connector provides the interface with the engine harness.

The head of each CMP sensor faces a sensor wheel attached to the front of the related VCT unit.

If a CMP sensor fails, the ECM:

- Defaults to base mapping for the ignition timing, with no cylinder correction
- Disables the VCT system.

ENGINE COOLANT TEMPERATURE SENSORS



E108397

The ECT sensors are NTC (negative temperature coefficient) thermistors that allow the ECM to monitor the engine coolant temperature.

There are two identical ECT sensors installed, which are identified as ECT 1 and ECT 2. Each sensor is secured with a twist-lock and latch mechanism, and is sealed with an O-ring. A two pin electrical connector provides the interface between the sensor and the engine harness.

ECT 1

ECT 1 is installed in the heater manifold, at the rear of the RH (right-hand) cylinder head. The input from this sensor is used in calibration tables and by other systems.

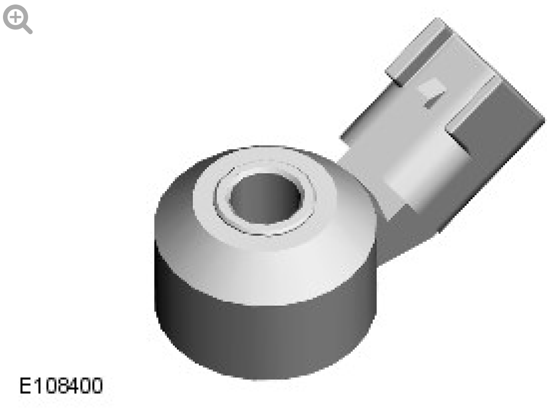
If there is an ECT 1 fault, the ECM adopts an estimated coolant temperature. On the second consecutive trip with an ECT 1 fault, the ECM illuminates the MIL (malfunction indicator lamp).

ECT 2

ECT 2 is installed in the lower hose connector which attaches to the bottom of the thermostat. The input from this sensor is used for OBD (on-board diagnostic) 2 diagnostics and, in conjunction with the input from ECT 1, to confirm that the thermostat is functional.

If there is an ECT 2 fault, the ECM illuminates the MIL on the second consecutive trip.

KNOCK SENSORS



The knock sensors are piezo-ceramic sensors that allow the ECM to employ active knock control and prevent engine damage from pre-ignition or detonation.

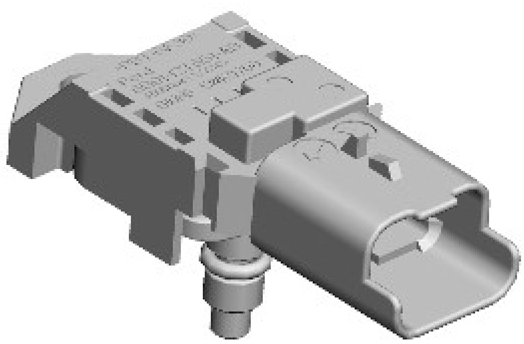
Two knock sensors are installed on the inboard side of each cylinder head, one mid-way between cylinders 1 and 2, and one mid-way between cylinders 3 and 4. Each knock sensor is secured with a single screw. On each knock sensor, a two pin electrical connector provides the interface with the engine harness.

The ECM compares the signals from the knock sensors with mapped values stored in memory to determine when detonation occurs on individual cylinders. When detonation is detected, the ECM retards the ignition timing on that cylinder for a number of engine cycles, then gradually returns it to the original setting.

The ECM cancels closed loop control of the ignition system if the signal received from a knock sensor becomes implausible. In these circumstances the ECM defaults to base mapping for the ignition timing. This ensures the engine will not become damaged if low quality fuel is used. The MIL will not illuminate, although the driver may notice that the engine 'pinks' in some driving conditions and displays a drop in performance and smoothness.

The ECM calculates the default value if one sensor fails on each bank of cylinders.

MANIFOLD ABSOLUTE PRESSURE SENSOR



E108402

The MAP sensor allows the ECM to calculate the load on the engine, which is used in the calculation of fuel injection time.

The MAP sensor is installed in the air inlet of the SC (supercharger). The sensor is secured with a single screw and sealed with an O-ring. A three pin electrical connector provides the interface with the engine harness.

If the MAP sensor fails, the ECM adopts a default value of 1 bar (14.5 lbf/in.^{2}).

With a failed MAP sensor, the engine will suffer from poor starting, rough running and poor driveability.

MASS AIR FLOW AND TEMPERATURE SENSORS

E116091

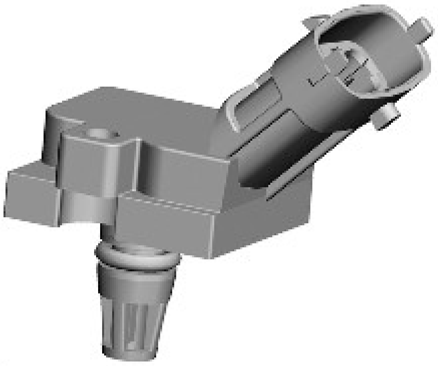
The MAFT sensors allow the ECM to measure the mass and the temperature of the air flow into the engine. The mass air flow is measured with a hot film element in the sensor. The temperature of the air flow is measured with a NTC thermistor in the sensor. The mass air flow is used to determine the fuel quantity to be injected in order to maintain the stoichiometric air:fuel mixture required for correct operation of the engine and the catalytic converters.

There are two MAFT sensors installed, one in each air cleaner outlet duct. Each MAFT sensor is secured with two screws and sealed with an O-ring. On each MAFT sensor, a five pin electrical connector provides the interface with the engine harness.

If the hot film element signal fails the ECM invokes a software backup strategy to calculate the mass air flow from other inputs. Closed loop fuel control, closed loop idle speed control and evaporative emissions control are discontinued. The engine will suffer from poor starting, poor throttle response and, if the failure occurs while driving, the engine speed may dip before recovering.

If the NTC thermistor signal fails the ECM adopts a default value of 25 °C (77 °F) for the intake air temperature.

MANIFOLD ABSOLUTE PRESSURE AND TEMPERATURE SENSOR



E116088

The MAPT sensor allows the ECM to calculate the air charge density immediately before it enters the cylinders. This is used to adjust the ignition timing relative to the boost pressure, and to monitor the performance of the charge air coolers.

The MAPT sensor is installed in the rear of the LH intake manifold. The sensor is secured with a single screw and sealed with an O-ring. A four pin electrical connector provides the interface with the engine harness.

THROTTLE POSITION SENSORS

The TP (throttle position) sensors allow the ECM to determine the position and angular rate of change of the throttle blade.

There are two TP sensors located in the electronic throttle. See below for details of the electronic throttle.

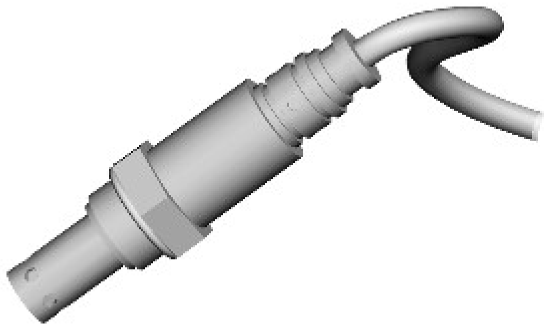
If a TP sensor fails, the ECM:

- Adopts a limp home mode where engine speed is limited to a maximum of approximately 2000 rev/min

- Discontinues evaporative emissions control
- Discontinues closed loop control of engine idle speed.

With a failed TP sensor, the engine will suffer from poor running and throttle response.

HEATED OXYGEN SENSORS



E119261

The heated oxygen sensors allow the ECM to measure the oxygen content of the exhaust gases, for closed loop control of the air:fuel mixture and for catalytic converter monitoring.

An upstream heated oxygen sensor is installed in the outlet of each exhaust manifold, which enables independent control of the air:fuel mixture for each cylinder bank. A downstream heated oxygen sensor is installed in each catalytic converter, which enables the performance of the catalytic converters to be monitored.

Oxygen sensors need to operate at high temperatures in order to function correctly. To achieve the high temperatures required, the sensors are fitted with heater elements that are controlled by a PWM (pulse width modulation) signal from the ECM. The heater elements are operated immediately after each engine start and during low load conditions when the temperature of the exhaust gases is insufficient to maintain the required sensor temperature. The PWM duty cycle is carefully controlled to prevent thermal shock to cold sensors. A non-functioning heater delays the sensor's readiness for closed loop control and increases emissions.

The upstream heated oxygen sensors produce a constant voltage, with a variable current that is proportional to the lambda ratio. The downstream heated oxygen sensors produce an output voltage dependant on the ratio of the exhaust gas oxygen to the ambient oxygen.

The heated oxygen sensors age with mileage, increasing their response time to switch from rich to lean and lean to rich. This increase in response time influences the ECM closed loop control and leads to progressively increased emissions. Measuring the period of rich to lean and lean to rich switching monitors the response rate of the upstream sensors.

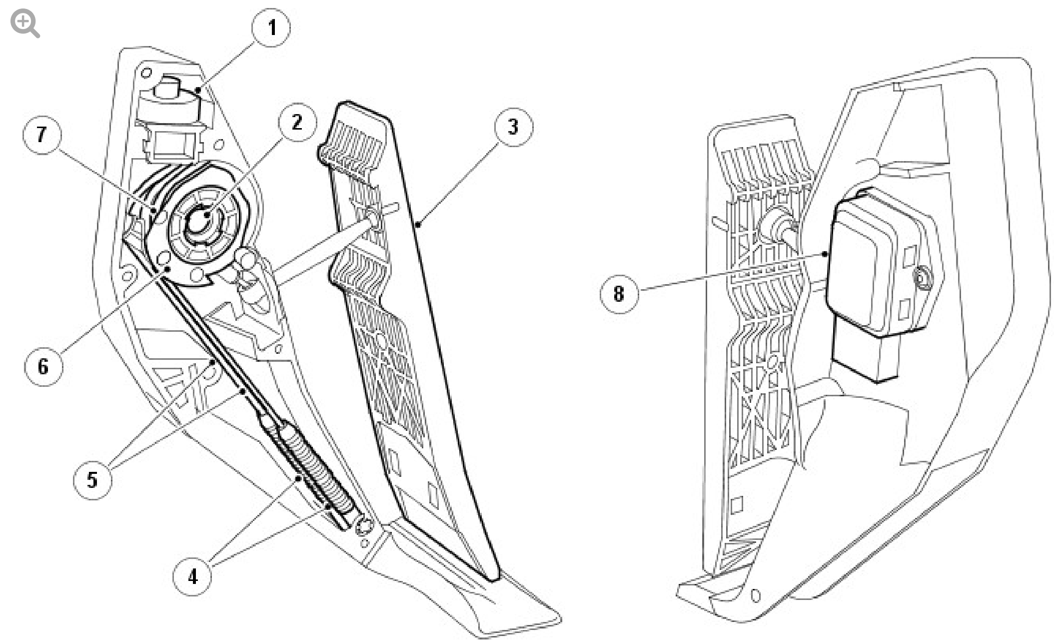
Diagnosis of electrical faults is continually monitored in both the upstream and downstream sensors. This is achieved by checking the signal against maximum and minimum threshold, for open and short circuit conditions.

If a heated oxygen sensor fails:

- The ECM defaults to open loop fueling for the related cylinder bank
- The CO (carbon monoxide) and emissions content of the exhaust gases increases
- The exhaust smells of rotten eggs (hydrogen sulphide).

With a failed heated oxygen sensor, the engine will suffer from unstable operation and reduced performance.

ACCELERATOR PEDAL POSITION SENSOR



M180772

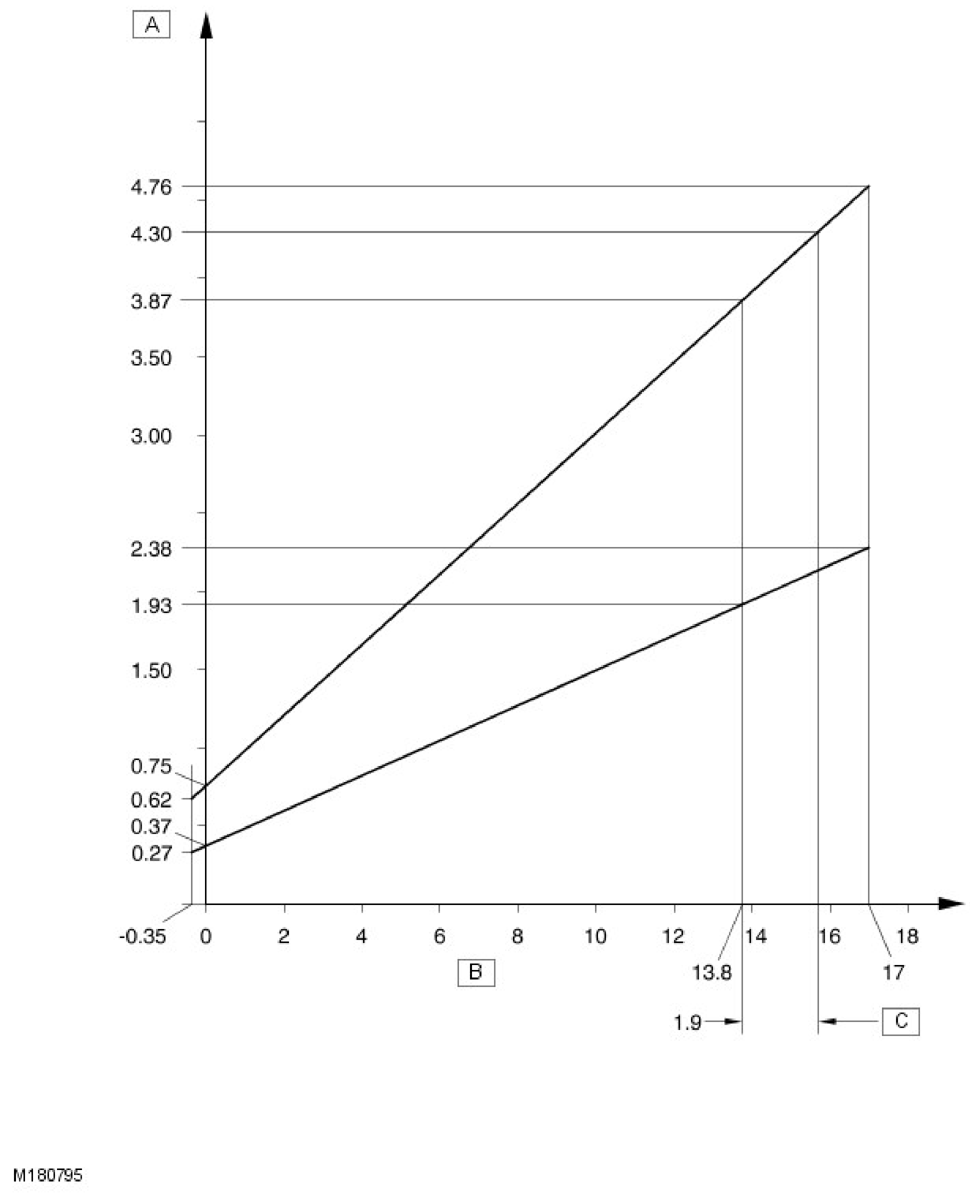
ITEM	DESCRIPTION
1	Detente mechanism
2	Sensor spigot
3	Pedal
4	Springs
5	Cables
6	Bush
7	Drum
8	APP sensor

The APP sensor allows the ECM to determine the driver requests for vehicle speed, acceleration and deceleration. The ECM uses this information to determine the setting of the electronic throttle.

The APP sensor is located on the accelerator pedal and secured with two Torx screws. The sensor has a six pin connector which provides the interface with the vehicle harness.

The APP sensor has a spigot which protrudes into the housing of the accelerator pedal and provides the pivot point for the pedal mechanism. The spigot has a slot which allows for a pin, which is attached to the sensor potentiometers, to rotate through approximately 90 degrees , which relates to pedal movement. The pedal is connected via a link to a drum, which engages with the sensor pin, changing the linear movement of the pedal into rotary movement of the drum. The drum has two steel cables attached to it. The cables are secured to two tension springs which are secured in the opposite end of the housing. The springs provide 'feel' on the pedal movement and require an effort from the driver similar to that of a cable controlled throttle. A detente mechanism is located at the forward end of the housing and is operated by a ball located on the drum. At near maximum throttle pedal movement, the ball contacts the detente mechanism. A spring in the mechanism is compressed and gives the driver the feeling of depressing a 'kickdown' switch when full pedal travel is achieved.

APP Sensor Output Graph



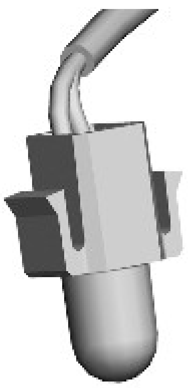
ITEM	DESCRIPTION
A	Voltage
B	APP sensor angle
C	Kick down angle

The APP sensor has two potentiometer tracks which each receive a 5 V input voltage from the ECM. Track 1 provides an output of 0.5 V with the pedal at rest and 2.0 V at 100% full throttle. Track 2 provides an output of 0.5 V with the pedal at rest and 4.5 V at 100% full throttle. The signals from the two tracks are used by the ECM to determine fueling for engine operation and also by the ECM and the TCM (transmission control module) to initiate a kickdown request for the automatic transmission.

The ECM monitors the outputs from each of the potentiometer tracks and can determine the position, rate of change and direction of movement of the throttle pedal. The closed throttle position signal is used by the ECM to initiate idle speed control and overrun fuel cut-off.

The APP sensor signals are checked for range and plausibility. Should one signal fail, the ECM adopts a limp home mode, which limits the engine speed to 2000 rev/min maximum.

AMBIENT AIR TEMPERATURE SENSOR



E116093

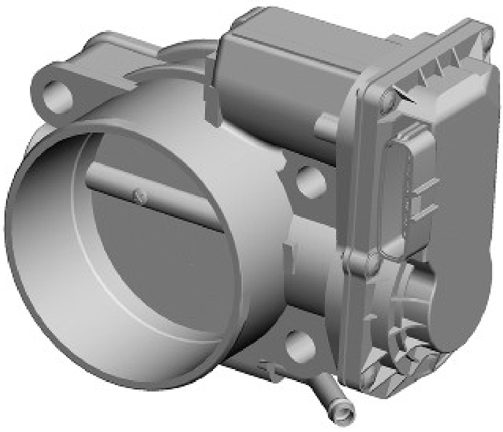
The AAT (ambient air temperature) sensor is a NTC thermistor that allows the ECM to monitor the temperature of the air around the vehicle. The ECM uses the AAT input for a number of functions, including engine cooling fan control. The ECM also transmits the ambient temperature on the high speed CAN (controller area network) bus for use by other control modules.

The AAT sensor is installed in the LH (left-hand) exterior mirror, with the bulb of the sensor positioned over a hole in the bottom of the mirror casing.

The ECM supplies the sensor with a 5 V reference voltage and a ground, and translates the return signal voltage into a temperature.

If there is a fault with the AAT sensor, the ECM calculates the AAT from the temperature inputs of the MAFT sensors. If the AAT sensor and the temperature inputs of the MAFT sensors are all faulty, the ECM adopts a default ambient temperature of 20 °C (68 °F).

ELECTRONIC THROTTLE



E116090

The ECM uses the electronic throttle to regulate engine torque.

The electronic throttle is installed between the T piece duct, of the intake air distribution and filtering system, and the inlet of the SC.
For additional information, refer to: Intake Air Distribution and Filtering (303-12D Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Description and Operation).

The throttle plate is operated by an electric DC (direct current) motor integrated into the throttle body. The ECM uses a PWM signal to control the DC motor. The ECM compares the APP sensor inputs against an electronic map to determine the required position of the throttle plate. The ECM and electronic throttle are also required to:

- Monitor requests for cruise control operation
- Automatically operate the electronic throttle for accurate cruise control
- Perform all dynamic stability control engine interventions
- Monitor and carry out maximum engine speed and road speed cut outs
- Provide different engine maps for the ride and handling optimization system

system.

A software strategy within the ECM calibrates the position of the throttle plate at the beginning of each ignition cycle. When the ignition is turned on, the ECM performs a self test and calibration routine by fully closing the throttle plate and then opening it again. This tests the default position springs and allows the ECM to learn the position of the closed hard stop. Subsequently the ECM keeps the throttle plate a minimum of 0.5 degree from the closed hard stop.

ECM RELAY

The ECM relay is used to initiate the power up and power down routines within the ECM. The main relay is installed in the EJB.

When the ignition is turned on, battery voltage is applied to the ignition sense input. The ECM then starts its power up routines and energizes the ECM relay.

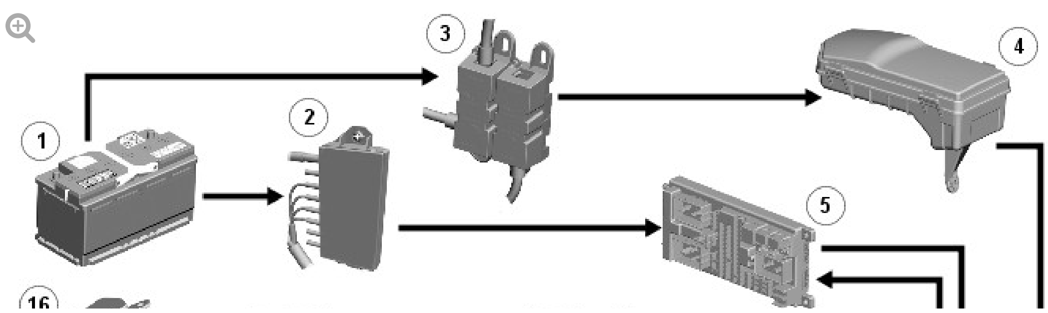
When the ignition is turned off, the ECM maintains its powered up state while it conducts the power down routines (up to 20 minutes in extreme cases, when cooling fans are required) and on completion will turn off the ECM relay.

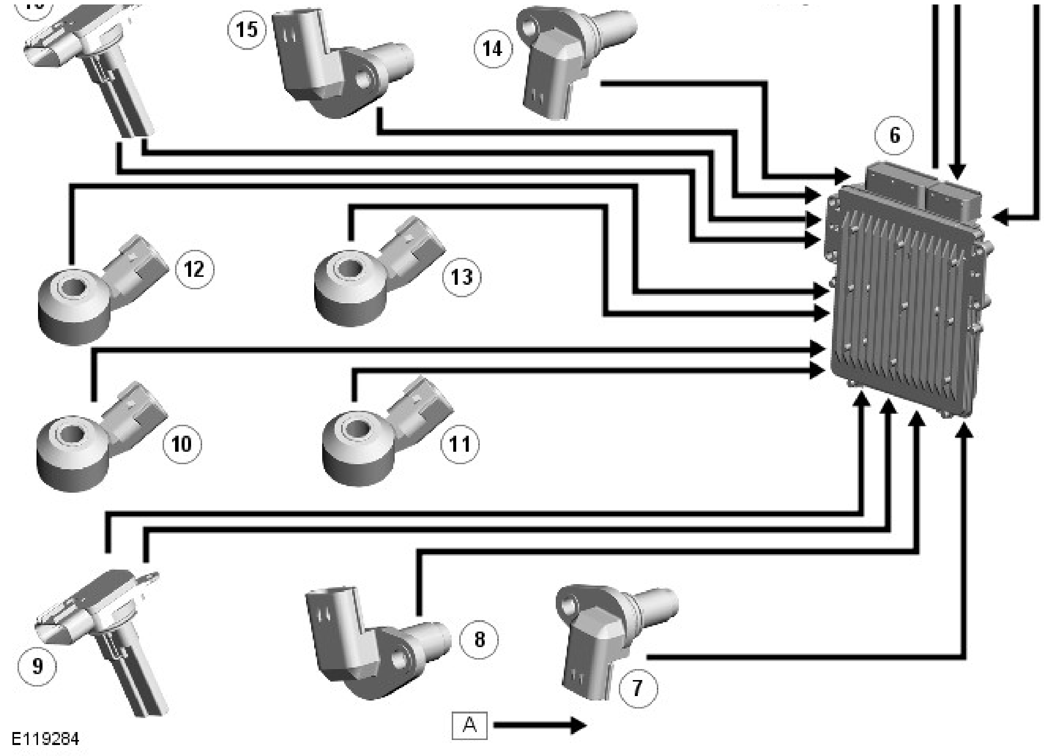
CONTROL DIAGRAM

Sheet 1 of 2

NOTE:

A = Hardwired.



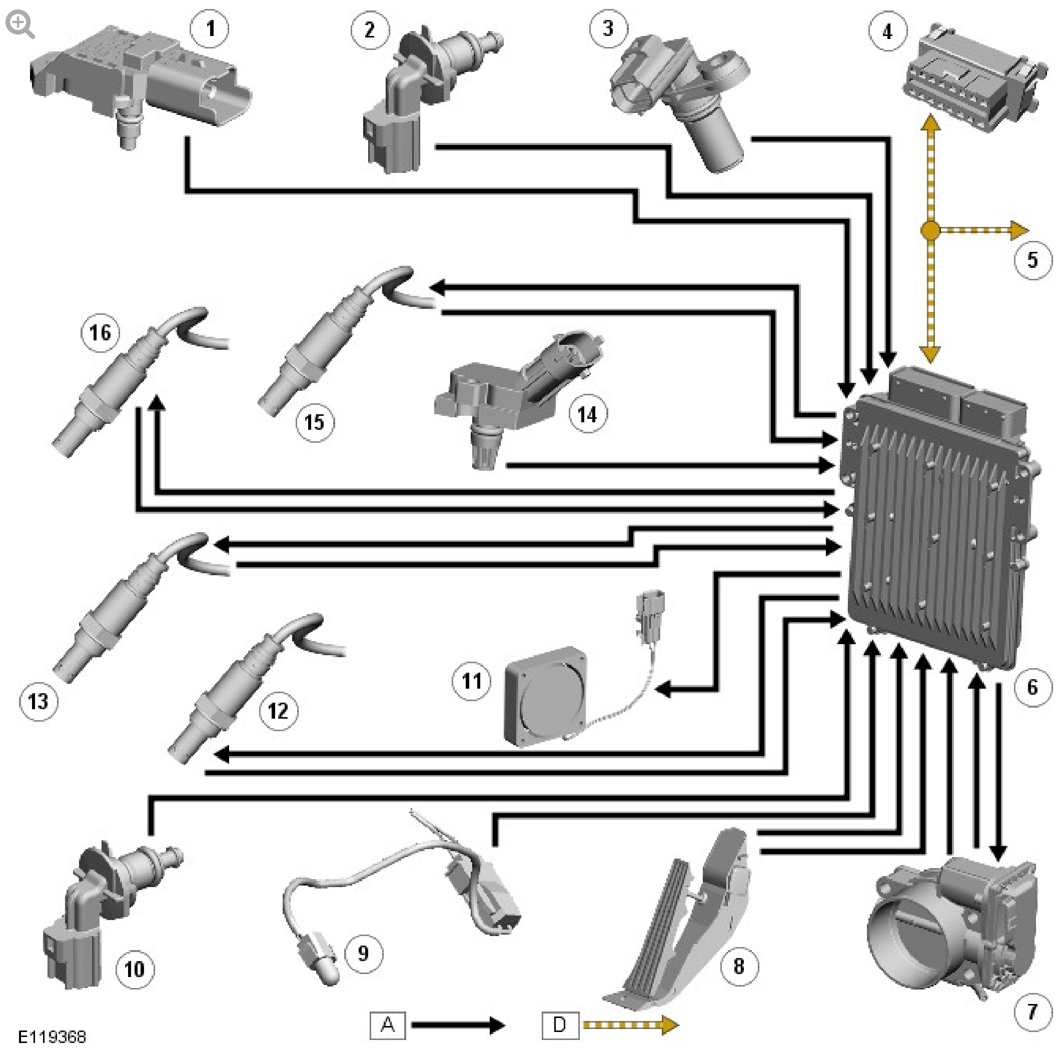


ITEM	DESCRIPTION
1	Battery
2	Pre fuse box
3	CJB (central junction box)
4	BJB (battery junction box) (250 A megafuse)
5	EJB (engine junction box)
6	ECM
7	LH (left hand) intake CMP sensor
8	LH exhaust CMP sensor
9	LH MAFT sensor
10	LH front knock sensor
11	LH rear knock sensor
12	RH (right hand) rear knock sensor
13	RH front knock sensor
14	RH intake CMP sensor
15	RH exhaust CMP sensor
16	RH MAFT sensor

Sheet 2 of 2

NOTE:

A = Hardwired; D = High speed CAN bus.



ITEM	DESCRIPTION
1	MAP sensor
2	ECT sensor (ECT 2)
3	CKP sensor
4	Diagnostic socket
5	To other system control modules
6	ECM

7	Electronic throttle
8	APP sensor
9	AAT sensor
10	ECT sensor (ECT 1)
11	ECM cooling fan
12	LH downstream HO2S
13	LH upstream HO2S
14	MAPT (manifold absolute pressure and temperature) sensor
15	RH downstream HO2S
16	RH upstream HO2S

OPERATION

ECM ADAPTIONS

The ECM has the ability to adapt the input values it uses to control certain outputs. This capability maintains engine refinement and ensures the engine emissions remain within the legislated limits. The components which have adaptions associated with them are:

- The APP sensor
- The heated oxygen sensors
- The MAFT sensors
- The CKP sensor
- Electronic throttle.

OXYGEN AND MAFT SENSORS

There are several adaptive maps associated with the fueling strategy. Within the fueling strategy the ECM calculates short-term adaptions and long term adaptions. The ECM will monitor the deterioration of the heated oxygen sensors over a period of time. It will also monitor the current correction associated with the sensors.

The ECM will store a fault code in circumstances where an adaption is forced to exceed its operating parameters. At the same time, the ECM will forced to exceed its operating parameters. At the same time, the ECM will record the engine speed, engine load and intake air temperature.

CRANKSHAFT POSITION SENSOR

The characteristics of the signal supplied by the CKP sensor are learned by the ECM. This enables the ECM to set an adaption and support the engine misfire detection function. Due to the small variation between different drive plates and different CKP sensors, the adaption must be reset if either component is renewed, or removed and refitted. It is also necessary to reset the drive plate adaption if the ECM is renewed or replaced. The ECM supports four drive plate adaptions for the CKP sensor. Each adaption relates to a specific engine speed range. The engine speed ranges are detailed in the table below:

ADAPTION	ENGINE SPEED, REV/MIN
1	1800 - 3000
2	3001 - 3800
3	3801 - 4600
4	4601 - 5400

MISFIRE DETECTION

Legislation requires that the ECM must be able to detect the presence of an engine misfire. It must be able to detect misfires at two separate levels. The first level is a misfire that could lead to the legislated emissions limit being exceeded by a given amount. The second level is a misfire that may cause catalytic converter damage.

The ECM monitors the number of misfire occurrences within two engine speed ranges. If the ECM detects more than a predetermined number of misfire occurrences within either of these two ranges, over two consecutive journeys, it will record a fault code and details of the engine speed, engine load and engine coolant temperature. In addition, the ECM monitors the number of misfire occurrences that happen in a 'window' of 200 engine revolutions. The misfire occurrences are assigned a weighting according to their likely impact on the catalytic converters. If the number of misfires exceeds a given value, the ECM stores catalytic converter damage fault codes, along with the engine speed, engine load and engine coolant temperature.

temperature.

The signal from the CKP sensor indicates how fast the poles on the drive plate are passing the sensor tip. A sine wave is generated each time a pole passes the sensor tip. The ECM can detect variations in drive plate speed by monitoring the sine wave signal supplied by the crankshaft position sensor. By assessing this signal, the ECM can detect the presence of an engine misfire. At this time, the ECM will assess the amount of variation in the signal received from the CKP sensor and assign a roughness value to it. This roughness value can be viewed within the real time monitoring feature using Land Rover approved diagnostic equipment. TheECM will evaluate the signal against a number of factors and will decide whether to record the occurrence or ignore it. The ECM can assign a roughness and misfire signal for each cylinder.

DIAGNOSTICS

The ECM stores each fault as a DTC (diagnostic trouble code). The DTC and associated environmental and freeze frame data can be read using Land Rover approved diagnostic equipment, which can also read real time data from each sensor, the adaption values currently being employed and the current fueling, ignition and idle speed settings.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

DIAGNOSIS AND TESTING

PRINCIPLES OF OPERATION

For a detailed description of the electronic engine control system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Electronic Engine Controls (303-14 Electronic Engine Controls - 5.0L, Vehicles With: Supercharger, 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. Verify the customer concern.

1. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

MECHANICAL	ELECTRICAL
▪ Engine oil level ▪ Cooling system coolant level ▪ Fuel level ▪ Fuel contamination/grade/quality ▪ Fuel leaks	▪ Fuses ▪ Wiring harness ▪ Electrical connector(s) ▪ 5 volt sensor supply ▪ Sensor(s)

▪ Accessory drive belt ▪ Sensor installation/condition ▪ Viscous fan and solenoid ▪ Air cleaner condition	▪ Engine Control Module (ECM) ▪ Transmission Control Module (TCM)

1. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

1. 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
Engine cranks, but does not fire	▪ Engine breather system disconnected/restricted ▪ Ignition system ▪ Fuel system ▪ Electronic engine control	Ensure the engine breather system is free from restriction and is correctly installed. Check for ignition system, fuel system and electronic engine control DTCs and refer to the relevant DTC Index
Engine cranks and fires, but will not start	▪ Evaporative emissions purge valve ▪ Fuel pump ▪ Spark plugs ▪ HT short to ground (tracking) check rubber boots for cracks/damage ▪ Ignition system	Check for evaporative emissions, fuel system and ignition system related DTCs and refer to the relevant DTC Index
Difficult cold start	▪ Engine coolant level/anti-freeze content ▪ Battery ▪ Electronic engine controls ▪ Exhaust Gas Recirculation (EGR)	Check the engine coolant level and condition. Ensure the battery is in a fully charged and serviceable condition. Check for electronic engine controls, engine emissions, fuel system and evaporative emissions system related DTCs and refer to the relevant DTC Index

	▪ Recirculation (EGR) valve stuck open ▪ Fuel pump ▪ Purge valve	
Difficult hot start	▪ Injector leak ▪ Electronic engine control ▪ Purge valve ▪ Fuel pump ▪ Ignition system ▪ EGR valve stuck open	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Difficult to start after hot soak (vehicle standing, engine off, after engine has reached operating temperature)	▪ Injector leak ▪ Electronic engine control ▪ Purge valve ▪ Fuel pump ▪ Ignition system ▪ EGR valve stuck open	Check for injector leak, install new injector as required. Check for electronic engine controls, evaporative emissions, fuel system, ignition system and engine emission system related DTCs and refer to the relevant DTC Index
Engine stalls soon after start	▪ Breather system disconnected/restricted ▪ ECM relay ▪ Electronic engine control ▪ Ignition system ▪ Air intake system restricted ▪ Air leakage ▪ Fuel lines	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine control, ignition system and fuel system related DTCs and refer to the relevant DTC Index. Check for blockage in air filter element and air intake system. Check for air leakage in air intake system
Engine hesitates/poor acceleration	▪ Fuel pressure, fuel pump, fuel lines ▪ Injector leak ▪ Air leakage ▪ Electronic engine control ▪ Throttle motor ▪ Restricted accelerator pedal travel (carpet, etc)	Check for fuel system related DTCs and refer to the relevant DTC Index. Check for injector leak, install new injector as required. Check for air leakage in air intake system. Ensure accelerator pedal is free from restriction. Check for electronic engine controls, ignition, engine emission system and transmission related DTCs and refer to the relevant DTC Index

	▪ Ignition system ▪ EGR valve stuck open ▪ Transmission malfunction	
Engine backfires	▪ Fuel pump/lines ▪ Air leakage ▪ Electronic engine controls ▪ Ignition system ▪ Sticking variable camshaft timing (VCT) hub	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls, ignition system and VCT system related DTCs and refer to the relevant DTC Index
Engine surges	▪ Fuel pump/lines ▪ Electronic engine controls ▪ Throttle motor ▪ Ignition system	Check for fuel system failures. Check for electronic engine controls, throttle system and ignition system related DTCs and refer to the relevant DTC Index
Engine detonates/knocks	▪ Fuel pump/lines ▪ Air leakage ▪ Electronic engine controls ▪ Sticking VCT hub	Check for fuel system failures. Check for air leakage in intake air system. Check for electronic engine controls and VCT system related DTCs and refer to the relevant DTC Index
No throttle response	▪ Electronic engine controls ▪ Throttle motor	Check for electronic engine controls and throttle system related DTCs and refer to the relevant DTC Index
Poor throttle response	▪ Breather system disconnected/restricted ▪ Electronic engine control ▪ Transmission malfunction ▪ Traction control event ▪ Air leakage	Ensure the engine breather system is free from restriction and is correctly installed. Check for electronic engine controls, transmission and traction control related DTCs and refer to the related DTC Index. Check for air leakage in intake air system

DTC INDEX

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 - 5.0L, DTC: Module Name: Engine Control Module (100-00, Description and Operation).

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

DIAGNOSIS AND TESTING

DIAGNOSIS OF BOSCH HEATED OXYGEN SENSORS (HO2S)

A full description of oxygen sensor monitoring, can be found in the workshop manual Documents Tab / Diagnostics Section / OBD II System Information

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

NOTES:

- **Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests**
- Generic scan tools may not read the codes listed, or may read only 5-digit codes. Match the 5 digits from the scan tool to the first 5 digits of the 7-digit code listed to identify the fault (the last 2 digits give extra information read by the manufacturer-approved diagnostic system).
- When performing voltage or resistance tests, always use a digital multimeter accurate to three decimal places, and with an up-to-date calibration certificate. When testing resistance always take the resistance of the digital multimeter leads into account.
- Inspect connectors for signs of water ingress, and pins for damage and/or corrosion.
- If DTCs are recorded and, after performing the pinpoint tests, a fault is not present, an intermittent concern may be the cause. Always check for loose connections and corroded terminals.
- Check DDW for open campaigns. Refer to the corresponding bulletins and SSMs which may be valid for the specific customer complaint and carry out the recommendations as required.

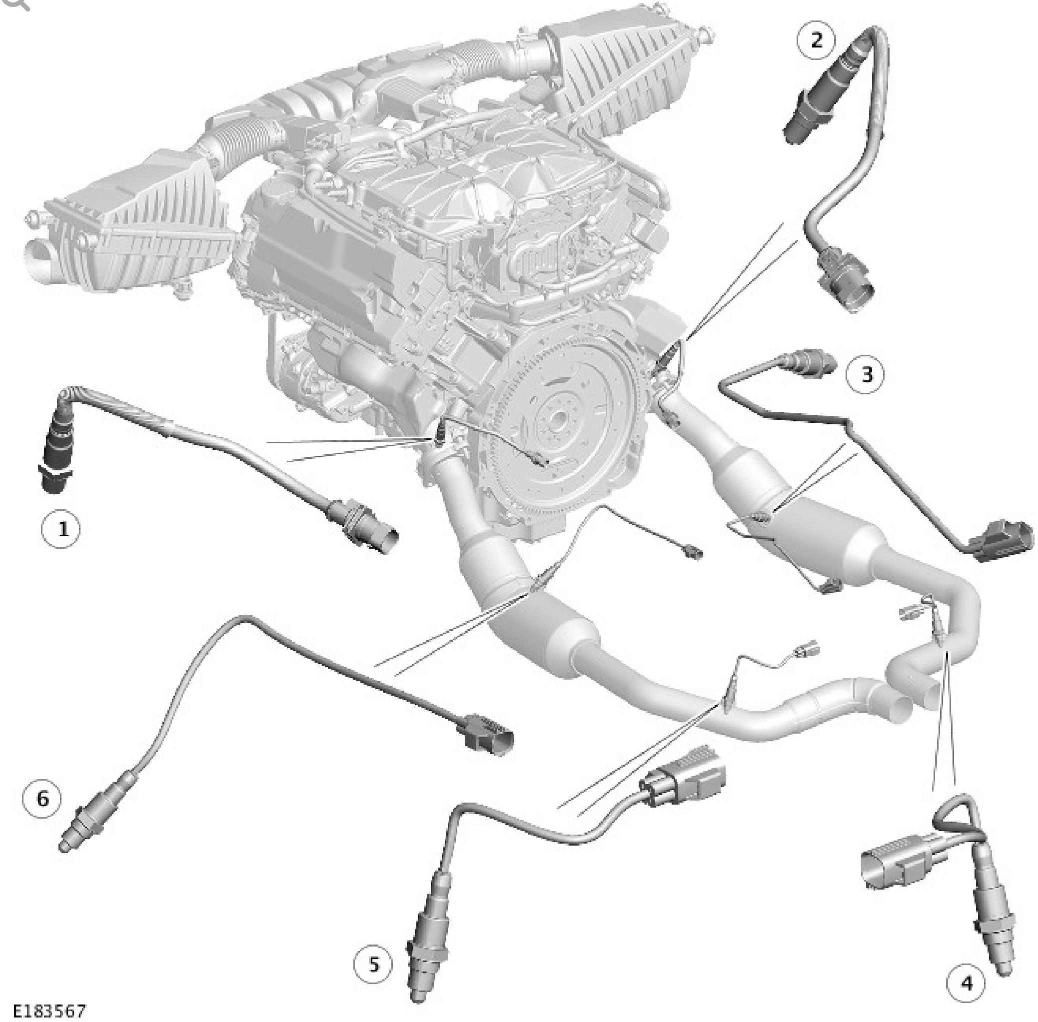
The purpose of this document is to aid in the correct diagnosis of Bosch Heated Oxygen Sensors (HO2S) and to prevent unnecessary installation of new parts. It may be deemed after diagnosis that a particular sensor has failed, in this case it would be expected that only the failed sensor is replaced and **NOT** a complete vehicle set.

PRINCIPLE OF OPERATION

For a detailed description of electronic engine controls, refer to the relevant

For a detailed description of electronic engine controls, refer to the relevant description and operation section of the workshop manual.

Heated Oxygen Sensor (HO2S) location



ITEM	DESCRIPTION
1	Heated Oxygen Sensor (HO2S) - Pre catalyst - Bank 2 sensor 1
2	Heated Oxygen Sensor (HO2S) - Pre catalyst - Bank 1 sensor 1
3	Heated Oxygen Sensor (HO2S) - Mid catalyst - Bank 1 sensor 2
4	Heated Oxygen Sensor (HO2S) - Post catalyst - Bank 1 sensor 3
5	Heated Oxygen Sensor (HO2S) - Post catalyst - Bank 2 sensor 3
6	Heated Oxygen Sensor (HO2S) - Mid catalyst - Bank 2 sensor 2

INSPECTION AND VERIFICATION

1. Verify the customer concern.

1. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

MECHANICAL	ELECTRICAL
▪ Heated Oxygen Sensor (HO2S) incorrect installation ▪ Heated Oxygen Sensor (HO2S) contamination by incorrect fuel or oil ▪ Heated Oxygen Sensor (HO2S) degraded ▪ Exhaust system leakage ▪ Exhaust system restriction ▪ Air intake system leakage ▪ Mass air flow sensor contamination ▪ Incorrect fuel pressure ▪ Pipe detached or union leakage between intake manifold and cylinder head	▪ Connector is disconnected, connector pin is backed out, connector pin corrosion ▪ Fuses ▪ Wiring harness ▪ Electrical connector(s)

1. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

1. **Using the approved diagnostic tool, check for Diagnostic Trouble Codes (DTCs).**

1. Refer to the DTC help text in Section 100-00 for diagnostic help specific to the logged DTC(s).

HEATED OXYGEN SENSOR (HO2S) ACTIVATION REQUIREMENTS

NOTE:

If the sensor has not become active, then DTCs will not be logged.

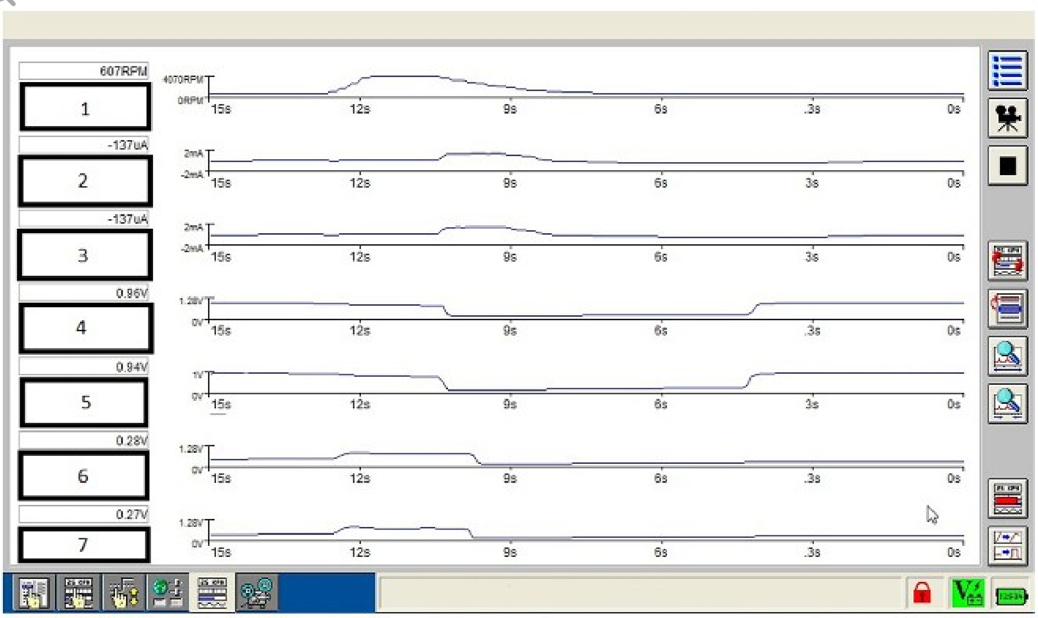
The drive cycle required to activate all of the Heated Oxygen Sensor (HO2S) can vary greatly in time. This is dependent on all of the sensors reaching 'dew point' during previous drive cycles. 'Dew point' is where the moisture content in the exhaust has evaporated and can no longer damage the Heated Oxygen Sensor (HO2S). The closer a Heated Oxygen Sensor (HO2S) is to the engine, the faster it will achieve 'dew point'. Once a Heated Oxygen Sensor (HO2S) has reached 'dew point' the Heated Oxygen Sensor (HO2S) heating is activated and shortly afterwards the Heated Oxygen Sensor (HO2S) will be functional. **Once functional the Heated Oxygen Sensor (HO2S) diagnostics become active and can report any error states with a DTC.**

VIEWING OPERATION OF HEATED OXYGEN SENSOR (HO2S)

Using Datalogger view the output signals for all Heated Oxygen Sensors (HO2S) and confirm correct operation. As each Heated Oxygen Sensor (HO2S) becomes active the output signal can be seen reacting to changes in engine speed/load.

NOTE:

Heated Oxygen Sensors (HO2S) will become functional at different times, depending on their location within the exhaust system and the previous drive cycles. See 'Drive Cycle' section below for further information.



E189631

ITEM	DESCRIPTION
1	Engine speed
2	Oxygen Sensor Current Bank 1 sensor 1
3	Oxygen Sensor Current Bank 2 sensor 1
4	Oxygen Sensor Output Voltage Bank 1 - sensor 2
5	Oxygen Sensor Output Voltage Bank 2 - sensor 2
6	Oxygen Sensor Output Voltage Bank 1 - sensor 3
7	Oxygen Sensor Output Voltage Bank 2 - sensor 3

HEATED OXYGEN SENSOR DATALOGGER SIGNALS

PID	DESCRIPTION	ACTION
BANK 1		
Datalogger signal for Heated Oxygen Sensor (HO2S) - Pre catalyst - Bank 1 sensor 1		
0x03A1	Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 1	Using the manufacturer approved diagnostic system check datalogger signal. The signal is a duty cycle displayed in % varying between limits
0xF434	Oxygen Sensor Current Bank 1 sensor 1	Using the manufacturer approved diagnostic system check datalogger signal. The signal is displayed in mA varying between limits
Datalogger signal for Heated Oxygen Sensor (HO2S) - Mid catalyst - Bank 1 sensor 2		
0x03A2	Oxygen Sensor (O2S) Heater Duty Cycle Bank 1 Sensor 2	Using the manufacturer approved diagnostic system check datalogger signal. The signal is a pulse width modulated signal digital output operating between 0 and 1
0xF415	Oxygen Sensor Output Voltage Bank 1 - sensor 2	Using the manufacturer approved diagnostic system check datalogger signal. The signal is displayed in volts varying between limits
Datalogger signal for Heated Oxygen Sensor (HO2S) - Post catalyst - Bank 1 sensor 3		
0x03A3	Oxygen sensor heater duty cycle - Bank 1 sensor 3	Using the manufacturer approved diagnostic system check datalogger signal. The signal is a pulse width modulated signal digital output operating between 0 and 1

0xF416	Oxygen Sensor Output Voltage Bank 1 - sensor 3	Using the manufacturer approved diagnostic system check datalogger signal. The signal is displayed in volts varying between limits
BANK 2		
Datalogger signal for Heated Oxygen Sensor (HO2S) - Pre catalyst - Bank 2 sensor 1		
0x03A4	Oxygen Sensor (O2S) Heater Duty Cycle Bank 2 Sensor 1	Using the manufacturer approved diagnostic system check datalogger signal. The signal is a duty cycle displayed in % varying between limits
0xF438	Oxygen Sensor Current Bank 2 sensor 1	Using the manufacturer approved diagnostic system check datalogger signal. The signal is displayed in mA varying between limits
Datalogger signal for Heated Oxygen Sensor (HO2S) - Mid catalyst - Bank 2 sensor 2		
0x03A5	Oxygen Sensor (O2S) Heater Duty Cycle Bank 2 Sensor 2	Using the manufacturer approved diagnostic system check datalogger signal. The signal is a pulse width modulated signal digital output operating between 0 and 1
0xF419	Oxygen Sensor Output Voltage Bank 2 - sensor 2	Using the manufacturer approved diagnostic system check datalogger signal. The signal is displayed in volts varying between limits
Heated Oxygen Sensor (HO2S) - Post catalyst - Bank 2 sensor 3		
0x03A6	Oxygen sensor heater duty cycle - Bank 2 sensor 3	Using the manufacturer approved diagnostic system check datalogger signal. The signal is a pulse width modulated signal digital output operating between 0 and 1
0xF41A	Oxygen Sensor Output Voltage Bank 2 - sensor 3	Using the manufacturer approved diagnostic system check datalogger signal. The signal is displayed in volts varying between limits

DRIVE CYCLE

Pre catalyst and Mid catalyst sensors

Drive the vehicle until the engine is fully warm (greater than +80 °C). The drive cycle should include driving the vehicle in a steady throttle condition at a road speed of 30 mph or above for a duration of at least 2 minutes. (Once functional the oxygen sensor output signal can be seen reacting to changes in engine speed/load or if the sensor is faulty a DTC(s) will be raised).

Post catalyst sensors

Post catalyst sensor monitoring can take over 30 minutes of driving to become active if the 'dew point' has not been achieved in previous drive cycles or an EMS ECU battery reset has occurred. The Drive cycle should consist of a constant speed and load allowing sufficient heat to build up in the exhaust system.

PINPOINT TEST A : ELECTRONIC ENGINE CONTROLS PINPOINT TEST	
TEST CONDITIONS	DETAILS/RESULTS/ACTIONS
A1: PERFORMANCE CHECK OF HEATED OXYGEN SENSOR(S) (HO2S)	
	NOTES: ▪ Refer to the **Heated Oxygen Sensor (HO2S) location** section for information on Heated Oxygen Sensor (HO2S) locations ▪ Oxygen sensors will become functional at different times, depending on their location within the exhaust system and the previous drive cycles 1 Refer to the **Heated Oxygen Sensor (HO2S) Activation Requirements** and **Drive Cycle** sections for information on Heated Oxygen Sensor (HO2S) activation requirements and drive cycles
	NOTE: Pre catalyst oxygen sensor - Signal displayed in mA - Signal changes either side of 0mA as fueling changes from lean to rich 2 Using the manufacturer approved diagnostic system check datalogger signal Oxygen Sensor Current Bank 1 - sensor 1 (low res)
	3 Using the manufacturer approved diagnostic system check datalogger signal Oxygen Sensor Current Bank 2 - sensor 1 (low res)
	NOTE: Mid and post catalyst oxygen sensor - Signal displayed in Volts - Signal changes between 0 and 1 volt as fueling switches from lean to rich 4 Using the manufacturer approved diagnostic system check datalogger signal Oxygen Sensor Output Voltage Bank 1 - sensor 3
	5 Using the manufacturer approved diagnostic system check

	datalogger signal Oxygen Sensor Output Voltage Bank 1 - sensor 2
	6 Using the manufacturer approved diagnostic system check datalogger signal Oxygen Sensor Output Voltage Bank 2 - sensor 2
	7 Using the manufacturer approved diagnostic system check datalogger signal Oxygen Sensor Output Voltage Bank 2 - sensor 3
	8 View the output signals for each Heated Oxygen Sensor (HO2S). Once active each sensor can be seen reacting to changes in engine speed/load
	Observe the oxygen sensor signal responsible for the DTC. Is the sensor functioning correctly? **Yes** No failure is found. Clear DTCs and perform road test to confirm no fault is present. Refer to the **Heated Oxygen Sensor (HO2S) Activation Requirements** and **Drive Cycle** sections for information on Heated Oxygen Sensor (HO2S) activation requirements and drive cycles **No** Proceed to the next step

A2: ELECTRICAL CHECK OF HEATED OXYGEN SENSOR(S) (HO2S) HEATER POWER SUPPLY

	NOTES: ▪ Refer to the **Heated Oxygen Sensor (HO2S) location** section for information on Heated Oxygen Sensor (HO2S) locations ▪ Carry out the following electrical checks **ONLY** on the sensor(s) with the related DTC(s) logged **1** Refer to the electrical circuit diagrams and check the heater power supply
	2 Switch ignition OFF
	3 Disconnect Heated Oxygen Sensor (HO2S) (with the related DTC(s) logged)
	4 Switch ignition ON
	5 **Pre catalyst oxygen sensor.** Measure the voltage between pin 4 and battery ground
	6 **Mid and post catalyst oxygen sensor.** Measure the voltage between pin 1 and battery ground
	Is the measured voltage between 11 and 14 volts? **Yes** Proceed to the next step **No** Check for fuse failure Check connectors for signs of water ingress, and pins for damage

	and/or corrosion Check for vehicle harness failure - Wiring integrity short circuit to ground, short circuit to power, open circuit, high resistance

A3: ELECTRICAL CHECK OF HEATED OXYGEN SENSOR(S) (HO2S) HEATER RESISTANCE

	NOTES: ■ Refer to the **Heated Oxygen Sensor (HO2S) location** section for information on Heated Oxygen Sensor (HO2S) locations ■ Carry out the following electrical checks **ONLY** on the sensor(s) with the related DTC(s) logged ■ Remove multimeter internal resistance value from measurement **1** Refer to the electrical circuit diagrams and check the heater resistance
	2 Switch ignition OFF
	3 Ensure the Heated Oxygen Sensor (HO2S) connector is disconnected
	4 **Pre catalyst oxygen sensor.** Measure the resistance of the sensor between pin 4 and pin 3
	5 **Mid and post catalyst oxygen sensor.** Measure the resistance of the sensor between pin 1 and pin 2
	Is the measured resistance between 1 and 15 Ohms? **Yes** Check connectors for signs of water ingress, and pins for damage and/or corrosion Check for vehicle harness failure - Wiring integrity short circuit to ground, short circuit to power, open circuit, high resistance **No** Install a new Heated Oxygen Sensor (HO2S) component

DTC INDEX

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

POWERTRAIN CONTROL MODULE (PCM) LONG DRIVE CYCLE SELF-TEST (G1225997)

GENERAL PROCEDURES

WARNING:

Where possible, all road tests should be on well surfaced and dry roads. Always comply with speed limits and local traffic regulations.

NOTES:

- This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.
- The vehicle must exceed 50mph (80 km/h) during the road test.

1. Connect the diagnostic equipment to the vehicle.
2. Follow on screen prompts and check for engine management fault codes.
3. Clear the fault codes following the on screen procedure.

4. Disconnect the diagnostic equipment from the vehicle.

5. **NOTE:**

   Make sure cruise control is not engaged.

   Make sure the engine temperature is above 60 °C (140 °F).

   Carry out a road test and perform the following operations.

   1. Accelerate to 55 mph (88 km/h) in 5th gear and cruise for 2 minutes with the engine speed at or above 1800rpm.
   2. Lift off the throttle and allow the vehicle to decelerate until the engine speed is less than 1000 rpm.
   3. Stop the vehicle.
   4. Release brake, allow the vehicle to move with no throttle for 1 minute.
   5. Road test is now complete.

6. Connect the diagnostic equipment to the vehicle.

7. **NOTE:**

   If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

   Follow on screen prompts and check for engine management fault codes.

8. Disconnect the diagnostic equipment from the vehicle.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

POWERTRAIN CONTROL MODULE (PCM) SHORT DRIVE CYCLE SELF-TEST

(G1225998)

GENERAL PROCEDURES

NOTE:

This procedure is an overcheck only. If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

1. Connect the diagnostic equipment to the vehicle.

2. Follow on screen prompts and check for engine management fault codes.

3. Clear the fault codes following the on screen procedure.

4. Start the engine.

    - Allow the engine to idle for 30 seconds.
    - Raise the engine speed to 1500 rpm and hold for 3 minutes until a temperature of 70°C (158 °F) is achieved.
    - Allow the engine to idle for 30 seconds.
    - Switch off the engine.

5. **NOTE:**

    If fault codes are found, interrogation of the relevant system must be carried out and claimed against.

    Follow on screen prompts and check for engine management fault codes.

6. Disconnect the diagnostic equipment from the vehicle.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

BRAKE PEDAL POSITION (BPP) SWITCH ADJUSTMENT

(G1395342)

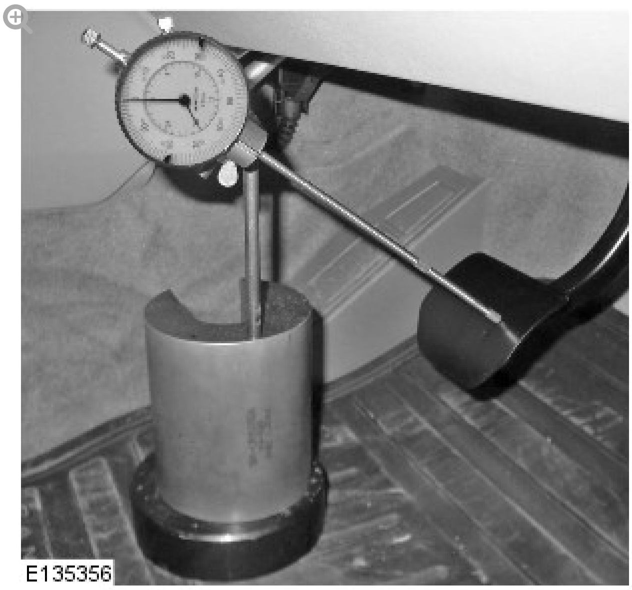
GENERAL PROCEDURES

CHECK

1. Remove the brake pedal rubber.

2. **NOTE:**

Make sure that the dial test indicator (DTI) gauge is in line with the brake pedal movement.



Position the DTI gauge on a suitable mounting block, as illustrated.

3. With the aid of another technician, gently press the brake pedal until the stop lamps illuminate.

4. **NOTE:**

   The specification is that the stop lamps should illuminate at between 5.5mm and 8.5mm brake pedal travel.

   Note the measurement of the brake pedal travel from rest position until the stop lamps illuminated.

ADJUST

NOTE:

The Brake Pedal Position Switch is self adjusting when removed and installed.

1. Remove and install Brake Pedal Position Switch.
   For additional information, refer to: Stoplamp Switch (417-01 Exterior Lighting, Removal and Installation).

2. Check the adjustment of the stop lamp switch by following the **Check** procedure in this procedure and carry out the **Adjust** procedure if required.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

CAMSHAFT POSITION (CMP) SENSOR LH (G1086656)

REMOVAL AND INSTALLATION

18.30.25	SENSOR - CAMSHAFT POSITION (CMP) - LH - RENEW	AJ V8, SUPERCHARGED	0.3	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. **WARNING:**

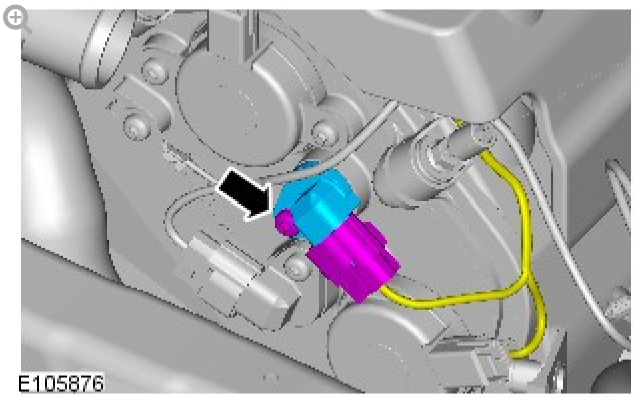
   Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: Thermostat Housing - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

4. **NOTE:**

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



Torque: **10 Nm**

INSTALLATION

1. **CAUTIONS:**

- Make sure that the mating faces are clean and free of foreign material.
- Make sure that the sensor tip is clean and free of foreign material.

NOTE:

Lubricate the O-ring seal with clean engine oil.

To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

CAMSHAFT POSITION (CMP) SENSOR RH (G1330847)

SENSOR KIT (G1220847)

REMOVAL AND INSTALLATION

18.30.23	SENSOR - CAMSHAFT POSITION (CMP) - EXHAUST CAMSHAFT - RENEW	5000 CC, AJ V8, SUPERCHARGED	1.2	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. **WARNING:**

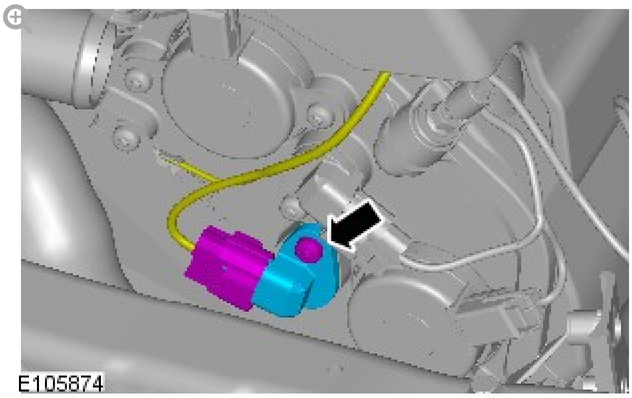
   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Thermostat Housing - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

4. **NOTE:**

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



- *Torque:* **10 Nm**

INSTALLATION

1. **CAUTIONS:**

- Make sure that the mating faces are clean and free of foreign material.
- Make sure that the sensor tip is clean and free of foreign material.

NOTE:

Lubricate the O-ring seal with clean engine oil.

To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

CATALYST MONITOR SENSOR LH (G1225148)

REMOVAL AND INSTALLATION

REMOVAL

NOTE:

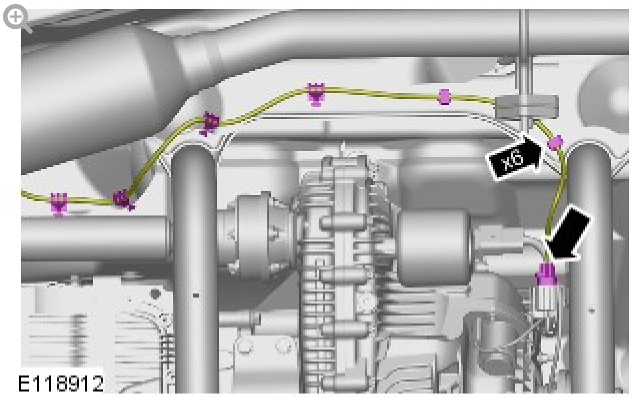
Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

2. **WARNING:**

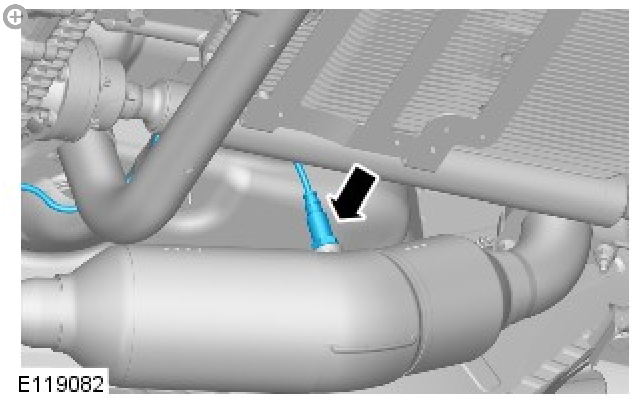
   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. 

4. **CAUTION:**

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

   Torque: **48 Nm**

INSTALLATION

1.

CAUTIONS:

- Make sure the anti-seize compound does not contact the HO2S tip.
- If accidentally dropped or knocked install a new sensor.
- Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

NOTE:

If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

CATALYST MONITOR SENSOR RH (G1225149)

REMOVAL AND INSTALLATION

REMOVAL

NOTE:

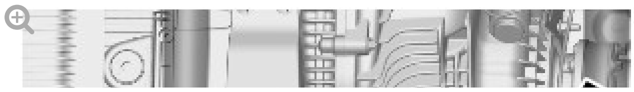
Removal steps in this procedure may contain installation details.

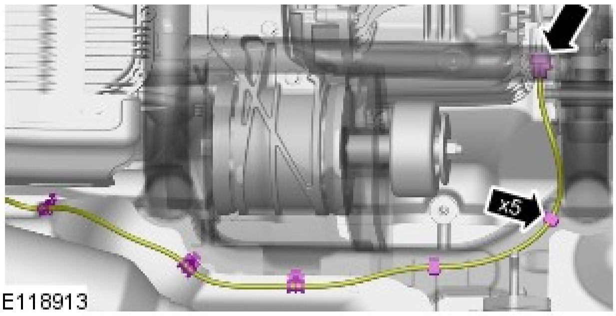
1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

2. **WARNING:**

   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

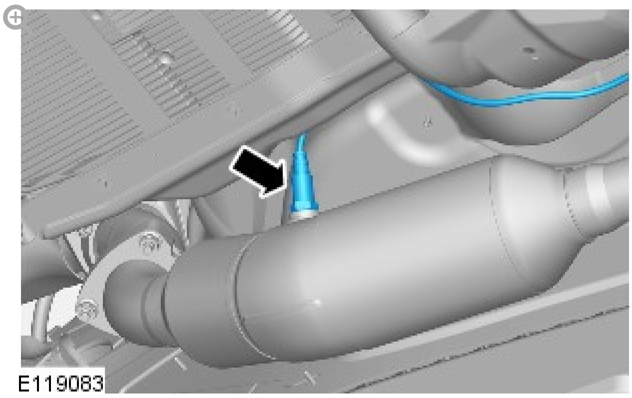
3. 



4.

CAUTION:

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



Torque: **48 Nm**

INSTALLATION

1.

CAUTIONS:

- Make sure the anti-seize compound does not contact the HO2S tip.
- If accidentally dropped or knocked install a new sensor.
- Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

NOTE:

If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

CRANKSHAFT POSITION

CRANKSHAFT POSITION (CKP) SENSOR (G1224146)

REMOVAL AND INSTALLATION

18.30.12	SENSOR - CRANKSHAFT POSITION (CKP) - RENEW	5000 CC, AJ V8	0.3	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. **WARNING:**

   Make sure to support the vehicle with axle stands.

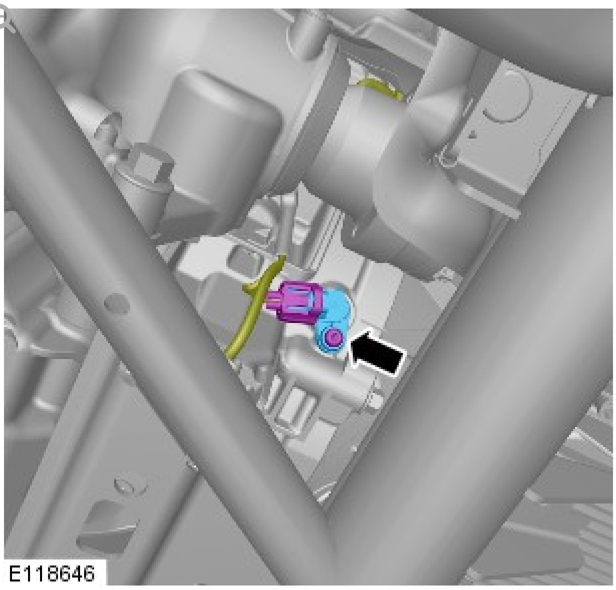
   Raise and support the vehicle.

2. Disconnect the battery ground cable.
   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

3. Refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

4. **CAUTION:**

   Before the disconnection or removal of any components, ensure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.



Remove the crankshaft position (CKP) sensor.

Torque: **10 Nm**

INSTALLATION

1. **CAUTIONS:**

- Make sure that the mating faces are clean and free of foreign material.
- Make sure that the component is clean, free of foreign material and lubricant.

To install, reverse the removal procedure.

2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

ENGINE CONTROL MODULE (ECM) (G1225068)

REMOVAL AND INSTALLATION

18.30.03	ELECTRONIC CONTROL UNIT - FUEL - RENEW	5000 CC, AJ V8	0.2	USED WITHINS	+

REMOVAL

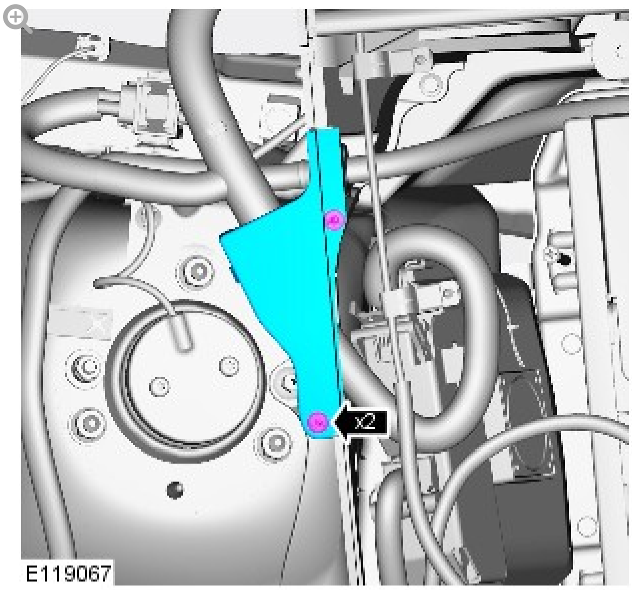
CAUTION:

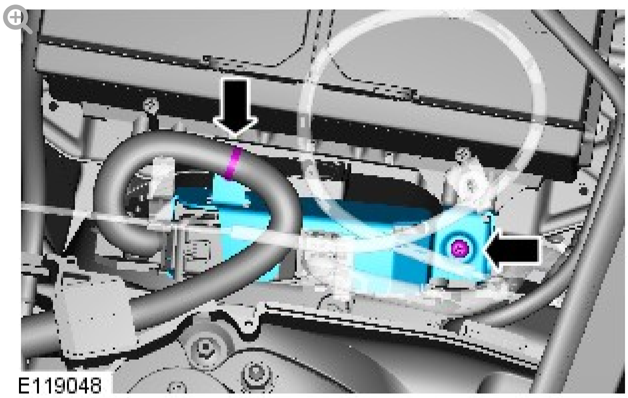
Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

NOTE:

Removal steps in this procedure may contain installation details.

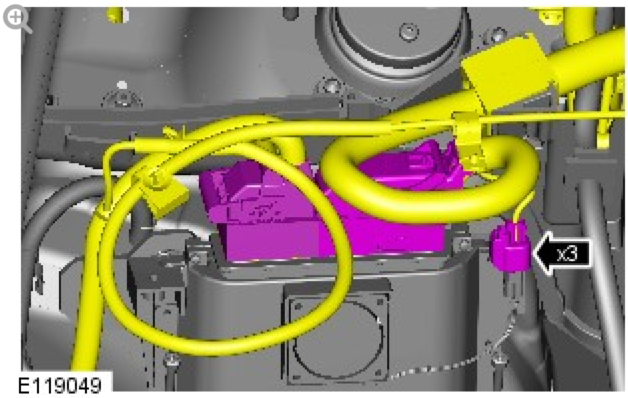
1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

2. 

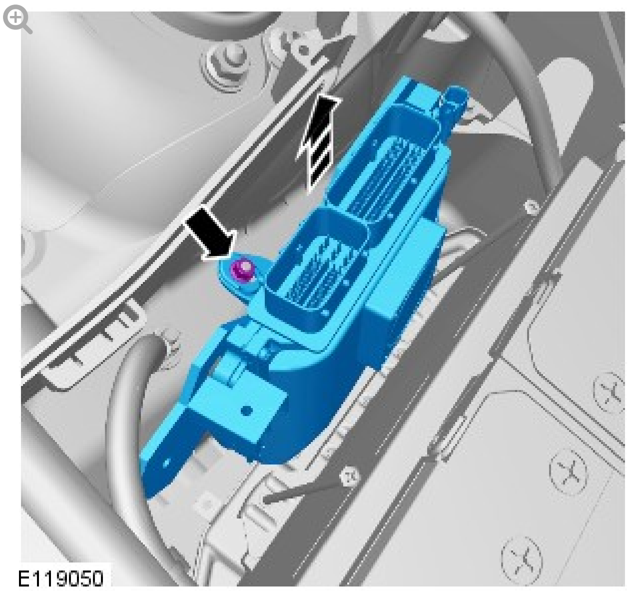
3. 

- *Torque:* **9 Nm**

4.



5.

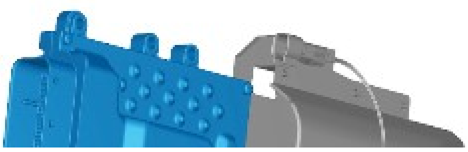


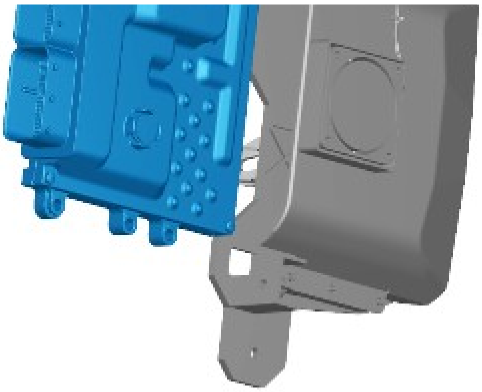
- *Torque:* **9 Nm**

6.

NOTE:

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





E119052

INSTALLATION

1. To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

ENGINE COOLANT TEMPERATURE (ECT) SENSOR (G1225172)

REMOVAL AND INSTALLATION

18.30.10	SENSOR - COOLANT TEMPERATURE (ECT SENSOR) - RENEW	5000 CC, AJ V8, SUPERCHARGED	1	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

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.
Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

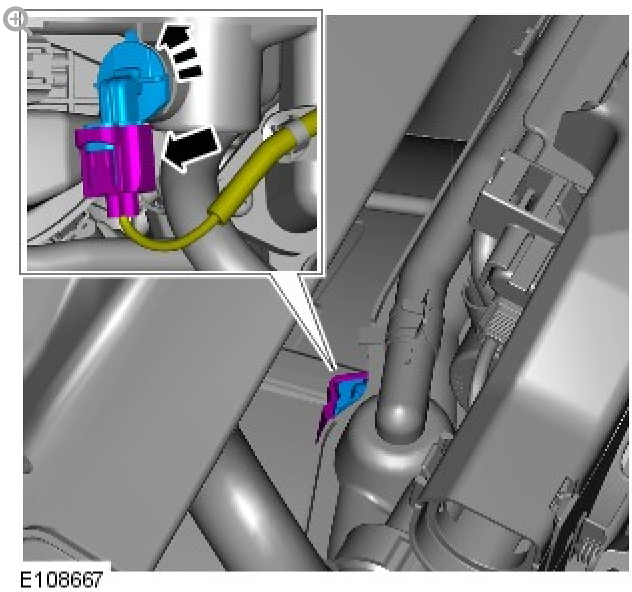
3. Refer to: Engine Cover - V8 5.0L Petrol/V8 S/C 5.0L Petrol (501-05 Interior Trim and Ornamentation, Removal and Installation).

4. Refer to: Cooling System Partial Draining and Vacuum Filling (303-03B Engine Cooling - TDV8 4.4L Diesel, General Procedures).

5. Refer to: Plenum Chamber (412-01A Air Distribution and Filtering, Removal and Installation).

6. **NOTE:**

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



INSTALLATION

1. To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

ENGINE OIL LEVEL SENSOR

(G1085874)

REMOVAL AND INSTALLATION

12.60.51	SWITCH – OIL LEVEL INDICATOR – RENEW	5000 CC, AJ V8	4.8	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. **WARNING:**

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

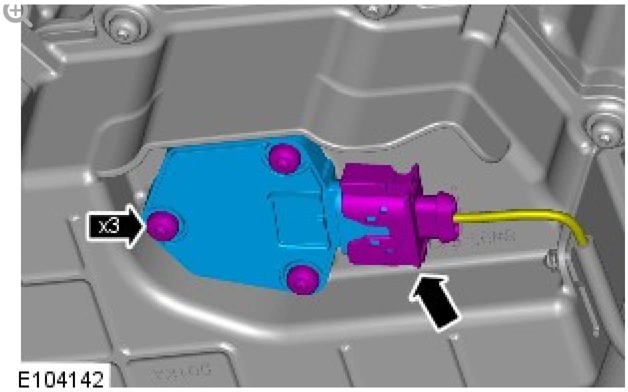
   Raise and support the vehicle.

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

3. Refer to: Engine Oil Draining and Filling (303-01F, General Procedures).

4. **CAUTION:**

   Be prepared to collect escaping fluids.



Torque: **11 Nm**

INSTALLATION

1. **CAUTION:**

A new O-ring seal is to be installed.

To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

FRONT KNOCK SENSOR (KS) LH (G1224248)

REMOVAL AND INSTALLATION

18.30.81	SENSOR - KNOCK (KS) - LH FRONT - RENEW	5000 CC, AJ V8, SUPERCHARGED	3.2	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

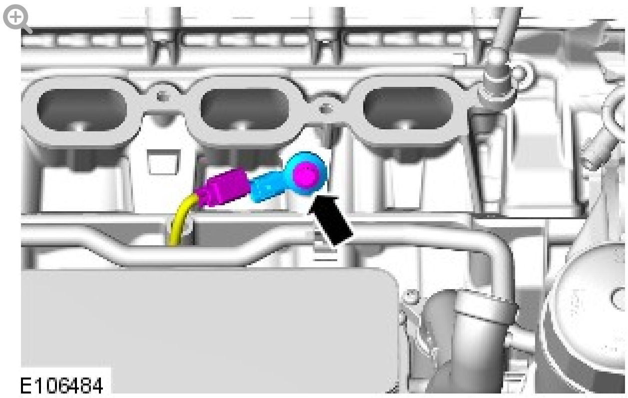
   Refer to: Specifications (414-00, Specifications).

2. **WARNING:**

   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Supercharger (303-12, Removal and Installation).

4. 

   Torque: **20 Nm**

INSTALLATION

1. To install, reverse the removal procedure.

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

FRONT KNOCK SENSOR (KS) RH (G1224249)

REMOVAL AND INSTALLATION

18.30.84	SENSOR - KNOCK (KS) - RH FRONT - RENEW	5000 CC, AJ V8, SUPERCHARGED	3.3	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

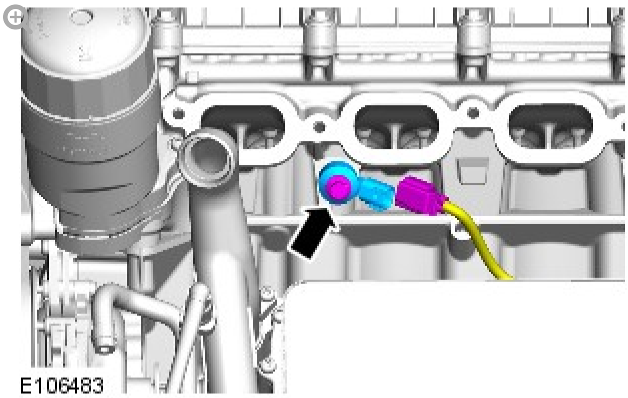
2. **WARNING:**

Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: Supercharger (303-12, Removal and Installation).

4.



Torque: **20 Nm**

INSTALLATION

1. To install, reverse the removal procedure.

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

FUEL RAIL PRESSURE (FRP) SENSOR (G1224149)

REMOVAL AND INSTALLATION

19.22.33	SENSOR - FUEL PRESSURE - RENEW	5000 CC, AJ V8, SUPERCHARGED	1.1	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Refer to: Fuel System Pressure Release - V8 5.0L Petrol/V8 S/C 5.0L Petrol (310-00 Fuel System - General Information, General Procedures).

2. Refer to: Fuel Injection Component Cleaning (303-04D Fuel Charging and Controls - V8 5.0L Petrol, General Procedures).

3. Disconnect the battery ground cable.
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

4. **WARNING:**

   Make sure to support the vehicle with axle stands.

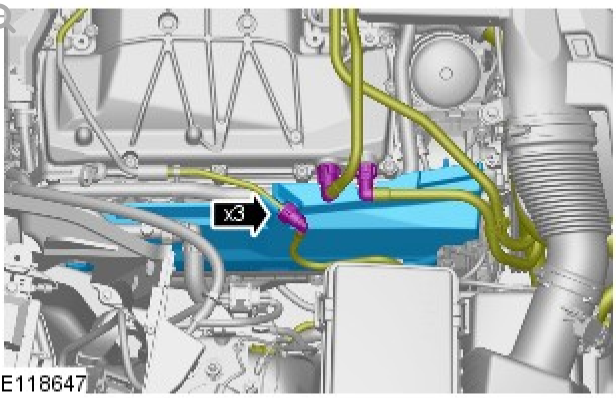
   Raise and support the vehicle.

5. Refer to: Cooling System Partial Draining and Vacuum Filling (303-03B Engine Cooling - TDV8 4.4L Diesel, General Procedures).

6. Refer to: Plenum Chamber (412-01A Air Distribution and Filtering, Removal and Installation).

7. **CAUTION:**

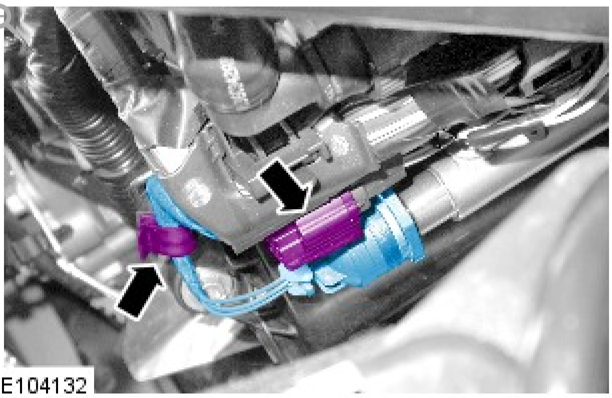
   Be prepared to collect escaping fluids.



E118647

8. **CAUTIONS:**

   - Be prepared to collect escaping fluids.
   - Make sure that all openings are sealed. Use new blanking caps.


E104132

- *Torque:* **32 Nm**

INSTALLATION

1. To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

HEATED OXYGEN SENSOR (HO2S) LH (G1225150)

REMOVAL AND INSTALLATION

SPECIAL TOOL(S)

310-121

Wrench, H02S

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00 Charging System - General Information, Specifications).

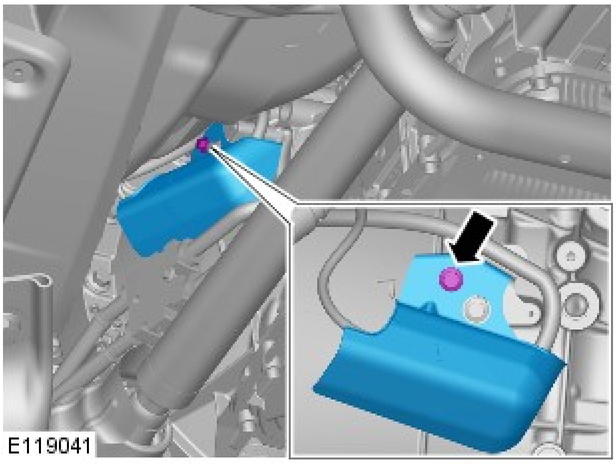
2. **WARNING:**

   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

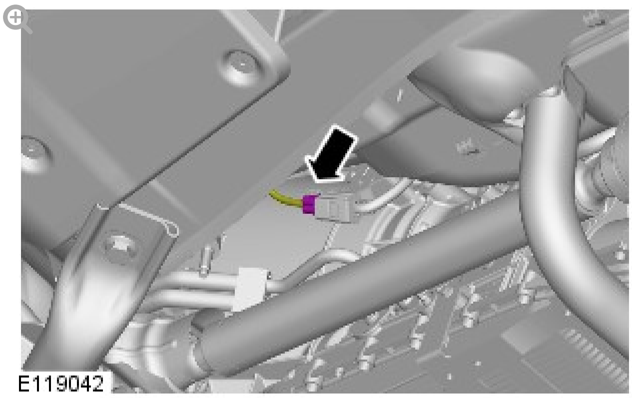
3. Refer to: Exhaust System (309-00 Exhaust System - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133, Removal and Installation).

4. 



Torque: **11 Nm**

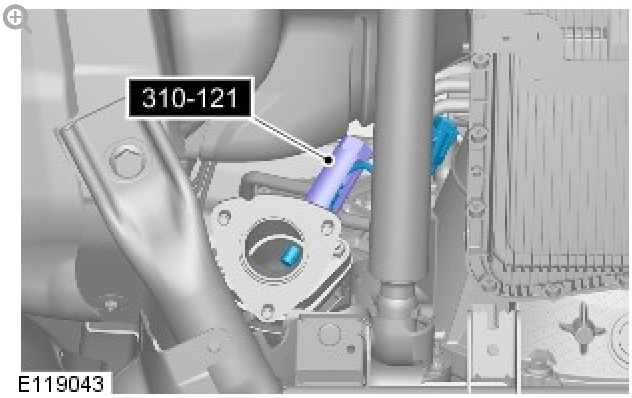
5.



6.

CAUTION:

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



Special Tool(s): 310-121

Torque: **48 Nm**

INSTALLATION

1. **CAUTIONS:**

   - Make sure the anti-seize compound does not contact the HO2S tip.
   - If accidentally dropped or knocked install a new sensor.
   - Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

   NOTE:

   If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

   To install, reverse the removal procedure.

2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

HEATED OXYGEN SENSOR (HO2S) RH (G1225151)

REMOVAL AND INSTALLATION

SPECIAL TOOL(S)

310-121

Wrench, H02S

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

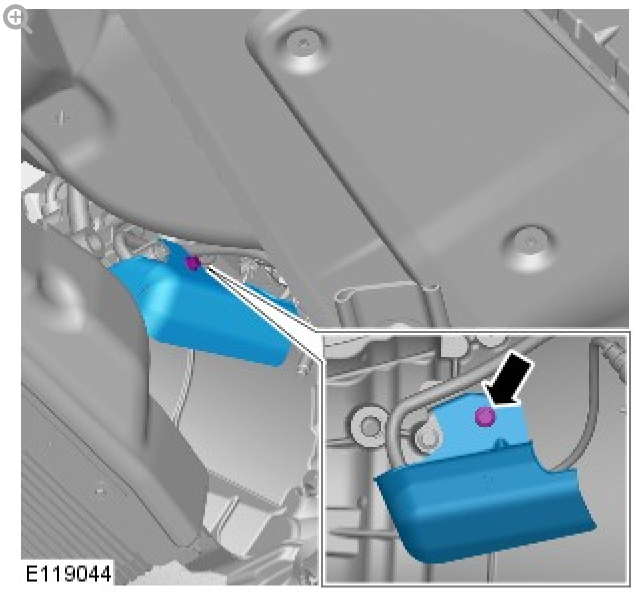
   Refer to: Specifications (414-00, Specifications).

2. **WARNING:**

   Make sure to support the vehicle with axle stands.

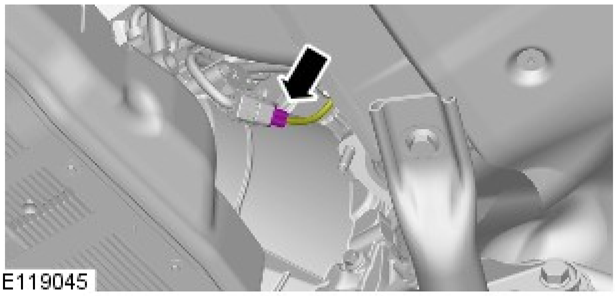
   Raise and support the vehicle.

3. Refer to: Exhaust System (309-00, Removal and Installation).

4. 

   Torque: **11 Nm**

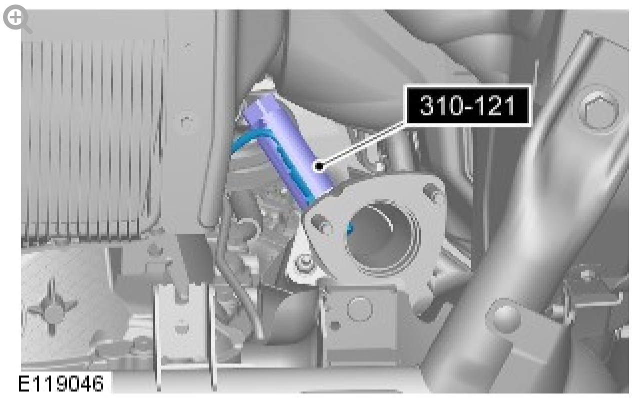
5. 



6.

CAUTION:

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



Special Tool(s): 310-121

Torque: **48 Nm**

INSTALLATION

1.

CAUTIONS:

- Make sure the anti-seize compound does not contact the HO2S tip.
- If accidentally dropped or knocked install a new sensor.
- Make sure the HO2S wiring harness is not twisted more than 180 degrees and is not in contact with either the exhaust or driveshaft.

NOTE:

> If the original sensor is to be installed, apply lubricant meeting specification ESE-M12A4-A to the thread of the sensor.

To install, reverse the removal procedure.

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

(G1224060)

REMOVAL AND INSTALLATION

18.30.56	SENSOR - MANIFOLD AIR PRESSURE - RENEW	5000 CC, AJ V8, SUPERCHARGED	0.5	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

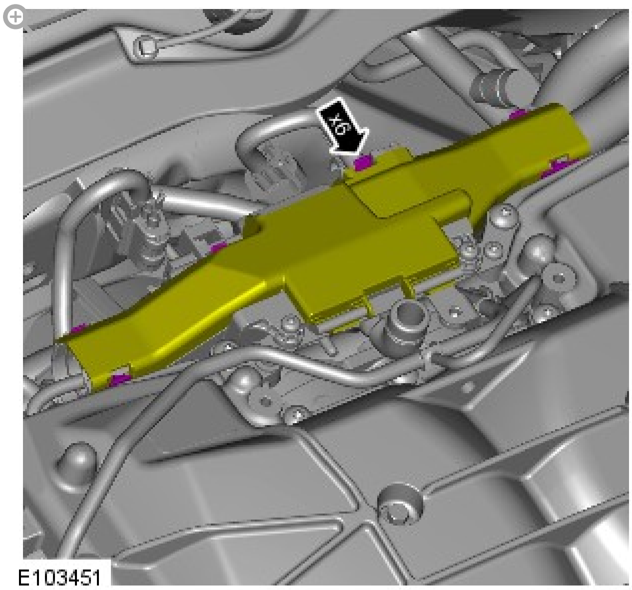
1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

2. Refer to: Engine Cover - 5.0L (501-05, Removal and Installation).

3. Refer to: Plenum Chamber (412-01, Removal and Installation).

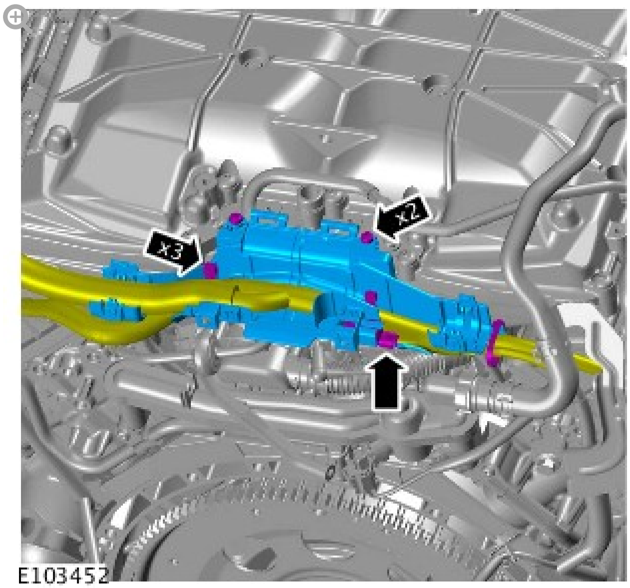
4. **NOTE:**

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



5. NOTE:

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

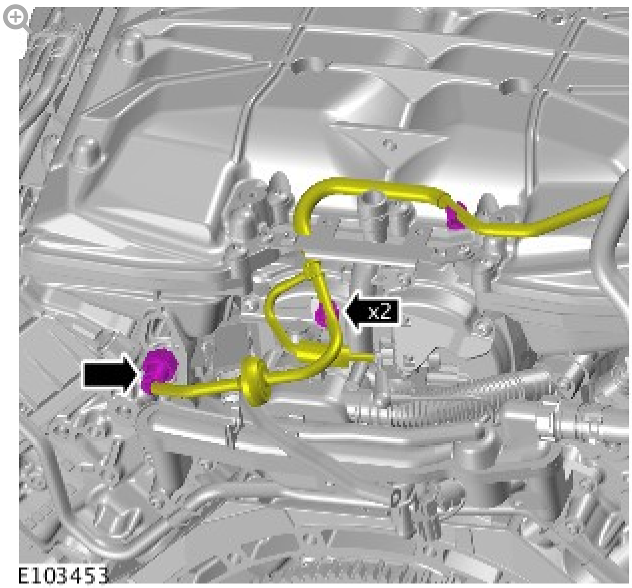


- *Torque:* **10 Nm**

6. NOTE:

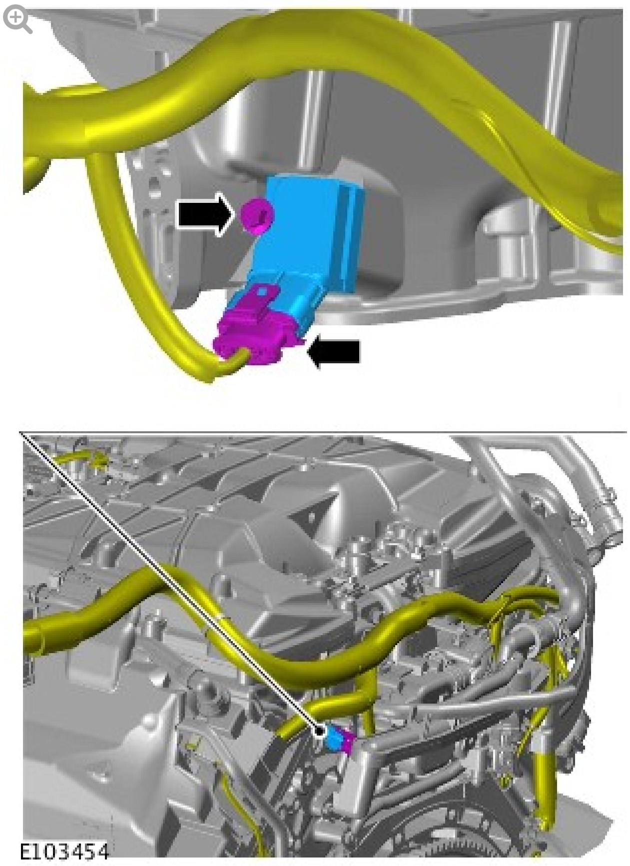
Some variation in the illustrations may occur, but the essential information is always correct.

information is always correct.



7. **NOTE:**

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



- *Torque:* **5 Nm**

INSTALLATION

1. To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

MASS AIR FLOW (MAF) SENSOR (G1224112)

REMOVAL AND INSTALLATION

SENSOR -

19.22.25	MASS AIR FLOW (MAFS) - RENEW	5000 CC, AJ V8	0.1	USED WITHINS	+
19.22.25	SENSOR – MASS AIR FLOW (MAFS) - RENEW	AJ V8, SUPERCHARGED	0.1	USED WITHINS	+

REMOVAL

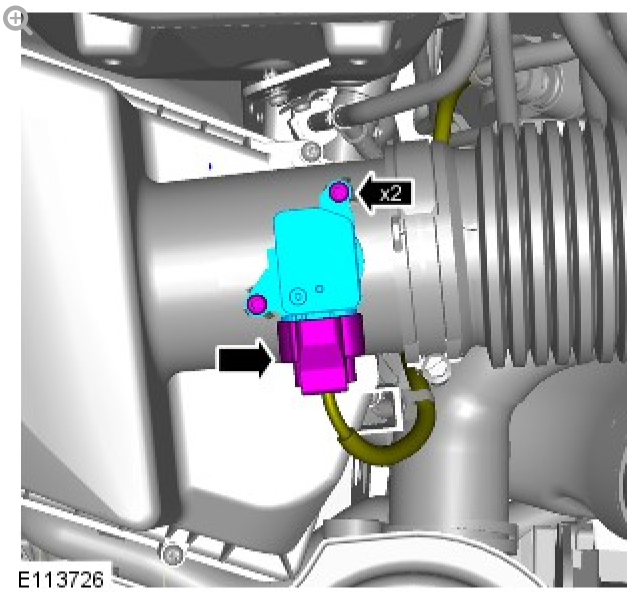
NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

2. **NOTES:**

   - Right-hand shown, left-hand similar.
   - Some variation in the illustrations may occur, but the essential information is always correct.



Torque: **2 Nm**

INSTALLATION

1. To install reverse the removal procedure.
2. Using the approved diagnostic equipment, clear the powertrain control module (PCM) adaptions.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

REAR KNOCK SENSOR (KS) LH (G1224250)

REMOVAL AND INSTALLATION

18.30.82	SENSOR - KNOCK (KS) - LH REAR - RENEW	5000 CC, AJ V8, SUPERCHARGED	3.3	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

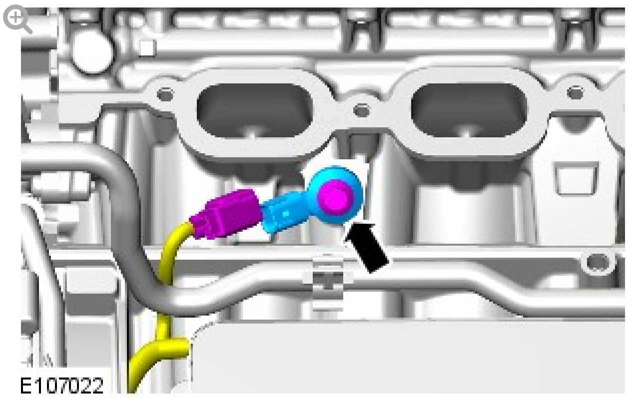
Refer to: Specifications (414-00, Specifications).

2. **WARNING:**

Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

3. Refer to: Supercharger (303-12, Removal and Installation).

4. 

Torque: **20 Nm**

INSTALLATION

1. To install, reverse the removal procedure.

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

REAR KNOCK SENSOR (KS) RH (G1224251)

REMOVAL AND INSTALLATION

18.30.85	SENSOR - KNOCK (KS) - RH REAR - RENEW	5000 CC, AJ V8, SUPERCHARGED	3.3	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

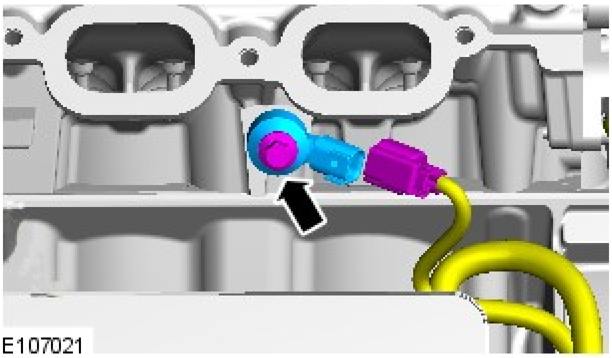
2. **WARNING:**

   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Supercharger (303-12, Removal and Installation).

4. 



Torque: **20 Nm**

INSTALLATION

1. To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

VARIABLE VALVE TIMING (VVT) OIL CONTROL SOLENOID LH (G1220958)

18.31.35	VARIABLE INTAKE VALVE TIMING SOLENOID – B BANK – RENEW	5000 CC, AJ V8, SUPERCHARGED	1.2	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. **WARNING:**

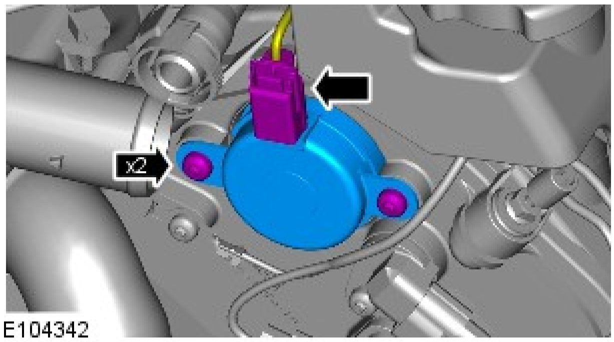
   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Thermostat Housing - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

4. **NOTE:**

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



Torque: **10 Nm**

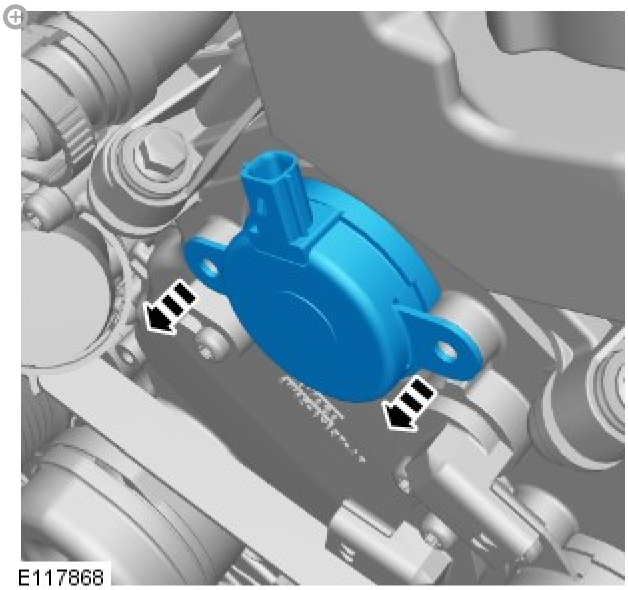
5.

CAUTION:

Evenly and progressively, remove the VVT units from each side.

NOTE:

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



INSTALLATION

1.

CAUTION:

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

NOTE:

Lubricate the O-ring seal with clean engine oil.

To install, reverse the removal procedure.

2.

NOTE:

For NAS vehicles only.

If required, carry out a short drive cycle.

Refer to: Powertrain Control Module (PCM) Short Drive Cycle Self-Test (303-14D Electronic Engine Controls - V8 S/C 5.0L Petrol, General Procedures).

2012.0 RANGE ROVER (LM), 303-14

ELECTRONIC ENGINE CONTROLS - V8 S/C 5.0L PETROL

VARIABLE VALVE TIMING (VVT) OIL CONTROL SOLENOID RH (G1220959)

REMOVAL AND INSTALLATION

18.31.36	VARIABLE EXHAUST VALVE TIMING SOLENOID - B BANK - RENEW	5000 CC, AJ V8, SUPERCHARGED	1.3	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00 Battery and Charging System - General Information, Specifications).

2. **WARNING:**

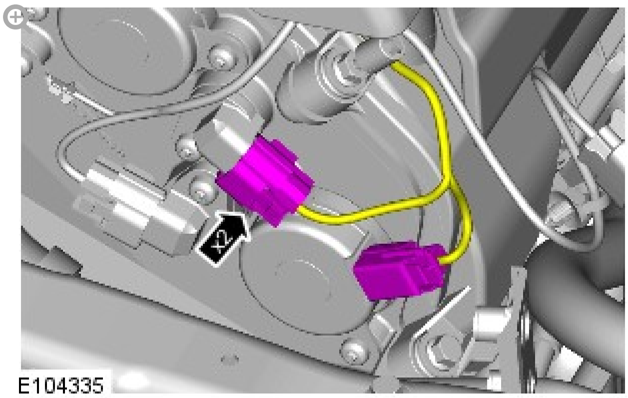
   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Thermostat Housing - V8 S/C 5.0L Petrol (303-03C Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Removal and Installation).

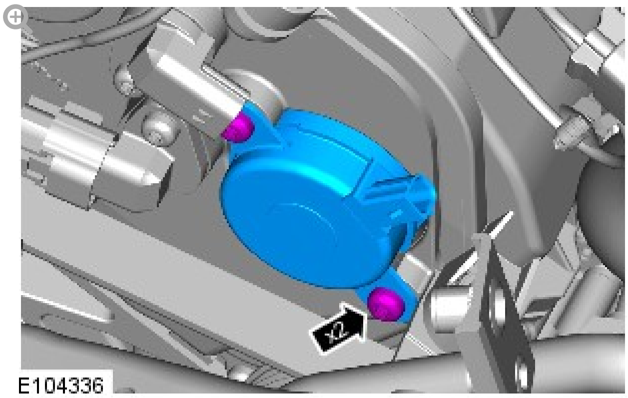
4. **NOTE:**

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



5. **NOTE:**

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



Torque: **10 Nm**

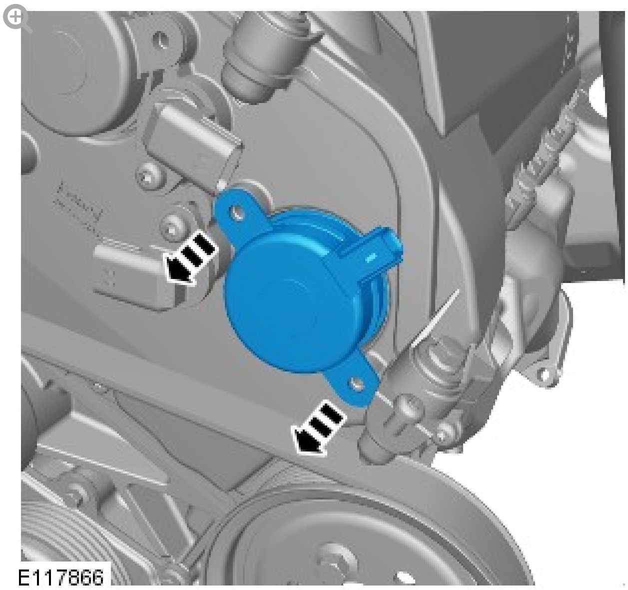
6.

CAUTION:

Evenly and progressively, remove the VVT units from each side.

NOTE:

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



INSTALLATION

1. **CAUTION:**

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

   NOTE:

   Lubricate the O-ring seal with clean engine oil.

   To install, reverse the removal procedure.

2. **NOTE:**

   For NAS vehicles only.

   If required, carry out a short drive cycle.
   Refer to: Powertrain Control Module (PCM) Short Drive Cycle Self-Test (303-14D Electronic Engine Controls - V8 S/C 5.0L Petrol, General Procedures).

AUTOMATIC TRANSMISSION/TRANSAXLE – V8 5.0L PETROL/V8 S/C 5.0L PETROL

SPECIFICATIONS

Maintenance

CAUTION:

Use only Shell M1375.4 Automatic transmission fluid. Use of any other fluids may result in a transmission malfunction or failure.

DESCRIPTION	INTERVALS
Normal maintenance	Filled for life.
Severe duty maintenance	Change the fluid at 48,000 km (30,000 miles) intervals.

Capacities

	LITERS
Transmission	9.9

Lubricants, Fluids, Sealers and Adhesives

DESCRIPTION	SPECIFICATION
Transmission fluid	Shell M1375.4

Sealant	WSS-M4G323-A6
Metal surface cleaner	WSW-M5B392-A
High temperature grease	Molecote FB180

Torque Specifications

NOTE:

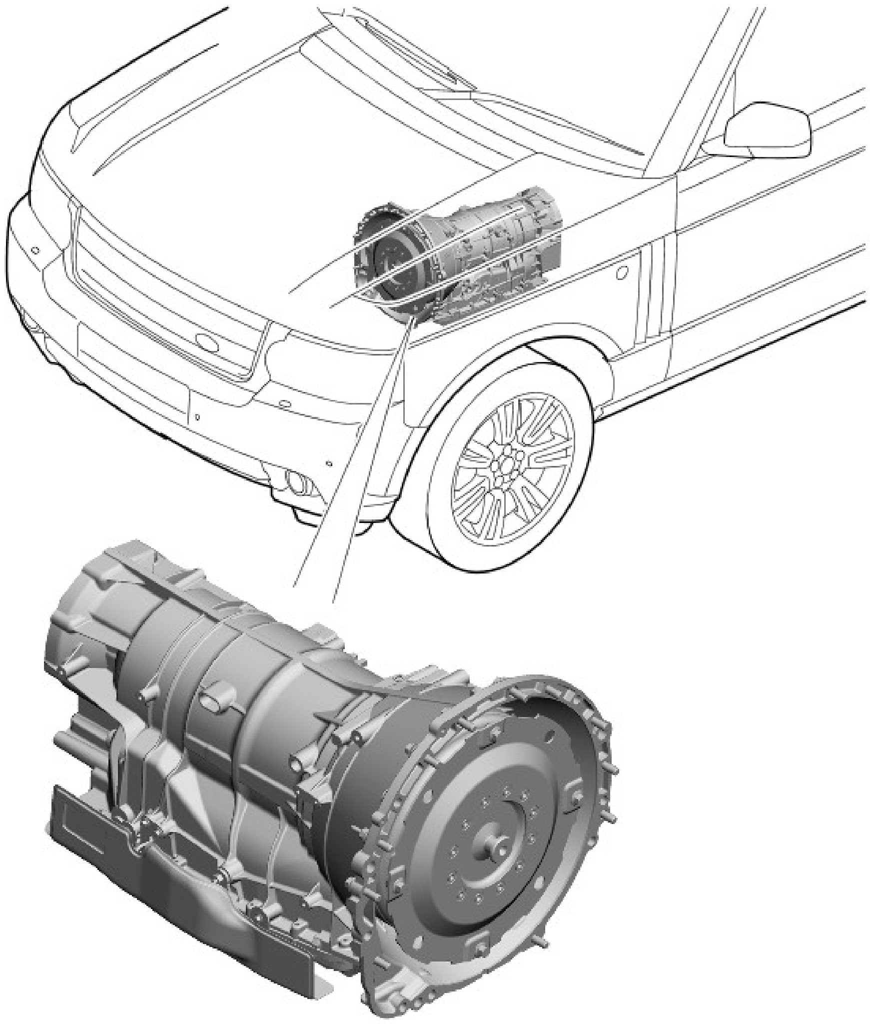
A = refer to the procedure for correct torque sequence

DESCRIPTION	NM	LB-FT	LB-IN
Transmission retaining bolts	48	35	-
Transmission mount retaining bolts	60	44	-
Transmission fluid fill plug	A	A	A
Transmission control module (TCM) and main control valve body retaining bolts	8	-	53
Torque converter retaining bolts	62	46	-
Transmission fluid cooler tube retaining bolt	22	16	-
Transmission fluid drain plug	8	-	53
Transmission fluid pan, gasket and filter retaining bolts	8	-	53

2012.0 RANGE ROVER (LM), 307-01

AUTOMATIC TRANSMISSION/TRANSAXLE – V8 5.0L PETROL/V8 S/C 5.0L PETROL

COMPONENT LOCATION



E119472

INTRODUCTION

The ZF 6HP28 transmission is an electronically controlled, hydraulically operated, six speed automatic unit. The hydraulic and electronic control elements of the transmission, including the TCM (transmission control module), are incorporated in a single unit located inside the transmission and is known as 'Mechatronic'.

On SC (supercharger) models, the transmission used is an uprated derivative of the ZF 6HP28 transmission used in the 5.0L naturally aspirated models.

The ZF 6HP28 transmission has the following features:

- Designed to be maintenance free
- Transmission fluid is 'fill for life'
- The torque converter features a controlled slip feature with electronically regulated control of lock-up, creating a smooth transition to the fully locked condition
- Shift programs controlled by the TCM
- ASIS (adaptive shift strategy), to provide continuous adaptation of shift changes to suit the driving style of the driver, which can vary from sporting to economical
- Connected to the ECM (engine control module) via the high speed CAN (controller area network) bus for communications
- Default mode if major faults occur
- Diagnostics available from the TCM via the high speed CAN bus.

The transmission selections are made using the selector lever in the floor console.
For additional information, refer to: External Controls (307-05B, Description and Operation).

TRANSMISSION

The transmission comprises the main casing which houses all of the transmission components. The main casing also incorporates an integral bell housing.

A fluid pan is attached to the lower face of the main casing and is secured with bolts. The fluid pan is sealed to the main casing with a gasket. Removal of the fluid pan allows access to the Mechatronic valve block. The fluid pan has a magnet located around the drain plug which collects any metallic particles present in the transmission fluid.

A fluid filter is located inside the fluid pan. If the transmission fluid becomes contaminated or after any service work, the fluid pan with integral filter must be replaced.

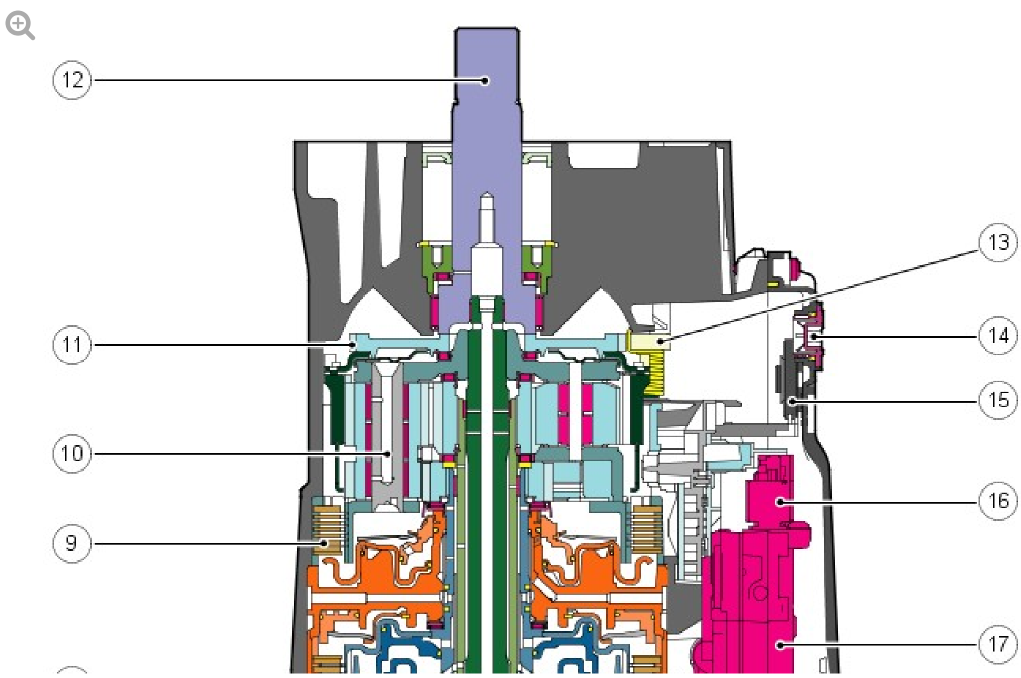
be replaced.

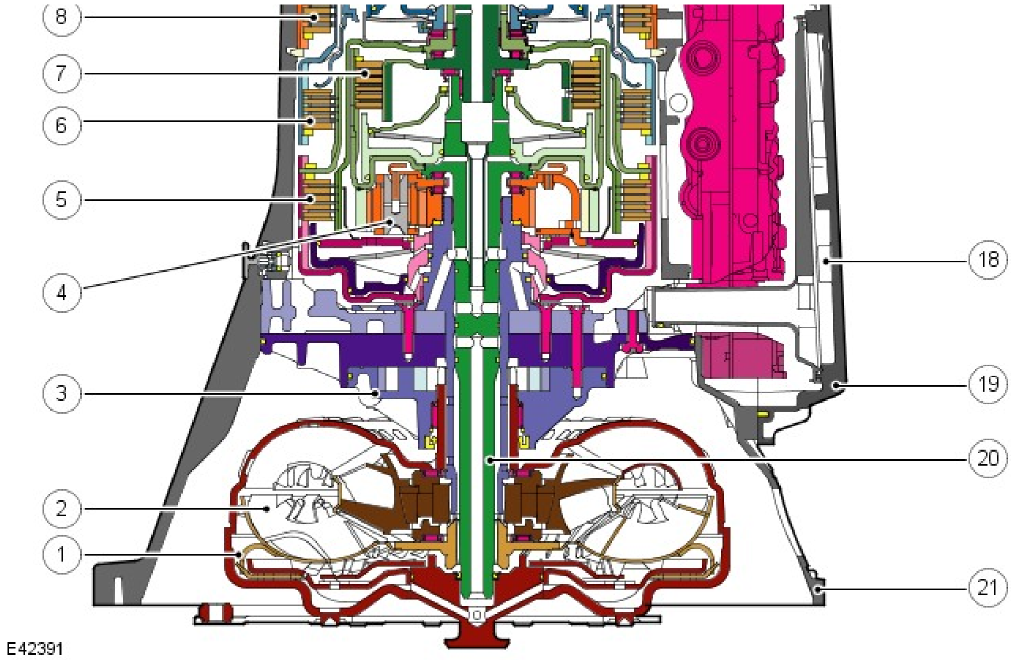
On the RH (right-hand) side of the transmission, a gear change lever is installed on the end of a selector shaft. The selector shaft operates a selector spool valve and a selector switch in the transmission. A selector cable, connected between the gear change lever and the selector lever in the floor console, controls the position of the selector shaft.

The integral bell housing provides protection for the torque converter assembly and also provides the attachment for the gearbox to the engine. The torque converter is a non-serviceable assembly which also contains the lock-up clutch mechanism. The torque converter drives a crescent type pump via drive tangs. The fluid pump is located in the main casing, behind the torque converter.

The main casing contains the following major components:

- Input shaft
- Output shaft
- Mechatronic valve block which contains the solenoids, speed sensors and the TCM
- Three rotating multiplate drive clutches
- Two fixed multiplate brake clutches
- A single planetary gear train and a double planetary gear train.

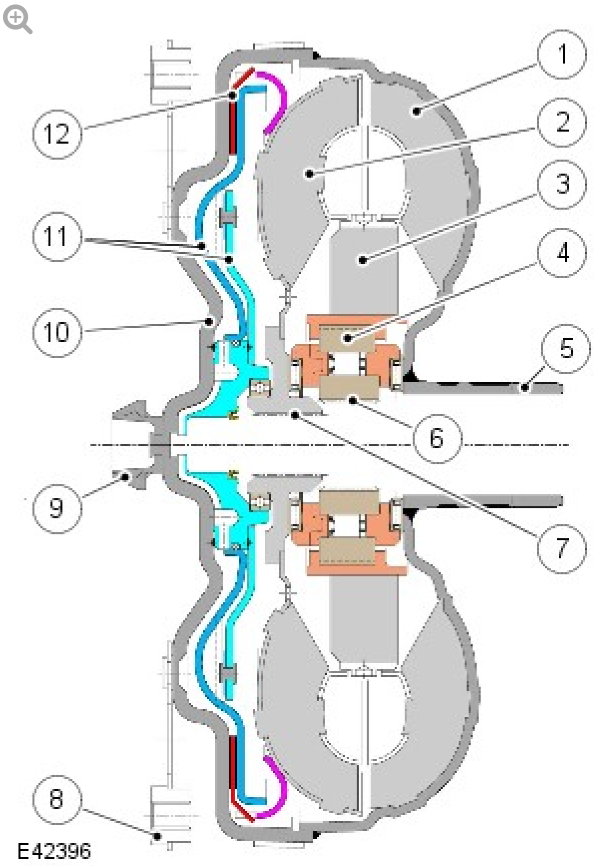




ITEM	DESCRIPTION
1	Torque converter lock-up clutch
2	Torque converter
3	Fluid pump
4	Single planetary gearset
5	Clutch A
6	Clutch B
7	Clutch E
8	Brake C
9	Brake D
10	Double planetary gearset
11	Park lock gear
12	Output shaft
13	Park lock pawl
14	Drain plug
15	Magnet
16	Pressure regulator
17	Mechatronic valve block
18	Fluid filter

19	Fluid pan
20	Input shaft
21	Transmission casing

TORQUE CONVERTER



ITEM	DESCRIPTION
1	Impeller
2	Turbine
3	Stator
4	Freewheel clutch
5	Torque converter hub
6	Stator shaft
7	Turbine shaft
8	Drive plate
9	Journal - Drive plate/crankshaft location

9	Journal - Drive plate/crankshaft location
10	Torque converter cover
11	Lock-up clutch piston
12	Lock-up clutch plate

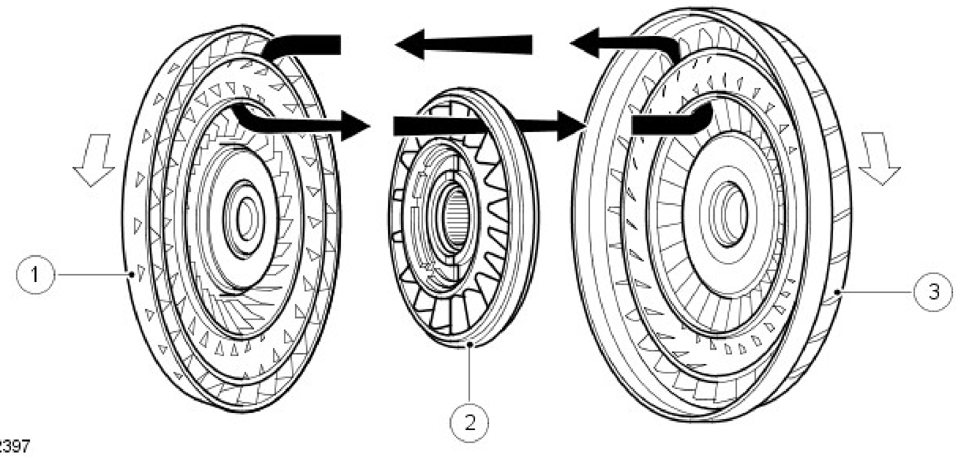
The torque converter is the coupling element between the engine and the transmission and is located in the bell housing, on the engine side of the transmission. The driven power from the engine crankshaft is transmitted hydraulically and mechanically through the torque converter to the transmission. The torque converter is connected to the engine by a drive plate attached to the rear of the crankshaft.

The torque converter comprises an impeller, a stator and a turbine. The torque converter is a sealed unit with all components located between the converter housing cover and the impeller. The two components are welded together to form a sealed, fluid filled housing. With the impeller welded to the converter housing cover, the impeller is therefore driven at engine crankshaft speed.

The converter housing cover has four threaded bosses, which provide for attachment of the engine drive plate. The threaded bosses also provide for location of special tools which are required to remove the torque converter from the bell housing.

IMPELLER

Fluid Flow



E42397

ITEM	DESCRIPTION
1	Turbine
2	Stator
3	Impeller

When the engine is running the rotating impeller acts as a centrifugal pump, picking up fluid at its center and discharging it at high velocity through the blades on its outer rim. The design and shape of the blades and the curve of the impeller body cause the fluid to rotate in a clockwise direction as it leaves the impeller. This rotation improves the efficiency of the fluid as it contacts the outer row of blades on the turbine.

The centrifugal force of the fluid leaving the blades of the impeller is passed to the curved inner surface of the turbine via the tip of the blades. The velocity and clockwise rotation of the fluid causes the turbine to rotate.

TURBINE

The turbine is similar in design to the impeller with a continuous row of blades. Fluid from the impeller enters the turbine through the tip of the blades and is directed around the curved body of the turbine to the root of the blades. The curved surface redirects the fluid back in the opposite direction to which it entered the turbine, effectively increasing the turning force applied to the turbine from the impeller. This principle is known as torque multiplication.

When engine speed increases, turbine speed also increases. The fluid leaving the inner row of the turbine blades is rotated in a counter-clockwise direction due to the curve of the turbine and the shape of the blades. The fluid is now flowing in the opposite direction to the engine rotation and therefore the impeller. If the fluid was allowed to hit the impeller in this condition, it would have the effect of applying a brake to the impeller, eliminating the torque multiplication effect. To prevent this, the stator is located between the impeller and the turbine.

STATOR

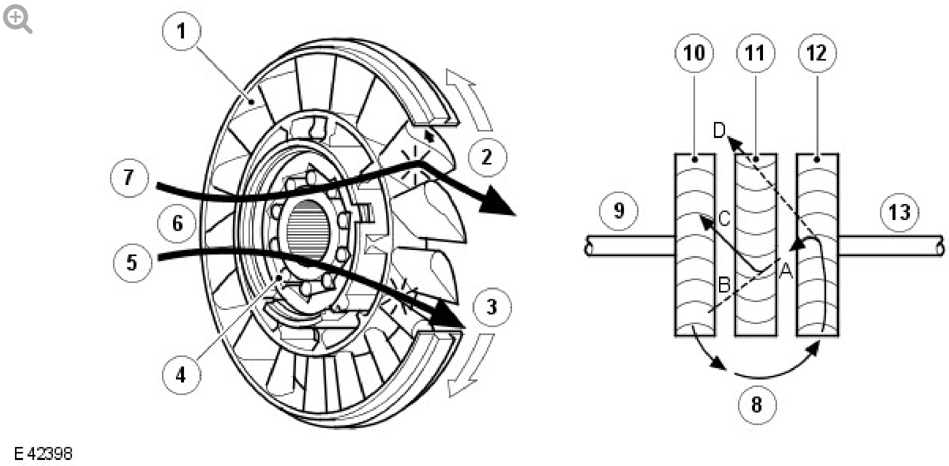
The stator is located on the splined transmission input shaft via a freewheel clutch. The stator comprises a number of blades which are aligned in an opposite direction to those of the impeller and turbine. The main function of opposite direction to those of the impeller and turbine. The main function of the stator is to redirect the returning fluid from the turbine, changing its direction to that of the impeller.

The redirected fluid from the stator is directed at the inner row of blades of the impeller, assisting the engine in turning the impeller. This sequence increases the force of the fluid emitted from the impeller and thereby increases the torque multiplication effect of the torque converter.

Stator Functions

NOTE:

> The following illustration shows a typical stator



ITEM	DESCRIPTION
1	Blades
2	Stator held – fluid flow redirected
3	Stator rotates freely
4	Roller
5	Converter at coupling speed
6	Fluid flow from turbine
7	Converter multiplying
8	Fluid flow from impeller
9	Drive from engine

9	Drive from engine
10	Impeller
11	Stator
12	Turbine
13	Output to transmission

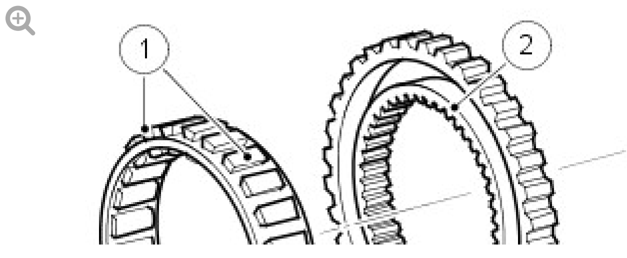
Fluid emitted from the impeller acts on the turbine. If the turbine is rotating at a slower speed than the fluid from the impeller, the fluid will be deflected by the turbine blades in the path **'A'**. The fluid is directed at and deflected by the stator blades from path **'B'** to path **'C'**. This ensures that the fluid is directed back to the pump in the optimum direction. In this condition the sprag clutch is engaged and the force of the fluid on the stator blades assists the engine in rotating the impeller.

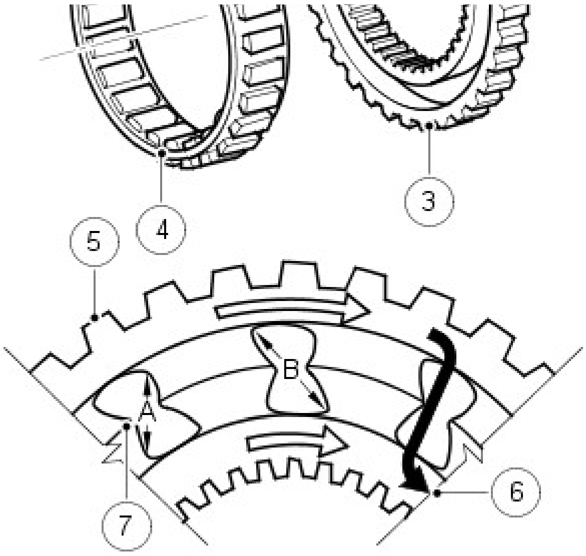
As the rotational speed of the engine and therefore the turbine increases, the direction of the fluid leaving the turbine changes to path **'D'**. The fluid is now directed from the turbine to the opposite side of the stator blades, rotating the stator in the opposite direction. To prevent the stator from resisting the smooth flow of the fluid from the turbine, the sprag clutch releases, allowing the stator to rotate freely on its shaft.

When the stator becomes inactive, the torque converter no longer multiplies the engine torque. When the torque converter reaches this operational condition it ceases to multiply the engine torque and acts solely as a fluid coupling, with the impeller and the turbine rotating at approximately the same speed.

The stator uses a sprag type, one way, freewheel clutch. When the stator is rotated in a clockwise direction the sprags twist and are wedged between the inner and outer races. In this condition the sprags transfer the rotation of the outer race to the inner race which rotates at the same speed.

ONE WAY FREE WHEEL CLUTCH – TYPICAL





ITEM	DESCRIPTION
1	Sprags
2	Inner race
3	Outer race
4	Sprag and cage assembly
5	Sprag outer race
6	Sprag inner race
7	Retaining ring

The free wheel clutch can perform three functions; hold the stator stationary, drive the stator and free wheel allowing the stator to rotate without a drive output. The free wheel clutch used in the ZF 6HP28 transmission is of the sprag type and comprises an inner and outer race and a sprag and cage assembly. The inner and outer races are pressed into their related components with which they rotate. The sprag and cage assembly is located between the inner and outer races.

The sprags are located in a cage which is a spring which holds the sprags in the 'wedge' direction and maintains them in contact with the inner and outer races.

Referring to the illustration, the sprags are designed so that the dimension **'B'** is larger than the distance between the inner and outer race bearing

'B' is larger than the distance between the inner and outer race bearing surfaces. When the outer race rotates in a clockwise direction, the sprags twist and the edges across the dimension **'B'** wedge between the races, providing a positive drive through each sprag to the inner race. The dimension **'A'** is smaller than the distance between the inner and outer race bearing surfaces. When the outer race rotates in an anti-clockwise direction, the dimension **'A'** is too small to allow the sprags to wedge between the races, allowing the outer race to rotate freely.

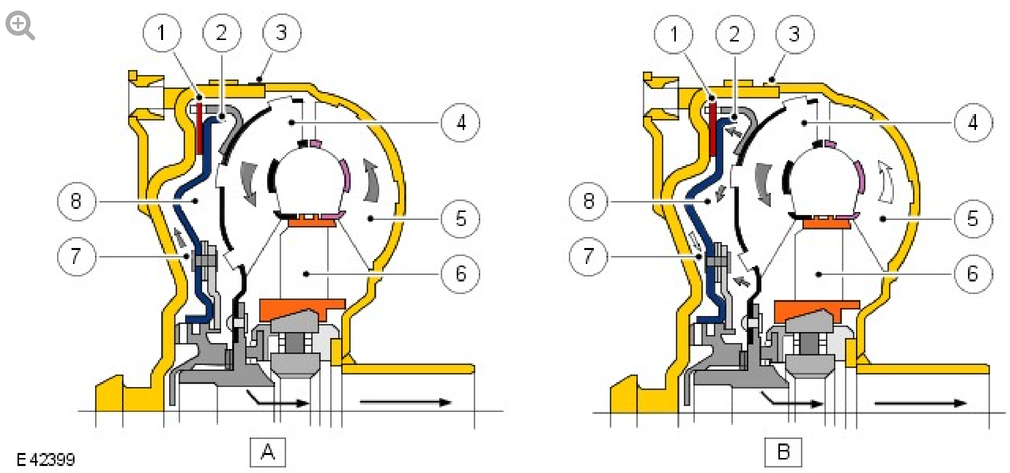
On the illustration shown, when the outer race is rotated in a clockwise direction, the sprags twist and are 'wedged' between the inner and outer races. The sprags then transfer the rotation of the outer race to the inner race, which rotates at the same speed.

LOCK-UP CLUTCH MECHANISM

The TCC (torque converter clutch) is hydraulically controlled by an EPRS (electronic pressure regulating solenoid), which is controlled by the TCM. This allows the torque converter to have three states of operation as follows:

- Fully engaged
- Controlled slip variable engagement
- Fully disengaged.

The TCC is controlled by two hydraulic spool valves located in the valve block. These valves are actuated by pilot pressure supplied via a solenoid valve which is also located in the valve block. The solenoid valve is operated by PWM (pulse width modulation) signals from the TCM to give full, partial or no lock-up of the torque converter.



ITEM	DESCRIPTION
A	Unlocked condition
B	Locked condition
1	Clutch plate
2	Clutch piston
3	Torque converter body
4	Turbine
5	Impeller
6	Stator
7	Piston chamber
8	Turbine chamber

The lock-up clutch is a hydro-mechanical device which eliminates torque converter slip, improving fuel consumption. The engagement and disengagement is controlled by the TCM to allow a certain amount of controlled 'slip'. This allows a small difference in the rotational speeds of the impeller and the turbine which results in improved shift quality. The lock-up clutch comprises a piston and a clutch friction plate.

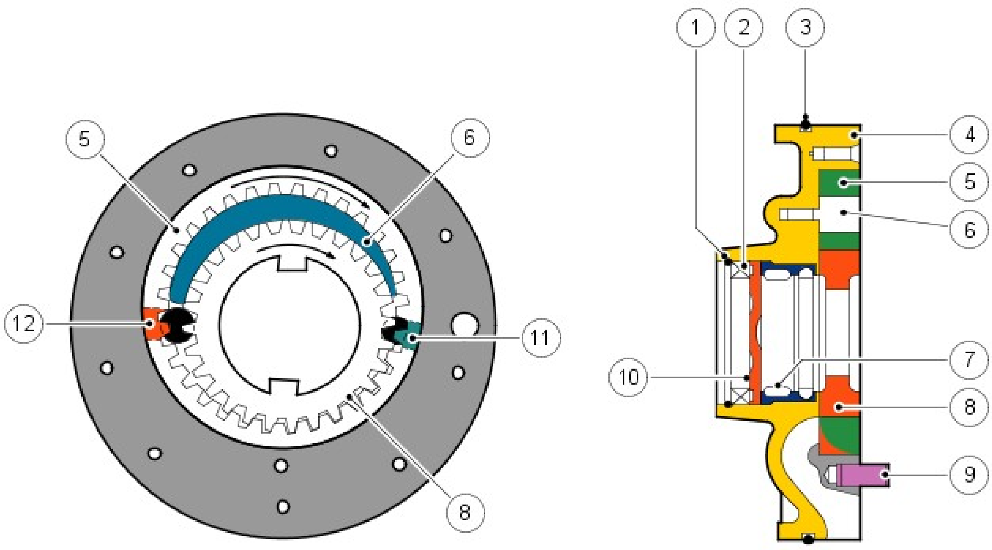
In the unlocked condition, the oil pressure supplied to the piston chamber and the turbine chamber is equal. Pressurized fluid flows through a drilling in the turbine shaft and through the piston chamber to the turbine chamber. In this condition the clutch plate is held away from the torque converter body and torque converter slip is permitted.

In the locked condition, the TCC spool valves are actuated by the EPRS. The fluid flow in the unlocked condition is reversed and the piston chamber is vented. Pressurized fluid is directed into the turbine chamber and is applied to the clutch piston. The piston moves with the pressure and pushes the clutch plate against the torque converter body. As the pressure increases, the friction between the clutch plate and the body increases, finally resulting in full lock-up of the clutch plate with the body. In this condition there is direct mechanical drive from the engine crankshaft to the transmission planetary gear train.

FLUID PUMP

The fluid pump is an integral part of the transmission. The fluid pump is used to supply hydraulic pressure for the operation of the control valves and clutches, to pass the fluid through the transmission cooler and to lubricate the gears and shafts.

The ZF 6HP28 fluid pump is a crescent type pump and is located between the intermediate plate and the torque converter. The pump has a delivery rate of 16 cm^3 per revolution.



E42400

ITEM	DESCRIPTION
1	Securing ring
2	Shaft oil seal
3	O-ring seal
4	Pump housing
5	Ring gear
6	Crescent spacer
7	Roller bearing
8	Impeller

9	Centering pin
10	Spring washer
11	Outlet port (high pressure)
12	Inlet port (low pressure)

The pump comprises a housing, a crescent spacer, an impeller and a ring gear. The housing has inlet and outlet ports to direct flow and is located in the intermediate plate by a centering pin. The pump action is achieved by the impeller, ring gear and crescent spacer.

The crescent spacer is fixed in its position by a pin and is located between the ring gear and the impeller. The impeller is driven by drive from the torque converter hub which is located on a needle roller bearing in the pump housing. The impeller teeth mesh with those of the ring gear. When the impeller is rotated, the motion is transferred to the ring gear which rotates in the same direction.

The rotational motion of the ring gear and the impeller collects fluid from the intake port in the spaces between the teeth. When the teeth reach the crescent spacer, the oil is trapped in the spaces between the teeth and is carried with the rotation of the gears. The spacer tapers near the outlet port. This reduces the space between the gear teeth causing a build up of fluid pressure as the oil reaches the outlet port. When the teeth pass the end of the spacer the pressurized fluid is released into the outlet port.

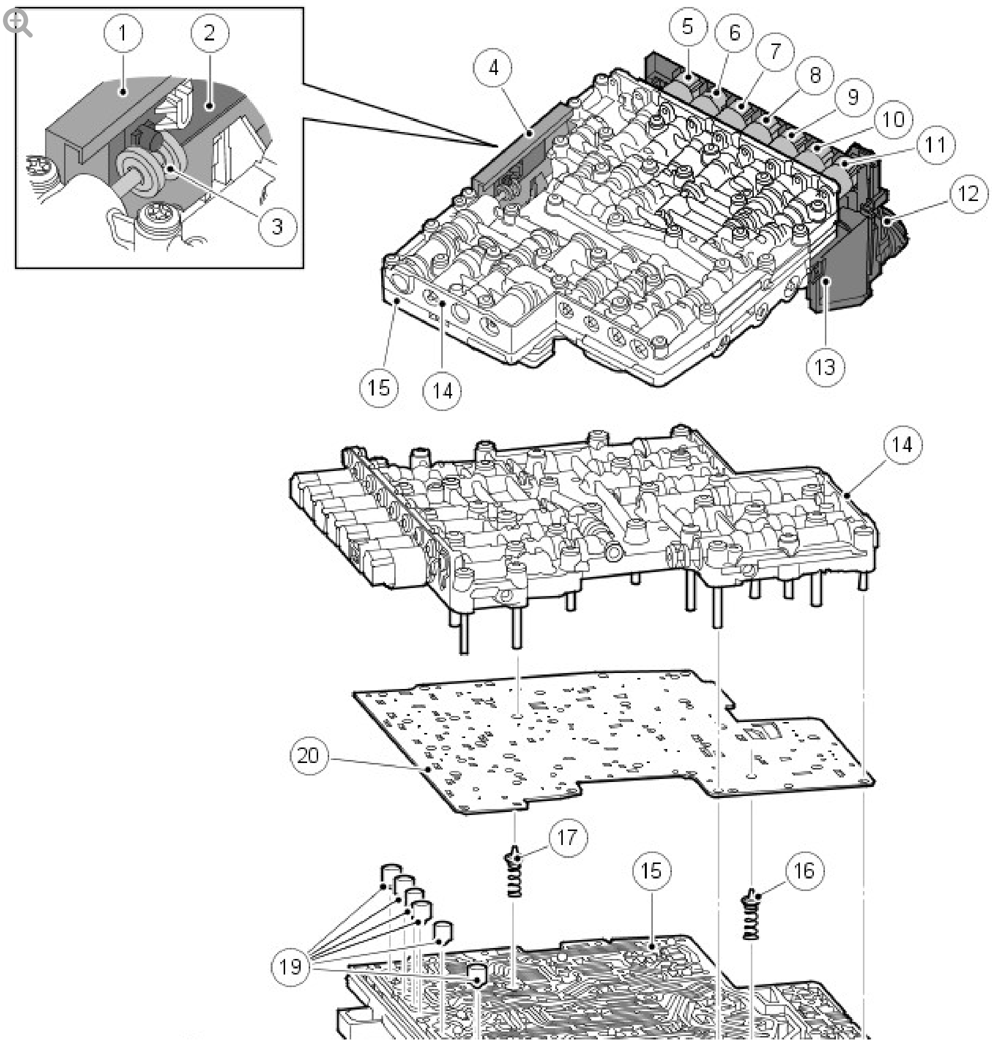
The fluid emerging from the outlet port is passed through the fluid pressure control valve. At high operating speeds the pressure control valve maintains the output pressure to the gearbox at a predetermined maximum level. Excess fluid is relieved from the pressure control valve and is directed, via the main pressure valve in the valve block, back to the pump inlet port. This provides a pressurized feed to the pump inlet which prevents cavitation and reduces pump noise.

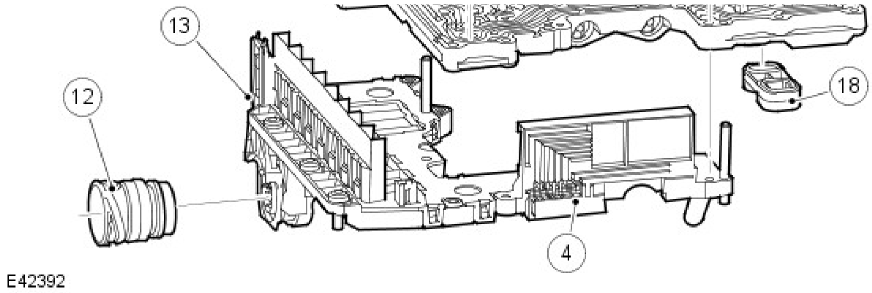
MECHATRONIC VALVE BLOCK

The Mechatronic valve block is located in the bottom of the transmission and is covered by the fluid pan. The valve block houses the TCM, electrical and is covered by the fluid pan. The valve block houses the TCM, electrical actuators, speed sensors and control valves which provide all electro-hydraulic control for all transmission functions. The Mechatronic valve block comprises the following components:

- TCM
- Six pressure regulator solenoids
- One shift control solenoid
- One damper
- Twenty one hydraulic spool valves
- Manually operated selector valve
- Temperature sensor
- Turbine speed sensor
- Output shaft speed sensor.

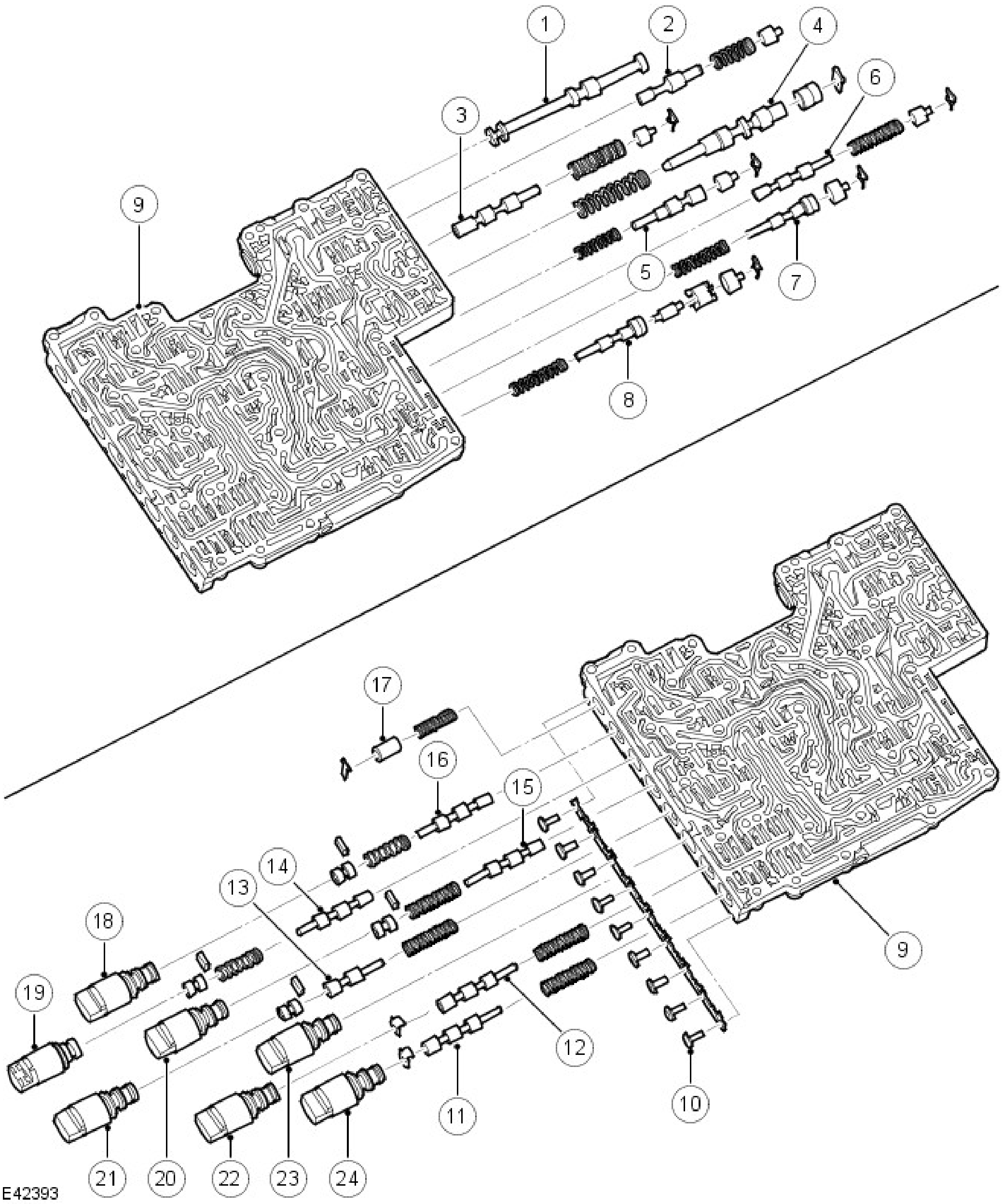
Mechatronic Valve Block





ITEM	DESCRIPTION
1	Position switch
2	Sliding block
3	Selector spool valve
4	Position switch assembly
5	EPRS 6
6	Solenoid Valve 1
7	EPRS 4
8	EPRS 5
9	EPRS 3
10	EPRS 2
11	EPRS 1
12	Electrical connector
13	TCM
14	Valve housing
15	Valve plate
16	Torque converter retaining valve
17	Clutch return valve
18	Element seal
19	Pressure regulator dampers
20	Intermediate plate

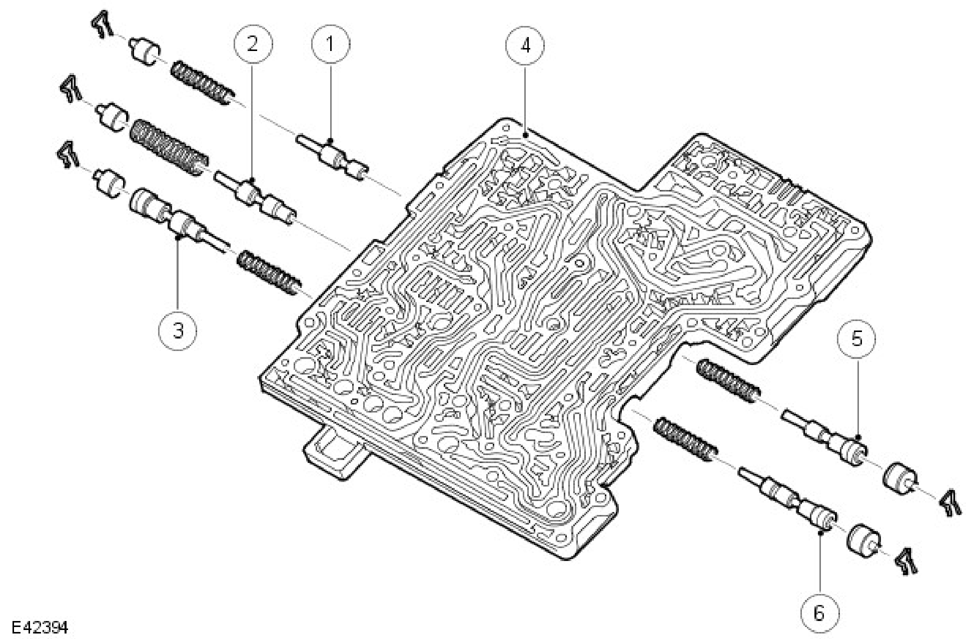
Valve Housing Components



ITEM	DESCRIPTION
1	Selector spool valve
2	Lubricating valve
3	Torque converter pressure valve
4	System pressure valve
5	Torque converter clutch valve
6	Retaining valve – Clutch E
7	Clutch valve E
8	Clutch valve A
9	Valve housing

10	Bolts
11	Retaining valve – Clutch A
12	Retaining valve – Clutch B
13	Pressure reducing valve
14	Shift valve 1
15	Retaining valve – Brake D
16	Shift valve 2
17	Damper
18	EPRS 6
19	Solenoid valve 1
20	EPRS 4
21	EPRS 5
22	EPRS 2
23	EPRS 3
24	EPRS 1

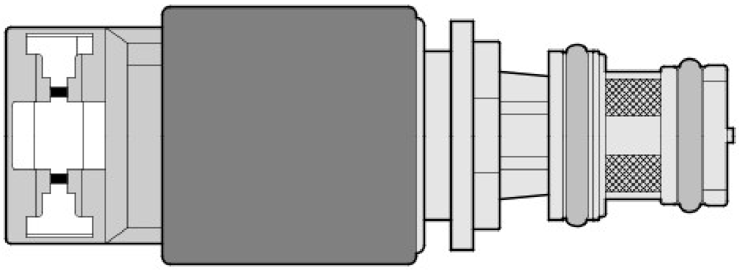
Valve Plate Components



ITEM DESCRIPTION

ITEM	DESCRIPTION
1	Retaining valve – Brake D2
2	Clutch valve – Brake D2
3	Clutch valve B
4	Valve plate
5	Clutch valve – Brake D1
6	Clutch valve – Brake C

ELECTRONIC PRESSURE REGULATOR SOLENOIDS



E42713

Six EPRS are located in the valve block. The solenoids are controlled by PWM signals from the TCM. The solenoids convert the electrical signals into hydraulic control pressure proportional to the signal to actuate the spool valves for precise transmission operation.

The following table shows EPRS and their associated functions:

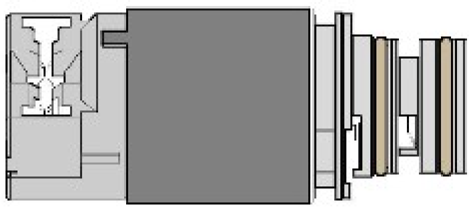
EPRS	FUNCTION
1	Clutch A
2	Clutch B
3	Clutch C
4	Brake clutches D and E
5	System pressure control
6	Torque converter lock-up control

Solenoids EPRS 1, 3 and 6 supply a lower control pressure as the signal amperage increases and can be identified by a black connector cap. The TCM operates the solenoids using PWM signals. The TCM monitors engine load and clutch slip and varies the solenoid duty cycle accordingly. The solenoids have a 12 V operating voltage and a pressure range of 0 - 4.6 bar (0 - 67 lbf.in^2).

Solenoids EPRS 2, 4 and 5 supply a higher control pressure as the signal amperage increases and can be identified by a green connector cap. The solenoids are normally open, regulating flow solenoid valves. The operates the solenoids using a PWM earth proportional to the required increasing or decreasing clutch pressures. The solenoids have a 12 V operating voltage and a pressure range of 4.6 - 0 bar (67 - 0 lbf.in^2).

The resistance of the solenoid coil winding for solenoid is between 26 to 30.4 ohms at 20 °C (68 °F).

CONTROL SOLENOID



E42714

A shift control SV (solenoid valve) is located in the valve block. The solenoid is controlled by the TCM and converts electrical signals into hydraulic control signals to control clutch application.

The shift control solenoid is an open/closed, on/off solenoid which is controlled by the TCM switching the solenoid to earth. The TCM also supplies power to the solenoid. The TCM energises the solenoid in a programmed sequence for clutch application for gear ratio changes and shift control.

The resistance of the solenoid coil winding for solenoid is between 26 to 30.4 ohms at 20 °C (68 °F).

SENSORS

Speed Sensors

The turbine speed sensor and the output shaft speed sensor are Hall effect type sensors located in the Mechatronic valve block and are not serviceable items. The TCM monitors the signals from each sensor to determine the input (turbine) speed and the output shaft speed.

The turbine speed is monitored by the TCM to calculate the slip of the torque converter clutch and internal clutch slip. This signal allows the TCM to accurately control the slip timing during shifts and adjust clutch application or release pressure for overlap shift control.

The output shaft speed is monitored by theTCM and compared to engine speed signals received on the CAN bus from the ECM. Using a comparison of the two signals the TCM calculates the transmission slip ratio for plausibility and maintains adaptive pressure control.

Temperature Sensor

The temperature sensor is also located in the Mechatronic valve block. The TCM uses the temperature sensor signals to determine the temperature of the transmission fluid. These signals are used by the TCM to control the transmission operation to promote faster warm-up in cold conditions or to assist with fluid cooling by controlling the transmission operation when high fluid temperatures are experienced. If the sensor fails, the TCM will use a default value and a fault code will be stored in the TCM.

Damper

There is 1 damper located in the valve housing. The damper is used to regulate and dampen the regulated pressure supplied via EPRS 5. The damper is load dependent through modulation of the damper against return spring pressure.

The damper comprises a piston, a housing bore and a spring. The piston is subject to the pressure applied by the spring. The bore has a connecting port to the function to which it applies. Fluid pressure applied to the applicable component (i.e. a clutch) is also subjected to the full area of the piston, which moves against the opposing force applied by the spring. The movement of the piston creates an action similar to a shock absorber, momentarily delaying the build up of pressure in the circuit. This results in a more gradual application of clutches improving shift quality.

Spool Valves

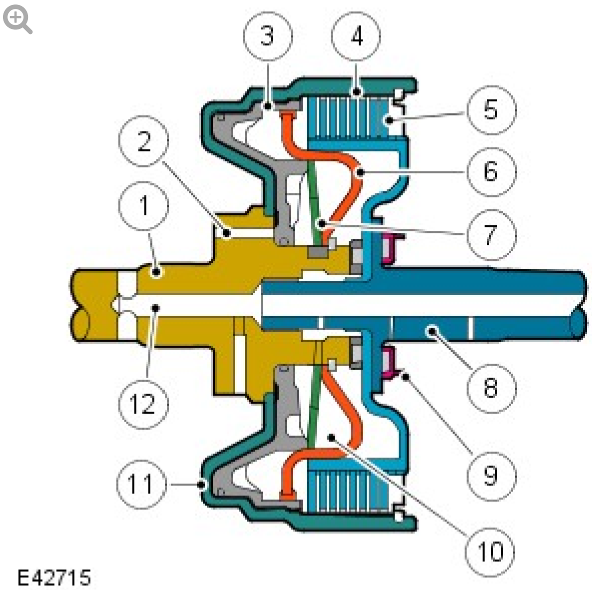
The valve block contains 21 spool valves which control various functions of the transmission. The spool valves are of conventional design and are operated by fluid pressure.

Each spool valve is located in its spool bore and held in a default (unpressurized) position by a spring. The spool bore has a number of ports which allow fluid to flow to other valves and clutches to enable transmission operation. Each spool has a piston which is waisted to allow fluid to be diverted into the applicable ports when the valve is operated.

When fluid pressure moves a spool, 1 or more ports in the spool bore are covered or uncovered. Fluid is prevented from flowing or is allowed to flow around the applicable waisted area of the spool and into another uncovered port. The fluid is either passed through galleries to actuate another spool, operate a clutch or is returned to the fluid pan.

DRIVE CLUTCHES

Multiplate Drive or Brake Clutch – Typical



ITEM	DESCRIPTION
1	Input shaft
2	Main pressure supply port
3	Piston
4	Cylinder – external plate carrier
5	Clutch plate assembly
6	Baffle plate
7	Diaphragm spring
8	Output shaft
9	Bearing
10	Dynamic pressure equalization chamber
11	Piston chamber
12	Lubrication channel

There are three drive clutches and two brake clutches used in the ZF 6HP28 transmission. Each clutch comprises one or more friction plates dependent on the output controlled. A typical clutch consists of a number of steel outer plates and inner plates with friction material bonded to each face.

On SC models, the uprated transmission includes additional clutch plates to enable the transmission to manage the additional power output of the SC engine.

The clutch plates are held apart mechanically by a diaphragm spring and hydraulically by dynamic pressure. The pressure is derived from a lubrication channel which supplies fluid to the bearings etc. The fluid is passed via a drilling in the output shaft into the chamber between the baffle plate and the piston. To prevent inadvertent clutch application due to pressure build up produced by centrifugal force, the fluid in the dynamic pressure equalization chamber overcomes any pressure in the piston chamber and holds the piston off the clutch plate assembly.

When clutch application is required, main pressure from the fluid pump is applied to the piston chamber from the supply port. This main pressure overcomes the low pressure fluid present in the dynamic pressure equalization chamber. The piston moves, against the pressure applied by the diaphragm spring, and compresses the clutch plate assembly. When the main pressure falls, the diaphragm spring pushes the piston away from the clutch plate assembly, disengaging the clutch.

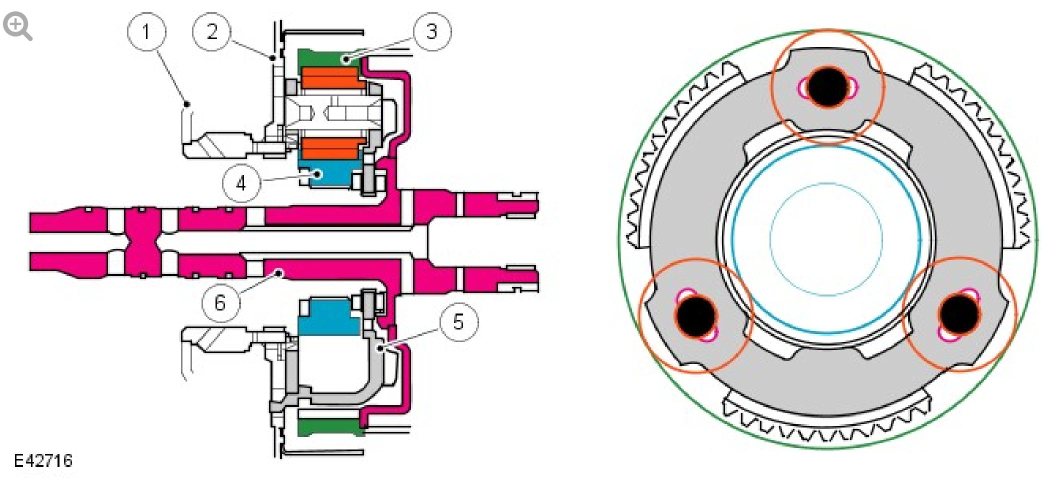
PLANETARY GEAR TRAINS

The planetary gear trains used on the ZF 6HP28 transmission comprise a single web planetary gear train and a double web planetary gear train. These gear trains are known as Lepelletier type gear trains and together produce the six forward gears and the one reverse gear.

SINGLE WEB PLANETARY GEAR TRAIN

The single web planetary gear train comprises:

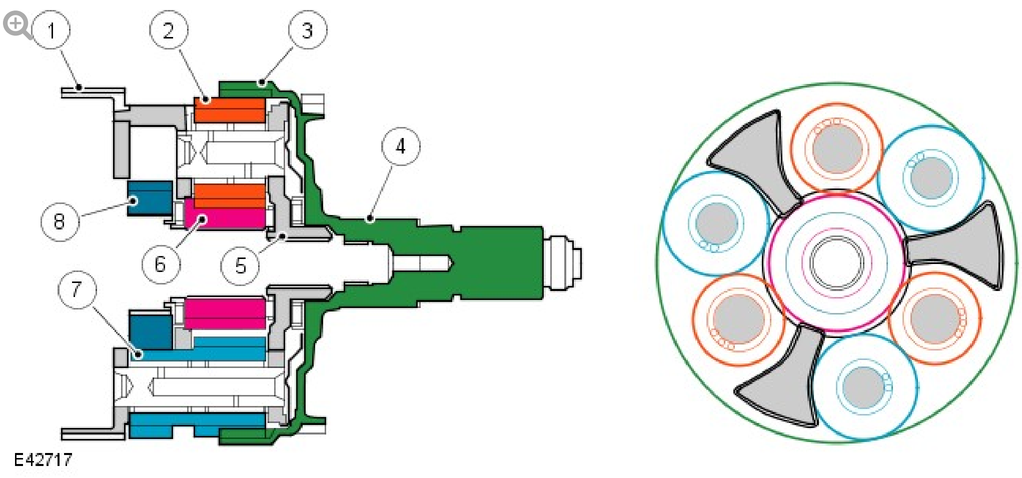
- Sunwheel
- Four planetary gears
- Planetary gear carrier (spider)
- Ring gear or annulus.



ITEM	DESCRIPTION
1	Cylinder
2	Baffle plate
3	Ring gear

4	Sun gear
5	Planetary gear spider
6	Torque converter input shaft

Torque Converter Input Shaft



ITEM	DESCRIPTION
1	Planetary gear spider
2	Planetary gears (short)
3	Ring gear
4	Output shaft
5	Planetary gear carrier
6	Sunwheel
7	Double planetary gears (long)
8	Sunwheel

The double planetary gear train comprises:

- Two sunwheels
- Three short planetary gears
- Three long planetary gears
- Planetary gear carrier
- Ring gear or annulus

- Ring gear or annulus

TRANSMISSION CONTROL MODULE

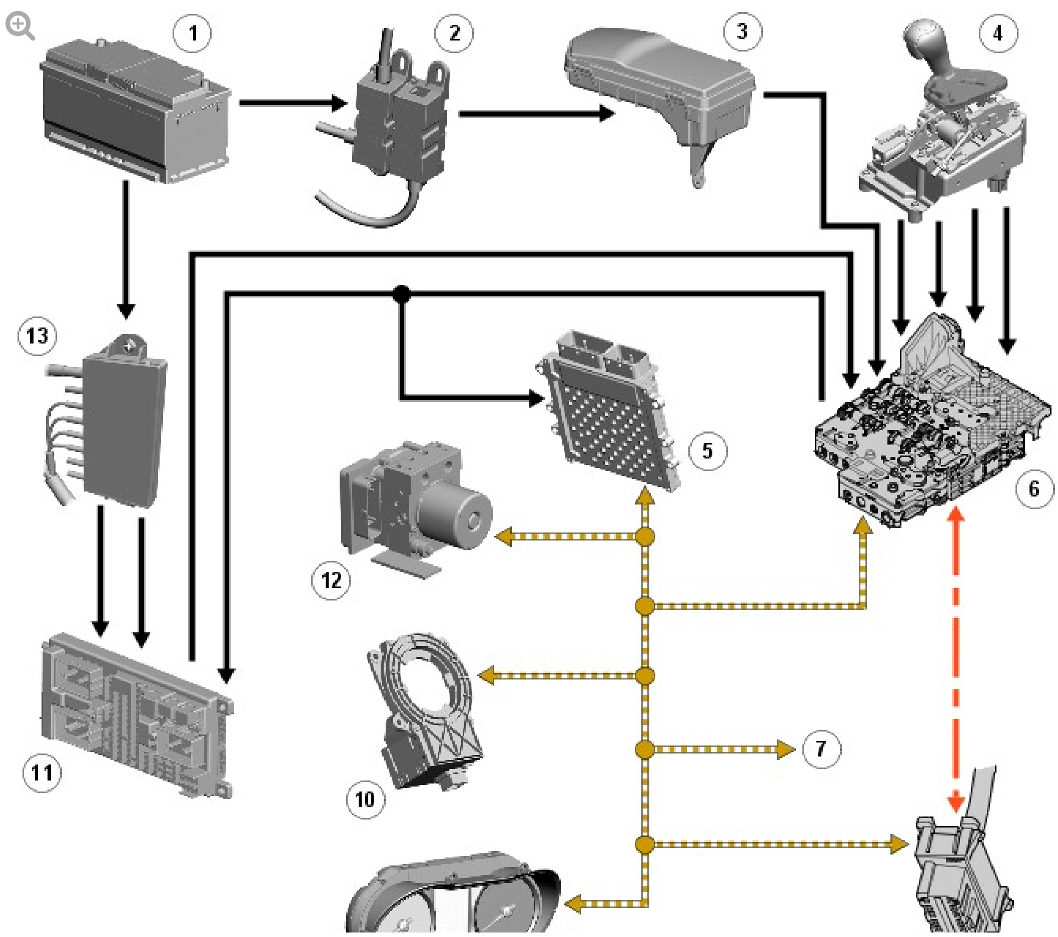
The TCM is an integral part of the Mechatronic valve block which is located at the bottom of the transmission, within the fluid pan. The TCM is the main controlling component of the transmission.

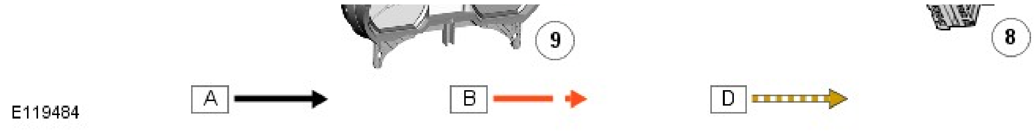
The TCM processes signals from the transmission speed and temperature sensors, ECM and other vehicle systems. From the received signal inputs and pre-programmed data, the module calculates the correct gear, torque converter clutch setting and optimum pressure settings for gear shift and lock-up clutch control.

CONTROL DIAGRAM

NOTE:

A = Hardwired; B = K bus; D = High speed CAN bus.



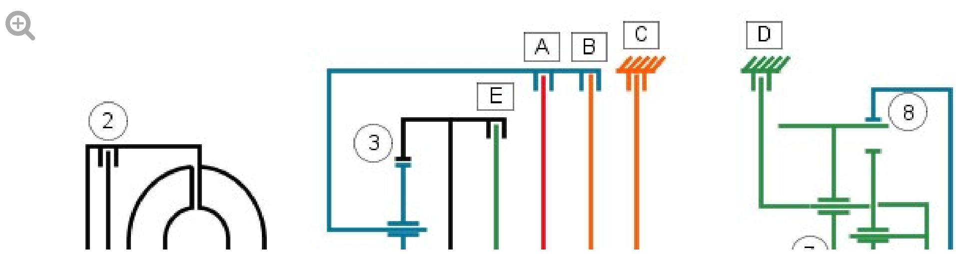


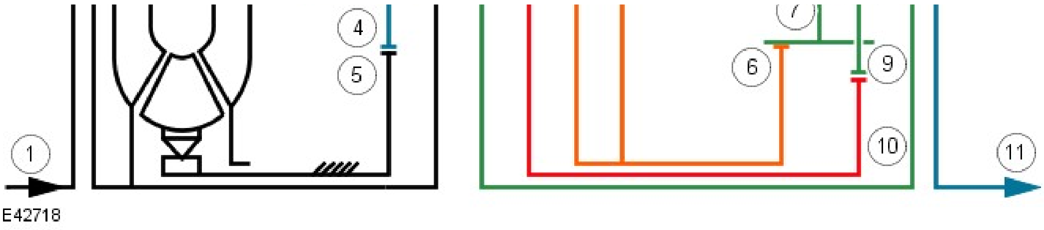
ITEM	DESCRIPTION
1	Battery
2	BJB (battery junction box) 2 (175 A megafuse)
3	CJB (central junction box)
4	Selector lever
5	ECM (engine control module)
6	TCM
7	To other systems
8	Diagnostic socket
9	Instrument cluster
10	Steering angle sensor
11	CJB (central junction box)
12	ABS module
13	BJB

OPERATION

POWER FLOWS

Operation of the transmission is controlled by the TCM, which electrically activates various solenoids to control the transmission gear selection. The sequence of solenoid activation is based on programmed information in the TCM memory and physical transmission operating conditions such as vehicle speed, throttle position, engine load and selector lever position.



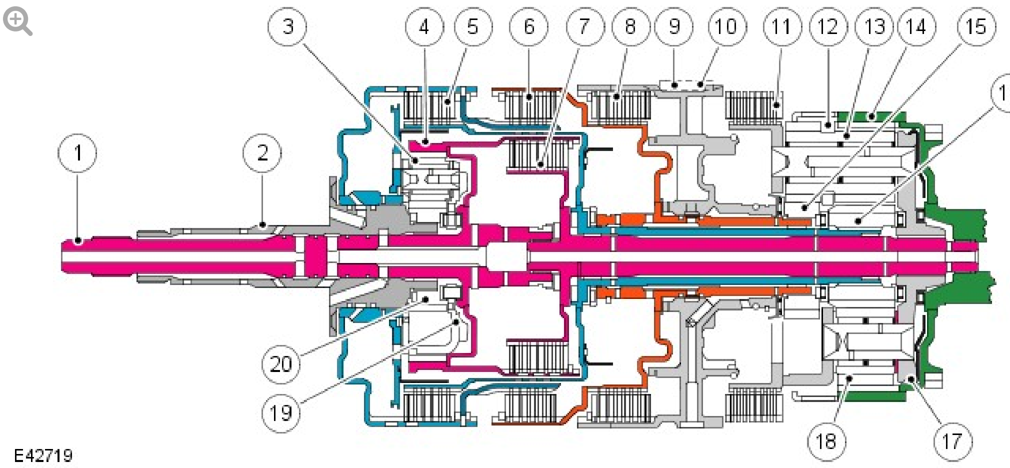


ITEM	DESCRIPTION
1	Torque input from engine
2	Torque converter lock-up clutch
3	Single web planetary gear carrier
4	Single web planetary gears
5	Single web sunwheel 1
6	Double web sunwheel 2
7	Double web planetary gears - long
8	Double web planetary gear carrier
9	Double web planetary gears - short
10	Double web sunwheel 3
11	Torque output from transmission
A	Multiplate clutch
B	Multiplate clutch
C	Multiplate brake
D	Multiplate brake
E	Multiplate clutch

Engine torque is transferred, via operation of single or combinations of clutches to the 2 planetary gear trains. Both gear trains are controlled by reactionary inputs from brake clutches to produce the 6 forward gears and 1 reverse gear. The ratios are as follows:

GEAR	1ST	2ND	3RD	4TH	5TH	6TH	REVERSE
Ratio	4.171	2.340	1.521	1.143	0.867	0.691	3.403

Shift Elements



ITEM	DESCRIPTION
1	Turbine shaft

2012.0 RANGE ROVER (LM), 307-01

AUTOMATIC TRANSMISSION/TRANSAXLE - V8 5.0L PETROL/V8 S/C 5.0L PETROL

DIAGNOSIS AND TESTING

PRINCIPLE OF OPERATION

For a detailed description of the automatic transmission/transaxle system and operation, refer to the relevant Description and Operation sections in the workshop manual. REFER to:

Transmission Description (307-01B Automatic Transmission/Transaxle - TDV8 4.4L Diesel, Description and Operation), Transmission Description (307-01C Automatic Transmission/Transaxle - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

FLUID LEVEL AND CONDITION CHECK

CAUTION:

The vehicle should not be driven if the fluid level is low as internal failure can result.

NOTE:

The transmission fluid temperature must not be allowed to exceed 50°C (122°F) whilst checking level. Should the temperature rise above this figure, abort the check and allow the transmission fluid to cool to below 30°C (86°F).

This vehicle is not equipped with a fluid level indicator. An incorrect level may affect the transmission operation and could result in transmission damage. To correctly check and add fluid to the transmission. Refer to the relevant section in the workshop manual.

HIGH FLUID LEVEL

A fluid level that is too high may cause the fluid to become aerated due to the churning action of the rotating internal parts. This will cause erratic control pressure, foaming, loss of fluid from the vent tube and possible transmission damage. If an overfill condition is identified, with the engine at idle ensure the fluid temperature is within the specified range and allow the excess fluid to drain until a small thread of fluid runs from the filler/level plug hole.

LOW FLUID LEVEL

A low fluid level could result in poor transmission engagement, slipping, or damage. This could also indicate a leak in one of the transmission seals or gaskets.

ADDING FLUID

CAUTION:

> The use of any other type of transmission fluid other than that specified can result in transmission damage.

If fluid needs to be added, add fluid in 0.50 liter increments through the fill hole opening. Do not overfill the fluid. For fluid type, refer to the Specification section in the workshop manual.

FLUID CONDITION CHECK

1. Check the fluid level.

1. Observe the color and the odor of the fluid. The color under normal circumstances should be like honey, not dark brown or black.

1. Allow the fluid to drip onto a facial tissue and examine the stain.

1. If evidence of solid material is found, the transmission fluid pan should be removed for further inspection.

NOTE: In the event of a transmission unit replacement for internal failure, the oil cooler and pipes must also be replaced.

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 tested and/or the donor vehicle.

1. Verify the customer concern.

1. Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

MECHANICAL	ELECTRICAL	HYDRAULIC
▪ Damaged/stuck shift mechanism ▪ Damaged automatic transmission casing	▪ Blown fuse(s) ▪ Damaged, loose or corroded connectors ▪ Wiring harness	▪ Fluid level too high/low ▪ Poor condition of fluid ▪ Fluid leak

1. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

1. If the cause is not visually evident check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC INDEX

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

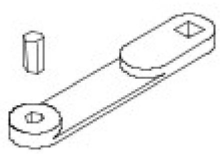
AUTOMATIC TRANSMISSION/TRANSAXLE - V8 5.0L PETROL/V8 S/C 5.0L PETROL

TRANSMISSION FLUID LEVEL CHECK (G1225338)

GENERAL PROCEDURES

19.22.16	SENSOR - HEATED OXYGEN (HO2S) - FRONT/LEFT/EACH - RENEW	5000 CC, AJ V8	0.6	USED WITHINS	+
44.24.06	LUBRICATION SYSTEM - CHECK AND TOP UP	5000 CC, AJ V8	0.5	USED WITHINS	+

SPECIAL TOOL(S)



307-452

Wrench, Transmission Filler Plug

CHECK

WARNINGS:

- Observe due care when draining, as the fluid can be very hot.
- Observe due care when working near a hot exhaust system.

NOTE:

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

1.
   - The following steps must be observed before starting the transmission fluid level check.
   - The vehicle must be on a horizontal ramp.
   - The parking brake must be applied.
   - The engine must be running for 2 minutes with the transmission control switch (TCS) in the "P" position.

2.
   ### CAUTION:

   Make sure that the transmission fluid temperature is below 30 degrees before starting the fluid level check.

   Connect the diagnostic tool to the vehicle.

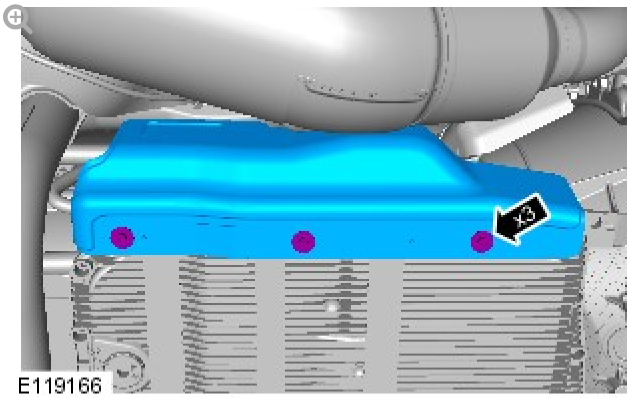
3.
   - Start the engine.
   - Apply, and hold, the footbrake.
   - Move the selector lever from 'P' through all gear positions, pausing in each gear position for 2-3 seconds and return to the

'P' position.

4. **WARNING:**

Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

5. 

Torque: **9 Nm**

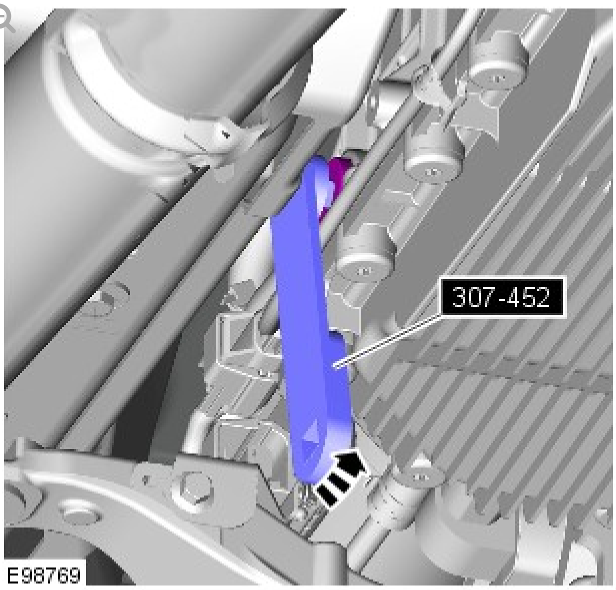
6. Place a suitable container under the transmission fluid fill plug.

7. **WARNINGS:**

- Observe due care when draining, as the fluid can be very hot.
- Observe due care when working near a hot exhaust system.

CAUTIONS:

- The transmission fluid level must only be checked when the temperature of the fluid is between 30 degrees and 50 degrees. The fluid level obtained will be incorrect if the reading is outside this temperature range.
- Discard the seal.



- *Special Tool(s):* 307-452
- Clean the area around the transmission fluid level plug.

ADJUSTMENT

WARNINGS:

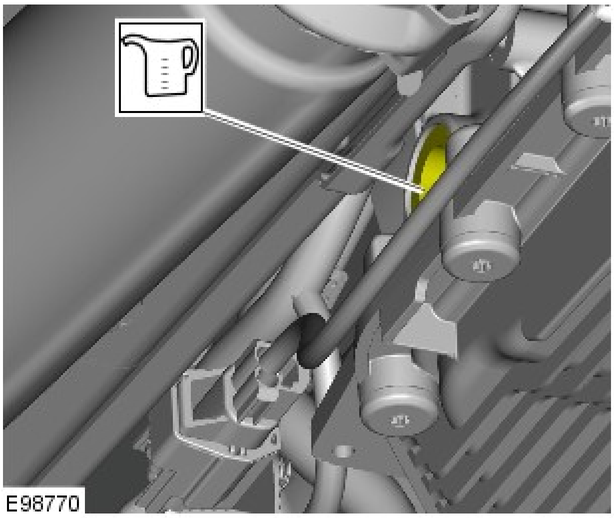
- Observe due care when draining, as the fluid can be very hot.
- Observe due care when working near a hot exhaust system.

NOTE:

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

1. **NOTE:**

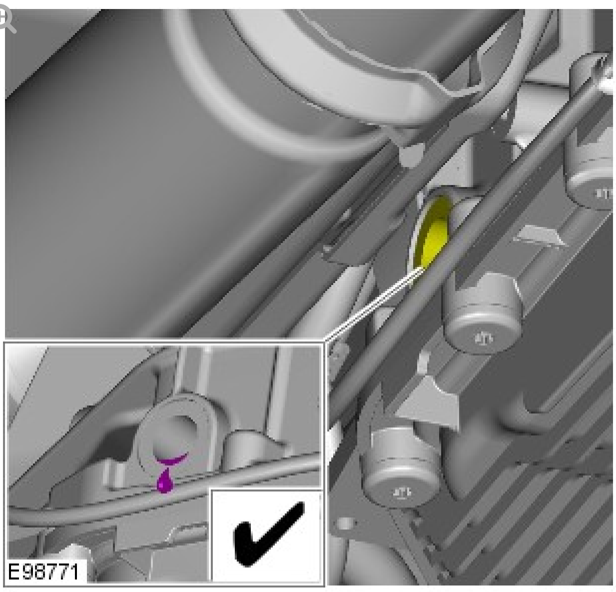
   Use transmission fluid meeting Land Rover specification.



If the transmission fluid does not come out of the transmission fluid fill plug hole the transmission fluid level is insufficient. If this is the case add the transmission fluid in 0.5 liter units into the transmission fluid fill plug hole until fluid comes out.

2. **NOTE:**

Make sure the transmission fluid temperature does not exceed 50 °C (122 °F). If the transmission fluid temperature does exceed 50 °C (122 °F) stop the transmission fluid level check and allow the transmission fluid to cool until the temperature is below 30 °C (86 °F).

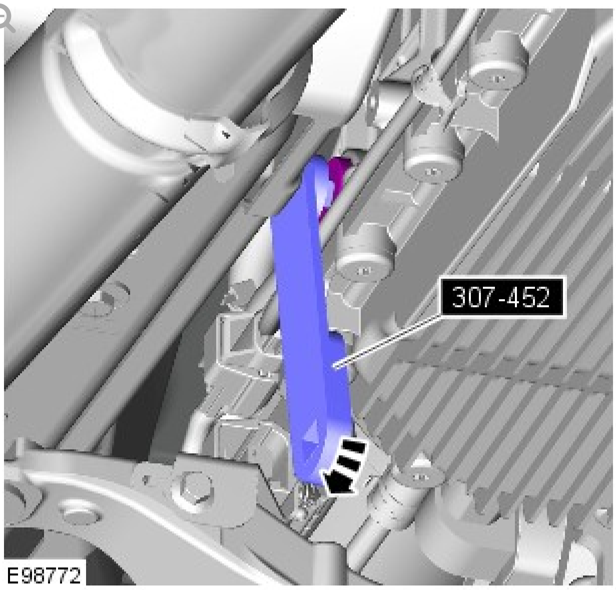


Allow the transmission fluid to drain from the transmission fluid filler

Allow the transmission fluid to drain from the transmission fluid filler plug hole until the flow almost stops.

3. **NOTE:**

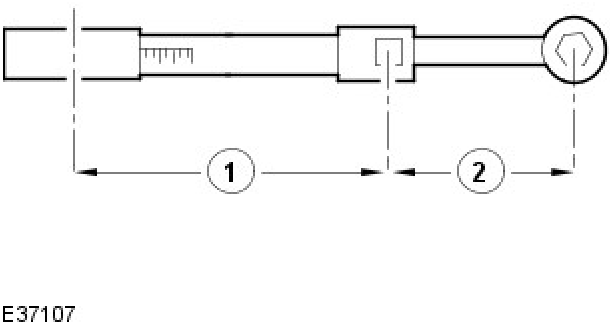
> Install a new sealing washer.



Using the special tool, install the new transmission fluid fill plug.

4. **CAUTION:**

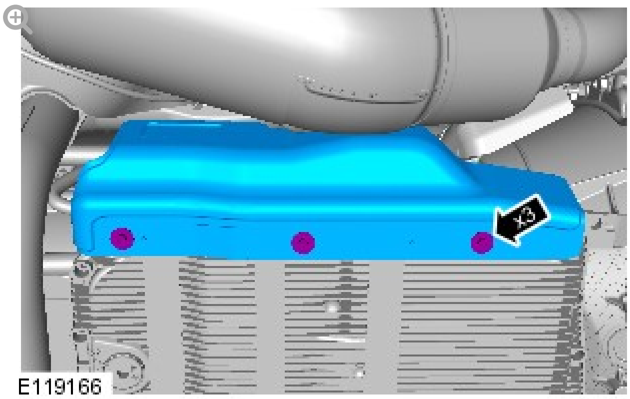
> Make sure the transmission fluid fill plug is tightened to the correct specification. Failure to follow this instruction may result in damage to the vehicle.



- To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
- Step 1. Multiply 35 Nm by the effective length of the torque wrench (1).
- Step 2. Add the effective length of the special tool (2) to the effective length of the torque wrench (1).
- Step 3. Divide the total of step 1 by the total of step 2.
- Step 4. Set the torque wrench to the figure arrived at in step 3.
- Tighten the transmission fluid fill plug to the torque given by the calculation.

5. Remove the special tool.

6. Remove the container.

7. 

   Torque: **9 Nm**

8. Lower the vehicle.

9. Disconnect the diagnostic tool from the vehicle.

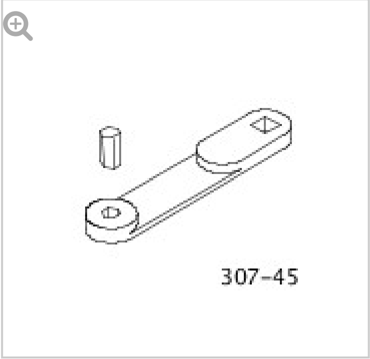
2012.0 RANGE ROVER (LM), 307-01

AUTOMATIC TRANSMISSION/TRANSAXLE - V8 5.0L PETROL/V8 S/C 5.0L PETROL

TRANSMISSION FLUID DRAIN AND REFILL (G1225339)

44.24.02	LUBRICATION SYSTEM - DRAIN AND REFILL	5000 CC, AJ V8	0.9	USED WITHINS	+

SPECIAL TOOL(S)



307-452

Wrench, Transmission Filler Plug

WARNINGS:

- Observe due care when draining, as the fluid can be very hot.
- Observe due care when working near a hot exhaust system.

NOTE:

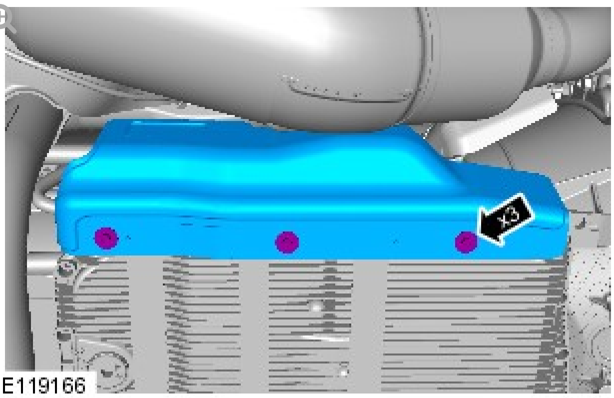
Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING:

WARNING:

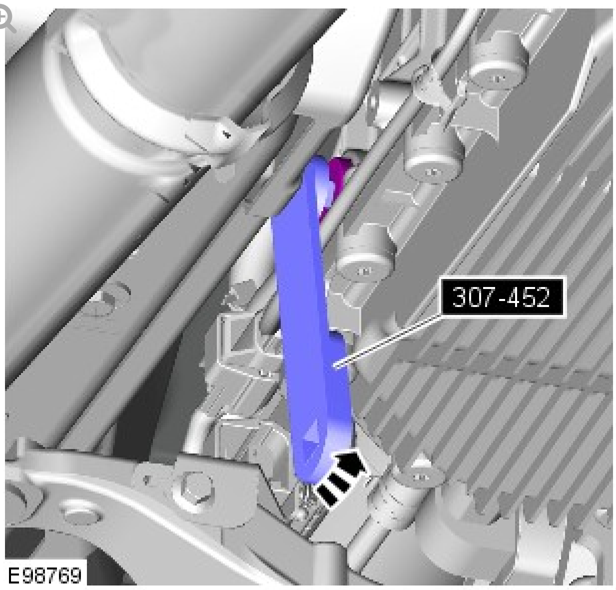
Make sure to support the vehicle with axle stands.

Raise and support the vehicle.

2. 

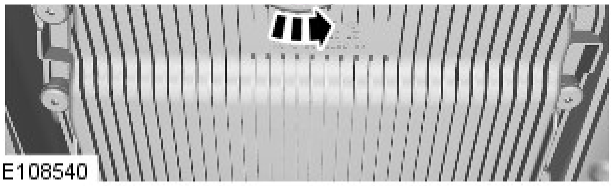
Torque: **9 Nm**

3. Place a container under the transmission.

4. 

Special Tool(s): 307-452

5. 

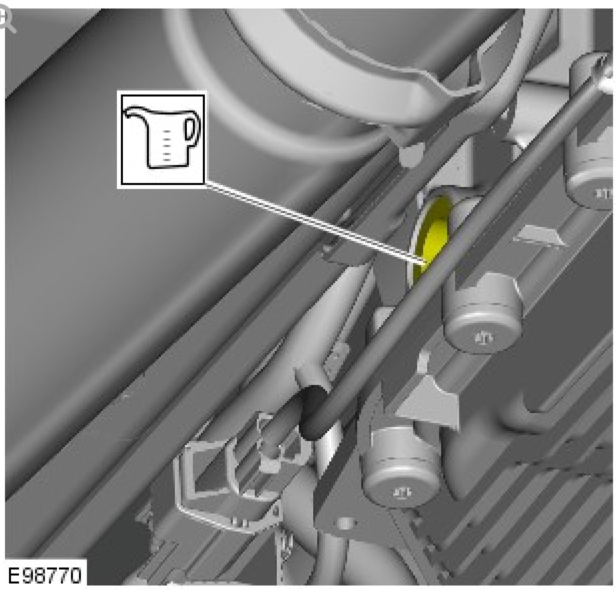


- Allow the fluid to drain.
- Discard the component.

6.

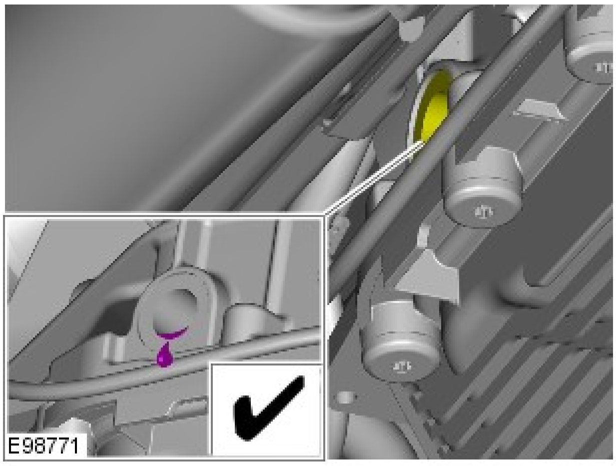
Torque: **8 Nm**

7.



- Refill the transmission with fluid.
- Use transmission fluid meeting Land Rover specification.

8.

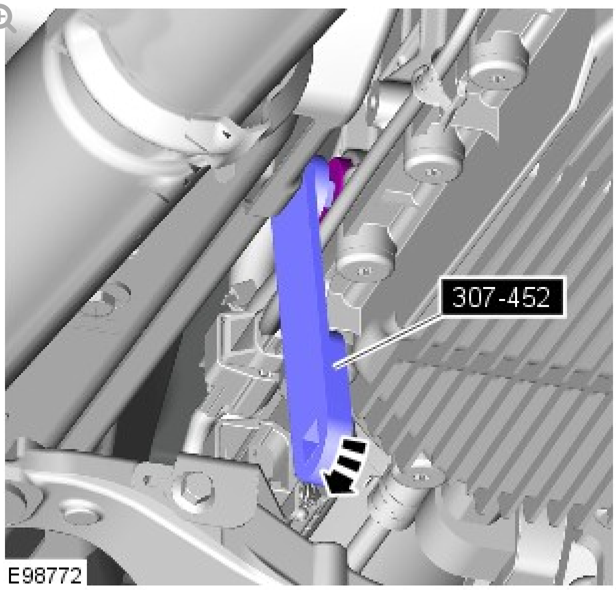


Allow the transmission fluid to drain from the transmission fluid filler plug hole until the flow almost stops.

9.

NOTE:

Install a new sealing washer.

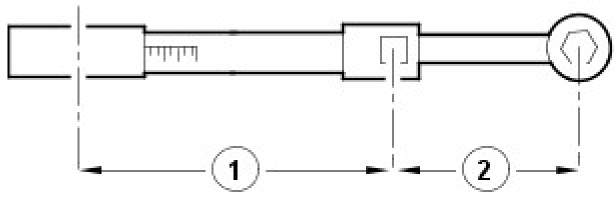


- Loosely install the transmission fluid fill plug.

10.

CAUTION:

Make sure the transmission fluid fill plug is tightened to the correct specification. Failure to follow this instruction may result in damage to the vehicle.

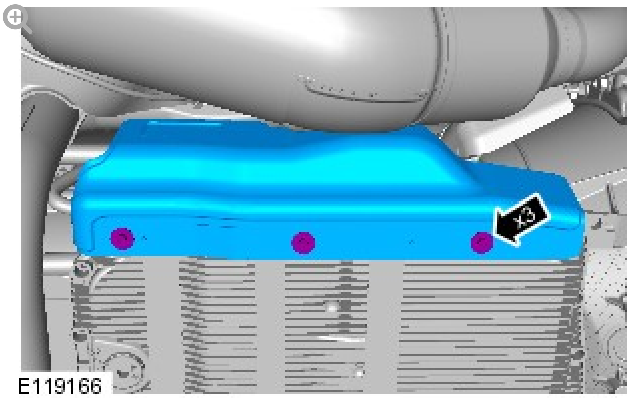


E37107

- To make sure the transmission fill plug is torqued to the correct specification. Using the special tool and torque wrench the following calculation steps must be followed.
- Step 1. Multiply 35 Nm by the effective length of the torque wrench (1).
- Step 2. Add the effective length of the special tool (2) to the effective length of the torque wrench (1).
- Step 3. Divide the total of step 1 by the total of step 2.
- Step 4. Set the torque wrench to the figure arrived at in step 3.
- Tighten the transmission fluid fill plug to the torque given by the calculation.

11. Carry out a transmission fluid level check.
Refer to: Transmission Fluid Level Check (307-01B, General Procedures).

12.



Torque: **9 Nm**

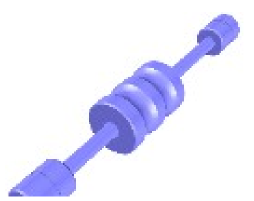
13. Lower the vehicle.

AUTOMATIC TRANSMISSION/TRANSAXLE - V8 5.0L PETROL/V8 S/C 5.0L PETROL

INPUT SHAFT SEAL (G1225986)

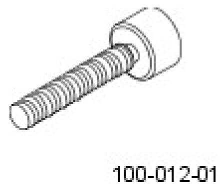
REMOVAL AND INSTALLATION

SPECIAL TOOL(S)



100-012

Slide Hammer

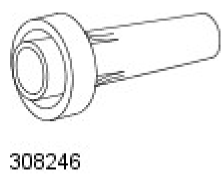


100-012-01

Slide Hammer Adapter

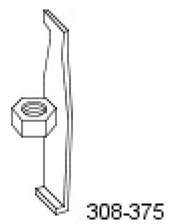
307-613

Holding Pins, Torque Converter



308-246

Installer, Front Seal



308-375

Remover, Input and Output Seal

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

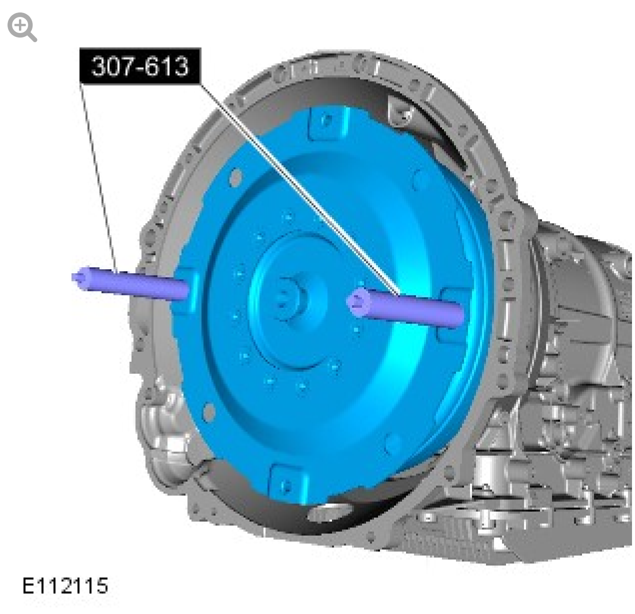
1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

2. **WARNING:**

   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

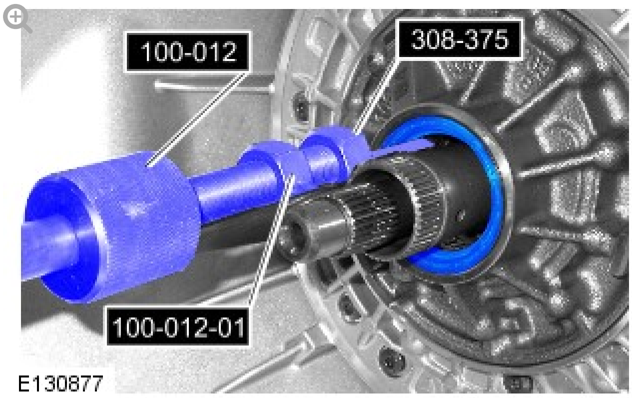
3. Refer to: Transmission - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133 (307-01, Removal).

4. 

   Special Tool(s): 307-613

5. **CAUTIONS:**

- Discard the seal.
- Care must be taken to avoid damage to the seal register and running surface.

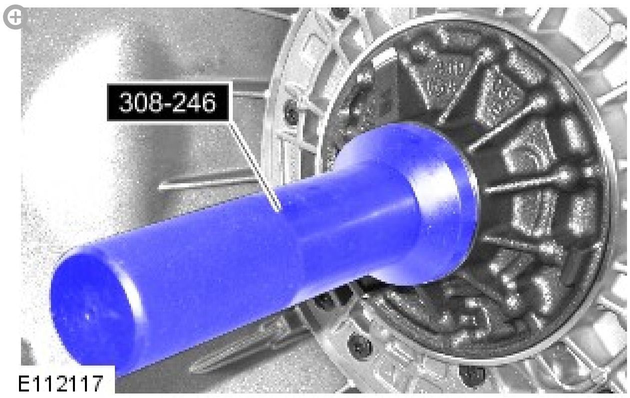


Special Tool(s): 100-012, 100-012-01, 308-375

INSTALLATION

1. **CAUTION:**

Install a new seal.

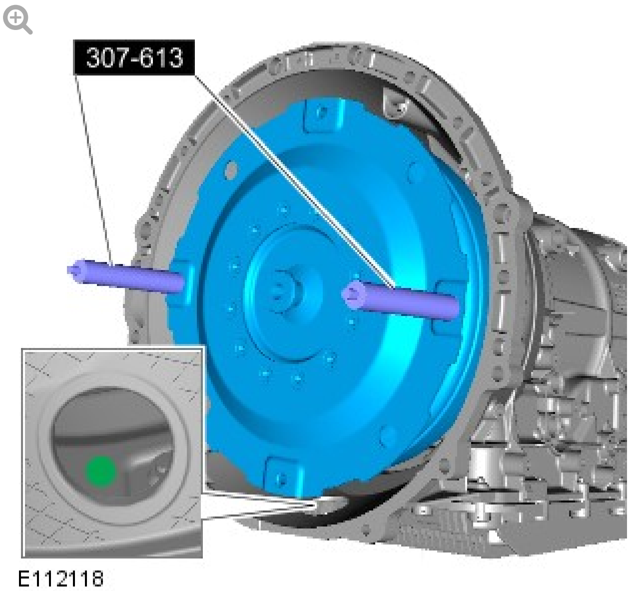


Special Tool(s): 308-246

2.

NOTE:

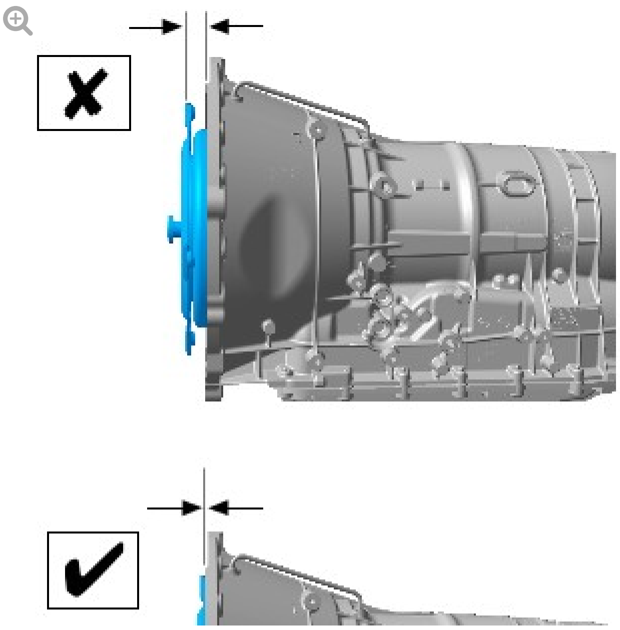
Make sure that the alignment mark is visable through the inspection hole as illustrated.

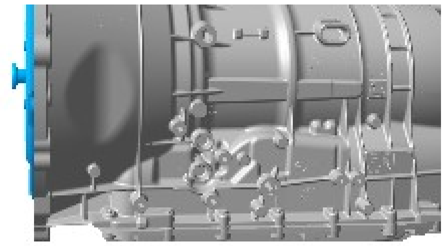


- Clean the seal contact area.

3. CAUTION:

Make sure the torque converter is fully located into the oil pump drive.





E118200

4. Refer to: Transmission - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133 (307-01B, Installation).

5. Connect the battery ground cable.
Refer to: Specifications (414-00, Specifications).

6. Refer to: Transmission Fluid Level Check (307-01B, General Procedures).

AUTOMATIC TRANSMISSION/TRANSAXLE - V8 5.0L PETROL/V8 S/C 5.0L PETROL

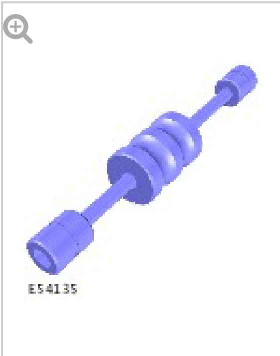
EXTENSION HOUSING SEAL

(G1225987)

REMOVAL AND INSTALLATION

44.20.21	OIL SEAL - OUTPUT SHAFT - RENEW	5000 CC, AJ V8	2.3	USED WITHINS	+

SPECIAL TOOL(S)



100-012

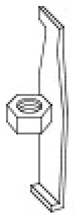
Slide Hammer

100-012-01

Slide Hammer Adapter

307-520

Installer, Output Shaft Seal



308-375

Remover, Input and Output Seal

REMOVAL

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. **WARNING:**

   Make sure to support the vehicle with axle stands.

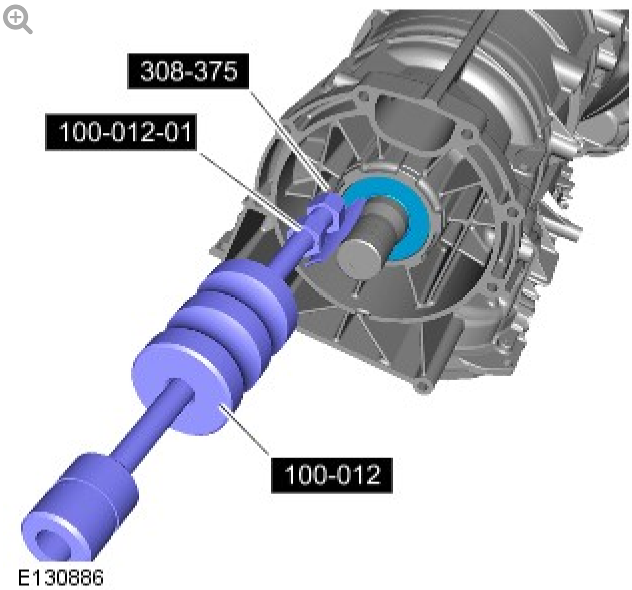
   Raise and support the vehicle.

3. Remove the transfer case.

Refer to: Transfer Case - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133 (308-07, Removal).

4. **CAUTION:**

Care must be taken to avoid damage to the seal register and running surface.

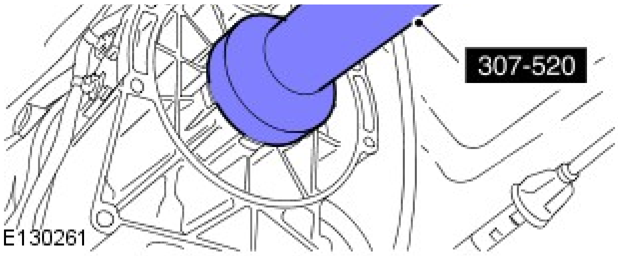


Special Tool(s): 100-012, 100-012-01, 308-375

INSTALLATION

1. **CAUTIONS:**

- Oil seals must be fitted dry.
- Make sure that the mating faces are clean and free of foreign material.



Special Tool(s): 307-520

2. Install the transfer case.
   Refer to: Transfer Case - 5.0L NA V8 - AJ133/5.0L SC V8 - AJ133 (308-07B, Installation).

3. Connect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

4. Carry out a transmission fluid level check.
   Refer to: Transmission Fluid Level Check (307-01B, General Procedures).

2012.0 RANGE ROVER (LM), 307-01

AUTOMATIC TRANSMISSION/TRANSAXLE - V8 5.0L PETROL/V8 S/C 5.0L PETROL

SELECTOR SHAFT SEAL (G1346660)

SPECIAL TOOL(S)

307-509-1(LRT-44-033/1)

Seal extractor

307-509-2(LRT-44-033/2)

Seal extractor

307-509-3(LRT-44-033/3)

Seal installer

REMOVAL

NOTE:

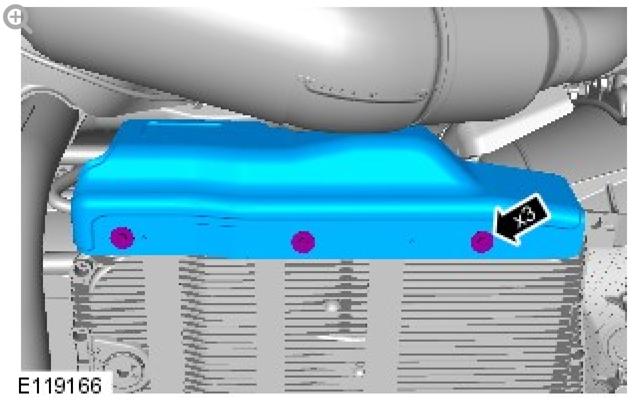
Some variation in the illustrations may occur, but the essential information is always correct.

1. **WARNING:**

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

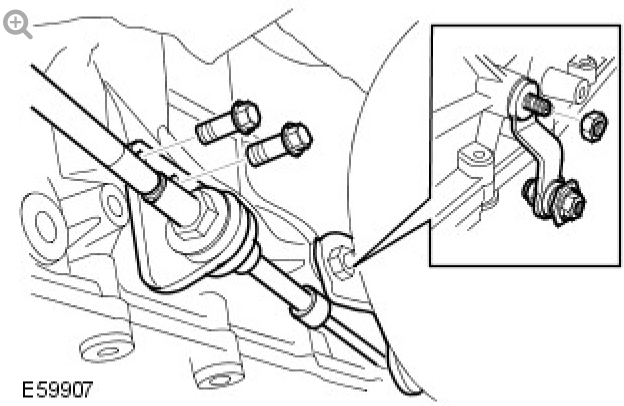
Raise and support the vehicle.

2.



Remove the transmission heat shield.

3.



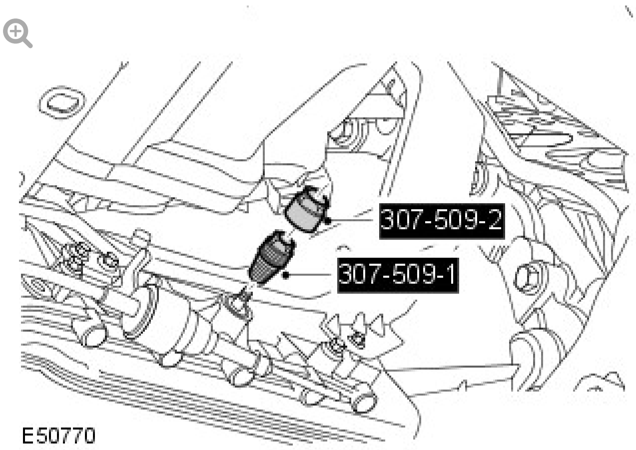
RH side only: Release the selector cable and lever.

- Remove the 2 bolts.
- Remove the nut.

4.

CAUTION:

Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

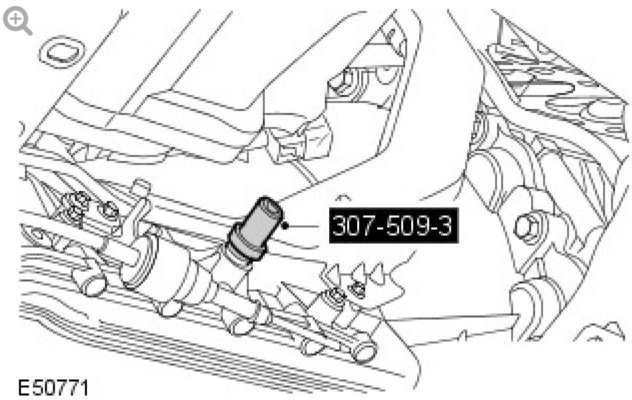


Remove the selector shaft seal.

- Install 307-509-1 to the seal.
- Install 307-509-2 to 307-509-1 and extract the seal.

INSTALLATION

1.



Using 307-509-3, install the selector shaft seal.

- Clean the components.

2. RH side only: Install the selector cable and lever.

   - Tighten the nut to 12 Nm (9 lb.ft).
   - Tighten the bolts to 10 Nm (7 lb.ft).

3. Carry out a transmission fluid level check.
   For additional information, refer to: Transmission Fluid Level Check (307-01, General Procedures).

4. Install the transmission heat shield.

   - Tighten the 3 bolts to 9 Nm (7 ft.lb).

2012.0 RANGE ROVER (LM), 307-01

AUTOMATIC TRANSMISSION/TRANSAXLE - V8 5.0L PETROL/V8 S/C 5.0L PETROL

TRANSMISSION CONTROL MODULE (TCM) AND MAIN CONTROL VALVE BODY (G1225988)

REMOVAL AND INSTALLATION

44.24.05	GASKET-OIL/FLUID PAN - RENEW	5000 CC, AJ V8	1.5	USED WITHINS	+

VALVE

44.40.01	VALVE BODY ASSEMBLY – RENEW	5000 CC, AJ V8	1.9	USED WITHINS	+

REMOVAL

NOTES:

- The transmission control module (TCM) is part of the main control valve body and cannot be serviced separately.
- Some variation in the illustrations may occur, but the essential information is always correct.

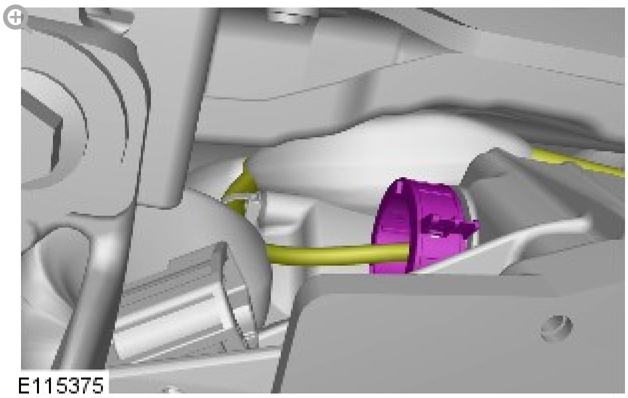
1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

2. **WARNING:**

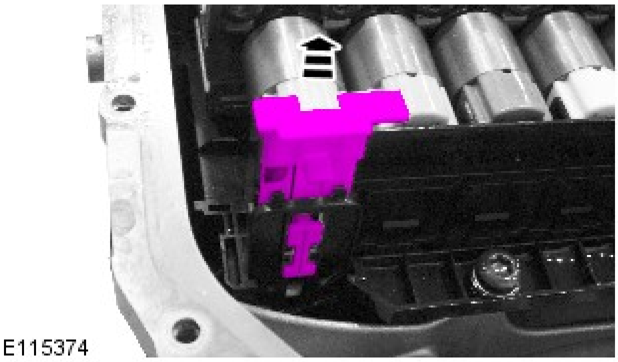
   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Transmission Fluid Pan, Gasket and Filter (307-01, Removal and Installation).

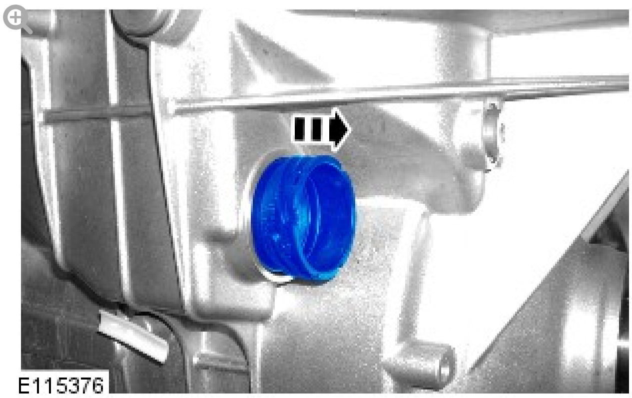
4. 

5. 



6. **CAUTION:**

Discard the component.

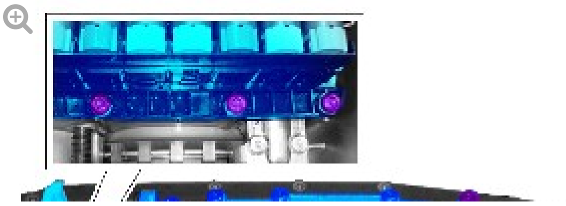


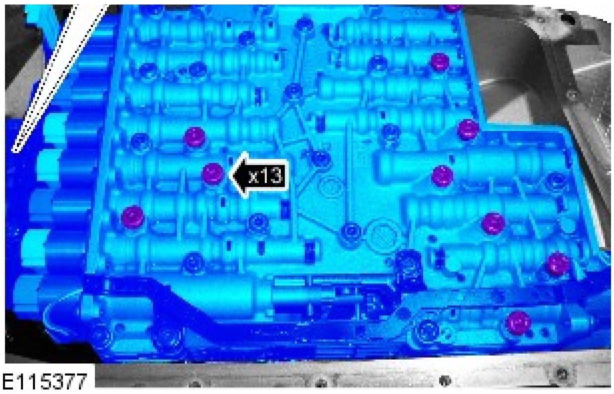
7. **CAUTION:**

Be prepared to collect escaping fluids.

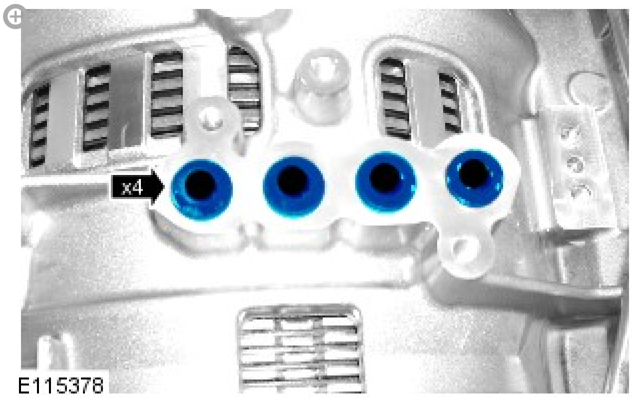
NOTE:

Note the position of the manual park brake release.





8.



9.

INSTALLATION

1.

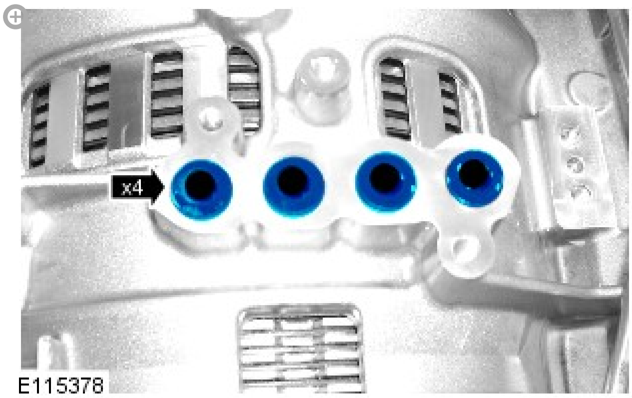
CAUTIONS:

- Make sure that when fully fitted, all seals protrude by the same amount.
- Install the new seals.

- Install a new seal block.

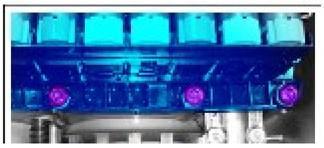
2. **CAUTIONS:**

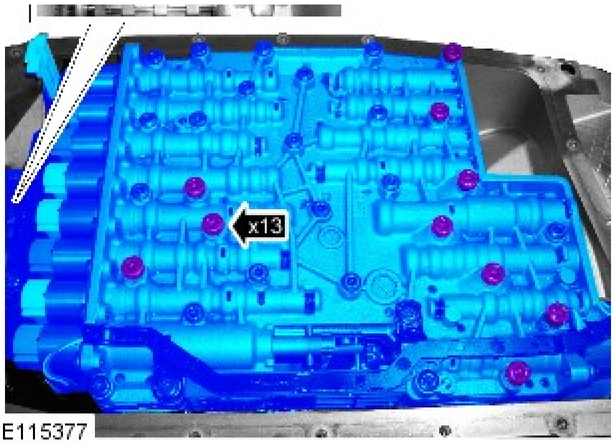
- Install the new seals.
- Make sure that when fully fitted, all seals protrude by the same amount.



3. **CAUTION:**

Make sure the manual park release is correctly engaged.



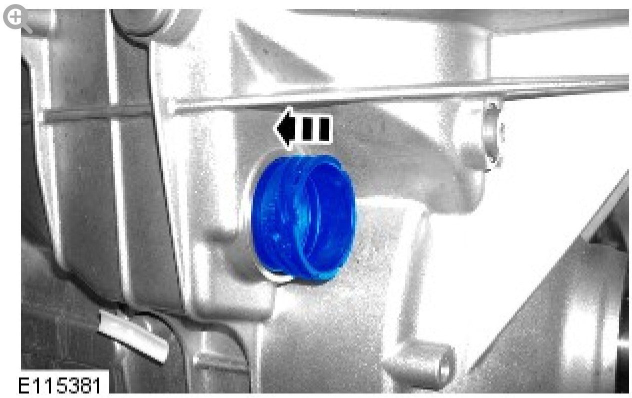


Torque: **8 Nm**

4.

CAUTION:

Make sure that a new component is installed.



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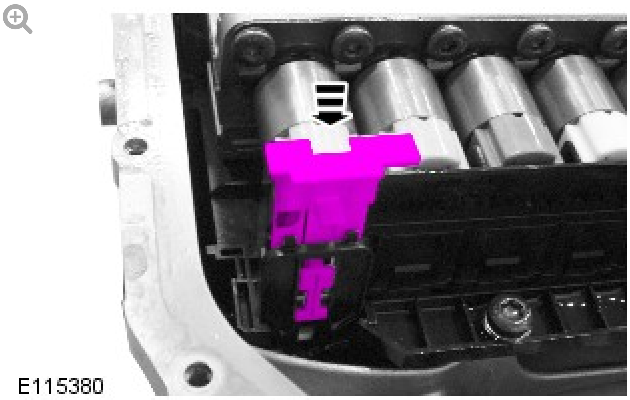
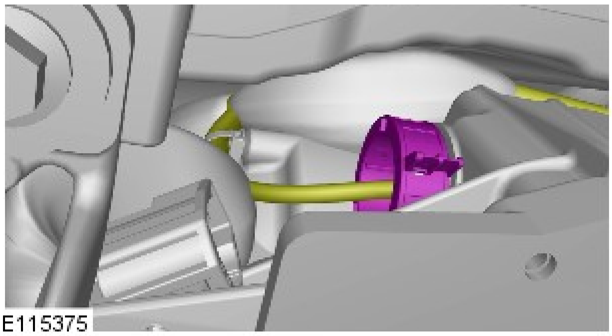


6.



7. Refer to: Transmission Fluid Pan, Gasket and Filter (307-01, Removal and Installation).

8. Connect the battery ground cable.
Refer to: Specifications (414-00, Specifications).

9. If a new component has been installed, configure using Jaguar approved diagnostic equipment.

2012.0 RANGE ROVER (LM), 307-01

AUTOMATIC TRANSMISSION/TRANSAXLE - V8 5.0L PETROL/V8 S/C 5.0L PETROL

TRANSMISSION FLUID PAN, GASKET AND FILTER (G1225989)

REMOVAL AND INSTALLATION

44.24.05	GASKET-OIL/FLUID PAN - RENEW	5000 CC, AJ V8	1.5	USED WITHINS	+

REMOVAL

NOTES:

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

1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

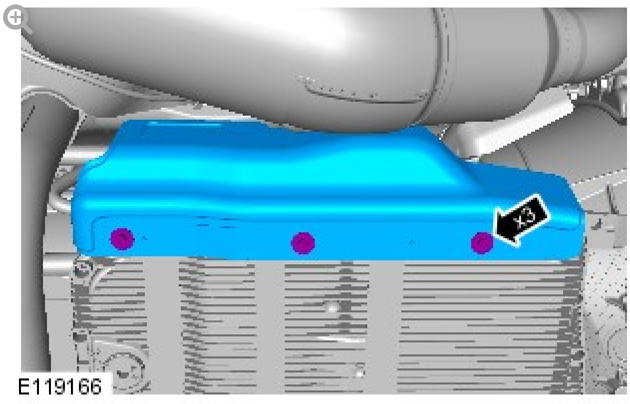
2. **WARNING:**

Make sure to support the vehicle with axle stands.

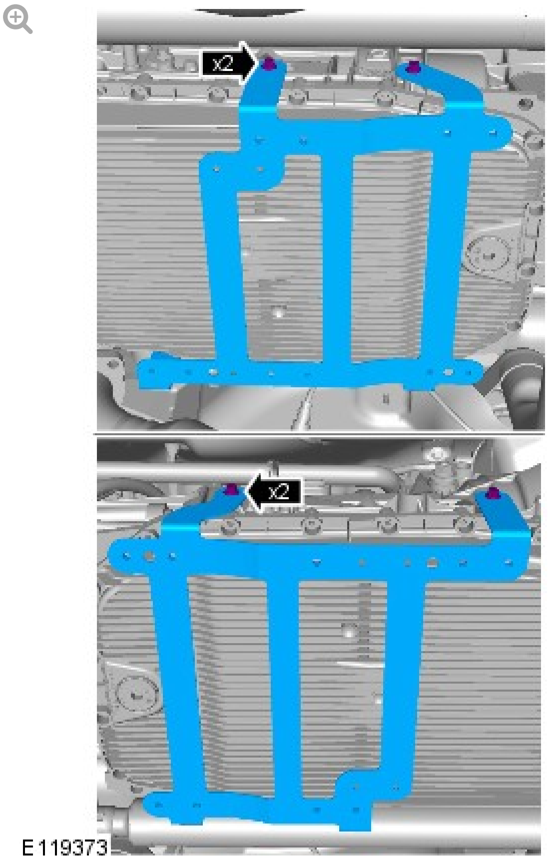
Raise and support the vehicle.

3. Refer to: Transmission Fluid Drain and Refill (307-01, General Procedures).

4.

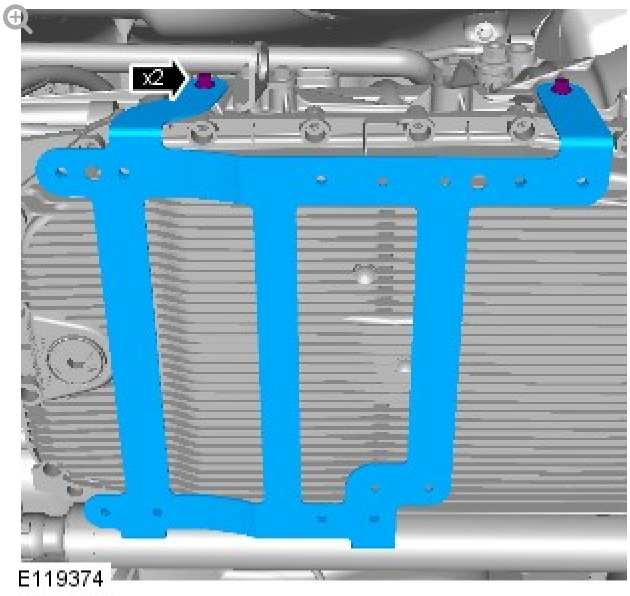


5.



Torque: **9 Nm**

6.



Torque: **9 Nm**

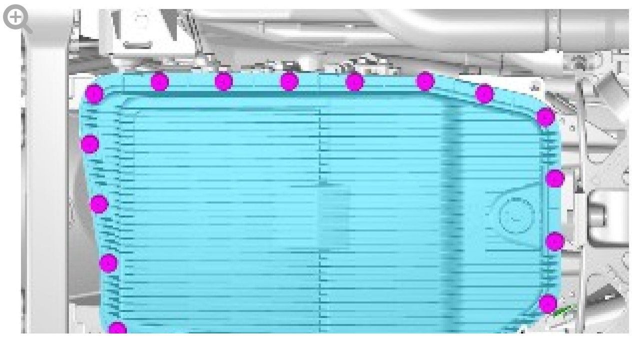
7.

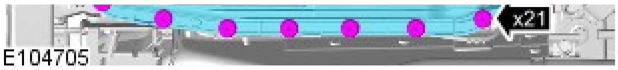
CAUTIONS:

- Make sure that the area around the component is clean and free of foreign material.
- Be prepared to collect escaping fluids.
- Make sure that the mating faces are clean and free of foreign material.
- Make sure that the mating faces are clean and free of foreign material.

NOTE:

Remove and discard the gasket.





Torque: **10 Nm**

INSTALLATION

1.

NOTE:

Install a new gasket.

To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 307-01

AUTOMATIC TRANSMISSION/TRANSAXLE - V8 5.0L PETROL/V8 S/C 5.0L PETROL

TRANSMISSION SUPPORT INSULATOR (G1225912)

REMOVAL AND INSTALLATION

12.45.08	MOUNTING – REAR – CENTRE – RENEW	5000 CC, AJ V8	1.1	USED WITHINS	+

REMOVAL

NOTE:

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

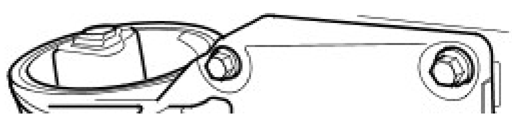
1. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).

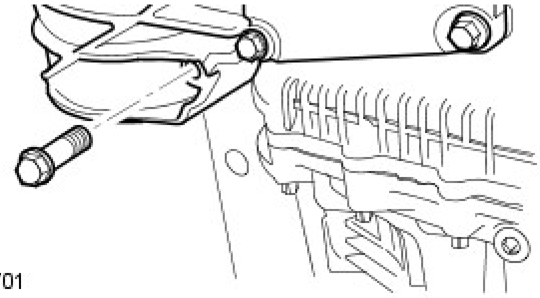
2. **WARNING:**

   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Remove the transmission support crossmember.
   For additional information, refer to: Transmission Support Crossmember - 5.0L (502-02, Removal and Installation).

4. 



E59701

Remove the transmission support insulator.

- Remove the 5 bolts.

INSTALLATION

1. Install the transmission support insulator.
    - Tighten the bolts to 45 Nm (33 lb.ft).

2. Install the transmission support crossmember.
   For additional information, refer to: Transmission Support Crossmember - 5.0L (502-02, Removal and Installation).

3. Connect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).

2012.0 RANGE ROVER (LM), 307-01

AUTOMATIC TRANSMISSION/TRANSAXLE - V8 5.0L PETROL/V8 S/C 5.0L PETROL

TRANSMISSION - V8 5.0L PETROL/V8 S/C 5.0L PETROL (G1225173)

REMOVAL

44.20.01	GEARBOX – RENEW	5000 CC, AJ V8	4.7	USED WITHINS	+

44.20.02	GEARBOX AND TORQUE CONVERTER - RENEW	5000 CC, AJ V8	4.6	USED WITHINS	+

REMOVAL

NOTES:

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

1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

2. **WARNING:**

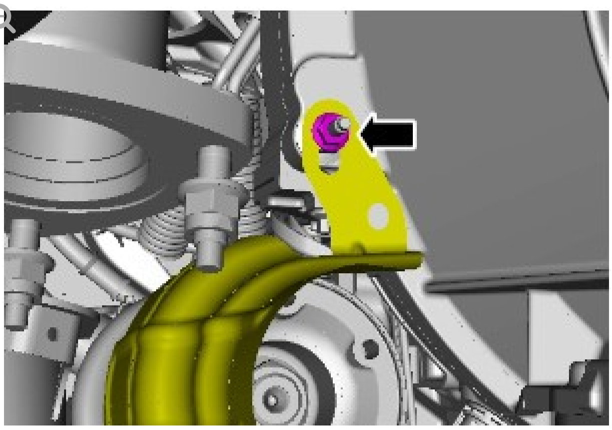
   Make sure to support the vehicle with axle stands.

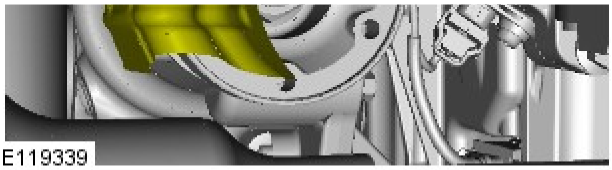
   Raise and support the vehicle.

3. Refer to: Rear Driveshaft - 5.0L (205-01, Removal and Installation).

4. Refer to: Exhaust System (309-00, Removal and Installation).

5. Refer to: Front Driveshaft - 5.0L (205-01, Removal and Installation).

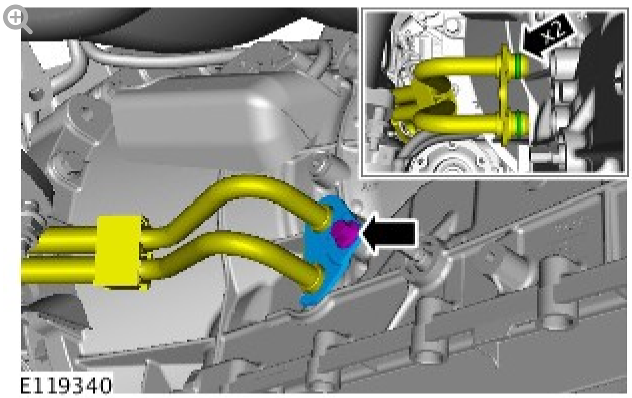
6. 



7.

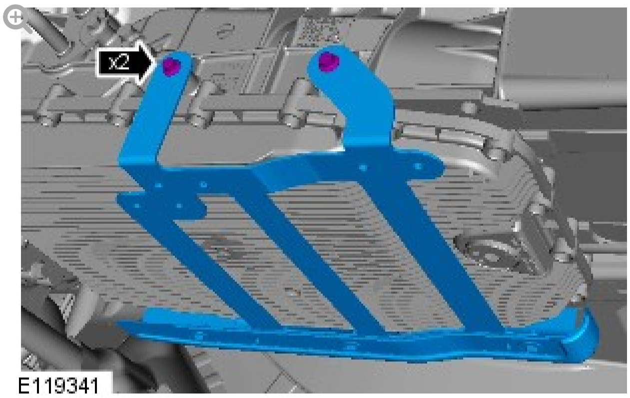
CAUTIONS:

- Be prepared to collect escaping fluids.
- Make sure that all openings are sealed. Use new blanking caps.



- Discard the O-ring seals.

8.



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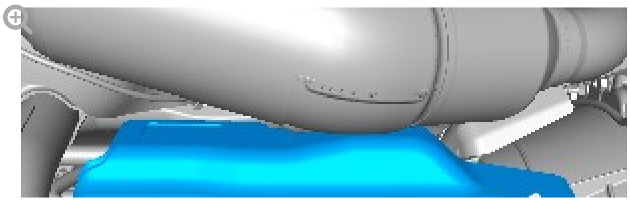

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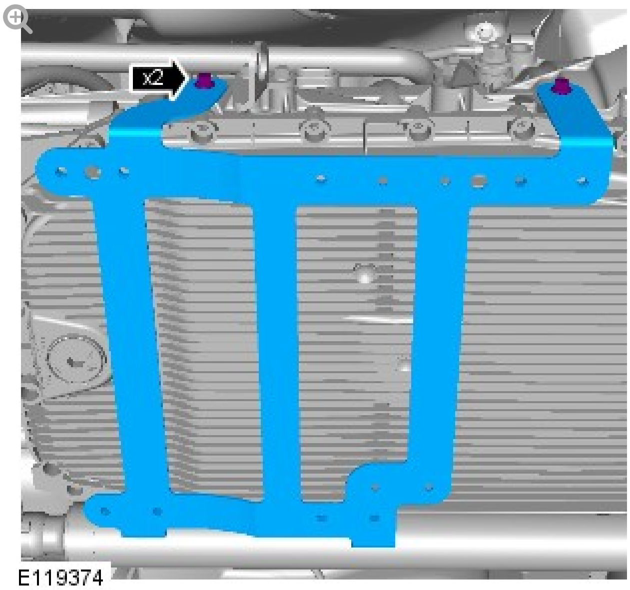

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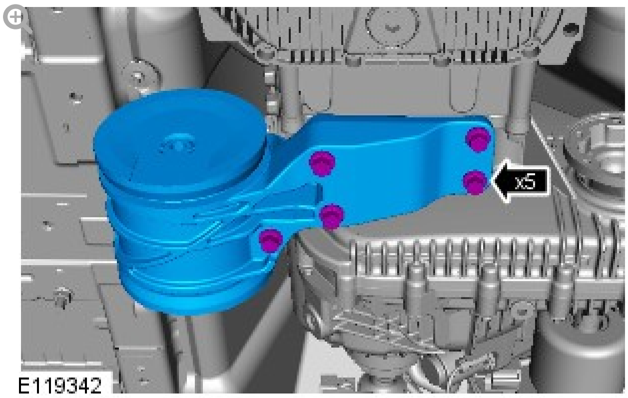

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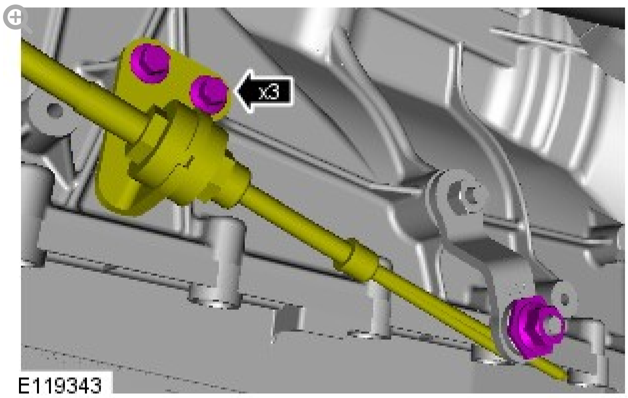

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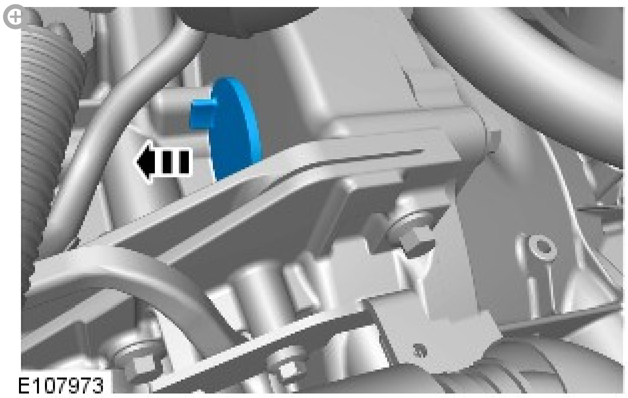


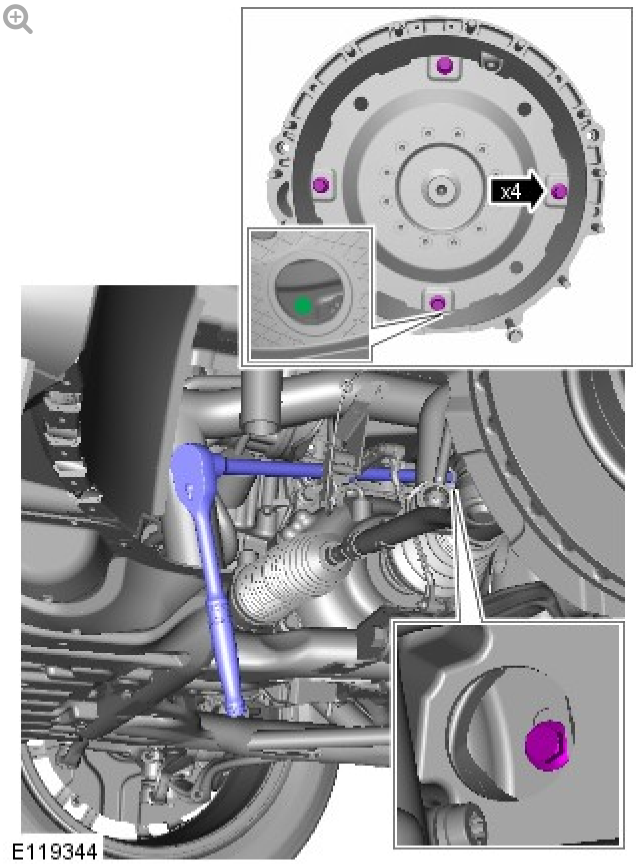
14.

CAUTION:

Only rotate the crankshaft clockwise.

NOTE:

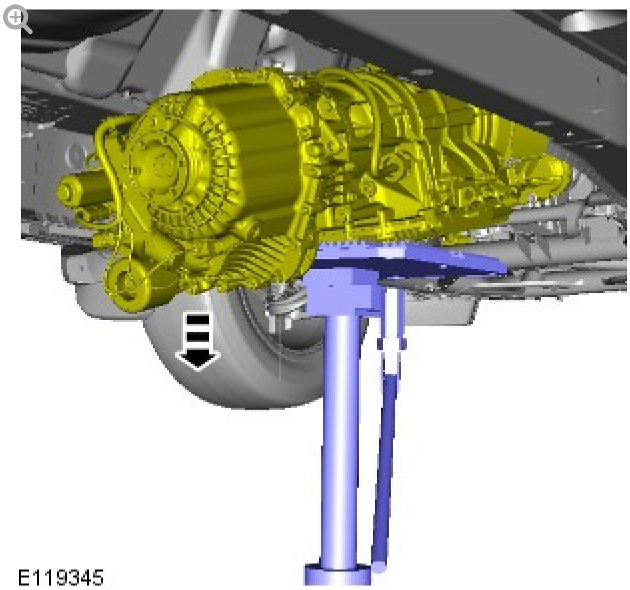
Wheel shown removed for clarity.



- Make sure that the alignment mark is visable through the inspection hole on removal of the last torque converter bolt.
- *Torque:* **63 Nm**

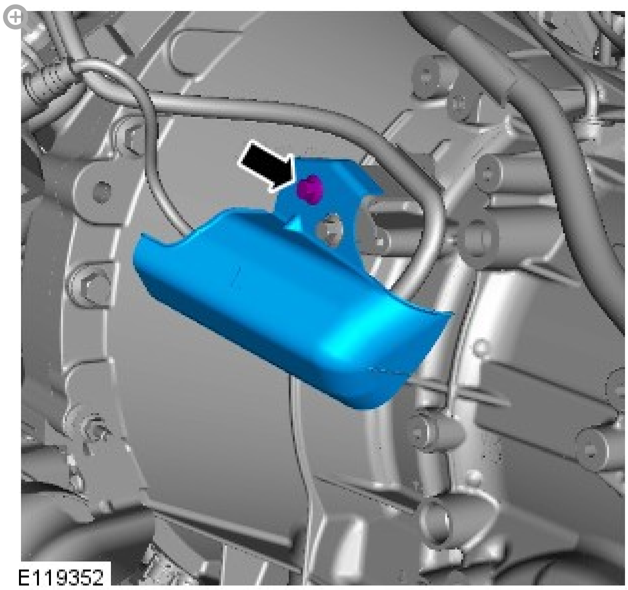
15. **WARNING:**

Make sure that the transmission is secured with suitable retaining straps.

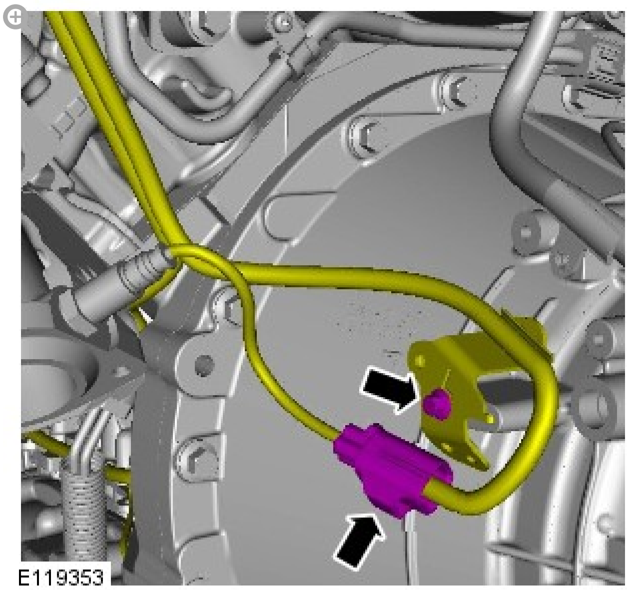


Lower the rear of the transmission for access.

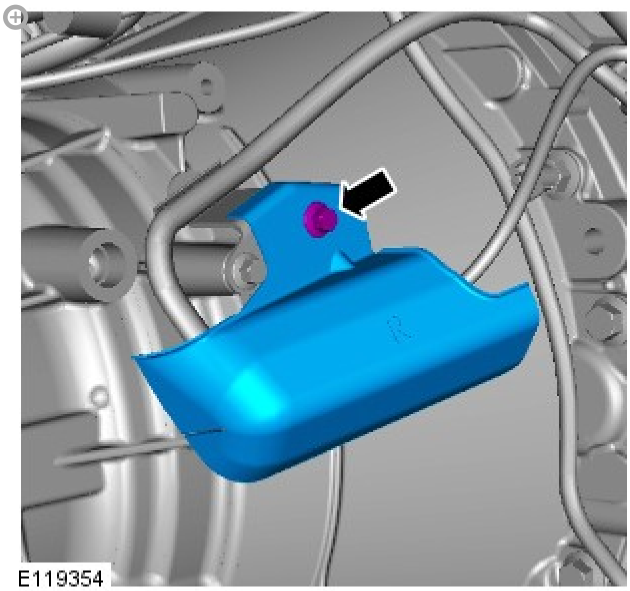
16.



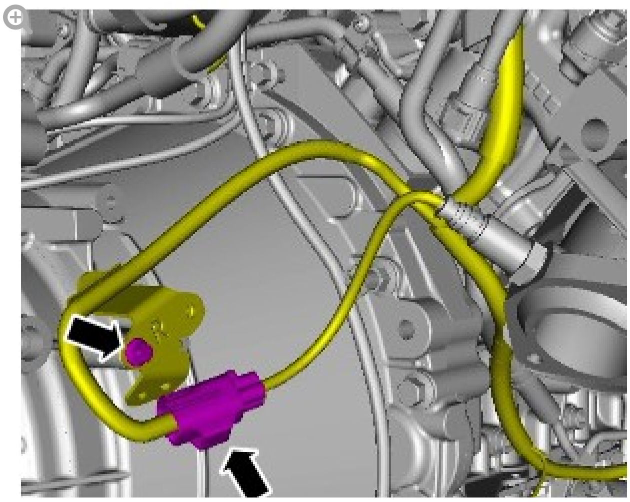
17.



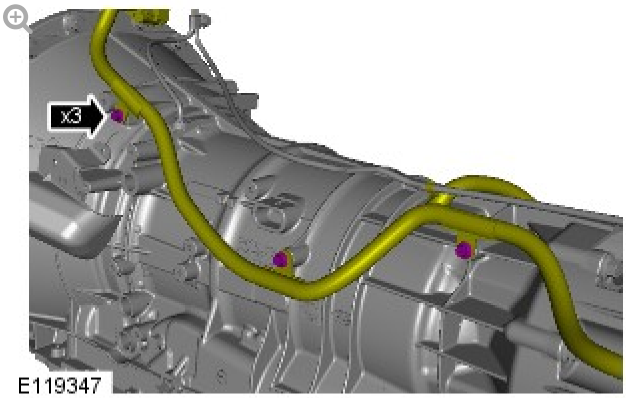
18.



19.



20.



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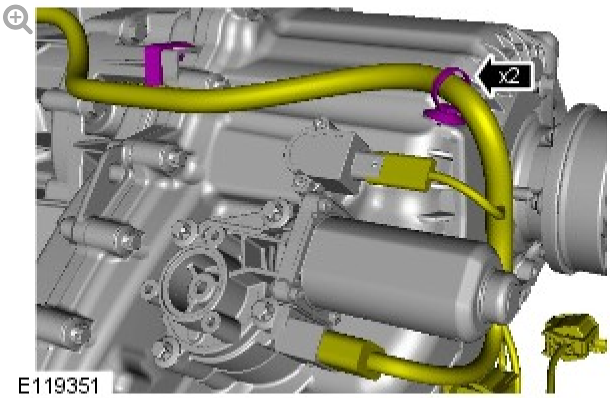

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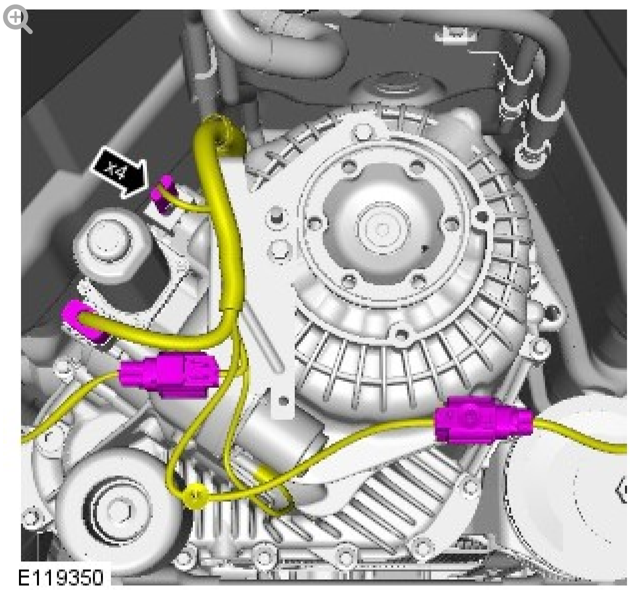
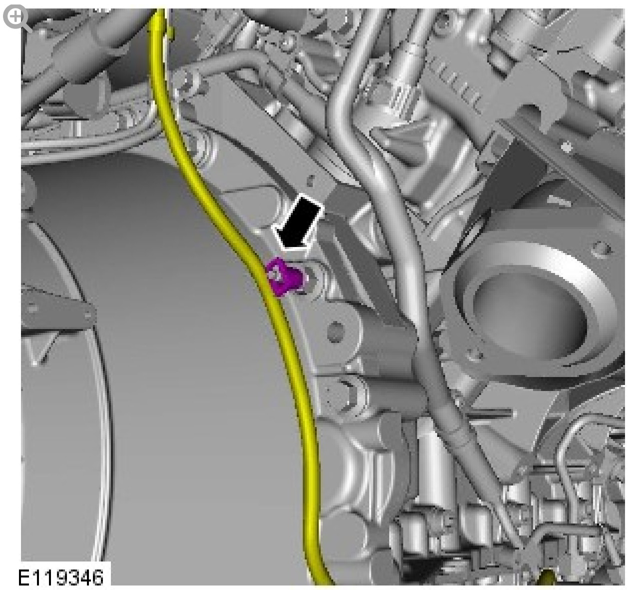
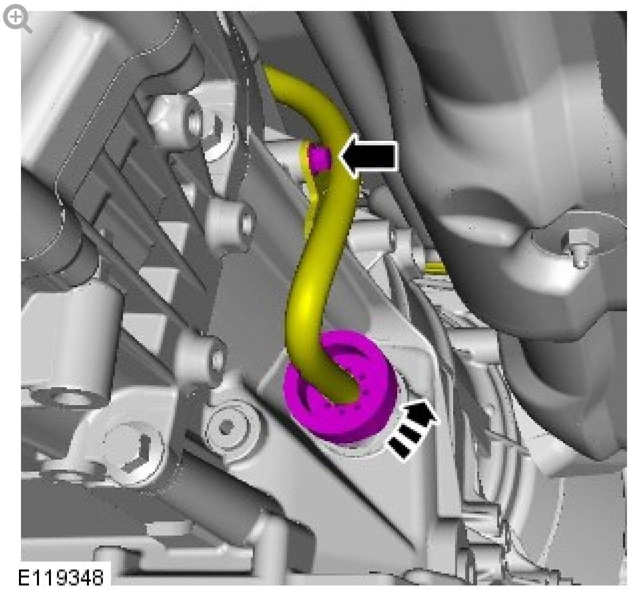


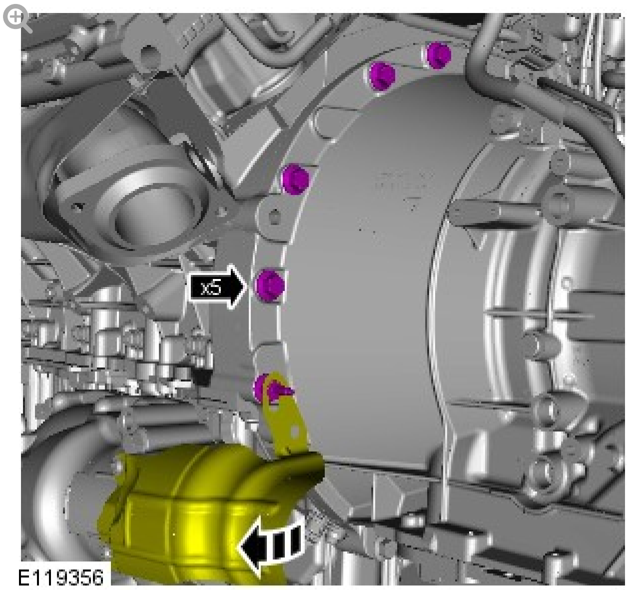
23.



24.



25.



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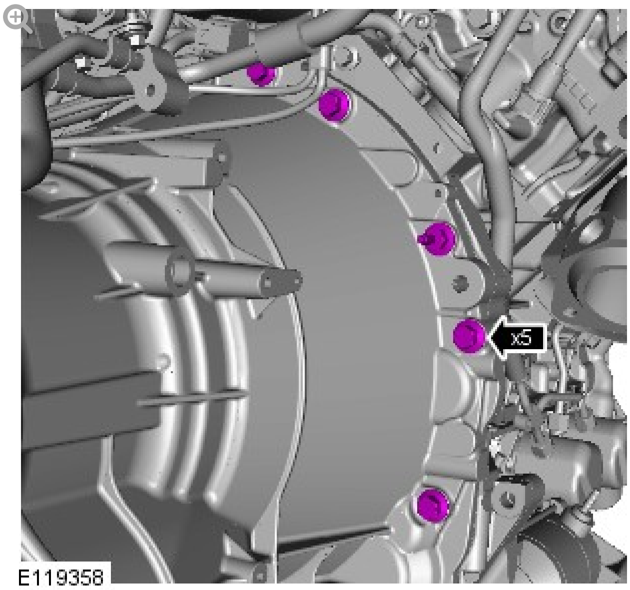

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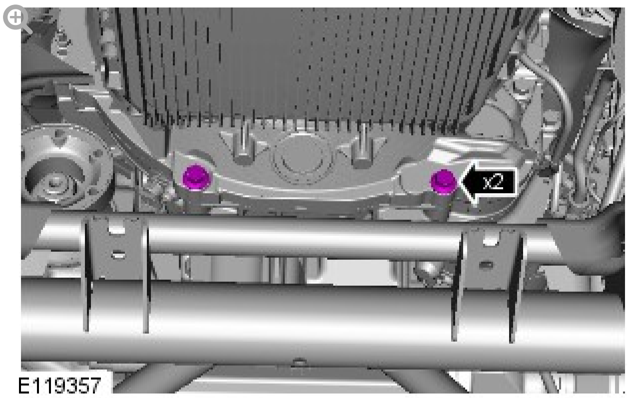


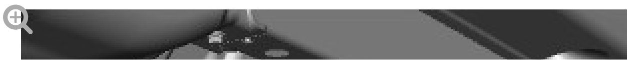
28.

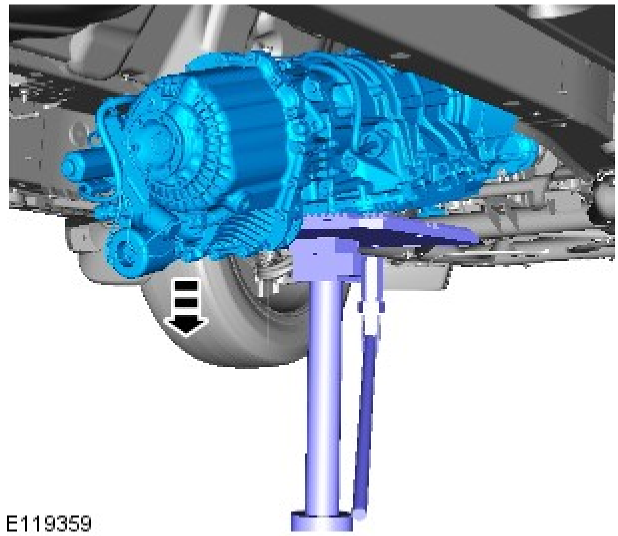
CAUTION:

Make sure that the torque converter remains in the transmission.

NOTE:

This step requires the aid of another technician.





- Using a suitable hydraulic jack, support the transmission.
- Do not disassemble further if removed for access only
- Install the torque converter retainer.

AUTOMATIC TRANSMISSION/TRANSAXLE - V8 5.0L PETROL/V8 S/C 5.0L PETROL

TRANSMISSION - V8 5.0L PETROL/V8 S/C 5.0L PETROL (G1225174)

INSTALLATION

INSTALLATION

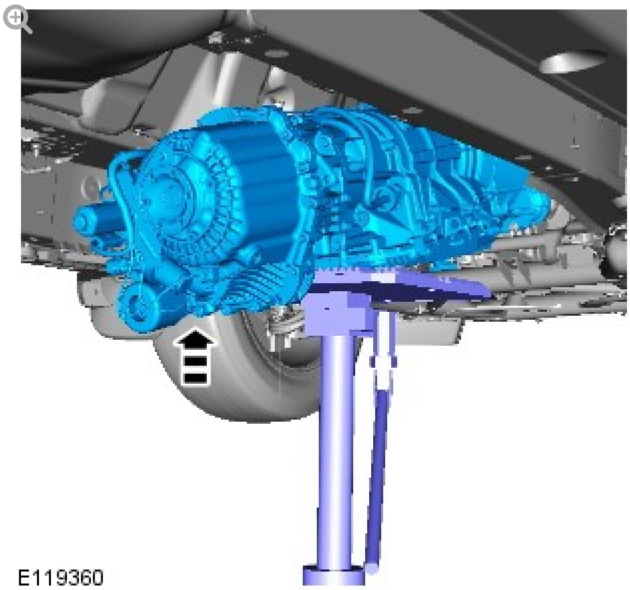
NOTES:

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

1. **CAUTIONS:**

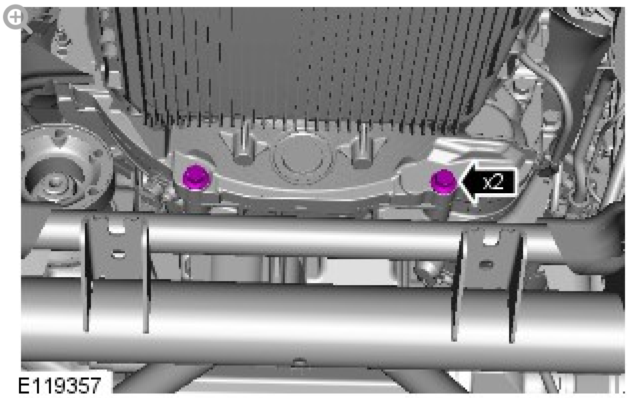
- Apply grease of the correct specification to the torque converter spigot.

- Make sure the torque converter remains connected to the transmission.



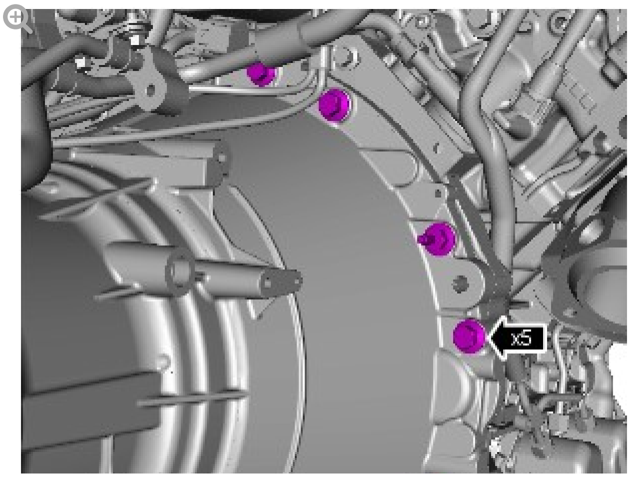
With assistance, install the transmission.

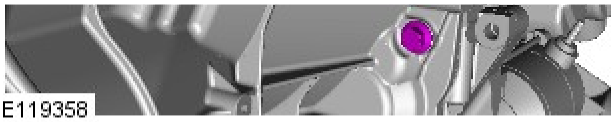
2.



Torque: **40 Nm**

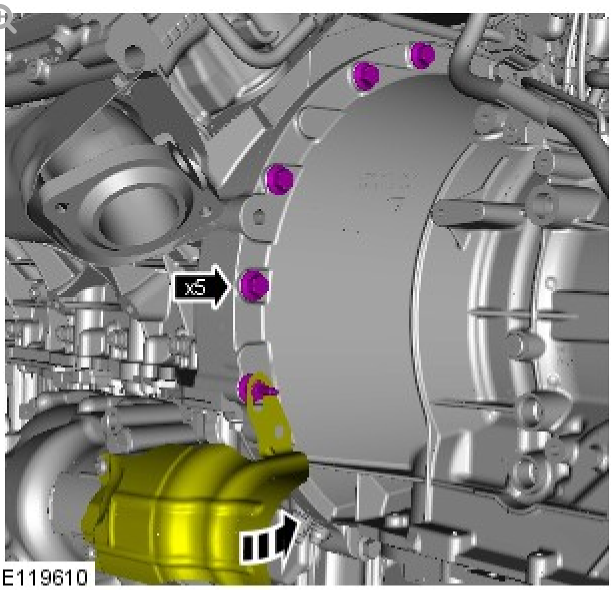
3.





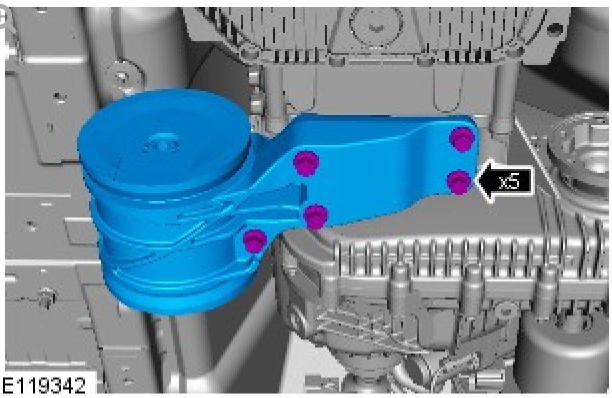
Torque: **40 Nm**

4.



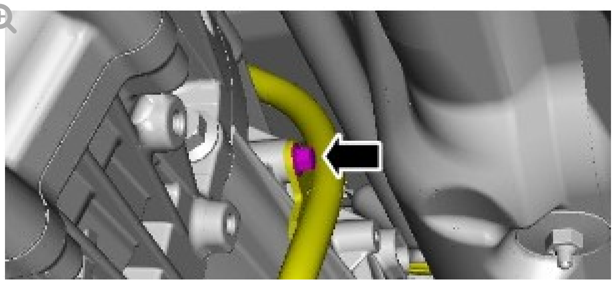
Torque: **40 Nm**

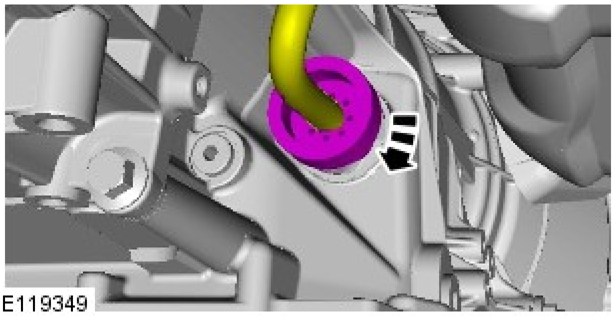
5.



- Clean the component mating faces.
- *Torque:* **60 Nm**

6.





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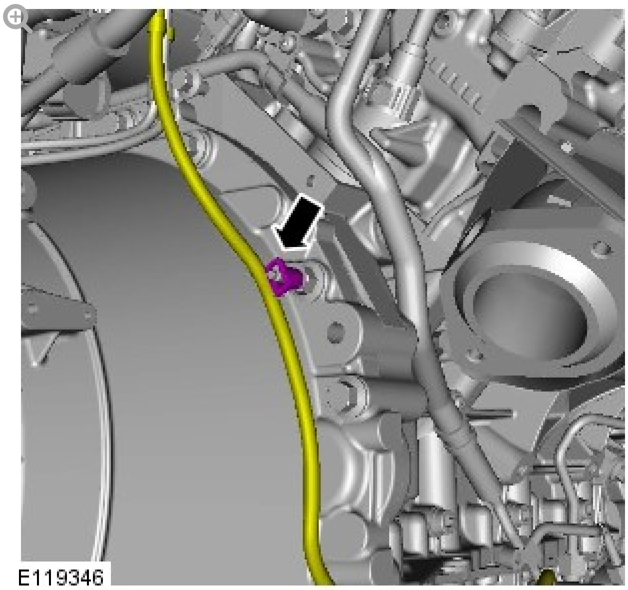

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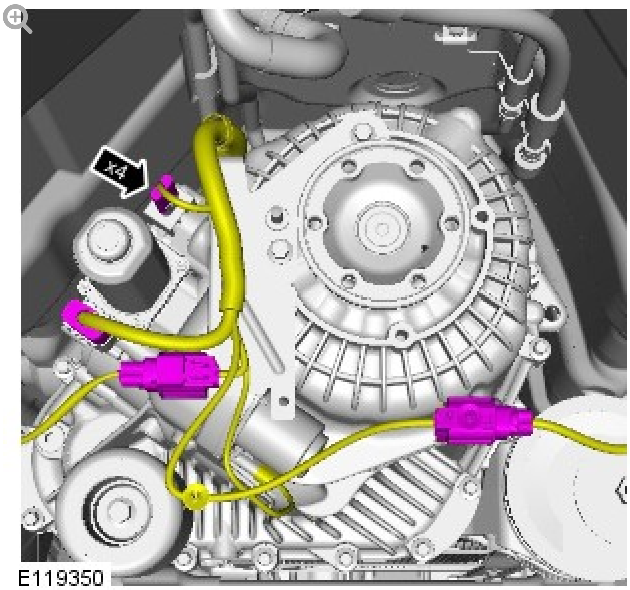

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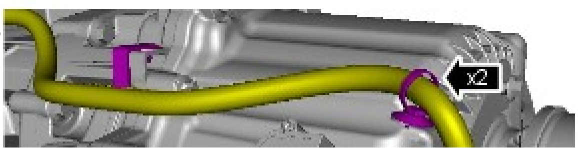

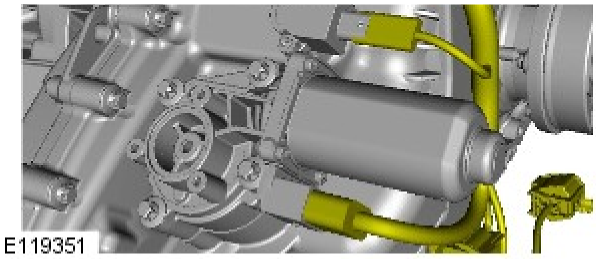

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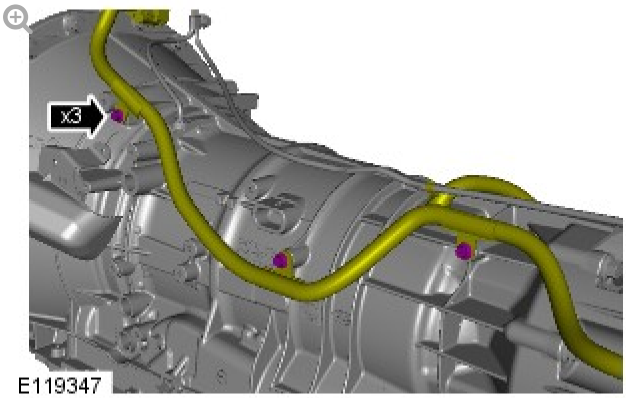
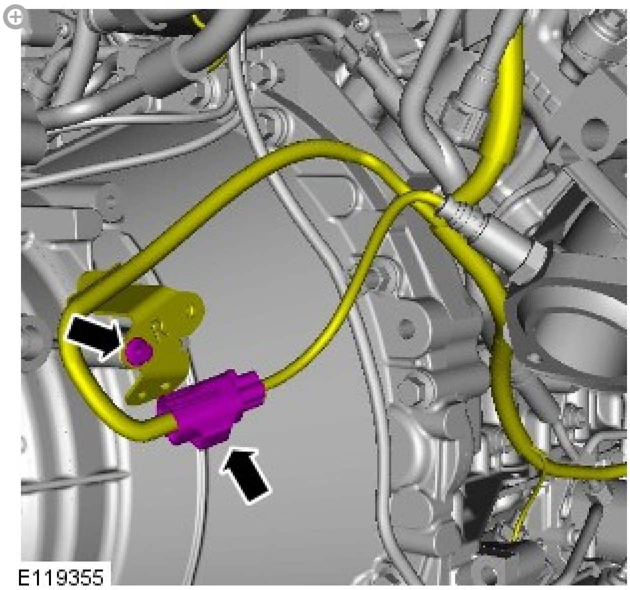


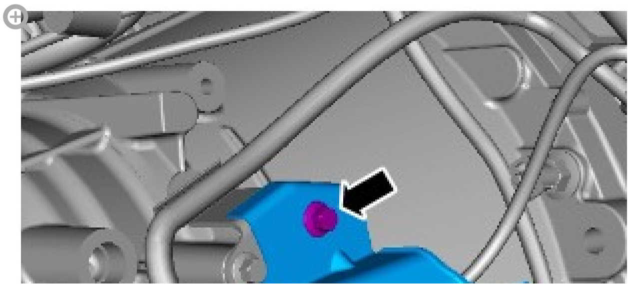
Torque: **10 Nm**

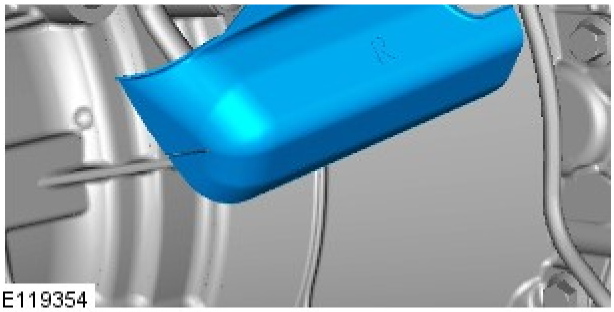
11.



Torque: **10 Nm**

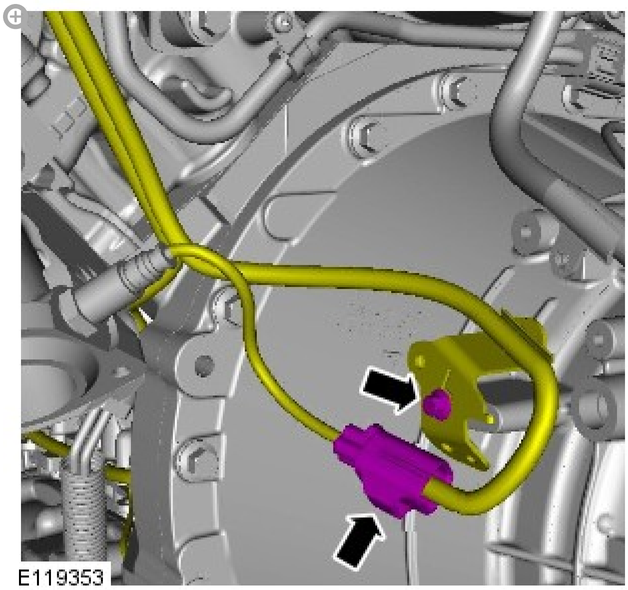
12.





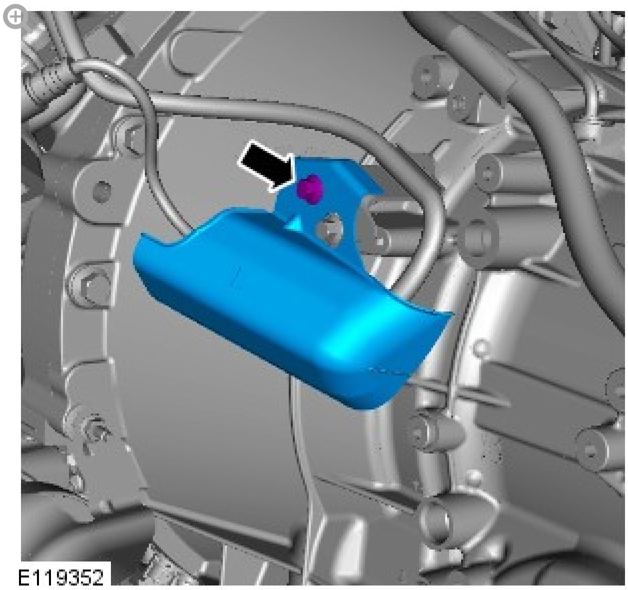
Torque: **10 Nm**

13.



Torque: **10 Nm**

14.



Torque: **10 Nm**

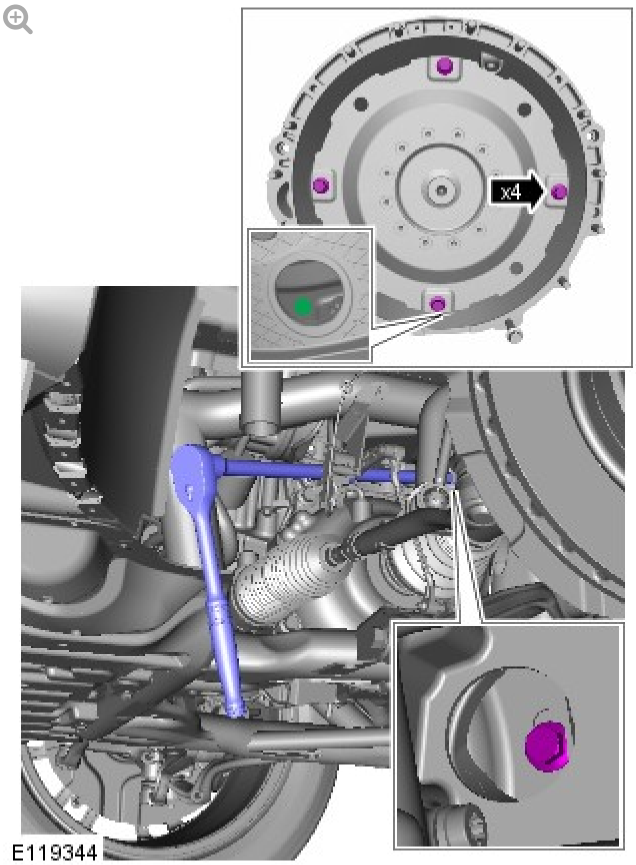
15.

CAUTION:

Only rotate the crankshaft clockwise.

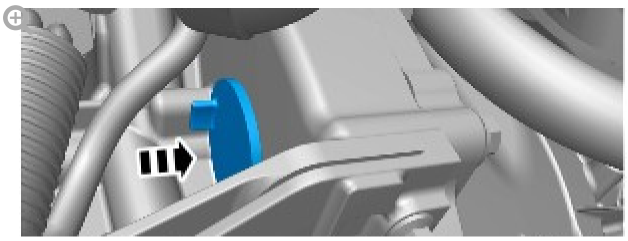
NOTE:

Wheel shown removed for clarity.



- Rotate the crankshaft clockwise to align the flexplate bolt holes.
- Make sure that the alignment mark is visable through the inspection hole on installation of the first torque converter bolt.
- *Torque:* **63 Nm**

16.



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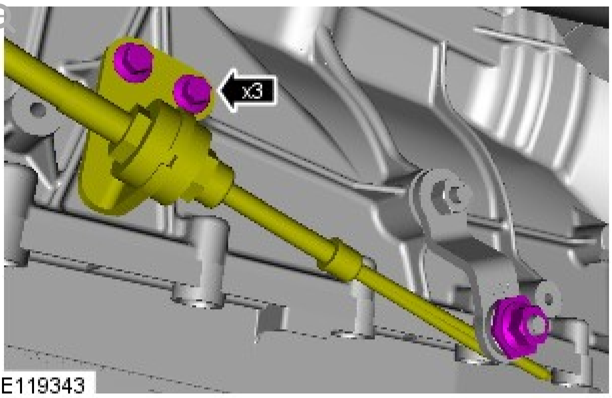
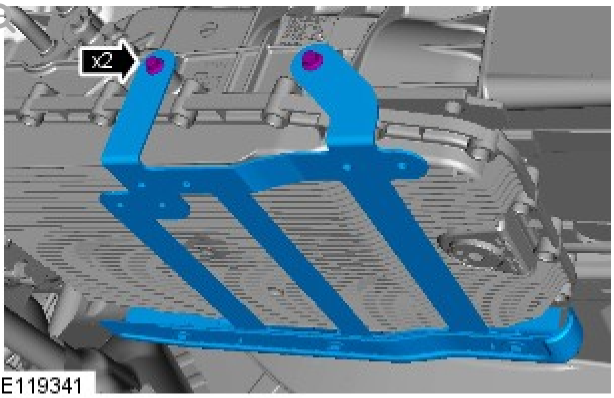


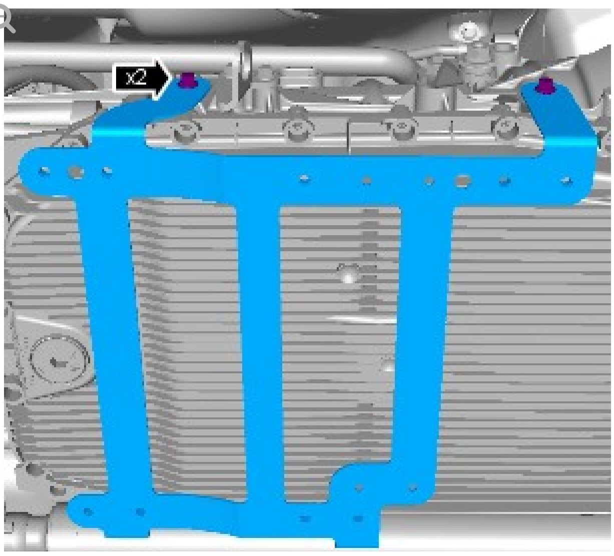
- *No text.

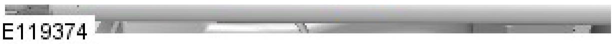
18.



Torque: **9 Nm**

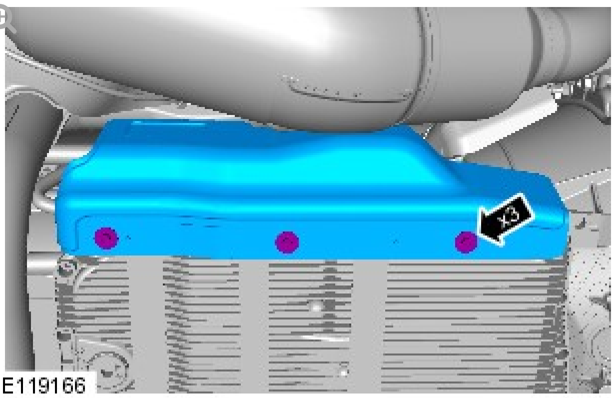
19.





Torque: **9 Nm**

20.

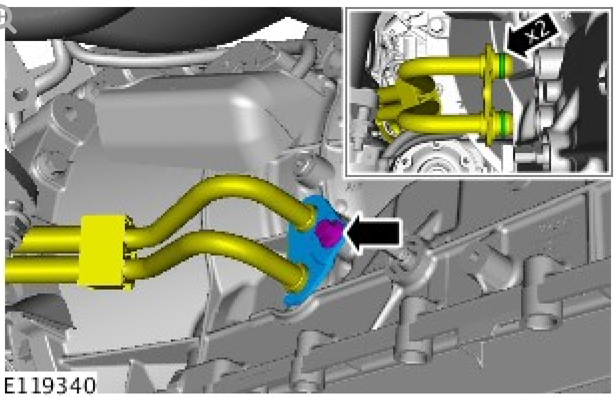


Torque: **9 Nm**

21.

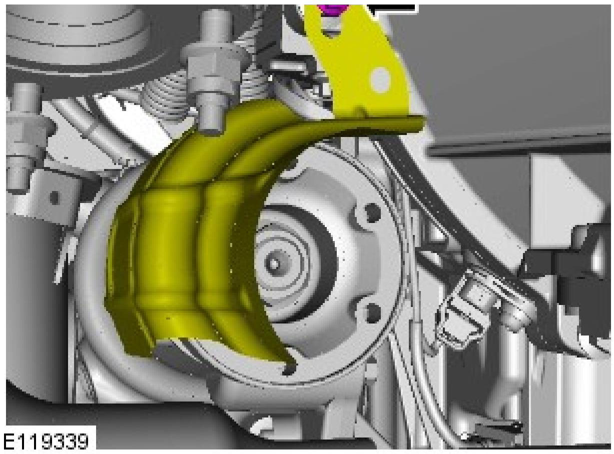
CAUTIONS:

- Be prepared to collect escaping fluids.
- Make sure that all openings are sealed. Use new blanking caps.



- Install new O-ring seals.
- *Torque:* **12 Nm**

22.



Torque: **10 Nm**

23. Refer to: Front Driveshaft - 5.0L (205-01, Removal and Installation).

24. Refer to: Exhaust System (309-00, Removal and Installation).

25. Refer to: Rear Driveshaft - 5.0L (205-01, Removal and Installation).

26. Lower the vehicle.

27. Connect the battery ground cable.
    Refer to: Specifications (414-00, Specifications).

2012.0 RANGE ROVER (LM), 307-02

TRANSMISSION/TRANSAXLE

TRANSMISSION/TRANSAXLE COOLING – V8 5.0L PETROL/V8 S/C 5.0L PETROL

SPECIFICATIONS

Lubricants

CAUTIONS:

- Do not use any lubricant other than that specified.
- Do not over lubricate.

ITEM	SPECIFICATION
Transmission fluid	ATF Shell M 1375.4 Land Rover Part No. TYK500050

Capacity

ITEM	CAPACITY
Initial dry fill	9.5 Litres (16.7 pints) (10.0 US quarts)

Torque Specification

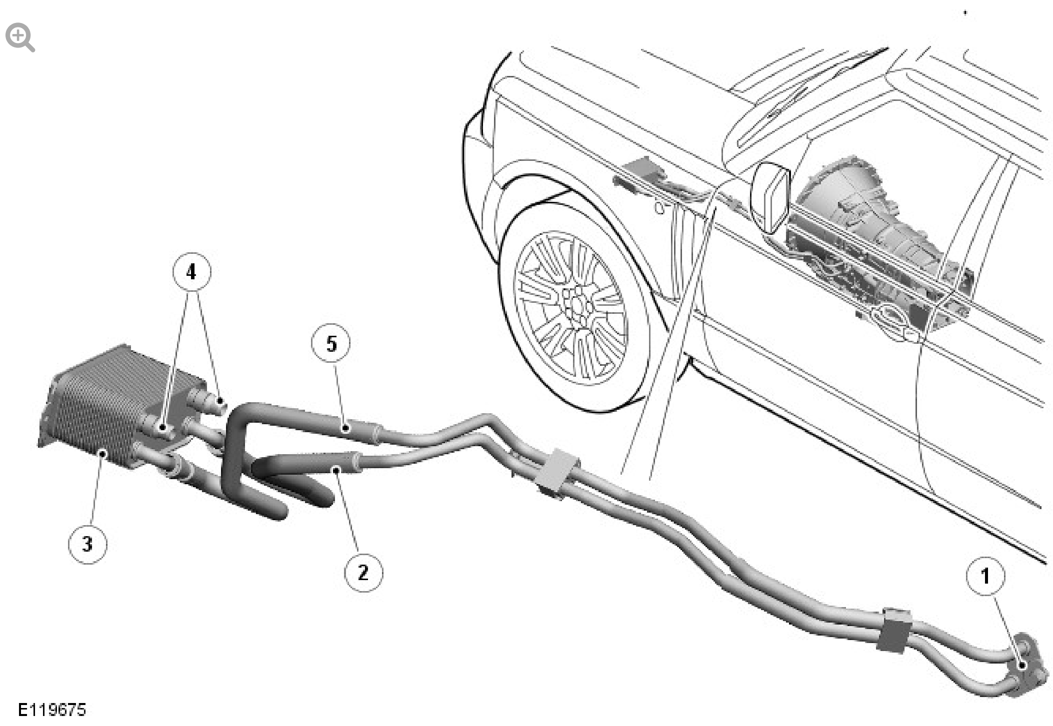
DESCRIPTION	NM	LB-FT	LB-IN
Transmission fluid cooler tube to transmission housing bolt	23	17	-
Transmission fluid cooler tube bracket to engine retaining bolt	10	7	-
Transmission fluid cooler retaining bolt	6	-	53

2012.0 RANGE ROVER (LM), 307-02

TRANSMISSION/TRANSAXLE COOLING - V8 5.0L PETROL/V8 S/C 5.0L PETROL

DESCRIPTION AND OPERATION

COMPONENT LOCATION



ITEM	DESCRIPTION
1	Latch-plate
2	Feed hose and pipe (from transmission)
3	Transmission fluid cooler
4	Engine coolant hose connections
5	Return hose and pipe (to transmission)

INTRODUCTION

Transmission cooling is provided by a transmission fluid cooler, which transfers heat from the transmission to the engine cooling system. The transmission fluid cooler is attached to the lower fan cowl on the rear of the cooling module.

Two hose and pipe assemblies connect the transmission fluid cooler to the automatic transmission. Two engine coolant hose connections are incorporated into the transmission fluid cooler for the supply and return of coolant from the engine cooling system.
For additional information, refer to: Engine Cooling (303-03C Engine Cooling - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

Fluid from the pump in the automatic transmission flows through the feed hose and pipe to the transmission fluid cooler. The fluid then flows through the transmission fluid cooler, and the return hose and pipe, to the sump of the automatic transmission.

TRANSMISSION/TRANSAXLE COOLING - V8 5.0L PETROL/V8 S/C 5.0L PETROL

DIAGNOSIS AND TESTING

PRINCIPLE OF OPERATION

For a detailed description of the automatic transmission cooling system, refer to the relevant Description and Operation sections in the workshop manual. REFER to: Transmission Cooling (307-02 Transmission/Transaxle Cooling - 5.0L, Description and Operation).

INSPECTION AND VERIFICATION

1. Verify the customer concern by operating the system.

1. Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

MECHANICAL
- Feed and return tubes - Connections to the automatic transmission and the automatic transmission fluid cooler - Automatic transmission fluid level

1. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

1. 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

CONDITION	POSSIBLE CAUSES	ACTION
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid cooler	Flush out the automatic transmission fluid cooler with new automatic transmission fluid. If the flushing is unsuccessful, install a new transmission fluid cooler.
Over heating of the automatic transmission	Obstruction in the automatic transmission fluid tubes	Flush out the automatic transmission fluid cooler tubes with new automatic transmission fluid. If the flushing is unsuccessful install new automatic transmission fluid cooler tubes.
Loss of automatic transmission fluid	Connections to the automatic transmission and the automatic transmission fluid cooler	Check the integrity of the tubes, connections and seals. Check the torque of the tube fixings.
Loss of automatic transmission fluid	Leak at oil cooler	Check the integrity of tubes, connections and seals. Check the torque of the tube fixings.

DTC INDEX

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00. REFER to: Diagnostic Trouble Code (DTC) Index - DTC: Module Name: Transmission Control Module - Siemens (100-00, Description and Operation).

TRANSMISSION/TRANSAXLE COOLING - V8 5.0L PETROL/V8 S/C 5.0L PETROL

TRANSMISSION FLUID COOLER - V8 5.0L PETROL/V8 S/C 5.0L PETROL (G1225382)

REMOVAL AND INSTALLATION

44.24.10	COOLER - OIL/FLUID - RENEW	5000 CC, AJ V8	1.8	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.
   Refer to: Specifications (414-00, Specifications).

2. **WARNING:**

   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Cooling System Draining and Vacuum Filling (303-03, General Procedures).

4. Refer to: Transmission Fluid Level Check (307-01B, General

4. Refer to: Transmission Fluid Level Check (307-01B, General Procedures).

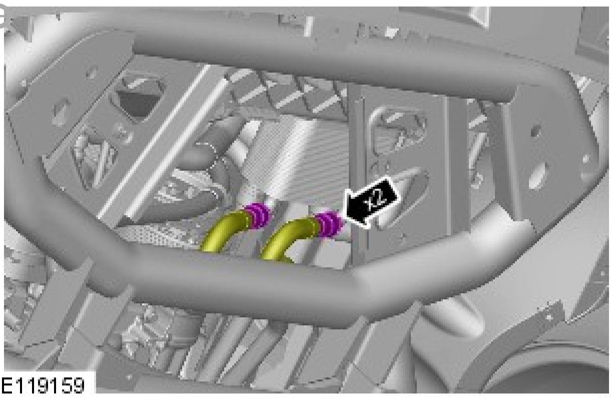
5.

WARNING:

Be prepared to collect escaping fluids.

CAUTION:

Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.

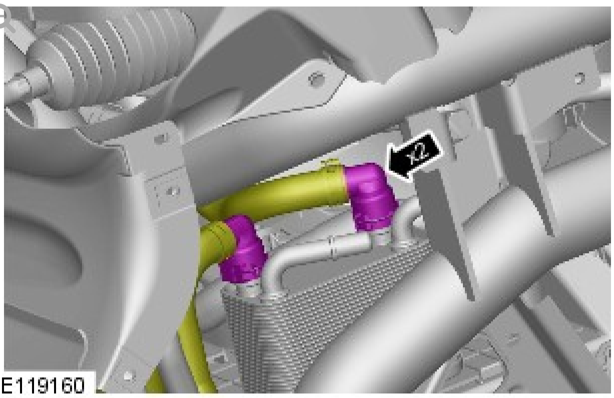


E119159

6.

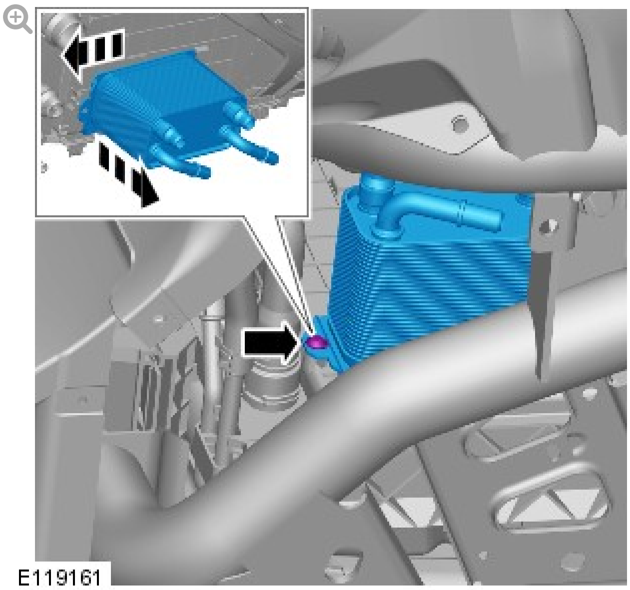
WARNING:

Be prepared to collect escaping fluids.



E119160

7.



Torque: **6 Nm**

INSTALLATION

1. To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 307-02

TRANSMISSION/TRANSAXLE COOLING – V8 5.0L PETROL/V8 S/C 5.0L PETROL

TRANSMISSION FLUID COOLER TUBES – V8 5.0L PETROL/V8 S/C 5.0L PETROL (G1225383)

REMOVAL AND INSTALLATION

44.24.15	HOSES/PIPES – OIL/FLUID COOLER – SET – RENEW	AJ V8, SUPERCHARGED	3.1	USED WITHINS	+

REMOVAL

NOTE:

Removal steps in this procedure may contain installation details.

1. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).

2. **WARNING:**

   Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

3. Refer to: Engine Undershield (501-02, Removal and Installation).

4. Refer to: Front Driveshaft - 5.0L (205-01, Removal and Installation).

5. Refer to: Transmission Fluid Level Check (307-01B, General Procedures).

6. Remove the LH front road wheel.

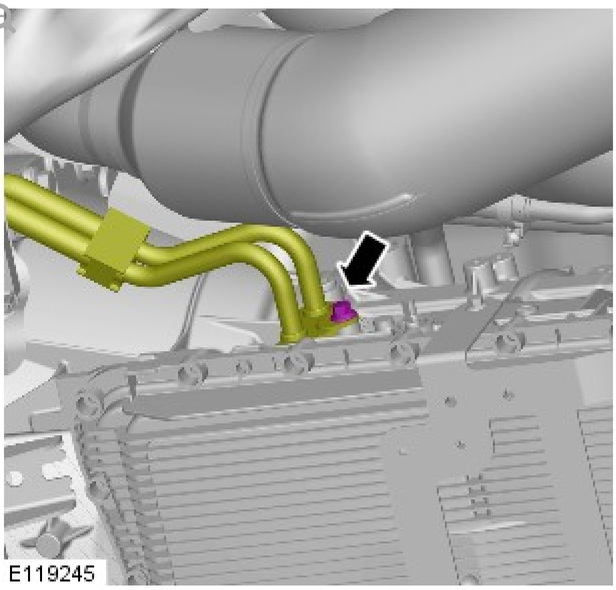
   Torque: **140 Nm**

7. **WARNING:**

   Be prepared to collect escaping fluids.

CAUTION:

Always plug any open connections to prevent contamination.



Torque: **23 Nm**

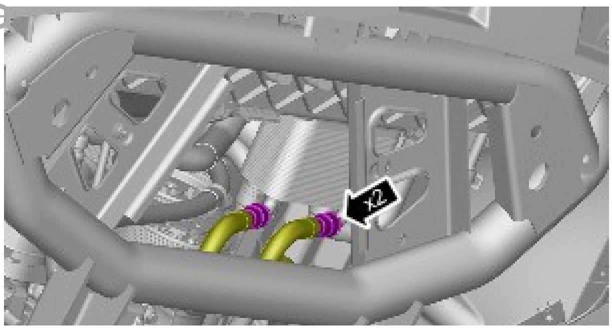
8.

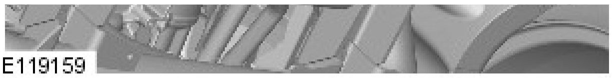
WARNING:

Be prepared to collect escaping fluids.

CAUTION:

Before disconnecting or removing the components, ensure the area around the joint faces and connections are clean and dry. Plug open connections to prevent contamination.





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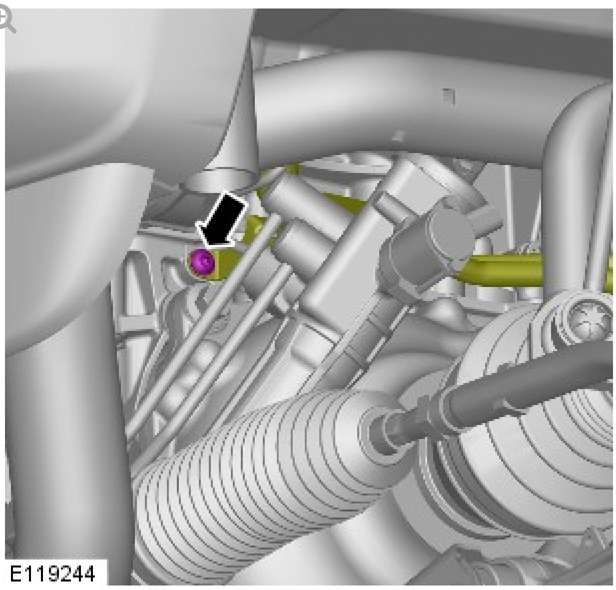
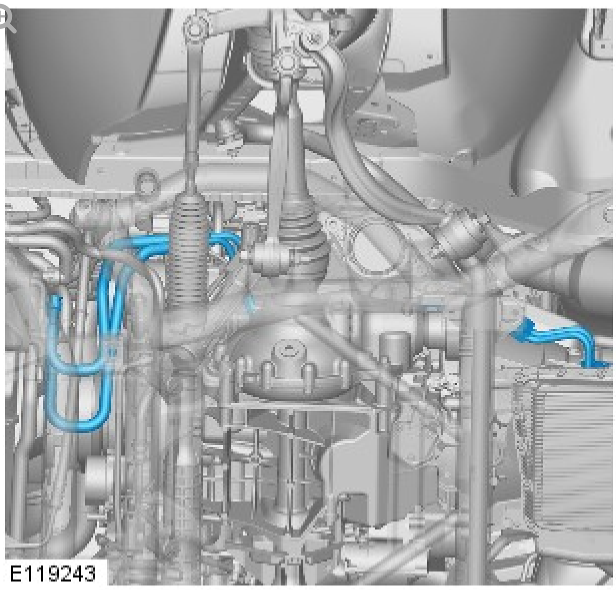


Torque: **10 Nm**

10.



INSTALLATION

1. To install, reverse the removal procedure.

2012.0 RANGE ROVER (LM), 307-05

AUTOMATIC TRANSMISSION/TRANSAXLE EXTERNAL CONTROLS - V8 5.0L PETROL/V8 S/C 5.0L PETROL

SPECIFICATIONS

General Specification

ITEM	SPECIFICATION
Type	Cable operated from shift mechanism to bell crank on side of transmission with manual release from Park 'P' position in the event of electrical failure

Torque Specifications

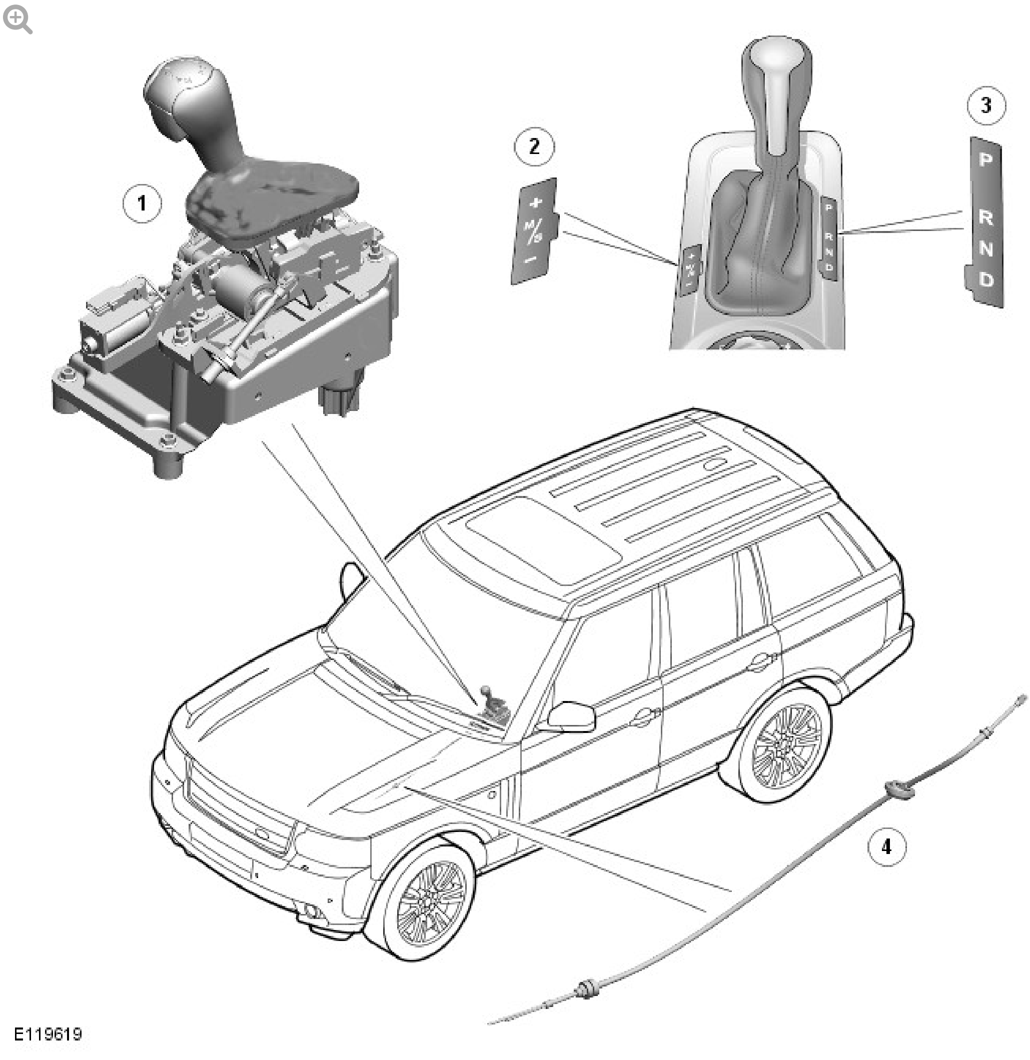
DESCRIPTION	NM	LB-FT
Selector lever locknut	14	10
Transmission heat shield bolts	9	7

Transmission under shield bolts	9	7
Transmission selector cable retaining bracket bolts	9	7

AUTOMATIC TRANSMISSION/TRANSAXLE EXTERNAL CONTROLS - V8 5.0L PETROL/V8 S/C 5.0L PETROL

DESCRIPTION AND OPERATION

COMPONENT LOCATION



ITEM	DESCRIPTION
1	Selector lever assembly
2	M/S (manual/sport) display
3	Selector lever position display
4	Selector cable

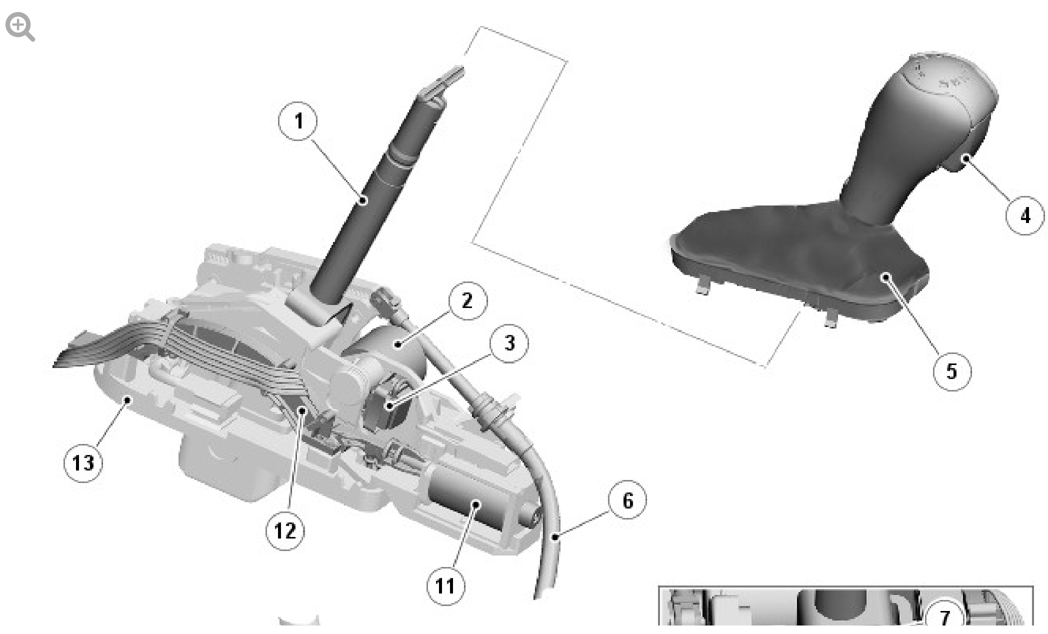
INTRODUCTION

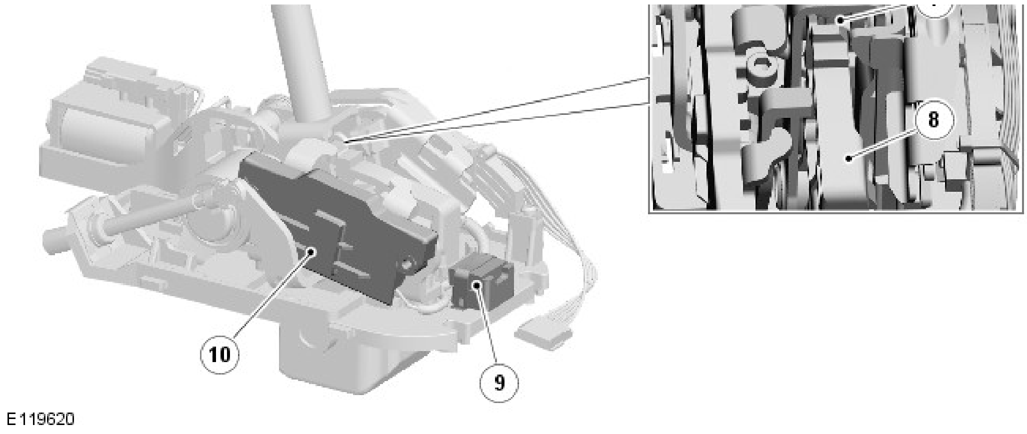
The external controls for the transmission consist of a selector lever assembly, a selector cable, a selector lever position display and a M/S display.

The selector cable transmits the position of the selector lever to the transmission.

The selector lever positions are displayed on the selector lever position display and the M/S display. The selector lever position and current forward gear are also displayed in the instrument cluster.
For additional information, refer to: Transmission Description (307-01C Automatic Transmission/Transaxle - V8 5.0L Petrol/V8 S/C 5.0L Petrol, Description and Operation).

SELECTOR LEVER ASSEMBLY





ITEM	DESCRIPTION
1	Selector lever
2	Shift interlock solenoid
3	Park lock switch
4	Release button
5	Gaiter
6	Selector cable
7	Plunger
8	Cam
9	M/S switch
10	Manual +/- CommandShift switch
11	Park lock solenoid
12	Selector lever position switch
13	Mounting plate

The selector lever assembly is located in the floor console. A bracket on the transmission tunnel provides the mounting for the selector lever assembly. A leather gaiter seals the gap between the selector lever and the trim of the floor console.

The selector lever positions are as follows:

- P (park) : no torque transmitted to the drive wheels and prevents the vehicle from moving by locking the transmission

- R (reverse) : selects reverse gear - only to be selected when the vehicle is stationary and the engine is at idle
- N (neutral) : no torque transmitted to the drive wheels - allows the vehicle to roll, so ensure the EPB (electronic parking brake) is applied before leaving the vehicle in this state
- D (drive) : this position uses all six forward gears in automatic operation
- M/S (manual/sport) : this position engages the sport mode, which uses all six forward gears as in D, but will upshift at higher engine speeds improving acceleration
- + and - : initiates upshifts and downshifts respectively, allowing the transmission to be used as a sequential manual transmission (CommandShift mode) with six forward gears.

The selector lever assembly has a cast mounting plate which provides for the location of the selector components. The selector lever is connected to a gimbal mechanism which allows for the selection of P, R, N, D in a forward or backward direction and, when D is selected, selection between D and M/S in a left/right direction. In the M/S position, the selector lever can be moved in a forward or backward direction to select + or - for manual (CommandShift) operation.

The mounting plate also houses the following components:

- Manual +/- CommandShift switch
- Shift interlock solenoid
- Selector lever position switch
- Manual/Sport switch
- Park lock solenoid
- Park lock switch.

A release button on the head of the selector lever operates a plunger, which rests on a cam at the base of the selector lever. Pressing the release button raises the plunger clear of the cam. The cam profile is such that the release button must be pressed to move the selector lever into and out of the P, and from N to the R positions.

MANUAL +/– COMMANDSHIFT SWITCH

The manual +/- switch is located on the LH (left-hand) side of the selector lever assembly. The switch comprises a housing which provides the location for a sliding contact. When the selector lever is moved to the M/S position, a dog on the selector lever engages with a slotted abutment on the sliding contact. When the selector lever is moved to the + or - position the dog moves the sliding contact, which completes a momentary ground circuit with one of two microswitches at each end of the switch, which correspond to the + or - positions.

This momentary signal is received by the TCM (transmission control module), which, on first operation of the switch, initiates manual mode and operates the transmission in the selected gear.

In this position, a spring moves the selector lever to the center position when released.

SHIFT INTERLOCK SOLENOID

The shift interlock solenoid is located at the front of the selector lever assembly. The selector lever is connected to a locking plate which has two holes that correspond to the P and N positions. When the ignition is on and the selector lever is in the P or N position, the solenoid is energized by the TCM. When energized, the solenoid ejects a pin which engages in the locking plate, preventing the lever from being moved.

When the footbrake is applied, the ECM (engine control module) sends a high speed CAN (controller area network) message to the TCM, which de-energizes the solenoid allowing the lever to be moved from the P or N position. This prevents the selector lever from being moved to the D or R position unintentionally and the application of the brakes also prevents the vehicle 'creeping' when the gear is engaged.

SELECTOR LEVER POSITION SWITCH

The selector lever position switch is located on the RH (right-hand) side of the selector lever assembly. The switch has a moving contact which is connected to the selector lever. As the selector lever is moved, the sliding contact moves in the switch and, in turn, completes a circuit with four further contacts in the switch, which represent the four lever positions P, R, N and D. The switch is connected to the selector lever position display via a ribbon

D. The switch is connected to the selector lever position display via a ribbon cable and provides the ground connection for the LED (light emitting diode)'s under the P, R, N and D symbols.

MANUAL/SPORT SWITCH

The M/S switch is a cam operated microswitch located at the rear of the selector lever assembly. A lever with a roller is attached to the body of the M/S switch. When the selector lever is moved between the D and M/S positions, the roller rides along a cam on the selector lever, which operates the switch. When the selector lever moves from the D position to the M/S position, the M/S switch closes. When the selector lever moves from the M/S position to the D position, the M/S switch opens.

The M/S switch is installed in a ground circuit from the TCM. The TCM operates the transmission in the sport mode when the M/S switch is closed and in the normal automatic mode when the M/S switch is open. When closed, the M/S switch also provides a ground for the M/S display, to illuminate the M/S symbol.

PARK LOCK SWITCH

This switch detects that the park lock lever has engaged in the selector mechanism and allows the P position to be confirmed both inside the transmission and at the selector lever. This signals to the TCM that shutdown is allowable following an ignition off sequence. Failure to activate this switch will result in a flashing P in the transmission status display of the instrument cluster and the TRANSMISSION NOT LOCKED IN PARK warning in the message center on ignition off, with the TCM still alive for up to 10 minutes or until the vehicle is locked.

PARK LOCK SOLENOID

The park lock solenoid is part of a normally locked selector lever mechanism which requires the ignition on to unlock. This solenoid prevents movement of the selector lever from the P position in the ignition off state, to prevent vehicle roll-away due to inadvertent operation. This solenoid is energized continuously with the ignition on.

SELECTOR CABLE

The selector cable is a Bowden cable that connects the selector lever to the gear change lever on the RH side of the transmission. A clip secures the outer cable to the mounting plate of the selector lever assembly. The inner cable is secured to an arm which is connected to the selector lever via a U shaped bracket and pin.

The transmission end of the outer cable is secured to a bracket on the transmission by a clamp nut. The inner cable is attached to the gear change lever by a clamp bush and locknut, which provide a means of adjustment for the selector cable.

A grommet seals the selector cable where it passes through the transmission tunnel.

SELECTOR LEVER POSITION DISPLAY

The selector lever position display is located in the trim of the floor console, to the right of the selector lever. The display contains the symbols P, R, N and D, with a red LED under each symbol. When the ignition is on, the appropriate symbol is illuminated to indicate the position of the selector lever.

The four LED have a common power feed from the M/S display and individual ground connections with the selector lever position switch. At any one time, the selector lever position switch connects to ground only the LED under the symbol that corresponds to the position of the selector lever.

MANUAL/SPORT DISPLAY

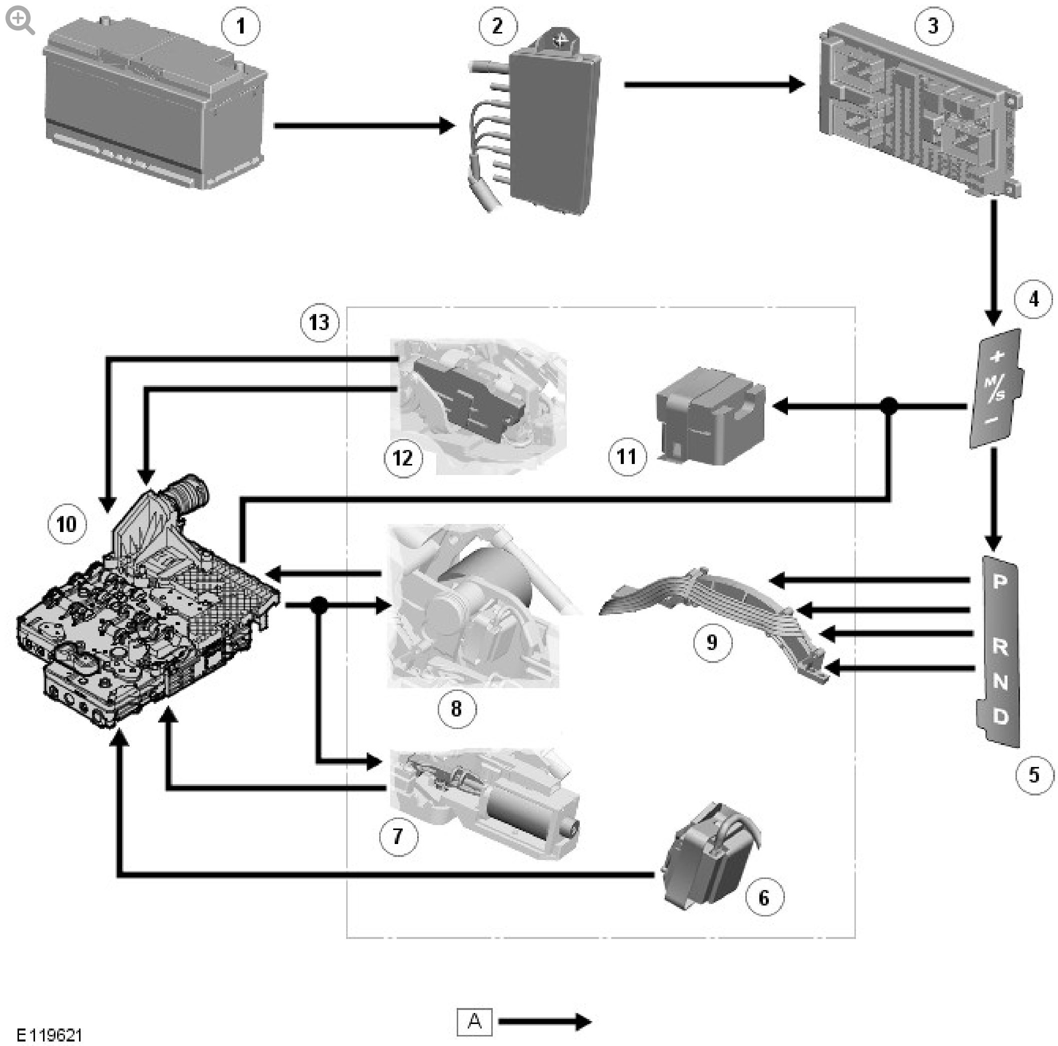
The M/S display is located in the trim of the floor console, to the left of the selector lever. The display contains the symbol M/S, with a red LED under the symbol. When the ignition is on, the symbol is illuminated when the selector lever is in the M/S position.

The LED has a power feed from the ignition relay in the CJB (central junction box) and a ground connection with the M/S switch. The M/S switch connects the LED to ground only when the selector lever is in the M/S position.

CONTROL DIAGRAM

NOTE:

A = Hardwired.



ITEM	DESCRIPTION
1	Battery
2	BJB (battery junction box) (50 A megafuse)
3	CJB (central junction box) (ignition relay)
4	M/S display
5	Selector lever position display
6	Park lock switch
7	Park lock solenoid

8	Shift interlock solenoid
9	Selector lever position switch
10	TCM
11	M/S switch
12	Manual +/- CommandShift switch
13	Selector lever assembly

2012.0 RANGE ROVER (LM), 307-05

AUTOMATIC TRANSMISSION/TRANSAXLE EXTERNAL CONTROLS - V8 5.0L PETROL/V8 S/C 5.0L PETROL

PRINCIPLES OF OPERATION

For a detailed description of the automatic transmission/transaxle external controls system and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: External Controls (307-05 Automatic Transmission/Transaxle External Controls - 5.0L, 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 tested and/or the donor vehicle.

NOTE:

Check and rectify basic faults before beginning diagnostic routines involving pinpoint tests.

1. Verify the customer concern.

1. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

MECHANICAL	ELECTRICAL
▪ Check for correct gear selector lever cable adjustment. ▪ Visibly worn or damaged components ▪ Loose or missing fastners	▪ Fuses ▪ Loose or corroded electrical connectors

1. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

1. If the cause is not visually evident, check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC INDEX

For a list of Diagnostic Trouble Codes (DTCs) that could be logged on this vehicle, please refer to Section 100-00.

2012.0 RANGE ROVER (LM), 308-07

FOUR–WHEEL DRIVE SYSTEMS

SPECIFICATIONS

Torque Specifications

NOTE:

*** New bolts must be used when a new component is installed.**

DESCRIPTION	NM	LB-FT
* Transfer case shift motor Torx bolts	35	26
* Transfer case clutch control solenoid Torx bolts	5	4
* High/Low range sensor Torx bolts	5	4

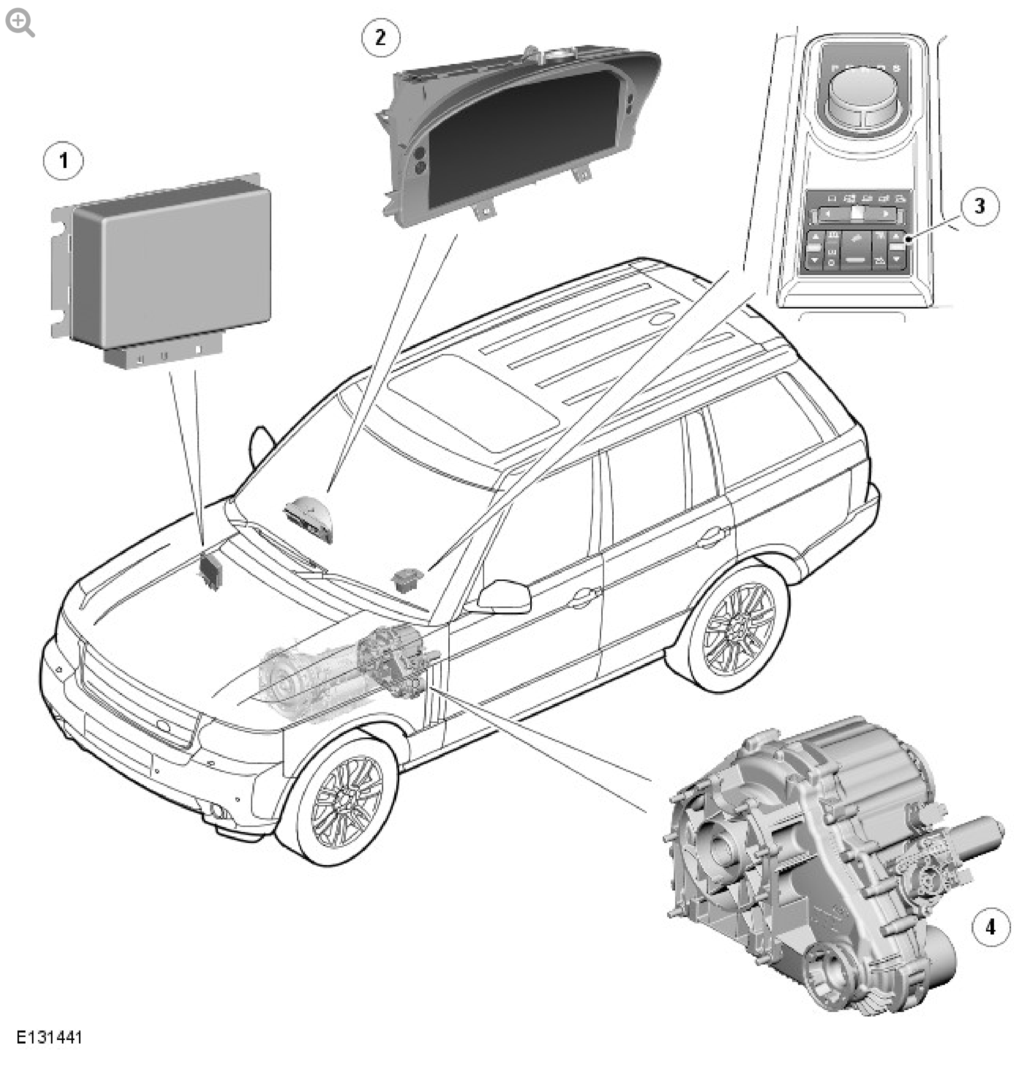
FOUR-WHEEL DRIVE SYSTEMS

DESCRIPTION AND OPERATION

Transfer Box Component Location

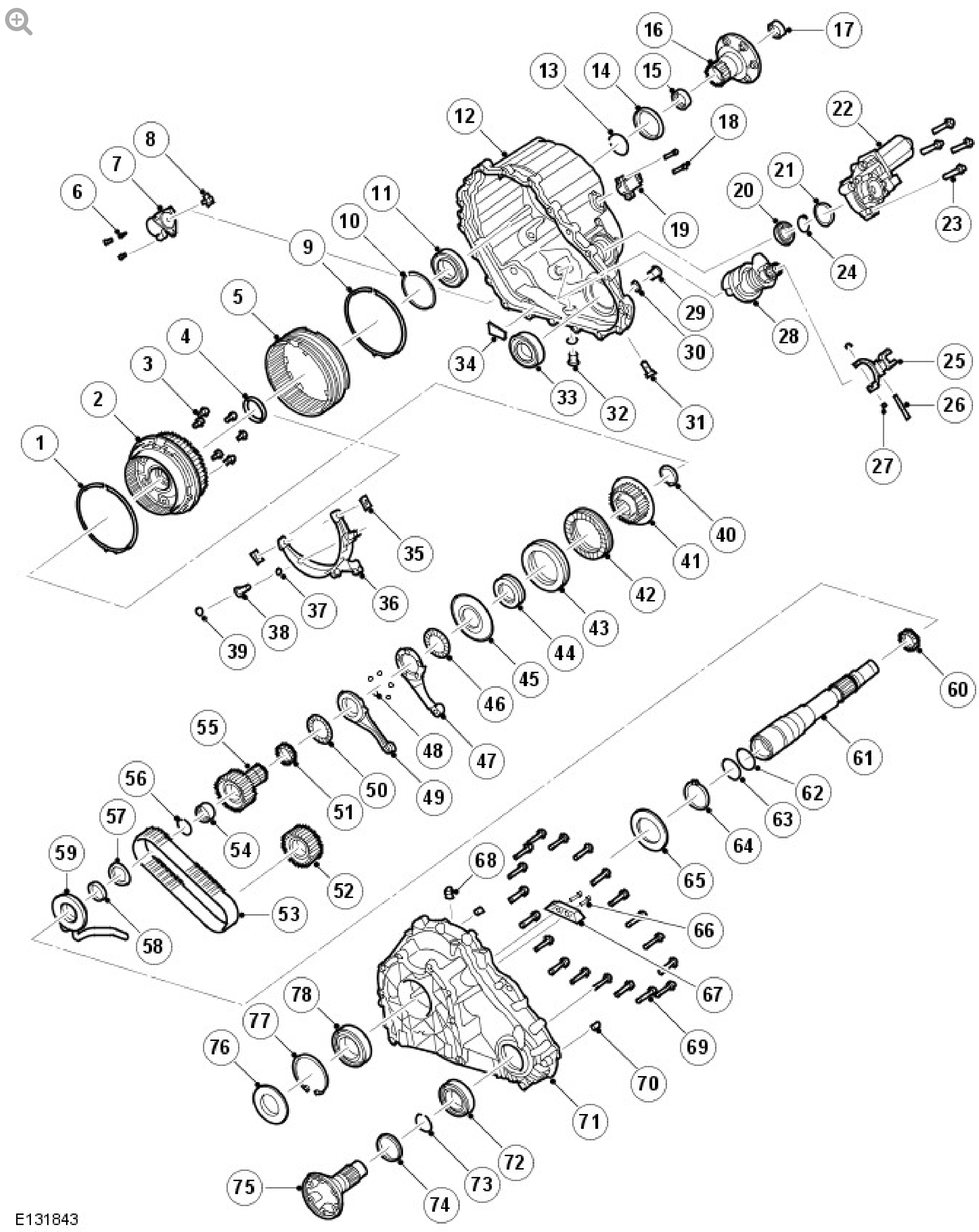
NOTE:

4.4L TDV8 shown - other models similar



ITEM	DESCRIPTION
1	Transfer box control module
2	Instrument cluster
3	Range change selection switch
4	Transfer box

Transfer Box Exploded View



ITEM	DESCRIPTION
1	Synchronisation spring
2	Differential assembly
3	Bolt, 6 off
4	Spacer ring
5	Shifting sleeve
6	Bolt, 3 off
7	Solenoid
8	Shifting element
9	Synchronisation spring
10	Circlip
11	Ball bearing
12	Rear casing
13	Circlip
14	Seal ring
15	Needle roller bearing
16	Rear output flange
17	Needle roller bearing
18	Bolt, 2 off
19	Selector fork position sensor
20	Bearing
21	Circlip
22	Transfer box motor assembly
23	Bolt, 4 off
24	Circlip
25	Shifting fork
26	Fork pin
27	Sliding block
28	Actuator assembly
29	Fill plug

30	Seal ring
31	Ball retention
32	Drain plug
33	Seal ring
34	Particle collector magnet
35	Sliding blocks, 2 of
36	High/low shifting fork
37	O-ring
38	High/low fork pin
39	Circlip
40	Circlip
41	Clutch hub
42	Clutch friction plate, 10 off
43	Clutch steel plate, 10 off
44	Disc spring, 6 off
45	Clutch piston
46	Axial needle roller bearing
47	Transfer box motor lever assembly
48	Ball, 5 off
49	Transfer box motor lever assembly
50	Axial needle roller bearing
51	Needle roller bearing
52	Front output sprocket
53	Chain
54	Needle roller bearing
55	Sprocket
56	Circlip
57	Thrust washer
58	Spacer ring
59	Oil pump assembly

60	Needle roller bearing
61	Input shaft
62	Retaining ring
63	O-ring
64	Circlip
65	Shim
66	Screw (2 off)
67	Snubber
68	Breather cartridge
69	Bolt, 19 off
70	Dowel pin (2 off)
71	Front casing
72	Bearing
73	Circlip
74	Seal ring
75	Front output flange
76	Seal ring
77	Circlip
78	Bearing

GENERAL

The DD295 transfer box is full time, permanent four-wheel-drive unit, with 50/50 torque distribution to the front and rear driveshafts. Magna Steyr Powertrain manufactures the unit, which is identical for all engine derivatives and supports the following features:

- Permanent four-wheel-drive with a bevel gear centre differential, providing a 50:50 torque split
- Selectable high and low range for optimum on-road and off-road performance
- Two-speed, fully synchronized 'shift-on-the-move' system allows the driver

- Two-speed, fully synchronized 'shift-on-the-move' system allows the driver to change the range without having to stop the vehicle
- Electronically controlled multi-plate clutch providing a centre differential lock and torque biasing function to give improved traction performance and vehicle dynamic stability.

A strategy, to electronically control the centre differential multi plate clutch assembly, has been developed to provide;

- a pre-loading function, increasing locking torque with increased driving torque
- a slip controller to increase locking torque under off-road conditions and decrease locking torque for optimum comfort, e.g. parking.

The unit is located under the vehicle and is mounted on the cross-member, behind the transmission.

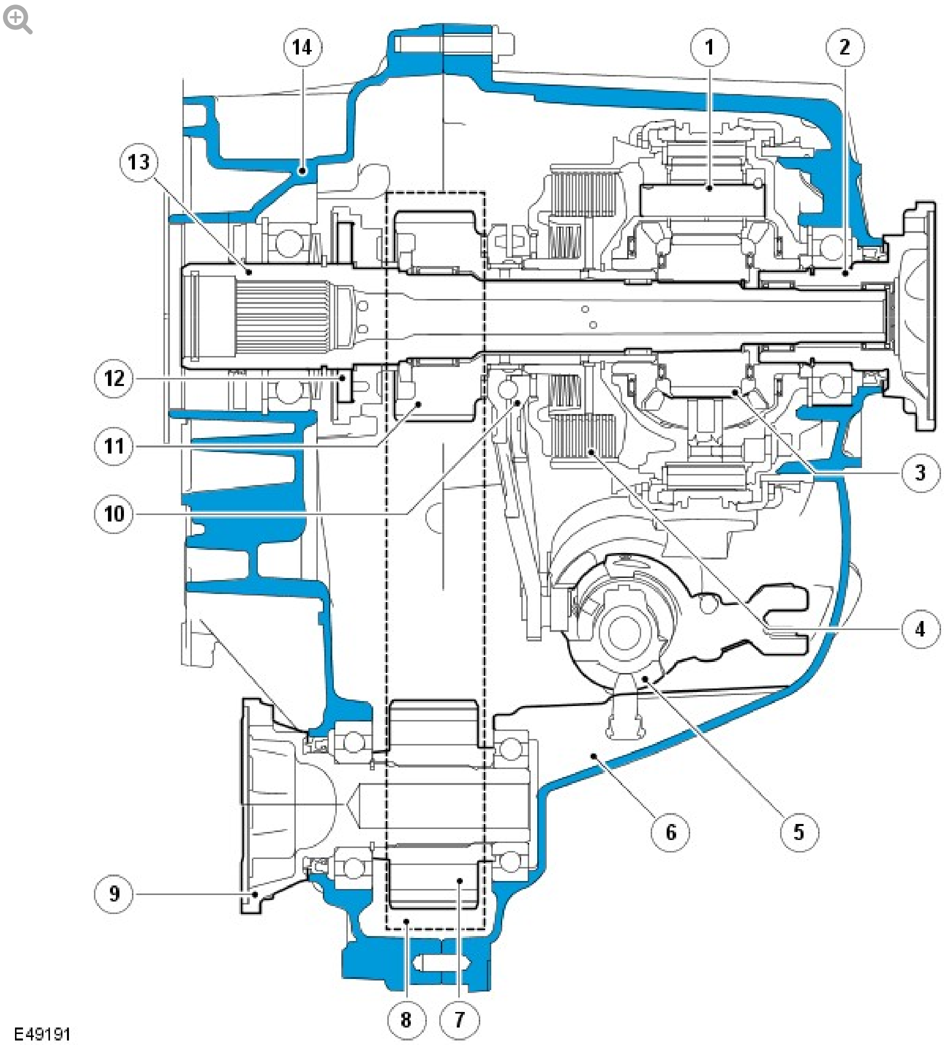
The transfer box receives a torque input from the transmission output shaft, which is passed through the unit to 2 outputs for the front and rear drive shafts.

The input torque is equally distributed via a bevel gear type differential. In order to provide an optimal torque distribution to each wheel in all driving conditions, the unit is equipped with an electronically controlled locking and torque-biasing device. This device detects wheel slip via various vehicle system inputs to the transfer box control module and locks the differential accordingly. The locking torque is applied through a multi-plate clutch assembly.

A planetary gear set, located in the differential assembly, allows the driver to select high or low range whilst driving, this is known as 'shift on the move'. When in low range, the planetary gear set provides a ratio of 2.93:1, which gives the vehicle an extremely low crawl speed for off road driving and trailer towing. High range is a direct drive from the transmission output shaft and provides a 1:1 ratio.

Both the centre differential locking and biasing and the 'shift on the move' features are actuated via a DC (direct current) transfer box motor, which is controlled by the transfer box control module, via a PWM (pulse width modulation) signal.

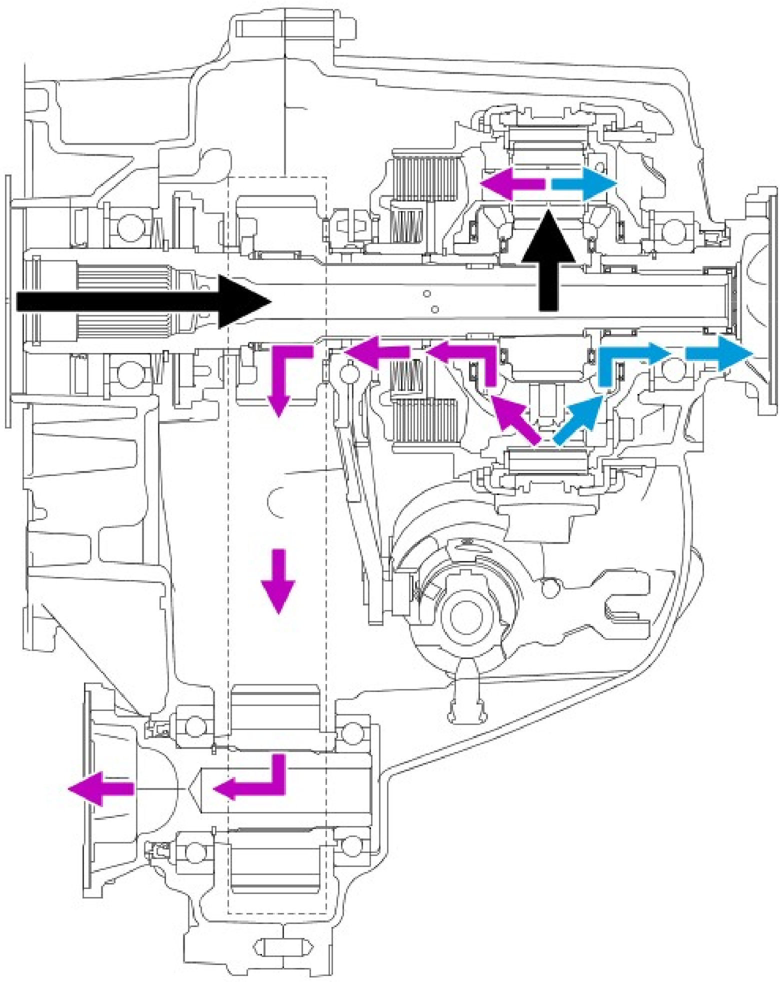
Transfer Box - Sectional View



ITEM	DESCRIPTION
1	Planetary gear set
2	Rear output flange
3	Centre differential assembly
4	Multi-plate clutch
5	Transfer box motor module
6	Rear housing assembly
7	Front output sprocket
8	Chain drive
9	Front output flange

10	Transfer box motor levers
11	Sprocket
12	Oil pump assembly
13	Input shaft
14	Front housing assembly

Transfer Box Power Flow



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Input torque from the transmission is transferred to the input shaft of the transfer box and then onto the planetary sun gear and planetary pinion gears. The planetary pinion gears are held in place by the planet pinion shafts, which are connected to the differential carrier, and drive the differential pinion gears. The torque is then distributed to both the front and rear carriers, which are connected to the outputs of the transfer box. The rear carrier is connected directly to the rear output flange; the front carrier is connected to the sprocket and therefore to the chain drive, which provides front output flange rotation.

TRANSFER BOX CASINGS

The front and rear casing assemblies are manufactured from cast aluminium.

FRONT CASING ASSEMBLY

The front casing assembly provides the location for the input shaft bearing, the front output flange bearing and the oil pump. It is also equipped with threaded holes to mount the chassis mounting bush, 2 lifting eyes and a breather cartridge for the transfer box breather pipe. The breather pipe allows an equalisation between atmospheric and internal transfer box pressure.

On models from 2011MY, the front casing has an additional boss cast on the inside. The boss is used to mount a snubber which is secured with 2 screws. The snubber suppresses chain vibrations which can occur under medium acceleration conditions, therefore improving NVH issues. During normal operation the chain does not contact the snubber.

REAR CASING ASSEMBLY

The rear casing assembly provides the location for the rear output flange bearing, the transfer box motor and the oil fill and drain plug. Fins are cast into the rear casing assembly to improve heat dissipation. The unit number is also stamped into the rear housing.

OIL PUMP

An oil pump assembly is located in the front casing to provide lubrication for the bearings and rotary components through cross-drillings in the input shaft. A flat-sectioned coupling on the input shaft drives the rotor of the pump; the stator is fixed to the front housing assembly. A tube is attached to the pump, which leads into a calm suction area at the bottom of the 2 casing assemblies. The collector magnet in the suction area of the pump collects any metallic debris.

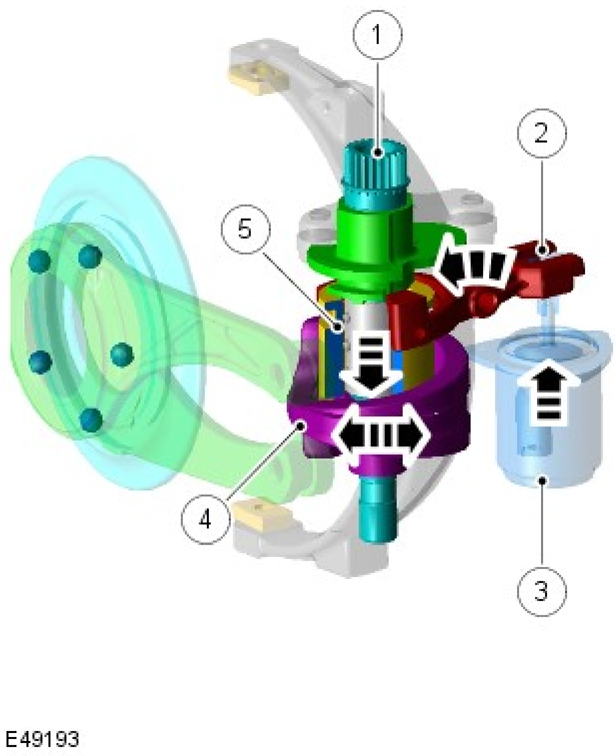
CHAIN DRIVE

The chain-drive transfers drive from the centre differential to the front output flange. A 3/8" pitch chain connects the sprocket on the transfer box input shaft with the sprocket on the front output flange. As both sprockets have the same number of teeth, the rotational speed of both sprockets is identical.

TRANSFER BOX MOTOR

One motor operates both the high/low range change and the differential locking and torque-biasing device (multi-plate clutch). The motor solenoid switches between the 2 functions, while the motor provides the rotational movement for both operations.

TRANSFER BOX MOTOR POSITION FOR CLUTCH CONTROL MODE



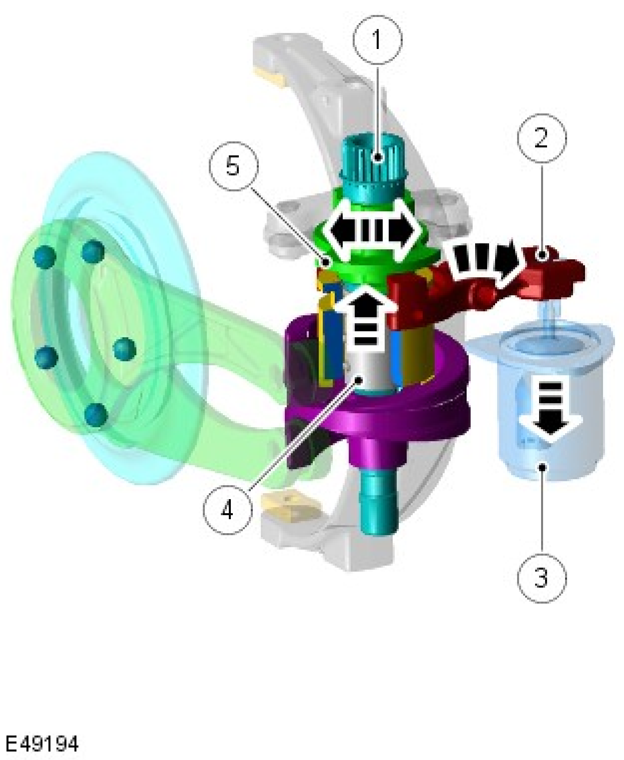
ITEM	DESCRIPTION
1	Motor shaft
2	Solenoid shift fork
3	Solenoid

4	Clutch control disc
5	Shifting sleeve

To actuate the multi-plate clutch, the transfer box control module energizes the solenoid. The solenoid pin pivots the solenoid shift fork, which engages the shifting sleeve into the dogteeth on the clutch control disc. The rotational movement of the motor shaft is then linked to the clutch control disc via the shifting sleeve.

This is the normal operating mode of the transfer box. In this position, the range change function is disengaged and mechanically locked.

TRANSFER BOX MOTOR POSITION FOR HIGH/LOW RANGE MODE



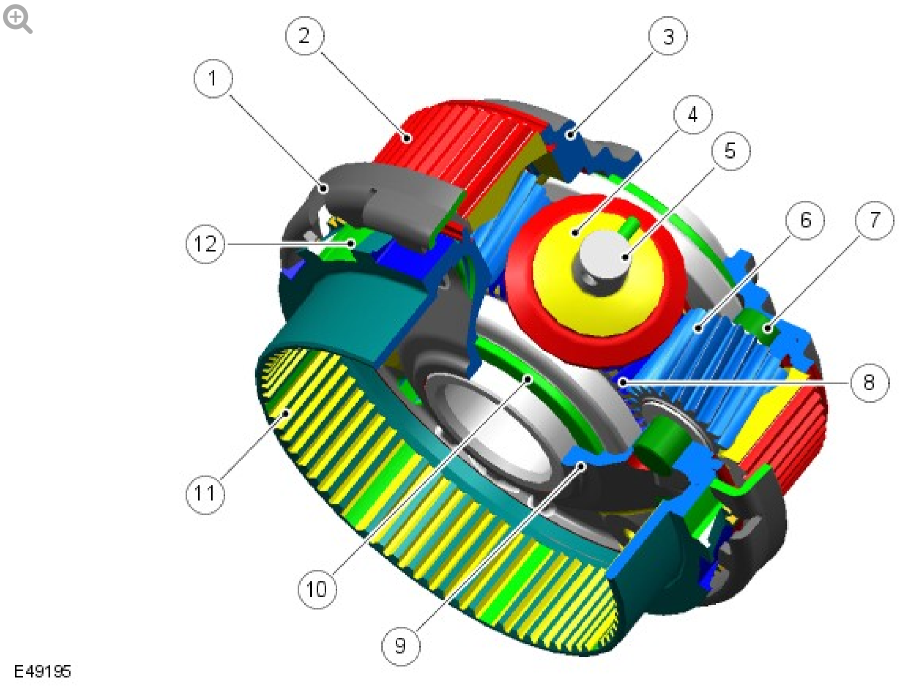
ITEM	DESCRIPTION
1	Motor shaft
2	Solenoid shift fork
3	Solenoid
4	Shifting sleeve

5	Actuation cam

To actuate the high/low range change, the transfer box control module de-energizes the solenoid. A spring in the solenoid retracts the solenoid pin and rotates the solenoid shift fork. This engages the shifting sleeve to the dogteeth on the high/low actuation cam. The rotational movement of the motor shaft is then linked to the cam.

In this position, the multi-plate clutch is open, the differential cannot be locked and torque cannot be biased. Once the range change is complete the system returns to clutch control mode. In the event of an electrical failure, the motor will default to this position.

CENTER DIFFERENTIAL ASSEMBLY



ITEM	DESCRIPTION
1	Synchronisation cup and spring
2	Planetary ring gear
3	Differential carrier
4	Pinion gears
5	Pinion gear shafts

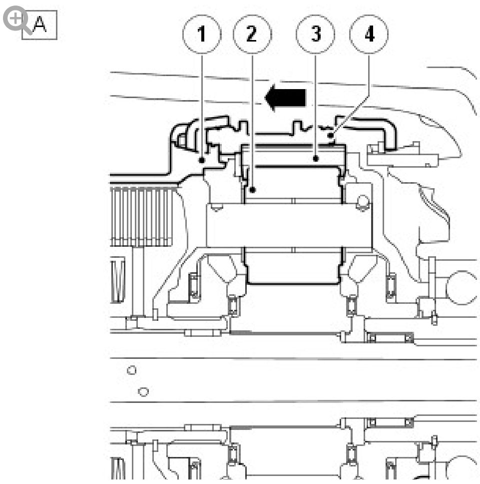
6	Planetary pinion gears
7	Planetary pinion gear shafts
8	Planetary sun gear
9	Differential cover
10	Differential side gears
11	Multi-plate clutch basket
12	Dogteeth

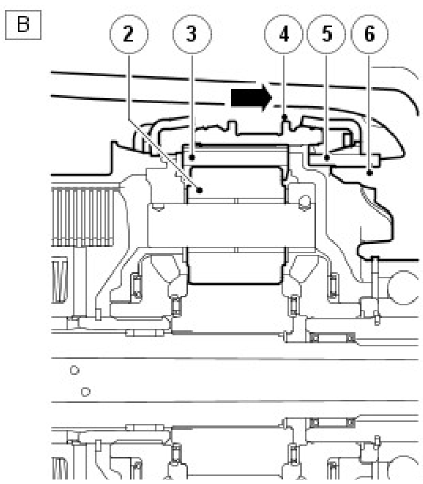
The center differential assembly is the primary feature of the transfer box. Torque is transmitted through the center differential carrier and distributed to the differential gears and the front and rear output flanges. The planetary gear set, for the high/low range change function, is also an integral part of the centre differential assembly.

The assembly comprises 3 differential pinion gears and shafts, which are equally spaced within the centre differential carrier. The differential shafts have a rigid connection to the differential carrier. Located between the pinion gears are 3 planetary pinion gears and shafts. The planetary sun gear and 2 differential side gears are located in the centre line of the carrier.

The planetary ring gear is supported in both directions by the differential casing and the differential cover. The planetary ring gear is connected to a shifting sleeve, which is engaged in either high or low range.

The multi-plate clutch basket, which is welded to the differential casing, supports the friction plates, the dogteeth for high range engagement and the synchronisation cup and spring for the 'shift-on-the-move' function.





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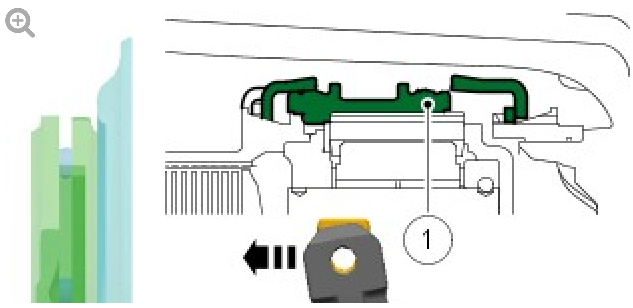
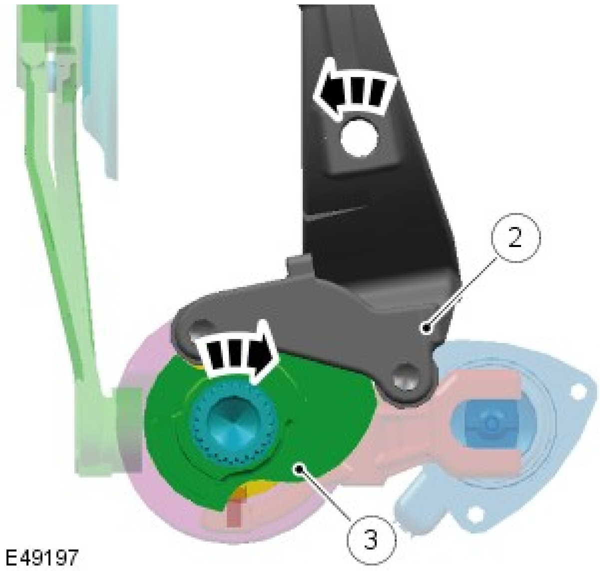
ITEM	DESCRIPTION
A	High range position
B	Low range position
1	Dogteeth
2	Planetary pinion gears
3	Planetary ring gear
4	Shifting sleeve
5	Low range dogteeth
6	Rear carrier assembly

When high range is engaged, the shifting sleeve connects to the differential carrier via dogteeth. The planetary ring gear, via the shifting sleeve, and the planetary pinion gears, via the planetary shafts, which are also attached to the differential carrier. The planetary gear set rotates as 1 unit and therefore turns the differential side gear with a 1:1 ratio.

In low range the motor moves the shifting sleeve in the direction of the low range dogteeth. The low range dogteeth, with the synchronisation cup and spring, are fixed to the rear carrier assembly. When the shifting sleeve is engaged with the low range dogteeth, the planetary ring gear, via the shifting sleeve, is stationary and the planetary pinion gears, via the planetary bolts, turn the differential side gears with 2.93: 1 ratio.

HIGH RANGE ACTUATION SEQUENCE

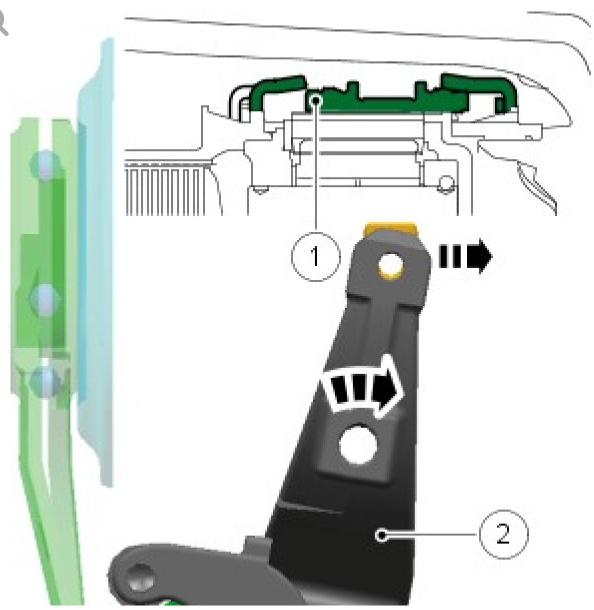


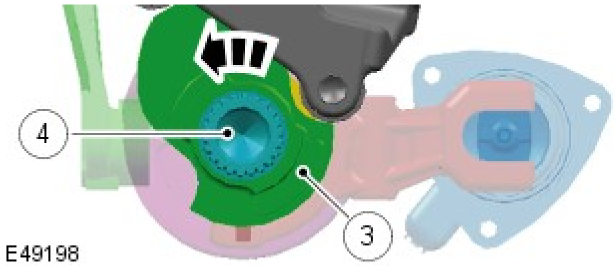


ITEM	DESCRIPTION
1	Shifting sleeve
2	High/low shifting fork
3	Shifting cam

The rotational movement of the motor shaft turns the shifting cam to high range position. The shifting cam then moves the shifting sleeve, via the high/low shifting fork, into the high range position. After the synchronisation sequence, the planetary ring gear is connected to the high range dogteeth, via the shifting sleeve, on the differential carrier. In this position, the input speed equals the output speed, which equates to a high range ratio of 1:1.

LOW RANGE ACTUATION SEQUENCE

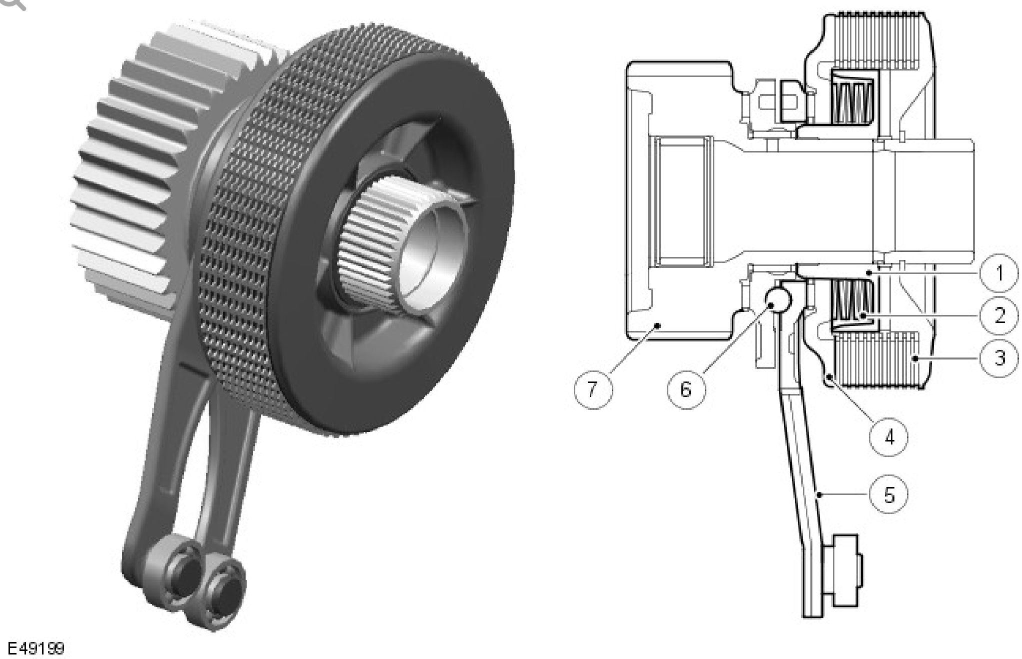




ITEM	DESCRIPTION
1	Shifting sleeve
2	High/low shifting fork
3	Shifting cam
4	Motor shaft

The rotational movement of the motor shaft turns the shifting cam into low range position. The shifting cam then moves the shifting sleeve of the centre differential assembly via the high/low shifting fork into low range position. After the synchronisation sequence, the planetary ring gear is connected to the low range dogteeth, via the shifting sleeve, on the rear carrier assembly. The output speed is then reduced to a ratio of 2.93:1.

MULTI-PLATE CLUTCH ASSEMBLY



ITEM	DESCRIPTION
1	Clutch hub
2	Cup springs
3	Clutch plates
4	Clutch piston
5	Motor levers
6	Ball ramp mechanism
7	Sprocket

The multi-plate clutch assembly for both centre and rear differentials act in a similar way. The aim of the multi-plate clutch assembly is to prevent excessive differential slip and therefore maximise the traction performance of the vehicle. This is fundamentally different from the 'braked' traction control, which can only counteract differential slip when it occurs.

A certain amount of differential slip is required to allow the vehicle to turn corners and to remain stable under control of the ABS (anti-lock brake system). The transfer box control module monitors the driver's demands through primary vehicle controls and automatically sets the slip torque at the differentials. The system is completely automatic and does not require any special driver input.

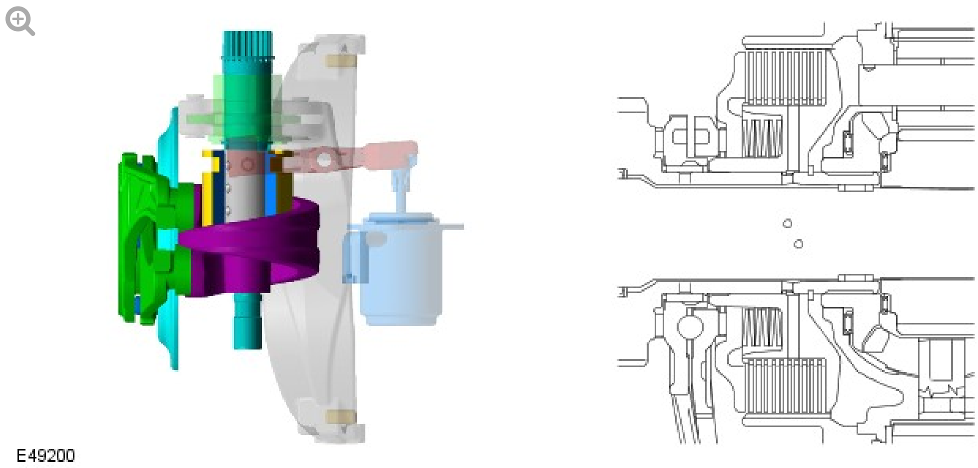
The multi-plate clutch assembly actively controls the torque flow through the centre differential and optimises the torque distribution in the driveline. The clutch assembly biases the torque from the transmission to the axle and wheels with the higher grip and prevents the wheels with the lower grip from spinning.

The multi-plate clutch assembly comprises the sprocket, which is connected to the front differential side gear, the motor levers with the ball ramp mechanism, the clutch hub as support for the clutch plates, the clutch piston to generate friction between the clutch plates, and a pack of cup springs (2) to return the clutch piston into its original position.

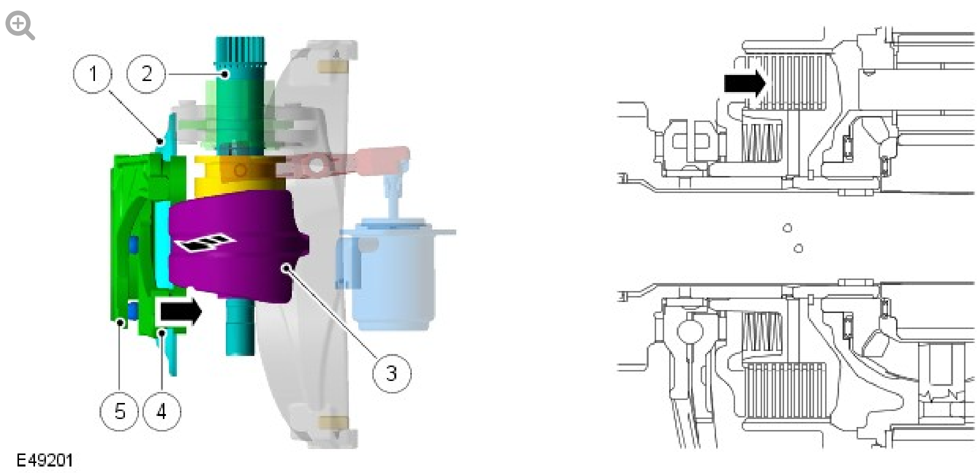
One set of friction plates are connected to the clutch hub; the other set of friction plates are connected to the multi-plate clutch basket, which is welded to the centre differential housing.

MULTI-PLATE CLUTCH ACTUATION

Transfer box motor levers in initial position, multi-plate clutch open condition



Transfer box motor in end position, multi-plate clutch closed condition

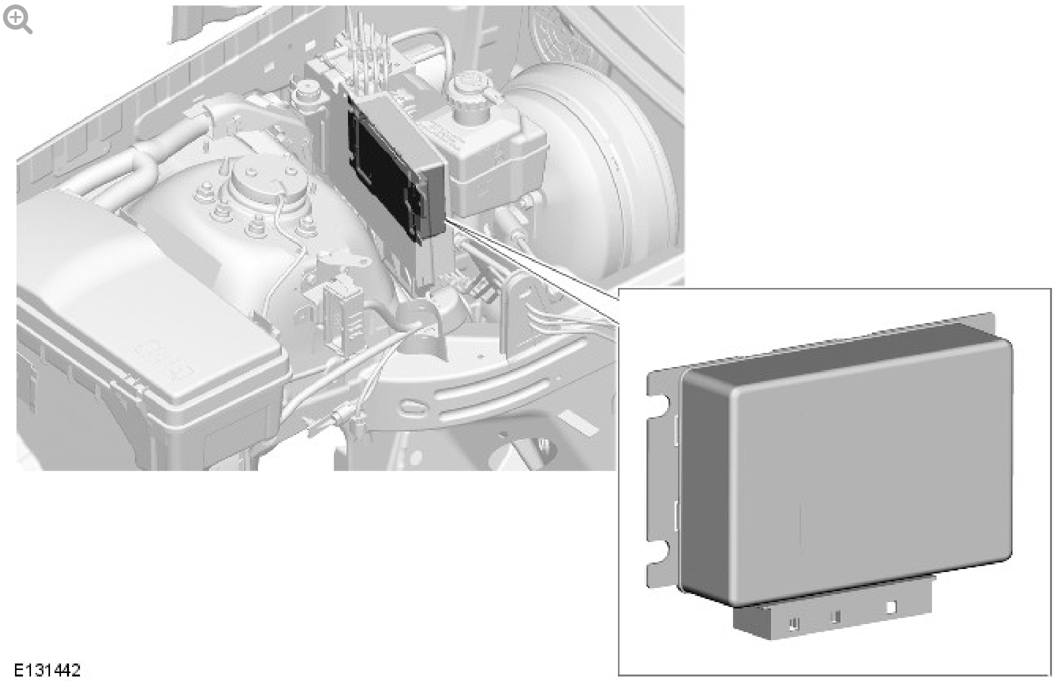


ITEM	DESCRIPTION
1	Clutch piston
2	Motor shaft
3	Clutch control disc
4	Motor levers
5	Ramp mechanism balls

By turning the clutch control disc, via the motor shaft, the motor levers are rotated relative to each other. This relative movement acts on 5 balls in a ramp mechanism between the 2 levers and give a defined axial movement. The movement forces the clutch piston to induce friction between the plates supported by the clutch hub and the plates supported by the clutch basket on the differential carrier. This frictional force inhibits the differential rotation; the differential carrier and front differential side gear are locked together.

TRANSFER BOX CONTROL MODULE

The transfer box control module controls the high/low 'shift-on-the-move' actuation and the multi-plate clutch actuation. The control module is located on the RH (right-hand) side of the engine compartment, rearward of the suspension turret.



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ITEM	DESCRIPTION
1	Engine Control Module (ECM)
2	Transfer box control module
3	Battery Junction Box (BJB)
4	E-box

The control module is connected to the CAN (controller area network) bus and controls transfer box operation using CAN messages from other control modules on the network.

The control module memorises the position of the transfer box motor when the ignition is switched off.

The transfer box control module uses the same actuator to control both range change function and application of centre differential locking torque. The module uses position feed back from the actuator to provide smooth range changing capability and graduated application of locking torque appropriate for the current driving conditions. Range change can be carried out while moving providing the transmission is in neutral and the vehicle is below the speed necessary for the requested range change.

The control module uses 3 connectors for all inputs and outputs. It receives a permanent power supply via a 30A fuse located in the BJB (battery junction box), and an ignition supply via a 5A fuse in the CJB (central junction box).

The control module uses a series of programmed shift maps to control the synchronisation speed and ensure that a maximum shift time of approximately 1 second is achieved.

If the control module is replaced, the Land Rover approved diagnostic system must be connected to the vehicle and the transfer box control module self-calibration procedure must be performed. This procedure must also be performed if the transfer box motor assembly is replaced.

DEFAULT/LIMP-HOME STRATEGY

If a fault occurs with the transfer box, the transfer box control module or 1 of the required input signals i.e. road speed signal, the control module records an error code and will respond appropriately to provide the highest level of system capability under the specific fault conditions. The following fault states are possible:

FAULT STATE	SYSTEM RESPONSE	DRIVER WARNING
No reduction in	Diagnostic Trouble Code	None

reduction in capability	Trouble Code (DTC) will be recorded but no effect on performance	
Clutch control not possible. Temporary over temperature condition	The tractive capability of the vehicle, off road, is reduced	Driveline over temperature warning lamp or 'TRANSMISSION OVERHEAT SLOW DOWN' on message centre
Clutch control not possible. Permanent fault	The tractive capability of the vehicle, off road, is reduced	Driveline fault warning lamp or 'TRANSMISSION FAULT TRACTION REDUCED' on message centre
Range change not possible	The system inhibits the driver from making a range change	Driveline fault warning lamp or 'TRANSMISSION RANGE CHANGE NOT AVAILABLE' on message centre
Stuck in Transfer box neutral	The transfer box is stuck between high and low range resulting in no drive to wheels	Flash low range indicator plus 'APPLY HANDBRAKE' (PARK BRAKE US/CAN) message on message centre. The message will only display at times when it is deemed safe or necessary for the hand/parkbrake to be applied. It will not display during normal driving for example

If a driveline over temperature condition has occurred, after the driveline has been allowed to cool, clutch control will be re-enabled and the warnings will disappear. There is no need to seek service assistance following an over temperature event.

If clutch control or range change is not possible due to a permanent fault the driver must seek service assistance at the earliest opportunity.

If the system suffers a fault, which causes the transfer box to fail in neutral, the control module is designed to continue attempting to engage the requested range or return to its original range for a fixed number of attempts. If this has not been successful and the low range lamp is still flashing the driver should bring the vehicle to a halt and attempt the range change again while stationary. If this does not work after a number of attempts, key off for 30 seconds, restart engine and request range change again while stationary. The driver must seek service assistance at the earliest opportunity.

opportunity.

TRANSFER BOX CONTROL MODULE INPUTS

The transfer box control module receives the following inputs:

- Range change selection switch
- High/low position sensor
- Transfer box actuator motor temperature
- Transfer box actuator motor position sensor
- CAN bus messages.

CAN BUS MESSAGES

The CAN bus is a high speed broadcast network connected between various vehicle control modules. The CANbus carries an extensive list of messages between the different control modules enabling more sophisticated control with reduced complexity. Data on the network is packaged for efficient communication and prioritised according the urgency and importance of the messages. The bus comprises 2 wires, which are twisted together to minimise electromagnetic interference (noise) produced by the CAN messages.

The transfer box control module is connected on the CAN bus and controls transfer box operation using CAN messages from other control units on the network. Wheel speed, vehicle acceleration, engine torque and speed, gear information, from the transmission, temperature information, car configuration, axle ratios and Terrain Response mode inputs, are some of the main signals received by the control module.

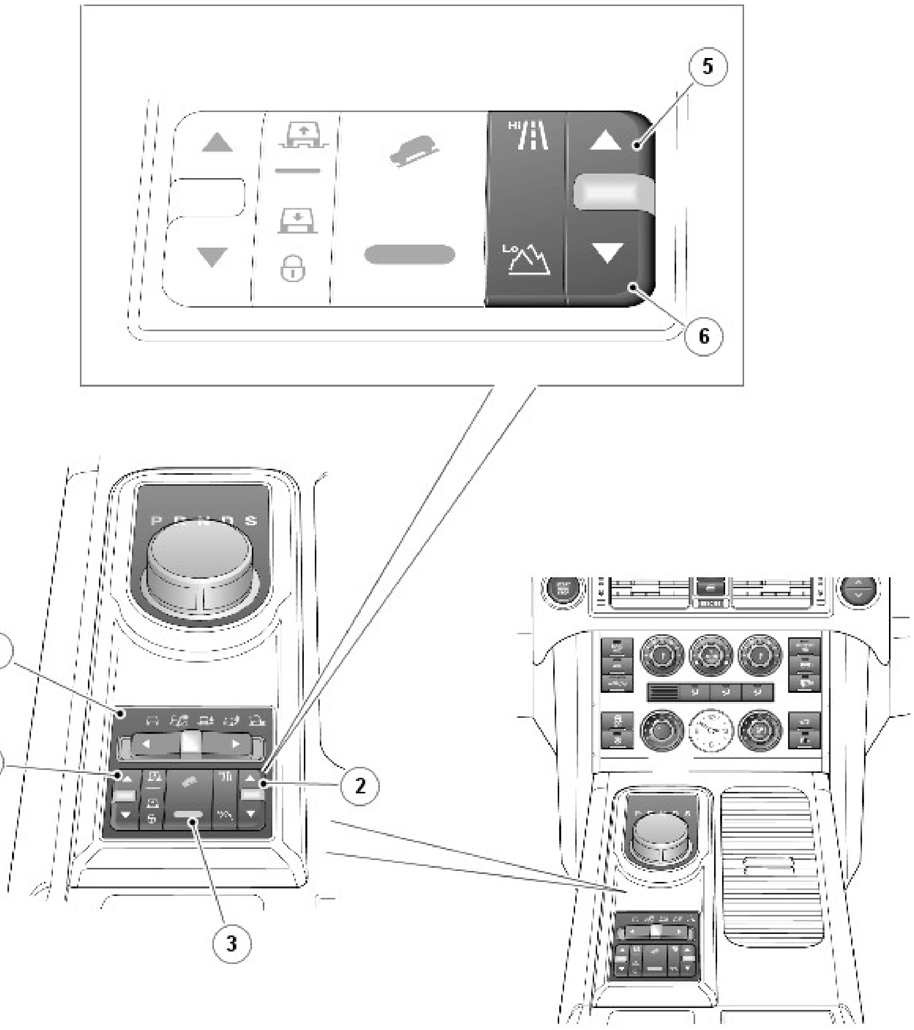
In the event of a CAN bus failure the following symptoms may be observed:

- Shift from high to low or low to high inoperative
- Instrument cluster low range warning lamp inoperative
- Warning messages or lamps displayed in instrument cluster.

RANGE CHANGE SELECTION SWITCH

NOTE:

4.4L TDV8 shown - other models similar



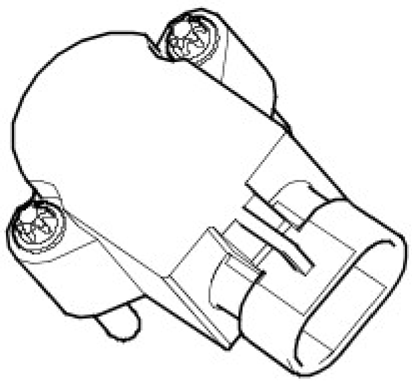
E131443

ITEM	DESCRIPTION
1	Transfer box high range switch
2	Transfer box low range switch

The range change selection switch is located behind the Electronic Transmission Selector (ETS), in the floor console. The switch is a 2-position sprung device. The driver presses the switch in the appropriate direction to select a range change, the transfer box will then change to the other available range. Pressing the opposite side of the switch reverts the previously selected range.

When the switch is moved to the high or low range position, it completes a momentary connection to 12V with the transfer box control module. The transfer box control module receives this momentary signal and attempts a range change. The switch will return to its normal (central) position when released.

HIGH/LOW POSITION SENSOR



E49209

The high/low position sensor converts the pivotal movement of the high/low fork into a PWM signal on the input. The PWM signal of the position sensor differs between high range and low range. The control module checks this signal and informs the driver, via the instrument cluster and the range change selection switch LED's, if a range change is in progress or has been completed.

The high/low position sensor is connected to the transfer box control module via a 3-pin connector.

TRANSFER BOX CONTROL MODULE OUTPUTS

The transfer box control module sends the following outputs:

- CAN bus messages
- Key interlock solenoid
- High/low range change LED
- Transfer box motor
- Solenoid.

CAN BUS MESSAGES

CAN BUS MESSAGES

The control module also sends messages via the CAN bus to tell other control modules on the network, the status of the transfer box. The high/low status, clutch torque and default mode status are some of the main signals sent out by the transfer box control module.

HIGH/LOW RANGE CHANGE LED

The control module is responsible for illuminating the 2 'high/low' range change LED (light emitting diode)'s adjacent to the range change switch. One LED indicates high range and the other indicates low range.

One LED will be on continuously when in the corresponding range.

When changing range, the current range LED will remain on until the new range status has been achieved.

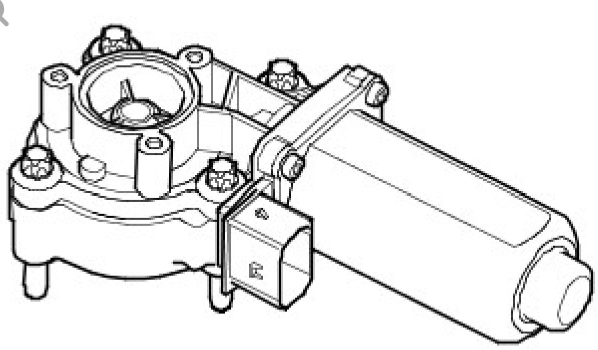
The new range LED will start flashing only when the range change has commenced (i.e. speed and neutral conditions have been met). The new range LED will be illuminated continuously at the same instant that the current range (now the old range) LED turns off.

The flash rate is 2 Hz with a 50% duty cycle.

The LED's have 2 levels of intensity, high when the vehicle lights are switch off and low when they are switched on.

If both lights are flashing at 0.5 Hz, this would indicate a transfer box fault or that the transfer box is in undefined range and may require calibration.

TRANSFER BOX MOTOR



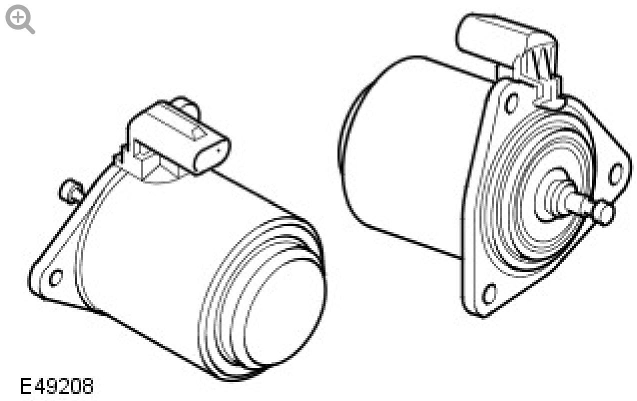
E49207

The transfer box motor provides the necessary movement to perform the high/low range change and the multi-plate clutch actuation. The motor is located on the rear casing assembly and secured with four bolts.

The motor is a PWM controlled, DC motor with an integrated worm gear reduction drive. It is connected to the transfer box control module with an 8-pin connector; the power supply of the motor is maintained through 2 large diameter cables on the motor connector. An internal position sensor checks the rotational movement of the motor.

There is a temperature sensor located within the motor housing.

SOLENOID



The solenoid switches the power flow on the actuation system between high/low range change mode and clutch control mode. When the solenoid is energized, the solenoid pin deploys and activates the clutch control mode. When the solenoid is de-energized, the internal spring rejects the solenoid pin and activates the high/low range change mode.

NOTE:

> In order to replace the solenoid in service, the solenoid must be energized using the Land Rover approved diagnostic system.

The solenoid is connected to the transfer box control module with a 2-pin connector.

STATUS INDICATION

The low range status indicator will take the form of a mountain symbol and has the following logic:

- Lamp on = low range
- Lamp off = high range
- Lamp flashing = range change in progress/range undefined/range fault.

There will also be a message displayed in the message centre, which can also inform the driver of any faults with the transfer box.

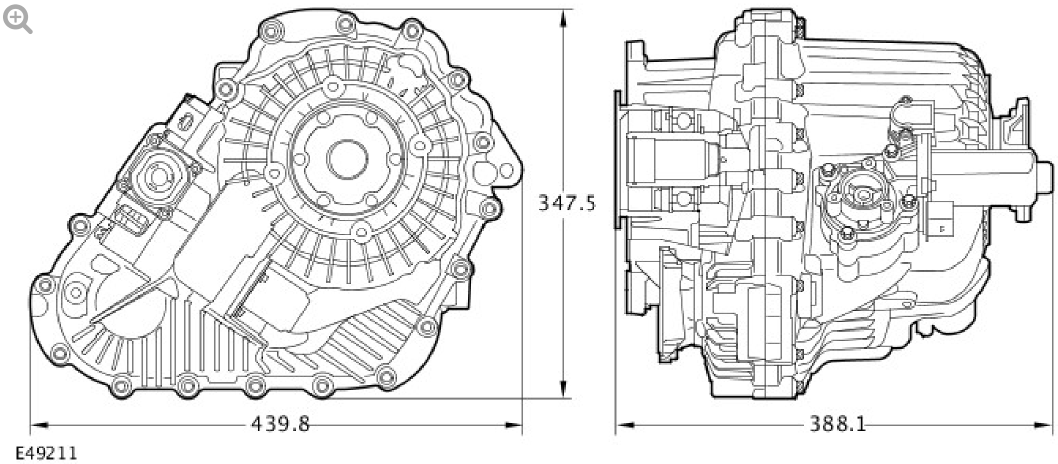
The following table shows the messages that can be displayed in the message centre relating to the transfer box:

MESSAGE	DESCRIPTION	CHIME
'LOW RANGE SELECTED'	Transfer case has engaged low range after a range change request	Single
'HIGH RANGE SELECTED'	Transfer case has engaged high range after a range change request	Single
'SPEED TOO HIGH FOR RANGE CHANGE'	Range change request when vehicle speed too high	Single
'SELECT NEUTRAL FOR RANGE CHANGE'	Range change request when lever not in neutral	Single
'APPLY HANDBRAKE' (PARKBRAKE US/CAN)	This alerts the driver that the transmission park lock function is inoperative due to transfer box out of high or low range. Transfer box control module has stopped transmitting on the CAN bus during a range change or while in neutral and as a result the transmission park lock function is inoperative	Continuous
'TRANSMISSION RANGE CHANGE NOT AVAILABLE'	Transfer box has detected a fault inhibiting a new range change. Control unit has shut down due to thermal overload	Single
'TRANSMISSION OVER HEAT SLOW DOWN'	Centre differential temperature is approaching the over heated threshold	Single
'TRANSMISSION FAULT – TRACTION REDUCED'	Centre differential has failed - operating as an open differential	Single
'TRANSMISSION FAULT –	Transfer box control module has stopped transmitting on the CAN bus and defaults to open	Single

FAULT – TRACTION REDUCED'	transmitting on the CAN bus and defaults to open centre differential	

SERVICE

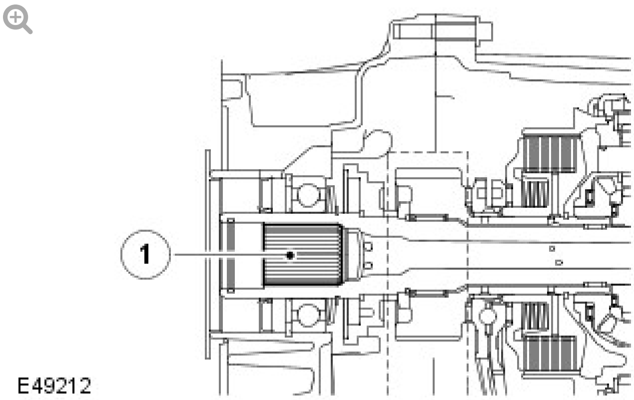
Basic Dimensions (Millimetres)



The transfer box weighs 40.30 kg without oil and 41.55 kg with oil. The unit requires 1500 ml ± 2% of oil from empty (dry).

The oil used in the transfer box is Shell TF 0753, which has been specially developed by Magna Steyr and Shell. The oil contains unique additives, which enhance the transfer box operation. No other oil must be used in the transfer box.

There is a unique type of grease, Weicon anti-seize montagepaste grau TL 7391, that needs to be applied to the units input shaft spline when installing or reinstalling the transfer box.



ITEM	DESCRIPTION
1	Input shaft spline

DIAGNOSTICS

The transfer box control module can store fault codes, which can be retrieved using a Land Rover approved diagnostic system.

The information is communicated via a diagnostic socket.

The diagnostic socket allows the exchange of information between the various control modules on the bus systems and the Land Rover approved diagnostic system or another suitable diagnostic tool. The information is communicated to the socket via the CAN bus. This allows the retrieval of diagnostic information and programming of certain functions using the Land Rover approved diagnostic system.

The transfer box control module uses Diagnostic Trouble Codes (DTC), which relate to transfer box electrical faults.

CLUTCH AND RANGE CHANGE MECHANISM CALIBRATION

In order for the range change mechanism to function correctly, the transfer box control module must be calibrated to the mechanical dimensions of the transfer box that it is connected to.

This procedure is required if one of the following occurs:

2012.0 RANGE ROVER (LM), 308-07

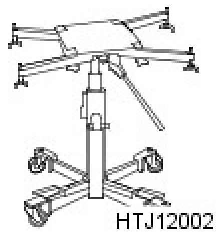
FOUR-WHEEL DRIVE SYSTEMS

TRANSFER CASE SHIFT MOTOR (G1341829)

REMOVAL AND INSTALLATION

41.30.03	MOTOR – RATIO CONTROL – RENEW	5000 CC, AJ V8	0.3	USED WITHINS	+

SPECIAL TOOL(S)



1200-2

Powertrain Assembly Jack, HTJ

REMOVAL

NOTE:

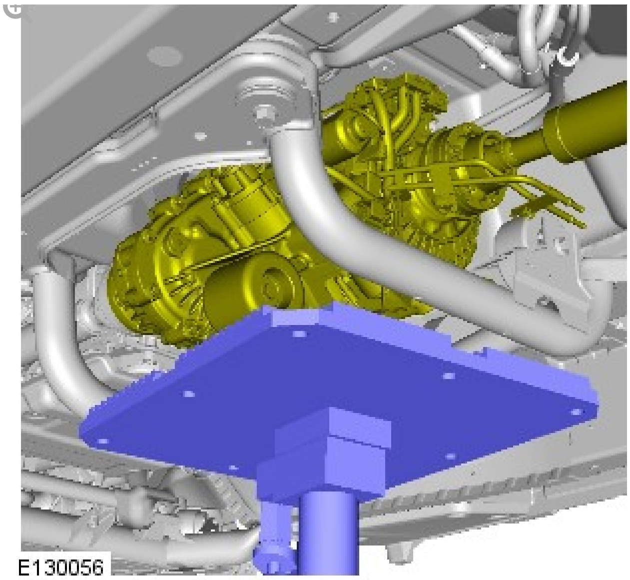
Some variation in the illustrations may occur, but the essential information is always correct.

1. **WARNING:**

   Make sure to support the vehicle with axle stands.

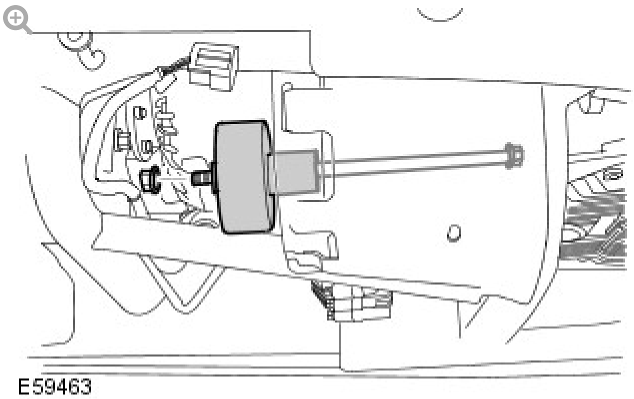
   Raise and support the vehicle.

2.



Using a transmission jack, support the transfer case.

3.

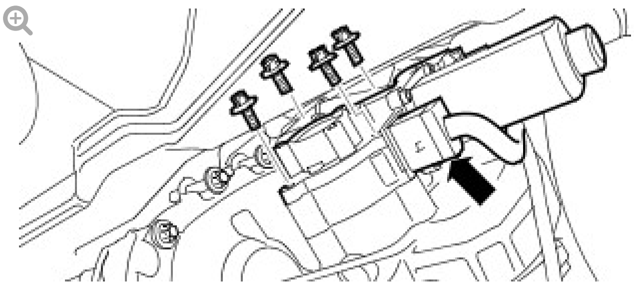


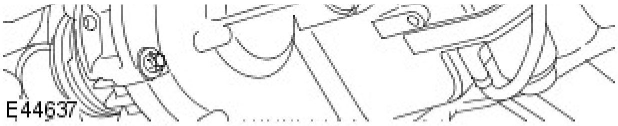
Remove the transmission support insulator nut, bolt and damper.

4.

CAUTIONS:

- To avoid damage to the joints or gaiters, do not allow the transmission to hang on the driveshafts.
- Discard the bolts.





Remove the shift motor.

- Lower the transmission.
- Disconnect the electrical connector.
- Remove the 4 Torx bolts.

INSTALLATION

1. **CAUTION:**

   Make sure that new bolts are installed.

   Install the shift motor.

   - Clean the components.
   - Tighten the Torx bolts to 35 Nm (26 lb.ft).
   - Connect the electrical connector.

2. Install the transmission support insulator nut, bolt and damper.

   - Raise the transmission.
   - Tighten the nut and bolt to 115 Nm (85 lb.ft).
   - Remove the transmission jack.

3. Connect the Land Rover approved diagnostic equipment.

   1. Start the diagnostic service function **transfer case-transfer case replacement.**
   2. Clear any Diagnostic Trouble Codes (DTCs) after calibration and check for correct operation.

2012.0 RANGE ROVER (LM), 308-07

FOUR-WHEEL DRIVE SYSTEMS

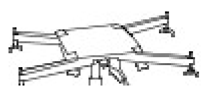
HIGH/LOW RANGE SENSOR

(G1341830)

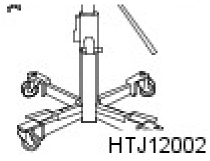
REMOVAL AND INSTALLATION

41.30.07	SENSOR - POSITION - HI/LOW RATIO - RENEW	ALL DERIVATIVES	0.2	USED WITHINS	+

SPECIAL TOOL(S)



HTJ1200-2



Power train assembly jack

REMOVAL

NOTE:

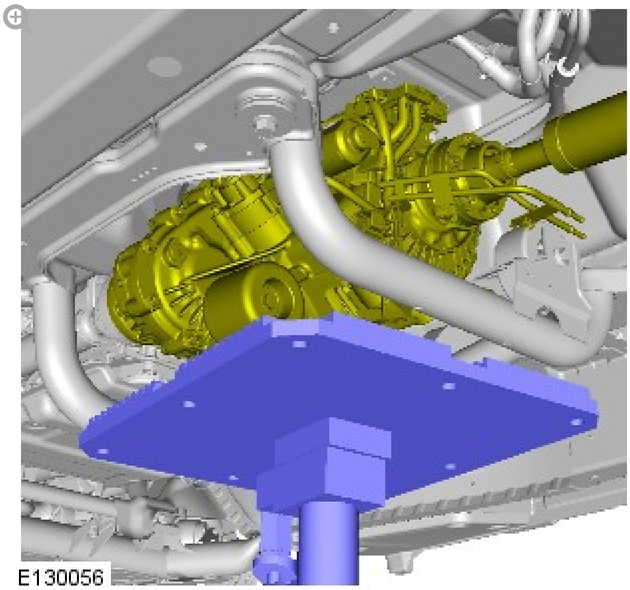
Some variation in the illustrations may occur, but the essential information is always correct.

1. **WARNING:**

Make sure to support the vehicle with axle stands.

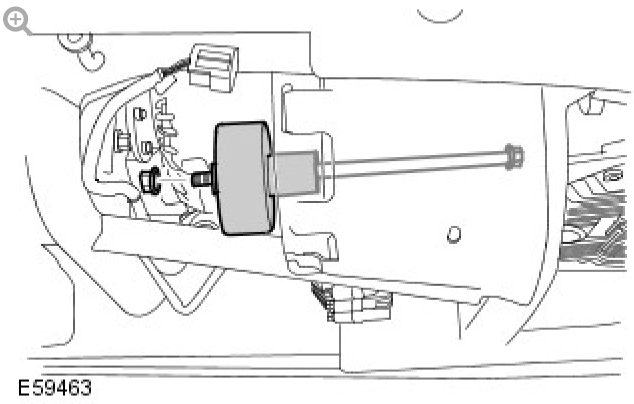
Raise and support the vehicle.

2.



Using a transmission jack, support the transfer case.

3.

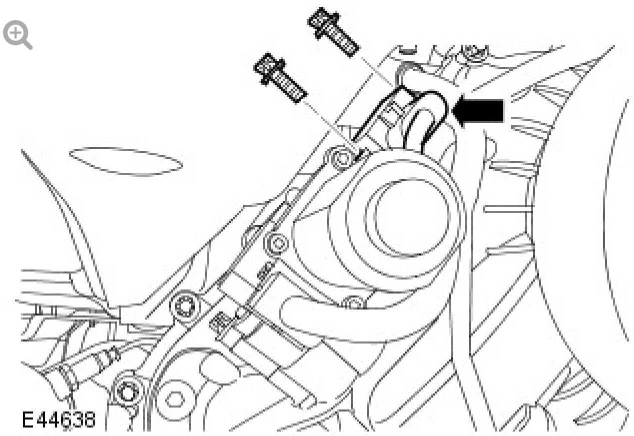


Remove the transmission support insulator nut, bolt and damper.

4.

CAUTIONS:

- To avoid damage to the joints or gaiters, do not allow the transmission to hang on the driveshafts.
- Discard the bolts.



Remove the high/low range sensor.

- Lower the transmission.
- Disconnect the electrical connector.
- Remove the 2 Torx bolts.

INSTALLATION

1. **CAUTION:**

Make sure that new bolts are installed.

Install the high/low range sensor.

- Clean the components.
- Tighten the new Torx bolts to 5 Nm (4 lb.ft).
- Connect the electrical connector.

2. Install the transmission support insulator nut, bolt and damper.

- Raise the transmission.
- Tighten the bolt to 115 Nm (85 lb.ft).
- Remove the transmission jack.

3. Connect the Land Rover approved diagnostic equipment.

   1. Start the service function **transfer case-absolute position sensor replacement.**
   2. Clear any Diagnostic Trouble codes (DTCs) after calibration and check for correct operation.