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Suspension System - General Information -

Air Spring Suspension

Item	Specification
Type	Independent with standard/Dynamic Response stabilizer bars, and air springs with multiple, driver selectable ride heights - Standard, off-road and access.

Wheel Alignment Specification (All Markets) - Front LHD - Vehicles with 5.0L Supercharged and diesel vehicles with Dynamic Response

 CAUTION: When checking or adjusting front or rear steering geometry, the vehicle must either have a full fuel tank or have sufficient weight placed in the vehicle's load space to give the equivalent weight of a full fuel tank. The weight must be evenly distributed at the front and the right hand side of the load space. The fuel tank capacity is 86.3 litres (18.9 Imperial gallons) (22.7 US gallons). Depending on the amount of fuel in the tank, calculate the amount of weight which must be added:

- 1 litre of fuel weighs 0.8 kg (1.7 pounds)
- 1 Imperial gallon of fuel weighs 3.6 kg (8.0 pounds)
- 1 US gallon of fuel weighs 3.0 kg (6.7 pounds)

 NOTE: All figures are with vehicle at 'Showroom' ride height - full fluids, full tank of fuel, no occupants/luggage, tires inflated to normal pressures

Item		Left-hand		Right-hand		Total/Balance	
Camber		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	-0.63°	± 0.75°	-0.75°	± 0.75°	0.12°	± 0.75°
	Degrees/minutes	-38'	± 45'	-45'	± 45'	7'	± 45'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	-1.38°	0.12°	-1.50°	0.00°	-0.63°	0.87°
	Degrees/minutes	-1°23'	7'	-1°30'	0'	-38'	52'
Castor		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	3.96°	± 0.75°	4.07°	± 0.75°	-0.11°	± 0.75°
	Degrees/minutes	3°58'	± 45'	4°4'	± 45'	-7'	± 45'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	3.21°	4.71°	3.32°	4.82°	-0.86°	0.64°
	Degrees/minutes	3°13'	4° 43'	3°19'	4° 49'	-52'	38'
Toe		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	0.08°	±0.10°	0.08°	±0.10°	0.15°	±0.20°
	Degrees/minutes	5'	±6'	5'	±6'	9'	±12'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	-0.03°	0.18°	-0.03°	0.18°	-0.05°	0.35°
	Degrees/minutes	-2'	11'	-2'	11'	-3'	21'

Wheel Alignment Specification (All Markets) - Front LHD - Vehicles with 5.0L Naturally Aspirated and diesel vehicles without Dynamic Response

 CAUTION: When checking or adjusting front or rear steering geometry, the vehicle must either have a full fuel tank or have sufficient weight placed in the vehicle's load space to give the equivalent weight of a full fuel tank. The weight must be evenly distributed at the front and the right hand side of the load space. The fuel tank capacity is 86.3 litres (18.9 Imperial gallons) (22.7 US gallons). Depending on the amount of fuel in the tank, calculate the amount of weight which must be added:

- 1 litre of fuel weighs 0.8 kg (1.7 pounds)
- 1 Imperial gallon of fuel weighs 3.6 kg (8.0 pounds)
- 1 US gallon of fuel weighs 3.0 kg (6.7 pounds)

 NOTE: All figures are with vehicle at 'Showroom' ride height - full fluids, full tank of fuel, no occupants/luggage, tires inflated to normal pressures

Item		Left-hand		Right-hand		Total/Balance	
Camber		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	-0.38°	± 0.75°	-0.50°	± 0.75°	0.12°	± 0.75°
	Degrees/minutes	-23'	± 45'	-30'	± 45'	7'	± 45'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	-1.13°	0.37°	-1.25°	0.25°	-0.63°	0.87°
	Degrees/minutes	-1°8'	22'	-1°15'	15'	-38'	52'
Castor		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	3.96°	± 0.75°	4.07°	± 0.75°	-0.11°	± 0.75°
	Degrees/minutes	3°58'	± 45'	4°4'	± 45'	-7'	± 45'

		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
	Decimal degrees	3.21°	4.71°	3.32°	4.82°	-0.86°	0.64°
	Degrees/minutes	3°13'	4° 43'	3°19'	4°49'	-52'	38'
Toe		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	0.05°	±0.10°	0.05°	±0.10°	0.10°	±0.20°
	Degrees/minutes	3'	±6'	3'	±6'	6'	±12'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	-0.05°	0.15°	-0.05°	0.15°	-0.10°	0.30°
	Degrees/minutes	-3'	9'	-3'	9'	-6'	18'

Wheel Alignment Specification (All Markets) - Front RHD - Vehicles with 5.0L Supercharged and diesel vehicles with Dynamic Response

CAUTION: When checking or adjusting front or rear steering geometry, the vehicle must either have a full fuel tank or have sufficient weight placed in the vehicle's load space to give the equivalent weight of a full fuel tank. The weight must be evenly distributed at the front and the right hand side of the load space. The fuel tank capacity is 86.3 litres (18.9 Imperial gallons) (22.7 US gallons). Depending on the amount of fuel in the tank, calculate the amount of weight which must be added:

- 1 litre of fuel weighs 0.8 kg (1.7 pounds)
- 1 Imperial gallon of fuel weighs 3.6 kg (8.0 pounds)
- 1 US gallon of fuel weighs 3.0 kg (6.7 pounds)

NOTE: All figures are with vehicle at 'Showroom' ride height - full fluids, full tank of fuel, no occupants/luggage, tires inflated to normal pressures

Item		Left-hand		Right-hand		Total/Balance	
Camber		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	-0.75°	± 0.75°	-0.63°	± 0.75°	-0.12°	± 0.75°
	Degrees/minutes	-45'	± 45'	-38'	± 45'	-7'	± 45'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	-1.50°	0.00°	-1.38°	0.12°	-0.87°	0.63°
	Degrees/minutes	-1°30'	0'	-1°23'	7'	-52'	38'
Castor		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	4.07°	± 0.75°	3.96°	± 0.75°	0.11°	± 0.75°
	Degrees/minutes	4°4'	± 45'	3°58'	± 45'	7'	± 45'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	3.32°	4.82°	3.21°	4.71°	-0.64°	0.86°
	Degrees/minutes	3°19'	4° 49'	3°13'	4° 43'	-38'	52'
Toe		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	0.08°	±0.10°	0.08°	±0.10°	0.15°	±0.20°
	Degrees/minutes	5'	±6'	5'	±6'	9'	±12'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	-0.03°	0.18°	-0.03°	0.18°	-0.05°	0.35°
	Degrees/minutes	-2'	11'	-2'	11'	-3'	21'

Wheel Alignment Specification (All Markets) - Front RHD - Vehicles with 5.0L Naturally Aspirated and diesel vehicles without Dynamic Response

CAUTION: When checking or adjusting front or rear steering geometry, the vehicle must either have a full fuel tank or have sufficient weight placed in the vehicle's load space to give the equivalent weight of a full fuel tank. The weight must be evenly distributed at the front and the right hand side of the load space. The fuel tank capacity is 86.3 litres (18.9 Imperial gallons) (22.7 US gallons). Depending on the amount of fuel in the tank, calculate the amount of weight which must be added:

- 1 litre of fuel weighs 0.8 kg (1.7 pounds)
- 1 Imperial gallon of fuel weighs 3.6 kg (8.0 pounds)
- 1 US gallon of fuel weighs 3.0 kg (6.7 pounds)

NOTE: All figures are with vehicle at 'Showroom' ride height - full fluids, full tank of fuel, no occupants/luggage, tires inflated to normal pressures

Item		Left-hand		Right-hand		Total/Balance	
Camber		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	-0.50°	± 0.75°	-0.38°	± 0.75°	-0.12°	± 0.75°
	Degrees/minutes	-30'	± 45'	-23'	± 45'	-7'	± 45'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	-1.25°	0.25°	-1.13°	0.37°	-0.87°	0.63°
	Degrees/minutes	-1°15'	15'	-1°8'	22'	-52'	38'
Castor		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**

	Decimal degrees	4.07°	± 0.75°	3.96°	± 0.75°	0.11°	± 0.75°
	Degrees/minutes	4°4'	± 45'	3°58'	± 45'	7'	± 45'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	3.32°	4.82°	3.21°	4.71°	-0.64°	0.86°
	Degrees/minutes	3°19'	4° 49'	3°13'	4° 43'	-38'	52'
Toe		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	0.05°	±0.10°	0.05°	±0.10°	0.10°	±0.20°
	Degrees/minutes	3'	±6'	3'	±6'	6'	±12'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	-0.05°	0.15°	-0.05°	0.15°	-0.10°	0.30°
	Degrees/minutes	-3'	9'	-3'	9'	-6'	18'

Wheel Alignment Specification (All Markets) - Rear

NOTE: All figures are with vehicle at 'Showroom' ride height - full fluids, full tank of fuel, no occupants/luggage, tires inflated to normal pressures

Item		**Left-hand**		**Right-hand**		**Total/Balance**		**Thrust Angle**	
Camber		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**				
	Decimal degrees	-1.00°	± 0.75°	-1.00°	± 0.75°				
	Degrees/minutes	-1°	± 45'	-1°	± 45'				
		Minimum	**Maximum**	**Minimum**	**Maximum**				
	Decimal degrees	-1.75°	-0.25°	-1.75°	-0.25°				
	Degrees/minutes	-1°45'	-15'	-1°45'	-15'				
Toe		**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**	**Nominal**	**Tolerance**
	Decimal degrees	0.10°	± 0.10°	0.10°	± 0.10°	0.19°	± 0.14°	0°	± 0.14°
	Degrees/minutes	6'	± 6'	6'	± 6'	11'	± 8'	0'	± 8'
		Minimum	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**	**Minimum**	**Maximum**
	Decimal degrees	0.00°	0.20°	0.00°	0.20°	0.05°	0.33°	-0.14°	0.14°
	Degrees/minutes	0'	12'	0'	12'	3'	20'	-8'	8'

Suspension System - General Information - Suspension System

Diagnosis and Testing

Principle of Operation

For a detailed description of the Suspension System and operation, refer to the relevant Description and Operation section of the workshop manual.

Inspection and Verification

 WARNING: Before carrying out a road test, make sure the vehicle is safe to do so. Failure to follow this instruction may result in personal injury.

 CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

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

1. Gather as much information from the driver as possible and verify the customer concern by carrying out a road test, as closely as possible reproducing the conditions under which the fault occurs.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
• Tire pressures • Damaged wheels or tires • Wheel bearing(s) • Loose or damaged front or rear suspension components • Loose, damaged or missing suspension fastener(s) • Damaged or leaking air suspension components • Worn or damaged suspension bushing(s) • Loose, worn or damaged steering system components • Damaged axle components • Damaged Chassis

3. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the symptom chart.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Crabbing	• Incorrect rear thrust angle • Front or rear suspension components	• Check the rear alignment • Check the front and rear suspension for signs of damage or wear
Drift/Pull/Wander	• Tire pressures • Uneven tire wear • Damaged steering components • Wheel alignment • Brake drag • Unevenly loaded or overloaded vehicle	• Check and adjust the tire pressures (see visual inspection) • Check for uneven tire wear, investigate the cause and rectify as necessary • Check the steering for wear/damage • Check and adjust the wheel alignment as necessary • Check for binding brakes, rectify as necessary • Advise the driver of the load issues
Front bottoming or riding low	• Damaged suspension components • Air spring fault	• Check the suspension components for damage • Check the dynamic suspension
Uneven tire wear	• Incorrect tire pressure (rapid centre rib or inner and outer edge wear) • Incorrect front or rear toe (rapid inner or outer edge wear) • Incorrect camber (rapid inner or outer edge wear) • Tires out of balance (tires cupped or dished)	• Check and adjust the tire pressures (see visual inspection) • Check and adjust the wheel alignment as necessary • Balance the wheels and tires as necessary

Harsh ride	• Damaged suspension components • Air spring fault	• Check the suspension components for damage • Check the dynamic suspension
Shimmy or wheel tramp	• Wheels/tires • Loose wheel nut(s) • Loose front suspension fasteners • Front wheel bearing(s) fault • Worn or damaged suspension component bushing • Loose, worn or damaged ball joint(s) • Loose, worn or damaged steering components • Front wheel alignment	• Check the wheels and tires for condition and balance • Check and tighten the wheel nuts and suspension fasteners to specification • Check the front wheel bearings, suspension bushings, ball joints and steering components for wear or damage • Check and adjust the wheel alignment as necessary
Poor return ability of the steering (self-centering)	• Steering column • Ball joints • Steering components	• Check the steering column universal joints, etc • Check the ball joints and other steering components
Sway or roll	• Loose front or rear stabilizer bar • Worn lower suspension arm stabilizer bar insulators • Air spring fault	• Check the stabilizer bar security and condition. Rectify as necessary • Check the function of the active stabilization system (where installed) • Check the air springs
Vehicle leans to one side	• Front or rear suspension components • Air spring fault	• Check the front and rear suspension • Check the air springs

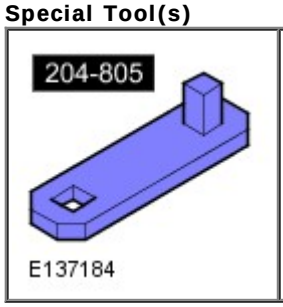
DTC Index

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: Air Suspension Control Module (100-00 General Information, Description and Operation).

Suspension System - General Information - Four-Wheel Alignment

General Procedures

Special Tool(s)

	204-805

CAUTIONS:

Make sure the vehicle is on a flat level surface.

Make sure the tire pressures are within specification.

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

Make sure the vehicles fuel tank is full, if not distribute extra weight evenly over the fuel tank area to represent a full tank of fuel.

Make sure there are no heavy objects in the vehicle.

Make sure the air suspension is set to NORMAL ride height.

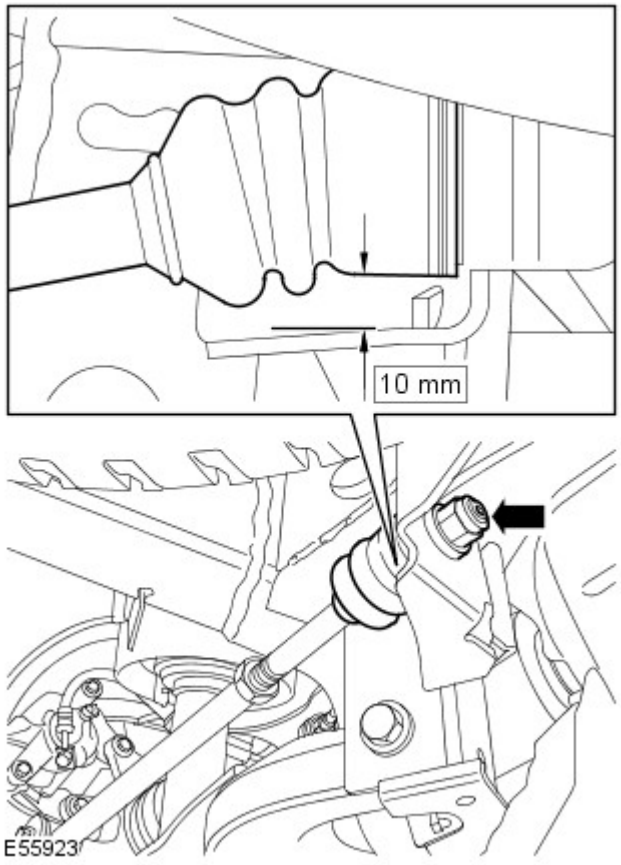
Make sure the steering is in the straight ahead position.

Make sure the slip plates (turntables) are free to move before adjusting the geometry.

NOTE: This procedure can be used for vehicles with either air or coil spring suspension.

1. Check the tie rod ends, suspension joints, wheel bearings and wheels and tires for damage, wear and free play.
   - Adjust or repair any worn, damaged or incorrectly adjusted components.
2. Check and adjust tire pressures.
3. Position the vehicle on a calibrated, level, vehicle lift.
4. Release the vehicle parking brake.
5. Vehicles with dynamic suspension: Using the approved diagnostic tool, check the air suspension control module for fault codes and clear as required.
6. Vehicles with dynamic suspension: Using the diagnostic tool, set vehicle to 'Geometry Set Mode', using the instructions below. Putting the vehicle into this mode will make sure that the ride heights are controlled more accurately.
   1. Select the 'Configuration' tab
   2. Select 'Set up and Configure'.
   3. Select 'Air Suspension'.
   4. Select 'Suspension Geometry Set Up'.
   5. Select 'Tight Tolerance Mode'.
   6. Follow the on-screen instructions until the set up process has finished.
7. NOTE: If rear camber adjustment is required, loosen the rear camber adjustment bolts enough to allow adjustment before starting any other wheel alignment adjustments. Do not fully loosen the rear camber adjustment bolts.

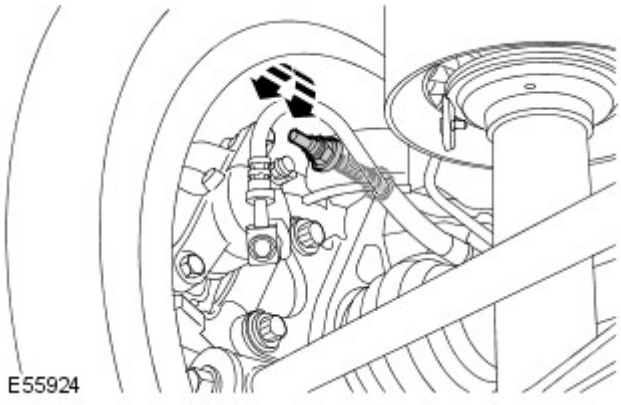
Using only four wheel alignment equipment approved by Land Rover, check and adjust the wheel alignment.



8. CAUTION: Make sure the toe link anti-rotation tang is fully seated in the integrated body frame before tightening the toe link retaining nut. Failure to follow this instruction will result in damage to the toe link or integrated body frame.

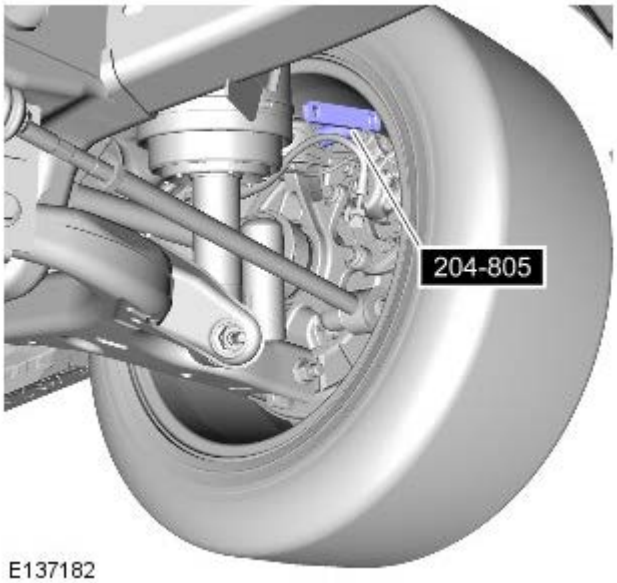
   NOTE: This step is only required if the toe links have been removed or replaced.

   Adjust the rear bump steer.
   - Loosen the toe link inner ball joint retaining nut.
   - Set the gap, between the underside of the toe link rubber boot and the integrated body frame bracket, to 10 mm (0.473 in).
   - Tighten the toe link inner ball joint retaining nut to 133 Nm (98 lb.ft)
   - Repeat the above procedure for the other side.

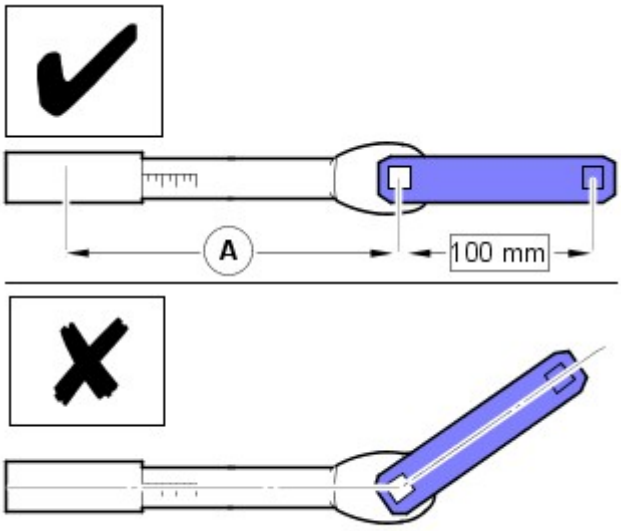


9. Adjust the rear camber.
   - Loosen the rear camber adjusting bolts.
   - Rotate the rear camber adjusting bolt until the correct value is obtained.
   - Repeat the above procedure for the other side.
   - Tighten the rear camber adjusting bolts.

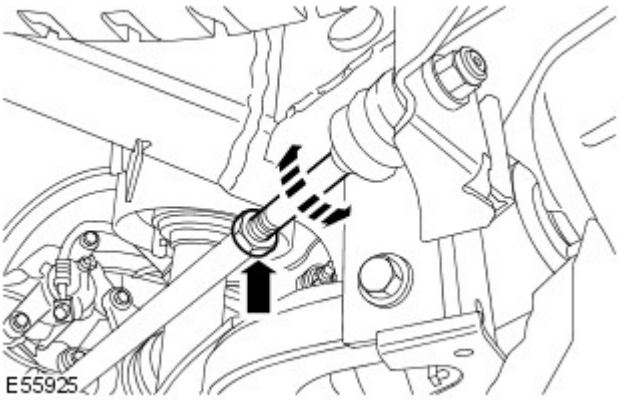
10. Install the special tool and a suitable socket to the rear camber adjusting bolt retaining nut.



E137182



E137185


E55925

11. NOTES:

The torque wrench must be installed in a direct line with the special tool, as shown.

Calculate the torque wrench setting using the formula below.

Key to letters:

- **A** = Effective length of the torque wrench, measured in mm.

Formula:

- **Torque wrench setting (Nm) = (133xA)/(A+100)**

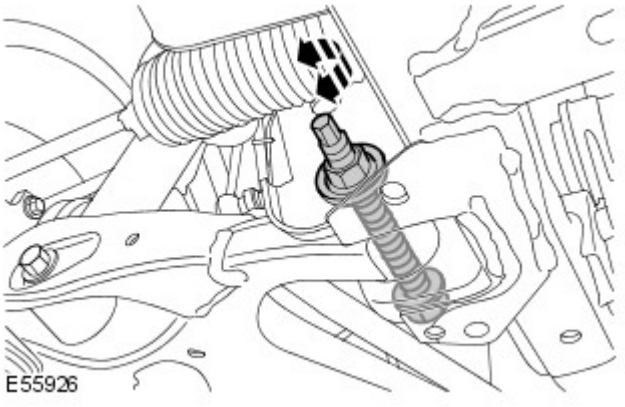
Using the special tool, a suitable extension bar and a torque wrench, fully tighten the camber adjusting bolt retaining nut.

- Use the torque wrench setting calculated above.
- Repeat the above procedure for the other side.

12. Adjust the rear toe.
    - Loosen the toe link adjustment locking nut.
    - Rotate the toe link inner ball joint until the correct rear toe value is obtained.
    - Tighten the toe link adjustment locking nut to 130 Nm (96 lb.ft).
    - Repeat the above procedure for the other side.
    - Repeat the rear toe measurement.

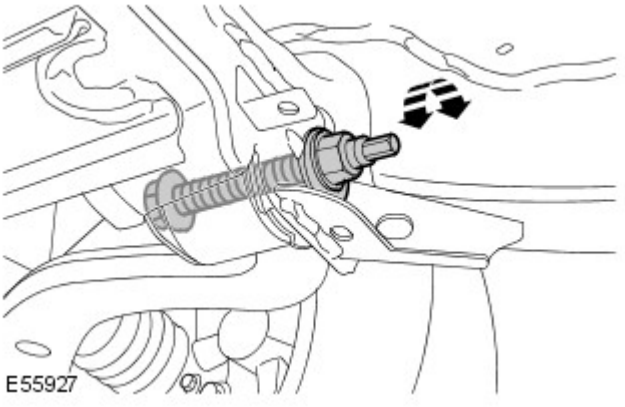
13. CAUTION: Make sure the slip plates (turntables) are free to move before adjusting the geometry.

    Adjust the front camber.
    - Loosen the lower arm front camber adjusting bolt.
    - Rotate the front camber adjusting bolt until the correct value is obtained.

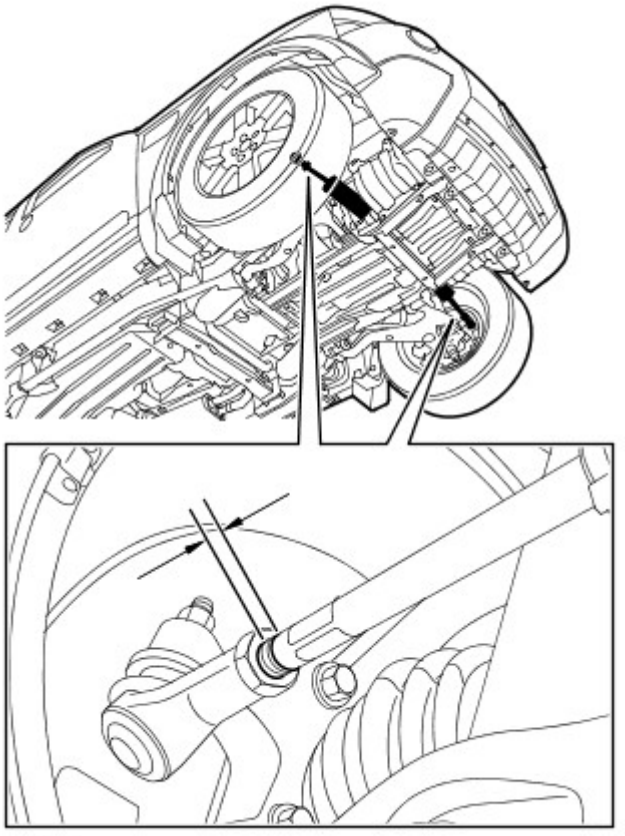


- Tighten the lower arm front camber adjusting bolt to 275 Nm (203 lb.ft).
- Repeat the above procedure for the other side.

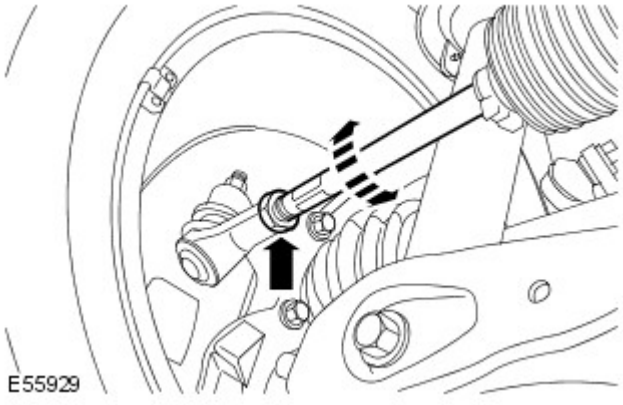
14. Adjust the front castor.
    - Loosen the lower arm rear castor adjusting bolt.
    - Rotate the castor adjusting bolt until the correct value is obtained.
    - Tighten the lower arm rear castor adjusting bolt.
    - Repeat the above procedure for the other side.
    - Repeat the castor measurement.
    - Repeat the above procedure until both castors achieve the correct value.
    - Tighten the lower arm rear castor adjusting bolts to 275 Nm (203 lb.ft).



15. Align the steering to straight ahead.
    - Measure the length of the exposed thread on each track rod.
    - If the exposed thread lengths differ by more than two millimetres:
    - Stage one: Loosen one track rod end locking nut.
    - Stage two: Rotate the track rod until the lengths of the exposed threads on both track rods are equal.
    - Stage three: Tighten the track rod end locking nut.
    - Stage four: Rotate the steering wheel until both front toe measurements are equal.



16. Adjust the front toe.
    - Loosen the track rod end locking nuts.
    - Rotate the track rods to adjust each individual front toe to the correct value.
    - Tighten the track rod end locking nuts to 53 Nm (39 lb.ft).



17. Vehicles with dynamic suspension: Using the diagnostic tool, return the vehicle to 'Normal Mode'.
    1. Select the 'Configuration' tab
    2. Select 'Set up and Configure'.
    3. Select 'Air Suspension'.
    4. Select 'Suspension Geometry Set Up'.
    5. Select 'Normal Mode'.
    6. Follow the on-screen instructions until the normal mode process has finished.

18. Calibrate the steering angle sensor using the diagnostic tool.

Suspension System - General Information - Front Wheel Bearing and Wheel Hub Runout Check

General Procedures

NOTES:

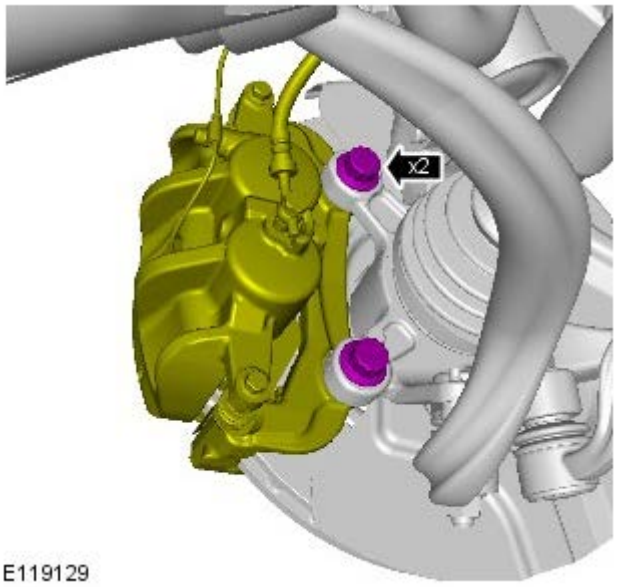
Some variation in the illustrations may occur, but the essential information is always correct.

LH illustration shown, RH is similar.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the road wheel.



E119129

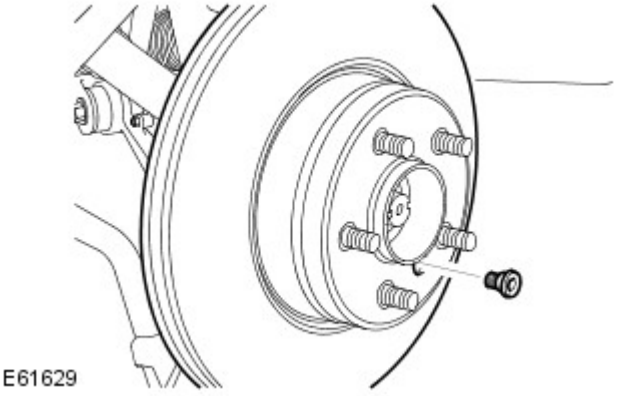
3. CAUTIONS:

   Do not allow the brake caliper to hang on the brake hose.

   LH side: Do not allow the brake caliper to hang on the brake pad wear warning sensor lead.

   NOTE: Models with standard brakes shown, models with high performance brakes similar.

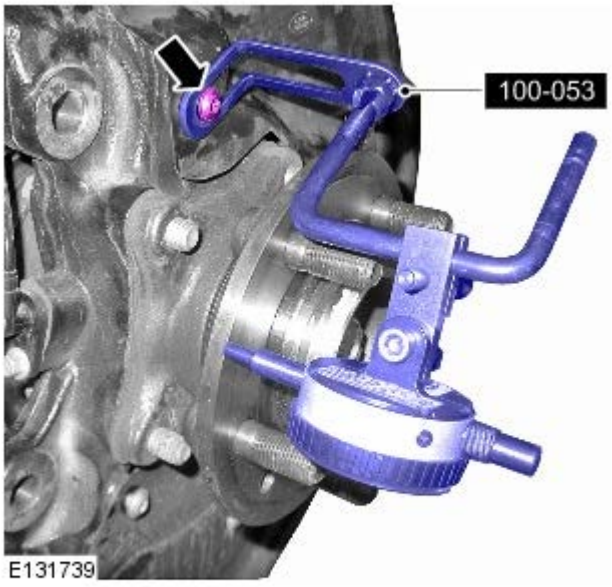
   Release the brake caliper and tie aside.


E61629

4. Remove the front brake disc.
   - Remove the Allen screw.

5. Thoroughly clean the hub mounting face.

6. Using special tool (100-053) mount a Dial Test Indicator (DTI) to and secure to the backplate using the upper backplate fixing.



7. CAUTION: Make sure the DTI is positioned clear of the wheel studs.

   Position the DTI probe on the outer edge of the hub face.

8. Zero the DTI and rotate the hub one complete revolution to measure hub runout.
   - The hub runout limit is 0.0135 mm.

9. NOTE: If the hub runout exceeds the limit replace the hub.

   For additional information, refer to: Front Wheel Bearing and Wheel Hub (204-01 Front Suspension, Removal and Installation).

10. Remove the DTI.

11. Install the brake disc.
    - Tighten the Torx screw to 35 Nm (26 lb.ft).

12. Install the brake caliper and tighten the bolts. TORQUE: 275 Nm

13. Install the road wheel and tighten nuts to 140Nm (103 lb-ft).

14. Repeat the above procedure on the opposite side.

15. Depress the brake pedal several times to set brake pads.

16. Lower the vehicle.

Front Suspension -

General Specifications

Item	Specification
Gap between underside of the toe link rubber boot and the chassis bracket	12.0 mm (0.473 in)
Height/distance between centre of halfshaft and edge of the fender trim	462 mm (18.19 in)

Torque Specifications

Description	Nm	lb-ft
* Stabilizer bar link nuts	175	129
Stabilizer bar clamp nuts	115	85
Front axle crossmember bolts	115	85
Shock absorber and spring assembly to lower arm bolt	300	221
Shock absorber top mounting nuts	70	52
* Shock absorber upper bush rebound plate nut	98	72
Heat shield bolts	10	7
* Upper arm and wheel knuckle nut	70	52
* Tie-rod end ball joint nut	70	52
Brake hose retaining bracket to wheel knuckle bolt	25	18
*+ Halfshaft retaining nut	230	169
Brake hose to upper arm bolt	22	16
Upper arm nuts and bolts	175	129
Radiator access panel bolts	10	7
Wheel hub bolts	115	85
Brake disc dust shield bolts	10	7
Lower arm bolts	275	203
Lower arm ball joint retaining nut	115	85
Lower arm front camber adjusting bolt	275	203
Lower arm rear castor adjusting bolts	275	203
Toe link inner ball joint retaining nut	133	98
Rear camber adjusting bolts	133	98
Track rod end locking nuts	53	39
Wheel speed sensor bolt	10	7
Axle carrier bushing bolt - M14	105	77
Axle carrier bracket bolts	80	59
Road wheel nuts	140	103

*** New nut/bolts must be installed**

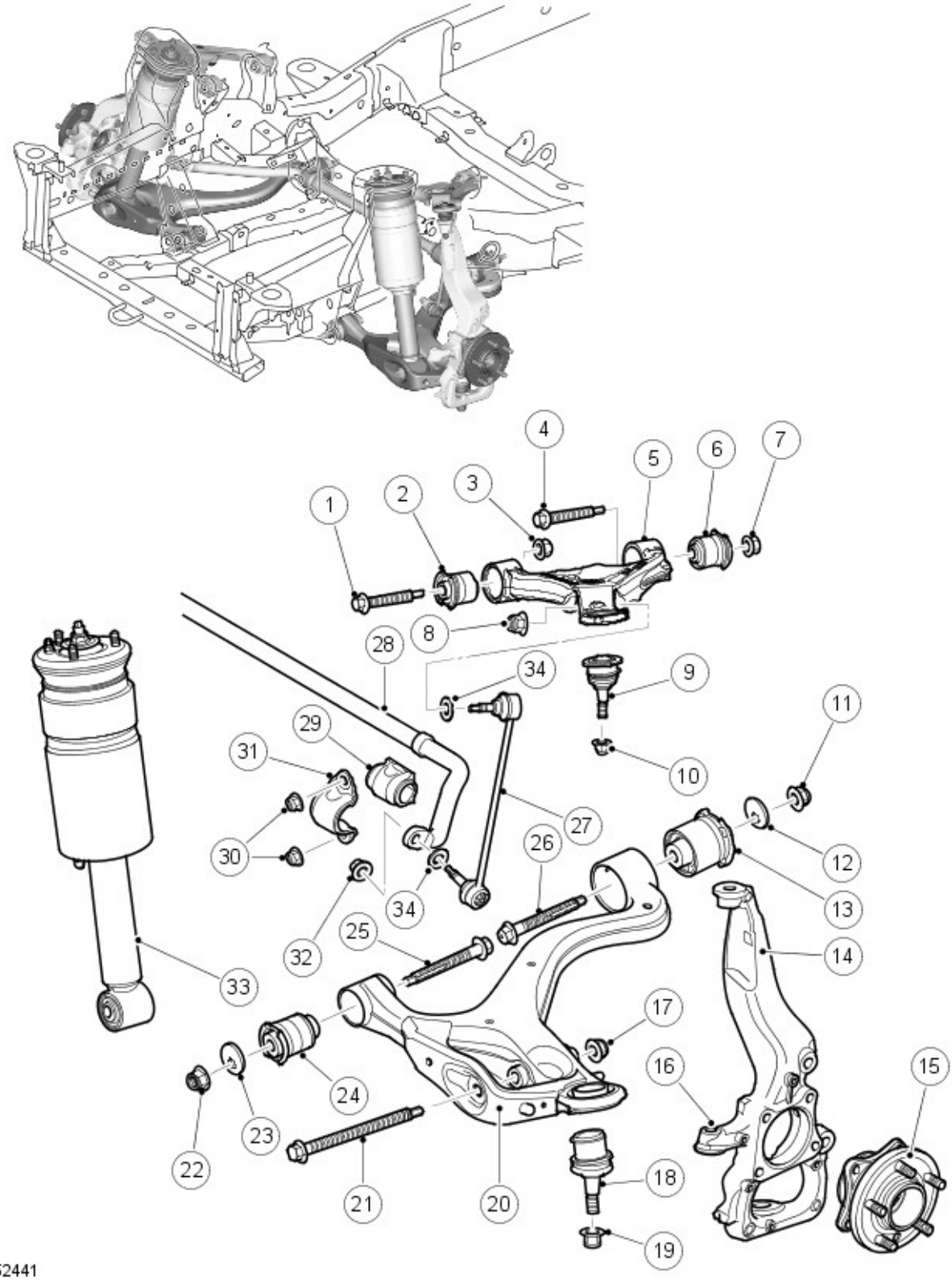
+ Stake nut on completion

Front Suspension - Front Suspension

Description and Operation

Front Suspension Component Layout

NOTE: Without Dynamic Response version shown



E52441

Item	Part Number	Description
1	-	Flanged bolt (Upper arm forward bush)
2	-	Bush - forward (Upper arm)
3	-	Nut (Upper arm forward bush)
4	-	Flanged bolt (Upper arm forward bush)
5	-	Bush - rearward (Upper arm)

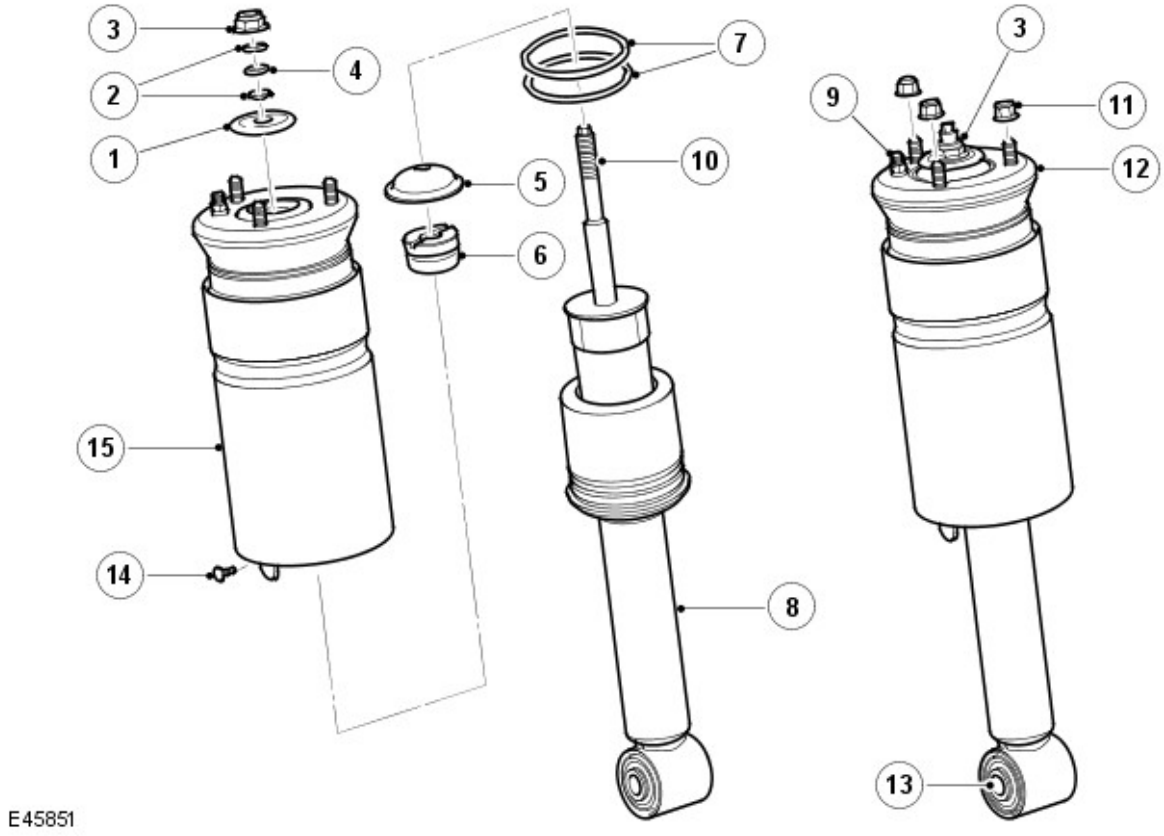
6	-	Nut (Upper arm rearward bush)
7	-	Nut (Stabilizer bar link to upper arm)
8	-	Upper arm
9	-	Ball joint (Upper arm to swivel hub)
10	-	Nut (Ball joint to swivel hub attachment)
11	-	Nut (Lower arm rearward bush)
12	-	Cam washer (Lower arm rearward bush)
13	-	Bush - rearward (Lower arm)
14	-	Wheel knuckle
15	-	Wheel hub and bearing assembly
16	-	Steering gear attachment
17	-	Nut (Damper assembly lower attachment)
18	-	Ball joint (Lower arm to swivel hub)
19	-	Nut (Ball joint to swivel hub attachment)
20	-	Lower arm
21	-	Bolt (Damper assembly lower attachment)
22	-	Nut (Lower arm forward bush)
23	-	Cam washer (Lower arm forward bush)
24	-	Lower arm forward bush
25	-	Bolt (Lower arm forward bush)
26	-	Bolt (Lower arm rearward bush)
27	-	Stabilizer bar link
28	-	Stabilizer bar
29	-	Stabilizer bar bush
30	-	Nut (Stabilizer bar bracket)
31	-	Stabilizer bar bracket
32	-	Nut (Stabilizer bar link to stabilizer bar)
33	-	Damper assembly
34	-	Hardened washer (2 off per link)

GENERAL

The front suspension is a fully independent design which offers a reduction in unsprung weight over the beam axle design. The front suspension comprises an upper arm, a lower arm, a wheel knuckle and hub, a stabilizer bar and links assembly and an air damper assembly. A conventional stabilizer bar is fitted to some models, with a Dynamic Response stabilizer bar system available as a standard or optional fitment.
For additional information, refer to: Active Stabilization System (204-06, Description and Operation).

The suspension lower arms have been designed for maximum ground clearance and also allow for adjustment of the camber and castor using cam adjusters.

AIR SUSPENSION DAMPER MODULE



Item	Part Number	Description
1	-	Rebound washer*
2	-	O-ring - damper rod (2 off)*
3	-	Self-locking nut*
4	-	Spacer - damper rod*
5	-	Bump washer
6	-	Spring aid*
7	-	O-ring - air spring sleeve support (2 off)*
8	-	Damper assembly*
9	-	Voss air fitting
10	-	Damper rod
11	-	Self-locking nut (3 off)
12	-	Top mount
13	-	Bush
14	-	Retaining pin - air spring assembly*
15	-	Air spring assembly*

NOTE: * shows service items

The damper module comprises an air spring assembly, top mount and a damper assembly. The damper and air spring are only serviceable as complete assemblies.

Damper

The damper assembly is a mono tube design with an air spring. The lower end of the damper is fitted with a bush and is attached to the lower arm with a bolt and nut.

The damper functions by restricting the flow of hydraulic fluid through internal galleries within the damper. The damper rod moves axially within the damper, its movement limited by the flow of fluid through the galleries, providing damping of undulations in the terrain. The damper rod is sealed at its exit point from the damper body to maintain the fluid within the unit and to prevent the ingress of dirt and moisture. The seal also incorporates a wiper to keep the rod clean.

Air Spring

The air spring comprises an aluminium restraining cylinder, top mount, spring aid, air sleeve and an inner support sleeve.

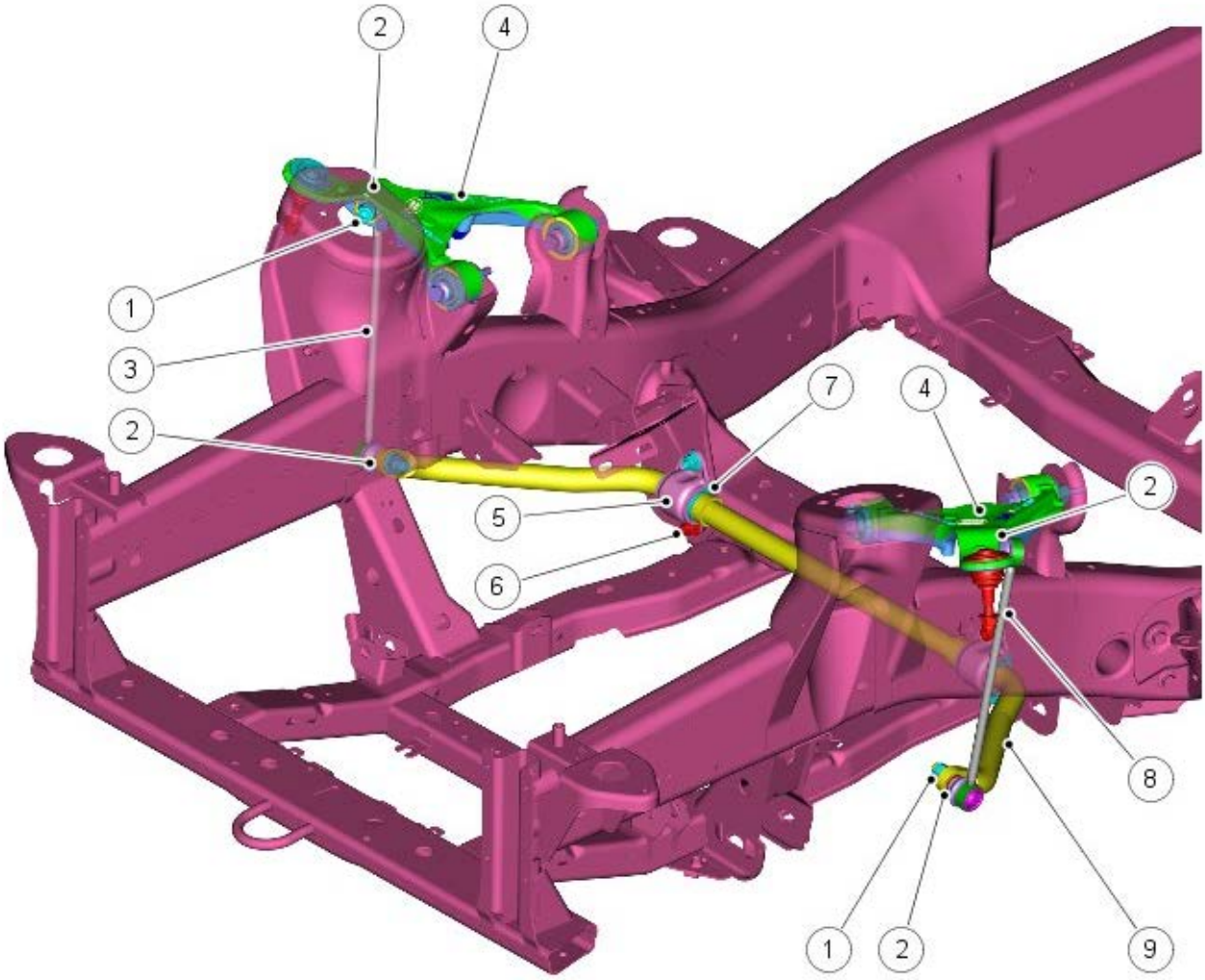
The air sleeve is made from a flexible rubber material which allows the sleeve to roll up and down the air spring piston as the vehicle changes height. The air sleeve is attached to the restraining cylinder and support sleeve by crimp rings which provide an air tight seal. The support sleeve contains a seal carrier which has two O-rings sealing the support sleeve and two O-rings sealing to the damper body. The top of the air sleeve is crimped to the top mount which attaches to the chassis frame with three integral studs and self-locking nuts.

A spring aid is fitted to the damper rod and prevents the top mount contacting the top of the damper during full suspension compression and assists the suspension tune. The lower end of the air spring is located over the damper body and seats on a fabricated seat on the damper body. The air sleeve is positively attached to the seat with a retaining pin.

The damper rod is located through a central hole in the top mount. The rod is threaded at its outer end. A self-locking nut secures the air spring to the damper rod.

The top mount is an integral part of the air spring and is fitted with a bush and a rebound washer. A bump washer is located between the top mount plate and the damper rod. The top mount is secured to the damper rod with a self-locking nut. The top mount attaches to a housing on the chassis with three integral studs and self-locking nuts. The top mount also incorporates a 6 mm Voss air fitting which allows for the attachment of the air harness.

STABILIZER BAR



E56035

Item	Part Number	Description
1	-	Nut - link to stabilizer bar/upper arm (4 off)
2	-	Hardened washer (4 off)
3	-	Right hand Link
4	-	Upper arm
5	-	Bracket (2 off)
6	-	Locknut (4 off)
7	-	Bush (2 off)
8	-	Left hand link
9	-	Stabilizer bar

Vehicles with the Dynamic Response system use an active stabilizer bar.
For additional information, refer to: Active Stabilization System (204-06, Description and Operation).

The stabilizer bar is fabricated from induction hardened, 31 mm diameter solid spring steel bar. The stabilizer bar operates, via a pair of links, from their attachment to the upper arm.

The stabilizer bar is mounted on the forward face of the chassis front cross member and is attached to the cross member with two, Teflon lined bushes. Brackets, which are pressed onto the bushes, are attached to the cross member with nuts,

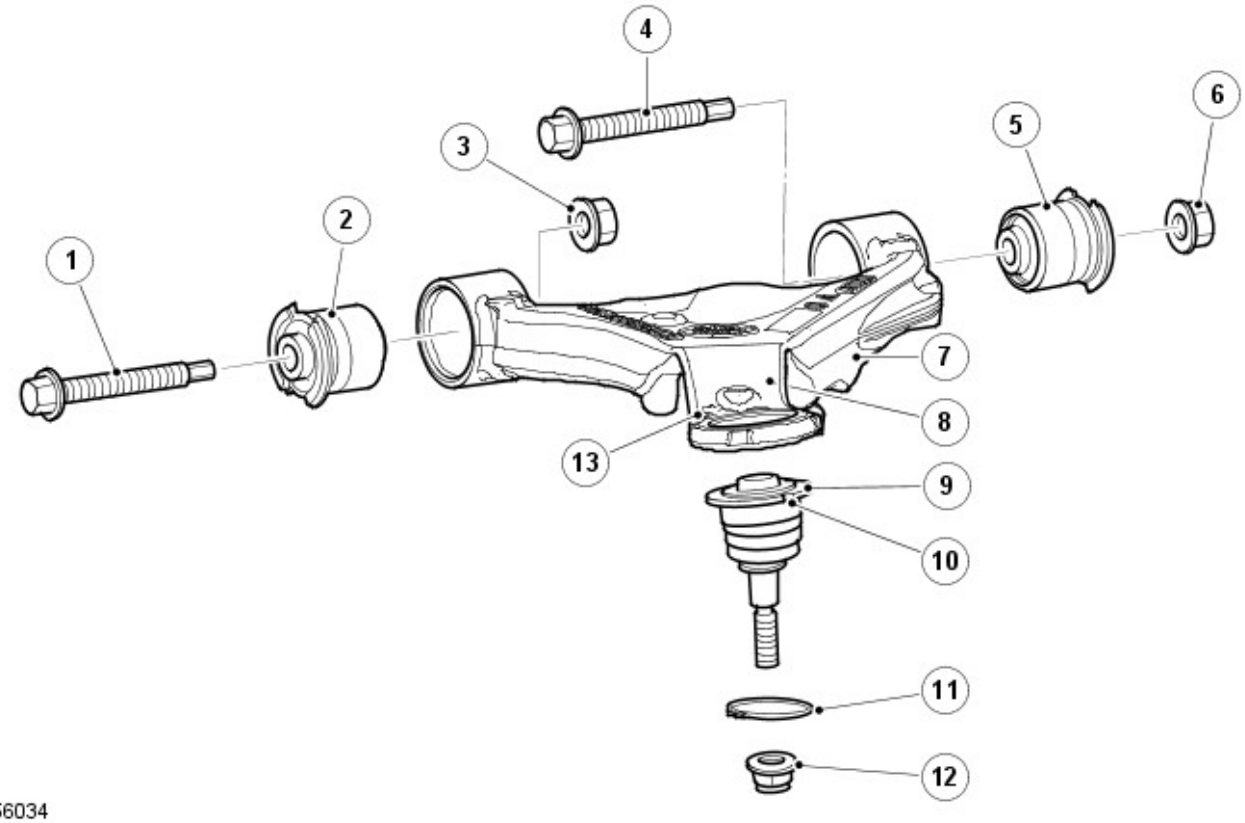
screwed onto studs in the cross member. The stabilizer bar has crimped, 'anti-shuffle' collars pressed in position on the inside edges of the bushes. The collars prevent sideways movement of the stabilizer bar.

The links, which are handed and have a ball joint at each end, are fitted with hardened steel washers at both ends. The top ball joint is attached to the link at 90 degrees to the link axis. The ball joint is located in a hole in the side of the upper arm and secured with the hardened steel washer on one side of the interface and a slef-locking nut on the other. The bottom ball joint is attached to the link at 90 degrees to the link axis. The ball joint is located in a hole in the end of the stabilizer bar and secured with the hardened steel washer on one side of the interface and the self-locking nut on other.

It is important that hardened steel washer is in the correct position between the stabilizer bar and the link ball joint and the upper arm and the link ball joint and the correct, hardened washer is fitted.

CAUTION: Failure to fit the washer or using an incorrect washer will result in relaxation of the torque on the self-locking nut and damage will be caused to the stabilizer bar, link and suspension upper arm.

UPPER ARM



E56034

Item	Part Number	Description
1	-	Flanged bolt
2	-	Bush
3	-	Self locking nut
4	-	Flanged bolt
5	-	Bush
6	-	Self locking nut
7	-	Upper arm
8	-	Stabilizer bar link attachment hole (hidden)
9	-	Ball joint
10	-	Timing mark
11	-	Circlip
12	-	Self locking nut
13	-	Timing mark

The upper arm assembly comprises, the upper arm, two bushes and a ball joint. The upper arm is made from cast and machined iron. Its outer end has a hole to accept the ball joint. A small indentation is located adjacent to the ball joint hole and is used to obtain the correct orientation of the ball joint. A hole on the rear side of the arm provides for the attachment of the stabilizer bar link.

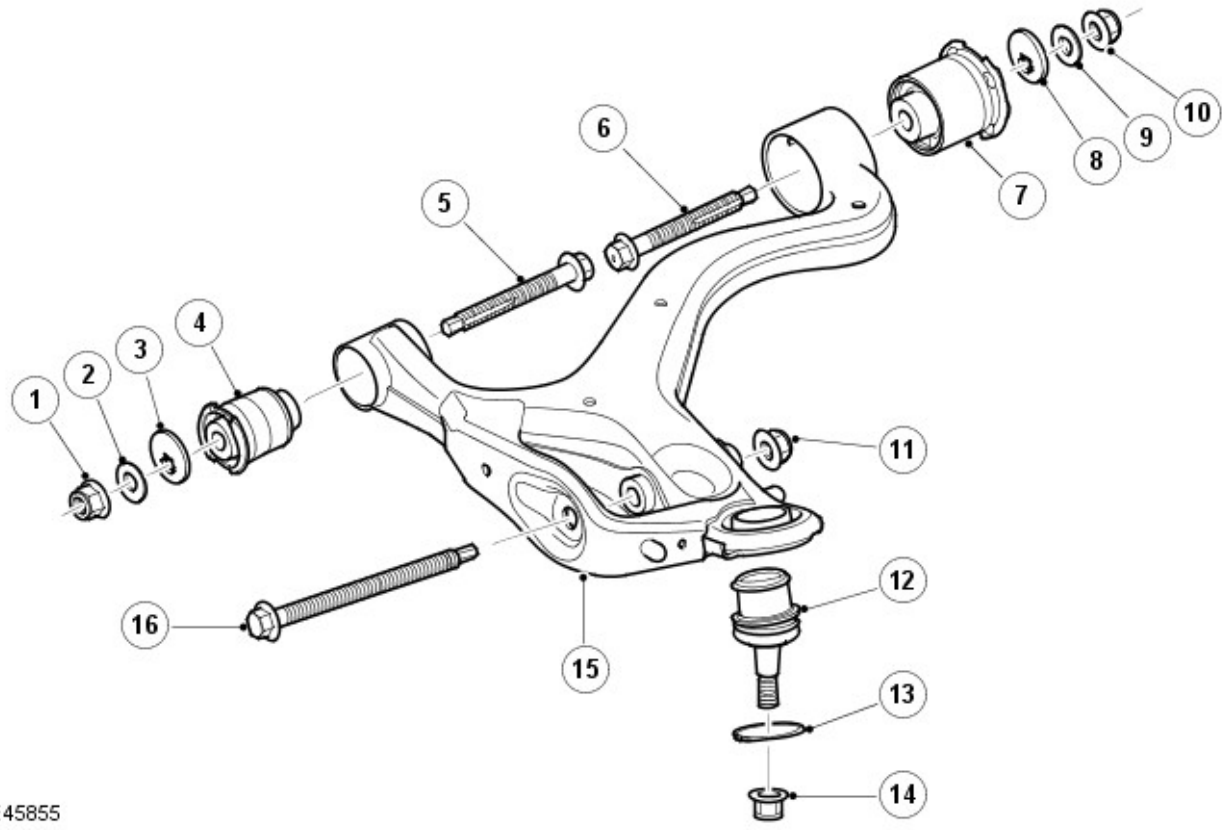
The inner end of the arm has two bush housings which are machined in the arm casting. A bush is pressed into each housing. The bushes are located between lugs on the chassis and are secured with bolts and self-locking nuts through metal inserts in the centre of the bushes.

The ball joint is pressed into the upper arm. The ball joint is an interference fit in the hole which prevents the ball joint from moving. A circlip is fitted to the ball joint to retain it in the hole. The top face of the ball joint has two semi-circular cut-outs. One of these cut-outs must be aligned with the small indentation in the upper arm to ensure the correct

operation of the ball joint.

A bracket, located on on the underside of the upper arm, provides for the attachment of the air suspension height sensor drop link.

LOWER ARM



Item	Part Number	Description
1	-	Self locking nut
2	-	Washer
3	-	Cam washer
4	-	Bush
5	-	Bolt
6	-	Bolt
7	-	Hydrobush
8	-	Cam washer
9	-	Washer
10	-	Self locking nut
11	-	Self locking nut - damper lower attachment
12	-	Ball joint
13	-	Circlip
14	-	Self locking nut
15	-	Lower arm
16	-	Bolt - damper lower attachment

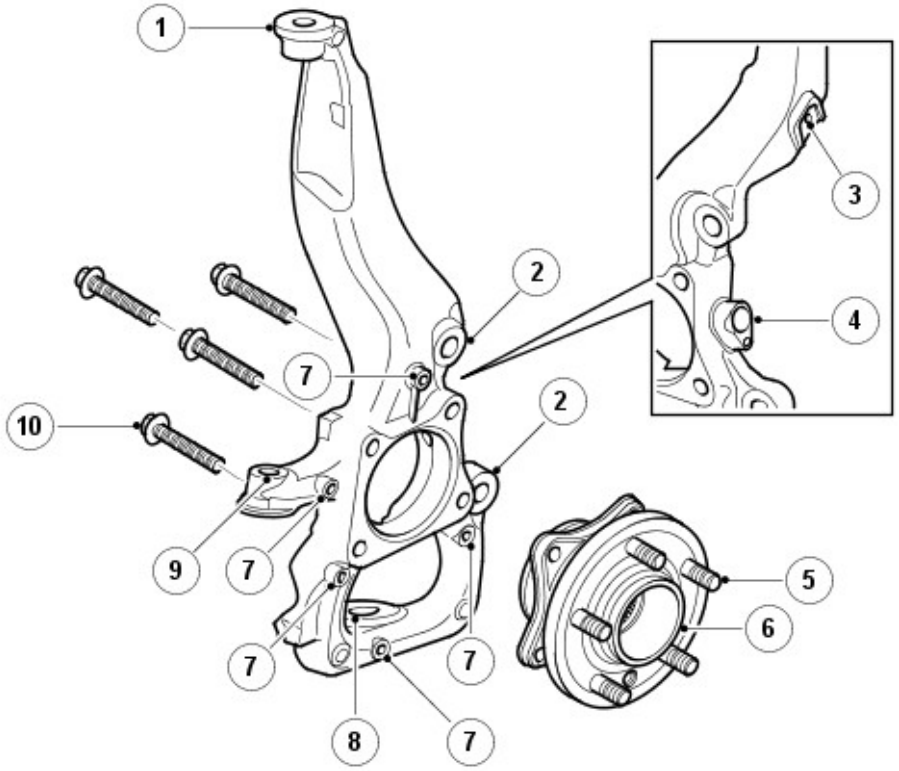
The lower arm assembly comprises, the lower arm, two bushes and a ball joint. The lower arm is a pressed steel fabrication with a hole at its outer end to accept the ball joint.

The inner end of the arm has two fabricated bush housings which are welded to the arm pressing. A bush is pressed into each housing. The rear bush is a hydrobush which provides a progressive increase in the hardness of the bush as the deflection of the wheel increases. The bushes are located between lugs on the chassis and are secured with bolts and self-locking nuts through metal inserts in the centre of the bushes. The forward bush, self-locking nut, has a cam washer located beneath it. The cam washer is located between lugs on the chassis bracket and its orientation can be adjusted to set the front camber. The rear bush, self-locking nut, also has a cam washer located beneath it. The cam washer is located between lugs on the chassis bracket and its orientation can be adjusted to set the front castor.

A central aperture in the arm provides for the attachment of the damper module lower bush. The damper is secured with a long bolt which is positioned through holes in the lower arm and secured with a self-locking nut.

The ball joint is pressed into the lower arm. The ball joint is an interference fit in the hole which prevents the ball joint from moving. A circlip is fitted to the ball joint to retain it in the hole.

WHEEL KNUCKLE, HUB AND BEARING ASSEMBLY



E45856

Item	Part Number	Description
1	-	Upper arm attachment
2	-	Brake caliper attachment holes
3	-	Brake hose bracket attachment point
4	-	Wheel speed sensor location
5	-	Wheel studs
6	-	Wheel hub
7	-	Brake disc dust shield attachment holes
8	-	Lower arm ball joint attachment
9	-	Steering gear ball joint attachment
10	-	Wheel hub bolts (4 off)

The wheel knuckle is a machined casting which is located between the ball joints of the upper and lower arms. The knuckle has four clearance holes which allow for the fitment of four bolts which secure the wheel hub housing. A cast boss on the forward edge of the knuckle provides for attachment of the steering gear, tie rod ball joint.

The wheel hub and bearing assembly comprises the wheel hub housing, wheel hub and taper roller bearing. The wheel hub and bearing assembly is a non-serviceable component. Five M14 studs are pressed into the wheel hub and provide for the attachment of the road wheel with wheel nuts.

The wheel hub housing is a machined forging which houses a taper roller bearing. The housing has four threaded holes which provide for the attachment to the wheel knuckle with four bolts.

The wheel hub has a splined centre bore which mates with corresponding splines on the half shaft. Rotation of the half shaft is passed, via the splines, to the wheel hub which rotates on the taper roller bearing.

Front Suspension - Front Suspension

Diagnosis and Testing

For additional information.
REFER to: Suspension System (204-00, Diagnosis and Testing).

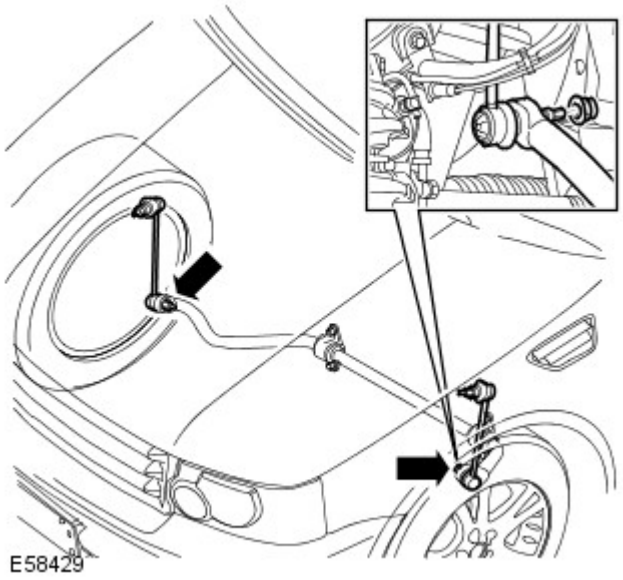
Front Suspension - Front Stabilizer Bar
Removal and Installation

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 wheels and tires.

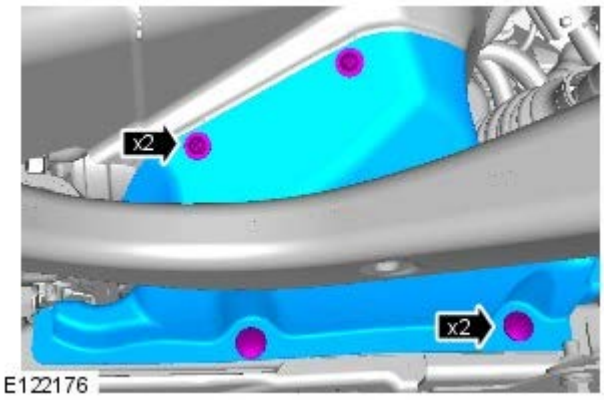


3. CAUTIONS:

   Note the position of the hardened steel washer. The hardened steel washer must be installed between the stabilizer bar link and the stabilizer bar. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst removing the nut.

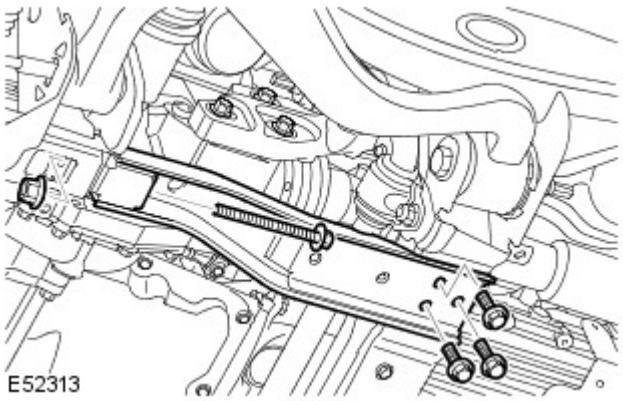
   Disconnect both the stabilizer bar links from the stabilizer bar.
   - Remove and discard the 2 nuts.



4. NOTE: RH side only.

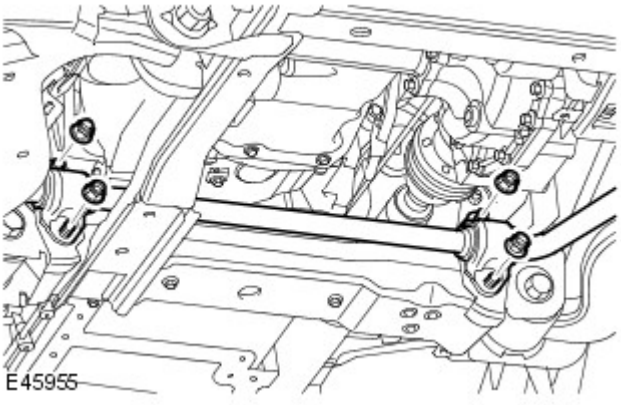
   Remove the fender splash shield lower extension panel.
   - Remove the 2 screws.
   - Remove the 2 clips.

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



6. Remove the front axle crossmember.
   - Remove the 4 bolts.

7. Remove the stabilizer bar bushing.



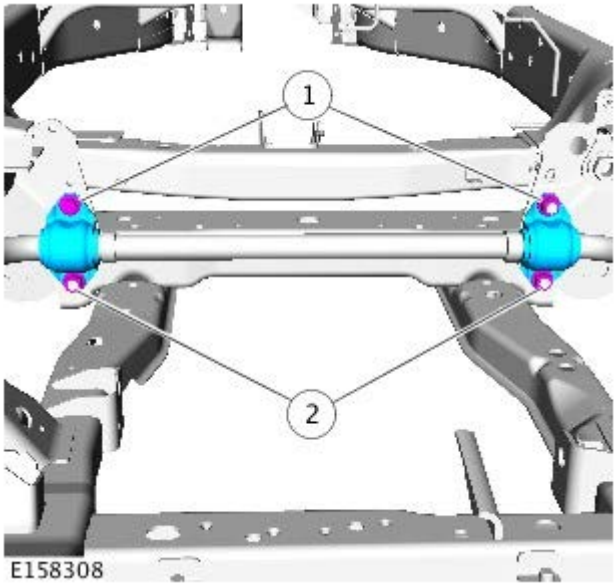
- Remove the 4 nuts.
- Remove the stabilizer bar clamps.

8. Remove the stabilizer bar.
    - Remove the stabilizer bar out through the LH side wheel arch.

Installation

1. Install the stabilizer bar.
    - Install the stabilizer bar through the LH side wheel arch.

2. Install the stabilizer bar bushing and clamps.
    - Tighten fixings 1 to 115 Nm (85 lb.ft).
    - Tighten fixings 2 to 115 Nm (85 lb.ft).
    - Tighten fixings 1 to 115 Nm (85 lb.ft).



3. Install the front axle crossmember.
    - Tighten the 4 bolts to 115 Nm (85 lb.ft).

4. Install the engine undershield.
   For additional information, refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

5. NOTE: RH side only.

   Install the fender splash shield lower extension panel.
    - Install the 2 screws.
    - Install the 2 clips.

6. CAUTIONS:

   Make sure the hardened steel washer is installed between the stabilizer bar link and the stabilizer bar. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

   Connect both stabilizer bar links to the stabilizer bar.
    - Install new nuts and tighten to 175 Nm (129 lb.ft).

7. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Suspension - Front Stabilizer Bar Link

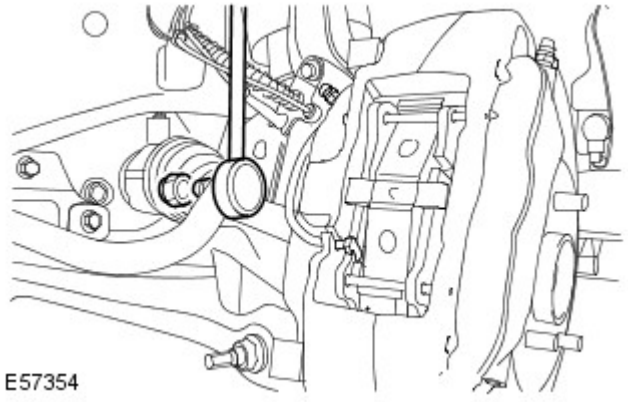
Removal and Installation

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 wheel and tire.

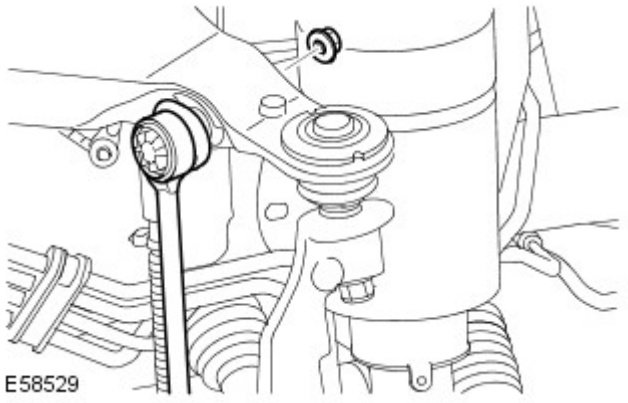


3. CAUTIONS:

   Note the position of the hardened steel washer. The hardened steel washer must be installed between the stabilizer bar link and the stabilizer bar. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

   Release the stabilizer bar link.
   - Remove and discard the nut.



4. CAUTIONS:

   Note the position of the hardened steel washer. The hardened steel washer must be installed between the stabilizer bar link and the upper arm. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst removing the nut.

   Remove the stabilizer bar link.
   - Remove and discard the nut.

Installation

Vehicles without Active Stabilization

1. CAUTIONS:

   Make sure the hardened steel washers are installed between the stabilizer bar link and the stabilizer bar, and between the stabilizer bar link and the upper arm. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

   Install the stabilizer bar link.
   - Install new nuts and tighten to 175 Nm (129 lb.ft).

Vehicles with Active Stabilization

2. CAUTIONS:

   Make sure the hardened steel washers are installed between the stabilizer bar link and the stabilizer bar, and between the stabilizer bar link and the upper arm. Failure to follow this instruction may result in damage to the vehicle.

 Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

Install the stabilizer bar link.

- Install new nuts and tighten to 175 Nm (129 lb.ft).

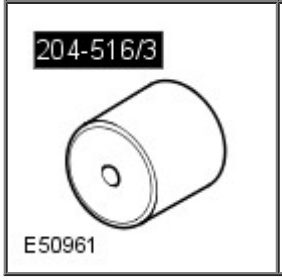
All vehicles

3. Install the wheel and tire.

Front Suspension - Upper Arm Ball Joint

Removal and Installation

Special Tool(s)

	Ball joint remover/installer 204-530-1
	Ball joint remover/installer 204-530-2
	Ball joint remover/installer 204-530-3
	Ball joint remover/installer 204-516/3(LRT-64-026/3)

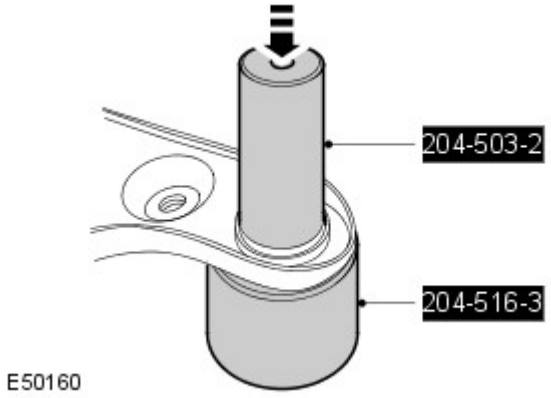
Removal

NOTE: This procedures shows removal and installation of the upper arm ball joint.

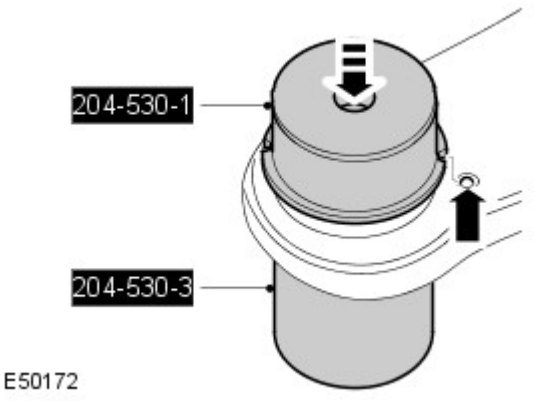
1. Remove the upper arm.
   For additional information, refer to: Upper Arm (204-01, Removal and Installation).

2. Remove the dust seal.
   - Remove the seal retainer.
   - Remove the circlip.

3. Using the special tools, remove the ball joint.



Installation



E50172

1. CAUTION: Make sure the timing marks are aligned.

   Using the special tools, install the ball joint.


E50173

2. CAUTION: Circlip holes to be 90 degrees rotated from timing marks.

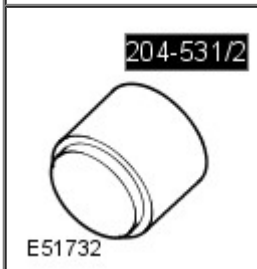
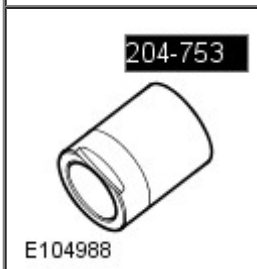
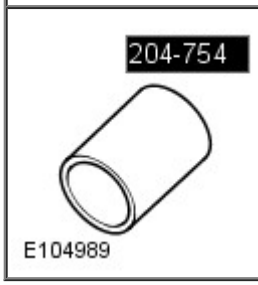
   Install the circlip.

3. Install the upper arm.
   For additional information, refer to: Upper Arm (204-01, Removal and Installation).

Front Suspension - Lower Arm Ball Joint

Removal and Installation

Special Tool(s)

	Remover/installer front lower arm ball joint 204-531/3
	Remover/installer front lower arm ball joint 204-531/2
	Remover/installer front lower arm ball joint 204-531/1
	Remover/installer front lower arm ball joint 204-753
	Remover/installer front lower arm ball joint 204-754

Removal

All vehicles

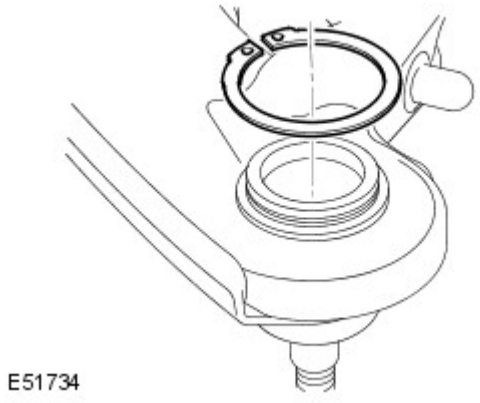
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

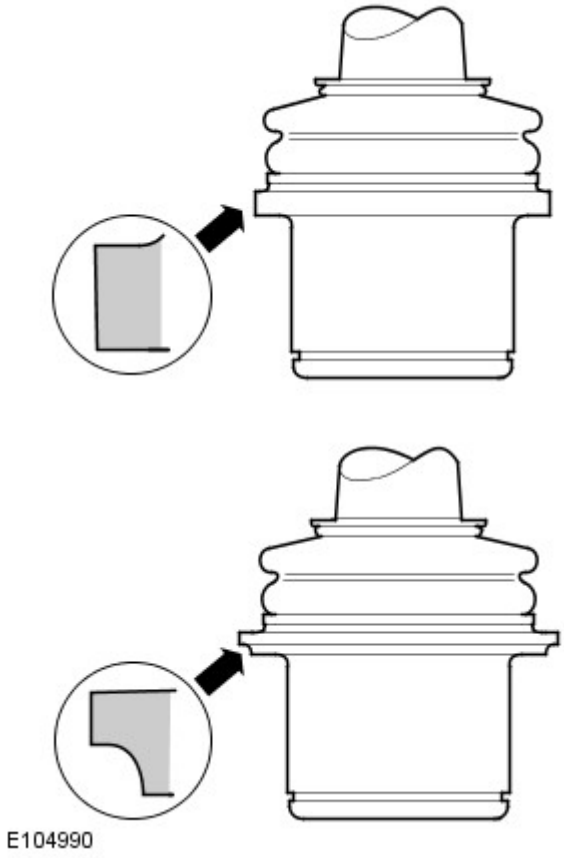
2. Remove the wheel and tire.

3. Remove the lower arm.
   For additional information, refer to: Lower Arm (204-01, Removal and Installation).

4. Remove the circlip.

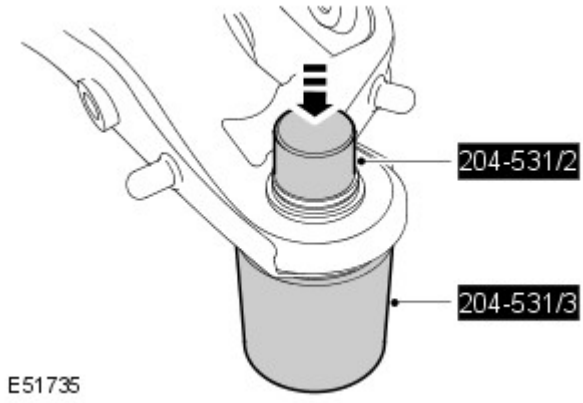


5. Inspect the installed ball joint to determine if a radius is present.



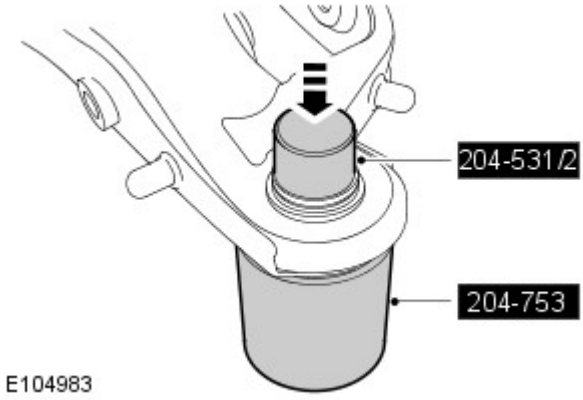
Ball joint without radius

6. Using the special tools, remove the ball joint.



Ball joint with radius

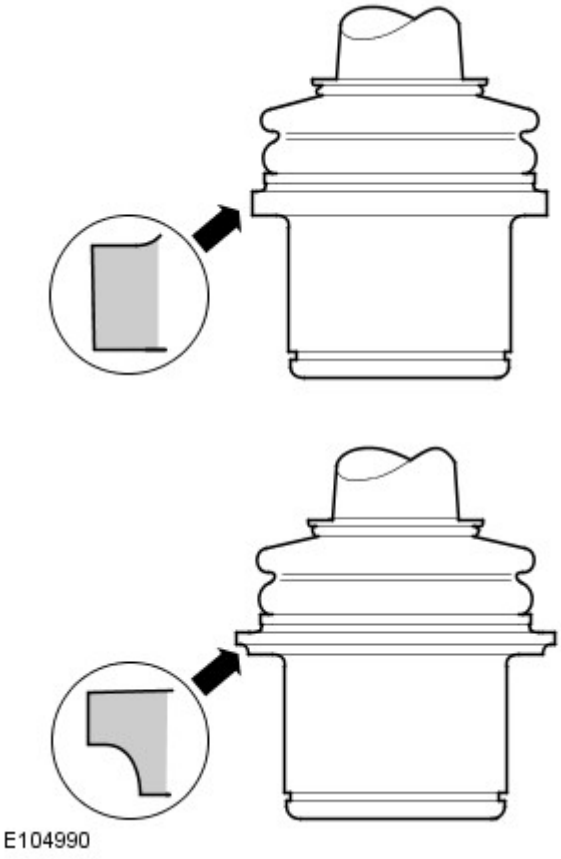
7. Using the special tools, remove the ball joint.



Installation

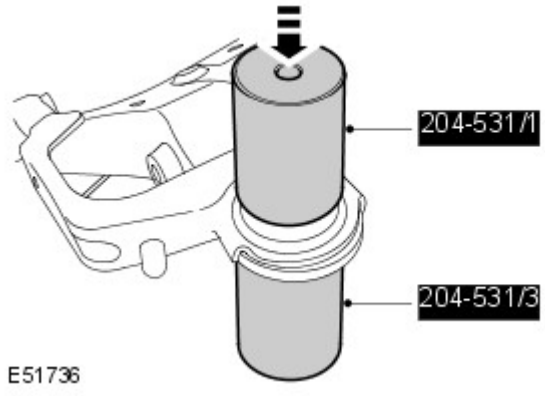
All vehicles

1. Clean the components.
2. Inspect the new ball joint to determine if a radius is present.



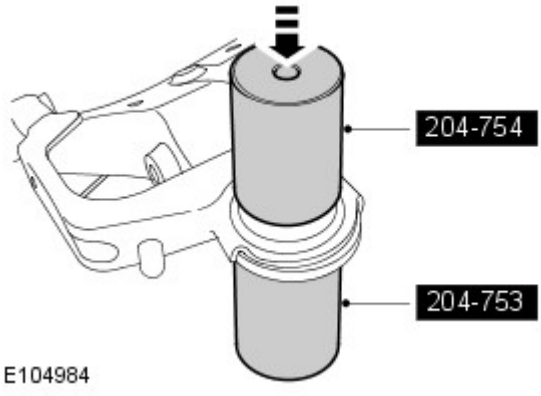
Ball joint without radius

3. Using the special tools, install the ball joint.



Ball joint with radius

4. Using the special tools, install the ball joint.



All vehicles

5. Install the circlip.

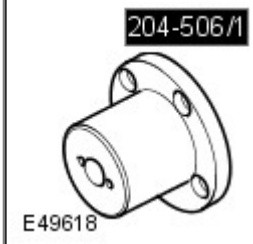
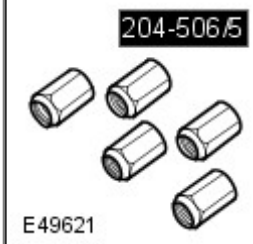
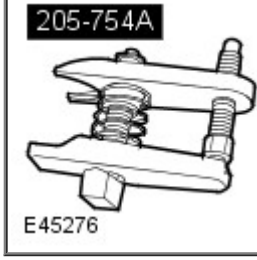
6. Install the lower arm.
   For additional information, refer to: Lower Arm (204-01, Removal and Installation).

7. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Suspension - Wheel Knuckle

Removal and Installation

Special Tool(s)

	Halfshaft remover/replacer 204-506/1 (LRT-60-030/1)
	Halfshaft remover/replacer 204-506/2(LRT-60-030/2)
	Halfshaft remover/replacer 204-506/3 (LRT-60-030/3)
	Retainers - halfshaft remover/replacer 204-506/5 (LRT-60-030/5)
	Halfshaft installer adapter 204-506-01
	Ball joint separator 205-754 (LRT-54-027)

Removal

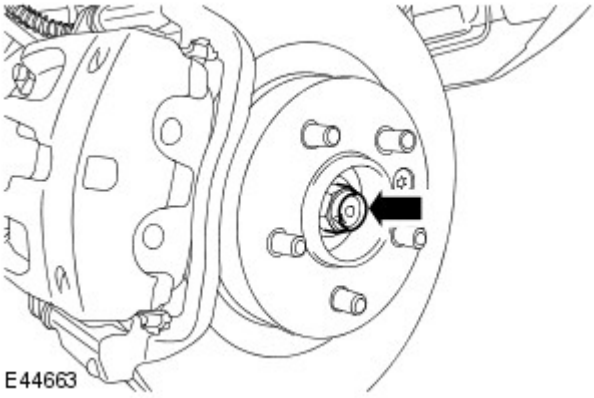
All vehicles

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

   Raise and support the vehicle.

2. Remove the wheel and tire.

3. Loosen the halfshaft retaining nut.



Vehicles with standard brakes

4. Remove the brake disc.
   For additional information, refer to: Brake Disc - Vehicles With: Standard Brakes (206-03 Front Disc Brake, Removal and Installation).

Vehicles with high performance brakes

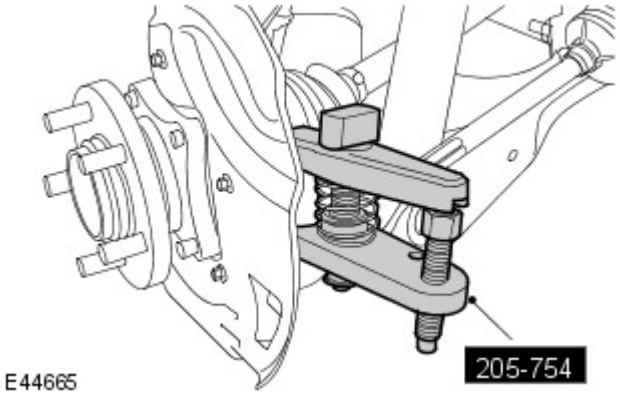
5. Remove the brake disc.
   For additional information, refer to: Brake Disc - Vehicles With: High Performance Brakes (206-03 Front Disc Brake, Removal and Installation).

All vehicles

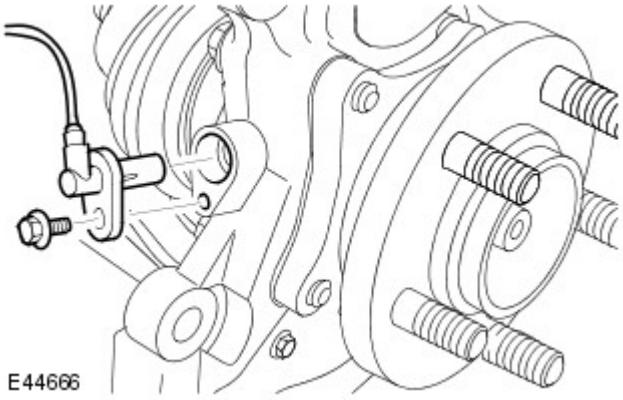
6. Remove the halfshaft retaining nut.
   - Discard the nut.

7. Loosen the tie-rod end ball joint retaining nut.

8. Using the special tool, release the tie-rod end ball joint from the wheel knuckle.
   - Discard the nut.

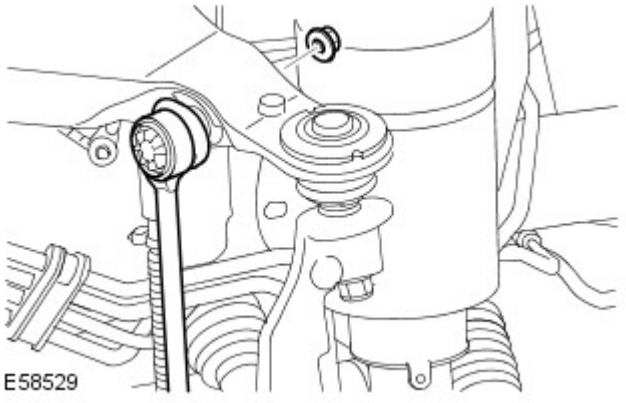


9. Release the wheel speed sensor from the wheel knuckle.
   - Remove the bolt.



10. CAUTIONS:

Use a Torx socket to prevent the ball joint



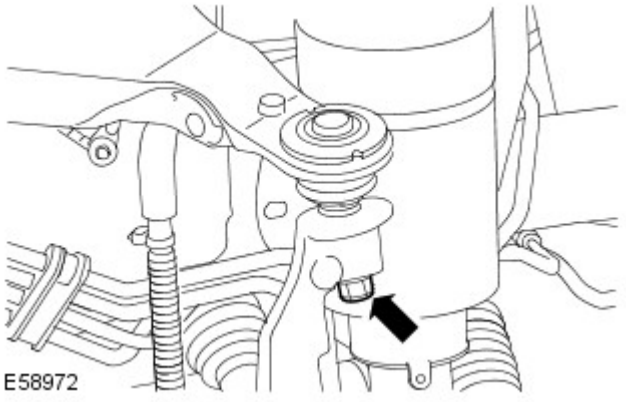
rotating whilst removing the nut.

CAUTION: Note the position of the hardened steel washer. The hardened steel washer must be installed between the stabilizer bar link and the upper arm. Failure to follow this instruction may result in damage to the vehicle.

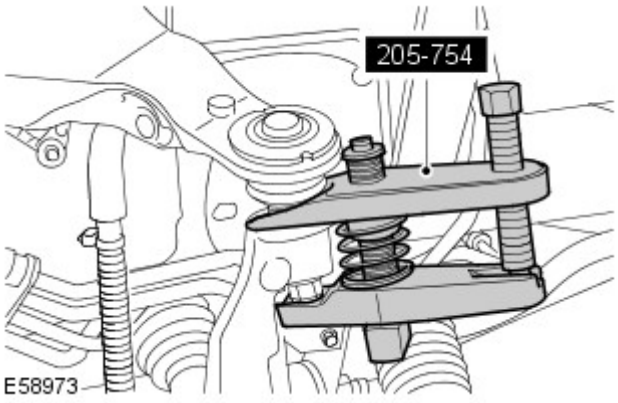
Release the stabilizer bar link.

- Discard the nut.

11. Loosen the upper arm retaining nut.

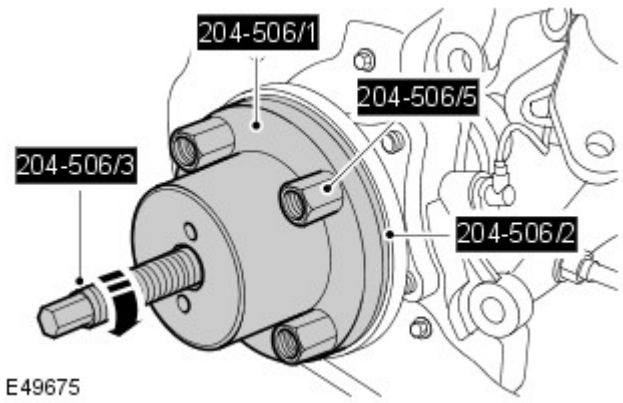


12. Using the special tool, release the upper arm ball joint.



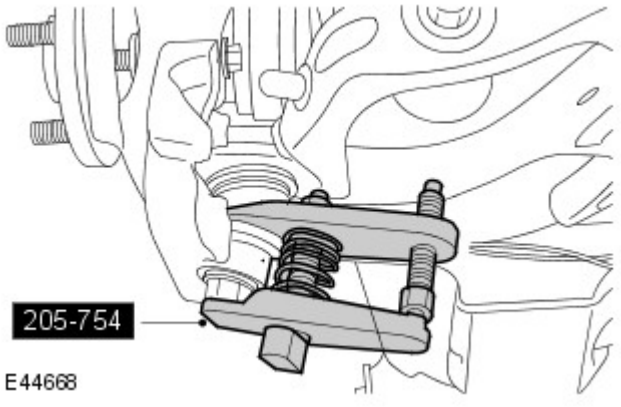
13. CAUTION: Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

    Using the special tools, release the halfshaft from the drive flange.



14. Remove the lower ball joint retaining nut.

15. Using the special tool, release the lower ball joint from the steering knuckle.



16. Remove the upper arm retaining nut.
    - Discard the nut.

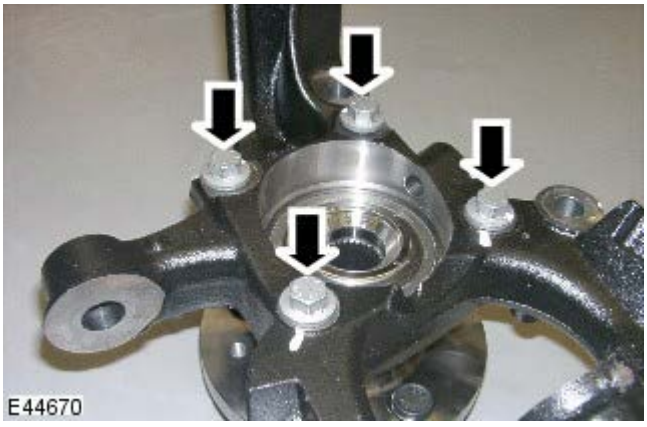
17. CAUTION: The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

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

    Remove the wheel knuckle.



18. Remove the brake disc dust shield.
    - Remove the four retaining bolts.



19. Remove the wheel hub.
    - Remove the 4 bolts.

Installation

All vehicles

1. Clean the components.

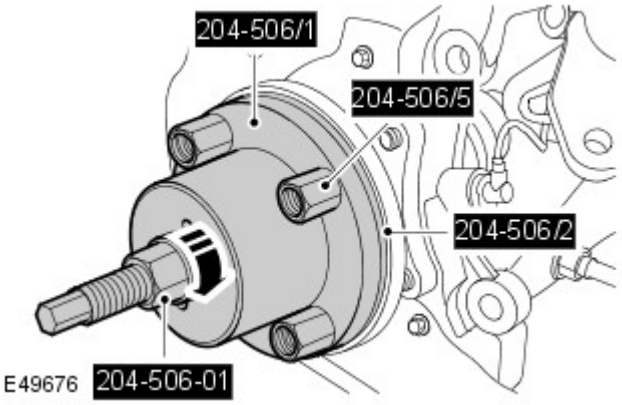
2. Install the wheel hub.
    - Tighten the 4 bolts to 115 Nm (85 lb.ft).

3. Install the brake disc dust shield.
    - Tighten the 4 bolts to 10 Nm (7 lb.ft).

4. CAUTION: The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

   With assistance, install the wheel knuckle.

5. Using the special tools, install the halfshaft in the wheel hub.



6. Connect the upper arm and wheel knuckle.
   - Install a new nut and tighten to 70 Nm (52 lb.ft).

Vehicles without Active Stabilization

7. CAUTIONS:

   Make sure the hardened steel washer is installed between the stabilizer bar link and the upper arm. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

   Secure the stabilizer bar link.
   - Install a new nut and tighten to 175 Nm (129 lb.ft).

Vehicles with Active Stabilization

8. CAUTIONS:

   Make sure the hardened steel washer is installed between the stabilizer bar link and the upper arm. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

   Secure the stabilizer bar link.
   - Install a new nut and tighten to 175 Nm (129 lb.ft).

9. Tighten the lower arm ball joint retaining nut to 115 Nm (85 lb.ft).

10. Connect the tie-rod end ball joint.
    - Install a new nut and tighten to 76 Nm (56 lb.ft).

11. Install a new halfshaft retaining nut and lightly tighten.

12. Install the wheel speed sensor.
    - Tighten the bolt to 10 Nm (7 lb.ft).

Vehicles with standard brakes

13. Install the brake disc.
    For additional information, refer to: Brake Disc - Vehicles With:

Standard Brakes (206-03 Front Disc Brake, Removal and Installation).

Vehicles with high performance brakes

14. Install the brake disc.
    For additional information, refer to: Brake Disc - Vehicles With: High Performance Brakes (206-03 Front Disc Brake, Removal and Installation).

All vehicles

15.  CAUTION: Do not use air tools to install the nut. Failure to follow this instruction may result in damage to the component.

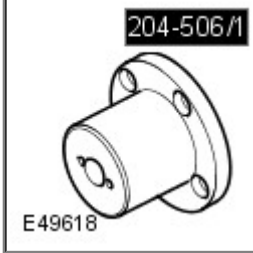
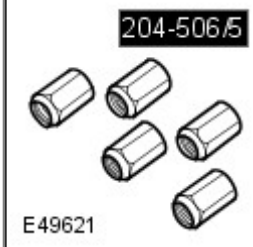
    Tighten the new halfshaft retaining nut to 230 Nm (169 lb.ft).
    - Stake the nut to the halfshaft.

16. Install the wheel and tire.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Suspension - Front Wheel Bearing and Wheel Hub

Removal and Installation

Special Tool(s)

	Halfshaft remover/replacer 204-506/1(LRT-60-030/1)
	Halfshaft remover/replacer 204-506/2(LRT-60-030/2)
	Halfshaft remover/replacer 204-506/3(LRT-60-030/3)
	Retainers - halfshaft remover/replacer 204-506/5(LRT-60-030/5)
	Halfshaft installer adapter 204-506-01(LRT-60-030/4)

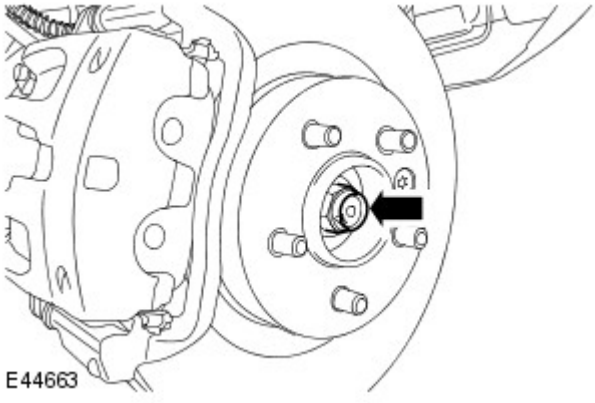
Removal

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

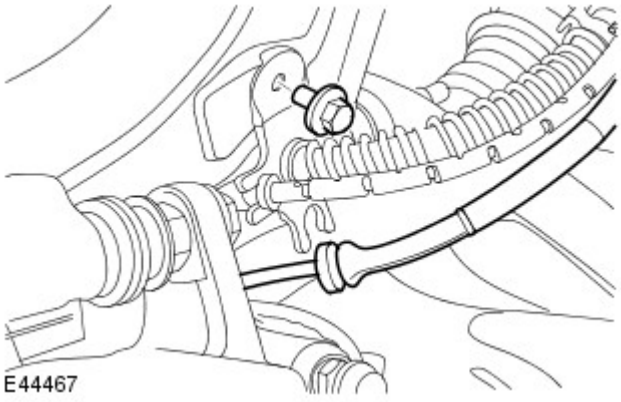
   Raise and support the vehicle.

2. Remove the wheel and tire.

3. Loosen the halfshaft retaining nut.


E44663

4. Release the brake hose bracket from the wheel knuckle.
    - Remove the bolt.

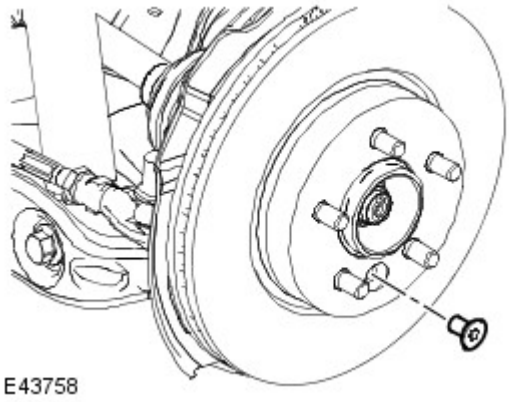

E44467

5. Remove the wheel speed sensor retaining bolt.

6. CAUTION: Do not allow the brake caliper to hang on the brake hose.

   Release the brake caliper anchor plate from the wheel knuckle and tie the caliper aside.
    - Tie aside complete with the wheel speed sensor.

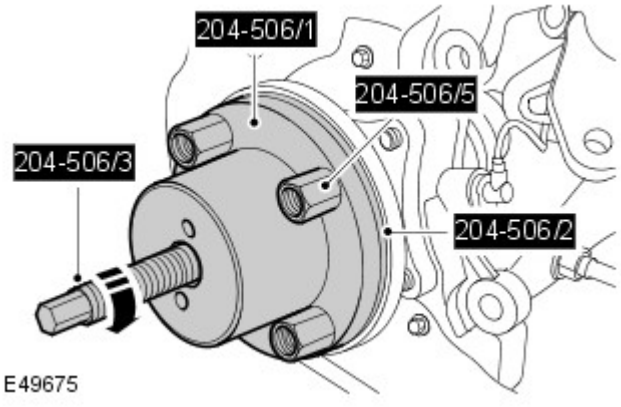
7. Remove the brake disc.
    - Remove the Torx screw.


E43758

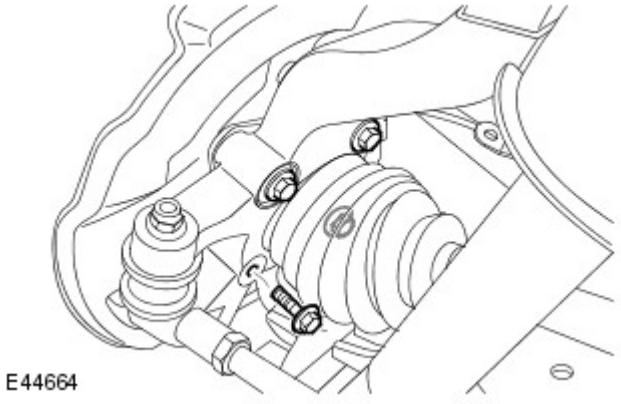
8. Remove the halfshaft retaining nut.
    - Discard the nut.

9. CAUTION: Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

   Using the special tools, release the halfshaft from the wheel hub.

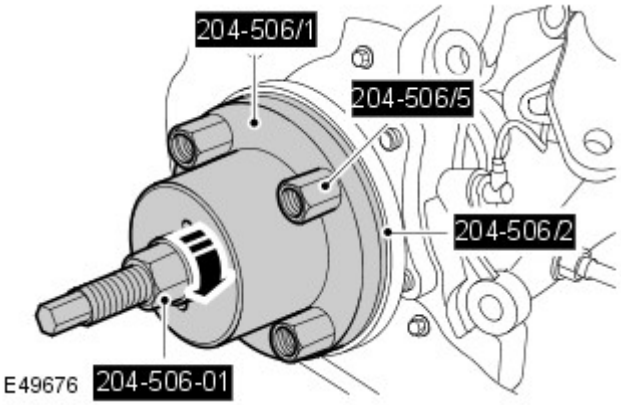


10. Remove the wheel hub.
    - Remove the 4 bolts.



Installation

1. Clean the components.



2. Install the wheel hub.
    - Using the special tools, install the halfshaft in the wheel hub.
    - Tighten the 4 bolts to 115 Nm (85 lb.ft).
3. Install a new halfshaft retaining nut and lightly tighten.
4. Make sure the brake disc and hub mating surfaces are clean.
5. Install the brake disc.
    - Tighten the Torx screw to 35 Nm (26 lb.ft).
6. Install the brake caliper and anchor plate.
    - Install the wheel speed sensor.
    - Tighten the bolts to 275 Nm (203 lb.ft).
7. Install the wheel speed sensor retaining bolt.
8. Secure the brake hose retaining bracket to the wheel knuckle.
    - Tighten the bolt to 22 Nm (16 lb.ft).
9. CAUTION: Do not use air tools to install the nut. Failure to follow this instruction may result in damage to the component.

   Tighten the new halfshaft retaining nut to 230 Nm (170 lb.ft).
    - Stake the nut to the halfshaft.

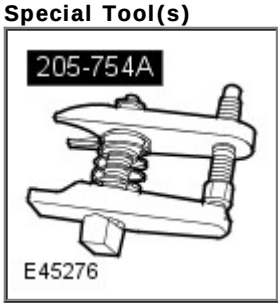
10. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.

11. Install the wheel and tire.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Suspension - Upper Arm

Removal and Installation

Special Tool(s)

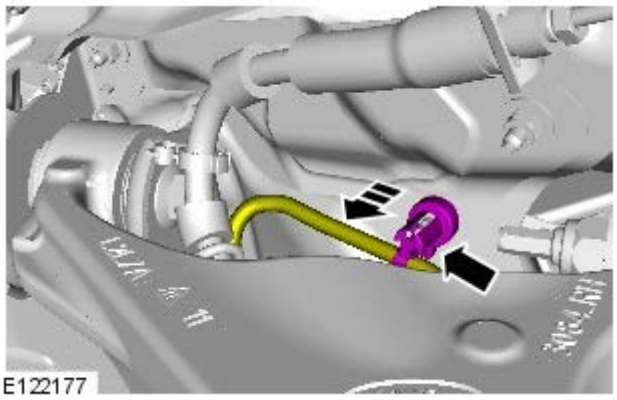
	Ball joint separator 205-754(LRT-54-027)

Removal

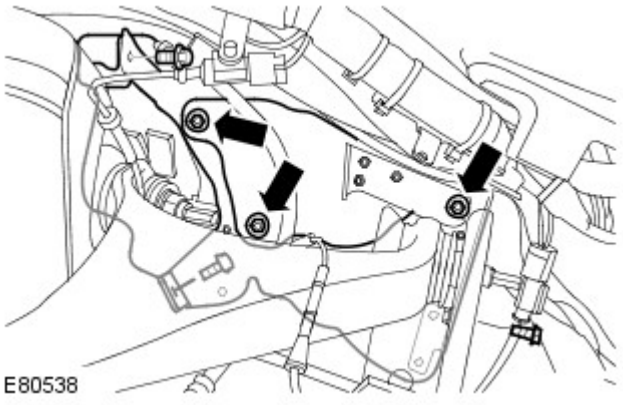
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

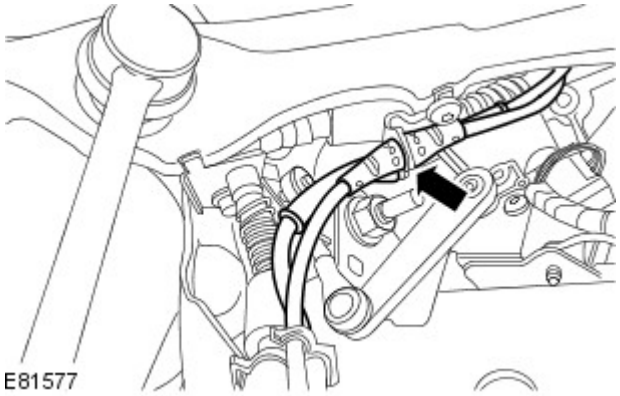
2. Remove the wheel and tire.



3. RH side front: Release the height sensor wiring harness.

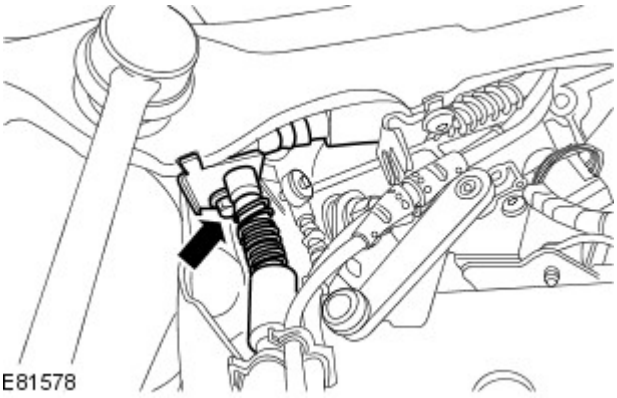


4. Remove the upper arm and brake line heat shields for access.
   - Remove the 3 nuts.
   - Remove the 3 bolts.



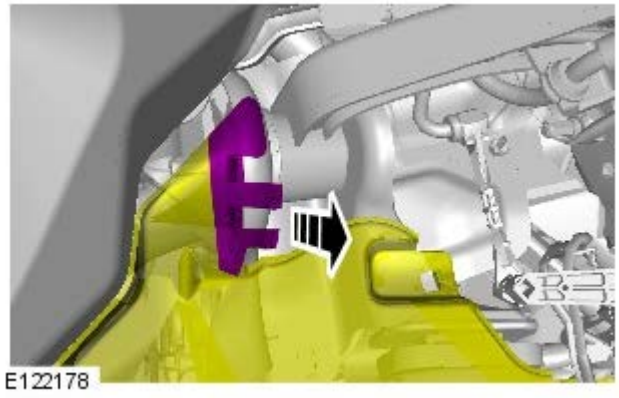
5. Release the wheel speed sensor leads from the upper arm.
   - Remove the bolt.

6. Release the brake hose from the upper arm.

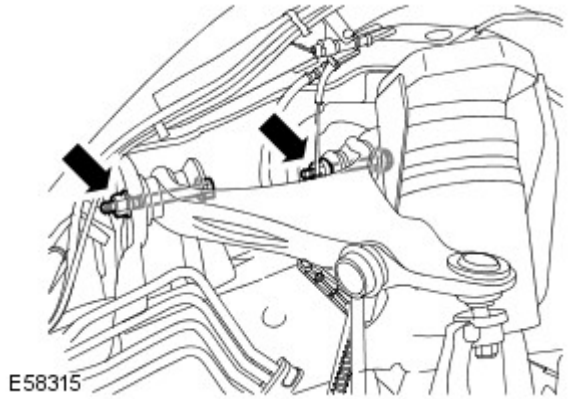


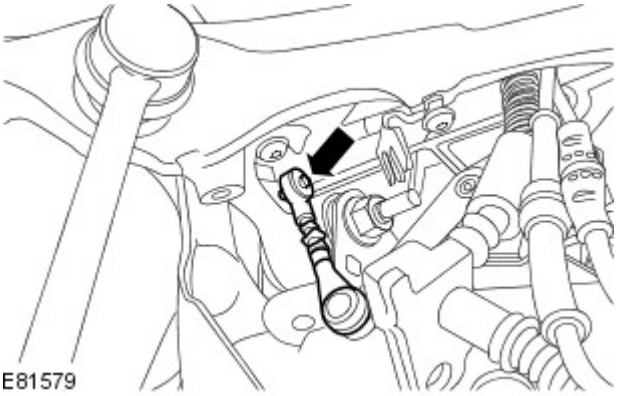
Remove the bolt.

7. RH side front: Release the front splash guard.



8. Loosen the upper arm bolts.





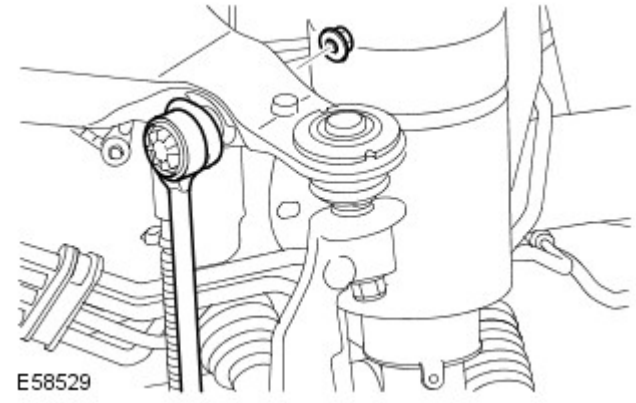
9. CAUTION: Do not use excessive force to disconnect the height sensor link.

Disconnect the height sensor link arm.

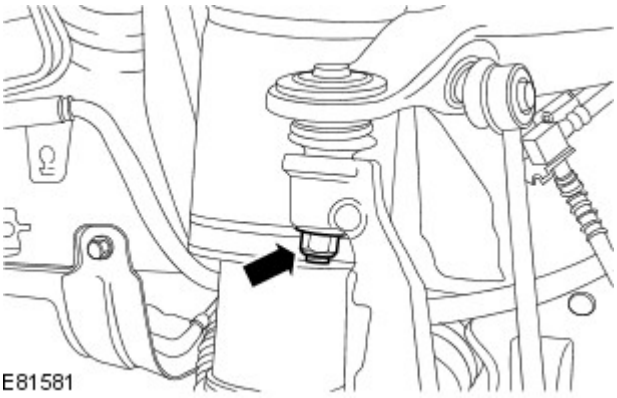
10. CAUTIONS:

Use a Torx socket to prevent the ball joint rotating whilst removing the nut.

Note the position of the hardened steel washer. The hardened steel washer must be installed between the stabilizer bar link and the upper arm. Failure to follow this instruction may result in damage to the vehicle.

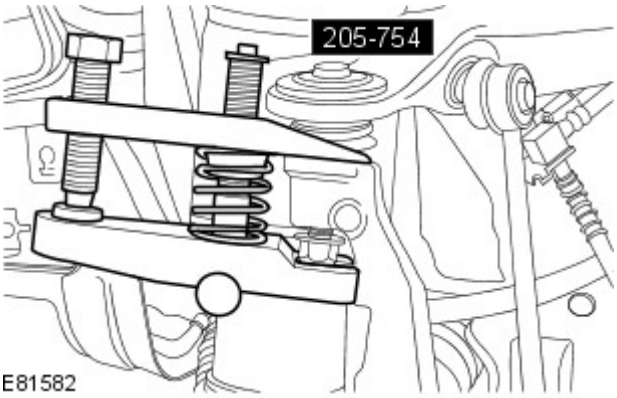


Remove the stabilizer bar link nut.
- Discard the nut.

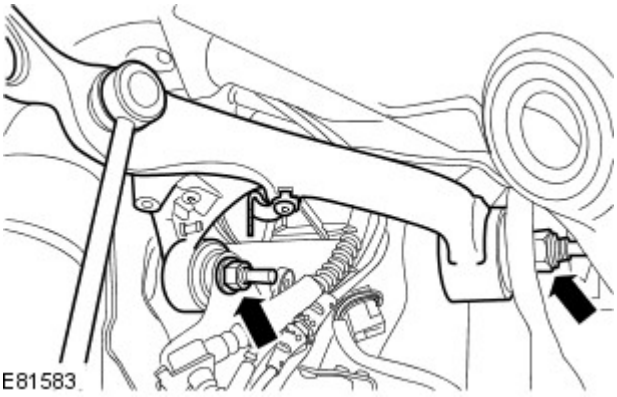


11. CAUTION: To prevent the wheel knuckle falling outwards and disconnection of the halfshaft inner joint, support the wheel knuckle.

    Loosen the upper arm retaining nut.



12. Using the special tool, release the upper arm ball joint.
    - Remove and discard the nut.



13. Remove the upper arm.
    - Remove and discard the 2 nuts.

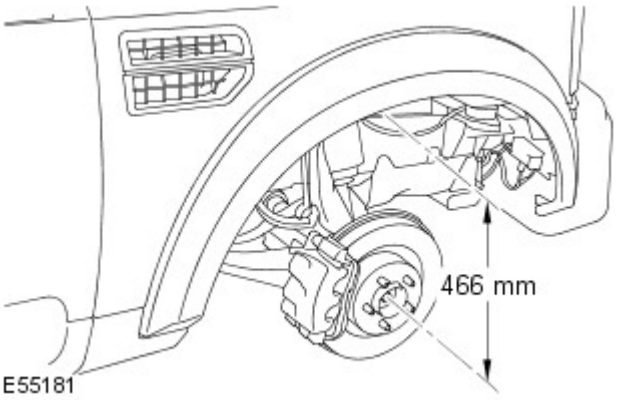
Installation

1. Install the upper arm.
   - Fit the bolts but do not fully tighten at this stage.
   - Install new nuts.
2. Connect the upper arm and wheel knuckle.
   - Install a new nut and tighten to 70 Nm (52 lb.ft).
3. Secure the stabilizer bar link.
   - Install a new nut and tighten to 115 Nm (85 lb.ft).
4. Connect the height sensor link.

5. Secure the brake hose to the upper arm.
    - Tighten the bolt to 23 Nm (17 lb.ft).

6. Secure the wheel speed sensor leads to the upper arm.
    - Tighten the bolt to 10 Nm (7 lb.ft).

7. Set the height distance between the centre of the halfshaft end and the edge of the fender trim to 466 mm (18.34").



8. Tighten the 2 upper arm nuts and bolts to 175 Nm (129 lb.ft).

9. RH side front: Secure the front splash guard.

10. Install the upper arm and brake line heat shields.
    - Install the 3 bolts.
    - Install the 3 nuts.

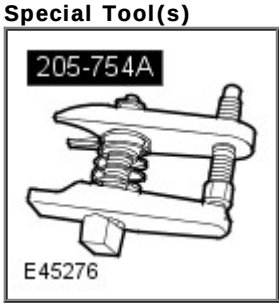
11. RH side front: Secure the height sensor wiring harness.

12. Install the wheel and tire.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

13. Using the Land Rover approved diagnostic system, calibrate the suspension ride height.

Front Suspension - Lower Arm
Removal and Installation

Special Tool(s)

 E45276	Ball joint separator 205-754(LRT-54-027)

Removal

All vehicles

1. Place vehicle into access mode.


E99855

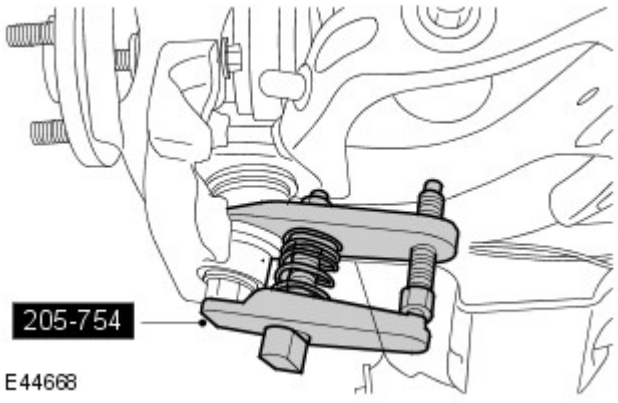
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

3. Remove the wheel and tire.

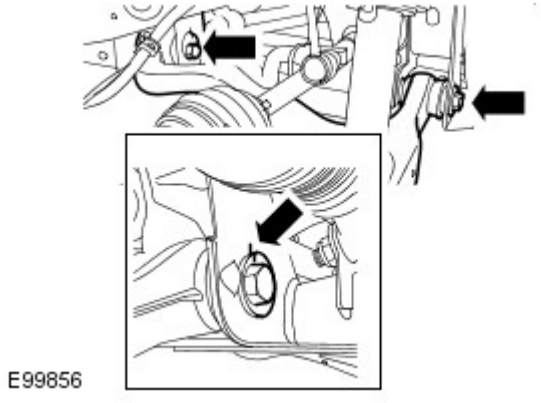
4. Remove the lower ball joint retaining nut.

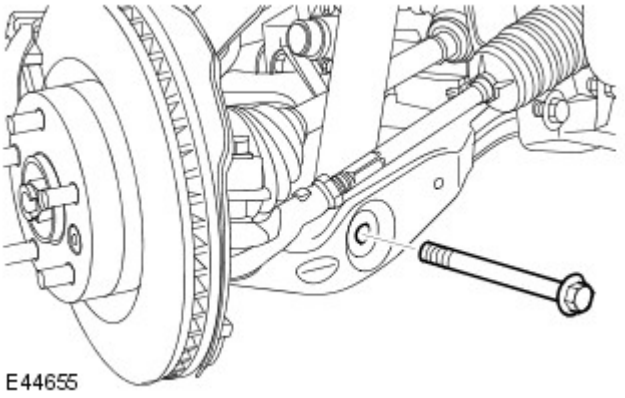
5. Using the special tool, release the lower ball joint from the steering knuckle.



E44668

6. Mark the position of the bolts in relation to the chassis brackets.
   - Remove the 2 bolts.


E99856


E44655

7. Disconnect the shock absorber and spring assembly from the lower arm.
    - Remove the nut and bolt.

8. CAUTION: Only displace the wheel knuckle sufficiently outboard to release the lower arm past the undertray. This will prevent the inboard driveshaft joint from separating. Failure to follow this instruction may result in damage to the vehicle.

   NOTE: Make sure the steering is in the straight ahead position.

   Remove the lower arm.
    - Release the lower arm from the subframe and reposition downwards.
    - Rotate the lower arm and position forward to release from the wheel knuckle.

Vehicles with Active Stabilization

9. Position a transmission jack to support the hub assembly.

Installation

Vehicles with Active Stabilization

1. Remove the transmission jack.

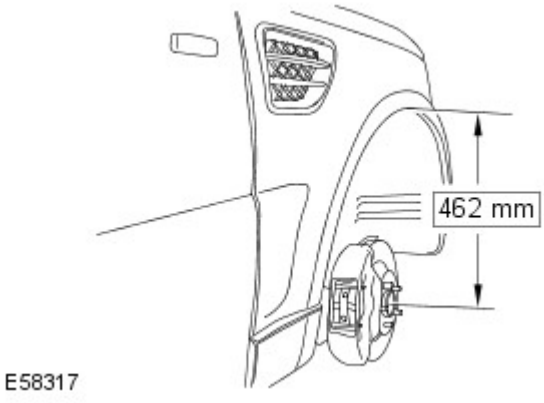
All vehicles

2. Install the lower arm.
    - Fit the bolts but do not fully tighten at this stage.

3. CAUTION: The lower arm ball joint can be damaged by excessive articulation. Do not over articulate the ball joint. Failure to follow this instruction will result in damage to vehicle.

   Connect the lower arm to the wheel knuckle.
    - Tighten the lower arm ball joint retaining nut to 115 Nm (85 lb.ft).

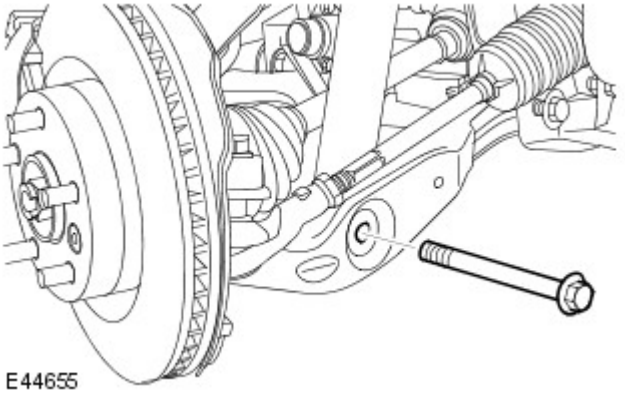
4. Set the height distance, between the center of the halfshaft end, and the edge of the fender to 462 mm (18.19'').



E58317

5. Tighten the lower arm bolts to 275 Nm (203 lb.ft).
    - Align the bolts to the marks made previously.

6. Connect the shock absorber and spring assembly to the lower arm.
    - Tighten the nut and bolt to 300 Nm (221 lb.ft).


E44655

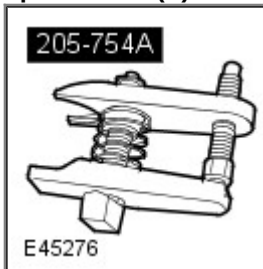
7. Install the wheel and tire.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

8. Carry out the wheel alignment procedure.

Front Suspension - Upper Arm Bushing

Removal and Installation

Special Tool(s)

	Ball joint separator 205-754(LRT-54-027)
	Receiver cup upper arm bushes 204-532/1
	Remover upper arm bushes 204-532/2
	Installer upper arm front bush 204-532/3
	Installer upper arm rear bush 204-532/4

Removal

NOTE: The bushings must be replaced in pairs, LH and RH sides.

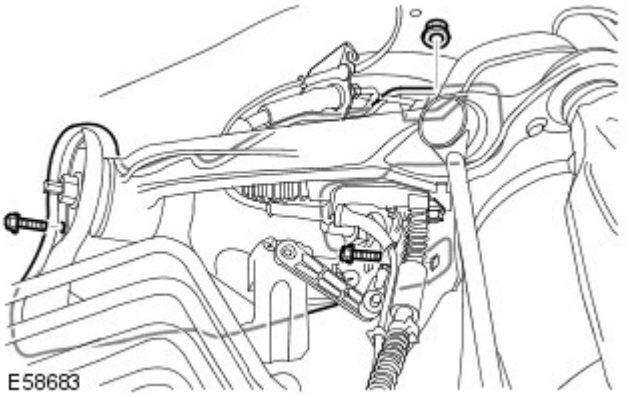
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

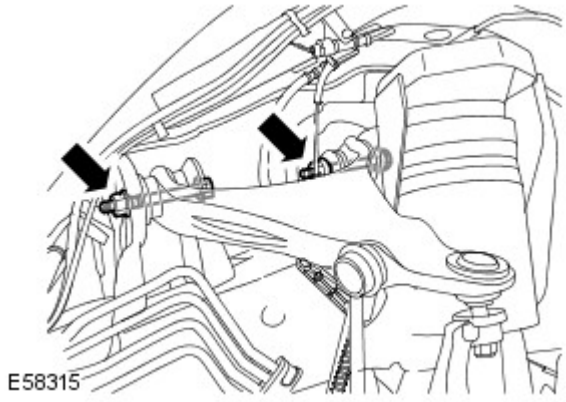
2. Remove the front wheels and tires.

3. Remove the RH upper arm.
   For additional information, refer to: Upper Arm (204-01, Removal and Installation).

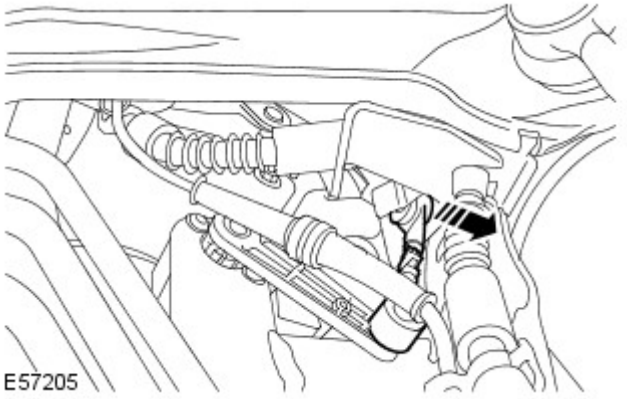
4. Release the heat shield for access to the upper arm bolts.
   - Remove the retaining nut and two bolts.



5. Loosen the upper arm bolts.



6. Disconnect the height sensor link.

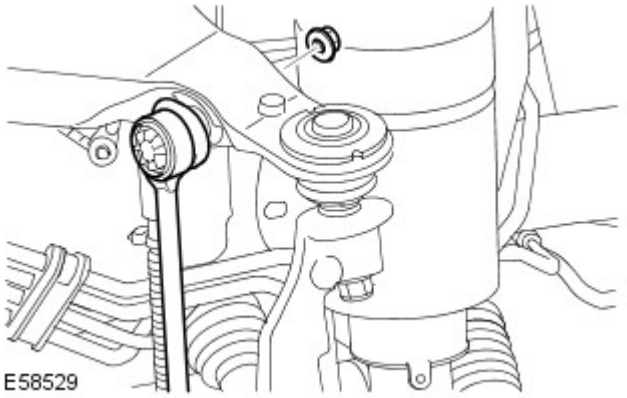


7. CAUTIONS:

   Use a Torx socket to prevent the ball joint rotating whilst removing the nut.

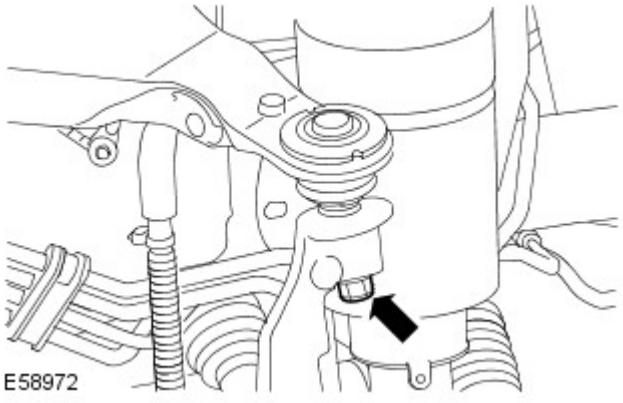
   Note the position of the hardened steel washer. The hardened steel washer must be installed between the stabilizer bar link and the upper arm. Failure to follow this instruction may result in damage to the vehicle.

   Remove the stabilizer bar link nut.
   - Discard the nut.

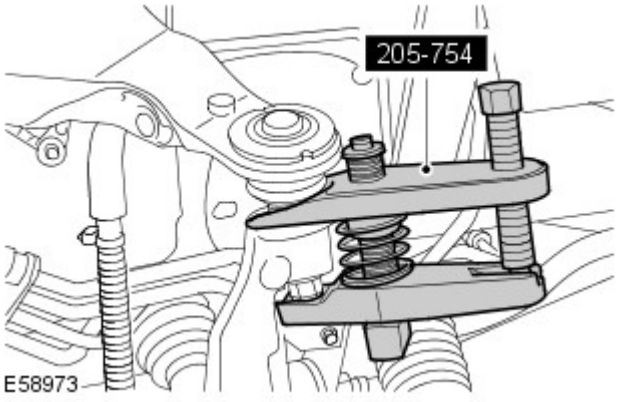


8. CAUTION: To prevent the wheel knuckle falling outwards and disconnection of the halfshaft inner joint, support the wheel knuckle.

   Loosen the upper arm retaining nut.



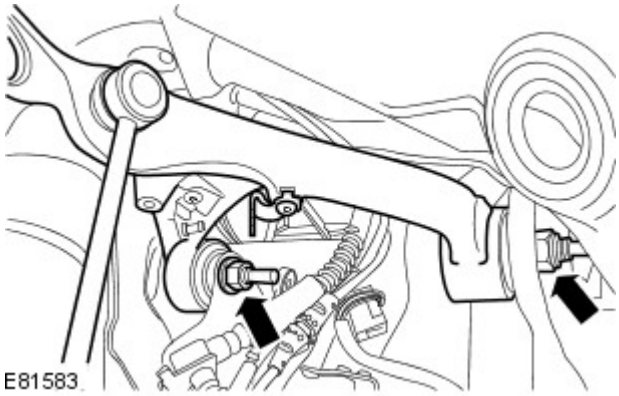
9. Using the special tool, release the upper arm ball joint.
    - Remove and discard the retaining nut.



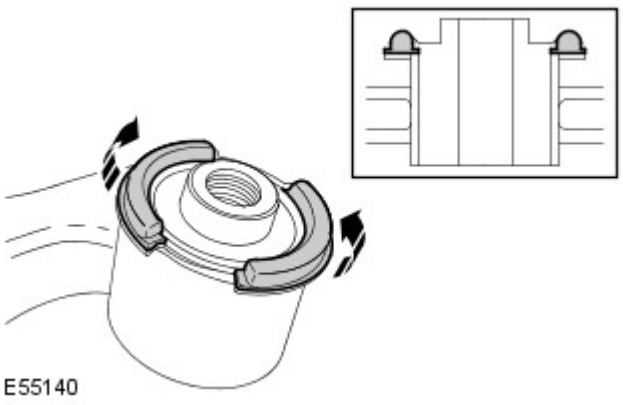
10. Release the brake hose from the upper arm.
    - Remove the bolt.

11. Release the wheel speed sensor lead from the upper arm.
    - Remove the bolt.

12. Remove the LH upper arm.
    - Remove and discard the 2 nuts.



13. Note the position of the bushing in relation to the upper arm.



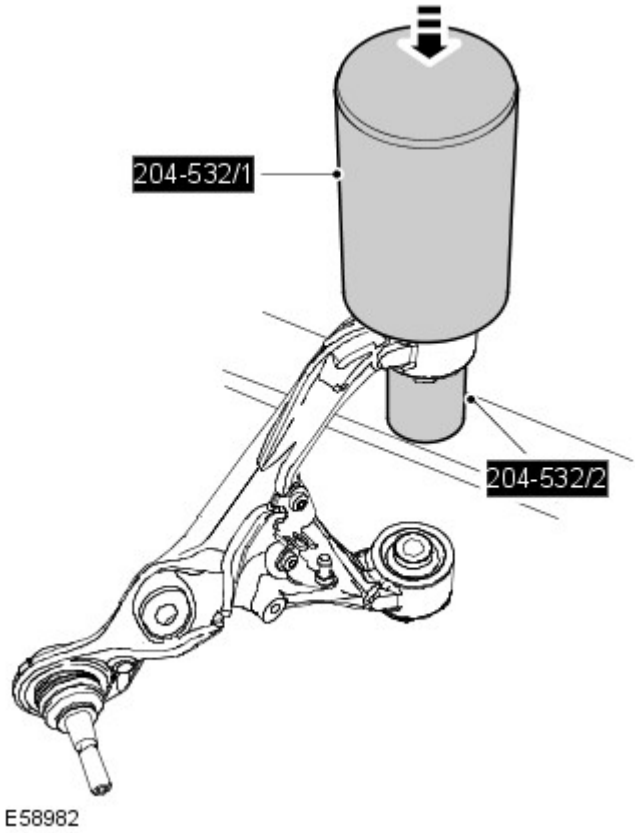
14. CAUTION: The bush flanges need to be removed to allow bush removal.

    Using a suitable tool, bend over the bush flanges.

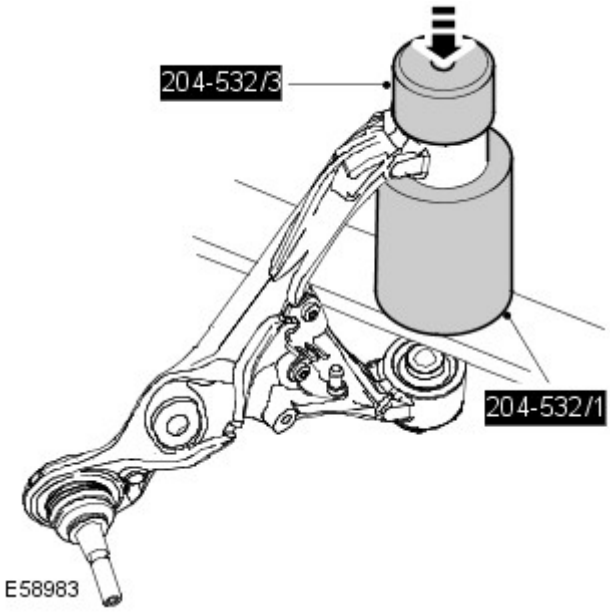
15. Using a hacksaw, remove the flange from the bushing, making sure the upper arm is not damaged.

16. Using the special tools, remove and discard the

upper arm bushings.



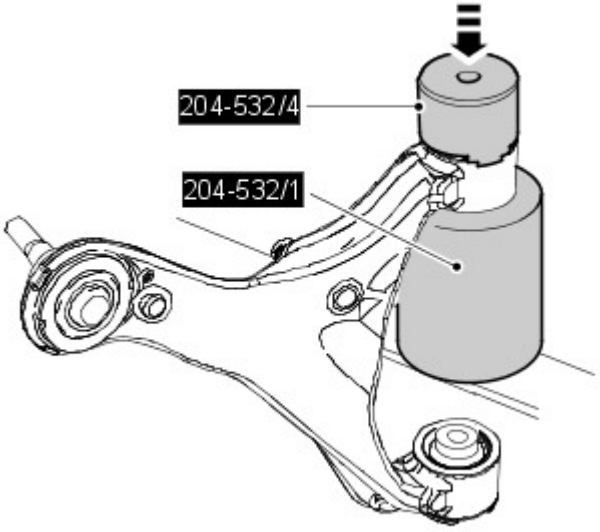
Installation



1. CAUTION: Make sure the correct special tool is used to install the bushings to the correct depth.

   Using the special tools, install the upper arm rear bushings.
   - Align the arrow on the bush with the mark, previously made on the upper arm.

2. Using the special tools, install the upper arm front bushings.
   - Align the arrow on the bush with the mark, previously made on the upper arm.



E58984

3. WARNING: Make sure that new nuts are installed.

   Install the LH upper arm.
   - Fit the bolts but do not fully tighten at this stage.

4. Secure the brake hose to the upper arm.
   - Tighten the bolt to 23 Nm (17 lb.ft).

5. Secure the wheel speed sensor lead to the upper arm.
   - Tighten the bolt to 10 Nm (7 lb.ft).

6. Connect the upper arm and wheel knuckle.
   - Install a new nut and tighten to 70 Nm (52 lb.ft).

7. CAUTIONS:

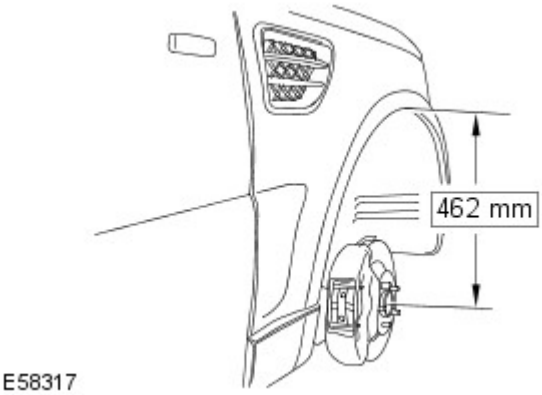
   Make sure the hardened steel washer is installed between the stabilizer bar link and the upper arm. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

   Secure the stabilizer bar link.
   - Install a new nut and tighten to 175 Nm (129 lb.ft).

8. Connect the height sensor link.

9. Set the height distance, between the center of the halfshaft end, and the edge of the fender to 462 mm (18.19'').



E58317

10. Tighten the 2 upper arm nuts and bolts to 175 Nm (129 lb.ft).

11. Secure the heat shield.
    - Tighten to 10 Nm (7 lb.ft).

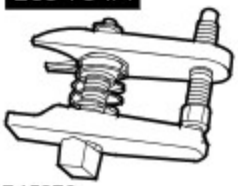
12. Install the RH upper arm.
    For additional information, refer to: Upper Arm (204-01, Removal and Installation).

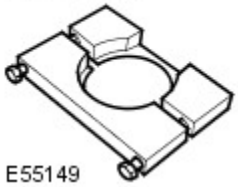
13. Install the front wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Suspension - Lower Arm Bushing

Removal and Installation

Special Tool(s)

 E75373	Hydraulic cylinder 10t 204-598
204-536/1  E55144	Receiver front lower arm front bush 204-536/1
204-536/2  E55145	Remover front lower arm front bush 204-536/2
204-535/2  E55148	Remover front lower arm rear bush 204-535/2
204-536/3  E55146	Installer front lower arm front bush 205-536/3
205-754A  E45276	Ball joint separator 205-754(LRT-54-027)
204-535/1  E55147	Receiver lower arm rear bush 204-535/1
	Remover plate front lower arm rear bush 204-535/4

204-535/4  E55149	
204-535/3  E55150	Installer lower arm rear bush 204-535/3
204-535/5  E55151	Installer/depth setter front lower arm rear bush 204-535/5

Removal

NOTES:

If installing the front bushes, both front bushes must be installed.

If installing the rear bushes, both rear bushes must be installed.

Note orientation of the bush.

Removal steps in this procedure may contain installation details.

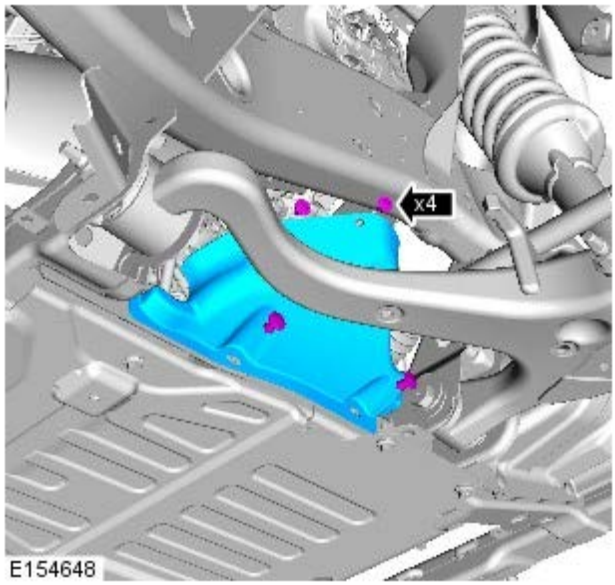
All vehicles

1. Make sure that the tire pressures are correct and that the vehicle is at the correct ride height.
   For additional information, refer to: Ride Height Adjustments (204-05 Vehicle Dynamic Suspension, 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.

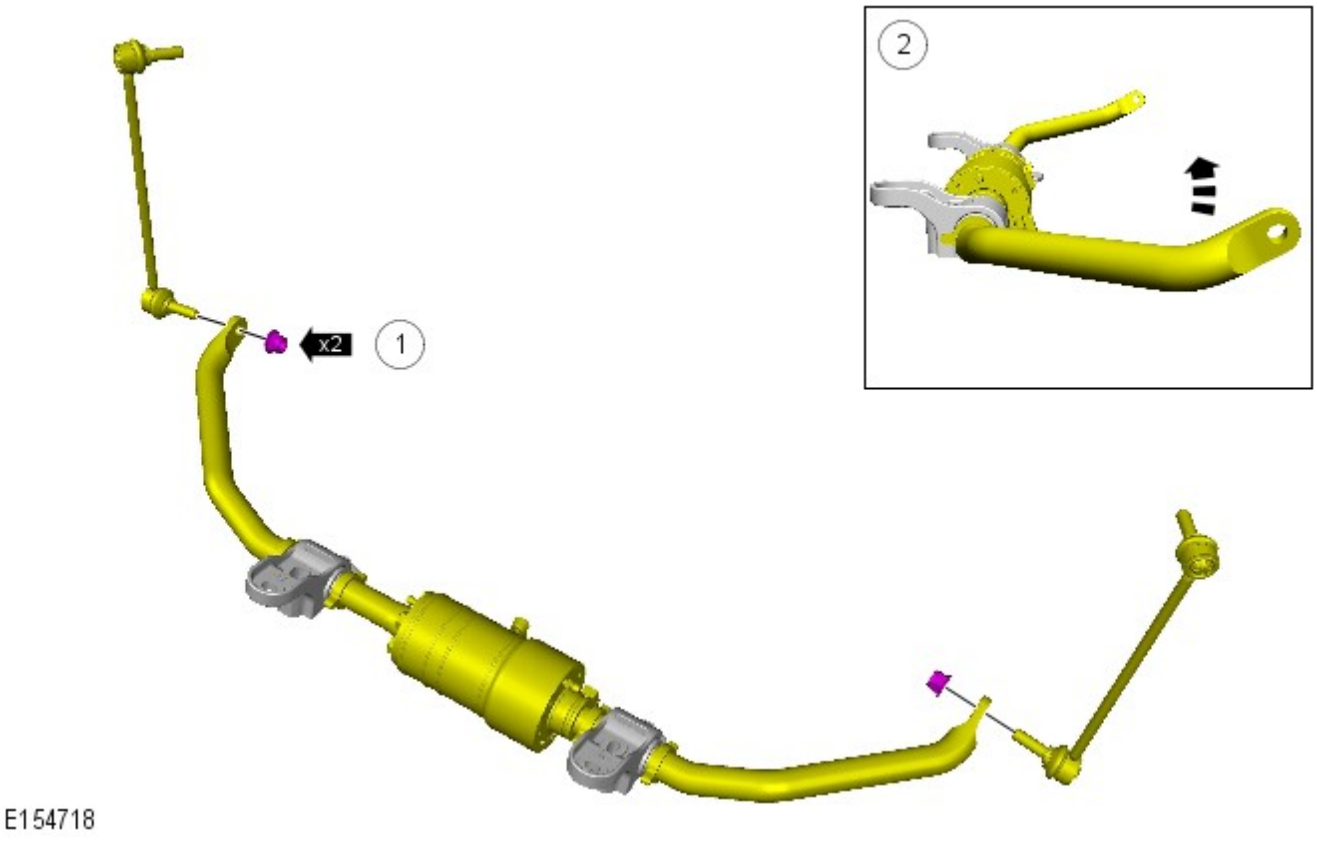
3. Remove the clips and trim for access to the lower arm camber bolts.



Vehicles with dynamic suspension

4. NOTE: Discard the nuts.

   Disconnect the front stabilizer bar links and rotate bar upwards to access lower arm bolts.



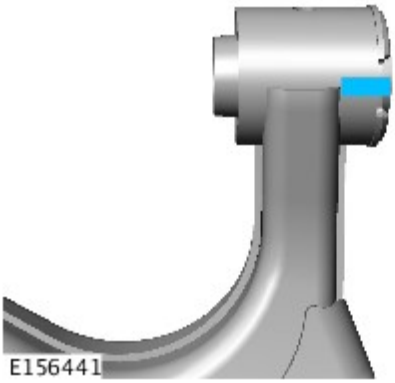
All vehicles

5. For additional information, refer to: Lower Arm (204-01 Front Suspension, Removal and Installation).

6. Secure lower arm in a suitable vice or similar to carry out the following steps.

7. NOTE: Mark the new bush to aid correct orientation on installation.

   Mark alignment of original bush prior to removal.



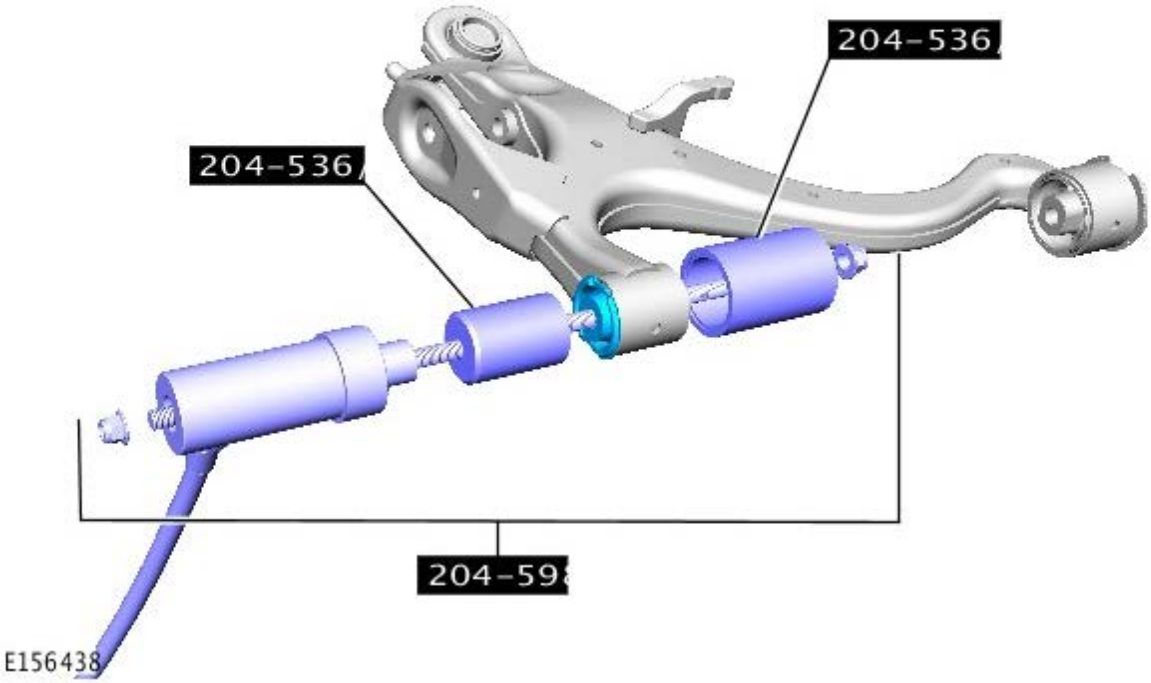
8. CAUTION: The bush flanges need to be removed to allow bush removal.

   Remove the lower arm front bushing flanges.



9. CAUTION: Make sure correct alignment is maintained whilst carrying out the step.

   Using the special tools, remove the bush.



10. NOTE: Mark the new bush to aid correct orientation on installation.

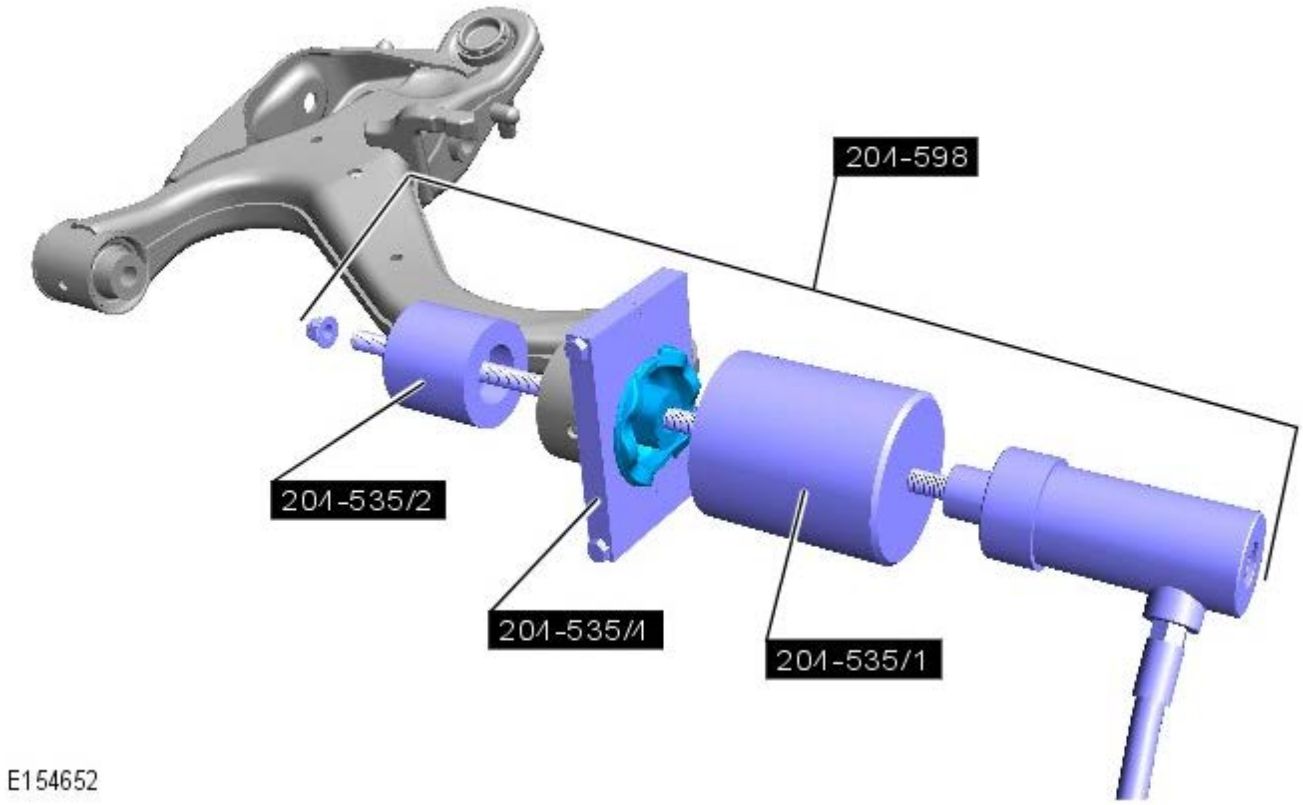
    Mark alignment of original bush prior to removal.



E154651

11. CAUTION: Make sure correct alignment is maintained whilst carrying out the step.

    Using the special tools, remove the bush.



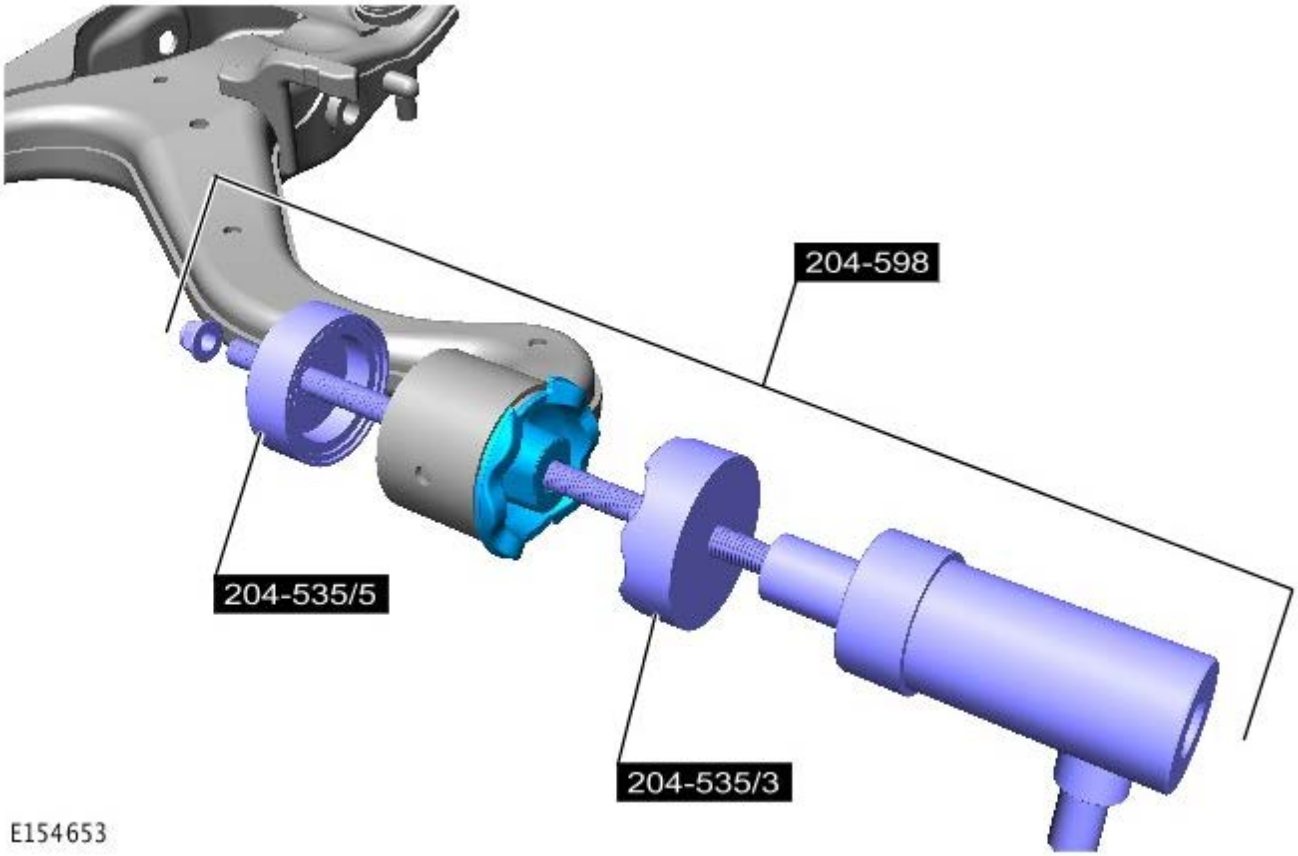
E154652

Installation

All vehicles

1. CAUTION: Make sure correct alignment is maintained whilst carrying out the step.

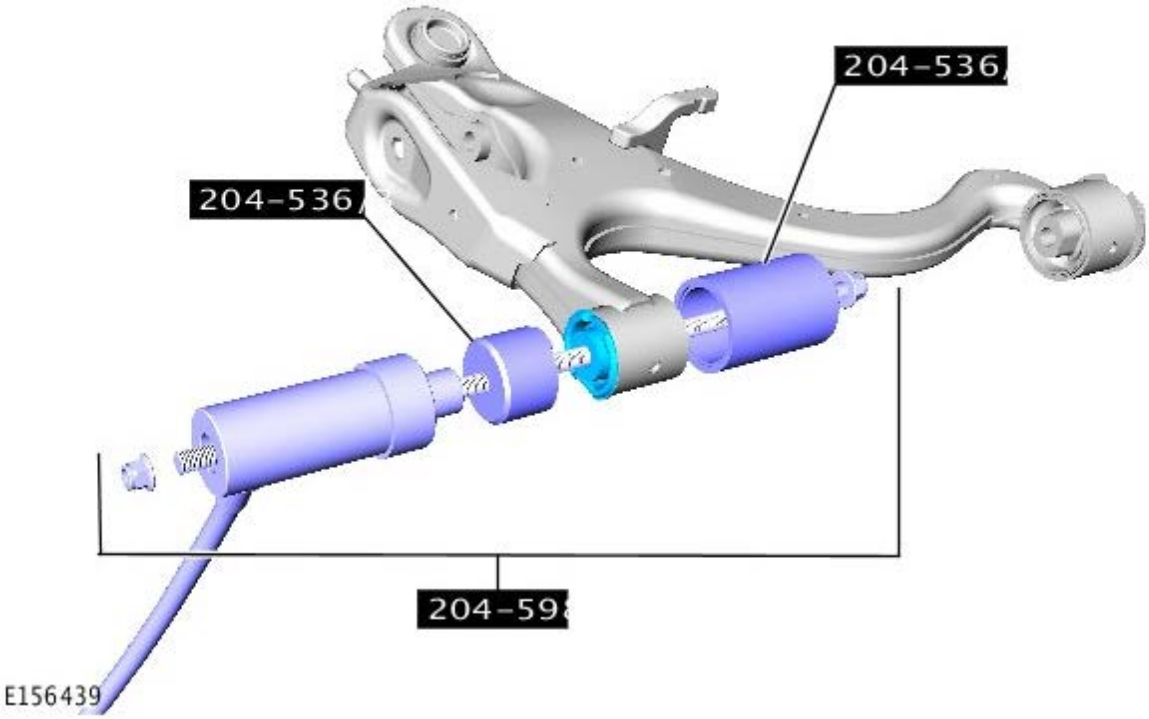
   Using the special tools install the bush.



E154653

2. CAUTION: Make sure correct alignment is maintained whilst carrying out the step.

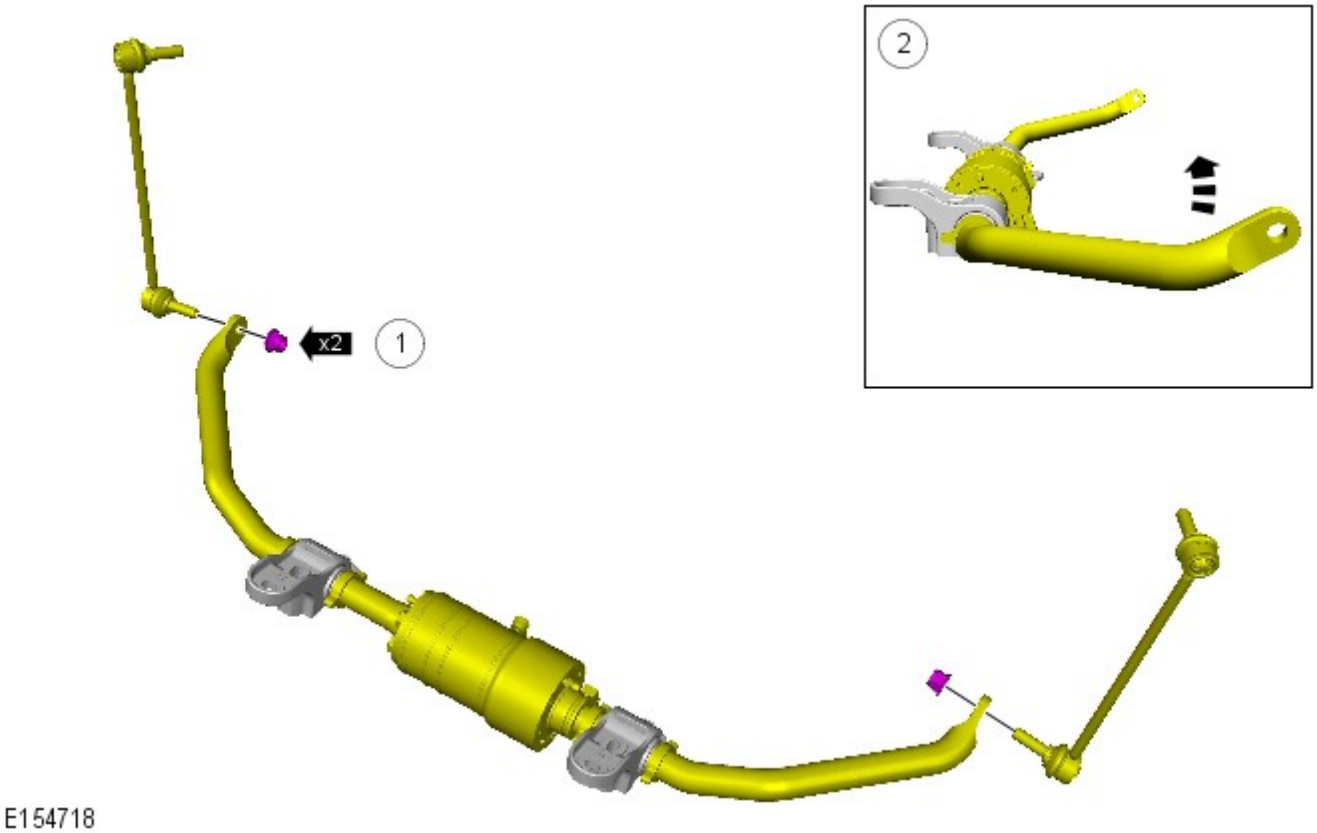
   Using the special tools install the bush.



3. For additional information, refer to: Lower Arm (204-01 Front Suspension, Removal and Installation).

Vehicles with dynamic suspension

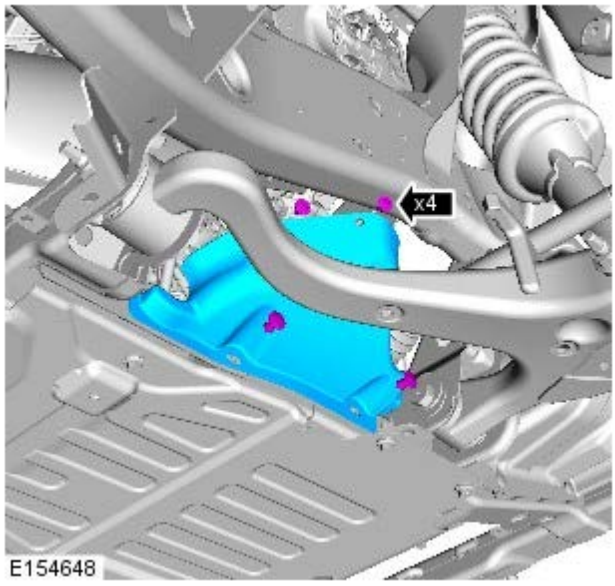
4. Connect both stabilizer links to the stabilizer bar.
   - Install new nuts and tighten to 115 Nm.



E154718

All vehicles

5. Refit the trim.



E154648

6. Carry out the wheel alignment procedure.

Front Suspension - Lower Arm Rear Bushing

Removal and Installation

Special Tool(s)

 E75373	Hydraulic cylinder 10t 204-598
 204-535/2 E55148	Remover front lower arm rear bush 204-535/2
 204-536/1 E55144	Receiver front lower arm front bush 204-535/1
 204-535/4 E55149	Remover plate front lower arm rear bush 204-535/4
 204-535/3 E55150	Installer front lower arm rear bush 204-535/3
 204-535/5 E55151	Installer/depth setter front lower arm rear bush 204-535/5

Removal

NOTES:

If installing the rear bushes, both rear bushes must be installed.

Take note of the fitted position of the bush.

Removal steps in this procedure may contain installation details

All vehicles

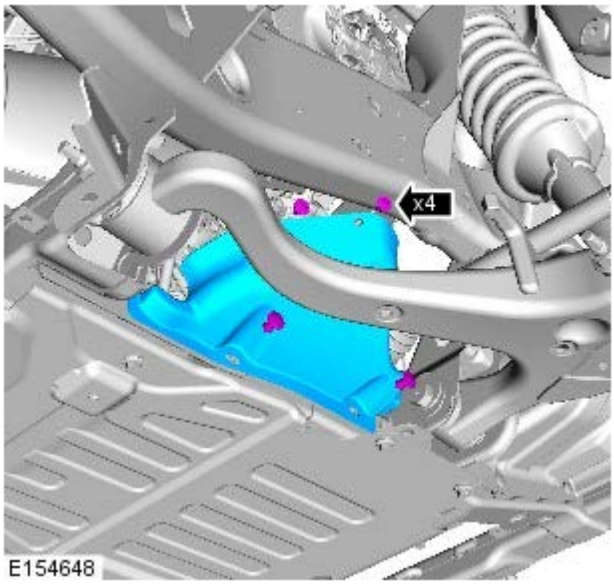
1. Make sure that the tire pressures are correct and that the

vehicle is at the correct ride height.
For additional information, refer to: Ride Height Adjustments (204-05 Vehicle Dynamic Suspension, General Procedures).

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

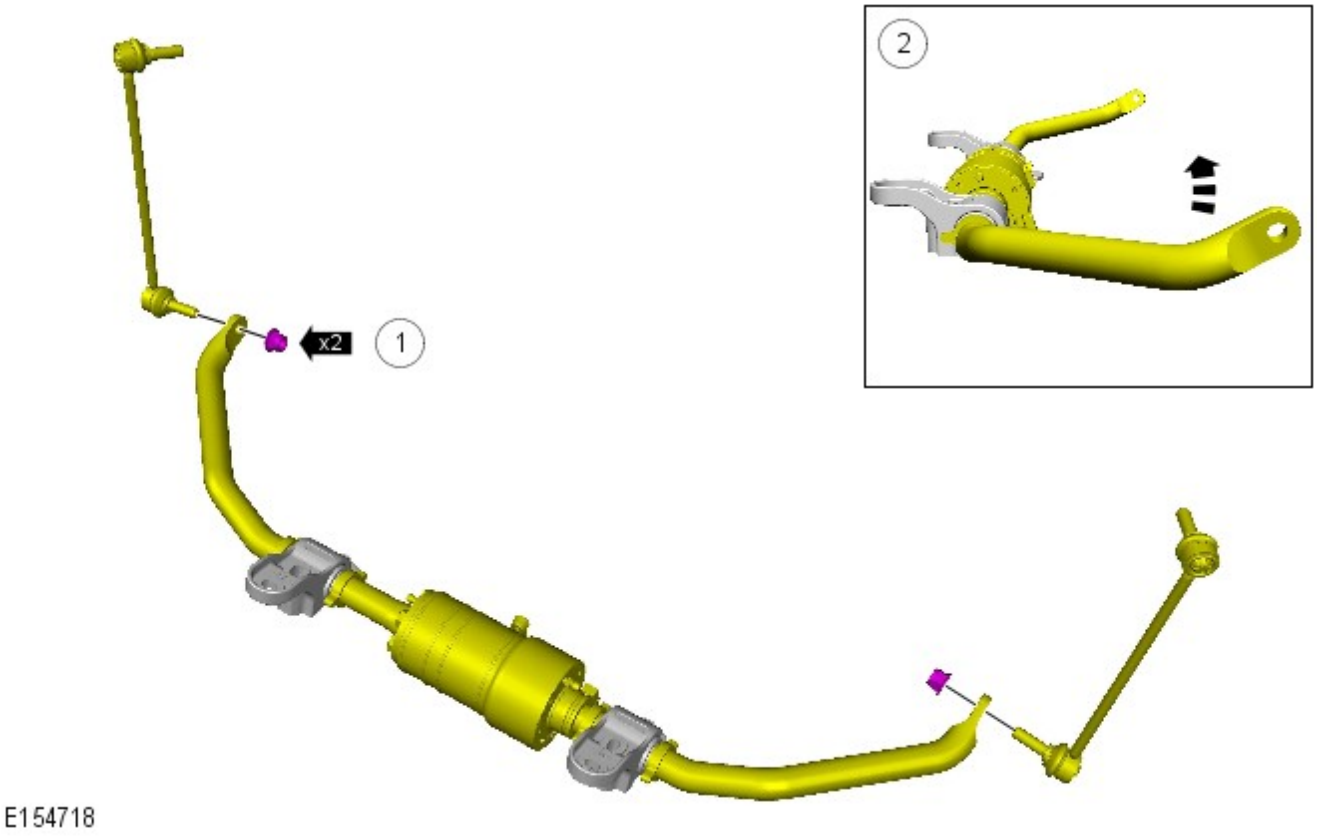
   Raise and support the vehicle.

3. Remove the clips and trim for access to the lower arm camber bolts.



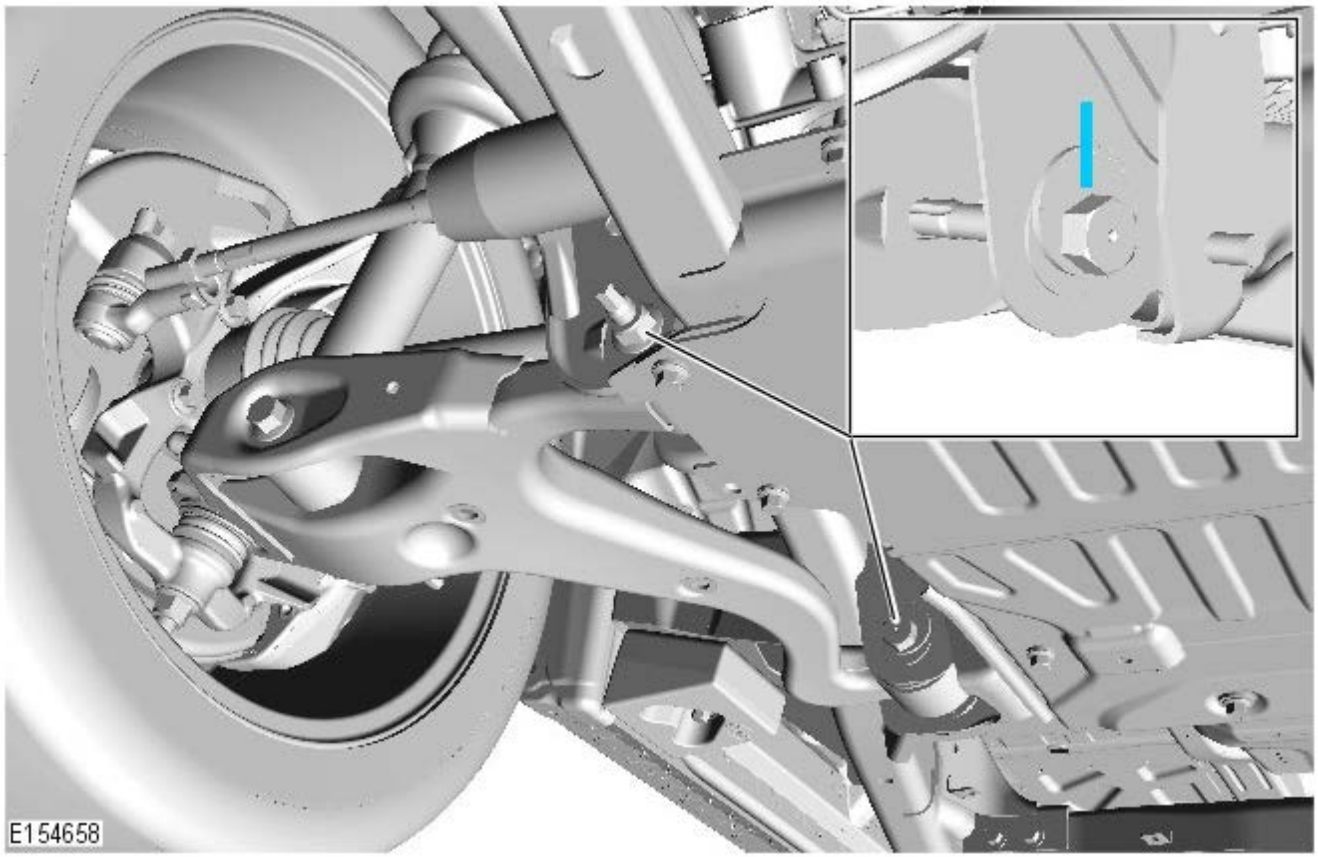
Vehicles with dynamic suspension

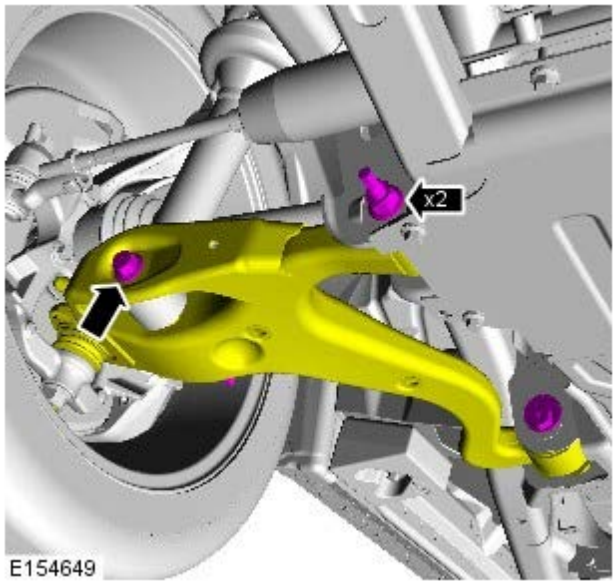
4. Disconnect the front stabilizer bar links and rotate bar upwards to access lower arm bolts.



All vehicles

5. Mark the position of the bolts in relation to the chassis brackets making note of the original position.

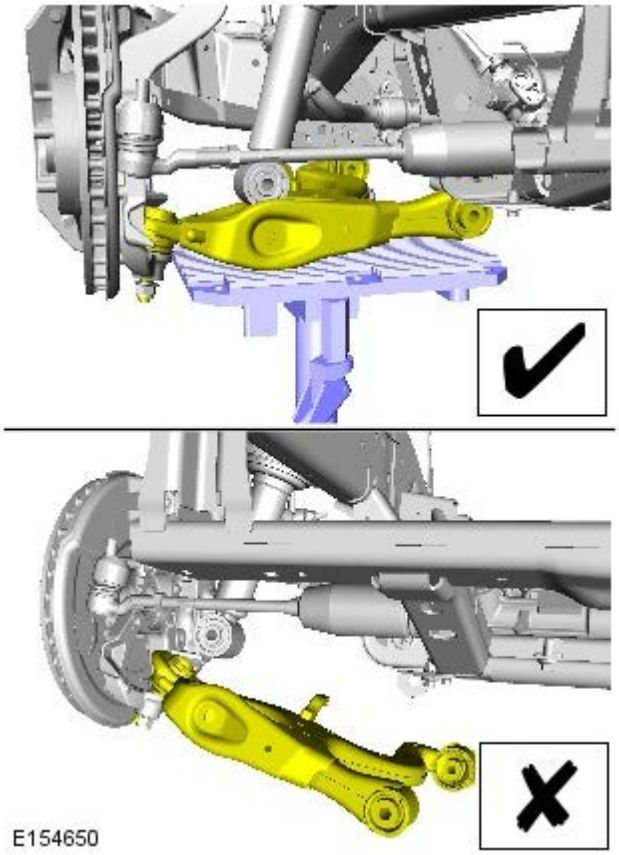




6. CAUTION: Make sure the lower arm is supported. Failure to follow this instruction may result in damage to the ball joint.

   Remove lower arm camber bolts and the lower damper bolt and rotate arm downwards for access.

7. Using a suitable transmission jack, support the lower arm in the position illustrated.



E154650

8. NOTE: Mark the new bush to aid correct orientation on installation.

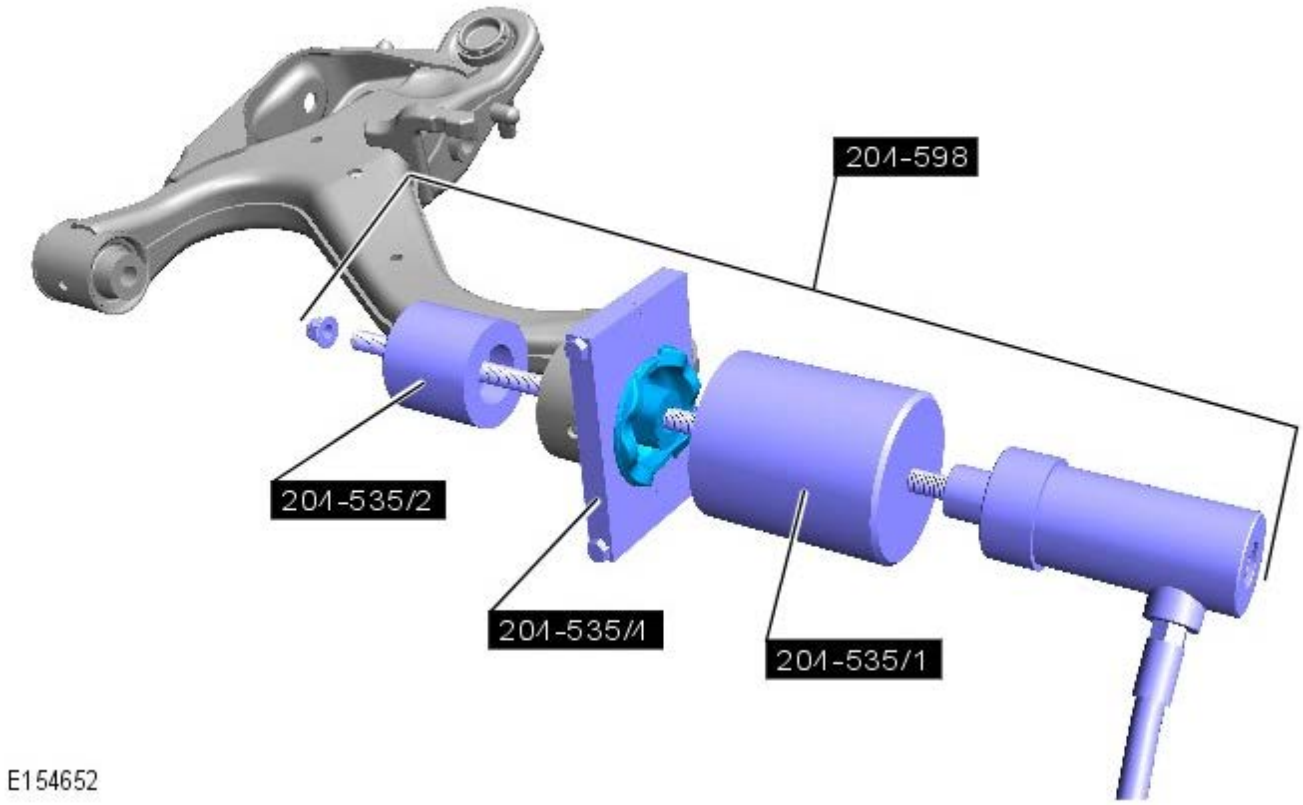
   Mark alignment of original bush prior to removal.



E154651

9. CAUTION: Make sure correct alignment is maintained whilst carrying out the step.

   Using the special tools, remove the bush.



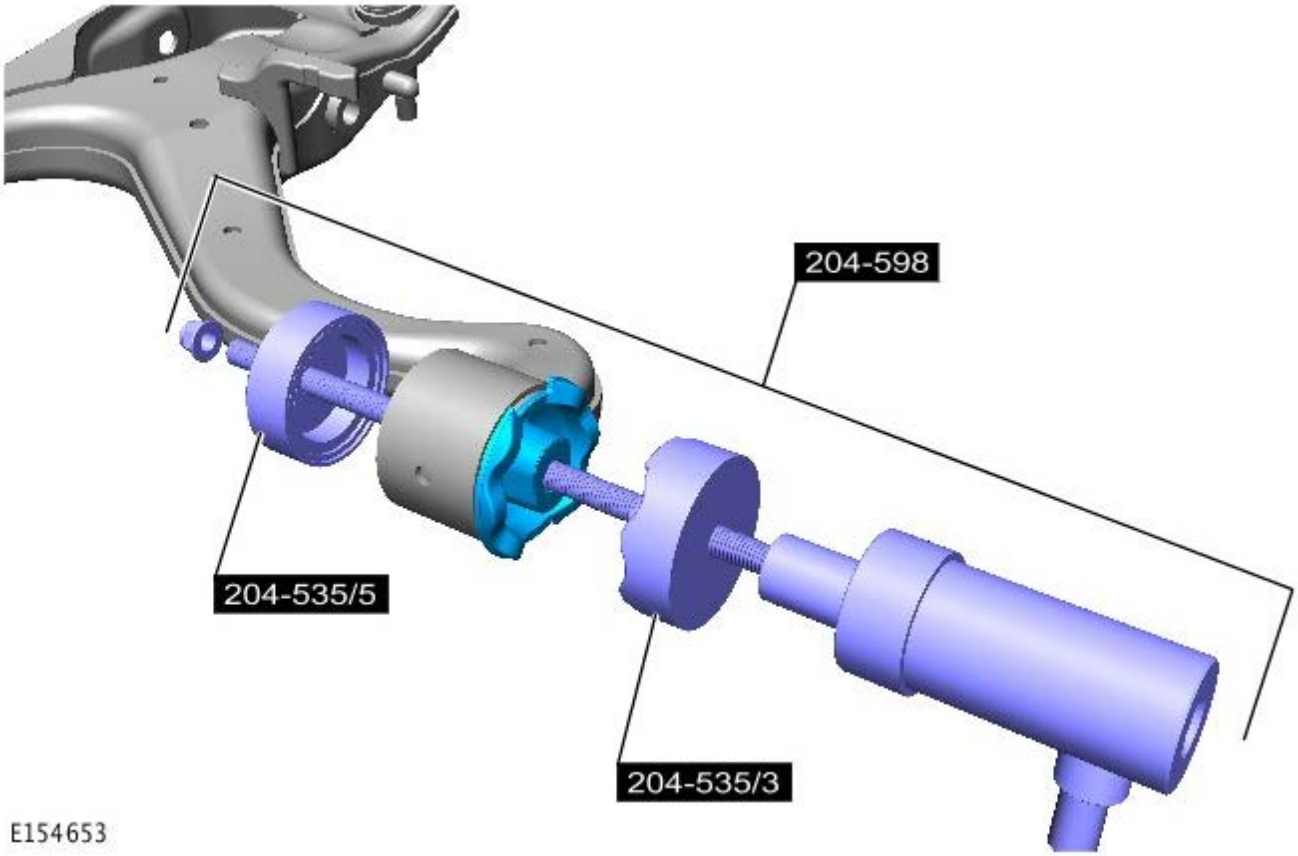
E154652

Installation

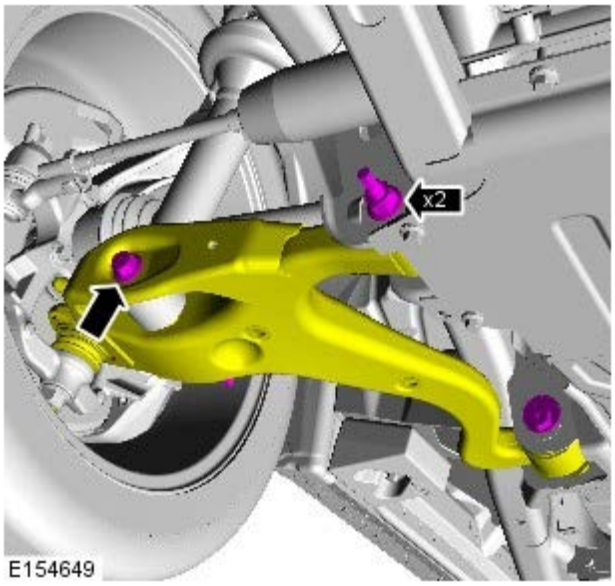
All vehicles

1. CAUTION: Make sure correct alignment is maintained whilst carrying out the step.

   Using the special tools install the bush.

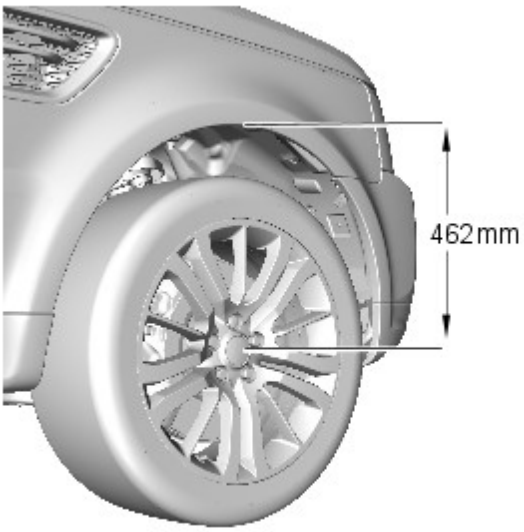


E154653

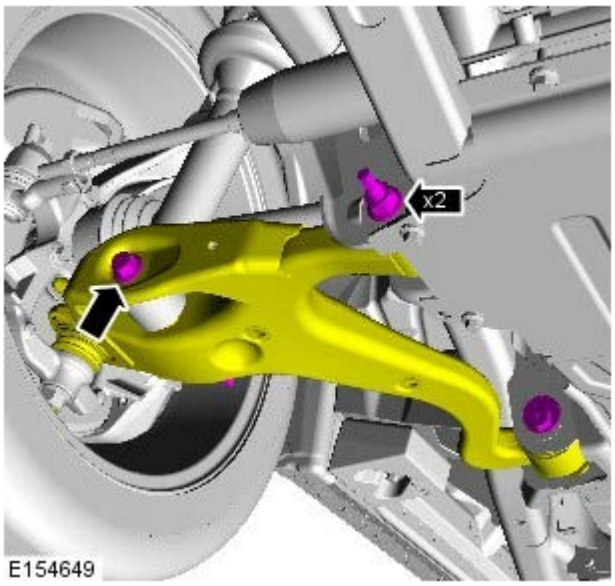


2. NOTE: Do not tighten the bolts at this stage.

   Install the lower front arm.



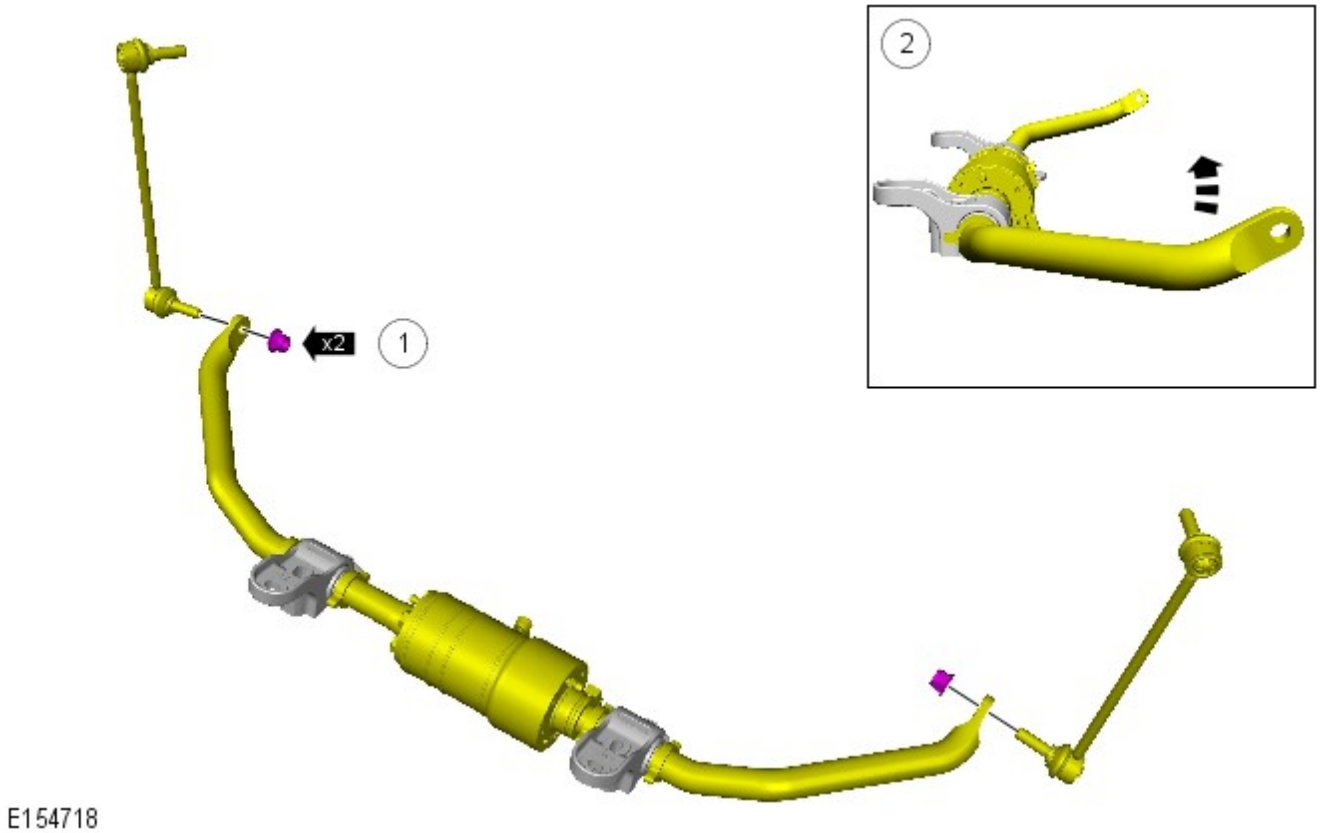
3. Set the height distance between the centre of the half shaft end and the edge of the fender trim to 462 mm (18.19") before tightening lower arm bolts.



4. Attach the lower arm.
   - Align the bolts to the marks made previously.
   - Tighten the lower arm camber bolts to 275 Nm.
   - Tighten the shock absorber and spring assembly to lower arm bolt to 300 Nm.

Vehicles with dynamic suspension

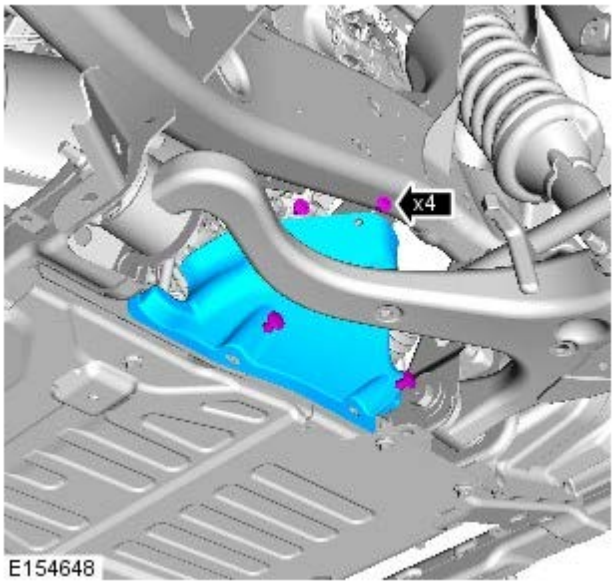
5. Connect both stabilizer links to the stabilizer bar.
   - Install new nuts and tighten to 175 Nm.



E154718

All vehicles

6. Refit the trim.



E154648

7. Carry out the wheel alignment procedure.

Rear Suspension -

Coil Spring Suspension

Item	Specification
Road spring color coding - 5 Seat Model:	
	BROWN/WHITE
	BROWN/GREEN
	BROWN/ORANGE
	BROWN
Road spring color coding - 7 Seat Model:	
	RED/WHITE
	RED/GREEN
	RED/ORANGE
	RED

Note: The first color indicates the fitted position of the spring on the vehicle i.e. rear. The secondary color identifies the thickness of the isolator which is fitted to a particular spring to ensure that the vehicle ride height is maintained within specified limits. Replacement springs will be supplied with the appropriate isolator fitted.

General Specifications

Item	Specification
Gap between underside of the toe link rubber boot and the integrated body frame bracket	15.0 mm (0.591 in)
Height between the center of the halfshaft end and the edge of the fender trim	463 mm (18.19 in)

Torque Specifications

Description	Nm	lb-ft
Toe link bolt	175	129
* Toe link inner ball joint retaining nut	133	98
* Stabilizer bar link nuts	115	85
Stabilizer bar clamp bolts	62	46
Body mount retaining bolts	133	83
Shock absorber to the lower suspension arm nut and bolt	300	221
Shock absorber to suspension turret nuts	70	52
Lower arm to wheel knuckle bolt	175	129
Lower arm bolts	275	203
*+ Halfshaft nut	420	311
Upper arm to wheel knuckle nut	133	98
Upper arm front bolt	175	129
Upper arm rear bolt	275	203
Brake tube unions	18	13
Rear camber adjusting bolts	133	98
Wheel speed sensor	9	7
Brake disc dust shield bolts	9	7
Parking brake cable coupling	8	6
Road wheel nuts	• Stage 1: 4 • Stage 2: 70 • Stage 3: 140	• Stage 1: - • Stage 2: 52 • Stage 3: 103

*** New nut must be installed**

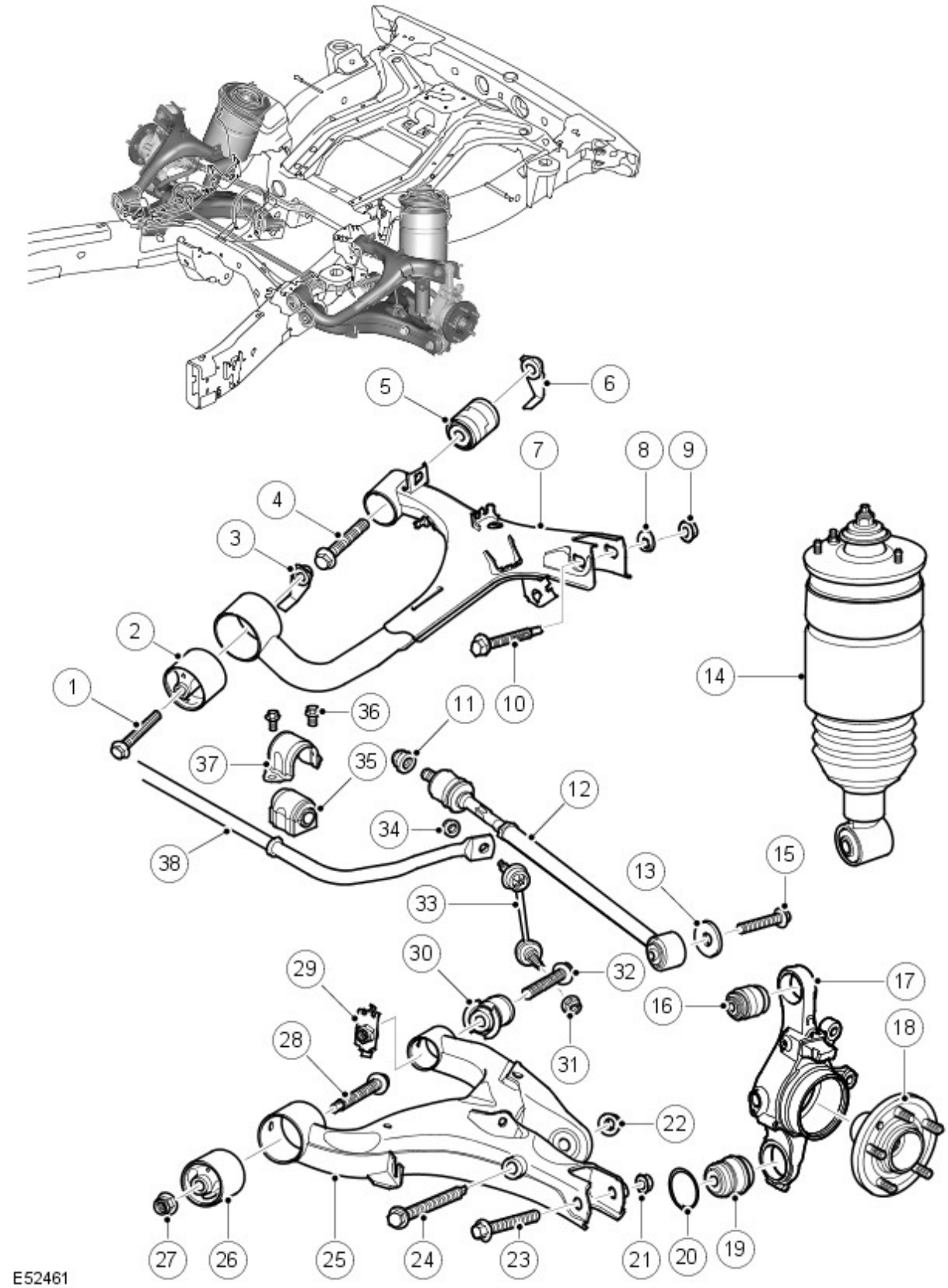
+ Nut must be staked after tightening

Rear Suspension - Rear Suspension

Description and Operation

Rear Suspension Component Location

NOTE: Without Dynamic Response version shown



Item	Part Number	Description
1	-	Bolt (Upper arm forward bush)
2	-	Bush - Forward (Upper arm)

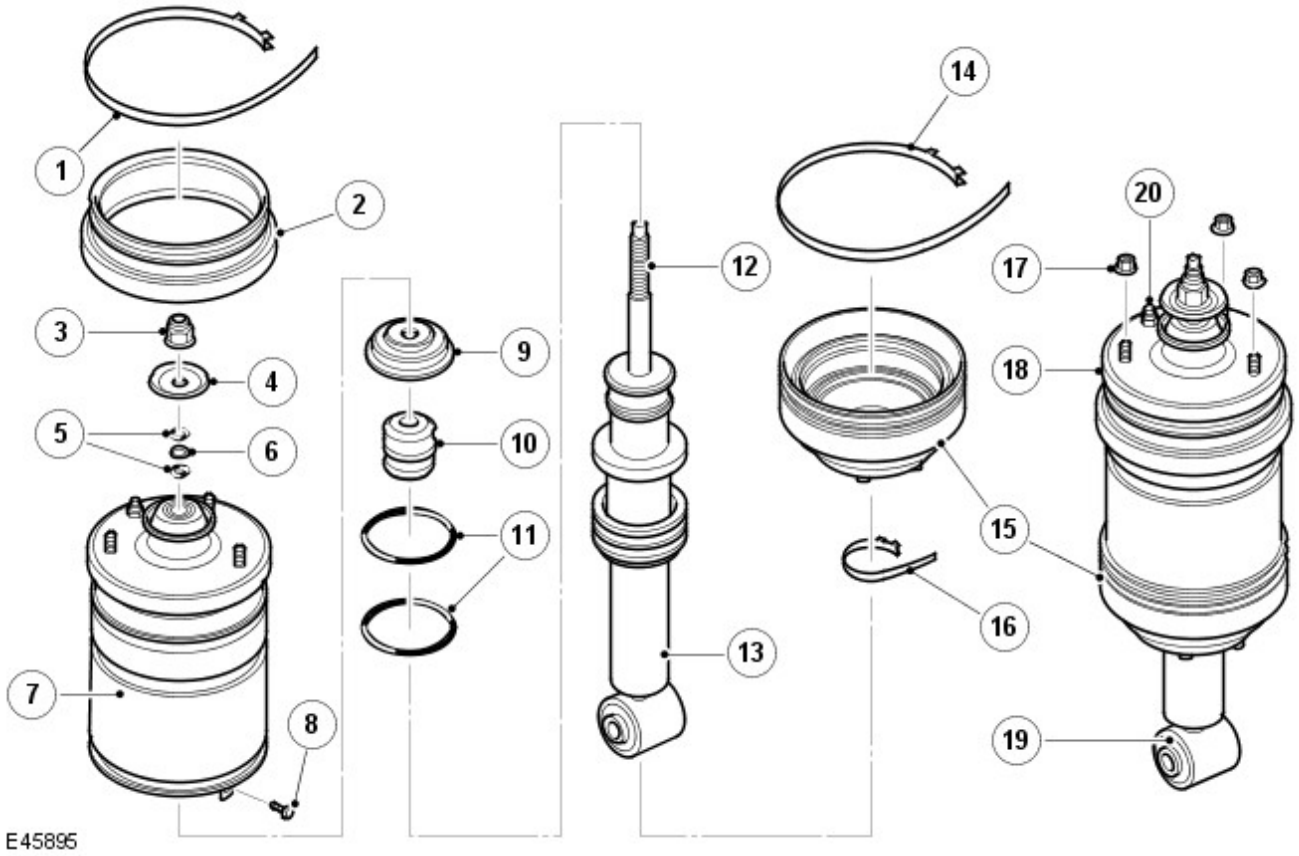
3	-	Caged nut (Upper arm forward bush)
4	-	Bolt (Upper arm rearward bush)
5	-	Bush - Rearward (Upper arm)
6	-	Caged nut (Upper arm rearward bush)
7	-	Upper arm
8	-	Eccentric washer (Wheel knuckle upper ball joint)
9	-	Nut (Wheel knuckle upper ball joint)
10	-	Bolt (Wheel knuckle upper ball joint)
11	-	Special nut (Adjustable transverse toe link)
12	-	Adjustable transverse toe link
13	-	Washer (Adjustable transverse toe link)
14	-	Damper module assembly
15	-	Bolt (Adjustable transverse toe link)
16	-	Ball joint (Wheel knuckle upper)
17	-	Wheel knuckle and bearing assembly
18	-	Wheel hub
19	-	Ball joint (Wheel knuckle lower)
20	-	Circlip (Wheel knuckle lower ball joint)
21	-	Self-locking nut (Wheel knuckle lower ball joint)
22	-	Self-locking nut (Damper assembly lower attachment)
23	-	Bolt (Wheel knuckle lower ball joint)
24	-	Bolt (Damper assembly lower attachment)
25	-	Lower arm
26	-	Bush - Forward (Lower arm)
27	-	Self-locking nut (Lower arm forward bush)
28	-	Bolt (Lower arm forward bush)
29	-	Nut and retainer (Lower arm rearward bush)
30	-	Bush - Rearward (Lower arm)
31	-	Self-locking nut (Stabilizer bar link to lower arm)
32	-	Bolt (Lower arm rearward bush)
33	-	Stabilizer bar link
34	-	Self-locking nut (Stabilizer bar link to stabilizer bar)
35	-	Stabilizer bar bush
36	-	Bolt (Stabilizer bar bracket)
37	-	Stabilizer bar bracket
38	-	Stabilizer bar

GENERAL

The independent rear suspension offers a reduction in unsprung weight over the beam axle design. The rear suspension comprises an upper arm, a lower arm, a wheel knuckle and wheel hub, two air spring damper modules and a stabilizer bar and links assembly.

The rear suspension arms have been designed to give maximum ground clearance. The suspension geometery can be adjusted for camber using a cam bolt and toe and bump steer adjustment can be corrected via an adjustable transverse link.

AIR SUSPENSION DAMPER MODULE



Item	Part Number	Description
1	-	Strap*
2	-	Upper gaitor*
3	-	Self-locking nut*
4	-	Rebound washer*
5	-	O-ring - Damper rod*
6	-	Spacer - Damper rod*
7	-	Air spring*
8	-	Retaining pin - Air spring sleeve support*
9	-	Bump washer*
10	-	Spring aid*
11	-	O-ring - Air sleeve support (2 off)*
12	-	Damper rod
13	-	Damper assembly
14	-	Strap*
15	-	Lower gaitor*
16	-	Strap*
17	-	Self-locking nut (3 off)
18	-	Top mount assembly
19	-	Bush
20	-	Voss connector

NOTE: * Shows service items

The damper module comprises an air spring assembly, top mount and a damper assembly. The damper and air spring are only serviceable as complete assemblies.

Damper

The damper assembly is a mono tube design with an air spring. The lower end of the damper is fitted with a bush and is attached to the lower arm with a bolt and nut.

The damper functions by restricting the flow of hydraulic fluid through internal galleries within the damper. The damper rod moves axially within the damper, its movement limited by the flow of fluid through the galleries, providing damping of undulations in the terrain. The damper rod is sealed at its exit point from the damper body to maintain the fluid within the unit and to prevent the ingress of dirt and moisture. The seal also incorporates a wiper to keep the rod clean.

Air Spring

The air spring is similar in design to the air spring used on the front suspension.

The air spring comprises an aluminium restraining cylinder, top mount, spring aid, air sleeve and an inner support sleeve.

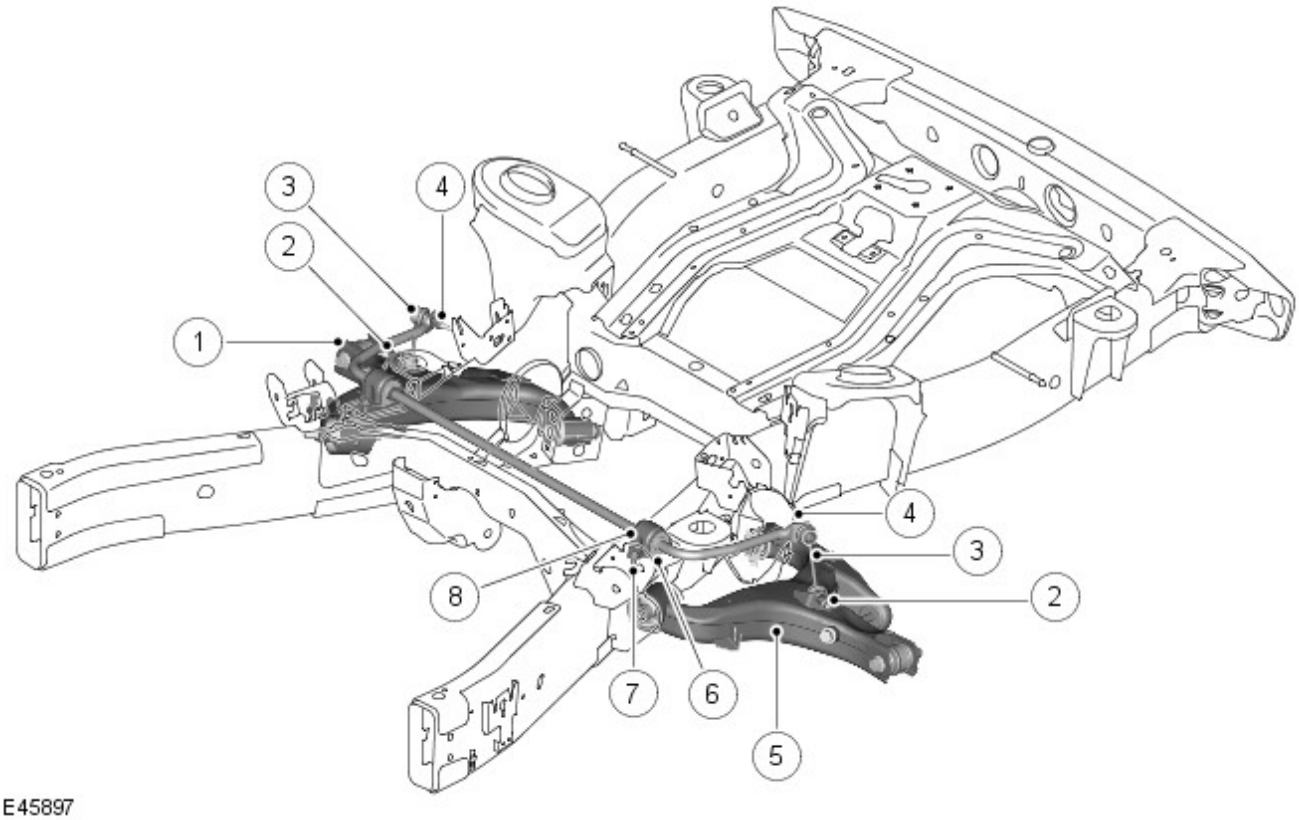
The air sleeve is made from a flexible rubber material which allows the sleeve to roll up and down the air spring piston as the vehicle changes height. The air sleeve is attached to the restraining cylinder and the support sleeve with crimp rings which provide an air tight seal. The support sleeve contains a seal carrier which has two O-rings sealing the support sleeve and two O-rings sealing to the damper body. The top of the air sleeve is crimped to the top mount which attaches to a mounting on the chassis with 3 integral studs and self-locking nuts.

A spring aid is fitted to the damper rod and prevents the top mount contacting the top of the damper during full suspension compression and assists the suspension tune. The lower end of the air spring is located over the damper body and seats on a fabricated seat on the damper body. The air sleeve is positively attached to the seat with a retaining pin. The damper rod is located through a central hole in the top mount. The rod is threaded at its outer end and accepts a self-locking nut which secures the air spring to the damper rod.

The top mount is an integral part of the air spring. A bump washer is located between the top mount plate and the damper rod. A self locking nut secures the damper rod to the top mount. The top mount attaches to a housing on the chassis with 3 integral studs and self-locking nuts. The top mount also incorporates a 6 mm Voss air fitting which allows for the attachment of the air harness.

The air spring is fitted with two gaitors. The upper gaitor is fitted between the top mount and the air spring restraining cylinder. The lower gaitor is secured to the lower end of the restraining cylinder and the damper body with metal straps. The gaitors prevent dirt and debris becoming trapped between the air sleeve and the restraining cylinder.

STABILIZER BAR



E45897

Item	Part Number	Description
1	-	RH lower arm
2	-	Nut - link to lower arm (2 off)
3	-	Link (2 off)
4	-	Nut - link to stabilizer bar (2 off)
5	-	LH lower arm
6	-	Bush (2 off)
7	-	Bolt (4 off)
8	-	Bracket (2 off)

Vehicles without the Dynamic Response stabilizer bar system use a conventional stabilizer bar. The Dynamic Response system is detailed in a separate section.
For additional information, refer to: Active Stabilization System (204-06, Description and Operation).

The stabilizer bar is fabricated from heat treated, 23 mm diameter solid, spring steel bar. The stabilizer bar operates, via a pair of links, from their attachment to the lower arm.

The stabilizer bar is located on the upper face of a combined body mount and stabilizer bar bracket which is welded to each chassis side member. The stabilizer bar is attached to the brackets with two, Teflon lined bushes. The bushes are fitted with brackets, which are pressed onto the bushes and secured to the chassis brackets with bolts.

The stabilizer bar has crimped, 'anti-shuffle' collars pressed into position on the inside edges of the bushes. The collars prevent sideways movement of the stabilizer bar.

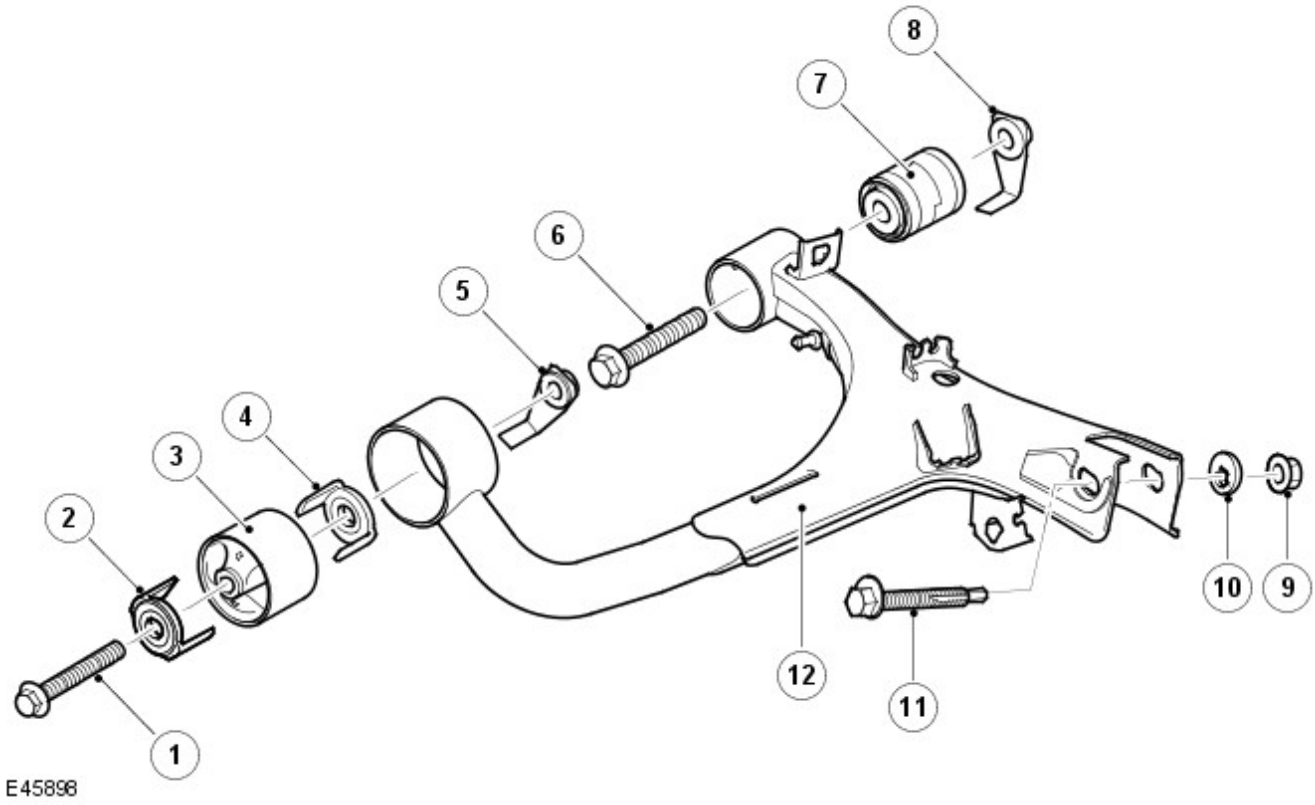
The ends of the stabilizer bar are attached to the lower arms via links. These allow the stabilizer bar to move with the wheel travel providing maximum effectiveness.

The rear stabilizer links are unique to vehicles with a passive (non-Dynamic Response) stabilizer bar. The passive (non-Dynamic Response) links can be identified by a white colored plastic bearing moulding. The Dynamic Response rear links are identified by a grey color plastic bearing moulding.

Each link has a ball joint at each end. The top ball joint is attached to the link at 90 degrees to the link axis. The ball joint is located in a hole in the end of the stabilizer bar and secured with a self locking nut.

The bottom ball joint is also attached to the link at 90 degrees to the link axis. The ball joint is located a hole in a bracket on the lower arm and secured with a self-locking nut. The links are not handed and therefore can be fitted to either side of the stabilizer bar.

UPPER ARM



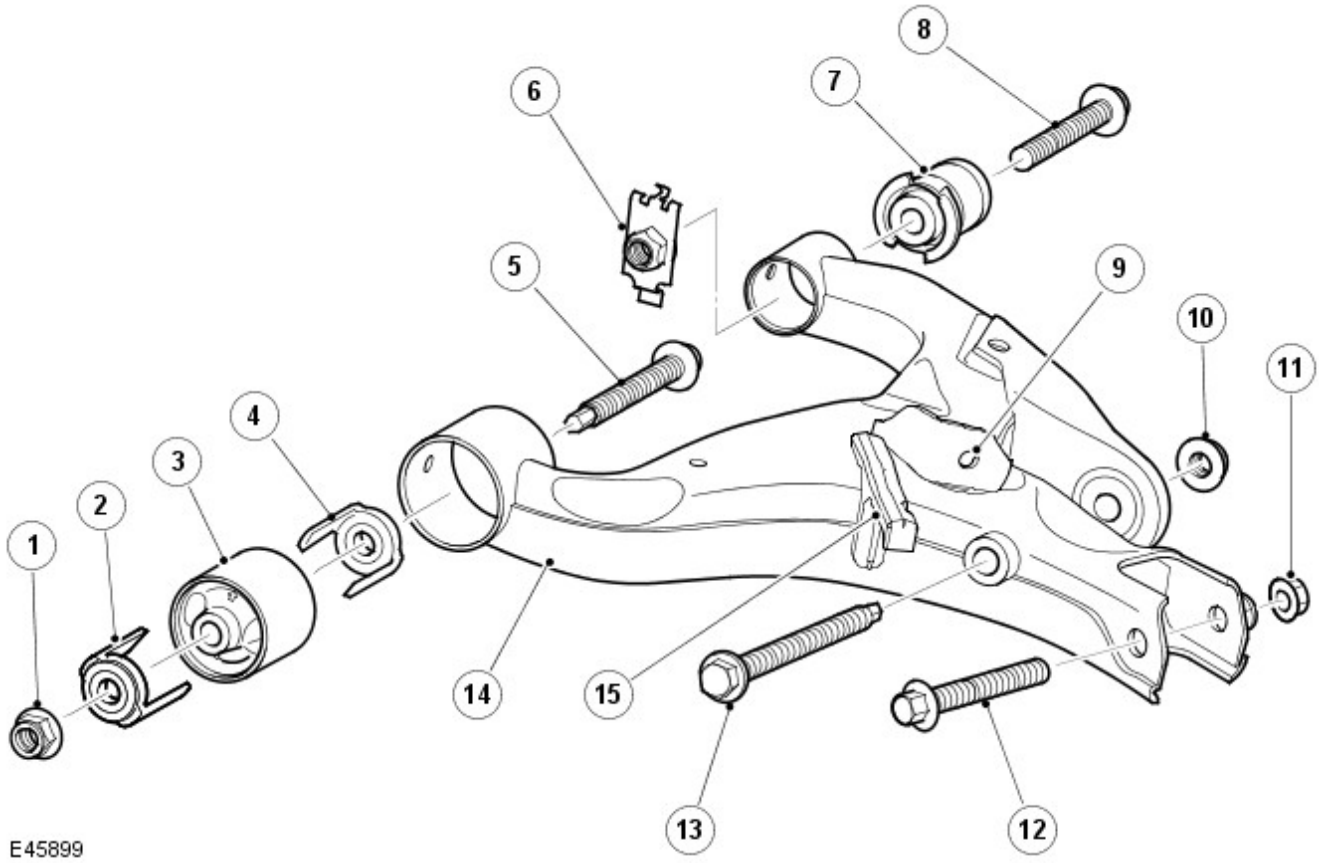
Item	Part Number	Description
1	-	Bolt
2	-	Bumpstop clip
3	-	Forward bush
4	-	Bumpstop clip
5	-	Caged nut
6	-	Bolt
7	-	Rearward bush
8	-	Caged nut
9	-	Self-locking nut - upper knuckle ball joint
10	-	Eccentric washer - upper knuckle ball joint
11	-	Cam bolt - upper knuckle ball joint
12	-	Upper arm

The upper arm locates in brackets on the upper surface of each chassis side member. The upper arm assembly comprises the upper arm and two bushes. The upper arm is a pressed steel fabrication. Its outer end has two brackets with slotted holes which locate the upper ball joint of the knuckle. The ball joint is secured in the upper arm with a cam bolt, eccentric washer and a self-locking nut. The cam bolt and the eccentric washer allow for the adjustment of the wheel camber.

Two fabricated tubular housings provide the location for the forward and rearward bushes. The bushes, which are

pressed into the housings, locate between brackets on the chassis side members and are secured with bolts and caged nuts through metal inserts in the centre of the bushes.

LOWER ARM



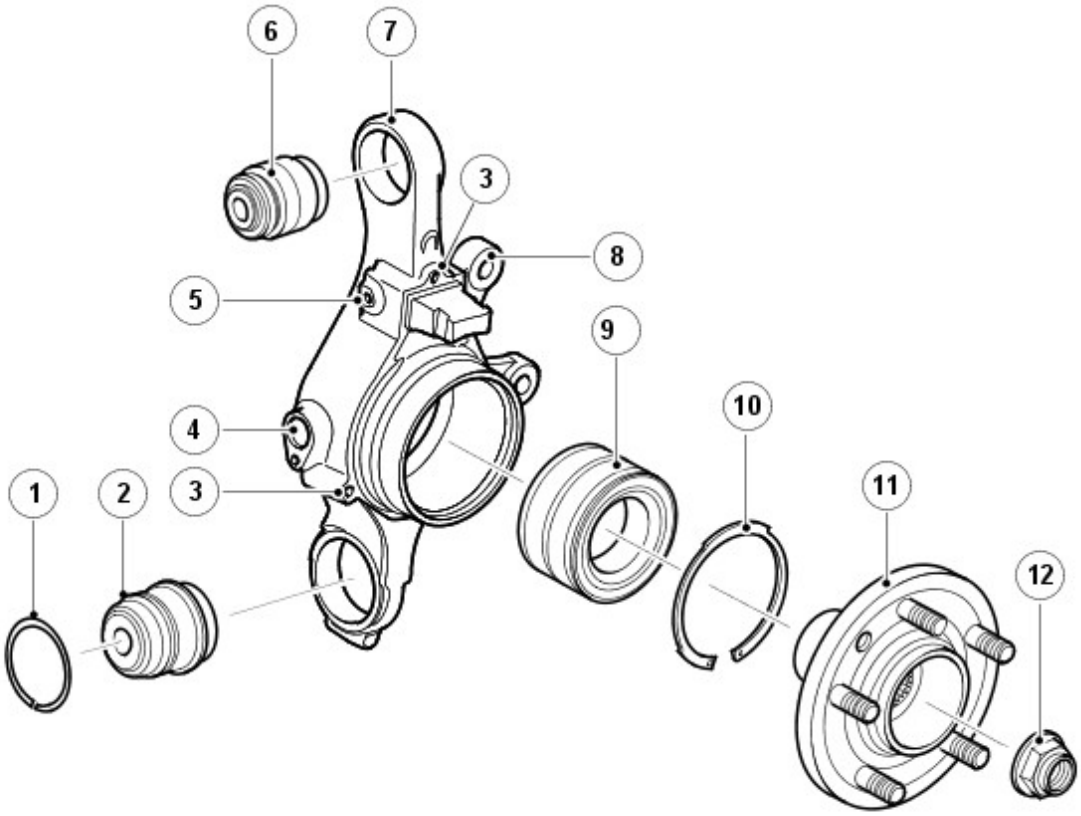
Item	Part Number	Description
1	-	Self-locking nut
2	-	Bumpstop clip
3	-	Forward bush
4	-	Bumpstop clip
5	-	Bolt
6	-	Nut and retainer
7	-	Rearward bush
8	-	Bolt
9	-	Stabilizer bar link bracket
10	-	Self-locking nut - damper lower attachment
11	-	Self-locking nut - knuckle lower ball joint attachment
12	-	Bolt - knuckle lower ball joint attachment
13	-	Bolt - damper lower attachment
14	-	Lower arm

The lower arm locates in brackets on the lower surface of each chassis side member. The lower arm assembly comprises the lower arm and two bushes. The lower arm is a pressed steel fabrication. Its outer end has two brackets which locate the lower ball joint of the knuckle. The ball joint is secured with a bolt and self-locking nut. The lower control arm also provides for the attachment of the damper bush which is secured with a bolt and a self-locking nut.

A bracket, welded to the upper surface of the lower arm, allows for the attachment of the bottom ball joint of the stabilizer bar link. The ball joint is secured to the bracket with a self-locking nut.

Two fabricated tubular housings provide the location for the forward and rearward bushes. The bushes, which are pressed into the housings, locate between brackets on the chassis side members. The forward bush is secured to the chassis bracket with a bolt and self-locking nut. The rearward bush is secured to the chassis bracket with a bolt and a nut with retainer. The nut and retainer allows for easy installation or removal of the bolt by removing the requirement to hold the self-locking nut when installing or removing the bolt.

WHEEL KNUCKLE, WHEEL HUB AND BEARING ASSEMBLY



E45900

Item	Part Number	Description
1	-	Circlip - lower ball joint
2	-	Ball joint - lower
3	-	Park brake assembly attachment holes
4	-	Wheel speed sensor location
5	-	Wheel speed sensor cable bracket attachment
6	-	Ball joint - upper
7	-	Knuckle
8	-	Brake caliper attachment holes
9	-	Wheel bearing
10	-	Circlip - wheel bearing retention
11	-	Wheel hub
12	-	Nut - halfshaft

The wheel knuckle is a machined forging which is located between the upper and lower arms. The knuckle is fitted with two ball joints which are pressed into the knuckle, with the lower ball joint being secured with a circlip. The ball joints are positioned between brackets on the upper and lower arms and secured to the arms with a bolt and self-locking nut.

The wheel knuckle provides the location for the rear wheel taper roller bearing, which is pressed into a machined bore and retained with a circlip. The wheel bearing is a serviceable item. The knuckle has a machined bore which provides the location for the wheel speed sensor. Four threaded holes allow for the attachment of the park brake assembly. A cast boss on the knuckle provides positive location for the park brake assembly. Two bosses on the knuckle casting provide the attachment points for the rear brake caliper.

The wheel hub is a machined casting which is pressed into the wheel bearing in the knuckle. The hub has a splined centre bore which mates with corresponding splines on the halfshaft. Five M14 studs are pressed into the wheel hub and provide for the attachment of the road wheel with wheel nuts. Rotation of the halfshaft is passed, via the splines, to the wheel hub which rotates on the taper roller bearing.

Rear Suspension - Rear Suspension

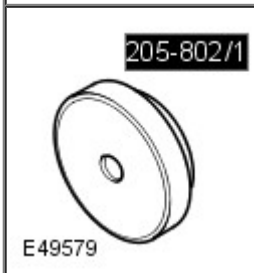
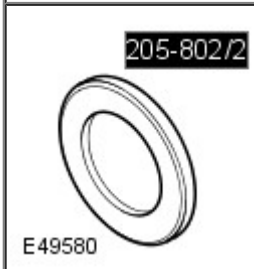
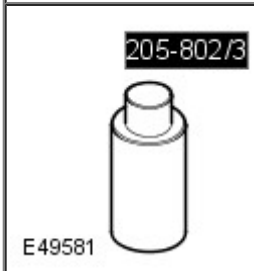
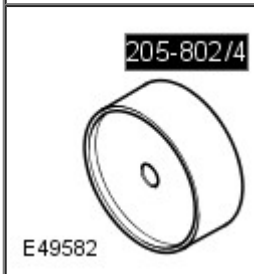
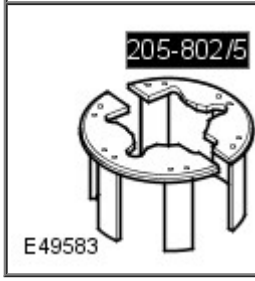
Diagnosis and Testing

For additional information.
REFER to: Suspension System (204-00, Diagnosis and Testing).

Rear Suspension - Wheel Bearing and Wheel Hub

Removal and Installation

Special Tool(s)

	Rear wheel bearing remover/installer 204-509/10(LRT-60-033/10)
	Rear wheel bearing remover/installer 205-802/1
	Rear wheel bearing remover/installer 205-802/2
	Rear wheel bearing remover/installer 205-802/3
	Rear wheel bearing remover/installer 205-802/4
	Rear wheel bearing remover/installer 205-802/5

Removal

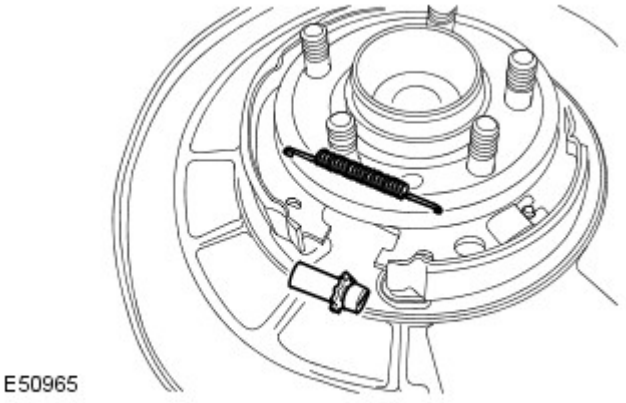
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

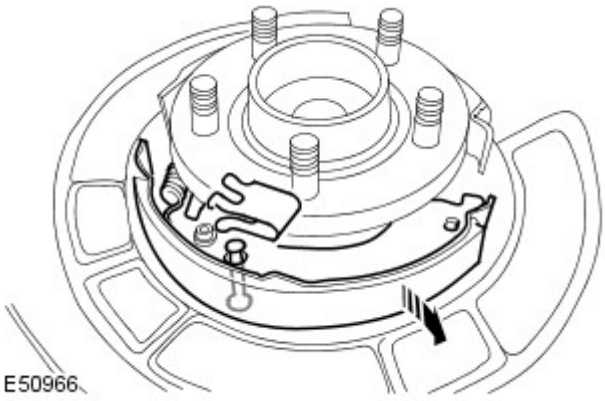
2. Remove the wheel and tire.

3. Remove the wheel knuckle.
   For additional information, refer to: Wheel Knuckle (204-02, Removal and Installation).

4. Remove the adjuster and return spring.

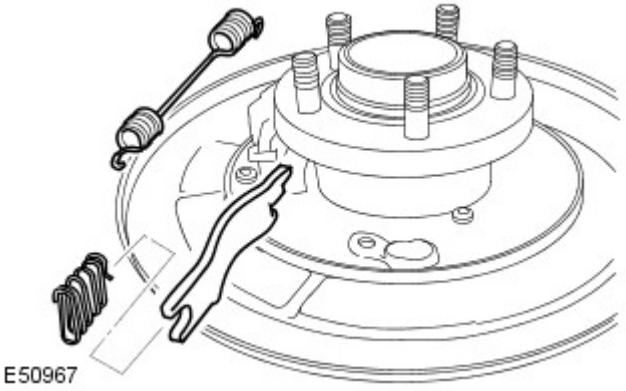

E50965

5. Remove the primary brake shoe.
   - Remove the hold-down spring and retaining pin.
   - Pivot the shoe to release it from the spreader plate and return spring.

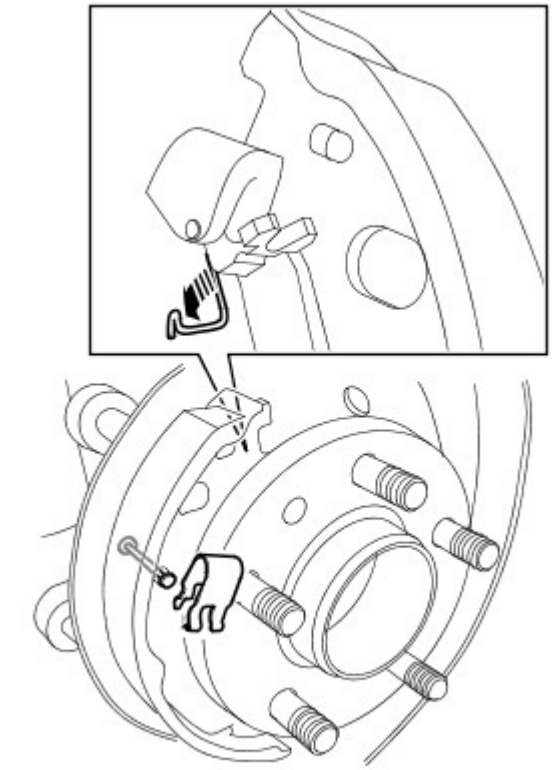

E50966

6. Remove the spreader plate and spring.

7. Remove the return spring.

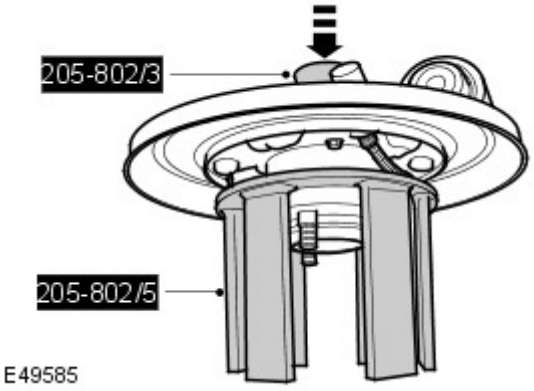

E50967

8. Remove the secondary brake shoe.
   - Remove the hold-down spring and retaining pin.
   - Disconnect the parking brake cable retaining spring from the brake shoe lever.



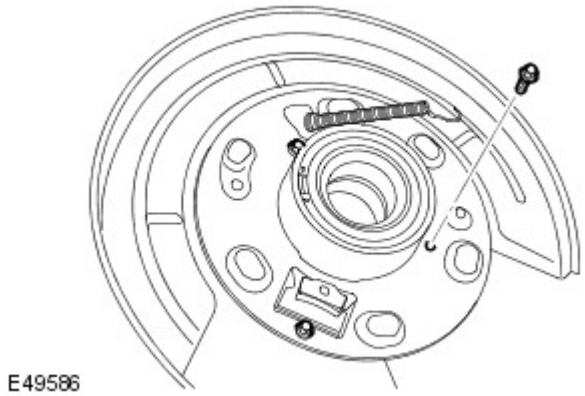
E50181

9. Using the special tools, remove the drive flange.



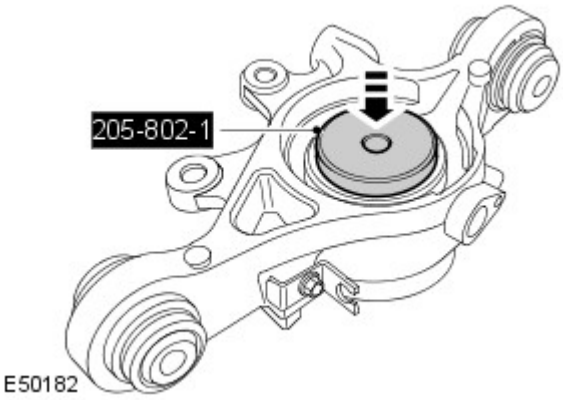
E49585

10. Remove the brake disc dust shield.
    - Remove the 3 screws.



E49586

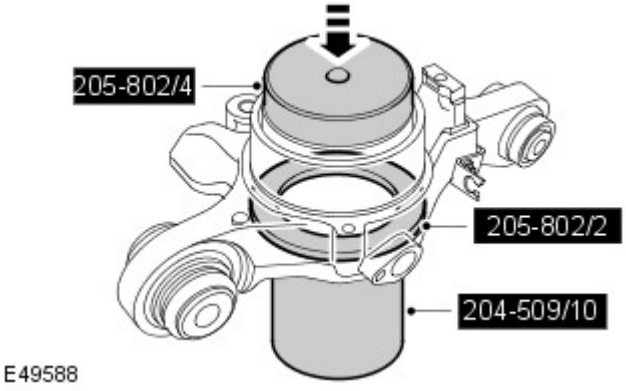
11. Using the special tools, remove the wheel bearing.
    - Remove the circlip.

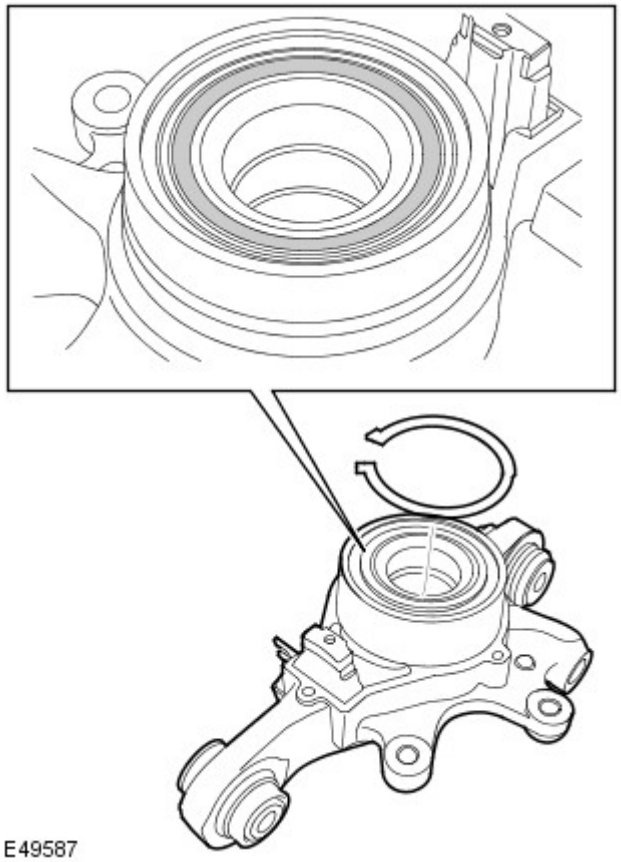


Installation

1. Clean the components.

2. Using the special tools, install the wheel bearing.





3. CAUTION: Make sure that the bearing seal is not damaged when installing the circlip.

   Install the circlip.

4. Install the brake disc dust shield.
   - Tighten the bolts to 9 Nm (7 lb.ft).

5. WARNING: Do not use compressed air to clean brake components. Dust from friction materials can be harmful if

inhaled.

Clean the backing plate and apply grease to the brake shoe contacts.

6. Clean the adjuster and set it to its minimum extension.

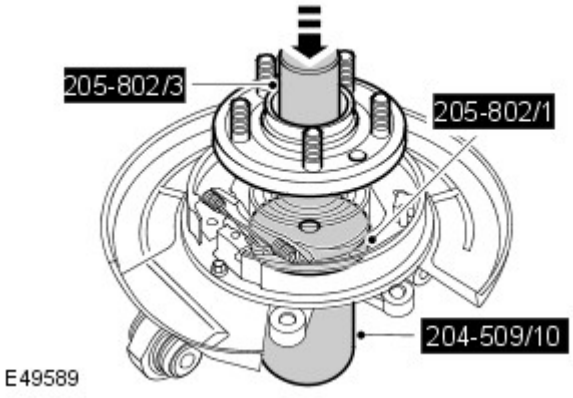
7. Install the secondary brake shoe.
   - Connect the parking brake cable retaining spring to the brake shoe lever, making sure the spring is not twisted.
   - Install the hold-down spring and retaining pin.

8. Install the primary brake shoe.
   - Install the spreader plate and the spring.
   - Install the return spring.
   - Install the hold-down spring and retaining pin.

9. Install the return spring.

10. Install the brake shoe adjuster.

11. Using the special tools, install the drive flange.



12. Install the wheel knuckle.
    For additional information, refer to: Wheel Knuckle (204-02, Removal and Installation).

Rear Suspension - Upper Arm

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.

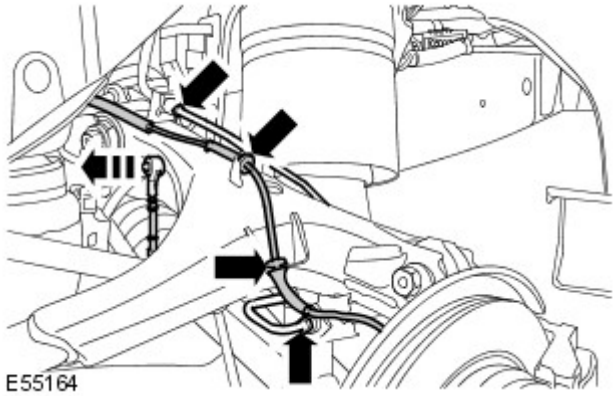
2. Remove the wheel and tire.

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

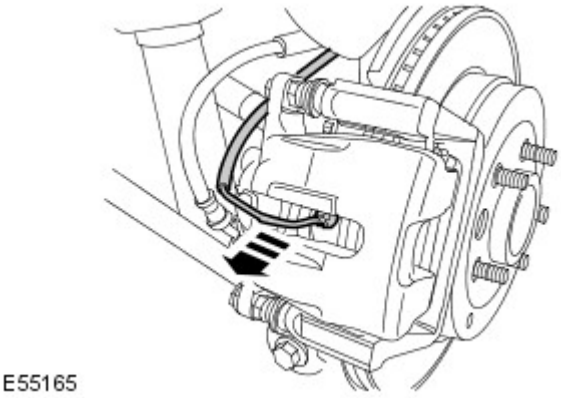
   Remove the brake tube.
   - Disconnect the 2 brake tube unions.
   - Remove the brake hose clips and release the hoses.
   - Release the brake tube from the clip.

4. Disconnect the height sensor link.

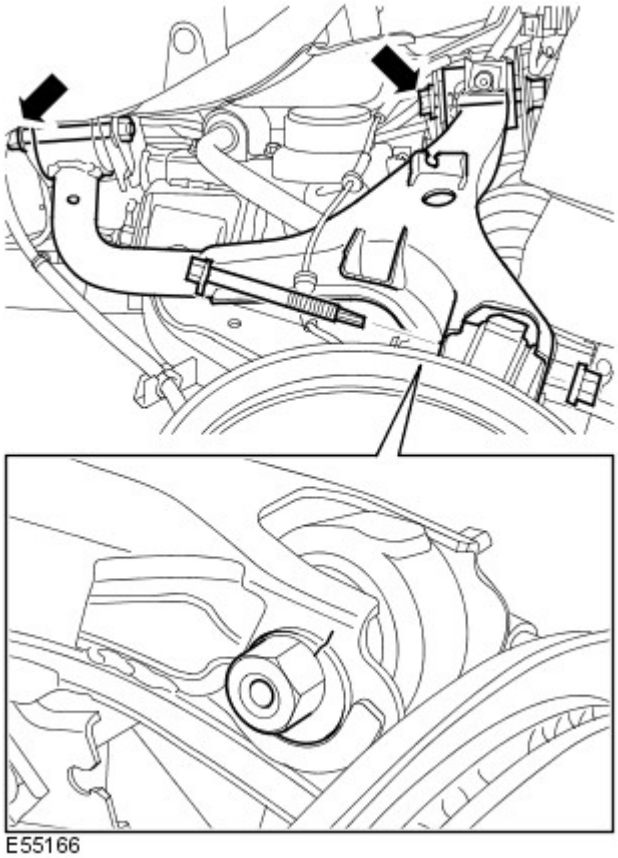
5. Release the wheel speed sensor lead.



6. RH side only: Release the brake pad wear indicator sensor lead.



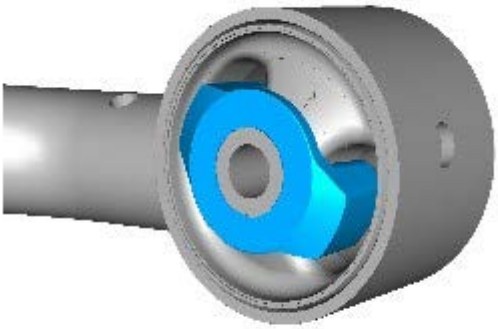
7. Remove the upper arm.
   - Loosen the upper arm bolts.
   - Mark the position of the bolt in relation to the upper arm.
   - Remove the nut and bolt, then release the upper arm from the wheel knuckle.
   - Remove the upper arm bolts.



E55166

Installation

All vehicles



E155405

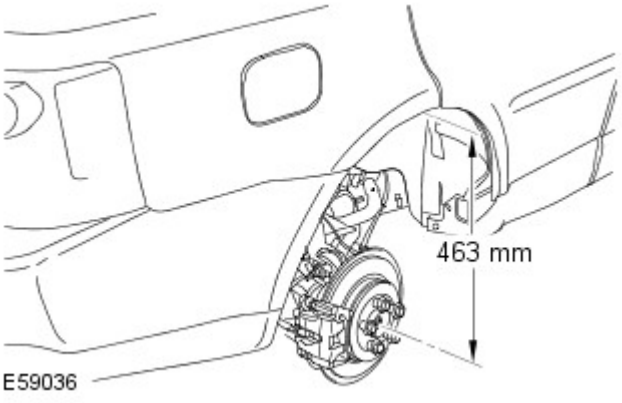
1. CAUTION: **Make sure that bumpstop inserts are fitted on both sides of the front bushing prior to installation of the arm. Failure to follow this instruction may result in damage to the bushing.**

   NOTE: Bumpstop inserts are installed to both sides of the bushing.

   Check the bumpstop inserts are correctly installed.

2. Install the upper arm.
   - Fit the bolts but do not fully tighten at this stage.

3. Set the height, between the center of the halfshaft end and the edge of the fender trim, to 463 mm (18.23'').
   - Support with an axle stand.



4. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

   Connect the upper arm and wheel knuckle.
   - Align the bolt to the marks made previously.
   - Tighten the bolt to 133 Nm (98 lb.ft).

5. Tighten the upper arm front bolt to 175 Nm (129 lb.ft).

6. Tighten the upper arm rear bolt to 275 Nm (203 lb.ft).

7. Secure the wheel speed sensor lead.

8. Secure the brake pad wear indicator sensor lead.

9. Connect the height sensor link.

10. Install the brake tube.
    - Tighten the brake tube unions to 18 Nm (13 lb.ft).

Vehicles with standard brakes

11. Bleed the brake system.
    For additional information, refer to: Component Bleeding - Vehicles With: Standard Brakes (206-00 Brake System - General Information, General Procedures).

Vehicles with high performance brakes

12. Bleed the brake system.
    For additional information, refer to: Component Bleeding - Vehicles With: High Performance Brakes (206-00 Brake System - General Information, General Procedures).

All vehicles

13. Install the wheel and tire.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

14. Carry out the wheel alignment procedure.

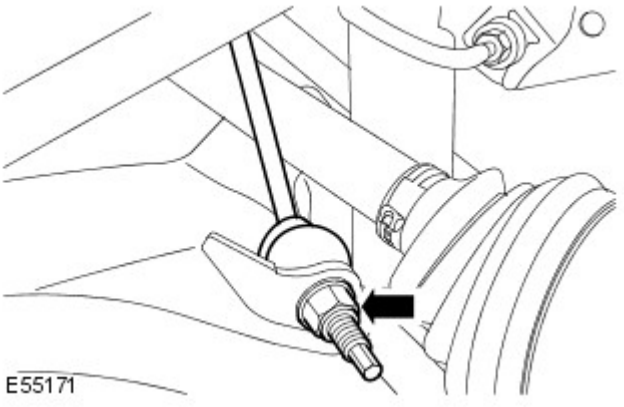
Rear Suspension - Lower Arm
Removal and Installation

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 wheel and tire.



3. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

   Release the stabilizer bar link.
   - Remove and discard the retaining nut.

4. Loosen the 2 lower arm bolts.

5. Disconnect the shock absorber and spring assembly from the lower arm.
   - Remove the nut and bolt.

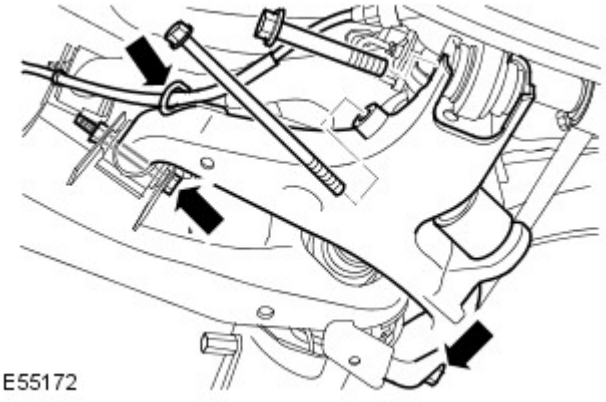
6. Release the parking brake cable.

7. Remove the 2 lower arm bolts.

8. CAUTION: Ensure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

   Release the knuckle from the lower arm.
   - Remove the bolt.

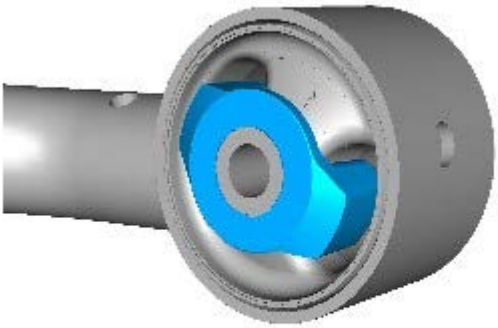
9. Remove the lower arm.



Installation

1. CAUTION: **Make sure that bumpstop inserts are fitted on both sides of the front bushing prior to installation of the arm. Failure to follow this instruction may result in damage to the bushing.**

   NOTE: Bumpstop inserts are installed to both



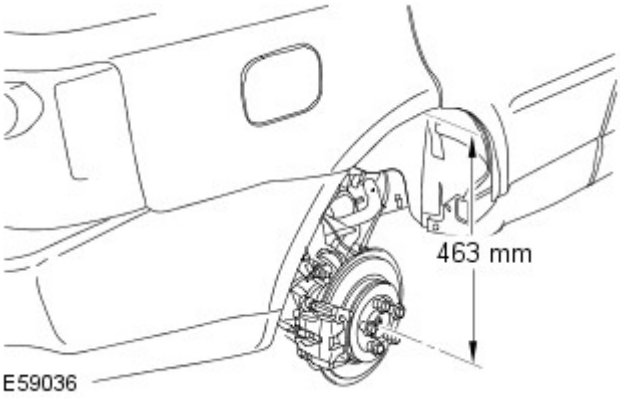
E155405

sides of the bushing.

Check the bumpstop inserts are correctly installed.

2. Install the lower arm.
    - Fit the bolts but do not fully tighten at this stage.
3. CAUTION: Ensure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

    Connect the lower arm to the wheel knuckle.
    - Tighten the bolt to 175 Nm (129 lb.ft).
4. Connect the shock absorber and spring assembly to the lower arm.
    - Tighten the nut and bolt to 300 Nm (221 lb.ft).
5. Set the height, between the center of the halfshaft end and the edge of the fender trim, to 463 mm (18.23'').



E59036

6. Tighten the lower arm bolts to 275 Nm (203 lb.ft).
7. Secure the parking brake cable.
8. Connect the stabilizer link.
    - Install a new nut and tighten to 115 Nm (85 lb.ft).
9. Install the wheel and tire.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).
10. Carry out the wheel alignment procedure.

Rear Suspension - Upper Arm Ball Joint
Removal and Installation

Special Tool(s)

	Remover/installer rear upper arm ball joint 204-525/1
	Remover/installer rear upper arm ball joint 204-525/2
	Remover/installer rear upper arm ball joint 204-525/3

Removal

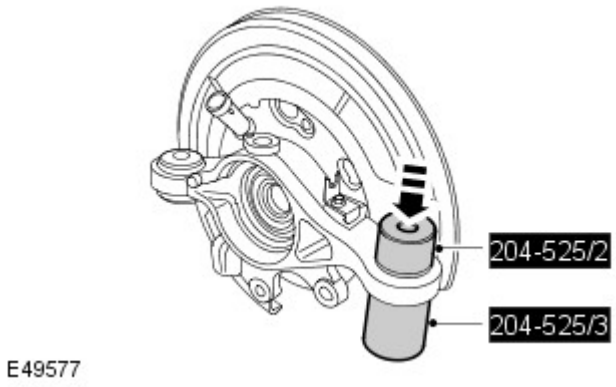
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the wheel and tire.

3. Remove the wheel knuckle.
   For additional information, refer to: Wheel Knuckle (204-02, Removal and Installation).

4. Using the special tools, remove the ball joint.
   - Position machined face against the special tool.

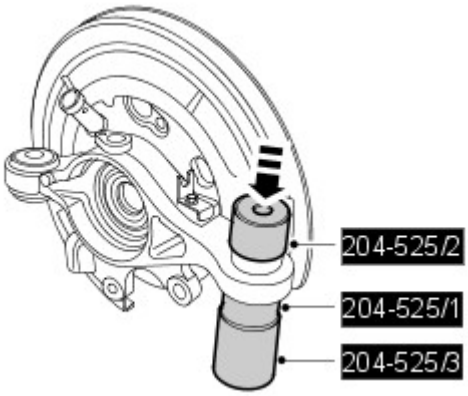


Installation

1. Clean the components.

2. CAUTIONS:

   Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure



E49578

of the joint.

If the push in force is less than 10 kN the wheel knuckle must be replaced.

Using the special tools, install the ball joint.

- Position machined face against the special tool.

3. Install the wheel knuckle.
   For additional information, refer to: Wheel Knuckle (204-02, Removal and Installation).

4. Install the wheel and tire.

Rear Suspension - Rear Stabilizer Bar

Removal and Installation

Removal

CAUTION: It is possible to install the stabilizer bar incorrectly. Note the position of the stabilizer bar before removal.

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

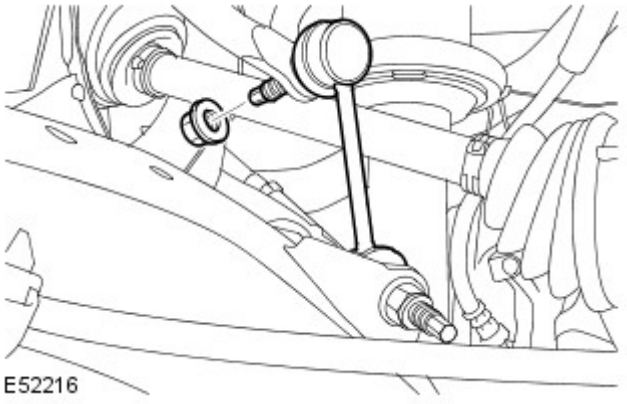
   Raise and support the vehicle.

2. Remove the rear bumper cover.
   For additional information, refer to: Rear Bumper Cover (501-19 Bumpers, Removal and Installation).

3. Remove the spare wheel and tire.

4. Raise the vehicle.

5. Remove the rear wheels and tires.

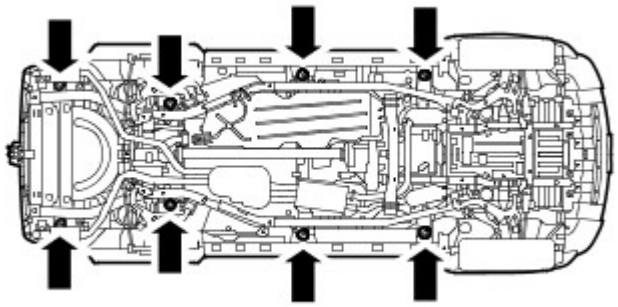


E52216

6. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

   Release both stabilizer bar links.
   - Remove and discard the 2 nuts.

7. Remove the body mount retaining bolts.
   - Remove the 8 bolts.

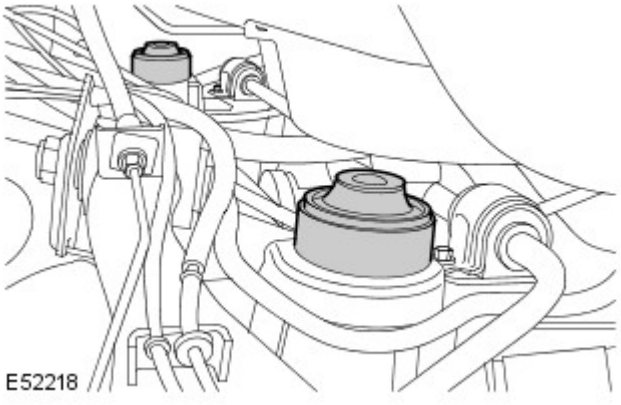


E52217

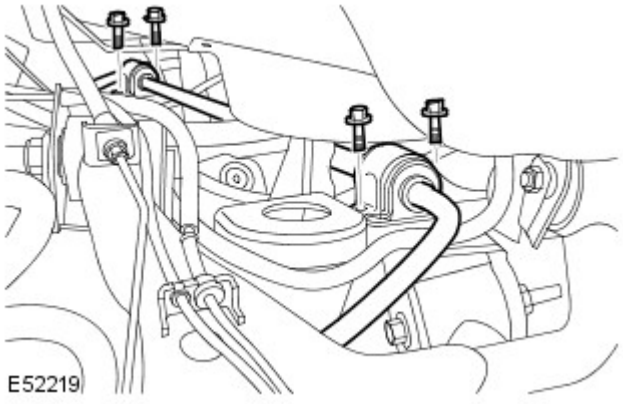
8. CAUTION: Only raise the body sufficiently to remove the body mount.

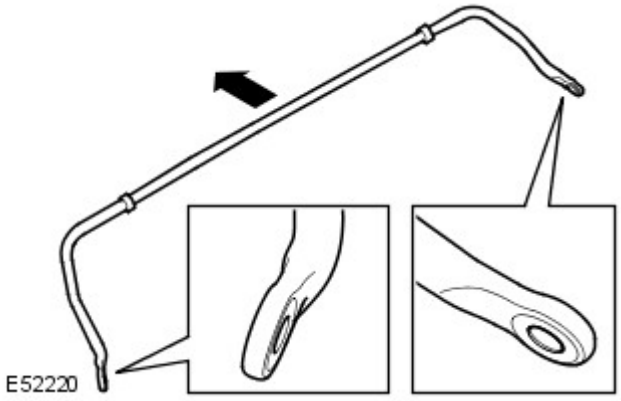
   Carefully raise the body.
   - Using suitable stands, raise the body to release the body mounts.

9. Remove the 2 rear body mounts.



10. Remove the stabilizer bar bushing.
    - Remove the stabilizer bar clamps.
    - Remove the 4 bolts.





11. CAUTION: Mark the position of the stabilizer bar.

    Remove the stabilizer bar.

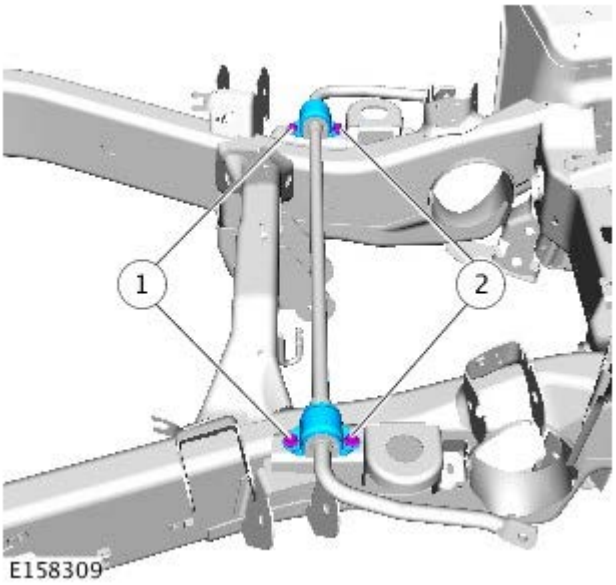
Installation

1. CAUTION: Make sure the stabilizer bar is correctly installed.

   Install the stabilizer bar.

2. Install the stabilizer bar bushing.

3. Install the stabilizer bar bushing and clamps.
   - Tighten fixings 1 to 62 Nm (46 lb.ft).
   - Tighten fixings 2 to 62 Nm (46 lb.ft).
   - Tighten fixings 1 to 62 Nm (46 lb.ft).



4. Install the body mounts.

5. Lower the body.
   - Remove the stands.

6. Install the body mount retaining bolts.
   - Tighten the 8 retaining bolts to 133 Nm (98 lb.ft).

7. Attach both stabilizer bar links.
   - Tighten the nuts to 115 Nm (85 lb.ft).

8. Install the wheels and tires.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

9. Lower the vehicle.

10. Install the spare wheel and tire.

11. Install the rear bumper cover.
    For additional information, refer to: Rear Bumper Cover (501-19 Bumpers, Removal and Installation).

Rear Suspension - Rear Stabilizer Bar Link

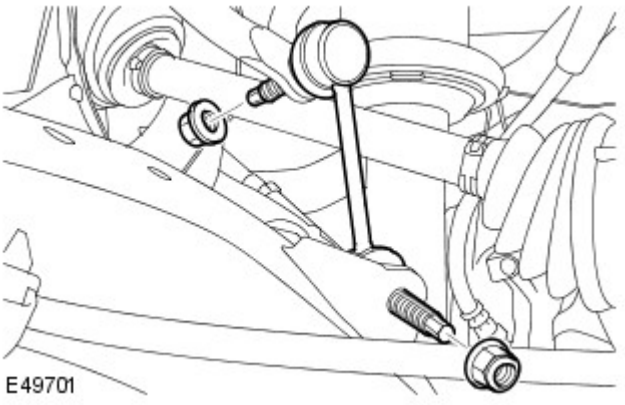
Removal and Installation

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 wheel and tire.



3. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

   Remove the stabilizer bar link.
   - Remove and discard the 2 nuts.

Installation

1. Install the stabilizer bar link.
   - Tighten the nuts to 115 Nm (85 lb.ft).

2. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Suspension - Lower Arm Bushing

Removal and Installation

Special Tool(s)

	Receiver rear lower arm front bush 204-526/1
	Remover rear lower arm front bush 204-526/2
	Installer rear lower arm front bush 204-526/3
	Receiver rear lower arm rear bush 204-540/1
	Remover rear lower arm rear bush 204-540/2
	Installer rear lower arm rear bush 204-540/3

Removal

NOTE: The bushings must be replaced in pairs, LH and RH sides.

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 wheels and tires.

3. Remove the LH lower arm.
   For additional information, refer to: Lower Arm (204-02 Rear Suspension, Removal and Installation).

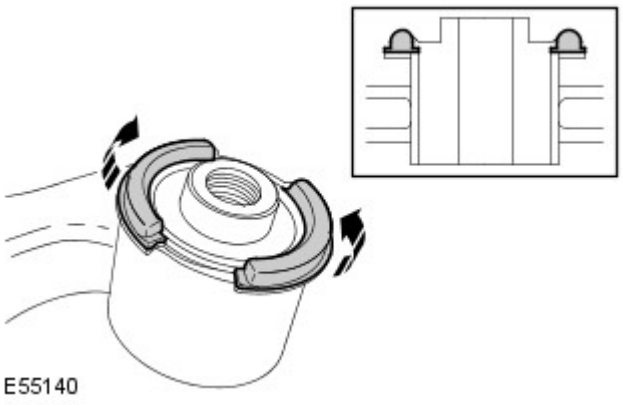
4. Remove the RH lower arm.

5. Note the position of the bushing in relation to the lower arm.

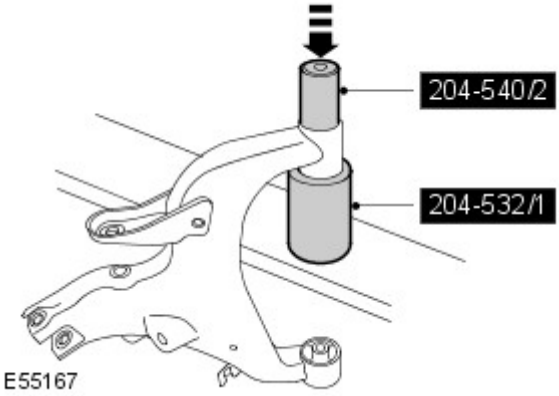
6. CAUTION: The bush flanges need to be removed to allow bush removal.

   NOTE: Take note of the fitted position of the bush.

   Using a suitable tool, bend over the bush flanges.

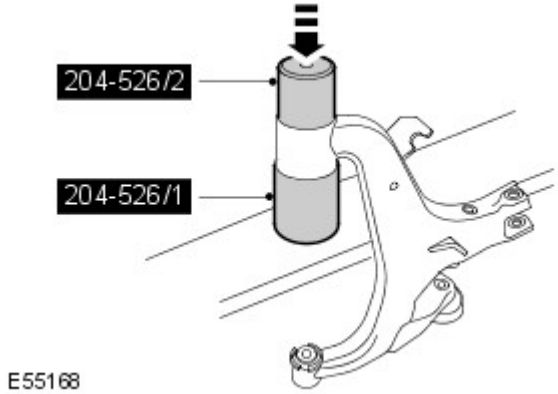

E55140

7. Using a hacksaw, remove the flange from the bushing, making sure the upper arm is not damaged.



E55167

8. Using the special tools, remove and discard the lower arm rear bushings.



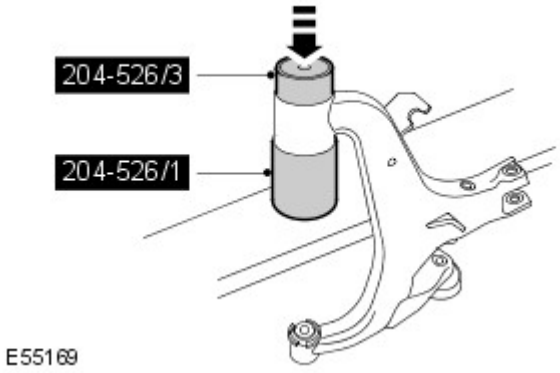
E55168

9. Using the special tools, remove and discard the lower arm front bushings.

Installation

1. CAUTIONS:

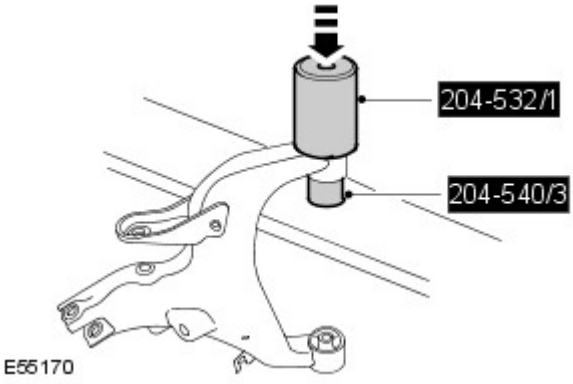
   Make sure the bush is correctly aligned.



E55169

Make sure the correct special tool is used to install the bushings to the correct depth.

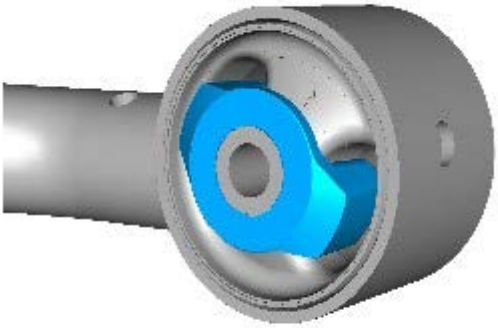
Using the special tools, install the lower arm front bushings



E55170

2. CAUTION: Make sure the bush is correctly aligned.

   Using the special tools, install the lower arm rear bushings.


E155405

3. CAUTION: **Make sure that bumpstop inserts are fitted on both sides of the front bushing prior to installation of the arm. Failure to follow this instruction may result in damage to the bushing.**

   NOTE: Bumpstop inserts are installed to both sides of the bushing.

   Check the bumpstop inserts are correctly installed.

4. Install the LH lower arm.
   For additional information, refer to: Lower Arm (204-02 Rear Suspension, Removal and Installation).

5. Install the RH lower arm.

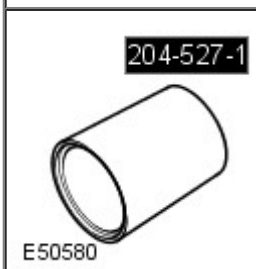
6. Install the wheels and tires.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

7. Carry out the wheel alignment procedure.

Rear Suspension - Upper Arm Bushing

Removal and Installation

Special Tool(s)

	Remover/installer - rear suspension upper arm front bushing 204-528/1
	Remover/installer - rear suspension upper arm front bushing 204-528/2
	Remover/installer - rear suspension upper arm front bushing 204-528/3
	Remover/installer rear suspension upper arm rear bushing 204-527/1
	Remover/installer rear suspension upper arm rear bushing 204-527/2
	Remover/installer rear suspension upper arm rear bushing 204-527/3

Removal

NOTE: The bushings must be replaced in pairs, LH and RH sides.

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.

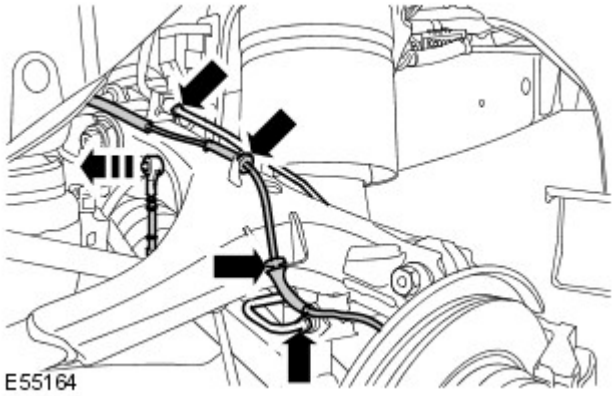
2. Remove the wheels and tires.

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

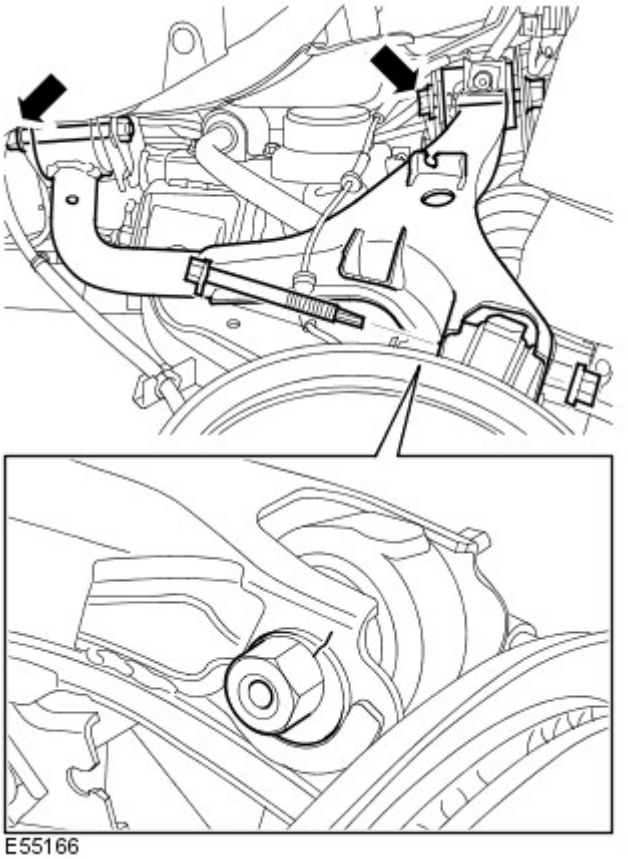
   Remove the brake tube.
   - Disconnect the 2 brake tube unions.
   - Remove the brake hose clips and release the hoses.
   - Release the brake tube from the clip.

4. Disconnect the height sensor link.

5. Release the wheel speed sensor lead.


E55164

6. Remove the LH upper arm.
   - Loosen the upper arm bolts.
   - Mark the position of the bolt in relation to the upper arm.
   - Disconnect the upper arm from the wheel knuckle.
   - Remove the upper arm bolts.


E55166

7. Remove the RH upper arm.
   For additional information, refer to: Upper Arm (204-02 Rear Suspension, Removal and Installation).

8. Mark the position of the bushing in relation to the upper arm.

9. Using the special tools, remove and discard the rear upper arm front bushing.

10. Using the special tools, remove and discard the rear upper arm rear bushing.

Installation

1. CAUTIONS:

   Make sure the bush is correctly aligned.

   Make sure the correct special tool is used to install the bushings to the correct depth.

   Using the special tools, install the rear upper arm front bushing.

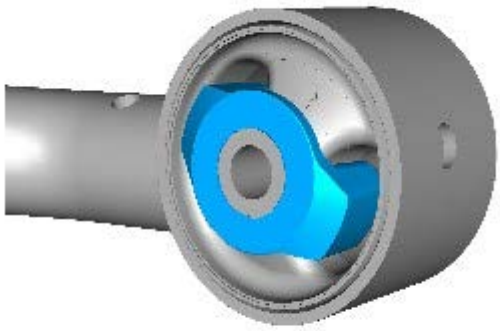
2. CAUTION: Make sure the bush is correctly aligned.

   Using the special tools, install the rear upper arm rear bushing.

3. CAUTION: **Make sure that bumpstop inserts are fitted on both sides of the front bushing prior to installation of the arm. Failure to follow this instruction may result in damage to the bushing.**

   NOTE: Bumpstop inserts are installed to both sides of the bushing.

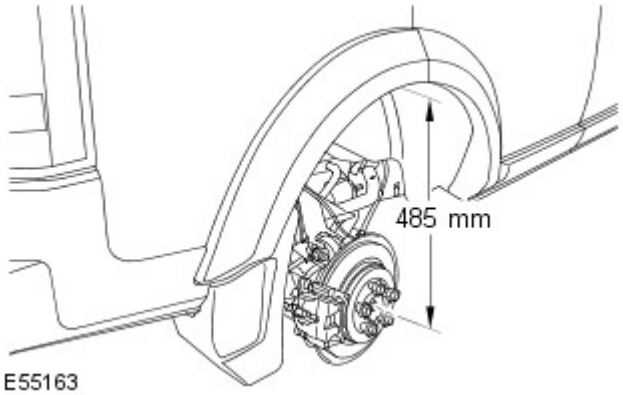
   Check the bumpstop inserts are correctly installed.



E155405

4. Install the LH upper arm.
   - Fit the bolts but do not fully tighten at this stage.

5. Set the height between the center of the halfshaft end and the edge of the fender trim to 485 mm (19.10'').
   - Support with an axle stand.



E55163

6. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

   Connect the upper arm and wheel knuckle.
   - Align the bolt to the marks made previously.
   - Tighten the bolt to 133 Nm (98 lb.ft).

7. Tighten the upper arm front bolt to 175 Nm (129 lb.ft).

8. Tighten the upper arm rear bolt to 275 Nm (203 lb.ft).

9. Secure the wheel speed sensor lead.

10. Secure the brake pad wear indicator sensor lead.

11. Connect the height sensor link.

12. Install the brake tube.
    - Tighten the brake tube unions to 18 Nm (13 lb.ft).

13. Install the RH upper arm.
    For additional information, refer to: Upper Arm (204-02 Rear Suspension, Removal and Installation).

14. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Suspension - Lower Arm Ball Joint

Removal and Installation

Special Tool(s)

 E46795	Ball joint remover/installer 204-516/1 (LRT-64-026/1)
 E50960	Ball joint remover/installer 204-516/2 (LRT-64-026/2)
 E50961	Ball joint remover/installer 204-516/3 (LRT-64-026/3)
 E50962	Ball joint remover/installer 204-516/4 (LRT-64-026/4)
 E49618	Halfshaft remover/replacer 204-506/1 (LRT-60-030/1)
 E49620	Halfshaft remover/replacer 204-506/3 (LRT-60-030/3)
 E49622	Halfshaft installer adapter 204-506-01
	Retainers - halfshaft remover/replacer

	204-506/5 (LRT-60-030/5)

Removal

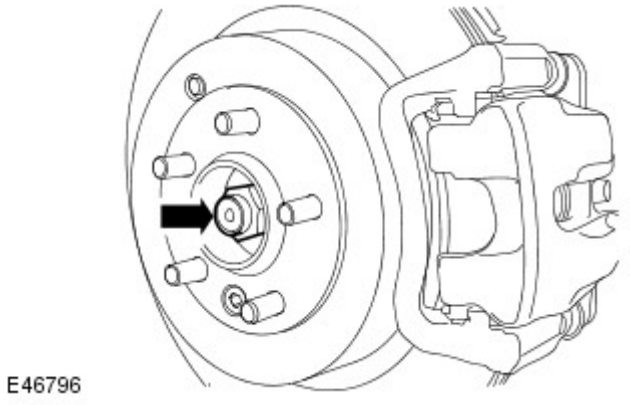
CAUTION: The bolt securing the toe link to the wheel knuckle must not be used more than 5 times. Mark the bolt head with a suitable centre punch.

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

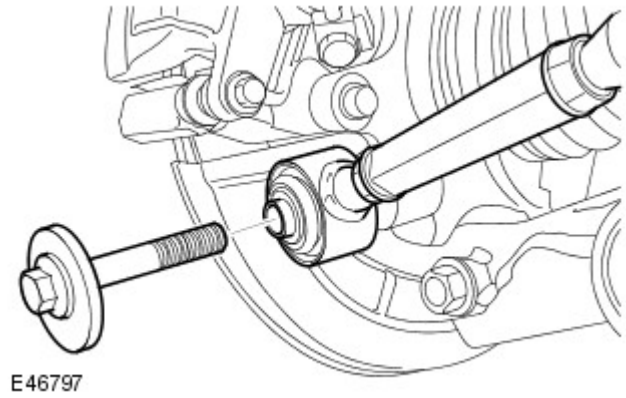
   Raise and support the vehicle.

2. Remove the wheel and tire.

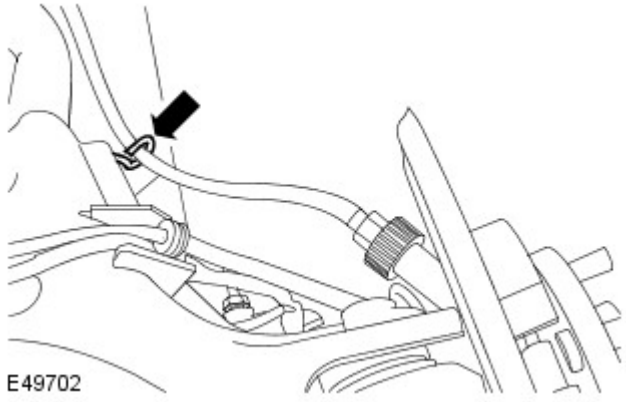
3. Loosen the halfshaft retaining nut.



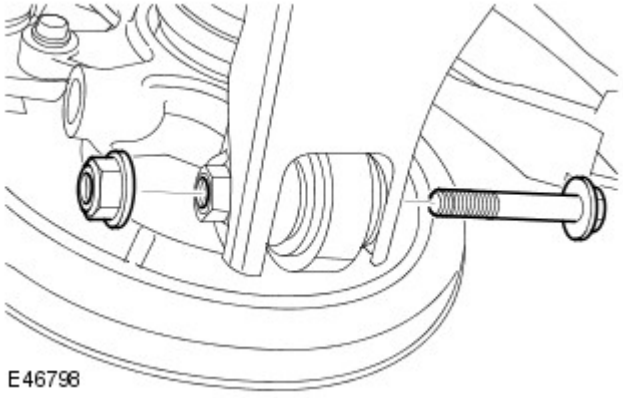
4. Disconnect the toe link.
   - Remove the bolt.



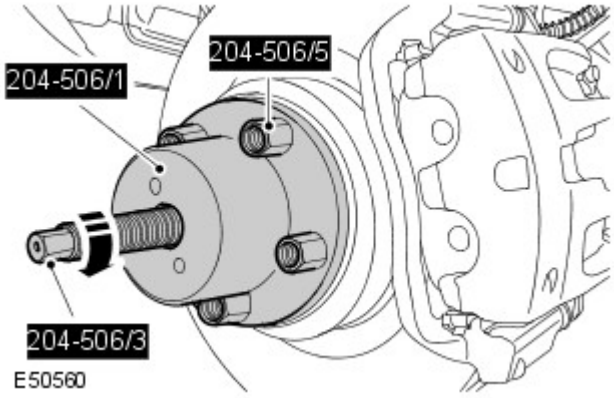
5. Release the parking brake cable from the lower arm.



6. Remove the halfshaft retaining nut.

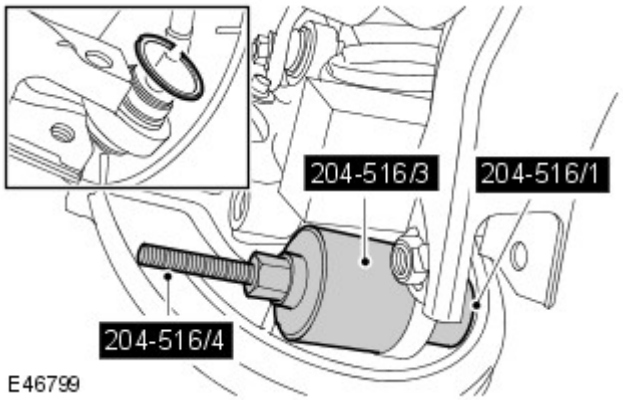

E46798

7. Release the knuckle from the lower arm.
    - Remove the bolt.



E50560

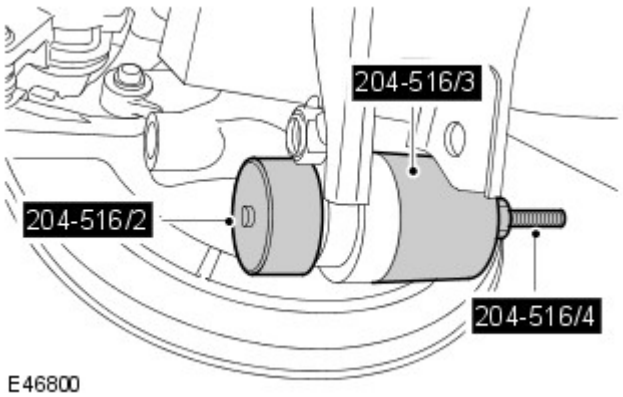
8. Using the special tools, release the halfshaft from the wheel hub.



E46799

9. Using the special tool, remove the lower arm ball joint.
    - Support the wheel knuckle to give access to the lower ball joint.
    - Remove and discard the snap ring.

Installation



E46800

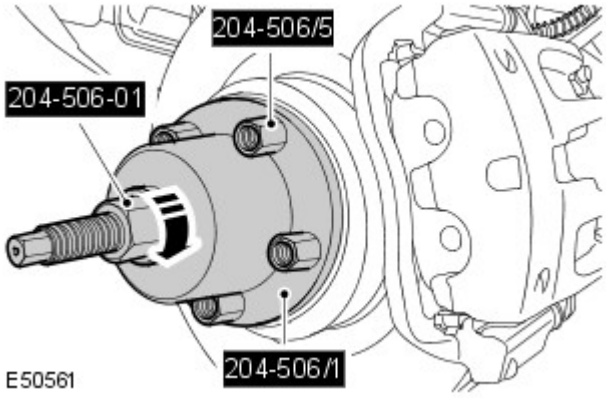
1. CAUTIONS:

    If the push in force is less than 17 kN the wheel knuckle must be replaced.

    Make sure the ball joint in installed from the chamfered side of the wheel knuckle.

    Using the special tool, install the lower arm ball joint.
    - Install the snap ring.

2. Using the special tools, install the halfshaft in the wheel hub.



3. CAUTION: Ensure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

   Connect the lower arm to the wheel knuckle.
   - Tighten the bolt to 175 Nm (129 lb.ft).

4. Install a new halfshaft retaining nut and lightly tighten.

5. Secure the parking brake cable.

6. CAUTION: Do not use a bolt that has been installed more than 5 times. Check the bolt head for centre punch marks. A bolt head with 4 centre punch marks indicates the bolt has been installed 5 times and must be replaced.

   Connect the toe link.
   - Tighten the bolt to 175 Nm (129 lb.ft).
   - Mark the bolt head with a centre punch, to indicate the number of times it has been used.

7. Tighten the halfshaft retaining nut to 350 Nm (258 lb.ft).
   - Stake the nut to the halfshaft.

8. Install the wheel and tire.

9. Carry out the wheel alignment procedure.

Rear Suspension - Toe Link

Removal and Installation

Removal

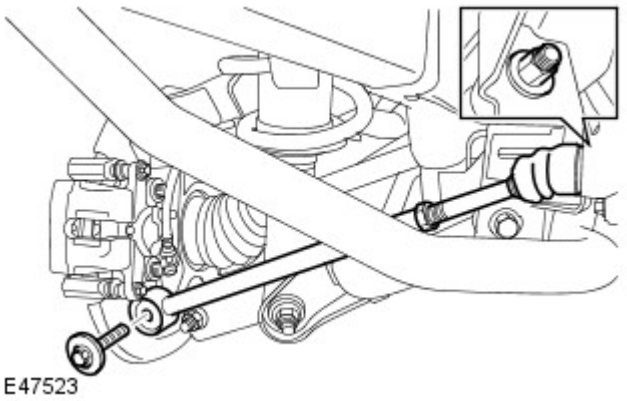
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Remove the wheel and tire.

3. Disconnect the toe link.
   - Remove and discard the bolt.

4. Remove the toe link.
   - Remove and discard the nut.



E47523

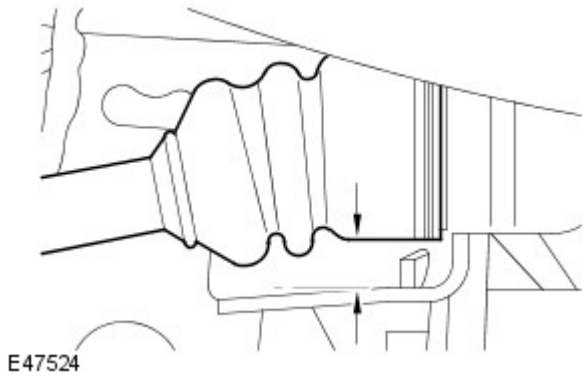
Installation

1. CAUTION: Make sure the toe link anti-rotation tang is fully seated in the integrated body frame before tightening the toe link retaining nut. Failure to follow this instruction will result in damage to the toe link or integrated body frame.

   Install the toe link.
   - Install a new nut and lightly tighten.

2. Connect the toe link.
   - Using a M14 x 2 tap, clean the threads of the knuckle fixing hole. Blow out debris with an air-line.
   - Tighten the new bolt to 175 Nm (129 lb.ft).

3. Set the gap, between the underside of the toe link rubber boot and the integrated body frame bracket, to 15 mm (0.590 in).
   - Tighten the toe link inner ball joint retaining nut to 133 Nm (98 lb.ft)



E47524

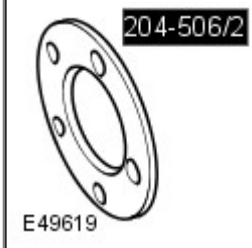
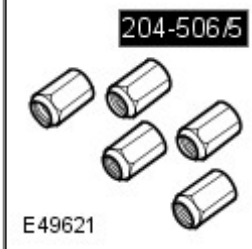
4. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

5. Carry out the wheel alignment procedure.

Rear Suspension - Wheel Knuckle

Removal and Installation

Special Tool(s)

	Halfshaft remover/replacer 204-506/1(LRT-60-030/1)
	Halfshaft remover/replacer 204-506/2(LRT-60-030/2)
	Halfshaft remover/replacer 204-506/3(LRT-60-030/3)
	Retainers - halfshaft remover/replacer 204-506/5(LRT-60-030/5)
	Halfshaft installer adapter 204-506-01(LRT-60-030/4)

Removal

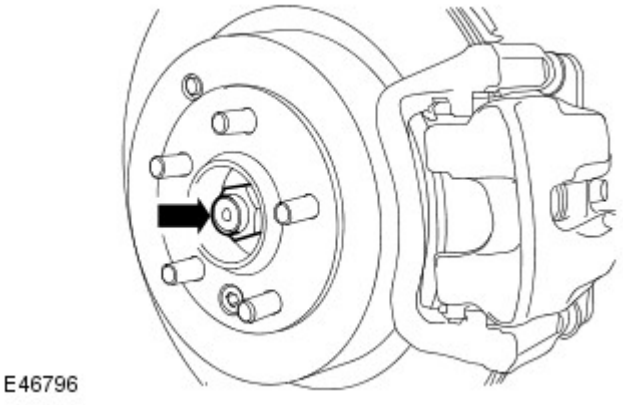
NOTE: If a new knuckle is installed a new wheel bearing must be installed.

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

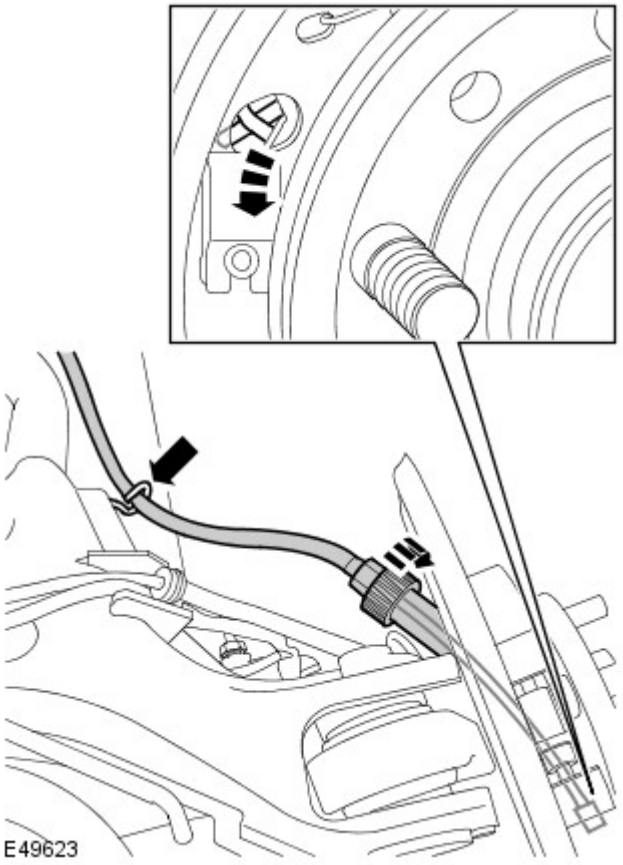
   Raise and support the vehicle.

2. Remove the wheels and tires.

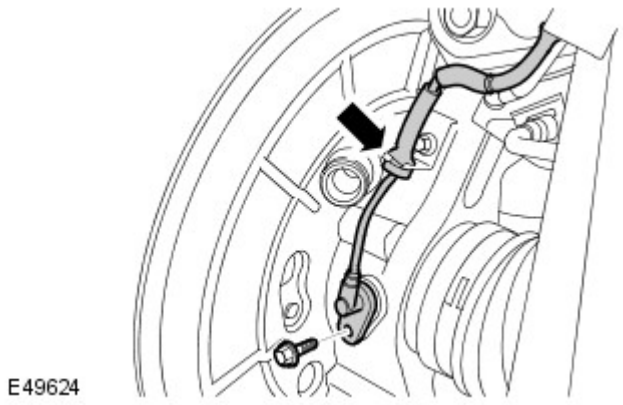
3. Loosen the halfshaft retaining nut.


E46796

4. Remove the brake disc.
   For additional information, refer to: Brake Disc (206-04 Rear Disc Brake, Removal and Installation).

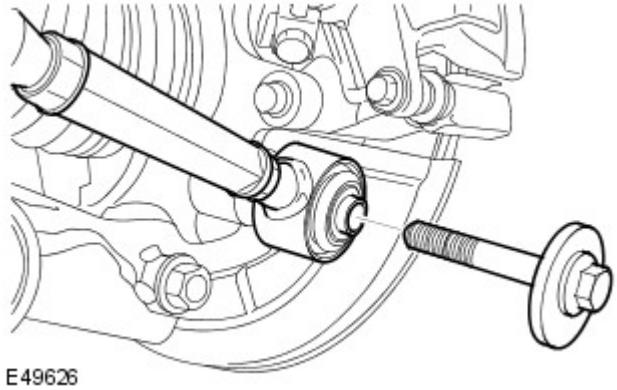

E49623

5. Release the parking brake cable.
   - Disconnect the parking brake cable from the brake shoe lever.
   - Disconnect the parking brake cable from the backplate.
   - Release the cable from the lower arm.

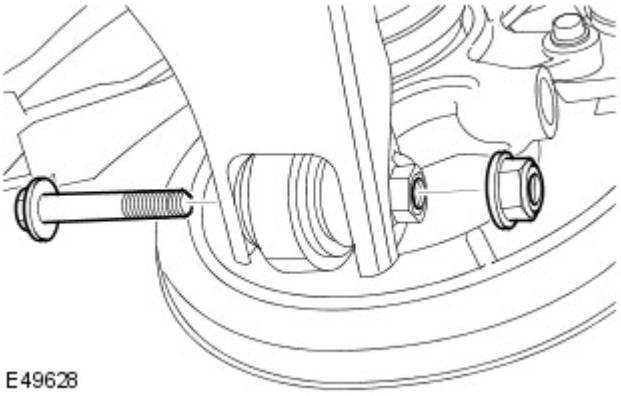

E49624

6. Release the wheel speed sensor from the wheel knuckle.

7. Disconnect the toe link.
   - Remove and discard the bolt.

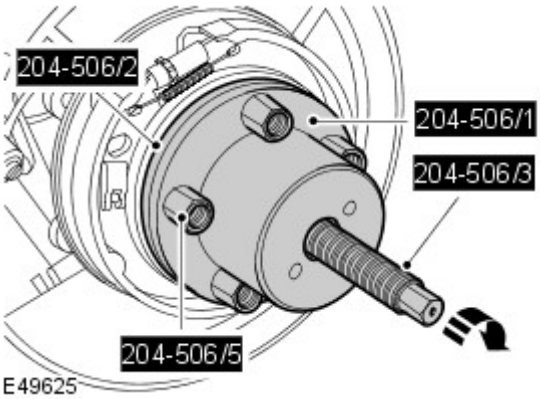

E49626

8. Remove the halfshaft retaining nut.


E49628

9. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

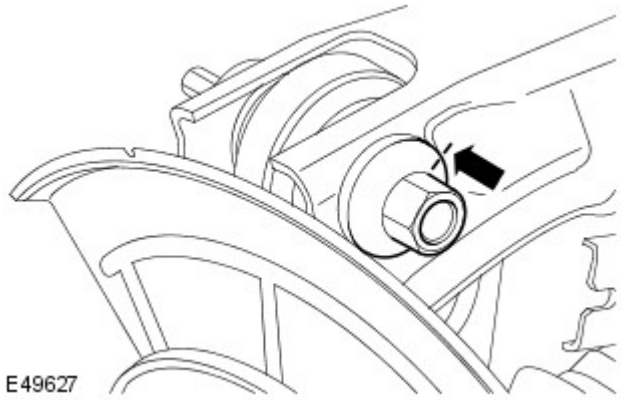
   Release the knuckle from the lower arm.
   - Remove the bolt.



E49625

10. CAUTION: Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

    Using the special tools, release the halfshaft from the wheel hub.


E49627

11. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

    Disconnect the upper arm from the wheel knuckle.
    - Mark the position of the bolt in relation to the upper arm.
    - Remove the nut and bolt.
    - Discard the nut.

12. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

    Remove the wheel knuckle.

Installation

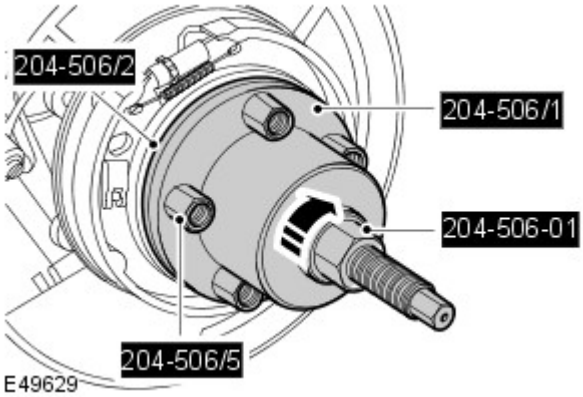
1. Clean the components.

2. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

   Install the wheel knuckle.
   - Locate the halfshaft.

3. Connect the upper arm and wheel knuckle.
   - Align the bolt to the marks made previously.
   - Install a new nut and tighten to 133 Nm (98 lb.ft).

4. Using the special tools, install the halfshaft in the wheel hub.



5. CAUTION: Install the halfshaft nut finger tight.

   Install a new halfshaft retaining nut and lightly tighten.

6. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

   Connect the lower arm to the wheel knuckle.
   - Tighten the nut and bolt to 175 Nm (129 lb.ft).

7. Connect the toe link.
   - Tighten the new bolt to 175 Nm (129 lb.ft).

8. Install the wheel speed sensor.
   - Tighten the bolt to 9 Nm (7 lb.ft).

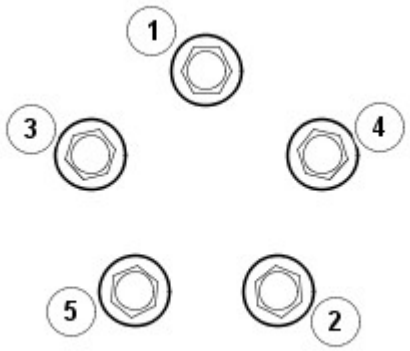
9. Locate the parking brake cable to the backplate.
   - Connect the cable to the brake shoe lever.
   - Tighten the coupling to 8 Nm (6 lb.ft).
   - Secure the parking brake cable to the lower arm.

10. Install the brake disc.
    For additional information, refer to: Brake Disc (206-04 Rear Disc Brake, Removal and Installation).

11. CAUTION: Do not use air tools to install the nut. Failure to follow this instruction may result in damage to the component.

    Tighten the new halfshaft retaining nut to 420 Nm (311 lb.ft).
    - Stake the nut to the halfshaft.

12. Install the wheel and tire.
    - Tighten the wheel nuts in the sequence shown:
      1. 1. Stage 1: 4 Nm
      2. 2. Stage 2: 70 Nm
      3. 3. Stage 3: 140 Nm



E74593

13. Carry out the wheel alignment procedure.

Wheels and Tires -

Wheels

Wheel type	Wheel size
Alloy wheel	9J x 19
Alloy wheel	9.5J x 20
Reduced size spare wheel - Alloy	5.5J x 19
Durable spare wheel - Alloy	8J x 19

CAUTIONS:

 Reduced Size Spare wheel to be fitted to V6 Diesel and non Supercharged vehicles only.

 Durable Spare may be fitted to all derivatives and is fitted as standard to all V8 Diesel and Supercharged Vehicles

 Full size spare is available on vehicles fitted with 19" wheels only.

 With either 'Reduced Size' or 'Durable' spare wheel installed, do not exceed 50 mph (80 kph) and replace with standard size wheel at earliest opportunity.

 Do not use power tools when operating the spare wheel winch, raise and lower winch manually using hand tools only.

Tire Sizes - Standard Fit

Wheel size	Tire size	Tire load index
8J x 19 - Alloy	255/50 R19Y - All terrain	107
9J x 19 - Alloy	255/50 R19Y - All terrain	107
9J x 19 - Alloy	* 255/50 R19V - All terrain	107
9.5J x 20 - Alloy	275/40 R20Y - All terrain	106

CAUTIONS:

 * Fitted to NAS/Gulf/Brazil non Supercharged Vehicles Only

 Inner tubes must not be installed with any of these tires.

Tire Pressures - Not NAS, Gulf and Brazil Vehicles

Loading condition	bar	lb/in²	kPa
Normal operating conditions - Up to 4 people:			
Front	2.3	34	230
Rear	2.5	36	250
Vehicle loaded to maximum gross vehicle weight:			
Front	2.6	38	260
Rear	2.9	42	290
*** Reduced size spare wheel**	4.2	60	420
**** Standard size spare wheel**	2.9	42	290
Durable spare wheel	2.9	42	290

CAUTIONS:

 * The Reduced Section Spare must not be fitted to V8 Diesel or Supercharged vehicles

 ** The standard size spare wheel tire should be inflated to the maximum gross vehicle weight pressure and the pressure for the front or rear wheel locations must be adjusted accordingly if the wheel is to be used under conditions other than with the vehicle loaded to maximum gross vehicle weight.

Tire Pressures - NAS, Gulf and Brazil Vehicles

Loading condition	bar	lb/in²	kPa
All conditions - all Y rated Tires:			
Front	2.6	38	260
Rear	2.9	42	290
All conditions - 19" V rated Tires Only:			
Front	2.7	39	270
Rear	3.0	43	300
*** Reduced size spare wheel**	4.2	60	420
**** Standard size spare wheel**	2.9	42	290
Durable spare wheel	2.9	42	290

CAUTIONS:

 * The Reduced Section Spare must not be fitted to V8 Diesel or Supercharged vehicles

 ** The standard size spare wheel tire should always be inflated to the highest loading condition pressure which must be adjusted accordingly if the wheel is to be installed to the front wheel locations.

General Specification

Item	Make	Location
Tire low pressure sensor	Continental/Siemens	On inside of wheel rim
Tire pressure sensor initiator:		
Front	Continental/Siemens	Attached to the fender splash shield adjacent to the front bumper
Rear	Continental/Siemens	Attached to the fender splash shield adjacent to the rear bumper

Recommended Lubricant

Application	Land Rover Part No.
Wheel hub spigot	RYL 105020

Torque Specifications

Description	Nm	lb-ft
* Road wheel nuts	140	103
Tire low pressure sensor	8	6

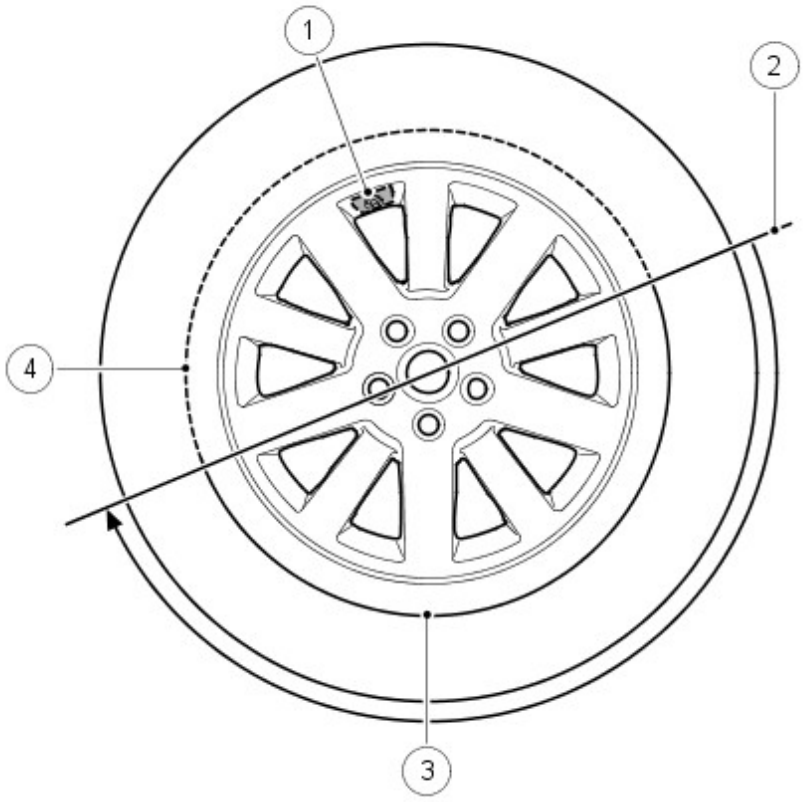
*** Wheel nuts must be tightened by diagonal selection**

Wheels and Tires - Wheels and Tires
Description and Operation

TIRES

NOTE: The TPMS valve should be serviced using the suitable service kit, each time the tyre is dismounted, to ensure an air tight seal. Attention should be made to the detail of fitting this kit.

Care must be taken when removing and refitting tires to ensure that the tire pressure sensor is not damaged.



E45549

Item	Part Number	Description
1	-	Tire valve and pressure sensor
2	-	Tire fitting/removal tool initial start position
3	-	High tire and bead tension area
4	-	Low tire and bead tension area

When removing the tire, the bead breaker must not be used within 90 degrees of the tire valve in each direction.

When using the tire removal machine, the fitting arm start position must be positioned as shown in the tire changing illustration. The wheel can then be rotated through 180 degrees in a counterclockwise direction. This will relieve the high tension from the tire bead allowing the remaining 180 degrees of the tire to be manually pulled from the rim.

When refitting the tire, position the fitting arm as shown. Rotate the tire and take care that the bead on the low tension side of the tire does not damage the sensor.

Tread Act - NAS Only

Vehicles supplied to the North American markets must comply with the legislation of the Transport Recall Enhancement, Accountability and Documentation (TREAD) act. Part of the requirement of the TREAD act is for the vehicle to display a label, positioned on the driver's side B-pillar, which defines the recommended tire inflation pressure, load limits and maximum load of passengers and luggage weight the vehicle can safely carry. This label will be specific to each individual vehicle and will be installed on the production line.

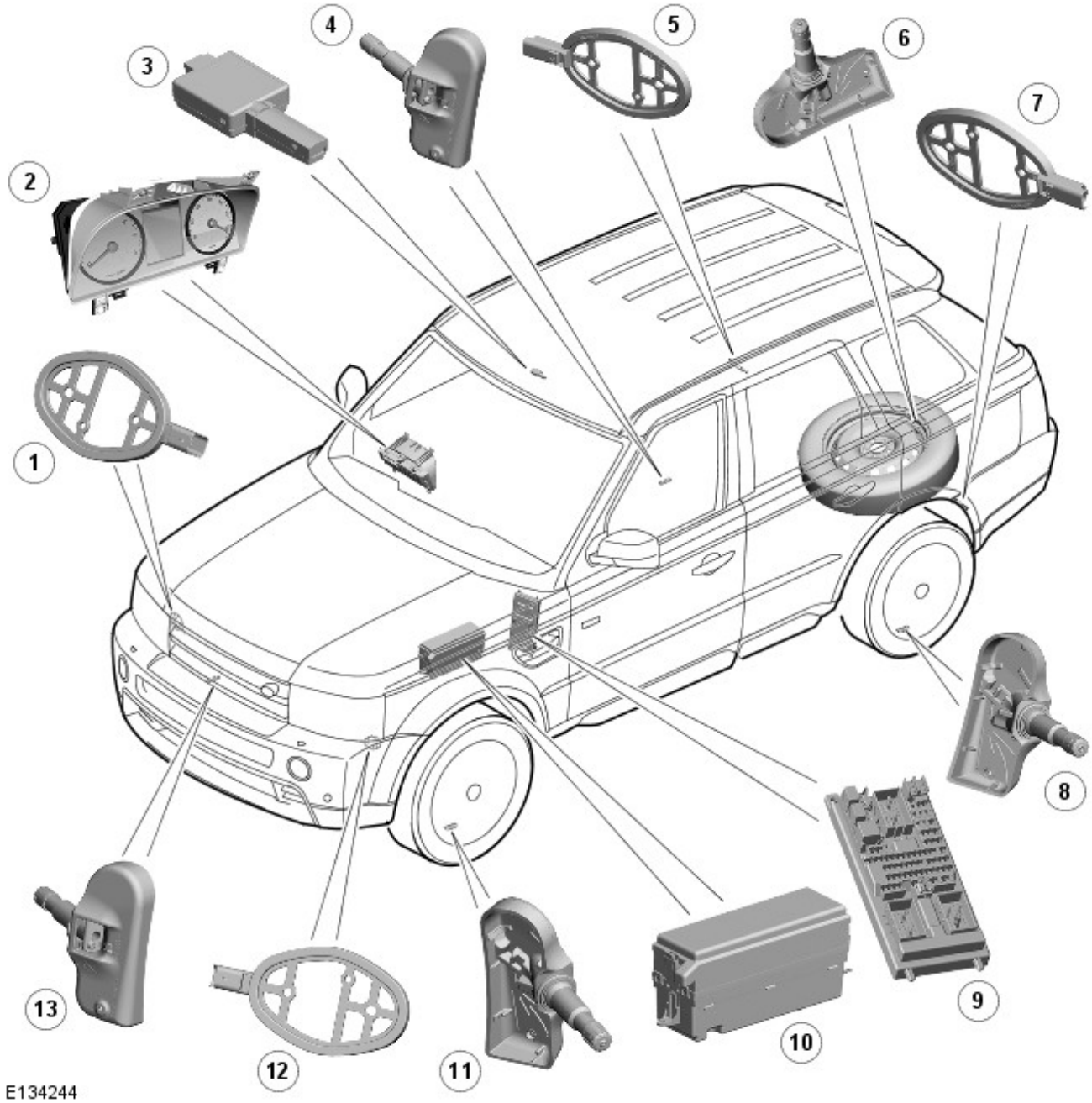
This label must not be removed from the vehicle. The label information will only define the specification of the vehicle as it came off the production line. It will not include dealer or owner fitted accessory wheels and tires of differing size from the original fitment.

NOTE: If tires and wheels of a non-standard size are fitted to the vehicle, the car configuration file must be updated using a Land Rover approved diagnostic system.

If the label is damaged or removed for body repair, it must be replaced with a new label specific to that vehicle. A new label is requested from Land Rover parts and will be printed specifically for the supplied VIN of the vehicle.

TIRE PRESSURE MONITORING SYSTEM (TPMS)

Tire Pressure Monitoring System - Component Location



Item	Part Number	Description
1	-	RH (right-hand) front initiator
2	-	Instrument cluster
3	-	TPMS RF receiver
4	-	RH rear tire pressure sensor
5	-	RH rear initiator
6	-	Spare tire pressure sensor
7	-	LH (left-hand) rear initiator
8	-	LH rear tire pressure sensor
9	-	CJB (central junction box)
10	-	EJB (engine junction box)
11	-	LH front tire pressure sensor
12	-	LH front initiator
13	-	RH front tire pressure sensor

The purpose of the Tire Pressure Monitoring System (TPMS) is to assist the driver in maintaining the vehicle's tire pressures at the optimum level in order to:

- improve fuel consumption
- maintain ride and handling characteristics
- reduce the risk of rapid tire deflation – which may be caused by under inflated tires

- comply with legislation in relevant markets.

The TPMS measures the pressure in each of the tires on the vehicle (including the spare, if required) and issues warnings to the driver if any of the pressures deviate from defined tolerances.

NOTES:

 During a 'blow out' a very rapid reduction in pressure is experienced. The system is not intended to warn the driver of a 'blow out', since it is not possible to give the driver sufficient warning that such an event is occurring, due to its short duration. The design of the TPMS is to assist the driver in keeping the tires at the correct pressure, which will tend to reduce the likelihood of a tire 'blow out' occurring.

 TPMS is inhibited when the vehicle is in Delivery mode. For more details on Delivery mode refer to the PDI manual.

A single TPMS hardware configuration is used. TPMS status information is relayed to the driver with a message displayed in the instrument cluster message center and a amber warning indicator.

Tire Location

Because of the requirement for different pressure targets and thresholds for the front and rear tires, the CJB can identify the location of the tires on the vehicle, and assign a received tire pressure sensor identification to a specific position on the vehicle (i.e. FL (front left), FR (front right), RL (rear left) or RR (rear right)).

Tire location is performed automatically by the CJB using an auto-location function. This function requires no manual intervention by the driver. The CJB can automatically learn the position of tires on the vehicle if the tire pressure sensors or their positions are changed on the vehicle.

The tire learn and location process is ready to commence when the vehicle has been stationary or is traveling at less than 12 mph (20 km/h) for 15 minutes. This is known as 'parking mode'. The learn/locate process requires the vehicle to be driven at speeds of more than 12 mph (20 km/h) for 15 minutes. If the vehicle speed reduces to below 12 mph (20 km/h), the learn process timer is suspended until the vehicle speed increases to more than 12 mph (20 km/h), after which time the timer is resumed. If the vehicle speed remains below 12 mph (20 km/h) for more than 15 minutes, the timer is set to zero and process starts again.

The CJB can automatically detect, under all operating conditions, the following:

- one or more tire pressure sensors have been replaced
- one or more tire pressure sensor identifications are missing
- one or more 'alien' identifications are being received, i.e. the CJB can reject identifications from tire pressure sensors that do not belong to the vehicle
- the spare tire and one of the tires in use on the vehicle have exchanged position on the vehicle.

If the tire pressure sensors fitted to the running wheels (not the spare) are changed, the CJB can learn the new sensor identifications automatically. The learn function requires no manual intervention by the driver.

If a new sensor is fitted to the spare tire it must have its identification code programmed into the CJB using a Land Rover approved diagnostic system, or used on the vehicle as a 'running' wheel and the vehicle driven for 15 minutes at more than 12.5 mph (20 km/h).

Spare Tire Identification

Depending on the vehicle specification, the spare tire may or may not be fitted with a tire pressure sensor.

 NOTE: Tire pressure sensors cannot be fitted to steel space saver spare wheels.

If the spare tire is fitted with a tire pressure sensor, the CJB can detect it, determine that it is the spare tire and monitor its pressure and issue warnings to the driver accordingly. If the CJB expects the spare tire to be fitted with a tire pressure sensor and it does not, the CJB will not show a fault to the driver, however a fault code will be stored in the CJB.

If the spare tire is being monitored and the driver replaces a flat 'running' tire with the spare tire, the CJB will not continually warn the driver that the original flat tire (now in the spare position) is flat. This prevents distraction of the driver by constant pressure warnings being issued. The driver is reminded by a message displayed for 20 seconds at each ignition on cycle that the spare tire is flat.

System Operation

Each time the vehicle is driven, the CJB transmits a Low Frequency (LF) (125 KHz) signal to each initiator in turn. This is received by the tire pressure sensor which transmits a Radio Frequency (RF) (315 or 433 MHz depending on market) signal to the RF receiver. This signal contains coded data which corresponds to sensor identification, air pressure, air temperature and acceleration data. This signal is communicated to the CJB via a K-bus line.

The system enters 'parking mode' after the vehicle speed has been less than 12.5 mph (20 km/h) for 12 minutes. In parking mode the tire pressure sensors transmit a coded signal to the CJB once every 13 hours. If the tire pressure decreases by more than 1 lbf/in^2 (0.6 bar) the sensor will transmit more often if pressure is being lost.

The spare tire sensor transmits a signal every 13 hours in the same manner as the road wheels when in parking mode. If the tire pressure decreases by more than 1 lbf/in^2 (0.6 bar) the sensor will transmit more often if pressure is being lost.

As each wheel responds to the LF signal from the CJB, it is assigned a position on the vehicle and is monitored for the remainder of that drive cycle in that position.

When the vehicle has been parked for more than 15 minutes and then driven at a speed of more than 12.5 mph (20 km/h), the initiators fire in turn for 18 seconds in the following order:

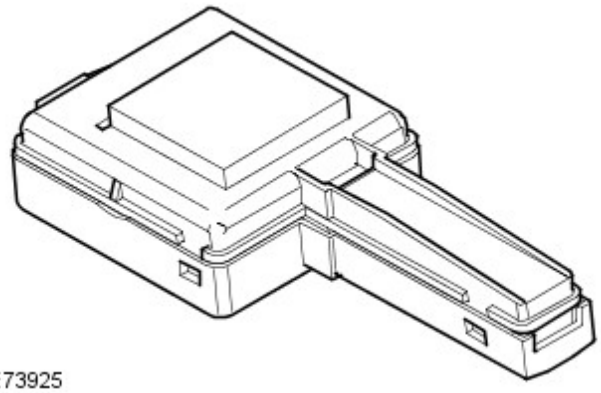
- Front left
- 6 second pause (for the to detect a response from the tire pressure sensor)
- Front right
- 6 second pause
- Rear right
- 6 second pause
- Rear left
- 6 second pause.

Each tire pressure sensor responds in turn so the CJB can establish the sensor positions at the start of the drive cycle. This process is repeated up to three times but less if the sensor positions are already known in the CJB. The process is known as 'Auto Location' and takes 7 to 8 minutes to complete. During this period the tire sensors transmit at regular intervals, once every 15 seconds. For the remainder of the drive cycle the tire sensors transmit once every 60 seconds or if a change in tire pressure is sensed until the vehicle stops and the system returns to parking mode.

Once the wheel position is established, the initiators stop firing a signal and do not fire again until the vehicle has been parked for more than 15 minutes. The signal transmissions from each wheel sensor continue at 1 minute intervals whilst the vehicle is being driven. This transmission is to monitor the tire pressure.

At 25% deflation the amber warning indicator in the instrument cluster is illuminated and an appropriate message displayed in the message center.

RF Receiver

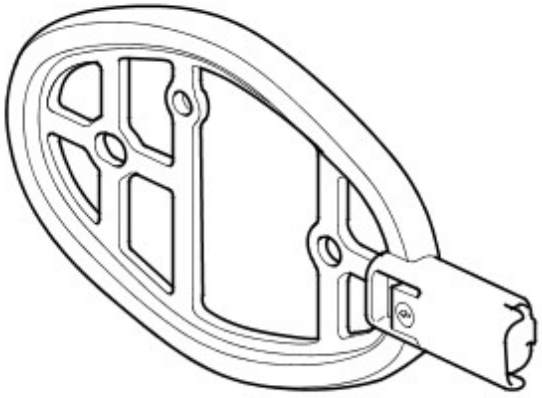


E73925

The RF receiver is mounted behind the overhead console and connects to the vehicle harness via a fly lead.

The RF receiver receives transmissions from each of the tire pressure sensors via an internal antenna. This information is then communicated to the CJB via a dedicated Local Interconnect Network (K-bus).

Initiator



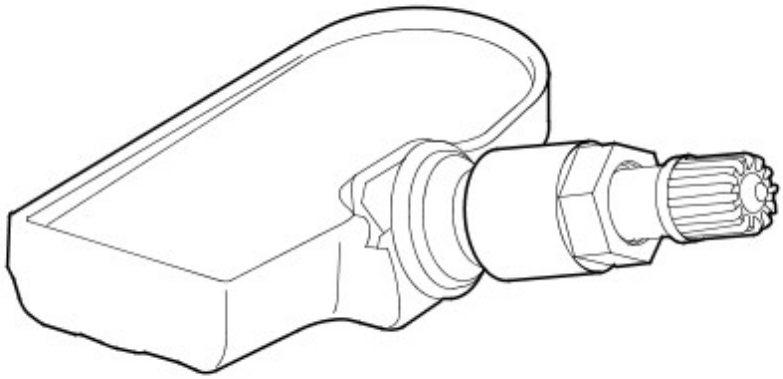
E45552

The initiators are located at the front of the front wheel arches and at the rear of the rear wheel arches and are secured with two scrivets. The TPMS has four initiators and each has a connector which connects with the body harness.

The initiator is a passive, Low Frequency (LF) transmitter. Each initiator provides an auto-location feature to identify tire positions on the vehicle and transmit that data to the CJB.

The CJB energizes each initiator in turn using LF drivers. The corresponding tire pressure sensor detects the resulting LF transmission and responds by initiating an RF transmission of its data. This data is received by the RF receiver and communicated to the CJB via a K-bus. The CJB can then determine which sensor is transmitting and its location on the vehicle.

Tire Pressure Sensor



E45553

The TPMS system uses ‘active’ tire pressure sensors which are mounted on each wheel, inside the tire cavity. The sensor is retained in position by the valve attachment to the wheel structure. The sensors transmit their RF signals at either 315 MHz or 433 MHz dependent on market requirements.

The sensors periodically measure the pressure and temperature of the air inside the tire plus the centripetal acceleration acting on the sensor. These measurements are transmitted periodically to the RF receiver located behind the overhead console.

The tire pressure sensors are self-contained units which have no electrical connections into or out of the sensor.

The care points detailed in the 'Tires' section of this chapter must be followed to avoid damage to the sensor. If the sensor is replaced, the nut, seal and washer must also be replaced and the sensor tightened to the correct torque value as given in the Service Repair manual.

The RF transmission from the sensor contains a unique identification code in its transmission data, so that the CJB can identify the tire on the vehicle. If the sensor is replaced on a 'running' wheel, the new sensor identification will be learnt when the vehicle is first driven at a speed of more than 12.5 mph (20 km/h) for 15 minutes. If a new sensor is fitted to the spare wheel, the identification for that sensor must be programmed into the CJB using a Land Rover approved diagnostic system or that wheel will not be monitored. The code is provided on a label with the complete wheel and tire assembly when new and is also printed on the casing of each sensor.

The replacement spare wheel may also be programmed to the vehicle by using it as a 'running' wheel for 15 minutes at more than 12.5 mph (20 km/h), then replacing it to the spare wheel position.

In order to conserve battery power, the tire sensor module uses different transmission rates when the wheel is stationary or moving. The wheel speed required to change between the stationary and moving transmission rates is very low to allow for the requirement for slow off-road driving.

Instrument Cluster Indications



E134246

Item	Part Number	Description
1	-	Message center
2	-	Amber warning indicator

The warning indications to the driver are common on all vehicles fitted with TPMS. Warnings are conveyed by an amber light emitting diode (LED) warning indicator and a text message displayed in the message center.

The warning indicator and message center are driven by CAN messages from the CJB. The warning indicator is illuminated by the cluster software for 3 seconds when the vehicle is in power mode 6 for a bulb check.

For additional information, refer to: Information and Message Center (413-08, Description and Operation).

Controller Area Network (CAN)

The CJB sends and receives a number of digital messages via the medium speed controller area network (CAN). The received messages are used for the operation of the TPMS. The transmitted messages comprise of TPMS status and requests to the instrument cluster to illuminate warnings indicators and/or display messages in the message center.

Transmitted Messages

The CJB transmits the messages shown in the following table.

Message	Received By
TPMS diagnostic response	A Land Rover approved diagnostic system.
TPMS amber warning indicator request at 25% tire deflation	Instrument cluster
TPMS message display request	Instrument cluster

Diagnostics

The CJB has a diagnostic connection via the medium speed CAN to enable system status and faults to be retrieved using a Land Rover approved diagnostic system.

Additionally, an on-board diagnostic routine within the CJB constantly monitors the system and alerts the driver to system faults by illuminating the amber warning indicator and/or displaying a message in the instrument cluster message center.

Fault Detection

If a sensor fails, the amber warning indicator in the instrument cluster will be illuminated. A message 'XX Tyre Not Monitored' will be displayed in the message center in addition to the amber warning indicator.

NOTE: 'XX' is the tire position on the vehicle, e.g. FL (front left), FR (front right), RL (rear left) or RR (rear right).

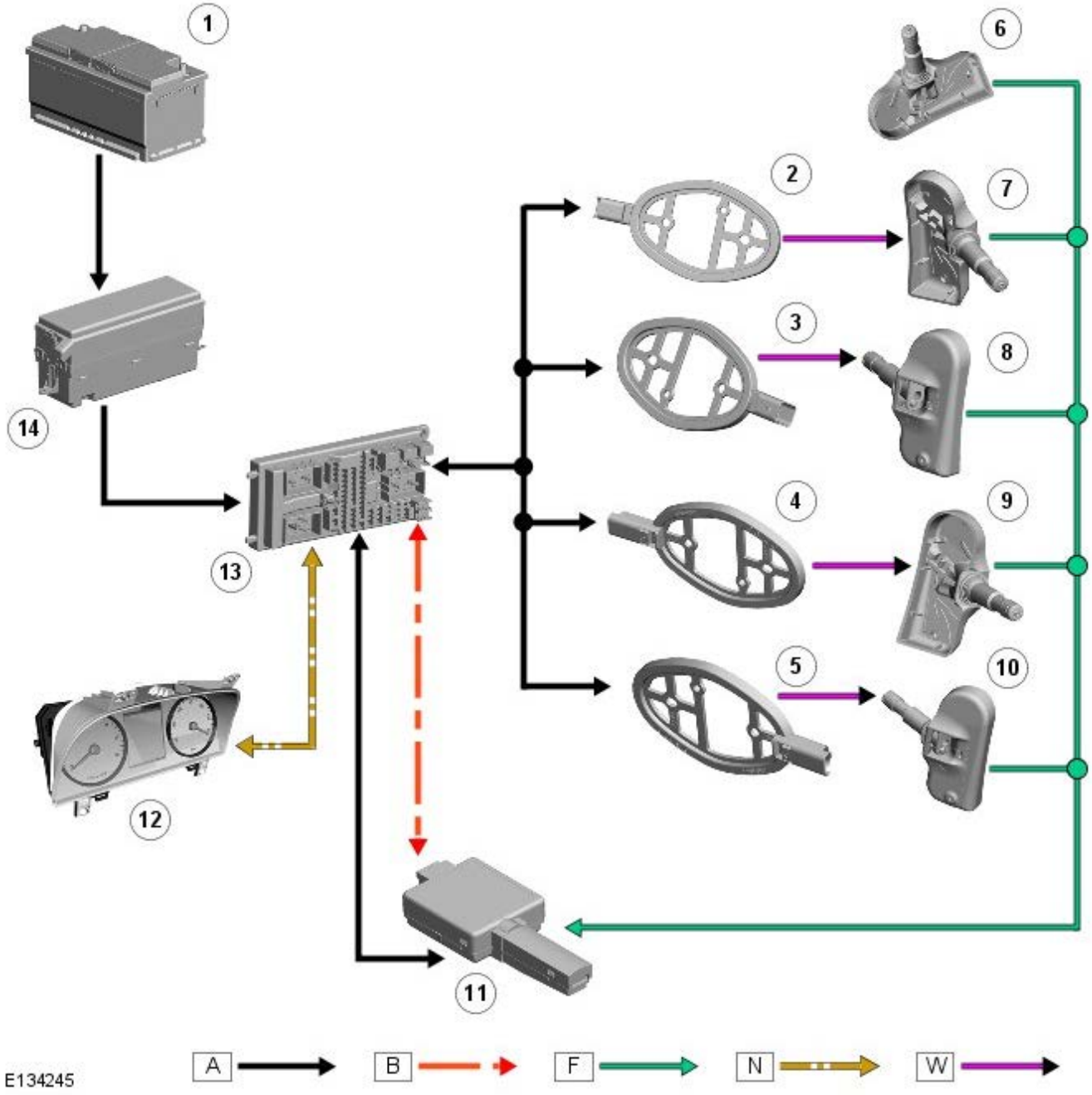
If more than one sensor fails or the CJB develops a fault, the amber warning indicator will be illuminated. A message 'Tyre Monitoring System Fault' will be displayed in the message center in addition to the amber warning indicator.

This fault could also be caused if RF interference near the vehicle affects the system signal reception. When the interference has ceased, the fault will be automatically cancelled and the TPMS will operate normally.

If a tire pressure sensor battery voltage becomes low, the sensor transmits a message to the CJB. The CJB stores the low battery condition as a fault flag in its memory with no other visual warnings displayed. If the battery fails, the sensor will stop transmitting and the CJB will transmit a message to display 'FL Tyre Not Monitored' for example in the message center. The dealer should interrogate the CJB for the fault flag using a Land Rover approved diagnostic system to determine the cause of the message. If the battery has failed, the sensor must be replaced and the stored fault flags removed using a Land Rover approved diagnostic system. The CJB will learn the identification of the new sensor when the vehicle is driven. If the replaced sensor is fitted to the spare wheel (if fitted), its identification must be manually programmed into the CJB using a Land Rover approved diagnostic system or by using it as a 'running' wheel for 15 minutes at more than 12.5 mph (20 km/h), then replacing it to the spare wheel position.

CONTROL DIAGRAM

NOTE: **A** = Hardwired; **B** = K-Bus; **F** = RF Transmission; **N** = Medium Speed CAN Bus; **W** = LF Transmission



Item	Part Number	Description
1	-	Battery
2	-	RH rear initiator
3	-	LH rear initiator
4	-	RH front initiator
5	-	LH front initiator
6	-	Spare tire pressure sensor
7	-	RH rear tire pressure sensor

8	-	LH rear tire pressure sensor
9	-	RH front tire pressure sensor
10	-	LH front tire pressure sensor
11	-	TPMS RF receiver
12	-	Instrument Cluster
13	-	CJB
14	-	EJB

Wheels and Tires - Wheels and Tires
Diagnosis and Testing

Principles of Operation

For a detailed description of the wheels and tires, refer to the relevant Description and Operation section in the workshop manual.
REFER to: Wheels and Tires (204-04 Wheels and Tires, 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 complaint. As much information as possible should be gathered from the driver to assist in diagnosing the cause(s). Confirm which of the following two warning types (A or B) exist for the Tire Pressure Monitoring System when the ignition status is switched from 'OFF' to 'ON'
   - **(A) Check Tire Pressure Warnings.** A low tire pressure warning will **continuously** illuminate the low tire pressure warning lamp. This warning may be accompanied by a text message such as CHECK TIRE PRESSURE (refer to owner literature). The manufacturer approved diagnostic system does NOT need to be used. Diagnostic Trouble Codes (DTCs) are not generated with this type of warning. To extinguish this warning it is essential that, with the ignition 'ON', all vehicle tires (including the spare) are to be set to the correct pressure as stated in the vehicle handbook or as indicated on the placard label in the passenger/driver door aperture. **It is not necessary to drive the vehicle to clear 'check tire pressure' warnings - just changing the tire pressure causes the tire low pressure sensor to transmit new data.**

     NOTES:

     The tire pressures should be set by:

     - Using a calibrated tire pressure gauge
     - With 'cold' tires (vehicle parked in the ambient temperature for at least one hour, not in a garage with an artificial ambient temperature)

     If the tire pressure warning does not clear within two minutes, it is likely that the gauge is not correctly calibrated or the tires are 'warm'. Carry out the following steps until the warning has cleared:

     - Rotate wheels approximately 180 degrees
     - Increase the tire pressures by 3psi
     - Wait a further two minutes
     - When the tires are at ambient temperature and a **calibrated** gauge is available, reset the tire pressures to the correct pressure.

     Tire pressure adjustments are part of routine owner maintenance. Tire pressure adjustments that are required due to a lack of owner maintenance are not to be claimed under vehicle warranty.

   - **(B) System Fault Warnings.** When a system fault is detected, the low tire pressure warning lamp will flash for approximately 75 seconds prior to being continuously illuminated. Visually inspect wheel arch Tire Pressure Monitoring System Antennas and check for system DTCs. External visual damage to the tire low pressure sensors and air leaks will not cause system fault warnings (note: nut and seal system should be replaced at each tyre change using the available service kit). Check for the presence of tire low pressure sensors on all four wheels (note: a tire low pressure sensor has a metal valve stem rather than a rubber one).
2. Check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

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

Pinpoint Tests

PINPOINT TEST A : U201F11 TIRE PRESSURE MONITORING SYSTEM EXTERNAL RECEIVER DATA LINE CIRCUIT SHORT TO GROUND			
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**		
A1: U201F11 VERIFY EXTERNAL RECEIVER DATA LINE CIRCUIT SHORT TO GROUND			
	1 Ignition OFF.		
	2 Disconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.		
	3 Measure the resistance between		
	C2875, harness side	**Battery**	

	Pin 1	Negative terminal
	Is the resistance less than 5 Ohms? **Yes** GO to A2. **No** GO to A3.	
A2: U201F11 CHECK THE EXTERNAL RECEIVER DATA LINE CIRCUIT FOR SHORT CIRCUIT TO GROUND		
	1 Disconnect the Body Control Module electrical connector, C0580.	
	2 Measure the resistance between	
	C2875, harness side	**Battery**
	Pin 1	Negative terminal
	Is the resistance less than 5 Ohms? **Yes** REPAIR the short circuit in wiring harness. **No** GO to A4.	
A3: U201F11 CHECK THE TIRE PRESSURE MONITORING SYSTEM EXTERNAL RECEIVER FOR SHORT CIRCUIT TO GROUND		
	1 Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.	
	2 Using manufacturer approved diagnostic system run On Demand Self Test **(0x0202)**.	
	Is the DTC U201F11 set? **Yes** Replace Tire Pressure Monitoring Receiver. **No** Investigate possible cause of intermittent failure.	
A4: U201F11 CHECK THE BODY CONTROL MODULE FOR SHORT CIRCUIT TO GROUND		
	1 Reconnect the Body Control Module electrical connector, C0580.	
	2 Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.	
	3 Using manufacturer approved diagnostic system run On Demand Self Test **(0x0202)**.	
	Is the DTC U201F11 set? **Yes** Replace Body Control Module. **No** Investigate possible cause of intermittent failure.	

PINPOINT TEST B : U201F12 TIRE PRESSURE MONITORING SYSTEM EXTERNAL RECEIVER DATA LINE CIRCUIT SHORT TO POWER		
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**	
B1: U201F12 VERIFY EXTERNAL RECEIVER DATA LINE CIRCUIT SHORT TO POWER		
	1 Ignition OFF.	
	2 Disconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.	
	3 Measure the resistance between	
	C2875, harness side	**Battery**
	Pin 1	Positive terminal
	Is the resistance less than 5 Ohms? **Yes** GO to B2. **No** GO to B3.	
B2: U201F12 CHECK THE EXTERNAL RECEIVER DATA LINE CIRCUIT FOR SHORT CIRCUIT TO POWER		
	1 Disconnect the Body Control Module electrical connector, C0580.	
	2 Measure the resistance between	
	C2875, harness side	**Battery**
	Pin 1	Positive terminal
	Is the resistance less than 5 Ohms? **Yes** REPAIR the short circuit in wiring harness. **No** GO to B4.	
B3: U201F12 CHECK THE TIRE PRESSURE MONITORING SYSTEM EXTERNAL RECEIVER FOR SHORT CIRCUIT TO POWER		
	1 Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.	
	2 Using manufacturer approved diagnostic system run On Demand Self Test **(0x0202)**.	
	Is the DTC U201F12 set? **Yes** Replace Tire Pressure Monitoring Receiver. **No** Investigate possible cause of intermittent failure.	
B4: U201F12 CHECK THE BODY CONTROL MODULE FOR SHORT CIRCUIT TO POWER		
	1 Reconnect the Body Control Module electrical connector, C0580.	

	2 Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.
	3 Using manufacturer approved diagnostic system run On Demand Self Test **(0x0202)**.
	Is the DTC U201F12 set? **Yes** Replace Body Control Module. **No** Investigate possible cause of intermittent failure.

PINPOINT TEST C : U201F87 TIRE PRESSURE MONITORING SYSTEM EXTERNAL RECEIVER DATA LINE MISSING MESSAGE	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
C1: U201F87 VERIFY EXTERNAL RECEIVER DATA LINE MISSING MESSAGE	
	1 Using manufacturer approved diagnostic system run On Demand Self Test (0x0202).
	Is the DTC U201F87 set? **Yes** GO to C2. **No** Investigate possible cause of intermittent failure.
C2: U201F87 CHECK EXTERNAL RECEIVER DATA LINE CIRCUIT	
	1 Ignition OFF.
	2 Disconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.
	3 Disconnect the Body Control Module electrical connector, C0580.
	4 Measure the resistance between **C2875, harness side**: Pin 1 **C0580, harness side**: Pin 25
	Is the resistance less than 5 ohms? **Yes** GO to C3. **No** REPAIR the high resistance/open circuit in wiring harness.
C3: U201F87 CHECK EXTERNAL RECEIVER	
	1 Reconnect the Body Control Module electrical connector, C0580.
	2 Reconnect the Tire Pressure Monitoring System Receiver electrical connector, C2875.
	3 Using manufacturer approved diagnostic system run On Demand Self Test **(0x0202)**.
	Is the DTC U201F87 set? **Yes** Replace Tire Pressure Monitoring Receiver.GO to C4. **No** Investigate possible cause of intermittent failure.
C4: U201F87 CHECK BODY CONTROL MODULE.	
	1 Using manufacturer approved diagnostic system run On Demand Self Test **(0x0202)**.
	Is the DTC U201F87 set? **Yes** Replace Body Control Module. **No** Test is complete. No further action is required.

PINPOINT TEST D : C1A5693, C1A5893, C1A6093, C1A6293 DEFECTIVE RUNNING TIRE LOW PRESSURE SENSOR OR RECEIVER	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
D1: C1A5693, C1A5893, C1A6093, C1A6293 CHECK FOR ADDITIONAL DTCS	
	1 Using manufacturer approved diagnostic system check for additional DTCs C1A5693, C1A5893, C1A6093, C1A6293, with identical time stamps.
	Have all four DTCs logged with identical time stamps in the Body Control module? **Yes** Diagnose and fix DTCs related to the tire pressure monitoring receiver. **No** Using manufacturer approved diagnostic system, perform diagnostic routine to verify reception of all tire low pressure sensors, by carrying out 'TPMS wheel unit & receiver reception test' from set up and configuration application and complete remedial actions.

PINPOINT TEST E : C1D1800 LOCALIZATION FAILURE	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
E1: C1D1800 ESTABLISH THE LOCATIONS OF THE TIRE LOW PRESSURE SENSOR LOCALIZATION FAILURES	
	NOTE: To clear or reset information read in datalogger signal 'Unsuccessful wheel position triggering statistic' (0x4149) Use manufacturer approved diagnostic system and carry out 'Reset/ Clear Specified Function' (0x040E) from Special Applications. **1** Using manufacturer approved diagnostic system read datalogger signal 'Unsuccessful wheel

	position triggering statistic' (0x4149) to establish the locations of the tire low pressure sensor localization failures.
	Have the locations of the tire low pressure sensor localization failures been identified? **Yes** GO to E2. **No** Investigate possible cause of intermittent failure.
E2: C1D1800 CHECK FOR ADDITIONAL LF INITIATOR CIRCUIT DTCS	
	1 Using manufacturer approved diagnostic system check for additional DTCs C1A5712, C1A5714, C1A5912, C1A5914, C1A6112, C1A6114, C1A6312, C1A6314.
	Are any of the following DTCs logged C1A5712, C1A5714, C1A5912, C1A5914, C1A6112, C1A6114, C1A6312, C1A6314? **Yes** Refer to the DTC Index. Check for possible causes for each of the logged DTCs and carry out the repair operations specified. **No** GO to E3.
E3: C1D1800 CHECK FOR ADDITIONAL TIRE LOW PRESSURE SENSOR DTCS	
	1 Using manufacturer approved diagnostic system check for additional DTCs C1A5693, C1A5893, C1A6093, C1A6293, C1D2105.
	Are any of the following DTCs logged C1A5693, C1A5893, C1A6093, C1A6293, C1D2105? **Yes** Refer to the DTC Index. Check for possible causes for each of the logged DTCs and carry out the repair operations specified. **No** GO to E4.
E4: C1D1800 CHECK INITIATORS ARE CORRECTLY INSTALLED	
	1 Check for correct installation of Initiators for the locations identified. REFER to: (204-04 Wheels and Tires) Tire Pressure Monitoring System (TPMS) Front Antenna (Removal and Installation), Tire Pressure Monitoring System (TPMS) Rear Antenna (Removal and Installation).
	Are the Initiators correctly installed? **Yes** GO to E5. **No** Install Initiators to the correct locations.
E5: C1D1800 CHECK FOR SHORT CIRCUIT IN INITIATOR HARNESS	
	1 Ignition OFF.
	2 Disconnect the Body Control Module electrical connector, C0584 (Front LF Initiators).
	3 Disconnect the Body Control Module electrical connector, C0586 (Rear LF Initiators).
	4 Measure the resistance of Front Right Hand Initiator.

C0584, harness side	C0584, harness side
Pin 1	Pin 2

	5 Measure the resistance of Front Left Hand Initiator.

C0584, harness side	C0584, harness side
Pin 14	Pin 15

	6 Measure the resistance of Rear Right Hand Initiator.

C0586, harness side	C0586, harness side
Pin 30	Pin 31

	7 Measure the resistance of Rear Left Hand Initiator.

C0586, harness side	C0586, harness side
Pin 18	Pin 19

	Are any of the Initiator resistance measurements less than 1 Ohm? **Yes** REPAIR the short circuit as required. **No** Install the correct tire low pressure sensor, of correct frequency, in accordance with that defined in the manufacturer approved diagnostic system new tire low pressure sensor application, to the position(s) identified. REFER to: Tire Low Pressure Sensor (204-04 Wheels and Tires, Removal and Installation).

PINPOINT TEST F : C1D2105 MISSING, INCOMPATIBLE OR DEFECTIVE RUNNING TIRE LOW PRESSURE SENSOR(S) OR RECEIVER	
TEST CONDITIONS	**DETAILS/RESULTS/ACTIONS**
F1: C1D2105 CHECK FOR CORRECT WHEEL AND TIRE ASSEMBLY AND TIRE LOW PRESSURE SENSORS	
	NOTE: As a visual check, a tire low pressure sensor has a metal valve stem rather than a rubber one and cannot be installed to a mini or space saver spare wheel.

	1 Check that all full size running wheel and tire assemblies have tire low pressure sensors installed.
	Is a full size wheel and tire assembly with tire low pressure sensor installed to all running wheel positions? **Yes** Using manufacturer approved diagnostic system, perform diagnostic routine to verify reception of all tire low pressure sensors, by carrying out 'TPMS wheel unit & receiver reception test' from set up and configuration application and complete remedial actions. **No** If agreed with the customer, install the correct wheel and tire assembly or tire low pressure sensor(s), of correct frequency, in accordance with that defined in the manufacturer approved diagnostic system new tire low pressure sensor application. (Note: If the datalogger signal 'Number Of Missing Tire Pressure Wheel Units' is 4 and the Instrument Panel Cluster displays text message 'Tire Pressure Monitoring Unavailable', the system has detected winter tire installation, as detailed in the owner's manual. Confirm why the vehicle has non-TPMS wheel & tire assemblies installed before installing tire low pressure sensors, which are not to be claimed under vehicle warranty.)

Component Tests

Wheels and Tires

For wheel and tire specification information (pressures, torques, etc).
REFER to: Specifications (204-04 Wheels and Tires, Specifications).

When replacing wheels or tires, local legislation regarding health and safety must be complied with.

If the vehicle has a Tire Pressure Monitoring System installed, only manufacturer approved wheels and tires should be used. If the wheel and tire size is changed (for example from R18 to R20) the Tire Pressure Monitoring System module should be updated with the correct pressure information appropriate to the new wheel and tire set. Update the Tire Pressure Monitoring System module using the manufacturer approved diagnostic system.

As a general guideline, only replace tires in pairs or as a set, and only with tires of equivalent size and specification.

Confirm the symptoms of the customer complaint.

As much information as possible should be gathered from the driver to assist in diagnosing the cause(s).

1. Before a road test, carry out a basic inspection to make sure the vehicle is safe and legal to drive.

Basic inspection

- Correct tire inflation.
  REFER to: Specifications (204-04 Wheels and Tires, Specifications).
- Legal tire tread depth
- Cuts/Bulges in tire sidewall(s)
- Tire ply separation
- Embedded objects
- Wheel rim damage
- Correct tire installation (specification, direction of rotation, etc)
- Any obvious distortion of the tire (flat/high spots)
- Worn/Damaged steering or suspension components

Road test

If the results of the basic inspection are acceptable, carry out a road test to confirm the symptoms.

To reproduce the symptoms, test the vehicle on similar roads to those on which the fault occurs and at similar speeds (provided it is legal to do so).

If the vibration or noise can be reproduced, note the speed at which it occurs and see if it is possible to drive through the symptom, meaning, is it possible to alter the fault by driving faster or slower than the speed at which it occurs?

If it **is** possible, it is likely that the fault is caused by an imbalance in the wheel or tire.

If the vibration or noise gets worse as the vehicle speed increases, it is likely that the fault is caused by distortion in the wheel or tire, or worn or damaged components.

Distortion checks

Check for distortion by raising the vehicle so that the wheels are free and placing an axle stand or similar fixed object next to each wheel in turn.

If the stand is placed at the tread of the tire, the tire can be checked for ovality by turning the wheel by hand and checking for high or low spots where the gap between the tread and the stand increases or reduces.

If the stand is placed next to the wheel rim or tire sidewall, the wheel and tire can be checked for run-out in a similar way.

Wheels and Tires - Tire Low Pressure Sensor

Removal and Installation

Removal

NOTE: It is strongly recommended that the valve seal and steel washer is replaced each time a tire is changed to avoid a seal failure. The seal and washer must be replaced if the sensor is removed. Removal of the sensor retaining nut must be regarded as sensor removal. The valve cap must always be in place except when inflating, releasing pressure or checking pressure.

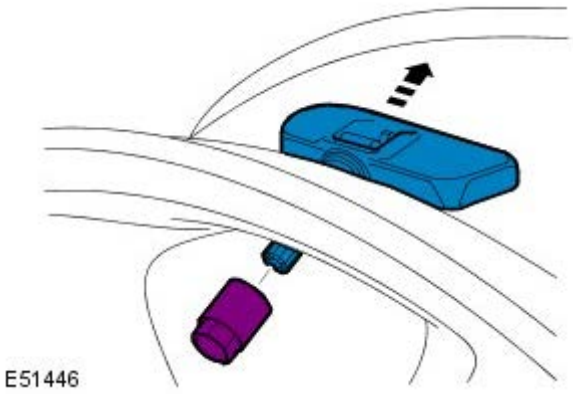
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Remove the wheel and tire.

3. CAUTION: To avoid damage to the tire low pressure sensor, release the tire bead from the rim, 180 degrees from the valve.

   Remove the tire from the wheel.



E51446

4. CAUTIONS:

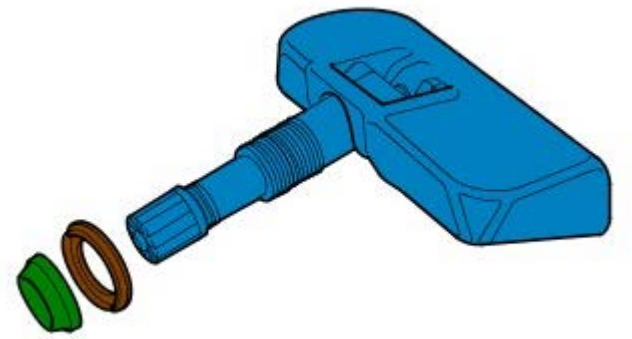
   Do not push on the valve.

   If the tire low pressure sensor is to be re-installed, a new washer, seal and nut must be installed.

   If the tire low pressure sensor is to be re-installed, a new washer, seal, nut and silver coloured nickel valve core must be installed.

   Remove the tire low pressure sensor.
   - Remove the nut.
   - Release and withdraw the sensor along the valve axis.

5. If necessary, install a new seal and washer.
   - Remove and discard the seal and washer.
   - Install a new washer and seal, making sure the valve remains pressed fully onto its seat.



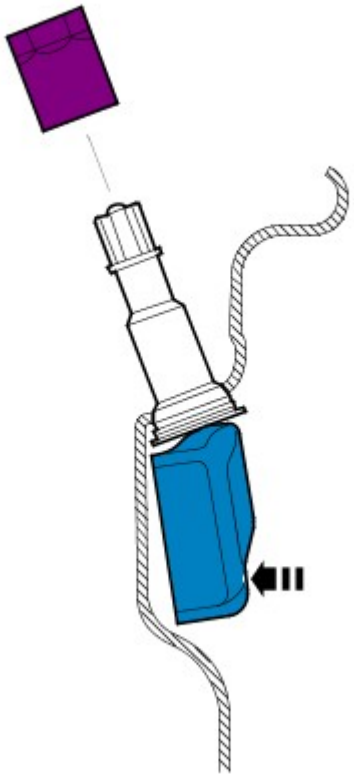
E51447

Installation

1. CAUTION: Do not use compressed air to clean the sensor. Do not clean the sensor with solvents or cleaning agents of any type, use a clean dry cloth.

   Clean the component mating faces.

2. CAUTION: Do not apply any lubricant to the new valve.



E51449

NOTE: If the sensor is replaced on a 'running' wheel, the new sensor identification will be learnt when the vehicle is first driven. If a new sensor is fitted to the spare wheel the identification for that sensor must be programmed into the Tire Pressure Monitoring System (TPMS) module using T4. The identifcation code is provided on a label with the complete assembly and is also printed on the casing of each sensor.

Install the tire low pressure sensor.

- Install and hand tighten the nut whilst keeping the sensor in place.
- Tighten the nut to 6.5 Nm (4.8 lb.ft).

3. Install the tire and balance the wheel.

4. Install the wheel and tire.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Wheels and Tires - Tire Pressure Monitoring System (TPMS) Front Antenna

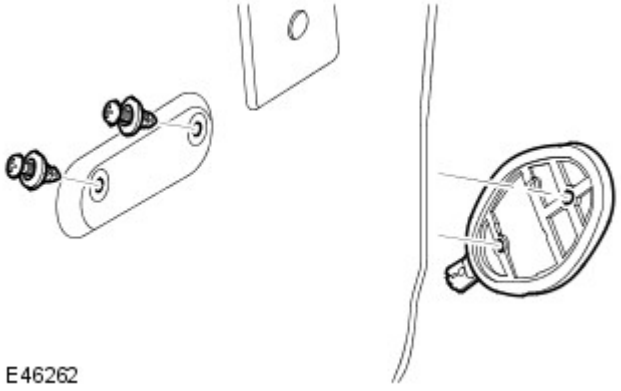
Removal and Installation

Removal

1. Raise and support the vehicle.

2. Remove the fender splash shield.
   For additional information, refer to: Fender Splash Shield (501-02, Removal and Installation).

3. Remove the tire pressure antenna.
   - Remove the 2 retainers.



E46262

Installation

1. To install, reverse the removal procedure.

2. Initiate a new tire pressure antenna using T4.

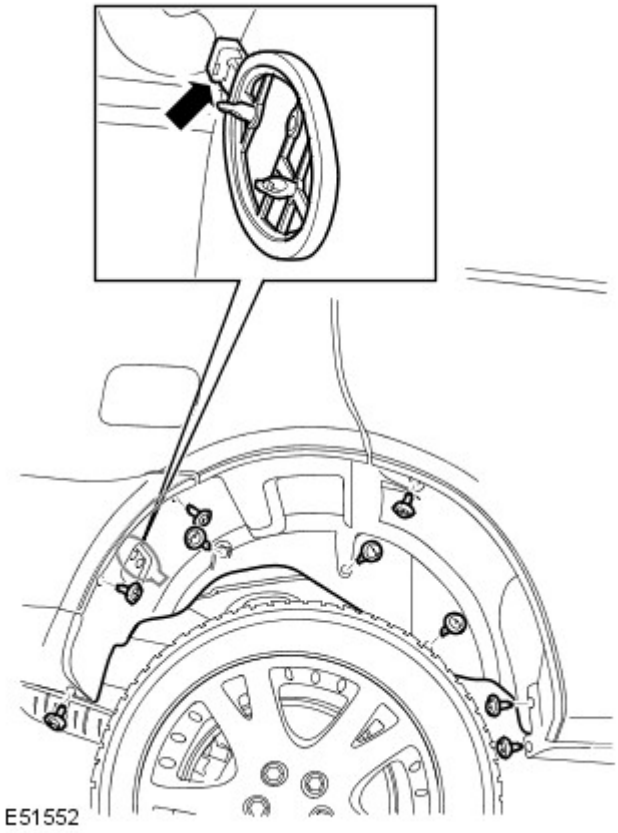
Wheels and Tires - Tire Pressure Monitoring System (TPMS) Rear Antenna

Removal and Installation

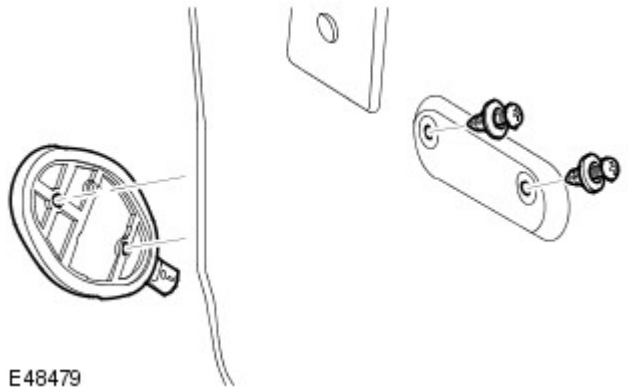
Removal

1. Raise and support the vehicle.

2. Remove the fender splash shield.
   - Remove the 9 screws.
   - Disconnect the electrical connector.



3. Remove the tire pressure antenna.
   - Remove the 2 retainers.



Installation

1. To install, reverse the removal procedure.

2. Initiate a new tire pressure antenna using T4.

Wheels and Tires - Tire Pressure Monitoring System (TPMS) Module

Removal and Installation

Removal

1. The tire pressure monitoring system (TPMS) module is an integral part of the central junction box (CJB).
   For additional information, refer to: Central Junction Box (CJB) (418-00, Removal and Installation).

Installation

1. To install, reverse the removal procedure.

Vehicle Dynamic Suspension -

Air Suspension - General Specification

Item	Specification
Ride height:	
Off road	55 mm (2.1 in) above standard
Access - reselectable whilst vehicle is moving	50 mm (1.9 in) below standard
Trim height	Configured using approved diagnostic equipment
Height sensors:	
Location	4 per vehicle - one sensor for each wheel
Height sensor arm colour coding:	
Front	GREY
Left-hand rear	WHITE
Right-hand rear	BLACK
Height sensor operating voltages:	
Supply voltage	5 volts - supplied by air suspension ECU
Output voltage	**Left hand front and right hand rear** - Decreases to 0.5 volts with bump travel. **Right hand front and left hand rear** - Decreases to 4.5 volts with bump travel
Spring/damper modules:	
Type	Guided air spring surrounding twin tube damper
Pressures:	
Normal - Front	800 to 1000 kPa (8.0 to 10.0 bar) (116.0 to 145.0 lbf/in²)
Normal - Rear	500 to 800 kPa (5.0 to 8.0 bar) (72.5 to 116.0 lbf/in²)
Burst pressure	3500 kPa (35 bar) (507.5 lbf/in²)
Maximum spring pressure - Full bump at gross vehicle weight	Approximately 2700 kPa (27 bar) (391.5 lbf/in²)
Air compressors:	Supplied with air drier, electrically switched, pilot operated exhaust valve and double temperature sensors
Old type	Hitachi
*New type	AMK
Controlled by	Electronic Control Unit (ECU)
Maximum pressure	1680 kPa (16.8 bar) (243.6 lbf/in²)
Air reservoir:	
Volume	9 litres (0.31 cu.ft)
Working pressure	1750 kPa (17.5 bar) (253.75 lbf/in²)
Maximum operating pressure	2300 kPa (23 bar) (333.5 lbf/in²)
Reservoir valve block	Incorporates pressure sensor to monitor spring and air reservoir pressures
Valve blocks:	
Front	2 corner valves, 1 cross link valve - all mounted on front bumper armature
Rear	2 corner valves, 1 cross link valve - all mounted on left hand rear spring tower

Note: The front height sensors are not handed.

*** If an AMK air compressor is installed to replace an Hitachi air compressor then a new corresponding air compressor relay must also be installed**

General Specifications

Item	Specification
Gap between underside of the toe link rubber boot and the chassis bracket	12.0 mm (0.473 in)

Torque Specifications

Description	Nm	lb-ft
Air suspension compressor bolts	10	7
Air suspension compressor lower cover bolts	10	7
Voss connector to the front solenoid valve block	2.5	1.7
Voss connector to the front and rear air springs	3.5	2.6
Voss connector to the rear solenoid valve block	2.5	1.7
Voss connector to the air suspension reservoir	5	4
Voss connector to the air suspension reservoir solenoid valve block	2.5	1.7
Air suspension control module bolt	10	7
Air suspension reservoir bolts	23	17
* Stabilizer bar link nuts	115	85
Toe link bolt	175	129
Toe link inner ball joint retaining nut	133	98
Toe link nut	103	76
Toe link adjustment locking nut	130	96
Lower front arm camber adjusting bolt	275	203
Lower arm rear castor adjusting bolts	275	203
Track rod end locking nuts	53	39

Rear camber adjusting bolts	133	98
Front and rear air spring/shock absorber to the suspension turret nuts	70	52
Front and rear air spring/shock absorber to the lower suspension arm nut and bolt	300	221
* Front and rear air spring/shock absorber top nut	98	72
Heat shield bolts	10	7
*+ Halfshaft nut	350	258
Wheel speed sensor bolt	10	7
Brake disc dust shield bolts	10	7
Wheel hub bolts	115	85
* Lower arm ball joint retaining nut	115	85
* Tie-rod end ball joint	70	52
Suspension height sensor Torx bolts	2.2	1.5
Road wheel nuts	140	103

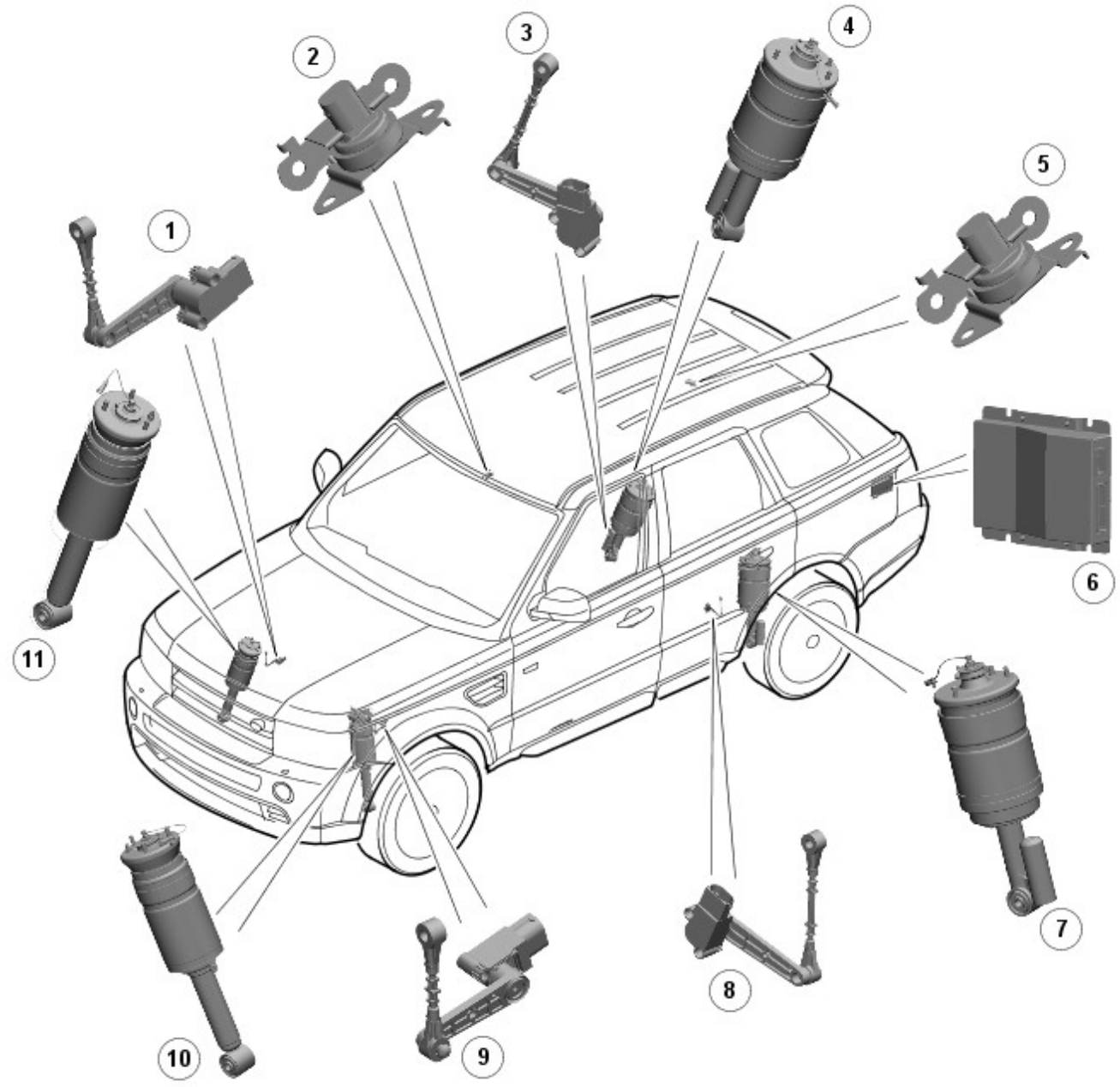
*** New nut must be installed**

+ Stake nut on completion of tightening

Vehicle Dynamic Suspension - Vehicle Dynamic Suspension
Description and Operation

Adaptive Dynamics - Component Location

NOTE: LHD (left-hand drive) vehicle shown, RHD (right-hand drive) similar.



E140668

Item	Part Number	Description
1	-	Front RH (right-hand) height sensor
2	-	Accelerometer
3	-	Rear RH height sensor
4	-	Rear RH air spring damper module
5	-	Accelerometer
6	-	Adaptive Damping Module (ADM)
7	-	Rear LH (left-hand) air spring damper module
8	-	Rear LH height sensor
9	-	Front LH height sensor
10	-	Front LH air spring damper module
11	-	Front RH air spring damper module

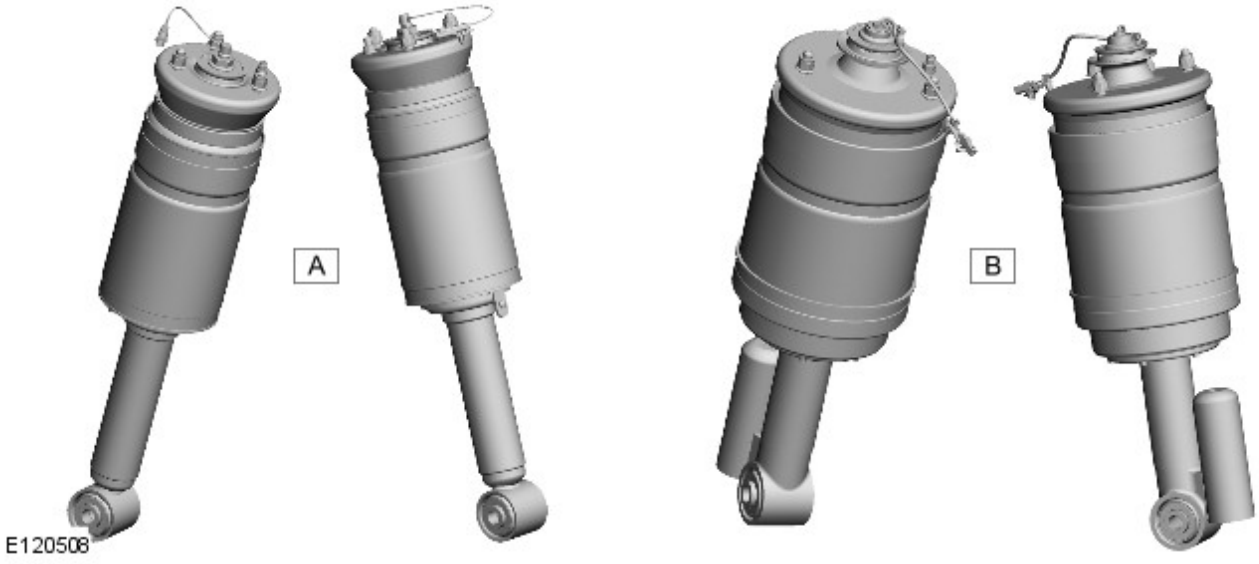
Continuously variable damping, known as Adaptive Dynamics, is available on Range Rover. Adaptive dynamics is an electronically controlled suspension system which continuously adjusts the damping characteristics of the suspension

dampers in reaction to the current driving conditions.

Adaptive dynamics is standard on 5.0 S/C variants, not available on 5.0 N/A and it is optional on TdV6 variants.

The system is controlled by an Adaptive Damping Module (ADM). The ADM receives signals from three accelerometers, four suspension height sensors and from other vehicle systems to determine vehicle state, body and wheel motions and driver inputs. These signals are used by the ADM to continuously control the damping characteristics of each damper to the appropriate level resulting in optimum body control and vehicle ride.

DAMPERS



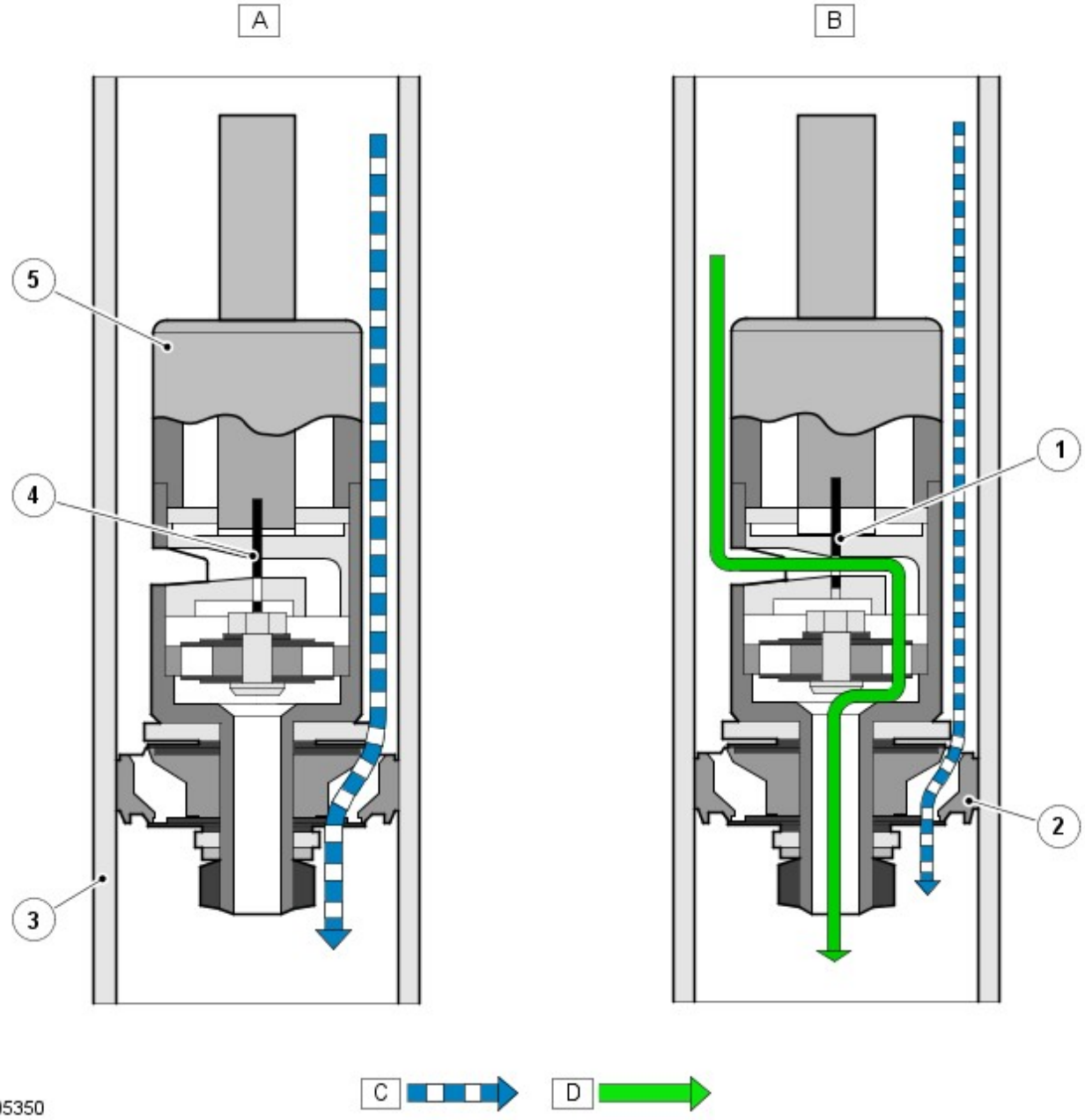
Item	Part Number	Description
A	-	Front Dampers
B	-	Rear Dampers

The adaptive dynamics dampers are monotube, nitrogen gas and oil filled units. The dampers are continuously variable, which allows the damping force to be electrically adjusted when the vehicle is being driven. The dampers provide the optimum compromise between vehicle control and ride comfort. To maintain wheel travel, the rear dampers feature an additional external accumulator. This is to provide adequate rebound travel by recovering the volume through the external source. All the dampers have an electrical connector on the end of the piston rod, in the center of the top mount.

In each damper, the damping adjustment is achieved by a solenoid operated variable orifice, which opens up an alternative path for oil flow within the damper. When de-energized, the bypass is closed and all the oil flows through the main (firm) valve. When energized, the solenoid moves an armature and control blade, which work against a spring. The control blade incorporates an orifice which slides inside a sintered housing to open up the bypass as required. In compression, oil flows from the lower portion of the piston through a hollow piston rod, a separate soft (comfort) valve, the slider housing and orifice and into the upper portion of the damper, thereby bypassing the main (firm) valve. In rebound, the oil flows in the opposite direction.

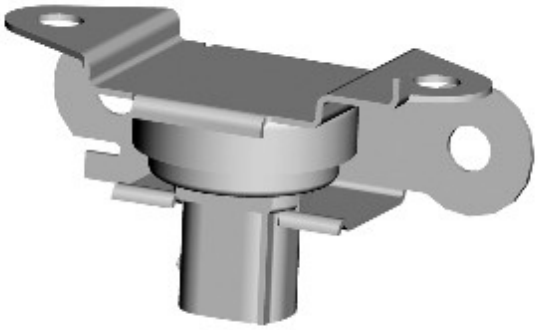
The damper operates continuously between these two boundary conditions.

The solenoid in each damper is operated by a 526 Hz PWM (pulse width modulation) signal from the ADM. When fully energized, the ADM applies a 1.5 A current to operate the damper in the soft setting. When de-energized (0.0 A), the damper is in the firm setting. The current varies continuously as required to increase and decrease the damping individually in each of the dampers.



Item	Part Number	Description
A	-	Firm Setting
B	-	Soft Setting
C	-	Main Oil Flow
D	-	Bypass oil flow
1	-	Bypass valve (open)
2	-	Main valve
3	-	Tube
4	-	Bypass valve (closed)
5	-	Piston and rod assembly

ACCELEROMETERS



E105087

Three accelerometers are used in the adaptive dynamics system.

Accelerometers locations are as follows

- center front bulkhead area (below wind shield)
- Right rear luggage area (behind light unit)
- Left rear luggage area (below rear window)

The accelerometers measure acceleration in the vertical plane and output a corresponding analogue signal to the ADM. The algorithms in the ADM calculate the heave, pitch and roll motions of the vehicle, which are used by the controller to control road induced body modes.

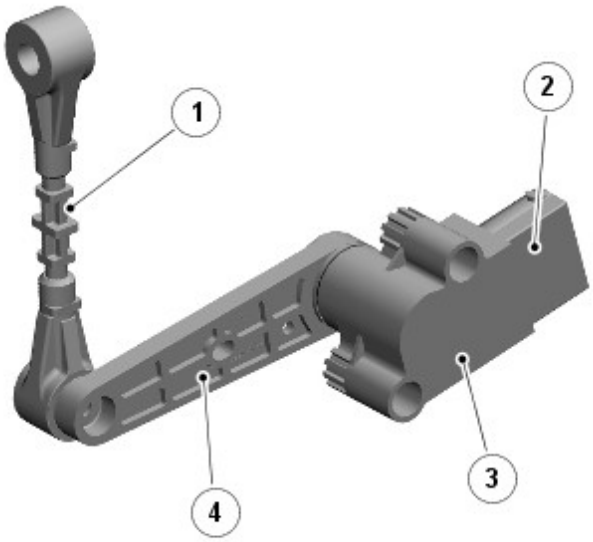
Each accelerometer is connected to the ADM via three wires, which supply ground, 5 V supply and signal return.

The sensing element comprises a single parallel plate capacitor, one plate of which moves relative to the other dependent on the force (acceleration) applied. This causes the capacitance to change as a function of applied acceleration. This capacitance is compared with a fixed reference capacitor in a bridge circuit and the signal is processed by means of a dedicated integrated circuit to generate an output voltage that varies as a function of applied acceleration. The sensors output a signal voltage of approximately 1 V/g ± 0.05 V/g.

HEIGHT SENSORS

The four suspension height sensors that are used in the air suspension system also supply input to the adaptive dynamics system, two for the front suspension and two for the rear suspension. A front suspension height sensor is attached to each side of the chassis rail and connected by a sensor arm and sensor link to the related upper lateral arm of the front suspension. A rear suspension height sensor is attached to each side of the chassis rail and connected by a sensor arm and sensor link to the related upper control arm of the rear suspension. On each suspension height sensor, the sensor arm and sensor link convert linear movement of the suspension into rotary movement of the sensor shaft.

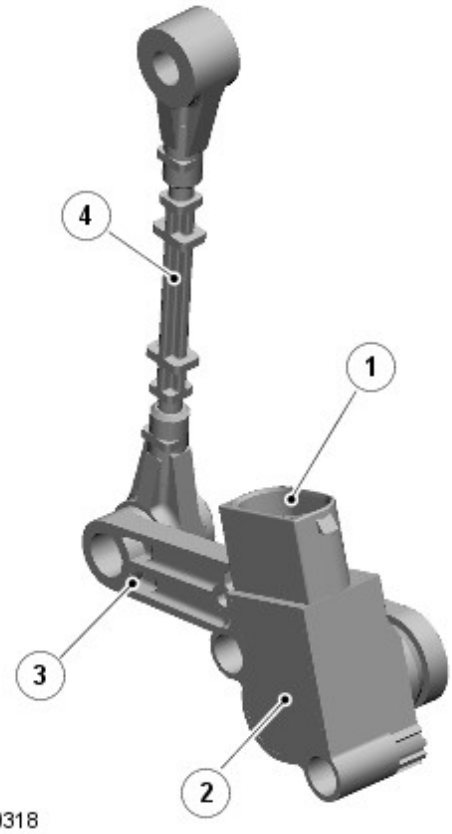
Front Height Sensor



E140317

Item	Part Number	Description
1	-	Drop link
2	-	Electrical connector
3	-	Sensor body
4	-	Lever arm

Rear Height Sensor



E140318

Item	Part Number	Description
1	-	Electrical connector

2	-	Sensor body
3	-	Lever arm
4	-	Drop link

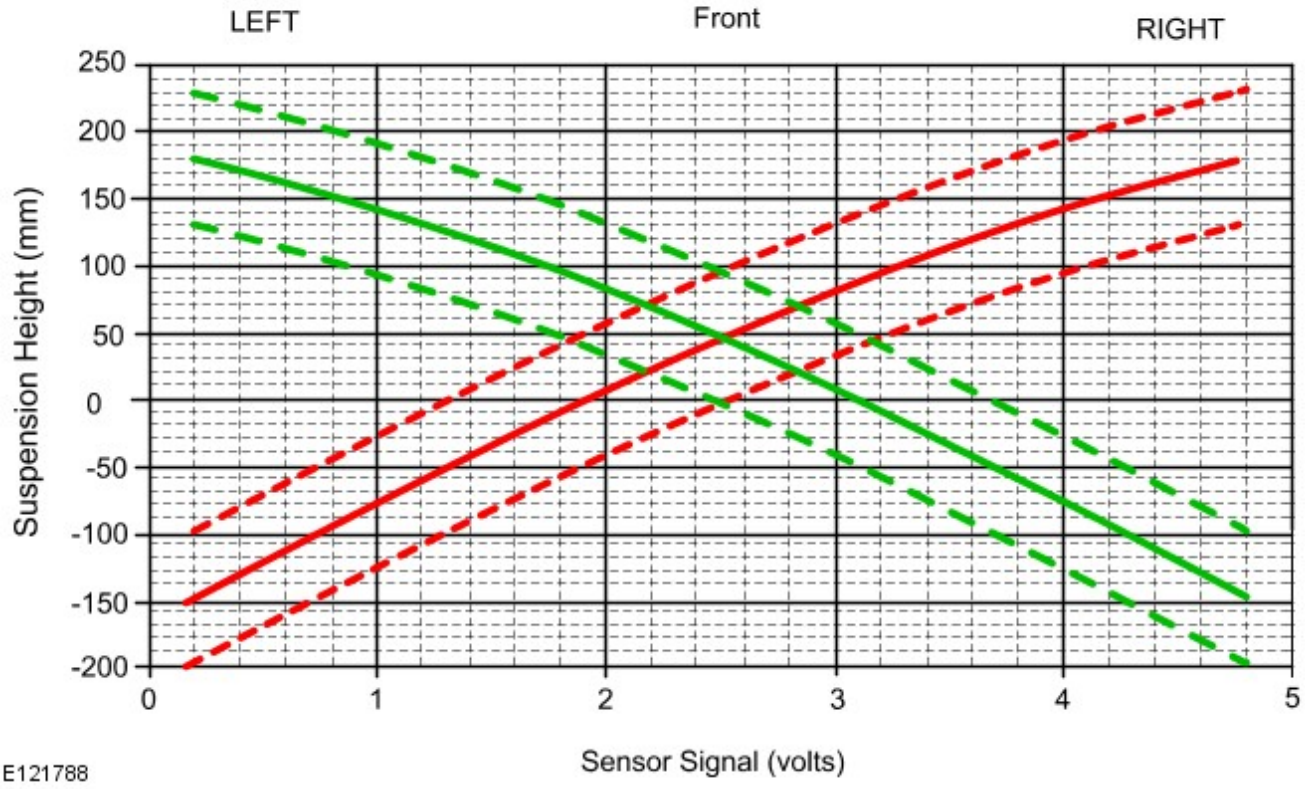
The suspension height sensors measure suspension displacement at each corner of the vehicle and output a corresponding analogue signal to the ADM. The algorithms in the ADM calculate the position, velocity and frequency content of the signals and use the results for wheel control.

A calibration routine is performed using the Land Rover approved diagnostic system to read the position of each corner of the vehicle and record the settings in the control module memory. Once set, the calibration is not required to be performed unless the air suspension control module or adaptive damping module is removed or replaced, a height sensor is removed or replaced or a suspension arm to which the sensor is connected is removed or replaced. If the removed height sensor is subsequently refitted, the calibration procedure will have to be performed to ensure the integrity of the system.

The front and rear sensor drop links are serviceable items.

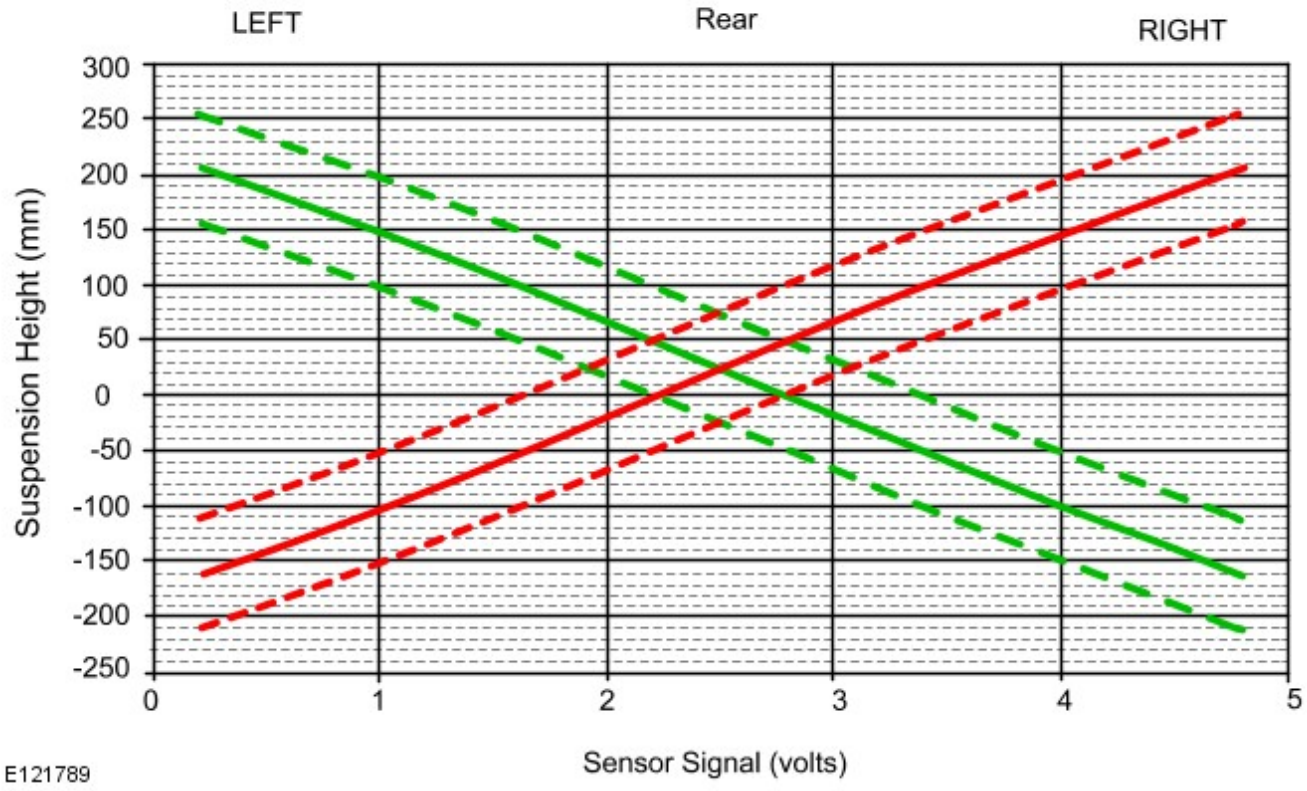
The following graph shows the vehicle height displacement from normal against output voltage for the front height sensors. The center line represents the "nominal" condition but depending on tolerances, the actual line may lie anywhere between the upper and lower lines.

Front Height Sensor



The following graph shows the vehicle height displacement from normal against output voltage for the rear height sensors. The center line represents the "nominal" condition but depending on tolerances, the actual line may lie anywhere between the upper and lower lines.

Rear Height Sensor



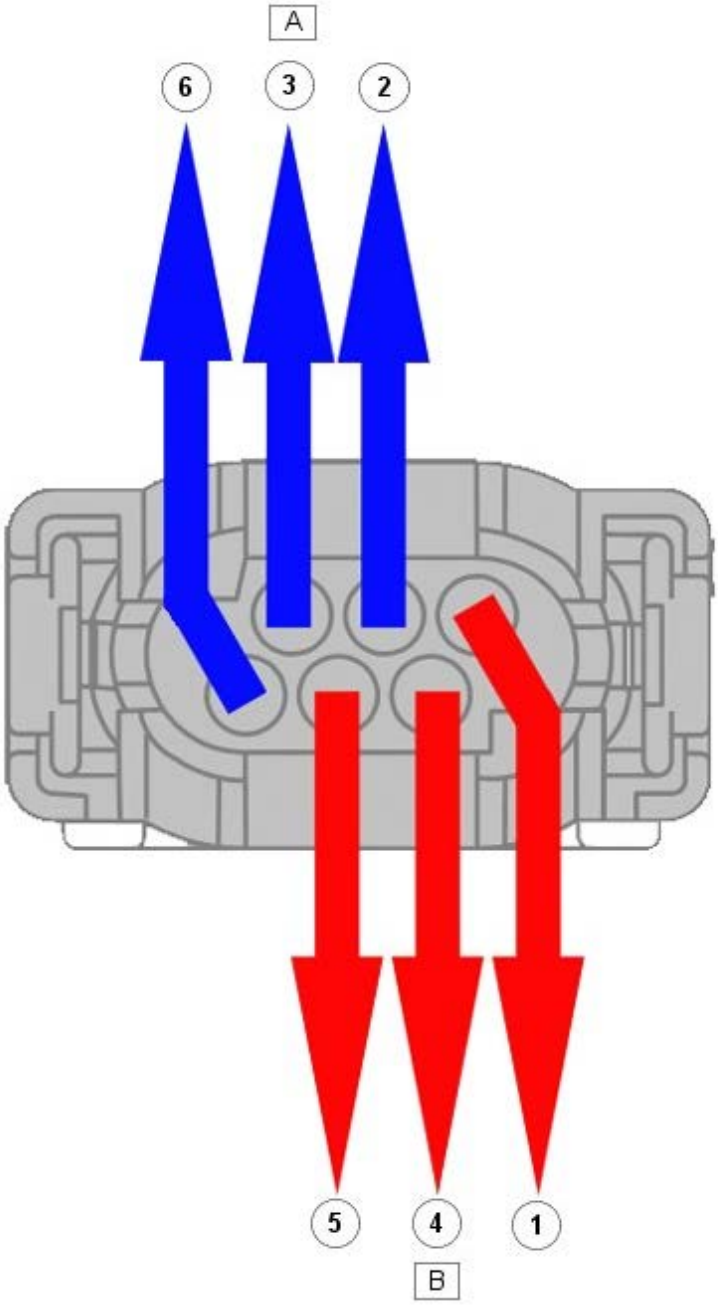
Height Sensor Calibration

A calibration routine is performed using a Land Rover approved diagnostic system to read the position of each corner of the vehicle and record the settings in the control module memory. Once set, the calibration is not required to be performed unless the air suspension control module or adaptive damping module is removed or replaced, a height sensor is removed or replaced or a suspension arm to which the sensor is connected is removed or replaced. If the removed height sensor is subsequently refitted, the calibration procedure will have to be performed to ensure the integrity of the system.

If a replacement drop link is fitted calibration is required.

The sensing element consists of an array of hall effect devices arranged to measure the direction of the magnetic field of a small magnet attached to the end of the sensor shaft. As the sensor shaft rotates, so do the lines of magnetic flux from the magnet. The signals from the Hall effect elements are processed by means of a dedicated integrated circuit to generate an output voltage that varies as the sensor shaft is rotated. The sensor has a measurement range of ± 40° around its nominal position and the nominal sensitivity is 57 mV/° of shaft rotation. The graphic below describes the repetition of the output signal as the sensor is rotated through and beyond 40°.

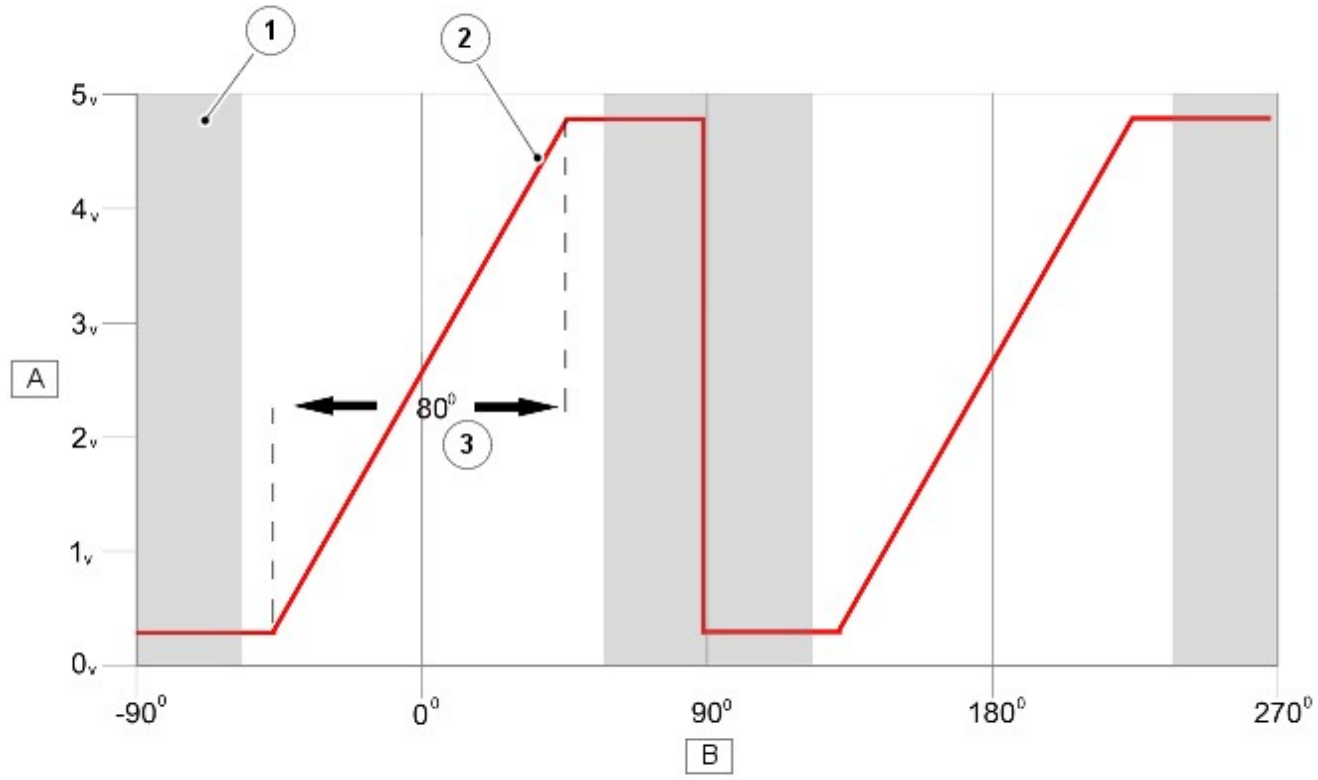
Height Sensor Wiring



E120503

Item	Part Number	Description
A	-	Adaptive Damping Module
B	-	Air Suspension Module
1	-	Ground
2	-	Ground
3	-	5v Supply
4	-	Signal Output (Air Suspension)
5	-	5v Supply
6	-	Signal Output (ADM)

Height Sensor Voltage



E120502

Item	Part Number	Description
A	-	Sensor voltage
B	-	Angle of rotation
1	-	Outside measuring range
2	-	Voltage output
3	-	+- 40 degree measuring range

Adaptive Damping Module (ADM)

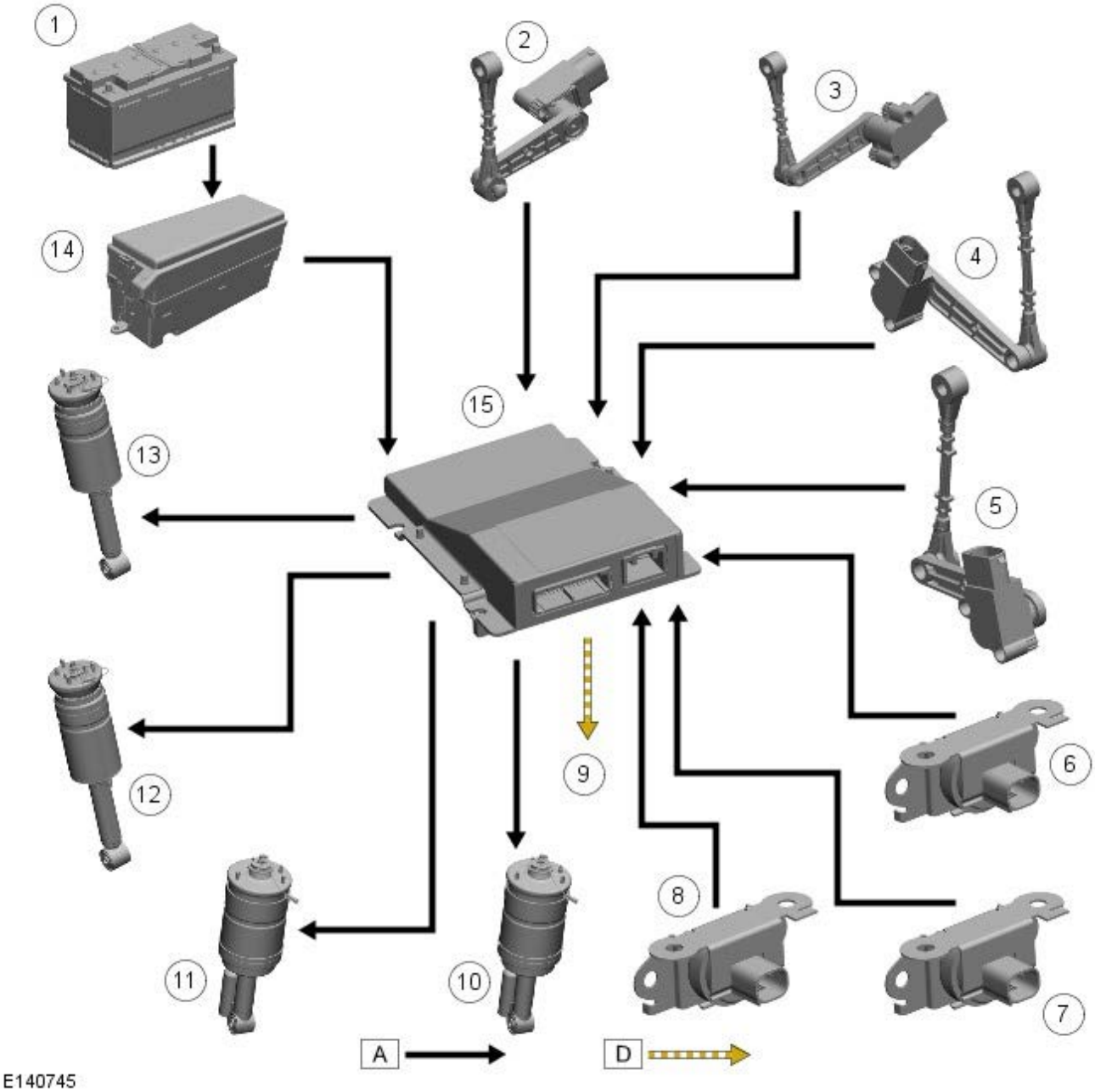


E105086

The adaptive damping module (ADM) is located in the LH rear quarter panel.

CONTROL DIAGRAM - ADAPTIVE DYNAMICS

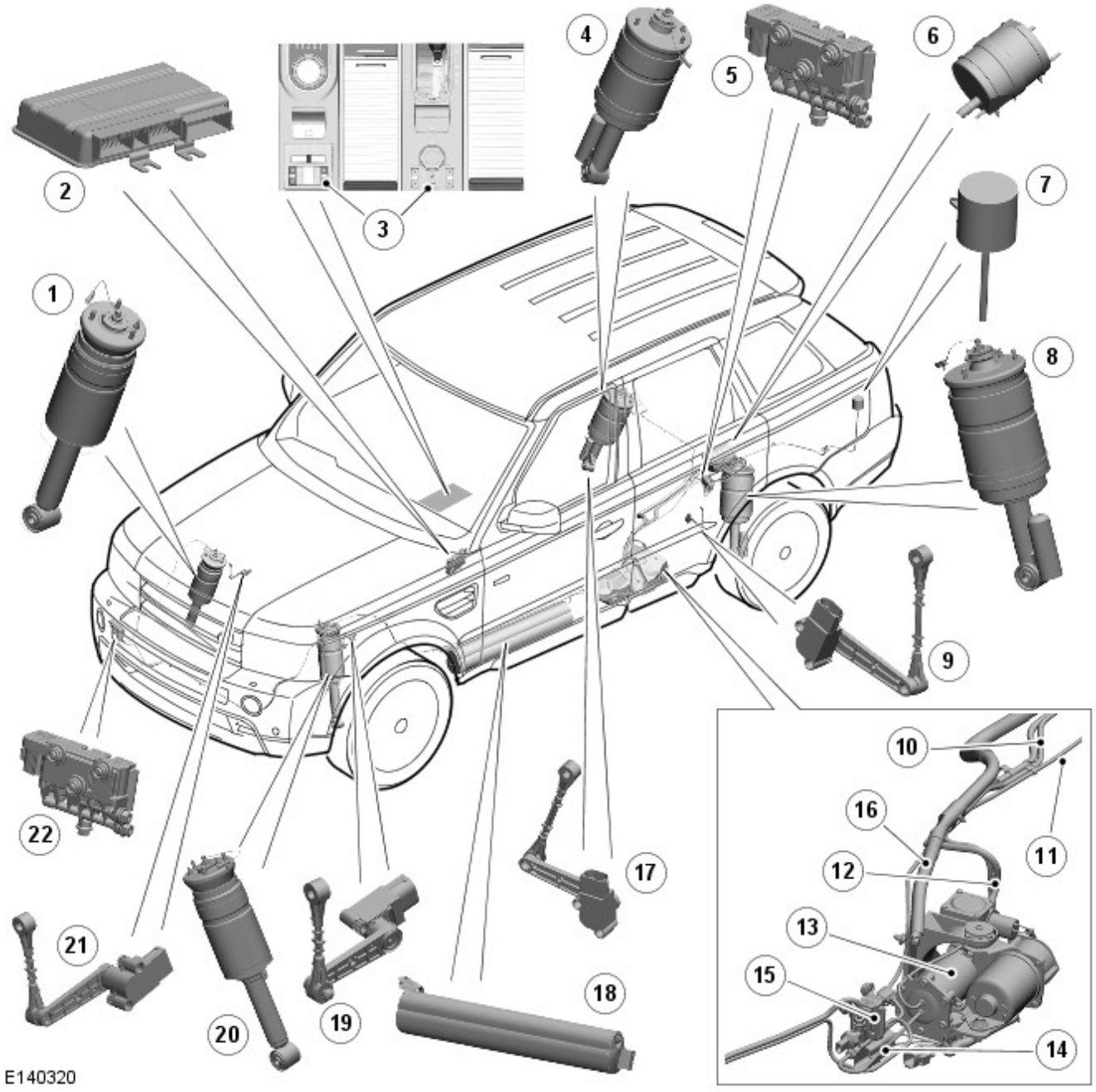
NOTE: **A** = Hardwired; **D** = High Speed CAN (controller area network) bus



Item	Part Number	Description
1	-	Battery
2	-	LH front height sensor
3	-	RH front height sensor
4	-	LH rear height sensor
5	-	RH rear height sensor
6	-	Accelerometer
7	-	Accelerometer
8	-	Accelerometer
9	-	CAN connection to other systems
10	-	LH rear damper solenoid
11	-	RH rear damper solenoid
12	-	LH front damper solenoid
13	-	RH front damper solenoid
14	-	BJB (battery junction box)
15	-	Adaptive Damping Module (ADM)

AIR SUSPENSION

Air Suspension - Component Location



Item	Part Number	Description
1	-	RH air spring damper module
2	-	Air suspension control module
3	-	Air suspension control switch
4	-	Rear RH air spring damper module
5	-	Rear axle valve block
6	-	Air supply unit silencer
7	-	Air supply unit filter
8	-	Rear LH air spring damper module
9	-	Rear LH height sensor
10	-	Pipe - Compressor inlet
11	-	Pipe - Reservoir valve block to rear axle valve block
12	-	Pipe - Compressor exhaust
13	-	Air supply unit
14	-	Pipe - Air supply unit to reservoir valve block
15	-	Reservoir valve block
16	-	Pipe - exhaust
17	-	Rear RH height sensor
18	-	Air reservoir
19	-	Front LH height sensor
20	-	Front LH air spring damper module

21	-	Front RH height sensor
22	-	Front axle valve block

General Information

The air suspension system is a four corner system which is fitted to all models.

The system is electronically controlled by an air suspension control module which controls the air supply unit, reacts to inputs from four height sensors and distributes air around the system via valve blocks.

The main air suspension system components are:

- Air suspension control module
- Air supply unit
- Four height sensors
- Three valve block assemblies
- Reservoir
- Air harness
- Two front struts incorporating air spring damper modules
- Two rear struts incorporating air spring damper modules
- Air Suspension Switch

The four corner air suspension system maintains the vehicle height under all operating conditions by controlling the mass of air in the air springs. The air suspension control module uses signals from the four height sensors to maintain the correct suspension height, irrespective of vehicle load. Additionally, the system allows the driver to request ride height changes to improve off-road performance or ease access or loading. The system automatically adjusts the ride height to improve the vehicle handling and dynamics when speed increases or decreases. This is achieved by operating pneumatic control valves to increase or decrease the mass of air in the air springs.

The air suspension system has three driver selectable, pre-determined ride heights and an automated high speed ride height. A driver interface indicates the selected ride height and height change movement. Additional information is also relayed to the driver via the instrument cluster message center and by audible warnings also transmitted by the instrument cluster.

Most height changes can only be made when the engine is running and the driver's and passenger doors are closed.

The air suspension can be controlled manually by the driver using a switch on the floor console to select the required height change.

The system will temporarily inhibit height adjustments when the vehicle is subject to cornering, heavy acceleration or heavy braking. The inhibit function prevents unsettling of the vehicle.

Height changes are also restricted for safety reasons, when a door is opened and the vehicle is stationary for example.

The air suspension system is controlled by the air suspension control module which is located on the driver side 'A' pillar. The control module monitors the height of each corner of the vehicle via four height sensors, which are mounted in-board of each road wheel. The control module also performs an 'on-board diagnostic' function to perform 'health checks' on the system. If faults are detected, codes are stored in the control module and can be retrieved using the Land Rover approved diagnostic system.

Ride Height Tolerance Control

The air suspension control module has two ride height tolerance bands; normal tolerance and tight tolerance.

The control module considers the vehicle to be at target height if the current height is within the appropriate tolerance band. Height adjustments are not made until the vehicle height falls outside of the tolerance band for a pre-determined time. The time period is different depending on if the vehicle is moving or stationary. The tolerance bands are as follows:

- Normal ± 10 mm
- Tight ± 3 mm.

The tight tolerance band is only used if set by the Land Rover approved diagnostic system for diagnostic purposes or when the vehicle has been stationary for more than 5 minutes.

OPERATING MODES

The driver can manually select, using the air suspension switch, one of four ride states:

- ON-ROAD - this height is the normal operating height of the vehicle
- OFF-ROAD - this height is higher than the on-road height and provides improved ground clearance, approach, departure and breakover angles
- ACCESS - this height is lower than the on-road height and makes entering and exiting the vehicle easier for the occupants
- CRAWL (Locked at access) - this mode allows the vehicle to be driven at the access height at low speeds to provide increased roof clearance in low car parks etc.

HIGH SPEED - A non-selectable, automatic high speed mode is provided which lowers the vehicle height to improve vehicle handling.

NOTE: Vehicle height changes are restricted if the air suspension control module receives a 'Door Open' signal and the speed is less than 5 mph (8 km/h).

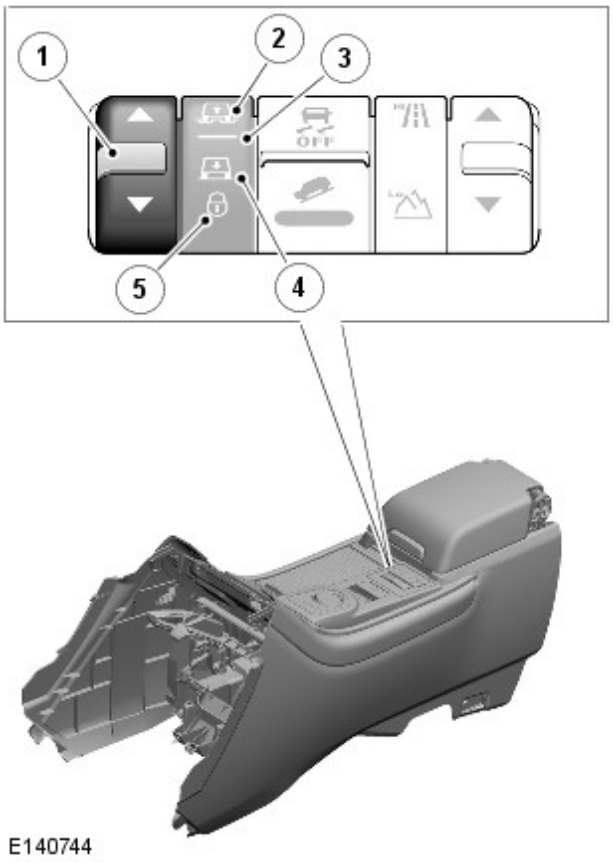
A complete vehicle delivery mode is available but is only selectable using the Land Rover approved diagnostic system. When this mode is active most vehicle systems, in addition to the air suspension, are inhibited or restricted to a minimal functionality. In this mode the air suspension is set to the transportation mode.

If the air suspension control module senses that the vehicle has grounded and lost traction, the control module can temporarily increase and/or redistribute the volume of air supplied to the affected air spring(s) to maximize the available traction. This is known as extended mode and will be indicated to the driver by the lamps on the air suspension switch flashing and an 'EXTENDED MODE' message being displayed in the instrument cluster.

If a fault is detected by the air suspension control module, the control module will reduce the system functionality dependent on the type and severity of the fault. The control module will also store a fault code which can be retrieved using the Land Rover approved diagnostic system. If a severe fault occurs, the control module will attempt to put the vehicle in a safe condition. A fault is relayed to the driver by the instrument cluster message center and an audible warning emitted from the instrument cluster.

All information messages will be displayed for four seconds.

Air Suspension Switch Pack



Item	Part Number	Description
1	-	Raise/lower switch
2	-	Off-Road Mode
3	-	On-Road Mode
4	-	Access Mode
5	-	Crawl (Locked at Access) Mode

The air suspension control switch is located in the floor console, behind the transmission selector. The switch is a three position, non-latching switch which allows selection of the following driver selectable modes:

- Off-road mode
- On-road mode
- Access mode
- Crawl (locked at access) mode.

The air suspension switch can be rocked from its central position. The switch is non-latching and returns to the central position when released. The switch completes an earth path to the air suspension control module when operated. This earth path is completed on separate wires for the raise and lower switch positions, allowing the control module to determine which selection the driver has made.

The switch has six symbols which illuminate to show the current selected height and the direction of movement. The raise and lower symbols will flash and a warning tone will be emitted from the instrument cluster sounder when a requested height change is not allowed, i.e. vehicle speed too fast.

A flashing symbol indicates that the air suspension system is in a waiting state or that the system will override the driver's selection because the speed threshold is too high.

The driver can also ignore the system's warnings signals and allow the height to change automatically. For example,

increasing the vehicle speed to more than 25 mph (40 km/h) when locked to access height will cause the control module to automatically change the ride height from access mode to on-road mode.

On-Road Mode

This is the normal ride height for the vehicle.

Off-Road Mode

Off-road mode will only be selectable if the vehicle speed is less than 25 mph (40 km/h). The vehicle will be raised 55mm (2.2 inches) to provide additional body clearance and improved approach, departure and breakover angles. If the vehicle speed exceeds 31 mph (50 km/h), the air suspension control module will automatically lower the vehicle to the on-road mode height. At 25 to 28 mph (40 to 45 km/h) a message is displayed in the message center to warn the driver to slow down or the vehicle will lower.

Access Mode

Access mode lowers the vehicle body height and provides easier entry, exit and loading of the vehicle.

Access mode can be selected at any vehicle speed. When access mode is selected, the response of the air suspension system will depend on the vehicle speed:

- If the vehicle speed is more than 12.5 mph (20 km/h), the air suspension control module will wait for up to one minute for the vehicle speed to be reduced. The access mode light emitting diode (LED) and the lowering LED will flash while the air suspension control module waits for the vehicle speed to be reduced, the on-road mode lamp will remain illuminated. If the vehicle speed is not reduced sufficiently, the access mode request will be cancelled after 1 minute.
- If the vehicle speed is less than 12.5 mph (20 km/h), the air suspension control module will lower the suspension to a part lowered height and will remain at this height for up to one minute. The on-road mode lamp will extinguish as the air suspension control module lowers the suspension to the part lowered height. The access mode lamp and the lowering LED will illuminate. When part lowered is reached, the lowering LED will flash. If the vehicle speed is not reduced to less than 5 mph (8 km/h) in the one minute period, the access mode request will be cancelled.
- If the vehicle speed is less than 5 mph (8 km/h), the suspension will be lowered to access mode immediately. The access mode LED and the lowering LED will illuminate. When the access mode height is reached, the lowering LED will be extinguished.

Access height may be selected up to 40 seconds after the ignition is turned off, provided that the driver's door has not been opened within this time.

The suspension will automatically rise from access mode when the vehicle speed exceeds 6.2 mph (10 km/h). If access mode was selected directly from off-road mode then the system will return to off-road mode when the vehicle speed exceeds 6.2 mph (10 km/h). Otherwise the system will lift the suspension to On-road height.

Selecting Access Mode Directly from Off-Road Mode

When the suspension is in off-road mode height, pressing the 'Access' height change switch once, or pressing the lowering switch twice before the lowering LED is extinguished, the control module will lower the suspension to access mode height. The control module will remember to return the suspension to off-road height automatically if the vehicle speed increases above 6.2 mph (10 km/h).

Crawl (Locked at Access) Mode

Crawl mode allows the vehicle to be driven at low speeds with the suspension locked at the access mode height. This allows the vehicle to be driven in low car parks etc. with increased roof clearance.

Crawl mode can be selected up to 21.7 mph (35 km/h) with a long press of the switch in a down direction. The access mode lamp and the crawl mode lamp will be illuminated. When the control module is in crawl mode, on-road mode height will be selected automatically if the vehicle speed exceeds 24.8 mph (40 km/h). At 18.6 to 21.7 mph (30 to 35 km/h) a message is displayed in the message center to warn the driver to slow down or the vehicle will rise. Crawl mode can also be manually cancelled by moving the switch in the up direction for 1 second. The crawl mode lamp will now be extinguished.

High Speed Mode

High speed mode is a non-selectable, automatic mode which lowers the vehicle height to improve vehicle handling. This feature is fully automated and is 'invisible' to the driver.

If the vehicle speed exceeds 100 mph (160 km/h) for more than five seconds, the air suspension control module initiates the high speed mode. When the vehicle speed reduces to less than 80 mph (130 km/h) for more than 30 seconds, the vehicle returns to the On-Road height. This function is cancelled if a trailer is connected to the trailer socket.

Automatic Height Change Warnings

When the suspension is in off-road mode, access mode or crawl mode height, the air suspension control module will change the suspension height automatically when the vehicle speed exceeds a predetermined threshold.

When the suspension is at off-road mode or crawl mode height, the control module issues a warning to advise the driver that the vehicle is approaching the speed threshold. The instrument cluster sounder will emit a chime, a message will be displayed in the message center and the on-road mode LED and either the raising or lowering LED will flash.

The off-road mode or crawl mode height speed warning is removed when the vehicle speed is reduced.

SPECIAL MODES

Door Open Functionality

If one or more of the vehicle doors are opened during a height change when the vehicle is stationary, the air suspension control module will restrict further height change.

The LED on the air suspension LED display for the target mode height will remain illuminated and the raising or lowering LED will flash.

If all of the doors are closed within 90 seconds, the height change will resume. If the 90 second period is exceeded, the message 'CONFIRM REQUIRED SUSPENSION HEIGHT' will be displayed in the instrument cluster.

Extended Modes

Raise Inhibit Raise inhibit is a reactive mode invoked when the following conditions are satisfied, vehicle speed below 10kph and vehicle raising very slowly. Raise inhibit is normally invoked when vehicle is lifting against an obstacle, it can also be used when the vehicle is winching or is tethered down.

Jacking Jacking is a reactive mode invoked when the following conditions are satisfied, vehicle stationary, system attempts to level the vehicle down and rate of vehicle lowering is below a predefined threshold for a predefined time. Jacking mode is normally invoked under the following conditions, vehicle jacking or vehicle grounded and stationary

Lower Inhibit Lower inhibit is a reactive mode invoked when the following conditions are satisfied, vehicle stationary, rate of vehicle lowering is below a predefined threshold for a predefined time. Lower inhibit is normally invoked under the following conditions, vehicle lowered onto an obstacle during a height change.

Belly-Out Belly-Out is a pro-active mode invoked when the following conditions are satisfied, vehicle moving and speed is below 50kph, traction activity is induced on axle pairs for fixed period of time and wheel heights above a predetermined threshold on coinciding axle pairs for the same fixed period of time. Belly-Out is normally invoked under the following condition, vehicle is attempting to move and with low levels of traction and supported by an obstacle.

If the vehicle becomes grounded and the traction control becomes operational, the air suspension control module automatically increases the mass of air in the air springs to raise the vehicle clear of the obstruction. Extended mode is activated automatically and cannot be selected manually.

When the air suspension control module has activated the extended mode, the off-road mode lamp will flash if the suspension is above off-road mode height. The off-road mode and on-road mode lamps will flash if the suspension is between off-road mode and on-road mode heights. The on-road mode and access mode lamps will flash if the suspension is between on-road mode and access mode. A message will also be displayed in the message center.

To exit the extended mode, press the air suspension switch briefly in the up or down position or alternatively drive the vehicle at a speed of more than 2 mph (3 km/h) for 45 seconds.

Additional Lift in Extended Mode

When extended mode has been invoked and the automatic lifting of the vehicle is complete, the driver can request an additional lift of the vehicle. This can be particularly useful when extended mode has been activated on soft surfaces.

The additional lift can be requested once the height change LED has extinguished. Press and hold the air suspension switch in the up position for 3 seconds whilst simultaneously depressing the brake pedal. A chime from the instrument cluster will sound to confirm that the request has been accepted. The raising LED will be illuminated while the vehicle is being lifted.

Periodic Re-leveling

When the vehicle is parked, the air suspension control module 'wakes up' two hours after the ignition was last switched off and then once every twenty four hours. The vehicle height is checked and if the vehicle is not level within a pre-set tolerance, small downwards height adjustments may be made automatically.

Transportation Mode

Transportation mode is a factory set mode which locks the suspension to enable the vehicle to be safely lashed to a transporter. The suspension transportation mode is automatically set when the vehicle is configured for delivery mode using the Land Rover approved diagnostic system. Delivery mode also affects other vehicle systems which are inhibited or restricted to a minimal functionality.

When the ignition switch is switched off, the vehicle will be lowered to access mode. This ensures that the securing straps do not become loose should air leak from the air springs.

When transportation mode is active, the air suspension switches are disabled. Periodic re-levelling is also disabled.

When the engine is started, the air suspension control module will cause the vehicle to rise allowing sufficient ground clearance for the vehicle to be loaded. While the height is changing, all the LED's in the air suspension control switch will flash and a chime will be emitted by the instrument cluster. When the sufficient height reached, all the LED's will illuminate continuously and the chime will stop.

When the engine is switched off, the air suspension control module will cause the vehicle to lower allowing the vehicle to be strapped down. While the height is changing, all the LED's in the air suspension control switch will flash. When the height of –50mm is reached, all the LED's will illuminate continuously.

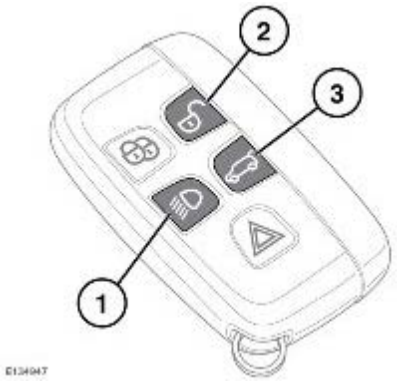
Calibration Mode

This mode is used when the air suspension control module has been replaced or a height sensor or suspension component has been dismantled or replaced.

The following conditions apply when the vehicle is in calibration mode:

- The ride height is set to tight tolerance
- Fault reaction to vehicle identification number (VIN) mis-match with the Car Configuration File (CCF) is disabled
- The raise, lower, access and hold switches are disabled
- Message "Air suspension not in customer mode" is displayed in the instrument pack.

Remote Operation



Item	Part Number	Description
1	-	Hold
2	-	Raise vehicle
3	-	Lower vehicle

The buttons on the Smart Key may be used to operate the air suspension system, allowing the vehicle to be raised or lowered remotely. This may be useful in attaching a trailer or loading the vehicle.

To change the suspension height using the Smart Key, the vehicle must be stationary, all the doors closed and the hazard warning lamps switched on.

To raise the vehicle suspension buttons 1 and 2 to are to be press simultaneously.

To lower the vehicle suspension buttons 1 and 3 to are to be press simultaneously

Air Harness

The air harness comprises ten separate nylon pipes which are connected between the system components with Voss connectors. The pipes have the following diameters:

Pipe	Diameter
High pressure pipes	6 mm
Compressor inlet pipe	8 mm
Inlet filter to silencer	8 mm
Compressor exhaust pipe	10 mm
Silencer exhaust pipe	19 mm

If a pipe becomes damaged, an in-line connector is available for repair purposes. The pipes are secured to the body and chassis with a number of plastic clips.

LEAK DETECTION

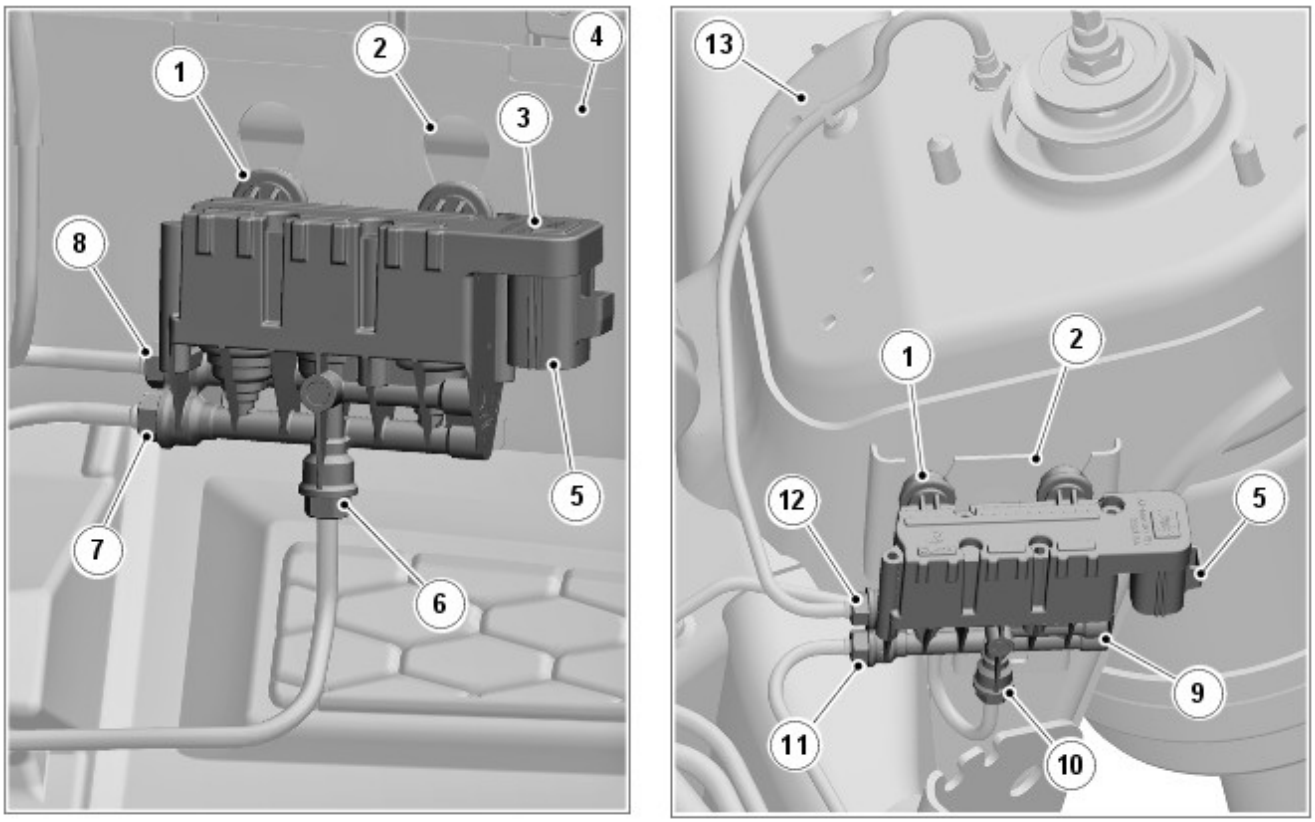
Leak detection can be carried out using a Land Rover approved leak detection spray.

If the vehicle appears to be leaking, perform a leak check on all aspects of the system, i.e.; air spring hose fittings and the associated connections on the valve blocks, air springs and reservoir. Failure to correctly diagnose leakage will result in unnecessary exchange of serviceable components and recurrence of original problem.

AIR SUSPENSION COMPONENTS

Valve Blocks

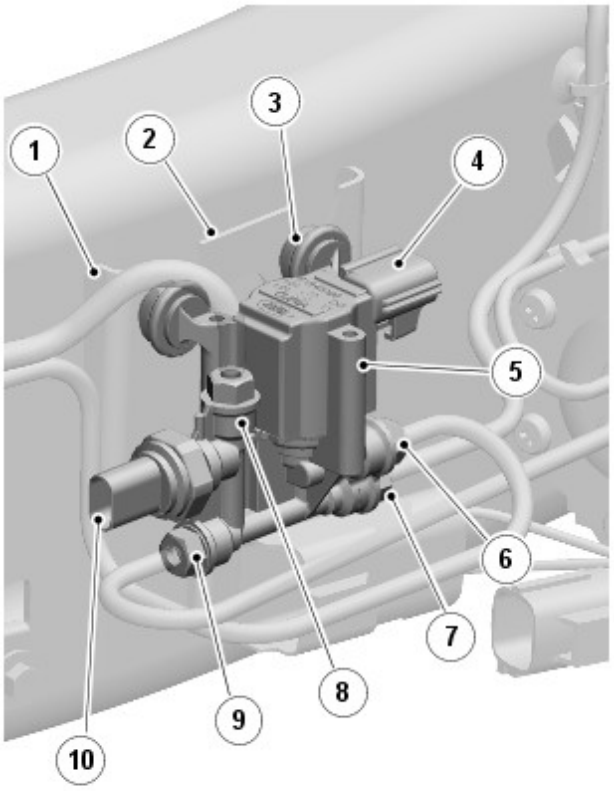
Front and Rear Valve Blocks



E140308

Item	Part Number	Description
1	-	Isolation rubber mounts (3 off)
2	-	Location slots
3	-	Front valve block, valves and solenoid assembly
4	-	Front bumper armature
5	-	Electrical connector
6	-	LH air spring damper module air harness connection
7	-	Air inlet/outlet connection
8	-	RH air spring damper module air harness connection
9	-	Rear valve block, valves and solenoid assembly
10	-	RH air spring damper module air harness connection
11	-	Air inlet/outlet connection
12	-	LH air spring damper module air harness connection
13	-	Rear suspension turret

Reservoir Valve Block



E140309

Item	Part Number	Description
1	-	Chassis mounting bracket
2	-	Location slot
3	-	Isolation rubber mounts (3 off)
4	-	Electrical connector
5	-	Reservoir valve block, valves and solenoid assembly
6	-	Reservoir connection
7	-	Rear valve block connection
8	-	Front valve block connection
9	-	Air supply unit connection
10	-	Pressure sensor

Front and Rear Valve Blocks

The front and rear axle valve blocks are similar in their design and construction and control the air supply and distribution to the front or rear pairs of air spring damper modules respectively. The difference between the two valves is the connections from the valve block to the left and right hand air spring damper modules and the valve size. It is important that the correct valve block is fitted to the correct axle. Fitting the incorrect valve block will not stop the air suspension system from functioning but will result in slow raise and lower times and uneven raising and lowering between the front and rear axles.

The front valve block is attached to the RH end of the front bumper armature assembly. The valve block has three attachment lugs which are fitted with isolation rubber mounts. The rubber mounts locate in slots in the armature. The valve lugs locate in the holes above the slots and are pushed downwards into positive location in the slots.

The rear valve block is located on the forward face of the left hand rear suspension turret. The valve block has three attachment lugs which are fitted with isolation rubber mounts which locate in a bracket with three slotted holes. The bracket is attached to the left hand side of the chassis. The isolation rubber mounts locate in the 'V' shaped slots and are pushed downwards into positive location in the slots.

The front and rear valve blocks each have three air pipe connections which use 'Voss' type air fittings. One connection is an air pressure inlet/outlet from the reservoir valve block. The remaining two connections provide the pressure connections to the left and right hand air springs.

Each valve block contains three solenoid operated valves; two corner valves and one cross-link valve. Each of the valve solenoids is individually controlled by the air suspension control module. The solenoids have a resistance value of 2 Ohms at a temperature of 20°C (68°F).

Reservoir Valve Block

The reservoir valve block is attached to a bracket on the outside of the left hand chassis rail, between the reservoir and the air supply unit. The valve block is located within the air supply unit acoustic box to protect it from dirt ingress and damage from stones. The valve block has three attachment lugs which are fitted with isolation rubber mounts. The rubber mounts locate in the chassis bracket which has three corresponding 'V' shaped slots. The rubber mounts are pushed downwards into positive location in the slots.

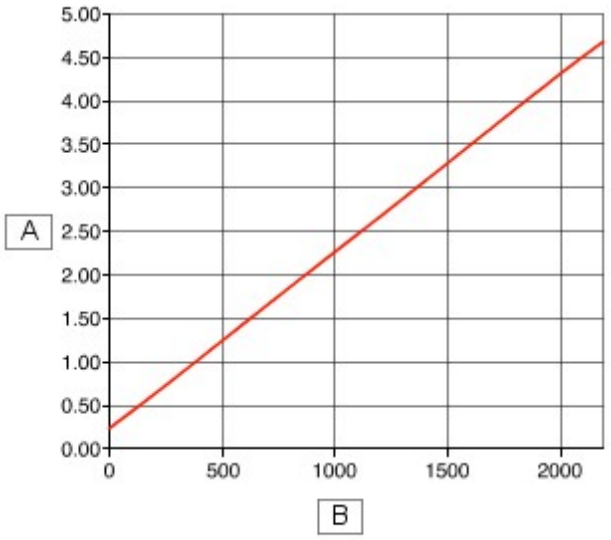
The reservoir valve block controls the storage and distribution of air from the reservoir. The reservoir valve block also contains the system's pressure sensor.

The valve block has four air pipe connections which use 'Voss' type air fittings. The connections provide for air supply from the air supply unit, air supply to and from the reservoir and air supply to and from the front and rear valve blocks. The connections from the air supply unit and the front and rear control valves are all connected via a common gallery within the valve and therefore are all subject to the same air pressures.

The valve block contains a solenoid operated valve which is controlled by the air suspension control module. The solenoid valve controls the pressure supply to and from the reservoir. The solenoid has a resistance value of 2 Ohms at a temperature of 20°C (68°F). When energized, the valve spool moves allowing air to pass to or from the reservoir.

The valve block also contains a pressure sensor which can be used to measure the system air pressure in the air springs and the reservoir. The pressure sensor is connected via a harness connector to the air suspension control module. The control module provides a 5V reference voltage to the pressure sensor and monitors the return signal voltage from the sensor.

Using this sensor, the control module controls the air supply unit operation and therefore limits the nominal system operating pressure to 244 lbf/in^2 (16.8 bar gage).

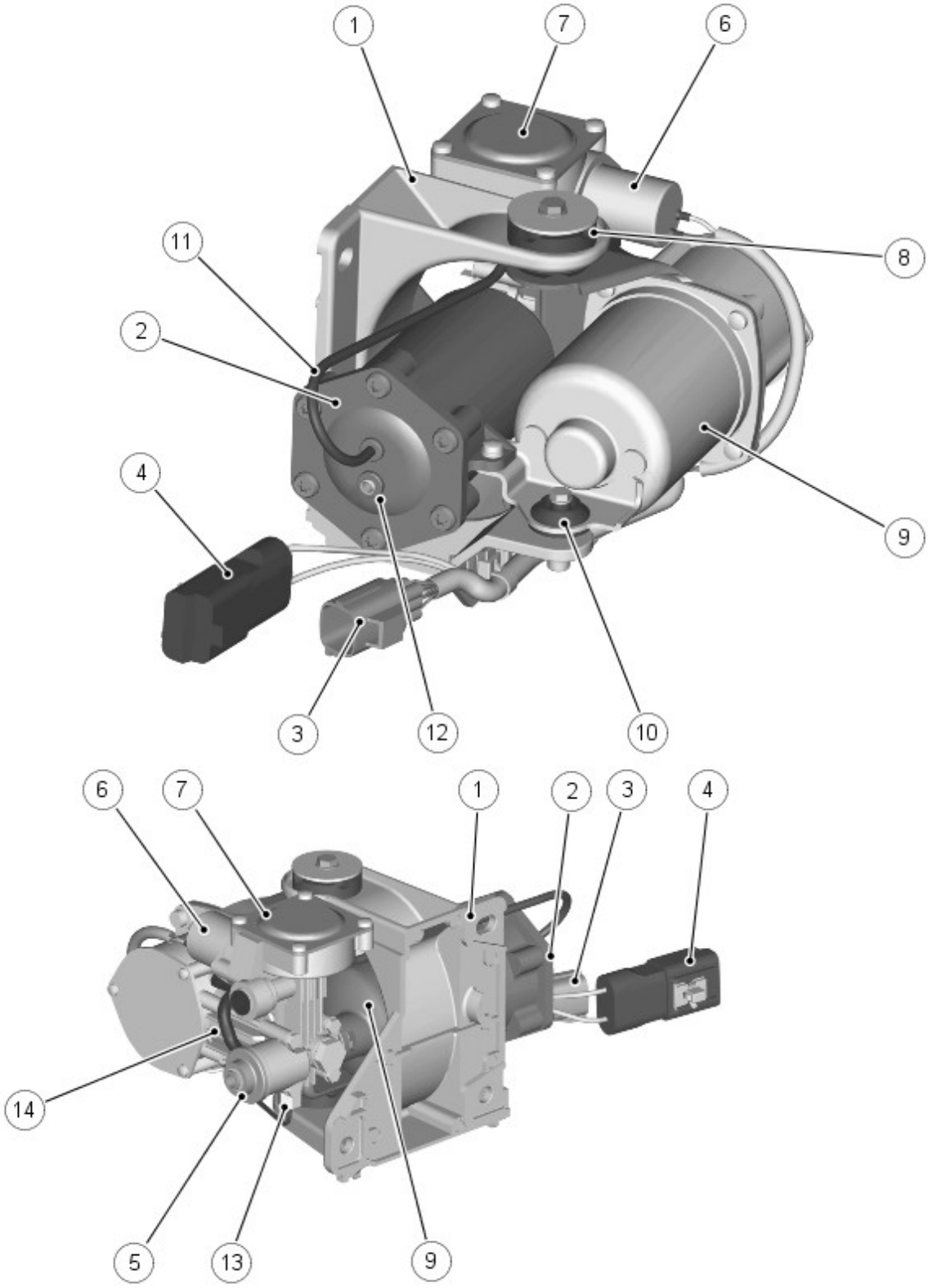


E61677

Item	Part Number	Description
A	-	Output voltage (V)
B	-	Pressure (kPa)

Removal of the reservoir valve block will require full depressurization of the reservoir. The valve block is a non-serviceable item and should not be disassembled other than for replacement of the pressure sensor.

Air Supply Unit



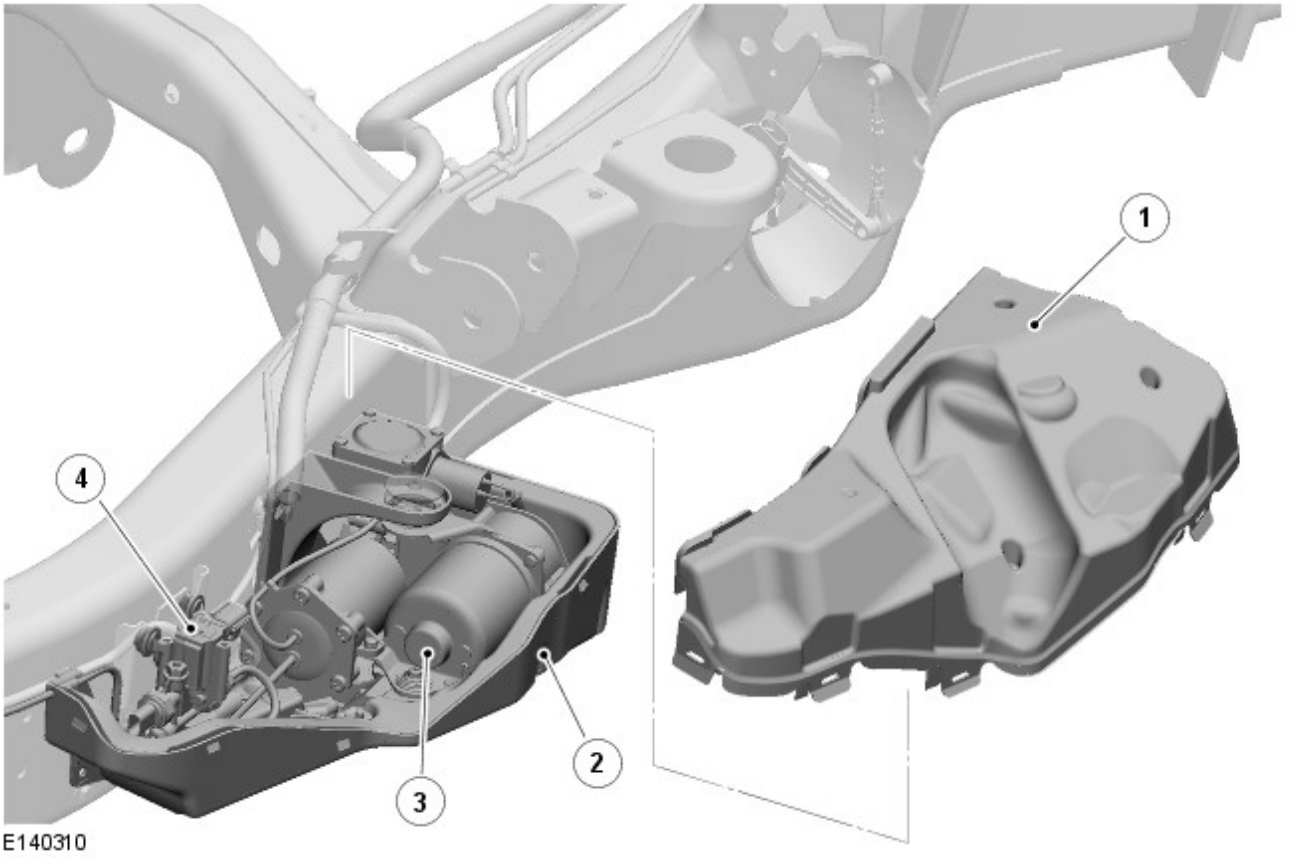
E45180

Item	Part Number	Description
1	-	Mounting bracket
2	-	Air dryer
3	-	Pilot exhaust valve solenoid and temperature sensors harness connector
4	-	Motor harness connector
5	-	Intake port
6	-	Pilot exhaust valve
7	-	Exhaust valve
8	-	Isolation mounting rubber (2 off)
9	-	Electric motor
10	-	Isolation mounting rubber (1 off)

11	-	Pilot air pipe
12	-	High pressure supply to the air suspension system
13	-	Compressor cylinder head temperature sensor
14	-	Compressor

The air supply unit is located on the outside of the left hand chassis rail, forward of the upper control arm. The unit is attached to the chassis rail with three bolts and is protected by an acoustic box.

Acoustic Box



Item	Part Number	Description
1	-	Upper cover
2	-	Lower cover
3	-	Air supply unit
4	-	Reservoir valve block

The acoustic box, which comprises of two parts; upper and lower, surrounds the air supply unit. The acoustic box is a plastic moulding which is lined with an insulating foam which controls the operating noise of the air supply unit. The reservoir valve block is also located in the acoustic box, forward of the air supply unit.

The air supply unit comprises the following major components:

- A piston compressor
- A 12V electric motor
- A solenoid operated pilot valve
- An exhaust valve
- An air dryer unit

The air supply unit supplies dry, compressed air into the air suspension system where it is directed into the air springs or the reservoir by solenoid operated valves. Air can be exhausted from the system when required by the opening of an air spring or reservoir valve in addition to the exhaust valve which is part of the air supply unit.

The compressor operates to pressurize either the reservoir or to inflate one or more of the air springs. Height changes of less than 20 mm are achieved using the compressor alone. Height changes of more than 20 mm are achieved using the reservoir and the compressor. The compressor cannot operate without the engine running, with the following exceptions:

- During remote operation to raise the vehicle to allow for the attachment of a trailer
- When under control of a Land Rover approved diagnostic system.

The air supply unit can be serviced in the event of component failure, but is limited to the following components; air dryer, pilot exhaust pipe and the rubber mounts.

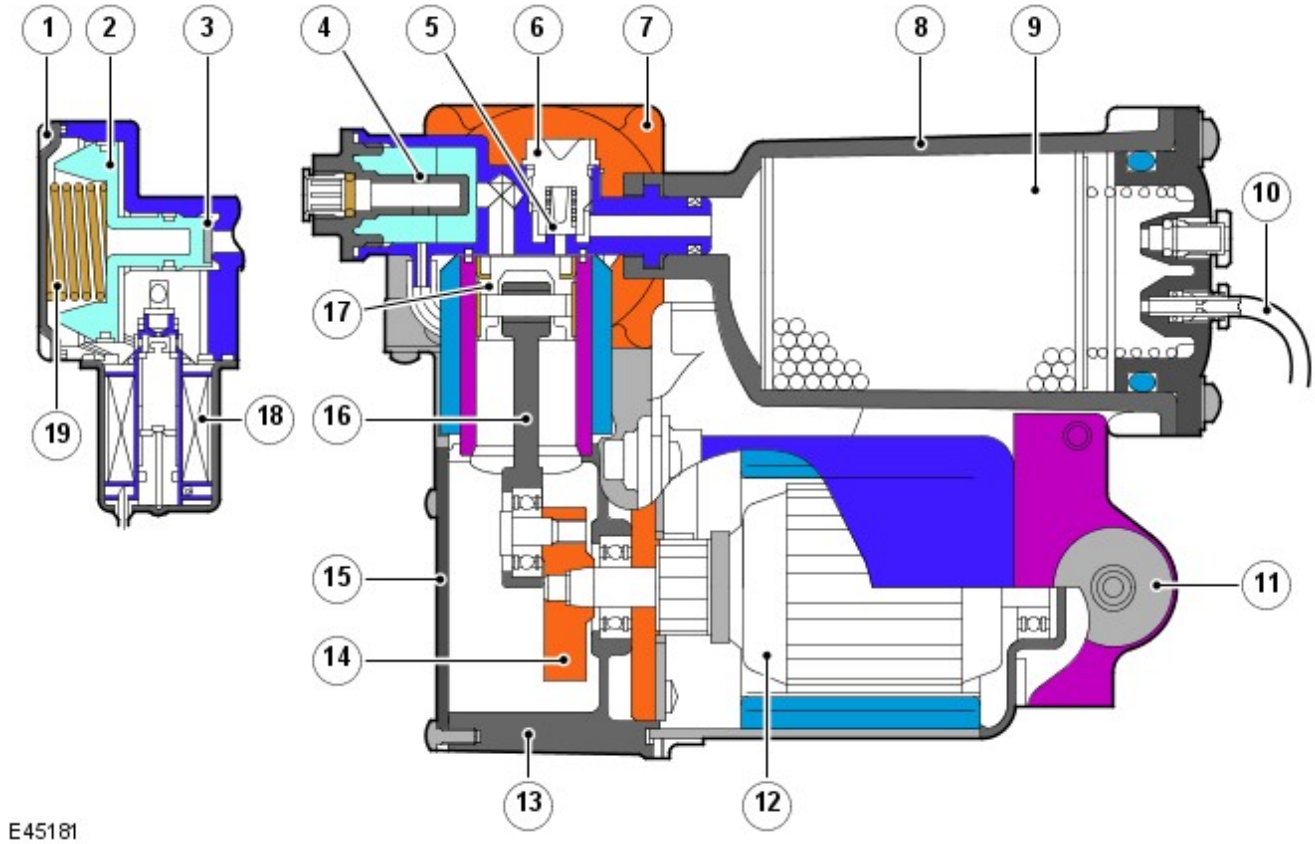
The air supply unit is attached to a bracket which is bolted to the chassis. The unit is mounted to the bracket with flexible isolation mounting rubbers which assist with preventing operating noise being transmitted to the chassis.

Removal of the air supply unit does not require the whole air suspension system to be depressurized. The front and

rear valve blocks and the reservoir valve block are normally closed when de-energized, preventing air pressure in the air springs and the reservoir escaping when the unit is disconnected.

There are a number of conditions that will inhibit operation of the air supply unit. It is vitally important that these system inhibits are not confused with a system malfunction. A full list of air supply unit inhibits are given in the compressor section of this document.

Air Supply Unit - Sectional View



Item	Part Number	Description
1	-	Exhaust valve cap
2	-	Plunger
3	-	Valve seat
4	-	Intake silencer port
5	-	Delivery valve
6	-	Valve guide
7	-	Cylinder head
8	-	Dryer case
9	-	Desiccant
10	-	Pilot exhaust line
11	-	Isolation rubber mount
12	-	Motor assembly
13	-	Crankcase
14	-	Crank
15	-	Crankcase cover
16	-	Connecting rod
17	-	Piston
18	-	Pilot exhaust valve
19	-	Spring - pressure relief

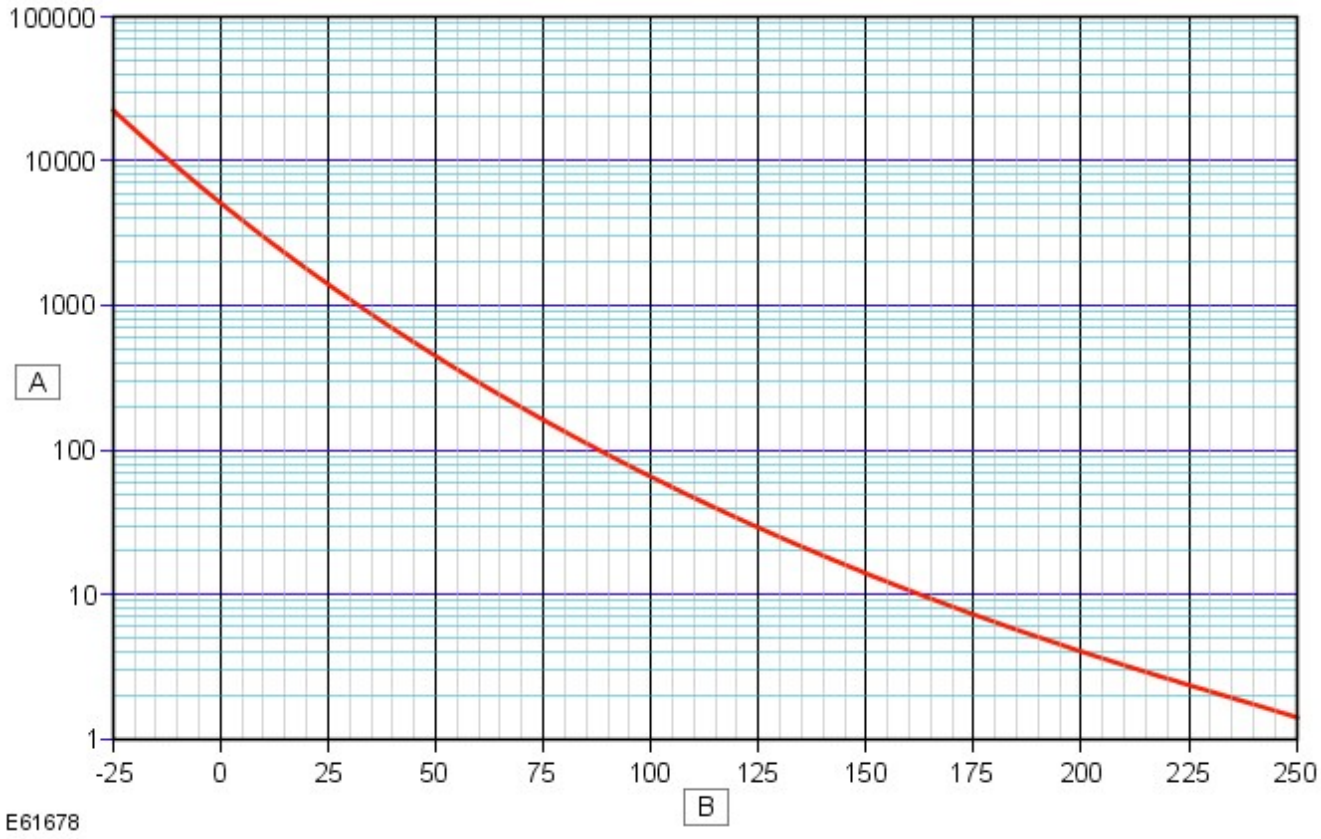
Electric Motor

The electric motor is a 12V DC (direct current) motor with a nominal operating voltage of 13.5V. The motor drives a crank which has an eccentric pin to which the compressor connecting rod is attached.

The motor is fitted with a temperature sensor on the brush Printed Circuit Board (PCB) assembly. The sensor is connected to the air suspension control module which monitors the motor temperature and can suspend motor operation if the operating thresholds are exceeded.

The following graph shows motor temperature sensor resistance values against given temperatures.

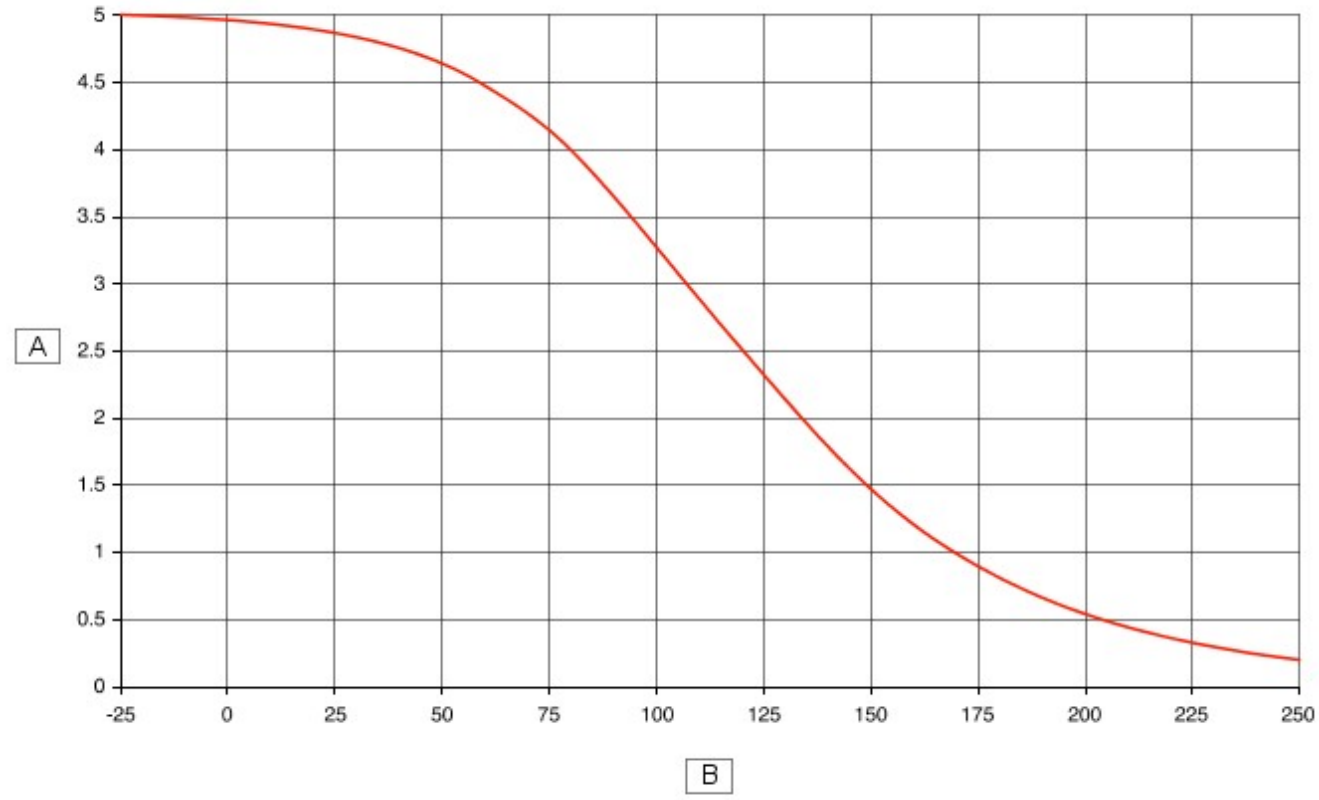
NOTE: This graph is also applicable for the compressor cylinder head temperature sensor.



Item	Part Number	Description
A	-	Resistance (kOhms)
B	-	Temperature (°C)

The following graph shows air suspension control module output voltages against motor temperature sensor temperatures.

NOTE: This graph is also applicable for the compressor cylinder head temperature sensor.



E61679

Item	Part Number	Description
A	-	Control module input voltage (V)
B	-	Temperature sensor (°C)

Compressor

The compressor is used to supply air pressure to the air suspension reservoir. The air suspension control module monitors the pressure within the reservoir and, when the engine is running, maintains a pressure of 16.8 bar gage (244 lbf/in^2).

The compressor comprises a motor driven connecting rod and piston which operate in a cylinder with a separate cylinder head. The motor rotates the crank moving the piston up and down in the cylinder bore. The air in the cylinder is compressed with the up stroke and is passed via the delivery valve through the air dryer and into the system.

The cylinder head is fitted with a temperature sensor. The sensor is connected to the air suspension control module which monitors the cylinder temperature and can suspend motor and compressor operation if an overheat condition occurs.

The compressor will not be allowed to start if the pressure sensor reads greater than 4 bar (absolute).

The following table shows the control module operating parameters for the differing air supply unit functions and the allowed compressor cylinder head operating temperatures.

Compressor Cylinder Head Operating Temperatures

	Leveling	Reservoir Filling
OFF	140°C (284°F)	130°C (266°C)
ON	120°C (248°F)	110°C (230°F)

Refer to the motor temperature sensor graph for compressor cylinder head temperature sensor resistance values and the air suspension control module output voltage / temperature sensor graph.

Air Dryer

Attached to the compressor is the air dryer which contains a Desiccant for removing moisture from the compressed air. Pressurized air is passed through the air dryer which removes any moisture in the compressed air before it is passed into the reservoir and/or the system.

When the air springs are deflated, the exhaust air also passes through the air dryer, removing the moisture from the unit and regenerating the Desiccant.

The air dryer is an essential component in the system ensuring that only dry air is present in the system. If moist air is present, freezing can occur resulting in poor system operation or component malfunction or failure.

Pilot Exhaust Valve

Attached to the cylinder head is a solenoid operated exhaust pilot valve. This valve is opened when the air springs are to be deflated or when the system pressure needs to be reduced.

The pilot exhaust valve is connected to the air delivery gallery, downstream of the air dryer. The pilot valve, when opened, operates the compressor exhaust valve allowing the air springs to be deflated.

When the solenoid is energized, pilot air moves the exhaust valve plunger, allowing pressurized air from the air springs and/or the reservoir to pass through the air dryer to atmosphere.

Exhaust Valve

The exhaust valve operates when the pilot exhaust valve is opened, allowing air returning from the air springs and/or the reservoir to be exhausted quickly.

The pilot exhaust valve also provides the system pressure relief function which protects the air springs from over inflation. The valve is pneumatically operated, responding to air pressure applied to it to overcome pressure from its internal spring. The valve is connected into the main pressure gallery which is always subject to the system pressure available in either the air springs or the reservoir. The valve is controlled by a spring which restricts the maximum operating pressure to between 22 to 27 bar gage (319 to 391 lbf/in^2).

The minimum pressure in the system is also controlled by the exhaust valve to ensure that, even when deflated, the air springs contain a positive pressure with respect to atmosphere. This protects the air spring by ensuring it can still 'roll' over the piston without creasing.

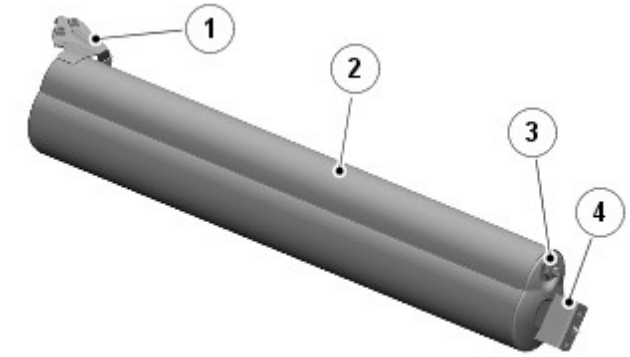
Air Supply Unit Specifications

Description	Value
Working pressure	16.8 bar gage
Maximum pressure (stabilized)	22.0 to 27.0 bar gage
Operating voltage	10 to 16.5 Volts (13.5 Volts nominal)
Running current consumption	20-50 Amps depending on load
Maximum start-up current	120 Amps
Pilot Exhaust Valve - Solenoid valve resistance at 20°C (68°F)	4 Ohms ± 10%

NOTE: Resistance values will vary with coil temperature. Resistance of test leads must be measured before any readings are taken. Resistance value of the test leads must be subtracted from final solenoid resistance value.

There are a number of conditions that will inhibit operation of the air suspension compressor. It is vitally important that these inhibits are not confused with a system malfunction. A full list of compressor inhibits is contained in the compressor section of this document.

Reservoir



E140311

Item	Part Number	Description
1	-	Front bracket
2	-	Reservoir
3	-	Air hose connection to reservoir valve block
4	-	Rear bracket

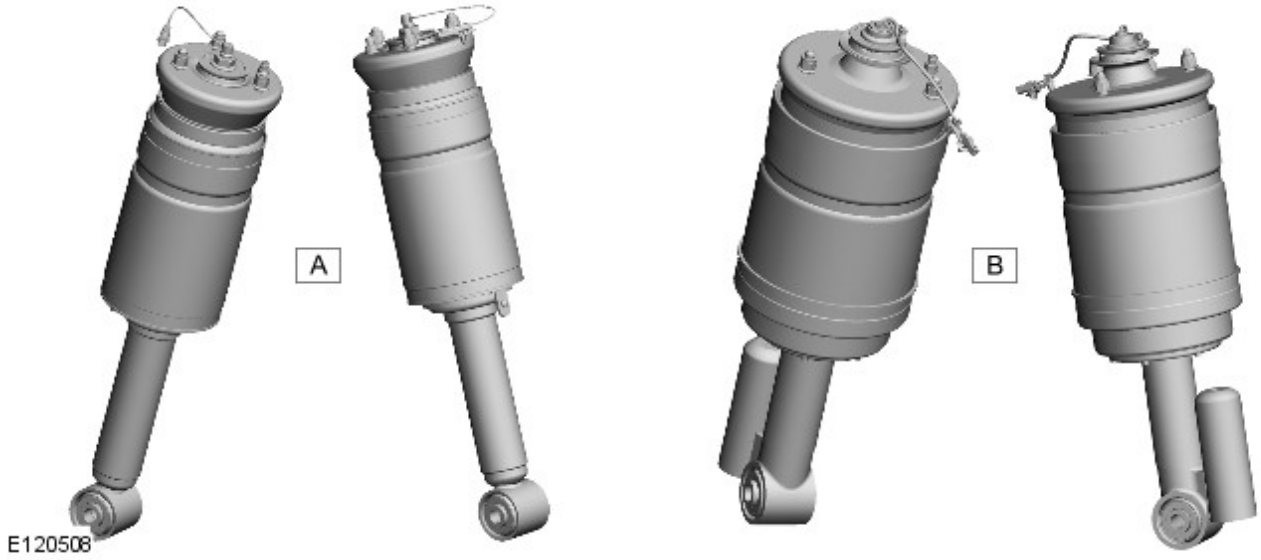
The reservoir is an air storage vessel which provides fast air suspension lift times by the immediate availability of pressurized air into the system.

The reservoir is a steel fabrication and is located on the outside of the left hand chassis rail, in front of the air supply unit. The reservoir has a bracket at each end which attach to the body mounting brackets on the chassis.

The rearward end of the reservoir has a 'Voss' air fitting which provides for the connection of the air hose between the reservoir and the reservoir valve block.

The reservoir has a capacity of 9 liters (550 in^{3}0). The nominal working pressure of the reservoir is 16.8 bar gage (243.6 lbf/in^2), with a maximum pressure of 35 bar gage (507 lbf/in^2).

Air Springs



Item	Part Number	Description
A	-	Front air spring and damper assembly
B	-	Rear air spring and damper assembly

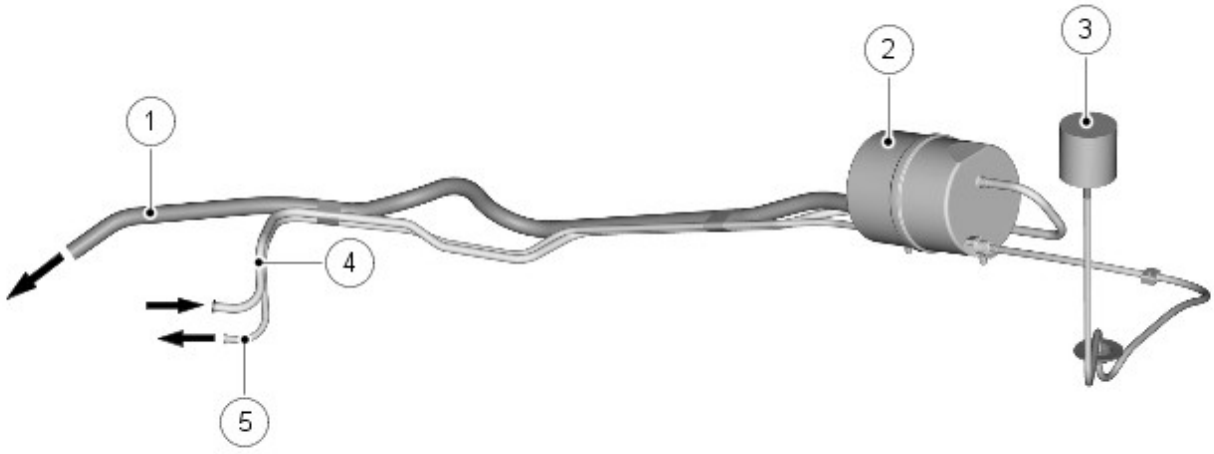
The air springs on the front and rear suspension are similar in construction. The air springs are manufactured from a flexible rubber and each air spring forms an air tight cavity which provides the required spring rate for each corner of the vehicle.

As the air spring is compressed, the rubber material compresses and rolls down the side of the vertical housing (piston) below the spring. An air connection port is located on the top of each spring and allows air to be added or removed from each spring. The port is connected via a Voss connector and a plastic tube to the axle valve block.

Replacement of an individual air spring does not require a full depressurization of the air suspension system. Only the corner concerned need be depressurized. This is achieved using a routine in the Land Rover approved diagnostic system.

When servicing of an air spring or a full system depressurization is required, the weight of the vehicle must be supported before the system is depressurized. On reassembly, the air spring must be fully pressurized before the weight of the vehicle is applied to it.

AIR SILENCER AND INLET AIR FILTER



Item	Part Number	Description
1	-	Exhaust (to atmosphere)
2	-	Inlet and exhaust silencer
3	-	Air inlet filter
4	-	Exhaust air from air supply unit
5	-	Air inlet supply to air supply unit

The air silencer is required to limit any noise produced from the air supply unit during inflation or deflation of the air springs.

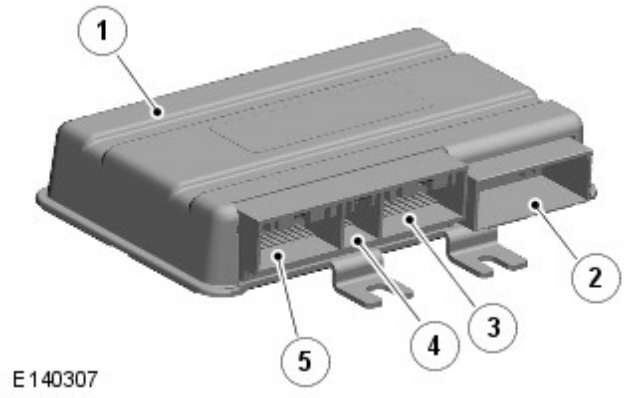
The silencer comprises two plastic molded cans, which are bonded together. A silencing foam in the large internal chamber forms the exhaust silencer. A pipe connection is molded onto each end of the silencer and provides for the attachment of the exhaust air to atmosphere pipe and the exhaust air pipe from the air supply unit.

A secondary chamber, located around the outside of the exhaust chamber forms the silencer for the inlet air. Pipe connections are molded onto each end of the intake silencer and provide for the attachment of the air inlet pipe from the inlet air filter and the air inlet pipe to the air supply unit. The intake air silencer is a hollow chamber with no noise reduction foam filling.

The air intake filter is connected via a pipe to the intake silencer chamber of the air silencer unit. The filter is located in the rear left hand corner of the body, away from possible sources of dirt and moisture.

The filter contains a foam element which removes particulate matter from the inlet air before it reaches the silencer or the air supply unit.

AIR SUSPENSION CONTROL MODULE



Item	Part Number	Description
1	-	Air suspension control module
2	-	Connector C2321
3	-	Connector C2320
4	-	Connector C2030
5	-	Connector C0867

The air suspension system fitted is controlled by the air suspension control module which is located behind the instrument panel, on the driver's side 'A' pillar.

The control module monitors the height of each corner of the vehicle via four height sensors, which are mounted in-board of each road wheel.

The control module has the following modes of operation:

- Calibration
- Normal
- Periodic Wake-Up.

When a new air suspension control module is fitted, the air suspension system will not function until the air suspension software is loaded and the system calibrated using the Land Rover approved diagnostic system.

Calibration

A calibration routine is performed using the Land Rover approved diagnostic system to access the position of each corner of the vehicle and record the settings in the control module memory. Once set, the calibration is not required to be performed unless the air suspension control module or adaptive damping module is removed or replaced, a height sensor or bracket is removed, replaced or disturbed or a suspension arm to which the sensor is connected is removed or replaced. If the removed height sensor is subsequently refitted, the calibration procedure will have to be performed to ensure the integrity of the system.

If the air supply unit, the reservoir, a valve block, a damper module or the air harness is removed or replaced, the system will not require recalibration.

Periodic Wake-Up Mode

When the vehicle is parked, the air suspension control module 'wakes up' two hours after the ignition was last switched off and once every twenty four hours thereafter. The vehicle height is checked and if the vehicle is not level within a pre-set tolerance, small downwards height adjustments may be made automatically.

SYSTEM OPERATION

Under normal operating conditions, the air suspension control module keeps the vehicle level at the 'current' ride height. The incoming height signals from the sensors are passed through filters to remove irregular signals produced by road noise or other irregularities. When the vehicle is stationary or a height change is in progress, the signals are passed through a 'fast' filter, which tracks the true rate of change of height. When the vehicle is moving, the signals are passed through a 'slow' filter. The 'slow' filtered signals remove almost all road noise from the signals and output a true long term average for each corner height. The 'slow' filtered signals cannot be used to respond quickly during

height changes.

The air suspension control module monitors each corner height signal using the fast filtered signals if the vehicle is stationary or the slow filtered signals if the vehicle is moving. If the height remains in a 'dead band' which is ±10 mm from the target height, the control module does not implement any height adjustment changes. When the control module detects that a corner has moved outside of the 'dead band', the control module operates the compressor and/or the valves to raise or lower the corresponding corner(s) back into the target height.

SYSTEM INHIBITS

A number of conditions exist where a change in ride height is undesirable. To counter this, the air suspension control module is programmed with a number of system inhibits. If any of the conditions detailed below exist, the air suspension control module will suspend height changes and height corrections.

Compressor

System Pressure

The compressor will not start if the system pressure is greater than 4 bar (gage)

Compressor Temperature

Two temperature sensors are located within the compressor to prevent overheating. If the temperature of the motor brush assembly or the compressor cylinder head rise above pre-set limits, the air suspension control module will inhibit the compressor operation. The limits are detailed in tables in the Air Supply Unit section of this manual.

Cornering

If the air suspension control module registers a cornering force greater than 0.2g it will inhibit all height changes and corrections. The system will remain inhibited until the cornering force falls to less than 0.15g. The air suspension control module receives a message from the lateral acceleration sensor (which is an integral part of the anti-lock brake system (ABS) yaw rate sensor) on the high speed controller area network (CAN) bus for the cornering force.

Rapid Acceleration

If the air suspension control module registers a rapid acceleration greater than 0.2g it will inhibit all height changes and corrections. The system will remain inhibited until the rapid acceleration falls to less than 0.15g. Acceleration is calculated by the control module from a vehicle speed signal received via the high speed CAN bus.

Rapid Deceleration

If the air suspension control module registers a rapid deceleration smaller than - 0.2g it will inhibit all height changes and corrections. The system will remain inhibited until the rapid deceleration rises above - 0.15g. Deceleration is calculated by the control module from a vehicle speed signal received via the high speed CAN bus.

Vehicle Jack

The air suspension control module will inhibit all height changes and corrections if it detects a corner lowering too slowly for more than 1.2 seconds. This is interpreted as the corner identified as moving too slowly being supported on a jack. In this situation, the corner height will not change when air is released from the air spring because the jack acts as a mechanical prop.

The system will remain inhibited until any of the following conditions exist:

- The air suspension rotary switch is moved to the up or down position
- The vehicle speed rises to more than 3 km/h (2 mph) for more than 45 seconds.

Door Open

The air suspension control module will stop all height change requests while any of the doors are open. Vehicle leveling continues with a door open by keeping the vehicle at the height when the door was opened if the vehicle load changes. Door open status is ignored when the vehicle speed is above 8 km/h (5 mph).

DIAGNOSTICS

The air suspension control module can store fault codes which can be retrieved using the Land Rover approved diagnostic system. The diagnostics information is obtained via the diagnostic socket which is located below the instrument panel, above the driver's foot pedals. The socket is protected by a hinged cover.

The diagnostic socket allows the exchange of information between the various control modules on the bus systems and the Land Rover approved diagnostic system. This allows the fast retrieval of diagnostic information and programming of certain functions using the Land Rover approved diagnostic system.

Fault Messages

The air suspension has two methods which it can use to inform the driver of a fault in the air suspension system; the air suspension control switch LED's and the instrument cluster message center.

If the air suspension control module suffers a major failure and there is no air suspension control, all the control switch LED's will remain unlit.

If a fault occurs and the control module can determine the ride height and the vehicle is not above on-road height, the driver will be notified via a message in the message center. If the control module cannot determine the height of the vehicle, or the vehicle is above on-road height and cannot be lowered, a message is displayed and accompanied

with a maximum speed message.

If a fault is detected within the DSC (dynamic stability control) the message 'SUSPENSION LOWERED FOR SAFETY' and a chime will be emitted. This is not a fault with the air suspension system. The fault should be investigated and rectified as soon as possible.

For additional information, refer to: Information and Message Center (413-08, Description and Operation).

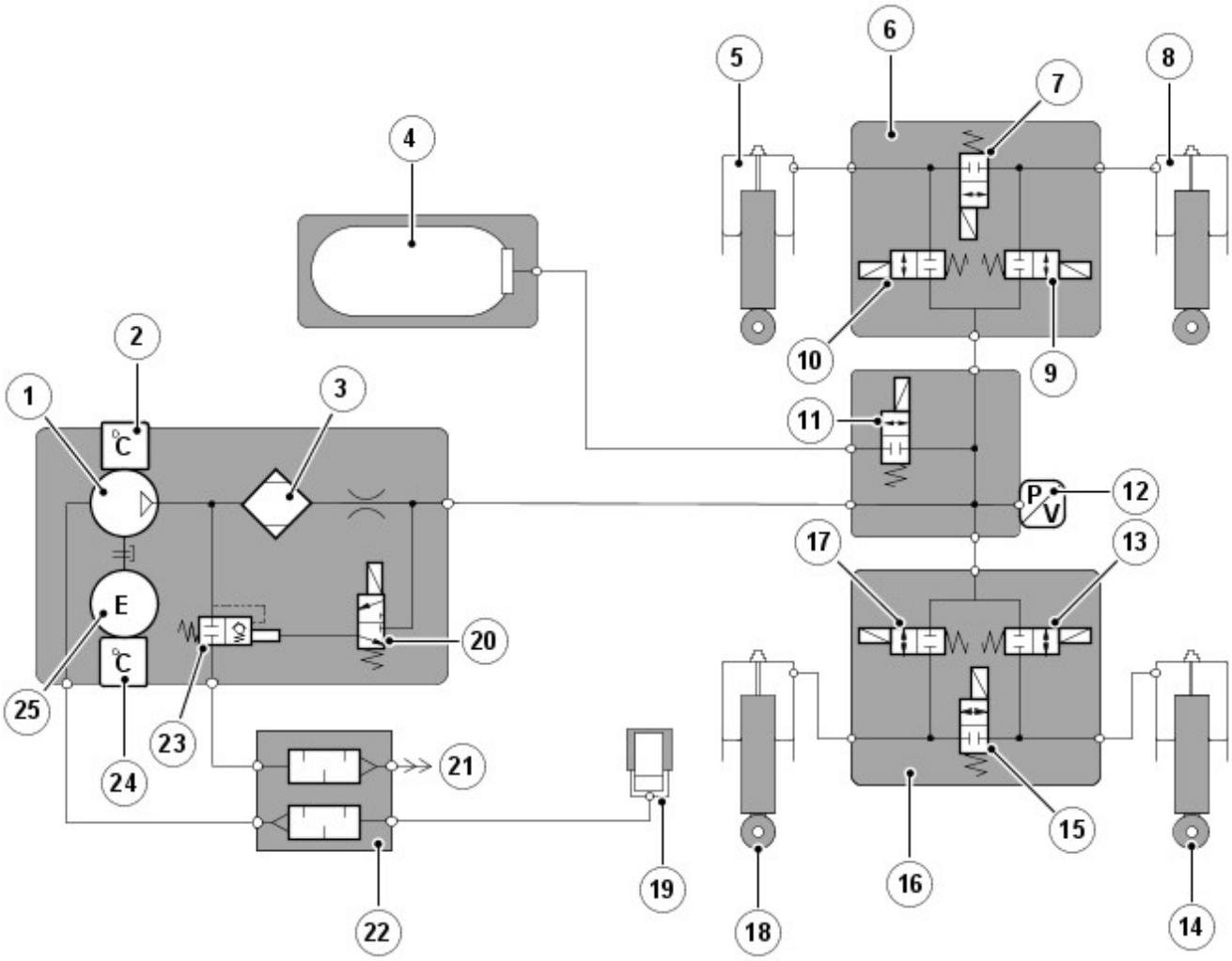
RESERVOIR

The air suspension control module assumes the reservoir has sufficient pressure, which is measured before a vehicle raise is started. The control module then uses a software model to operate the compressor as required.

SYSTEM PNEUMATIC CIRCUIT

The following schematic diagram shows the connection relationship between the air supply unit, the reservoir, the reservoir valve block, the cross-link valves and the air springs.

Schematic Pneumatic Circuit



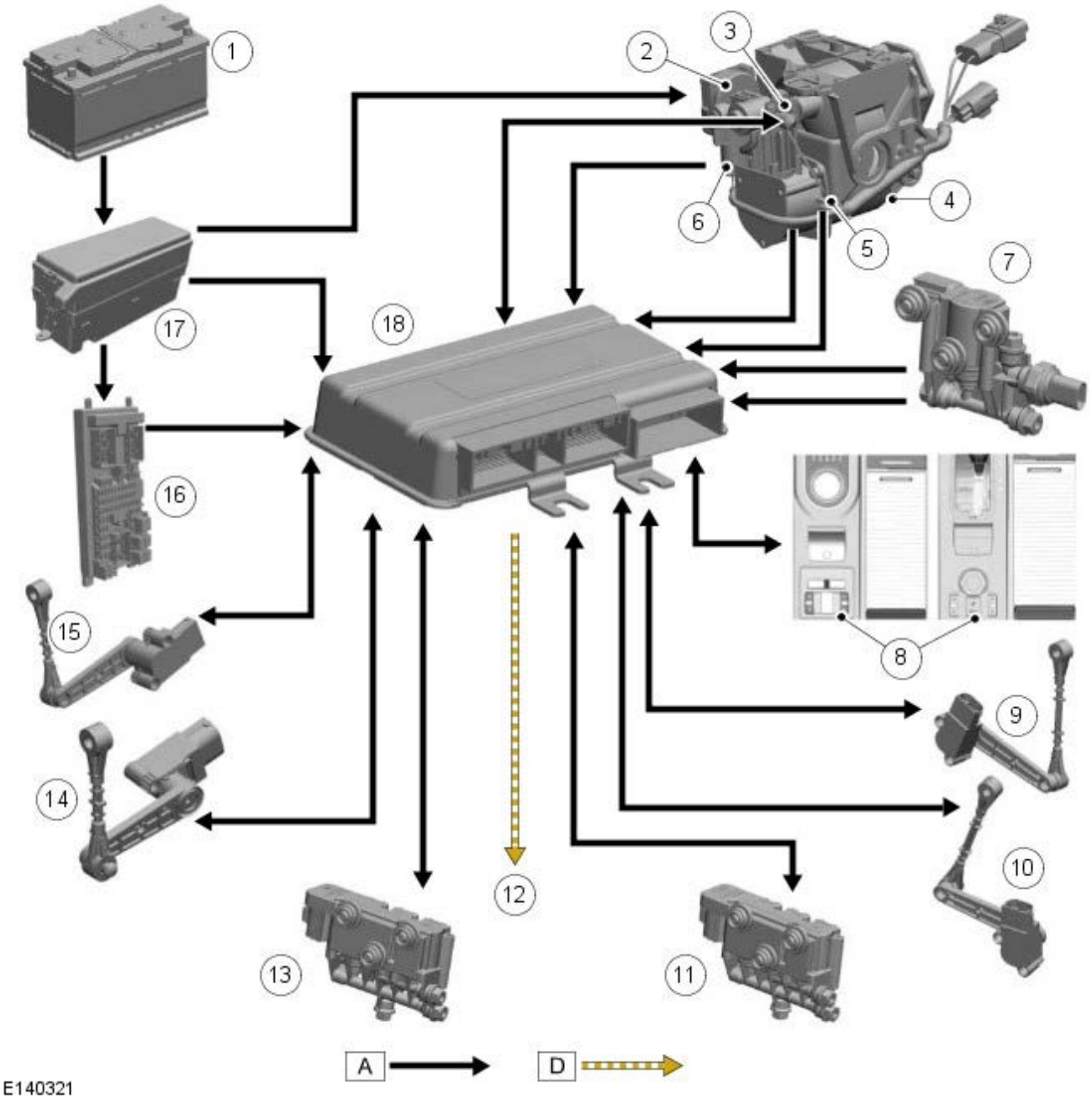
E45175

Item	Part Number	Description
1	-	Compressor
2	-	Compressor temperature sensor
3	-	Air dryer
4	-	Reservoir
5	-	Front LH air spring damper module
6	-	Front valve block

7	-	Cross link valve
8	-	Front RH air spring damper module
9	-	Front RH corner valve
10	-	Front LH corner valve
11	-	Reservoir control valve
12	-	Pressure sensor
13	-	Rear RH corner valve
14	-	Rear RH air spring damper module
15	-	Cross link valve
16	-	Rear valve block
17	-	Rear LH corner valve
18	-	Rear LH air spring damper module
19	-	Inlet air filter
20	-	Pilot exhaust valve
21	-	Exhaust
22	-	Air silencer
23	-	Pressure relief and exhaust valve
24	-	Motor temperature sensor
25	-	Electric motor

CONTROL DIAGRAM - AIR SUSPENSION

 NOTE: **A** = Hardwired; **D** = High Speed CAN bus



E140321

Item	Part Number	Description
1	-	Battery
2	-	Air supply unit
3	-	Compressor temperature sensor
4	-	Motor temperature sensor
5	-	Motor
6	-	Exhaust valve solenoid
7	-	Reservoir control valve
8	-	Air suspension switch
9	-	RH front height sensor
10	-	RH rear height sensor
11	-	Rear control valve
12	-	CAN connection to other systems
13	-	Front control valve
14	-	LH rear height sensor
15	-	LH front height sensor
16	-	CJB (central junction box)
17	-	BJB
18	-	Air suspension control module

Vehicle Dynamic Suspension - Vehicle Dynamic Suspension
Diagnosis and Testing

Principle of Operation

For a detailed description of the Vehicle Dynamic Suspension System and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Vehicle Dynamic Suspension (204-05 Vehicle Dynamic Suspension, Description and Operation).

Inspection and Verification

CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

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

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

Visual Inspection

Mechanical	Electrical
• Air leakage • Air springs • Reservoir • Compressor • Compressor air filter • Pipework and unions • Sensor installation • Valve block(s) • Suspension components	• Battery • Fuse(s) • Wiring harness physical damage or water ingress • Loose or corroded electrical connectors • Air suspension control switch • Controller Area Network (CAN) circuits • Sensors • Actuators • Valve block(s) • Air suspension control module

3. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the symptom chart.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Message	Possible Other Warnings	Possible Causes	Action
Vehicle on bump stops	• Suspension fault	• Two chimes repeated regularly, red warning indicator permanently illuminated	• Water ingress to wiring harness or connectors • Air leak(s) • Vehicle in transportation mode • System not calibrated or calibration corrupt • Implausible articulation symptoms detected • Failure of multiple height sensors • Air suspension control module failure	• Visually inspect the wiring harness and connectors for water ingress • Visually inspect the system for air leakage • Check the system mode and calibration using the approved diagnostic system • Check for implausible articulation symptoms, i.e. height sensor or linkage fault, deflated air spring, under inflated tire etc • Note implausible articulation symptoms may be caused by an un-calibrated

				height sensor • Check for height sensor DTCs and refer to the DTC index
Vehicle does not sit level	• Suspension fault	• Two chimes repeated regularly, red warning indicator permanently illuminated	• Water ingress to wiring harness or connectors • Air leak(s) • Calibration corrupt • cross-link valve fault • Height sensor fault • Reservoir valve stuck open • Exhaust valve stuck closed • Corner valves stuck open • Air suspension control module failure	• Visually inspect the wiring harness and connectors for water ingress • Visually inspect the system for air leakage and refer to the guided diagnostic routine on the approved diagnostic system • Check the system calibration using the approved diagnostic system • For front and rear cross link valve tests refer to the guided diagnostic routine on the approved diagnostic system • Check for height sensor DTCs and refer to the DTC index • For reservoir and exhaust valve tests refer to the guided diagnostic routine on the approved diagnostic system • Check for corner valve DTCs and refer to the DTC index
Vehicle sits too low	• Suspension fault • Hill descent control (HDC) fault, system not available • Dynamic stability control (DSC)	• Two chimes, amber warning indicator permanently illuminated • One chime • DSC amber warning indicator permanently illuminated • Anti-lock brake system warning indicator permanently illuminated	• Water ingress to wiring harness or connectors • Air leak(s) • Air suspension compressor temperature sensor fault • Inlet air filter blockage/restriction • Air suspension compressor fault • Exhaust valve stuck/sticking • Air suspension control module lost communication with ABS module • ABS fault. • Air suspension	• Visually inspect the wiring harness and connectors for water ingress • Visually inspect the system for air leakage • For air compressor temperature sensor, inlet air filter, exhaust valve and air compressor tests refer to the guided diagnostic routine on the approved

			control module failure	diagnostic system • For air suspension control module lost communication with anti-lock brake system control module, refer to the lost communication codes statement at the end of this table • Check for anti-lock brake system DTCs, refer to the relevant section of the workshop manual
Vehicle sits too high	• Suspension fault	• Two chimes, amber warning indicator permanently illuminated	• Reservoir valve stuck open • Exhaust valve stuck closed • Corner valves stuck open • Air suspension control module failure	• For reservoir valve and exhaust valve tests refer to the guided diagnostic routine on the approved diagnostic system • Check for corner valve DTCs and refer to the DTC index
System detects extended mode unnecessarily when lowering	• Suspension fault	• Two chimes, amber warning indicator permanently illuminated	• Crossed gallery and air spring pipes • Incorrect valve block installed to front or rear • Damage or blockage in air harness	• Refer to the guided diagnostic routine on the approved diagnostic system
Vehicle leans/tilts after being left over-night or for some days	• -	• -	• Leaking air spring(s) • Leak from corner valve to gallery • Exhaust valve stuck open	• Refer to the guided diagnostic routine on the approved diagnostic system
After vehicle left over-night or for some days system regularly indicates "Suspension vehicle raising slowly" when first driving off	• Suspension vehicle raising slowly	• -	• Leaking air spring(s) • Leaking reservoir	• Refer to the guided diagnostic routine on the approved diagnostic system

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: Air Suspension Control Module (100-00 General Information, Description and Operation).

Air Suspension Deflation Exit Routine

1. Key on, engine off.
2. Key off.
3. Press and release raise switch.

4. Press and release lower switch.
5. Key on, engine off.
6. Key on, engine running.
7. Press and release raise switch twice.
8. Press and release lower switch twice.
9. Press and release raise switch.

Vehicle Dynamic Suspension - Ride Height Adjustments

General Procedures

Special Tool(s)

	Gauge, Ride height 204-557B

CAUTIONS:

Make sure the wheels and tires, tie rod ends, suspension joints and wheel bearings are free from damage, wear and free play.

Make sure there are no heavy objects in the vehicle.

The ride height must be measured with the vehicle weight supported by the suspension.

With the engine running and all vehicle doors closed, make sure the air suspension is functioning and the vehicle height can be raised and lowered using the air suspension switch.

Drive the vehicle on to a flat, level surface.

Make sure the steering is in the straight ahead position.

NOTE: This procedure must be carried out after replacement of the air suspension control module or height sensor link arm, removal or replacement of the front or rear upper arms or the height sensor. The ride height does not need calibration after removal or replacement of the front or rear air springs or shock absorbers.

1. Using the Land Rover approved diagnostic system, carry out the ride height adjustments.

2. CAUTION: Make sure the vehicle is not moved once it has been positioned to take measurements.

   Position the vehicle on a flat level surface.

3. Connect IDS to the vehicle data link connector.
   - Connect the vehicle data link cable into the vehicle communications module.
   - Connect the IDS USB Lead into the vehicle communications module.
   - Connect the data link cable to the data link connector.
   - Connect the IDS USB lead to the IDS USB port.

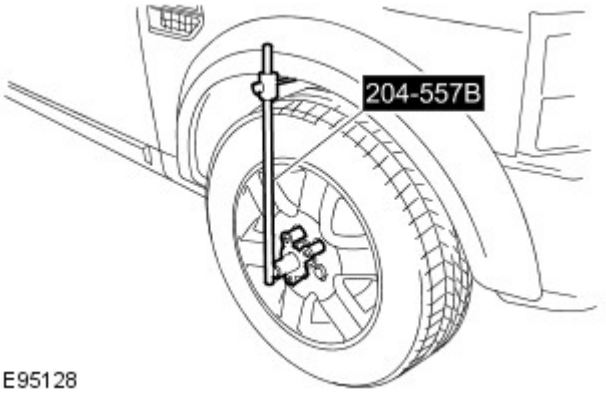
4. CAUTION: Make sure the ignition switch is turned off, the park brake is on and the selector lever is in park.

   NOTE: IDS already loaded with the latest issue of software.

   Switch IDS on and navigate to the vehicle identification number (VIN) input screen.

5. Enter the VIN and navigate to the vehicle configuration menu.
   - Select setup and configuration.
   - Select air suspension height calibration and read all warnings and cautions.

6. NOTES:



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Do not install the special tool over a locking wheel nut.

Make sure the special tool is square to the wheel face with the measuring rod in a vertical position.

Take the measurement from the top edge of the slider on the special tool.

Make sure the fender splash shields are correctly fitted.

Once in the suspension height measurement screen, use the special tool to measure and record the height setting from each wheel center to the wheel arch.

7. CAUTION: IDS will now cause the vehicle height to change.

   Input the ride height measurements taken from the vehicle into IDS.

8. Using the special tool, repeat the vehicle ride height measurements.

9. After successful calibration of the air suspension switch off IDS and return to its original position.

Vehicle Dynamic Suspension - Air Suspension System Depressurize and Pressurize

General Procedures

WARNINGS:

 A small amount of air pressure will be left in the air suspension system.

 Eye protection must be worn.

 Wear protective gloves.

CAUTIONS:

 Make sure tailgate, hood and all doors are closed.

 Make sure the vehicle is in a clear working area.

1.  WARNING: The air suspension is pressurised. Make sure dirt or grease does not enter the system. Always wear hand, eye and ear safety standard protection when working on the system.

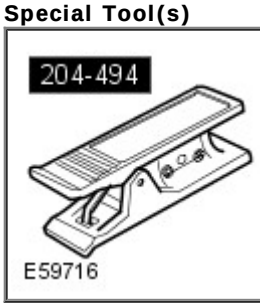
   Using the Land Rover approved diagnostic system, depressurize the air suspension.
   - Follow the on-screen prompts.

2. Using the Land Rover approved diagnostic system, pressurize the air suspension.
   - Start and run the engine.

Vehicle Dynamic Suspension - Air Leaks

General Procedures

Special Tool(s)

	Hose Cutter 204-494 (LRT 60-002)

1. CAUTION: Any leak detection spray used must have a corrosion inhibitor, and must not cause damage to paintwork, plastics, metals or plastic lines.

   NOTE: The recommended leak detection spray is GOTEC LDS, Landrover part number STC 1090.

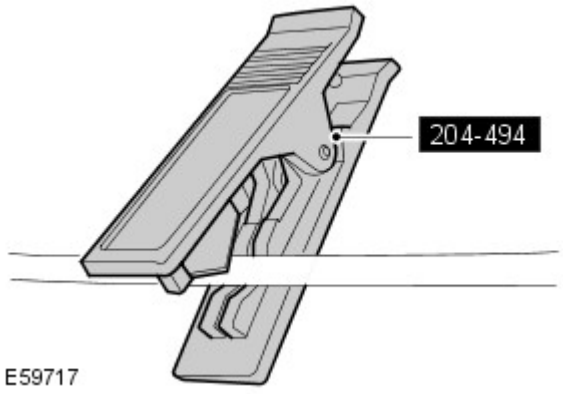
   The recommended leak detection spray should be used to identify any suspected leaks. This procedure should also be used where any of the air suspension components have been disturbed.

2. Clean around the area of the suspected air leak.

3. Using the recommended leak detection spray, spray around all of the air suspension components, working systematically until the source of the air leak has been found.

4. If any of the air suspension components are found to be leaking e.g. air spring, compressor, reservoir or a solenoid valve block, repair is effected by replacement only.

5. Using T4, depressurize the air suspension system.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05, General Procedures).



6. CAUTIONS:

   Different air lines in the air suspension system have different material properties and wall thicknesses. It is important, in order to prevent subsequent air line failure, that the new air line material and wall thicknesses are identical to those of the air line being removed.

   Replacement air line must be cut from a new air line with the equivalent Land Rover part number as the one being replaced. Do not use air line cut from a roll or coil.

   Any existing heatsleeves and abrasion sleeves must be replaced as part of the repair.

   Air line connectors should be positioned in areas away from heat sources such as the exhaust system, and away from any section of air line with a heat shield installed.

   Do not trim air line ends. If the end of the air line is damaged, the air line must be cut and a new section added using a Land Rover approved air line connector, or the air line must be renewed completely.

   NOTES:

 Air lines must only be cut using either Hose cutter 204-494 (LRT 60-002), available from SPX LTD or Hose cutter YA1000A, available from Snap-On Tools. Make sure the cut air line end is free from damage or burrs.

 Only Land Rover approved air lines have been tested to the correct pressure and temperature specifications.

 Only the Land Rover approved air line connector, RYC500210, has been tested to the correct pressure and temperature specifications.

 If the markings or tape adjacent to the air line connections are removed when cutting air lines, the cut end of the air line must be clearly marked with a suitable colored tape or paint mark.

If the source of the air leak is found to be an air line connection, renew the Voss connector and, if required, the end of the air line. Using the special tool, cut off the damaged end of the air line and replace with new Land Rover approved air line and air line connectors as required.

7. If the source of the air leak is found to be in a section of air line, either; renew the air line, or, using the special tool, cut out the damaged section of air line and replace with new Land Rover approved air line, and air line connectors, as required.

8.  NOTE: If the repair has been unsuccessful repeat the above steps until the air leak is rectified.

   Using T4, pressurize the air suspension system.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05, General Procedures).

Vehicle Dynamic Suspension - Front Shock Absorber and Air Spring Assembly

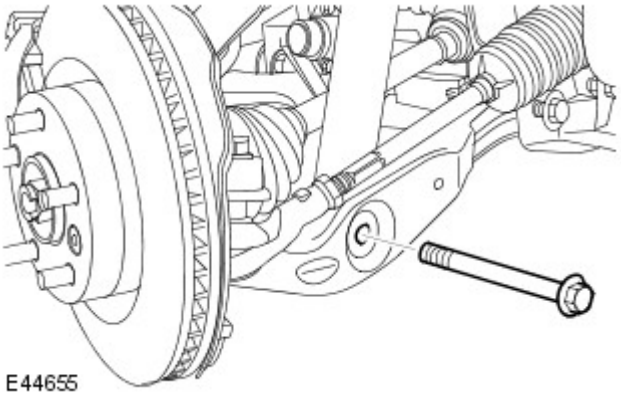
Removal and Installation

Removal

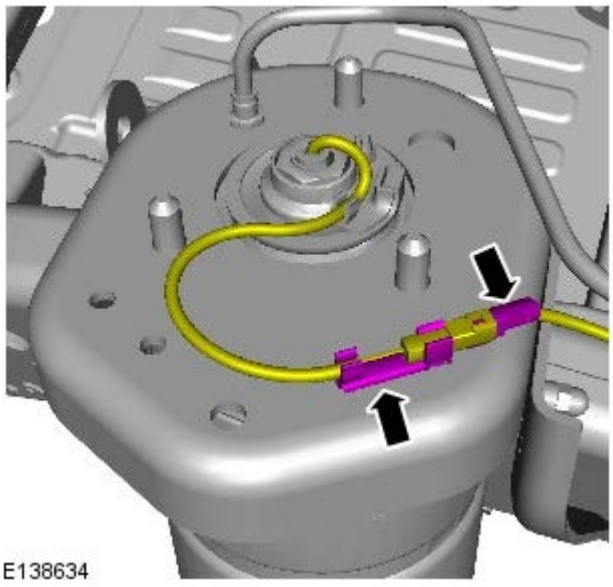
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

1. For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05 Vehicle Dynamic Suspension, General Procedures).
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

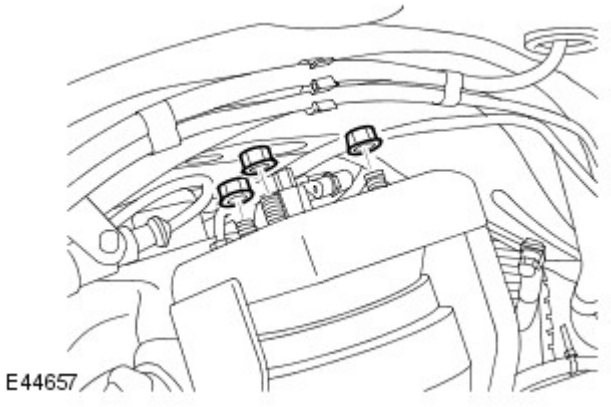
   Raise and support the vehicle.
3. Remove the wheel and tire.
4. Using the Land Rover approved diagnostic system, depressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05 Vehicle Dynamic Suspension, General Procedures).

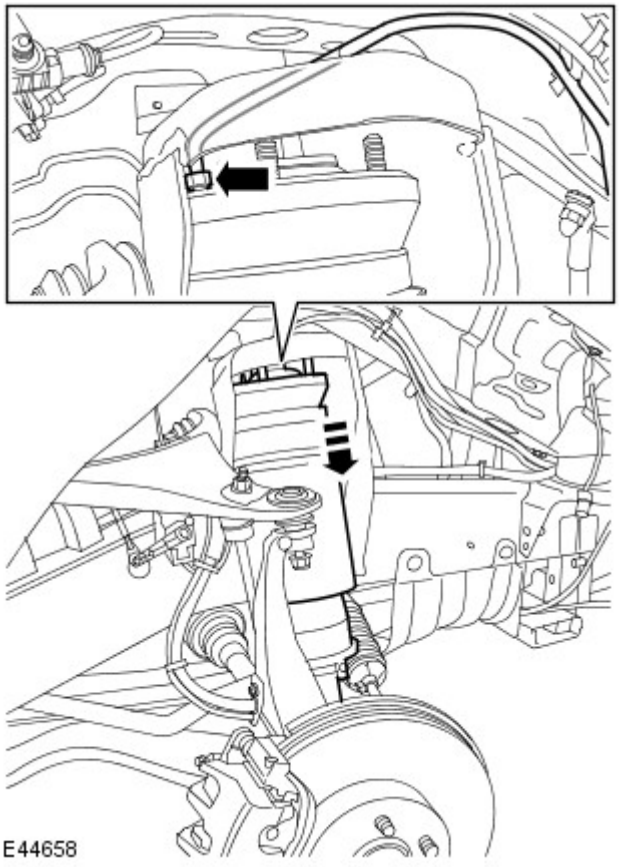

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5. Disconnect the shock absorber and air spring assembly from the lower arm.
   - Remove the nut and bolt.


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6. Disconnect the active damping wiring.
7. Release the shock absorber and air spring assembly.
   - Remove the 3 nuts.





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

   Release the shock absorber and air spring assembly and disconnect the air line.

9. Remove the shock absorber and air spring assembly.

10. Remove the Voss connector from the air line.
    - Remove and discard the collet and the union.

Installation

1. CAUTION: Make sure the new Voss connector is installed and fully tightened with the alignment plug installed.

   Install a new Voss connector to the air spring.
   - Tighten to 3.5 Nm (2.6 lb.ft)

2. NOTE: Remove and discard the blanking caps.

   Install the shock absorber and air spring assembly.
   - Make sure the shock absorber and air spring assembly top mounting to body mating faces are clean.
   - Fit the nuts and tighten to 63 Nm (46 lb.ft).
   - Connect the air line into the Voss connector.
   - Pull on the air line to make sure it is fully installed into the Voss connecter.

3. Attach the active damping wiring.

4. Connect the shock absorber and air spring assembly to the lower arm.
    - Do not fully tighten at this stage.

5. Using the Land Rover approved diagnostic system, pressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05 Vehicle Dynamic Suspension, General Procedures).

6. Tighten the shock absorber and air spring assembly to the lower arm.
    - Tighten the nut and bolt to 300 Nm (221 lb.ft).

7. Install the wheel and tire.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Vehicle Dynamic Suspension - Front Air Shock Absorber

Removal and Installation

Special Tool(s)

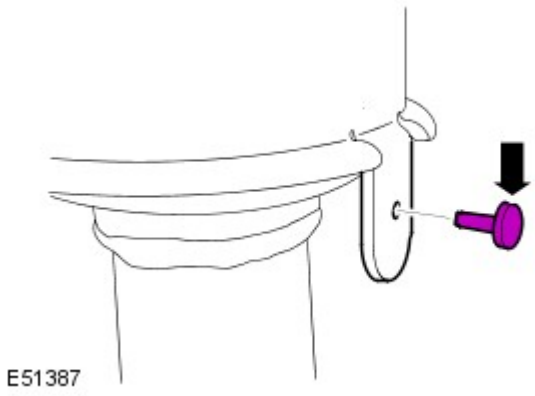
	Air spring tester 204-538
	Remover front air shocker absorber spindle nut 204-700

Removal

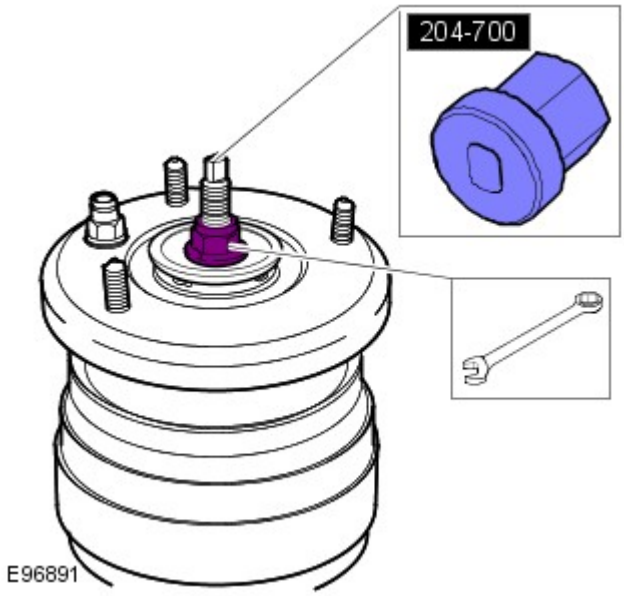
NOTE: This procedure should also be used to remove the front air spring.

1. Remove the front shock absorber and air spring assembly. For additional information, refer to: Front Shock Absorber and Air Spring Assembly (204-05 Vehicle Dynamic Suspension, Removal and Installation).
2. NOTE: If no leak is detected, investigate other areas of the air suspension for faults.

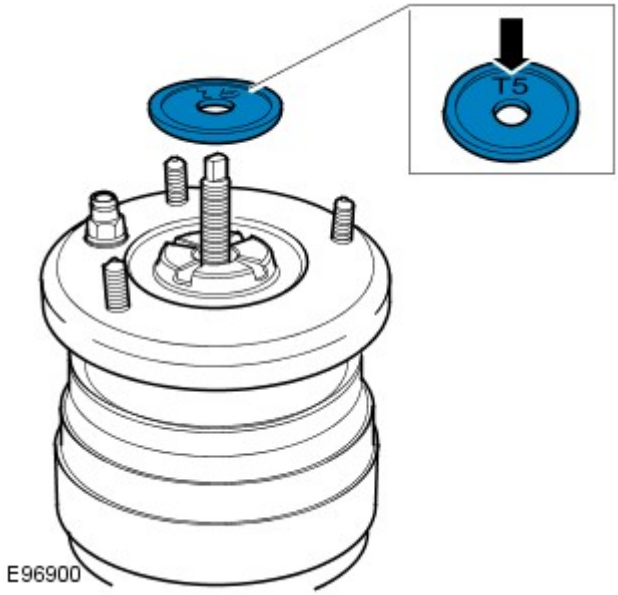
   Check the assembly for leaks.
   - Inflate the module to 4 bar and check for pressure loss using leak detector spray.
   - If a leak is suspected, immerse the shock absorber and air spring assembly in a tank of water to locate the source of the leak and mark the area.
3. Remove the nylon retaining pin.



4. Using the special tool, remove the nut.



5. Remove the rebound washer.

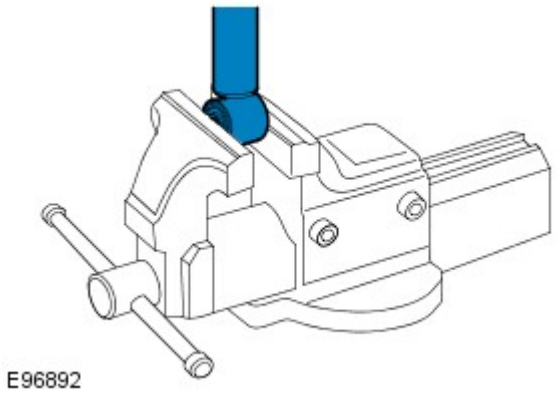


6. CAUTIONS:

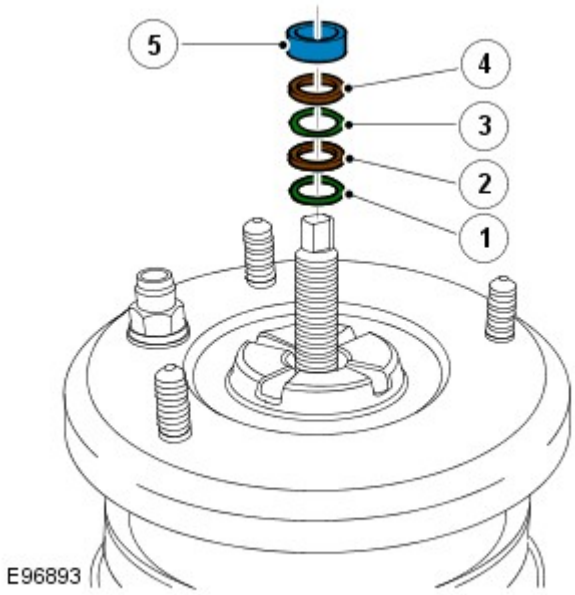
   Make sure protective jaws are installed to the vice. Failure to follow this instruction may result in damage to the component.

   Do not clamp the shock absorber tube. Failure to follow this instruction may result in damage to the component.

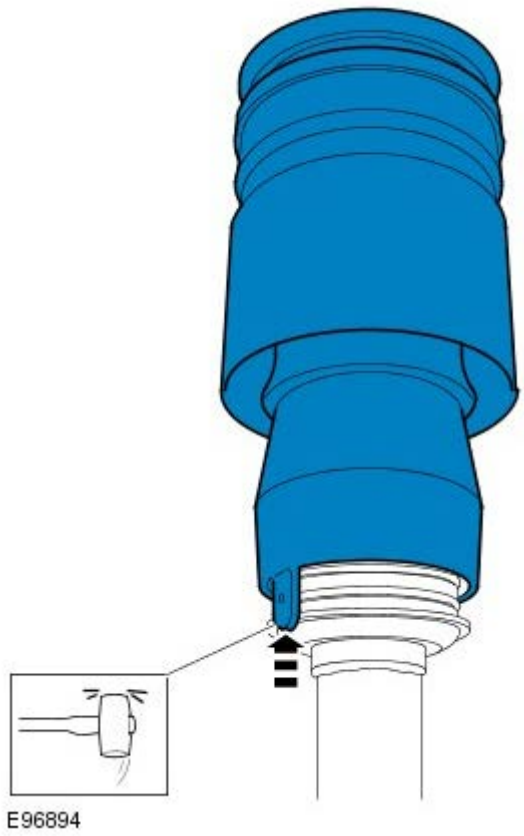
   Position the front shock absorber and air spring assembly in a vice.



7. Remove and discard the 3 spacers and 2 O-ring seals.

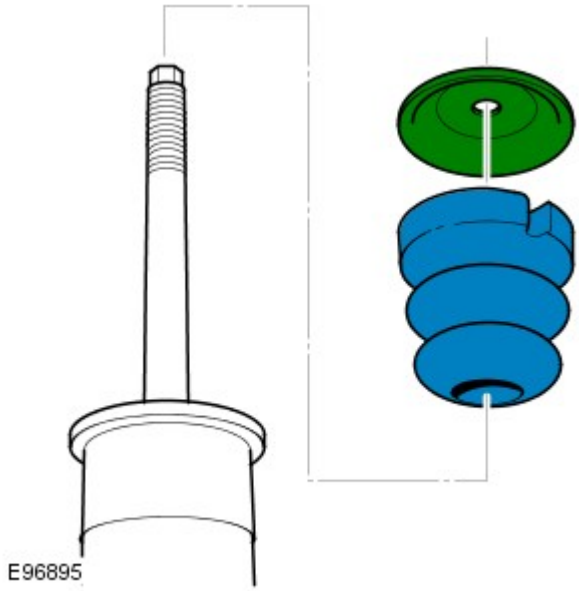


8. Remove the air spring.
    - Using a soft faced mallet, gently tap the sleeve support upwards to release it from the O-ring seals.

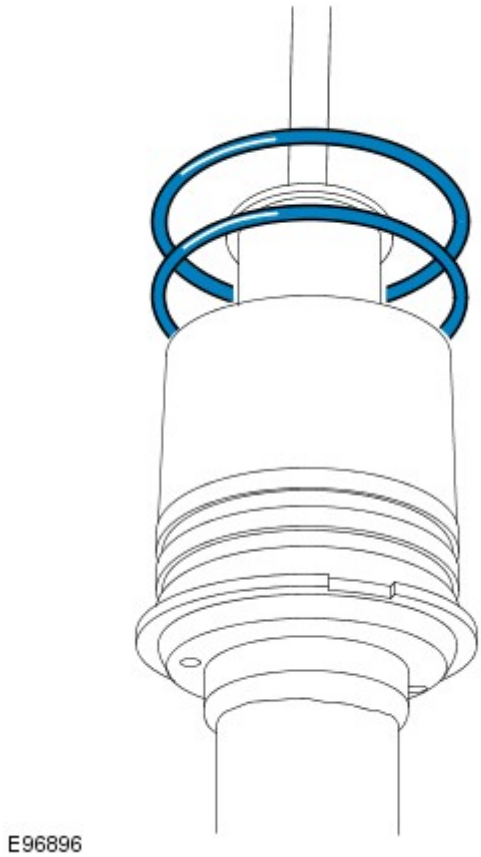


9. NOTE: Note the fitted position.

   Remove the bump plate and spring aid.


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10. Remove and discard the 2 large black O-ring seals from the lower seal carrier.


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11. Remove the front shock absorber and air spring assembly from the vice.

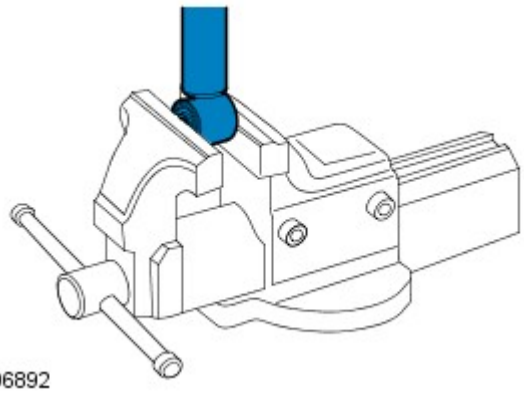
Installation

1. CAUTIONS:

   Make sure protective jaws are installed to the vice. Failure to follow this instruction may result in damage to the component.

   Do not clamp the shock absorber tube. Failure to follow this instruction may result in damage to the component.

   Position the front shock absorber and air spring



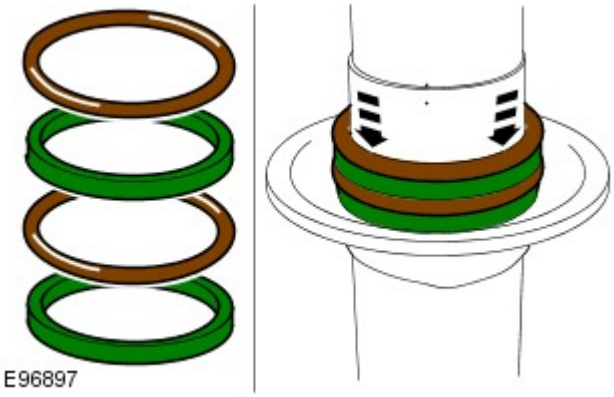
E96892

assembly in a vice.

2. CAUTION: Use compressed air and lint free non-flocking material.

   Clean the components.

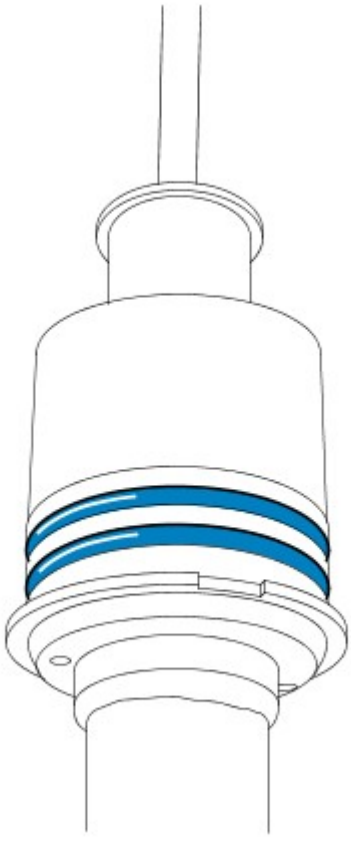
3. Lift the seal carrier to expose the O-ring seal stack.
   - Make sure that the damper body O-ring seals and spacers are fully seated to the spring seat.



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4. CAUTION: Take care not to damage the O-ring seals during installation.

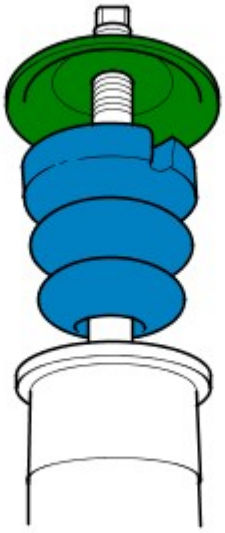
   Install new O-ring seals to the seal carrier.
   - Apply loctite 8021 (silicon-based oil) to the O-ring seals.



E96898

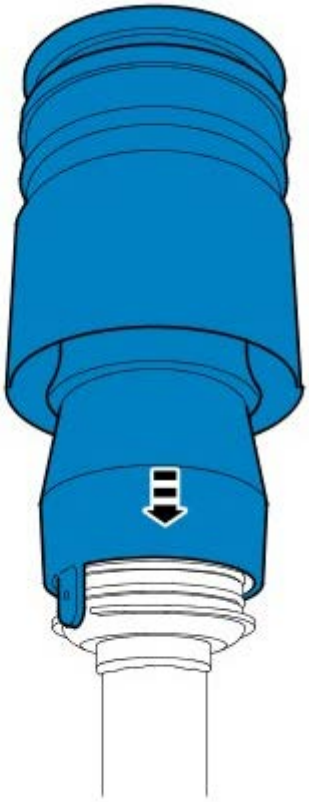
5. NOTE: Make sure that these components are installed to the noted removal position.

   Install the bump plate and spring aid.



E96899

6. Install the air spring.
    - Align the sleeve support with the first O-ring seal making sure that the location tag is correctly aligned with the spring seat cut-out.



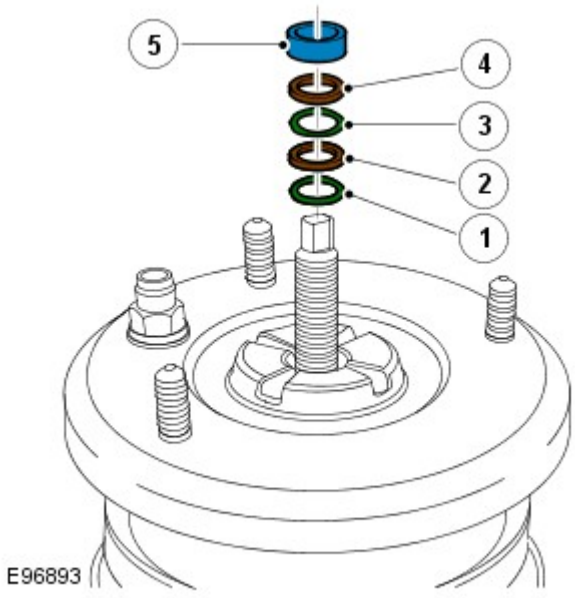
E99908

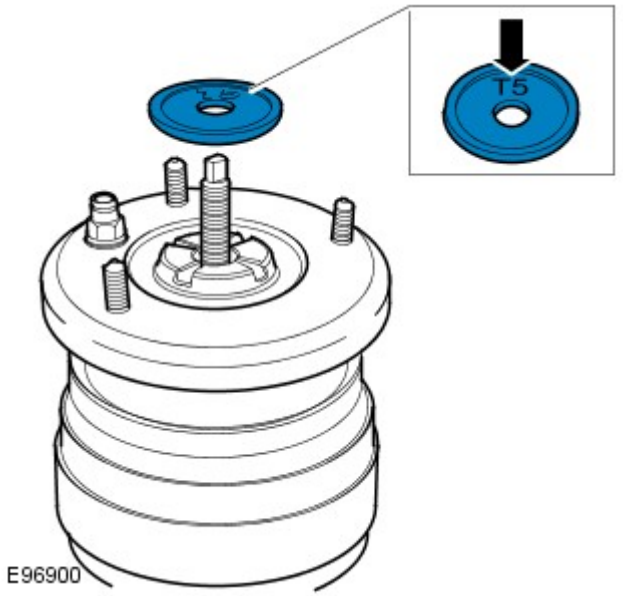
7. CAUTIONS:

    Make sure that the threads of the front air shock absorber are covered with protective tape.

    Take care not to damage the O-ring seals during installation.

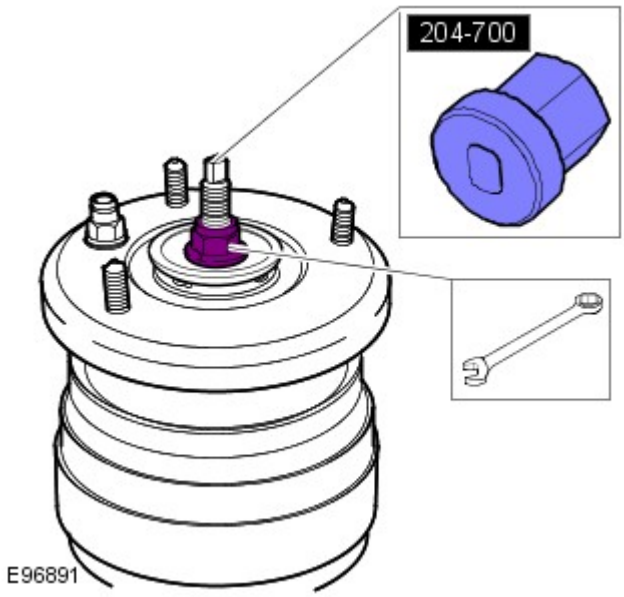
    Install the components in the following order:
    1. O-ring seal
    2. Spacer
    3. O-ring seal
    4. Spacer
    5. Spacer





8. NOTE: The "T5" stamp on the upper face of the rebound washer must be visable after assembly.

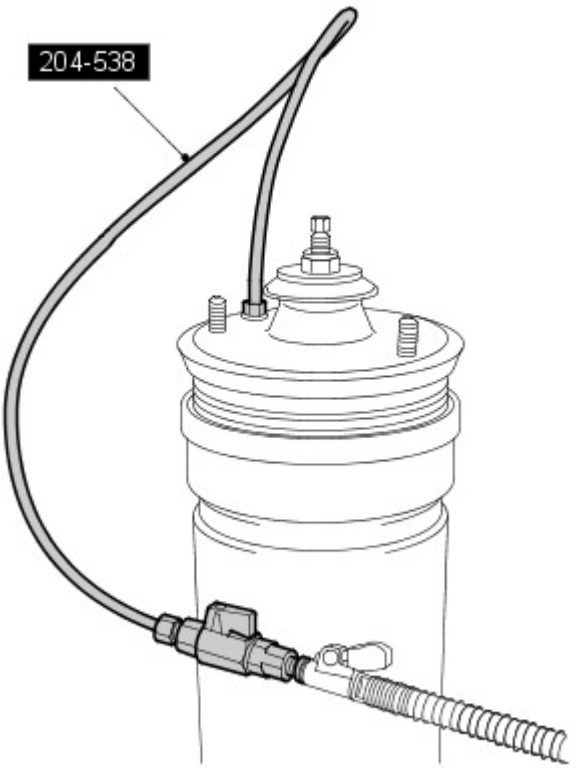
   Install the rebound washer.



9. Install a new nut and using the special tool, and tighten to 98 Nm (72 lb.ft).

10. CAUTIONS:

    The air supply must be free of any moisture.



E51445

If during disassembly the air sleeve is unrolled, the air sleeve may inflate incorrectly (to one side). If this occurs, release the air pressure, and insert a suitable tool that will not damage the air sleeve or piston (a screw driver handle), into the side opposite the bulge. Inflate and deflate until the air sleeve inflates correctly (the air sleeve will be uniform inside the shroud).

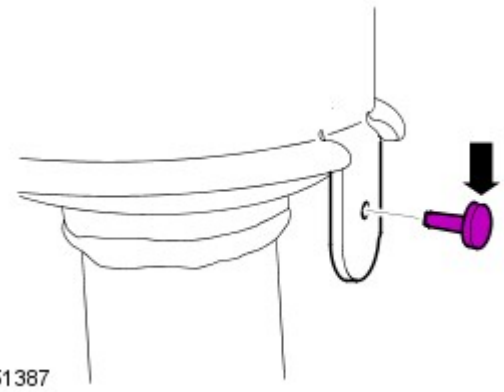
NOTE: To prevent damage when seating the sleeve support over the large black O-rings, compressed air should be used to inflate the air spring.

Using the special tool coupled to a tire inflator with a gauge, apply approximately 2 bar of air pressure to the air spring to fully seat the sleeve support over the O-ring seals.

11. Check the assembly for leaks.
    - Inflate the module to 4 bar and check for pressure loss using leak detector spray.
    - If a leak is suspected, immerse the shock absorber and air spring assembly in a tank of water to locate the source of the leak.

12. Depressurize and remove the special tool from the shock absorber and air spring assembly.

13. Install the nylon retaining pin.



E51387

14. NOTE: Install a new air spring pipe connector.

    Install the front shock absorber and air spring assembly. For additional information, refer to: Front Shock Absorber and Air Spring Assembly (204-05 Vehicle Dynamic Suspension, Removal and Installation).

Vehicle Dynamic Suspension - Suspension Height Sensor

Removal and Installation

Removal

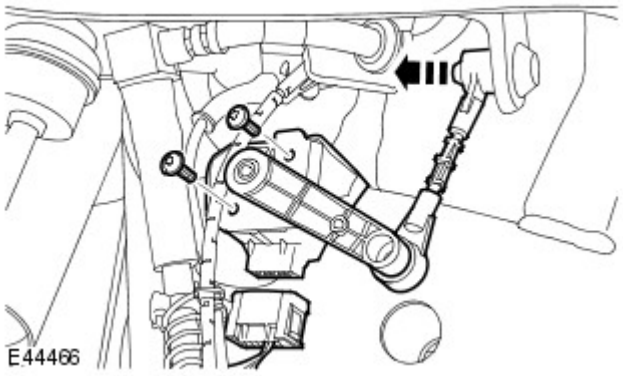
NOTES:

The rear height sensors are handed. The right hand sensor has a black colored lever and the left hand sensor has a white colored lever. The front height sensors are not handed, and are fitted with grey levers for identification.

This procedure covers removal and installation of both the front and rear suspension height sensors.

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. CAUTION: Do not use excessive force to disconnect the height sensor link.

   Remove the suspension height sensor.
   - Disconnect the height sensor link.
   - Disconnect the electrical connector.
   - Remove the 2 Torx screws.

Installation

1. CAUTION: Make sure the Torx screw is not over tightened. Failure to follow this instruction will result in damage to the vehicle.

   To install, reverse the removal procedure.
   - Tighten the screws to 3 Nm (2 lb.ft).

2. Using Land Rover approved diagnostic equipment, calibrate the ride hight.

Vehicle Dynamic Suspension - Air Suspension Reservoir

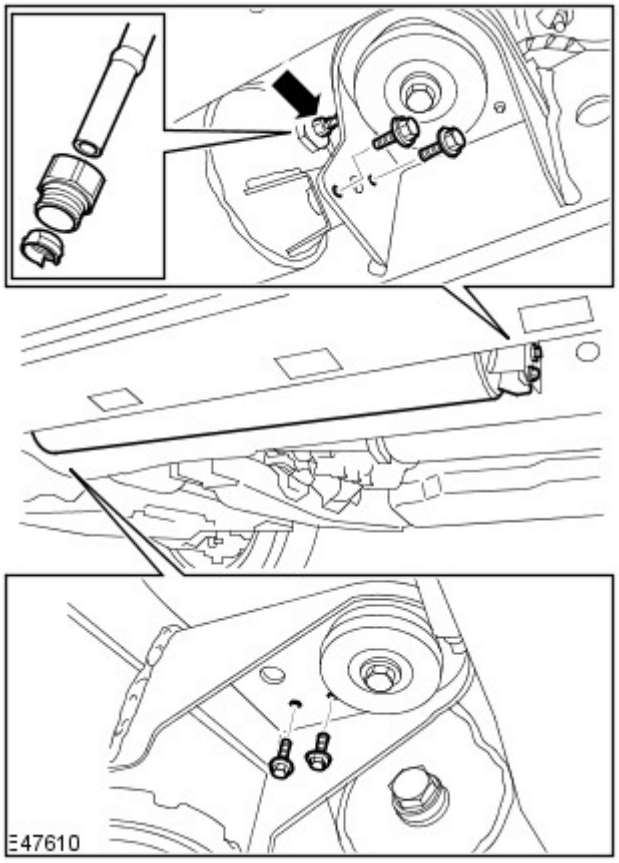
Removal and Installation

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. Using T4, depressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05 Vehicle Dynamic Suspension, General Procedures).



3. CAUTIONS:

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

   The air line must only be disconnected by removal of the voss connector. Do not remove the air line retaining boss from the air suspension reservoir. Failure to follow this instruction may result in damage to the vehicle.

   Visually inspect the air line ends for damage or wear. Repair or replace the air line as necessary.

   Disconnect the air line from the air suspension reservoir.

4. Remove the air suspension reservoir.
   - Remove the 4 bolts.

5. Remove the Voss connector from the air line.
   - Remove and discard the collet and the union.

Installation

1. CAUTION: Make sure the new Voss connector is installed and fully tightened with the alignment plug installed.

   Install a new Voss connector to the air reservoir.
   - Tighten the new Voss connector to 5 Nm (4 lb.ft).

2. Install the air suspension reservoir.
   - Locate the air reservoir to the chassis brackets, fit the bolts and tighten to 23 Nm (17 lb.ft).
   - Fully seat the air line into the Voss connector.
   - Pull on the air line to make sure it is fully installed into the Voss connecter.

3. Using T4, pressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05 Vehicle Dynamic

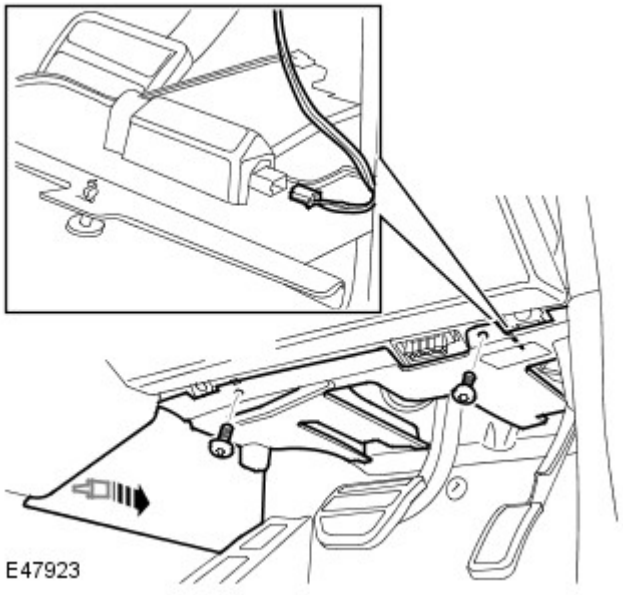
Suspension, General Procedures).

Vehicle Dynamic Suspension - Air Suspension Control Module
Removal and Installation

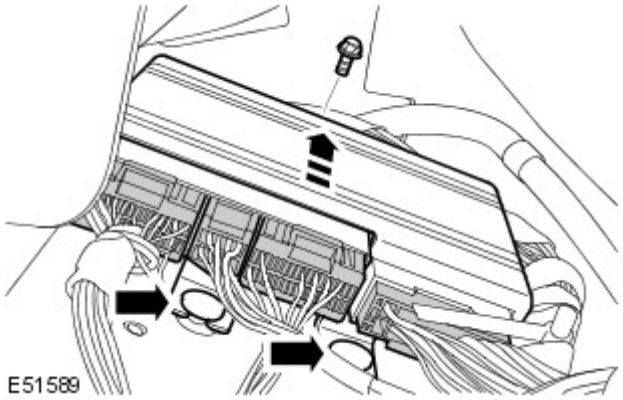
Removal

1. Driver side: Remove the cowl side trim panel.
   For additional information, refer to: Cowl Side Trim Panel (501-05, Removal and Installation).

2. Remove the closing trim panel.
   - Release the clip.
   - Remove the 2 screws.
   - Disconnect the electrical connector.



3. Remove the air suspension control module.
   - Disconnect the 4 electrical connectors.
   - Remove the bolt.
   - Release from the 2 clips.



Installation

1. Install the air suspension control module.
   - Secure with the clips.
   - Connect the electrical connectors.
   - Tighten the bolt to 9 Nm (7 lb.ft).

2. Install the closing trim panel.
   - Connect the electrical connector.
   - Secure the clip.
   - Tighten the screws.

3. Install the cowl side trim panel.
   For additional information, refer to: Cowl Side Trim Panel (501-05, Removal and Installation).

4. Initiate a new control module using T4.

Vehicle Dynamic Suspension - Air Suspension Reservoir Solenoid Valve Block

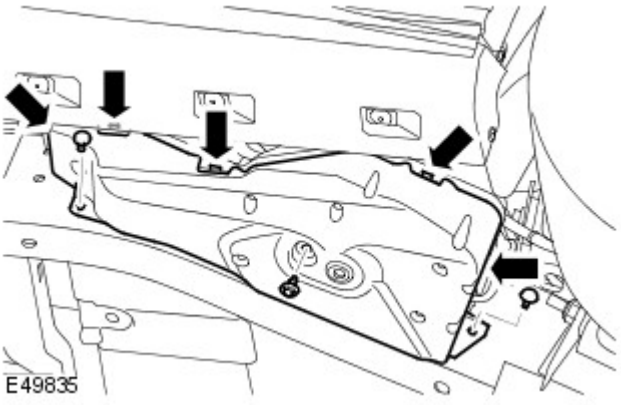
Removal and Installation

Removal

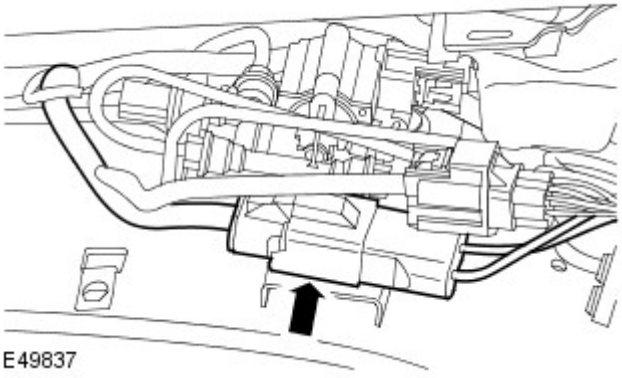
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

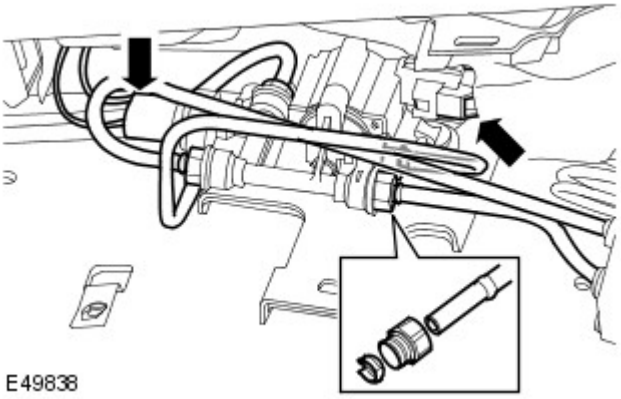
2. Using T4, depressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05, General Procedures).



3. Remove the air suspension compressor lower cover.
   - Remove the 3 bolts.
   - Release the 5 clips.



4. Move the air compressor electrical connector aside.
   - Release the 2 clips.



5. CAUTIONS:

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

   Visually inspect the air line ends for damage or wear. Repair or replace the air line as necessary.

   NOTE: Note the air line fitted positions.

   Remove the air suspension reservoir solenoid valve block.
   - Disconnect the 4 air lines.
   - Disconnect the 2 electrical connectors.
   - Release the valve block 3 rubber insulators.

6. Remove the Voss connectors.
   - Remove and discard the collets and the unions.

Installation

1.  CAUTION: Make sure the new Voss connector is installed and fully tightened with the alignment plug installed.

    NOTE: New air suspension components are supplied with new Voss connectors tightened to the correct torque. Do not install new voss connectors if a new component is being installed.

   Install new Voss connectors to the air suspension reservoir solenoid valve block.
   - Tighten to 2.5 Nm (1.7 lb.ft).

2.  NOTE: Make sure the valve block does not become detached during connection of the air lines.

   Install the air suspension reservoir solenoid valve block.
   - Secure the 3 valve block rubber insulators.
   - Connect the electrical connectors.
   - Connect the air lines into the Voss connector.
   - Pull on each air line to make sure it is fully installed into the Voss connecter.

3. Secure the air compressor electrical connector.

4. Install the air suspension compressor lower cover.
   - Install the bolts and tighten to 10 Nm (7 lb.ft).

5. Using T4, pressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05, General Procedures).

Vehicle Dynamic Suspension - Air Suspension Compressor Drier

Removal and Installation

Removal

CAUTION: If a new air suspension compressor, air compressor drier or air compressor delivery valve kit is installed due to failure, an air compressor relay must be installed. Failure to follow this instruction may result in damage to the air suspension system components.

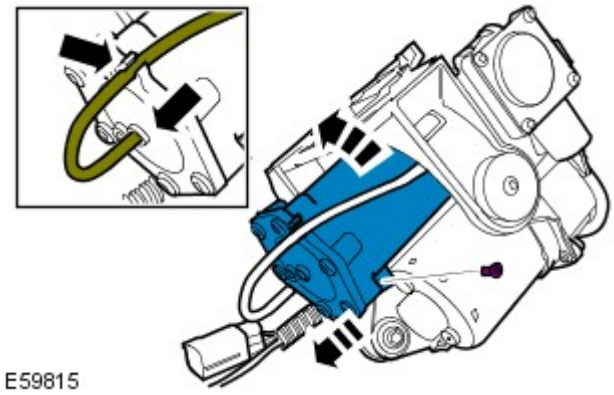
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Remove the air suspension compressor.
   For additional information, refer to: Air Suspension Compressor (204-05 Vehicle Dynamic Suspension, Removal and Installation).

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

   Disconnect the air line from the air suspension compressor drier.
   - Release the air line from the retaining clip.


E59815

4. NOTE: If equipped, note the position of the air suspension compressor retaining cable.

   Remove the air suspension compressor drier.
   - Remove the retaining screw.
   - Remove and discard the O-ring seal.

Installation

1. Install a new O-ring seal.
   - Lubricate the O-ring with a lithium based grease.

2. NOTE: If equipped, make sure the air suspension compressor retaining cable is correctly routed around the compressor cylinder head.

   Install the air suspension compressor drier.
   - Install the retaining screw and tighten to 3 Nm (2.2 lb.ft).

3. CAUTIONS:

   Visually inspect the air line ends for damage or wear. Replace the air line as necessary.

   Pull on the air line to make sure it is securely intalled in the connector.

   Connect the air line to the air suspension compressor drier.
   - Attach the air line to the retaining clip.

4. Install the air suspension compressor.

For additional information, refer to: Air Suspension Compressor (204-05 Vehicle Dynamic Suspension, Removal and Installation).

Vehicle Dynamic Suspension - Air Suspension Compressor

Removal and Installation

Removal

WARNING: Steps 1 and 2 must be carried out within 10 minutes of each other. Failure to follow this instruction may result in personal injury.

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

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

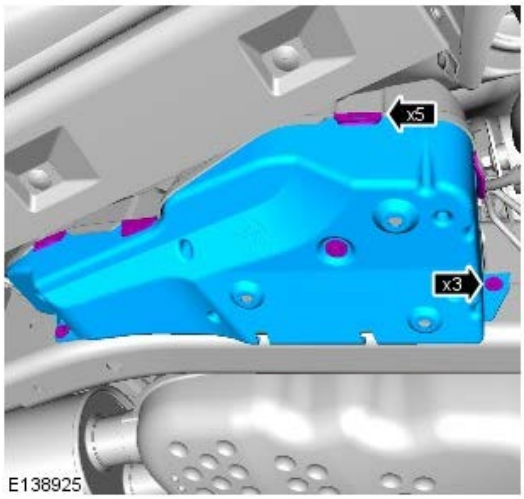
1. CAUTION: Make sure the ignition switch is turned off, the park brake is on and the selector lever is in park.

   Open the front door.

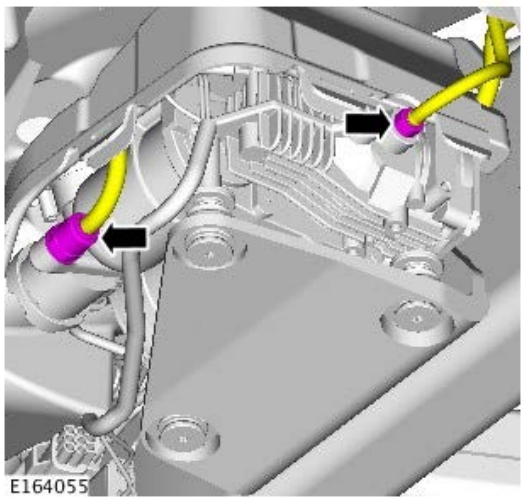
2. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle. Make sure at least one of the wheels is off the ground.

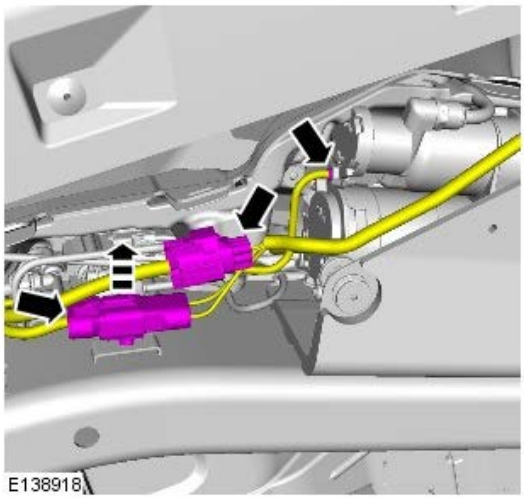
3.

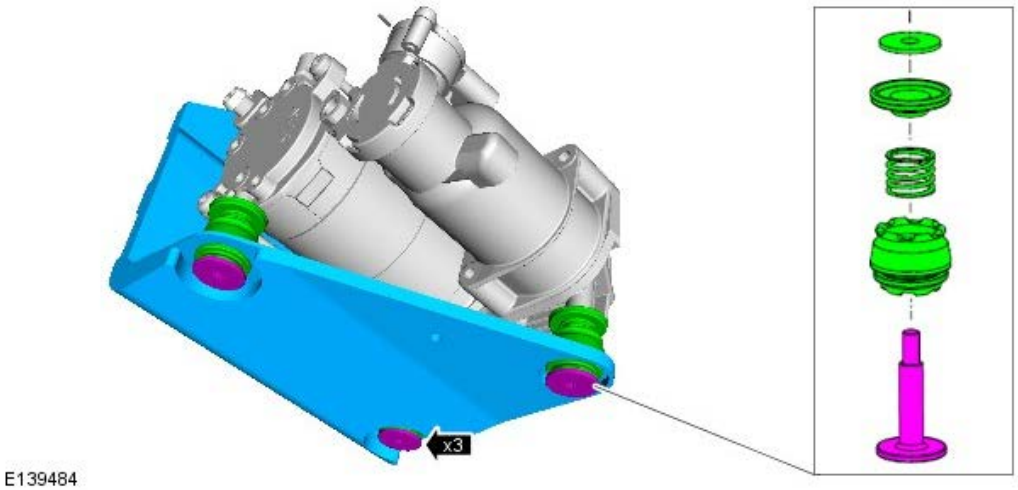


4. CAUTION: Always plug any open connections to prevent contamination.



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



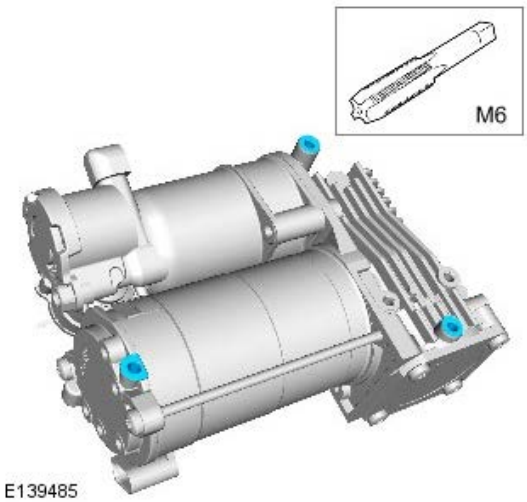


6. NOTE: Note the orientation of the component prior to removal.

Installation

1. NOTE: Check the air compressor type. If an AMK air compressor is installed to replace an Hitachi air compressor then a new corresponding relay must also be installed.

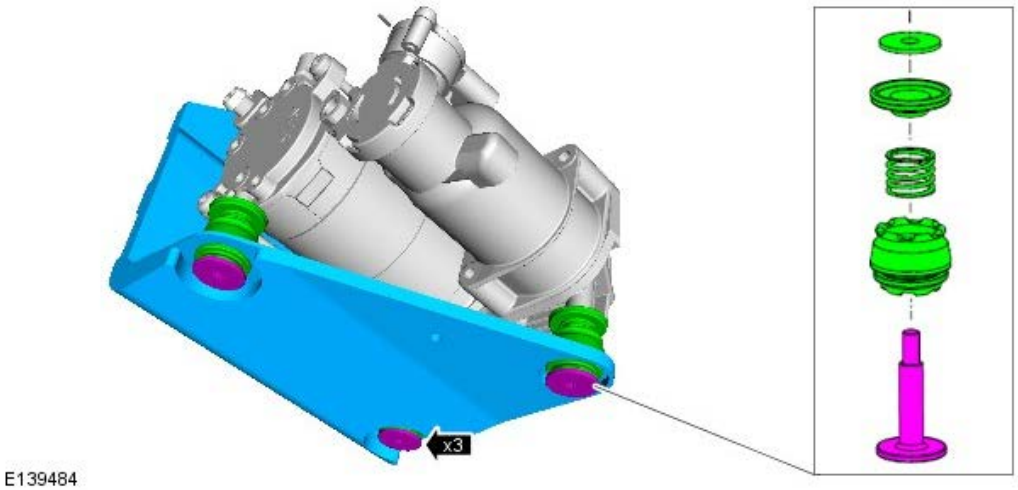
   For additional information, refer to: Specifications (204-05, Specifications).



2. CAUTION: Using a suitable tap, cut a starting thread to align the self tapping bolts.

3. CAUTIONS:

   Make sure that these components are installed to the noted removal



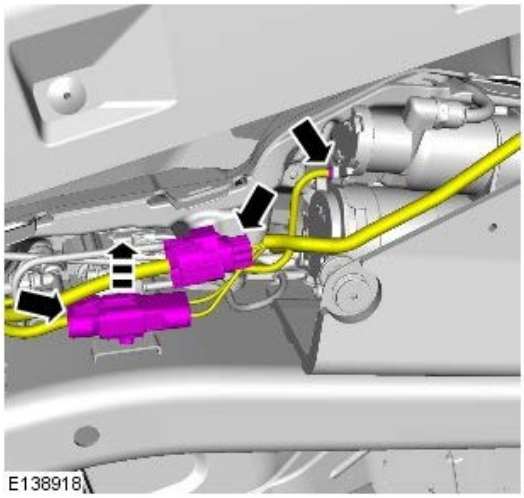
E139484

position.

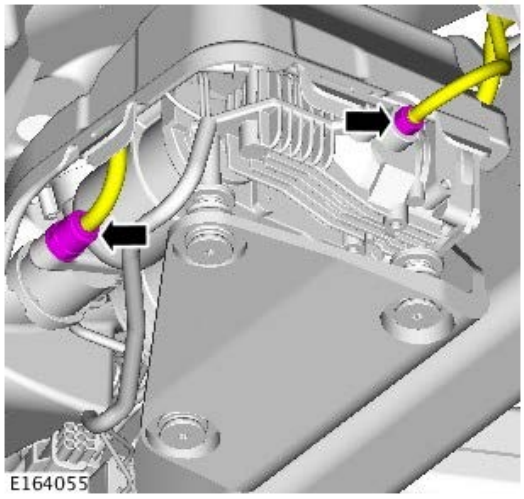
Make sure that the self tapping bolts remains aligned during the tightening process.

TORQUE: 10 Nm

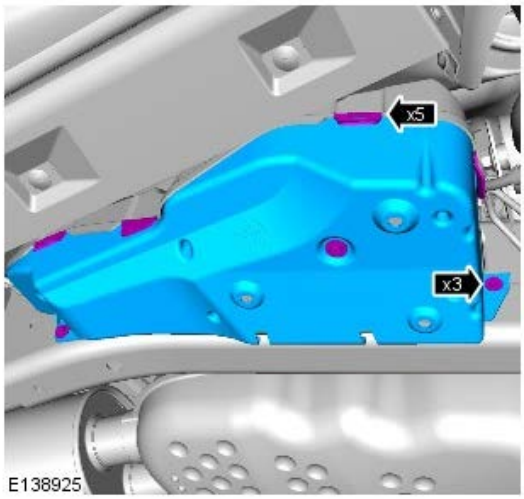
4.


E138918

5.


E164055

6. TORQUE: 9 Nm


x5
x3
E138925

Vehicle Dynamic Suspension - Air Suspension Front Solenoid Valve Block

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 RH fender splash shield.
   For additional information, refer to: Fender Splash Shield (501-02, Removal and Installation).

3. Using T4, depressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05, General Procedures).

4. CAUTIONS:

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

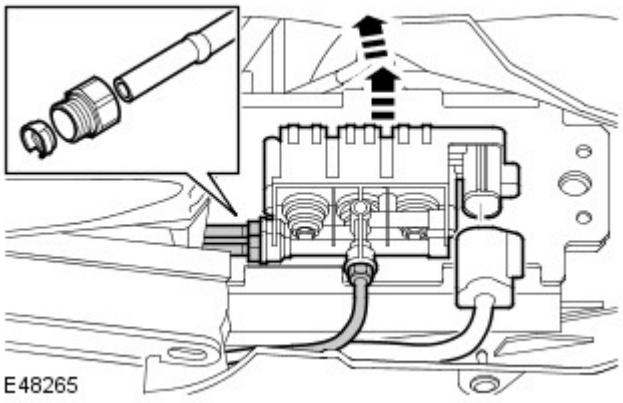
   Visually inspect the air line ends for damage or wear. Replace the air line as necessary.

   NOTE: Note the air line fitted positions.

   Disconnect the 3 air lines from the air suspension front solenoid valve block.

5. Remove the air suspension front solenoid valve block.
   - Disconnect the electrical connector.
   - Release the valve block 3 rubber insulators.

6. Remove the Voss connectors from the air lines.
   - Remove and discard the collet and the union.



Installation

1. CAUTION: Make sure the new Voss connector is installed and fully tightened with the alignment plug installed.

   NOTE: New air suspension components are supplied with new Voss connectors tightened to the correct torque. Do not install new voss connectors if a new component is being installed.

   Install new Voss connectors to the air suspension front solenoid valve block.
   - Tighten to 2.5 Nm (1.7 lb.ft).

2. NOTE: Make sure the valve block does not become detached during connection of the air lines.

   Install the air suspension front solenoid valve block.
   - Secure the 3 valve block rubber insulators.
   - Connect the air lines into the Voss connector.
   - Pull on each air line to make sure it is fully installed into the Voss connecter.
   - Connect the electrical connector.

3. Using T4, pressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05, General Procedures).

4. Install the RH fender splash shield.
   For additional information, refer to: Fender Splash Shield (501-02, Removal and Installation).

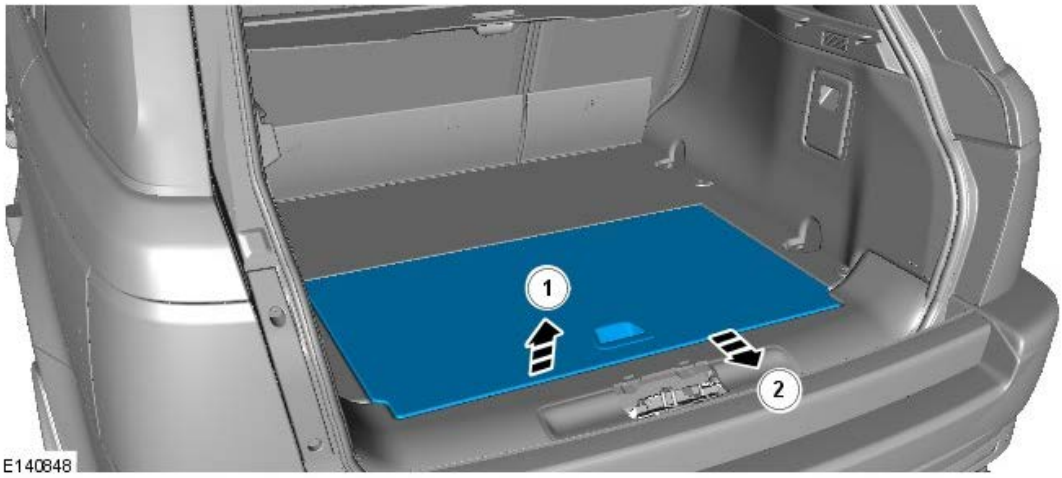
Vehicle Dynamic Suspension - Rear Shock Absorber and Air Spring Assembly

Removal and Installation

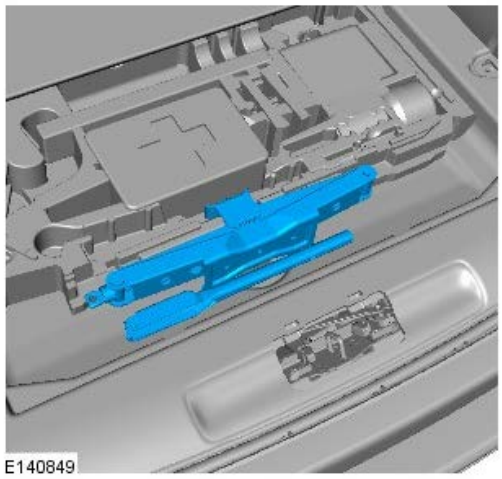
Removal

NOTE: RH illustration shown, LH is similar.

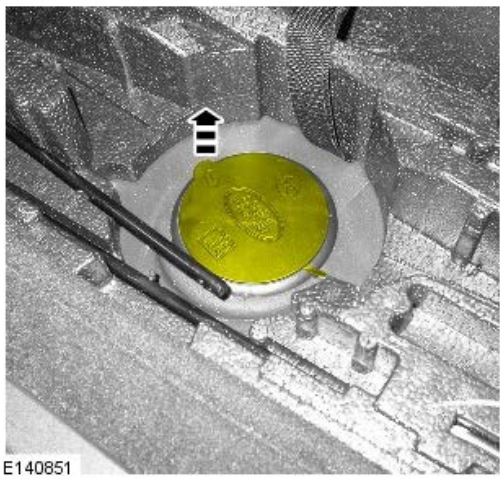
1. Using the Land Rover approved diagnostic system, depressurize the air suspension. For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05 Vehicle Dynamic Suspension, General Procedures).
2. Remove the loadspace floor panel.



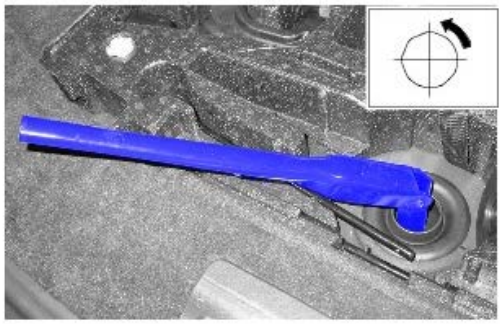
3. Remove the jack and wheel brace.



4. Remove the spare wheel/tool compartment cover.

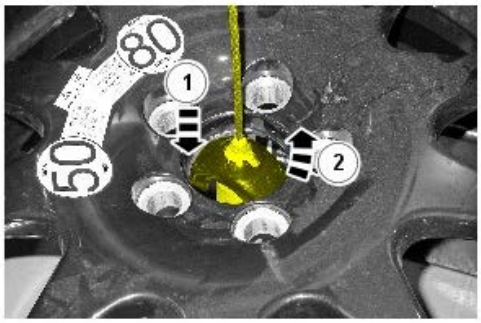


5. Lower the spare wheel and tire.





6. Remove the spare wheel.
   - Disconnect the spare wheel release strap and position aside.



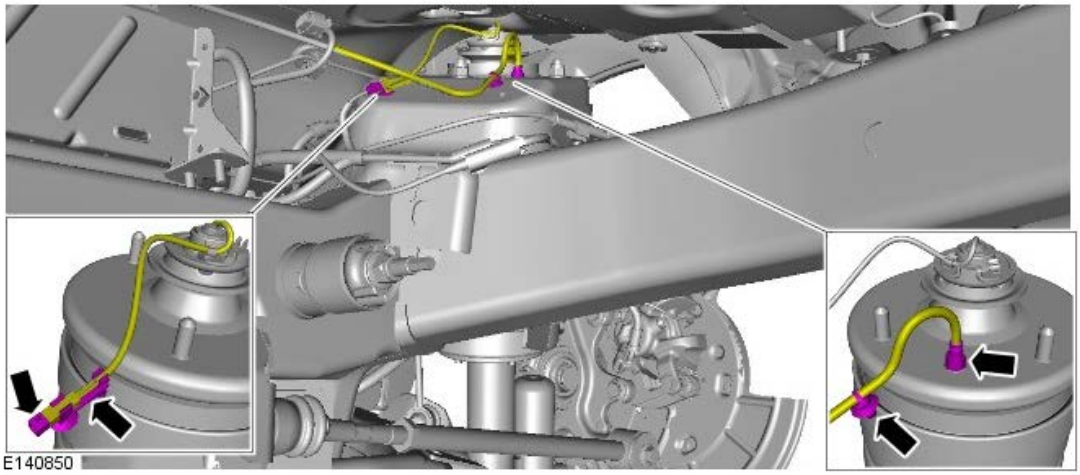


7. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

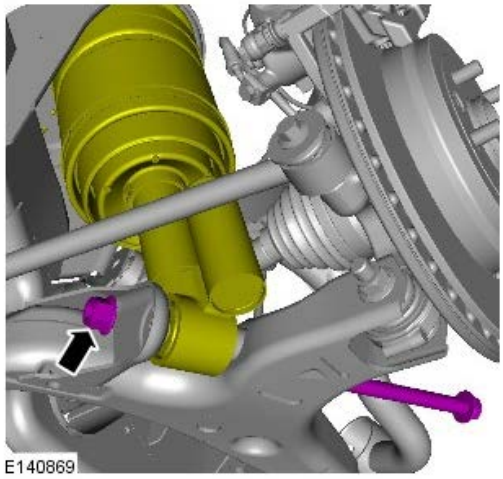
8. CAUTION: Make sure that all openings are sealed. Use new blanking caps.

   Remove the Voss connector from the air line.
   - Remove and discard the collet and the union.
   - Disconnect the active damping wiring.

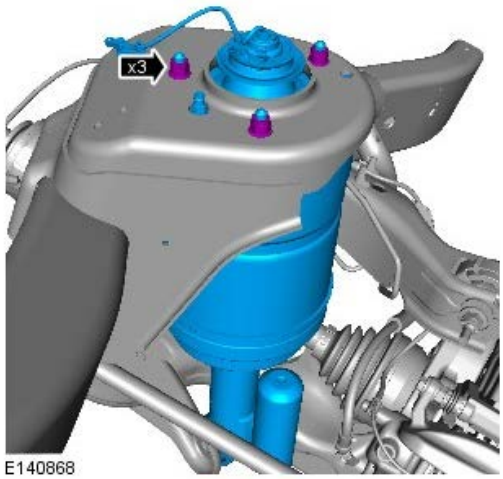


9. Remove the wheel and tire.

10. Disconnect the shock absorber and air spring assembly from the lower arm.
    - Remove the nut and bolt.



11. Remove the three shock absorber and air spring retaining nuts.
    - Remove the shock absorber and air spring assembly.



Installation

1. Install the shock absorber and air spring assembly.
    - Make sure the shock absorber and air spring assembly top mounting to body mating faces are clean.
    - Fit the nuts and tighten to 63 Nm (46 lb.ft).
    - Connect the air line into the Voss connector.
    - Pull on the air line to make sure it is fully installed into the Voss connecter.

2. Connect the shock absorber and air spring assembly to the lower arm.
    - Do not fully tighten at this stage.

3. Using the Land Rover approved diagnostic system, pressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05 Vehicle Dynamic Suspension, General Procedures).

4. Tighten the shock absorber and air spring assembly to the lower arm.
    - Tighten the nut and bolt to 300 Nm (221 lb.ft).

5. CAUTION: Make sure the new Voss connector is installed and fully tightened with the

alignment plug installed.

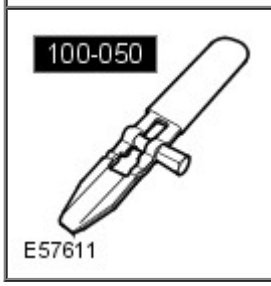
Install a new Voss connector to the air spring.
- Tighten to 3.5 Nm (2.6 lb.ft)
- Attach the active damping wiring.

6. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).
7. Lower the vehicle on the lift.
8. Connect the spare wheel release strap to the spare wheel and tire.
9. Install the spare wheel and tire.
   - Raise the spare wheel and tire.
10. Install the spare wheel/tool compartment cover.
11. Install the jack and wheel brace.
12. Install the loadspace floor panel.

Vehicle Dynamic Suspension - Rear Air Shock Absorber

Removal and Installation

Special Tool(s)

	Air spring tester 204-538
	Band-it Thrift tool 100-050 (LRT-99-019)

Removal

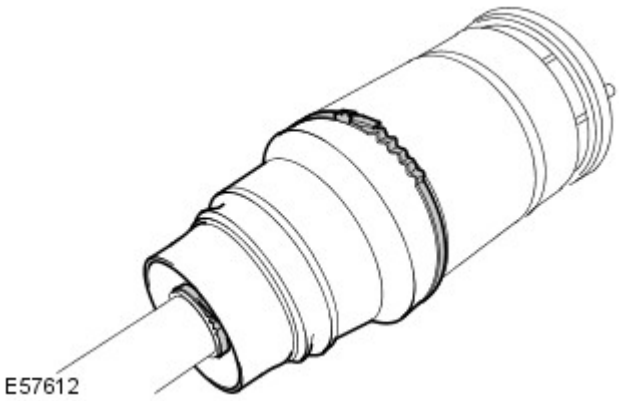
NOTE: This procedure should also be used to remove the rear air spring.

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

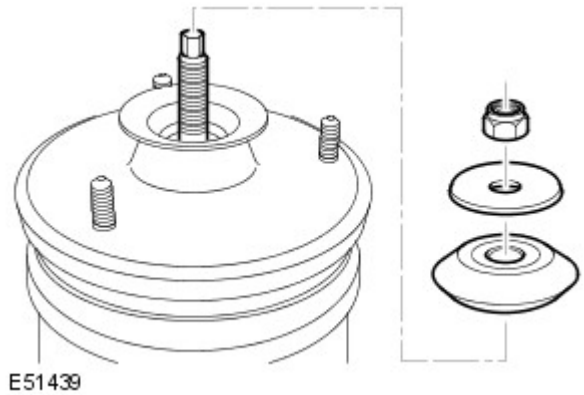
   Raise and support the vehicle.

2. Remove the wheel and tire.

3. Remove the shock absorber and spring assembly.
   For additional information, refer to: Rear Shock Absorber and Air Spring Assembly (204-05, Removal and Installation).

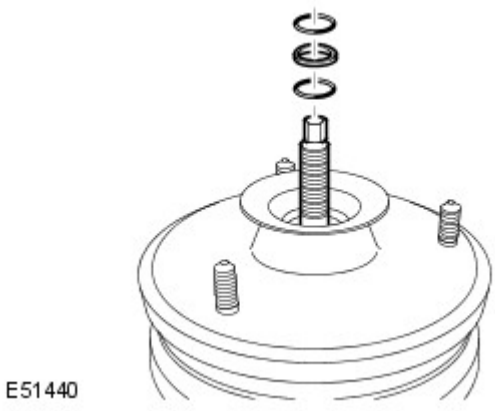


4. Remove the gaiter.
   - Remove and discard the 2 straps.



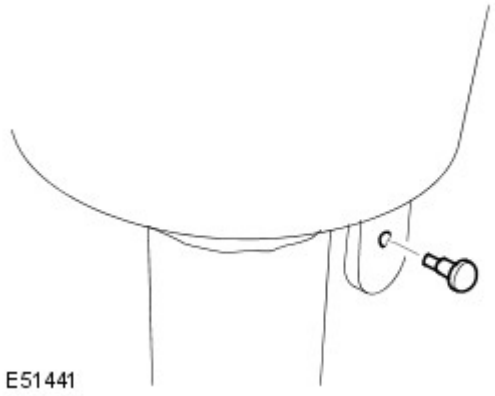
5. Remove the nut, rebound washer and rubber bushing.
   - Discard the nut.

6. Remove and discard the O-ring seals and spacer.



E51440

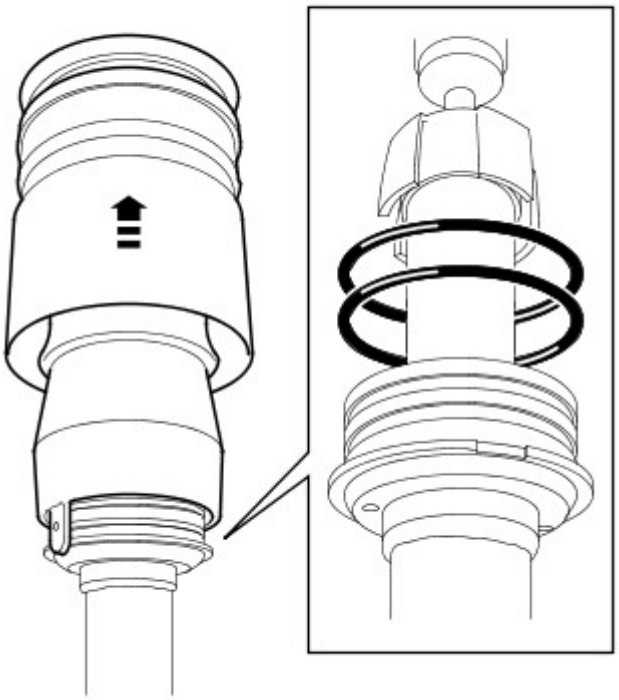
7. Remove the nylon retaining pin.



E51441

8. Remove the rebound plate and spring aid.

9. Remove the air spring.
   - Using a soft faced mallet, gently tap the sleeve support upwards to release it from the O-ring seals.
   - Remove and discard the 2 O-ring seals.



E51442

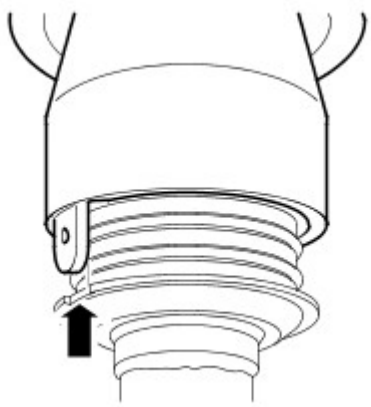
10. Remove the shock absorber from the vise.

Installation

1. Install the shock absorber in the vise.
2. Clean the components.

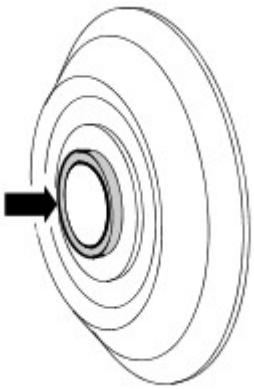
3. Lubricate and install new O-rings to the seal carrier.

4. Install the spring aid and rebound plate.


E51443

5. Install the air spring.
   - Align the piston with the first O-ring seal, making sure the location tag is correctly aligned.

6. Install the new O-ring seals and spacer, taking care not to damage the seals.


E51444

7. Install the rubber bushing and rebound washer.
   - Make sure the formed insert on the bushing is located against the O-ring seal.

8. Install and lightly tighten the nut.

9. CAUTIONS:

   The air supply must be free of any moisture.

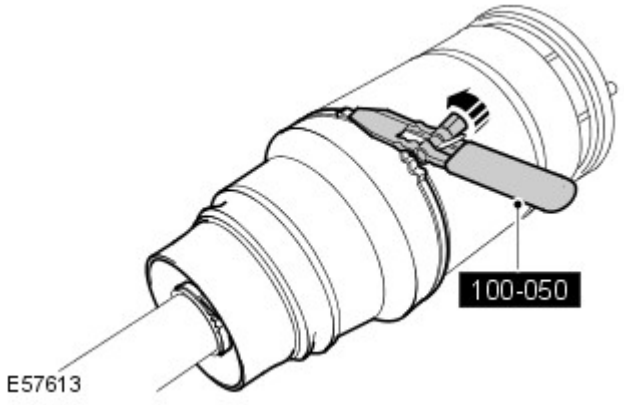
   If during disassembly the air sleeve is unrolled, the air sleeve may inflate incorrectly (to one side). If this occurs, release the air pressure, and insert a suitable tool that will not damage the air sleeve or piston (a screw driver handle), into the side opposite the bulge. Inflate and deflate until the air sleeve inflates correctly (the air sleeve will be uniform inside the shroud).

   Install the air spring piston over the O-ring seals.
   - Using the special tool coupled to a tire inflator with a gauge, apply approximately 2 bar of air pressure to the air spring to fully seat the piston over the O-ring seals.

10. Tighten the top nut to 98 Nm (72 lb.ft).

11. Check the assembly for leaks.
    - Inflate the module to 4 bar and check for pressure loss.
    - If a leak is suspected, immerse the spring and shock absorber assembly in a tank of water to locate the source of the leak.

12. Install the gaiter.
    - Using the special tool, install new straps.



13. Install the shock absorber and spring assembly.
    For additional information, refer to: Rear Shock Absorber and Air Spring Assembly (204-05, Removal and Installation).

Vehicle Dynamic Suspension - Air Suspension Rear Solenoid Valve Block

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 LH rear wheel and tire.

3. Using T4, depressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05, General Procedures).

4. CAUTIONS:

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

   Visually inspect the air line ends for damage or wear. Repair or replace the air line as necessary.

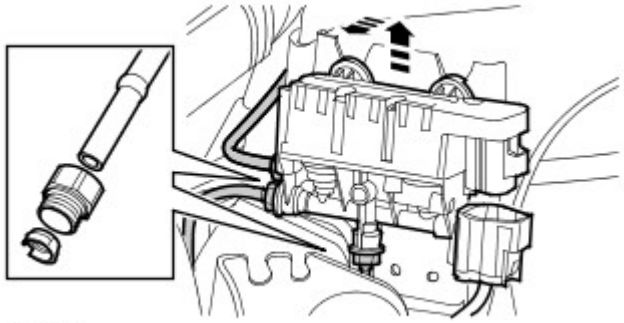
   NOTE: Note the air line fitted positions.

   Disconnect 3 air lines from the rear valve block.

5. Disconnect the electrical connector.

6. Remove the rear valve block.
   - Release the valve block 3 rubber insulators.

7. Remove the Voss connectors from the air lines.
   - Remove and discard the collets and the unions.



E48266

Installation

1. NOTE: New air suspension components are supplied with new Voss connectors tightened to the correct torque. Do not install new voss connectors if a new component is being installed.

   Install new Voss connectors to the rear valve block.
   - Tighten to 2.5 Nm (1.7 lb.ft).

2. Install the rear valve block.
   - Secure the 3 valve block rubber insulators.
   - Connect the electrical connector.
   - Connect the air lines into the Voss connector.
   - Pull on each air line to make sure it is fully installed into the Voss connecter.

3. Using T4, pressurize the air suspension.
   For additional information, refer to: Air Suspension System

Depressurize and Pressurize (204-05, General Procedures).

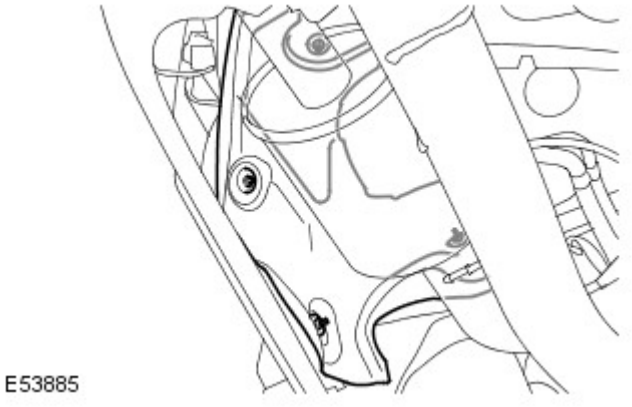
4. Install the wheel and tire.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Vehicle Dynamic Suspension - Air Suspension Air Filter

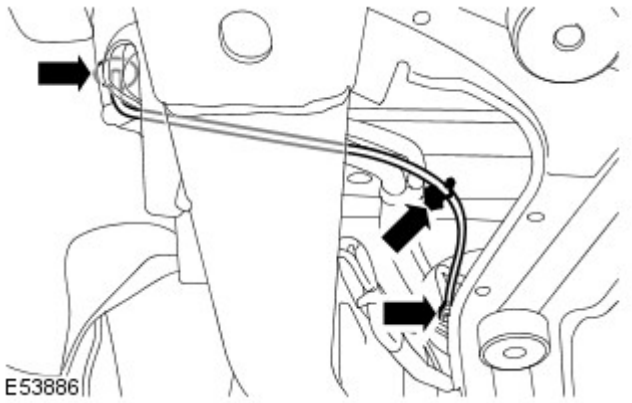
Removal and Installation

Removal

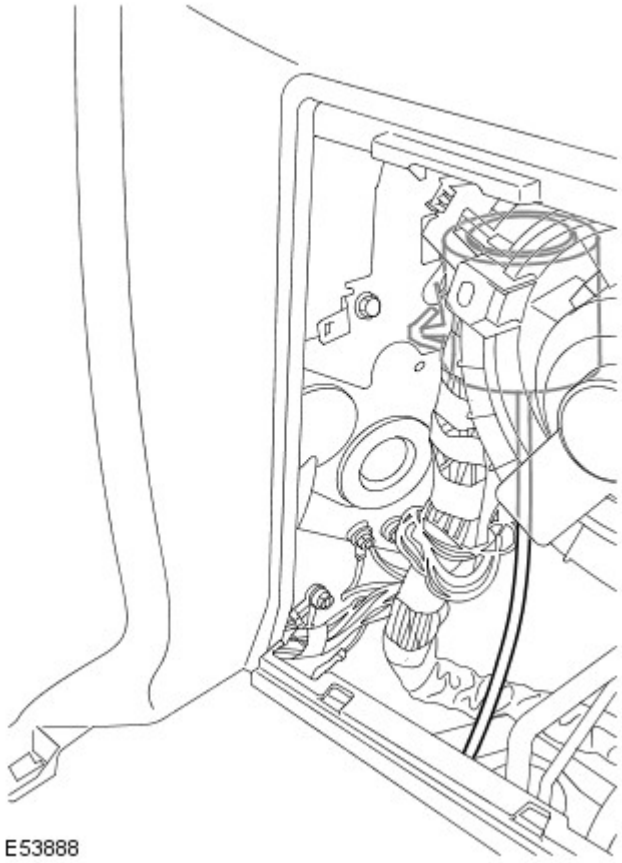
1. Open the liftgate and tailgate.
2. Remove the spare wheel and tire.
3. Remove the 4 nuts securing the LH rear tail pipe heat shield.



4. Reposition the LH rear tail pipe heat shield.
5. Disconnect the air suspension intake filter line.
6. Detach the air suspension intake filter.
   - Release the grommet.
   - Release from the clip.



7. Remove the LH lower rear quarter trim panel.
   For additional information, refer to: Rear Quarter Trim Panel (501-05, Removal and Installation).
8. Remove the air suspension intake filter.



Installation

1. NOTE: Make sure the air suspension air filter retaining clip is fully seated in the vehicle body. An audible click will be heard when the retaining clip is fully seated.

   Install the air suspension intake filter.
   - Install the grommet.

2. Install the LH rear quarter trim panel.
   For additional information, refer to: Rear Quarter Trim Panel (501-05, Removal and Installation).

3. Attach the air suspension intake filter.

4. Connect the air suspension intake filter line.

5. Reposition the LH rear tail pipe heat shield.
   - Install the nuts.

6. Install the spare wheel and tire.

7. Close the liftgate and tailgate.

Vehicle Dynamic Suspension - Air Suspension Muffler

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.

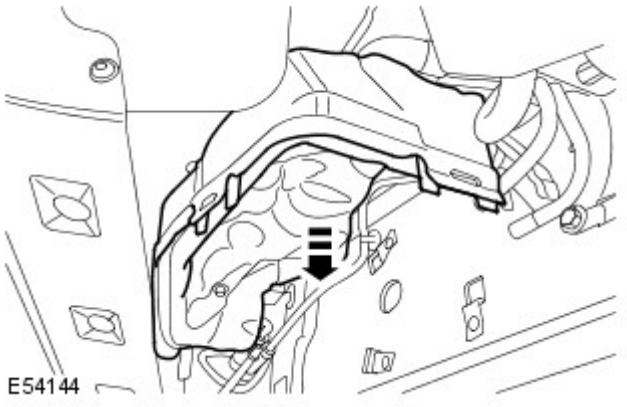
   Raise and support the vehicle.

2. Remove the muffler assembly.
   For additional information, refer to: Muffler (309-00B Exhaust System - 4.4L, Removal and Installation).

3. Remove the evaporative emissions canister.
   For additional information, refer to: Evaporative Emission Canister (303-13B, Removal and Installation).

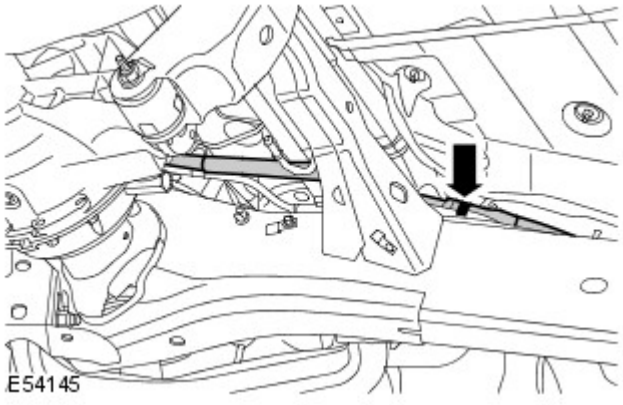
4. Remove the air suspension compressor.
   For additional information, refer to: Air Suspension Compressor (204-05, Removal and Installation).

5. Remove the air suspension compressor upper cover.



6. Disconnect the air suspension intake filter pipe.

7. Remove the air suspension muffler.
   - Release clip from the air suspension muffler pipe.
   - Release the air suspension compressor to air suspension silencer pipes.



Installation

1. Install the air suspension muffler.
   - Locate the air suspension muffler pipes.
   - Secure the clip.

2. Connect the air suspension intake filter.

3. CAUTION: Make sure the air suspension compressor upper cover is correctly positioned.

   Install the air suspension compressor upper cover.

4. Install the air suspension compressor.
   For additional information, refer to: Air Suspension Compressor (204-05, Removal and Installation).

5. Install the evaporative emissions canister.
   For additional information, refer to: Evaporative Emission Canister (303-13B, Removal and Installation).

6. Install the muffler assembly.
   For additional information, refer to: Muffler (309-00B Exhaust System - 4.4L, Removal and Installation).

Vehicle Dynamic Suspension - Air Suspension Pressure Sensor

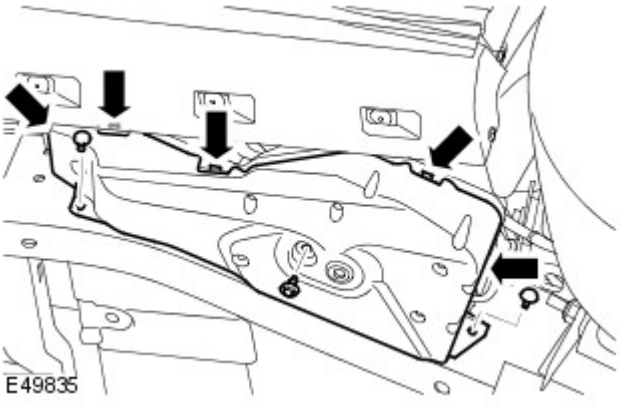
Removal and Installation

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 air compressor housing cover.
   - Remove the 3 bolts.
   - Release the 5 clips.



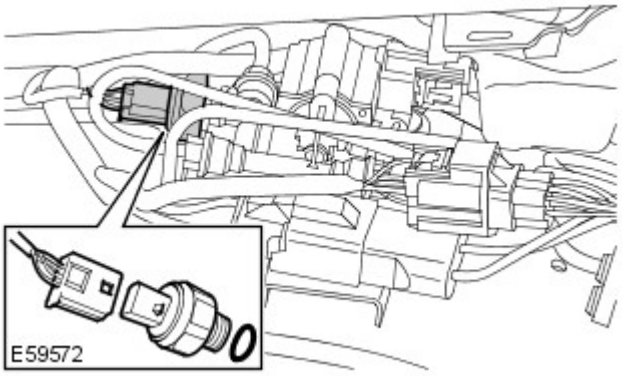
3. Using T4, depressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05, General Procedures).

4. NOTE: Make sure the valve block does not become detached during removal of the air pressure sensor.

   Disconnect the electrical connector.

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

   Remove the air pressure sensor.
   - Remove and discard the O-ring seal.



Installation

1. NOTE: Make sure the valve block does not become detached during installation of the air pressure sensor.

   Install the air pressure sensor.
   - Install a new O-ring seal.
   - Tighten to 5 Nm (4 lb.ft).

2. Connect the electrical connector.

3. Using T4, pressurize the air suspension.
   For additional information, refer to: Air Suspension System Depressurize and Pressurize (204-05, General Procedures).

4. CAUTIONS:

   Make sure the air suspension compressor upper cover is

correctly positioned.

 Make sure the air suspension exhaust pipe is correctly located in to the air suspension upper cover.

Install the air compressor housing cover.

- Install the bolts and tighten to 9 Nm (7 lb.ft).

Ride and Handling Optimization -

General Specifications

Item	Specification
Dynamic Response fluid	Texaco Cold Climate Fluid 33270
Capacity	2.4 Liters (4.2 pints) (2.5 US quarts)
System pressure	Variable between 3-165 bar dependant on lateral acceleration

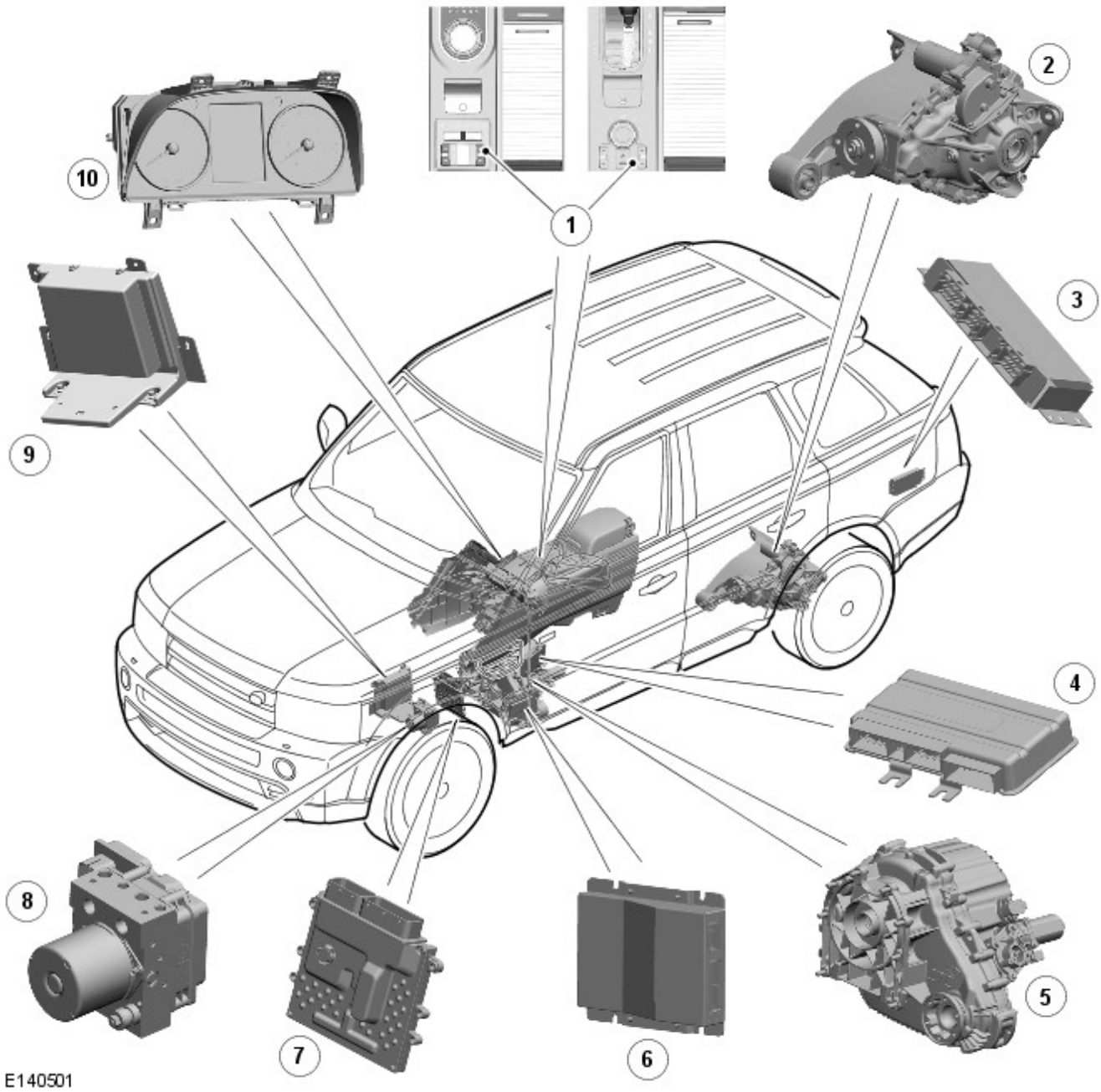
Torque Specifications

Description	Nm	lb-ft
Dynamic Response actuator bleed screw	15	11
Dynamic Response pump bolts	23	17
Fluid pipe banjo bolt	35	26
Dynamic Response pump drive pulley bolts	22	16
Radiator access panel	10	7
Dynamic Response module	4	3
* Front actuator pipes to valve block nuts	22	16
Valve block bolts	22	16
* Rear actuator pipes to valve block nuts	22	16
Dynamic Response fluid pipe securing bracket nuts/bolts	9	7
Valve block filter access plug	62	46
Body mount bolts	133	98
Upper suspension arm to wheel knuckle nut	70	52
Wheel speed sensor	9	7
Brake caliper to wheel knuckle bolt	275	203
Brake hose bracket bolt	23	17
Fluid lines to actuator bolts	22	16
* Stabilizer bar link nut	175	129
Valve block transducer	25	18
Front stabilizer bar to body clamp bolts	115	85
Rear stabilizer bar to body clamp bolts	62	46
LH stabilizer bar to actuator bolts	120	89

*** New nuts/bolts must be installed**

Ride and Handling Optimization - Ride and Handling Optimization
Description and Operation

Terrain Response - Component Location



Item	Part Number	Description
1	-	Terrain Response control and control module
2	-	Rear differential
3	-	Rear differential control module
4	-	Air suspension control module
5	-	Transfer box (center differential and high/low range)
6	-	Adaptive Damping Module (ADM)
7	-	ECM (engine control module)
8	-	ABS (anti-lock brake system) module
9	-	Transfer box control module
10	-	Instrument cluster

GENERAL

The Terrain Response™ system allows the driver to select a program which aims to provide the optimum settings for traction and performance for the prevailing terrain conditions. The system cannot be switched off. The 'special programs off' is the default program and covers all general driving conditions. Four specific terrain programs are selectable to cover all terrain surfaces.

The system is controlled by a rotary control located on the center console, rearward of the selector lever (automatic transmission) or gearshift lever (manual transmission). The rotary control allows the selection of one of the following five programs:

- Special programs off
- Grass/Gravel/Snow
- Mud-Ruts
- Sand
- Rock crawl.

The rotary control can be rotated through 360 degrees or more in either direction and selects each program in turn. When Terrain Response is fitted to a vehicle the instrument cluster will display the selected program in the message center.

The Terrain Response system uses a combination of a number of vehicle subsystems to achieve the required vehicle characteristics for the terrain selected. The following subsystems make up the Terrain Response system:

- Engine management system
- Automatic transmission (if fitted)
- Transfer box (center differential)
- Rear differential (electronically controlled)
- Brake system (ABS/DSC/ETC/HDC functions)
- Air suspension.

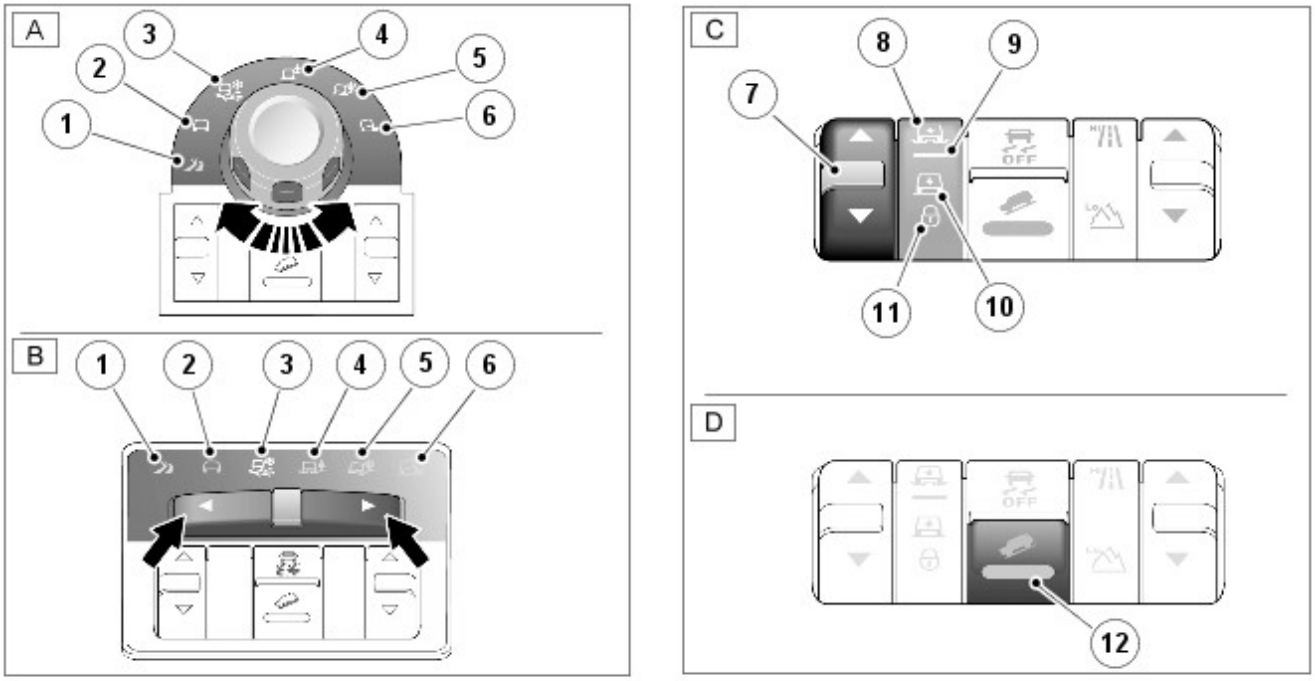
A Terrain Response control module is located below the rotary control. The control module detects the selection made on the rotary control and transmits a signal on the high speed CAN (controller area network) which is received by each of the subsystem control modules.

Each of the affected sub-system control modules contain software which applies the correct operating parameters to their controlled system for the Terrain Response program selection made.

Each sub-system control module also provides a feedback for the selected program so that the Terrain Response control module can check that all systems have changed to the correct operating parameters.

Information is displayed in the instrument cluster message center which informs the driver of improvements which can be made to the vehicle operating parameters to optimise the vehicle for the prevailing conditions. Inexperienced off-road drivers may benefit from the automatic assistance of the Terrain Response system and the driver information. Experienced off-road drivers can select the specific programs for extreme conditions to access control over the vehicle systems (e.g., throttle shift maps or traction settings) which are not accessible on vehicles without Terrain Response.

AIR SUSPENSION AND TERRAIN RESPONSE SWITCH PACK



E140319

Item	Part Number	Description
A	-	Terrain Response™ control - Non-Electronic Transmission Shifter
B	-	Terrain Response™ control - Electronic Transmission Shifter
C	-	Air suspension switch location in switch pack
D	-	Hill Descent Control (HDC) switch location in switch pack
1	-	Dynamic
2	-	General program (special programs off)
3	-	Grass/Gravel/Snow
4	-	Mud-Ruts
5	-	Sand
6	-	Rock crawl
7	-	Raise/lower switch
8	-	Off-Road Mode
9	-	On-Road Mode
10	-	Access Mode
11	-	Crawl (Locked at Access) Mode
12	-	Hill Descent Control (HDC) switch

Each program is denoted by a symbol which represents the terrain encountered. The rotary control can be depressed downwards to lock it in a position flush with the trim surround. A second push of the control releases the lock and the control emerges from the surround allowing it to be rotated.

The rotary control can be rotated to select the required program. The control will only select the last program in its direction of rotation. Further rotation of the control once the last program in either direction has been selected, will

have no effect, e.g. once rock crawl has been selected, further rotation in a clockwise direction will have no effect.

The Terrain Response control module is located below the rotary control. The module is connected via a harness connector which also contains the wiring for the HDC switch, the transfer box high/low range switch, the air suspension switch and the switch illumination circuits. The control module and switch uses four of these wires for a 12V battery supply when the ignition switch is in ignition position II, a ground and high speed CAN positive and negative.

TERRAIN RESPONSE OPERATION

The following vehicle subsystem control modules are used for the Terrain Response system:

- Engine management (engine control module)
- Transmission control (transmission control module - automatic transmission only)
- Transfer box control (transfer box control module)
- Rear differential control (rear differential control module - if fitted)
- Air suspension control (air suspension control module)
- Brake system (ABS/DSC/ETC/HDC functions) (ABS module)

Each subsystem operates in different ways in relation to the selected Terrain Response program to achieve the optimum traction, stability and ease of control for the terrain encountered. The system has a safety factor built in which ensures that any program can be safely used on any surface, even when an inappropriate program selection has been made.

ECM

The ECM varies the throttle pedal response to control the engine torque output. The ECM can change the throttle maps to change the amount of torque per percentage of pedal travel. The ECM can also change the throttle response to control the allowed torque change relative to the percentage pedal travel.

Each terrain program uses a combination of operating parameters for each subsystem. Changing between terrain programs initiates a different set of operating characteristics which will be noticeable to the driver. The driver will notice differences in engine and throttle response when, for example, the throttle pedal is held in a constant position and the terrain program is changed from grass/gravel/snow to sand, the driver will notice the torque and engine speed increase. If the terrain program is changed from sand to grass/gravel/snow the driver will notice a reduction in torque and engine speed.

 NOTE: The change in torque and engine speed can take approximately 30 seconds and care must be taken not to confuse the Terrain Response system operation with an ECM fault.

Transmission Control

The transmission control module changes the shift maps for the Terrain Response program selected. This changes the shift points providing early or late upshifts and downshifts.

On slippery surfaces the transmission will select 2nd gear in high range or 3rd gear in low range for starting from a standstill to minimise wheel slip. In muddy conditions the transmission will provide maximum torque output from the transmission. In sand the transmission will provide an output which passes maximum engine power from the transmission.

In rock crawl special program (low range) the transmission will select 1st gear for driving off.

Sport mode is only available when the general program is selected and the transfer box is in high range. Sport mode is disabled in low range and all Terrain Response special programs. CommandShift™ is available in any program and also in high or low range.

If the transmission is in 'Sport' mode and a special program is subsequently selected, the transmission will automatically change to manual 'CommandShift™' mode. If a special program is already selected and the transmission selector lever is moved from drive 'D' to the 'Sport' mode position, the transmission will automatically change to 'CommandShift™' mode.

Transfer Box and Rear Differential Control

The transfer box electronically controlled differential and the rear electronically controlled differential (if fitted) are treated as one system. The electronic rear differential is an optional fitment on vehicles fitted with the Terrain Response system. The differential control has two operating strategies; pre-emptive and reactive.

The pre-emptive strategy anticipates and predicts the locking torque value required for each differential to minimise slip and maximise stability. Each Terrain Response program has a different threshold and input criteria for the pre-emptive strategy. The pre-emptive strategy improves vehicle traction and composure by avoiding wheel spin. This is achieved by anticipating the amount of differential lock required for the program selected. For example, a high locking torque would be applied for rock crawl or slippery surfaces.

The reactive strategy varies the amount of locking torque in response to the actual slip level and the dynamic behaviour of the vehicle. Each Terrain Response program has a different threshold and input for the reactive strategy. The reactive strategy improves vehicle traction and composure by eliminating any wheel spin which has occurred after the pre-emptive strategy was applied. The locking response applied is applicable to the terrain program selected, for example, very sensitive on slippery surfaces to provide maximum traction and minimise surface damage.

The locking torque calculations use various signals from other subsystems, for example, engine torque, throttle position, selected gear, steering angle, vehicle speed, lateral acceleration and yaw behaviour.

The Dynamic Stability Control function of the ABS system can override the Terrain Response differential control and reduce any applied locking torque during DSC action.
For additional information, refer to: Anti-Lock Control - Traction Control (206-09A Anti-Lock Control - Traction Control, Description and Operation).

Air Suspension Control

The air suspension control module contains a strategy which provides automatic switching between normal and off-road heights. Changes in vehicle height settings will be relayed to the driver via the instrument cluster message center and LED (light emitting diode) illuminated icons on the switch. The automatic selection and deselection of the vehicle height provides automatic increase and decrease in ground clearance and aims to provide maximum benefit to the selected terrain program.

On a vehicle fitted with a correctly installed, Land Rover approved trailer socket, if an electrical load is sensed on the trailer socket, height changes are prohibited and the message center displays a message advising that a trailer is connected and off-road height is not automatically selected. The driver can raise the suspension manually using the air suspension switch.

 NOTE: The prohibiting of the automatic ride height selection is only operational if a Land Rover approved trailer socket is fitted and an electrical load is sensed on the socket.

ABS Control

The ABS module controls several vehicle functions and adjusts the operating parameters of these functions to optimise the selected Terrain Response program.

Traction control uses different slip/acceleration thresholds to improve traction and vehicle composure. For example, the system sensitivity is increased on slippery surfaces to reduce wheel spin.

If DSC is switched off (with the DSC switch on the instrument panel) when using a Terrain Response special program, if the special program is subsequently changed for a different program DSC is automatically switched back on.

The stability control uses different threshold values for the selected program to automatically reduce DSC intervention, removing the requirement for the driver to disable the DSC system in order to reduce engine intervention which is sometimes induced in extreme off-road conditions. In extreme sand conditions, there may be an additional benefit of disabling the DSC function using the DSC switch on the instrument panel in addition to selecting the sand program.

HDC is automatically switched on or off and target speeds are adjusted in response to the Terrain Response program selected. The responsiveness of the HDC function is also increased where required.

Automatic operation of HDC aims to assist the driver by switching the system on or off when it is of most benefit. Target speeds for HDC operation are also adjusted according the vehicle operating conditions.

Incorrect Program Usage

Selection of an inappropriate program is discouraged in the following ways:

- The active program icon is continually displayed in the instrument cluster message center
- The Terrain Response control module 'locks' out certain functions in some programs, e.g.
  - cruise control is only available with the special programs off or grass/gravel/snow program
  - transmission 'Sport' mode is deactivated in all special programs.
- In any special program, except the grass/gravel/snow program, when the ignition has been in the off position, continually for more than six hours, the Terrain Response system defaults to the Special Programs off. When in the grass/gravel/snow program, the Terrain Response system will never default to the Special Programs off. This is to allow for drivers in cold climates where continuous use of the grass/gravel/snow program would be beneficial.
- The rock crawl program is only available with the transfer box in low range.

Selection of an inappropriate program for the terrain conditions will not endanger the driver or cause damage to the vehicle. Continued use of an inappropriate program may reduce the life of some components. The driver may notice reduced vehicle response, with the engine and transmission being less responsive than in the special programs off. Also, in some programs, HDC will remain on, signified by illumination of the HDC indicator in the instrument cluster. The driver may also notice torque 'wind-up' in the center and rear differentials causing a 'braking' effect when the vehicle is manoeuvred in some special programs.

The use of the special programs in the Terrain Response system is monitored by the Terrain Response control module which records the mileage and time the vehicle has operated in a specific program in high and low range. This information can be retrieved using T4 and used by the dealer technician to check customer concerns, e.g. high fuel consumption which may be due to continued use of a certain program.

Driver Information

The instrument cluster contains a message center which displays vehicle information to the driver. The message center contains the Terrain Response program icons which display the currently selected program. If no symbol is displayed, no special program is selected and the system is in special programs off.

Any required changes to the subsystems are also passed to the driver in the form of indicator illumination in the instrument cluster or appropriate messages in the message center, HDC off or air suspension height change for example.

In certain operating conditions, the Terrain Response system also displays advice or warning messages to ensure the driver is using the vehicle to its full potential, e.g.

- Steering angle is displayed in the message center to avoid driving in deep ruts with steering lock applied
- gear information is displayed to recommend a gear for slippery conditions
- if the system automatically provided off road ride height, but the driver subsequently lowers the vehicle to normal height, then the system may advize that this will cause a risk of grounding.

The messages which can be displayed in the instrument cluster message center are detailed in the Information and Message Center section.
For additional information, refer to: Information and Message Center (413-08 Information and Message Center, Description and Operation).

DIAGNOSTICS

The Terrain Response control module stores information on detected Terrain Response faults and CAN errors which can be interrogated using T4. The Terrain Response sub-systems and the instrument cluster also store fault information relating to CAN errors from the Terrain Response control module.

The control module also stores the miles travelled and time elapsed in high range for the individual programs and in low range for use of all programs which can also be retrieved using T4. This information aids diagnosis of the Terrain Response system and also provides an indication of Terrain Response system abuse by the driver which can lead to premature component failure.

Terrain Response System Fault Diagnosis

Terrain Response relies on the correct functionality of the five sub-systems. If one of the sub-systems develops a fault, the Terrain Response system will not function, even though the fault is not in the Terrain Response system. The Terrain Response control module and rotary control should only be investigated if there are no apparent faults in any of the sub-systems. If a fault in a sub-system is subsequently corrected, the Terrain Response system will function normally after an ignition on and off cycle.

Terrain Response Sub-System Faults

If a fault occurs in a sub-system, the driver is alerted by the illumination of a warning indicator and/or an appropriate message for that sub-system in the instrument cluster message center. There will be no warning of a Terrain Response system fault.

When a sub-system fault is present and the driver attempts to select a different Terrain Response program using the rotary control or at the next ignition on cycle, a message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' will appear in the message center. This implies that the Terrain Response system has a fault, but only because a sub-system fault is preventing its operation. This message will be displayed for 5 seconds per ignition cycle, but is repeated if a further selection is made by the driver using the Terrain Response rotary control or at the next ignition on cycle.

NOTE: The message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' can also be generated by a fault in the Terrain Response rotary control or control module. See following section for details of rotary control or control module faults.

It is not possible for the Terrain Response control module to cause any fault behaviour (warning indicator illumination or message generation) in any of the five sub-systems. Illumination of a sub-system warning indicator and/or a sub-system related message will never be associated with a Terrain Response control module or Terrain Response system fault.

The sub-system control modules can detect a fault with the CAN signal from the Terrain Response control module. If a fault in the Terrain Response system is detected, the sub-system control modules will operate in the 'special programs off' setting. The sub-system control modules will record a fault code for a failure of the Terrain Response CAN signal. These faults can be retrieved using T4 and will provide useful information to indicate investigation of the Terrain Response control module or the CAN network.

Terrain Response Rotary Control or Control Module Fault

If a fault occurs in the Terrain Response rotary control, all rotary control icon amber LEDs will be turned off (background illumination will remain on) and rotation of the rotary control is ignored. The instrument cluster message center will display a message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' when the fault occurs, if the fault is present and the driver attempts to select a special program (if the control module is able to do this) or at the next ignition on cycle.

If a failure of a rotary control icon amber LED occurs, the Terrain Response system will still function. Any selected special program will default to 'special programs off' at every ignition on cycle, with the exception of the grass/gravel/snow program.

The Terrain Response rotary control and the control module are an integral unit. If a fault occurs in either component, the whole unit will require replacement.

CAN Faults

If a CAN fault exists and prevents Terrain Response system operation, all of the Terrain Response rotary control icon LEDs will be illuminated and rotation of the rotary control is ignored.

If the instrument cluster does not receive a Terrain Response system CAN message from the Terrain Response Control module, the message 'SYSTEM FAULT SPECIAL PROGRAMS NOT AVAILABLE' will be displayed when the fault occurs and will be repeated at every ignition on cycle.

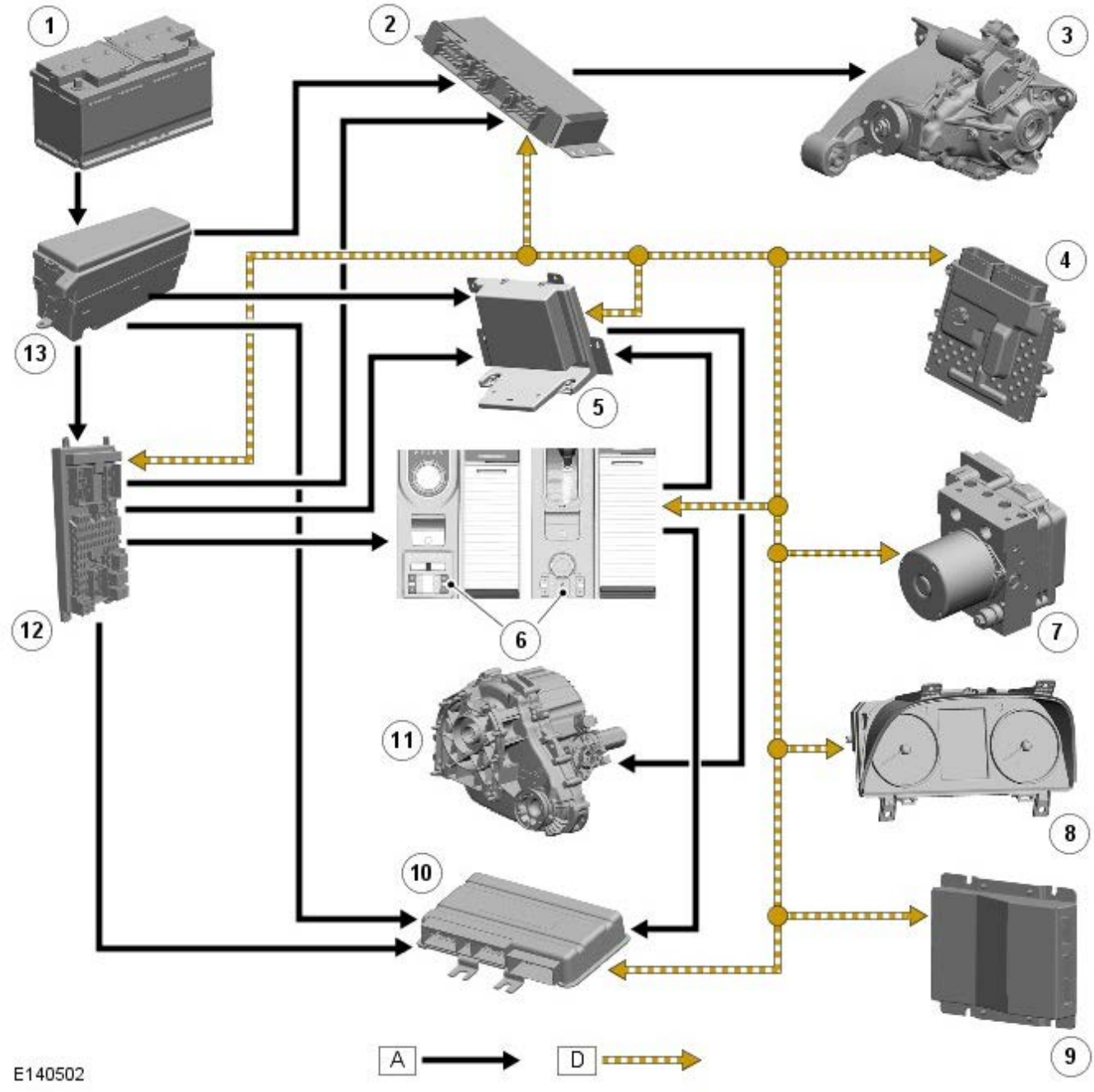
User Error

The following incorrect usage of the system may be misinterpreted as a system fault:

- Engine not running - Program changes and driver advisory messages are only available with the engine running
- Rock crawl program selected but transfer box in high range
- Special program change attempted with DSC or ABS active (this includes ABS cycling which is operational when HDC is being used on slippery or loose surfaces).
- Special program change attempted with overheat condition present on center or rear differential.

CONTROL DIAGRAM

NOTE: **A** = Hardwired; **D** = High Speed CAN bus



Item	Part Number	Description
1	-	Battery
2	-	Rear differential control module
3	-	Rear differential
4	-	ECM
5	-	Transfer box control module
6	-	Terrain Response control and control module
7	-	ABS module
8	-	Instrument cluster
9	-	Adaptive Damping Module (ADM)
10	-	Air suspension control module

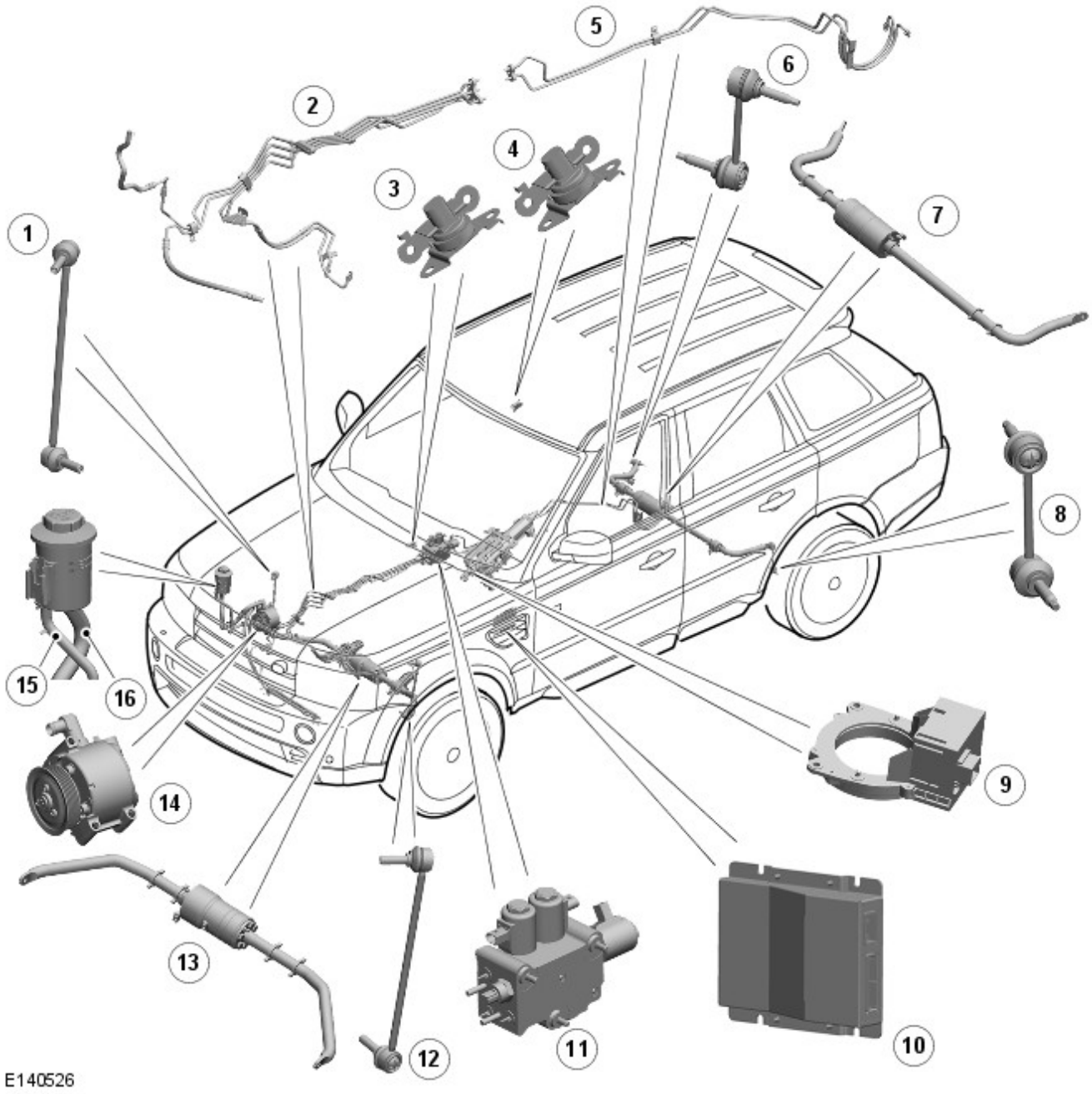
11	-	Transfer box (center differential and high/low range)
12	-	CJB (central junction box)
13	-	BJB (battery junction box)

Ride and Handling Optimization - Active Stabilization System

Description and Operation

Dynamic Response Component Location

NOTE: LHD (left-hand drive) V8 Petrol shown, other models similar



Item	Part Number	Description
1	-	RH (right-hand) front stabilizer link
2	-	Front hydraulic pipes
3	-	Accelerometer
4	-	Accelerometer
5	-	Rear hydraulic pipes
6	-	RH rear stabilizer link
7	-	Rear actuator and stabilizer bar
8	-	LH (left-hand) rear stabilizer link
9	-	Steering angle sensor
10	-	Dynamic Response control module
11	-	Valve block
12	-	LH front stabilizer link
13	-	Front actuator and stabilizer bar

14	-	Pump
15	-	Return pipe - valve block to reservoir
16	-	Feed pipe - reservoir to pump

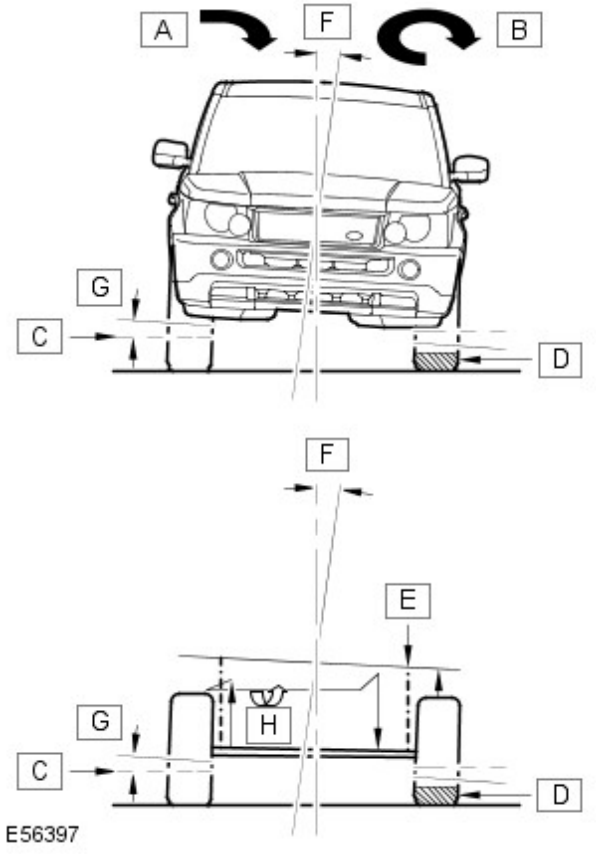
OVERVIEW

The Dynamic Response system provides improved vehicle handling and ride characteristics and is active for both on and off-road driving.

The Dynamic Response system uses two accelerometers to detect vehicle lateral acceleration and inputs from the steering angle sensor and vehicle speed to supply data to the Dynamic Response control module. The control module then operates solenoid valves in a valve block which apply hydraulic pressure to actuators fitted to the front and rear stabilizer bars. The application of hydraulic pressure to the actuators applies a specified amount of torque to the stabilizer bars to counteract the cornering forces and reduces vehicle body roll.

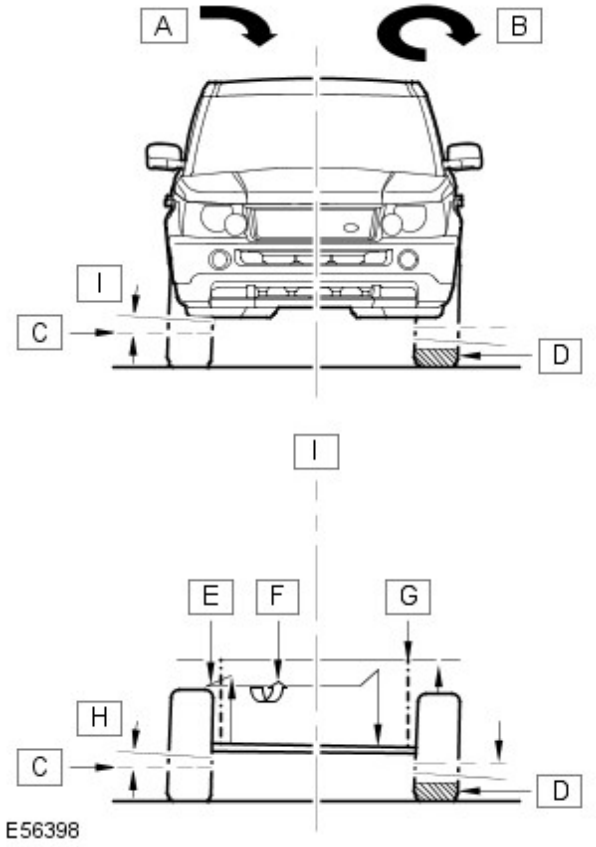
The following illustrations demonstrate the difference in body angle between a conventional 'passive' (non-Dynamic Response) stabilizer bar vehicle and a vehicle fitted with the Dynamic Response system.

Conventional 'Passive' Stabilizer Bar



Item	Part Number	Description
A	-	Direction of travel - Right hand bend
B	-	Body roll
C	-	Axle roll
D	-	Tire squash
E	-	Dampers
F	-	Body roll angle
G	-	Axle roll angle
H	-	Direction of stabilizer bar twist

Dynamic Response System



Item	Part Number	Description
A	-	Direction of travel - Right hand bend
B	-	Body roll
C	-	Axle roll
D	-	Tire squash
E	-	Stabilizer bar
F	-	Direction of stabilizer bar twist
G	-	Dampers
H	-	Axle roll angle
I	-	Reduced body roll with Dynamic Response system

The Dynamic Response system is electrically and hydraulically operated. Electrical and hydraulic operation is controlled by the Dynamic Response control module which is located on the driver's side 'A' pillar, behind the instrument panel.

The Dynamic Response system comprises front and rear stabilizer bars with integral actuators, two accelerometers, a control module, a hydraulic pump, hydraulic pipes, hydraulic hoses, a valve block and a fluid reservoir.

The Dynamic Response system reduces body roll with cornering forces of up to 0.4 g. From 0.4 g there is a progressive increase in body roll but significantly lower than on a 'passive' system. A 'passive' system will have a progressive increase in body roll angle as soon as cornering forces are applied and will have a greater roll angle than the Dynamic Response system for the same cornering force.

The Dynamic Response system can also detect when the vehicle is driven off-road. If off-road conditions are detected and the vehicle is traveling at 25 mph (40 km/h) or less, the control module will reduce roll compensation. On side slopes of more than 11 degrees the Dynamic Response system will switch to a 'locked bars' condition at slow speed.

Lateral acceleration of the body is sensed by two accelerometers, signals from these together with steering angle and vehicle speed are transmitted to the control module. The engine driven hydraulic pump supplies a constant hydraulic flow to the valve block. Two directional control valves are solenoid operated by the control module and supply hydraulic pressure to the applicable side of each actuator to apply a force equal to and opposite to the body roll force. In operation the Dynamic Response system maintains the attitude of the vehicle body when cornering.

The Dynamic Response hydraulic system uses a semi-synthetic hydraulic fluid which is the same fluid used in the power steering system. The total capacity of the Dynamic Response system is 2.50 liters (0.66 US gallons).

CAUTION: The Dynamic Response hydraulic system is extremely sensitive to the ingress of dirt and debris. The smallest amount can cause the system to become unserviceable. It is imperative that the following precautions are followed:

- Dynamic Response components are thoroughly cleaned externally before work commences
- All opened pipe and component ports are capped immediately
- All fluid is stored in clean containers.

In the event of a control module failure the system will 'fail-safe' to a 'locked bars' condition. The 'locked bars' condition will allow the stabilizer bars to operate in a similar manner as conventional 'passive' stabilizer bars. Prolonged cornering forces will allow a progressive increase in roll angle due to hydraulic leakage through the actuators and valve block. Failures of the system are relayed to the driver by illumination of the air suspension/dynamic response warning indicator in the instrument cluster, an audible warning chime and a message displayed in the instrument cluster message center. Faults are recorded by the control module and can be retrieved using a Land Rover approved diagnostic system.

When the ignition switch is moved to position II, the warning indicator is illuminated for two seconds to check functionality. The warning indicator functionality can also be checked using a Land Rover approved diagnostic system.

A Land Rover approved diagnostic system must also be used to perform a hydraulic system response test after bleeding post repair or maintenance operations have been performed. This is to ensure that the system is completely free from air. Trapped air in the system can significantly reduce system performance.

FLUID RESERVOIR

The fluid reservoir is located in the front right hand side of the engine compartment. The reservoir is attached to the front of air cleaner housing or radiator cooling pack by two slotted rails which positively locate the reservoir.

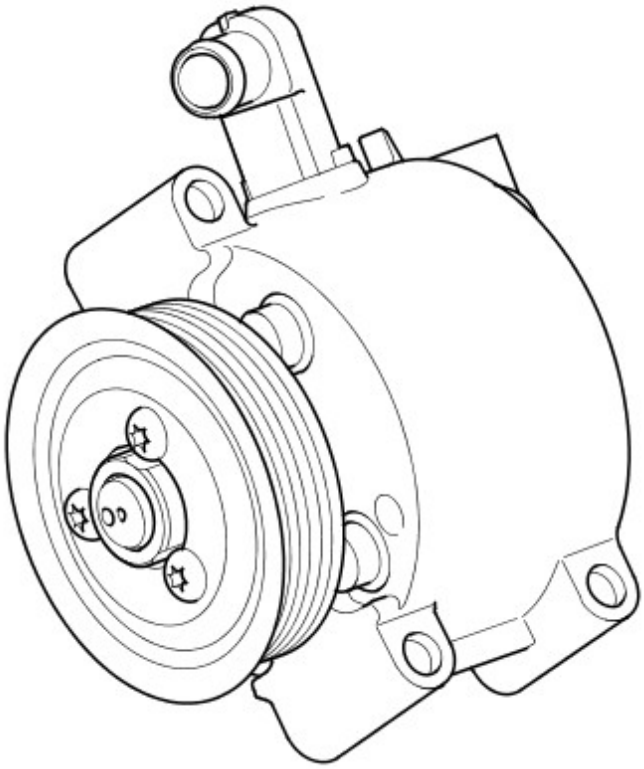
The reservoir is a molded plastic container with a twist lock neck which is fitted with a sealed cap. Two connections on the bottom of the reservoir provide for connection of the feed pipe to the pump and the return pipe from the valve block.

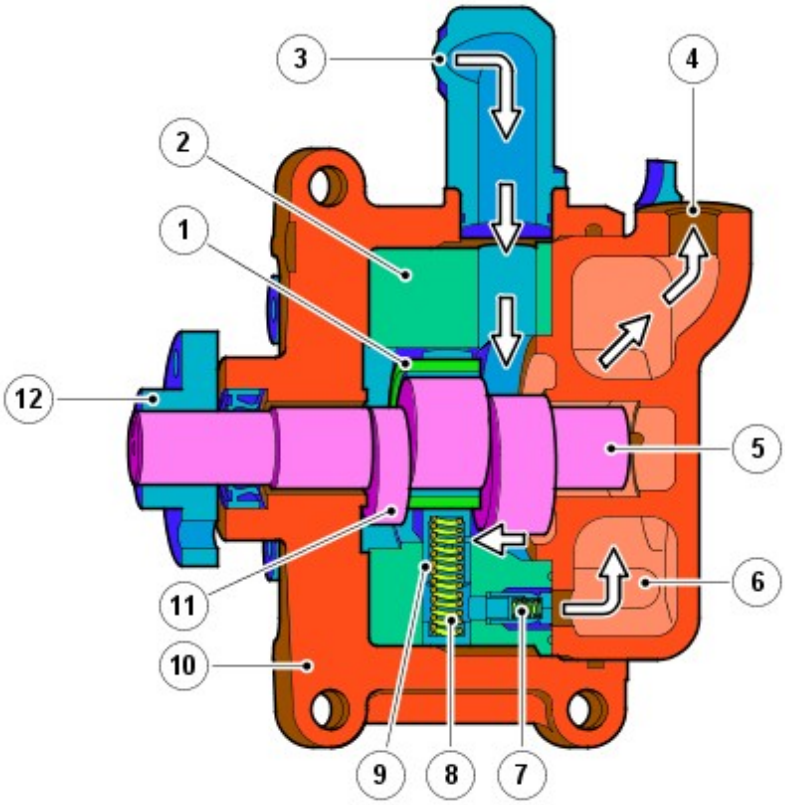
A non-serviceable filter assembly is fitted to the base of the reservoir. The filter is made from a fine nylon mesh which is molded into the bottom of the reservoir. The filter removes particulate matter from the fluid before it is drawn into the pump.

Upper and lower fluid level marks are molded onto the reservoir body. The capacity of the reservoir to the upper level mark is 0.4 liter (0.11 US gallon).

DYNAMIC RESPONSE PUMP

The Dynamic Response hydraulic pump is located on the RH side of the engine. The pump is attached to a mounting bracket below the generator on TdV6 engines and above the generator on V8 petrol engines. On both engines the pump is driven by the accessory drive belt from the crankshaft.





E56399

Item	Part Number	Description
1	-	Cam ring
2	-	Cylinder housing
3	-	Inlet port
4	-	Outlet port
5	-	Shaft
6	-	Silencer volume
7	-	Discharge valve
8	-	Piston spring
9	-	Piston
10	-	Housing

11	-	Counter balance
12	-	Pulley attachment flange

The hydraulic pump is driven at approximately 1.7 times crankshaft speed by the auxiliary drive belt. The pump is a radial piston type which delivers fluid at high pressures.

The radial pump has eight pistons located in bores in a cylinder housing. A balanced central shaft, which is driven by a pulley and the auxiliary drive belt, has a cam which operates the pistons as the shaft rotates.

As the cam lobe reaches each piston, the piston is pushed outward, moving the fluid above the piston. The pressure created by the fluid flow from the bore opens a spring loaded discharge valve. When the valve opens, the now pressurized fluid flows, via the silencer volume area of the cylinder housing, to the outlet port. The silencer volume assists with damping out operating noise from the pump. When the piston reaches its full stroke, the flow reduces and the discharge valve closes under spring pressure.

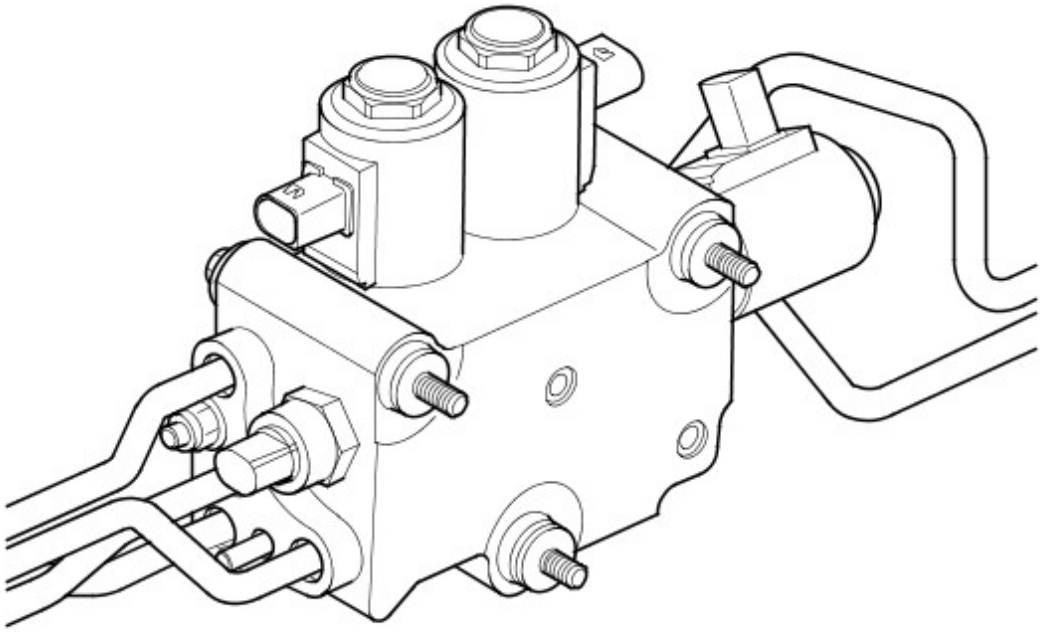
As the cam lobe moves away from the piston, a spring pushes the piston down the bore, creating a vacuum above the piston. As the piston moves down the bore, ports in the piston are exposed and connect with the fluid inlet port. The vacuum draws fluid into the piston filling the piston and the chamber above it. As the piston is again pushed upwards, the ports in the piston are closed off by the bore and the pressurized fluid opens the discharge valve and flows to the outlet port.

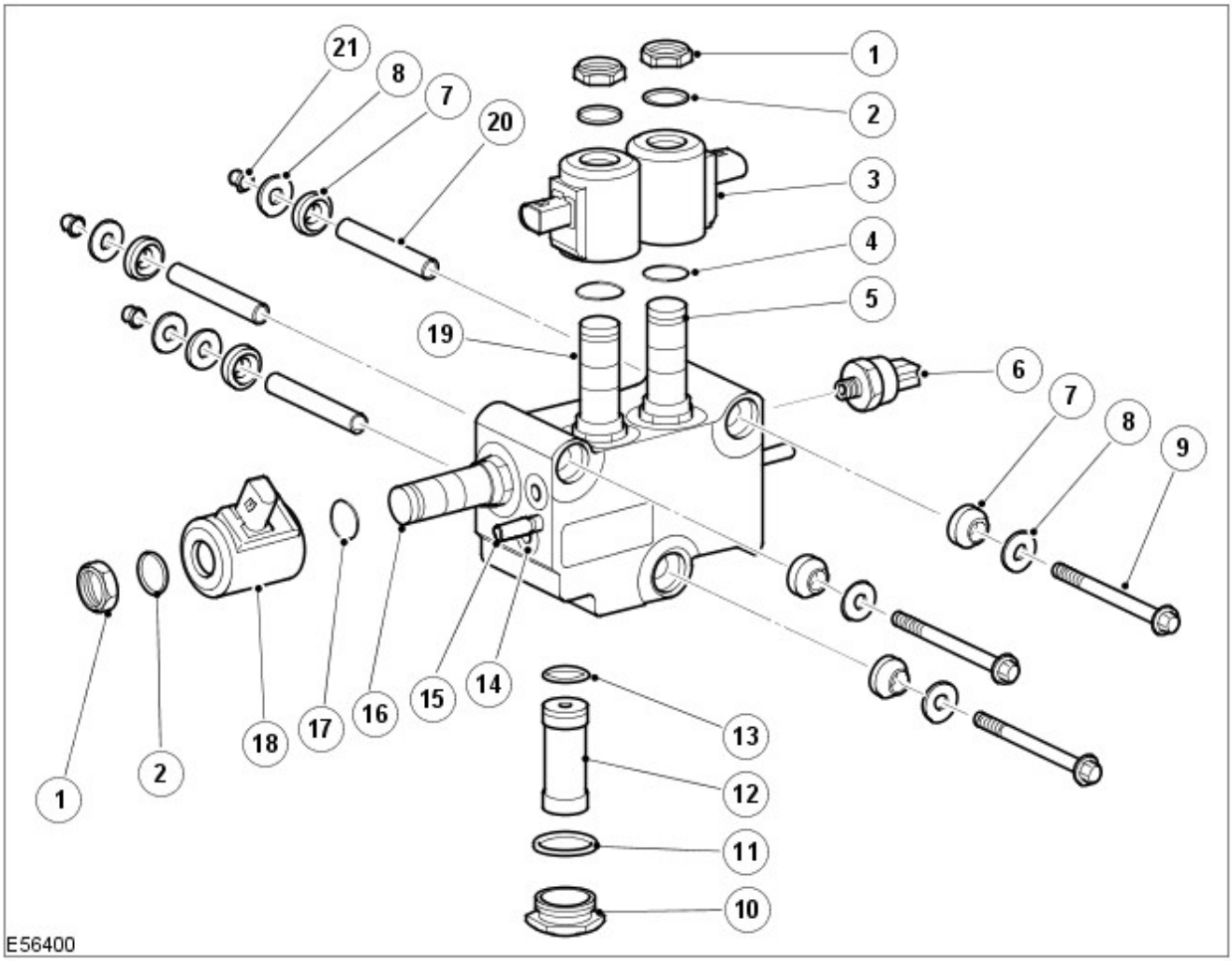
The above sequence is applied to each of the eight pistons for every revolution of the shaft and cam. When the engine is running the sequence occurs rapidly creating a constant flow of fluid. The fluid flow varies with engine speed and the rotational speed of the shaft. The pressure applied to the actuators, created by the flow from the pump, is controlled by the pressure control valve in the valve block.

The pump has a displacement of 6cm^3/rev and an operational pressure of 165 bar (2248 lbf/in^2). The pump output flow ranges from 6.5 l/min (1.7 US Gallons/min) at idle to 10 l/min (2.64 US Gallons/min) at 1000 rev/min and above.

DYNAMIC RESPONSE VALVE BLOCK

The valve block is located below the RH sill of the body and is secured with three bolts and rubber bushes to captive nuts located in the chassis. The rubber bushes isolate the valve block preventing hydraulic noise from transmitting through the body.





Item	Part Number	Description
1	-	Nut (3 off)
2	-	O ring (3 off)
3	-	Directional control valve coils (DCV1 and DCV2)
4	-	O ring (3 off)
5	-	DCV1 (Directional control valve)
6	-	Pressure transducer
7	-	Mounting bush (6 off)
8	-	Washer (7 off)
9	-	Bolt (3 off)
10	-	Nut

11	-	O ring
12	-	High pressure filter
13	-	O ring
14	-	Pipe connections
15	-	Stud (3 off)
16	-	Pressure control valve
17	-	O ring
18	-	Pressure control valve coil
19	-	DCV2
20	-	Spacer (3 off)
21	-	Captive nut (3 off) (chassis mounting)

The valve block directs hydraulic pressure to the actuators via solenoid operated directional control valves. A solenoid operated pressure control valve regulates the required pressure to the actuators. The three solenoid valves are controlled by signals received from the dynamic response control module. A pressure transducer monitors the pressure generated by the Pressure Control Valve (PCV). A serviceable high pressure filter is installed into the underside of the valve block and filters the hydraulic fluid before it reaches the control valves. The filter must be changed at the intervals defined on the vehicle service schedule.

The two Directional Control Valves (DCV's) are fitted to ports in the top face of the valve block. The DCV's are screwed into the valve block and are sealed with O rings. Each DCV has a solenoid for electrical operation of the valve. The solenoid is sealed to the DCV with two O rings and secured with a threaded nut. The DCV's, nut, coil and O rings are serviceable parts.

The PCV is fitted to a port in the rear facing end of the valve block. The PCV is screwed into the valve block and is sealed with O rings. The PCV has a coil for electrical operation which is sealed to the PCV with two O rings and secured with a threaded nut. The nut, coil and O rings are serviceable items. The PCV is serviceable.

The pressure transducer is located in the forward facing end of the valve block and is sealed with an O ring. The pressure transducer measures the hydraulic pressure and returns a signal to the Dynamic Response control module.

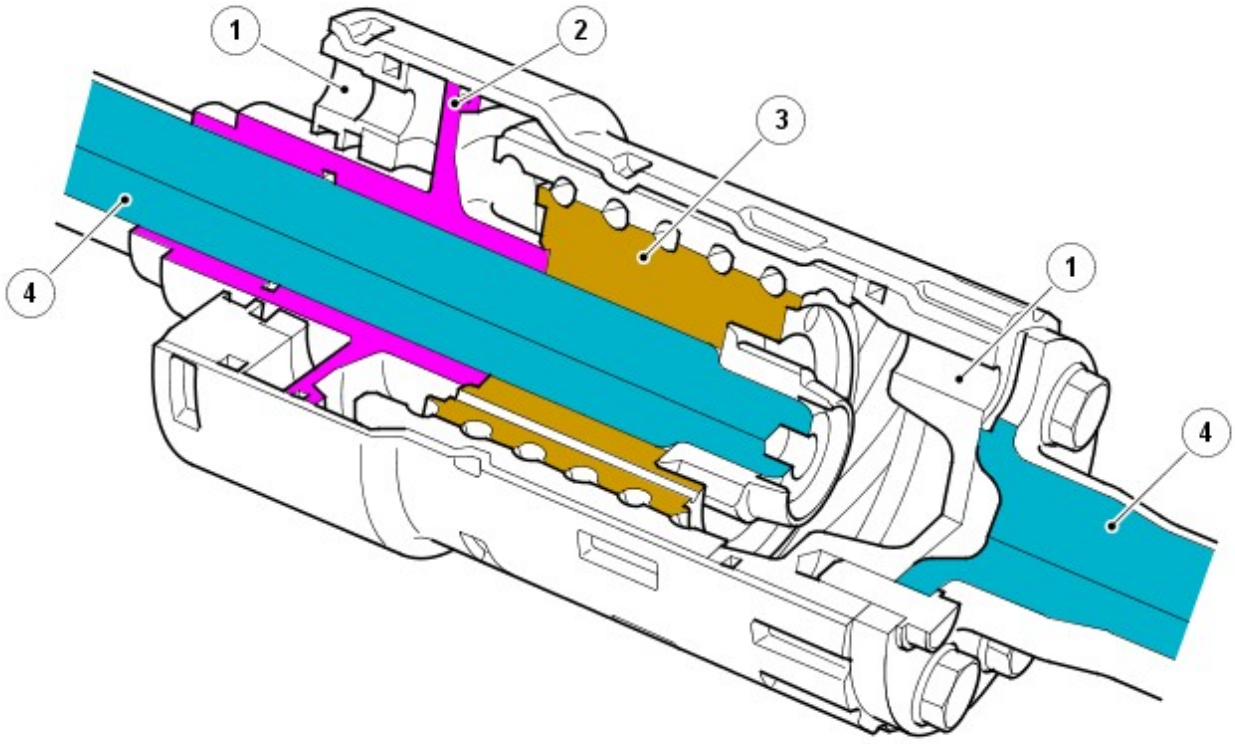
A high pressure filter locates in a port on the lower face of the valve block. The gauze and fiber filter is sealed in the port with O rings and is secured with a threaded cap which is also sealed with an O ring. A threaded hole in the lower face of the filter allows a bolt to be fitted to remove the filter from the port. If a system hydraulic component is replaced, the filter must also be replaced.

Four ports are located on the forward facing end of the valve block and two ports on the opposite end. Each port is fitted with a seal pack which contains two O rings and backing rings. The pipes locate and seal in the seal packs and are secured to the valve block with studs and nuts.

ACTUATORS AND STABILIZER BARS

Two stabilizer bars with integral hydraulic actuators are used for the Dynamic Response system. The actuators apply a hydraulically generated force or rotational torque to the stabilizer bar to oppose lateral forces caused by the vehicle cornering.

Actuator Sectional View

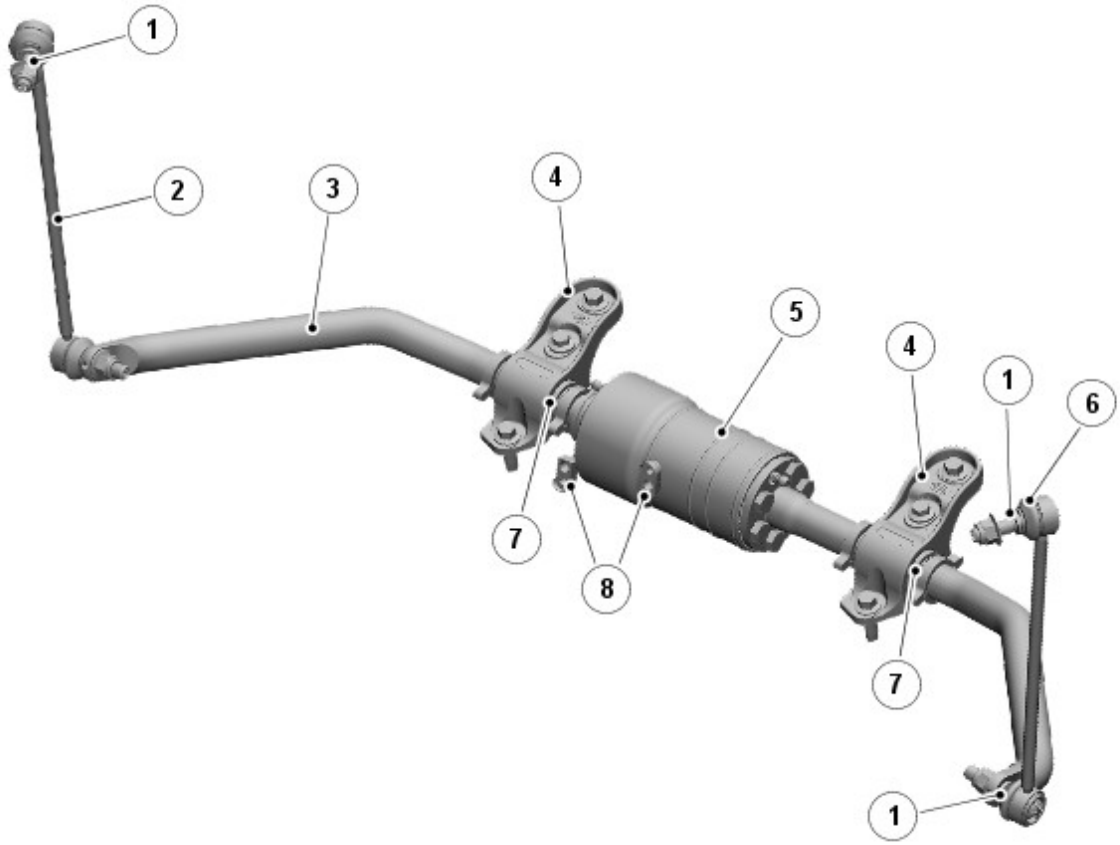


E56408

Item	Part Number	Description
1	-	Air bleed ports
2	-	Piston
3	-	Ball screw
4	-	Stabilizer bar

Each actuator has a piston which is attached to the inner part of a rota linear ball screw, which is splined to one half of the stabilizer bar. The outer part of the ball screw is crimped and welded into a housing which is attached to the other half of the stabilizer bar. As pressure is applied to one side of the piston or the other, the ball screw converts the linear force applied to the piston into a rotational torque between the two halves of the stabilizer bar.

Front Actuator and Stabilizer Bar

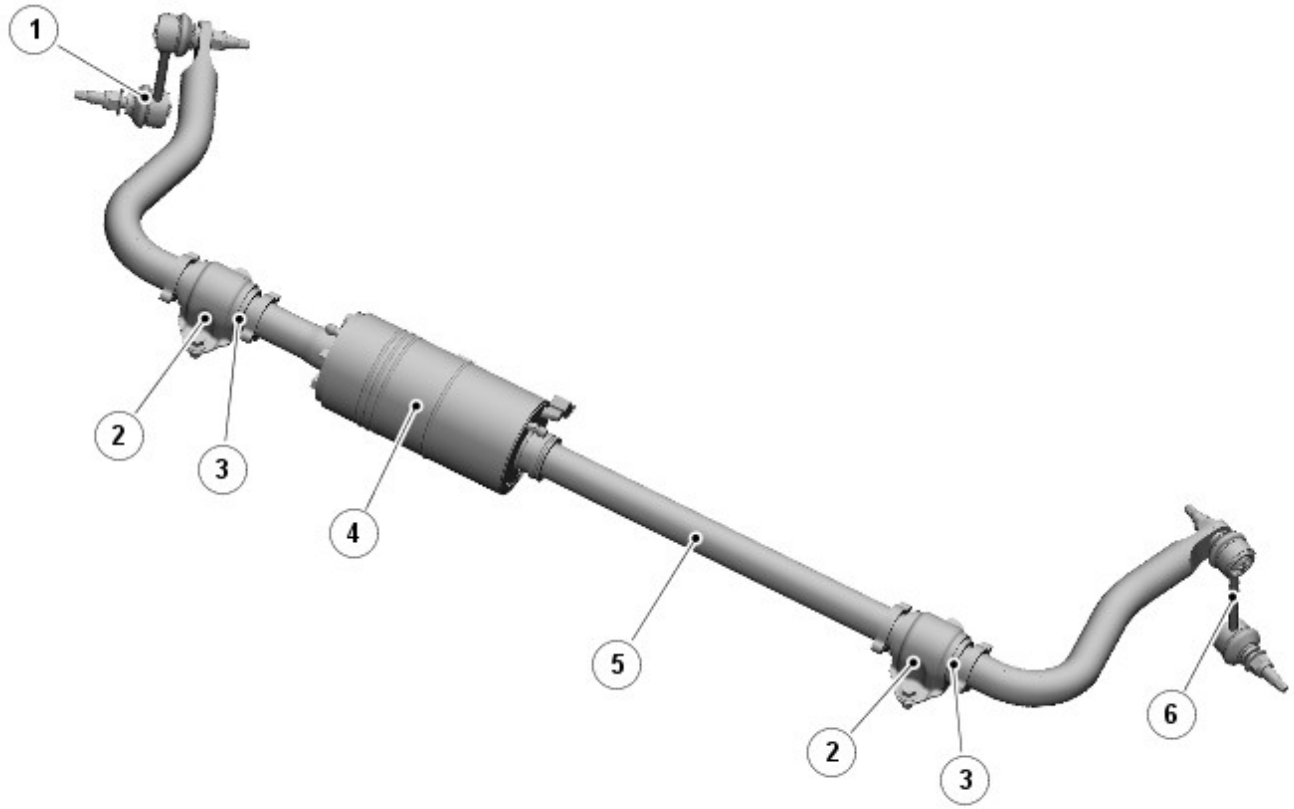


E140527

Item	Part Number	Description
1	-	Hardened washer (4 off)
2	-	RH stabilizer link
3	-	Stabilizer bar
4	-	Chassis mounting brackets
5	-	Actuator
6	-	LH stabilizer link
7	-	Stabilizer bar mounting bush
8	-	Pipe fluid connections

Rear Actuator and Stabilizer Bar

NOTE: The internal piston size of the rear actuator changes amongst the different vehicle derivatives, it is important to ensure the correct parts are fitted to the relevant derivatives.



E140528

Item	Part Number	Description
1	-	RH stabilizer link
2	-	Stabilizer bar bracket
3	-	Stabilizer bar mounting bush
4	-	Actuator
5	-	Stabilizer bar
6	-	LH stabilizer link

NOTE: On vehicles from 2007MY, the positions of the FRONT actuator ports have been moved and therefore care must be taken to ensure matching pipes and actuators are fitted in service.

Two hydraulic connections provide for the attachment of the hydraulic pipes from the valve block. The connections provide hydraulic flow to each side of the actuator piston.

The front and rear actuator assemblies are similar in their construction, with the rear actuator being smaller than the front. Each stabilizer bar is made from 34 mm (1.34 in) diameter spring steel bar.

The actuator assembly and the stabilizer bars are not serviceable items. Only the stabilizer bar attachment bushes, brackets and stabilizer links are serviceable components.

The front stabilizer links are not handed on the front stabilizer bar and are also common to vehicles not fitted with Dynamic Response. The rear stabilizer links are unique to vehicles with Dynamic Response. The Dynamic Response rear links are identified by a grey color plastic bearing moulding. The passive (non-Dynamic Response) links can be identified by a white colored plastic bearing moulding.

The front stabilizer bar and actuator is attached to a chassis strengthening member known as the secondary load path and to the front cross-member. Two serviceable, split rubber bushes are fitted to the stabilizer bar and are located in cast brackets. Each bracket is secured to the secondary load path with two bolts and to the front cross-member with a third bolt.

The rear stabilizer bar and actuator is attached to fabricated brackets which are located on the outside of the chassis side members, forward of the rear wheels.

Two rubber bushes are fitted to each stabilizer bar and are located in clamp brackets. The front and rear bushes and brackets are not interchangeable.

On both the front and rear stabilizer bars, roll correction force is transmitted to the suspension arm via ball jointed stabilizer bar links. The front links are attached to the front suspension upper arm and the rear links are attached to the rear lower arm.

Each front stabilizer link is fitted with a hardened steel washer which is located between the stabilizer bar and the link ball joint and the upper arm and the link ball joint. It is important that these washers are in the correct position and the correct, hardened washers are fitted. Failure to fit the washers or using incorrect washers will result in relaxation of the torque on the self-locking nut and damage will be caused to the stabilizer bar, link and suspension upper arm.

SYSTEM PIPES

Fluid is moved through the Dynamic Response system via a series of six pipes and hoses. The pipes are mounted on brackets at strategic points to provide quiet operation of the system.

The six pipes connecting the pump, reservoir and actuators are one-piece components. If the pipes require replacement during service, the pipes are supplied individually and are removed and replaced in one piece. The front and rear pipes require the body to be lifted slightly to allow access for removal and replacement.

The flexible high pressure hose which supplies pressure from the pump to the high pressure pipe is fitted with attenuators. The attenuators comprise of tuned lengths of PTFE pipe and restrictors within the flexible hose. The attenuators damp pressure pulsations in the hydraulic fluid produced by the pump, reducing noise and strain on components downstream. The attenuator is integral with the high pressure hose and cannot be serviced separately.

CAUTION: Under no circumstances during repairs should clamps be used on the high pressure hose or the front and rear actuator feed pipes to prevent fluid loss. The use of clamps will damage the pipes and hoses leading to premature failure.

DYNAMIC RESPONSE CONTROL MODULE

The Dynamic Response control module is located on the driver's side 'A' pillar, behind the instrument panel. The control module is secured to the vehicle body with two screws. Two connectors are located on the control module and allow for the connection of the harness connectors. The two connectors supply power, ground, signal and sensor information to and from the control module for control of the Dynamic Response system.

When a replacement control module is fitted, the correct tune is selected from the data contained within the Car Configuration File (CCF). Post Dynamic Response control unit installation lateral accelerometer calibration needs to be completed.



E105086

The Dynamic Response control module receives a power supply from the main relay via fuse 9E in the BJB (battery junction box).

An engine speed signal is transmitted to the control module from the ECM (engine control module) via the high speed CAN (controller area network) bus. The engine speed signal is used by the Dynamic Response control module to detect that the engine is running and hydraulic pressure for the Dynamic Response system is available.

A road speed signal is transmitted to the control module from the ABS (anti-lock brake system) module on the high speed CAN. A steering angle signal is transmitted on the high speed CAN bus from the steering angle sensor. The Dynamic Response control module uses the road speed and steering angle signals to calculate lateral acceleration and for on and off-road roll compensation.

When reverse gear is selected and reverse wheel rotation is transmitted on the high speed CAN bus, the Dynamic Response system reverts to a 'locked bars' condition. This condition is maintained until reverse gear is deselected and a forward wheel rotation message is transmitted on the CAN bus.

The Dynamic Response control module receives an "ignition on" signal on the high speed CAN bus. The ignition signal provides an input into the control module to inform the control module that the ignition switch is in position II. The control module initiates a 250 ms start time which is used to prevent functions operating when the software routines are being initialized.

When the 'ignition-on' CAN signal is removed, the control module senses that the ignition has been switched off. The control module remains powered for a 30 second period to allow fault information and adaptive values to be stored in the memory. The values and fault information are read by the control module when the ignition is next switched on. The power supply to the control module is maintained for as long as the main relay remains energized.

The Dynamic Response control module is connected via the high speed CAN bus to the diagnostic socket which allows diagnostic interrogation of the control module. The diagnostic socket allows for the connection of a Land Rover approved diagnostic system to read any stored fault codes in the control module. The control module can also be updated with revised software using a Land Rover approved diagnostic system should a software update be required.

When system faults are detected, the control module issues a message on the CAN bus which is received by the instrument cluster. The instrument cluster then illuminates the air suspension/Dynamic Response warning indicator as follows:

- Minor faults - warning indicator illuminated in an amber color with an applicable message in the message

center
- Major faults - warning indicator illuminated in a flashing red color with an applicable message in the message center and an audible warning. The message will instruct the driver to stop the vehicle immediately or drive with caution.

Two messages relating to Dynamic Response are displayed in the instrument cluster message center:

- SUSPENSION FAULT, VEHICLE LEAN, WHEN CORNERING
- SUSPENSION FAULT, STOP SAFELY, STOP ENGINE.

The Dynamic Response control module supplies a control current to the Pressure Control Valve (PCV) in the valve block. The current supplied is determined by a number of input signals from the upper and lower accelerometers, road speed, steering angle etc. The PCV controls the hydraulic pressure supplied to the actuators proportional to the current supplied by the control module.

Power is supplied to the two solenoid operated Directional Control Valves (DCV) in the valve block by the control module. Together, the two DCV's control the direction of flow of hydraulic fluid to the actuators. When the control module supplies power to the solenoids the valves open allowing hydraulic fluid to flow to the actuators. When power is removed, the DCV's close. DCV1 is open for right hand corners and DCV2 is opened for left hand corners.

The pressure transducer located in the valve block receives a 5V current from the control module. The transducer measures the hydraulic pressures in the range of 0 to 180 bar (0 to 2610 lbf/in^2) and returns a linear output voltage to the control module dependent on the hydraulic pressure.

The Dynamic Response control module supplies a 5V current to each of the accelerometers. Each accelerometer is capable of measuring lateral acceleration in the range of ± 1.11 g. An analogue input to the control module of between 0.5 and 4.5V relative to the lateral acceleration sensed is returned by each accelerometer. The control module processes the two signals received, together with the steering angle and vehicle speed signals, to produce a 'pure' lateral acceleration signal which is then used as the main control signal for the Dynamic Response system.

Failure Modes

Failures where the vehicle can still be driven safely are indicated by the air suspension/Dynamic Response warning indicator in the instrument cluster illuminating continuously in an amber color. The amber indicator will remain illuminated until the ignition is switched off. For all faults, the warning indicator will only illuminate again if the fault is still present.

Failures which require the driver to stop the vehicle immediately are indicated by the air suspension/Dynamic Response warning indicator flashing in a red color and an audible warning. This will also be accompanied by an applicable message displayed in the message center.

All faults are recorded by the control module and can be retrieved using a Land Rover approved diagnostic system. The diagnostic system provides a description of the fault, possible causes and corrective action to rectify the fault. The control module can fail to one of two states; 'locked bars' or 'reduced operation'.

The 'locked bars' condition means that pump flow is directed through the valve block and returns to the reservoir. Both DCV's close, trapping the fluid in the actuators. The fluid can flow from one actuator to the other via the valve block. The stabilizer bars will perform similar to a conventional stabilizer bar, resisting roll but still allowing suspension articulation.

The 'reduced operation' condition means that the system can still operate, but one of the input signals is not being received and so the system performance is not optimum.

If the steering angle sensor develops a fault or is out of calibration, there is a possibility that the dynamic response control module will record a fault code. A Land Rover approved diagnostic system should be used to check for fault codes and the adaptive data should be cleared by resetting the fault codes in the control module after the steering angle sensor has been recalibrated.
For additional information, refer to: Anti-Lock Control - Traction Control (206-09A Anti-Lock Control - Traction Control, Description and Operation).

ACCELEROMETERS

Two accelerometers are used; an upper and a lower. Both accelerometers are identical in their construction.

The lower accelerometer is secured to the underside of the vehicle floor, on the RH inner sill panel, below the front door. The upper accelerometer is secured to a bracket on the body roof panel, in a central position at the top of the windscreen.



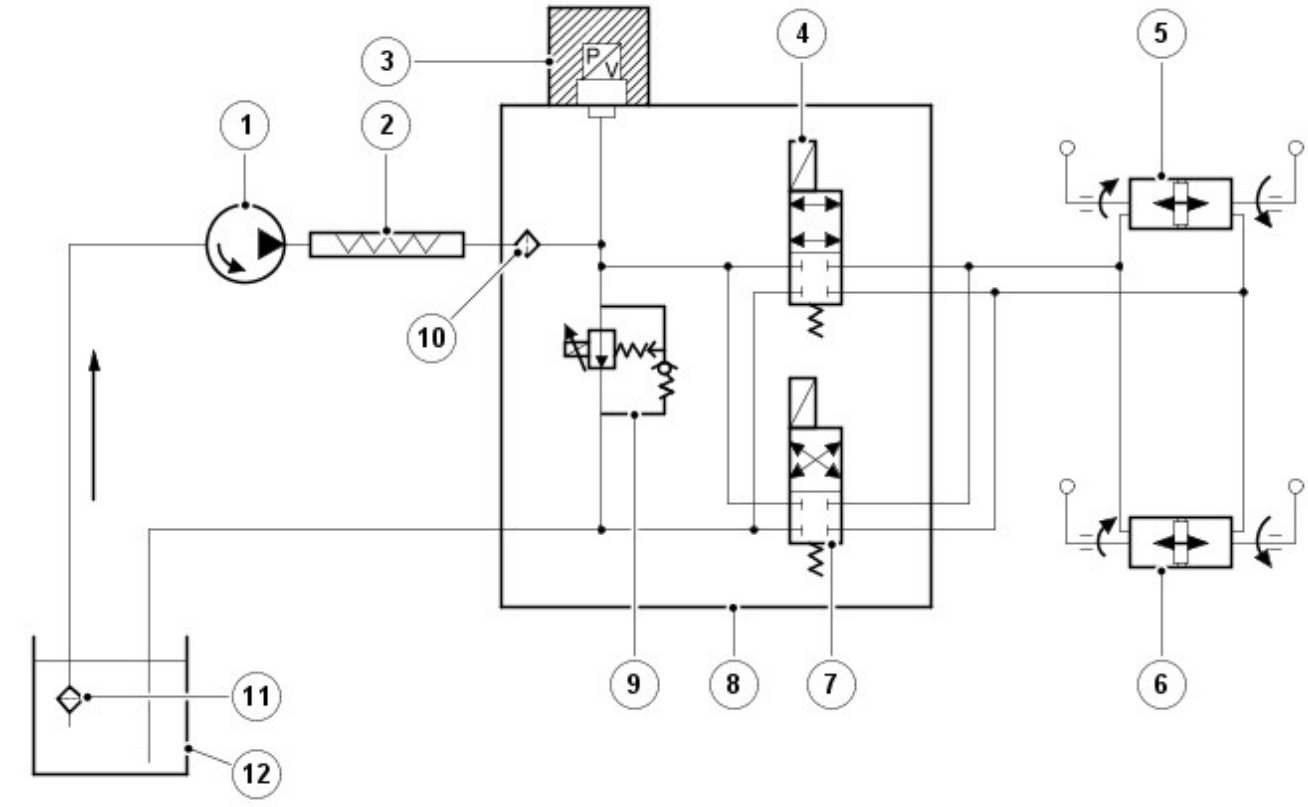
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The lower accelerometer is the primary sensor used to measure lateral acceleration of the vehicle for roll control. The upper accelerometer is used by the Dynamic Response control module for roll correction and fault detection in conjunction with the lower accelerometer.

Each accelerometer is a capacitive acceleration sensor and operates on a 5V supply from the dynamic response control module. The upper and lower accelerometers can measure acceleration in the range of ±1.11 g and return an output to the control module of between 0.5 and 4.5V.

Failures of an accelerometer are recorded by the control module and can be retrieved using a Land Rover approved diagnostic system. A special tool is required to remove and replace the accelerometer in the mounting bracket.

HYDRAULIC CIRCUIT DIAGRAM



E56406

Item	Part Number	Description
1	-	Hydraulic pump
2	-	Attenuator hose
3	-	Pressure transducer
4	-	Directional control valve 2 (DCV2)
5	-	Front actuator assembly
6	-	Rear actuator assembly
7	-	Directional control valve 1 (DCV1)
8	-	Valve block
9	-	Pressure Control Valve (PCV)
10	-	High pressure filter
11	-	Filter

DYNAMIC RESPONSE SYSTEM OPERATION

Vehicle Not Moving

When the engine is running and the vehicle is not moving, both DCV's are closed, locking fluid in each side of the actuator piston. The hydraulic pump draws fluid from the reservoir and passes it at low pressure to the valve block.

Because both DCV's are closed, after the fluid passes through the high pressure filter, it is directed through the PCV to the reservoir.

The PCV is open fully to allow the full flow to pass to the reservoir. The DCV's will remain closed until the control module detects a requirement to operate.

Vehicle Moving and Turning Left

When the vehicle is turning left the steering sensor detects steered angle, the accelerometers detect the cornering forces applied. These signals are transmitted to the control module. The control module determines that an opposing force must be applied to the stabilizer bars to counter the cornering forces. The control module supplies a current to the solenoid of DCV2. Simultaneously, a current is supplied from the control module to the PCV which operates to restrict the flow of fluid returning to the reservoir.

The restriction causes the hydraulic pressure in the system to rise and the pressure is sensed by the pressure transducer which sends a signal to the control module. The control module determines from the inputs it receives what pressure is required and adjusts the pressure accordingly.

The pressure in the system is applied to the piston of each actuator, applying a force to the stabilizer bar and minimizing the cornering effect on the vehicle and maintaining the vehicle attitude. The fluid displaced from the other side of the piston is returned to the reservoir via the valve block.

As the cornering force is removed when the vehicle straightens up, the control module opens the PCV to reduce the pressure in the system. The fluid bleeds from the actuator back into the system as the cornering force is reduced, removing the force applied to the stabilizer bar. When the vehicle is moving in a straight line DCV2 closes.

Vehicle Moving and Turning Right

When the vehicle is turning right the steering sensor detects steered angle, the accelerometers detect the cornering forces applied. These signals are transmitted to the control module. The control module determines that an opposing force must be applied to the stabilizer bars to counter the cornering forces. The control module supplies a current to the solenoid of DCV1. Simultaneously, a current is supplied from the control module to the PCV which operates to restrict the flow of fluid returning to the reservoir.

The restriction causes the hydraulic pressure in the system to rise and the pressure is sensed by the pressure transducer which sends a signal corresponding to the pressure to the control module. The control module determines from the inputs it receives what pressure is required and adjusts the pressure control valve accordingly.

The pressure in the system is applied to the piston of each actuator, applying a force to the stabilizer bar and minimizing the cornering effect on the vehicle and maintaining the vehicle attitude. The fluid displaced from the other side of the piston is returned to the reservoir via the valve block.

As the cornering force is removed when the vehicle straightens up, the control module opens the PCV to reduce the pressure in the system. The fluid bleeds from the actuator back into the system as the cornering force is reduced, removing the force applied to the stabilizer bar. When the vehicle is moving in a straight line DCV1 closes.

Off-Road Driving

Off-road detection is achieved by the control module by monitoring the signals from the upper and lower accelerometers for varying degrees of body movement. Off-road driving generates differing signals to the accelerometers which in turn produce differing outputs due to their vertical separation and the location of the roll center of the vehicle.

The two signals are passed through a filter to remove any offset caused by the vehicle leaning or the terrain. The control module then uses this signal to calculate the percentage of road roughness.

Below 25 mph (40 km/h) the percentage of road roughness calculated is used by the control module to limit the operation of the Dynamic Response system. At speeds above 25 mph (40 km/h) the system disables the percentage road roughness signal and full Dynamic Response system assistance is restored. The system is completely inoperative at speeds below 2 mph (3 km/h).

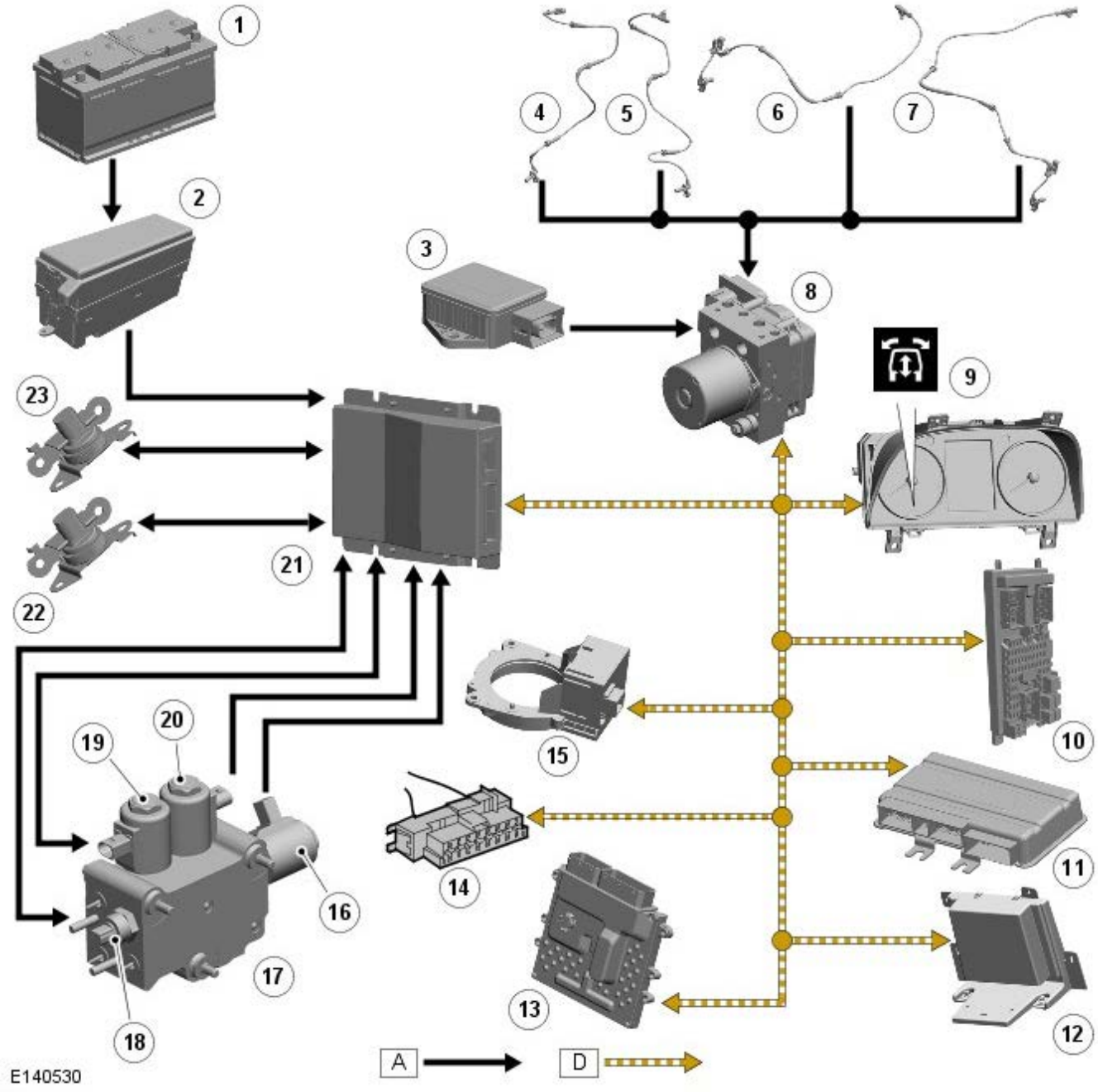
Side Slope Detection

The control module uses side slope detection when the upper and lower accelerometers detect an average acceleration of more than ± 0.2 g or 11 degrees of side slope and a road speed of less than 25 mph (40 km/h).

When side slope is detected, both DCV's close to provide a 'locked bars' condition. This condition increases stability and gives a constant vehicle response. As the road speed increases up to 25 mph (40 km/h), the level of average lateral acceleration must also increase and be maintained for the system to recognize that the vehicle is on a side slope. If the side slope angle is steep and the road speed is low, the control module will detect the side slope in a short time.

CONTROL DIAGRAM

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



Item	Part Number	Description
1	-	Battery
2	-	BJB
3	-	Yaw rate and lateral acceleration sensor
4	-	RH front wheel speed sensor
5	-	LH front wheel speed sensor
6	-	RH rear wheel speed sensor
7	-	LH rear wheel speed sensor
8	-	ABS module
9	-	Instrument cluster
10	-	CJB (central junction box)
11	-	Air suspension control module
12	-	Transfer box control module
13	-	ECM
14	-	Diagnostic socket
15	-	Steering angle sensor
16	-	Pressure Control Valve (PCV) coil
17	-	Valve block
18	-	Pressure transducer

19	-	DCV 1 coil
20	-	DCV 2 coil
21	-	Dynamic Response Module
22	-	Lower accelerometer
23	-	Upper accelerometer

Ride and Handling Optimization - Ride and Handling Optimization
Diagnosis and Testing

Principles of Operation

Ride and handling optimization incorporates the terrain response system which links a number of modules around the vehicle to give the best combination of settings in the different systems.

For a detailed description of the Ride and Handling System and operation, refer to the relevant Description and Operation section of the workshop manual.
REFER to: Ride and Handling Optimization (204-06 Ride and Handling Optimization, Description and Operation).

Inspection and Verification

CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

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

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

Visual Inspection

Mechanical	Electrical
• Tire condition, pressures, etc • Driveline components (correct installation, damage, etc) • Engine components (correct installation, damage, etc) • Transmission components (correct installation, damage, etc) • Suspension components (correct installation, damage, etc)	• Fuses • Harnesses/connectors • Terrain response switchpack • Engine Control Module (ECM) • Transmission Control Module (TCM) • Transfer Case Control Module (TCCM) • Anti-lock Braking System control module (ABS) • Rear Differential Control Module (RDCM) • Adaptive Damping Control Module (ADCM) • Controller Area Network (CAN) circuits

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Because the overall function of the system is dependent on sub-systems, it is possible to misinterpret displays in the message centre as being terrain response faults when they are actually a result of a fault in one of the sub-systems.

Refer to the table below for help in deciding when to investigate terrain response faults and when the fault is likely to be in a sub-system.

Symptom	Description	Possible Causes	Action
Message centre display indicating a sub-system fault	The message centre indicates to the driver that a fault has occurred and in which sub-system	• Any sub-system fault supported by the message centre	• For details of the available messages, refer to the relevant section of the workshop manual. Carry out a complete vehicle DTC read and follow the diagnostic routine(s) indicated
Message centre display: **System fault special programs not available**, terrain response switch operation normal	This message will display when a sub-system fault has occurred if the driver attempts to change the special program, and at each ignition on cycle for 5 seconds until the fault is rectified	• Any sub-system fault supported by the message centre	• For details of the available messages, refer to the relevant section of the workshop manual. Carry out a complete vehicle DTC read and follow the diagnostic routine(s) indicated
Message centre display: **System fault special programs not available**, all terrain response	CAN circuit errors	• CAN circuit: short circuit to ground • CAN circuit: short circuit to	• Carry out a complete vehicle DTC read and follow the diagnostic routine(s) indicated

switch LEDs illuminated		power • CAN circuit: high resistance	
Special program changes not available	User error	• Engine not running • Rock crawl selected with transfer box in high range • Special program change attempted with anti-lock brake system or dynamic stability control active - This includes anti-lock brake system cycling as part of hill descent control • Special program change attempted with an overheat condition present in the centre or rear differential	• Refer to the relevant section of the workshop manual. Make sure that the driver is familiar with the correct operation of the system

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: (100-00 General Information)

Diagnostic Trouble Code (DTC) Index - DTC: Adaptive Damping Control Module (ADCM) (Description and Operation),
Diagnostic Trouble Code (DTC) Index - DTC: Air Suspension Control Module (Description and Operation),
Diagnostic Trouble Code (DTC) Index - DTC: Terrain Response Switch Pack (TR) (Description and Operation).

Ride and Handling Optimization - Active Stabilization System
Diagnosis and Testing

Principles of Operation

For a detailed description of the Active Stabilization System and operation, refer to the relevant Description and Operation section of the workshop manual.
REFER to: Active Stabilization System (204-06 Ride and Handling Optimization, Description and Operation).

Inspection and Verification

CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

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

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

Mechanical	Electrical
• Fluid level/condition, pipes, reservoir, etc • Pump and pulley • Drive belt condition • Hoses • Valve block • Accelerometers (correct fitment, etc) • Tire condition, pressures, etc • Suspension components (correct fitment, damage, etc)	• Fuses (battery junction box) • Engine Control Module (ECM) relay • Harnesses/connectors • Upper accelerometer • Lower accelerometer • Steering wheel rotation sensor • Dynamic Response Control Module (DRM) • Air suspension control module • Anti-lock Brake System control module (ABS) • Instrument cluster • Transmission Control Module (TCM) • Controller area network (CAN) circuits

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Poor on-center response	• System bleed required • Stabilizer bar bushes • Residual pressure • Steering angle sensor offset • Control module adaptive data	• Carry out the manual bleed procedure • Check the stabilizer bar bushes • Check for residual pressure in the system • Check and calibrate the steering angle sensor, clear the adaptive data after calibration
Asymmetrical response	• Steering angle sensor offset • Accelerometer calibration • System bleed required	• Check and calibrate the steering angle sensor, clear the adaptive data after calibration • Calibrate the accelerometers using the approved diagnostic system • Carry out the manual bleed procedure
Excessive roll	• System bleed required • Stabilizer bar bushes • Stabilizer bar drop-links	• Carry out the manual bleed procedure • Check the stabilizer bar bushes and drop links
Powered roll-rock	• Harness faults • Valve block fault • Control module adaptive data • Accelerometer fault	• Check for DTCs indicating any of the possible causes are present
Oversteer or	• Stabilizer bar drop-	• Check the stabilizer bar drop links and the system actuators

understeer	links • System actuators	

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: Dynamic Response Control Module (DRM) (100-00 General Information, Description and Operation).

Ride and Handling Optimization - Active Stabilization System Bleeding

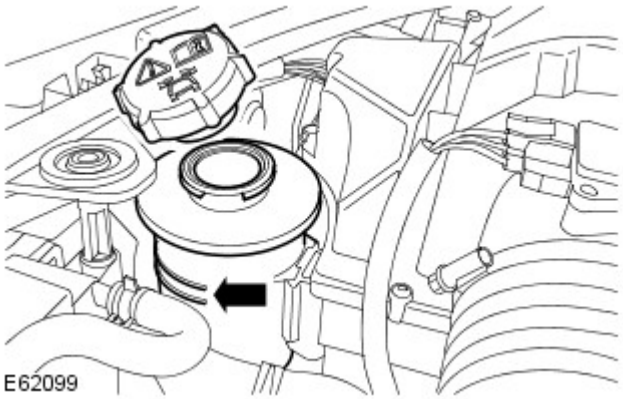
General Procedures

Special Tool(s)

	Dynamic Response Bleed Bottle 204-591-01
	Dynamic Response Control Box 204-591-02

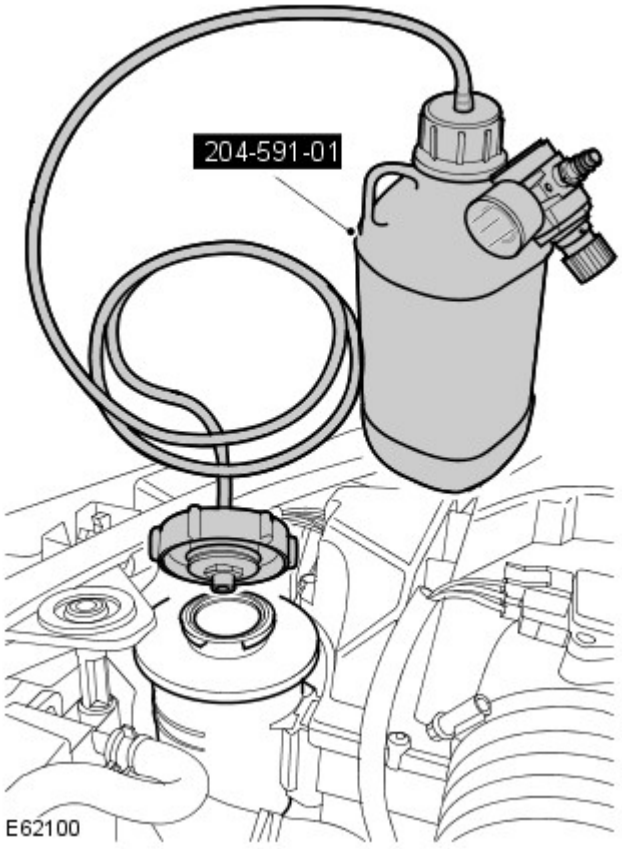
CAUTION: Dynamic Response system components are manufactured to very precise tolerances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the dynamic response system.

NOTE: This procedure should be carried out if the following components have been removed or replaced: front or rear stabilizer bar, front or rear valve block to actuator bar pipe assemblies, or the valve block. It is possible to bleed only the front or rear of the system if only a stabilizer bar or pipe assembly has been removed. If the valve block has been removed, the complete system must be bled.



1. Check and top-up the dynamic response system fluid reservoir.
    - Top-up the fluid level to the mid-way mark on the reservoir.

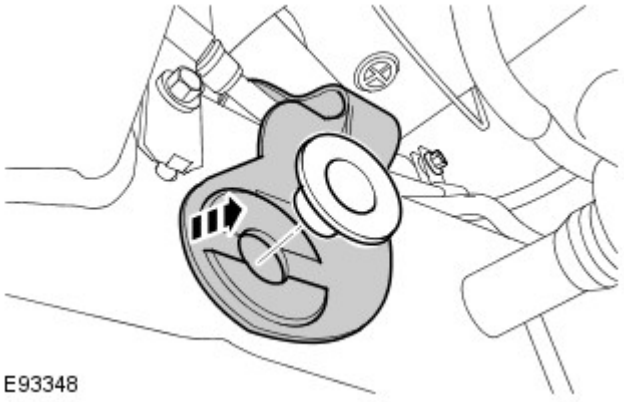
2. Install the special tool to the dynamic response reservoir.
    - Completely fill the reservoir with fluid.
    - Make sure the pressure regulator on the special tool is turned OFF.
    - Fill the special tool bottle approximately three-quarters full with fluid.
    - Connect the special tool to a suitable workshop air supply.



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

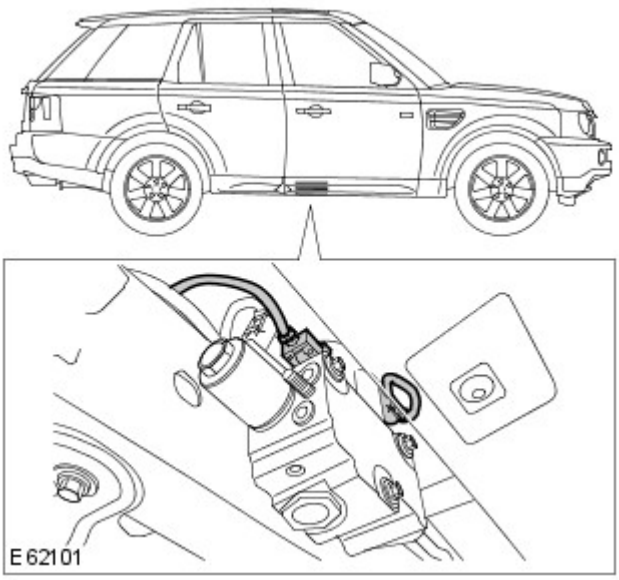
   Raise and support the vehicle.

4. Remove the RH rear wheel and tire.



5. RH side rear: To improve access to RH rear actuator bleed screw, remove bracket from body frame securing fuel breather pipes.

6. Disconnect the two direction control valve electrical connectors.

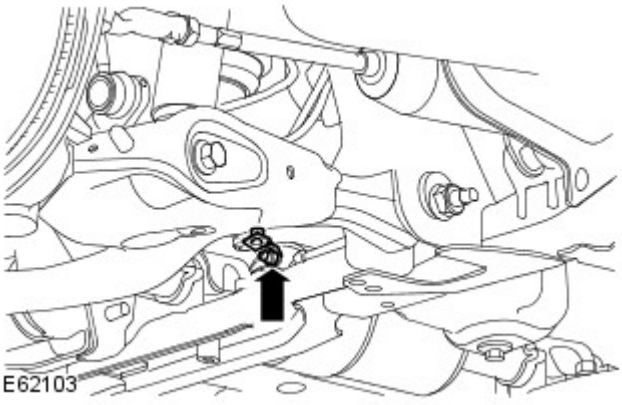


7. Connect the special tool electrical connectors to the valve block.
    - Connect the special tool power supply leads to the vehicle battery.



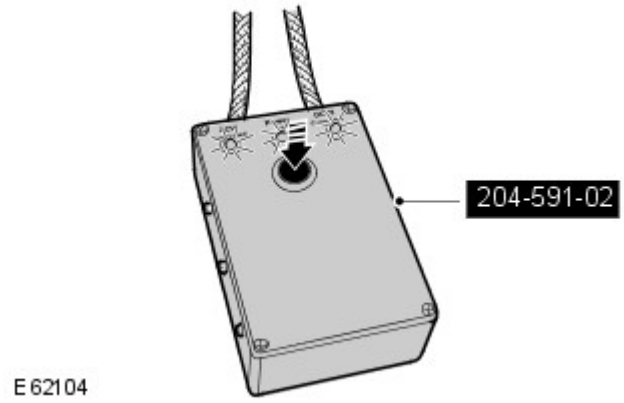
8. Remove the engine undershield.
   For additional information, refer to: Engine Undershield (501-02, Removal and Installation).

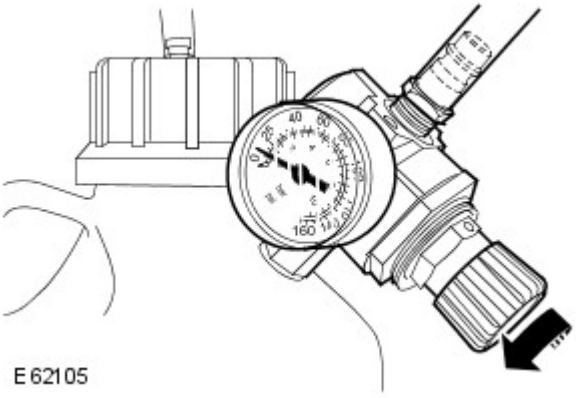
9. Connect the hose from special tool kit to the front stabilizer bar bleed screws.
    - Remove the bleed screw covers.



10. Loosen the front actuator RH bleed screw by one-half of a turn.

11. Using the special tool, open both actuator control valves.



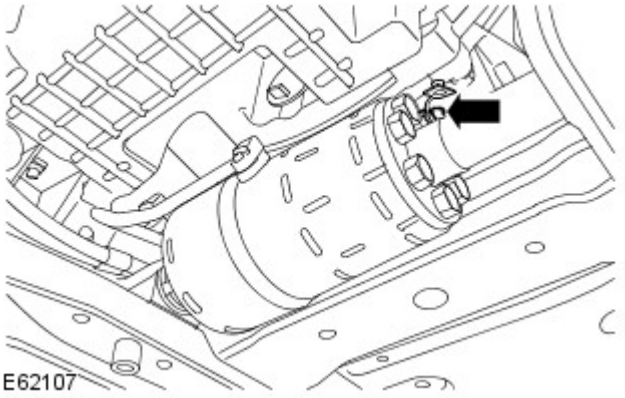


12. CAUTION: The Dynamic Response bleed tool fluid reservoir must remain full with new, clean fluid, at all times during bleeding.

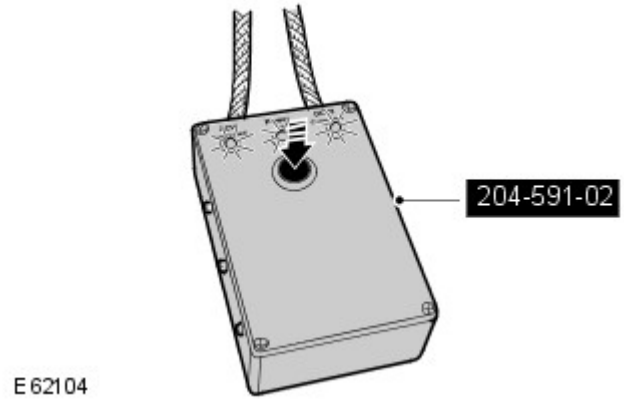
    NOTE: It may be necessary to operate the switch several times to help pulse the air out of the actuator.

    Bleed the dynamic response system until a flow of clean, air-free fluid, is being pumped into the bleed jar.
    - Using the special tool pressure regulator, carefully increase the air pressure to approx. 5 - 10 PSI / 0.3 - 0.7 kPa, until air/fluid is being expelled from bleed screw.

13. When a steady flow of clean air free fluid is running from the bleed point, tighten the bleed screw to 15 Nm (11 lb.ft).
    - Release the switch on the special tool to switch off the actuator control valves.



14. Loosen the front actuator LH bleed screw by one-half of a turn.



15. Using the special tool, open both actuator control valves.

16. NOTE: It may be necessary to operate the switch several times to help pulse the air out of the actuator.

    Bleed the dynamic response system until a flow of clean, air-

free fluid, is being pumped into the bleed jar.

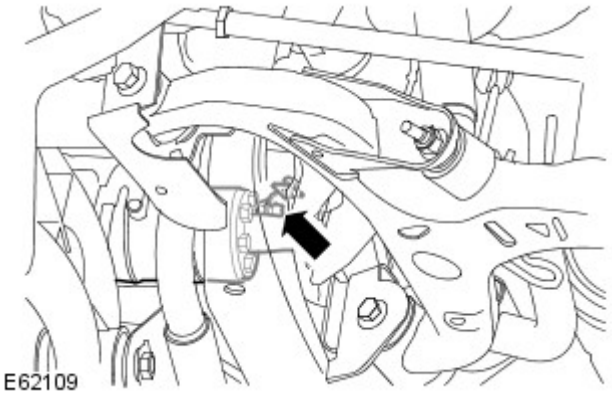
17. When a steady flow of clean air free fluid is running from the bleed point, tighten the bleed screw to 15 Nm (11 lb.ft).
    - Release the switch on the special tool to switch off the actuator control valves.

18. Repeat the front stabilizer bar bleed procedure, from steps 9 to 17, a further two times, to make sure all air is removed from the actuator.

19. Disconnect the special tool hose from the front stabilizer bar bleed screws.
    - Install the bleed screw covers.
    - Discard the fluid from the bleed jar.

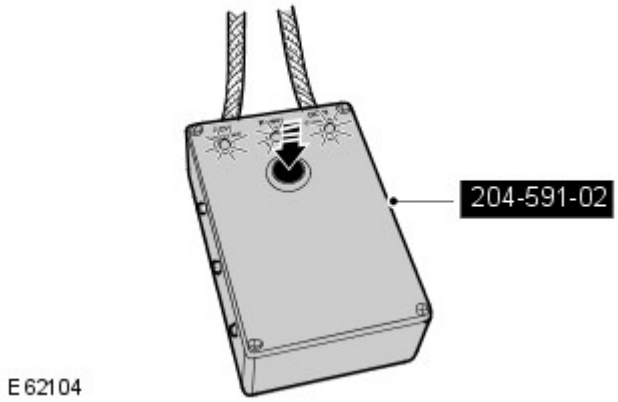
20. Install the engine undershield.
    For additional information, refer to: Engine Undershield (501-02, Removal and Installation).

21. Check and top-up the special tool fluid reservoir.


E62109

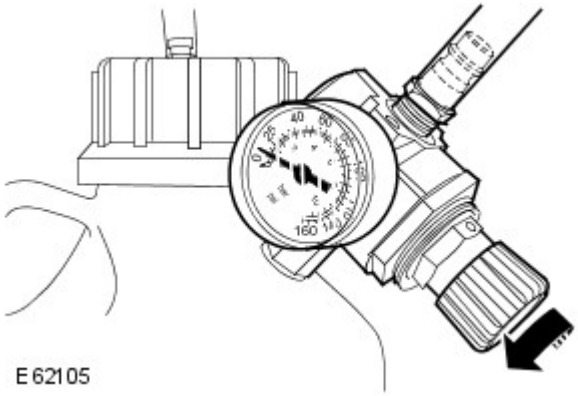
22. Connect the hose from the special tool kit to the rear stabilizer bar bleed screws.
    - Remove the bleed screw covers.

23. Loosen the rear actuator RH bleed screw by one-half of a turn.



E62104

24. Using the special tool, open both actuator control valves.

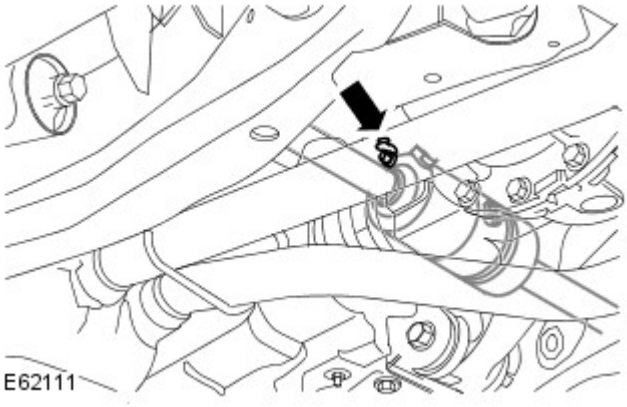

E62105

25. CAUTION: The Dynamic Response bleed tool fluid reservoir must remain full with new, clean fluid, at all times during bleeding.

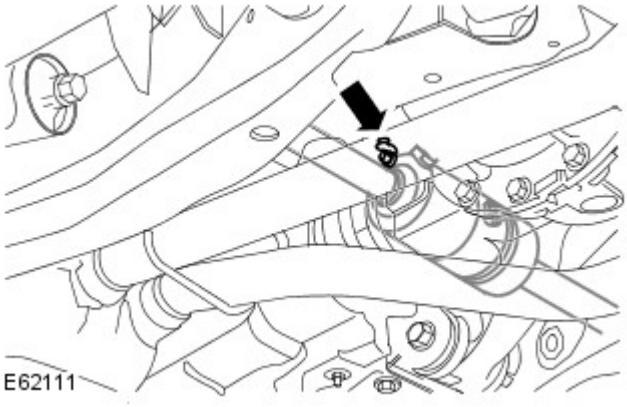
    NOTE: It may be necessary to operate the switch several times to help pulse the air out of the actuator.

    Bleed the dynamic response system until a flow of clean, air-free fluid, is being pumped into the bleed jar.

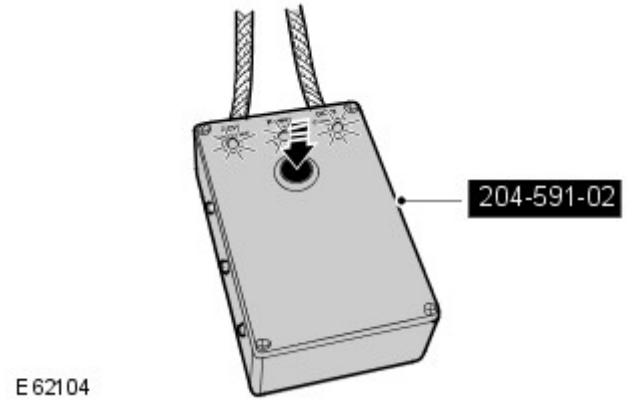
26. When a steady flow of clean air free fluid is running from the bleed point, tighten the bleed



screw to 15 Nm (11 lb.ft).
- Release the switch on the special tool to switch off the actuator control valves.



27. Loosen the rear actuator LH bleed screw by one-half of a turn.



28. Using the special tool, open both actuator control valves.

29. NOTE: It may be necessary to operate the switch several times to help pulse the air out of the actuator.

    Bleed the dynamic response system until a flow of clean, air-free fluid, is being pumped into the bleed jar.

30. When a steady flow of clean air free fluid is running from the bleed point, tighten the bleed screw to 15 Nm (11 lb.ft).
    - Release the switch on the special tool to switch off the actuator control valves.

31. Repeat the rear stabilizer bar bleed procedure, from steps 22 to 30, a further two times, to make sure all air is removed from the actautor.

32. Disconnect the special tool hose from the rear stabilizer bar bleed screws.
    - Discard the fluid from the bleed jar.
    - Install the bleed screw covers.

33. Disconnect the special tool from the valve block.
    - Connect the valve block electrical connectors.

34. WARNING: The special tool is still pressurised when the source air pressure is removed. Release air pressure within

special tool slowly before removing.

Remove the special tool from the dynamic response system reservoir.

- Remove the special tool.
- Top-up the fluid level to the mid-way mark on the reservoir.

35. Install bracket securing fuel breather pipes.

36. Using IDS, check operation of the dynamic response system.

37. If necessary, repeat the above procedure.

38. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Ride and Handling Optimization - Upper Accelerometer

Removal and Installation

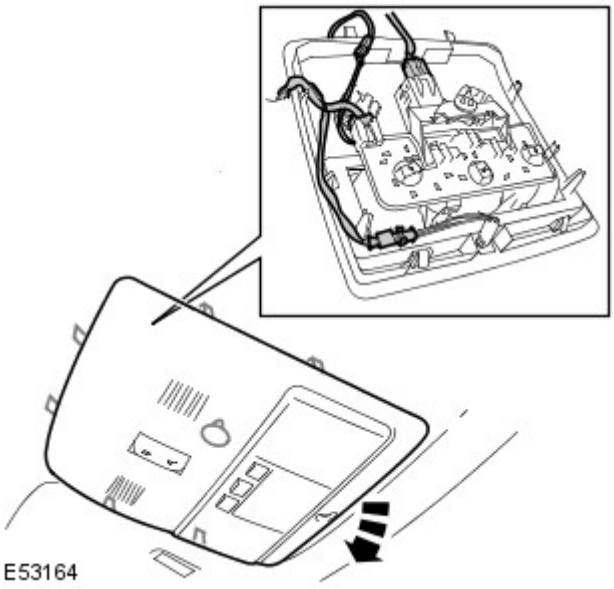
Special Tool(s)

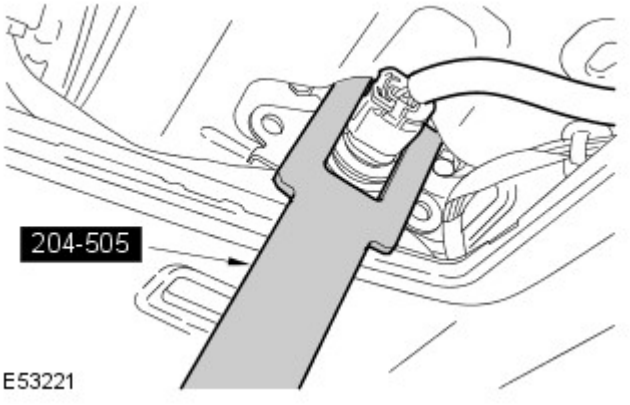
	Accelerometer remover/replacer 204-505 (LRT-60-014A)

Removal

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

2. Remove the front overhead console.
   - Carefully release the 9 clips.
   - Disconnect the 2 electrical connectors.





3. CAUTION: The accelerometer is an extremely delicate component and can easily be rendered unserviceable. Never use an accelerometer which has been dropped or subjected to mistreatment of any type.

   Remove the upper accelerometer.
   - Using the special tool, release the accelerometer.
   - Release and disconnect the electrical connector.

Installation

1. Using the special tool, install the upper accelerometer.
   - Connect and secure the electrical connector.

2. Install the front overhead console.
   - Connect and secure the electrical connectors.
   - Carefully secure the clips.

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

4. Using T4, calibrate the dynamic response system.

Ride and Handling Optimization - Lower Accelerometer

Removal and Installation

Special Tool(s)

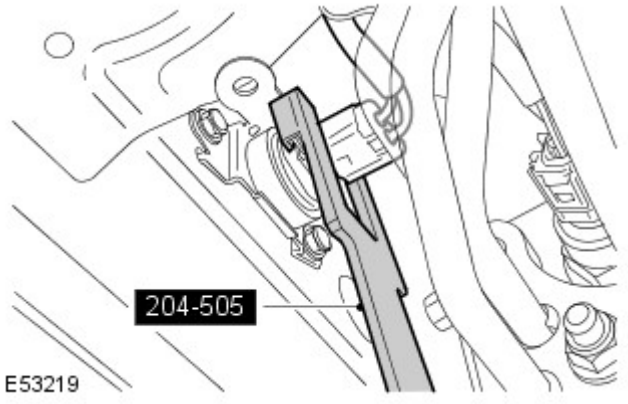
	Accelerometer remover/replacer 204-505 (LRT-60-014A)

Removal

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

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. CAUTION: The accelerometer is an extremely delicate component and can easily be rendered unserviceable. Never use an accelerometer which has been dropped or subjected to mistreatment of any type.

   Remove the lower accelerometer.
   - Using the special tool , release the accelerometer.
   - Release and disconnect the electrical connector.

Installation

1. Using the special tool, install the lower accelerometer.
   - Connect and secure the electrical connector.

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

3. Using T4, calibrate the dynamic response system.

Ride and Handling Optimization - Fluid Pump 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. Disconnect the battery ground cable.

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

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

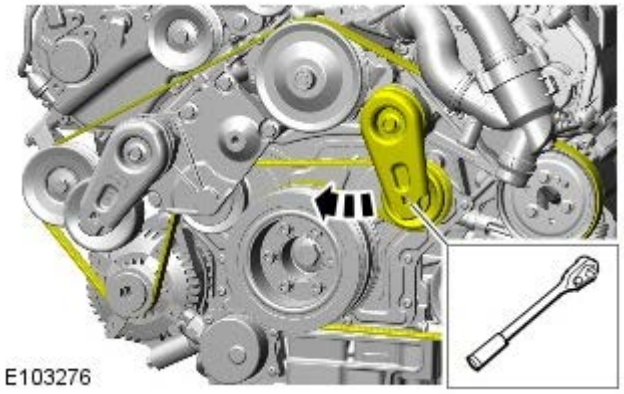
   Raise and support the vehicle.

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

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

5. Remove the RH front wheel and tire.

   Torque: 140 Nm

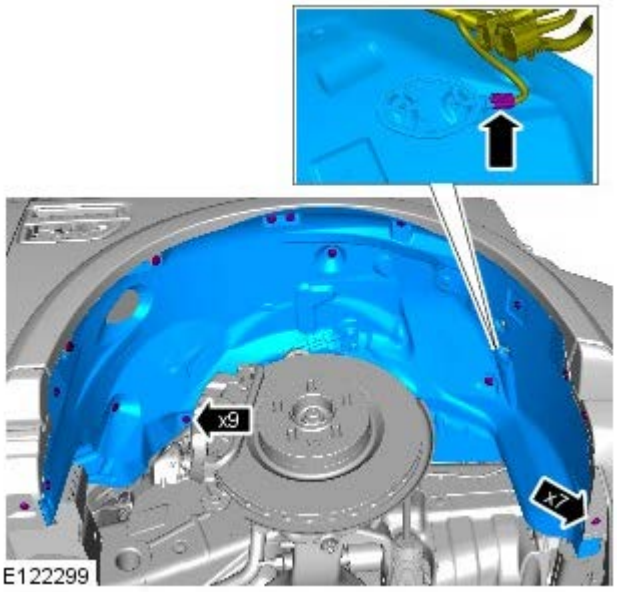


6. NOTES:

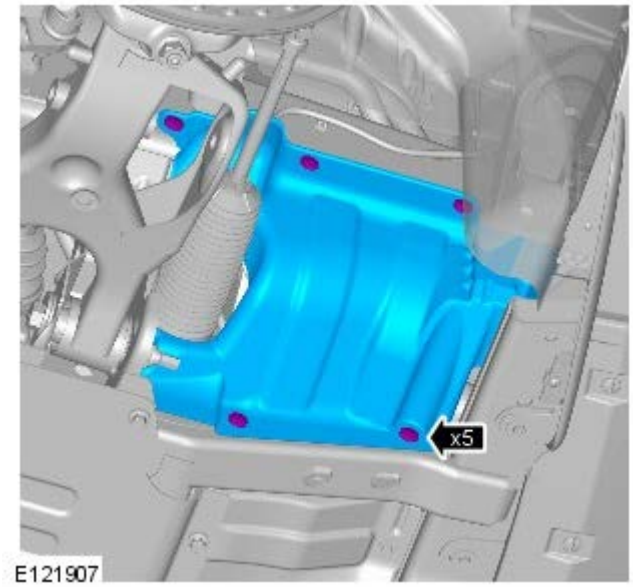
   Some variation in the illustrations may occur, but the essential information is always correct.

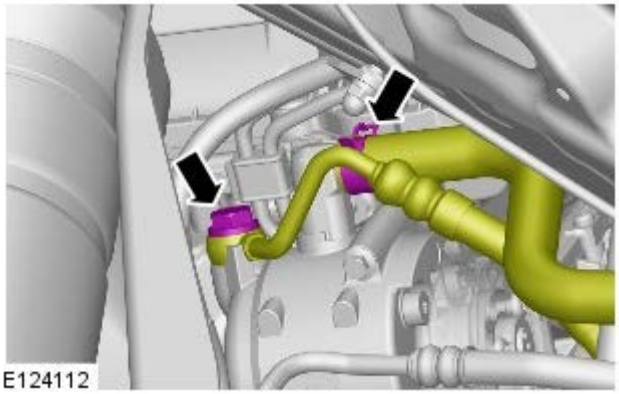
   Engine shown removed for clarity.

7.



8.



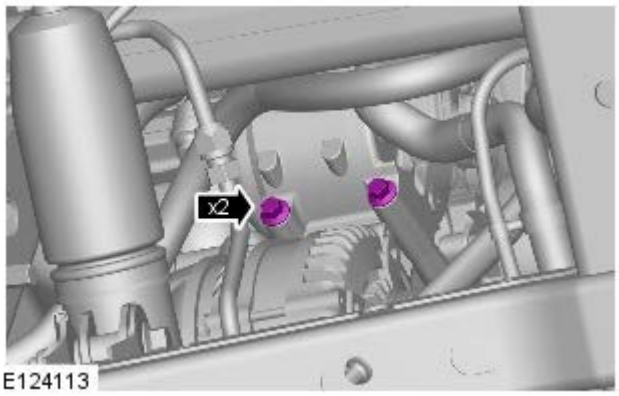


9. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

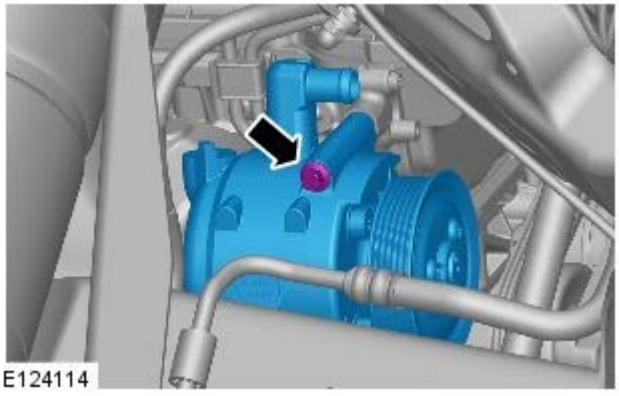
   CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

   NOTE: Remove and discard the O-ring seals.

   Torque: 35 Nm



10. *Torque:* 22 Nm



11. *Torque:* 22 Nm

Installation

1.  CAUTION: Make sure both O-ring seals are correctly installed on the high pressure union.

    NOTE: Prime the pump with clean fluid.

   To install, reverse the removal procedure.

2.  NOTE: Start the engine and allow to idle. Remove reservoir cap and inspect for fluid circulation, if no flow is observed stop engine and apply a small amount of pressure to the reservoir using the dynamic response system bleed kit to encourage fluid flow into the fluid pump, and restart engine with this pressure applied for approx 1 minute.

   Fill the power steering reservoir.

Ride and Handling Optimization - Fluid Pump TDV6 3.0L Diesel
Removal and Installation

Removal

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

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

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

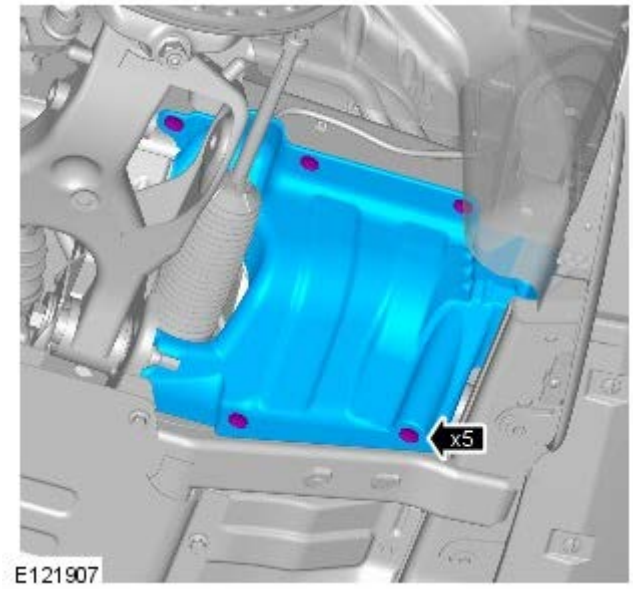
   Raise and support the vehicle.

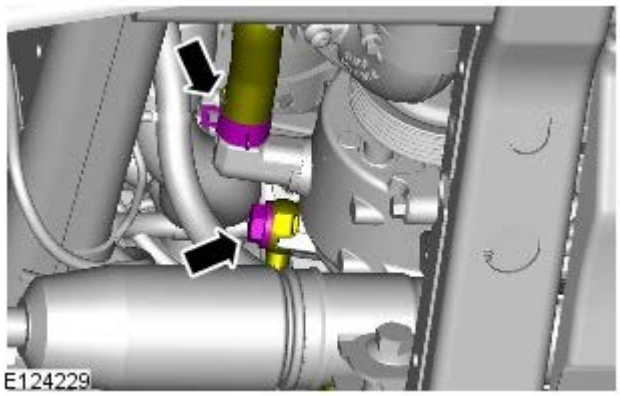
3. For additional information, refer to: Accessory Drive Belt (303-05, Removal and Installation).

4. For additional information, refer to: Engine Undershield (501-02, Removal and Installation).

5. Remove the RH front wheel and tire.
   - TORQUE: 140 Nm

6.





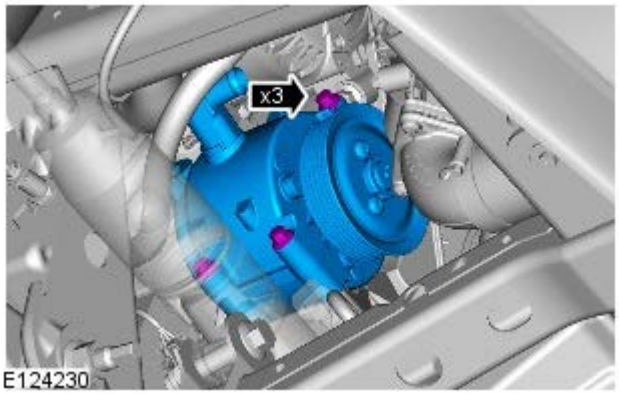
7. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

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

   NOTE: Remove and discard the O-ring seals.

   TORQUE: 35 Nm

8. TORQUE: 22 Nm



Installation

1. CAUTION: Make sure both O-ring seals are correctly installed on the high pressure union.

   NOTE: Prime the pump with clean fluid.

   To install, reverse the removal procedure.

2. NOTE: Start the engine and allow to idle. Remove reservoir cap and inspect for fluid circulation, if no flow is observed stop engine and apply a small amount of pressure to the reservoir using the dynamic response system bleed kit to encourage fluid flow into the fluid pump, and restart engine with this pressure applied for approx 1 minute.

   Fill the power steering reservoir.

Ride and Handling Optimization - Dynamic Response Module

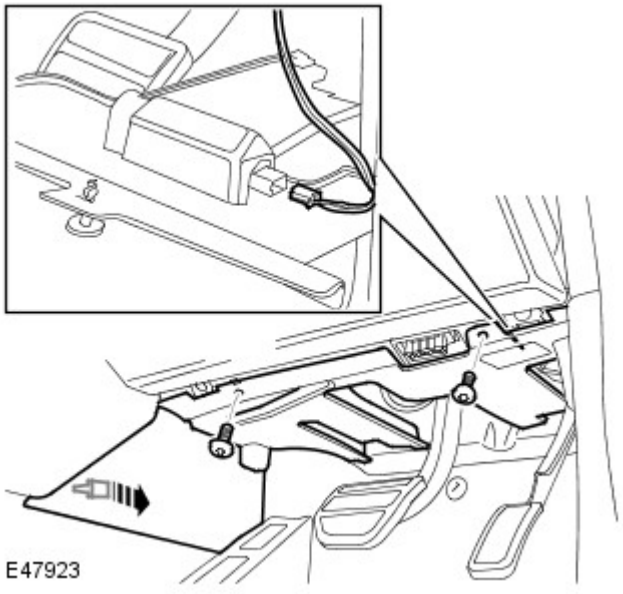
Removal and Installation

Removal

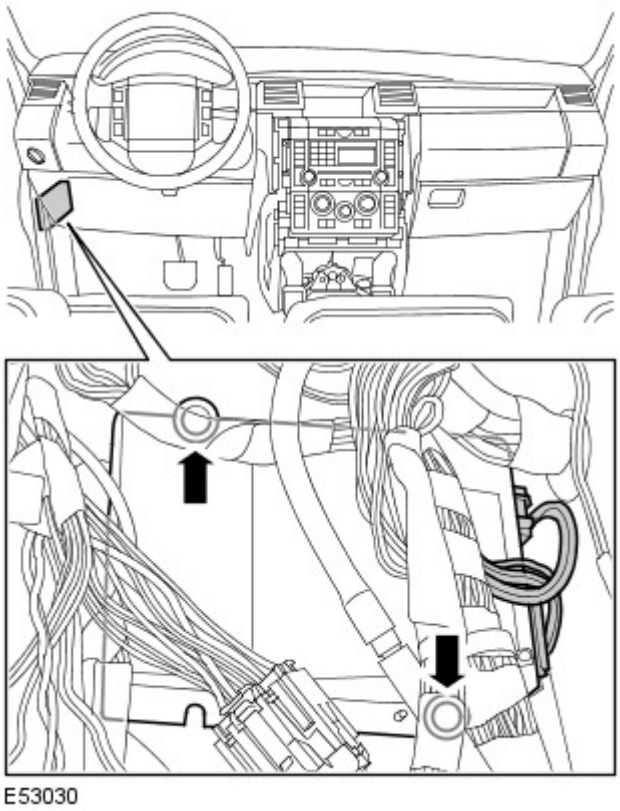
NOTE: The dynamic response module is always located on the driver's side of the vehicle.

1. Remove the cowl side trim panel.
   For additional information, refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

2. Remove the closing trim panel.
   - Release the clip.
   - Remove the 2 screws.
   - Disconnect the electrical connector.



3. Remove the dynamic response module.
   - Remove the 2 bolts.
   - Disconnect the 2 electrical connectors.



Installation

1. Install the dynamic response module.
   - Connect the electrical connectors.
   - Tighten the 2 bolts to 4 Nm (3 lb.ft).

2. Install the closing trim panel.
    - Connect the electrical connector.
    - Secure the clip.
    - Tighten the screws.

3. Install the cowl side trim panel.
   For additional information, refer to: Cowl Side Trim Panel (501-05 Interior Trim and Ornamentation, Removal and Installation).

4. Initiate a new control module using T4.

Ride and Handling Optimization - Valve Block

Removal and Installation

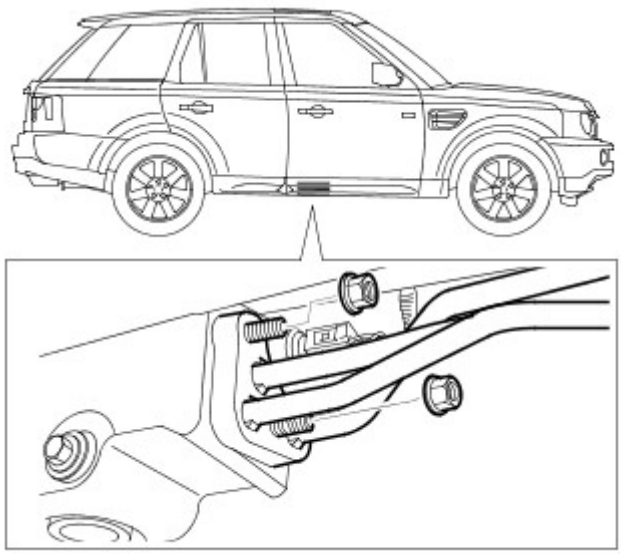
Removal

CAUTION: Dynamic Response system components are manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the Dynamic Response system.

NOTE: The valve block seals do not require replacement unless there is evidence of a fluid leak. A new valve block is supplied with new seals installed.

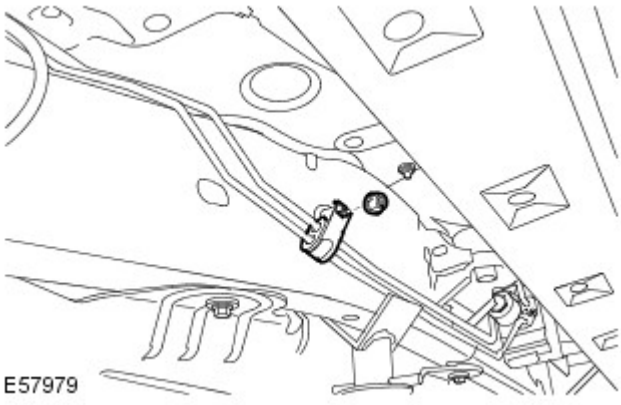
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.


E57817

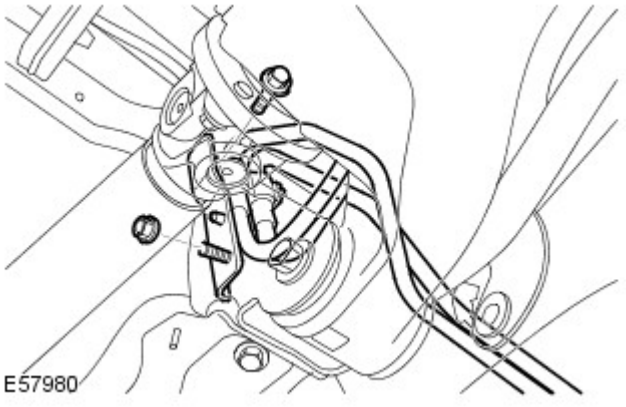
2. NOTE: Some fluid spillage is inevitable during this operation.

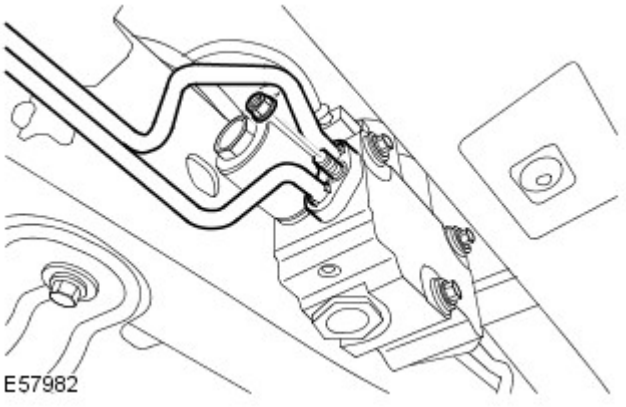
   Release the front actuator pipes from the valve block.
   - Position a container to collect the fluid spillage.
   - Remove and discard the 2 nuts.

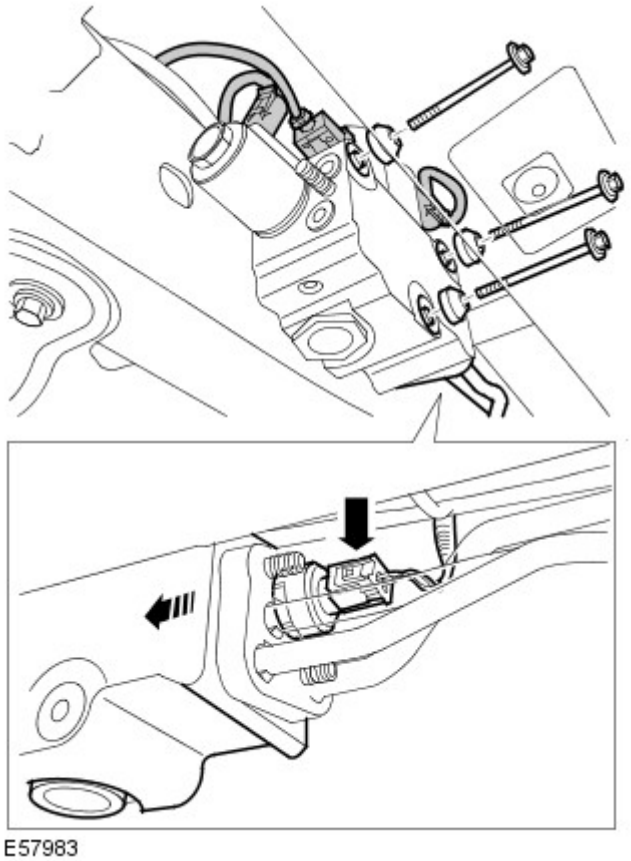

E57979

3. Release the valve block to rear stabilizer bar actuator pipe assembly mounting.
   - Remove the nut.

4. Release the valve block to rear stabilizer bar actuator pipe assembly mounting.
   - Remove the bolt.
   - Remove the nut.
   - Remove the bracket.







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

   NOTE: Some fluid spillage is inevitable during this operation.

   Disconnect the rear actuator pipes from the valve block.
   - Position a container to collect the fluid spillage.
   - Remove and discard the nut.

6. CAUTIONS:

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

   Make sure the actuator fluid lines are not clamped or kinked. Failure to follow this instruction will result in damage to the vehicle.

   NOTES:

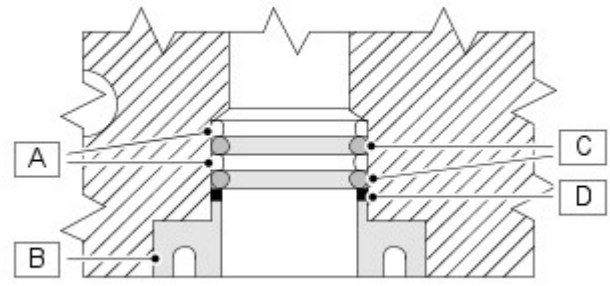
   Some fluid spillage is inevitable during this operation.

   Note the fitted position of the washers.

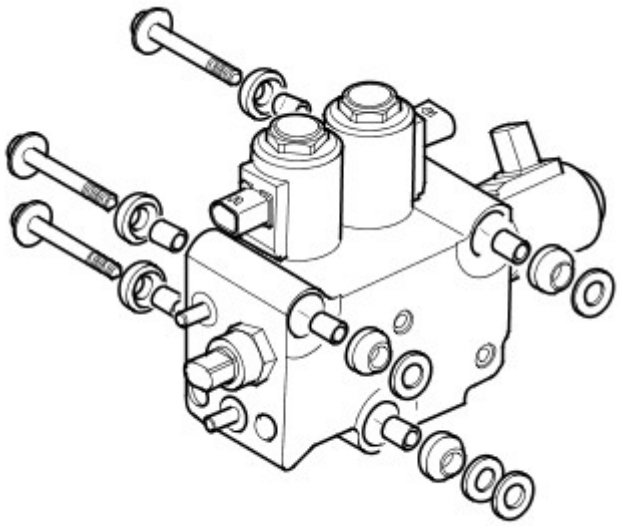
   Remove the valve block.
   - Disconnect the 4 electrical connectors.
   - Remove the 3 bolts.
   - Collect the 4 washers.
   - Disconnect the front actuator pipes from the valve block.

Installation

1. Check the valve block O-rings seals and plastic spacer washers are correctly installed.
   - A: Backing rings (white)
   - B: Outer clamping ring
   - C: O-ring seals
   - D: Outer backing ring (Black)



E58627

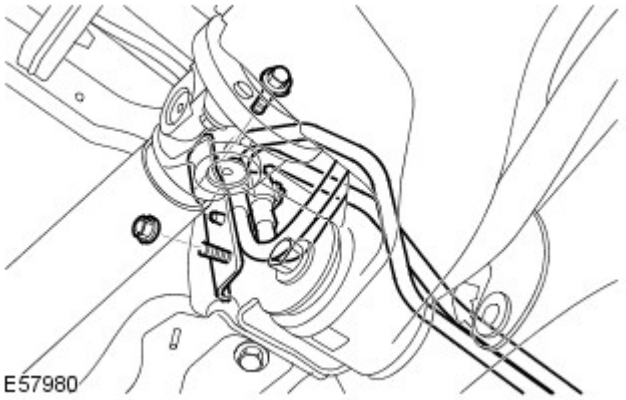


E58615

2. NOTE: Make sure there are two washers installed between the integrated body frame and the valve block lower retaining bolt.

   Install the valve block.
   - Remove the blanking caps from the ports.
   - Connect the front actuator pipes to the valve block.
   - Install 3 new nuts and tighten to 23 Nm (17 lb.ft).
   - Discard the 3 valve block retaining bolts, fit new ones and tighten to 20 Nm (15 lb.ft).
   - Connect the electrical connectors.

3. Connect the rear actuator pipes to the valve block.
   - Remove the blanking caps from the ports.
   - Install a new nut and tighten to 22 Nm (16 lb.ft).
   - Remove the container.



E57980

4. Secure the valve block to rear stabilizer bar actuator pipe assembly mounting.
   - Install the bracket.
   - Install the nut and bolt and tighten to 9 Nm (7 lb.ft).

5. Secure the valve block to rear stabilizer bar actuator pipe assembly mountings.
   - Tighten the nut to 9 Nm (7 lb.ft)

6. Using T4, bleed the Dynamic Response system.

Ride and Handling Optimization - Valve Block Filter

Removal and Installation

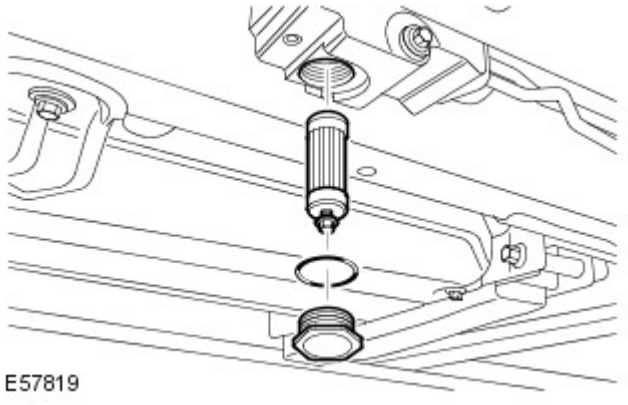
Removal

CAUTION: Dynamic Response system components are manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the Dynamic Response system.

NOTE: This procedure does not require the Dynamic Response system to be bled.

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

   Remove and discard the valve block filter.
   - Position container to collect fluid loss.
   - Remove the access plug.
   - Remove and discard the access plug O-ring seal.
   - Using a suitable M6 bolt, release the filter from the valve block.

Installation

1. Install the new valve block filter.
   - Clean the component mating faces.
   - Install a new access plug O-ring seal.
   - Tighten the access plug to 62 Nm (46 lb.ft).
   - Remove the container.

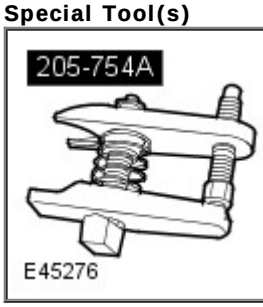
2. Start the engine and allow to idle.

3. Check and top-up the Dynamic Response system fluid reservoir.

Ride and Handling Optimization - Valve Block to Front Stabilizer Bar Actuator Pipe Assembly

Removal and Installation

Special Tool(s)

	Ball joint separator 205-754 (LRT-54-027)

Removal

CAUTION: Dynamic Response system components are manufactured to very precise tolerances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the Dynamic Response system.

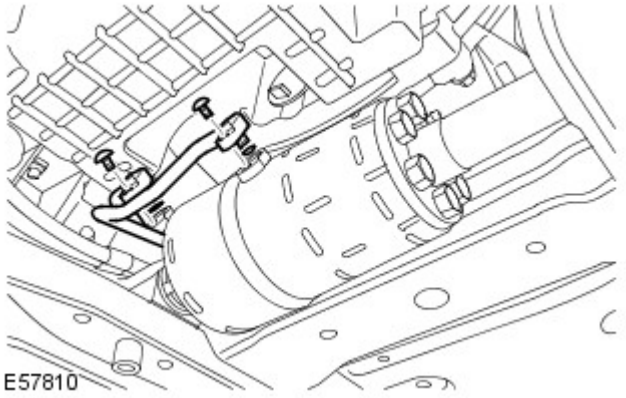
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Remove the rear bumper cover.
   For additional information, refer to: Rear Bumper Cover (501-19 Bumpers, Removal and Installation).

3. Remove the spare wheel and tire.

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



5. CAUTIONS:

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

   Make sure the actuator fluid lines are not damaged or kinked during removal or installation.

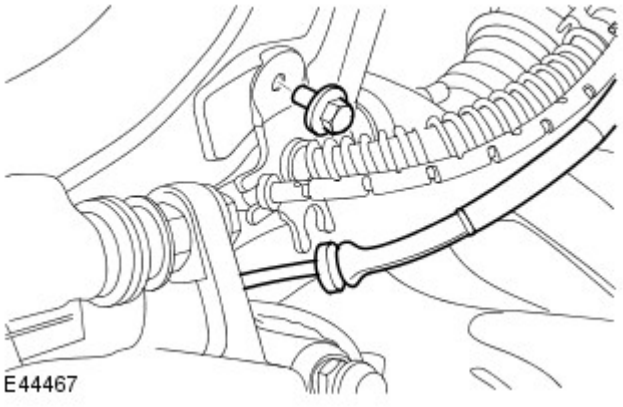
   NOTE: Some fluid spillage is inevitable during this operation.

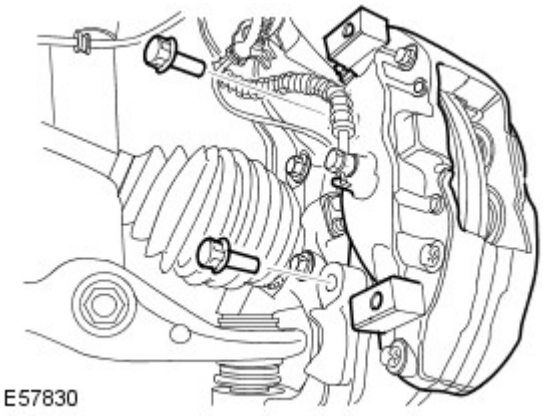
   Disconnect the fluid lines from the actuator.
   - Position container to collect fluid loss.
   - Remove the 2 bolts.
   - Remove and discard the O-ring seals.
   - Remove and discard the plastic spacer washers.
   - Install blanking caps to the exposed ports.

6. Remove the front wheels and tires.

7. RH front: Remove the shock absorber and air spring assembly.
   For additional information, refer to: Front Shock Absorber and Air Spring Assembly (204-05 Vehicle Dynamic Suspension, Removal and Installation).

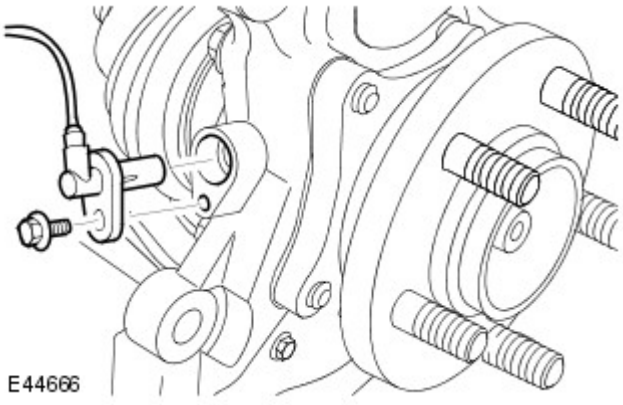
8. Release the brake hose bracket from the wheel knuckle.
   - Remove the retaining bolt.


E44467


E57830

9. CAUTION: Do not allow the brake caliper to hang on the brake hose.

   Release the brake caliper from the wheel knuckle.
   - Remove the 2 retaining bolts.
   - Tie the brake caliper aside.


E44666

10. NOTE: The brake disc is shown removed for clarity.

    Release the wheel speed sensor from the wheel knuckle.
    - Remove the bolt.

11. CAUTIONS:

    Note the position of the hardened steel washer. The hardened steel washer must be installed between the stabilizer bar link and the upper arm. Failure to follow this instruction may result in damage to the vehicle.

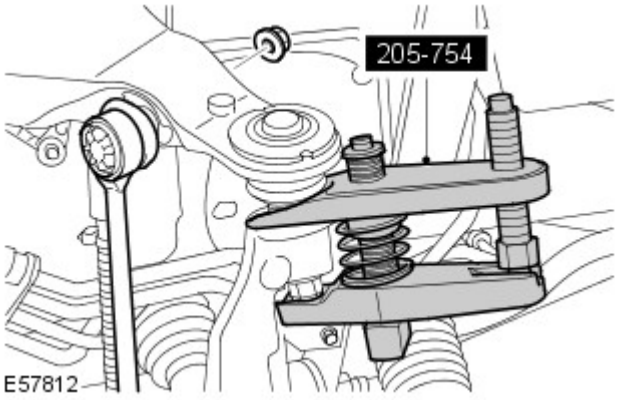
    Use a Torx socket to prevent the ball joint rotating whilst removing the nut.

    Remove the stabilizer bar link nut.
    - Discard the nut.

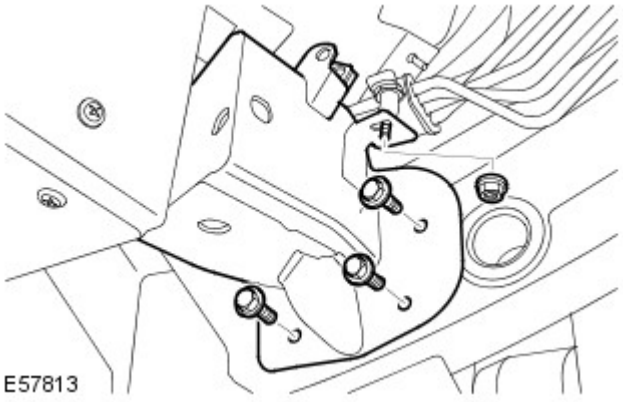
12. CAUTION: To prevent the wheel knuckle falling outwards and disconnection of the halfshaft inner joint, support the wheel knuckle.

    Loosen the upper arm retaining nut.

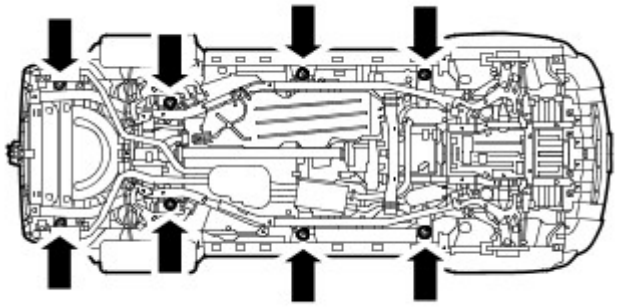
13. Using the special tool, release the upper arm ball joint.
    - Remove and discard the retaining nut.



14. Remove the integrated body frame bracket.
    - Remove the 3 bolts and 1 nut.



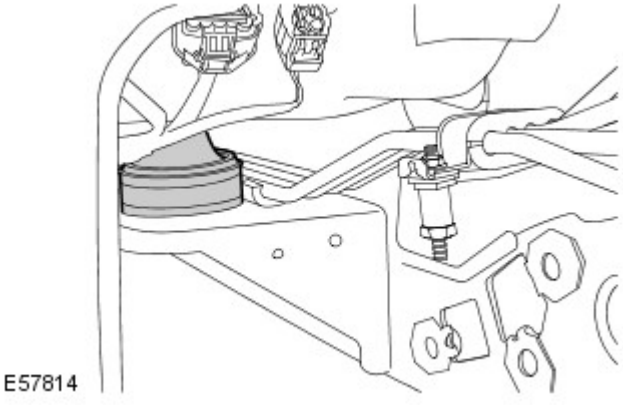
15. Remove the body mount retaining bolts.
    - Remove the 8 bolts.



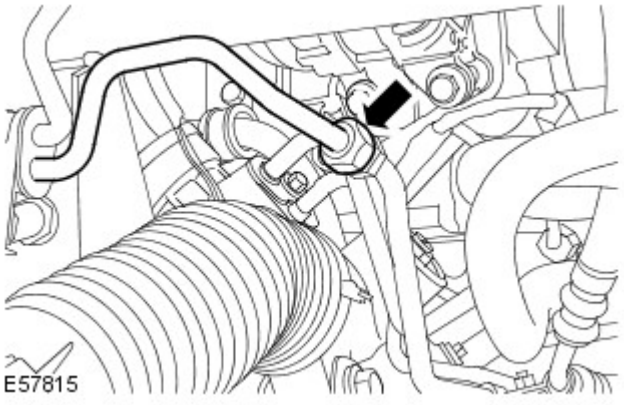
16. CAUTION: Only raise the body sufficiently to remove the body mount.

    Raise the body.
    - Using suitable stands, raise the body to release the body mounts.

17. Remove the body mount.



18. CAUTION: Before disconnecting or removing the components, ensure the area around the joint



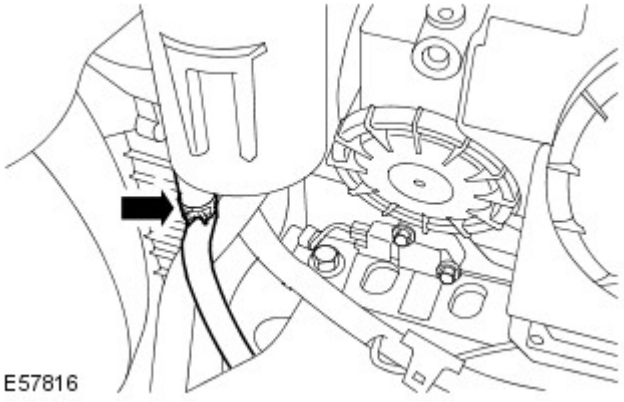
faces and connections are clean. Plug open connections to prevent contamination.

NOTE: Some fluid spillage is inevitable during this operation.

Disconnect the high pressure line.

- Position a container to collect the fluid spillage.
- Install blanking caps to the exposed ports.

19. Remove the air cleaner assembly.
    For additional information, refer to: Air Cleaner (303-12A Intake Air Distribution and Filtering - 4.2L, Removal and Installation).



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

    NOTE: Some fluid spillage is inevitable during this operation.

    Disconnect the fluid return line from the reservoir.
    - Position a container to collect the fluid spillage.
    - Reposition the fluid line into the wheel arch area.



21. Release the valve block to front stabilizer bar actuator pipe assembly mountings.
    - Remove the 2 nuts and 1 bolt.

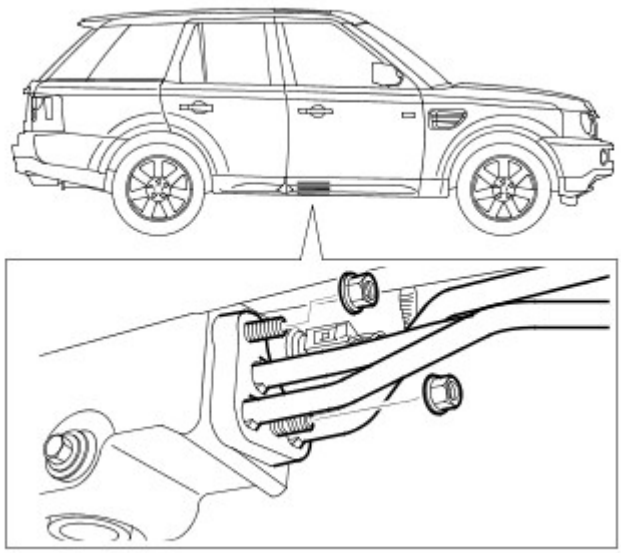
22. CAUTIONS:

    Always plug any open connections to prevent contamination.

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

    NOTE: Some fluid spillage is inevitable during this operation.

    Disconnect the front actuator pipes from the valve block.
    - Position a container to collect the fluid spillage.
    - Remove and discard the 2 nuts.
    - Install blanking caps to the exposed ports.

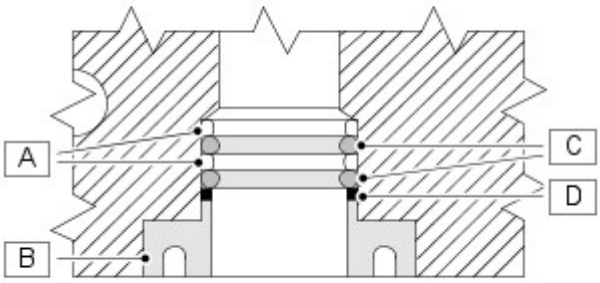


E57817

23. Remove the valve block to front stabilizer bar actuator pipe assembly.

Installation

1. Check the valve block O-rings and plastic spacer washers are correctly installed.
    - A: Backing rings (white)
    - B: Outer clamping ring
    - C: O-ring seals
    - D: Outer backing ring (Black)



E58627

2. Install the valve block to front stabilizer bar actuator pipe assembly.
    - Clean the components.
3. Connect the front actuator pipes to the valve block.
    - Remove the blanking caps from the ports.
    - Install 2 new nuts and tighten to 22 Nm (16 lb.ft).
    - Remove the container.
4. Attach the valve block to front stabilizer bar actuator pipe assembly mountings.
    - Tighten the 2 nuts and 1 bolt to 9 Nm (7 lb.ft).
5. Connect the fluid line to the reservoir.
    - Reposition the fluid line from the wheel arch area.
    - Install the clip.
    - Remove the container.
6. Install the air cleaner assembly.
   For additional information, refer to: Air Cleaner (303-12A Intake Air Distribution and Filtering - 4.2L, Removal and Installation).
7. Connect the high pressure line.
    - Remove the blanking caps from the ports.
    - Tighten the union to 21 Nm (15 lb.ft).
    - Remove the container.
8. Install the body mount.
9. Lower the body.
    - Remove the stands.

10. Install the body mount retaining bolts.
    - Tighten the 8 retaining bolts to 133 Nm (98 lb.ft).

11. Install the integrated body frame bracket.
    - Install the 3 bolts and tighten to 40 Nm (30 lb.ft).
    - Tighten the nut to 9 Nm (7 lb.ft)

12. Connect the upper arm and wheel knuckle.
    - Install a new nut and tighten to 70 Nm (52 lb.ft).

13. Install the wheel speed sensor.
    - Tighten the bolt to 9 Nm (7 lb.ft).
    - Connect the electrical connector.
    - Secure the wiring harness in the clips.

14. Secure the brake caliper to the wheel knuckle.
    - Tighten the bolts to 275 Nm (203 lb.ft).

15. Secure the brake hose retaining bracket to the wheel knuckle.
    - Tighten the bolt to 23 Nm (17 lb.ft).

16. Install the shock absorber and air spring assembly.
    For additional information, refer to: Front Shock Absorber and Air Spring Assembly (204-05 Vehicle Dynamic Suspension, Removal and Installation).

17. CAUTIONS:

    Make sure the actuator fluid lines are not damaged or kinked during removal or installation.

    Care must be taken to avoid damage to the plastic spacer washers and O-ring seals during installation of the fluid lines to the actautor.

    NOTE: Some fluid spillage is inevitable during this operation.

    Connect the fluid lines to the actuator.
    - Clean the component mating faces.
    - Remove the blanking caps from the ports.
    - Install new plastic spacer washers and O-ring seals.
    - Tighten the 2 bolts to 22 Nm (16 lb.ft).

18. Bleed the front of the Dynamic Response system using T4.

19. Install the engine undershield.
    For additional information, refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

20. CAUTIONS:

    Make sure the hardened steel washer is installed between the stabilizer bar link and the upper arm. Failure to follow this instruction may result in damage to the vehicle.

    Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

    Secure the stabilizer bar link.
    - Install a new nut and tighten to 175 Nm (129 lb.ft).

21. Install the front wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

22. Install the spare wheel and tire.

23. Install the rear bumper cover.
    For additional information, refer to: Rear Bumper Cover (501-19 Bumpers, Removal and Installation).

Ride and Handling Optimization - Valve Block to Rear Stabilizer Bar Actuator Pipe Assembly

Removal and Installation

Removal

CAUTION: Dynamic Response system components are manufactured to very precise tolerances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the Dynamic Response system.

NOTE: The valve block seals do not require replacement unless there is evidence of a fluid leak.

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

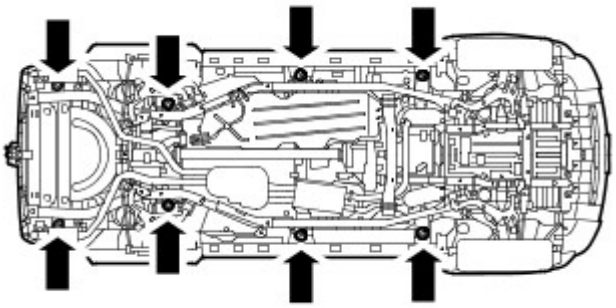
   Raise and support the vehicle.

2. Remove the rear bumper cover.
   For additional information, refer to: Rear Bumper Cover (501-19, Removal and Installation).

3. Remove the spare wheel and tire.

4. Remove the rear wheels and tires.

5. Remove the body mount retaining bolts.
   - Remove the 8 bolts.

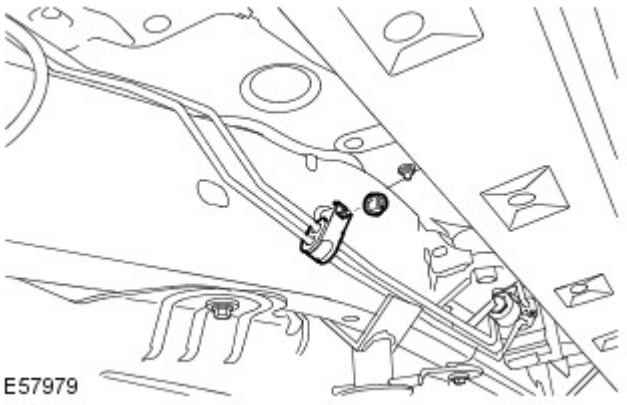


E52217

6. CAUTION: Only raise the body sufficiently to remove the valve block to rear stabilizer bar actuator pipe.

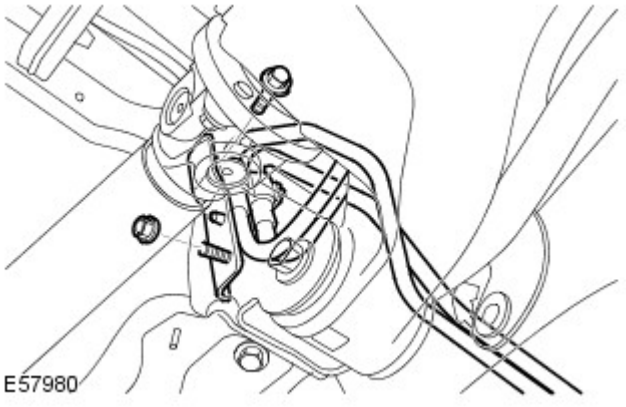
   Using suitable stands, raise the body.

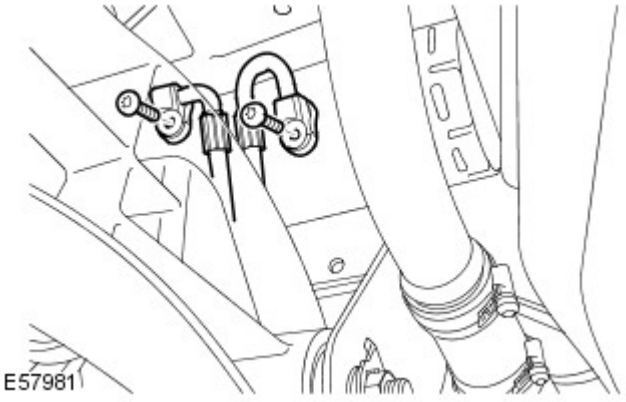
7. Release the valve block to rear stabilizer bar actuator pipe assembly mounting.
   - Remove the nut.



E57979

8. Release the valve block to rear stabilizer bar actuator pipe assembly mounting.
   - Remove the nut.
   - Remove the bolt.
   - Remove the bracket.





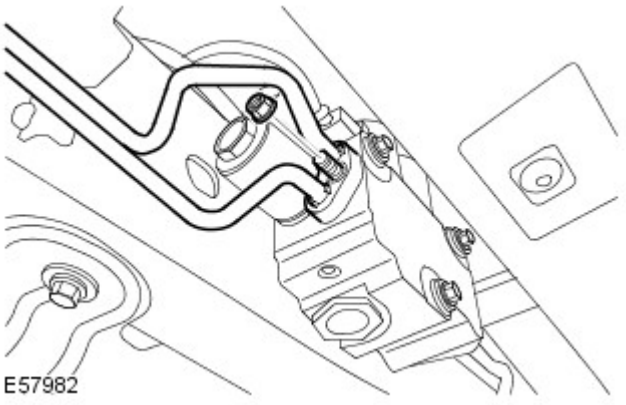
9. CAUTIONS:

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

   Make sure the actuator fluid lines are not damaged or kinked during removal or installation.

   NOTE: Some fluid spillage is inevitable during this operation.

   Disconnect the fluid lines from the actuator.
   - Position container to collect fluid loss.
   - Remove the 2 bolts.
   - Remove and discard the O-ring seals.
   - Remove and discard the plastic spacer washers.
   - Install blanking caps to the exposed ports.



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

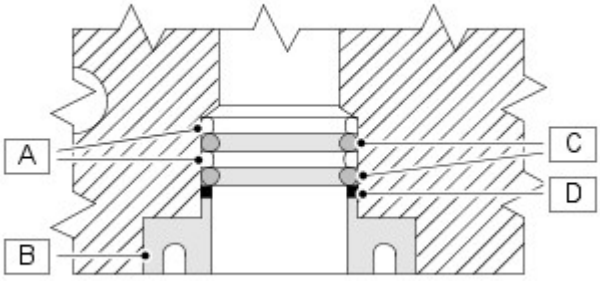
    NOTE: Some fluid spillage is inevitable during this operation.

    Disconnect the rear actuator pipes from the valve block.
    - Position a container to collect the fluid spillage.
    - Remove and discard the nut.

11. Remove the valve block to rear stabilizer bar actuator pipe assembly.

Installation

1. Check the valve block O-rings and plastic spacer washers are correctly installed.
   - A: Backing rings (white)
   - B: Outer clamping ring
   - C: O-ring seals
   - D: Outer backing ring (Black)



E58627

2. CAUTION: Make sure the actuator fluid lines are not damaged or kinked during removal or installation.

   Install the valve block to rear stabilizer bar actuator pipe assembly.

3. NOTE: Some fluid spillage is inevitable during this operation.

   Connect the rear actuator pipes to the valve block.
   - Remove the blanking caps from the ports.
   - Install a new nut and tighten to 22 Nm (16 lb.ft).
   - Remove the container.

4. CAUTIONS:

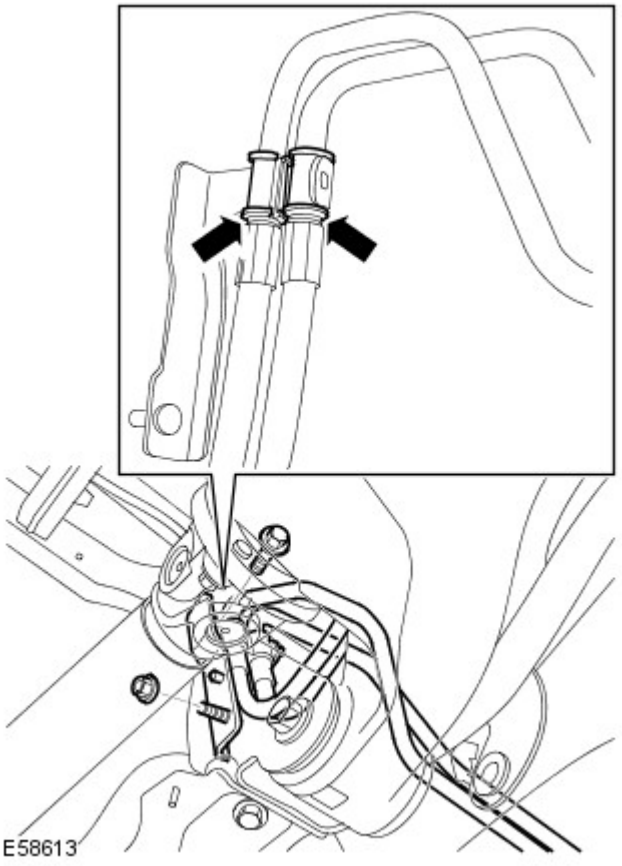
   Make sure the actuator fluid lines are not damaged or kinked during removal or installation.

   Care must be taken to avoid damage to the plastic spacer washers and O-ring seals during installation of the fluid lines to the actuator.

   NOTE: Some fluid spillage is inevitable during this operation.

   Connect the fluid lines to the actuator.
   - Clean the component mating faces.
   - Remove the blanking caps from the ports.
   - Install new plastic spacer washers and O-ring seals.
   - Tighten the 2 bolts to 22 Nm (16 lb.ft).

5. Secure the valve block to rear stabilizer bar actuator pipe assembly mounting.
   - Install the bracket.
   - Install the nut and bolt and tighten to 9 Nm (7 lb.ft).



6. Secure the valve block to rear stabilizer bar actuator pipe assembly mounting.
    - Tighten the nut to 9 Nm (7 lb.ft)
7. Bleed the rear of the Dynamic Response system using T4.
   For additional information, refer to: Active Stabilization System Bleeding (204-06, General Procedures).
8. Lower the body.
    - Remove the stands.
9. Install the body mount retaining bolts.
    - Tighten the 8 retaining bolts to 133 Nm (98 lb.ft).
10. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).
11. Install the spare wheel and tire.
12. Install the rear bumper cover.
    For additional information, refer to: Rear Bumper Cover (501-19, Removal and Installation).

Ride and Handling Optimization - Valve Block Transducer

Removal and Installation

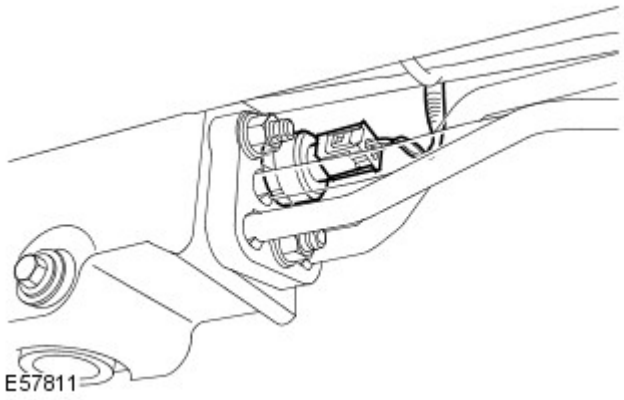
Removal

CAUTION: Dynamic Response system components are manufactured to very precise tolerances and fine clearances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the Dynamic Response system.

NOTE: This procedure does not require the Dynamic Response system to be bled.

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

   Remove the valve block transducer.
   - Disconnect the electrical connector.
   - Position container to collect fluid loss.

Installation

1. Install the valve block transducer.
   - Clean the component mating faces.
   - Tighten to 25 Nm (18 lb.ft).
   - Remove the container.
2. Start the engine and allow to idle.
3. Check and top-up the Dynamic Response system fluid reservoir.

Ride and Handling Optimization - Front Stabilizer Bar Bushing V8 5.0L Petrol/V8 S/C 5.0L Petrol

Removal and Installation

Special Tool(s)

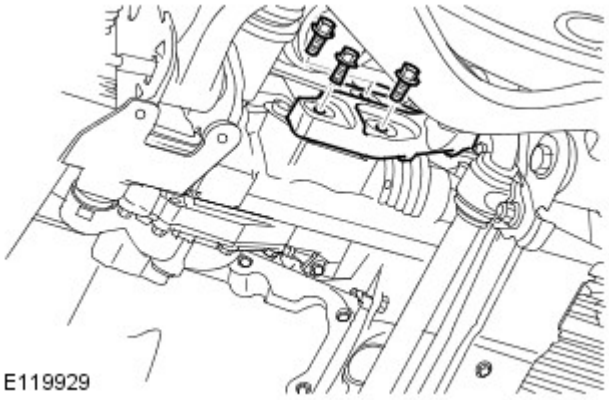
	Front Stabilizer Bar Bushing Tightening Tool 204-703
	Front Stabilizer Bar Bushing Tightening Tool 204-705

Removal

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

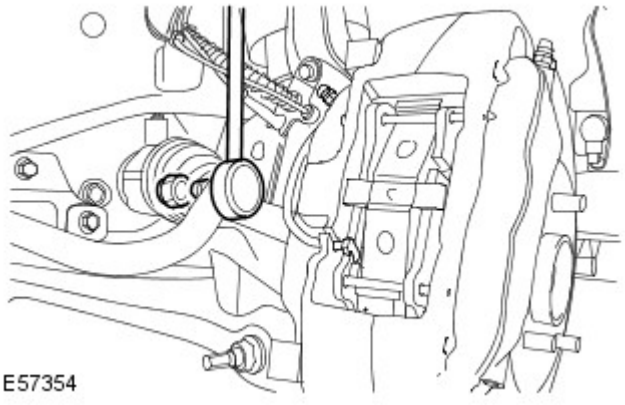
   Raise and support the vehicle.

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



3. NOTE: Crossmember shown removed for clarity.

   Using a suitable jack, support the differential.
   - Remove and discard the three differential mounting bolts.
   - Raise and reposition the front differential case.



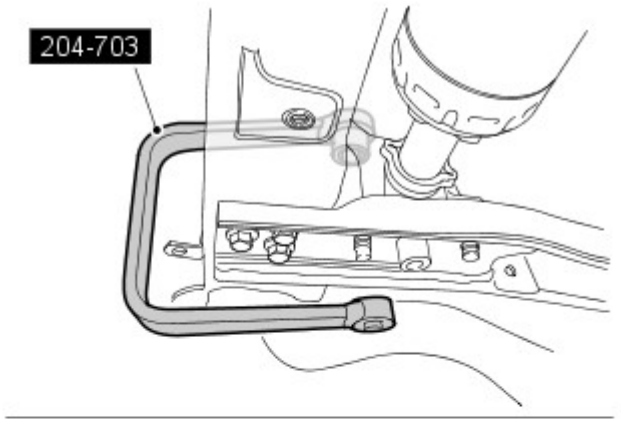
4. CAUTIONS:

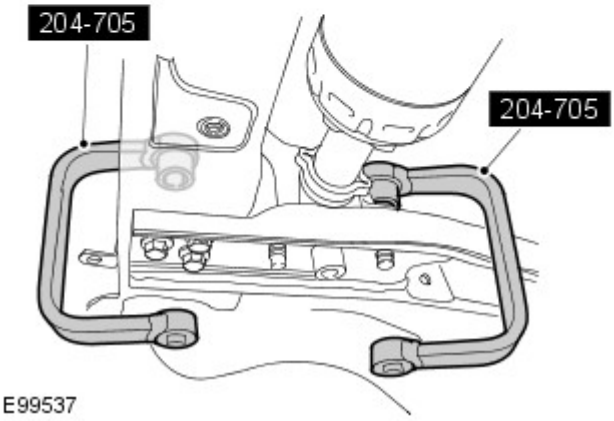
   Use a Torx socket to prevent the ball joint rotating whilst removing the nut.

   Note the position of the hardened steel washer. The hardened steel washer must be installed between the stabilizer bar link and the stabilizer bar. Failure to follow this instruction may result in damage to the vehicle.

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

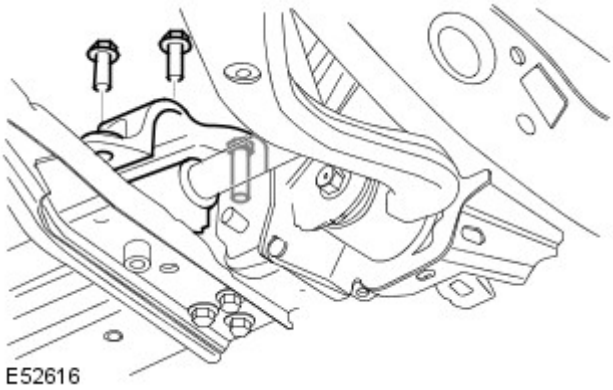
   Disconnect both the stabilizer bar links from the stabilizer bar.
   - Remove and discard the 2 nuts.





5. NOTE: Right-hand shown, left-hand similar.

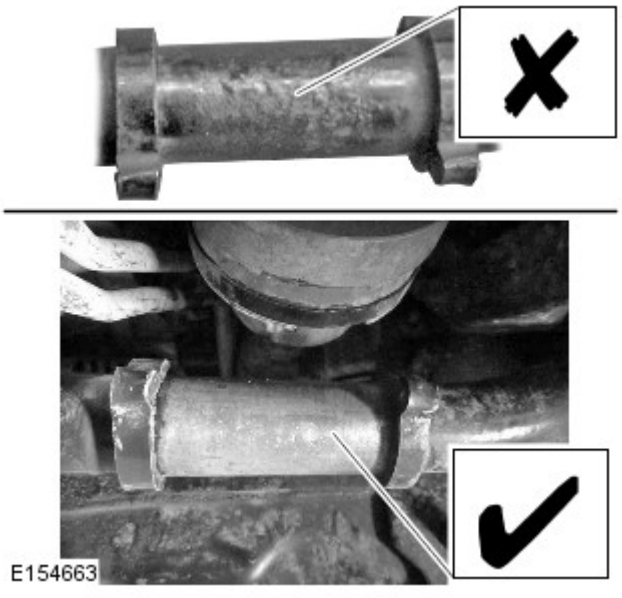
Position the special tools.



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

Remove the stabilizer bar bushings.

- Using the special tools, remove and discard the 6 bolts.
- Remove the stabilizer bar clamps.



7. CAUTIONS:

Make sure that the stabilizer bar is cleaned back to the paint. Do not remove the paint.

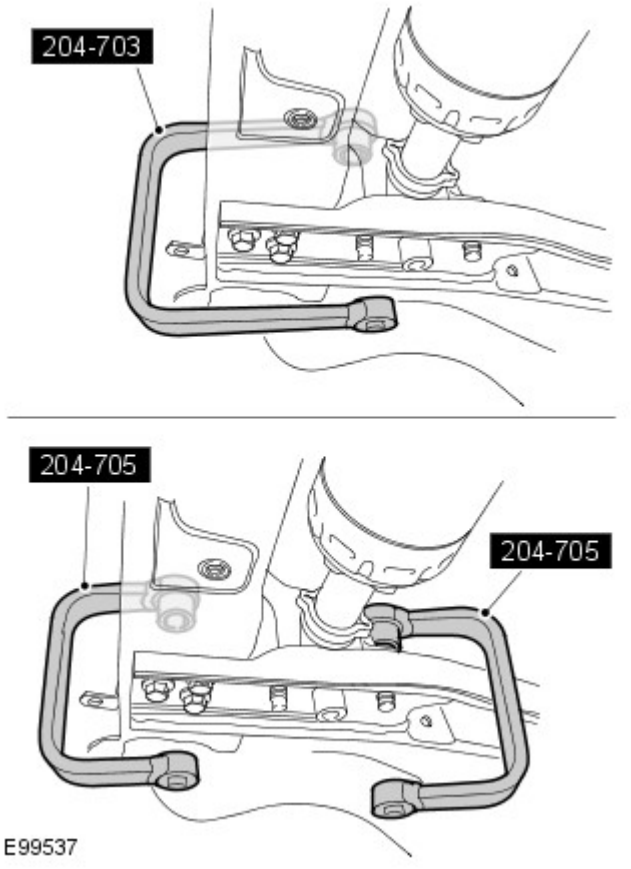
The paint on the stabilizer bar may have worn away, this is an acceptable condition. Do not install a new stabilizer bar for this issue.

Inspect the condition of the front stabilizer bar.

- Remove any dirt or debris from the section of the stabilizer bar that is clamped in the bush. Paint, if present, does not need to be removed.
- If required, use a suitable strip of 320 grade abrasive paper/cloth to remove any built-up deposits. Use a suitable brake cleaner to remove any dirt or grease residue.

Installation

CAUTION: The bush must be installed without any additional lubricant. Failure to follow this instruction may cause damage to the component.



1. CAUTION: **Make sure the faces of the bush clamp and the upper and lower mating faces of the chassis are clean, smooth and free from debris. Use a suitable brake cleaner to remove any dirt or debris from the mating faces.**

   Install the stabilizer bar bushings.
   - To make sure that the bush is clamped correctly the fixings must be tightened to 115 Nm in the following order:
   - Stage 1: Tighten the middle fixing.
   - Stage 2: Tighten the front fixing.
   - Stage 3: Tighten the rear fixing.

2. CAUTIONS:

   Make sure the hardened steel washer is installed between the stabilizer bar link and the stabilizer bar. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

   Connect both stabilizer bar links to the stabilizer bar.
   - Install new nuts and tighten to 175 Nm.

3. Align and secure the front differential case.
   - Tighten the new axle carrier bracket bolts to 80 Nm, then a further 60 degrees.

4. Install the engine undershield.
   For additional information, refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

Ride and Handling Optimization - Front Stabilizer Bar Bushing TDV6 3.0L Diesel

Removal and Installation

Special Tool(s)

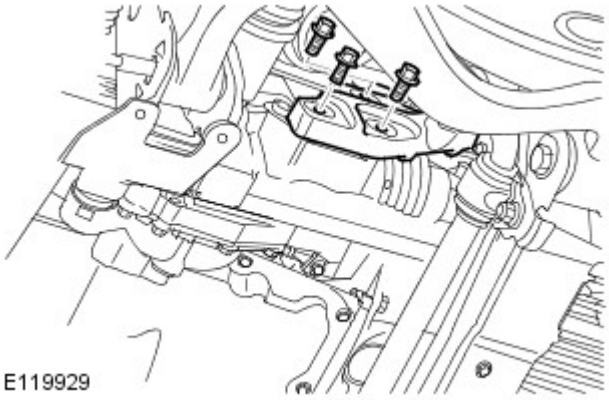
 E99557	Front Stabilizer Bar Bushing Tightening Tool 204-703
 E99558	Front Stabilizer Bar Bushing Tightening Tool 204-705

Removal

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

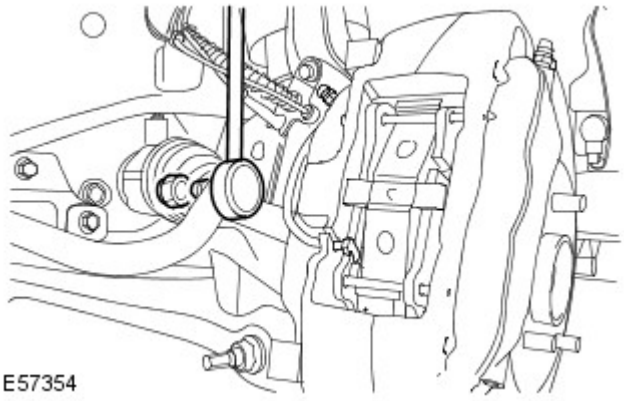
   Raise and support the vehicle.

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


E119929

3. NOTE: Crossmember shown removed for clarity.

   Using a suitable jack, support the differential.
   - Remove and discard the three differential mounting bolts.
   - Raise and reposition the front differential case.


E57354

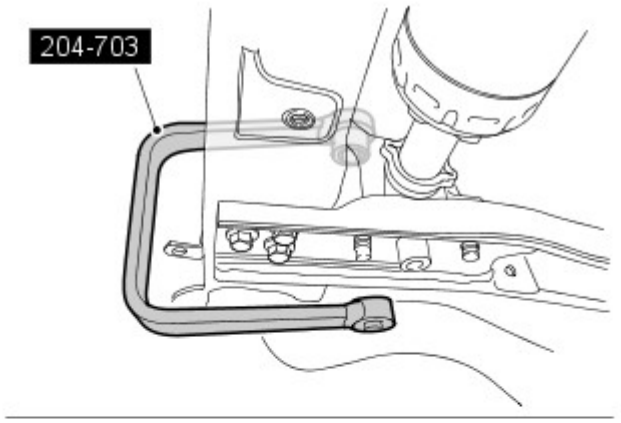
4. CAUTIONS:

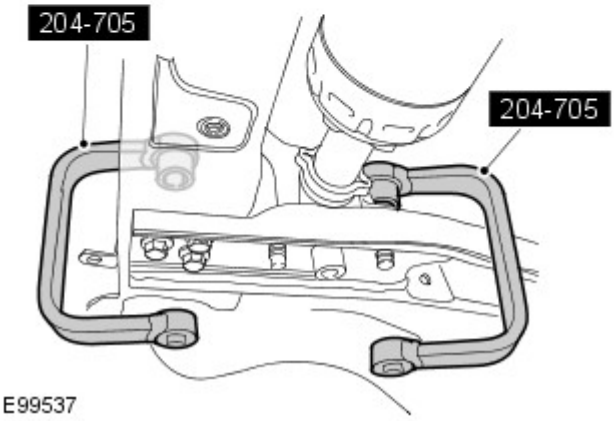
   Use a Torx socket to prevent the ball joint rotating whilst removing the nut.

   Note the position of the hardened steel washer. The hardened steel washer must be installed between the stabilizer bar link and the stabilizer bar. Failure to follow this instruction may result in damage to the vehicle.

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

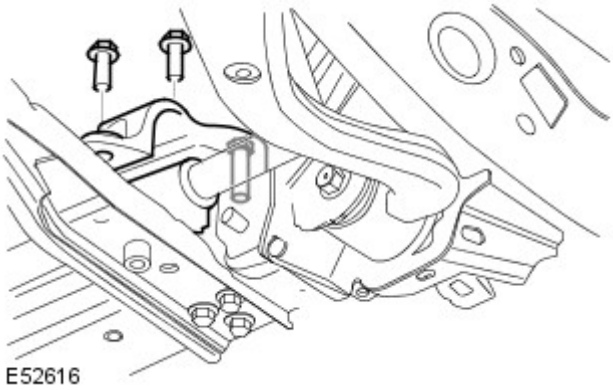
   Disconnect both the stabilizer bar links from the stabilizer bar.
   - Remove and discard the 2 nuts.





5. NOTE: Right-hand shown, left-hand similar.

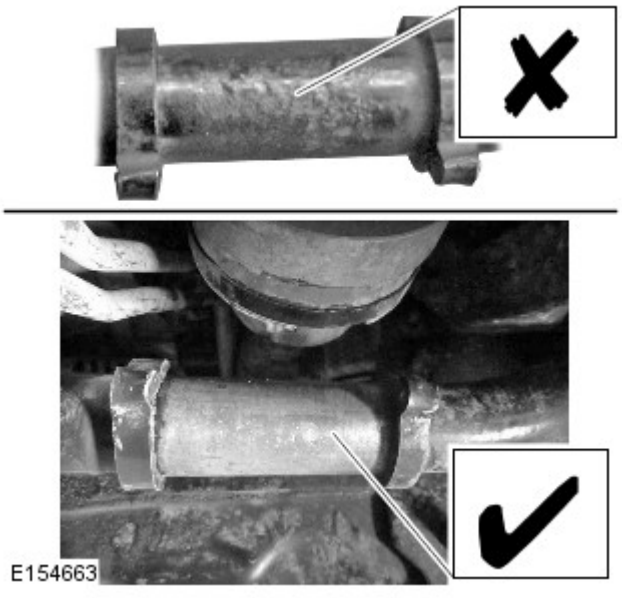
Position the special tools.



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

Remove the stabilizer bar bushings.

- Using the special tools, remove and discard the 6 bolts.
- Remove the stabilizer bar clamps.



7. CAUTIONS:

Make sure that the stabilizer bar is cleaned back to the paint. Do not remove the paint.

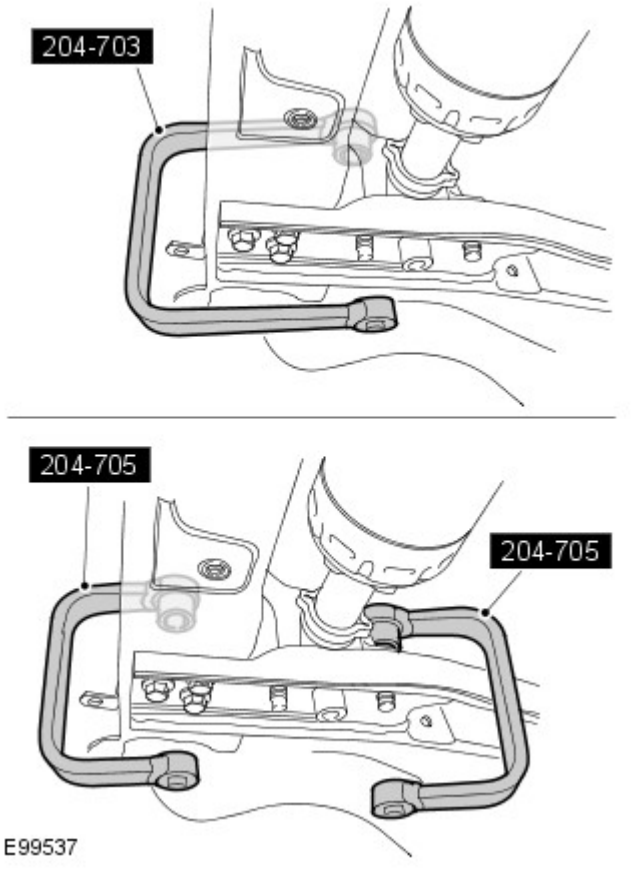
The paint on the stabilizer bar may have worn away, this is an acceptable condition. Do not install a new stabilizer bar for this issue.

Inspect the condition of the front stabilizer bar.

- Remove any dirt or debris from the section of the stabilizer bar that is clamped in the bush. Paint, if present, does not need to be removed.
- If required, use a suitable strip of 320 grade abrasive paper/cloth to remove any built-up deposits. Use a suitable brake cleaner to remove any dirt or grease residue.

Installation

CAUTION: The bush must be installed without any additional lubricant. Failure to follow this instruction may cause damage to the component.



1. CAUTION: **Make sure the faces of the bush clamp and the upper and lower mating faces of the chassis are clean, smooth and free from debris. Use a suitable brake cleaner to remove any dirt or debris from the mating faces.**

   Install the stabilizer bar bushings.
   - To make sure that the bush is clamped correctly the fixings must be tightened to 115 Nm in the following order:
   - Stage 1: Tighten the middle fixing.
   - Stage 2: Tighten the front fixing.
   - Stage 3: Tighten the rear fixing.

2. CAUTIONS:

   Make sure the hardened steel washer is installed between the stabilizer bar link and the stabilizer bar. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

   Connect both stabilizer bar links to the stabilizer bar.
   - Install new nuts and tighten to 175 Nm.

3. Align and secure the front differential case.
   - Tighten the new axle carrier bracket bolts to 80 Nm, then a further 60 degrees.

4. Install the engine undershield.
   For additional information, refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

Ride and Handling Optimization - Front Stabilizer Bar V8 5.0L Petrol/V8 S/C 5.0L Petrol

Removal and Installation

Special Tool(s)

	Front Stabilizer Bar Bushing Tightening Tool 204-703
	Front Stabilizer Bar Bushing Tightening Tool 204-705

Removal

CAUTIONS:

Do not remove or loosen the 6 bolts on the stabilizer bar. Failure to follow this instruction may result in damage to or failure of the stabilizer bar.

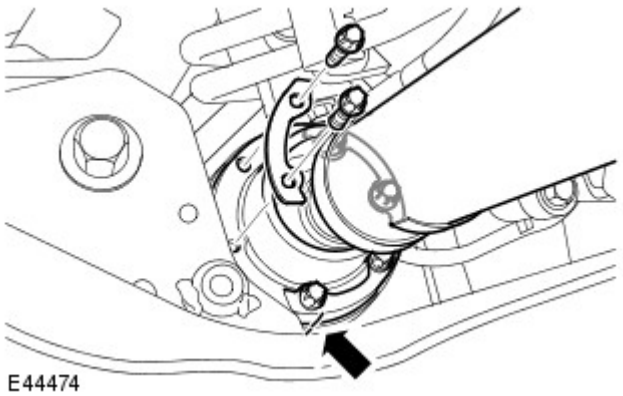
Dynamic Response system components are manufactured to very precise tolerances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the dynamic response system.

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 wheels and tires.

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



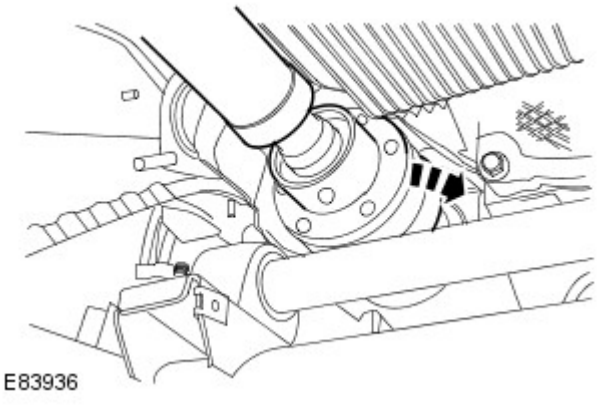
4. CAUTIONS:

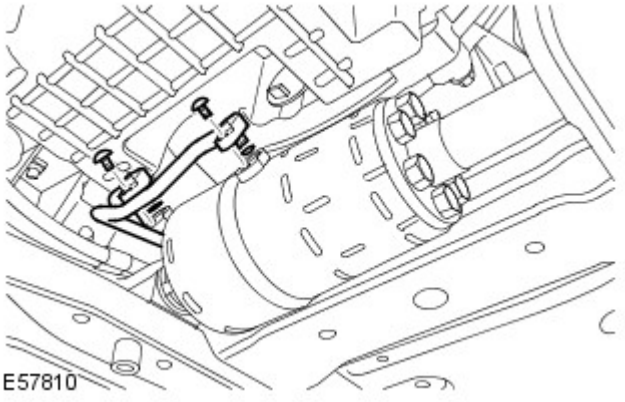
   Mark the position of the driveshaft flange in relation to the drive pinion flange.

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Release the driveshaft from the front axle drive flange.
   - Remove the 6 Torx bolts and washers.
   - Discard the bolts.

5. Support the driveshaft.
   - Compress the joints to disengage the drive flanges.
   - Using suitable securing strap, reposition and support the driveshaft.





6. CAUTIONS:

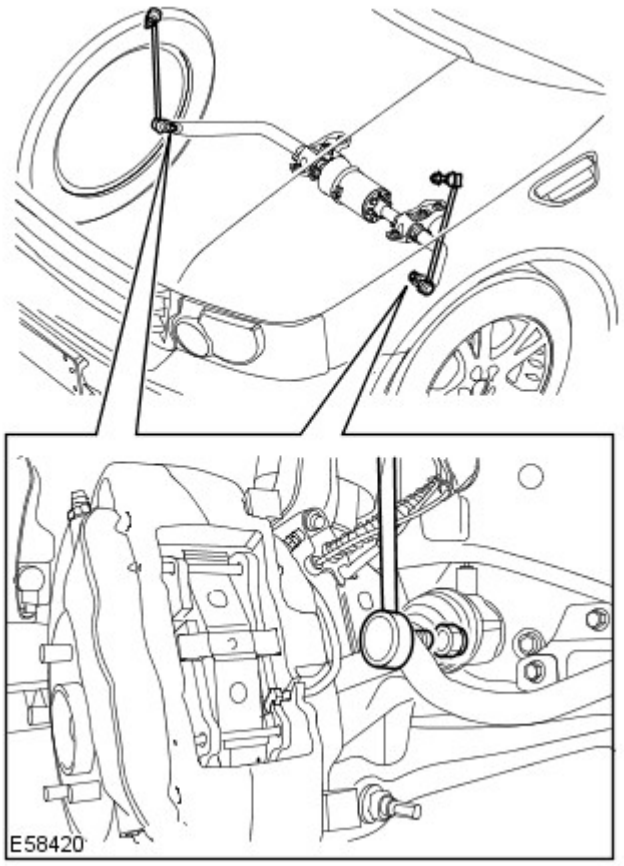
Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Make sure the actuator fluid lines are not damaged or kinked during removal or installation.

NOTE: Some fluid spillage is inevitable during this operation.

Disconnect the fluid lines from the actuator.

- Position container to collect fluid loss.
- Remove the 2 bolts.
- Remove and discard the O-ring seals.
- Remove and discard the plastic spacer washers.



7. CAUTIONS:

Note the position of the hardened steel washer. The hardened steel washer must be installed between the stabilizer bar link and the stabilizer bar. Failure to follow this instruction may result in damage to the vehicle.

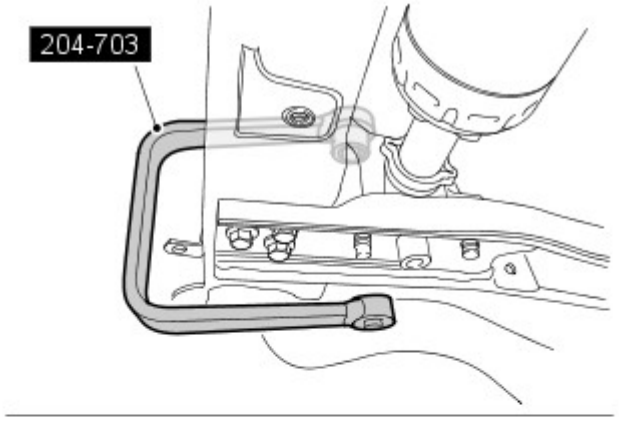
Use a Torx socket to prevent the ball joint rotating whilst removing the nut.

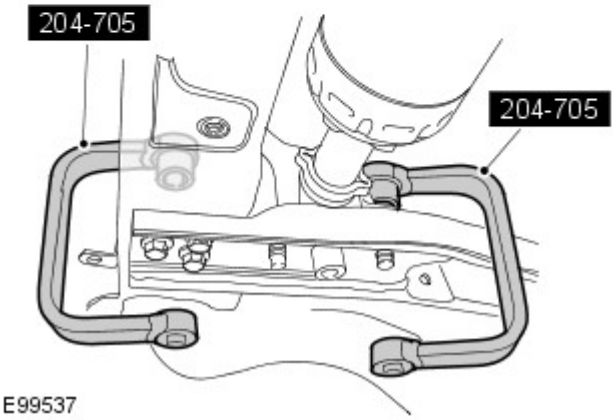
Release both of the stabilizer bar links from the stabilizer bar.

- Remove and discard the 2 nuts.

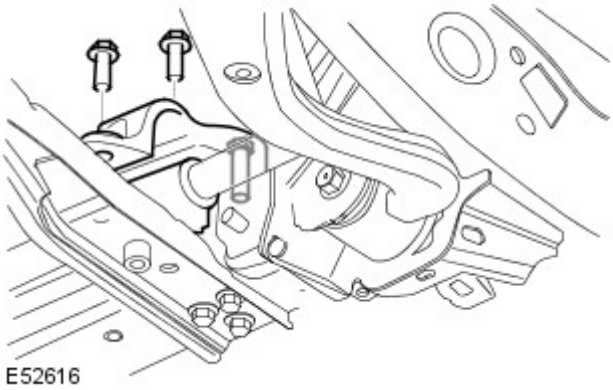
8. NOTE: Right-hand shown, left-hand similar.

Position the special tools.





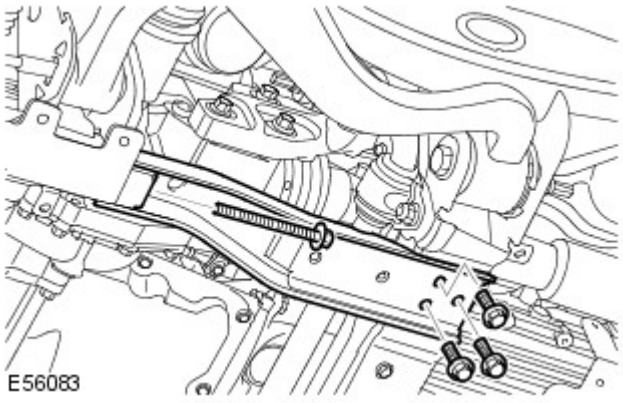
E99537



E52616

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

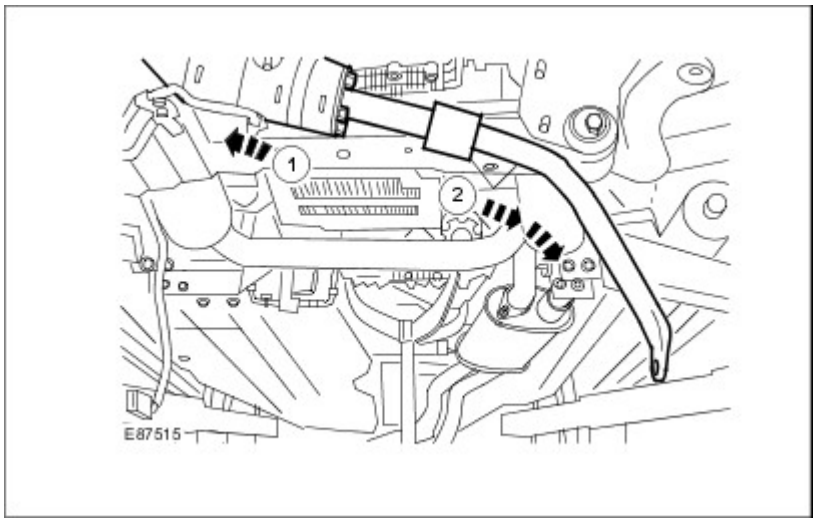
   Remove the stabilizer bar bushings.
   - Using the special tools, remove and discard the 6 bolts.
   - Remove the stabilizer bar clamps.



E56083

10. Remove the front axle crossmember.
    - Remove the 4 bolts.

11. Remove the stabilizer bar and actuator assembly.

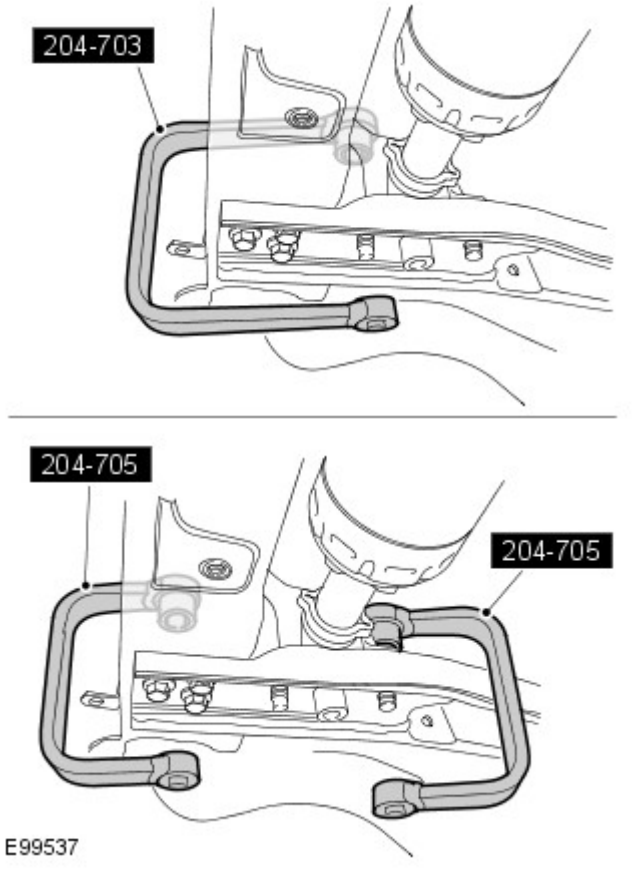


Installation

1. Install the stabilizer bar and actuator assembly.

2. Install the front axle crossmember.
   - Tighten the 4 bolts to 115 Nm (85 lb.ft).

3. Install the stabilizer bar clamps.
   - Clean the components.
   - Install the stabilizer bar clamps.
   - Using the special tools, tighten the bolts to 115 Nm (85 lb.ft).



4. CAUTIONS:

   Make sure the hardened steel washer is installed between the stabilizer bar link and the stabilizer bar. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

   Secure both stabilizer bar links to the stabilizer bar.
   - Install a new nut and tighten to 175 Nm (129 lb.ft).

5. CAUTIONS:

Make sure the actuator fluid lines are not damaged or kinked during removal or installation.

Care must be taken to avoid damage to the plastic spacer washers and O-ring seals during installation of the fluid lines to the actuator.

NOTE: Remove and discard the blanking caps.

Connect the fluid lines to the actuator.

- Clean the component mating faces.
- Install new plastic spacer washers and O-ring seals.
- Tighten the 2 bolts to 22 Nm (16 lb.ft).

6. Using the approved Land Rover diagnostic system, bleed the active stabilization system.

7. NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

   Secure the driveshaft to the front axle drive flange.
   - Remove and discard the tie strap.
   - Clean the components.
   - Compress the joints to engage the drive flanges.
   - Install new retaining bolts.
   - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
   - Stage 2: Tighten the bolts a further 90 degrees.

8. Install the engine undershield.
   For additional information, refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

9. Install the front wheels and tires.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Ride and Handling Optimization - Front Stabilizer Bar TDV6 3.0L Diesel
Removal and Installation

Special Tool(s)

 E99557	Front Stabilizer Bar Bushing Tightening Tool 204-703
 E99558	Front Stabilizer Bar Bushing Tightening Tool 204-705

Removal

CAUTIONS:

Do not remove or loosen the 6 bolts on the stabilizer bar. Failure to follow this instruction may result in damage to or failure of the stabilizer bar.

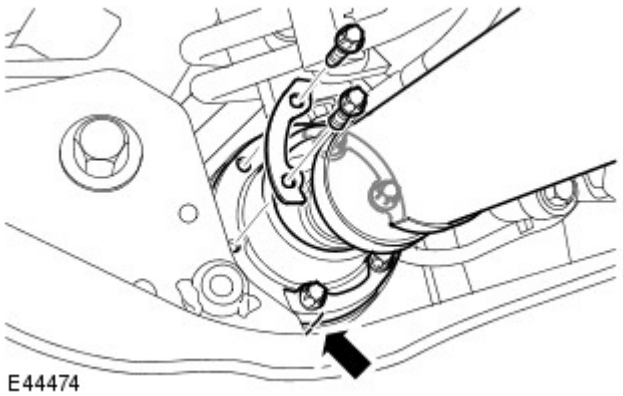
Dynamic Response system components are manufactured to very precise tolerances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the dynamic response system.

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 wheels and tires.

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


E44474

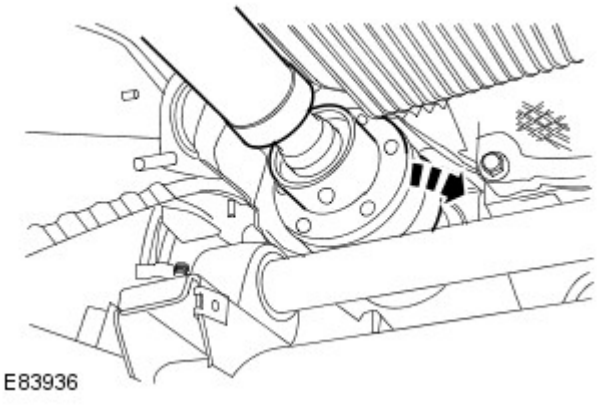
4. CAUTIONS:

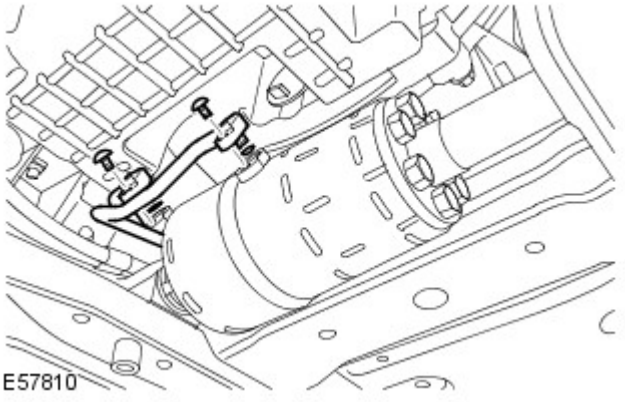
   Mark the position of the driveshaft flange in relation to the drive pinion flange.

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Release the driveshaft from the front axle drive flange.
   - Remove the 6 Torx bolts and washers.
   - Discard the bolts.

5. Support the driveshaft.
   - Compress the joints to disengage the drive flanges.
   - Using suitable securing strap, reposition and support the driveshaft.





6. CAUTIONS:

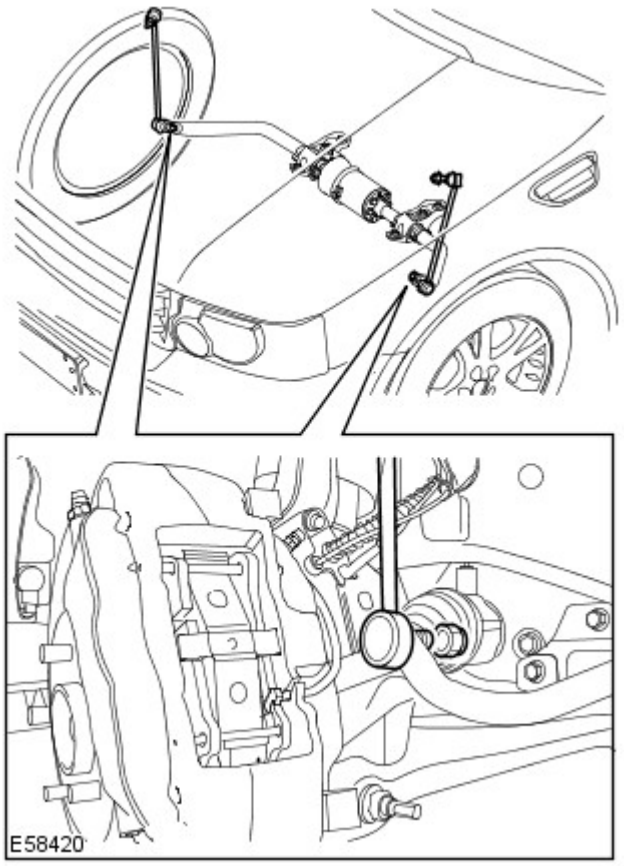
Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

Make sure the actuator fluid lines are not damaged or kinked during removal or installation.

NOTE: Some fluid spillage is inevitable during this operation.

Disconnect the fluid lines from the actuator.

- Position container to collect fluid loss.
- Remove the 2 bolts.
- Remove and discard the O-ring seals.
- Remove and discard the plastic spacer washers.



7. CAUTIONS:

Note the position of the hardened steel washer. The hardened steel washer must be installed between the stabilizer bar link and the stabilizer bar. Failure to follow this instruction may result in damage to the vehicle.

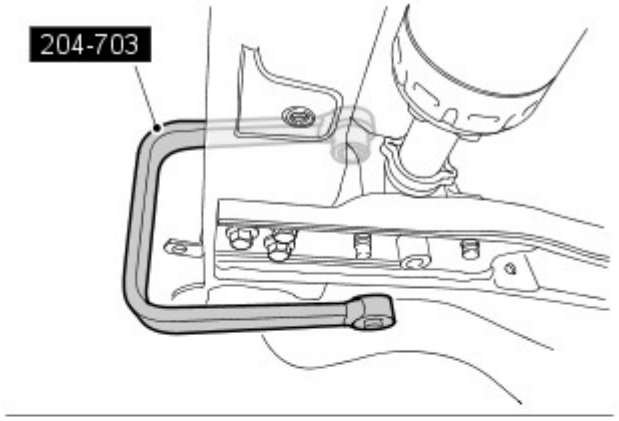
Use a Torx socket to prevent the ball joint rotating whilst removing the nut.

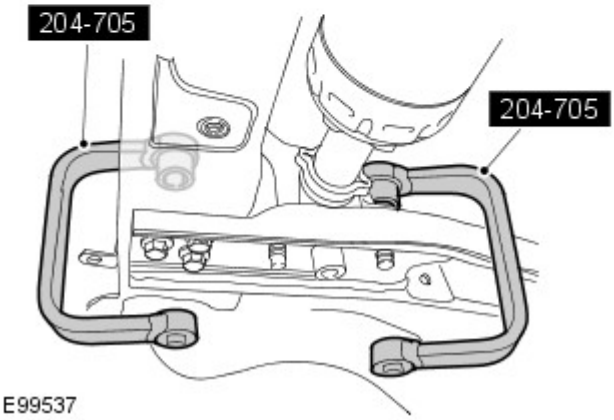
Release both of the stabilizer bar links from the stabilizer bar.

- Remove and discard the 2 nuts.

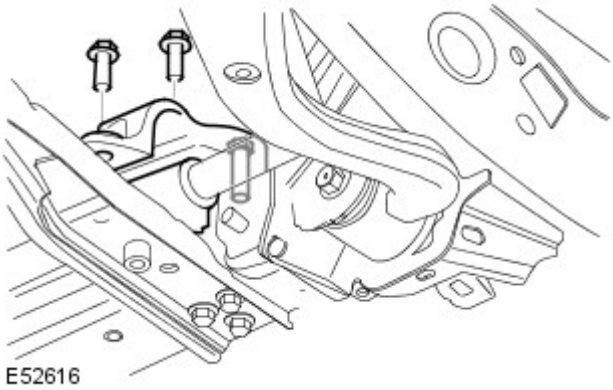
8. NOTE: Right-hand shown, left-hand similar.

Position the special tools.





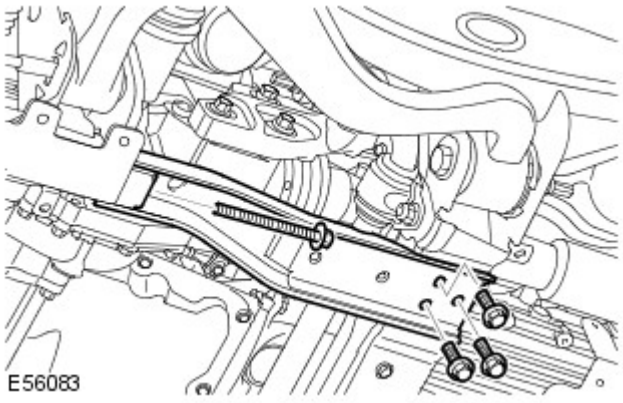
E99537



E52616

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

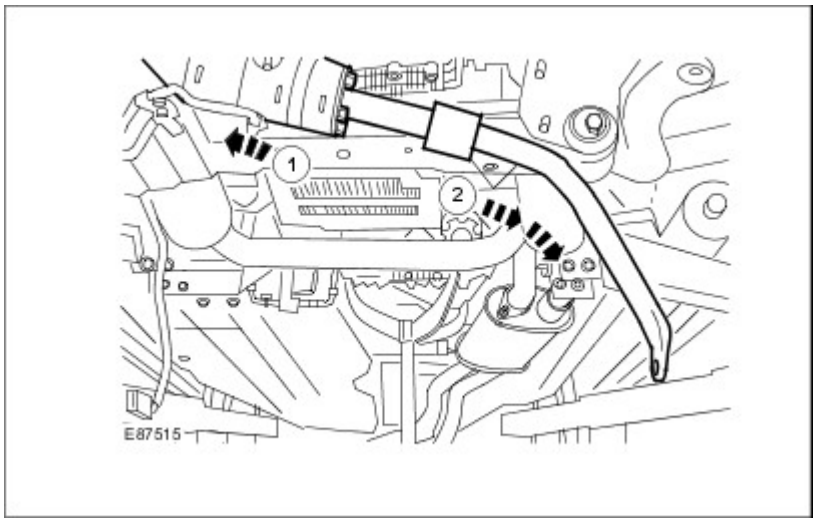
   Remove the stabilizer bar bushings.
   - Using the special tools, remove and discard the 6 bolts.
   - Remove the stabilizer bar clamps.



E56083

10. Remove the front axle crossmember.
    - Remove the 4 bolts.

11. Remove the stabilizer bar and actuator assembly.

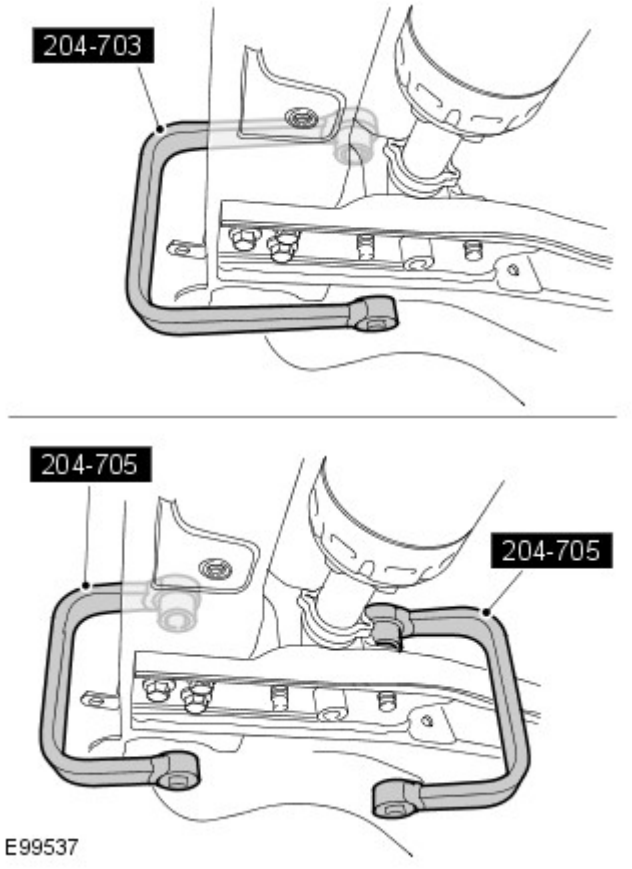


Installation

1. Install the stabilizer bar and actuator assembly.

2. Install the front axle crossmember.
   - Tighten the 4 bolts to 115 Nm (85 lb.ft).

3. Install the stabilizer bar clamps.
   - Clean the components.
   - Install the stabilizer bar clamps.
   - Using the special tools, tighten the bolts to 115 Nm (85 lb.ft).



4. CAUTIONS:

   Make sure the hardened steel washer is installed between the stabilizer bar link and the stabilizer bar. Failure to follow this instruction may result in damage to the vehicle.

   Use a Torx socket to prevent the ball joint rotating whilst installing the nut.

   Secure both stabilizer bar links to the stabilizer bar.
   - Install a new nut and tighten to 175 Nm (129 lb.ft).

5. CAUTIONS:

Make sure the actuator fluid lines are not damaged or kinked during removal or installation.

Care must be taken to avoid damage to the plastic spacer washers and O-ring seals during installation of the fluid lines to the actuator.

NOTE: Remove and discard the blanking caps.

Connect the fluid lines to the actuator.

- Clean the component mating faces.
- Install new plastic spacer washers and O-ring seals.
- Tighten the 2 bolts to 22 Nm (16 lb.ft).

6. Using the approved Land Rover diagnostic system, bleed the active stabilization system.

7. NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

   Secure the driveshaft to the front axle drive flange.
   - Remove and discard the tie strap.
   - Clean the components.
   - Compress the joints to engage the drive flanges.
   - Install new retaining bolts.
   - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
   - Stage 2: Tighten the bolts a further 90 degrees.

8. Install the engine undershield.
   For additional information, refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

9. Install the front wheels and tires.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Ride and Handling Optimization - Rear Stabilizer Bar Bushing
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.

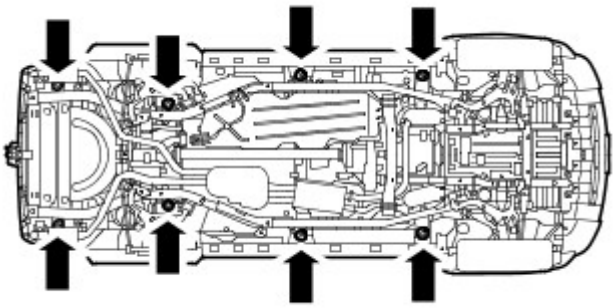
2. Remove the rear bumper cover.
   For additional information, refer to: Rear Bumper Cover (501-19 Bumpers, Removal and Installation).

3. Remove the spare wheel and tire.

4. Raise the vehicle.

5. Remove the rear wheels and tires.

6. Remove the body mount retaining bolts.
   - Remove the 8 bolts.

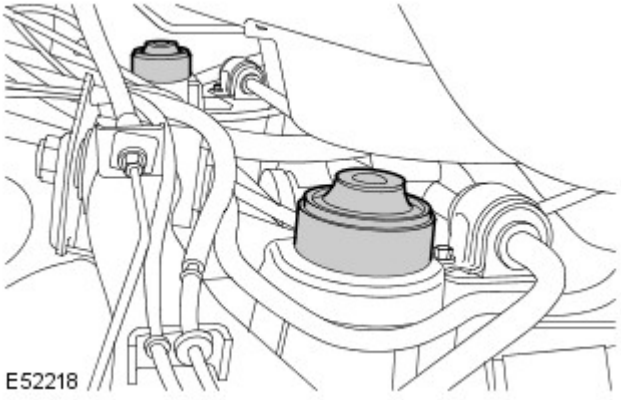


E52217

7. CAUTION: Only raise the body sufficiently to remove the body mounts.

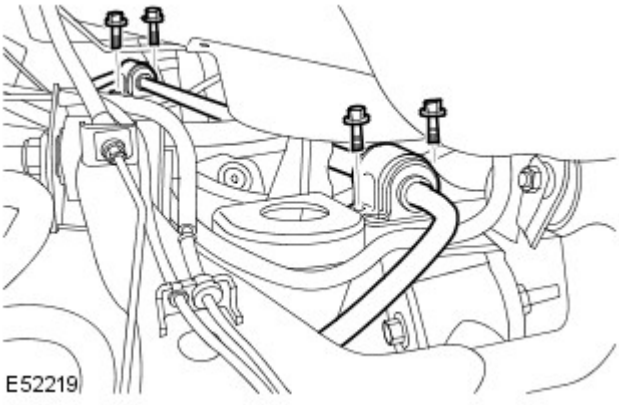
   Raise the body.
   - Using suitable stands, raise the body to release the body mounts.

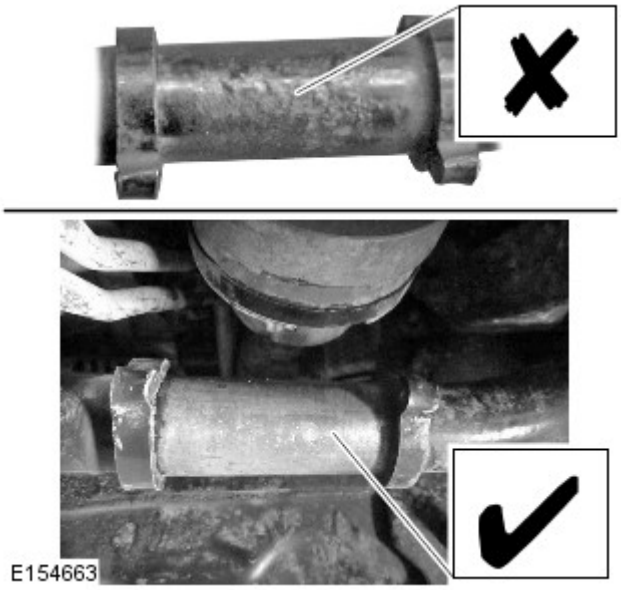
8. Remove the 2 rear body mounts.



E52218

9. Remove the stabilizer bar bushings.
   - Remove and discard the 4 bolts.
   - Remove the 2 clamps.





10. CAUTIONS:

    Make sure that the stabilizer bar is cleaned back to the paint. Do not remove the paint.

    The paint on the stabilizer bar may have worn away, this is an acceptable condition. Do not install a new stabilizer bar for this issue.

    NOTE: Front stabilizer bar shown, rear stabilizer bar similar.

    Inspect the condition of the rear stabilizer bar.
    - Remove any dirt or debris from the section of the stabilizer bar that is clamped in the bush. Paint, if present, does not need to be removed.
    - If required, use a suitable strip of 320 grade abrasive paper/cloth to remove any built-up deposits. Use a suitable brake cleaner to remove any dirt or grease residue.

Installation

CAUTION: The bush must be installed without any additional lubricant. Failure to follow this instruction may cause damage to the component.

1. CAUTION: Make sure the faces of the bush clamp are clean, smooth and free from debris. Use a suitable brake cleaner to remove any dirt or debris from the mating faces.

   Install the stabilizer bar bushings.

2. Install the stabilizer bar clamps.
   - Tighten the 4 retaining bolts to 62 Nm (46 lb.ft).

3. Install the body mounts.

4. Lower the body.
   - Remove the stands.

5. Install the body mount retaining bolts.
   - Tighten the 8 retaining bolts to 133 Nm (98 lb.ft).

6. Install the wheels and tires.

7. Lower the vehicle.

8. Install the spare wheel and tire.

9. Install the rear bumper cover.
   For additional information, refer to: Rear Bumper Cover (501-19 Bumpers, Removal and Installation).

Ride and Handling Optimization - Rear Stabilizer Bar

Removal and Installation

Removal

CAUTIONS:

Do not remove or loosen the 6 bolts on the stabilizer bar. Failure to follow this instruction may result in damage to or failure of the stabilizer bar.

It is possible to install the stabilizer bar incorrectly. Note the position of the stabilizer bar before removal.

Dynamic Response system components are manufactured to very precise tolerances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the Dynamic Response system.

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

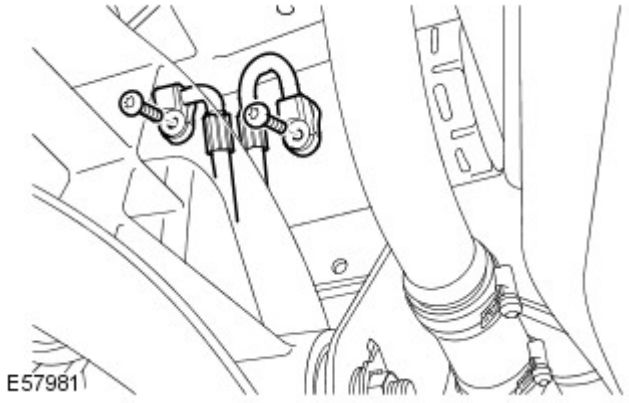
   Raise and support the vehicle.

2. Remove the rear bumper cover.
   For additional information, refer to: Rear Bumper Cover (501-19 Bumpers, Removal and Installation).

3. Remove the spare wheel and tire.

4. Raise the vehicle.

5. Remove the rear wheels and tires.



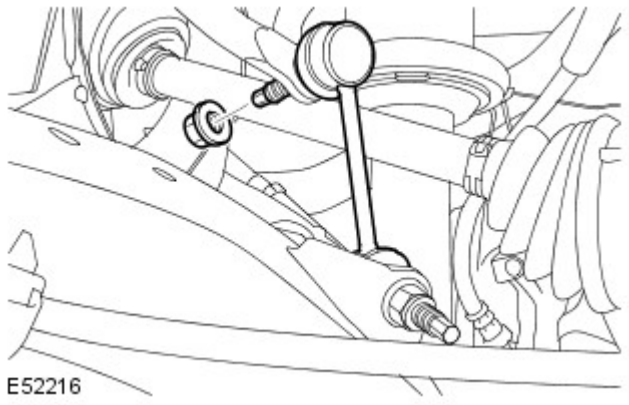
6. CAUTIONS:

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

   Make sure the actuator fluid lines are not damaged or kinked during removal or installation.

   NOTE: Some fluid spillage is inevitable during this operation.

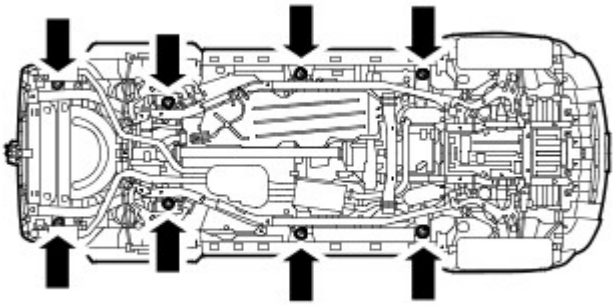
   Disconnect the fluid lines from the actuator.
   - Position container to collect fluid loss.
   - Remove the 2 bolts.
   - Remove and discard the plastic spacer washers.
   - Remove and discard the O-ring seals.
   - Install blanking caps to the exposed ports.



7. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

   Release both stabilizer bar links.
   - Remove the 2 nuts.

8. Remove the body mount retaining bolts.
    - Remove the 8 bolts.

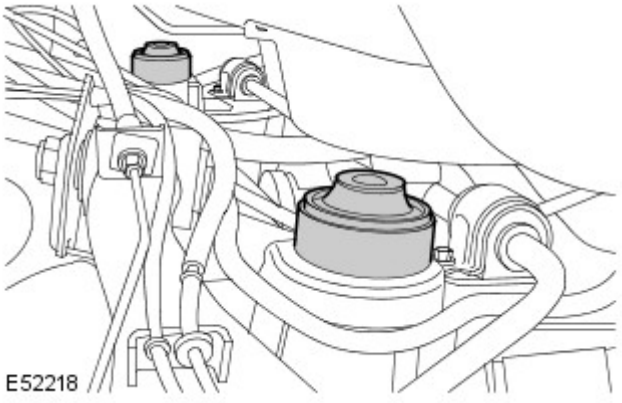


E52217

9. CAUTION: Only raise the body sufficiently to remove the body mount.

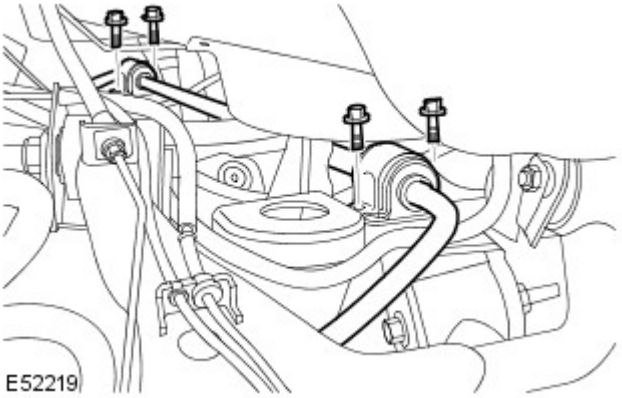
   Raise the body.
    - Using suitable stands, raise the body to release the body mounts.

10. Remove the 2 rear body mounts.



E52218

11. Remove the stabilizer bar and actuator assembly bushings.
    - Remove and discard the 4 bolts.
    - Remove the 2 clamps.



E52219

12. NOTE: Note the fitted position.

    With assistance, remove the stabilizer bar and actuator assembly.

Installation

1. CAUTION: Make sure the stabilizer bar is correctly installed.

   With assistance, install the stabilizer bar and actuator assembly.

2. Install the stabilizer bar and actuator assembly bushings.

3. Install the stabilizer bar clamps.

Tighten the 4 retaining bolts to 62 Nm (46 lb.ft).

4. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

   Connect the RH stabilizer bar link.
   - Install a new nut and tighten to 115 Nm (85 lb.ft).

5. CAUTIONS:

   Make sure the actuator fluid lines are not damaged or kinked during removal or installation.

   Care must be taken to avoid damage to the plastic spacer washers and O-ring seals during installation of the fluid lines to the actuator

   NOTE: Some fluid spillage is inevitable during this operation.

   Connect the fluid lines to the actuator.
   - Clean the component mating faces.
   - Remove the blanking caps from the ports.
   - Install new plastic spacer washers and O-ring seals.
   - Tighten the 2 bolts to 22 Nm (16 lb.ft).

6. Bleed the rear of the Dynamic Response system using T4.

7. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

   Connect the LH stabilizer bar link.
   - Install a new nut and tighten to 115 Nm (85 lb.ft).

8. Install the body mounts.

9. Lower the body.
   - Remove the stands.

10. Install the body mount retaining bolts.
    - Tighten the 8 retaining bolts to 133 Nm (98 lb.ft).

11. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

12. Lower the vehicle.

13. Install the spare wheel and tire.

14. Install the rear bumper cover.
    For additional information, refer to: Rear Bumper Cover (501-19 Bumpers, Removal and Installation).

Ride and Handling Optimization - Pressure Control Valve

Removal and Installation

Removal

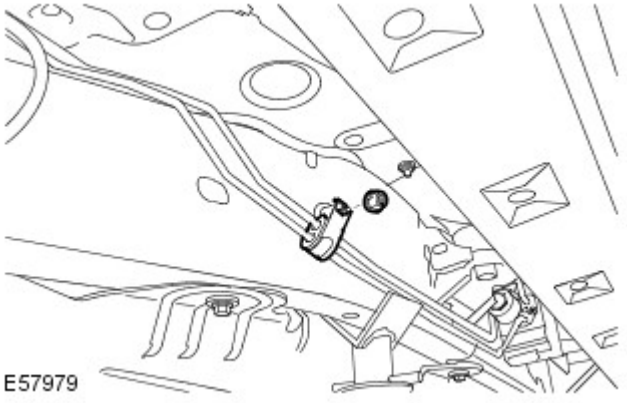
CAUTION: Dynamic Response system components are manufactured to very precise tolerances. It is therefore essential that absolute cleanliness is observed when working with these components. Always install blanking plugs to any open orifices or lines. Failure to follow this instruction may result in foreign matter ingress to the dynamic response system.

NOTE: This procedure does not require the Dynamic Response system to be bled.

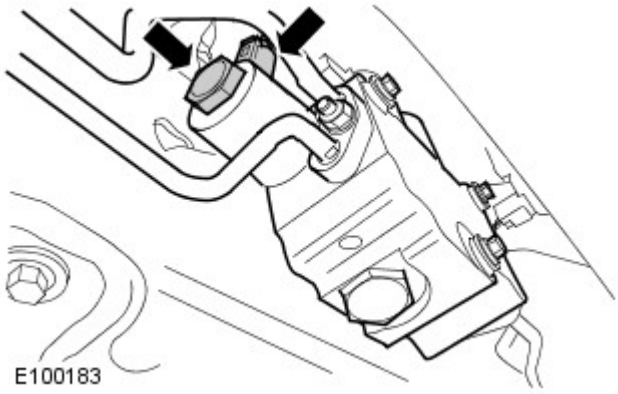
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Release the valve block to rear stabilizer bar actuator pipe assembly mounting.
   - Remove the nut.
   - Remove the bracket.

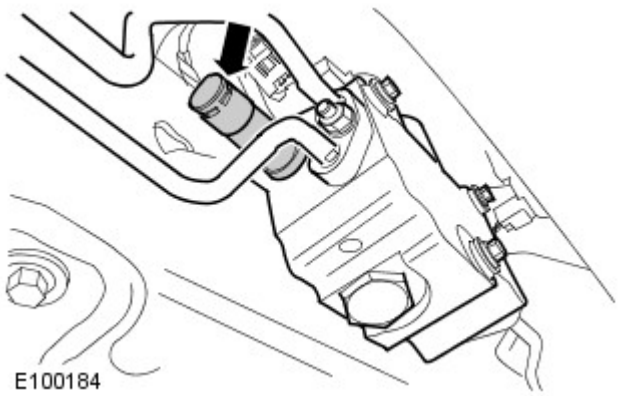


3. Remove the solenoid.
   - Remove the electrical connector.
   - Remove the solenoid nut.
   - Remove and discard the O-ring seal.



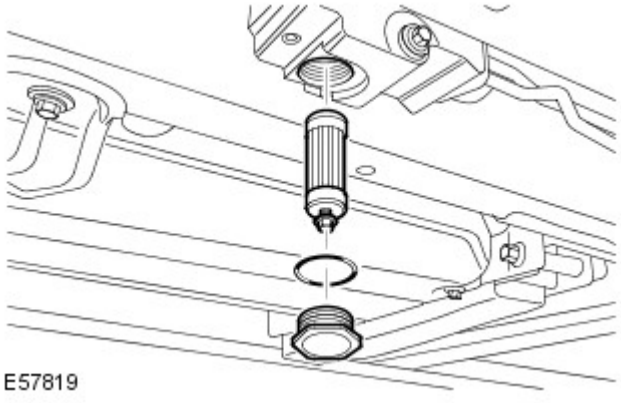
4. CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

   Remove the PCV valve.
   - Clamp the fluid pump supply and return hoses to minimise fluid loss.
   - Position container to collect fluid loss.
   - Remove the PCV valve.



5. CAUTIONS:

   Before disconnecting or removing the components, make sure the area around the joint



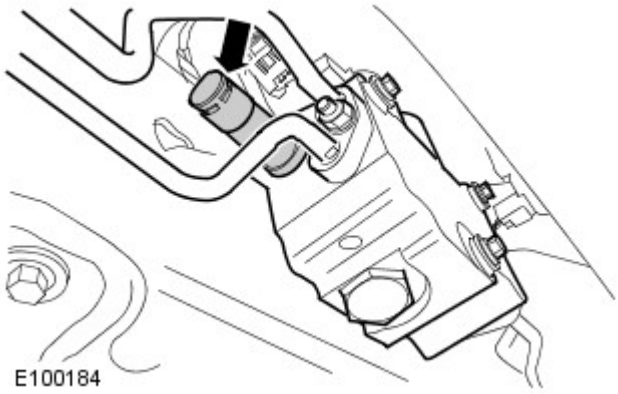
faces and connections are clean. Plug open connections to prevent contamination.

Make sure the actuator fluid lines are not clamped or kinked. Failure to follow this instruction will result in damage to the vehicle.

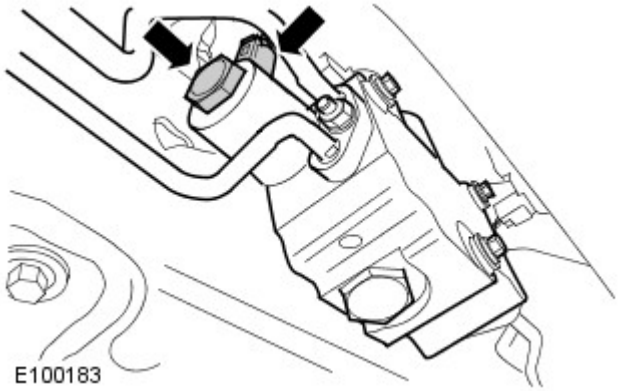
Remove and discard the valve block filter.

- Remove the access plug.
- Remove and discard the access plug O-ring seal.
- Using a suitable M6 bolt, release the filter from the valve block.

Installation



1. Install the PCV valve.
   - Clean the component mating faces.
   - Install the PCV valve.
   - Torque: 35 Nm (26 lb.ft).



2. Install the solenoid.
   - Install the O-ring seal.
   - Tighten to 5 Nm.
   - Install the electrical connector.

3. Install the new valve block filter.
   - Clean the component mating faces.
   - Install a new access plug O-ring seal.
   - Tighten the access plug to 62 Nm (46 lb.ft).
   - Remove the container.
   - Remove the hose clamps.

4. Secure the valve block to rear stabilizer bar actuator pipe assembly mountings.
   - Tighten the nut to 9 Nm (7 lb.ft)

5. Check and top-up the dynamic response system fluid reservoir.

6. Start the engine and allow to idle.

7. Check and top-up the dynamic response system fluid reservoir.
   - Make sure there is fluid circulation through the reservoir.

Ride and Handling Optimization - Ride and Handling Optimization Switch

Removal and Installation

Removal

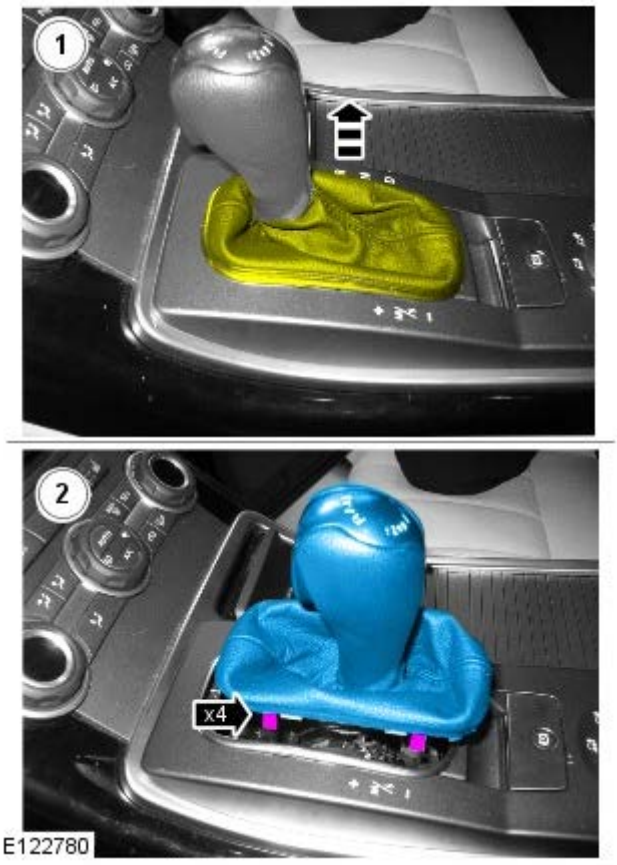
NOTES:

Removal steps in this procedure may contain installation details.

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

Make sure that the gear selector lever is in position N before removing any components.

1.



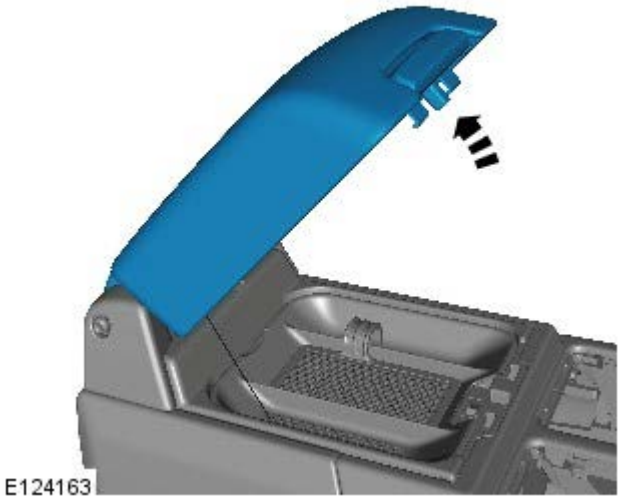
2.



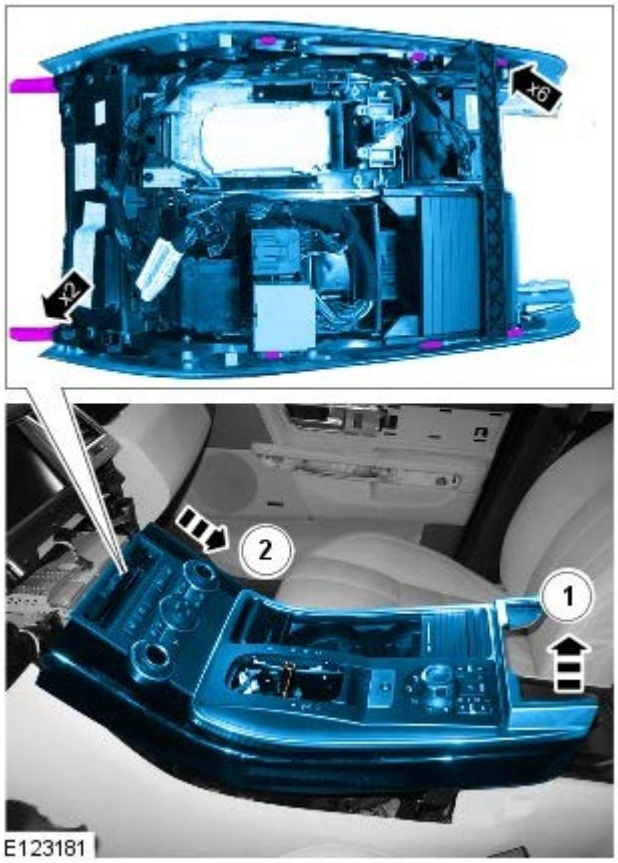
3.



4.



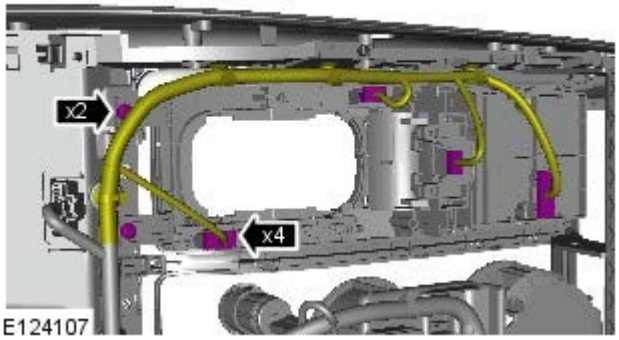
5.



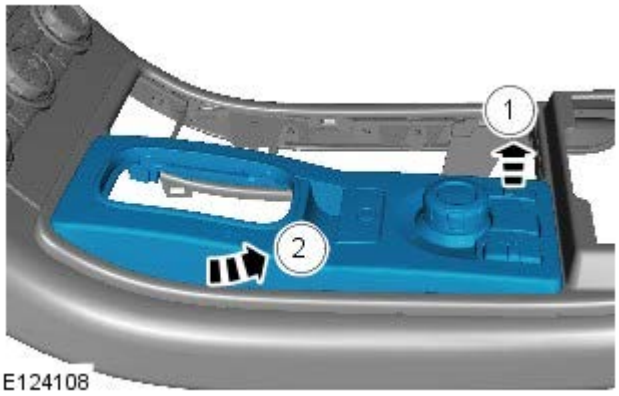
6.



7.



8.



Installation

1. To install, reverse the removal procedure.

Ride and Handling Optimization - Direction Control Valve Solenoid

Removal and Installation

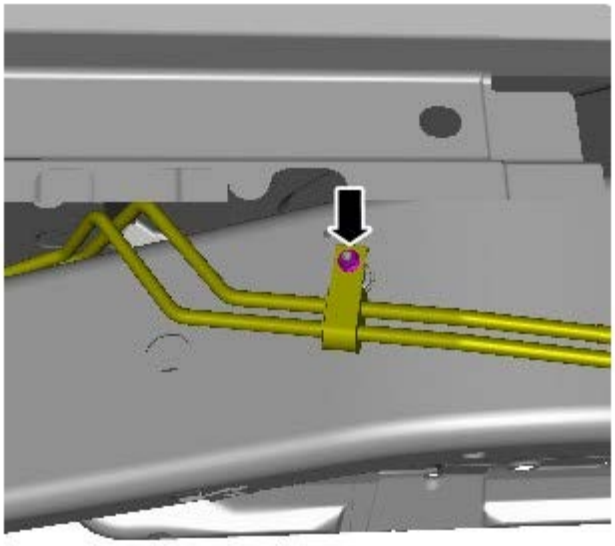
Removal

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

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

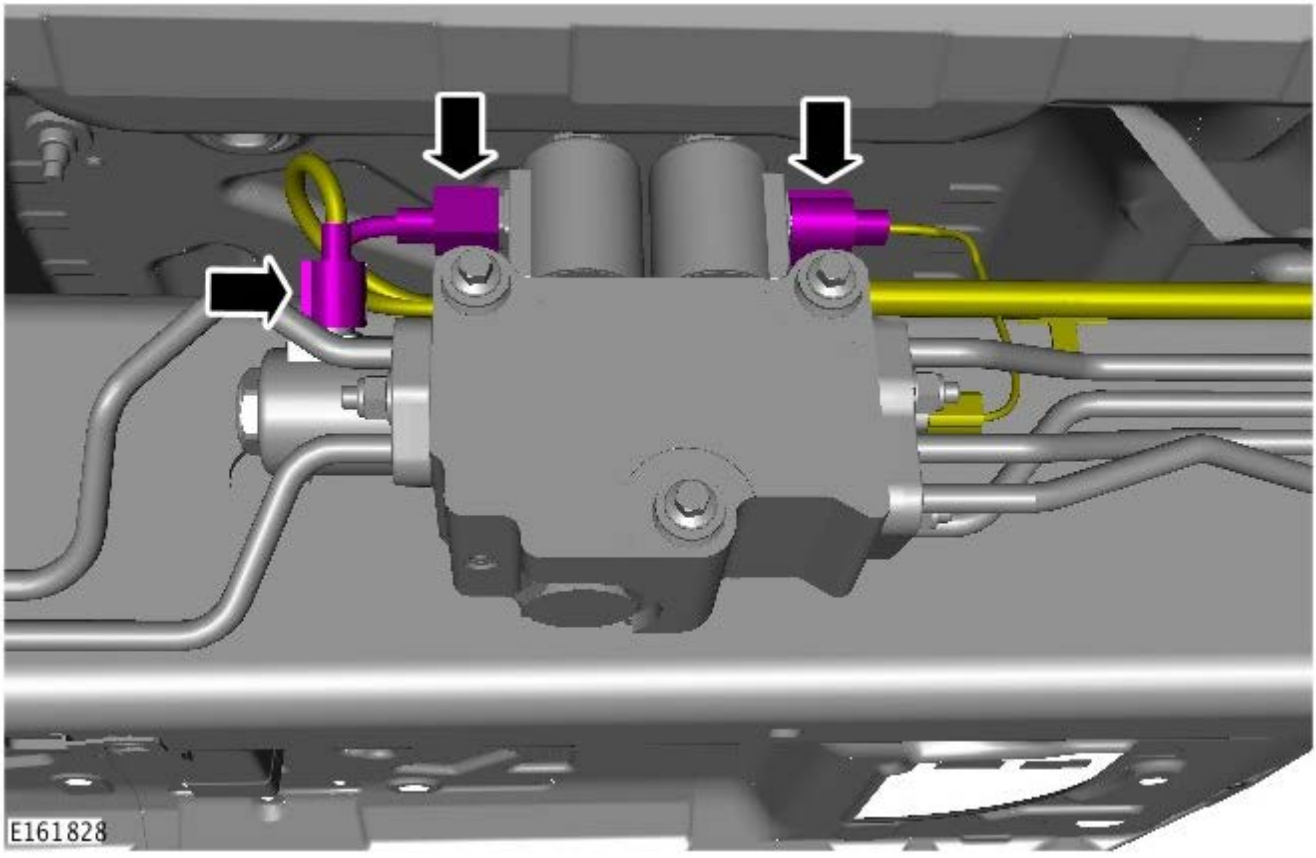
   Raise and support the vehicle.

2. TORQUE: 10 Nm



E161827

3.

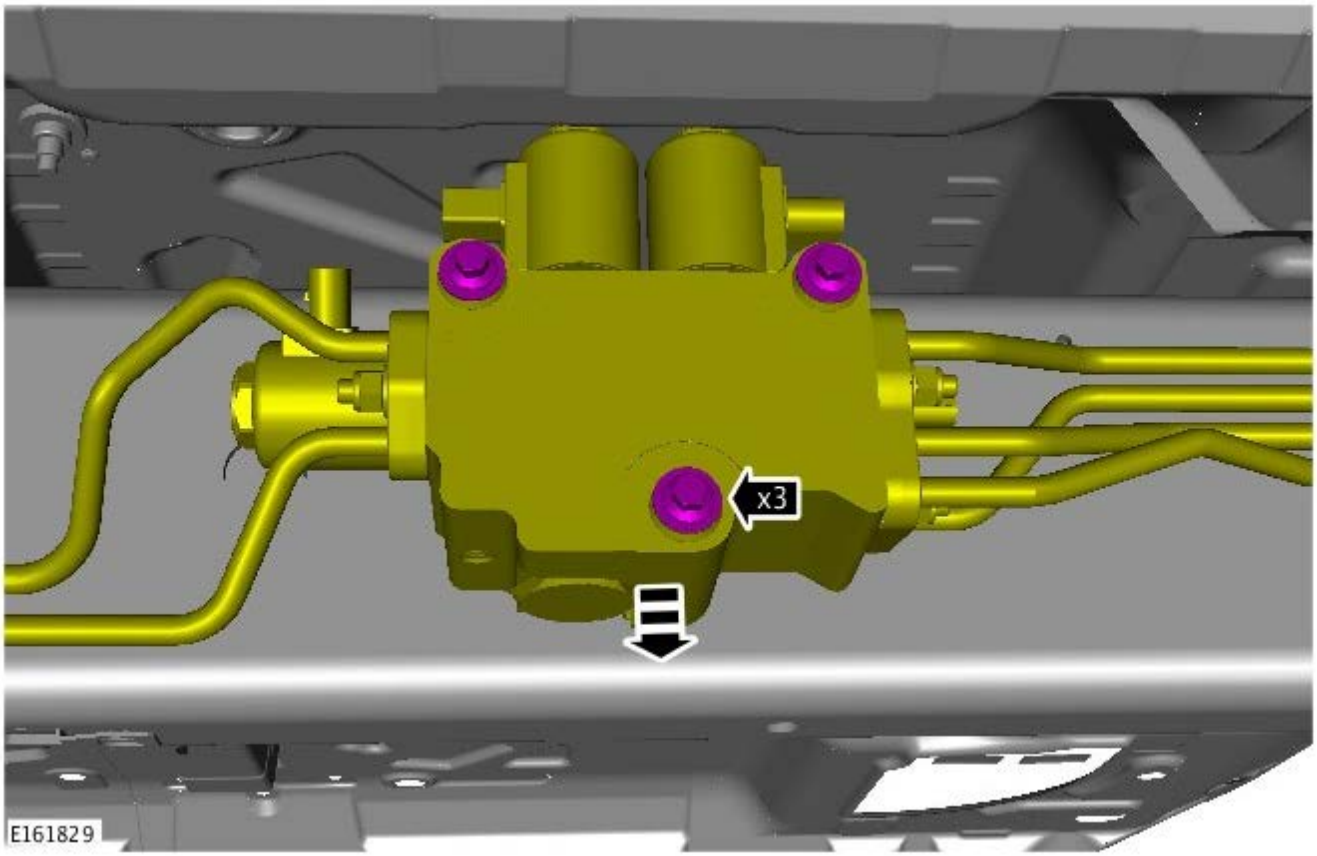


E161828

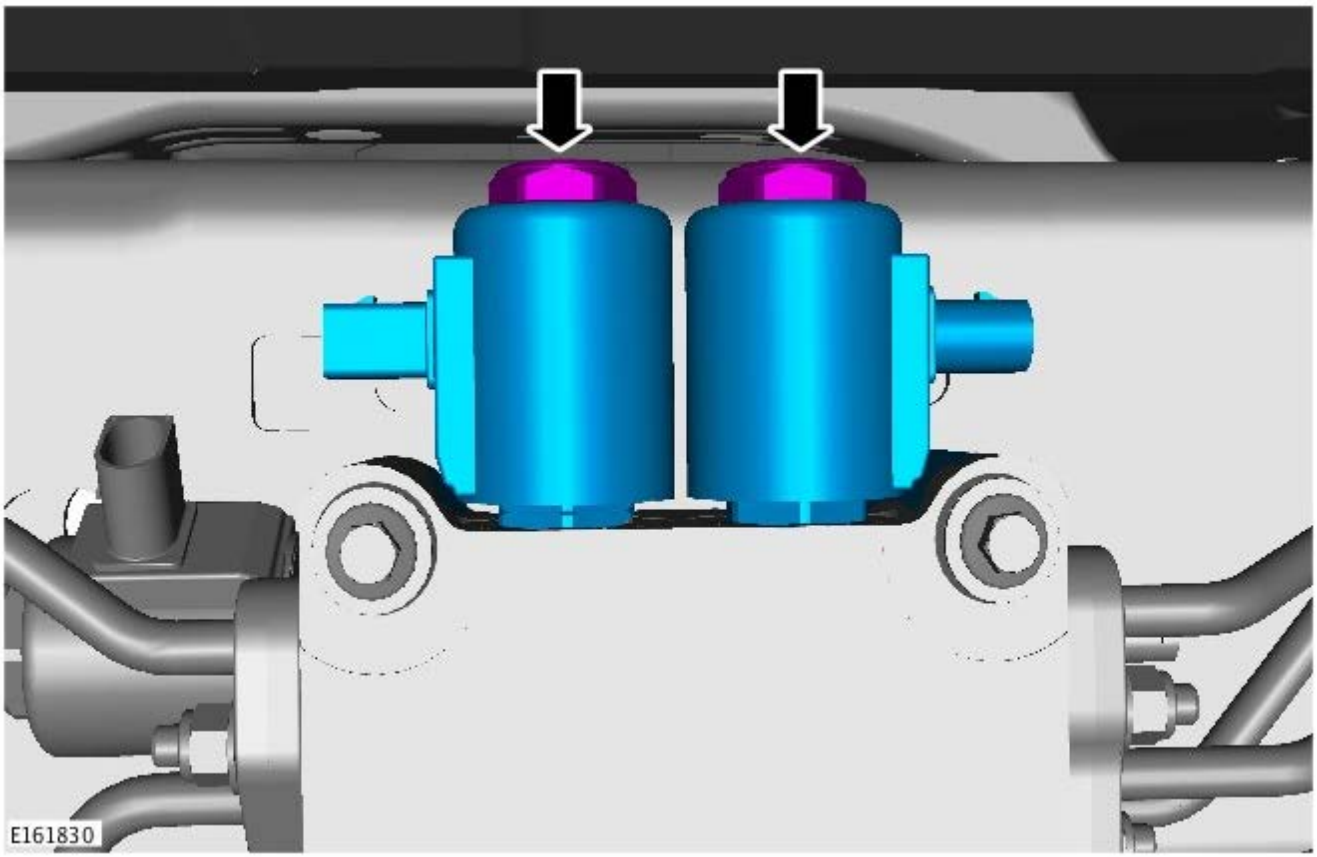
4. NOTE: Make sure there are two washers installed between

the integrated body frame and the valve block lower retaining bolt.

TORQUE: 23 Nm



5. TORQUE: 5 Nm
   - •Install the O-ring seal.



Installation

1. To install reverse the removal procedure.

Driveline System - General Information - Driveline System

Diagnosis and Testing

Principle of Operation

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

Driveshaft (205-01 Driveshaft, Description and Operation),
Universal Joints (205-01 Driveshaft, Description and Operation),
Rear Drive Axle and Differential (205-02 Rear Drive Axle/Differential, Description and Operation),
Front Drive Axle and Differential (205-03 Front Drive Axle/Differential, Description and Operation),
Front Drive Halfshafts (205-04 Front Drive Halfshafts, Description and Operation),
Halfshaft Joint (205-04 Front Drive Halfshafts, Description and Operation),
Rear Drive Halfshafts (205-05 Rear Drive Halfshafts, Description and Operation).

Inspection and Verification

CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault, and may also cause additional faults in the vehicle being tested and/or the donor vehicle.

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

1. Verify the customer concern.
   - If a road test is necessary make sure the vehicle is safe to do so.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
• Wheel rim and tire damage or runout • Check all the driveshafts and halfshafts for damage including dents, cracks and excessive runout • Check all the CV joint gaiters for splits, damage and security • Check all the driveshafts and halfshafts for correct alignment • Check the driveshaft mounting bolts security • Check all the driveshaft and halfshaft joints for excessive movement • Check the rear driveshaft centre support bearing for security, damage and excessive wear • Check the front and rear differential mounting bolts and bushes for wear, damage and security • Check the front and rear differentials for oil leaks

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Vibration through the vehicle body at a specified speed	• Road wheel imbalance • Driveshaft imbalance	Road test the vehicle. If the vibration is only at a specified speed, balance the road wheels. Test for normal operation. Disconnect the rear driveshaft. Check CV and universal joints for smooth and full movement. Disconnect the front driveshaft. Check CV joints for smooth and full movement. If any joints are faulty, replace the driveshaft. Test for normal operation.
Vibration through the vehicle body at all speeds	• Misalignment of the rear driveshaft • Bent or misaligned stub axle	Road test the vehicle. Check the rear driveshaft for correct alignment through the centre support bearing. Rectify as necessary. Test for normal operation. Check for a damaged or bent stub axle. Rectify as necessary.
Rumbling noise from the rear of the vehicle varying at different vehicle speed and load	• Rear differential bearings worn • Rear wheel bearings worn • Rear driveshaft centre support bearing worn	Using a suitable listening device (e.g. stethoscope) listen to the rear differential pinion bearings and output bearings, the rear wheel bearings and the rear driveshaft centre bearing. Rectify as necessary. Test for normal operation.

Rumbling noise from the front of the vehicle varying at different vehicle speed and load	• Front differential bearings worn • Front wheel bearings worn	Using a suitable listening device (e.g. stethoscope) listen to the front differential pinion bearings and output bearings and the front wheel bearings. Rectify as necessary. Test for normal operation.
Whining noise from the rear of the vehicle during acceleration and overrun conditions	• Rear differential gears worn or damaged	Check and top up the rear differential oil level if necessary. Using a suitable listening device (e.g. stethoscope) listen to the rear differential. Replace the rear differential unit if there is excessive gear noise.
Whining noise from the front of the vehicle during acceleration and overrun conditions	• Front differential gears worn or damaged	Check and top up the front differential oil level if necessary. Using a suitable listening device (e.g. stethoscope) listen to the front differential. Replace the front differential unit if there is excessive gear noise.
Knocking, clicking or clunking noise from rear of vehicle during acceleration and overrun conditions	• Rear driveshaft joint fixings insecure • Rear driveshaft joints worn or damaged • Rear halfshaft joints or splined shaft worn or damaged • Rear differential internal components worn or damaged	Disconnect the rear driveshaft. Check joint mounting bolt holes for elongation. Check the joints. Disconnect the rear halfshafts. Check the shaft splines for wear or damage. Check the CV joints. Rectify as necessary. With the rear driveshaft and halfshafts disconnected, check the rear differential for tight spots or excessive play. Rectify as necessary.
Knocking, clicking or clunking noise from front of vehicle during acceleration and overrun conditions	• Front driveshaft CV joints worn or damaged • Front halfshaft joints or splined shaft worn or damaged • Front differential internal components worn or damaged	Disconnect the front driveshaft. Check joint mounting bolt holes for elongation. Check the joints. Disconnect the front halfshafts. Check the shaft splines for wear or damage. Check the CV joints. Rectify as necessary. With the front driveshaft and halfshafts disconnected check the front differential for tight spots or excessive play. Rectify as necessary.

DTC Index

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

Driveshaft -

Front Drive (Propeller) Shaft

Item	Specification
Type	One piece, variable length steel tube.
Constant velocity joints	Plunging type, fitted at front and rear.

Rear Drive (Propeller) Shaft

Item	Specification
Type	Two piece, variable length steel tube with isolated centre bearing and swaged front section to provide controlled collapse of the shaft during a crash.
Constant velocity joints	Plunging constant velocity joints are positioned at the front and centre of the shaft with a fixed, Hookes type universal joint at the rear.

Torque Specifications

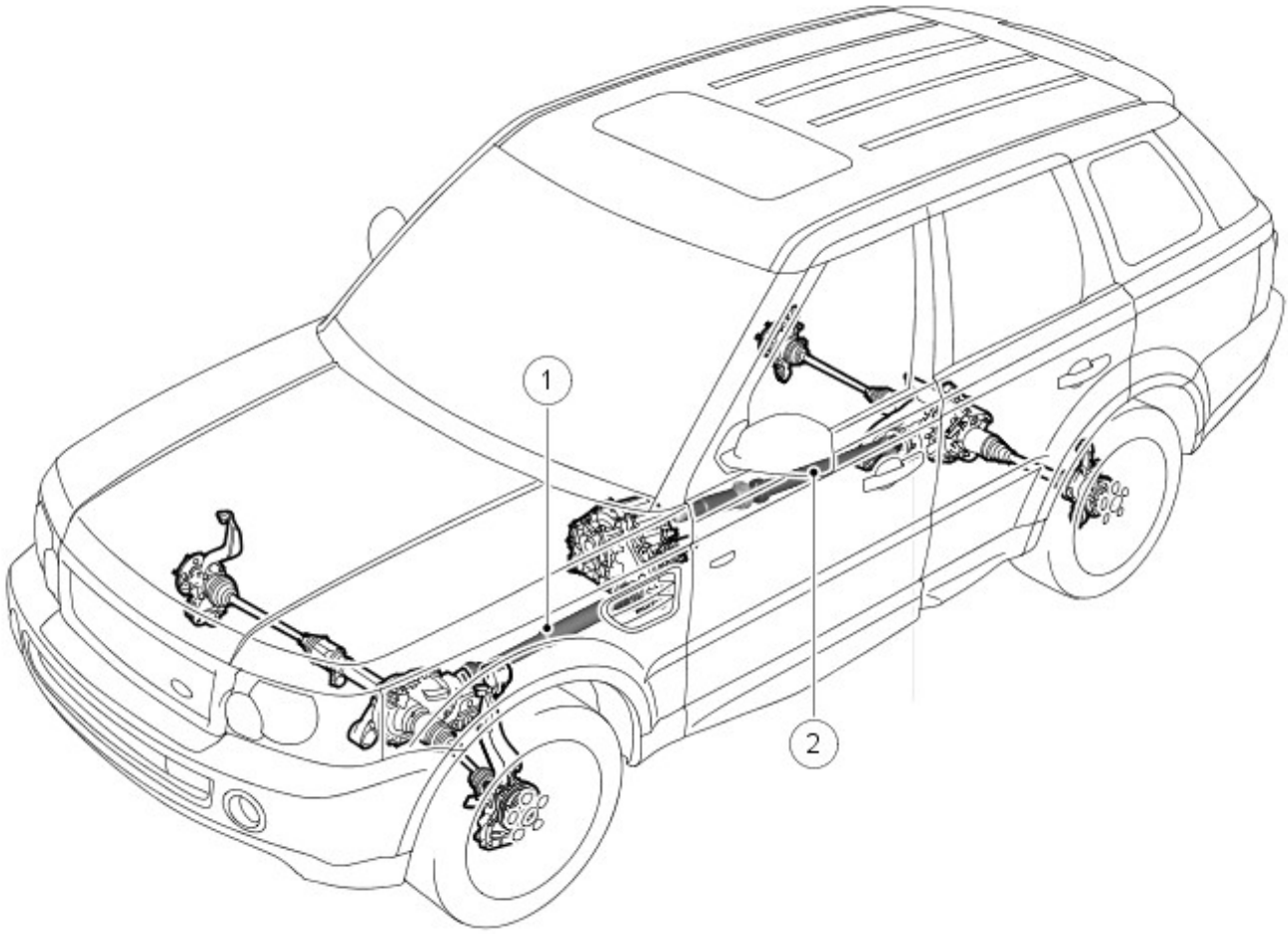
Description	Nm	lb-ft
*** Front driveshaft to front axle drive flange Torx bolts:**		
Stage 1	45	33
Stage 2	Further 90°	Further 90°
*** Front driveshaft to transfer case drive flange Torx bolts:**		
Stage 1	45	33
Stage 2	Further 90°	Further 90°
* Rear driveshaft to rear axle drive flange Torx bolts	150	110
Rear driveshaft to transfer case drive flange Torx bolts	73	54
Rear driveshaft center bearing bolts	30	22
Fuel tank heat shield bolts	5	4
Fuel tank heat shield nuts	3	2

*** New 'Patched' Torx bolts must be installed**

Driveshaft - Driveshaft

Description and Operation

Drive shaft Component Location



E56469

Item	Part Number	Description
1	-	Front drive shaft
2	-	Rear drive shaft

GENERAL

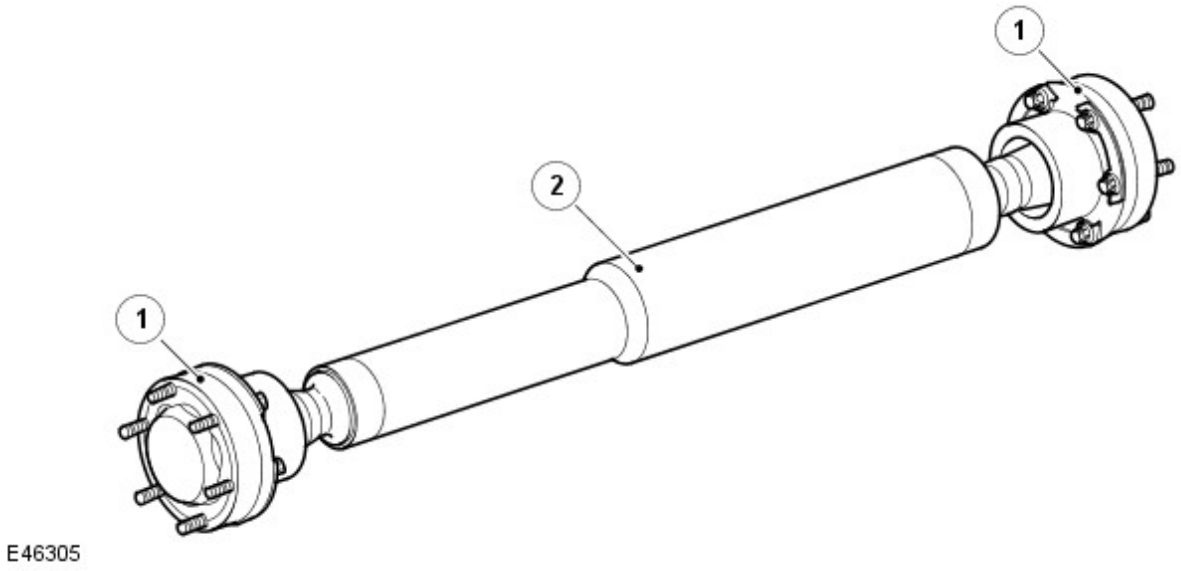
Drive shafts are used to transmit drive from the transfer box to the front and rear differentials.

The front drive shaft is a one-piece unit, connected to the transfer box and front differential unit via Constant Velocity (CV) joints.

The rear drive shaft is a two-piece unit, supported on a central bearing due to its increased length. The rear drive shaft is connected to the transfer box via a CV joint and the rear differential with a universal joint. These joints allow for angular deviations of the drive shaft due to acceleration and braking.

The front and rear drive shafts are not serviceable items and a failure will require the replacement of the complete drive shaft assembly.

FRONT DRIVE SHAFT



E46305

Item	Part Number	Description
1	-	CV joint
2	-	Front drive shaft

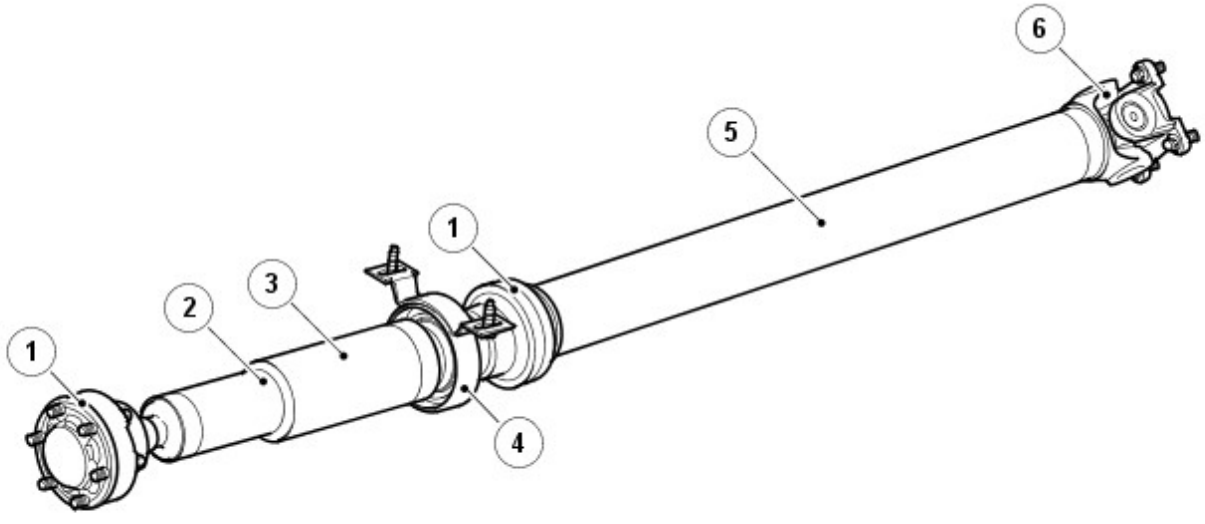
The front drive shaft is constructed from 1.7 mm wall tubular steel. A CV joint is attached to each end of the drive shaft (see 'Halfshaft Joint' section for more information on CV joints).

Each CV joint has six holes, which allow for attachment to the input flange of the front differential and the front output flange of the transfer box. The CV joints are secured to the front differential and transfer box with six Torx head adhesive retained bolts.

Three compression link washers are fitted under each pair of bolts. The washers are required to prevent compression of the CV joints attachment flange.

A shroud is pressed over the CV joint. The shroud seals to the joint body using an internal gasket and to the front output flange of the transfer box using an end cap and internal gasket. This prevents the ingress of dirt and moisture. The CV joints allow for movement of the drive shaft caused by small movements in the transmission and transfer box mountings.

REAR DRIVE SHAFT ASSEMBLY



E46306

Item	Part Number	Description
1	-	CV joints
2	-	Collapsible crash section
3	-	Front shaft assembly
4	-	Support bearing
5	-	Rear shaft assembly
6	-	Universal joint

The rear drive shaft assembly comprises front and rear shaft assemblies and a centrally mounted shaft bearing.

Front Shaft Assembly

The front shaft assembly incorporates a crash feature within the tube, which controls the collapse of the drive shaft during a crash.

The front shaft assembly comprises a CV joint at each end (see 'Halfshaft Joint' section for more information on CV joints).

The front CV joint (transfer box end) has six radial holes, which provide for the attachment to the transfer box rear output flange. The joint is secured to the output flange with six torx bolts, which screw into threaded holes in the flange. Three compression link washers are fitted under each pair of bolts. The rear splined shaft mates with splines in the rear shaft CV joint hub and is pressed in and fixed with Locktite. A machined surface on the shaft accepts the shaft bearing, which is a press fit.

Rear Shaft Assembly

The rear shaft assembly comprises a Hookes type universal joint at the rear (rear differential end).

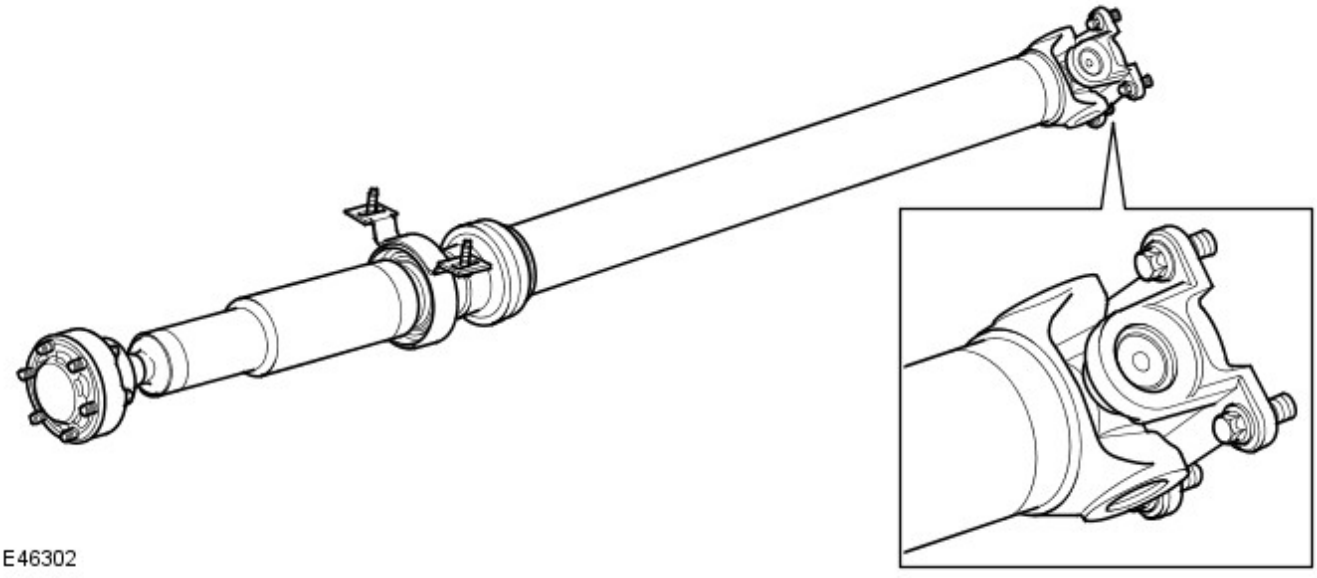
The universal joint is welded to the rear shaft tube and is secured to the input shaft of the rear differential with four flanged nuts. The opposite end of the rear shaft tube is welded directly to the CV joint body.

Shaft Bearing Assembly

The shaft bearing assembly comprises a pressed steel housing, a rubber diaphragm and a ball bearing. The diaphragm is bonded into the housing. An internal metal ring, bonded to the bush, allows for the bearing to be press fitted into it. The rubber bush allows for small deviations in alignment and also absorbs vibrational forces. The shaft bearing assembly is located by screws, which pass through plain holes in the bearing assembly and locate into nuts welded on the inside face of the chassis cross-member.

Driveshaft - Universal Joints

Description and Operation



E46302

A Hookes type universal joint is used to connect the rear drive shaft assembly to the rear differential, allowing for angular deviations of the drive shafts due to acceleration and braking.

The joint is bolted to the input shaft of the rear differential with four flanged adhesive screws and is lubricated during manufacture and sealed for life.

Driveshaft - Driveshaft

Diagnosis and Testing

For additional information.
REFER to: Driveline System (205-00, Diagnosis and Testing).

Driveshaft - Front Driveshaft V8 5.0L Petrol/V8 S/C 5.0L Petrol

Removal and Installation

Removal

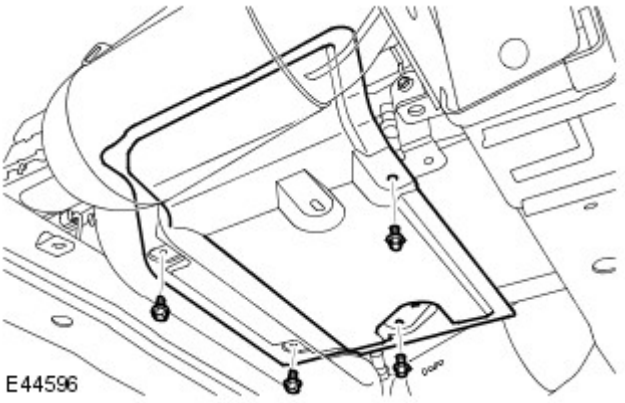
CAUTION: It is possible to fit the driveshaft incorrectly. Note the orientation before removal.

NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

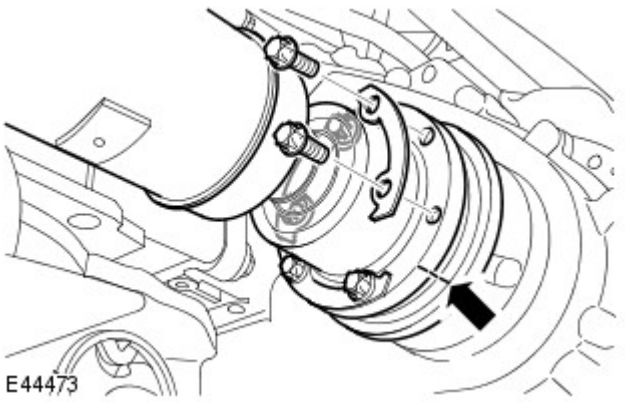
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

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



3. Remove the transmission heat shield.
   - Remove the 4 bolts.

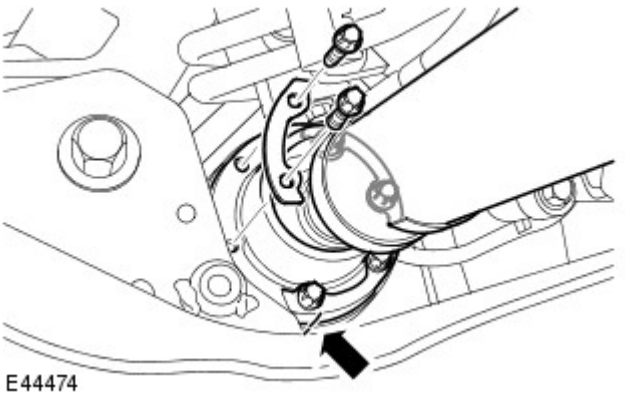


4. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Release the driveshaft from the transfer case drive flange.
   - Remove the 6 Torx bolts and washers, discard the bolts.



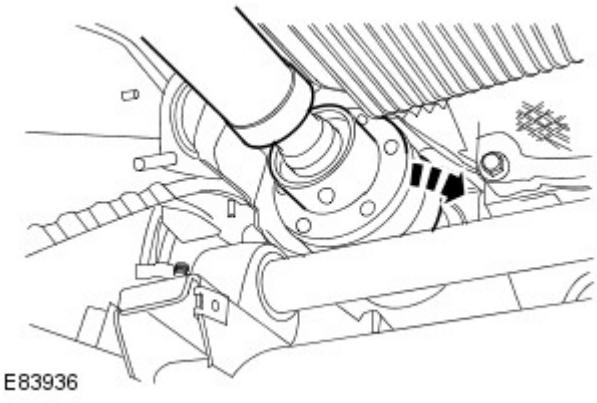
5. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Release the driveshaft from the front axle drive flange.
   - Remove the 6 Torx bolts and washers, discard the bolts.

6. Remove the front driveshaft.
   - Compress the joints to disengage the drive flanges.



Installation

1. NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

   Install the driveshaft.
   - Clean the components.
   - Compress the joints to engage the drive flanges.

2. CAUTION: Make sure that new bolts are installed.

   Secure the driveshaft to the front axle drive flange.
   - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
   - Stage 2: Tighten the bolts a further 90 degrees.

3. CAUTION: Make sure that new bolts are installed.

   Secure the driveshaft to the transfer case drive flange.
   - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
   - Stage 2: Tighten the bolts a further 90 degrees.

4. Install the transmission heat shield.
   - Tighten the bolts to 10 Nm (7 lb.ft).

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

Driveshaft - Front Driveshaft TDV6 3.0L Diesel

Removal and Installation

Removal

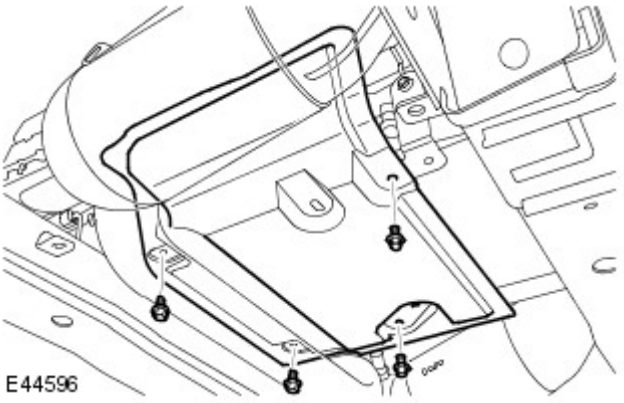
CAUTION: It is possible to fit the driveshaft incorrectly. Note the orientation before removal.

NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

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

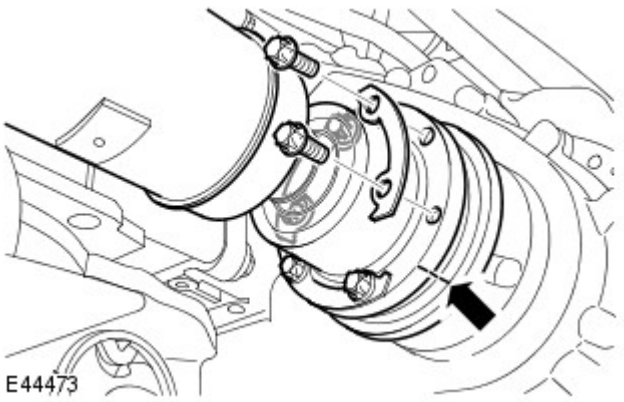
   Raise and support the vehicle.

2. Remove the transmission crossmember.
   For additional information, refer to: Transmission Support Crossmember - 3.0L Diesel (502-02, Removal and Installation).



3. NOTE: If equipped.

   Remove the transmission heat shield.
   - Remove the 4 bolts.

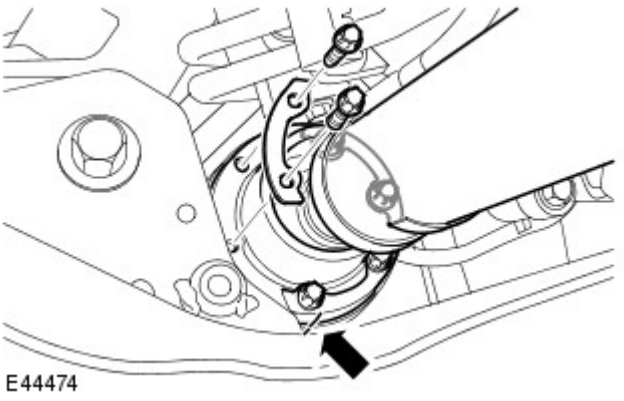


4. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Release the driveshaft from the transfer case drive flange.
   - Remove the 6 Torx bolts and washers, discard the bolts.



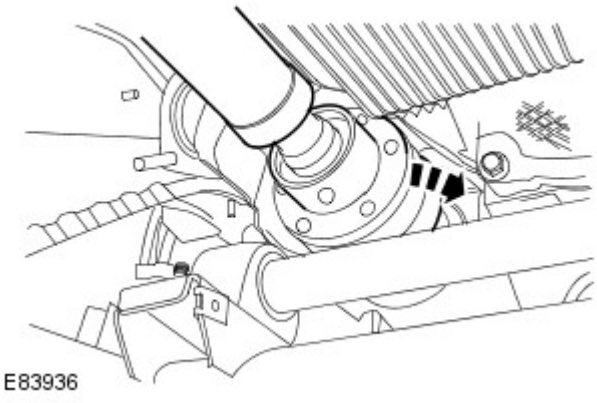
5. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Release the driveshaft from the front axle drive flange.
   - Remove the 6 Torx bolts and washers, discard the bolts.

6. Remove the front driveshaft.
   - Compress the joints to disengage the drive flanges.



Installation

1. NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

   Install the driveshaft.
   - Clean the components.
   - Compress the joints to engage the drive flanges.

2. CAUTION: Make sure that new bolts are installed.

   Secure the driveshaft to the front axle drive flange.
   - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
   - Stage 2: Tighten the bolts a further 90 degrees.

3. CAUTION: Make sure that new bolts are installed.

   Secure the driveshaft to the transfer case drive flange.
   - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
   - Stage 2: Tighten the bolts a further 90 degrees.

4. Install the transmission heat shield.
   - Tighten the bolts to 10 Nm (7 lb.ft).

5. Install the transmission crossmember.
   For additional information, refer to: Transmission Support Crossmember - 3.0L Diesel (502-02, Removal and Installation).

Driveshaft - Rear Driveshaft

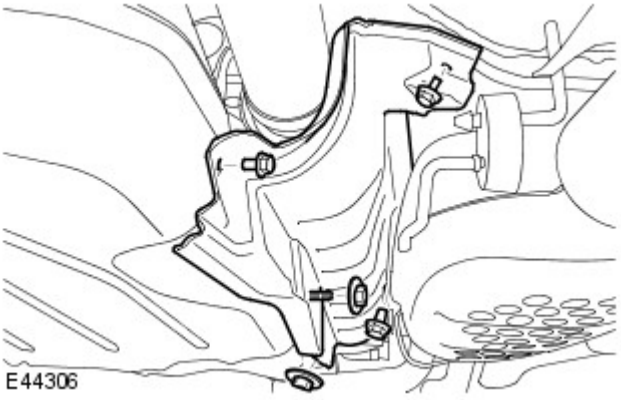
Removal and Installation

Removal

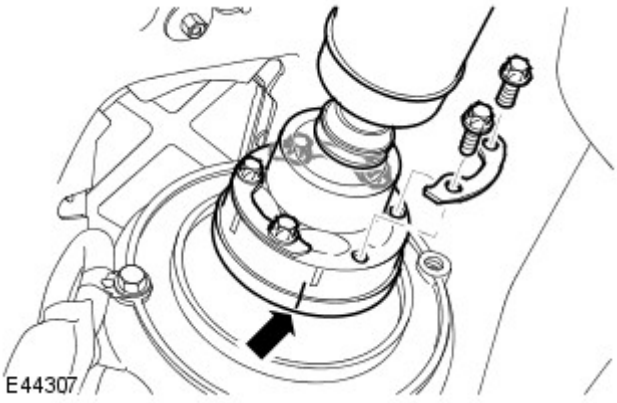
NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

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 fuel tank heat shield.
   - Remove the 3 bolts and 2 nuts.

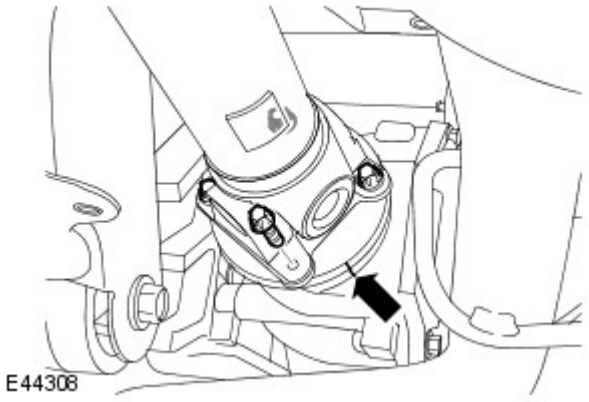


3. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Release the driveshaft from the transfer case drive flange.
   - Remove the 6 Torx bolts and washers.



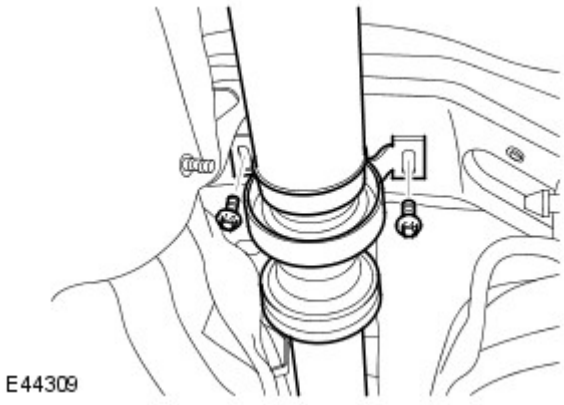
4. CAUTIONS:

   Mark the position of the driveshaft flange in relation to the drive pinion flange.

   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Release the driveshaft from the rear axle drive flange.
   - Remove and discard the 4 Torx bolts.

5. With assistance, remove the driveshaft.
   - Remove the 2 driveshaft center bearing mount bolts.



Installation

1. NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

   Attach the driveshaft to the rear axle drive flange.
   - Clean the component mating faces.
   - Attach the driveshaft to the rear axle drive flange.
   - Tighten the new Torx bolts to 150 Nm (110 lb.ft).

2. NOTE: A small amount of oil may weep from the driveshaft joints during storage. The loss of this oil will not affect the operation or durability of the joint.

   Attach the driveshaft to the transfer case drive flange.
   - Clean the component mating faces.
   - Tighten the Torx bolts to 73 Nm (54 lb.ft).

3. CAUTIONS:

   Align the driveshaft center bearing mount by moving the floating front section of the shaft backward or forwards until the bolt holes in the mount align with the holes in the chassis.

   Make sure the center bearing mount is not under tension.

   Install the driveshaft center bearing mount bolts.
   - Align the center bearing mount.
   - Tighten the driveshaft center bearing retaining bolts to 30 Nm (22 lb.ft).

4. Install the fuel tank heat shield.
   - Tighten the bolts to 6 Nm (4 lb.ft).
   - Tighten the nuts to 3 Nm (2 lb.ft).

Rear Drive Axle / Differential -

Lubricants

NOTE: Do not use any lubricant other than that specified

Item	Specification
Recommended lubricant:	
'Open' differential	Castrol SAF-XO - 75W/90
Differential with locking motor	Castrol SAF Carbon Mod Plus

Capacities

Unit	Capacity
'Open' differential	1.25 litres (1.32 US quarts)
Differential with locking motor	1.76 litres (1.86 US quarts)

Rear 'Open' Differential

Item	Specification
Reduction ratio:	
V6 Diesel engine - 8HP70 Automatic transmission	3.21:1
V6 Diesel engine - 6HP28 Automatic transmission	3.54:1
V8 Petrol engine - 6HP28 Automatic transmission	3.54:1

Rear Differential with Locking Motor

Item	Specification
Range	Up to 2500 Nm (98.5 lbf/ft)
Differential locking motor	Operates the ball/ramp mechanism and wet clutch. Motor incorporates a temperature sensor and is controlled by a module
Differential type	4 pin
Reduction ratio:	
V6 Diesel engine - 8HP70 Automatic transmission	3.21:1
V6 Diesel engine - 6HP28 Automatic transmission	3.54:1
V8 Petrol engine - 6HP28 Automatic transmission	3.54:1

Torque Specifications

Description	Nm	lb-ft
Oil drain plug	29	21
Oil filler plug	29	21
Oil temperature sensor	22	16
++ Differential locking motor bolts	10	7
Differential front mounting bolts	275	203
Differential rear mounting bolts	175	129
* Driveshaft to rear axle drive flange Torx bolts	150	110
Lower arm to wheel knuckle	275	203
Toe link bolt	175	129
Stabilizer bar link nuts	115	85
**+ Halfshaft retaining nut	350	258
Fuel tank heat shield nuts	3	2
Fuel tank heat shield bolts	5	4
Road wheel nuts	140	103

*** New patchlok torx bolts must be installed**

**** New nut must be installed**

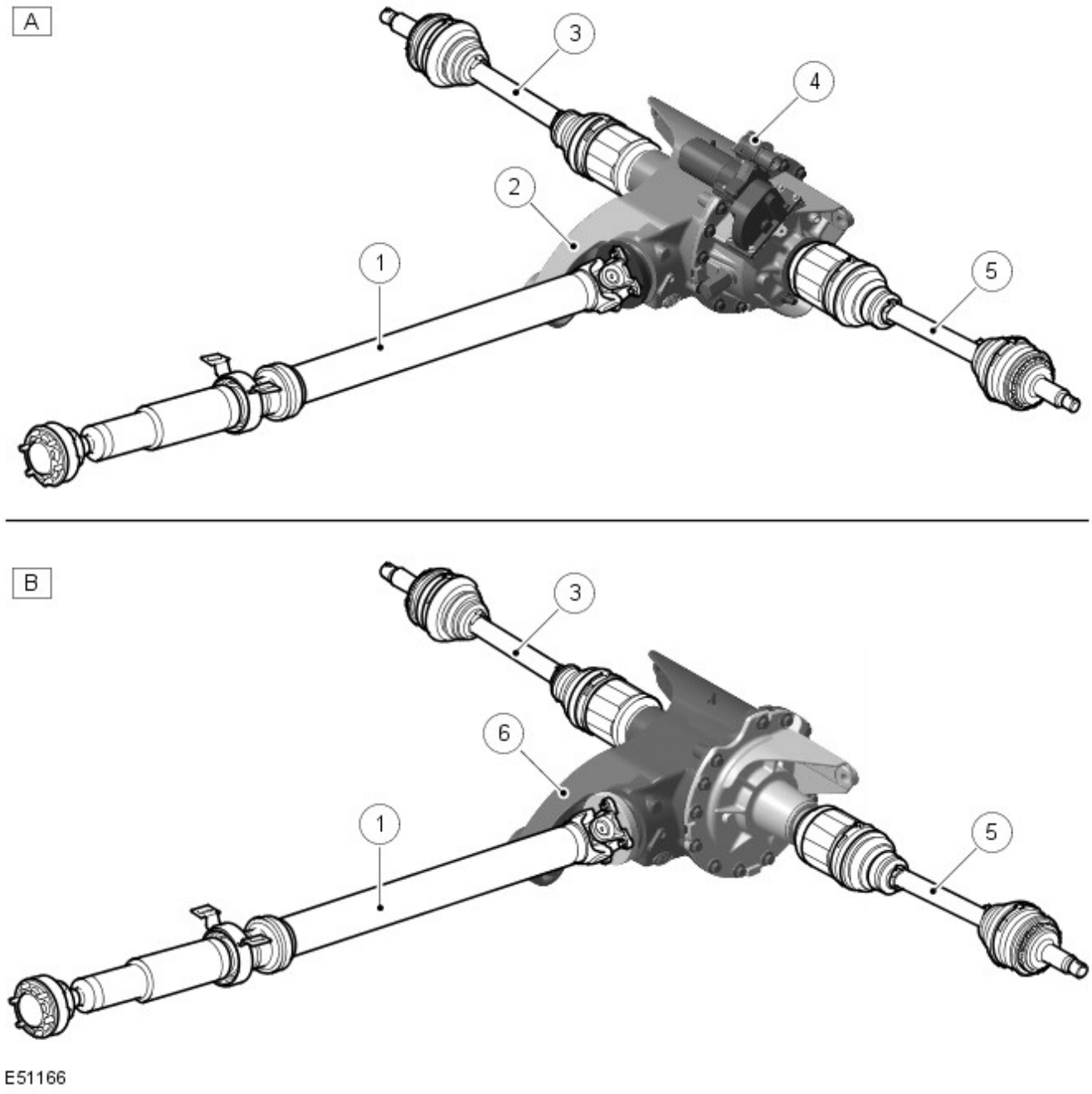
+ Stake nut on completion of tightening operation

++ Apply sealant to flange of locking motor

Rear Drive Axle / Differential - Rear Drive Axle and Differential

Description and Operation

Overview



E51166

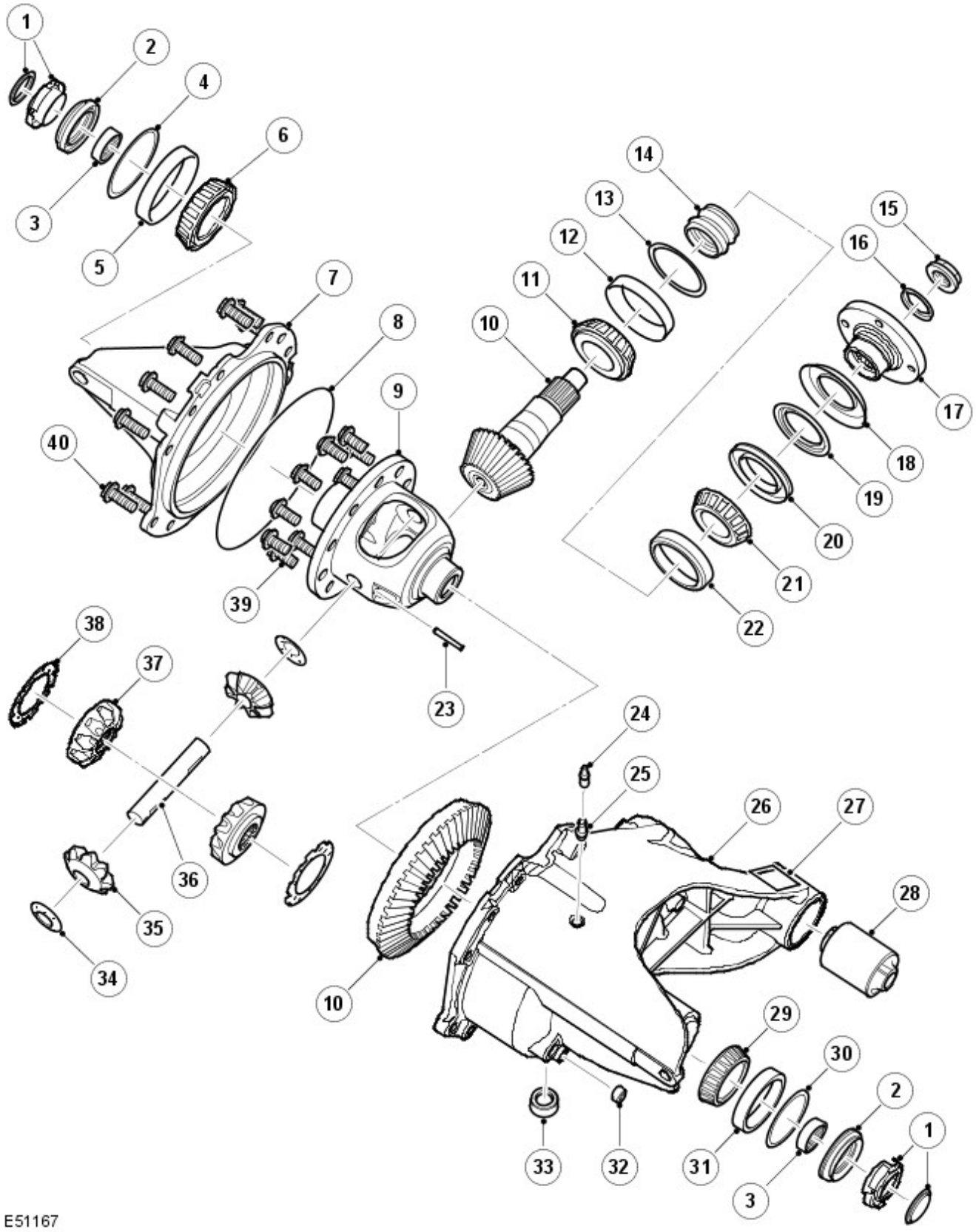
Item	Part Number	Description
A	-	Electronic rear differential
B	-	Open rear differential
1	-	Rear driveshaft
2	-	Electronic rear differential
3	-	RH rear drive halfshaft
4	-	Actuator (locking) motor assembly
5	-	LH rear drive halfshaft
6	-	Rear differential

The open rear differential converts the 'angle of drive' through 90° and distributes drive, via the rear drive halfshafts, to the rear wheels.

The differential unit is mounted to the chassis via rubber bushes and bolts; two mounting points at the rear of the unit and one at the front.

OPEN REAR DIFFERENTIAL ASSEMBLY

Open Rear Differential - Exploded View



E51167

Item	Part Number	Description
1	-	Cap
2	-	Seal
3	-	Bearing assembly, without race
4	-	Bearing pre-load spacer
5	-	Bearing
6	-	Roller bearing cup
7	-	Cover
8	-	Seal
9	-	Differential carrier
10	-	Gear and pinion assembly

11	-	Bearing
12	-	Roller bearing cup
13	-	Shim
14	-	Collapsible spacer
15	-	Pinion nut
16	-	Retainer
17	-	Flange
18	-	Outer deflector
19	-	Inner deflector
20	-	Oil seal
21	-	Bearing
22	-	Roller bearing cup
23	-	Roll pin
24	-	Breather cap
25	-	Breather
26	-	Case
27	-	Data location
28	-	Mounting bush
29	-	Bearing
30	-	Bearing pre-load spacer
31	-	Roller bearing cup
32	-	Plug
33	-	Drain plug
34	-	Thrust washer
35	-	Planet gears
36	-	Crosspin shaft
37	-	Sunwheel
38	-	Thrust washer
39	-	Bolt, 10 of
40	-	Bolt, 12 of

The cast iron casing comprises two parts; a cover and a carrier. The carrier provides locations for all the internal components. The carrier is sealed to the cover via an O-ring seal and secured with twelve bolts. The cover and carrier have cast fins, which assist mobility. A breather tube is fitted to the top of the carrier. This allows a plastic tube to be fitted and routed to a high point under the vehicle body, preventing the ingress of water when the vehicle is wading.

The carrier contains an oil drain plug. The differential unit contains a specified oil.
For additional information, refer to: Specifications (205-02, Specifications).

The differential is a conventional design using a hypoid gear layout, similar to the front differential. The open rear differential is available in various ratios depending on engine installation.
For additional information, refer to: Specifications (205-02, Specifications).
Changing the number of teeth between the crown wheel drive gear and pinion gear changes the ratio.

The differential comprises a pinion shaft and hypoid pinion-gear and a crown wheel drive-gear with an integral cage, which houses two planet gears. Two sun wheels are also located in the cage and pass the rotational drive to the drive shafts.

The pinion shaft is mounted on two opposed taper roller bearings, with a collapsible spacer located between them. The spacer is used to hold the bearings in alignment and also collapses under the pressure applied to the pinion flanged nut. This allows the flanged nut to be tightened to a predetermined torque, which collapses the spacer, setting the correct bearing preload.

The pinion shaft has an externally splined outer end, which accepts and locates the input flange, which is retained by the pinion nut and retainer. The input flange has four threaded holes and mates with the rear drive shaft. Four bolts secure the rear drive shaft to the input flange. An oil seal is pressed into the pinion housing and seals the input flange to the pinion housing. The pinion shaft has a hypoid gear at its inner end, which mates with the crown wheel drive gear.

The crown wheel drive gear is located on the differential case and secured with ten screws. The differential case is mounted on taper roller bearings located in machined bores on each side of the pinion housing. Shims are retained in the casing behind the bearing cups, the shim thickness is selected to apply the correct bearing preload and hypoid backlash.

The differential carrier has a through hole, which provides location for the shaft. The shaft is supported by a sun gear and a needle roller bearing. The shaft is fitted with a snap ring at one end, which locates in a machined groove in the sun gear, locking the shaft in position.

The sun gears are located in pockets in the carrier cage and mesh with the planet gears. Spacers are fitted between the sun wheels and the carrier and set the correct mesh contact between the planet gears and the sun wheels. Each sun wheel has a machined bore with internal splines and machined groove near the splined end. The groove provides positive location for a snap ring fitted to the end of each output flange.

Each output shaft has a spline, which locates in each sun wheel. A snap ring fitted to the splined shaft locates in the

groove the sun wheel bore and positively located the output shaft. Oil seals are pressed into each side of the pinion housing and seal the seal the output shaft.

Differential Operation

The operating principles of the front and rear differentials are the same. Rotational input from the drive shaft is passed via the input flange to the pinion shaft and pinion gear. The angles of the pinion gear to the crown wheel drive gear moves the rotational direction through 90°.

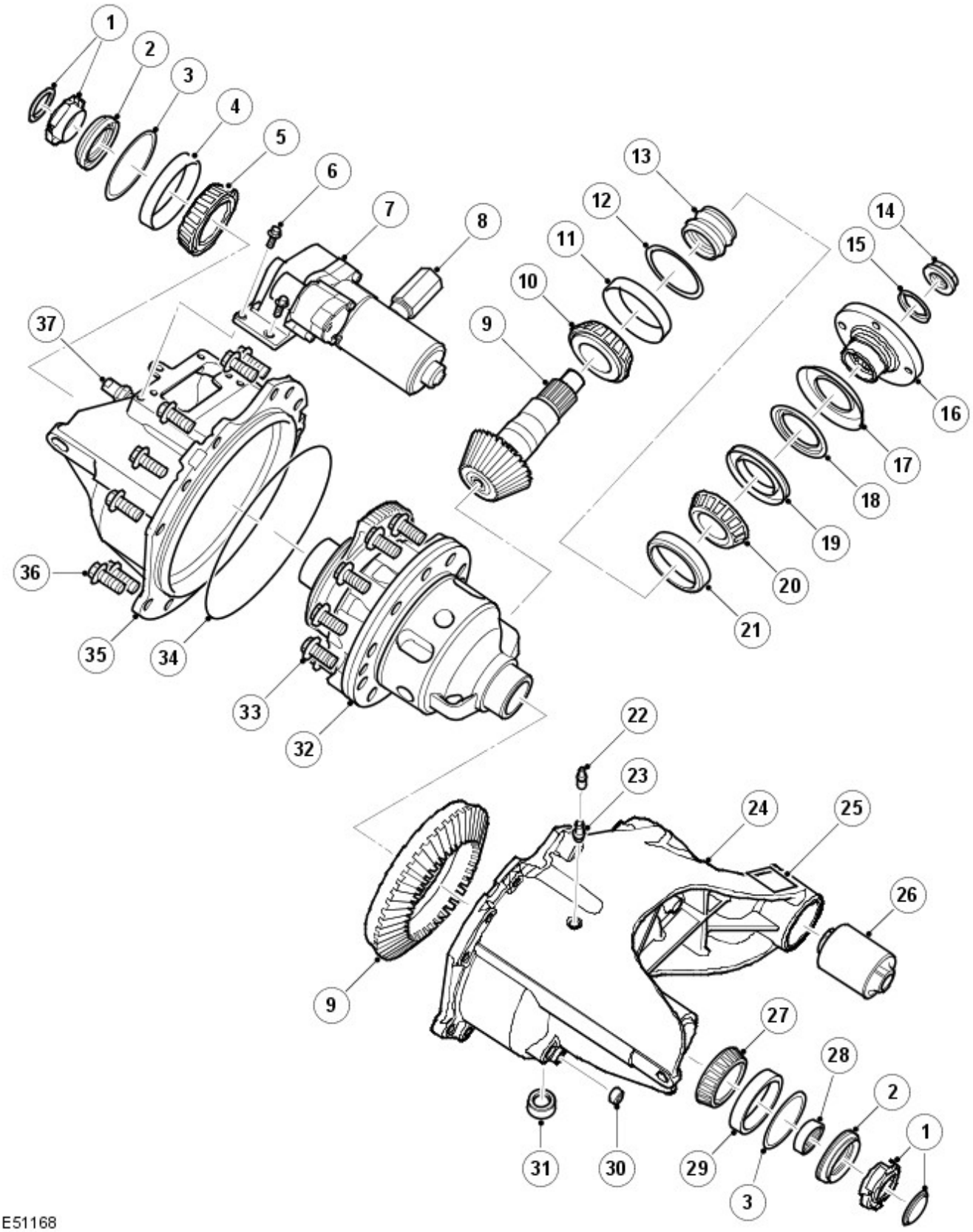
The transferred rotational motion is now passed to the crown wheel drive gear, which in turn rotates the differential casing. The shaft, which is secured to the casing, also rotates at the same speed as the casing. The planet gears, which are mounted on the shaft, also rotate with the casing. In turn, the planet gears transfer their rotational motion to the left and right hand sun wheels, rotating the drive halfshafts.

When the vehicle is moving in a forward direction, the torque applied through the differential to each sun wheel is equal. In this condition both drive halfshafts rotate at the same speed. The planet gears do not rotate and effectively lock the sun wheels to the differential casing.

If the vehicle is turning, the outer wheel will be forced to rotate faster than the inner wheel by having a greater distance to travel. The differential senses the torque difference between the sun wheels. The planet gears rotate on their axes to allow the outer wheel to rotate faster than the inner one.

ELECTRONIC REAR DIFFERENTIAL ASSEMBLY

Electronic Rear Differential - Exploded View



E51168

Item	Part Number	Description
1	-	Cap
2	-	O ring
3	-	Bearing pre-load spacer
4	-	Bearing
5	-	Bearing cup
6	-	Bolt, 4 of
7	-	Housing and motor assembly
8	-	Damper
9	-	Gear and pinion assembly
10	-	Bearing

11	-	Bearing cup
12	-	Shim
13	-	Collapsible spacer
14	-	Pinion nut
15	-	Retainer
16	-	Flange
17	-	Deflector, outer
18	-	Deflector, inner
19	-	Seal
20	-	Bearing
21	-	Bearing cup
22	-	Breather cap
23	-	Breather
24	-	Case
25	-	Data location
26	-	Mounting bush
27	-	Bearing
28	-	Bearing assembly without race
29	-	Bearing cup
30	-	Filler plug
31	-	Drain plug
32	-	Electronic differential assembly
33	-	Bolt, 10 of
34	-	O ring
35	-	Cover
36	-	Bolt, 12 of
37	-	Temperature sensor

The electronic rear differential has the same functionality as the open rear differential but incorporates a locking feature.

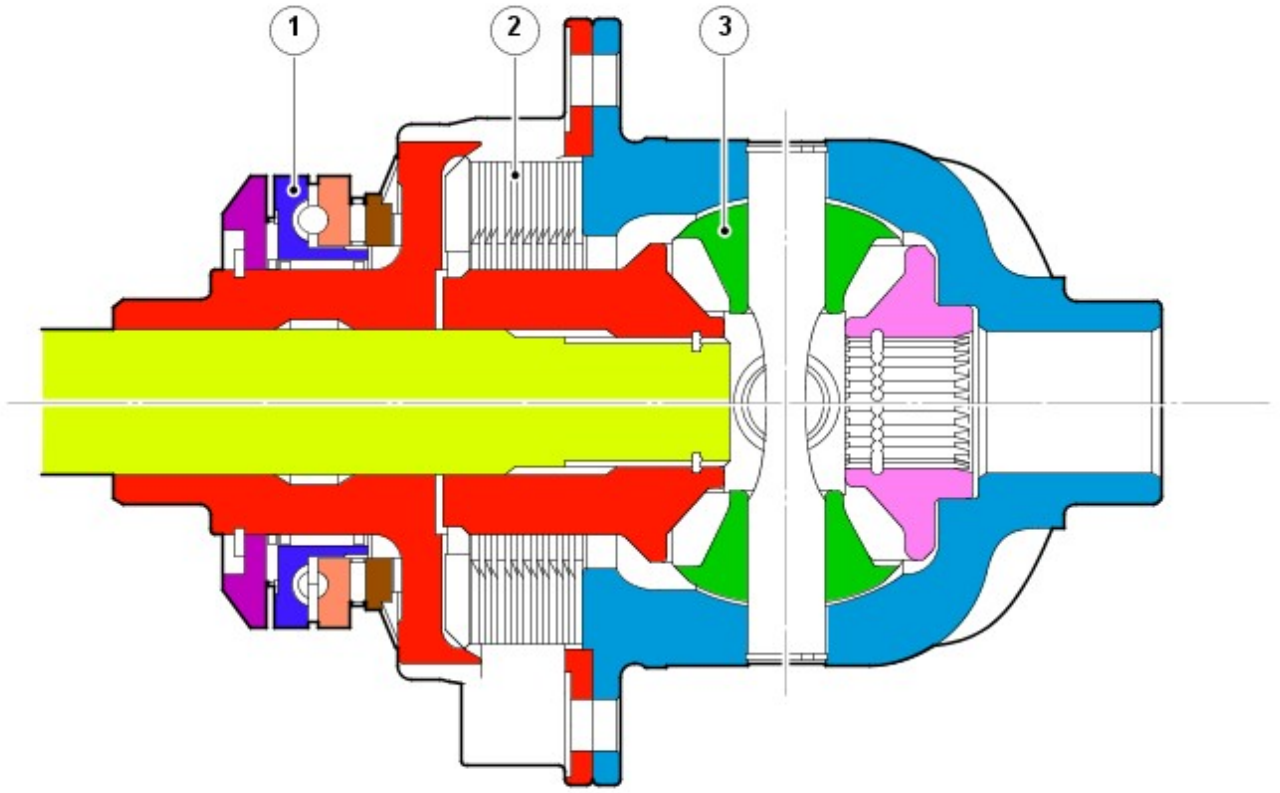
An electronically controlled multi-plate clutch provides a rear differential lock and torque biasing function to give improved traction performance and vehicle dynamic stability.

A strategy to electronically control the rear differential multi-plate clutch assembly, has been developed to provide:

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

The unit receives a torque input from the transfer box output-shaft, which is passed through the unit to two outputs for the rear drive halfshafts.

The unit detects wheel-slip via various vehicle system inputs to the differential locking module and locks the differential accordingly.

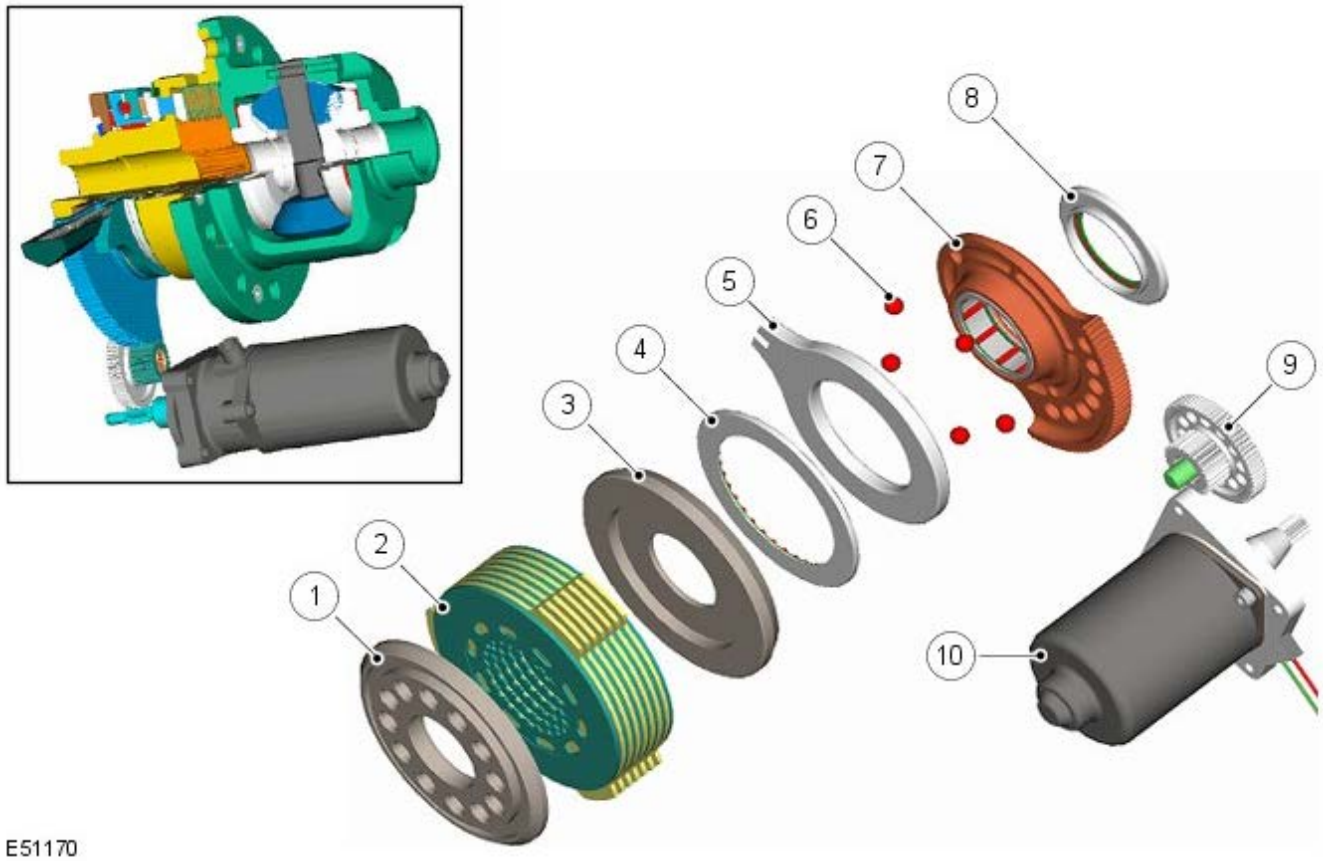


E51169

Item	Part Number	Description
1	-	Actuator
2	-	Clutch pack
3	-	Differential

The electronic rear differential locking and biasing feature is actuated via a DC motor, which is controlled by the differential locking module, via a PWM (pulse width modulation) signal.

Multi-plate Clutch Assembly



E51170

Item	Part Number	Description

1	-	Pressure disc
2	-	Clutch plate assembly
3	-	Pressure disc
4	-	Thrust race
5	-	Output actuator
6	-	Actuator balls
7	-	Input actuator
8	-	Bearing pre-load spacer
9	-	Reduction gearset
10	-	Actuator motor

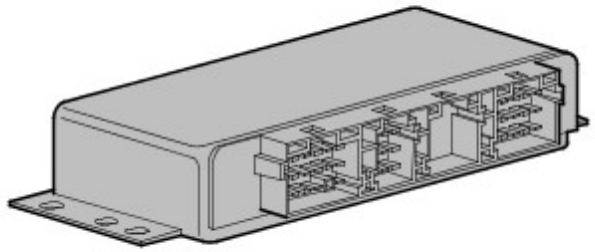
The multi-plate clutch assembly for both centre (transfer box) and electronic rear differentials act in a similar way. The aim of the multi-plate clutch assembly is to prevent excessive differential slip and therefore maximize the traction performance of the vehicle. This is fundamentally different from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

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

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

By turning the input actuator disc, via the motor shaft, the output actuator is rotated. This movement acts on 5 balls in a ramp mechanism between the input and output actuators and gives a defined axial movement. The movement forces the pressure disc to induce friction between the sun gear and differential case via the clutch plates supported by the sun gear and the plates supported by the clutch basket on the differential case. This frictional force inhibits the differential rotation; the differential case and left hand differential side gear are locked together.

Differential Locking Module



E140538

The differential locking module controls the multi-plate clutch actuation. The locking module is mounted on a bracket located on the LH C-pillar, behind the trim.

The module is connected on the high-speed CAN (controller area network) bus and controls the differential operation using CAN messages from other control modules on the network.

The module uses three connectors for all inputs and outputs. It receives a permanent power supply from the EJB (engine junction box), and an ignition supply from the CJB (central junction box).

The module memorizes the position of the differential actuator motor when the engine is switched off.

The locking module controls the closed-loop position sensing system within the motor and regulates the power supply to the motor.

If any of following components are replaced:

- differential locking module
- differential actuator motor
- differential assembly.

An approved diagnostic system must be connected to the vehicle and the differential locking module self-calibration procedure performed.

If a fault occurs with the electronic differential, the locking module or one of the required input signals, for example; road speed signal, the locking module records an error code and a warning lamp, in the instrument cluster, illuminates permanently.

CAN Bus Messages

The high-speed CAN is a broadcast network connected between various vehicle control modules. It allows the fast exchange of data between control modules every few microseconds.

The differential locking module is connected on the high-speed CAN bus, via the transfer box control module, and controls differential operation using CAN messages from other control units on the network. Wheel speed, steering angle, automatic transmission speed, temperature information, vehicle configuration, axle ratios and mode inputs, are some of the main signals received by the locking module.

The locking module also sends messages via the CAN bus to tell other control modules on the network, the status of the electronic rear differential. The clutch torque and default mode status are some of the main signals sent out by the locking module.

The following table shows the messages that can be displayed in the message centre of a high-line instrument cluster relating to the electronic rear differential:

Message	Description	Chime
'TRANSMISSION OVERHEAT' 'SLOW DOWN'	Rear differential temperature has reached or is approaching the overheat threshold.	None
'TRANSMISSION FAULT' 'TRACTION REDUCED'	Transfer box control module has stopped transmitting CAN bus messages. Defaults to open centre differential. Message also displayed when fault occurs with electronic rear differential.	None
'TRANSMISSION FAULT' 'STOP SAFELY'	Fault has occurred with electronic rear differential. Stop vehicle at earliest opportunity.	Single

On vehicles fitted with the low line instrument cluster, in place of the message centre there will be a status lamp, which has the following logic:

- Amber - Over temperature
- Red - Failure, stop vehicle

DIAGNOSTICS

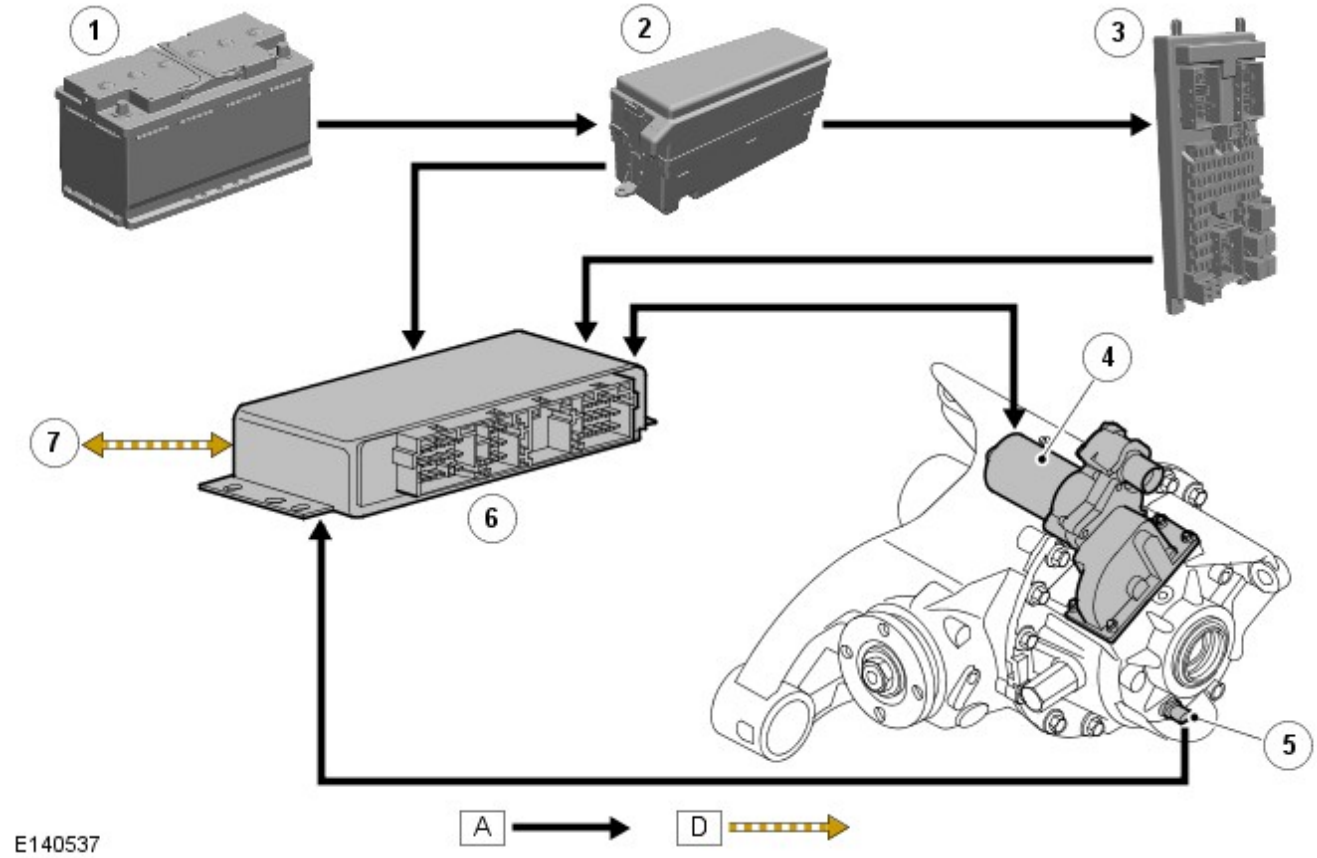
The electronic rear differential locking module can store fault codes, which can be retrieved using an approved diagnostic system.

The information is communicated via a diagnostic socket. The diagnostic socket allows the exchange of information between the various control modules on the bus systems and the diagnostic equipment. The information is communicated to the socket via the CAN bus. This allows the retrieval of diagnostic information and programming of certain functions using the diagnostic equipment.

The electronic differential locking module uses DTC (diagnostic trouble code), which relate to electronic rear differential electrical faults.

ELECTRONIC DIFFERENTIAL CONTROL DIAGRAM

NOTE: A = Hardwired; D = high-speed CAN bus.



Item	Part Number	Description
1	-	Battery
2	-	EJB
3	-	CJB
4	-	Actuator motor
5	-	Oil temperature sensor
6	-	Differential locking module
7	-	High- speed CAN to other vehicle systems

Rear Drive Axle / Differential - Rear Drive Axle and Differential

Diagnosis and Testing

Principles of Operation

For a detailed description of the Rear Drive Axle and Differential and operation, refer to the relevant Description and Operation section of the workshop manual.
REFER to: Rear Drive Axle and Differential (205-02 Rear Drive Axle/Differential, Description and Operation).

Inspection and Verification

CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

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

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

Visual Inspection

Mechanical	Electrical
• Differential oil leakage • Sensor installation	• power • Fuse(s) • Wiring harness physical damage or water ingress • Loose or corroded electrical connectors • Controller Area Network (CAN) circuits • Sensors • Rear differential control module

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Message	Possible Other Warnings	Possible Causes	Action
Running at reduced capability with fault present	• Rear differential fault	• Driveline overheat warning lamp illuminated • Rear differential/driveline fault warning lamp illuminated	• Water ingress to wiring harness or connectors • Reduced differential capability • Differential increased tolerances • Internal fault • Rear differential control module fault (Rear differential control module)	Visually inspect the wiring harness and connectors for water ingress. Refer to the warranty policy and procedures manual if a module is suspect.
Rear differential overheat	• Rear Differential Overheat Slow Down	• Driveline overheat warning lamp illuminated	• Oil level incorrect • Oil level incorrect specification • Sensor fault • Internal fault	Check for correct oil quantity and specifications. Refer to the relevant section of the workshop manual.

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: Rear Differential Control Module (RDCM) (100-00, Description and Operation).

Rear Drive Axle / Differential - Differential Draining and Filling

General Procedures

CAUTION: Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, and not to act as a level indicator.

NOTE: The only way to check the fluid level in the differential is to drain all the fluid out and refill with the correct quantity, shown in the specification section.
For additional information, refer to: Specifications (205-02, Specifications).

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. CAUTION: Do not undo or remove the large protruding hexagon on the differential casing.

   Remove the differential case lubricant filler plug.
   - Clean the area around the lubricant filler plug.
   - Position container to collect fluid loss.



3. Drain the differential lubricant.
   - Clean the area around the drain plug.
   - Remove the fluid drain plug.

4. CAUTION: There has been 2 different types of fixings used for the drain plug. Note the type and make sure the correct torque is applied, see below.

   Install the lubricant drain plug.
   - Clean the drain plug.
   - Up to differential serial number 254325: Tighten the hexagonal drive drain plug to 54 Nm (40 lb.ft).
   - From differential serial number 254326: Tighten the 3/8'' square drive drain plug to 28 Nm (21 lb.ft).

5. CAUTIONS:

   There have been 2 different types of fixings used for the drain plug. Note the type and differential serial number, and make sure the correct torque is applied, see below.

   Make sure the correct specification and quantity of oil is used.

   Fill the differential with the correct amount of lubricant.

For additional information, refer to: Specifications (205-02 Rear Drive Axle/Differential, Specifications).

6. Install the differential filler plug.
    - Clean the filler plug.
    - Tighten the filler plug to 34 Nm (25 lb.ft).

Rear Drive Axle / Differential - Differential Locking Motor

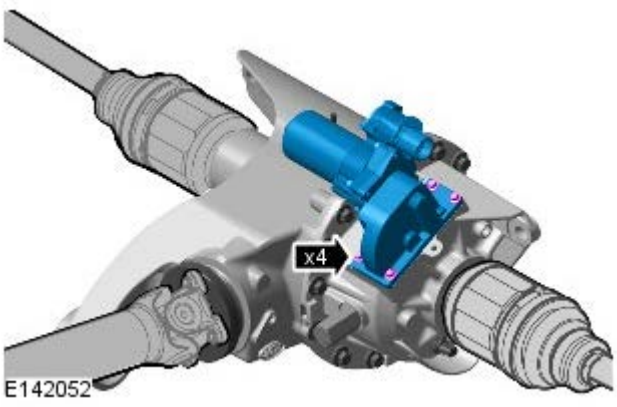
In-vehicle Repair

Removal

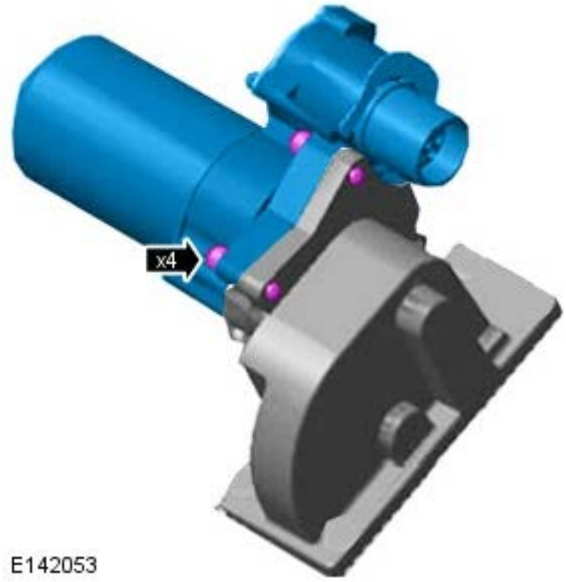
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Remove the differential locking motor.
   - Disconnect the electrical connector.
   - Remove the 4 bolts.



3. Remove the 4 bolts.



4. Discard the motor.



5. Check the gear set for damage to the gears.

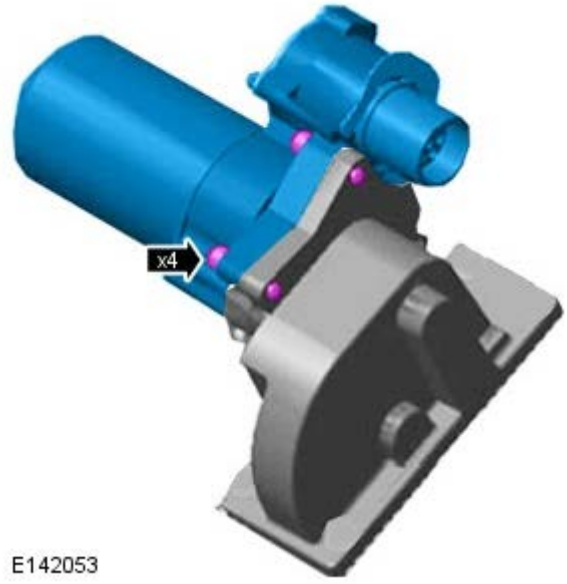
Installation

1. Clean the component mating faces.
2. Install the new motor with new O ring seal.



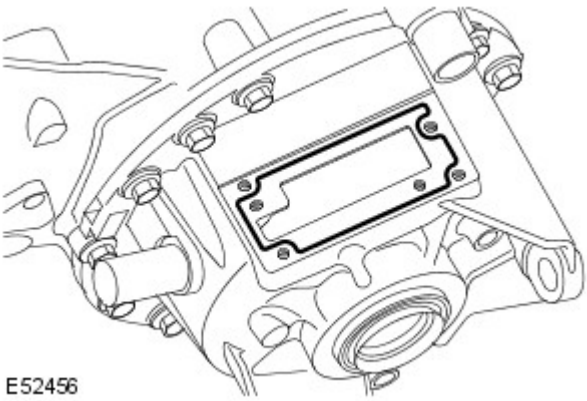
E142055

3. Install the 4 bolts 12 Nm.



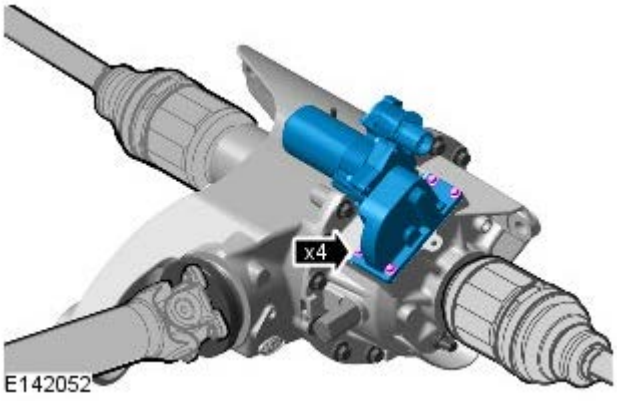
E142053

4. Clean the component mating faces and apply continuous bead of sealant to the motor mating face on the differential.



E52456

5. Install the differential locking motor.
   - Tighten the bolts to 10 Nm.
   - Connect the electrical connector.



6. Lower the vehicle.
7. Calibrate the differential locking motor using the diagnostic tool.

Rear Drive Axle / Differential - Rear Axle Oil Temperature Sensor

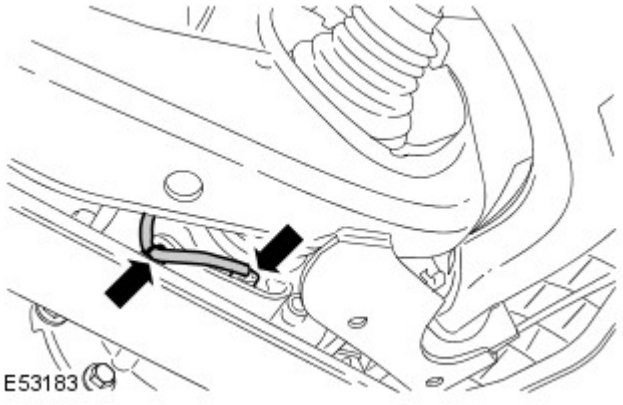
In-vehicle Repair

Removal

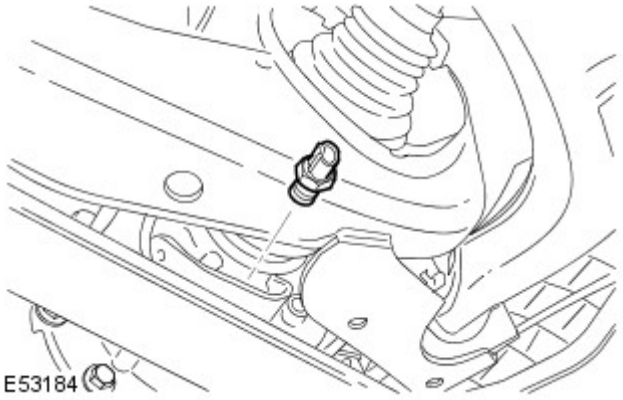
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Drain the differential lubricant.
   For additional information, refer to: Differential Draining and Filling (205-02, General Procedures).



3. Disconnect the electrical connector.
   - Release the wiring harness retaining clip.



4. Remove the oil temperature sensor.
   - Remove and discard the O-ring seal.

Installation

1. Clean the component mating faces.

2. Install the oil temperature sensor.
   - Tighten to 22 Nm (16 lb.ft).

3. Connect the electrical connector.
   - Secure the wiring harness clip.

4. Fill the differential with the correct amount of lubricant.
   For additional information, refer to: Differential Draining and Filling (205-02, General Procedures).

Rear Drive Axle / Differential - Drive Pinion Seal

In-vehicle Repair

Special Tool(s)

	Flange holding tool 205-053
	Adapter for 205-053
	Impulse extractor 100-012(LRT-99-004)
	Installer drive pinion oil seal 205-821
	Remover drive flange 205-824
	Remover drive pinion seal 205-823
	Seal installer, adaptor 205-821-01

Removal

CAUTIONS:

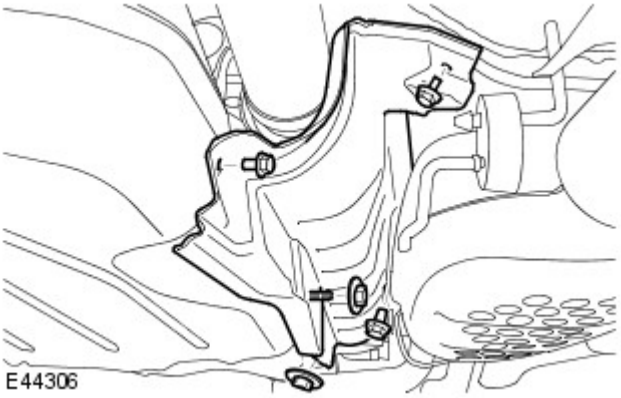
The input flange must not be change for one from another unit.

The drive pinion seal must only be renewed for 1 repair.

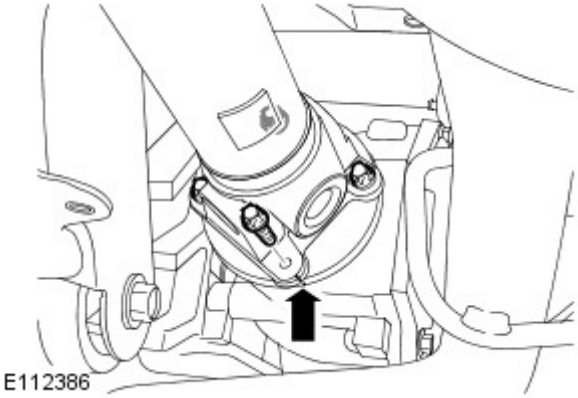
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Drain the differential lubricant.
   For additional information, refer to: Differential Draining and Filling (205-02, General Procedures).

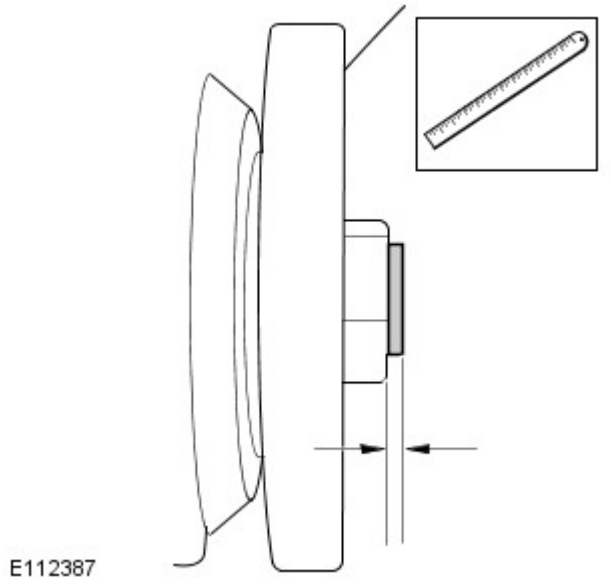


3. Remove the fuel tank heat shield.
   - Remove the 3 bolts and 2 nuts.

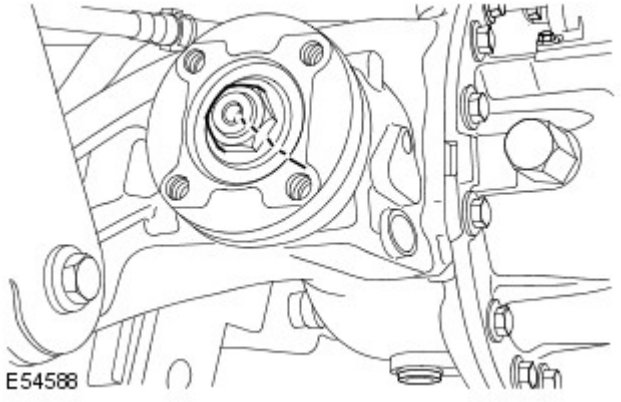


4. CAUTION: Mark the position of the driveshaft flange in relation to the drive pinion flange.

   Release the driveshaft from the rear axle drive pinion flange.
   - Remove and discard the 4 Torx bolts.

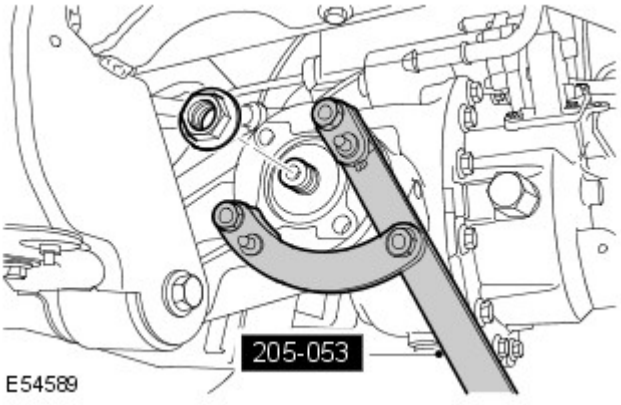


5. Measure the depth of the pinion nut on the pinion shaft.
   - Note measurement for installation.

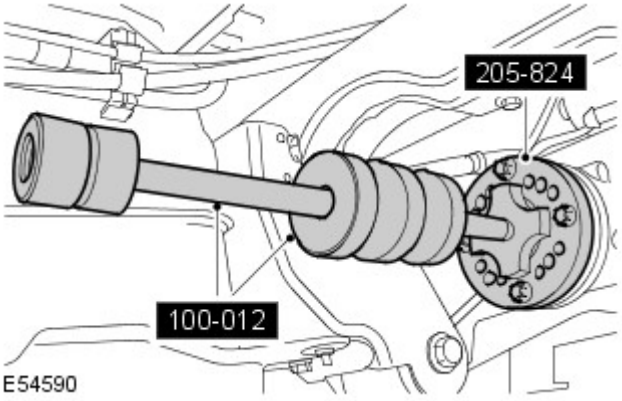


6. CAUTION: This step must be carried out to make sure that the drive pinion nut is correctly tightend on assembly.

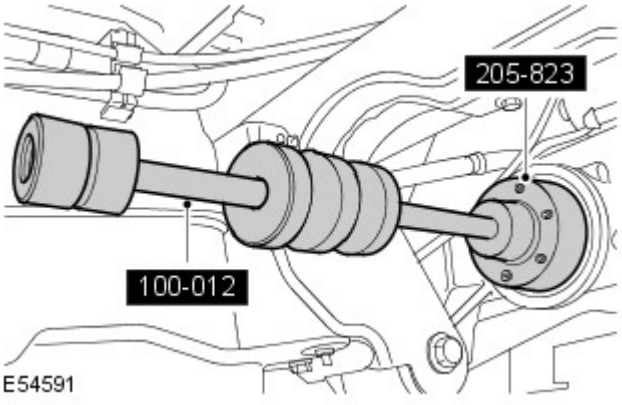
   Accurately scribe a line to mark the drive pinion shaft to the drive pinion nut and pinion flange.



7. Remove the drive pinion flange retaining nut.
   - Using the special tool, counter hold the drive pinion flange.
   - Note number of turns for installation.



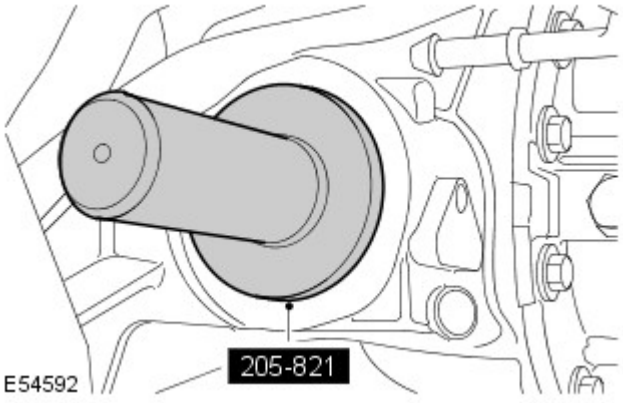
8. Using the special tool, remove the drive pinion flange.
   - Check flange seal journal for any damage.



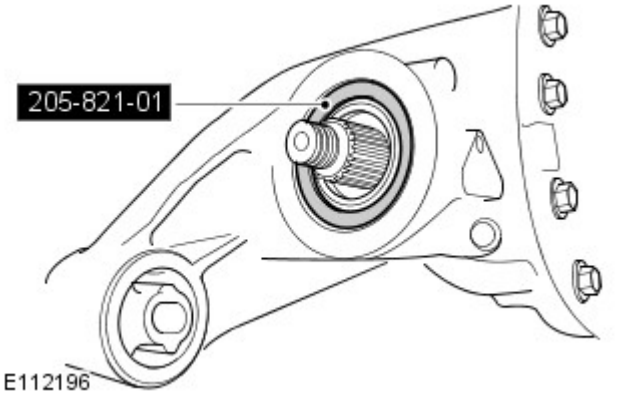
9. Using the special tool, remove the drive pinion seal.

Installation

1. Clean the drive pinion flange.
2. Clean the drive pinion seal mating faces.
3. Using the special tool, install the new drive pinion seal.

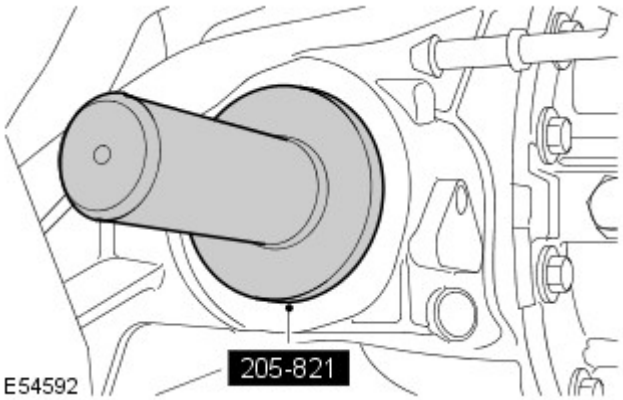


4. Remove the special tool.
    - Install special tool 205-821-01 to the seal face.



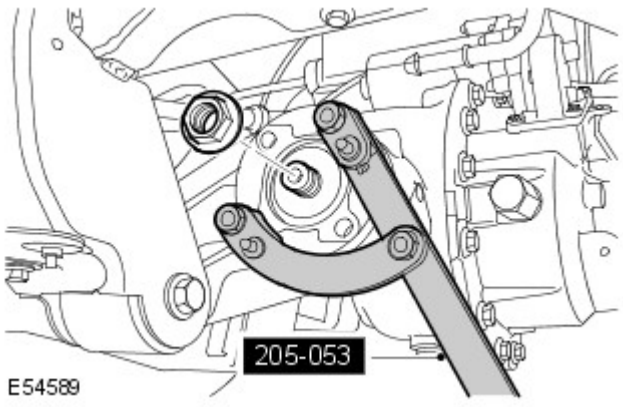
5. CAUTION: Make sure adaptor is removed or damage to the vehicle may occur.

   Using the special tool, install the new drive pinion seal.
    - Remove the special tools.



6. CAUTION: Make sure the drive pinion flange scribed marks are aligned.

   Install the drive pinion flange.



7. CAUTIONS:

   Make sure the mark on the drive pinion nut is never tightened short of the scribed mark on the drive pinion shaft.

   Make sure the drive pinion flange has no end float and is free to rotate.

   Make sure the scribed mark on the drive pinion nut is no more than a maximum of 5 degrees past the scribed mark on the drive pinion shaft.

   Install the drive pinion flange retaining nut.
    - Using the special tool, counter hold the drive pinion flange.
    - Install nut to previously noted number of turns.

- Measure the depth of the pinion nut on the pinion shaft.

8. Attach the driveshaft to the rear axle drive flange.
   - Clean the component mating faces.
   - Attach the driveshaft to the rear axle drive flange.
   - Tighten the new Torx bolts to 150 Nm (110 lb.ft).

9. Install the fuel tank heat shield.
   - Tighten the bolts and nuts to 10 Nm (7 lb.ft).

10.  CAUTION: Make sure the correct specification and quanity of oil is used.

    Fill the differential with the correct amount of lubricant.
    For additional information, refer to: Differential Draining and Filling (205-02, General Procedures).

Rear Drive Axle / Differential - Differential Locking Module

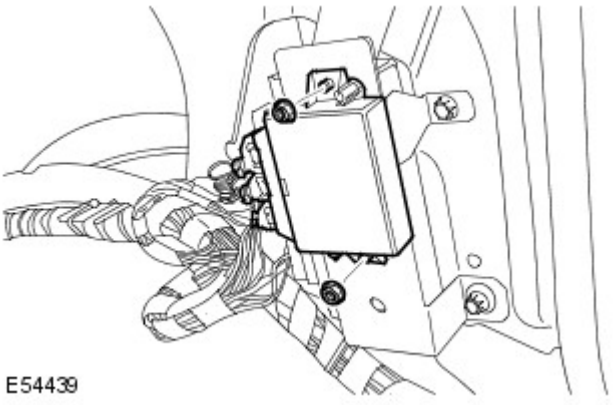
In-vehicle Repair

Removal

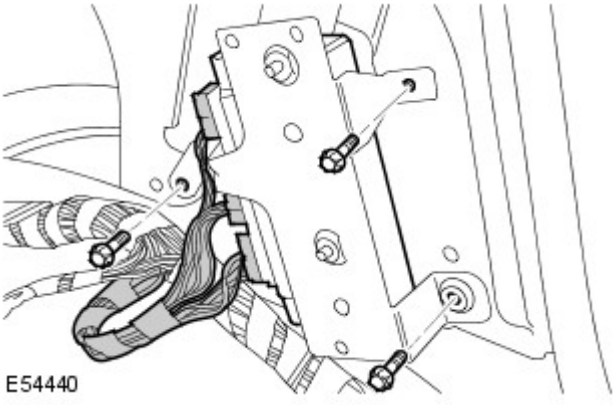
1. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).

2. Remove the rear quarter trim panel.
   For additional information, refer to: Rear Quarter Trim Panel (501-05, Removal and Installation).

3. Release the parking aid module.
   - Remove the 2 nuts.



4. Remove the differential locking module.
   - Disconnect the 3 electrical connectors.
   - Remove the 3 bolts.



Installation

1. Install the differential locking module.
   - Install the bolts and tighten to 10 Nm (7 lb.ft).
   - Connect and secure the electrical connectors.

2. Install the parking aid module.
   - Tighten the nuts to 10 Nm (7 lb.ft).

3. Install the rear quarter trim panel.
   For additional information, refer to: Rear Quarter Trim Panel (501-05, Removal and Installation).

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

5. Use T4 to calibrate a new differential locking module.

Rear Drive Axle/Differential - Axle Assembly

Removal and Installation

Removal

CAUTION: Do not undo or remove the large protruding hexagon on the differential casing.

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.

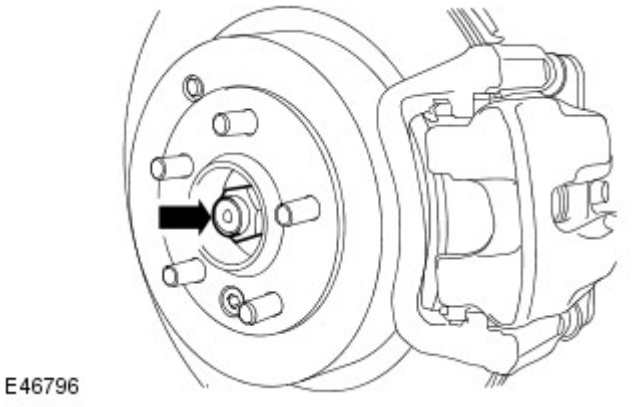
2. Remove the rear wheels and tires.

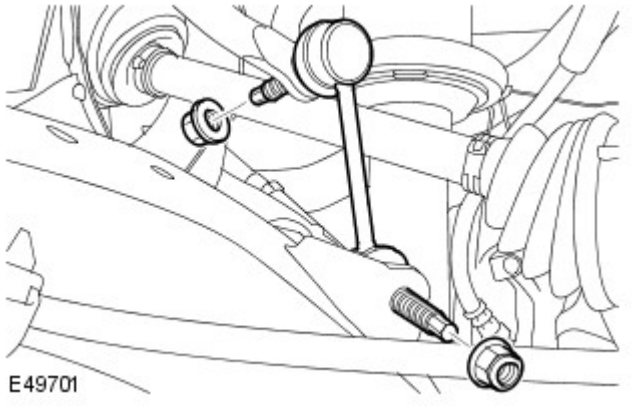
3. Remove the exhaust system.
   For additional information, refer to: Muffler (309-00 Exhaust System - 4.2L, Removal and Installation).

4. Drain the differential fluid.
   For additional information, refer to: Differential Draining and Filling (205-02 Rear Drive Axle/Differential, General Procedures).

5. Remove the RH halfshaft.
   For additional information, refer to: Rear Halfshaft (205-05 Rear Drive Halfshafts, Removal and Installation).

6. Remove the LH halfshaft retaining nut.
   - Discard the nut.

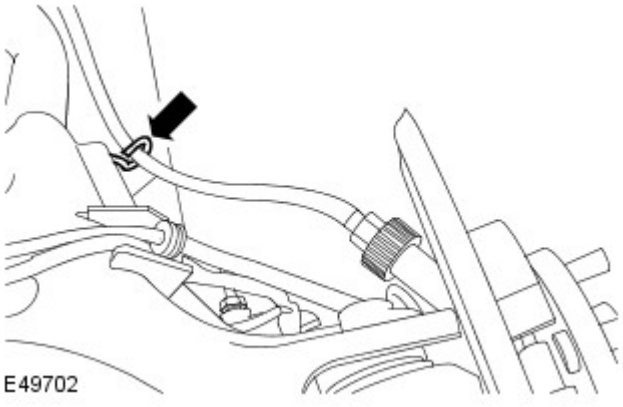




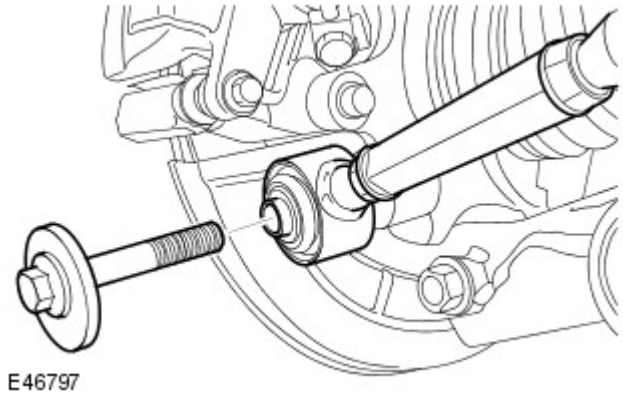
7. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

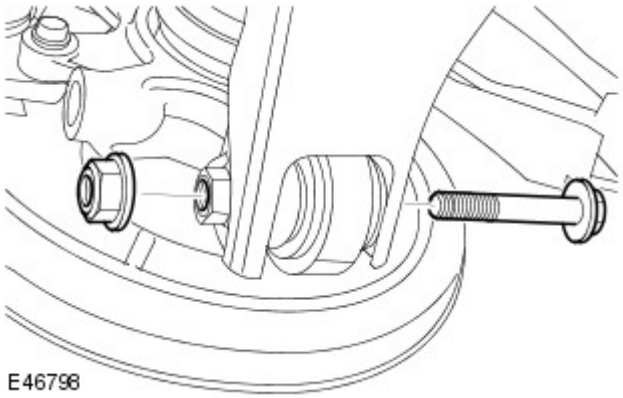
   Remove the LH stabilizer bar link and discard the nuts.

8. Release the LH parking brake cable from the lower arm.



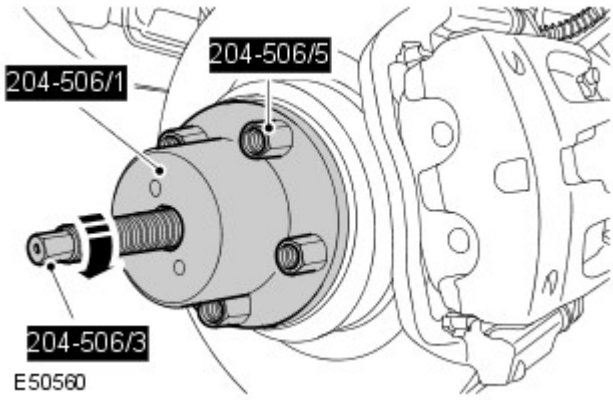
9. Disconnect the LH toe link.
   - Remove the bolt.





10. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

    Release the LH knuckle from the lower arm.
    - Remove the bolt.

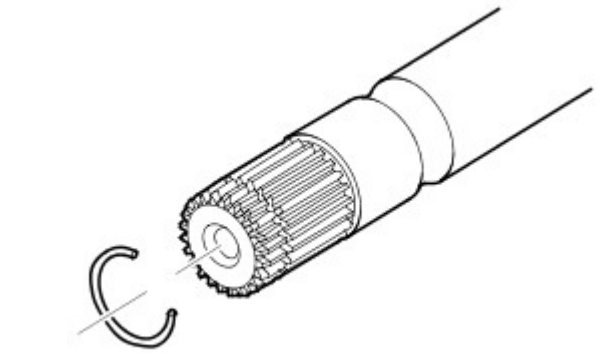


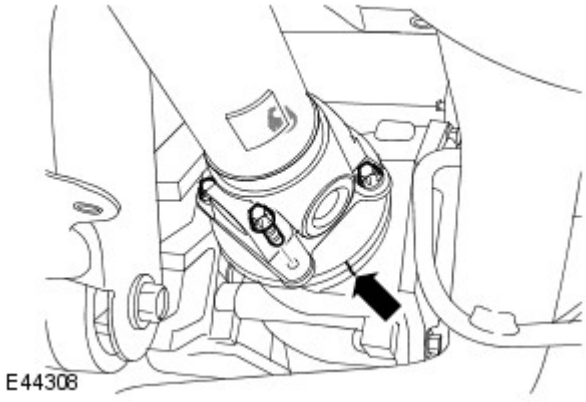
11. Using the special tools, release the LH halfshaft from the wheel hub.

12. Position a container to collect the oil spillage.

13. Release the LH halfshaft from the differential housing.

14. With assistance, remove the LH halfshaft.
    - Remove and discard the snap ring.


E45752


E44308

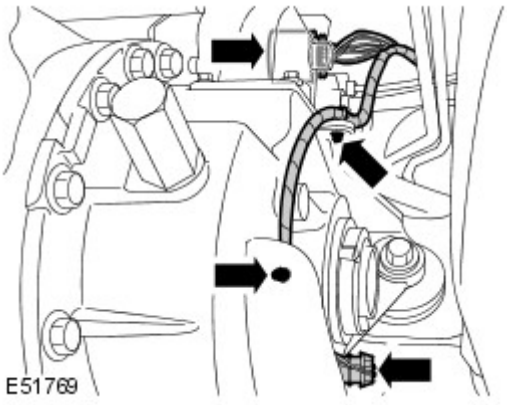
15. CAUTIONS:

    Mark the position of the driveshaft flange in relation to the drive pinion flange.

    To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

    Release the driveshaft from the rear axle drive flange.
    - Remove and discard the 4 Torx bolts.
    - Tie aside.

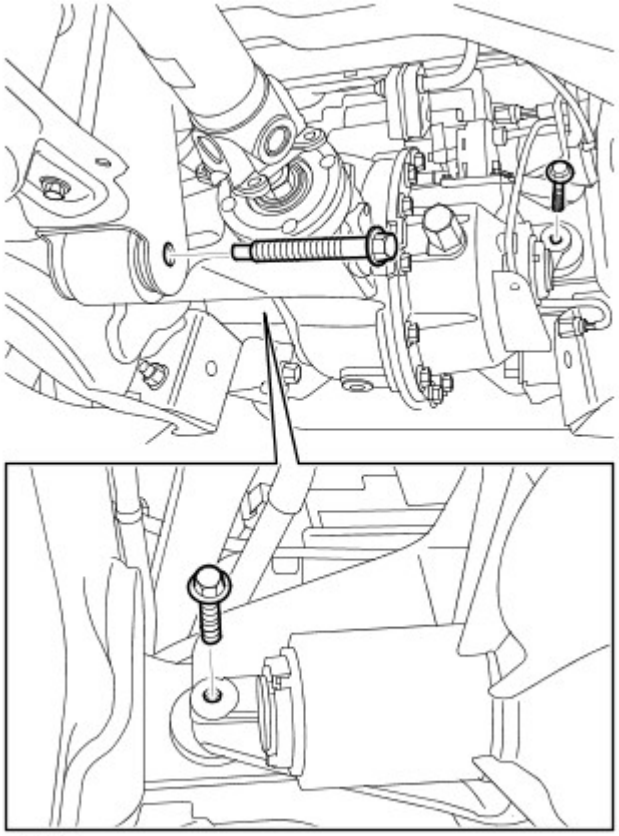
16. Vehicles with differential locking motor: Disconnect the 2 electrical connectors.
    - Release the 2 wiring harness clips.


E51769

17. Using a transmission jack, support the differential.

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

    Remove the rear differential.
    - Remove the 3 bolts.
    - Disconnect the breather line.



E51590

Installation

1. Install the rear differential.
   - Connect the breather line.
   - Tighten the front mounting bolt to 275 Nm (203 lb.ft).
   - Tighten the rear mounting bolts to 175 Nm (129 lb.ft).

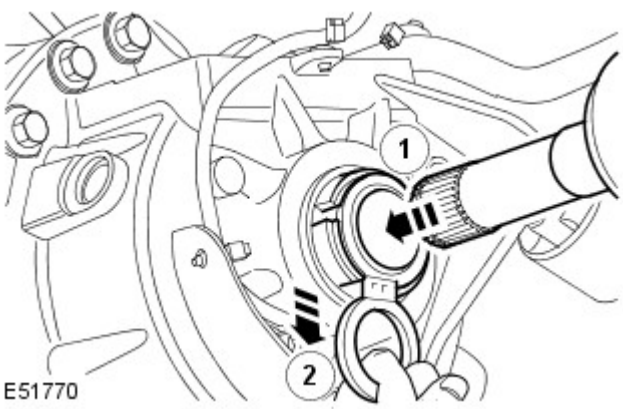
2. Vehicles with differential locking motor: Connect the electrical connectors.
   - Secure the wiring harness clips.

3. Attach the driveshaft to the rear axle drive flange.
   - Clean the component mating faces.
   - Tighten the new Torx bolts to 150 Nm (110 lb.ft).

4. Install the exhaust system.
   For additional information, refer to: Muffler (309-00 Exhaust System - 4.2L, Removal and Installation).

5. Clean the components.

6. With assistance, install the LH halfshaft.
   - Install the snap ring.
   - Open the halfshaft oil seal protector.
   - Make sure the snap ring is fully engaged and retains the halfshaft.



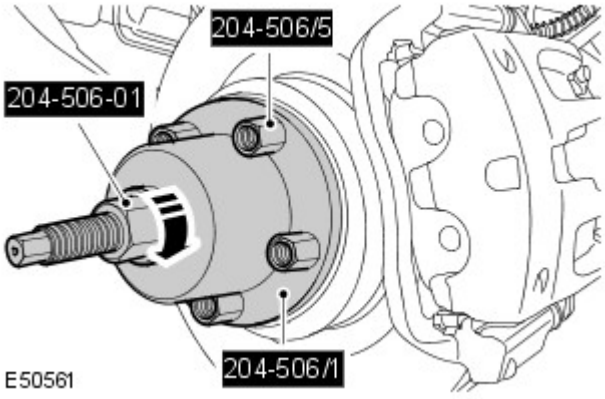
E51770

7. NOTES:

   The oil seal protector is designed to break into two pieces.

   RH illustration shown, LH is similar.

   Remove and discard the halfshaft oil seal protector.
   - Use pull ring to break seal protector as shown.



8. Using the special tools, install the LH halfshaft in the wheel hub.

9. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

   Connect the LH lower arm to the wheel knuckle.
   - Tighten to 275 Nm (203 lb.ft).

10. Install a new halfshaft retaining nut and lightly tighten.

11. Connect the LH toe link.
    - Tighten the bolt to 175 Nm (129 lb.ft).

12. Secure the LH parking brake cable to the lower arm.

13. Install the LH stabilizer bar link.
    - Tighten the new nuts to 115 Nm (85 lb.ft).

14. Tighten the LH halfshaft retaining nut to 350 Nm (258 lb.ft).
    - Stake the nut to the halfshaft.

15. Install the RH halfshaft.
    For additional information, refer to: Rear Halfshaft (205-05 Rear Drive Halfshafts, Removal and Installation).

16. Fill the differential with fluid.
    For additional information, refer to: Differential Draining and Filling (205-02 Rear Drive Axle/Differential, General Procedures).

17. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Drive Axle / Differential - Axle Housing Bushing

Removal and Installation

Special Tool(s)

502-009/2  E54205	Remover rear differential rear bush 502-009/2
211-294  E54206	Hydraulic two legged puller 211-294
205-825/4  E54207	Adaptor/button 205-825/4
205-825/3  E54208	Installer rear differential front bush 205-825/3
205-825/5  E54209	Receiver cup rear differential front bush 205-825/5
205-825/6  E54210	Bearing Housing 205-825/6
51203  E54149	Bearing Set for 16mm Bolt 51203
	Remover/Installer long 16mm bolt

205-825/7  E54211	205-825/7
205-825/8  E55277	Nut for long 16mm bolt 205-825/8

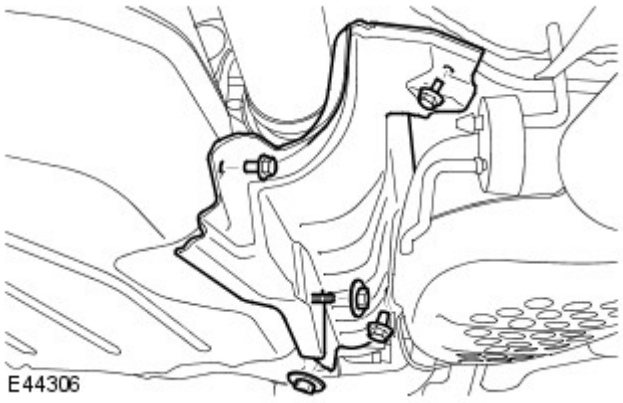
Removal

NOTE: Take note of the fitted position of the bush.

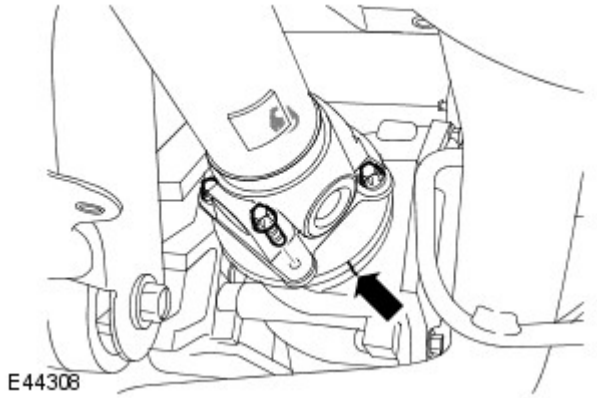
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Remove the muffler assembly.
   For additional information, refer to: Muffler (309-00, Removal and Installation).


E44306

3. Remove the fuel tank heat shield.
   - Remove the 3 bolts and 2 nuts.


E44308

4. CAUTIONS:

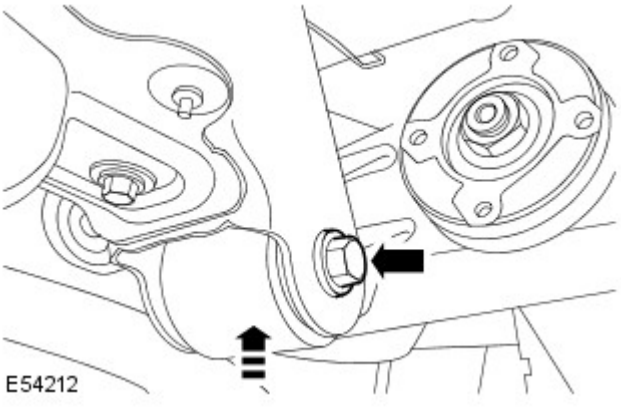
   Mark the position of the driveshaft flange in relation to the drive pinion flange.

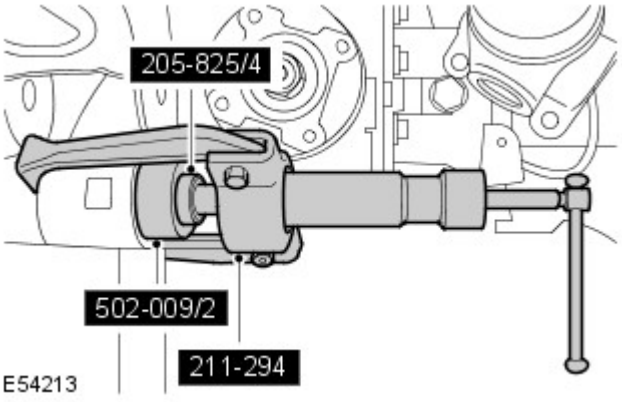
   To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

   Release the driveshaft from the rear axle drive flange.
   - Remove and discard the 4 Torx bolts.

5. CAUTION: Make sure the weight of the axle is always supported.

   Using a suitable jack, lower the front of the axle.
   - Remove the axle front retaining bolt.

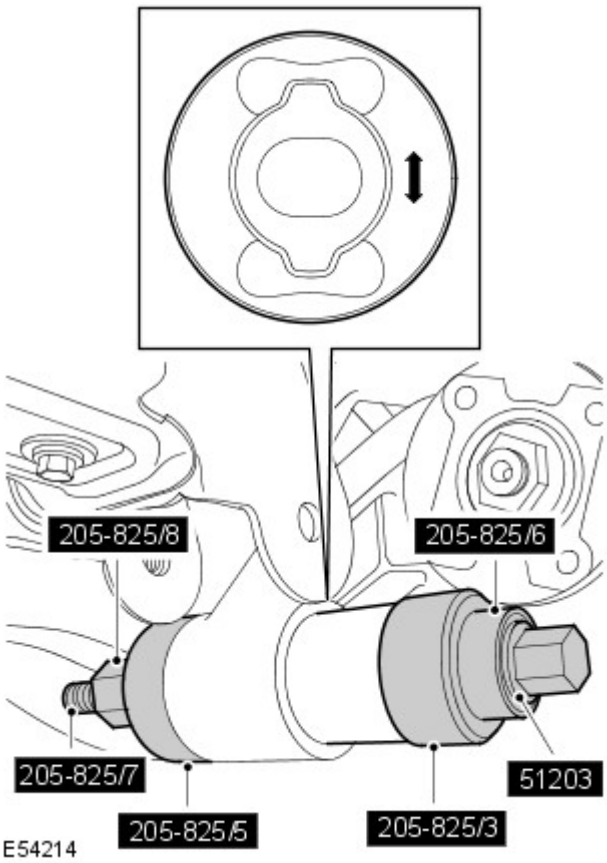




6. Using the special tools, remove the axle housing bushing.

Installation

1. Using the special tools, install the axle housing bushing.



2. CAUTION: Make sure the weight of the axle is always supported.

   Using a suitable jack, raise the front of the differential.
   - Install the axle front retaining bolt.
   - Tighten to 275 Nm (203 lb.ft).

3. Attach the driveshaft to the rear axle drive flange.
    - Clean the component mating faces.
    - Attach the driveshaft to the rear axle drive flange.
    - Tighten the new Torx bolts to 150 Nm (110 lb.ft).

4. Install the fuel tank heat shield.
    - Tighten the bolts and nuts to 10 Nm (7 lb.ft).

5. Install the muffler assembly.
   For additional information, refer to: Muffler (309-00, Removal and Installation).

Rear Drive Axle/Differential - Rear Axle Housing Support Insulator

Removal and Installation

Special Tool(s)

	Remover/Installer long 14mm bolt 502-009/5
	Bearing set for 14mm and 16mm bolt, 51203
	Receiver cup rear differential rear bush 502-009/1
	Remover rear differential rear bush 502-009/2
	Installer rear differential rear bush 502-009/3

Removal

NOTE: Take note of the fitted position of the bush.

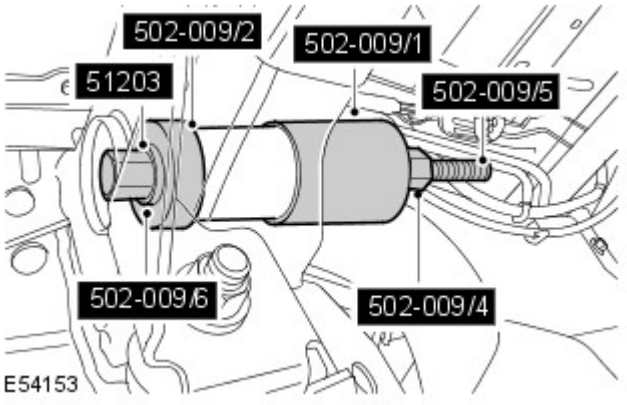
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Remove the wheels and tires.

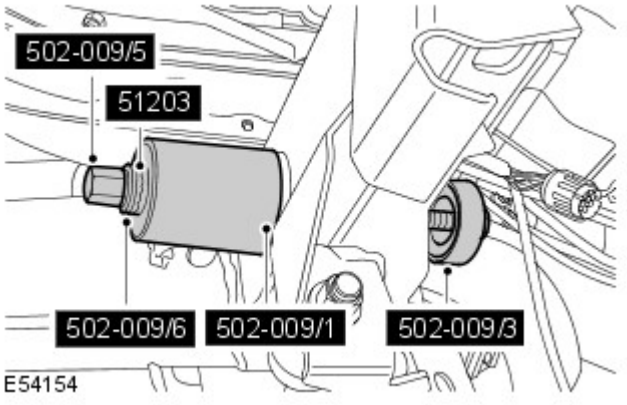
3. Remove the rear differential.
   For additional information, refer to: Axle Assembly (205-02, Removal and Installation).

4. NOTE: Take note of the fitted position of the bush.



Using the special tools, remove the rear axle housing support insulator.

Installation



1. Using the special tools, install the rear axle housing support insulator.
2. Install the rear differential.
   For additional information, refer to: Axle Assembly (205-02, Removal and Installation).
3. Install the wheels and tires.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Axle / Differential -

Lubricants

 NOTE: Do not use any lubricant other than that specified

Item	Specification
Recommended lubricant	Castrol SAF-XO - 75W/90

Capacities

Item	Capacity
Front differential	0.61 litres (1.07 pints) (0.64 US quarts)

Front Differential

Item	Specification
Reduction ratio:	
V6 Diesel engine - 8HP70 Automatic transmission	3.21:1
V6 Diesel engine - 6HP28 Automatic transmission	3.54:1
V8 Petrol engine - 6HP28 Automatic transmission	3.54:1

Torque Specifications

Description	Nm	lb-ft
Oil drain plug	29	21
Oil filler plug	29	21
Differential case mounting bolts:		
Front mounting bolt	105	77
* Rear mounting bracket to differential casing bolts		
Stage 1	80	59
Stage 2	Further 60°	Further 60°
Front axle crossmember bolts	115	85
**** Driveshaft to front axle drive flange Torx bolts:**		
Stage 1	45	33
Stage 2	Further 90°	Further 90°
Road wheel nuts	140	103

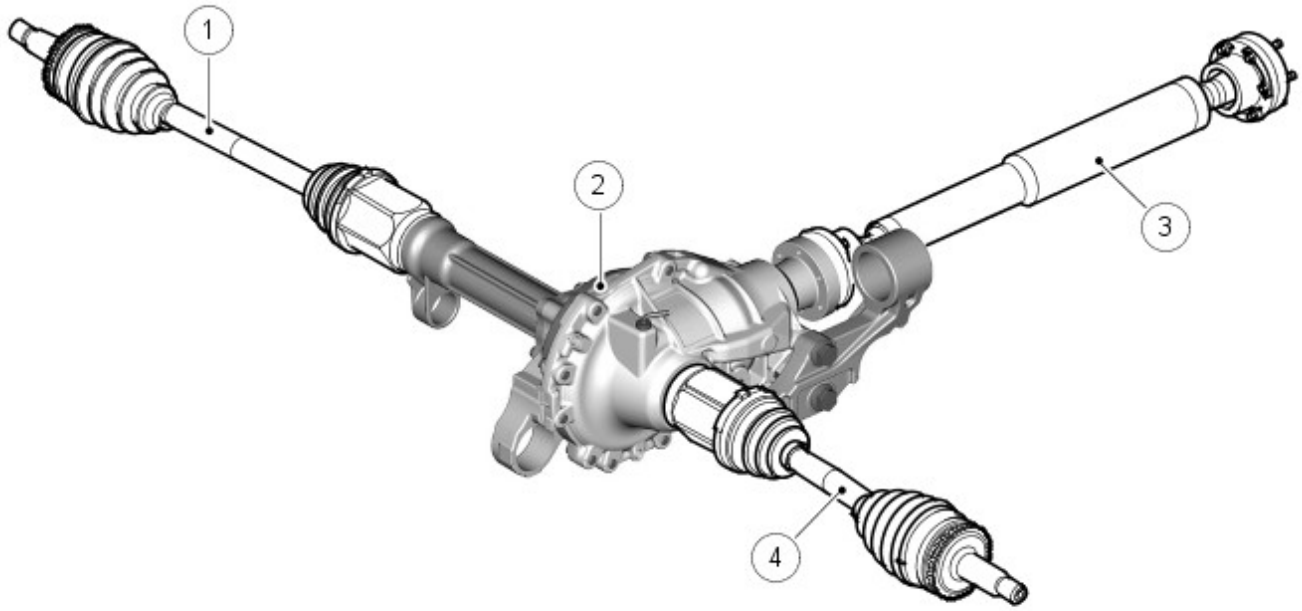
*** New bolts must be installed**

**** New patchlok torx bolts must be installed**

Front Drive Axle / Differential - Front Drive Axle and Differential

Description and Operation

GENERAL



E50981

Item	Part Number	Description
1	-	RH front drive halfshaft
2	-	Front differential assembly
3	-	Front driveshaft
4	-	LH front drive halfshaft

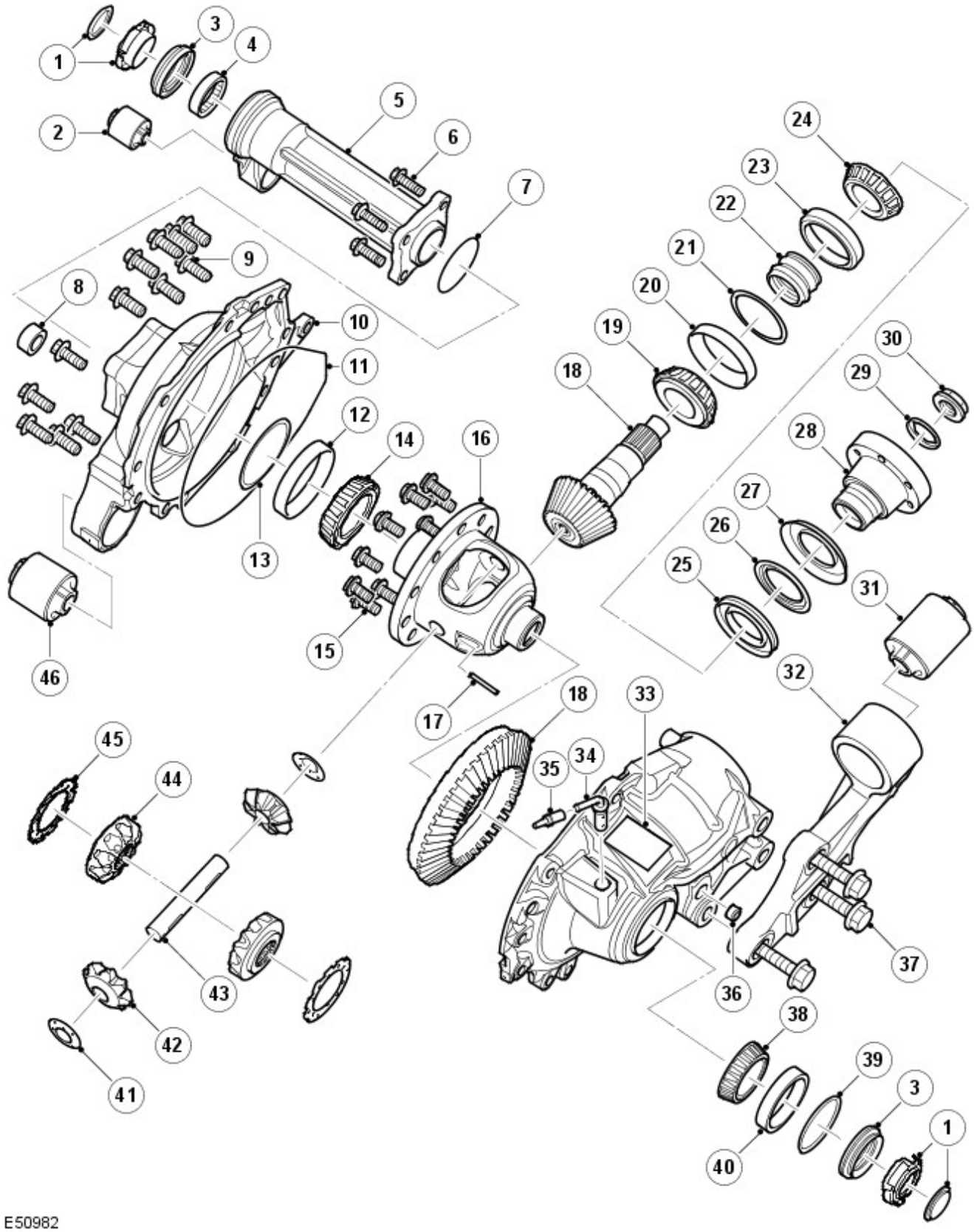
The front differential converts the 'angle of drive' through 90° and distributes drive, via the front drive halfshafts, to the front wheels.

The front differential for the V8 petrol variants utilise the same output ratio, which differs to that used on the TdV6.

The front differential is mounted on the LH side of the chassis.

FRONT DIFFERENTIAL ASSEMBLY

Front Differential - Exploded View



E50982

Item	Part Number	Description
1	-	Protection cap
2	-	Mounting bush assembly
3	-	Seal
4	-	Bearing assembly
5	-	Front tube
6	-	Bolt, 4 of
7	-	O-ring
8	-	Drain plug
9	-	Bolt, 14 of
10	-	Cover assembly

11	-	Cover seal
12	-	Roller bearing cup
13	-	Bearing preload spacer
14	-	Taper roller bearing
15	-	Bolt, 10 of
16	-	Differential case
17	-	Roll pin
18	-	Gear and pinion assembly
19	-	Taper roller bearing
20	-	Roller bearing cup
21	-	Shim
22	-	Collapsible spacer
23	-	Roller bearing cup
24	-	Taper roller bearing
25	-	Oil seal
26	-	Inner deflector
27	-	Outer deflector
28	-	Flange
29	-	Pinion nut retainer
30	-	Pinion nut
31	-	Mounting bush assembly
32	-	Axle mounting bracket
33	-	Data label
34	-	Breather tube
35	-	Cap
36	-	Fill plug
37	-	Bolt, 3 of
38	-	Taper roller bearing
39	-	Bearing preload spacer
40	-	Roller bearing cup
41	-	Thrust washer
42	-	Planet gear
43	-	Shaft
44	-	Sunwheel
45	-	Thrust washer
46	-	Mounting bush assembly

The casing comprises two halves with machined mating faces. When assembled, the cast iron casing halves are sealed with a thin film of Loctite 5999 sealant and secured together with fourteen bolts. A breather tube is fitted to the casings. This allows a plastic tube to be fitted and routed to a high point in the engine compartment, preventing the ingress of water when the vehicle is wading.

The RH casing is fitted with a drain plug. The front differential unit contains approximately 0.7 litre of oil for a dry fill.

The differential is a conventional design using a hypoid gear layout. This employs a hypoid bevel pinion gear and crown wheel, with the pinion offset above the centre line of the crown wheel. This design allows for a larger pinion gear to be used, which has the advantages of increased gear strength and reduced operating noise.

The front differential is available in two ratios. V8 petrol engine vehicles use a front differential with a final drive ratio of 3.73:1 and TdV6 diesel engine vehicles use a final drive ratio of 3.54:1. Changing the number of teeth between the crown-wheel drive gear and pinion gear changes the ratio.

The differential comprises a pinion shaft and hypoid bevel gear, a crown wheel drive gear with an integral cage, which houses two planet gears. Two sunwheels are also located in the cage and pass the rotational drive to the drive shaft shafts.

The pinion shaft is mounted on two opposed taper roller bearings with a collapsable spacer located between them. The spacer is used to hold the bearings in alignment and also collapses under the pressure applied to the pinion nut. This allows the nut to be tightened to a predetermined torque, which collapses the spacer, setting the correct bearing preload.

The pinion shaft has an externally splined outer end which accepts and locates the input flange, which is retained by the pinion nut. The opposite end of the output flange has an internal spline which provides positive location for the front propeller shaft. The flange has an external O-ring seal, which seals against the front propeller shaft shroud preventing the ingress of dirt and moisture into the splines. An oil seal is pressed into the LH casing and seals the input flange to the differential unit. The pinion shaft has a hypoid bevel gear at its inner end which mates with the crown wheel drive gear.

The crown wheel drive gear is located on the carrier and secured with ten bolts. The carrier is mounted on taper roller bearings located in each casing half. The bearings are press fitted into the casing and a spacer is located on the outside face to set backlash and apply preload to the bearing.

The carrier is fitted with a shaft onto which the two planet gears are mounted. The shaft is secured in the carrier with

a roll pin. The sunwheels are located in pockets within the carrier and mesh with the planet gears. Thrust washers are located between the carrier and the sunwheels and hold the sunwheels in mesh with the planet gears. Each sunwheel has a machined, splined, bore to accept the drive shaft. A groove is machined in the bore to locate the snap ring fitted to the drive shaft, providing positive drive shaft location.

Differential Operation

The operating principles of the front and rear differentials are the same. Rotational input from the drive shaft is passed via the input flange to the pinion shaft and pinion gear. The angles of the pinion gear to the crown wheel drive gear moves the rotational direction through 90°.

The transferred rotational motion is now passed to the crown wheel drive gear, which in turn rotates the carrier. The shaft, which is secured to the carrier, also rotates at the same speed as the carrier. The planet gears, which are mounted on the shaft, also rotate with the carrier. In turn, the planet gears transfer their rotational motion to the left and right hand sunwheels, rotating the drive shafts.

When the vehicle is moving in a forward direction, the torque applied through the differential to each sunwheel is equal. In this condition both drive shafts rotate at the same speed. The planet gears do not rotate and effectively lock the sunwheels to the carrier.

If the vehicle is turning, the outer wheel will be forced to rotate faster than the inner wheel by having a greater distance to travel. The differential senses the torque difference between the sunwheels. The planet gears rotate on their axes to allow the outer wheel to rotate faster than the inner one.

SERVICE

The oil used in the front differential is Castrol SAF-XO. The oil contains unique additives, which enhance the differentials operation. No other oil must be used in the front differential.

Front Differential Serviceable Components

- Halfshaft seals
- Needle roller bearing assemblies
- Chassis bush/fixings
- Lubricant.

Front Drive Axle / Differential - Front Drive Axle

Diagnosis and Testing

For additional information.
REFER to: Driveline System (205-00, Diagnosis and Testing).

Front Drive Axle / Differential - Differential Draining and Filling

General Procedures

CAUTION: Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, not to act as a level indicator.

NOTE: The only way to check the fluid level in the differential is to drain all the fluid out and refill with the correct quantity, shown in the specification section.
For additional information, refer to: Specifications (205-03, Specifications).

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



3. Remove the differential case lubricant filler plug.
   - Clean the area around the lubricant filler plug.
   - Position container to collect fluid loss.



4. Drain the differential lubricant.
   - Clean the area around the drain plug.
   - Remove the fluid drain plug.

5. CAUTION: There have been 2 different types of fixings used for the drain plug. Note the type and differential serial number, and make sure the correct torque is applied, see below.

   Install the lubricant drain plug.
   - Clean the drain plug.
   - Up to differential serial number 254845: Tighten the hexagonal drive drain plug to 54 Nm (40 lb.ft).
   - From differential serial number 254846: Tighten the 3/8'' square drive drain plug to 28 Nm (21 lb.ft).

6. CAUTION: Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, not to act as a level indicator.

   Fill the differential with the correct amount of lubricant.
   For additional information, refer to: Specifications (205-03 Front Drive Axle/Differential, Specifications).

7. Install the differential filler plug.
    - Tighten the filler plug to 34 Nm (25 lb.ft).

8. Install the engine undershield.
   For additional information, refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

Front Drive Axle / Differential - Drive Pinion Seal

In-vehicle Repair

Special Tool(s)

	Flange holding tool 205-053
	Remover drive flange 205-824
	Installer - drive pinion oil seal 205-820
	Impulse extractor 100-012(LRT-99-004)

Removal

CAUTION: The drive pinion seal must only be renewed once.

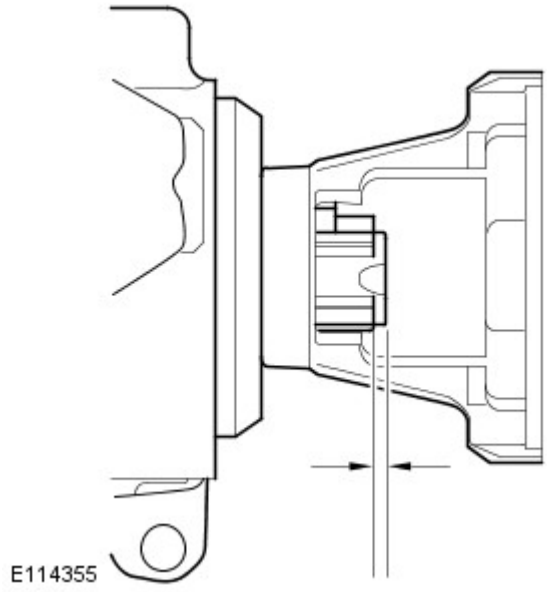
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

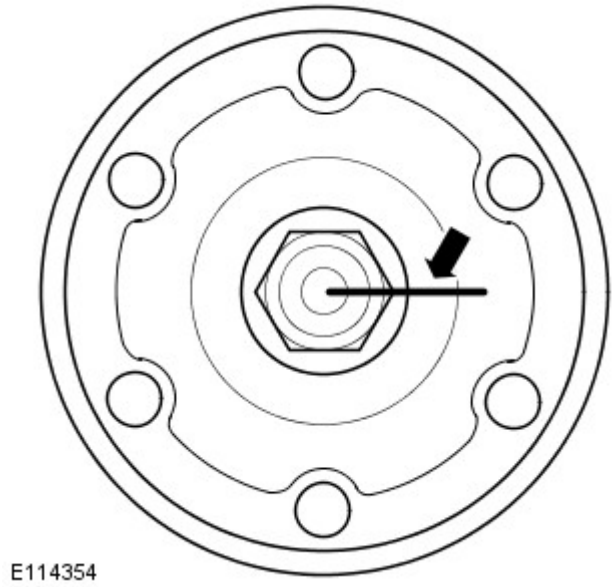
   Raise and support the vehicle.

2. Drain the differential lubricant.
   For additional information, refer to: Differential Draining and Filling (205-03, General Procedures).

3. Remove the front driveshaft.
   For additional information, refer to: Front Driveshaft - 5.0L (205-01, Removal and Installation) /
   Front Driveshaft - 3.6L (TdV8) Diesel (205-01, Removal and Installation) /
   Front Driveshaft - 3.0L Diesel (205-01, Removal and Installation).

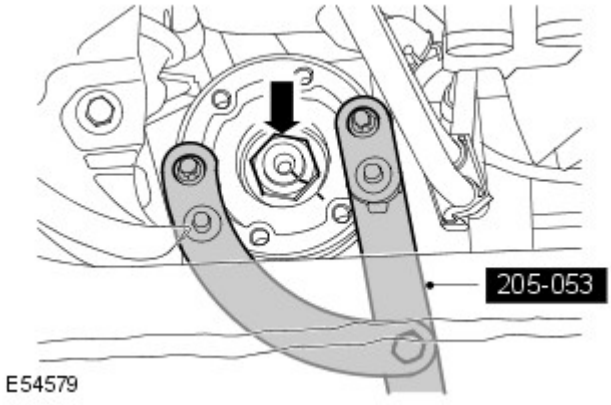
4. Measure the depth of the pinion nut on the pinion shaft.
   - Note measurement for installation.


E114355


E114354

5. CAUTION: This step must be carried out to make sure that the drive pinion nut is correctly tightend on assembly.

   Accurately scribe a line to mark the drive pinion shaft to the drive pinion nut and pinion flange.

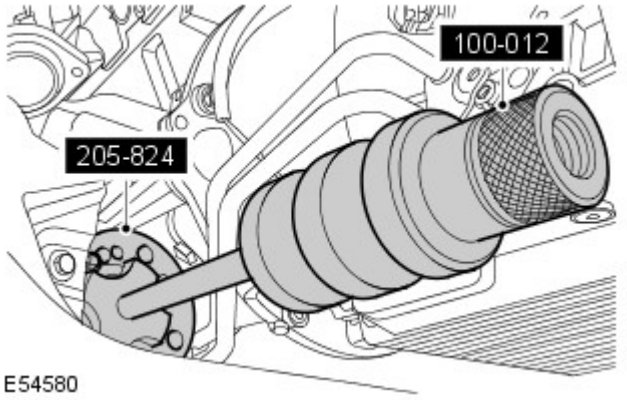


E54579

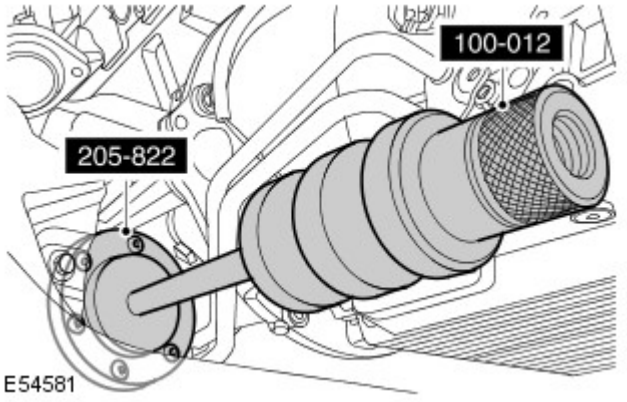
6. Remove the drive pinion flange retaining nut.
   - Using the special tool, counter hold the drive pinion flange.
   - Discard the drive pinion nut retainer.

7. CAUTION: Make sure only a bolt is used with the special tool, to draw the drive pinion flange off the drive pinion shaft.

   Using the special tool, remove the drive pinion flange.

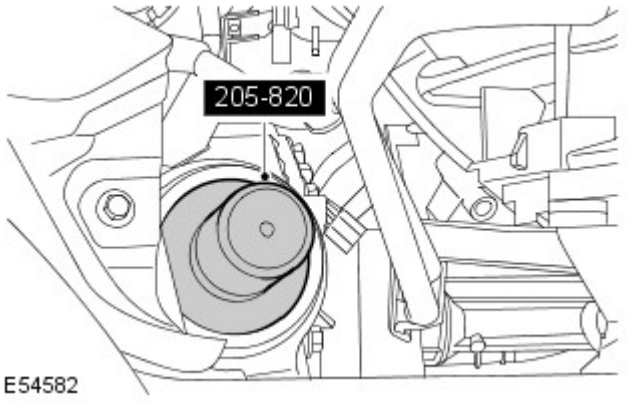


8. Using the special tool, remove the drive pinion seal.



Installation

1. Clean the drive pinion flange.
2. Clean the drive pinion seal mating faces.
3. Using the special tool, install the new drive pinion seal.



4. CAUTION: Make sure the drive pinion flange scribed marks are aligned.

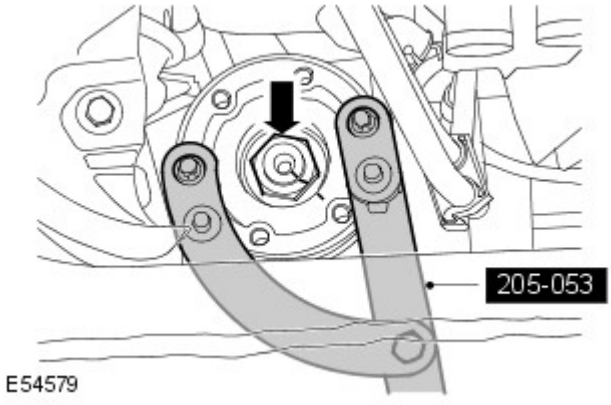
   Install the drive pinion flange.

5. CAUTIONS:

   Make sure the mark on the drive pinion nut is never tightened short of the scribed mark on the drive pinion shaft.

   Make sure the drive pinion flange has no end float and is free to rotate.

   Make sure the scribed mark on the drive pinion nut is no more than a maximum of 5 degrees past the scribed mark on the drive pinion



shaft.

Install the drive pinion flange retaining nut.

- Using the special tool, counter hold the drive pinion flange.
- Install nut to previously noted number of turns.
- Measure the depth of the pinion nut on the pinion shaft.

6. Install the front driveshaft.
   For additional information, refer to: Front Driveshaft - 5.0L (205-01, Removal and Installation) /
   Front Driveshaft - 3.6L (TdV8) Diesel (205-01, Removal and Installation) /
   Front Driveshaft - 3.0L Diesel (205-01, Removal and Installation).

7. CAUTION: Make sure the correct specification and quanity of oil is used.

   Fill the differential with the correct amount of lubricant.
   For additional information, refer to: Differential Draining and Filling (205-03, General Procedures).

Front Drive Axle / Differential - Front Axle Housing Support Insulator

In-vehicle Repair

Special Tool(s)

502-009/6  E55285	Bearing Housing 502-009/6
51204  E55278	Bearing set for 14mm bolt 51204
205-825/3  E54216	Installer rear axle front bush 205-825/3
502-009/2  E54205	Remover rear differential rear bush 502-009/2
502-009/5  E54148	Remover/Installer long 14mm bolt 502-009/5
502-009/4  E55284	Nut for long 14mm bolt 502-009/4
205-825/1  E54219	Receiver cup front axle front bush 205-825/1

Removal

CAUTION: Make sure the bush is correctly aligned.

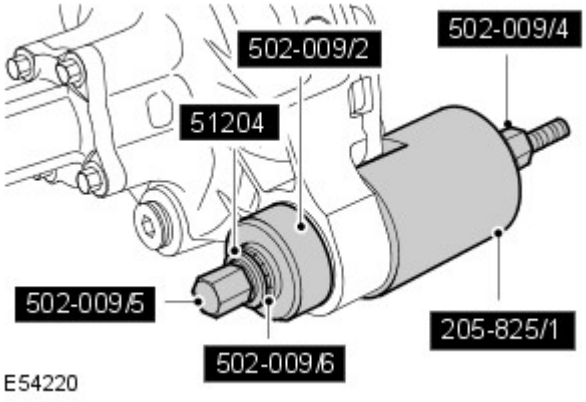
NOTE: Take note of the fitted position of the bush.

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 wheels and tires.

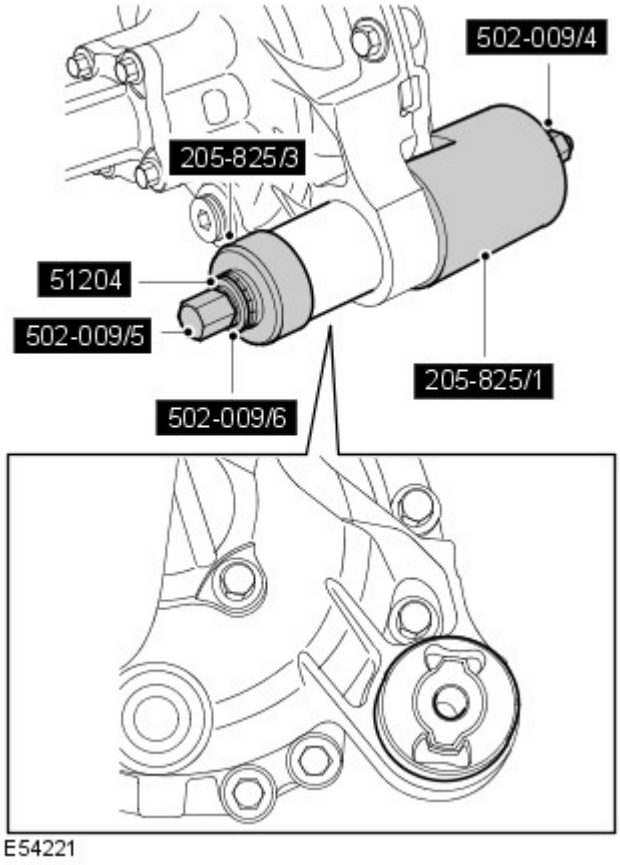
3. Remove the front differential.
   For additional information, refer to: Axle Assembly (205-03, Removal and Installation).



4. NOTE: Take note of the fitted position of the bush.

   Using the special tools, remove the front axle housing support insulator.

Installation



1. CAUTION: Make sure the bush is correctly aligned.

   Using the special tools, install the front axle housing support insulator.

2. Install the front differential.
   For additional information, refer to: Axle Assembly (205-03, Removal and Installation).

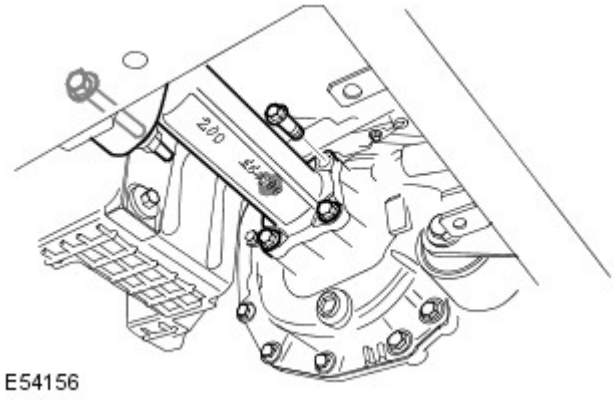
3. Install the front wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Axle / Differential - Axle Tube

In-vehicle Repair

Removal

1. Remove the RH halfshaft.
   For additional information, refer to: Front Halfshaft RH (205-04 Front Drive Halfshafts, Removal and Installation).



2. Remove the axle tube.
   - Remove the bolt from the bushing.
   - Remove the 4 bolts.
   - Rotate and remove the axle tube.
   - Early models: Remove and discard the O-ring seal.
   - Later models: Remove the sealant.

Installation

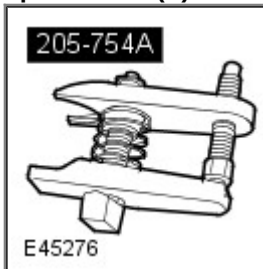
1. Install the axle tube.
   - Clean the component mating faces.
   - Early models: Install a new O-ring seal.
   - Later models: Apply sealant to the mating face.
     For additional information, refer to: Specifications (205-03, Specifications).
   - Tighten the 4 axle tube bolts to 50 Nm (37 lb.ft).
   - Tighten the axle tube bushing bolt to 63 Nm (46 lb.ft).

2. Install the RH halfshaft.
   For additional information, refer to: Front Halfshaft RH (205-04 Front Drive Halfshafts, Removal and Installation).

Front Drive Axle/Differential - Axle Assembly

Removal and Installation

Special Tool(s)

	Ball joint separator 205-754(LRT-54-027)
	Front Stabilizer Bar Bushing Tightening Tool 204-703
	Front Stabilizer Bar Bushing Tightening Tool 204-705

Removal

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

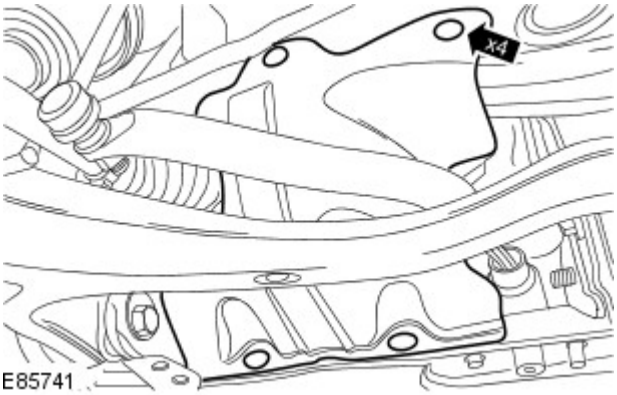
All vehicles

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

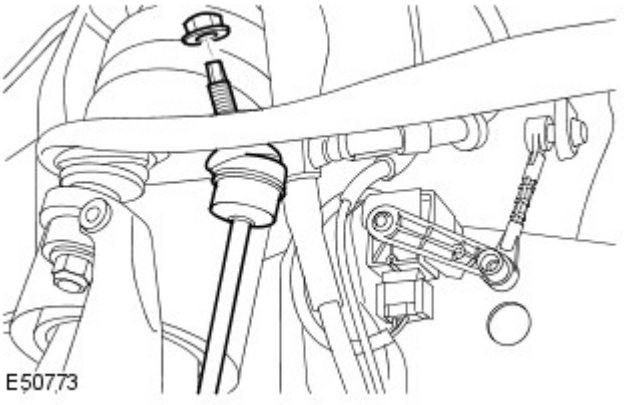
2. Remove the front wheels and tires.

3. Remove the axle tube.
   For additional information, refer to: Axle Tube (205-03 Front Drive Axle/Differential, In-vehicle Repair).

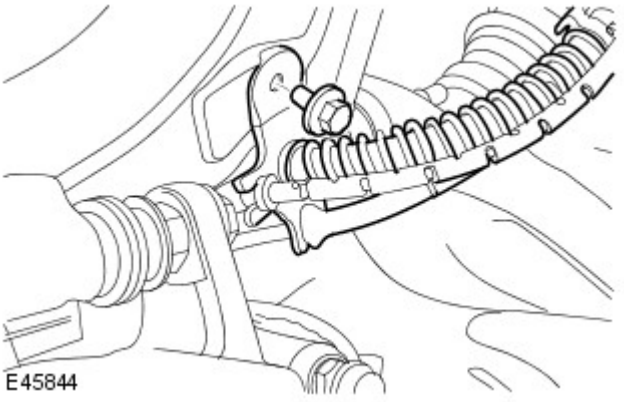


4. Remove the LH splash shield.
   - Remove the 4 clips.

5. Release the LH stabilizer bar link.
   - Remove and discard the nut.

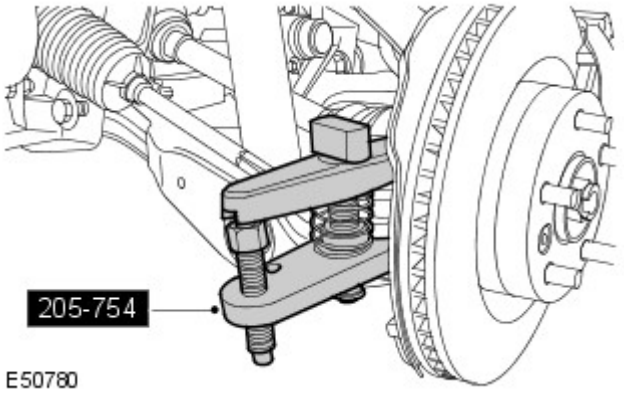


6. Release the LH brake hose bracket from the wheel knuckle.
    - Remove the bolt.



7. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

    Using the special tool, release the LH tie-rod end ball joint from the wheel knuckle.
    - Remove and discard the nut.

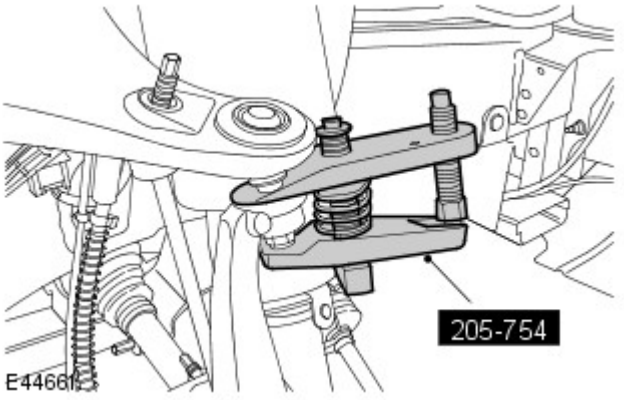


8. CAUTIONS:

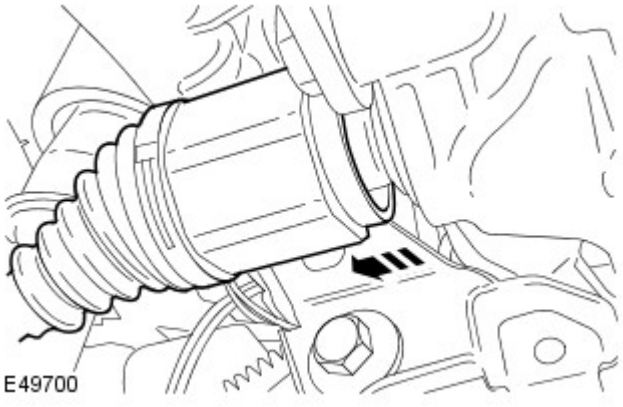
    Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

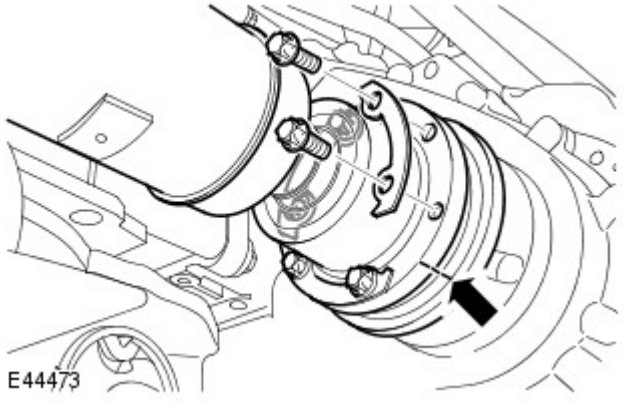
    The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

    Using the special tool, release the LH upper arm ball joint.
    - Remove and discard the nut.



9. Release the LH halfshaft from the axle assembly.
    - Remove and discard the snap ring.
    - Using a suitable tie strap, support the LH halfshaft.





10. CAUTIONS:

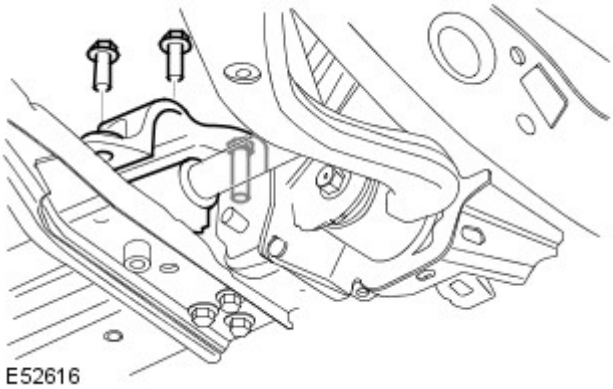
    Mark the position of the driveshaft flange in relation to the drive pinion flange.

    To avoid damage to the joint or gaiter, do not allow the driveshaft to hang.

    Release the driveshaft from the front axle drive flange.
    - Remove the 6 Torx bolts and washers, discard the bolts.
    - Using a suitable tie strap, secure the driveshaft end plate.

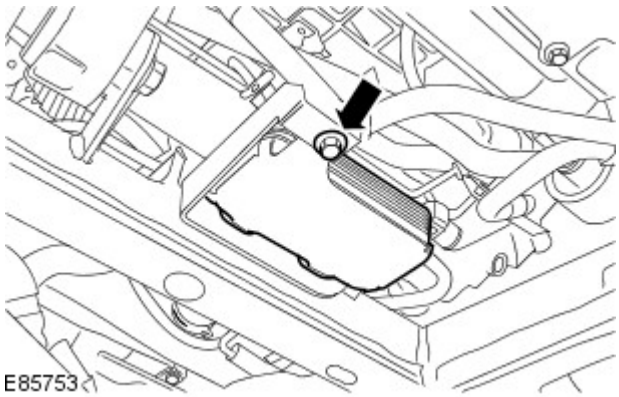
Vehicles with Active Stabilization

11. Remove the stabilizer bar bushing.
    - Remove the 3 bolts.
    - Remove the clamp.
    - Remove the stabilizer bar bushing.



Vehicles with diesel engine

12. Release the fuel cooler.
    - Remove the bolt.



Vehicles with 5.0L engine

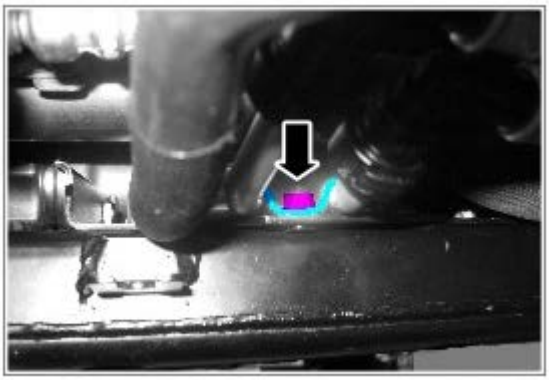
13. Release the automatic transmission fluid cooler.
    - Remove the 4 bolts.

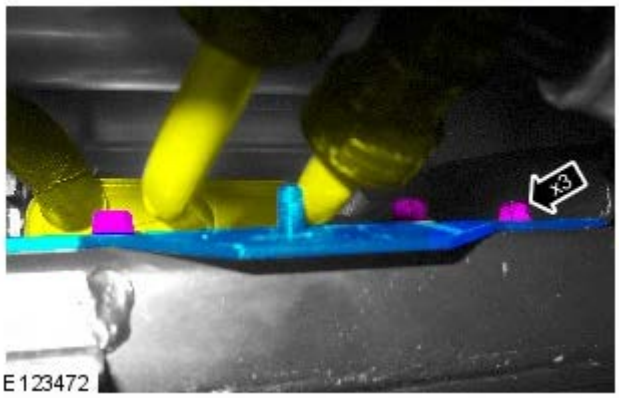




E123471

14. Remove the transmission fluid cooler mounting bracket.
    - Release the transmission fluid cooler pipe bracket.
    - Remove the nut.
    - Remove the 3 bolts.

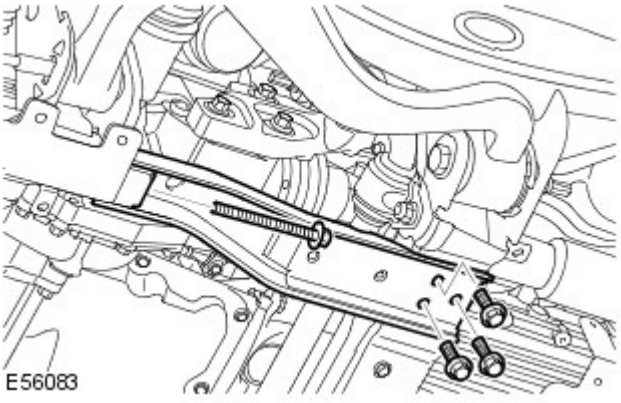


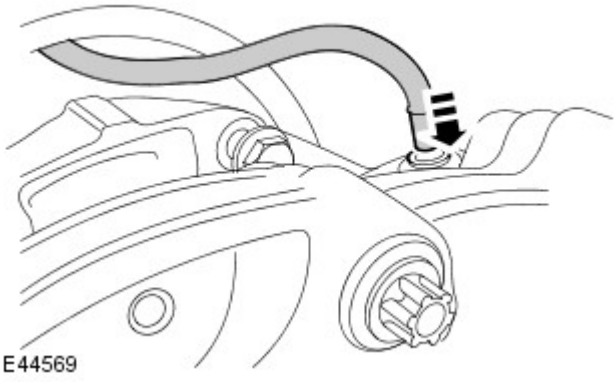


E123472

All vehicles

15. Remove the front axle crossmember.
    - Remove the 4 bolts.

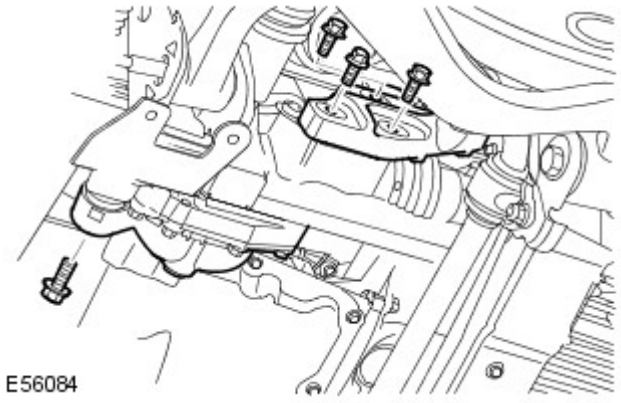




16. CAUTION: Before the disconnection or removal of any components, make sure the area around joint faces and connections are clean. Plug any open connections to prevent contamination.

    Disconnect the breather line.
    - Release the clip.

17. Using a transmission jack, support the front axle assembly.



18. With assistance, remove the front axle assembly.
    - Remove and discard the 3 axle assembly rear mounting bolts.
    - Remove the front axle assembly front mounting bolt.

Installation

All vehicles

1. With assistance, install the front axle assembly.
    - With assistance, raise and manoeuvre the front final drive unit.
    - Tighten the 3 new bolts in the front axle assembly to 80 Nm (59 lb.ft), then a further 60 degrees.
    - Tighten the front axle assembly front mounting bolt to 105 Nm (77 lb.ft).

2. Connect the breather line.

3. Install the front axle crossmember.
    - Tighten the 4 bolts to 115 Nm (85 lb.ft).

Vehicles with 5.0L engine

4. Install the transmission fluid cooler mounting bracket.
    - Tighten the 3 bolts to 25 Nm (18 lb.ft.).
    - Secure the transmission fluid cooler coolant pipe to the coolant hose bracket.
    - Tighten the nut to 15 Nm (11 lb.ft).

5. Install the automatic transmission fluid cooler.
    - Tighten the 4 bolts to 25 Nm (18 lb.ft.).

Vehicles with diesel engine

6. Secure the fuel cooler.
    - Tighten the bolt to 23 Nm (17 lb.ft).

Vehicles with Active Stabilization

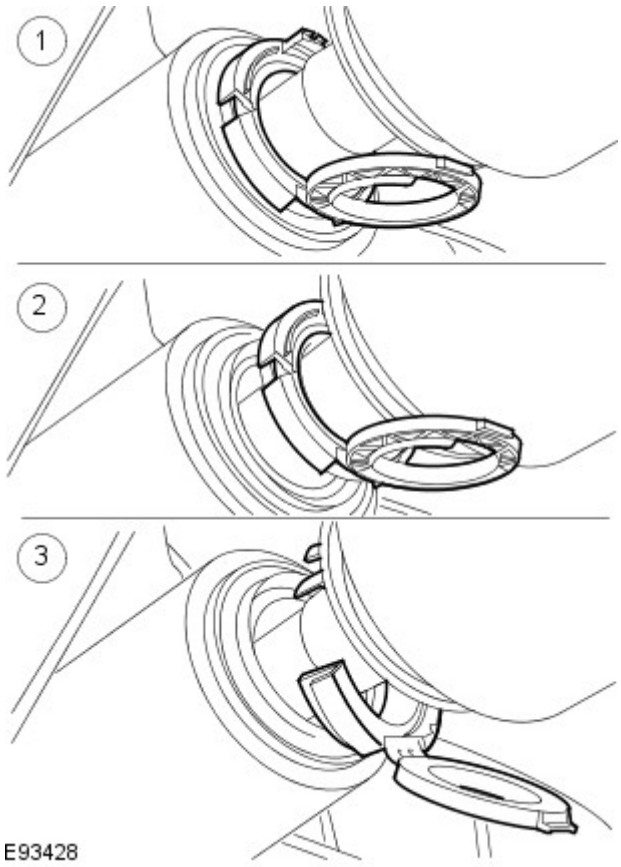
7. Install the stabilizer bar bushing.
    - Install the clamp.
    - Install the bolts.
    - Tighten the bolts to 115 Nm (85 lb.ft).

All vehicles

8. NOTE: Make sure that new bolts are installed.

    Secure the driveshaft to the front axle drive flange.
    - Stage 1: Tighten the bolts to 45 Nm (33 lb.ft).
    - Stage 2: Tighten the bolts a further 90 degrees.
    - Remove and discard the tie strap.

9. Install a new snap ring to the LH halfshaft.
    - Remove and discard the tie strap.



10. NOTE: Do not fully engage the halfshaft until the oil seal protector has been removed.

    Secure the LH halfshaft in the axle assembly.
    1. Open the halfshaft seal protector and install the halfshaft.
    2. Release the halfshaft seal protector from the halfshaft seal.
    3. Remove the halfshaft seal protector.
    4. Fully install the halfshaft.

11. WARNING: Make sure that a new nut is installed.

    Secure the LH upper arm to the wheel knuckle.
    - Install a new nut and tighten to 70 Nm (52 lb.ft).

12. WARNING: Make sure that a new nut is installed.

    Secure the LH tie-rod end ball joint to the wheel knuckle.
    - Install a new nut and tighten to 70 Nm (52 lb.ft).

13. Secure the LH brake hose bracket to the wheel knuckle.
    - Tighten the bolt to 22 Nm (16 lb.ft).

14. Secure the LH stabilizer bar link.
    - Install a new nut and tighten to 115 Nm (85 lb.ft).

15. Install the LH splash shield.
    - Install the clips.

16. Install the axle tube.
    For additional information, refer to: Axle Tube (205-03 Front Drive Axle/Differential, In-vehicle Repair).

17. If a new differential is installed, fill with the recommended fluid.
    For additional information, refer to: Differential Draining and Filling (205-03 Front Drive Axle/Differential, General Procedures).

18. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Axle / Differential - Axle Carrier Bushing

Removal and Installation

Special Tool(s)

	Installer rear axle front bush 205-825/3
	Receiver cup rear differential front bush 205-825/5
	Remover rear differential rear bush 502-009/2

Removal

CAUTION: Make sure the bush is correctly aligned.

NOTE: Take note of the fitted position of the bush.

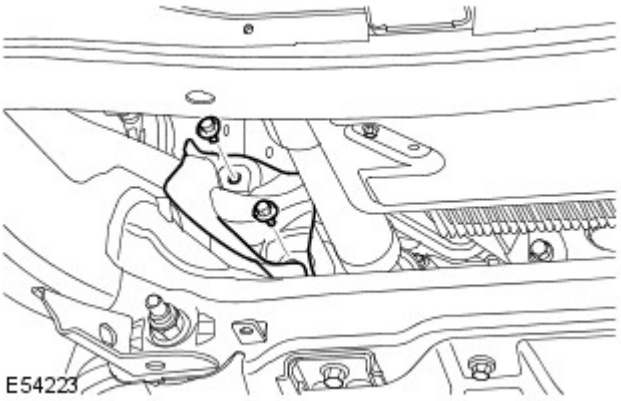
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

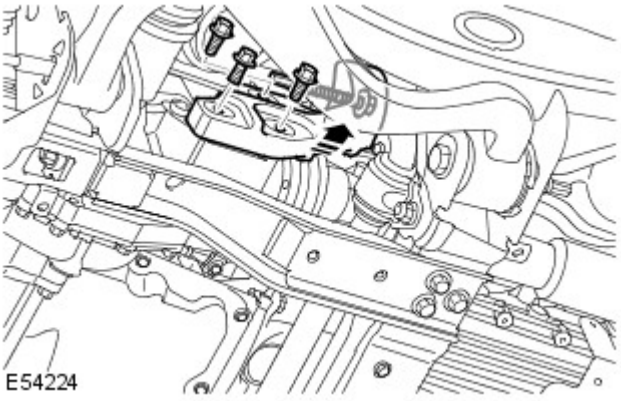
   Raise and support the vehicle.

2. Remove the exhaust system.
   For additional information, refer to: Exhaust System (309-00C, Removal and Installation) /
   Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00B, Removal and Installation) /
   Exhaust System (309-00A, Removal and Installation).

3. Using a jack, support the axle assembly.

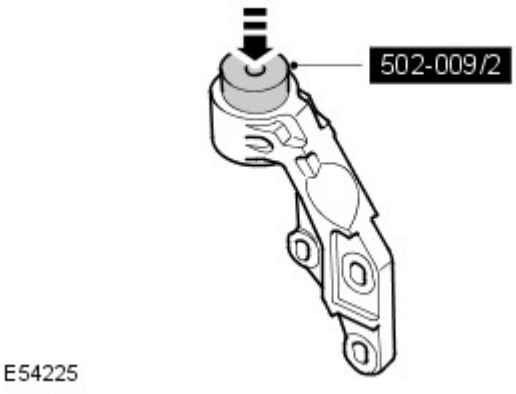
4. Remove the axle carrier bushing heat shield.
   - Remove the two retaining bolts.





5. CAUTION: The bolts must only be used once.

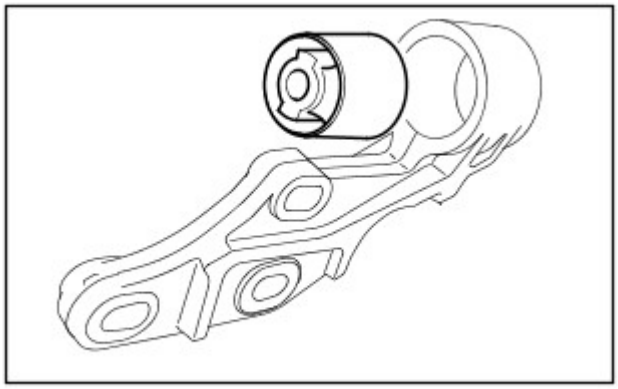
   Remove the axle carrier.
   - Remove and discard the three bolts retaining the axle carrier to the axle.
   - Remove the axle carrier bushing bolt.



6. NOTE: Take note of the fitted position of the bush.

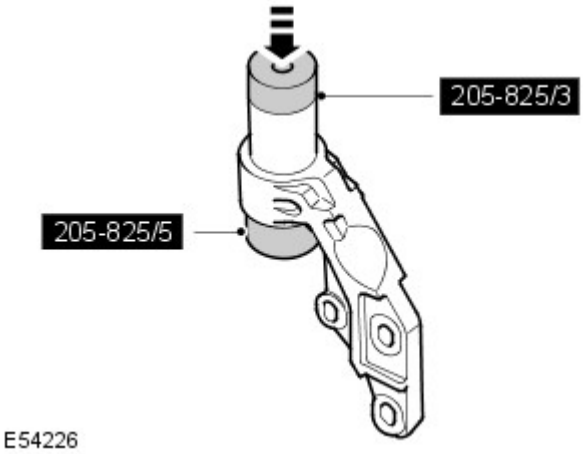
   Using the special tools, remove the axle carrier bushing.

Installation



1. CAUTION: Make sure the bush is correctly aligned.

   Using the special tools, install the axle carrier bushing.



2. Install the axle carrier.
   - Tighten the M14 bolt to 105 Nm (77 lb.ft).
   - Tighten the new axle carrier bracket bolts to 80 Nm (59 lb.ft), then a further 60 degrees.

3. Install the axle carrier bushing heat shield.

4. Remove the axle support.

5. Install the exhaust system.
   For additional information, refer to: Exhaust System (309-00C, Removal and Installation) /
   Exhaust System - Vehicles Without: Diesel Particulate Filter (DPF) (309-00B, Removal and Installation) /
   Exhaust System (309-00A, Removal and Installation).

Front Drive Axle / Differential - Axle Tube Bushing

Removal and Installation

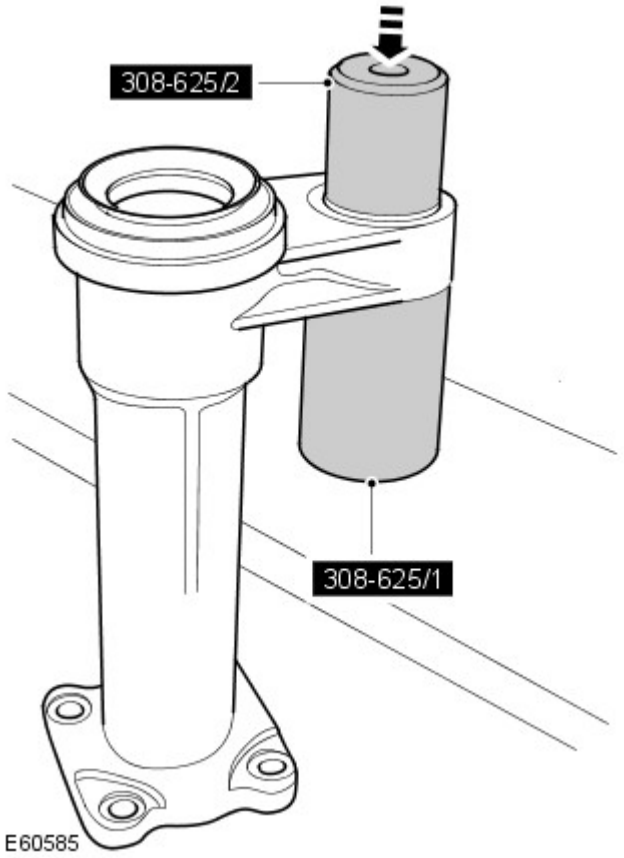
Special Tool(s)

	Remover/installer - Front axle extension support bush 308-625/1
	Remover/installer - Front axle extension support bush 308-625/2
	Remover/installer - Front axle extension support bush 308-625/3

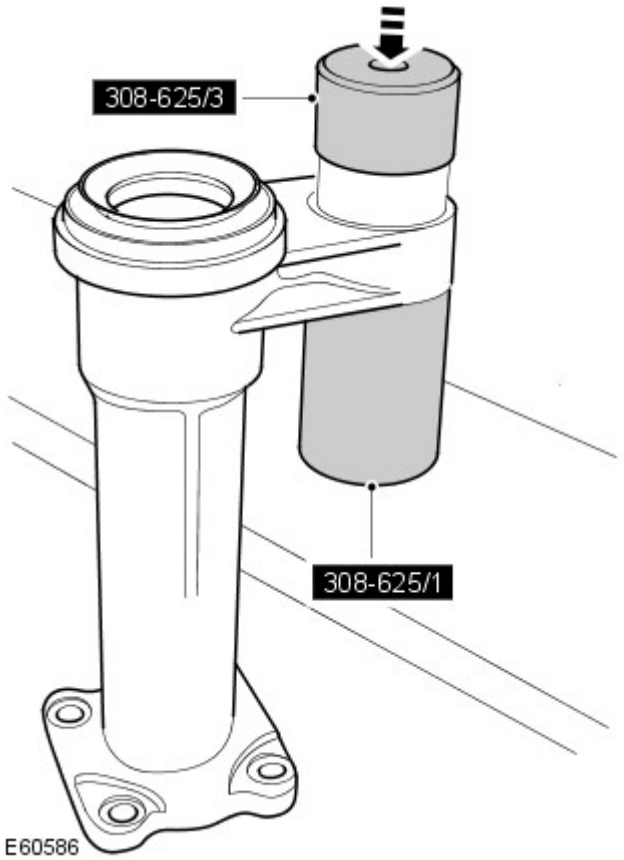
Removal

1. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).
2. Raise and support the vehicle.
3. Remove the axle tube.
   For additional information, refer to: Axle Tube (205-03, In-vehicle Repair).
4. NOTE: Note the fitted position.

   Using the special tools, remove the bushing.



Installation



1. NOTE: Note the fitted position.

   Using the special tools, install the bushing.

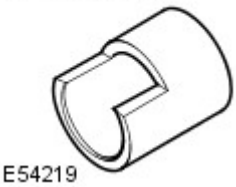
2. Install the axle tube.
   For additional information, refer to: Axle Tube (205-03, In-vehicle Repair).

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

Front Drive Axle / Differential - Axle Cover Bushing

Removal and Installation

Special Tool(s)

502-009/6  E55285	Bearing Housing 502-009/6
51204  E55278	Bearing set for 14mm bolt 51204
205-825/3  E54216	Installer rear axle front bush 205-825/3
502-009/2  E54205	Remover rear differential rear bush 502-009/2
502-009/5  E54148	Remover/Installer long 14mm bolt 502-009/5
502-009/4  E55284	Nut for long 14mm bolt 502-009/4
205-825/1  E54219	Receiver cup front axle front bush 205-825/1

Removal

CAUTION: Make sure the bush is correctly aligned.

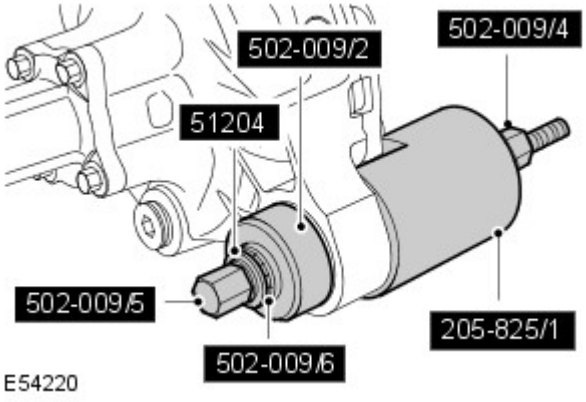
NOTE: Take note of the fitted position of the bush.

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 wheels and tires.

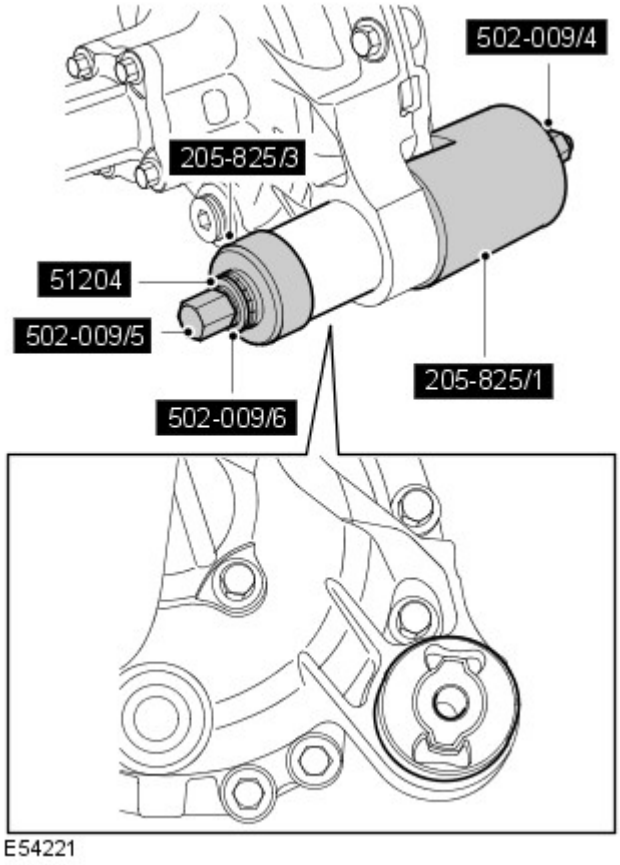
3. Remove the front differential.
   For additional information, refer to: Axle Assembly (205-03, Removal and Installation).



4. NOTE: Take note of the fitted position of the bush.

   Using the special tools, remove the front axle housing support insulator.

Installation



1. CAUTION: Make sure the bush is correctly aligned.

   Using the special tools, install the front axle housing support insulator.

2. Install the front differential.
   For additional information, refer to: Axle Assembly (205-03, Removal and Installation).

3. Install the front wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Halfshafts -

General Specification

Item	Specification
Type	Fully floating, fixed length, solid shafts incorporating constant velocity joints at each end of shaft

Recommended Lubricant

Item	Specification
Outboard joint	Use grease supplied with replacement boot kit (Optimol MS139G)
Inboard joint	Use grease supplied with replacement boot kit (1 Luber C MS132G)

Torque Specifications

Description	Nm	lb-ft
* Stabilizer bar link nuts	115	85
* Stabilizer bar link nuts - vehicles with Dynamic Response	175	129
* Upper arm to wheel knuckle nut	70	52
* Tie rod end ball joint nut	76	56
Brake hose retaining bracket to wheel knuckle bolt	25	18
*+ Halfshaft retaining nut	230	169
Road wheel nuts	140	103

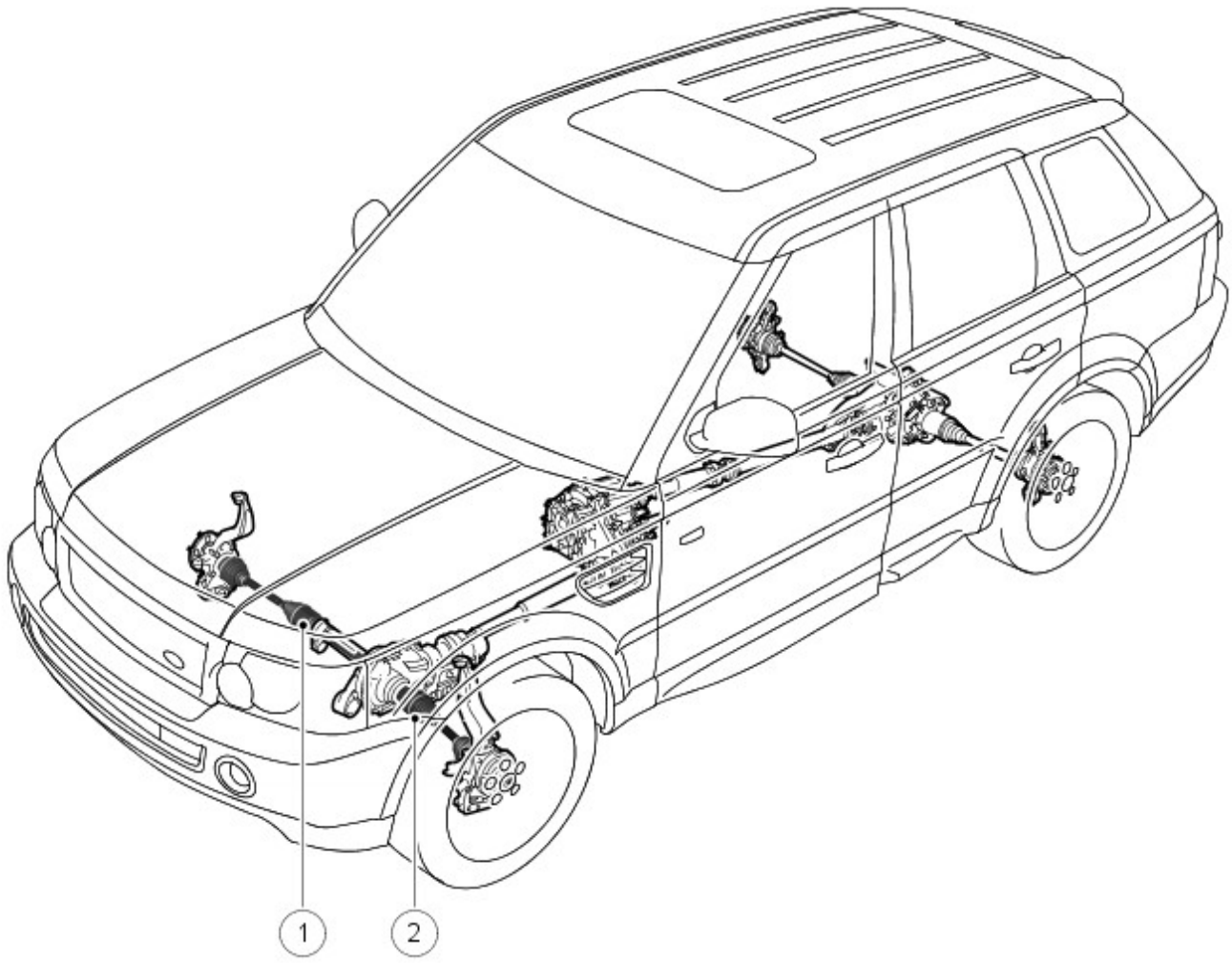
*** New nut must be installed**

+ Stake nut on completion

Front Drive Halfshafts - Front Drive Halfshafts

Description and Operation

Front Drive Halfshaft Component Location



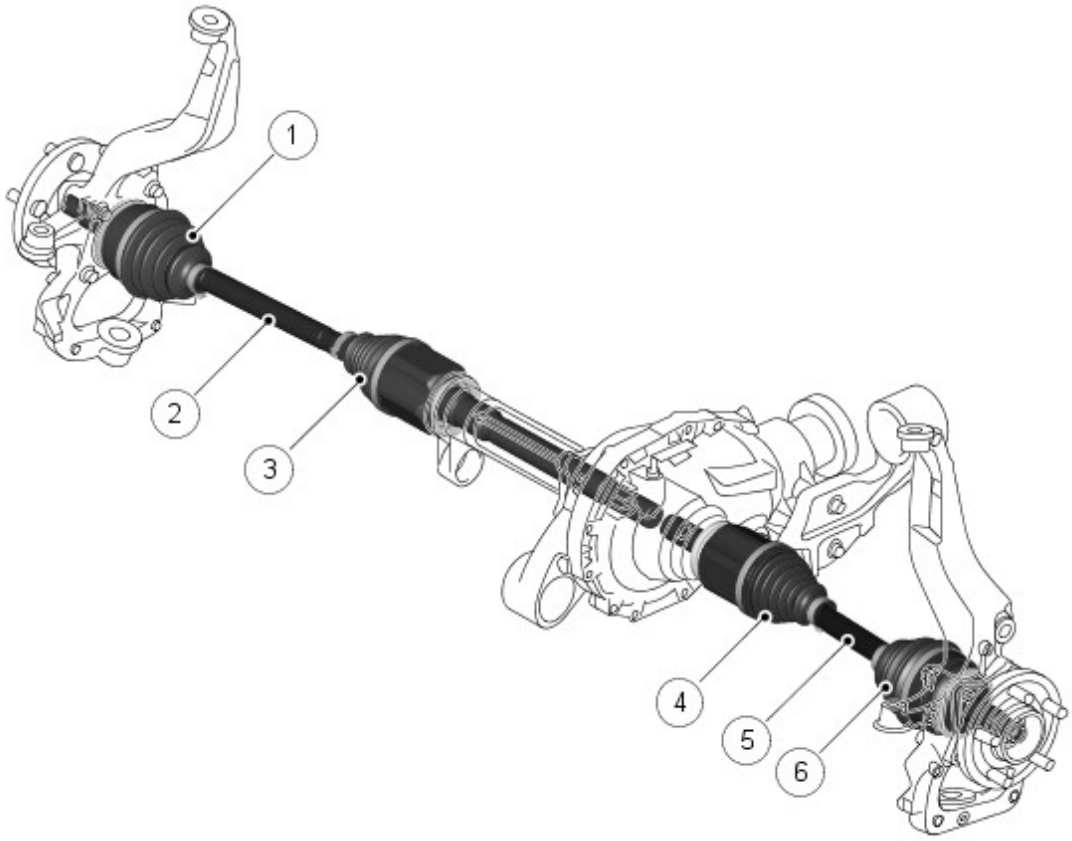
E56495

Item	Part Number	Description
1	-	RH front drive halfshaft
2	-	LH front drive halfshaft

GENERAL

The front drive shafts are handed components with the RH drive shaft being longer than the LH drive shaft. Both shafts are of similar construction with Constant Velocity (CV) joints at each end to allow for steering and suspension movement.

FRONT DRIVE HALFSHAFT ASSEMBLY



E46377

Item	Part Number	Description
1	-	RH outer CV joint
2	-	RH front drive halfshaft
3	-	RH inner CV joint
4	-	LH inner CV joint
5	-	LH front drive halfshaft
6	-	LH outer CV joint

The front drive shafts are similar in their construction. The only difference is the lengths of each shaft, the RH drive shaft is a longer shaft with an extended stem.

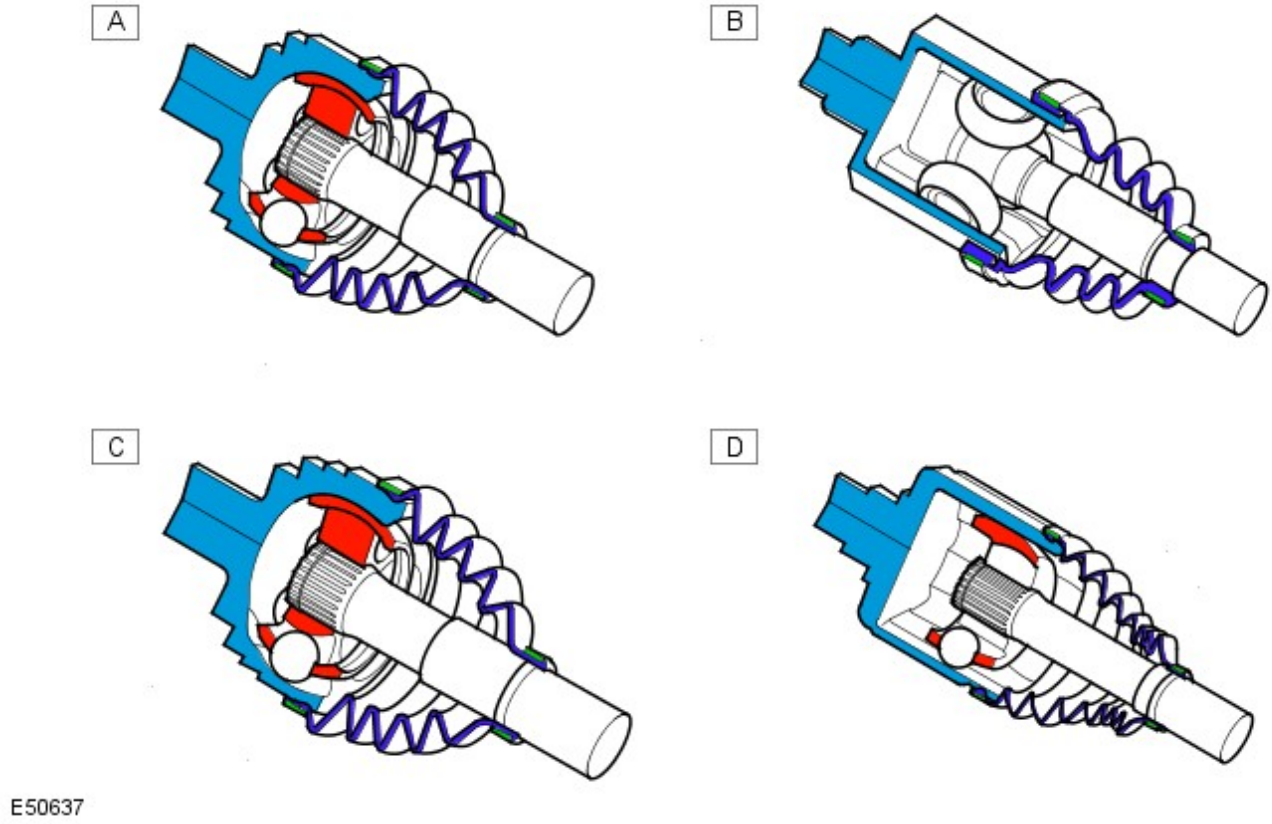
The outer CV joints have a target wheel on the outer diameter. This is used by the ABS wheel speed sensor for vehicle and wheel speed calculations.

Each drive shaft comprises two CV joints (inner and outer), boots, an outer tube and a solid barshaft, which is retained in the front differential by a circlip (see 'Halfshaft Joint' section for more information on CV joints).

Front Drive Halfshafts - Halfshaft Joint

Description and Operation

Front Drive Halfshaft – Sectional Views



E50637

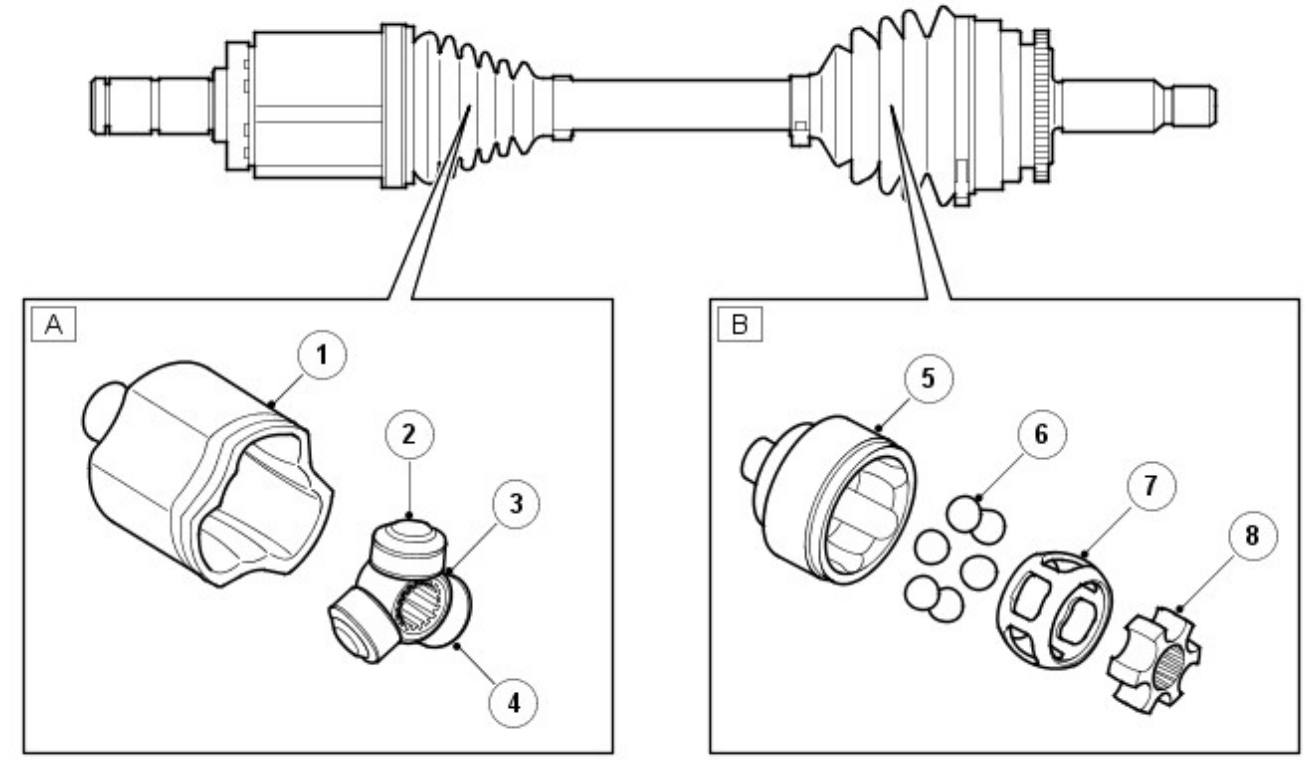
Item	Part Number	Description
A	-	Front outboard halfshaft joint
B	-	Front inboard halfshaft joint
C	-	Rear outboard halfshaft joint
D	-	Rear inboard halfshaft joint

The outboard and rear inboard CV joints are of the Birfield design. This design uses longitudinal, elliptical grooves, which retain six steel balls. A cage further retains the balls. Constant velocity is achieved by the position of the steel balls. If a centre line is drawn through the balls and the driven hub or differential shaft, the two centre lines always bisect each other at the angle of drive. This condition allows the rotational speed of the driven shaft to be passed to the driven hub or differential shaft with no loss of rotational speed regardless of the shaft angle. The CV joints are packed with grease, which is retained in the joint by a synthetic rubber gaiter. The gaiter is retained at each end by a metal clamp, which provides a watertight seal to prevent the ingress of dirt and moisture. The CV joints are retained on their respective shaft or tube by an internal snap ring. The snap rings are located in a groove on each shaft or tube end and locate in a mating groove in the CV joint.

CAUTION: The inner hub is not retained in the joint body on this type of joint. The joint is held together in its unfitted state only by the boot. Pulling on the barshaft can therefore pull the hub out of the joint body. For this reason care must be taken when handling and fitting the front driveshafts.

The shaft is a sliding fit inside the outer tube, which allows for the small length changes, which occur with articulation of the suspension. The shaft is located in a ball cage, which is retained inside the outer tube. The ball cage ensures that the shaft is held rigidly in the outer tube whilst allowing it to freely move in and out of the tube as necessary. A sealing plug is pressed into the outer tube and retains grease around the balls in the cage.

The inner CV joints are similar in design and operation to the outer joints except that the inner joints use rollers rather than balls to transmit the drive.



E46396

Item	Part Number	Description
A	-	Inner CV joint
B	-	Outer CV joint
1	-	Tulip outer race
2	-	Trunions (3 of)
3	-	Spider
4	-	Rollers (3 of)
5	-	Outer race
6	-	Steel balls (6 of)
7	-	Cage
8	-	Inner race

The front inboard joint is a 'tripode joint', having three 'feet' or 'podes'. The torque is transmitted from the outer race to the connecting shaft by means of rollers running on needle rollers around the trunions of the tripode spider. The roller tracks of the outer race enable the tripode assembly to move angularly and axially within the joint.

The inner CV joint shaft is splined and mates with splines in the front differential. There is no internal retaining mechanism for this type of joint so care must be taken during service as the shaft and CV joint can separate.

Front Drive Halfshafts - Front Drive Halfshafts

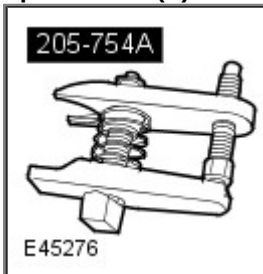
Diagnosis and Testing

For additional information.
REFER to: Driveline System (205-00, Diagnosis and Testing).

Front Drive Halfshafts - Front Halfshaft LH

Removal and Installation

Special Tool(s)

	Ball joint separator 205-754(LRT-54-027)
	Halfshaft remover/replacer 204-506/1(LRT-60-030/1)
	Halfshaft remover/replacer 204-506/3(LRT-60-030/3)
	Halfshaft installer adapter (L319 up to VIN 671700, L320 up to VIN 810673) 204-506-01(LRT-60-030/4)
	Halfshaft installer adapter (L319 from VIN 671701, L320 from VIN 810674) JLR-204-506-01
	Retainers - halfshaft remover/replacer 204-506/5(LRT-60-030/5)
	Axle oil seal remover 308-005(LRT-37-004/2)
	Impulse extractor

100-012  E54135	100-012(LRT-99-004)
308-626/2  E54137	Installer/Guide halfshaft oil seal 308-626/2
308-626/1  E54136	Installer halfshaft oil seal 308-626/1

Removal

CAUTIONS:

Do not store or install halfshafts with joints at maximum articulation or damage may occur to the joint.

Do not allow halfshafts to hang unsupported at one end or joint damage will occur.

Angularly Adjusted Roller (AAR) joints, used at the inboard end of some halfshafts have no internal retaining mechanism and can separate.

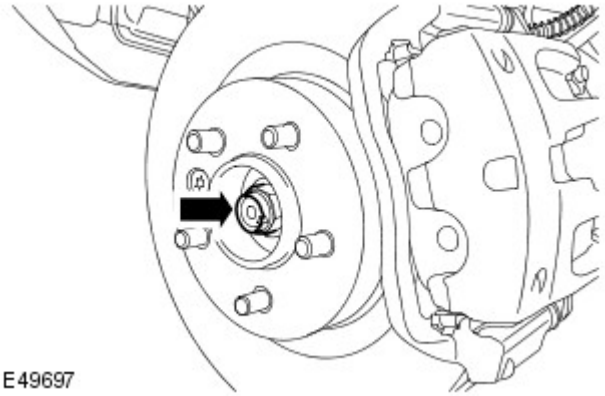
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

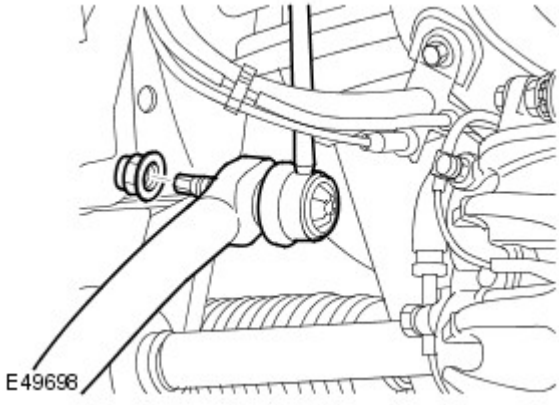
2. Drain the differential lubricant.
   For additional information, refer to: Differential Draining and Filling (205-03 Front Drive Axle/Differential, General Procedures).

3. Remove the wheel and tire.

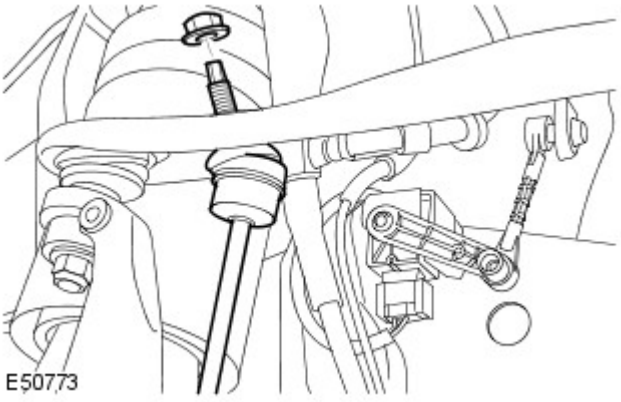
4. Remove the halfshaft retaining nut.
   - Discard the nut.


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5. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

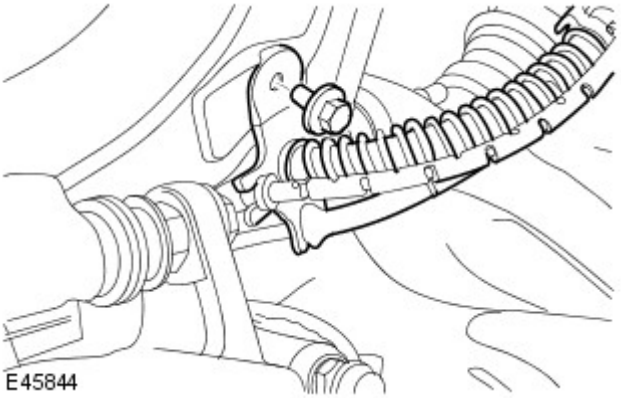


Disconnect the RH stabilizer bar link.
- Remove and discard the nut.



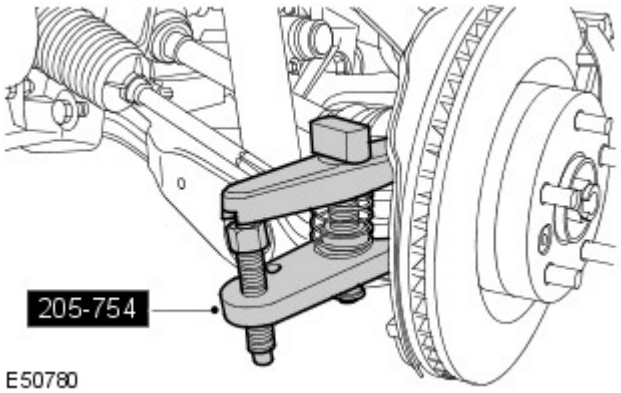
6. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

   Remove the stabilizer bar link nut.
   - Remove and discard the nut.



7. Release the brake hose bracket from the wheel knuckle.
   - Remove the bolt.

8. Loosen the tie-rod end ball joint retaining nut.



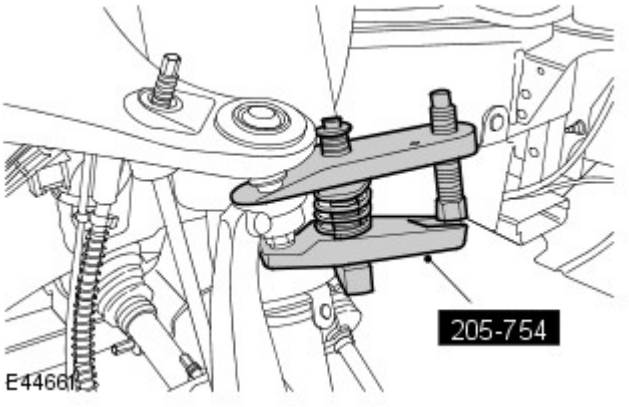
9. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

   Using the special tool, release the tie-rod end ball joint from the wheel knuckle.
   - Discard the nut.

10. CAUTION: To prevent the wheel knuckle falling outwards and disconnection of the halfshaft inner joint, support the wheel knuckle.

    Loosen the upper arm retaining nut.

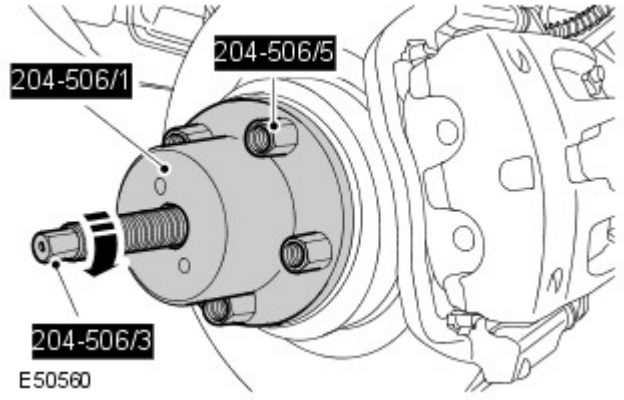
11. CAUTION: Make sure the ball joint seal is not



damaged. A damaged seal will lead to the premature failure of the joint.

Using the special tool, release the upper arm ball joint.

- Remove and discard the retaining nut.



12. CAUTIONS:

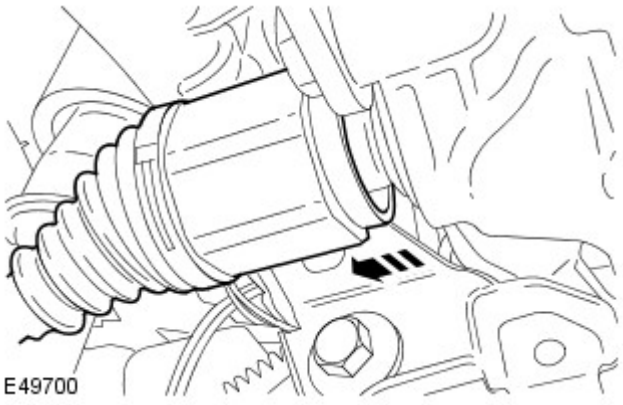
The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

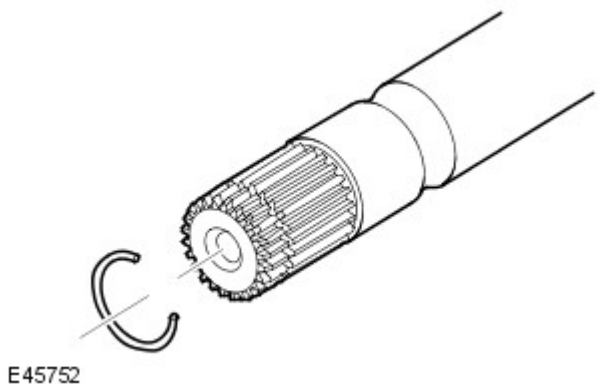
Using the special tools, release the halfshaft from the wheel hub.

13. Release the halfshaft from the wheel knuckle.

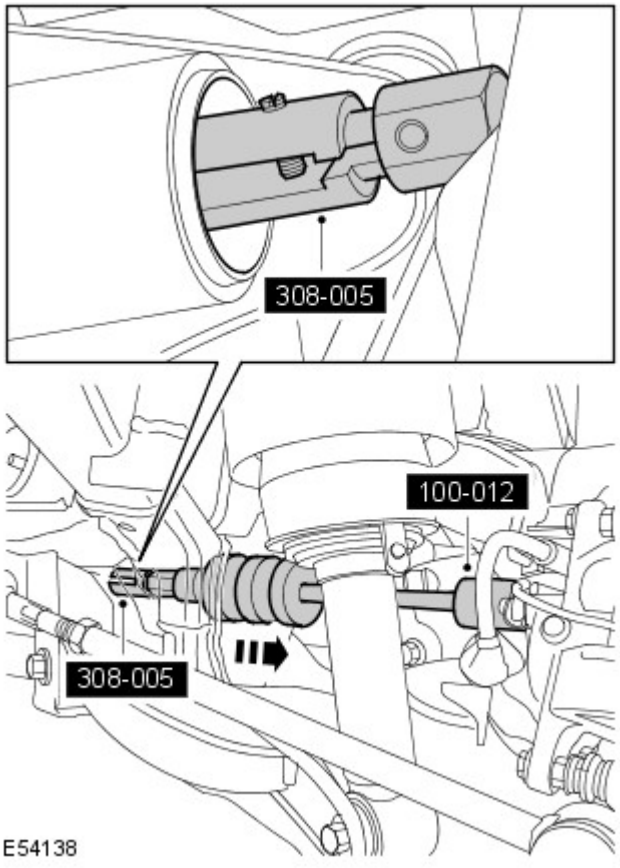
14. Release the halfshaft from the differential housing.



15. Remove the halfshaft.
    - Raise the stabilizer bar to allow removal of the halfshaft.
    - Remove and discard the snap ring.

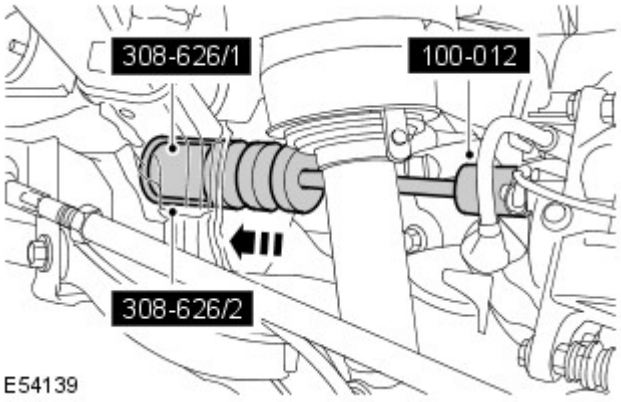


16. Using the special tools, remove and discard the halfshaft oil seal.

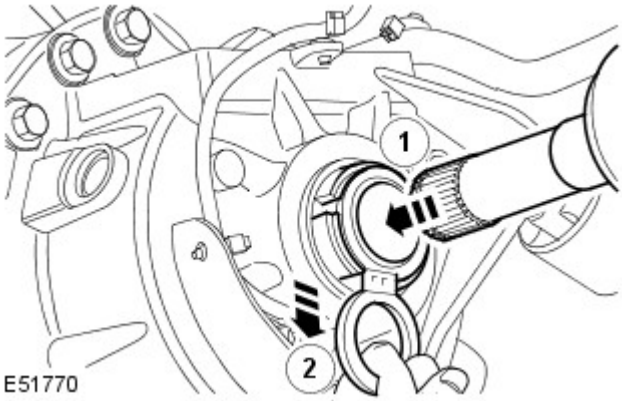


Installation

1. Clean the components.



2. Using the special tools, install a new halfshaft oil seal.
    - The halfshaft oil seal protector must be left in place, until the halfshaft is fully installed.



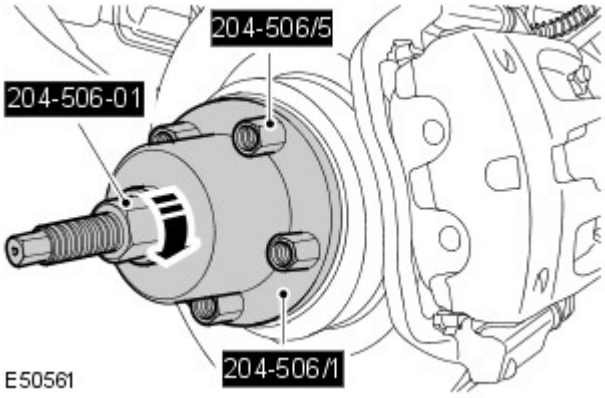
3. CAUTION: Do not fully engage the halfshaft until the oil seal protector has been removed.

   NOTE: The oil seal protector is designed to break into two pieces.

   Install the halfshaft.
    - Install the snap ring.
    - Lubricate the seal and the bearing running surfaces with clean axle oil.
    - Open the halfshaft oil seal protector.
    - Partially install the halfshaft.
    - Remove and discard the halfshaft oil seal protector.
    - Make sure the snap ring is fully engaged and retains the halfshaft.

4. CAUTIONS:

   The lower arm ball joint can be damaged by



excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

Use tool 204-506-01(LRT-60-030/4) for L319 up to VIN 671700, L320 up to VIN 810673. Use tool number JLR-204-506-01 for L319 from VIN 671701, L320 from VIN 810674. Failure to follow this instruction will result in damage to vehicle.

Using the special tools, install the halfshaft in the wheel hub.

5. Connect the upper arm and wheel knuckle.
   - Install a new nut and tighten to 70 Nm (52 lb.ft).
6. Secure the stabilizer bar link.
   - Install a new nut and tighten to 115 Nm (85 lb.ft).
7. Connect the tie-rod end ball joint.
   - Install a new nut and tighten to 76 Nm (56 lb.ft).
8. CAUTION: Install the halfshaft nut finger tight.

   Install a new halfshaft retaining nut and lightly tighten.
9. Secure the brake hose retaining bracket to the wheel knuckle.
   - Tighten the bolt to 22 Nm (16 lb.ft).
10. Secure the RH stabilizer link.
    - Install a new nut and tighten to 115 Nm (85 lb.ft).
11. CAUTION: Do not use air tools to install the nut. Failure to follow this instruction may result in damage to the component.

    Tighten the new halfshaft retaining nut to 230 Nm (170 lb.ft).
    - Stake the nut to the halfshaft.
12. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).
13. CAUTION: Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, and not to act as a level indicator.

    Fill the differential with the correct amount of lubricant.
    For additional information, refer to: Differential Draining and Filling (205-03 Front Drive Axle/Differential, General Procedures).

Front Drive Halfshafts - Front Halfshaft RH

Removal and Installation

Special Tool(s)

	Ball joint separator 205-754(LRT-54-027)
	Halfshaft remover/replacer 204-506/1(LRT-60-030/1)
	Halfshaft remover/replacer 204-506/3(LRT-60-030/3)
	Halfshaft installer adapter 204-506-01(LRT-60-030/4)
	Retainers - halfshaft remover/replacer 204-506/5(LRT-60-030/5)
	Axle oil seal remover 308-005(LRT-37-004/2)
	Impulse extractor 100-012(LRT-99-004)
	Installer/Guide halfshaft oil seal

308-626/2  E54137	308-626/2
308-626/1  E54136	Installer halfshaft oil seal 308-626/1
205-819  E54141	Halfshaft bearing installer 205-819

Removal

CAUTIONS:

Angularly Adjusted Roller (AAR) joints, used at the inboard end of some halfshafts have no internal retaining mechanism and can separate.

Do not allow halfshafts to hang unsupported at one end or joint damage will occur.

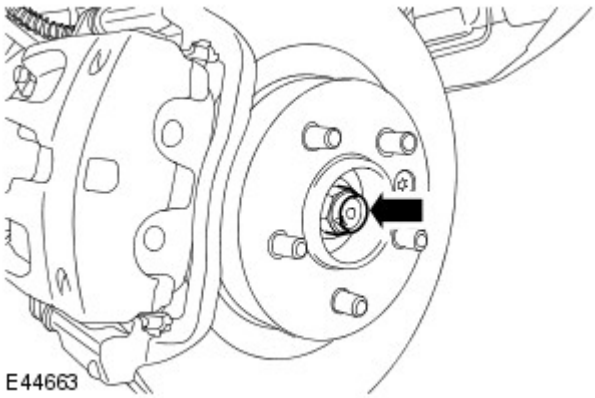
Do not store or install halfshafts with joints at maximum articulation or damage may occur to the joint.

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.

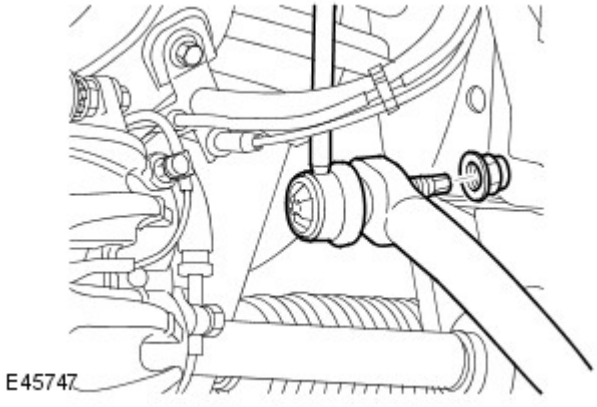
2. Drain the differential lubricant.
   For additional information, refer to: Differential Draining and Filling (205-03 Front Drive Axle/Differential, General Procedures).

3. Remove the wheels and tires.


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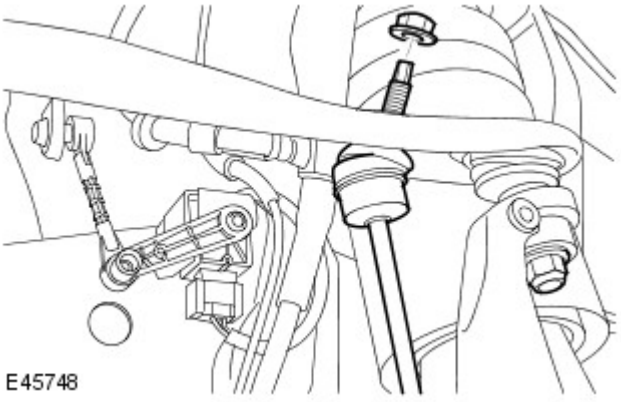
4. Remove the halfshaft retaining nut.
   - Discard the nut.

5. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.



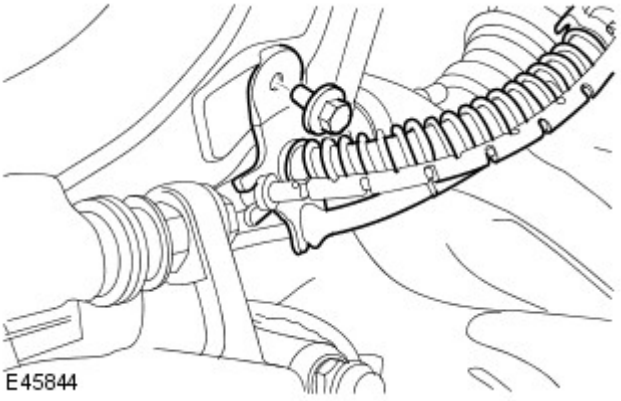
Disconnect the stabilizer bar link.

- Remove and discard the nut.



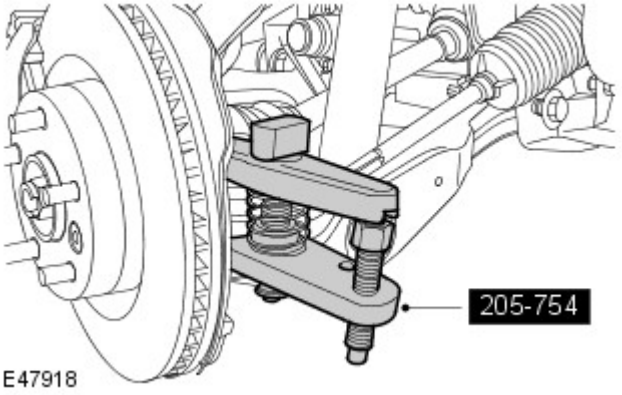
6. CAUTION: Use a wrench on the hexagon provided to prevent the ball joint rotating.

   Remove the stabilizer bar link nut.



7. Release the brake hose bracket from the wheel knuckle.
   - Remove the bolt.

8. Loosen the tie-rod end ball joint retaining nut.



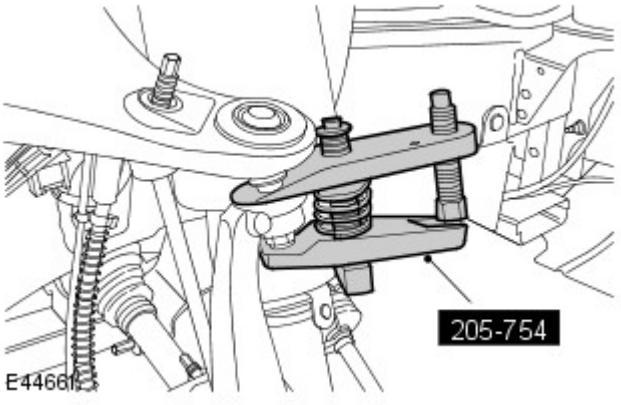
9. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

   Using the special tool, release the tie-rod end ball joint from the wheel knuckle.
   - Discard the nut.

10. CAUTION: To prevent the wheel knuckle falling outwards and disconnection of the halfshaft inner joint, support the wheel knuckle.

    Loosen the upper arm retaining nut.

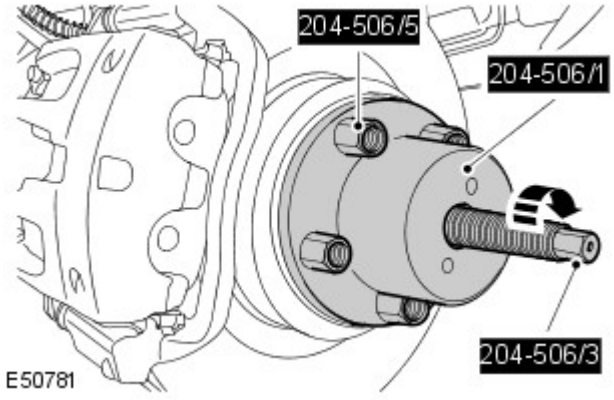
11. CAUTION: Make sure the ball joint seal is not



damaged. A damaged seal will lead to the premature failure of the joint.

Using the special tool, release the upper arm ball joint.

- Remove and discard the retaining nut.



12. CAUTIONS:

    The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

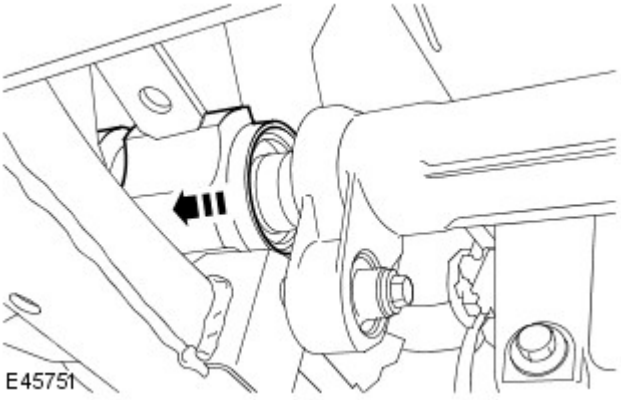
    Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

    Using the special tools, release the halfshaft from the wheel hub.

13. Release the halfshaft from the wheel knuckle.

14. Position a container to collect the oil spillage.

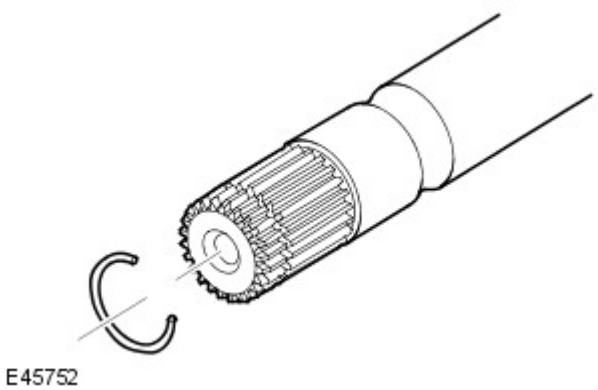
15. Release the halfshaft from the differential housing.



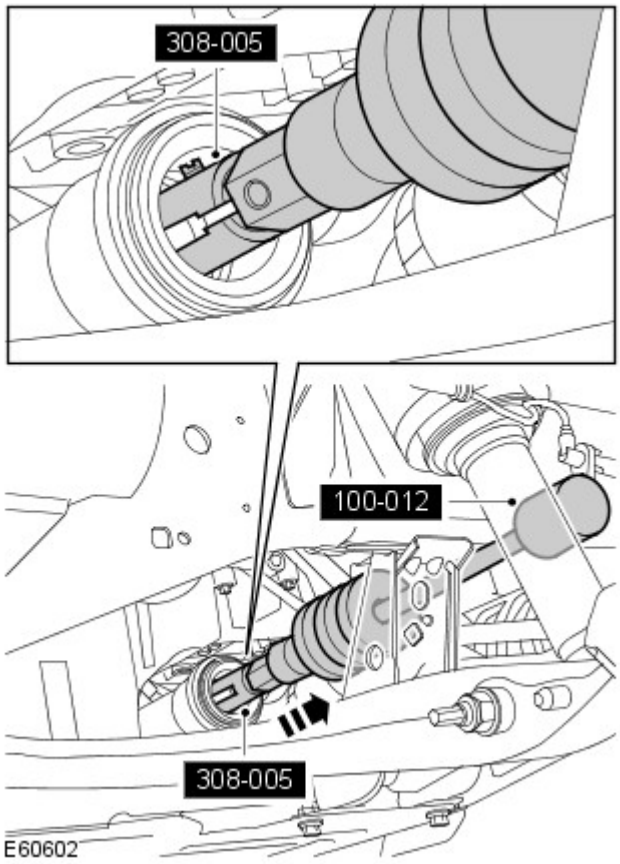
16. CAUTION: Keep the halfshaft horizontal to avoid damaging the oil seal.

    Remove the halfshaft.

    - Raise the stabilizer bar to allow removal of the halfshaft.
    - Remove and discard the snap ring.

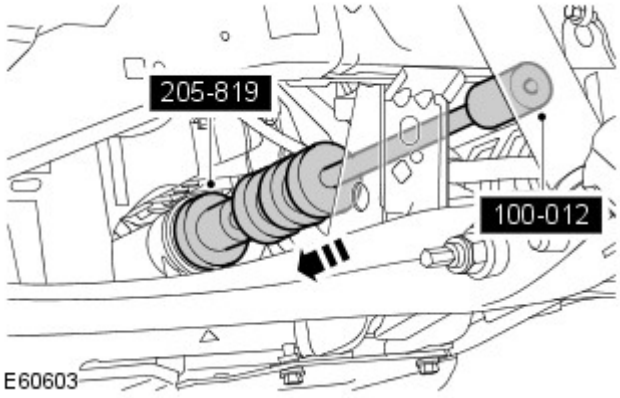


17. Using the special tools, remove and discard the halfshaft oil seal.



Installation

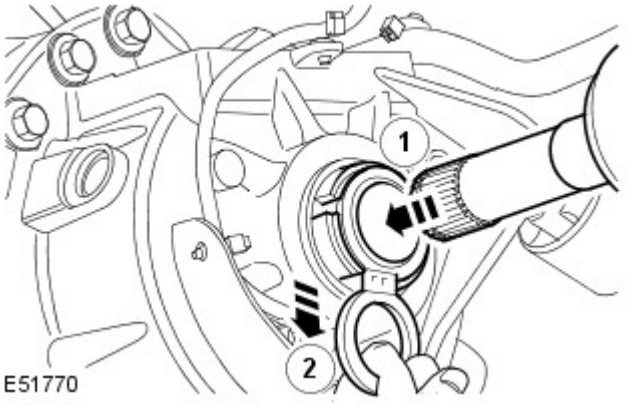
1. Clean the components.

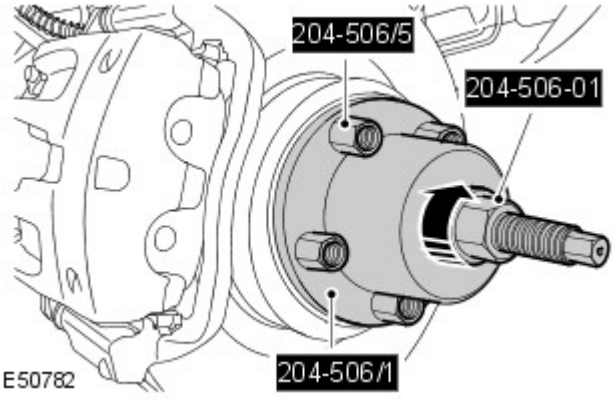


2. Using the special tools, install a new halfshaft oil seal.
    - The halfshaft oil seal protector must be left in place, until the halfshaft is fully installed.
3. NOTE: Do not fully engage the halfshaft until the oil seal protector has been removed.

   Install the halfshaft.
    - Install the snap ring.
    - Lubricate the seal and the bearing running surfaces with clean axle oil.
    - Make sure the snap ring is fully engaged and retains the halfshaft.
    - Open the halfshaft oil seal protector.
4. NOTE: The oil seal protector is designed to break into two pieces.

   Remove and discard the halfshaft oil seal protector.





5. CAUTION: The lower arm ball joint can be damaged by excessive articulation. The wheel knuckle must be fully supported at all times. Do not allow the wheel knuckle to hang on the lower arm. Failure to follow this instruction will result in damage to vehicle.

   Using the special tools, install the halfshaft in the wheel hub.

6. Connect the upper arm and wheel knuckle.
   - Install a new nut and tighten to 70 Nm (52 lb.ft).

7. Secure the stabilizer bar link.
   - Install a new nut and tighten to 115 Nm (85 lb.ft).

8. Connect the tie-rod end ball joint.
   - Install a new nut and tighten to 76 Nm (56 lb.ft).

9. CAUTION: Install the halfshaft nut finger tight.

   Install a new halfshaft retaining nut and lightly tighten.

10. Secure the brake hose retaining bracket to the wheel knuckle.
    - Tighten the bolt to 22 Nm (16 lb.ft).

11. Secure the LH stabilizer link.
    - Install a new nut and tighten to 115 Nm (85 lb.ft).

12. CAUTION: Do not use air tools to install the nut. Failure to follow this instruction may result in damage to the component.

    Tighten the new halfshaft retaining nut to 230 Nm (170 lb.ft).
    - Stake the nut to the halfshaft.

13. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

14. CAUTION: Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, and not to act as a level indicator.

    Fill the differential with the correct amount of lubricant.
    For additional information, refer to: Differential Draining and Filling (205-03 Front Drive Axle/Differential, General Procedures).

Front Drive Halfshafts - Outer Constant Velocity (CV) Joint Boot

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 wheel and tire.

3. Remove the halfshaft.
   For additional information, refer to: Front Halfshaft LH (205-04 Front Drive Halfshafts, Removal and Installation).

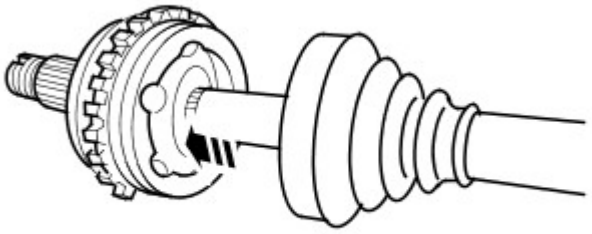
4. Clamp the halfshaft in a vise.



5. Remove and discard the CV joint boot retaining clamps.

6. Slide the CV joint boot along the halfshaft to gain access to the joint.

7. Using a drift against the inner part of the CV joint, remove the CV joint from the halfshaft.
   - Remove and discard the snap ring.



E46875

8. Remove the outer CV joint boot.

Installation

1. Clean the components.

2. Install the CV joint boot.

3. Install the outer CV joint.
   - Install the snap ring.
   - Position the CV joint on the halfshaft, press the snap ring into it's groove and push the CV joint fully on to the halfshaft.
   - Pull on the CV joint to ensure the snap ring has fully engaged.

4. Pack the CV joint with the grease supplied.


E137494

5. CAUTIONS:

   Make sure the CV boot is not pushed too far onto the drive shaft and the recess is exposed, failure to follow this instruction may result in damage to the component.

   After the clamps have been secured do not adjust them, failure to follow this instruction may result in damage to the component.

   Install the CV joint boot to the CV joint.
   - Using a suitable tool, secure the CV joint boot with the new clamps.

6. Install the halfshaft.
   For additional information, refer to: Front Halfshaft LH (205-04 Front Drive Halfshafts, Removal and Installation).

7. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Halfshafts - Outer Constant Velocity (CV) Joint

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 wheel and tire.

3. Remove the halfshaft.
   For additional information, refer to: Front Halfshaft LH (205-04 Front Drive Halfshafts, Removal and Installation).

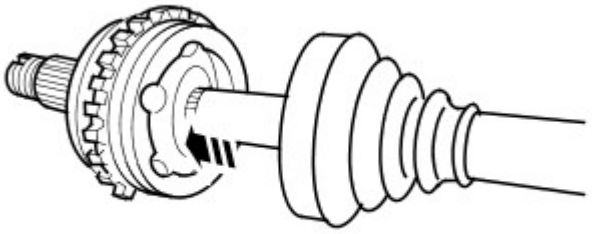
4. Clamp the halfshaft in a vise.



5. Remove and discard the CV joint boot retaining clamps.

6. Slide the CV joint boot along the halfshaft to gain access to the joint.

7. Using a drift against the inner part of the CV joint, remove the CV joint from the halfshaft.
   - Remove and discard the snap ring.



E46875

8. Remove the outer CV joint boot.

Installation

1. Clean the components.

2. Install the CV joint boot.

3. Install the outer CV joint.
   - Install the snap ring.
   - Position the CV joint on the halfshaft, press the snap ring into it's groove and push the CV joint fully on to the halfshaft.
   - Pull on the CV joint to ensure the snap ring has fully engaged.

4. Pack the CV joint with the grease supplied.


E137494

5. CAUTIONS:

   Make sure the CV boot is not pushed too far onto the drive shaft and the recess is exposed, failure to follow this instruction may result in damage to the component.

   After the clamps have been secured do not adjust them, failure to follow this instruction may result in damage to the component.

   Install the CV joint boot to the CV joint.
   - Using a suitable tool, secure the CV joint boot with the new clamps.

6. Install the halfshaft.
   For additional information, refer to: Front Halfshaft LH (205-04 Front Drive Halfshafts, Removal and Installation).

7. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Halfshafts - Inner Constant Velocity (CV) Joint Boot

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 wheel and tire.

3. Remove the halfshaft.
   For additional information, refer to: Halfshaft LH (205-04, Removal and Installation).

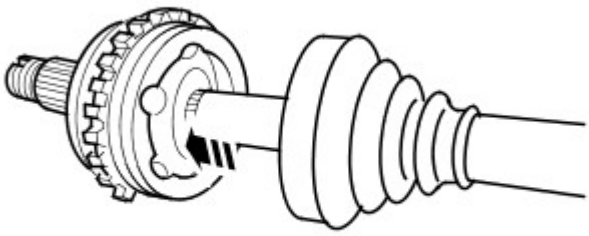
4. Clamp the halfshaft in a vise.



5. Remove and discard the CV joint boot retaining clamps.



6. Slide the CV joint boot along the halfshaft to gain access to the joint.



7. Using a drift against the inner part of the CV joint, remove the CV joint from the halfshaft.
   - Remove and discard the snap ring.

8. Remove the inner joint boot.

Installation

1. Clean the components.

2. Install the inner joint boot.

3. Install the inner joint.
    - Install a new snap ring.
    - Position the CV joint on the halfshaft, press the snap ring into it's groove and push the CV joint fully on to the halfshaft.
    - Pull on the CV joint to ensure the snap ring has fully engaged.

4. Pack the joint with the grease supplied.

5. Install the CV joint boot to the CV joint.
    - Secure with the new clamps.

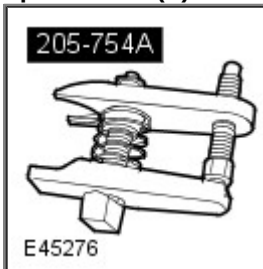
6. Install the halfshaft.
   For additional information, refer to: Halfshaft LH (205-04, Removal and Installation).

7. Install the wheel and tire.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Front Drive Halfshafts - Halfshaft Seal LH

Removal and Installation

Special Tool(s)

	Ball joint separator (LRT-54-027) 205-754
	Halfshaft remover/replacer (LRT-60-030/1) 204-506/1
	Halfshaft remover/replacer (LRT-60-030/3) 204-506/3
	Halfshaft installer adapter 204-506-01
	Retainers - halfshaft remover/replacer (LRT-60-030/5) 204-506/5
	Axle oil seal remover (LRT-37-004/2) 308-005
	Impulse extractor (LRT-99-004) 100-012
	Installer/Guide halfshaft oil seal

	308-626/2
	Installer halfshaft oil seal 308-626/1

Removal

CAUTIONS:

Do not store or install halfshafts with joints at maximum articulation or damage may occur to the joint

Do not allow halfshafts to hang unsupported at one end or joint damage will occur.

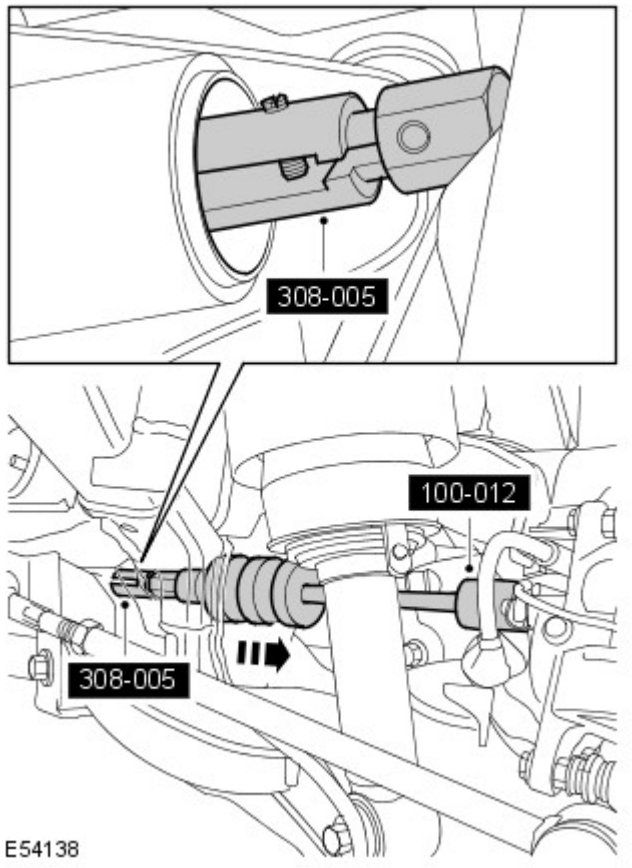
Angularly Adjusted Roller (AAR) joints, used at the inboard end of some halfshafts have no internal retaining mechanism and can separate.

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

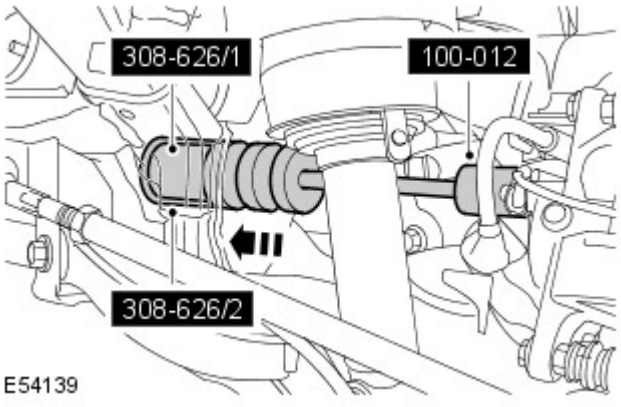
   Raise and support the vehicle.

2. Remove the LH halfshaft.
   For additional information, refer to: Halfshaft LH (205-04, Removal and Installation).

3. Using the special tools, remove and discard the halfshaft oil seal.



Installation

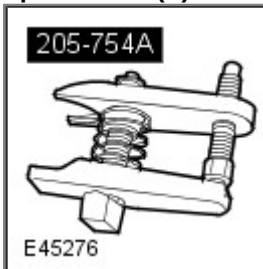


1. Using the special tools, install a new halfshaft oil seal.
    - The halfshaft oil seal protector must be left in place, until the halfshaft is fully installed.
2. Install the LH halfshaft.
   For additional information, refer to: Halfshaft LH (205-04, Removal and Installation).

Front Drive Halfshafts - Halfshaft Seal RH

Removal and Installation

Special Tool(s)

	Ball joint separator (LRT-54-027) 205-754
	Halfshaft remover/replacer (LRT-60-030/1) 204-506/1
	Halfshaft remover/replacer (LRT-60-030/3) 204-506/3
	Halfshaft installer adapter 204-506-01
	Retainers - halfshaft remover/replacer (LRT-60-030/5) 204-506/5
	Axle oil seal remover (LRT-37-004/2) 308-005
	Impulse extractor (LRT-99-004) 100-012
	Installer/Guide halfshaft oil seal

308-626/2  E54137	308-626/2
308-626/1  E54136	Installer halfshaft oil seal 308-626/1

Removal

CAUTIONS:

Angularly Adjusted Roller (AAR) joints, used at the inboard end of some halfshafts have no internal retaining mechanism and can separate.

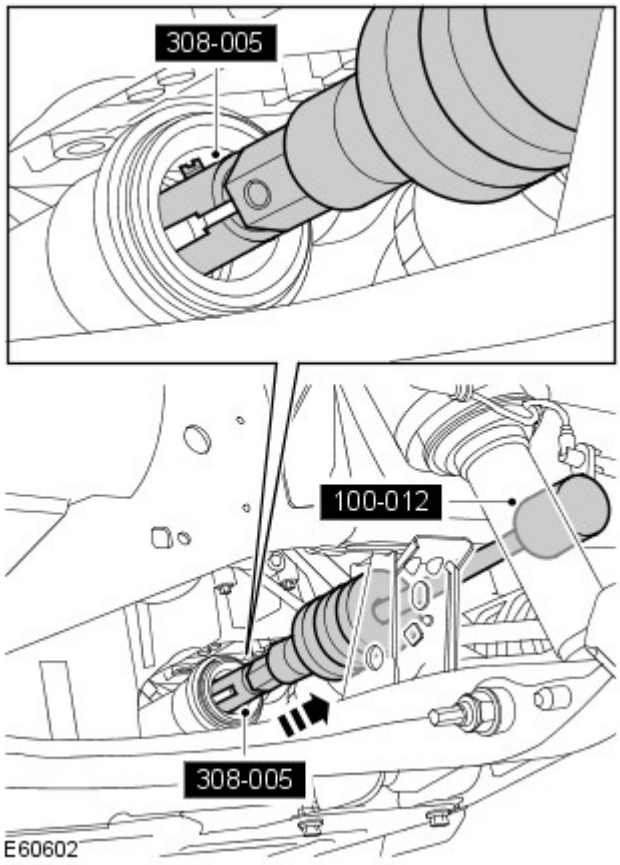
Do not allow halfshafts to hang unsupported at one end or joint damage will occur.

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

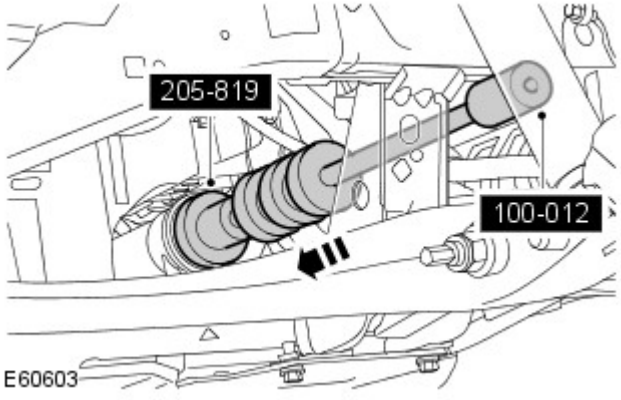
   Raise and support the vehicle.

2. Remove the RH halfshaft.
   For additional information, refer to: Halfshaft RH (205-04, Removal and Installation).

3. Using the special tools, remove and discard the halfshaft oil seal.



Installation



1. Using the special tools, install a new halfshaft oil seal.

2. Install the RH halfshaft.
   For additional information, refer to: Halfshaft RH (205-04, Removal and Installation).

Rear Drive Halfshafts -

Recommended Lubricant

Item	Specification
Outboard joint	Use grease supplied with replacement boot kit (Optimol MS139G)
Inboard joint	Use grease supplied with replacement boot kit (Thermax MS141G)

General Specification

Item	Specification
Type	Fully floating, solid shafts incorporating plunging constant velocity joint at inboard end and fixed constant velocity joint at outboard end of shaft

Torque Specifications

Description	Nm	lb-ft
* Lower arm to wheel knuckle nut	275	203
Toe link bolt	175	129
*+ Halfshaft nut	420	311
Road wheel nuts	• Stage 1: 4 • Stage 2: 70 • Stage 3: 140	• Stage 1: - • Stage 2: 52 • Stage 3: 103

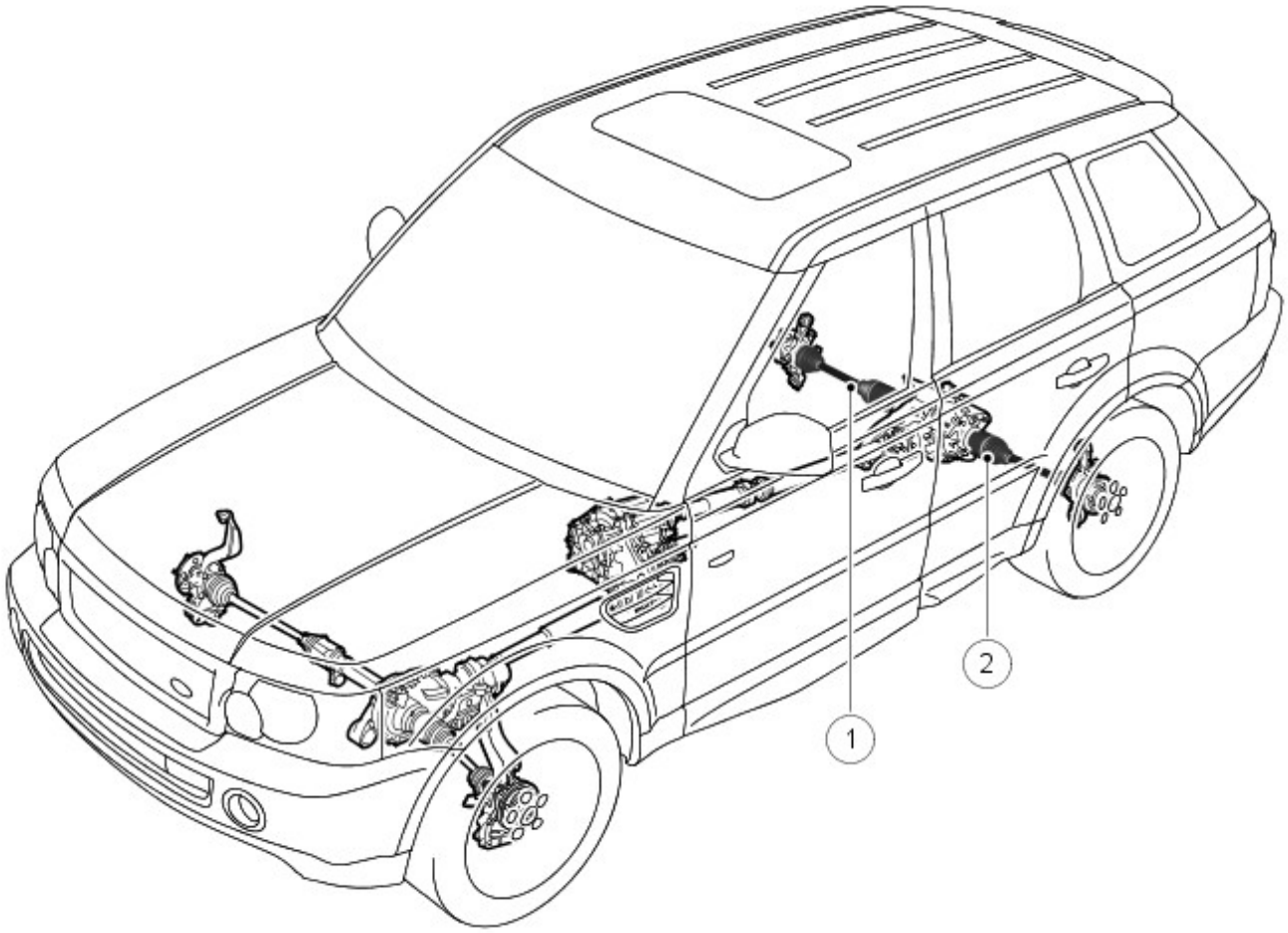
*** New nut must be installed**

+ Stake nut on completion

Rear Drive Halfshafts - Rear Drive Halfshafts

Description and Operation

Rear Drive Halfshaft Component Locations



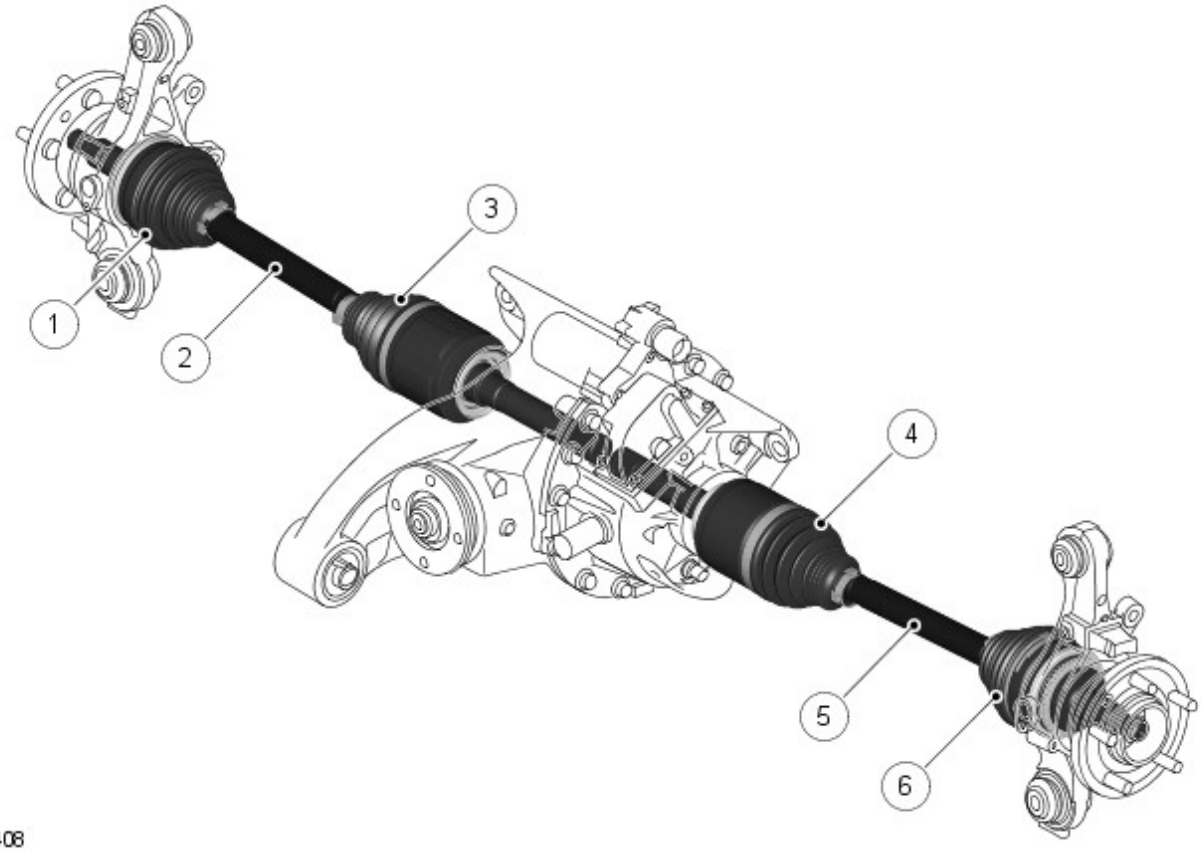
E56496

Item	Part Number	Description
1	-	RH rear drive halfshaft
2	-	LH rear drive halfshaft

GENERAL

The rear drive halfshafts are identical in their construction with a Constant Velocity (CV) joint at each end to allow for suspension movement.

REAR DRIVE SHAFT ASSEMBLY



E46408

Item	Part Number	Description
1	-	RH outer CV joint
2	-	RH rear drive halfshaft
3	-	RH inner CV joint
4	-	LH inner CV joint
5	-	LH rear drive halfshaft
6	-	LH outer CV joint

Each outer CV joint has a target wheel on the outer diameter. The ABS wheel speed sensor for vehicle and wheel speed calculations uses this target.

Each rear drive halfshaft comprises two CV joints (inner and outer), boots and a solid barshaft, which is retained in the rear differential by a circlip.

The CV joints used on the rear drive halfshafts share the same design and operating principles as the front drive halfshafts CV joints (see 'Halfshaft Joint' section for more information on CV joints). Peening over the lip of the joint body retains the rear drive halfshaft inner joint hubs.

Rear Drive Halfshafts - Rear Drive Halfshafts

Diagnosis and Testing

For additional information.
REFER to: Driveline System (205-00, Diagnosis and Testing).

Rear Drive Halfshafts - Outer Constant Velocity (CV) Joint Boot

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 wheel and tire.

3. Remove the halfshaft.
   For additional information, refer to: Halfshaft (205-05, Removal and Installation).

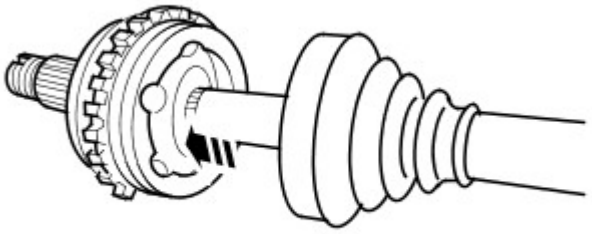
4. Clamp the halfshaft in a vise.



5. Remove and discard the CV joint boot retaining clamps.

6. Slide the CV joint boot along the halfshaft to gain access to the joint.

7. Using a drift against the inner part of the CV joint, remove the CV joint from the halfshaft.
   - Remove and discard the snap ring.



E46875

8. Remove the outer CV joint boot.

Installation

1. Clean the components.

2. Install the CV joint boot.

3. Install the outer CV joint.
   - Install the snap ring.
   - Position the CV joint on the halfshaft, press the snap ring into it's groove and push the CV joint fully on to the halfshaft.
   - Pull on the CV joint to ensure the snap ring has fully engaged.

4. Pack the CV joint with the grease supplied.

5. Install the CV joint boot to the CV joint.

- Secure with the new clamps.

6. Install the halfshaft.
   For additional information, refer to: Halfshaft (205-05, Removal and Installation).

7. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Drive Halfshafts - Inner Constant Velocity (CV) Joint Boot

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 wheel and tire.

3. Remove the halfshaft.
   For additional information, refer to: Halfshaft (205-05, Removal and Installation).

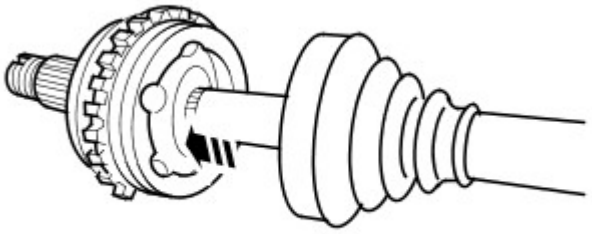
4. Clamp the halfshaft in a vise.



5. Remove and discard the CV joint boot retaining clamps.

6. Slide the CV joint boot along the halfshaft to gain access to the joint.

7. Using a drift against the inner part of the CV joint, remove the CV joint from the halfshaft.
   - Remove and discard the snap ring.



E46875

8. Remove the inner CV joint boot.

Installation

1. Clean the components.

2. Install the inner CV joint boot.

3. Install the inner joint.
   - Install a new snap ring.
   - Position the CV joint on the halfshaft, press the snap ring into it's groove and push the CV joint fully on to the halfshaft.
   - Pull on the CV joint to ensure the snap ring has fully engaged.

4. Pack the joint with the grease supplied.

5. Install the boot to the joint.

- Secure with the new clamps.

6. Install the halfshaft.
   For additional information, refer to: Halfshaft (205-05, Removal and Installation).

7. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Drive Halfshafts - Rear Halfshaft

Removal and Installation

Special Tool(s)

	Halfshaft remover/replacer 204-506/1(LRT-60-030/1)
	Retainers - halfshaft remover/replacer 204-506/5(LRT-60-030/5)
	Halfshaft remover/replacer 204-506/3(LRT-60-030/3)
	Halfshaft installer adapter 204-506-01(LRT-60-030/4)
	Axle oil seal remover 308-005(LRT-37-004/2)
	Impulse extractor 100-012(LRT-99-004)
	Installer halfshaft oil seal 308-626/1
	Installer/Guide halfshaft oil seal

	308-626/2

Removal

CAUTIONS:

Do not allow halfshafts to hang unsupported at one end or joint damage will occur.

Do not store or install halfshafts with joints at maximum articulation or damage may occur to the joint.

Angularly Adjusted Roller (AAR) joints, used at the inboard end of some halfshafts have no internal retaining mechanism and can separate.

Do not undo or remove the large protruding hexagon on the differential casing.

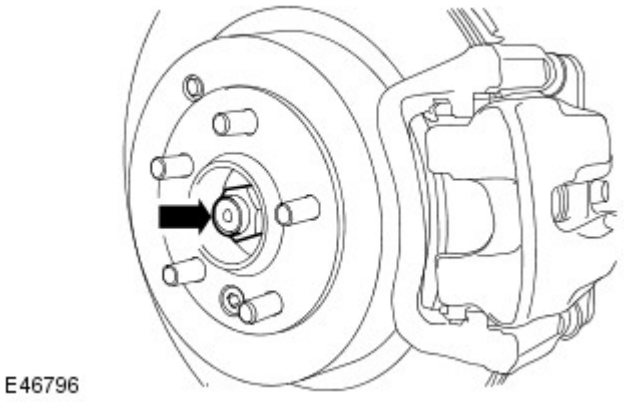
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Drain the differential lubricant.
   For additional information, refer to: Differential Draining and Filling (205-02 Rear Drive Axle/Differential, General Procedures).

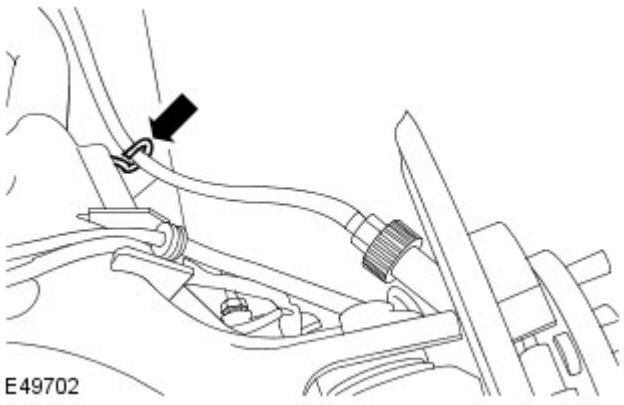
3. Remove the wheel and tire.

4. Loosen the halfshaft retaining nut.
   - Discard the nut.

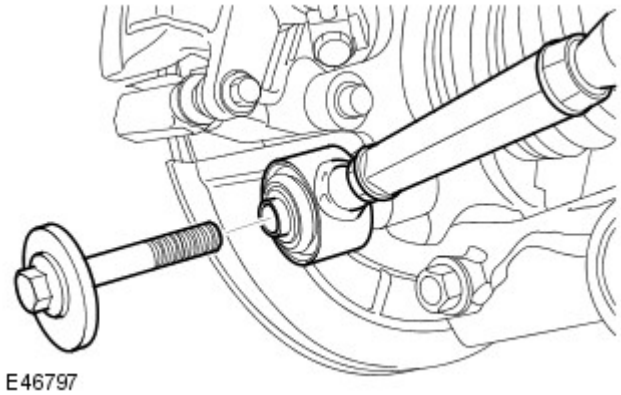


5. Remove the stabilizer bar link.
   For additional information, refer to: Rear Stabilizer Bar Link (204-02 Rear Suspension, Removal and Installation).

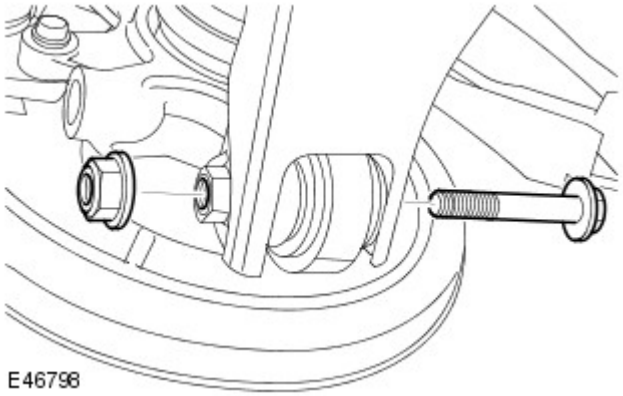
6. Release the parking brake cable from the lower arm.



7. Disconnect the toe link.
    - Remove the bolt.

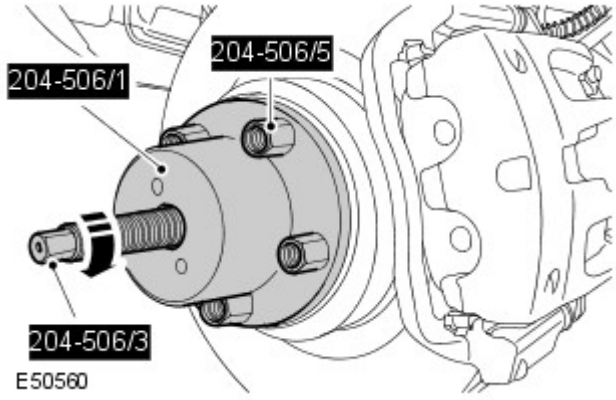

E46797

8. Remove and discard the halfshaft retaining nut.


E46798

9. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

   Release the knuckle from the lower arm.
    - Remove the bolt.



E50560

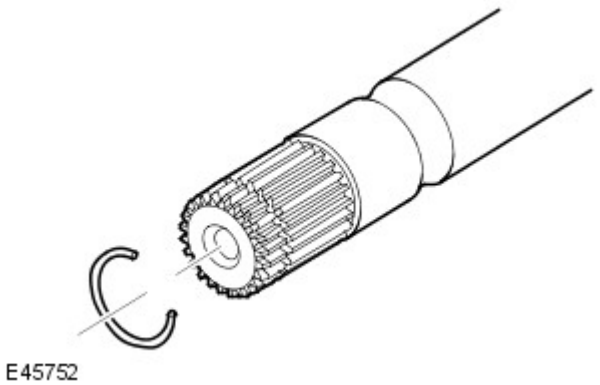
10. CAUTION: Do not use a hammer to detach the halfshaft from the hub assembly, failure to follow this instruction may result in damage to the halfshaft.

    Using the special tools, release the halfshaft from the wheel hub.

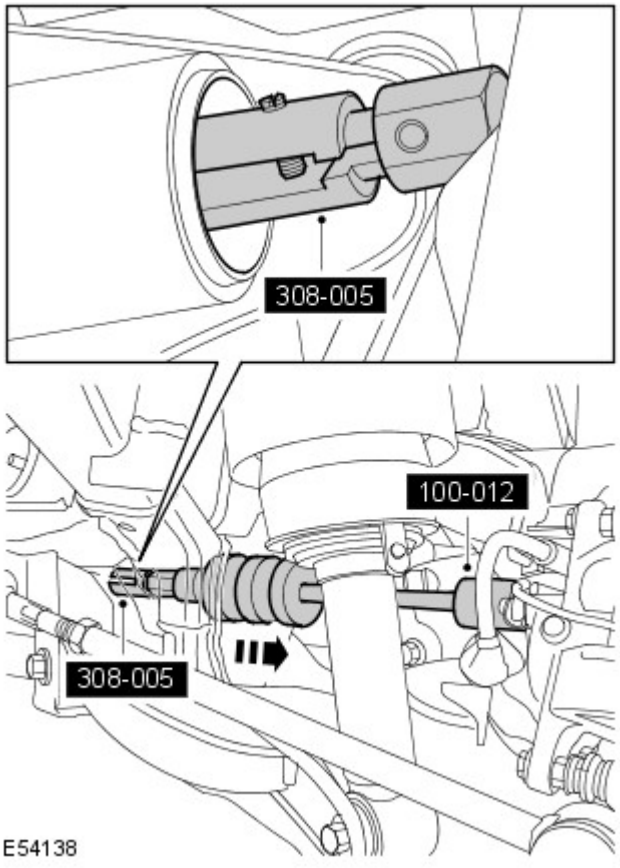
11. Position a container to collect the oil spillage.

12. Release the halfshaft from the differential housing.

13. With assistance, remove the halfshaft.
    - Remove and discard the snap ring.

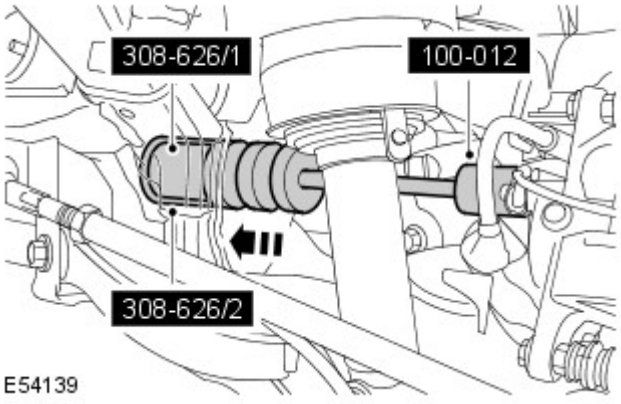

E45752

14. Using the special tools, remove and discard the halfshaft oil seal.

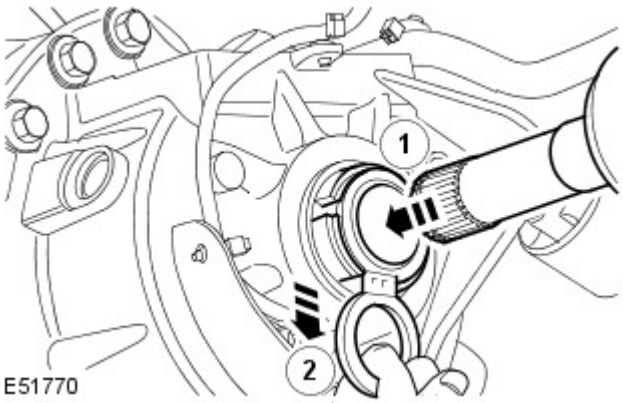


Installation

1. Clean the components.

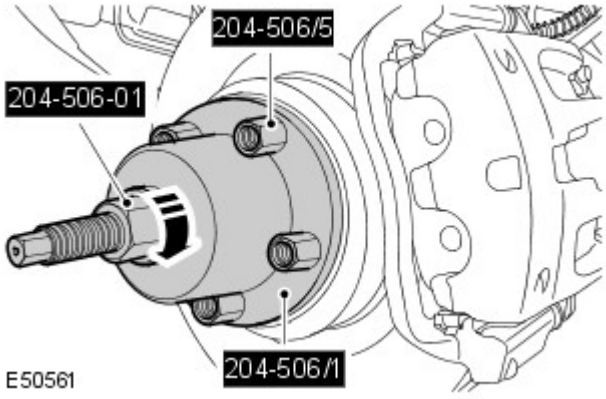


2. Using the special tools, install a new halfshaft oil seal.
    - The halfshaft oil seal protector must be left in place, until the halfshaft is fully installed.
3. With assistance, install the halfshaft.
    - Install the snap ring.
    - Open the halfshaft oil seal protector.
    - Make sure the snap ring is fully engaged and retains the halfshaft.



4. NOTE: The oil seal protector is designed to break into two pieces.

   Remove and discard the halfshaft oil seal protector.



5. Using the special tools, install the halfshaft in the wheel hub.

6. CAUTION: Make sure the ball joint seal is not damaged. A damaged seal will lead to the premature failure of the joint.

   Connect the lower arm to the wheel knuckle.
   - Tighten to 275 Nm (203 lb.ft).
   - Tighten the new nut to 275 Nm (203 lb.ft).

7. CAUTION: Install the halfshaft nut finger tight.

   Install a new halfshaft retaining nut and lightly tighten.

8. Connect the toe link.
   - Tighten the bolt to 175 Nm (129 lb.ft).

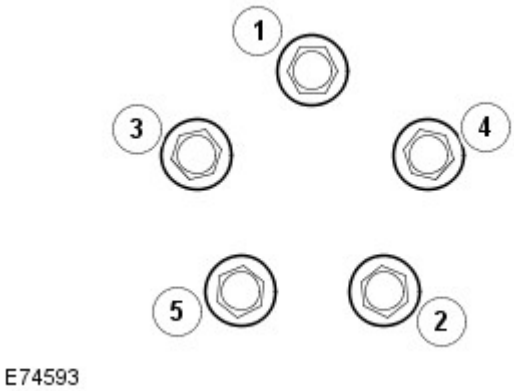
9. Secure the parking brake cable to the lower arm.

10. Install the stabilizer bar link.
    For additional information, refer to: Rear Stabilizer Bar Link (204-02 Rear Suspension, Removal and Installation).

11. CAUTION: Do not use air tools to install the nut. Failure to follow this instruction may result in damage to the component.

    Tighten the new halfshaft retaining nut to 420 Nm (311 lb.ft).
    - Stake the nut to the halfshaft.

12. Install the wheel and tire.
    - Tighten the wheel nuts in the sequence shown:
      1. 1. Stage 1: 4 Nm
      2. 2. Stage 2: 70 Nm
      3. 3. Stage 3: 140 Nm



13. CAUTION: Do not fill the differential with lubricant up to the filler plug. The filler plug is only used to fill the differential with lubricant, and not to act as a level indicator.

    Fill the differential with the correct amount of lubricant.
    For additional information, refer to: Differential Draining and Filling (205-02 Rear Drive Axle/Differential, General Procedures).

Brake System - General Information -

Brake Hydraulic Fluid

Item	Specification
* Recommended hydraulic fluid	SHELL DONAX YB DOT4 ESL FLUID

CAUTION: * If the above fluid is not available, use a low viscosity DOT 4 brake fluid meeting ISO 4925 Class 6 and Land Rover LRES22BF03 requirements.

General Specification

Item	Specification
Footbrake type:	
Vehicles without Brembo brakes	Hydraulic, servo assisted, self-adjusting with front/rear split hydraulic system, twin piston sliding calipers to the front and single piston sliding calipers to the rear
Vehicles with Brembo brakes	Hydraulic, servo assisted, self-adjusting with front/rear split hydraulic system, opposed six piston calipers to the front and single piston sliding calipers to the rear
Parking brake type	Twin shoe (leading/trailing) operating on rear wheels and controlled from park brake lever in floor console via twin cables

Brake System - General Information - Brake System

Diagnosis and Testing

Principles of Operation

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

Front Disc Brake (206-03 Front Disc Brake, Description and Operation),
Rear Disc Brake (206-04 Rear Disc Brake, Description and Operation),
Parking Brake (206-05 Parking Brake and Actuation, Description and Operation),
Hydraulic Brake Actuation (206-06 Hydraulic Brake Actuation, Description and Operation),
Brake Booster (206-07 Power Brake Actuation, Description and Operation),
Anti-Lock Control - Traction Control (206-09 Anti-Lock Control - Traction Control, Description and Operation).

Inspection and Verification

CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

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

1. Verify the customer concern.
   - If a road test is necessary make sure the vehicle is safe to do so.
2. Visually inspect for obvious signs of mechanical damage.

Visual Inspection

Mechanical
• Brake pad(s) condition and installation • Brake caliper(s) condition and installation • Brake disc(s) condition and installation • Parking brake disc(s)/parking brake drum(s) condition and installation • Parking brake shoes condition and installation • Parking brake cable(s) condition and installation • Brake booster condition and installation • Brake booster vacuum hose condition and installation • Brake master cylinder condition and installation • Hydraulic Control Unit (HCU) • Brake fluid leaks • Brake warning indicator

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Brake noise	• Debris • Brake pads • Brake disc(s)	Inspect for debris, remove as necessary. Check for excessive brake pad wear. Check for brake disc damage.
Brake vibration	• Suspension components • Brake disc(s)	Check for worn or damaged suspension components. Check for brake disc distortion or runout.
Excessive brake pedal travel/brake pedal spongy	• Brake pads • Air in the brake system • Brake master cylinder • Brake fluid leak (see visual inspection)	Worn pads may make the pedal travel excessive, new pads may make the pedal spongy. Check after bedding in the pads. Check the pedal travel. If the pedal "pumps-up", suspect air in the system. Check for a cause for air ingress, rectify as necessary. If the pedal sinks to the floor when held under pressure when there are no external leaks, suspect a master cylinder fault. Refer to the relevant section of the workshop manual.
Excessive brake pedal effort/brake pedal hard	• Brake pipe(s) • Brake caliper slide(s) • Brake caliper piston(s) • Brake vacuum pipe	Check for damaged brake pipes. Check the brake calipers. Check the brake vacuum pipe for air leaks, rectify as necessary. Check the brake vacuum pump operation. Refer to the relevant section of the workshop manual. Check the brake booster.

	• Brake vacuum pump • Brake booster	
Low foot brake efficiency/brakes pulling/sticking/binding	• Brake pipe(s) • Pads • Brake caliper piston(s) • Brake caliper slide(s) • Brake disc(s)	Check the vehicle for damaged brake pipes. Inspect the brake pads. Check the brake calipers. Check the brake discs. Refer to the relevant section of the workshop manual.
Parking brake will not engage or release Low parking brake efficiency/parking brake sticking/binding	• Parking brake cables • Parking brake shoes • Parking brake adjusters • Rear brake disc(s)/parking brake drum(s) • Parking brake actuator malfunction	Check the parking brake cable(s) for operation/condition. Check that the cable end connector(s) are correctly installed to the operating lever(s). Inspect the parking brake shoes for wear. Check the parking brake shoes for correct adjustment. Check the rear brake disc(s)/parking brake drum(s). Check the parking brake actuator for damage and/or excessive noise in normal operation. Refer to the relevant section of the workshop manual.
Brake warning indicator staying illuminated	• Brake reservoir fluid level • Brake pads • Brake pad wear sensor leads • Brake fluid level sensor	Check the brake fluid level, top up if required. Inspect the brake pads. Check the brake pad sensor circuit. Refer to the electrical guides. Check the function of the brake fluid level sensor. Refer to the relevant section of the workshop manual.

DTC Index

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

Brake System - General Information - Front Brake Disc Runout Check Vehicles Without: High Performance Brakes

General Procedures

NOTES:

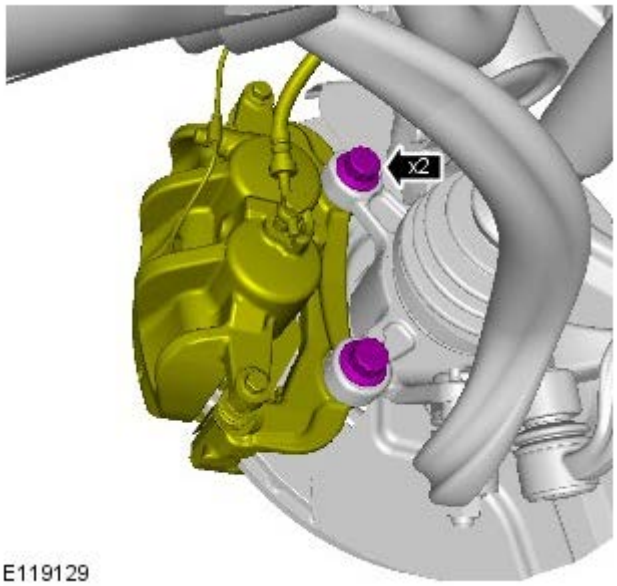
Some variation in the illustrations may occur, but the essential information is always correct.

LH illustration shown, RH is similar.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise the front of the vehicle.

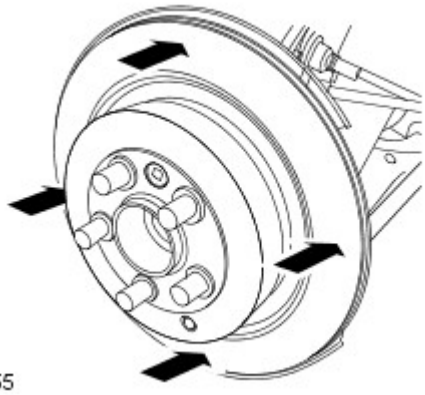
2. Remove the road wheel.



E119129

3. CAUTION: Do not allow the brake caliper to hang on the brake hose.

   Release the brake caliper and tie aside.

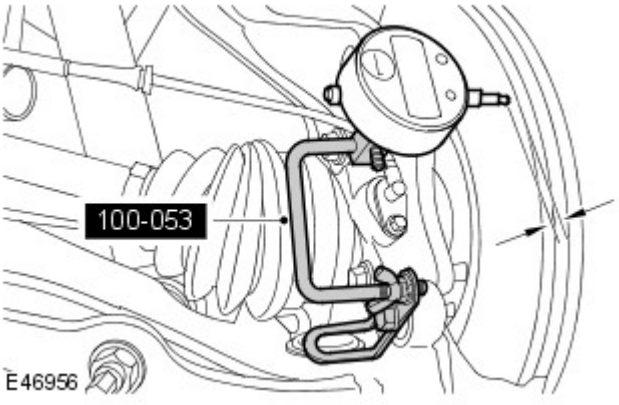


E46955

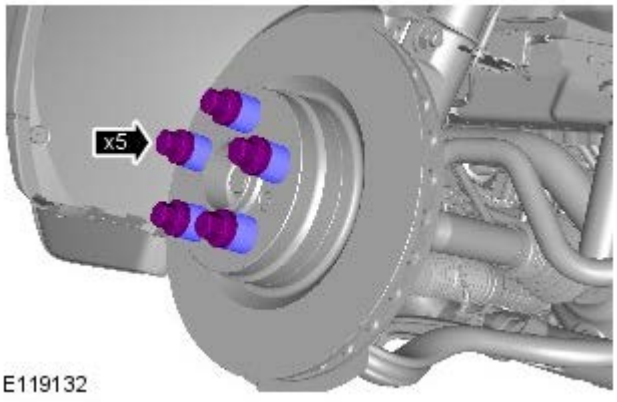
4. CAUTION: Brake discs must be renewed in pairs, unless one disc requires changing before 1000 miles (1600 kilometers) from new.

   At 4 points around disc, measure disc thisckness using a micrometer; renew disc if less than service limit or if variation is exceeded: Disc thickness, NEW 30 mm, Service limit = 27 mm. Thickness variation maximum = 0.01.

5. Mount a Dial Test Indicator (DTI) to and secure to inboard side of hub using caliper assembly upper bolt hole



6. Position DTI probe 5 mm in from outer edge of disc.



7. Install spacer washers under the wheel nuts.
    - Tighten the road wheel nuts to 140 Nm (103 lb.ft).
8. Zero DTI and rotate road wheel one complete revolution to measure disc runout. Disc runout must not exceed 0.05 mm (0.002 in).
9. If disc runout is outside limits:
10. Remove the wheel hub nuts.
    - Remove the spacers.
11. Remove Allen screw securing brake disc to drive flange.
12. Remove the brake disc.
13. Ensure mating surfaces of disc and drive flange are clean.
14. Install the brake disc.
    - Tighten the Torx screw to 35 Nm (26 lb.ft).
15. Install spacer washers under the wheel nuts.
    - Tighten the road wheel nuts to 140 Nm (103 lb.ft).
16. Check disc runout as detailed above.
17. If runout is still outside limits, renew disc and/or hub.
18. Remove the wheel hub nuts.
    - Remove the spacers.
19. Remove the DTI.
20. Install the brake caliper and tighten the bolts. TORQUE: 275 Nm
21. Install the road wheel(s) and tighten nuts to 140Nm (103 lb-ft).
22. Depress brake pedal several times to set brake pads.
23. Lower the vehicle.

Brake System - General Information - Front Brake Disc Runout Check Vehicles With: High Performance Brakes

General Procedures

NOTES:

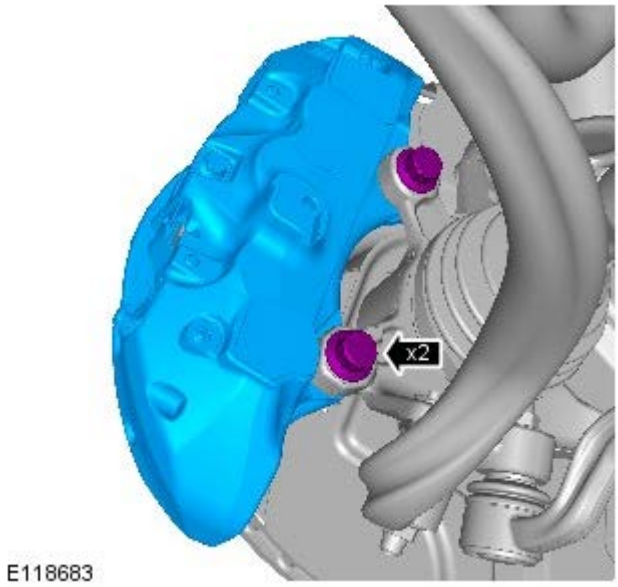
Some variation in the illustrations may occur, but the essential information is always correct.

LH illustration shown, RH is similar.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise the front of the vehicle.

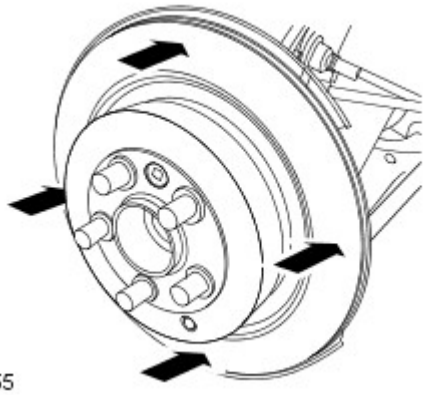
2. Remove the road wheel.



E118683

3. CAUTION: Do not allow the brake caliper to hang on the brake hose.

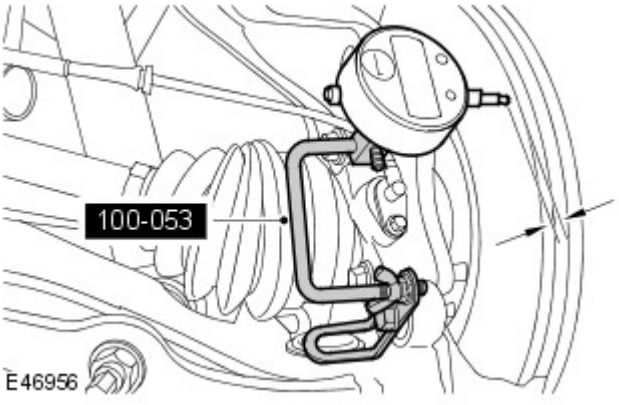
   Release the brake caliper and tie aside.


E46955

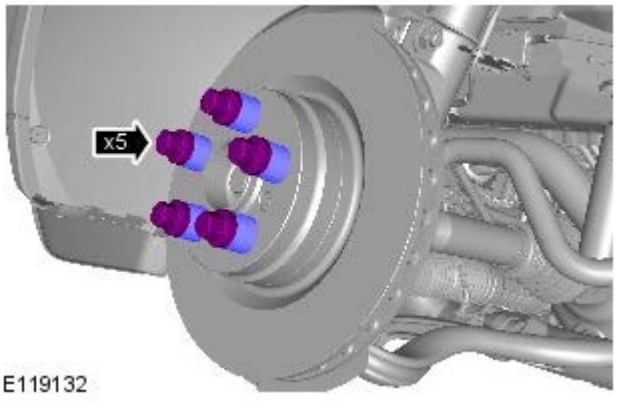
4. CAUTION: Brake discs must be renewed in pairs, unless one disc requires changing before 1000 miles (1600 kilometers) from new.

   At 4 points around disc, measure disc thickness using a micrometer; renew disc if less than service limit or if variation is exceeded: Disc thickness, NEW 34 mm, Service limit 31 mm. Thickness variation maximum = 0.01 mm

5. Mount a Dial Test Indicator (DTI) to and secure to inboard side of hub using caliper assembly upper bolt hole



6. Position DTI probe 5 mm in from outer edge of disc.



7. Install spacer washers under the wheel nuts.
   - Tighten the road wheel nuts to 140 Nm (103 lb.ft).
8. Zero DTI and rotate road wheel one complete revolution to measure disc runout. Disc runout must not exceed 0.05 mm (0.002 in).
9. If disc runout is outside limits:
10. Remove the wheel hub nuts.
    - Remove the spacers.
11. Remove Allen screw securing brake disc to drive flange.
12. Remove the brake disc.
13. Ensure mating surfaces of disc and drive flange are clean.
14. Install the brake disc.
    - Tighten the Torx screw to 35 Nm (26 lb.ft).
15. Install spacer washers under the wheel nuts.
    - Tighten the road wheel nuts to 140 Nm (103 lb.ft).
16. Check disc runout as detailed above.
17. If runout is still outside limits, renew disc and/or hub.
18. Remove the wheel hub nuts.
    - Remove the spacers.
19. Remove the DTI.
20. Install the brake caliper and tighten the bolts to 275 Nm (203 lb.ft)
21. Install the road wheel(s) and tighten nuts to 140Nm (103 lb-ft).
22. Depress brake pedal several times to set brake pads.
23. Lower the vehicle.

Brake System - General Information - Rear Brake Disc Runout Check

General Procedures

NOTES:

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

RH illustration shown, LH is similar.

It is not necessary to carry out the parking brake shoe 'bedding-in procedure' if the rear brake discs or parking brake shoes have been removed for access to other components.

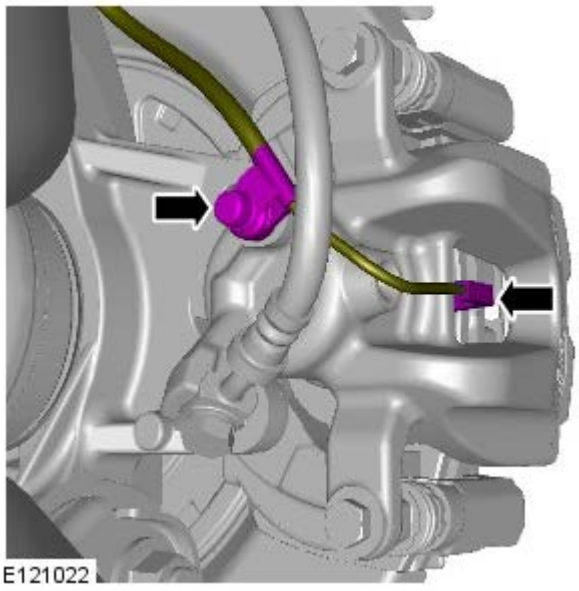
1. CAUTION: Do not turn the ignition on when the parking brake service mode has been set, this will result in the parking brake being released from the service mode.

   Enter the parking brake into the service mode.
   - Turn the ignition on.
   - Apply, and hold, the footbrake.
   - Apply, and hold, the parking brake switch to the RELEASE position.
   - Turn the ignition off.
   - Release the footbrake.
   - Release the parking brake switch.

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

   Raise rear of vehicle.

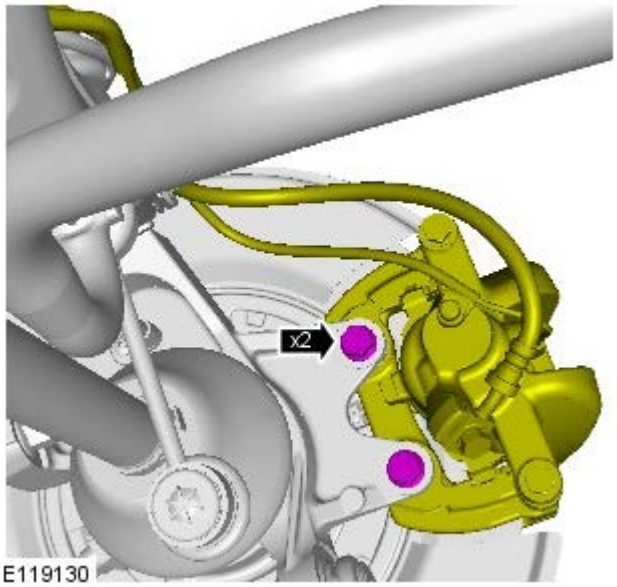
3. Remove road wheel.

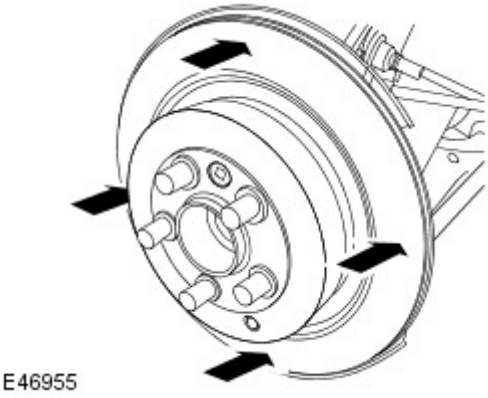


4. CAUTION: The brake pad wear indicator sensor is easily damaged. Do not use a lever to remove the sensor. Use fingers only.

   RH side rear only: Disconnect the brake pad wear indicator sensor lead.

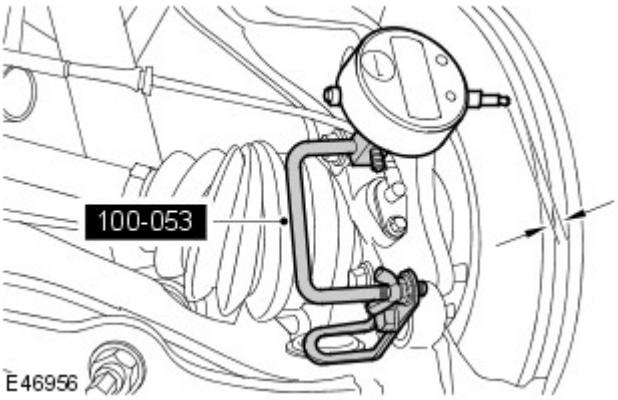
5. Remove 2 bolts securing brake caliper to hub. Release caliper from hub and tie aside.





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

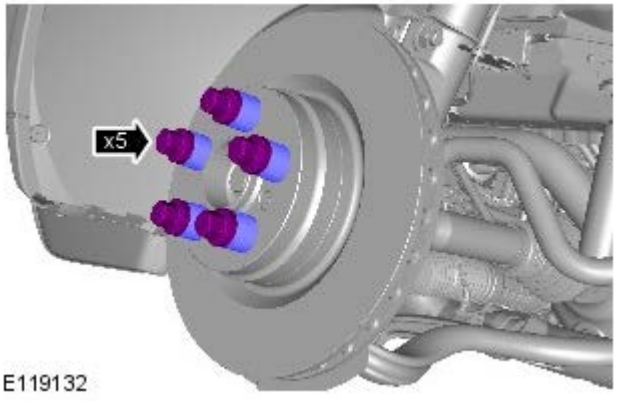
   At 4 points around the disc, measure disc thickness using a micrometer; renew disc if less than service limit or if variation is exceeded: Disc thickness, NEW = 20 mm Service limit = 18 mm. Thickness variation maximum = 0.01 mm.



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

   Mount a Dial Test Indicator (DTI) to and secure to inboard side of hub using caliper assembly upper bolt hole.

8. Position DTI probe 5 mm in from outer edge of disc.



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

   Tighten the wheel nuts to 140 Nm (103 lb.ft).
   - Install spacer washers under the wheel nuts.

10. Zero DTI and rotate wheel one complete revolution to measure disc runout. Disc runout must not exceed 0.09 mm (0.003 in).

11. If disc runout is outside limits:

12. Remove the wheel hub nuts.
    - Remove the spacer washers.

13. Remove Allen screw securing brake disc to drive flange.

14. Remove brake disc.

15. Ensure mating surfaces of disc and drive flange are clean.

16. Install the brake disc.
    - Tighten the Torx screw to 35 Nm (26 lb.ft).

17. Tighten the wheel nuts to 140 Nm (103 lb.ft).
    - Install spacer washers under the wheel nuts.

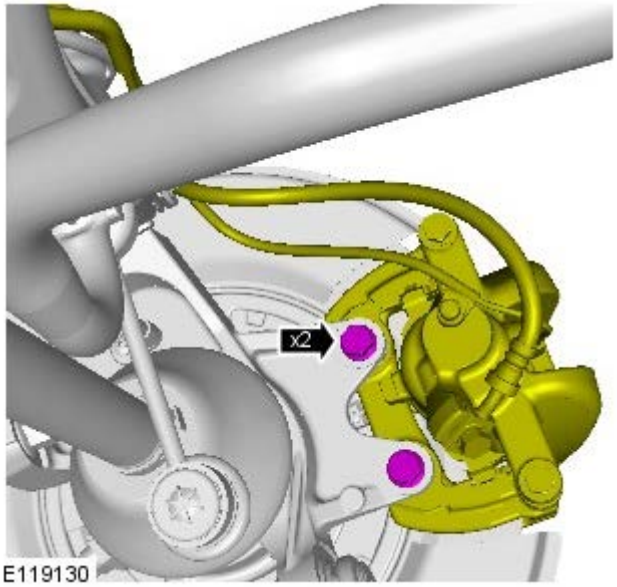
18. Check disc runout as detailed above.

19. If runout is still outside limits, renew disc and/or hub.

20. Remove the wheel hub nuts.
    - Remove the spacer washers.

21. Remove the DTI.

22. Install the brake caliper anchor bolts
    - Tighten the bolts to 115 Nm (85 lb.ft).



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

24. Depress brake pedal several times to set brake pads.

25. Remove stands and lower vehicle.

Brake System - General Information - Brake System Bleeding Vehicles With: High Performance Brakes

General Procedures

WARNING: If any components upstream of the Hydraulic Control Unit (HCU), including the HCU itself are replaced, the brake system must be bled using Land Rover approved diagnostic equipment. This will ensure that all air is expelled from the new component(s).

NOTES:

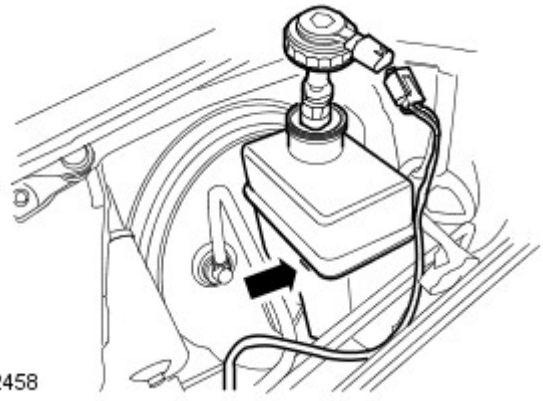
Bleeding of the complete brake system must be carried out using Land Rover approved diagnostic equipment. Where only the primary or secondary brake circuits have been disturbed in isolation, it should only be necessary to bleed that circuit. Partial bleeding of the hydraulic system is only permissible if a brake tube or hose has been disconnected with only minimal loss of fluid.

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

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

   Raise and support the vehicle.

2. Check that the brake fluid lines are secure and that there are no signs of a brake fluid leak. If a brake fluid leak is detected, investigate and rectify the cause of the leak before bleeding the brakes.



3. WARNING: Do not allow dirt or foreign liquids to enter the reservoir. Use only new brake fluid of the correct specification from airtight containers. Do not mix brands of brake fluid as they may not be compatible.

   CAUTIONS:

   Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

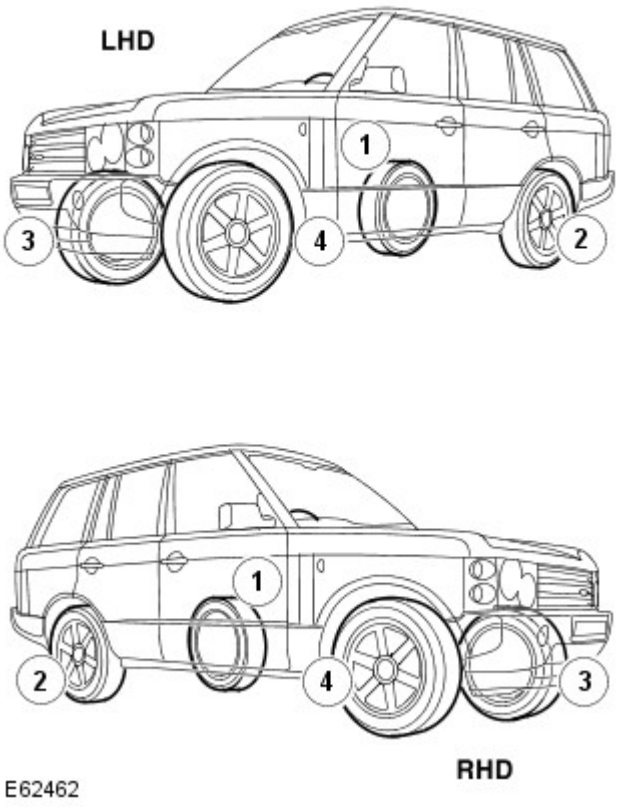
   The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

   Fill the brake fluid reservoir to the MAX mark.
   - Disconnect the brake fluid reservoir electrical connector.
   - Remove the brake fluid reservoir cap.

4. Conduct the bleed procedure with the engine running.

5. Connect the diagnostic tool to the vehicle, select diagnostic and proceed as directed for bleeding the brake system.

6. Starting at the brake caliper furthest away from the brake master cylinder, loosen the bleed screw by one-half to three-quarters of a turn.



7. Install the bleed tube to the brake caliper bleed screw and immerse the free end of the bleed tube in a bleed jar containing a small quantity of approved brake fluid.
    - Hold the bleed container at least 300 mm above the Caliper that is being bled.

8. CAUTION: The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

   With assistance, depress the brake pedal steadily through to 2/3 of its full stroke.

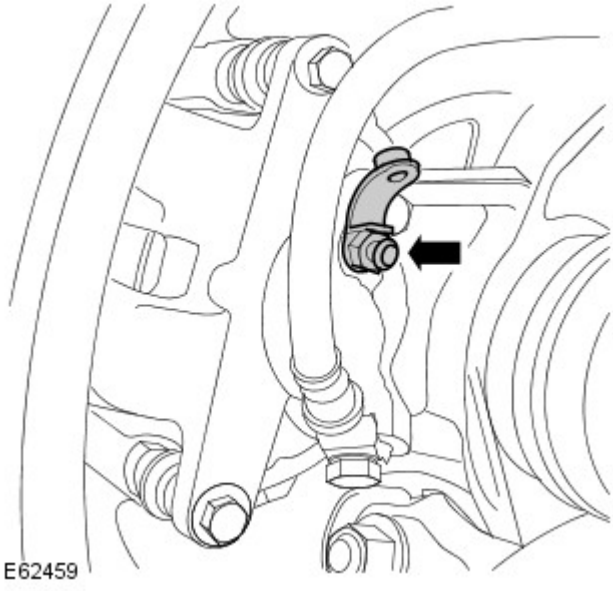
9. With the brake pedal held down, close bleed screw and then return the brake pedal to 1/3 of its full stroke and hold.

10. Repeat steps 8 and 9, 28 times for the rear brake and 10 times for the front brake.

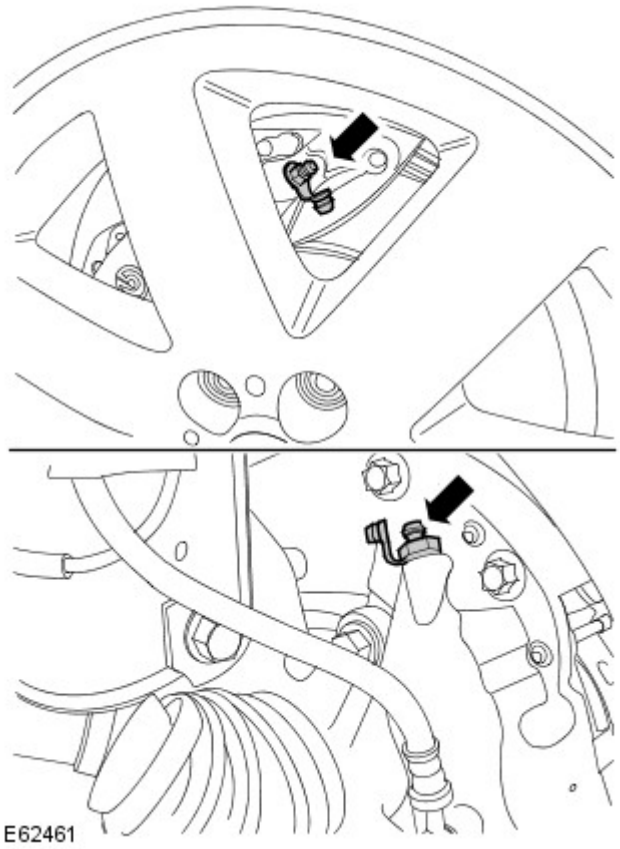
11. At the end of the bleed process, depress and hold the brake pedal down.

12. CAUTION: Make sure the bleed screw cap is installed after bleeding. This will prevent corrosion to the bleed screw.

    With the brake pedal fully depressed, tighten the bleed screw.
    - Tighten the front caliper bleed screws to 19 Nm (14 lb.ft).
    - Tighten the rear caliper bleed screws to 10 Nm (7 lb.ft).



13. Fill the brake fluid reservoir to the MAX mark.



14. WARNING: High performance front brake calipers have two bleed points. The inner bleed point must be bled before the outer bleed point. Braking efficiency may be seriously impaired if an incorrect bleed sequence is used.

CAUTION: Make sure the bleed screw cap is installed after bleeding. This will prevent corrosion to the bleed screw.

Repeat the brake bleeding procedure for each front brake caliper, following the above sequence.

- If access is restricted to the front caliper outer bleed screws, rotate the road wheels to gain access.
- Tighten the bleed screws to 19 Nm (14 lb.ft).

15. Fill the brake fluid reservoir to the MAX mark.

16. Apply the brakes and check for leaks.

17. Install the brake fluid reservoir cap.
    - Connect the brake fluid reservoir electrical connector.

18. On completion, road test the vehicle and check the brake pedal operation. The pedal travel should be short with a firm feel.

Brake System - General Information - Brake System Bleeding Vehicles With: Standard Brakes

General Procedures

WARNING: If any components upstream of the Hydraulic Control Unit (HCU), including the HCU itself are replaced, the brake system must be bled using Land Rover approved diagnostic equipment. This will ensure that all air is expelled from the new component(s).

NOTES:

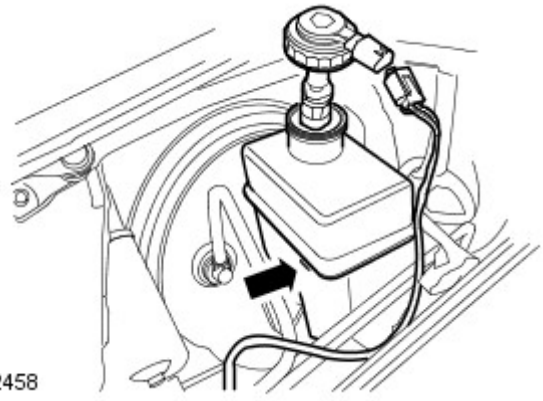
Bleeding of the complete brake system must be carried out using Land Rover approved diagnostic equipment. Where only the primary or secondary brake circuits have been disturbed in isolation, it should only be necessary to bleed that circuit. Partial bleeding of the hydraulic system is only permissible if a brake tube or hose has been disconnected with only minimal loss of fluid.

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

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Check that the brake fluid lines are secure and that there are no signs of a brake fluid leak. If a brake fluid leak is detected, investigate and rectify the cause of the leak before bleeding the brakes.



3. WARNING: Do not allow dirt or foreign liquids to enter the reservoir. Use only new brake fluid of the correct specification from airtight containers. Do not mix brands of brake fluid as they may not be compatible.

   CAUTIONS:

   Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

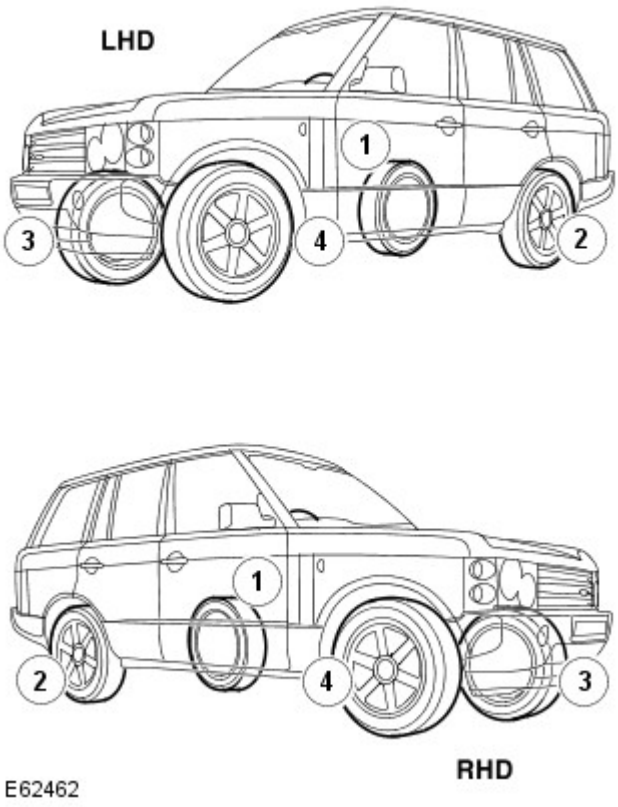
   The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

   Fill the brake fluid reservoir to the MAX mark.
   - Disconnect the brake fluid reservoir electrical connector.
   - Remove the brake fluid reservoir cap.

4. Conduct the bleed procedure with the engine running.

5. Connect the diagnostic tool to the vehicle, select diagnostic and proceed as directed for bleeding the brake system.

6. Starting at the brake caliper furthest away from the brake master cylinder, loosen the bleed screw by one-half to three-quarters of a turn.



7. Install the bleed tube to the brake caliper bleed screw and immerse the free end of the bleed tube in a bleed jar containing a small quantity of approved brake fluid.
    - Hold the bleed container at least 300 mm above the Caliper that is being bled.

8. CAUTION: The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

   With assistance, depress the brake pedal steadily through to 2/3 of its full stroke.

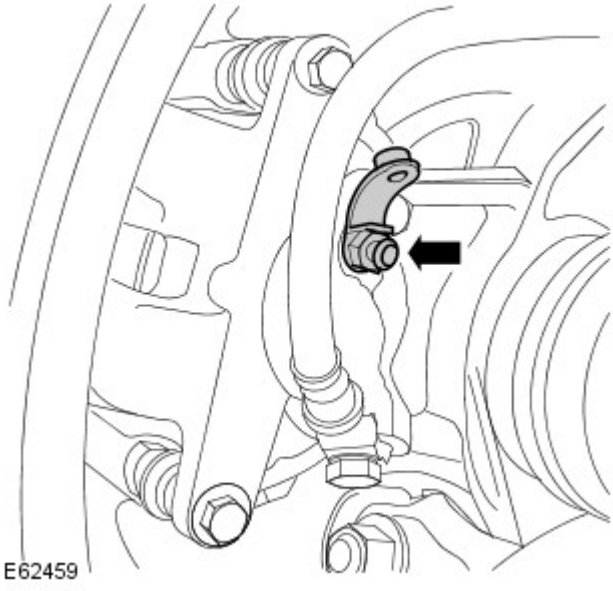
9. With the brake pedal held down, close bleed screw and then return the brake pedal to 1/3 of its full stroke and hold.

10. Repeat steps 8 and 9, 28 times for the rear brake and 10 times for the front brake.

11. At the end of the bleed process, depress and hold the brake pedal down.

12. CAUTION: Make sure the bleed screw cap is installed after bleeding. This will prevent corrosion to the bleed screw.

    With the brake pedal fully depressed, tighten the bleed screw to 10 Nm (7 lb.ft).



13. Fill the brake fluid reservoir to the MAX mark.

14. WARNING: Braking efficiency may be seriously impaired if an incorrect bleed sequence is used.

    Repeat the brake bleeding procedure for each brake caliper, following the above sequence.

15. Fill the brake fluid reservoir to the MAX mark.

16. Apply the brakes and check for leaks.

17. Install the brake fluid reservoir cap.
    - Connect the brake fluid reservoir electrical connector.

18. On completion, road test the vehicle and check the brake pedal operation. The pedal travel should be short with a firm feel.

Brake System - General Information - Brake System Pressure Bleeding

General Procedures

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

All vehicles

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Check that the brake fluid lines are secure and that there are no signs of a brake fluid leak. If a brake fluid leak is detected, investigate and rectify the cause of the leak before bleeding the brakes.

3. WARNING: Do not allow dirt or foreign liquids to enter the reservoir. Use only new brake fluid of the correct specification from airtight containers. Do not mix brands of brake fluid as they may not be compatible.

   CAUTIONS:

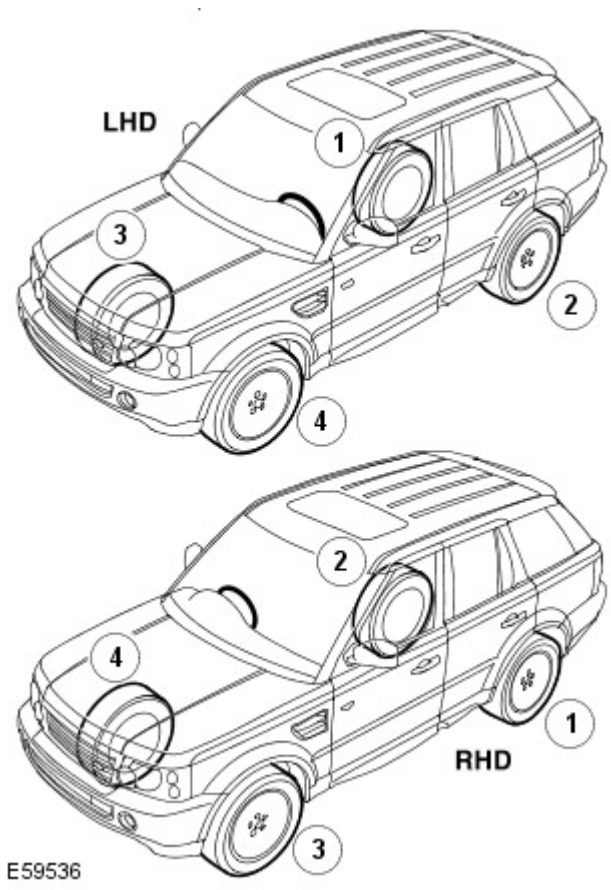
   Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

   The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

   Fill the brake fluid reservoir to the MAX mark.
   - Disconnect the brake fluid reservoir electrical connector.
   - Remove the brake fluid reservoir cap.

4. Conduct the bleed procedure with the engine running.

5. Starting at the brake caliper furthest away from the brake master cylinder, loosen the bleed screw by one-half to three-quarters of a turn.



Install the bleed tube to the brake caliper bleed screw and immerse the free end of the bleed tube in a bleed jar containing a small quantity of approved brake fluid.
- Hold the bleed container at least 300 mm above the Caliper that is being bled.

7.  CAUTION: The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

   With assistance, depress the brake pedal steadily through to 2/3 of its full stroke.

8. With the brake pedal held down, close bleed screw and then return the brake pedal to 1/3 of its full stroke and hold.

9. Repeat steps 7 and 8, 28 times for the rear brake and 10 times for the front brake.

10. At the end of the bleed process, depress and hold the brake pedal down.

11.  CAUTION: Make sure the bleed screw cap is installed after bleeding. This will prevent corrosion to the bleed screw.

    With the brake pedal fully depressed, tighten the bleed screw.
    - On vehicles with high performance brakes, tighten the front caliper bleed screw to 19 Nm (14 lb.ft).
    - On vehicles with standard brakes, tighten the front caliper bleed screw to 10 Nm (7 lb.ft).
    - Tighten the rear caliper bleed screws to 10 Nm (7 lb.ft).

12. Fill the brake fluid reservoir to the MAX mark.

13.  WARNING: Braking efficiency may be seriously impaired if an incorrect bleed sequence is used.

    Repeat the brake bleeding procedure for each brake caliper, following the above sequence.

Vehicles with supercharger

14.  WARNING: High performance front brake calipers have two bleed points. The inner bleed point must be bled before the outer bleed point. Braking efficiency may be seriously impaired if an incorrect bleed sequence is used.

    Repeat the brake bleeding procedure for each front brake caliper, following the above sequence.
    - If access is restricted to the front caliper outer bleed screws, rotate the road wheels to gain access.
    - Tighten the bleed screws to 19 Nm (14 lb.ft).

All vehicles

15. Fill the brake fluid reservoir to the MAX mark.

16. Apply the brakes and check for leaks.

17. Install the brake fluid reservoir cap.
    - Connect the brake fluid reservoir electrical connector.

18. On completion, road test the vehicle and check the brake pedal operation. The pedal travel should be short with a firm feel.

Brake System - General Information - Component Bleeding Vehicles With: High Performance Brakes

General Procedures

WARNING: If any components upstream of the Hydraulic Control Unit (HCU), including the HCU itself are replaced, the brake system must be bled using Land Rover approved diagnostic equipment. This will ensure that all air is expelled from the new component(s).

CAUTION: LH illustration shown, RH is similar.

NOTES:

Bleeding of the complete brake system must be carried out using Land Rover approved diagnostic equipment. The following manual procedure covers bleeding the brake system for components down stream of the HCU, where only the primary or secondary brake circuits have been disturbed in isolation. Partial bleeding of the hydraulic system is only permissible if a brake tube or hose has been disconnected with only minimal loss of fluid.

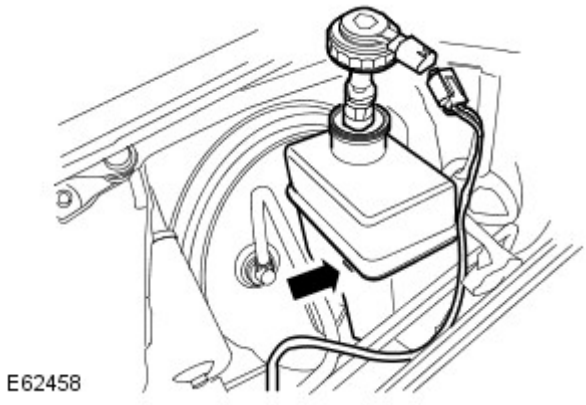
Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Check that the brake fluid lines are secure and that there are no signs of a brake fluid leak. If a brake fluid leak is detected, investigate and rectify the cause of the leak before bleeding the brakes.

3. Conduct the bleed procedure with the engine running.



4. WARNING: Do not allow dirt or foreign liquids to enter the reservoir. Use only new brake fluid of the correct specification from airtight containers. Do not mix brands of brake fluid as they may not be compatible.

   CAUTIONS:

   Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

   The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

   - Disconnect the brake fluid reservoir electrical connector.
   - Remove the brake fluid reservoir cap.
   - Fill the brake fluid reservoir to the MAX mark.

5. Install the bleed tube to the brake caliper bleed screw and immerse the free end of the bleed tube in a bleed jar containing a small quantity of approved brake fluid.
   - Hold the bleed container at least 300 mm above the Caliper that is being bled.

6. WARNING: High performance front brake calipers have two bleed points. The inner bleed point must be bled before the outer bleed point. Braking efficiency may be seriously impaired if an incorrect bleed sequence is used.

   - If access is restricted to the front caliper outer bleed screws, rotate the road wheels to gain access.
   - Loosen the bleed screw by one-half to three-quarters of a turn.

7.  CAUTION: The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

   With assistance, depress the brake pedal steadily through to 2/3 of its full stroke.

8. With the brake pedal held down, close bleed screw and then return the brake pedal to 1/3 of its full stroke and hold.

9. Repeat steps 7 and 8, 28 times for the rear brake and 10 times for the front brake.

10. At the end of the bleed process, depress and hold the brake pedal down.

11.  CAUTION: Make sure the bleed screw cap is installed after bleeding. This will prevent corrosion to the bleed screw.

    With the brake pedal fully depressed, tighten the bleed screw.
    - Tighten the front caliper bleed screws to 19 Nm (14 lb.ft).
    - Tighten the rear caliper bleed screws to 10 Nm (7 lb.ft).

12. Fill the brake fluid reservoir to the MAX mark.

13. Apply the brakes and check for leaks.

14. Install the brake fluid reservoir cap.
    - Connect the brake fluid reservoir electrical connector.

15. On completion, road test the vehicle and check the brake pedal operation. The pedal travel should be short with a firm feel.

Brake System - General Information - Component Bleeding Vehicles With: Standard Brakes

General Procedures

WARNING: If any components upstream of the Hydraulic Control Unit (HCU), including the HCU itself are replaced, the brake system must be bled using Land Rover approved diagnostic equipment. This will ensure that all air is expelled from the new component(s).

CAUTION: LH illustration shown, RH is similar.

NOTES:

Bleeding of the complete brake system must be carried out using Land Rover approved diagnostic equipment. The following manual procedure covers bleeding the brake system for components down stream of the HCU, where only the primary or secondary brake circuits have been disturbed in isolation. Partial bleeding of the hydraulic system is only permissible if a brake tube or hose has been disconnected with only minimal loss of fluid.

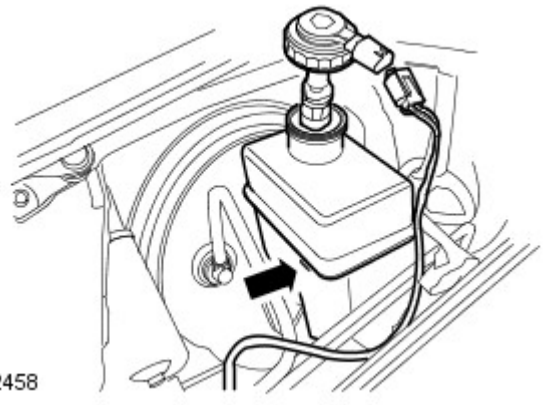
Some variation in the illustrations may occur, but the essential information is always correct.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Check that the brake fluid lines are secure and that there are no signs of a brake fluid leak. If a brake fluid leak is detected, investigate and rectify the cause of the leak before bleeding the brakes.

3. Pump the brake pedal until the brake vacuum assistance is exhausted.



4. WARNING: Do not allow dirt or foreign liquids to enter the reservoir. Use only new brake fluid of the correct specification from airtight containers. Do not mix brands of brake fluid as they may not be compatible.

   CAUTIONS:

   Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

   The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

   Remove the brake fluid reservoir cap.
   - Disconnect the brake fluid reservoir electrical connector.
   - Fill the brake fluid reservoir to the MAX mark.

5. Install the bleed tube to the brake caliper bleed screw and immerse the free end of the bleed tube in a bleed jar containing a small quantity of approved brake fluid.
   - Hold the bleed container at least 300 mm above the Caliper that is being bled.

6. Loosen the bleed screw by one-half turn to three-quarters of a turn.

7. CAUTION: The brake fluid reservoir must remain full with new, clean brake fluid at all times during bleeding.

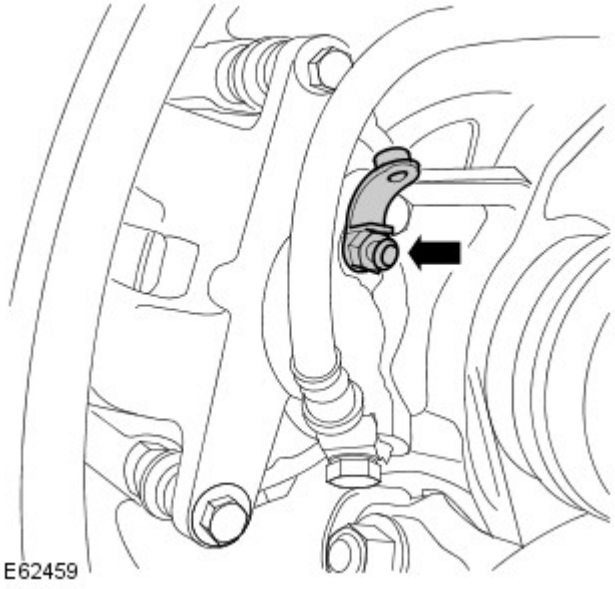
   With assistance, depress the brake pedal steadily through to

2/3 of its full stroke.

8. With the brake pedal held down, close bleed screw and then return the brake pedal to 1/3 of its full stroke and hold.

9. Repeat steps 7 and 8, 28 times for the rear brake and 10 times for the front brake.

10. At the end of the bleed process, depress and hold the brake pedal down.



11. CAUTION: Make sure the bleed screw cap is installed after bleeding. This will prevent corrosion to the bleed screw.

    With the brake pedal fully depressed, tighten the bleed screw.
    - On vehicles with high performance brakes, tighten the front caliper bleed screw to 19 Nm (14 lb.ft).
    - On vehicles with standard brakes, tighten the front caliper bleed screw to 10 Nm (7 lb.ft).
    - Tighten the rear caliper bleed screws to 10 Nm (7 lb.ft).

12. Fill the brake fluid reservoir to the MAX mark.

13. Apply the brakes and check for leaks.

14. Install the brake fluid reservoir cap.
    - Connect the brake fluid reservoir electrical connector.

15. On completion, road test the vehicle and check the brake pedal operation. The pedal travel should be short with a firm feel.

Brake System - General Information - Front Brake Disc Runout Check - With Wheel On Vehicles With: Standard Brakes

General Procedures

NOTES:

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

LH illustration shown, RH is similar.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise the front of the vehicle.


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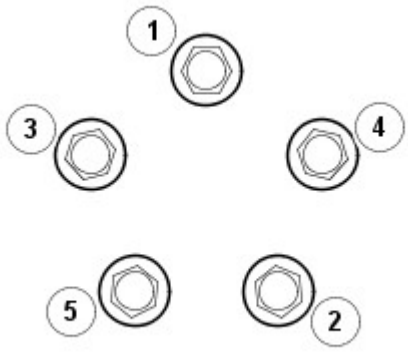
2. NOTES:

   Take care not to contact back plate with DTI probe.

   DTI probe extension maybe required.

   Use magnetic base stand to mount Dial Test Indicator (DTI) gauge gauge as shown 5 mm in from edge of disc.

3. Zero DTI and rotate the wheel one full complete revolution to measure disc runout. Disc runout must not exceed 0.03 mm.



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4. NOTE: The following steps must be followed if the runout exceeds 0.03 mm.

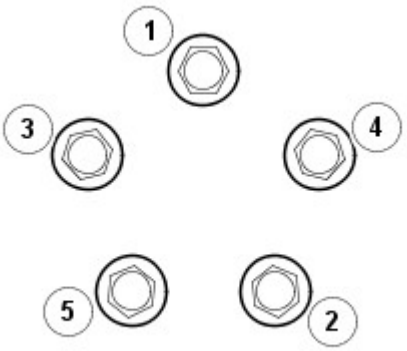
   Remove and rotate the wheel 2 stud holes and install the wheel and tire in the new position.
   - Tighten the road wheel nuts in sequence as shown above to the following:
   - Stage 1: 4 Nm.
   - Stage 2: 70 Nm.
   - Stage 3: 140 Nm.

5. Check runout as detailed above.

NOTE: If the runout still exceeds 0.03

6. Check hub drive flange runout.
   For additional information, refer to: Front Wheel Bearing and Wheel Hub Runout Check (204-00, General Procedures).

7. Install the wheel and tire.
   - Tighten the road wheel nuts in sequence as shown above to the following:
   - Stage 1: 4 Nm.



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Stage 2: 70 Nm.
- Stage 3: 140 Nm.

Brake System - General Information - Front Brake Disc Runout Check - With Wheel On Vehicles With: High Performance Brakes

General Procedures

CAUTION: Brake discs must be renewed in pairs, unless one disc requires changing before 1000 miles (1600 kilometers) from new.

NOTES:

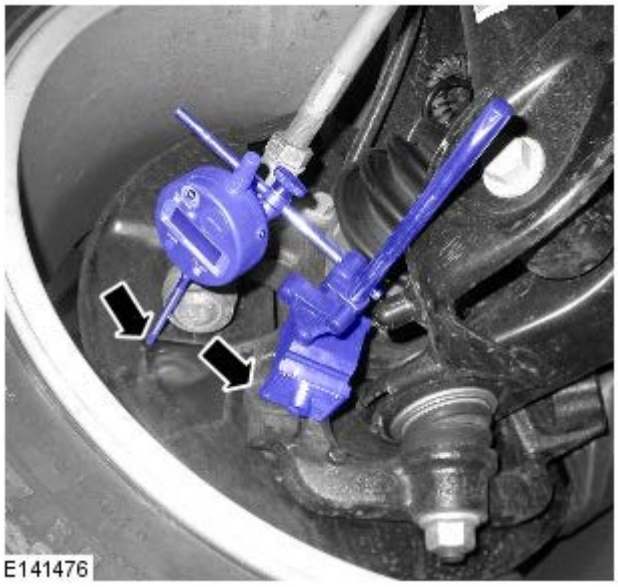
Some variation in the illustrations may occur, but the essential information is always correct.

RH illustration shown, LH similar.

All measurements must taken with the wheel installed.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise the front of the vehicle.



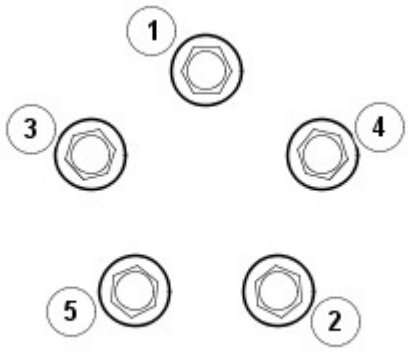
2. NOTES:

   DTI probe extension maybe required.

   Take care not to contact the back plate with the DTI probe.

   Use magnetic base stand to mount the Dial Test Indicator (DTI) gauge as shown. Position DTI probe 2 mm in from the front upper corner of the inspection window.

3. Zero DTI and rotate road wheel one complete revolution to measure disc runout. Disc runout must not exceed 0.03 mm.



E74593

4. NOTE: The following steps must be followed if the runout exceeds 0.03 mm.

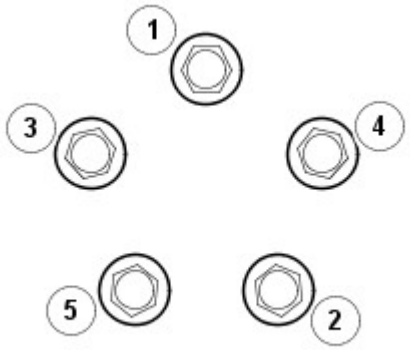
   Remove and rotate the wheel 2 stud holes and install the wheel and tire in the new position.
   - Tighten the road wheel nuts in sequence as shown above to the following:
   - Stage 1: 4 Nm.
   - Stage 2: 70 Nm.
   - Stage 3: 140 Nm.

5. Check disc runout as detailed above

NOTE: If the runout still exceeds 0.03 mm

6. Check hub drive flange runout.
   For additional information, refer to: Front Wheel Bearing and

Wheel Hub Runout Check (204-00 Suspension System - General Information, General Procedures).



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7. Install the wheel and tire.
    - Tighten the road wheel nuts in sequence as shown above to the following:
    - Stage 1: 4 Nm.
    - Stage 2: 70 Nm.
    - Stage 3: 140 Nm.

Brake System - General Information - Brake Pad Bedding-In

General Procedures

NOTE: This procedure is to gradually increase the temperature in the braking components without inducing thermal shock and to mate the brake pad and disc friction surfaces.

1. With the vehicle stationary, pump the brake pedal until the pedal is firm.
2. Drive the vehicle and make sure that the braking system operates correctly.
3. NOTE: The following steps must be done without excessive traffic.

   Using light to medium deceleration and varying speeds, leave at least 0.5 mile (0.8 Km) between each brake application.
4. Drive the vehicle, performing 30 brake applications, with a duration of 3 seconds for each application.

Front Disc Brake -

Item	Specification
Disc type	Ventilated
Disc diameter:	
Vehicles without High performance brakes	360 mm (14.2 in)
Vehicles with High performance brakes	380 mm (15.0 in)
Disc thickness:	
Vehicles without High performance brakes:	
New	30.0 mm (1.18 in)
Service limit	27.0 mm (1.063 in)
Maximum disc run-out - disc installed	0.05 mm (0.002 in)
Vehicles with High performance brakes:	
New	34.0 mm (1.34 in)
Service limit	31.0 mm (1.22 in)
Maximum disc run-out - disc installed	0.05 mm (0.002 in)
Vehicles without High performance brakes:	
Caliper type	Sliding pin, twin piston
Piston diameter	48.0 mm (1.9 in)
Pad minimum thickness	3.0 mm (0.12 in)
Vehicles with High performance brakes:	
Caliper type	Fixed, six piston
Piston diameter	40/38/36 mm (1.57/1.50/1.42 in)
Pad minimum thickness	3.0 mm (0.12 in)
Brake pad wear warning lead:	
Location	Front left hand brake pad
Activates at	75% of pad life utilised

Torque Specifications Vehicles without High performance Brakes

Description	Nm	lb-ft
Brake caliper bleed screw	10	7
Brake disc retaining bolt	35	26
Brake caliper anchor plate to hub bolts:	275	202
Brake caliper housing to anchor plate bolts	35	26
Brake hose union	32	24

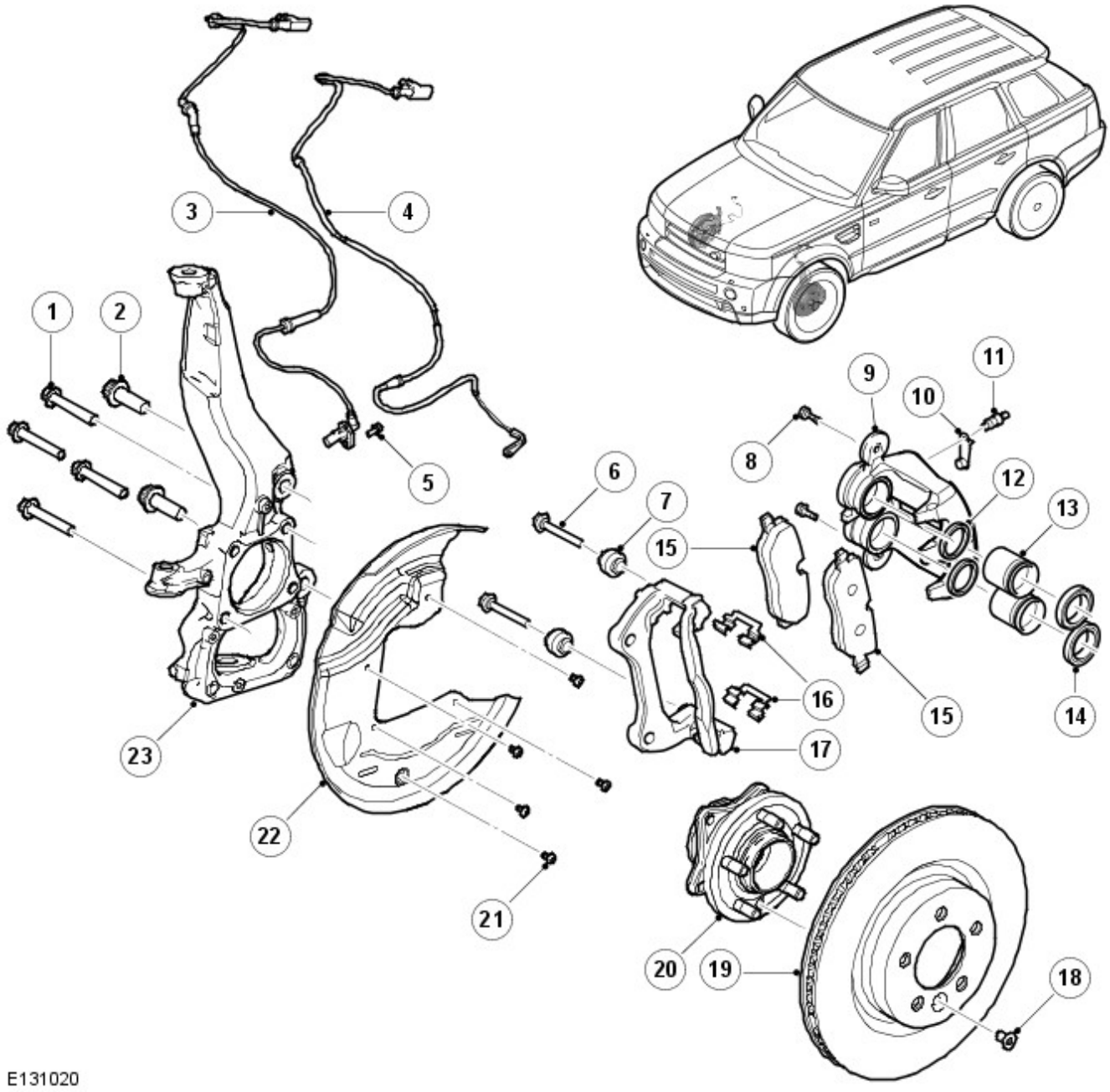
Torque Specifications Vehicles with High performance Brakes

Description	Nm	lb-ft
Brake caliper bleed screw	19	14
Brake disc retaining bolt	35	26
Brake caliper retaining bolts:	275	202
Brake hose union	32	24
Brake pad centre bolt	30	22

Front Disc Brake - Front Disc Brake

Description and Operation

COMPONENT LOCATIONS - STANDARD BRAKES

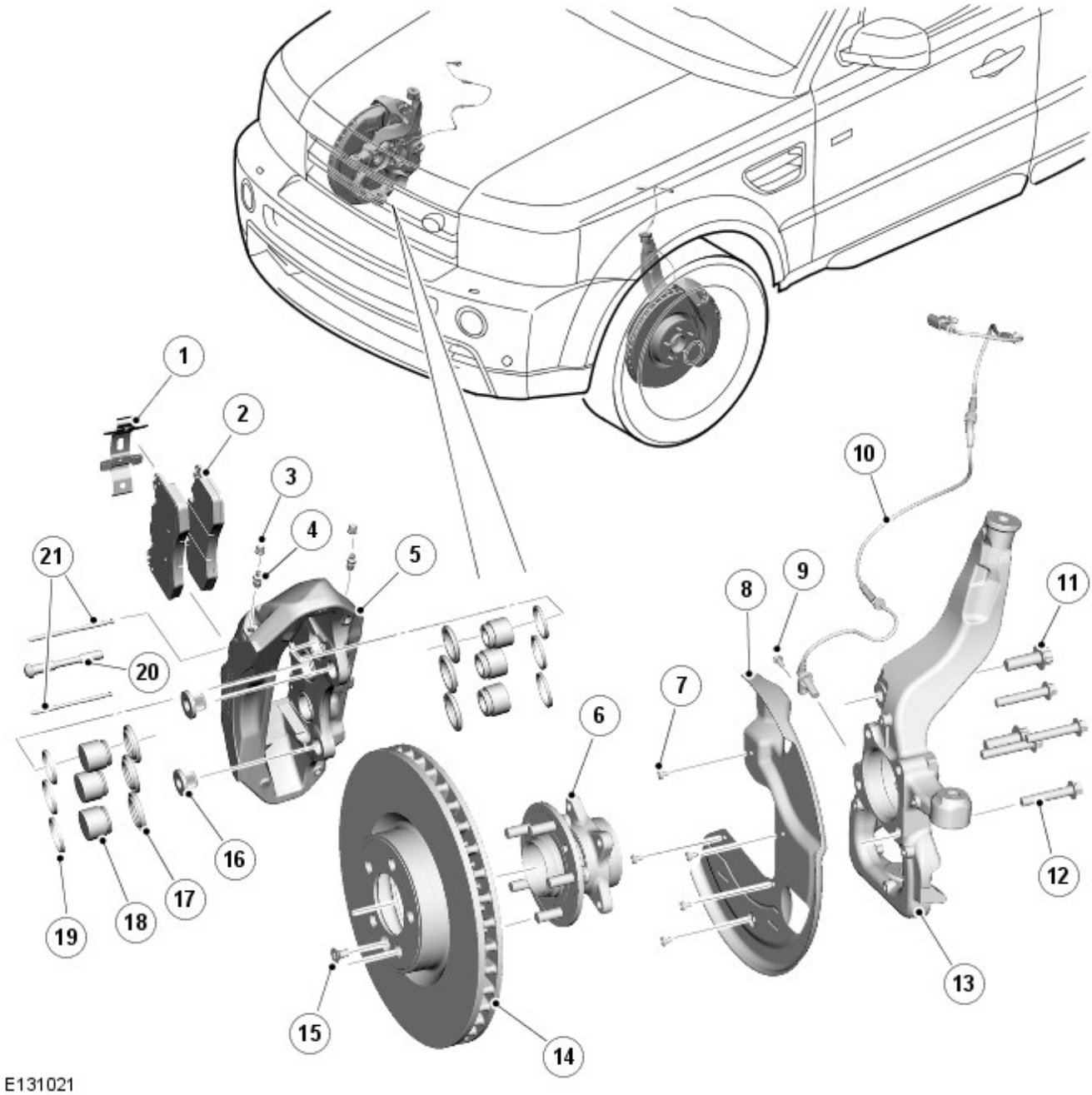


E131020

Item	Part Number	Description
1	-	Hub bearing assembly bolt (x 4)
2	-	Caliper bolt (x 2)
3	-	Wheel speed sensor
4	-	Brake pad wear sensor lead
5	-	Wheel speed sensor bolt
6	-	Guide pin (x 2)
7	-	Guide pin dust cover (x 2)
8	-	Guide pin bolt (x 2)
9	-	Caliper body
10	-	Bleed screw dust cap
11	-	Bleed screw
12	-	Piston seal (x 2)
13	-	Piston (x 2)
14	-	Piston dust cover (x 2)
15	-	Brake pad

16	-	Brake pad retainers
17	-	Caliper carrier
18	-	Brake disc retaining bolt
19	-	Brake disc
20	-	Hub bearing assembly
21	-	Dust shield screw (x 5)
22	-	Dust shield
23	-	Front knuckle

COMPONENT LOCATIONS - HIGH PERFORMANCE BRAKES



Item	Part Number	Description
1	-	Brake pad retainer
2	-	Brake pad
3	-	Bleed screw dust cap (x 2)
4	-	Bleed screw (x 2)
5	-	Caliper body
6	-	Hub bearing assembly
7	-	Dust shield screw (x 5)
8	-	Dust shield
9	-	Wheel speed sensor bolt
10	-	Wheel speed sensor
11	-	Caliper retaining bolt (x 2)

12	-	Hub bearing assembly bolt (x 4)
13	-	Front knuckle
14	-	Brake disc
15	-	Brake disc retaining bolt
16	-	Caliper thread insert (x 2)
17	-	Piston dust cover (x 6)
18	-	Piston (x 6)
19	-	Piston seal (x 6)
20	-	Caliper bridge bolt
21	-	Brake pad retaining pins (x 2)

GENERAL

The front brakes on all models feature ventilated brake discs, with different diameter brake discs for each model. All models except 5.0L SC feature twin piston sliding calipers. On 5.0L SC models, 6 piston, opposed piston Brembo calipers are installed.

On all models the brake caliper is attached to the rear of the front knuckle. The brake pads are made from an asbestos free material. The inboard brake pad of the left front brake incorporates a wear sensor.

With the standard brake sliding calipers, when hydraulic pressure is supplied to the caliper, the pistons extend and force the inner pad against the brake disc. The caliper body reacts and slides on the guide pins to bring the outer pad into contact with the brake disc.

With the high performance fixed calipers, when hydraulic pressure is supplied to the caliper, the three pairs of opposed pistons extend in the caliper. The three pistons in each side of the caliper force their related brake pads against the brake disc.

The front brake pad wear sensor is connected in series with the rear brake pad wear sensor, between the instrument cluster and ground. When a brake pad incorporating a brake pad wear sensor is approximately 75% worn, the brake pad wear sensor goes open circuit. When the instrument cluster detects the open circuit, it illuminates the amber light emitting diode (LED) in the brake warning indicator, displays an appropriate warning in the message center and sounds a warning chime. For additional information, refer to: Instrument Cluster (413-01, Description and Operation).

At the beginning of each ignition cycle, the instrument cluster performs a bulb check on the brake warning indicator: the indicator is illuminated amber for 1.5 seconds, red for 1.5 seconds, then goes off.

Front Disc Brake - Front Disc Brake

Diagnosis and Testing

For additional information.
REFER to: Brake System (206-00, Diagnosis and Testing).

Front Disc Brake - Brake Disc Vehicles With: Standard Brakes

Removal and Installation

Removal

WARNING: If installing a new brake disc, install new brake pads.

CAUTION: Brake discs must be renewed in pairs.

NOTES:

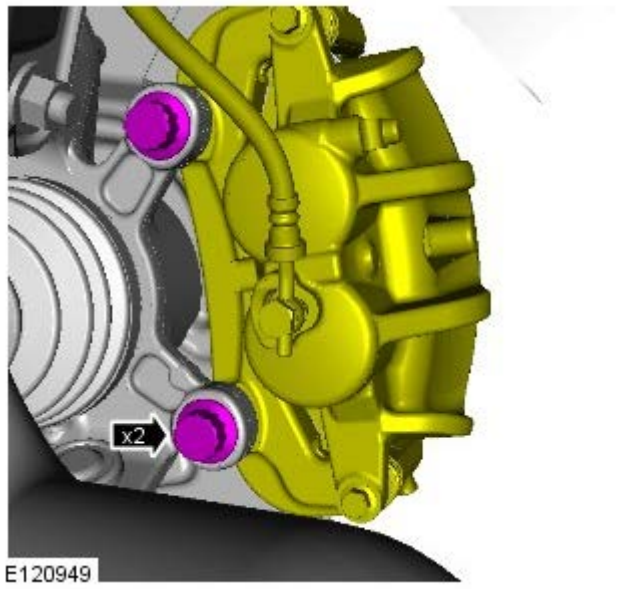
Some variation in the illustrations may occur, but the essential information is always correct.

The brake pad wear warning indicator sensor must be replaced each time the brake pads are serviced.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the front wheel and tire.

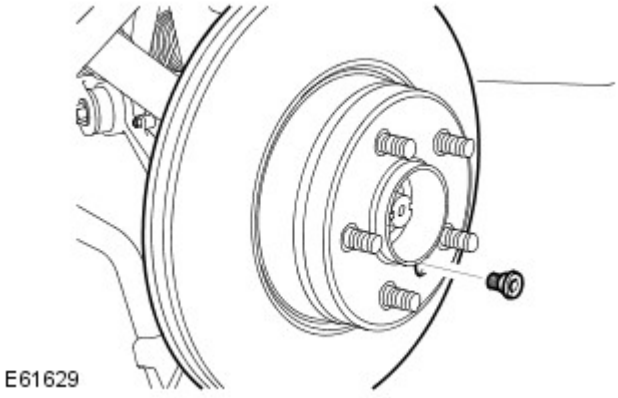


3. CAUTIONS:

   Do not allow the brake caliper to hang on the brake hose.

   LH side: Do not allow the brake caliper to hang on the brake pad wear warning sensor lead.

   Remove the brake caliper and anchor plate.
   - Remove the brake caliper anchor bolts.
   - Tie the brake caliper aside.

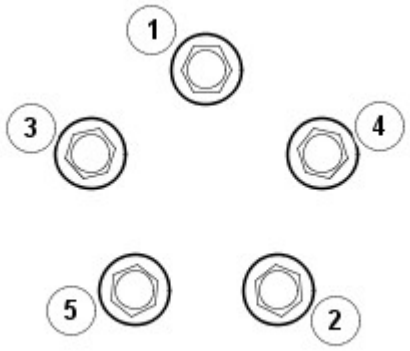


4. Remove the front brake disc.
   - Remove the Allen screw.

Installation

1. Make sure the brake disc and hub mating surfaces are clean.
2. Install the brake disc.
   - Tighten the Torx screw to 35 Nm (26 lb.ft).
3. Install the brake caliper and anchor plate.

- Clean the component mating faces.
- Tighten the bolts to 275 Nm (203 lb.ft).



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4. NOTE: Tighten the wheel nuts in the sequence shown:

   Install the wheels and tires.
   - Stage 1 : 4Nm
   - Stage 2 : 70Nm
   - Stage 3 : 140Nm

5. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.

6. For additional information, refer to: Brake Pad Bedding-In (206-00 Brake System - General Information, General Procedures).

Front Disc Brake - Brake Disc Vehicles With: High Performance Brakes

Removal and Installation

Removal

WARNING: If installing a new brake disc, install new brake pads.

CAUTION: Brake discs must be renewed in pairs.

NOTES:

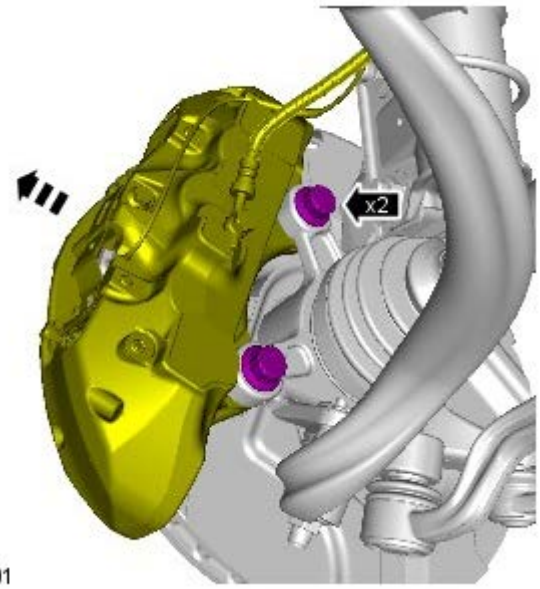
LH illustration shown, RH is similar.

The brake pad wear warning indicator sensor must be replaced each time the brake pads are serviced.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the wheel and tire.

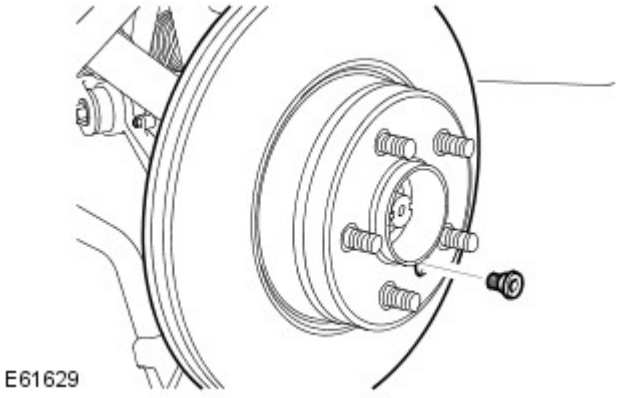


3. CAUTIONS:

   Do not allow the brake caliper to hang on the brake hose.

   LH side: Do not allow the brake caliper to hang on the brake pad wear warning sensor lead.

   Remove the brake caliper anchor bolts.
   - Release the brake caliper.
   - Tie the brake caliper aside.



4. Remove the brake disc.
   - Remove the Allen screw.

Installation

1. Make sure the brake disc and hub mating surfaces are clean.
2. Install the brake disc.
   - Tighten the bolt to 35 Nm (26 lb.ft).
3. Install the brake caliper and tighten the bolts to 275 Nm (203

lb.ft)
- Clean the component mating faces.

4. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

5. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.

6. For additional information, refer to: Brake Pad Bedding-In (206-00, General Procedures).

Front Disc Brake - Brake Pads Vehicles With: Standard Brakes

Removal and Installation

Removal

WARNINGS:

Brake pads must be renewed in axle sets only, otherwise braking efficiency may be impaired.

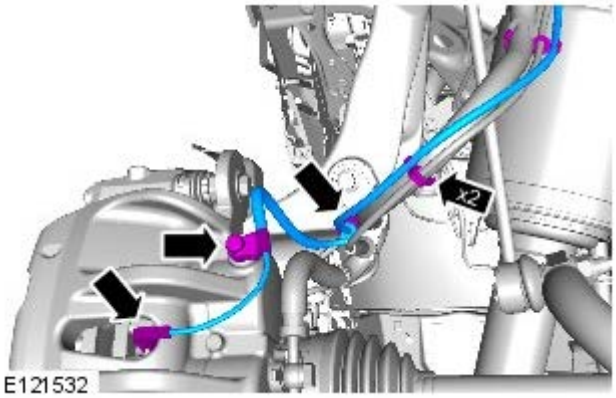
If the brake pad wear warning light has been activated, the pad wear sensor must be replaced.

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

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the wheels and tires.

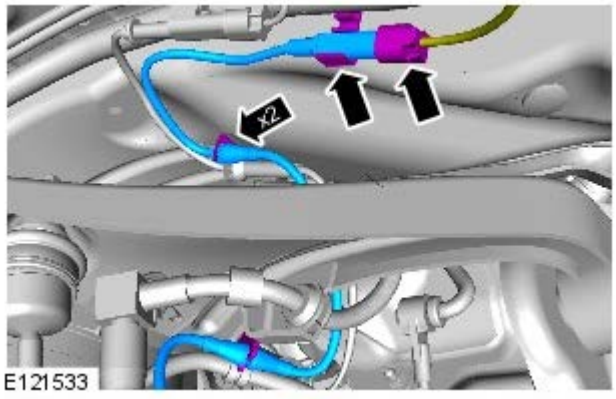


3. CAUTION: The brake pad wear indicator sensor is easily damaged. Do not use a lever to remove the sensor. Use fingers only.

   LH side front: Disconnect the brake pad wear indicator sensor wiring harness.

4. NOTE: This step is only required if a new wear indicator harness is installed.

   Remove the front LH fender splash shield.
   For additional information, refer to: Fender Splash Shield (501-02, Removal and Installation).

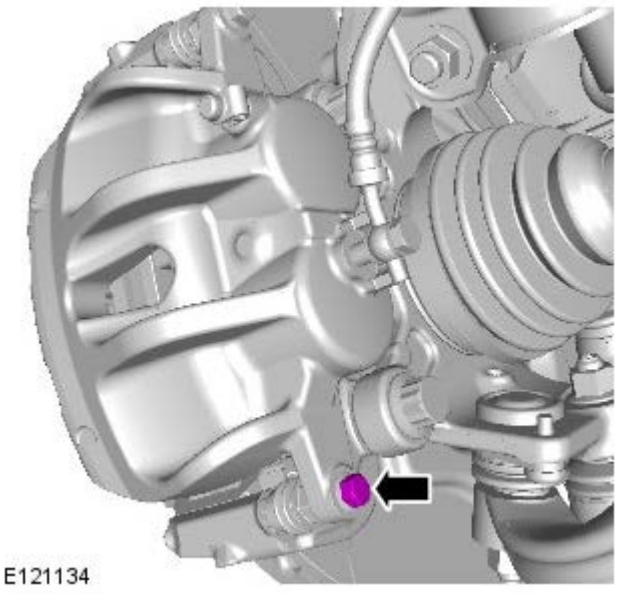


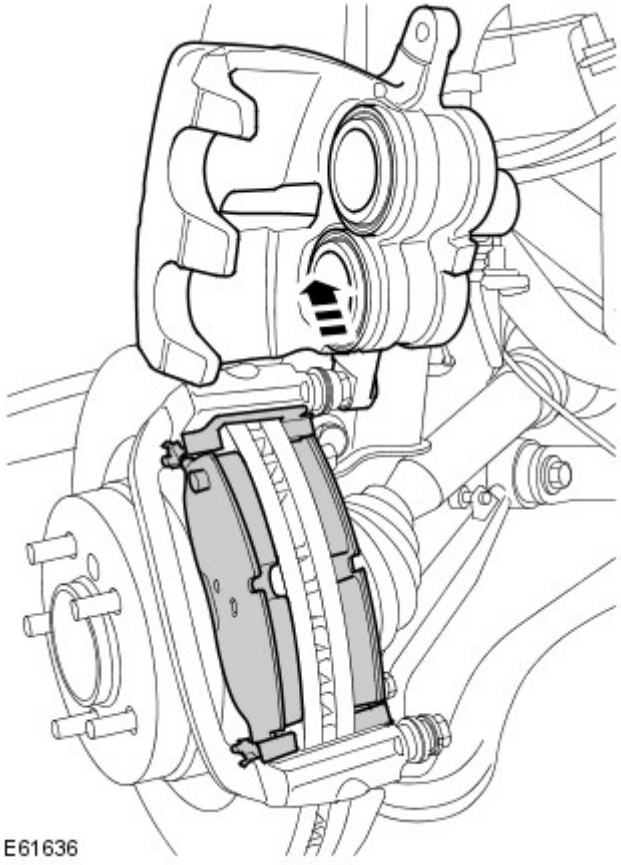
5. NOTE: This step is only required if a new wear indicator harness is installed.

   LH side front: Release and disconnect the brake pad wear indicator wiring harness.

6. NOTE: Use an additional wrench to prevent the component from rotating.

   Remove the brake caliper lower bolt.


E121134


E61636

7. NOTE: Note the orientation of the brake pads including the position of the small mass on the outer pad.

   Remove the brake pads.
   - Rotate the brake caliper upwards.
   - Remove the 2 clips.

8. Repeat the above 2 steps for the other side.

Installation

1. WARNING: Do not use compressed air to clean brake components. Dust from friction materials can be harmful if inhaled.

   Clean the brake caliper housing and anchor plate using brake cleaning fluid.

2. Inspect the caliper piston and slide pin seals for damage.

3. CAUTIONS:

   The brake caliper should move freely on both slide pins.

If necessary, renew the components.

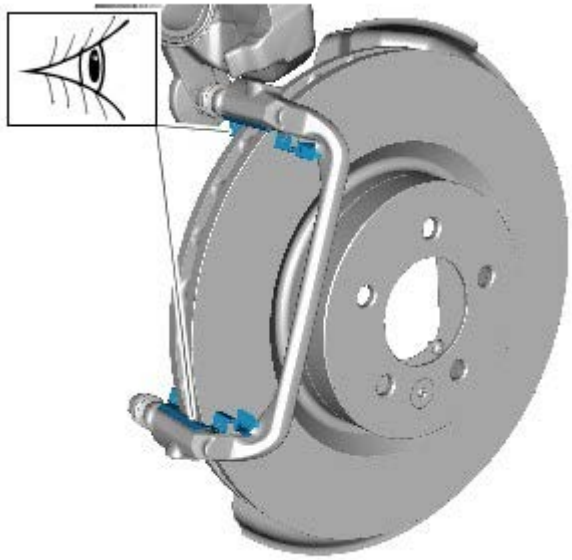
Make sure that the plain slide pin is installed to the upper part of the caliper and the bushed slide pin is installed to the lower part.

Check the slide pins for correct operation.

4. CAUTION: Check the brake fluid reservoir level before pushing the piston back, failure to follow this instruction may result in damage to the vehicle.

   NOTE: As the piston is pushed back into the caliper housing, the brake fluid level in the reservoir will rise. Do not allow the reservoir to overflow.

   Press the pistons into the caliper housing.

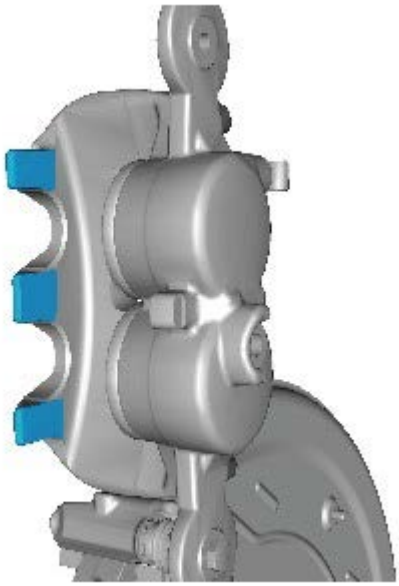


E147727

5. CAUTION: **Make sure that the plain clip is installed to the bottom part of the caliper and the rubber coated clip is installed to the upper part.**

   Install the 2 clips

6. Apply a suitable amount of the supplied grease to the caliper, as illustrated.



E147730

7. NOTE: Make sure the brake pads are installed in the correct orientation.

   Install the brake pads.

8. Rotate the brake caliper downwards.
   - Tighten the bolt to 35 Nm.

9. Repeat the above procedure for the other side.

10. NOTE: This step is only required if a new wear indicator harness is installed.

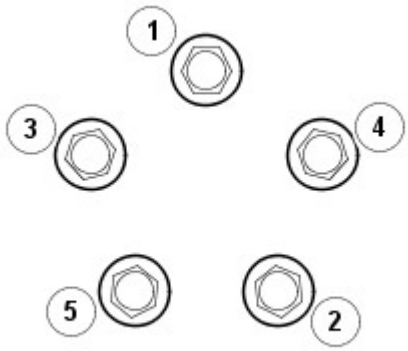
    LH side front: Connect the brake pad wear indicator wiring harness electrical connection.

11. NOTE: This step is only required if a new wear indicator harness is installed.

    Install the front LH fender splash shield.
    For additional information, refer to: Fender Splash Shield (501-02, Removal and Installation).

12. LH side front: Connect the brake pad wear indicator wiring harness.

13. Install the wheels and tires.
    - Tighten the wheel nuts in the sequence shown:
        1. Stage 1: 4 Nm
        2. Stage 2: 70 Nm
        3. Stage 3: 140 Nm



E74593

14. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.

15. For additional information, refer to: Brake Pad Bedding-In (206-00 Brake System - General Information, General Procedures).

Front Disc Brake - Brake Pads Vehicles With: High Performance Brakes

Removal and Installation

Removal

WARNING: Brake pads must be renewed in axle sets only. Failure to follow this instruction may result in braking efficiency being impaired.

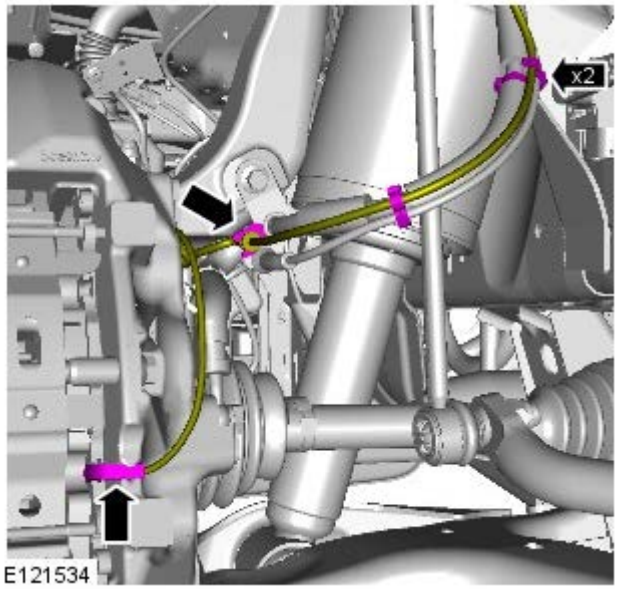
NOTE: The brake pad wear warning indicator sensor must be replaced each time the brake pads are serviced.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

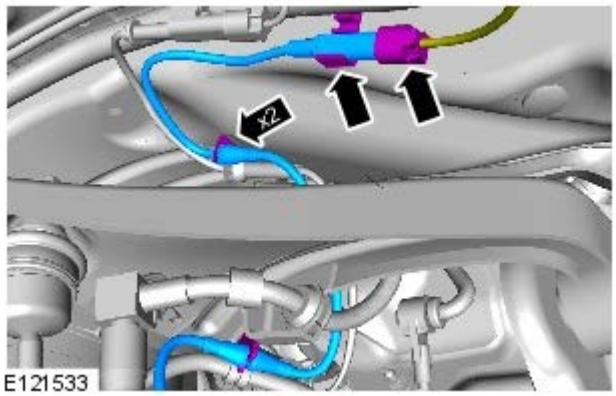
2. Remove the wheels and tires.

3. LH side front: Disconnect the brake pad wear indicator sensor wiring harness.



4. NOTE: This step is only required if a new wear indicator harness is installed.

   Remove the front LH splash shield.
   For additional information, refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).



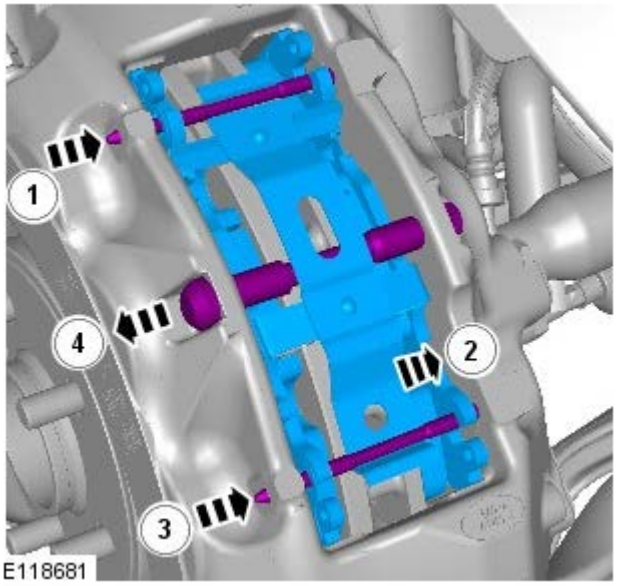
5. NOTE: This step is only required if a new wear indicator harness is installed.

   LH side front: Release and disconnect the brake pad wear indicator wiring harness.

6. NOTES:

   Note the orientation of the brake pads.

   Note the orientation of the anti-rattle spring



E118681

prior to removal.

Remove the front brake pads.
- Remove the 2 retaining pins.
- Remove the anti-rattle spring.
- Remove the bridge bolt from the centre of the caliper.

7. Repeat the above step for the other side.

Installation

1. WARNING: Do not use compressed air to clean brake components. Dust from friction materials can be harmful if inhaled.

   Clean the components.

2. Inspect the caliper piston seals for damage.

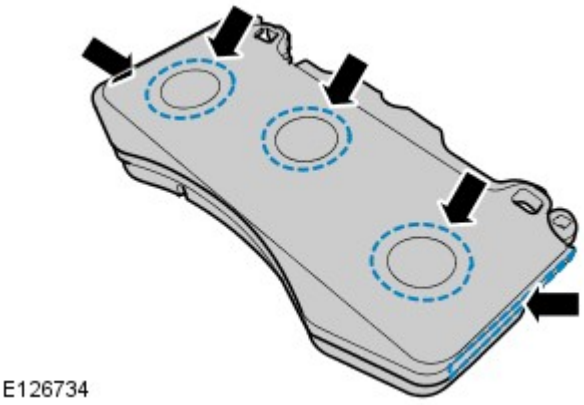
3. Position a bleed jar containing a small quantity of approved brake fluid. Connect the bleed tube to the bleed screw and loosen the screw.

4. Press the pistons into the caliper housing.
   - Tighten the bleed screw to 19 Nm (14 lb.ft).

5. Repeat the above process for the other 3 pistons.

6. Disconnect the bleed tube and remove the jar.

7. Apply grease LR020972 (Molykote CU7439 plus) to the areas indicated on the brake pads.


E126734

8. NOTES:

   Make sure the brake pads are installed in the correct orientation.

   Make sure the anti-rattle spring is installed in the correct orientation.

   Install the brake pads.
   - Tighten the bridge bolt to 30 Nm (22 lb.ft.).

- Position the anti-rattle spring.
- Install the pins, making sure the pin collets are fully engaged in the caliper.

9. Repeat the above procedure for the other side.

10. NOTE: This step is only required if a new wear indicator harness is installed.

    LH side front: Connect the brake pad wear indicator wiring harness electrical connection.

11. NOTE: This step is only required if a new wear indicator harness is installed.

    Install the front LH splash shield.
    For additional information, refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

12. LH side front: Connect the brake pad wear indicator wiring harness.

13. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

14. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.

15. For additional information, refer to: Brake Pad Bedding-In (206-00, General Procedures).

Front Disc Brake - Brake Caliper Vehicles With: Standard Brakes

Removal and Installation

Removal

CAUTION: LH illustration shown, RH is similar.

NOTES:

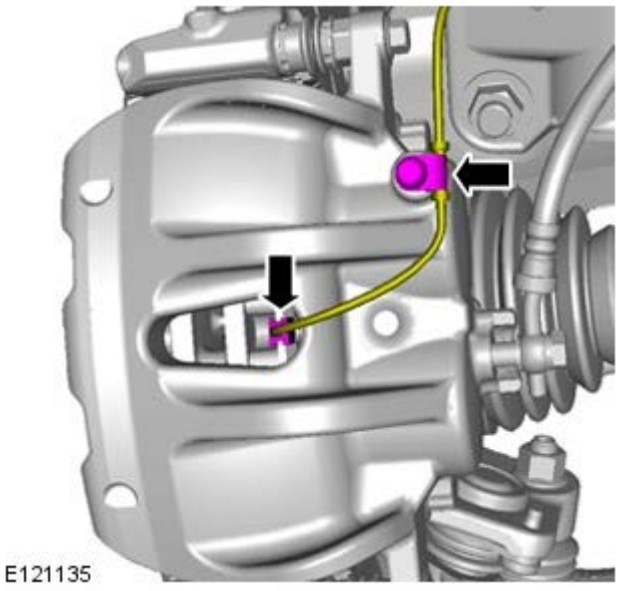
Removal steps in this procedure may contain installation details.

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

1. WARNING: Make sure to support the vehicle with axle stands.

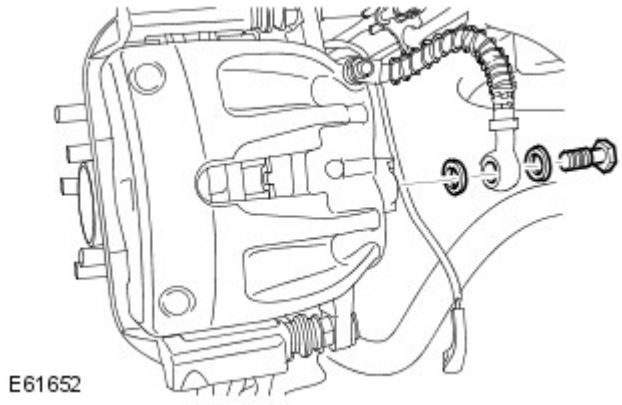
   Raise and support the vehicle.

2. Remove the wheel and tire.



3. CAUTION: The brake pad wear indicator sensor is easily damaged. Do not use a lever to remove the sensor. Use fingers only.

   LH side only: Disconnect the brake pad wear indicator sensor.



4. WARNING: Be prepared to collect escaping fluid.

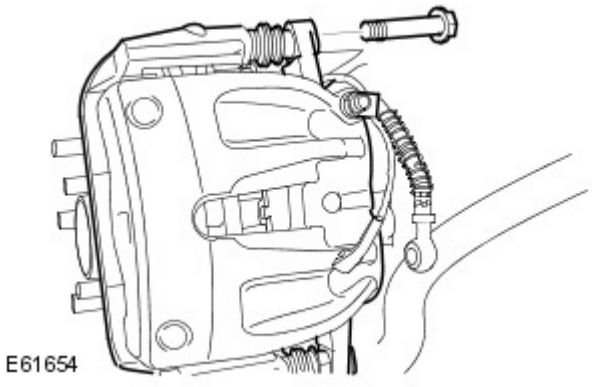
   CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

   Disconnect the brake hose from the brake caliper.
   - Remove the union.
   - Remove and discard the two sealing washers.
   - Install blanking caps to the exposed ports.

5. NOTE: Note the orientation of the brake pads.

   Remove the brake pads.
   For additional information, refer to: Brake Pads - Vehicles With: Standard Brakes (206-03 Front Disc Brake, Removal and Installation).

6. NOTE: Use an additional wrench to prevent the component from rotating.


E61654

Remove the brake caliper housing.
- Remove the brake caliper upper bolt.

Installation

1. NOTES:

   Use an additional wrench to prevent the component from rotating.

   Make sure the brake caliper guide pins are installed in the correct orientation.

   Install the brake caliper.
   - Tighten the brake caliper upper bolt to 35 Nm (26 lb.ft).

2. NOTE: Make sure the brake pads are installed in the correct orientation.

   Install the brake pads.
   For additional information, refer to: Brake Pads - Vehicles With: Standard Brakes (206-03 Front Disc Brake, Removal and Installation).
   - Apply a suitable amount of the supplied grease to the mating faces of the brake pads and brake calipers.

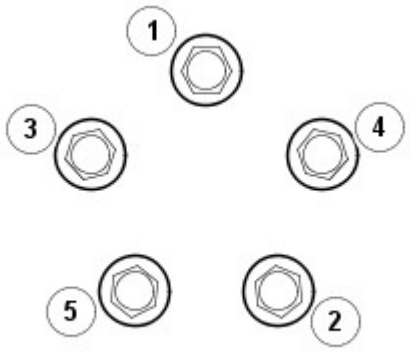
3. Connect the brake hose to the brake caliper.
   - Clean the component mating faces.
   - Remove the blanking caps from the ports.
   - Install new sealing washers.
   - Tighten the brake hose union to 32 Nm (24 lb.ft).

4. LH side only: Connect the brake pad wear indicator sensor.

5. Bleed the brake caliper.
   For additional information, refer to: Component Bleeding - Vehicles With: Standard Brakes (206-00 Brake System - General Information, General Procedures).

6. NOTE: Tighten the wheel nuts in the sequence shown:

   Install the wheels and tires.
   - Stage 1 : 4Nm
   - Stage 2 : 70Nm
   - Stage 3 : 140Nm



E74593

Front Disc Brake - Brake Caliper Vehicles With: High Performance Brakes

Removal and Installation

Removal

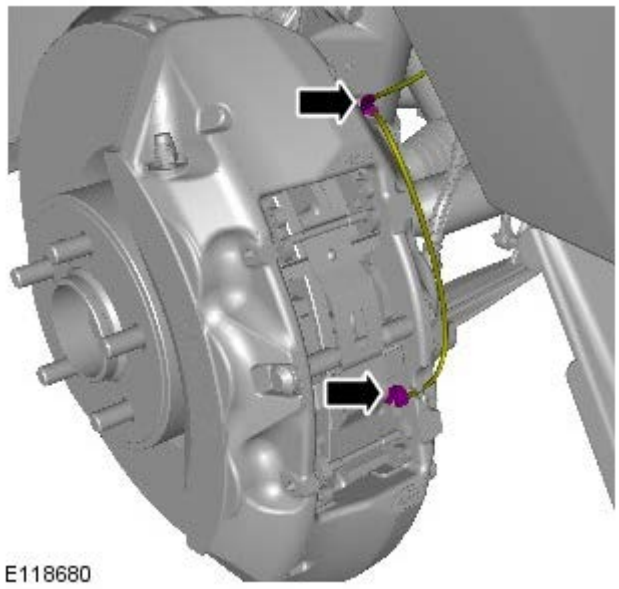
CAUTION: LH illustration shown, RH is similar.

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

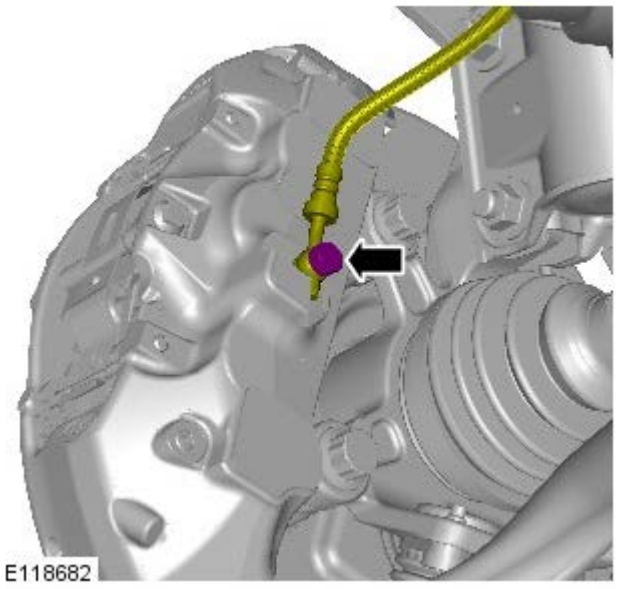
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the wheel and tire.


E118680

3. CAUTION: The brake pad wear indicator sensor, which is installed on the left hand side only, is easily damaged. Do not use a lever to remove the sensor.


E118682

4. WARNING: Be prepared to collect escaping fluid.

   CAUTIONS:

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

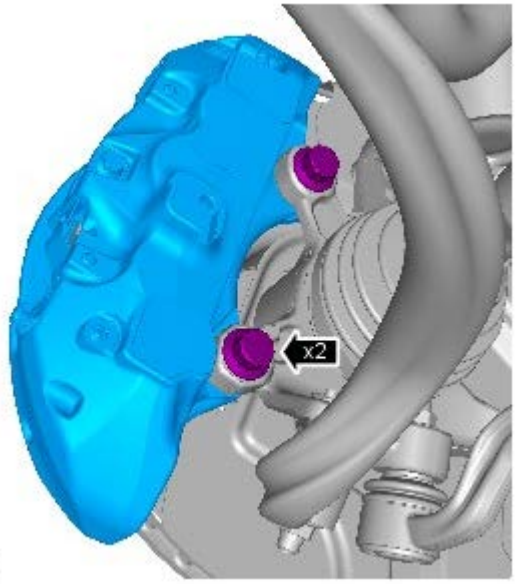
   Make sure that new sealing washers are installed.

   TORQUE: 32 Nm

5. NOTE: Note the orientation of the brake pads.

   Remove the front brake pads.
   For additional information, refer to: Brake Pads - Vehicles With: High Performance Brakes (206-03, Removal and Installation).

6. TORQUE: 275 Nm



E118683

Installation

1. NOTE: Make sure the brake pads are installed in the correct orientation.

   To install, reverse the removal procedure.

2. Bleed the brake caliper.
   For additional information, refer to: Component Bleeding - Vehicles With: High Performance Brakes (206-00, General Procedures).

Rear Disc Brake -

Item	Specification
Disc type	Ventilated
Disc diameter:	
Vehicles without High performance brakes	354 mm (13.9in)
Vehicles with High performance brakes	365 mm (14.4 in)
Disc thickness - All engines:	
New	20.0 mm (0.78 in)
Service limit	18.0 mm (0.71 in)
Maximum disc run-out - disc installed	0.09 mm (0.003 in)
Caliper type	Sliding pin, single piston
Piston diameter	45.0 mm (1.7 in)
Pad minimum thickness	3.0 mm (0.12 in)
Brake pad wear warning lead:	
Location	Rear right hand brake pad
Activates at	75% of pad life utilised

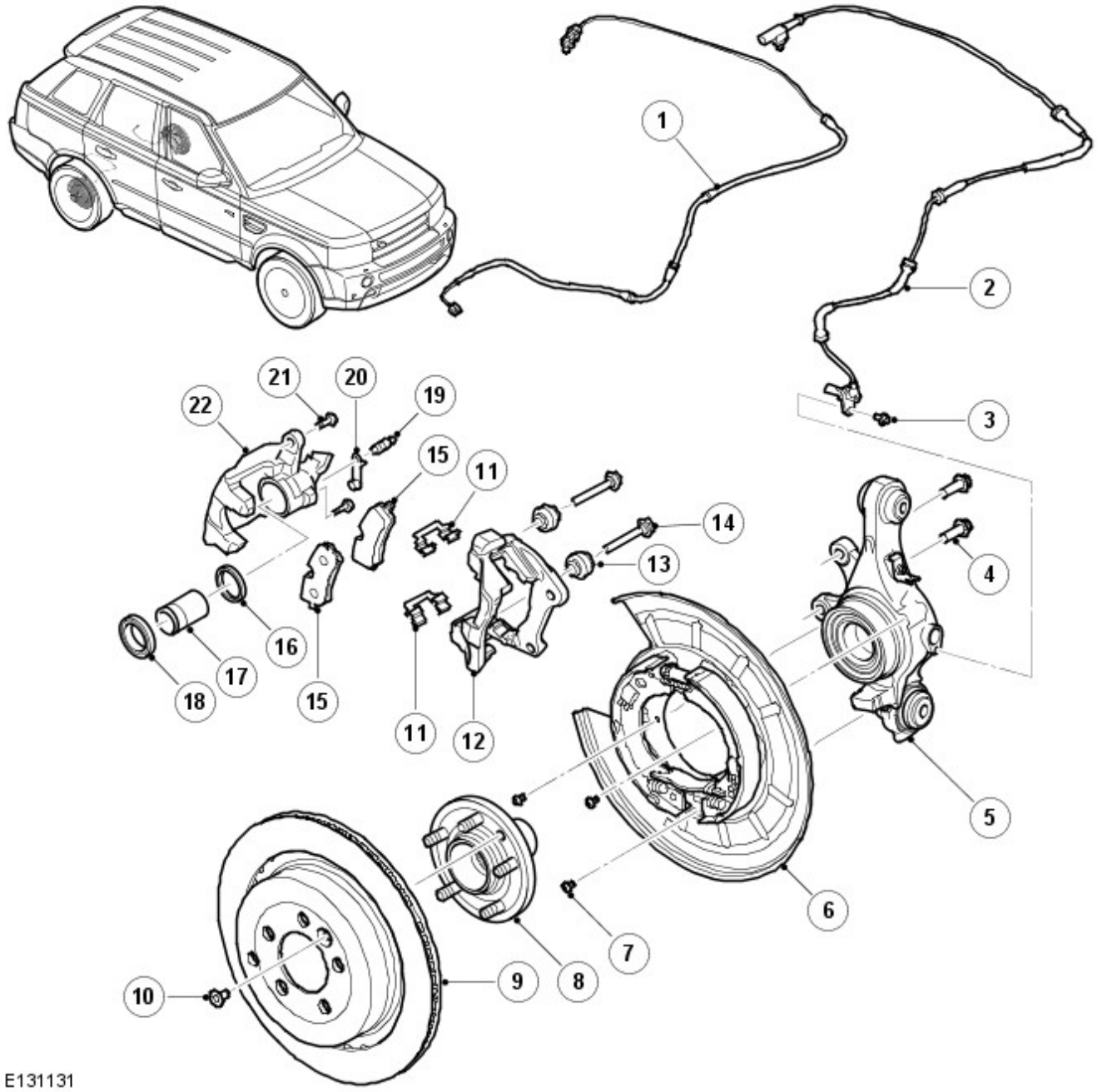
Torque Specifications

Description	Nm	lb-ft
Brake caliper bleed screw	10	7
Brake caliper housing to anchor plate bolts	35	26
Brake hose union	32	24
Brake disc Torx screw	35	26
Brake caliper anchor plate to wheel knuckle bolts	115	85
Road wheel nuts	140	103

Rear Disc Brake - Rear Disc Brake

Description and Operation

COMPONENT LOCATIONS



Item	Part Number	Description
1	-	Brake pad wear sensor lead
2	-	Wheel speed sensor
3	-	Wheel speed sensor bolt
4	-	Caliper bolt (x 2)
5	-	Rear knuckle
6	-	Backplate assembly and dust shield
7	-	Dust shield screw (x 3)
8	-	Drive flange assembly
9	-	Brake disc
10	-	Brake disc retaining bolt
11	-	Brake pad retainers
12	-	Caliper carrier
13	-	Guide pin dust cover (x 2)
14	-	Guide pin (x 2)
15	-	Brake pad

16	-	Piston seal
17	-	Piston
18	-	Piston dust cover
19	-	Bleed screw
20	-	Bleed screw dust cap
21	-	Guide pin bolt (x 2)
22	-	Caliper body

GENERAL

The rear brakes consist of a single piston brake caliper, a ventilated brake disc and a dust shield (integrated as part of the parking brake). The dust shield, caliper and disc on 5.0L SC are unique to that model.

The brake caliper is attached to the rear knuckle. The brake pads are made from an asbestos free material. The inboard brake pad of the right rear brake incorporates a wear sensor.

When hydraulic pressure is supplied to the caliper, the piston extends and forces the inner pad against the disc. The caliper body reacts and slides on the guide pins to bring the outer pad into contact with the disc.

The rear brake pad wear sensor is connected in series with the front brake pad wear sensor, between the instrument cluster and ground. When a brake pad incorporating a brake pad wear sensor is approximately 75% worn, the brake pad wear sensor goes open circuit. When the instrument cluster detects the open circuit, it illuminates the amber light emitting diode (LED) in the brake warning indicator, displays an appropriate warning in the message center and sounds a warning chime. For additional information, refer to: Instrument Cluster (413-01, Description and Operation).

At the beginning of each ignition cycle, the instrument cluster performs a bulb check on the brake warning indicator: the indicator is illuminated amber for 1.5 seconds, then red for 1.5 seconds.

Rear Disc Brake - Rear Disc Brake

Diagnosis and Testing

For additional information.
REFER to: Brake System (206-00, Diagnosis and Testing).

Rear Disc Brake - Brake Disc

Removal and Installation

Removal

WARNING: If installing a new brake disc, install new brake pads.

CAUTION: Brake discs must be renewed in pairs.

NOTES:

If the parking brake shoes or the brake discs have been removed for access to other components then DO NOT carry out the bedding in procedure.

LH illustration shown, RH is similar.

The brake pad wear warning indicator sensor must be replaced each time the brake pads are serviced.

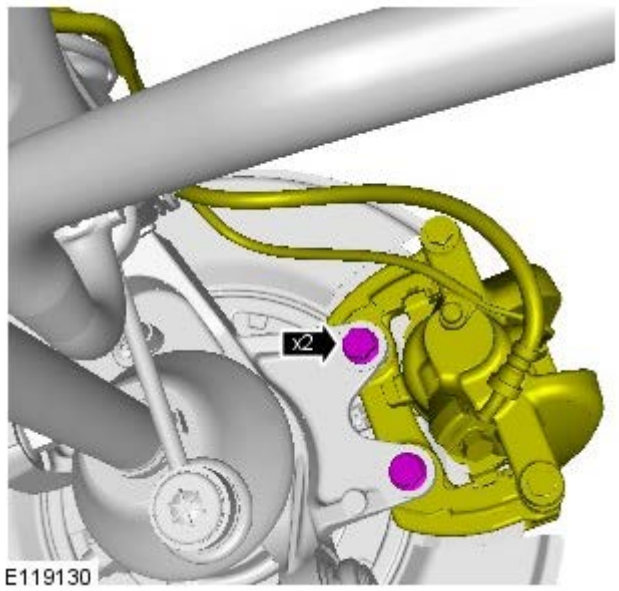
1. Using the Land Rover approved diagnostic system, drive the parking brake to the 'mounting position'.

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

   Raise and support the vehicle.

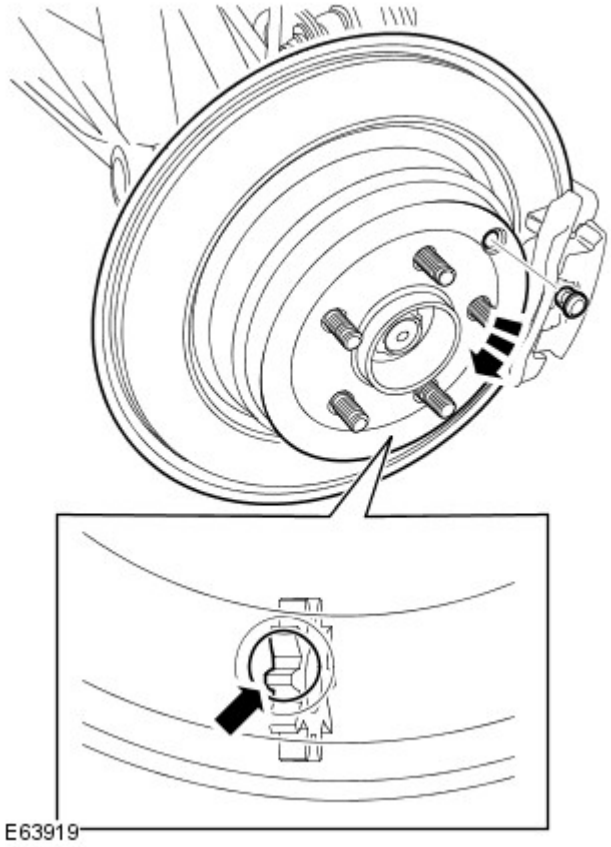
3. Remove the rear wheel and tire.

4. Remove the brake caliper and anchor plate.

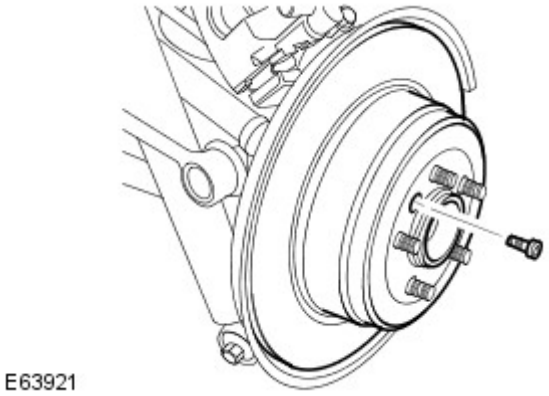


5. NOTE: Rotate the rear brake disc to locate the parking brake shoe adjuster.

   Release the parking brake shoe adjustment.
   - Remove the parking brake shoe adjuster access plugs.
   - Rotate the parking brake shoe adjuster.



6. Remove the rear brake disc.
    - Remove the Allen screw.



Installation

1. Make sure that the rear brake disc and hub mating surfaces are clean.
2. Install the rear brake disc.
    - Tighten the bolt to 35 Nm (26 lb.ft).
3. Install the brake caliper and anchor plate.
    - Tighten the bolts to 115 Nm (85 lb.ft).
4. Adjust the parking brake.
   For additional information, refer to: Parking Brake Shoe and Lining Adjustment (206-05 Parking Brake and Actuation, General Procedures).
5. Install the rear wheel and tire.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).
6. For additional information, refer to: Brake Pad Bedding-In (206-00, General Procedures).

Rear Disc Brake - Brake Pads

Removal and Installation

Removal

WARNING: Brake pads must be renewed in axle sets only, otherwise braking efficiency may be impaired.

NOTES:

RH illustration shown, LH is similar.

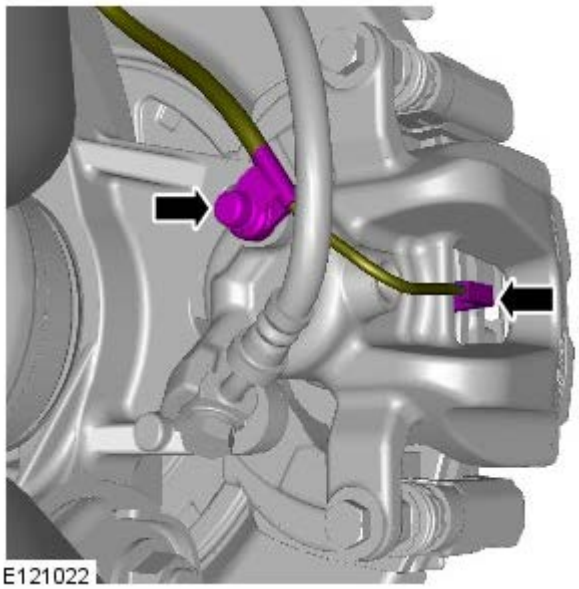
The brake pad wear warning indicator sensor must be replaced each time the brake pads are serviced.

1. WARNING: Make sure to support the vehicle with axle stands.

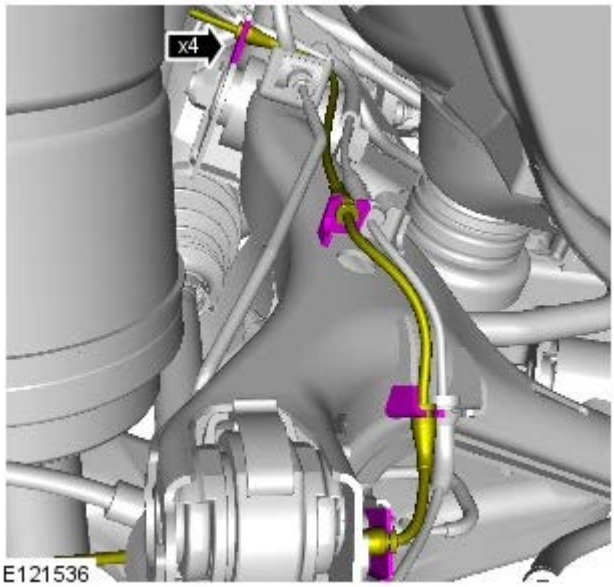
   Raise and support the vehicle.

2. Remove the wheels and tires.

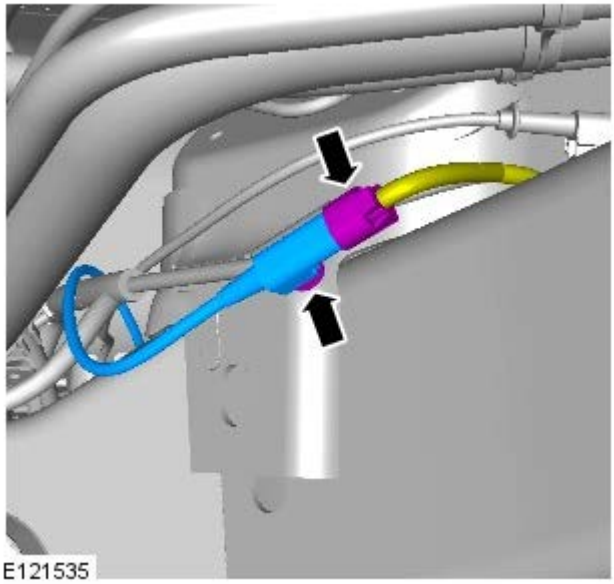
3. RH side rear: Disconnect the brake pad wear indicator sensor wiring harness.

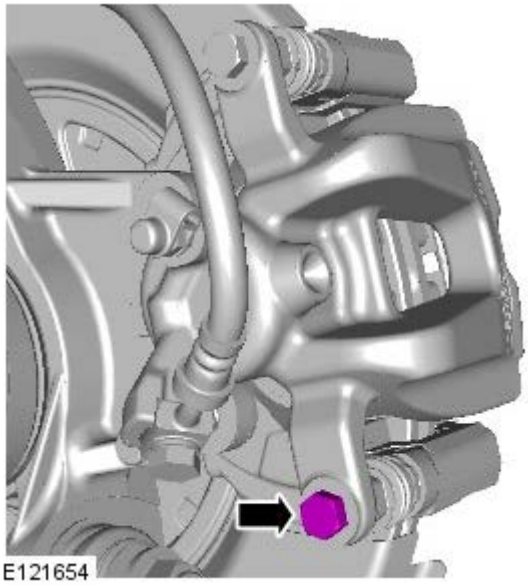


4. RH side rear: Disconnect the brake pad wear indicator sensor wiring harness.



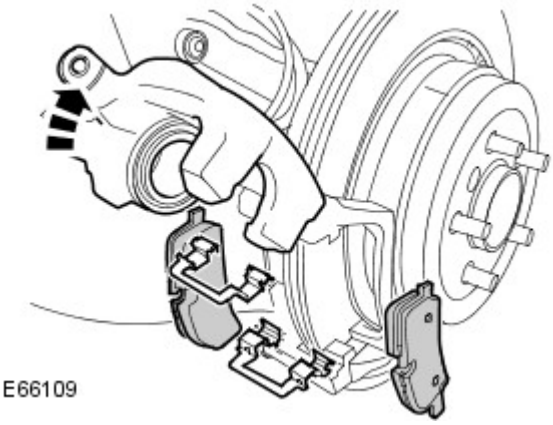
5. RH side rear: Release and disconnect the brake pad wear indicator wiring harness electrical connector.


E121535


E121654

6. NOTE: Use an additional wrench to prevent the component from rotating.

   Remove the brake caliper lower bolt.


E66109

7. NOTES:

   Note the orientation of the brake pads.

   Note the orientation of the clips.

   Remove the brake pads.
   - Rotate the brake caliper upwards.
   - Remove the 2 clips.

8. Repeat the above 2 steps for the other side.

Installation

1. WARNING: Do not use compressed air to clean brake components. Dust from friction materials can be harmful if inhaled.

   Clean the brake caliper housing and anchor plate using brake cleaning fluid.

2. Inspect the caliper piston and slide pin seals for damage.

3. CAUTIONS:

   The brake caliper should move freely on both slide pins.

   If necessary, renew the components.

   Check the slide pins for correct operation.

4. CAUTION: Check the brake fluid reservoir level before pushing the piston back, failure to follow this instruction may result in damage to the vehicle.

   NOTE: As the piston is pushed back into the caliper housing, the brake fluid level in the reservoir will rise. Do not allow the reservoir to overflow.

   Press the piston into the caliper housing.

5. CAUTION: If installed, the adhesive strips covering the outer brake pads must be removed before installation. Failure to follow this instruction may result in damage to the vehicle.

   If installed, remove the adhesive strips from the 2 outer brake pads.

6. NOTES:

   Make sure the brake pads are installed in the correct orientation.

   Make sure that the clips are installed in the correct orientation.

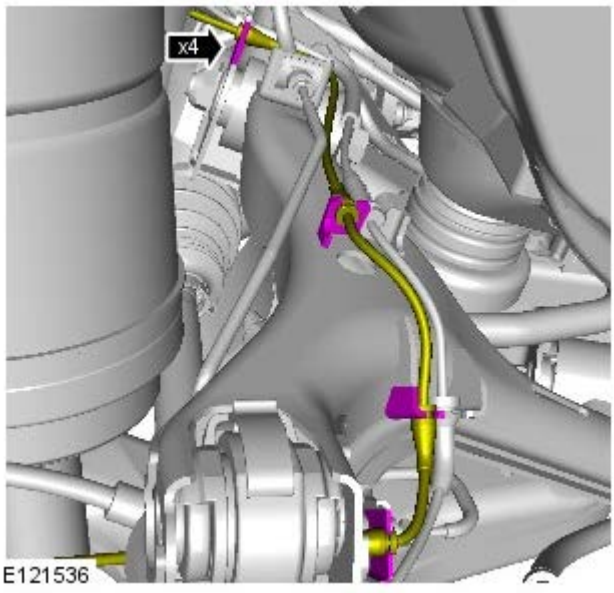
   Install the brake pads.
   - Install the 2 clips.

7. Rotate the brake caliper downwards.
   - Tighten the brake caliper lower bolt to 35 Nm (26 lb.ft).

8. Repeat the above procedure for the other side.

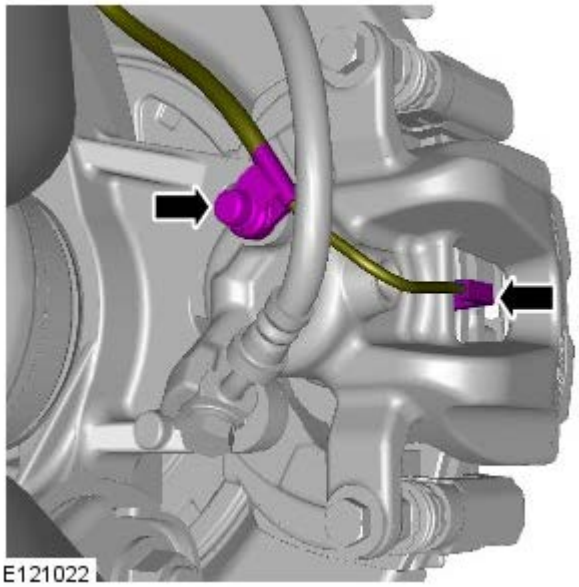
9. RH side rear: Connect the brake pad wear indicator wiring harness electrical connection.

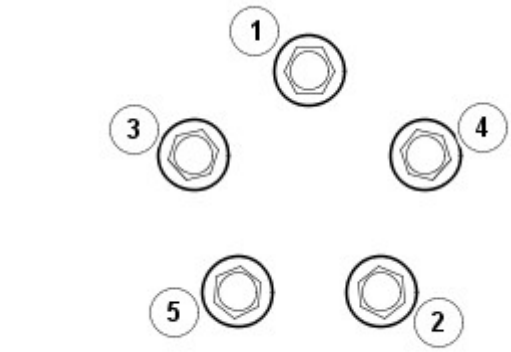
10. RH side rear: Connect the brake pad wear indicator sensor wiring harness.



11. RH side rear: Connect the brake pad wear indicator

sensor wiring harness.


E121022



E74593

12. NOTE: Tighten the wheel nuts in the sequence shown:

    Install the wheels and tires.
    - Stage 1 : 4Nm
    - Stage 2 : 70Nm
    - Stage 3 : 140Nm

13. Depress the brake pedal several times, check the fluid level in the brake fluid reservoir and top-up with brake fluid if necessary.

14. For additional information, refer to: Brake Pad Bedding-In (206-00 Brake System - General Information, General Procedures).

Rear Disc Brake - Brake Caliper

Removal and Installation

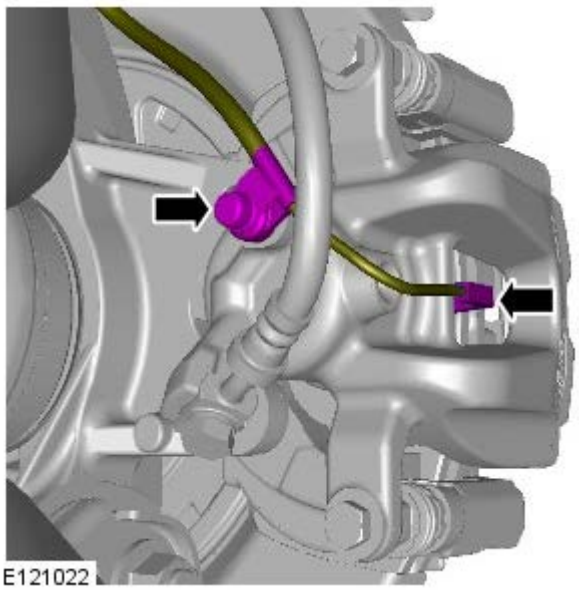
Removal

NOTE: RH illustration shown, LH is similar.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

2. Remove the wheel and tire.

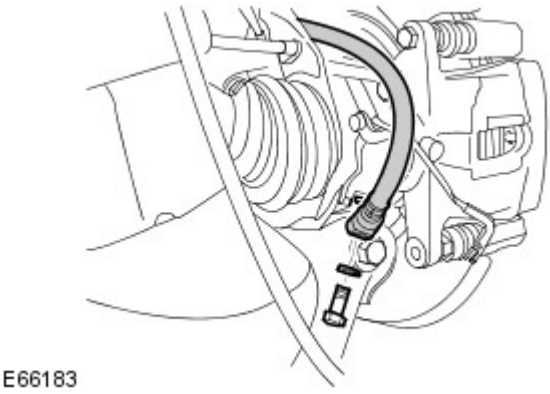


3. CAUTION: The brake pad wear indicator sensor is easily damaged. Do not use a lever to remove the sensor. Use fingers only.

   RH side only: Disconnect the brake pad wear indicator sensor.
   - Release from the clip.

4. NOTE: Note the orientation of the brake pads.

   Remove the brake pads.
   For additional information, refer to: Brake Pads (206-04, Removal and Installation).

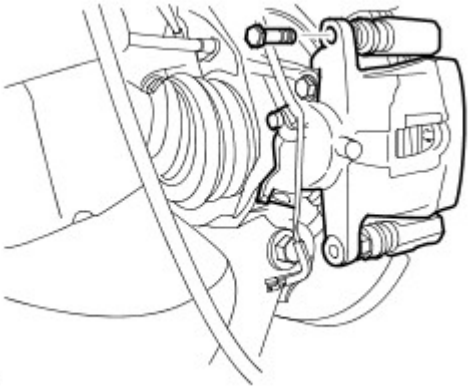


5. CAUTION: Before disconnecting or removing components, ensure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

   Disconnect the brake hose from the brake caliper.
   - Remove the union.
   - Remove and discard the two sealing washers.
   - Install blanking caps to the exposed ports.

6. NOTE: Use an additional wrench to prevent the component from rotating.

   Remove the brake caliper housing.
   - Remove the brake caliper upper bolt.



E66184

Installation

1. NOTE: Use an additional wrench to prevent the component from rotating.

   Install the brake caliper.
   - Tighten the brake caliper upper bolt to 35 Nm (26 lb.ft).

2. NOTE: Make sure the brake pads are installed in the correct orientation.

   Install the brake pads.
   For additional information, refer to: Brake Pads (206-04, Removal and Installation).

3. Connect the brake hose to the brake caliper.
   - Clean the component mating faces.
   - Remove the blanking caps from the ports.
   - Install new sealing washers.
   - Tighten the brake hose union to 32 Nm (24 lb.ft).

4. Connect the brake pad wear indicator sensor.

5. Bleed the brake caliper.
   For additional information, refer to: Component Bleeding - Vehicles With: Standard Brakes (206-00, General Procedures).

6. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Rear Disc Brake - Brake Caliper Anchor Plate

Removal and Installation

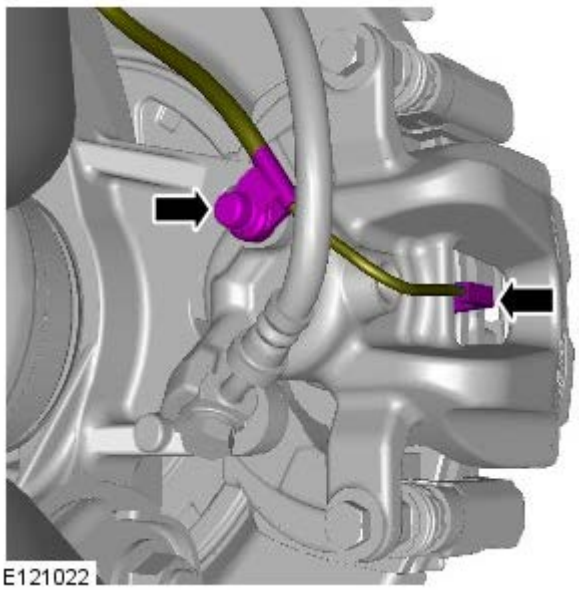
Removal

NOTE: RH illustration shown, LH is similar.

1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.

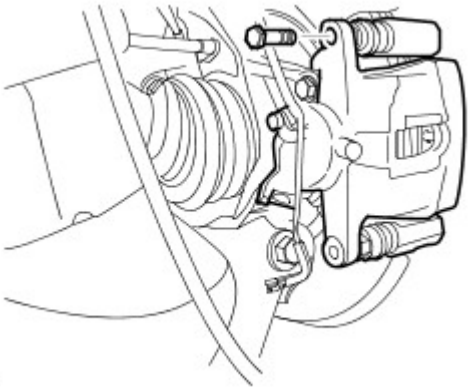
2. Remove the wheel and tire.


E121022

3. CAUTION: The brake pad wear indicator sensor is easily damaged. Do not use a lever to remove the sensor. Use fingers only.

   RH side only: Disconnect the brake pad wear indicator sensor.
   - Release from the clip.

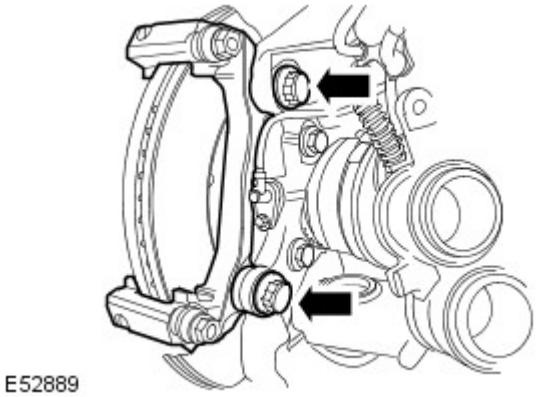
4. Remove the rear brake pads.
   For additional information, refer to: Brake Pads (206-04, Removal and Installation).

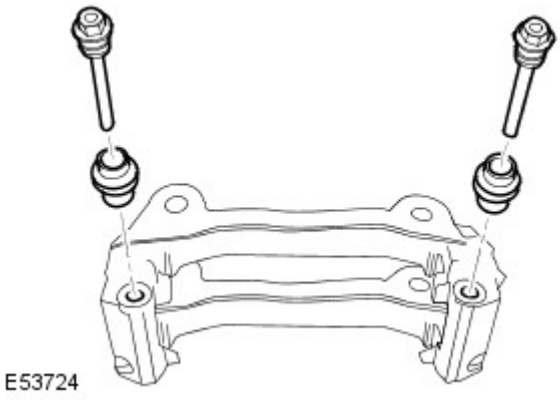

E66184

5. NOTE: Use an additional wrench to prevent the component from rotating.

   Remove the brake caliper housing.
   - Remove the brake caliper upper bolt.

6. Remove the brake caliper anchor plate.


E52889


E53724

7. NOTE: Note the orientation of the brake caliper guide pins.

   Remove the guide pins and seals.

Installation

1. CAUTIONS:

   The brake caliper should move freely on both slide pins.

   If necessary, renew the components.

   NOTE: Make sure the brake caliper guide pins are installed in the correct orientation.

   Install the brake caliper guide pins.
   - Check the condition of the caliper guide pin seals.
   - Check for correct operation.

2. Install the brake caliper anchor plate.
   - Tighten the bolts to 115 Nm (85 lb.ft).

3. NOTE: Use an additional wrench to prevent the component from rotating.

   Install the brake caliper.
   - Tighten the brake caliper upper bolt to 35 Nm (26 lb.ft).

4. Install the rear brake pads.
   For additional information, refer to: Brake Pads (206-04, Removal and Installation).

5. Connect the brake pad wear indicator sensor.

6. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Parking Brake and Actuation -

General Specification

Item	Specification
Make	Continental Teves
Model/type	N5528001
Operation	Twin cable operation to park brake with emergency cable release located in passenger compartment
Minimum brake lining material thickness	2.0 mm (0.078 in)

Torque Specifications

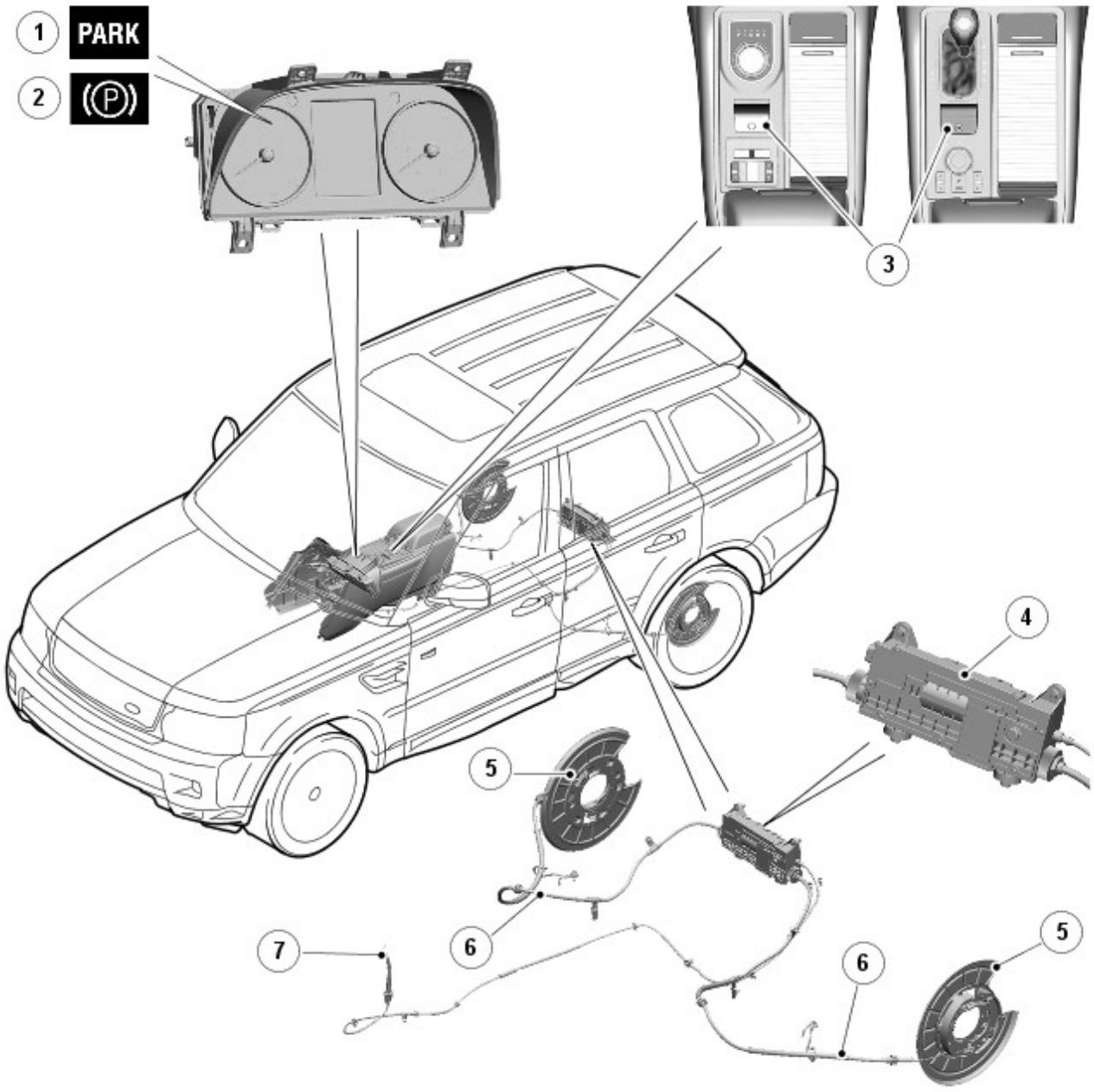
Description	Nm	lb-ft
Wedge adjuster Allen screw	7	5
Rear brake disc Torx screw	35	26
Brake caliper anchor plate to wheel knuckle bolts	115	85
Brake caliper to anchor plate bolts	35	26
Parking brake actuator and cable assembly nuts	5	4
Parking brake actuator mounting bracket bolts	22	16
Fuel tank heat shield nuts	3	2
Fuel tank heat shield bolts	6	4
* LH/RH parking brake cable bolts	22	16
Parking brake cable coupling	8	6
Road wheel nuts	140	103

*** New nuts/bolts must be installed**

Parking Brake and Actuation - Parking Brake

Description and Operation

COMPONENT LOCATION



E140244

Item	Part Number	Description
1	-	Parking brake indicators (NAS only)
2	-	Parking brake indicators (all except NAS (north America specification))
3	-	Parking brake switch
4	-	Parking brake module
5	-	Drum brake
6	-	Parking brake cable
7	-	Emergency release cable

GENERAL

The parking brake is an electrically actuated system that operates drum brakes integrated into the rear brake discs. The parking brake system consists of:

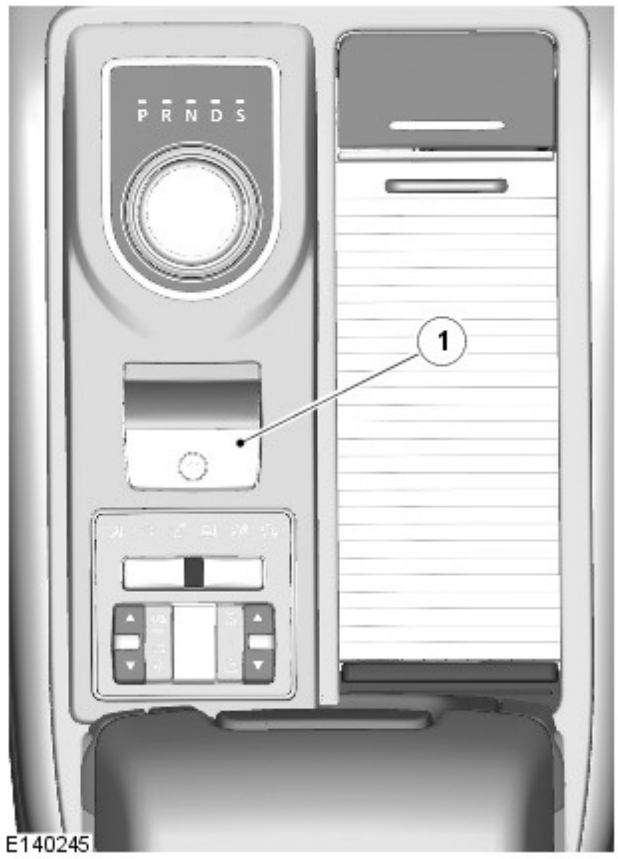
- A parking brake switch.
- Left and right drum brakes.
- Left and right brake cables.
- An emergency release cable.
- Two parking brake indicators.

- A parking brake module.

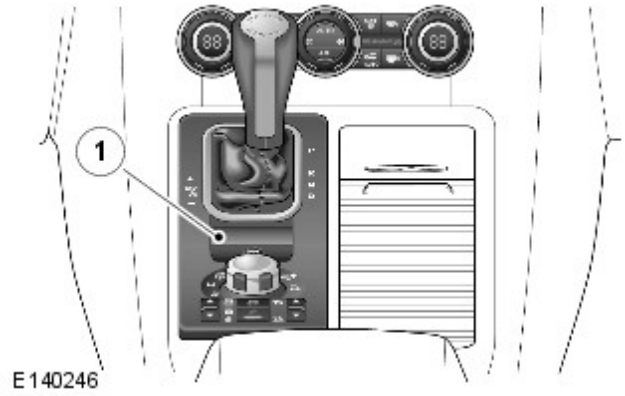
The parking brake is operated by the parking brake module, which adjusts the tension of the brake cables to apply and release the drum brakes. Operation of the parking brake module is initiated by the parking brake switch.

PARKING BRAKE SWITCH

Parking Brake Switch - Electronic Transmission Shifter



Parking Brake Switch - Non-Electronic Transmission Shifter



The parking brake switch is used by the driver to apply and release the parking brake, and is installed in the center console adjacent to the gear lever.

Slots on the sides of the parking brake switch engage with the top panel of the center console, and a screw secures the parking brake switch in position. An electrical connector on the back of the switch provides the interface with the vehicle wiring. A brake symbol on the switch illuminates when the exterior lamps are selected on.

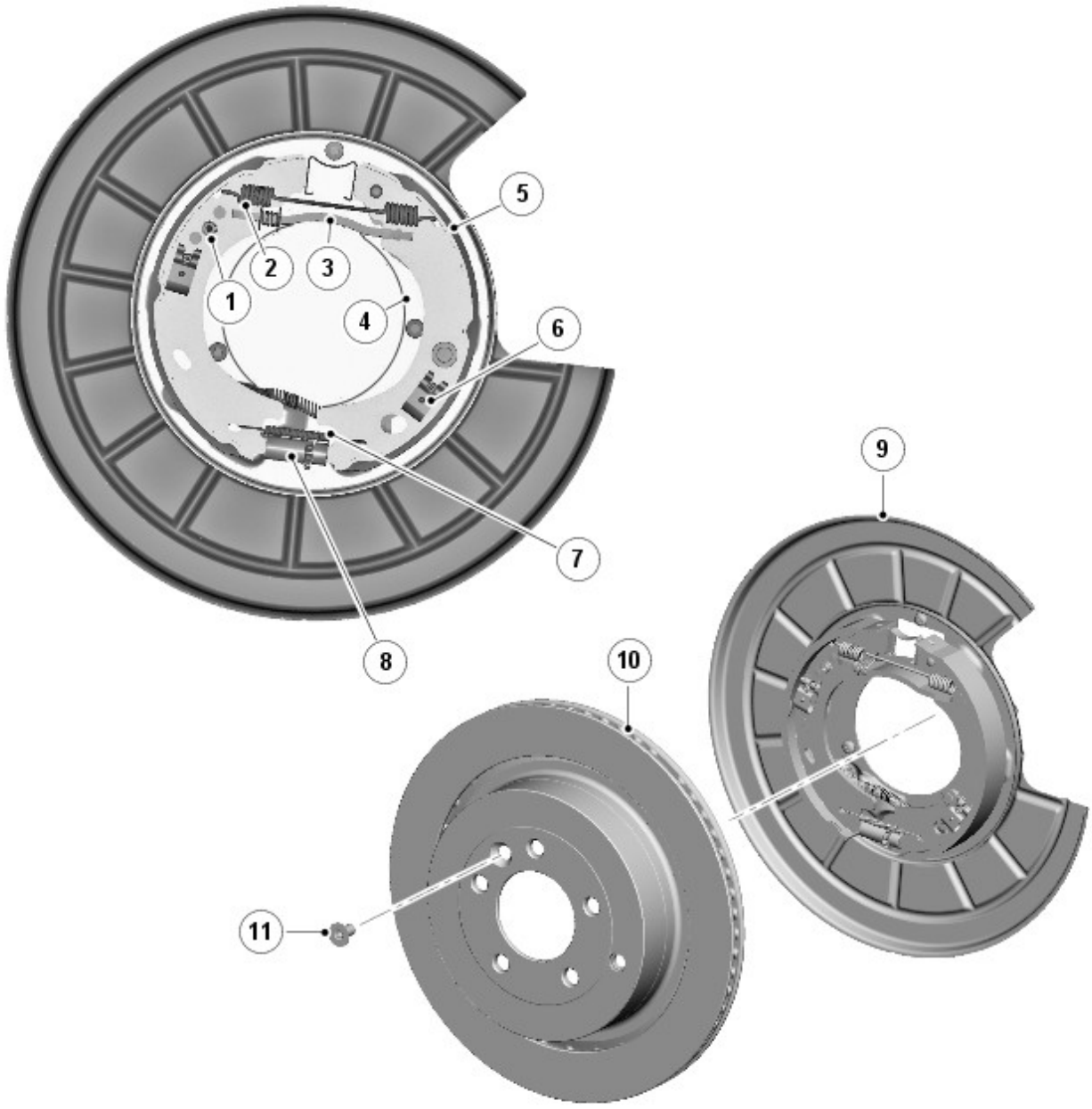
There are three states for the parking brake switch:

- Apply request, when the handle of the parking brake switch is pulled up.
- Release request, when the handle of the parking brake switch is pushed down.
- Idle, when the handle of the parking brake switch is in the central or rest position.

Microswitches, incorporated into the parking brake switch, are activated by the handle of the parking brake switch. To determine the operating state of the parking brake switch, the parking brake module scans the circuits containing the microswitches.

DRUM BRAKES

NOTE: LH (left-hand) brake shown, RH (right-hand) brake similar



E140238

Item	Part Number	Description
1	-	Wedge adjuster screw
2	-	Return spring
3	-	Cross strut
4	-	Backplate
5	-	Brake shoe
6	-	Shoe locating pin and clip
7	-	Adjuster spring
8	-	Toothed wheel adjuster
9	-	Dust shield
10	-	Rear brake disc
11	-	Adjuster access plug

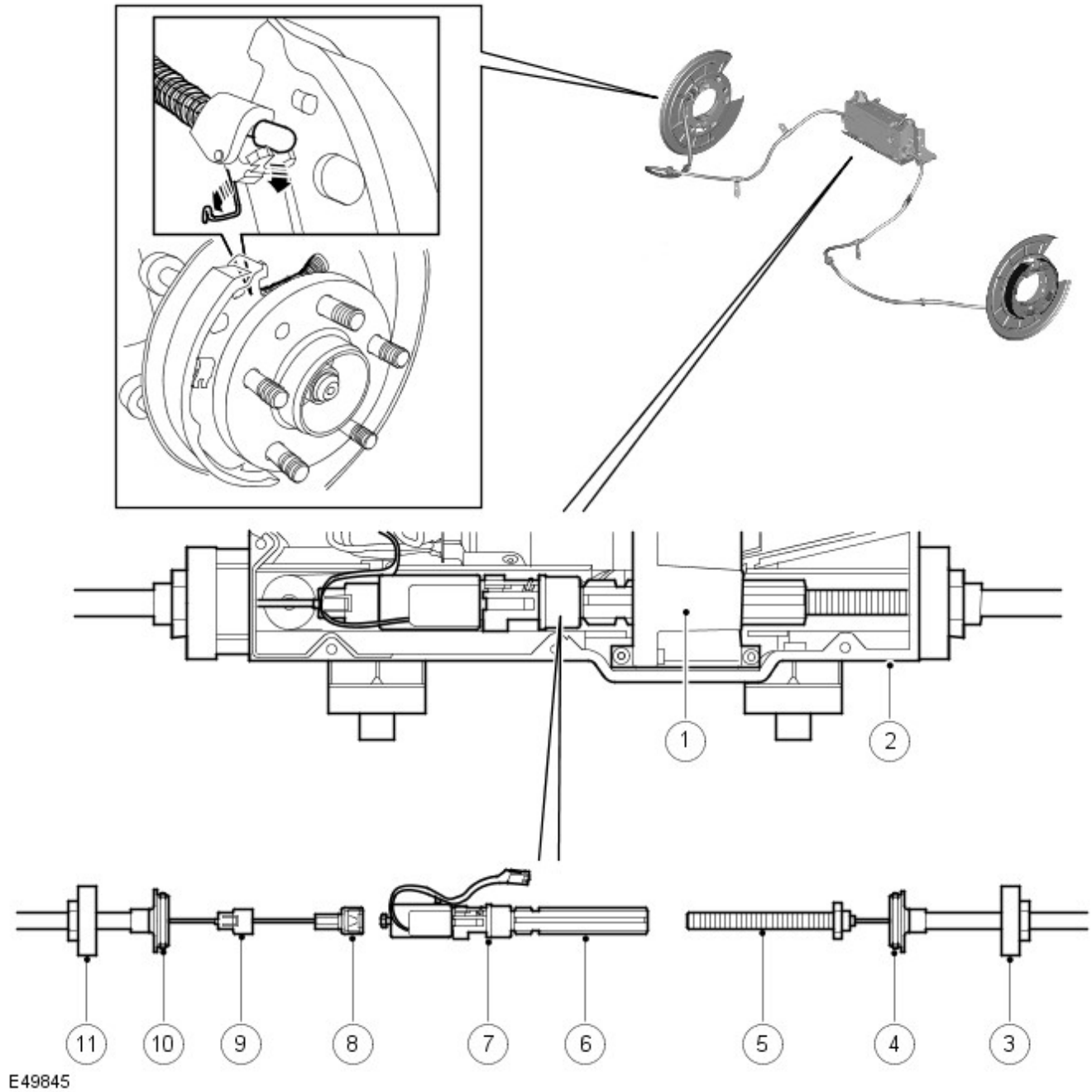
WARNING: Prior to removing a brake disc from a vehicle, power should be disconnected from the parking brake module. Operation of the parking brake switch while a brake disc is removed can cause the actuating mechanism in the parking brake module to seize. In addition, the parking brake may not switch off until 20 minutes after key-off; automatic re-apply cannot be eliminated until this period has expired.

Each drum brake consists of a pair of brake shoes installed on a backplate attached to the rear hub carrier. The brake shoes operate on the drum integrated into the rear brake disc. The orientation of the brake shoes differ by 180° between the left-hand (LH) and right-hand (RH) brakes.

When the parking brake module tensions the brake cables, the movement is transmitted to an operating lever on one of the brake shoes. The operating lever pivots against a cross strut, which forces the brake shoes apart and into contact with the drum in the rear brake disc. Brake shoe to drum clearance is set with two manual adjusters, which are accessed through a hole in the brake disc. One of the adjusters is a conventional toothed wheel adjuster. The second adjuster is a wedge adjuster operated by an Allen screw.

After replacement of the brake shoes or brake discs, a bedding in procedure must be performed to ensure the drum brakes operate satisfactorily.
For additional information, refer to: Parking Brake (206-05, Description and Operation).

BRAKE CABLES



Item	Part Number	Description
1	-	Gearbox
2	-	Parking brake module housing
3	-	Cable nut
4	-	Sealing collar
5	-	Threaded connector
6	-	Spline shaft
7	-	Force sensor
8	-	Shoe
9	-	Locking cover
10	-	Sealing collar
11	-	Cable nut

WARNING: Prior to disconnecting a brake cable, power should be disconnected from the parking brake module. Operation of the parking brake switch while a brake cable is disconnected can cause the actuating mechanism in the parking brake module to seize. In addition, the parking brake may not switch off until 20 minutes after key-off; automatic re-apply cannot be eliminated until this period has expired.

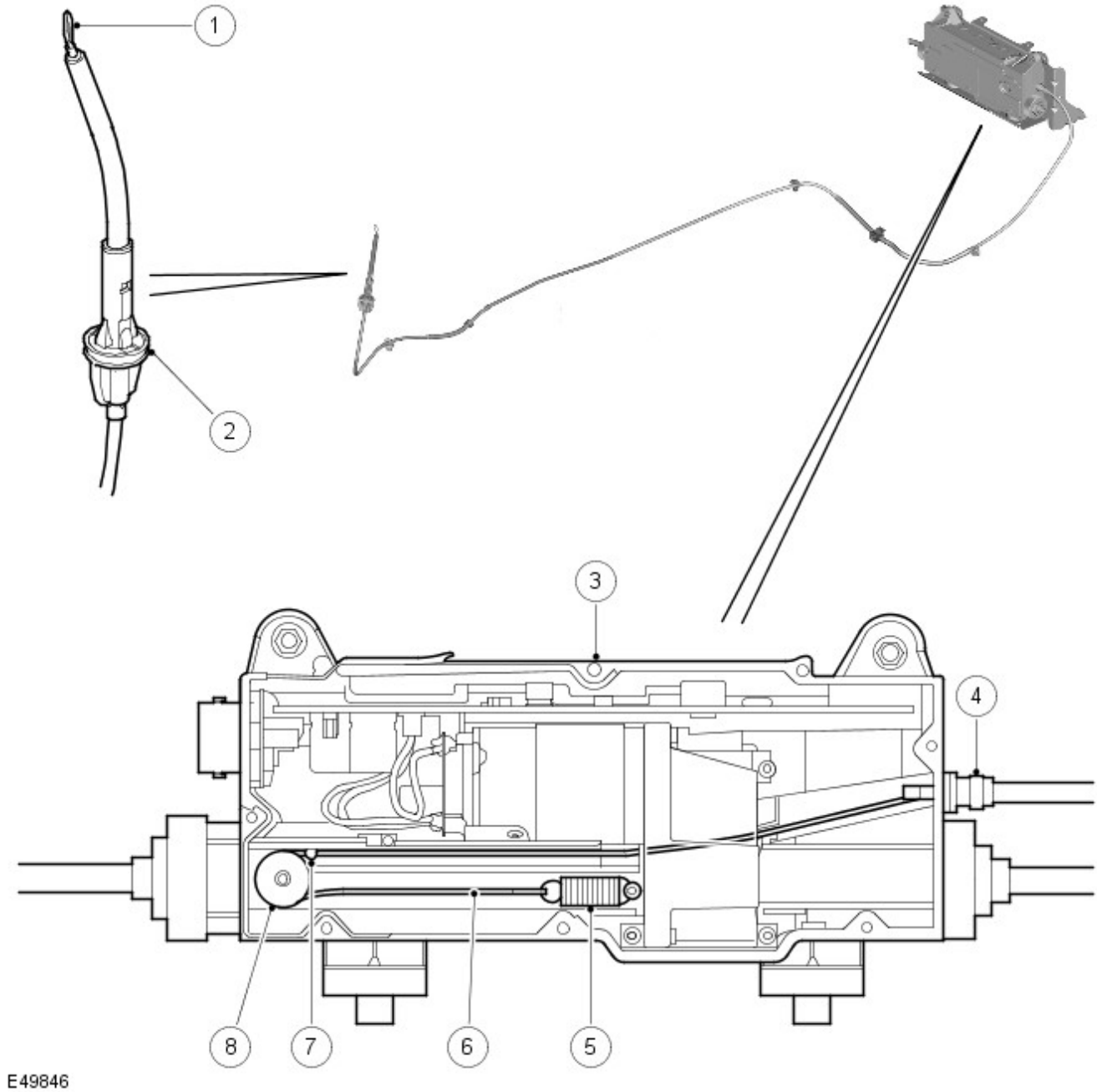
The brake cables consist of Bowden cables installed between the parking brake module and the drum brakes. Nuts, on the ends of the outer cables, secure the brake cables to the parking brake module and the backplate of the related drum brake. In each drum brake, the inner cable is located in the guide spring and connected to the brake shoe operating lever by a nipple on the end of the cable. In the parking brake module, the two inner cables are joined together via the force sensor and the spline shaft.

The inner cable of the RH brake cable is connected to a nipple on the force sensor by a 'shoe' on the end of the cable; a locking cover keeps the shoe engaged with the nipple.

The inner cable of the LH brake cable is connected to the spline shaft by a threaded connector (LH thread); a squared flange at the end of the threaded connector locates in the housing of the parking brake module, to prevent the threaded connector from turning with the spline shaft.

When the spline shaft turns, the threaded connector of the LH brake cable is screwed into or out of the spline shaft, which changes the effective length of the inner cables and operates the drum brakes. The ability of the spline shaft to move axially in the gearbox equalizes the load applied by the inner cables to the two drum brakes.

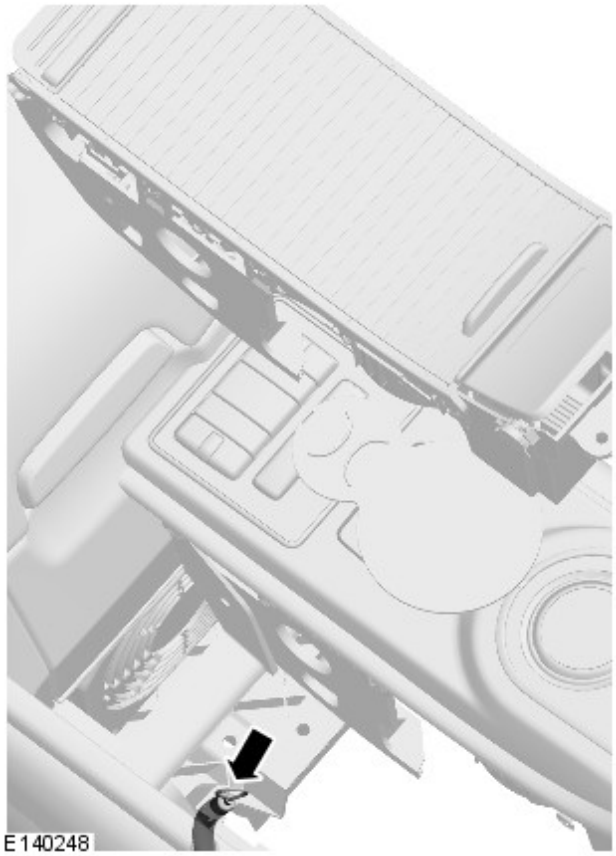
EMERGENCY RELEASE CABLE



Item	Part Number	Description
1	-	Pull ring
2	-	Quick release fitting

3	-	Parking brake module
4	-	Sealing collar
5	-	Spring
6	-	Inner cable
7	-	Nipple
8	-	Pulley wheel

Emergency Park Brake Release



The emergency release cable allows the parking brake to be mechanically released if:

- The parking brake cannot be electrically released because of a system fault.
- The battery is disconnected or battery voltage decreases below 7.5 volts while the parking brake is applied, so that the parking brake cannot be electrically released.

The parking brake is mechanically released by disconnecting the force sensor from the spline shaft in the parking brake module. During normal operation, the force sensor and the spline shaft are locked together by a lever operated pawl on the end of the spline shaft, which engages with a spigot on the force sensor.

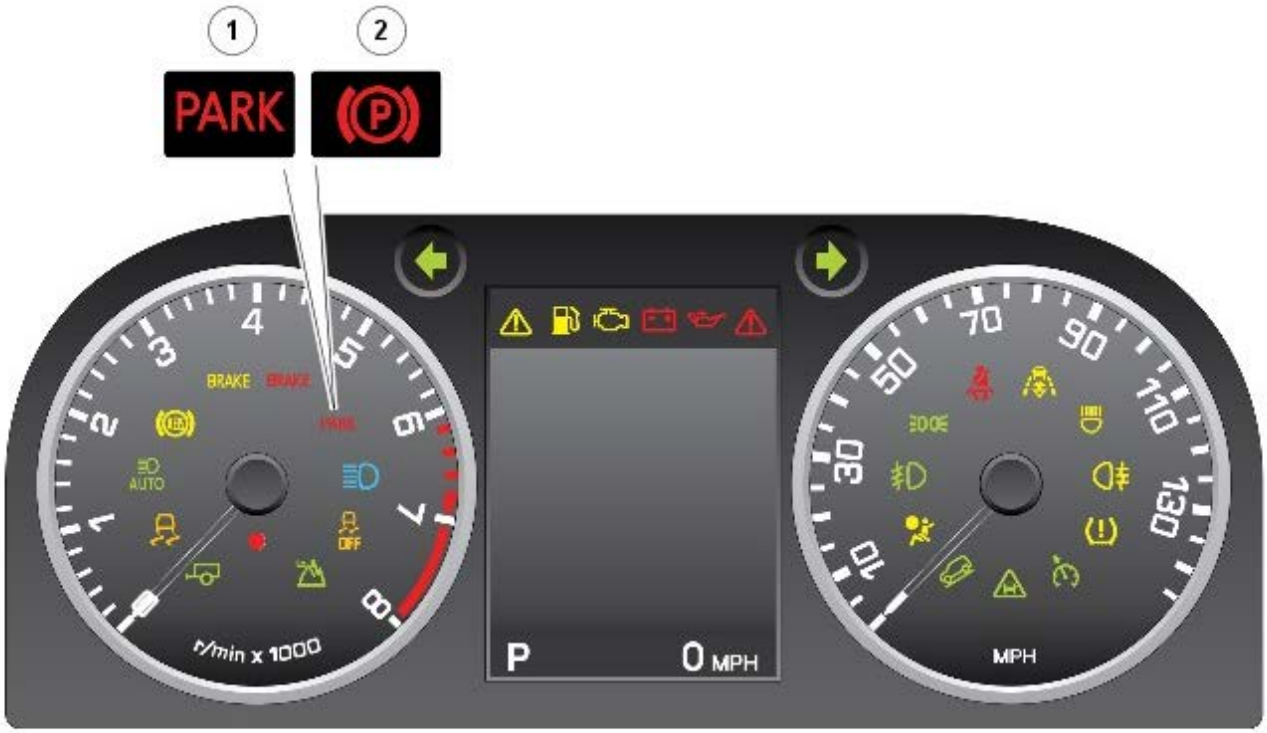
The emergency release cable is a Bowden cable installed between the parking brake module and the center console. The emergency release cable is held in clips along the underside of the vehicle and enters the passenger compartment below the center console through an aperture in the transmission tunnel. A quick release fitting seals the emergency release cable in the aperture. At the parking brake module, a sealing collar on the outer cable is a push fit in the housing of the parking brake module.

In the center console, a pull ring is installed on the end of the inner cable. The pull ring is designed to fit the hook on the end of the jack handle which, in combination with a screwdriver shaft, can be used to pull on the cable. The pull ring can be accessed by removing a circular panel in the bottom of the center console cupholders, on left-hand drive (LHD) vehicles, or by removing the parking brake switch on right-hand drive (RHD) vehicles.

The pull required to release the latch is approximately 200 N (45 lbf). When the pull ring of the emergency release cable is released, the spring in the parking brake module retracts the inner cable and the nipple moves away from the pawl operating lever.

After the emergency release cable has been used to release the parking brake, the next time an apply selection is made with the parking brake switch, the parking brake module automatically runs through a latching procedure to reconnect the spline shaft with the force sensor. The parking brake module turns the spline shaft so that it moves towards the force sensor. The pawl of the spline shaft then re-engages with the spigot of the force sensor. A second apply selection with the parking brake switch is required to apply the parking brake.

PARKING BRAKE INDICATORS



E140240

Item	Part Number	Description
1	-	Red or amber warning indicator (NAS only)
2	-	Red or amber warning indicator (all except NAS)

The parking brake has two warning indicators, one amber and one red, located in the speedometer of the instrument cluster (same symbol, illuminated in either red, or amber).

Amber Parking Brake Warning Indicator

The amber parking brake warning indicator is continuously illuminated if there is a parking brake system fault. Operation of the indicator is controlled by a high speed controller area network (CAN) bus signal from the parking brake module to the instrument cluster.

Red Parking Brake Warning Indicator

When the parking brake is applied, the red parking brake warning indicator is continuously illuminated while the ignition is on and for 3 minutes after the ignition is switched off. If the system is unable to comply with an apply or release request, due to a system fault, the indicator flashes.

When the ignition is on and the indicator is not flashing, operation is controlled by a high speed CAN bus signal from the parking brake module to the instrument cluster. When the ignition is off or when the indicator is flashing, operation is controlled by a hardwired signal from the parking brake module to the instrument cluster.

Messages Center

When there is a fault condition, illumination of the warning indicators is accompanied by a text message displayed in the message center.
For additional information, refer to: Instrument Cluster (413-01, Description and Operation).

PARKING BRAKE MODULE

The parking brake module monitors external and internal inputs and adjusts the tension of the brake cables to operate the drum brakes and provide the required parking brake function.

The parking brake module is installed on a support bracket attached to the front of the spare wheel carrier. Two rubber mounts, installed on lugs on the underside of the parking brake module, locate in holes in the support bracket. The top corners of the parking brake module are secured to the support bracket with rubber mounts and flanged nuts.

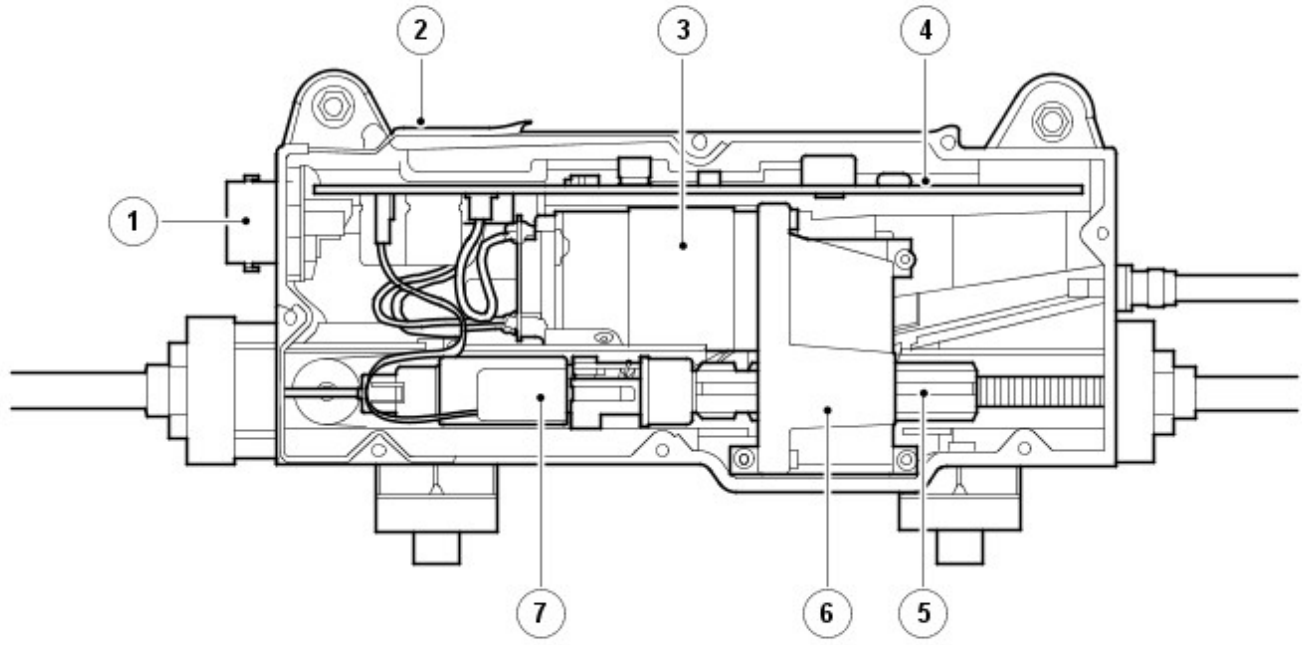
The main components of the parking brake module are:

- A PCB (printed circuit board) incorporating the ASIC (application specific integrated circuit) for control of the parking brake.
- An electric motor.
- A gearbox.
- A spline shaft.
- A force sensor.

The spline shaft and the force sensor are connected together by a latch on the end of the spline shaft. The spline shaft rotates on the latch and moves axially in the gearbox. The latch and the force sensor slide in a channel in the body of the parking brake module.

To apply or release the drum brakes, the parking brake module runs the electric motor, which drives the gearbox. The gearbox turns the spline shaft to increase or decrease the tension in the brake cables. The parking brake module monitors the load exerted by the brake cables using the input from the force sensor.

Interior of Parking Brake Module



E49850

Item	Part Number	Description
1	-	Electrical connector
2	-	Housing
3	-	Electric motor
4	-	PCB (Printed Circuit Board)
5	-	Spline shaft
6	-	Gearbox
7	-	Force sensor

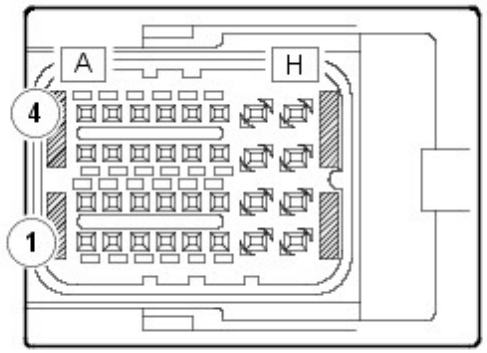
Inputs and Outputs

A 32 pin electrical connector on the RH side of the parking brake module provides the interface between the PCB and the vehicle wiring.

The parking brake module is powered by two permanent battery power feeds from the battery junction box (BJB). Two further connections with the central junction box (CJB) provide battery voltage signals when the key is in the ignition switch (key in) and when the ignition switch is in position II (ignition). Other hardwired inputs include those from the parking brake switch.

In addition to the hardwired connections, the parking brake module is connected to the medium speed CAN bus to enable communication with other vehicle systems.

Parking Brake Module Harness Connector C2178



E49851

Parking Brake Module Harness Connector C2178 Pin Details

Pin No.	Description	Input/Output
A1	Not used	-
A2	Medium speed CAN bus low out	Input/Output
A3	Medium speed CAN bus high in	Input/Output
A4	Medium speed CAN bus low in	Input/Output
B1	Not used	-
B2	Medium speed CAN bus high out	Input/Output
B3	Parking brake switch SW1	Input
B4	Parking brake switch SW4	Input
C1 and C2	Not used	-
C3	Parking brake switch SW2	Input
C4	Parking brake switch SW5	Output
D1 to F1	Not used	-
F2	Key in ignition switch	Input
F3	Ignition power supply	Input
F4	Red parking brake indicator	Output
G1	Not used	-
G2	Ground	Output
G3	Not used	-
G4	Battery power supply	Input
H1	Not used	-
H2	Ground	Output
H3	Not used	-
H4	Battery power supply	Input

PARKING BRAKE OPERATION

The parking brake can be applied at any time provided sufficient battery power is available. For the parking brake to be released, various pre-conditions are required. The parking brake has manual and automatic actuating modes, to cater for different operating circumstances, as detailed in the following table:

Actuating Modes

Mode	Pre-Conditions	Driver Action
Static apply	Vehicle speed less than 2.5 km/h (1.6 mph).	Pull up parking brake switch.
Static release	1. Vehicle speed less than 2.5 km/h (1.6 mph). 2. Engine running. **OR** Ignition switch in position II and brake pedal or accelerator pedal pressed.	Press down parking brake switch.
Dynamic apply	Vehicle speed more than 2.5 km/h (1.6 mph).	Pull up parking brake switch as required.
Dynamic release	Vehicle speed more than 2.5 km/h (1.6 mph).	Release (to neutral position) or press down parking brake switch.
DAR (drive away release)	1. Ignition switch in position II. 2. Transmission in gear 1, 2 or R (with high range selected) or 1, 2, 3 or R (with low range selected). 3. Accelerator pedal pressed more than 5%.	None. Parking brake released automatically on drive away.

Operating Voltages

Actuation of the parking brake (apply or release) is only started if the power supply to the parking brake module is within 9 to 18 volts. At any voltage in this range, the parking brake module is able to tighten the brake cables to the maximum, to fully apply the parking brake, although at voltages between 9 and 10.5 volts the actuation time may exceed 1.0 second.

During a parking brake actuation:

- If the power supply to the parking brake module decreases to less than 8.3 volts, the parking brake module continues the actuation, but stores a related fault code. If the ignition is on, the parking brake module also signals the instrument cluster to illuminate the amber parking brake warning indicator and flash the red

parking brake warning indicator. On the instrument cluster, a message advising there is a parking brake fault is shown in the message center. The warning indications are discontinued if the power supply voltage increases to 8.3 volts or more.

- If the power supply voltage decreases to less than 7.5 volts, the parking brake module discontinues the actuation. Actuation is automatically resumed if the power supply voltage subsequently increases to 7.5 volts or more and the parking brake switch request is still valid.
- If the power supply voltage decreases below 6.5 volts, the parking brake function is disabled for the remainder of the ignition cycle.
- If the power supply voltage increases to more than 18.0 volts, the parking brake module immediately disables the parking brake function and stores a related fault code. If the ignition is on, the parking brake module also signals the instrument cluster to illuminate the amber parking brake warning indicator and flash the red parking brake warning indicator. On the instrument cluster, a message advising that the parking brake has a fault and is not functioning is shown in the message center. The parking brake function remains disabled until the power supply voltage is within 9 to 18 volts again. When the power supply voltage is within 9 to 18 volts again, the warning indications are cancelled and actuation is automatically resumed if the parking brake module is in a dynamic mode of operation with a valid parking brake switch request.

NOTE: The instrument cluster shuts down below 8 volts, so warning indications and messages are not displayed below 8 volts. CAN transmission stops if battery voltage drops below 7.0 volts and re-starts when voltage goes above 7.5 volts.

Sleep Mode

To reduce quiescent drain on the vehicle battery, the parking brake module incorporates a sleep mode. The parking brake module enters the sleep mode, provided the ignition is off and there are no signals from the wheel speed sensors, when one of the following occurs:

- 20 minutes elapse after the last actuation of the parking brake.
- If no actuation occurred, 20 minutes elapse after the ignition is switched off.

The parking brake module wakes up from the sleep mode when one of the following occurs:

- An apply or release request is made with the parking brake switch.
- The ignition is turned on.

The parking brake module wakes up within 500 ms. The high speed CAN bus is activated within 200 ms maximum.

When the parking brake module is woken with a release request from the parking brake switch, the parking brake module ignores the request but illuminates the red brake warning indicator. The parking brake module extinguishes the red brake warning indicator and goes back to sleep immediately the switch is released to the neutral position.

When the parking brake module is woken with an apply request from the parking brake switch, if the parking brake is already applied the parking brake module ignores the request but illuminates the red brake warning indicator. The parking brake module extinguishes the red brake warning indicator and goes back to sleep immediately the switch is released to the neutral position. If the parking brake is in the released condition when the apply request is made, the parking brake module illuminates the red brake warning indicator and applies the parking brake. The parking brake module extinguishes the red brake warning indicator and goes back to sleep 3 minutes after the apply activation, or immediately after the switch is released to the neutral position, whichever occurs last.

Dynamic Apply

In the dynamic apply mode, if the vehicle speed is more than 10 km/h (6.25 mph) when the parking brake switch is selected to apply, the parking brake module requests the anti-lock brake system (ABS) module to activate the disc brakes on all four wheels. When the vehicle comes to a standstill, the parking brake module statically applies the parking brake. Once the static load is achieved, the hydraulic pressure is removed. If the parking brake switch is released to the neutral position, or pressed down to the release position, during dynamic apply, braking is cancelled.

The ABS module monitors the deceleration rate using the wheel speed sensor signals, and adjusts the hydraulic pressure to the disc brakes as required to achieve the required rate. All of the anti-lock control - traction control system brake functions remain enabled in the dynamic apply mode.

The parking brake module incorporates two fallback functions for the dynamic apply mode:

- Fallback 1 is invoked if vehicle speed is between 2.5 km/h (1.25 mph) and V_{max} when the parking brake switch is selected to apply and the ABS module is unable to fulfill a hydraulic request. When fallback 1 is invoked, the parking brake module decelerates the vehicle using only the parking brake. The parking brake module monitors the deceleration rate using the wheel speed information from the ABS module, and adjusts the tension of the brake cables to achieve the required rate. During deceleration the parking brake module also uses the wheel speed inputs from the ABS module to operate an anti-lock function for the rear wheels. When vehicle speed decreases to 2.5 km/h (1.25 mph) the parking brake module changes to the static apply mode.
- Fallback 2 is invoked if there is a loss of communication between the parking brake module and the ABS module or the CAN bus has failed. When fallback 2 is invoked, the parking brake module decelerates the vehicle using only the parking brake. The parking brake module tightens the brake cables under the control of the driver, no anti-lock function is available.

While dynamic apply is active, including fallback 1 and fallback 2, the parking brake module also outputs high speed CAN bus signals to:

- The ABS module, to apply the stoplamps.
- The instrument cluster, to sound an intermittent warning buzzer, at 0.5 second on, 1.0 second off.
- The instrument cluster, to illuminate the red parking brake warning indicator. The indicator is permanently

illuminated except in fallback 2, when it flashes.

DAR Pre-arming

The DAR pre-arming function operates when the transfer box is in high range to reduce the parking brake release time during DAR and to provide a smooth take-off. DAR pre-arming is invoked when:

- The ignition switch is in position II.
- The transmission is in gear 1, 2 or R.
- The vehicle is stationary.
- No failsafe tighten actuation has occurred.

Automatic Load Adjustment

While the ignition is on, the parking brake module constantly monitors the input from the force sensor. If the tension of the brake cables goes outside the limits for a given operating mode, the parking brake module automatically restores the tension within limits.

Failsafe Tighten. If, during DAR pre-arming, the vehicle moves, then the maximum cable force is reinstated for the remainder of that ignition cycle.

Automatic Apply. While the parking brake is applied, if the tension of the brake cables decreases by a prescribed amount from the initial setting, the parking brake module automatically restores the tension to the initial setting.

Automatic Release. While the parking brake is released, if the tension of the brake cables increase to a prescribed amount, the parking brake module automatically reduces the tension to zero.

Parking Brake Switch Monitoring

The parking brake module monitors for the following types of fault in the parking brake switch system:

- Short circuits between a pull-down transistor in the parking brake module and battery voltage.
- Broken wires and microswitches.
- Plausibility.

If a fault is detected, the parking brake module stores a related fault code.

The parking brake switch has a degree of in-built redundancy. If a single microswitch fault is detected the parking brake module can still determine the operating state of the parking brake switch. Short circuits or multiple failures cause the parking brake module to disable the parking brake switch for the remainder of the ignition cycle. The parking brake module also disables the parking brake switch if a plausibility fault occurs. However, since plausibility faults are usually caused by incomplete operation of the parking brake switch, the parking brake switch is re-enabled if the parking brake module subsequently establishes a plausible operating state.

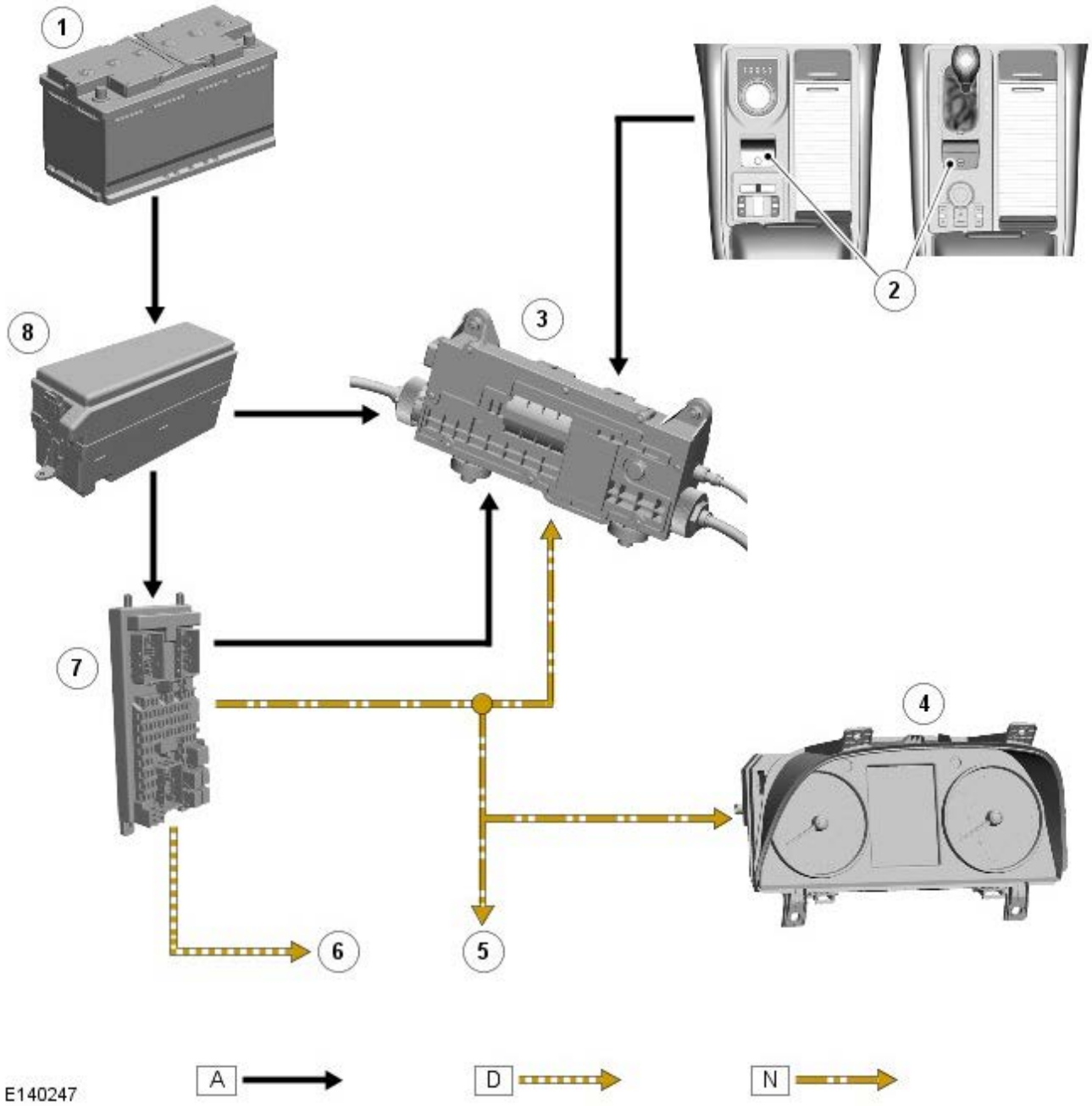
If a single microswitch fault is detected, the parking brake module signals the instrument cluster to illuminate the amber parking brake warning indicator. The parking brake module also signals the instrument cluster to display a message advising there is a parking brake fault. During an apply actuation, the parking brake module also signals the instrument cluster to flash the red parking brake warning indicator.

For all other fault types, the parking brake module signals the instrument cluster to illuminate the amber parking brake warning indicator and to display a message advising the parking brake has a fault and is not functioning. If it makes an apply actuation, the parking brake module signals the instrument cluster to flash the red parking brake warning indicator for the remainder of the ignition cycle.

On the next ignition cycle, the warning indicators and the messages are only activated if the fault is still present, although the fault code is retained by the parking brake module until cleared by T4.

PARKING BRAKE CONTROL DIAGRAM

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



Item	Part Number	Description
1	-	Battery
2	-	Parking brake switch
3	-	Parking brake module
4	-	Instrument cluster
5	-	CAN (controller area network) connection to other systems
6	-	CAN connection to other systems
7	-	CJB (central junction box)
8	-	BJB (battery junction box)

Parking Brake and Actuation - Parking Brake

Diagnosis and Testing

Principles of Operation

For a detailed description of the Parking Brake System and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Parking Brake (206-05 Parking Brake and Actuation, Description and Operation).

Inspection and Verification

CAUTIONS:

 Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

 Please note this is a sealed unit and no attempt must be made to open the actuator as it will invalidate any warranty claim.

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

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

Visual Inspection

Mechanical	Electrical
• Electric park brake cable(s) condition and installation • Electric park brake shoes condition and fitment • Electric park brake drums (integrated into rear brake discs) • Electric park brake actuator module condition and installation	• Electric park brake warning indicators • Fuses • Wiring harness / electrical connectors - Check for bent/corroded pins • Controller Area Network (CAN) circuits • Electric park brake switch • Electric park brake actuator

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Electric park brake will not engage or release Low electric park brake efficiency / electric park brake sticking/binding	• Electric park brake cables fouled, trapped or damaged • Electric park brake cables incorrectly routed or fixed • Electric park brake shoes, linings worn/contaminated • Electric park brake drums (integrated into rear brake discs) • Electric park brake shoes incorrectly adjusted following replacement • Electric park brake actuator malfunction	• Check the electric park brake cables for fouling, trapping or damage • Check the electric park brake cables for correct routing • Check that the electric park brake cable end fitting connector(s) are correctly installed to the operating lever(s) • Inspect the electric park brake shoes and drums for condition/wear/contamination • Check the electric park brake shoes for correct adjustment • Check the operation of the electric park brake actuator , check for damage and/or excessive noise during operation • Check for electric park brake control module DTCs

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: Electric Park Brake Control Module (EPBCM) (100-00 General Information, Description and Operation).

Brake Bedding Mode

Bedding mode is a special mode available in the Electric Park Brake Control Module (EPBCM) that disables the stability assist system and allows the parking brake to provide the braking force rather than the conventional braking system whilst the vehicle is moving at a velocity of >3kph. This mode is entered via a series of brake pedal

presses and switch applications, full details on this procedure is available in the relevant section of the workshop manual. If brake bedding mode is entered accidentally by the driver the RED warning lamp will flash in the instrument cluster, the electric park brake control module will return to normal operational mode when the ignition has been cycled. This DTC (C1104-68) is intended to highlight the fact that although the RED lamp was illuminated there was no fault present in the control module.

Drive Cycles

Drive Cycle 1 Description

- Ignition on
- Make sure that no electric park brake activation (diagnostic command or switch input) is attempted for a minimum of 3 seconds
- Retest for functionality

Drive Cycle 2 Description

- Ignition on
- Drive vehicle at a constant speed of 20kph (13mph) or slightly above in 2nd gear
- At a constant speed of 20kph (13mph) or slightly above, apply the electric park brake via the electric park brake switch
- Press the brake pedal

Drive Cycle 3 Description

- Ignition on
- Make sure that the vehicle is stationary and that the electric park brake is released
- Operate the electric park brake switch to the apply position and hold in this position until the electric park brake motor has stopped (this may take up to 5 seconds)
- Release the electric park brake switch to the idle position, leave in the idle position for 2 seconds
- Operate the electric park brake switch to the release position (while pressing the brake pedal) and hold in this position until the parking brake motor has stopped (this may take up to 5 seconds)
- Release the electric park brake switch to the idle position

Parking Brake and Actuation - Parking Brake Shoe and Lining Adjustment

General Procedures

Check

NOTE: This procedure must be carried out if the vehicle has been mud wading (not water) for more than 50 miles or if the park brake is adjusted as part of a vehicle service.

1. Check the park brake for correct operation.

2. CAUTIONS:

   When the vehicle is in the mounting position a red flashing light may appear on the instrument cluster. This indicates that the park brake actuator is in the mounting position. It does not indicate a vehicle fault.

   The warning lamp on the instrument cluster will flash whilst the park brake is being driven into the mounting position.

   Using Land Rover approved diagnostic equipment, drive the park brake to the mounting position.

3. Place the vehicles transmission into NEUTRAL.

4. 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.

5. Remove the wheels and tires.

6. NOTES:

   LH shown.

   Align the access hole in the position shown.

   Locate the park brake lever cable attachment point.
   - Remove the access plug.
   - Rotate the brake disc.



E161325

7. NOTES:

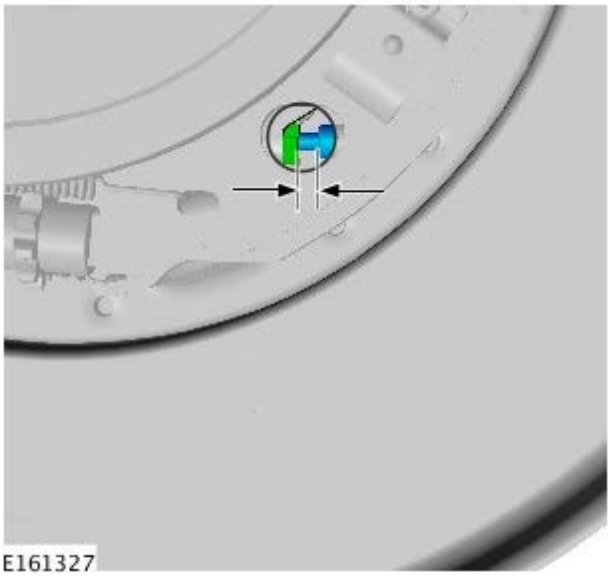
   RH shown.

   Align the access hole in the position shown.

   Locate the park brake lever cable attachment point.
   - Remove the access plug.
   - Rotate the brake disc.



E161326



E161327

8. CAUTIONS:

   The park brake shoe lever should be visible as shown.

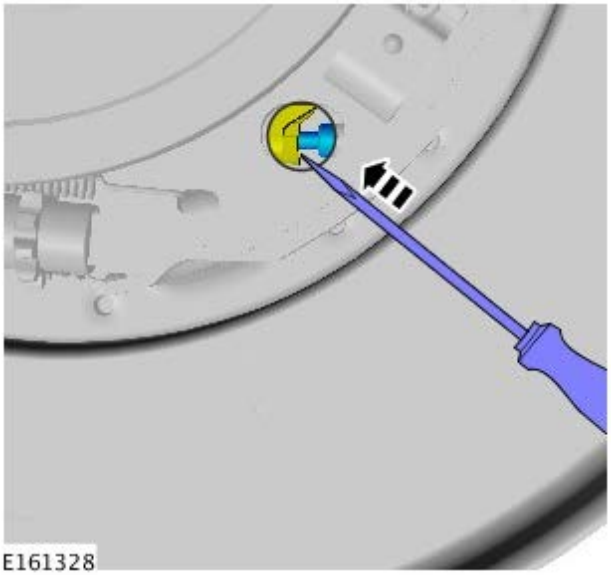
   There should be clearance between the park brake shoe lever and the park brake cable cap as shown.

   NOTES:

   LH shown.

   The step must be carried out on both sides.

   Observe the position of the park brake shoe lever and the park brake cable cap.
   - If the park brake shoe lever and park brake cable cap are not as shown, proceed to the next step.
   - If the park brake shoe lever and park brake cable cap are as shown, proceed to step 11.



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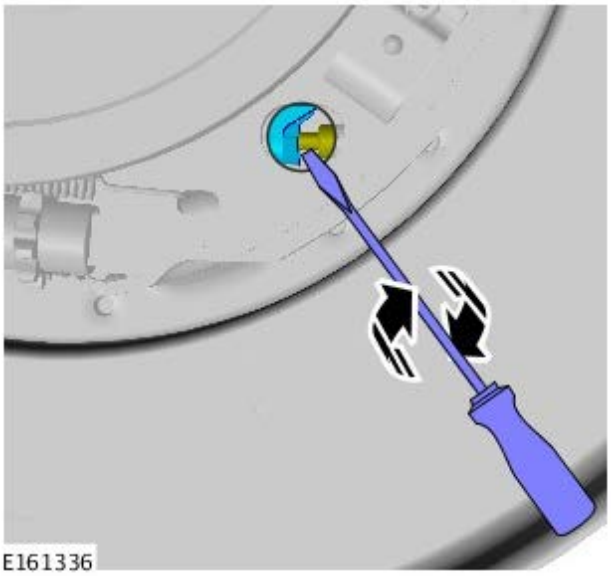
9. NOTES:

   LH shown.

   The step must be carried out on both sides.

   Using a suitable tool, check that the park brake shoe lever will move easily in the direction shown and returns to its original position.
   - If the park brake shoe lever moves easily, proceed to the next step.
   - If the park brake shoe lever does not move easily, rectify any concerns before proceeding.

10. NOTES:



LH shown.

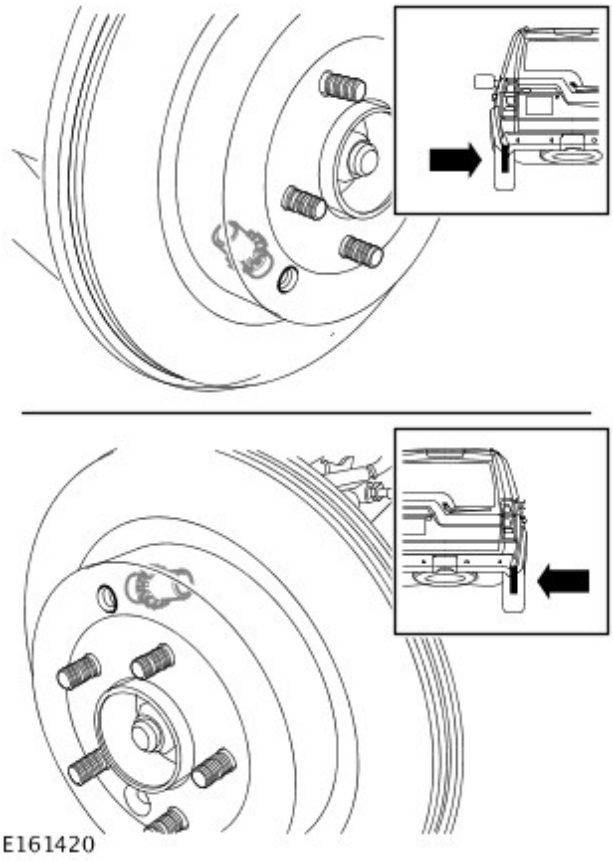
The step must be carried out on both sides.

Using a suitable tool, check that the park brake cable moves easily as shown.

- If the park brake cable does not move easily, rectify any concerns before proceeding.

Adjust

NOTE: This procedure must be carried out if new park brake shoes are installed, new rear brake discs are installed, or if the vehicle has been mud wading (not water) for more than 50 miles or if the park brake is adjusted as part of a vehicle service.



1. NOTE: Align the access hole with the indicators located on the back plate.

   Locate the park brake shoe adjuster.
   - Rotate the brake disc.

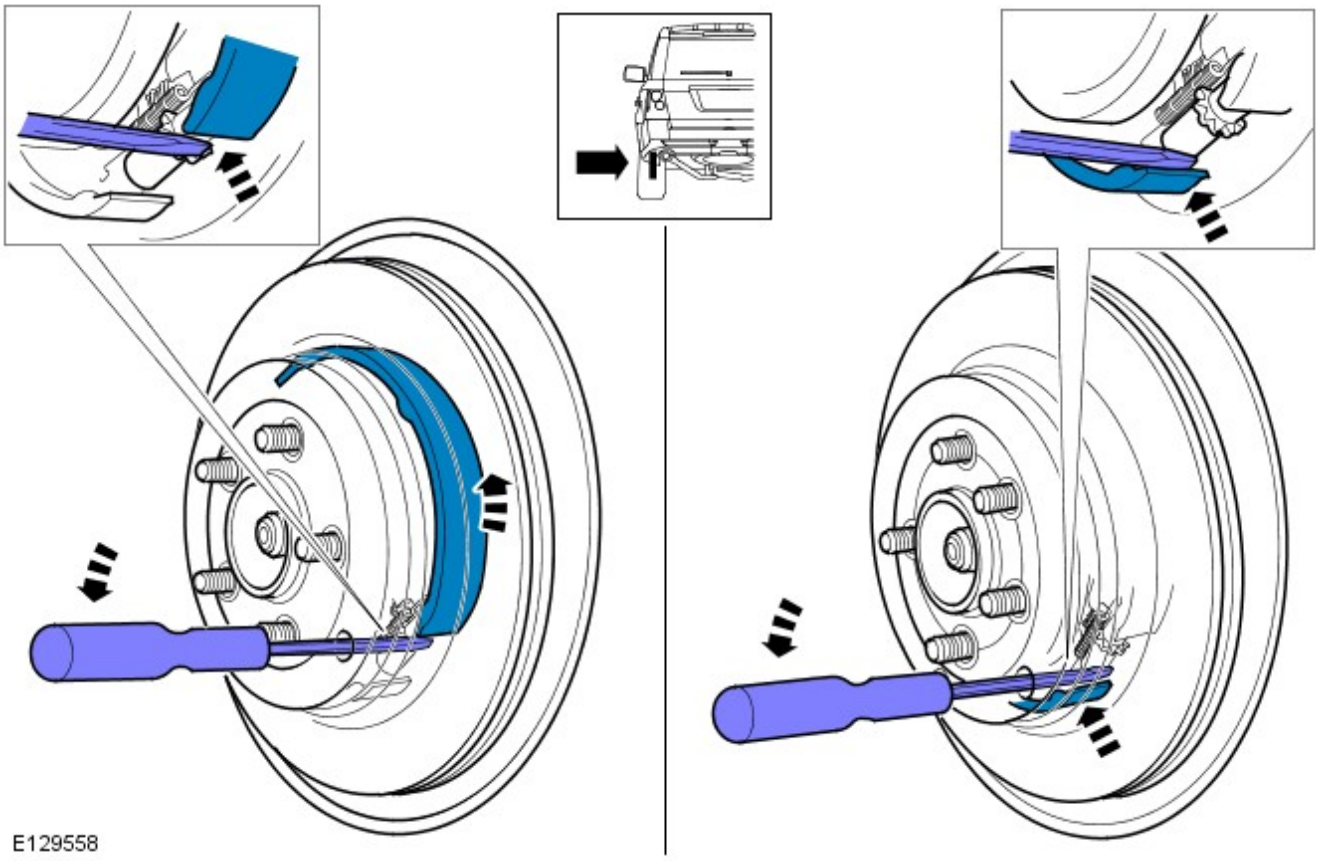
2. CAUTION: Failure to follow this step may cause damage to the park brake system. Failure to displace the park brake shoes, as shown, will result in incorrect clearance when carrying out the adjustment step.

   NOTES:

   The movement of the park brake shoe will be small and may not be felt when levering.

   LH shown.

Using a flat blade screwdriver, lever the brake shoes as indicated.



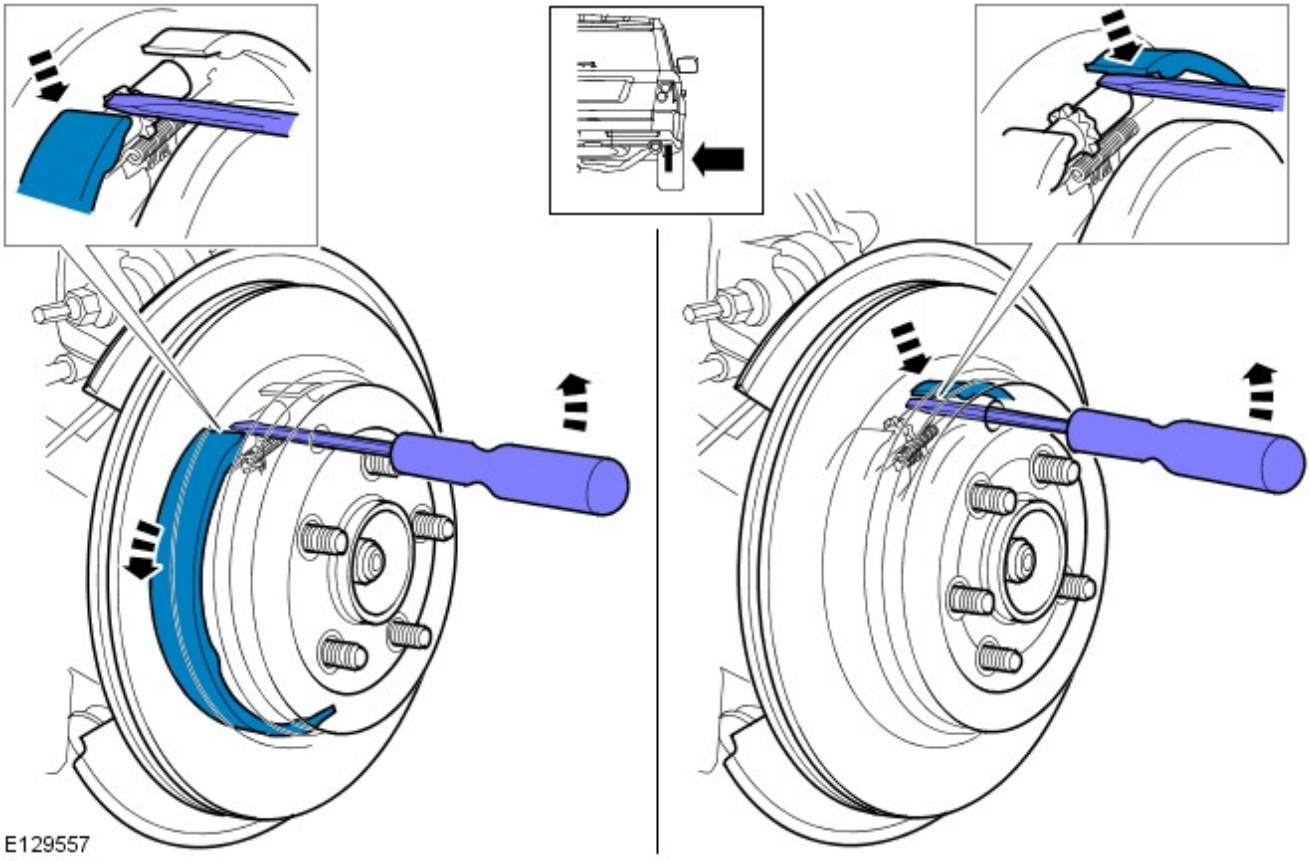
3. CAUTION: Failure to follow this step may cause damage to the park brake system. Failure to displace the park brake shoes, as shown, will result in incorrect clearance when carrying out the adjustment step.

   NOTES:

   The movement of the park brake shoe will be small and may not be felt when levering.

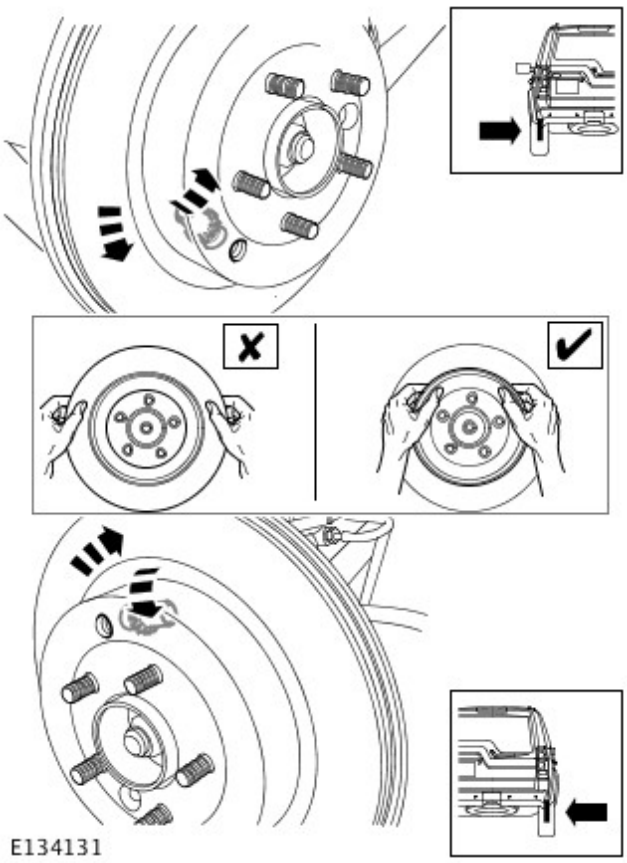
   RH Shown.

   Using a flat blade screwdriver, lever the brake shoes as indicated.



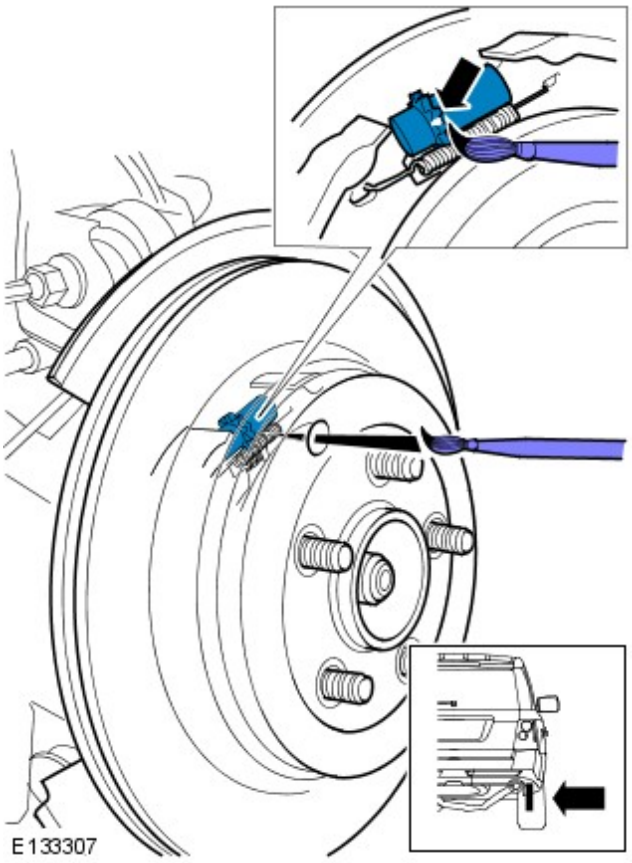
4. CAUTION: Do dot apply excessive force on the park brake shoe adjuster. Failure to follow this instruction may result in damage to the park brake system.

   Using a flat bladed screwdriver rotate the brake shoe adjuster to extend it until the brake disc is locked hand tight.



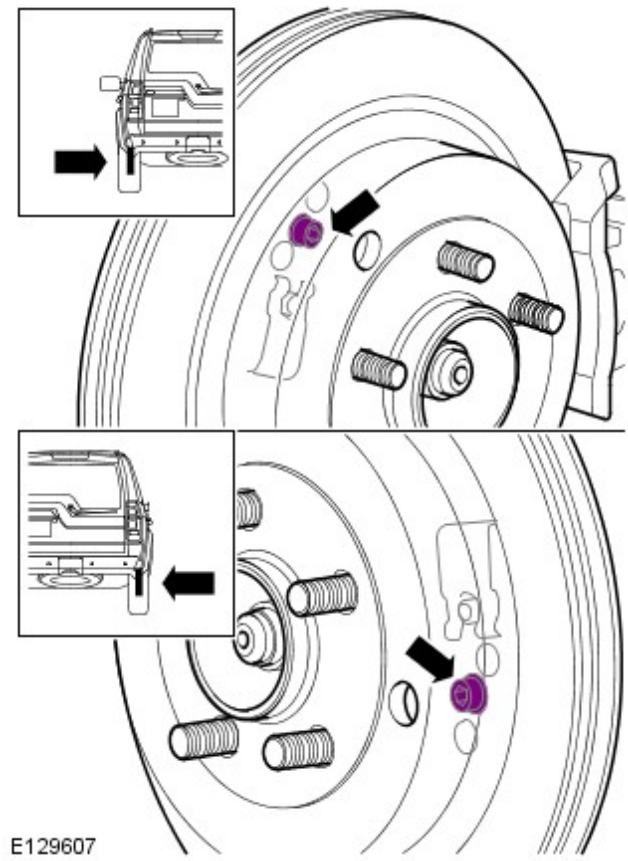
5. CAUTION: The following steps sets the running clearance for the park brake shoes, failure to adhere to the paint marking process may cause damage to the park brake system when the adjustment steps are carried out.

   Using suitable marker, mark the position of the park brake shoe adjuster.



6. CAUTION: The park brake adjuster must be rotated back **EXACTLY one full revolution (10 clicks).** Failure to follow this instruction may result in damage to the park brake system.

   Rotate the adjuster back **one revolution (10 clicks)** until paint mark is visible.



7. CAUTION: The wedge adjuster must be correctly seated to make sure the park brake cable is correctly adjusted. Failure to follow this instruction may result in damage to the park brake system.

   Loosen the wedge adjuster Allen screw half a turn.
   - Tap the brake disc lightly with a soft faced mallet, around the park brake shoe location within the brake disc.
   - Tighten the wedge adjuster Allen screw to 6 Nm (5 lb.ft).

8. Repeat the above procedure for the other side.

9. Take the vehicle out of the mounting position by operating the park brake twice.

10.  CAUTION: **The next step should only be carried out when new park brake shoes or brake disc have been installed.**

    Carry out the park brake shoe bedding-in procedure.
    For additional information, refer to: Parking Brake Shoes Bedding-In (206-05 Parking Brake and Actuation, General Procedures).

Parking Brake and Actuation - Parking Brake Shoes Bedding-In

General Procedures

NOTE: This procedure must be carried out if, new parking brake shoes are fitted, new rear brake discs are fitted or if the vehicle has been mud wading (not water) for more than 50 miles.

1. Carry out the parking brake shoe bedding-in procedure.

2. NOTE: The electronic parking brake 'Service Bedding-in Procedure mode' will be active for the remainder of the igntion cycle, or until the vehicle speed exceeds 31 mph (50 kph). If the procedure needs to be re-entered, the entry actions must be repeated.

   To enter 'Service Bedding-in Procedure' mode.
   - Start and run the engine.
   - Apply the footbrake 3 times within 10 seconds and hold applied after the 3rd application.
   - Apply the electronic parking brake switch 4 times, followed by 3 release applications within 10 seconds.

3. Once the Service Bedding-in procedure mode has been entered, the electronic parking brake linings can be bedded-in by conducting 10 repeated stops from 30 - 35 kph (19 - 22 mph), followed by a 500 metre (547 yard) interval between each stop to allow the brakes to cool, using the electronic parking brake control switch.
   - The electronic parking brake brake force will be increased up to the dynamic maximum so long as the switch is held in the applied position.
   - If the switch is released to either the NEUTRAL or OFF positions, the electronic parking brake will be released.
   - The electronic parking brake MUST be allowed to cool between applications, either by driving at 19 mph (30 kph) for 500 metres (547 yards) or remaining stationary for 1 minute between each application.

Parking Brake and Actuation - Parking Brake Cable LH

Removal and Installation

Removal

CAUTION: To avoid accidental operation of the parking brake, and possible damage to the parking brake actuator, remove Fusible link 8, located in the engine compartment fuse box before commencing work.

NOTE: If the parking brake system has completed less than 50,000 cycles it is permissible to replace the parking brake cables. If over 50,000 cycles have been completed, then the cables can only replaced as part of the parking brake actuator and cable assembly. The parking brake cycle count can be checked using using the Land Rover approved diagnostic system, (ON/OFF = 1 cycle). If a cable breaks or becomes detached whilst the vehicle is being driven, a 'parking brake actuator unjaming procedure' may be required using the Land Rover approved diagnostic system.

1. Using the Land Rover approved diagnostic system, drive the parking brake to the 'mounting position'.

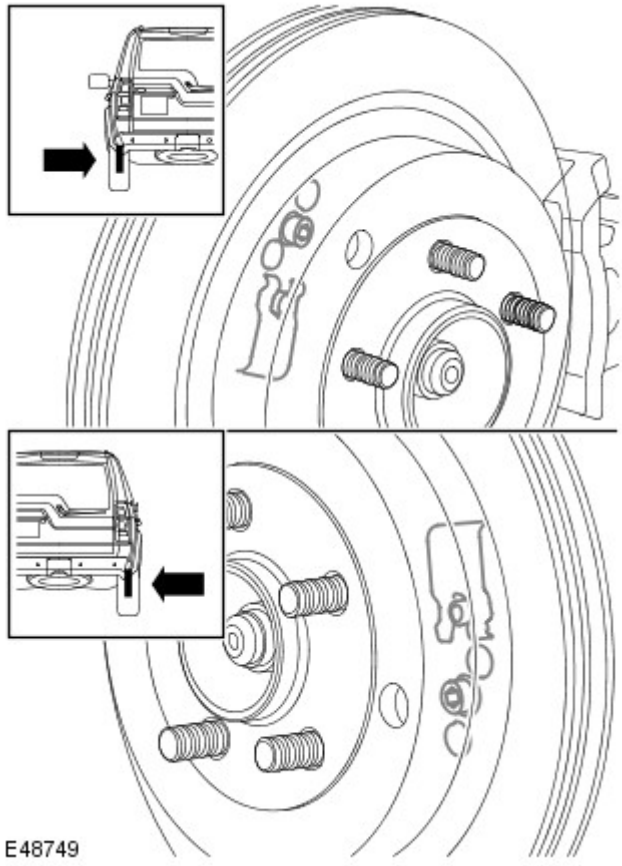
2. Isolate the parking brake electrical circuit.
   - Remove fuse number 8 from the BJB.

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

   Raise and support the vehicle.

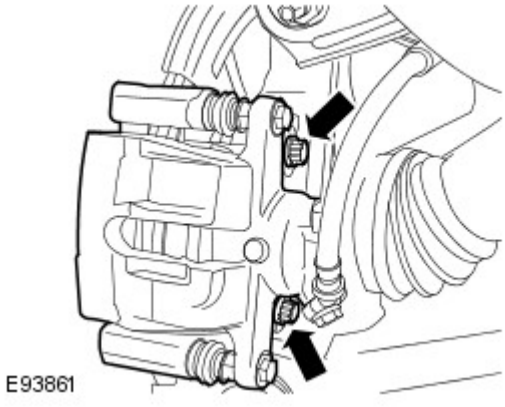
4. Remove both rear wheels and tires.

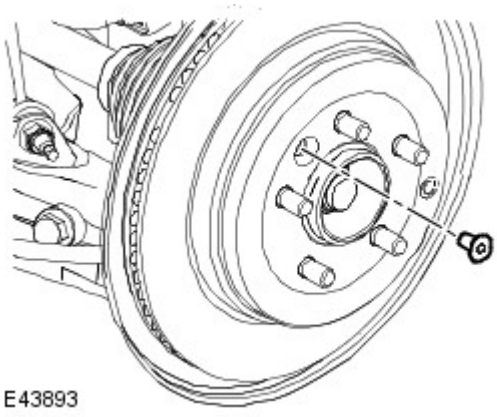
5. Release the parking brake shoe adjustment.
   - Loosen the screw.



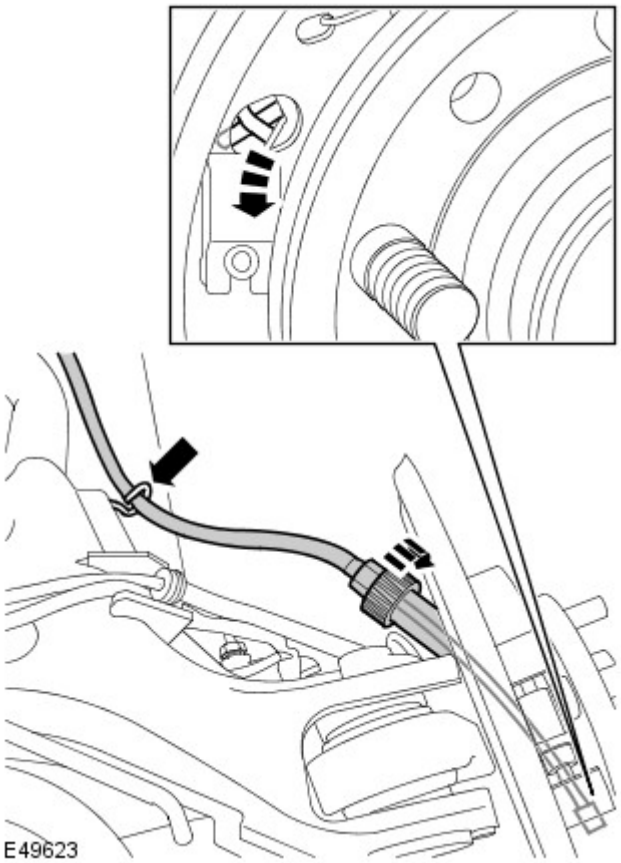
6. CAUTION: Do not allow the brake caliper to hang on the brake hose.

   Reposition the LH rear brake caliper.
   - Remove the 2 bolts.
   - Using a suitable tie strap, support the brake caliper.



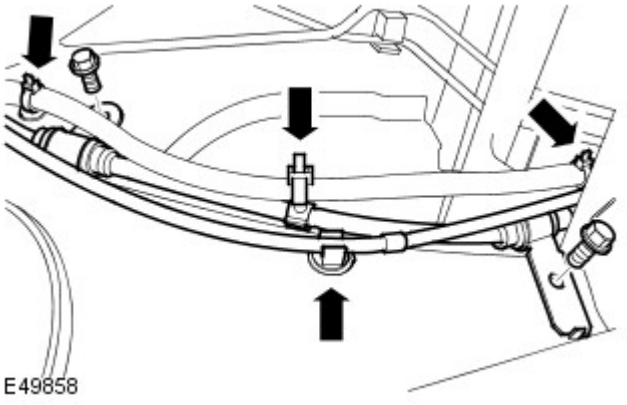


7. Remove the LH rear brake disc.
    - Remove the screw.

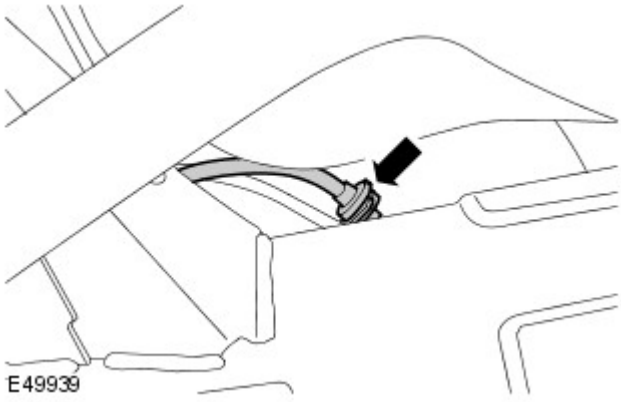


8. Disconnect parking brake cable from the wheel hub.
    - Fully loosen the nut.
    - Release the cable from the lower arm.
    - Disconnect the inner cable from the brake shoe.

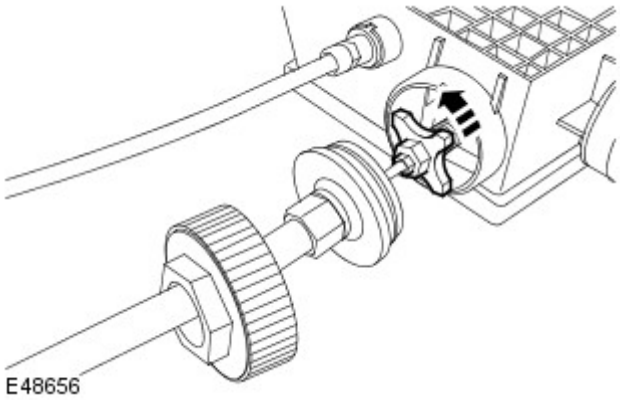
9. Release the LH parking brake cable.
    - Remove the 2 bolts.
    - Release the 3 wiring harness clips.
    - Release the cable from the clip on the chassis.



10. Release the LH parking brake cable.



11. Remove the LH parking brake cable.
    - Release the retaining nut.
    - Release and remove the cable.



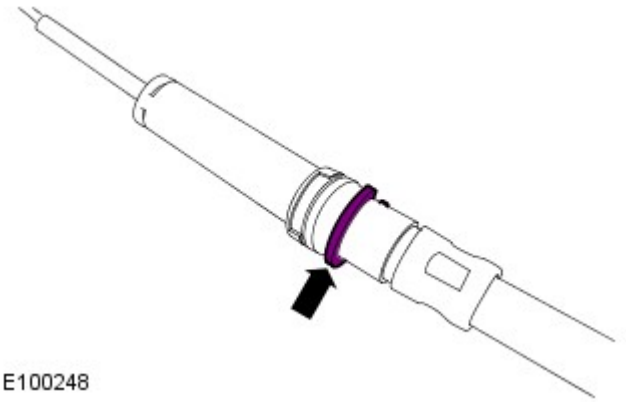
Installation

1. Install the LH parking brake cable.
    - LH cable: Screw the cable in 5 complete turns.
    - Tighten the retaining nut.

2. Locate and secure the LH parking brake cable.
    - Tighten the bolts to 22 Nm (16 lb.ft).
    - Secure the wiring harness.
    - Secure the cable grommet to the integrated body frame bracket.

3. NOTE: Make sure that the brake cable circlip is positioned as shown.

   Connect the parking brake cable to the wheel hub.
    - Connect the cable to the brake shoe lever.
    - Locate the cable to the backplate.
    - Tighten the nut to 8 Nm (6 lb.ft).



E100248

4. CAUTION: Make sure that the component is clean, free of foreign material and lubricant.

   Install the LH rear brake disc.
   - Tighten the Torx screw to 35 Nm (26 lb.ft).

5. Secure the LH rear brake caliper.
   - Remove and discard the tie strap.
   - Tighten the bolts to 115 Nm (85 lb.ft).

6. NOTE: The adjustment procedure must be carried out in full.

   Adjust the parking brake shoes.
   For additional information, refer to: Parking Brake Shoe and Lining Adjustment (206-05, General Procedures).

7. Install the rear wheels and tires.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

8. Install fuse number 8 into the BJB.

Parking Brake and Actuation - Parking Brake Cable RH

Removal and Installation

Removal

CAUTION: To avoid accidental operation of the parking brake, and possible damage to the parking brake actuator, remove Fusible link 8, located in the engine compartment fuse box before commencing work.

NOTE: If the parking brake system has completed less than 50,000 cycles it is permissible to replace the parking brake cables. If over 50,000 cycles have been completed, then the cables can only replaced as part of the parking brake actuator and cable assembly. The parking brake cycle count can be checked using using the Land Rover approved diagnostic system, (ON/OFF = 1 cycle). If a cable breaks or becomes detached whilst the vehicle is being driven, a 'parking brake actuator unjaming procedure' may be required using the Land Rover approved diagnostic system.

1. Using the Land Rover approved diagnostic system, drive the parking brake to the 'mounting position'.

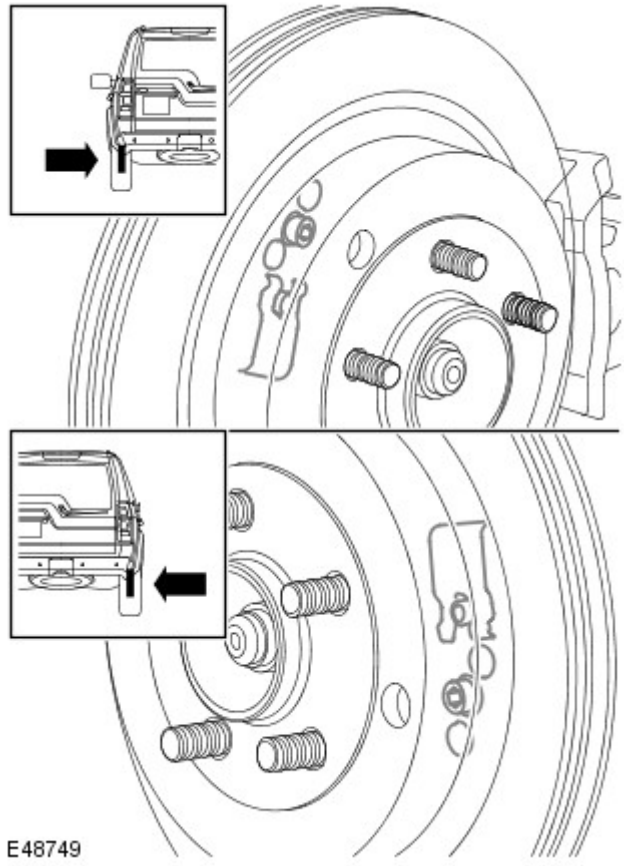
2. Isolate the parking brake electrical circuit.
   - Remove fuse number 8 from the BJB.

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

   Raise and support the vehicle.

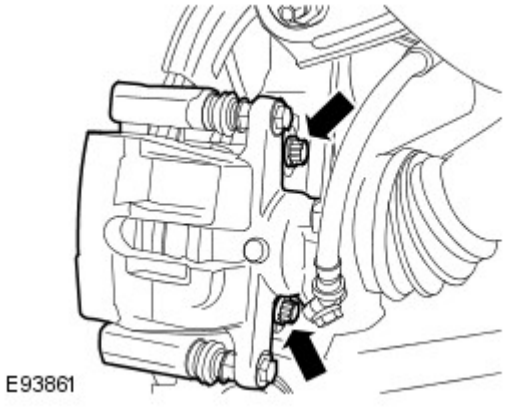
4. Remove the wheels and tires.

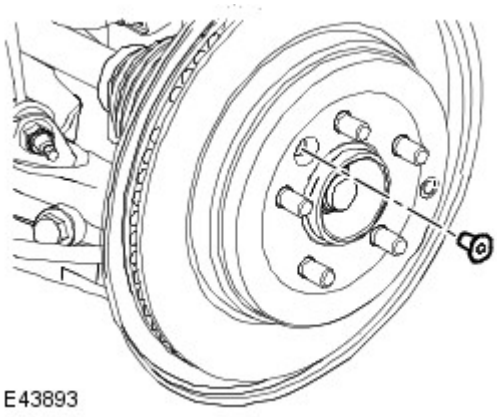
5. Release the parking brake shoe adjustment.
   - Loosen the screw.



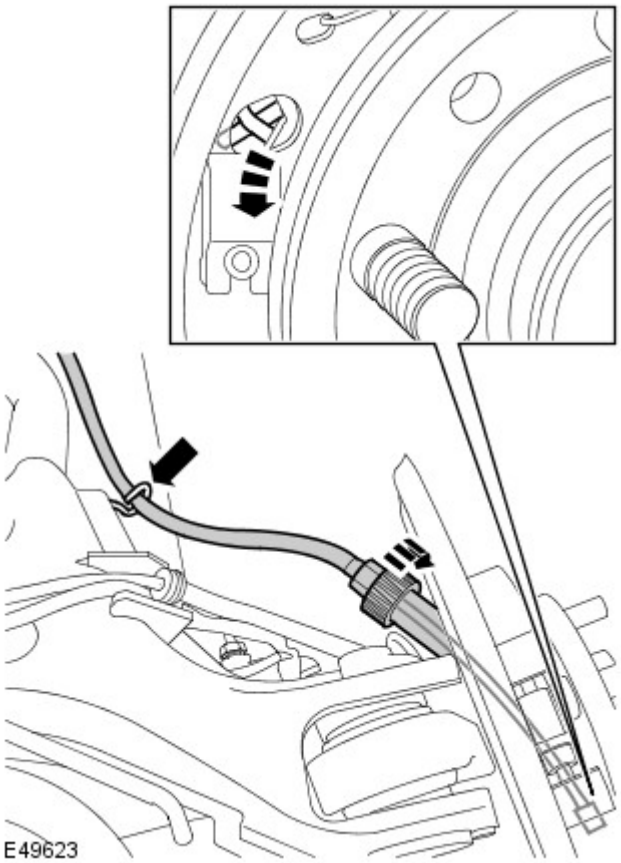
6. CAUTION: Do not allow the brake caliper to hang on the brake hose.

   Reposition the RH rear brake caliper.
   - Remove the 2 bolts.
   - Using a suitable tie strap, support the brake caliper.





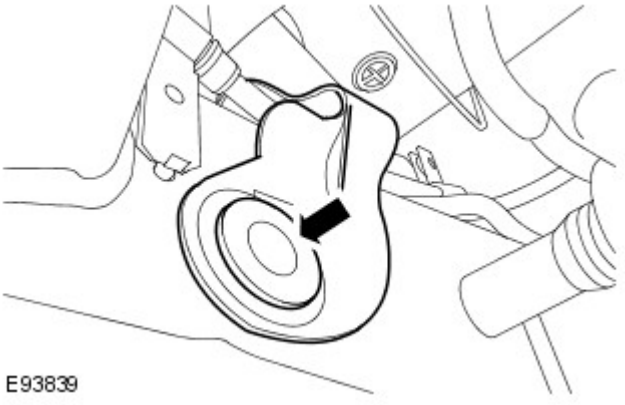
7. Remove the RH rear brake disc.
    - Remove the screw.



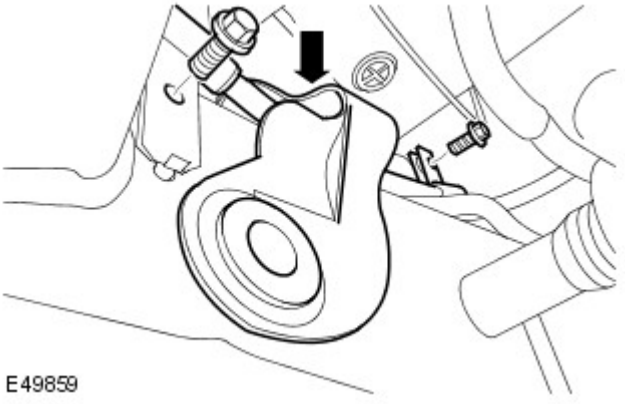
8. Disconnect parking brake cable from the wheel hub.
    - Fully loosen the nut.
    - Release the cable from the lower arm.
    - Disconnect the inner cable from the brake shoe.

9. CAUTION: The fuel tank breather line bracket can be easily damaged when releasing it from the chassis.

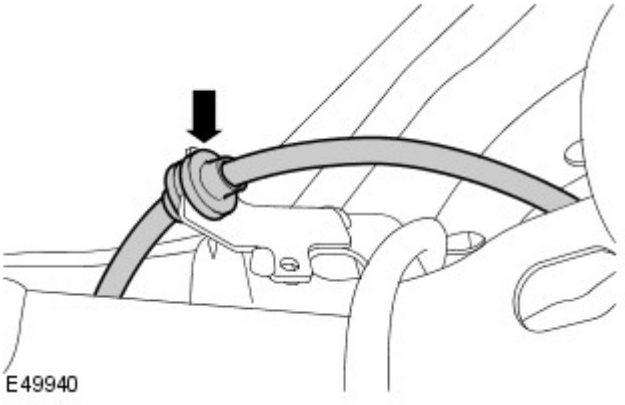
    Release the fuel tank breather line bracket.
    - Remove the plastic insert.



10. Release the RH parking brake cable.
    - Remove the 2 bolts.
    - Release the parking brake cable from the 2 pipe clips.
    - Release the cable from the clip on the chassis.

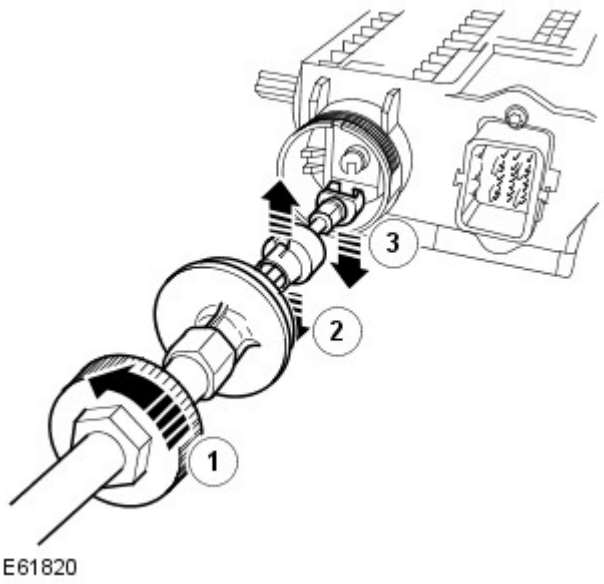


11. Release the RH parking brake cable.



12. CAUTION: Make sure that no dirt or moisture enters the actuator during cable replacement.

    Remove the RH parking brake cable.
    - Release the retaining nut.
    - Release the cable retaining clip.
    - Release and remove the cable.



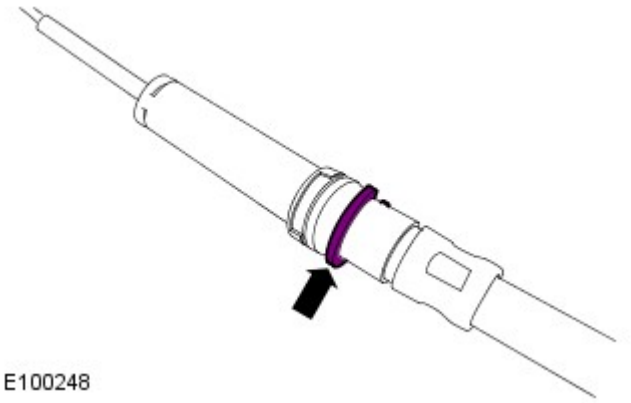
Installation

1. Install the RH parking brake cable.
    - Install the cable.

- Install the cable retaining clip.
- Tighten the retaining nut.

2. Secure the fuel tank breather line bracket.
   - Install the plastic insert.

3. Locate and secure the RH parking brake cable.
   - Tighten the bolts to 22 Nm (16 lb.ft).
   - Secure the parking brake cable to the 2 pipe clips.
   - Secure the cable grommet to the integrated body frame bracket.


E100248

4. NOTE: Make sure that the brake cable circlip is positioned as shown.

   Connect the parking brake cable to the wheel hub.
   - Connect the cable to the brake shoe lever.
   - Locate the cable to the backplate.
   - Tighten the nut to 8 Nm (6 lb.ft).

5. CAUTION: Make sure that the component is clean, free of foreign material and lubricant.

   Install the RH rear brake disc.
   - Tighten the Torx screw to 35 Nm (26 lb.ft).

6. Secure the RH rear brake caliper.
   - Remove and discard the tie strap.
   - Tighten the bolts to 115 Nm (85 lb.ft).

7. NOTE: The adjustment procedure must be carried out in full.

   Adjust the parking brake shoes.
   For additional information, refer to: Parking Brake Shoe and Lining Adjustment (206-05, General Procedures).

8. Install the rear wheels and tires.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

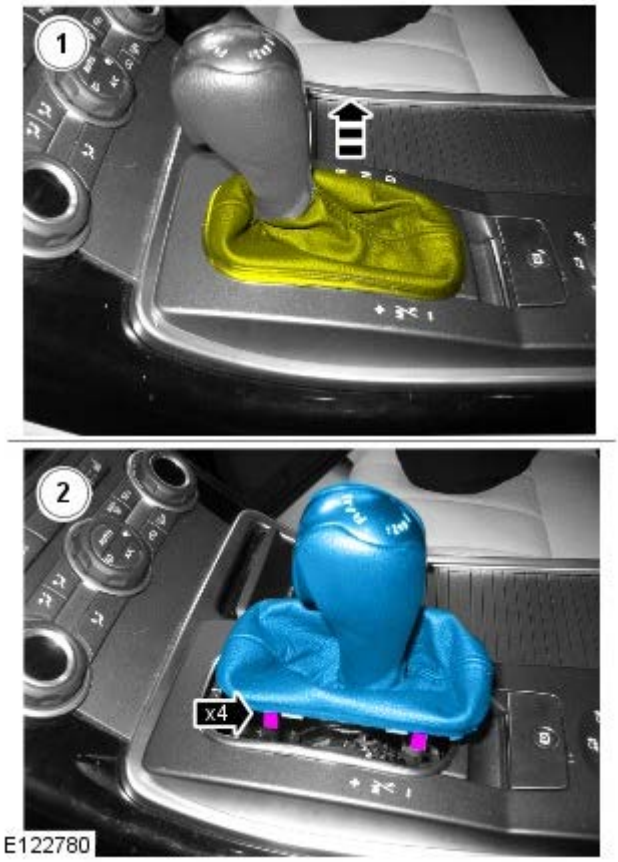
9. Install fuse number 8 into the BJB.

Parking Brake and Actuation - Parking Brake Switch
Removal and Installation

Removal

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

1.



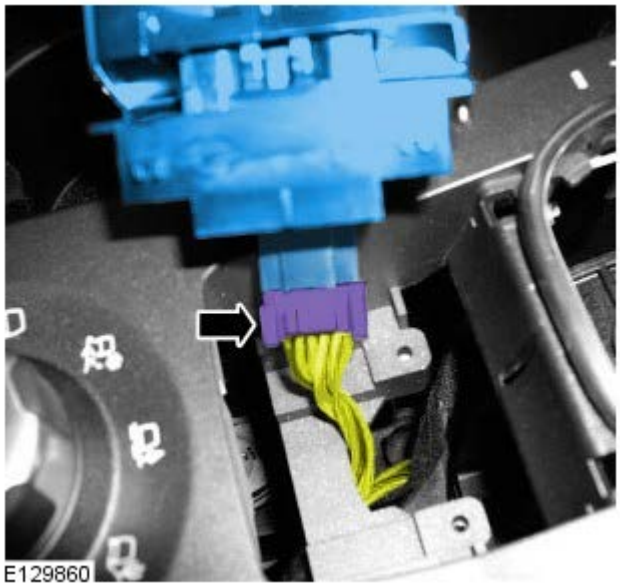
2.



3.



4.



Installation

1. To install, reverse the removal procedure.

Parking Brake and Actuation - Parking Brake Actuator Vehicles With: Standard Brakes

Removal and Installation

Removal

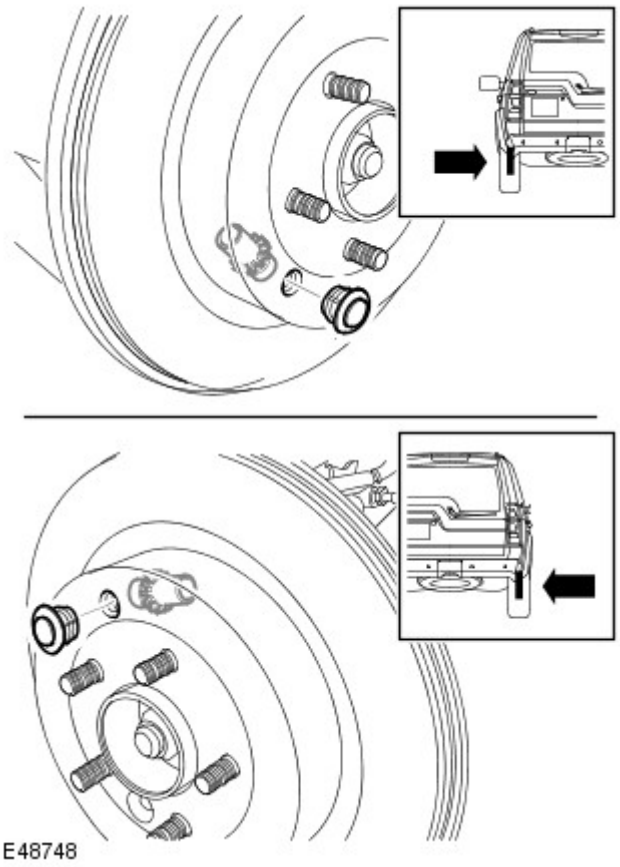
1. Using the Land Rover approved diagnostic system, drive the parking brake to the 'mounting position'.

2. Isolate the parking brake electrical circuit.
   - Remove fuse number 8 from the BJB.

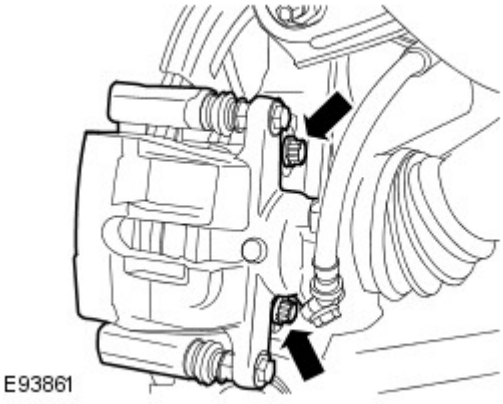
3. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

4. Remove the rear wheels and tires.



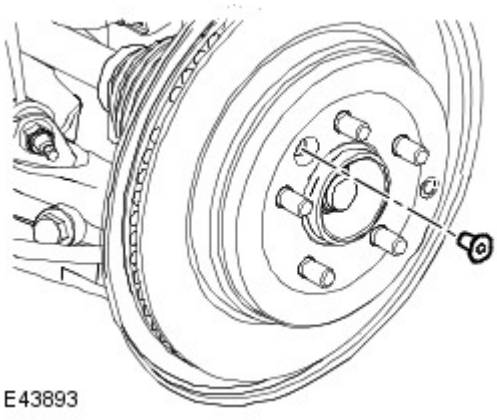
5. Release the parking brake shoe adjustment.
   - Remove the plug from the access hole in the brake disc.
   - Using a suitable tool, rotate the brake shoe adjuster to release the adjustment.

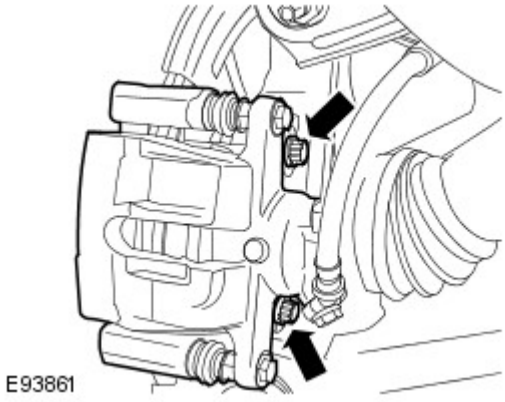


6. CAUTION: Do not allow the brake caliper to hang on the brake hose.

   Reposition the RH rear brake caliper.
   - Remove the 2 bolts.
   - Using a suitable tie strap, support the brake caliper.

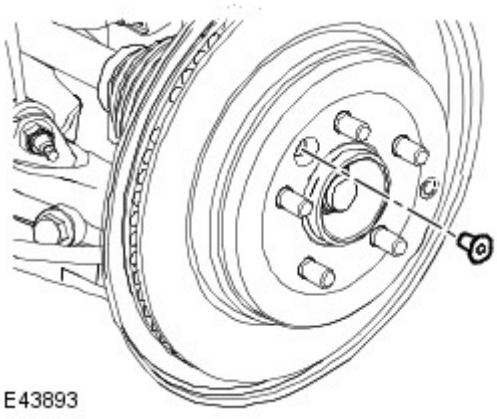
7. Remove the RH rear brake disc.
   - Remove the screw.





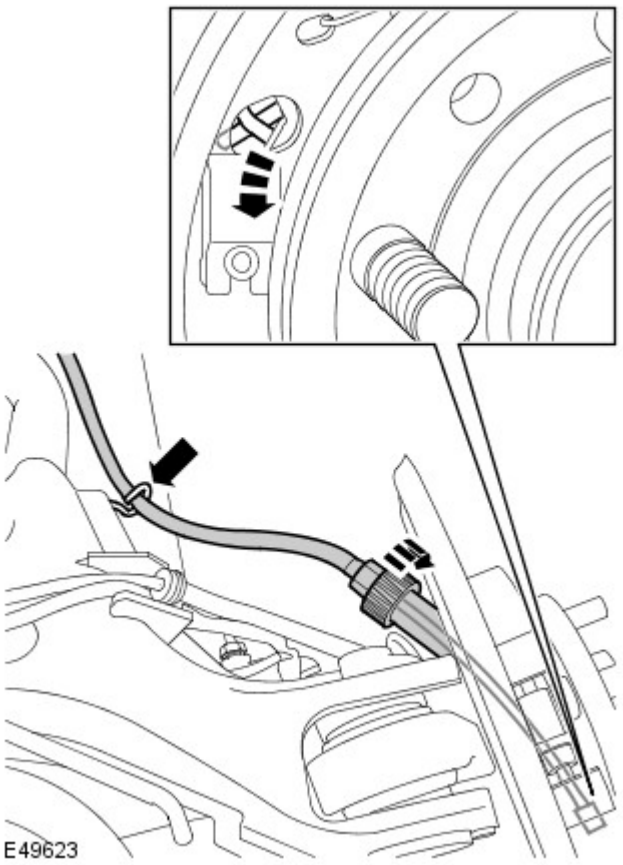
8. CAUTION: Do not allow the brake caliper to hang on the brake hose.

   Reposition the LH rear brake caliper.
   - Remove the 2 bolts.
   - Using a suitable tie strap, support the brake caliper.

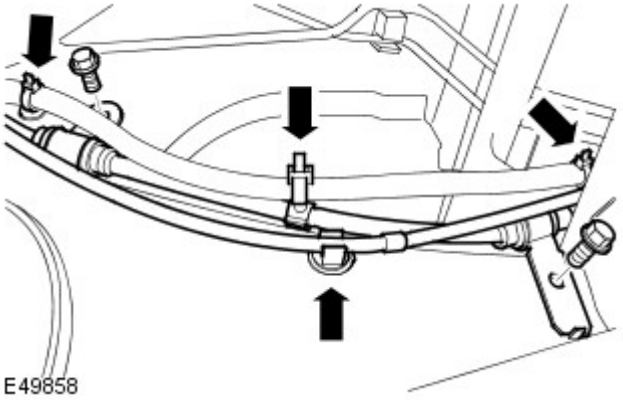


9. Remove the LH rear brake disc.
   - Remove the screw.

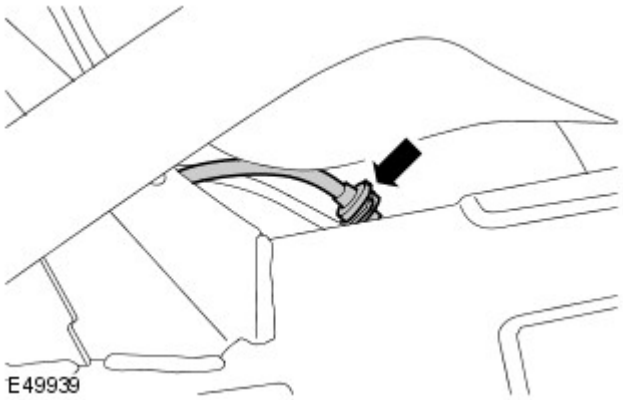
10. Disconnect both parking brake cables from the wheel hubs.
    - Fully loosen the nut.
    - Release the cable from the lower arm.
    - Disconnect the inner cable from the brake shoe.



11. Release the LH parking brake cable.
    - Remove the 2 bolts.
    - Release the 3 wiring harness clips.
    - Release the cable from the clip on the chassis.

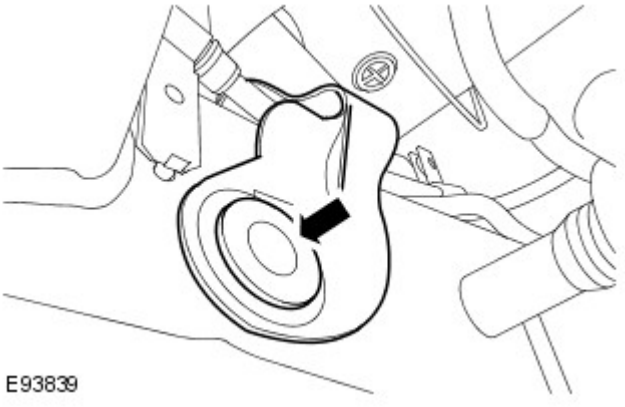


12. Release the LH parking brake cable.

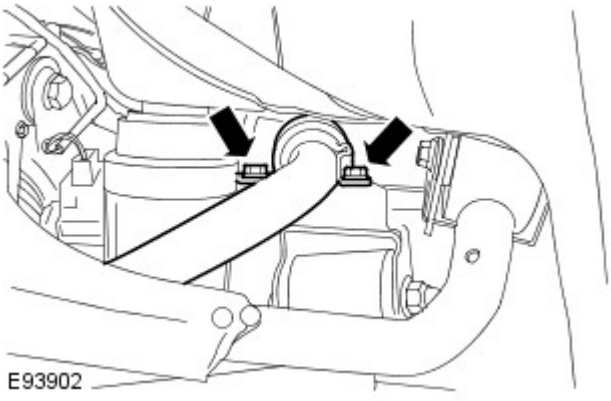


13. CAUTION: The fuel tank breather line bracket can be easily damaged when releasing it from the chassis.

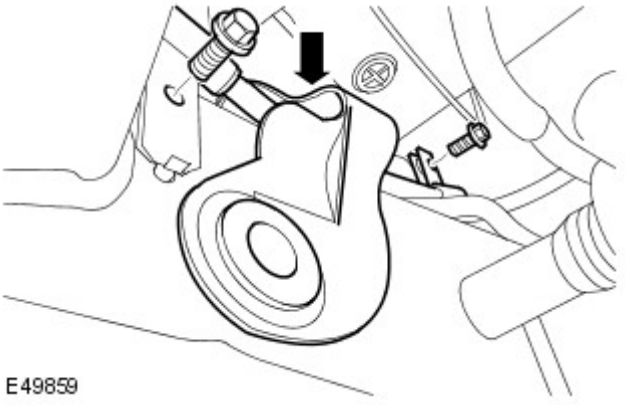
    Release the fuel tank breather line bracket.
    - Remove the plastic insert.



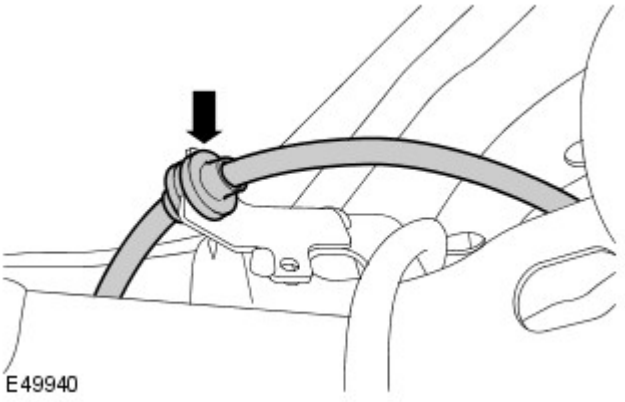
14. Raise the RH side of the rear stabilizer bar.
    - Loosen the 2 bolts.



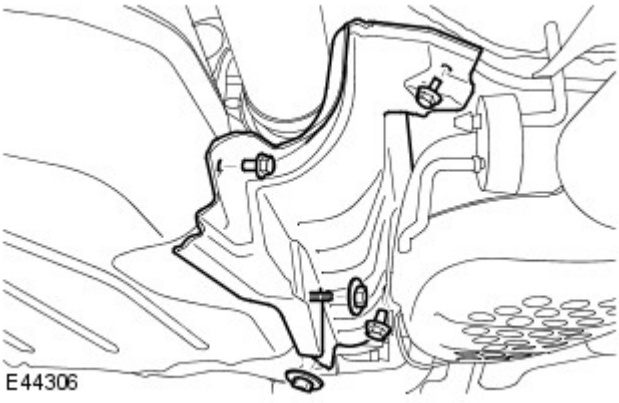
15. Release the RH parking brake cable.
    - Remove the 2 bolts.
    - Release the parking brake cable from the 2 pipe clips.
    - Release the cable from the clip on the chassis.

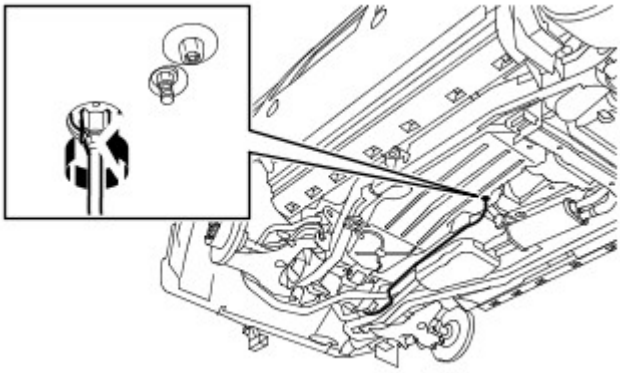


16. Release the RH parking brake cable.



17. Remove the fuel tank heat shield.
    - Remove the 3 bolts and 2 nuts.

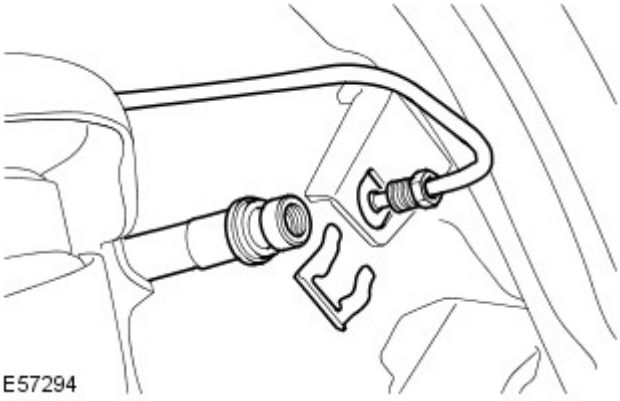

E44306


E49860

18. CAUTION: Inspect the parking brake emergency release cable to body seal and replace if damaged.

NOTE: Note the fitted position of the parking brake emergency release cable to body seal.

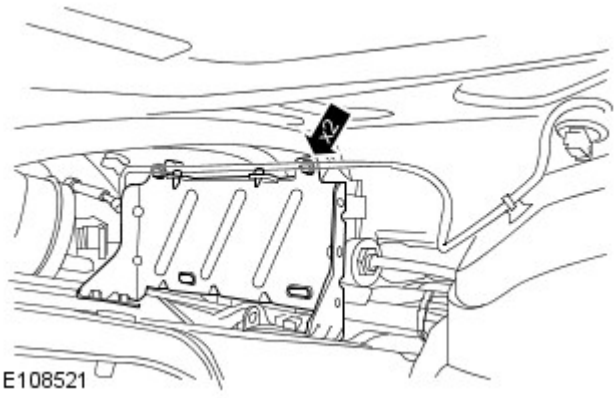
Release the parking brake emergency release cable.


E57294

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

RH side rear: Disconnect the brake line.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.


E108521

20. NOTE: Note the routing of the parking brake emergency release cable.

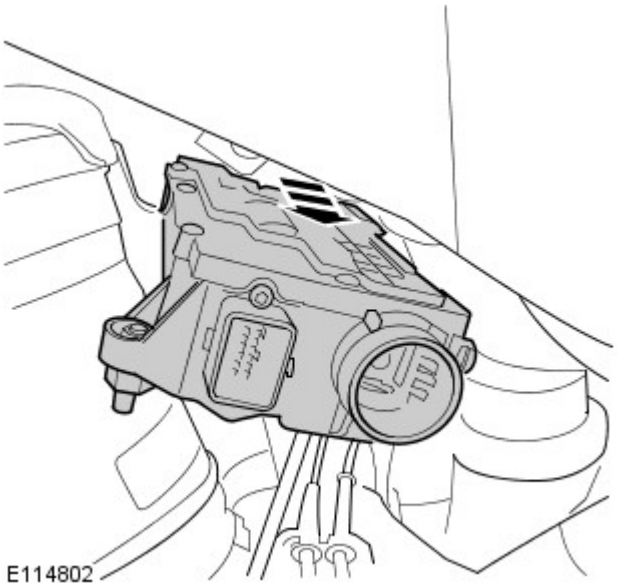
Displace the parking brake actuator and cable assembly.

- Disconnect the electrical connector.
- Remove the 2 nuts.

21. NOTE: Brake cable shown removed for clarity.

Remove the parking brake actuator and cable assembly.

- Withdraw from the RH rear wheel arch aperture.



Installation

1. NOTE: Note the routing of the parking brake emergency release cable.

   Install the parking brake actuator and cable assembly.
   - Install the 2 nuts.
   - Connect the electrical connector.

2. NOTE: Remove and discard the blanking caps.

   RH side rear: Connect the brake line.
   - Clean the component mating faces.
   - Secure the clip.
   - Tighten the brake line union to 16 Nm (12 lb.ft).

3. CAUTION: Make sure the parking brake emergency release cable to body seal is installed correctly.

   Locate and secure the parking brake emergency release cable.

4. Install the fuel tank heat shield.
   - Tighten the bolts to 6 Nm (4 lb.ft).
   - Tighten the nuts to 3 Nm (2 lb.ft).

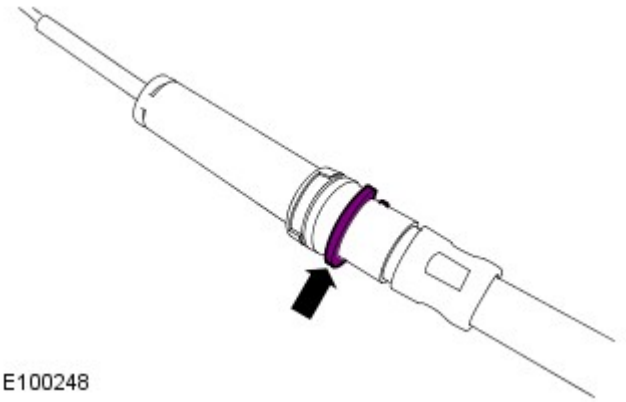
5. Secure the fuel tank breather line bracket.
   - Install the plastic insert.

6. Locate and secure the RH parking brake cable.
   - Tighten the bolts to 22 Nm (16 lb.ft).
   - Secure the parking brake cable to the 2 pipe clips.
   - Secure the cable grommet to the integrated body frame bracket.

7. Locate and secure the LH parking brake cable.
   - Tighten the bolts to 22 Nm (16 lb.ft).
   - Secure the wiring harness.
   - Secure the cable grommet to the integrated body frame bracket.

8. NOTE: Make sure that the brake cable circlip is positioned as shown.

   Connect the parking brake cables to the wheel hubs.
   - Connect the cable to the brake shoe lever.
   - Locate the cable to the backplate.
   - Tighten the nut to 8 Nm (6 lb.ft).



E100248

9. CAUTION: Make sure that the component is clean, free of foreign material and lubricant.

   Install the LH rear brake disc.
   - Tighten the Torx screw to 35 Nm (26 lb.ft).

10. Secure the LH rear brake caliper.
    - Remove and discard the tie strap.
    - Tighten the bolts to 115 Nm (85 lb.ft).

11. CAUTION: Make sure that the component is clean, free of foreign material and lubricant.

    Install the RH rear brake disc.
    - Tighten the Torx screw to 35 Nm (26 lb.ft).

12. Secure the RH rear brake caliper.
    - Remove and discard the tie strap.
    - Tighten the bolts to 115 Nm (85 lb.ft).

13. Adjust the parking brake shoes.
    For additional information, refer to: Parking Brake Shoe and Lining Adjustment (206-05, General Procedures).

14. Bleed the brake system.
    For additional information, refer to: Component Bleeding (206-00, General Procedures).

15. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

16. Install fuse number 8 into the BJB.

17. Using the Land Rover approved diagnostic system, calibrate the parking brake actuator on an even surface.

18. Apply and release hand brake to confirm operation.

Parking Brake and Actuation - Parking Brake Actuator Vehicles With: High Performance Brakes

Removal and Installation

Removal

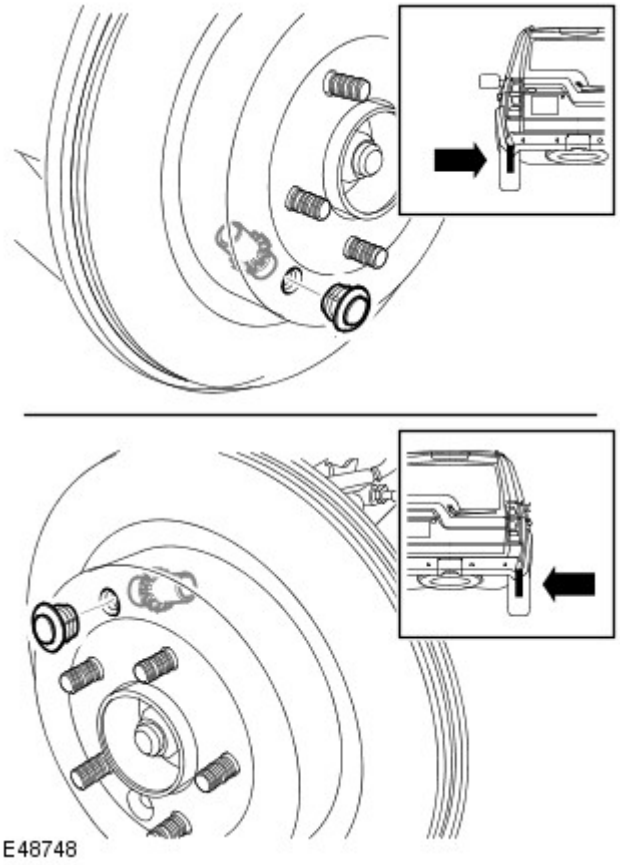
1. Using the Land Rover approved diagnostic system, drive the parking brake to the 'mounting position'.

2. Isolate the parking brake electrical circuit.
   - Remove fuse number 8 from the BJB.

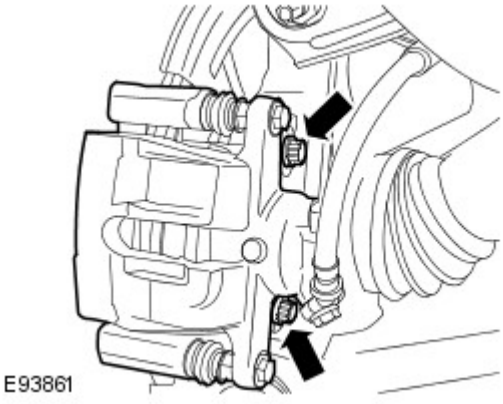
3. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

4. Remove the rear wheels and tires.



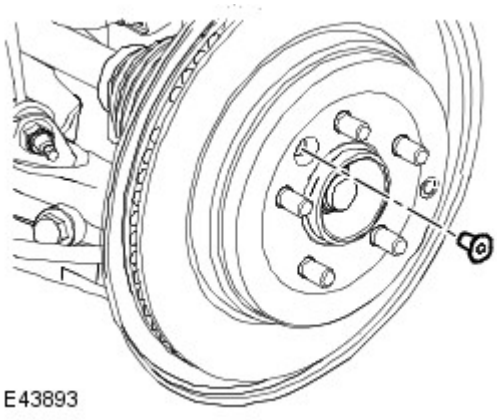
5. Release the parking brake shoe adjustment.
   - Remove the plug from the access hole in the brake disc.
   - Using a suitable tool, rotate the brake shoe adjuster to release the adjustment.

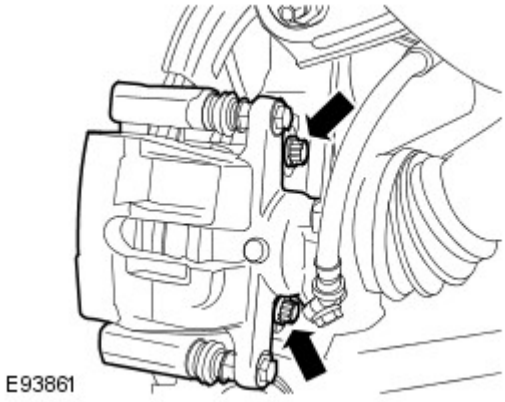


6. CAUTION: Do not allow the brake caliper to hang on the brake hose.

   Reposition the RH rear brake caliper.
   - Remove the 2 bolts.
   - Using a suitable tie strap, support the brake caliper.

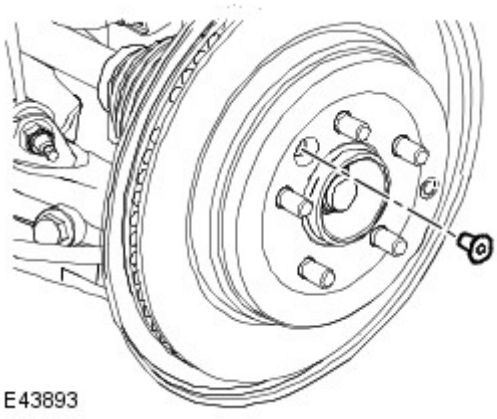
7. Remove the RH rear brake disc.
   - Remove the screw.





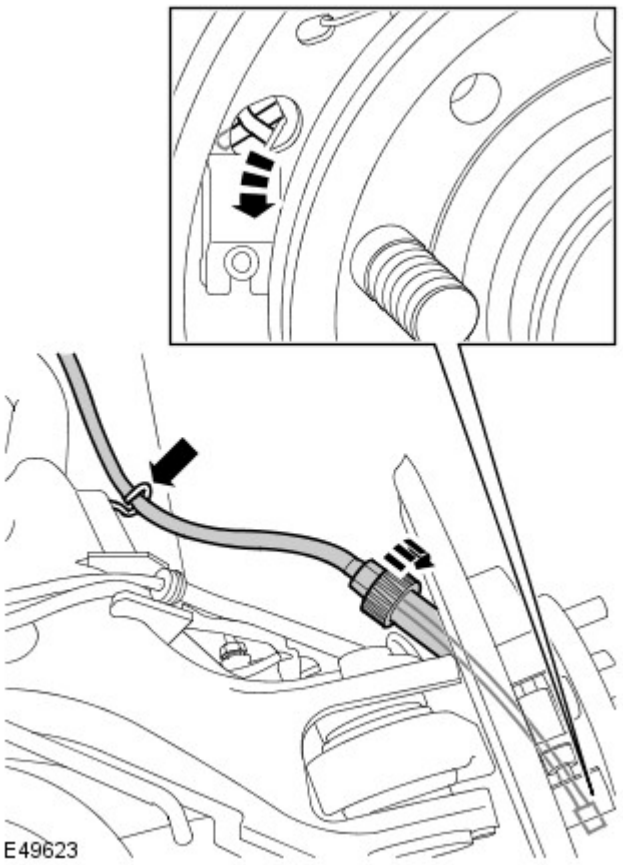
8. CAUTION: Do not allow the brake caliper to hang on the brake hose.

   Reposition the LH rear brake caliper.
   - Remove the 2 bolts.
   - Using a suitable tie strap, support the brake caliper.

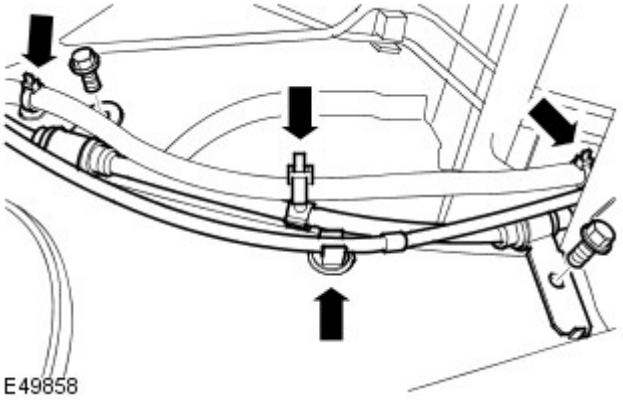


9. Remove the LH rear brake disc.
   - Remove the screw.

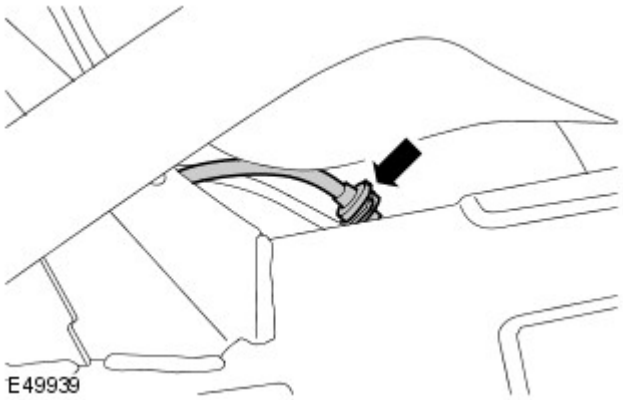
10. Disconnect both parking brake cables from the wheel hubs.
    - Fully loosen the nut.
    - Release the cable from the lower arm.
    - Disconnect the inner cable from the brake shoe.



11. Release the LH parking brake cable.
    - Remove the 2 bolts.
    - Release the 3 wiring harness clips.
    - Release the cable from the clip on the chassis.

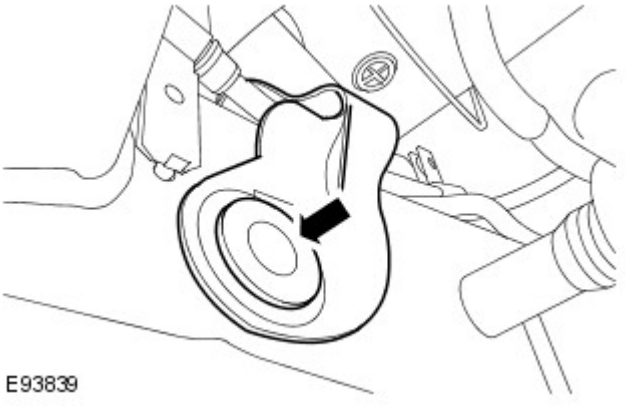


12. Release the LH parking brake cable.

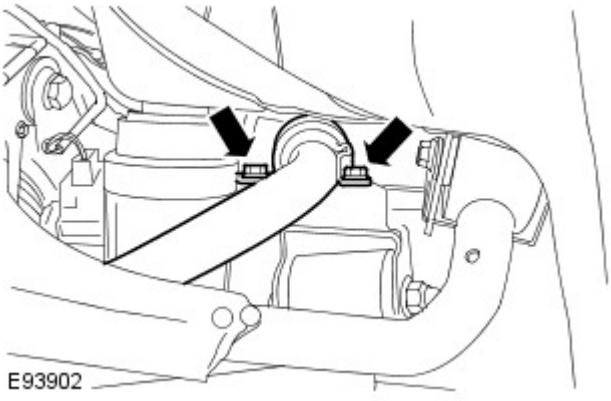


13. CAUTION: The fuel tank breather line bracket can be easily damaged when releasing it from the chassis.

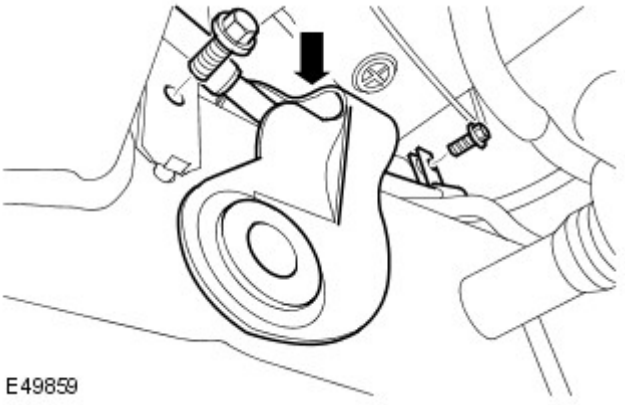
    Release the fuel tank breather line bracket.
    - Remove the plastic insert.



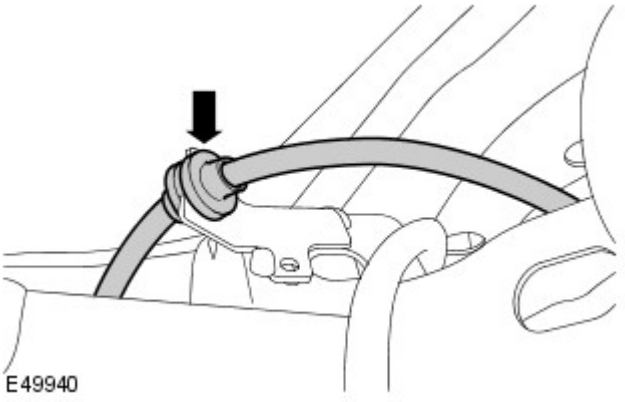
14. Raise the RH side of the rear stabilizer bar.
    - Loosen the 2 bolts.



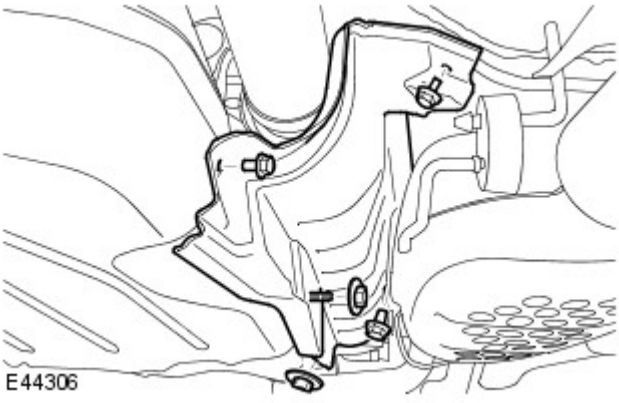
15. Release the RH parking brake cable.
    - Remove the 2 bolts.
    - Release the parking brake cable from the 2 pipe clips.
    - Release the cable from the clip on the chassis.

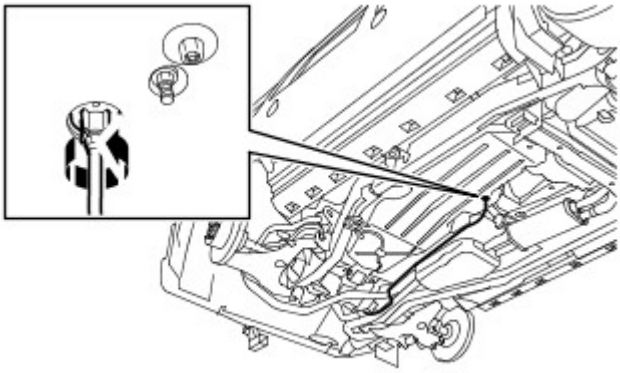


16. Release the RH parking brake cable.



17. Remove the fuel tank heat shield.
    - Remove the 3 bolts and 2 nuts.

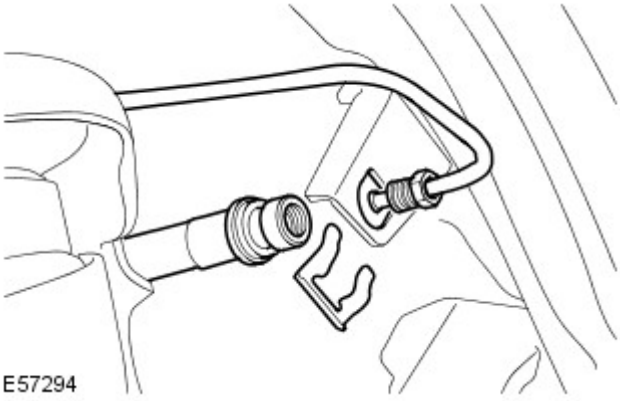

E44306


E49860

18. CAUTION: Inspect the parking brake emergency release cable to body seal and replace if damaged.

NOTE: Note the fitted position of the parking brake emergency release cable to body seal.

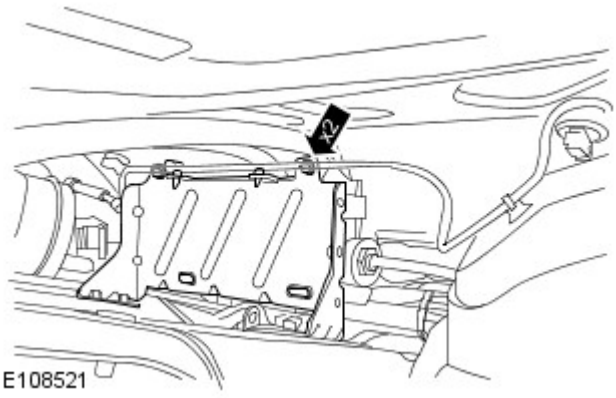
Release the parking brake emergency release cable.


E57294

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

RH side rear: Disconnect the brake line.

- Position an absorbent cloth to collect fluid spillage.
- Disconnect the line union.
- Remove the clip.


E108521

20. NOTE: Note the routing of the parking brake emergency release cable.

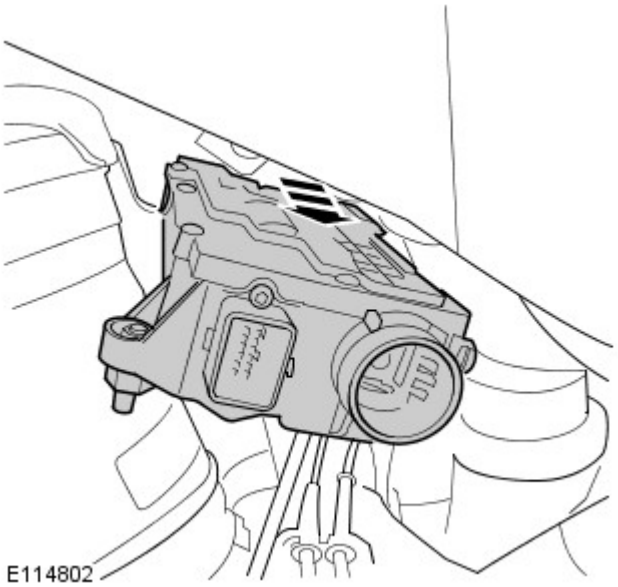
Displace the parking brake actuator and cable assembly.

- Disconnect the electrical connector.
- Remove the 2 nuts.

21. NOTE: Brake cable shown removed for clarity.

Remove the parking brake actuator and cable assembly.

- Withdraw from the RH rear wheel arch aperture.



Installation

1. NOTE: Note the routing of the parking brake emergency release cable.

   Install the parking brake actuator and cable assembly.
   - Install the 2 nuts.
   - Connect the electrical connector.

2. NOTE: Remove and discard the blanking caps.

   RH side rear: Connect the brake line.
   - Clean the component mating faces.
   - Secure the clip.
   - Tighten the brake line union to 16 Nm (12 lb.ft).

3. CAUTION: Make sure the parking brake emergency release cable to body seal is installed correctly.

   Locate and secure the parking brake emergency release cable.

4. Install the fuel tank heat shield.
   - Tighten the bolts to 6 Nm (4 lb.ft).
   - Tighten the nuts to 3 Nm (2 lb.ft).

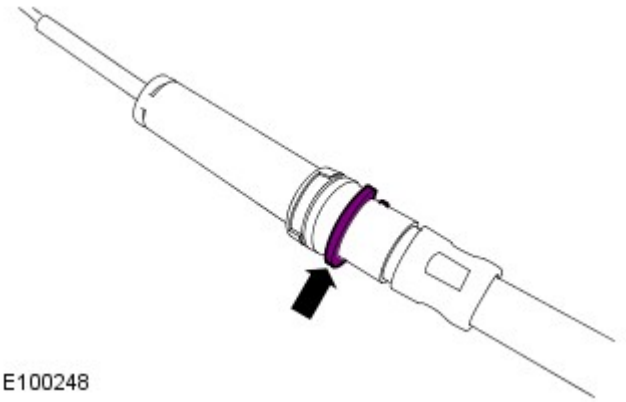
5. Secure the fuel tank breather line bracket.
   - Install the plastic insert.

6. Locate and secure the RH parking brake cable.
   - Tighten the bolts to 22 Nm (16 lb.ft).
   - Secure the parking brake cable to the 2 pipe clips.
   - Secure the cable grommet to the integrated body frame bracket.

7. Locate and secure the LH parking brake cable.
   - Tighten the bolts to 22 Nm (16 lb.ft).
   - Secure the wiring harness.
   - Secure the cable grommet to the integrated body frame bracket.

8. NOTE: Make sure that the brake cable circlip is positioned as shown.

   Connect the parking brake cables to the wheel hubs.
   - Connect the cable to the brake shoe lever.
   - Locate the cable to the backplate.
   - Tighten the nut to 8 Nm (6 lb.ft).



E100248

9. CAUTION: Make sure that the component is clean, free of foreign material and lubricant.

   Install the LH rear brake disc.
   - Tighten the Torx screw to 35 Nm (26 lb.ft).

10. Secure the LH rear brake caliper.
    - Remove and discard the tie strap.
    - Tighten the bolts to 115 Nm (85 lb.ft).

11. CAUTION: Make sure that the component is clean, free of foreign material and lubricant.

    Install the RH rear brake disc.
    - Tighten the Torx screw to 35 Nm (26 lb.ft).

12. Secure the RH rear brake caliper.
    - Remove and discard the tie strap.
    - Tighten the bolts to 115 Nm (85 lb.ft).

13. Adjust the parking brake shoes.
    For additional information, refer to: Parking Brake Shoe and Lining Adjustment (206-05, General Procedures).

14. Bleed the brake system.
    For additional information, refer to: Component Bleeding - Vehicles With: High Performance Brakes (206-00, General Procedures).

15. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

16. Install fuse number 8 into the BJB.

17. Using the Land Rover approved diagnostic system, calibrate the parking brake actuator on an even surface.

18. Apply and release hand brake to confirm operation.

Parking Brake and Actuation - Parking Brake Shoes

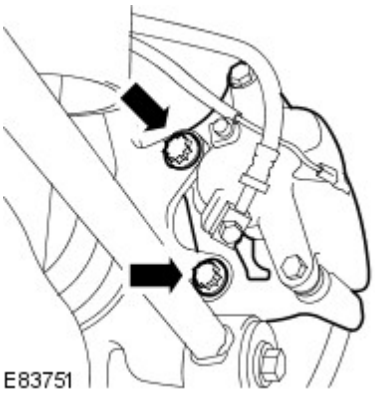
Removal and Installation

Removal

NOTE: If the parking brake shoes or the brake discs have been removed for access to other components then DO NOT carry out the bedding in procedure.

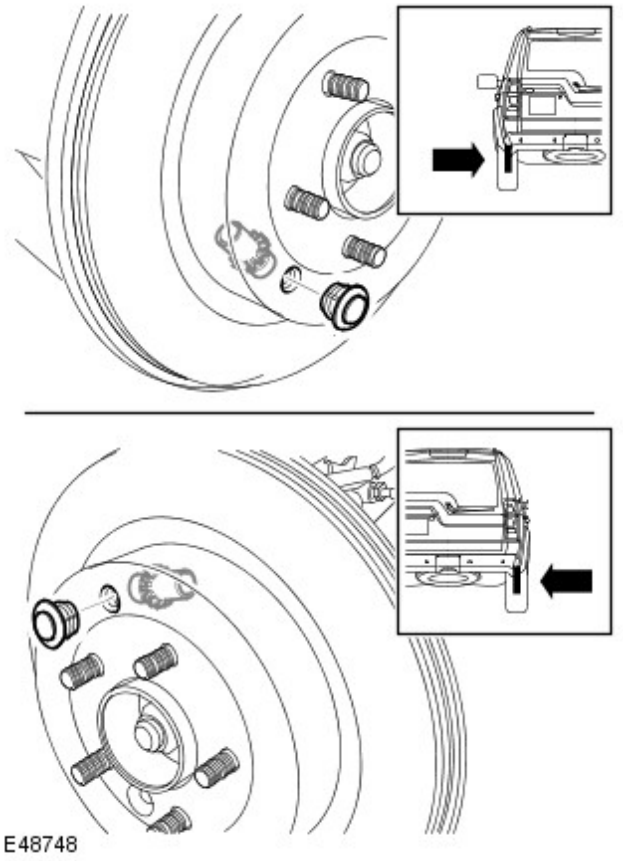
1. Using the Land Rover approved diagnostic system, drive the parking brake to the 'mounting position'.
2. Isolate the parking brake electrical circuit.
   - Remove fuse number 8 from the BJB.
3. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.
4. Remove the wheels and tires.
5. Release the brake caliper.
   - Remove the brake caliper anchor bolts.

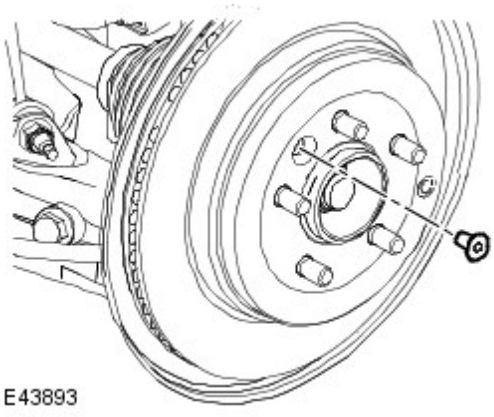


6. CAUTION: Do not allow the brake caliper to hang on the brake hose.

   Tie the brake caliper aside.
7. Release the park brake shoe adjustment.
   - Remove the plug from the access hole in the brake disc.
   - Using a suitable tool, rotate the brake shoe adjuster to release the adjustment.



8. Remove the brake disc.
    - Remove the Torx screw.



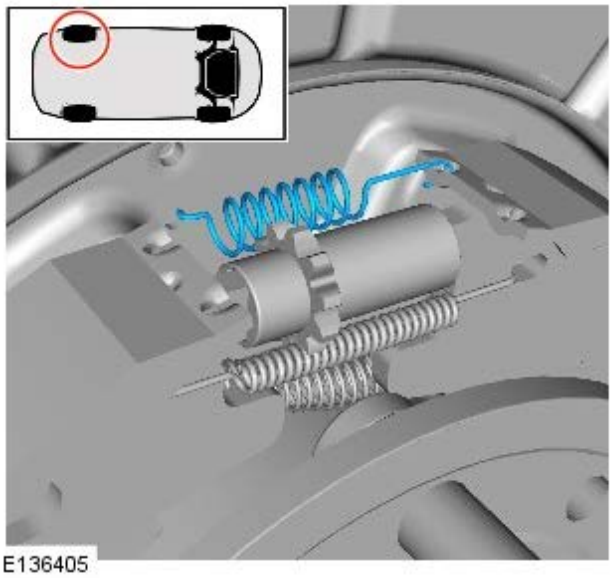
9. CAUTIONS:

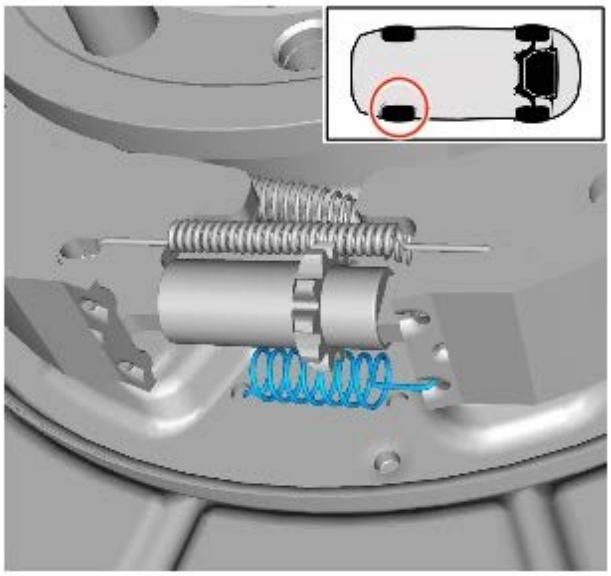
    Make sure that the green bias spring is installed to the right hand parking brake shoes and the red bias spring is installed to the left hand parking brake shoes.

    Make sure the brake shoe spring is not over stretched.

    NOTE: **If equipped.**

    Remove the bias spring(s).

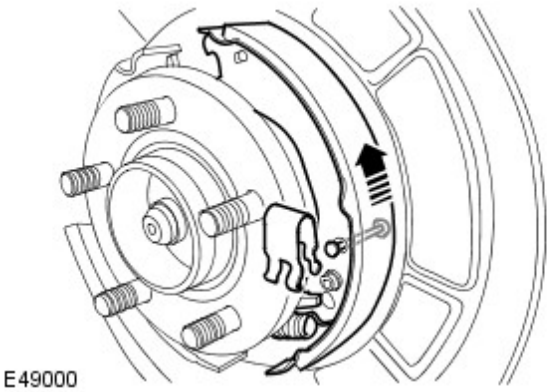

E136405



10. Remove the adjuster and return spring.
    - Release the parking brake shoe adjuster to the minimum adjustment.

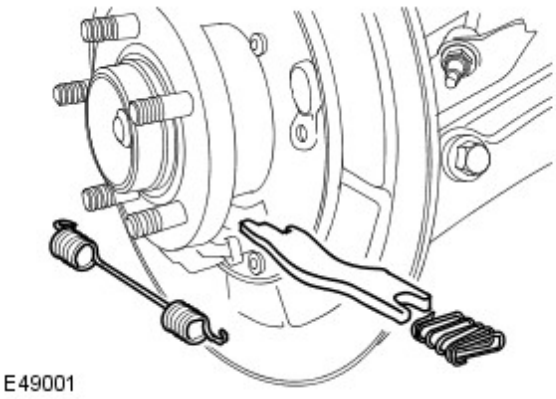

E48999

11. Remove the primary brake shoe.
    - Remove the hold-down spring and retaining pin.
    - Pivot the shoe to release it from the spreader plate and return spring.

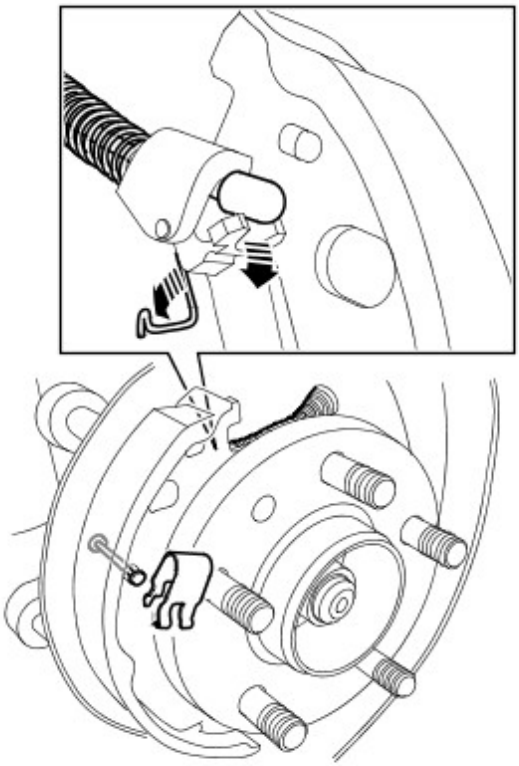

E49000

12. Remove the spreader plate and spring.

13. Remove the return spring.


E49001

14. Remove the secondary brake shoe.
    - Remove the hold-down spring and retaining



E49002

pin.
- Disconnect the parking brake cable retaining spring from the brake shoe lever.
- Release the parking brake cable.

15. Repeat the above procedure for the other side.

Installation

1. WARNING: Do not use compressed air to clean brake components. Dust from friction materials can be harmful if inhaled.

   Clean the backing plate and apply grease to the brake shoe contacts.

2. Clean the adjuster and set it to its minimum extension.

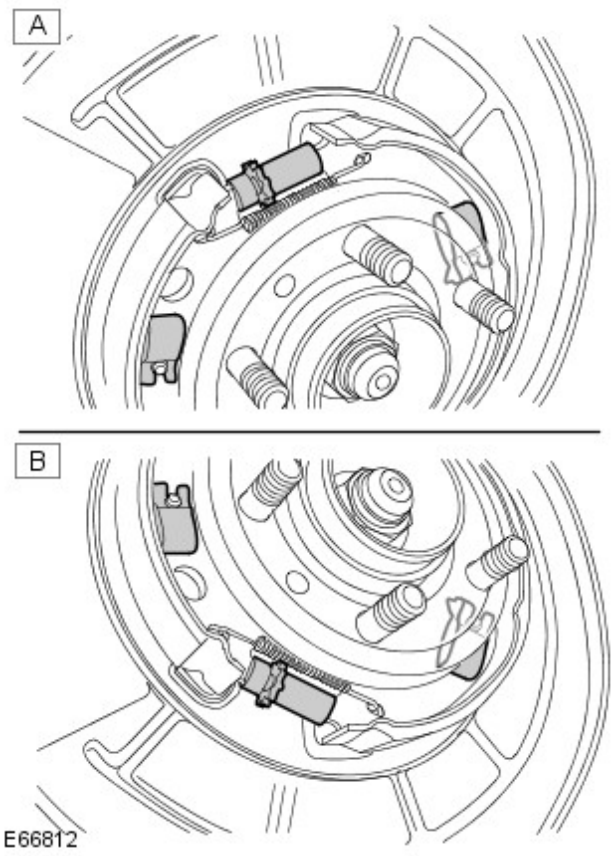
3. CAUTIONS:

   Make sure the brake shoe spring is not over stretched.

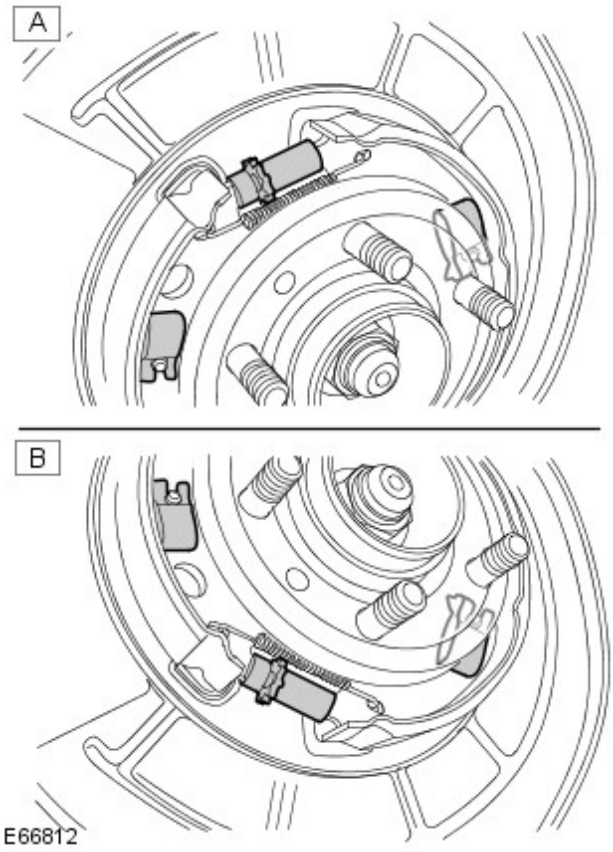
   Make sure the closed end of the retaining clip is installed facing the brake shoe adjuster. Failure to follow this instruction may result in damage to the vehicle.

   Illustration 'A' is the LH side and 'B' is the RH side.

   Install the secondary brake shoe.
   - Connect the parking brake cable.
   - Connect the parking brake cable retaining spring to the brake shoe lever, making sure the spring is not twisted.
   - Install the hold-down spring and retaining pin.



4. Install the spreader plate and the spring.
   - Using a tie strap, tie back the spreader plate spring.



5. WARNING: Make sure the return spring and the adjuster spring are correctly installed to the primary shoe.

   CAUTIONS:

   Make sure the brake shoe spring is not over stretched.

   Make sure the closed end of the retaining clip is installed facing the brake shoe adjuster. Failure to follow this instruction may result in damage to the vehicle.

   Illustration 'A' is the LH side and 'B' is the RH side.

   Install the primary brake shoe.
   - Install the return spring.
   - Connect the primary brake shoe to the return spring.
   - Locate the primary brake shoe to the spreader plate.
   - Install the hold-down spring and retaining pin.

6. CAUTION: Make sure the brake shoe spring is not over stretched.

   Install the brake shoe adjuster and the retaining spring.

7. Remove and discard the spreader plate spring tie strap.

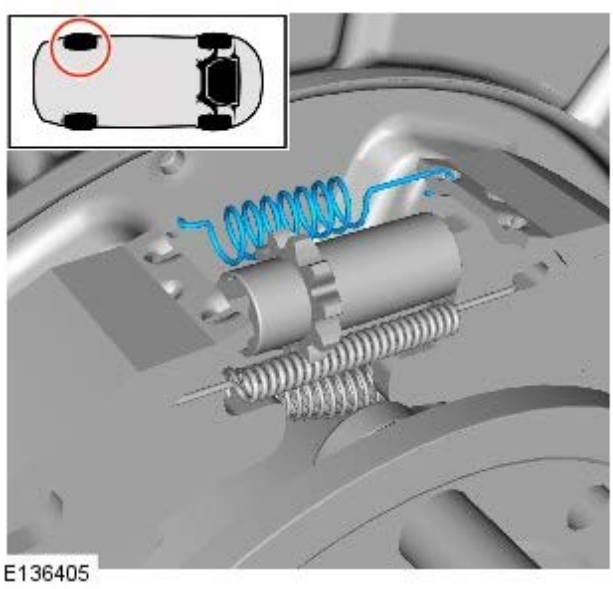
8. CAUTIONS:

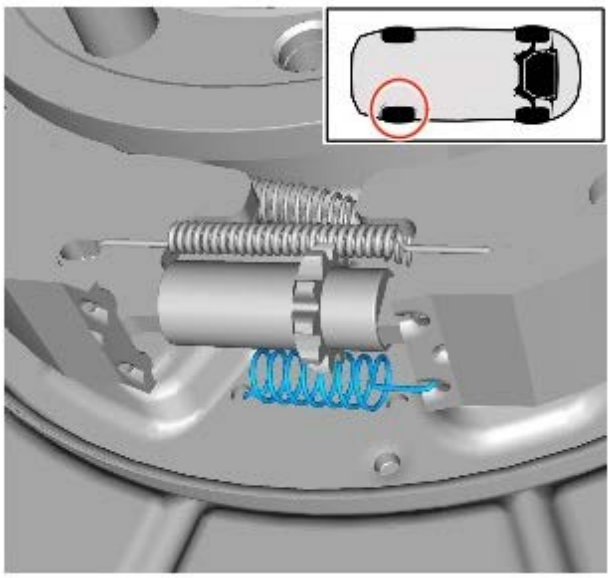
   Make sure that the green bias spring is installed to the right hand parking brake shoes and the red bias spring is installed to the left hand parking brake shoes.

   Make sure the brake shoe spring is not over stretched.

   NOTE: **If equipped.**

   Install the bias spring(s).


E136405



9. Make sure the brake disc and hub mating surfaces are clean.

10. Install the brake disc.
    - Tighten the Torx screw to 35 Nm (26 lb.ft).

11. Install the brake caliper.
    - Tighten the bolts to 115 Nm (85 lb.ft).

12. Repeat the above procedure for the other side.

13. Adjust the parking brake.
    For additional information, refer to: Parking Brake Shoe and Lining Adjustment (206-05 Parking Brake and Actuation, General Procedures).

14. Install the wheels and tires.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).

15. Install fuse number 8 into the BJB.

Hydraulic Brake Actuation -

General Specifications

Item	Specification
Master cylinder bore diameter:	
Primary	27 mm (1.1 in)
Secondary	20.6 mm (0.8 in)
Stroke	36 mm (1.4 in)

Torque Specifications

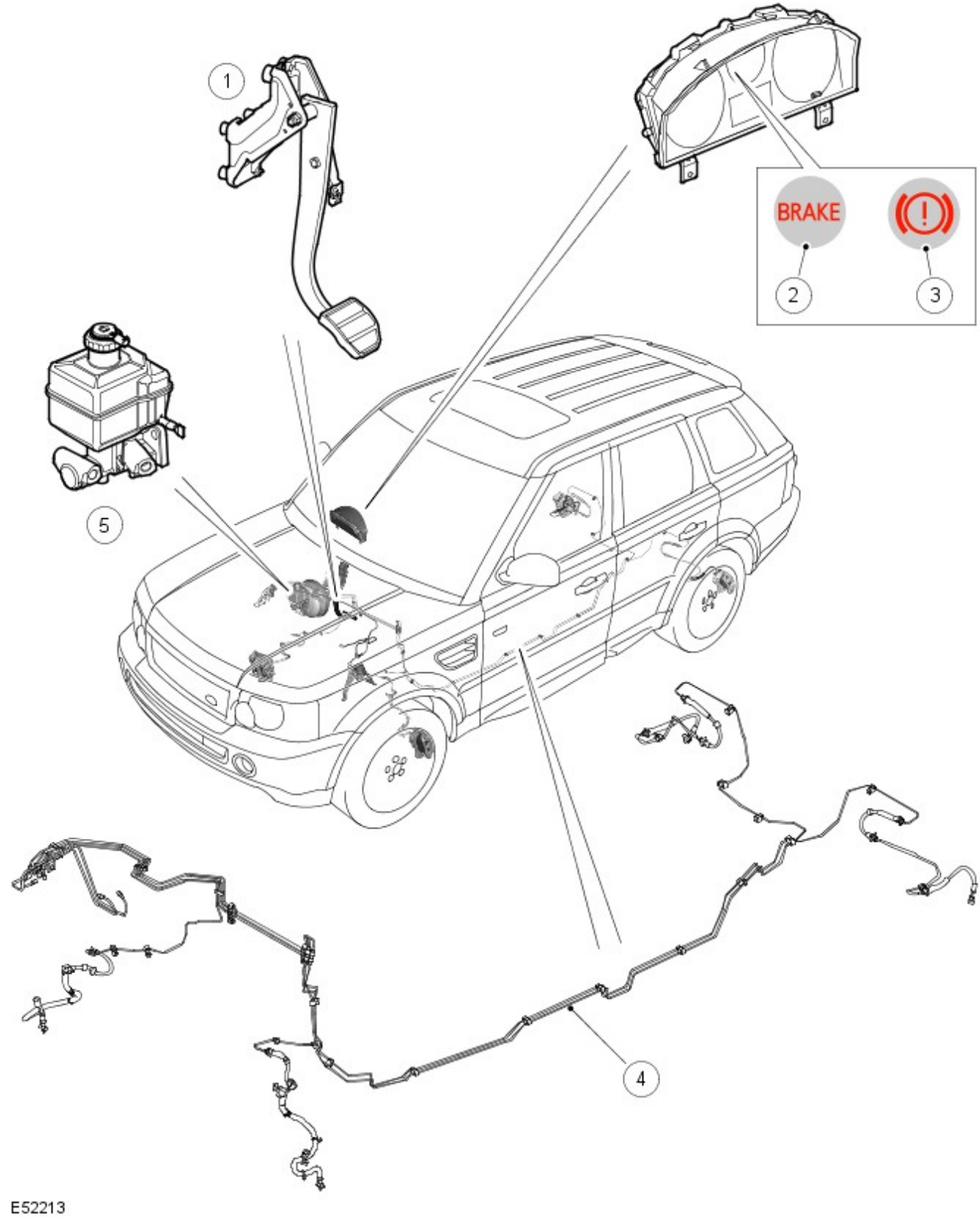
Description	Nm	lb-ft
Brake pedal nut and bolt	45	33
Brake pedal bracket Torx bolts	10	7
Brake booster to brake pedal bracket nuts	25	18
Brake master cylinder nuts	26	19
Brake pipe unions	18	13

Hydraulic Brake Actuation - Hydraulic Brake Actuation

Description and Operation

COMPONENT LOCATIONS

NOTE: right-hand drive (RHD) shown, left-hand drive (LHD) similar



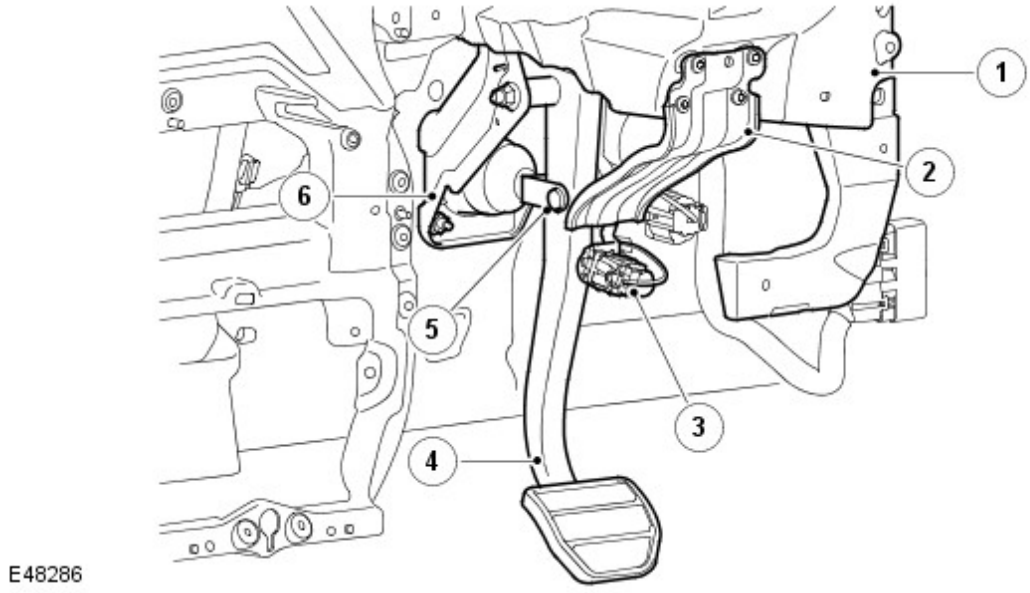
Item	Part Number	Description
1	-	Brake pedal
2	-	Brake warning indicator NAS (north American specification)

3	-	Brake warning indicator (all except NAS)
4	-	Brake pipes and hoses
5	-	Brake master cylinder and reservoir

GENERAL

Hydraulic brake actuation consists of the brake pedal, the brake master cylinder and the hydraulic pipes and hoses.

BRAKE PEDAL



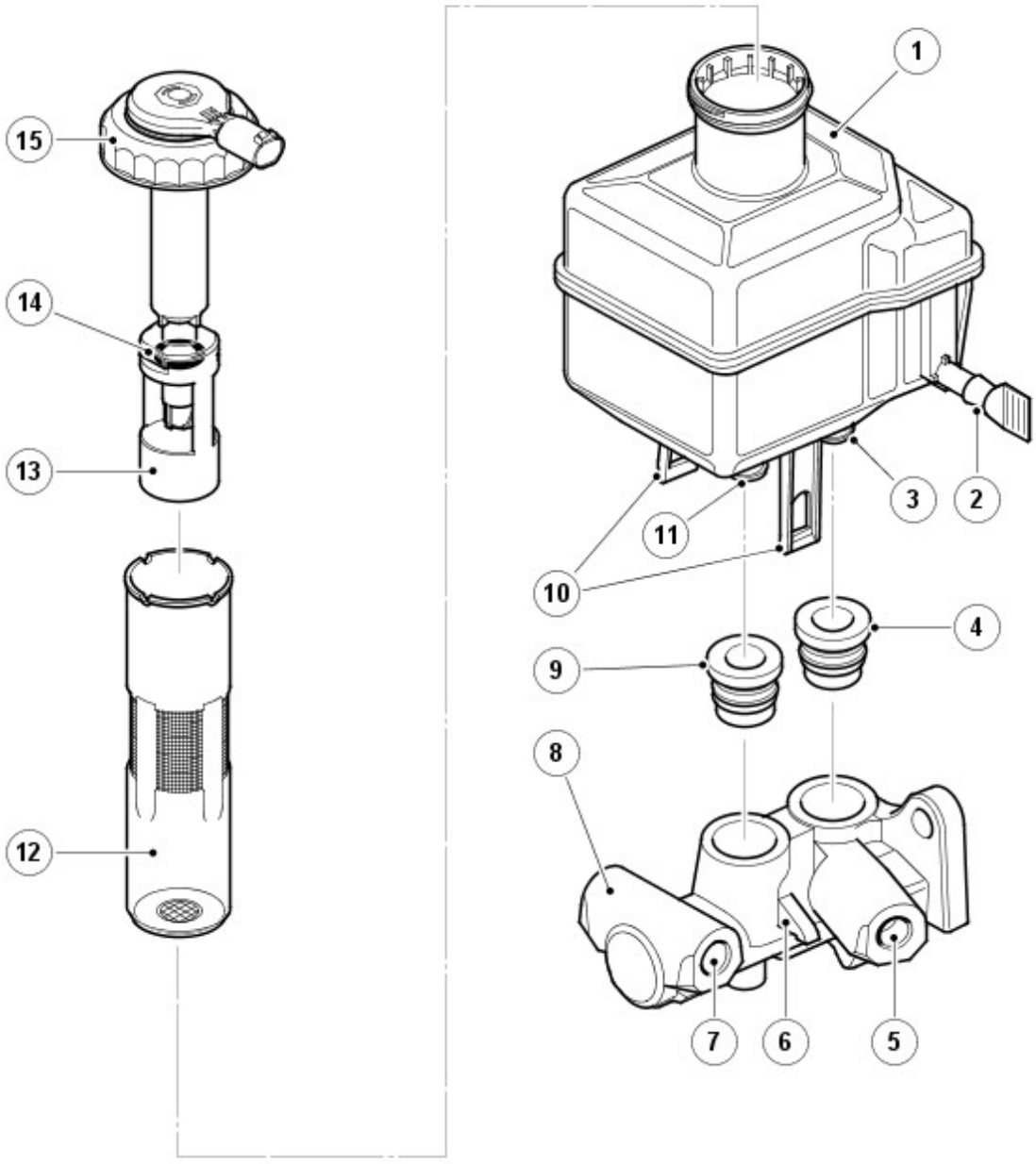
Item	Part Number	Description
1	-	In-vehicle cross beam
2	-	Brake pedal buffer
3	-	Stoplamp switch
4	-	Brake pedal
5	-	Clevis pin and clip
6	-	Brake pedal bracket

The brake pedal is mounted in a bracket attached to the rear side of the engine bulkhead. A clevis pin and clip connect the brake pedal to the push rod of the brake booster. A brake pedal buffer is installed on the in-vehicle cross beam to restrain rearward movement of the brake pedal in an accident.

The stoplamp switch is mounted in the brake pedal bracket and operated by the brake pedal.
For additional information, refer to: Anti-Lock Control - Traction Control (206-09A Anti-Lock Control - Traction Control, Description and Operation).

BRAKE MASTER CYLINDER AND RESERVOIR

NOTE: RHD version shown, LHD version similar



E48287

Item	Part Number	Description
1	-	Reservoir
2	-	Clutch outlet spigot and sealing cap (reference, not used)
3	-	Primary outlet spigot
4	-	Reservoir to master cylinder seal, primary inlet
5	-	Primary outlet port
6	-	Reservoir securing lug
7	-	Secondary outlet port
8	-	Cylinder housing
9	-	Reservoir to master cylinder seal, secondary inlet
10	-	Reservoir securing straps
11	-	Secondary outlet spigot
12	-	Filter
13	-	Float
14	-	Magnet
15	-	Reservoir cap and level switch

The brake master cylinder and reservoir is attached to the front of the brake booster, on the driver side of the engine compartment.

Master Cylinder

The brake master cylinder consists of a cylinder housing containing two pistons in tandem. The rear piston produces pressure for the primary circuit and the front piston produces pressure for the secondary circuit. The pistons

incorporate center valves with a high flow rate to ensure there is always sufficient fluid available at the hydraulic control unit for stability control operations.

When the brake pedal is pressed, the front push rod in the brake booster pushes the primary piston along the bore of the cylinder housing. This produces pressure in the primary pressure chamber which, in conjunction with the primary spring, overcomes the secondary spring and simultaneously moves the secondary piston along the bore. The initial movement of the pistons, away from the piston stops, closes the primary and secondary center valves. Further movement of the pistons then pressurizes the fluid in the primary and secondary pressure chambers, and thus the brake circuits. The fluid in the chambers behind the pistons is unaffected by the movement of the pistons and can flow unrestricted through the feed holes between the chambers and the reservoir.

When the brake pedal is released, the primary and secondary springs push the pistons back down the bore of the cylinder housing. As the pistons contact the piston stops, the primary and secondary center valves open, which allows fluid to circulate unrestricted between the two hydraulic circuits and the reservoir, through the center valves, the chambers behind the pistons and the cylinder housing inlets.

Should a failure occur in one of the brake circuits, the remaining brake circuit will still operate effectively, although brake pedal travel and vehicle braking distances will increase.

Reservoir

The reservoir is installed on top of the master cylinder to provide a supply of brake fluid for the primary and secondary circuits of the brake system.

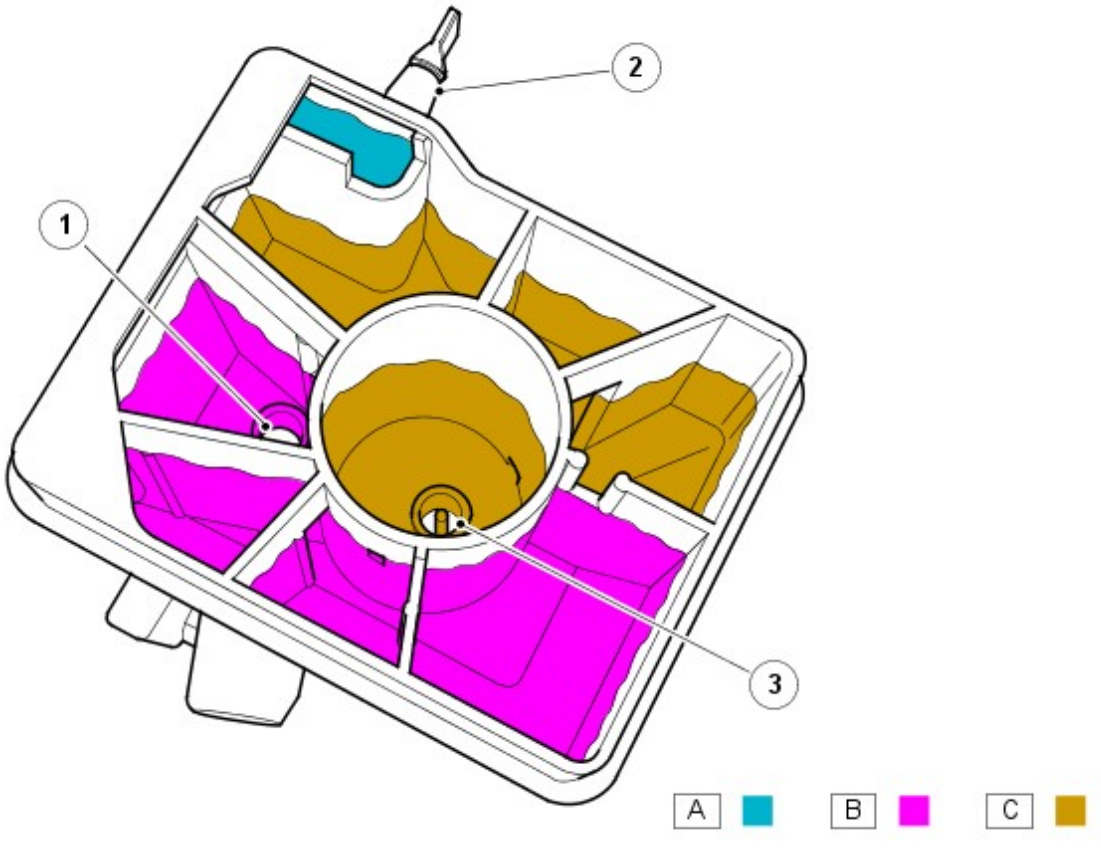
Two straps, integrated onto the sides of the reservoir, engage with lugs on the master cylinder to secure the reservoir in position. Two outlet spigots on the underside of the reservoir locate in seals installed in the inlet ports of the master cylinder. An outlet port is incorporated into the left side of the reservoir for use on vehicles with a clutch.

The reservoir is internally divided to isolate the circuits from each other at low fluid levels, and so prevent a leak in one circuit from disabling the other circuit(s). The dividing walls support a central well and divide the area around the well into a further eight separate compartments. The well forms an extension of the filler neck and contains the filter and the fluid level switch.

The well and the surrounding compartments are interconnected by slots in the dividing walls. The slots are positioned such that when the reservoir is full, fluid can move between the well and all of the surrounding compartments, but at low fluid levels the interior forms separate reservoirs for each circuit. The following figure shows the separate reservoirs for each circuit and the amount retained in each reservoir if there is a leak from one of the other circuits.

Reservoir Interior

NOTE: A = Clutch reservoir (reference, not used); B = Primary circuit reservoir; C = Secondary circuit reservoir



Item	Part Number	Description
1	-	Primary outlet
2	-	Clutch outlet (reference, not used)
3	-	Secondary outlet

The filler neck of the reservoir is sealed with a cap incorporating the level switch. The level switch is operated by a magnet, which is installed in the float on the bottom of the switch. The switch reacts to the influence of the magnetic field surrounding the magnet.

When the reservoir is full, the float rests against the bottom of the switch and holds the level switch open. When the fluid level decreases, the float moves down and the switch closes to connect a ground to the instrument cluster. When the ground is made, the instrument cluster illuminates the red light emitting diode (LED) in the brake warning indicator. The instrument cluster also display an appropriate warning in the message center.
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

At the beginning of each ignition cycle, the instrument cluster performs a bulb check on the brake warning indicator; the indicator is illuminated amber for 1.5 seconds, then red for 1.5 seconds.

The instrument cluster broadcasts the status of the brake fluid level, on the high speed controller area network (CAN) bus, to the anti-lock brake system (ABS) module.
For additional information, refer to: Anti-Lock Control - Traction Control (206-09A Anti-Lock Control - Traction Control, Description and Operation).

BRAKE PIPES AND HOSES

The brake pipes and hoses connect the master cylinder to the wheel brakes via the hydraulic control unit. The pipes are arranged to provide a front and rear split braking system. The brakes on the front axle are operated by the primary system; the brakes on the rear axle are operated by the secondary system.

Hydraulic Brake Actuation - Hydraulic Brake Actuation

Diagnosis and Testing

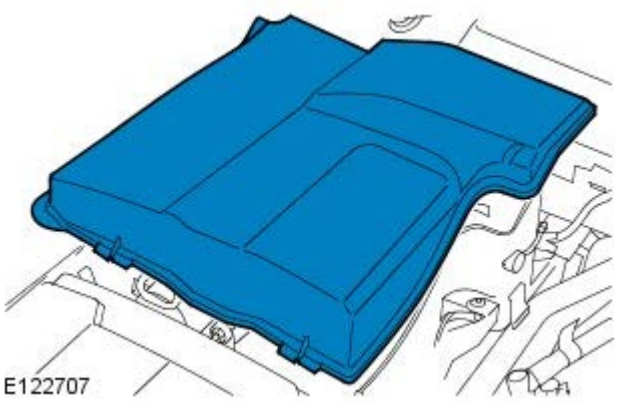
For additional information.
REFER to: Brake System (206-00, Diagnosis and Testing).

Hydraulic Brake Actuation - Brake Fluid Reservoir

Removal and Installation

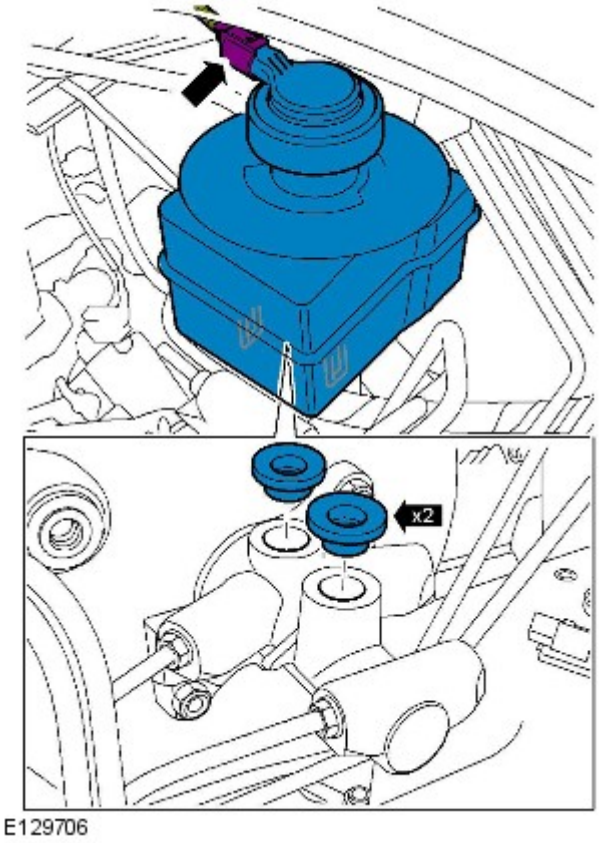
Removal

CAUTION: Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.



1. Remove the cover.
2. Position an absorbent cloth to collect fluid spillage.
3. Disconnect the low brake fluid warning indicator switch electrical connector.
4. CAUTION: Always plug any open connections to prevent contamination.

   Remove the brake fluid reservoir.
   - Release the 2 clips.
   - Remove and discard 2 brake fluid reservoir seals.



Installation

1. Clean the components.
2. NOTE: Remove and discard all blanking caps.

   Install the brake fluid reservoir.
   - Install new brake fluid reservoir seals.
3. Connect the low brake fluid warning indicator switch electrical

connector.

4. Bleed the brake system using T4.
   For additional information, refer to: Brake System Bleeding - Vehicles With: Standard Brakes (206-00, General Procedures).

5. Install the cover.

Hydraulic Brake Actuation - Brake Master Cylinder

Removal and Installation

Removal

1. WARNING: Make sure to support the vehicle with axle stands.

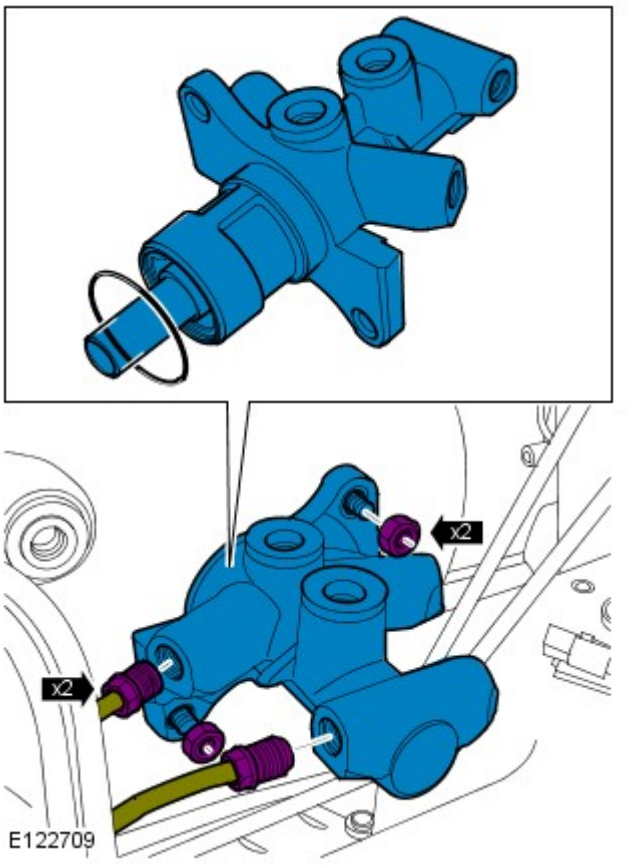
   Raise and support the vehicle.

2. Remove the brake fluid reservoir.
   For additional information, refer to: Brake Fluid Reservoir (206-06 Hydraulic Brake Actuation, Removal and Installation).

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

   Disconnect the brake master cylinder brake tubes.

4. Remove the brake master cylinder.
   - Remove the 2 nuts.
   - Remove and discard the O-ring seal.



Installation

1. Install the brake master cylinder.
   - Install a new O-ring seal.
   - Tighten the nuts to 23 Nm (17 lb.ft).

2. Connect the brake tubes.
   - Tighten the brake tube unions to 18 Nm (13 lb.ft).

3. Install the brake fluid reservoir.
   For additional information, refer to: Brake Fluid Reservoir (206-06 Hydraulic Brake Actuation, Removal and Installation).

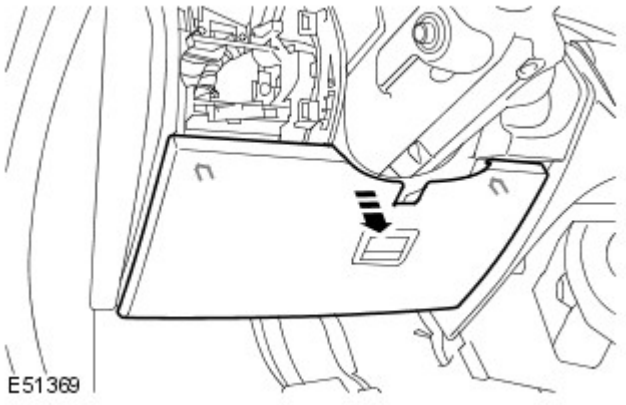
Hydraulic Brake Actuation - Brake Pedal

Removal and Installation

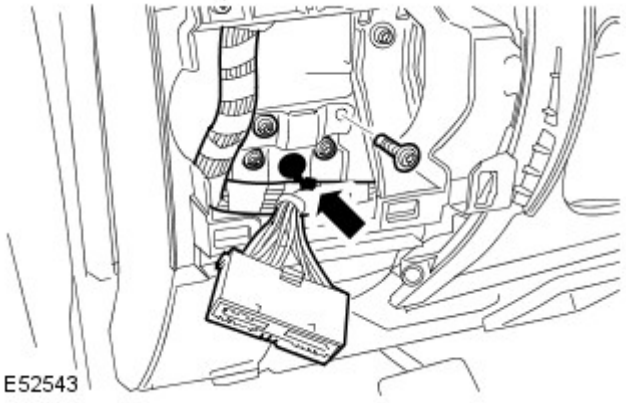
Removal

1. Remove the headlamp switch.
   For additional information, refer to: Headlamp Switch (417-01, Removal and Installation).

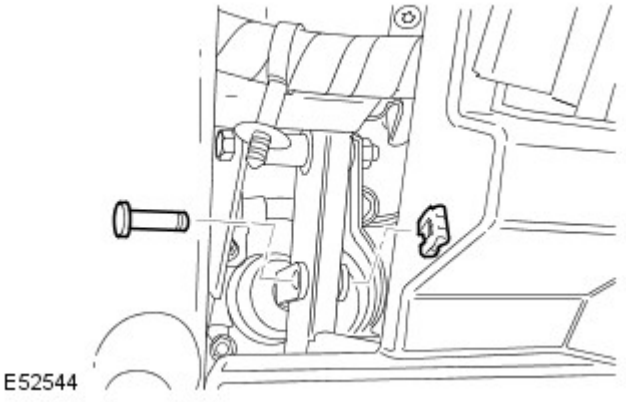
2. Remove the stoplamp switch.
   For additional information, refer to: Stoplamp Switch (417-01, Removal and Installation).



3. Remove the instrument panel access panel.
   - Release the 2 clips.

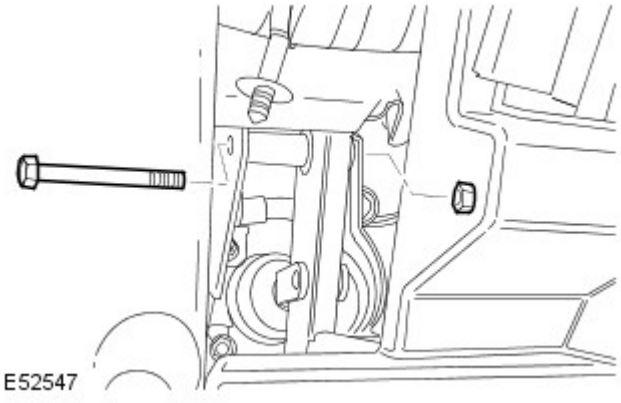


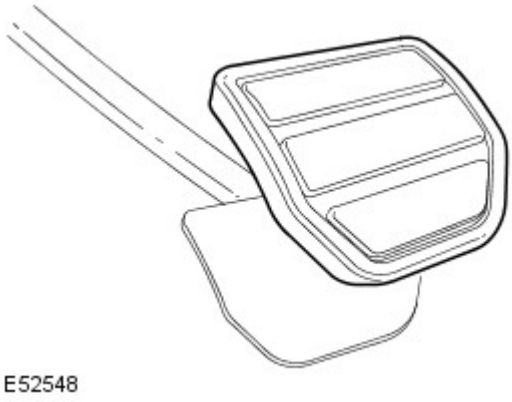
4. Remove the brake pedal bracket.
   - Release the wiring harness clip.
   - Remove the 4 Torx bolts.



5. Remove the brake pedal clevis pin.
   - Remove the clip.

6. Remove the brake pedal.
   - Remove the nut and bolt.





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

   Remove the brake pedal pad.

Installation

1. Install the brake pedal pad.

2. Install the brake pedal.
   - Clean the component mating faces.
   - Tighten the nut and bolt to 45 Nm (33 lb.ft).

3. Install the brake pedal clevis pin.
   - Install the clip.

4. Install the brake pedal bracket.
   - Tighten the Torx bolts to 10 Nm (7 lb.ft).
   - Secure the wiring harness.

5. Install the instrument panel access panel.
   - Secure with the clips.

6. Install the stoplamp switch.
   For additional information, refer to: Stoplamp Switch (417-01, Removal and Installation).

7. Install the headlamp switch.
   For additional information, refer to: Headlamp Switch (417-01, Removal and Installation).

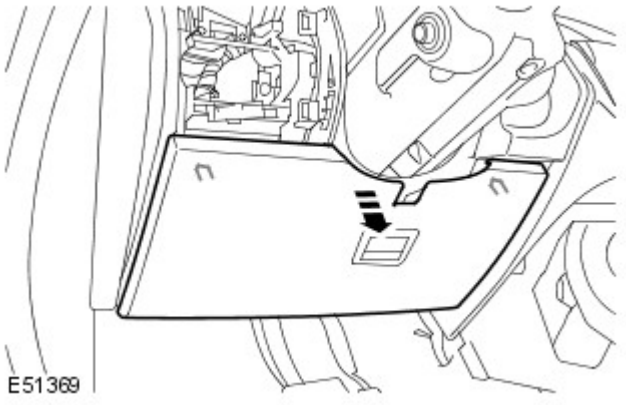
Hydraulic Brake Actuation - Brake Pedal and Bracket

Removal and Installation

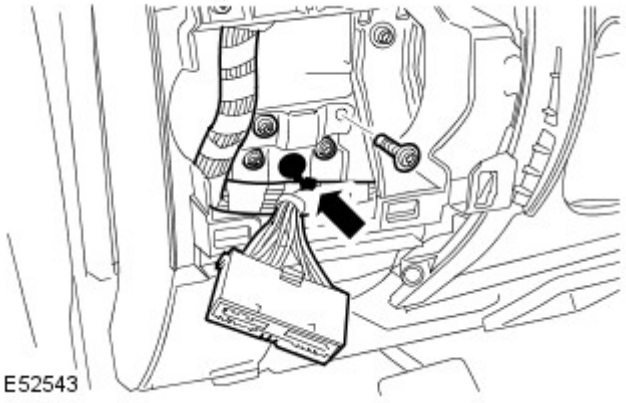
Removal

1. Remove the headlamp switch.
   For additional information, refer to: Headlamp Switch (417-01, Removal and Installation).

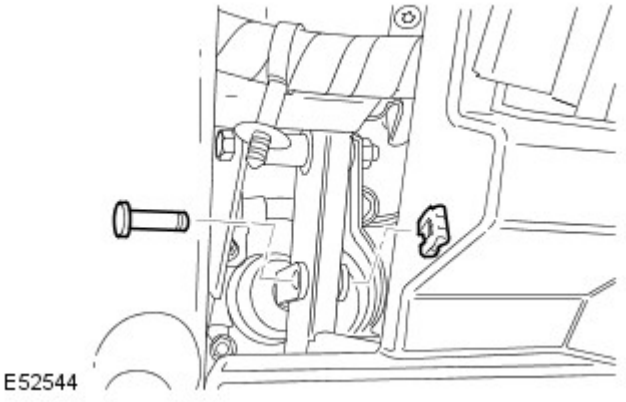
2. Remove the stoplamp switch.
   For additional information, refer to: Stoplamp Switch (417-01, Removal and Installation).



3. Remove the instrument panel access panel.
   - Release the 2 clips.

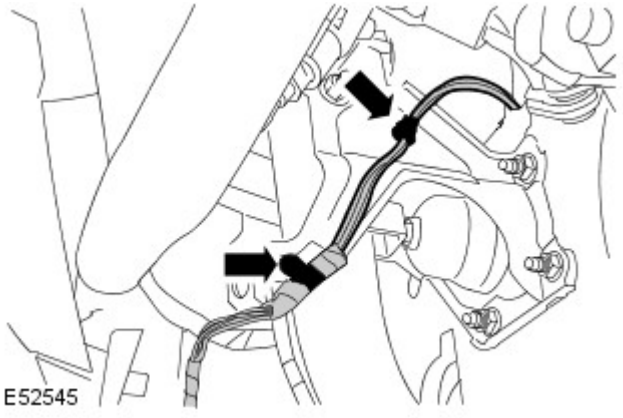


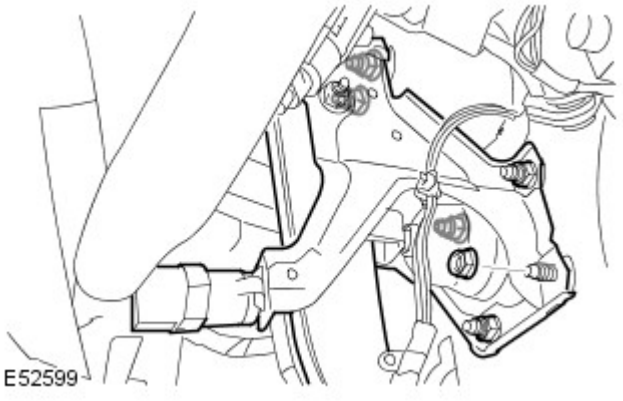
4. Remove the brake pedal bracket.
   - Release the wiring harness clip.
   - Remove the 4 Torx bolts.



5. Remove the brake pedal clevis pin.
   - Remove the clip.

6. Release the stoplamp wiring harness.
   - Release the 2 clips.





7. Remove the brake pedal assembly.
    - Remove the 6 nuts.
    - Position the brake booster forward to aid the removal of the brake pedal assembly.

Installation

1. Install the brake pedal assembly.
    - Position the brake booster to the brake pedal bracket.
    - Tighten the nuts to 25 Nm (18 lb.ft).
2. Secure the wiring harness.
    - Secure the clips.
3. Install the brake pedal clevis pin.
    - Install the clip.
4. Install the brake pedal bracket.
    - Tighten the Torx bolt to 10 Nm (7 lb.ft).
    - Secure the wiring harness.
5. Install the instrument panel access panel.
    - Secure with the clips.
6. Install the stoplamp switch.
   For additional information, refer to: Stoplamp Switch (417-01, Removal and Installation).
7. Install the headlamp switch.
   For additional information, refer to: Headlamp Switch (417-01, Removal and Installation).

Power Brake Actuation -

General Specifications

Item	Specification
Brake booster type	Twin chamber 228 and 254 mm (9.0 and 10.0 in)
Boost ratio - vehicles without Brembo brakes	7:1
Boost ratio - vehicles with Brembo brakes	8:1

Torque Specifications

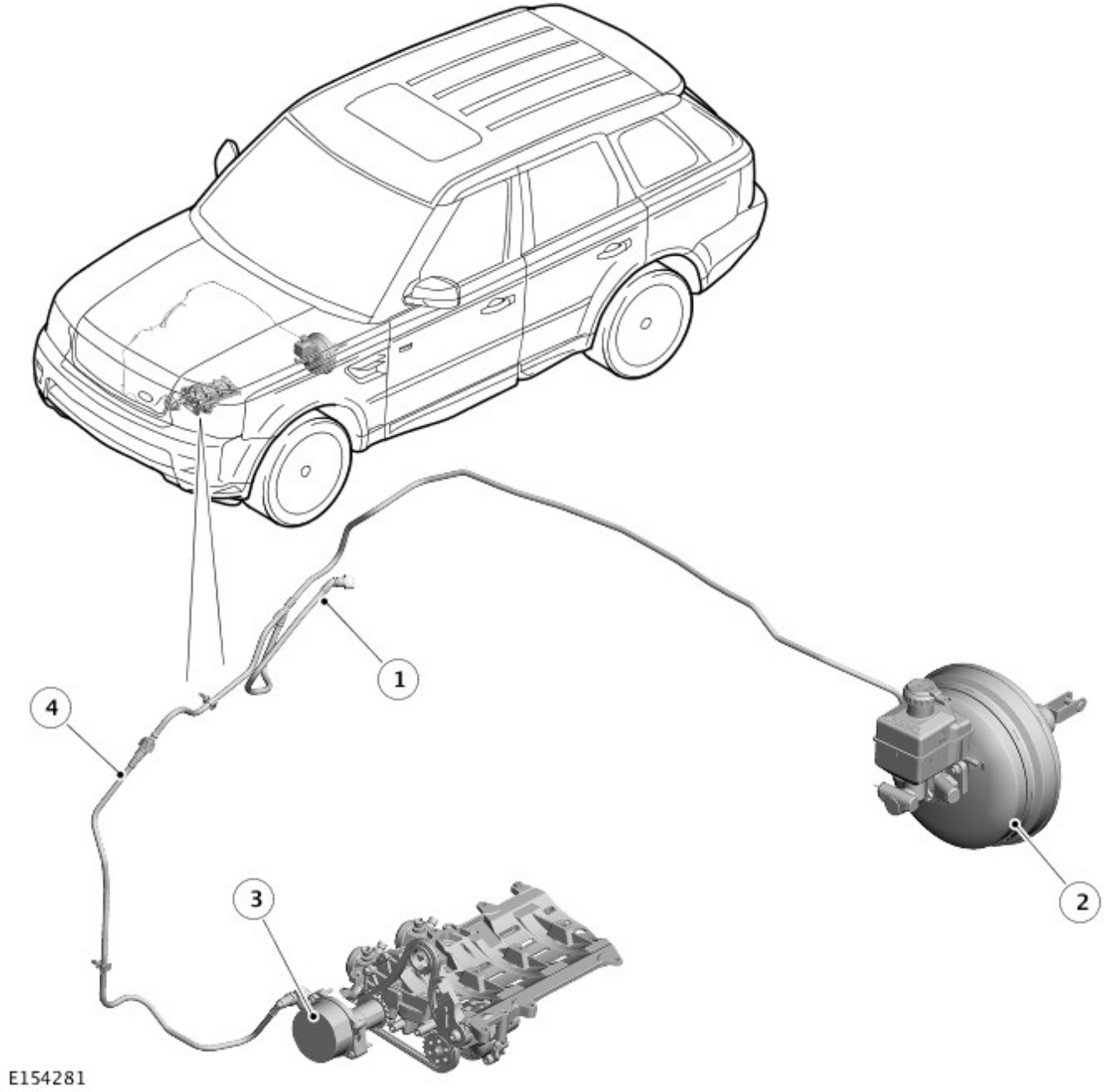
Description	Nm	lb-ft
Brake booster nuts	23	17
Brake master cylinder nuts	26	19
M12 brake pipe unions	16	12
M14 brake pipe unions	18	13
Brake pedal buffer bolts	10	7
Brake vacuum pump nuts - 4.2 and 4.4 liter engines	5	4
Brake vacuum pump bolts - 2.7 liter engine	23	17
Brake vacuum pump stud - 2.7 liter engine	13	10
Brake vacuum pump nut - 2.7 liter engine	13	10
Brake vacuum pump bolts - 3.6 liter engine	23	17
Brake vacuum pump stud - 3.6 liter engine	10	7
Brake vacuum pump nut - 3.6 liter engine	23	17

Power Brake Actuation - Brake Booster

Description and Operation

COMPONENT LOCATIONS - (5.0L NA and SUPERCHARGED)

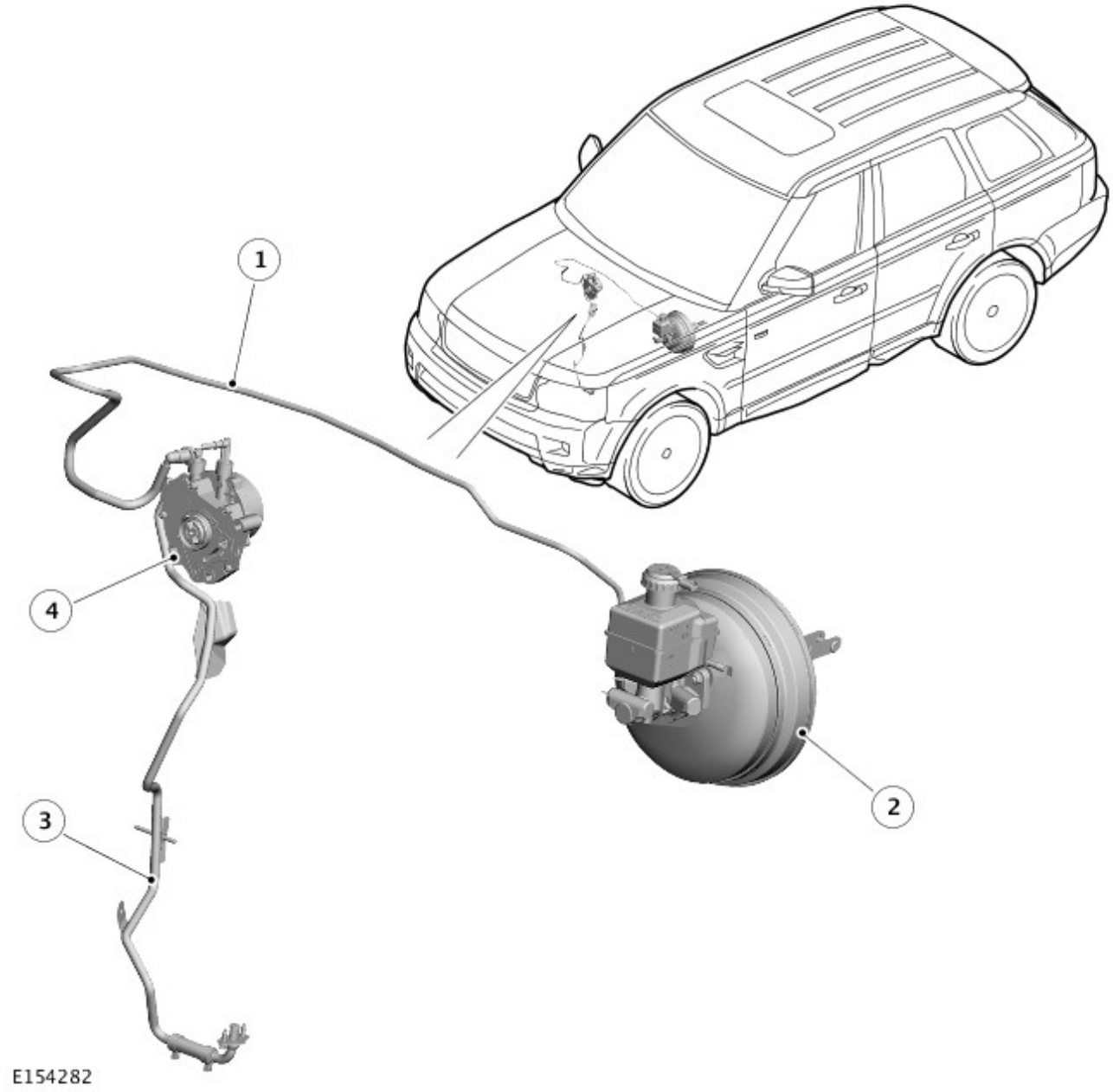
NOTE: LHD shown, RHD similar



Item	Part Number	Description
1	-	Vacuum pipe connection to intake manifold
2	-	Brake Booster
3	-	Vacuum pump
4	-	Vacuum pipes

COMPONENT LOCATIONS - 3.0L DIESEL

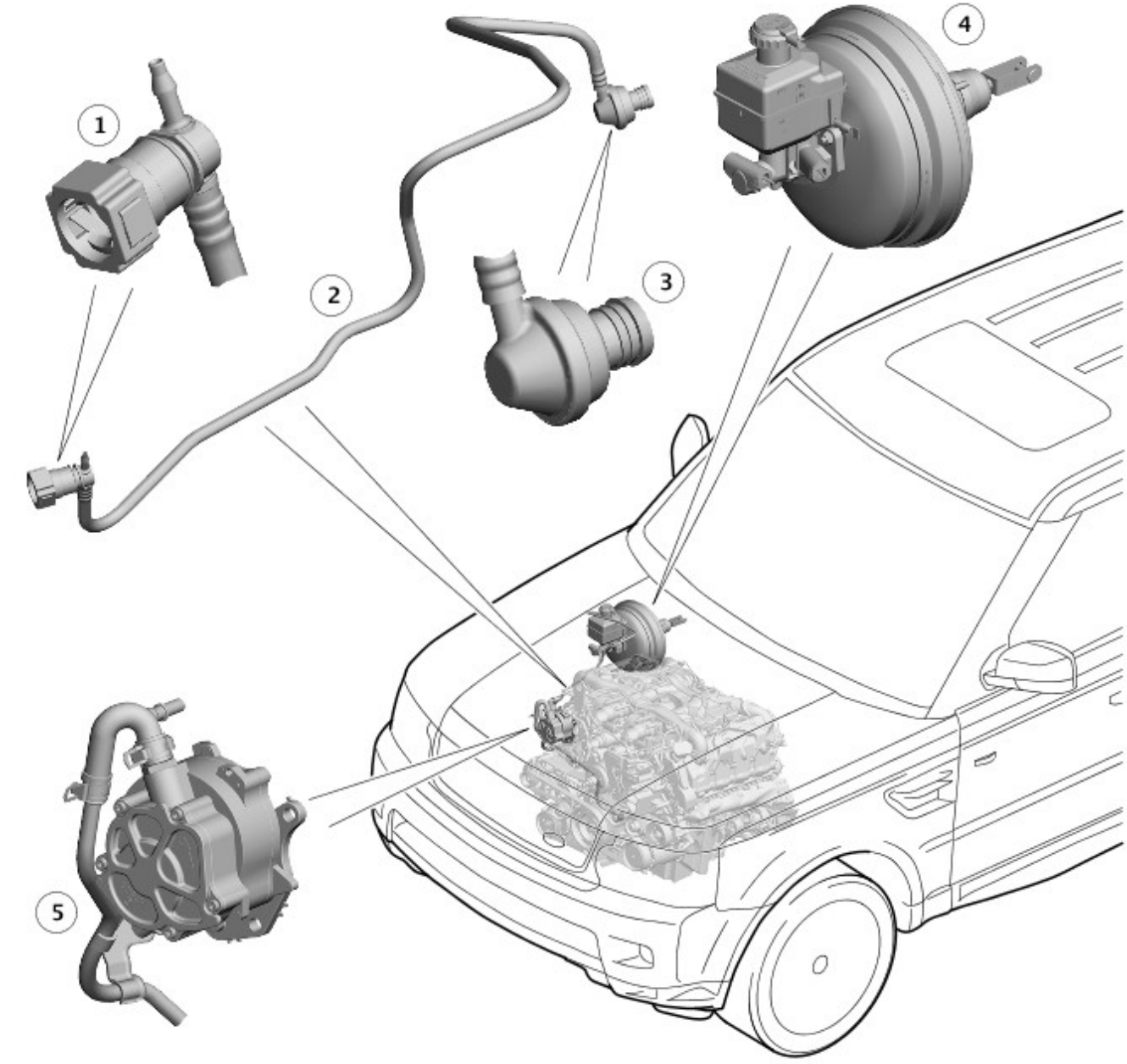
NOTE: LHD shown, RHD similar



Item	Part Number	Description
1	-	Vacuum pipe connection to brake booster
2	-	Brake booster
3	-	Oil Scavenger pipe
4	-	Vacuum pump

COMPONENT LOCATIONS - 3.6L DIESEL

NOTE: RHD shown, LHD similar



E154269

Item	Part Number	Description
1	-	Vacuum pipe connection to vacuum pump
2	-	Vacuum pipe
3	-	Check valve
4	-	Brake booster
5	-	Vacuum pump

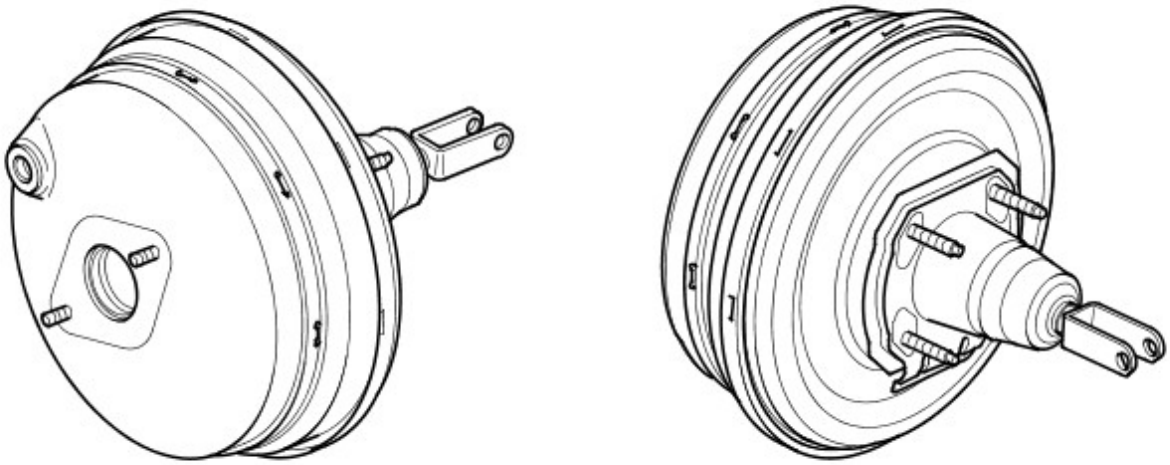
GENERAL

Power assistance for the brakes is provided by a vacuum operated brake booster. The vacuum is supplied by an engine mounted vacuum pump.

VACUUM PIPES

Plastic vacuum pipes connect the brake booster to the vacuum source. Check valves are incorporated into the vacuum pipes. On petrol models there are two in-line check valves, to maintain the vacuum in the brake booster when the throttle is open and the vacuum pump is not running, and prevent fuel vapor entering the brake booster. On diesel models there is a single check valve integrated into the vacuum pipe connection with the brake booster, to maintain the vacuum in the brake booster when the vacuum pump is operating at less than the optimum.

BRAKE BOOSTER

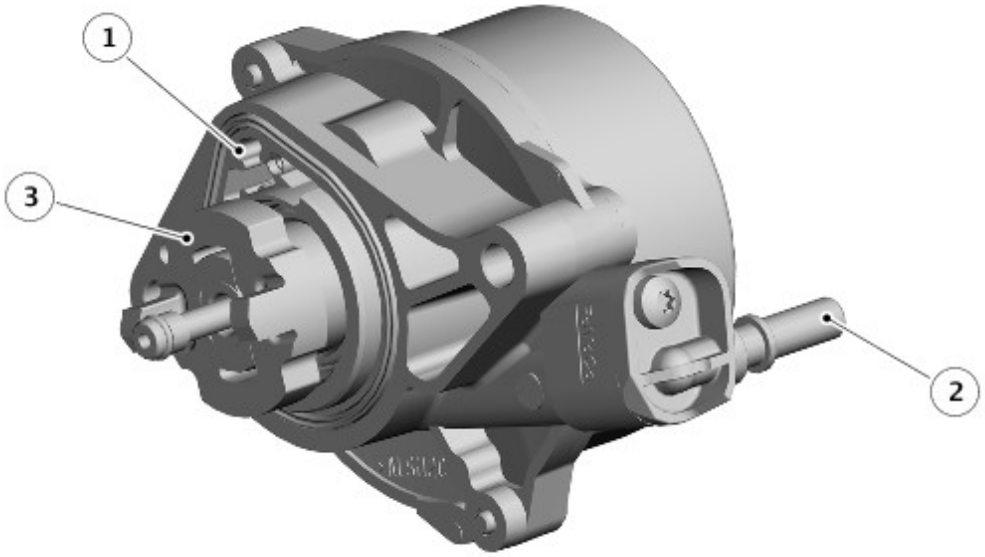


E49905

The brake booster is installed in the driver side of the engine compartment, on the engine bulkhead.

The brake booster is a dual diaphragm unit with a boost ratio of 8.0 : 1 and 28 bar loop-in in all engine variants. The input push rod is connected to the brake pedal. The output push rod locates in the primary piston of the brake master cylinder. A vacuum pipe, installed in a grommet in the front face of the housing, connects the brake booster to the intake manifold and electric vacuum pump (petrol models) or the engine driven vacuum pump (diesel models).

VACUUM PUMP (5.0L NA and SUPERCHARGED)



E154213

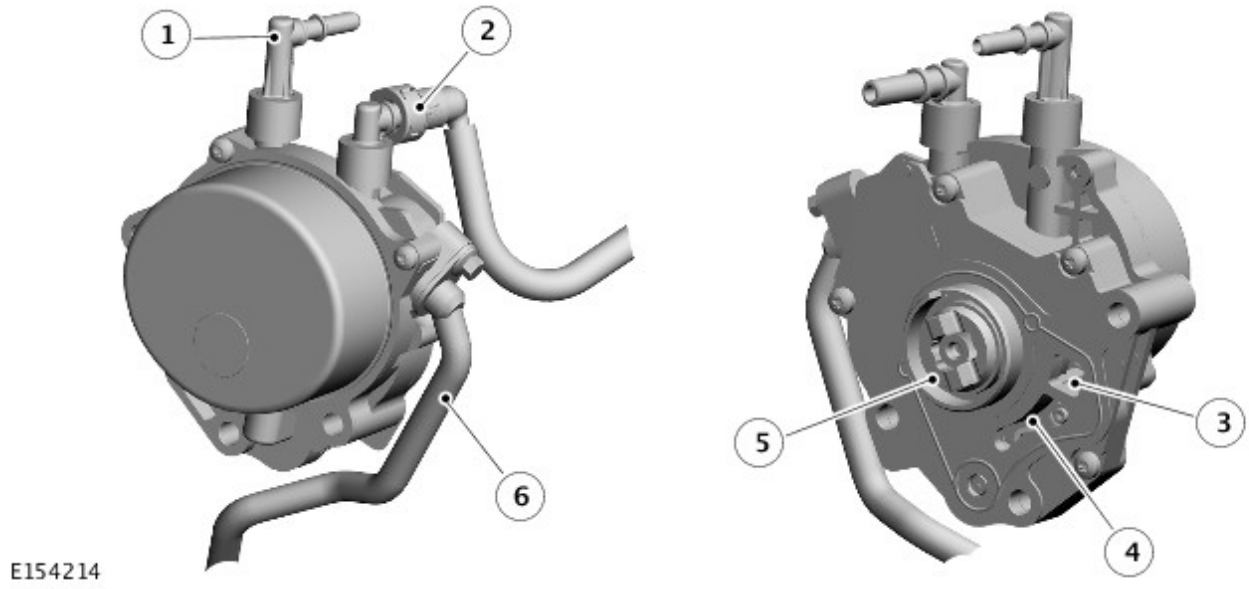
Item	Part Number	Description
1	-	Air vent
2	-	Vacuum pump inlet
3	-	Pump drive

On 5.0L (NA and Supercharged) petrol models the vacuum pump supplements the main vacuum supply from the engine manifold.

The vacuum pump is a radial vane pump which is attached to the end of the auxiliary drive camshaft and driven by crankshaft via the auxiliary drive chain. The vacuum pipe from the brake booster connects to an elbow on the rim of the vacuum pump.

The vacuum pump is lubricated and cooled by engine oil supplied from the gallery in the block, through the auxiliary shaft, to the oil pick up tube (see small hole in green shaft in picture above!). The oil return is through twin outlet ports in the front face of the pump into a drain cavity in the sump. Air extracted from the brake booster is vented into the drain cavity along with the returning engine oil.

VACUUM PUMP (3.0L DIESEL)



E154214

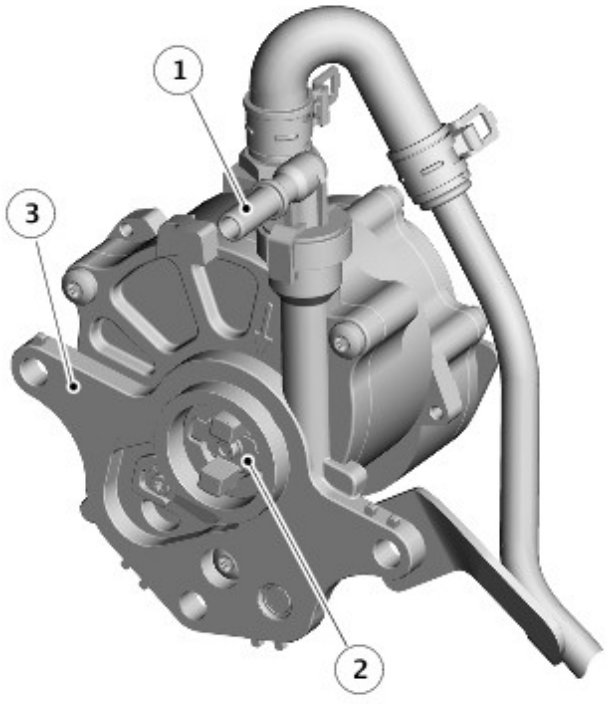
Item	Part Number	Description
1	-	Vacuum connection (turbo control)
2	-	Vacuum connection for brake booster
3	-	Oil inlet port
4	-	Air vent
5	-	Drive dog
6	-	Oil return/scavenge pipe

The vacuum pump is a combined vacuum and oil scavenge pump. The scavenge pump is g-rotor type pump that drains oil from the secondary turbocharger to accommodate vehicle tilt. The pump is located at the rear of the RH side cylinder head and is driven from the exhaust camshaft.

The vacuum pump is a radial vane pump. The vacuum pipe from the brake booster connects to an elbow on the rim of the vacuum pump.

The vacuum pump is lubricated and cooled by engine oil supplied to a port in the front face of the vacuum pump from a gallery in the cylinder head. The oil return is through a vent in the front face of the pump into a drain cavity in the cylinder head. Air extracted from the brake booster is vented into the drain cavity with the returning engine oil.

VACUUM PUMP (3.6L DIESEL)



E154270

Item	Part Number	Description
1	-	Vacuum pump connection to brake booster
2	-	Camshaft drive lobe
3	-	Mounting flange

The Vacuum required for brake booster operation on TdV8 vehicles is provided by an engine driven vacuum pump. The vacuum pump is a radial vane type pump mounted to the front of the right-hand (RH) cylinder head which is driven by the intake camshaft. The vacuum pipe from the brake booster connects to an elbow on the rim of the vacuum pump.

The vacuum pump is lubricated and cooled by engine oil supplied to a port in the front face of the vacuum pump from a gallery in the cylinder head. The oil return is through a vent in the front face of the pump into a drain cavity in the cylinder head. Air extracted from the brake booster is vented into the drain cavity with the returning engine oil.

The vacuum pump is also used to supply vacuum for operation of the following components:

- The exhaust gas recirculation (EGR) system
- The adaptive engine mounts.

Power Brake Actuation - Power Brake System

Diagnosis and Testing

For additional information.
REFER to: Brake System (206-00, Diagnosis and Testing).

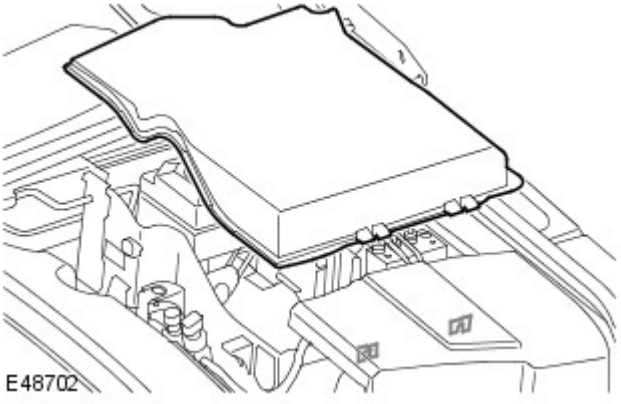
Power Brake Actuation - Brake Booster

Removal and Installation

Removal

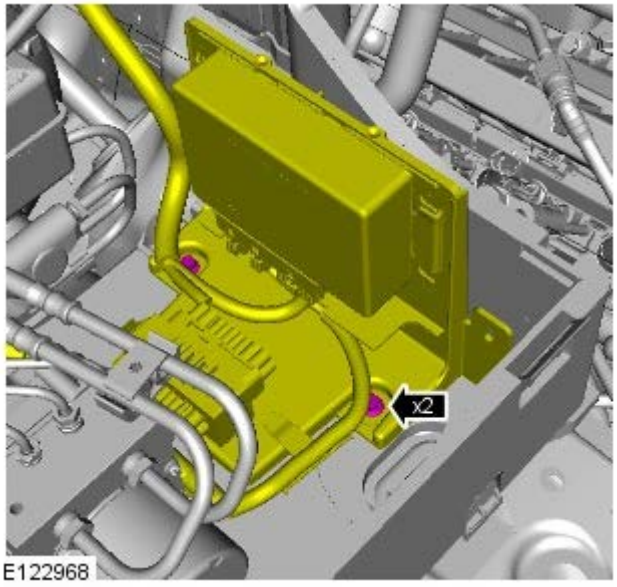
1. Pump the brake pedal until the brake vacuum assistance is exhausted.

2. Remove the auxiliary battery cover.
   - Release the 2 clips.

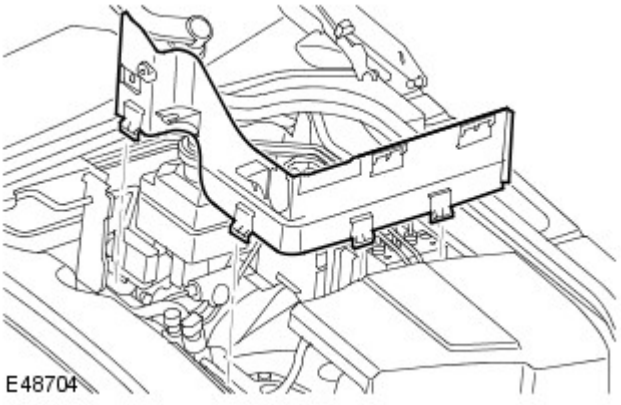


3. If installed, remove the auxiliary battery.

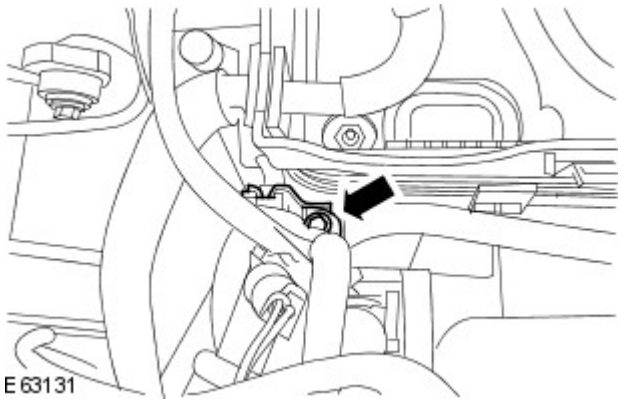
4. Detach the automatic transmission module bracket and position it to one side.
   - Remove the 2 bolts.



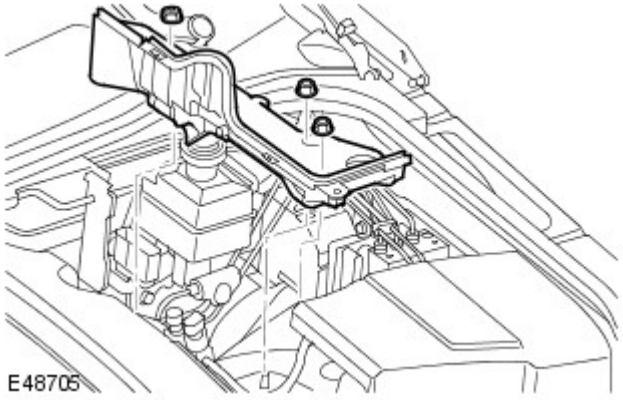
5. Remove the auxiliary battery compartment side wall.
   - Release the four clips.



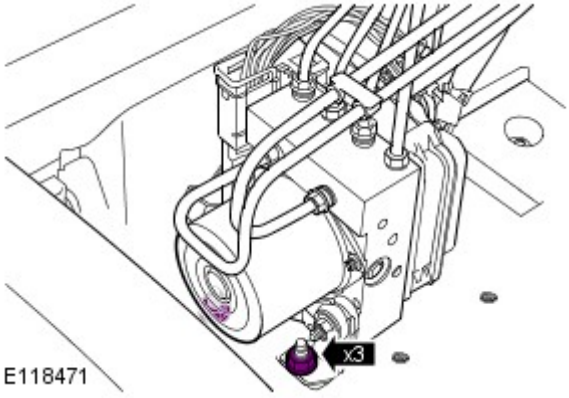
6. Release the Air Conditioning (A/C) pipes.
   - Remove the retaining screw.



7. Remove the auxiliary battery tray.
    - Remove the 3 bolts.



8. Release the Anti-lock Brake System (ABS) module.
    - Remove the 3 nuts.
    - Release the brake tubes from the clip.

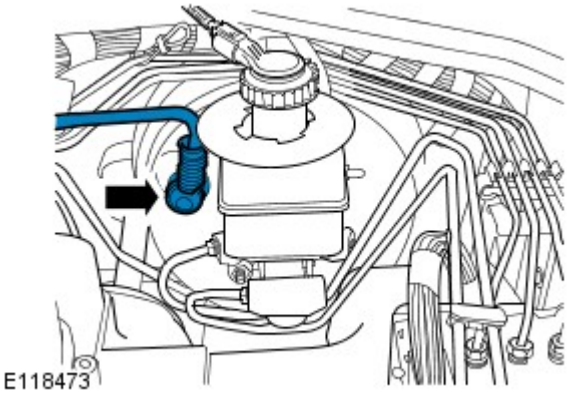


9. Disconnect the low brake fluid warning indicator switch electrical connector.

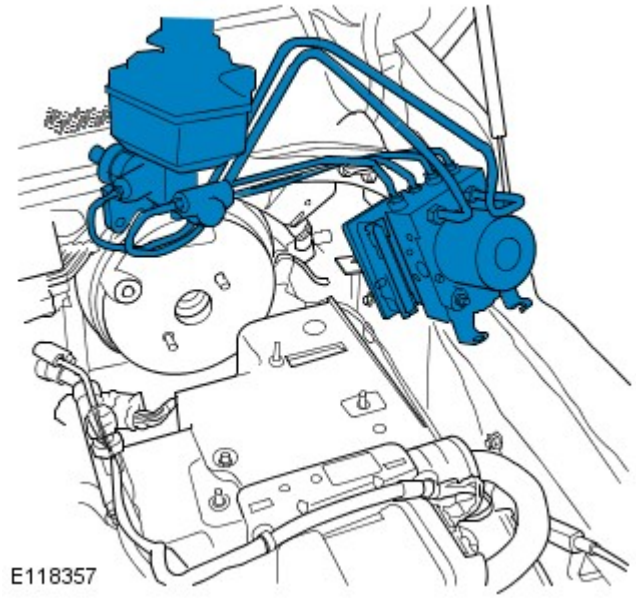
10. CAUTION: Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

    Position an absorbent cloth to collect fluid spillage.

11. Disconnect the brake booster vacuum hose from the brake booster.



12. CAUTIONS:



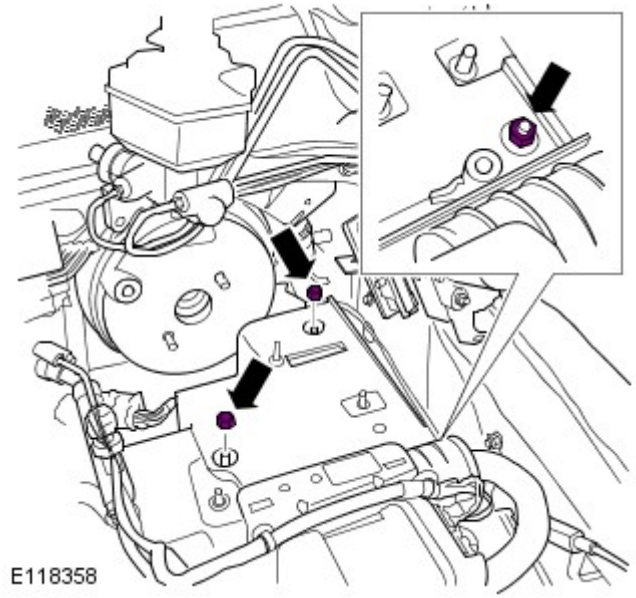
Make sure that excessive force is not used. Failure to follow this instruction may result in damage to the vehicle.

Make sure the wings and trim panels are covered and protected, failure to follow this instruction may result in damage to the vehicle.

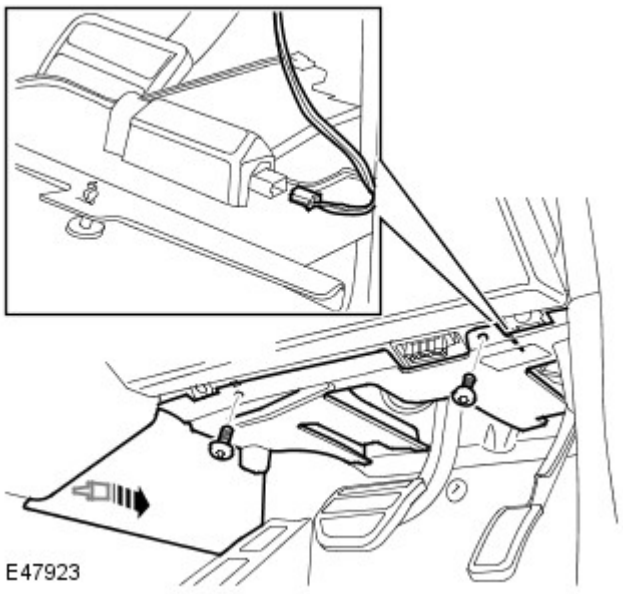
Make sure the brake pipes are not damaged when displacing the brake master cylinder and ABS module. Failure to follow this instruction may result in damage to the vehicle.

Displace the brake master cylinder and ABS module as a complete assembly.

- Remove the 2 nuts.
- Discard the master cylinder seals.



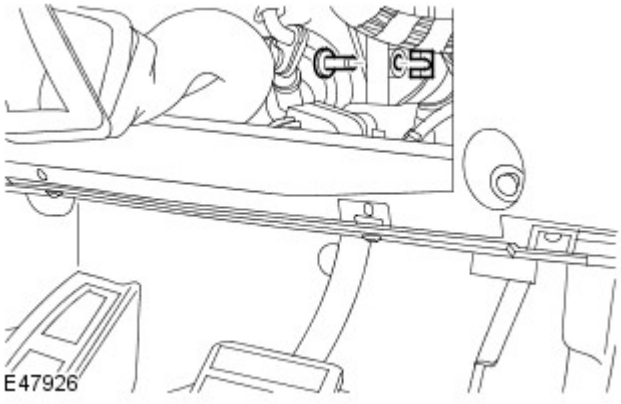
13. Remove the outer plenum base.
    - Remove the 3 nuts.



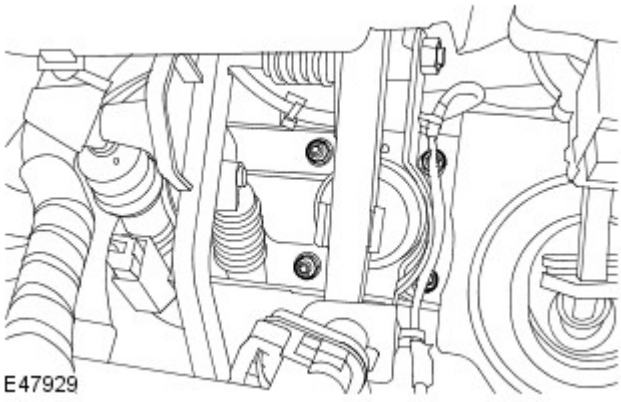
14. Remove the driver side closing trim panel.
    - Release the clip.
    - Remove the 2 screws.
    - Disconnect the electrical connector.

15. NOTE: The cover is shown removed for clarity.

    Remove the brake booster push rod clevis pin.
    - Remove the retaining clip.



16. Remove the brake booster.
    - Remove the 4 nuts.



Installation

1. Install the brake booster.
    - Tighten the nuts to 23 Nm (17 lb.ft).
2. Install the brake booster push rod clevis pin.
    - Install the retaining clip.
3. Connect the brake booster vacuum hose.
4. Install the outer plenum base.
    - Carefully lift the anti-lock brake system modulator for access.
    - Install the 3 nuts.
5. CAUTION: Make sure the master cylinder is correctly aligned.

   NOTE: Install new seals and nuts.

   Install the the brake master cylinder and ABS module.
    - Tighten the nuts to 23 Nm (17 lb.ft).
6. Secure the anti-lock brake system modulator.
    - Install the 3 nuts.
    - Secure the brake tubes to the clip.
7. Connect the low brake fluid warning indicator switch electrical connector.
8. Install the auxiliary battery tray.
    - Install the 3 bolts.
9. Install the auxiliary battery compartment side wall.
    - Secure with the four retaining clips.
10. Secure the A/C pipes.
    - Install the retaining screw.
11. Secure the automatic transmission module bracket
    - Install the 2 bolts.

12. If installed, install the auxiliary battery.

13. NOTE: This step is to check the tightness of the retaining nuts after the initial tighten to make sure that torque has not relaxed.

    Check the brake booster retaining nuts.
    - Tighten the nuts to 23 Nm (17 lb.ft).

14. Install the closing trim panel.
    - Connect the electrical connector.
    - Secure the clip.
    - Tighten the screws.

15. Start engine and check the brake booster operation.

Power Brake Actuation - Brake Vacuum Pump TDV6 3.0L Diesel
Removal and Installation

Removal

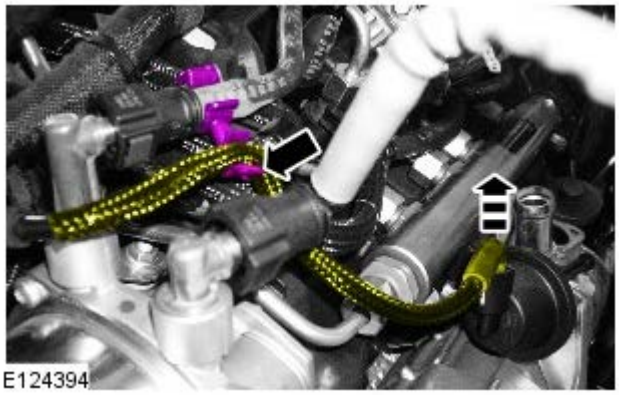
NOTES:

Removal steps in this procedure may contain installation details.

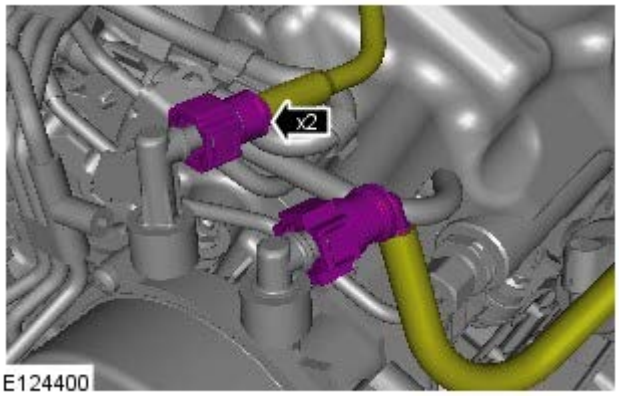
Some variation in the illustrations may occur, but the essential information is always correct.

1. Refer to: Body - Diesel (502-02, Removal and Installation).

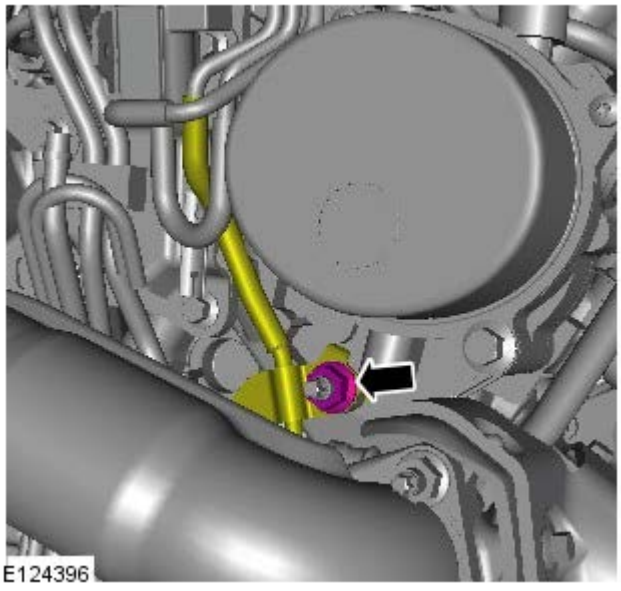
2.



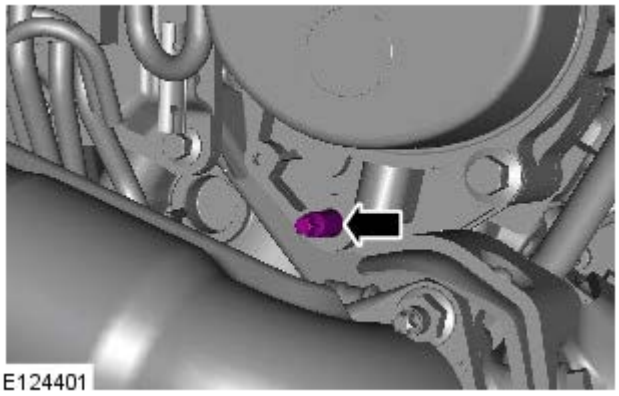
3.



4. *Torque:* 23 Nm

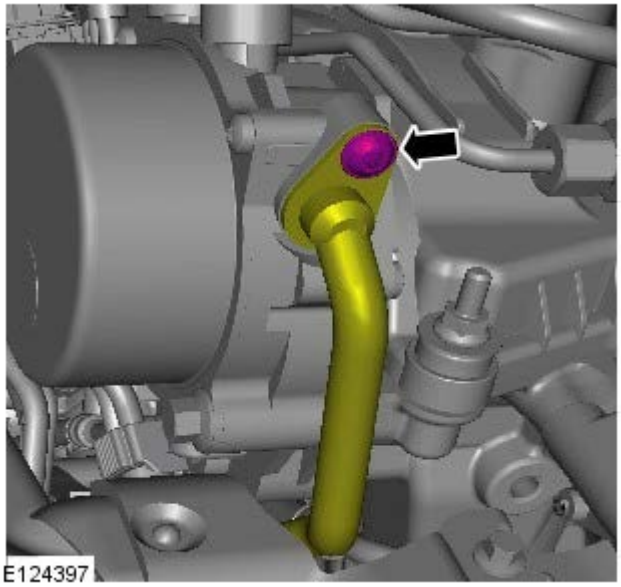


5. *Torque:* 13 Nm

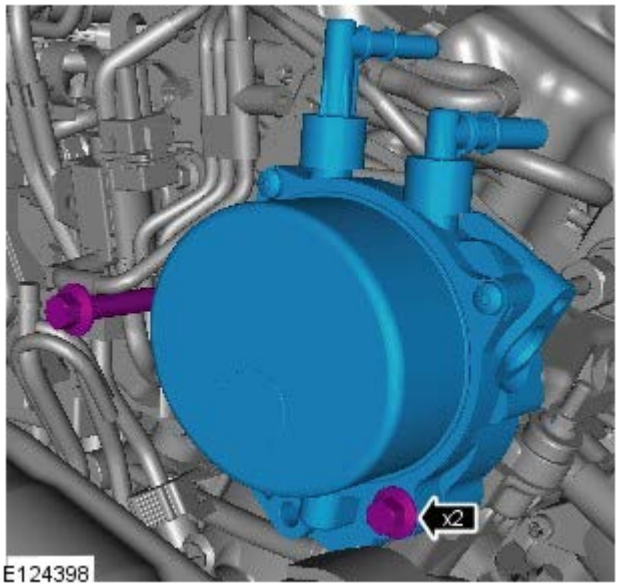

E124401

6. NOTE: Discard the O-ring seal.

   Torque: 10 Nm

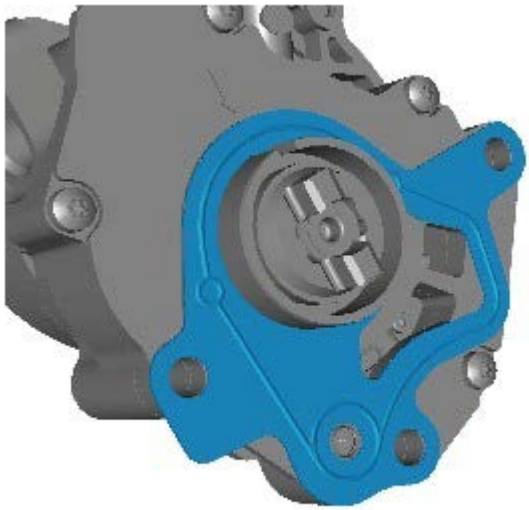

E124397

7. *Torque:* 23 Nm



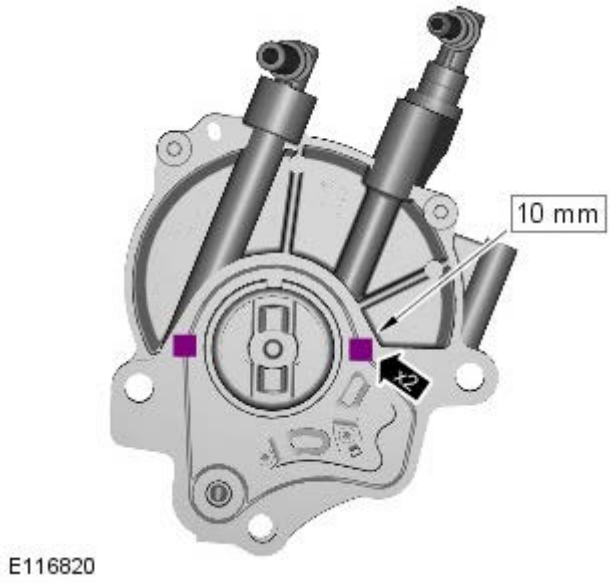
E124398

8.



E124399

Installation



E116820

1. NOTES:

   Install a new gasket.

   Install a new O-ring seal.

   Apply silicone gasket sealant or equivalent meeting Land Rover specification.

   The application of sealant must be 10 mm square in two places. Install the brake vacuum pump immediately after applying the sealant.

   The brake vacuum pump should be fitted directly to the engine without smearing the sealant.

   Make sure that the drive coupling is aligned with camshaft coupling.

   To install, reverse the removal procedure.

Power Brake Actuation - Brake Vacuum Pump 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.

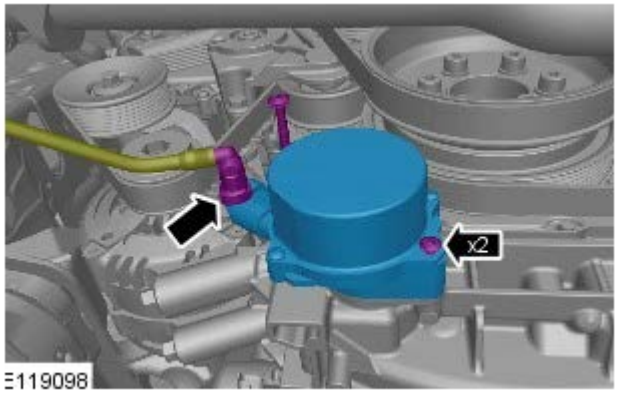
   Raise and support the vehicle.

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

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

4.





5. NOTES:

   Discard the seal.

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

   Torque: 12 Nm

Installation

1. NOTE: Install a new seal.

   To install, reverse the removal procedure.

Anti-Lock Control - Traction Control -

General Specification

Item	Specification
System make/type	Bosch 8.0 Anti-lock braking system with Electronic Brake Distribution (EBD), Corner Brake Control (CBC), Electronic Traction Control (ETC), Hill Descent Control (HDC), Anti-roll Mitigation (ARM), Emergency Brake Assist (EBA), and Dynamic Stability Control (DSC)
Wheel speed sensors:	
Make/type	Bosch DF11i
Location	Front and rear knuckles with the active directional sensor acting on the driveshaft pole wheel
Yaw rate sensor make/type	Bosch DRS MM1.OR

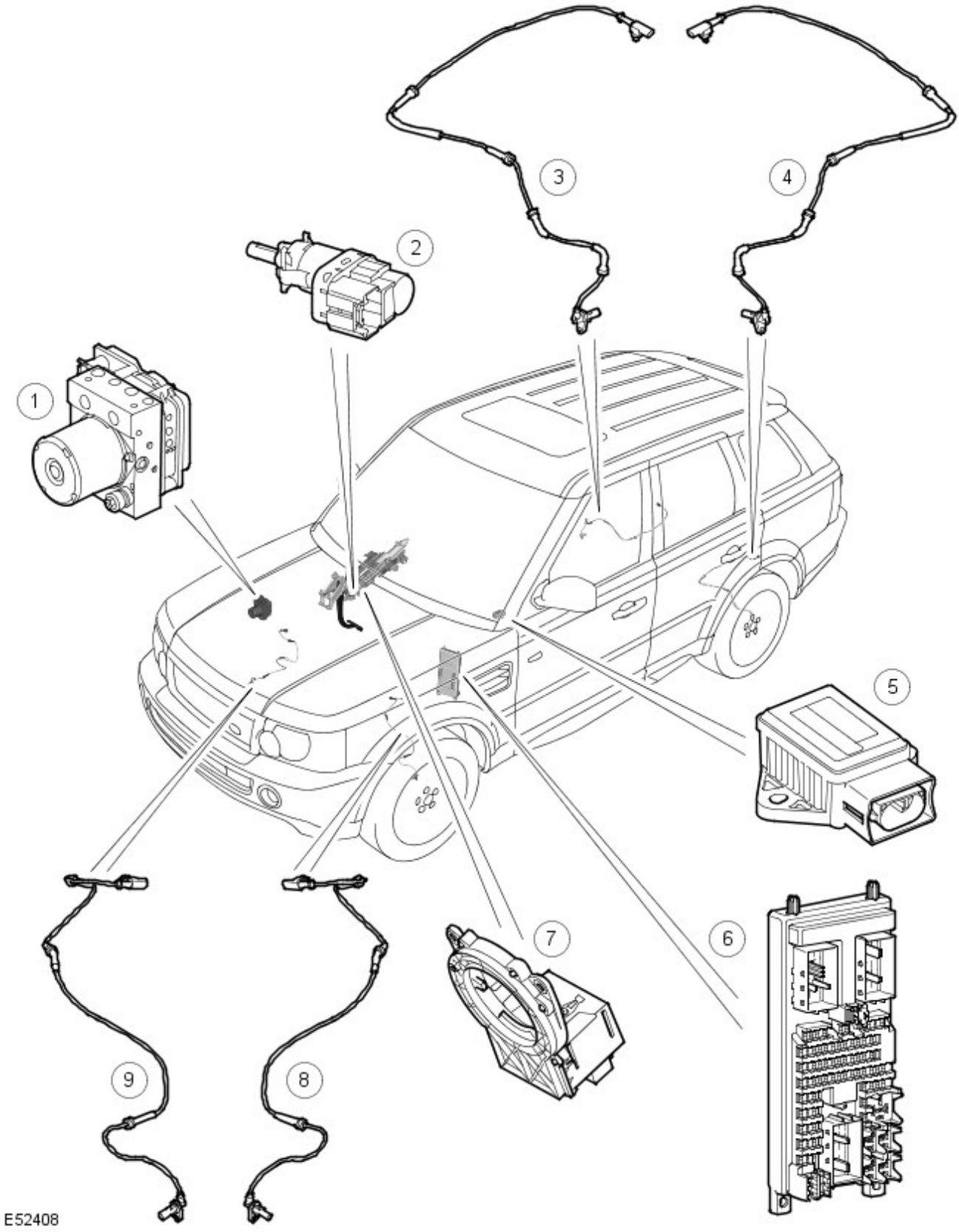
Torque Specifications

Description	Nm	lb-ft
Front road wheel speed sensor bolt	9	7
Front brake caliper anchor plate to wheel knuckle bolts	275	203
Brembo front brake caliper to wheel knuckle bolts	275	203
Front brake hose retaining bracket to wheel knuckle bolt	22	16
Rear road wheel speed sensor to wheel knuckle bolt	9	7
ABS module to mounting bracket nuts	8	6
ABS module mounting bracket to body nuts	23	17
M10 Brake tube union nuts	15	11
M12 Brake tube union nuts	15	11
M14 Brake tube union nut	17	13
Yaw rate sensor bolts	7	5
Road wheel nuts	140	103

Anti-Lock Control - Traction Control - Anti-Lock Control - Traction Control

Description and Operation

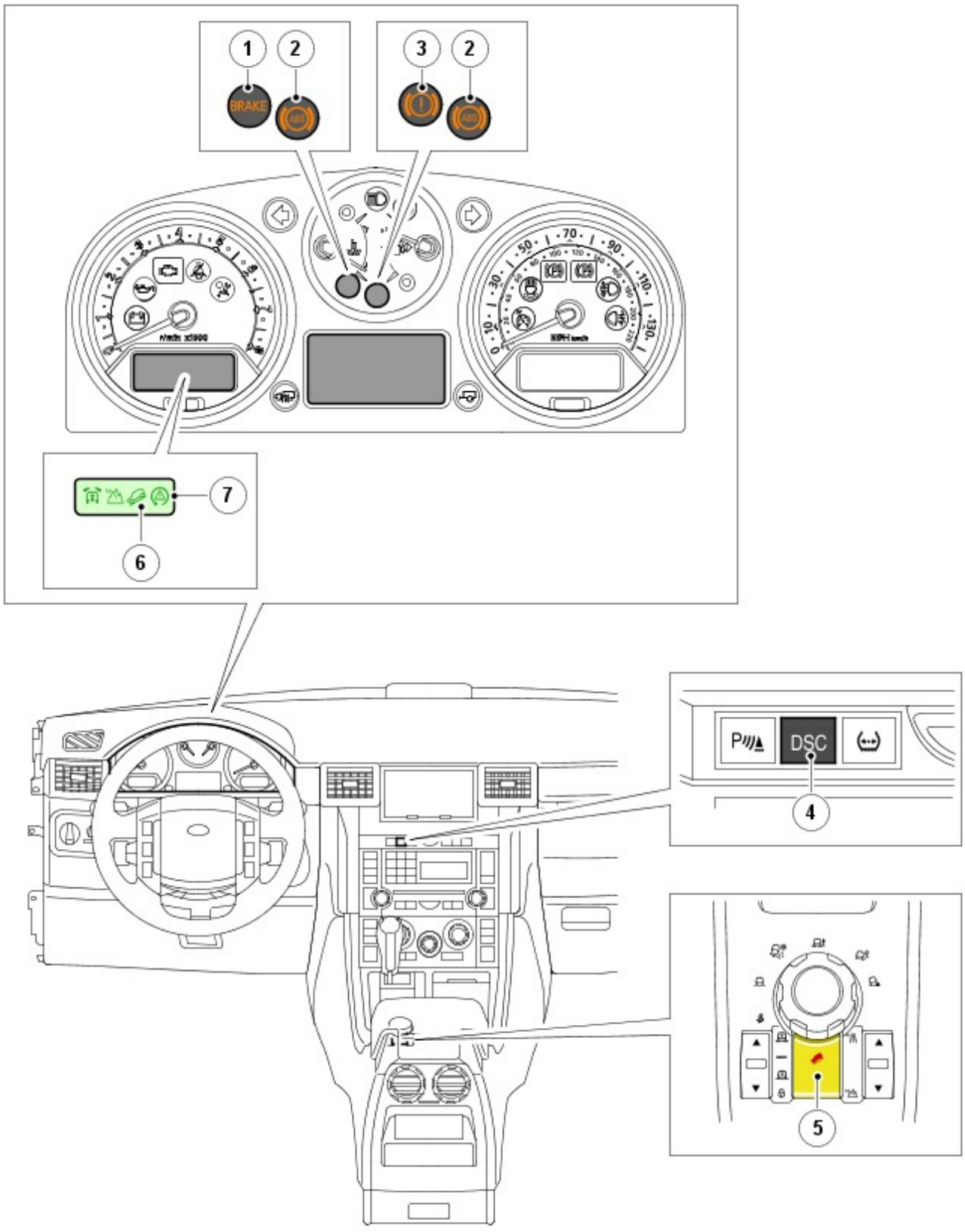
COMPONENT LOCATIONS - SHEET 1 OF 2



Item	Part Number	Description
1	-	hydraulic control unit (HCU) with attached anti-lock brake system (ABS) module
2	-	Stoplamp switch
3	-	Right rear wheel speed sensor
4	-	Left rear wheel speed sensor

5	-	Yaw rate and lateral acceleration sensor
6	-	HDC (hill descent control) relay (non-serviceable, integrated into central junction box (CJB))
7	-	Steering angle sensor
8	-	Left front wheel speed sensor
9	-	Right front wheel speed sensor

COMPONENT LOCATIONS - SHEET 2 OF 2



E52409

Item	Part Number	Description
1	-	Brake warning indicator (NAS (north American specification) only)
2	-	ABS warning indicator
3	-	Brake warning indicator (all except NAS)

4	-	DSC (dynamic stability control) switch
5	-	HDC switch
6	-	HDC information indicator
7	-	DSC warning indicator

GENERAL

The anti-lock control - traction control system is based on the 4 channel Bosch 8.0 system and provides the following brake functions:

- ARM (active roll mitigation).
- ABS.
- CBC (corner brake control).
- DSC.
- electronic brake force distribution (EBD).
- ETC (electronic traction control).
- emergency brake assist (EBA).
- EDC (engine drag-torque control).
- HDC.

The system consists of the following components:

- A DSC switch.
- An HDC switch.
- An HDC relay.
- A stoplamp switch.
- Four wheel speed sensors.
- A yaw rate and lateral acceleration sensor.
- A steering angle sensor.
- Four warning indicators.
- A HCU with attached ABS module.

DSC SWITCH

The DSC switch allows the DSC function to be selected off. Although Land Rover recommend that DSC is selected on for all normal driving conditions, it may be beneficial to de-select DSC, to maximize traction, under the following conditions:

- If the vehicle needs to be rocked out of a hollow or a soft surface.
- Driving on loose surfaces or with snow chains.
- Driving in deep sand, snow or mud.
- On tracks with deep longitudinal ruts.

The DSC switch is a non-latching switch installed in the center switch pack on the instrument panel. Pressing the DSC switch connects an ignition power feed to the ABS module. With the first press of the DSC switch, the ABS module disables the DSC functions. When the DSC switch is pressed again, the ABS module re-enables the DSC functions. The DSC switch must be pressed for a minimum of 0.3 second for the ABS module to react. The DSC function is re-enabled at the beginning of each ignition cycle.

The status of the DSC switch selection is shown by the DSC warning indicator. The DSC warning indicator is off while DSC is selected on, and continuously illuminated while DSC is selected off.

A DSC switch request to disable DSC is ignored if the air suspension system has failed, or is in off-road height at speeds above 60 km/h (37.5 mph).

To guard against incorrect operation or a broken switch, if the input from the DSC switch is held high for more than one minute, a failure is stored in the ABS module.

Even if DSC is deselected, driving maneuvers with extreme yaw or lateral acceleration may trigger DSC activity to assist vehicle stability.

HDC SWITCH

The HDC switch controls the selection of the HDC function.

The HDC switch is a non-latching switch installed on the center console, to the rear of the gear shift lever. Pressing and releasing the HDC switch momentarily connects an ignition power feed to the ABS module. With the first press and release of the HDC switch, the ABS module enables operation of the HDC function. When the HDC switch is pressed and released again, the ABS module disables operation of the HDC function.

To guard against incorrect operation or a broken switch, if the switch is pressed for more than 10 seconds no change of state occurs. If the input from the HDC switch is held high for more than one minute, a failure is stored in the ABS module.

HDC RELAY

The HDC relay is used to illuminate the stoplamps when the brakes are activated:

- During HDC operation.
- During dynamic application of the parking brake.
  For additional information, refer to: Parking Brake (206-05, Description and Operation).
- By the adaptive speed control system. For additional information, refer to:
  Speed Control (310-03B, Description and Operation),

Speed Control (310-03C, Description and Operation).

The HDC relay is a non-serviceable, solid state relay on the circuit board of the CJB. Operation of the HDC relay is controlled by the ABS module switching the coil to ground.

To operate the stoplamps during HDC or adaptive speed control operation, the ABS module monitors brake system hydraulic pressure and energizes the HDC relay during active braking. A pressure threshold and time filter prevent the stoplamps from flickering when HDC is braking. During dynamic application of the parking brake, the ABS module energizes the HDC relay when it receives a stoplamp request message from the parking brake module on the high speed controller area network (CAN) bus.

STOPLAMP SWITCH

The stoplamp switch is mounted in the brake pedal bracket and operated by the brake pedal. The stoplamp switch is a two pole switch: The BS (brake switch) pole supplies a brake pedal status signal to the ABS module; the BLS (brake lamp switch) pole operates the stoplamps and also supplies a brake pedal status signal to the ABS module and to the engine control module (ECM).

While the brake pedal is released:

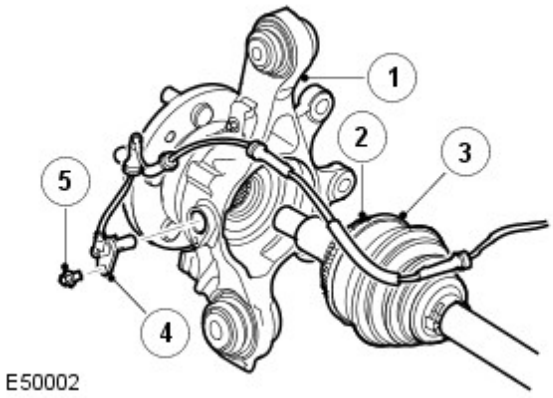
- The BS contacts are closed, and connect an ignition power feed from the CJB to the ABS module.
- The BLS contacts are open.

When the brake pedal is pressed:

- The BS contacts open.
- The BLS contacts close, and connect an ignition power feed from the CJB to the three stoplamps, the ABS module and the ECM.

The ABS module monitors the status inputs from the stoplamp switch and broadcasts the brake pedal status and an associated quality factor on the high speed CAN bus.

WHEEL SPEED SENSORS



Item	Part Number	Description
1	-	Knuckle assembly
2	-	Sensor ring
3	-	Halfshaft
4	-	Wheel speed sensor
5	-	Screw

An active wheel speed sensor is installed in each wheel hub to provide the ABS module with a rotational speed signal from each road wheel. The head of each wheel speed sensor is positioned close to a 48 tooth sensor ring on the outer diameter of the constant velocity joint of the halfshaft. A flying lead connects each sensor to the vehicle wiring.

The wheel speed sensors each have a power supply connection and a signal connection with the ABS module. When the ignition switch is in position II, the ABS module supplies power to the wheel speed sensors and monitors the return signals. Any rotation of the halfshafts induces current fluctuations in the return signals which are converted into individual wheel speeds and the overall vehicle speed by the ABS module.

The ABS module outputs the individual wheel speeds and the vehicle speed on the high speed CAN bus for use by other systems. The quality of the vehicle speed signal is also broadcast on the high speed CAN bus. If all wheel speed signals are available to calculate vehicle speed from, the quality of the vehicle speed signal is set to 'data calculated within specified accuracy'. If one or more wheel speed sensors is faulty, the quality of the vehicle speed signal is set to 'accuracy outside specification'.

The ABS module monitors the wheel speed sensor circuits for faults. If a fault is detected the ABS module stores a related fault code and illuminates the appropriate warning indicators, depending on the system functions affected (DSC/ETC, ABS, EBA/EBD, HDC). Also a warning chime sounds and a related message is shown in the message center.
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

Since the wheel speed sensors are active devices, a return signal is available when the road wheels are not turning, which enables the ABS module to check the sensors while the vehicle is stationary. In addition, the direction of travel of each wheel can be sensed. This information is broadcast on the high sped CAN bus for use by other systems.

YAW RATE AND LATERAL ACCELERATION SENSOR

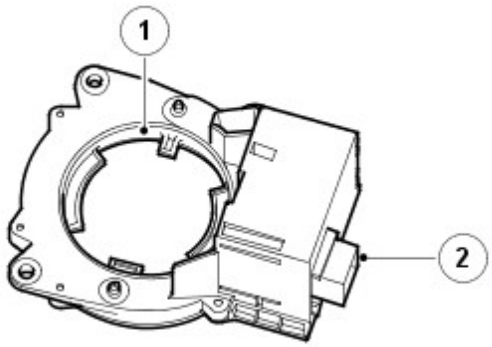
The yaw rate and lateral acceleration sensor provides the ABS module with inputs of yaw rate and lateral acceleration.

The yaw rate and lateral acceleration sensor is installed under the center console and secured to the transmission tunnel with two bolts.

When the ignition switch is in position II, the yaw rate and lateral acceleration sensor receives an ignition power feed from the CJB. The sensor is self diagnosed by the ABS module and can be interrogated using T4. The ABS module broadcasts the yaw rate and lateral acceleration values, on the high speed CAN bus, for use by other systems.

The ABS module monitors the yaw rate and lateral acceleration sensor for faults. If a fault is detected the ABS module stores a related fault code and illuminates the DSC warning indicator. Also, a warning chime sounds and a message advising of an HDC fault is shown in the message center.
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

STEERING ANGLE SENSOR



E50003

Item	Part Number	Description
1	-	Gear wheel
2	-	Electrical connector

The steering angle sensor measures the steering wheel angle and the rate of change of the steering wheel angle (known as the steering wheel angle speed). These measurements are output on the high speed CAN bus, together with a quality factor signal, for use by other systems. The ABS module uses the steering angle sensor signals for CBC and DSC operation.

The steering angle sensor is fixed to the pivot bracket of the steering column by three screws. A gear wheel in the steering angle sensor engages with a plastic drive collar fixed onto the lower shaft of the column. Inside the steering angle sensor, the gear wheel meshes with a gear train containing magnets. An eight pin electrical connector provides the interface between the vehicle wiring and integrated circuits in the steering angle sensor.

The steering angle sensor uses the MR (magneto resistive) effect, which evaluates the direction of magnetic fields, to measure the angular position of the lower shaft, and thus the steering wheel angle. When the steering wheel turns, the steering column lower shaft rotates the gear wheel in the steering angle sensor, which drives the gear train and rotates the magnets on the gears. The direction of the magnetic fields is constantly monitored by the steering angle sensor and converted into a steering wheel angle and steering wheel angle speed.

The steering angle sensor performs a plausibility check of the steering wheel angle each time the following conditions co-exist:

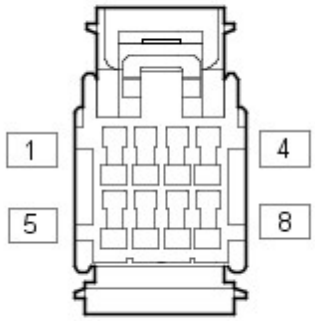
- The vehicle is traveling in a straight line.
- The vehicle speed is between 20 and 25 km/h (12.5 and 15.6 mph).
- The transfer box is in high range.
- The brake pedal is not pressed.
- There is no ABS, DSC or ETC activity.

The steering angle sensor uses inputs of wheel speed, yaw rate and lateral acceleration to determine when the vehicle is traveling in a straight line. When all of the conditions co-exist, the steering angle sensor checks the steering angle, which should be 0 ± 15°. If the steering angle is outside the limits on two successive checks, the steering angle sensor changes the quality factor signal to 'outside specification' for the remainder of the ignition cycle and stores a fault code. At the beginning of each ignition cycle the quality factor signal is reset to 'within specified accuracy'.

The status of the steering angle sensor can be determined using T4.

If the steering angle sensor is replaced, the new sensor must be calibrated using T4. The steering angle sensor must also be re-calibrated any time it is disturbed from the steering column, or if the upper and lower steering columns are separated.

Steering Angle Sensor Harness Connector C0862



E50004

Steering Angle Sensor Harness Connector C0862 Pin Details

Pin No.	Description	Input/Output
1 to 4	Not used	-
5	Ignition power supply	Input
6	High speed CAN bus high	Input/Output
7	High speed CAN bus low	Input/Output
8	Ground	-

WARNING INDICATORS

The following anti-lock control - traction control indicators are installed in the instrument cluster:

ABS Warning Indicator

The ABS warning indicator is an amber colored indicator located between the coolant temperature gage and the fuel level gage.

The ABS warning indicator is continuously illuminated if there is a fault that affects ABS performance or causes the ABS function to be disabled.

Operation of the ABS warning indicator is controlled by a high speed CAN bus message from the ABS module to the instrument cluster.

When the ignition switch is first turned to position II, the ABS warning indicator illuminates for approximately 3 seconds as a bulb check. During the bulb check, if a fault is stored in the memory of the ABS module, the ABS warning indicator goes off for 0.5 second, 0.5 second after the start of the bulb check. If a fault during the previous ignition cycle caused the ABS warning indicator to be illuminated, the ABS warning indicator may remain illuminated after the next bulb check, even if the fault has been rectified and cleared from the ABS module; the ABS warning indicator remains illuminated until vehicle speed reaches 15-20 km/h (9.5-12.5 mph) while additional checks of the related inputs are performed.

Brake Warning Indicator

The brake warning indicator is a dual colored indicator, located in the coolant temperature gage, that illuminates amber for EBA faults and red for EBD faults. The brake warning indicator is also used to give warnings of:

- Low brake fluid level (illuminates red).
  For additional information, refer to: Hydraulic Brake Actuation (206-06 Hydraulic Brake Actuation, Description and Operation).
- Brake pad wear (illuminates amber).
  For additional information, refer to: Rear Disc Brake (206-04 Rear Disc Brake, Description and Operation).

Operation of the brake warning indicator is controlled by a high speed CAN bus message from the ABS module to the instrument cluster.

When the ignition switch is first turned to position II, the brake warning indicator illuminates amber for approximately 1.5 seconds then red for approximately 1.5 seconds, as a bulb check.

DSC Warning Indicator

The DSC warning indicator is an amber colored warning indicator located in the tachometer.

Each time the DSC or the ETC function is active, the DSC warning indicator flashes at 2 Hz. If DSC has been selected off, or there is a fault that disables the DSC or the ETC function, the DSC warning indicator is continuously illuminated. If DSC has been selected off the instrument cluster also displays a message advising that DSC is switched off.
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

Operation of the DSC warning indicator is controlled by a high speed CAN bus message from the ABS module to the instrument cluster.

When the ignition switch is first turned to position II, the DSC warning indicator illuminates for approximately 3 seconds as a bulb check. If a fault during the previous ignition cycle caused the DSC warning indicator to be illuminated, the DSC warning indicator may remain illuminated after the next bulb check, even if the fault has been rectified and cleared from the ABS module; the DSC warning indicator may remain illuminated during vehicle operation while additional checks of the related inputs are performed.

HDC Information Indicator

The HDC information indicator is a green colored indicator located in the tachometer.

The HDC information indicator is continuously illuminated while the HDC function is selected on and the vehicle is within the parameters for HDC operation; when the vehicle is outside the parameters for HDC operation, the HDC information indicator is flashed at 2 Hz.

Operation of the HDC information indicator is controlled by a high speed CAN bus message from the ABS module to the instrument cluster.

HCU

The HCU is a 4 channel unit that modulates the supply of hydraulic pressure to the brakes under the control of the ABS module.

The HCU is attached by three mounting bushes to a bracket in the plenum box on the driver side of the engine compartment. Hydraulic pipes connect the HCU to the master cylinder and the brakes.
For additional information, refer to: Hydraulic Brake Actuation (206-06 Hydraulic Brake Actuation, Description and Operation).

The primary and secondary outlets of the master cylinder are connected to primary and secondary circuits within the HCU. The primary circuit in the HCU has separate outlet ports to the front brakes. The secondary circuit in the HCU has separate outlet ports to the rear brakes. Each of the circuits in the HCU contain the following components to control the supply of hydraulic pressure to the brakes:

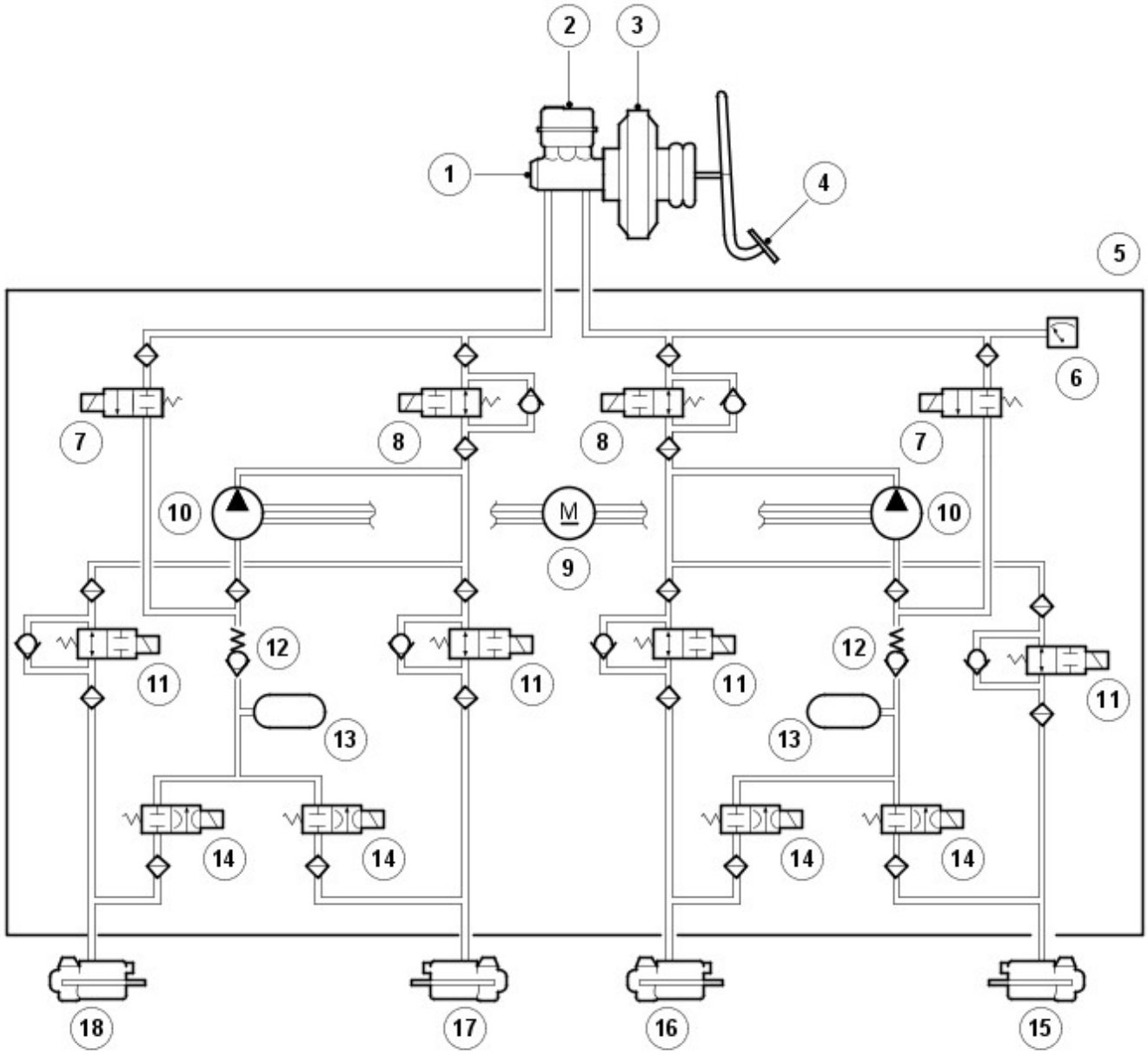
- A normally open, solenoid operated, pilot valve, to enable active braking.
- A normally closed, solenoid operated, priming valve, to connect the brake fluid reservoir to the return pump during active braking.
- A return pump, to generate hydraulic pressure for active braking and return brake fluid to the reservoir.
- Normally open, solenoid operated, inlet valves and normally closed, solenoid operated, outlet valves, to modulate the hydraulic pressure in the individual brakes.
- An accumulator and a relief valve, to allow the fast release of pressure from the brakes.
- Filters, to protect the components from contamination.

The primary circuit also incorporates a pressure sensor to provide the ABS module with a hydraulic pressure signal.

Contact pins on the HCU mate with contacts on the ABS module to provide the electrical connections from the ABS module to the return pump motor and the pressure sensor. The solenoids that operate the valves are installed in the ABS module.

Replacement HCU are supplied pre-filled. After installation on the vehicle, T4 must be used to operate the solenoid valves and the return pump to ensure correct bleeding of the HCU and brake circuits.

Schematic of HCU



E50005

Item	Part Number	Description
1	-	Master cylinder
2	-	Reservoir
3	-	Brake booster
4	-	Brake pedal
5	-	HCU
6	-	Pressure sensor
7	-	Priming valve
8	-	Pilot valve
9	-	Return pump motor
10	-	Return pump
11	-	Inlet valve
12	-	Relief valve
13	-	Accumulator
14	-	Outlet valve
15	-	Left front brake
16	-	Right front brake
17	-	Right rear brake
18	-	Left rear brake

The HCU has three operating modes: Normal braking/EBD mode, ABS braking and active braking.

Normal Braking/EBD Mode

Initially, all of the solenoid operated valves are de-energized. Operating the brake pedal produces a corresponding increase or decrease of pressure in the brakes, through the open pilot valves and inlet valves. If the ABS module determines that EBD is necessary, it energizes the inlet valves for the brakes of the trailing axle, to isolate the brakes from any further increase in hydraulic pressure.

ABS Braking Mode

If the ABS module determines that ABS braking is necessary, it energizes the inlet and outlet valves of the related brake and starts the return pump. The inlet valve closes to isolate the brake from pressurized fluid; the outlet valve opens to release pressure from the brake into the accumulator and the return pump circuit; the reduced pressure allows the wheel to accelerate. The ABS module then operates the inlet and outlet valves to modulate the pressure in the brake to apply the maximum braking effort without locking the wheel. Control of the valves for each wheel takes place individually.

Active Braking Mode

The active braking mode is used to generate and control hydraulic pressure to the brakes for functions other than ABS braking, e.g. DSC, EBA, ETC, HDC, dynamic application of the parking brake and adaptive speed control.

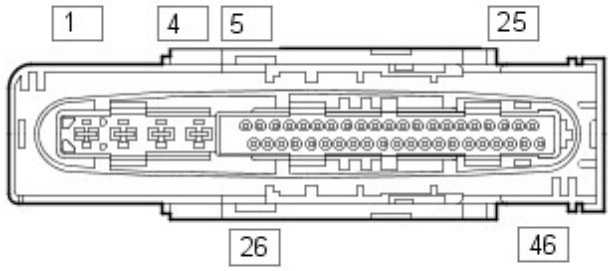
For active braking, the ABS module energizes the pilot valves and priming valves, starts the return pump and energizes all of the inlet valves. Brake fluid, drawn from the reservoir through the master cylinder and priming valve, is pressurized by the return pump and supplied to the inlet valves. The ABS module then operates the inlet valves and outlet valves, as required, to modulate the pressure in the individual brakes. Some noise may be generated during active braking.

ABS MODULE

The ABS module controls the brake functions using the HCU to modulate hydraulic pressure to the individual wheel brakes.

The ABS module is attached to the HCU, in the plenum box on the driver side of the engine compartment. A 46 pin connector provides the electrical interface between the ABS module and the vehicle wiring.

ABS Module Harness Connector C0506



E50006

ABS Module Harness Connector C0506 Pin Details

Pin No.	Description	Input/Output
1	Ground	Output
2	Battery power supply	Input
3	Battery power supply	Input
4	Ground	Output
5	Front left wheel speed sensor signal	Input
6	Rear left wheel speed sensor power supply	Output
7	Rear right wheel speed sensor power supply	Output
8	Rear right wheel speed sensor signal	Input
9	Front right wheel speed sensor power supply	Output
10	Front right wheel speed sensor signal	Input
11 to 13	Not used	-
14	High speed CAN bus low	Input/Output
15	Yaw rate and lateral acceleration sensor ground	Input
16	Yaw rate signal	Input
17	Not used	-
18	Yaw rate and lateral acceleration sensor reference	Input
19	Not used	-
20	Lateral acceleration signal	Input
21	Not used	-
22	HDC relay	Output
23 to 25	Not used	-
26	Front left wheel speed sensor power supply	Output
27	Rear left wheel speed sensor signal	Input
28	Ignition power supply	Input

29	Not used	-
30	Stoplamp switch BLS contacts	Input
31	DSC switch	Input
32	Not used	-
33	Road speed signal	Output
34	Not used	-
35	High speed CAN bus high	Input/Output
36	HDC switch	Input
37	Yaw rate and lateral acceleration sensor test	Output
38 to 40	Not used	-
41	Stoplamp switch BS contacts	Input
42 to 46	Not used	-

SYSTEM OPERATION

ARM

The ARM function uses the brakes and the engine to attempt to restore stability if the vehicle is forced into such a harsh manoeuver that it risks tipping over.

The ABS module monitors driver inputs and vehicle behavior using various powertrain signals and the inputs from the wheel speed sensors, the steering angle sensor and the yaw rate and lateral acceleration sensor. These are compared with modeled behavior and, if vehicle behavior reaches a given risk level, the ABS module cuts the engine power, or brakes one or more wheels, just enough to help the vehicle regain its poise and help the driver remain in control.

While the ignition is on, ARM is permanently enabled, even when DSC has been selected off.

ABS

ABS controls the speed of all road wheels to ensure optimum wheel slip when braking at the adhesion limit. This prevents the wheels from locking, which helps to retain effective steering control of the vehicle.

On the front axle, the brake pressure is modulated separately for each wheel. On the rear axle, brake pressure is modulated by select low. Select low applies the same pressure to both rear brakes, with the pressure level being determined by the wheel on the lower friction surface. This maintains rear stability on split friction surfaces.

CBC

CBC influences the brake pressures, below the DSC and ABS thresholds, to counteract the yawing moment produced when braking in a corner. CBC produces a correction torque by limiting the brake pressure on one side of the vehicle.

DSC

DSC uses the brakes and powertrain torque control to help maintain the lateral stability of the vehicle. While the ignition is on the DSC function is permanently enabled unless selected off by the DSC switch. Even if DSC is deselected, driving maneuvers with extreme yaw or lateral acceleration may trigger DSC activity to assist vehicle stability.

DSC enhances driving safety in abrupt maneuvers and in understeer or oversteer situations which may occur in a bend. The ABS module monitors the yaw rate and lateral acceleration of the vehicle, and the steering input, then selectively applies individual brakes and signals for powertrain torque adjustments to reduce understeer or oversteer.

In general: in an understeering situation, the inner wheels are braked to counteract the yaw movement towards the outer edge of the bend; in an oversteering situation, the outer wheels are braked to prevent the rear end of the vehicle from pushing towards the outer edge of the bend.

The ABS module monitors the tracking stability of the vehicle using inputs from the wheel speed sensors, the steering angle sensor and the yaw rate and lateral acceleration sensor. The tracking stability is compared with stored target data and, whenever the tracking stability deviates from the target data, the ABS module intervenes by applying the appropriate brakes. When the DSC function is active, the ABS module also signals the transmission control module (TCM) to prevent gear shifts. If necessary, the ABS module also signals:

- The ECM, to reduce engine torque.
- The transfer box control module, to adjust the locking torque of the center differential.
- The rear differential control module, to adjust the locking torque of the rear differential.

The DSC function overrides the differential locking torque requests from the terrain response system.

EBD

EBD limits the brake pressure applied to the rear wheels. When the brakes are applied, the weight of the vehicle transfers forwards, which reduces the ability of the rear wheels to transfer braking effort to the road surface. This can cause the rear wheels to slip and make the vehicle unstable.

EBD uses the anti-lock braking hardware to automatically optimize the pressure of the rear brakes, below the point where anti-lock braking would be invoked. Only the rear axle is under EBD control.

ETC

ETC attempts to optimize forward traction by reducing engine torque or braking a spinning wheel until it regains grip.

ETC is activated if an individual wheel speed is above that of the vehicle reference speed (positive slip) and the brake

pedal is not pressed. The spinning wheel is braked, allowing the excess torque to be transmitted to the non spinning wheels through the drive line. If necessary, the ABS module also sends a high speed CAN bus message to the ECM to request a reduction in engine torque. Torque reduction requests are for either a slow or fast response: a slow response requests a reduction of throttle angle (4.2L and 4.4L only); a fast response requests an ignition cut-off (4.2L and 4.4L) or a fuel cut-off (2.7L Diesel).

When the DSC function is selected off with the DSC switch, the engine torque reduction feature is disabled.

When the ETC function is active the ABS module also signals the TCM to prevent gear shifts.

EBA

EBA assists the driver, in emergency braking situations, by automatically maximizing the braking effort. There are two situations when the ABS module will invoke EBA: when the brake pedal is pressed very suddenly and when the brake pedal is pressed hard enough to bring the front brakes into ABS operation.

When the brake pedal is pressed very suddenly, the ABS module increases the hydraulic pressure to all of the brakes until they reach the threshold for ABS operation, thus applying the maximum braking effort for the available traction. The ABS module monitors for the sudden application of the brakes using the inputs from the stoplamp switch and from the pressure sensor in the HCU. With the brake pedal pressed, if the rate of increase of hydraulic pressure exceeds the predetermined limit, the ABS module invokes emergency braking.

When the brake pedal is pressed hard enough to bring the front brakes into ABS operation, the ABS module increases the hydraulic pressure to the rear brakes up to the ABS threshold.

EBA operation continues until the driver releases the brake pedal enough for the hydraulic pressure in the HCU to drop below a threshold value stored in the ABS module.

EDC

EDC prevents wheel slip caused by any of the following:

- A sudden decrease in engine torque when the accelerator is suddenly released.
- A downshift using the CommandShift™.

When the ABS module detects the onset of wheel slip without the brakes being applied, it signals the ECM, on the high speed CAN bus, to request a momentary increase in engine torque.

HDC

HDC uses brake intervention to control vehicle speed and acceleration during low speed descents in off-road and low grip on-road conditions. Generally, equal pressure is applied to all four brakes, but pressure to individual brakes can be modified by the ABS and DSC functions to retain stability. Selection of the HDC function is controlled by the HDC switch on the center console. HDC operates in both high and low ranges, at vehicle speeds up to 50 km/h (31.3 mph).

HDC may be used in D, R and CommandShift 1 in high range, and in D, R and all CommandShift gears in low range. When in D, the transmission control module will automatically select the most appropriate gear. The vehicle should not be driven with HDC active and the transmission in N.

HDC can be selected at speeds up to 80 km/h (50 mph), but will only be enabled at speeds below 50 km/h (31.3 mph). When HDC is selected:

- At speeds up to 50 km/h (31.3 mph), the HDC information indicator is permanently illuminated if a valid gear is selected.
- At speeds from >50 to 80 km/h (>31.3 to 50 mph) the HDC information indicator flashes and a message advising that the speed is too high is displayed in the message center.
  For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).
  If the HDC switch is pressed while vehicle speed is more than 80 km/h (50 mph), the HDC information indicator will not illuminate and HDC will not be selected.
- If the speed reaches 80 km/h (50 mph) or more, a warning chime sounds, the HDC function is switched off, the information indicator goes off and a message advising that HDC has been switched off is displayed in the message center.

When HDC is enabled, the ABS module calculates a target speed and compares this with the actual vehicle speed. The ABS module then operates the HCU, in the active braking mode, as required to achieve and maintain the target speed. During active braking for HDC, the ABS module also energizes the HDC relay to operate the stoplamps. Applying the foot brakes during active braking may result in a pulse through the brake pedal, which is normal.

The target speed varies, between minimum and maximum values for each gear and transmission range, depending on driver inputs through the foot pedals. If the foot pedals are not operated, the ABS module adopts a default target speed.

Low Range Target Speeds

Limit	Speed, km/h (mph)	
		Gear
	1, R	D, 2 to 6
Default	3.5 (2.19)	6 (3.75)
Minimum	3.5 (2.19)	3.5 (2.19)
Maximum	20 (12.5)	20 (12.5)

High Range Target Speeds

Limit	Speed, km/h (mph)

	Gear	
	1, R	D
Default	6 (3.75)	10 (6.25)
Minimum	6 (3.75)	6 (3.75)
Maximum	20 (12.5)	20 (12.5)

The target speed is varied between the minimum and maximum values using the accelerator pedal.

The target speed can also be varied by pressing the speed control '+' and '-' buttons (where fitted). For additional information, refer to:

Speed Control (310-03A Speed Control - 4.2L, Description and Operation),
Speed Control (310-03B Speed Control - 4.4L, Description and Operation),
Speed Control (310-03C Speed Control - 2.7L (TdV6) Diesel, Description and Operation).

During changes of target speed, the ABS module limits deceleration and acceleration to -0.5 m/s^2 (-1.65 ft/s^2) and +0.5 m/s^2 (+1.65 ft/s^2) respectively.

To provide a safe transition from active braking to brakes off, the ABS module invokes a fade out strategy, which gradually discontinues the braking effort, if it detects any of the following during active braking:

- HDC selected off with the HDC switch.
- Failure of a component used by HDC, but not critical to fade out function.
- Accelerator pedal pressed when transmission is in neutral.
- Brake overheat.

If fade out is invoked because of deselection or component failure, the HDC function is cancelled by the ABS module. If fade out is invoked because the accelerator pedal is pressed with the transmission in neutral, or because of brake overheat, the HDC function remains in standby and resumes operation when the accelerator pedal is released or the brakes have cooled.

The fade out strategy increases the target speed, at a constant acceleration rate of 0.5 m/s^2 (1.65 ft/s^2), until the maximum target speed is reached or until no active braking is required for 0.5 s. If the accelerator pedal is positioned within the range that influences target speed, the acceleration rate is increased to 1.0 m/s^2 (3.3 ft/s^2).

When fade out is invoked because of component failure, a warning chime sounds, the HDC information indicator is extinguished and a message advising there is a fault is displayed in the message center.

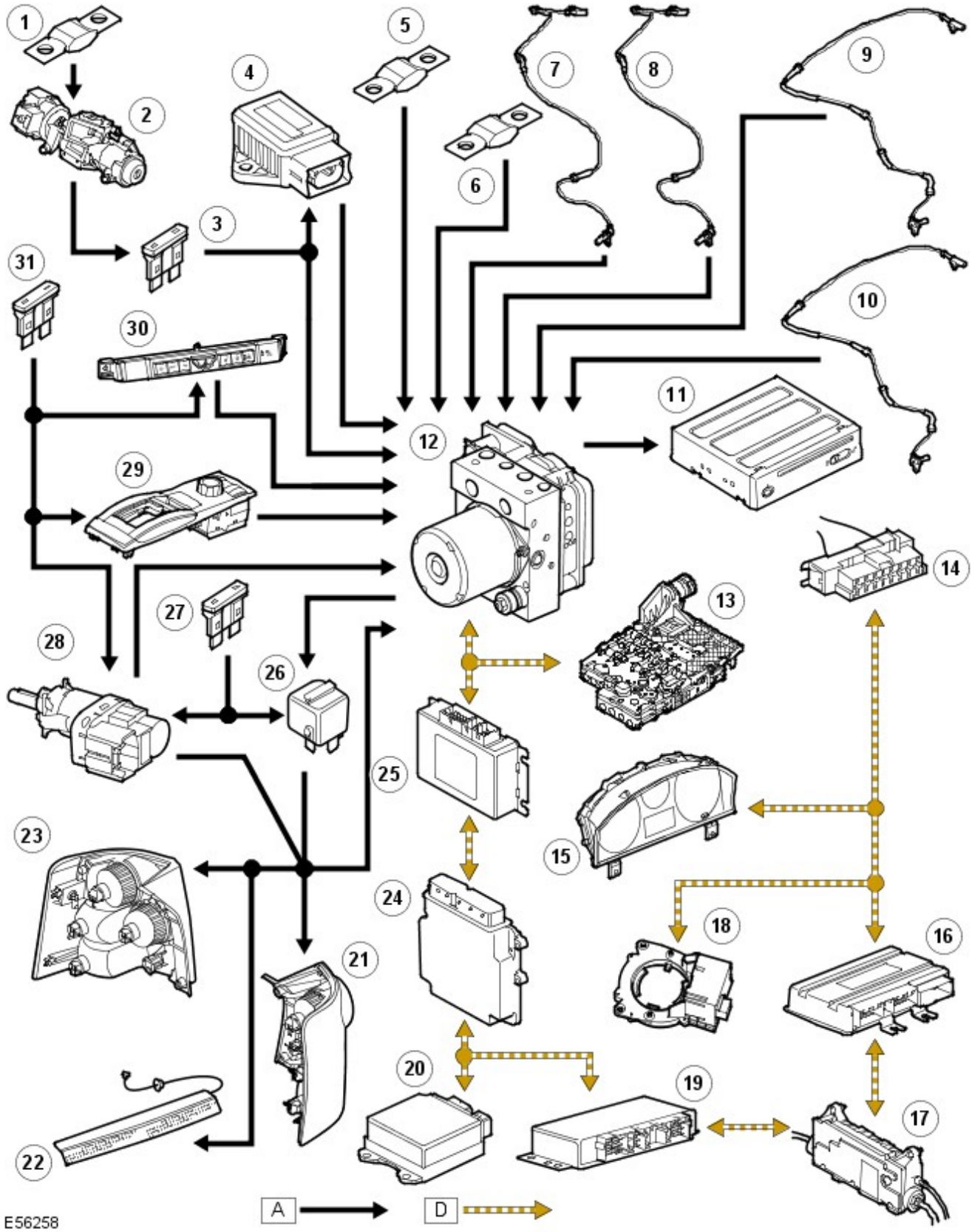
When fade out is invoked because of brake overheat, a message advising that HDC is temporarily unavailable is displayed. At the end of fade out, the HDC information indicator flashes. The message is displayed, while HDC remains selected, until the brakes have cooled.

To monitor for brake overheat, the ABS module monitors the amount of braking activity and, from this, estimates the temperature of each brake. If the estimated temperature of any brake exceeds a preset limit, the ABS module invokes the fade out strategy. After the fade out cycle, the HDC function is re-enabled when the ABS module estimates that all of the brake temperatures are at less than 64% of the temperature limit.

If there is a fault that affects the HDC function, or if the HDC function is temporarily unavailable because of brake overheat, an appropriate message is displayed in the message center.
For additional information, refer to: Instrument Cluster (413-01 Instrument Cluster, Description and Operation).

ANTI-LOCK CONTROL DIAGRAM

NOTE: A = Hardwired connection; D = High speed CAN bus



Item	Part Number	Description
1	-	Fusible link 11E, battery junction box (BJB)
2	-	Ignition switch
3	-	Fuse 37P, CJB
4	-	Yaw rate and lateral acceleration sensor
5	-	Fusible link 9E, BJB
6	-	Fusible link 23E, BJB
7	-	Front wheel speed sensor
8	-	Front wheel speed sensor
9	-	Rear wheel speed sensor
10	-	Rear wheel speed sensor

11	-	Navigation computer
12	-	ABS module
13	-	TCM
14	-	Diagnostic socket
15	-	Instrument cluster
16	-	Air suspension control module
17	-	Parking brake module
18	-	Steering angle sensor
19	-	Rear differential control module
20	-	restraints control module (RCM)
21	-	Left stoplamp
22	-	Center stoplamp
23	-	Right stoplamp
24	-	ECM
25	-	Transfer box control module
26	-	HDC relay (non-serviceable, integrated into CJB)
27	-	Fuse 15P, CJB
28	-	Stoplamp switch
29	-	HDC switch
30	-	DSC switch
31	-	Fuse 66P, CJB

Anti-Lock Control - Traction Control - Anti-Lock Control - Traction Control

Diagnosis and Testing

Principles of Operation

For a detailed description of the Anti-Lock Control- Traction Control System and operation, refer to the relevant Description and Operation section of the workshop manual. REFER to: Anti-Lock Control - Traction Control (206-09A Anti-Lock Control - Traction Control, Description and Operation).

Inspection and Verification

 CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

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

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

Visual Inspection

Mechanical	Electrical
• Tire size, condition and installation • Wheel speed sensor condition and installation • Steering Angle Sensor Module (SASM) condition and installation • Yaw rate sensor and accelerometer condition and installation • Hydraulic control unit (with attached anti-lock brake system control module) condition and installation	• Fuses • Harnesses and connectors • Warning indicator operation • Wheel speed sensors • Central Junction Box (CJB) • Hill Descent Control (HDC) switch • Dynamic Stability Control (DSC) switch • Stop lamp switch • Yaw rate sensor and accelerometer • Steering Angle Sensor Module (SASM) • Anti-lock Brake System control module (ABS) • Controller Area Network (CAN) circuits

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 Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

DTC Index

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

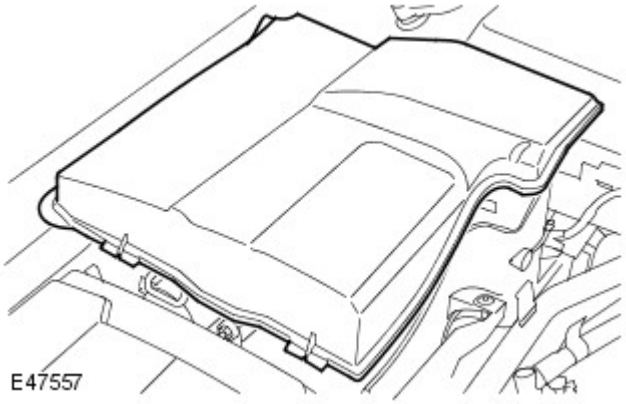
Anti-Lock Control - Traction Control - Anti-Lock Brake System (ABS) Module

Removal and Installation

Removal

CAUTION: Make sure the ignition switch is in position 0.

1. Remove the cover.



2. Disconnect the electrical connector.

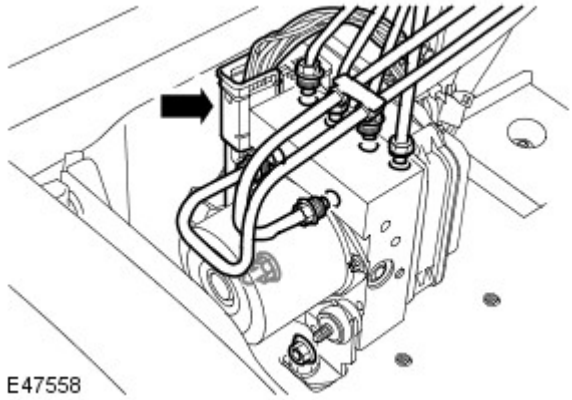
3. CAUTIONS:

   Brake fluid will damage paint finished surfaces. If spilled, immediately remove the fluid and clean the area with water.

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

   Disconnect the 6 brake tubes.
   - Position an absorbent cloth to collect fluid spillage.

4. Remove the ABS module from the mounting bracket.
   - Loosen, but do not remove, the 2 nuts securing the ABS module to the bracket.



Installation

1. NOTES:

   Make sure the ABS module locating grommet is correctly seated in the bracket before installing the ABS module.

   Make sure the ABS module locating pin is correcly located in the grommet, and the 2 front isolators are fully seated in the bracket slots.

   Install the ABS module.
   - Tighten the 2 ABS module retaining nuts to 8 Nm (6 lb.ft).

- Remove the blanking caps from the ports.
- Tighten the two M10 and three M12 brake tube unions to 15 Nm (11 lb.ft).
- Tighten the M14 brake tube union to 17 Nm (13 lb.ft).
- Connect the electrical connector.
- Remove the ABS module from the mounting bracket.

2. Using T4, bleed the braking system.
   For additional information, refer to: Brake System Bleeding - Vehicles With: Standard Brakes (206-00, General Procedures) / Brake System Bleeding - Vehicles With: High Performance Brakes (206-00, General Procedures).

3. Install the cover.

4. If a new ABS module has been installed, interrogate the ABS system using T4.

Anti-Lock Control - Traction Control - Front Wheel Speed Sensor

Removal and Installation

Removal

All vehicles

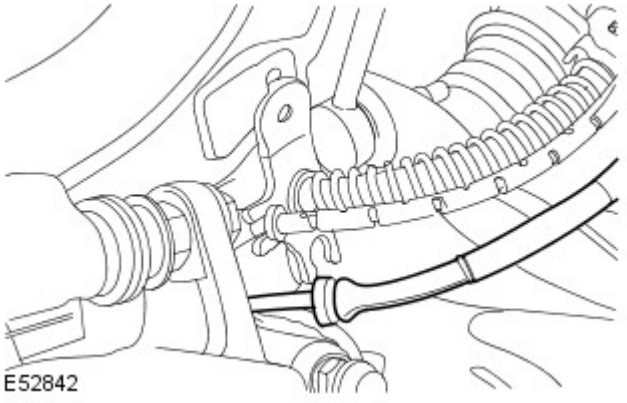
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

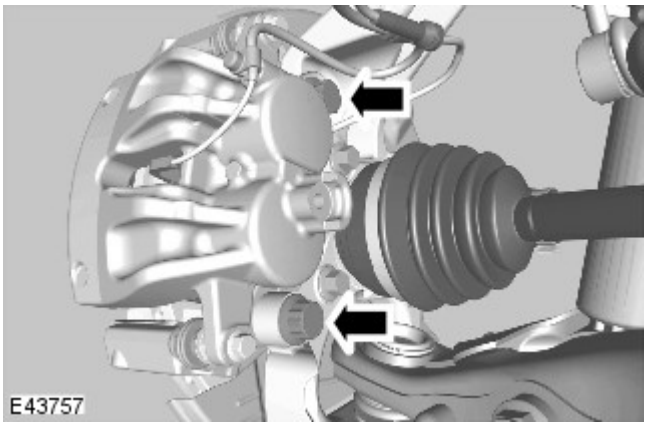
2. Remove the front wheel and tire.

3. Remove the fender splash shield.
   For additional information, refer to: Fender Splash Shield (501-02, Removal and Installation).

4. Release the wheel speed sensor lead from the brake hose retaining bracket.



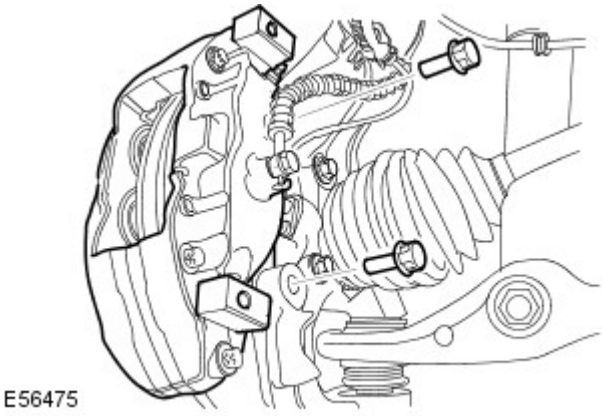
Vehicles with standard brakes



5. CAUTION: Do not allow the brake caliper to hang on the brake hose.

   Release the brake caliper anchor plate from the wheel knuckle and tie the caliper aside.
   - Remove the 2 retaining bolts.

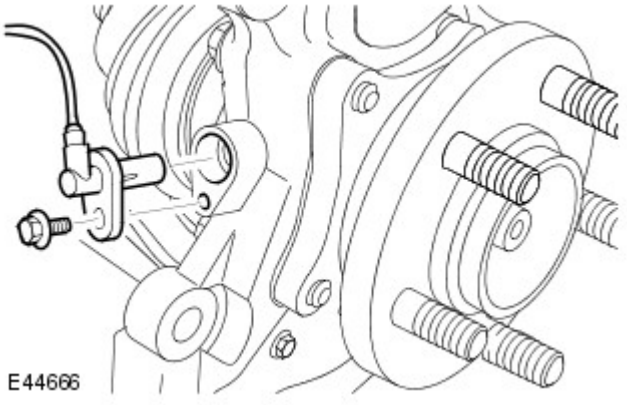
Vehicles with high performance brakes



6. CAUTION: Do not allow the brake caliper to hang on the brake hose.

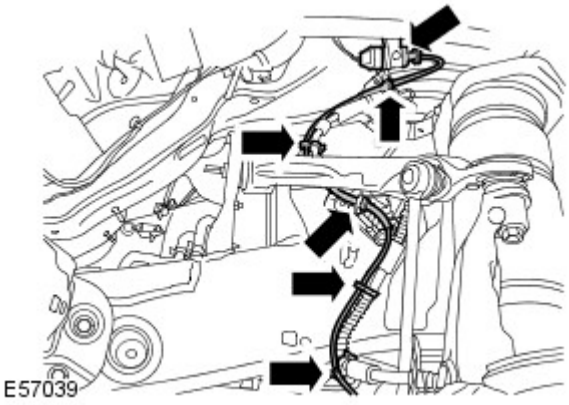
   Release the brake caliper from the wheel knuckle.
   - Remove the 2 retaining bolts.
   - Tie the brake caliper aside.

All vehicles



7. NOTE: The brake disc is shown removed for clarity.

   Release the wheel speed sensor from the wheel knuckle.
   - Remove the bolt.



8. Remove the wheel speed sensor.
   - Disconnect the electrical connector.
   - Release the wiring harness from the clips.

Installation

All vehicles

1. Make sure the wheel speed sensor location in the wheel knuckle is free of dirt.

2. NOTE: Make sure the electrical connector retaining clip is attached to the body wiring harness.

   Install the wheel speed sensor.
   - Tighten the bolt to 9 Nm (7 lb.ft).
   - Connect the electrical connector.
   - Secure the wiring harness in the clips.

Vehicles with standard brakes

3. Secure the brake caliper and anchor plate to the wheel knuckle.
   - Tighten the bolts to 275 Nm (203 lb.ft).

Vehicles with high performance brakes

4. Secure the brake caliper to the wheel knuckle.
   - Tighten the bolts to 275 Nm (203 lb.ft).

All vehicles

5. Secure the wheel speed sensor lead to the brake hose retaining bracket.

6. Install the fender splash shield.
   For additional information, refer to: Fender Splash Shield (501-02, Removal and Installation).

7. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

Anti-Lock Control - Traction Control - Rear Wheel Speed Sensor

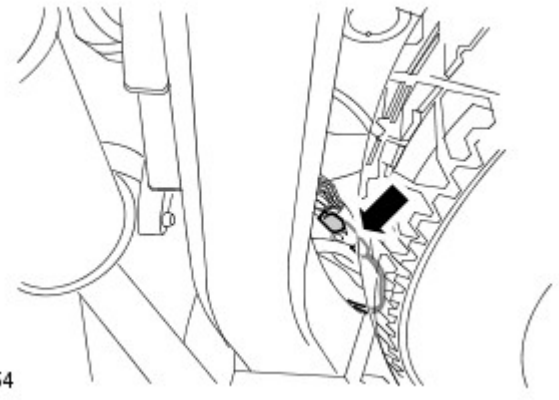
Removal and Installation

Removal

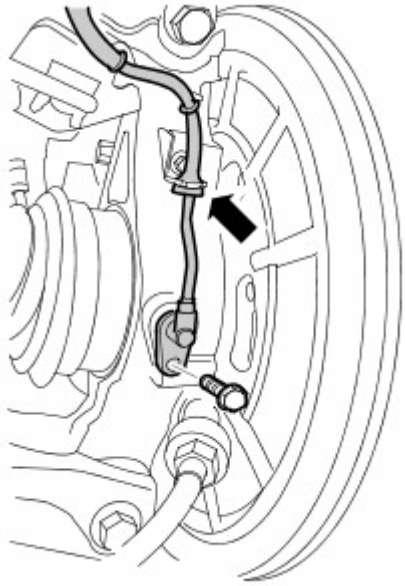
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

2. Remove the wheel and tire.

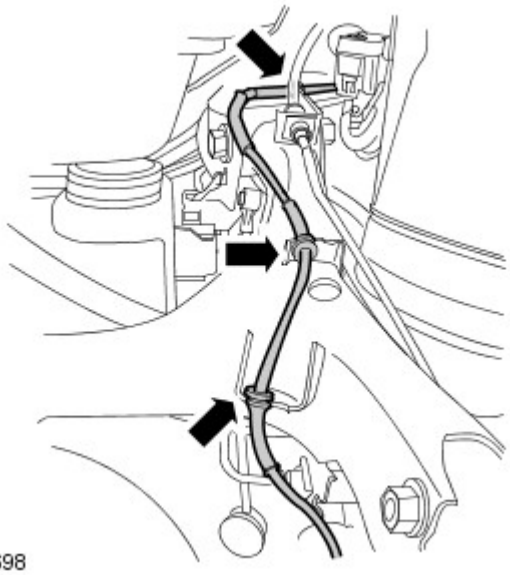

E52454

3. Disconnect the anti-lock brake system (ABS) sensor electrical connector.
   - Release the wiring harness retaining clip.


E56445

4. Release the wheel speed sensor from the wheel knuckle.
   - Release the wiring harness.
   - Remove the retaining bolt.

5. Remove the wheel speed sensor.
   - Release the wiring harness from the 4 clips.



Installation

1. Make sure the wheel speed sensor location in the wheel knuckle is free of dirt.

2. Install the wheel speed sensor.
   - Attach the wiring harness to the 4 clips.

3. Secure the wheel speed sensor to the wheel knuckle.
   - Tighten the bolt to 9 Nm (7 lb.ft).
   - Attach the wiring harness to the clip.

4. NOTE: Make sure the electrical connector retaining clip is attached to the body wiring harness.

   Connect the ABS sensor electrical connector.
   - Attach the wiring harness.

5. If a new wheel speed sensor has been installed, interrogate the ABS system using T4.

Anti-Lock Control - Stability Assist -

General Specification

Item	Specification
Yaw Rate Sensor	Bosch DRS MM1.OR

Torque Specifications

Description	Nm	lb-ft
Yaw rate sensor bolts	10	7

Anti-Lock Control - Stability Assist - Anti-Lock Control - Stability Assist

Diagnosis and Testing

For additional information.
REFER to: Anti-Lock Control - Traction Control (206-09A Anti-Lock Control - Traction Control, Diagnosis and Testing).

Anti-Lock Control - Stability Assist - Yaw Rate Sensor

Removal and Installation

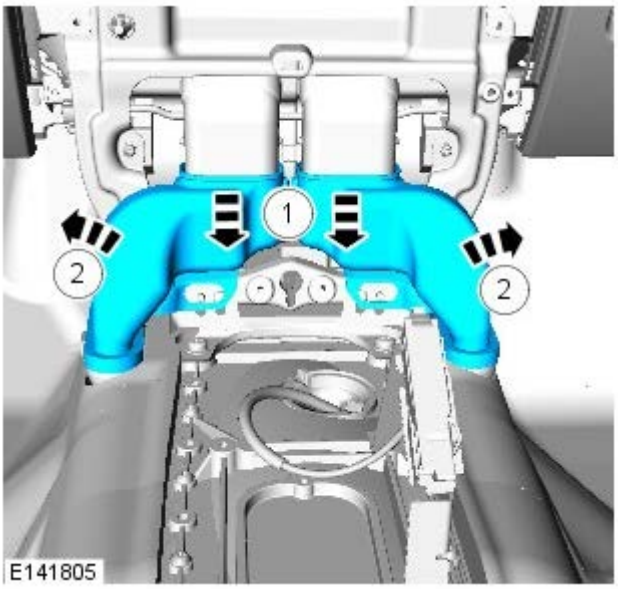
Removal

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

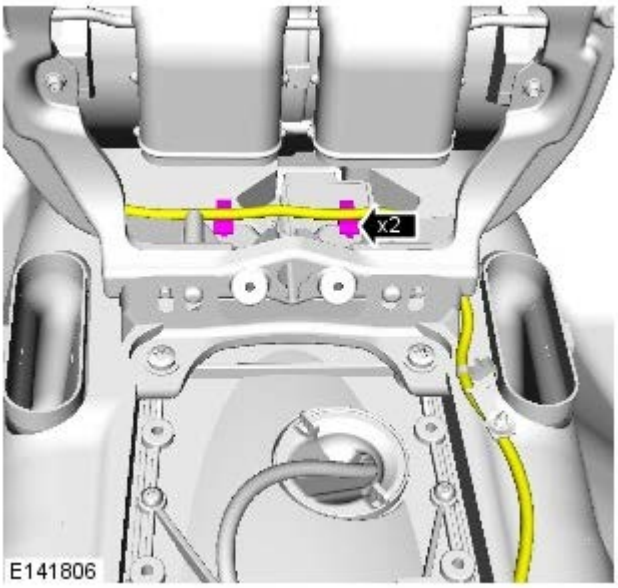
2. Remove the floor console.
   For additional information, refer to: Floor Console (501-12 Instrument Panel and Console, Removal and Installation).

3. Remove the instrument panel center reinforcement.
   For additional information, refer to: Instrument Panel Center Reinforcement (501-12 Instrument Panel and Console, Removal and Installation).

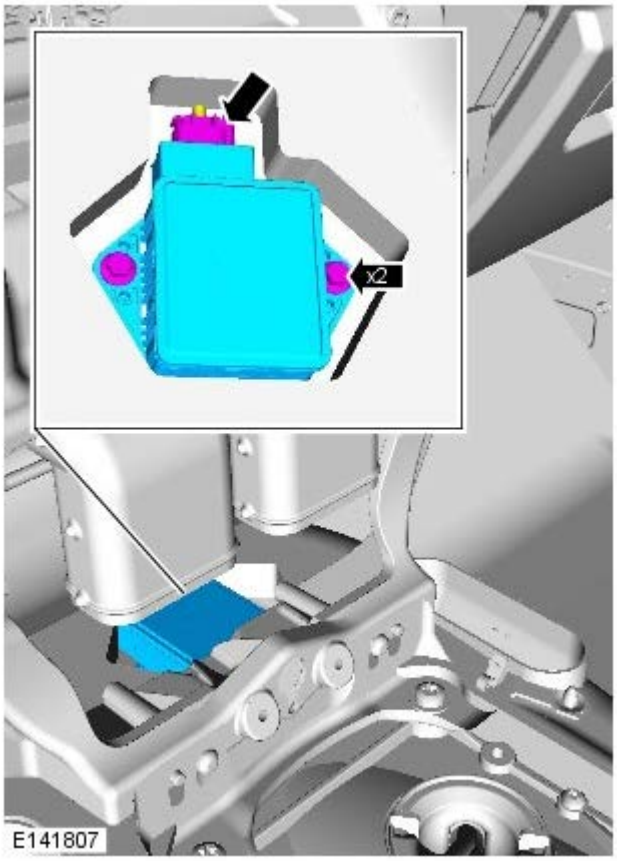
4.



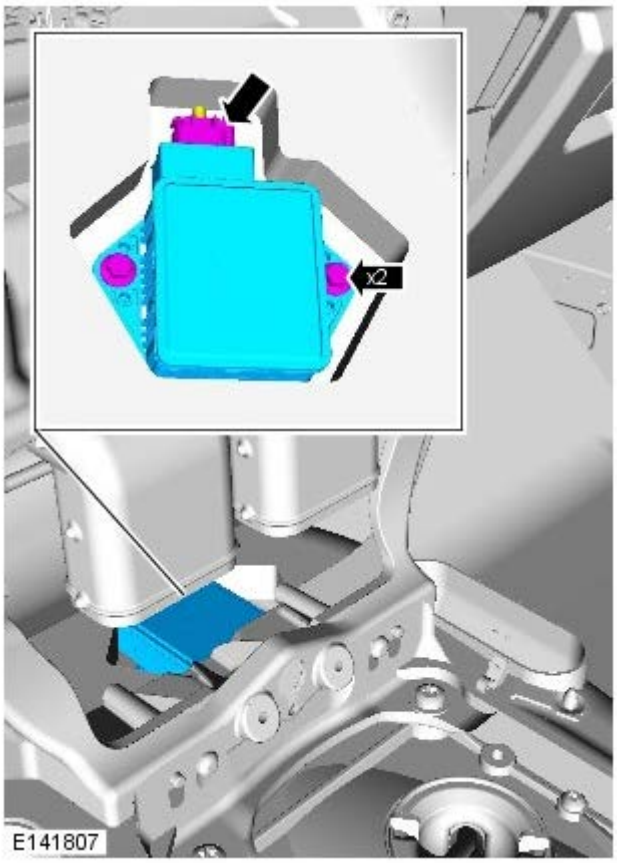
5.



6. Remove the yaw rate sensor.

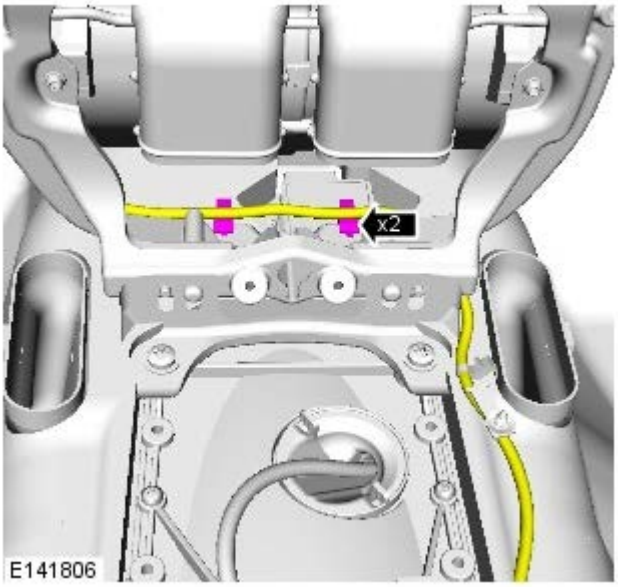


Installation

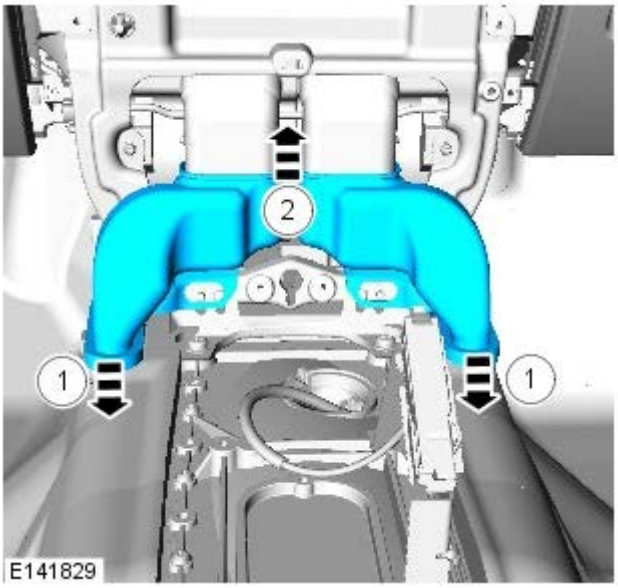


1. Install the yaw rate sensor.
    - Install the 2 bolts and tighten to 7 Nm (5 lb.ft).

2.



3.



4. Install the instrument panel center reinforcement.
   For additional information, refer to: Instrument Panel Center Reinforcement (501-12 Instrument Panel and Console, Removal and Installation).

5. Install the floor console.
   For additional information, refer to: Floor Console (501-12 Instrument Panel and Console, Removal and Installation).

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

Steering System - General Information - Steering System

Diagnosis and Testing

Principles of Operation

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

Power Steering (211-02 Power Steering, Description and Operation),
Steering Linkage (211-03 Steering Linkage, Description and Operation),
Steering Column (211-04 Steering Column, Description and Operation).

Inspection and Verification

CAUTION: Diagnosis by substitution from a donor vehicle is **NOT** acceptable. Substitution of control modules does not guarantee confirmation of a fault and may also cause additional faults in the vehicle being checked and/or the donor vehicle.

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

1. Verify the customer concern.
   - If a road test is necessary make sure the vehicle is safe to do so.
2. Visually inspect for obvious signs of mechanical or electrical damage.

Visual Inspection

Mechanical	Electrical
• Check the tires for correct pressure, size and tread pattern • Check for wheel rim and tire damage • Check road wheel security • Check the power steering fluid level and the hydraulic circuit for oil leaks • Check the power steering pump drive belt condition and tension • Check the power steering pump for security, wear, damage and excessive noise • Check the steering gear assembly for damage, wear and security • Check the hydraulic pipes and cooler lines for damage and correct routing • Check the steering joints for damage, excessive play, wear and security • Check the steering column and joints for damage, excessive play, wear and security	• Steering Angle Sensor Module (SASM) and circuits • Controller Area Networks (CAN) circuits

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the cause is not visually evident, verify the symptom and refer to the Symptom Chart, alternatively check for Diagnostic Trouble Codes (DTCs) and refer to the DTC Index.

Symptom Chart

Symptom	Possible Causes	Action
Steering wanders	• Excessive free play in the steering system • Steering geometry incorrectly aligned	• Check for excessive movement or play in the steering system with the engine running. Check for play at several different steering positions • Carry out steering geometry and alignment checks. Refer to the relevant section of the workshop manual
Steering pulls to the left or right	• Steering geometry incorrectly aligned	• Carry out steering geometry and alignment checks using a four wheel alignment system. Ensure that the tire direction of rotation is correct for the position on the vehicle (where directional tires are installed)
Steering feels notchy when turning from lock to lock Steering feels tight and does not self-centre	• Steering or suspension swivel joints seized • Steering tie rod end joints or track rod inner joints seized • Steering	• Disconnect the steering gear from the suspension. Check for freedom of movement in the suspension • Disconnect the steering column from the steering gear. Check the steering column and universal joints for freedom of movement • Check the steering gear for freedom of movement. Rectify as necessary

	• column or universal joints seized • Steering gear internal components misaligned, worn or damaged	
Power steering hydraulics noisy operation	• Power steering fluid level low or contaminated • Incorrect specification of power steering fluid • Filter in the power steering reservoir blocked • Power steering fluid aerated • Power steering hoses twisted or restricted	• Check and top-up the power steering fluid level if required, using the correct specification of fluid • Check for contaminated fluid • Drain the fluid from the reservoir and visually inspect the filter for obstructions/blockage. Repair/renew as necessary • Check for air ingress into the system • Check the power steering hoses for twisting or restrictions. Rectify as necessary
Power steering pump noisy	• Power steering fluid level low or contaminated • Filter in the power steering reservoir blocked • Pump internal components worn or damaged	• Check and top-up the power steering fluid level if required • Check for contaminated fluid • Drain the fluid from the reservoir and visually inspect the filter for obstructions/blockage. Repair/renew as necessary • Check for excessive pump noise. Rectify as necessary
Power steering gear noisy	• Power steering fluid level low or contaminated • Steering gear internal components worn or damaged	• Check and top-up the power steering fluid level if required. Refer to the relevant section of the workshop manual. Check for contaminated fluid • Check for excessive steering gear noise. Rectify as necessary
Steering column noisy	• Steering column fouling or universal joints dry	• Check the steering column and universal joints. Rectify as necessary
Power steering feels heavier than normal through its operating range	• Lack of power assistance	• Check the power steering pump pressure. Check the steering column has no damage and rotates freely
Power steering feels too light at speed		
Power steering feels too heavy at standstill and low speed		

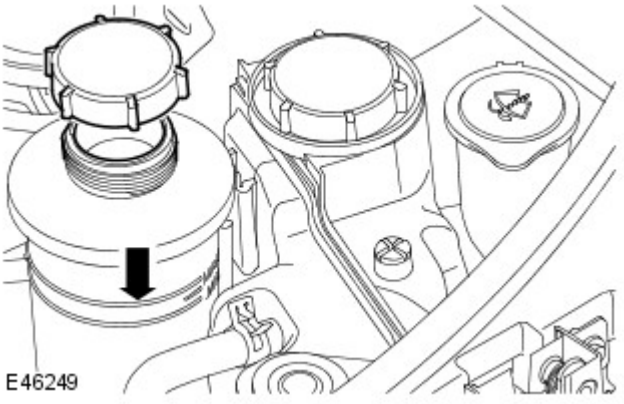
DTC Index

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: Steering Angle Sensor Module (SASM) (100-00 General Information, Description and Operation) / Diagnostic Trouble Code (DTC) Index - DTC: Electric Steering Column Lock Control Module (ESCL) (100-00 General Information, Description and Operation).

Steering System - General Information - Power Steering System Filling and Bleeding

General Procedures

1. Check the power steering fluid level.



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

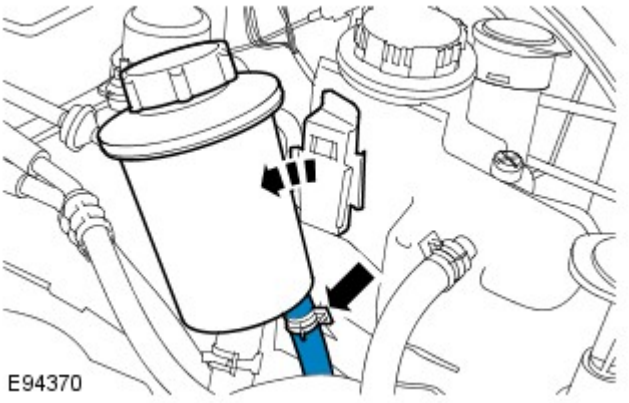
General Procedures

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.

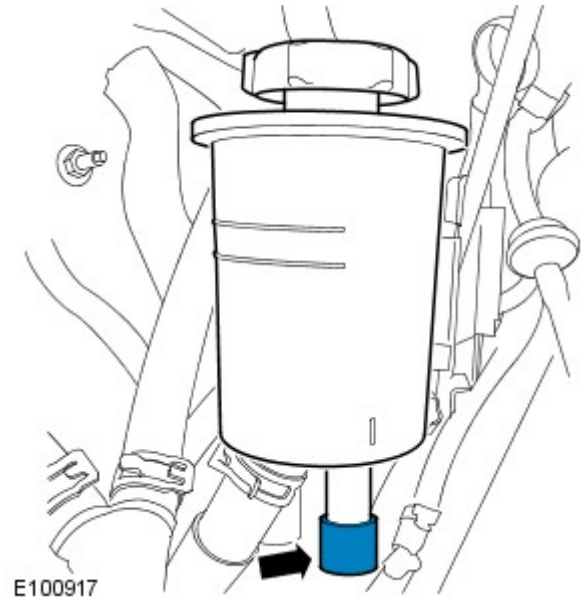
1. Remove the power steering fluid reservoir cap.
2. Using a suitable syringe, remove the power steering fluid from the power steering fluid reservoir.



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.

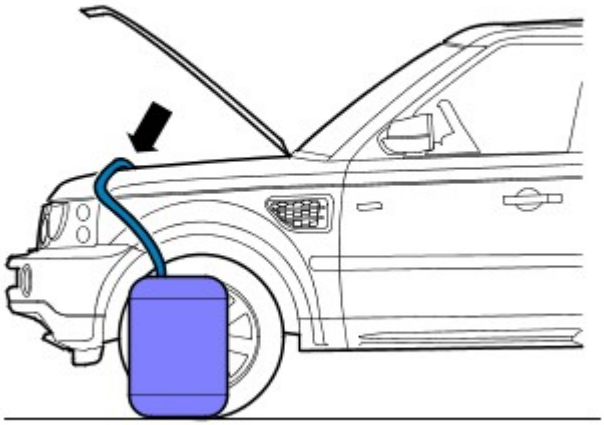
   NOTE: Make sure that all openings are sealed. Use new blanking caps.

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

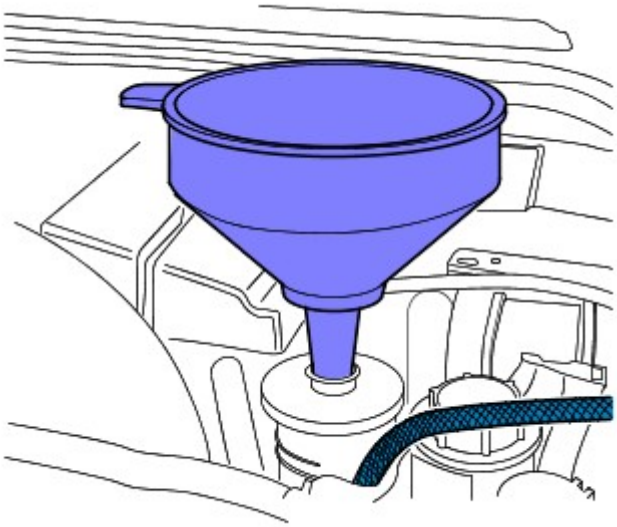
5. CAUTION: Be prepared to collect escaping fluids.

   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.



E100918



E94372

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.

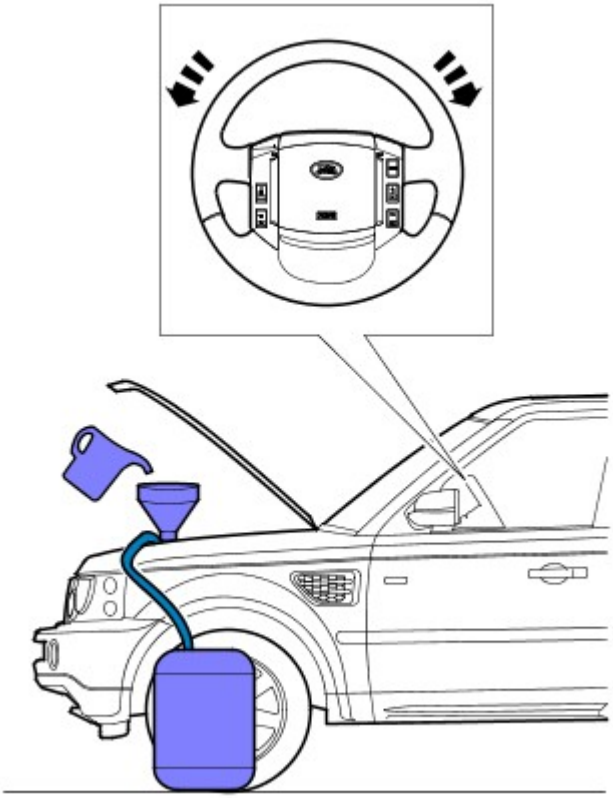
   Be prepared to collect escaping fluids.

   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.

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



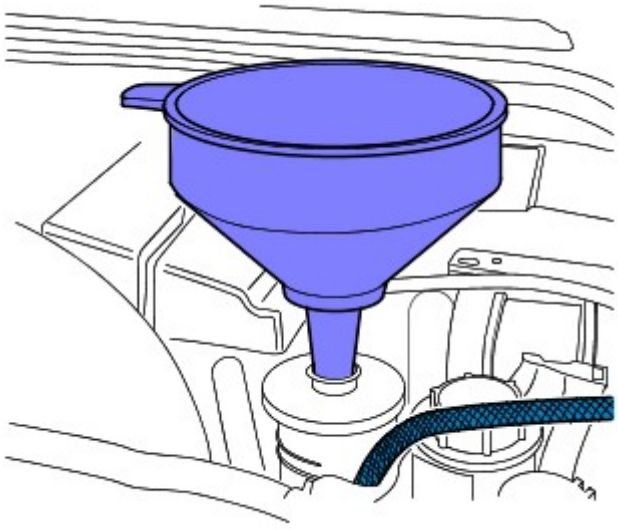
E94373

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.



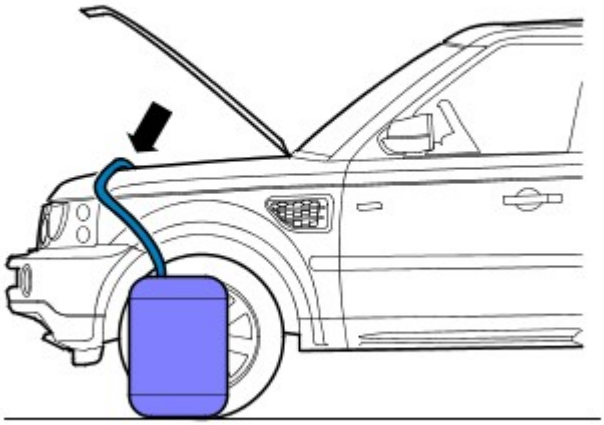
E94372

10. CAUTION: Be prepared to collect escaping fluids.

    Remove the suitable funnel.

11. CAUTION: Be prepared to collect escaping fluids.

    Remove the suitable pipe to the power steering return hose.



E100918

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: Power Steering Fluid Reservoir (211-02, Removal and Installation).

Power Steering -

Recommended Fluid

Item	Specification
Fluid	Texaco Cold Climate Fluid 33270

General Specification

Item	Specification
Type	Power assisted rack and pinion, speed proportional with belt driven pump, remote hydraulic fluid reservoir and fluid cooler
Steering wheel diameter	395 mm (15.55 in)
Number of turns - lock to lock	3.1
System ratio	Variable - 19.5:1 on center
Pump relief valve operating pressure	
Petrol vehicles	114 ± 4 bar (11400 ± 400 kPa) (1653 ± 58 lb/in²)
Diesel vehicles	115 ± 4 bar (11500 ± 400 kPa) (1668 ± 58 lb/in²)
Fluid flow rate - constant	
For all petrol vehicles and V6 diesel	8.8 ± 0.5 liter/min (15.4 ± 0.8 pints/min) (9.2 ± 0.5 US quarts/min)
V8 diesel vehicles	9.5 ± 0.5 liter/min (16.7 ± 0.8 pints/min) (10 ± 0.5 US quarts/min)
Steering rack travel	158 mm (6.22 in)
Piston diameter	50 mm (1.93 in)
Rack bar diameter	30 mm (1.18 in)

Description	Nm	lb-ft
High-pressure line to pump bolt	25	18
Steering gear mounting bolts	175	129
High-pressure line to steering gear support bracket bolt	10	7
Power steering return line support bracket.	10	7
* High-pressure line and return line to steering gear bolt	22	16
Power steering Pump bolts	23	17
* Lower steering column universal joint to steering gear bolt	24	18

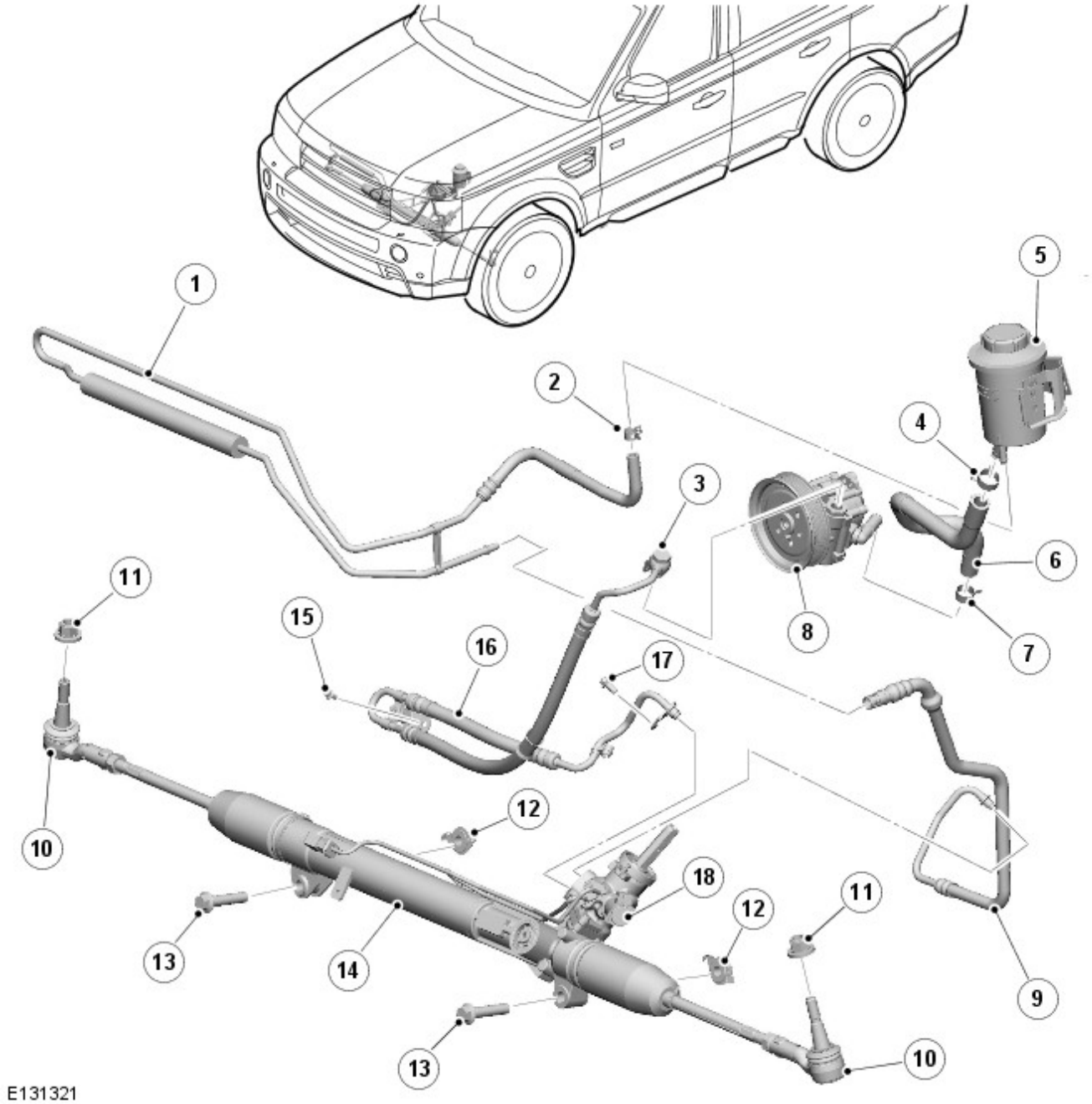
*** New bolt/nuts must be installed**

Power Steering - Power Steering

Description and Operation

COMPONENT LOCATION

NOTE: Petrol version shown



Item	Part Number	Description
1	-	Fluid cooler and hose assembly - Fluid return (petrol models only)
2	-	Spring clip
3	-	Banjo bolt
4	-	Spring clip
5	-	Reservoir
6	-	Suction hose - Reservoir to pump
7	-	Spring clip
8	-	Power steering pump
9	-	Hose assembly - Steering gear to cooler - Fluid return
10	-	Tie rod end (2 off)
11	-	Locknut (2 off)
12	-	Caged nut (2 off)
13	-	Bolt (2 off)

14	-	Steering gear
15	-	Screw
16	-	Hose - pump to steering gear - Fluid pressure
17	-	Screw
18	-	Servotronic valve

OVERVIEW

The steering system comprises a ZF manufactured rack and pinion Servotronic 2 steering gear, a power steering pump, a reservoir, a fluid cooler 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.

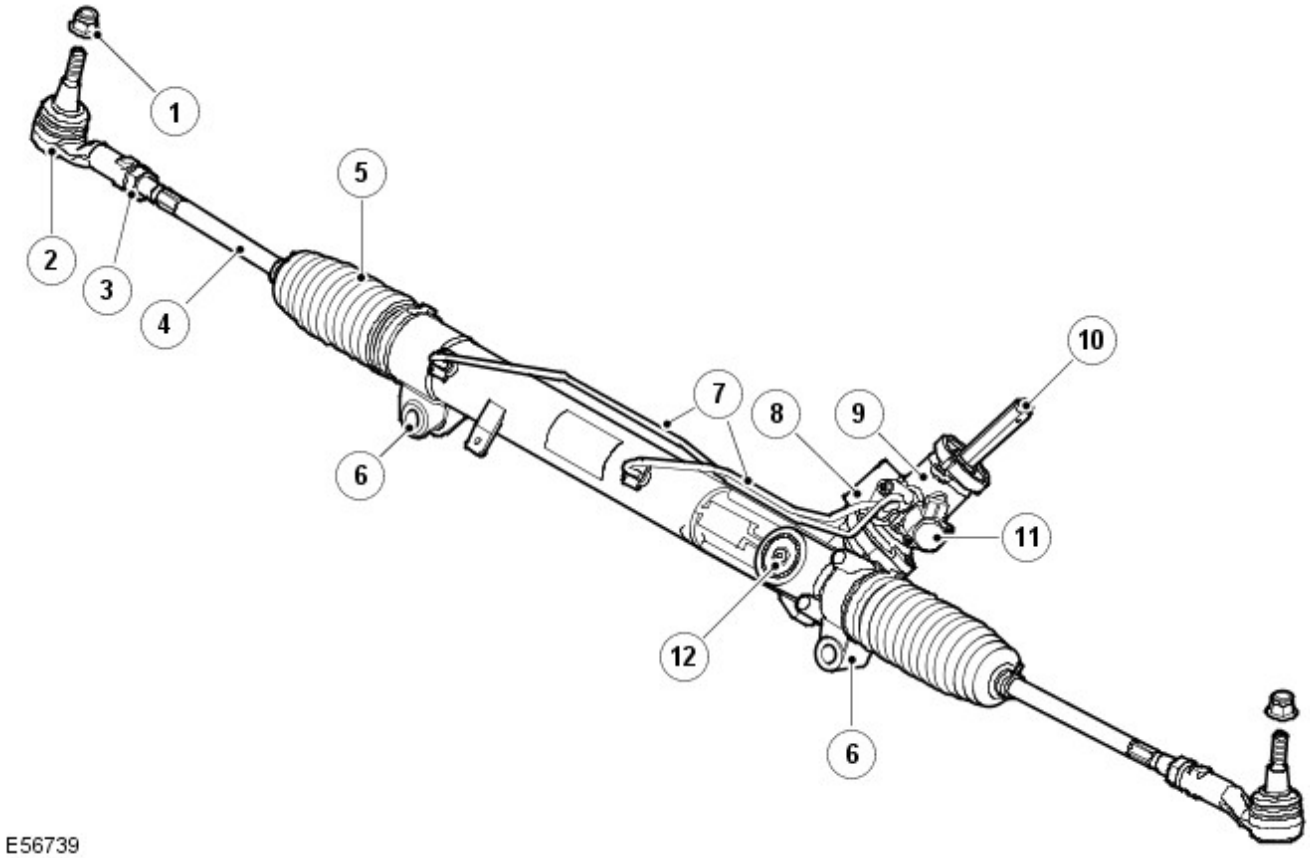
Servotronic 2 adds electronic control and speed sensitive steering to the steering gear. The Servotronic 2 feature provides easy and comfortable steering operation when parking, improved 'road feel' at increased road speeds and adds an integrated, positive centre feel feature which optimises steering wheel torque during high speed driving.

The Servotronic 2 system is controlled by software which is incorporated into the air suspension control module. The software responds to steering torque inputs and road speed signals and controls the assistance via a transducer valve located on the steering gear valve.

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 steer as the turning angle increases. The variable ratio provides precise and rapid steering response at high speeds and optimizes the steering of the vehicle when manoeuvring into parking spaces, turning in tight areas and when cornering in extreme conditions.

The steering gear rack has a travel of 158 mm (6.22 in). Lock to lock requires 3.167 revolutions of the steering wheel which gives a ratio of 45 mm (1.77 in)/revolution at the centre position and 52.6 mm (2.07 in)/revolution at end of lock.

STEERING GEAR



E56739

Item	Part Number	Description
1	-	Locknut
2	-	Tie-rod end
3	-	Locknut
4	-	Tie rod
5	-	steering gear boot
6	-	Steering gear casing attachment lugs
7	-	Pressure/return pipes
8	-	Pressure/return connection from/to pump
9	-	Valve unit housing
10	-	Input shaft

11	-	Servotronic valve
12	-	Pinion housing

The steering gear is located at the front of the engine, below the accessory belt drive. The gear is attached to two brackets on the chassis and is secured to the brackets with flanged bolts and caged nuts. The cage prevents the nuts from turning when the bolts are loosened or tightened. The cage nuts can only be used once and must be replaced when the gear is removed. For service, M12 Nylock nuts are available as a replacement for the cage nuts.

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 power unit are located in a tubular 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 pinion and is initiated by the valve unit. This movement is transferred into movement of the road wheels by adjustable tie-rods.

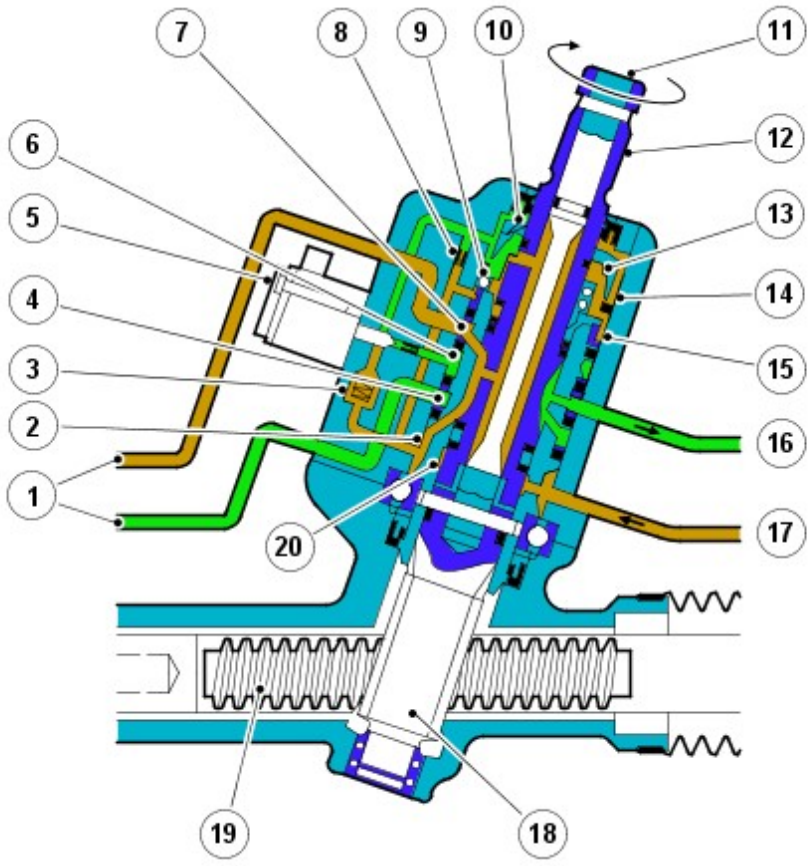
The rack teeth angles vary from 20 degrees in the centre position to 40 degrees at the end sections of the rack. It is this variation in teeth angles which provides the variable ratio.

The 50 mm (1.97 in) diameter piston of the hydraulic power unit is located at one end of the cylinder. 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 gear has a threaded hole which provides for the fitment of the tie-rod. The external ends of the gear are sealed with steering gear 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 is achieved, a locknut is tightened against the tie-rod end preventing inadvertent movement.

The gear has a central hole machined along part 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 zip ties.

Valve Unit



E56740

Item	Part Number	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	-	Pressure supply from pump
17	-	Return to reservoir
18	-	Pinion
19	-	Steering gear rack
20	-	Valve sleeve

The valve unit is an integral part of the steering gear. The principle function of the valve unit is to provide maximum power assistance (i.e. when parking) with minimum 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 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 to maintain the optimum phase angle. 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 central diameter of 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.

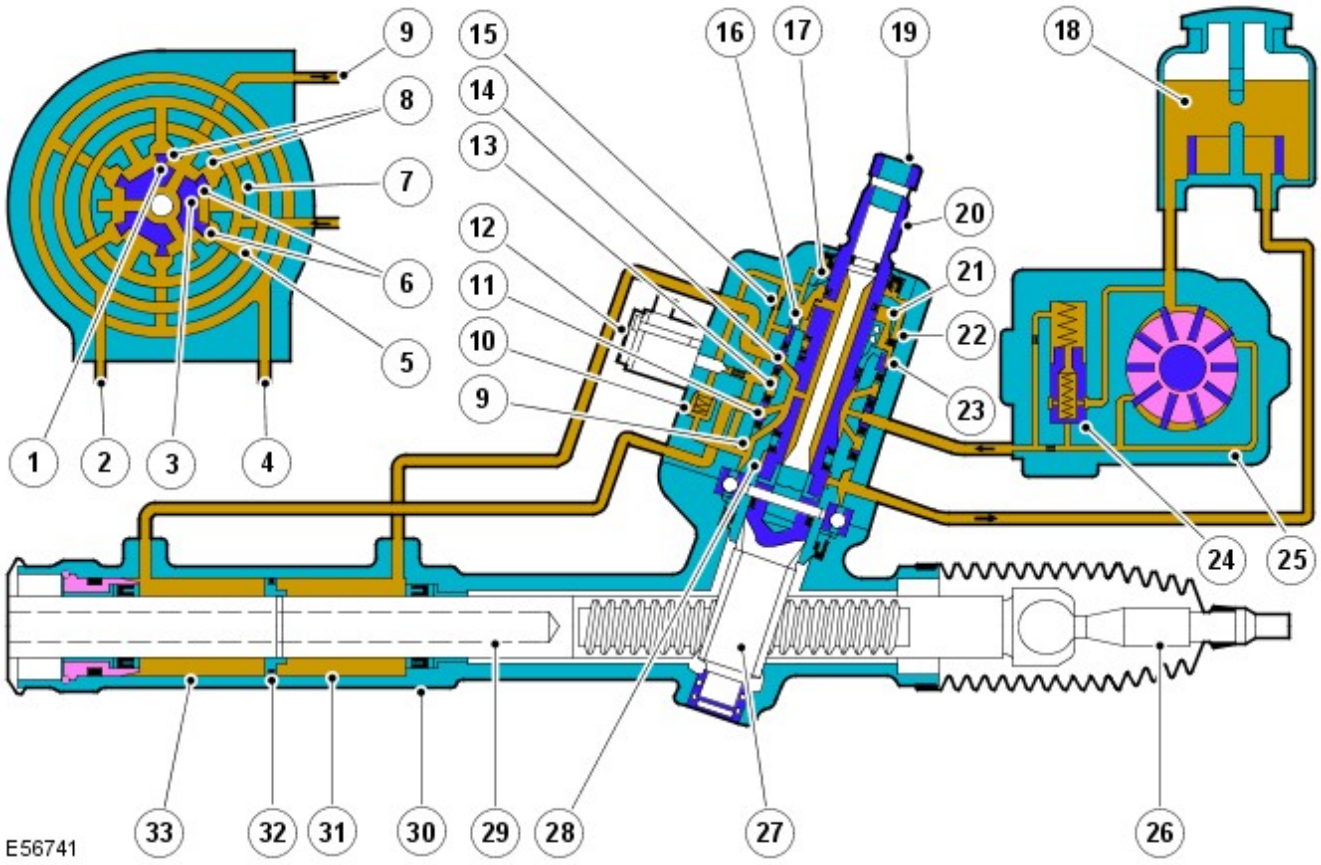
The pinion shaft has machined upper teeth on its central diameter which mate with teeth on the steering gear rack. A slot, machined in the upper end of the pinion shaft mates with the dog-tooth on the input shaft. The pinion shaft locates in the pinion housing and rotates on ball and roller bearings.

Power Steering Hydraulic 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

 NOTE: Circuit shows steering rotary valve in neutral position with the vehicle not moving.



Item	Part Number	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 track rod
27	-	Pinion
28	-	Valve sleeve
29	-	Steering gear
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, via a hose, to the steering rack valve unit.

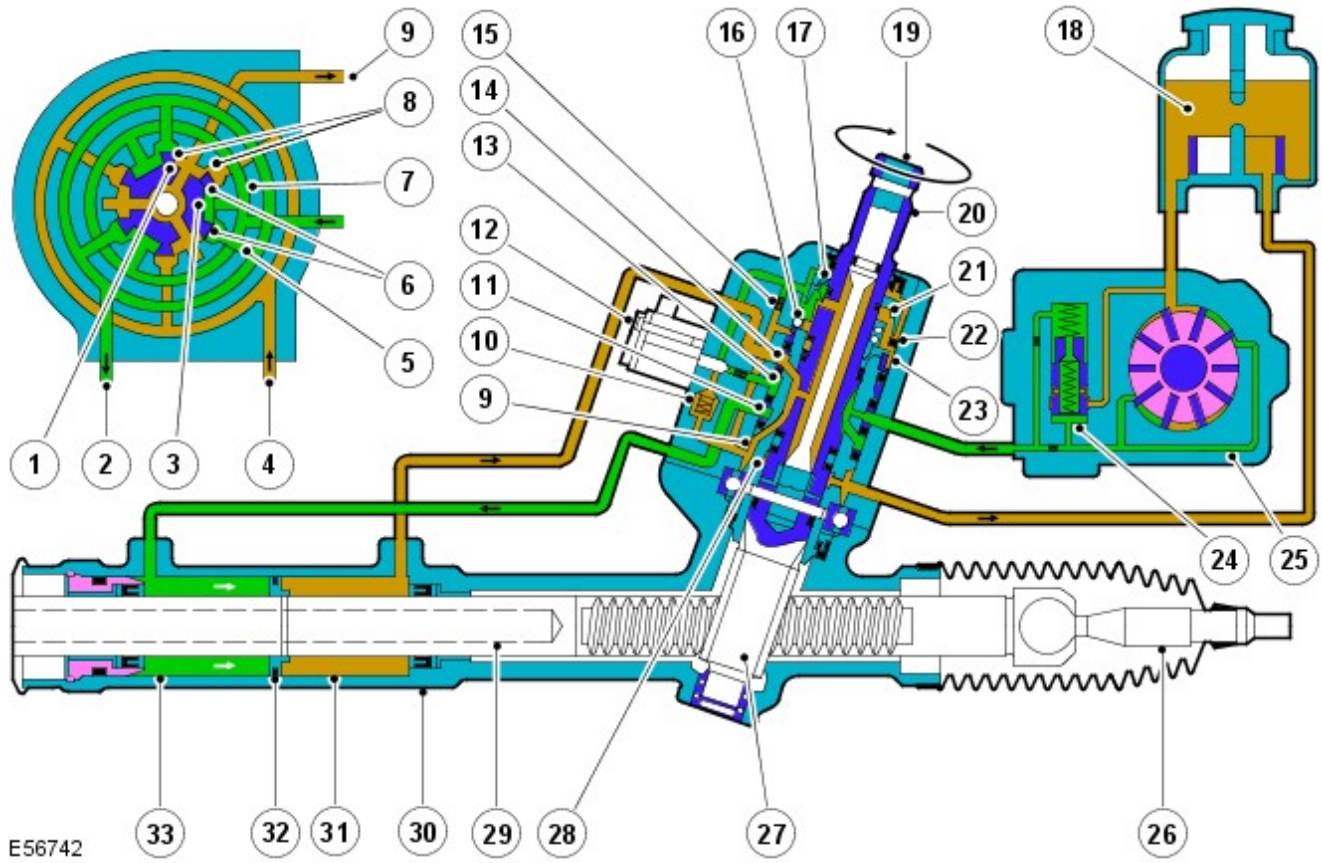
The pressurized fluid flows through a connecting bore in the valve and, via the feed fluid radial groove and the transverse bores in the valve sleeve, passes to the feed fluid control groove of the valve rotor.

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 the open return fluid control edges and the return fluid control grooves of the valve rotor. The fluid then passes via connecting bores to the return fluid chamber and to the reservoir via an external hose.

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

Power Steering in Right Turn Position

NOTE: Circuit shows steering rotary valve in right turn position, at high vehicle speed and with rapid steering corrections. The Servotronic transducer valve is fully open and the maximum hydraulic reaction is limited by the cut-off valve.



Item	Part Number	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	-	Power steering fluid reservoir
19	-	Torsion bar

20	-	Valve rotor
21	-	Reaction piston
22	-	Reaction chamber
23	-	Centering piece
24	-	Pressure relief/flow limiting valve
25	-	Power steering pump
26	-	Inner track rod
27	-	Pinion
28	-	Valve sleeve
29	-	Steering gear
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 right in the piston bore. The valve rotor is rotated to the right (clockwise) which directs pressurized fluid over the further opened feed fluid control edges and 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 VALVE

The Servotronic transducer valve is located in a port on 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 the body control module.

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 minimum 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 body control module contains a microprocessor which receives road speed signals from the ABS module and calculates the correct controlling signal for the Servotronic valve. The Servotronic software within the control module has a diagnostic capability which allows T4 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 body control module contains a number of steering maps which are selected via the car configuration file depending on the vehicle model, tire fitment and fitment of Dynamic Response.

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

Servotronic Operation

When the vehicle is manoeuvred into and out of a parking space (or other similar manoeuvre), the Servotronic function of the body control module uses road speed data from the ABS module to determine the vehicle speed, which in this case will be slow or stationary. The control module microprocessor 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.

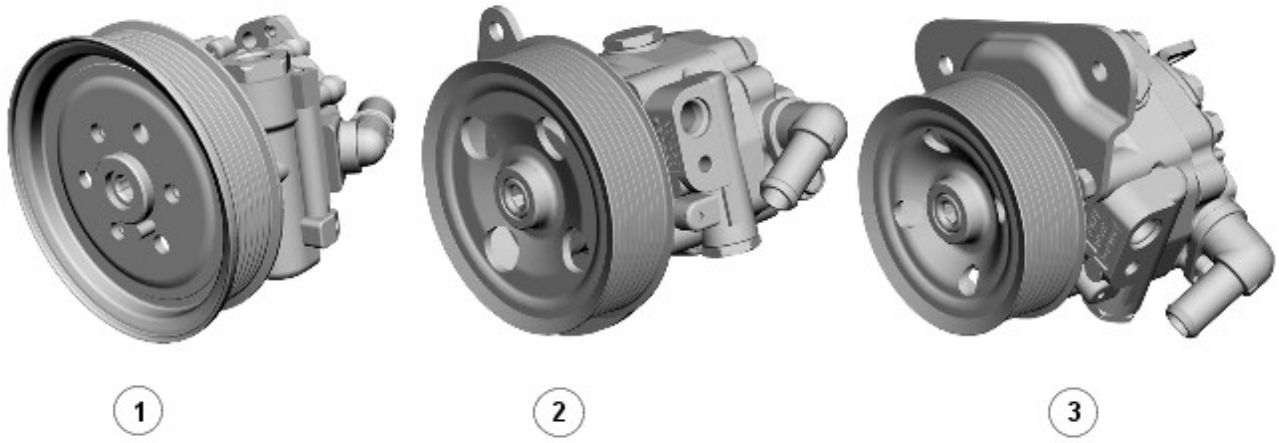
As the vehicle is driven and the road speed increases, the body control module microprocessor analyses the road speed signals from the ABS module and reduces the amount of control current supplied to the Servotronic valve. The Servotronic valve reacts to the control current and opens the valve by an amount appropriate to the road speed. This allows a controlled fluid supply from the feed fluid radial groove to the reaction chamber. The orifice prevents the loss of large amounts of fluid to the return fluid chamber. The higher fluid pressure acting on the reaction piston causes compression of the balls which are located between the reaction piston and the centering piece which in turn is securely connected to the valve sleeve. When driving in a straight line, this has a positive effect on the exact centralising of the steering valve. When the steering valve is actuated, the balls, with a higher load on them, provide additional torsional resistance to rotation of the valve rotor. This mode of Servotronic assistance requires an established higher steering wheel torque until the hydraulic assistance required in the left or right power assist

cylinder is determined.

At high driving speeds, i.e. on a motorway, the Servotronic valve is fully open due to a very low or non-existent control current supplied from the body control module. This enables maximum pressure supply from the feed fluid radial groove to the reaction piston.

When the steering wheel is turned, the reaction pressure increases appropriate to the existing operating pressure and pressurizes the piston in the reaction chamber. As soon as the reaction pressure reaches its upper limit, the fluid is discharged to the return fluid chamber via the cut-off valve and prevents further increases in reaction pressure. This maintains the input torque applied through the steering wheel and provides the driver with an improved 'road feel' allowing precise steering and directional stability.

POWER STEERING PUMP



E131322

Item	Part Number	Description
1	-	5.0L V8
2	-	3.0L TdV6
3	-	3.6L TdV8 (from 2007MY)

The power steering pumps used are basically the same pump with different connection fitments, therefore they are not interchangeable.

Power Steering Pump - Petrol Engines

The pump is a fixed displacement, vane type pump which supplies hydraulic pressure 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 flow control valve which also incorporates a pressure relief valve. The pressure relief valve limits the maximum pressure supplied to the steering gear to 115 bar (1667 lbf in^2) ± 4 bar (58 lbf in^2). The flow control valve limits the maximum flow to 8.8 l/min (1.93 gal/min) ± 0.5 l/min (0.1 gal/min) regardless of engine speed. The pump has a displacement of 11 cc/rev (0.67 in^3/rev).

A shaft runs longitudinally through the pump. One end of the shaft is bolted on the 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 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 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 activates only to limit the maximum system 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.

Power Steering Pump - Diesel Engines

The pump is a variable displacement, vane type pump which 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 a Poly Vee belt which is directly driven from the crankshaft. 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 115 bar (1667 lbf in^2) ± 4 bar (58 lbf in^2). The flow control valve limits the maximum flow as follows:

- TdV6 - 8.8 l/min (1.93 gal/min) ± 0.5 l/min (0.1 gal/min) at 10 bar (145 lbf in^2)
- TdV8 - 9.5 l/min (2.09 gal/min) ± 0.5 l/min (0.1 gal/min) at 10 bar (145 lbf in^2).

Both pumps have a displacement of 9.6 cc/rev (0.58 in^3/rev).

The output from the pump increases proportionally with the load applied to the steering valve unit. Inside the pump, a cartridge set consisting of 11 vanes and a rotor is mounted on the input shaft and is surrounded by the variable displacement cam.

The variable displacement pump maintains a constant fluid output by varying the internal displacement of the pump, unlike a conventional fixed displacement pump which has to use a flow control valve to recirculate the excess flow within the pump. At low engine speeds, the internal displacement of the variable displacement pump is at its maximum to generate the controlled fluid output.

As the pump speed increases with engine speed, the increased flow inside the pump generates a back pressure within the pump. This back pressure causes the cam ring to move and reduce the internal displacement of the pump to maintain the constant fluid flow from the pump. As the internal displacement of the pump decreases, the power and torque required to drive the pump reduces, which leads to improved fuel economy.

RESERVOIR



E46941

The fluid reservoir is located on a bracket in the left hand side of the engine compartment, behind the radiator. The reservoir comprises a body, cap and filter. The purpose of the reservoir is to contain a surplus of the hydraulic fluid in the system to allow for expansion and contraction of the fluid due to temperature variations. The fluid level ensures that the supply connection on the bottom of the reservoir is covered with fluid at all operating vehicle attitudes. Any air which is present in the system is exhausted from the system in the reservoir.

The body is a plastic moulding with two ports at the bottom which provide for the connection of the suction supply and return hoses. Moulded markings on the side of the reservoir denote the upper and lower fluid levels. A non-serviceable, 100 micron nylon mesh filter is fitted in the body. The filter removes particulate matter from the fluid before it is drawn into the pump supply connection.

The cap is rotated counterclockwise for one quarter turn to release from the body. The cap is fitted with an O-ring to prevent fluid leakage. The cap incorporates a breather hole to allow for changes in fluid level during operation and prevent vacuum or pressurization of the reservoir.

HIGH PRESSURE HOSE

The high pressure hose connecting the pump to the steering gear valve unit contains two attenuators. Each attenuator has a restrictor which is secured inside the hose. The restrictors damp pressure pulses from the pump, consequently reducing noise and strain on downstream components. The attenuators are an integral part of the hose and cannot be serviced separately.

FLUID COOLER

NOTE: Diesel engine vehicles are not fitted with a fluid cooler.

The fluid cooler is located in the return line from the steering gear to the reservoir. The cooler comprises a flexible hose and a solid pipe which connect between the reservoir and the return pipe from the steering gear. The cooler is an integral part of the pipe and cannot be replaced as a separate component.

The cooler is a fabricated aluminum tube, through which the power steering fluid passes. The outer diameter of the cooler tube has aluminum loops attached to it which dissipate heat. Cool air entering the front of the vehicle passes over the cooler and flows through the loops. The loops act as heat exchangers, conducting heat from the fluid as it passes through the tube.

Power Steering - Power Steering

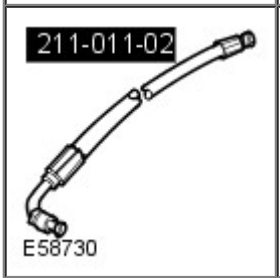
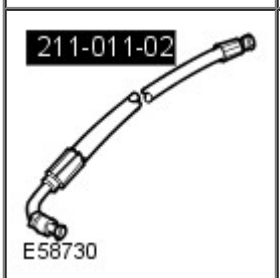
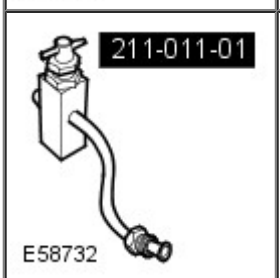
Diagnosis and Testing

For additional information.
REFER to: Steering System (211-00, Diagnosis and Testing).

Power Steering - Power Steering Pressure Test TDV6 3.0L Diesel / TDV8 3.6L Diesel

General Procedures

Special Tool(s)

	Adaptor, power steering pressure test 211-011-14
	Hose - power steering pressure test 211-011-02(LRT-57-002)
	Hose - power steering pressure test 211-011-02(LRT-57-002)
	Valve block power steering test 211-011-01(LRT-57-001)
	Hose and gauge - power steering pressure test 211-287(LRT-57-005)

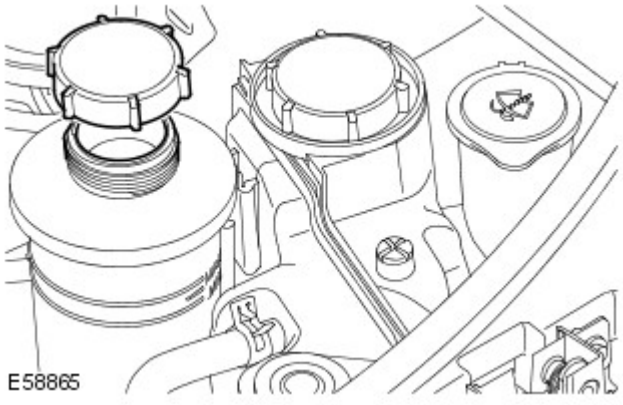
CAUTION: If power steering fluid comes into contact with the paintwork, the affected area must be immediately washed down with cold water.

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

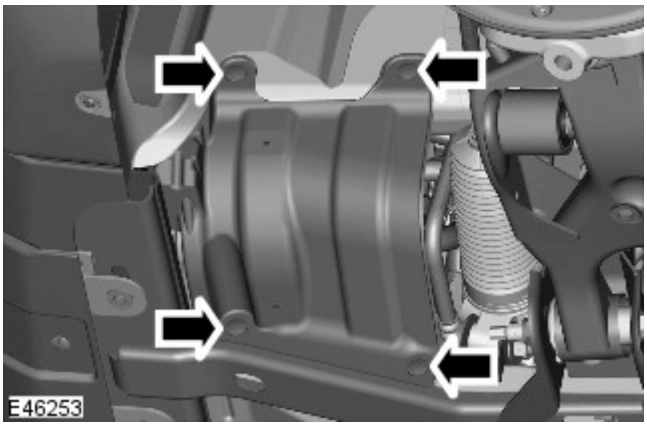
   Raise and support the vehicle.

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

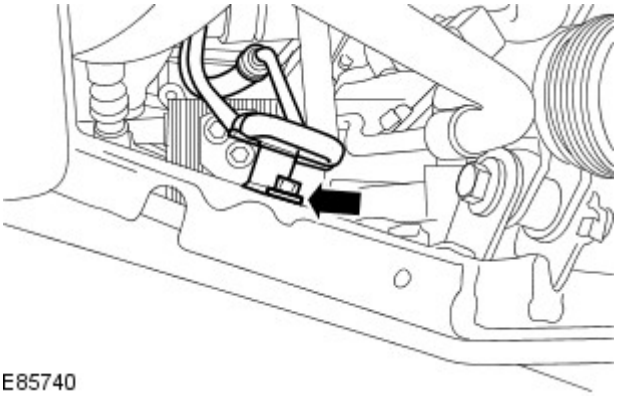
3. Siphon the fluid from the power steering reservoir.
   - Remove the filler cap.



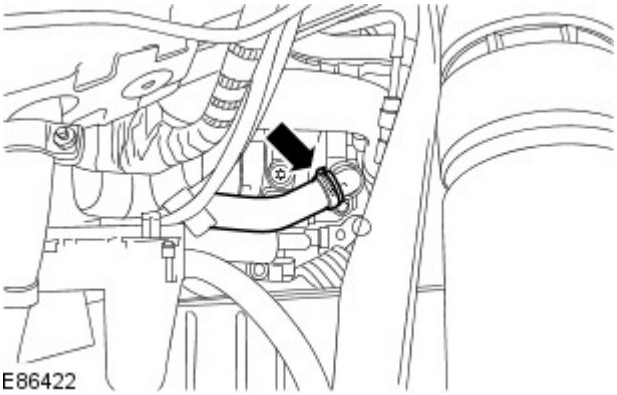
4. Remove the front LH splash shield.
   - Remove the 4 clips.



5. Release the steering gear high-pressure line.
   - Remove the bolt.



6. Remove the front LH fender splash shield.
   For additional information, refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).



7. CAUTIONS:

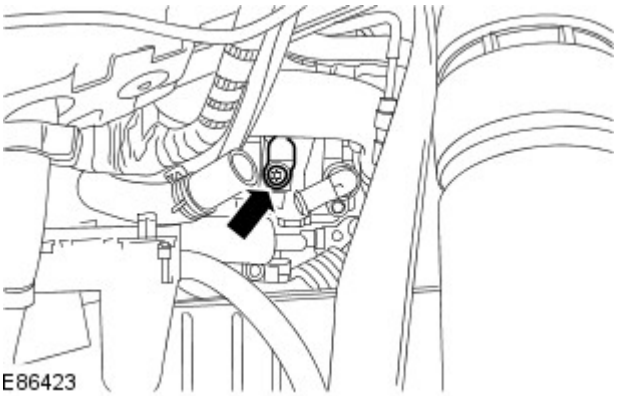
   Make sure that all openings are sealed. Use new blanking caps.

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

   Disconnect the power steering pump supply hose.
   - Release the clip.
   - Position a container to collect the fluid.

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

   Disconnect the power steering pump high-pressure line.
   - Remove the bolt.



9. Install the special tools.
    - Tie the pressure gauge aside.

10. NOTE: Remove and discard the blanking caps.

    Connect the power steering pump supply hose.
    - Secure with the clip.

11. Fill the power steering reservoir.

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

13. NOTES:

    Make sure the steering components and test equipment are free from leaks.

    Maintain the maximum fluid level during the test.

    Make sure the steering is in the straight ahead position.

    Under no circumstances must the low pressure spigot be removed from the steering pump.

    With the test valve open start the engine.
    - Start the engine and turn steering fully lock to lock, stop the engine.
    - Top-up the power steering fluid reservoir.
    - Install the reservoir filler cap.

14. For correct power steering pressures, refer to the steering specification section.
    For additional information, refer to: Specifications (211-02 Power Steering, Specifications).

15. CAUTION: Do not hold steering at full lock for longer than 10 seconds.

    With the engine at idle, slowly turn the steering wheel and hold on full lock.
    - Record the pressure reading.

16. Repeat the above procedure for the other side.
    - Record the pressure reading.

17. With the engine at idle, release the steering wheel. The pressure should be, at or below, the pressure specified.

18. Pressure outside this tolerance, indicates a fault.

19. CAUTION: Pump damage will occur if test valve is closed

for longer periods.

To determine if the fault is in the steering pump or the steering rack, close the test valve for a maximum of 5 seconds.

20. If the pressures recorded fall outside the given values, replace the power steering pump.

21. If the maximum pump pressure is correct, check the hoses for correct routing and condition, if correct suspect the steering gear.

22. On completion of the test stop the engine, disconnect the battery ground cable and siphon the steering fluid from the reservoir.

23. CAUTIONS:

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

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

Disconnect the power steering pump supply hose.
- Release the clip.

24. Disassemble the test equipment.

25. Connect the power steering pump high-pressure line.
    - Tighten the bolt to 25 Nm (18 lb.ft).

26.  NOTE: Remove and discard the blanking caps.

Connect the power steering pump supply hose.
- Secure with the clip.
- Remove the container.

27. Secure the steering gear high-pressure line.
    - Tighten the bolt to 10 Nm (7 lb.ft).

28. Install the front LH splash shield.
    - Install the clips.

29. Install the front LH fender splash shield.
    For additional information, refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

30. Connect the battery ground cable.

31. Fill and bleed the power steering system.
    For additional information, refer to: Power Steering System Filling and Bleeding (211-00 Steering System - General Information, General Procedures).

Power Steering - Power Steering Pressure Test V8 5.0L Petrol/V8 S/C 5.0L Petrol

General Procedures

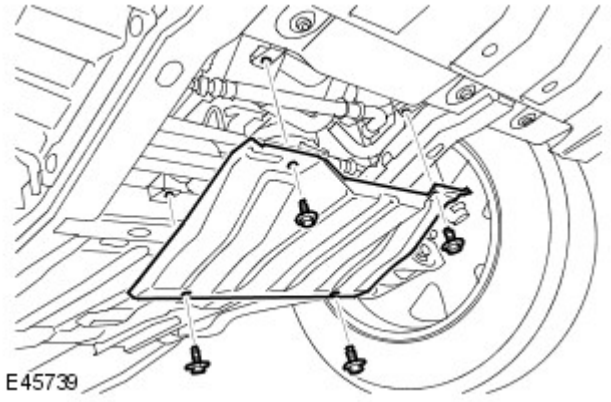
Special Tool(s)

	Adapter, power steering test 211-313 (LRT-57-035A)
	Hose, power steering test 211-011-02 (LRT-57-002)
	Hose, power steering test 211-011-11
	Valve block, power steering test 211-011-01 (LRT-57-001)
	Hose and gauge, power steering test 211-287 (LRT-57-005)
	Adapter, power steering test 211-325 (LRT-57-042)

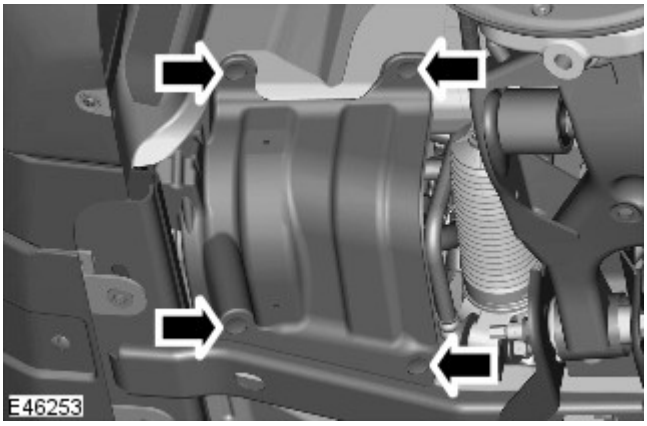
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

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

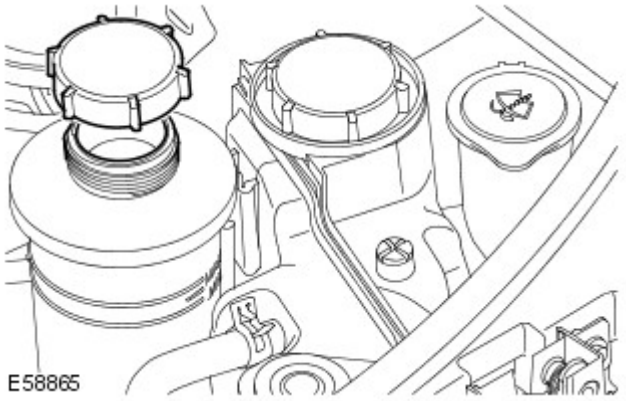


3. Remove the radiator access panel.
   - Remove the 4 bolts.



4. Remove the front LH splash shield.
   - Remove the 4 clips.

5. Remove the front LH fender splash shield.
   For additional information, refer to: Fender Splash Shield (501-02, Removal and Installation).



6. Siphon the fluid from the power steering reservoir.
   - Remove the filler cap.
   - Install the filler cap.

7. Position an absorbent cloth to collect fluid spillage.

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

   NOTES:

   Some fluid spillage is inevitable during this operation.

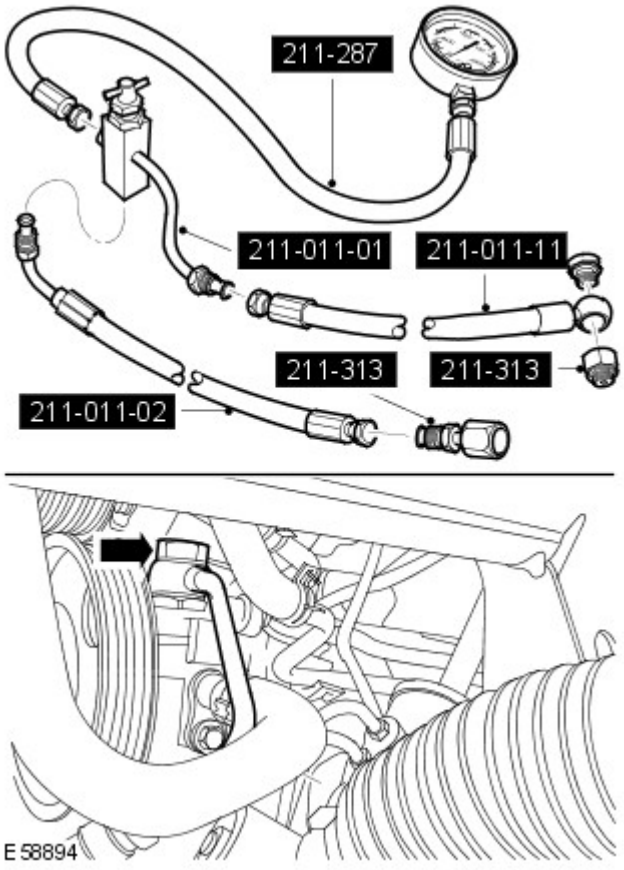
   Care must be taken to avoid contamination of the drive belt.

   Disconnect the power steering high-pressure pipe union.
   - Remove the bolt.
   - Remove and discard the 2 sealing washers.
   - Position a container to collect the fluid.

9. Install the special tools to the power steering high-pressure

port.
- Install the O-ring seal.
- Tie the pressure gauge aside under the hood.

10. Install the special tool to the high-pressure union.
    - Install the O-ring seals.
    - Connect the special tool line, to the special tool valve block assembly.



11. Refill the power steering reservoir.
    - Remove the filler cap.

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

13. NOTES:

    Ensure the steering components and test equipment are free from leaks.

    Maintain the maximum fluid level during the test.

    Make sure the steering is in the straight ahead position.

    Under no circumstances must the low pressure spigot be removed from the steering pump.

    With the test valve open start the engine.
    - Start the engine and turn steering fully lock to lock, stop the engine.
    - Top-up the power steering fluid reservoir.
    - Install the reservoir filler cap.

14. For correct power steering pressures, refer to the steering specification section. For additional information, refer to: Specifications (211-02, Specifications).

15. With the engine at idle, slowly turn the steering wheel and hold on full lock.
    - Record the pressure reading.

16. Repeat the above procedure for the other side.
    - Record the pressure reading.

17. With the engine at idle, release the steering wheel. The pressure should be, at or below, the pressure specified.

18. Pressure outside this tolerance, indicates a fault.

19. To determine if the fault is in the steering pump or the steering rack, close the test valve for a maximum of 5 seconds.

20. If the pressures recorded fall outside the given values, replace the power steering pump.

21. If the maximum pump pressure is correct, then suspect the power steering rack.

22. On completion of the test stop the engine, disconnect the battery ground cable and siphon the steering fluid from the reservoir.
    - Remove the filler cap.
    - Install the filler cap.

23. Disassemble the test equipment.

24. Connect the high-pressure line to the power steering pump.
    - Clean the component mating faces.
    - Install the new O-ring seals.
    - Tighten the bolt to 25 Nm (18 lb.ft).

25. Install the front LH fender splash shield.
    For additional information, refer to: Fender Splash Shield (501-02, Removal and Installation).

26. Install the front LH splash shield.
    - Secure with the clips.

27. Install the radiator access panel.
    - Tighten the M6 bolts to 10 Nm (7 lb.ft).
    - Tighten the M10 bolts to 45 Nm (33 lb.ft).

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

29. Refill and bleed the power steering.
    For additional information, refer to: Power Steering System Filling and Bleeding (211-00, General Procedures).

Power Steering - Power Steering Control Valve Actuator
Removal and Installation

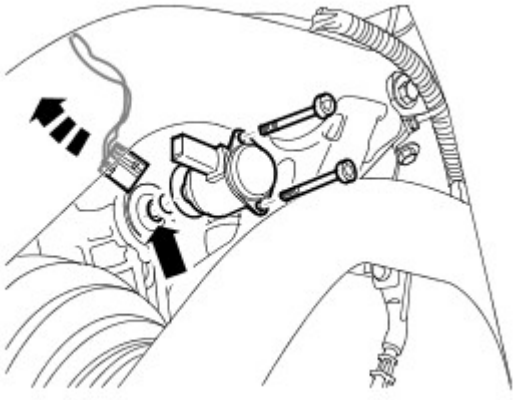
Removal

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

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

   Raise the vehicle on the lift.

3. Remove the front wheel and tire.


E71406

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

   NOTES:

   Note the fitted position.

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

   Remove the power steering control valve actuator.
   - Disconnect the electrical connector.
   - Position a container to collect the fluid spillage.
   - Remove and discard the 2 Torx screws.
   - Remove and discard the 2 O-ring seals.
   - Remove and discard the filter.

Installation

1. CAUTION: Make sure the working surfaces are thoroughly clean to avoid contamination of the sensitive hydraulic components.

   Clean the component mating faces.

2. Install a new filter to the steering gear.

3. Install new seals to the actuator.

4. NOTE: Align to the position noted on removal.

   Install the actuator.
   - Tighten the new Torx screws, evenly and progressively, to 3 Nm (2.2 lb.ft).
   - Connect the electrical connector.

5. Install the wheel and tire.
   - Tighten the wheel nuts to 140 Nm (103 lb.ft).

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

7. Refill and bleed the power steering.
   For additional information, refer to: Power Steering System Filling and Bleeding (211-00, General Procedures).

Power Steering - Power Steering Fluid Reservoir

Removal and Installation

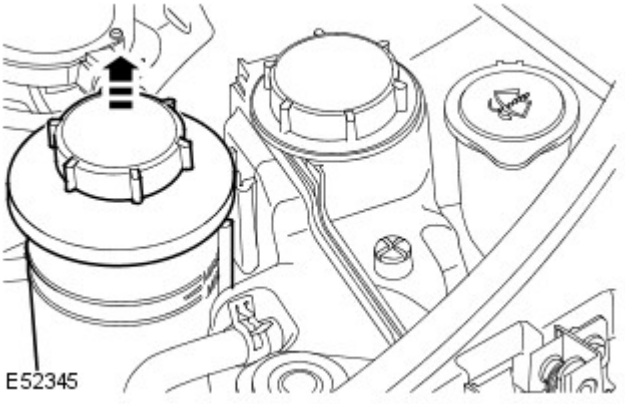
Removal

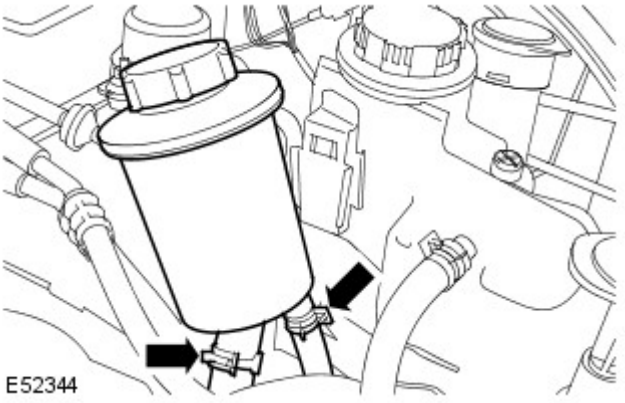
NOTE: Some variation in the illustrations may occur, but the essential information is always correct.

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

2. Siphon the fluid from the power steering reservoir.

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





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

   NOTE: Some fluid spillage is inevitable during this operation.

   Remove the power steering fluid reservoir.
   - Position an absorbent cloth to collect fluid spillage.
   - Release the hose clips and disconnect the hoses.

Installation

1. To install, reverse the removal procedure.

2. Fill and bleed the power steering system.
   For additional information, refer to: Power Steering System Filling and Bleeding (211-00, General Procedures).

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

Removal and Installation

Special Tool(s)

	Spring lock decoupler 310-044

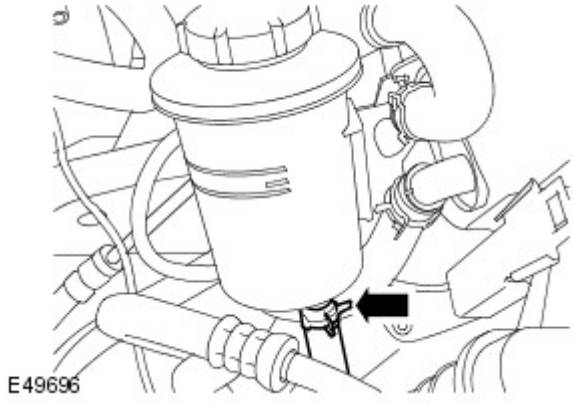
Removal

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

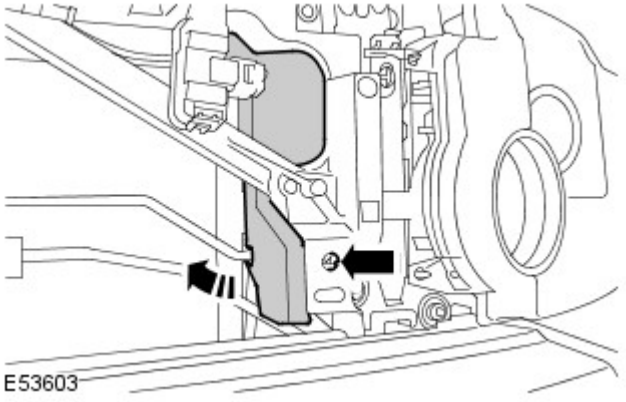
2. Remove the front radiator grille.
   For additional information, refer to: Radiator Grille (501-08, Removal and Installation).

3. Remove the coolant expansion tank.
   For additional information, refer to: Coolant Expansion Tank - 5.0L, Vehicles Without: Supercharger (303-03, Removal and Installation) /
   Coolant Expansion Tank - 5.0L, Vehicles With: Supercharger (303-03C, Removal and Installation).

4. Siphon the fluid from the power steering reservoir.

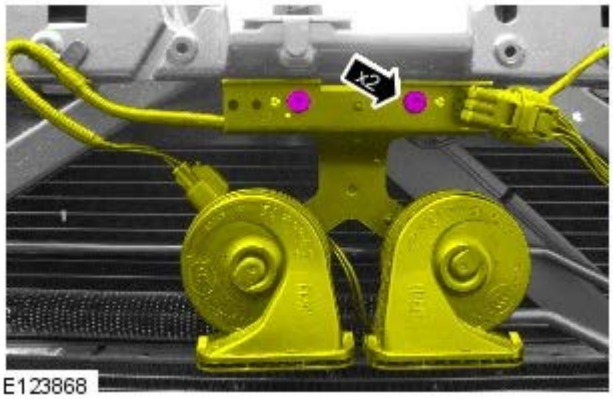


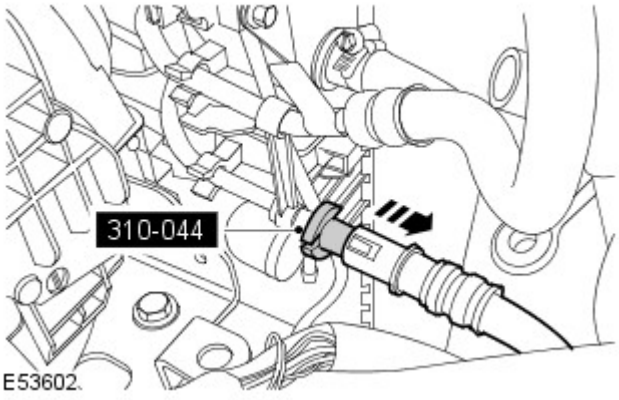
5. Disconnect the steering reservoir return hose.
   - Position an absorbent cloth to collect fluid spillage.
   - Release the clip.



6. Release the LH radiator air deflector lower clip, position the deflector aside.

7. Position the horns to one side for access.
   - Remove the 2 bolts.



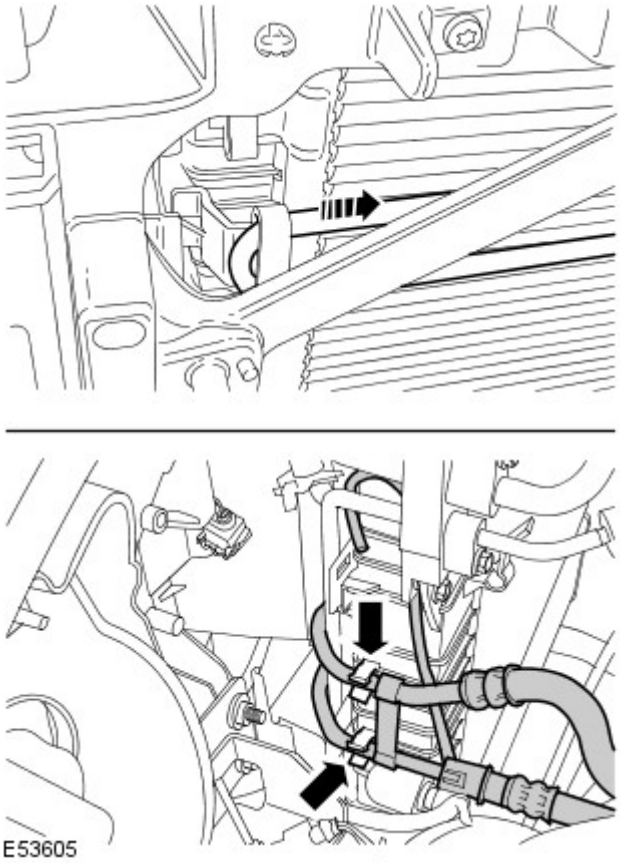


8. CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

NOTE: Some fluid spillage is inevitable during this operation.

Using the special tool, disconnect the cooler line.
- Position an absorbent cloth to collect fluid spillage.

9. Remove the cooler line seperating clip.



10. NOTE: Care must be taken to prevent damage to the cooler elements during removal and installation.

Remove the power steering fluid cooler.
- Release the 3 clips.

Installation

1. Install the power steering fluid cooler.
   - Position and secure in the clips.
2. Install the power steering fluid line and hose.
   - Clean the component mating faces.
   - Secure the hose with the clip.

3. Install the cooler line seperating clip.

4. Install the horn assemblies.
    - Tighten the 2 bolts to 10 Nm (7 lb.ft).

5. Install the radiator deflector.
    - Secure with the clip.

6. Install the coolant expansion tank.
   For additional information, refer to: Coolant Expansion Tank - 5.0L, Vehicles Without: Supercharger (303-03, Removal and Installation) /
   Coolant Expansion Tank - 5.0L, Vehicles With: Supercharger (303-03C, Removal and Installation).

7. Install the radiator grille.
   For additional information, refer to: Radiator Grille (501-08, Removal and Installation).

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

9. Fill and bleed the power steering system.
   For additional information, refer to: Power Steering System Filling and Bleeding (211-00, General Procedures).

Power Steering - Power Steering Pump 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. Disconnect the battery ground cable.

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

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

   Raise and support the vehicle.

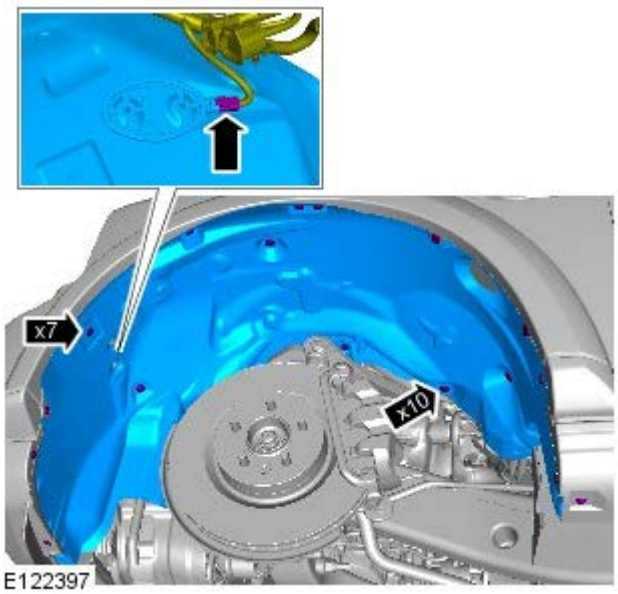
3. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00 Climate Control System - General Information, General Procedures).

4. Refer to: Accessory Drive Belt (303-05C Accessory Drive - V8 S/C 5.0L Petrol, Removal and Installation).

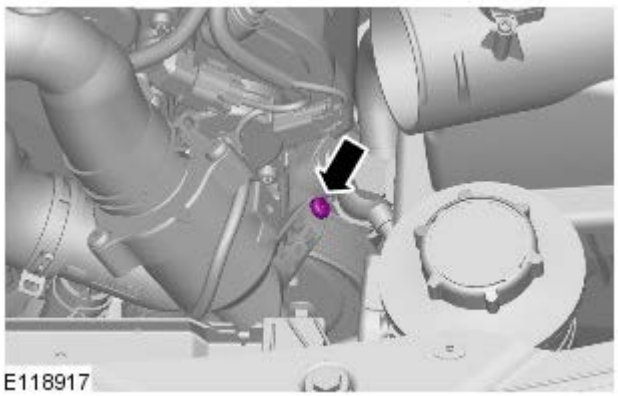
5. Remove the LH front road wheel.

   Torque: 140 Nm

6.



7. *Torque:* 10 Nm

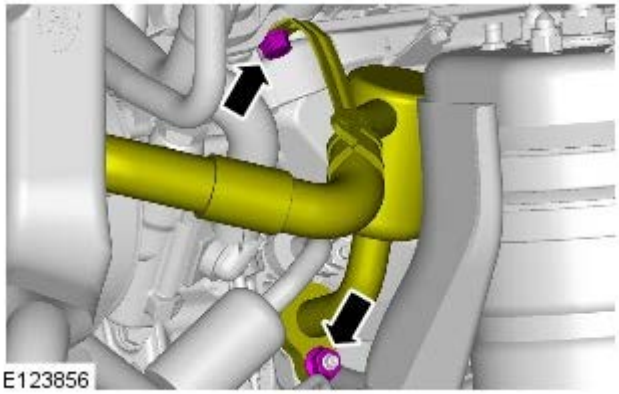


8. CAUTION: Note the fitted position of the



component prior to removal.

Torque: 25 Nm

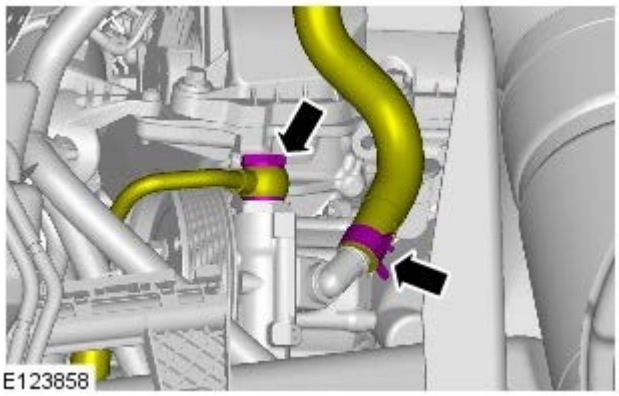


9. CAUTIONS:

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

   A new O-ring seal is to be installed.

   Torque: 18 Nm

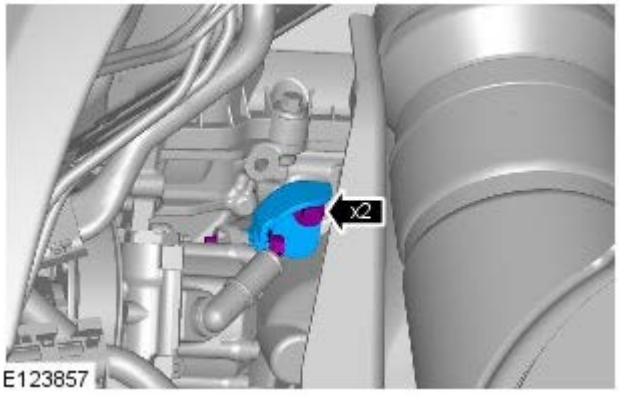


10. CAUTIONS:

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

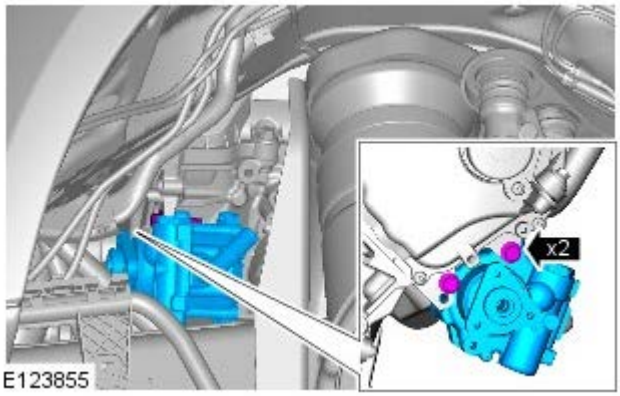
    Make sure that all openings are sealed. Use new blanking caps.

    Torque: 25 Nm



11. *Torque:* 25 Nm

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



Torque: 25 Nm

Installation

1. To install, reverse the removal procedure.
2. Refer to: Power Steering System Filling and Bleeding (211-00 Steering System - General Information, General Procedures).

Power Steering - Power Steering Pump TDV6 3.0L Diesel

Removal and Installation

Removal

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

1. Disconnect the battery ground cable.

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

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

   Raise and support the vehicle.

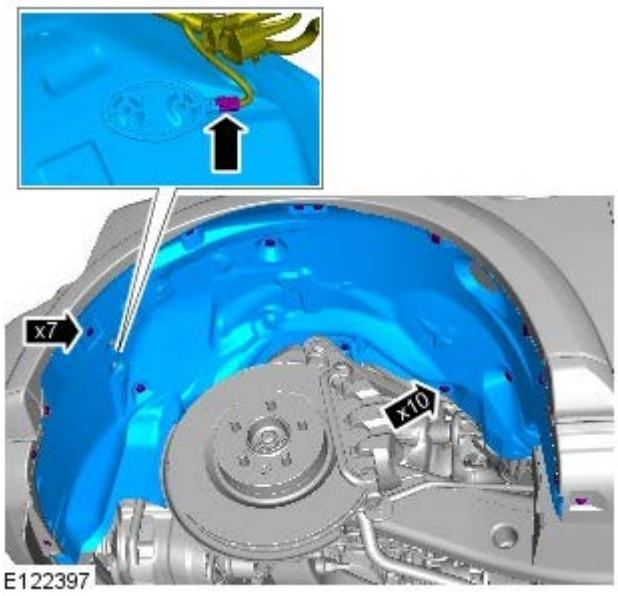
3. Refer to: Air Conditioning (A/C) System Recovery, Evacuation and Charging (412-00, General Procedures).

4. Refer to: Accessory Drive Belt (303-05, Removal and Installation).

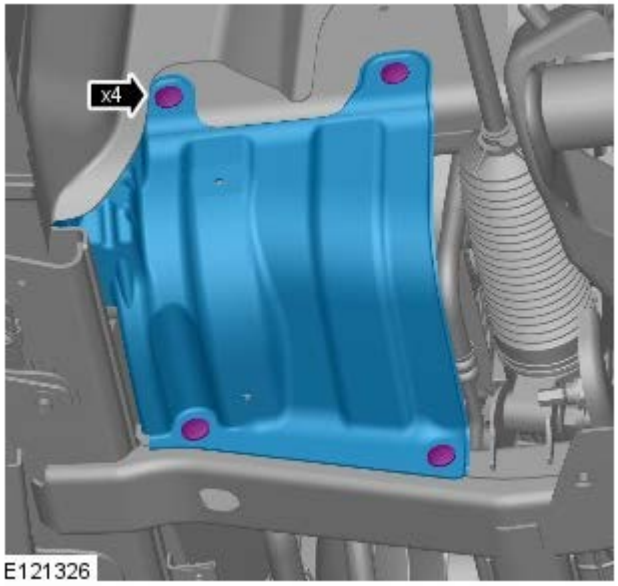
5. Remove the LH front wheel and tire.

   Torque: 140 Nm

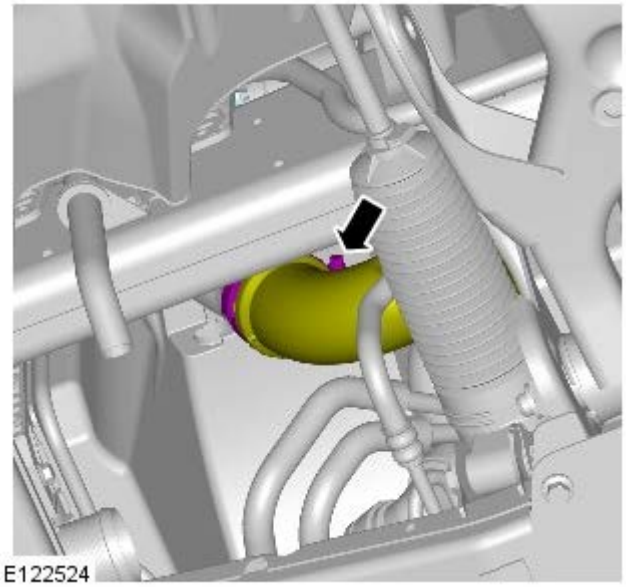
6.



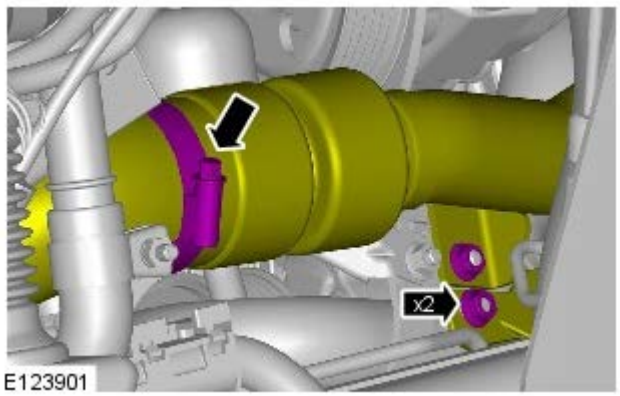
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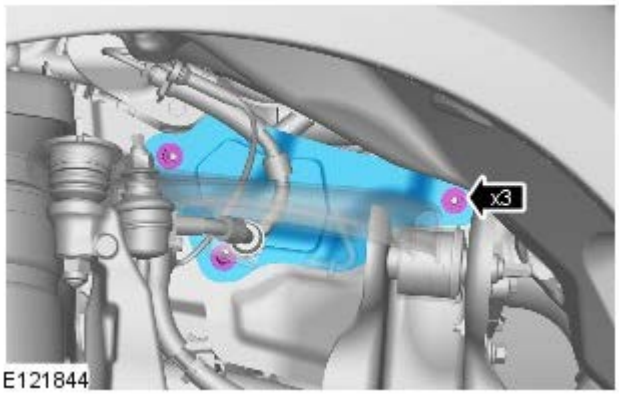
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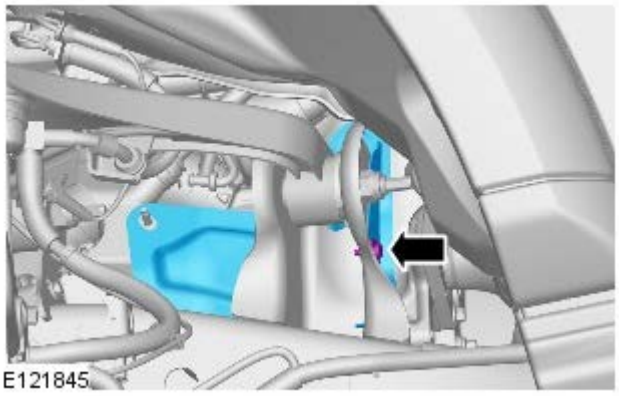
9. *Torque:*
   Nuts 6 Nm



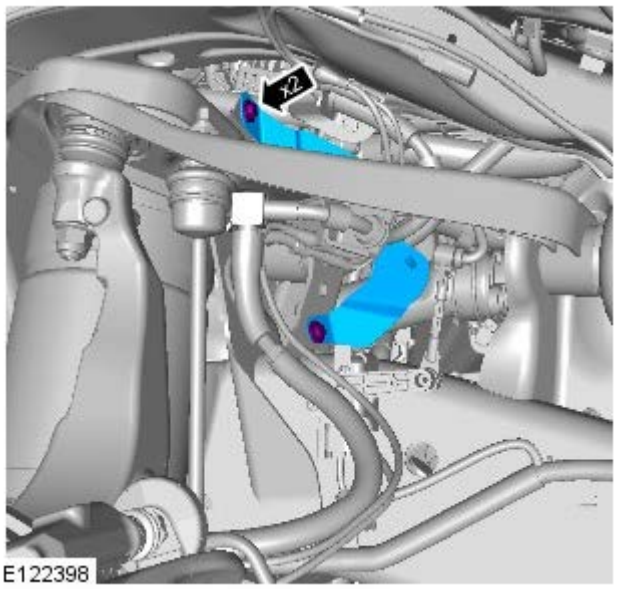
10. *Torque:* 9 Nm



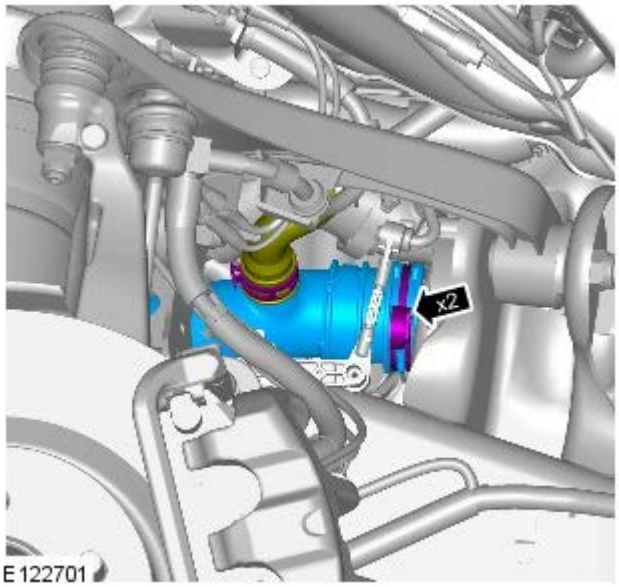
11. *Torque:* 9 Nm



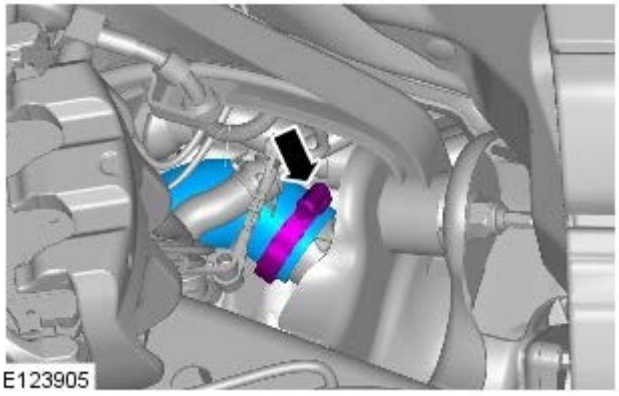
12. *Torque:* 9 Nm



13.

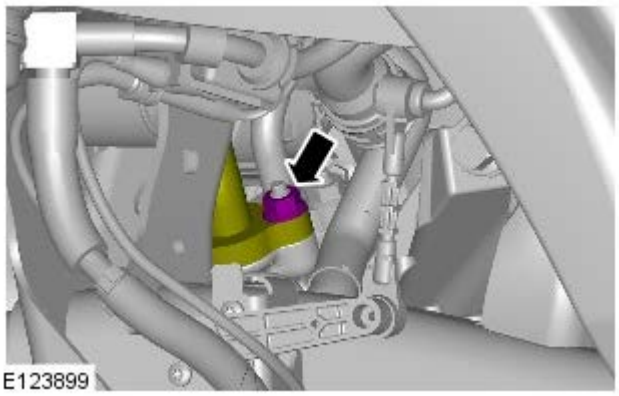


14.



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

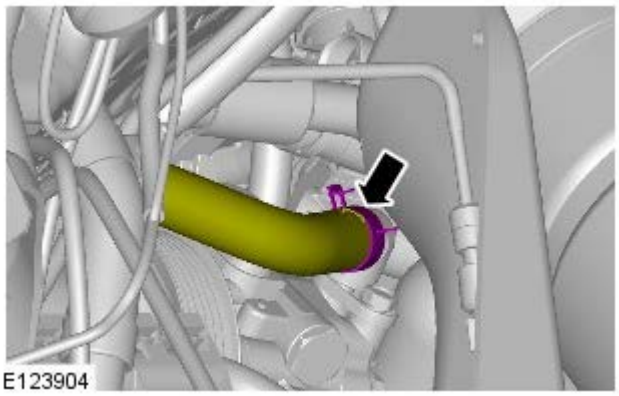
Torque: 18 Nm



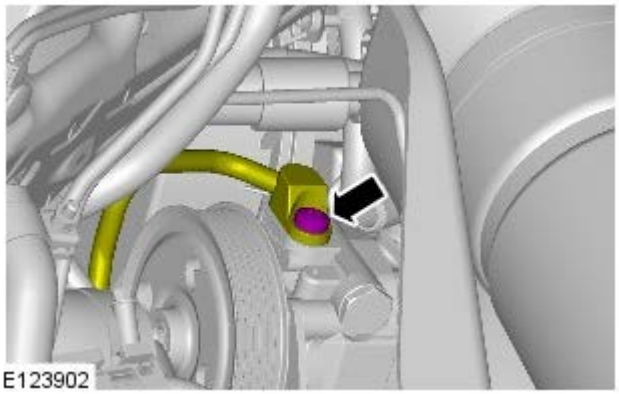
16. WARNING: Fluid loss is unavoidable, use absorbent cloth or a container to collect the fluid.

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

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



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

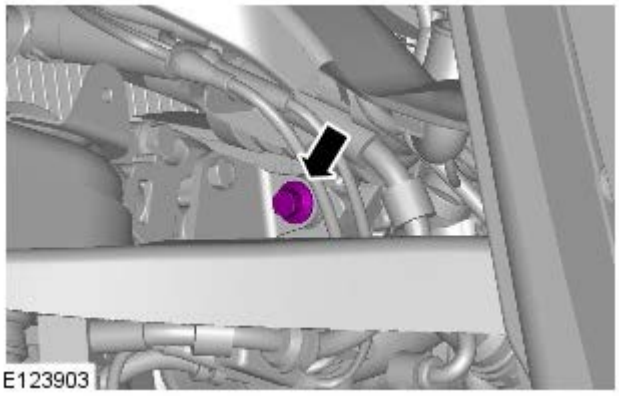


CAUTION: Make sure that the mating faces are clean and free of foreign material.

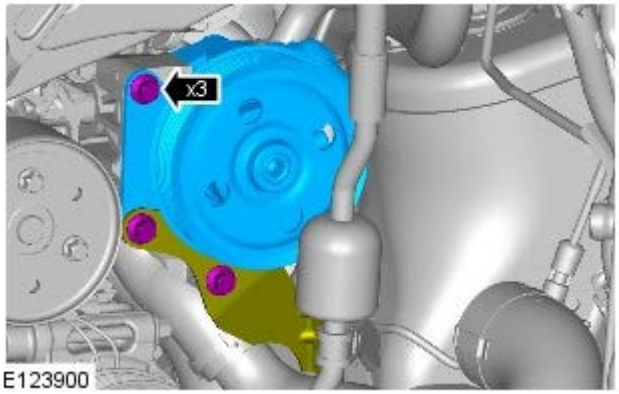
NOTE: Make sure that all openings are sealed. Use new blanking caps.

Torque: 24 Nm

18. *Torque:* 25 Nm



19. *Torque:* 25 Nm



Installation

1. To install, reverse the removal procedure.
2. Refer to: Power Steering System Filling and Bleeding (211-00, General Procedures).

Power Steering - Power Steering Pump to Steering Gear Pressure Line TDV6 3.0L Diesel / V8 5.0L Petrol / V8 S/C 5.0L Petrol

Removal and Installation

Removal

NOTES:

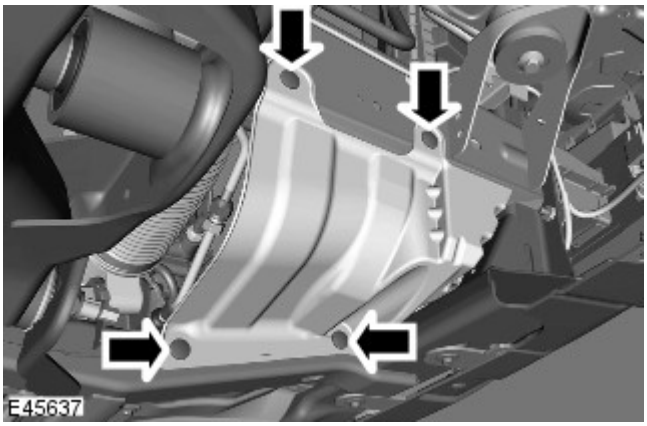
RHD shown, LHD is similar.

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

All vehicles

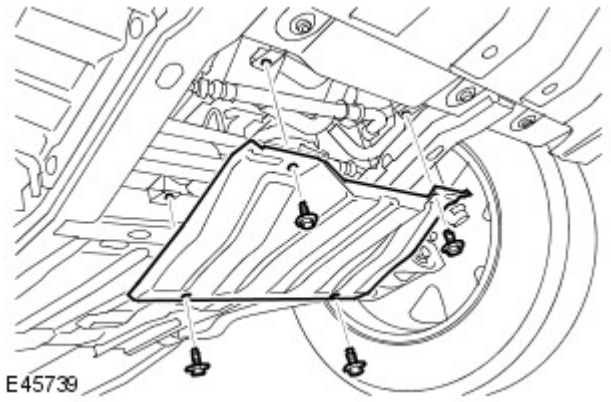
1. WARNING: Make sure to support the vehicle with axle stands.

   Raise and support the vehicle.



2. Remove the front RH splash shield.
   - Remove the 4 clips.

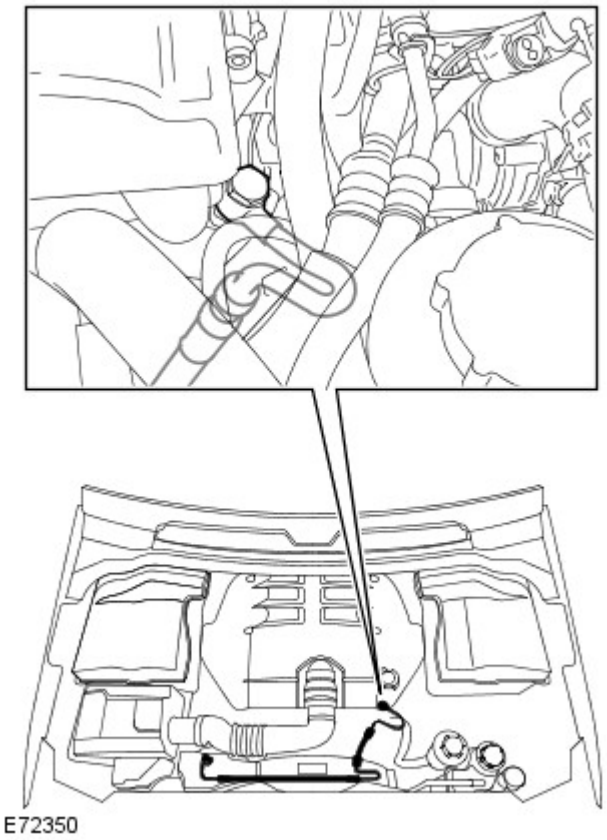
3. Remove the front LH fender splash shield.
   For additional information, refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).



4. Remove the radiator access panel.
   - Remove the 4 bolts.

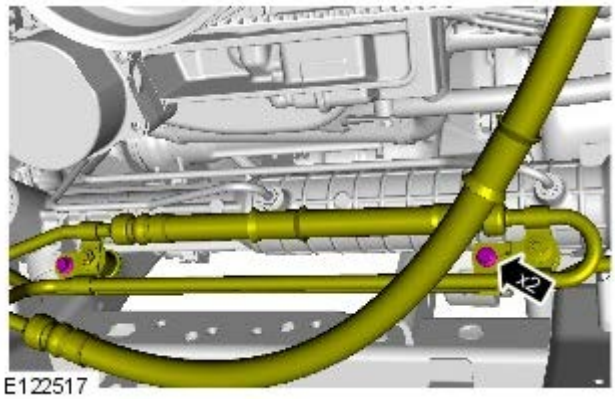
5. CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open connections to prevent contamination.

   Disconnect the high pressure line from the power steering pump.
   - Loosen and release the power steering pump line.
   - Allow the fluid to drain into a container.
   - Remove and discard the 2 sealing washers.


E72350

Vehicles with 5.0L engine

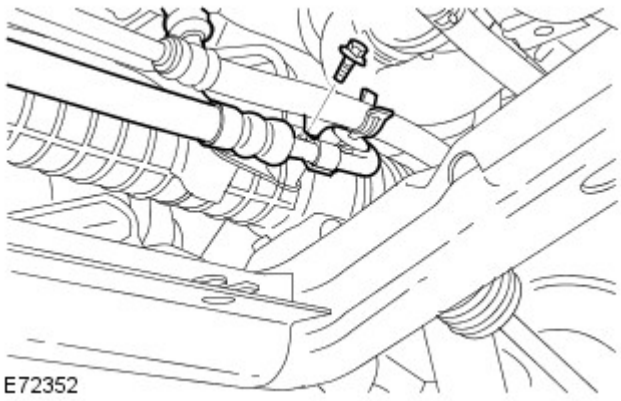
6. Release the power steering line support brackets.
   - Remove the 2 nuts.
   - Release the hose.



E122517

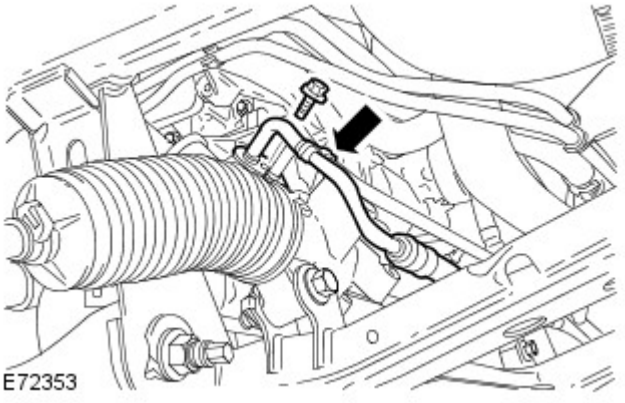
All other engine types

7. Release the power steering line support bracket.
   - Remove the nut.
   - Release the hose.


E72352

All vehicles

8. CAUTION: Before disconnecting or removing the components, make sure the area around the joint faces and connections are clean. Plug open



connections to prevent contamination.

Disconnect the high pressure line from the power steering gear.

- Remove the bolt.
- Release the power steering gear line.
- Remove and discard the O-ring seal.

9. Remove the steering gear high-pressure line.

Installation

All vehicles

1. Install the steering gear high-pressure line.

2. Connect the high-pressure line to the power steering gear.
   - Install the O-ring seal.
   - Attach the power steering gear high-pressure line.
   - Tighten the bolt to 25 Nm (18 lb.ft).

Vehicles with 5.0L engine

3. Install the power steering line support brackets.
   - Tighten the nuts to 10 Nm (7 lb.ft).
   - Secure the hose with the clip.

All other engine types

4. Install the power steering line support bracket.
   - Tighten the nut to 10 Nm (7 lb.ft).
   - Secure the hose with the clip.

All vehicles

5. Connect the high-pressure line to the power steering pump.
   - Install new sealing washers.
   - Connect the power steering pump high-pressure line.

6. Install the radiator access panel.
   - Tighten the bolts to 10 Nm (7 lb.ft).

7. Install the front LH fender splash shield.
   For additional information, refer to: Fender Splash Shield (501-02 Front End Body Panels, Removal and Installation).

8. Install the front RH splash shield.
   - Secure with the clips.

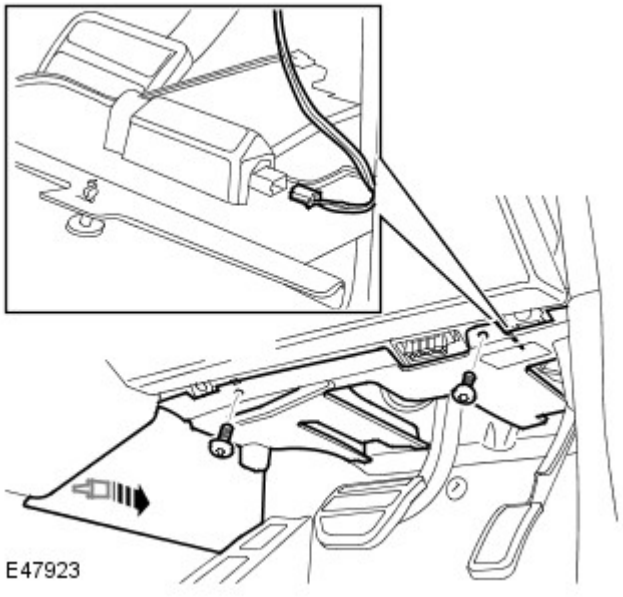
9. Fill and bleed the power steering system.
   For additional information, refer to: Power Steering System Filling and Bleeding (211-00 Steering System - General Information, General Procedures).

Power Steering - Steering Angle Sensor

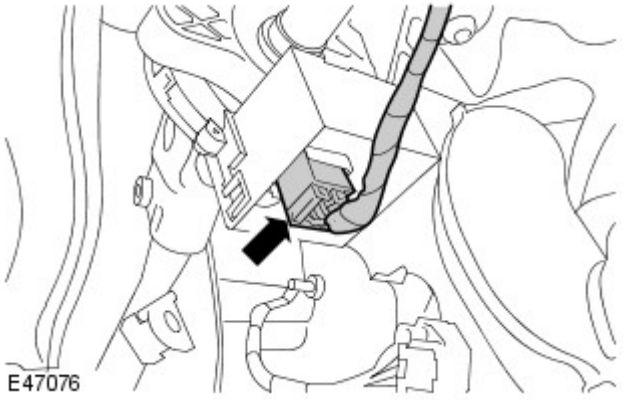
Removal and Installation

Removal

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



2. Remove the driver side closing trim panel.
   - Release the clip.
   - Remove the 2 screws.
   - Disconnect the electrical connector.

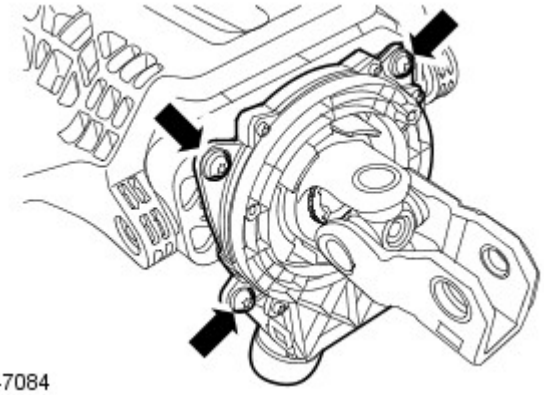


3. Disconnect the steering angle sensor electrical connector.



4. Disconnect the steering column intermediate shaft from the steering column.
   - Note the fitted position.
   - Remove the special bolt and discard the nut.

5. Remove the steering angle sensor.
   - Remove the 3 Torx screws.



E47084

Installation

1. Install the steering angle sensor.
    - Tighten the Torx screws to 3 Nm (2 lb.ft).

2. Connect the steering column intermediate shaft.
    - Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).

3. Connect the steering angle sensor electrical connector.

4. Install the closing trim panel.
    - Connect the electrical connector.
    - Secure the clip.
    - Tighten the screws.

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

6. Initiate a new steering angle sensor using T4.

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

Removal and Installation

Removal

NOTES:

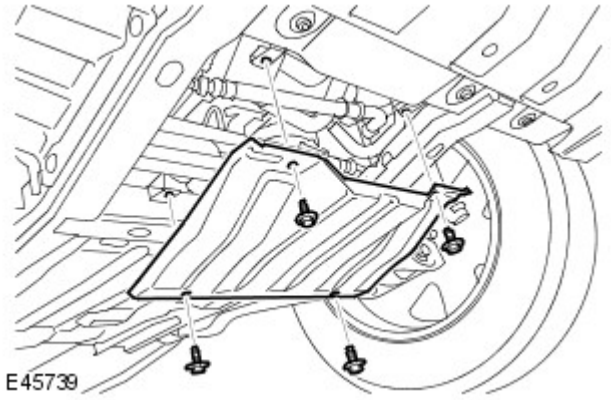
Some variation in the illustrations may occur, but the essential information is always correct.

LHD illustration shown, RHD is similar.

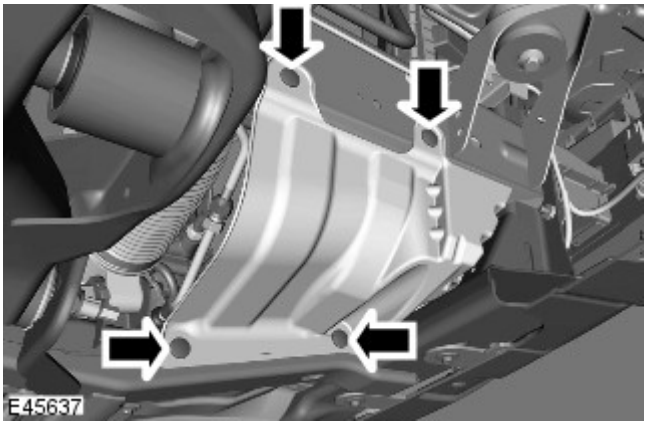
All vehicles

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

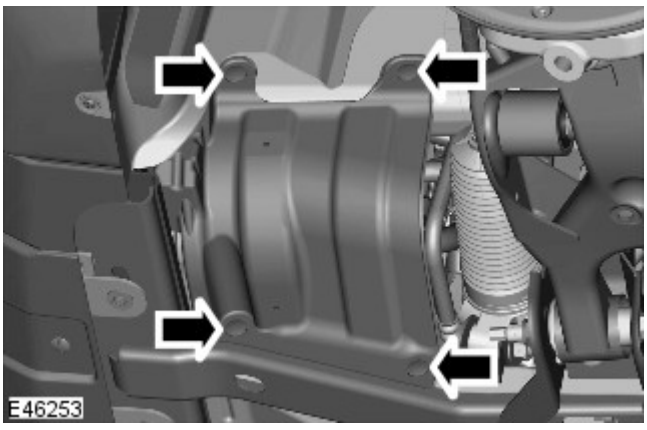
   Raise and support the vehicle.



2. Remove the radiator access panel.
   - Remove the 4 bolts.

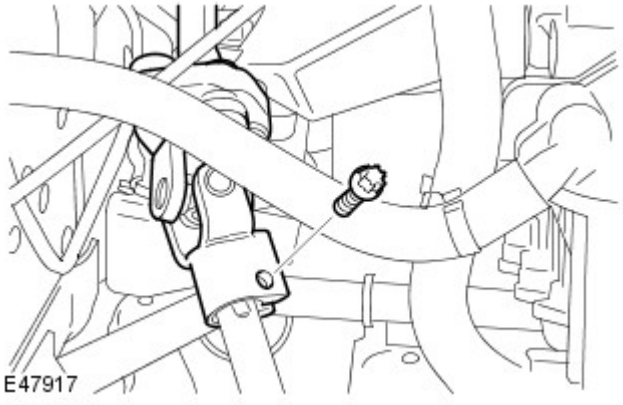


3. Remove the front RH splash shield.
   - Remove the 4 clips.



4. Remove the front LH splash shield.
   - Remove the 4 clips.

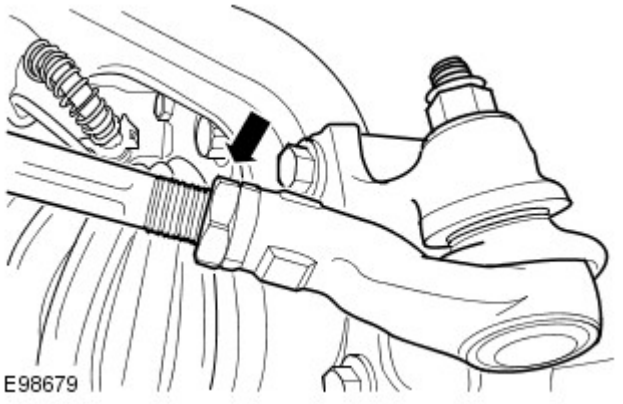
5. CAUTION: Do not turn the steering wheel with the steering column lower shaft disconnected as damage to the clockspring and steering wheel switches may occur.



NOTE: Make sure the steering is in the straight ahead position.

Release the universal joint from the steering gear.

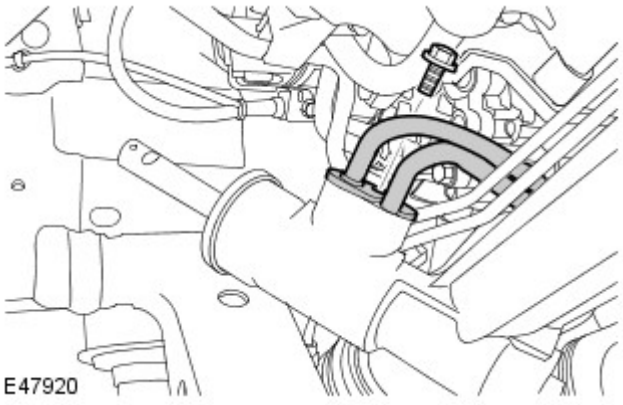
- Remove and discard the bolt.



6. NOTE: LH illustration shown, RH is similar.

Release both tie-rod end ball joints.

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



7. Disconnect the pressure lines from the power steering gear.
   - Remove the bolt.
   - Position an absorbent cloth to collect fluid spillage.
   - Remove and discard the O-ring seals.

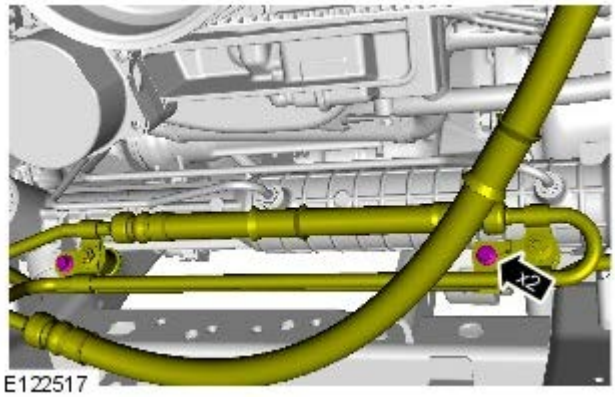
Vehicles with dynamic suspension



8. Release the dynamic response line supports.
   - Remove the 2 nuts.
   - Remove the 2 supports.

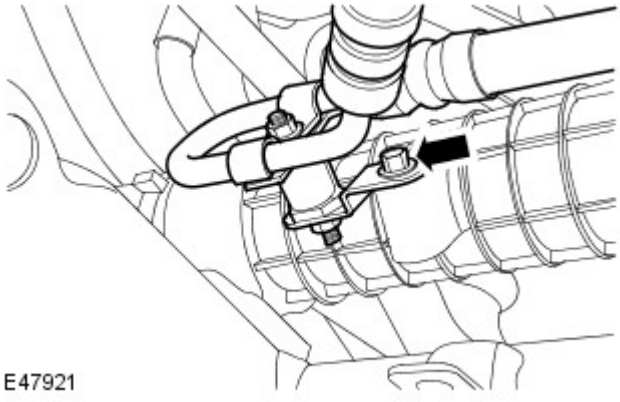
Vehicles without supercharger

9. Remove the steering gear high-pressure line.
   - Remove the bolts.



Vehicles with supercharger

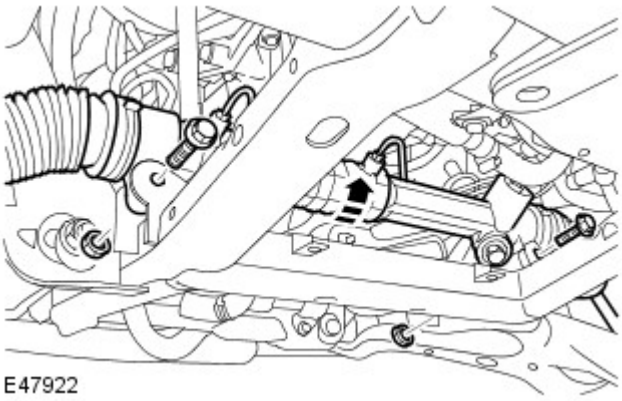
10. Remove the steering gear high-pressure line.
    - Remove the bolt.



All vehicles

11. Disconnect the steering gear electrical connector.





12. CAUTION: Make sure that the steering gear pipes and the dynamic suspension system pipes are not damaged during the removal of the steering gear.

    Remove the steering gear.
    - Remove the 2 bolts and discard the cage nuts.
    - Release the steering gear.

Installation

All vehicles

1. Clean the component mating faces.

2.  CAUTION: Make sure that the steering gear pipes and the dynamic suspension system pipes are not damaged during the installation of the steering gear.

   Install the steering gear.
   - Tighten the bolts to 175 Nm (129 lb.ft).

3. Connect the electrical connector.

4.  NOTE: Do not install the support bracket bolt until the steering gear connections are tightened.

   Install the steering gear high pressure line.

5.  NOTE: Lubricate the seals with clean power steering fluid.

   Connect the steering gear pressure lines.
   - Clean the component mating faces.
   - Install new O-ring seals.
   - Tighten the bolt to 22 Nm (16 lb.ft).

Vehicles with supercharger

6. Install the power steering line support bracket.
   - Tighten the bolt to 10 Nm (7 lb.ft).

Vehicles without supercharger

7. Install the power steering line support brackets.
   - Tighten the bolts to 10 Nm (7 lb.ft).

Vehicles with dynamic suspension

8. Install the dynamic response line supports.
   - Tighten the supports to 10 Nm (7 lb.ft).
   - Tighten the nuts to 10 Nm (7 lb.ft).

All vehicles

9. Connect the tie-rod end ball joints.
   - Attach both tie rods to previously noted positions.
   - Tighten the tie-rod locking nut.

10. Connect the universal joint to the steering gear.
    - Install a new patchlock bolt and tighten to 25 Nm (18 lb.ft).

11. Install the radiator access panel.
    - Install the 4 bolts and tighten to 10 Nm (7 lb.ft).

12. Install the front LH splash shield.

13. Install the front RH splash shield.

14. Fill and bleed the power steering system.
    For additional information, refer to: Power Steering System Filling and Bleeding (211-00 Steering System - General Information, General Procedures).

15. Adjust the front wheel alignment.

Power Steering - Steering Gear TDV6 3.0L Diesel
Removal and Installation

Removal

NOTES:

LHD illustration shown, RHD is similar.

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

All vehicles

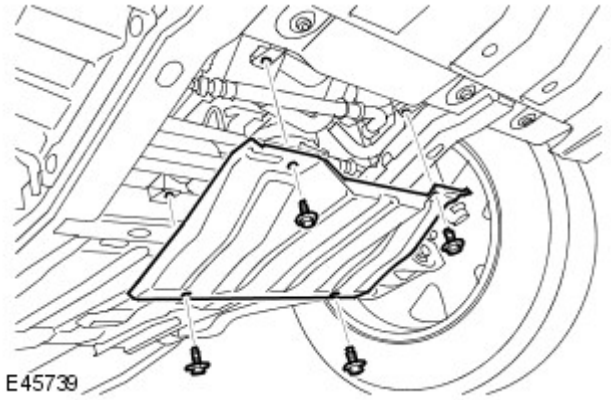
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

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

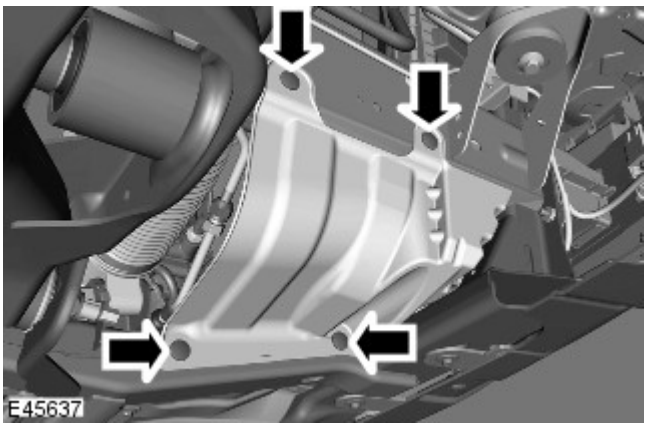
   Center the steering wheel.

3. Remove the radiator splash shield.
   - Remove the 4 bolts.

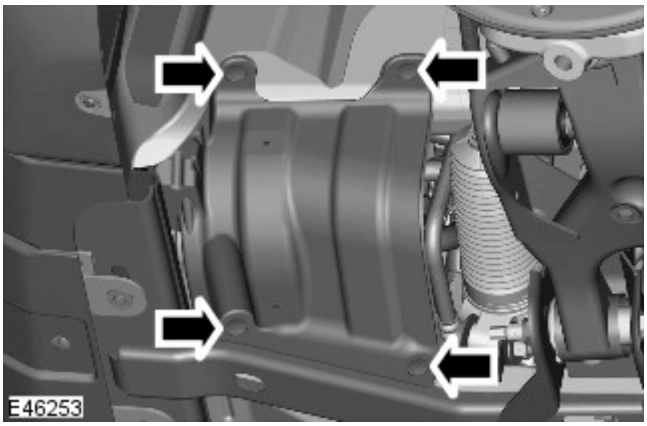


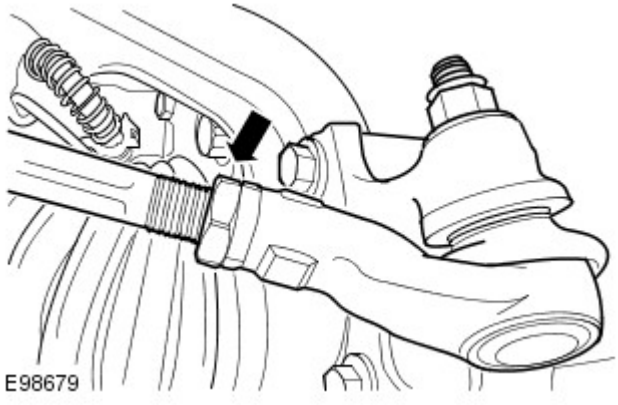
4. Remove the engine undershield.
   For additional information, refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

5. Remove the front RH splash shield.
   - Remove the 4 clips.



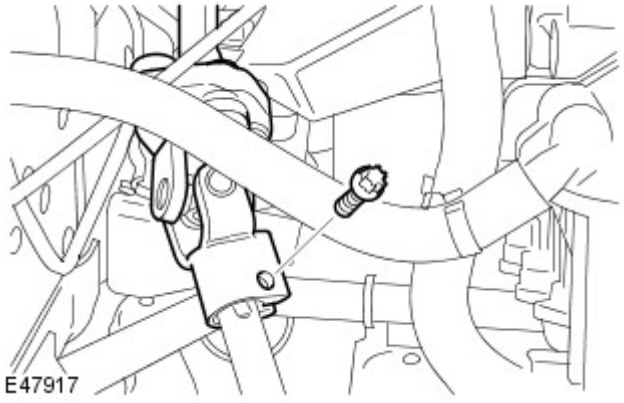
6. Remove the front LH splash shield.
   - Remove the 4 clips.





7. NOTE: LH illustration shown, RH is similar.

   Release both tie-rod end ball joints.
   - Loosen the locknut.
   - Release both track rods from tie rod ends, note the number of turns for installation.

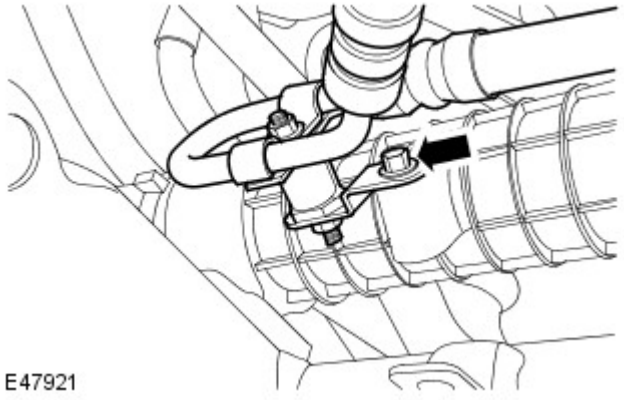


8. NOTE: Note the fitted position.

   Disconnect the lower steering column from the steering gear.
   - Remove and discard the bolt.

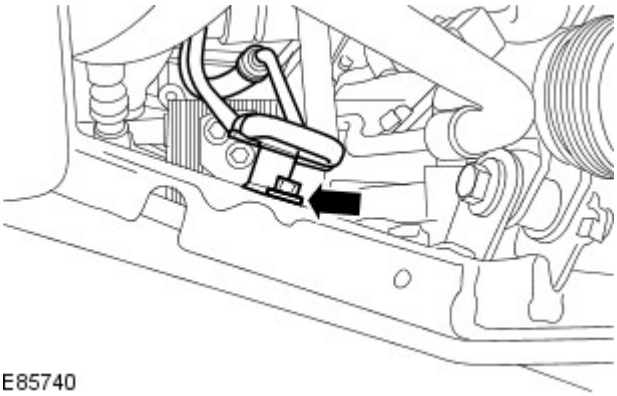
Vehicles with 3.0L diesel engine

9. Remove the steering gear high-pressure line.
   - Remove the bolts.

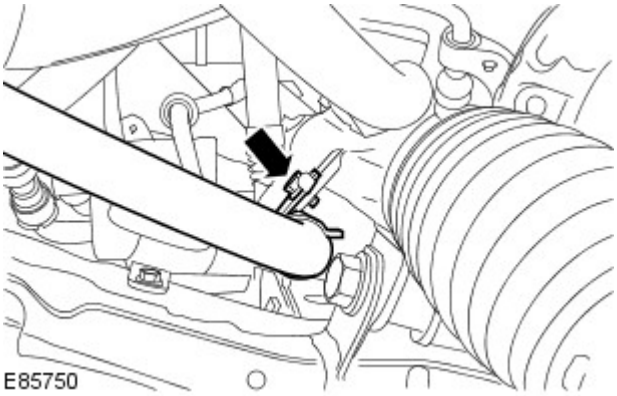


Vehicles with 3.6L diesel engine

10. Release the power steering return line support bracket.
    - Remove the bolt.


E85740

11. Release the steering gear high-pressure line.
    - Remove the bolt.

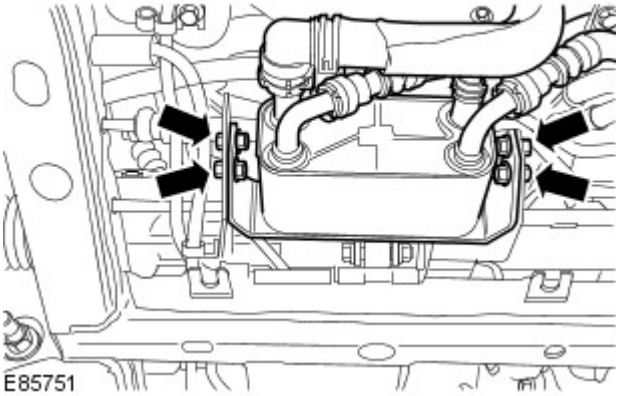

E85750

All vehicles


E60776

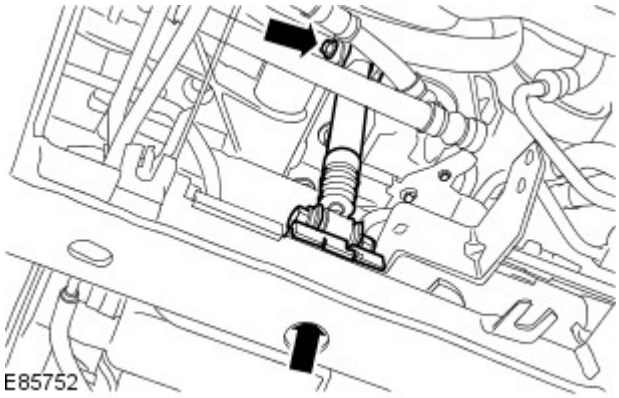
12. Disconnect the steering gear control valve actuator electrical connector.

13. Release the transmission fluid cooler.
    - Remove the 4 bolts.

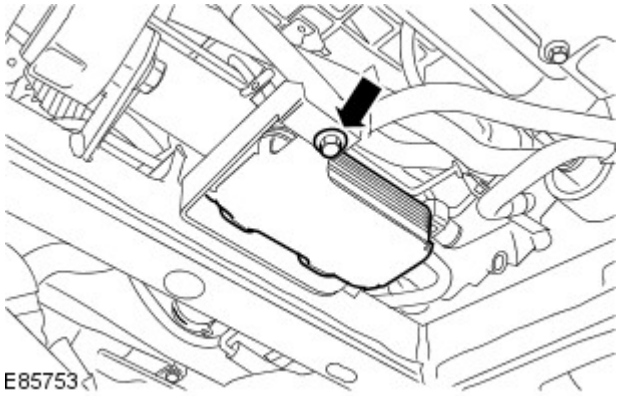

E85751

Vehicles with 3.6L diesel engine

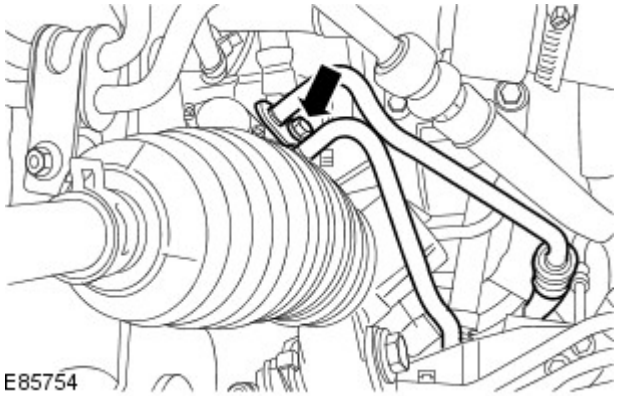
14. Remove the engine stabilizer and engine stabilizer bracket.
    - Remove the bolt.
    - Remove and discard the nut.



All vehicles



15. Release the fuel cooler.
    - Remove the bolt.

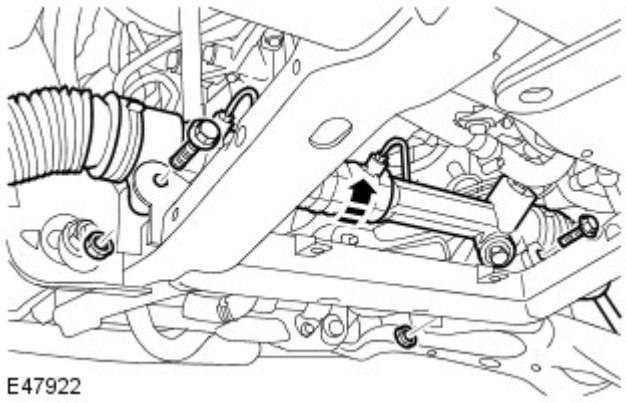


16. CAUTIONS:

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

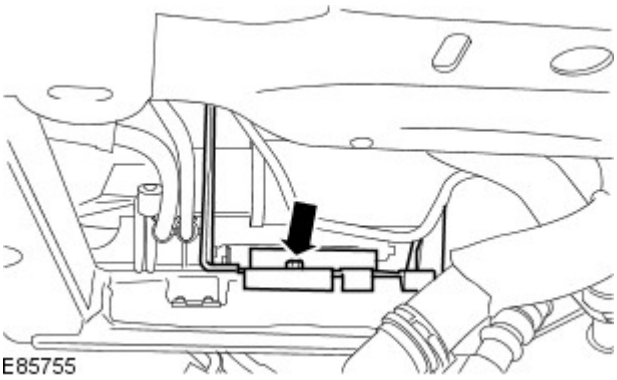
    Make sure that all openings are sealed. Use new blanking caps.

    Disconnect the power steering high pressure line and return line from the steering gear.
    - Remove and discard the bolt.
    - Remove and discard the 2 O-ring seals.



17. Release the steering gear.
    - Remove the 2 bolts.

18. Remove the transmission fluid cooler and fuel cooler support bracket.
    - Remove the bolt.
    - Release the coolant line.



CAUTION: Make sure that the steering gear pipes and the dynamic suspension system pipes are not damaged during the removal of the steering gear.

19. Remove the steering gear.

Installation

All vehicles

CAUTION: Make sure that the steering gear pipes and the dynamic suspension system pipes are not damaged during the installation of the steering gear.

1. Install the steering gear.
2. Install the transmission fluid cooler and fuel cooler support bracket.
   - Secure the coolant line.
   - Tighten the bolt to 23 Nm (17 lb.ft).
3. Secure the steering gear.
   - Tighten the bolts to 175 Nm (129 lb.ft).
4. NOTES:

   Remove and discard the blanking caps.

   Lubricate the seals with clean power steering fluid.

   Connect the power steering high pressure line and return line to the steering gear.
   - Install new O-ring seals.
   - Tighten the new bolt to 22 Nm (16 lb.ft).
5. Secure the fuel cooler.
   - Tighten the bolt to 23 Nm (17 lb.ft).

Vehicles with 3.6L diesel engine

6. Install the engine stabilizer and engine stabilizer bracket.
   - Tighten the nut.
   - Tighten the bolt.

All vehicles

7. Secure the transmission fluid cooler.
   - Tighten the nuts and bolts to 25 Nm (18 lb.ft).
8. Connect the steering gear control valve actuator electrical connector.

Vehicles with 3.6L diesel engine

9. Secure the steering gear high pressure line.
   - Tighten the bolt to 10 Nm (7 lb.ft).
10. Secure the power steering return line support bracket.
    - Tighten the bolt to 10 Nm (7 lb.ft).

Vehicles with 3.0L diesel engine

11. Install the power steering line support bracket.
    - Tighten the bolt to 10 Nm (7 lb.ft).

All vehicles

12. Connect the lower steering column shaft to the steering gear.
    - Tighten the new bolt to 24 Nm (18 lb.ft).

13. Connect the tie-rod end ball joints.
    - Attach both tie rods to previously noted positions.
    - Tighten the tie-rod locking nut.

14. Install the front LH splash shield.
    - Install the clips.

15. Install the front RH splash shield.
    - Install the clips.

16. Install the engine undershield.
    For additional information, refer to: Engine Undershield (501-02 Front End Body Panels, Removal and Installation).

17. Install the radiator splash shield.
    - Tighten the bolts to 10 Nm (7 lb.ft).

18. Fill and bleed the power steering system.
    For additional information, refer to: Power Steering System Filling and Bleeding (211-00 Steering System - General Information, General Procedures).

19. Adjust the front wheel alignment.

Steering Linkage -

Torque Specifications

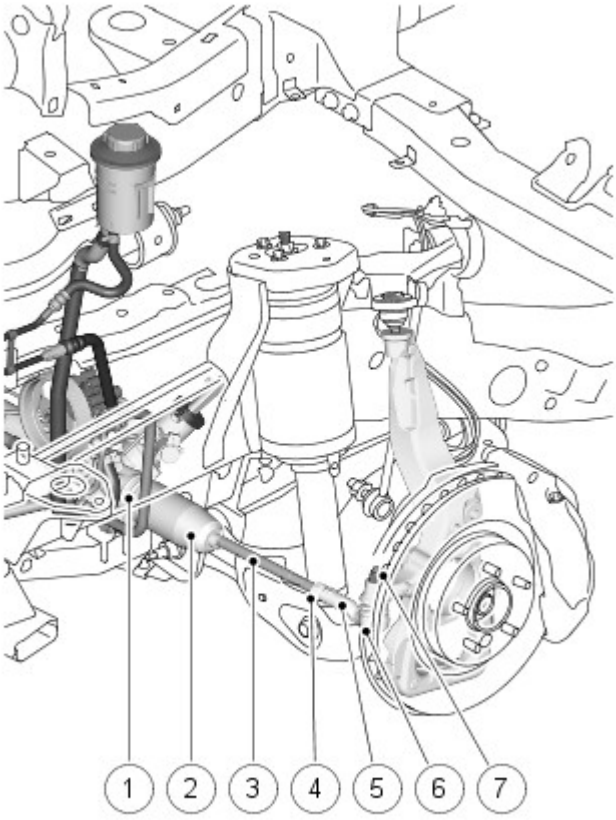
Description	Nm	lb-ft
* Tie-rod end nut - Vehicles fitted with an M12 nut	76	56
* Tie-rod end nut - Vehicles fitted with an M14 nut	150	111
Tie-rod locking nut	55	40
Road wheel nuts	140	103

*** New nut must be installed**

Steering Linkage - Steering Linkage

Description and Operation

Steering Linkage Component Location



E56789

Item	Part Number	Description
1	-	Steering gear
2	-	Steering gear gaitor
3	-	Tie rod
4	-	Locknut
5	-	Tie rod end
6	-	Ball joint
7	-	Self-locking nut

GENERAL

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 tie rods. The external ends of the tie rods are sealed with steering gear gaitors to prevent the ingress of dirt and moisture into the steering gear.

The outer ends of the tie rods are threaded to allow the fitment of the tie rod ends. The tie rod ends are screwed onto the tie rods and locked with locknuts to prevent inadvertent movement. The thread on the tie rod allows the position of the tie rod end to be adjusted in order to set the correct toe angle for each front wheel.

The tie rod end comprises a forged housing with a threaded bore for attachment to the tie rod. The tie rod end 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, Diagnosis and Testing).

Steering Linkage - Steering Gear Boot

Removal and Installation

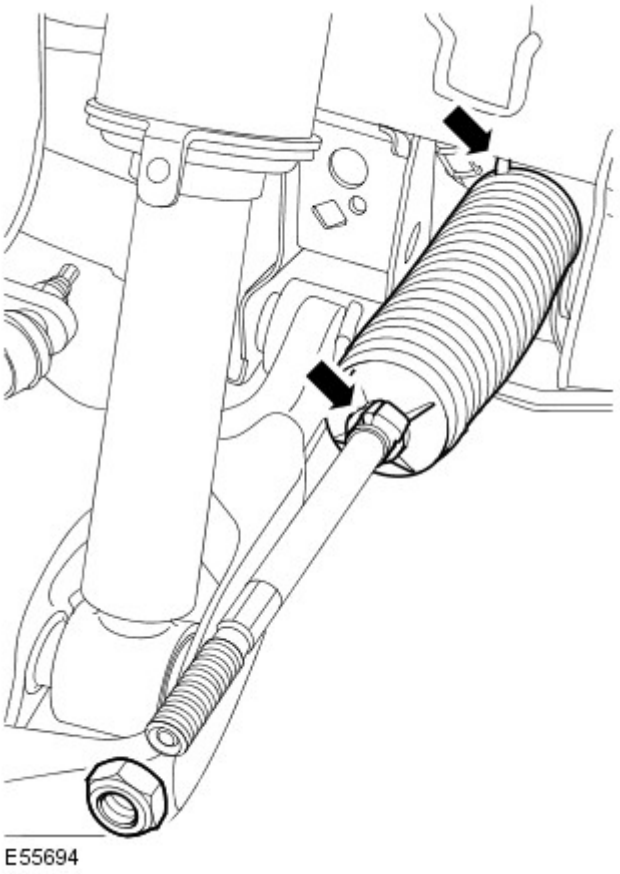
Removal

1. Remove the tie-rod end.
   For additional information, refer to: Tie-Rod End (211-03, Removal and Installation).

2. NOTE: Note the fitted position.

   Remove the locknut.

3. Remove the steering gear boot.
   - Release the 2 clips.



Installation

1. Install the steering gear boot.
   - Clean the component mating faces.
   - Secure with the clips.

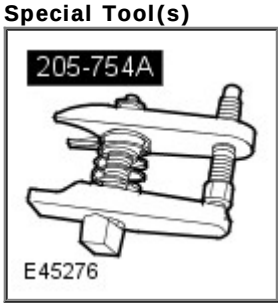
2. Install the locknut.

3. Install the tie-rod end.
   For additional information, refer to: Tie-Rod End (211-03, Removal and Installation).

Steering Linkage - Tie Rod

Removal and Installation

Special Tool(s)

	Ball joint separator 205-754(LRT-54-027)

Removal

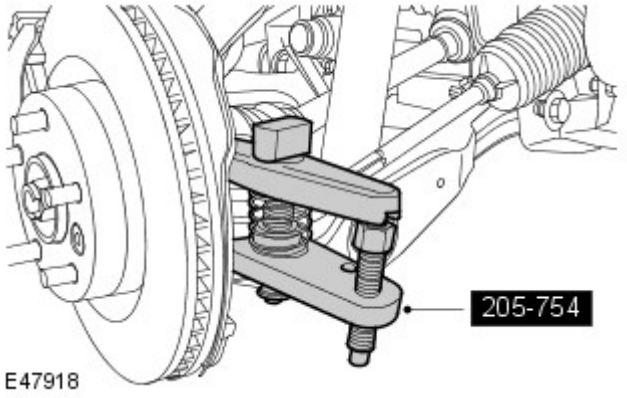
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

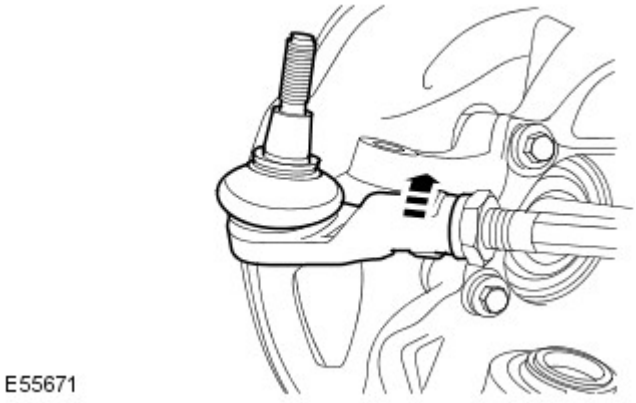
2. Remove the front wheel.

3. Loosen the outer tie-rod end ball joint retaining nut.

4. Loosen the outer tie-rod end lock nut.



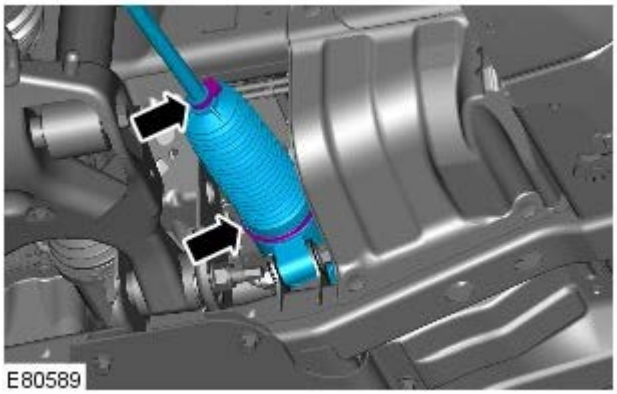
5. Using the special tool, release the tie-rod end ball joint from the wheel knuckle.
   - Remove and discard the tie rod end retaining nut.

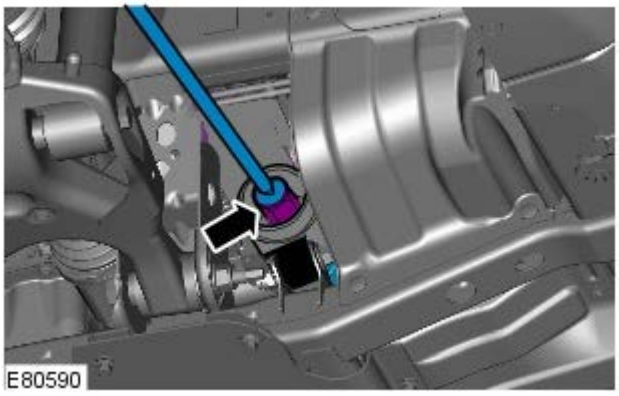


6. Remove the outer tie-rod end, note the number of turns for installation.

7. Remove the outer tie-rod end lock nut.

8. Remove the steering gear boot.
   - Release the 2 clips.





9. Remove the inner tie-rod end.
    - Loosen the nut.

Installation

1. Install the inner tie-rod end.
    - Tighten the nut to 100 Nm (74 lb.ft).
2. Install the steering gear boot.
    - Secure with the clips.
3. Install the outer tie-rod end lock nut.
4. Install the tie rod end, note the number of turns until adjacent to the locknut.
5. CAUTION: To prevent damage to the tie rods, use an additional wrench when loosening or tightening the components.

    Connect the tie-rod end ball joint.
    - Clean the component mating faces.
    - For vehicles fitted with an M12 nut, install a new nut and tighten to 76 Nm (56 lb.ft).
    - For vehicles fitted with an M14 nut, install a new nut and tighten to 150 Nm (111 lb.ft).
6. Tighten the tie-rod locking nut.
    - Clean the component mating faces.
    - Tighten the nut to 55 Nm (40 lb.ft).
7. Install the front wheel.
    - Tighten the wheel nuts to 140 Nm (103 lb.ft).
8. Lower the vehicle.
9. Using only four wheel alignment equipment approved by Land Rover, check and adjust the wheel alignment.

Steering Linkage - Tie Rod End

Removal and Installation

Special Tool(s)

	Ball joint separator 205-754 (LRT-54-027)

Removal

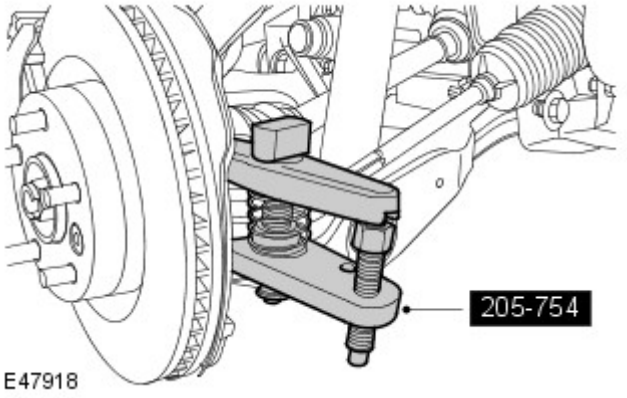
1. WARNING: Do not work on or under a vehicle supported only by a jack. Always support the vehicle on safety stands.

   Raise and support the vehicle.

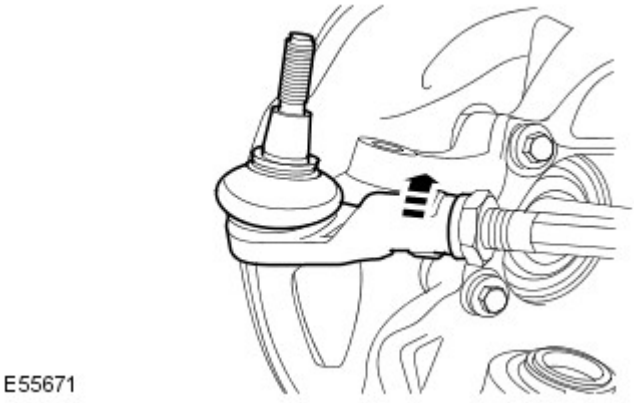
2. Remove the front wheel.

3. Loosen the tie rod end ball joint retaining nut.

4. Loosen the tie rod end lock nut.



5. Using the special tool, release the tie-rod end ball joint from the wheel knuckle.
   - Remove and discard the tie rod end retaining nut.



6. 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: To prevent damage to the tie rods, use an additional wrench when loosening or tightening the components.

   Connect the tie rod end ball joint.
   - Clean the component mating faces.
   - For vehicles fitted with an M12 nut, install a new nut

and tighten to 76 Nm (56 lb.ft).
- For vehicles fitted with an M14 nut, install a new nut and tighten to 150 Nm (111 lb.ft).

3. Tighten the tie rod locking nut.
   - Clean the component mating faces.
   - Tighten the nut to 55 Nm (40 lb.ft).

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

5. Lower the vehicle.

6. Using only four wheel alignment equipment approved by Land Rover, check and adjust the wheel alignment.

Steering Column -

General Specification

Item	Specification
Type	Two piece, articulated with flexible coupling to steering rack; fitted with energy absorption system and having a 120 mm (4.7 in) ride down capability with a 4.5 kN (0.45 ton force) maximum decoupling load on the intermediate shaft and a 77 mm (3.0 in) collapse stroke on the lower shaft.
Upper column adjustment:	
Reach	40 mm (1.57 in)
Rake	6°

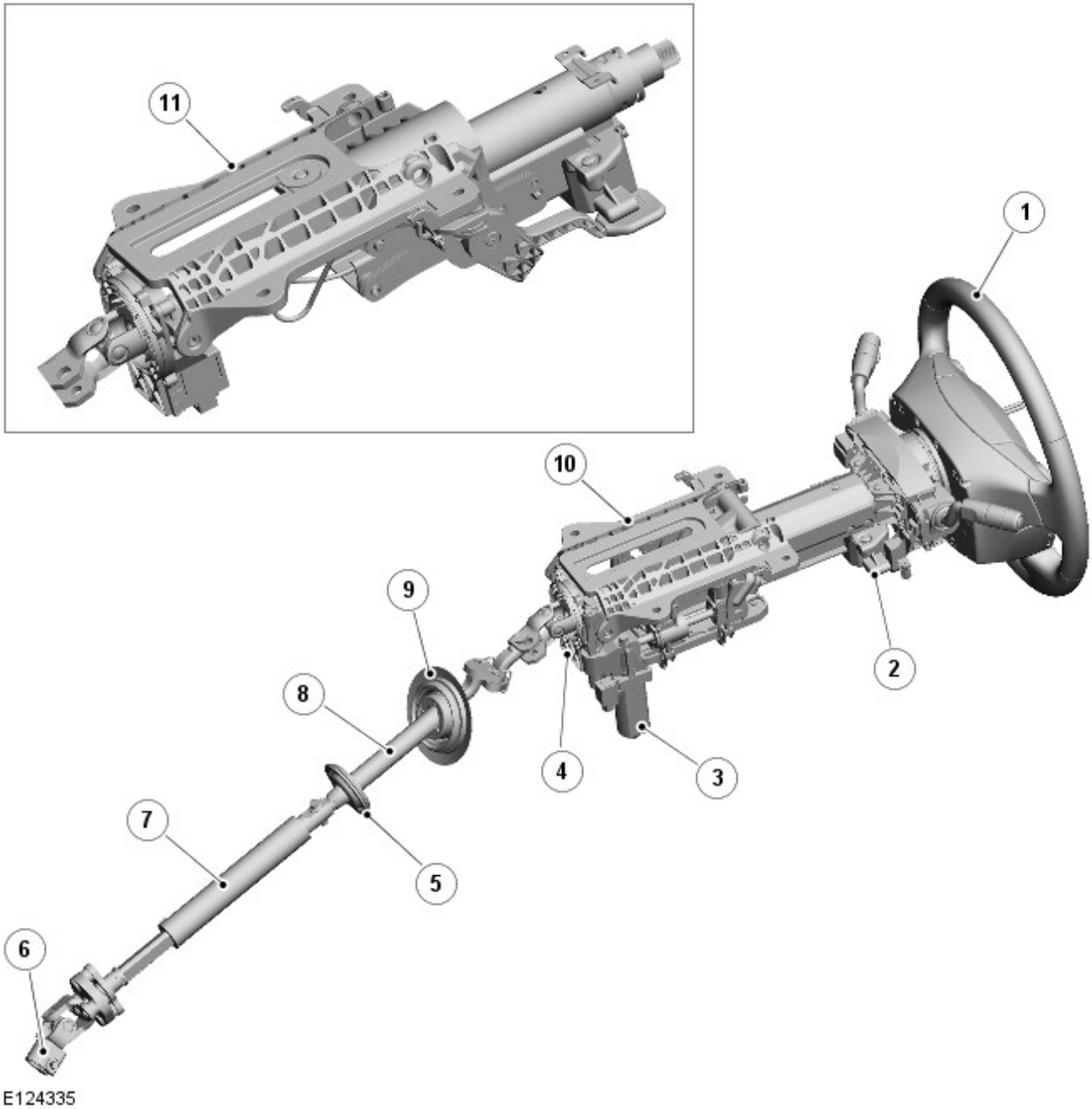
Torque Specifications

Description	Nm	lb-ft
Steering angle sensor Torx screws	3	2
* Steering column intermediate shaft to lower shaft bolts	30	22
* Steering column intermediate shaft to steering column nut	22	16
Steering column switch assembly Torx bolts	3	2
Steering wheel bolt	63	46

*** New bolts/nut must be installed**

Steering Column - Steering Column
Description and Operation

Component Location



E124335

Item	Part Number	Description
1	-	Steering wheel
2	-	Electronic steering lock
3	-	Electric motor
4	-	Steering angle sensor
5	-	Bulkhead mounting
6	-	Lower collapsible shaft yoke
7	-	Lower collapsible shaft
8	-	Intermediate shaft
9	-	Gaitor
10	-	Upper steering column assembly - Electric
11	-	Upper steering column assembly - Manual

Overview

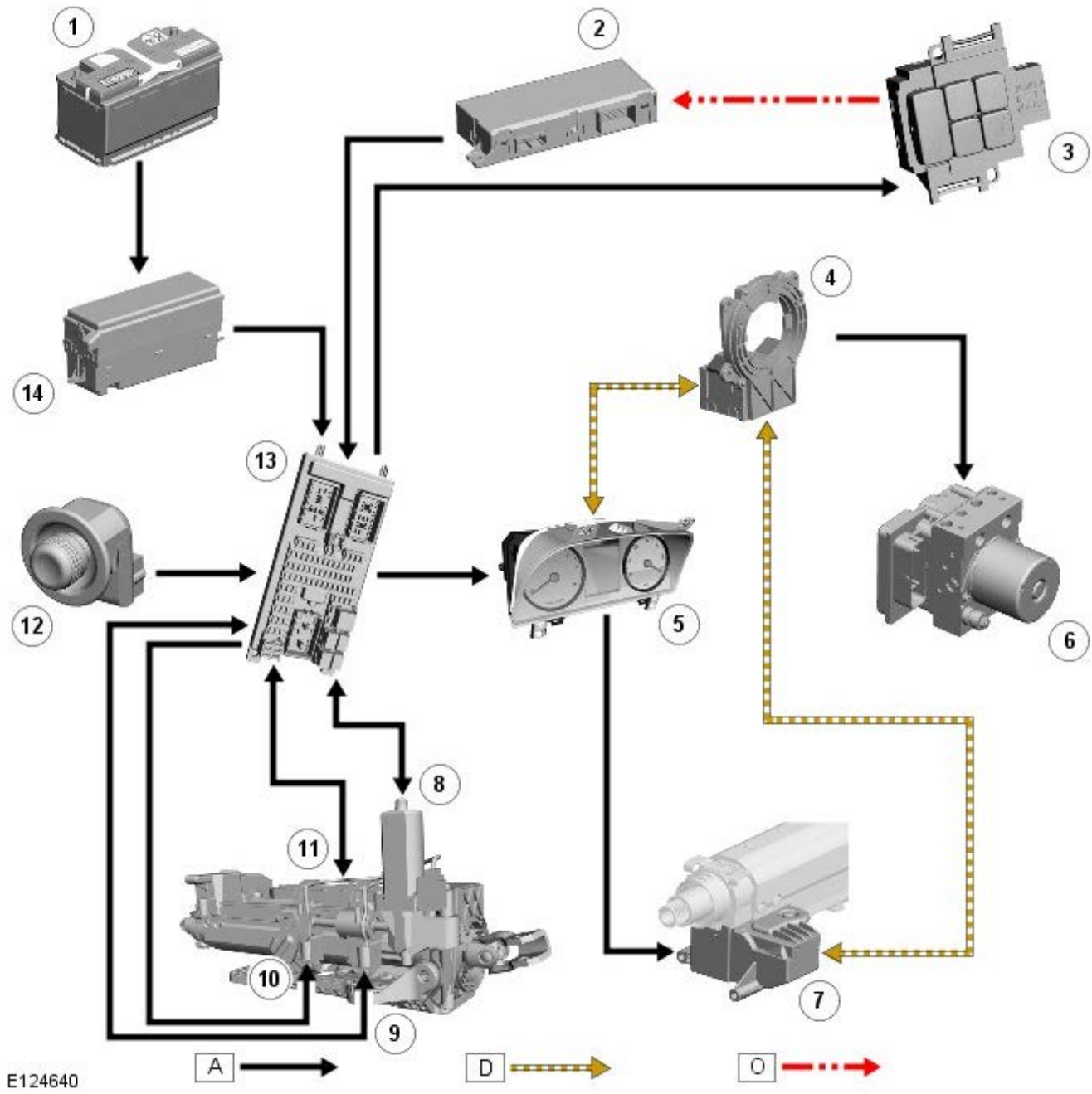
The steering column comprises the upper column assembly, the intermediate shaft and the lower collapsible shaft. The three components are positively connected together to pass driver rotary input from the steering wheel to a

linear output of the steering rack.

The upper steering column assembly is electronically adjustable for steering wheel reach and rake and is controlled by the CJB (central junction box). The upper steering column assembly also provides the location for the electronic steering lock mechanism and the steering angle sensor.

Control Diagram

NOTE: A = Hardwired; D = High-speed CAN (controller area network) bus; O = LIN (local interconnect network) bus

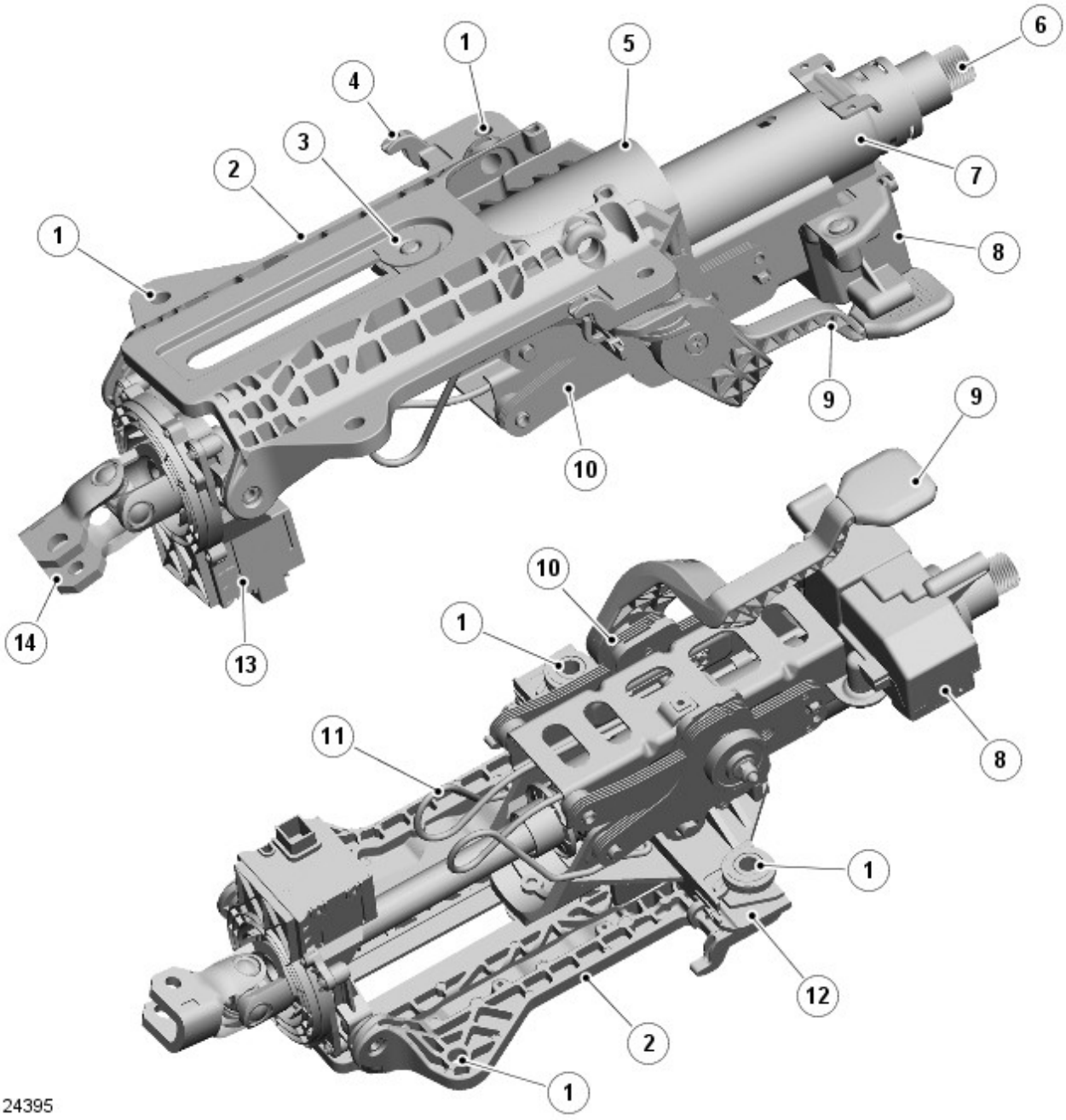


Item	Part Number	Description
1	-	Battery
2	-	Driver seat module
3	-	Driver memory switch pack
4	-	Steering angle sensor
5	-	Instrument cluster
6	-	ABS module
7	-	Electronic steering lock
8	-	Reach/rake motor
9	-	Reach solenoid and clutch
10	-	Rake solenoid and clutch
11	-	Potentiometer

12	-	Steering column switch
13	-	CJB
14	-	EJB

Component Description

Upper Column Assembly - Manual



E124395

Item	Part Number	Description
1	-	Attachment holes
2	-	Roof bracket
3	-	Screw
4	-	Locating hook
5	-	'U' bracket
6	-	Steering wheel splines
7	-	Main body
8	-	Electronic steering lock
9	-	Adjustment lever
10	-	Clamp plate assembly
11	-	Adjustment balance spring (2 off)
12	-	Shearing capsule (2 off)
13	-	Steering angle sensor
14	-	Swing yoke

The steering column is attached to the in-vehicle crossbeam and secured with four, 8 mm thread forming, pan head Torx drive screws. The two forward attachment screws are fixed through the column mounting bracket, the two rearward mounting screws also pass through the shearing capsules. In the event of a high energy frontal impact, the shearing capsules remain fixed to the crossbeam, but the 'U' bracket (with the main body) disengages from the capsules, allowing the column to shorten axially (collapse), with the coiled straps absorbing energy to reduce occupant loading.

 WARNING: Take care when handling the column not to trap fingers if releasing the adjustment lever at any point during the removal procedure when the column is not in the vehicle. The balance springs will cause the column to rapidly move to its uppper-most position.

The column comprises a cast magnesium roof bracket which is attached to the in-vehicle crossbeam. Attached to the roof bracket is a pivot housing, a 'U' bracket, upper and lower shafts and a main body. The roof bracket has two hooks which locate in slots in the in-vehicle crossbeam. The hooks assist in supporting the weight of the column during removal or installation.

The pivot housing is attached to the forward end of the roof bracket with two pivot pins. The pivot housing allows for adjustment of the column rake and contains a bearing which supports the column lower shaft.

The 'U' bracket is attached to the roof bracket by a screw, bush and plastic washer assembly (third fixing) located in a slot in the top of the roof bracket. When the column is assembled into the vehicle, the shearing capsules, which are attached to the 'U' bracket, are clamped up against the roof bracket by the fixing screws, preventing movement of the 'U' bracket. The bolts also pass through rectangular section steel straps, which at one end, have coils that locate around a plastic bush (positioned on the shearing capsule). The straps are used to control the rate of column collapse, in the event of a high energy frontal impact.

The main body is positioned in the 'U' bracket via the lever bolt. The bolt is captive within the vertical slots in the 'U' bracket and the horizontal slots in the main body. The bolt also passes through the clamp plate assemblies (one on either side of the 'U' bracket). The body houses the middle and upper bearings through which the upper shaft is located. Two offset holes in the main body provide for the attachment of the electronic steering lock assembly.

The upper and lower shafts are located through the length of the column assembly. The upper shaft is supported in two bearings in the main body and the lower shaft is located in the upper shaft and supported in a bearing in the pivot housing. The lower shaft has a tubular section with external splines. These mate with the internal splines in the upper shaft. The purpose of the splines is to transmit rotational movement of the upper shaft to the lower shaft, but allowing the two components to telescope into each other in the event of a collision. The length of the splined sections allow for 120 mm (4.72 in) of linear movement. The lower shaft is fitted with a universal joint spider to which a swivel yoke is attached. The swivel yoke attaches to the intermediate shaft of the steering column on the interior side of the bulkhead using a special cam bolt and self-locking nut.

A steering angle sensor is attached to the pivot housing of the column and its centre gear is rotated by a drive collar which is attached to the lower shaft and rotates with movement of the steering wheel. The sensor transmits steering angle data on the high speed CAN bus which is used by various systems on the vehicle. The steering angle sensor is designed to become detached from the column in the event of a frontal impact. Care must be taken when handling the column assembly to prevent accidental damage to the sensor.

The upper steering column assembly houses the electronic column lock mechanism and control module.

The steering column is adjustable for reach and rake. The column can be adjusted for 40 mm (1.57 in) of reach adjustment and 6º of rake adjustment. The adjustment mechanism comprises an adjustment lever, a cam plate, a lever bolt and nut, two brake pads and two clamp plate assemblies.

A plastic adjustment lever is located on the underside of the column assembly and is attached to a cam plate. When the lever is pulled downwards, the cam plate rotates and releases tension in the lever bolt. The lever bolt also passes through two sets of clamp plate assemblies. When the lever is moved upwards, the cam plate rotates applying tension to the lever bolt, which applies pressure to the brake pads which in turn apply pressure to the clamp plate assemblies (which lock the column in the desired position). The lever bolt is retained by a self-locking lever nut, which abuts a thrust bearing.

 WARNING: Under no circumstances should the lever nut torque be reduced, as this will reduce the clamping efficiency of the adjustment mechanism possibly affecting the stability of the column during a frontal impact.

The pivot housing is attached to the roof bracket with two pivot pins. When the rake adjustment is operated, the pivot housing rotates around the pivot pins to allow for the up and down adjustment, but maintains a positive location to the roof bracket. An adjustment spring is fitted between the 'U' bracket and the main body, to counteract the weight of the main body, upper shaft, steering wheel and airbag, preventing the steering wheel from dropping rapidly when the adjustment lever is released.

In the event of a high energy frontal impact, the upper column assembly is designed to axially collapse reducing impact injury to the driver. A number of components interact together to ensure that the collapse of the column is in a controlled manner. The following components control the column collapse:

- Pressure washer and bush (third fixing)
- Shearing capsules
- Straps
- Upper and lower shaft (splined) connection

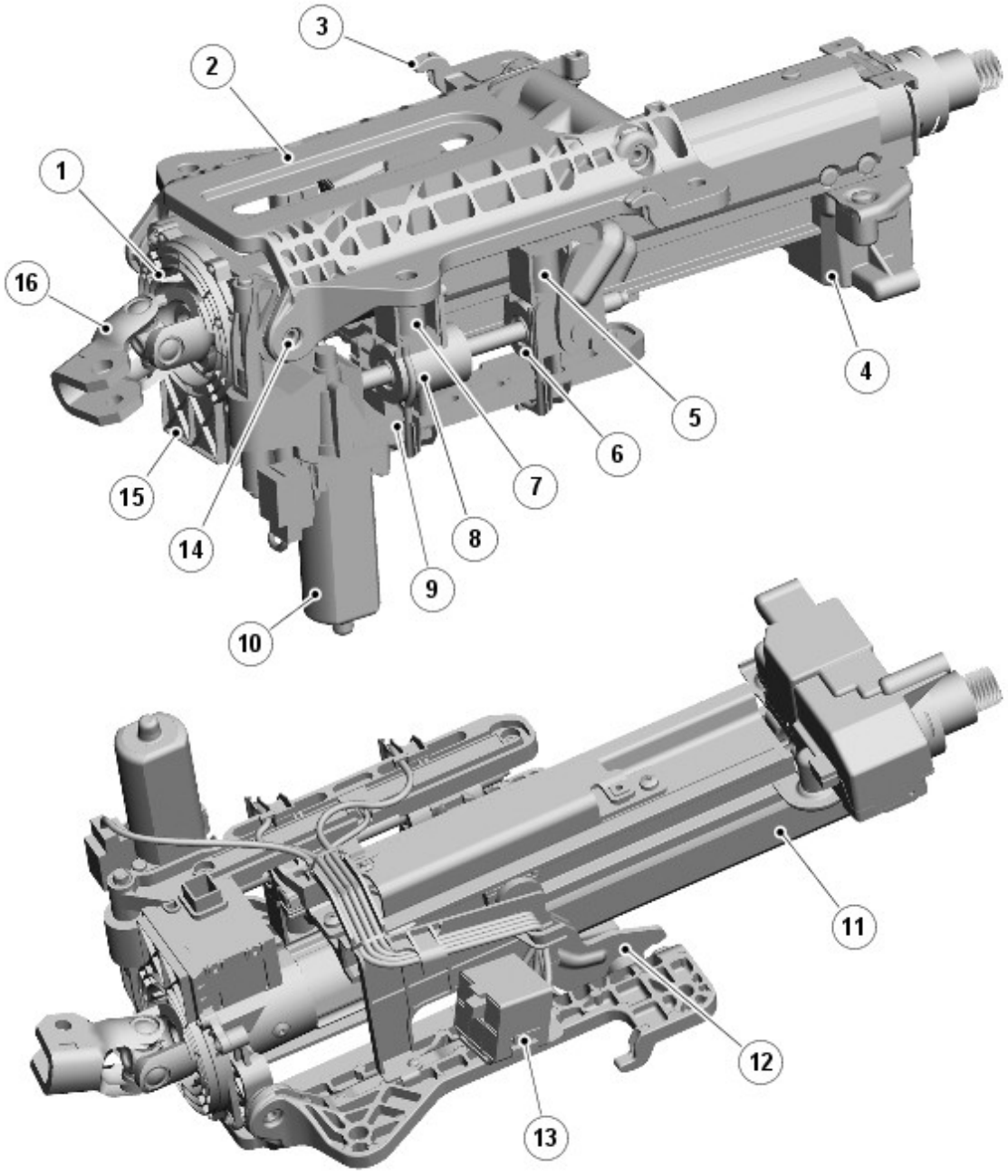
The shearing capsules have a central hole through which the rearward attachment bolts pass through into the roof bracket. The capsules are located in the 'U' bracket by tapered slots, which have small cut-outs in the inside faces. The shearing capsules have a number of small holes which align with the cut-outs in the 'U' bracket. When the capsules are installed, plastic is injected into the holes and cut-outs. This plastic retention of the capsules provides the initial controlled break-out force for the column in the event of a collision. After 10 mm of displacement, the 'U'

bracket is no longer located by the shearing capsules. When handling the column, care should be taken that the shearing capsules are not impacted or dislodged.

The tension in the 'Third Fixing' screw, applies a clamp load to the roof bracket (via the bush and compression washers). In the event of a collision, this clamp load (supplementary to the shearing capsules) must be overcome before the column can collapse. When this load has been exceeded (and the fixing has been displaced 20 mm (0.79 in)) it slides easily within the roof bracket slot, providing directional control to the column, as it collapses. Under no circumstances should the screw torque be adjusted.

The straps are rectangular section steel, which at one end, have coils that locate around a plastic bush (positioned on the shearing capsule). The other end is formed into a hook which locates within a slot in the 'U' bracket. When a collision has occurred, and the 'U' bracket has been displaced from the shearing capsules by 8 mm (0.3 in), the straps begin to un-roll due to the displacement of the 'U' bracket. The straps provide the main element for energy absorption as the column collapses. The cross section of the straps change after approximately 40 mm (1.6 in) of extension, changing the amount of energy that they absorb.

Upper Column Assembly - Electric



E124336

Item	Part Number	Description
1	-	Pivot housing
2	-	Roof bracket
3	-	Locating hook
4	-	Electronic steering lock
5	-	Rake solenoid
6	-	Rake clutch
7	-	Reach solenoid

8	-	Reach clutch
9	-	Potentiometer
10	-	Electric motor
11	-	Outer profile
12	-	Rake lever
13	-	Electrical connector
14	-	Pivot pin
15	-	Steering angle sensor
16	-	Swing yoke

The steering column is attached to the in-vehicle crossbeam and secured with four, 8mm, thread forming, pan head Torx drive screws. In the event of a high energy frontal impact, a strap and shear pin on the underside of the column provides a controlled collapse of the outer housing on the inner housing, allowing the column to shorten axially (collapse), absorbing energy to reduce occupant loading.

The column comprises a cast magnesium roof bracket which is attached to the in-vehicle crossbeam. Attached to the roof bracket is a pivot housing, a outer housing and upper and lower shafts. The roof bracket has two hooks which locate in slots in the in-vehicle crossbeam. The hooks assist in supporting the weight of the column during removal or installation.

The rake lever locates the aluminum outer profile, into which is fixed the electronic steering lock adaptor. The inner profile is located within the outer profile, by 2 linear bearing assemblies, which allow a telescopic action for the reach adjustment.

The assembly of the upper and lower shafts is located within the column by the bearings in the electronic steering lock adaptor and the pivot housing. Both shafts are tubular. The lower shaft has external splines (which are over molded with nylon), and these mate with the internal splines in the upper shaft. The purpose of the splines is to transmit rotational movement of the upper shaft to the lower shaft, yet allow telescopic movement during column axial collapse. The lower shaft is fitted with a universal joint spider to which a swivel yoke is attached. The swivel yoke attaches to the intermediate shaft of the steering column on the interior side of the bulkhead using a special cam bolt and self-locking nut.

A steering angle sensor is attached to the pivot housing of the column and its centre gear is rotated by a drive collar which is attached to the lower shaft and rotates with movement of the steering wheel. The sensor transmits steering angle data on the high speed CAN bus which is used by various systems on the vehicle. The steering angle sensor is designed to become detached from the column in the event of a frontal impact. Care must be taken when handling the column assembly to prevent accidental damage to the sensor.

The upper steering column assembly houses the electronic column lock mechanism and control module.

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 rake clutch and a reach clutch.

The column adjustment is controlled by the driver using a joystick switch located on the left hand side of the column 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 single electric motor is used for both adjustment ranges. The switch selection uses the applicable solenoid, engaging the applicable clutch on the lead screw.

When the auto function is activated, the steering column will adjust to the uppermost tilt position with ignition off, and re-adjust to the previous set position, with ignition on.

For the reach adjustment, the lead screw drives the outer housing in or out as required. For the rake adjustment, the lead screw drives a rake lever which moves the column up or down as applicable.

The pivot housing is attached to the roof bracket with two pivot pins. When the rake adjustment is operated, the pivot housing rotates around the pivot pins to allow for the up and down adjustment, but maintains a positive location to the roof bracket.

The electric steering column is linked to and controlled by the memory control module. The memory control module provides storage of three separate memory positions which are stored against three individual vehicle keys.
For additional information, refer to: Seats (501-10 Seating, Description and Operation).
. The electric column also has an easy egress feature which lifts the column to its maximum rake to allow easier access to the vehicle.

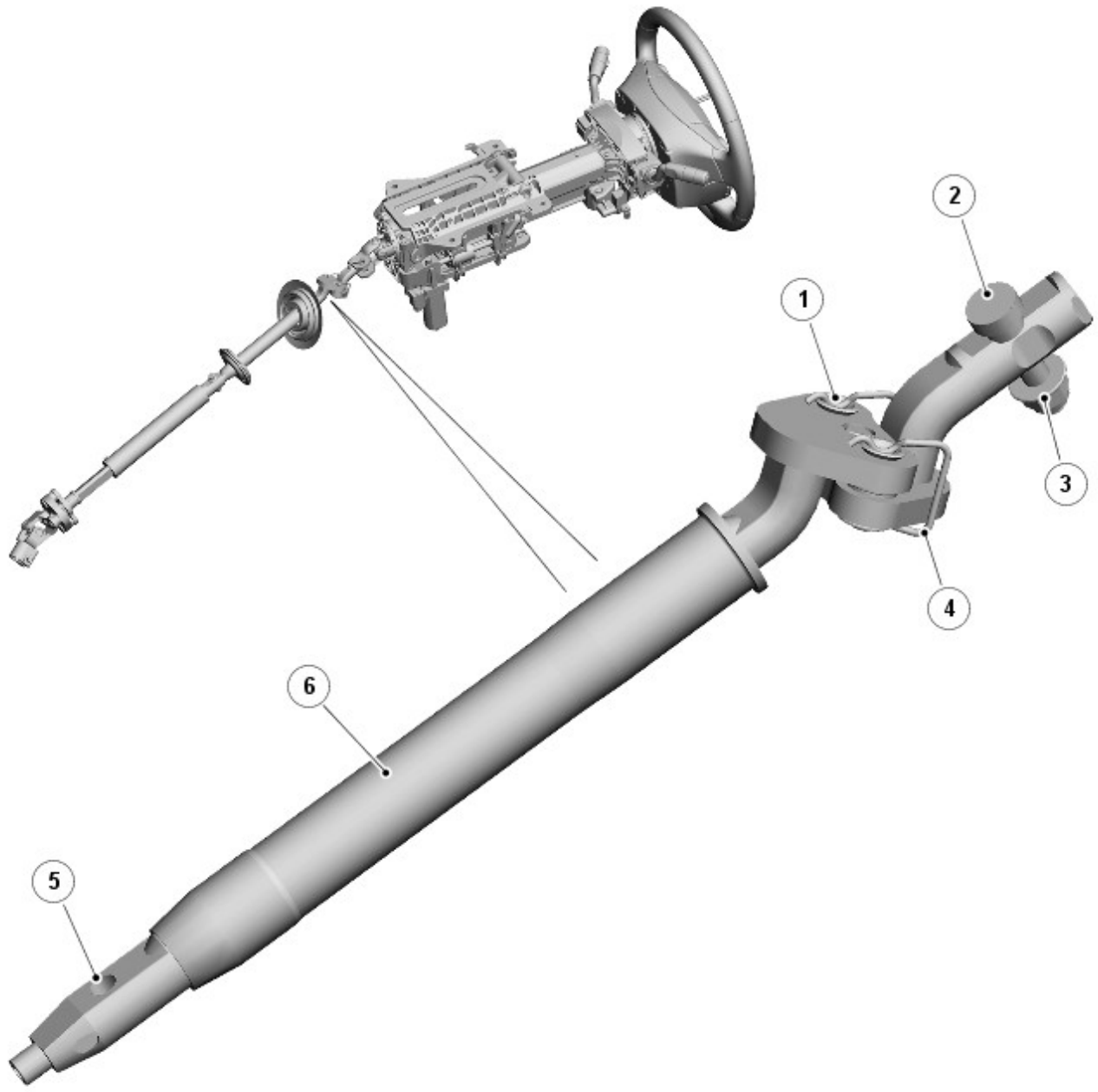
In the event of a high energy frontal impact, the upper column assembly is designed to collapse reducing impact injury to the driver. A number of components interact together to ensure that the collapse of the column is in a controlled manner. The following components control the column collapse:

- Shear pin
- Strap
- Upper and lower shaft (splined) connection

The strap is rectangular section steel, which is secured by two Allen screws to the outer housing and by a shear pin to the strap guide. The strap provides the main element for energy absorption as the column collapses. To initiate axial movement of the column, the shear pin has to be severed, friction between several column interfaces has to be overcome, and an axial load applied sufficient to initiate strap guide deformation. Once the column is telescoping, deformation of the strap guide, and sliding friction between column interfaces, absorbs the energy of the occupant in a controlled manner, as the column collapses.

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

Intermediate Shaft



E124337

Item	Part Number	Description
1	-	Load limiter pins
2	-	Cam bolt
3	-	Self-locking nut
4	-	Retention spring
5	-	Attachment hole
6	-	Seal sleeve

CAUTION: Care should be taken when handling the intermediate shaft, to ensure that it is not subject to impacts or that the retention spring is not displaced.

The non-handed, intermediate shaft is attached at its upper end to the swivel yoke on the lower shaft of the steering column assembly. The intermediate shaft comprises two main parts; the upper and lower axis which are joined together with a shear joint.

The upper axis has a cut-out in the shaft which allows for the fitment of the cam bolt. Only when the shaft is located correctly in the swivel yoke, can the cam bolt be inserted. A self-locking nut is fitted to the cam bolt. The torque applied as the nut is tightened, rotates the bolt, forcing the cam against the shaft, positioning it correctly in the swivel yoke prior to the joint being clamped.

NOTE: If the self-locking nut is removed for any reason, it is recommended that a new, correct nut is fitted to maintain the optimum torque on the cam bolt.

The lower axis is fitted with a plastic molded seal sleeve which provides a suitable surface for the location of the plastic bearings within the two bulkhead seals. The bottom of the lower axis is machined to a double 'D' shape which tapers at the end. One side of the taper has a slot which is used to align the intermediate shaft and the lower collapsible shaft to ensure that the correct orientation of the steering wheel to steering gear is maintained. A hole is drilled through the double 'D' shape and provides for attachment of the intermediate shaft to the lower collapsible shaft.

The upper and lower axis, are joined together via a load limiter. The load limiter is designed to disconnect the upper and lower axis in the event of a high energy frontal impact preventing an excessive load being applied to the steering column (causing intrusion into the passenger compartment or an unstable airbag deployment).

The load limiter comprises two plates which are part of the upper and lower axis. The plates have a central 'guide' pin, and two retention pins, which pass through bushes in the plates, onto which a rubber and steel washer are staked in position. The size of the staking controls the load at which the lower axis separates from the upper axis. A wire 'retention' spring is also fitted to the load limiter.

Lower Collapsible Shaft



Item	Part Number	Description
1	-	Bolt
2	-	Heat shield
3	-	Female shaft
4	-	Male shaft
5	-	Plastic spacer
6	-	Flexible coupling
7	-	Universal joint

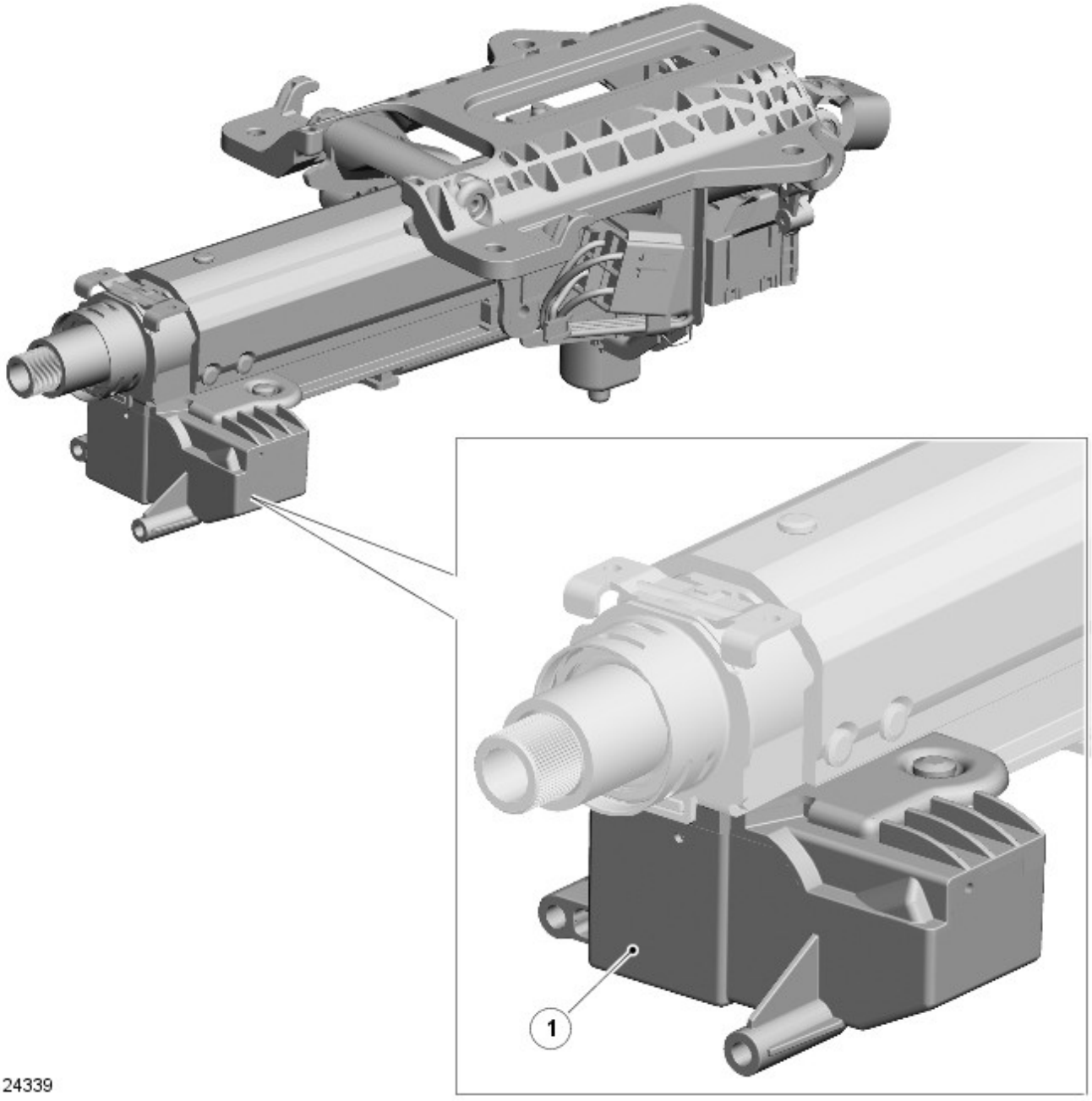
8 - Torx bolt

The lower collapsible shaft is a handed component and the correct component must be fitted to ensure that the steering phase angle is maintained. The shaft is attached at its upper end to the intermediate shaft and at its lower end to the valve unit pinion on the steering gear. These attachment joints can only be fitted in one orientation to ensure the correct alignment of the steering wheel to the steering gear. The shaft comprises two female and male shafts which are a telescopic fit on each other. The male shaft can slide up to 77 mm (3.03 in) within the female shaft in the event of a frontal impact, to minimize the effect of frontal intrusion. The sliding fit also allows for dynamic displacement between the chassis and the body during severe off-road driving. A plastic spacer is fitted to the male shaft which is only used as an assembly aid during vehicle production and serves no function once the shaft is assembled to the vehicle.

The female shaft is a triangular section tube which is formed to a double 'D' hole at its upper end which mates with the intermediate shaft. An indentation pressed in the wall of the tube ensures the correct alignment between the intermediate shaft and the lower collapsible shaft. A captive nut, clinched to one side of a hole in the double 'D' section, allows for the fitment of a patchlock bolt to secure the intermediate shaft. Clamped around the end of the female shaft is a dust seal which prevents the ingress of dirt and moisture into the sliding joint, and a heat sleeve is also fitted to reflect radiant heat from the exhaust.

The male shaft is a triangular section tube which is staked at its lower end into a flange. A cage and curved 'spring plates' are fitted to its upper end, which slide in the female shaft. A pin is fitted into the side of the female tube, to secure the male tube in the bore. The lower end of the male shaft is fitted with a flexible coupling to absorb vibration and steering 'kick back', transmitted from the steering gear. A 'stabilizing pin' is fitted through the coupling to prevent coupling articulation (acting as a universal joint), while still allowing rotational flexing and plunge movement. The coupling is a rubber molding within which are nylon fibres wound around the attachment holes to transmit torque applied to the steering. The coupling is attached to a drive flange (which is part of the male shaft), and to the 'U' yoke which in turn is connected to the pinion yoke, by the universal joint assembly.

Electronic Steering Column Lock



Item	Part Number	Description
1	-	Electronic steering column lock

With the passive start system, a conventional steering lock mechanism cannot be used. An electronic system was developed which comprises a steering column assembly locking unit with an integrated control module. The steering lock is operated with the door locks when the vehicle is locked or unlocked. A control module, located inside the steering column, controls a motor, releasing the steering lock when appropriate.

The upper steering column assembly houses the column lock mechanism and control module. The components are assembled with non-removable pins for security reasons and are therefore non-serviceable. Failure of any steering lock components will require replacement of the upper steering column assembly.

The steering column lock comprises a locking motor and locking bolt. The locking motor drives a cam, which moves the locking bolt into and out of engagement with the locking sleeve on the steering column. The locking motor is fitted with a Hall effect sensor, which informs the control module of the position (locked/unlocked) of the steering lock mechanism.

Steering Column - Steering Column

Diagnosis and Testing

For additional information.
REFER to: Steering System (211-00, Diagnosis and Testing).

Steering Column - Steering Column
Removal and Installation

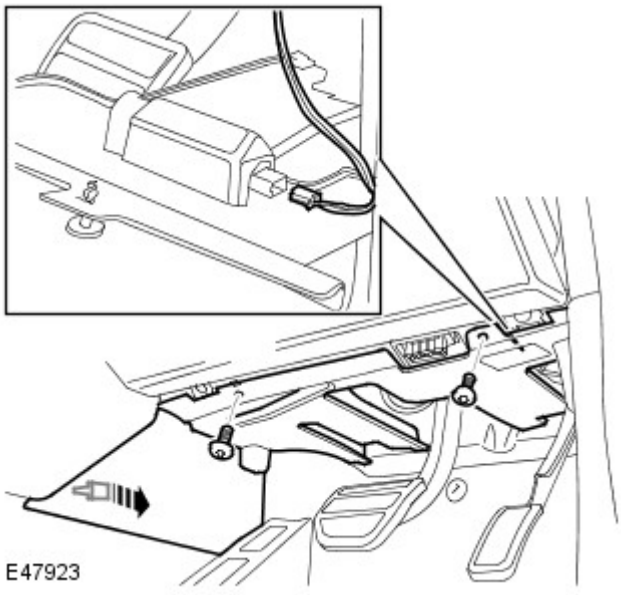
Removal

WARNING: Take care if releasing the adjustment lever when the column has been removed from the vehicle. The spring is under a high tension, and if released, could cause personal injury. Make sure fingers are clear from any areas, likely to be trapped.

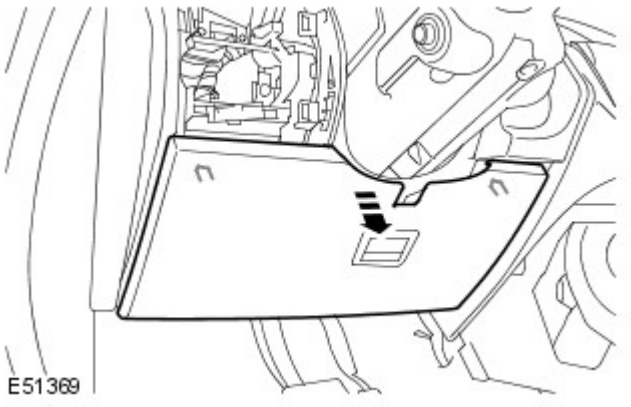
CAUTION: Air tools MUST NOT be used on steering column bolts.

All vehicles

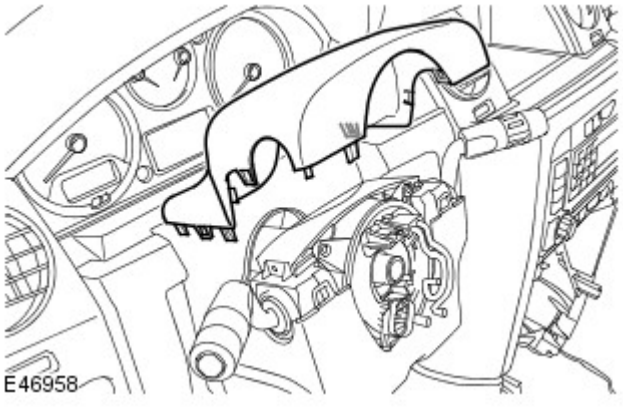
1. Fully extend the steering column for access.
2. Remove the steering wheel.
   For additional information, refer to: Steering Wheel (211-04, Removal and Installation).
3. Remove the drivers side register trim panel.
   For additional information, refer to: Driver Side Register Trim Panel (412-01, Removal and Installation).
4. Remove the driver side closing trim panel.
   - Release the clip.
   - Remove the 2 screws.
   - Disconnect the electrical connector.



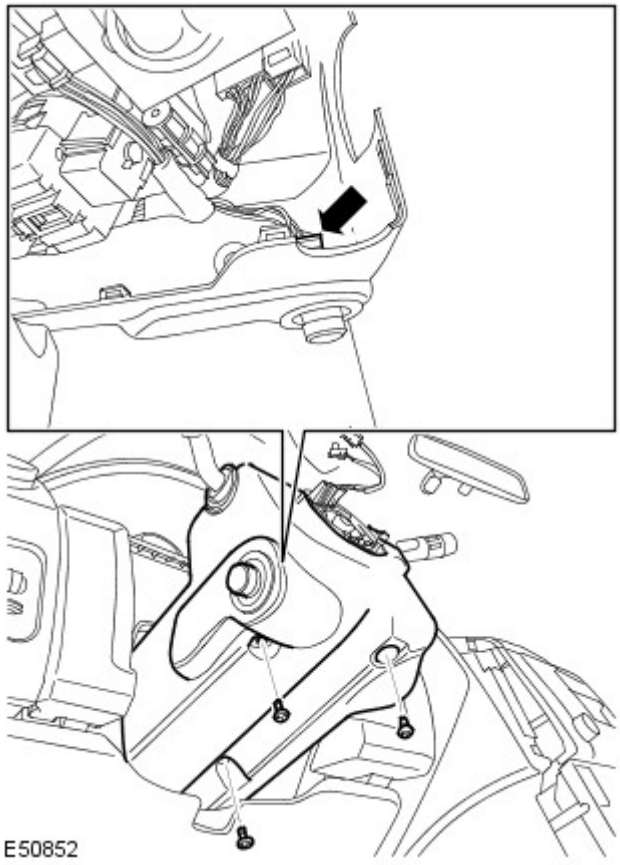
5. Remove the instrument panel access panel.
   - Release the 2 clips.



6. Remove the steering column upper shroud.
   - Release the 6 clips.



7. Remove the steering column lower shroud.
    - Remove the 3 Torx screws.
    - Disconnect the electrical connector.

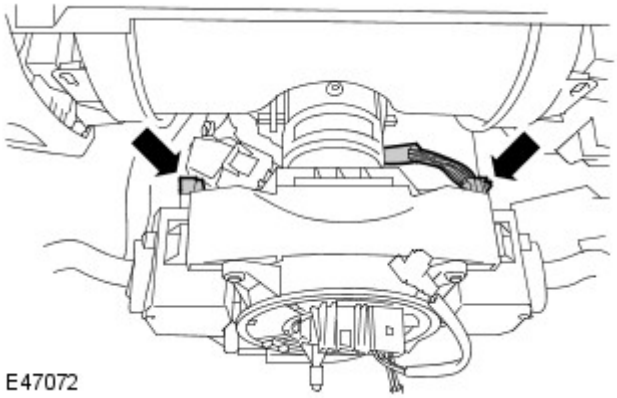


8. Remove the steering column side trim panel.
    - Release the 10 clips.
    - Disconnect the 3 electrical connectors.



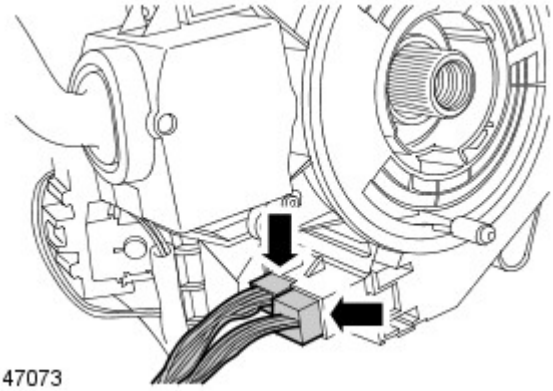
E122692

9. Disconnect the 2 electrical connectors from the steering column multifunction switches.



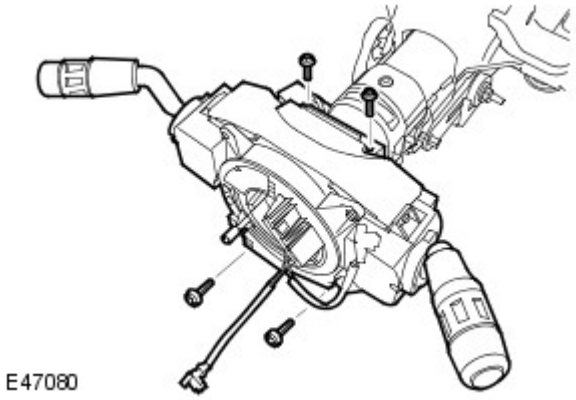
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10. Disconnect the 2 electrical connectors from the clockspring.

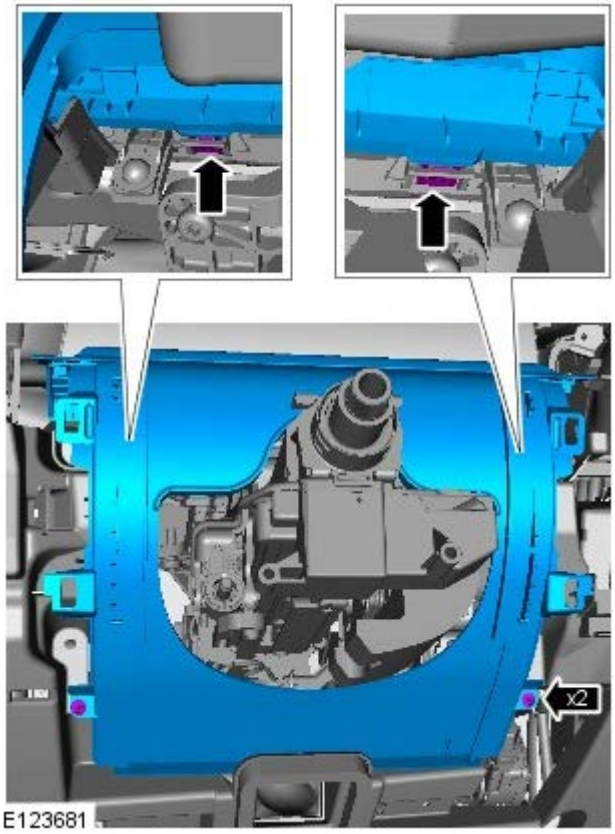


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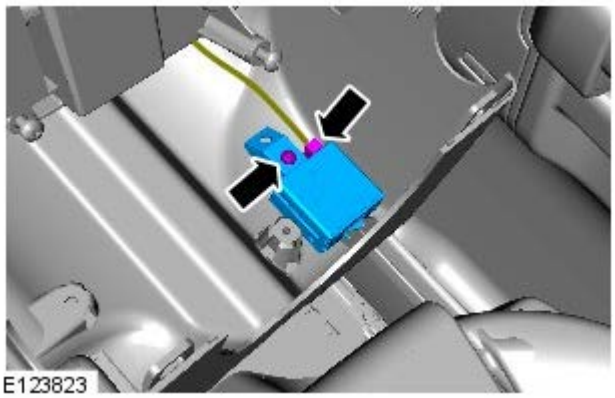
11. Remove the steering column switch assembly.
    - Remove the 4 Torx bolts.



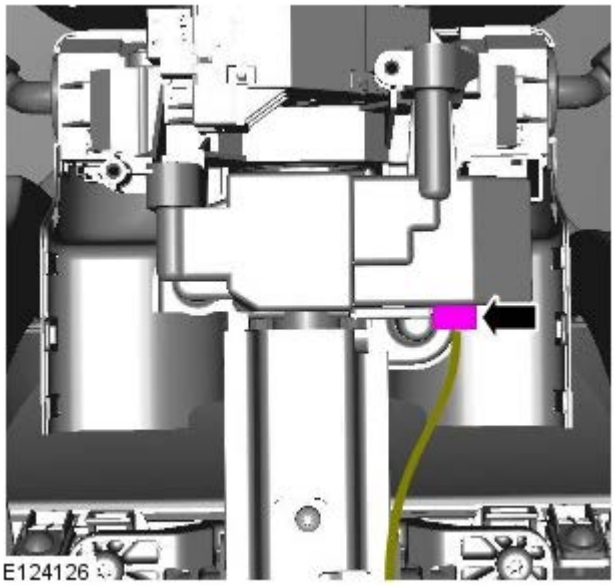
12. Remove the steering column gaiter panel.
    - Remove the 2 Torx screws.
    - Release the 2 clips.



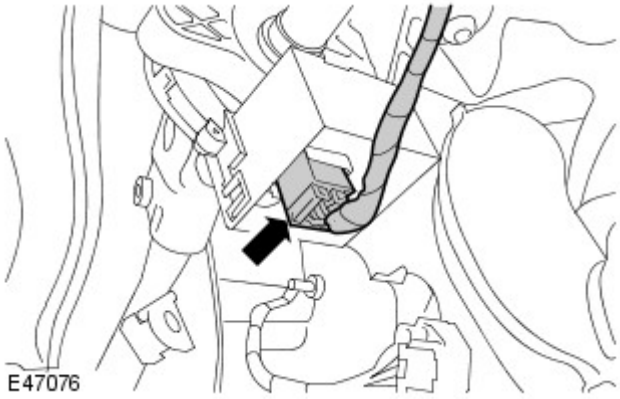
13. Disconnect the smart key antenna.



14. Disconnect the steering column lock electrical connector.



15. Disconnect the steering angle sensor electrical connector.



Vehicles with electric steering column

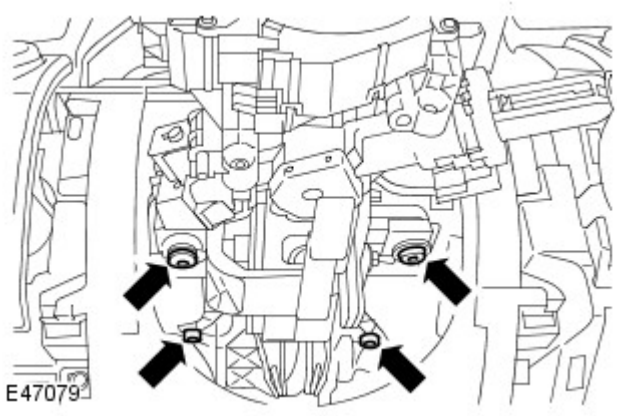
16. Disconnect the steering column adjustment motor electrical connector.



17. Disconnect the steering column intermediate shaft from the steering column.
    - Note the fitted position.
    - Remove the special bolt and discard the nut.



18. WARNING: Take care if releasing the



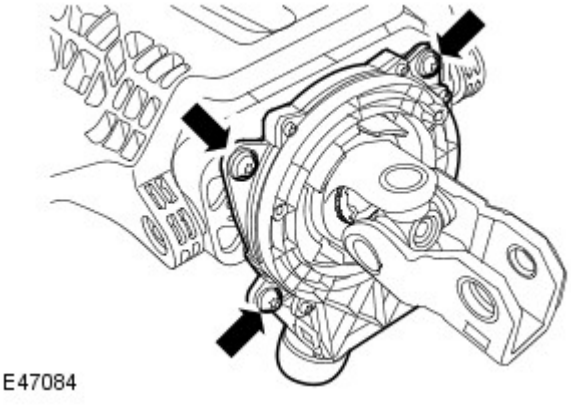
adjustment lever when the column has been removed from the vehicle. The spring is under a high tension, and if released, could cause personal injury. Make sure fingers are clear from any areas, likely to be trapped.

CAUTION: If the steering angle sensor is damaged upon removal of the steering column, the sensor MUST be replaced.

With assistance, remove the steering column.

- Remove the 4 Torx bolts.

19. Remove the steering angle sensor.
    - Remove the 3 Torx screws.



Installation

Vehicles with electric steering column

1. CAUTION: The potentiometer adjustment values are unique for each steering column. Failure to enter the correct code during calibration may result in damage to the vehicle.

   Note the potentiometer hexadecimal code on the new steering column label for future reference.



E102064

All vehicles

2. Install the steering angle sensor.
    - Tighten the Torx screws to 3 Nm (2.2 lb.ft).

3. CAUTIONS:

   Make sure the bolt holes are clean and free of swarf.

   The steering column bolts must by tighted by hand a minimum of 3 revolutions.

   Air tools MUST NOT be used on steering column bolts.

   With assistance, install the steering column.
    - Tighten the bolts in sequence to 25 Nm (18 lb.ft).

4. Connect the steering column intermediate shaft.
    - Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).

5. Secure the wiring harness to the steering column.

Vehicles with electric steering column

6. Connect the steering column adjustment motor electrical connector.

All vehicles

7. Connect the steering angle sensor electrical connector.
8. Connect the steering column lock electrical connector.
9. Connect the smart key antenna.
10. Install the steering column gaiter panel.
    - Secure with the clips.
    - Tighten the Torx screws.
11. Install the steering column switch assembly.
    - Tighten the Torx bolts to 3 Nm (2 lb.ft).
12. Connect the clockspring and multifunction switch electrical connectors.
13. Install the steering column side trim panel.
    - Secure with the clips.
14. Install the steering column shrouds.
15. Install the instrument panel access panel.
    - Secure with the clips.
16. Install the closing trim panel.
    - Connect the electrical connector.
    - Secure the clip.
    - Tighten the screws.
17. Install the steering wheel.
    For additional information, refer to: Steering Wheel (211-04, Removal and Installation).
18. Install the drivers side register trim panel.
    For additional information, refer to: Driver Side Register Trim Panel (412-01, Removal and Installation).
19. Calibrate the steering angle sensor using the Land Rover approved diagnostic tool.

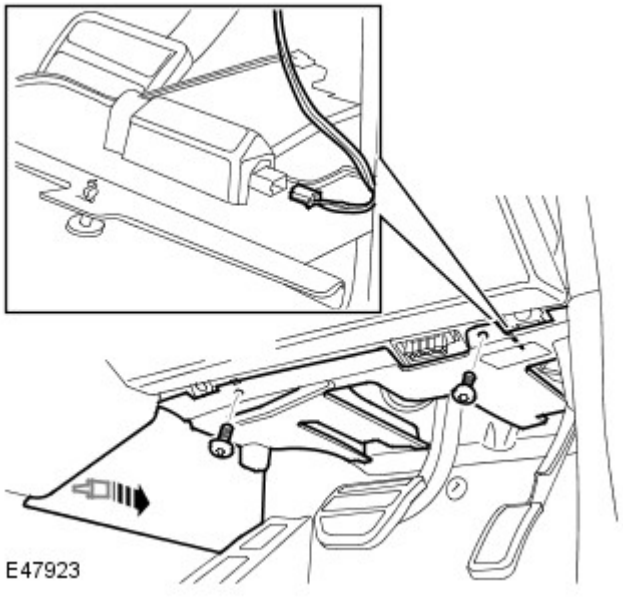
Vehicles with electric steering column

20. If a new electric steering column is fitted re-calibrate the steering column potentiometer using the Land Rover approved diagnostic system.

Steering Column - Steering Column Shaft
Removal and Installation

Removal

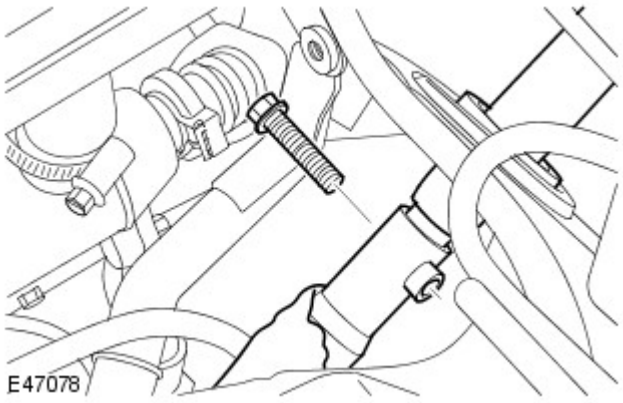
1. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).



2. Remove the driver side closing trim panel.
   - Release the clip.
   - Remove the 2 screws.
   - Disconnect the electrical connector.



3. Disconnect the steering column intermediate shaft from the steering column.
   - Note the fitted position.
   - Remove the special bolt and discard the nut.

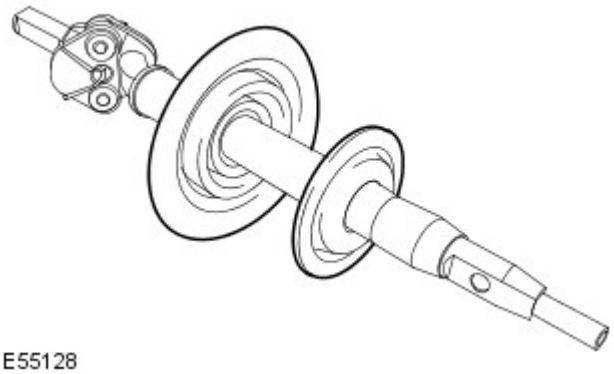


4. Disconnect the steering column intermediate shaft from the lower shaft.
   - Note the fitted position.
   - Remove and discard the bolt.

5. Remove the steering column intermediate shaft.
   - Release the 2 grommets.

6. NOTES:

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



E55128

Note the fitted position.

Remove the 2 intermediate shaft grommets.

Installation

1. Install the steering column intermediate shaft.
    - Install the grommets.

2. Connect the steering column intermediate shaft to the lower shaft.
    - Tighten the new bolt to 25 Nm (18 lb.ft).

3. Connect the steering column intermediate shaft to the steering column.
    - Install the special bolt and tighten the new nut to 22 Nm (16 lb.ft).

4. Install the driver side closing trim panel.
    - Connect the electrical connector.
    - Secure the clip.
    - Tighten the screws.

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

Steering Column - Steering Column Lower Shaft

Removal and Installation

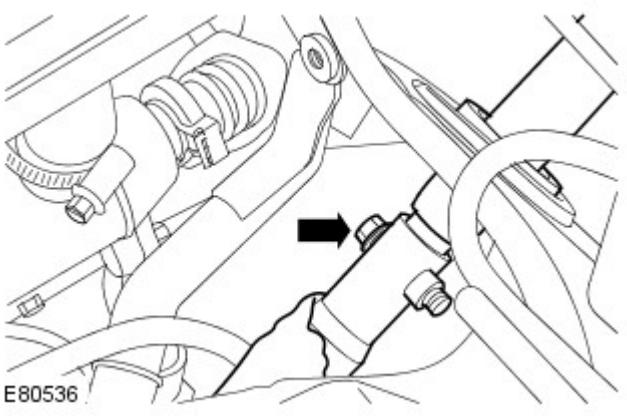
Removal

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

All vehicles

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

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



3. CAUTIONS:

   Make sure the steering wheel is in the straight ahead position.

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

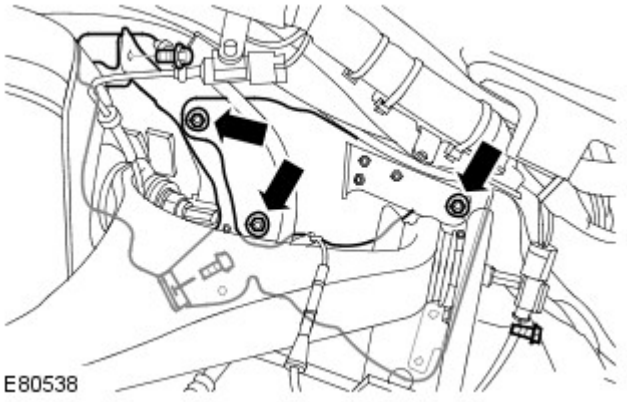
   NOTE: Note the fitted position.

   Remove and discard the steering column lower shaft upper bolt.

4. 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.

Vehicles with 3.6L diesel engine



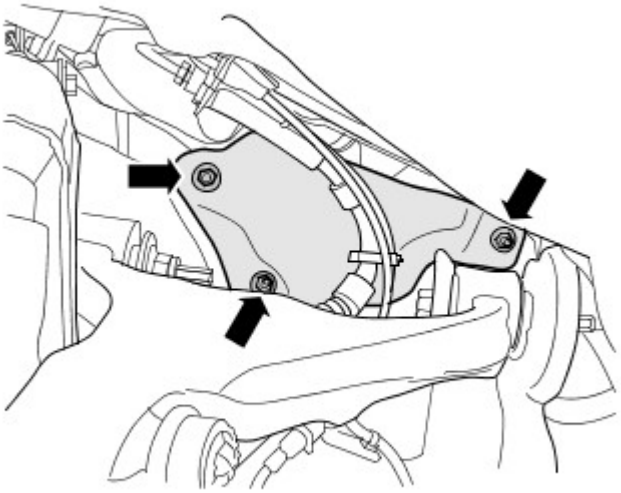
5. CAUTION: Make sure that the brake hose and the wiring harnesses are not damaged during the removal and installation of the heat shields.

   NOTE: Note the fitted position.

   Remove the upper suspension arm and brake line heat shields for access.
   - Remove the 3 nuts.
   - Remove the 2 bolts.

All other engine types

6. Remove the brake line heat shield for access.
   - Remove the 3 nuts.

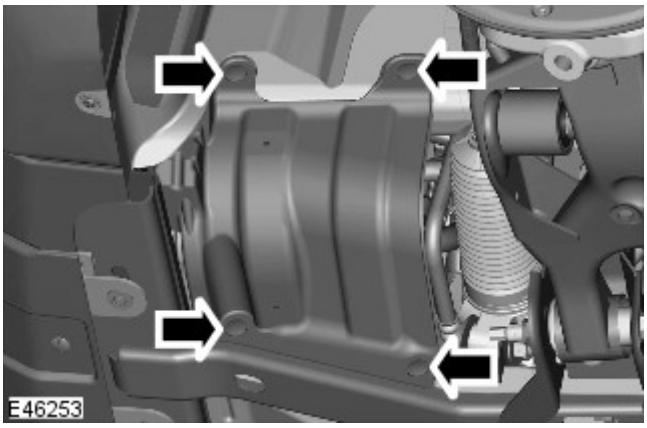


E102486

All vehicles

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

   Disconnect the steering column lower shaft from the intermediate shaft.

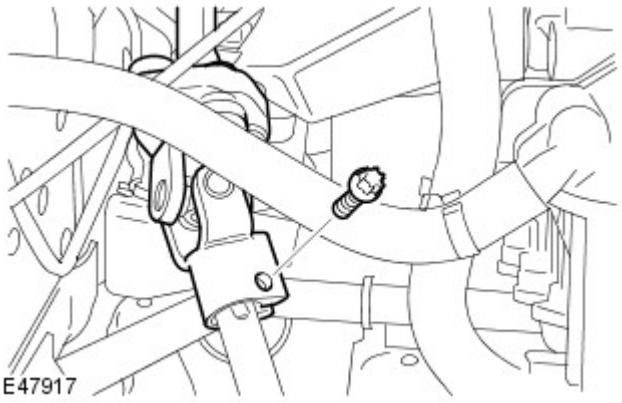


E46253

8. Remove the fender splash shield lower trim.
   - Remove the 4 clips.

9. CAUTION: Make sure that the steering is correctly positioned using the road wheels. Do not turn the steering wheel. Failure to follow this instruction my result in damage to the vehicle.

   Turn the steering until access can be gained to the steering column lower shaft bolt.



E47917

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

    Remove and discard the steering column lower shaft bolt.

Vehicles with 3.6L diesel engine

11. Lower the vehicle.

12. NOTE: The steering column lower shaft is removed from the vehicle through the inner wing.

    Remove the steering column lower shaft.
    - Disconnect the steering column lower shaft from the steering gear.

All other engine types

13. Disconnect the steering gear electrical connector.



14. Remove the steering column lower shaft.
    - Disconnect the steering column lower shaft from the steering gear.

Installation

All vehicles

1. Clean the component mating faces.

2. CAUTION: Make sure that the road wheels are in the straight ahead position.

    With assistance, install the steering column lower shaft.
    - Connect the steering column lower shaft to the steering gear.
    - Connect the steering column intermediate shaft to the lower shaft.

3. Lower the vehicle on the lift.

4. CAUTION: Make sure that a new bolt is installed.

    Install the steering column lower shaft upper bolt.
    - Install a new bolt and tighten to 30 Nm (22 lb.ft).

5. Raise the vehicle on the lift.

6. CAUTIONS:

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

    Make sure that the steering is correctly positioned using the road wheels. Do not turn the steering wheel. Failure to follow this instruction my result in damage to the vehicle.

    Turn the steering until access can be gained to the steering column lower shaft bolt.

7. CAUTION: Make sure that a new bolt is installed.

Install the steering column lower shaft to steering gear bolt.
- Install a new bolt and tighten to 30 Nm (22 lb.ft).

All other engine types

8. Connect the steering gear electrical connector.

All vehicles

9. Install the fender splash shield lower trim.
   - Install the 4 clips.

Vehicles with 3.6L diesel engine

10.  CAUTION: Make sure that the brake hose and the wiring harnesses are not damaged during the removal and installation of the heat shields.

    Install the upper arm and brake line heat shields.
    - Install the 3 nuts.
    - Install the 2 bolts.

All other engine types

11. Install the brake line heat shield.
    - Install the 3 nuts.

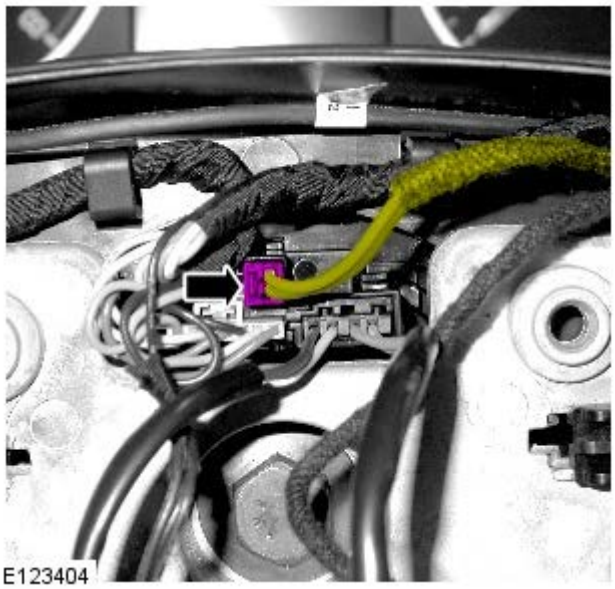
12. Lower the vehicle on the lift.

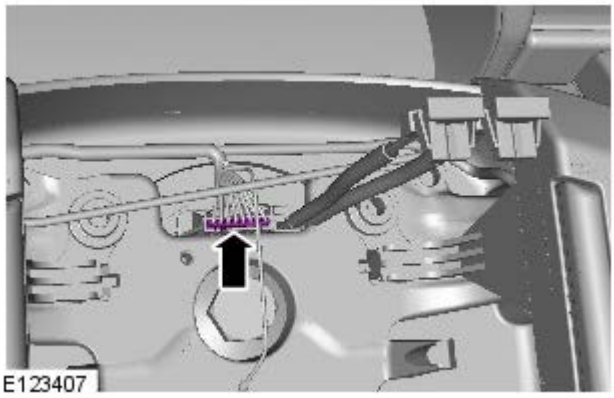
Steering Column - Steering Wheel
Removal and Installation

Removal

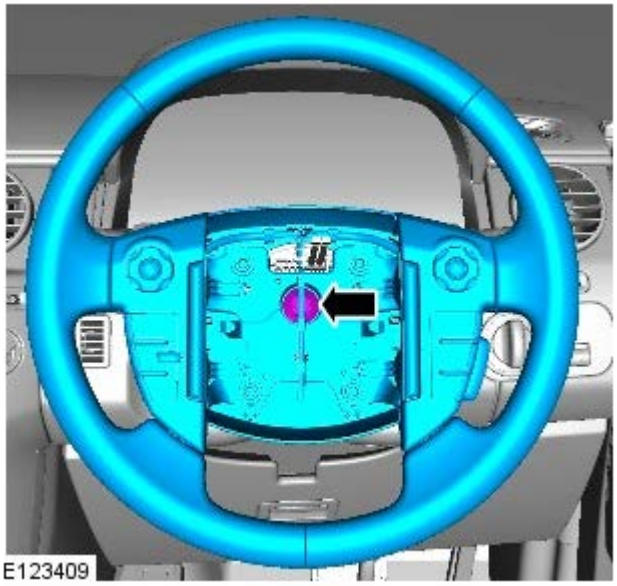
1. Refer to: Important Safety Instructions (100-00, Description and Operation).
2. Disconnect the battery ground cable.

   Refer to: Specifications (414-00, Specifications).
3. WARNING: To avoid accidental deployment and possible personal injury, the backup power supply must be depleted before repairing or replacing any air bag supplementary restraints system (SRS) components. To deplete the backup power supply energy, disconnect the battery ground cable and wait for one minute. Failure to follow this instruction may result in personal injury.

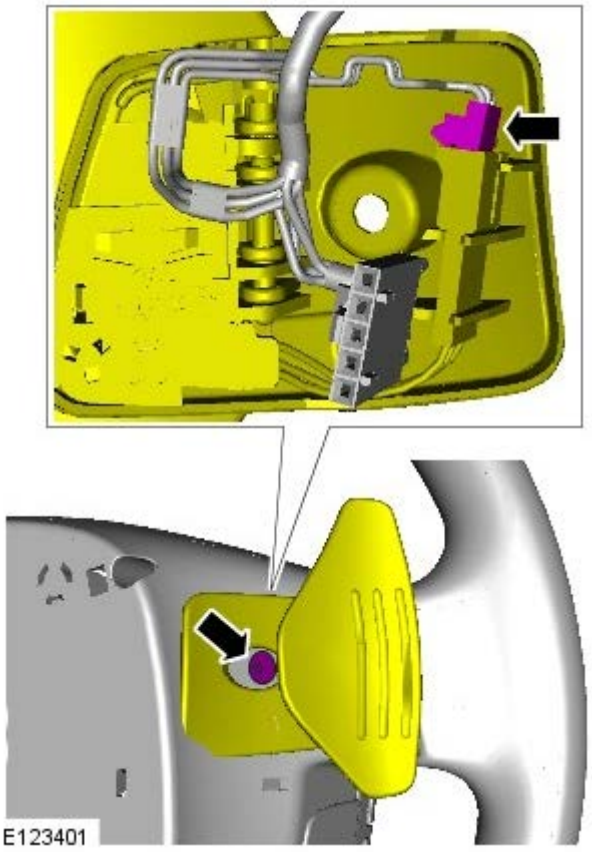
   Refer to: Driver Air Bag Module (501-20, Removal and Installation).
4. 

5. 

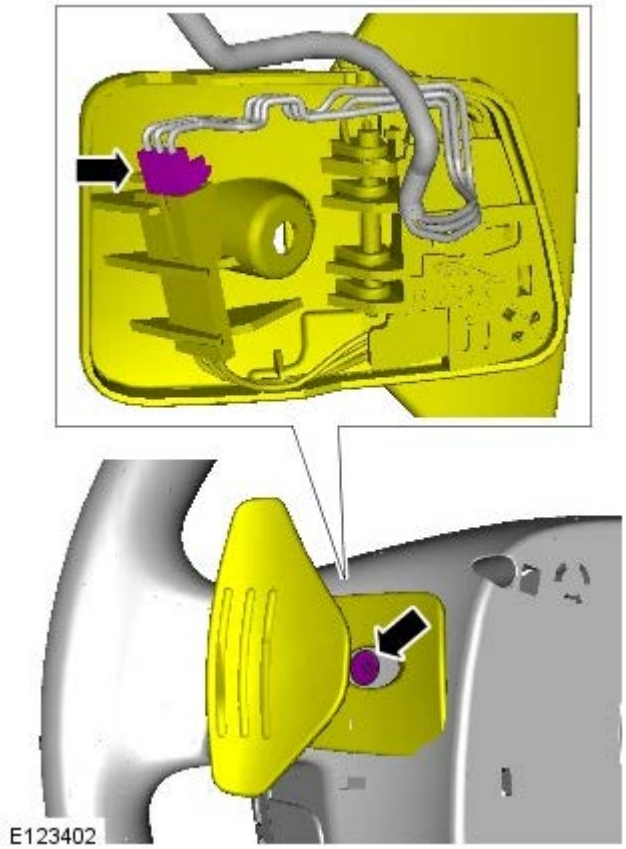
6. NOTE: Note the steering wheel to column alignment marks.



7.



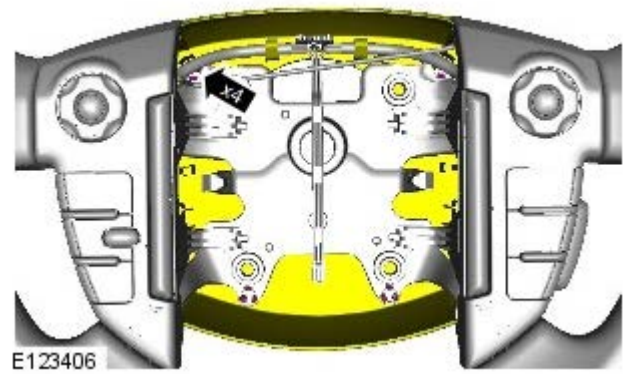
8.



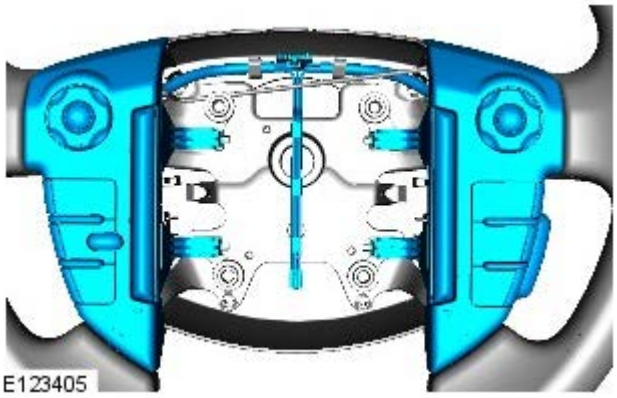
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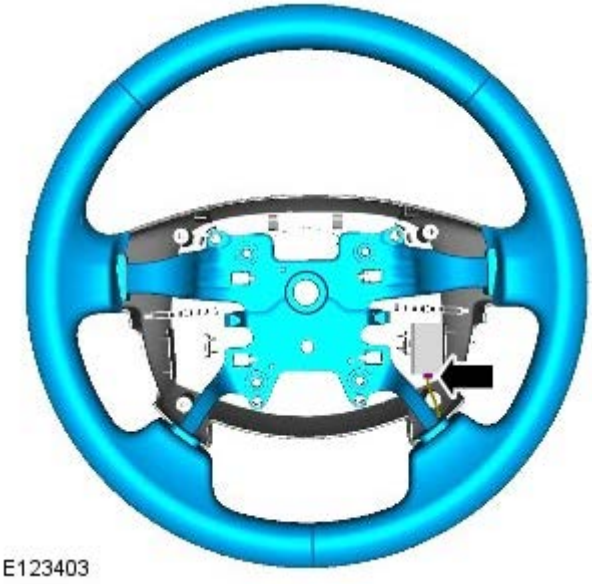
10.



11.

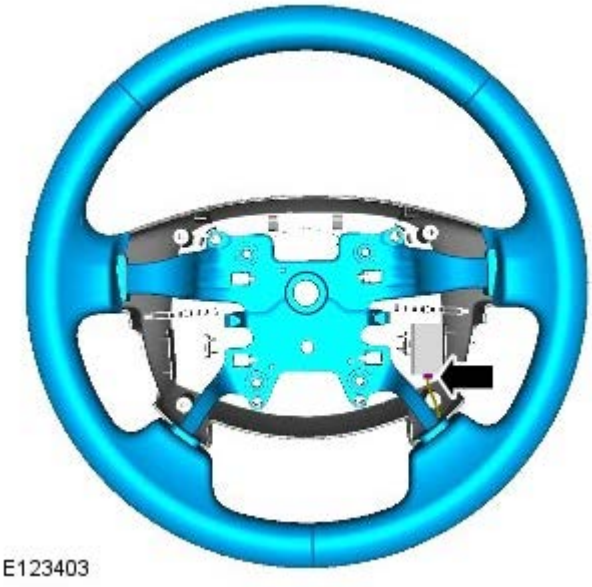


12.

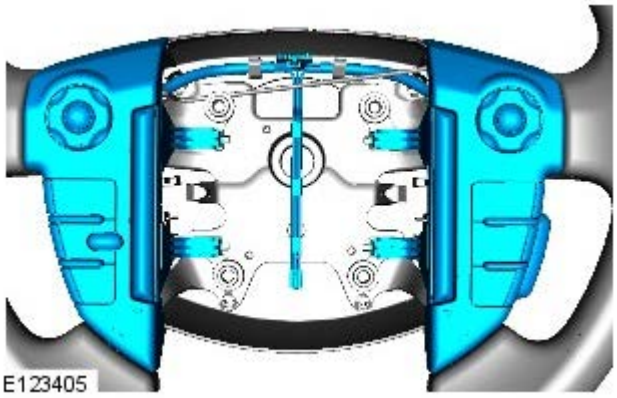


Installation

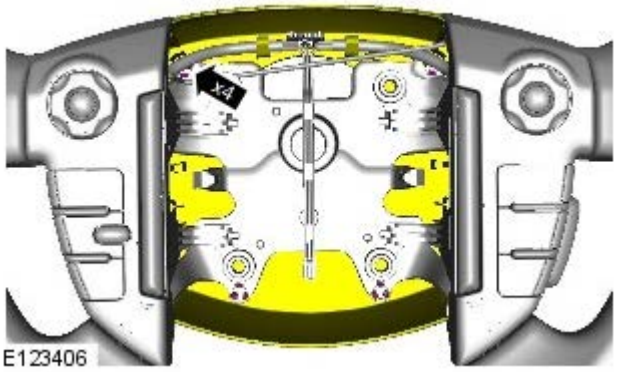
1.



2.



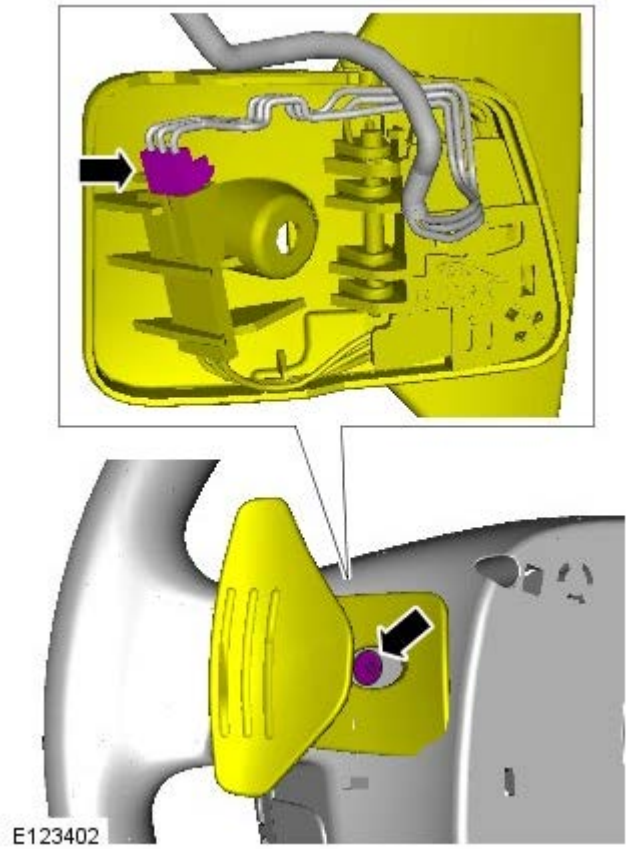
3.



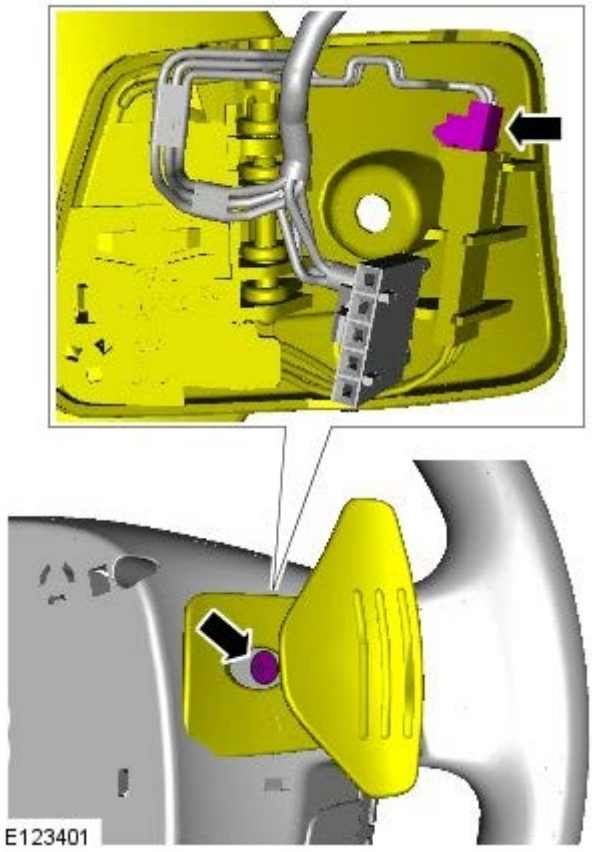
4. *Torque:* 6 Nm



5. *Torque:* 3 Nm

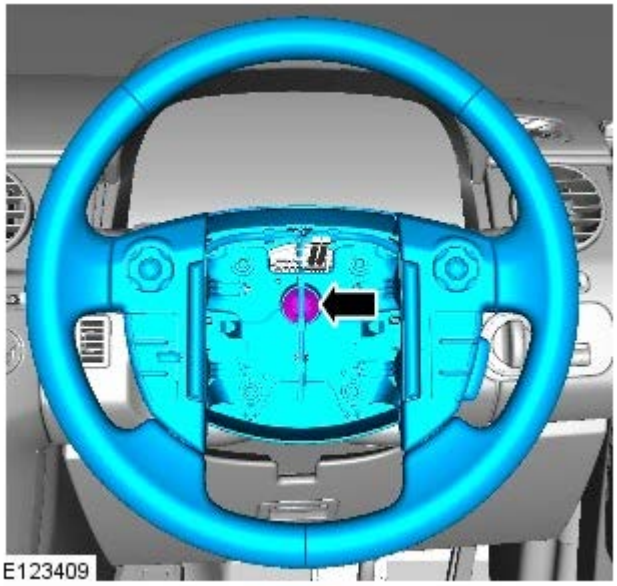


6. *Torque:* 3 Nm

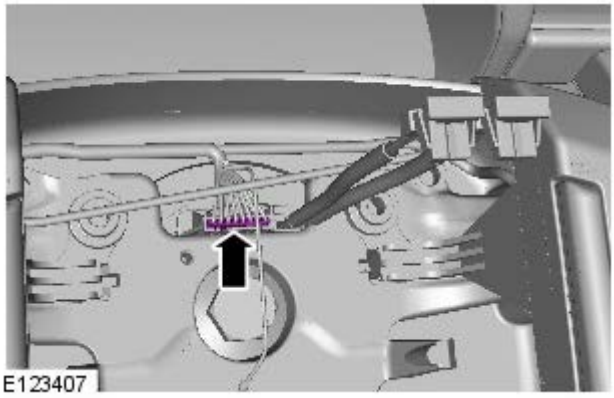


7. NOTE: Note the steering wheel to column alignment marks.

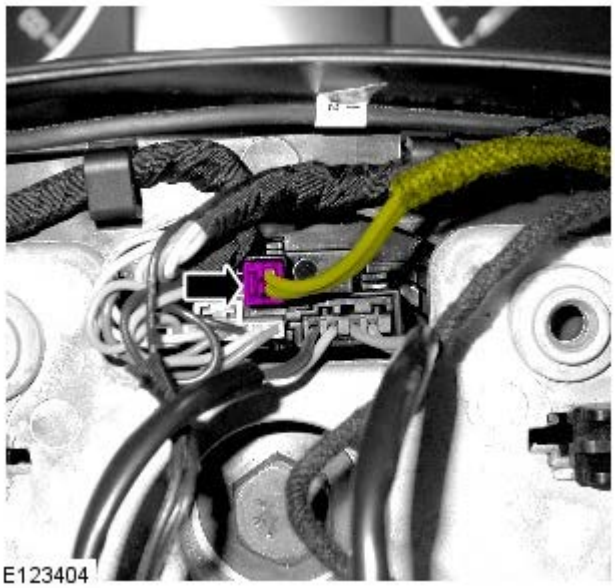
   Torque: 63 Nm



8.



9.



10. Refer to: Driver Air Bag Module (501-20, Removal and Installation).

11. Connect the battery ground cable.

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

Steering Column Switches -

Torque Specifications

Description	Nm	lb-ft
Steering column switch Torx screws	3	2

Steering Column Switches - Steering Column Switches

Diagnosis and Testing

For additional information. REFER to:

Steering System (211-00 Steering System - General Information, Diagnosis and Testing),
Turn Signal, Cornering and Hazard Lamps (417-01 Exterior Lighting, Diagnosis and Testing),
Wipers and Washers (501-16 Wipers and Washers, Diagnosis and Testing).

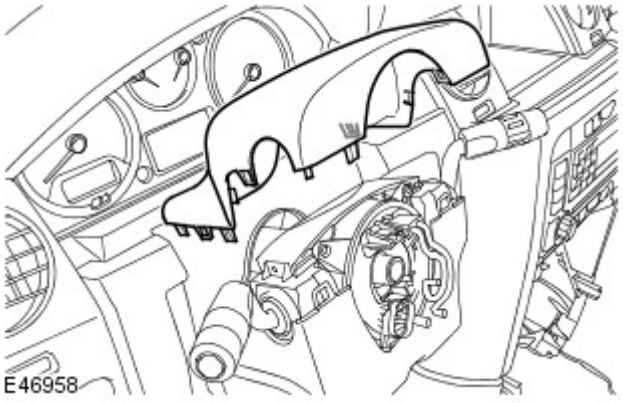
Steering Column Switches - Steering Column Lock and Ignition Switch Housing

Removal and Installation

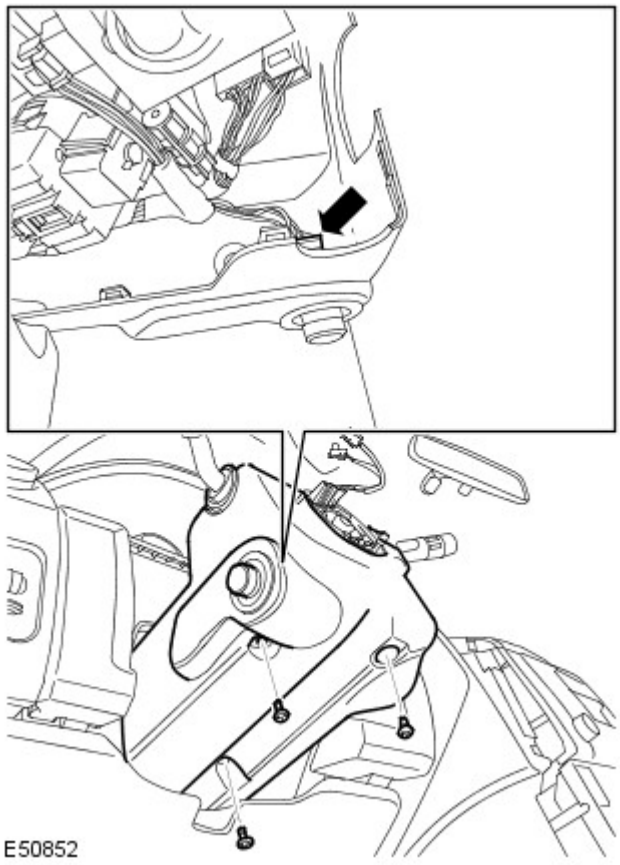
Removal

CAUTION: If the ignition lock cylinder and switch are both removed from the ignition switch assembly, the assembly shaft MUST NOT be rotated. Failure to comply will cause the incorrect operation of the lock, and the assembly must be replaced.

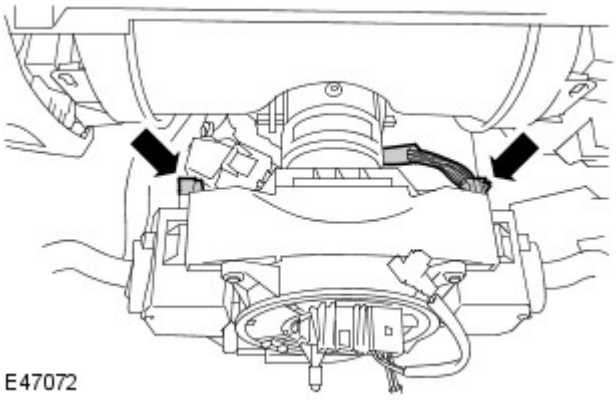
1. Fully extend the steering column for access.
2. Disconnect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).
3. Remove the steering wheel.
   For additional information, refer to: Steering Wheel (211-04, Removal and Installation).



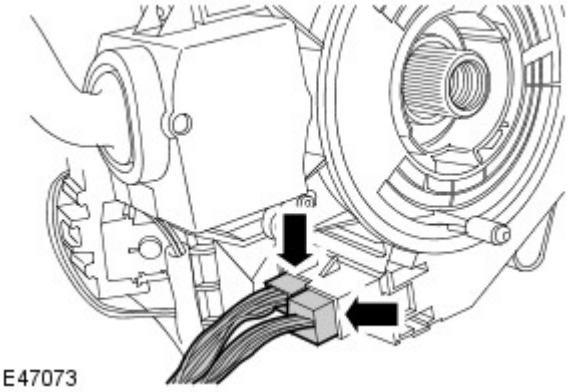
4. Remove the steering column upper shroud.
   - Release the 6 clips.



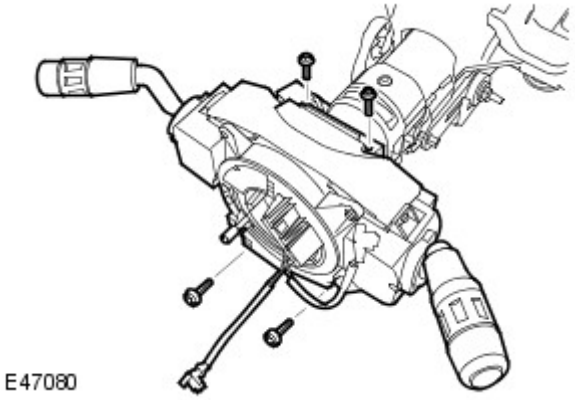
5. Remove the steering column lower shroud.
   - Remove the 3 Torx screws.
   - Disconnect the electrical connector.
6. Disconnect the 2 electrical connectors from the steering column multifunction switches.


E47072

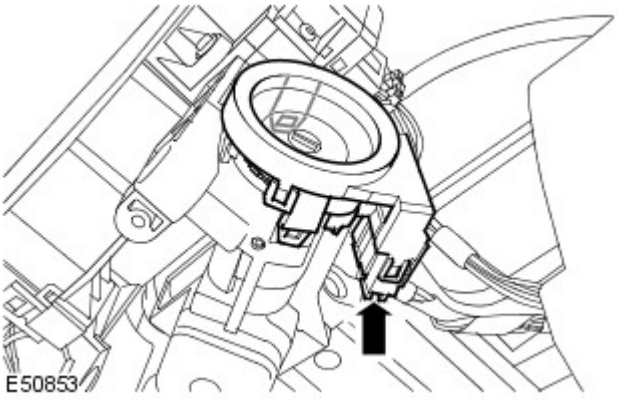
7. Disconnect the 2 electrical connectors from the clockspring.


E47073

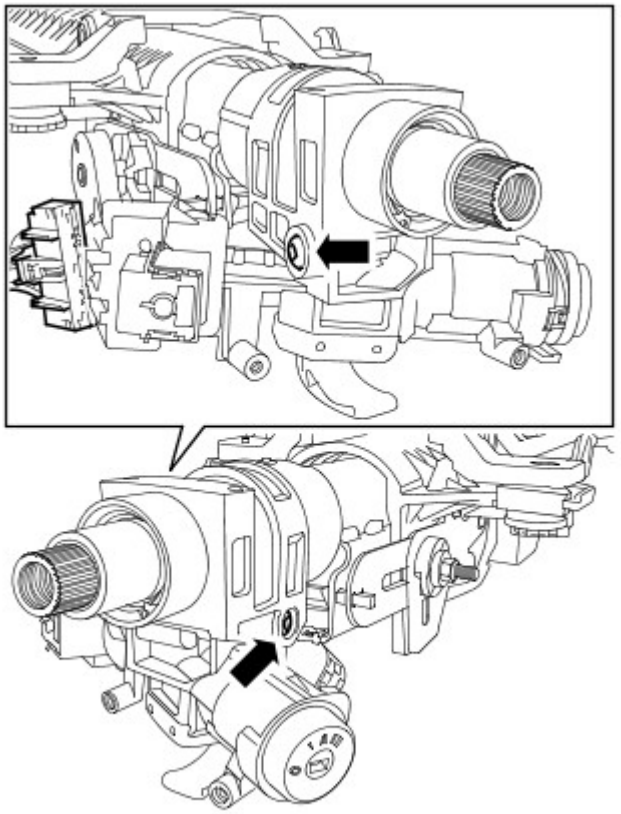
8. Remove the steering column switch assembly.
    - Remove the 4 Torx bolts.


E47080

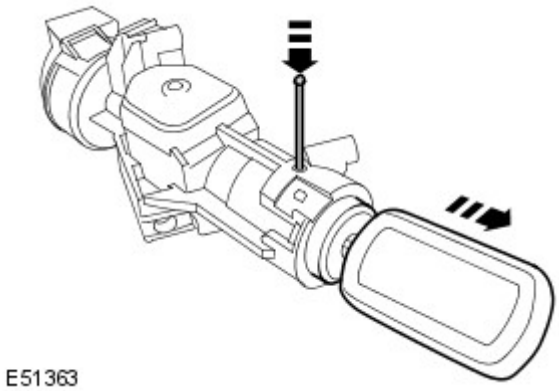
9. Remove the passive coil.
    - Disconnect the electrical connector.
    - Release the 2 clips.


E50853

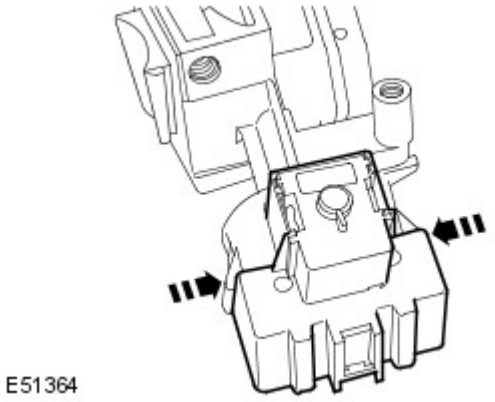
10. Remove the ignition switch assembly.
    - Remove and discard the 2 shear bolts.
    - Disconnect the electrical connector.



E50482



E51363



E51364

11. CAUTION: If the ignition lock cylinder and switch are both removed from the ignition switch assembly, the assembly shaft MUST NOT be rotated. Failure to comply will cause the incorrect operation of the lock, and the assembly must be replaced.

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

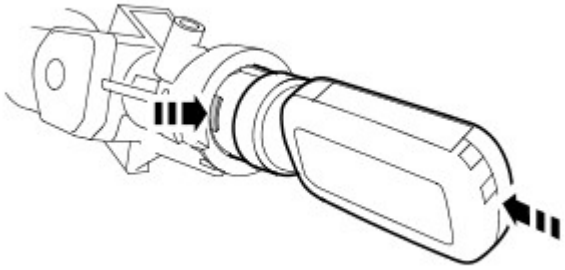
    Remove the ignition lock cylinder.
    - Turn the ignition key to position 1.
    - Insert a pin, not exceeding 2 mm diameter, through the access hole in the ignition lock cylinder housing to depress the plunger, and release the ignition lock cylinder.

12. Remove the ignition switch.
    - Depress the 2 clips.

Installation

1. Install the ignition switch.
   - Secure with the clips.

2. Install the ignition lock cylinder.
   - Turn the ignition key to position 1.
   - Locate into guides and depress the plunger.



E51372

3. Install the passive coil.
    - Secure the clips.
    - Connect the electrical connector.

4. Install the ignition switch assembly.
    - Tighten the shear bolts until the heads shear off.
    - Connect the electrical connector.

5. Install the steering column switch assembly.
    - Tighten the Torx bolts to 3 Nm (2 lb.ft).

6. Connect the clockspring and multifunction switch electrical connectors.

7. Install the steering column shrouds.
    - Connect the electrical connector.
    - Tighten the Torx screws.
    - Secure the clips.

8. Install the steering wheel.
   For additional information, refer to: Steering Wheel (211-04, Removal and Installation).

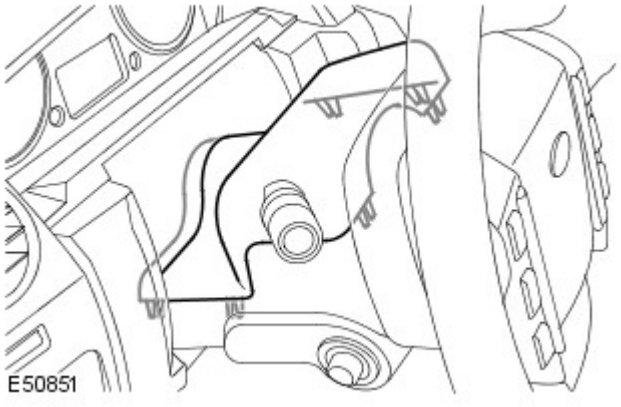
9. Connect the battery ground cable.
   For additional information, refer to: Specifications (414-00, Specifications).

Steering Column Switches - Ignition Switch

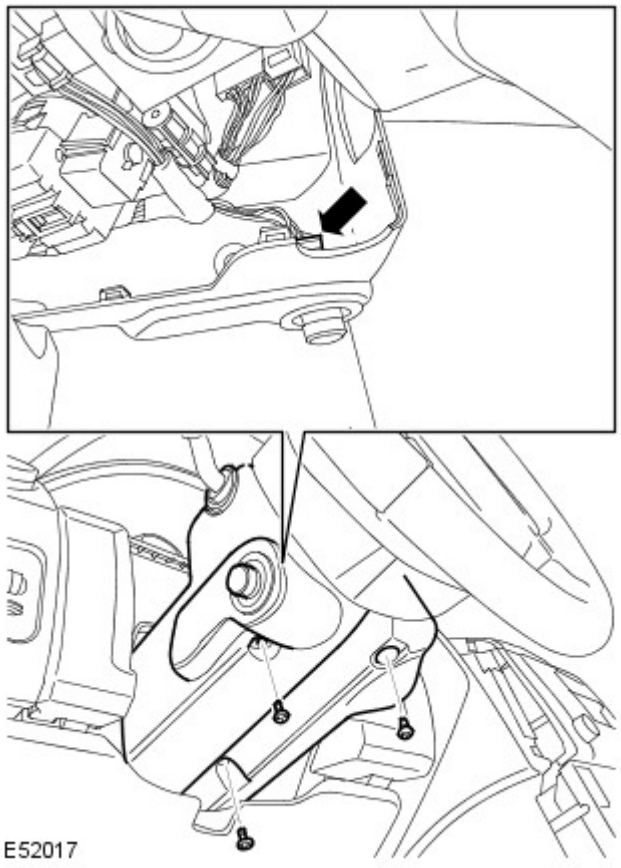
Removal and Installation

Removal

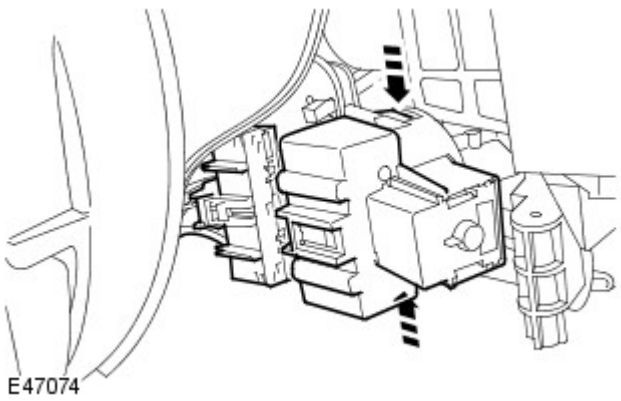
1. Fully extend the steering column for access.



2. Remove the steering column upper shroud.
   - Release the 6 clips.



3. Remove the steering column lower shroud.
   - Remove the 3 Torx screws.
   - Disconnect the electrical connector.



4. CAUTION: The ignition key must be removed prior to the removal of the ignition switch.

   Remove the ignition switch.
   - Disconnect the electrical connector.
   - Depress the 2 clips.

Installation

1. Install the ignition switch.
    - Secure with the clips.
    - Connect the electrical connector.

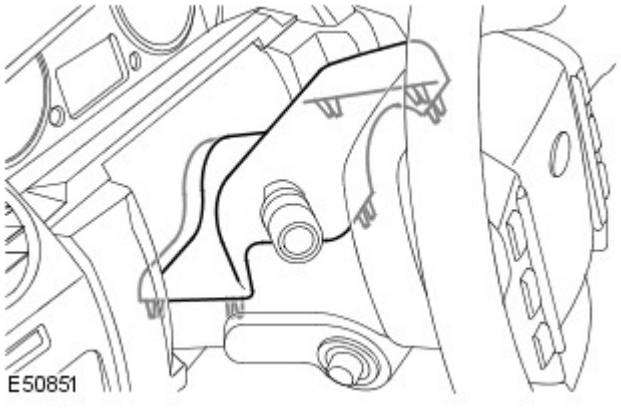
2. Install the steering column shrouds.
    - Connect the electrical connector.
    - Tighten the Torx screws.
    - Secure the clips.

Steering Column Switches - Steering Column Multifunction Switch RH

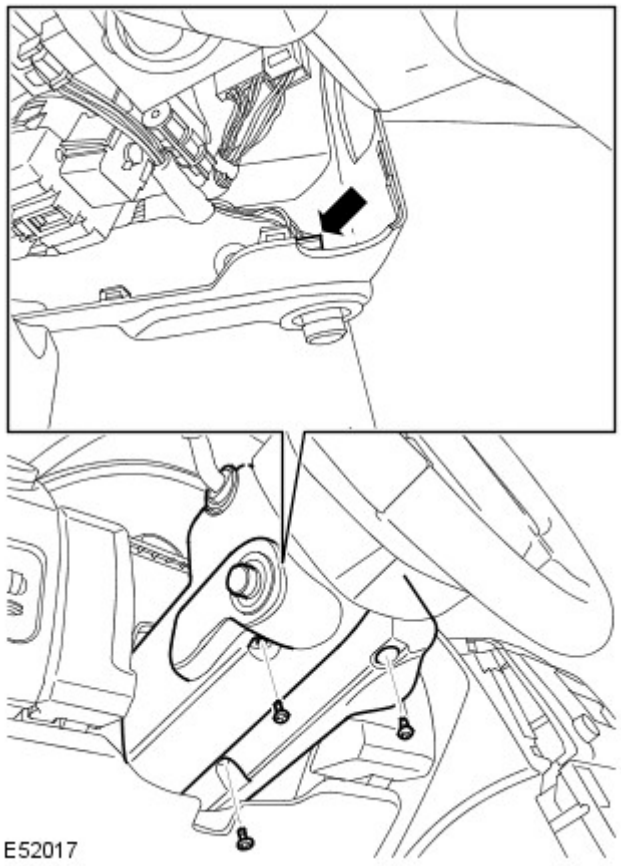
Removal and Installation

Removal

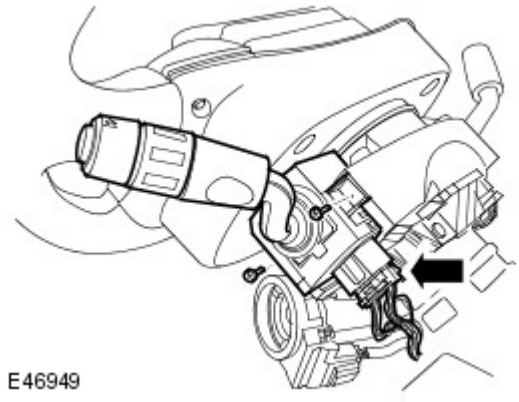
1. Fully extend the steering column for access.



2. Remove the steering column upper shroud.
   - Release the 6 clips.



3. Remove the steering column lower shroud.
   - Remove the 3 Torx screws.
   - Disconnect the electrical connector.



4. Remove the steering column multifunction switch.
   - Disconnect the electrical connector.
   - Remove the 2 screws.

Installation

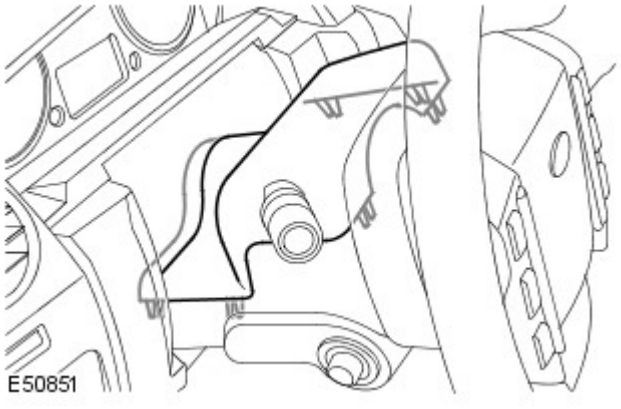
1. To install, reverse the removal procedure.

Steering Column Switches - Steering Column Multifunction Switch LH

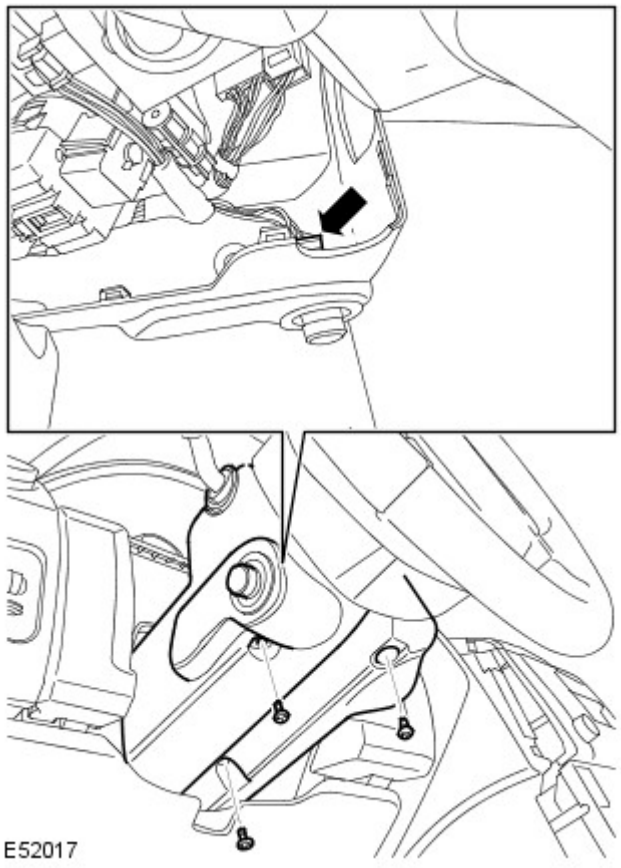
Removal and Installation

Removal

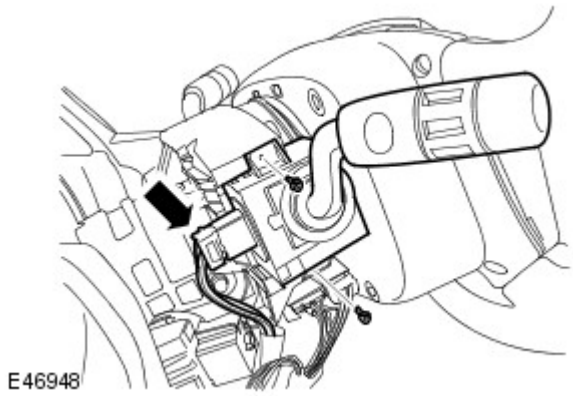
1. Fully extend the steering column for access.



2. Remove the steering column upper shroud.
   - Release the 6 clips.



3. Remove the steering column lower shroud.
   - Remove the 3 Torx screws.
   - Disconnect the electrical connector.



4. Remove the steering column multifunction switch.
   - Disconnect the electrical connector.
   - Remove the 2 screws.

Installation

1. To install, reverse the removal procedure.