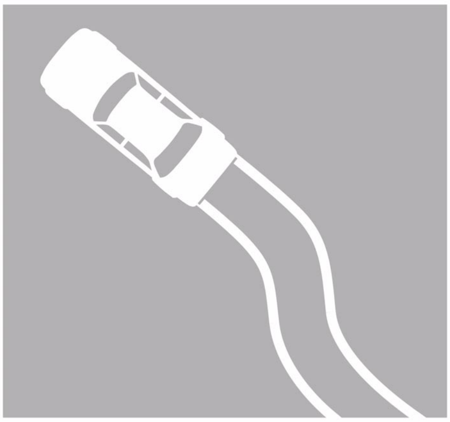
JAGUAR

TRAINING PROGRAM

JAGUAR CHASSIS, BRAKING AND TRACTION CONTROL SYSTEMS



INTRODUCTION

XJ SEDAN 1997-2003 MY

XK 1997 - 2002 MY

S-TYPE 2000-2002 MY

X-TYPE 2002 ONWARDS

S-TYPE 2003 ONWARDS

XK 2003 ONWARDS

XJ 2004 ONWARDS

REFERENCE INFORMATION

PUBLICATION CODE – 451

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OBJECTIVE

- Understand specific model differences on Jaguar suspension, steering and brake systems
- Understand construction and operation on each Jaguar system as it applies to the current Jaguar model range
- Be able to distinguish suspension, steering and brake system commonalities within the current Jaguar model range

PROGRAM CONTENT

1. INTRODUCTION
2. XJ SEDAN 1997-2003 MY
3. XK 1997 - 2002 MY
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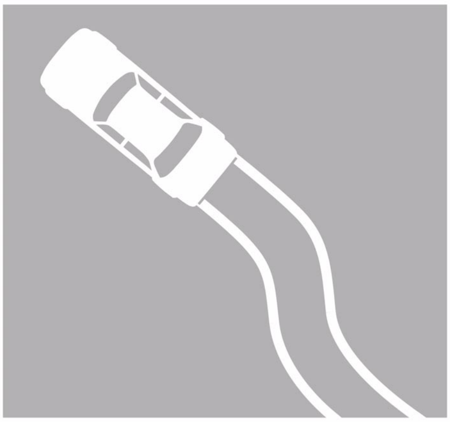

INTRODUCTION

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FRONT SUSPENSION

Overview

The XJ Series Sedan front suspension maintains the Jaguar pattern of unequal length “A” arms mounted to a subframe. The “A” arm inner fulcrum angles reduce dive during braking.

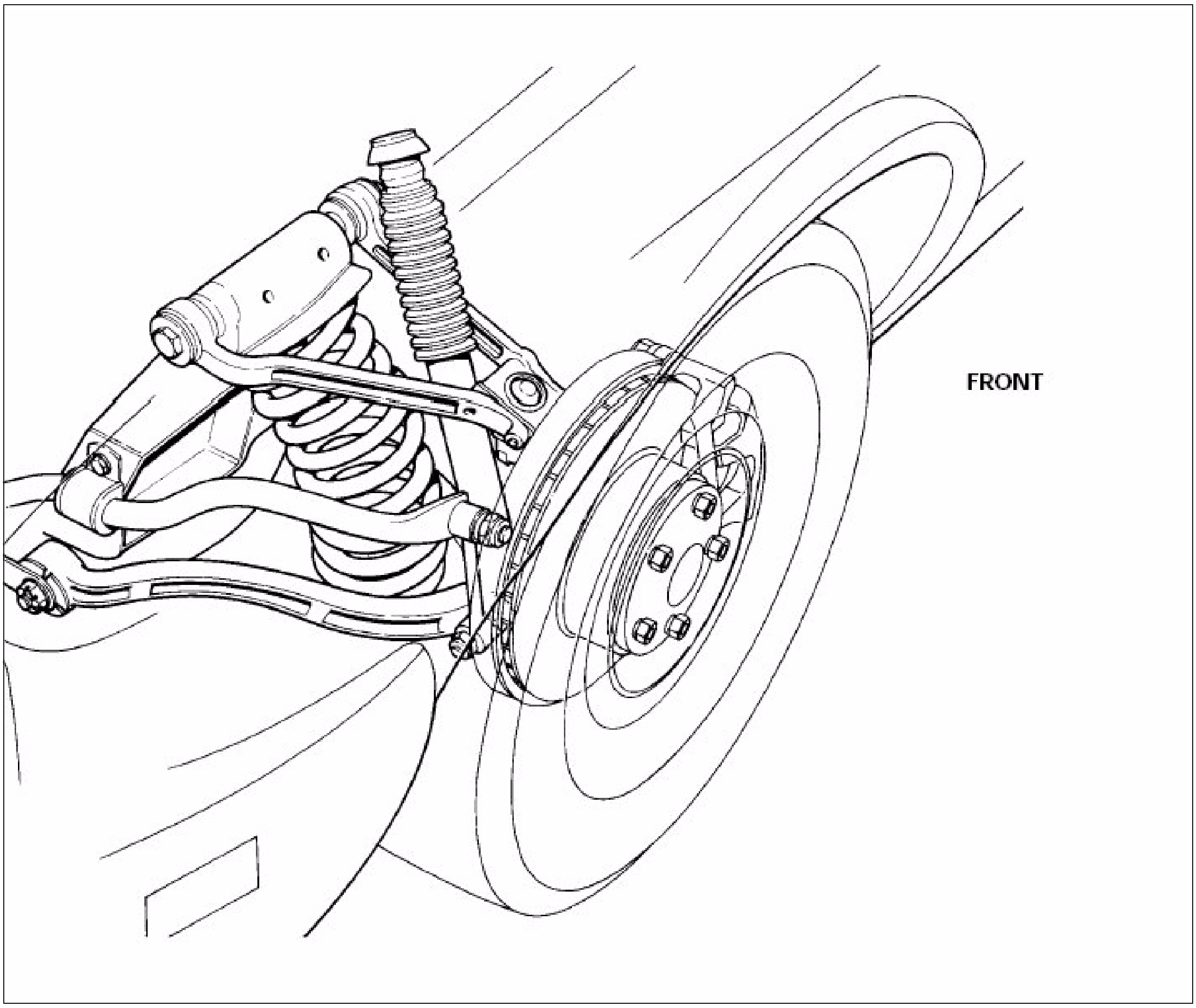


Fig. 1 XJ Front Suspension

Front subframe

The subframe is fabricated of pressed steel and formed side tubes, which are welded to the subframe. The side tubes pass through the subframe and are joined to each other at the front with a tie bar. If a front impact occurs, the side tubes are designed to deform and absorb some of the impact force.

Tuned vee mounts and bonded rear bushings improve ride refinement by reducing the transfer of braking energy, bumps, and road surface inputs to the body. The rear bushings are a press fit in the subframe and must be installed with their installation marks aligned with marks on the subframe.

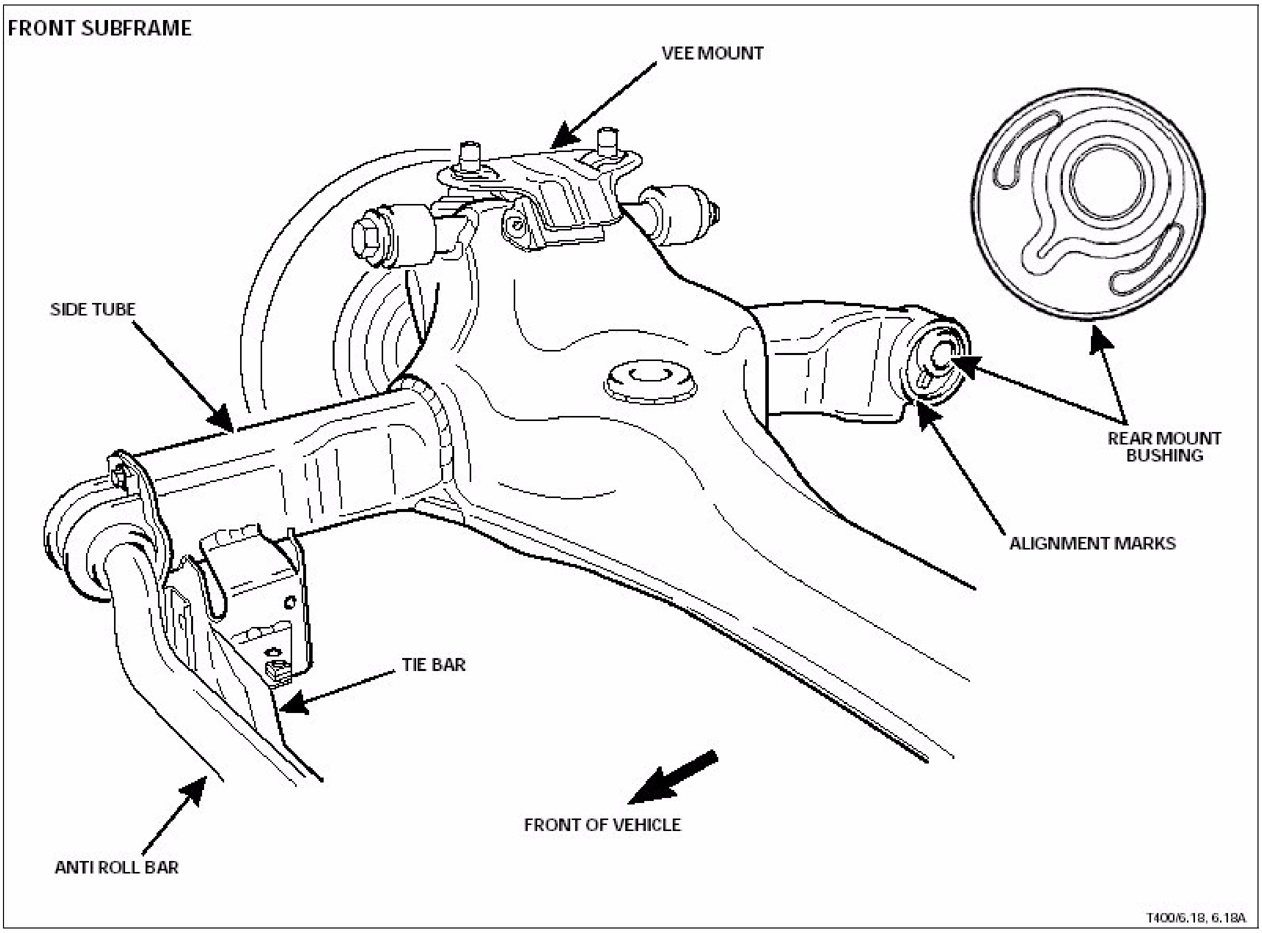


Fig. 2 Front Subframe

Upper A-Arms

The one-piece forged steel upper “A” arms are similar to those in the XK, with a nonadjustable ball joint pressed into the arm for the connection to the vertical link. The arm is located axially on the subframe upper fulcrum bolt by spacers between the “A” arm bushings and the subframe.

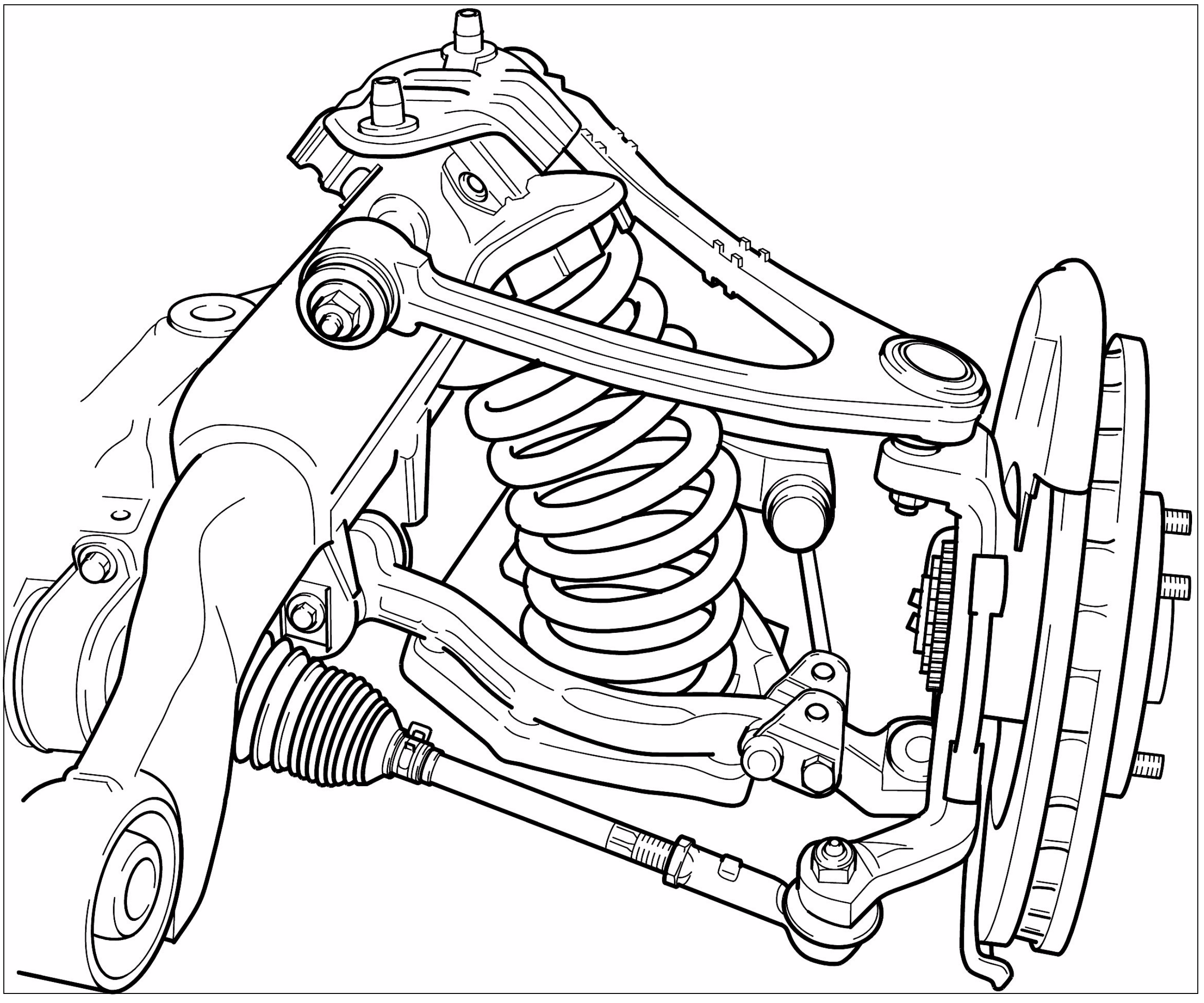


Fig. 3

Lower A-Arms

The lower "A" arms are two-piece steel forgings bolted together with plates for the lower shock absorber mounting point. Nonadjustable ball joints press into the rear arms to support the vertical link. The wide base lower "A" arm assembly reduces the suspension forces transmitted to the subframe and allows the use of cam fulcrum bolts for suspension geometry adjustment.

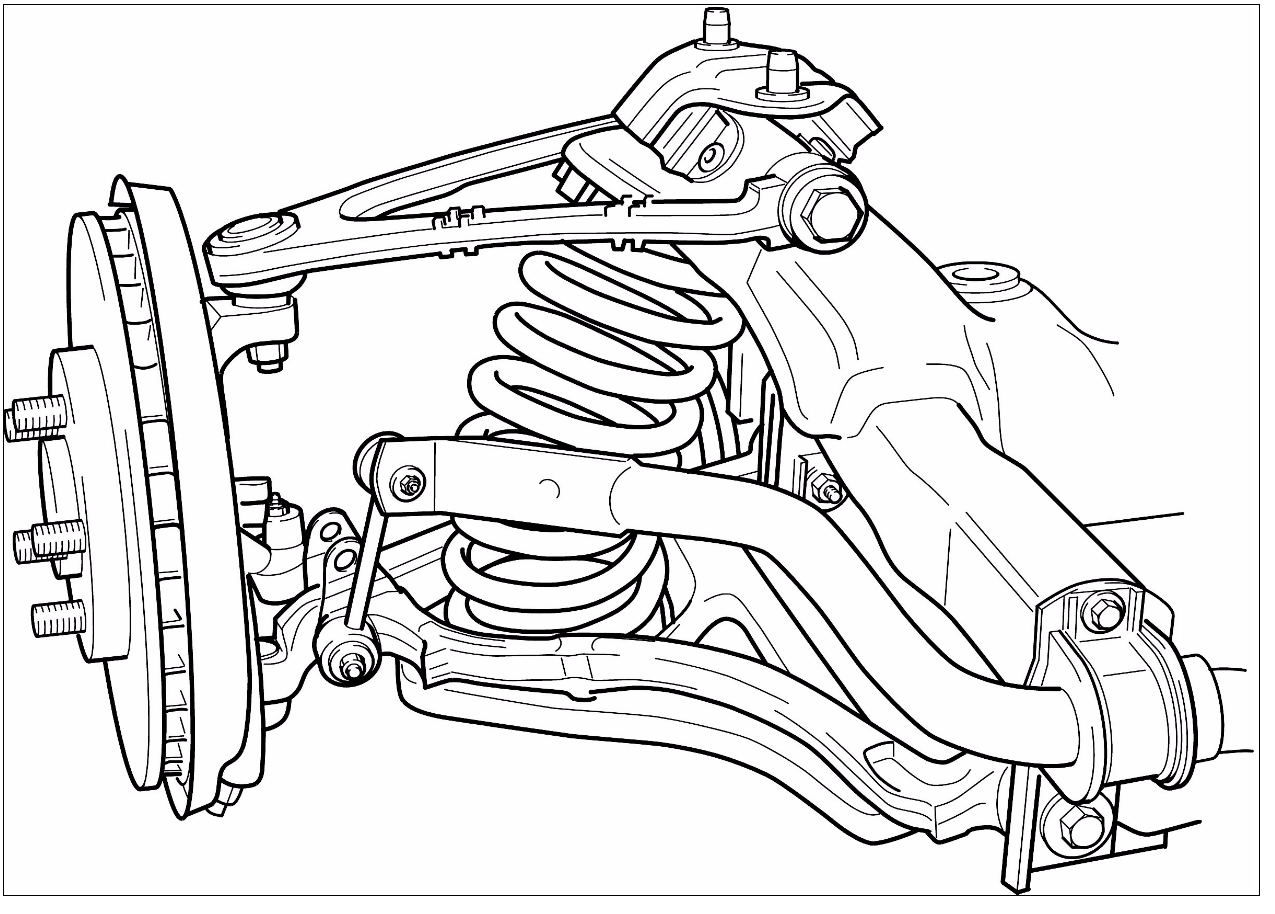


Fig. 4

NOTE:

Spring pan bolts should not be reused.

Front Shock Absorbers

The lower shock absorber mount is a rubber isolated bushing. The upper mount is redesigned to separate the shock absorber loads from the bump stop / spring aid loads. Shock absorber loads are transmitted to a tower bolted to the body within the engine compartment. The bump stop / spring aid loads are transmitted directly to the body. This design allows the shock absorber top mount isolators to be softened because they no longer need to accept the bump stop / spring aid loads.

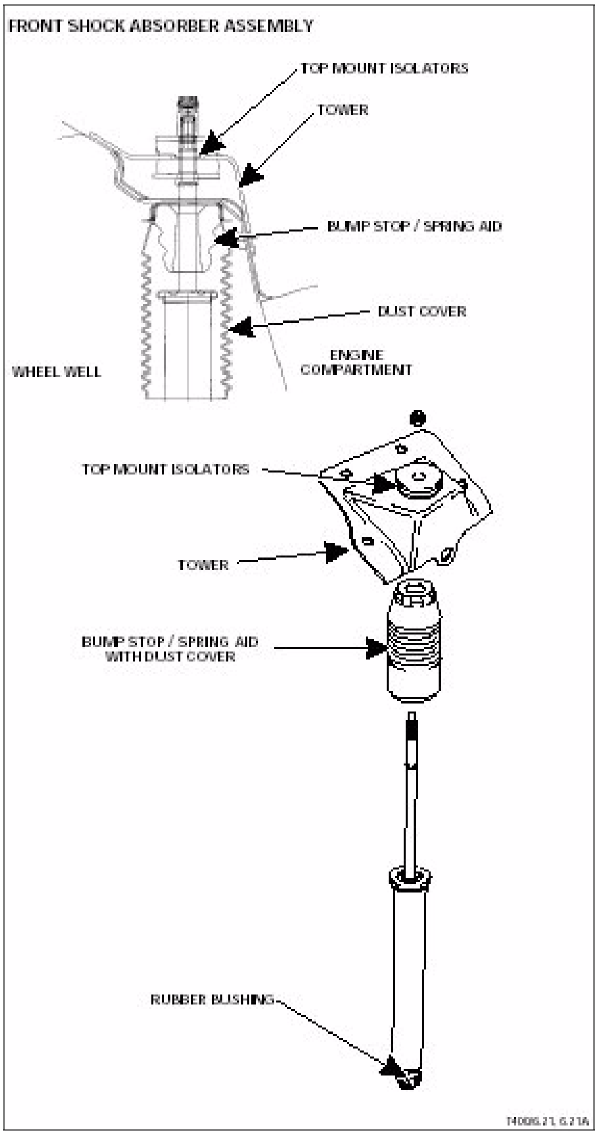


Fig. 5 Front Shock Absorber

REAR SUSPENSION

Overview

All Sedans are fitted with the fabricated monostrut and a 14 HU final drive unit. The 14 HU final drive unit is designed with the pinion shaft in the vehicle center line to improve NVH (noise, vibration, and harshness) levels.

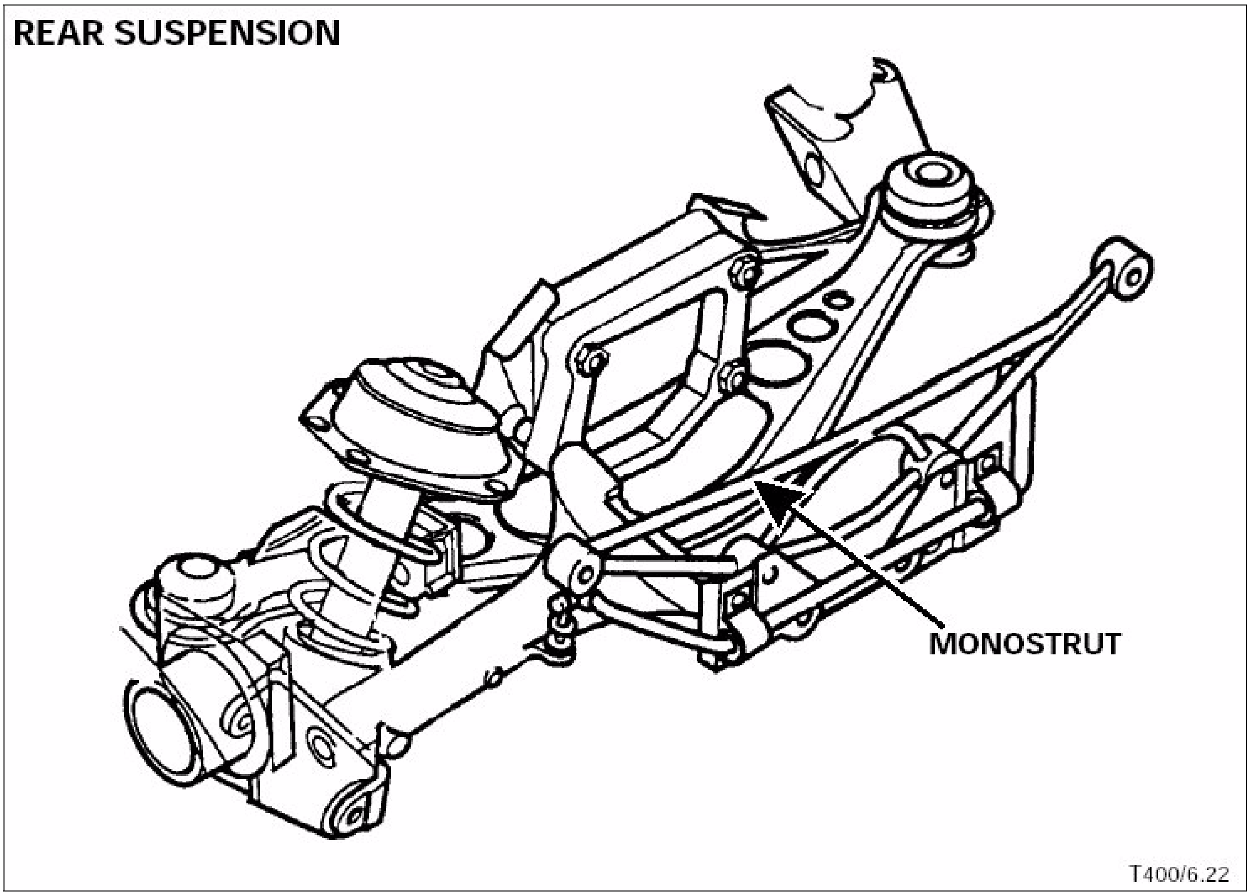


Fig. 6

DRIVELINE

Driveshaft

The drive shaft is constructed of thin wall tubing which reduces total weight and improves drive shaft balance. The on-center pinion design of the 14 HU final drive unit and the relocation of the drive shaft center bearing allows in-line shaft installation, which reduces the universal joint operating angles and resulting vibrations.

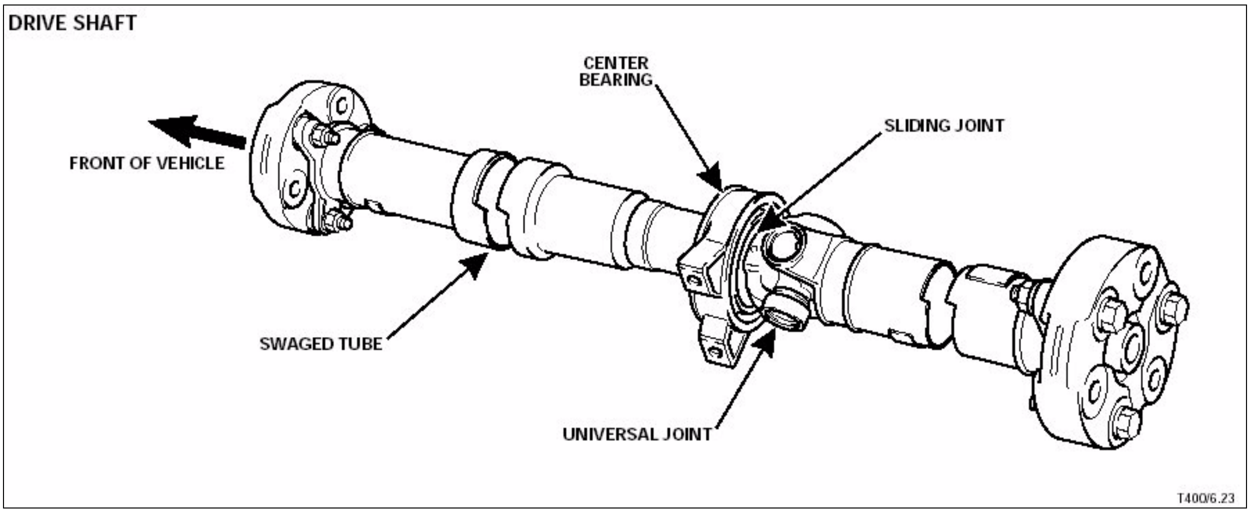


Fig. 7

The front half of the drive shaft is manufactured with a swaged tube section to provide collapse in the event of a collision. The front and rear halves are connected at the center bearing with a splined sliding joint. The center universal joint is relocated to the rear half of the drive shaft. Flexible couplings connect the assembly to the transmission and final drive flanges.

STEERING

Overview

A power assisted steering (PAS) system is used which provides speed sensitive power assist and also incorporates a variable steering ratio with a positive on-center feel.

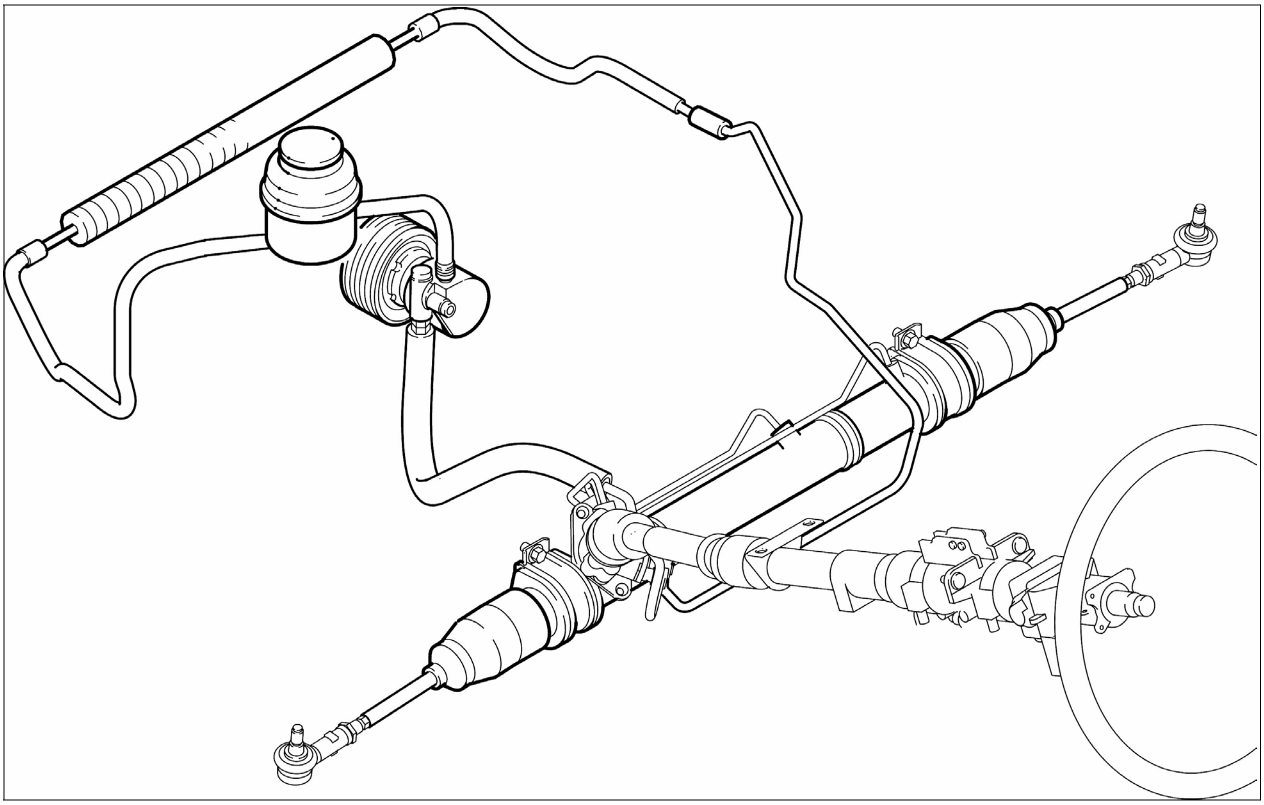


Fig. 8

Rack and Pinion Assembly

The Sedan steering rack is located behind the subframe. Two versions of the steering rack are used on Sedans. A “Comfort” steering rack, identified with a green plate, is used on all Sedans except XJR models. The torsion bar in the “Comfort” rack control valve / pinion assembly is 4.8 mm (0.189 in.) in diameter.

A “Sport” steering rack, identified with a silver plate, is used on XJR Sedans. The torsion bar in the “Sport” rack control valve / pinion assembly is 5 mm (0.197 in.) in diameter. The larger diameter torsion bar in the “Sport” rack provides less steering assist and requires more driver steering effort. All other specifications are the same between the racks

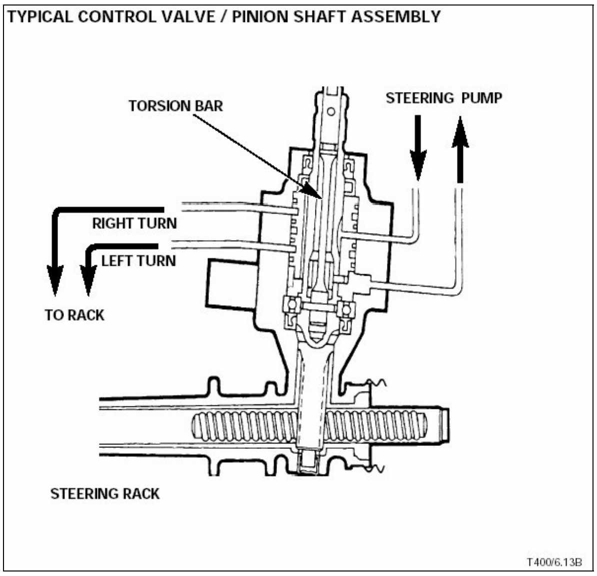


Fig. 9

Upper steering column

The upper steering column attachment points have been simplified and the connectors relocated for easier servicing. Because the redesigned fascia eliminates the fascia switch pods, wheel reach adjustment is increased from 32 mm (1.26 in.) to 40 mm (1.6 in.). In addition, the BPM software controlling the steering column motors is revised to prevent the column from jamming during entry / exit tilt-away mode. The software stops the adjustment motors before the column contacts its mechanical stops.

Cable reel cassette

The cable reel cassette assembly includes circuitry for the steering wheel mounted cruise control and ICE switches.

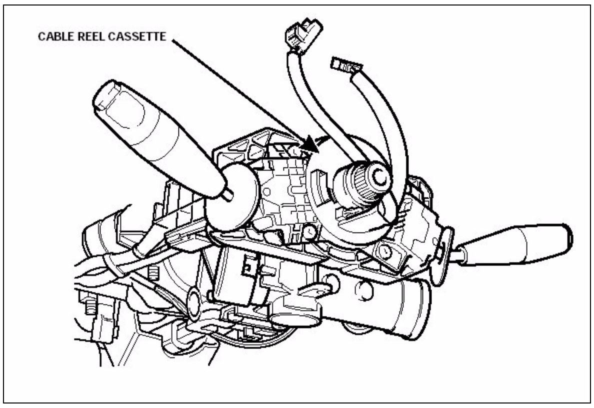


Fig. 10

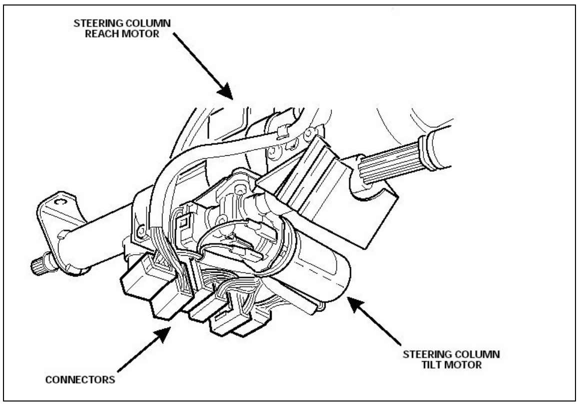


Fig. 11

Lower steering column

The lower steering column is fitted with a bellows type dust seal over the telescopic section. The telescopic section allows 20 mm (0.79 in.) movement of the column. The upper and lower universal joints allow the column to rotate on its axis supported by a rolling element assembly that helps centralize the column and reduce friction. The lower steering column telescopic section should not be separated, and the column assembly is not serviceable. The gaiter can be replaced separately.

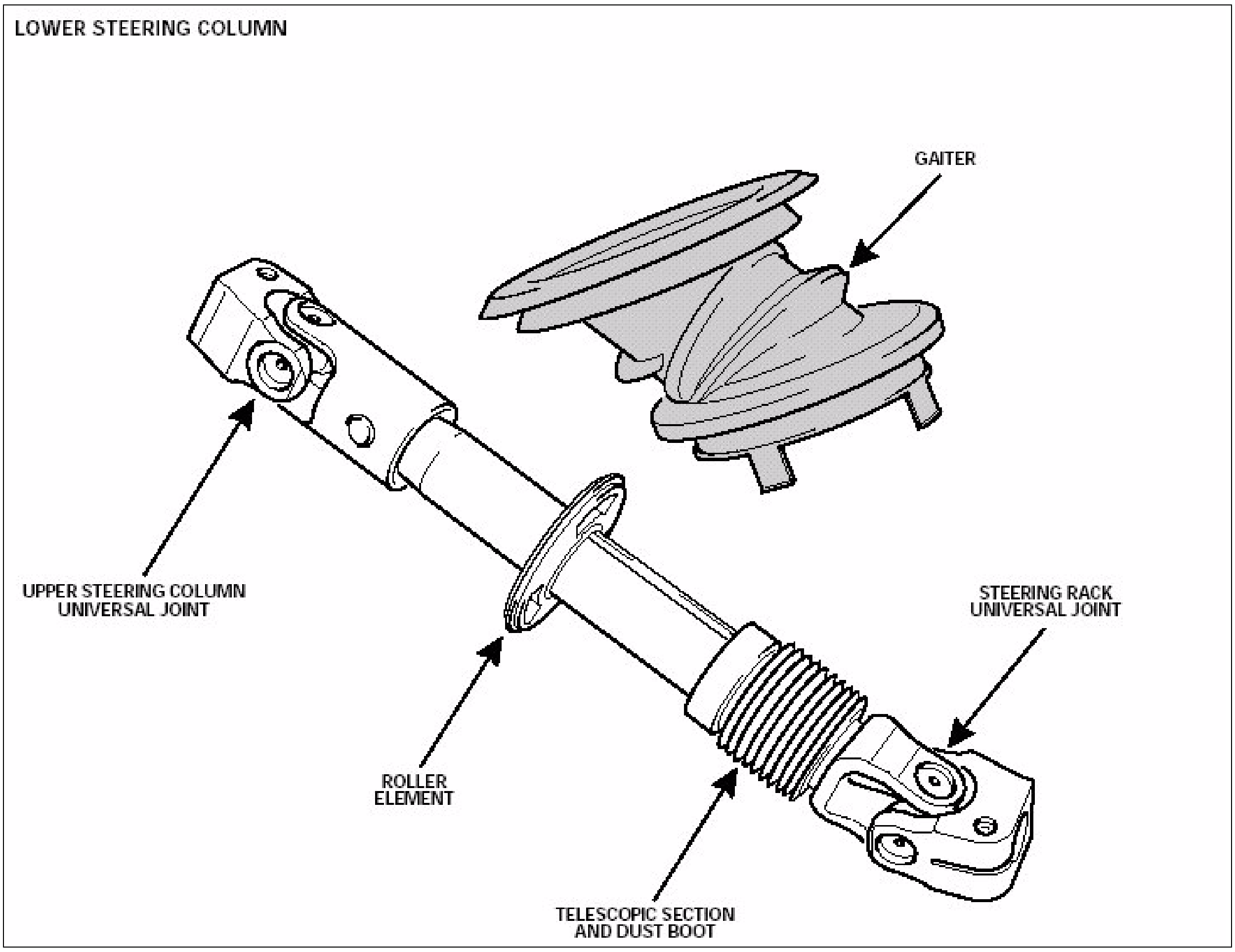


Fig. 12

NOTE:

The column must be disconnected from the steering rack and partially collapsed to remove the engine or front suspension subframe. Thread locking compound must be applied to the column universal joint pinch bolt if it is reused.

Steering control module

The power-assisted steering control module (PAS CM) varies the amount of steering assist according to vehicle speed. It is located above the passenger footwell near the “A” post. The PAS CM converts a B+ voltage pulsed vehicle speed signal from the instrument pack to a variable current signal. The variable current signal drives the PAS control valve converter (transducer), which acts on the pinion / control valve assembly to vary the amount of hydraulic assist pressure. At low vehicle speeds the steering assist pressure is high, and it progressively reduces as the vehicle speed increases.

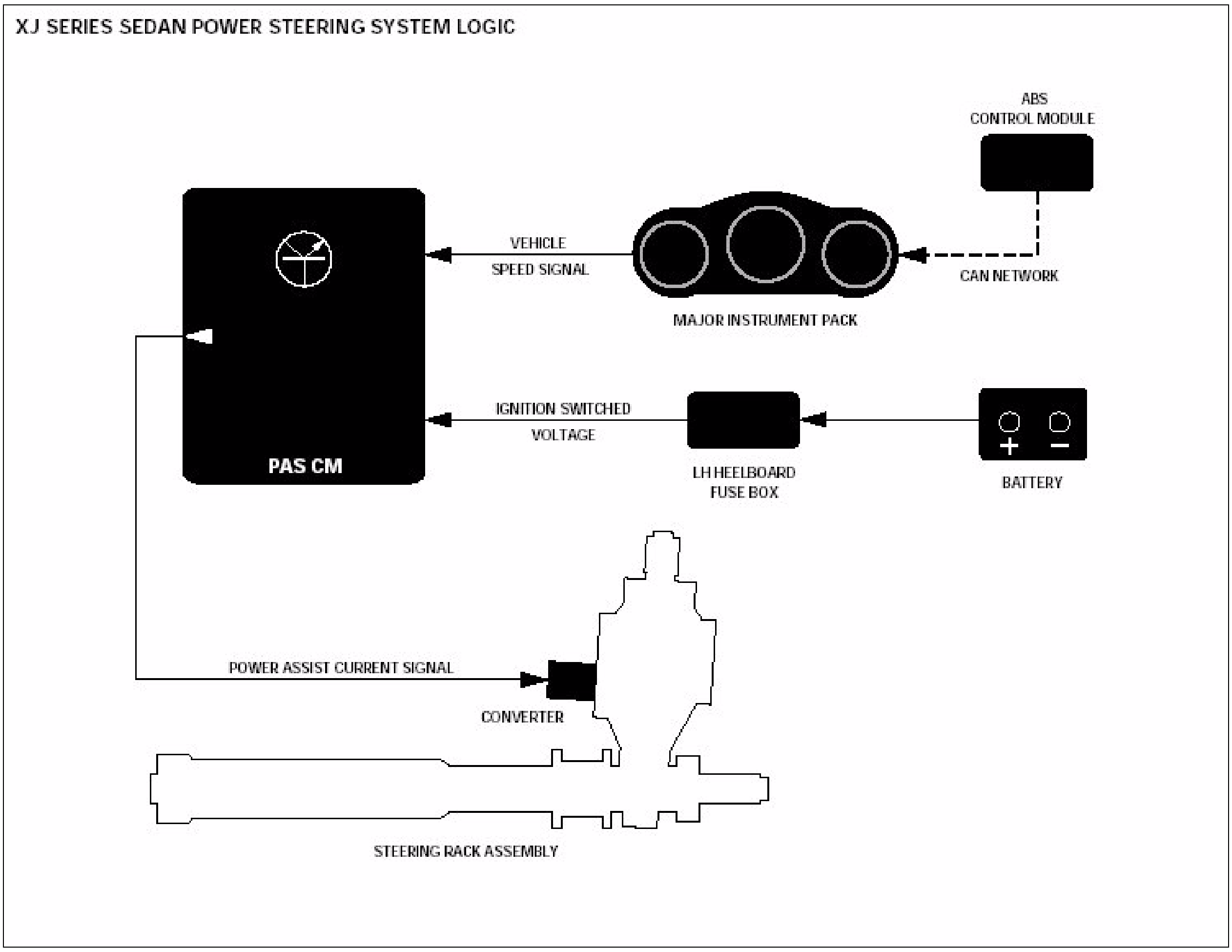


Fig. 13

BRAKE SYSTEM

Overview

Part of the Jaguar heritage is its role of leadership in refined comfort, superb handling and braking performance. At the forefront of braking technology, Jaguar introduced 4-wheel disc brakes to its production vehicles with the 1957 Model Year XK150. This added dimension of performance soon became the standard for all Jaguar vehicles, maintaining Jaguar's position of leadership.

Fig. 14

The XJ is fitted with 4-wheel anti-lock braking (ABS). The integrated anti-lock braking / traction control (ABS / TC) system provides automatic throttle control and individual drive wheel brake control to help prevent drive wheel spin during acceleration as well as four-wheel anti-lock braking.

Mechanical brake system components

Master Cylinder

The tandem brake master cylinder has two separate circuits – one for the front brakes and one for the rear brakes. Each circuit is supplied from a common fluid reservoir. The reservoir is partitioned to prevent both circuits from running dry in the event of a leak in one hydraulic circuit. A center valve in the rear brake circuit piston replaces the conventional compensating port. At rest, the center valve is open to allow rear circuit brake fluid to flow to and from the reservoir. This prevents a vacuum from forming during ABS / TC operation, prevents seal wear during ABS operation and vents pressure caused by fluid expansion.

If a rear brake hydraulic failure occurs, the rear brake piston will bottom but front brake hydraulic pressure can still be generated between the two seals in the master cylinder front brake chamber.

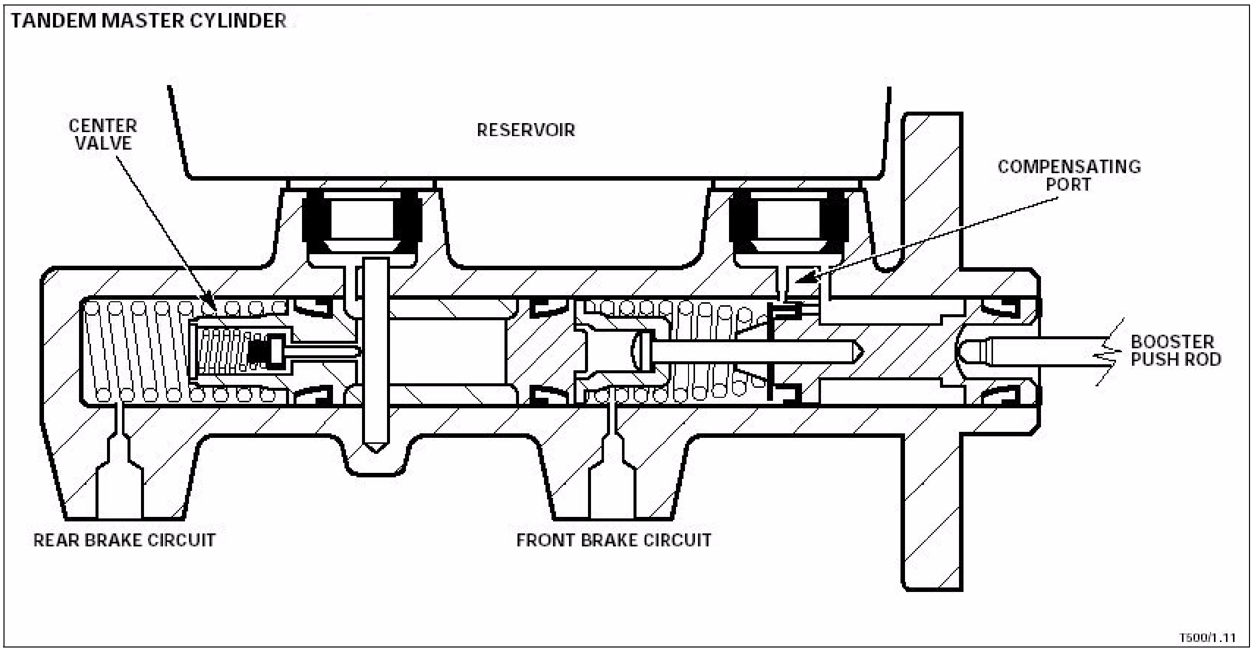


Fig. 15

Power Assist Brakes

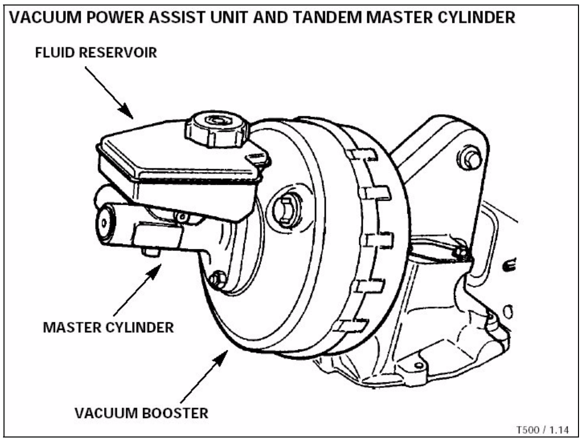


Fig. 16

The twin diaphragm vacuum power assist unit, or vacuum booster, provides a boost in the pedal force applied to the master cylinder. With brakes not applied and the engine running, engine manifold vacuum is applied equally to both sides of each diaphragm in four separate chambers.

Brake Calipers

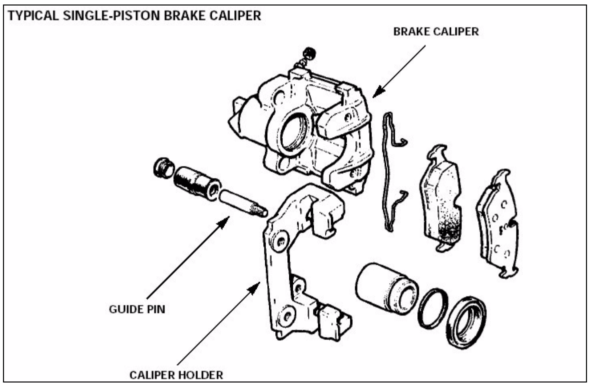


Fig. 17

Jaguar single-piston brake calipers use a deep cup-shaped single piston to transmit hydraulic force to the inside brake pad. As the inner brake pad presses against the brake disc, the caliper moves on its guide pins, applying equal force to the outer pad.

Front to rear braking forces are controlled with hydraulic pressure, differences in front to rear caliper piston size, brake pad friction material, or a combination of these methods, depending on the brake system and model year of the vehicle.

ANTI-LOCK BRAKING SYSTEM (ABS)

Mark 20-I Anti-lock Braking System (ABS)

ABS controls the hydraulic pressure to the front and rear wheel brake calipers to help prevent the wheels from locking and skidding during braking.

Traction control (TC)

TC is added to anti-lock braking systems to control wheel spin when starting off and at lower speed acceleration. Traction control reduces engine torque and applies braking to the slipping drive wheel(s). During traction control operation, the ABS / TC CM also cancels cruise control and inhibits transmission downshifting. Upshifts are also inhibited below a specified speed.

The Mk 20-I ABS system uses a hydraulic modulator assembly with two low-pressure accumulators, an electrically driven pump and a microprocessor-based control module (ABS CM) to modulate hydraulic pressure to the wheel brake calipers.

The ABS function controls pressure to the front calipers individually. The rear calipers are controlled as a pair. Each road wheel is equipped with a wheel speed sensor. The ABS control module (ABS CM) uses the input from the wheel speed sensors to provide anti-lock braking control. The microprocessor-controlled ABS or ABS / TC systems incorporate on-board diagnostics, warning indicators and malfunction indicator lamps (MILs) to alert the driver of system faults and to signal ASC or TC operating status.

ABS Hydraulic Operation

Normal braking

The system functions as a conventional braking system. Brake pedal force is increased by the vacuum booster and applied to the tandem master cylinder. The primary chamber of the tandem master cylinder applies brake pressure to the front wheel calipers. The secondary chamber of the master cylinder applies brake pressure to the rear wheel calipers.

Rear wheel caliper hydraulic pressure routes through a brake proportioning valve (pressure conscious valve). The brake proportioning valve reduces rear brake circuit hydraulic pressure to account for vehicle weight transfer to the front wheels during braking. Sedan Range vehicles with traction control use separate brake lines for the rear calipers, each with a proportioning valve.

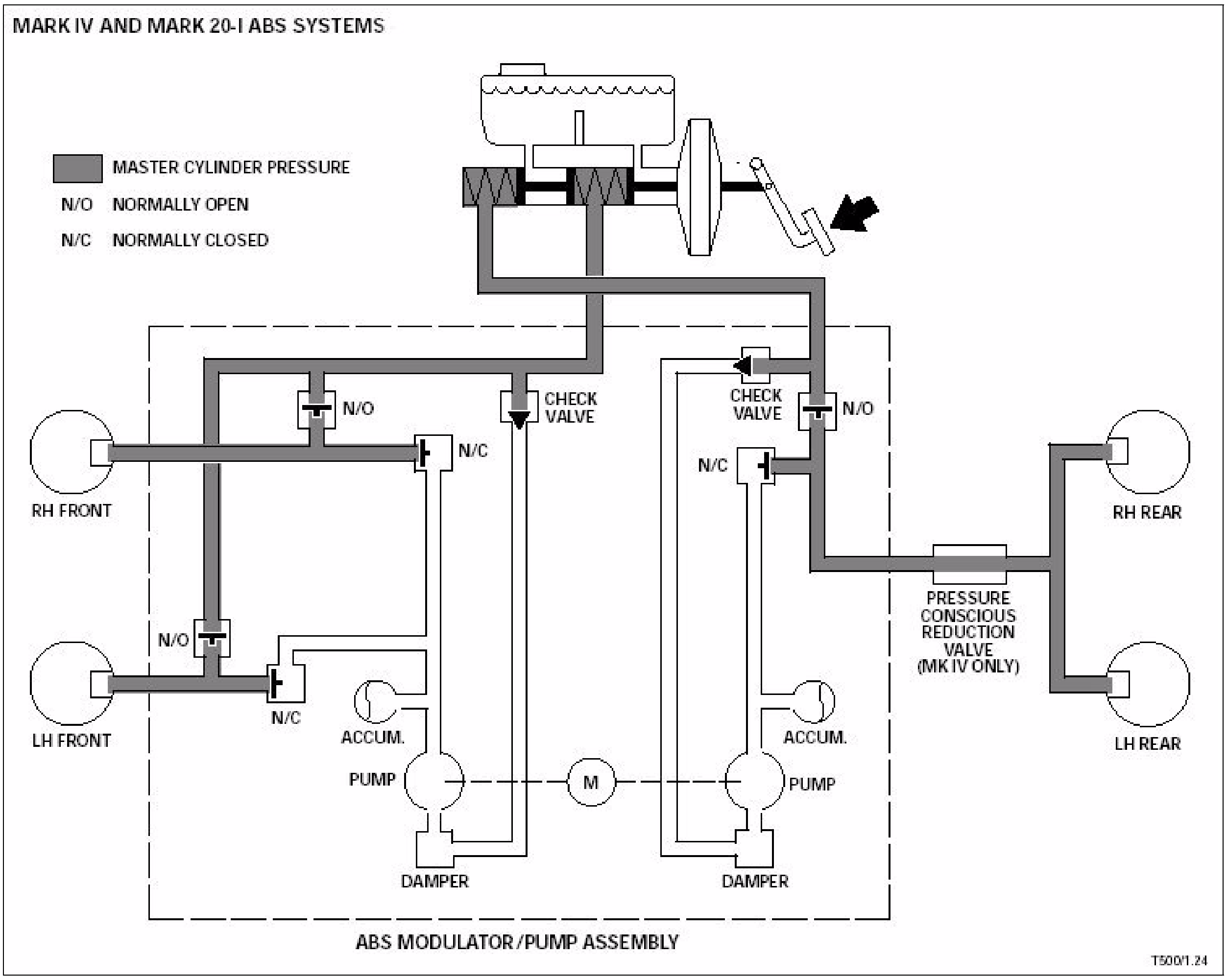


Fig. 18 XJ 1998 MY Onwards

Anti-lock braking

The ABS CM determines the need for ABS intervention by continuously monitoring individual wheel speeds.

During braking, if one wheel is decelerating at a rate greater than the other wheels or the deceleration of one or more wheels is greater than normal, the CM switches on the pump unit and closes the normally open inlet valves for that wheel or wheels. This prevents any increase in brake apply pressure to the affected brake caliper(s). If excessive wheel deceleration continues, the normally closed outlet valve is opened, releasing the trapped brake apply pressure to the low pressure accumulator, until the wheel accelerates. The released brake fluid is pumped through a noise damper back to the master cylinder. As the wheel begins to accelerate, the CM increases brake pressure by closing the outlet valve and opening the inlet valve to allow master cylinder brake apply pressure to the caliper. Valve opening and closing is controlled by a varying pulse width signal to maintain the optimum brake apply pressure for the wheel traction conditions.

Because the fluid volumes in the tandem master cylinder vary with the volumes in the brake calipers the brake pedal will pulse while ABS is active, providing driver feedback that anti-lock braking is underway. The low pressure accumulators in the modulator unit compensate for fluid volume peaks and controls brake pedal feedback harshness.

Both rear brake calipers operate on the same brake circuit during ABS operation. Rear brake pressure modulation caused by excessive deceleration of one rear wheel effects both rear brake calipers.

Automatic Stability Control

All 1998 MY onwards XJ vehicles are equipped with Automatic Stability Control (ASC), which controls acceleration drive wheel slip throughout the total vehicle speed range. If the ABS CM detects wheel slippage during acceleration, the CM transmits a traction active data message on the CAN multiplex network. When the TCM receives the message from the network, it adopts a traction control strategy that inhibits shifting depending on the vehicle speed and driver throttle demand and inhibits shifts to 5th gear. At the same time, the ABS CM transmits data messages requesting the ECM to control throttle opening, fuelling and ignition timing to reduce engine torque. There is no brake intervention during ASC operation.

The anti-lock braking malfunction indicator (ANTI-LOCK MIL) is activated for ASC malfunctions. A message will also be displayed in the driver information message center and the amber warning light will activate. During normal ASC operation the amber light will flash and an ASC active message will display in the driver information center.

Automatic Stability Control Operation

The ABS CM continuously transmits wheel speed and vehicle speed data messages on the CAN network. When ASC is switched ON (ASC is ON by default) and the ABS CM detects that a drive wheel rotates faster than the other, or both drive wheels rotate faster that the comparative norm of the front wheels, it transmits additional data messages to inform the CAN modules of the potential traction loss. Because CAN communications are virtually instantaneous (“real time”), the CAN modules act to reduce engine torque and control shifting to maintain the optimum traction.

The following is a list of the major actions that provide ASC:

Table 1

Control module	Action
ABS CM	Continuously transmits: • Individual wheel speeds • Vehicle reference speed • Traction control (ASC) status Detects wheel slip (potential loss of traction) Transmits throttle, fueling, ignition torque reduction and transmission control requests
ECM	Retards ignition and fueling for fast torque reduction response Closes throttle to achieve desired torque if required Cancels or inhibits cruise control
TCM	Adopts traction control (ASC) strategy Changes shift points Inhibits upshifts to 5th gear

During ASC operation the control modules are able to instantaneously adjust their actions to achieve optimum traction because the following data is available to them via the CAN network:

- Individual wheel speeds and vehicle speed
- Engine speed
- Traction control (ASC) status
- Cruise control status
- Brake switch status
- Transmission strategy
- Kickdown status
- Ignition, fueling and throttle torque reduction requests (ABS CM)
- Engine torque, throttle position, accelerator pedal position (ECM)

Traction Control Hydraulic Operation

Sedan vehicles equipped with traction control have individual braking circuits for each rear wheel and four additional valves in the modulator hydraulic valve body. A normally open inlet and a normally closed outlet valve are provided for each rear wheel brake circuit and a normally open isolation valve blocks pump return flow to the master cylinder rear brake circuit. In addition, a normally closed hydraulic supply valve, activated by differential pressure in the hydraulic circuit, controls the supply of brake fluid to the rear brake circuit pump. The pump is supplied either from the fluid reservoir via the master cylinder or from the accumulator as required.

During starting off and at lower speed acceleration, the CM determines the need for traction control by monitoring the individual acceleration rates of all four wheels. If a drive wheel accelerates faster than the other drive wheel or both drive wheels accelerate faster than the front wheels, the CM initiates engine torque reduction and transmits a traction active message to the transmission control module (TCM). The TCM adopts a shift strategy that enhances traction control effectiveness.
If wheel acceleration continues, the CM closes the normally open isolation valve, shutting off the rear brake circuit from the master cylinder. The pump is switched on, drawing fluid from the reservoir, through the master cylinder. The pump provides rear brake apply pressure, limited by a relief valve in the isolation valve. The normally open rear brake circuit inlet valves and normally closed outlet valves are operated by the CM to control brake application.

If the brakes are applied during traction control operation (brake switch closed), the ABS CM opens the isolation valve and switches the pump off. Differential brake fluid pressure closes the hydraulic supply valve and the system reverts to normal ABS mode.

On-Board Diagnostics

The ABS or ABS / TC control module continuously monitors the system and its components for faults. When the ignition is switched ON, the anti-lock braking malfunction indicator (ANTI LOCK MIL), and traction control off indicator (TRAC OFF) are activated for approximately 2 seconds as the system performs a self test. Because of the instrument pack bulb test routine, the indicators remain activated for 5 seconds after the ignition is switched ON. If a system fault is detected, the CM flags a diagnostic trouble code (DTC) corresponding to the fault, activates the appropriate MIL and stores the DTC in nonvolatile memory. If the fault is repaired or disappears, the MIL will remain ON until the vehicle is switched off, restarted and driven to a speed above 12.5 mph (20 km/h). Depending on the fault and vehicle speed, ABS, ASC or TC may be switched OFF or its operation may be inhibited. When ABS, ASC or TC is OFF or inhibited, the brake system operates as a normal, non-anti-lock system.

ABS System components

ABS or ABS/TC Modulator Assembly

The core of the ABS system is the modulator assembly, which comprises the motor / pump unit, the hydraulic valve block and the ABS or ABS/TC control module. The modulator assembly is located at the right rear of the engine compartment on Sedan Range vehicles.

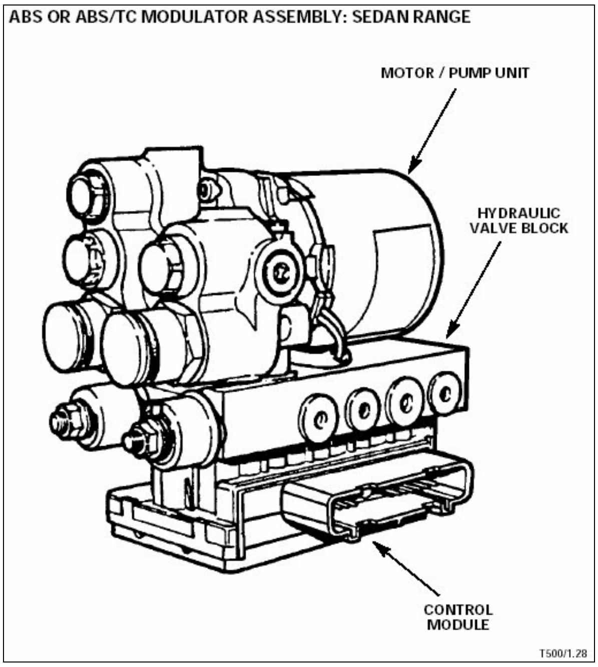


Fig. 19

ABS or ABS/TC Control Module

The control module (CM) is mounted below the hydraulic valve block of the ABS or ABS / TC modulator assembly. The CM uses wheel speed sensor and brake switch signals to determine when to activate the hydraulic valve solenoids, which are part of the control module.

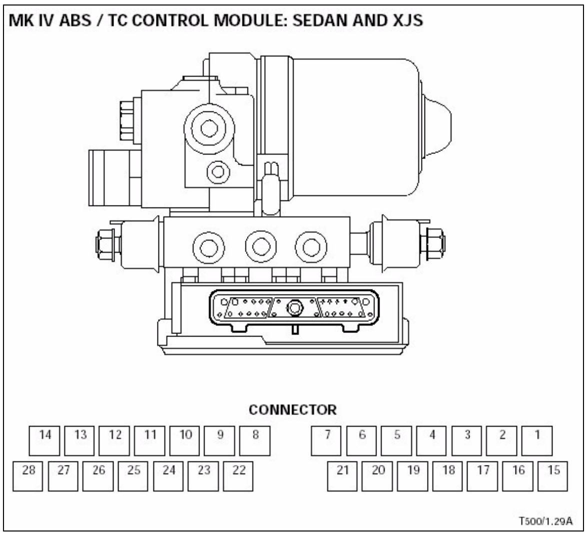


Fig. 20

For Sedan Range vehicles, the CM also provides the vehicle speed signal to the instrument pack, using the left rear wheel speed sensor input. In Sedan Range traction control applications the CM provides a traction active signal to the transmission control module (TCM), an inhibit signal to the cruise control CM, modulates throttle opening and activates the Traction Control OFF indicator.

Motor / Pump Unit

The motor / pump unit is part of the ABS modulator assembly. The motor is provided with a separate, fused battery voltage supply through the CM. The Sedan Range 30 Amp pump / motor fuse is located in the left heelboard fuse box under an orange cover. When ABS or TC is activated, the CM switches the motor ON to drive a two-circuit reciprocating pump. The pump circulates brake fluid separately for the front and rear brake circuits.

Hydraulic Valve Block

The hydraulic valve block is part of the ABS modulator assembly. It is mounted between the motor / pump unit and the CM. The valve block interfaces with the CM hydraulic valve solenoids. The ABS valve block contains 6 solenoid operated valves: 3 normally open inlet valves and 3 normally closed outlet valves. The ABS / TC valve block contains 9 solenoid operated valves: 4 normally open inlet valves, 4 normally closed outlet valves and a normally closed isolation valve. The valve block also contains a differential-pressure-operated hydraulic supply valve that controls the fluid supply to the pump rear brake circuit. The solenoid valves are powered by a fused battery voltage supply through the CM. The 30 Amp solenoid valve fuse is located in the right heelboard fuse box under an orange cover (Sedan).

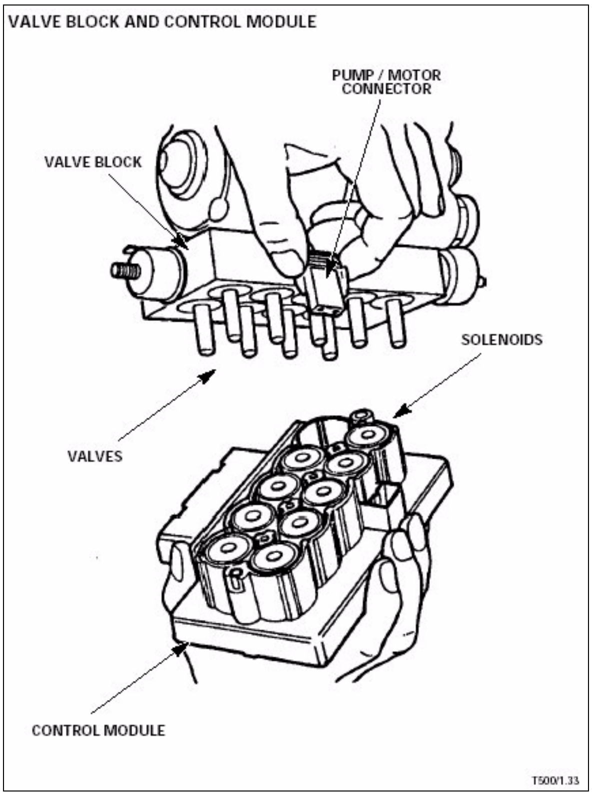


Fig. 21

ABS or ABS / TC control module diagnostic monitoring

The CM is powered with ignition switched battery voltage. The pump and the modulator valves are provided with separate, independently fused battery voltage supplies that are routed through the CM. If the CM supply voltage is out of range, either high or low, a DTC will be flagged and the CM will adopt a default action.

Wheel Speed Sensors

Each wheel speed sensor is made up of a magnetic sensor and a 48 tooth reluctor. The reluctor rotates with the road wheel. As the reluctor turns, its teeth pass through the magnetic field of the sensor inducing a variable AC voltage in its coil. The control module uses the sensor signal frequency to calculate individual wheel speed. The front wheel speed sensors are located in the vertical link / stub axle assemblies and the rear wheel speed sensors are located in the hub carriers.

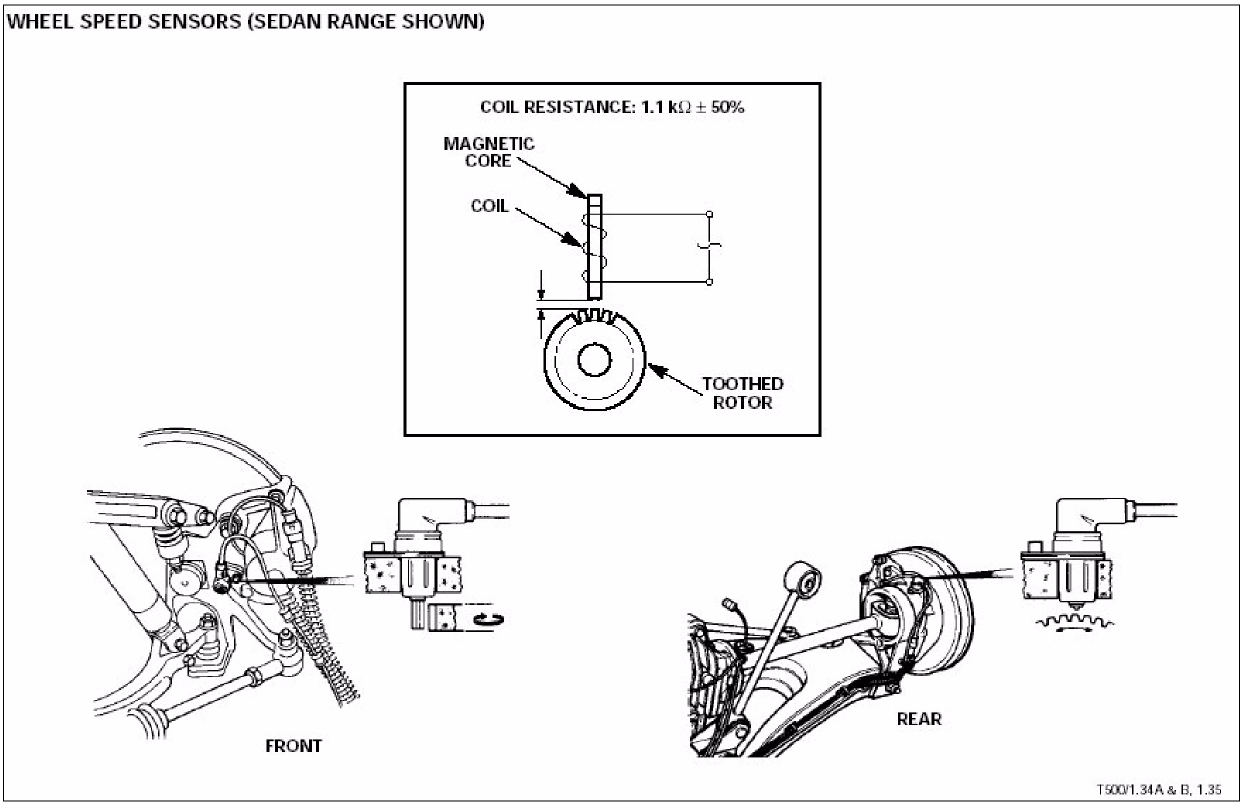


Fig. 22

On 1997 MY Sedan Range vehicles, the signal from the left rear sensor is output from the CM to the instrument pack for distribution to other vehicle systems requiring a vehicle speed signal.

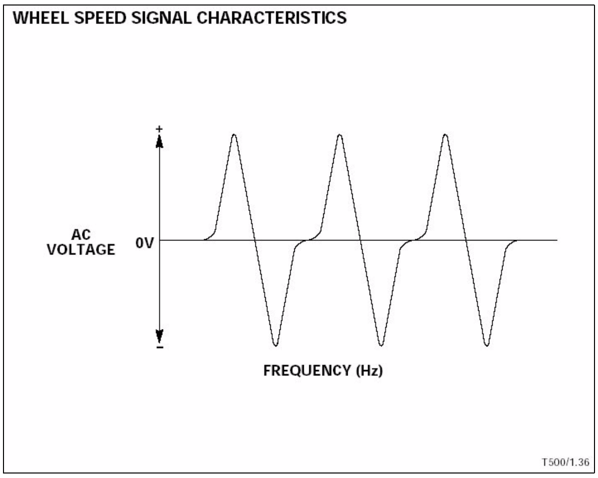
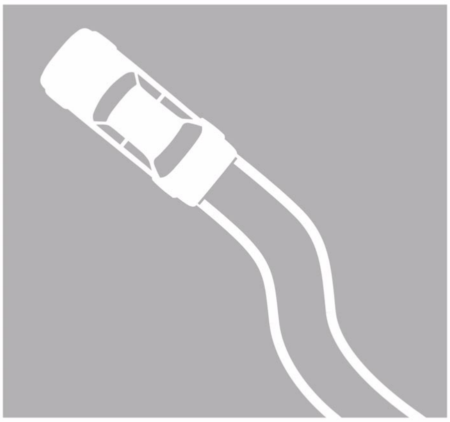


Fig. 23

TRAINING PROGRAM

JAGUAR CHASSIS, BRAKING AND TRACTION CONTROL SYSTEMS



PUBLICATION CODE – 451

FRONT SUSPENSION

Subframe

The front subframe is manufactured from aircraft grade heat-treated aluminum. It mounts to the body with two bonded rubber bushings at the front and two bonded rubber mounts at the rear. The engine mounts are supported by the subframe.

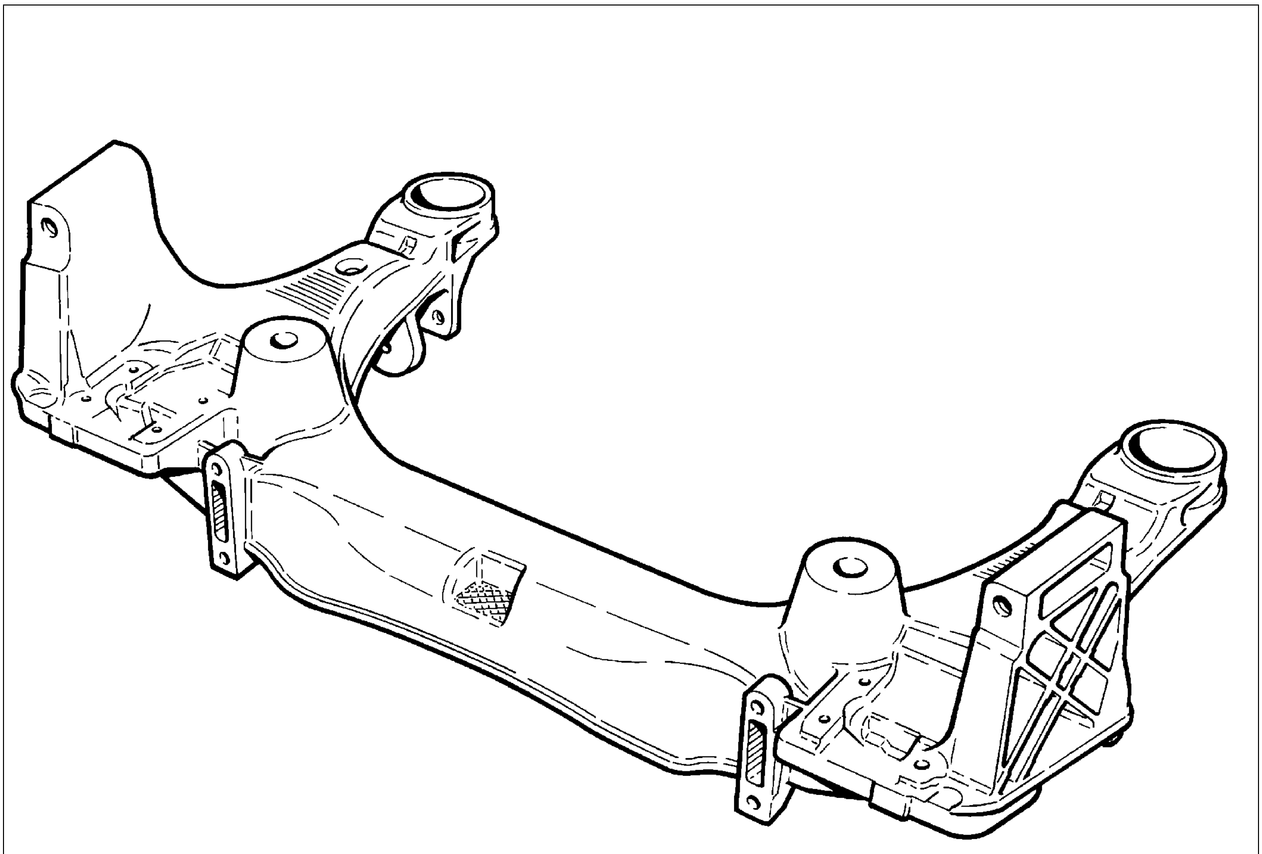


Fig. 24

CAUTION:

Do not jack the vehicle on the front subframe. Do not attempt to weld or repair the subframe; if the subframe is damaged, it must be replaced.

Front upper "A" arms

The upper "A" arms are one-piece steel forgings with slipflex bushings for the fulcrum bolt. Each "A" arm is located axially on its fulcrum bolt by four spacers: two 1.6 mm (0.0629 in.) blue spacers and two 0.9 mm (0.0355 in.) red spacers. Spacer position tailors the front suspension caster angle for various markets. Spacer positions are different between the left side and the right side.

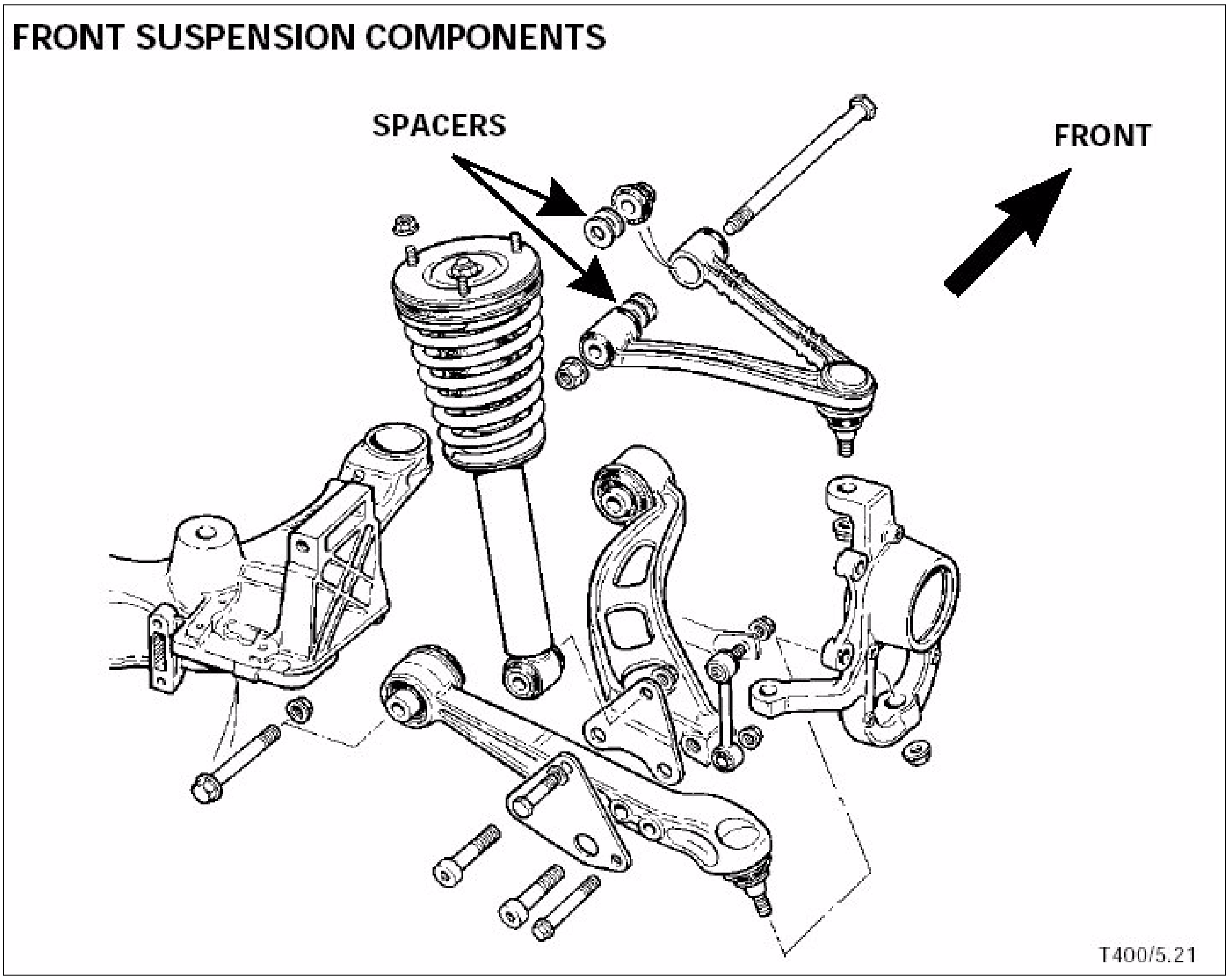


Fig. 25

Front lower “A” arms

The lower “A” arms are two-piece steel forgings bolted together to form the assembly. The lower road spring / shock absorber mounting plates are secured by the “A” arm connecting bolts. Nonadjustable ball joints are pressed into the “A” arms to support the vertical link.

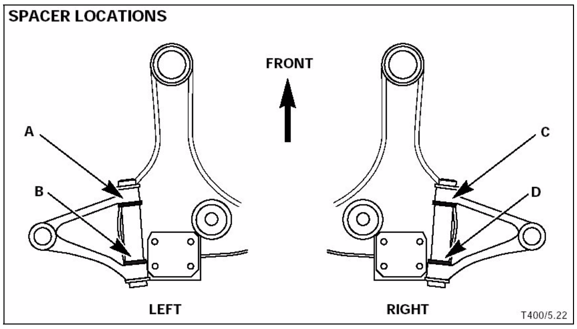


Fig. 26

Table 2

Location	Size	Qty.
Left Forward (A)	1.6 mm (0.0629in.)	2
	0.9 mm (0.0355 in.)	1
Left rearward (B)	0.9 mm (0.0355 in.)	1
Right forward (C)	0.9 mm (0.0355 in.)	1
Right rearward (D)	1.6 mm (0.0629 in.)	2
	0.9 mm (0.0355 in.)	1

Front wheel bearings

The front wheel bearings are sealed units requiring no service or adjustment. The bearing is pressed into the vertical link. The wheel hub is pressed into the bearing and retained by a special nut that acts as the wheel speed sensor rotor. The special hub nut is locked with a two pin spring loaded device. A Jaguar Service tool is needed to remove the bearing hub.

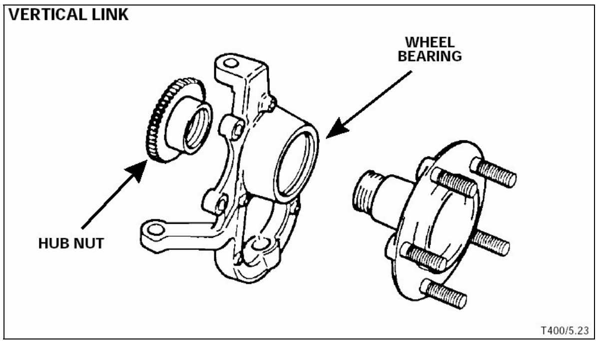


Fig. 27

NOTE:

If the hub is removed, the wheel bearing must be replaced.

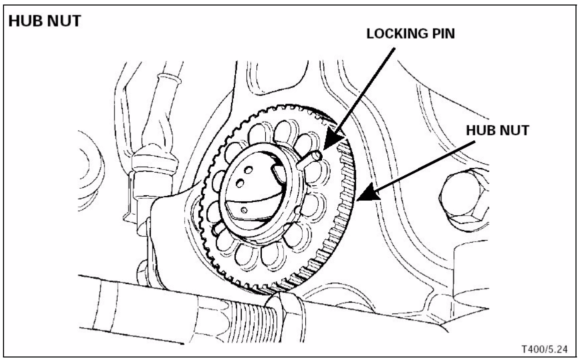


Fig. 28

Front springs and shock absorbers

A tapered road spring mounts coaxially on each shock absorber. The spring is compressed between a lower spring pan collar, supported by the shock absorber body, and a composite upper mount, which is attached to the shock absorber piston rod. Packers are used between the lower pan and the spring. The composite upper mount bolts to the body. The lower shock absorber bushing and the composite upper mount are insulated to isolate the body from road vibrations.

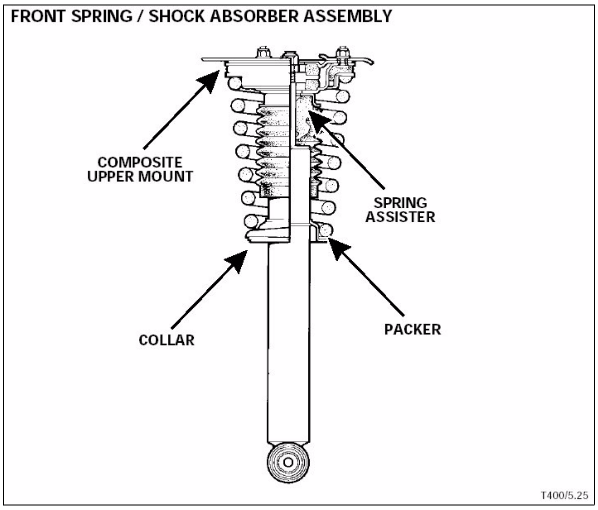


Fig. 29

REAR SUSPENSION

The rear suspension assembly is similar to that in the XJ Sedan Range. A fabricated monostrut takes the place of the two single struts used by the N/A (normally aspirated) Sedan. To improve drive shaft alignment, the new 14 HU final drive unit is constructed so that the drive pinion is on the vehicle center line. Camber and rear toe are adjustable, as on the Sedan.

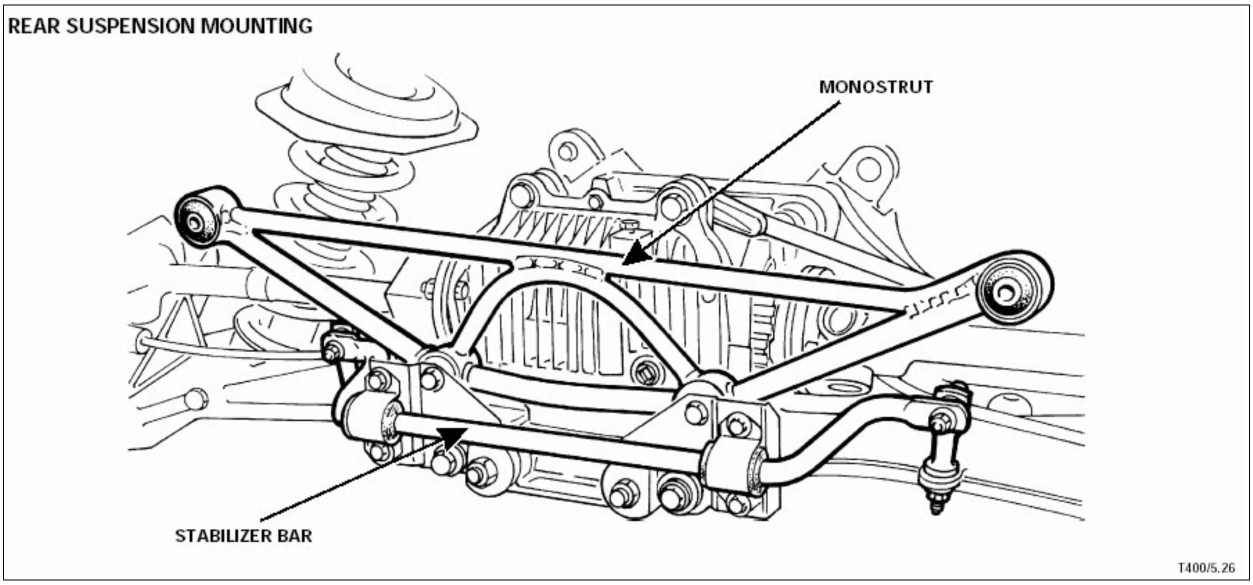


Fig. 30

ADAPTIVE DAMPING

Overview

Adaptive damping is available as an option on XK8 and standard on XKR vehicles, matches damping effect with vehicle driving forces, to provide optimum ride and handling performance. The system which is completely automatic and requires no drive input, comprises the following components:

- Four adaptive damping units installed in the normal shock absorber positions. These are identified by a harness connector incorporated in the top of each unit.
- An adaptive damping control module (ADCM) installed in the trunk adjacent to the battery.
- Two vertical movement sensors (accelerometers), one installed on the bulkhead below the air conditioning unit, the other in the trunk below the fuel tank.
- A lateral movement sensor (accelerometer) installed within the RH side false bulkhead.

Operation

The four adaptive damping units are simultaneously switched to either firm or soft setting to suit circumstances. When the vehicle is stationary, the system adopts the firm setting to minimize vehicle pitch during initial acceleration. From 8km/h (5mph) upwards, the system reverts to the soft setting until otherwise switched by the ADCM.

On detecting cornering forces, the lateral sensor transits signals to the ADCM, which in turn switches the damping units to the firm setting, reducing vehicle roll-rate and improving wheel control. On detection of a bump or depression in the road, the vertical sensors transmit signals to the ADCM, which in turn switches the damping units to the firm setting to minimize vehicle body movement.

Under braking conditions, the ACDM, on receipt of a signal, commences calculation of vehicle deceleration. When deceleration exceeds a pre-determined threshold, the ADCM switches the damping units to the firm setting, reducing vehicle pitch rate and improving wheel control. Following completion of a cornering manoeuvre, negotiation of road surface undulations, or heavy braking, that has necessitated switching to the firm setting, the ADCM always returns the damping units to the soft setting.

In the event of failure of the Adaptive Damping System, the damping units automatically revert to the Firm setting, ensuring that the vehicle remains safe to drive under all circumstances. The driver will be alerted to such a failure by illumination of a "SUSPENSION FAULT" warning on the fascia message center and the amber warning light in the instrument cluster.

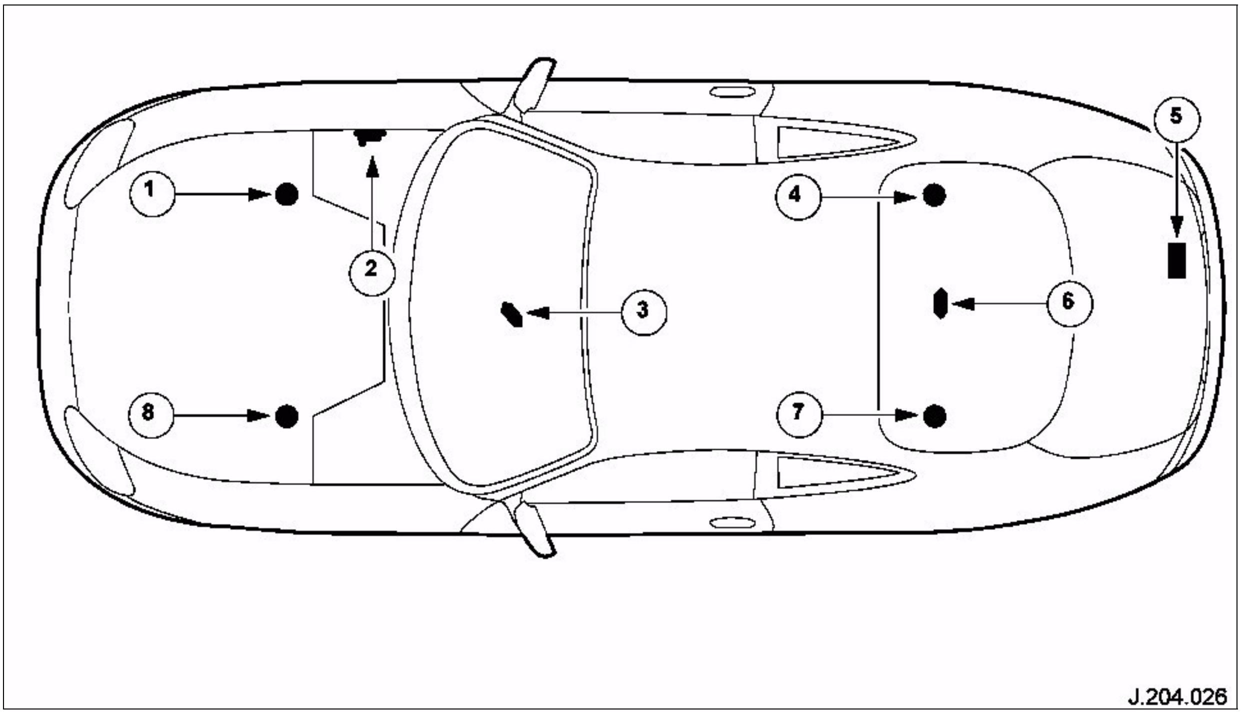


Fig. 31

1. Adaptive Damper Unit Front-Right Hand
2. Accelerometer-Lateral
3. Accelerometer Vertical-Front
4. Adaptive Damper Unit Rear-Right Hand
5. Input from lateral accelerometer
6. Electronic Control Module (ADCM)
7. Accelerometer Vertical-Rear
8. Adaptive Damper Unit Rear-Left Hand
9. Adaptive Damper Unit Front-Left Hand

DRIVELINE

Driveshaft

An aluminum drive shaft connects to the transmission drive flange with a flexible coupling. A conventional universal joint is used at the final drive flange. The drive shaft sliding joint is nylon coated to reduce noise, vibration and harshness. When removing the drive shaft, disconnect the front coupling from the transmission drive flange before disconnecting at the final drive.

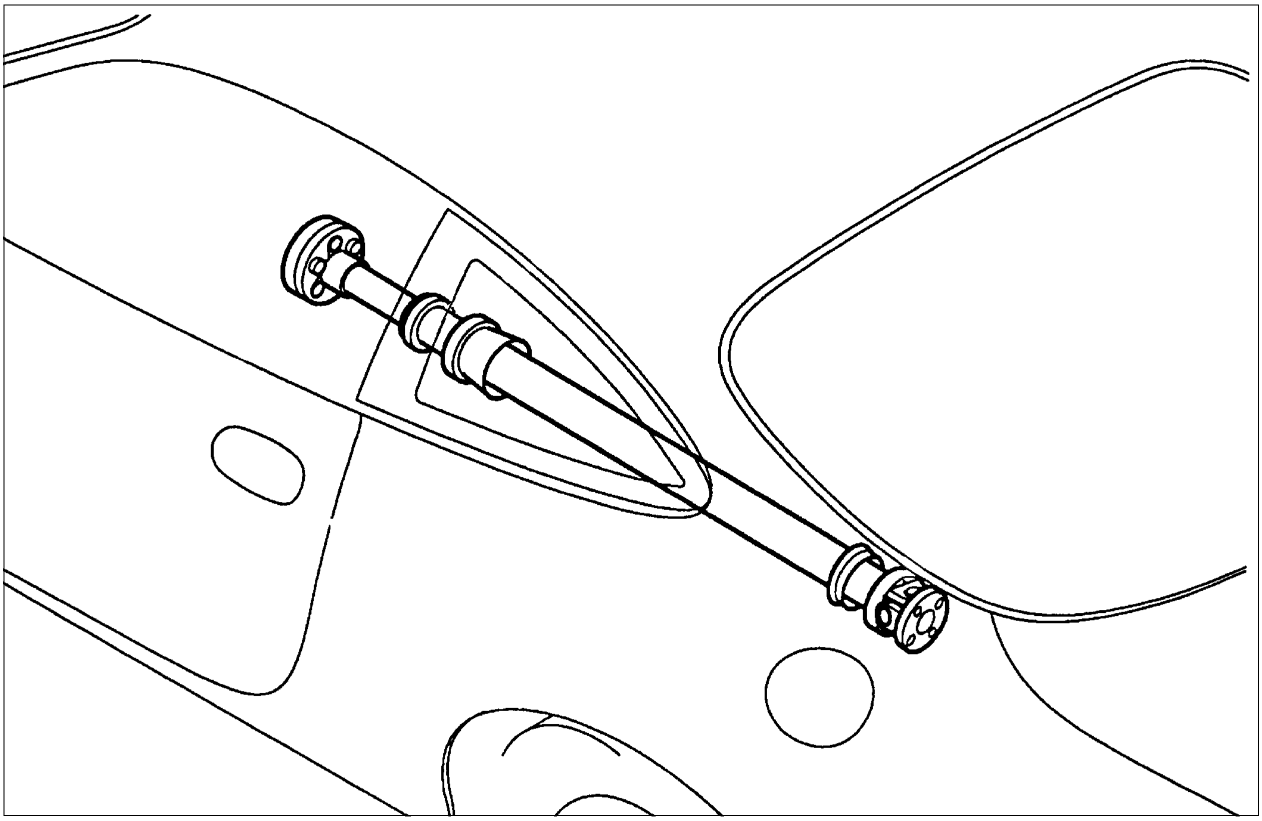


Fig. 32

STEERING

Overview

The XK power steering system is manufactured by ZF and functions the same way as the XJ Sedan Range power steering system, with the addition of a variable steering ratio rack and pinion assembly that provides precise steering and optimum control by mechanically reducing the steering ratio as the steering wheel is turned to the left or right of center.

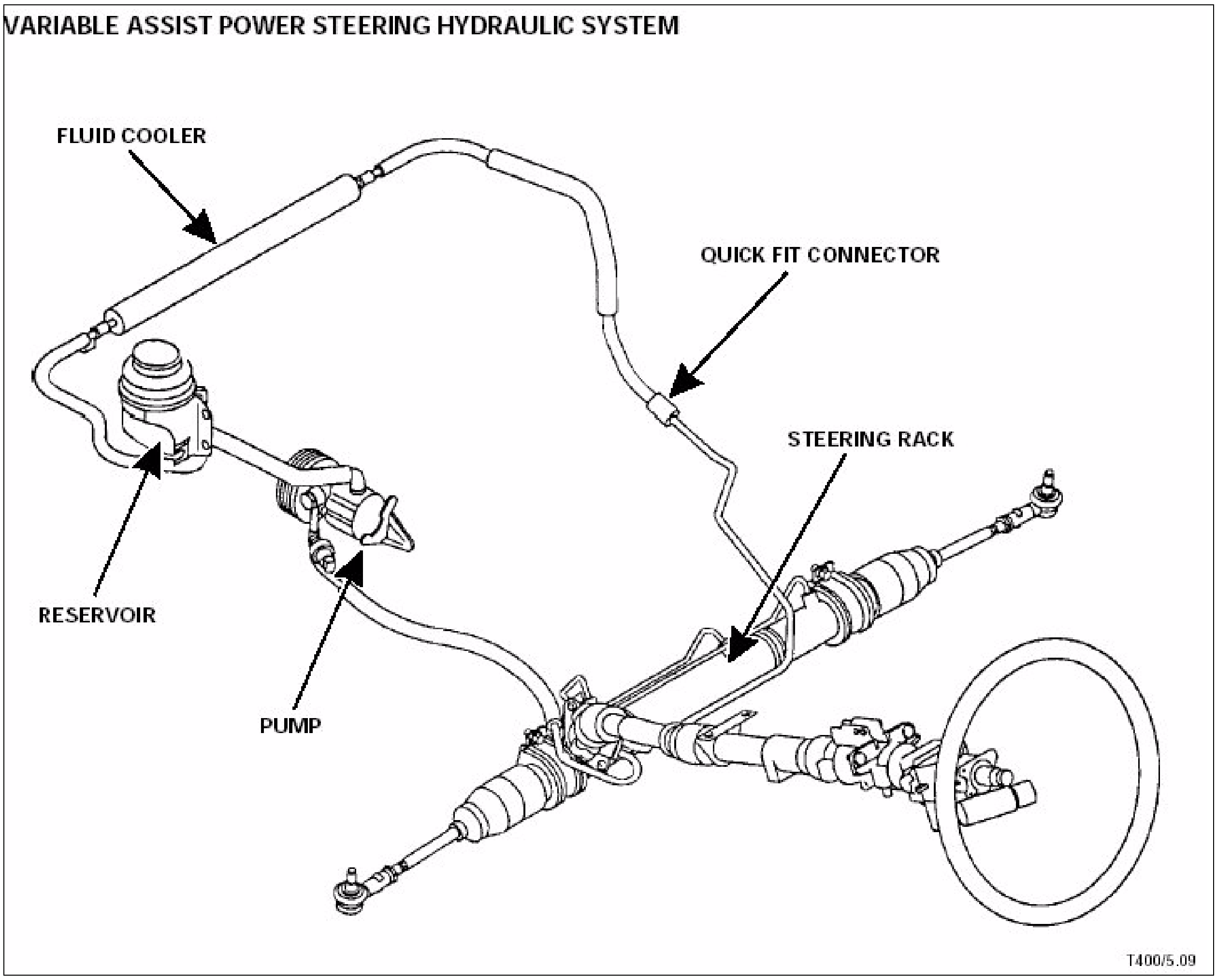


Fig. 33

Steering rack

The steering rack assembly is mounted directly to the subframe in rubber bushings. The steering must be centered during steering column or suspension geometry adjustment. To center the steering, align the pinion centralizing cap with the index mark on the pinion / valve assembly.

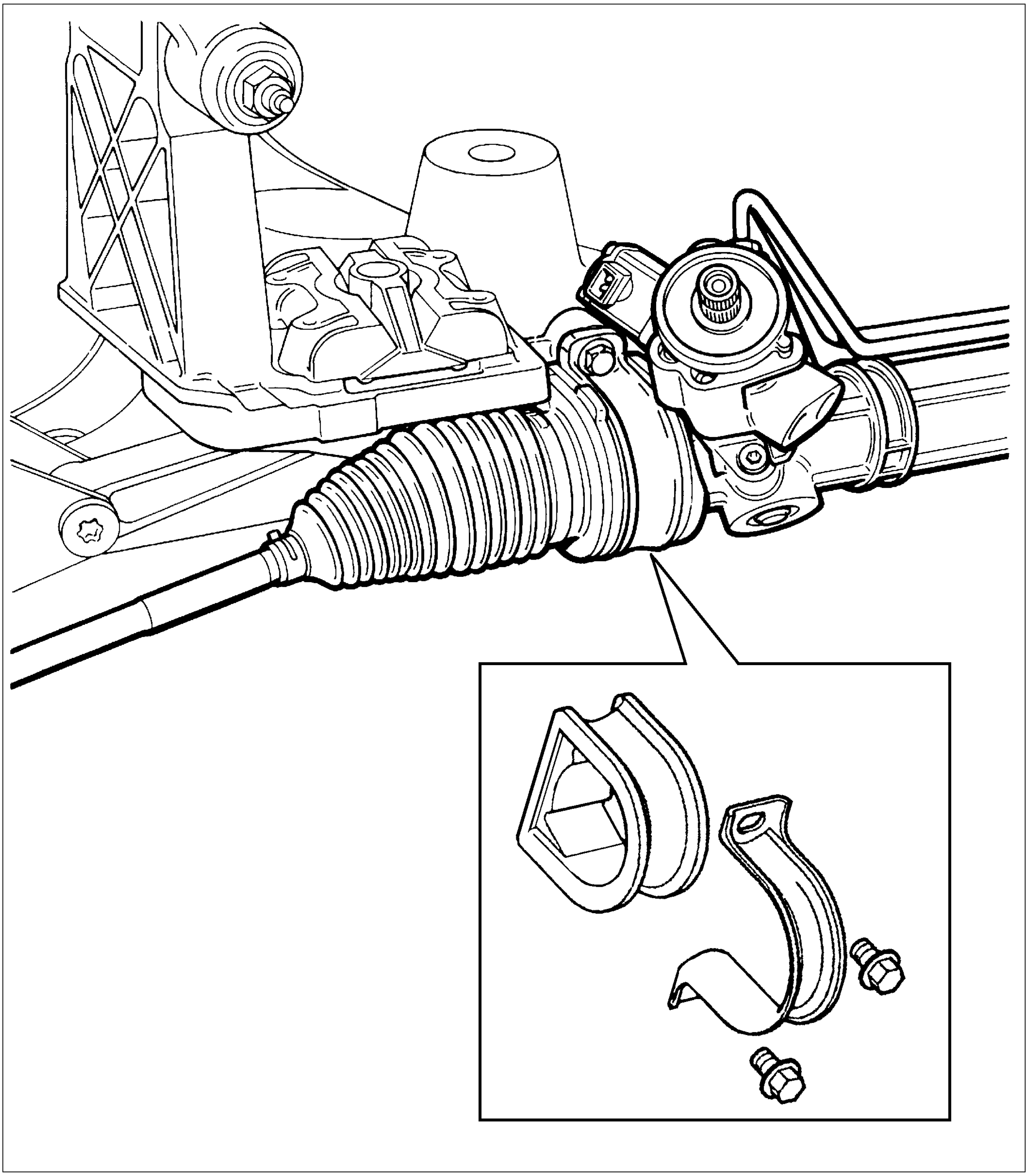


Fig. 34

Variable Steering rack

The variable steering ratio is achieved by the tooth design of the pinion gear and rack bar. As the steering is moved to the left and right of center, the pinion gear tooth / rack bar contact point progressively changes, effectively increasing the pinion gear diameter. The steering ratio becomes more direct as the pinion diameter increases.

VARIABLE RATIO RACK AND PINION GEARS

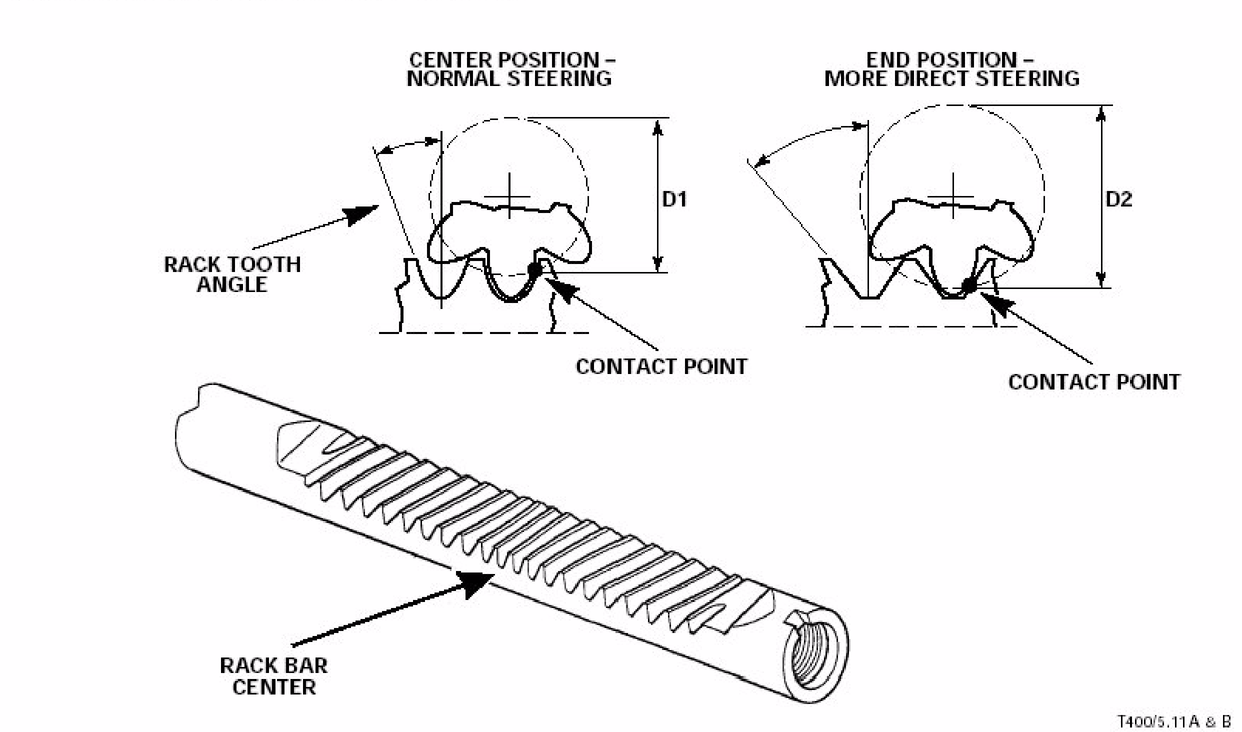


Fig. 35

Lower steering column

The telescopic lower steering column and its boot are a non-serviceable assembly. The telescopic slider allows 20 mm (0.79 in.) movement. If the telescopic slider is separated for any reason, the column must be replaced. It must not be reassembled. The column universal joints can be connected to the pinion and upper steering column on any spline.

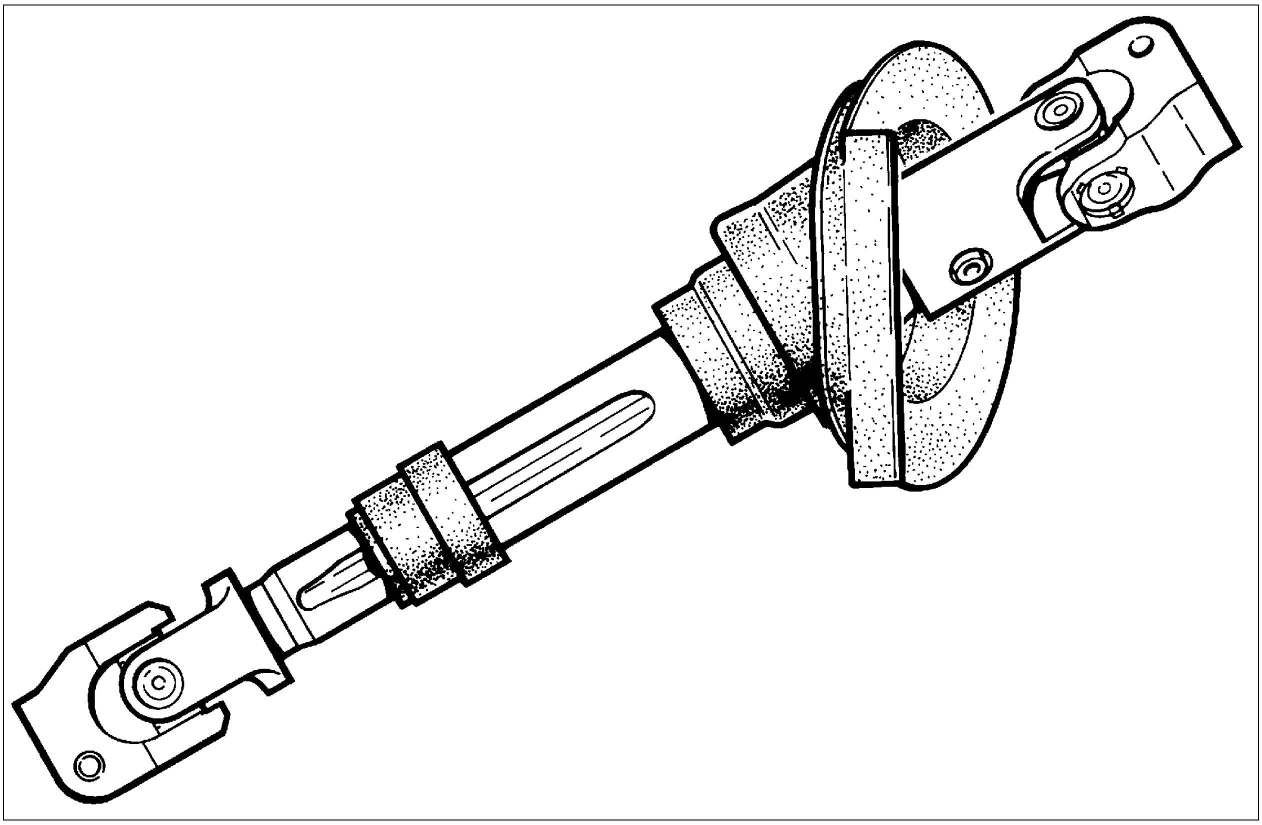


Fig. 36

NOTE:

The column must be disconnected from the steering rack before the engine or the front suspension subframe is removed.

Lower steering column

The upper steering column is the same as the XJ MY Sedan Range, but with differences in adjustment range, connector mounting brackets, and the reach adjustment motor.

Steering Fluid Cooler

The PAS fluid cooler is located in front of the radiator, rubber mounted on the body front crossmember. The cooler is a non-serviceable assembly complete with its hoses. The right side hose connects to the rack-mounted return pipe with a quick fit connector sealed by two replaceable "O" rings. The left side hose connects to the reservoir with a conventional spring clamp.

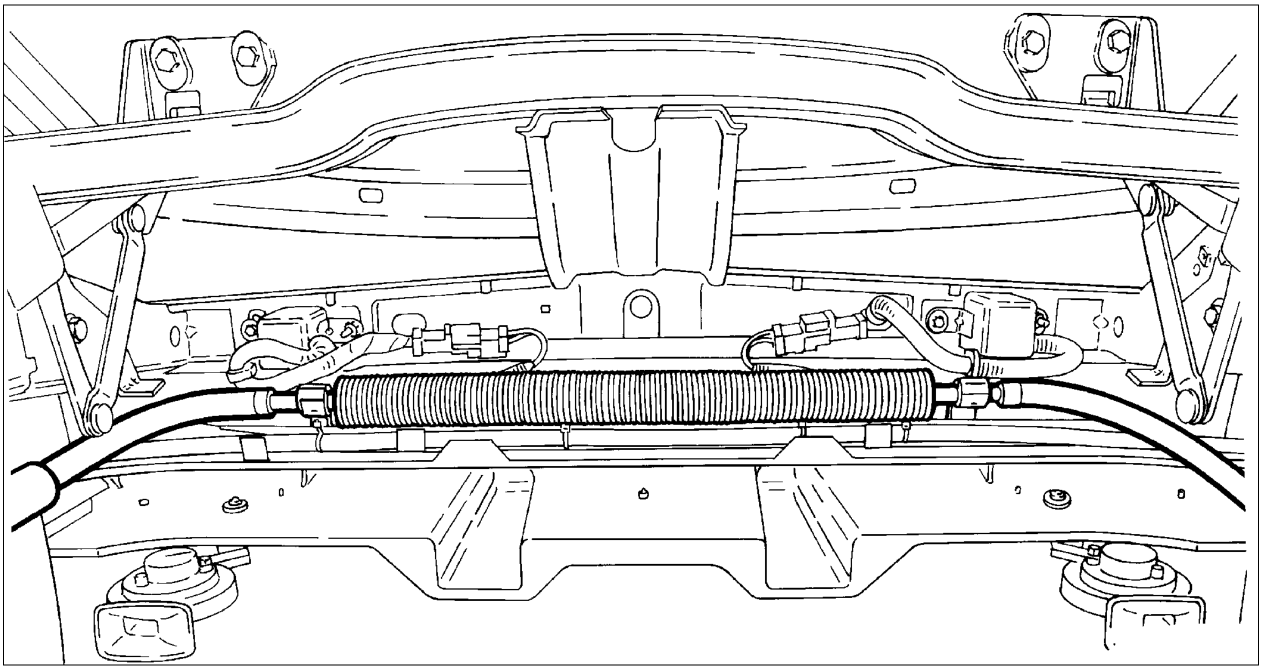


Fig. 37

Steering Pump

The “roller vane type” hydraulic pump is mounted directly on the engine block. Powered by the engine drive belt, the pump provides 107 bar (1,550 psi) of hydraulic pressure to the steering rack assembly. The pump is not serviceable.

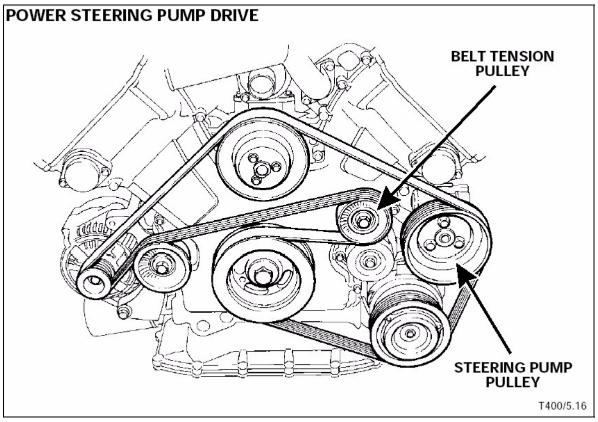


Fig. 38

Drive belt tension

A single belt is used to drive the steering pump and other engine accessories. Belt tension is automatically regulated with a spring loaded idler pulley. A belt stretch indicator on the pulley mechanism determines the need for belt replacement.

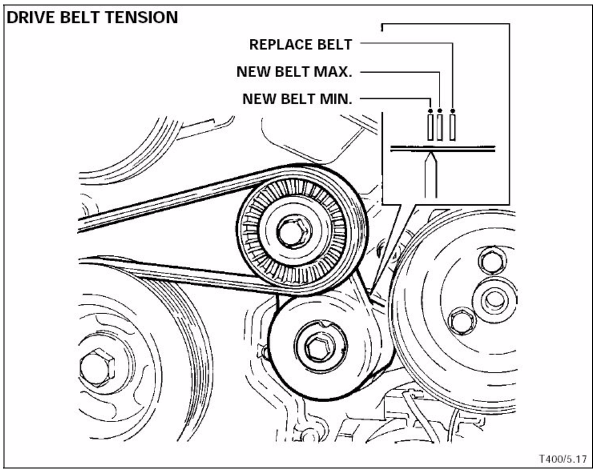


Fig. 39

Power steering fluid reservoir

The fluid reservoir contains a 10 micron filter and is not serviceable. If the system is damaged or a major component is replaced, the reservoir must also be replaced.

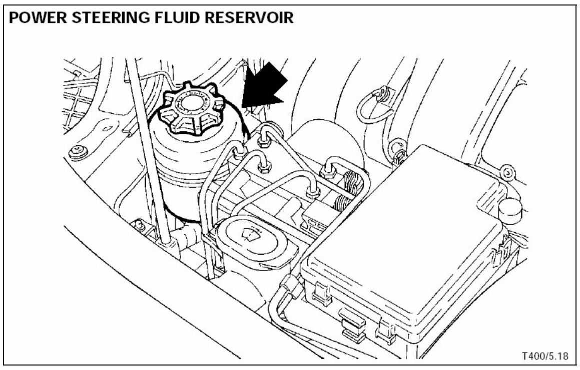


Fig. 40

BRAKE SYSTEM

Overview

The XK range is fitted with the stability control system (ASC) which is also used on the XJ range (1997–2002 MY) was included as standard equipment with the anti-lock braking system. ASC controls acceleration wheel slippage throughout the entire vehicle speed range by reducing engine torque (throttle, ignition timing and fueling control) if wheel slippage is detected.

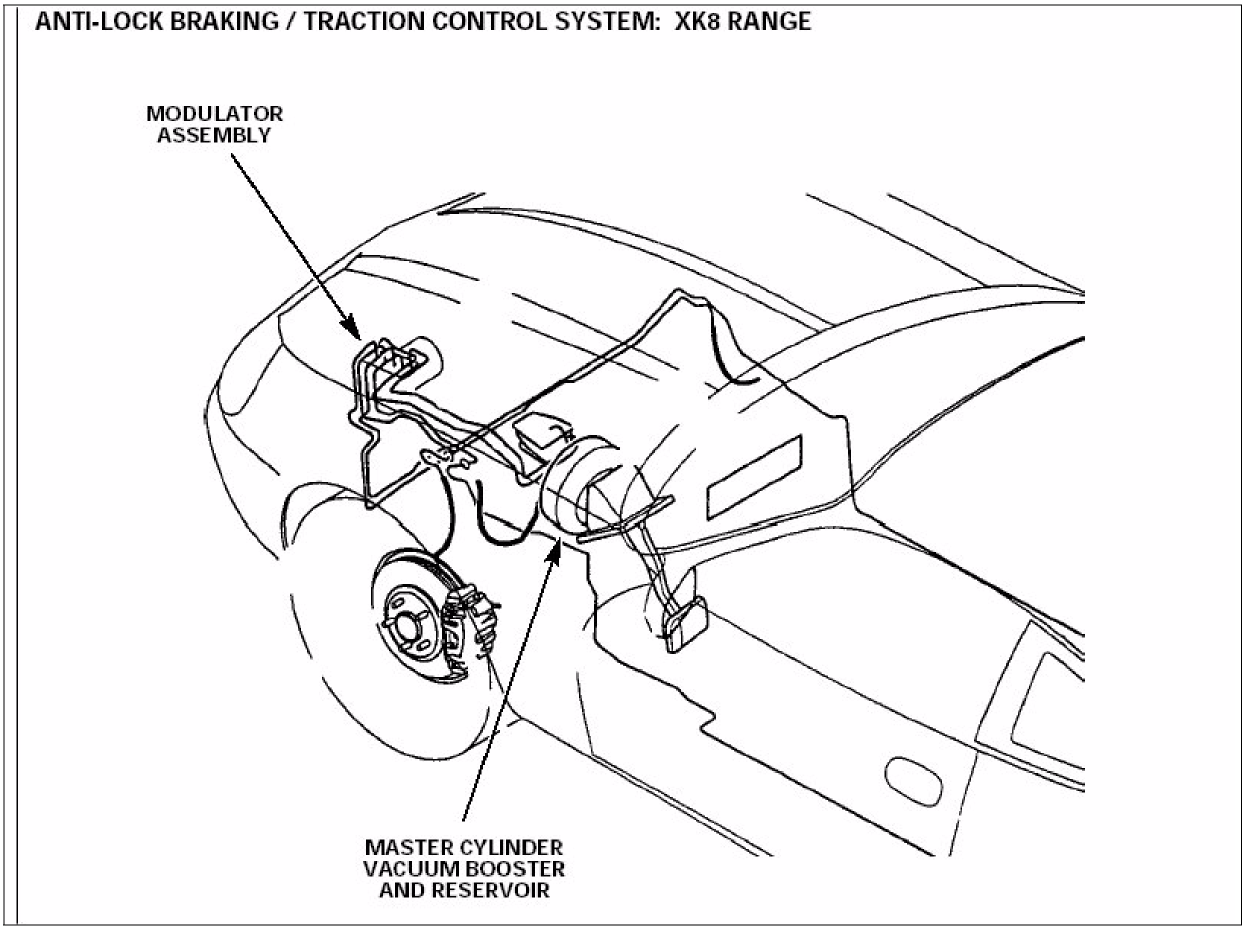


Fig. 41

Parking Brake

The parking brake mechanism is unique to the XK due to the fact of its location and operation. The cable is routed from the hand brake behind the driver's seat under the carpet and passes into the tunnel to the side of the abutment bracket. The hand brake cable terminates at a relay lever assembly mounted on the tunnel closing plate.

This converts the sill mounted hand lever system to the conventional system used on the XJ center pull system. The tunnel closing plate is not interchangeable between the coupe and the convertible because the convertible plate is longer. From the relay lever assembly the cable arrangement is as the XJ sedan.

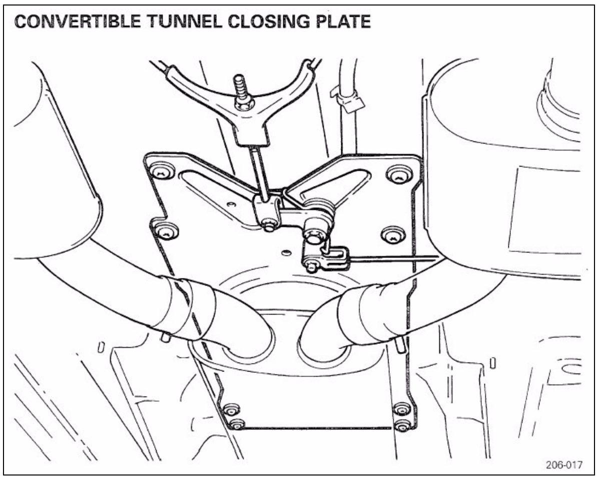


Fig. 42

Adjustment of the cable is from a central point in front of the rear axle as the XJ sedan. If the vehicle is driven above 5 km/h (3 mph) with the parking brake on, then a warning light and text message will appear on the message center. The message clears when the parking brake is disengaged or the speed drops below 3km/h (1.8 mph).

Running changes

Starting with the MY 2000, the XK ABS system benefitted from new hardware software changes

Front Discs

The XK8 was fitted with the 325mm front brake discs as fitted to the XKR models

Brembo Brakes

During the 2001 MY, Jaguar introduced a limited edition **Silverstone Model** fitted with Brembo brakes. The Brembo brakes are 4–piston monoblock calipers with cross-drilled rotors that provide maximum braking performance.

Brake Booster and Pedal Assembly

Changes to the brake booster and pedal assembly were introduced to improve brake pedal feel and effort and reduce pedal travel. A shorter pedal arm is used and the new booster unit produces a greater jump in booster pressure (approx. double the previous pressure) in response to initial pedal movement. The unit is fixed via four studs to the pedal box.

ABS Plus system

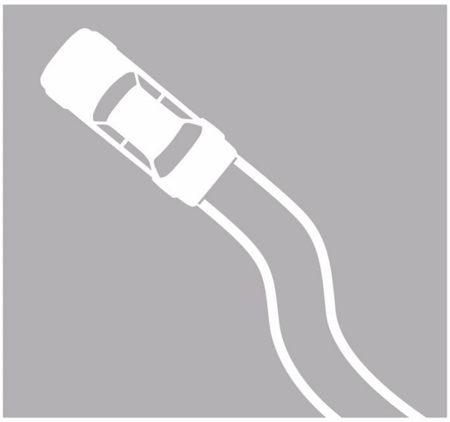
ABS plus is an enhanced anti-lock system which is designed to improve dynamic stability when braking. The system uses the existing sensors and braking hardware but the brake control modulator software is modified to provide a more detailed analysis of the input sensor data. This allows the system to recognize any differences in speed between the four wheels due to slip angle and load changes, caused by critical situations on bends, varying road surfaces or abrupt steering movements. Under these conditions, the system reduces or increases braking on individual wheels to provide compensating yaw movements which stabilize the course of the vehicle.

Note that he ABS plus system is only active when the brakes are applied (unlike traction control)

The modified brake control modulator is physically unchanged from the previous unit except that the valve block is keyed to the ABS/TC module to ensure that only ABS Plus components are assembled together.

TRAINING PROGRAM

JAGUAR CHASSIS, BRAKING AND TRACTION CONTROL SYSTEMS



PUBLICATION CODE – 451

FRONT SUSPENSION

Overview

This is an all-new Jaguar suspension, having commonality in construction to the Lincoln (DEW98), designed with traditional Jaguar refinement but with an added sporty feel for the driver. Both front and rear suspensions have double wishbone construction with the front having a high balljoint. Jaguar's Computer Active Technology Suspension (CATS), is offered as an optional fit to further enhance the vehicle ride and handling quality.

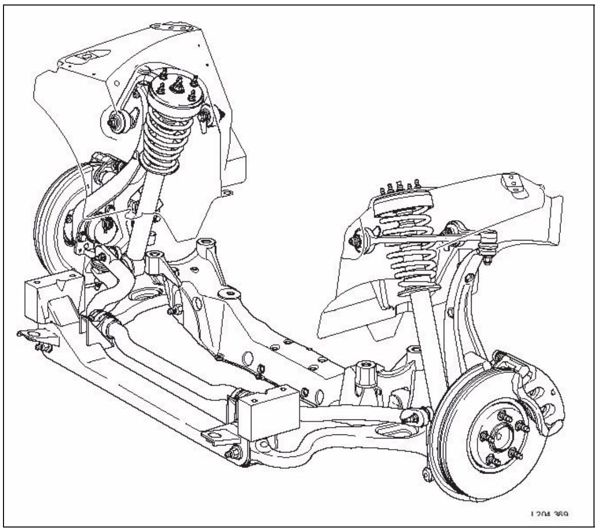


Fig. 43

The suspension arrangement offers a standard set-up for most markets. The front and rear control arms are set at angles to counteract dive when braking and squat when accelerating, giving a stable platform under most conditions. It is vitally important that before removing either of the front cross members or the rear axle cross members, the vehicle body and the component being removed are marked to ensure correct realignment during assembly. The Jaguar S-TYPE body-in-white fixings have a greater clearance than previous Jaguar cars so require this extra special care with alignment on re-assembly. Vibration and ride and handling concerns may arise if alignment is not maintained. Care must also be taken when jacking the vehicle. The sills and sill panels can be damaged if the jack or lifting device is not correctly placed at the correct points on the body.

The independent front wheel suspension is a double wishbone axle arrangement with aluminium control arms. The two arms are of different lengths, which minimizes the changes in track and camber. Inclination of the upper control arm axis provides anti-dive front suspension action. There are two front cross members, known as Number 1 and Number 2.

Number 1, the forward cross member, is a steel fabrication, non-isolated, which locates the lower control arm front mounting, the anti-roll bar and the cooling module.

The rear cross member, Number 2, is an aluminium casting, non-isolated and it locates the lower control arm rear mounting, the power steering rack and the engine hydromounts.

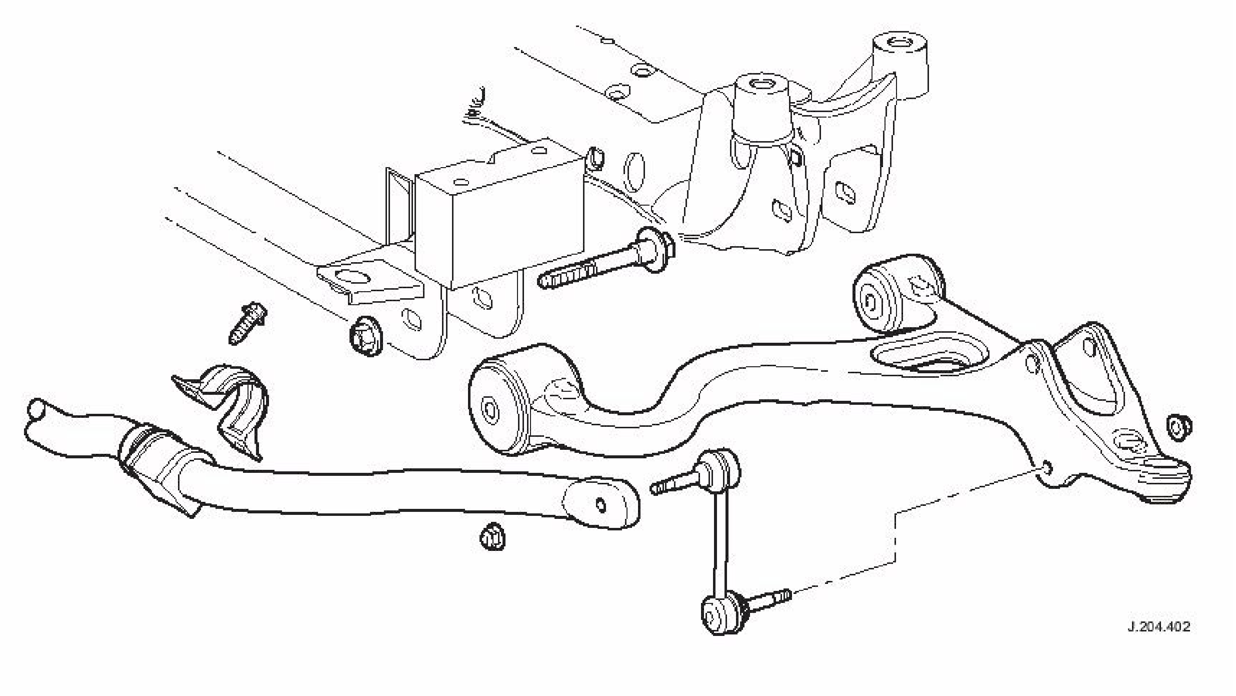


Fig. 44

WARNING:

No attempt must be made to weld or repair the aluminium cross member. If it is damaged, a new one must be installed.

The lower control arm is an aluminium forging and has locations for the damper and the anti-roll bar drop link. It is mounted with one hydro-bush, the front lower bush, and one rubber bush, both serviceable. This is the first time that a hydraulic bush has been fitted to a Jaguar wishbone. The hydro-bush is tuned for refinement and helps to reduce brake vibration.

Service adjustments for caster and camber are made to the lower control arm geometry with cam bolts (available through Parts). The upper control arm is also an aluminium forging, mounted with two rubber bushes and has an integral, non-serviceable ball joint.

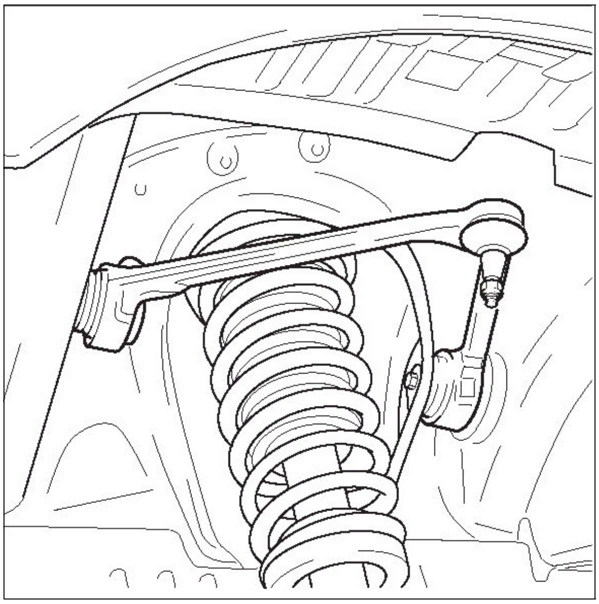


Fig. 45

The vertical front knuckle is an aluminium casting with integral steering arm, installed between the upper and lower control arms. The lower ball joint is serviceable and is a press fit. The knuckle locates the upper balljoint, riveted disk shield and brake calliper and wheel bearing/hub. The wheel bearing is a new type and contains the integral ABS rotor and sensor. The bearing is not serviceable and must be replaced as a complete unit. A service kit is available for the ABS sensor.

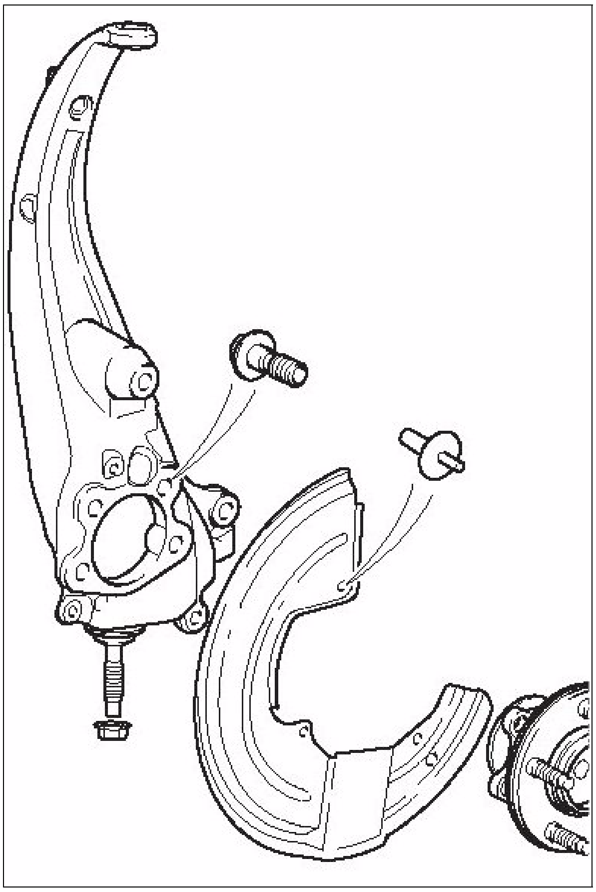


Fig. 46

REAR SUSPENSION

Overview

The rear suspension is a double wishbone arrangement with aluminium control arms. The rear crossbeam is steel fabricated and isolated to the body with four bushes. The crossbeam locates the upper and lower control arms and the anti-roll bar.

Control arms are aluminium castings and heavily inclined in plan view. The lower control arm locates the damper and anti-roll bar drop link. The damper fixing is tapped into the aluminium casting. The upper control arm has one cross axis bush and one rubber bush. It contains an integral balljoint. The rear knuckle is an aluminium casting and has a press fit cartridge bearing.

REAR SUSPENSION

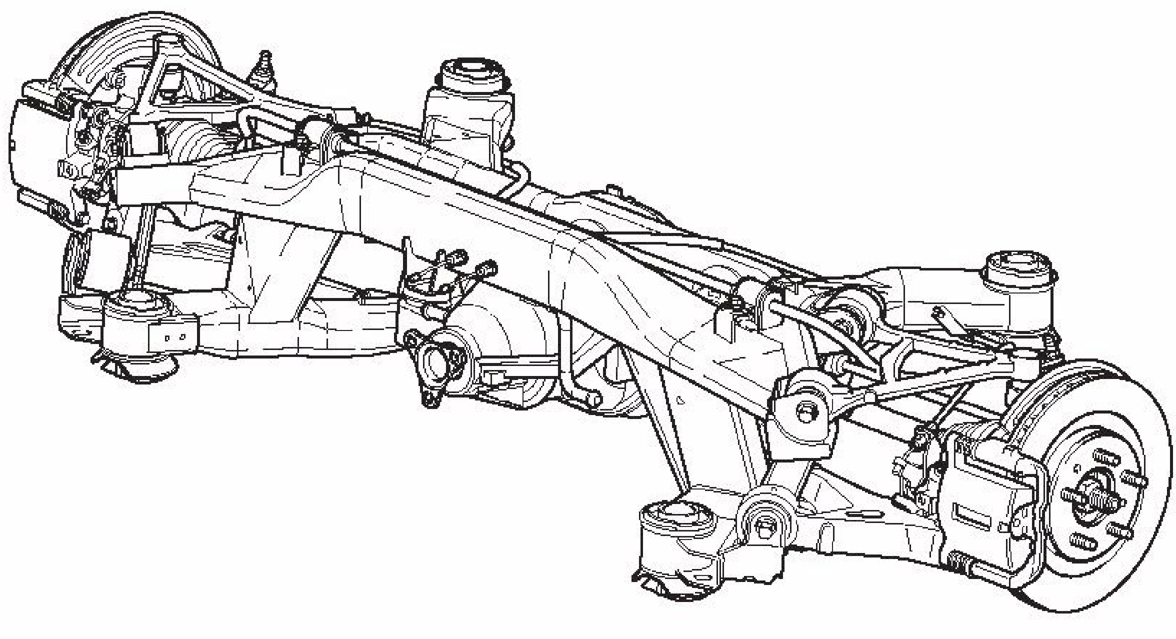


Fig. 47

The independent rear suspension upper and lower front bushes are conventional rubber bonded bushes. The upper and lower rear bushes contain no rubber and are essentially pressed in 'rose' bearings for superior suspension geometry control. These are common components between all vehicle variants and are similar concept to the A-frame bush on XK and XJ vehicles. The bushes are not bonded in place but require a special lubricant when assembling. Care must be taken to ensure that the replacement bushes are pushed fully home, the angular orientation of the bushes is important and it is essential to mark the position of the subframe before removing from the vehicle or else driveline alignment will be lost.

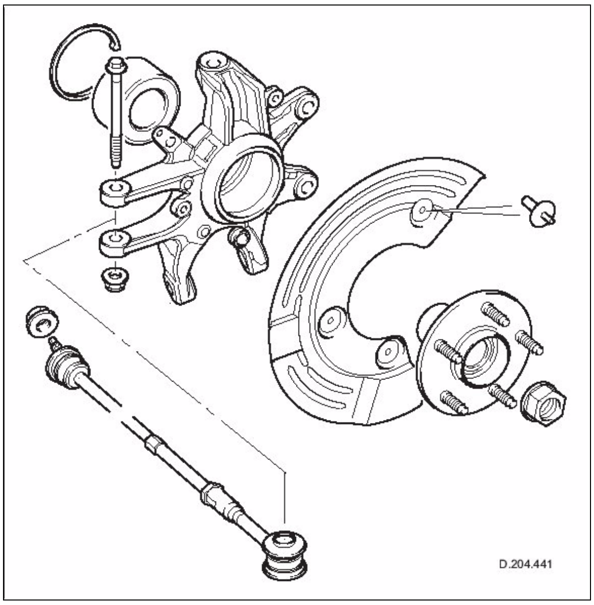


Fig. 48

The crossbeam forms the mounting points for the three differential mounting bushes. All three bushes are conventional rubber bushes, common to all S-type vehicles and are serviceable items. They control the driveline and isolate differential noise and vibration. Avoid disturbing the subframe mounts when servicing differential bushes. The front differential bush is a two-part bush and the right-hand and left-hand rear bushes are handed and color coded to differentiate them.

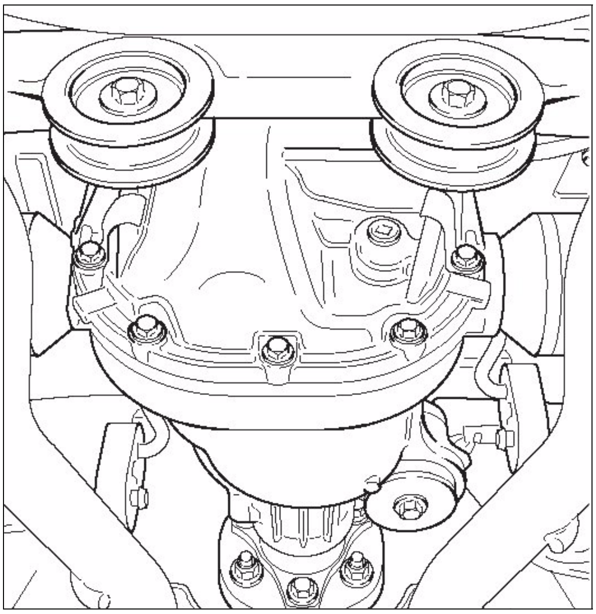


Fig. 49

Wheel Alignment

Camber caster and toe are adjustable on the front suspension only. Toe is the only adjustment on the rear suspension. Camber and caster are adjusted by means of eccentric cams on the lower control arm mounting bolts. The front toe is adjusted by use of the front tie rod. The rear toe is adjusted by the use of toe link assemblies connecting the knuckles to the rear sub-frame.

Stabilizer Bars

There are two types of front anti-roll bars, one for all V6 and base V8 engine vehicles and one for V8 sport. There are two types of rear anti-roll bars, one for all V6 and base V8 engine vehicles and one for V8 sport. All anti-roll bars are similar to current XJ except that the front bushes have moulded insert for tuning.

Springs and Dampers

There are numerous variants to suit both standard and sport derivatives of the V6 and V8 engine vehicles. Both front and rear springs and dampers are similar to current sports vehicles. With a strut type assembly, integrated top mount and two-position lower spring pan. The front and rear co-axial strut and spring assemblies are installed between the lower control arms and the vehicle body.

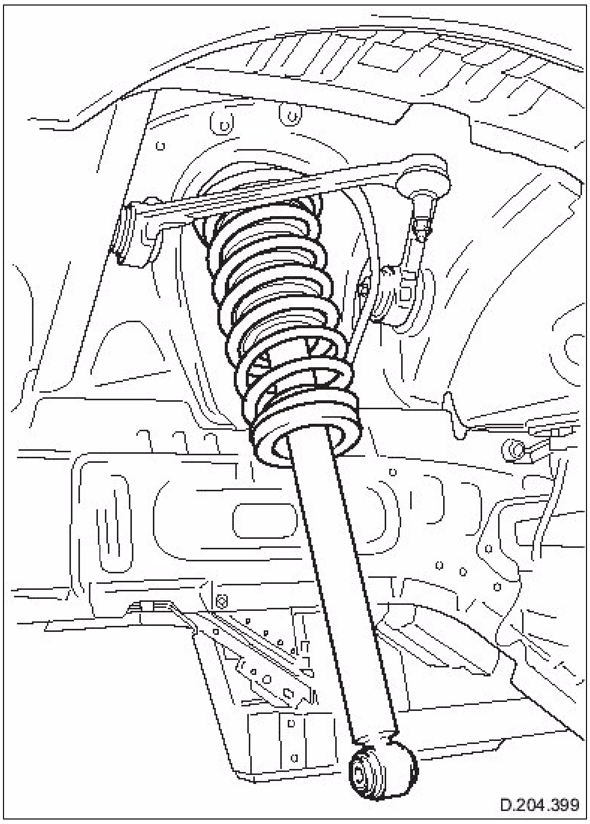


Fig. 50

Sports dampers are CATS only, as XK series. The CATS suspension is similar to the system introduced on the XK. It is a two-stage adaptive damping ride control. The control module is located in the rear left-hand corner of the spare wheel well. Three accelerometers are fitted. The front vertical and lateral accelerometers are mounted as an assembly to the vapor management valve bracket. The lateral accelerometer is used for Dynamic Stability control (yaw control). The rear vertical accelerometer is fixed to the Rear Electronic Module bracket on the rear right-hand side of the luggage compartment between the rear wheel arch and the rear light cluster.

STEERING

Overview

The Jaguar S-TYPE has a variable assist rack and pinion steering gear and variable rack ratio (VAPS). The variable steering rack ratio reduces the number of turns from lock to lock (2.8) to enhance parking manoeuvrability whilst maintaining the on-centre steering precision required at high speed. Full power assistance is provided for parking. Steering assistance decreases smoothly at a calibrated rate to raise driver steering efforts as vehicle speed increases.

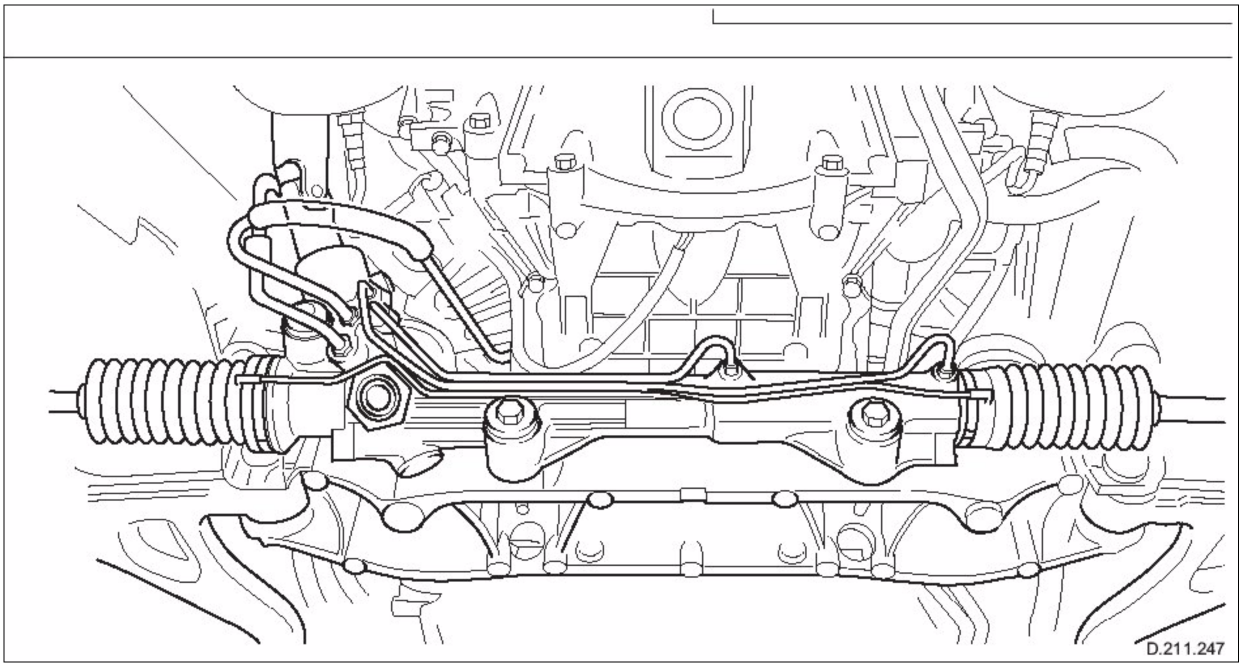


Fig. 51

- There are no carry over parts from XK or XJ series vehicles.
- The rack is mounted to the rear of cross member No. 2. The PAS pump is belt driven.
- A PAS cooler matrix is located within the radiator package.
- Low PAS pump speeds problems are prevented by increasing engine speed.
- A hydraulic pressure switch senses the demand hydraulic pressure switch

senses the demand on the pump at low engine speeds and increases the speed to a pre-set minimum.

NOTE:

Early S-Type vehicles were fitted with a Visteon-supplied steering rack. During the 2001 a new ZF-supplied steering rack was introduced to replace the Visteon rack.

Service Information

- Hose connections to the pump and the steering gear are quickfit connectors. The quick connect tube must be pushed into the existing tube nut port, along the centerline.
- The assembly is complete when the tube end bottoms out in the port with an audible click/snap. Correct assembly should be verified by pulling the quickfit tube end.
- Servicing of the PAS line involves removal of the quickfit nut. Replacement PAS lines are supplied complete with quickfit nut and sealing washer.
- If the threaded union is opened, replace the seal otherwise leaks are inevitable. Replacement sealing washers may be installed with the use of Ford Service tool D90P-3517-A
- Care must be taken when removing the quickfit nut from the V6 engine pump as the pulley is PHENOLIC and is susceptible to damage.
- The V8 pump installation provides a short jumper tube from the pump to improve accessibility to the high-pressure hose connection.
- The PAS pulley requires a Service tool to assist removal. Low-pressure hose connections are made using Constant Tension (CT) clamps. Pinion hydraulic connections are orientated with the bottom connector low pressure with the longer nut, as current vehicles.
- The PAS fluid is a FORD fluid for PAS only (2000 MY only); it is not to be used for transmissions. After manual filling, the system must be bled using a vacuum pump to remove all the air from the system to prevent system noises. Fluid level is checked through a sight window on the reservoir.
- Components replaceable are complete pump, steering rack, reservoir or hose assembly.
- A non-serviceable 10-micron filter is located within the reservoir to maintain fluid cleanliness throughout the life of the vehicle. It is essential as with all Jaguars that the system does not become contaminated. Cap all ports on disassembly to prevent contamination ingress.
- As with current vehicles, the fluid and reservoir must be renewed if any major component is replaced i.e. Rack, pump or cooler.
- The road wheels should be set straight ahead and the steering wheel locked (using service The road wheels should be set straight ahead and the steering wheel locked (using service assembly of the steering gear or intermediate shaft is required. This is necessary to prevent damage to the air bag clock spring within the steering upper column assembly. The intermediate shaft can only be assembled to its mating components in one location. Steering wheel alignment can only be achieved by adjustment at the tie-rods. A dimensional check of the steering rack position may be necessary to verify rack centre.

BRAKE SYSTEM

Overview

Brakes are controlled with a Teves Mk 20EI brake modulator. The module contains the integral software for ABS and traction control, similar to current saloon and sports vehicles. It is supplied as a 10 valve, 4-channel module and calibration is the same to all powertrains. It is connected to the SCP bus for traction control, warnings and vehicle speed.

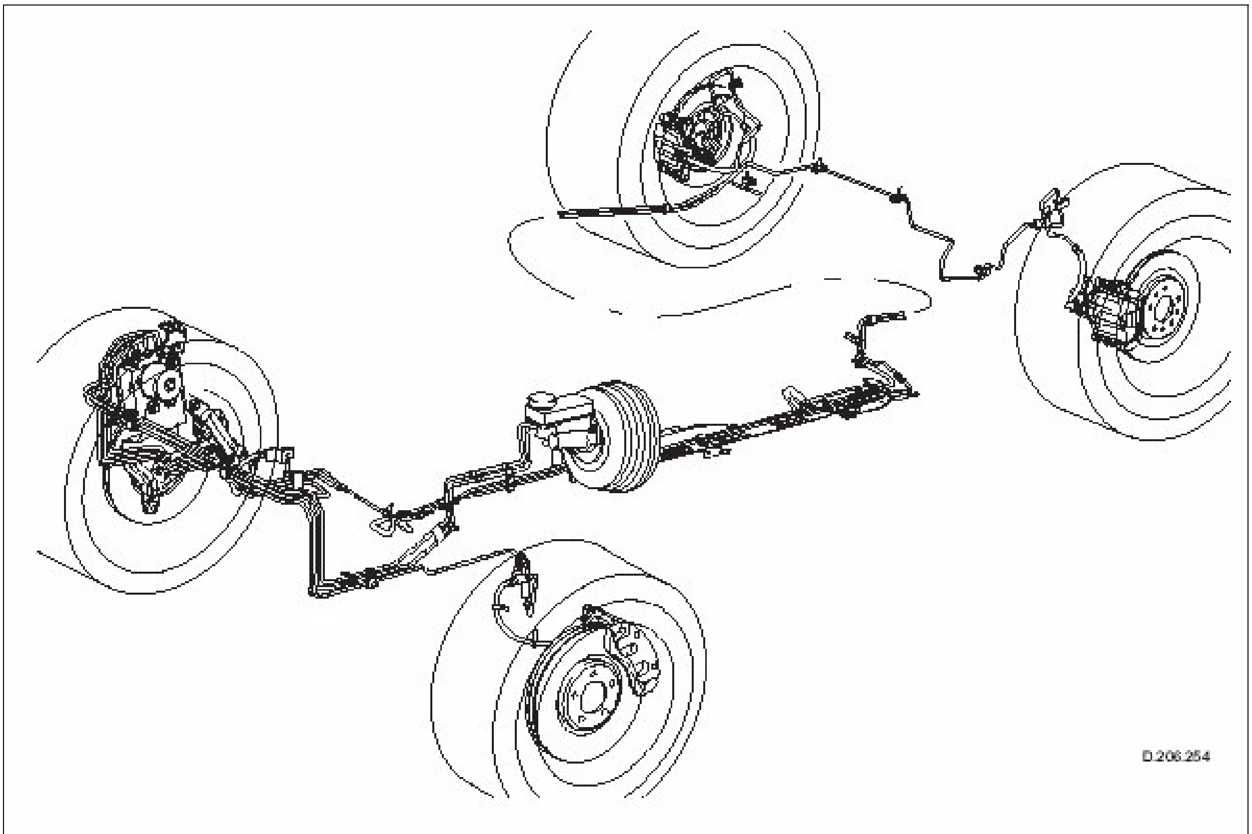


Fig. 52

Dynamic stability control is a new Jaguar safety feature, which uses ABS and traction control to control yaw movements of the vehicle. Yaw is the rotary motion of the vehicle on its vertical axis, a force that would cause under or oversteer and sideslip. slip.

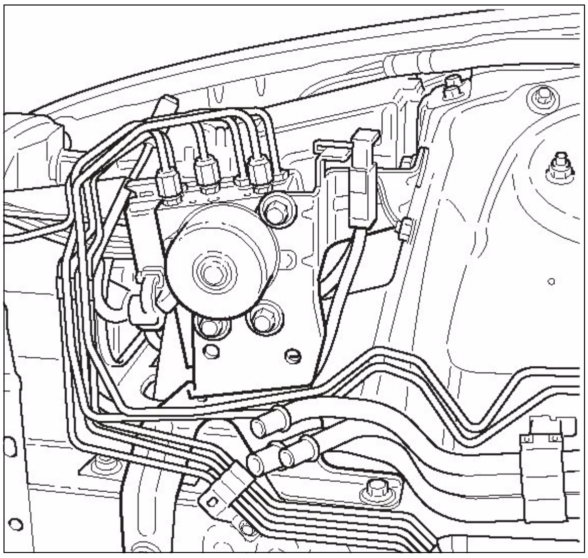


Fig. 53

The modulator contains the same software as described but with the addition of DSC software. The modulator is supplied as a 12 valve, 4-channel module calibrated for base suspension only. The connectors differ between the two; the 10 valve unit has a 25-way with sliding cam, as current vehicles and the 12 valve unit has a 47-way connector with lever cam. DSC calculates the real vehicle motion (forward and gearing) and compares it to the direction initially chosen by the driver. A steering rate sensor is located on the steering column and is used to calculate steering angle. A yaw rate sensor and lateral accelerometer are located on a bracket behind the hand brake lever and are used to calculate the vehicle under or over steer and any side

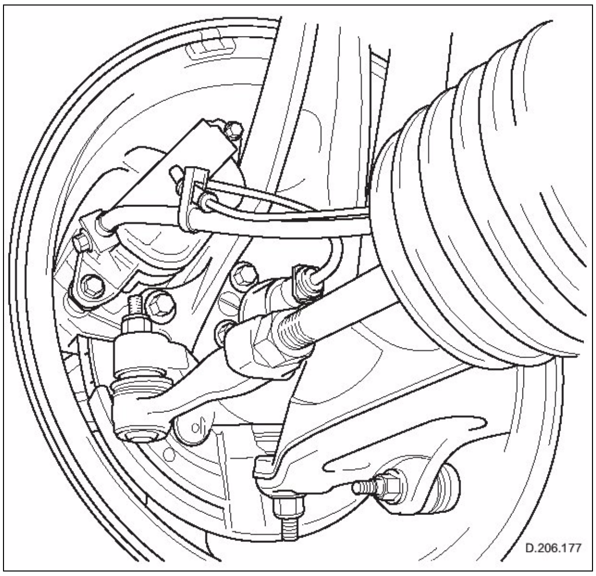


Fig. 54

The front wheel active ABS speed sensors are incorporated into the wheel bearings, connected via a flying lead routed along the brake hose.

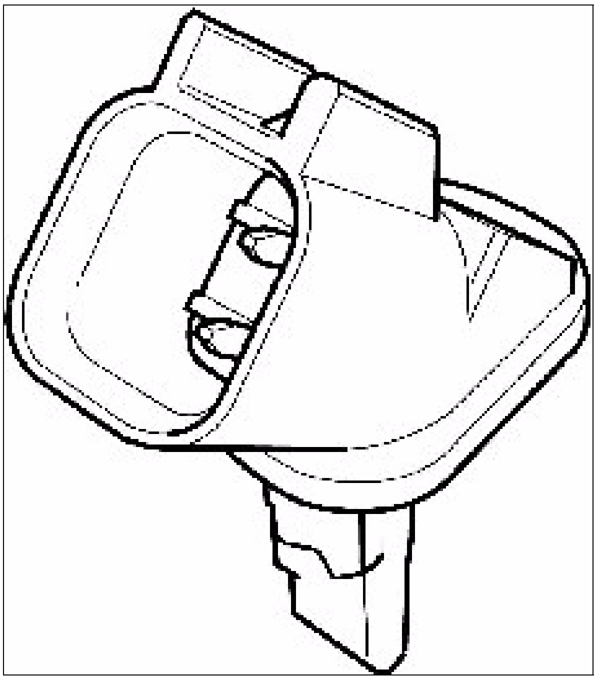


Fig. 55 Front wheel speed sensor

The rear sensors are mounted on the hub carrier and connected by a flying lead routed along the control arm.

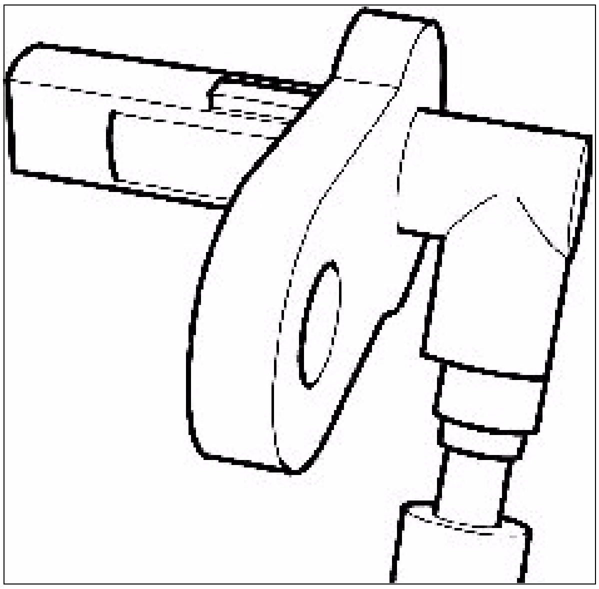


Fig. 56 Rear wheel sensor

None of the sensors are adjustable. Wheel speed sensors are active sensors, which are more sensitive at lower speeds than the current XJ and XK wheel speed sensors.

Front callipers are twin piston aluminium construction. The ventilated disc sizes are 300 mm x 32 mm. The rear brakes have cast iron callipers. This is because of the hand brake operation using the rear callipers. The ventilated disc sizes are 288 mm x 20 mm. Each rear calliper has a ball and ramp park brake mechanism, operating on the main calliper pads.

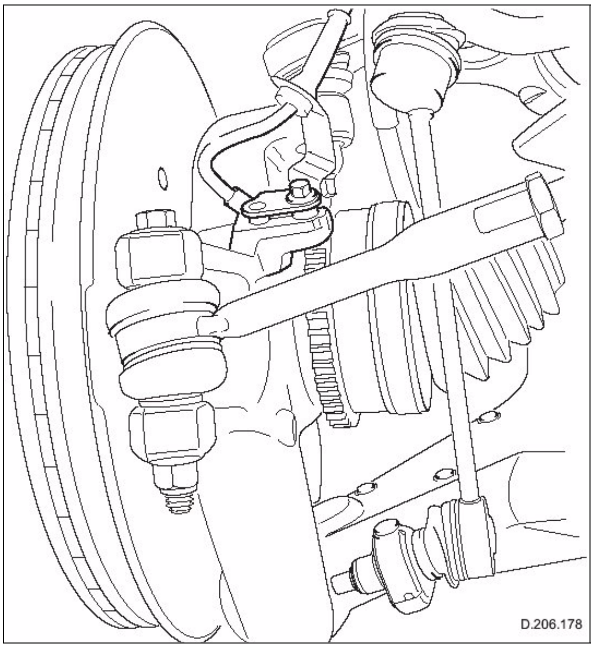


Fig. 57

Brake booster

The brake booster is a Lucas unit mounted on the engine bay bulkhead with a 25.4mm diameter master cylinder and integral brake fluid reservoir.

The DSC booster is different having integral pressure transducers and solenoids with air control valves for the booster. The transducers are located on the brake master cylinder and are used for pressure feedback, brake application and fail safe operation. The booster is used to supply brake pressure without driver input.

During a stability control event the driver may experience any of the following behavior:

- A rumble or grinding sound much like ABS or Traction Control
- A small deceleration or reduction in the acceleration of the vehicle
- The Traction indicator will flash

- If their foot is on the brake pedal, they will feel a vibration in the pedal much like ABS.
- If the event is severe and their foot is not on the brake, the brake pedal will move to apply higher brake forces, a whoosh of air may also be heard from under the dashboard in an event this severe.

The DSC continually monitors and checks all of the sensors and actuators used to improve the stability of the vehicle.

Some drivers may notice a slight movement of the brake pedal when the system checks itself. If the brake system has not been bled properly the pedal movement may become more significant. The pedal moves when an active test of the booster is run. During this test a small amount of pressure will be generated at the master cylinder, but no pressure will be generated in the callipers. This test will occur above 30 mph after the vehicle has been running approximately 8 minutes.

The test will run if the vehicle is stable, the driver is not braking and the accelerator pedal is depressed at least a small amount.

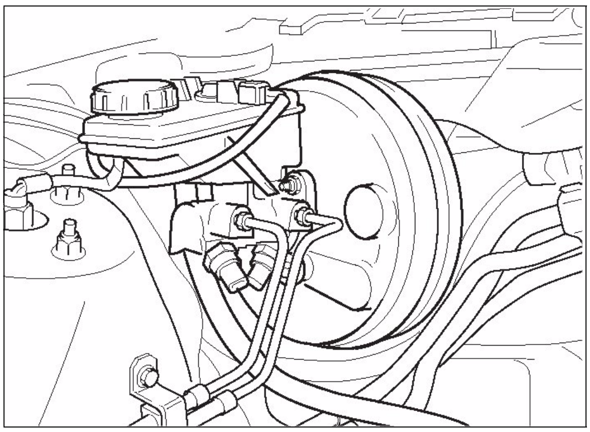


Fig. 58

The DSC booster is a normal brake booster which has the added function that it can be actuated electrically by the Electronic Control Unit. Within the booster are a solenoid for electrical actuation and a release switch to indicate when the driver is stepping on the brake.

The solenoid provides electrical actuation of the active booster. The force to the input rod does not exist and the air valve is directly opened due to the movement of the energized solenoid. With increasing current applied to the solenoid, the air valve opens and output force is created. With decreasing current applied to the solenoid, the air valve is closed and the vacuum valve opens reducing output force.

The steering rate sensor has a pair of optical switches packaged inside one housing. This sensor sends a infrared light in the direction of a receiver. The receiver transistor is either blocked off or light is allowed to pass to the receiver depending on the position of the ring.

The ring has 20 holes per 360 degrees. Using both channels of the sensor the current excitation wiring provides a signal every 4.5 degrees of steering wheel rotation. The sensor does not tell the Electronic Control Unit the position of the steering wheel relative to ‘straight ahead’. The DSC learns this by comparing the steering wheel position with other signals and remembering the position it has learned.

The DSC confirms this position and modifies it as necessary during every drive cycle of the vehicle. In this way the DSC compensates for small changes in the suspension and steering over the life of the vehicle. ABS operation is no different to current Jaguar vehicles.

Parking Brake

The hand brake lever is console mounted right-hand side of the console for all models, with conventional button operation as current saloon vehicles. It is a self-adjusting system operating on the rear brake callipers. It has a moulded grip for entry models and leather grip on high series vehicles.

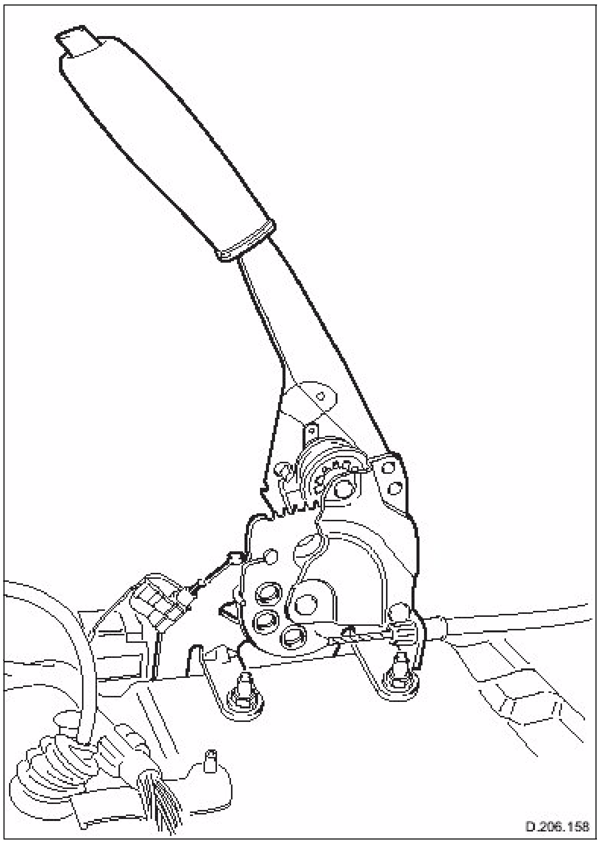
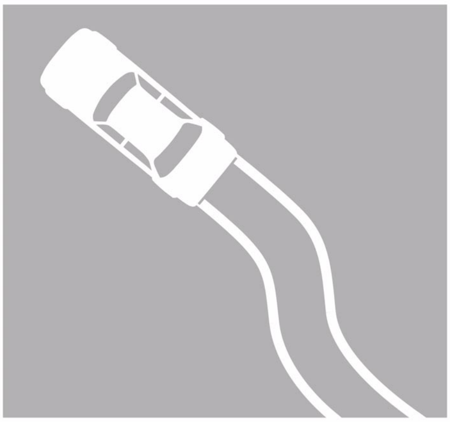


Fig. 59

JAGUAR

TRAINING PROGRAM

JAGUAR CHASSIS, BRAKING AND TRACTION CONTROL SYSTEMS



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FRONT SUSPENSION

Overview

The front suspension system has been engineered to provide the Jaguar customer with the ride and handling characteristics that haves become the hallmark of Jaguar Cars. The new suspension system consists of a MacPherson strut arrangement mounted on an isolated subframe, with the power steering rack rigidly mounted to the subframe assembly.

Correct orientation of the subframe rubber isolation bushes is required to maintain the correct NVH-designed characteristics. The whole subframe must be correctly aligned for the driveline angle to be maintained. This state is achieved by using a multipurpose hydraulic lift with special adaptors. Checks on subframe and engine alignment are achieved using an alignment gauge, which is provided as a service tool. The suspension system has antidive and antisquat characteristics built in to the suspension geometry. There is no adjustment for castor or camber; tracking is the only adjustment available. Jacking must be carried out only on recognized body location points.

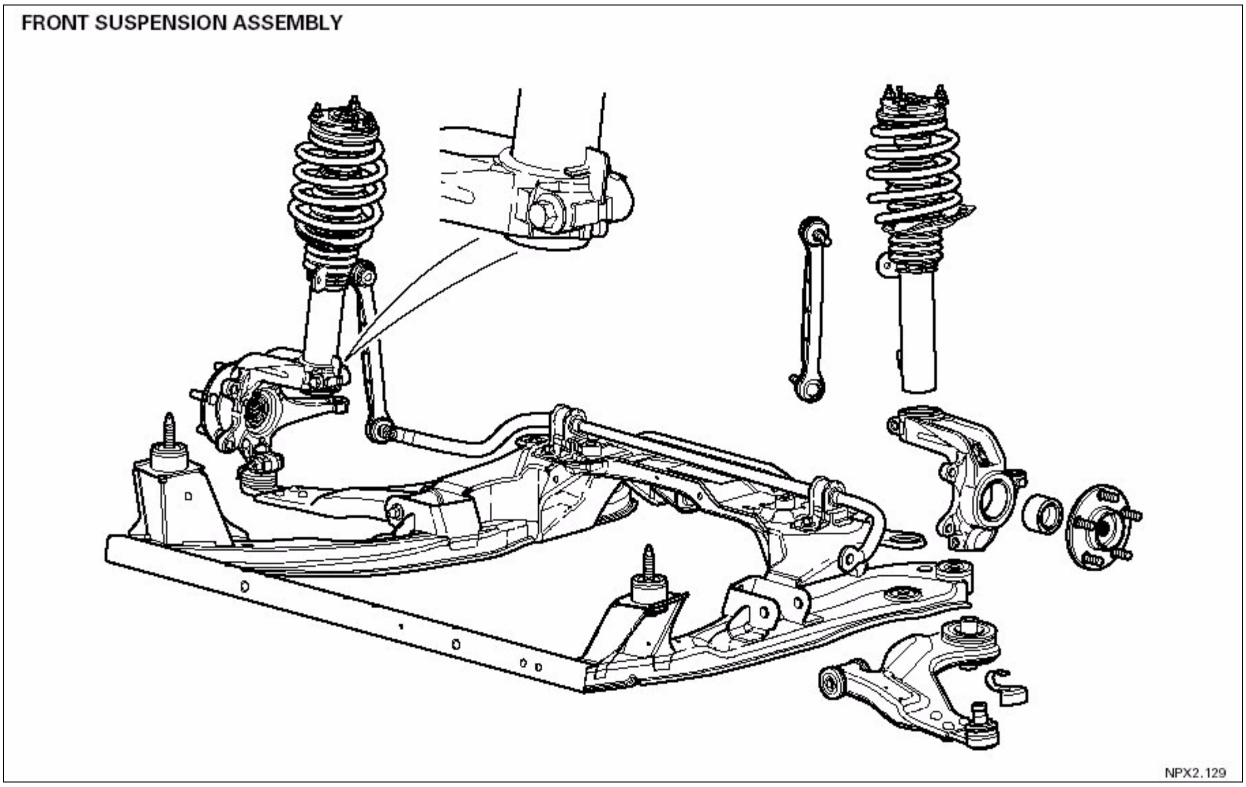


Fig. 60

Subframe

- The subframe is a steel fabricated assembly.
- It has 4 rubber isolation mounting bushes.
- There are locating points for lower control arm (LCA).
- The rack is rigidly mounted to subframe.
- It locates the antiroll bar.
- There is an engine roll-restrictor mounting location.
- Subframe bushes require correct orientation to achieve ride characteristics and NVH levels.
- A service tool is provided to check subframe alignment.

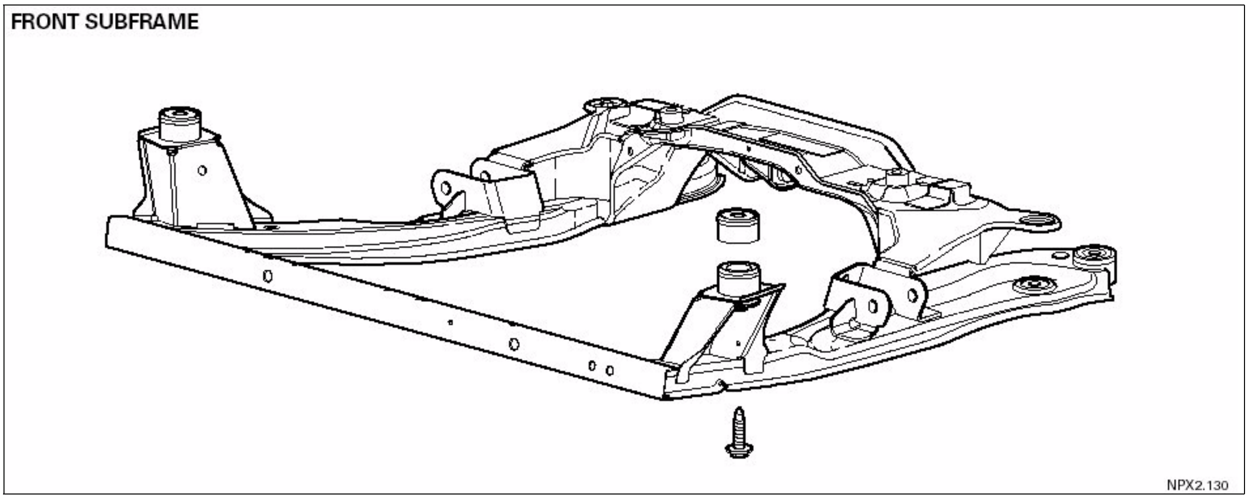


Fig. 61

Lower Control Arm (LCA)

- The LCA has a pressed steel assembly.
- There is a vertically mounted hydro bush.
- There is a horizontally mounted rubber bush.
- The LCA is not a serviceable item.

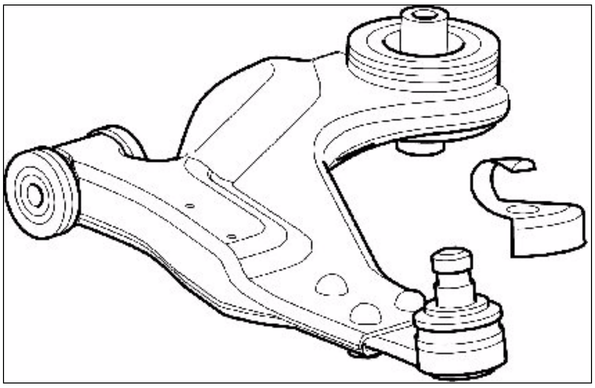


Fig. 62

Knuckle Assembly

- The knuckle assembly is manufactured from SG iron casting; it locates the strut.
- It has a pressed fit hub bearing that contains an integral magnetic pole ring.
- There is a location for the lower ball joint and the ball joint heat shield.

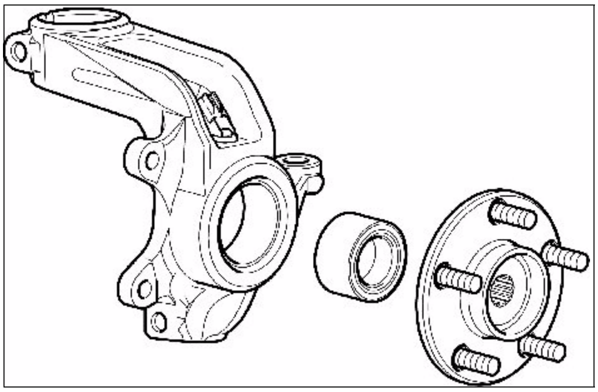


Fig. 63

MacPherson Strut

- The front spring is a constant-rate spring. However, it is 'S' shaped to allow for side load thrusts; it must be fitted correctly to obtain the correct frictional characteristics throughout its operational range.
- The spring is cold formed using cutting edge technology rather than the usual hot-wire formed method.
- The damper unit has a welded plate (shark's fin) to prevent the damper from turning in the front knuckle joint.
- Dual bearings and the top mount carry the turning load of the suspension system.
- The dual bearing provides a low turning effort while orchestrating low speed maneuvers such as parking.
- The top mount carries structural loads in two directions (fore and aft) plus side to side. The top mount assembly includes an arrow to ensure the correct orientation of the mounting to the fore and aft position of the vehicle.
- This alignment is due to the different compliance rates built into the top mount for fore-and-aft and side-to-side forces, which counteract road irregularities; for example, potholes, and so on.

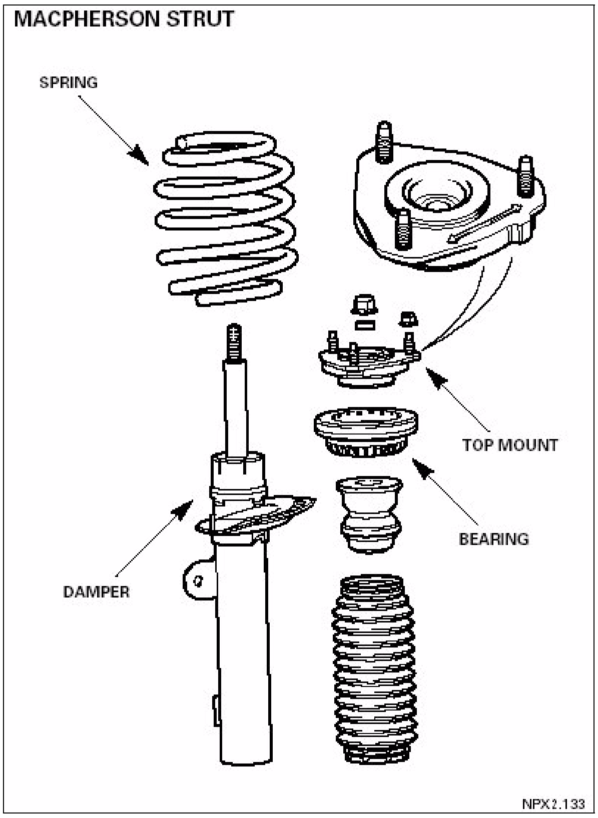


Fig. 64

REAR SUSPENSION

Overview

The rear suspension system consists of a multilink coil spring system with a subframe that provides double isolation for the driveline. The Bilstein damper units are inclined to the body in white (BIW) and consist of a single tube with a 46 mm piston element. There is no adjustment for castor or camber; tracking is the only adjustment available. The suspension system has antidive and antisquat characteristics built in to the suspension geometry.

Correct orientation of the subframe bushes is required, and the whole subframe must be aligned for the correct driveline angle to be maintained. Jacking must be carried out only on recognized body location points, not on the suspension assembly (refer to JTIS).

REAR SUSPENSION ASSEMBLY

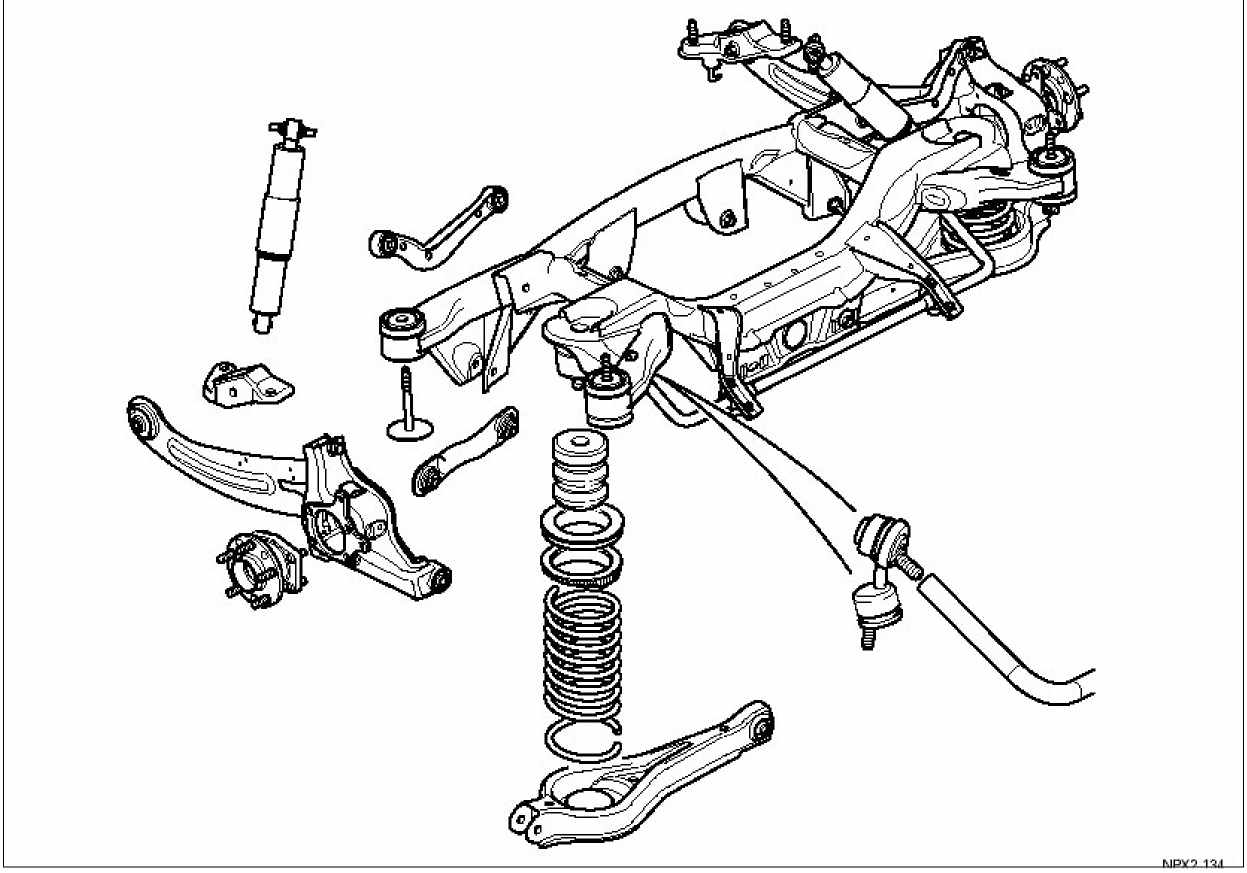


Fig. 65

Subframe

- The assembly is a steel fabricated unit.
- The subframe is located by 4 rubber mounts.
- Different compliance rates exist between the front and rear bushes.
- The front and rear bush compliance rating can be identified by the number of molded rubber pips formed in the bush.
- One pip indicates a (4-void) front bush.
- Two pips indicates a (2-void) rear bush.
- The subframe provides the locating points for the upper and lower control arms.
- There are location points for the upper road spring coil.
- There are mounting points for the antiroll bar.
- The subframe provides the location for the final drive assembly.
- It houses one integral bush for the final drive assembly rear mounting.

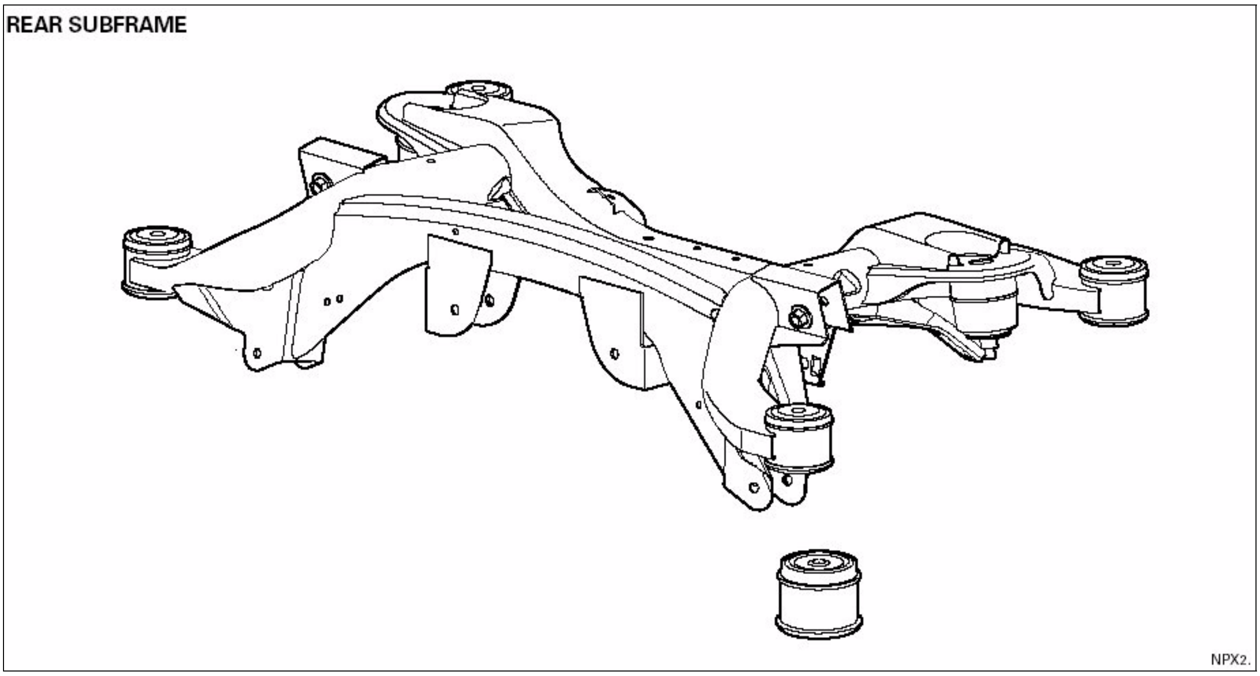


Fig. 66

Upper Control Arm

- Steel forging
- Two rubber mounts
- Unit not serviceable

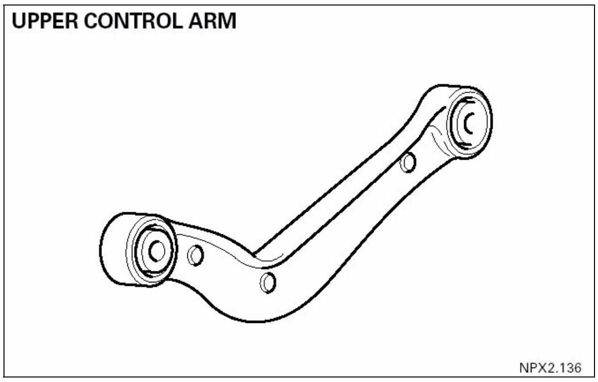


Fig. 67

Lower Control Arm

- Steel fabrication
- One rubber mount
- One cross axis joint
- Unit not serviceable

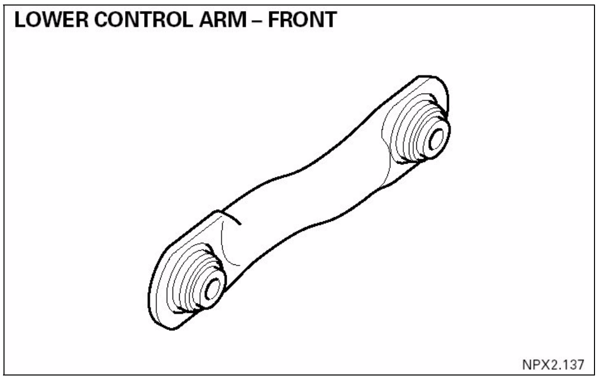


Fig. 68

Knuckle Assembly

- ABS sensor mounting point
- Tooth ring for ABS located on driveshaft
- Hub bearing mounting point
- Hub bearing unit not serviceable
- Two rubber mounts
- Bushes serviceable

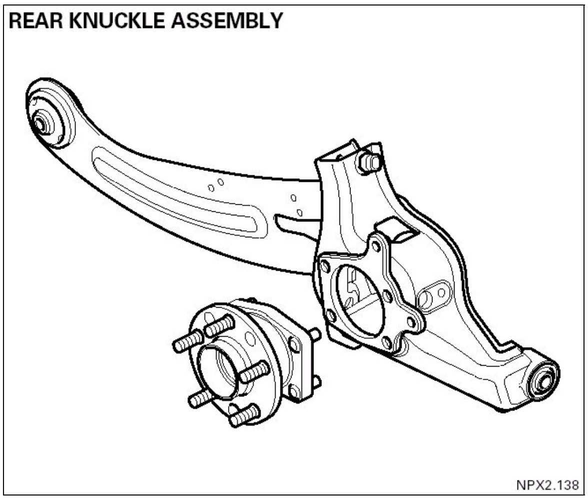


Fig. 69

Lower Control Arm

- Steel fabrication
- Locates the antiroll bar link
- Location point for the road spring
- One rubber mount
- Unit not serviceable

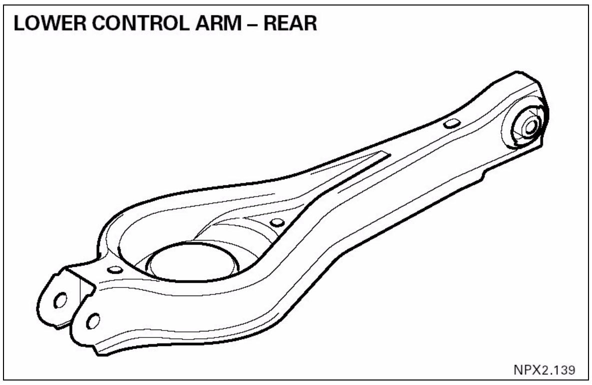


Fig. 70

RIDE AND HANDLING

Overview

The spring and damper settings on the new suspension system have been specifically tuned to achieve NVH target levels with enhanced ride comfort and sporty performance that is expected by a Jaguar customer. These settings, plus the suspension arm configuration, which assists in limiting antidive and antisquat characteristics, thus provide stability under acceleration and braking. The result is a ride and handling package second to none.

Front and Rear Springs

- There are two settings, Sport and Comfort.
- Front springs are cold formed with a double pigtail to aid correct fitting.
- Front springs have an 'S' shaped profile for side load compensation.
- Springs are color coded to identify spring rating; that is, Comfort or Sport.
- Rear springs are hot-wire formed.

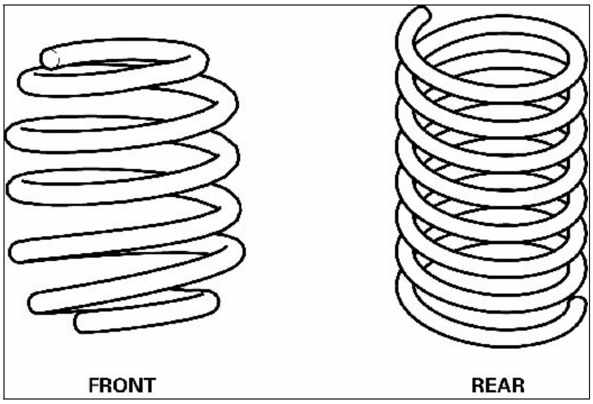


Fig. 71

Table 3

Spring	Sport	Comfort
Front	2 springs available: automatic & manual	2 springs available: automatic & manual
Rear	2 springs available: 33% option & 100% option	2 springs available: 33% option & 100% option

Front and rear Dampers

- Front dampers are a twin-tube design, manufactured by Bilstein to ensure ride and handling characteristics to standards expected by a Jaguar customer. DAMPER UNITS
- Bearings are fitted in the top damper mount to provide low strut friction, thus enhancing steering feel.
- The rear dampers are a monotube design using a 46 mm piston; this design provides excellent control over the damper setting capabilities.
- Front and rear damper settings are different for Sport and Comfort handling packages.
- Rear dampers are attached to the BIW; this configuration provides excellent ride and handling response, with good NVH characteristics.

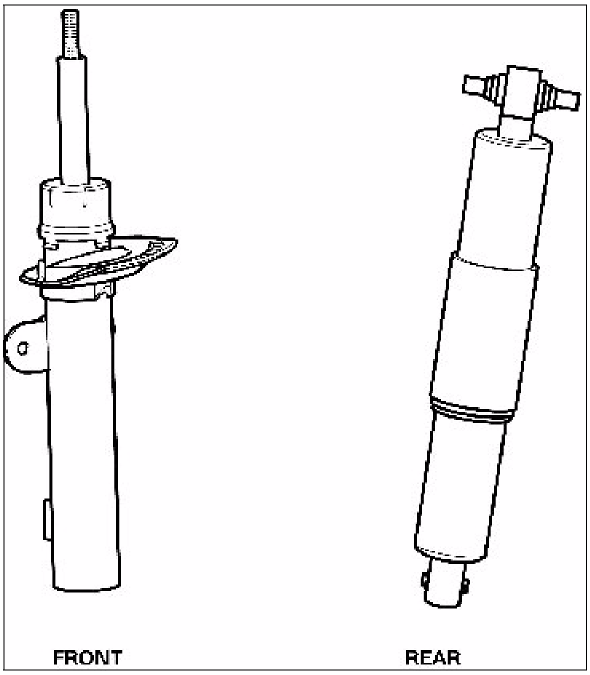


Fig. 72

DRIVELINE

Overview

The complete driveline configuration incorporates three separate differentials:

- A front differential housed in the transmission casing
- The familiar rear differential mounted in the rear subframe
- The third differential in the AWD unit

Front final drive

- The front final drive unit is part of the transmission system, and is not covered in any great detail in this section.
- However, we will be reviewing its connectivity to the AWD unit when we discuss AWD operation later in this workbook section.

Rear Final Drive

- The assembly consists of an iron main casing with an aluminum rear cover which is sealed using RTV.
- The final drive unit weighs 26.9 kg.
- For NVH control, the final drive assembly has a 3– point isolated mounting system:
- Two mountings at the front of the final drive unit.
- One mounting at the rear of the assembly.
- Double isolation is provided, when combined with the rear subframe mounting bushes.
- Plug-in driveshafts are retained by C clips in the side gears.
- The unit is filled for life, with an oil capacity of 1.2 liters.
- The oil used is a synthetic hypoid gear oil to an SAE 75W-140 specification.
- This is the same thermally stable oil as used by the AWD unit.
- The rear final drive has the ratio 2.53:1.
- A compact size is achieved because only 60% of the drive is transmitted.
- The differential pinion seal replacement will be the subject of a follow-up curriculum program.

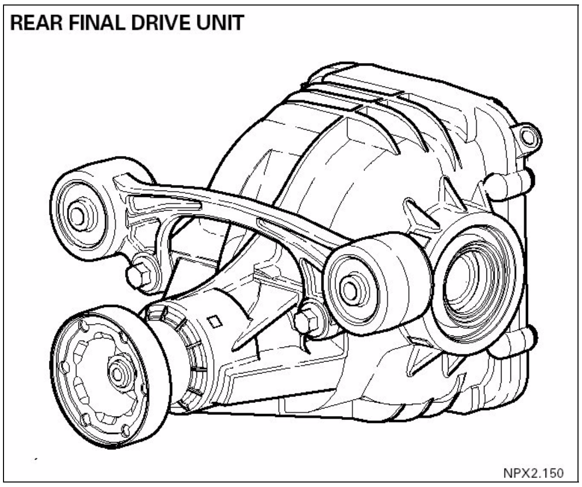


Fig. 73

Driveshaft

The driveshaft is the longest driveshaft used by Jaguar in the shortest body produced by the company to date. It consists of a two-piece steel construction using a Mag-arc welding process. The driveshaft incorporates CV joints at both ends, providing plunge capability and a Hooke's joint at the center. The center bearing is rubber isolated to the body for enhanced NVH. One design exists for both automatic (2091.7mm installed length) and manual (2097mm installed length) transmissions.

A service tool for the alignment of the driveshaft (propshaft) has been developed. This tool will position the driveshaft by taking a number of measurements from points underneath the body.

Front Halfshafts

The front halfshaft is manufactured from solid Boron steel bar, with twin CV joints. The outer CV is fixed, while the inner CV is of the plunging variety. The left-hand shaft is retained in the front differential by a spring clip. The right-hand shaft is also retained by a spring clip, but is attached to a link shaft. Special rubber gaiters on the inboard joints are fitted to withstand the heat from the exhaust system.

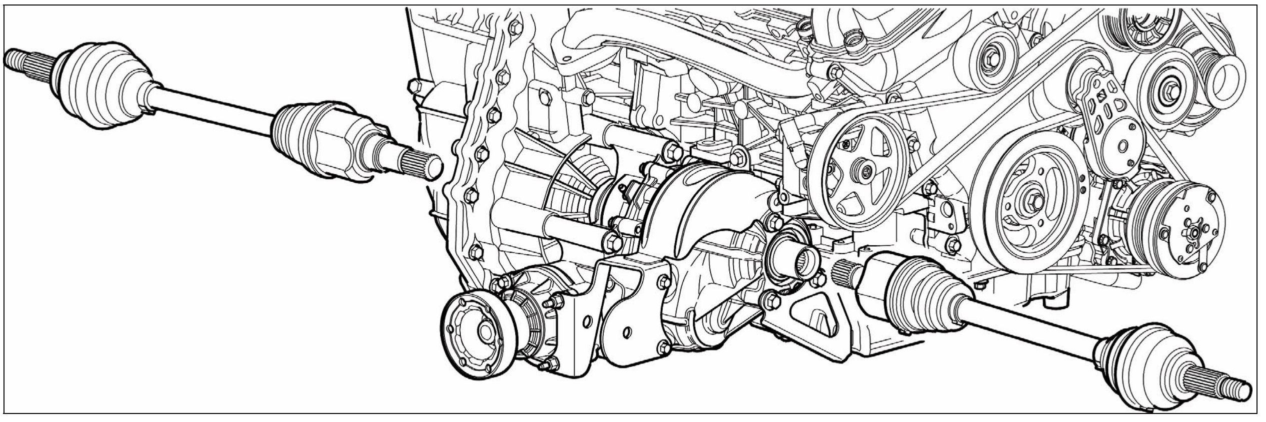


Fig. 74

Rear Halfshafts

Rear halfshafts are GKN-manufactured from a solid bar, with twin plunging CV joints. Rear driveshafts are unequal in length and have an ABS sensor ring mounted on the outboard joint. The driveshaft is retained in the final drive unit by a spring clip.

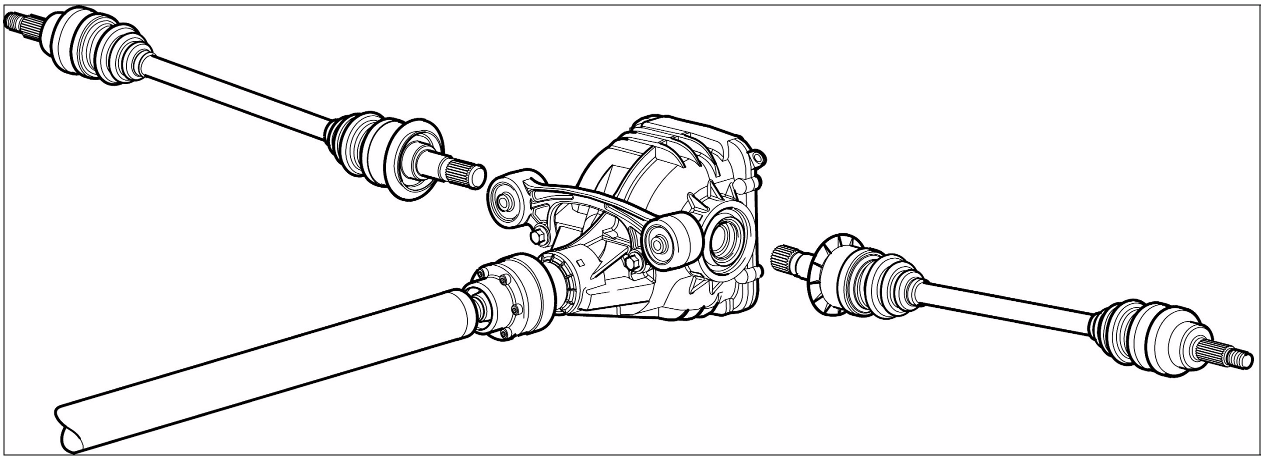


Fig. 75

STEERING

Overview

The power assisted steering (PAS) system provides agile handling and positive feedback response with stability at high speed, but maneuverability at low speeds. The PAS system consists of a ZF PAS pump and ZF Servotronic II rack and pinion steering assembly. The system is complete when added to the remaining system components – that is, the reservoir, hoses, and an air-to-fluid cooler. The X-TYPE system is very similar to the current XJ V8 sedan, XK V8 sports, and 2001MY S-TYPE system.

ZF POWER ASSISTED STEERING SYSTEM

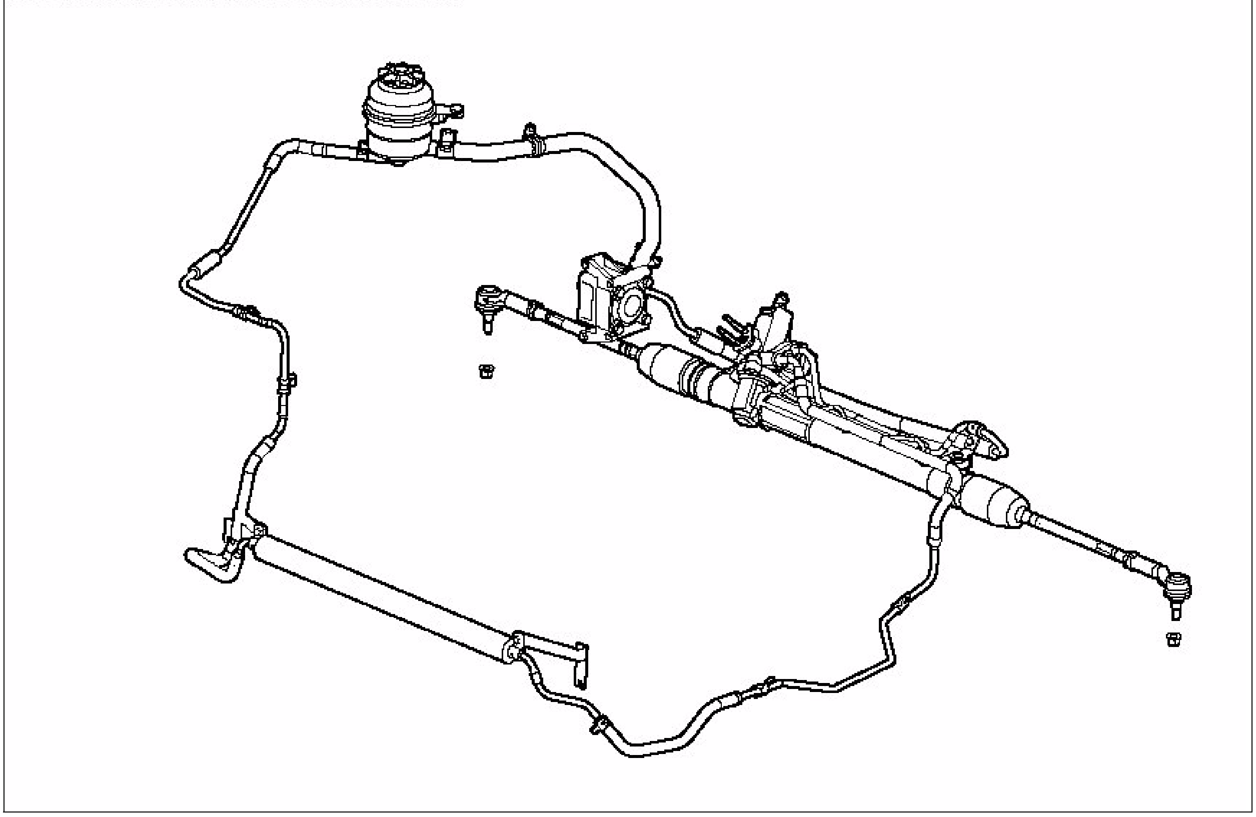


Fig. 76

Servotronic ll Rack and Pinion Assembly

The ZF Servotronic ll is a speed-sensitive rack and pinion assembly with a variable ratio gearing to provide a reduced number of turns (2.63) lock-to-lock.

This configuration enhances slow-speed parking type maneuvers, while maintaining excellent high-speed stability. The rack and pinion assembly is rigidly mounted to the subframe by two fixings.

Serviceable Items

- Transducer
- Track rod end ball joints
- Bellows and clips
- Fluid transfer pipes

Pump

- The pump is an aluminum vane pump driven by a steel pulley.
- An existing pressure gauge and adaptors connect to the system.
- PAS pressure data has not been released.
- The pump and pulley are not serviceable items.

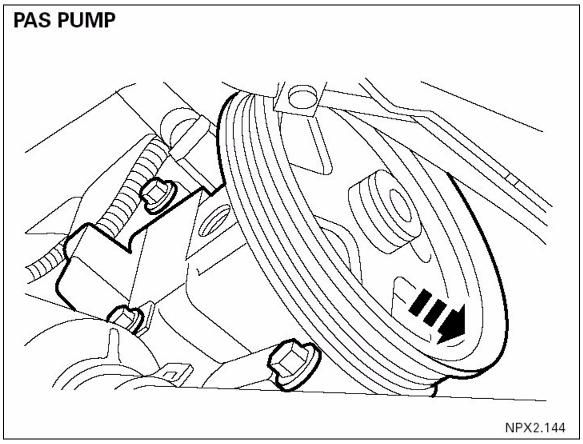


Fig. 77

Reservoir

- The reservoir is a unit similar to that of current XJ and XK vehicles.
- The reservoir has a non-serviceable 10-micron internal filter.
- The fluid used is Dexron llE.
- PAS system fluid quantity is approximately 1 liter.
- Top it up cold, between level indicators.
- Rubber bushes and spacers are serviceable items.

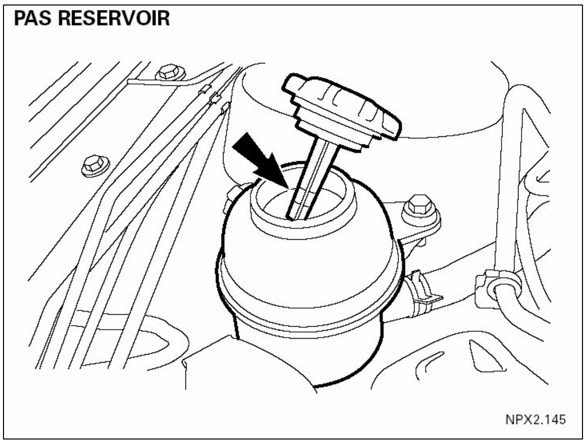


Fig. 78

Servotronic Steering Control Module

- The steering control module is integrated into the instrument cluster. It receives a vehicle speed signal, which is then converted into a current supply for the pinion housing transducer.
- Current provided by the steering control module is fed to the rack and pinion transducer and operates a variable-orifice needle valve that controls the fluid pressure within the pinion housing.
- The current value is between 15 milliamps (heavy steering) and 854 milliamps (light steering).

- The overall effect is to increase or decrease the turning effort required at the pinion housing torsion bar.
- Should the system fail in an open circuit condition, the system defaults to heavy steering.
- System diagnosis is by WDS via the instrument cluster. Additional information can be obtained from JTIS.
- Two CM configurations exist: Sport or Comfort. These configurations are differentiated by their road wheel size – 16” = Comfort, 17” = Sport.

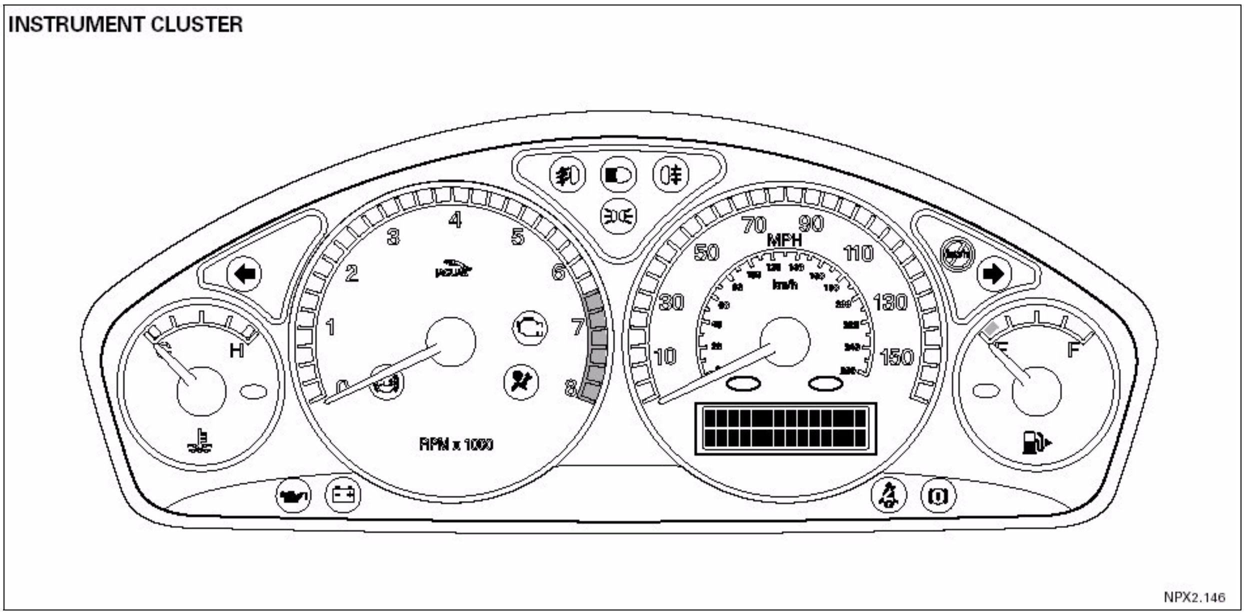


Fig. 79

Service Information

- There are no unique special tools; existing tools carry over from the XJ and XK range.
- Fluid fill is per the XJ and XK vehicles.
- Cleanliness is vital to system integrity.
- Dexron IIE is the fluid used, per current XJ, XK, and 2001MY S-TYPE vehicles.
- Steering adjustment is only achieved via the PAS rack tie-rod bars.
- Rack removal requires the rear of the subframe lowering; ensure that the panel seal is refitted correctly.
- If a main component, such as the rack, pump or cooler, fails, then the reservoir must also be changed as a serviceable part.
- No pressure checks are available, although pressure gauge adaptors will fit from previous tooling issues.
- The main diagnostic area to check first for any relevant DTCs is the instrument cluster.
- The steering CM is combined into the instrument cluster (IC) assembly.
- It is important to ensure that all heat shields are in place and not damaged in any way.
- The tie rods are not serviceable items.
- The steering rack must be centralized prior to performing wheel alignment.

BRAKE SYSTEM

Overview

The foundation braking system is a self-adjusting system. This system itself is not unusual, however, the method employed is slightly different from that of previous Jaguar vehicles. The main difference can be seen on the park brake lever – the rear calipers are similar to those of the 2000 — 2002 MY S-TYPE range.

Bosch supplies a vast majority of the braking system components. These components include the following:

- Front and rear brake discs
- Front and rear calipers
- Master cylinder
- Vacuum booster assembly
- Self-adjusting park brake lever
- ABS / DSC system
- Pedal box assembly
- Hoses, excluding metal pipework

A diagonal braking split of RHF to LHR and LHF to RHR is employed. The following pages describe the individual components that go to form the foundation brake system.

Front Brakes

- The 300 x 24 mm ventilated front discs are mounted over the hubs and clamped in place by the road wheel.
- Removing one caliper bolt and rotating the caliper away provides access to pads for changing; refer to JTIS.
- Antirattle springs are riveted to the brake pad.
- No additional pad springs are required.
- The pads are operated via a single 57 mm piston in a sliding caliper.
- The sliding caliper pins are retained in the caliper housing, thus preventing dirt ingress and extending service life.
- Main serviceable items are the brake discs and brake pads.
- For disc runout or disc thickness service data, refer to JTIS.

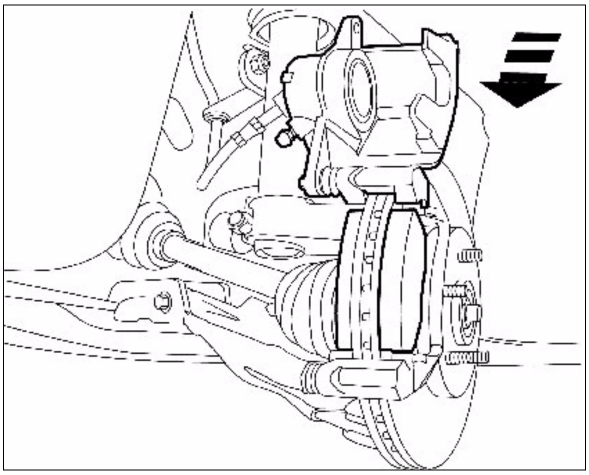


Fig. 80

Rear Brakes

- The 280 x 12 mm solid brake disc is held in position by the road wheel.
- Pads have antirattle springs riveted to the brake pads.
- No other antirattle springs are required.
- Pads are operated via a single 38 mm piston in a sliding caliper.
- The rear caliper incorporates a self-adjusting mechanism within the piston.
- Each piston requires retracting to allow space for new brake pads to be fitted.
- A service tool (206-080) is provided to retract the pistons, allowing new pads to be fitted.

- Retracting the pistons back into the caliper is handed; that is, RH side clockwise vs. LH side counterclockwise.
- Main serviceable parts are brake discs and brake pads.
- For disc thickness or disc runout service data, refer to JTIS.

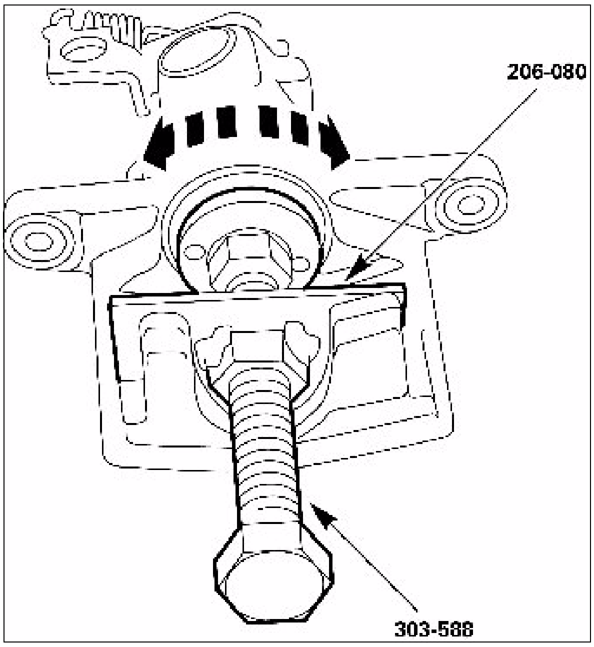


Fig. 81 Caliper piston retractor tool

Parking Brake Assembly

- The park brake lever incorporates a friction clutch spring and drum mechanism.
- The park brake lever drum has a one-way self adjusting mechanism via a recoil spring.
- A short cable from the drum attaches to both rear calipers via an equalizer and two cables. The equalizer's role is to maintain an even load to both rear caliper assemblies.
- As the park brake lever is applied, a coiled spring grips the drum outer

surface, thus joining the drum and lever assemblies together.
- Automatic adjustment is provided by the drum and the internal recoil spring mechanism, which is set at approximately 15 kg to maintain the correct cable length.
- The transit spring clip is located on the lever assembly. It requires releasing to allow the park brake cable to be extended, which is done by applying the park brake.

PARK BRAKE LEVER

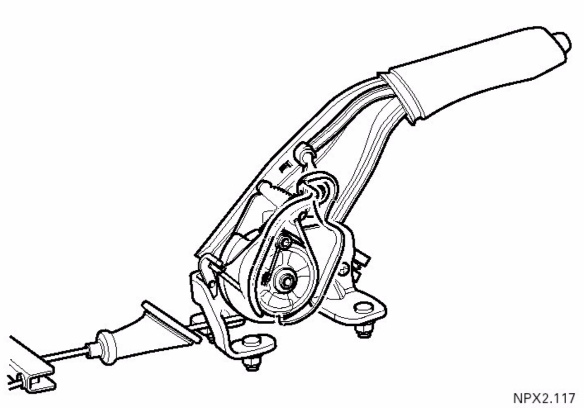


Fig. 82

Brake Pedal Decoupler

BRAKE PEDAL DECOUPLER

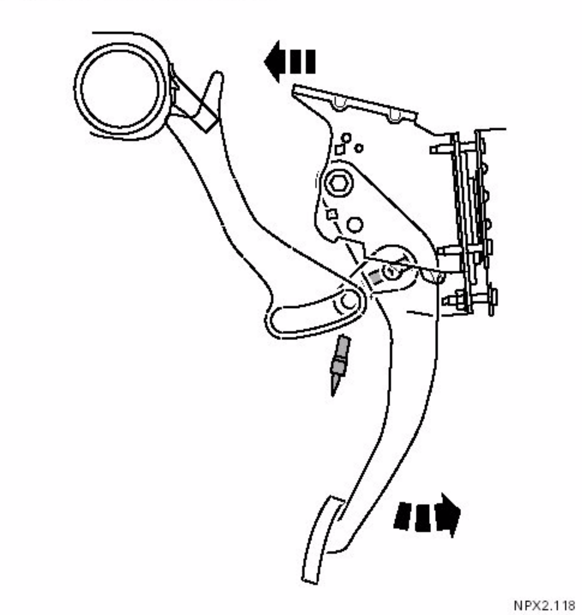


Fig. 83

- The pedal box is mounted inside the cabin area as a separate unit.
- It incorporates the brake pedal plus the clutch pedal and master cylinder where fitted.
- The pedal box is attached by four fixings at the lower bulkhead and two further fixings to the upper bulkhead.
- To accommodate tolerances between the upper and lower bulkheads, a bracket is fitted to the pedal box by two bolts.
- These two bolts should be tightened as the last operation.
- The pedal box assembly incorporates a new safety feature – the brake pedal decoupling system.
- This system is designed to protect the driver in the event of a severe collision by decoupling the brake pedal from the

push rod, thus allowing the brake pedal to fall away from the driver's feet area.

- The crash pulse is transmitted to the decoupling lever. The lever rotates and severs the brake pedal pushrod, thus allowing the now free pedal to fall away from the driver's feet area, thereby reducing the chance of injury.

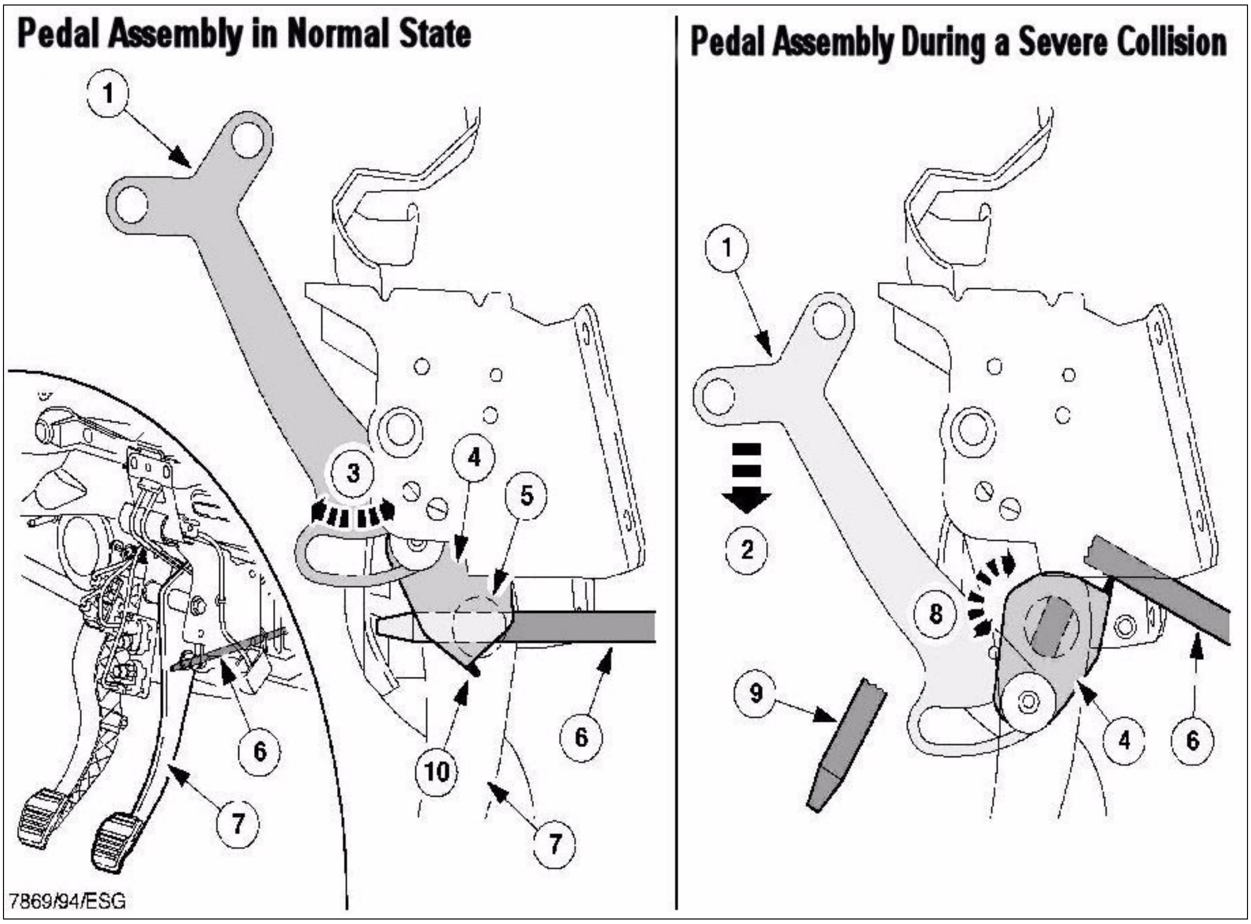


Fig. 84

1. Uncoupling Lever
2. Direction of movement of uncoupling lever
3. Direction of movement during braking
4. Mechanism for uncoupling brake pedal
5. Connector for push-rod of master cylinder
6. Push-rod for brake master cylinder
7. Brake pedal
8. Pivoting movement of uncoupling mechanism
9. Broken Push-rod

Brake Booster/Master Cylinder

- The vacuum brake booster is always fitted to the LH of the engine bay bulkhead.
- A 23.8 x 37 mm stroke master cylinder is attached to the brake booster. Between the two units is a seal; this seal is a serviceable item, should the two parts be separated during service.
- The reservoir is preassembled onto the master cylinder. It contains a level switch and hydraulic feed pipe for the clutch release mechanism where fitted.
- Both of the above assemblies are not serviceable and should be changed as a complete unit.

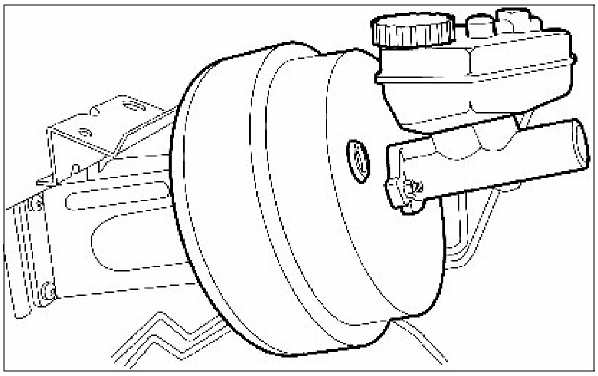


Fig. 85

Bosch 5.7 ABS

ABS maximizes vehicle stability and steerability while maintaining the minimum stopping distance during braking under all conditions. The ABS system monitors individual wheel speed signals and, during braking, will control brake pressures at individual wheels to maximize vehicle stability and minimize stopping distances. Wheel antilocking control is achieved by either holding, releasing, or increasing brake pressure to the individual brake calipers by the modulator solenoid valves. A pump mounted on the hydraulic valve block is used to return the excess fluid generated during the pressure hold/ reduction stage back to the accumulator/master cylinder circuits.

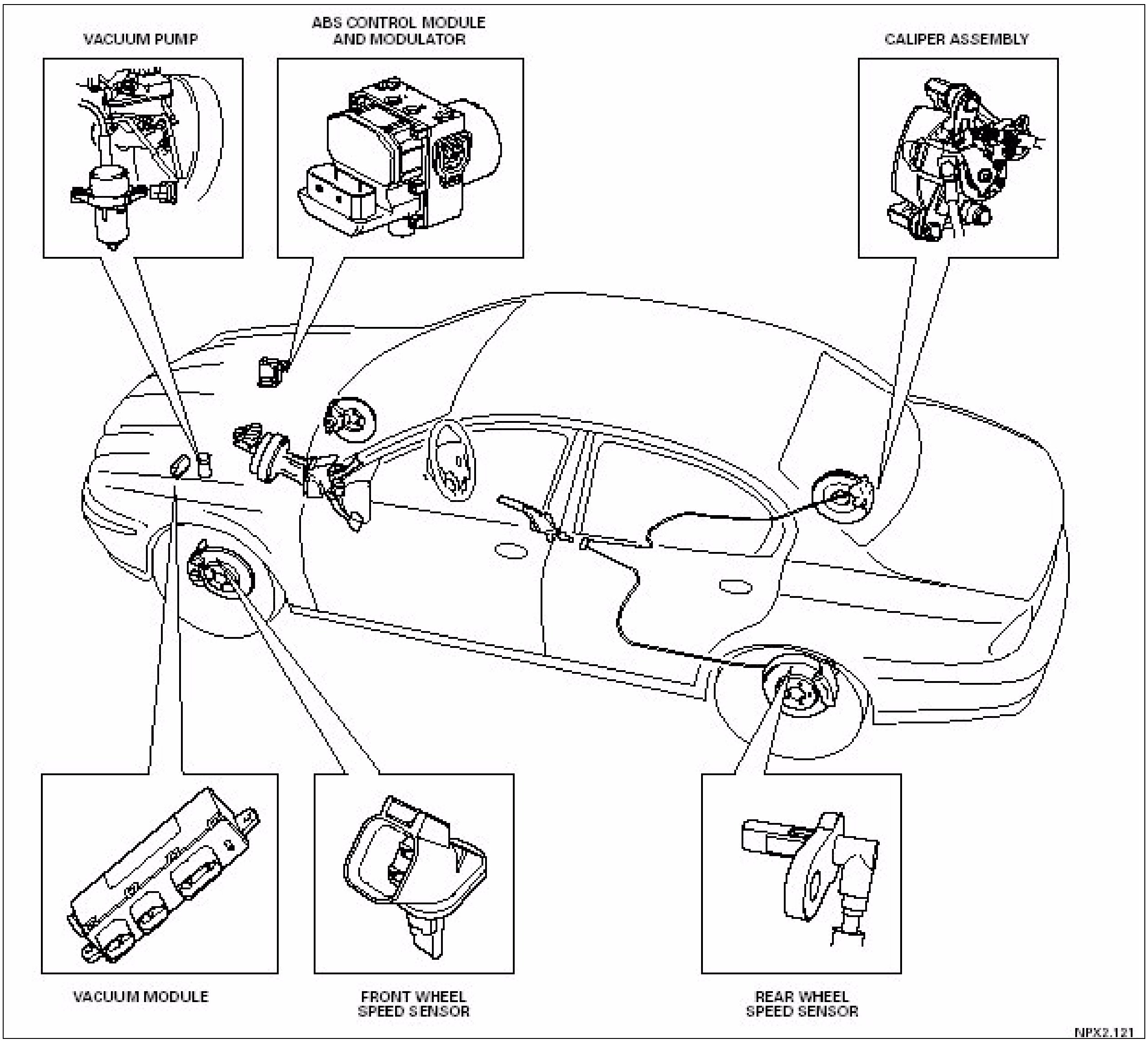

VACUUM PUMP
ABS CONTROL MODULE
AND MODULATOR
CALIPER ASSEMBLY
VACUUM MODULE
FRONT WHEEL
SPEED SENSOR
REAR WHEEL
SPEED SENSOR
NPX2.121

Fig. 86

Electronic Brake force Distribution (EBD)

In the ABS software, there is an algorithm for Electronic Brake Distribution (EBD); this algorithm replaces the need for a mechanical valve type system. The reason the EBD is used is that, under heavy braking, the vehicle's weight transfers to the front. The ABS modulator reduces brake pressure to the rear calipers in these circumstances to prevent the rear wheels from having a tendency to lock before the front wheels.

Control Module/Hydraulic Unit

- The ABS system that is used has the hydraulic modulator and the CM integrated as a combined unit.
- An algorithm for both ABS and EBD functionality is contained in the CM.
- The unit consists of a 4-channel 8-valve system with a brake fluid return pump.
- The system has independent input signals from all four road wheels.
- The harness connection is via a 42-way rotating lever connector assembly.
- Wheel speed is detected by four active wheel speed sensors.
- The differential hall elements can detect close to zero rotational speeds.
- Six pipes connect to the valve block; these pipes are labeled as follows:
- FL
- FR
- RL
- RR
- MC1
- MC2

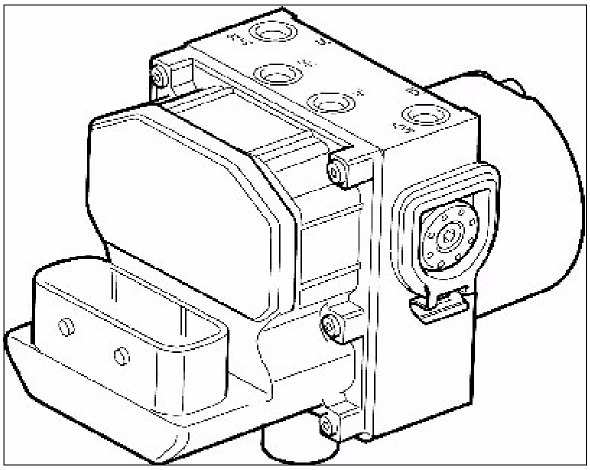


Fig. 87

Wheel Speed Sensors

- Four independent wheel speed sensors supply the ABS CM with road speed data.
- The individual units have microelectronics built in; therefore, resistance will not be measured across the terminals as it is with inductive type sensors.
- The wheel speed sensors are of the active differential hall-effect type.
- This type of sensor allows a near zero wheel rotational speed to be measured.
- The front active wheel speed sensors have integral connectors.
- Rear active wheel speed sensors have electrical fly leads.

Modern ABS, traction control, and stability control systems are tending to use active wheel speed sensors in lieu of the previous passive (variable reluctance) sensors. The active wheel speed sensors use electronic components based on either the hall-effect or magneto-resistive principles. These sensors measure almost zero rotational wheel speeds. In either case, whether hall-effect or magneto-resistive, the result is that the sensor effectively changes its resistance, depending on the magnetic field state at the sensor tip.

The magnetic field is generated from either a magnetic pole wheel or magnet fitted behind the electronic chip in the sensor tip. Both of these options provide the same effect of switching the sensor's output state between high and low. The electronic controller provides a voltage supply to the sensor and monitors the level of current passed back. The output of the sensor as monitored by the CM is a square wave of current with a high and low milliamp status level.

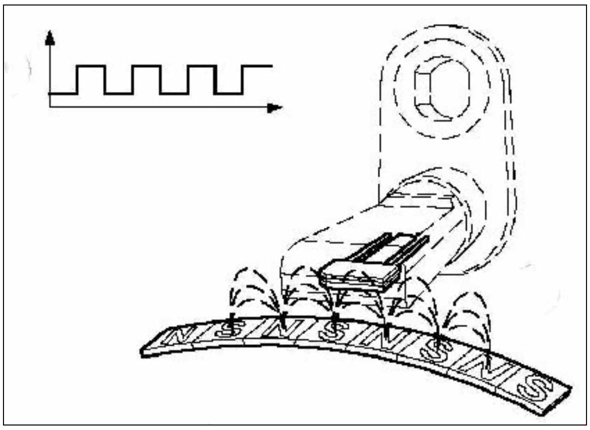


Fig. 88
A. Wheel Speed Sensor output signal

Dynamic Stability Control (DSC)

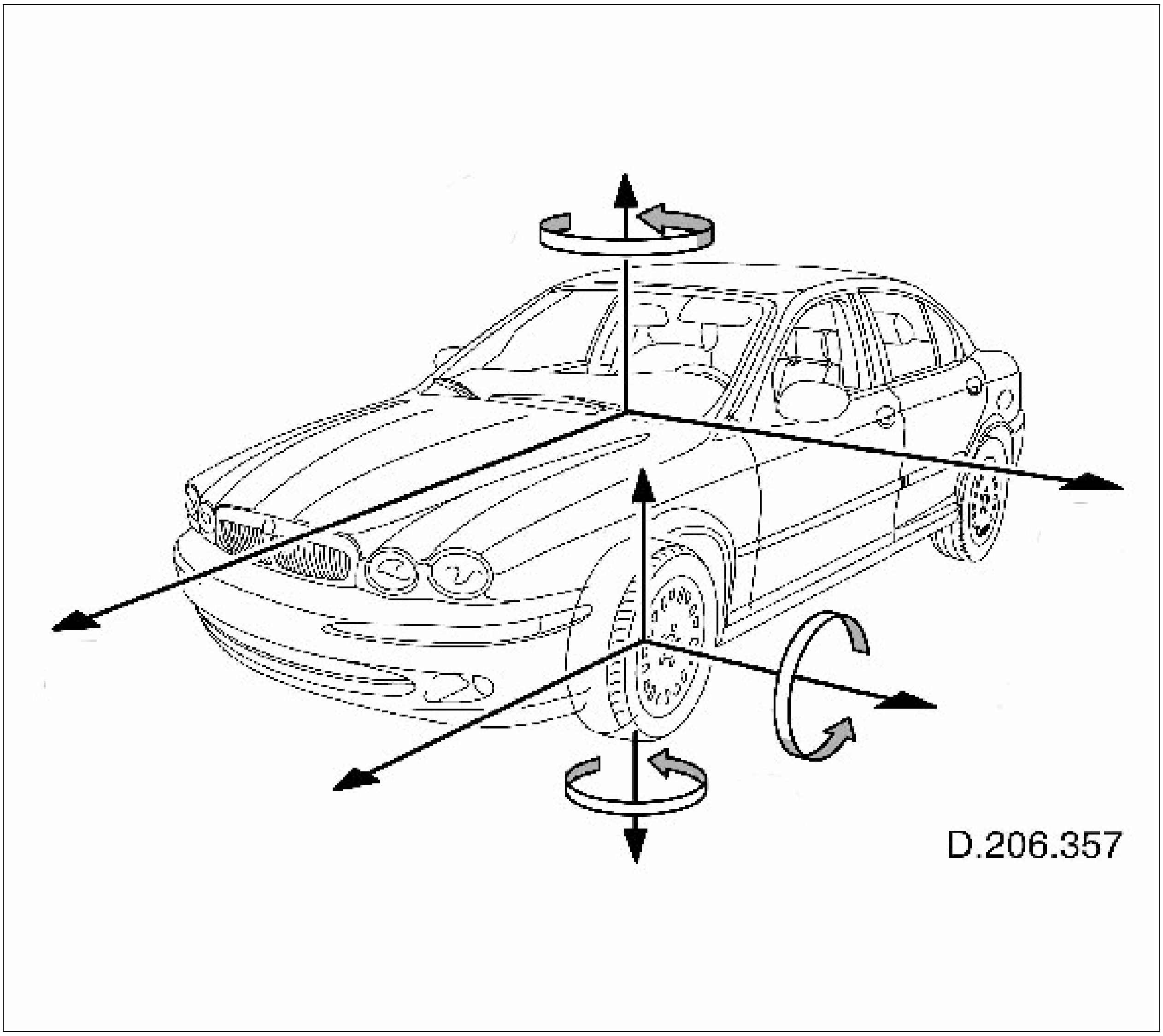


Fig. 89

Dynamic stability control (DSC) maximizes vehicle stability under all conditions. The DSC system compares actual vehicle course to that intended by the driver. If the intended course differs from the actual course because of oversteer or understeer conditions, the DSC system will brake individual wheels and reduce engine torque to bring the vehicle back to the driver's intended direction. By using a combined yaw rate sensor and lateral accelerometer, the vehicle's rotational motion around its vertical axis and centrifugal forces generated while cornering are calculated to determine the vehicle's actual behavior.

Using additional sensors for detecting steering wheel position and road wheel speed enables the system to recognize the driver's original intentions. If the vehicle begins to stray off the desired path, the DSC system interacts and provides exactly the right amount of metered brake pressure at the correct brake caliper. Torque reduction can also be requested to assist in correcting the vehicle's attitude.

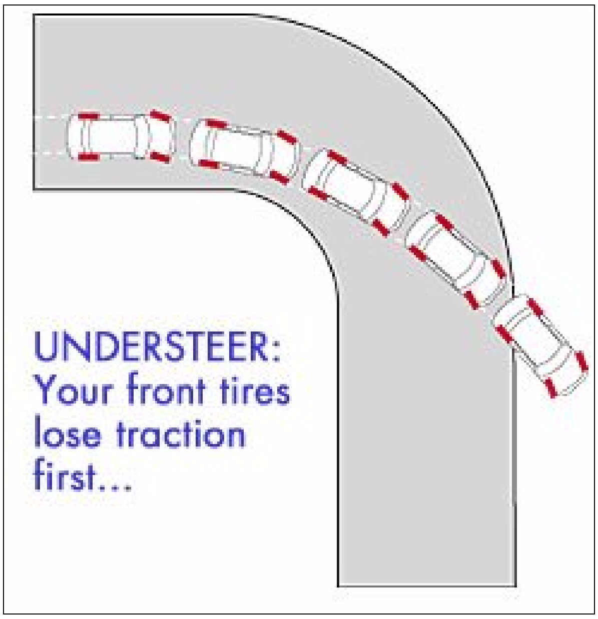


Fig. 90

Understeer

Oversteer indicates that the slip angle is greater at the rear than the front; the vehicle takes a smaller cornering radius than that prescribed by the driver. This condition is produced when the rear of the vehicle breaks away and pushes out towards the outside curve. Under these circumstances, the DSC system will apply braking to the front road wheel on the outside of the curve.

Oversteer

Understeer indicates that the slip angle is greater at the front than at the rear; the vehicle takes a larger cornering radius than that prescribed by the driver. In this situation, the front of the vehicle pushes out towards the outside of the curve. The resulting action is that the DSC system will apply brake pressure to the rear brake caliper on the inside of the curve.

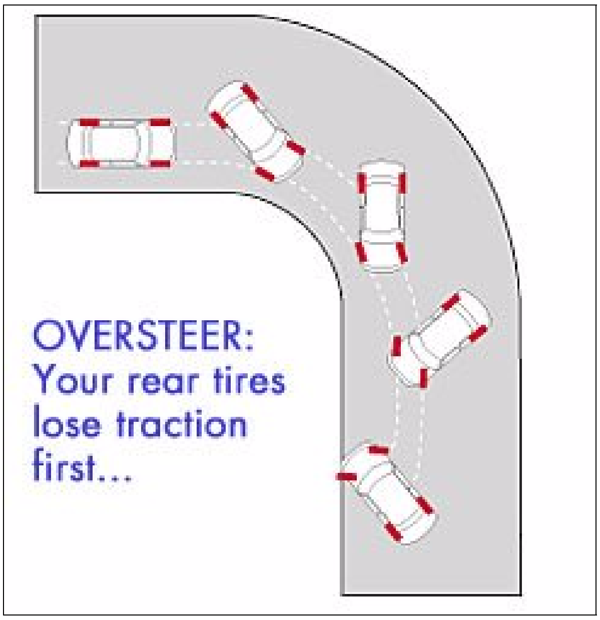


Fig. 91

Traction Control System (TC)

The traction control system (TCS) is combined with the DSC system. The TC system optimizes road wheel traction and vehicle stability by controlling road wheel spin. It controls the spin by using either brake actuation or engine torque reduction; where possible, both may be utilized. Individual wheel speed signals are compared against each other and against the vehicle reference speed. The TC system will then, either by using brakes or engine intervention, reduce the slip of all affected road wheels to that of the lowest wheel speed.

In order to ensure that the brakes do not overheat, traction control braking is limited to low speeds. If the TCS system dictates that the temperature threshold has been reached, engine torque reduction is implemented and braking is ceased. It is important to remember that the TCS enhances vehicle stability under acceleration conditions only.

Steering Wheel angle sensor

- The SWAS is located on the steering column.
- It measures the steering angle and turn rate.
- The SWAS is one of the sensors connected to the CAN bus.
- Changing the steering wheel angle sensor requires the removal of the steering column.
- New units require calibration for straight ahead position by WDS.

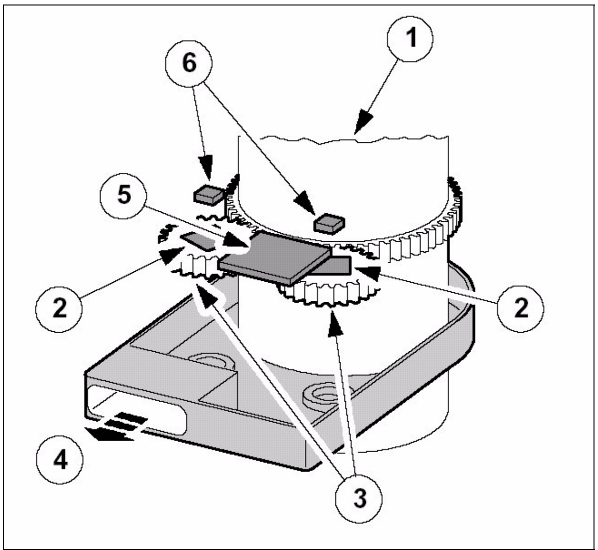


Fig. 92
1. Steering Column
2. Magnets
3. Measuring gears
4. CAN bus
5. Microprocessor
6. Anisotropic magneto resistive elements

Brake Pressure Sensor

- A brake pressure sensor is only fitted on DSC systems; the purpose of the sensor is to monitor pressure within the system.
- This sensor provides the CM with a voltage input relative to pressure; it also indicates if the driver is activating the brakes.
- From this signal, the CM can determine whether to hold, add, or reduce brake pressure to any of the calipers.
- The signal is also used to indicate the driver's change of intention; for example, panic braking.

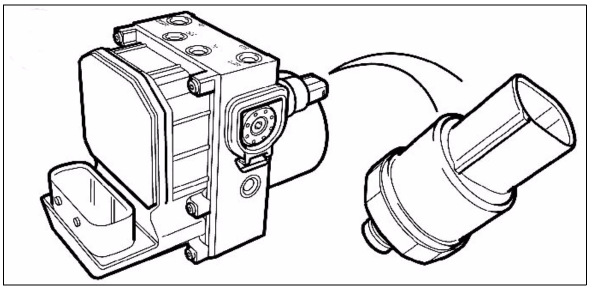


Fig. 93

Yaw Rate Sensor

- The yaw rate sensor is a micromechanical sensor located in front of the Auto / Man gearshift lever.
- The yaw rate sensor is combined with a lateral accelerometer.
- The combined unit calculates oversteer and understeer.
- This sensor is also connected to the CAN bus.
- Vibration will damage the unit; do not use impact wrenches near the sensor.
- The DSC module detects faults within the circuit for diagnosis.

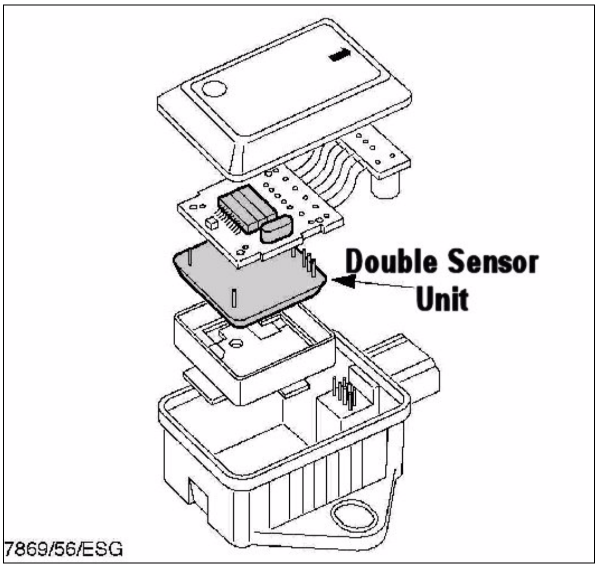


Fig. 94

CAUTION:

The yaw rate sensor can be damaged by excessive shock and vibration. Use only a meter or bar type torque wrench when tightening the mounting bolts.

Additional Service Information

- All faults are diagnosed via the DSC CM as in the ABS system.
- On non message center IC display packs, an additional DSC warning light accompanies the ABS and brake warning lamps and depicts a vehicle losing traction.
- On vehicles with an LCD message center display, text is displayed indicating the DSC system status; for example, no warning lamp.
- Traction control and DSC operation are indicated by the DSC warning lamp flashing or a text message appearing in the message center LCD display panel.
- An Off / On switch controls both DSC and traction control together; it is situated in the center console.
- The LED within the DSC / TC switch housing has nothing to do with the DSC / TC system.
- The DSC / TC system always defaults to ON with each ignition cycle.

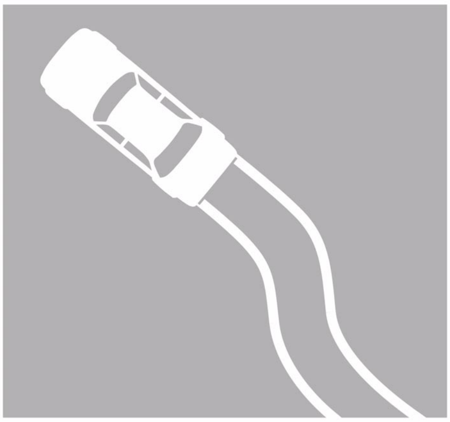
Unit	System Response		Warning Lamp or Message		
	ABS	DSC	DSC	YELLOW ABS	RED BRAKE (EBD)
1 or 2 wheel speed sensors	ABS off EBD on	DSC off ABS off EBD on	ON	ON	OFF
Yaw rate sensor	Unit not fitted	DSC off ABS on EBD on	ON	OFF	OFF
Steering wheel angle sensor	Unit not fitted	DSC off ABS on EBD on	ON	OFF	OFF
Brake pressure sensor	Unit not fitted	DSC off ABS off EBD on	ON	ON	OFF

Fig. 95

- The CAN communication bus is used for diagnostics to Jaguar protocols.
- Driver indications that something is wrong with the system include:
- ABS and brake warning lights
- Vehicle speed odometer not registering
- Maximum system supply voltage is 20 volts. Above this level, the system will shut down to protect the CM. The brakes are still available.
- DTCs are stored in the ABSCM or the DSCCM and are extracted by the WDS

TRAINING PROGRAM

JAGUAR CHASSIS, BRAKING AND TRACTION CONTROL SYSTEMS



PUBLICATION CODE – 451

FRONT SUSPENSION

The front suspension is assembled on a subframe replacing the two separate crossmembers previously used. The subframe is rigidly mounted via four bolts to the vehicle body providing the driver with improved steering feel.

The suspension arrangement is a double wish-bone axle type the length ratio between the two control arms is calculated to optimize track and camber control. A new upper control arm has been introduced to improved castor trail and therefore steering feel.

Inclination of the upper control arm axis provides anti-dive action when the vehicle is under braking force. The lower control arm is now split design which de-couples allowing for improved bush-tuning. A hydraulic bush fitted to the forward lower control arm where it attaches to the subframe provides improved vibration damping.

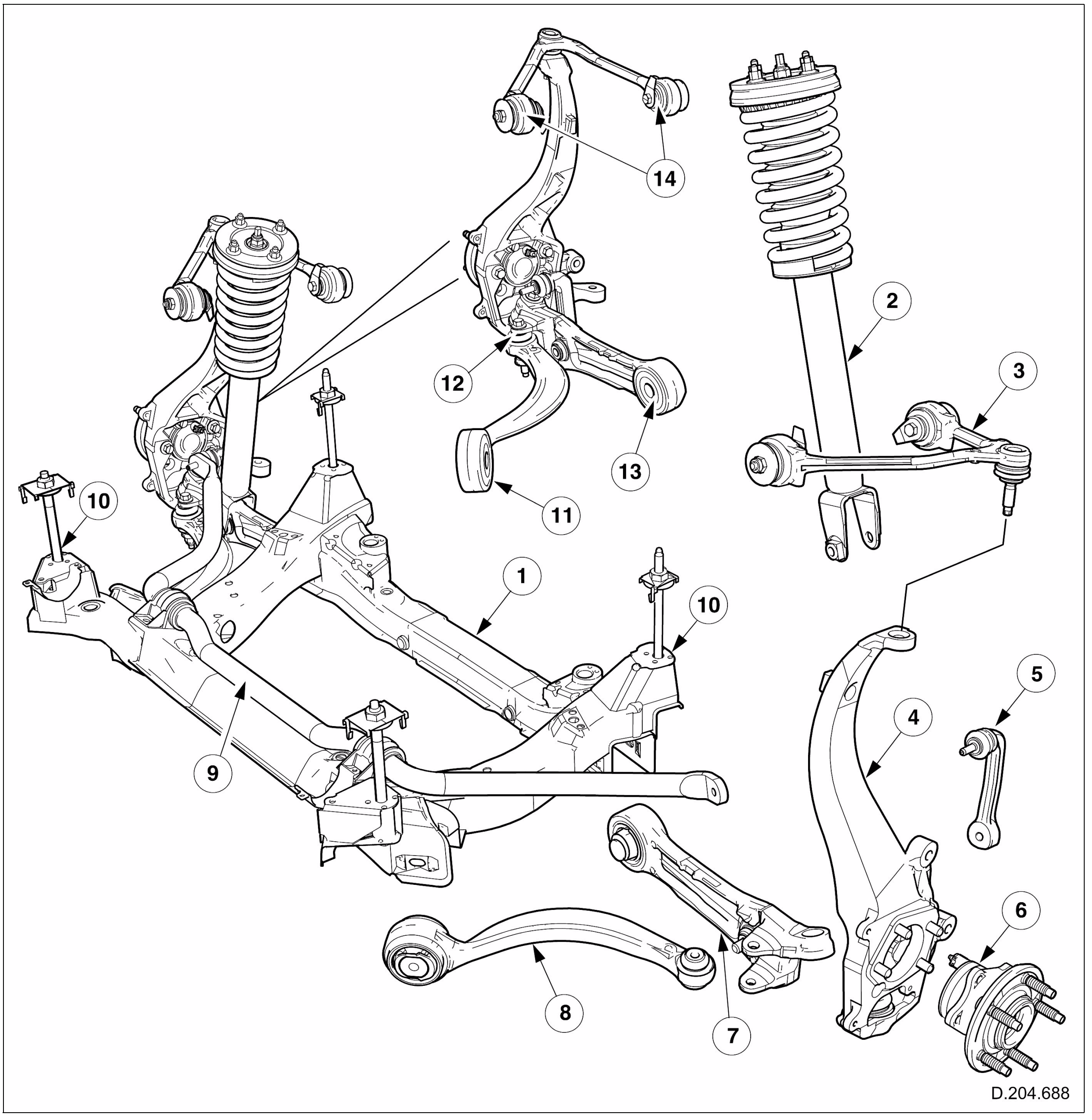


Fig. 96 Front Suspension Components

1. Subframe
2. Spring and damper assembly
3. Upper control arm with integral ball joint
4. Swan neck wheel knuckle
5. Stabilizer bar drop link
6. Wheel hub and bearing assembly
7. Lower control arm lateral
8. Lower control arm forward
9. Stabilizer bar
10. Subframe mounting
11. Hydrabush

12. Ball bush
13. Rubber bush
14. Fluid block bushes

NOTE:

The subframe must be correctly aligned to the vehicle body to ensure the correct operating angle of the driveshaft. Refer to JTIS for more information.

NOTE:

The conventional bush on the forward arm requires a torque and angle tightening sequence performing, this fastener requires replacement after disassembly.

NOTE:

The tightening method is 60Nm then 135° angular torque.

CAUTION:

All control arm bushes to be tightened at kerb ride height.

NOTE:

Where rubber bushes are to be replaced, they should be lubricated with Castrol Optimol MP3, this is a non silicon based lubricant (Part Number 10558 - 1 Liter)

NOTE:

Case type bushes are installed dry.

Front Knuckle

This assembly is similar for the N/A and S/C variants the difference between the two are the caliper mounting points.

Geometry of the bottom ball joint has changed and is now in an upright condition, the previous design accommodated clearance for an additional halfshaft for a 4WD system.

By inverting the ball joint, more surface area contact between ball and cup is achieved thereby enhancing durability.

NOTE:

Ball joint design change, requires the use of a different ball joint separator service tool. The ball joint is not serviceable separately, replacement is achieved by changing the knuckle assembly.

Front Hub

The front hub receives an updated wheel bearing assembly which accommodates the revised ball joint arrangement.

Each wheel bearing also incorporates a magnetic pole ring similar to the one introduced on the X-TYPE.

The hub bearing is an assembly and not a serviceable item.

Anti Roll Bar

There are three variants of front anti-roll bars fitted to the 2003 MY S-TYPE, the difference being in the diameters of the bar to cater for the N/A and S/C ride and handling characteristics.

Springs and Dampers

The front spring and damper arrangement are essentially same as before, however the lower damper fixing is now of a clevis design with a spherical joint located in the LCA.

The purpose behind this change is to enable the strut to straddle the LCA, thus preventing side loads twisting the LCA.

The damper settings have been tuned to accommodate between sports, comfort, ACD and the 'R' ACD version.

The spring is uprated to comply with the different vehicle loads.

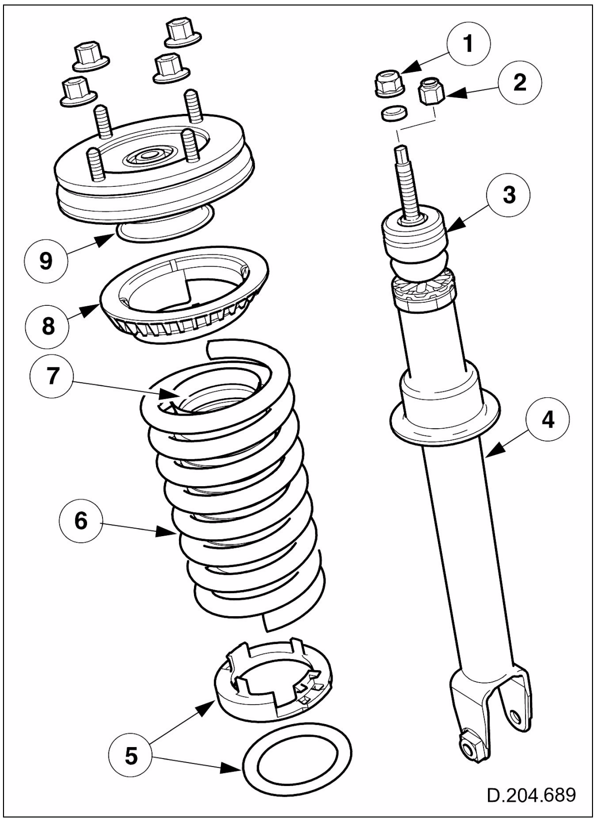


Fig. 97

1. Damper nut (standard damping)
2. Damper nut (adaptive damping)
3. Spring aid
4. Damper
5. Spring load packer
6. Spring
7. Gaiter
8. Spring isolator
9. Upper mount

Geometry

Castor, camber and toe are adjustable as before, the main difference is that the cam bolts for castor / camber adjustments are fitted as original equipment.

Geometry data is carry over, although slight changes might be incorporated prior to launch.

REAR SUSPENSION

The changes for the rear suspension are as follows:

- New subframe
- New subframe bushes
- New knuckle assembly
- New LCA for S/C variants
- New toe links
- New double shear brackets

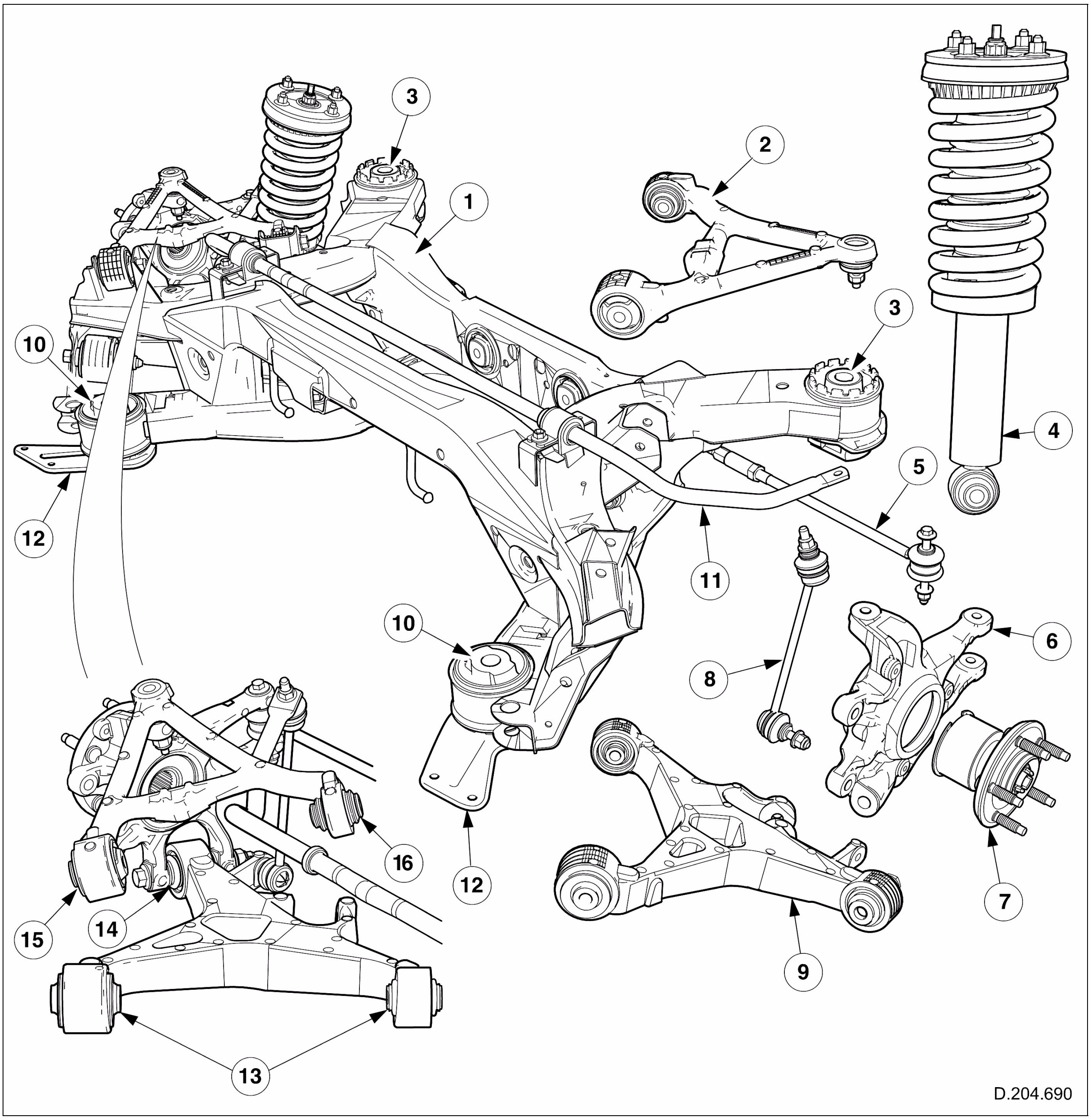


Fig. 98

1. Subframe

2. Voided rubber bush
3. Spring and damper assembly
4. Toe control link
5. Wheel knuckle
6. Wheel hub and bearing assembly
7. Stabilizer bar drop link
8. Lower control arm
9. Hydrabush
10. Stabilizer bar
11. Double shear bracket
12. Cross axis bush and rubber bush
13. Rubber bush
14. Rubber bush
15. Cross axis bush

Subframe

The changes to the rear subframe surround the re-design of the subframe to accommodate the S/C variant, i.e. it has been strengthened for the increase in engine torque output.

However the subframe is a common component, i.e. it is used for both the N/A and the S/C variants

A change that may not be apparent is a change in subframe geometry, the new subframe accommodates changes to the roll centre which reduces head roll and toss.

Subframe bushing has been updated, larger bushes are introduced for drive refinement and durability.

The forward mounting bushes are of the hydrobush design, thus providing enhanced NVH levels.

Bushes require special tools and orientation when replacing end of life components.

NOTE:

The subframe must be aligned if displaced from vehicle, this is due to a 3mm float around the subframe fixing bolts. At the time of writing, the S-TYPE body datum points were being reviewed to enable the X-TYPE alignment gauge to be used for the alignment process.

Rear Knuckle

The rear knuckle is a carry-over component, the S/C variant has different support positions for mounting the Brembo braking components.

The wheel bearing and hub assembly are carry over serviceable components.

Rear LCA

N/A vehicles use carry over components, whilst the S/C variant has a stronger LCA for the increased torque capacity.

Upper Control Arm

The upper control arm is a carry over component.

CAUTION:

As per the front suspension control arms, only tighten the rear control arm bushes at kerb ride height.

NOTE:

Where rubber bushes are to be replaced, they should be lubricated with Castrol Optimol MP3, this is a non silicon based lubricant (Part Number 10558 - 1 Litre)

NOTE:

Case type bushes are installed dry.

Rear Toe Link

This component has been lengthened to accommodate the revised geometry settings.

REAR SUSPENSION

Double Shear Brackets

The double shear bracket is a steel pressing that serves to act as an additional clamping surface for the rear subframe mounting bushes.

This additional plate prevents the subframe from moving (slipage) under acceleration input forces.

Anti Roll Bar

There are two variants of rear anti-roll bars fitted to the 2003 MY S-TYPE, the difference being in the diameters of the bar to cater for the N/A and S/C ride and handling characteristics.

Springs and Dampers

New rear road springs are fitted to cater for the different vehicle loads.

New rear damper setting have been incorporated to accommodate sports, comfort, ACD and the 'R' ACD variant.

Geometry

The 2003 MY S-TYPE vehicle has toe adjustment only on the rear suspension, similar to that of the previous model year.

No camber or caster adjustments are available.

Geometry data is carry over, although slight changes might be incorporated prior to launch.

ECATS

This section will cover the changes to the CATS system, but will also cover any relevant care points as required.

ECATS is the new name for the 2003 MY updated CATS system.

The 'E' in ECATS means Enhanced, although the system is visibly not that much different a number of changes have occurred in the background for enhanced ride handling and customer comfort during braking and cornering events.

Accelerometers

The front lateral and vertical accelerometers have changed position from the LHS suspension turret, the new location is behind the front bumper splitter vane next to the ACC sensor if the option is fitted.

The reason for the change in location is to provide the CM with enhanced detection to changes in vehicle attitude.

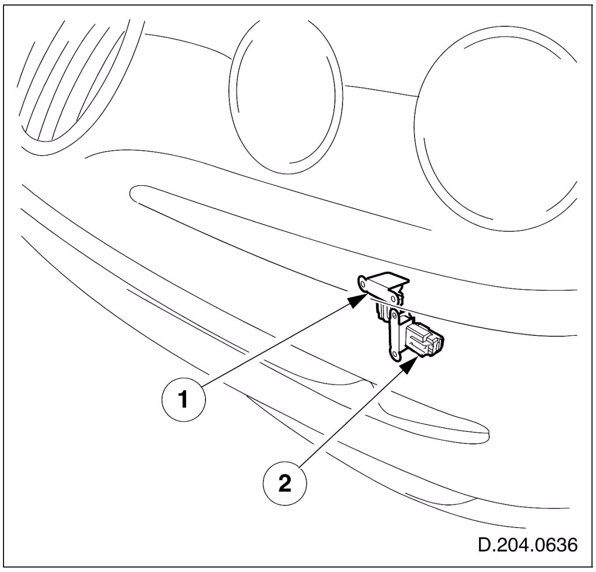


Fig. 99
1. Front vertical accelerometer
2. Lateral accelerometer

Damper Switching

Some of the main changes to the ECATS system is governed by the ADCM software and its control over the damper solenoid switching.

The damper operation and design are carry over, each unit having a 400Hz PWM, two stage (open / closed) 5.4 ohm solenoid.

Control over damper solenoid switching can be one of the following:

- All Firm
- All Soft
- Front or Rear (New)
- Left or Right (New)

ECATS Operation

Location of the ADCM is in the luggage compartment on the rear panel next to the spare wheel well.

ADCM operating voltage is between 6.8v minimum - 16v maximum and has reverse polarity protection.

Signal input to the ADCM is from three Texas Instruments accelerometers, in the form of a variable voltage between 0.25v (high 'g') - 4.70v (low 'g').

The accelerometers receive a 5v supply from the ADCM and the voltage output is relative to inertia, i.e. vehicle 'g' force.

Within each accelerometer an internal contact closes under pressure by the vehicles inertia forces, the pressure acting on the contacts increases the electrical capacitance in the circuit and subsequently reduces voltage output to the ADCM.

The changing voltage to the ADCM from the accelerometers decides the strategy of the damper switching, which now has enhanced functionality.

Damper Switching Modes

At system start-up the dampers are set to firm, this is also the default condition should an electrical fault occur within the system.

From 0 - 8Km/h (0 - 5mph) the setting will be switched to firm, however above 8km/h (5mph) the dampers are switched to soft for vehicle ride comfort.

At a vehicle speed of 145km/h (90mph) the system is switched back to firm, this provides the vehicle stability for higher road speeds and reduces the wallow effect that a comfort setting would have at these higher road speeds.

ECATS SWITCHING

This is the new part of the ECATS system and involves a new strategy for controlling the damper switching between front dampers or rear dampers as an axle set, or by switching the dampers between the left side or right side as required by the vehicle conditions.

Longitudinal

The front and rear switching is to assist in resisting anti-dive and anti-squat characteristics as the vehicle accelerates and brakes.

Inputs required to provoke this switching action are a brake switch input from the REM and vehicle speed from the Teves Mark 25 CM via the CAN bus through the IC gateway with the appropriate SCP vehicle speed message.

Long Wave

This again is a new function and follows a situation where the vehicle is on a long fast straight section of road and there are undulations in the road surface, (autobahns etc.).

The effect of the road wheel is to hop across the top of the undulations due to the vehicle speed, thus reducing road wheel to road surface contact.

ADCM will counteract this effect by switching the dampers to a soft setting thereby allowing the road wheels to follow the road surface contours and increase the road wheel to road contact thus increasing vehicle traction.

Inside / Outside

The right side vs left side switching is introduced to oppose vehicle oversteer and understeer characteristics.

This function is designed to check for differences in vehicle road wheel speeds indicating vehicle cornering.

If the time limit for such an event is met or exceeded then the ADCM will go through a sequence of events to control and stabilize the vehicle during the cornering maneuver.

As an example, the vehicle turns into a right corner, the left front body and suspension will dip and tuck-in which could possibly lead to an understeer event depending on the severity, the ADCM will react to this effect by switching the front dampers to firm.

Should the time of this occurrence continue, then the next sequence is invoked so that all dampers will be set to firm.

The sequence is then completed if a further time limit is met by setting both the left side dampers to firm and the right side dampers to soft thus counteracting the left side body roll.

SUMMARY CARE POINTS

Care and Observation

2003 MY damper retaining nut finish has changed from the yellow cromat finish to a black finish, this change identifies an electrical connector retention enhancement to the connector retaining groove recess.

CAUTION:

Do not interchange fixings as the two designs are not compatible with each other.

The damper connector color has also changed from grey to black indicating a redesigned connector with improved connector lead-in, the new connector has been introduced to prevent damper terminal pin damage.

CAUTION:

When working with the earlier connector design or the new black connector, care must be taken when connecting to the damper to avoid pin damage.

When working with the accelerometers, care must be taken when handling the units as shock will damage the internal circuitry.

CAUTION:

Orientation of the unit is very important, as little as 1-2° out will have adverse effects.

The final care point is associated with the CM connectors, these are positive locking devices and the release can be difficult if observation is not adhered.

CAUTION:

When releasing the connector from the CM, the release clip requires pressing at 90° to the connector.

DRIVELINE

Driveshaft

A new two piece driveshaft manufactured of lightweight steel is used and comes in three derivatives to accommodate each powertrain application:

- V6 engine with manual transmission
- V6 engine with automatic transmission
- V8 engine(s) with automatic transmission

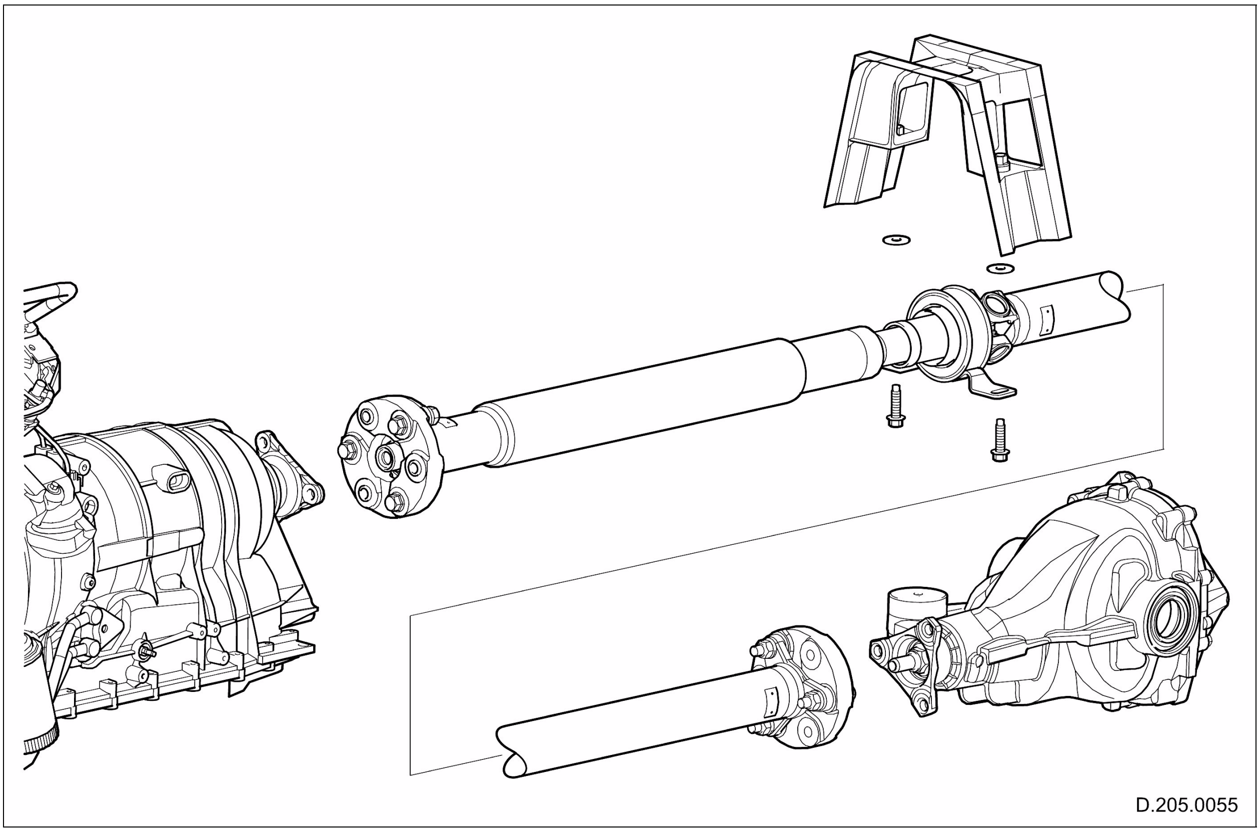


Fig. 100

The driveshaft is aligned with the vehicle center line and is mounted in a rubber center bearing.

NOTE:

A special tool and procedure is required to align the driveshaft. Refer to JTIS for more information.

Differential

The differential is mounted at three points as on the X-Type. This mounting arrangement plus the subframe to vehicle body mounting arrangement provides the rear driveline with double isolation from the vehicle′s body.

The differential is constructed of a cast iron main casing which is a new lightweight design with an aluminum rear cover.

The differential ratios are:

- V6 engine with manual transmission — 3.07:1
- V6 engine with automatic transmission — 3.31:1
- V8 engine(s) with automatic transmission — 2.87:1

Axle shafts

There are two different types of axle shafts:

- V6 and V8 (N/A) tubular axle shafts with high torque capacity constant velocity joints
- V8 (S/C) engines with solid axle shafts with high torque capacity constant velocity joints

The axle shafts are different lengths and are therefore handed left and right. Inboard sliding constant velocity joint provide the axle shaft plunge capacity. Outboards are fixed.

The axle shafts:

- are splined interference fit into the wheel hubs
- and a spline fit into the differential where they are retained by a spring circlip.

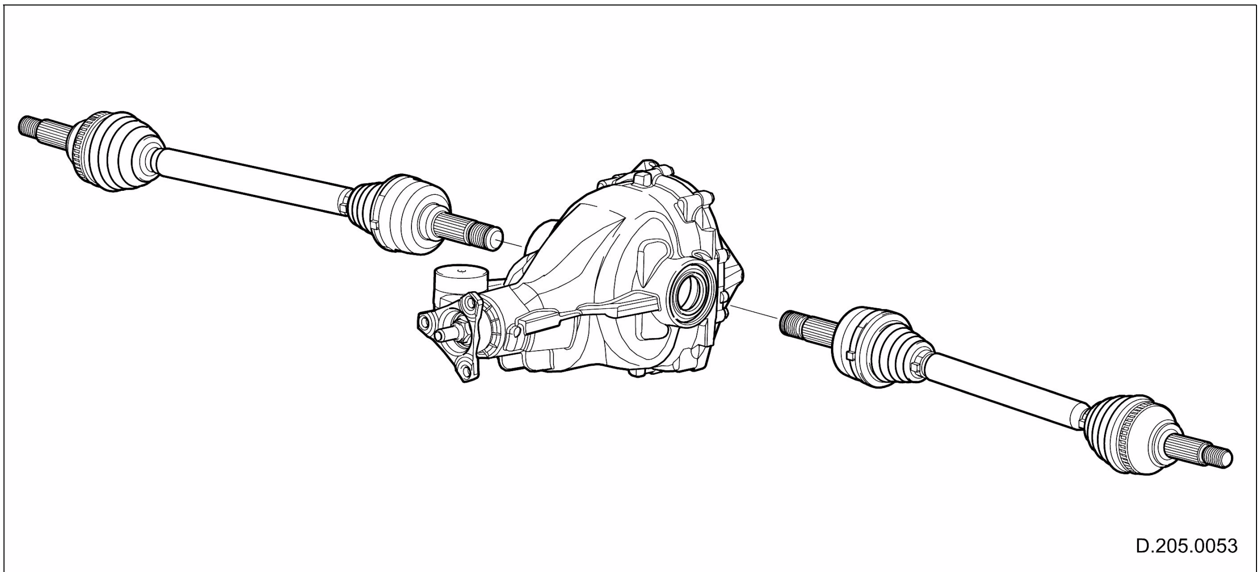


Fig. 101

STEERING

Column

A new designed steering column has been introduced which incorporates a single motor for both reach and rake adjustment.

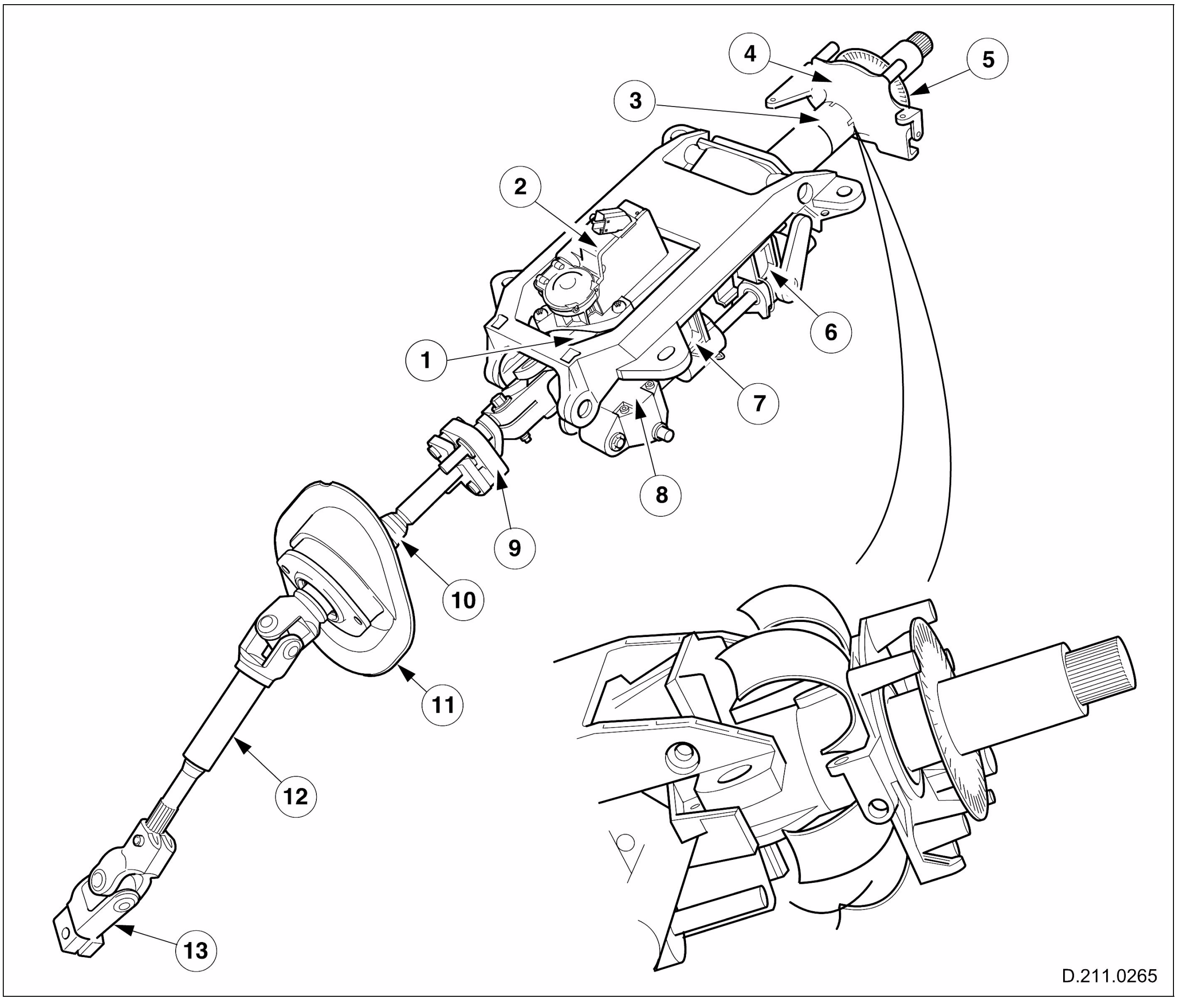


Fig. 102
1. Upper Column
2. Column lock
3. Peeling tube crash mechanism
4. Crash adaptor
5. Sensor ring — DSC
6. Rake adjustment housing, lever and solenoid
7. Reach adjustment housing and solenoid
8. Adjustment motor
9. NVH isolator
10. Lower column

11. Body seal and bearing
12. Collapsible mechanism
13. Splined lower universal joint

The adjustment values are:

- 50mm of reach adjustment
- 5.5° of rake adjustment provided

The column joystick control, spindle motor and feedback pot are hard wired and controlled by the instrument cluster as per the current S-TYPE.

The adjustments are calibrated on track and will require calibration in service using WDS.

Replacement Parts

If the steering column, spindle motor or feedback pot are changed as part of a repair, a WDS calibration for column range will be required.

Steering Column Lock (SCL)

All NAS 3.0 liter V6 engines fitted with the 5–speed manual transmission are fitted with an electronic steering column lock. The SCL system locks the steering column using an electrically operated solenoid. This solenoid operates any time the key is removed from the ignition barrel.

Solenoid operation is controlled by the FEM and the REM which provide 12V power and ground respectively. When the key is removed from the ignition, both modules provide the necessary signals to energize the solenoid and lock the steering column.

ZF PAS SYSTEM

The ZF PAS system is largely a carry over system from the current S-TYPE, i.e. speed sensitive variable ratio assembly.

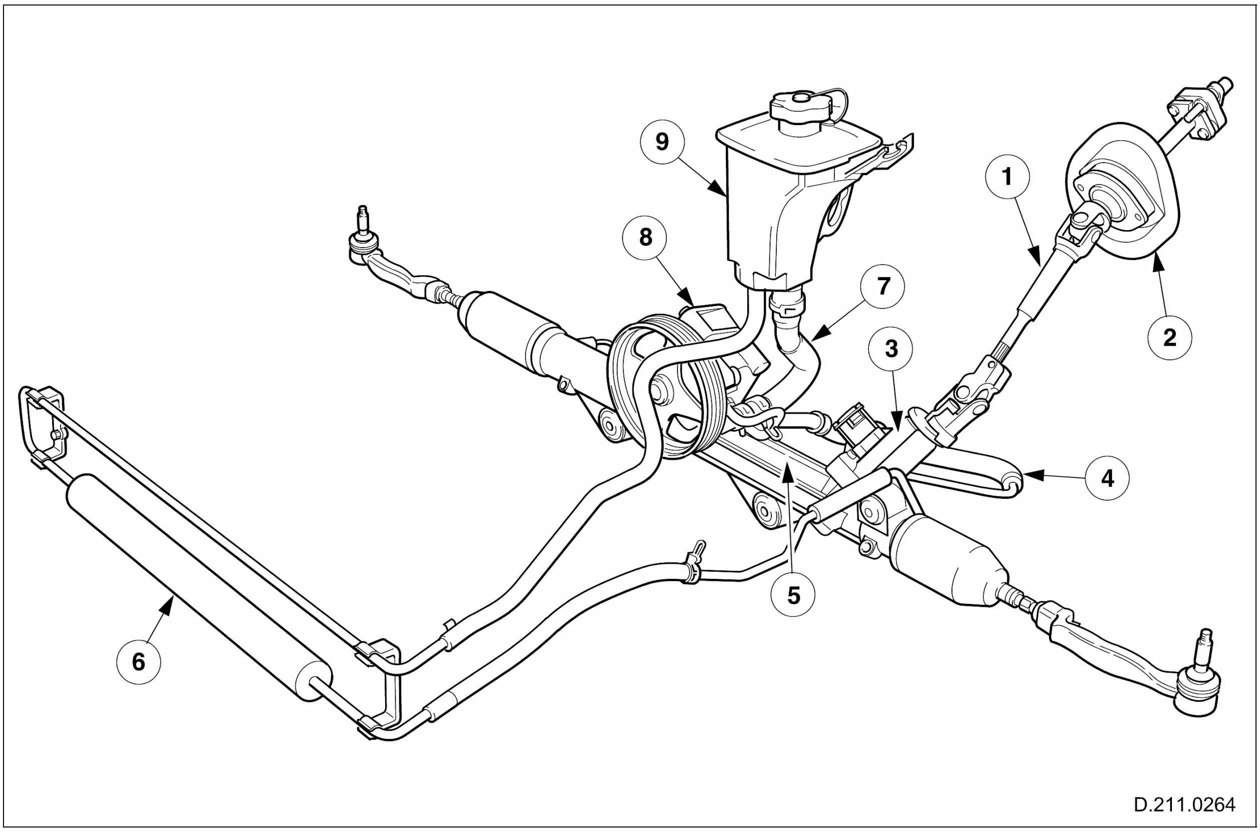


Fig. 103
1. Lower steering column
2. Body seal and bearing
3. Rotary valve housing and Servotronic transducer
4. High pressure feed line
5. Steering rack
6. Fluid cooler
7. Suction hose
8. Power steering pump
9. Fluid reservoir

Where changes have taken place these are to enhance steering feel and feedback.

Rack Bushes

These are of a single rate design.

Pinion

The pinion has now been changed to a splined shaft in-line with XJ and XK.

Oil Cooler

For the 2003 MY PAS system a stand alone PAS oil cooler has been introduced and is therefore no longer part of the radiator assembly.

Oil Specification

The oil used for the PAS system is Dexron IIe, however this specification may change in the very near future.

Pressure Switch

The pressure switch has been deleted from the high pressure hose and the functionality becomes part of the ECM strategy.

Because of enhancements to the engine management system, the reaction time is improved and idle speed control can be achieved without the need for a pressure switch.

Steering Control Module

The steering control module is located in the Front Electronics Module (FEM).

BRAKE SYSTEM

Brakes

Changes to the foundation brake system include larger brake discs for the V8 engine derivative, whilst continuing to utilize carry over components for the V6 engine variant.

Where Super Charged engines are specified, Brembo braking components are employed.

Teves supply the dual vacuum booster and the short stroke master cylinder plus an upgraded Mark 25 ABS/DSC system.

The system is finally complemented by the use of steel braided brake hoses to the brake calipers.

Front Brake Discs (N/A)

For V6 variants the brake discs used are carry over ventilated 300mm x 30mm.

The V8 variant has larger ventilated discs at 320mm x 30 to help reduce the possibility of brake fade occuring.

Both V6 and V8 N/A variants use a common sized splash shield of 320mm.

NOTE:

N/A minimum front brake disc thickness is 28.5mm (–1.5mm).

Front Brake Discs (S/C)

Brembo braking components are employed for the more powerful super charged vehicles.

The company is world renowned for their involvement in F1 racing and are chosen by other manufacturers such as Ferrari and Porsche.

For the 2003 MY S/C S-TYPE Brembo ventilated front brake discs are 365mm x 32mm are specified, offering superior all round braking performance.

NOTE:

S/C minimum front brake disc thickness is 30mm (–2mm).

Rear Brake Discs (N/A)

Carry over brake disc components are used for the V6 and V8 N/A variants, this being a ventilated brake disc of 288mm x 20mm.

NOTE:

N/A minimum rear brake thickness is 18mm (–2mm).

Rear Brake Discs (S/C)

High performance super charged vehicles utilize a Brembo solid rear brake discs which are 330mm x 15mm.

Although the Brembo rear brake disc is in fact thinner than the N/A variants, good thermal conductivity is achieved due to the metal mass of the solid disc used.

NOTE:

S/C minimum rear brake disc thickness is 13mm (–2mm).

CAUTION:

Brake disc resurfacing or grinding is not recommended by Jaguar Cars Ltd.

Brake Calipers - N/A Front

Both the V6 and V8 N/A vehicles use a TRW manufactured sliding aluminium calipers which are carry over components.

The caliper double piston configuration is 45mm + 38mm which provides the required brake force characteristics in a progressive manner.

Brake Caliper - Front S/C

For the super charged variants a Brembo quad piston, fixed type aluminium caliper is employed which has a 38mm + 44mm piston configuration.

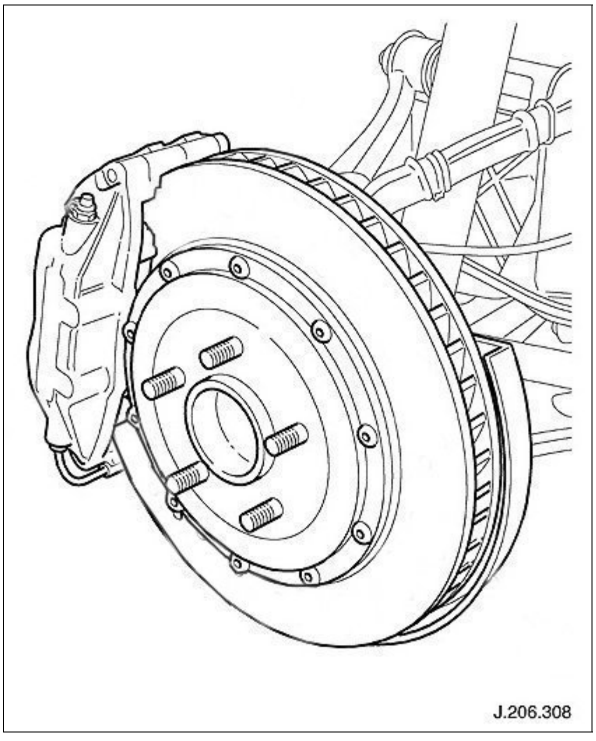


Fig. 104 Front Caliper S/C.

Brake Calipers - Rear N/A

Carry over TRW cast iron single piston sliding caliper is used for V6 and V8 N/A vehicles.

The caliper has a 43mm piston which is retractable using service tool 204-080 for the fitting of new brake pads.

The rear brake caliper on the N/A variants also houses the park brake apply mechanism which consists of a ball and ramp mechanism with a helix guide on the apply piston.

The park brake caliper apply levers have a progressive ramp which contact three ball bearings, the three ball bearings make contact with a second ramp on the caliper piston.

Brake Calipers - Rear S/C

For the high performance super charged vehicles, separate calipers for the park brake and foundation brakes are provided.

The quad piston rear brake caliper is an aluminium two piece fixed unit using 28mm + 30mm piston configuration.

The park brake caliper is purely a mechanical assembly with no hydraulic connection.

Braided Hoses

Goodridge steel braided brake hoses are now used on all the S-TYPE 2003 MY.

The steel braided hoses have inherent features which naturally enhance the braking system.

Electric Parking Brake (EPB)

An Electric Park Brake (EPB) is now fitted to all 2003 MY S-TYPE.

The EPB system comprises of the following main components:

- Park Brake Actuator Unit
- Electronic Control Module
- EPB Centre Console Switch

The park brake caliper levers are activated by the use of an electric motor and actuator unit.

Actuator assembly consists of:

- Motor, Hall Sensor, Gearbox and Actuator Assembly

The park brake actuator is mounted via a bracket onto the rear subframe assembly.

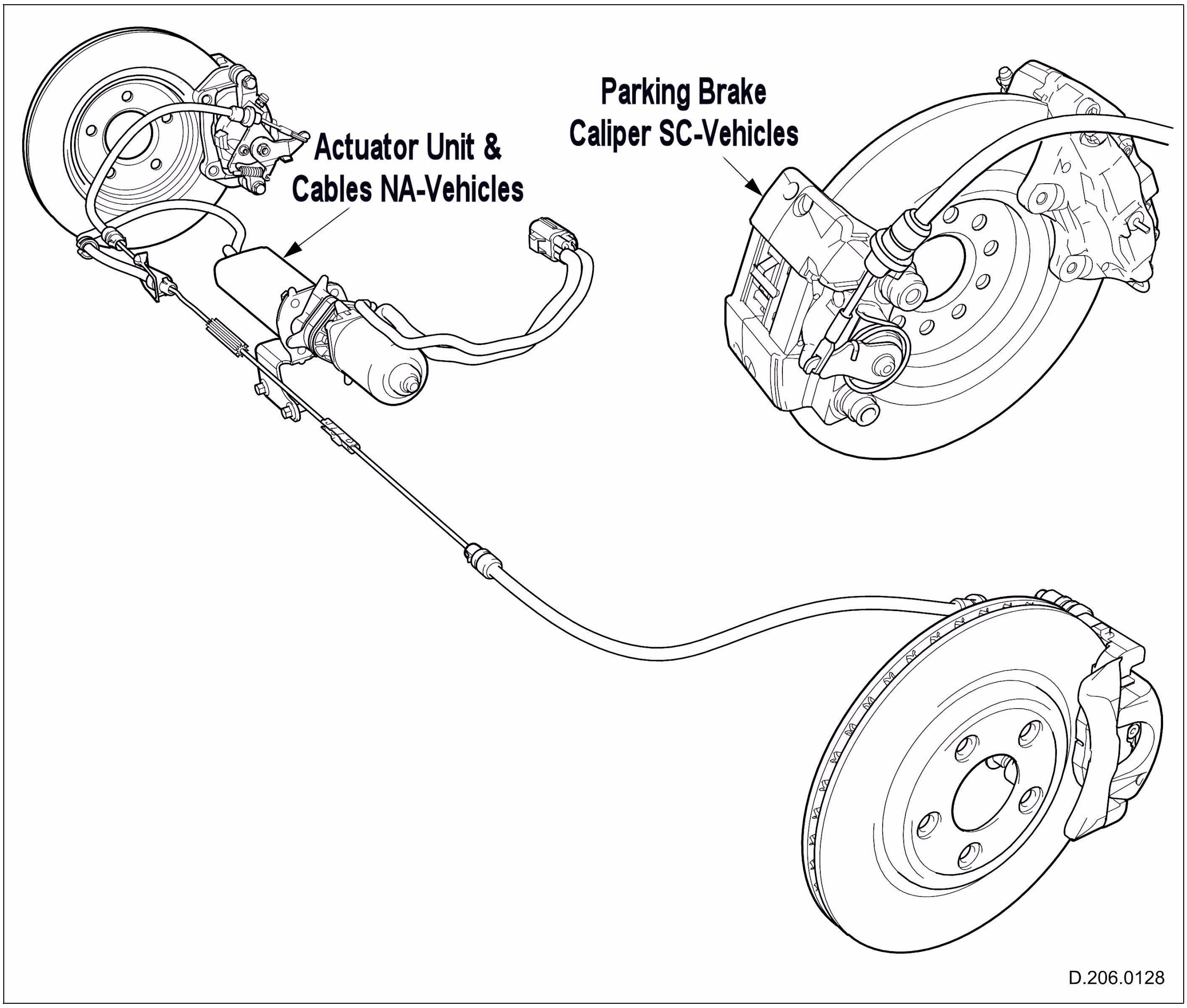

Parking Brake
Caliper SC-Vehicles
Actuator Unit &
Cables NA-Vehicles
D.206.0128

Fig. 105

EPB Activation

Activation of the EPB system is via a new switch mounted in the centre console.

- Switch UP = EPB on
- Switch DOWN = EPB off

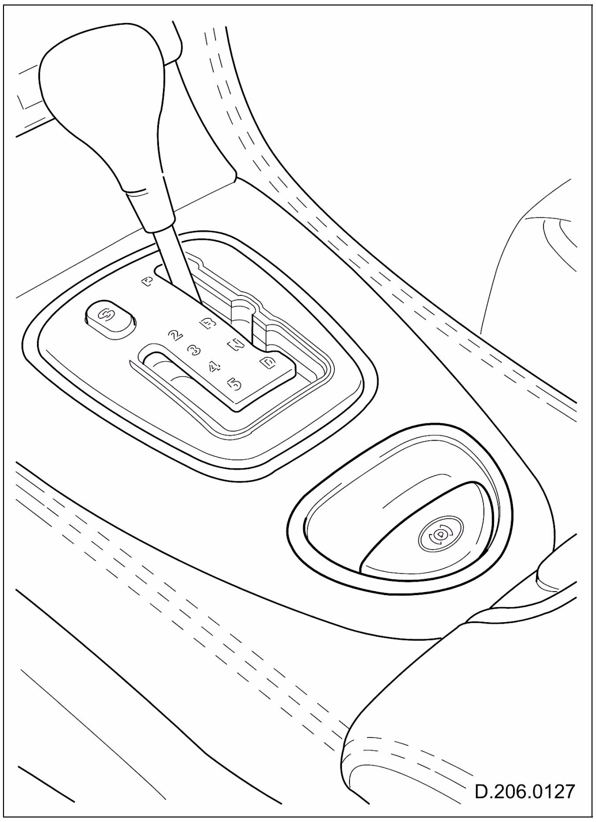


Fig. 106 EPB switch

The EPB system applies to a current level and backs off to a distance, this distance measurement is implemented via a Hall pulse counter (two pulses per revolution).

If the park brake system has not been applied when the ignition key is removed, the EPB control module will self apply the park brake actuator as a safety measure.

NOTE:

During an ignition key out phase, if the EPB switch is held in the down position then the EPB control module will respond by not applying the park brake.

EPB Release

The EPB system will release the park brake on detecting the following sequence:

- Ignition Key Position II
- Foot Brake On
- Push EPB Switch Down

EPB System Operation

There are three modes of operation:

- Static (<3km/h - 1.86mph)
- Low speed dynamic (3-32km/h / 1.86-20mph)
- High speed dynamic (>32km/h - 20mph)

Low Speed Dynamic

In this mode pulling the EPB switch up will result in the system responding with a 500mS of actuator apply time.

Each subsequent pull, the system applies another 250mS of apply time, until full force has been reached (3-4 pulls).

If the EPB switch is pulled up and held on, the system responds by applying at full force.

High Speed Dynamic

In this mode the system operates very similar to Low Speed Dynamic.

Pulling the EPB switch up will result in the system responding with a 500mS of actuator apply time.

Each subsequent pull, the system applies another 250mS of apply time, until full force has been reached (3-4 pulls).

Pull and Hold results in a ramp up sequence as follows:

- Ramp on for 500mS
- Stop for 500mS
- Apply for 250mS
- Stop for 500mS
- Apply for 250mS
- Repeat until full loading registered

In both High and Low Dynamic states when the vehicle speed drops to zero, full EPB force will be applied even if only the first 500mS step has been applied.

NOTE:

Whilst the actuator steps have not been designed to emulate a mechanical park brake, a way of thinking about the applied steps is to consider the ratchet mechanism of a mechanical park brake lever.

Drive Away Release - Automatics

On automatic vehicles the EPB will be released when the 'J' gate out of park signal is detected, i.e. in drive or reverse.

Warnings

In conjunction with an instrument cluster warning lamp and message, an audible warning chime will be heard if vehicle motion is detected whilst the park brake is being applied, i.e. a dynamic mode

In the instance where the park brake system is applied and vehicle motion is detected, the EPB control module will react by releasing the park brake actuator via detection of a positive throttle pedal movement, at this point the message and chimes will cease.

Service Mode

A system service mode has been made available using WDS via the J1962 socket.

The purpose of the service mode is to decouple the park brake system to allow rear caliper service work to be carried out.

NOTE:

The difference between pushing the EPB switch down and removing the ignition key (3/4 off position) and that of the service mode (ship condition), is that whilst in the service mode additional cable slack is introduced to permit rear caliper servicing.

A full diagnostic capability exists for the EPB system via WDS.

Refer to the following table for a full list of DTC's available from the CM.

Calibration Apply Mode

Where vehicles are transported (docks / car transporters) with a transit relay attached, the EPB system will lose its positional memory each time power is removed from the module.

In these circumstances the park brake could already be applied, therefore multiple pulls on the EPB switch would try to overdrive the park brake actuator and put unnecessary strain on the components.

To prevent this from occurring the control module backs off for 200mS, thus preventing multiple applications with multiple pulls.

Secondly the system does not monitor the current rise to 15amps indicating fully on, however it does count the Hall pulses (160) and if this is not seen, the control module will back off the actuator to the ship condition and store a DTC.

NOTE:

WHERE POWER HAS BEEN LOST THE INSTRUMENT CLUSTER (IC) WILL INFORM THE DRIVER TO APPLY PARK BRAKE. HOWEVER WHAT IT DOES NOT MENTION IS TO APPLY THE FOOT BRAKE TO PREVENT POSSIBLE VEHICLE ROLL-BACK, THEREFORE ALWAYS APPLY THE FOOT BRAKE BEFORE TURNING ON THE IGNITION AS A PRECAUTION.

Master Cylinder

This unit is a compact 25.4mm x 36mm short stroke Teves master cylinder with an integrally mounted reservoir.

Brake fluid used is Super Dot 4.

The reservoir has a brake fluid level sensor which is hard wired to the Mark 25 control module.

No ABS default strategy exists if the brake fluid level is low, however the signal is processed by the ABS CM and passed to the IC for warning lamp activation.

Connected externally to the body of the master cylinder is a pressure transducer which is used to determine brake pressure generated within the braking circuit.

This pressure signal is used by the Teves ABS CM as an indication of pressure available for system operation.

Vacuum Booster Unit

Teves supply the active vacuum booster which is a compact 8″+8″ assembly with a boost ratio of 7.5:1.

Improved crash performance is achieved with the Teves assembly, this is due to the way the booster is clamped together and through elimination of the retaining studs as used by the previous TRW design.

The Teves unit has an internal solenoid for active boost operation with the solenoid power supply via a connector mounted on the LHS face of the booster unit.

A booster travel position sensor is mounted on the in-board front face.

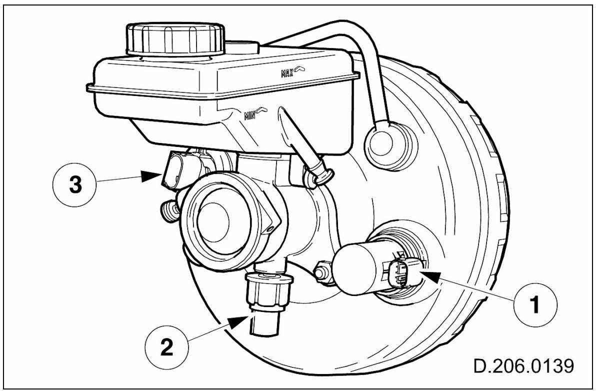


Fig. 107
1. Pedal travel sensor
2. Pressure transducer
3. Active booster and brake pedal force switch

The travel position sensor consists of a push-rod mounted on the diaphragm which slides in and out of a coil type potentiometer.

This sensor is responsible for determining the position of the diaphragm and also speed of diaphragm movement, i.e. distance versus time, and forms part of an enhancement package for the ABS system which is known as PBA.

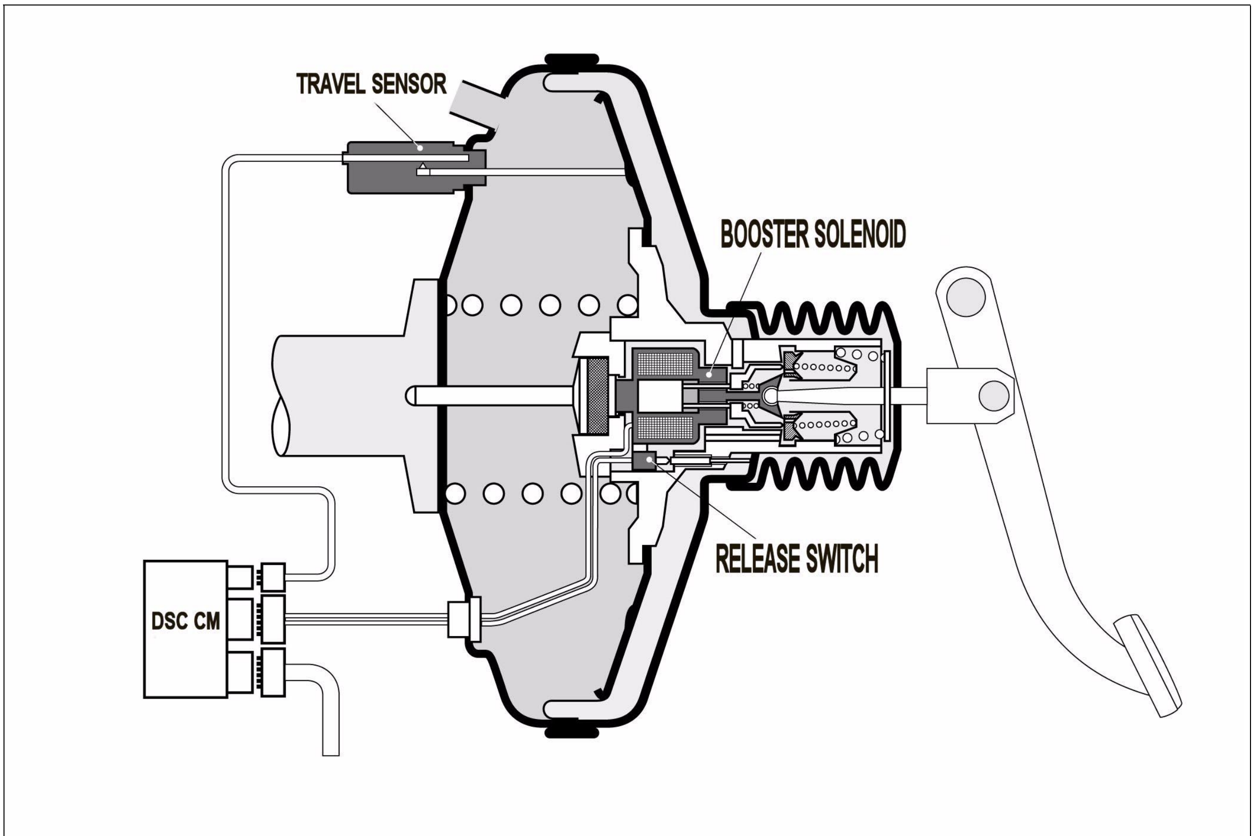


Fig. 108

Panic Brake Assist (PBA)

This system has been introduced for a variety of reasons, but mainly because the driver does not always depress the brake pedal hard enough to activate the ABS system, especially at times when system activation would be desirable.

The following are offered as examples:

- Seat is too far back to press the brake pedal fully
- Driver consciously does not press brake pedal sufficiently in fear of locking the brakes
- Some drivers do not exert enough brake pressure force to activate ABS even though the seat is in a forward position

The PBA system monitors the action of the drivers input (application speed) via the vacuum booster position travel sensor, this is a separate sensor mounted internally within the booster and monitors drivers interaction for DSC operation.

When the rate of brake pedal application exceeds a pre-determined speed, i.e. at such times when panic braking is being adopted the system will activate the active booster solenoid thus introducing additional vacuum boost pressure to activate the ABS system.

Using PBA results in a faster application of the ABS system, thereby reducing the vehicle stopping distance.

TEVES MARK 25 - ABS

For the S-TYPE 2003 MY a number of changes have taken place which includes an updated ABS system.

The main system components are as follows:

- Teves Mark 25 modulator and CM
- Active wheel speed sensors
- High resolution steering angle sensor
- Yaw rate sensor
- Teves active booster

At 2003 MY S-TYPE all vehicles have the following systems as standard equipment:

- Anti-Lock Braking - ABS
- Traction Control System - TCS
- Dynamic Stability Control - DSC
- Panic Brake Assist - PBA

Many of the applications work exactly as they did with the previous system.

The vehicle has a diagonal split braking circuit which during ABS operates on the select low principle, however during TCS or DSC operation individual brakes are independently controlled.

There is no PCR valve or EBD functionality as the 2003 MY S-TYPE braking balance is adequate and therefore does not require any system braking intervention.

However a number of enhancements have been implemented by the introduction of the Teves Mark 25 unit, these are listed in separate topics as follows:

ABS

Benefits to the ABS system are:

- Improved stopping distances on split Mu surfaces and through transitional states.
- Improved NVH whilst ABS is active.

The way this is achieved is by closer electronic control of the hydraulic solenoid valves during wheel lock situation, i.e.

- Limit pressure to both wheels thus preventing pulling
- Apply high pressure to side with the high Mu surface
- Increase the pressure progressively to the low Mu surface

Improved NVH is also obtained by control of the hydraulic solenoid valves using the latest control system technology cycling, i.e.

- Optimized use of braking force with the minimum amount of hydraulic valve activity

TCS

The traction control system again operates largely the same as the previous system with a number of enhancements such as:

- Improved T-junction start performance
- Improved mid-corner tip-in control
- Enhanced split Mu start performance
- Hill Start feature

T-junction start performance is achieved by improved braking control of the inside rear wheel, i.e. when pulling out of a T-junction, e.g.

- Pulling out at a T-junction the rear inside wheel spins and loses power, this is controlled by braking the spinning wheel which then transfer torque to the other wheel.
- If the control of the braked wheel is improved more traction is deposited on the tarmac and enhances traction when pulling out of a junction.

Mid corner tip-in (acceleration) is control of the positive throttle movement.

Whilst cornering at a steady throttle angle, the increase in the throttle position (tip-in) causes the engine torque to increase which can provoke wheel spin if over zealous.

The Mark 25 system is enhanced in its calculation of wheel spin relative to throttle movement and reacts much faster than the previous system allowed.

Enhanced split Mu start performance is a refinement to the braking system by closer electronic control of the hydraulic solenoids.

Hill Start is a new feature that is mainly for manual transmission variants, this feature assists where the driver lets the clutch out and the engine dips and attempts to stall, the system does not request as much torque reduction enabling engine speed to recover.

DSC

DSC is now standard on all 2003 MY S-TYPE vehicles, the system uses active booster for an initial pressure precharge to approximately 20bar.

The reason behind using an active booster for the precharge pressure is because its faster at applying pressure to the brake calipers than the hydraulic pump and therefore DSC activation time is optimized.

The system has been upgraded to recognize understeer in addition to the previous oversteer feature and has a more sportier tune which provides the driver more involvement via the steering wheel.

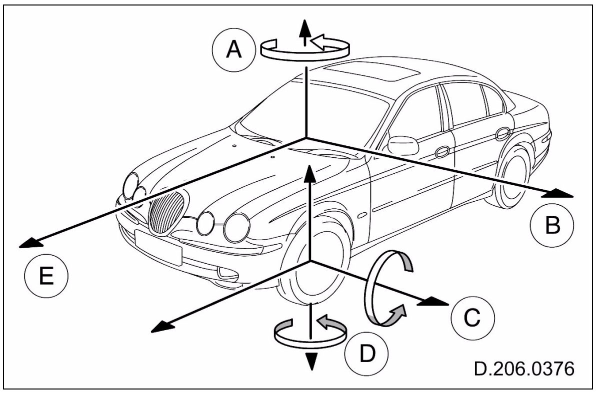


Fig. 109
A. Yaw Rate
B. Lateral acceleration
C. Wheel roll
D. Steering motion
E. Longitudinal acceleration

The additional driver involvement is via the steering input from the steering angle sensor and from the fact the system has a much higher resolution allowing greater input tuning to take place.

For 2003 MY S-TYPE a 1.5° high resolution steering wheel angle sensor replaces the 4.5° unit previously used.

The Steering Wheel Angle Sensor (SWAS) is a completely different assembly, although it works on the same optical principle using LED's and an optical receiver.

The sensor produces a square wave signal 90° apart to detect the direction of turn.

The SWAS has now moved from the lower part of the steering column to the top, it is not possible to interchange old and new sensors due to cable length incompatibility.

Component Enhancements

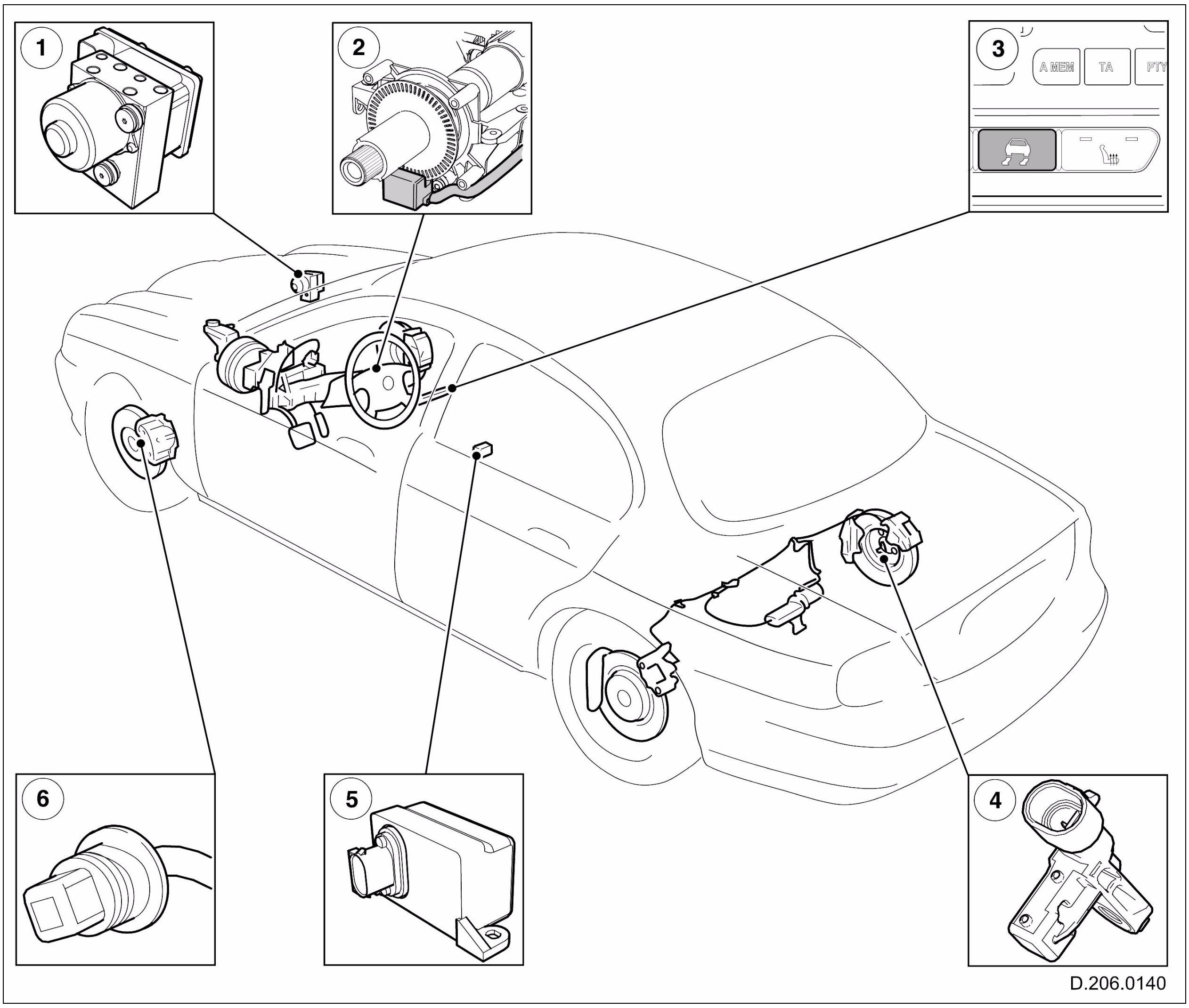


Fig. 110

1. Hydraulic control unit with brake control module
2. Steering angle sensor
3. DSC switch
4. Rear wheel speed sensor
5. Front wheel speed sensor

Other areas and components that have benefitted from upgraded units are the active wheel speed sensors.

The rear wheel speed sensors are modified components and have improved sealing to guard against moisture ingress.

Front wheel speed sensors are new and use a magnetic tone ring built into the front hub bearing, similar to X-TYPE.

The yaw rate sensor and lateral accelerometer are now a combined assembly positioned on the transmission tunnel.

ADJUSTABLE PEDALS

Adjustable vehicle control pedals (throttle, brake and clutch) are introduced as a new optional feature for the 2003 MY S-TYPE.

This option feature achieves improved driver ergonomics relative to the drivers seating position and pedal actuation.

The system comprises of a new throttle pedal with an adjustment motor attached,

The motor connects to the two remaining pedals if fitted, i.e. clutch and brake, via two drive cables (similar to speedo cables).

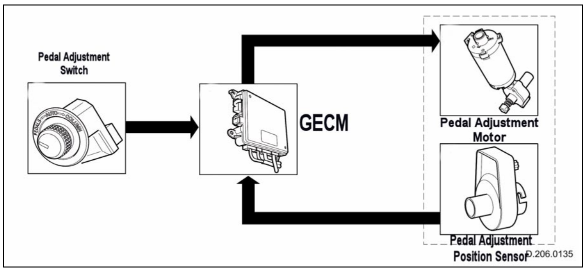


Fig. 111 Adjustable Pedals.

The system is hardwired between the components and the instrument cluster (IC).

Pedal position adjustment is via a new selectable position on the column joystick.

As the joystick is moved through its axis of forwards and rearwards the pedals move likewise forward and rearwards in relation to the seating position.

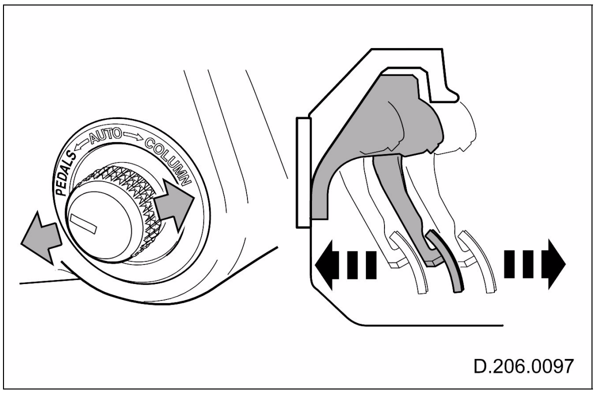


Fig. 112 Adjustment Switch.

All pedals move together in unison and are completely independent from the column position movement.

Two separate pedal positions can be set and stored into memory for driver recall.

Installation

The pedals are supplied in a shipping (transit) condition (fully down) and will require connecting to the drive cables.

Once the drive cables are connected the system is required to be fully operated through the complete pedal axis.

Having achieved this, the final stage of setting the memory can be accomplished.

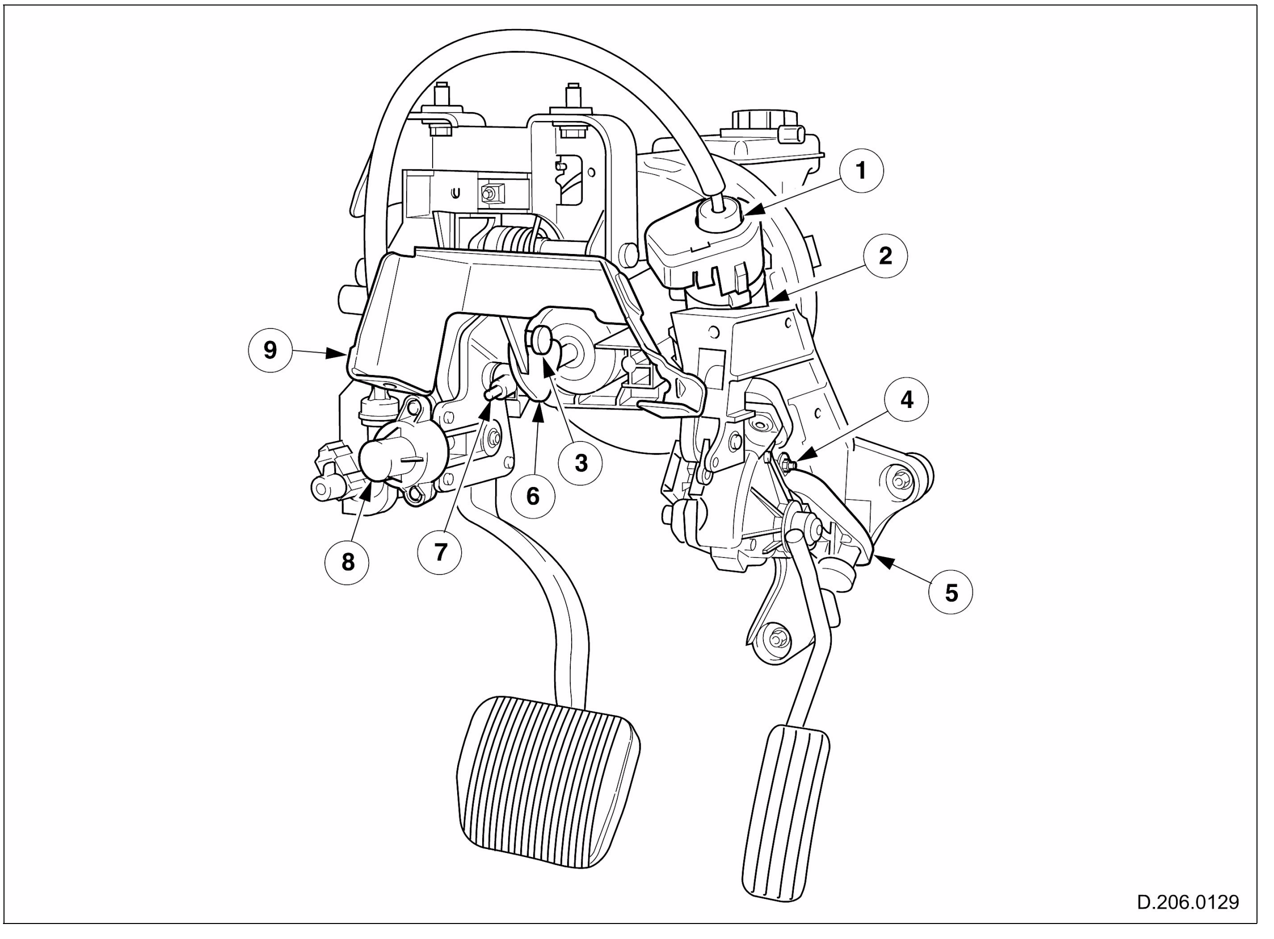


Fig. 113 Pedal assembly (automatic transmission)

1. Pedal adjustment position sensor
2. Pedal adjustment motor
3. Decoupling pin
4. Accelerator pedal adjustment pivot
5. Pedal adjustment bracket
6. Decoupling arm
7. Brake pedal push rod
8. Brake pedal adjustment drive gear
9. Decoupling bracket

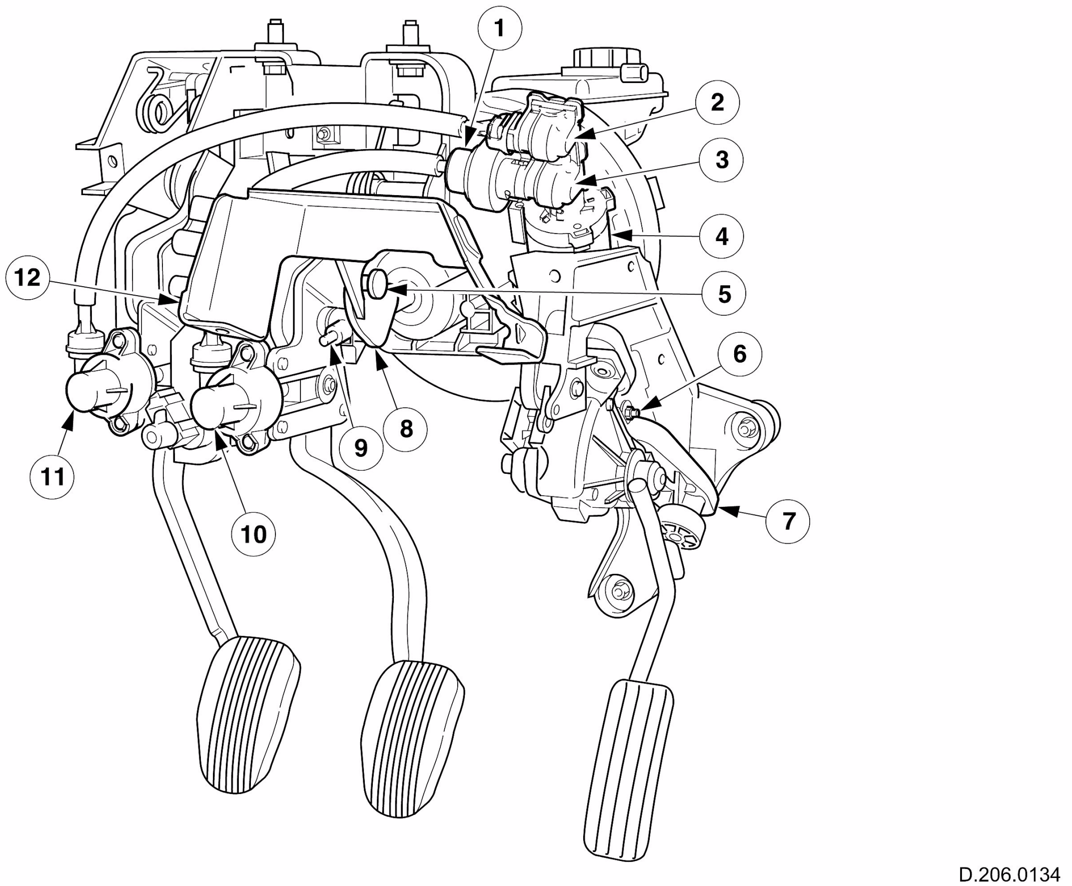


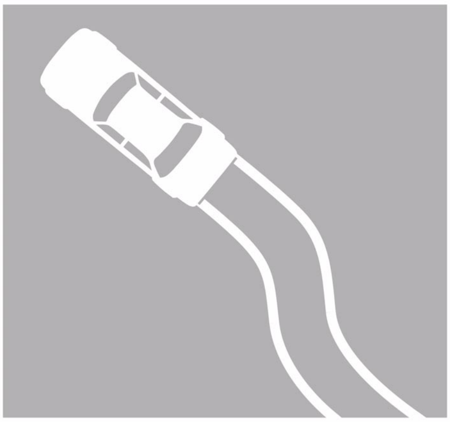
Fig. 114 Pedal assembly (manual transmission)

1. Pedal adjustment position sensor
2. Motor to clutch pedal adjustment drive gear
3. Motor to brake pedal adjustment drive gear
4. Pedal adjustment motor
5. Decoupling pin
6. Accelerator pedal adjustment pivot
7. Pedal adjustment bracket
8. Decoupling arm
9. Brake pedal push-rod
10. Brake pedal adjustment drive gear
11. Clutch pedal adjustment drive gear
12. Decoupling bracket

JAGUAR

TRAINING PROGRAM

JAGUAR CHASSIS, BRAKING AND TRACTION CONTROL SYSTEMS



PUBLICATION CODE – 451

VEHICLE CHANGES

Overview

The 2003 MY XK benefitted from several improvements on the brake system which continue improve the braking characteristics of this model

Mechanical Brake System

XKR models use Brembo brakes with non cross-drilled rotors while cross-drilled rotors are available as an option.

The aluminum 4-piston caliper is now painted silver, featuring the new "Jaguar R" logo. Brembo rotor sizes are 355mm front and 330mm rear. XK8 rotors are unchanged at 325mm front and 305mm rear.

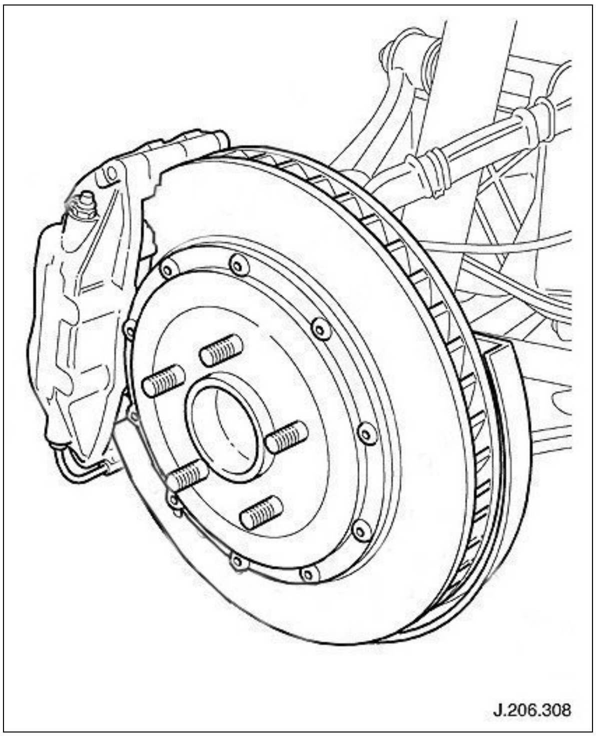


Fig. 115

Dynamic Stability Control (DSC)

The DSC system used on the 2003 MY XK uses the same principle of operation as the system used on the 2003 MY S-TYPE. The system incorporates the traction control and ABS capabilities all into a combined ABS + TC + DSC unit.

The DSC system can be switched OFF by pressing the switch on the center console switch pack. A warning light in the instrument cluster will illuminate and a message will be shown to indicate that the system has been switched OFF. When the system is switched ON, the warning light will flash when the system is active.

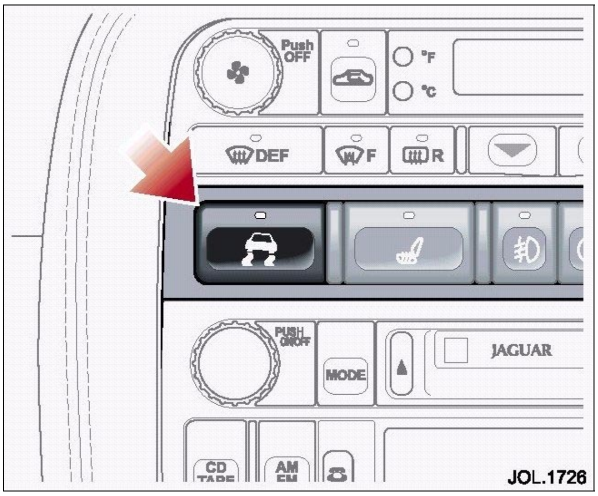


Fig. 116 DSC ON/OFF Switch

NOTE:

If cruise control is engaged, it will automatically disengage when the DSC is active.

System malfunction is indicated by the message "DSC NOT AVAILABLE" in the instrument cluster message center. In addition, the warning light in the instrument cluster will also illuminate.

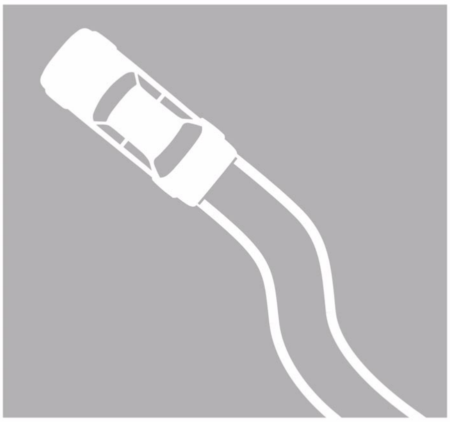
Panic Brake Assist (PBA)

The PBA system used on the 2003 MY XK uses the same principle of operation as the system used on the 2003 MY S-TYPE. PBA helps the driver in an emergency when it senses maximum braking power isn't being used. Often in emergency braking, the driver does not push the brake pedal hard enough. PBA senses an emergency-braking situation from the speed at which the driver pushes the brake pedal, and at that precise moment, applies maximum available braking power.

JAGUAR

TRAINING PROGRAM

JAGUAR CHASSIS, BRAKING AND TRACTION CONTROL SYSTEMS



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FRONT SUSPENSION

Front suspension design is a double wishbone using lightweight aluminium for greater unsprung weight.

The suspension package delivers an assured stable ride at high speed with the comfort and agility that's in a class of its own.

Front Subframe

The front subframe is of a fabricated steel ring frame design and it has isolation bushes to provide the degree of NVH characteristics required, i.e. it is mounted indirectly to the vehicle body.

The new XJ range is the use of two carrier plates for the cooling pack assembly.

The cooling system support carrier are plates are sandwiched between the subframe and vehicle body.

Upper Control Arm

The lightweight forged aluminium upper control arm has a revised geometry setting to enhance caster trail and hence straight-line steering stability.

If the arms were interchanged between the different vehicles then the geometry settings for that vehicle would not be obtained.

Ball joint and slipflex bushes are not service items and therefore a complete upper control arm is required to replace worn components.

Lower Control Arm

The forged aluminium lower lateral control arm is of an uncoupled design, i.e. not connected directly to the lower forward control arm.

This permits enhanced independent bush tuning and thus improved steering NVH characteristics.

Front knuckle lower ball joint is positioned in a upright condition for mounting to the lower lateral control arm.

The lower damper mounting uses a clevis design to assist in preventing the lower lateral control arm from twisting.

Lower damper isolation bush forms part of the lower lateral control arm.

The three bushes, i.e. the lower control arm bush, damper bush and the anti-roll bar bush are serviceable items.

Refer to JTIS for the remove and refit process and any special tool requirements.

Forward Control Arm

The lower forward control arm connects to the lateral lower control arm at one end via a ball joint and to the front subframe at the opposite end using hydrabush technology.

This split design from the lateral lower control arm allows the design engineer to tune the bushes to the requirements of the vehicle and thereby reducing vibrations felt through the steering system.

The lower lateral control arm bush has far less compliance, i.e. stiffer, than the hydrabush fitted to its lower forward control arm counterpart.

FRONT SUSPENSION

Front Knuckle

The front knuckle looks very similar to the 2000 MY S-TYPE component, but on closer inspection it can be seen that the lower ball joint is positioned in an upright condition.

This change was also included as a modification on the 2003 MY S-TYPE.

Front knuckle assemblies are similar for N/A and S/C vehicles with the only diffrence being the different caliper mounting points.

The front knuckle locates the front brake caliper, front hub bearing, upper control arm ball joint and lower lateral control arm pivot point.

The front knuckle lower ball joint is not serviced separately and requires a complete knuckle assembly to replace worn components.

Front Hub

The front hub assembly is non serviceable and therefore the whole front bearing and flange is changed as a complete part.

Combined within the bearing is a magnetic pole ring similar to that used on the X-TYPE for the wheel speed sensing signal.

Refer to JTIS for the remove and refit procedure and any special tool requirements.

FRONT SUSPENSION

Table 4

All suspension bushes to be tightened at kerb ride height and the ball joint type bush fitted to the forward control arm requires a torque and angle procedure for tightening. (60Nm and then 135 degrees angular rotation)

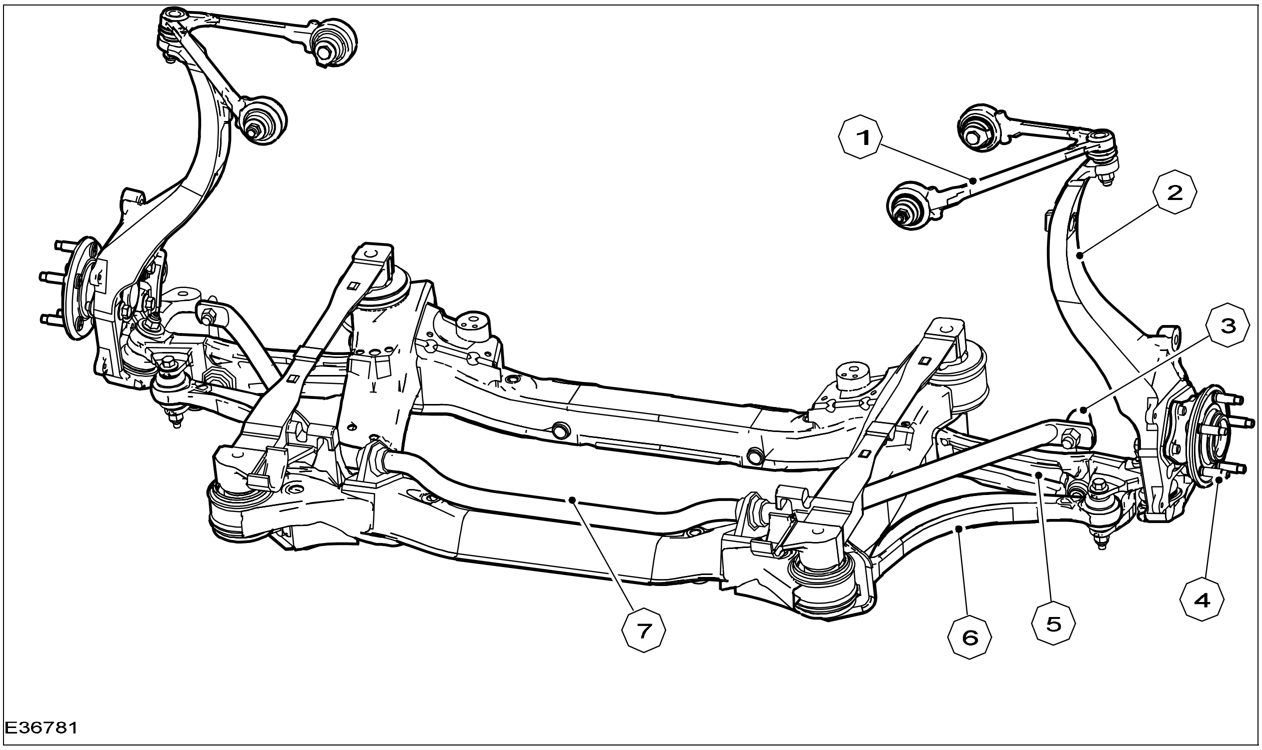


Fig. 117 Front Suspension Components

1. Upper Control Arm (not serviceable)
2. Front Knuckle (not serviceable)
3. Anti-Roll Bar Link (not serviceable)
4. Front Hub (not serviceable)
5. Lower Lateral Control Arm (serviceable)
6. Forward Lower Control Arm (not serviceable)
7. Anti-Roll Bar (bushes fitted dry)

REAR SUSPENSION

In this section we will review the rear suspension components, some of which are shared with 2003 MY S-TYPE.

In many ways the rear suspension is similar to the front assembly in that it has double wishbone type layout.

The upper and lower control arms are manufactured in lightweight aluminium connected to a much stronger rear subframe which has been redesigned to accommodate the supercharge variants higher torque output.

Rear Subframe

A steel fabricated assembly isolated to the aluminium body by four large mounting bushes for exceptional ride refinement.

The bushes are of the hydrabush design at the two forward location points and void bush design at the two rear mounting points.

Additional subframe clamping load is provided by two double shear brackets fitted to the forward mounting bushes.

The double shear brackets are located using an aluminium brace for additional stiffness and is fitted to prevent the subframe from torque slippage, i.e. movement under the higher acceleration input forces.

The subframe bushes are serviceable items and require the use of specific special tools for bush remove and refitting.

Refer to JTIS for the remove and refit procedure and any special tool requirements.

Alignment of the rear subframe is by use of the alignment gauge 501-081 with additional drop down links to suit the gauge.

Upper Control Arm

Upper control arms are fabricated from aluminium for weight reduction and contains a ball joint, cross axis bush and a void bush to control the forces applied through the arm and is linked to the subframe and knuckle assembly for road wheel articulation.

The upper control arm also locates the height sensor for ASM and HID operation.

Bushes and ball joints are not serviceable items and therefore a complete upper control arm will be required to replace any worn parts.

Refer to JTIS for the remove and refit procedure and any special tool requirements.

Lower Control Arm

An aluminium component for lightweight and derivitised for N/A and S/C vehicles.

This is due to the power output on the supercharged variant, i.e. S/C versions are strengthened for higher torque capacity.

Mounted on the lower control arm are the following components: anti-roll bar link, damper and the rear knuckle assembly.

The lower control arm contains two cross axis bushes and one rubber bush which control the forces through the lower control arm and is linked to the subframe and knuckle assembly for road wheel articulation.

The bushes are serviceable items using specific service tools. Refer to JTIS for the bush remove and refit process.

REAR SUSPENSION

Rear Knuckle

Manufactured from aluminium and locates the upper control arm ball joint, lower control arm bush, toe link control arm, hub bearing assembly and wheel speed sensor.

The rear knuckle is derivitised due to the different rear brake caliper support mounting points that exists between the N/A and S/C variants.

Rear Hub

The rear hub bearing is a self contained cartridge type unit and is a carry over component from the 2000 MY S-TYPE this bearing is also included on the 2003 MY S-TYPE.

Refer to JTIS for the bearing removal and refit process plus the special tools required to complete the task.

Anti-Dive & Anti-Squat

Viewing the upper and lower control arms on the front and rear suspensions it can clearly be seen that the arms are angled differently to each other.

These angles are purposely designed into the suspension geometry and form the anti-dive and anti-squat characteristics.

CAUTION:

For setting vehicle geometry the car has to be level. WDS has a level setting procedure to aid geometry setting.

Once the control module drops out of setting mode the system will automatically level to the standard ride height.

REAR SUSPENSION

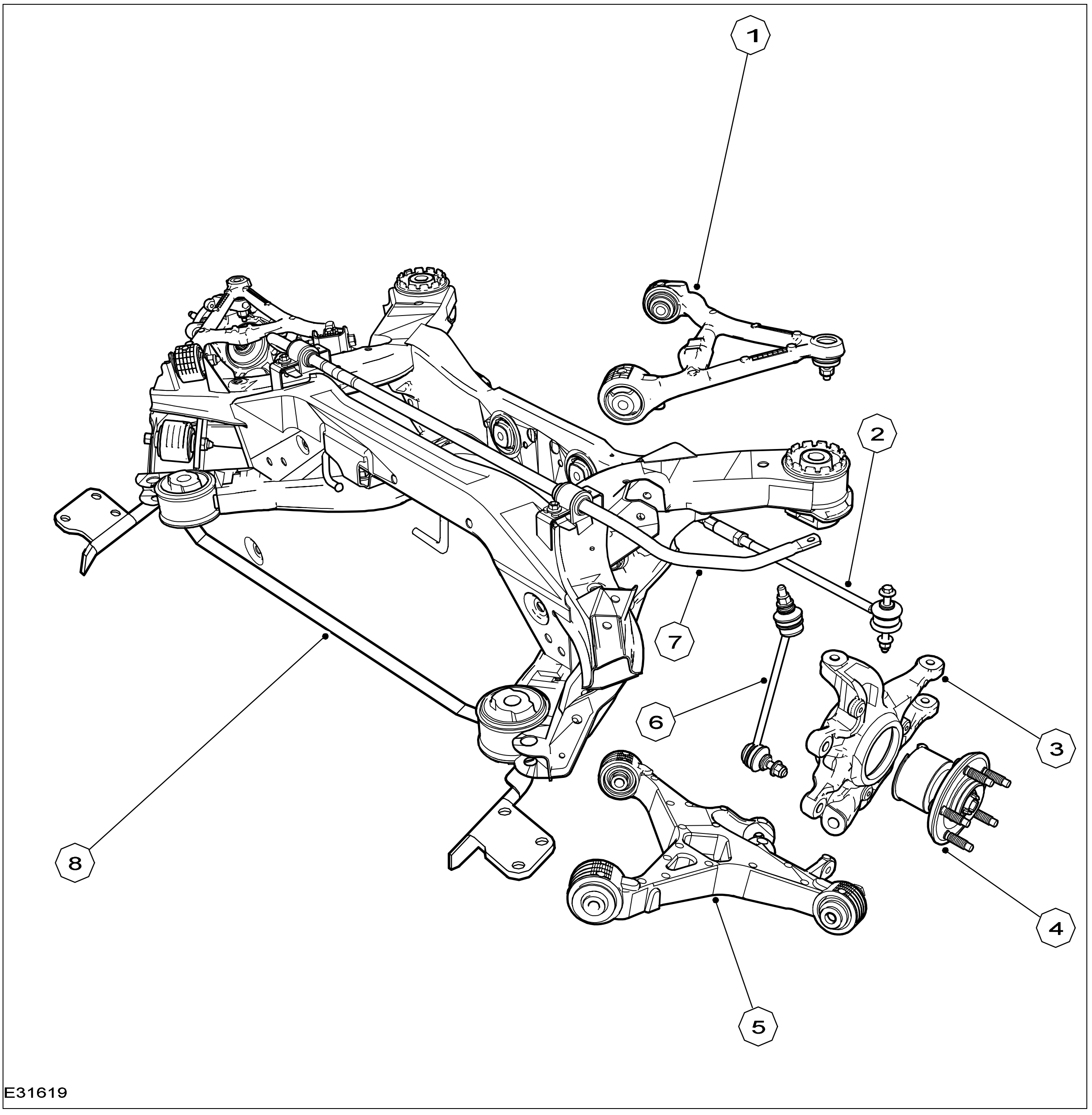


Fig. 118 Rear Suspension Components

1. Upper Control Arm
2. Toe Link
3. Rear Knuckle Assembly
4. Rear Hub Assembly
5. Lower Control Arm
6. Anti-Roll Bar Link
7. Anti-Roll Bar
8. NVH Bar and Double Shear Brackets

AIR SUSPENSION

Ride and Handling

The new air suspension system offers the best ride, handling characteristics and assists in reducing ride float.

Data capture is achieved via various methods and fall into subjective and objective measurements.

Using machine collected data leads to reproducible results and thus can not be considered as subjective evaluation.

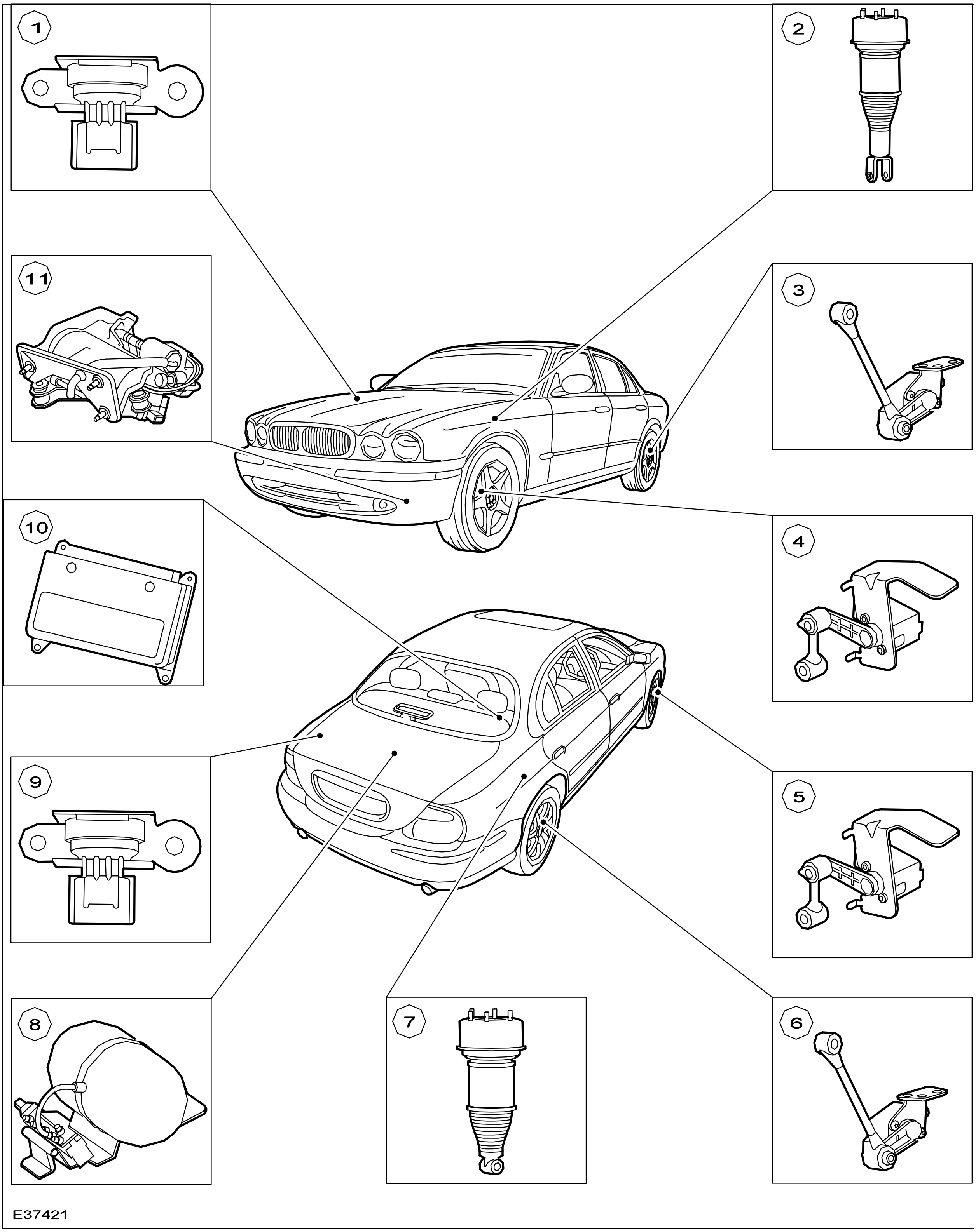


Fig. 119 Air Suspension Components

1. Front vertical accelerometer
2. Front air spring and damper assembly
3. LHR height sensor
4. LHF height sensor
5. RHF height sensor
6. RHR height sensor
7. Rear air spring and damper assembly
8. Reservoir and valve block assembly
9. Rear vertical accelerometer
10. ASCM
11. Compressor Assembly

However both subjective and objective data capture is used in parallel with each other.

It should be pointed out that ride and handling characteristics are always a compromise between their individual strengths and weaknesses.

By using an air suspension system, the ride and handling compromise is closer to the designer's particular intention.

Service Awareness

The air suspension system uses a number of modes for complete operation.

In conjunction with these modes of operation are a number of service implications that need to be taken into account when working on the system.

These will be broken down into their respective areas as we delve further into system operation.

SYSTEM ASSEMBLIES

In this section we will describe the features and functionality of the air suspension system and cover any service related issues as we progress through the topics.

To begin understanding the system listed below are the components that are relied upon for system operation.

These components will be covered separately in a number of individual topics.

System Components

The system components consist of the follow items:

- Air Compressor
- Control Module
- Height Sensors
- Air spring and Damper
- Valve Block
- Reservoir
- Air Harness

Air Compressor

The single piston high pressure air supply compressor pump is located forward of the left front wheel arch behind the bumper beam assembly.

Each compressor assembly has an intake air filter, an integral regenerative air drier element and an air exhaust solenoid valve.

Nominal pressure developed by the compressor system is 15 bar (218 psi).

A compressor pressure relief valve is fitted and set at 17.5 bar (254 psi).

The compressor system is mounted on an isolated subframe to ensure the quietest possible system operation.

A pressure retaining valve (PRV) ensures a minimum pressure of 3 bar (43.5 psi) is maintained within the air supply system.

NOTE:

It is important to understand that the compressor operation only occurs whilst the engine is running.

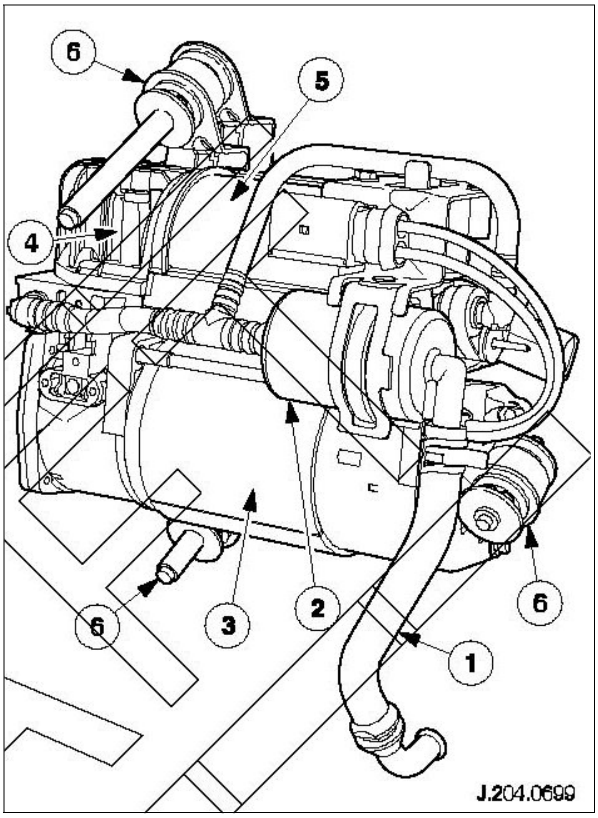


Fig. 120 Air compressor

1. Air intake/outlet snorkel
2. Filter
3. Motor
4. Piston cylinder head
5. Air drier
6. Mountings

COMPRESSOR COOLING

Compressor Temperature

Another important point to remember is that the compressor only operates for a maximum of two minutes to control piston and cylinder head temperature.

In the majority of cases the compressor will only run when the vehicle is moving above 25 mph (40 km/h) and will be inhibited when the vehicle speed is lower than 18mph (30km/h).

An algorithm based on compressor run time versus temperature generated per second is used to guard against compressor overheat conditions. The ambient temperature sensor signal is used in the calculation of compressor temperature.

Should the algorithm dictate the temperature has exceeded a pre-determined value and is too hot, then the compressor is shut down to allow it to cool.

The time limit before being allowed to re-run depends on vehicle activity and is generally around 30-40 seconds but no longer than 120 seconds maximum.

There are times when the engine management system will request an air suspension inhibit. This is via the ECM load management feature thereby protecting battery load being too excessive.

The above should only be for a few seconds whilst cranking and normally the compressor only runs when the vehicle is moving unless the vehicle ride height is low.

CONTROL SYSTEMS

Control Module

The acronym used is ASM - Air Suspension Module.

Other acronyms that will be seen:

- ASU - Air Suspension Unit
- ACD - Adaptive Controlled Damper
- SSP - Switched System Power

The Wabco CM is unique to The new XJ range and is located behind the RHR seat back.

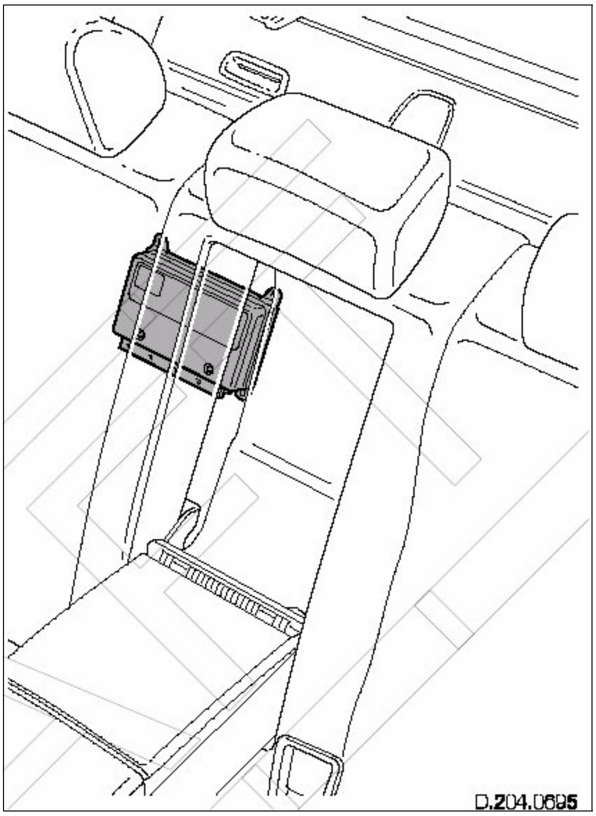


Fig. 121 ASCM

The control module can be recognized by the four individually colored harness connectors and the WABCO logo on the canister.

Adaptive damping in addition to air suspension operation is controlled via the air suspension control module electronics where fitted.

Module calibration is required when either a replacement module is fitted, or if any height sensor is removed and refitted or replaced.

Calibration involves the measurements from each corner of the vehicle to be entered into WDS and then a calculation of the correct height is evaluated from the input data.

The calibrated trim height (standard ride height) is taken from the road wheel centre to the wheel arch eyebrow.

WDS is used for ride height checks and requires a procedure to be performed prior to checking the ride height datum points.

The control module voltage requirement is between 9-16 volts with a typical operation voltage being around 12-14 volts.

HEIGHT SENSORS

Height Information

The Hall effect (using a ring magnet design), single channel height sensors are components that meet industry standards and are used by other manufacturers such as: Mercedes, BMW and Audi.

There are four height sensors per vehicle and these are mounted on the front and rear subframe assemblies.

The height sensor is linked to the suspension arm by a drop link connection and spring clip secured.

Height sensor brackets are handed and therefore can only be fitted in one position due to the 'Poke Yoke' design.

Each height sensor uses 3 pins for height sensing; supply, ground and feedback. The remaining three pins are for dual channel sensors.

Height sensing for HID is sent from the Wabco control module to the HID circuit.

The air suspension control module supplies height sensor with 5 volts in pairs diagonally.

Height sensor feedback voltage range to the air suspension control module is between 0.5v - 4.5v.

Although the readings from the sensors are in 0 - 5v range the voltages are inversed between the axle sets, i.e. one side will read 0.5 - 4.5 volts range whilst the opposite will display 4.5 - 0.5 volts range.

This means the voltage values are the same diagonally. The inverse voltage effect occurs due to the mounting position of the sensor.

The arm operates through a 35° arc either side of zero (2.5 volts approximately)

NOTE:

Height sensors require calibration if removed and refitted or replaced.

Height sensor circuit has software filters for different operating characteristics, e.g. at times fast changes are required to respond to changes in levelling, whilst at other times very small changes take place over a long distance.

These two differences can be thought of as loading or un-loading the vehicle (fast filter) or fuel level being emptied (slow filter).

When checking geometry a procedure has to be invoked via WDS prior to any ride height measurements being taken.

AIR SUSPENSION COMPONENTS

Air Spring and Damper

Vehicle attitude is controlled by operation of four Krupp Bilstein air spring and damper units via the use of various operating modes.

There are two derivatives of the air spring:

- Comfort - Higher volume = softer
- Sport - Lower volume = stiffer

The air springs are complemented by two versions of damper assembly:

- Passive
- Adaptive

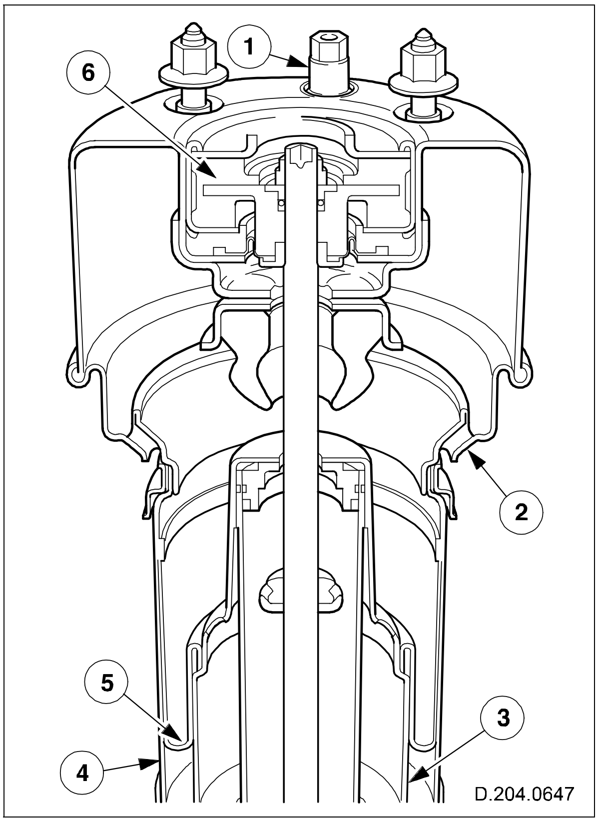


Fig. 122 Air Spring cut-away

1. Retaining valve
2. Isolator
3. Piston
4. Outer sleeve
5. Rolling bellows membrane
6. Top mount

The air spring burst pressure is around 40 bar (580 psi) with normal running pressure around 7-9 bar (101.5-130.5 psi).

Maximum 'full bump' spring pressure at gross vehicle weight (GVW) is in the region of 20 bar (290 psi).

Construction is of a guided air spring over damper assembly, thus allowing a de-coupled air spring guide to permit greater damper articulation without trapping the air sleeve.

This form of construction provides improved ride characteristics over a non-guided air spring designed unit

Utmost care is required when removing and refitting air spring and damper units so as not to damage the top mount diaphragm seal.

Whilst working with the air spring and damper assembly ensure no twisting between the air spring top pot and damper clevis occurs as this will result in damage to the sleeve.

The air spring has a pressure retaining valve (PRV). The purpose of the valve is to retain 3 bar (43.5 psi) within the air spring at all times which offers protection to the air spring membrane by preventing it from creasing.

Depressurization using WDS is required prior to any service work being carried out.

Repressurization via WDS is also required after the work has been completed.

Air spring assemblies outside of warranty requires a manual process for releasing the retained air pressure. Refer to JTIS.

Valve Block and Reservoir

The valve block and reservoir units are both located in the luggage compartment within the spare wheel well and situated underneath the spare wheel.

These components are contained under a cover for protection. This cover also aids reducing valve block noise and therefore should be in place at all times.

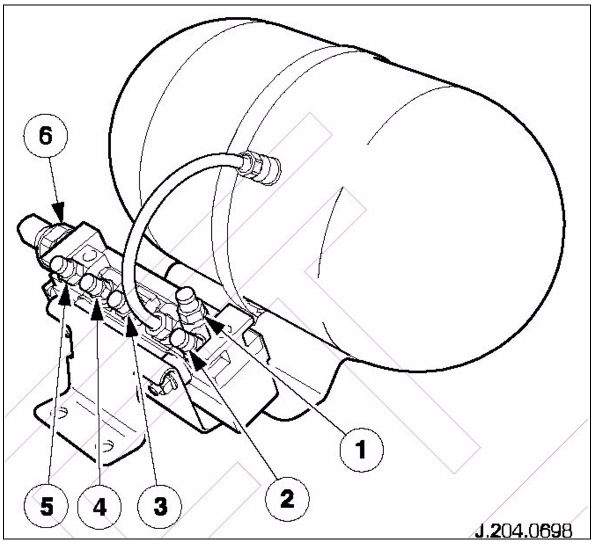


Fig. 123 Reservoir and valve block

1. Air compressor port
2. Air spring port — LH rear
3. Air spring port — LH front
4. Air spring port — RH rear
5. Air spring port — RH front
6. Pressure sensor

AIR SYSTEM COMPONENTS

Reservoir

The reservoir has a volume of 4.5 liters with a maximum design pressure of 15 bar (217 psi).

When fully charged the reservoir is capable of at least one full vehicle lift at G.V.W.

The air supply compressor is used to recharge the reservoir once the pressure has been depleted to its lower limit. The recharging process should take no longer than two minutes.

The air suspension system does not deplete the reservoir contents below 9 bar under normal operating conditions.

This means that the system is operating within a pressure range. This is done to prevent the air pressure held in the air springs from being transferred into the reservoir.

Valve Block

The valve block (serviceable as a complete unit) contains five individual solenoid valves. One for each of the four air springs and one for the reservoir.

A pressure sensor is incorporated into the valve block manifold and monitors system pressure.

The pressure sensor is not a serviceable component and requires a complete replacement valve block assembly if faulty.

The valve block is mounted on serviceable rubber isolators which assists in reducing solenoid valve operation noise.

Replacement Voss pipe connections are provided as service items for the front and rear air spring units, reservoir, valve block and air compressor unit.

Air spring ports and pipe work are 6mm diameter for front air springs and 4mm for rear air spring and air compressor units.

Each pipe connection is color coded to the air harness for ease of identification.

Air Harness

The pipe tubing is manufactured from Polyamid (Nylon) which has good properties for abrasion resistance.

Front air spring and air compressor unit pipe work is routed underfloor from the spare wheel well to the left hand front wheel arch and air spring tops underbonnet.

Removal of the underfloor air harness requires the fuel tank and rear suspension subframe removing from the vehicle.

The rear air spring pipework is routed inside the electrical telematics harness within the luggage compartment.

Localized damage can be repaired using sectional replacement tubing and in-line connectors. It is important to ensure that pipework is kept away from any potential heat source.

Any pipework needing repair has to be cut square to the tube using a guillotine type cutter, part number LRT 60-002.

Pipe burring or deformation and any length wise scoring or scratches must be avoided at all cost as this could lead to a potential leak.

CAUTION:

Pipes are color coded to match valve block. Once the pipe is cut this color match is lost. Care must be taken to identify the correct pipe to the correct valve block port.

AIR SUSPENSION OPERATION

The air suspension control module located behind the right hand rear seat receives vehicle attitude signals from four Hall effect height sensors connected to the individual suspension control arms.

From this information the control module will decide whether to raise or lower the vehicle body to maintain a level attitude.

Load changes mainly occur when the vehicle is stationary before or after a driving period.

Loads do not normally change whilst driving apart from fuel usage over a long distance.

Should the vehicle require raising, then the system utilizes the reserve air supply contained within the reservoir if below 25 mph (40 km/h).

However if the reservoir is unable to supply demand then in extreme cases the compressor will be activated, i.e. Vehicle Too Low.

In normal circumstances the compressor only operates at vehicle speeds above 25 mph (40 km/h). Below this speed threshold the residual pressure held in the reservoir is utilized.

If reservoir pressure is insufficient then the levelling action is inhibited until the vehicle speed of 25 mph (40 km/h) is acquired. At this point the air compressor will raise the vehicle and then the reservoir will be replenished once vehicle levelling has been completed.

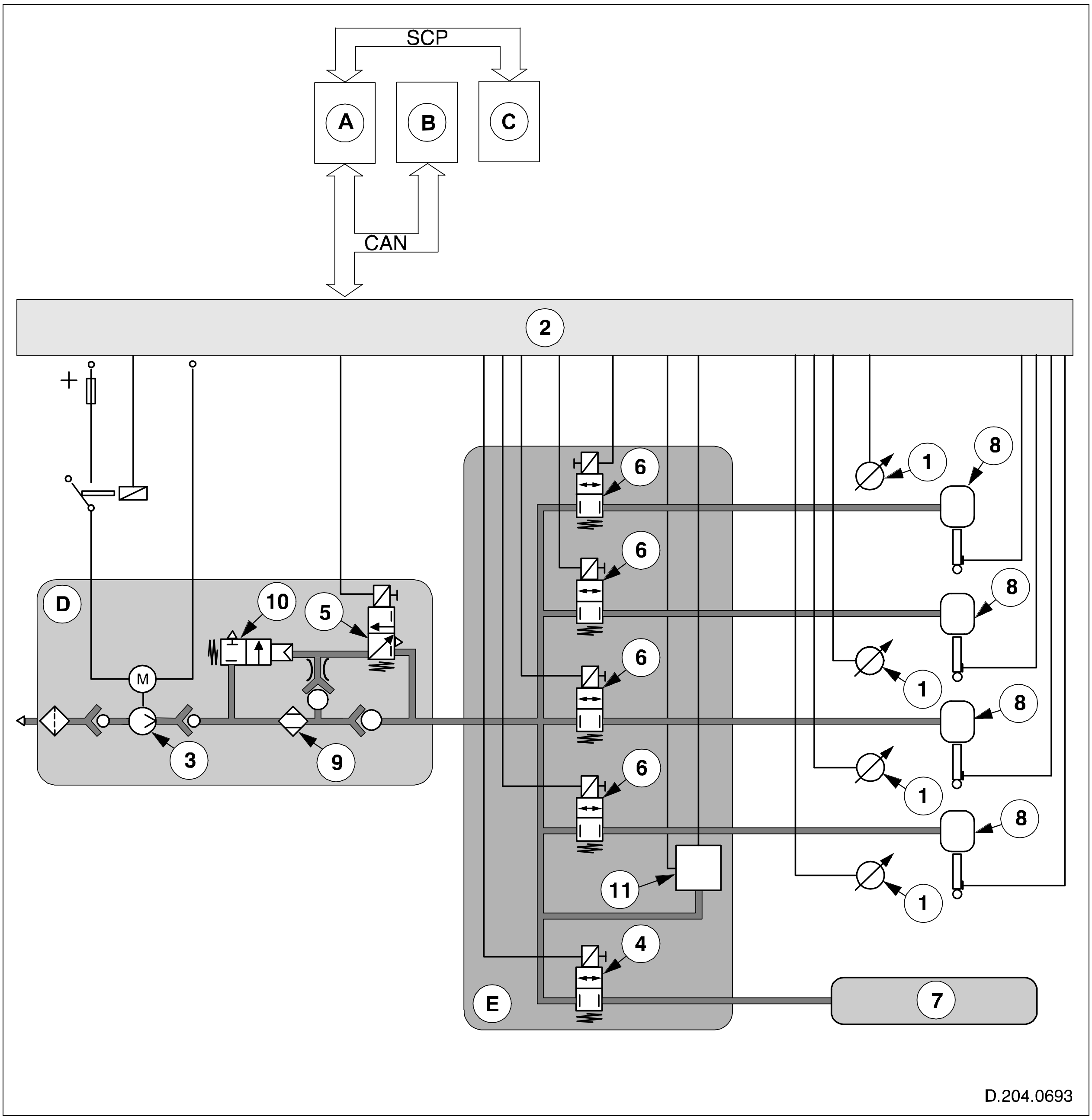


Fig. 124 System diagram

A. A. Instrument cluster — provides signals of system status
B. B. ABS modules — provides vehicle speed signal
C. C. REM — provides trailer tow signal, brake switch on/off status, and system switch power signals
D. D. Air compressor unit
E. E. Valve block
F. 1. Height sensors

G. 2. Air suspension module
H. 3. Air compressor motor
I. 4. Reservoir solenoid
J. 5. Vent solenoid
K. 6. Air spring solenoid valves
L. 7. Reservoir
M. 8. Air springs
N. 9. Air drier
O. 10. Relay valve
P. 11. Pressure sensor

Compressor Operation

Air in:

- Inlet pipe through filter
- Piston pump chamber
- Through drier
- To valve block

Valve block air venting:

- Air spring solenoid valve
- Compressor exhaust valve

Under normal circumstances front air springs operate as a pair whilst the rear units operate individually.

This is due to how the vehicle is loaded. The front loading remains fairly constant whilst at the rear loads can change quite dramatically with side to side loading being completely different.

When lifting a vehicle, the rear air springs are operated first, followed by the front units until a level vehicle is indicated.

This is because occupants do not like the front of the vehicle rising before the rear. This lifting and lowering method achieves a preferred condition.

Should in extreme cases where the vehicle height is very low, then the system will alternate between rear and front until level.

Caravan Towing

The connection of a caravan to a Jaguar trailer pack disables the speed lowering strategy but will allow vehicle levelling functionality.

Levelling

The system will not attempt to level whilst braking, accelerating and cornering. Signals are:

- Braking - Pressure Transducer and Switch
- Cornering - Lateral Accelerometer (Teves)
- Acceleration - Engine Torque Signal

OPERATIONAL MODES

The air suspension system has a number of different modes of operation; these are as follows:

- Transportation mode
- Sleep mode
- Preliminary mode
- Stance mode
- Drive mode
- Jacking mode
- Inclination mode
- Over GVW mode
- Rough road mode
- Vehicle too low mode

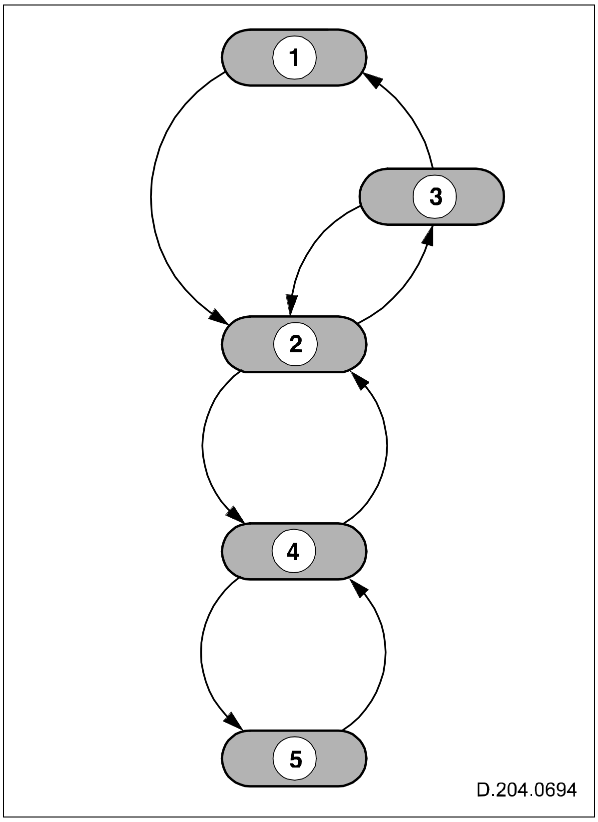


Fig. 125 Customer modes

1. Sleep mode
2. Preliminary mode
3. Post mode
4. Stance mode
5. Drive mode

Transportation Mode

In this mode the vehicle will be lowered to a preset transportation height (almost to bump stops) to allow secure tie-down of the vehicle body during transportation. Vehicles will require setting into customer ride level mode at PDI using WDS.

Transportation mode is ignition key initiated, engine running for normal ride height and key-off for transportation height. Whilst in transportation mode the Air Suspension Fault message will be illuminated and a DTC will be logged.

The vehicle should only be tied down using the road wheels. If the vehicle body is tied down whilst vehicle height is high followed by the suspension subsequently lowering (air in the air springs cooling), the tie-down straps will become loose.

No other vehicle towing concerns are associated with the air suspension system.

Vehicles should be flat bed transported and tied down using the road wheels not the body.

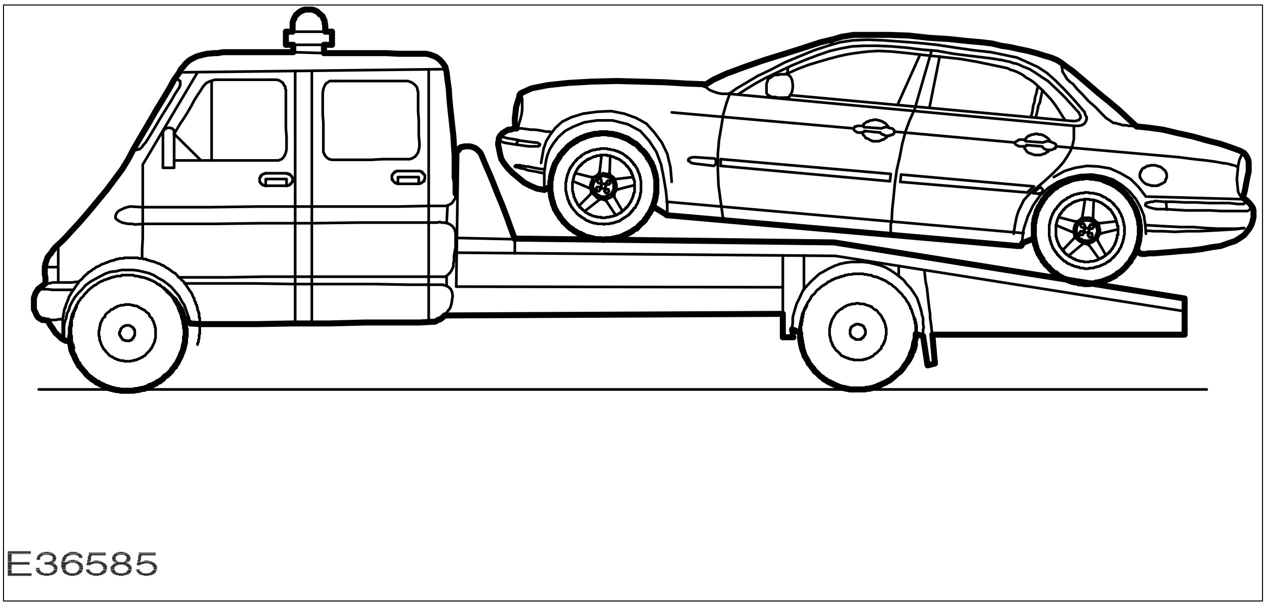


Fig. 126 Preferred Transport Method

OPERATIONAL MODES

Sleep Mode

Sleep mode is invoked approximately 30 minutes after key off and the last door or luggage compartment activity (SSP) has been detected.

The system will wake up periodically (24 hours) and monitor vehicle height and adjust if required. Adjustments will have been made because of temperature changes.

In sleep mode only lowering corrections are permitted which balances the vehicle height to the lowest corner.

Post Mode

Post mode is used because ride height will change with temperature. As the air cools towards ambient the vehicle will lower.

Under these circumstances the system will correct the ride height to compensate for the change.

Preliminary Mode

The preliminary mode uses quite a wide tolerance band for height control.

This mode is activated when luggage compartment, door or ignition activity is detected on the SCP bus.

Lift correction is via reservoir source only and lowering corrections are permitted.

The fast filter strategy is employed for vehicle levelling.

Stance Mode

The stance mode uses a tighter tolerance band for control of vehicle height than used in the preliminary mode.

This mode occurs when the is engine running and a zero road wheel speed is detected.

Lifting correction is from the reservoir supply. However if the vehicle is too low, compressor operation is permitted for corrective action.

Fast filter strategy is employed, and therefore the system reacts quickly to changes in vehicle height, i.e. luggage in or out.

Drive Mode

In drive mode the tolerance band is tighter than the previous two modes.

Slow filter application is used where the vehicle is moving above 0.62 mph (1.0 km/h) and the system increases the filter time to avoid unnecessary corrections to height changes.

NOTE:

Although the slow filter is applied whilst in drive mode, should a height correction be required, then the fast filter strategy is invoked.

Curve mode occurs when the system recognizes the vehicle is cornering and consequently does not compensate for body roll through the corner.

The same applies if a braking or acceleration signal is detected. The system will not attempt to correct the body attitude, i.e. not an active suspension system.

Trailer mode is activated when towing and inhibits the vehicle speed lowering functionality. However, this only occurs when a Jaguar tow bar kit is fitted.

Speed lowering is where the vehicle is automatically lowered to a predetermined amount at specific road speeds. This improves vehicle aerodynamics and in return enhances fuel consumption.

- 0-105 mph (0-170 km/h) (Standard height)
- >105 mph (170 km/h) (Standard height -15mm)

Reducing the speed to below 80 mph (130 km/h), the vehicle will automatically default to the standard ride height.

OPERATIONAL MODES

Jacking and Ramp Mode

The system recognizes customer vehicle jacking and vehicle ramp operation.

The result of detecting either condition is to inhibit any corrective action from height changes where no response is detected.

System inhibit is to prevent problems occurring with the vehicle lowering and a possibility of the jack or vehicle becoming stuck.

The system monitors height changes at the corner being jacked up.

If the system lowers the air suspension but no reduction in height is achieved, the system will time out at approximate 10 seconds.

If all four height sensor change by preset values, the system will recognize the vehicle is being lifted on a hoist and initializes the inhibit function.

Inhibit mode will continue to exist unless the vehicle height returns to normal or a wheel speed signal 2 mph (3 km/h) is detected.

The above events are triggered by either the height sensor arm change in position or a wheel speed message on the CAN bus.

Inclination Mode

This occurs where the vehicle is parked on a kerb and the system provides corrective action using an average of left and right ride height values thus avoiding vehicle lean when driven away and damaging the vehicle.

Vehicle Too Low

Should the warning message "VEHICLE TOO LOW" appear when stationary, do not attempt to drive the vehicle until the warning message has gone. The system may take several seconds to reach its standard ride height from cold.

OPERATION MODES

Table 5 Mode Summary

MODE	VEHICLE CONDITION	SENSOR CRITERIA	COMPRESSOR STATUS	NOTES
Sleep	Static or parked with no occupant or luggage compartment loading	SSP signal low, Post mode time out occurred and compressor duty cycle algorithm has finished	Un-powered	Only lowering allowed
Prelimi-nary	Static or parked with occupant entry or luggage compartment loading activity under way	SSP signal high or preliminary time out not occurred	Un-powered, lifting via reservoir	Vehicle levelled to standard height with preliminary tolerance gaps
Post	Static or parked with no occupantor luggage compartment loading	SSP signal low and preliminary time out occurred	Un-powered, lifting via reservoir	Vehicle levelled to standard height with post tolerance gaps
Stance	Static or parked	SSP signal high and engine speed signal greater than the minimum engine rpm for air suspension compressor to run	Un-powered, lifting via reservoir (compressor enabled if reservoir pressure below minimum pressure for raising and vehicle below compressor activation height)	Vehicle levelled to standard height with stance tolerance gaps
Drive	Driving	Vehicle speed limit greater than speed limit drive	Vehicle speed: <Speed limit for compressor activation 25 mph (40 km/h), un-powered lifting via reservoir. Compressor enabled if reservoir pressure below: Minimum pressure for raising and vehicle below compressor activation height. Vehicle speed: >Speed limit for compressor activation 25 mph (40 km/h). Compressor is used for lifting vehicle and filling the reservoir.	Vehicle levelled to standard height or speed lowering height with drive tolerance gaps

OPERATION VERSUS TOLERANCES

Table 6 Lifting Table

Mode	Tolerance	Vehicle Height <-40mm		Vehicle Height <-40 to -30mm		Vehicle Height <-30 to -10mm		Ride Height Filter
Reservoir Volume		Charged	Not Charged	Charged	Not Charged	Charged	Not Charged	
Pre	+15 to -30 mean figure	Reservoir Lift	No Lift	Reservoir Lift	No Lift	No Lift	No Lift	Fast
Stance	±9mm	Reservoir Lift	Compressor Lift	Reservoir Lift	No Lift	Reservoir Lift	No Lift	Fast
Drive: <compressor activation speed	±9mm	Reservoir Lift	Compressor Lift	Reservoir Lift	No Lift	Reservoir Lift	No Lift	Slow
Drive: >compressor activation speed	±9mm	Compressor Lift	Compressor Lift	Compressor Lift	Compressor Lift	Compressor Lift	Compressor Lift	Slow
Post	±6mm	Reservoir Lift	No Lift	Reservoir Lift	No Lift	Reservoir Lift	No Lift	Fast

Key Parameters

- Tolerances: Pre, Stance, Drive and Post
- Compressor activation height = -40mm
- Compressor activation speed = 25 mph (40 km/h)
- Minimum engine speed for compressor = 400 rpm

The above and any other figure quoted within this workbook can be subject to change

ECATS

This section will cover the changes to the CATS system, but will also cover any relevant care points as required.

ECATS is the new name for the updated CATS system.

The 'E' in ECATS means Enhanced.

Although the system is visibly not that much different, a number of changes have occurred in the background for enhanced ride handling and customer comfort during braking and cornering events.

Accelerometers

Front vertical accelerometer location is behind RHF wheel arch liner, towards the rear.

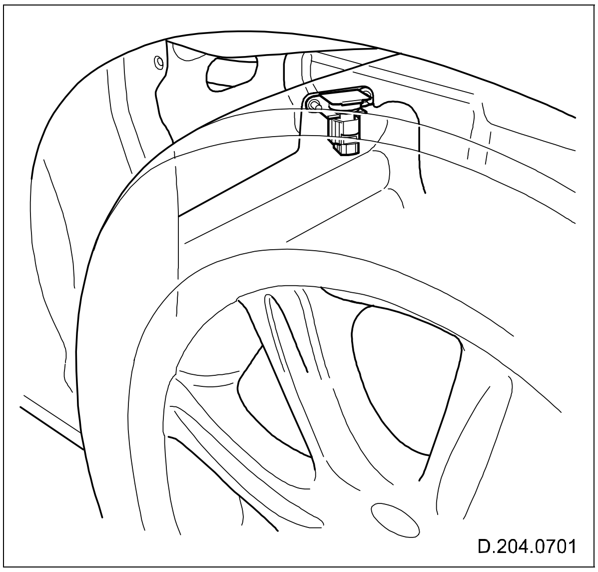


Fig. 127 Front accelerometer

Rear vertical accelerometer position in the rear luggage compartment to the right of the telematic stack.

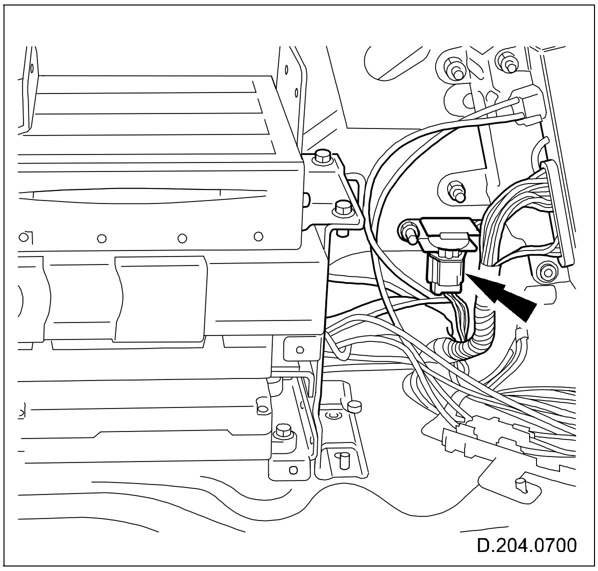


Fig. 128 Rear accelerometer

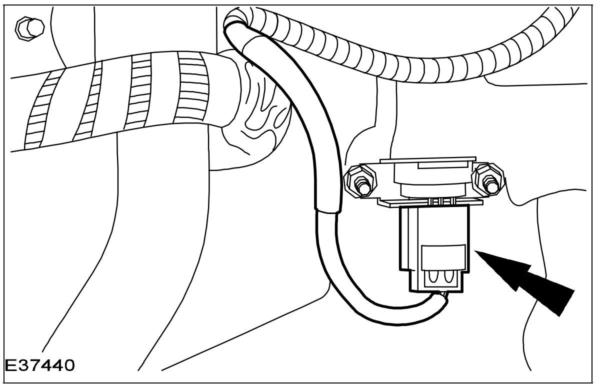


Fig. 129 Vertical Accelerometer

The sensor location provides the CM with a good level of detection to changes in vehicle attitude.

Lateral acceleration data is provided by the Teves Mk25 control module over the CAN bus network.

Damper Switching

Some of the main changes to the ECATS system is governed by the adaptive damping software and its control over the damper solenoid switching.

The damper operation and design are carry over, each unit having a 400Hz PWM, two stage (open / closed) 5.4 ohm solenoid.

Control over damper solenoid switching can be one of the following:

- All Firm
- All Soft
- Front Soft / Rear Firm (New)
- Front Firm / Rear Soft (New)

ECATS Operation

The adaptive damping ride control is part of the Air Suspension Control Module (ASCM) which is located behind the rear seat back.

ASCM operating voltage is between 7 - 20 volts and has reverse voltage protection.

The vertical accelerometer signal input to the ADCM is from two Texas Instruments accelerometers, in the form of a variable voltage between 0.25v (high 'g') - 4.75v (low 'g').

The vertical accelerometers receive a 5v supply from the ASCM and the voltage output is relative to the vehicle 'g' force.

Within each accelerometer an internal contact closes under pressure by the vehicles inertia forces, the pressure acting on the contacts increases the electrical capacitance in the circuit and subsequently reduces voltage output to the ADCM.

The changing voltage to the ADCM from the accelerometers decides the strategy of the damper switching, which now has enhanced functionality.

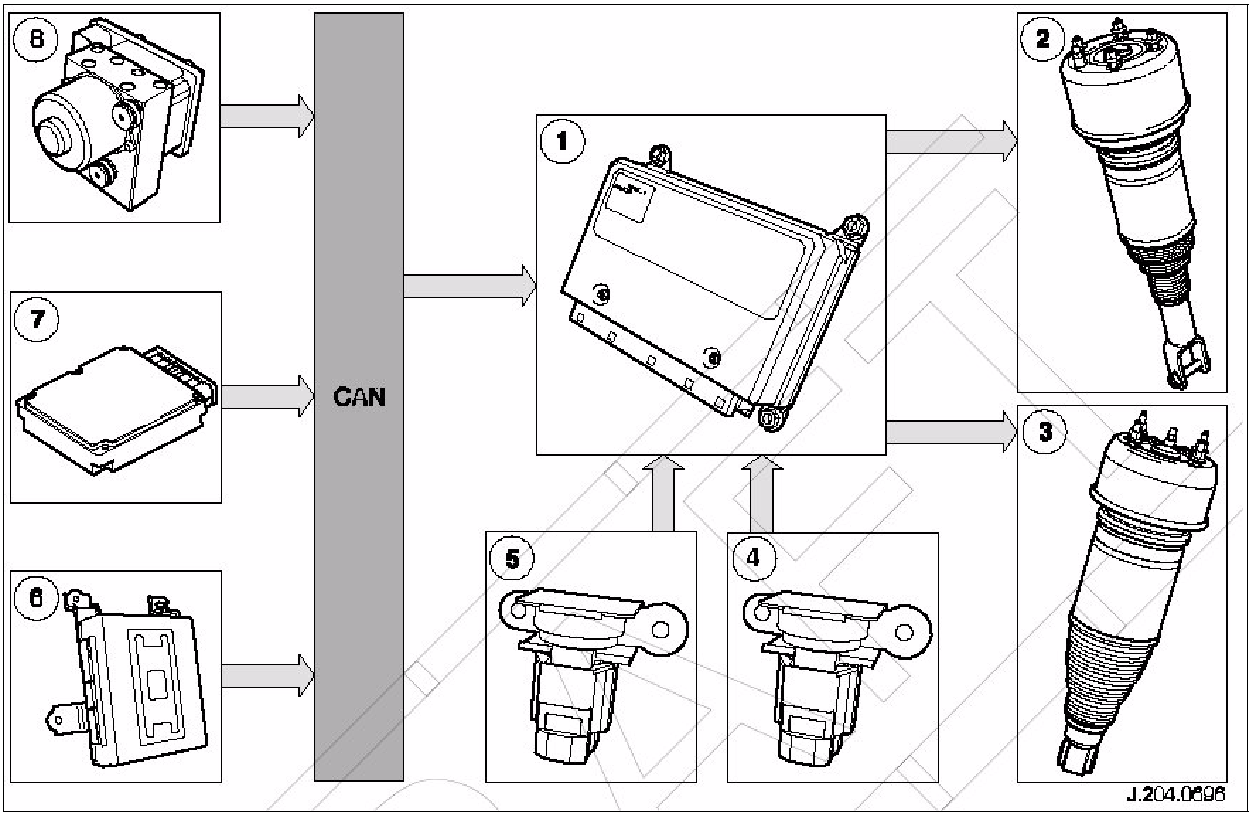


Fig. 130 Control system operation

1. Air suspension module
2. Front damper
3. Rear damper
4. Front vertical accelerometer
5. Rear vertical acceleroemeter
6. Climate control module
7. Engine control module
8. ABS module

ADAPTIVE DAMPING CONTROL

General Functionality

At system start-up the dampers are set to firm. This is also the default condition should an electrical fault occur within the system.

Below a predefined lower threshold speed, the setting will be switched to firm. However, above this pre-set threshold the dampers are switched to soft for vehicle ride comfort.

Above the pre-determined upper threshold speed the system is switched back to firm.

This provides vehicle stability for higher road speeds and reduces the wallow effect that a comfort setting would have at these increased road speeds.

Longitudinal

The front and rear switching is to assist in resisting anti-dive and anti-squat characteristics as the vehicle accelerates and subsequently brakes.

Inputs required to provoke this switching action are: brake switch, brake pressure (Longitudinal decceleration) and engine torque rate (Longitudinal acceleration) via the CAN bus with the appropriate vehicle speed message.

Long Wave

This is a carry over function and follows a situation where the vehicle is on a long fast straight section of road and there are undulations in the road surface.

This function is activated when both vertical accelerometers detect a balanced sinusoidal input, at which time the dampers will be switched to firm to counteract vertical body oscillations.

ECATS Switching

This is the new part of the ECATS system and involves a new strategy for controlling the damper switching between front dampers or rear dampers as an axle set, as required by the vehicle condition.

Front - Rear

The Front-Rear switching improves the behavior of the car during cornering.

At low speeds the rear dampers are switched to firm slightly ahead of the front dampers. This reduces transient understeer.

At high speeds, the dampers are switched to firm in reverse order to increase transient understeer.

SUMMARY CARE POINTS

Care and Observation

The new XJ range 2003 MY damper retaining nut finish has changed from the yellow cromat finish to a black finish.

This change identifies an electrical connector retention enhancement to the connector retaining groove recess machined into the securing nut.

The above design condition is the same as fitted to S-TYPE 2003 MY.

CAUTION:

Do not interchange fixings as the two designs are not compatible with each other.

For identification, the damper electrical connector color has also changed from grey to black indicating a redesigned connector with an improved connector lead-in.

The new connector has been introduced to prevent damper terminal pin damage.

CAUTION:

When working with the earlier connector design or the new black connector, care must be taken when connecting to the damper to avoid pin damage.

When working with the accelerometers, care must be taken when handling the units as shock will damage the internal micro-mechanical components.

CAUTION:

Orientation of the sensors is very important, just 1-2° out will have adverse effects.

DRIVELINE

Driveshaft

A two piece driveshaft manufactured of lightweight steel is used and comes in one derivative to accommodate the V8(s) powertrain applications:

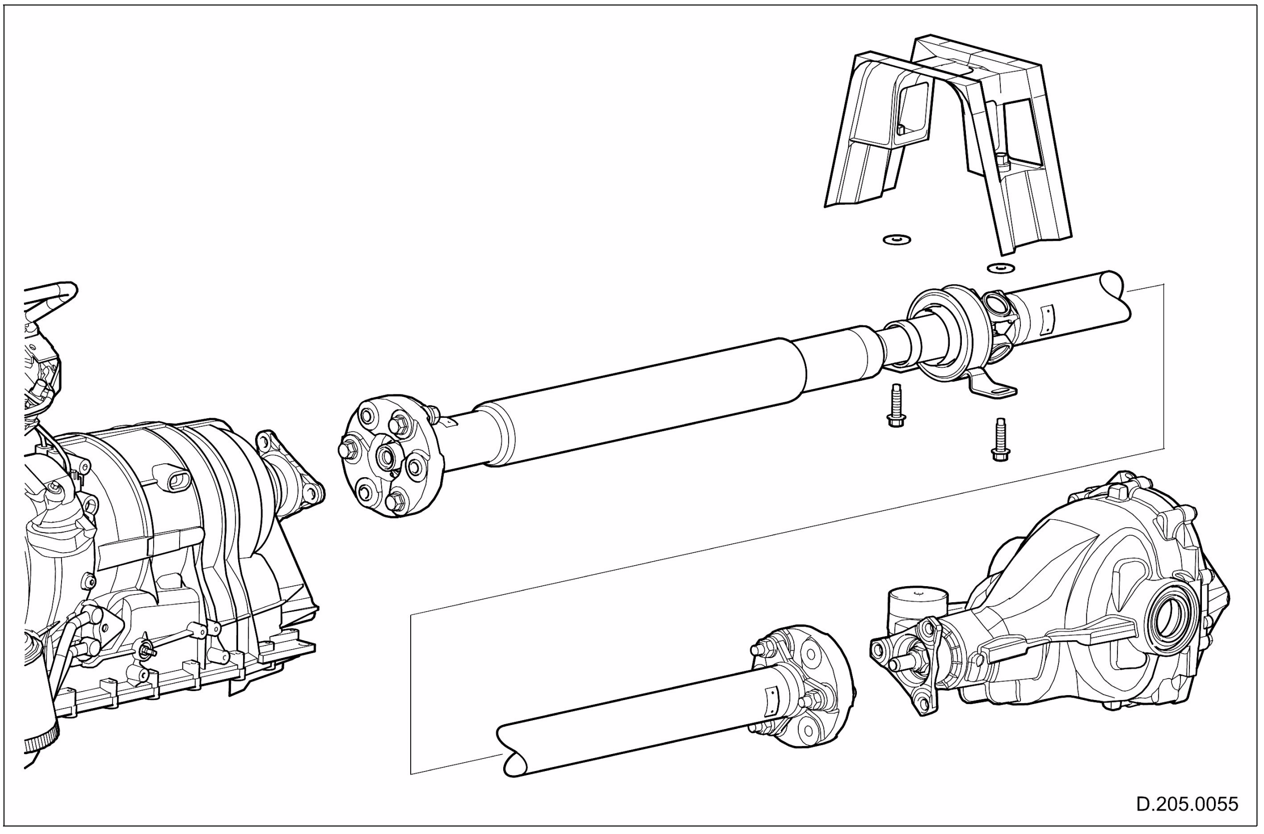


Fig. 131

The driveshaft is aligned with the vehicle center line and is mounted in a rubber center bearing.

NOTE:

A special tool and procedure is required to align the driveshaft. Refer to JTIS for more information.

Differential

The differential is mounted at three points as on the S-Type (2003 MY). This mounting arrangement plus the subframe to vehicle body mounting arrangement provides the rear driveline with double isolation from the vehicle's body.

The differential is constructed of a cast iron main casing which is a new lightweight design with an aluminum rear cover.

The differential ratio is 2.87:1:

Axle shafts

There are two different types of axle shafts:

- V8 (N/A) tubular axle shafts with high torque capacity constant velocity joints
- V8 (S/C) engines with solid axle shafts with high torque capacity constant velocity joints

The axle shafts are different lengths and are therefore handed left and right. Inboard sliding constant velocity joint provide the axle shaft plunge capacity. Outboards are fixed.

The axle shafts:

- are splined interference fit into the wheel hubs
- and a spline fit into the differential where they are retained by a spring circlip.

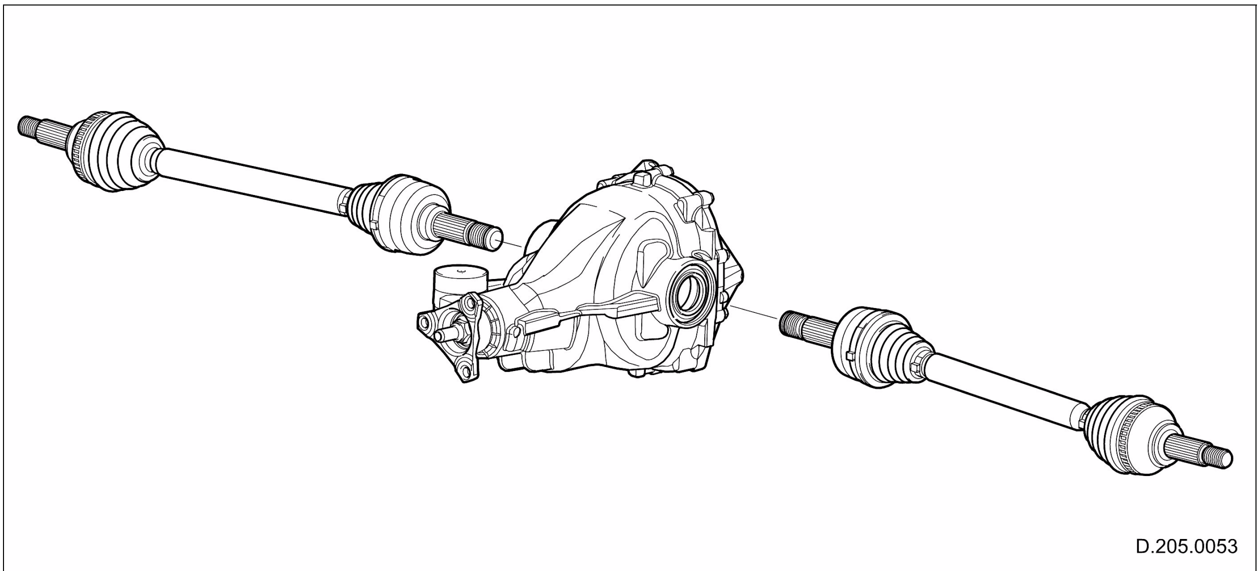


Fig. 132

STEERING

Column

The steering column incorporates a single motor for both reach and rake adjustment.

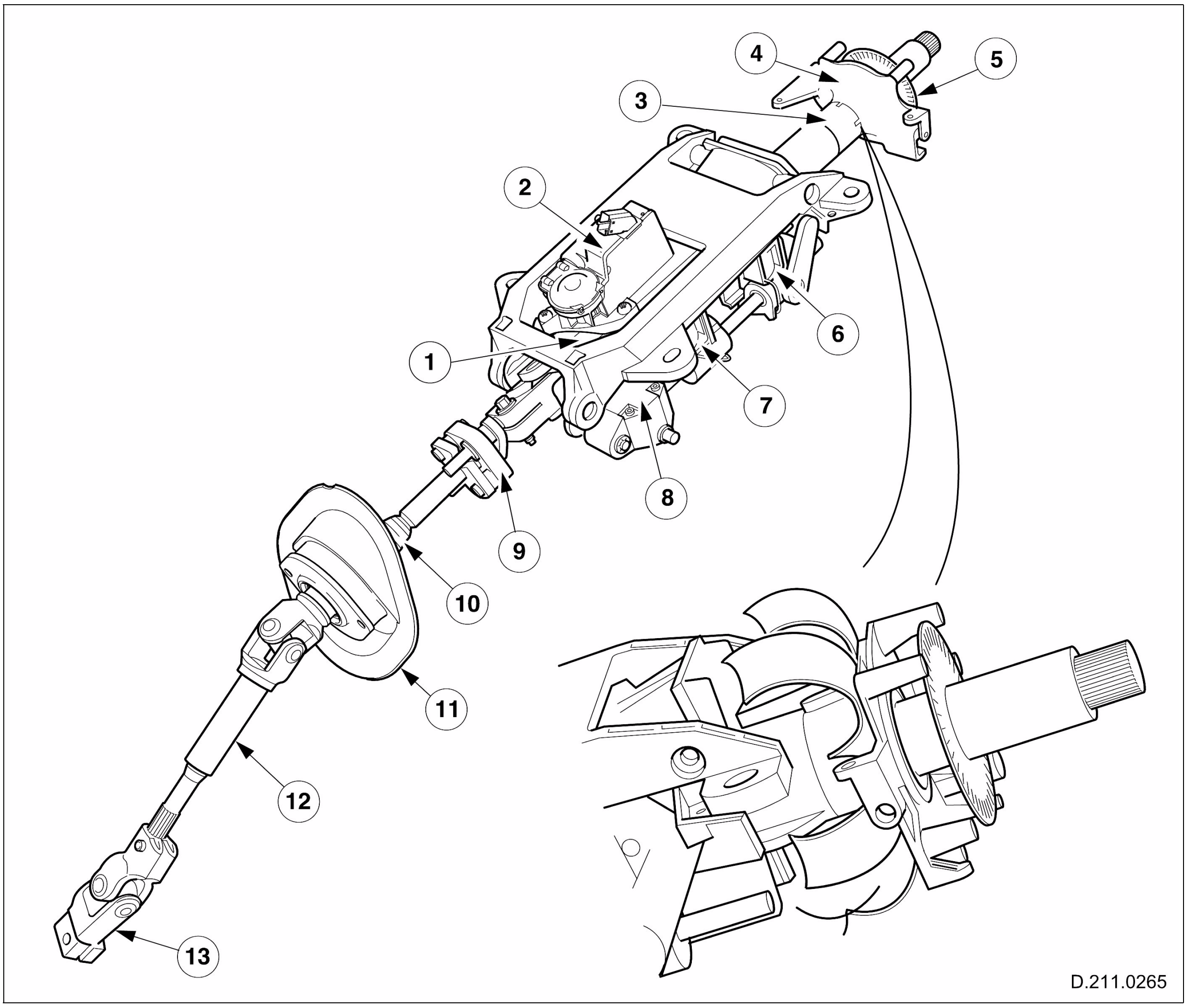


Fig. 133

1. Upper Column
2. Column lock (not available on NAS XJ models)
3. Peeling tube crash mechanism
4. Crash adaptor
5. Sensor ring — DSC
6. Rake adjustment housing, lever and solenoid
7. Reach adjustment housing and solenoid
8. Adjustment motor
9. NVH isolator
10. Lower column
11. Body seal and bearing

12. Collapsible mechanism
13. Splined lower universal joint

The adjustment values are:

- 50mm of reach adjustment
- 5.5° of rake adjustment provided

The column joystick control, spindle motor and feedback pot are hard wired and controlled by the instrument cluster as per the current S-TYPE.

The adjustments are calibrated on track and will require calibration in service using WDS.

Replacement Parts

If the steering column, spindle motor or feedback pot are changed as part of a repair, a WDS calibration for column range will be required.

STEERING

Setting Procedure

- Connect lower column to rack pinion shaft
- Tighten pinion fixing to recommended torque
- Set steering wheel to straight ahead position
- Fully extend the swing link downwards
- Mark the splines relative to the lower UJ
- Move the swing link up towards its nominal position
- Set the mark placed on the splines between 6mm - 8mm from the top of the UJ yoke
- The swing link is now set to the nominal position

During manufacture a setting tool is used to ensure correct positioning of the swing link assembly.

However, the recommended procedure stated above is the method to be used for service replacement components.

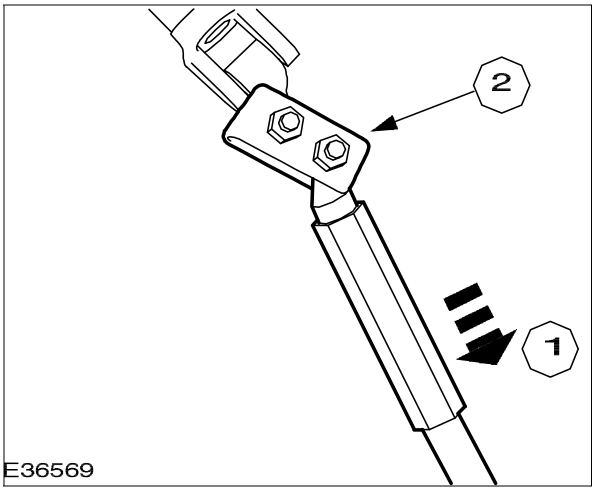


Fig. 134 Swing Link Assembly

Care Points

Renew steering wheel patch lock bolt each time displaced.

Remove the steering column if changing the steering column rake or reach solenoids.

This is to prevent the very small screws from falling in to the steering column tubing and jamming the mechanism.

Tighten the steering column frame to body in the correct order.

This is due to the way the frame is clamped and machined and the inherent twist that occurs during the assembly build process.

When removing the steering column it is best to lower and extend the column to its furthest points wherever possible to aid the removal process.

Ensure column clamp pinch bolt is fitted from the correct side, i.e. none threaded side when refitting. This will ensure the two parts are fully locked together and not just retained.

PAS SYSTEM

The power assisted steering system used is carry over from S-TYPE 2003 MY.

It features a ZF speed sensitive variable ratio rack assembly known as Servotronic II and includes a PCF valve.

Positive Centre Feel valves use a ball and ramp with a spring bellow assembly to provided an improved steering centre feel.

Rack Bushes

Rack bushes are carry over from S-TYPE 2003 MY, and being a single rate bush requires no particular orientation when installing.

Refer to JTIS for the correct service tools to use when replacing worn parts.

Pinion

The pinion is a splined shaft in-line with current XJ, XK and S-TYPE 2003 MY range.

Up to $\pm 3^\circ$ of steering wheel misalignment may be taken up using the steering track rods.

Any steering wheel alignment more than $\pm 3^\circ$ should be initially adjusted by removing and refitting the steering wheel.

Oil Cooler

Oil cooling is via a stand alone oil cooler mounted at the front of the vehicle as part of the cooling pack assembly.

Oil Specification

The oil used for the Servotronic II PAS system is Dexron 3.

Reservoir shape is similar to the S-TYPE 2003 MY which contains a 10 micron filter to remove any contaminants within the system.

PAS SYSTEM

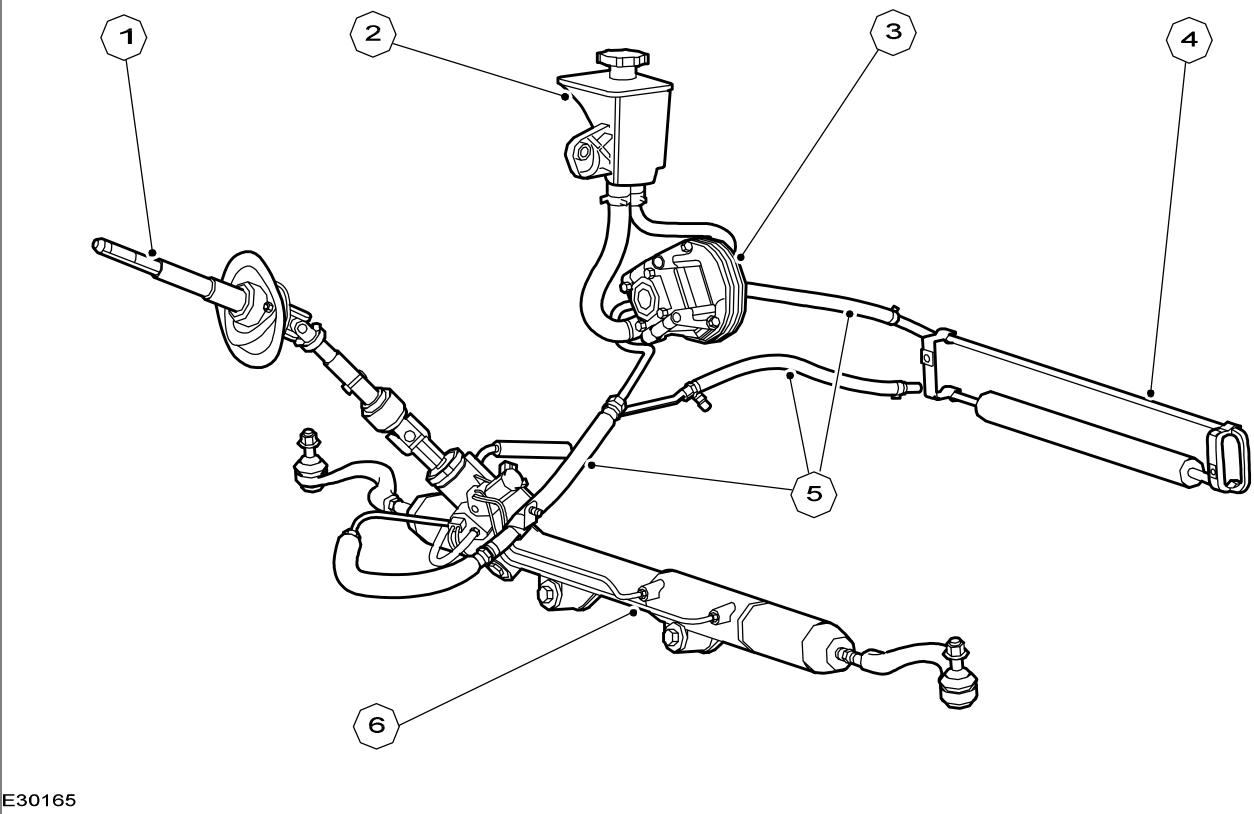


Fig. 135 PAS Components

1. Lower column
2. Reservoir
3. ZF PAS pump assembly
4. Oil cooler
5. PAS hoses
6. ZF variable ratio Servotronic II rack and pinion assembly

Pressure Switch

Because engine management reaction time has improved, idle speed anti-dip control can be achieved without the need for an in-line pressure switch.

The pressure switch has been deleted from the high pressure hose and the functionality becomes part of the ECM strategy.

Steering Control Module

The steering control module for the variable orifice control valve is located in the instrument cluster.

BRAKE SYSTEM

Front Brakes

Front discs used for The new XJ range 2003 MY N/A vehicles are 320mm x 30mm ventilated units which are the same components used for the V8 N/A 2003 MY S-TYPE.

The front caliper is an original S-TYPE component being of a sliding aluminium design from TRW with a 45mm + 38mm piston configuration.

This configuration design of the caliper pistons provide an even pad wear characteristic throughout the service life of the brake pads.

For the high performance supercharged vehicles, Brembo braking components are specified because of their superior braking performance.

The Brembo brake company are world renowned for their involvement in high performance F1 racing.

Disc's used are ventilated, but not cross drilled to maintain a good visual appearance throughout their service life and are 365mm x 32mm for excellent heat dissipation.

The front caliper for the supercharged vehicle is another Brembo component and consists of an aluminium fixed four piston design with a 44mm + 38mm piston configuration.

Table 7 Service Change Data

Front	New	Replace
N/A	320 x 30mm	320 x 28.5mm
S/C	365 x 32mm	365 x 30mm
Pads	12mm	3mm
Rear	New	Replace
N/A	288 x 20mm	288 x 18mm
S/C	330 x 15mm	330 x 13mm
Pads	11mm	3mm

BRAKE SYSTEM

Rear Brakes

The rear brake discs are 288mm x 20mm ventilated units and are an original S-TYPE component which have been carried over for both the S-TYPE 2003 MY and The new XJ range 2004 MY N/A vehicles.

The new XJ range 2004 MY N/A rear caliper is an aluminium unit in-lieu of the cast iron component that is used on the 2003 MY S-TYPE N/A vehicles and houses the park brake apply mechanism consisting of a ball and ramp arrangement.

The park brake apply lever ramp contacts three ball bearings which in turn makes contact with a second ramp attached to the park brake piston. A helix guide pin is used to ensure efficient and smooth piston operation.

Supercharged variants use Brembo components with the rear brake discs are solid 330mm x 15mm and operated from an aluminium fixed 30mm + 28mm quad piston caliper configuration design.

The supercharged vehicles have separate park brake calipers for park brake operation via the electric park brake system.

Park Brake Service

To wind back the park brake piston on the S/C park brake caliper use Snap On universal piston retractor tool.

For the N/A park brake calipers use the X-TYPE service tool 204-080 for piston retraction.

Braided Hoses

Goodridge steel braided hoses which were introduced on the 2003 MY S-TYPE are utilized on The new XJ range 2004 MY.

The braided hose design has inherent features which naturally benefit the braking system.

Disc Grinding

Brake disc resurfacing or grinding is not a recommended practice by Jaguar Cars Ltd.

BRAKE SYSTEMS

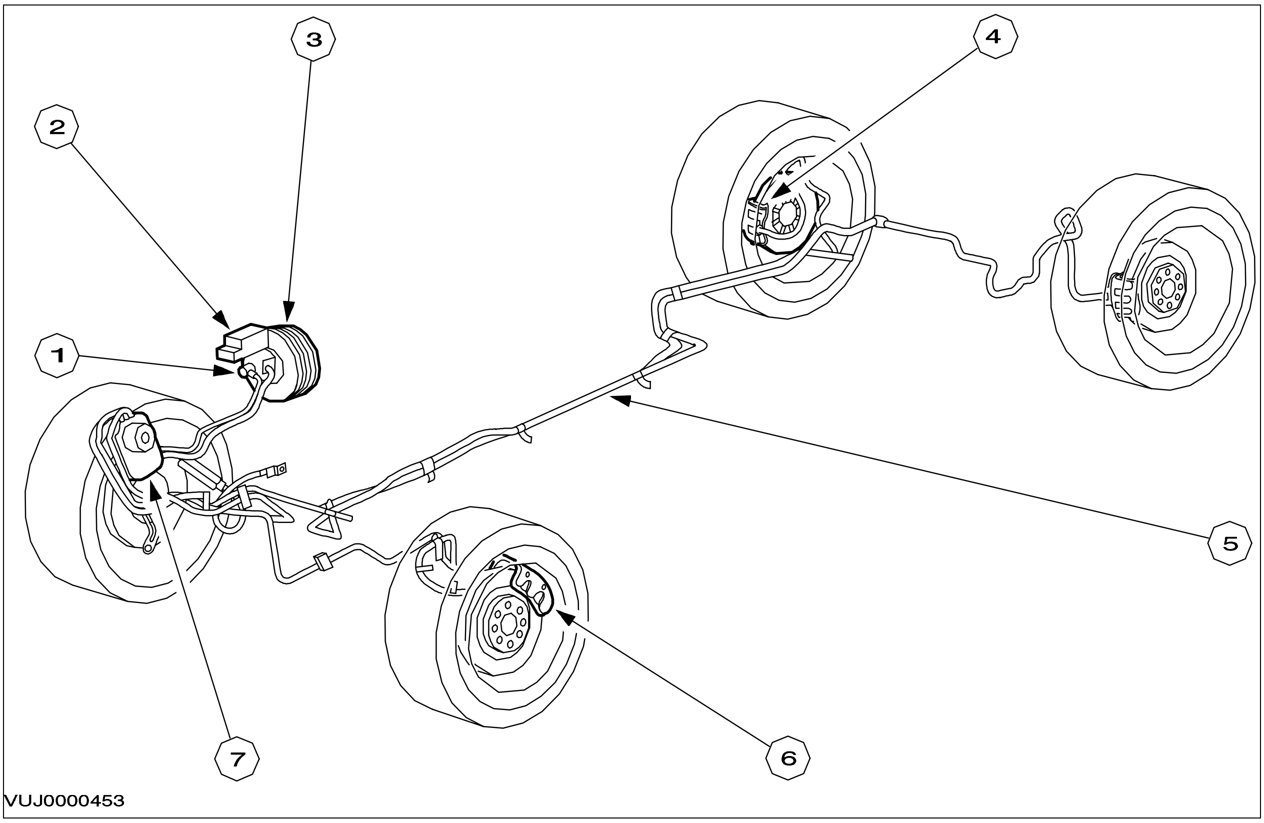


Fig. 136 Hydraulic System Layout

1. Master Cylinder
2. Reservoir
3. Brake Booster
4. Rear Caliper
5. Brake Pipework
6. Front Caliper
7. Teves Mk25 Hydraulic Modulator

BRAKE SYSTEM

This section is a review of the differences that occurred with changing from the Teves Mk20 to the Teves Mk25 ABS system.

These updates were also carried over to the 2003 MY S-TYPE.

System Components

The main system components are as follows:

- Teves Mk25 Modulator and CM
- 4 Active Wheel Speed Sensors
- High Resolution Steering Angle Sensor
- Yaw Rate Sensor
- Lateral Accelerometer
- Teves Active Vacuum Booster

The new XJ range 2003 MY has the same attributes as the 2003 MY S-TYPE in that all vehicles have the following systems fitted as standard equipment:

- Anti-Lock Braking (ABS)
- Traction Control System (TCS)
- Dynamic Stability Control (DSC)
- Panic Brake Assist (PBA)

Many of these system applications work exactly as they did with the previous vehicle, hence the reason for only covering the system changes.

Component Locations

The control module for ABS, TC, DSC and PBA system is located in the right hand front inner wing area.

A combined yaw rate sensor and lateral accelerometer (DSC use) is fitted behind the J′ gate on the transmission tunnel.

Four magneto resistive (MR) wheel speed sensors are used, i.e. one per wheel hub.

Steering wheel angle sensor (SWAS) (DSC use) is located at the top of the steering column.

Background Information

The vehicle has a diagonal split braking circuit which during ABS operation the system is controlled on the select low principle.

However, during TCS or DSC operation the brake calipers are controlled independently of each other.

There is no system requirement for a PCR valve or EBD functionality as the braking balance is adequate and does not require any braking system pressure intervention.

A number of enhancements have taken place with the introduction of the Teves Mk25 braking system and these will be covered in separate topics.

Component Enhancements

Other areas and components that have benefited from upgraded units are the all-new active wheel speed sensors.

The rear wheel speed sensors are modified and have improved sealing to guard against moisture ingress.

Front wheel speed sensors are new and use a magnetic tone ring built into the front hub bearing, similar to X-TYPE.

The yaw rate sensor and lateral accelerometer are now a combined assembly positioned on the transmission tunnel.

TEVES MK25

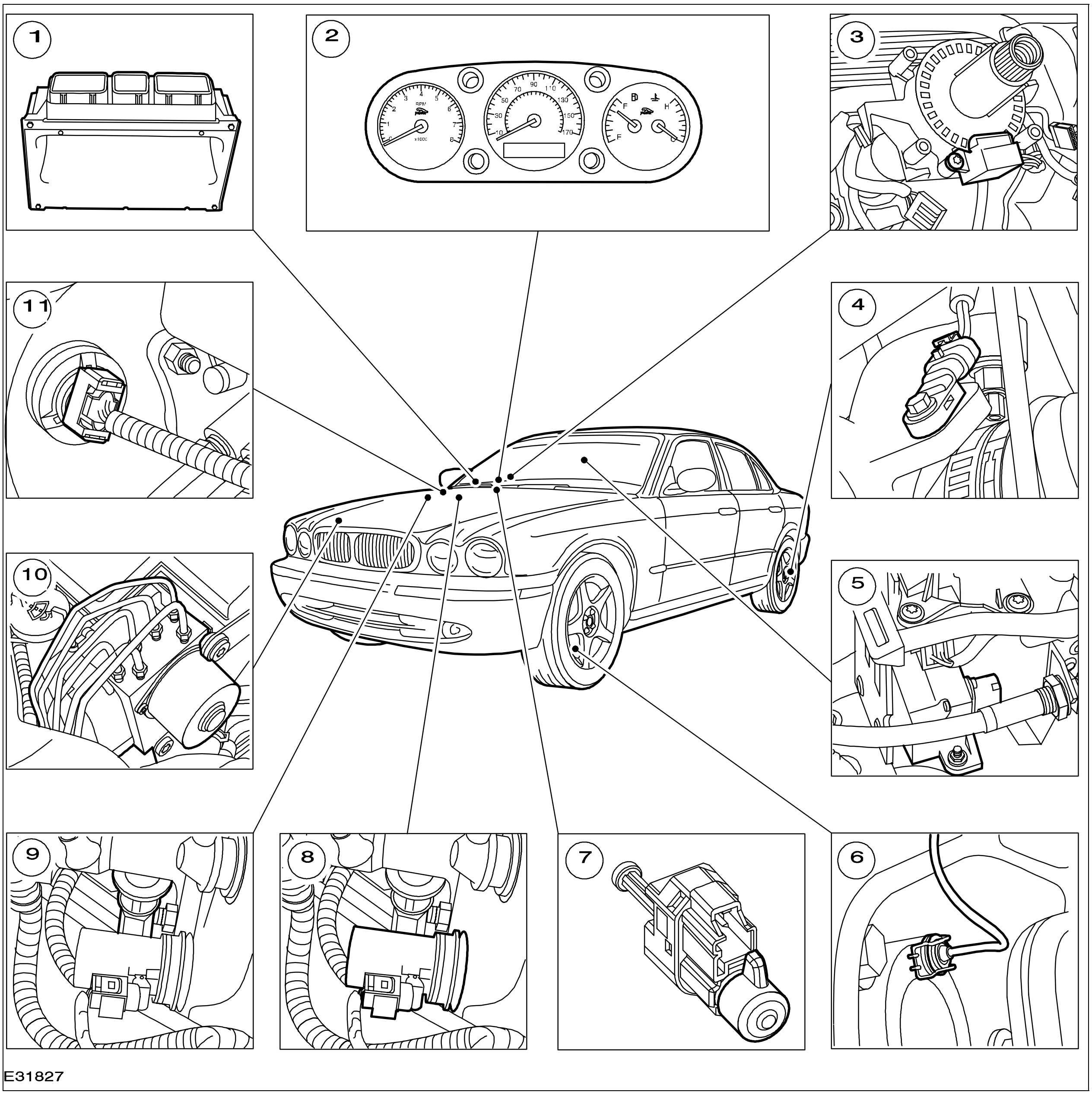


Fig. 137 Teves Mk25 Components

1. ECM
2. Instrument Cluster
3. Steering Wheel Angle Sensor
4. Wheel Speed Sensor
5. Yaw Rate Sensor
6. Wheel Speed Sensor
7. Brake Switch
8. Brake Pressure Transducer and Travel Position Sensor
9. Teves Mk25 Hydraulic Modulator

10. Active Booster Solenoid Connector

ABS

Changes to the ABS system include:

- Improved stopping distances on split traction surfaces
- Improved NVH when the ABS system is operational

Improved stopping distance on split traction surfaces is achieved by closer control over the hydraulic solenoids during a wheel locking phase, the action occurs as follows:

- Limit pressure to both wheels to reduce the possibility of brake pull
- Apply a higher pressure to the side with the highest traction surface
- Increase the pressure progressively to the side with the lower traction surface

Improved NVH is obtained by closer control over the hydraulic solenoids using the latest control system technology cycling, i.e.

- Maximum utilization of braking force with the minimum amount of hydraulic valve activity

TCS

The traction control system (TCS) operates largely the same as the previous Teves system, however again there are a number of modification to take into account.

- Improved T-junction start performance
- Improved mid-corner tip-in control
- Enhanced split surface traction performance
- New Hill Start feature
- New Launch Control Feature

T-junction Start Performance

This is achieved by improved braking control of the inside rear road when pulling out of a T-junction with utilisation of the SWAS as an additional input.

- When pulling out of a junction under hard acceleration the vehicle weight transfers causing the inside rear wheel to spin and lose traction. This is overcome by braking the spinning wheel which has the effect of re-directing the torque to the other wheel
- Better control of the braked wheel via control of the hydraulic solenoid valve (earlier threshold) ensures more traction is deposited on the tarmac, thus improving road wheel traction in this type of driving situation

Mid Corner Tip-In

Mid corner tip-in control is control over positive throttle movements, i.e. acceleration.

Imagine cornering at a steady throttle angle, then suddenly increasing the throttle position angle. This creates an increase in engine torque which if over zealous will provoke a wheel spin condition.

The Teves Mk25 is enhanced in its calculation of wheel spin (earlier threshold) relative to throttle movement and reacts much faster than the previous system could allow.

Enhanced Split Traction

Enhanced split surface traction start performance is a refinement to the braking system by closer electronic control and operation of the hydraulic solenoid valves.

HILL START

This is a new feature, mainly for manual transmission variants (S-TYPE 2003 MY).

The feature assists the driver by reducing the amount of engine torque reduction.

Imagine a vehicle with a caravan at the base of a steep hill and the driver lets the clutch out and the engine dips and attempts to stall.

The reduced engine torque reduction request enables the engine to recover that much easier and thus prevents the engine from stalling in the first instance.

Launch Control

The launch control feature maximizes the standing start performance.

This is achieved by satisfying entry conditions which include:

- Vref <18 mph (30 km/h)
- Lateral Acceleration <1.2 m/s^2
- Vehicle Acceleration >0.3g

The launch control minimizes the brake intervention and optimizes the engine torque in order to provide the vehicle with optimum acceleration.

During launch control activation the customer may experience some tire noise.

DSC

DSC is a standard fitment on all The new XJ range 2003 MY vehicles and operates at speeds above 9-12 mph (15-20 km/h).

The system uses an active brake vacuum booster for initial pressure pre-charge to approximately 20 bar when required.

Prior to using active brake booster operation, engine torque reduction is requested first as this may be sufficient to stabilize the vehicle.

DSC operates in both the non-braked mode and also when brake pedal is being applied by the driver.

Driver intervention is detected by an internal switch located within the booster control valve area and informs the control module to react to a change in circumstances.

WARNING:

It is important to set the brake switch correctly. If the switch is maladjusted then the internal release micro-switch will be affected and results in the cancelling of DSC either intermittently or permanently. A procedure to calibrate the system has been implemented and should be used when the brake switch, booster unit or pedal box is replaced. Use the calibration procedure if DTC C1286 is detected; before changing the booster unit.

Active Booster

The reason for using active boost for the initial pre-charge and not the built-in hydraulic pump is due to a faster caliper apply time is possible.

Using brake booster vacuum for the initial control of the brake calipers is far quicker than the operation and run-up time of the electric motor that drives the hydraulic pump.

TEVES MK25

SWAS

The steering wheel angle sensor (SWAS) has received improvements and the Teves Mk25 system now recognizes both understeer and oversteer conditions.

A sportier tune has been provided via the steering wheel input.

The SWAS has been upgraded from a 4.5° low resolution unit to a 1.5° high resolution unit.

Operation is in the same manner as before using an optical receiver and LED generating two square wave signals 90° apart to detect the direction of rotation and angle.

Being a completely different unit, it is therefore not possible to interchange with any earlier components.

The SWAS is located at the top of the steering column and has different cable length and 5mm mounting points in-lieu of 4mm to prevent incompatibility with any previous component.

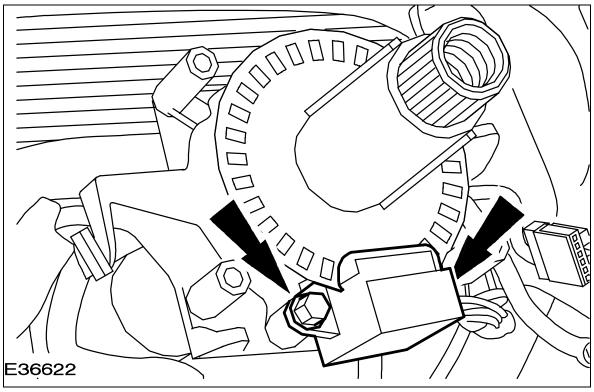


Fig. 138 SWAS Assembly

Diagnostics

Most of the on-board diagnostics are dynamic (i.e. run when the vehicle is moving).

Therefore, clearing and reading fault codes whilst the vehicle is stationary is not always sufficient.

It is recommended to drive the vehicle at a speed >12 mph (20 km/h) to enable and run full diagnostics.

Warranty Returns

The warranty returns show that a large percentage of ABS or DSC components are being returned with no fault found.

- 77% Wheel speed sensors
- 43% Modulators

Suggested fault tracing routine:

- Record DTC
- Change wheel speed sensor side to side

Record the fault code in case a faulty part requires replacing and details need providing.

Change over wheel speed sensor side to side, if fault moves with the sensor move then replace sensor.

BRAKE SYSTEM

In this section a review of the foundation braking components and the Teves Mk25 anti-lock system will be covered.

These systems have been previously seen in the 2003 MY S-TYPE training material so will only be touched upon in this document.

Vacuum Booster

Teves supplied unit consisting of a dual 8"+8" booster assembly which delivers a boost ratio of 7.5:1.

The booster has an internal solenoid fitted for active boost operation with the 12v electrical power being supplied via the connector mounted on the left hand face of the booster casing.

This connector also connects to an internal micro-switch for the detection of driver or system applied braking.

A booster travel position sensor is mounted on the right hand face of the booster casing.

This sensor determines the position of the booster diaphragm and also the speed at which the diaphragm moves, i.e. distance versus time.

The sensor consists of a push-rod mounted on the booster diaphragm which slides in and out of a coil type potentiometer and is part of a system to enhance the ABS system that is known as PBA.

The travel sensor replaces one of the pressure transducers previously employed on the Teves Mk20 system by acting as part of the fail safe strategy.

Master Cylinder

Teves supply the short stroke compact master cylinder with an integrally mounted brake fluid reservoir.

The brake fluid reservoir has fluid level markings and a brake fluid level sensor which is hardwired to the Teves Mk25 control module.

Specified brake fluid is Super Dot 4.

No default strategy exists if the brake fluid level signal indicates low brake fluid.

However, the signal is processed by the Teves Mk25 control module and passed to the instrument cluster for the low brake fluid warning lamp activation.

Connected externally to the body of the master cylinder is a pressure transducer which provides the Teves Mk25 control module with information regarding brake pressure within the brake circuit.

Redundancy and cross checking is carried out between the travel sensor and pressure transducer.

Brake pressure information is used by the Teves Mk25 control module as an indication of the pressure available for system operation and is also used to cancel the cruise control function if active during a non braked DSC operation.

Pressure information is also used by the air suspension system to indicate heavy braking and used as a control input for system operation.

PANIC BRAKE ASSIST

This system has been introduced for a variety of reasons, but mainly because the driver does not always apply the brake pedal with sufficient force to activate the ABS system, especially at times where it would be a desirable function.

The following options are offered as example reasons:

- Driver consciously does not press the brake pedal with sufficient force for fear of locking the road wheels
- Some drivers because of their slight build do not exert enough brake pedal force to enter into the ABS mode even through the seat is in a forward position

The Teves PBA system monitors the action of the drivers input, i.e. brake pedal application speed via the brake vacuum booster travel position sensor.

Diaphragm position sensing is monitored by the Teves Mk25 control module and indicates the drivers interaction with the brake pedal in the form of a speed versus time graph held as an algorithm within the control module operational strategy.

This information controls the active boost operation, i.e. at times when panic braking has been detected.

When the brake pedal application exceeds a pre-determined value the system responds by operating the active boost solenoid with 12v, thus introducing additional boost pressure to enter the ABS strategy.

Using PBA intervention benefits the driver by providing a faster entry to ABS, thereby retarding the vehicle quicker.

As the vehicle speed approaches above 30 mph (48 km/h) the PBA application rate decreases.

Under normal operation the system will pass through the PBA stage and enter into ABS in the normal manner.

A release switch positioned within the booster assembly informs the Teves control module of a change in status, i.e. if the driver releases the brake pedal then it is determined that the panic situation has subsided.

It is important to ensure that items such as the brake light switch and cruise control cancel switch are adjusted correctly, otherwise the release switch in the booster will be affected and DSC could be inhibited.

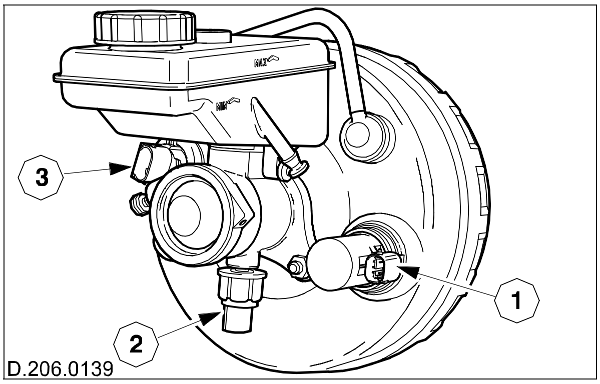


Fig. 139 Booster Assembly

Booster Assembly - Legend

1. Travel Sensor
2. Pressure Transducer
3. Internal Solenoid Connector

ELECTRIC PARK BRAKE (EPB)

The electric park brake (EPB) manufactured by DURA was introduced on the 2003 MY S-TYPE and is also utilized on The new XJ range 2003 MY.

The EPB system is comprised of following components:

- Park Brake Actuator
- Electronic Control Module
- Centre Console Switch

NOTE:

2003 MY S-TYPE manual variants have an in-gear switch and a clutch pedal sensor.

The park brake caliper levers are activated by an electric motor and actuator.

Actuator

Actuator assembly consists of :

- Electric Motor
- Hall Sensor
- Gearbox Mechanism
- Actuator Linkage

The park brake motor and actuator is located on the rear subframe assembly and depending on whether a N/A variant or a S/C variant decides on the actuator position as follows:

- N/A = Rear - Rear Subframe
- S/C = Front - Rear Subframe

Control Module

The electric park brake system is controlled via the EPB control module which is located on the RHS rear quarter panel.

Two multi-plugs connect the control module to the EPB electric motor and to the vehicle electrical systems, i.e. EPB switch, instrument cluster, fuse boxes, etc.

Multi-plug removal is slightly difficult and therefore requires care to be taken so no force is applied through to the cables during the multi-plug removal process.

NOTE:

Always remove the 4-way power connector before the 12-way signal connector to prevent spurious fault codes being generated.

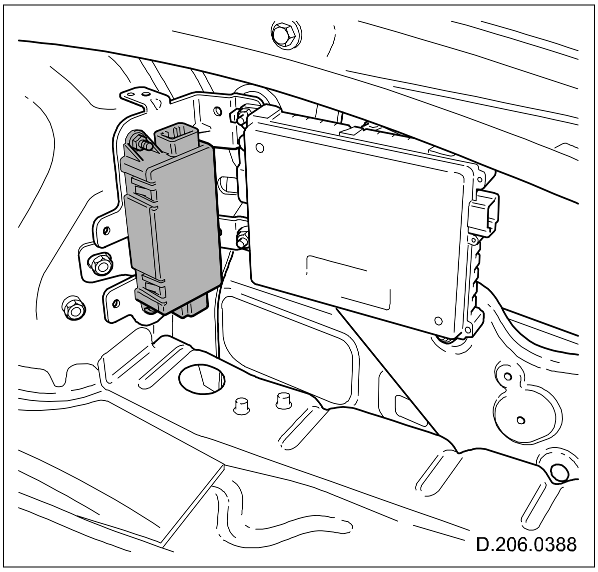


Fig. 140 EPB Control Module

EPB ACTUATOR

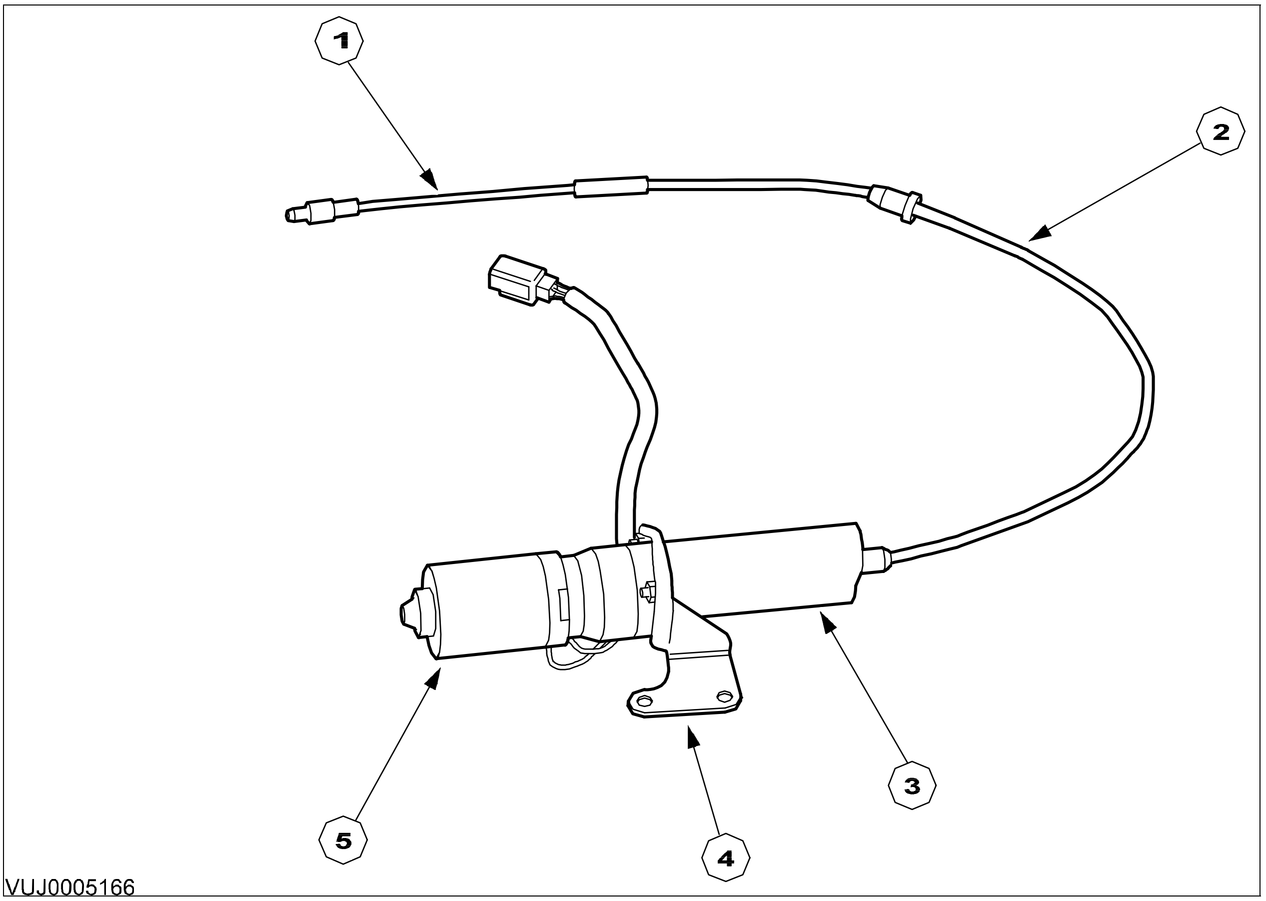


Fig. 141 EPB Assembly

1. Apply cable inner
2. Apply cable outer
3. Actuator mechanism
4. Subframe mounting bracket (two positions N/A and S/C)
5. 12v motor

EPB ACTIVATION

Activation of the EPB system is via the centre console mounted push - pull switch.

In the very simplest of terms the EPB switch can be related to a mechanical park brake lever for operation.

- Switch up - EPB apply
- Switch down - EPB release

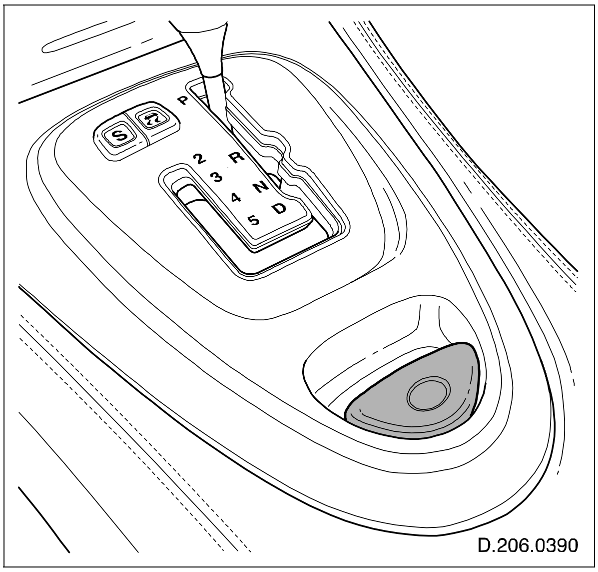


Fig. 142 EPB Switch

However full operation and knowledge of the different modes need to be reviewed for complete system understanding.

EPB Benefit

Benefits of fitting EPB apart from a cabin ergonomic aspect, is that driver strength plays no part in park brake activation.

The system has been designed with a feature that when the ignition key is removed the park brake system automatically applies, providing it has not been manually overridden or deactivated.

Dealer Option

An option of being able to switch the key-out automatic engagement ON or OFF can be accessed by WDS.

This has been requested by cold market countries where there is a chance of the park brake freezing in the on position.

It should be pointed out that the system has the capability of being immobilized by pressing and holding the park brake switch downwards whilst the ignition key is removed. When this occurs the park brake will not apply.

EPB Operation Modes

There are three main modes of operation:

- Static
- Low Speed Dynamic
- High Speed Dynamic

The modes of operation can be broken down into speed ranges and these are as follows:

- Static (<2 mph / 3 km/h)
- Low Speed (>2-20 mph / 3-32 km/h)
- High Speed (>20 mph / 32 km/h)

Static Mode

When the vehicle is in the static mode speed range, activating the EPB switch in the up direction will result in the park brake actuator applying at full force.

The EPB switch application time has no relationship to the park brake actuator motor run time, i.e. apply the switch for one second results in the park brake actuator motor applying at full operating force.

Low Speed Dynamic

The first apply is for 500mS and each subsequent application is 250mS.

If the EPB is applied for less than 250mS the motor will run for 250mS. However, if the switch is activated for a period greater than 250mS the motor will run until the EPB switch is released or EPB reaches full force.

EPB SYSTEM

High Speed Dynamic

In the high speed dynamic range the park brake system operates in a more progressive manner.

The park brake control module has in effect an apply and wait time strategy.

Pulling the EPB switch once and releasing will result in the control module responding with an actuator apply time of 500mS.

Each subsequent pull on the EPB switch adds another 250mS of motor run time until full force has been achieved (approximately 3-4 pulls).

If the driver pulls and holds the switch in the up direction the control module will result in a ramp-up sequence as follows:

- Ramp-on for 500mS
- Stop for 500mS
- Apply for 250mS
- Stop for 500mS
- Apply for 250mS
- Repeat until full loading registered

NOTE:

The park brake actuator motor applies to a current (15 amps) and releases to a position.

DRIVE AWAY RELEASE - AUTOMATIC VEHICLES

There are two forms of park brake release to consider on automatic vehicle variants:

- Out of Park Release
- Drive Away Release

Out of Park Release

EPB will be released when the 'J' gate out of park signal is detected, i.e. brake pressed and the selector lever moved from park to drive or reverse.

Drive Away Release

If the EPB switch has been activated in the on position and the selector lever has been placed into drive or reverse from the neutral position, drive away release does not occur until a positive throttle movement has been detected.

Warnings

In conjunction with an instrument warning lamp and message, an audible warning chime will be heard if vehicle motion is detected whilst the park brake is being applied, i.e. dynamic mode.

In situations where the park brake switch has been activated inadvertently whilst the vehicle is in motion the EPB control module will release the park brake actuator on detecting a positive throttle override.

At this point the instrument cluster warning lamp, message and audible chime will cease.

Of course it should also be pointed out that pressing the EPB down will also release the park brake system in this situation.

WARNING:

In all cases the EPB switch always has priority. This means that even when a positive throttle is being applied it will be overruled by an EPB switch held in the up position.

SERVICE

Diagnostics

A service tool (206-082) in the form of a two-way rocker switch connected through a thermal fuse has been produced.

It connects into the actuator motor multi-plug and permits operation of the electric motor via a battery connection to the switch. The tool therefore is an aid for park brake system diagnosis.

Full diagnostic capability exists for the EPB system via WDS. Refer to the Park Brake - Fault Code table for a list of DTC's available from the park brake control module.

Calibration Apply Mode

A calibration apply mode exists for instances where the park brake module has lost electrical power.

Such instances are as follows:

- Battery Disconnection
- Transit Relay Operation
- Diagnostic Mode

When power has been disrupted, the park brake control module loses its actuator position memory.

The loss of positional information is indicated by 'Apply Park Brake' message on the IC to warn of the calibration mode request.

To regain positional information once battery power has been restored the following operation must be carried out:

- Apply Foot Brake
- Activate Park Brake
- In both directions On-Off-On

EPB ACTUATOR ASSEMBLY

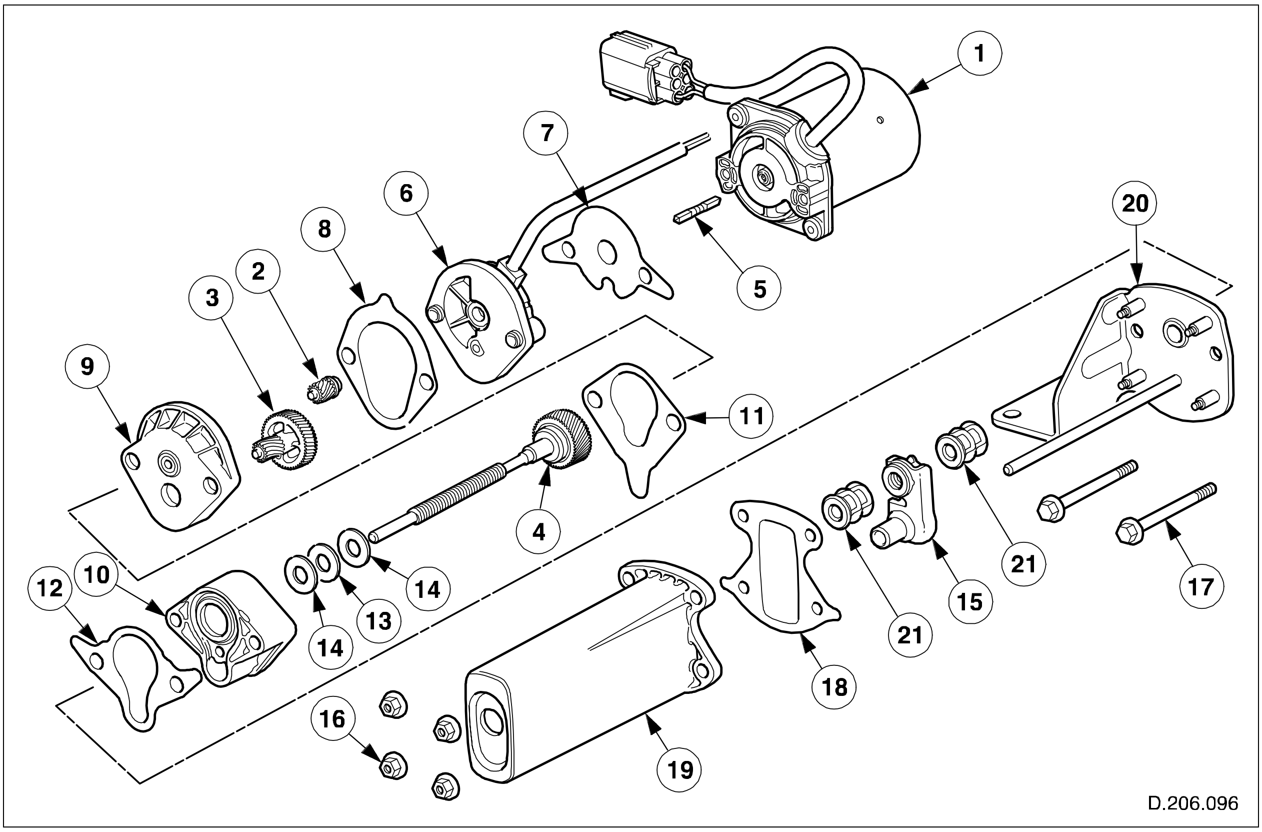


Fig. 143 EPB Exploded View

1. 12V motor
2. Motor drive gear
3. Actuator drive gear
4. Motor drive gear
5. Hall sensor
6. Gasket
7. Gasket
8. Gearbox mechanism housing
9. Actuator drive gear housing
10. Gasket
11. Gasket
12. Bearing
13. Thrust washers
14. Actuator cable drive
15. Actuator housing
16. Motor securing fixing
17. Gasket
18. Actuator housing
19. Separator plate
20. Rubber end stops

NOTE:

The EPB unit no serviced separately

ADJUSTABLE PEDALS

Adjustable vehicle control pedals (throttle, brake and clutch) are introduced as a new optional feature for The new XJ range 2003 MY.

This optional feature achieves improved driver ergonomics relative to the drivers seating position and pedal actuation.

System components comprise of a new throttle pedal with an electrically operated adjustment motor.

Each motor connects to the two remaining pedals where fitted, i.e. clutch and brake, via two drive cables (similar to speedo cables).

The system is hardwired between the components and the front electronic module (FEM).

Pedal position adjustment is via a new selectable position on the column joystick.

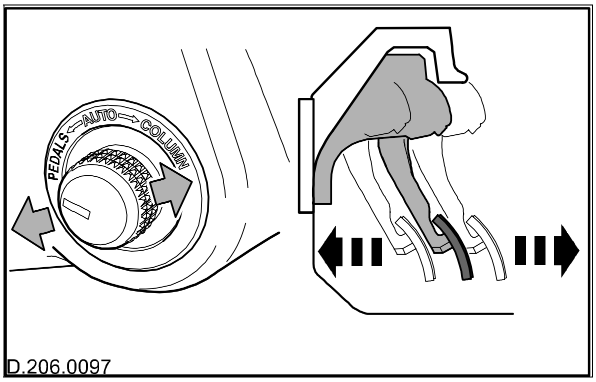


Fig. 144 Adjustment Control

As the joystick is moved through its axis of forwards and rearwards the pedals move likewise forward and rearwards in relation to the seating position.

All pedals move together in unison and are completely independent from the column position movement.

Two separate pedal positions can be set and stored into memory for driver recall.

Installation

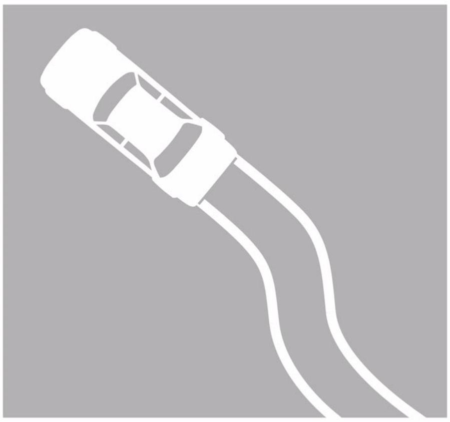
The pedals are supplied in a shipping (transit) condition (fully down) and will require connecting to the drive cables.

Once the drive cables are connected the system is required to be fully operated through the complete pedal axis.

Having achieved this, the final stage of setting the memory can be accomplished.

TRAINING PROGRAM

JAGUAR CHASSIS, BRAKING AND TRACTION CONTROL SYSTEMS



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X-TYPE SUSPENSION AND DRIVELINE ALIGNMENT

The alignment gauge will check the following areas:

- Powertrain alignment
- Drive shaft alignment
- Rear sub frame alignment

Normally, you would only concentrate on the area of concern and not necessarily the whole alignment procedure.

Alignment Pre-Checks

Prior to using the alignment gauge, a vehicle condition check should be carried out to determine if the body or suspension components have been damaged.

NOTE:

A two post ramp is required to conduct the alignment check, but vehicle condition checks can be completed using a four post ramp.

- Place the vehicle on the ramp, preferably of the two-post variety, for the condition check.
- Carry out a close visual inspection of the vehicle's body and determine if the structural condition meets the expected design intent.
- When conducting the inspection, look for cracks, twisting or bent chassis members.
- Whilst inspecting the chassis members, also check for damaged suspension components, plus the soundness of any mounting brackets or supporting metalwork.
- Use JTIS for body height, length and width data as required.
- Make any service adjustments or replacements as required before continuing to the next stage.
- Use JTIS for any torque figures required during assembly.

Having determined the body, suspension and driveline components are satisfactory, the next stage is to become familiar with the components of the alignment gauge.

Alignment Gauge Kit

The alignment gauge kit is manufactured by JNE (Johanssen & Nielson Engineering), a Swedish company, and bears the global Service Tool part number of: (501-081).

The kit is divided into areas as follows:

- Front suspension alignment.
- The alignment gauge measuring bar.
- Rear suspension alignment.
- Drive shaft alignment.

Identification and Assembly

This section looks at the alignment gauge measurement bar and points out a number of areas that need to be understood prior to its use.

Remove the alignment gauge from the carrying case and note it is made up of three differently sized aluminum sections.

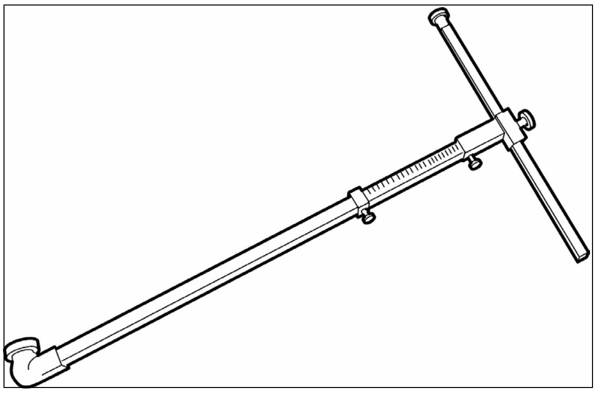

Fig. 146

CAUTION:

When using the alignment gauge, it is important to operate the measuring gauge in the correct plane.

The alignment gauge is correctly positioned and ready for use when the flat surface is uppermost and the Jaguar logo is the right way up.

NOTE:

Should the gauge be used incorrectly, then the measurement taken will be substantially wrong; this is due to the offset nature of the end housing on the small bar.

Measurement Axis

Using engineering practice, the axes used when discussing measurement points on the car are as follows:

- X axis: measurement taken lengthwise from the vehicle.
- Y axis: measurement taken across the vehicle.
- Z axis: measurement taken vertically through the vehicle.
- Loosen the knurled thumbscrews and extend the alignment gauge to reveal the measurement scale printed on the small bar and the middle bar. This measurement scale is the X axis.
- Remove the aluminum rod with the graduated measurement scale from the carrying case. This measurement scale is the Z axis.

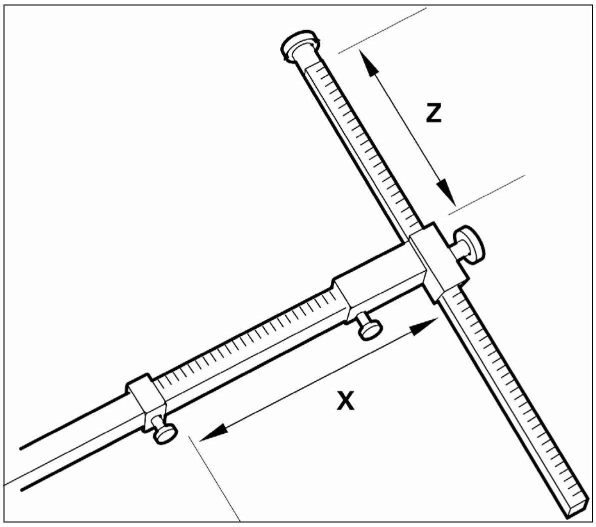

Fig. 147

It is recommended to carry out an alignment gauge check prior to conducting a four-wheel alignment procedure.

NOTE:

For more information on how to perform the complete alignment procedure, refer to JTIS.

S-TYPE (2003 MY ONWARDS) DRIVELINE ANGLE INSPECTION

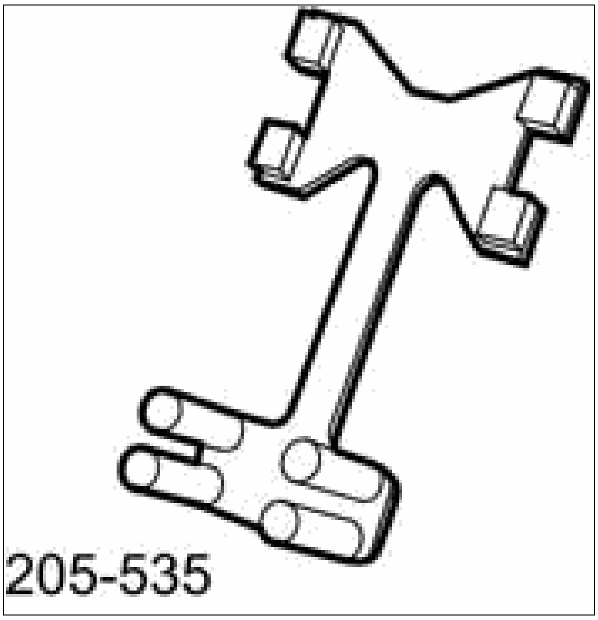

Fig. 148 Driveline angle check tool

- Raise and support the vehicle.
- Remove the support bracket

NOTE:

Right-hand shown, Left-hand similar.

- Detach the rear muffler and tailpipe exhaust hanger insulator.

CAUTION:

Using a suitable transmission jack, support the intermediate muffler.

- Detach the intermediate muffler exhaust hanger insulators.
- Remove the driveshaft heat shield. Remove the retaining bolts. Remove the driveshaft heat shield.
- Loosen the driveshaft centre bearing retaining bolts two complete turns.

- Remove the driveshaft heat shield. Remove the retaining bolts. Remove the driveshaft heat shield.
- Loosen the driveshaft centre bearing retaining bolts two complete turns.

CAUTION:

Make sure the driveshaft centre bearing is correctly aligned to the driveshaft. Failure to follow these instructions may result in damage to the vehicle.

- Using the special tool, align driveshaft centre bearing. Tighten to 40 Nm.
- Install the driveshaft heat shield retaining bolts. Install the driveshaft heat shield. Install the driveshaft heat shield retaining bolts. Tighten to 7 Nm.
- Remove special tool and reverse steps

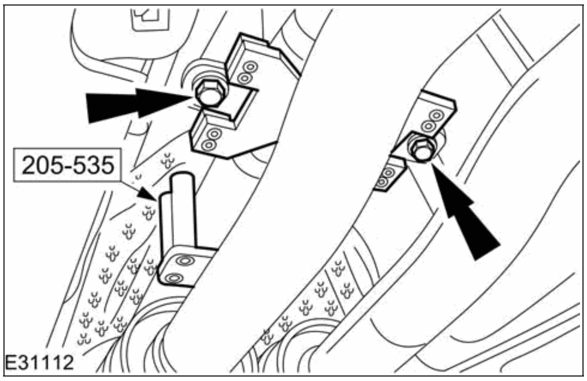

Fig. 149 Checking alignment with special tool

Subframe alignment

When re-installing the subframe, a set of special bolts are required to align the subframe to the body. Refer to JTIS for more information

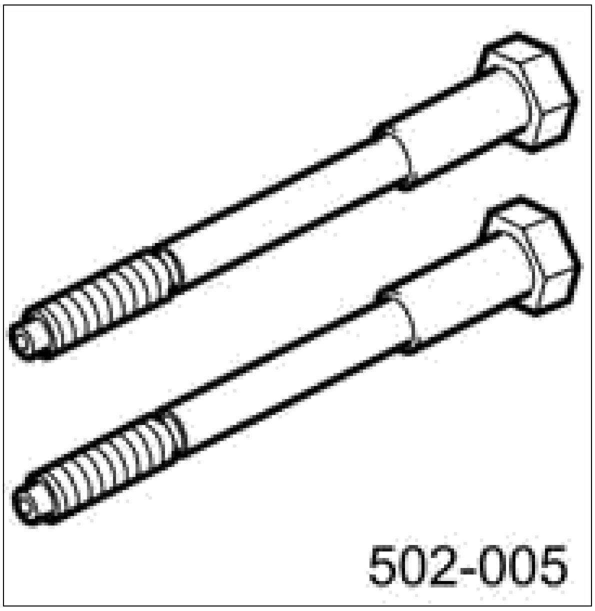

Fig. 150