

Steering System - General Information -

Steering Linkage Specifications

Steering Linkage Free Play	Measurement (mm)	Measurement (in)
Free play (measured at the steering wheel rim)	0-6	0-0.24

Power Steering Pump Specifications

Item	Specification
Power steering pump relief pressure	106-114 bar

Lubricants, Fluids, Sealers and Adhesives

Item	Specification
Power steering fluid	Dexron 3

Steering System - General Information - Steering System

Diagnosis and Testing

Principle of Operation

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

[Power Steering](#) (211-02 Power Steering, Description and Operation),
[Power Steering](#) (211-02 Power Steering, Description and Operation),
[Power Steering](#) (211-02 Power Steering, Description and Operation),
[Steering Linkage](#) (211-03 Steering Linkage, Description and Operation),
[Steering Linkage](#) (211-03 Steering Linkage, Description and Operation),
[Steering Linkage](#) (211-03 Steering Linkage, Description and Operation),
[Steering Column](#) (211-04 Steering Column, Description and Operation),
[Steering Column](#) (211-04 Steering Column, Description and Operation),
[Steering Column](#) (211-04 Steering Column, Description and Operation),
[Steering Column Switches](#) (211-05 Steering Column Switches, Description and Operation),
[Steering Column Switches](#) (211-05 Steering Column Switches, Description and Operation),
[Steering Column Switches](#) (211-05 Steering Column Switches, Description and Operation).

Inspection and Verification

1. Verify the customer concern.
2. Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> • Tire condition/pressure • Fluid level • Leaks • Security, condition and correct installation of suspension components • Security, condition and correct installation of steering system components 	<ul style="list-style-type: none"> • Fuses • Harnesses for damage/corrosion • Electrical connector(s) • Damaged/corroded pins



CAUTION: If a steering gear assembly is returned under warranty with leaking output shaft seals, but there is also damage to the steering gear boot/boots the steering gear warranty will be invalid. This is due to the steering gear output shaft seals being damaged due to foreign materials entering the steering gear boot and damaging the steering gear output shaft seals thereafter.

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern is not visually evident, verify the symptom and refer to the symptom chart.

Symptom Charts



WARNING: It is not possible to CHECK the torque of a patchlock bolt, if the torque is suspected to be low, the bolt must be REMOVED/DISCARDED and a new bolt MUST be INSTALLED and torque to the correct value.



NOTE: If the module or a component is suspect and the vehicle remains under manufacturer warranty, refer to the Warranty Policy and Procedures manual (section B1.2), or determine if any prior approval programme is in operation, prior to the installation of a new module/component.

Fluid Leakage



NOTE: Confirm the location of the fluid leak. CLEAN the area of the leak, inspect the area and confirm the exact position. Ensure the fluid is not from another system on the vehicle.

Symptom	Possible Causes	Action
<ul style="list-style-type: none"> • Power steering fluid leakage 	<ul style="list-style-type: none"> • Overfilled system 	<ul style="list-style-type: none"> • Correct the fluid level as required
	<ul style="list-style-type: none"> • Steering gear 	<ul style="list-style-type: none"> • Check and install new steering gear as required, refer to the new module/component installation note at the top of the Symptom Charts

Symptom	Possible Causes	Action
	<ul style="list-style-type: none"> Damaged fluid cap/reservoir 	<ul style="list-style-type: none"> Check and install a new fluid cap/reservoir as required
	<ul style="list-style-type: none"> Loose or damaged hoses and fittings O-ring or Dowty seals 	<ul style="list-style-type: none"> Tighten the hose connection or latch plate fixing to the recommended torque. REFER to: Specifications (211-00 Steering System - General Information, Specifications). Check and install new components as required Install new O-ring or Dowty seals as required
	<ul style="list-style-type: none"> Fluid cooler 	<ul style="list-style-type: none"> Check and install a new fluid cooler as required, refer to the new module/component installation note at the top of the Symptom Charts
	<ul style="list-style-type: none"> Power steering pump 	<ul style="list-style-type: none"> Check and install a new power steering pump as required, refer to the new module/component installation note at the top of the Symptom Charts

Functional

Symptom	Possible Causes	Action
<ul style="list-style-type: none"> Steering wheel misalignment 	<ul style="list-style-type: none"> Steering not correctly centred 	<ul style="list-style-type: none"> Check the steering alignment. REFER to: Specifications (204-00 Suspension System - General Information, Specifications).
<ul style="list-style-type: none"> Excessive free play at steering wheel (refer to the Steering Linkage Inspection and Backlash (Free play) Check in this section) 	<ul style="list-style-type: none"> Steering wheel loose 	<ul style="list-style-type: none"> Check and tighten the steering wheel retaining bolt as required. REFER to: Specifications (211-00 Steering System - General Information, Specifications).
	<ul style="list-style-type: none"> Excess play in the steering linkage 	<ul style="list-style-type: none"> Check and install new components as required
	<ul style="list-style-type: none"> Steering gear not correctly adjusted (causing excessive backlash) 	<p> CAUTION: DO NOT attempt to adjust the steering gear yoke. Failure to follow this instruction will invalidate the steering gear warranty</p> <ul style="list-style-type: none"> Check and install a new steering gear as required, refer to the new module/component installation note at the top of the Symptom Charts
	<ul style="list-style-type: none"> Lower steering column universal joint pinch bolts loose 	<ul style="list-style-type: none"> Check and tighten the lower steering column pinch bolts as required. REFER to: Specifications (211-00 Steering System - General Information, Specifications).
	<ul style="list-style-type: none"> Excessive wear in steering column universal joints 	<ul style="list-style-type: none"> Check and install a new steering column or steering column lower shaft as required, refer to the new module/component installation note at the top of the Symptom Charts
	<ul style="list-style-type: none"> Steering gear mounting bolts loose or damaged 	<ul style="list-style-type: none"> Check/tighten and install new steering gear mounting bolts as required. REFER to: Specifications (211-00 Steering System - General Information, Specifications).

Symptom	Possible Causes	Action
	<ul style="list-style-type: none"> Wear in steering gear tie-rod end ball joints 	<ul style="list-style-type: none"> Check and install new tie-rod ends as required, refer to the new module/component installation note at the top of the Symptom Charts
	 <p>NOTE: Inner ball joint wear is rare. The steering gear installed to all Jaguar vehicles has a spring loaded pinion to ensure the correct level of engagement between the rack and pinion. This play is optimized with the steering gear in the central position and should not be confused with inner ball joint wear. Check for vertical motion in the inner ball joint with the steering gear in the central position.</p> <ul style="list-style-type: none"> Wear in steering gear inner ball joints 	<ul style="list-style-type: none"> Check and install new steering gear as required, refer to the new module/component installation note at the top of the Symptom Charts
	<ul style="list-style-type: none"> Wear in suspension ball joints/bushings 	<ul style="list-style-type: none"> Check and install new components as required
<ul style="list-style-type: none"> Veer under braking 	<ul style="list-style-type: none"> Steering gear not correctly adjusted 	 <p>CAUTION: DO NOT attempt to adjust the steering gear yoke. Failure to follow this instruction will invalidate the steering gear warranty</p> <ul style="list-style-type: none"> Check and install a new steering gear as required, refer to the new module/component installation note at the top of the Symptom Charts
	<ul style="list-style-type: none"> Contamination of brake pads and discs 	<ul style="list-style-type: none"> Check and rectify the source of the contamination and install new brake pads and discs as required, refer to the new module/component installation note at the top of the Symptom Charts
	<ul style="list-style-type: none"> Seized front brake caliper slide pins or piston <ul style="list-style-type: none"> Damaged brake discs 	<ul style="list-style-type: none"> Check and rectify sticking slide pins and install new calipers as required, refer to the new module/component installation note at the top of the Symptom Charts Check and install new brake discs as required, refer to the new module/component installation note at the top of the Symptom Charts
<ul style="list-style-type: none"> Vehicle pulls to one side when driving on a level surface 	<ul style="list-style-type: none"> Uneven tire wear Incorrect tire pressure 	<ul style="list-style-type: none"> For information on diagnosis of uneven tire wear. REFER to: Suspension System (204-00 Suspension System - General Information, Diagnosis and Testing). Check and adjust tire pressures as required. REFER to: Specifications (204-04 Wheels and Tires, Specifications).
	<ul style="list-style-type: none"> Incorrect geometry settings 	 <p>NOTE: Dealerships must keep a copy of the BEFORE and AFTER geometry figures with job card for future reference</p> <ul style="list-style-type: none"> Check and adjust geometry as required. REFER to: (204-00

Symptom	Possible Causes	Action
		Suspension System - General Information) Camber and Caster Adjustment (General Procedures), Front Toe Adjustment (General Procedures), Rear Toe Adjustment (General Procedures).
	<ul style="list-style-type: none"> Vehicle is unevenly loaded or overloaded 	<ul style="list-style-type: none"> Notify the customer of incorrect vehicle loading
	<ul style="list-style-type: none"> Steering gear is not correctly adjusted 	 CAUTION: DO NOT attempt to adjust the steering gear yoke. Failure to follow this instruction will invalidate the steering gear warranty <ul style="list-style-type: none"> Check and install a new steering gear as required, refer to the new module/component installation note at the top of the Symptom Charts
	<ul style="list-style-type: none"> Loose, damaged or worn front suspension components 	<ul style="list-style-type: none"> Check/tighten and install new front suspension components as required. REFER to: Specifications (204-00 Suspension System - General Information, Specifications).
	<ul style="list-style-type: none"> Loose, damaged or worn rear suspension components 	<ul style="list-style-type: none"> Check/tighten and install new rear suspension components as required. REFER to: Specifications (204-00 Suspension System - General Information, Specifications).
	<ul style="list-style-type: none"> Incorrect brake operation 	<ul style="list-style-type: none"> For information on diagnosis of the brake system. REFER to: Brake System (206-00 Brake System - General Information, Diagnosis and Testing).
	<ul style="list-style-type: none"> Incorrect underbody alignment 	<ul style="list-style-type: none"> Set underbody alignment referring to the Removal and Installation procedures in section 502-00 of the workshop manual for instruction
<ul style="list-style-type: none"> Vehicle wanders from side to side when driven straight ahead and the steering wheel is held in a firm position 	<ul style="list-style-type: none"> Incorrect tire pressure or tire size 	<ul style="list-style-type: none"> Check and adjust the tire pressures as required. REFER to: Specifications (204-04 Wheels and Tires, Specifications). Check and install a new tire as required
	<ul style="list-style-type: none"> Vehicle is unevenly or excessively loaded 	<ul style="list-style-type: none"> Notify the customer of incorrect vehicle loading
	<ul style="list-style-type: none"> Incorrect toe adjustment 	<ul style="list-style-type: none"> Check and adjust as required. REFER to: (204-00 Suspension System - General Information) Camber and Caster Adjustment (General Procedures), Front Toe Adjustment (General Procedures), Rear Toe Adjustment (General Procedures).

Noise

Symptom	Possible Causes	Action
<ul style="list-style-type: none"> Continuous noise 	<ul style="list-style-type: none"> Low power steering fluid level 	<ul style="list-style-type: none"> Check for leaks and rectify as required. For further information refer to the symptom charts for leakage in this section. Fill power steering fluid reservoir to correct level
	 <p>NOTE: Look for small air bubbles visible in the fluid, air may also get trapped in the hydraulic system</p> <ul style="list-style-type: none"> Air in hydraulic system 	<ul style="list-style-type: none"> Bleed the power steering system. REFER to: Power Steering System Bleeding (211-00 Steering System - General Information, General Procedures).
	<ul style="list-style-type: none"> Power steering pipe/hose in contact with the vehicle body 	<ul style="list-style-type: none"> Check and reposition, or install new IF damaged/deformed, power steering pipe/hose
	<ul style="list-style-type: none"> Power steering pipe/hose restricted or twisted 	<ul style="list-style-type: none"> Check and clear restriction to pipe/hose Reposition power steering pipe/hose. Install new pipe/hose IF permanently damaged/deformed
	<ul style="list-style-type: none"> Power steering pump mounting bolts loose 	<ul style="list-style-type: none"> Tighten the power steering pump mounting bolts to the correct torque. REFER to: Specifications (211-00 Steering System - General Information, Specifications).
<ul style="list-style-type: none"> Noise gets worse when system is loaded 	 <p>NOTE: Refer to the power steering pressure check in this section</p> <ul style="list-style-type: none"> Low power steering fluid level <ul style="list-style-type: none"> Aerated fluid Low power steering pump pressure 	<ul style="list-style-type: none"> Check and fill power steering fluid reservoir to correct level <ul style="list-style-type: none"> Bleed the power steering system. REFER to: Power Steering System Bleeding (211-00 Steering System - General Information, General Procedures). Check power steering pump pressure. If the pump pressure is low, install a new power steering pump
<ul style="list-style-type: none"> Front End Accessory Drive (FEAD) belt squeal 	<ul style="list-style-type: none"> FEAD belt incorrectly tensioned or glazed 	<ul style="list-style-type: none"> Check FEAD belt tension Check FEAD belt condition and install a new belt as required
<ul style="list-style-type: none"> Chirp noise from the steering pump when a load is applied 	<ul style="list-style-type: none"> Loose or worn FEAD belt 	<ul style="list-style-type: none"> Check FEAD belt tension Check FEAD belt condition and install a new belt as required
<ul style="list-style-type: none"> Scrape/grind noise from behind steering wheel while steering 	<ul style="list-style-type: none"> Steering column shroud foul condition or clockspring 	<ul style="list-style-type: none"> Correctly install the steering column shroud to eliminate the foul condition Install a new clockspring as required
	<ul style="list-style-type: none"> Foreign objects 	<ul style="list-style-type: none"> Remove foreign objects from between steering column shroud and steering wheel/steering column rotating components
<ul style="list-style-type: none"> Click 	<ul style="list-style-type: none"> Clockspring or steering column multifunction switch LH 	<ul style="list-style-type: none"> Correctly install and install new components as required
	<ul style="list-style-type: none"> Loose universal joint pinch bolt 	<ul style="list-style-type: none"> Install a new universal joint pinch bolt and tighten to correct specification. REFER to: Specifications (211-00 Steering System - General Information, Specifications).
<ul style="list-style-type: none"> Squeak 	<ul style="list-style-type: none"> Steering column shroud joints 	<ul style="list-style-type: none"> Apply Krytox spray to steering column shroud joints
	<ul style="list-style-type: none"> Clockspring 	<ul style="list-style-type: none"> Install new clockspring as required

Symptom	Possible Causes	Action
<ul style="list-style-type: none"> Knock 	<ul style="list-style-type: none"> Loose fixings (universal joint pinch bolt and steering column fixings) 	<ul style="list-style-type: none"> Tighten fixings to correct specification. REFER to: Specifications (211-00 Steering System - General Information, Specifications).
<ul style="list-style-type: none"> Rattle 	<ul style="list-style-type: none"> Foreign objects 	<ul style="list-style-type: none"> Remove foreign objects from between steering column shroud and steering wheel/steering column rotating components
	<ul style="list-style-type: none"> Loose fixings 	<ul style="list-style-type: none"> Tighten steering column fixings to correct specification. REFER to: Specifications (211-00 Steering System - General Information, Specifications).
<ul style="list-style-type: none"> Noise while adjusting column 	<ul style="list-style-type: none"> Electric motor/solenoid 	 NOTE: Before carrying out repairs/replacement, assess column adjustment noise levels against other vehicles of the same model <ul style="list-style-type: none"> Install new components as required
	<ul style="list-style-type: none"> Motor spindle/lead screw 	<ul style="list-style-type: none"> Lubricate lead screw

Vibration

Symptom	Possible Causes	Action
<ul style="list-style-type: none"> Wheel Fight (Kick Back) - condition where roughness is felt in the steering wheel by the driver when the vehicle is driven over rough surfaces 	<ul style="list-style-type: none"> Loose or worn steering components/bushings 	 CAUTION: DO NOT attempt to adjust the steering gear yoke. Failure to follow this instruction will invalidate the steering gear warranty. <ul style="list-style-type: none"> Tighten and install new steering components/bushings as required
	<ul style="list-style-type: none"> Loose or worn suspension components/bushings 	<ul style="list-style-type: none"> Tighten and install new suspension components/bushings as required
<ul style="list-style-type: none"> Nibble (Shimmy) - condition where oscillation of the steering wheel occurs (not vertical which is Shake). This is driven by road wheel imbalance 	<ul style="list-style-type: none"> Road wheel and tire condition 	<ul style="list-style-type: none"> Check for wheel and tire damage. Install new components as required Check for tire uniformity. Install new tire(s) as required
	<ul style="list-style-type: none"> Road wheel imbalance 	<ul style="list-style-type: none"> Check and adjust road wheel balance as required
<ul style="list-style-type: none"> Shake - condition where vertical vibration of the steering wheel/column occurs (not oscillation which is Nibble) 	 NOTE: Vibration smooths out after several miles of driving <ul style="list-style-type: none"> Road wheel imbalance due to tire flat-spotting 	<ul style="list-style-type: none"> Ensure tires installed are to Jaguar specification. Install new tires as required Check and adjust tire pressures to correct specification

Component Tests

Steering Linkage Inspection and Backlash (Free play) Check



CAUTION: Steering gear boots must be handled carefully to avoid damage. Use new clamps when installing steering gear boots.

Inspect the boots for cuts, deterioration, twisting or distortion. Check the steering gear boots to make sure they are tight. Install new boots or clamps as required.



NOTE: The following steps must be carried out with assistance.

- With the wheels in the straight ahead position, gently turn the steering wheel to the left and the right to check for free play.

- Free play should be between 0 and 6 mm (0 and 0.24 in) at the steering wheel rim. If the free play exceeds this limit, either the ball joints are worn, the lower steering column joints are worn or the backlash of the steering gear is excessive.



CAUTION: DO NOT attempt to adjust the steering gear yoke. Failure to follow this instruction will invalidate the steering gear warranty.

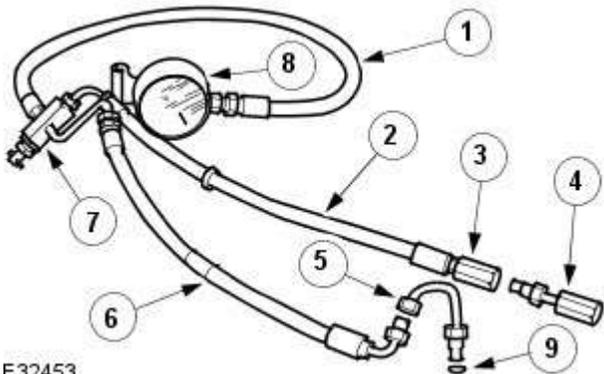
- The backlash of the steering gear cannot be adjusted, install a new steering gear if excessive backlash is diagnosed.
- Grasp the steering wheel firmly and move it up and down and to the left and right without turning the wheel to check for column bearing wear, steering wheel or steering column.

Power Steering Fluid Condition Check

- Run the engine for 2 minutes.
- Check the power steering fluid system level.
- Observe the color and the odor. The color under normal circumstances should be dark reddish, not brown or black.
- Using a suitable clean syringe extract a suitable amount of fluid from the reservoir.
- Allow the fluid to drip onto a facial tissue and examine the stain.
- If evidence of solid material is found, the power steering fluid system should be drained for further inspection.
- If fluid contamination or steering component failure is confirmed by the sediment in the power steering fluid system, refer to Steering Fault Diagnosis by Symptom Charts in this section.

Power Steering Pressure Test

Test Equipment



E32453

Item	Part Number	Description
1	211-011	Pressure Gauge Hose
2	211-011-08	Pump Return Hose
3	211-011-07	Pump Return Hose Connector
4	211-011-03/2	Test Equipment to High Pressure Hose Adaptor
5	211-011-03/1	Pump High Pressure Outlet to Hose Adaptor
6	211-011-02	Pump Adaptor to Control Valve Hose
7	211-011-01	Control Valve
8	211-011	Pressure Gauge
9	-	'O' Ring Seal

The measurement of the maximum system pressure, (which is governed by the pressure relief valve) is achieved by inserting the Service Tool (pressure gauge and adaptors) into the fluid circuit of the power steering system. Run the engine at idle speed, turn the steering from lock to lock and read the maximum pressure recorded on the gauge.

Installing Test Equipment

To install the pressure test equipment:

- Place a suitable drain tray below the power steering pump.
- Install a hose clamp on the reservoir to pump hose prior to disconnecting any hoses, to avoid unnecessary loss of fluid.
- Disconnect the hose from the power steering pump high pressure outlet.
- Install the pump outlet to hose adaptor (5). Do not omit the 'O' ring seal (9).
- Connect the power steering pump adaptor to control valve hose (6) of the test equipment.
- Install the adaptor (4) in the high pressure hose previously removed from the power steering pump outlet.
- Connect the connector (3) of the test equipment hose (2) to the adaptor (4).
- Remove the hose clamp from the reservoir hose.
- Start the engine to check the system pressure.

With the control valve (7) OPEN and the engine idling, the following system pressures may be checked:

- During turning when static (dry parking pressure).
- When the steering is held on full lock (maximum system pressure or pressure relief).
- With the steering at rest (idle pressure or back pressure).

CAUTIONS:



To avoid excessive heating of the power steering pump when checking the pressure, do not close the valve for more than 5 seconds maximum.



When checking the pump pressure DO NOT drive the vehicle with the test equipment installed.

With the control valve (7) CLOSED the power steering pump maximum output pressure can be checked.

Removing Test Equipment

To remove the test equipment:

- Install a hose clamp on the reservoir to power steering pump hose.
- Removing the test equipment is a reversal of the installation instructions.
- Install a new 'O' ring seal (9) to the power steering pump high pressure outlet to hose connection.
- Install the original hose to the power steering pump.
- Remove the clamp from the reservoir to the power steering pump hose.
- Top-up the reservoir fluid.
- Bleed the power steering system.
REFER to: [Power Steering System Bleeding](#) (211-00 Steering System - General Information, General Procedures).

Description of Terms

General Steering System Noises

Boom

Rhythmic sound like a drum roll or distant thunder. May cause pressure on the ear drum.

Buzz

Low-pitched sound, like a bee. Usually associated with vibrations.

Chatter

Rapidly repeating metallic sound.

Chuckle

Rapid noise that sounds like a stick against the spokes of a spinning bicycle wheel.

Chirp

High pitched rapidly repeating sound, like chirping birds.

Click

Light sound, like a ball point pen being clicked.

Click/Thump

Heavy metal-to-metal sound, like a hammer striking steel.

Grind

Abrasive sound, like a grinding wheel or sandpaper rubbing against wood.

Groan/Moan

Continuous, low-pitched humming sound.

Groan/Howl

Low, guttural sound, like an angry dog.

Hiss

Continuous sound like air escaping from a tire valve.

Hum

Continuous sound of varying frequencies, like a wire humming in the wind.

Knock

Heavy, loud repeating sound like a knock on a door.

Ping

Similar to knock, except at higher frequency.

Rattle

A sound suggesting looseness, such as marbles rolling around in a can.

Roar

Deep, long, prolonged sound like an animal, or winds and ocean waves.

Rumble

Low, heavy continuous sound like that made by wagons or thunder.

Scrape

Grating noise like one hard plastic part rubbing against another.

Squeak

High-pitched sound like rubbing a clean window.

Squeal

Continuous, high-pitched sound like running finger nails across a chalkboard.

Tap

Light, hammering sound like tapping pencil on edge of table. May be rhythmic or intermittent.

Whirr/Whine

High-pitched buzzing sound, like an electric motor or drill.

Whistle

Sharp, shrill sound, like wind passing a small opening.

Specific Steering System Noise Types

Belt Squeal

Belt squeal is a high frequency air-borne noise generated by slippage of the ribbed Vee belt on the power steering pump pulley. Squeal increases with system loading and at full lock.

Clonk

Clonk is a structure-borne noise heard as a loose-sounding rattle or vibration coming from the steering column. Clonk can be identified by driving and turning over cobblestones, rough roads, or high frequency bumps such as 25-50 mm tall tar strips. Clonk requires a tie-rod load impact.

Column Knock

Column knock is a loose-sounding rattle or vibration generated by the steering column shaft contacting other portions of the column assembly. The noise is both audible and tactile. Column knock is generated by driving over cobblestones or rough pavement. It is not necessary to turn the steering wheel to create this noise.

Column Rattle

Column rattle is a metallic sounding noise created when applying a highly impulsive force to the steering wheel. Column rattle is often used to combine the more general group of column noises including clonk and column knock. Column rattle noises can be caused by clonk, knock, loose column components, bonus parts etc. A series of parked, straight-line driving, and cornering tests should be carried out to isolate the source/sources.

Grinding/Scrape

Grinding is a low frequency noise in the column when the steering wheel is turned. It is generally caused by interference

between moving components such as the steering wheel to steering column shroud.

Grunt (Squawk/Whoop)

Grunt is a 'honking' sound elicited when coming off one of the steering stops. Grunt is generally excited during parking manoeuvres with a low to medium speed steering input.

Hiss (Swish)

Hiss or Valve Hiss is a high-frequency sound coming from the steering gear when the system is loaded. It is a rushing or 'swish' noise that doesn't change frequency with RPM. Hiss is the general noise generated by the flow of hydraulic fluid through restrictions in the steering system. Restrictions include the rotary steering valve, power steering tubes, connectors, tuning orifices, etc. Hiss can be air-borne and structure-borne, but the structure-borne path through the steering intermediate shaft is usually dominant.

Moan (Groan)

Moan is the general structure-borne noise of the steering system. Moan is primarily transmitted to the driver via the body structure through the pump mount, engine mounts, power steering lines and power steering brackets. On some vehicles, moan is a loud humming noise, often present when the wheel is turned and the system is loaded. It may change frequency with engine RPM and if the system is loaded or unloaded.

Steering Gear Knock (Steering Gear Slap)



CAUTION: DO NOT attempt to adjust the steering gear yoke. Failure to follow this instruction will invalidate the steering gear warranty.

Steering gear knock is a rattle sound and steering wheel vibration caused by separation of the steering gear and pinion while driving over bumps. It is a structure-borne noise transmitted through the intermediate shaft and column. Steering gear knock can also be heard as a 'thump' or impact noise that occurs with the vehicle stationary when the steering wheel is released from a loaded position and allowed to return to rest. Noise occurs with the engine on or off.

Rattles

Rattles are noises caused by knocking or hitting of components in the steering system. Steering rattles can occur in the engine compartment, the suspension, or the passenger compartment. Rattles can be caused by loose components, movable and flexible components, and improper clearances.

Squeaks/Scrapes

Squeaks/Scrapes are noises due to friction or component rubbing anywhere in the steering system. Squeaks/Scrapes have appeared in steering linkages and joints, in column components and in column and steering wheel trim.

Weep

Weep is an air-borne noise, occasionally generated when turning the steering across lock at a constant rate. When present on a vehicle the noise, once initiated can often be maintained across a large proportion of the available steering movement.

Whistle

Whistle is similar to hiss but is louder and of a higher frequency. It is also more of a pure tone noise than hiss. Whistle is air-borne and is generated by a high flow rate of hydraulic fluid through a small restriction.

Zip

Zip noise is the air-borne noise generated by power steering pump cavitation when power steering fluid does not flow freely through the suction hose from the reservoir to the pump. Zip primarily occurs during cold weather at start-up.

Steering System Vibrations and Harshness

Buzz

Buzz is a tactile rotary vibration felt in the steering wheel when steering inputs are slow. Buzz can also be called a grinding feel and it is closely related to grunt and is caused by high system gain with low damping. Buzz is generally excited during parking manoeuvres with low to medium speed steering input.

Buzz (Electrical)

A different steering buzz can be caused by pulse width modulated (PWM) electric actuators used in variable assist steering systems. This buzz is felt by turning the ignition key to run without starting the engine and holding onto the steering wheel. In extreme cases, the buzz can be felt with the engine running also.

Column/Steering Wheel Shake

Column shake is a low frequency vertical vibration excited by primary engine vibrations.

Nibble (Shimmy)

Steering nibble is a rotary oscillation or vibration of the steering wheel, which can be excited at a specific vehicle speed. Nibble is driven by wheel and tire imbalance exciting a suspension recession mode, which then translates into steering gear travel and finally steering wheel nibble.

Shudder (Judder)

Shudder is a low frequency oscillation of the entire steering system (tire, wheels, steering gear and linkage, etc.) when the vehicle is steered during static-park or at low speeds. Shudder is very dependent on road surface.

Torque/Velocity Variation (Phasing/Effort Cycling)

Steering wheel torque variation occurring twice in one revolution is normally as a result of problems with the lower steering column (intermediate shaft), but foul conditions generally result in either constant stiffness or single point stiffness. Depending upon the orientation of the joints, the steering can feel asymmetric (torque falling off in one direction and rising in the other) or else it can simply have pronounced peaks and troughs as the steering moves from lock to lock.

Wheel Fight (Kick Back)

Wheel fight is excess feedback of sudden road forces through the steering system and back to the driver. It is evaluated at all vehicle speeds over cobblestones, rough roads, and potholes. The tires, wheels, and suspension generate forces into the steering systems. Steering friction, hydraulic damping, hydraulic compliance, mechanical compliance, steering ratio, and assist gain all affect how much is transmitted to the driver.

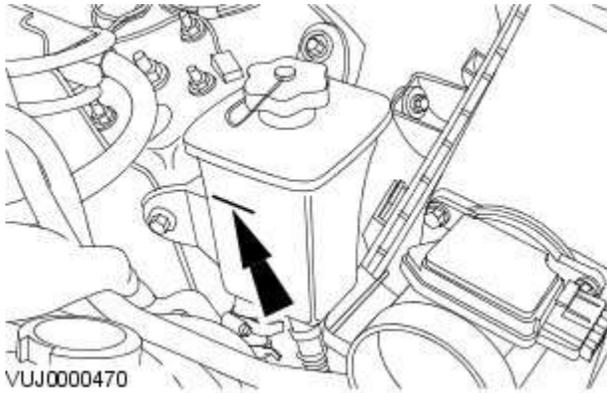
Steering System - General Information - Power Steering System Bleeding

General Procedures



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

1. Clean power steering fluid reservoir around the filler cap and fluid indicator.
 - Check the power steering fluid, if aerated, wait until fluid is free from bubbles then top-up reservoir to UPPER level mark with recommended fluid.



2. CAUTION: Fluid must always be present in the reservoir during bleeding.

Remove the filler cap and fill to the MAX level mark.

- Install the reservoir filler cap.

3. Start the engine and allow to run for 10 seconds, stop the engine.
 - Check the power steering fluid, if aerated, wait until fluid is free from bubbles then top-up reservoir to UPPER level mark with recommended fluid.



4. CAUTION: Do not hold steering on full lock for longer than 10 seconds.

Start the engine and turn steering fully lock to lock, stop the engine.

- Check and top-up power steering fluid level.

5. Start and run the engine for 2 minutes, turn the steering fully lock to lock.
 - Check and top-up power steering fluid level.

Steering System - General Information - Power Steering System Flushing

General Procedures

NOTES:

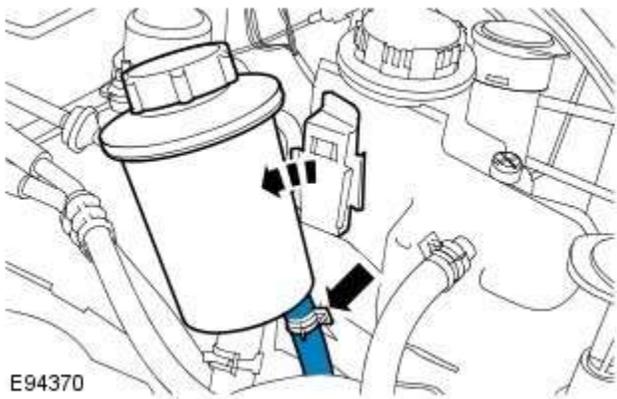


If heavy steering or contamination within the power steering system is found, it is necessary to carry out the system flush procedure as detailed below. If any components have been replaced in the power steering system the procedure below must be carried out in full.



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

1. Remove the power steering fluid reservoir cap.
2. Using a suitable syringe, remove the power steering fluid from the power steering fluid reservoir.



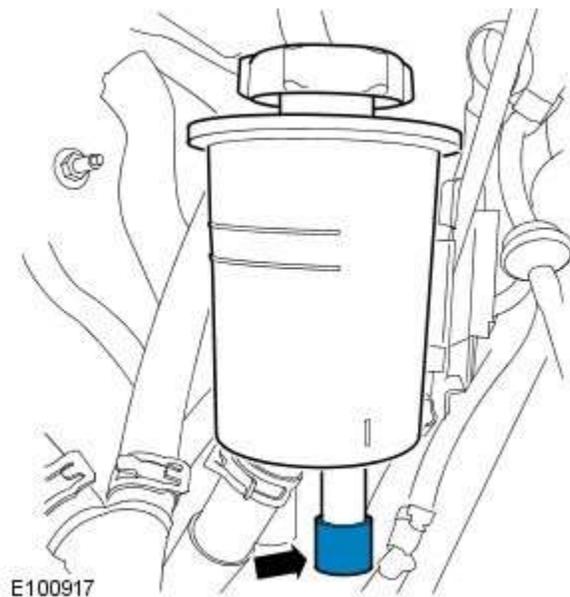
3.  CAUTION: Be prepared to collect escaping fluids.



NOTE: Note the orientation of the clip.

Detach the power steering fluid reservoir.

- Detach but do not remove the power steering fluid reservoir.
- Release the power steering fluid return hose from the power steering fluid reservoir.
- If a quick release coupling is fitted to the power steering return hose, release the power steering fluid return hose from the coupling by removing the clip.

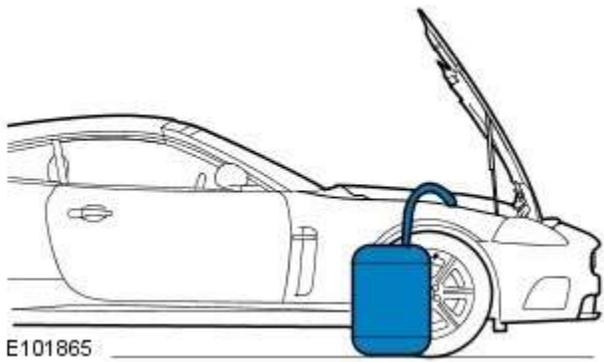


4.  CAUTION: Be prepared to collect escaping fluids.



NOTE: Make sure that all openings are sealed. Use new blanking caps.

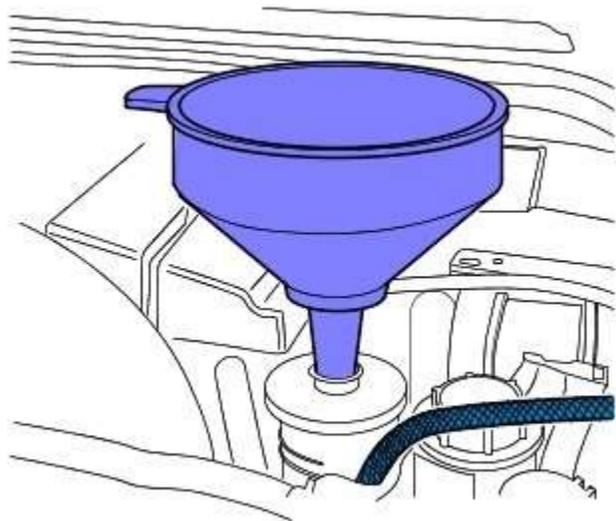
Using a suitable blanking cap, cap the power steering reservoir return pipe.



5.  CAUTION: Be prepared to collect escaping fluids.

 NOTE: Make sure the extended pipe is not kinked or twisted and is correctly secured with hose clips.

Attach a suitable pipe to the power steering return hose to allow the fluid to drain.



6. NOTES:

 The suitable funnel should have the a capacity of 4 litres and O-ring seal

 The suitable funnel must be tightly sealed to the power steering fluid reservoir to avoid fluid leakage.

Install a suitable funnel onto the power steering fluid reservoir.



7. 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 with the wheels just clear of the ground.

8. CAUTIONS:

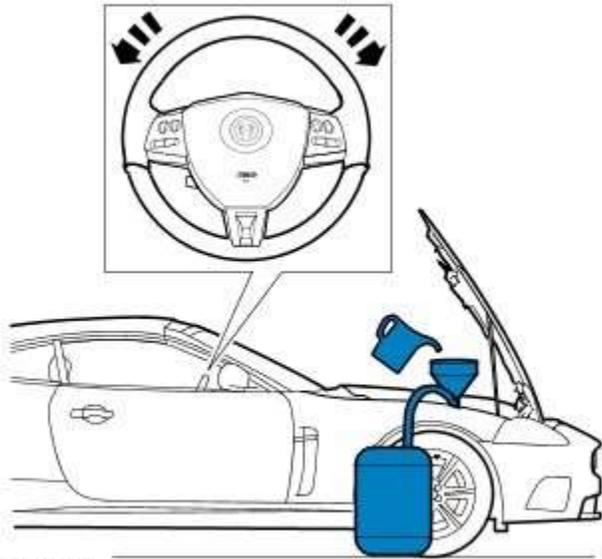


Steps 8 and 9 must be carried out within 2 - 3 seconds of each other. Failure to follow this instruction may result in damage to the power steering system.



Be prepared to collect escaping fluids.

Using the suitable funnel, top up the power steering system with the specified fluid. Make sure the fluid level is maintained at two thirds full in the funnel.



E119674

9. CAUTIONS:

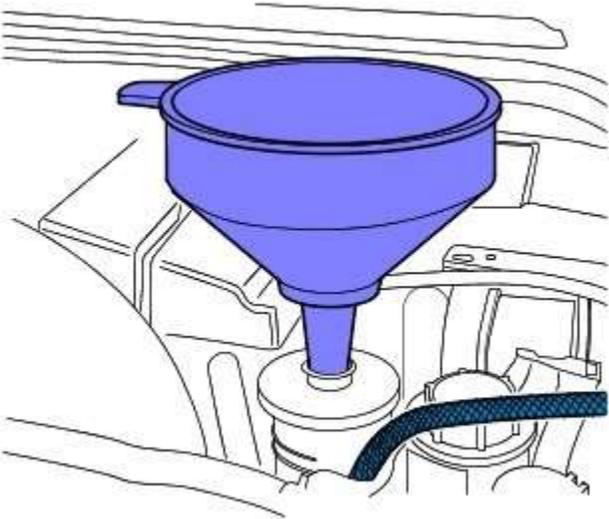
 Be prepared to collect escaping fluids.

 Do not allow the power steering fluid level in the power steering fluid reservoir to fall below the minimum power steering fluid level. Failure to follow this instruction may result in damage to the power steering system.

 Make sure the engine is switched off as soon as the full 4 litres of power steering fluid has entered the power steering fluid reservoir.

Flush the power steering system.

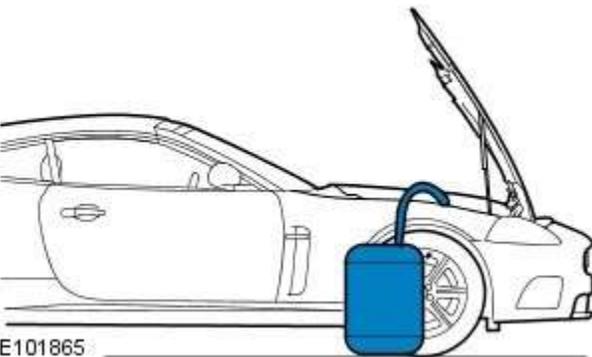
- Start the engine
- With assistance turn the steering slowly lock to lock 3 times at approximately 1 revolution every 5 seconds.
- Continue to flush the power steering system until 4 litres of power steering fluid has been added to the power steering reservoir. This should take approximately 30 seconds.



E94372

10.  CAUTION: Be prepared to collect escaping fluids.

Remove the suitable funnel.



E101865

11.  CAUTION: Be prepared to collect escaping fluids.

Remove the suitable pipe to the power steering return hose.

12.  CAUTION: Be prepared to collect escaping fluids.



NOTE: Note the orientation of the clip.

If a quick release coupling is fitted to the power steering return hose, connect the power steering fluid return hose to the coupling by installing the clip.

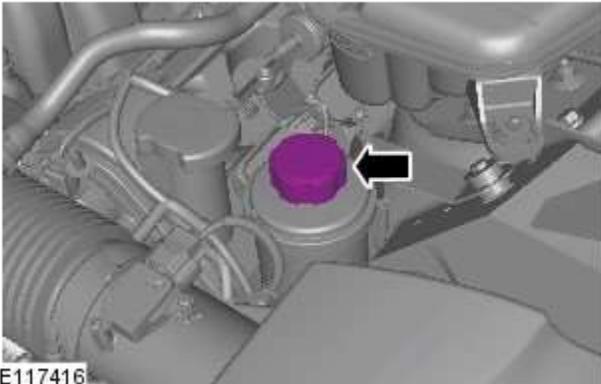
13. Install a new power steering fluid reservoir. For additional information, refer to: (211-02 Power Steering)
[Power Steering Fluid Reservoir - V6 3.0L Petrol](#) (Removal and Installation),
[Power Steering Fluid Reservoir - TDV6 3.0L Diesel](#) (Removal and Installation).

Steering System - General Information - Power Steering System Filling V8 5.0L Petrol/V8 S/C 5.0L Petrol

General Procedures

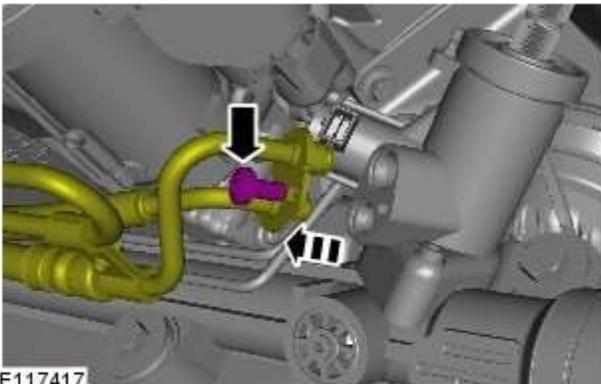
Draining

1.



2. **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.

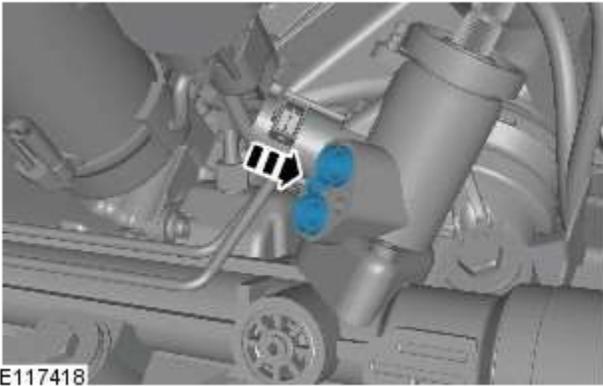
3. Refer to: [Air Deflector](#) (501-02 Front End Body Panels, Removal and Installation).



4.  **CAUTION:** Be prepared to collect escaping fluids.



NOTE: Remove and discard the O-ring seals.



E117418

5. CAUTIONS:

 Make sure that the area around the component is clean and free of foreign material.

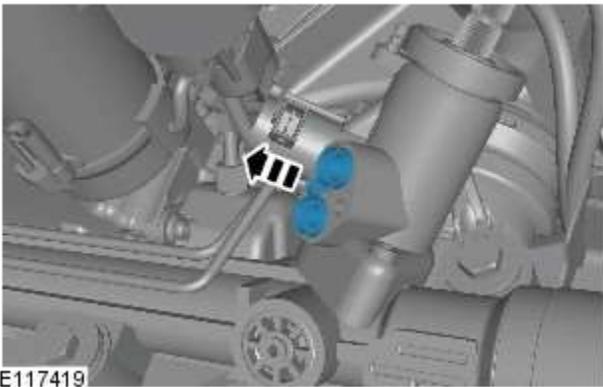
 The blanking plugs must not be removed until the power steering pipes are ready to be connected.

Filling

1. CAUTIONS:

 Make sure that the area around the component is clean and free of foreign material.

 The blanking plugs must not be removed until the power steering pipes are ready to be connected.



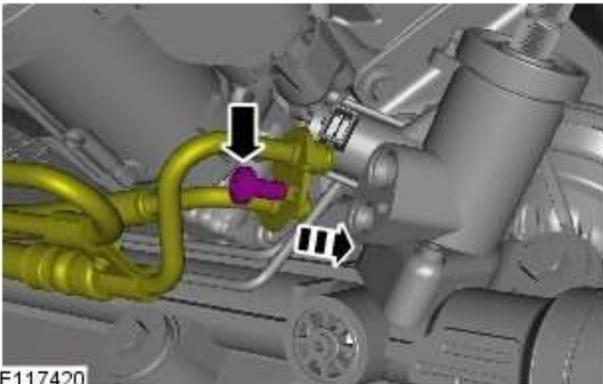
E117419

2. CAUTIONS:

 Make sure that the area around the component is clean and free of foreign material.

 Install new o-ring seals

Torque: 20 Nm



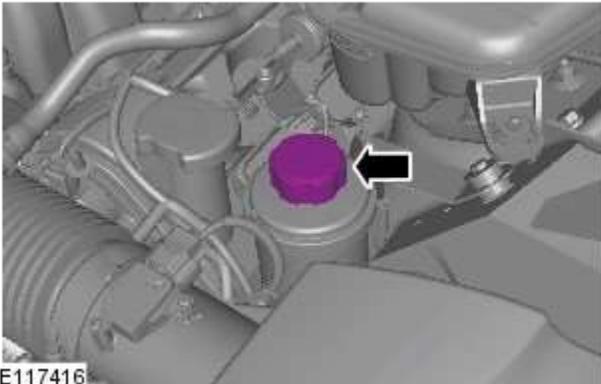
E117420

3. Lower the vehicle.



4. CAUTION: Fluid must always be present in the reservoir during bleeding.

- Fill the power steering reservoir.



5. Install the vacuum hand pump to the power steering fluid reservoir.



6. NOTE: Apply the maximum vacuum possible on the reservoir for 1 minute.

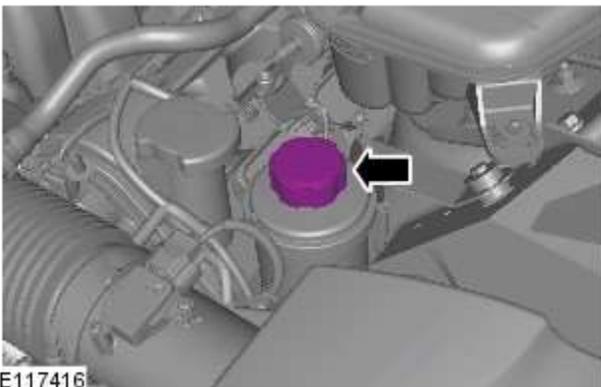
- Apply a vacuum to the power steering fluid reservoir.

7. Remove the vacuum hand pump from the power steering fluid reservoir.



8. CAUTION: Fluid must always be present in the reservoir during bleeding.

- Fill the power steering reservoir.



- 9.

- Run the engine for 30 seconds.
- Turn the steering fully lock-to-lock, stop the engine.

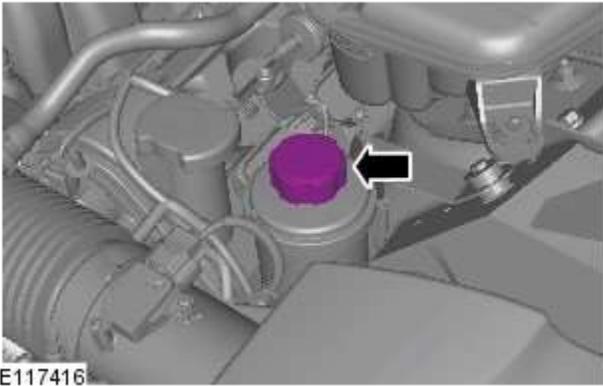
10. Install the vacuum hand pump to the power steering fluid reservoir.



11. NOTE: Apply the maximum vacuum possible on the reservoir for 1 minute.

- Apply a vacuum to the power steering fluid reservoir.

12. Remove the vacuum hand pump from the power steering fluid reservoir.



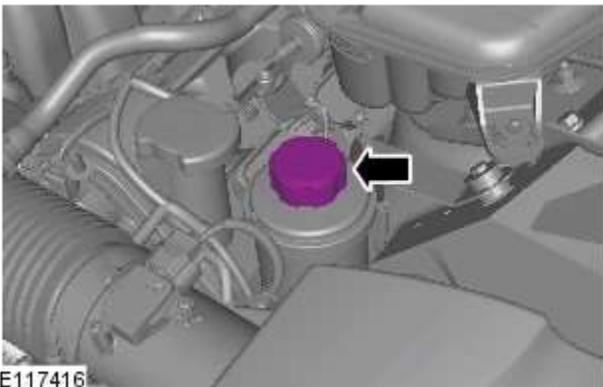
13.  CAUTION: Fluid must always be present in the reservoir during bleeding.
- Fill the power steering reservoir.

- 14.
- Run the engine for 30 seconds.
 - Turn the steering fully lock-to-lock, stop the engine.

15. Install the vacuum hand pump to the power steering fluid reservoir.

16.  NOTE: Apply the maximum vacuum possible on the reservoir for 1 minute.
- Apply a vacuum to the power steering fluid reservoir.

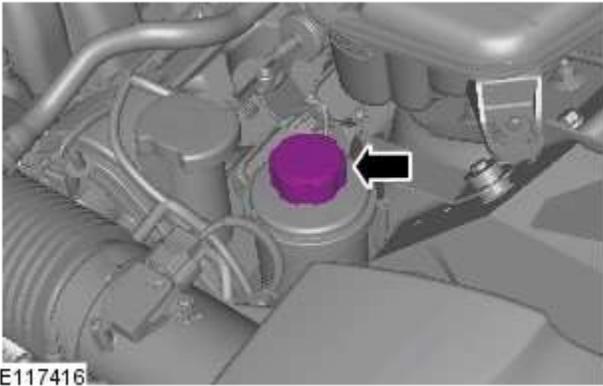
17. Remove the vacuum hand pump from the power steering fluid reservoir.



18.  CAUTION: Fluid must always be present in the reservoir during bleeding.
- Fill the power steering reservoir.

- 19.
- Run the engine for 30 seconds.
 - Turn the steering fully lock-to-lock, stop the engine.

20.



21. Check for fluid leaks.

22. Refer to: [Air Deflector](#) (501-02 Front End Body Panels, Removal and Installation).

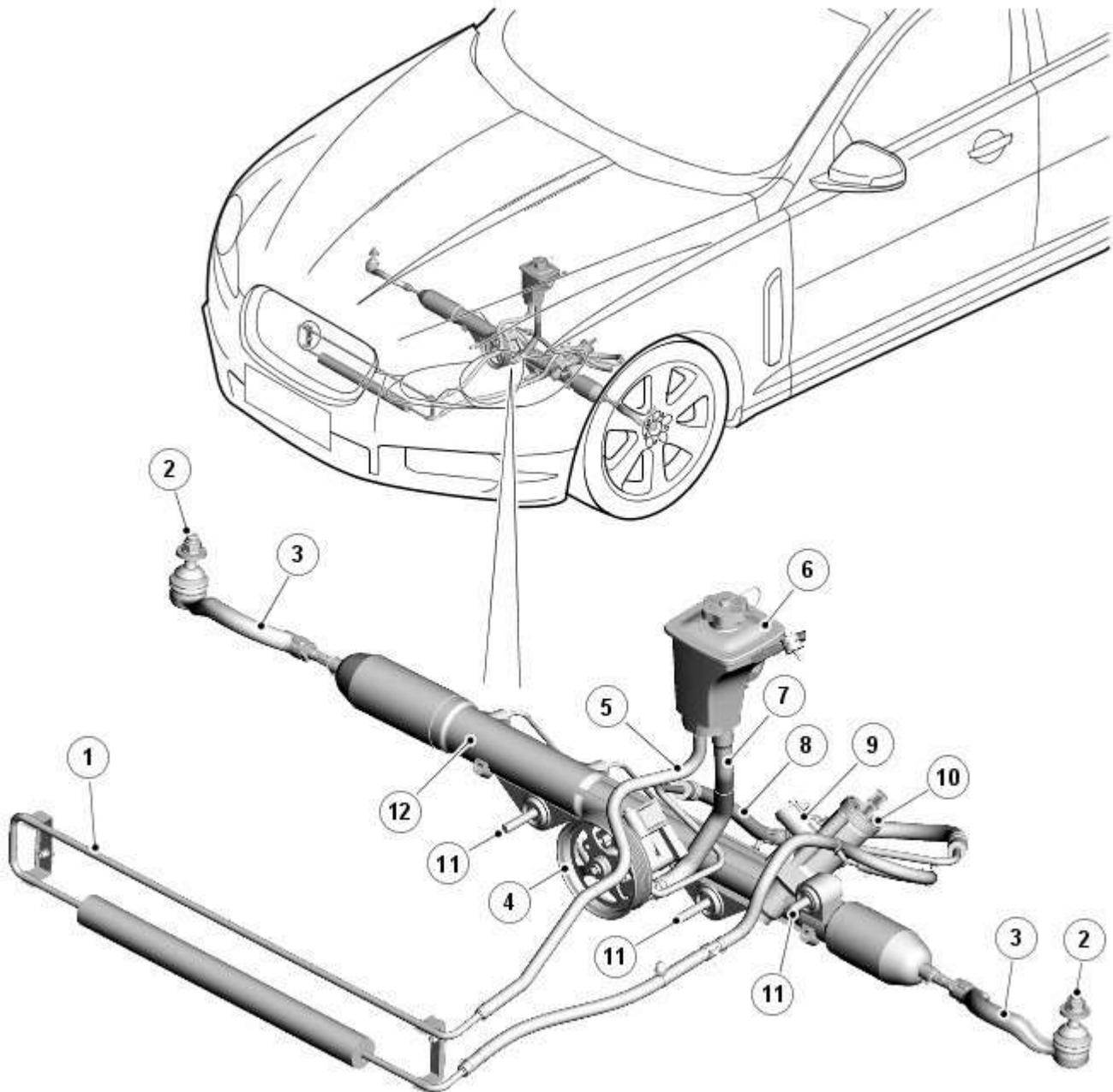
Power Steering -

Description	Nm	lb-ft	lb-in
Lower steering column slider pinch bolt	35	26	-
Lower steering column to steering gear pinch bolt	35	26	-
Power steering control valve actuator	2	-	18
Power steering fluid cooler retaining bolts	7	-	62
Power steering pump pulley retaining bolts	20	25	-
Power steering pump retaining bolts - All except vehicles with diesel engine	25	18	-
Power steering pump retaining bolts - Vehicles with diesel engine	22	16	-
Power steering pump to steering gear pressure line	25	18	-
Steering gear retaining bolts	100	74	-
Steering gear supply and return lines	10	-	89

Power Steering - Power Steering - Component Location

Description and Operation

POWER STEERING - COMPONENT LOCATION 5.0L V8



E93503

Item	Description
	NOTE: Naturally aspirated 5.0L V8 shown, Supercharged 5.0L V8 similar
1	Power steering fluid cooler
2	Tie-rod end (2 off)
3	Tie-rod (2 off)
4	Power steering pump
5	Low pressure fluid return hose
6	Power steering fluid reservoir
7	Feed pipe to pump
8	High pressure feed pipe to steering gear
9	Servotronic transducer valve
10	Valve unit
11	Mounting bolt (3 off)
12	Steering gear

Power Steering - Power Steering - Overview

Description and Operation

OVERVIEW

The steering system comprises a ZF manufactured rack and pinion Servotronic 2 steering gear, a power steering pump, a fluid reservoir, a fluid cooler (if fitted) and fluid hoses. The steering gear is an end take-off rack and pinion power assisted unit with the addition of road speed proportional ZF Servotronic 2 assistance.

The steering rack is connected to the front wheel knuckles by adjustable tie-rods. The tie-rods allow for adjustment to centralize the steering wheel and also adjust the toe setting of the front wheel geometry.

The steering gear has a variable ratio rack. This provides conventional response when the steering is in the centre, straight ahead position, but provides more direct and faster steering as the turning angle increases. The variable ratio provides precise and rapid steering response at high speeds and provides optimized steering of the vehicle when manoeuvring into parking spaces, turning in tight areas and when cornering in extreme conditions.

Fluid is supplied to the steering gear by a fixed displacement vane pump on petrol models and a variable displacement pump on diesel models. The pump is driven by a belt from the crankshaft pulley. The pump is mounted on the **LH (left-hand)** side of the engine, above the **A/C (air conditioning)** compressor. A fluid reservoir is positioned at the front **LH** side of the engine compartment, forward of the front suspension housing.

On petrol engine vehicles, a fluid cooler is located in front of the engine cooling radiator. Diesel models do not have a fluid cooler.

Servotronic 2 adds electronic control and speed sensitive steering to the steering gear. The Servotronic 2 feature provides easy and comfortable steering operation when parking, improved 'road feel' at increased road speeds and adds an integrated, positive center feel feature which optimises steering wheel torque during high speed driving. The Servotronic 2 system is controlled by software which is incorporated into the instrument cluster. The software responds to road speed signals and controls the power assistance via a transducer valve located on the steering gear valve housing.

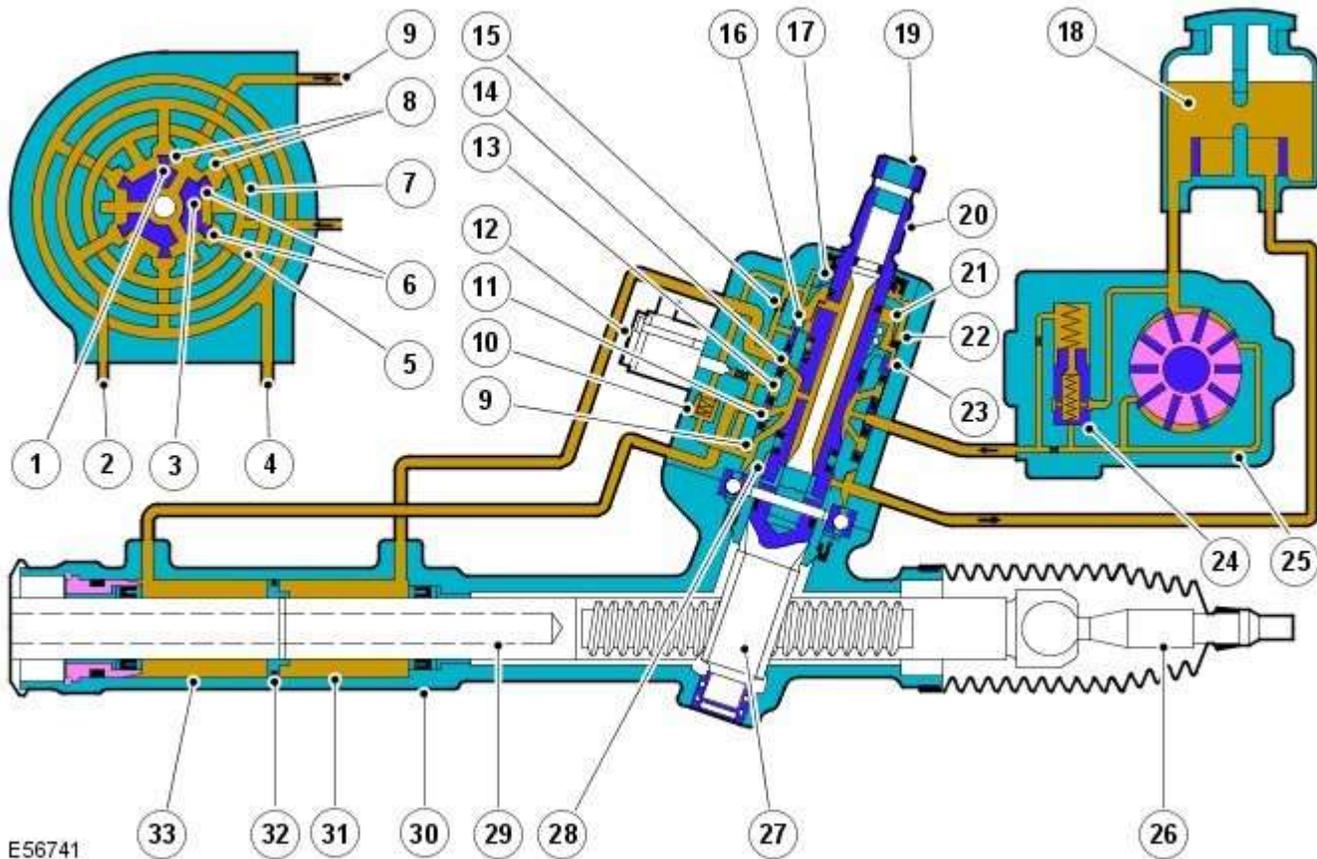
Power Steering - Power Steering - System Operation and Component Description

Description and Operation

System Operation

The following hydraulic circuits show power steering operation and fluid flow for the steering in a straight ahead, neutral position and when turning right. The circuit diagram for turning left is similar to that shown for turning right.

Power Steering in Neutral Position



Item	Description
1	Return fluid control groove
2	Radial groove
3	Feed fluid control groove
4	Radial groove
5	Axial groove
6	Feed fluid control edge
7	Feed fluid radial groove
8	Return fluid control edge
9	Return fluid chamber
10	Cut-off valve
11	Radial groove
12	Servotronic transducer valve
13	Feed fluid radial groove
14	Radial groove
15	Orifice
16	Balls
17	Compression spring

18	Torsion bar
19	Power steering fluid reservoir
20	Valve rotor
21	Reaction piston
22	Reaction chamber
23	Centering piece
24	Pressure relief/flow limiting valve
25	Power steering pump
26	Inner tie-rod
27	Pinion
28	Valve sleeve
29	Steering gear rack
30	Steering gear housing
31	Power assist cylinder - right
32	Piston
33	Power assist cylinder - left

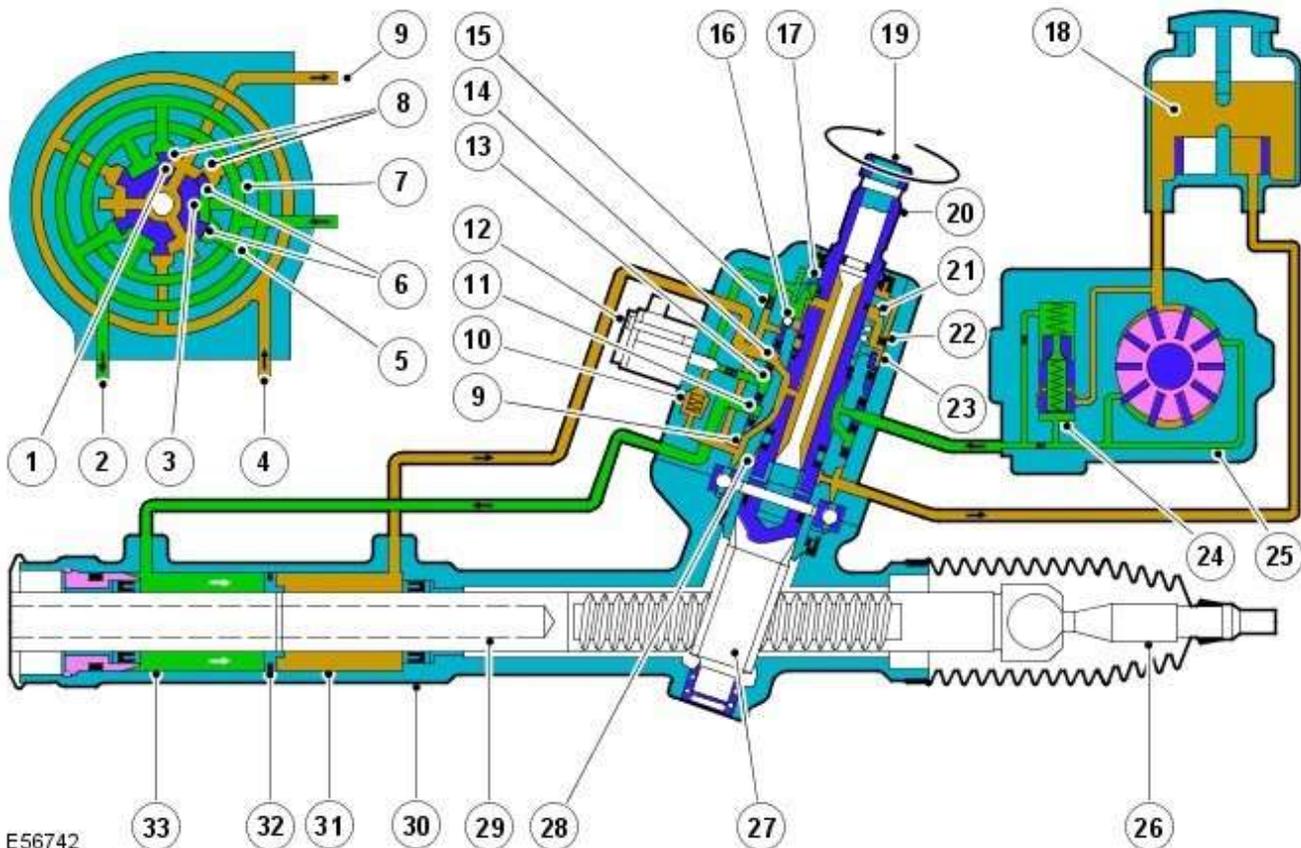
When the engine is started, the power steering pump draws fluid from the reservoir down the low pressure suction line. The fluid passes through the pump and is delivered at pressure, via a hose, to the steering rack valve unit.

The pressurized fluid flows through a connecting bore in the valve and, via the feed fluid radial groove and the transverse bores in the valve sleeve, passes to the feed fluid control groove of the valve rotor.

In the neutral (straight ahead) position, the fluid passes over the open feed fluid control edges to all valve sleeve axial grooves. The fluid then passes through return fluid control edges and the return fluid grooves of the valve rotor, back to the reservoir passes via the fluid cooler.

Simultaneously, the radial grooves of the valve and their associated pipes provide a connection the left and right power assist cylinders.

Power Steering in Right Turn Position



E56742

Item	Description
1	Return fluid control groove
2	Radial groove
3	Feed fluid control groove
4	Radial groove
5	Axial groove
6	Feed fluid control edge
7	Feed fluid radial groove
8	Return fluid control edge
9	Return fluid chamber
10	Cut-off valve
11	Radial groove
12	Servotronic transducer valve
13	Feed fluid radial groove
14	Radial groove
15	Orifice
16	Balls
17	Compression spring
18	Torsion bar
19	Power steering fluid reservoir
20	Valve rotor
21	Reaction piston
22	Reaction chamber
23	Centering piece
24	Pressure relief/flow limiting valve
25	Power steering pump
26	Inner tie-rod
27	Pinion
28	Valve sleeve
29	Steering gear rack
30	Steering gear housing
31	Power assist cylinder - right
32	Piston
33	Power assist cylinder - left

When the steering wheel is turned to the right, the steering rack and piston moves to the left in the piston bore. The valve rotor is rotated to the right (clockwise) and pressurized fluid is directed over the further opened feed fluid control edges and to the associated axial grooves, the radial groove and via an external pipe to the left power assist cylinder chamber. The pressure applied to the piston from the left power assist cylinder chamber provides the hydraulic assistance.

An adaptable pressure build-up is achieved by the partially or fully closed feed fluid control edges restricting or preventing a connection between the fluid pressure inlet and the other axial grooves connected to the radial groove.

Simultaneously, the fluid pressure outlet to the pressurized axial grooves are restricted or partially restricted by the closing return fluid control edges. The fluid displaced by the piston from the right power assist cylinder chamber, flows through an external pipe to the radial grooves. From there the fluid passes to the associated axial grooves and on to the return fluid control grooves, via the further opened return fluid control edges.

The return flow of fluid to the reservoir passes via interconnecting bores which lead to the return fluid chamber. When the steering wheel is turned to the left the operating sequence is as above but the pressure is applied to the opposite side of the piston.

Servotronic Operation

The Servotronic software contains a number of steering maps which are selected via the car configuration file depending on the vehicle mode and tire fitment.

If a failure of the Servotronic valve or software occurs, the system will suspend Servotronic assistance and only normal power steering wheel be available. Fault codes relating to the fault are stored, but no warning lamps are illuminated and the driver may be aware of the steering being 'heavier' than usual.

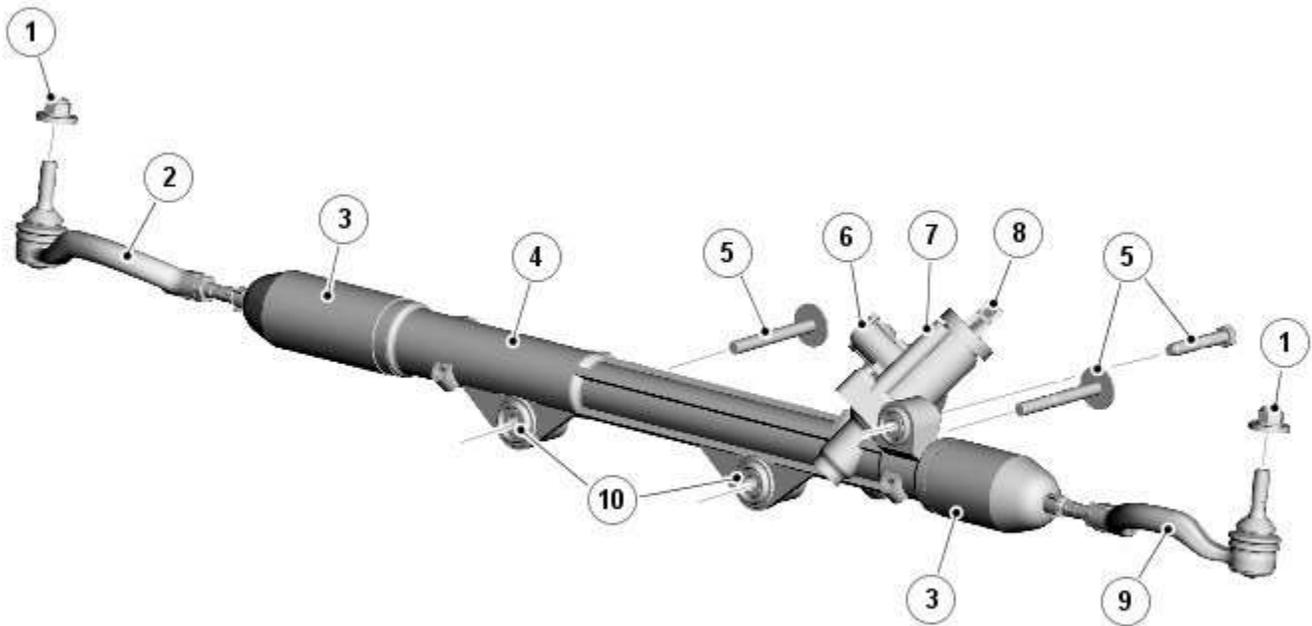
When the vehicle is manoeuvred into and out of a parking space (or other similar manoeuvre), the Servotronic software uses road speed data from the ABS module to determine the vehicle speed, which in this case will be slow or stationary. The Servotronic software analyses the signals and outputs an appropriate control current to the Servotronic transducer valve. The Servotronic valve closes and prevents fluid flowing from the feed fluid radial groove to the reaction chamber. An orifice also

ensures that there is return pressure in the reaction chamber. This condition eliminates any 'reaction' ensuring that the steering is very light to operate, reducing the effort required to turn the steering wheel.

As the vehicle is driven and the road speed increases, the Servotronic software analyses the road speed signals from the [ABS \(anti-lock brake system\)](#) module and reduces the amount of control current supplied to the Servotronic valve which increases the reaction pressure. This modifies the input torque applied through the steering wheel and provides the driver with an improved 'road feel' allowing precise steering and directional stability.

Component Description

Steering Gear



E97211

Item	Description
1	Locknut (2 off)
2	RH (right-hand) tie-rod
3	Steering gear boot (2 off)
4	Steering gear
5	Bolt and washer (3 off)
6	Servotronic valve
7	Valve unit
8	Input shaft
9	LH (left-hand) tie-rod
10	Steering gear mounting bushes

The steering gear is located at the rear of the engine and attached to the front sub-frame. The gear is secured to the sub-frame with 3 bolts and washers which screw into threaded tubes in bushes which are integral with the sub-frame.

The steering gear comprises an aluminum, cast, valve housing which contains the hydraulic valve unit and Servotronic valve. The mechanical steering rack and the hydraulic actuator are located in a steel cylinder which is attached to the cast valve housing.

The steering gear uses a rack with an integrated piston which is guided on plain bearings within the cylinder and the valve housing. The pinion, which is attached to the valve unit, runs in bearings and meshes with the rack teeth. The rack is pressed against the pinion by a spring loaded yoke which ensures that the teeth mesh with the minimum of play. The pinion is connected to the valve unit via a torsion bar. The rotary motion of the steering wheel is converted into linear movement of the rack by the rack and pinion mechanism and is initiated by the valve unit. This movement is transferred into movement of the road wheels by adjustable tie-rods.

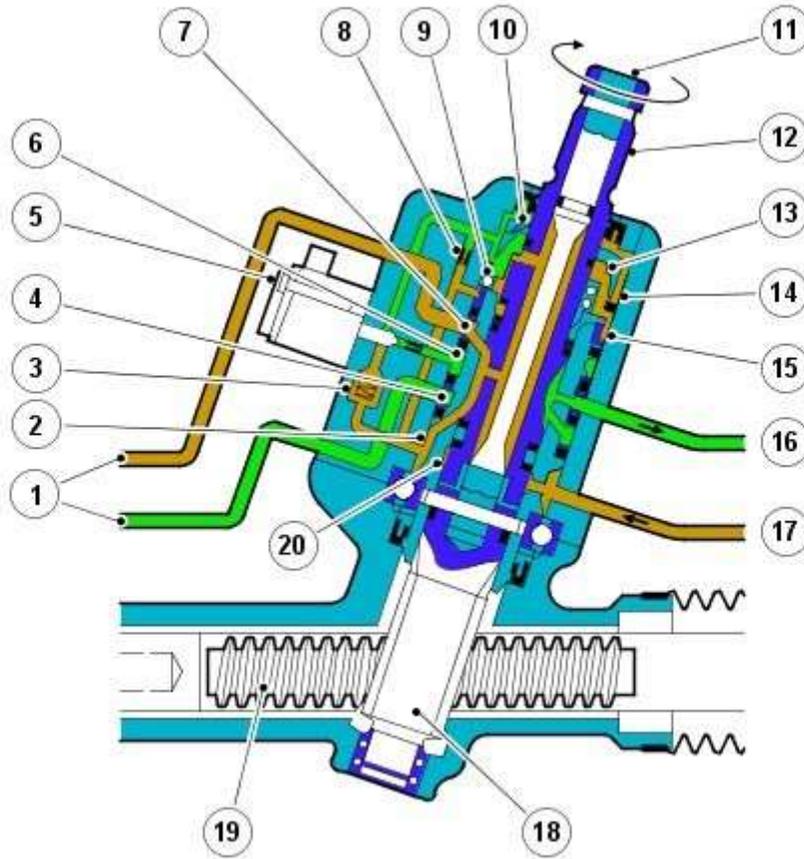
The rack teeth angles vary from 20 degrees in the centre position to 40 degrees at the end sections of the rack. It is this variation in teeth angles which provides the variable ratio.

The piston of the hydraulic actuator is located on the rack bar. Each side of the piston is connected to fluid pressure or fluid return via external metal pipes which are connected to the valve unit.

Each end of the rack bar has a threaded hole which provides for the fitment of the tie-rod. The external ends of the gear are sealed with boots which prevent the ingress of dirt and moisture. The tie-rod has a long threaded area which allows for the fitment of the tie-rod end. The thread allows for the adjustment of the steering toe. When the correct toe setting is achieved, a locknut is tightened against the tie-rod end preventing inadvertent movement.

The gear has a central hole machined along most of its length. The hole allows the air in the boots to be balanced when the steering is turned. The boots are serviceable items and are retained on the gear housing and the tie-rod with clips.

Valve Unit



E56740

Item	Description
1	Pressure/return to/from steering gear
2	Return fluid chamber
3	Cut-off valve
4	Radial groove
5	Servotronic transducer valve
6	Fluid feed radial groove
7	Radial groove
8	Orifice
9	Balls
10	Compression spring
11	Torsion bar
12	Valve rotor
13	Reaction piston
14	Reaction chamber
15	Centering piece
16	Return to reservoir

17	Pressure supply from pump
18	Pinion
19	Steering gear rack bar
20	Valve sleeve

The valve unit is an integral part of the steering gear. The principle function of the valve unit is to provide power assistance (i.e. when parking) to optimize the effort required to turn the steering wheel.

The pinion housing of the valve is an integral part of the main steering gear casting. The pinion housing has four machined ports which provide connections for pressure feed from the power steering pump, return fluid to the reservoir and pressure feeds to each side of the cylinder piston.

The valve unit comprises an outer sleeve, an input shaft, a torsion bar and a pinion shaft. The valve unit is co-axial with the pinion shaft which is connected to the steering column via the input shaft. The valve unit components are located in the steering gear pinion housing which is sealed with a cap.

The outer sleeve is located in the main bore of the pinion housing. Three annular grooves are machined on its outer diameter. PTFE (polytetrafluoroethylene) rings are located between the grooves and seal against the bore of the pinion housing. Holes are drilled radially in each annular groove through the wall of the sleeve. The bore of the outer sleeve is machined to accept the input shaft. Six equally spaced slots are machined in the bore of the sleeve. The ends of the slots are closed and do not continue to the end of the outer sleeve. The radial holes in the outer sleeve are drilled into each slot.

The input shaft has two machined flats at its outer end which allow for the attachment of the steering column intermediate shaft yoke. The flats ensure that the intermediate shaft is fitted in the correct position. The inner end of the input shaft forms a dog-tooth which mates with a slot in the pinion shaft. The fit of the dog-tooth in the slot allows a small amount of relative rotation between the input shaft and the pinion shaft before the dog-tooth contacts the wall of the slot. This ensures that, if the power assistance fails, the steering can be operated manually without over stressing the torsion bar. The central portion of the input shaft has equally spaced longitudinal slots machined in its circumference. The slots are arranged alternately around the input shaft.

The torsion bar is fitted inside the input shaft and is an interference fit in the pinion shaft. The torsion bar is connected to the input shaft by a drive pin. The torsion bar is machined to a smaller diameter in its central section. The smaller diameter allows the torsion bar to twist in response to torque applied from the steering wheel in relation to the grip of the tyres on the road surface.

The pinion shaft has machined teeth on its central diameter which mate with teeth on the steering gear rack. A slot, machined in the upper end of the pinion shaft mates with the dog-tooth on the input shaft. The pinion shaft locates in the pinion housing and rotates on ball and roller bearings.

Servotronic Valve

The Servotronic transducer valve is located in a port in the side of the steering gear valve housing. The valve is sealed in the housing with an O-ring seal and is secured with two long screws into threaded holes in the housing. The Servotronic valve is a transducer controlled valve which responds to control signals supplied from Servotronic software in the instrument cluster.

The Servotronic valve determines the hydraulic reaction at the steering gear rotary valve and controls the input torque required to turn the steering wheel. The Servotronic system allows the steering to be turned with the optimum effort when the vehicle is stationary or manoeuvred at slow speed. The hydraulic reaction changes proportional to the vehicle speed, with the required steering effort increasing as the vehicle moves faster. At high speeds, the Servotronic system provides the driver with a good feedback through the steering providing precise steering and improved stability.

The instrument cluster receives road speed signals from the [ABS](#) module and calculates the correct controlling signal for the Servotronic valve. The Servotronic software within the instrument cluster has a diagnostic capability which allows a Jaguar approved diagnostic system to check the tune of the steering and retrieve fault codes relating to the Servotronic valve. Two fault codes are stored relating to the valve for positive connection short to ground or battery and negative connection short to ground or battery.

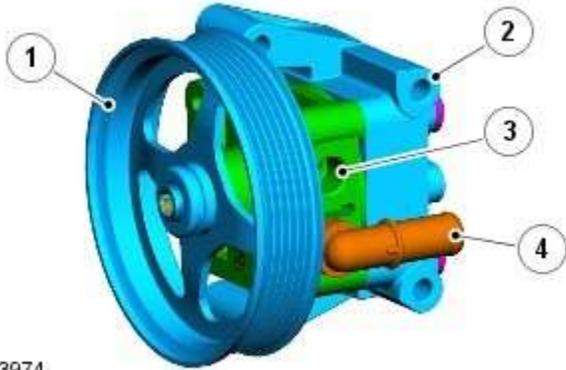
The Servotronic software within the instrument cluster also contains a number of steering maps which are selected via the car configuration file depending on the vehicle model and tire fitment.

If a failure of the Servotronic valve or software occurs, the system will suspend Servotronic assistance and only a default level of assistance will be available. Fault codes relating to the fault are stored in the instrument cluster. No warning lamps are illuminated and the driver may be aware of the steering being 'heavier' than usual.

Power Steering Pump - V6 and V8 Petrol Models



NOTE: V8 pump shown



E83974

The power steering pumps used on the different petrol engine variants are basically the same pump with different flow control valve mechanisms. The pump is a positive displacement, vane type pump which supplies a constant fluid flow to the steering gear valve unit. The pump is driven by a Poly Vee belt from the crankshaft pulley. A self-adjusting tensioner is fitted to maintain the correct tension on the belt.

The pump has an internal pressure relief valve and a flow control valve. The pressure relief valve limits the maximum pressure supplied to the steering gear to 110 bar (1595 lbf in²) \pm 4 bar (58 lbf in²). The flow control valve limits the maximum flow to 7.5 l/min (1.64 gal/min) \pm 0.75 l/min (0.16 gal/min) regardless of engine speed. The pump has a displacement of 10.5 cm³/rev (0.64 in³/rev).

A shaft runs longitudinally through the pump. One end of the shaft is fitted with a pressed-on drive pulley, the opposite end of the shaft is closed by a cover. The shaft runs in bearings located in the body and oil seals at each end of the shaft prevent leakage of hydraulic fluid. The pump contains ten vanes which rotate within a cam ring and are driven by the shaft. As the vanes rotate, the cam ring causes the space between the vanes to increase. This causes a depression between the vanes and fluid is drawn from the reservoir via the suction hose into the space between the vanes.

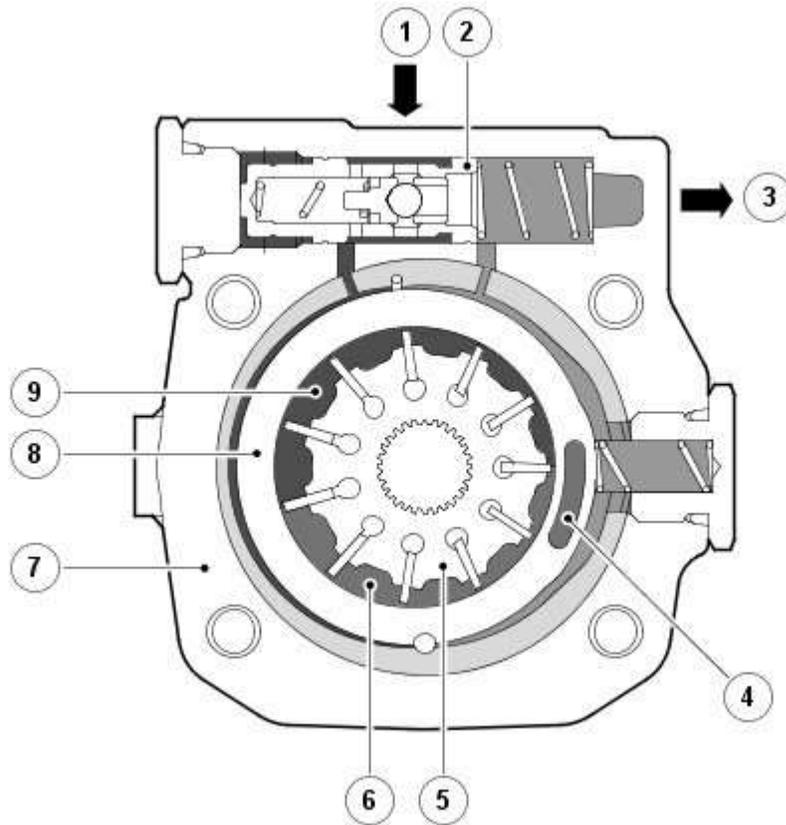
As the shaft rotates, the inlet port is closed to the vanes which have drawn in fluid, trapping the fluid between the vanes. The cam ring causes the space between the vanes to reduce and consequentially compresses and pressurises the hydraulic fluid trapped between them.

Further rotation of the shaft moves the vanes to the outlet port. As the vanes pass the port plate the pressurized fluid passes from the pump outlet port into the pressure hose to the steering gear.

The pressurized fluid is subject to control by the flow control and pressure relief valve. The flow control valve maintains a constant flow of fluid supplied to the steering gear irrespective of engine speed variations. The pressure relief valve limits the maximum pressure on the output side of the pump. A metering orifice is included in the discharge port of the pump. If the pressure in the orifice reaches a predetermined level, a spring loaded ball in the centre of the flow control valve is lifted from its seat and allows pressurized fluid to recirculate within the pump.

The pressure relief valve will operate if the discharge from the pump is restricted, i.e.: steering held on full lock. If the output from the pump is blocked, all output is recirculated through the pump. In this condition, as no fresh fluid is drawn into the pump from the reservoir, the fluid temperature inside the pump will increase rapidly. Consequentially, periods of operation of the steering gear on full lock should be kept to a minimum to prevent overheating of the pump and the fluid within it.

A variable displacement power steering pump is used on the diesel engine variants. The variable displacement, vane type pump supplies the required hydraulic pressure to the steering gear valve unit. The pump is located at the front of the engine and is driven by the **FEAD (front end accessory drive)** Poly Vee belt which is directly driven from the crankshaft. The output from the pump increases proportionally with the load applied to the steering valve unit.



E62615

Item	Description
1	Power steering fluid inlet port
2	Flow control valve
3	Power steering fluid outlet port
4	Variable Orifice
5	Pump rotor
6	High pressure
7	Adapter ring
8	Cam Ring
9	Low pressure

The pump consists of a shaft containing a number of slots into which vanes are inserted and these vanes run within a cam ring in the pump body. The centerline of the shaft is not concentric with that of the bore of the body and this creates the expanding and contracting cavities that form the pumping action.

The vanes rotate within the cam ring and are driven by the shaft. As the vanes rotate, the cam ring causes the space between the vanes to increase. This causes a depression between the vanes and fluid is drawn from the reservoir via the suction hose into the space between the vanes. As the shaft rotates, the inlet port is closed to the vanes which have drawn in fluid, trapping the fluid between the vanes. The cam ring causes the space between the vanes to reduce and consequentially compresses and pressurizes the hydraulic fluid trapped between them. Further rotation of the shaft moves the vanes to the outlet port. As the vanes pass the port plate the pressurized fluid passes from the pump outlet port into the pressure hose to the steering gear.

The cam ring in the pump body can move within the valve body. By moving the cam ring it is possible to vary the eccentricity of the shaft and the vanes in relation to the cam ring. As the eccentricity is decreased, the volume of hydraulic fluid trapped between the vanes decreases, maintaining the flow in response to pump speed. This reduces the load required to turn the pump and therefore improves engine output and economy. This allows the flow rate to be matched to the system demands and increased flow rate is only required when the steering wheel is turned.

The pump has an internal regulating valve which controls the eccentricity of the cam ring and therefore varies the flow rate according to demand. The regulating relief valve limits the maximum pressure supplied to the steering gear to 110 bar (1595 lbf in²) ± 4 bar (58 lbf in²) and also limits the maximum flow to 8.5 l/min (1.86 gal/min) ± 0.5 l/min (0.1 gal/min) regardless of engine speed.

Fluid Reservoir



E97212

Item	Description
1	Bolt and washer (2 off)
2	Rubber mounting (2 off)
3	Cap
4	Reservoir body
5	Return connection
6	Suction hose connection
7	Max/Min level
8	Lanyard

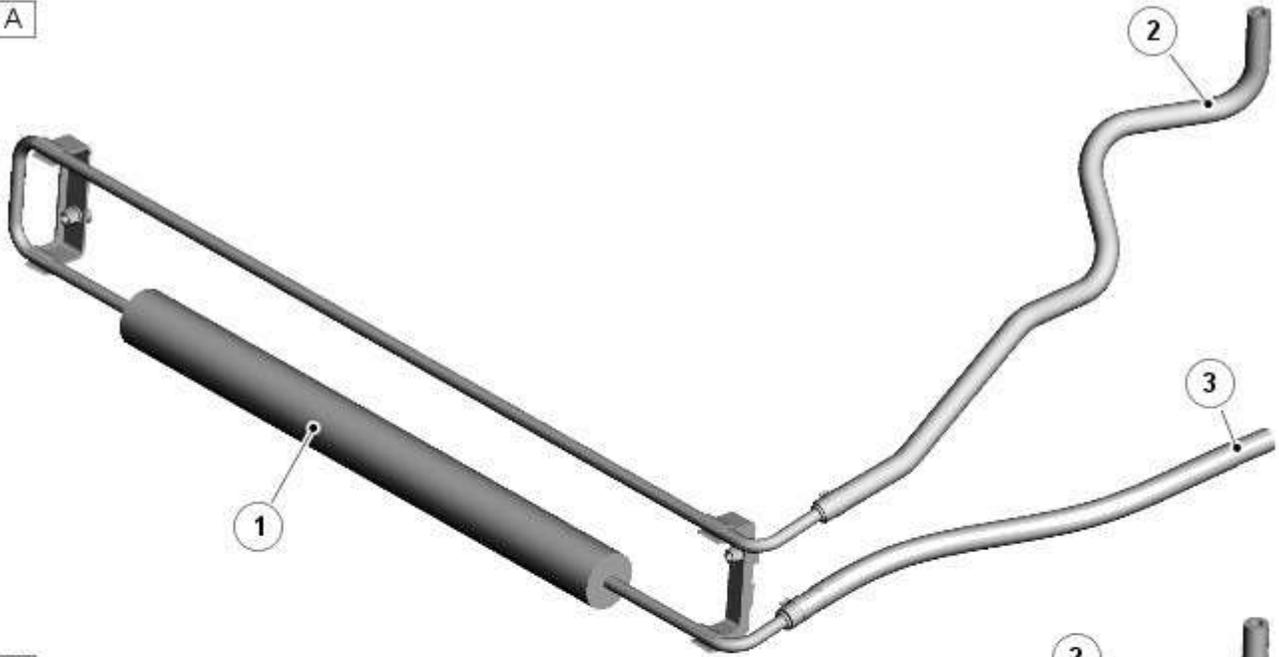
The reservoir is located in the engine compartment, on the [LH](#) suspension housing. The reservoir is attached to a bracket via 2 rubber mounts, and the bracket is attached to the suspension housing.

The reservoir is a plastic moulding with an integral 80 micron, non-serviceable filter. Two moulded ports at the base of the reservoir provide for attachment of the fluid supply hose to the power steering pump and fluid return hose from the fluid cooler. The reservoir is fitted with a removable cap which is screwed 1/4 turn to lock into the reservoir body.

The reservoir has upper and minimum marks moulded on its outside of the body.

Fluid Cooler

A



B



E97213

Item	Description
A	V8 naturally aspirated and 3.0 V6
B	V8 supercharged
1	Fluid cooler
2	Hose - return to fluid reservoir
3	Hose - Return from steering gear valve unit

The fluid cooler is located in the return circuit from the steering gear to the reservoir. The cooler is an aluminum fin and tube design. Cool air entering the front of the vehicle passes over the cooler and flows through the fins. The fins act as heat exchangers, conducting heat from the fluid as it passes through the tube.

Power Steering - Power Steering

Diagnosis and Testing

For additional information.

REFER to: [Specifications](#) (211-00 Steering System - General Information, Specifications).

Power Steering - Steering Gear

Removal and Installation

Removal

CAUTIONS:



Make sure that only the manufacturers' recommended four wheel alignment equipment is used.



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

NOTES:



Make sure the steering is in the straight ahead position.



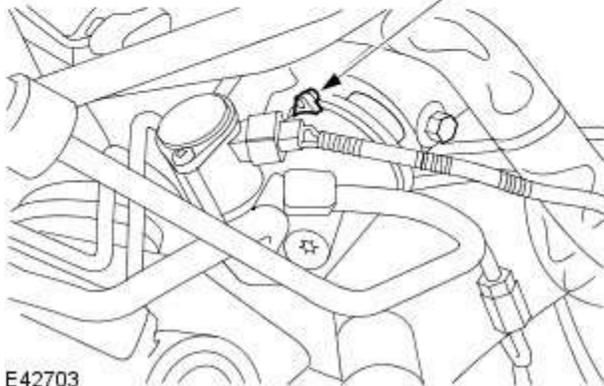
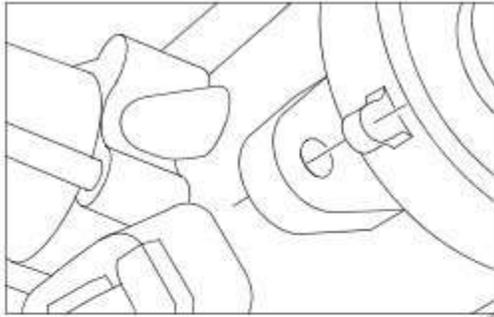
RHD illustration shown, LHD is similar.



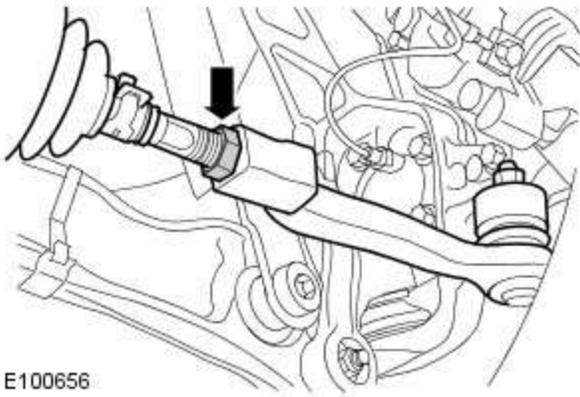
Some variation in the illustrations may occur, but the essential information is always correct.

1. Raise and support the vehicle.
2. Center the steering wheel.
 - Lock in position and remove the ignition key.
3. Remove the front wheels and tires.
For additional information, refer to: [Wheel and Tire](#) (204-04 Wheels and Tires, Removal and Installation).
4. Remove the air deflector.
For additional information, refer to: [Air Deflector](#) (501-02 Front End Body Panels, Removal and Installation).

5. Make sure the alignment mark, on the steering gear pinion seal protection cover, is central to the steering gear pinion casting.



E42703



E100656

6.  CAUTION: Do not allow the gaiter to twist.

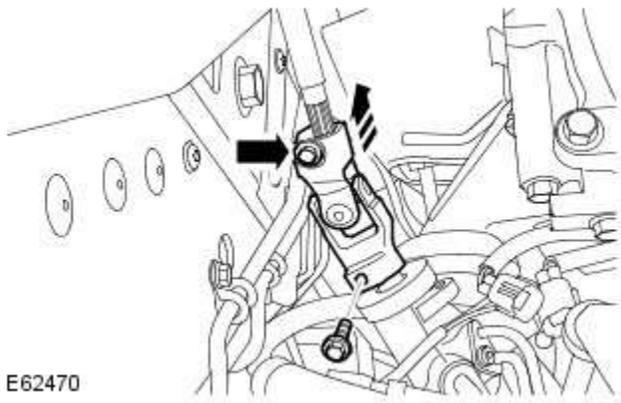
Release both track rods from tie rod ends, note the number of turns for installation.

- Loosen the tie-rod ends lock nuts.



E62469

7. Disconnect the power steering control valve actuator electrical connector.



E62470

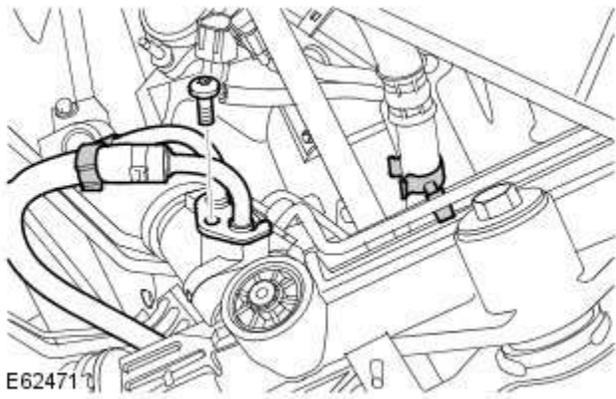


8. CAUTION: Air tools MUST NOT be used on steering column bolts.

Disconnect the lower steering column from the steering gear.

- Remove and discard the bolt.

9. Release the power steering line support bracket.



E62471

10. CAUTIONS:



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



Cap the power steering line to prevent loses of fluid and dirt ingress.



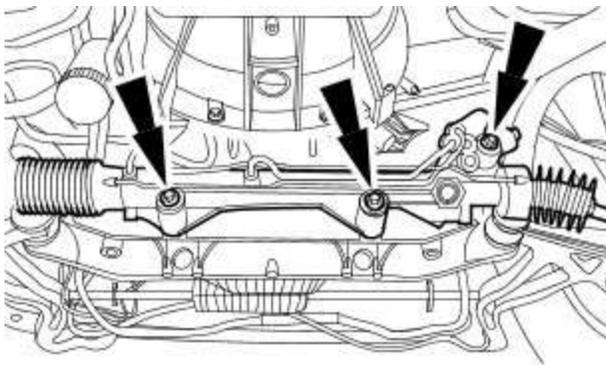
If power steering fluid is spilt on the paintwork, the effected area must be immediately washed down with cold water. Failure to follow this instruction may result in damage to the vehicle.



NOTE: Some fluid spillage is inevitable during this operation.

Disconnect the power steering feed and return fluid lines from the steering gear.

- Remove the bolt.
- Position a container to collect spillage.
- Remove and discard both O-ring seals.

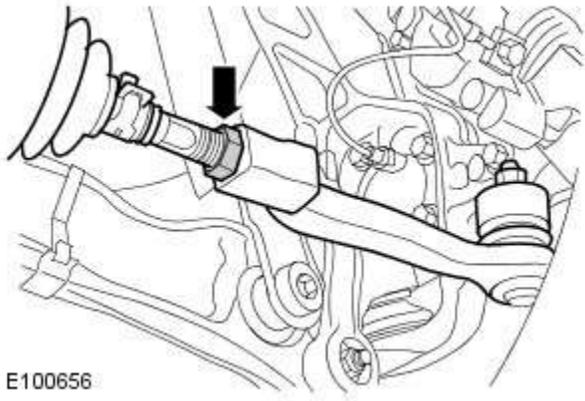


VUJ0002963

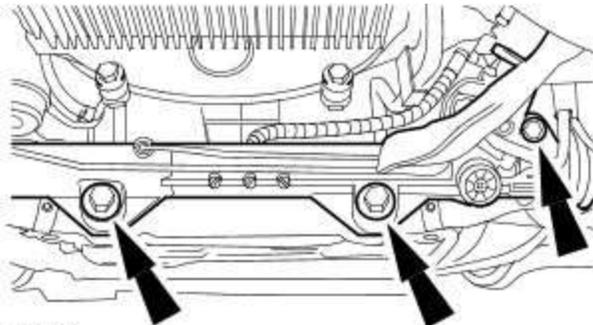
11. Remove the steering gear.
- Remove the 3 bolts.

Installation

1. To install, reverse the removal procedure.

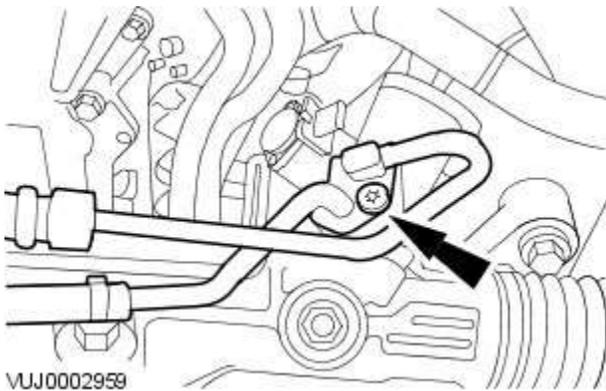


2. Install the tie rod end, note the number of turns until adjacent to the locknut.
 - Repeat the above procedure for the other side.



3. Tighten the bolts to 117 Nm.

E31036



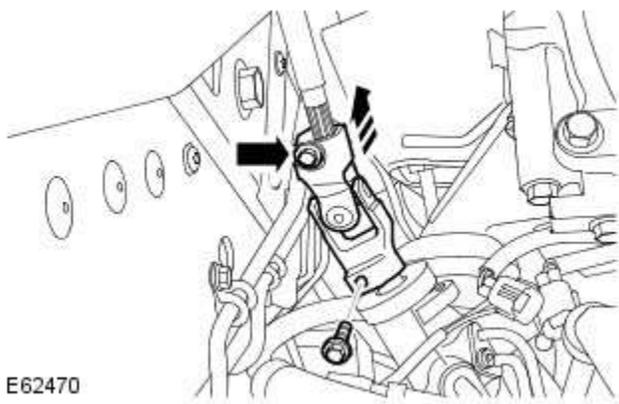
4.  NOTE: Make sure that all the component mating faces are clean.

Tighten to 20 Nm.

- Install the new O-ring seals.

VUJ0002959

5. Tighten to 35 Nm.
 - Install a new retaining bolt.



E62470

6. Fill and bleed the power steering system.
For additional information, refer to: [Power Steering System Bleeding](#)

(211-00 Steering System - General Information, General Procedures).

7. Using only four-wheel alignment equipment approved by Jaguar, check and adjust the wheel alignment.
For additional information, refer to: [Front Toe Adjustment](#) (204-00 Suspension System - General Information, General Procedures).

Power Steering - Power Steering Fluid Reservoir V8 5.0L Petrol/V8 S/C 5.0L Petrol

Removal and Installation

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. Refer to: [Power Steering System Filling - V8 5.0L Petrol/V8 S/C 5.0L Petrol](#) (211-00 Steering System - General Information, General Procedures).

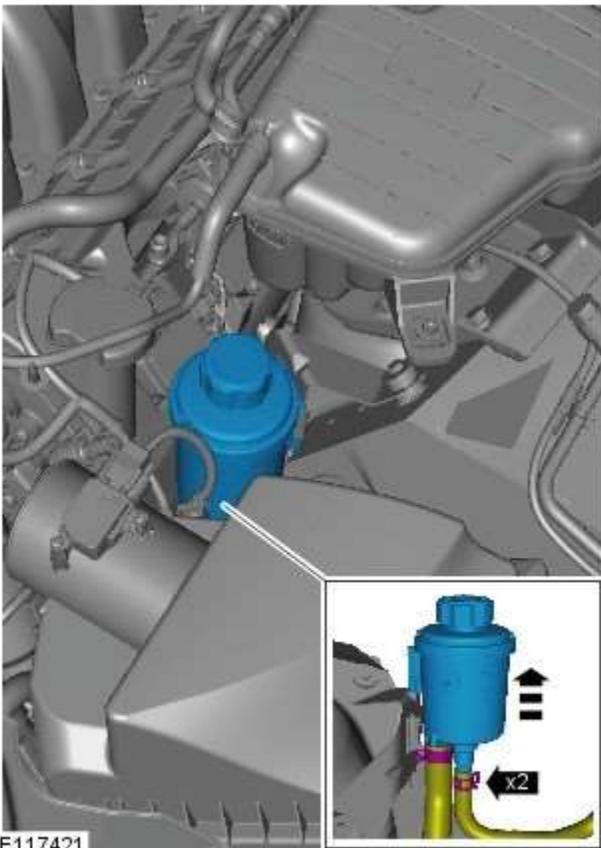
3. CAUTIONS:



Be prepared to collect escaping fluids.



Make sure that all openings are sealed. Use new blanking caps.



Installation

1. To install, reverse the removal procedure.

Power Steering - Power Steering Pump V8 5.0L Petrol/V8 S/C 5.0L Petrol

Removal and Installation

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. Refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

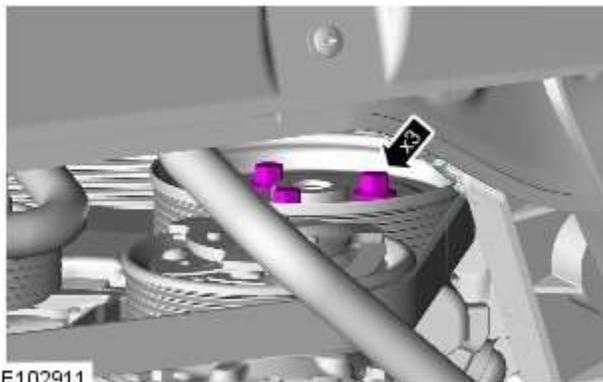
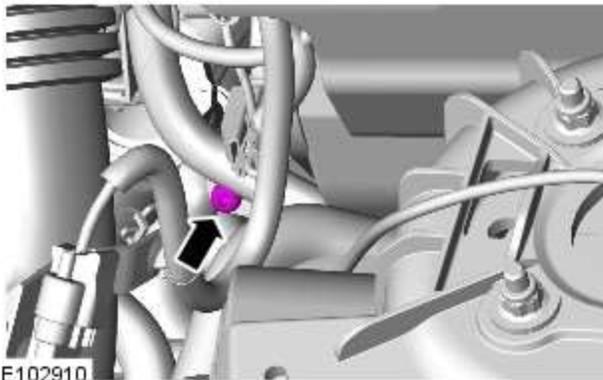


2. **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

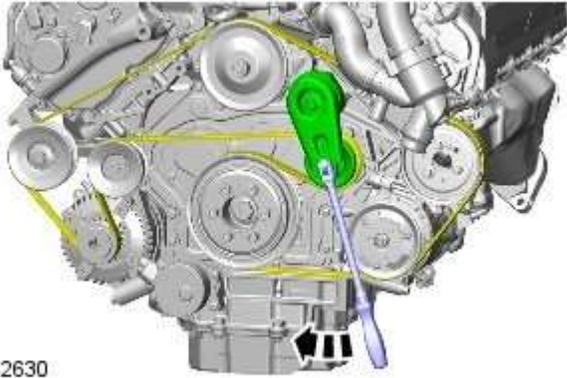
3. Refer to: [Power Steering System Bleeding](#) (211-00 Steering System - General Information, General Procedures).
4. Refer to: [Air Cleaner Outlet Pipe LH](#) (303-12D Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).
5. Refer to: [Air Cleaner LH](#) (303-12D Intake Air Distribution and Filtering - V8 S/C 5.0L Petrol, Removal and Installation).

6. **Torque:** 25 Nm



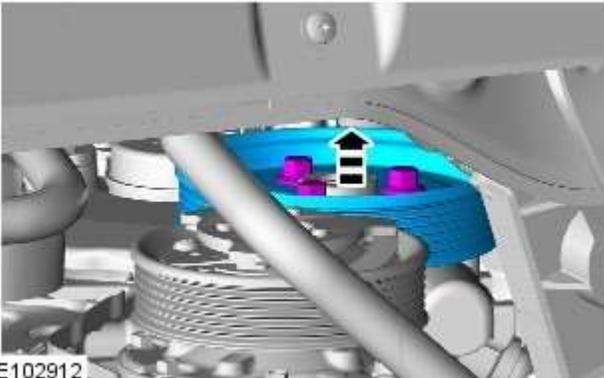
7.  **NOTE:** Do not loosen the bolts more than 2 turns.

Torque: 25 Nm



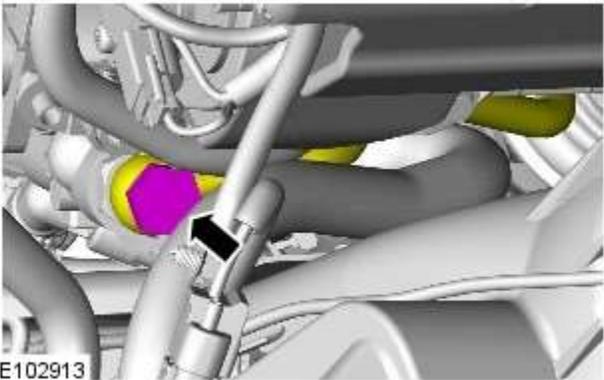
E102630

8.



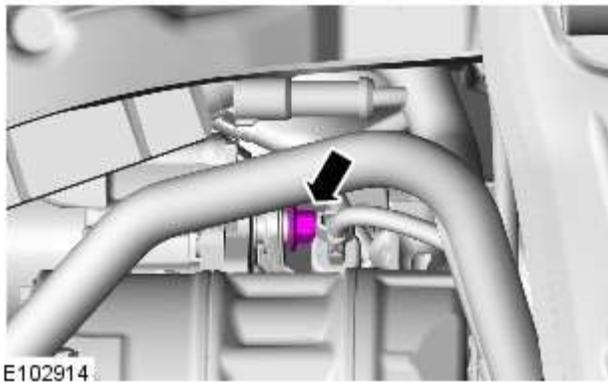
E102912

9.



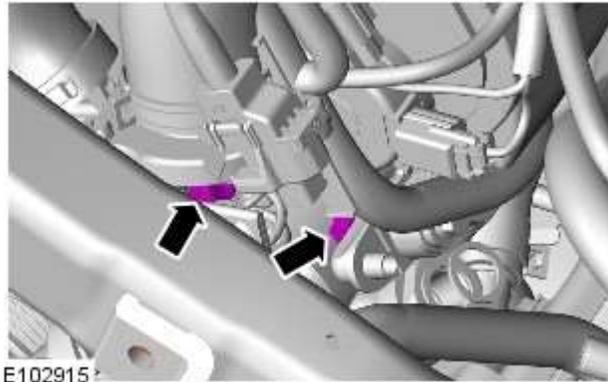
E102913

10. *Torque:* 25 Nm



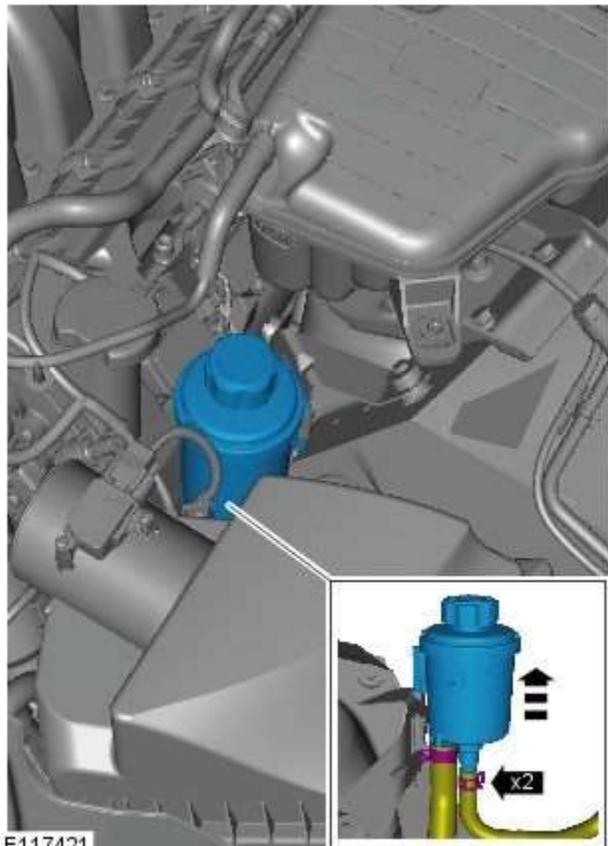
11. *Torque:* 25 Nm

E102914



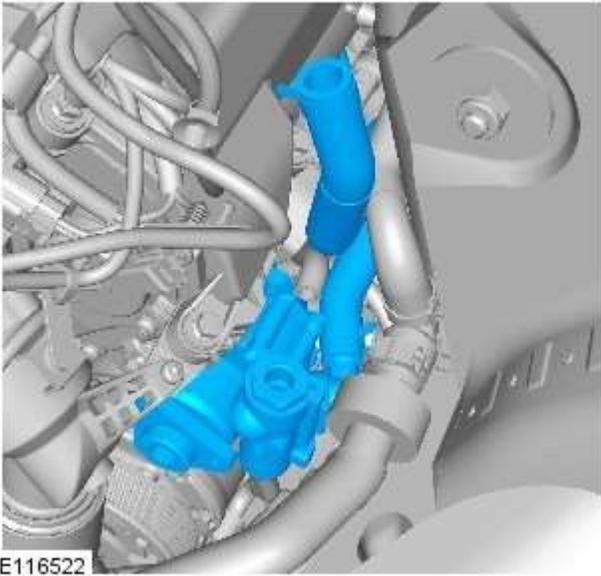
12. *Torque:* 25 Nm

E102915



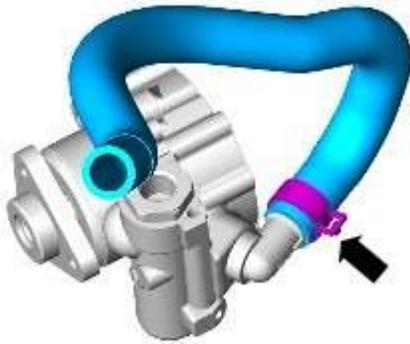
13.

E117421



E116522

14.  CAUTION: Note the fitted position of the component prior to removal.



E102918

- 15.

Installation

1. To install, reverse the removal procedure.

Power Steering - Power Steering Pump to Steering Gear Pressure Line V8 5.0L Petrol/V8 S/C 5.0L Petrol

Removal and Installation

Removal

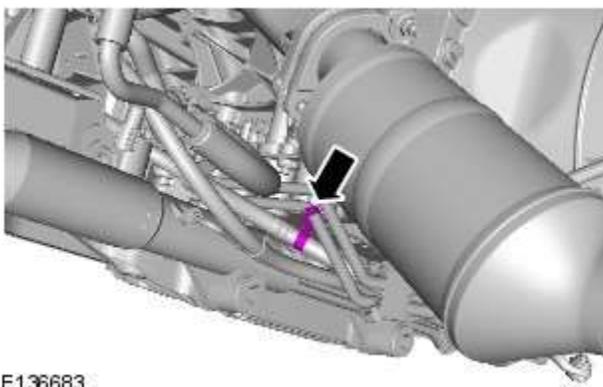
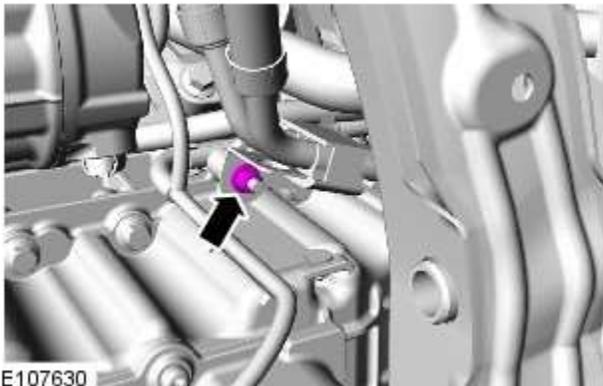


NOTE: Removal steps in this procedure may contain installation details.



1. **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.
2. Refer to: [Power Steering System Filling - V8 5.0L Petrol/V8 S/C 5.0L Petrol](#) (211-00 Steering System - General Information, General Procedures).

3. **Torque:** 11 Nm

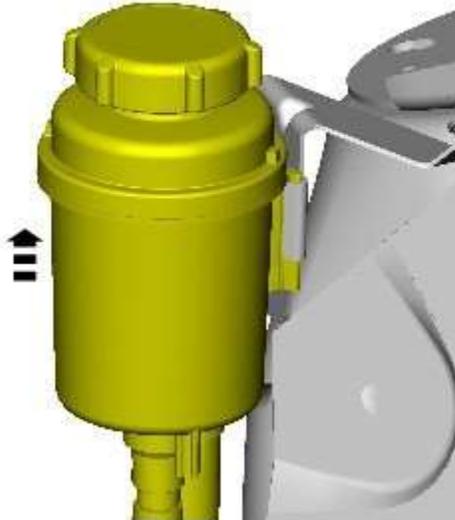


4.  NOTE: RHD shown, LHD is similar.

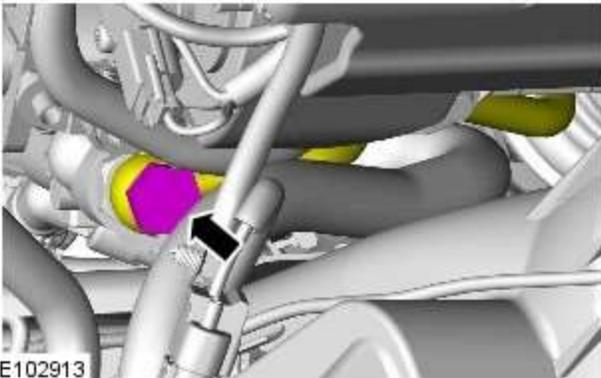
5. Lower the vehicle.



6. CAUTION: Make sure on installation the component is correctly located.



E163646



E102913

7.  WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.



- CAUTION: Always plug any open connections to prevent contamination.

NOTES:



Note the fitted position.



Discard the sealing washers.

Torque: 28 Nm

8. Raise the vehicle.



9. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.



- CAUTION: Always plug any open connections to prevent contamination.

NOTES:



RHD shown, LHD is similar.

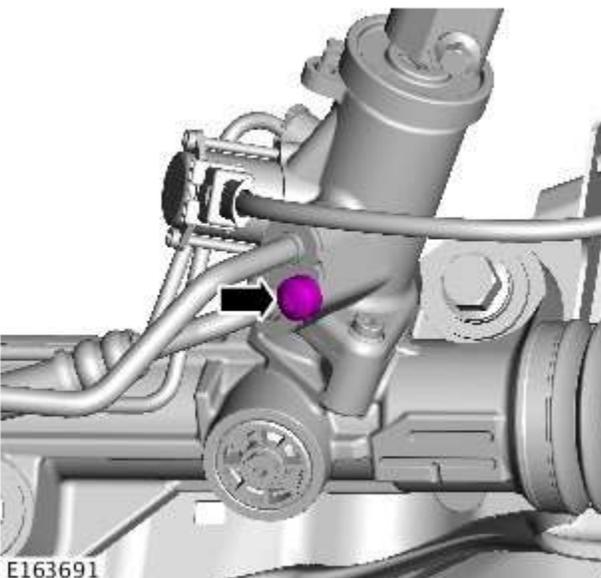


Discard the retaining bolt.

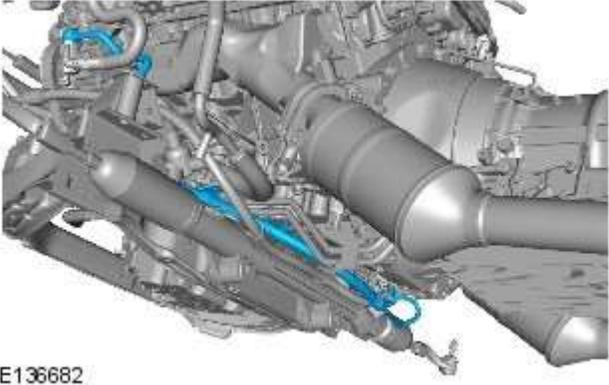


Discard the o-ring seals.

Torque: 20 Nm



E163691



E136682

10.  NOTE: RHD shown, LHD is similar.

Installation

1. To install, reverse the removal procedure.

Power Steering - Steering Gear to Fluid Cooler Return Hose V8 5.0L Petrol/V8 S/C 5.0L Petrol

Removal and Installation

Removal

NOTES:



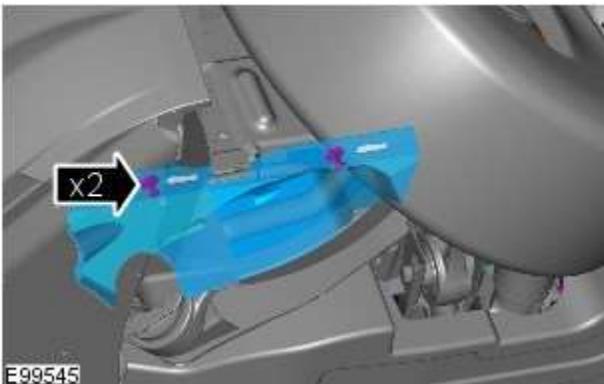
Some variation in the illustrations may occur, but the essential information is always correct.



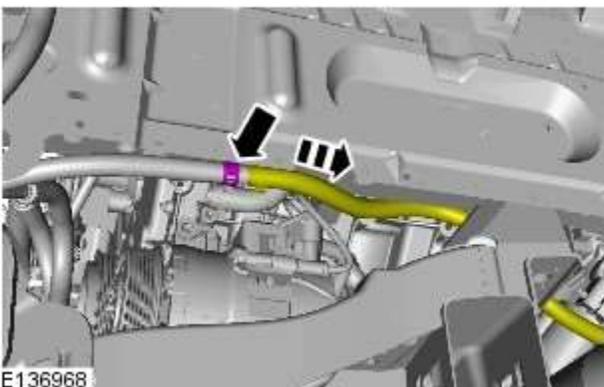
Removal steps in this procedure may contain installation details.

All vehicles

-  **WARNING:** Make sure to support the vehicle with axle stands. Raise and support the vehicle.
- Refer to: [Power Steering System Filling - V8 5.0L Petrol/V8 S/C 5.0L Petrol](#) (211-00 Steering System - General Information, General Procedures).

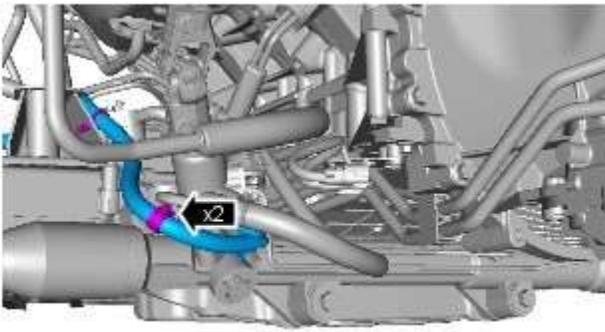


-  **NOTE:** If equipped.



-

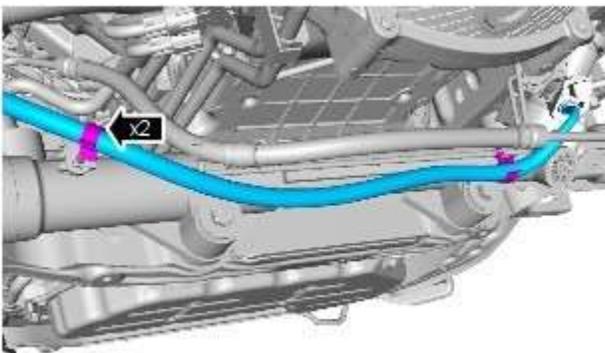
Left-hand drive vehicles



E136965

5.

Right-hand drive vehicles



E136967

6.

Installation

1. To install, reverse the removal procedure.
2. Refer to: [Power Steering System Filling - V8 5.0L Petrol/V8 S/C 5.0L Petrol](#) (211-00 Steering System - General Information, General Procedures).

Steering Linkage -

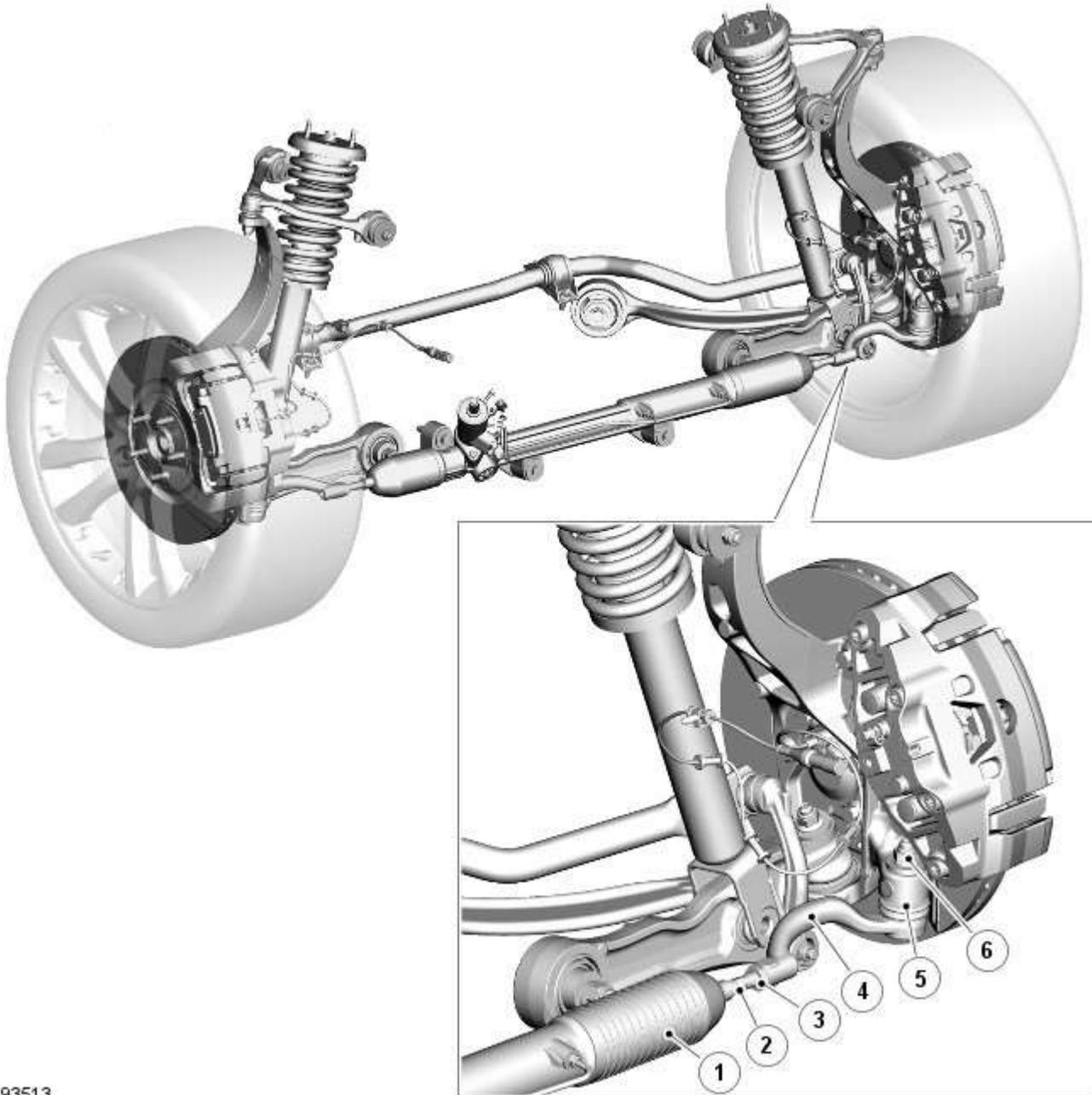
Torque Specifications

Description	Nm	lb-ft	lb-in
Tie-rod end retaining nut	133	98	-
Tie-rod end lock nut	55	41	-

Steering Linkage - Steering Linkage - Component Location

Description and Operation

STEERING LINKAGE COMPONENT LOCATION



E93513

Item	Description
1	Steering gear boot
2	Inner tie-rod arm
3	Locknut
4	Outer tie-rod arm
5	Taper ball joint
6	Locknut

Steering Linkage - Steering Linkage - Overview

Description and Operation

OVERVIEW

The steering linkage comprises the tie rod which provides the connection between the steering gear and the front wheel knuckle. Each end of the steering gear has a threaded hole which provides for the fitment of the inner tie rods. The external ends of the inner tie rods are sealed with boots to prevent the ingress of dirt and moisture into the steering gear.

Steering Linkage - Steering Linkage - System Operation and Component Description

Description and Operation

System Operation

TIE-ROD

The threads on the tie rods allow the position of the outer tie rod to be adjusted in order to set the correct toe angle for each front wheel.

Component Description

TIE-ROD

Each tie rod comprises two parts; an inner and outer tie rod. The inner and outer tie rods are screwed into each other and locked with a locknut to prevent inadvertent movement.

The outer tie rod incorporates a non-serviceable tapered ball joint which locates in a tapered hole in the front wheel knuckle and is secured with a self-locking nut. The ball joint has an internal hexagonal drive which enables the joint to be held stationary when the self-locking nut is tightened.

Steering Linkage - Steering Linkage

Diagnosis and Testing

For additional information.

REFER to: [Steering System](#) (211-00 Steering System - General Information, Diagnosis and Testing).

Steering Linkage - Tie Rod End

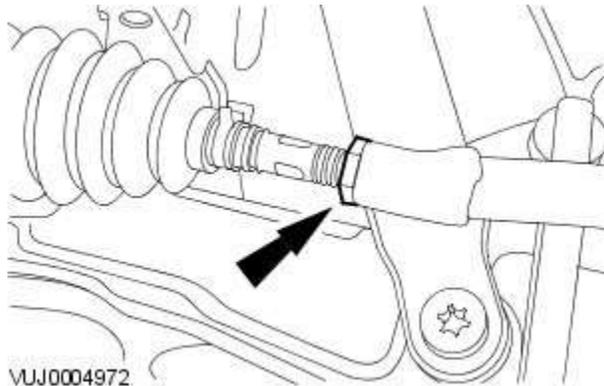
Removal and Installation

Removal

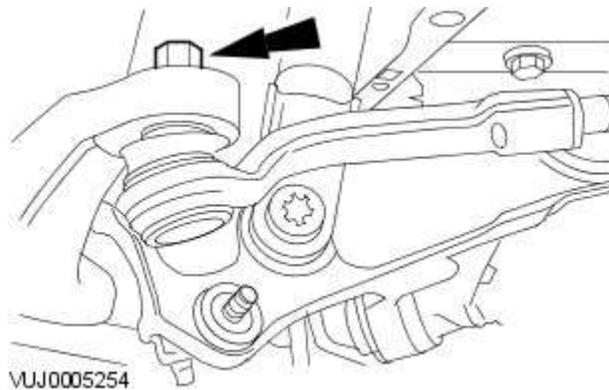
1.  **WARNING:** Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

Raise and support the vehicle.

2. Remove the front wheel and tire.
For additional information, refer to: [Wheel and Tire](#) (204-04 Wheels and Tires, Removal and Installation).

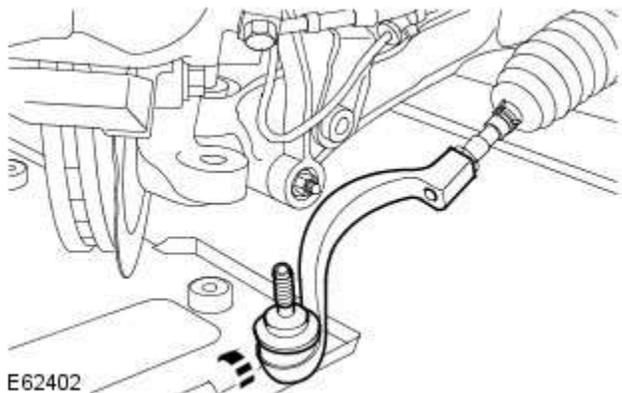


3. Loosen the tie-rod end lock nut.



4.  **CAUTION:** Make sure that the ball joint ball does not rotate.

Remove and discard the tie rod end retaining nut.



5. Remove the tie-rod end, note the number of turns for installation.

Installation

1. Install the tie rod end, note the number of turns until adjacent to the locknut.



2. **CAUTION:** Make sure that the ball joint ball does not rotate.

Connect the tie-rod end ball joint.

- Clean the component mating faces.
- Install a new nut and tighten to 133 Nm.

3. Tighten the tie-rod locking nut.

- Clean the component mating faces.
- Tighten the nut to 55 Nm.

4. Install the front wheel.

For additional information, refer to: [Wheel and Tire](#) (204-04 Wheels and Tires, Removal and Installation).

5. Using only four-wheel alignment equipment approved by Jaguar, check and adjust the wheel alignment.

For additional information, refer to: [Four-Wheel Alignment](#) (204-00 Suspension System - General Information, General Procedures).

Steering Column -

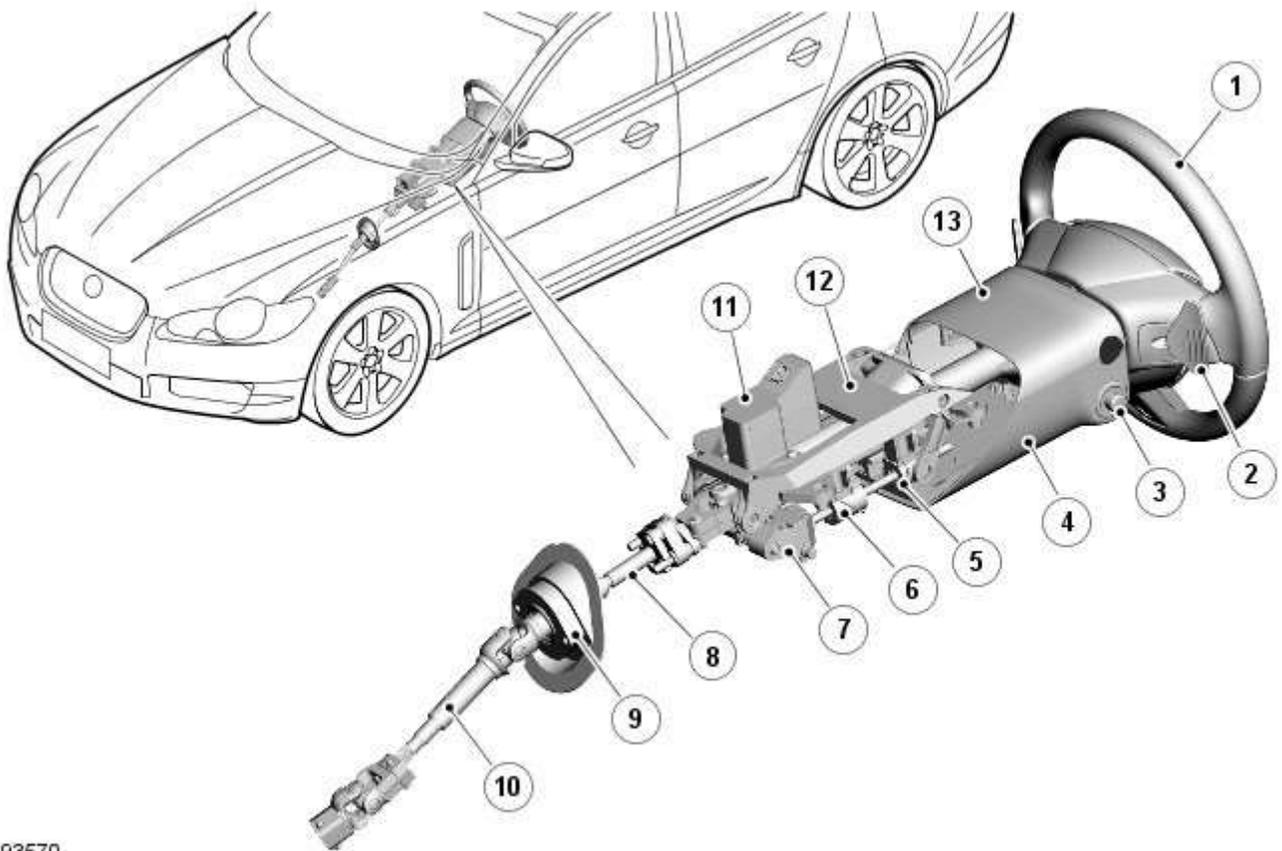
Torque Specifications

Description	Nm	lb-ft	lb-in
Steering wheel retaining bolt	60	44	-
Steering column pinch bolt	35	26	-
Steering column retaining nuts	30*	22	-
Tilt solenoid retaining bolts	1	-	9
Telescopic solenoid retaining bolts	1	-	9
Telescopic housing retaining bolts	8	-	71

If you are re-using this fixing on a vehicle built prior to VIN N83337, then tighten to 25 Nm. If you are replacing a fixing, then you must tighten to 30 Nm.

Steering Column - Steering Column - Component Location

Description and Operation



E93570

Item	Description
1	Steering wheel
2	Gear change paddle switch
3	Column adjust switch
4	Lower shroud
5	Rake adjustment housing
6	Reach adjustment housing
7	Column adjustment motor
8	Lower column - Upper collapse shaft
9	Bulkhead bearing and seal assembly
10	Lower column - Lower collapse shaft
11	Electric steering lock mechanism
12	Column mounting plate
13	Upper shroud

Steering Column - Steering Column - Overview

Description and Operation

OVERVIEW

The steering column comprises the upper column assembly, the lower column assembly and the steering wheel. The 3 components are positively connected together to pass driver rotary input from the steering wheel to a linear output of the steering rack.

The upper column assembly contains electrical adjustment for steering wheel reach and rake, the electric steering lock mechanism and the steering angle sensor. Steering adjustment memory positions are stored in the driver's seat module.

The electric steering column is a standard fitment on all models. The upper column assembly contains electrical adjustment for steering wheel reach and rake, the electric column lock mechanism and the steering angle sensor. Steering adjustment memory positions are stored in the driver's seat module. The column also features a 'tilt away' function which moves the steering column away from the driver allowing easier exit and entry to the vehicle.

Column adjustment is provided by a single motor for both reach and rake adjustment. Operation of the column adjustment is controlled by a four way joystick type switch located in the column lower shroud. Column adjustment is an integral part of the driver position memory system.

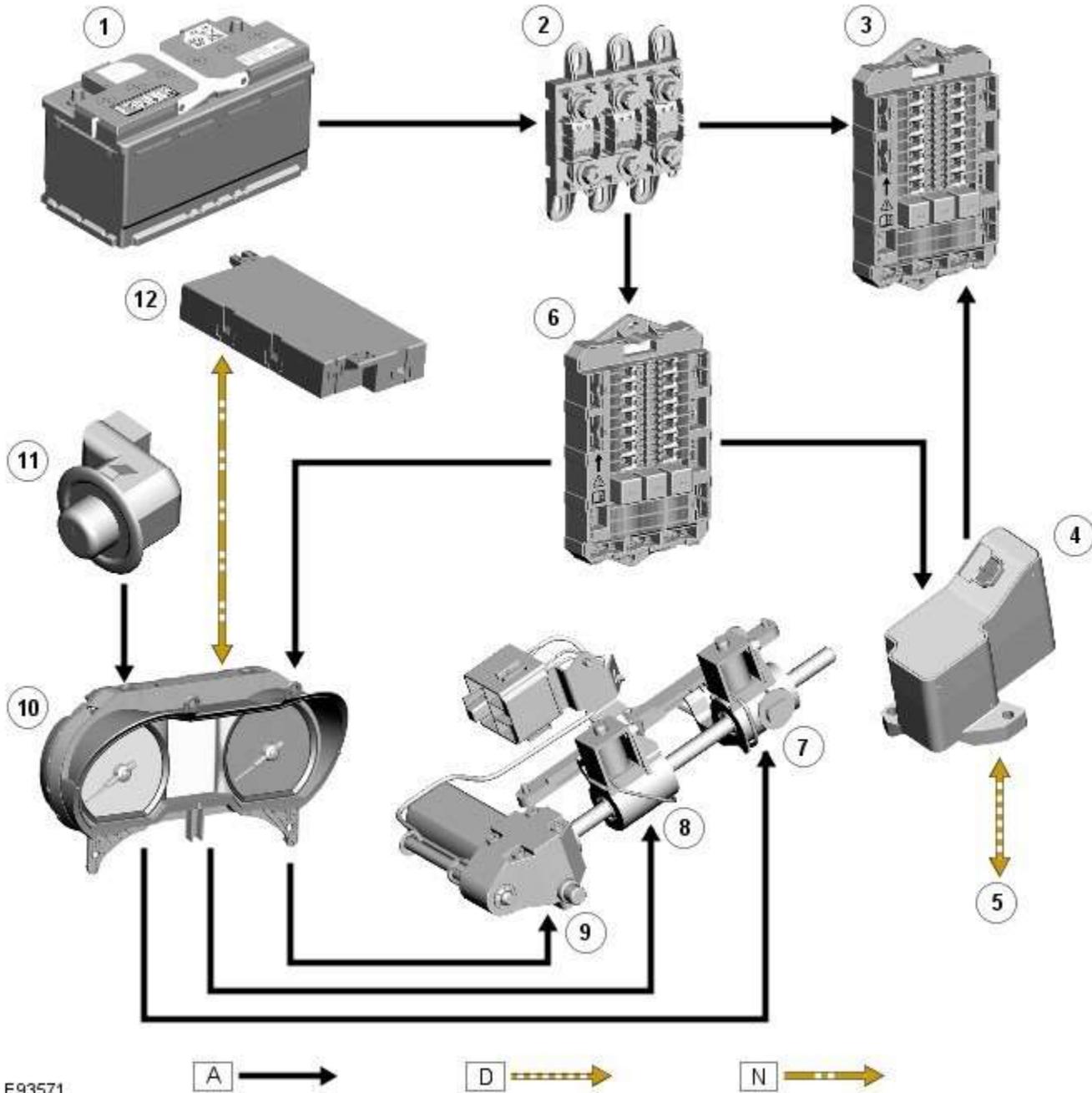
Steering Column - Steering Column - System Operation and Component Description

Description and Operation

Control Diagram



NOTE: **A** = Hardwired; **D** = High speed CAN bus; **N** = Medium speed CAN bus



E93571



Item	Description
1	Battery
2	BJB (battery junction box) - Megafuse (175A)
3	RJB (rear junction box)
4	Electric steering column lock
5	High Speed CAN (controller area network) bus to other vehicle systems
6	CJB (central junction box)

7	Rake adjustment solenoid and potentiometer
8	Reach adjustment solenoid and potentiometer
9	Column adjustment motor
10	Instrument cluster
11	Steering column adjust switch
12	Driver's seat module (position memory)

System Operation

STEERING COLUMN ADJUSTMENT

Power for the column adjustment motor is supplied via a megafuse in the [BJB](#) to the [CJB](#). A fused supply from the [CJB](#) is passed to the instrument cluster which controls the power application to the motor.

The column adjust switch is hardwired to the instrument cluster. Up/down and in/out selections on the switch are each passed through a resistor of differing values to the instrument cluster. The cluster monitors the output value from the switch and operates the motor in the required direction and simultaneously energizes the required solenoid for rake or reach adjustment. When the applicable solenoid is energized, a clutch is engaged and locates on a lead screw. The motor rotates the lead screw and the rotational drive of the screw is transferred into linear movement of the applicable clutch to move either the rake or reach adjustment. For reach adjustment, the lead screw drives the outer housing in or out as required. For rake adjustment the lead screw drives a rake lever which moves the column up or down as required.

The position of the column is monitored by potentiometers which are connected to the instrument cluster. The cluster monitors the output signal from the potentiometers to precisely control the positioning of the column in each plane.

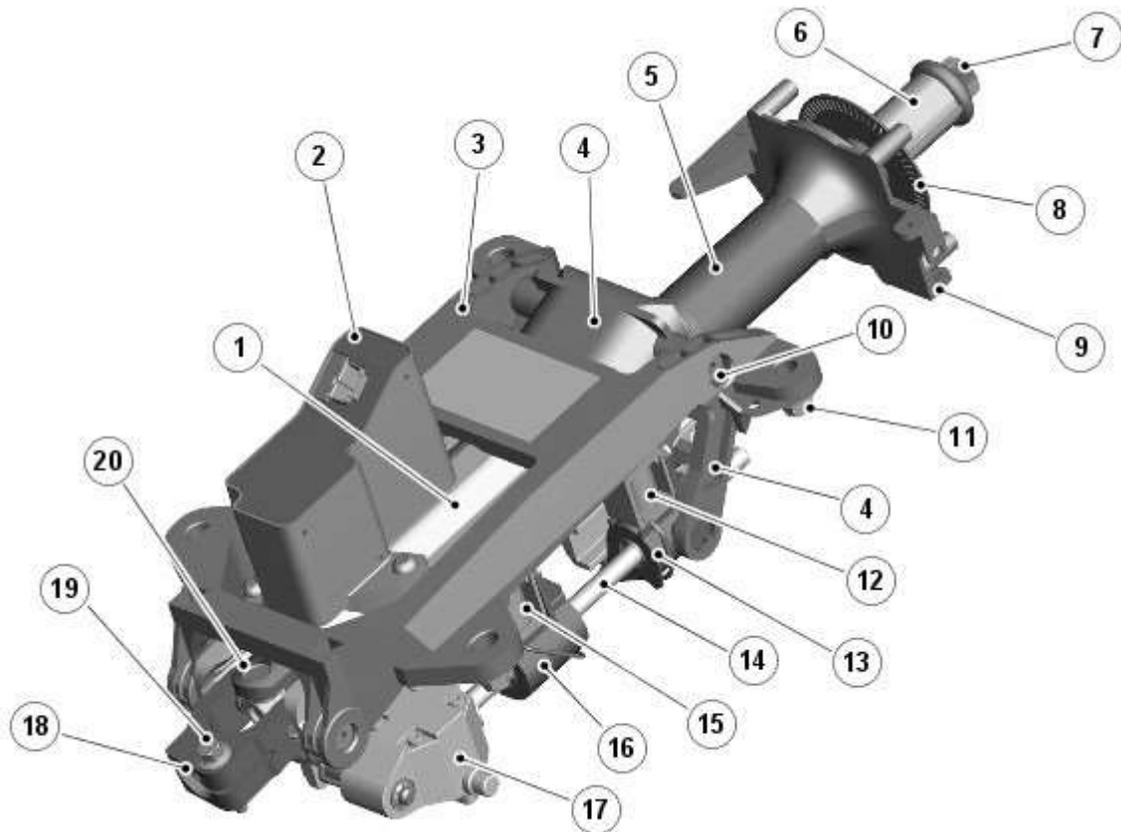
The instrument cluster controls the memory positioning of the column via a medium speed [CAN](#) bus connection to the driver's seat module. The driver's seat module receives information regarding the particular remote handset used to enter the vehicle and outputs positional information relative to that stored for the handset. This information is passed to the instrument cluster via the medium speed [CAN](#) bus which moves the column to the memorized positions.

The column logic in the instrument cluster also incorporates an entry/exit mode. When the vehicle is unlocked or the ignition is switched off, the instrument cluster lifts the column upwards to its maximum rake position to allow the driver more room below the steering wheel and improve access/egress of the vehicle. When the ignition is next switched on the column will adjust to its previous position.

The electric steering column lock is controlled by the [CJB](#).

Component Description

STEERING COLUMN



E97704

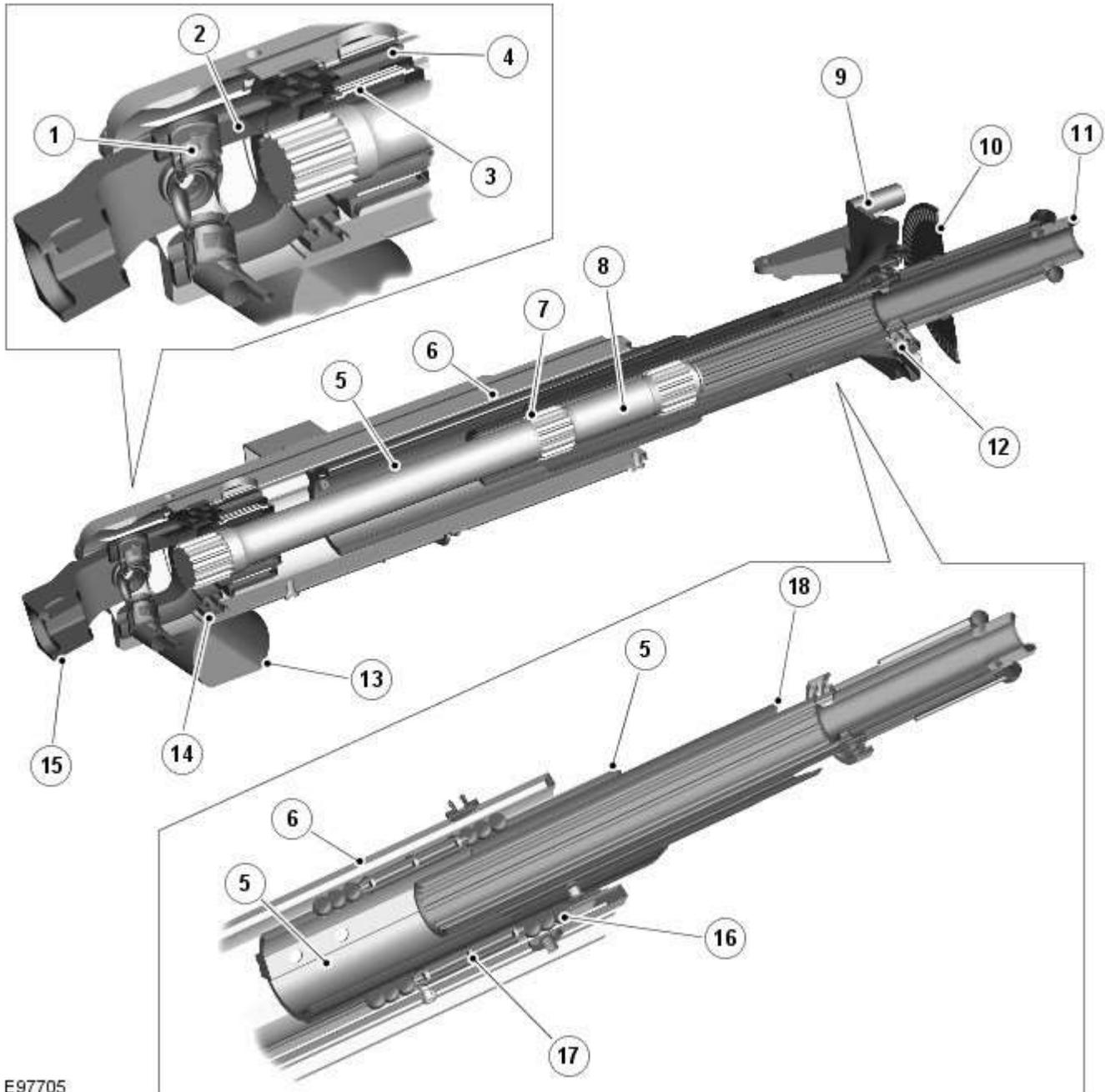
Item	Description
1	Rake housing
2	Electric steering column lock
3	Mounting plate
4	Rake lever
5	Crash tube
6	Distance keeper
7	Steering wheel mounting splines
8	Steering angle sensor ring
9	Crash adaptor
10	Rake lever pivot bearing (2 off)
11	Flanged locknut (4 off) - mounting to cross-beam
12	Rake solenoid
13	Rake clutch
14	Spindle
15	Reach solenoid
16	Reach clutch
17	Column adjustment motor
18	Outer clamping yoke
19	Clamp bolt
20	Inner tube yoke



WARNING: Do not attempt to dismantle the steering column. The crash safety of the unit will be compromised.

The steering column is attached to the in-vehicle cross-beam and secured with 4 flanged lock nuts onto 4 studs integral with the cross-beam.

Steering Column - Sectional View



E97705

Item	Description
1	Tube and clamping yoke pivot bearing
2	Tube yoke
3	Tolerance ring
4	Locking ring
5	Axial housing
6	Rake housing
7	Tube
8	Splined shaft
9	Crash adaptor
10	Steering angle sensor ring
11	Steering wheel mounting splines
12	Upper bearing
13	Column adjustment motor
14	Lower bearing

15	Outer clamping yoke
16	Ball (12 off)
17	Distance keeper
18	Crash tube

The column comprises a cast magnesium mounting bracket which provides the attachment to the cross-beam. Attached to the mounting bracket is a rake lever which is attached to the mounting bracket at the lower end with two pivot bearings. The bearings allow the rake lever to rotate upwards or downward to adjust the column rake.

The rake lever also provides for the attachment of the rake housing which can slide within the lever to provide the reach adjustment. Within the rake housing is the axial housing which is supported on each side with 6 ball bearings which allow the rake housing to move forward or backwards. The bearings on each side are arranged in groups of 3 bearings and are separated by a distance keeper which allows the housing to be supported on bearings along its length. Within the axial housing is a tube which is supported at the upper end of the column on the upper bearing. The tube has a central splined hole which provides for the fitment of the splined shaft. The splined shaft can slide within the tube on the splines when the column reach is adjusted or the column collapses in a crash condition. The splined shaft also passes rotary motion from the steering wheel through the length of the column to the outer clamping yoke which is supported on the lower bearing.

The electric steering column lock is attached to the top of the rake lever. A lock bolt within the steering column lock engages in one of 8 slots in the locking sleeve located at the lower end of the column preventing rotation of the steering wheel. The locking sleeve is retained by a tolerance ring which in turn is located on the outer diameter of the tube yoke. The tolerance ring allows a specified amount of torque to be applied to the splined shaft before it slips, preventing damage to the column lock due to excessive force being applied to the steering wheel when the lock is engaged. The tolerance ring is designed to slip on the splined shaft when the applied torque exceeds the fitted slip load of 200 Nm minimum. Repeated rotation of the lock collar will reduce its slipping torque to 100 Nm minimum. The lock is controlled by the [CJB](#).

A steering angle sensor is located at the upper end of the steering column and is attached to the crash adaptor. The sensor measures steering rotation via a toothed wheel located on the splined tube at the upper end of the column. The sensor receives a power supply from the [CJB](#) and supplies 2 signals (A and B) relating to the steering rotation to the [ABS \(anti-lock brake system\)](#) module. The module transmits this data on the high speed [CAN](#) bus for use by other vehicle systems. Refer to: [Anti-Lock Control - Stability Assist](#) (206-09 Anti-Lock Control - Stability Assist, Description and Operation).

The steering column is adjustable electrically, for reach and rake. The adjustment mechanism comprises an electric adjustment motor, a lead screw, a rake solenoid, a reach solenoid, a reach clutch and a rake clutch. The column adjustment is controlled manually using a joystick switch located on the [LH \(left-hand\)](#) side of the column lower cowl. The joystick can be moved forward and backward to adjust the column reach in and out and moved up and down to adjust the rake. The switch selection energizes the adjustment motor in the applicable direction and also engages the applicable solenoid and clutch.

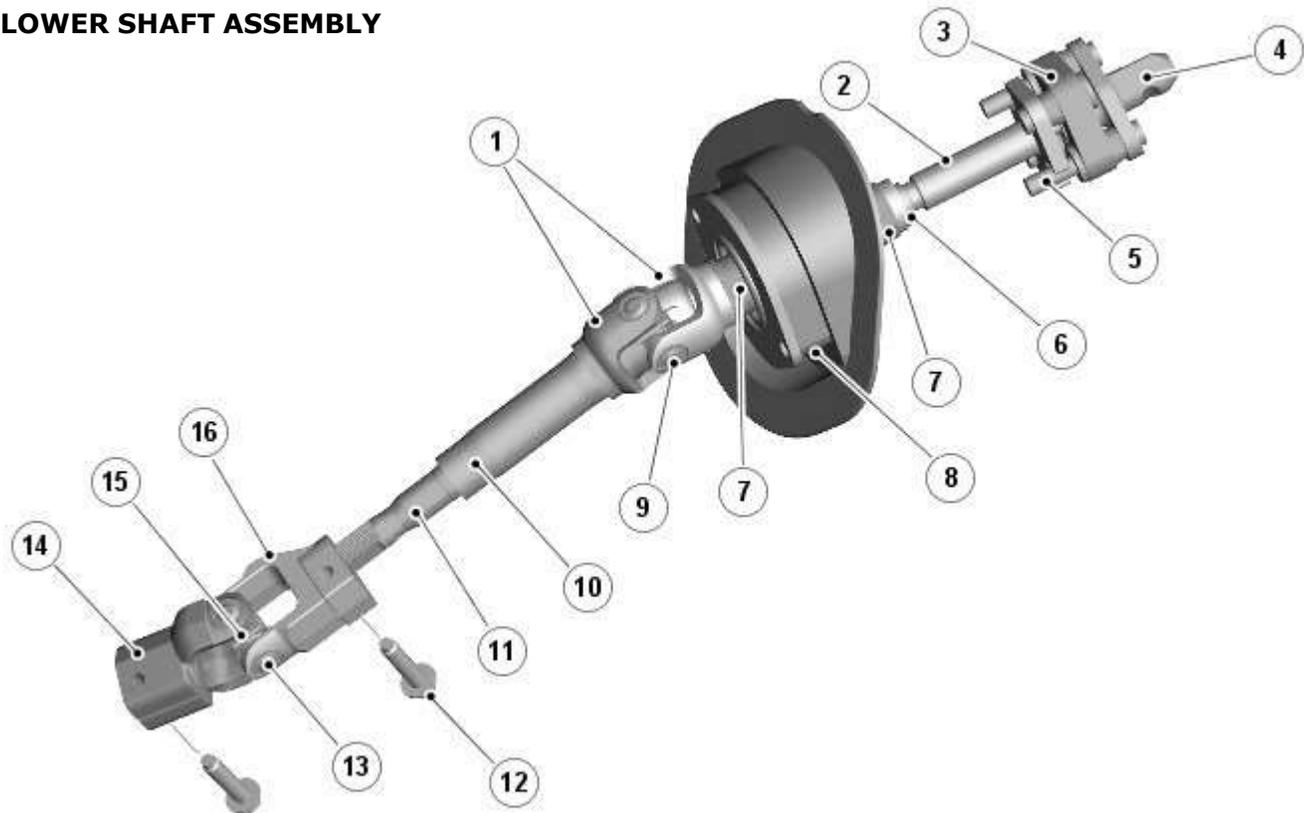
When the joystick switch is rotated to the 'auto' position, the steering column will adjust to the uppermost rake position when the ignition is switched off. It will re-adjust to the position corresponding to the memory position for the remote handset when the ignition is switched on.

The memory function of the electric column is linked to and controlled by the driver's seat module. The module provides for the storage of three separate memory positions which are stored against 3 individual remote handsets. Refer to: [Seats](#) (501-10 Seating, Description and Operation).

The steering wheel locates on a splined shaft in the upper column assembly and is secured with a bolt. The steering wheel houses the driver's airbag and switches for the audio system, gear change and speed control. A clockspring is used to connect the steering wheel electrical components to the vehicle harness.

Two plastic shrouds are fitted to the upper column assembly. The lower shroud is fitted with an energy absorbing foam pad to minimize leg injury in the event of an accident.

LOWER SHAFT ASSEMBLY



E97706

Item	Description
1	Yoke
2	Upper collapse shaft
3	Flexible coupling
4	Shaft plate
5	Rivet (4 off)
6	Upper tube
7	Plastic sleeve
8	Boot
9	Bearing (4 off)
10	Teeth tube
11	Lower shaft
12	Yoke clamp bolt (2 off)
13	Bearing (4 off)
14	Lower yoke
15	Spider
16	Upper yoke

The lower shaft assembly comprises 2 splined shafts connected by a universal joint in the center.

The upper collapse shaft has a flexible couple at its upper end. The flexible coupling controls axial and torsional movements and also assists with noise and vibration damping. The flexible coupling is fitted with a shaft plate which has a boss with machined flats on it. The flats provide positive location on the upper column outer clamping yoke. A cut-out in the boss allows for the fitment of a clamping bolt to secure the upper column outer clamping yoke. The cut-out ensures that the lower shaft assembly can only be fitted in one orientation.

The upper collapse shaft is connected to the stopper plate of the flexible coupling with splines. The stopper plate is connected to the shaft plate via the flexible coupling and is secured with rivets. The upper collapse shaft has a series of splines which engage with the upper tube. The splines allow the upper collapse shaft to slide into the upper tube in the event of an accident.

The upper tube is positively connected to the upper half of the yoke of the universal joint. A plastic tube is located around the upper tube and provides for the attachment of a boot which seals the lower shaft assembly where it passes through the vehicle bulkhead.

The yoke is attached to the teeth tube which in turn is located over the lower shaft on splines. The teeth tube is fitted with a tolerance ring which provides resistance to movement of the splines on the lower shaft. The splines of the lower shaft allow it to slide into the teeth tube with the tolerance ring controlling the collapse.

The lower shaft is fitted with a yoke which provides the attachment to the torsion bar of the steering valve unit.

Steering Column - Steering Column

Diagnosis and Testing

For additional information.

REFER to: [Steering System](#) (211-00 Steering System - General Information, Diagnosis and Testing).

Steering Column - Steering Column

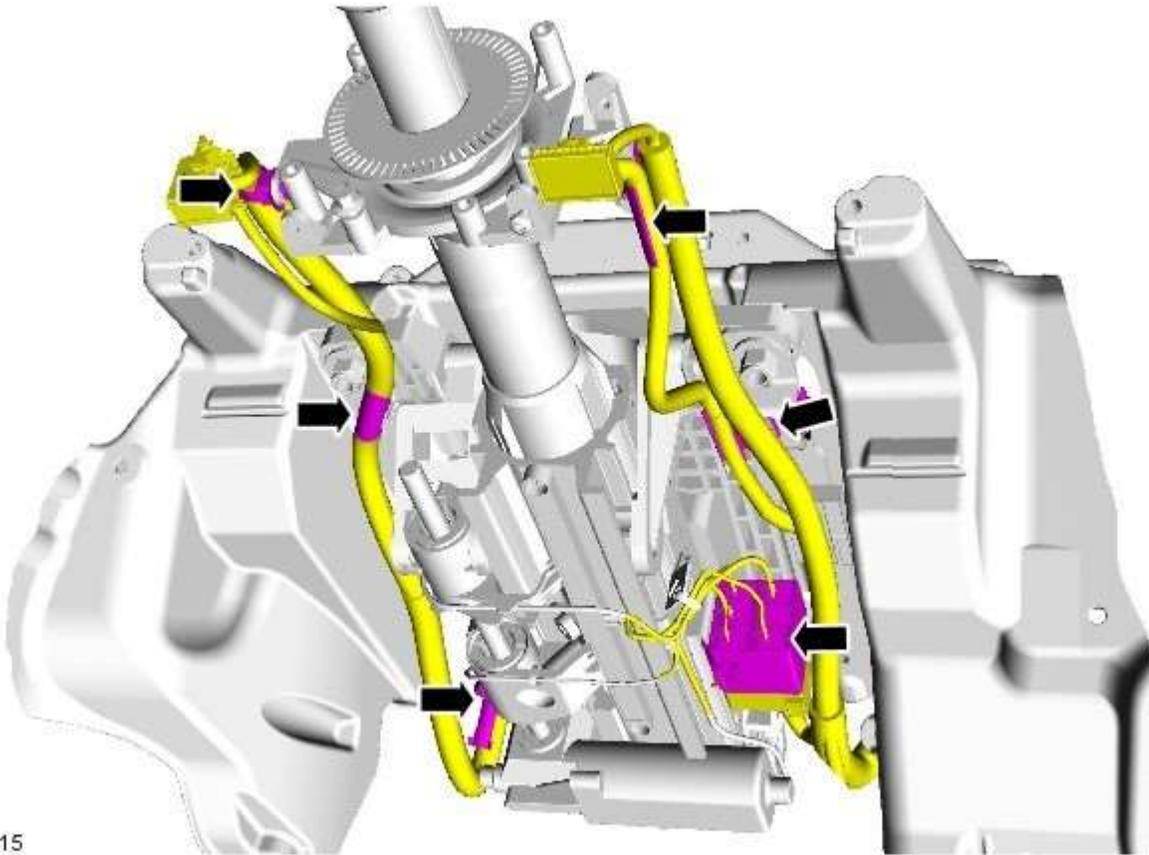
Removal and Installation

Removal



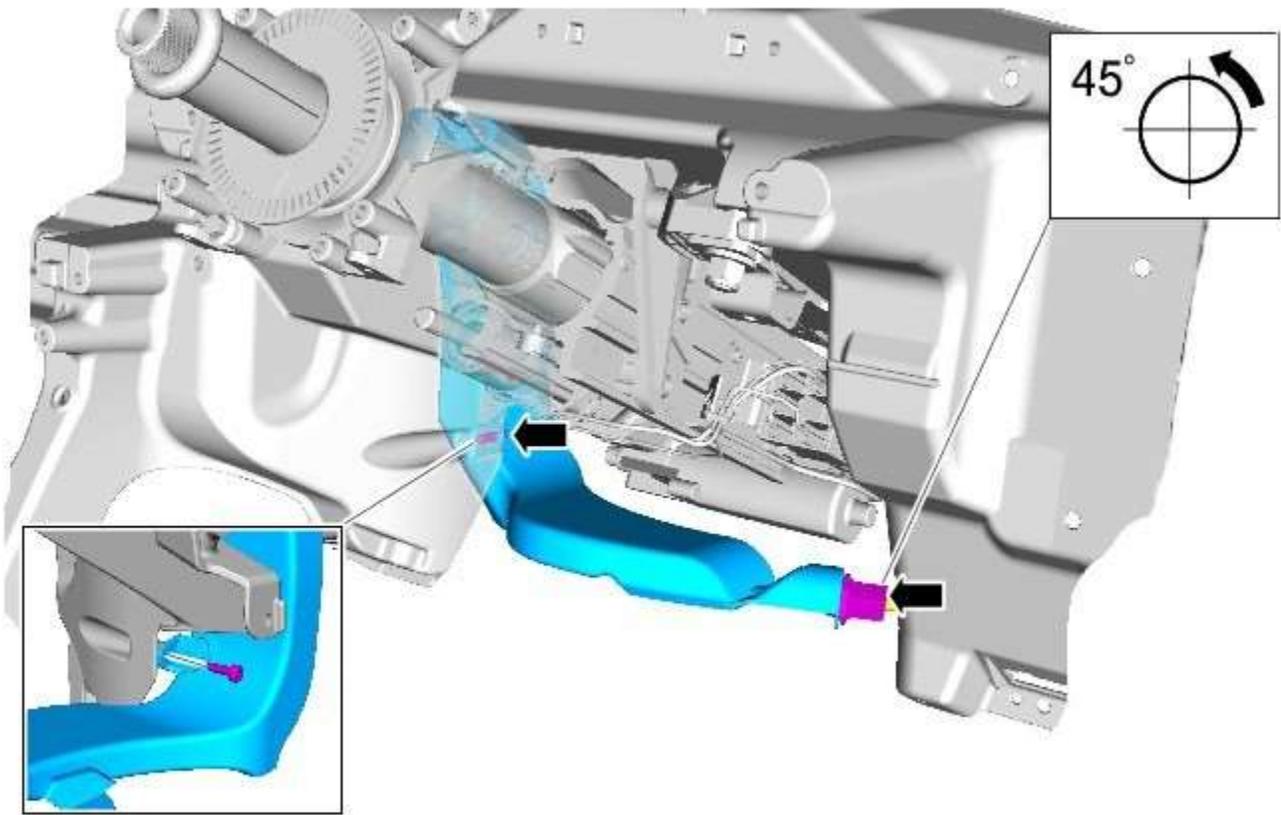
NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: [Instrument Panel Lower Trim Panel](#) (501-12 Instrument Panel and Console, Removal and Installation).
3. Refer to: [Steering Wheel Rotation Sensor](#) (206-09 Anti-Lock Control - Stability Assist, Removal and Installation).
- 4.



E133415

- 5.

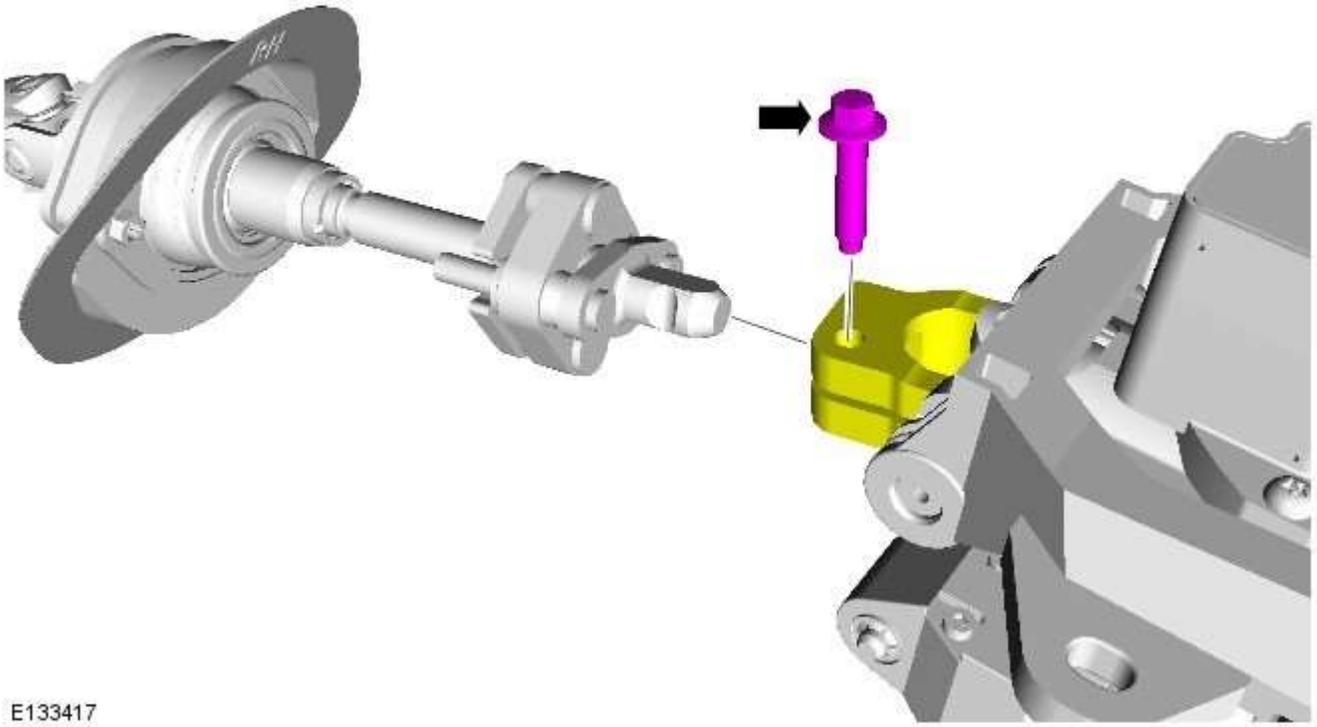


E133416



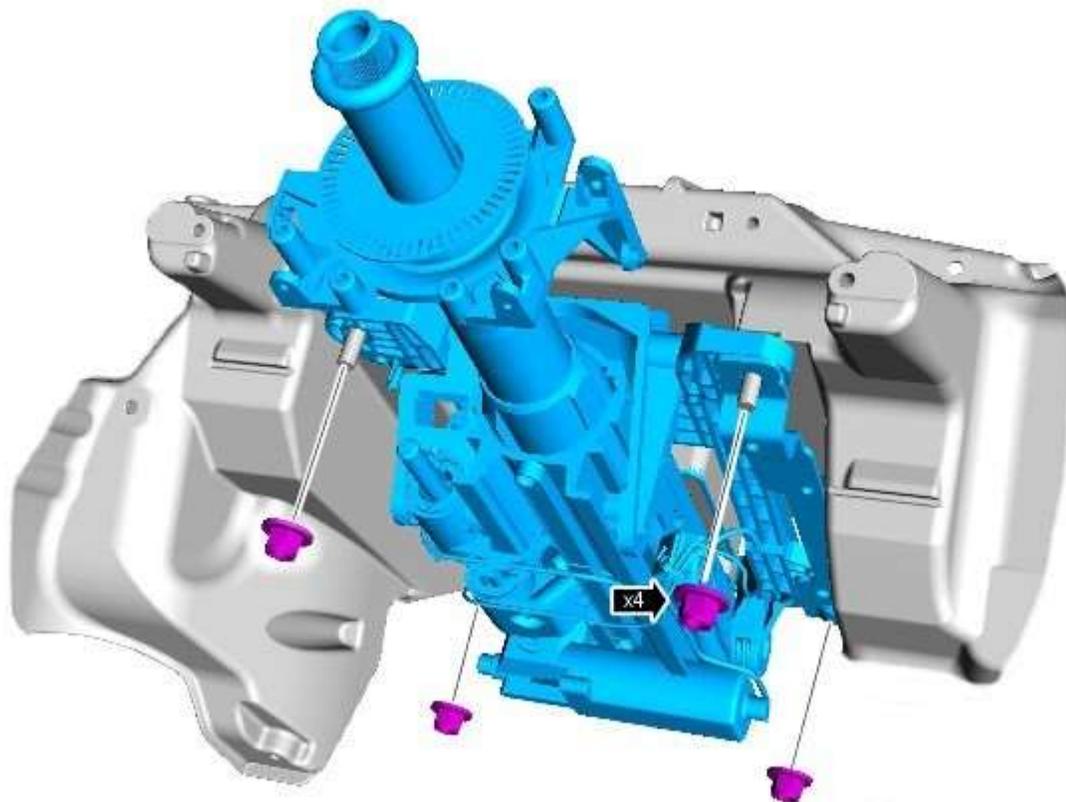
6. WARNING: Make sure that a new steering column flexible coupling bolt is installed.

Torque: 30 Nm



E133417

7. *Torque:* 25 Nm



E133418

Installation

1. To install, reverse the removal procedure.

Steering Column - Steering Column Flexible Coupling

Removal and Installation

Removal



NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).



2. **WARNING:** Make sure to support the vehicle with axle stands.
Raise and support the vehicle.

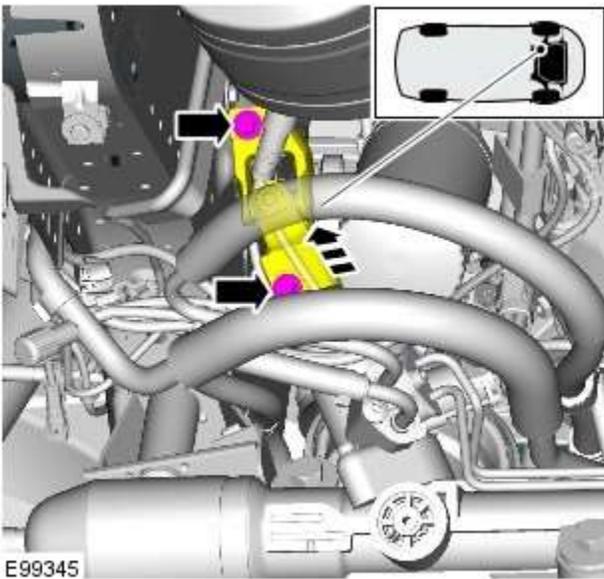
3. Refer to: [Air Deflector](#) (501-02 Front End Body Panels, Removal and Installation).

4. Refer to: [Instrument Panel Lower Trim Panel](#) (501-12 Instrument Panel and Console, Removal and Installation).

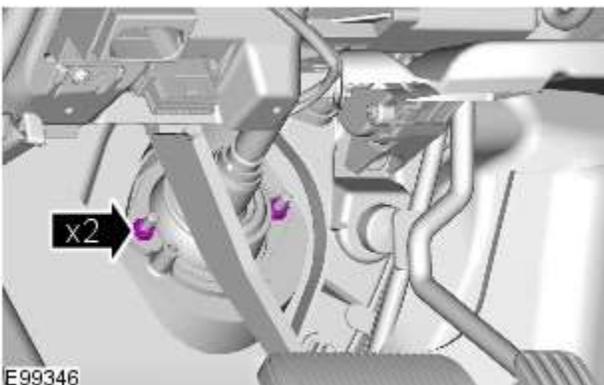


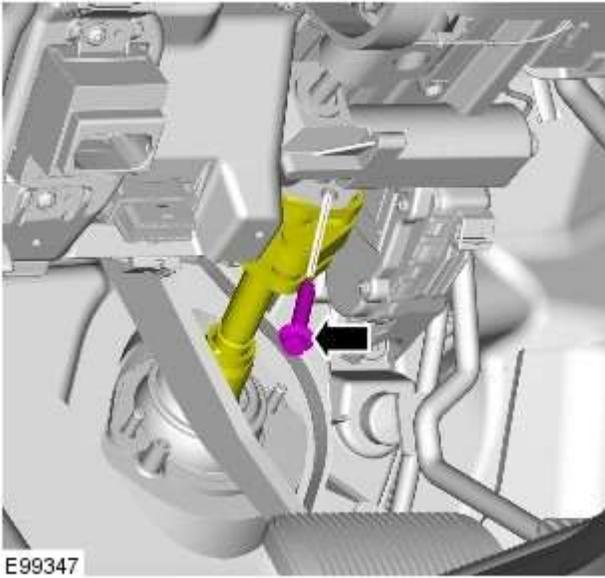
5. **WARNING:** Make sure that a new steering column flexible coupling bolt is installed.

Torque: 30 Nm



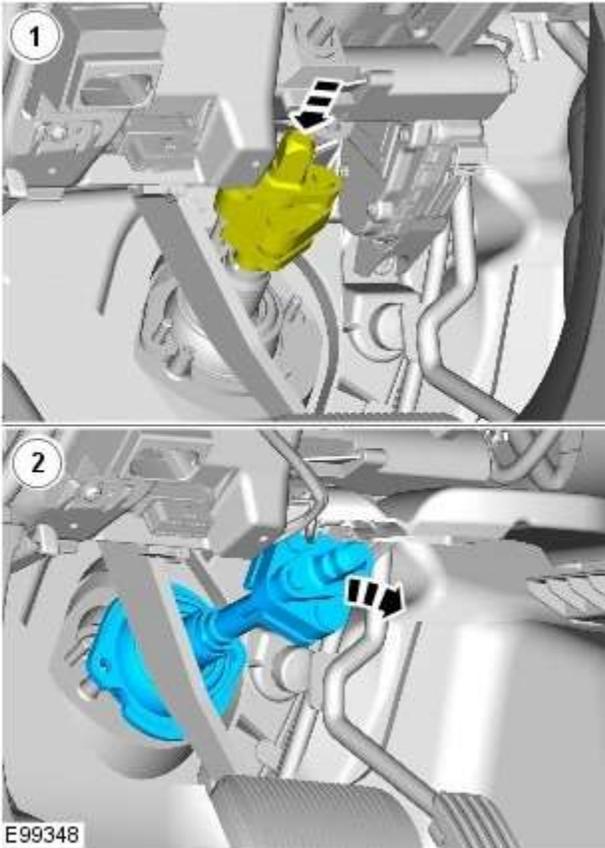
6. *Torque:* 10 Nm





7.  **WARNING:** Make sure that a new steering column flexible coupling bolt is installed.

Torque: 30 Nm



- 8.

Installation

1. To install, reverse the removal procedure.

Steering Column - Steering Wheel

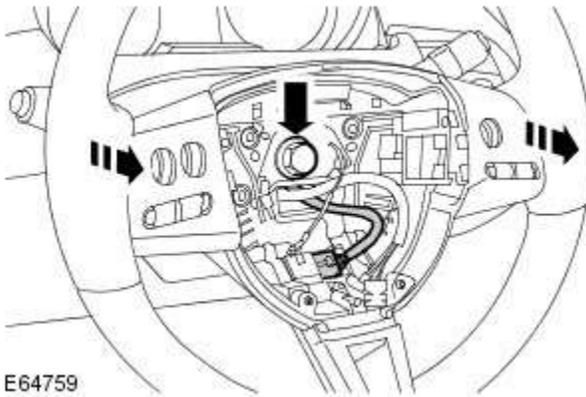
Removal and Installation

Special Tool(s)

 <p>E43628</p>	<p>Clockspring locking tool 211-326</p>
---	---

Removal

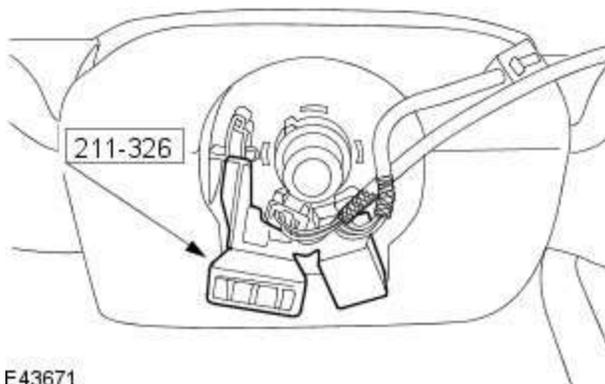
1. Make the SRS system safe.
For additional information, refer to: [Standard Workshop Practices](#) (100-00 General Information, Description and Operation).
2. Disconnect the battery ground cable.
For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
3. Remove the driver air bag module.
For additional information, refer to: [Driver Air Bag Module](#) (501-20B Supplemental Restraint System, Removal and Installation).



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

Remove the steering wheel.

- Disconnect the electrical connector.
- Loosen, but do not fully remove the bolt.
- Release the steering wheel from the spline.
- Remove the bolt.
- Release the electrical harness.



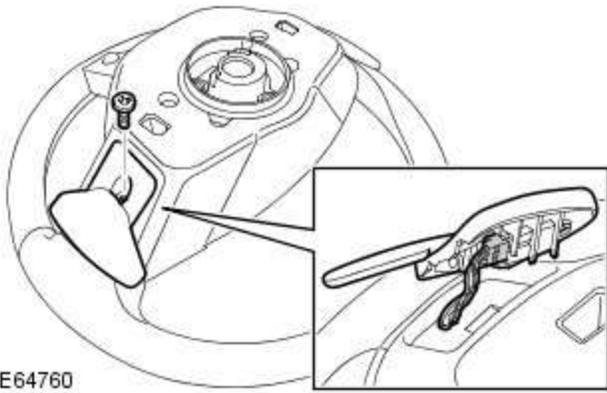
5. **CAUTIONS:**

 Failing to install the clockspring special tool, may result in damage to vehicle.

 Do not dismantle the clockspring, it has no serviceable parts and must be replaced as a complete assembly.

 Do not allow the clockspring to unwind.

Install the special tool to the clockspring.



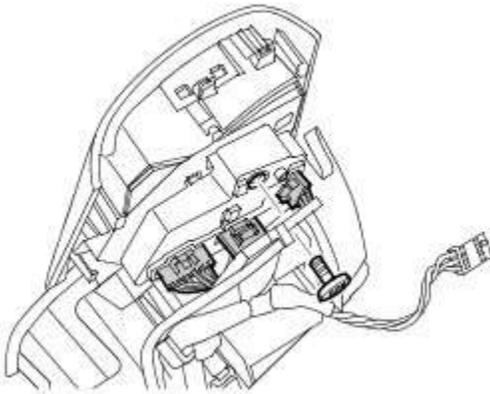
E64760



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

Remove the upshift and downshift paddle switches.

- Remove the Torx bolt.
- Release the assembly.
- Disconnect the electrical connector.
- Repeat the procedure and remove the opposite hand.



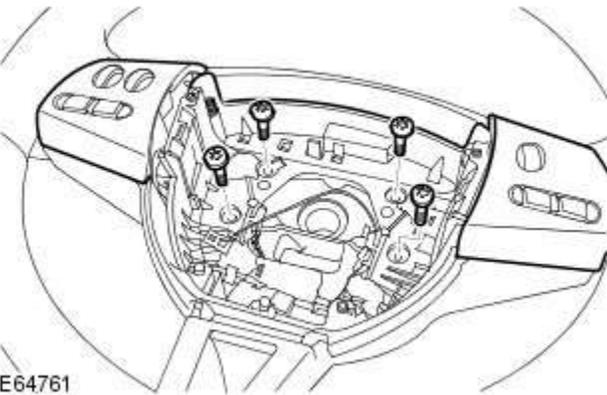
E64762



7. NOTE: The steering wheel is shown removed for clarity.

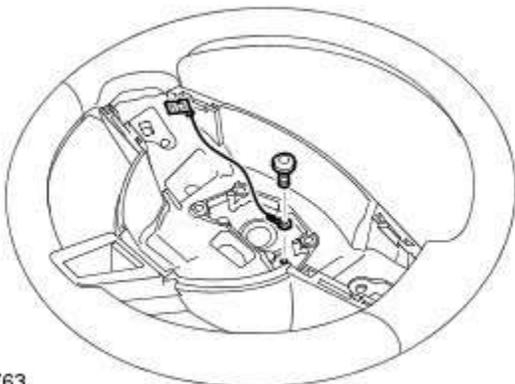
Release the steering wheel switch assembly.

- Remove the Torx bolt.
- Repeat the procedure and remove the opposite hand.



E64761

8. Remove the air bag housing.
- Remove the 4 Torx bolts.
 - Release the electrical harness.

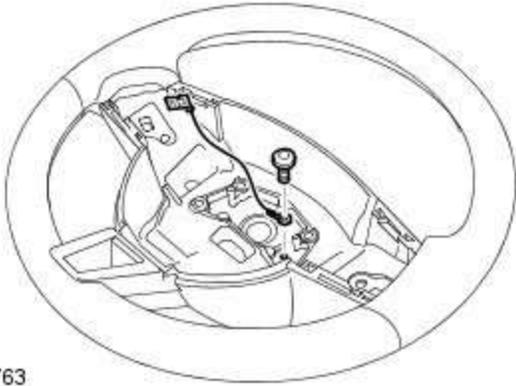


E64763

9. Remove the air bag ground cable.
- Remove the Torx screw.

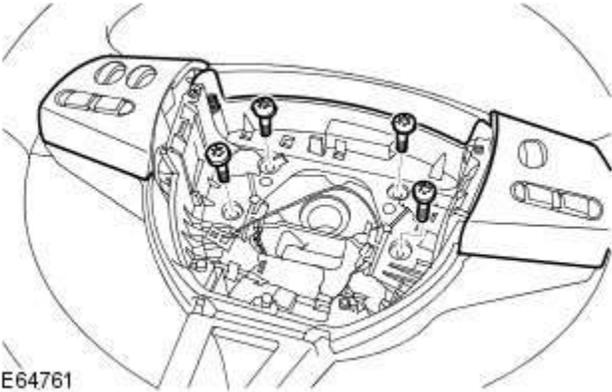
Installation

1. Install the air bag ground cable.
 - Install the Torx screw.



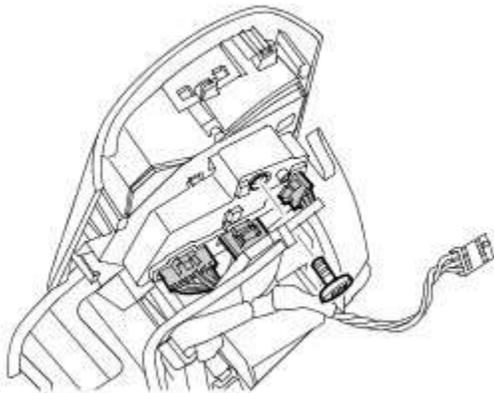
E64763

2. Install the air bag housing.
 - Secure the electrical harness.
 - Tighten to 6 Nm.

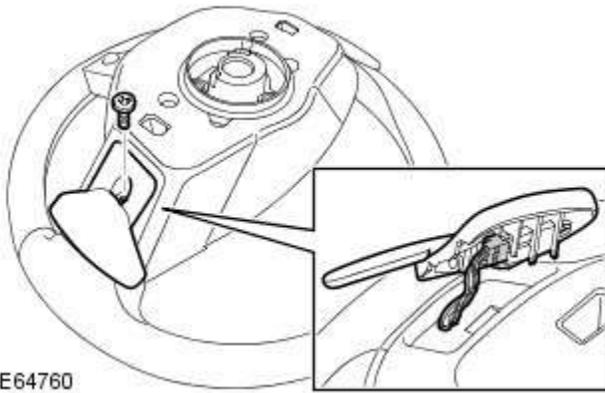


E64761

3. Secure the steering wheel switch assembly.
 - Connect and secure the electrical connectors.
 - Tighten to 3 Nm.
 - Repeat the above procedure on the opposite hand.

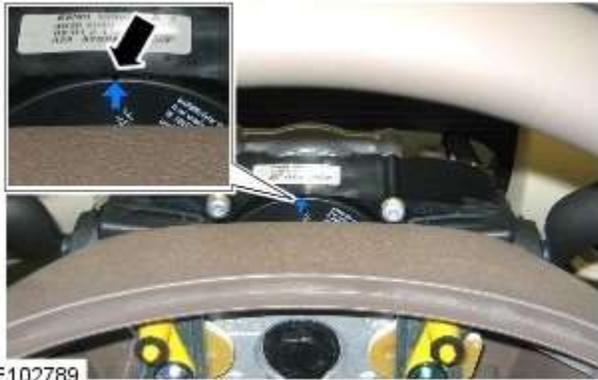


E64762



E64760

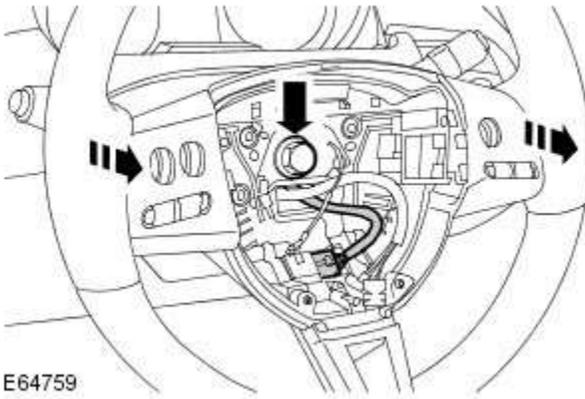
4. Install the upshift and downshift paddle switches.
 - Connect and secure the electrical connector.
 - Tighten to 3 Nm.
 - Repeat the above procedure on the opposite hand.



E102789

5.  CAUTION: Make sure that the arrow on the cassette is centered and pointing vertically prior to the steering wheel installation. On removal of the special tool keep the clockspring cables taught to prevent the cassette moving from the set position. Do not allow the clockspring to unwind. Failure to follow this instruction may result in damage to the component.

Remove the special tool.



E64759

6.  CAUTION: Check the alignment arrow is still in the vertical position with the wheels straight ahead to make sure that the directional indicator cancellation is central.

Install the steering wheel.

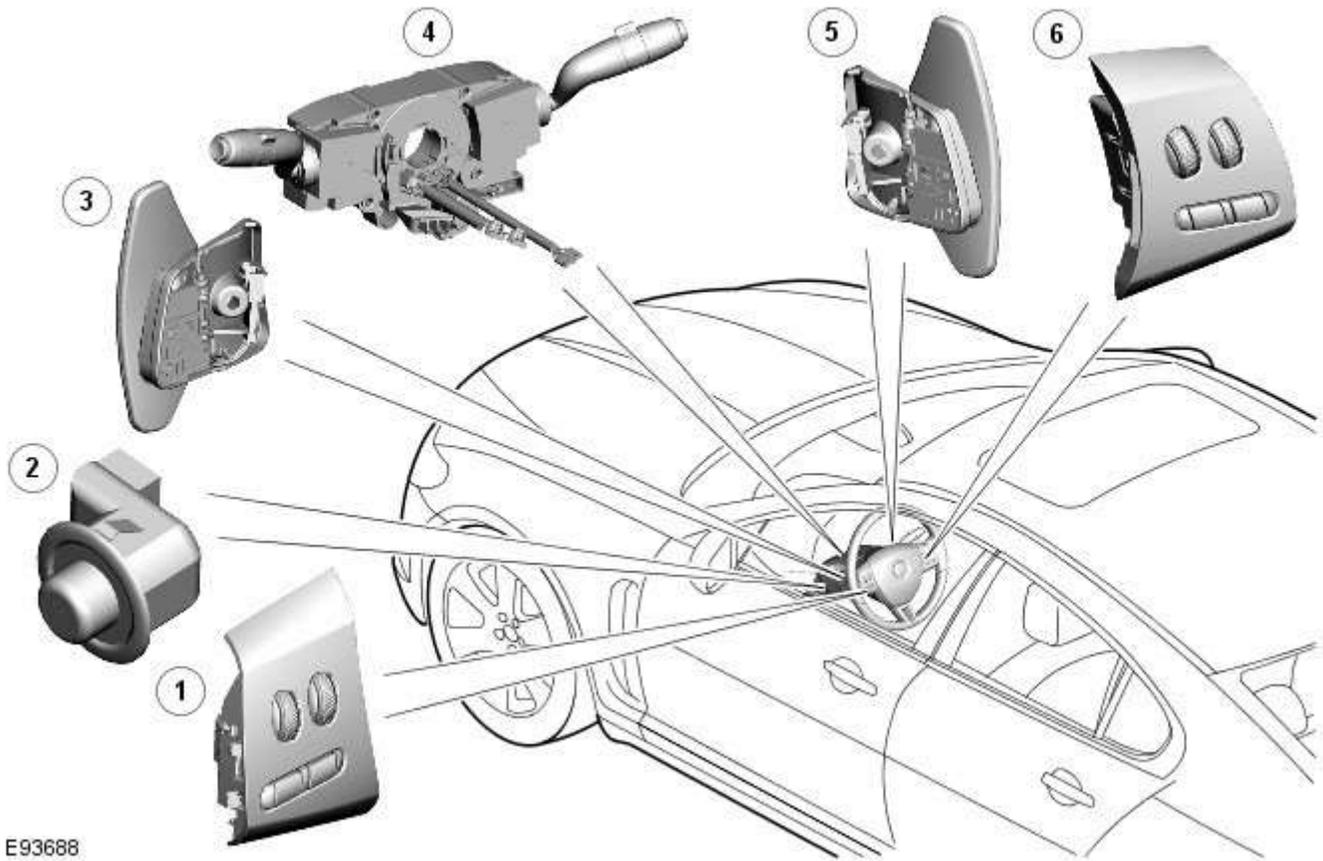
- Check the clockspring is aligned.
- Position the electrical harness.
- Connect the electrical connector.
- Tighten to 60 Nm.

7. Install the driver air bag module.
For additional information, refer to: [Driver Air Bag Module](#) (501-20B Supplemental Restraint System, Removal and Installation).
8. Connect the battery ground cable.
For additional information, refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).

Steering Column Switches - Steering Column Switches - Component Location

Description and Operation

STEERING COLUMN SWITCHES COMPONENT LOCATION



E93688

Item	Description
1	Audio and telephone switches
2	Steering column adjustment switch
3	LH (left-hand) (-) gear change paddle switch
4	Steering column multifunction switches and clockspring
5	RH (right-hand) (+) gear change paddle switch
6	Speed control switches (Adaptive Speed Control switch pack shown, non adaptive speed control switch pack similar)

Steering Column Switches - Steering Column Switches - Overview

Description and Operation

OVERVIEW

The steering column multifunction switch is situated on the steering column and consists of the wiper switch, the turn signal indicator/lighting switch and the trip computer switch.

The [RH \(right-hand\)](#) multifunction switch controls the following windshield wiper functions:

- Flick wipe
- Intermittent wipe
- Slow speed wipe
- High speed wipe
- Wash/Wipe
- Headlamp powerwash
- Rain sensing / variable wipe selection.

The [LH \(left-hand\)](#) multifunction switch controls the following functions:

- Turn signal indicators
- Side lamps
- Headlamps
- Auto lamps
- High/low beam
- Headlamp flash
- Headlamp timer
- Trip computer.

The steering column adjustment switch is located in the steering column lower shroud on the [LH](#) side. The switch is a 4 position 'joystick' which controls reach and rake adjustment.

The trip button allows the driver to cycle through an option menu and also reset trip cycle mileage calculations. The trip computer information is displayed in the instrument cluster message centre.

Steering wheel mounted switches on the [LH](#) side of the driver's airbag, control the audio and telephone functions. Switches on the [RH](#) side of the driver's airbag, control the speed control functions.

The steering wheel has an internal heating element. This is controlled by the driver via the Touch Screen Display (TSD).

7	Steering column adjustment switch
8	Steering column LH (left-hand) multifunction switch
9	Steering column RH (right-hand) multifunction switch
10	Instrument cluster
11	Speed control switches
12	Audio/telephone switches
13	Clockspring
14	Information and entertainment module
15	Media Oriented System Transport (MOST) ring connection to other vehicle systems
16	Medium speed CAN (controller area network) bus to other vehicle systems

System Operation

LEFT HAND MULTIFUNCTION SWITCH

Turn Signal Indicators

The instrument cluster outputs a reference voltage to the turn signal indicator switch. When the switch is in the central off position, the voltage flows through 3 resistors which are connected in series and back to the instrument cluster which monitors the signal and determines the turn signal indicators are off. This information is broadcast on the medium speed [CAN](#) bus to the [CJB](#).

When the switch is operated in the [LH](#) turn signal indicator position, the reference voltage from the instrument cluster is routed via 1 of the resistors. The returned signal voltage is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#). The [CJB](#) activates the applicable turn signal indicators until it receives an off message from the instrument cluster.

When the switch is operated in the [RH](#) turn signal indicator position, the reference voltage from the instrument cluster is routed via 2 of the resistors. The returned signal voltage is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#). The [CJB](#) activates the applicable turn signal indicators until it receives an off message from the instrument cluster.

Lighting Control Switch

The instrument cluster outputs 2 reference voltages to the rotary lighting control switch; one feed being supplied to the light selection function of the switch and the second feed being supplied to the autolamp exit delay function. The switch position is determined by instrument cluster by the change in returned signal voltage which is routed through up to 4 resistors in series depending on the selection made.

When the lighting control switch is in the off position, the reference voltage flows through 1 of the resistors. The returned signal voltage is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#) that no lighting selection is made. The reference voltage to the autolamp exit delay switch is routed through 4 resistors which is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#) that autolamp or exit delay has not been selected.

When the lighting control switch is in the sidelamp position, the reference voltage flows through 2 of the resistors. The returned signal voltage is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#) to activate the sidelamps. The reference voltage to the autolamp exit delay switch is routed through 4 resistors which is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#) that autolamp or exit delay has not been selected.

When the lighting control switch is in the headlamp position, the reference voltage flows through 3 of the resistors. The returned signal voltage is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#) to activate the headlamps. The reference voltage to the autolamp exit delay switch is routed through 4 resistors which is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#) that autolamp or exit delay has not been selected.

When the lighting control switch is in the autolamp position, the reference voltage flows through 4 of the resistors. The returned signal voltage is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#) to activate the autolamp function. The reference voltage to the autolamp exit delay switch is routed through 4 resistors which is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#) that autolamp has been selected.

Autolamp Exit Delay

When the lighting control switch is in any of the autolamp exit delay position, the lighting control switch reference voltage flows through 4 of the resistors. The returned signal voltage is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#) that autolamps has been selected.

Depending on the selected position, the reference voltage to the autolamp exit delay switch is routed through 3, 2 or 1 resistors which is detected by the instrument cluster. The cluster outputs a message on the medium speed [CAN](#) bus to the [CJB](#) that autolamp exit delay period has been selected at 30, 60 or 120 seconds respectively.

Trip Function Button

The instrument cluster outputs a reference voltage to the trip function button. When the function button is pressed a ground

path is completed and a signal voltage is returned to the instrument cluster via a resistor. The returned reference voltage is detected by the instrument cluster and performs the requested trip function.

RIGHT HAND MULTIFUNCTION SWITCH

The instrument cluster outputs 4 separate reference voltages to the following switch functions:

- Wash/wipe switch
- Intermittent wipe switch
- Master wiper switch
- Flick wipe switch.

Wash/Wipe Switch

The reference voltage is supplied to one of two resistors connected in parallel. When the switch is not being operated the current flows through one resistor and the returned signal voltage is monitored by the instrument cluster. When the wash/wipe switch is operated, a connection is made and the current flows through the second resistor. The change in signal voltage is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#) to activate the wash/wipe function.

Intermittent Delay/Auto Wipe Switch

The reference voltage is supplied to the switch and can pass through up to 7 resistors, connected in series, for intermittent delay selections and the auto wipe function.

When the rotary switch is in the auto position the reference voltage flows through 1 resistor. The returned signal voltage is detected by the instrument cluster which determines auto wipe is selected. The instrument cluster outputs a message on the medium speed [CAN](#) bus to the [CJB](#) to activate the auto wipe function.

With the rotary switch in one of the intermittent positions, the reference voltage is routed through up to 7 of the resistors depending on the delay period selected. The returned signal voltage is detected by the instrument cluster which determines selected delay period. The instrument cluster outputs a message on the medium speed [CAN](#) bus to the [CJB](#) to activate the selected intermittent wipe function.



NOTE: The delay period for the intermittent selections can vary according to vehicle speed.

Master Wiper Switch

The reference voltage supplied from the instrument cluster to the master wiper switch. The voltage can pass through up to 4 resistors connected in series.

When the switch is in the off position, the reference voltage passes through 4 resistors and the returned voltage is monitored by the instrument cluster. The instrument cluster outputs a message on the medium speed [CAN](#) bus to the [CJB](#) that no wiper selections have been requested.

With the switch in the intermittent, slow wipe or fast wipe position, the reference voltage passes through 3, 2 or 1 resistors respectively. The returned signal voltage is detected by the instrument cluster which determines selected delay period. The instrument cluster outputs a message on the medium speed [CAN](#) bus to the [CJB](#) to activate the selected wipe function.

Flick Wipe Switch

The reference voltage is supplied to one of two resistors connected in parallel. When the switch is not being operated the current flows through one resistor and the returned signal voltage is monitored by the instrument cluster. When the flick wipe switch is operated, a connection is made and the current flows through the second resistor. The change in signal voltage is detected by the instrument cluster which outputs a message on the medium speed [CAN](#) bus to the [CJB](#) to activate the flick wipe function.

STEERING COLUMN ADJUSTMENT SWITCH

The instrument cluster supplies 2 reference voltages to the column adjustment switch.

The first reference voltage is supplied to the joystick switch. When the switch is moved to one of its 4 positions, the switch contact is completed and the reference voltage is passed through one of 4 different resistors with different values. The returned signal voltage is measured by the instrument cluster which determines the selected column adjust request. The instrument cluster outputs a supply to the steering column adjustment motor and energizes the applicable clutch solenoid to move the column to the desired position.

The second reference voltage is supplied to the auto/manual selection of the switch. When the switch is in the auto position, the reference voltage passes directly through the switch contacts and is measured by the instrument cluster. The instrument cluster outputs a message on the medium speed [CAN](#) bus to the driver seat module which responds with the recorded memory position setting. The instrument cluster then activates the column adjustment motor and clutch solenoids to move the column to the memorized position. When the switch is in the manual position the reference circuit is broken. The instrument cluster detects the broken circuit and allows manual operation of the column adjustment switch to move the column.

HEATED STEERING WHEEL

The heated steering wheel receives a battery power supply via the [CJB](#). The heated steering wheel is controlled by the driver using a selection on the TSD. When the driver selects the heated steering wheel to be active, the request is passed from the TSD on the MOST ring to the information and entertainment module. The information and entertainment module converts the

message into a medium speed [CAN](#) bus message which is passed to the [CJB](#). The [CJB](#) processes the request and allows the battery power supply to be passed via the slip ring assembly in the steering wheel to the heated steering wheel control module. The steering wheel module supplies power to the steering wheel heater element and also monitors the temperature via a [NTC \(negative temperature coefficient\)](#) temperature sensor incorporated into the heater element. The control module varies the power supply to the element to maintain the steering wheel rim at the optimum temperature.

Component Description

STEERING COLUMN MULTIFUNCTION SWITCHES

The steering column multifunction switches are situated on the steering column and consists of the wiper switch, the turn signal indicator/lighting switch and the trip computer switch.

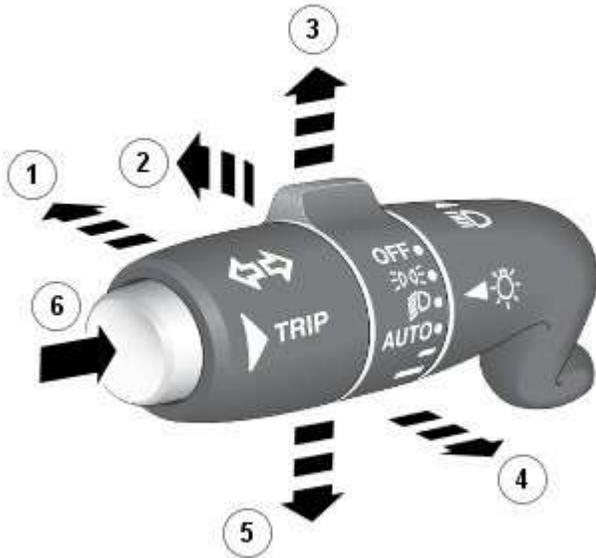
The steering column adjustment switch is located in the steering column lower shroud on the [LH](#) side. The switch is a 4 position 'joystick' which controls reach and rake adjustment.

Steering wheel mounted switches on the [LH](#) side of the driver's airbag, control the audio and telephone functions. Switches on the [RH](#) side of the driver's airbag, control the speed control functions. For additional information, refer to:

[Audio System](#) (415-01A Information and Entertainment System, Description and Operation),
[Speed Control](#) (310-03A, Description and Operation),
[Speed Control](#) (310-03B, Description and Operation),
[Speed Control](#) (310-03C, Description and Operation).

Two transmission paddle switches are located at the rear of the steering wheel.
Refer to: [External Controls](#) (307-05, Description and Operation).

LH Multifunction Switch



E97751

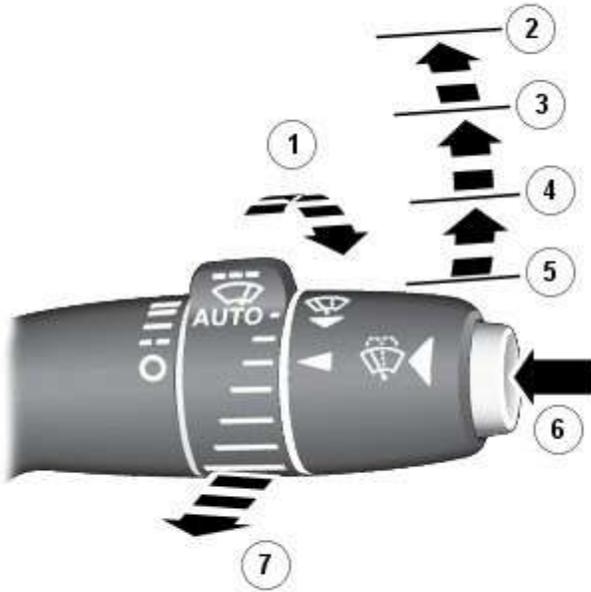
Item	Description
1	High beam
2	Lighting control rotary switch
3	RH turn signal indicator
4	Headlamp flash
5	LH turn signal indicator
6	Trip computer function button

The [LH](#) multifunction switch controls the following windshield wiper functions:

- Turn signal indicators
- Side lamps
- Headlamps
- Auto lamps
- High/low beam
- Headlamp flash
- Headlamp timer
- Trip computer.

The switch is located in a slot in the clockspring and secured with 2 plastic clips.

RH Multifunction Switch



E97752

Item	Description
1	Auto/intermittent rotary switch
2	Fast wipe
3	Slow wipe
4	Intermittent wipe
5	Off position
6	Wash/wipe
7	Flick wipe

The RH multifunction switch controls the following windshield wiper functions:

- Flick wipe
- Intermittent wipe
- Slow speed wipe
- High speed wipe
- Wash/Wipe
- Headlamp powerwash
- Rain sensing / variable wipe selection.

The switch is located in a slot in the clockspring and secured with 2 plastic clips.

STEERING COLUMN ADJUSTMENT SWITCH

The column adjustment switch is located in the steering column lower shroud and held in place with a spring clip. The switch allows the adjustment of the steering column for both reach and rake angle. The switch has an auto position which allows the desired position of the column to be set by the driver using the driver's seat memory buttons. The column position is

automatically reset once the applicable remote handset has been detected by the vehicle security systems.

STEERING WHEEL HEATER

On certain models the rim of the steering wheel contains a heater element. Operation of the heater is selected using the Touch Screen Display (TSD).

The heater temperature is controlled by a heated steering wheel control module located within the steering wheel. Power for the heater element is supplied to the steering wheel via 2 contacts on the clockspring and a slip ring mounted on the steering wheel.

Steering Column Switches - Steering Column Switches

Diagnosis and Testing

Principle of Operation

For a detailed description of the steering column lock and switches, refer to the relevant Description and Operation section in the workshop manual. REFER to: (211-05 Steering Column Switches)

[Steering Column Switches](#) (Description and Operation),

[Steering Column Switches](#) (Description and Operation),

[Steering Column Switches](#) (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.

1. Verify the customer concern.
2. Visually inspect for obvious signs of damage and system integrity.

Visual Inspection

Mechanical	Electrical
<ul style="list-style-type: none"> • Switches • Steering column lock 	<ul style="list-style-type: none"> • Fuse(s) • Electrical connector(s) • Wiring Harness

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, check for 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: Central Junction Box \(CJB\)](#) (100-00 General Information, Description and Operation).

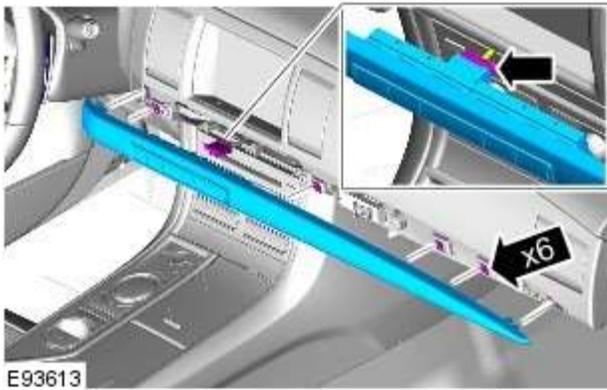
Steering Column Switches - Hazard Flasher Switch

Removal and Installation

Removal

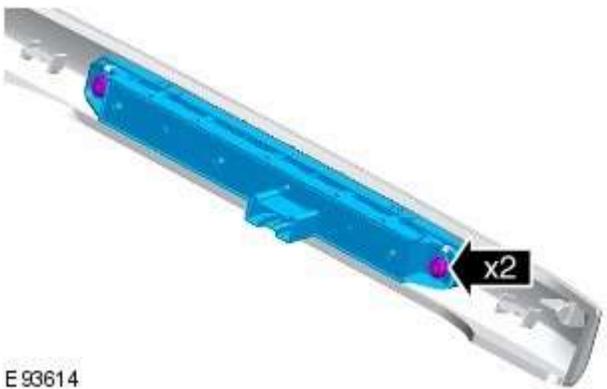


NOTE: Removal steps in this procedure may contain installation details.



E93613

1.  NOTE: When removing the component, some of the clips may remain attached. These clips should be removed and returned to their original positions in the instrument panel.



E93614

- 2.

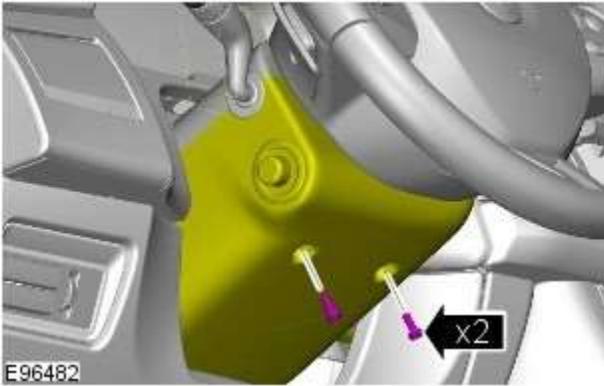
Installation

1. To install, reverse the removal procedure.

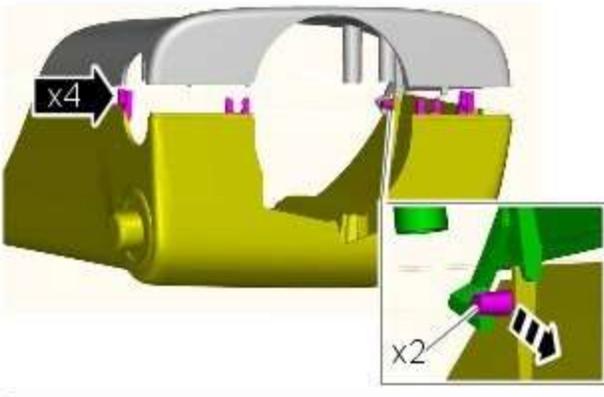
Steering Column Switches - Steering Column Multifunction Switch LH

Removal and Installation

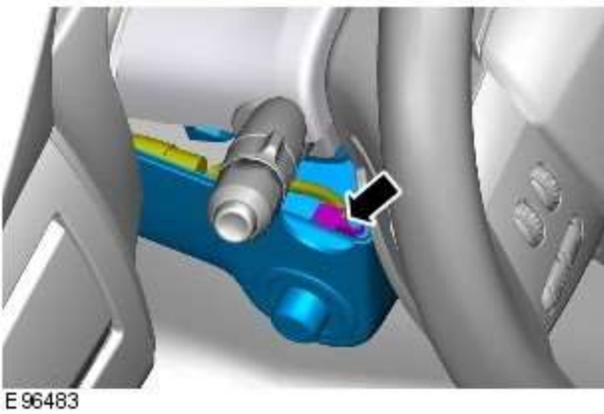
Removal



1.

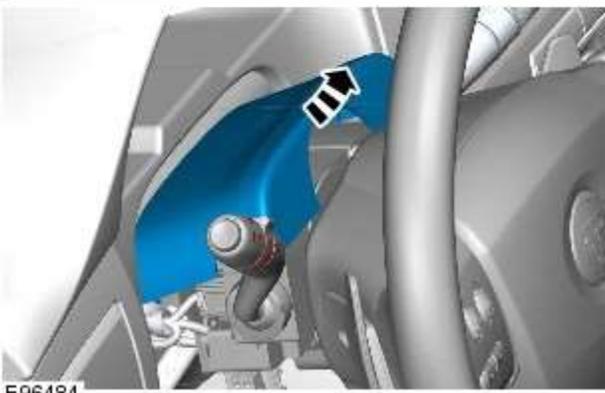
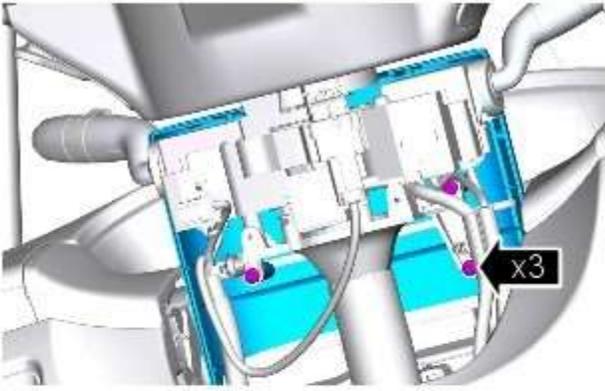


2.

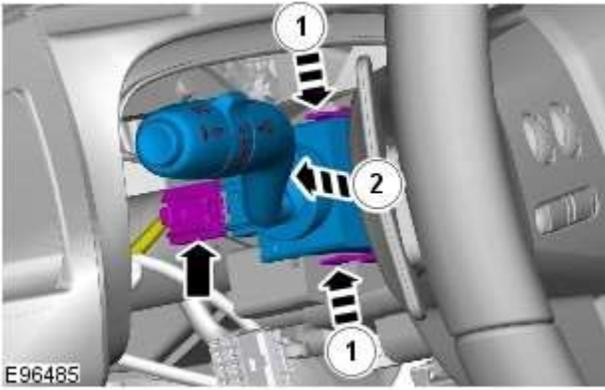


E 96483

3.



4.



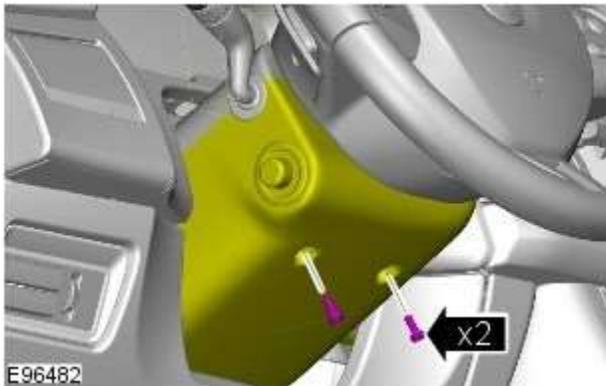
Installation

1. To install, reverse the removal procedure.

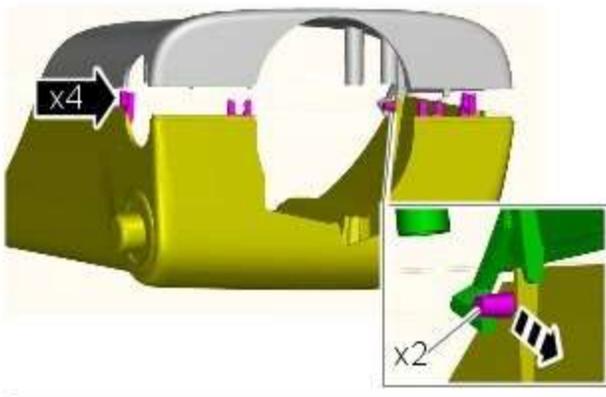
Steering Column Switches - Steering Column Multifunction Switch RH

Removal and Installation

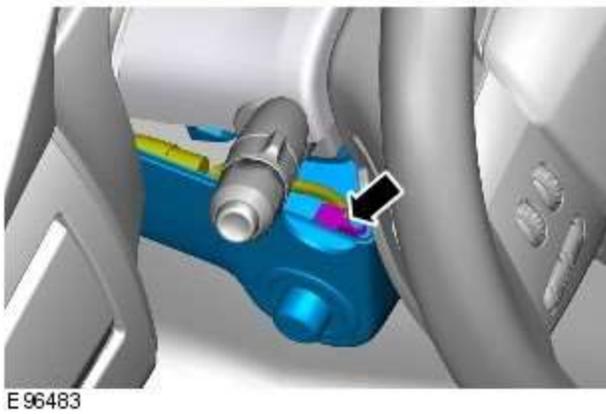
Removal



1.

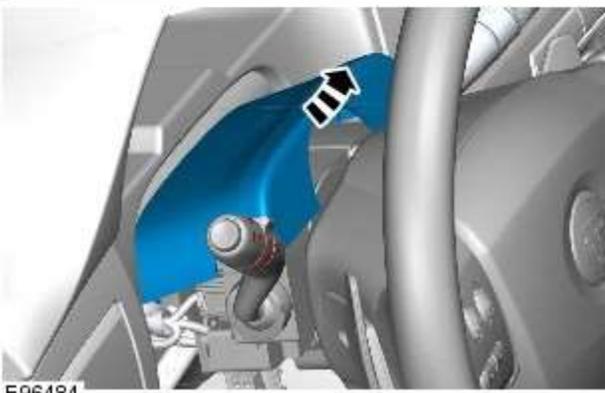
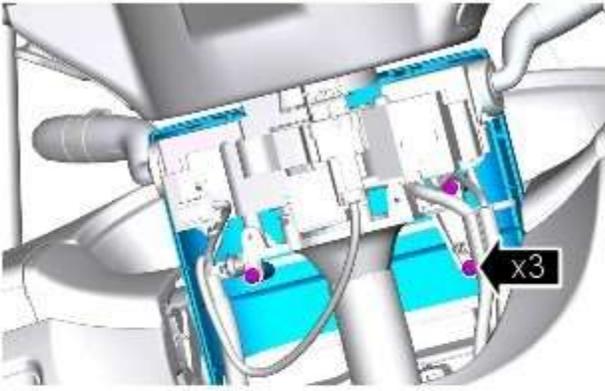


2.



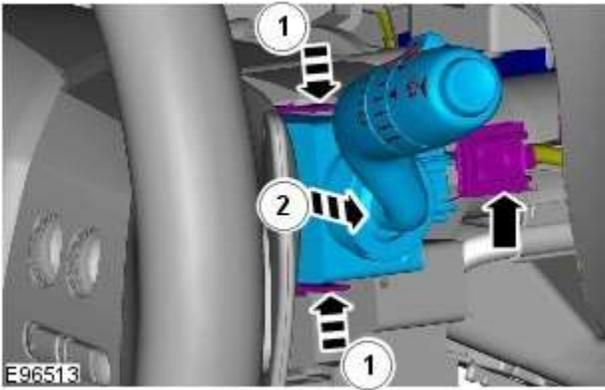
E 96483

3.



E96484

4.



E96513

Installation

1. To install, reverse the removal procedure.

Steering Column Switches - Steering Column Lock Actuator

Removal and Installation

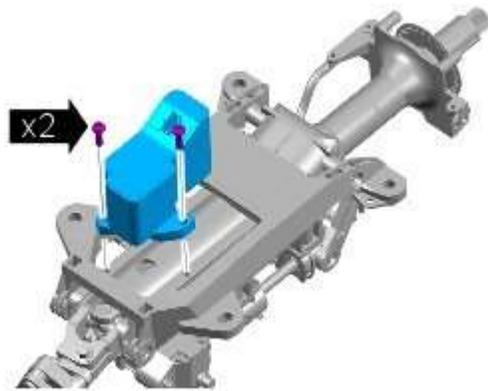
Removal



NOTE: Removal steps in this procedure may contain installation details.

1. Refer to: [Battery Disconnect and Connect](#) (414-01 Battery, Mounting and Cables, General Procedures).
2. Refer to: [Steering Column](#) (211-04 Steering Column, Removal and Installation).

3. **Torque:** 12 Nm



Installation

1. To install, reverse the removal procedure.