



Technical Guide



S-TYPE

2003 Model Year Update



BY APPOINTMENT TO
HER MAJESTY QUEEN ELIZABETH II
MANUFACTURERS OF DAIMLER AND JAGUAR CARS
JAGUAR CARS LIMITED COVENTRY



BY APPOINTMENT TO
HER MAJESTY QUEEN ELIZABETH
THE QUEEN MOTHER
MANUFACTURERS OF DAIMLER AND JAGUAR CARS
JAGUAR CARS LIMITED COVENTRY



BY APPOINTMENT TO
HIS ROYAL HIGHNESS THE PRINCE OF WALES
MANUFACTURERS OF DAIMLER AND JAGUAR CARS
JAGUAR CARS LIMITED COVENTRY



Technical Guide

S-TYPE 2003 Model Year Update

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Preface

This Technical Guide is intended to provide Jaguar Dealer workshop personnel with an overview of changes introduced for S-TYPE 2003 MY vehicles. The document is for information purposes only, will not be updated and must not be used as a reference source for servicing procedures; all servicing must be carried out in accordance with the appropriate JTIS disc. While every effort is made to ensure accuracy, changes may occur between going to press and the equipment being introduced to the market. Once the equipment is in service, details of the changes can be obtained from Service Bulletins and revisions to the JTIS disc.

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Glossary

The following abbreviations and acronyms are used in this publication:

Abbreviation / Acronym	Description
ABS	anti-lock braking system
ac	alternating current
ALR	automatic locking retractor
AM	amplitude modulation
CAN	controller area network
CCM	climate control module
CD	compact disc
CKP sensor	crankshaft position sensor
cm	centimeter
CPCM	cellular phone control module
D2B	digital data bus
dc	direct current
DDCM	driver door control module
DSC	dynamic stability control
DTC	diagnostic trouble code
DVD	digital versatile disc
ECM	engine control module
EGR	exhaust gas recirculation
EVAP canister	evaporative emission canister
FM	frequency modulation
FP module	fuel pump module
GECM	general electronic control module
GPS	global positioning system
GVW	gross vehicle weight
HO2 sensor 1	heated oxygen sensor 1
HO2 sensor 2	heated oxygen sensor 2
IAT sensor	intake air temperature sensor
IFS switch	inertia fuel shutoff switch
IMT valves	intake manifold tuning valves
in	inch
ISO	International Standards Organization
JTIS	Jaguar technical information system
kbps	kilobits per second
km/h	kilometers per hour
kV	kilovolt
LCD	liquid crystal display
LED	light emitting diode
LH	left-hand
LHD	left-hand drive
MAF sensor	mass air flow sensor
MAP sensor	manifold absolute pressure sensor
MHz	megahertz
MIL	malfunction indicator lamp
mile/h	miles per hour
mm	millimeter
ms	millisecond
MY	model year

N	newton
N/A	normally aspirated
NAS	North American specification
NCM	navigation control module
Nm	Newton-metres
NOx	oxides of nitrogen
NVH	noise, vibration and harshness
OBD	on-board diagnostics
ORVR	on-board refueling vapor recovery
PATS	passive anti-theft system
PBA	panic brake assist
PCV	positive crankcase ventilation
PWM	pulse-width modulated
RCM	restraints control module
RECM	rear electronic control module
RF	radio frequency
RH	right-hand
RHD	right-hand drive
SC	supercharged
SCLM	steering column lock module
SCP	standard corporate protocol
SRS	supplementary restraints system
TC	traction control
TCM	transmission control module
TG	technical guide
TP sensor	throttle position sensor
VACM	voice activation control module
VAPS	variable assisted power steering
VEMS	vehicle emergency messaging system
VICS	vehicle information communications system
VIN	vehicle identification number
VVT	variable valve timing
W	watt
WDS	worldwide diagnostic system

At first glance S-TYPE appears to have undergone only subtle changes, in fact there have been extensive changes to the interior of the vehicle, the powertrain, chassis and electrical areas.

- The 'R' variant features a unique front bumper, new grille surround with mesh grille, dark headlamps, sill appliqué and luggage compartment lid spoiler.

The interior of the vehicle carries the most obvious indications of change:

- The floor and roof consoles are new. The instrument panel and center console is a new assembly built around a magnesium cross-car beam.
- Post-trims and the headlining have been redesigned to accommodate side-curtain air bags.
- In the rear of the vehicle, new casket-style damped grab-handles with integral map and courtesy lamps have been introduced.
- The sun visors are a new rigid design and include a vanity pack with improved lighting.
- Both front and rear seats have all new trim styles. The front seats have new structures and incorporate anti-whiplash mechanisms. The 'R' variant features revised front seat functionality and increased ergonomic adjustment in the form of electrically adjustable head restraints and extendible seat cushions. The rear seats have unique interior styling, a new seat structure and an improved latching system.

New Occupant Safety features include:

- front/rear side-curtain air bags;
- occupancy sensing;
- rear safety-belt pre-tensioners.

Changes to the Powertrain area:

- A new electronic engine control system for both the V6 and V8 engines.
- The addition to the range of a 2.5 liter capacity engine, developed from the 3.0 liter V6 engine.
- The 4.2 liter engine is an upgrade and replacement of the previous S-TYPE 4.0 liter V8 engine. Improvements made to the engine provide better performance, economy, and refinement. The supercharged version of the engine is available for the 'R' derivative.
- The cooling pack assembly is new. Key features include the integration of the receiver-drier into the condenser and the cooling fan directly driven by a brushless motor.
- New low-weight exhaust systems: the normally aspirated system has revised resonator internals to optimize noise quality; the supercharged exhaust system has a unique single-piece resonator tuned to give low back-pressure and optimum sound quality.
- A 6-speed automatic transmission which when compared to the previous 5-speed automatic transmission, provides: higher torque capacity; reduced length and weight; improved fuel consumption and vehicle performance.
- The increased fuel requirements of the supercharged engine are met by twin fuel pumps and a larger bore, fuel feed pipe.

Changes to the Chassis area:

- The front suspension is assembled on a subframe, replacing the two separate crossmembers previously used. The suspension has been extensively upgraded to further enhance the steering-feel and has been strengthened to accommodate the introduction of the supercharged engine.
- The installation of a two-piece driveshaft, manufactured of lightweight steel and unique for each powertrain application.
- The upper steering column features a unique crash-load absorption system and the lower column incorporates a new crash-collapse mechanism.
- Dynamic Stability Control is fitted as standard and designed to enhance driving safety by improving vehicle handling when the tires are at the limits of their grip capabilities.
- Panic brake assist which, responds to the driver's reactions in a emergency braking situation by providing a increased braking force to activate the ABS.
- The option of adjustable pedals, designed to complement the adjustable steering column in providing some drivers with a range of improved driving positions. The brake pedal has a decoupling feature providing additional driver protection in the case of severe frontal collisions.

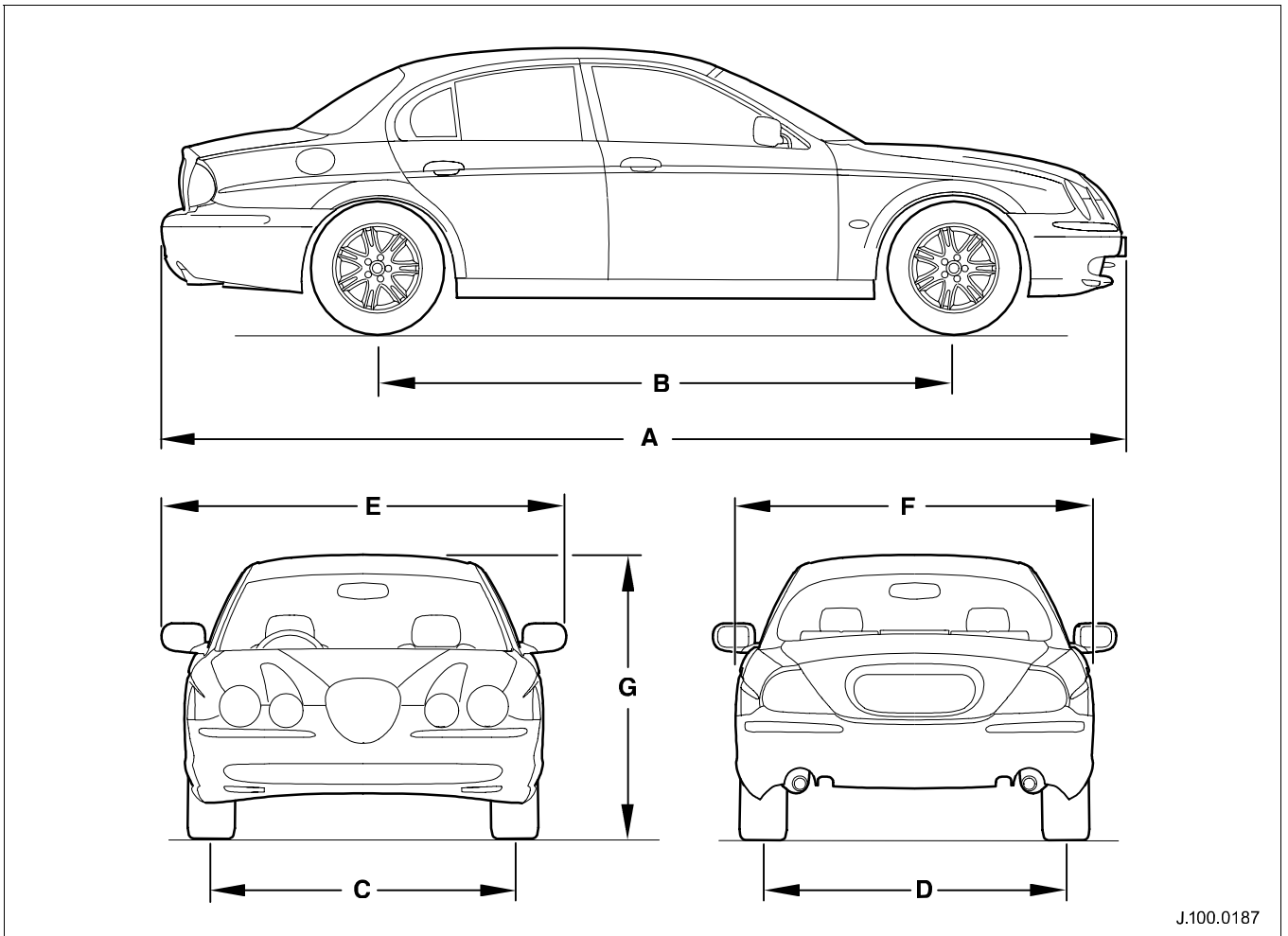
Introduction

- The replacement of the conventional parking brake with an electric version which, in addition to saving space is also easier to use and automatically actuated when the ignition key is removed.
- Brembo brakes and unique 18in alloy wheels fitted as standard for the 'R' derivative

In the Electrical area, many of the features first introduced for X-TYPE have been carried over but there are some unique features:

- Xenon headlamps complete with automatic headlamp leveling and powerwash.
- Telematics system with optional multi-functional touch-screen which allows control of audio, climate, phone, navigation, JaguarNet and TV. DVD technology is used for the navigation system.
- Improved climate control functionality and new hidden features. The incorporation of the receiver-drier within the condenser.

Dimensions



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Fig. 1 External dimensions

Dimension	inches	millimeters
A	192	4877
B	114.5	2909
C	60.4	1534
D	60.71	1542
E	81.1	2060
F	71.57	1818
G	57.17	1452 (max)

NOTE: Measurement G is for curb weight condition (complete vehicle with all fluids filled to capacity without occupants, optional equipment or luggage).

Minimum ground clearance measured at gross vehicle weight (GVW) = 4.1 in (104.9 mm).

Table 1 External dimensions (refer to Fig. 1)

Suspension

Introduction

The suspension has been strengthened to accommodate the introduction of the supercharged engine, and extensively upgraded to further enhance the steering-feel beyond the improvements introduced by the new steering system at 2001 MY. These and other suspension enhancements include:

- noise, vibration and harshness (NVH) damping performance,
- improved roll-control,
- revised suspension geometry,
- vehicle crash performance.

CAUTION: Do not use jacking equipment on suspension components, use identified jacking points only, refer to 'JTIS' for revised jacking point information.

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-wishbone 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 improve 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 a split design which de-couples, allowing for improved bush tuning. A hydrabush fitted to the forward lower-control arm where it attaches to the subframe provides improved vibration damping.

NOTE: The subframe must be correctly aligned to the vehicle's body to ensure the correct operating angle of the drive shaft, refer to 'JTIS' for the installation procedure.

Chassis

Front Suspension Components

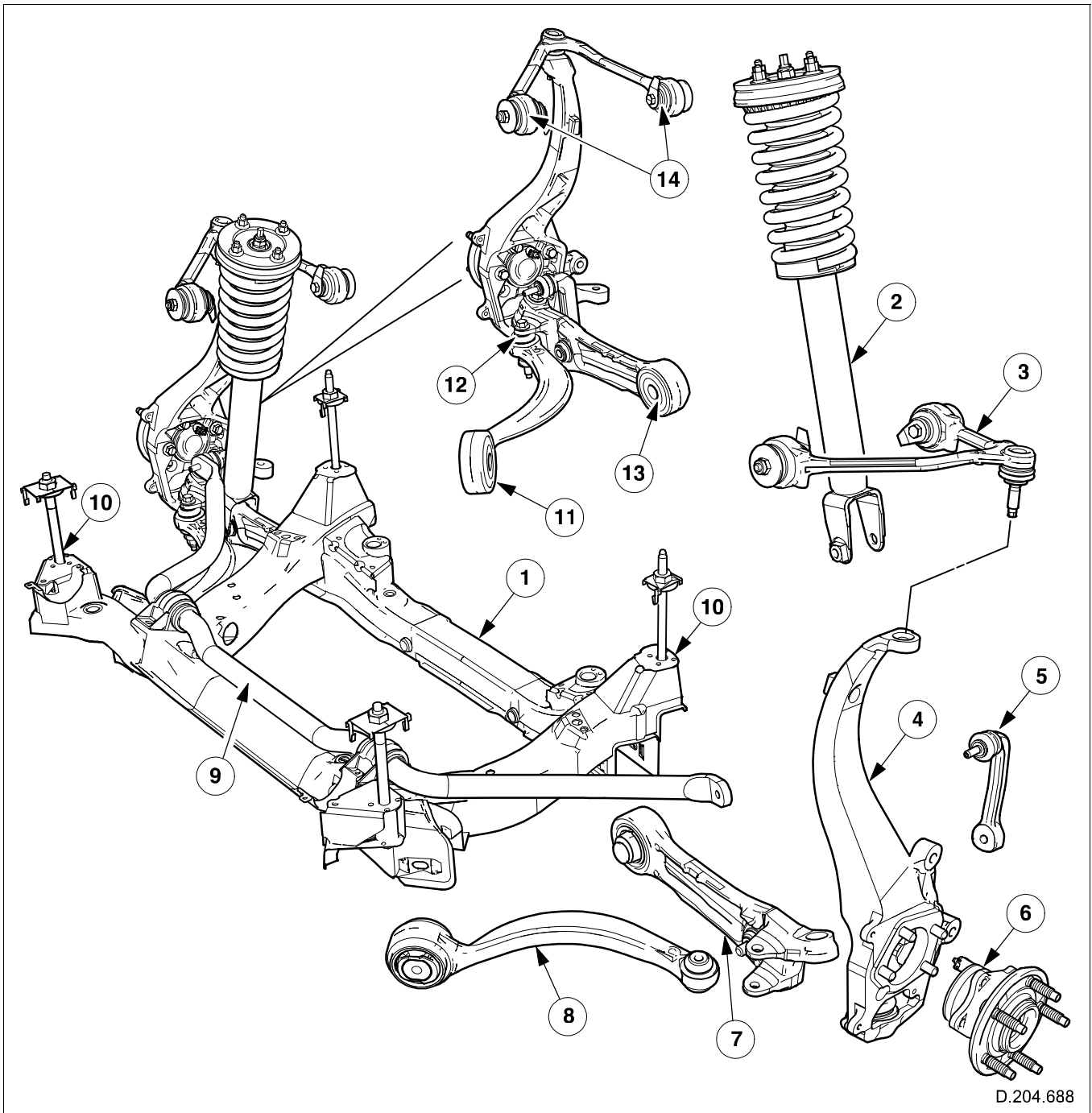


Fig. 2 Front suspension

Key to Fig. 2

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
- Steel-fabricated non-isolated subframe locates:
 - lower control arm,
 - stabilizer bar,
 - cooling module,
 - power steering rack,
 - engine hydramounts.
 - Upper control arm (aluminum), connects to the body via two fluid-block bushes, and houses an integral ball joint which connects to the swan neck wheel-knuckle.
 - Stiffened swan-neck wheel-knuckle (aluminum), with integral steering arm, houses the press-fit lower ball joint which locates the lateral lower control arm.
 - The wheel knuckle locates the disc shield and brake caliper, plus wheel hub and wheel bearing. The wheel bearing has been updated to accommodate the revised ball joint arrangement.
 - The lower ball joint has been inverted, providing more surface area contact between the ball and cup. The ball joint is compressively loaded during vehicle use.
 - The swan neck wheel-knuckle is unique to both N/A and SC vehicles to accommodate variations in brake-caliper fixing points.
 - Lower control arm (aluminum).
 - Castor and camber can be adjusted via eccentric cam bolts, located in the lower control arm and now installed as standard.
 - Lateral lower control arm, locates damper, stabilizer-bar drop link, wheel-knuckle and connects via a rubber bush to the subframe.
 - Forward lower control arm, locates via a ball bush to the lateral control arm, and via a hydrabush to the subframe.
 - The stabilizer bar is of tubular design and is provided in various diameters to support suspension variants. There is also two shapes of bar to accommodate both the N/A and SC cooling-pack assemblies.

Front Spring and Damper Assembly

The co-axial spring and damper assembly, which locates between the lower control arm and vehicle body, is supplied in numerous variants to support various options of both 'standard' and 'adaptive' damping suspensions.

- The road springs have been up-rated to accommodate the vehicle load differences.
- Dampers settings have been revised to support the various suspension derivatives.

The damper's lower spherical joint is now part of the lateral lower-control arm, and the damper takes the form of a clevis-end, which straddles the spherical joint.

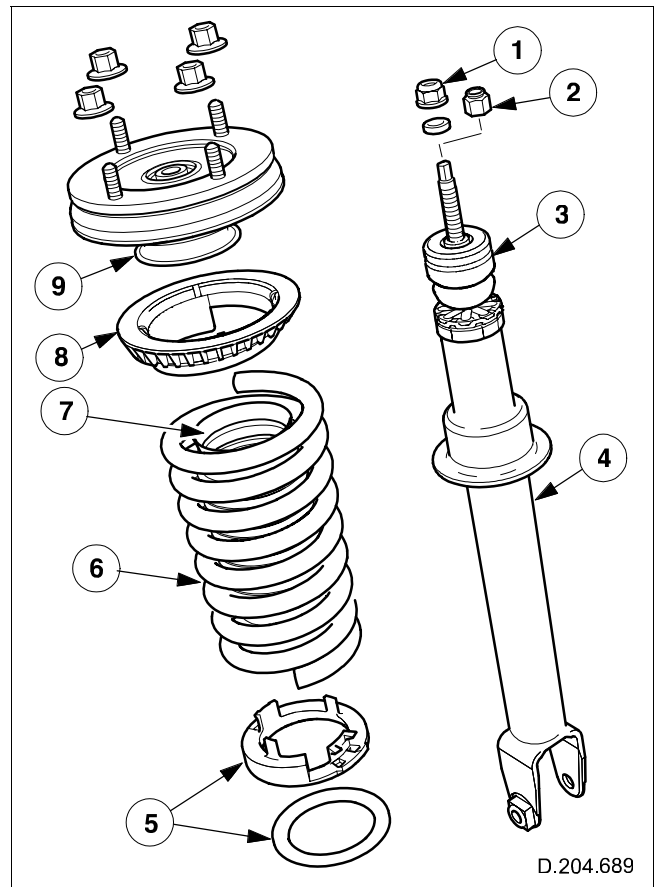


Fig. 3 Front spring and damper assembly

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

Rear Suspension

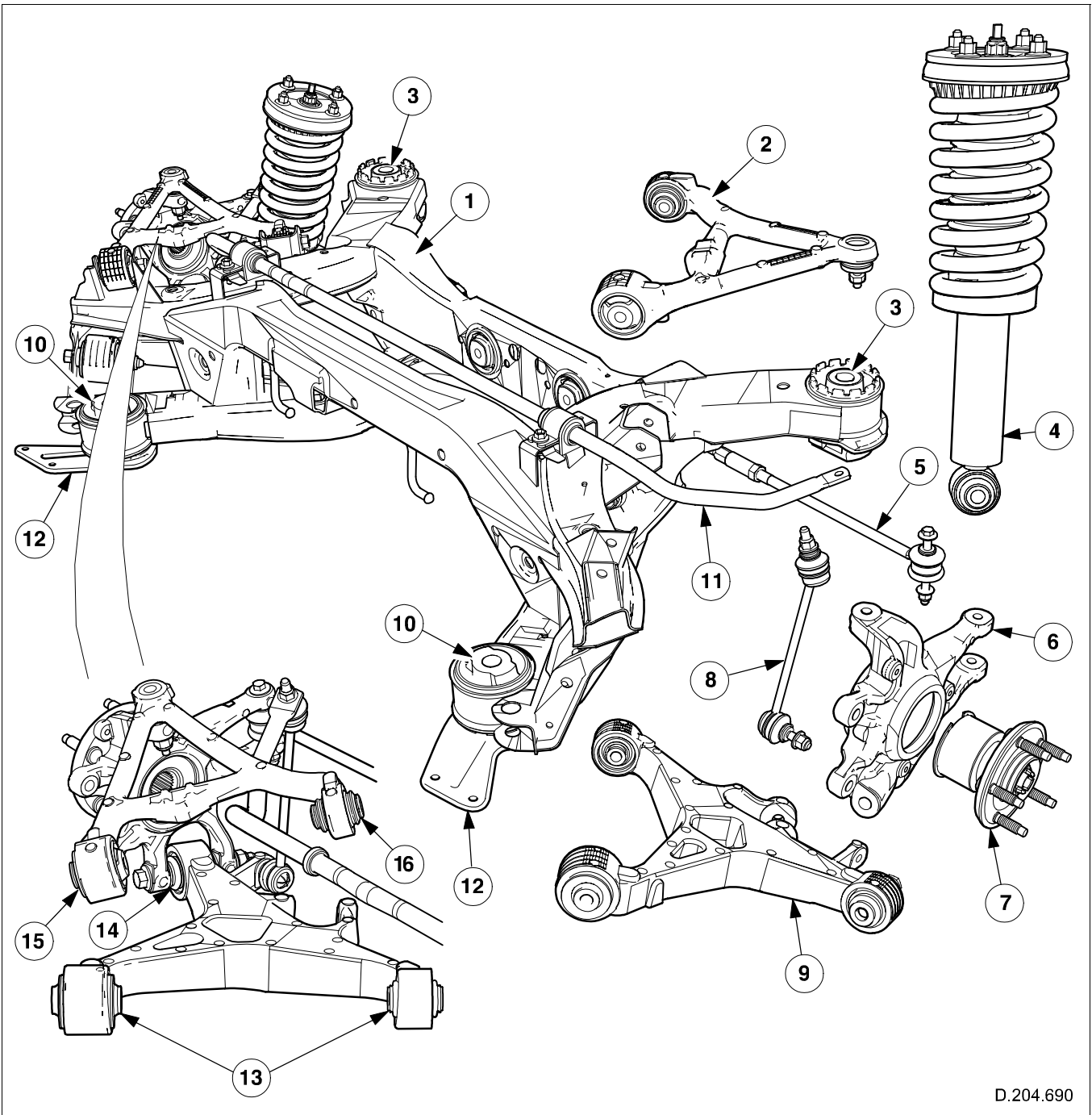
The suspension arrangement is a double wishbone type.

The rear suspension is assembled on a redesigned steel-fabricated subframe with raised roll-center and improved strength to accommodate supercharged V8 loads. Larger diameter mounting bushes are used to isolate the subframe from the vehicle's body providing improved durability and ride refinement. Double-shear brackets are also introduced to refine ride performance and prevent subframe slippage under vehicle acceleration.

NOTE: The subframe must be correctly aligned to the vehicle's body to ensure the correct operating angle of the drive shaft, refer to 'JTIS' for the installation procedure.

Chassis

Rear Suspension Components



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Fig. 4 Rear suspension

Key to Fig. 4

1. Subframe
 2. Upper control arm with integral ball-joint
 3. Voided rubber bush
 4. Spring and damper assembly
 5. Toe control link
 6. Wheel knuckle
 7. Wheel hub and bearing assembly
 8. Stabilizer-bar drop link
 9. Lower control arm
 10. Hydrabush
 11. Stabilizer bar
 12. Double-shear bracket
 13. Cross axis bush and rubber bush
 14. Rubber bush
 15. Rubber bush
 16. Cross axis bush
- Steel-fabricated isolated subframe locates:
 - Four subframe to body isolation bushes, the front bushes are hydrabushes and the rear are voided rubber; bushes must be installed in the correct orientation, refer to 'JTIS'.
 - Differential — two bushes located in the subframe, one bush located in differential,
 - Upper and lower control arms,
 - Stabilizer bar,
 - Electric park brake actuator.
 - Upper control arm (aluminum), with integral ball joint:
 - Connects to the subframe via one cross-axis and one rubber bush.
 - Wheel-knuckle (aluminum), with integral toe-control arm:
 - Unique wheel knuckle for both N/A and SC vehicles to accommodate variations in brake caliper fixings.
 - The wheel knuckle locates upper ball joint, lower control arm, disc shield, brake caliper, press-fit wheel bearing.
 - Toe control link:
 - New longer design to support revised suspension geometry.
 - Lower control arm (aluminum):
 - Unique for both N/A and SC vehicles, SC arms are strengthened due to increased engine torque.
 - Locates to subframe via one cross axis bush and one rubber bush, and to the wheel knuckle via a cross axis bush.
 - Locates damper and stabilizer bar drop-link.
 - Double shear brackets:
 - The double shear bracket is a steel pressing that acts as an additional clamping surface for the rear subframe mounting bushes. Preventing the subframe from moving (slippage) under vehicle acceleration forces.
 - Stabilizer-bar:
 - The stabilizer bar is of tubular design and comes in various diameters to accommodate suspension variants.

Enhanced functions

When road conditions change and accordingly vehicle dynamics. The adaptive damping system responds by adapting the most favorable damper setting to provide optimum ride-comfort and vehicle traction.

1. Uneven road surface:
 - Switches all four dampers to the ‘firm’ setting when the vehicle encounters a bump in the road, and then returns to a ‘soft’ setting.
 - This function has been enhanced to maintain a ‘firm’ setting on lengthy undulating road surfaces, this allows the wheels to follow the contours of the road, therefore counteracting vertical-body oscillations and increasing tire to road contact.
2. Cornering:
 - This function has been enhanced to assist in countering oversteer and understeer characteristics by switching the dampers between settings ‘front or rear’ and ‘left or right’ at predetermined periods of the vehicle’s cornering maneuver. This is achieved by the control module monitoring the wheel-speed sensors, and using these signals the control-module goes through a sequence of events to switch the dampers to the appropriate setting.
3. Braking:
 - Switches all four dampers to a ‘firm’ setting when the vehicle’s brakes are applied.
 - This function has been enhanced to allow the dampers to return to the ‘soft’ setting earlier to reduce the harshness of road inputs during braking. This is achieved by continually monitoring the brake switch and the vehicle’s instantaneous deceleration rate.
4. Accelerating and braking:
 - Switches damper settings between ‘front’ and ‘rear’ as appropriate, to prevent rear-end squat when the vehicle accelerates, and front-end dive when the vehicle brakes.

System Components

- Adaptive damping control module, located in the rear left corner of the spare-wheel stowage area.
- Three accelerometers (sensors):
 - front vertical-accelerometer,
 - rear vertical-accelerometer,
 - lateral accelerometer.
- Four adaptive dampers.

The location of the front vertical and lateral accelerometers has been changed from the LH suspension turret, to behind the front bumper. This location change provides the control module with enhanced detection information with regards to changes in vehicle dynamics.

The control module uses the information from the vehicle’s speed sensors and accelerometers and compares this with a pre-programmed set of tuned parameters in the software to determine the appropriate damper settings.

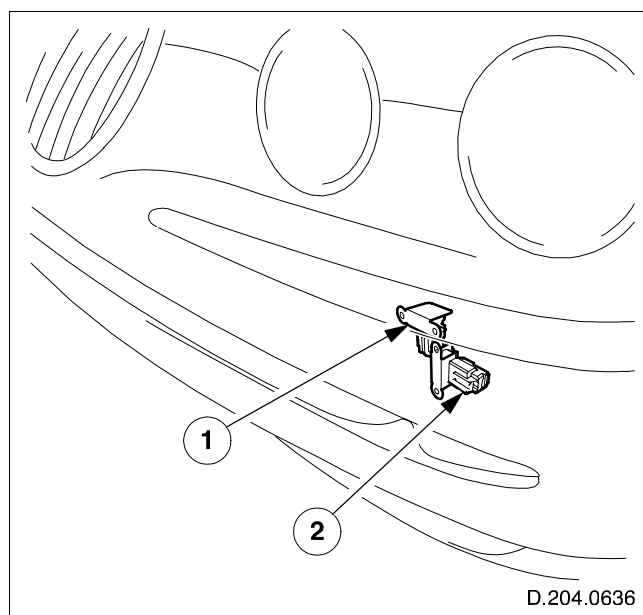


Fig. 6 Revised accelerometer location

1. Front vertical-accelerometer
2. Lateral accelerometer

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 with automatic transmission.
- The driveshaft is aligned with the vehicle body center-line and is mounted in a rubber center-bearing. The driveshaft consists of the following components:

- Rubber couplings at each end.
- Centre hookes joint.
- Swage construction of the driveshaft front-tube, to enable the driveshaft to collapse in a controlled manner, in the event that the vehicle is involved in a front-end collision.
- Low friction splines at the centre of the driveshaft provide the driveshaft's plunge capability. There is no spline locking feature on this driveshaft.

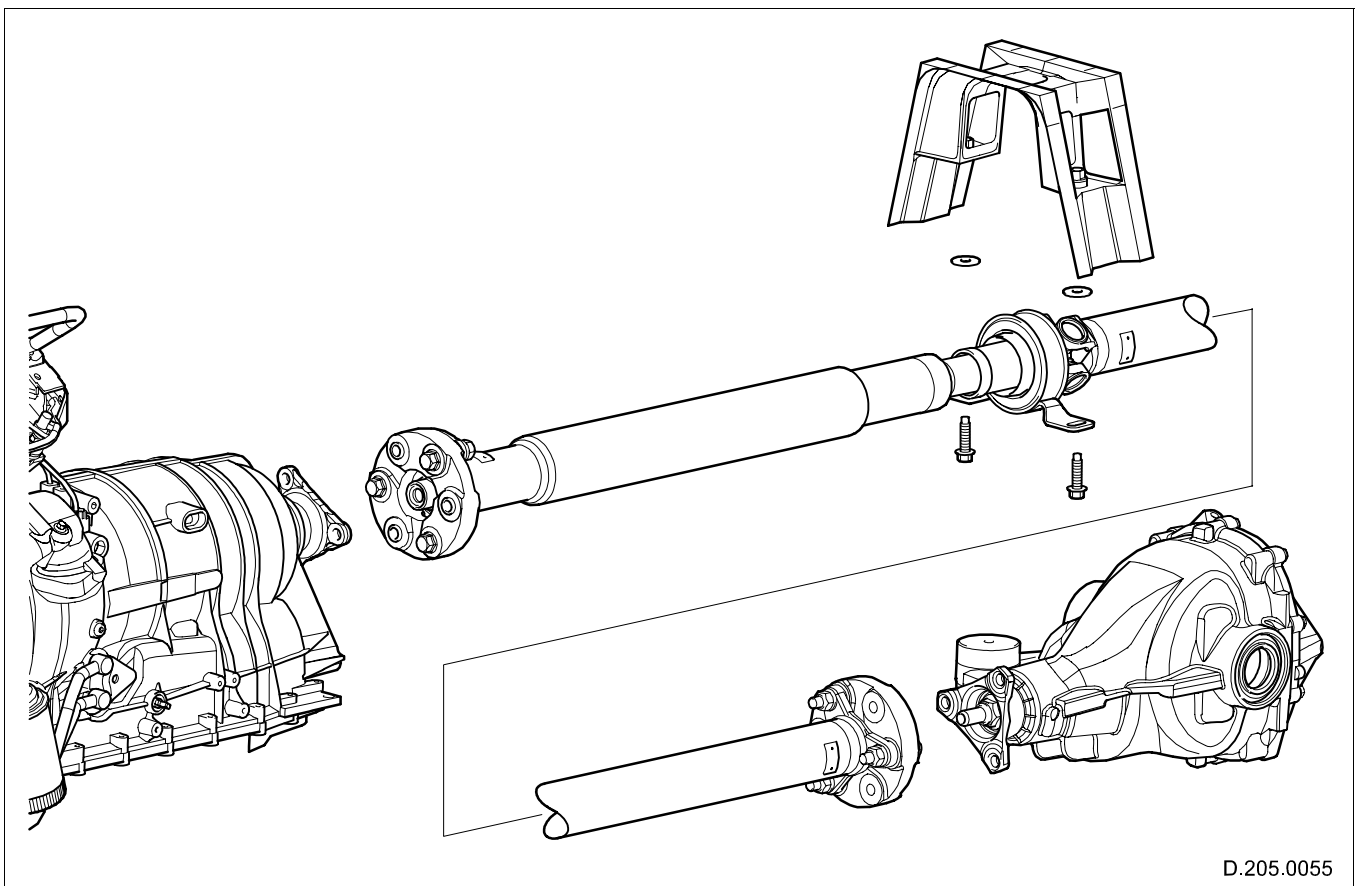


Fig. 7 Driveshaft and differential

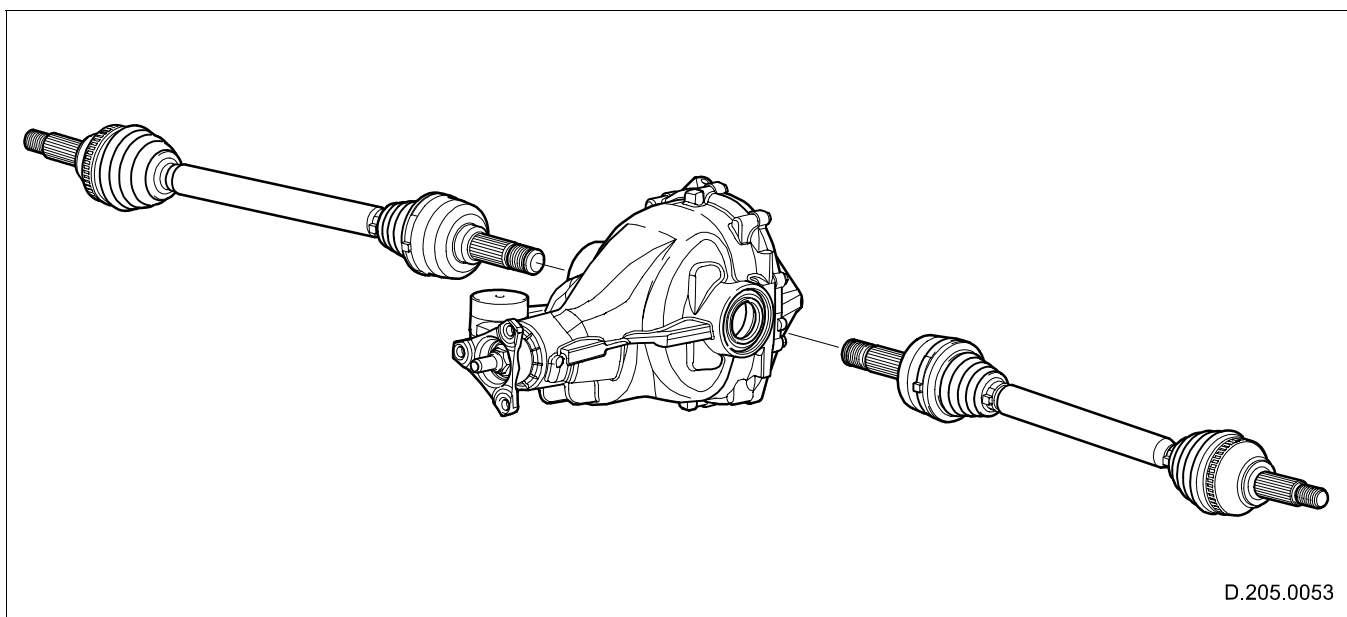
Differential

- The differential is mounted at three-points, one at the front and two at the rear, through rubber bushes to the rear subframe. This mounting arrangement plus the subframe to vehicle-body mounting arrangement, refer to **Suspension**, 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 pinion final-drive shaft, is mounted on two taper roller bearings, and is in line with the body centre line.
- The hypoid-gear set is mounted on taper roller bearings.
- The differential lubricant is fill for life with the level-plug in the rear cover.
- The differential ratios are:
 - V6 engine with manual transmission — 3.07:1.
 - V6 engine with automatic transmission — 3.31:1.

- V8 engine with automatic transmission — 2.87:1.

Axle Shafts

- There are three derivatives of axle shaft:
 - 2.5 liter V6 engine: tubular axle-shafts.
 - 3.0 liter V6 and V8 N/A engines: tubular axle-shafts with high-torque capacity constant-velocity joints.
 - V8 SC engine: 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 joints provide the axle shaft's plunge capability. Outboard joints are fixed.
- The axle shafts:
 - are a spline interference-fit into the wheel hubs,
 - and a spline slide-fit into the differential, where they are retained by a spring circlip.



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Fig. 8 Axle shafts and differential

Brake System

Introduction

The brake system has been upgraded and now includes the following components, all of which are discussed in this section:

- Panic brake assist.
 - Panic brake assist is an enhancement to the anti-lock braking system (ABS).
- Dynamic stability control.
 - The dynamic stability control system, now fitted as standard, incorporates all new hardware replacing the components on the previous S-TYPE.
- Electric parking brake.
- Brake pedal decoupling (safety feature).
- Pedal adjustment system (optional).

The foundation brakes have also been upgraded to enhance the vehicle's braking capability and complement the introduction of the supercharged engine.

Front calipers:

- N/A vehicles incorporate a double-piston sliding arrangement.
- SC vehicles incorporate a Brembo monobloc four-piston fixed arrangement.

Rear calipers:

- N/A vehicles incorporate a single piston sliding arrangement, these calipers have a self-adjusting mechanism within the piston, which has to be wound back before the installation of new brake pads.
- SC vehicles incorporate a Brembo two-piece four-piston fixed arrangement, a separate caliper is installed for the parking brake.

New steel-braided brake hoses are installed to all vehicle derivatives, providing the following advantages over conventional hoses:

- reduced expansion under pressure,
- light-weight design,
- reduced permeability.

The following table shows the application of the foundation brake components on the various S-TYPE derivatives:

	V6 + V8 N/A Standard Suspension	V6 + V8 N/A Sport Suspension	V8 SC
Ventilated Disc 300 x 30 – Front	X		
Ventilated Disc 320 x 30 – Front		X	
Ventilated Disc 288 x 20 – Rear	X	X	
Aluminum Caliper - Front	X	X	
Iron Caliper - Rear	X	X	
Brembo Ventilated Disc 365 x 32 – Front			X
Brembo Solid Disc 330 x 15 – Rear			X
Brembo Caliper - Front			X
Brembo Caliper - Rear			X
Electric Parking Brake	X	X	X
Separate Park Brake Caliper - Rear			X
Steel Braided Hoses - Front and Rear	X	X	X

Table 2 Brake components

Brake Booster and Master Cylinder

A new 'plunger' type master-cylinder is incorporated, which protrudes less from the booster, this provides improved packaging and crash performance. The master cylinder is a tandem design so that in the event of one brake circuit failing the other will remain fully operational. The master cylinder shares a common fluid reservoir with the clutch system on manual derivative vehicles, and incorporates an integral fluid-level switch.

A new active brake booster is used providing a faster response especially at low temperatures. The booster also incorporates improved crash capability, through the elimination of the retaining studs used on the previous S-TYPE booster.

Panic Brake Assist

Studies found that in an emergency situation, a driver presses down on the brake pedal three times faster than in normal braking conditions, but without enough force. In the first second of application there is only a reflex reaction and after that, the driver responds to how the car is slowing and then pushes harder on the pedal to stop the vehicle. To aid the driver in bringing the vehicle to a halt more quickly in an emergency situation, the panic brake assist (PBA) system monitors the speed of brake pedal activation and at a calibrated activation speed, the PBA intervenes to provide more brake force to activate the ABS.

The PBA system is controlled by the ABS module, which monitors a pedal travel sensor that rests on the internal vacuum diaphragm of the brake booster. If the sensor's signal indicates an emergency situation is present, the ABS module will open an electric solenoid on the brake booster. The solenoid lets atmospheric pressure into the rear of the brake booster, causing the booster diaphragm to move forward to fully apply the brakes. PBA takes full benefit of ABS to stop the vehicle in a controlled manner and in the shortest distance possible. When the brake pedal is released the ABS module instantly releases the brakes.

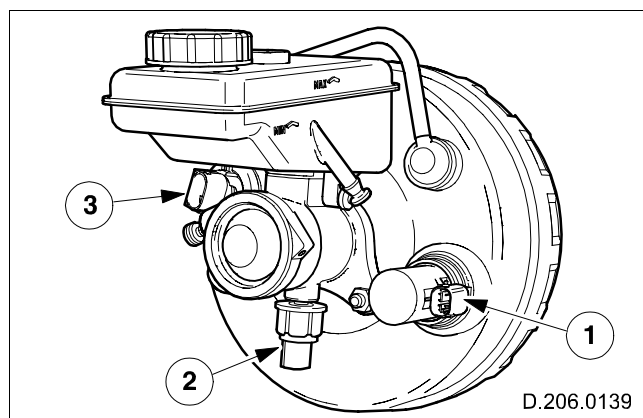


Fig. 9 Active brake booster

1. Pedal travel sensor
2. Pressure transducer
3. Active booster and brake pedal force switch — electrical connector

Anti-lock Braking System

The anti-lock braking system (ABS) is a four channel system having independent inputs from all four wheels. ABS is controlled by the ABS control module, which monitors signals from the wheel speed sensors to calculate the brake slip and the acceleration and deceleration of individual wheels. When the brake pedal is depressed, and the ABS control module detects incipient wheel lock-up from the incoming signals, it triggers the recirculation pump inside the hydraulic modulator and the solenoid valves for the wheel(s) concerned. Brake pressure is then modulated to increase/decrease or remain constant at the wheel(s) concerned until wheel lock-up is eliminated.

The ABS provides self-diagnosis and any malfunction within the system will be indicated to the driver by the anti-lock warning light illuminating. Should a fault develop within the ABS, the brake system will operate conventionally and with the same standard of performance as a vehicle not equipped with ABS.

Traction Control

The traction control (TC) system is part of dynamic stability control (DSC).

Traction control prevents excessive wheel-spin at standing starts, or during acceleration. Wheel-spin can be caused by excessive use of the accelerator, or slippery, loose or bumpy road surfaces. Excessive wheel-spin can lead to a loss of stability.

Such situations can be overcome by the intervention of the traction control system by:

- braking the driven-wheel when it starts to slip,
- and/or adapting the engine torque to a level corresponding to the traction available on the road surface.

Functional Description

Traction control uses the ABS electronic and mechanical/hydraulic hardware with additional valves (4) and control, to enable the system to generate braking pressure at the calipers, and an engine interface to enable the engine to respond to torque reduction requests from the traction control.

As with ABS, the signals from the wheel-speed sensors are supplied to the ABS/TC/DSC module. Where they are used to calculate the wheel slip of the individual wheels. Traction control intervention is initiated if the slip at one of the wheels is excessive.

Engine intervention

In the event of wheel slip the traction control module calculates the torque that should be applied by the engine to reduce the slip (this torque would never exceed driver demand). Engine torque reduction is then requested from the ECM via the CAN bus. The ECM, in response to these signals, reduces engine torque by controlling the ignition and fuelling.

On vehicles fitted with automatic transmission, a shift pattern is automatically selected to suit traction control conditions.

Brake intervention

This function operates so that the pressure will be increased in the brake caliper of the slipping wheel. This is achieved by closing the separation valve and the inlet valve of the non-slipping wheel and running the modulator pump. This takes fluid from the fluid reservoir via the non-actuated master cylinder and pressurizes the brake caliper. The pressure is then modulated at the caliper via the inlet and outlet valves to achieve the desired slip target to maximize traction.

Driver Interface

- Traction control is switched ON when the engine is started.

- When the system is operating, the warning light in the instrument cluster will flash, at the rate of twice a second.
- Traction control (and DSC) can be switched OFF by pressing the control switch, located in center console switchpack.
 - The warning light in the instrument cluster will illuminate continuously when the system is switched OFF.
 - A message will be displayed in the message center to indicate the system has been switched OFF.
 - If the control switch is pressed again the system will be switched ON.
- A malfunction in the traction control system will be indicated to the driver as described:
 - The warning light in the instrument cluster will illuminate continuously.
 - The message 'DSC NOT AVAILABLE' will be displayed in the message center with an associated amber light.
- If vehicle speed control is engaged it will automatically disengage when traction control is operating.

Dynamic Stability Control

Dynamic Stability Control (DSC) is a closed-loop system designed to enhance driving safety by improving vehicle handling when the tires are at the limits of their grip capabilities. This is achieved through instantaneous electronically controlled reduction of engine torque and strategic application of the brakes at individual wheels.

By using the principle that by controlling the brakes individually, it is possible, to an extent, to steer the vehicle. This principle can then be used to enhance driving safety by correcting the vehicle's yaw moment (turning force) when the vehicle fails to follow the driver's steering inputs.

Examples of DSC capabilities are listed below:

- When the vehicle fails to follow the driver's steering input, the DSC generates precisely defined braking forces at individual wheels to pull the vehicle into line. For example, in a left-hand bend a vehicle that oversteers tends to 'slide out' with the rear wheels, this motion is counteracted by applying the brake at the right-hand front wheel. This provides a corrective yaw moment and can reduce side forces at that wheel in order to stabilize the vehicle.
- Similarly in the same left-hand bend when the vehicle understeers, the vehicle tends to 'slide out' with the front wheels, this motion can be counteracted by applying the brakes at the left-hand rear wheel to generate a corrective yaw moment which helps to turn the vehicle.

- Even when the tires are at the limits of their grip, such as in sharp steering manoeuvres due to panic responses, DSC can intervene to reduce the dangers of skidding or breakaway.
- If understeer or oversteer is caused by excessive engine torque, the DSC will reduce the engine torque to provide the corrective yaw moment.

Driver Interface

- DSC can be switched OFF by pressing the switch on the centre console switchpack.
- 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.

NOTE: If speed (cruise) control is engaged, it will automatically disengage when DSC activates.

- A system malfunction is indicated by the message 'DSC NOT AVAILABLE' in the message center with an associated amber light.
- The warning light in the instrument cluster will also illuminate.

Dynamic Stability Control Concept

Satisfactory handling is determined according to whether a vehicle maintains a path, which accurately reflects the driver's input (steering wheel angle) while at the same time remaining stable.

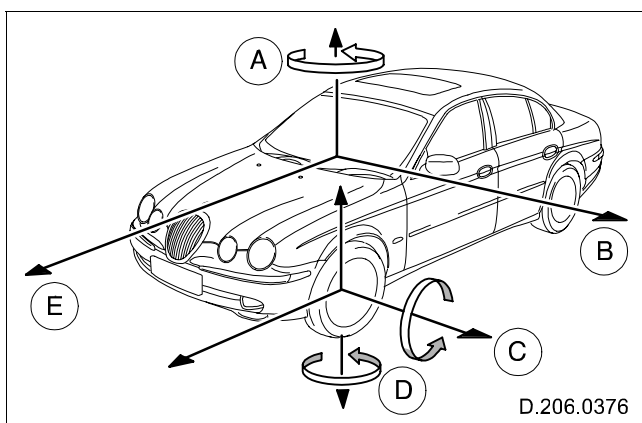


Fig. 10 Vehicle travel directions

- A. Yaw rate
- B. Lateral acceleration
- C. Wheel roll
- D. Steering motion
- E. Longitudinal acceleration

The DSC module measures the vehicle's motion using the sensors below and processes the information to maintain vehicle control and stability within its ultimate control limits, which are determined, by the physical limits set by the tire's grip.

- Longitudinal acceleration as measured through the wheel speed sensors;
- lateral acceleration as measured through the lateral acceleration sensor;
- and the yaw rate, defined as the rotation around the vertical axis, as measured by yaw rate sensor.

When there is insufficient tire grip for the driving situation (for example, the driver has entered a corner too fast) the DSC will maintain stability and optimize the cornering and stopping performance, but cannot always prevent the vehicle from running wide.

Driver demand is measured by using the steering wheel angle sensor and vehicle speed to calculate the optimum yaw rate. This is compared to the actual measured yaw-rate and a yaw-rate calculated from the lateral acceleration and the vehicle speed. If the deviation between these measurements is too great, an understeer or oversteer correction is made.

The first step in this process is to determine how the vehicle should respond to driver demand (ideal response) and how it actually does respond (actual response). Hydraulic control valves can then be activated to generate brake pressure and/or engine torque reduction can be used, to maintain the difference between the ideal and actual response within a tolerance band. This directly influences the forces on the tires to generate a corrective yaw moment to reduce the side forces of the tires where appropriate.

System Overview

The DSC system embraces capabilities far beyond that of ABS, or ABS and TC combined, while relying on the components of these systems. It also incorporates these additional sensors for measuring the vehicle's motion:

- yaw rate sensor,
- lateral acceleration sensor,
- steering angle sensor,
- brake master cylinder pressure sensor,
- and a control module to modulate braking and tractive forces where required to maintain vehicle stability.

The DSC control module supports data exchange with other vehicle electronic systems via the CAN; which also enables DTC interrogation via WDS.

The following components register driver demand and the DSC control module processes their signals as a basis for defining an ideal response:

- Electronic engine control system: position of accelerator pedal.
- Brake master cylinder pressure sensors: driver's braking effort.
- Steering angle sensor: position of steering wheel.

There are many supplementary parameters also included in the processing calculations these include the coefficient of friction and vehicle speed. The DSC control module monitors these factors based on signals transmitted by the sensors for:

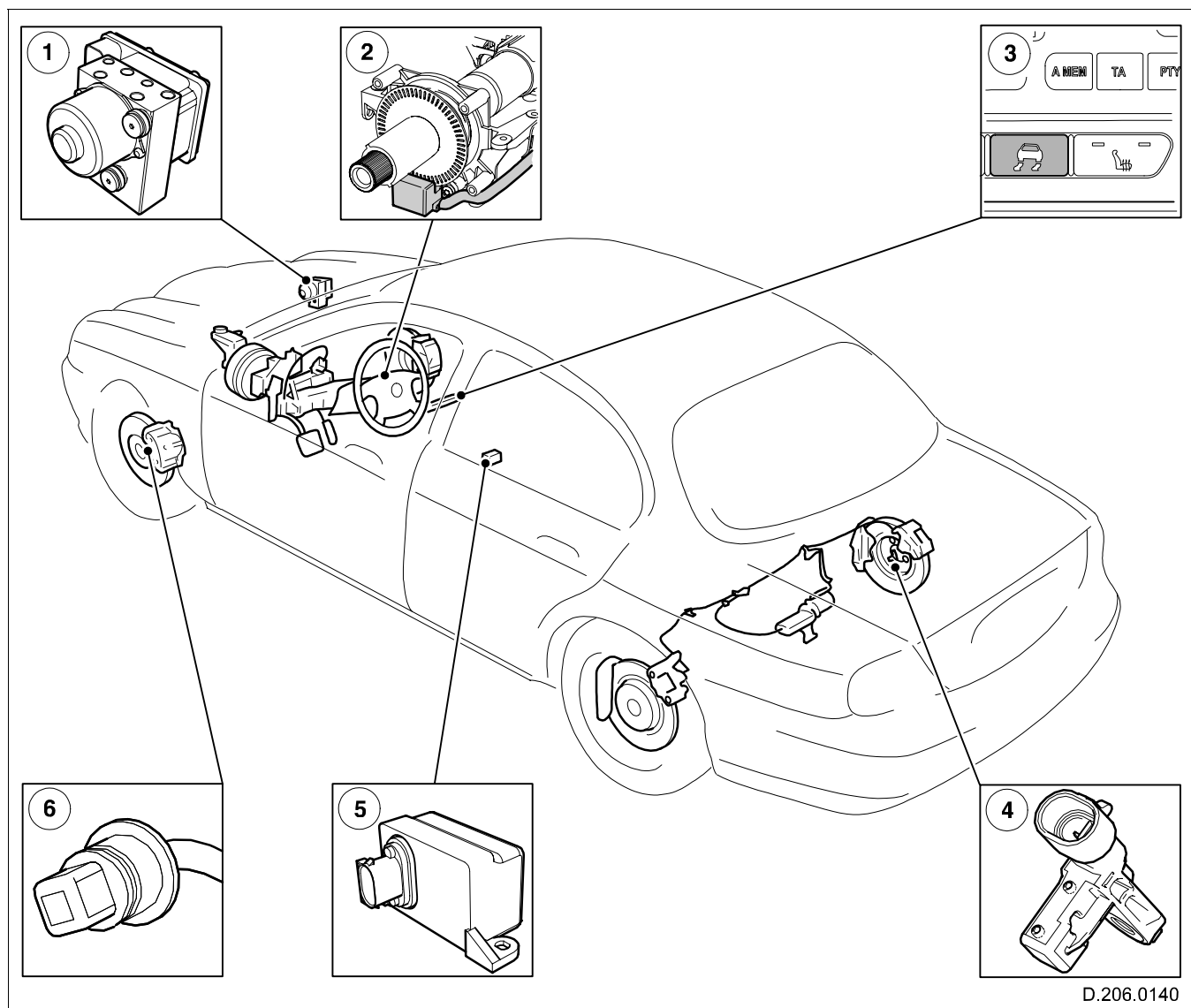
- wheel speed,
- lateral acceleration,
- brake pressure,
- and yaw rate.

Using these parameters, the function of the DSC control module is to determine the current vehicle status based on the yaw-rate signal and the slip as estimated by the DSC control module. It then maintains the vehicle response within a tolerance of the 'normal' behavior, which is easily controlled by the driver.

In order to generate the desired yaw behavior the DSC control module controls the selected wheels using the ABS hydraulic system and engine control system. In the event of engine intervention the DSC control module calculates the torque, which should be supplied by the engine to the wheels, and relays this request signal to the engine control module ECM, which implements the torque request.

The electronic engine control system in response to signals from the DSC reduces engine torque in three ways:

- The throttle is positioned to provide the requested engine target torque.
- During the transient phase of torque reduction caused by mechanical and combustion delays the other alternative torque reduction methods are used to provide a quicker response.
- The ignition is retarded and/or the fuel is cut-off at the injectors at selected cylinders.
- Ignition and fuelling are reinstated when the engine torque controlled by the throttle reaches the requested value.



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Fig. 11 Dynamic stability control components

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Hydraulic control unit with brake control module 2. Steering angle sensor 3. DSC switch | <ol style="list-style-type: none"> 4. Rear-wheel speed sensor 5. Yaw rate and lateral acceleration sensor 6. Front-wheel speed sensor |
|--|--|

Electric Parking Brake

An electric parking brake is fitted as standard to the S-TYPE, providing the following benefits over the conventional parking brake:

- 'Space' the deletion of conventional parking brake lever provides more vehicle interior space.
- 'Ease of use' the electric parking brake does not depend on the strength of the driver to achieve full parking brake application.
- 'Safety' the electric parking brake automatically applies when the ignition key is removed.

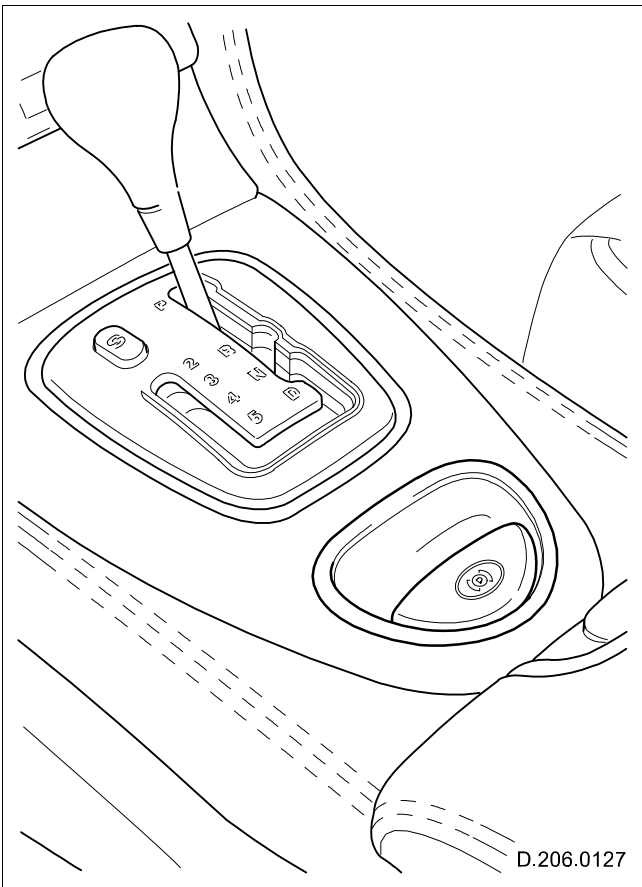


Fig. 12 Parking brake — operating switch

Driver Operation

The parking brake switch is mounted on the center console to the rear of the gear selector.

'Applying the parking brake'

- To apply the parking brake, 'pull and release' the switch. The switch will return to the neutral position. The 'Brake' warning light on the instrument cluster will illuminate.
- The parking brake automatically applies when the ignition key is removed. In circumstances when the parking brake needs to be disengaged when the ignition key is removed, hold the parking brake switch down and at the same time remove the key.
- When the ignition key is turned to position '0' or the key is removed, and parking brake has been applied, the 'Brake' warning light on the instrument cluster will illuminate for a short time.

'Releasing the parking brake (vehicle's with automatic transmission)'

- With the ignition switch in position 'II' or with the engine running, apply the foot brake and push the parking brake switch down.
- The parking brake will disengage if the vehicle is driven forward or reversed.
- The parking brake will automatically release when the gear selector is moved from the park 'P' position.

'Releasing the parking brake (vehicle's with manual transmission)'

- With the ignition switch in position 'II' or with the engine running, push the parking brake switch down.

Safety Functions

- If the parking brake is applied while the vehicle is moving, the message 'PARK BRAKE ON' will be displayed on the message center and a warning chime will sound.
- If the parking brake is applied while the vehicle is moving, push the parking switch down to release the parking brake. If the switch is in the neutral position after parking brake application, depressing the accelerator pedal will release the parking brake.

Components

The electric parking brake comprises the following components:

- Operating switch - center console.
- Parking brake module - located in the luggage compartment behind the right-hand-side wheel-arch liner.
- Motorized actuator unit and cables - mounted on the rear subframe.
 - The actuator mounting and cable routing is different on N/A and SC vehicles to correspond with the positioning of the calipers.
 - On N/A vehicles the brake and parking brake caliper are a combined unit.
 - On SC vehicles the brake caliper and parking brake caliper are separate units.

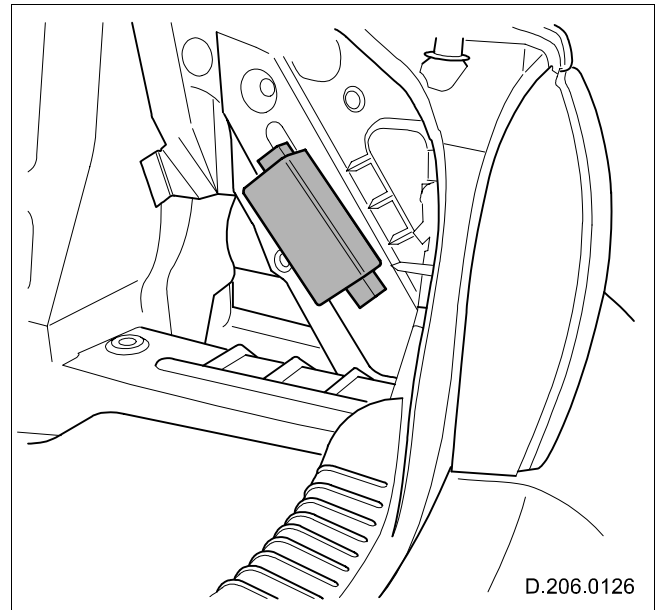
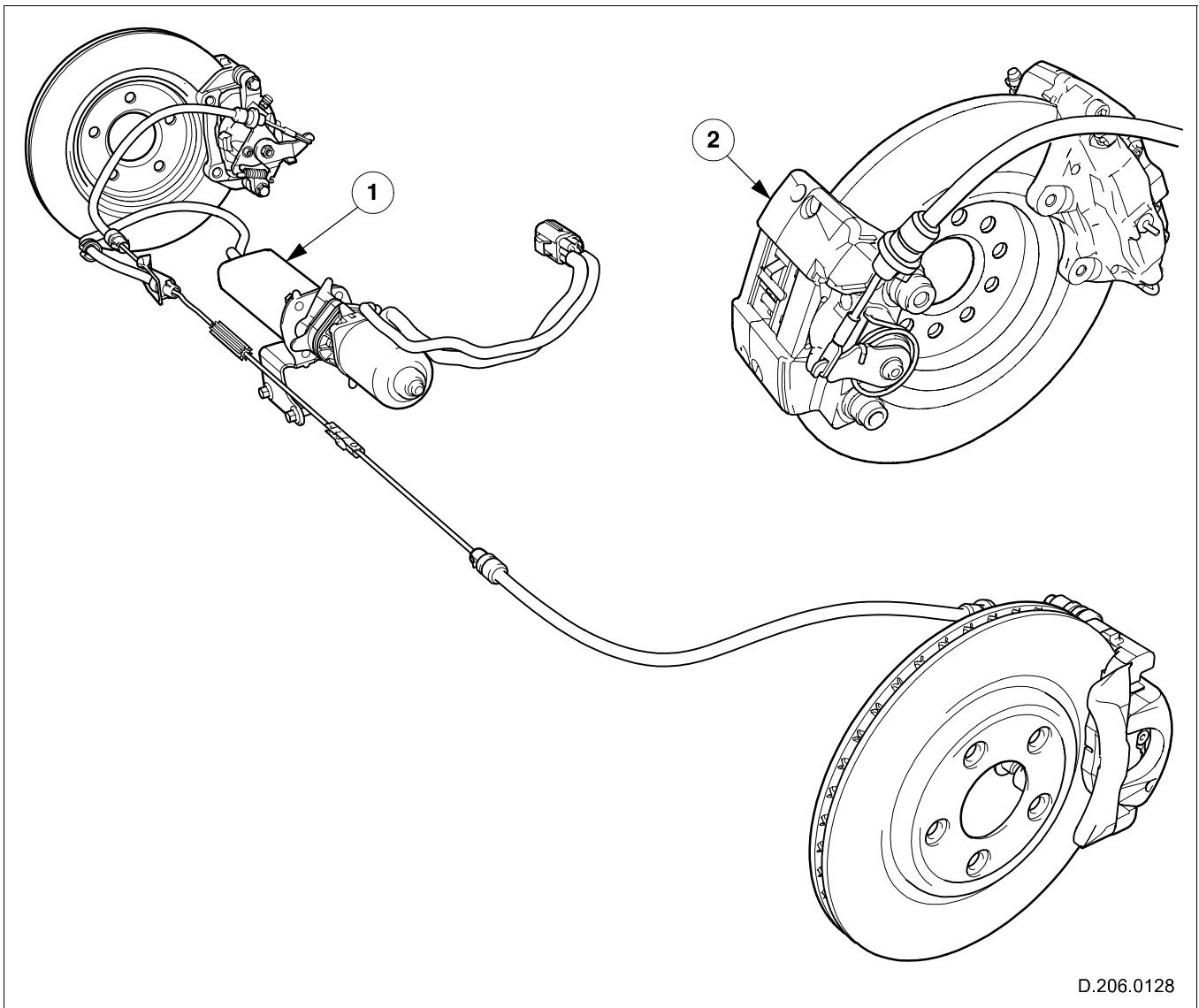


Fig. 13 Parking brake module



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Fig. 14 Actuator unit and cables

1. Actuator unit and cables — N/A vehicle arrangement
2. Parking brake caliper — SC vehicle arrangement

Mechanism and Activation

CAUTION: With the exception of emergency conditions, the electric parking brake should not be applied while the vehicle is moving.

There are three modes of parking brake operation dependant on vehicle speed:

- ‘Static’ speeds up to 3 km/h (2 mile/h), in this mode:
 - Application of the switch results in the parking brake being applied at full force.
- ‘Low Speed Dynamic’ speeds between 3 and 32 km/h (2 and 20 mile/h), in this mode:
 - The Parking brake will apply at full force to the corresponding time the switch is ‘pulled and held’ therefore, the parking brake will apply until the switch is released or the vehicle comes to a halt.
- ‘High Speed Dynamic’ speeds above 32 km/h (20 mile/h), in this mode:
 - One ‘pull and release’ of the switch will apply the parking brake for 500 ms to gently apply the parking brake. Each subsequent ‘pull and release’ of the switch will apply the parking brake for 250 ms. Full parking brake force will be met at between 3 and 4 ‘pull and releases’ of the switch.
 - If the switch is ‘pulled and held’ the parking brake will be automatically applied in a ramp-up sequence as follows:
 - ‘APPLY’ for 500 ms,
 - ‘HOLD’ for 500 ms,
 - ‘APPLY’ for 250 ms,
 - ‘HOLD’ for 500 ms,
 - ‘APPLY’ for 250 ms.

This sequence is repeated until full parking brake load is registered at the control module.

Drive-away Release (vehicle’s with automatic transmission only)

The parking brake will disengage if the vehicle is driven forward or reversed.

Activation of the drive-away release is functioned when the gear selector is in either ‘Drive’ or ‘Reverse’ and a positive throttle angle is detected.

Resetting the Parking Brake

If the electrical supply is disconnected from the electric parking-brake module, for example battery disconnection, the actuator will lose its actuator position memory. On battery connection a message ‘APPLY PARK BRAKE’ will be displayed when the ignition is next switched on. To reset the parking brake, depress the foot brake and pull the parking brake switch up.

Service

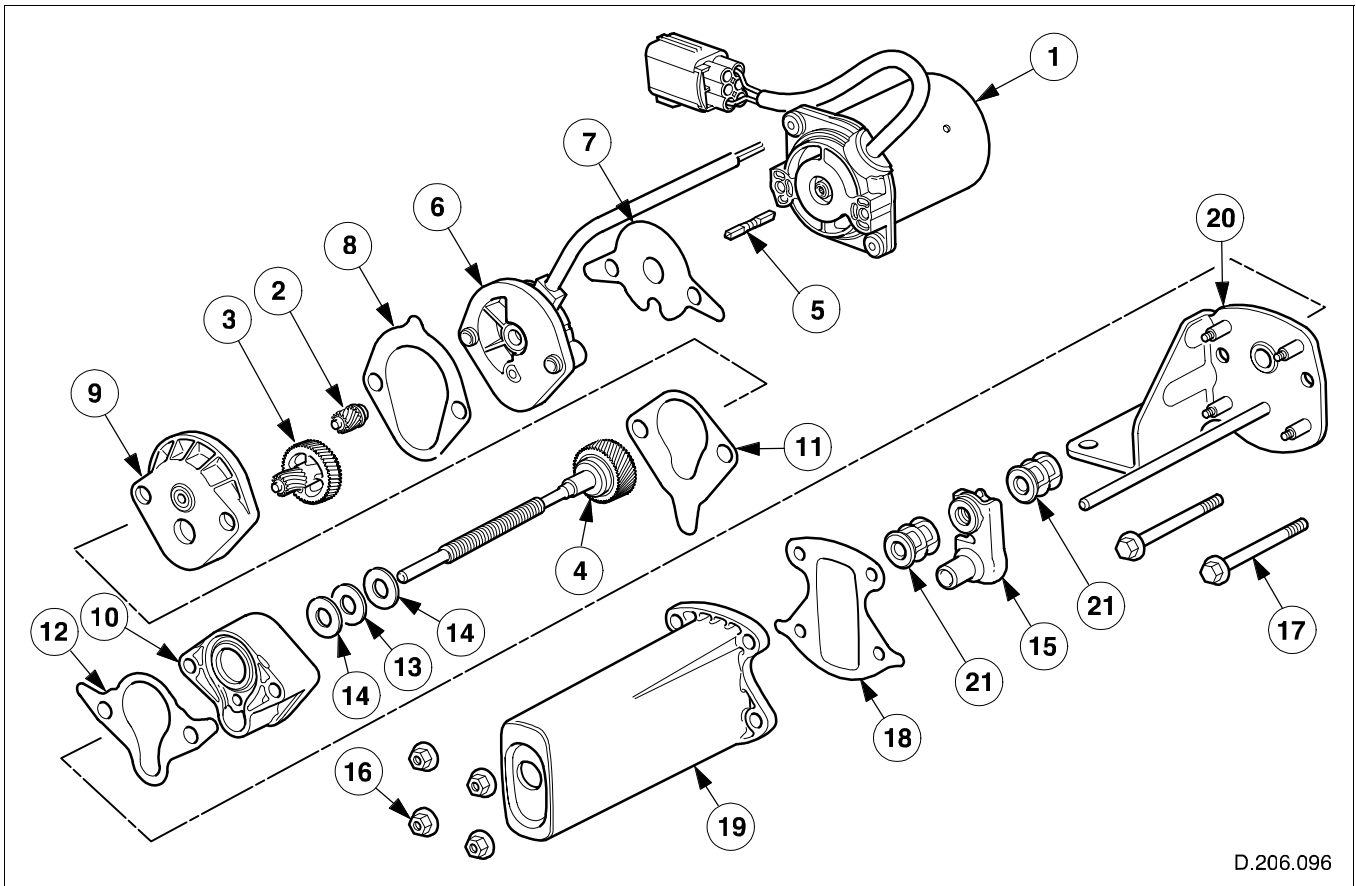
A service release is provided to de-couple the parking brake to allow work to be performed on the rear calipers. Refer to ‘JTIS’.

Diagnostics

Electric parking brake diagnosis is achieved using WDS.

Chassis

Actuator Internals



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Fig. 15 Motorized actuator unit — internals

- | | |
|-----------------------------------|----------------------------|
| 1. Motor | 12. Gasket end-cap bracket |
| 2. Gear pinion | 13. Thrust bearing |
| 3. Idler gear | 14. Thrust washer |
| 4. Gear-lead screw | 15. Drive nut |
| 5. Flex shaft | 16. Nut - cover |
| 6. End-plate transmission housing | 17. Bolt |
| 7. Gasket end-plate motor | 18. Gasket - cover |
| 8. Gasket end-plate housing | 19. Cover |
| 9. Transmission housing | 20. Bracket |
| 10. End-cap transmission housing | 21. Bumper |
| 11. Gasket end-cap housing | |

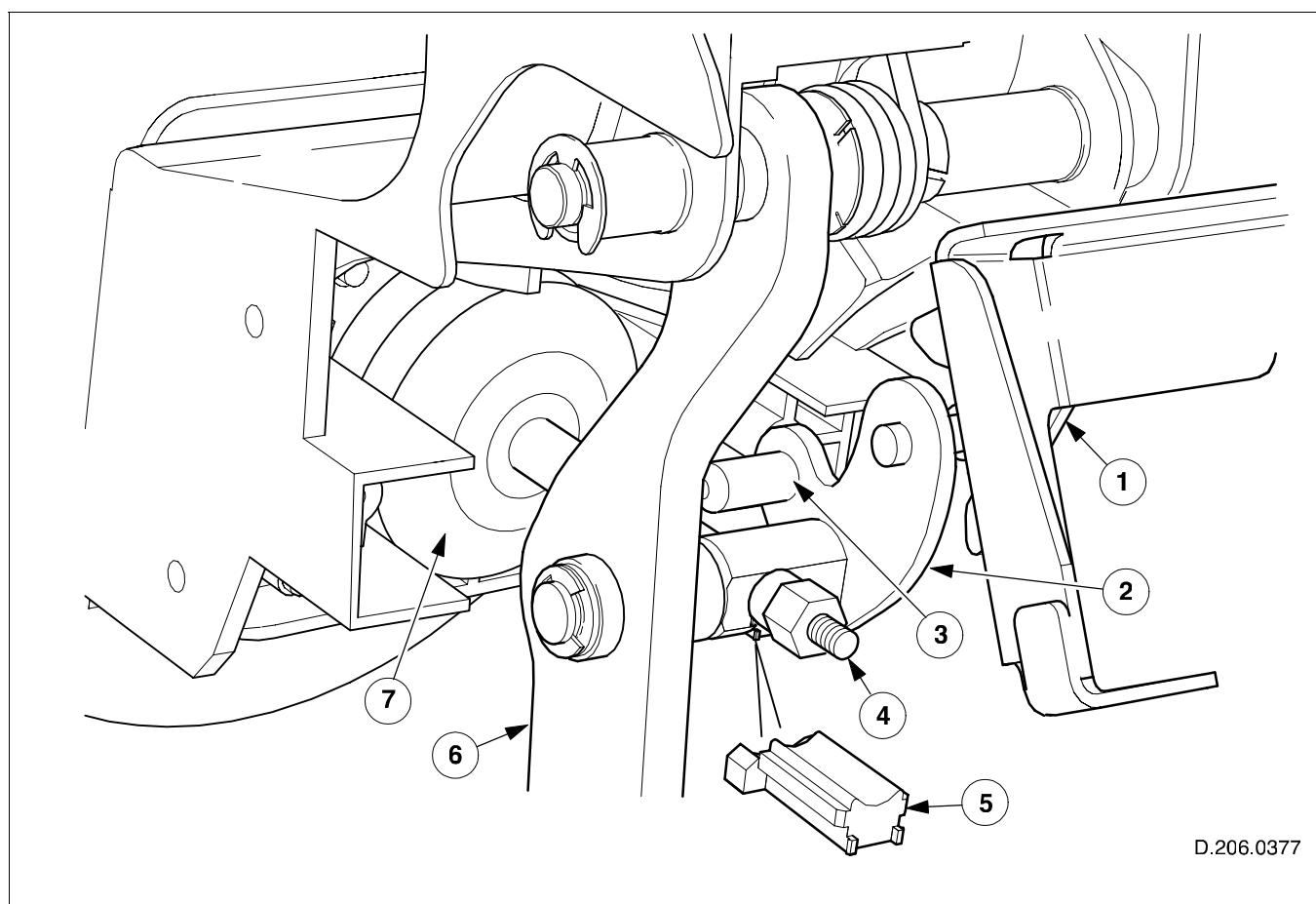
Brake Pedal

The brake pedal employs a safety device to reduce the risk of lower leg injuries to the driver.

In the event that the vehicle is involved in a severe frontal collision, the push-rod that connects the brake pedal to the brake booster becomes decoupled, allowing the brake pedal to pivot to the vehicle's floor.

The main components that allow the decoupling to take place are highlighted in **Fig. 16**.

In a severe frontal crash situation, the decoupling arm reacts against the decoupling bracket (which is mounted to the instrument panel via the upper steering column). The decoupling arm rotates, forcing the decoupling peg into contact with the booster push-rod. The downward pressure on the push-rod forces the plastic insert to break-away from the decoupling-arm assembly, allowing the push-rod to fall downward and the pedal to be pushed to the floor.



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Fig. 16 Brake pedal decoupling (switch bracket omitted for clarity)

- | | |
|-----------------------|-------------------|
| 1. Decoupling bracket | 5. Plastic insert |
| 2. Decoupling arm | 6. Brake pedal |
| 3. Decoupling peg | 7. Brake booster |
| 4. Booster push-rod | |

Pedal-adjustment System

The pedal-adjustment system is an optional installation, designed to allow drivers of particular statures, to improve their driving-position.

The system provides a range of adjustments up to a maximum of 2.75in (70mm) and comprises:

- general electronic control module (GECM);
- pedal-adjustment motor;
- pedal-adjustment sensor;
- pedal-adjustment switch.

The general electronic control module (GECM) controls the position of the pedals by providing an electrical output signal to the motor, in response to the:

- current position of the pedal-adjustment position sensor;
- pedal position chosen by the driver (using the pedal-adjustment switch).

NOTE: Using the driver switchpack, two different pedal-position settings may be stored in the vehicle memory-system.

Fig. 17 shows the basic system interconnections; refer to **S-TYPE Electrical Guide** for detailed information.

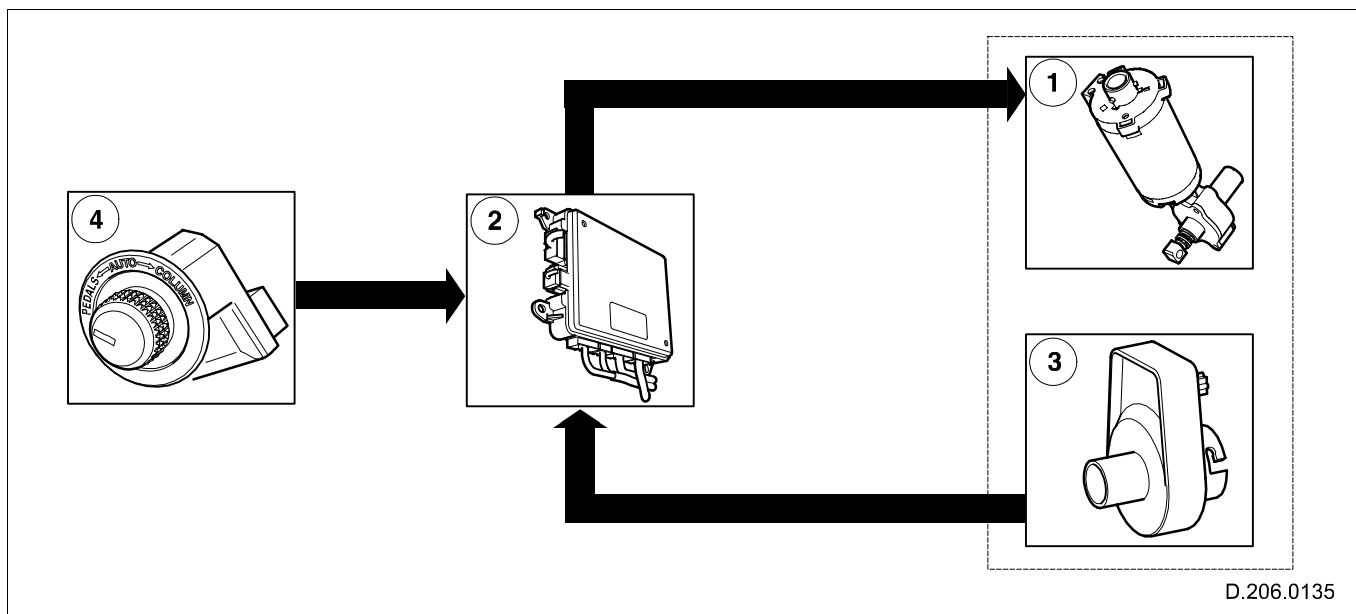


Fig. 17 Pedal adjustment system

1. Pedal-adjustment motor
2. GECM
3. Pedal-adjustment position sensor
4. Pedal-adjustment switch

The pedal-adjustment system:

- can be activated when the ignition key is in any position;
- cannot be activated when the ignition key has been removed;
- is inhibited during the operation of the adaptive speed control (where installed);
- requires initialization after any component of the system has been replaced; refer to **JTIS**.

NOTE: Diagnostics should be undertaken using WDS.

Pedal adjustment is enabled by setting the 3-way, rotary switch situated on the left-hand side of the steering column, to the appropriate position. Pedal adjustment is then controlled by operating the switch upwards, for pedals 'out' and downwards for pedals 'in'.

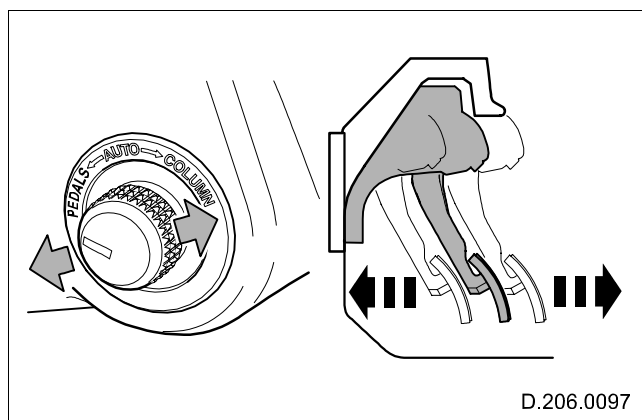
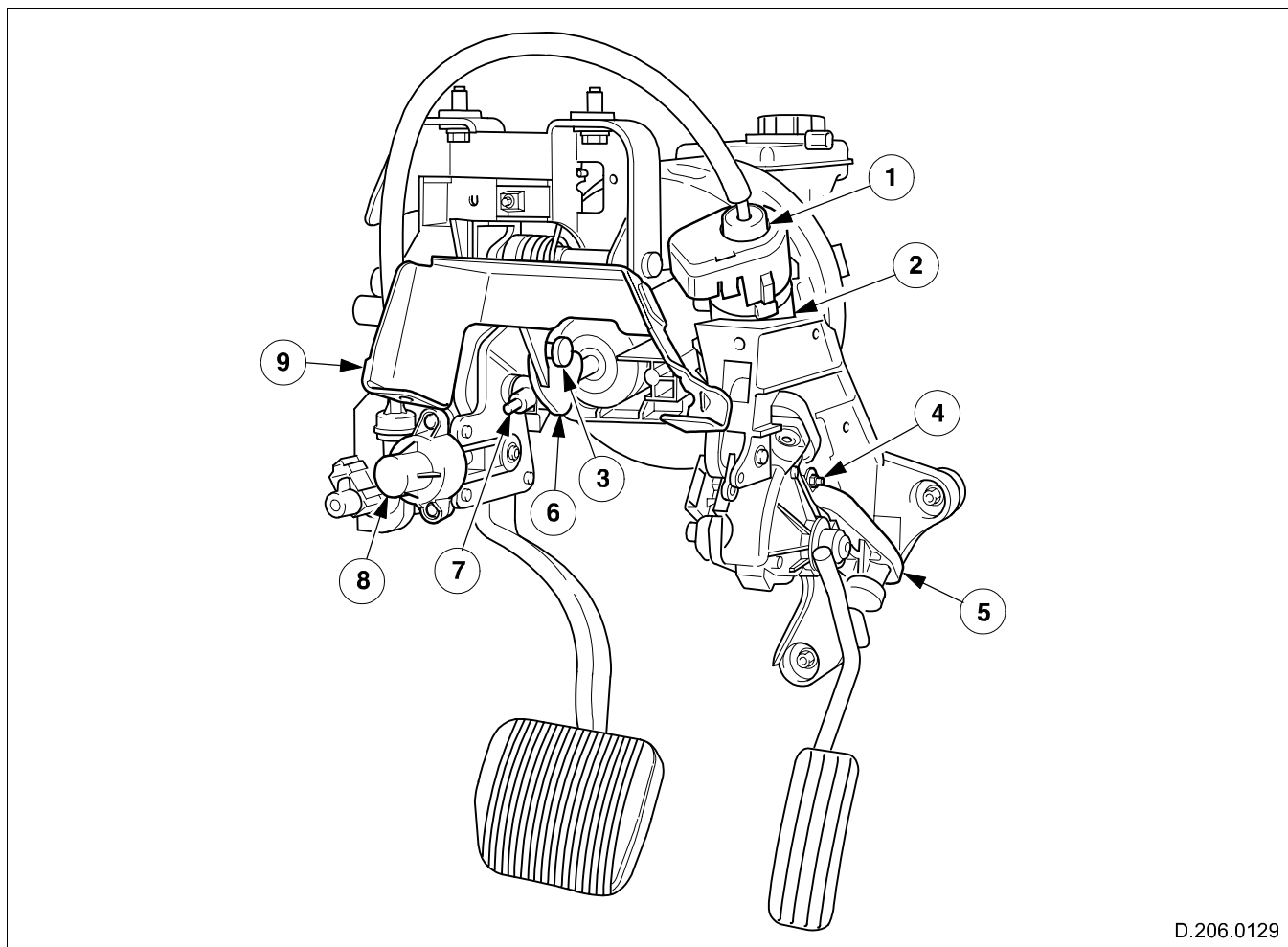


Fig. 18 Pedal-adjustment switch

Chassis

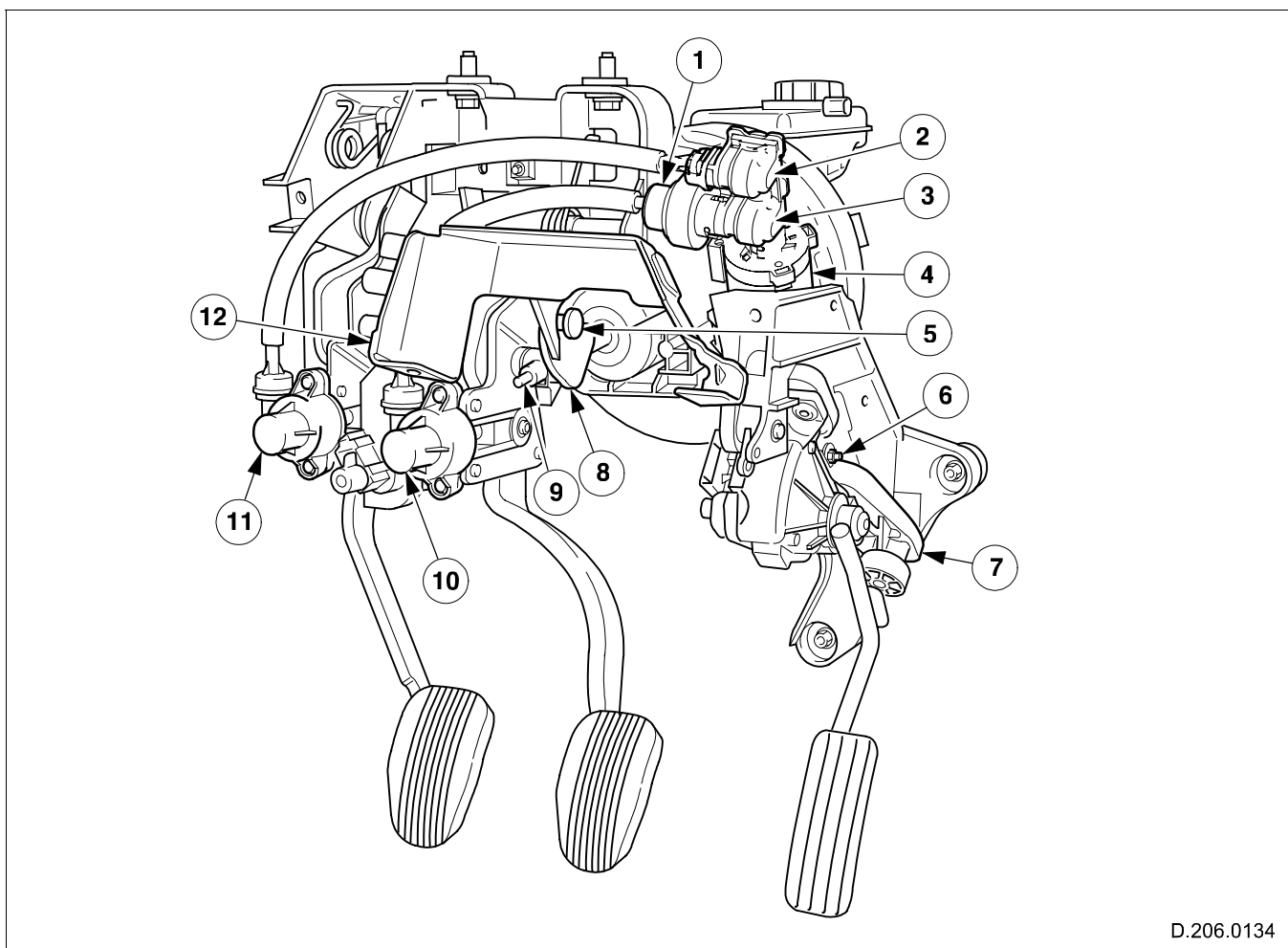
The pedal-adjustment motor connects directly to the accelerator-pedal module; a flexible drive-cable connects the motor to the pedal-adjustment drive-gear.



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Fig. 19 Pedal-adjustment assembly (automatic)

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



D.206.0134

Fig. 20 Pedal-adjustment assembly (manual)

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

Steering System

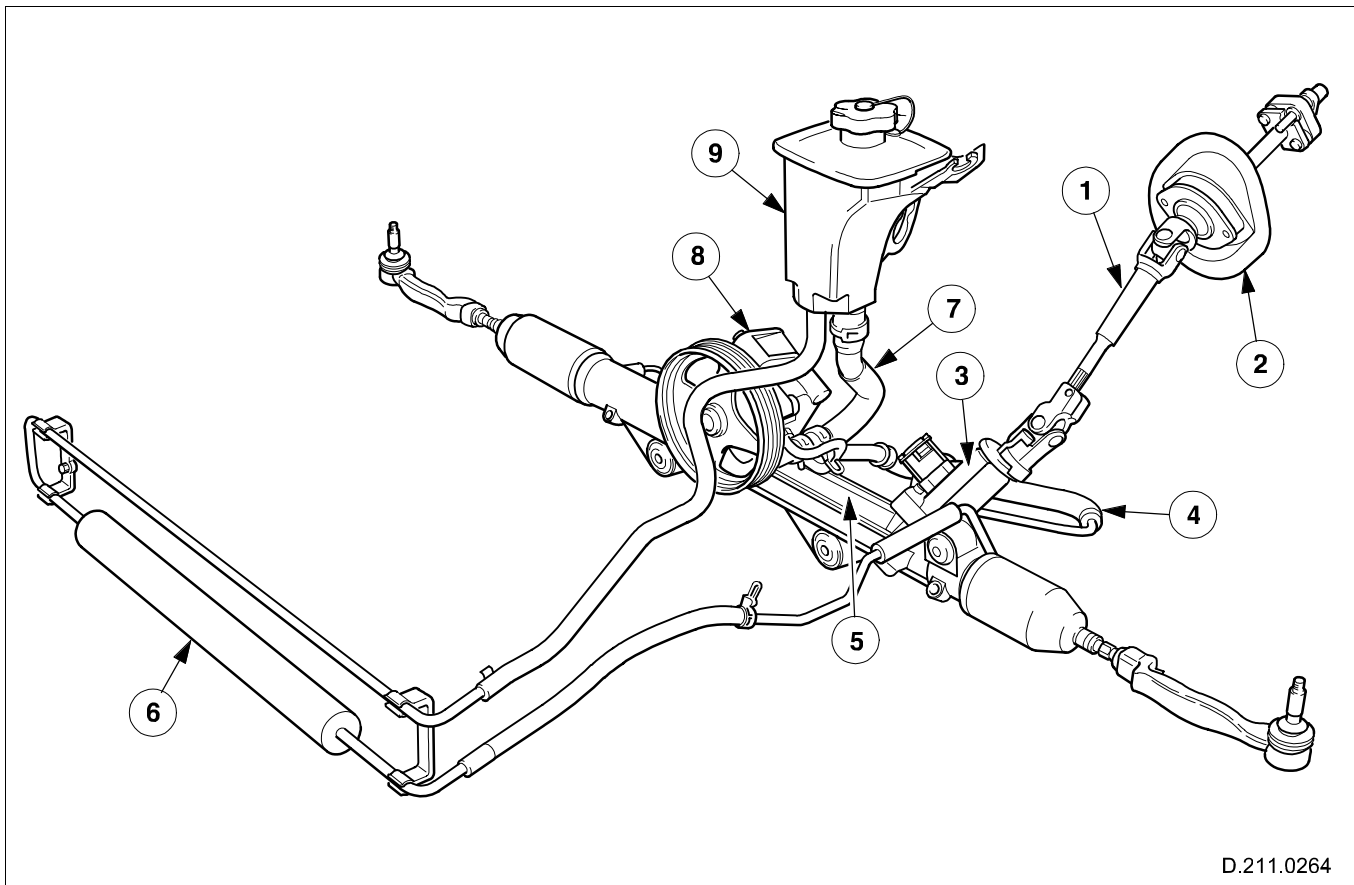
Introduction

The changes made to the suspension system, refer to **Suspension**, further enhance steering-feel. The steering system has also been retuned to complement the suspension changes and further enhance the vehicle's sports saloon characteristics.

Changes made to the steering system are listed below:

- New upper steering column, refer to **Steering Column**.
- New lower steering column, refer to **Steering Column**.
- The power-steering fluid cooler assembly is now a stand-alone unit, attached to and positioned in front of the engine cooling radiator.

- Steering rack alignment is now achieved by aligning the notch on the protection cover with the location hole in the pinion housing casting.
- The steering-rack pinion is now splined and is attached to the lower steering column via a splined universal joint.
- The hydraulic pressure switches have been deleted from the high pressure hoses, functionality is now integrated into the general electronic control module (GECM) which controls the Servotronic transducer.
- The power steering pump on the V8 engine has a smaller pulley than the V6 engine.



D.211.0264

Fig. 21 Steering system assembly

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

Servotronic Power Steering

The Servotronic power steering system operates using a conventional hydraulically operated rack and pinion, equipped with a rotary valve and added electronics to control the system's hydraulics. This system provides the driver with steering assistance proportional to the vehicle's speed:

- with full hydraulic power assistance provided at low vehicle speeds, for example when parking the vehicle;
- and a gradual reduction of hydraulic steering assistance as the vehicle speed increases, allowing the driver a precise feel of road contact.

Road speed data, as measured by the electronic speedometer is transmitted to the GECM by the instrument cluster using the SCP bus. The GECM uses the data to calculate the required supply current for the variable assisted power steering (VAPS) solenoid (part of the Servotronic transducer) based upon the VAPS curve data stored within the GECM's memory. On the basis of the amount of current supplied, the VAPS solenoid, which is attached to the rotary valve housing, controls the hydraulic reaction of the rotary valve, which determines the amount of torque the driver needs to apply to the steering wheel at various vehicle speeds.

A further advantage of the Servotronic system is the fact that the oil pressure and flow are never reduced and can therefore be utilized immediately in emergencies where sudden and unexpected steering corrections become necessary.

The power steering pump is mounted to the engine and is driven by the accessory drive belt. The pump provides a constant flow rate of 7.5 liters per minute and has a maximum pressure of 110 bars. The fluid reservoir incorporates a 10 micron internal filter to ensure cleanliness of the system.

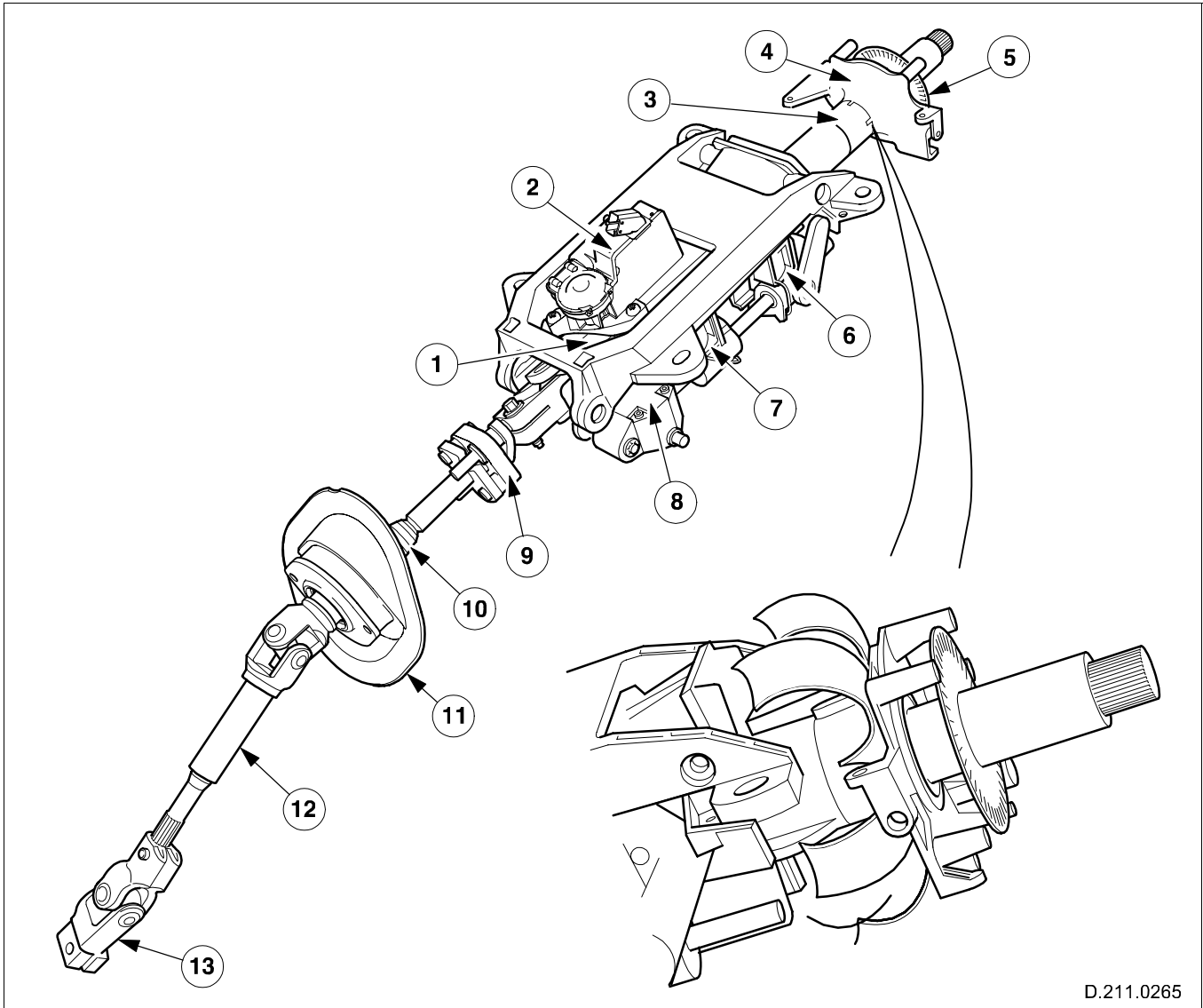
Steering Rack

The steering rack is a compact unit, which from lock-to-lock requires 2.8 steering-wheel turns. The rack is mounted via rubber bushes to the rear of the subframe. The rotary motion of the steering wheel is transformed by the pinion into an axial motion of the rack. The tie rods are attached at each end of the rack and transmit the motion to the wheel knuckles.

The steering rack is a variable ratio design, providing ease of parking manoeuvrability while maintaining the on-center steering precision required at high vehicle speeds.

The steering rack's pinion is now splined, the lower steering column attaches to the pinion via a splined universal-joint.

Steering Column



D.211.0265

Fig. 22 Steering column

- | | |
|--|-----------------------------------|
| 1. Upper column | 8. Adjustment motor |
| 2. Column lock | 9. NVH isolator |
| 3. Peeling-tube crash mechanism | 10. Lower column |
| 4. Crash adaptor | 11. Body seal and bearing |
| 5. Sensor ring — dynamic stability control | 12. Collapsible mechanism |
| 6. Rake adjustment housing, lever and solenoid | 13. Splined lower universal-joint |
| 7. Reach adjustment housing and solenoid | |

Upper Column

- The upper column is a new design attached to the in-vehicle cross-member.
- A unique crash-load absorption system is provided by a peeling-tube mechanism, refer to **Fig. 22**.
- The column is equipped with a sensor ring, which is monitored by the steering angle sensor for the dynamic stability control (DSC).
- All steering column electrical connections are made via a single ten-way connector module, mounted on the side of the column.
- Steering column adjustment is calibrated at vehicle production. If either the column or instrument cluster are replaced in service the steering column adjustment range must be calibrated using WDS.

Column adjustment

A single motor provides the drive for both the reach and rake adjustment of the column:

- reach adjustment is +/- 25 mm from the nominal setting,
- and +/- 2.5 degrees of rake adjustment from the nominal setting.

The steering column is adjusted for reach and rake by operating the rotary/joystick control switch on the left side of the steering column. Refer to **Fig. 23**.

1. Turn the switch to 'COLUMN'
2. Move the switch forwards or backwards to adjust reach.
3. Move the switch up or down to adjust rake.

Two column positions can be stored and recalled by the driver position memory system.

There is also an entry/exit mode to give the driver maximum room to enter and exit the vehicle. This mode is selected by setting the steering column adjustment switch to the 'AUTO' position. Then when either:

- the ignition key is removed,
- or the driver's door is opened with the ignition key in position '0' or '1',

the steering column will move to the uppermost rake position and the seat will move slightly rearwards.

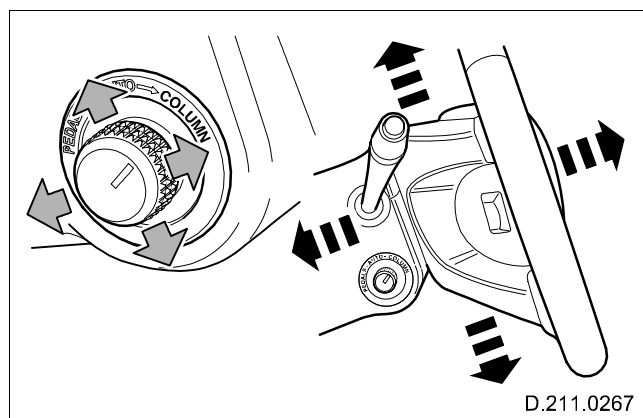


Fig. 23 Steering column adjustment

Steering column lock

The steering lock is remote from the ignition switch and controlled electronically. The lock engages when the key is removed from the ignition switch, while the vehicle is stationary. The lock will disengage when the key is placed in the ignition switch.

Steering column shrouds

The shroud comprises an upper and lower section. Contained in the lower shroud is an energy absorbing foam-pad/spreader plate to optimize leg protection in the event of an accident.

NOTE: If the foam pad is found to be damaged the lower shroud assembly must be replaced.

Lower Column

- The lower column incorporates a new crash-collapse mechanism in the lower section. It is a tube-in-tube arrangement, where the inner tube is designed to break-away from the crimped fixing of the outer tube at a predetermined load.
- The rubber isolator is now part of the lower column, and is located in the column's upper section. The isolator controls axial and torsional movements between the steering and suspension systems while also providing noise, vibration and harshness (NVH) damping.
- The body bearing seal is now part of the lower column assembly.
- The lower steering column attaches to the steering-rack's pinion via a splined universal-joint.

V6 Engine

Introduction

The 3.0 liter AJ-V6 engine, which includes the introduction of technology first seen in the X-TYPE, is an upgrade of the of the previous S-TYPE 3.0 liter engine. A 2.5 liter capacity engine, developed from the 3.0 liter engine, is also introduced into the S-TYPE.

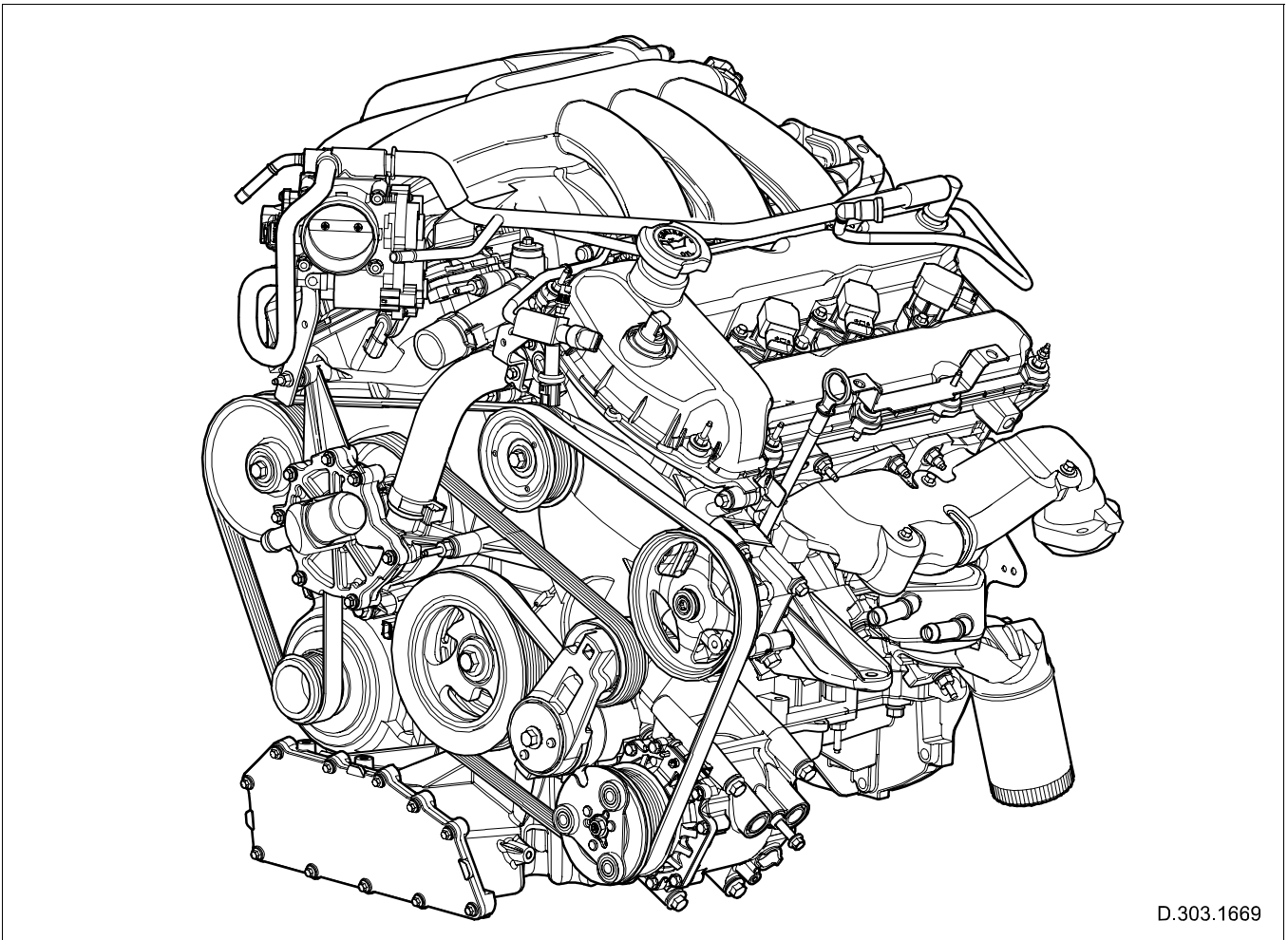
The following components, which are discussed in this section, are either new or revised for the 2003 MY S-TYPE application:

- Cylinder block
- Camshaft covers
- Cylinder heads
- Cylinder head gaskets
- Front engine cover
- Crankcase breather
- Variable valve timing

Base Engine

The engines are water-cooled six-cylinder units, arranged in two planes in a 60 degree 'V' configuration, comprising:

- Lightweight aluminum block with dry steel-liners.
- A steel crankshaft supported by four main-bearings.
- Aluminum pistons with valve cutouts in the crown to accommodate the advanced inlet timing of the variable valve timing (VVT) system.
- Connecting rods are sinter forged and fractured split.
- Two chain-driven overhead-camshafts per bank.
- Continuously VVT on the intake camshafts.
- Four-valves per cylinder, activated via direct acting mechanical bucket tappets with top mounted steel tappet shims.
- A lightweight aluminum engine-bedplate design, which combined with the inherent strength of the compact V6 configuration, minimizes vibration, increases torsional stiffness, and enhances engine refinement.
- Crankshaft mounted oil-pump, provides increased flow characteristics to supply VVT requirements.
- An intensive use of aluminium and some magnesium components to minimize engine weight.



D.303.1669

Fig. 24 V6 engine

Cylinder Block

Lightweight aluminium cylinder block with dry steel-liners. The 2.5 liter capacity is achieved by reducing the 3.0 liter's 89 mm bore size to 81.6 mm.

Camshaft Covers

Magnesium camshaft covers with rubber seals to reduce airborne noise.

Cylinder Heads

Aluminium cylinder heads with precision cooling technology, and square squish chambers to provide optimum economy and emissions.

- 3.0 liter cylinder heads are modified to accommodate new VVT system.
- 2.5 cylinder heads with smaller valves are manufactured to accommodate the smaller-bore cylinder block and new VVT system.

Cylinder Head Gaskets

New cylinder head gaskets for the 2.5 liter application.

Front Engine Cover

New single piece aluminium front cover to package the VVT units and water pump.

Crankcase Breather

The positive crankcase ventilation (PCV) valve, which regulates crankcase depression and controls the flow of crankcase gases into the intake manifold and the oil separator, is repositioned into the 'bank 2' camshaft cover.

Variable Valve Timing

The continuous variable valve timing (VVT) used on this engine is a further development of the two-positional system used on the previous S-TYPE 3.0L engine. Where instead of selecting one of two possible intake camshaft positions, the continuous system operates over a range of 30 degrees and is advanced or retarded to the optimum angle within this range. Continuing the theme of improved low and high-speed engine performance and excellent idle quality.

The VVT system changes the phasing of the intake valves, relative to the fixed timing of the exhaust valves, to alter:

- the mass of air-flow into the engine's cylinders,
- the engine's torque response and emissions.

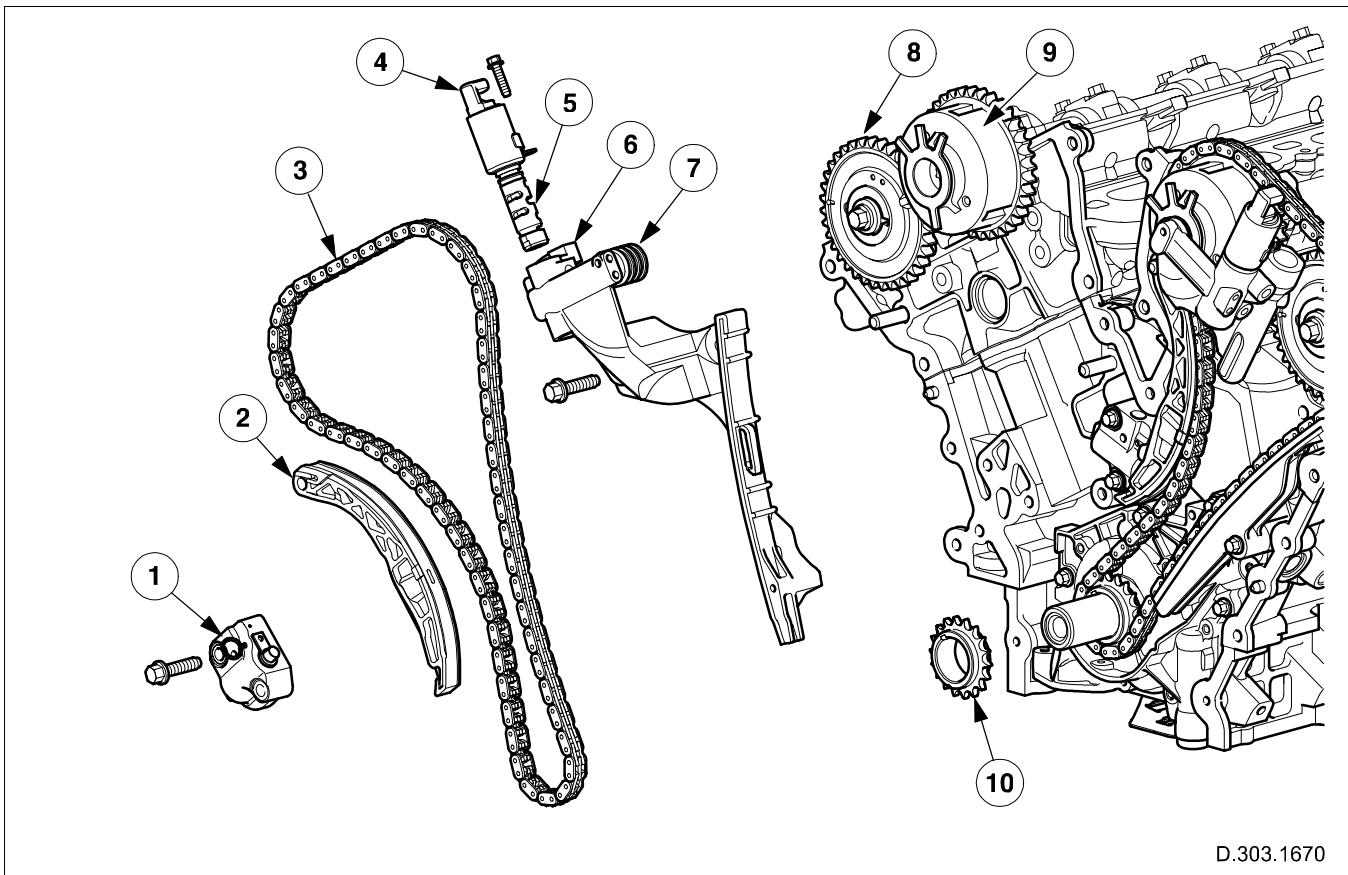
The VVT unit uses a vane device to control the camshaft angle, refer to **VVT Operation**.

The VVT is controlled by the engine control module (ECM), which uses engine control signals pertaining to engine speed and load, plus engine oil temperature to calculate the appropriate camshaft position.

The continuous VVT system provides the following advantages over the two-positional system:

- Reduces engine emissions and fuel consumption by further optimizing the camshaft timing, this improves the engine's internal exhaust gas recirculation (EGR) effect over a wider operating range, therefore eliminating the need for an external EGR system.
- Improved full-load torque characteristics as the camshaft timing can be optimized at all engine speeds for superior volumetric efficiency.
- Improves fuel economy by optimizing torque over the engine's speed range, this is not fully achievable with the two positional system.

The system also has the added benefits of operating at a lower oil pressure and faster response time.



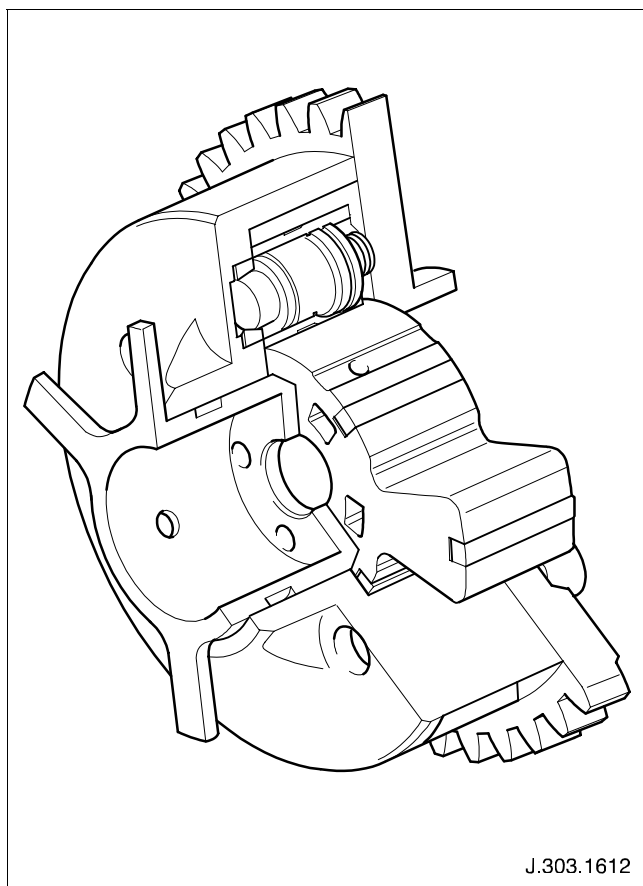
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Fig. 25 Timing gear

1. Tensioner
2. Tensioner arm
3. Timing chain
4. Oil control solenoid
5. Shuttle valve
6. Bush carrier and chain guide
7. Oil feed bush
8. Exhaust camshaft sprocket
9. VVT unit — intake camshaft
10. Crankshaft sprocket

VVT Operation

The VVT unit is a hydraulic actuator mounted on the end of the intake camshaft, which advances or retards the intake camshaft timing and thereby alters the camshaft to crankshaft phasing. The oil control solenoid, controlled by the ECM, routes oil pressure to either the advance or retard chambers located either side of the four vanes interspersed within the machined housing of the unit.



J.303.1612

Fig. 26 VVT unit

The VVT unit is driven by the timing chain and rotates relative to the exhaust camshaft sprocket. When the ECM requests the camshaft timing to advance, the oil control solenoid is energized moving the shuttle valve to the relevant position to allow engine oil pressure, via a filter, into the VVT unit's advance chambers. When the camshaft timing is requested to retard the shuttle valve moves position to allow oil pressure to exit the advance chambers, while simultaneously routing the oil pressure into the retard chambers.

When directed by the ECM the VVT unit will be set to the optimal position between full advance and retard for a particular engine speed and load. This is achieved by the ECM rapidly pulsing the energizing signal to the oil control solenoid. Due to this rapid pulsing the shuttle valve assumes a position between the limits of its travel and is continuously controlled by the ECM to maintain the requested camshaft angle. The actual position of the intake camshaft is monitored by the camshaft position sensor, which transmits signals to the ECM.

Engine oil properties and temperature can affect the ability of the VVT mechanism to follow demand changes to the cam phase angle. The VVT system is normally under closed-loop control except in extreme temperature conditions. For example, at very-low oil temperatures, such as cold starts below 0° Celsius, movement of the VVT mechanism is sluggish due to increased viscosity and may have to be limited by the ECM. Similarly, at extremely high oil temperatures the ECM may have to limit the amount of VVT advance to prevent the engine from stalling when returning to idle speed.

V8 Engine

Introduction

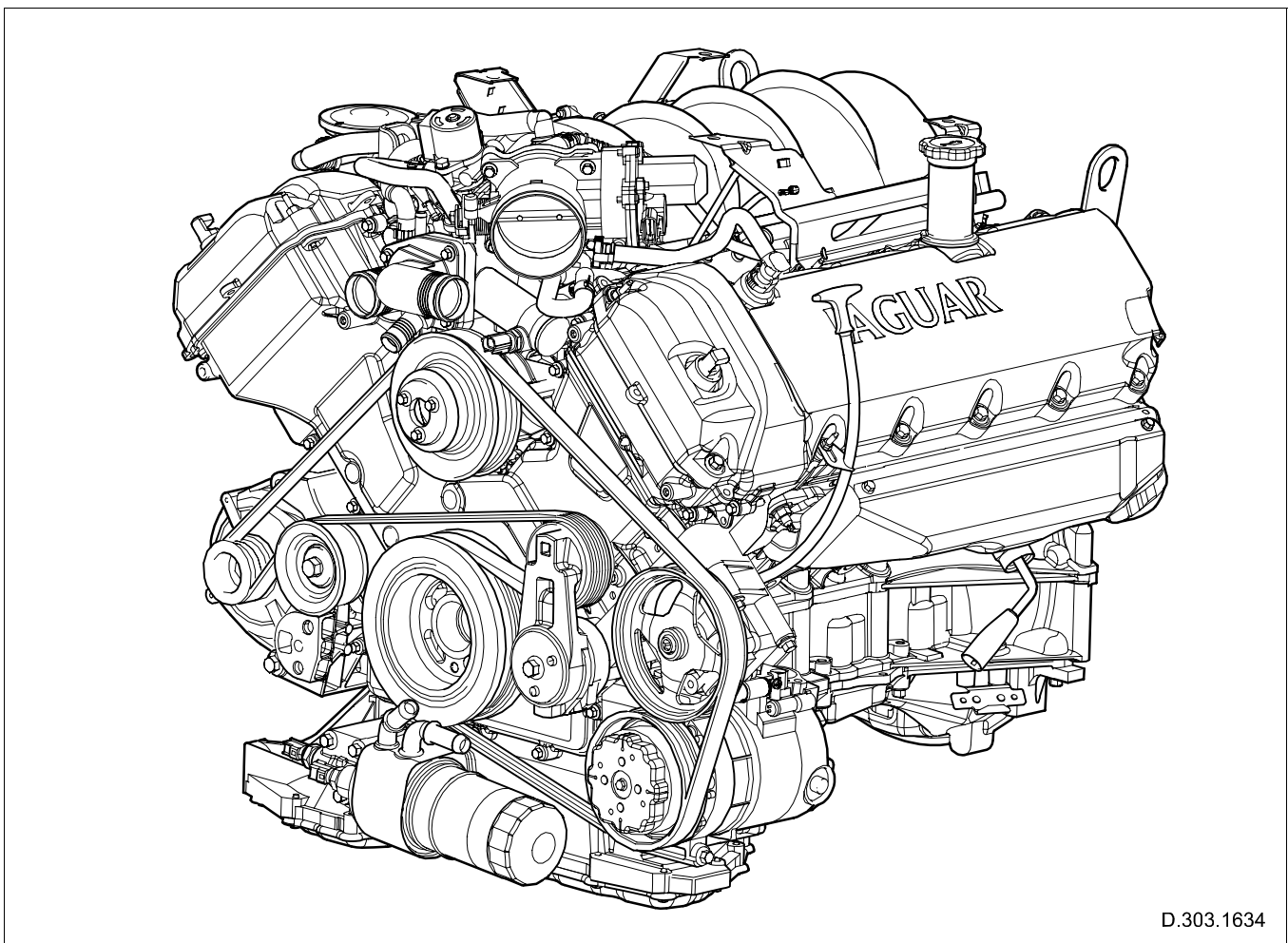
The AJ-V8 4.2 liter engine is an upgrade and replacement of the previous S-TYPE 4.0 liter V8 engine. Improvements made to the engine provide better performance, economy, and refinement, while also meeting both LEV2 and Stage-3 emission standards. An intensive use of aluminium components provide a low engine-weight.

In addition to the normally aspirated (N/A) engine, there is the introduction of a supercharged (SC) unit for the 'R' derivative S-TYPE.

Base Engine

The water-cooled engine, is constructed of aluminium alloy with eight cast-iron cylinder liners, arranged in two-planes in a 90-degree 'V' configuration. The crankshaft is supported by five main bearings. Two chain-driven overhead camshafts per bank activate four valves per cylinder via direct acting bucket tappets.

New and upgraded engine features are discussed in this section.



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Fig. 27 V8 normally aspirated engine

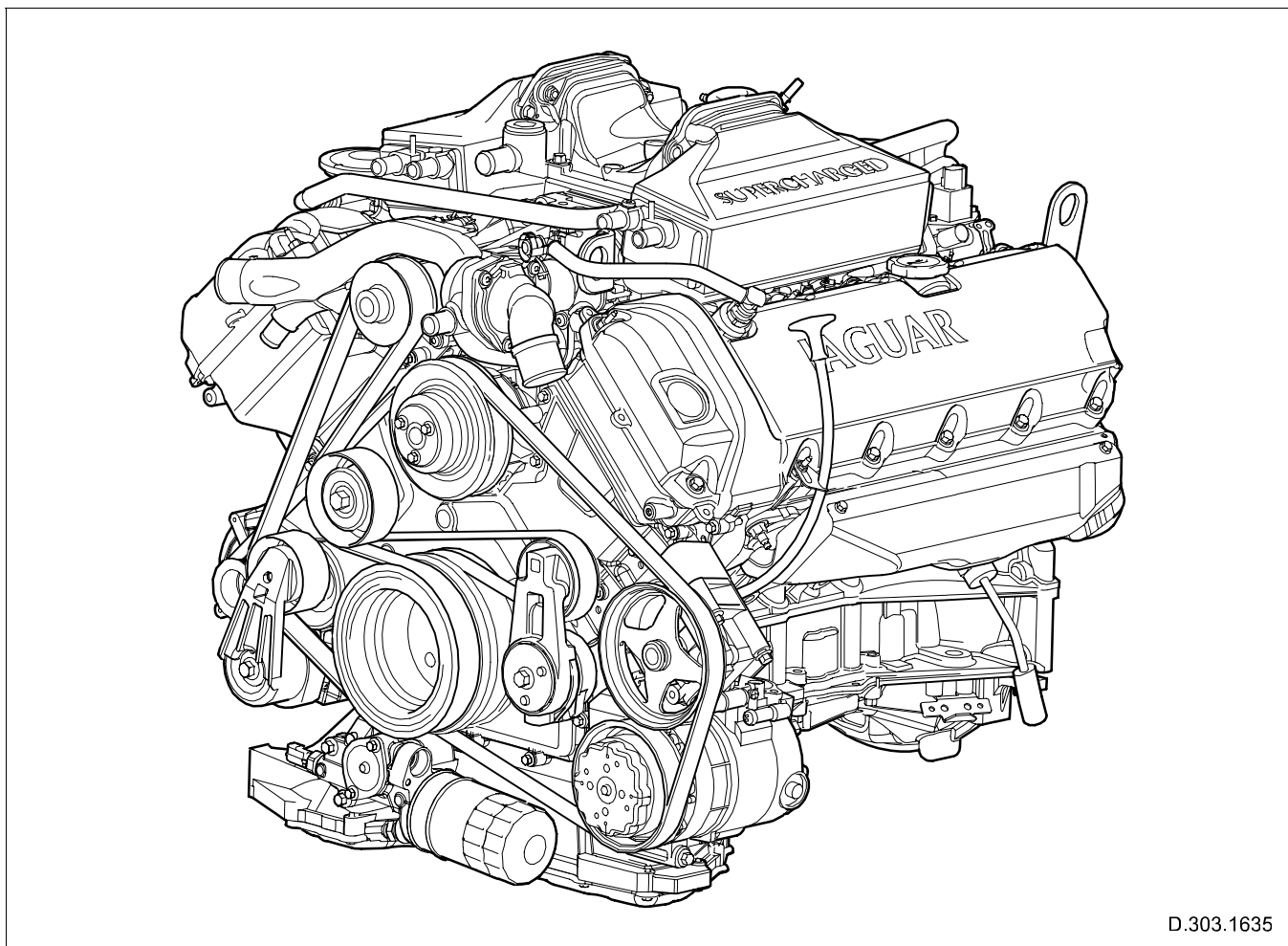


Fig. 28 V8 supercharged engine

Cylinder Heads

The cylinder heads, which are unique to each cylinder bank, have been modified:

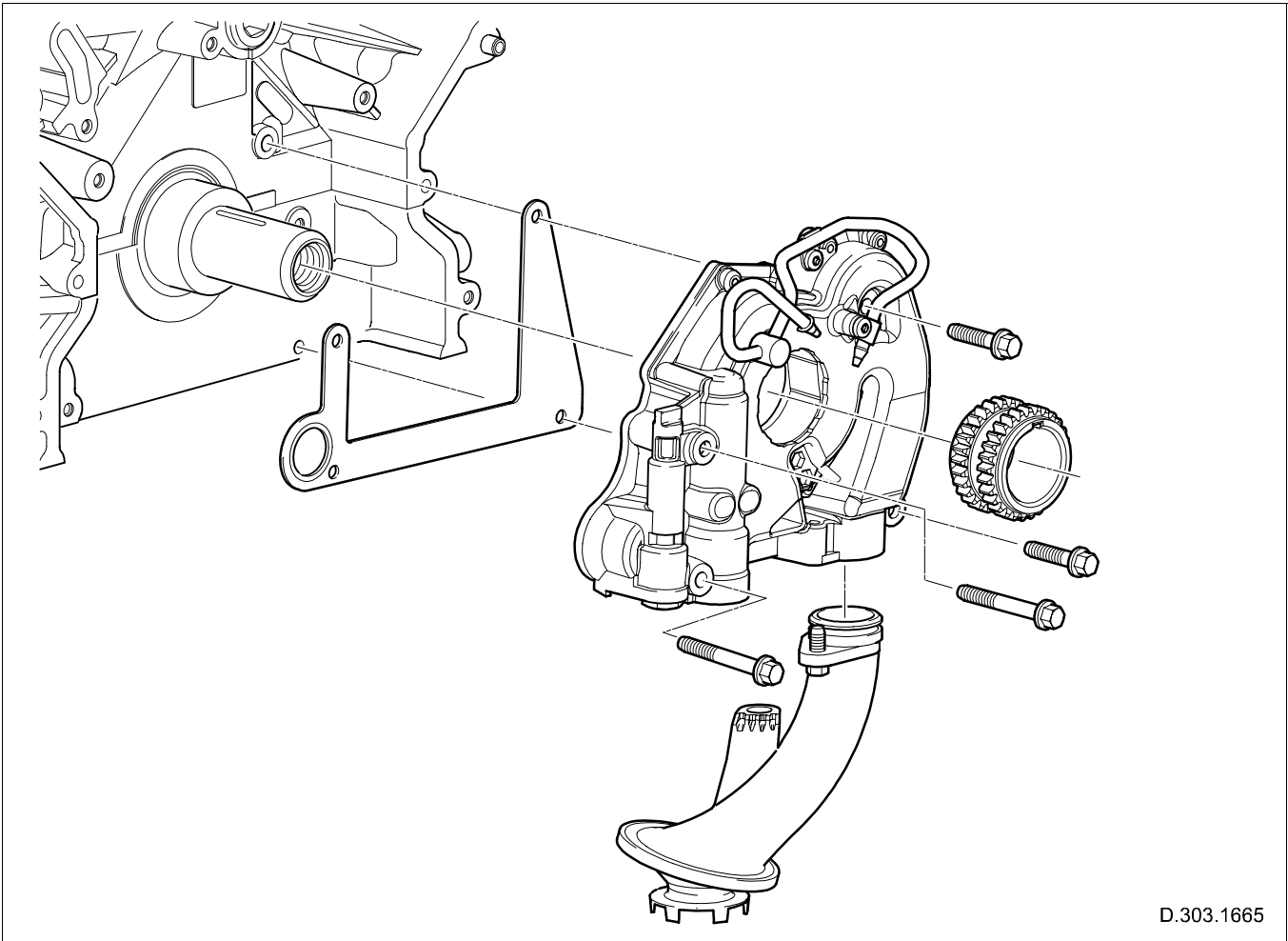
- The intake ports have been reworked to improve volumetric efficiency.
- The combustion chamber has been redesigned with the inclusion of squish areas around the valves to improve economy and emissions.
- New thinner cylinder head gaskets are introduced, constructed from multi-layer steel with sintered steel combustion rings.
- The engine lifting-eye, which was part of the cylinder-head cast, has been replaced by a threaded hole to accept a steel lifting-bracket.

Engine Lubrication

The lubrication system has been upgraded for improved variable valve timing (VVT) response on N/A engines. The pumping element is an eccentric rotor, directly driven by the crankshaft. The pump's inlet is supplied from a directly mounted pick-up pipe, and the outlet port aligns directly with the oil passage in the engine's bedplate. An integral pressure relief valve regulates pump pressure at 4.7 bar.

The pump includes two squirt jets, directly mounted to the pump, for lubrication of the primary chain. An over-pressure valve is also incorporated within the pump to protect engine components during cold starts.

Supercharged variants incorporate an oil-diverter valve installed in the pump's outlet passage to the inlet of the oil-filter head. The valve is thermostatically controlled and at high engine temperatures diverts the oil through to the engine's oil cooler.



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Fig. 29 Oil pump

Primary Chain

A new primary chain is introduced, which has a reduced pitch and inverted tooth design to provide improved acoustic damping. The chain tensioners, crankshaft and camshaft sprockets have also been modified to accommodate the new design of primary chain.

In addition, the crankshaft's primary-chain sprocket is now a one-piece unit located on the crankshaft by a woodruff key. A revised tuned torsional-vibration-damper retains the sprocket in position.

The primary chain and crankshaft sprockets are lubricated by two squirt-jets directly mounted to the oil pump.

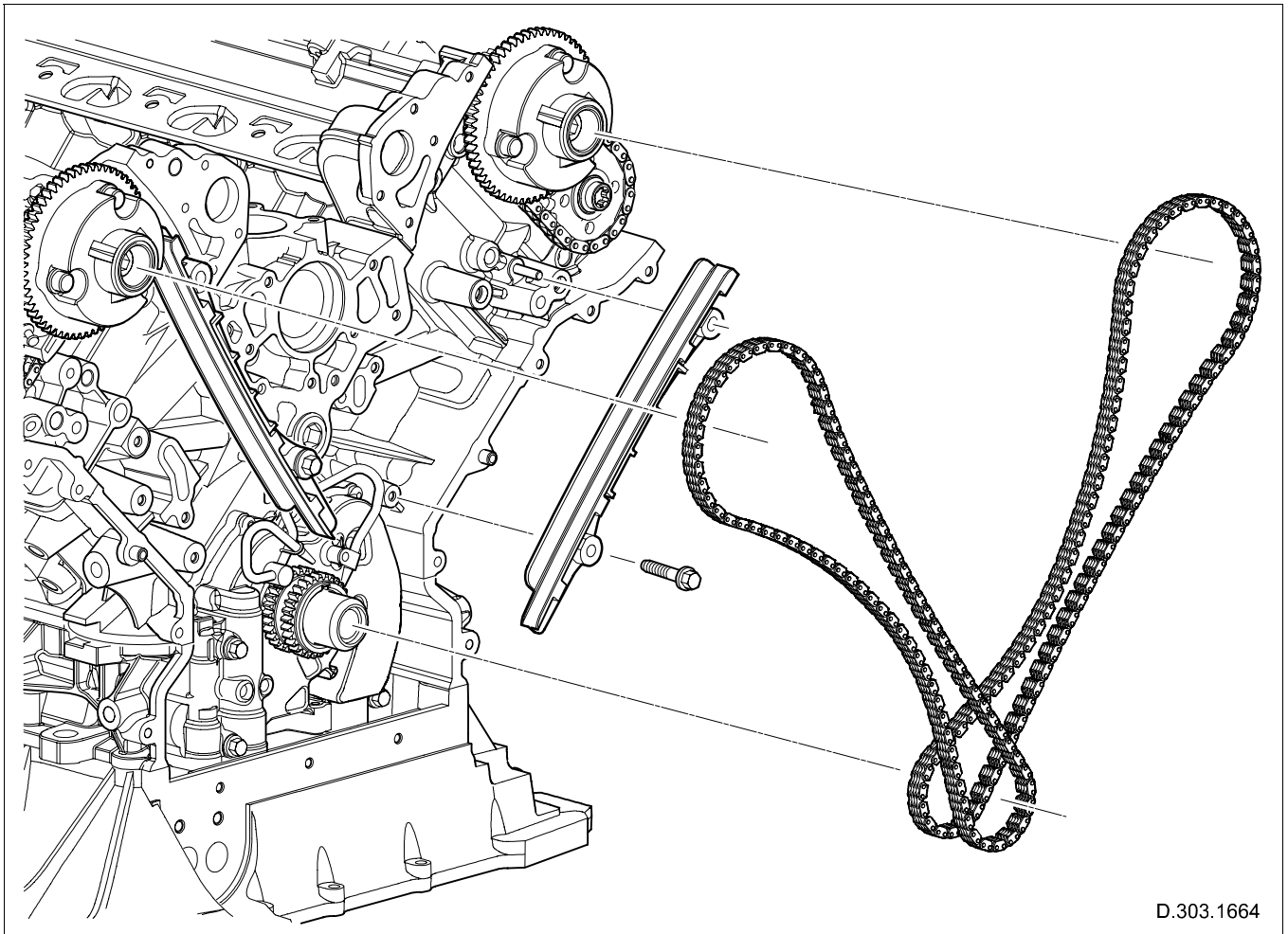


Fig. 30 Primary chain

Pistons

The pistons are a lightweight design with reduced crown height. A new piston ring pack is introduced to contain increased combustion gas-pressure and enhance temperature performance.

- The N/A piston is cast aluminum with a three-piece oil control ring.
- For improved robustness the SC piston is forged aluminum with a two-piece ultra compact oil control ring.
 - The SC engine also employs piston-cooling jets, which inject oil underneath the pistons to provide improved temperature control.

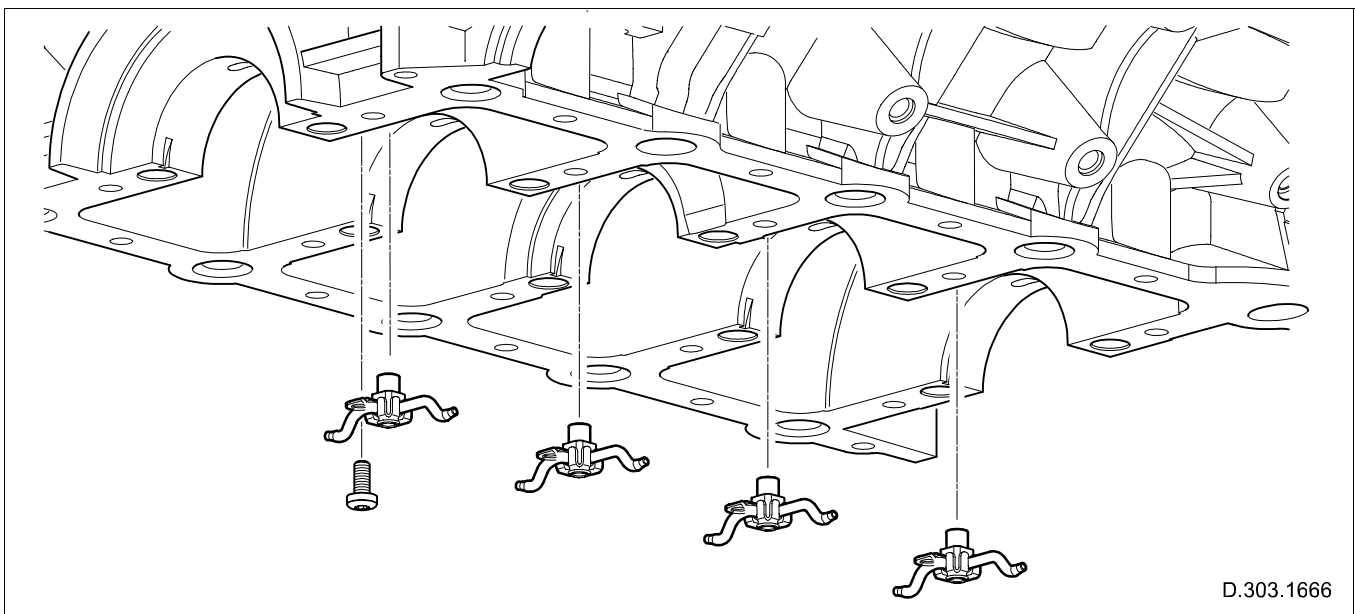


Fig. 31 Piston cooling jets — supercharged engine only

Crankshaft

The crankshaft stroke has been increased for 4.2 liter displacement. To reflect the stroke increase the crank-pin journal diameter has been reduced to accommodate the revised stroke within existing cylinder block constraints.

Connecting Rods

Connecting rods are sinter forged and fractured split. The small-end bearings have a 'Y' style oil groove for optimized bearing surface area.

Engine Bedplate

Structural changes have been made to the bedplate to improve its rigidity. This minimizes vibration therefore enhancing engine refinement.

Fuel Injectors

New multi-hole injectors are introduced, providing a spray performance equivalent to that of air-assist injection, with the addition of improved targeting. Therefore air-assist has been deleted.

Exhaust Manifold

The exhaust manifolds are now manufactured from cast stainless steel. On the N/A engine the manifolds are branched, providing a tuning effect that optimizes air/fuel ratio distribution. This provides increased performance throughout the engine's speed range and improved emissions. The exhaust manifold on the SC engine remains as the conventional 'log' design.

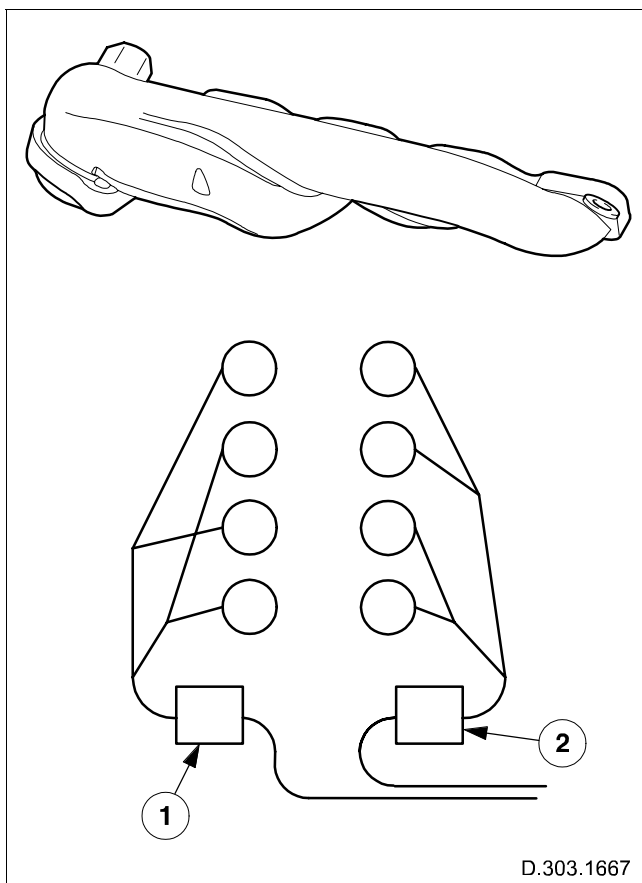


Fig. 32 Branched exhaust manifold - N/A engines

1. Catalytic converter left-hand
2. Catalytic converter right-hand

Variable Valve Timing (normally aspirated engine)

The continuous variable valve timing (VVT) on the normally aspirated engine continues the theme of improved low and high-speed engine performance and excellent idle quality.

The VVT system changes the phasing of the intake valves, relative to the fixed timing of the exhaust valves, to alter:

- the mass of air-flow into the engine's cylinders,
- and the engine's torque response and emissions.

Although the principle function of this VVT system is the same as that used on the V8 (AJ-27) engine, the internal operating components of this VVT unit are different. Instead of a helical gear construction this VVT unit uses a vane device to control the camshaft angle, refer to **VVT Operation**. The system operates over a range of 48 degrees and is advanced or retarded to the optimum angle within this range.

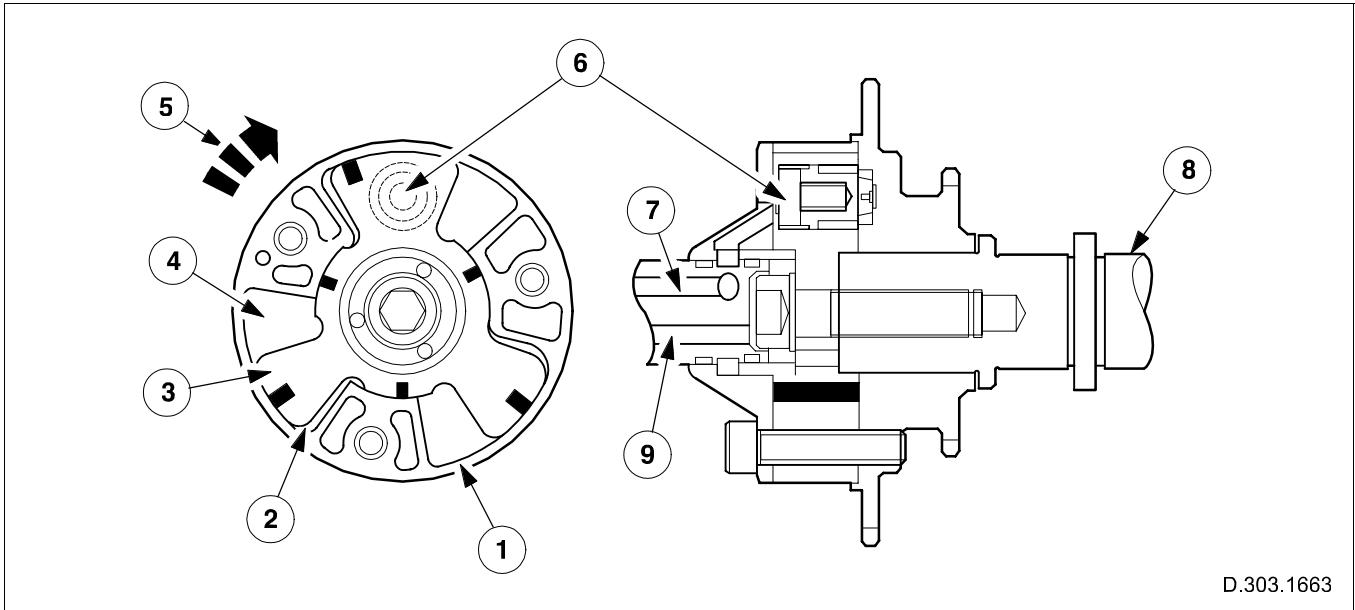
The VVT is controlled by the engine control module (ECM), which uses engine control signals pertaining to engine speed and load, and engine oil temperature to calculate the appropriate camshaft position.

The continuous VVT system provides the following advantages:

- Reduces engine emissions and fuel consumption by further optimizing the camshaft timing, this improves the engine's internal exhaust gas recirculation (EGR) effect over a wider operating range.
- Improved full-load torque characteristics as the camshaft timing can be optimized at all engine speeds for superior volumetric efficiency.
- Improves fuel economy by optimizing torque over the engine's speed range.

This system also has the added benefits of operating at a lower oil pressure and faster response time.

VVT Operation



D.303.1663

Fig. 33 VVT unit

- | | |
|--|---|
| <ul style="list-style-type: none"> 1. Vane housing 2. Advance chamber 3. Vane shaft 4. Retard chamber 5. Rotation direction | <ul style="list-style-type: none"> 6. Stopper pin 7. Advance chamber oil-channel 8. Intake camshaft 9. Retard chamber oil-channel |
|--|---|

The VVT unit is a hydraulic actuator mounted on the end of the intake camshaft, which advances or retards the intake camshaft timing and thereby alters the camshaft to crankshaft phasing. The oil control solenoid, controlled by the ECM, routes oil pressure to either the advance or retard chambers located either side of the three vanes interspersed within the machined housing of the unit.

The VVT unit is driven by the timing chain and rotates relative to the exhaust camshaft sprocket. When the ECM requests the camshaft timing to advance, the oil control solenoid is energized moving the shuttle valve to the relevant position to allow engine oil pressure, via a filter, into the VVT unit's advance chambers. When the camshaft timing is requested to retard the shuttle valve moves position to allow oil pressure to exit the advance chambers, while simultaneously routing the oil pressure into the retard chambers.

When directed by the ECM the VVT unit will be set to the optimal position between full advance and retard for a particular engine speed and load. This is achieved by the ECM rapidly pulsing the energizing signal to the oil control

solenoid. Due to this rapid pulsing the shuttle valve assumes a position between the limits of its travel and is continuously controlled by the ECM to maintain the requested camshaft angle. The actual position of the intake camshaft is monitored by the camshaft position sensor, which transmits signals to the ECM.

Engine oil properties and temperature can affect the ability of the VVT mechanism to follow demand changes to the cam phase angle. At very low oil temperatures, movement of the VVT mechanism is sluggish due to increased viscosity and at high temperatures the reduced viscosity may impair operation if the oil pressure is too low. To maintain satisfactory VVT performance, an increased capacity oil pump is installed and an engine oil temperature sensor to enable monitoring by the ECM. The VVT system is normally under closed-loop control except in extreme temperature conditions: such as cold starts below 0° Celsius. At extremely high oil temperatures the ECM may limit the amount of VVT advance to prevent the engine from stalling when returning to idle speed.

Engine Cooling

Cooling Pack Assembly

The cooling pack assembly is common to all derivatives and comprises:

- Radiator.
- Cooling fan (incorporating brushless motor with integral speed controller).
- Condenser (with integral receiver-drier).
- Transmission fluid cooler (integral to the radiator end-tank); refer to **Automatic Transmission**.
- Coolant expansion tank (with integral bleed screw).

NOTE: The coolant drain-plug is located beneath the radiator end-tank.

Vehicles fitted with V8 engine have the following additional components:

- Dual coolant-flow valve.
- Auxiliary coolant flow pump.

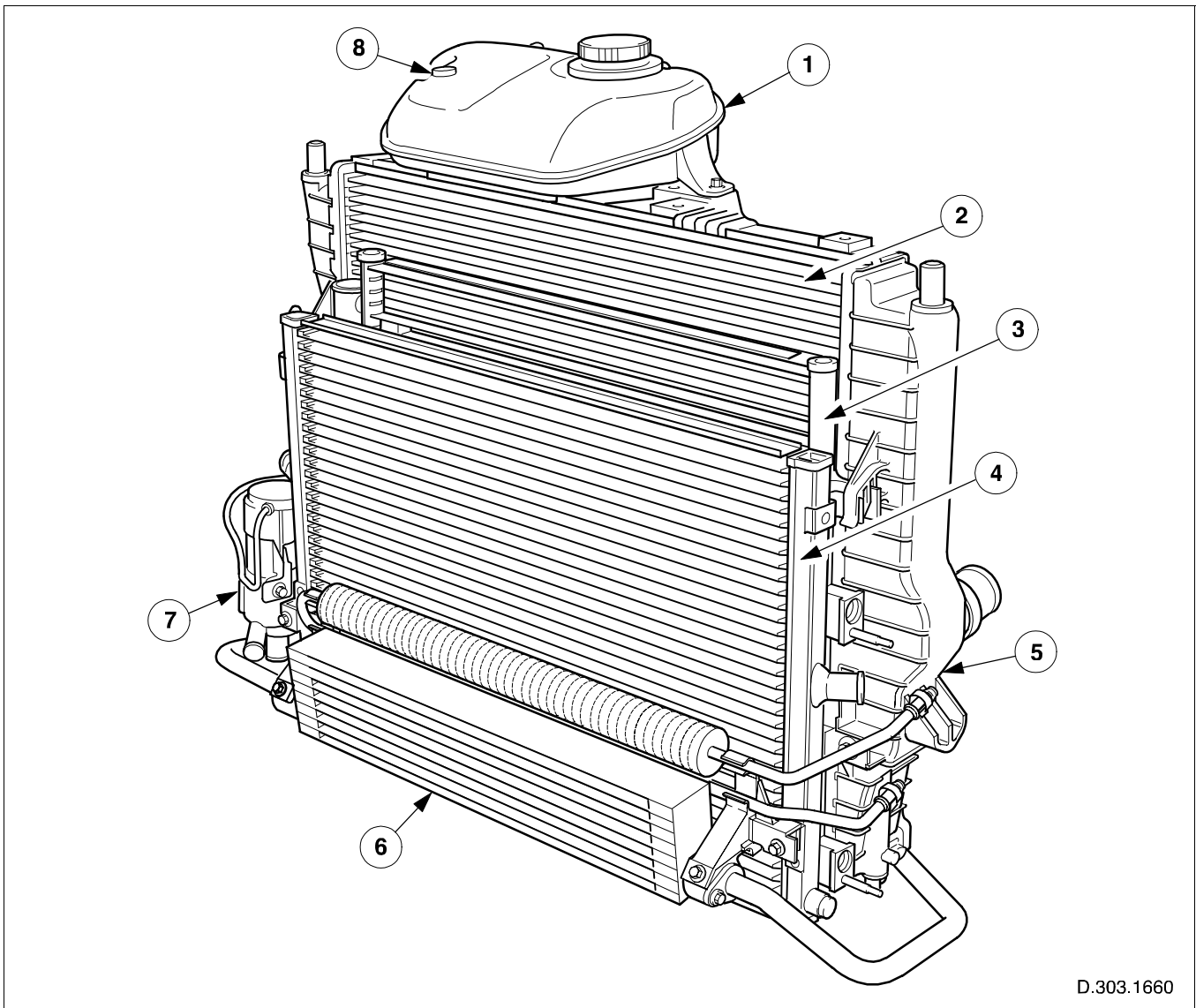
Vehicles fitted with the V8 supercharged (SC) engine have the following additional components:

- Dual coolant-flow valve
- Auxiliary coolant flow pump.
- Coolant pump (SC).
- Radiator (SC).
- Oil cooler (SC).

The cooling-fan speed is controlled directly by the engine control module (ECM) based on input data measured by the engine coolant temperature sensor and the climate control pressure-transducer. The ECM processes this input data and outputs a pulse width modulated signal which determines the fan speed. Should the output signal fall outside predetermined parameters, to protect the engine, maximum fan-speed is initiated. High engine temperature is indicated by the illumination of the engine over-temperature warning light, located on the instrument cluster.

Where appropriate, to provide an extended period of engine cooling, the ECM continues to control the fan speed after the ignition has been turned off.

NOTE: Airflow seals located around the edge of the radiator have a significant effect on performance of the cooling and air conditioning systems by preventing uncontrolled air from entering the assembly.

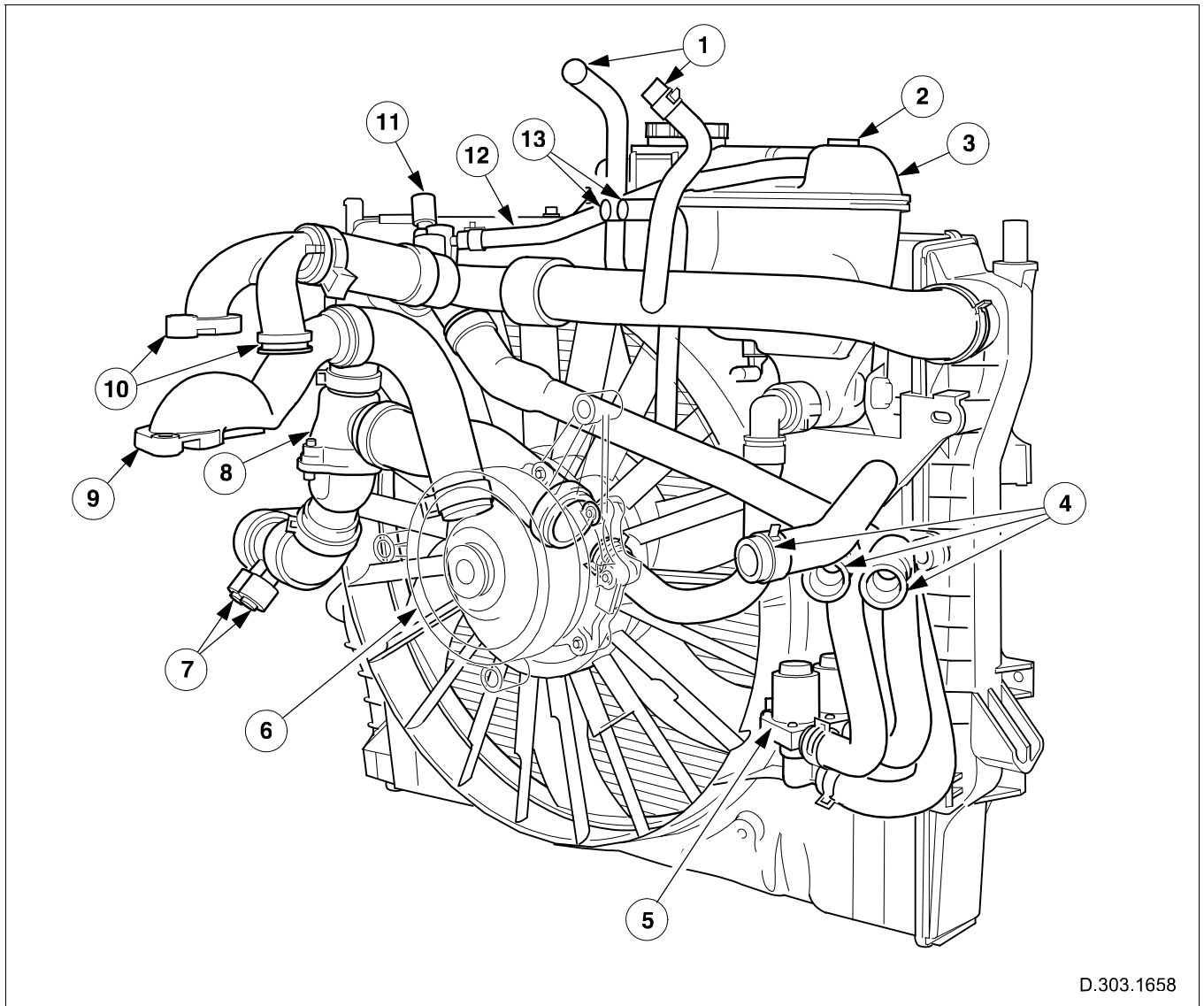


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Fig. 34 Cooling pack (SC)

- | | |
|-----------------------------|----------------------|
| 1. Coolant expansion tank | 5. Radiator end-tank |
| 2. Radiator | 6. Oil cooler (SC) |
| 3. Condenser/receiver-drier | 7. Coolant pump (SC) |
| 4. Radiator (SC) | 8. Bleed screw |

Cooling System (V6)



D.303.1658

Fig. 35 Cooling system components and connections (V6)

- | | |
|---|---------------------------------------|
| 1. Throttle body connections (air intake manifold side) | 8. Thermostat housing |
| 2. Bleed screw | 9. Engine coolant inlet |
| 3. Coolant expansion tank | 10. Engine coolant outlet |
| 4. Heater hose connections | 11. Engine coolant temperature sensor |
| 5. Dual coolant-flow valve | 12. Vent hose |
| 6. Coolant pump | 13. Throttle body connections |
| 7. Engine oil-cooler connections | |

Coolant Flow (V6)

The diagram below shows the coolant flow at normal running temperature (thermostat open).

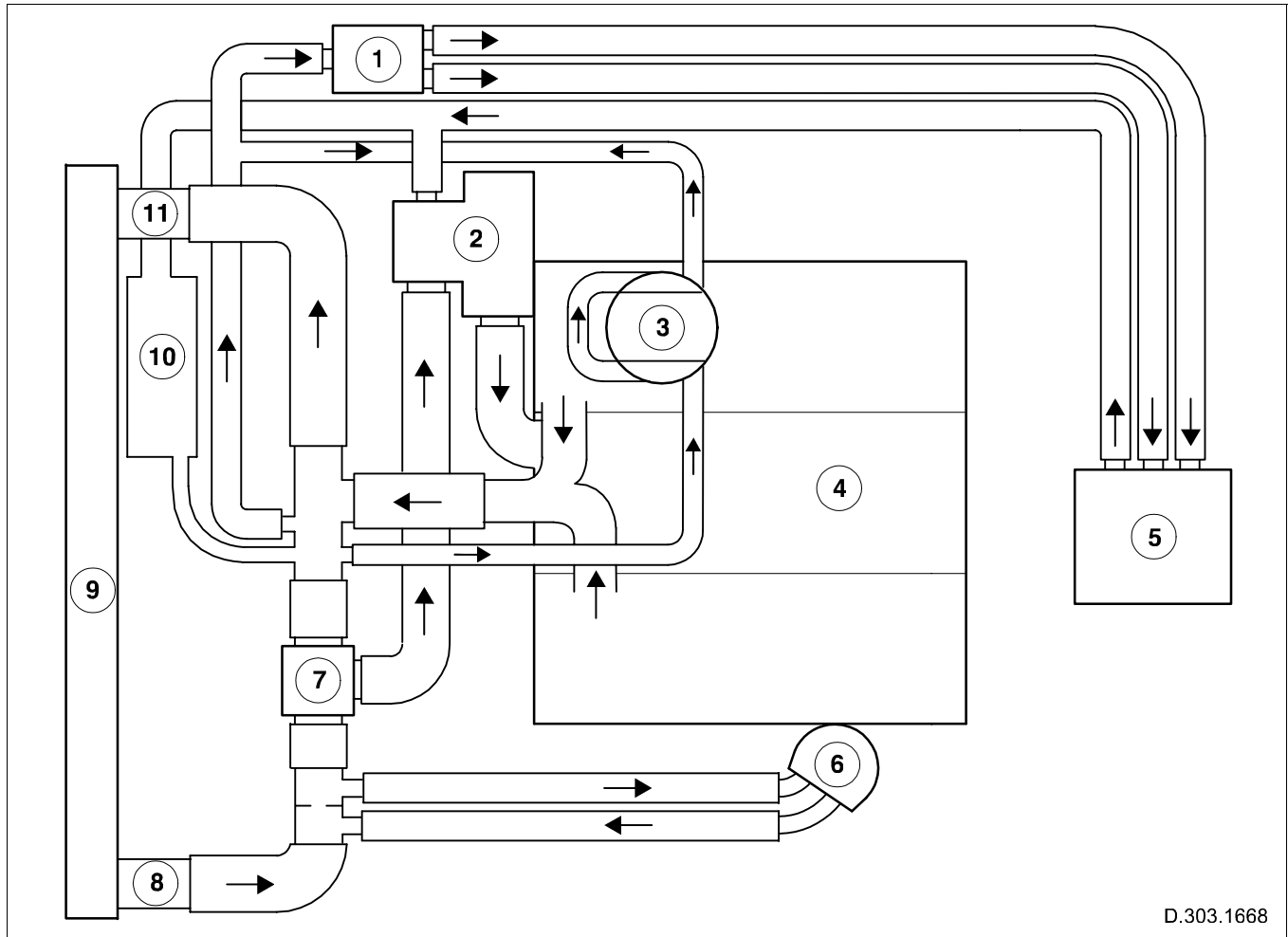
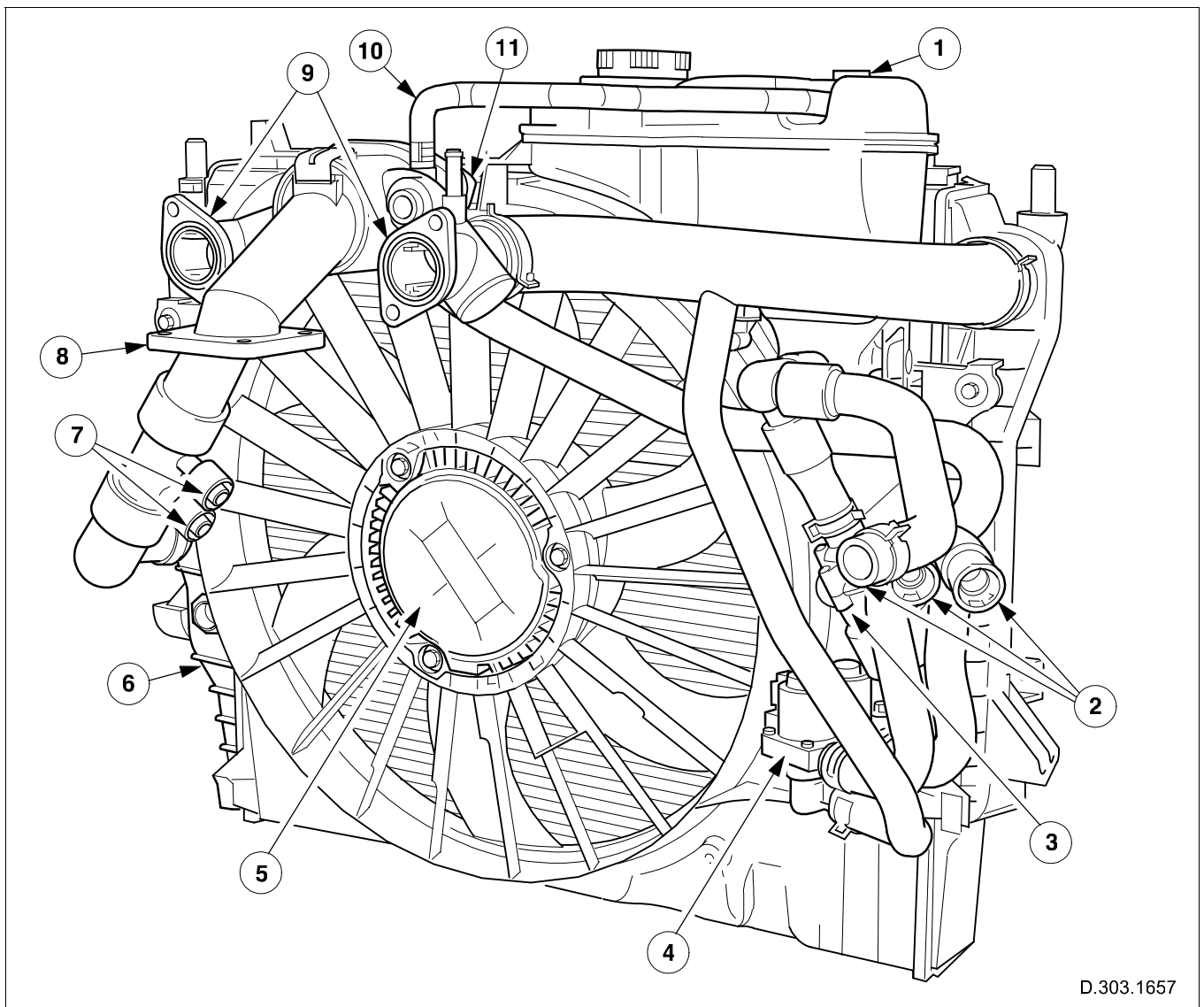


Fig. 36 Coolant-flow diagram (V6)

- | | |
|----------------------------|----------------------------|
| 1. Dual coolant-flow valve | 7. Thermostat |
| 2. Coolant pump | 8. Bottom hose |
| 3. Throttle body | 9. Radiator |
| 4. V6 engine | 10. Coolant expansion tank |
| 5. Heater core | 11. Top hose |
| 6. Engine oil cooler | |

Cooling System (V8)



D.303.1657

Fig. 37 Cooling system components and connections (V8)

- | | |
|--------------------------------|----------------------------------|
| 1. Bleed screw | 7. Engine oil-cooler connections |
| 2. Heater hose connections | 8. Engine coolant inlet |
| 3. Auxiliary coolant-flow pump | 9. Engine coolant outlet |
| 4. Dual coolant-flow valve | 10. Vent hose |
| 5. Cooling fan motor | 11. Thermostat housing |
| 6. Radiator end-tank | |

Coolant Flow (V8)

The diagram below shows the coolant flow at normal running temperature (thermostat open).

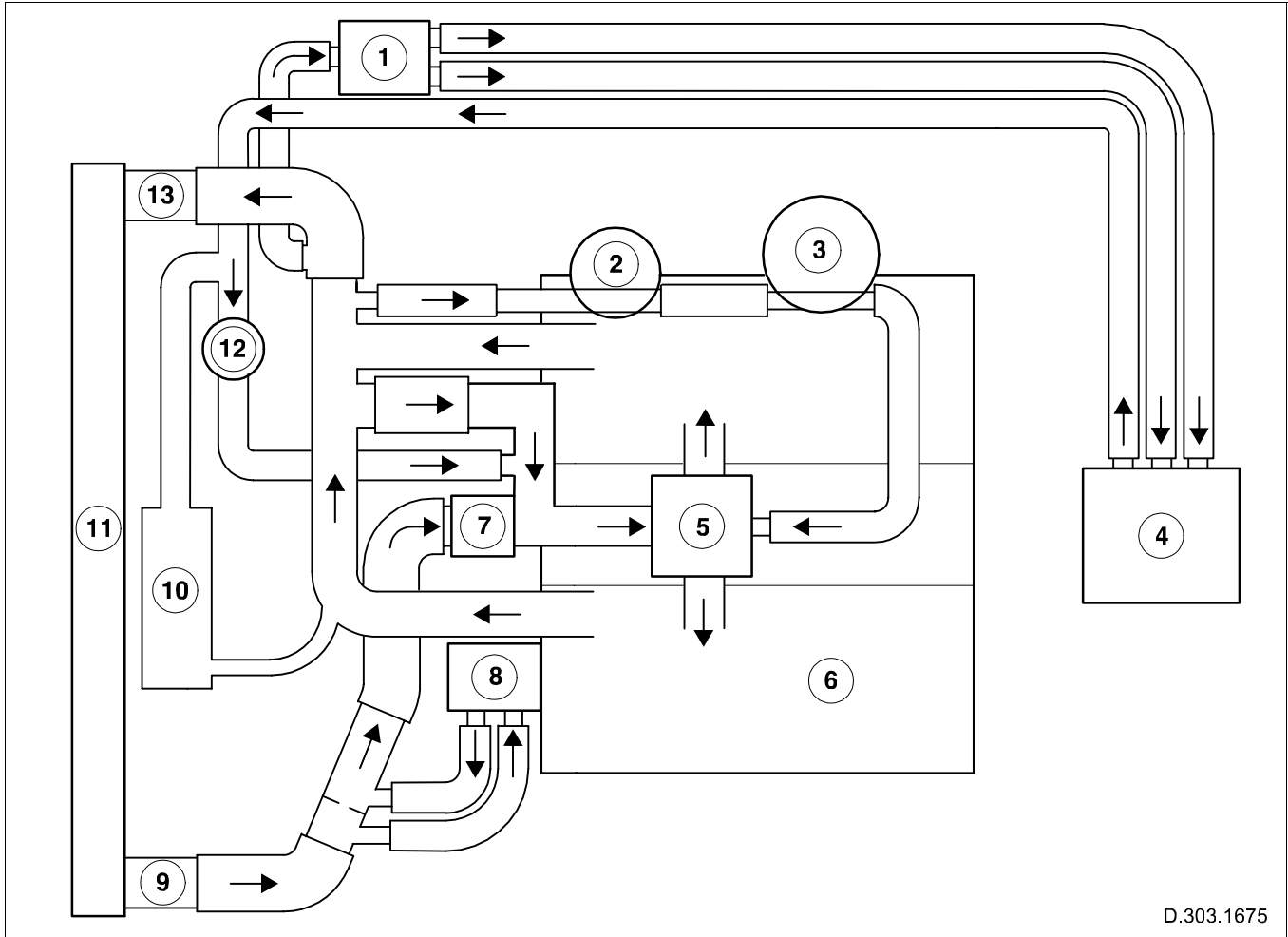
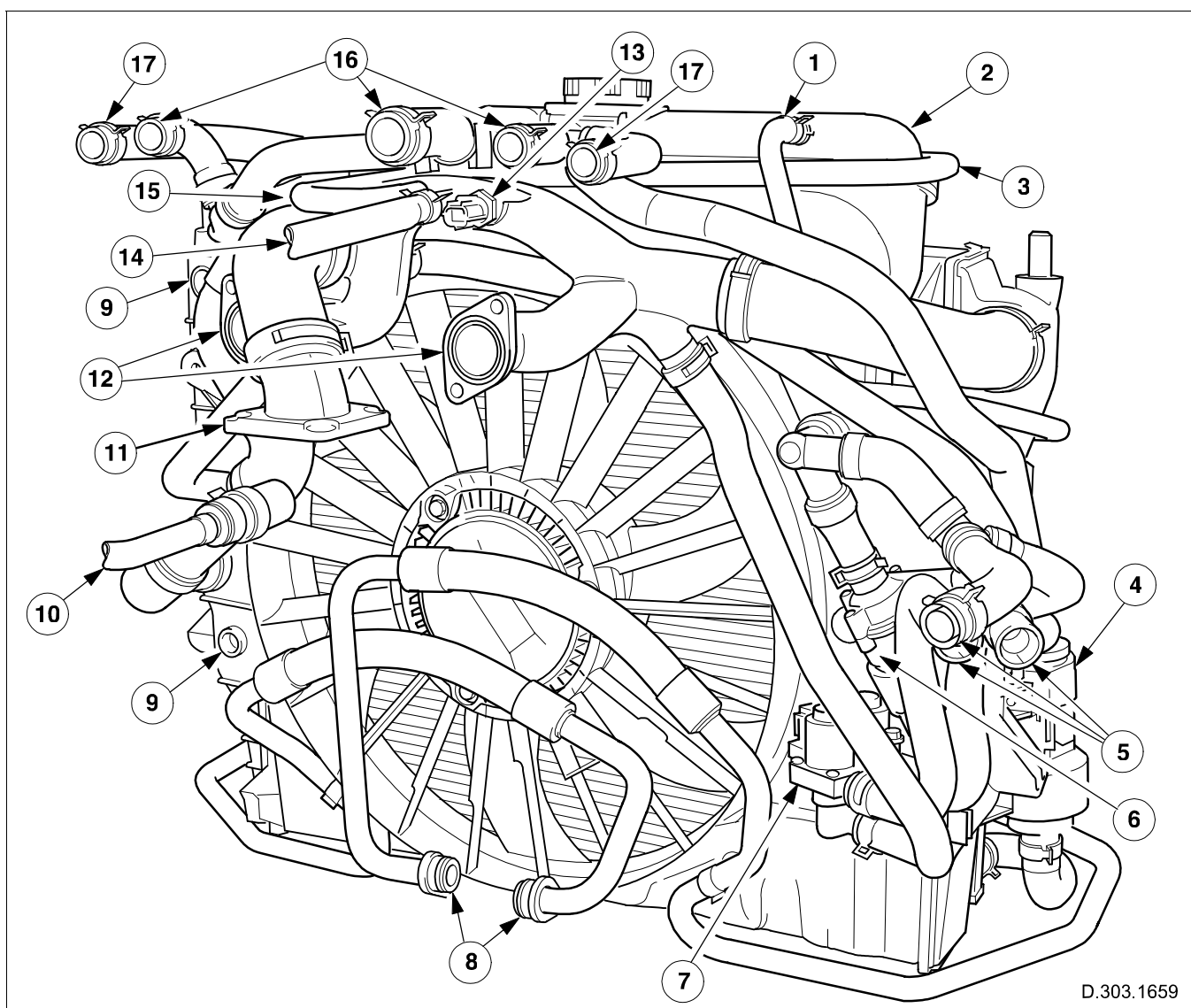


Fig. 38 Coolant-flow diagram (V8)

- | | |
|----------------------------|---------------------------------|
| 1. Dual coolant-flow valve | 8. Engine oil cooler |
| 2. EGR valve | 9. Bottom hose |
| 3. Throttle body | 10. Coolant expansion tank |
| 4. Heater core | 11. Radiator |
| 5. Coolant pump | 12. Auxiliary coolant flow pump |
| 6. V8 engine | 13. Top hose |
| 7. Thermostat | |

Cooling System (V8 SC)



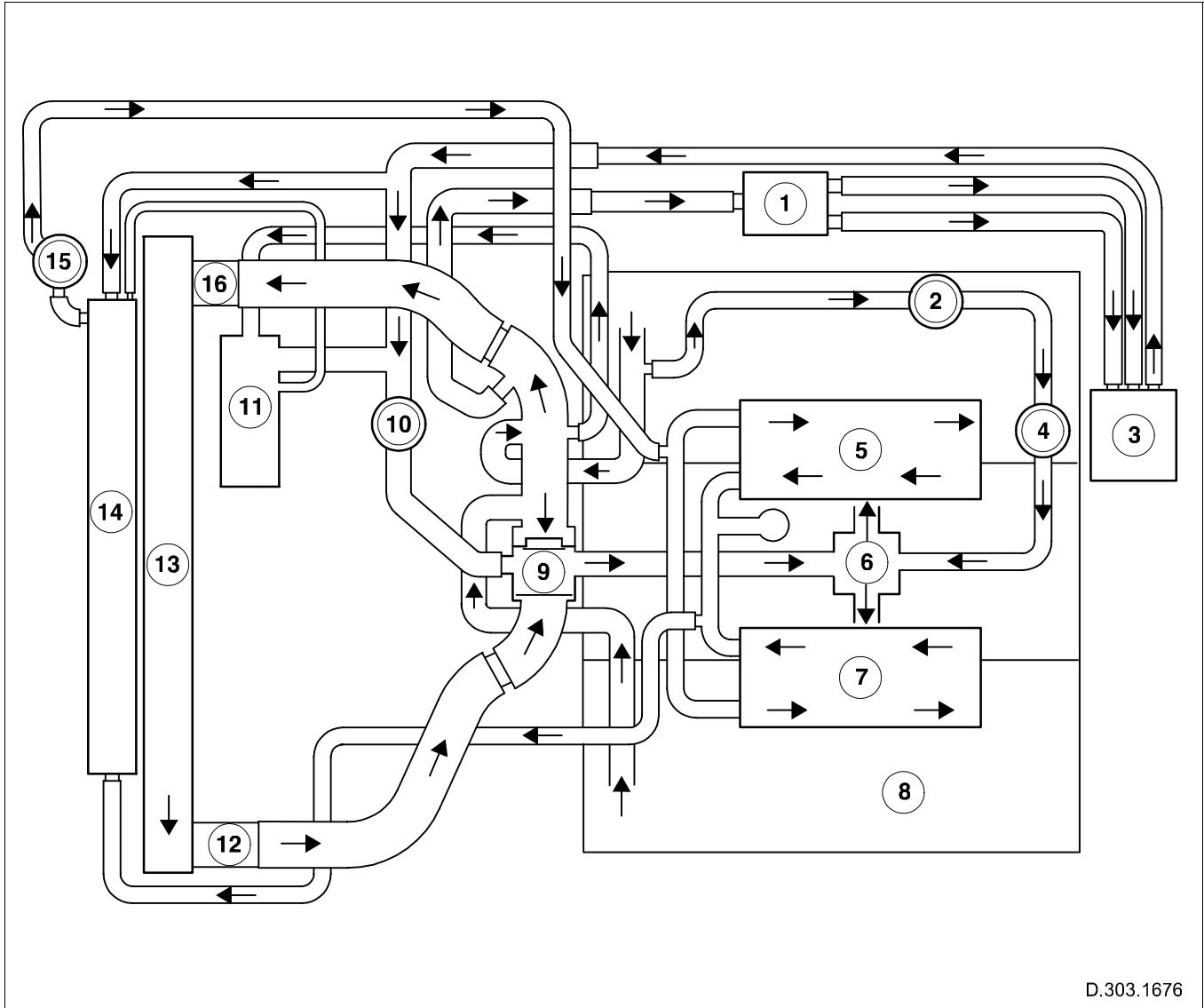
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Fig. 39 Cooling system components and connections (V8 SC)

- | | |
|---------------------------------------|---------------------------------------|
| 1. Vent hose (SC radiator) | 10. Throttle-body return hose |
| 2. Coolant expansion tank | 11. Engine coolant inlet |
| 3. Vent hose (radiator) | 12. Engine coolant outlet |
| 4. Supercharger coolant-pump | 13. Engine coolant temperature sensor |
| 5. Heater hose connections | 14. EGR coolant inlet hose |
| 6. Auxiliary coolant-flow pump | 15. Thermostat housing |
| 7. Dual coolant-flow valve | 16. Charge air cooler feed hoses |
| 8. Engine oil-cooler connections | 17. Charge air cooler return hoses |
| 9. Transmission oil-cooler connection | |

Coolant Flow (V8 SC)

The diagram below shows the coolant flow at normal running temperature (thermostat open).



D.303.1676

Fig. 40 Coolant-flow diagram (V8 SC)

- | | |
|-------------------------------|---------------------------------|
| 1. Dual coolant-flow valve | 9. Thermostat |
| 2. EGR valve | 10. Auxiliary coolant flow pump |
| 3. Heater core | 11. Coolant expansion tank |
| 4. Throttle body | 12. Bottom hose |
| 5. Charge air cooler (bank 1) | 13. Radiator |
| 6. Coolant pump | 14. SC Radiator |
| 7. Charge air cooler (bank 2) | 15. SC coolant pump |
| 8. V8 SC engine | 16. Top hose |

Fuel Charging and Controls

Electronic Throttle Control

A fully electronic throttle control is installed, requiring no mechanical connection between the accelerator pedal and throttle body. As the driver operates the accelerator pedal the accelerator pedal position sensor on the pedal shaft converts the mechanical rotation to electrical signals, which are sent to the engine control module (ECM) to indicate driver demand. Driver demand signals in conjunction with other engine control signals are processed by the ECM to provide the engine with the required charge of fuel and air.

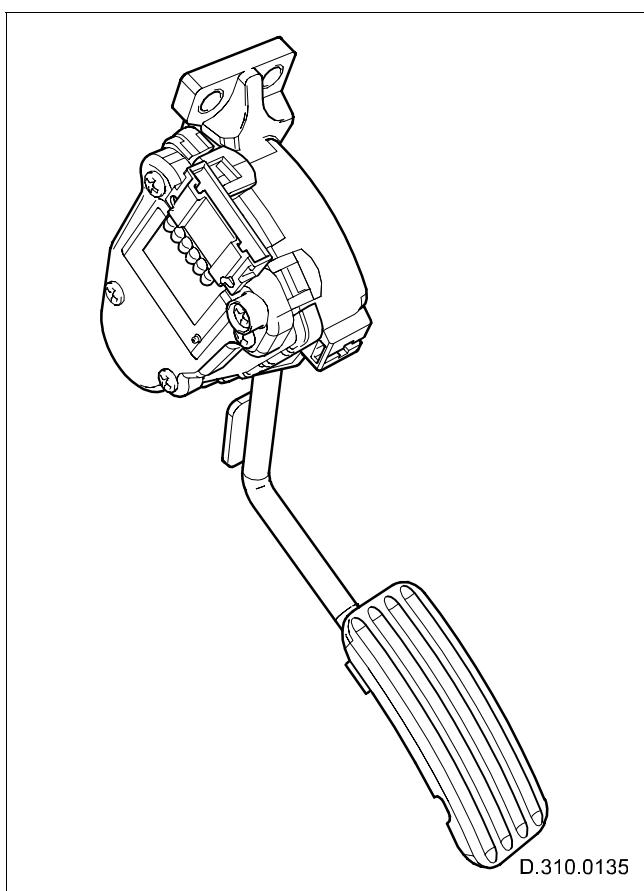


Fig. 41 Accelerator pedal

Fuel and Air Charging

Fuel Charging

The fuel pump module(s) controls the amount of fuel supplied by the fuel pump(s) to the fuel rail. This is achieved by the ECM receiving signals from the

- fuel pressure sensor,
- engine fuel temperature sensor,
- plus driver demand and other engine control signals, to indicate the fuel pressure in the fuel rail.

In response to these signals the ECM calculates the amount of fuel required by the engine at any given moment and requests the fuel pump module(s) to vary the fuel pump(s) delivery. Refer to **Fuel Tank and Lines** for more information on the fuel delivery system.

Fuel injectors

The ECM controls one injector per-cylinder in sequential order. The timing of the injector-firing during normal running conditions is optimized to give the best compromise between emissions and engine performance. The mass of fuel required per injection is derived from a calculation held in the ECM to match the metered mass air-flow from the intake manifold. Refer to **Electronic Engine Controls** for more information on fuel injection.

NOTE: New multi-hole injectors are introduced to V8 engines, providing a spray performance equivalent to that of air-assisted injection, with the addition of improved targeting. Therefore air-assist injection has been deleted.

Air Charging

Throttle body

The throttle body houses the throttle disc, which governs the volume of air entering the intake manifold. The throttle motor controls the position of the throttle disc, via driver demand and engine control signals provided by the ECM. The actual angle of the throttle disc is indicated to the ECM by the throttle position sensor, which works in conjunction with the throttle motor to provide closed loop control of the throttle.

V6 engine

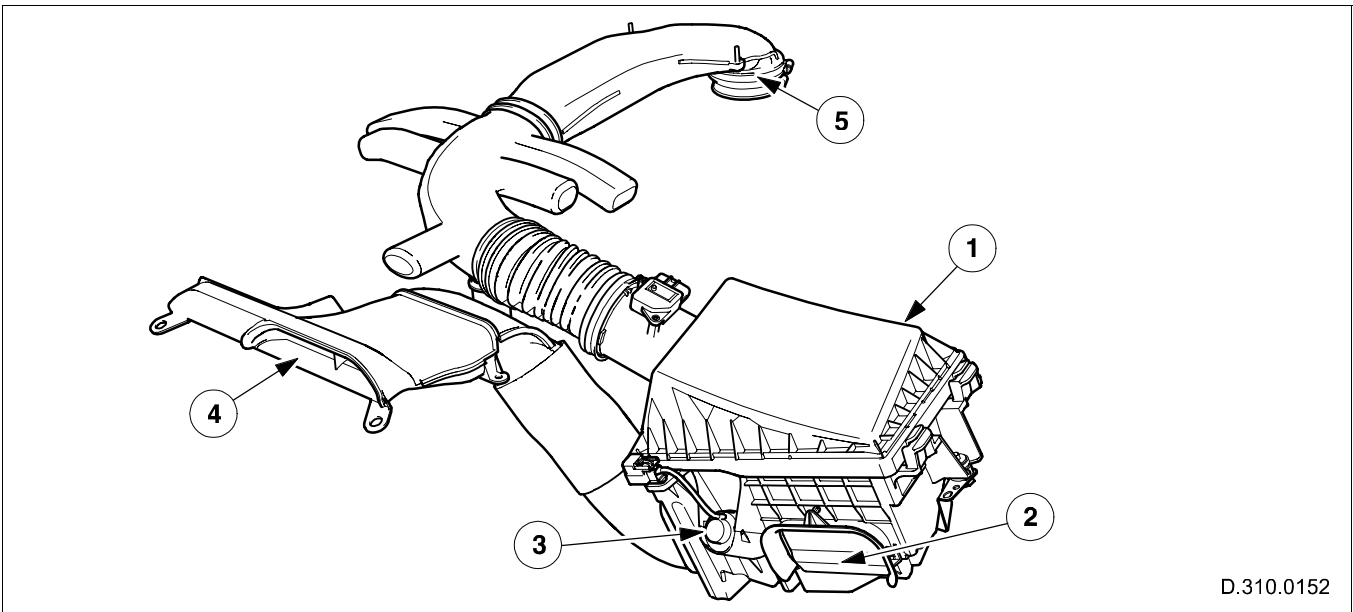
A reduced volume three-stage variable-geometry upper intake-manifold is introduced with identical concept and operating parameters as the intake manifold used on the previous S-TYPE. This manifold is designed to operate with both engine capacities, while also providing improved response rates.

The intake manifold, refer to **Fig. 43**, is designed to optimize torque across the engine speed and load range. The air-charge enters the intake manifold from the throttle body and passes through a plenum chamber for distribution to the cylinders. The function of the plenum chamber is to provide a resonance (or maximizing) effect so that large pulses of charge air will arrive at the inlet ports at the correct time for induction into the cylinders. This ram charging action is only effective over a restricted speed and load range for a particular plenum chamber volume and geometry. To extend the effect over the whole engine speed range, the manifold geometry can be set to three different configurations, by the ECM individually switching the intake manifold tuning valves (IMT valves) between fully open and fully closed at calibrated engine speeds. Each of these configurations modifies the geometry of the manifold plenum chamber, maximizing the tuning effect over different parts of the engine range. The resulting optimized volumetric efficiency, provides optimized engine torque output throughout the engine's entire speed range. Optimized plenum volume also acts to improve transient response where required.

V8 supercharged engine

The introduction of the V8 SC engine into the S-TYPE, introduces a revised air intake and supercharger unit for Jaguar, refer to **Fig. 45**. The revised unit improves performance by increasing supercharger speed by 5%. Improvements made to the unit include:

- Supercharger rotors driven by helical-cut gears in place of spur-cut gears.
- Rotors having a more efficient coating.
- High-density fin intercoolers.
- More efficient air-flow through the air-intake trunking.
- Low loss supercharger outlet ducts.
- Twin intake into the air cleaner housing, refer to **Fig. 42**.
 - The ECM directly controls the solenoid, to open and close the air intake control-flap in the air-cleaner housing. The control flap is opened at high engine speeds and loads to satisfy engine air-charge requirements.



D.310.0152

Fig. 42 V8 SC air intake assembly

1. Air cleaner housing
2. Control flap
3. Control flap solenoid
4. Air intake
5. Air outlet to throttle body

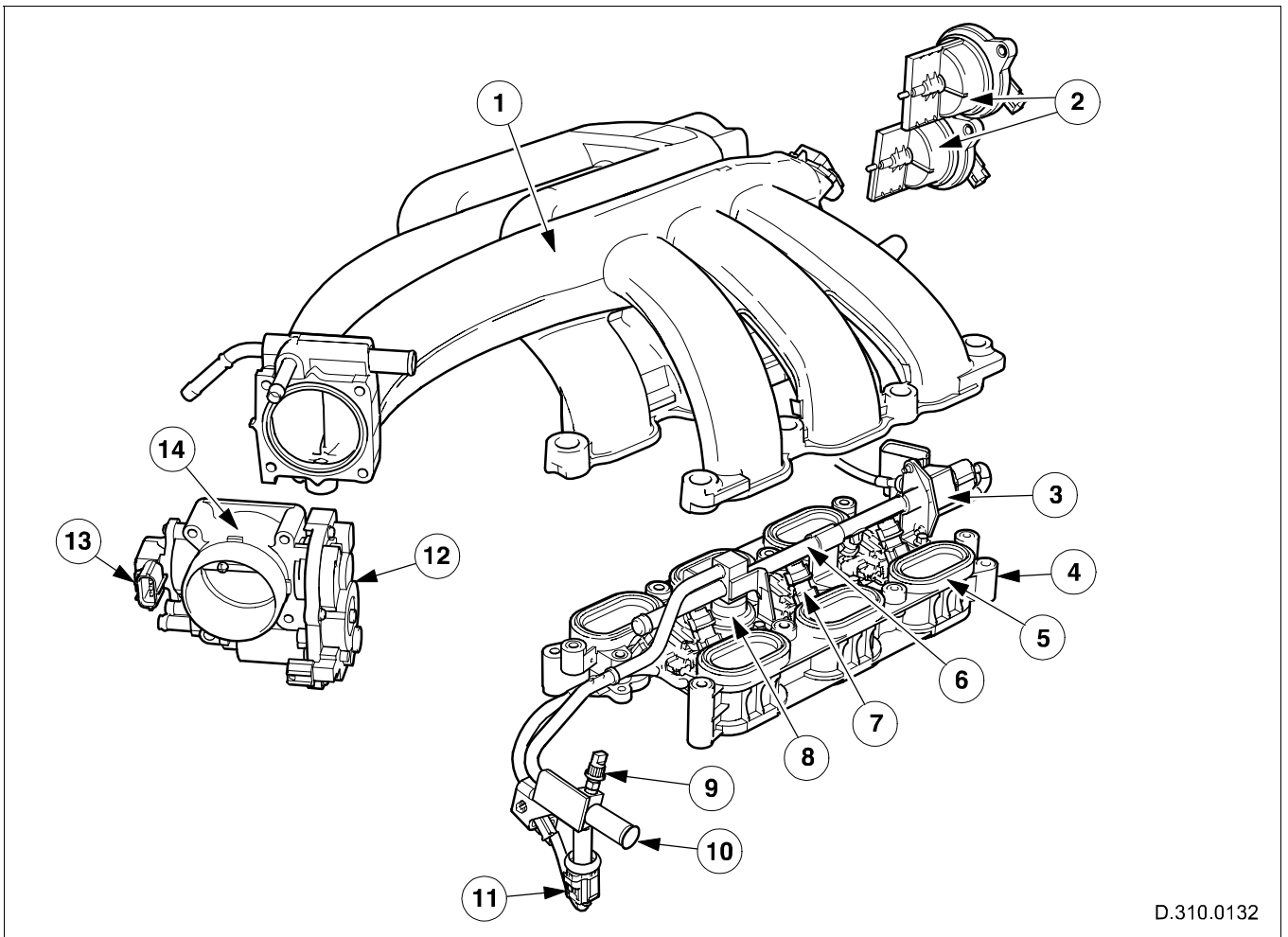
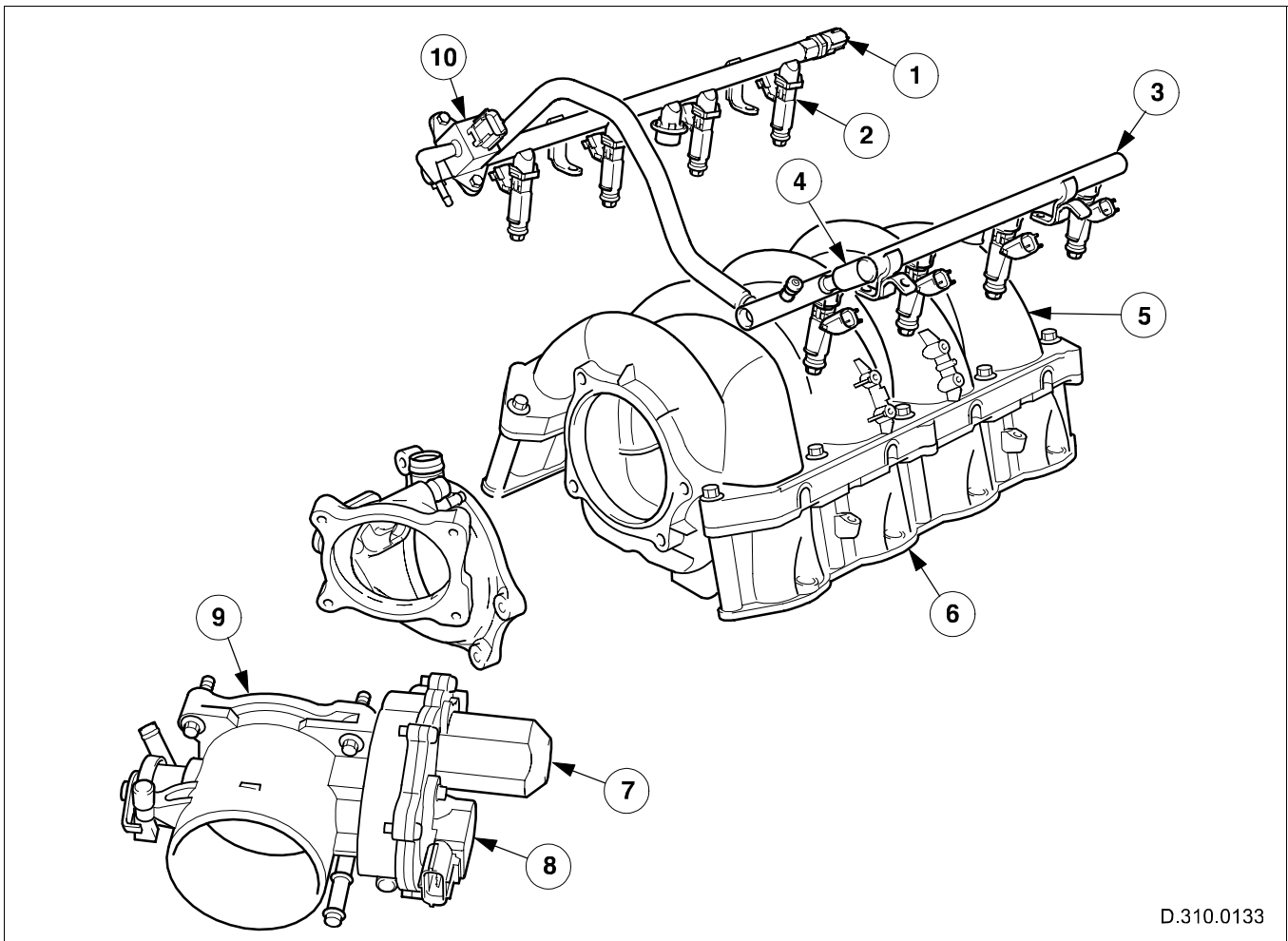


Fig. 43 Fuel charging system — V6 engine

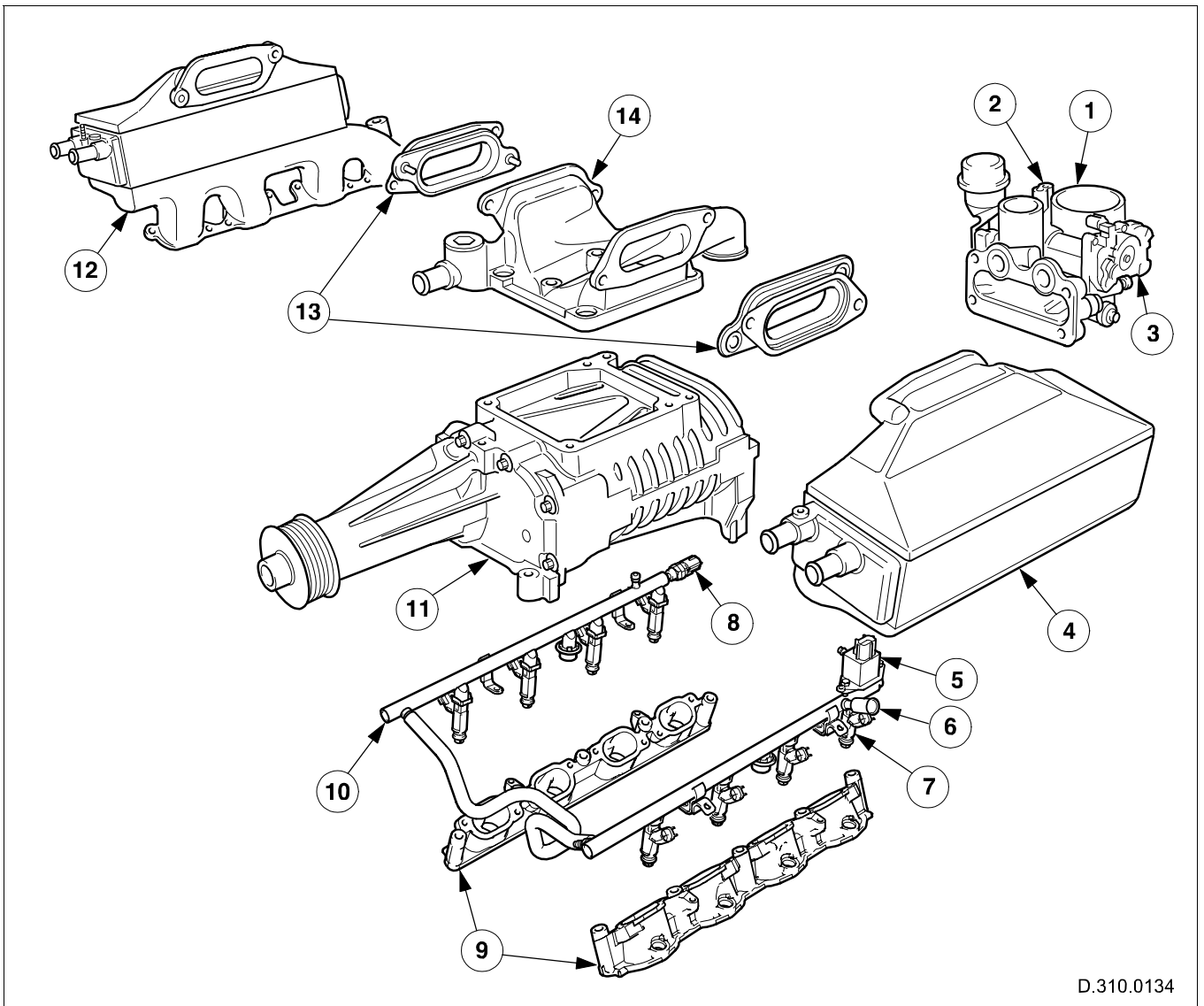
- | | |
|----------------------------------|------------------------------------|
| 1. Intake manifold | 8. Fuel pulse damper |
| 2. Intake manifold tuning valves | 9. Depressurization valve |
| 3. Fuel pressure sensor | 10. Fuel supply |
| 4. Lower intake manifold | 11. Engine fuel temperature sensor |
| 5. Gasket | 12. Throttle motor |
| 6. Fuel rail | 13. Throttle position sensor |
| 7. Injector | 14. Throttle body |



D.310.0133

Fig. 44 Fuel charging system — V8 engine N/A

- | | |
|-----------------------------------|-----------------------------|
| 1. Engine fuel temperature sensor | 6. Lower intake manifold |
| 2. Injector | 7. Throttle motor |
| 3. Fuel rail | 8. Throttle position sensor |
| 4. Fuel supply | 9. Throttle body |
| 5. Intake manifold | 10. Fuel pressure sensor |



D.310.0134

Fig. 45 Fuel charging system — V8 engine SC

- | | |
|--|---|
| 1. Throttle body | 8. Engine fuel temperature sensor |
| 2. Throttle position sensor | 9. Fuel rail adaptors |
| 3. Throttle motor | 10. Fuel rail |
| 4. Charge air cooler and intake manifold | 11. Supercharger |
| 5. Fuel pressure sensor | 12. Charge air cooler and intake manifold |
| 6. Fuel supply | 13. Cool-air engine charge duct |
| 7. Injector | 14. Supercharger outlet duct |

Evaporative Emissions

On-board Refueling Vapor Recovery

To meet on-board refueling vapor recovery (ORVR) requirements the fuel tank and associated components are designed to minimize fuel vapor loss by preventing fuel vapor from the fuel tank venting directly to the atmosphere. Fuel vapor therefore is vented into the evaporative emission canister (EVAP canister) where it is stored before being purged at intervals to the engine's inlet manifold.

During refueling the narrow fuel filler-tube below the nozzle region provides a liquid seal against the escape of vapor. A check valve also in the filler tube opens to incoming fuel to prevent splash-back. As the fuel tank fills, fuel vapor is routed through the open float-level vent valve located in the top of the tank, and then through to the EVAP canister where hydrocarbons are removed from the vapor to meet emission regulations. The purified vapor passes to atmosphere through the vent pipe, refer to **Evaporative Emission Canister**. The hydrocarbons are stored in the EVAP canister where at intervals they are purged into the engine for combustion, refer to **Evaporative Emission Canister Purge Valve**.

As refueling continues, the rising fuel-level in the fuel tank closes the float-level vent valve when the fuel tank reaches full. The resulting back pressure causes refueling to stop automatically. While the float-level vent valve is closed, any further rise in vapor pressure is vented to the EVAP canister via the grade vent valve.

The float-level vent valve is always open when the fuel-tank level is below full, providing an unrestricted vapor outlet to the EVAP canister.

If a malfunction occurs in the fuel tank delivery system and the tank overfills, an integral pressure relief valve in the float-level valve opens to provide a direct vent to the atmosphere.

The ORVR system also incorporates the following safety devices:

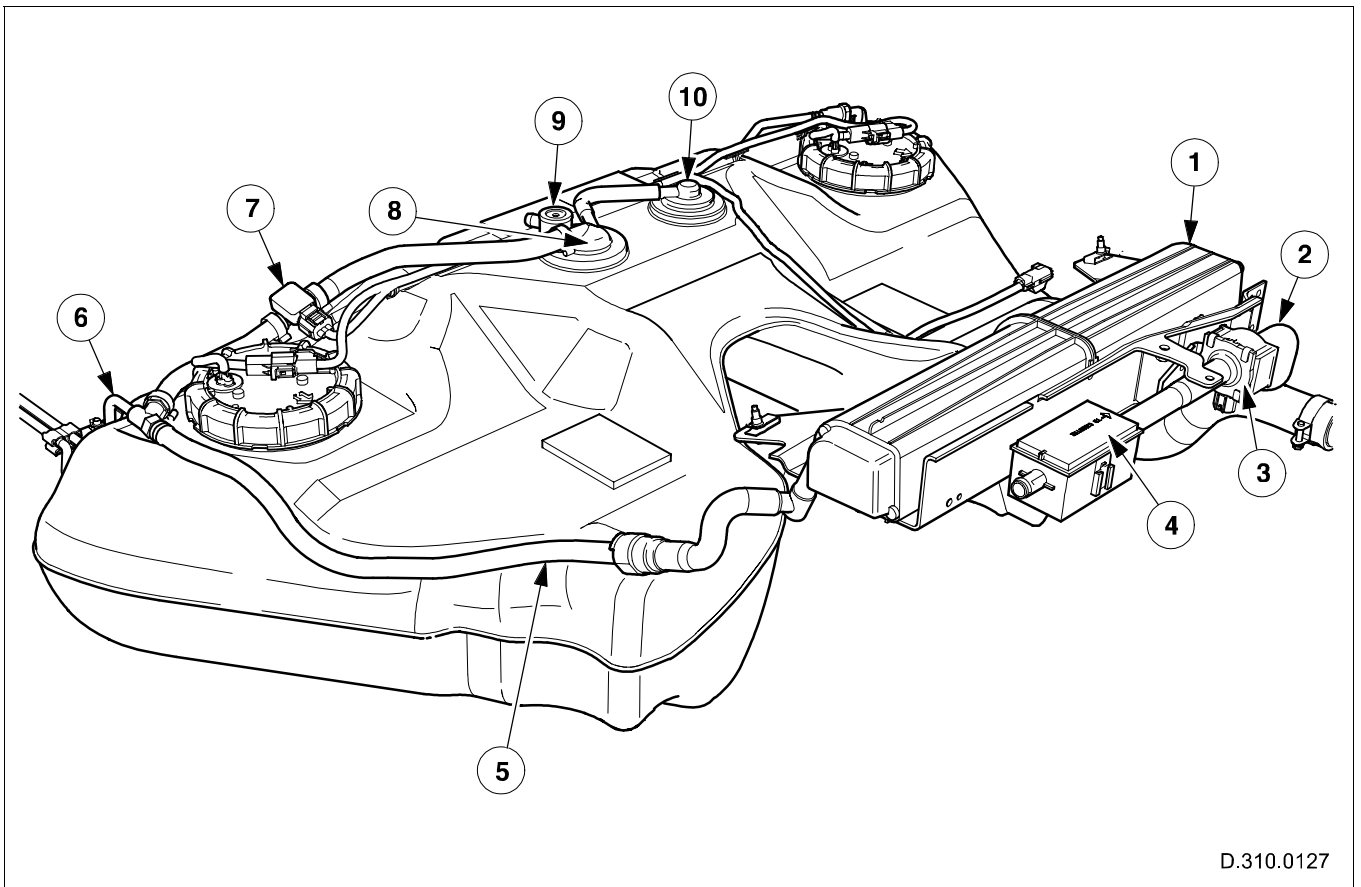
- The fuel filler cap incorporates both pressure and vacuum relief valves.
- Both the float-level vent valve and the grade vent valve incorporate protection against leakage in the event of a vehicle roll-over.

Evaporative Emission Canister

A new single EVAP canister is introduced, replacing the twin canister system, the canister has a volume of 2.3 liters and is positioned above the fuel tank and mounted to the vehicle's underbody. Owing to the limited storage volume of the EVAP canister the charcoal filter must be continually regenerated. This is achieved when the engine is running by drawing air through the EVAP canister, via the vent pipe, into the engine for combustion.

An EVAP canister close valve is attached to the EVAP canister, which when instructed by the ECM seals the vent pipe. At the same time the purge valve is opened to allow a vacuum from the intake manifold to be created in the fuel system. The purge valve is then closed to allow the ECM to perform fuel-vapor leak-check diagnostics. The ECM monitor's signals received from the fuel tank pressure sensor to measure the rate of increase in fuel tank pressure to determine if there is a leak within the system.

The vapor separator acts as a filter to protect the close valve from the ingress of moisture and dust particles.



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Fig. 46 Evaporative emission system

- | | |
|------------------------------|---|
| 1. EVAP emission canister | 6. Pipe to EVAP emission canister purge valve |
| 2. Vent pipe | 7. Fuel tank pressure sensor |
| 3. EVAP canister close valve | 8. Float level valve |
| 4. Vapor separator | 9. Pressure relief valve |
| 5. Pipe to EVAP canister | 10. Grade vent valve |

Evaporative Emission Canister Purge Valve

A new EVAP canister purge valve is located on the engine compartment bulkhead. The ECM operates the valve to purge fuel vapor from the EVAP canister into the engine for combustion. Purge rates, that is the extent the purge valve opens, are determined by the engine operating conditions and the vapor concentration level. The purge rates are adjusted to maintain vehicle driving characteristics and exhaust emissions at optimum levels.

The engine operating conditions that affect the purge rate are:

- speed and load;
- coolant temperature;
- time from engine start-up;
- closed loop fueling.

To determine the vapor concentration level, the ECM applies stepped opening signals to the purge valve and monitors the subsequent fuelling correction. This is usually performed before purging, so that when purging starts, the purge valve can immediately be set to the optimum position. If the ECM is unable to determine the vapor concentration before purging, it uses a default value, which it then modifies while purging is in process.

NOTE: A test port, for use in NAS markets only, is provided on the purge valve line to enable leak test diagnosis of the fuel system.

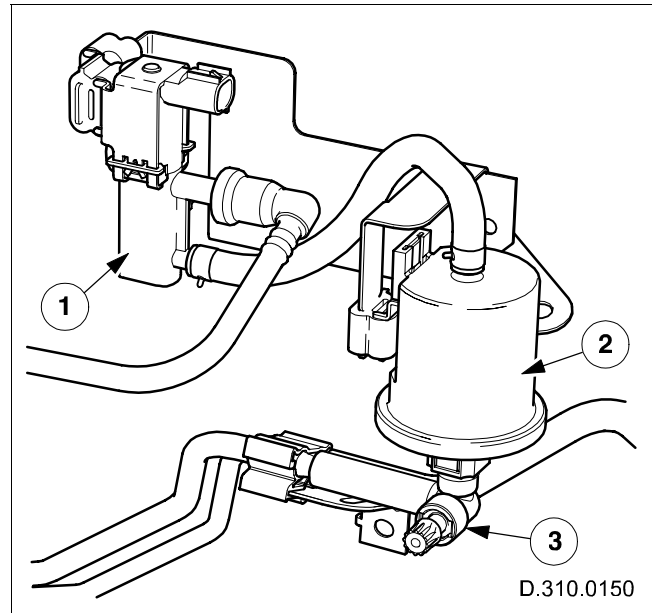


Fig. 47 Evaporative emission canister purge valve

1. Purge valve
2. Reservoir
3. Test port — NAS function only

Electronic Engine Controls

Introduction

A new electronic engine control system is introduced into the S-TYPE on both V6 and V8 engines. The system consists of an engine control module (ECM) and a number of sensing and actuating devices. The sensors supply the ECM with input signals, which relate to engine operating conditions and driver requirements. The sensor information is evaluated by the ECM using calibrated data-tables and maps. The ECM then uses the results to command an appropriate response from the actuating devices. The system provides the necessary engine control accuracy and adaptability to:

- minimize exhaust emissions and fuel consumption;
- provide optimum driver control under all conditions;
- minimize evaporative fuel emissions;
- provide system diagnostics when malfunctions occur.

In addition to these functions the ECM also interfaces with other vehicle systems through the controller area network (CAN).

Engine Control Module

The 32-bit ECM is at the center of the system and provides the overall control. Its functions are listed below, each of which are dependent on engine and vehicle state at any moment of time and driver requirements.

- Starting: ensures that conditions are safe to crank the engine.
- Engine: controls the rate of air and fuel flow into the cylinders; adjusts the intake manifold volume; controls the ignition and intake camshaft timing.
- Fuel supply: controls the operation of the fuel pump and vapor purge valve.
- Cooling: controls the engine cooling fans.
- Battery: optimizes the battery charging conditions.

- Air conditioning and screen heater: controls the speed of the engine when these additional loads are added, also disables the air conditioning when it is beneficial to reduce the load on the engine.
- Speed control: provides the option to maintain a fixed vehicle speed without driver intervention.
- Robustness: maintains engine running condition under intermittent or permanent single point failures on any sensors or actuators fitted to the system, and records fault codes of these failures for system diagnosis.
- Diagnosis: notifies the driver when a system malfunction occurs and records data for system diagnosis.

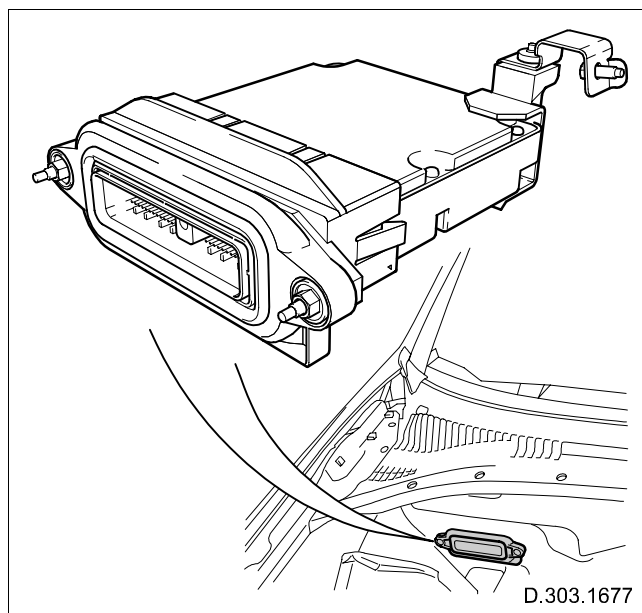


Fig. 48 Engine control module

Powertrain

System Interfaces

In the diagram below each rectangular box represents a system with which the ECM interfaces. The arrows represent the data flow between the system and the ECM.

The interface between the systems and the ECM is discussed in the relevant section of the publication.

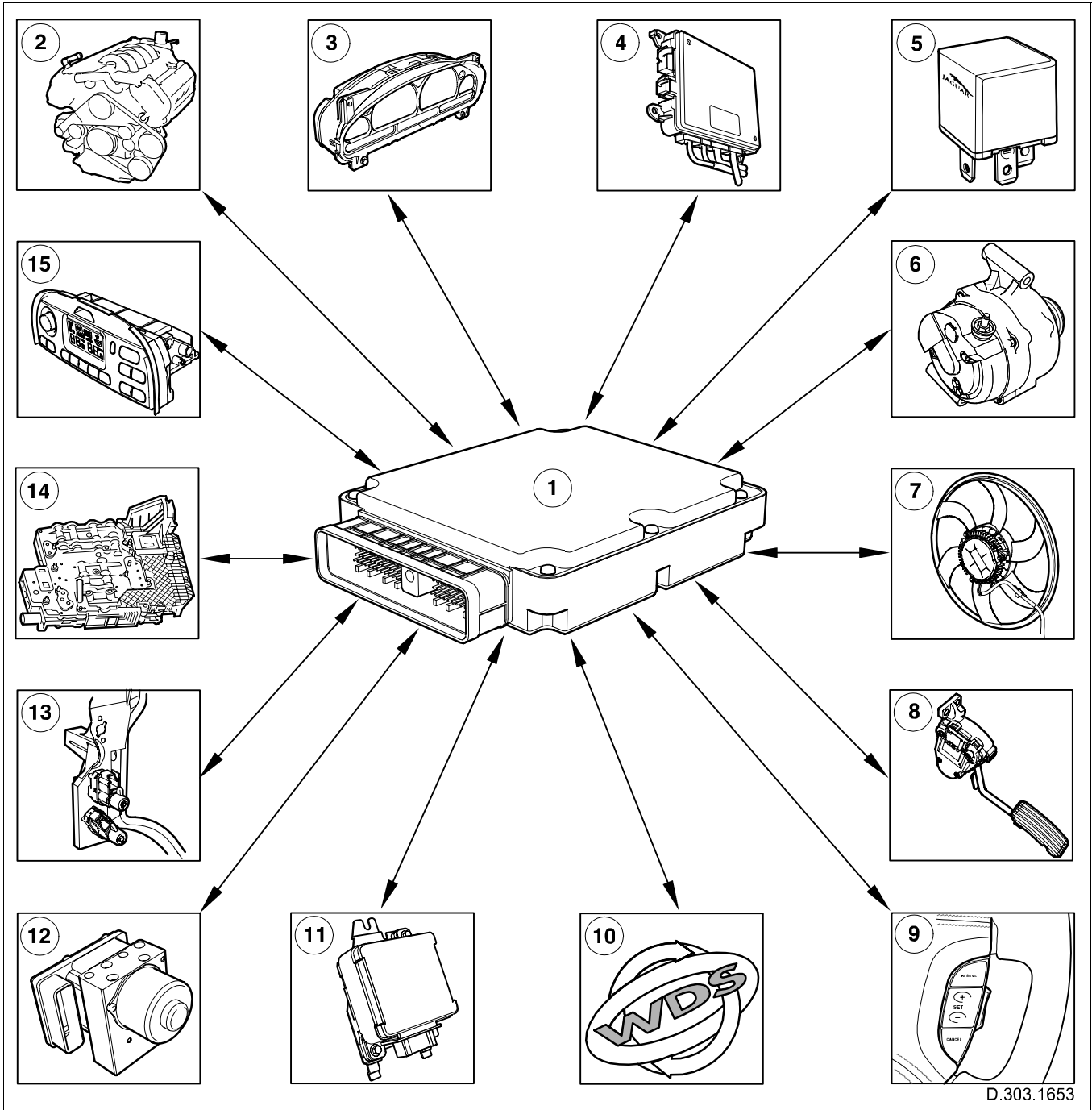


Fig. 49 System interfaces

Key to Fig. 49

1. Engine control module
2. Engine
3. Instrument cluster
4. Fuel pump driver module - integrated in rear electronic control module (RECM)
5. Starter relay
6. Alternator
7. Fan control module - integrated with fan motor
8. Accelerator pedal - electronic throttle control
9. Cruise control switches
10. Diagnostics
11. Second fuel pump driver module - supercharged vehicles only
12. ABS / TC / DSC
13. Brake pedal switches
14. Transmission control module (TCM) — automatic transmission
15. Climate control module

Engine Interface

NOTE: The following is an overview of the engine interface only.

Fuel Injection

- The ECM controls one injector per-cylinder in sequential operation. The size of the injector used is so that stoichiometric control is possible at minimum load with allowance for purge valve correction, and also at maximum load to provide sufficient fuel-flow at all engine speeds.
- The timing of injector firing relative to intake valve closing, during normal starting and running conditions is optimized to provide the best compromise between emissions and performance, time to first-ignition and smooth engine operation at start-up, for all engine conditions at all temperatures
- The mass of fuel required per-injection is derived from a calculation based on a ratiometric match to the metered air-flow.
- The ECM is capable of adapting to fuel system tolerances and engine internal wear under all operating conditions.
- The ECM continually monitors the differential pressure between the fuel rail and plenum, and uses this value to calculate the injector pulse-width with the required mass of fuel per-injection.
- The ECM continuously monitors the temperature of the fuel being injected into the engine and provides compensation for the changing flow characteristics of the fuel system at different temperatures.
- The ECM continuously monitors the battery supply voltage and using this information the ECM ensures that the fuel supply to the engine is unaffected by voltage fluctuation.

Ignition

The system uses one individual ignition coil per-cylinder.

- Base ignition map; is provided so that the engine can be optimized for emissions, fuel economy, performance and avoidance of cylinder knock throughout its speed and load range.
- Ignition timing during starting; is used during engine cranking and underspeed modes to provide the best compromise between emissions, time to first-ignition and smooth engine operation at start-up, at all temperatures.
- Air intake temperature correction; provision is made to compensate for the effect of changing air intake temperature on the combustion detonation limit.
- Knock control; the system contains the necessary hardware for the detection of combustion knock within the engine cylinders, the ECM uses this information to gradually adjust the ignition timing until the combustion knock is at a safe and inaudible level.

Variable Valve Timing (N/A Engines)

The ECM controls the fully variable phase change system, which acts on the intake camshafts.

- The target position of both camshafts are optimized to provide the best compromise between performance, refinement, fuel economy and emissions.
- During transient operation the rate of change of the camshaft position is controlled to optimize driveability.
- Operation of variable valve timing (VVT) will be restricted if environmental conditions exist that could affect normal operation of the VVT, for example very low ambient temperatures.
- Provision is made to ensure that the intake camshafts are restrained in the retard position during engine start.
- The ECM will detect a VVT mechanical malfunction, and act to compensate for the malfunction.

Variable Air Intake System (V6 Engines)

- The ECM controls two intake manifold tuning valves (IMT valves). Each valve is a two positional device, the switching point of the valve is dependant on engine speed and a definable change in engine performance.
- The valve switching points are optimized for maximum torque in the wide open throttle position.

Exhaust Gas Recirculation (V8 Engines)

- The ECM controls the flow of exhaust gases to reduce oxides of nitrogen (NOx) in emissions by recirculating metered amounts of exhaust gas into the intake of the engine. This lowers the combustion temperature, limiting the formation of NOx.
- The exhaust gas recirculation (EGR) flow is optimized for fuel economy, emissions and driveability for all engine operating conditions.

Interface to Electronic Throttle

- The system incorporates an electronic throttle to control the air-flow into the engine under closed-loop feed-back control of the ECM.
- The correct throttle-disc position is calculated as a function of driver demand value and of the engine's momentary operating mode.
- A fail-safe system is incorporated that complies to legislative requirements, including mechanical limp-home operation.

Idle Speed Control

- Idle speed is dependant on engine coolant temperature and gear selection (neutral or drive).
- Idle speed is optimized for combustion stability, idle quality, idle-speed control capability and fuel economy at all operating conditions.
- Compensations to the idle speed will be made for conditions, such as variable ambient air temperature, to increase idle speed to satisfy charging system requirements.

Vehicle Speed Control

- The system incorporates a speed control system. This enables the driver to set a speed, and control and maintain the speed of the vehicle without having to operate the accelerator pedal.
- The speed control switches are momentary action and are mounted on the steering wheel. The function of the switches is organized so that a function relating to a switch of a higher priority always overrides a function relating to a lower priority switch. The switch priority is shown in descending order:
 1. Cancel
 2. Set
 3. Resume

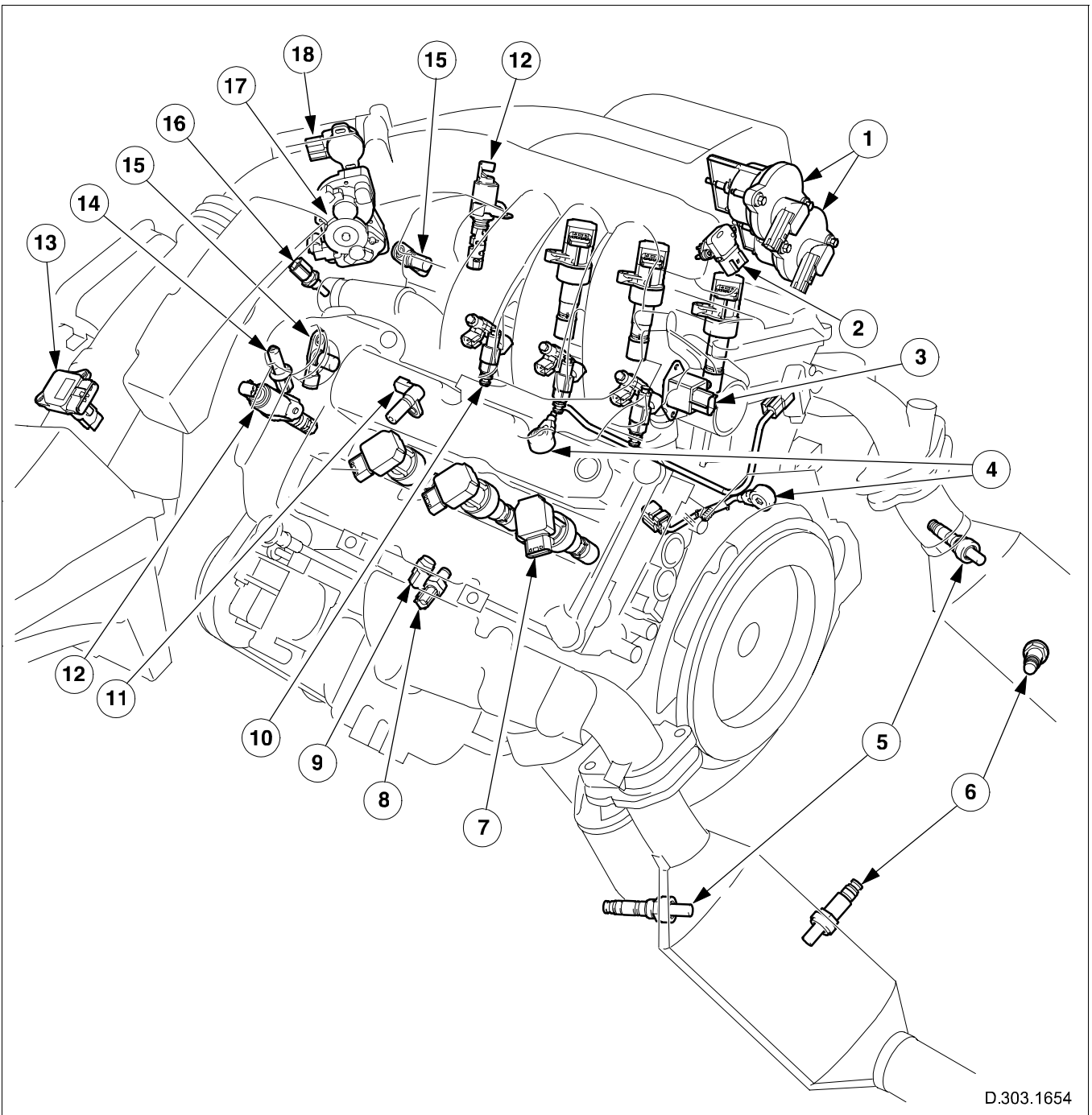
Failure Modes and Effects Management

- Each electronic engine control function will revert to a default value if the signal controlling the function is out of normal operating range.
- System fault diagnosis is achieved using WDS.

Function of Sensors and Actuators

- Fuel injector:
 - Delivers fuel to the engine cylinder intake ports in sequential order. There are 12 fuel injection-holes per injector, delivering fuel droplets as small as 60 microns in diameter. This size of fuel droplet reduces fuel wetting of the intake port and promotes excellent fuel-air mixing. Reducing noxious emissions and improving fuel economy while the engine is warming up.
- On-plug ignition coil with integrated amplifier:
 - The ECM controls one coil per spark plug in sequential order. The ignition coil provides the energy to the spark plug to ignite the air/fuel mixture in the engine cylinder. The ignition coil works on the principle of ‘mutual induction’, by closing and then opening the ignition-coil primary circuit, the primary current increases, and then suddenly decreases to induce the high voltage in the secondary circuit needed to fire the spark plug.
- Camshaft position sensor:
 - Signals from the camshaft position sensors are used to synchronize the ECM to the engine cycle during engine starting. For example, whether the crankshaft position sensor is indicating an induction or firing stroke.
 - The position of both intake camshafts are monitored to allow the ECM to control the phase of the intake camshafts relative to the position of the crankshaft.
 - On engines with VVT the camshaft position sensor provides feed-back control on the intake camshaft’s position relative to the position of the crankshaft and exhaust camshafts.
- Oil control solenoid — variable valve timing (N/A engines):
 - The oil control solenoid is a hydraulic actuator, which advances and retards the intake camshaft timing, thereby altering the camshaft-to-crankshaft phasing.
- Manifold absolute pressure sensor:
 - The manifold absolute pressure sensor (MAP sensor) is used for EGR diagnostic testing only.
- Knock sensor:
 - The knock sensors produce a voltage signal with respect to the engine’s combustion knock level.
 - The knock sensor detects and reports combustion knock within the engine cylinders, the ECM uses this information to gradually adjust the ignition timing until the combustion knock is at a safe and inaudible level. The knock control system cannot advance the ignition past the mapped values, it retards the ignition timing to reduce combustion knock and then advances to its original value.
- Fuel pressure sensor:
 - Continuously monitors the fuel pressure between the fuel rail and plenum, this value is used by the ECM as one of its factors to calculate the injector pulse-width required to deliver the correct mass of fuel per injection.
 - The ECM also uses this information to demand a specific fuel flow-rate from the fuel pump via the fuel pump module.
- Engine fuel temperature sensor:
 - Continuously monitors the temperature of fuel being injected into the engine, this value is used by the ECM to provide compensation for the changing flow-characteristics of the fuel system with temperature. The ECM therefore ensures that engine performance is unaffected by temperature changes to the fuel supply.
- Intake manifold tuning valves (V6 engines):
 - The intake manifold tuning valves (IMT valves) are a two positional ‘open or close’ device used to create a variable air intake system. The IMT valve positions are switched, via signals from the ECM, to optimize torque across the engine’s speed and load range.
 - The IMT valves work in conjunction with the operation of the throttle body sensors.
- Throttle body assembly:
 - The throttle body controls the air-flow into the engine by use of the throttle motor and throttle position sensor (TP sensor).
 - Throttle disc position is operated by the throttle motor via signals received from the accelerator pedal position sensor, via the ECM.
 - Throttle-disc angle is monitored by the ECM via the TP sensor.
 - Compensation is made to the throttle disc angle by the ECM on the application of external loads, for example the air conditioning compressor.

- Mass air flow sensor with integrated intake air temperature sensor (IAT sensor):
 - The mass air flow sensor (MAF sensor) informs the ECM of the rate of air-flow entering the engine by producing a voltage, which increases as the rate of air-flow increases.
 - The MAF sensor also takes into account the density of air entering the engine so it is possible to maintain the required air to fuel ratio, and compensate for variations in atmospheric pressure temperatures.
 - The integral IAT sensor measures the temperature of the air entering the intake system. The ECM uses this information to compensate for higher than normal air intake temperatures upon combustion detonation.
- Crankshaft position sensor:
 - The crankshaft position sensor (CKP sensor) is an inductive pulse generator, which scans protrusions on a pulse ring, to inform the ECM of the crankshaft's position and engine speed.
- Engine coolant temperature sensor:
 - The thermistor type sensor provides an input signal to the ECM, which is proportional to the temperature of the coolant being circulated around the coolant system.
- Engine oil temperature sensor:
 - The thermistor type sensor provides an input signal to the ECM, which is proportional to the temperature of the oil being circulated around the engine oil passageways.
- Heated oxygen sensor 1:
 - The heated oxygen sensor 1 (HO2 sensor 1), is a linear characteristic type sensor, fitted forward of the exhaust system's catalytic converter.
 - The sensor is used by the ECM as a primary sensor to measure oxygen content within the exhaust system.
 - The sensor is used in conjunction with the ECM to provide closed-loop fuelling control.
- Heated oxygen sensor 2:
 - The heated oxygen sensor 2 (HO2 sensor 2), is a non-linear characteristic type sensor fitted to the exhaust system's catalytic converter, and is used by the ECM as secondary sensor to measure oxygen content within the exhaust system.
 - Used in conjunction with the ECM and the HO2 sensor 1, the HO2 sensor 2 aids closed-loop fuelling control.
 - Also monitors catalyst efficiency.
- Exhaust gas recirculation valve:
 - A defined portion of the engine's exhaust emissions is extracted and returned to the intake mixture via a solenoid valve, as controlled by the ECM.
- Air intake control-flap solenoid (SC engine):
 - The ECM directly controls the solenoid, to open and close the air intake control-flap in the air-cleaner assembly. The control flap is opened at high engine speeds and loads to satisfy engine air-charge requirements.
- Engine oil pressure switch: the switch is connected to the instrument cluster and is not directly used as part of the engine control system.



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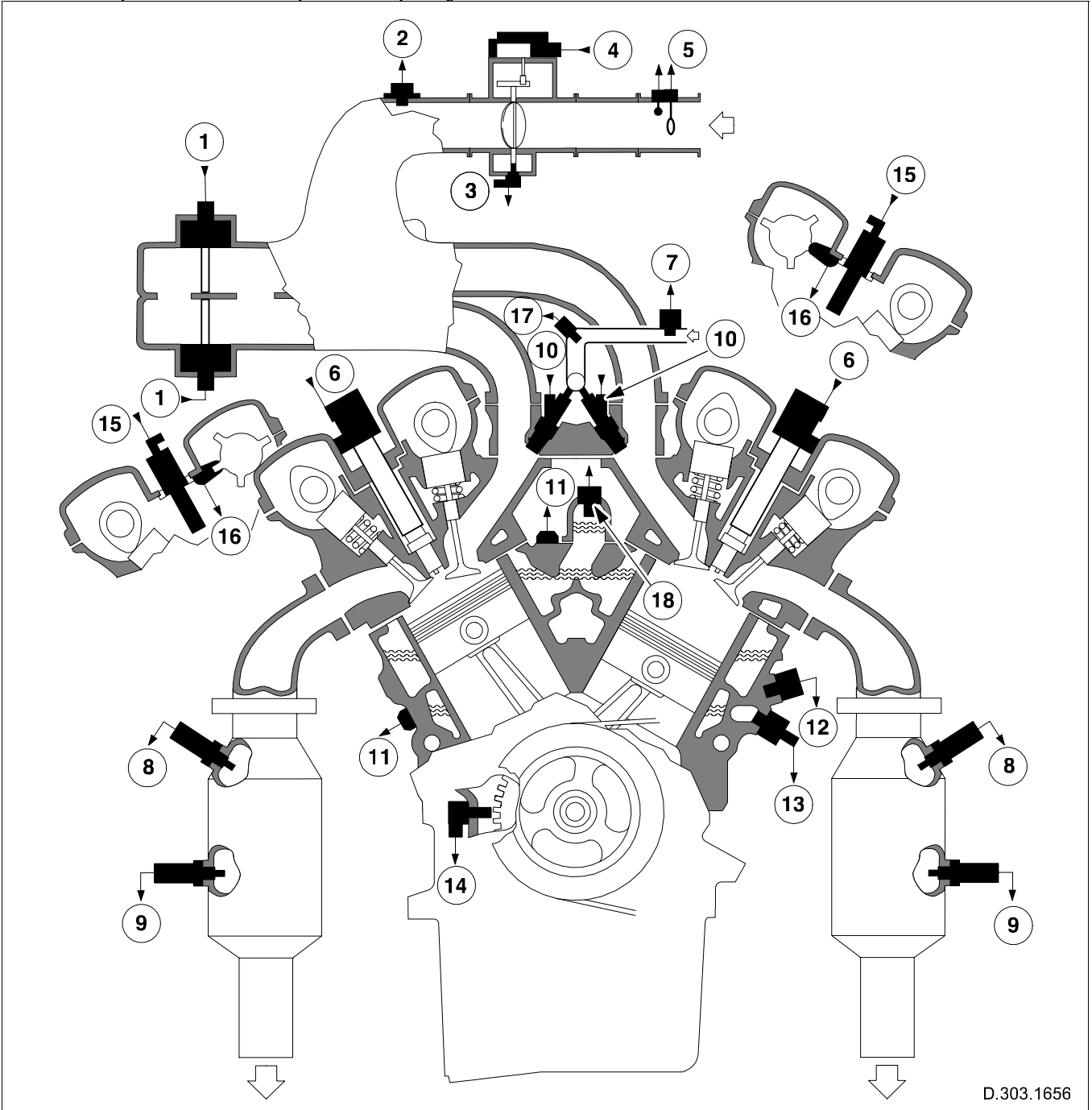
Fig. 50 V6 N/A Engine — sensor and actuator location

Key to Fig. 50

1. Intake manifold tuning valves
2. Manifold absolute pressure sensor
3. Fuel pressure sensor
4. Knock sensors
5. Heated oxygen sensor 1
6. Heated oxygen sensor 2
7. On-plug ignition coil with integrated amplifier
8. Engine oil pressure switch
9. Engine oil temperature sensor
10. Fuel injector
11. Crankshaft position sensor
12. Oil control solenoid — variable valve timing
13. Mass air flow sensor with integrated intake temperature sensor
14. Engine fuel temperature sensor
15. Camshaft position sensor
16. Engine coolant temperature sensor
17. Throttle motor
18. Throttle position sensor

Powertrain

The arrows represent the ECM's input and output signals.



D.303.1656

Fig. 51 V6 N/A Engine — sensors and actuators schematic

Key to Fig. 51

1. Intake manifold tuning valves
2. Manifold absolute pressure sensor
3. Throttle position sensor
4. Throttle motor
5. Mass air flow sensor with integrated intake air-temperature sensor
6. On-plug ignition coil with integrated amplifier
7. Fuel pressure sensor
8. Heated oxygen sensor 1
9. Heated oxygen sensor 2
10. Fuel injector
11. Knock sensor
12. Engine oil pressure switch
13. Engine oil temperature sensor
14. Crankshaft position sensor
15. Oil control solenoid — variable valve timing
16. Camshaft position sensor
17. Engine fuel temperature sensor
18. Engine coolant temperature sensor

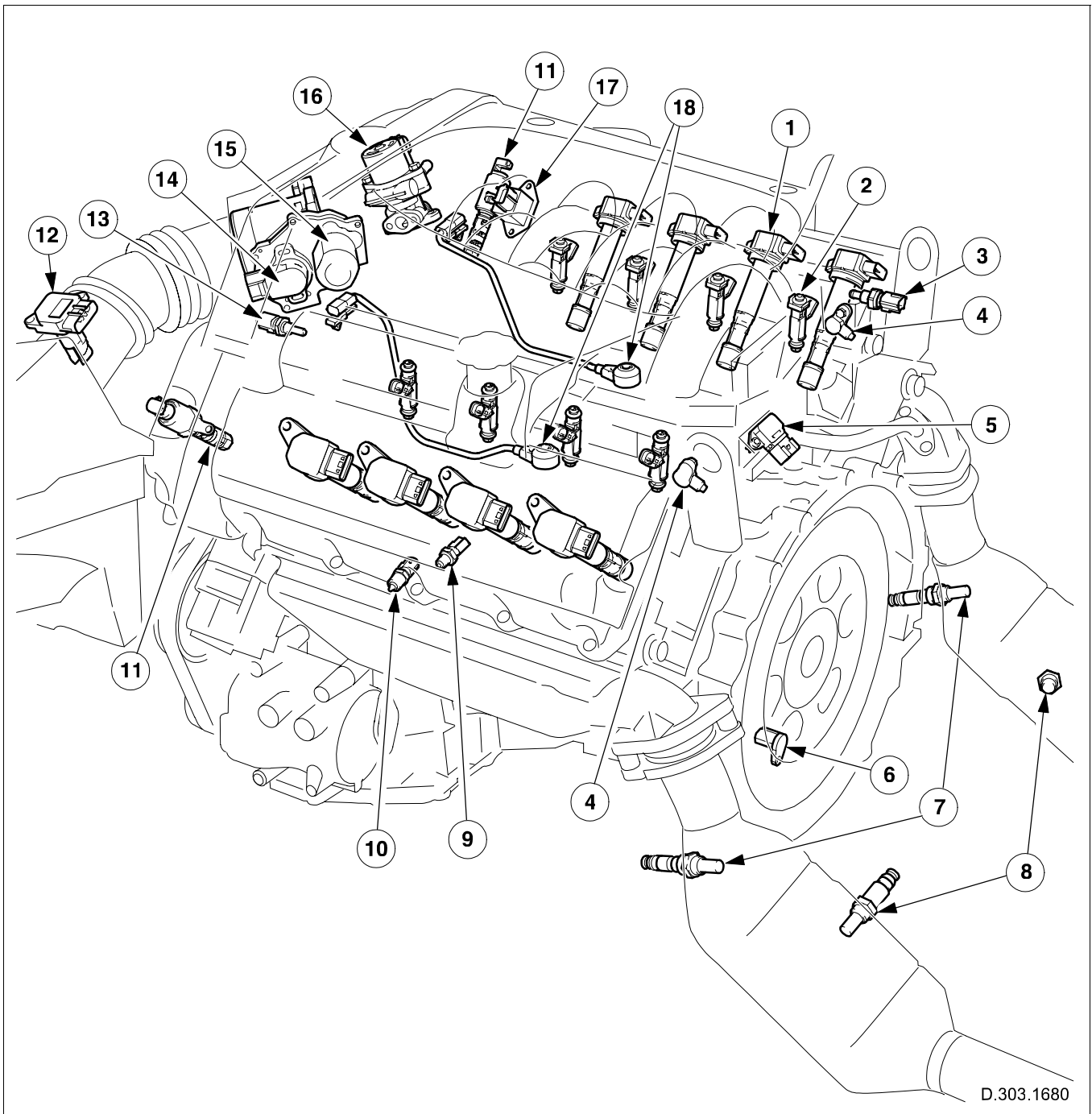


Fig. 52 V8 N/A Engine — sensor and actuator location

Key to Fig. 52

1. On-plug ignition coil with integrated amplifier
2. Fuel injector
3. Engine fuel temperature sensor
4. Camshaft position sensor
5. Manifold absolute pressure sensor
6. Crankshaft position sensor
7. Heated oxygen sensor 1
8. Heated oxygen sensor 2
9. Engine oil pressure switch
10. Engine oil temperature sensor
11. Oil control solenoid — variable valve timing
12. Mass air flow sensor with integrated intake air-temperature sensor
13. Engine coolant temperature sensor
14. Throttle position sensor
15. Throttle motor
16. Exhaust gas recirculation valve
17. Fuel pressure sensor
18. Knock sensor

Powertrain

The arrows represent the ECM's input and output signals.

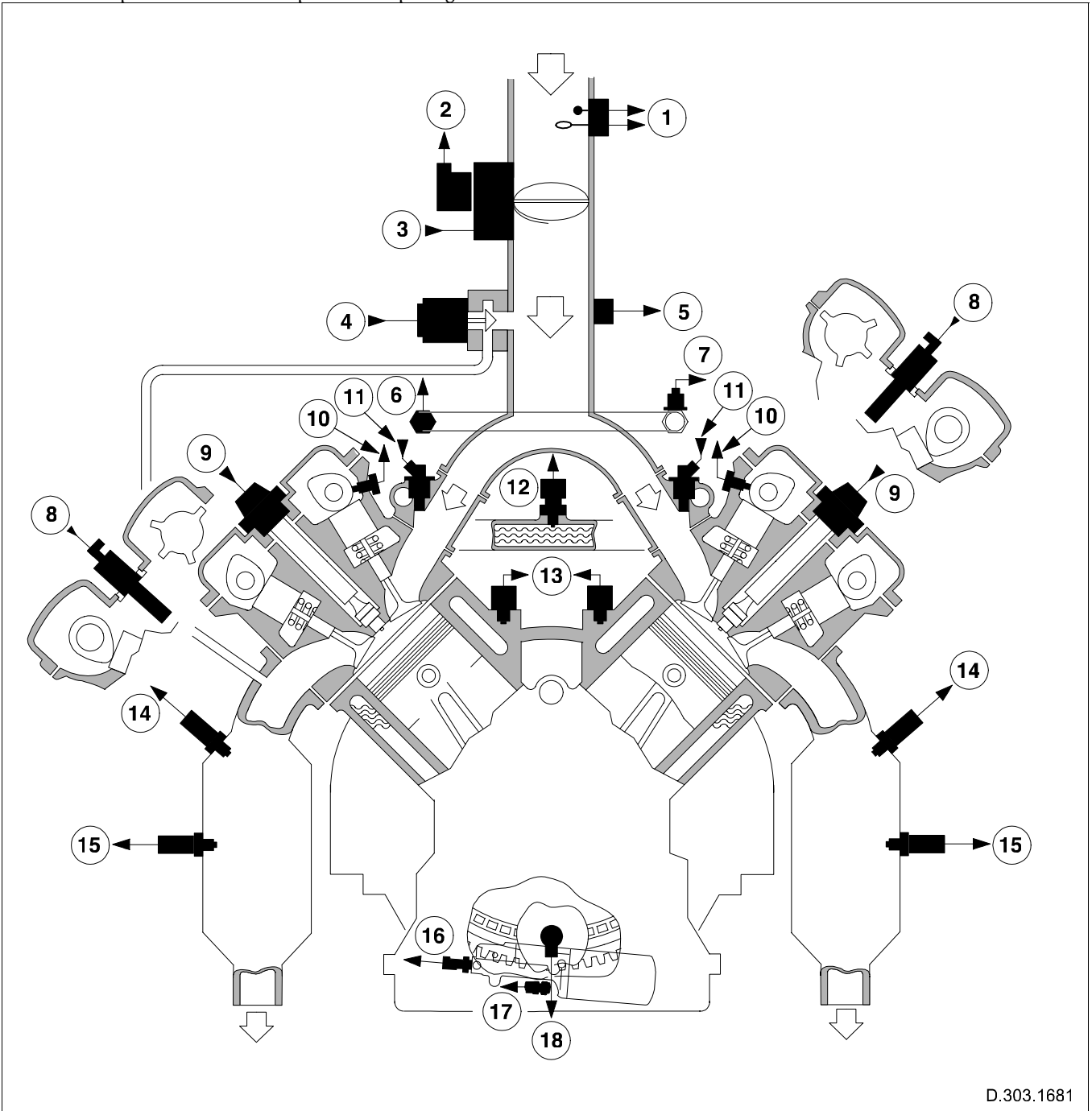


Fig. 53 V8 N/A Engine — sensors and actuators schematic

Key to Fig. 53

1. Mass air flow sensor with integrated intake air-temperature sensor
2. Throttle position sensor
3. Throttle motor
4. Exhaust gas recirculation valve
5. Manifold absolute pressure sensor
6. Engine fuel temperature sensor
7. Fuel pressure sensor
8. Oil control solenoid — variable valve timing
9. On-plug ignition coil with integrated amplifier
10. Camshaft position sensor
11. Fuel injector
12. Engine coolant temperature sensor
13. Knock sensor
14. Heated oxygen sensor 1
15. Heated oxygen sensor 2
16. Engine oil pressure switch
17. Engine oil temperature sensor
18. Crankshaft position sensor

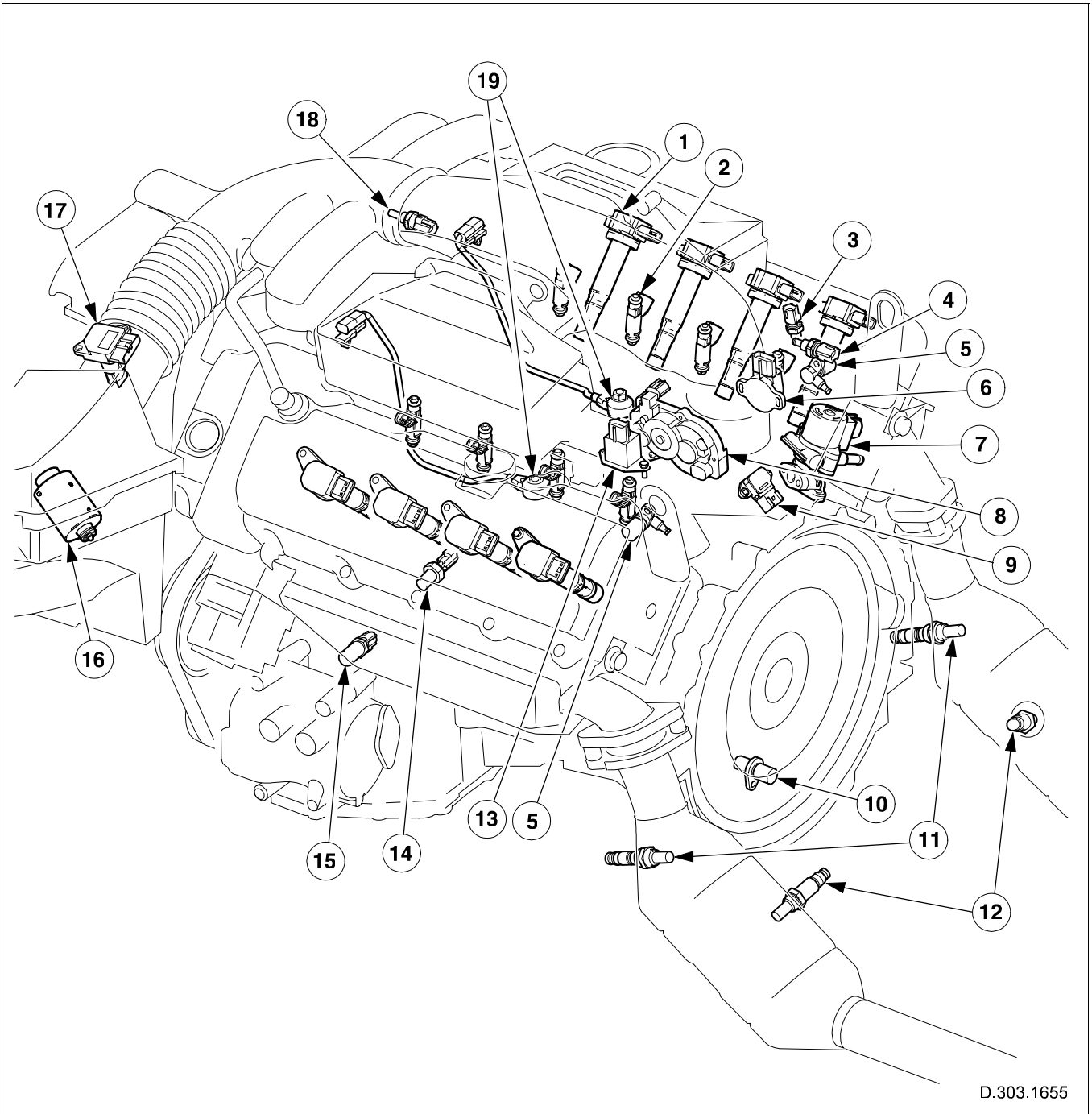
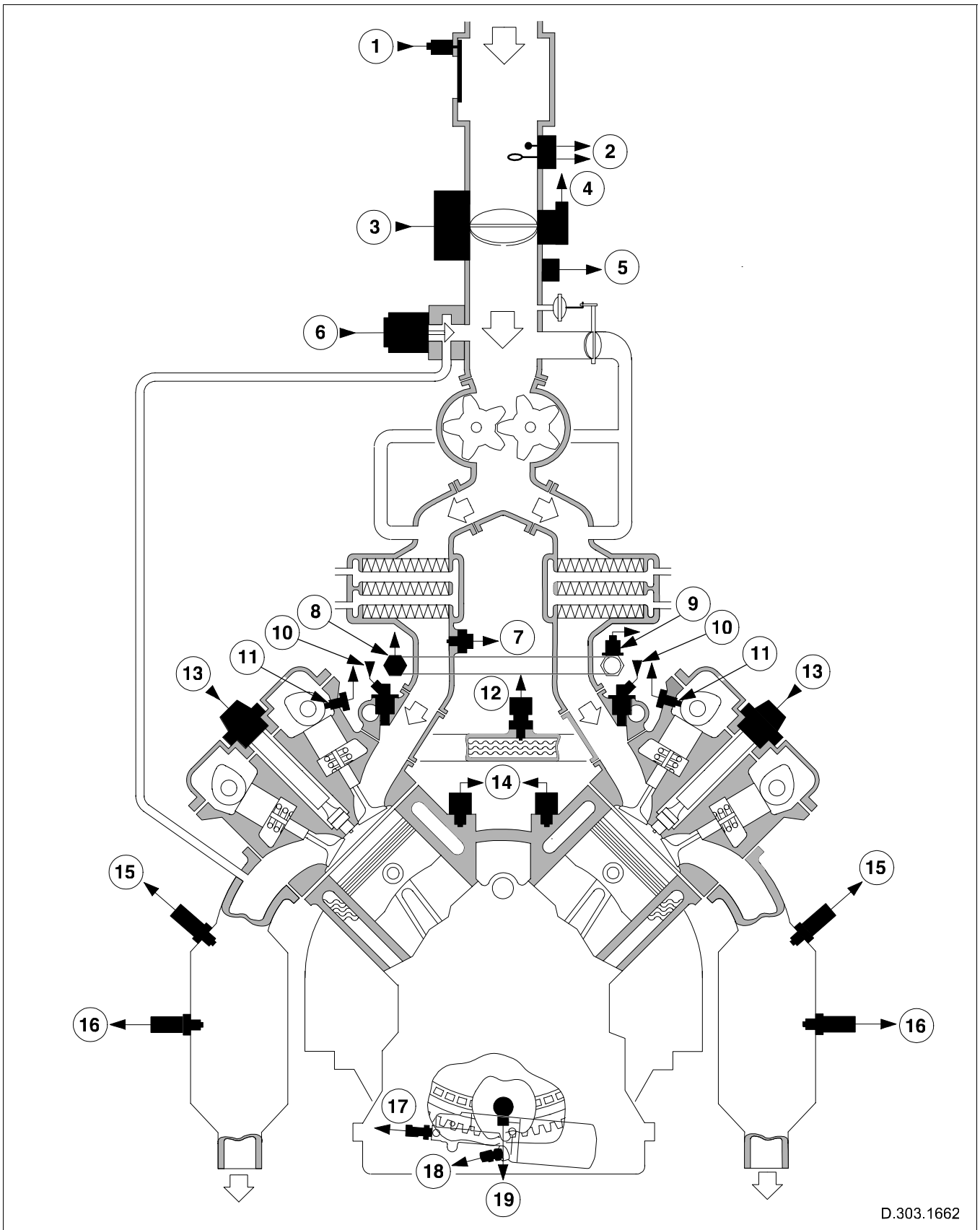


Fig. 54 V8 SC Engine — sensor and actuator location

Key to Fig. 54

1. On-plug ignition coil with integrated amplifier
2. Fuel injector
3. Air temperature sensor
4. Engine fuel temperature sensor
5. Camshaft position sensor
6. Throttle position sensor
7. Exhaust gas recirculation valve
8. Throttle motor
9. Manifold absolute pressure sensor
10. Crankshaft position sensor
11. Heated oxygen sensor 1
12. Heated oxygen sensor 2
13. Fuel pressure sensor
14. Engine oil pressure switch
15. Engine oil temperature sensor
16. Air intake control-flap solenoid
17. Mass air flow sensor with integrated intake air-temperature sensor
18. Engine coolant temperature sensor
19. Knock sensor



D.303.1662

Fig. 55 V8 SC Engine — sensors and actuators schematic

Key to Fig. 55

1. Air intake control-flap solenoid
2. Mass air flow sensor with integrated intake air-temperature sensor
3. Throttle motor
4. Throttle position sensor
5. Manifold absolute pressure sensor
6. Exhaust gas recirculation valve
7. Air temperature sensor
8. Engine fuel temperature sensor
9. Fuel pressure sensor
10. Fuel injector
11. Camshaft position sensor
12. Engine coolant temperature sensor
13. On-plug ignition coil with integrated amplifier
14. Knock sensor
15. Heated oxygen sensor 1
16. Heated oxygen sensor 2
17. Engine oil pressure switch
18. Engine oil temperature sensor
19. Crankshaft position sensor

Automatic Transmission

Introduction

A new six-speed electronically-controlled automatic transmission is introduced. Used with all S-TYPE engine derivatives, the transmission has been developed for vehicles with an engine torque of up to 600 Newton-metres (Nm).

In comparison to the previous five-speed transmission, the new transmission provides:

- Higher torque capacity.
- Reduced length.
- Reduced weight.
- Reduced assembly components.
- Improved fuel consumption.
- Improved vehicle performance.

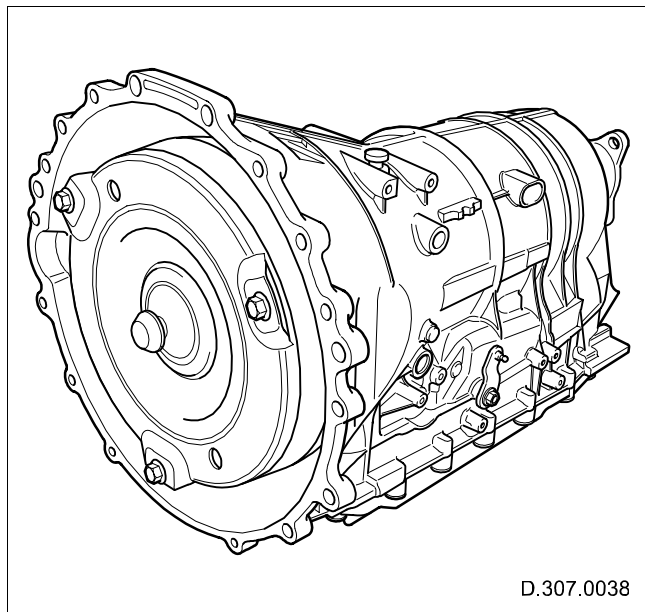


Fig. 56 Automatic transmission

Key Data

- Six automatic forward gears.
- One selectable reverse gear.
- Coaxial planetary transmission.
- Hydrodynamic torque converter with slip-controlled converter lock-up clutch.
- Hydraulic valve body with integral transmission control module.

- Electronic-hydraulic shift point position and gear shift control.
- Manual shifting.
- Self-diagnosis.
- Fill for life transmission fluid.

Gear Ratios

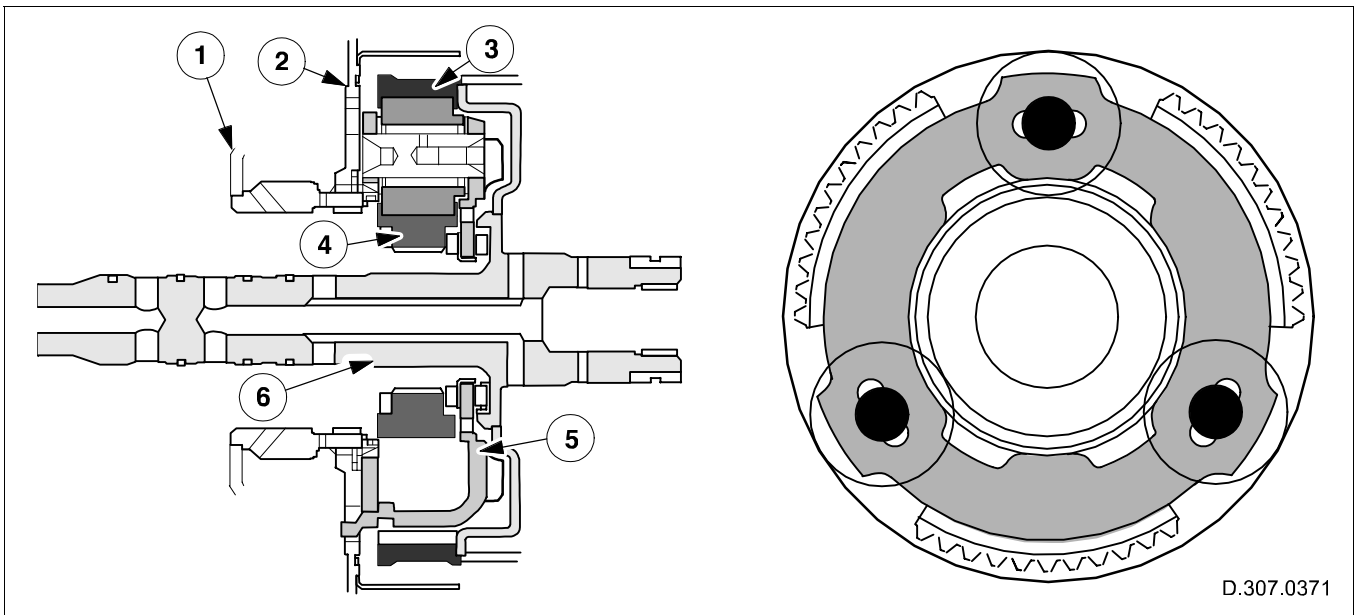
1st	— 4.17:1
2nd	— 2.34:1
3rd	— 1.52: 1
4th	— 1.14:1
5th	— 0.87:1
6th	— 0.69:1
Reverse	— 3.40:1

Transmission Operation

The transmission unit uses planetary gears, with hydraulic-electronic control. The valve body and transmission control module (TCM) form a composite element that is installed as a single unit in the transmission's fluid pan. The TCM uses a newly developed shift strategy known as adaptive shift strategy.

Engine power reaches the transmission via a hydrodynamic torque converter with integral converter lock-up clutch. The six forward gears and one reverse gear are obtained from a single-web planetary gear set followed by a double planetary gear set. Known as the Lepelletier-type gear sets, these gears make it possible to obtain 6 forward speeds.

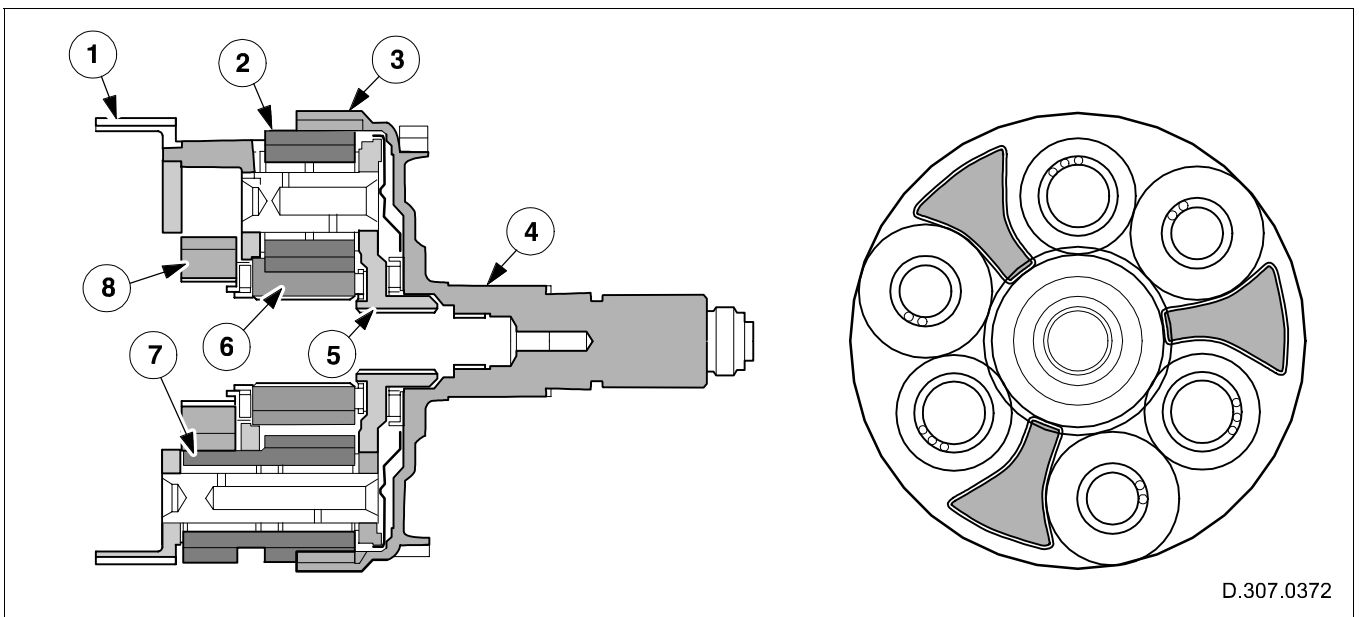
Gear selection is achieved by controlling the flow of automatic transmission fluid to operate various internal clutches. The TCM controls the electrical components for gear-selection shift pressure and torque converter slip-control. In the event of a system malfunction the TCM provides failure-mode effect management, to maintain maximum functional operation of the transmission, with minimum reduction in vehicle and occupant safety. In the event of loss of transmission control through electrical power failure, the basic transmission functions: Park, Reverse, Neutral and Drive are retained by the hydraulic system. The transmission will operate in limp-home mode: 3rd or 5th gear fixed, dependant upon gear selection at the time of the malfunction.



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Fig. 57 Single-web planetary gear set

- | | |
|-----------------|--------------------------|
| 1. Cylinder | 4. Planetary gear |
| 2. Baffle plate | 5. Planetary gear spider |
| 3. Ring gear | 6. Turbine shaft |



D.307.0372

Fig. 58 Double-web planetary gear set

- | | |
|----------------------------|----------------------------------|
| 1. Planetary gear spider | 5. Planetary gear spider |
| 2. Planetary gears (short) | 6. Sunwheel |
| 3. Ring gear | 7. Double planetary gears (long) |
| 4. Output | 8. Sunwheel |

Parking Lock

The parking lock acts by inserting a pawl into the teeth of the parking lock gearwheel on the transmission output shaft. This prevents the rear wheels from turning via the drive shaft.

Fluid Pump

The half-moon type fluid pump, is located between the torque converter and transmission housing. The pump is driven directly by the engine via the torque converter shell, and supplies fluid to the transmission and valve body. The pump draws in fluid through a filter and delivers it at high-pressure to the main pressure valve in the valve body. The valve adjusts the pressure and returns excess fluid to the fluid pan.

Torque Converter

The torque converter is a three-element unit containing a single-plate lock-up clutch and torsional vibration damper. The lock-up clutch eliminates slip in the torque converter, therefore helping to keep engine fuel consumption to a minimum. The lock-up clutch can be controlled and engaged in any gear from 1 to 6.

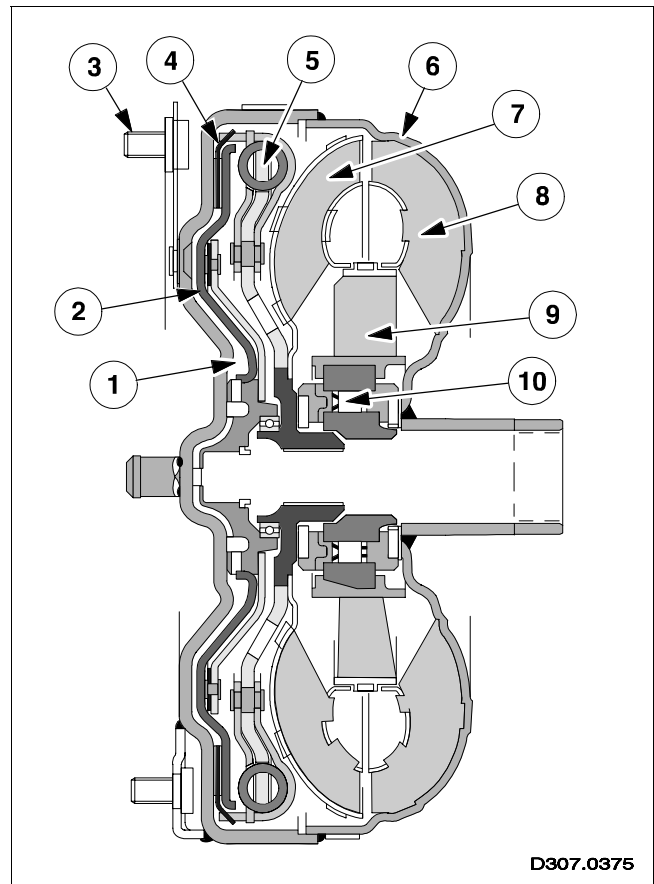


Fig. 59 Torque converter with torsional vibration damper

1. Space behind lock-up clutch
2. Lock-up clutch piston
3. Attachment to flywheel
4. Lined plate of lock-up clutch
5. Torsional vibration damper
6. Converter cover
7. Turbine
8. Impeller
9. Stator
10. Stator freewheel

Shift Elements

In addition to the torque converter lock-up clutch the other shift elements are:

- Three rotating multi-plate clutches 'A', 'B' and 'E'.
- Two fixed multi-disc brakes 'C' and 'D'.

All gear shifts '1st to 6th' or from '6th to 1st' are power-on overlapping shifts. When during the shift, one of the clutches must continue to transmit the drive at lower main pressure, until the other clutch is able to accept the input torque. The shift elements, clutches or brakes are engaged hydraulically. The fluid pressure is built up between the cylinder and the piston, therefore pressing the plates together. When fluid-pressure drops, the cup-spring that is pressing against the piston moves it back to its original position. The purpose of these shift elements is to perform in-load shifts with no interruption to traction. Multi-plate clutches 'A', 'B' and 'E' supply power from the engine to the planetary gear train. Multi-disc brakes 'C' and 'D' press against the transmission housing in order to achieve a torque reaction effect.

Shift Overlap Control

When overlap gearshift takes place, freewheels (one-way clutches) are not used but are replaced by suitable actuation of the relevant clutches. This both enables weight and space to be saved. The electronic-hydraulic shift action is obtained by means of various valves in the valve body being actuated by pressure regulators. They engage or disengage the relevant clutches or brakes at the correct moments.

Adaptive Shift Strategy

By increasing the interlinking of transmission control with other vehicle systems such as engine, brakes and steering, a number of signals are available that describe the actual driving status. For example, by applying: longitudinal and lateral acceleration, engine speed and engine torque, engine oil temperature, position and movement of the accelerator, and individual wheel speed,

additional functions in the electronic transmission control can be realized. On the basis of this information the transmission control recognizes whether:

the vehicle is maneuvering round a corner,
all the wheels are gripping,
the driver is braking,
or if the driver wishes to accelerate.

From these signals, conclusions can be drawn regarding the vehicle's actual load status and the topography of the stretch of road (uphill or downhill gradient), and be applied to the transmission function. It recognizes the driver's intentions and driving style and adapts its selection of gears accordingly. Also as a result of these electronics, the electronic system provides drive strategies that match other vehicle operating conditions, such as laden operation and cruise control.

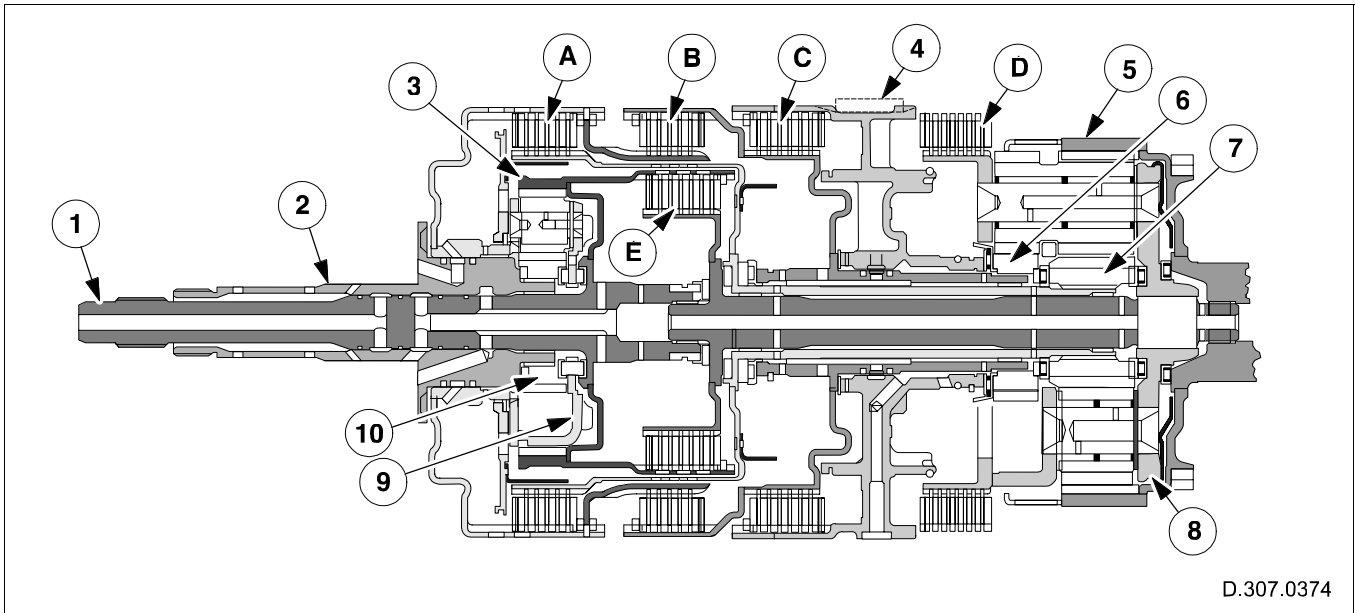


Fig. 60 Shift elements

- | | |
|--|---|
| <ul style="list-style-type: none"> A. Clutch B. Clutch C. Brake D. Brake E. Clutch 1. Turbine shaft 2. Stator shaft 3. Ring gear 1 | <ul style="list-style-type: none"> 4. Shaft key — fixed connection to transmission housing 5. Ring gear 2 6. Sunwheel 2 7. Sunwheel 3 8. Double planetary gear carrier 9. Planetary gear spider 10. Sunwheel 1 |
|--|---|

Transmission Control Module / Valve Body

The transmission control module (TCM) and valve body are combined into one unit, and installed in the transmission's fluid pan.

This combination of components provides the following advantages:

- Minimum tolerances, as the TCM is directly connected to the solenoids.
- Better coordination of gear-shifts.
- Increased refinement.
- Optimized shift quality.
- Good reliability, since the number of plug connections and interfaces are reduced.

CAUTION: When working on the TCM/Valve body, precaution must be taken to avoid damage to the component through electrostatic discharge. Refer to JTIS for further information.

The TCM controls the operation of the transmission, by processing signals such as:

- transmission input and output speeds,
- throttle pedal position,
- gear selector position,
- engine torque and speed,
- transmission fluid temperature,
- brake pedal status,
- engine oil temperature,
- engine coolant temperature,
- wheel speed, etc.

Using these signals and stored information the TCM calculates the correct gear and torque converter lock-up clutch setting and the optimum pressure settings for gear shift and lock-up clutch control.

Five pressure regulators and one solenoid valve are used to direct transmission-fluid flow. Select internal clutches and control the fluid pressure at the clutch for gear control. A separate pressure regulator is used exclusively for torque-converter clutch control. The TCM monitors input and output signals to confirm correct system operation. If a malfunction does occur the TCM reverts to a default state and informs the driver of a problem via the instrument cluster message center.

System diagnosis is performed using WDS.

Sensors

Speed sensors

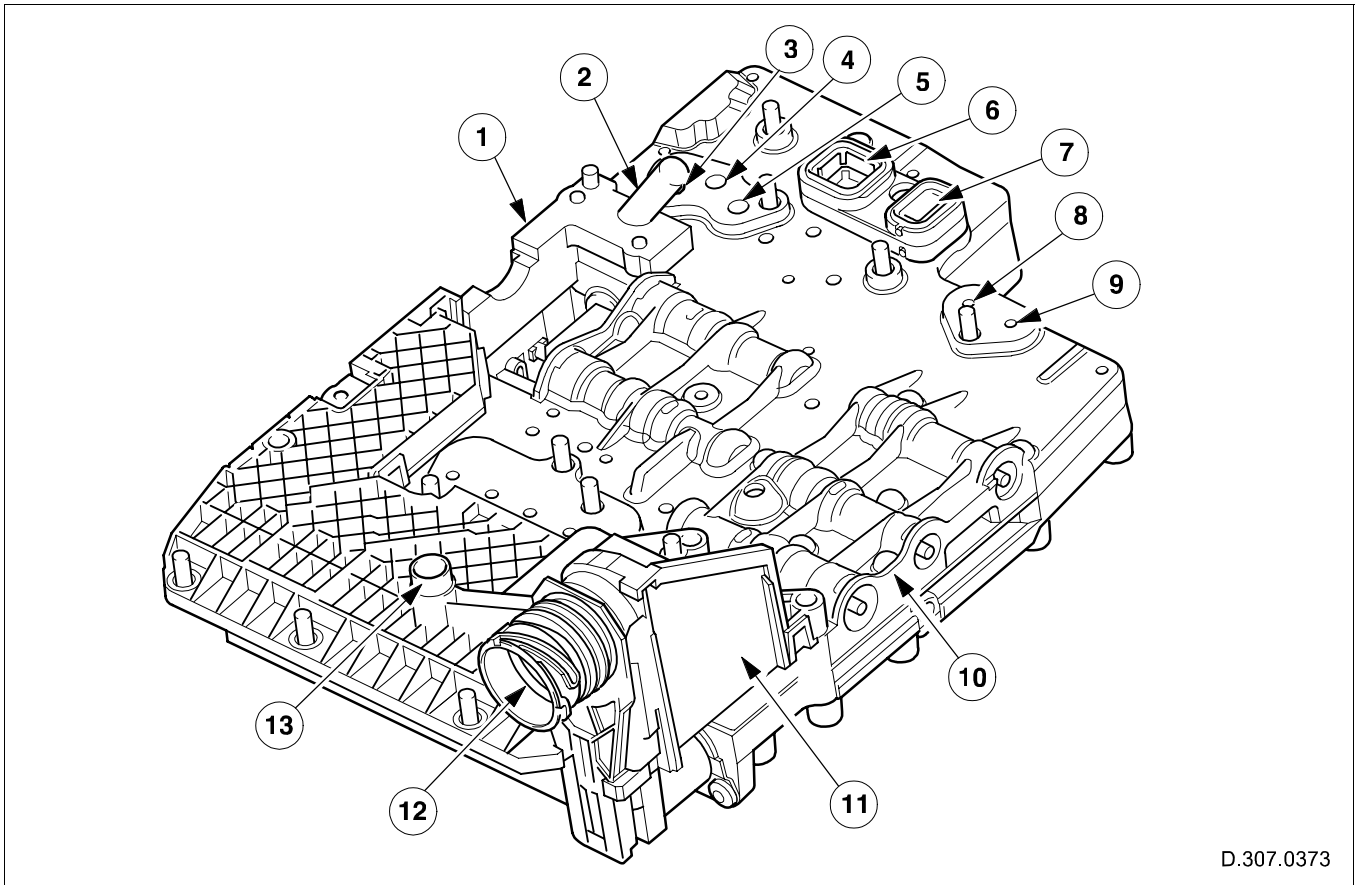
The TCM monitors the two transmission speed-sensors located on the valve body: one for measuring input shaft speed, and one for measuring output shaft speed.

Temperature sensor

The TCM uses the input signals from the temperature sensor located on the valve body, to activate various shift strategies.

Gearshift position sensor

The gearshift position sensor is located on the valve body. The TCM uses inputs from this sensor to determine the selected gear-range on the automatic side of the J-gate.



D.307.0373

Fig. 61 Transmission Control Module / Valve Body

- | | |
|--|-----------------------------|
| 1. Position switch | 8. Clutch E |
| 2. Turbine speed sensor | 9. Clutch A |
| 3. To cooler | 10. Hydraulic valve body |
| 4. Converter lock-up clutch — engaged | 11. Traction control module |
| 5. Converter lock-up clutch — released | 12. Transmission plug |
| 6. Discharge port | 13. Output speed sensor |
| 7. Suction port | |

Automatic Transmission Cooling

The transmission fluid-cooler is now integral with the radiator end-tank and water-cooled, replacing the previous air-cooled fluid cooler. This arrangement provides improved performance.

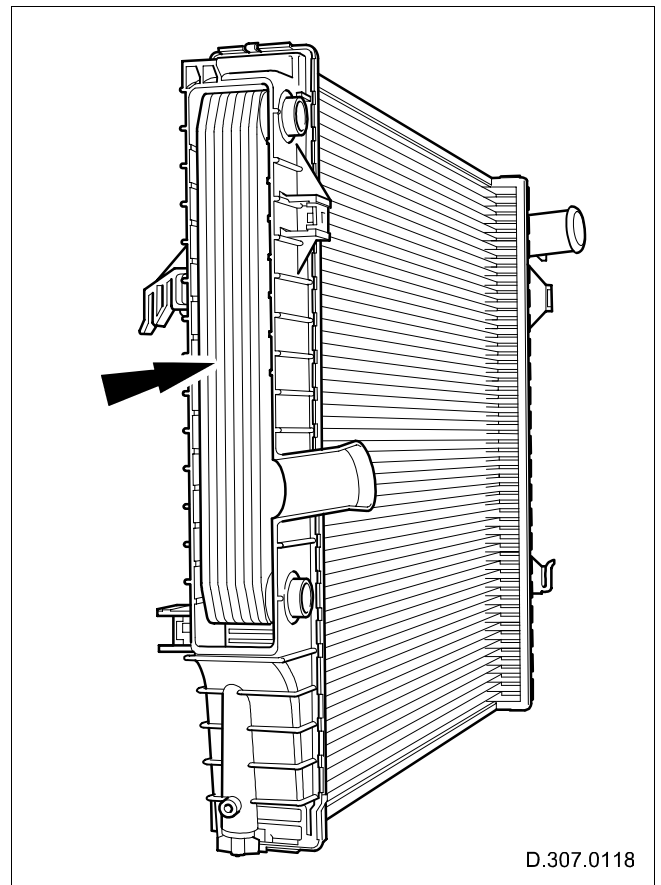


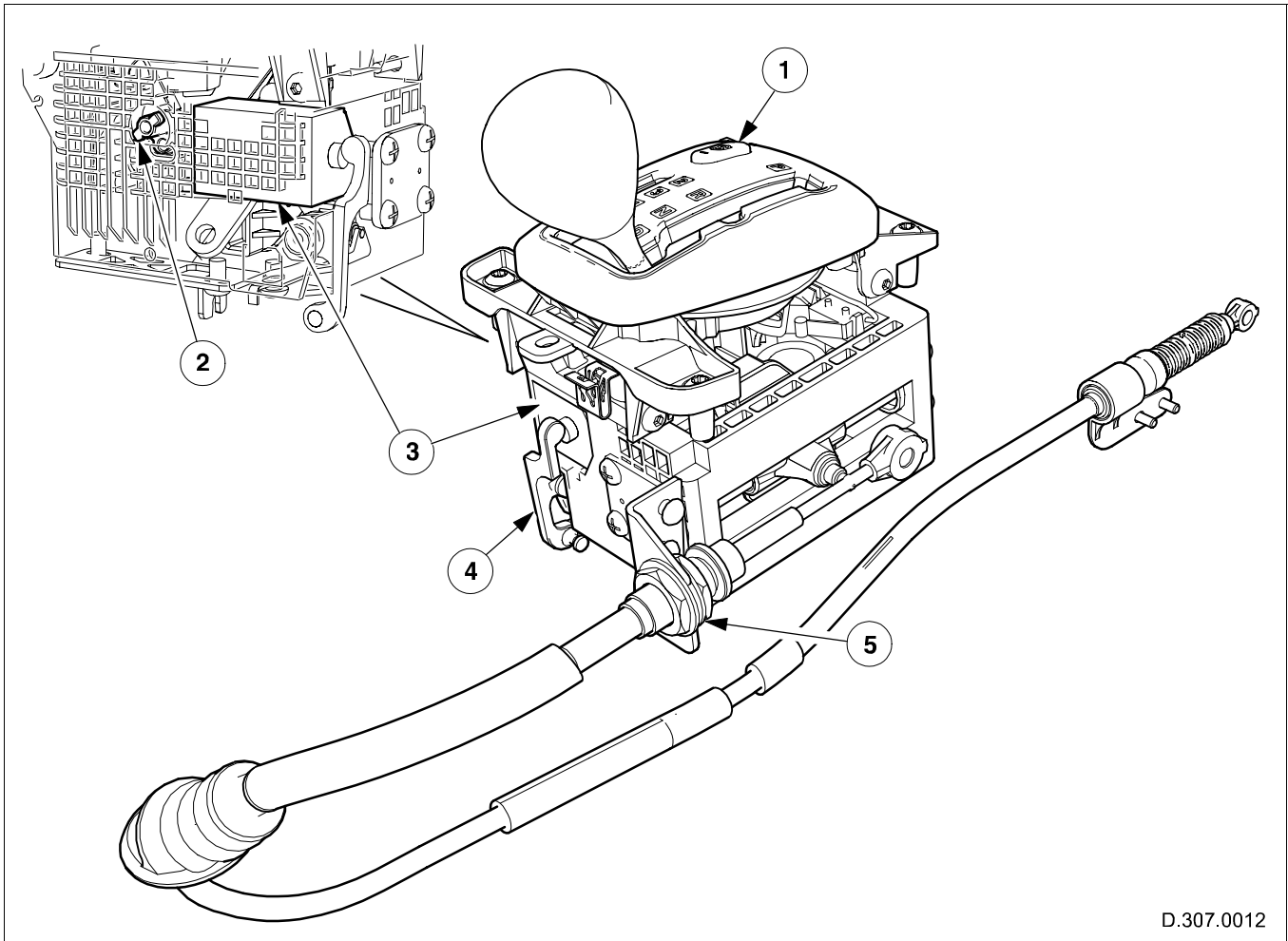
Fig. 62 Transmission cooler

Automatic Transmission External Controls

Introduction

The S-TYPE incorporates a new design of gearshift mechanism with:

- Improved mounting frame and method.
- Improved setting procedure.
- New design of gearshift interlock mechanism.
- New design of key interlock mechanism.
- Weight reduction.



D.307.0012

Fig. 63 Gearshift mechanism and cable

1. Sports mode switch
2. Gearshift interlock override
3. Gearshift interlock solenoid
4. Gearshift interlock mechanism
5. Cable adjustment mechanism

Gearshift Mechanism

The gearshift lever is designed to accommodate two different driving techniques as follows:

- Automatic — the right-hand side of the J-gate. The link between the gearshift lever and the transmission is via a cable.
 - With Drive ‘D’ selected, all six gears are changed automatically by the transmission control module (TCM), via signals pertaining to throttle position, vehicle speed, etc.
 - Also with ‘D’ selected and sixth gear engaged, the gear selector can be shifted sideways across the gate to ‘5’. Sixth gear will be inhibited until the gear selector is moved back to ‘D’.
- Manual — the left-hand side of the J-gate is for individual selection of 2nd, 3rd, 4th and 5th gear. These gears are selected electronically by the TCM; a gear higher than the one selected will not be engaged.

The sports mode switch, marked ‘S’ on the J-gate surround enables the driver to select either normal ‘N’ or sport ‘S’ modes.

When sport mode is selected the transmission operates normally, but the gear shift points are extended to make full use of the engine’s power reserves.

For further information on gear selection refer to the Driver’s Handbook.

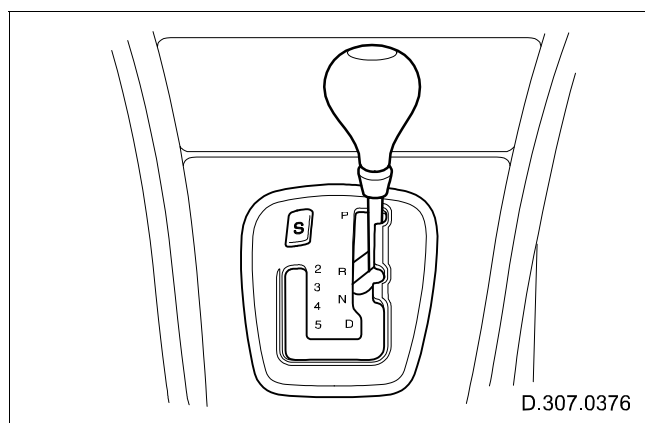


Fig. 64 Gear selector positions

Gearshift Interlock

The gearshift interlock, controlled by the J-gate, is a solenoid operated mechanism incorporated to prevent the gearshift lever being moved from ‘Park’ until the ignition is ‘On’ and the brake pedal is depressed (the solenoid remains in a de-energized state until the brake pedal is depressed).

NOTE: If the brake pedal is depressed while the ignition is switched ‘On’ the position ‘P’ on the J-gate will flash. This indicates to the driver that the brake pedal must be released and then depressed to enable the gearshift lever to be moved out of ‘Park’.

NOTE: If the gearshift lever is moved into ‘Park’ when the driver is simultaneously operating the brake pedal, the position ‘P’ on the J-gate will flash. This indicates to the driver that the brake pedal must be released and then depressed to enable the gearshift lever to be moved out of ‘Park’.

Gearshift interlock override

In the event of a discharged or disconnected battery, a provision is made to manually override the gearshift interlock solenoid, enabling the gearshift lever to be moved from the ‘Park’ position. The interlock override is accessed by removing the top cover of the J-gate.

Park Switch

A park switch is incorporated in the gearshift mechanism, it functions the key-lock solenoid via the ECM to prevent the removal of the ignition key, when the gearshift lever is not in the ‘Park’ position. The park switch signal also activates an audible warning via the instrument cluster, when the gearshift lever is out of the ‘Park’ position and the ignition is switched off.

Limp Home Mode

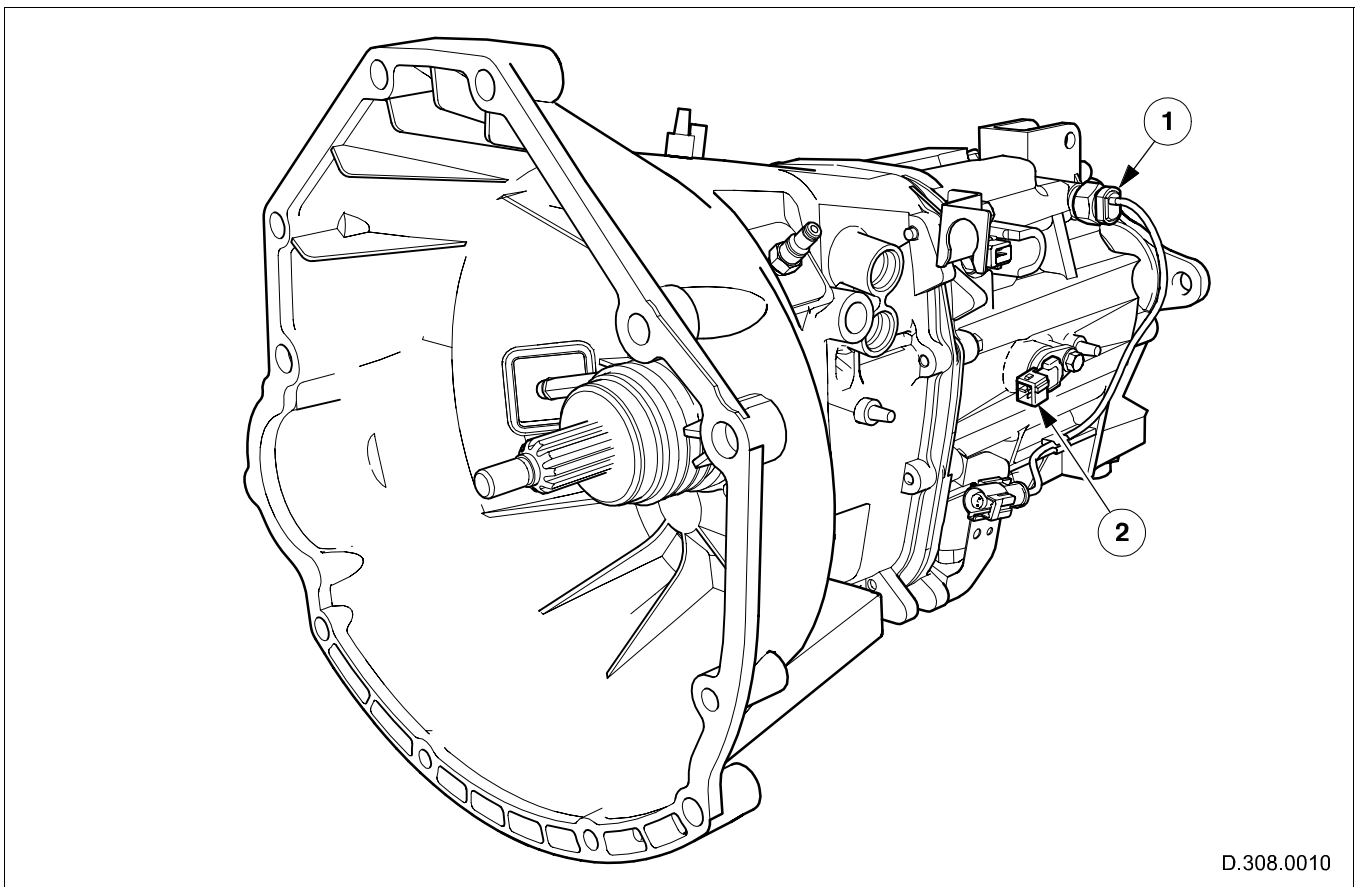
In the event of an electrical or mechanical malfunction, the selector ranges on the right-hand side of the J-gate will still function. Enabling the driver to get the vehicle to a dealership for diagnosis.

The J-gate mechanism performs its own internal fault monitoring and relays any fault codes to the TCM for diagnosis via WDS.

Manual Transmission

The manual transmission is fitted to V6 engine variants only. Changes to the manual transmission at this model year update are listed below:

- Introduction of a neutral switch, this component is used as part of the electric parking brake function.
- The manual transmission speed sensor is no longer functional. The wheel speed sensors provide the speed signal, the sensors are hard-wired to the ABS/TC/DSC module, which provides the wheel-speed signal to various units via the CAN.
- Introduction of a new transmission oil, refer to 'JTIS'.



D.308.0010

Fig. 65 Manual transmission

1. Neutral switch — electric parking brake
2. Speed sensor — non-functional

Exhaust System

The exhaust systems on the S-TYPE are constructed of stainless steel with polished end-pipes, and are designed to meet specific flow-resistance requirements and general engine conditions of each powertrain derivative. Exhaust system performance is optimized with the introduction of thin-wall high-cell-density substrates to increase geometric surface area and minimize back-pressure.

Low-weight exhaust systems on N/A vehicles are introduced with revised resonator internals to optimize noise quality. An exhaust system for the supercharged S-TYPE is also introduced, with a unique single-piece resonator tuned to give low back-pressure and optimum sound quality.

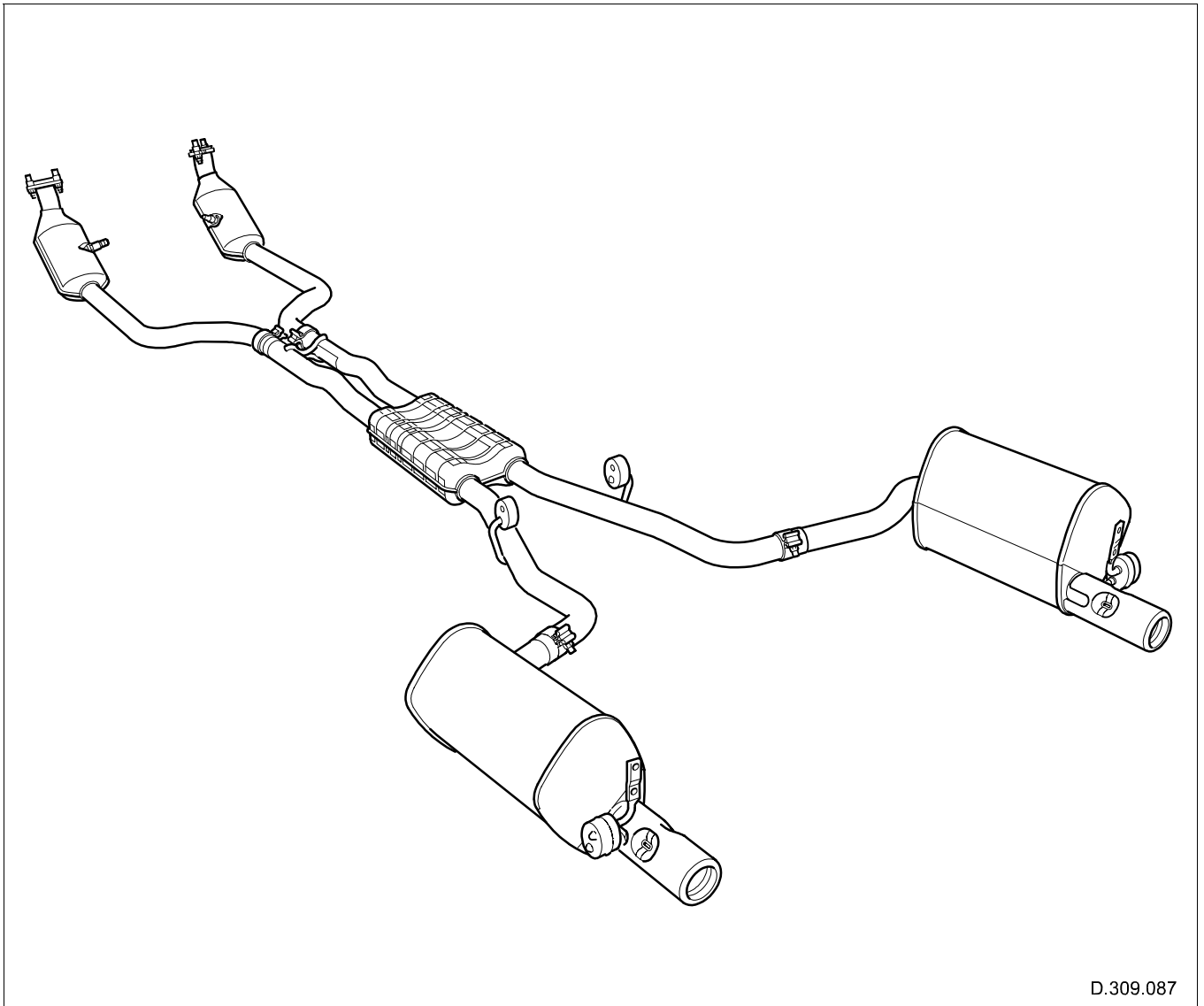


Fig. 66 Exhaust system — V8 SC variant shown

Powertrain

Tuning differences for each engine derivative are as follows:

- The V8 N/A system has 2 x 44 in³ catalyst bricks in each downpipe, the front having 900 cells/in² and the rear 400 cells/in².
- The V8 SC system has 2 x 44 in³ catalyst bricks in each downpipe, the front and rear bricks both having 600 cells/in².
- The V6 system has 2 x 44 in³ catalyst bricks in each downpipe, the front and rear bricks both having 600 cells/in².
- The internals of the rear mufflers are also different for each powertrain variant to achieve different sound quality.

The entire exhaust system is assembled as follows:

- The two downpipe catalyst assemblies are connected by self-sealing two-bolt flanges to the exhaust manifolds.
- The resonator assembly connects to the two downpipes via two clamps, and the two rear mufflers connect to the rear-end of the resonator via two clamps.
- The system is held up by four isolator rubbers: two connect to the resonator assembly and two at the tailpipe end of the rear mufflers.

Fuel Tank and Lines

Introduction

The fuel system has been redesigned to provide a decrease in weight and an increase in performance. The basic construction of the system remains the same, although many of the components have been updated. A twin-pump fuel delivery system is also introduced for supercharged applications.

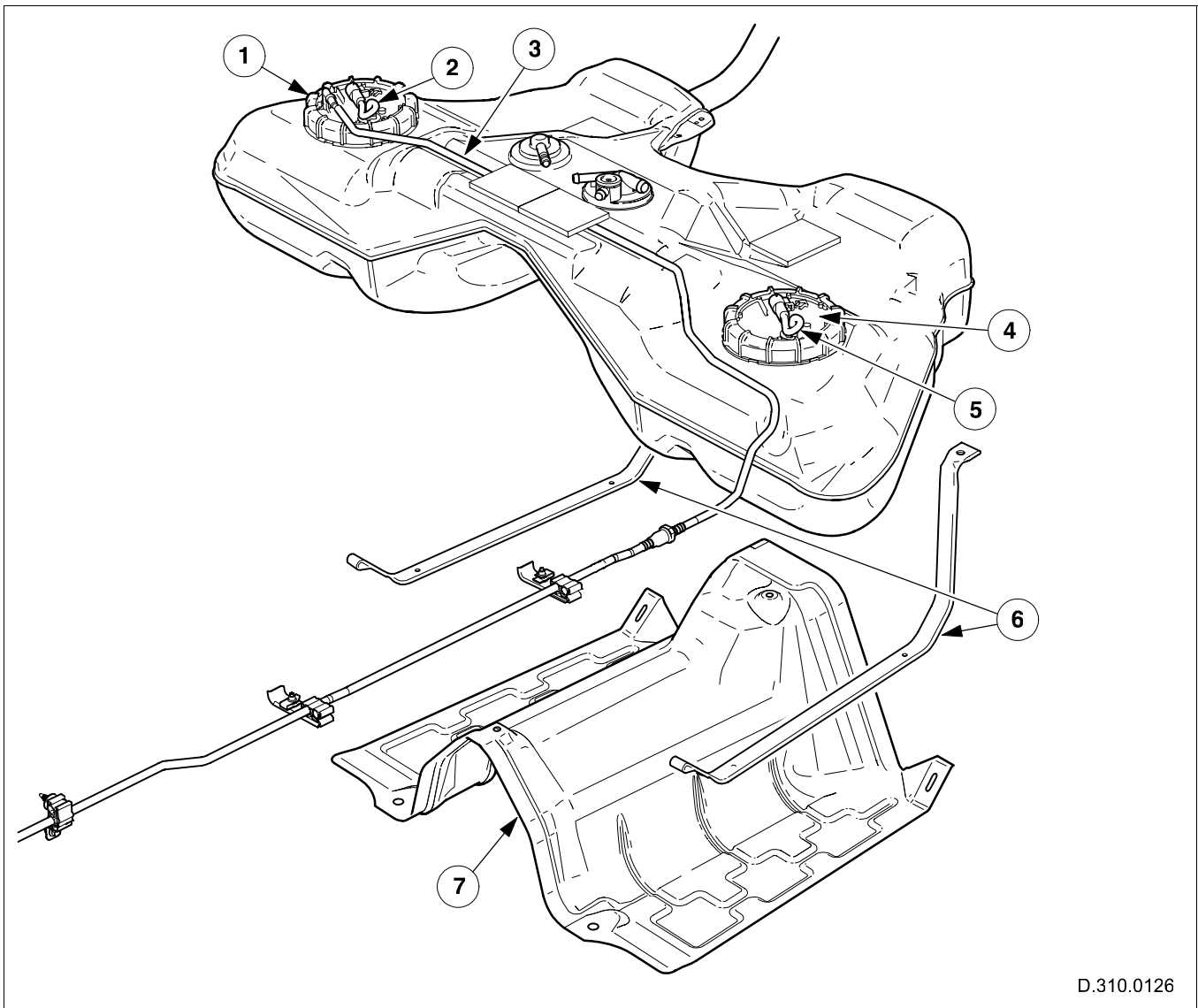
Key Data

- Fuel tank capacity: 69.5 liters (15 gallons).
- Fuel rail pressure: 3.8 – 5.0 Bar referenced to inlet manifold pressure.
- Max fuel flow (N/A systems): 120 liters/hour at 3.8 Bar (to atmosphere).
- Max fuel flow (SC systems): 180 liters/hour at 4.8 Bar (to atmosphere).

Fuel Tank

As with the previous S-TYPE the fuel tank construction and location remains the same, with the exception of the tank's cross-over pipes, which are now installed internally.

- The fuel tank is constructed of high density polyethylene and is 'saddle' shaped with left-hand and right-hand fuel compartments.
- The fuel tank is located underneath the vehicle, below the rear passenger seat.
- The driveshaft and exhaust pass through the arch of the fuel tank.
- The fuel tank is retained by two metal straps fixed to the vehicle's underbody, with the underside of the tank being protected by a fitted heatshield.



D.310.0126

Fig. 67 Fuel tank — N/A application shown

- | | |
|--|--|
| 1. Fuel pump | 5. Fuel level sensor, electrical connector |
| 2. Fuel pump and fuel level sensor, electrical connector | 6. Fuel tank retaining straps |
| 3. Fuel delivery pipe | 7. Heatshield |
| 4. Fuel transfer module | |

Fuel Delivery (N/A Engines)

The fuel pump is a variable-speed rotary-vane type, which operates in a fuel module located in the right-hand fuel tank compartment. A fuel transfer module is located in the left-hand compartment, refer to **Fig. 68**. Both components are secured by screw-on plastic closure rings and have integral top plates for external pipe-work and electrical connectors.

Fuel level is maintained equal in the fuel tank compartments by circulating the fuel through internal cross-over pipes via suction jet-pumps. High pressure fuel from the fuel pump is directed through the jet-pump's orifice, creating a low pressure area to be formed around the orifice. The fuel is drawn into this low-pressure area and directed into the cross-over pipe to the opposing module.

Fuel is pumped from the fuel pump to the fuel rail via the parallel pressure relief valve and fuel filter. The parallel pressure relief valve contains two spring-loaded valves, which operate in opposite directions. The function of the valve is to:

- assist engine starting by retaining a pre-set fuel pressure in the supply pipe and fuel rail;
- limit fuel-rail pressure due to temporary vapor increase in hot conditions;
- limit fuel-rail pressure caused by sudden load changes for example, a fully open to closed throttle transition;
- prevent leakage from the tank in the event that the fuel delivery pipe is severed.

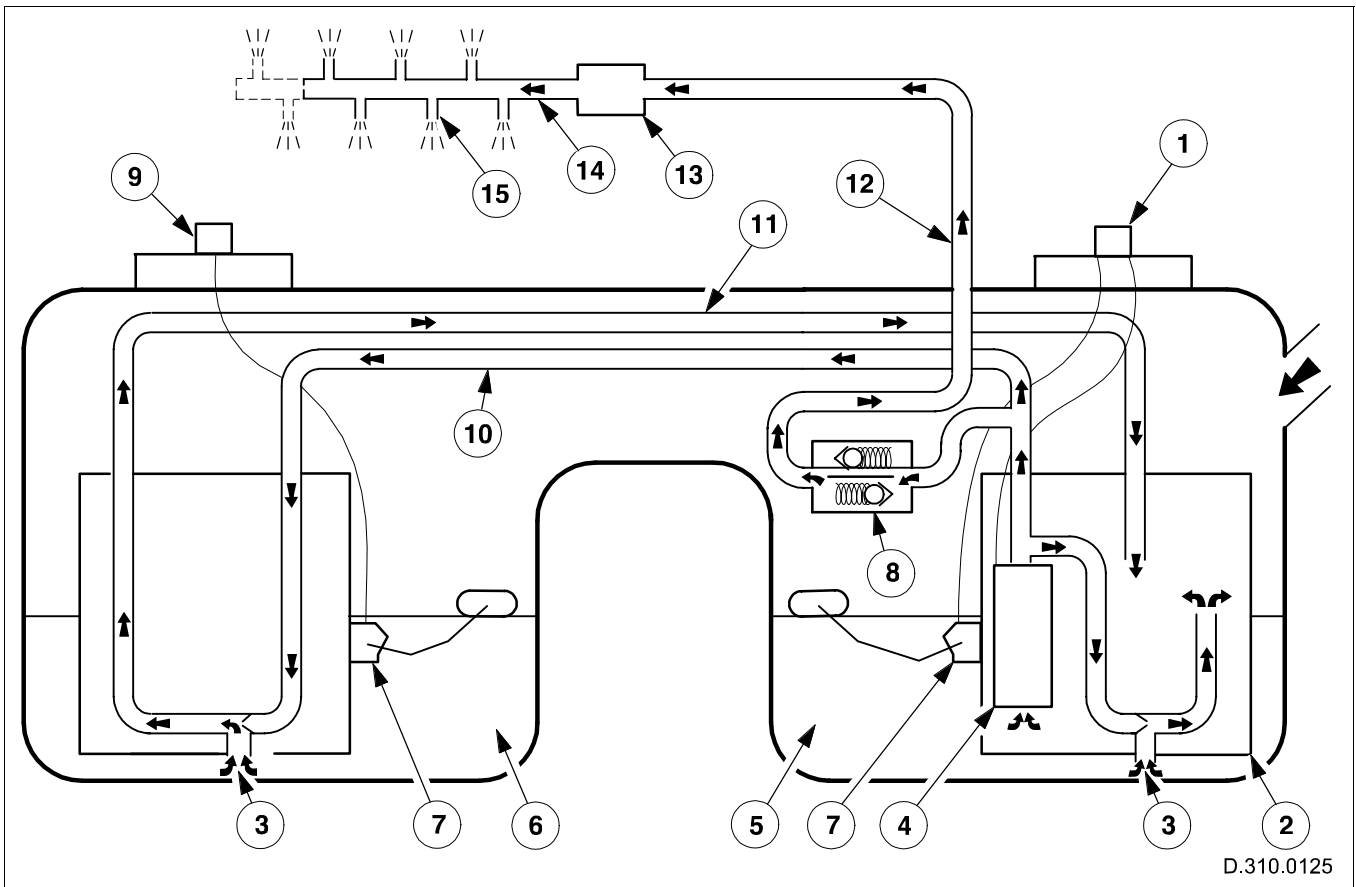


Fig. 68 Schematic of fuel tank internals — N/A application

- | | |
|--|---|
| 1. Fuel pump and fuel level sensor, electrical connector | 9. Fuel level sensor, electrical connector |
| 2. Fuel pump module | 10. High-pressure cross-over circulation pipe |
| 3. Suction jet-pump | 11. Low-pressure cross-over circulation pipe |
| 4. Fuel pump | 12. Engine fuel-delivery pipe |
| 5. Right-hand fuel compartment | 13. Fuel filter |
| 6. Left-hand fuel compartment | 14. Fuel rail |
| 7. Fuel level sensor | 15. Fuel injector |
| 8. Parallel pressure relief valve | |

Fuel Delivery (SC engines)

The twin gerotor fuel pumps are high-performance variable-speed types, with each pump operating in a fuel module located in each fuel tank compartment, refer to **Fig. 69**. The pumps are secured by screw-on plastic closure rings and have integral top plates for external pipe-work and electrical connectors.

Fuel level is maintained equal in the fuel tank compartments by circulating the fuel through internal cross-over pipes via suction jet-pumps. High pressure fuel from the fuel pumps is directed through the jet-pump's orifice, creating a low pressure area to be formed around the orifice. The fuel is drawn into this low-pressure area and directed into the cross-over pipes to the opposing module.

Fuel is pumped from the fuel pump to the fuel rail via the parallel pressure relief valves and a fuel filter. Each parallel pressure relief valve contains two spring-loaded valves, which operate in opposite directions. The function of the valves is to:

- assist engine starting by retaining a pre-set fuel pressure in the supply pipe and fuel rail;
- limit fuel-rail pressure due to temporary vapor increase in hot conditions;
- limit fuel-rail pressure caused by sudden load changes for example, a fully open to closed throttle transition;
- prevent leakage from the tank in the event that the fuel delivery pipe is severed.

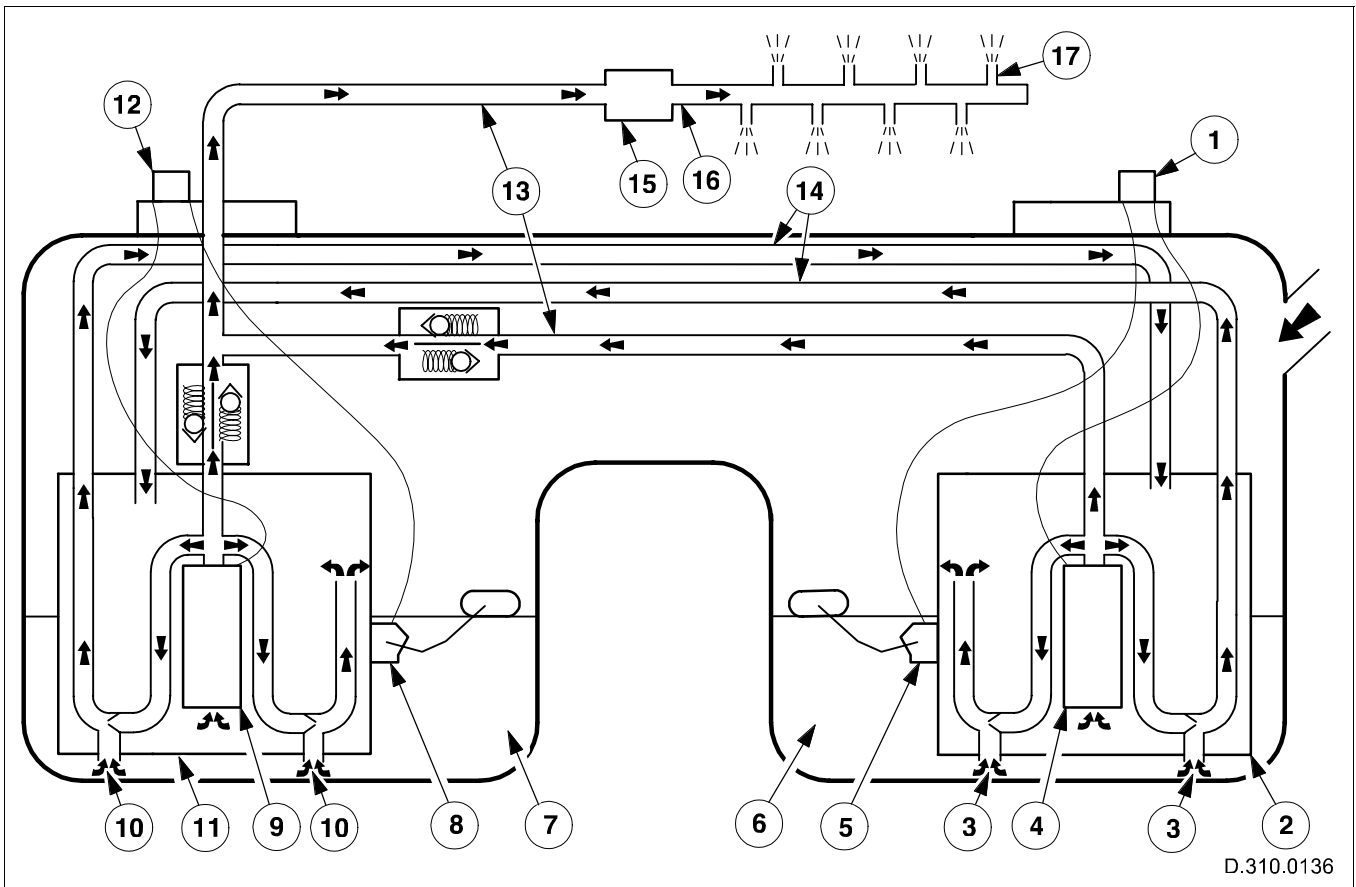


Fig. 69 Schematic of fuel tank internals — SC application

- | | |
|--|---|
| 1. Fuel pump and fuel level sensor, electrical connector | 10. Suction jet-pump |
| 2. Fuel pump module | 11. Fuel pump module |
| 3. Suction jet-pump | 12. Fuel pump and fuel level sensor, electrical connector |
| 4. Fuel pump | 13. Engine fuel-delivery pipe |
| 5. Fuel level sensor | 14. Low-pressure cross-over pipe |
| 6. Right-hand fuel compartment | 15. Fuel filter |
| 7. Left-hand fuel compartment | 16. Fuel rail |
| 8. Fuel level sensor | 17. Fuel injector |
| 9. Fuel pump | |

Returnless Fuel System

The returnless fuel system supplies the correct amount of fuel as required by the engine at any given moment. Eliminating the requirement for excess fuel returning to the fuel tank. The returnless fuel system:

- reduces load on the electrical system;
- improves fuel economy;
- eliminates the effects of fuel pressurization and depressurization;
- eliminates the effects of engine-heat causing extra fuel vapor being generated in the fuel tank by returning fuel.

Each fuel tank compartment incorporates an independent fuel level sensor. Signals from each sensor are calculated by the rear electronic control module (RECM) and relayed to the instrument cluster to enable the display of the total quantity of fuel in the tank. Driver low-fuel warning, via signals from the RECM, is displayed in the message center. Simultaneously, the amber general warning light to left of the message center will illuminate.

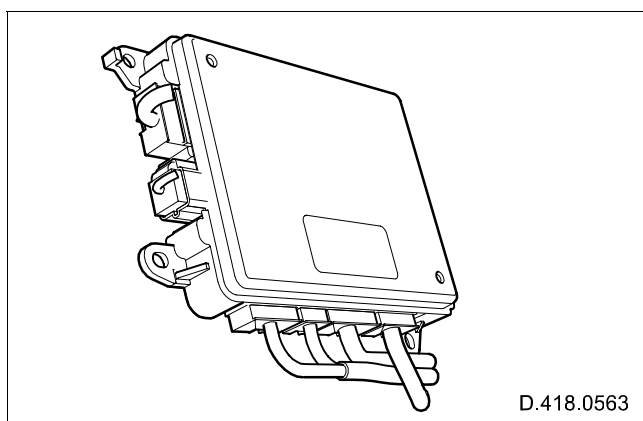


Fig. 70 Fuel pump module integrated into the rear electronic control module

N/A Vehicles

The fuel pump module (FP module), via pulse-width modulated signals from the ECM, controls the amount of fuel supplied by the fuel pump to the fuel rail. The ECM receives signals from the fuel pressure sensor and engine fuel temperature sensor, located on the fuel rail, to indicate the pressure of the fuel in the fuel rail. In response to these signals, plus other engine and driver demand signals, the ECM calculates the amount of fuel required and requests the FP module to vary the fuel pump delivery to suit the engine's requirements.

- The fuel pump module is integrated into the rear electronic control module (RECM), located in the right-hand side of the luggage compartment.

SC Vehicles

The SC fuel system works on the same principal as the N/A system, however to meet the fuel flow-rate requirements of the supercharged engine, the fuel tank incorporates two fuel pumps, which operate simultaneously, refer to **Fig. 69**. The right-hand fuel pump, is controlled by the FP module integrated into the RECM, via signals from the ECM. The left-hand fuel pump is controlled by a secondary FP module also via signals from the ECM.

- The secondary fuel pump module is located in the right-hand side of the luggage compartment.

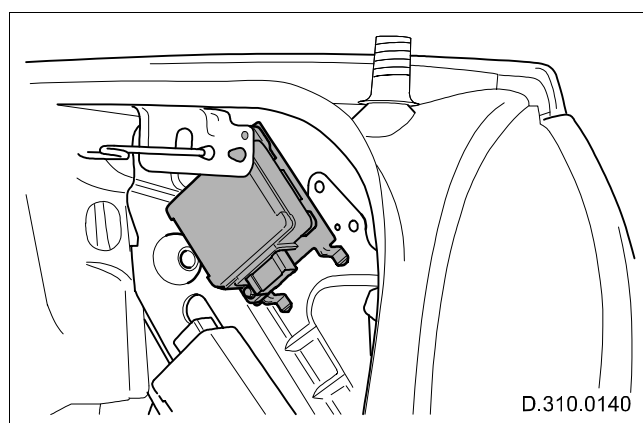


Fig. 71 Secondary fuel pump module SC

Inertia Fuel Shutoff Switch

In the event of an accident, the inertia fuel shutoff switch (IFS switch) will trip, isolating the fuel pump operation. Once the IFS switch has tripped it must be reset before attempting to restart the engine.

The IFS switch is located behind the trim on the left-hand side of the vehicle, forward of the front door post, below the fascia. A finger access hole in the trim allows access to reset the switch.

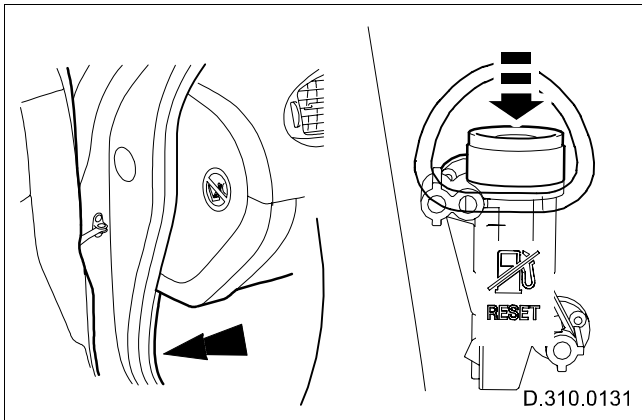


Fig. 72 Inertia fuel shutoff switch

Resetting the Switch

WARNING: To avoid the possibility of fire or personal injury, do not reset the inertia switch if you see or smell fuel.

If no fuel leaks are apparent, reset the inertia switch as follows:

1. Turn the ignition switch to position '0'.
2. Press down the rubber reset button on top of the inertia switch.
3. Turn the ignition switch to position 'II', pause for two seconds, then return the key to position '0'.
4. Make a further check for fuel leaks.

Climate Control System

The climate control system provides filtered air to the passenger compartment from a fully automatic, dual-zone, temperature controlled system. Driver and front passenger have independent control of the passenger compartment air temperature for their individual comfort.

The system is designed to provide efficient regulation of the vehicle environment without intervention from the occupant. Sensors inside the vehicle, monitor temperature, humidity and direct sunlight. In response, the electronic control system automatically adjusts the heat input, fan speed, air intake and air flow distribution to reduce misting and maintain the selected temperature(s).

NOTE: All windows and the closing roof panel should be closed before automatic operation is selected, in order to provide optimum comfort under most driving conditions.

Specific climate control features will vary depending on both vehicle and market specification.

NOTE: The automatic climate control system will also respond to spoken commands if the optional voice control system is fitted; refer to **Voice Activated Control System**.

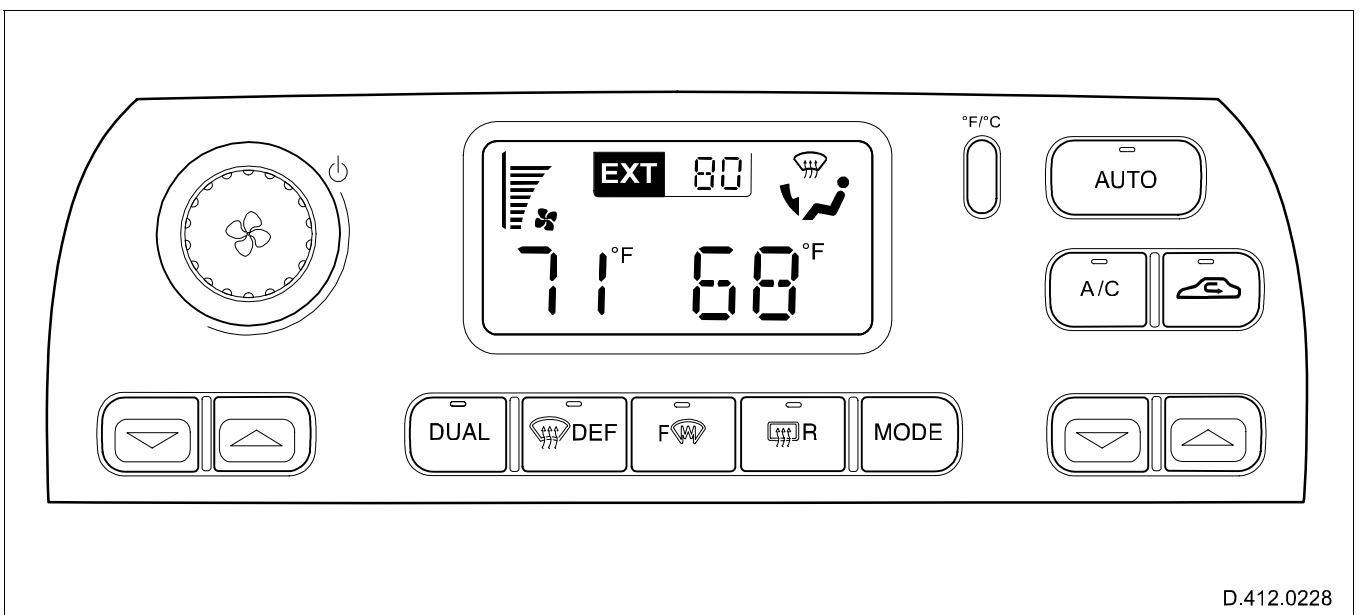
Display and User Controls

The user controls comprise either:

- Control panel with LCD.
- Control panel with touch-screen.

Control Panel With LCD

The climate control functions are selected by push buttons and a rotary control. When a function button is pressed, selection is confirmed by a ‘beep’ and illumination of the button LED. The LCD uses graphic symbols to provide additional confirmation of the system status.



D.412.0228

Fig. 73 Control panel with LCD (including heated front screen)

Electrical

Control Panel With Touch-screen

The control panel with touch-screen is a multifunction touch-screen console which comprises on-screen simulated buttons (soft buttons) and perimeter buttons (hard buttons); refer to **Telematics** for further information.

Temperature LCD

When the climate control system is operational, the small, integral LCD, located below the touch-screen, provides confirmation of:

- external (EXT) ambient temperature;
- required interior temperature (selected by the driver).
- required interior temperature (selected by the passenger).

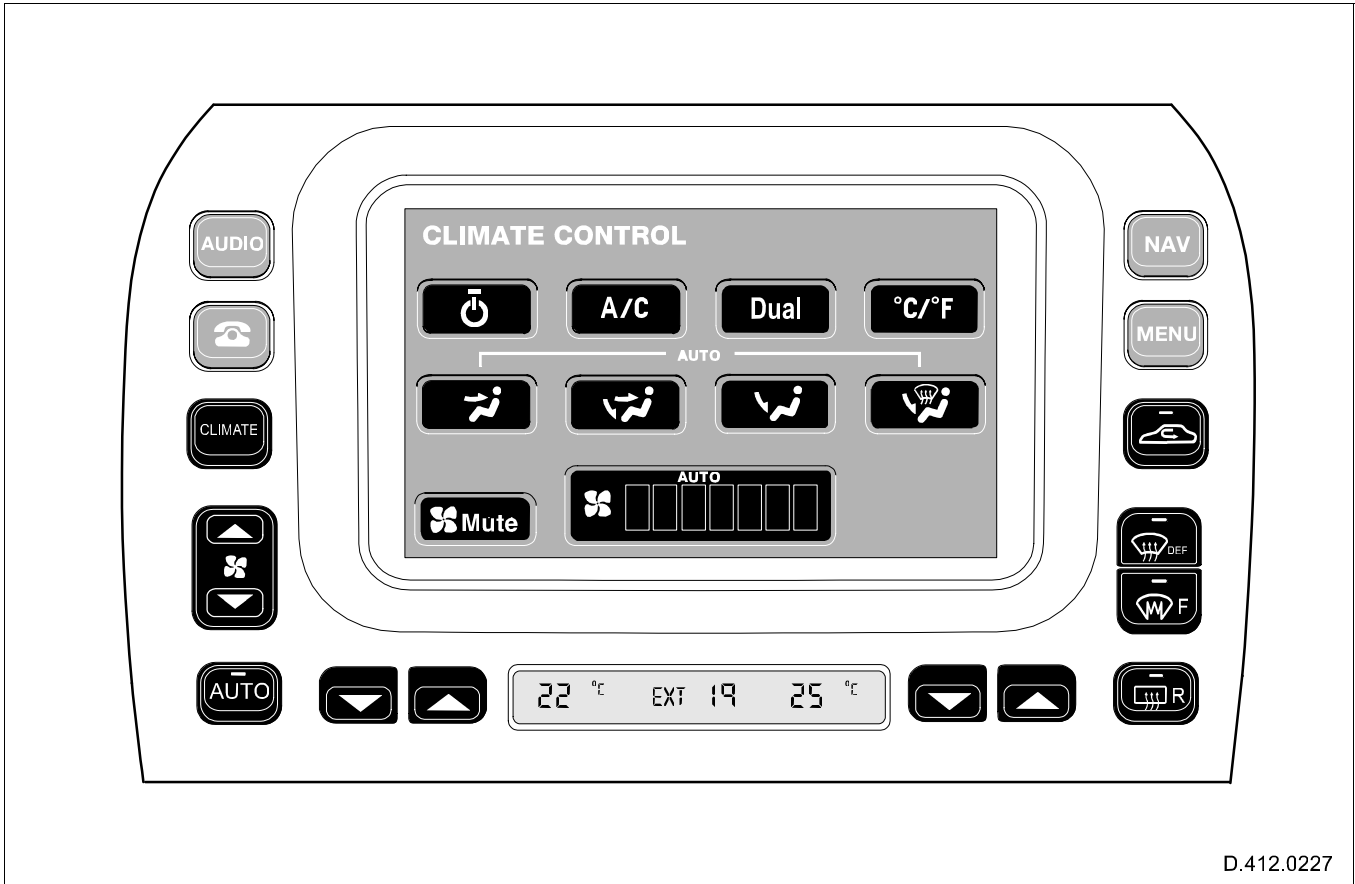


Fig. 74 Climate control buttons

Automatic Climate Control

The automatic climate control system comprises:

- Climate control assembly; refer to **Heating and Ventilation**.
- Air conditioning components; refer to **Air Conditioning**.
- Discrete sensors; refer to **Control Components**.
- Combined control panel with LCD and climate control module (**Fig. 73**).

or

- Control panel with touch-screen (telematics display module) and remote climate control module (**Fig. 74**).

NOTE: Following reconnection of the battery and with the ignition key at position 'II', the climate control system will default to OFF but with a stored value of 23°C. In circumstances when the display shows either HI or LO instead of a value, the default value can also be established by 'Pressing and holding' the AUTO button for 2 seconds.

Hidden System Features

A moisture-purge routine has been implemented to reduce misting and residual odors. If the air conditioning was operated during the last journey, approximately 25 minutes after ignition-off, the blower will be operated at high-speed for 2 minutes in order to remove the condensate from the evaporator. Under normal circumstances, the routine will be unnoticed by the customer, but occasionally the customer may be present when the feature initializes.

NOTE: The customer can intervene to stop the routine by turning the ignition key to position 'I' or can have the routine deactivated; refer to JTIS.

The climate control system-software includes a number of self-test and calibration features at power-on, involving the cycling of motors and consequent movement of distribution doors.

The system may take control of the motors to minimize 'misting' and to maintain the correct in-vehicle climate conditions; sometimes this control may continue after the key has been removed from the ignition.

Recirculated and fresh air

When automatic control (AUTO) is selected, as part of a complex strategy to prevent window-misting the fresh-air intake door is controlled automatically. The intake door can also be controlled manually in the following manner:

Timed air-recirculation

'Briefly pressing' the recirculation button engages the recirculation feature for a period of time that will vary depending on climatic conditions and is specifically designed to prevent 'misting'.

- The button LED will remain illuminated and extinguish after the time-out period has elapsed.

Latched air-recirculation

'Pressing and holding' the recirculation button for 2 seconds, latches the recirculation feature (does not time-out). Latched air-recirculation is confirmed by:

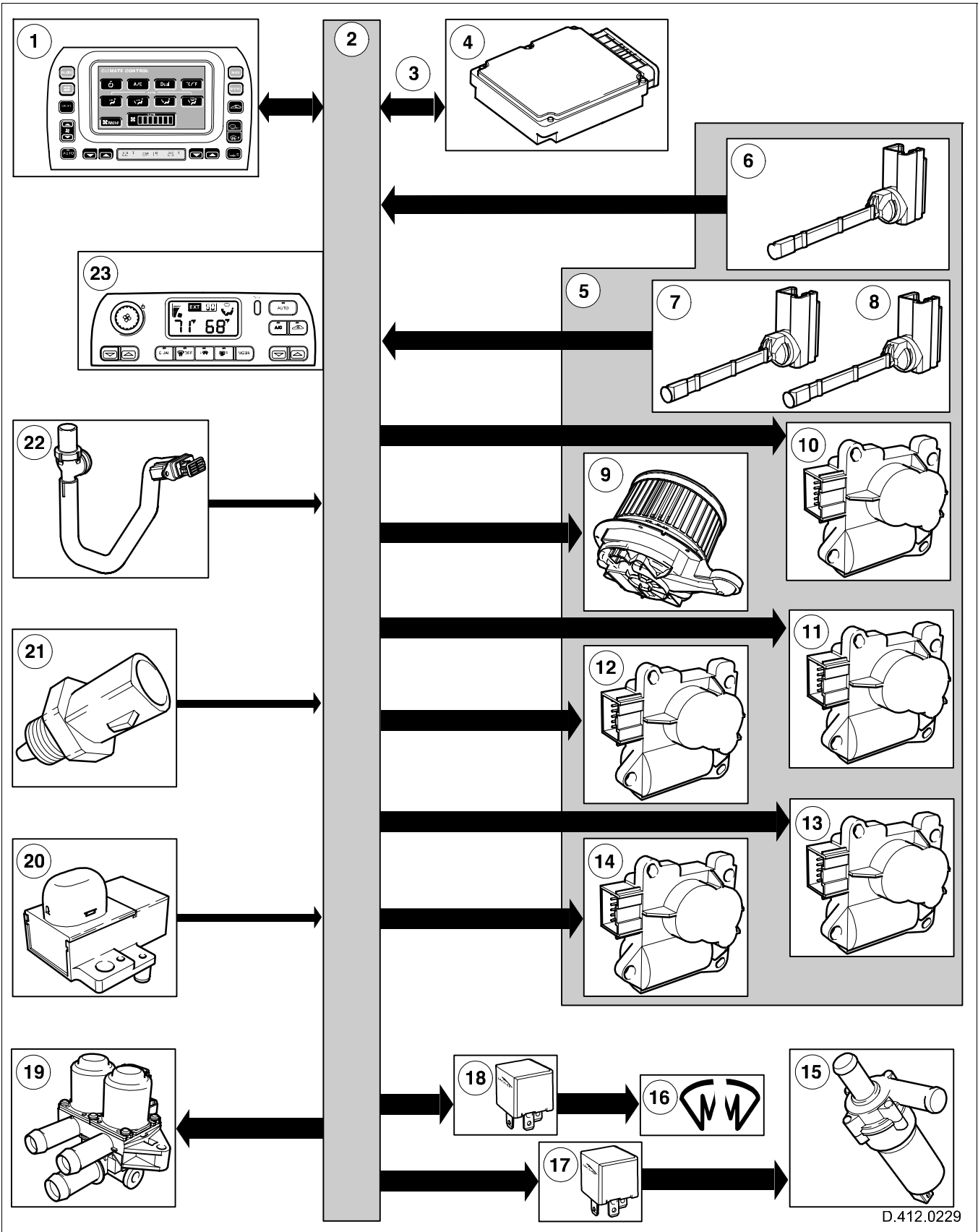
- a screen symbol;
- an audible 'double beep';
- the button LED flashing four times and then remaining illuminated.

NOTE: When latched recirculation has been selected, to reduce condensation, the air conditioning will operate automatically.

General

Fig. 75 provides an indication of the input/output flow of electrical data between climate control components; refer to **S-TYPE Electrical Guide** for detailed information.

NOTE: The CCM (2) is common to all configurations and is remotely mounted when the telematics display module (1) is installed. When control panel (24) is installed, the CCM is integrated into the control panel housing.



D.412.0229

Fig. 75 Climate control system (composite diagram)

Key to Fig. 75

1. Telematics display module ¹
2. Climate control module (remote¹ or combined²)
3. Controller area network (CAN)
4. Electronic control module (ECM)
5. Climate control assembly
6. Evaporator temperature sensor
7. Discharge temperature sensor
8. Discharge temperature sensor
9. Brushless blower motor
10. Recirculation actuator
11. Defrost actuator
12. Face actuator
13. Floor actuator
14. Temperature blend actuator
15. Dual-flow coolant valve
16. Heated front screen relay
17. Heated front screen (where fitted)
18. Auxiliary coolant pump relay
19. Auxiliary coolant pump
20. Sunload sensor
21. Ambient air temperature sensor
22. In-vehicle temperature and humidity sensor
23. Control panel with LCD (combined with item 2)

¹ option

² combined with item 23

Diagnostics

The climate control system:

- constantly monitors the status of the system;
- where appropriate, stores a DTC within the climate control module for analysis using WDS.

NOTE: Self-diagnostics can be accessed for vehicles with the control panel and LCD fitted, but not for the telematics version; refer to **JTIS**.

Electrical

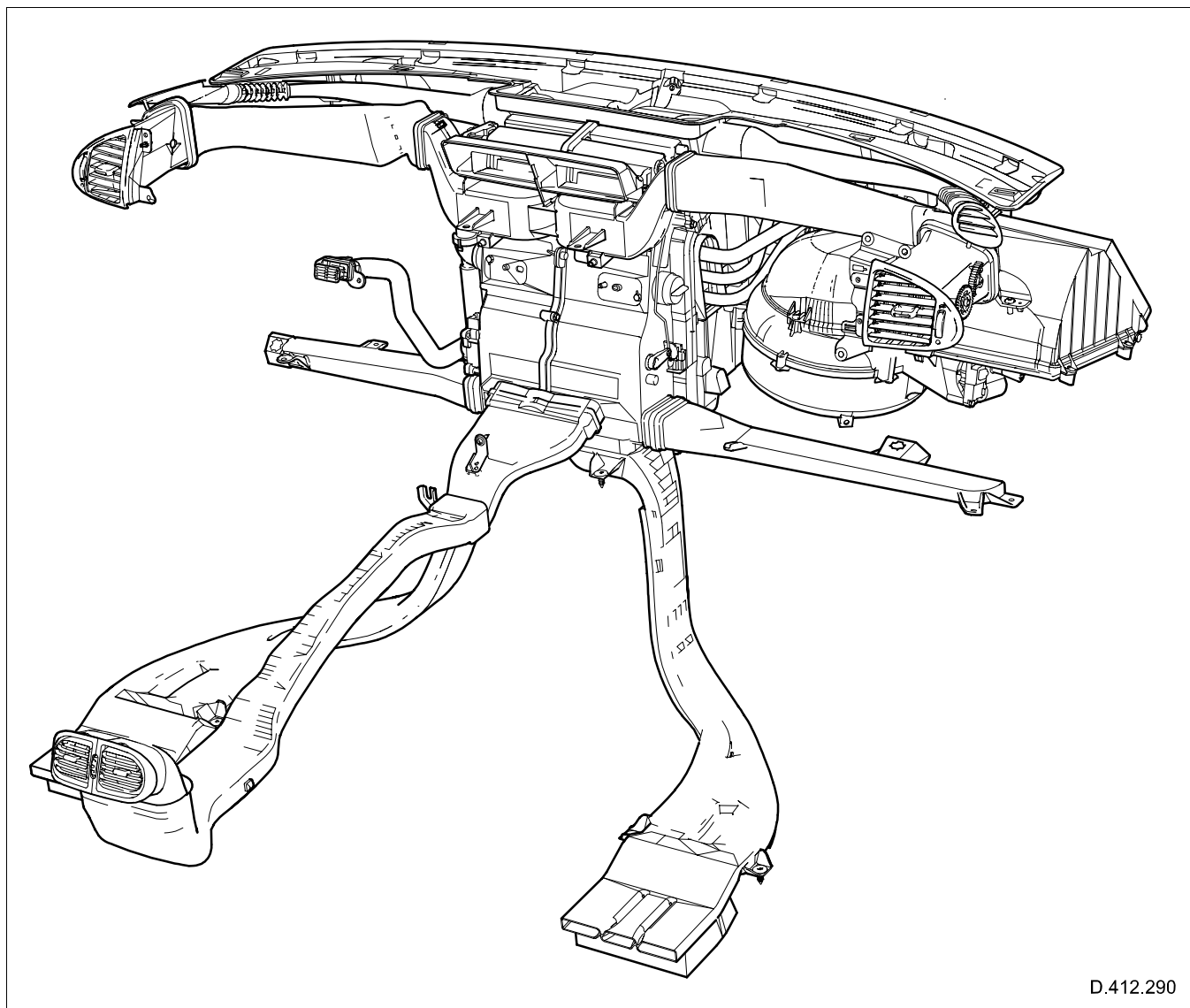
Air Distribution and Filtering

Air distribution and filtering is achieved using the following:

- Combination filter.
- Instrument panel registers.
- Rear foot-ducting.
- Footwell ducting.
- Defrost ducting.
- Defrost door.

- Face door.
- Floor door.
- Temperature blend door.
- Recirculation door.

A combination filter provides particle filtration and in addition prevents certain odors entering the vehicle via the air distribution system.



D.412.290

Fig. 76 Air distribution and filtering

Heating and Ventilation

Heating and ventilation is determined by the climate control assembly which comprises the following:

- Evaporator core; refer to **Air Conditioning**.
- Heater core.
- Auxiliary coolant pump

- Dual-flow coolant valve.
- Blower.
- Door actuators; refer to **Control Components**.
- Airflow doors; refer to **Air Distribution and Filtering**.
- Evaporator and discharge sensors; refer to **Control Components**.

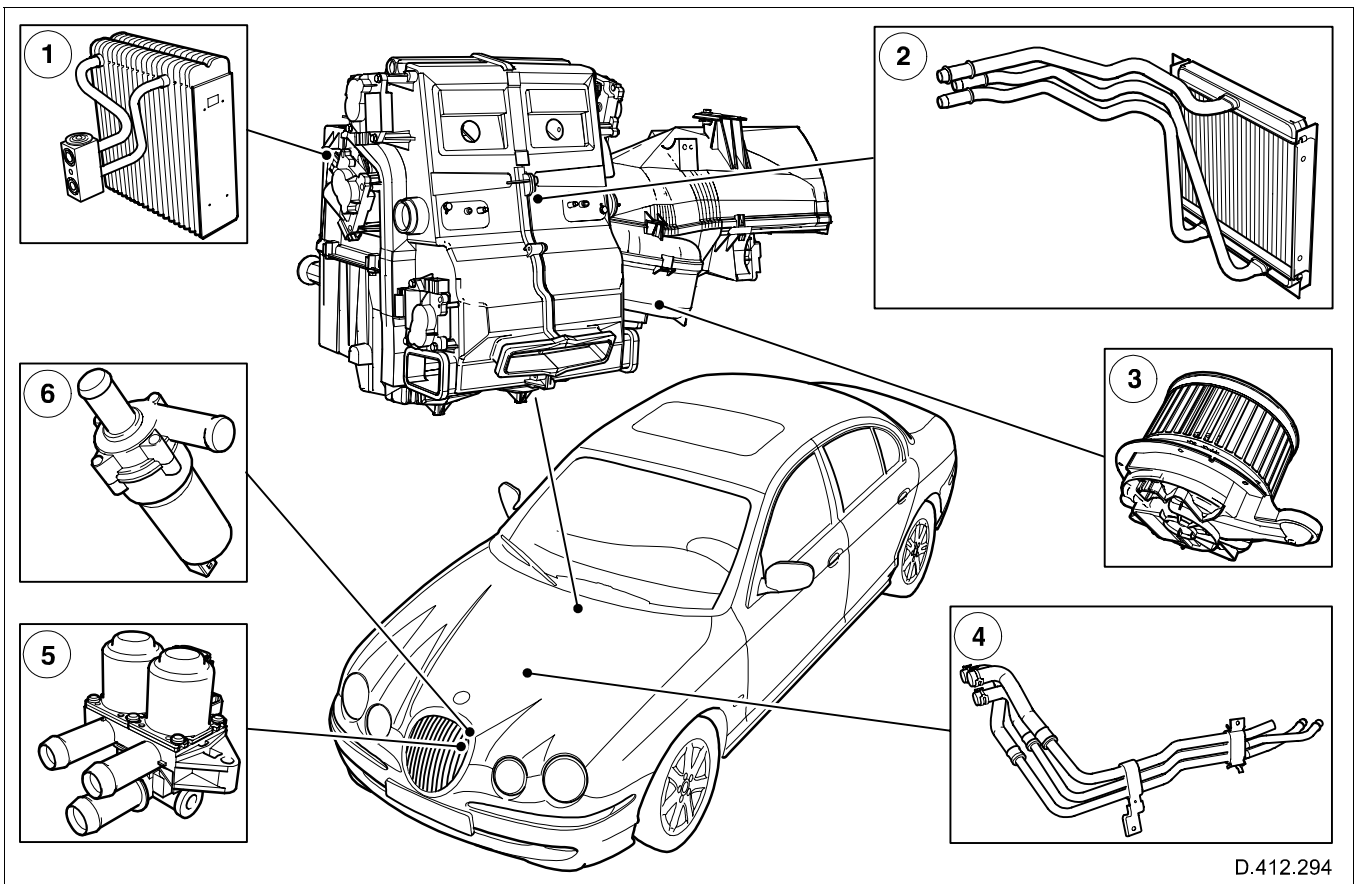


Fig. 77 Heating and ventilation components

- | | |
|--------------------|----------------------------|
| 1. Evaporator core | 4. Heater hose assembly |
| 2. Heater core | 5. Dual-flow coolant valve |
| 3. Blower | 6. Auxiliary coolant pump |

Heater Core

The heater core is a dual-matrix type, located within the climate control assembly and connected via the heater pipes and the dual-flow control-valves to the engine cooling system; refer to **Powertrain, Engine Cooling**.

Auxiliary coolant pump

The auxiliary coolant pump is located at the radiator and cooling fan assembly and controlled via the auxiliary coolant pump relay, by the CCM.

Dual-flow coolant valves

The three-port dual-flow coolant valve assembly is located at the radiator and cooling fan assembly and controlled directly by the CCM.

Blower

The blower is driven by a brushless, d.c. motor (with integral electronics), designed to provide:

- finer speed control;
- increased reliability;
- greatly improved electrical efficiency;
- reduced maintenance.

The motor speed is controlled by a pulse-width modulated (PWM) signal calculated and provided by the CCM if 'AUTO' mode is selected.

The motor speed (which can also be controlled manually) is visually indicated by display segments:

- 1 to 11 for the climate control panel with LCD
- 1 to 7 for the telematics display

NOTE: Irrespective of any pre-selections, until the engine coolant temperature has reached a predetermined level, the blower will only operate at low speed.

Heated Screens and Mirrors

NOTE: Depending on vehicle specification, the front screen may incorporate a fine-wire electrical grid for total heating, or a small grid in the area where the wipers park, only.

The heater elements will only be activated after data has been exchanged between the climate control module (CCM) and the engine control module (ECM):

- CCM sends request to ECM.
- ECM confirms or denies request.
- CCM activates the appropriate relay, provided the request has been confirmed.

Basic functionality

NOTE: Both screen heaters will be activated automatically at temperatures below predetermined levels.

The rear screen heater and both door mirror heaters will operate when selected, provided the engine is running; operation will halt after 10 minutes or can be manually halted.

The front screen heater (if fitted), will operate when selected, provided the engine is running; operation will halt after 4 minutes or can be manually halted.

Air Conditioning

Air conditioning comprises the following system components:

- Evaporator core and thermal expansion valve.
- Compressor tube assembly with integral low-side charging port.
- Compressor and clutch assembly.
- Condenser/receiver-drier.
- Condenser outlet-tube assembly with integral high-side charging port.
- Pressure transducer (part of compressor tube assembly but serviceable separately).
- Evaporator intake/discharge line assembly.

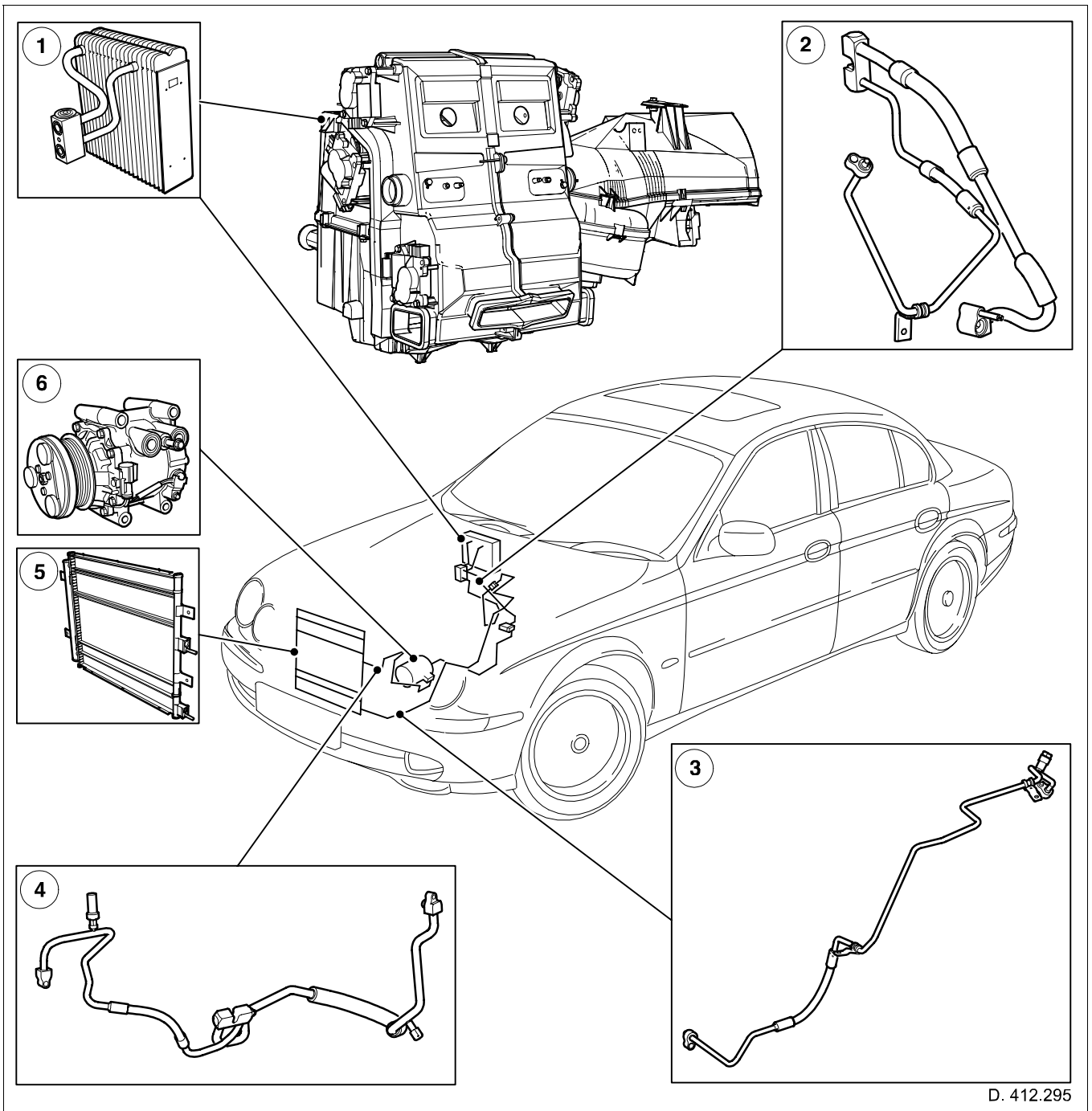


Fig. 78 Air conditioning components

- | | |
|--|-----------------------------------|
| 1. Evaporator core and thermal expansion valve | 4. Compressor tube assembly |
| 2. Evaporator intake/discharge line assembly | 5. Condenser/receiver-drier |
| 3. Condenser outlet tube assembly | 6. Compressor and clutch assembly |

Electrical

Operation

With reference to Fig. 79:

- The compressor (6) is mounted directly to the engine and driven by the accessory drive belt. The compressor, compresses the low-pressure, gaseous refrigerant received from the evaporator core. The refrigerant is discharged from the compressor to the condenser/receiver-drier (4) as a high-pressure, high-temperature vapor.

NOTE: The compressor incorporates a sensing element for over-temperature conditions. The manifold block of the compressor tube assembly incorporates a pressure relief valve.

- The condenser converts the high-pressure vapor to a liquid by utilizing the cooling effect of the air flowing over

the condenser. The high-pressure warm liquid leaves the condenser, travels along the liquid line and enters the thermal expansion valve (2).

- The thermal expansion valve regulates the flow of refrigerant and causes a pressure reduction as it enters the evaporator core (1).
- The resultant reduction in pressures, causes the refrigerant to boil and removes heat and moisture from the air passing through the evaporator core into the passenger compartment. The heat transfer results in cold refrigerant vapor leaving the evaporator and returning to the compressor.

NOTE: Moisture from the atmosphere condenses on the fins of the evaporator before draining to the outside of the vehicle via the drain tube.

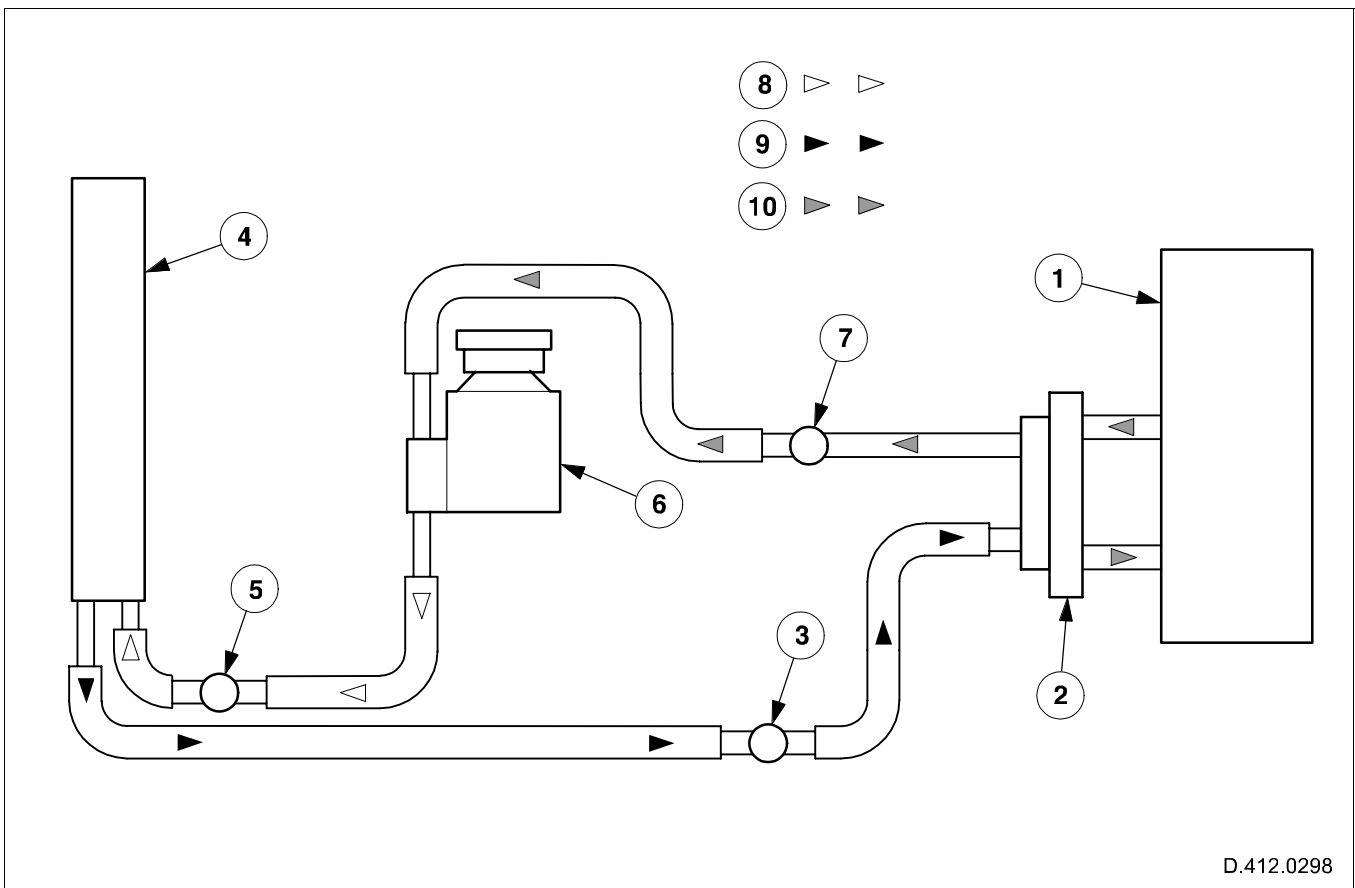


Fig. 79 Air-conditioning refrigerant flow

- | | |
|---------------------------------|--|
| 1. Evaporator core | 6. Compressor |
| 2. Thermostatic expansion valve | 7. Low-side charge port |
| 3. High-side charge port | 8. High-pressure refrigerant (gaseous and hot) |
| 4. Condenser/receiver-drier | 9. High-pressure refrigerant (liquid and warm) |
| 5. Pressure transducer | 10. Low-pressure refrigerant (gaseous/liquid) |

Compressor clutch and relay

The compressor clutch relay is controlled by the engine control module (ECM), based on requests from the climate control module.

NOTE: Under certain conditions like 'engine idle' and 'engine overheat' the ECM will override the 'clutch request' from the climate control module by disengaging the compressor clutch.

The air conditioning circuit is protected by a pressure transducer, installed in the compressor tube assembly. When the signal from the pressure transducer rises above a

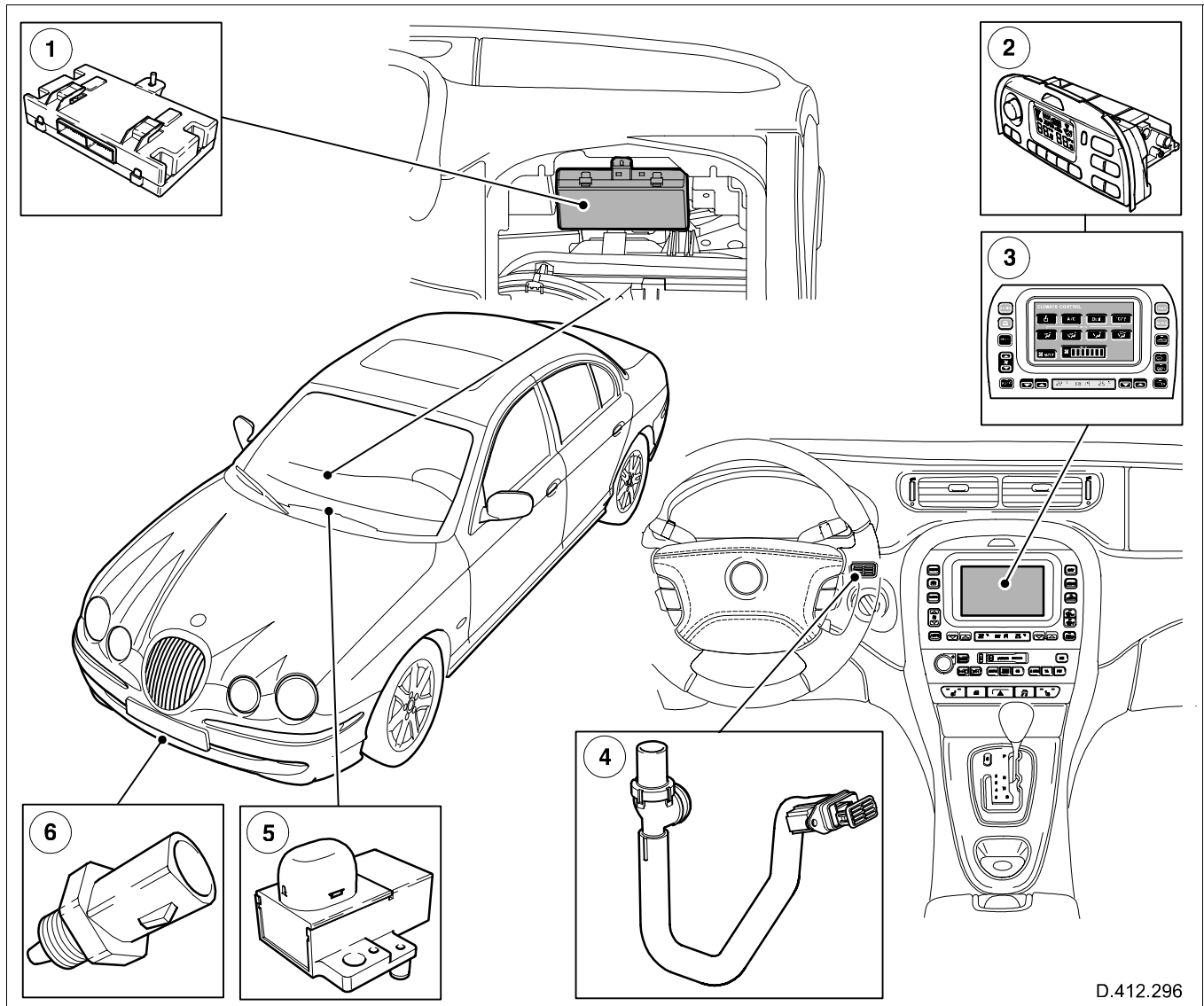
predetermined threshold, the climate control module will cancel the 'clutch request' and the ECM will deactivate the relay.

NOTE: If, for any reason, the climate control module malfunctions, the ECM will deactivate the relay and disengage the compressor at a second, slightly higher threshold.

Condenser/receiver-drier

The condenser and receiver-drier have been integrated into a single unit which, incorporates a serviceable dessicant-sack.

Control Components



D.412.296

Fig. 80 Automatic climate control components

1. Remote climate control module (optional installation)
2. Combined control panel with LCD and climate control module
3. Telematics display module (optional installation)
4. In-vehicle temperature and humidity sensor
5. Dual sunload-sensor
6. Ambient air temperature sensor

Climate Control Module

Depending on vehicle specification, the climate control module (CCM) is combined with the control panel with LCD to form a single unit or mounted remotely to the instrument panel; refer to **Fig. 80**.

NOTE: The remote-mounted climate control module is only necessary for vehicles fitted with the touch-screen (telematics display module).

Climate Control Sensors

The climate control module uses feedback from the following sensors; refer to **S-TYPE Electrical Guide** for detailed connection information:

Evaporator discharge temperature sensor

The evaporator discharge temperature sensor is a thermistor-type device that provides primary feedback to the climate control module, which in turn supplies electrical signals to the ECM to control cycling of the compressor clutch.

Discharge temperature sensors

The discharge temperature sensors are thermistor-type devices, strategically placed to measure the temperature of the air being discharged by the climate control assembly for both driver and front passenger. The sensors, feedback electrical signals to the climate control module, to enable the system to make any necessary adjustments.

In-vehicle temperature and humidity sensor

The in-vehicle temperature and humidity sensor comprises two components, a thermistor-type device for measuring in-vehicle temperature and a capacitive device for measuring humidity. The sensors, output electrical signals enabling the climate control module to make any necessary adjustments.

Ambient air temperature sensor

The ambient air temperature sensor is a thermistor-type device, located behind the lower front grille, which outputs an electrical signal enabling the climate control module to make any necessary adjustments.

NOTE: The sensor requires airflow in order to provide effective feedback to the system. The airflow must not be hindered by the addition of accessories.

Dual sunload-sensor

The dual sunload-sensor comprises:

- photo-diodes (that convert light levels to electrical output signals);
- electronic circuits for processing the electrical signals.
- security system indicator lamp (a totally independent led, located within the sensor for convenience; it has no affect on the functionality of the climate control system).

Separate areas of the internal electronic circuits are used to interpret the electrical signals and provide separate digital outputs to the:

- climate control module;
- instrument cluster for autolamp purposes; refer to **Autolamp**

NOTE: Obstructing the sunload sensor will significantly affect the behavior of the systems.

Signal processing and CAN

The climate control module processes electrical input signals from the control panel and the temperature sensors and then provides, where appropriate, output signals to the actuators and display modules. In addition data are sent bidirectionally between the engine control module and the climate control module using the CAN.

Signals provided by the ECM to the CCM include:

- engine speed;
- air conditioning system pressure;
- engine coolant temperature;
- heated screen inhibit.

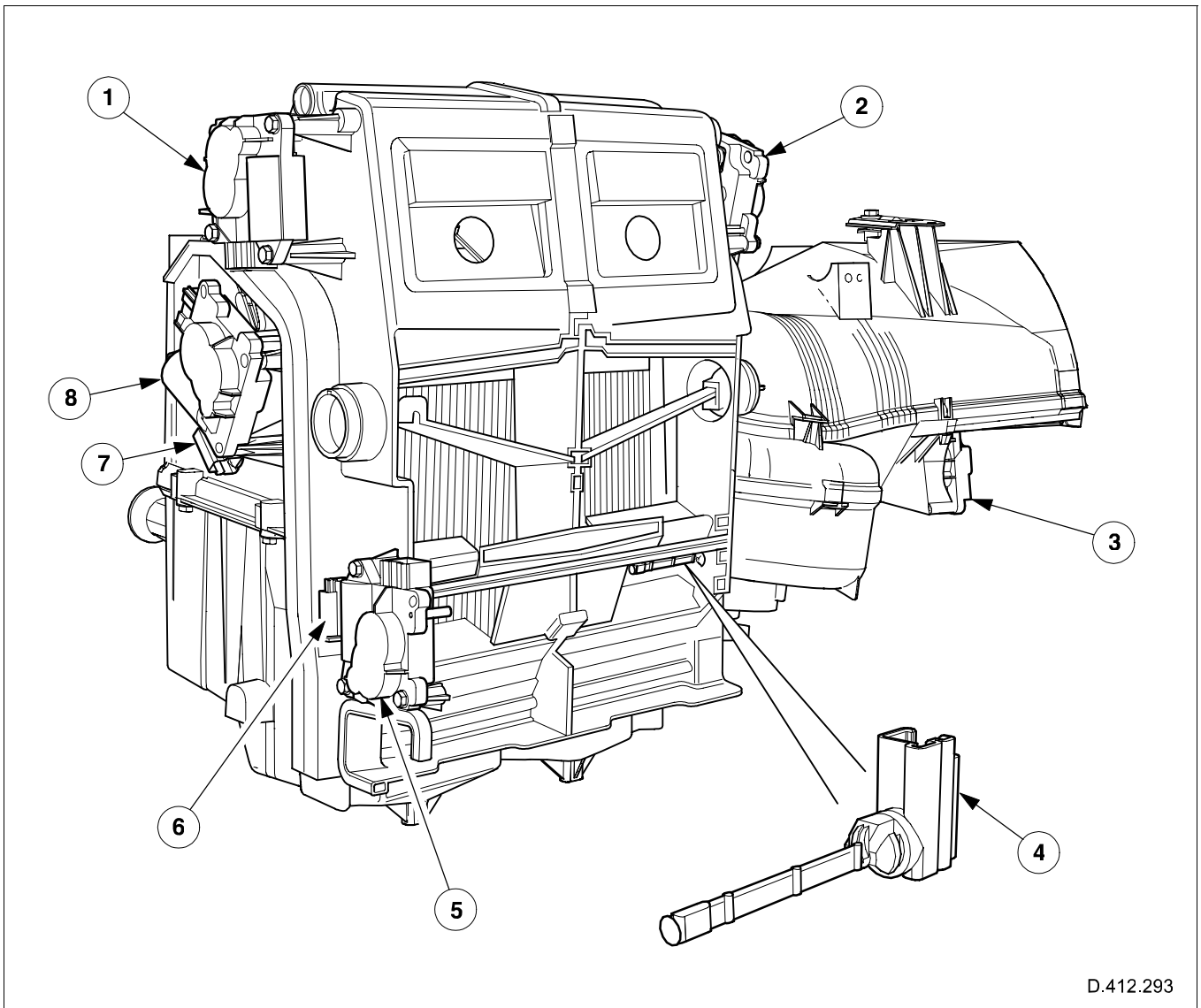
Signals provided by the CCM to the ECM include:

- compressor torque;
- compressor clutch command;
- heated screen request;
- cooling fan request.

Actuators

All actuators are dc motors (controlled by the CCM) mounted to the climate control assembly and control the following:

- Recirculation door.
- Defrost door.
- Face door.
- Floor door.
- Cold-air bypass door.



D.412.293

Fig. 81 Control components - climate control assembly

- | | |
|------------------------------------|----------------------------------|
| 1. Defrost door actuator | 5. Floor door actuator |
| 2. Temperature blend door actuator | 6. LH Discharge sensor |
| 3. Recirculation door actuator | 7. Evaporator temperature sensor |
| 4. RH Discharge sensor | 8. Cold-air bypass door actuator |

Instrumentation and Warning Systems

Instrument Cluster and Panel Illumination

The dimmer control is mounted within the auxiliary lighting switch assembly and is used to adjust the level of backlighting for switches and instruments including:

- Instrument cluster.
- Climate control panel (where applicable).
- Telematics display module (where applicable).
- Audio unit.
- Sports mode switch (J-gate module).
- Auxiliary lighting switch assembly.
- Steering wheel mounted switches.
- Center console switch assembly.
- Fuel filler-flap and trunk lid release assembly.
- Roof console switches and mood lamp.
- Driver door switch assembly.
- Window switches.
- Ashtray/cigar lighter.

NOTE: Pushing and releasing the dimmer control knob releases it from the stowed position for ease of operation.

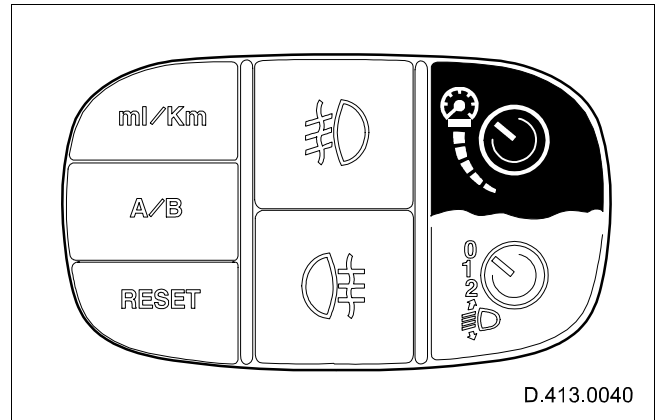


Fig. 82 Dimmer control

The driver-determined level of backlighting is set using the dimmer control, which is directly wired to the instrument cluster. The instrument cluster provides data (via the SCP network) to the general electronic control module (GECM), appropriate to the chosen setting. The GECM responds by outputting a pulse-width modulated (PWM) signal to drive the backlighting.

Instrument Cluster

Detailed instrument cluster features vary depending on market and vehicle specification.

The instrument cluster is a configurable module and:

- provides an interface between the passive anti-theft system (PATS) transceiver and the engine control module (ECM) to enable the immobilization feature;
- provides a signal to the steering column lock module (SCLM) via the SCP network;
- provides the control for the steering column position (refer to **Steering System**);
- provides multiplex network gateway functionality for CAN and SCP; refer to **Module Communications Network**;
- outputs the warning chimes;
- provides decoding for the ignition, courtesy lighting switch and exterior lighting switch.

NOTE: The instrument cluster is a calibrated part, which is also matched to the ECM and SCLM (refer to **JTIS**).

The cluster comprises four gauges, warning lamps and LCD message center.

Two warning lamps are located either side of the message center, one red, the other amber. The warning lamps alert the driver to the status of the warning message simultaneously displayed:

- The 'RED' warning lamp indicates a primary warning message that requires immediate investigation by the driver or a Jaguar Dealer.
- The 'AMBER' warning lamp indicates a secondary warning message requiring:
 - appropriate response by the driver;
 - the reporting of any associated malfunction to a Jaguar Dealer at the earliest opportunity.

Depending on market and vehicle specifications, the following warnings do not illuminate indicators on the cluster but instead, display the appropriate text via the message center:

- Engine malfunction.
- Door ajar warnings.
- Low washer fluid.
- Traction control warning.
- Speed (cruise) control.

The message center also conveys the following information, when appropriate:

- engine temperature warning;
- transmission fault warnings;
- turn signal indicator, rear bulb and brake bulb failure;
- low coolant warning;
- parking brake fault;
- check fuel filler cap;
- DSC on/off/fail;
- autolamp delay messages;
- memory status (stored / recall);
- pedal inhibit;
- column / pedal adjustment status (visual confirmation of selection made using rotary action of the column / pedal adjustment switch);
- ACC messages (where applicable).

Odometer, Trip Odometer / Trip Computer

Odometer

The odometer is an integral part of the instrument cluster. The current odometer value is displayed by the message center and is the default display of the trip computer. Odometer values are displayed in miles or kilometers, with suppressed leading zeroes, as six significant figures and no decimal places. The values are stored in non-volatile memory to prevent any loss of data during battery disconnection.

NOTE: The displayed odometer reading will not roll-over when it reaches its maximum value, it will stop.

Trip Computer

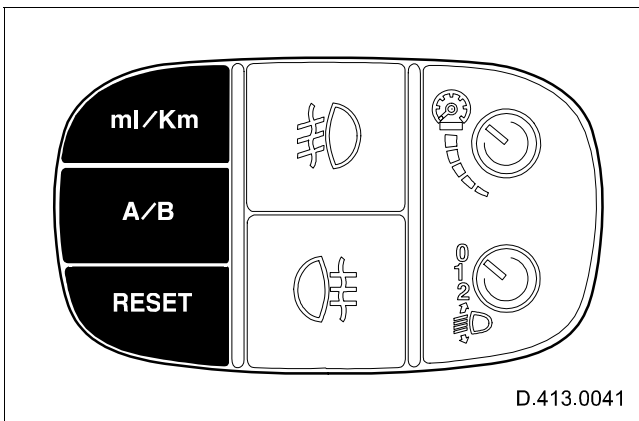


Fig. 83 Trip computer control switches

The trip computer is an integral part of the instrument cluster and is controlled by the three switches located at the outboard side of the auxiliary lighting switch.

- The 'ml/Km' button provides the option to display data in metric or imperial units.
- The 'A/B' button provides the option to track two separate journeys in the trip-computer memory.

- The 'RESET' button is multi-purpose and is used to:
 - cycle between the trip, odometer and message modes;
 - clear (hide) messages (briefly press the button with message-mode selected);
 - reset the selected (A or B) trip-computer memory to zero (hold the button for approximately 3 seconds).

Pressing the 'TRIP' button (located at the end of the left-hand column stalk) will cycle the trip-computer information in the following order:

- odometer;
- trip distance;
- distance-to-empty;
- average fuel consumption;
- instantaneous fuel consumption;
- average speed.

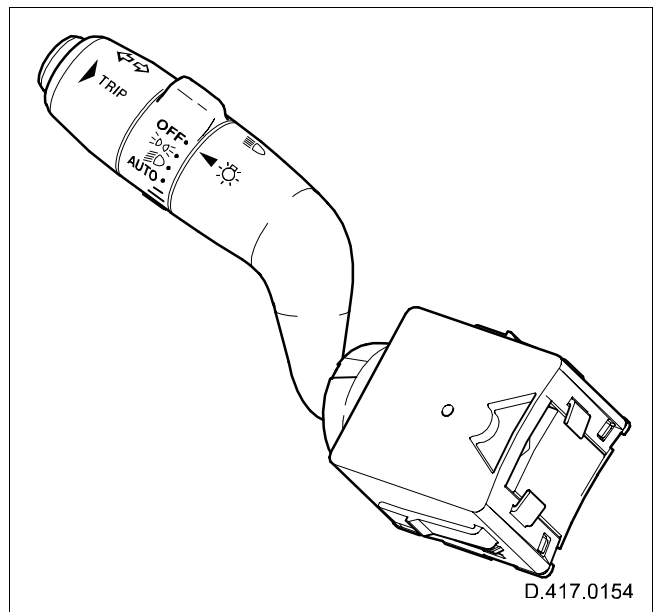


Fig. 84 Trip button

Battery and Charging Systems

Generator and Regulator

Electrically the generator is similar to previous models except for the voltage regulator functionality.

The engine control module (ECM) can switch the voltage regulator between two voltages to optimize the charging of the battery:

- The low voltage regulator setting is 13.6 volts
- The high voltage regulator setting is 15.3 volts

NOTE: The values, which will decrease with a rise in temperature or current flow, are measured with the generator at 25°C (77°F) and charging at a rate of 5 amps.

The ECM:

- Determines the voltage setting of the voltage regulator.
- Always selects the high voltage setting once the vehicle has started.
- Determines the period of time that the high voltage remains selected.

The ECM selects one of three different time periods dependent upon the operating conditions when the vehicle is started:

- The longest time period is selected if the ECM determines that the vehicle has been 'soaking' for sufficient time to allow the engine coolant temperature (ECT) and the intake air temperature (IAT) to fall within 6°C (11°F) of each other.
- The intermediate time period is selected when the ECT and the IAT fall below 15°C (59°F).
- The shortest time period is the default and is used to provide a short period of boost charge.

NOTE: At the end of these time periods the voltage is always set to the low voltage setting to prevent the battery from being overcharged.

The time periods are variable depending upon the temperature and the battery voltage.

The target voltage of the battery varies between 13.8 volts and 14.7 volts (measured at the front power-distribution box) depending upon the ambient temperature and the vehicle operating conditions.

NOTE: Once this target voltage has been achieved, providing the vehicle has been operating for at least the shortest time period, the ECM will reduce the voltage regulator to the minimum setting of 13.6 volts.

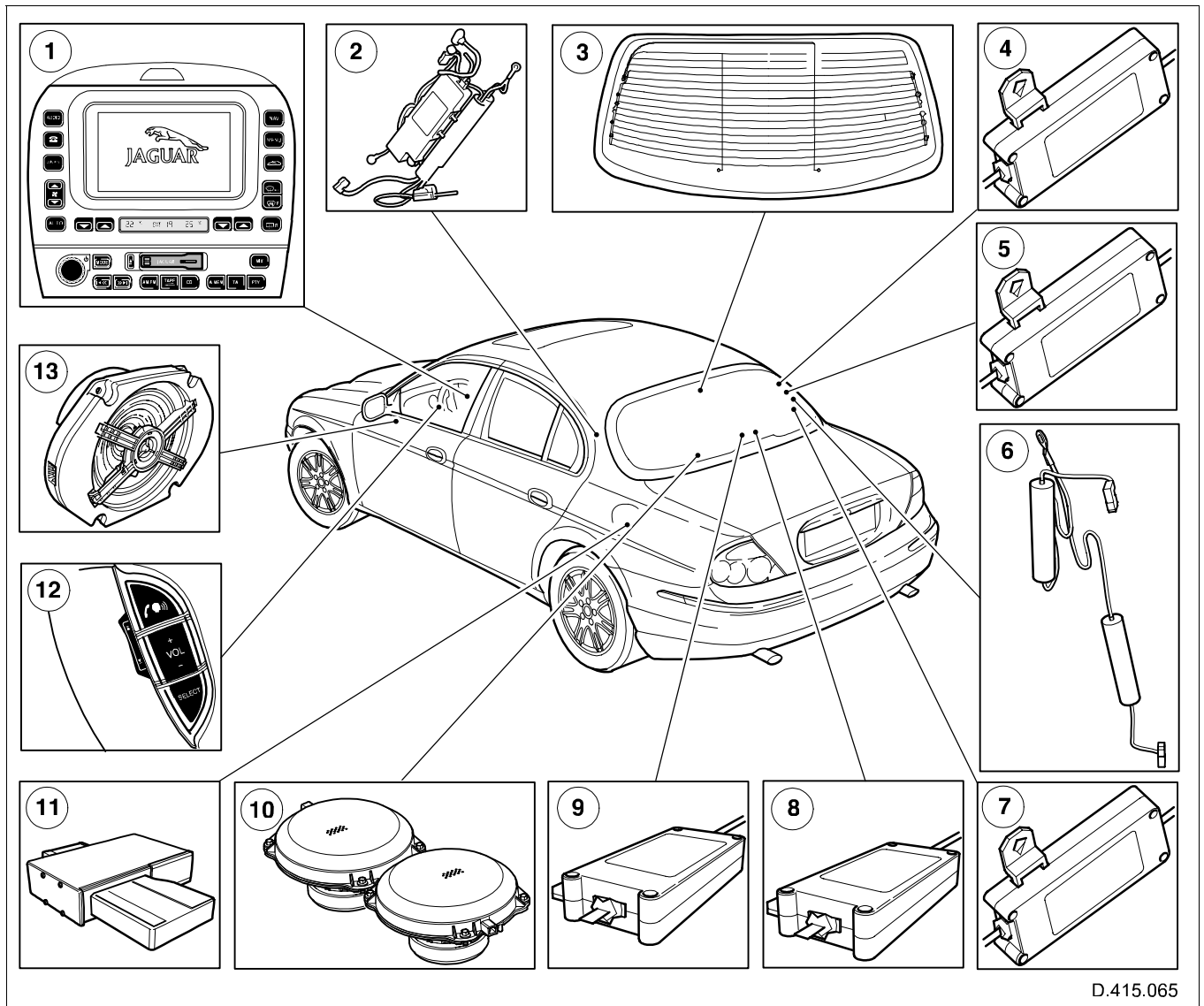
There are three connections between the ECM and the generator; refer to **S-TYPE Electrical Guide** for details:

1. The voltage regulator request setting from the ECM to the generator.
2. A pulse-width modulated (PWM) signal from the generator to the ECM which enables the ECM to monitor the generator load on the engine.
3. A charging system indicator signal wire from the generator to the ECM.

If the voltage regulator request line is open circuit or short circuit to battery voltage, the generator will permanently charge at 15.3v. If it is short to ground, it will permanently charge at the lower voltage, 13.6v.

NOTE: A DTC will be generated if a circuit malfunction is detected in any of the three lines connecting the ECM to the generator or if the connector is disconnected. The charging system indicator will also illuminate.

Entertainment Systems



D.415.065

Fig. 85 Entertainment system components

- | | |
|--|--|
| 1. Audio unit (telematics version) | 8. Television antenna amplifier |
| 2. Antenna amplifier and wavetrapp | 9. Television antenna amplifier |
| 3. Antennas | 10. Sub-woofers (premium system) |
| 4. Television antenna amplifier | 11. CD changer |
| 5. Television antenna amplifier | 12. Steering wheel telematics controls |
| 6. TV antenna-amplifier double-wavetrapp | 13. Speaker (premium system) |
| 7. VICS antenna amplifier (Japan only) | |

Electrical

Specific components will vary according to vehicle and market specifications.

The entertainment systems comprise:

- Audio system
- Antenna
- Speakers
- Video system

NOTE: The entertainment system may also be operated by spoken commands if the optional **Voice Activated Control System** is installed.

Audio System

The audio system comprises:

- Audio unit.
- CD changer (option).
- Steering wheel telematics controls.
- Remote amplifier (option).

Audio Unit

Depending on vehicle specification, the audio unit is combined with the telematics display module (telematics version, **Fig. 86**) or integrated with the phone keypad and LCD (non-telematics version, **Fig. 88**).

The audio unit:

- Manages the D2B network and provides the gateway to the SCP network; refer to **D2B network**.
- Stores diagnostic trouble codes for itself and the CD changer (where installed).

NOTE: The installation of new components within the D2B network will necessitate the reconfiguration of the system using WDS.

Telematics version

The telematics version of the audio unit is integrated with the telematics display module and comprises:

- radio cassette or single-slot CD or single-slot MD
- integral amplifier (4 x 35W output) or remote amplifier (8 x 40W output).

NOTE: The telematics display module is used in conjunction with the audio unit to control entertainment system functions but also provides the ability for the user to control such features as climate control; refer to **Telematics Display Module**.

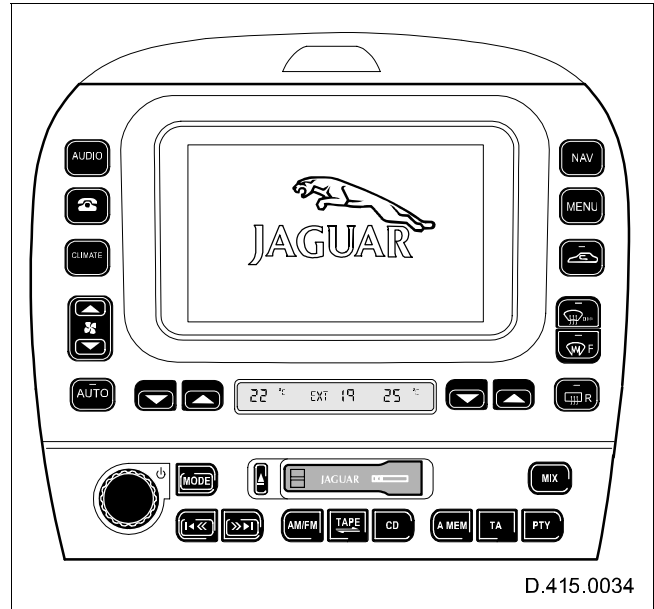


Fig. 86 Audio unit - telematics version

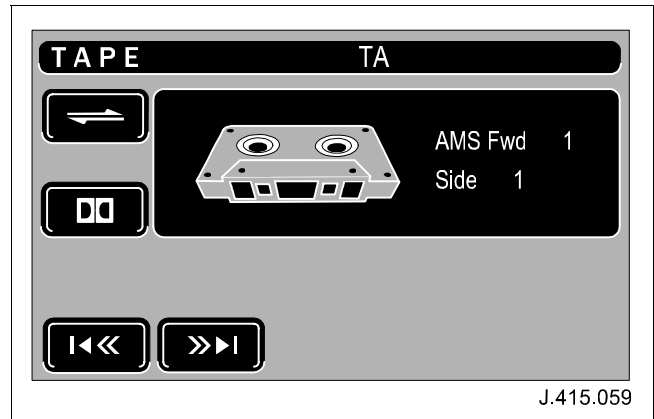


Fig. 87 Tape cassette - telematics display screen

Non-telematics version

The non-telematics audio unit comprises:

- radio cassette or single-slot CD or single-slot MD
- liquid crystal display (LCD) including clock;
- integrated phone keypad;
- integral amplifier (4 x 35W output) or remote amplifier (8 x 40W output).

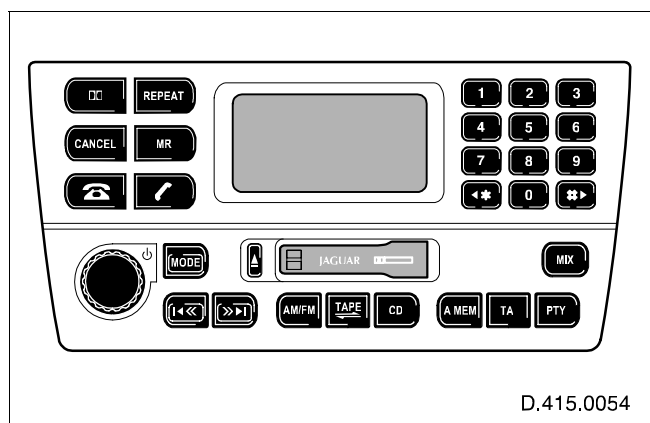


Fig. 88 Audio unit - non-telematics version

NOTE: The non-telematics version of the audio unit is complimented by the climate control panel/module; refer to **Climate Control System**.

Remote Amplifier

The remote amplifier (where installed) is:

- located in the luggage compartment to the left-hand side;
- mounted to the rear-stack bracket;
- capable of delivering 8 x 40W output;
- part of the **D2B network**.

CD Changer

The CD changer (where installed) is:

- located in the luggage compartment to the left-hand side;
- mounted to the rear-stack bracket;
- operated from either version of the audio unit; refer to **Audio Unit**;
- part of the **D2B network**.

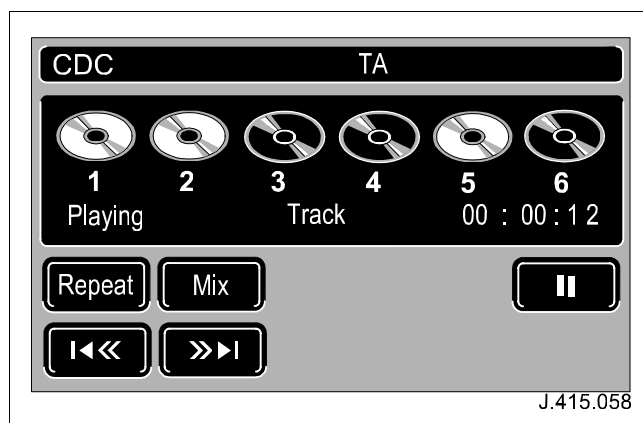


Fig. 89 CD changer - telematics display screen

Steering Wheel Telematics Controls

To ensure minimum disruption to concentration when driving, limited control of audio, telephone and voice activation systems is possible using the steering wheel telematics controls.

The controls provide the following functionality:

- Answer phone call, mute, or select voice activation.
- Increase or decrease volume.
- Selection of radio FM, AM, tape cassette, CDs, and phone ready mode.
- Cycle through preset radio stations, the next CD track or tape AMS (automatic music search).

Antenna

The following antennas (where applicable) are integrated into the rear window glass:

- FM element (incorporated into the demist pattern).
- AM element (separate element at the top left side of the glass).
- The FM/AM antenna amplifier is located at the left-hand C-post and is connected to the screen by press studs.

NOTE: The power connection to the demist screen includes an in-line filter known as a positive wavetrap.

Diversity antenna

Depending on vehicle and market specification the demist screen can be configured as a 3-part diversity antenna to provide improved FM reception in multipath areas. Three antennas are derived from the demist pattern to provide three FM inputs. The amplifier switches between each of the three FM inputs and sends the strongest to the radio.

Diversity antenna for TV and VICS

The television receiver uses '4-part antenna diversity' to obtain the optimum signal from four television antenna patterns. There are four television antenna amplifiers to suit, two are located on the package tray and two at the right-hand C-post.

Japan only

An additional antenna amplifier is installed for the vehicle information communications system (VICS); refer to **Fig. 85**.

Speakers

The premium audio sound system comprises:

- Four lightweight door speakers, each incorporating a mid-bass driver and a tweeter.
- Two sub-woofers.

The base audio sound system comprises:

- Four full-range door speakers

Video System

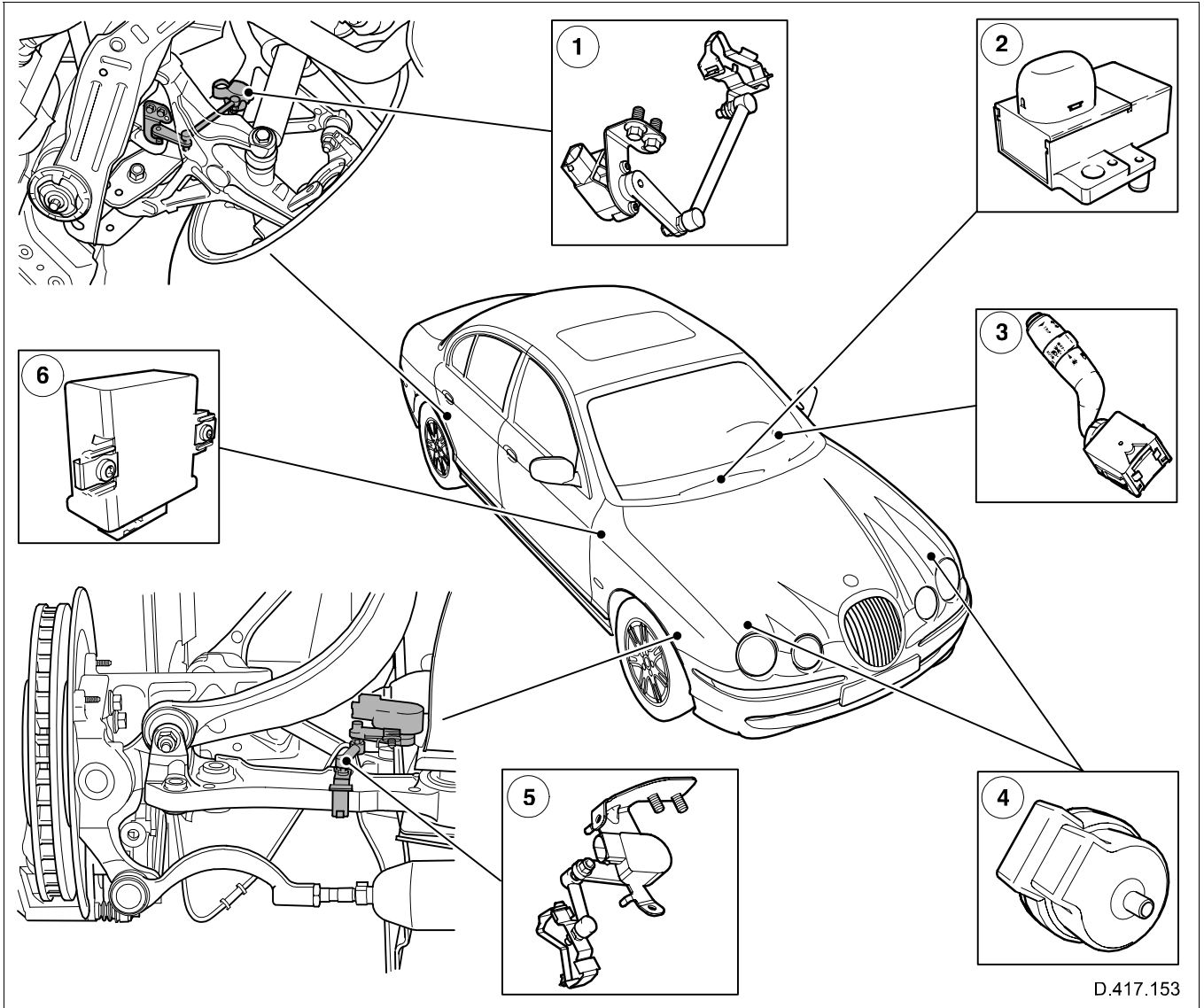
The video system is optional and dependent on market and vehicle specification, it comprises:

- Telematics display module; refer to **Telematics Display Module**.
- Television antennas and amplifiers; refer to **Antenna**.

The television receiver is integrated into the telematics display module (where applicable) and teletext is available in appropriate markets.

Lighting

Exterior Lighting



D.417.153

Fig. 90 Headlamp features

- | | |
|------------------------------------|--|
| 1. Rear-axle level sensor assembly | 4. Motor (automatic headlamp leveling) |
| 2. Autolamp sensor | 5. Front-axle level sensor assembly |
| 3. Main lighting switch | 6. Headlamp leveling control module |

Electrical

Depending on market and vehicle specification, S-TYPE has only two major deviations from a standard exterior lighting arrangement: autolamp and high-intensity discharge headlamps (complete with automatic headlamp leveling).

The exterior lighting is activated by choosing the appropriate option on the main lighting switch assembly (the left-hand column stalk).

NOTE: Due to the 'warm-up time' experienced with xenon lamps, the low beam lamp is not used for the headlamp flash feature; the high beam is used instead.

Switching is via allocated fuses and relays, with the exception of the turn signal lamps/ hazard warning lamps, which are controlled by the general electronic control module (GECM); refer to **S-TYPE Electrical Guide** for detailed information.

Main Lighting Switch

The left-hand stalk is a multi-function switch assembly used to activate the following as appropriate:

- Side lamps
- Low-beam headlamp
- High-beam headlamp
- Autolamp
- Turn signal indicator lamps
- Headlamp convenience
- Trip cycle. refer to **Odometer, Trip Odometer / Trip Computer**.

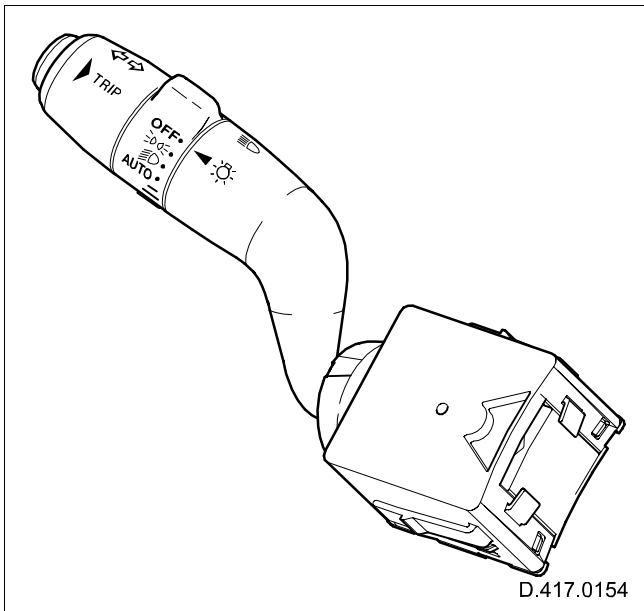


Fig. 91 Main lighting switch

Headlamp convenience

The headlamp convenience feature is controlled by the general electronic control module (GECM) and is activated when the headlamp convenience button on the integrated key transmitter is pressed. The main beam will illuminate for (10s, 30s, 2 min) depending on the position of the rotary collar or until the convenience button is pressed again or the ignition key is turned to position 'II'.

NOTE: The feature does not function when the ignition key has been removed or the rotary collar is set to 'AUTO'.

Auxiliary Lighting Switch

The auxiliary lighting switch assembly comprises:

- Dimmer control; refer to **Instrument Cluster and Panel Illumination**.
- Headlamp leveling control (where applicable); refer to **Headlamp Leveling**.
- Trip computer switches; refer to **Odometer, Trip Odometer / Trip Computer**.
- Front and rear fog switches; refer to **Front and Rear Fog Lamp Switches**.

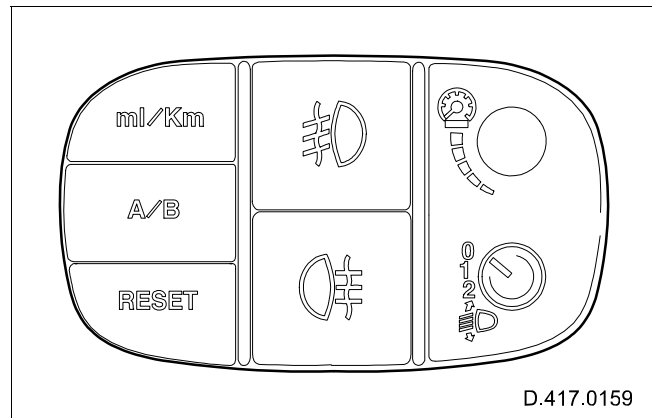


Fig. 92 Auxiliary lighting switch

Halogen Headlamps

NOTE: After approximately 5 minutes a noticeable fall in light output may be observed. The effect is due to a voltage boost feature that has been introduced; refer to **Generator and Regulator**.

High Intensity Discharge Headlamps (where applicable)

The high-intensity discharge headlamp assembly comprises:

- Low beam lamp (xenon)
- High beam lamp (halogen)
- Side lamp
- Turn signal lamp
- Xenon lamp control module
- Ignitor
- Headlamp leveling motor

Vehicles fitted with the high-intensity discharge lighting system use xenon lamps for the low beam instead of standard halogen lamps.

- The functionality of the low beam remains unchanged.
- The high beam, turn signal and side lamps are all conventional lamps.

NOTE: Due to national legislation, vehicles equipped with xenon lamps require the installation of **Automatic Headlamp Leveling** and a **Headlamp Cleaning System**; refer to the appropriate section.

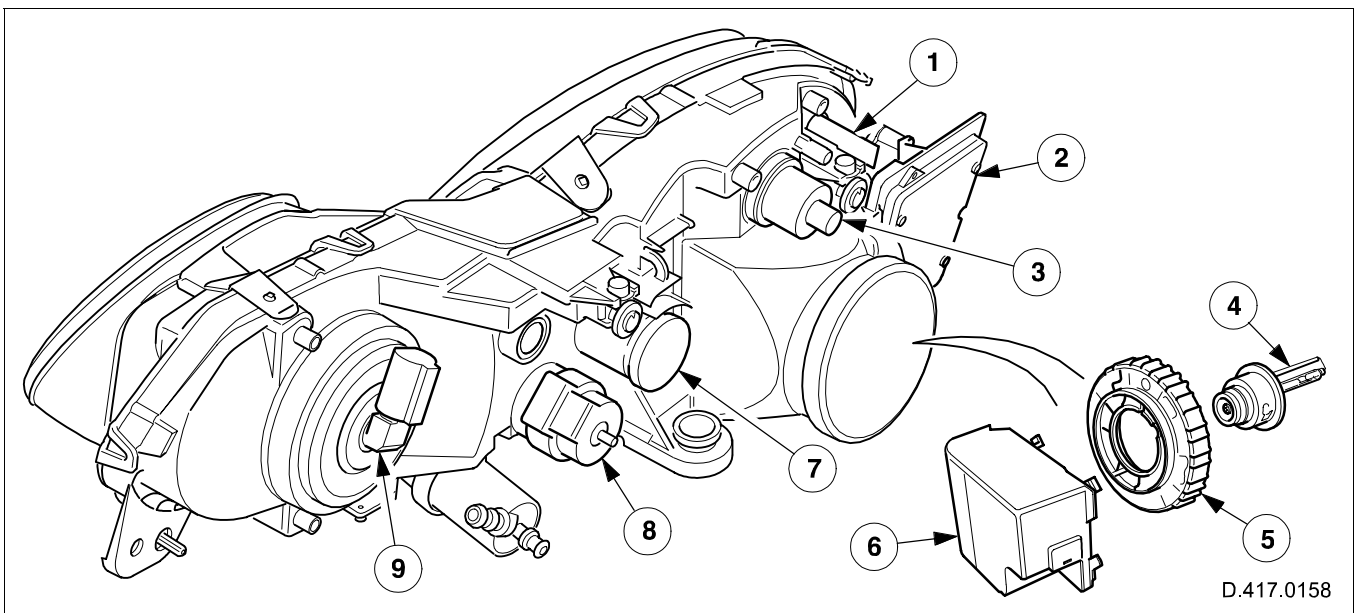


Fig. 93 High-intensity discharge lamp assembly

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Side lamp 2. Xenon lamp control module 3. Turn signal lamp 4. Low beam lamp 5. Clamping ring | <ol style="list-style-type: none"> 6. Ignitor 7. Access cover (beam-position lever) 8. Motor (automatic headlamp leveling) 9. High beam lamp |
|---|--|

Electrical

Xenon Lamp

WARNING: Electrical voltages of up to 30kV are possible at the xenon lamp, therefore suitable safety precautions must be observed; refer to JTIS.

The 35 watt xenon lamp produces a beam with an intensity that is approximately three times that produced by a conventional lamp of the same wattage.

The chamber, item 1 (Fig. 94) contains xenon gas and a mixture of metal halide salts.

High voltage (typically 20kV) ignition is provided by the xenon lamp control module and an arc forms in the chamber as the gap between the two electrodes is bridged. After ignition there is a warm-up period of approximately 3 three seconds during which the metal-halide salts evaporate. This brief excess-current phase is followed by stabilization of the arc and the regulation of the lamp output at 35W by the control module.

NOTE: Unlike conventional lamps, xenon lamps do not deteriorate and so should last the lifetime of the vehicle.

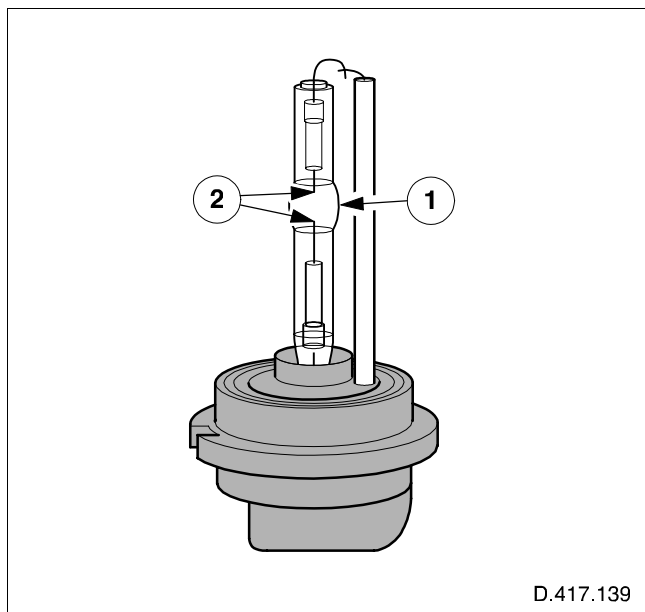


Fig. 94 Xenon lamp

1. Gas-filled chamber
2. Electrodes

Xenon Lamp Control Module

The module is a complex piece of electronics that in addition to regulating start-up and stabilizing output, provides circuit protection by recognizing malfunction conditions such as:

- Power supply deviations.
- Absence of light source.
- Short circuits.

NOTE: The high-voltage stage will be deactivated unless all system components are functional and correctly connected.

Headlamp Beam Position

A lever-operated shutter has been incorporated into the headlamp assembly to permit simple switching of the headlamp beam position to meet foreign driving regulations. The lever is located behind the access cover (item 7) Fig. 93.

Headlamp Leveling

- Headlamp leveling is fitted as standard for halogen lamps and is driver-controlled by a potentiometer (part of the auxiliary lighting switch).
 - ‘Pressing’ the headlamp leveling knob extends the control for ease of operation.
 - Turning the knob activates the headlamp leveling motors and consequently alters the position of the headlamp beam to suit vehicle load.
 - ‘Pressing’ the headlamp leveling knob a second time, returns the control for ease of operation.

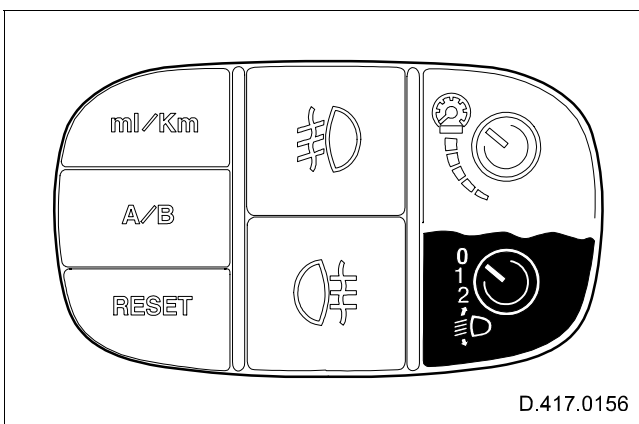


Fig. 95 Driver-controlled headlamp-leveling knob

- ‘Automatic headlamp leveling’ feature has been developed to support vehicles fitted with xenon lamps. The feature automatically maintains the headlamps within the legally required angular position to avoid dazzling other drivers as a result of vehicle acceleration, deceleration or variation in terrain.

Automatic Headlamp Leveling

The system comprises:

- Front-axle level sensor assembly
- Rear-axle level sensor assembly
- Headlamp leveling module
- Left-hand headlamp leveling motor
- Right-hand headlamp leveling motor

Automatic headlamp leveling is operational when the main lighting switch is set to the headlamp, rear fog lamp or autolamp position and the ignition key is at position ‘II’.

The headlamp leveling module is located at the right-hand side A-post, above the primary junction box.

The axle level-sensors are inductive devices that respond to the vertical position of the vehicle and supply feedback signals to the module. The module processes the data and supplies appropriate signals to the headlamp leveling motors causing the position of the headlamps to be adjusted accordingly; refer to **S-TYPE Electrical Guide** for detailed information.

NOTE: After disconnecting any element of the automatic headlamp leveling system, recalibration will be necessary using WDS.

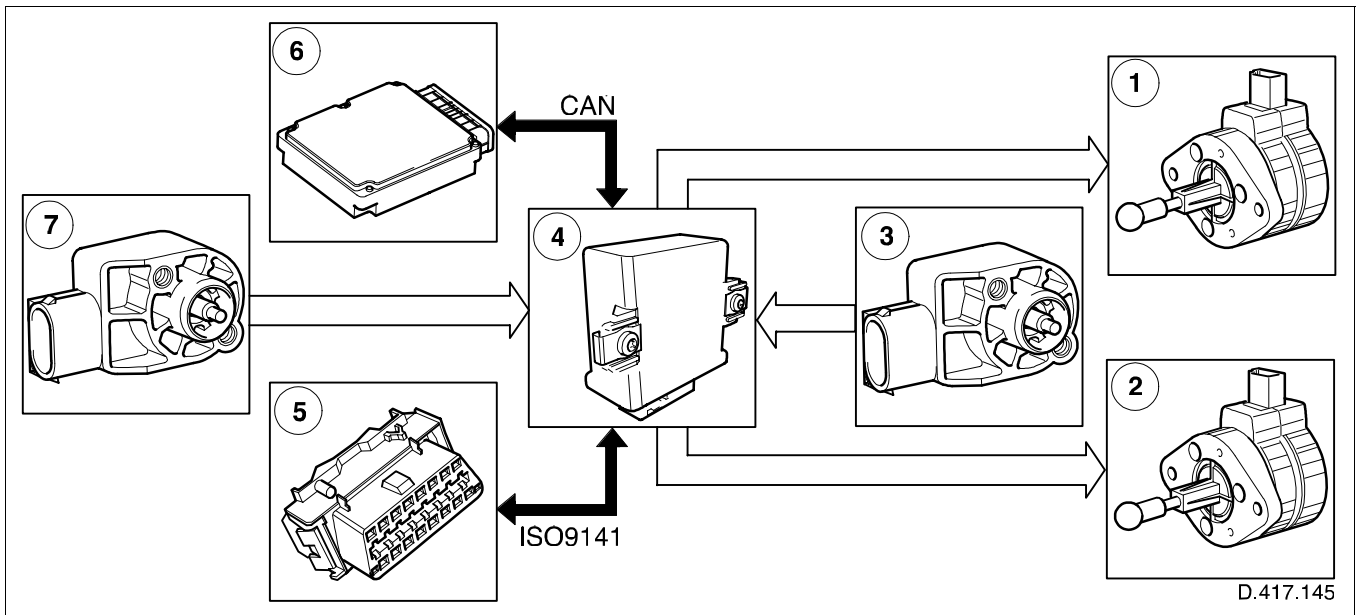


Fig. 96 Automatic headlamp leveling system

- | | |
|---------------------------------------|---------------------------|
| 1. Left-hand headlamp leveling motor | 5. Diagnostic connector |
| 2. Right-hand headlamp leveling motor | 6. Engine control module |
| 3. Front-axle level sensor | 7. Rear-axle level sensor |
| 4. Headlamp leveling module | |

Diagnostics

System malfunctions will cause a DTC to be stored in the ECM. Retrieval of the DTC and subsequent diagnosis of the system should be undertaken using WDS.

Autolamp

The operation of the autolamp feature (where applicable) is dependent on ambient light levels, monitored by photo-diodes integrated into the dual sunload-sensor; refer to **Dual sunload-sensor**. The sensor provides feedback to the instrument cluster, which responds by supplying control signals on SCP to the GECM and RECM that automatically control the operation of the side lamps and low-beam headlamps where appropriate, providing:

- The ignition key is at position II or III.
- The AUTO option on the main lighting switch is selected.

NOTE: Since the operation of the lamps depends on the sensor, which is located behind the demist grille of the instrument panel, it is important that the windshield be kept clean and that the sensor is not covered.

The sensor is calibrated to monitor ambient light levels as follows:

- Detection of darkness for 2 seconds continuously, will cause the low beam and side lamps to be activated.
- Detection of daylight for 15 seconds continuously, will cause the exterior lighting to be extinguished.
- Detection of semi-darkness for 15 seconds continuously, will cause the low beam and side lamps to be activated.

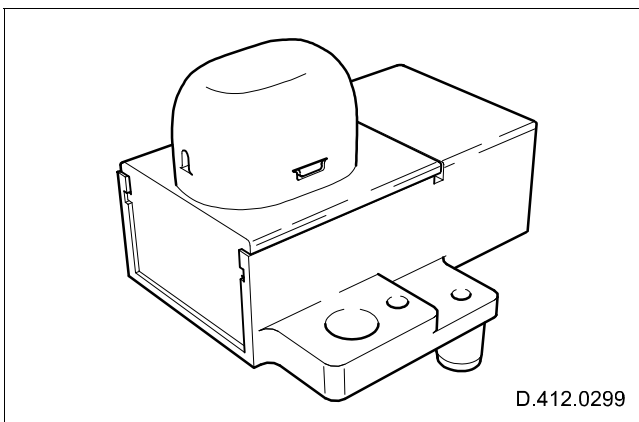


Fig. 97 Autolamp sensor

Front and Rear Fog Lamp Switches

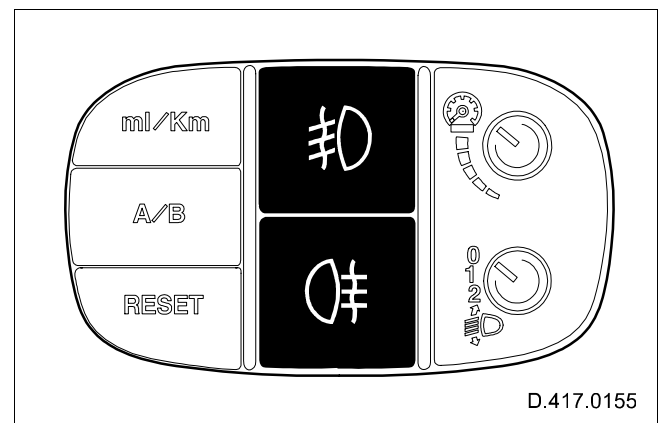
The switches are mounted within the auxiliary lighting switch assembly and intended to function as follows:

- Front fog lamps
 - The lamps are activated by ‘pressing’ the appropriate button, provided the SIDE LAMPS or LOW BEAM has been activated and the ignition key is at position II.
 - The lamps are deactivated by pressing the same button.

NOTE: In some markets the front fog lamps will not operate if main beam is selected.

- Rear fog lamps
 - The lamps are activated by ‘pressing’ the appropriate button, provided that the LOW BEAM has been activated with the ignition key at position II or the front fog lamps are already active.
 - The lamps are deactivated by pressing the same button.

NOTE: The rear fog lamps are not available for some markets.



Refer to **S-TYPE Electrical Guide** for detailed electrical connection information.

Interior Lighting

The interior lighting comprises:

- Footwell lamps.
- Front door puddle lamps.
- Courtesy lamps and switch.
- Front map lamps and switches.
- Vanity mirror lamps and switches.
- Rear map lamps and switches.
- Luggage compartment lamps and switch.
- Glove compartment lamp and switch.

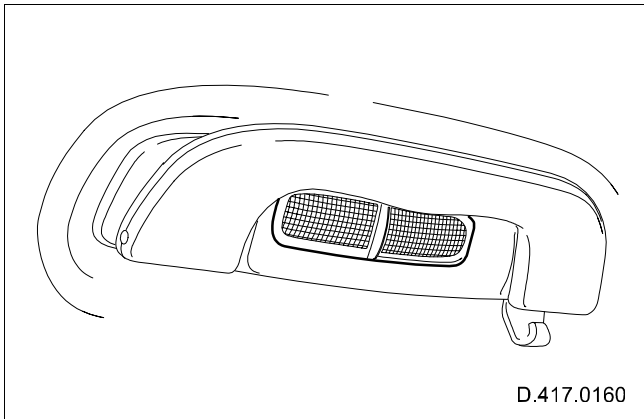


Fig. 99 Rear courtesy and map lamp

The glove compartment lamp, vanity mirror lamps and map lamps have direct ground returns. All courtesy lamps including footwell and front door puddle lamps receive a ground return via the general electronic control module (GECM) in the form of a controlled signal that provides progressive illumination and deactivation during normal operation. The luggage compartment lamps receive a ground via the rear electronic control module (RECM).

NOTE: Refer to **S-TYPE Electrical Guide** for detailed connection information.

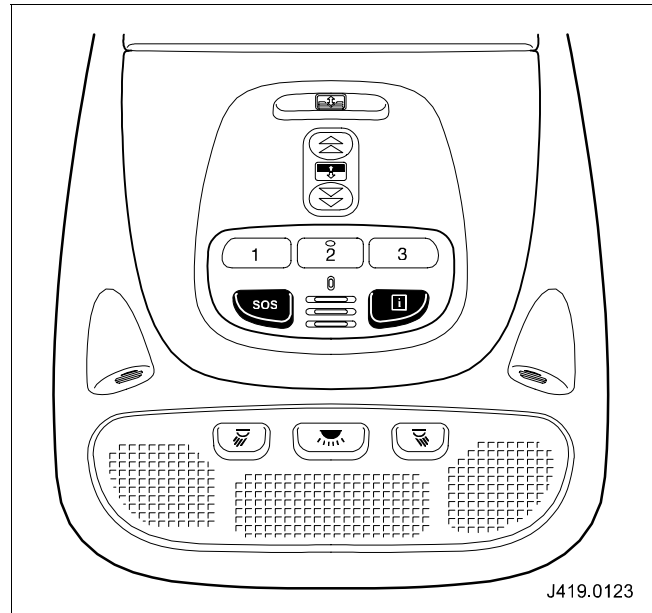


Fig. 100 Front interior lighting

Battery Saver

A timer function within the GECM and RECM controls the battery saver feature:

- The timer is initialized when the ignition key is turned to position '0' or removed from the ignition barrel.
- After a 40 minute period, the GECM and/or RECM will remove the battery voltage from the interior lighting by deactivating the appropriate relays.

The battery saver feature will be reactivated when:

- The ignition key position is changed.
- Any door (including the luggage compartment door) becomes ajar or is opened.
- An external unlock is activated using either the door lock cylinder or the integrated key transmitter.
- The courtesy lamps' switch is activated.

Courtesy Lighting

The courtesy lamps are controlled by the general electronic control module in the following circumstances:

- Any of the vehicle's doors are open.
- An external unlock is activated using either the door lock cylinder or the integrated key transmitter.
- The courtesy lamps' switch is activated.

Provided that the courtesy lamps' switch is not activated, the courtesy lighting feature extinguishes the courtesy lamps when all the vehicle's doors are closed and any of the following occurs:

- Twenty seconds have elapsed since either an external unlock or the last door has closed, whichever occurs last.
- The engine is started.
- An external lock is activated using the door lock cylinder or integrated key transmitter.

In addition, the courtesy lighting feature extinguishes the courtesy lamps when the battery saver timer has expired; refer to **Battery Saver**.

During normal operation the courtesy lamps:

- Progressively illuminate when activated.
- Progressively extinguish when deactivated.

NOTE: When the battery saver feature is active the lamps will extinguish immediately.

Electrical Distribution

Module Communications Network

Many of the electronic modules previously using the SCP network have been reallocated to the controller area network (CAN) that has now been incorporated into S-TYPE; refer to **Controller Area Network (CAN)**. The most significant change to the S-TYPE distribution system is the introduction of optical fiber cables which, accommodate the transfer of very high-speed, real-time audio data.

The optical fibers provide an optical network that interfaces to the SCP network via the audio unit; refer to **D2B network** for detailed information.

NOTE: The optical network currently uses a transfer protocol known as D2B. Although this protocol may change in the future, the optical network will be referred to as 'D2B' throughout this and other Jaguar technical publications.

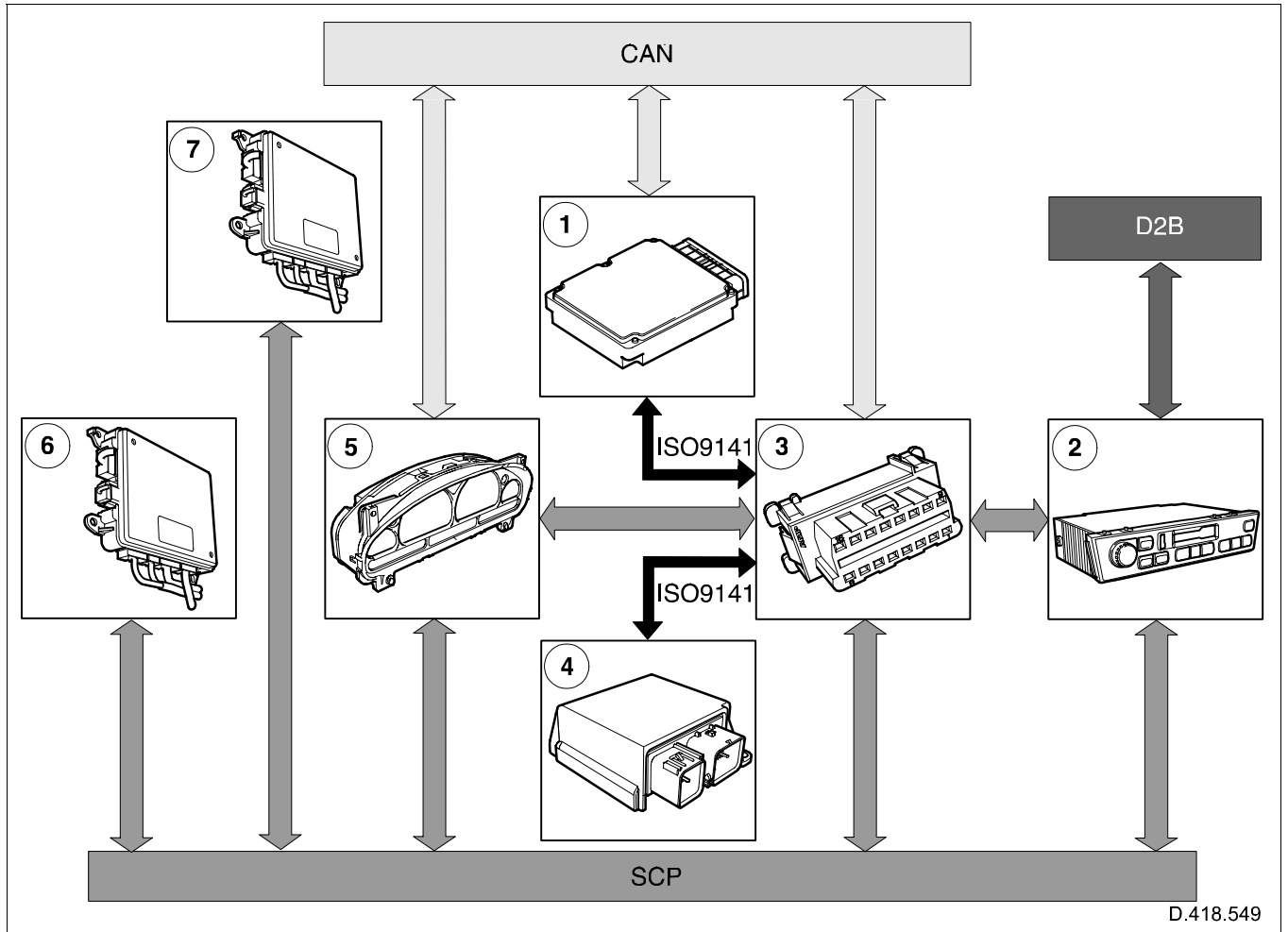
SCP, CAN and ISO9141 networks

The standard corporate protocol (SCP), controller area network (CAN) and ISO9141 networks are configured in a similar way to current Jaguar models to accommodate different data types and flow rates as required for the various vehicle features; refer to **Table 3**

Network	Communication between	Speed (kbps)
CAN	Engine, Transmission, Braking System	500
SCP	Lower Speed Body Systems	41.6
ISO9141	Diagnostic connector and ECM; control modules with self-diagnostic capability not connected to CAN or SCP	10.4

Table 3 Network communication

Fig. 101 provides a representation of the major network interconnections; refer to **S-TYPE Electrical Guide** for detailed information.



D.418.549

Fig. 101 Network interconnections

- | | |
|------------------------------|--------------------------------------|
| 1. Engine control module | 5. Instrument cluster |
| 2. Audio unit | 6. General electronic control module |
| 3. Diagnostic connector | 7. Rear electronic control module |
| 4. Restraints control module | |

Controller Area Network (CAN)

Fig. 102 provides a schematic representation of the CAN interconnections; refer to **S-TYPE Electrical Guide** for detailed information.

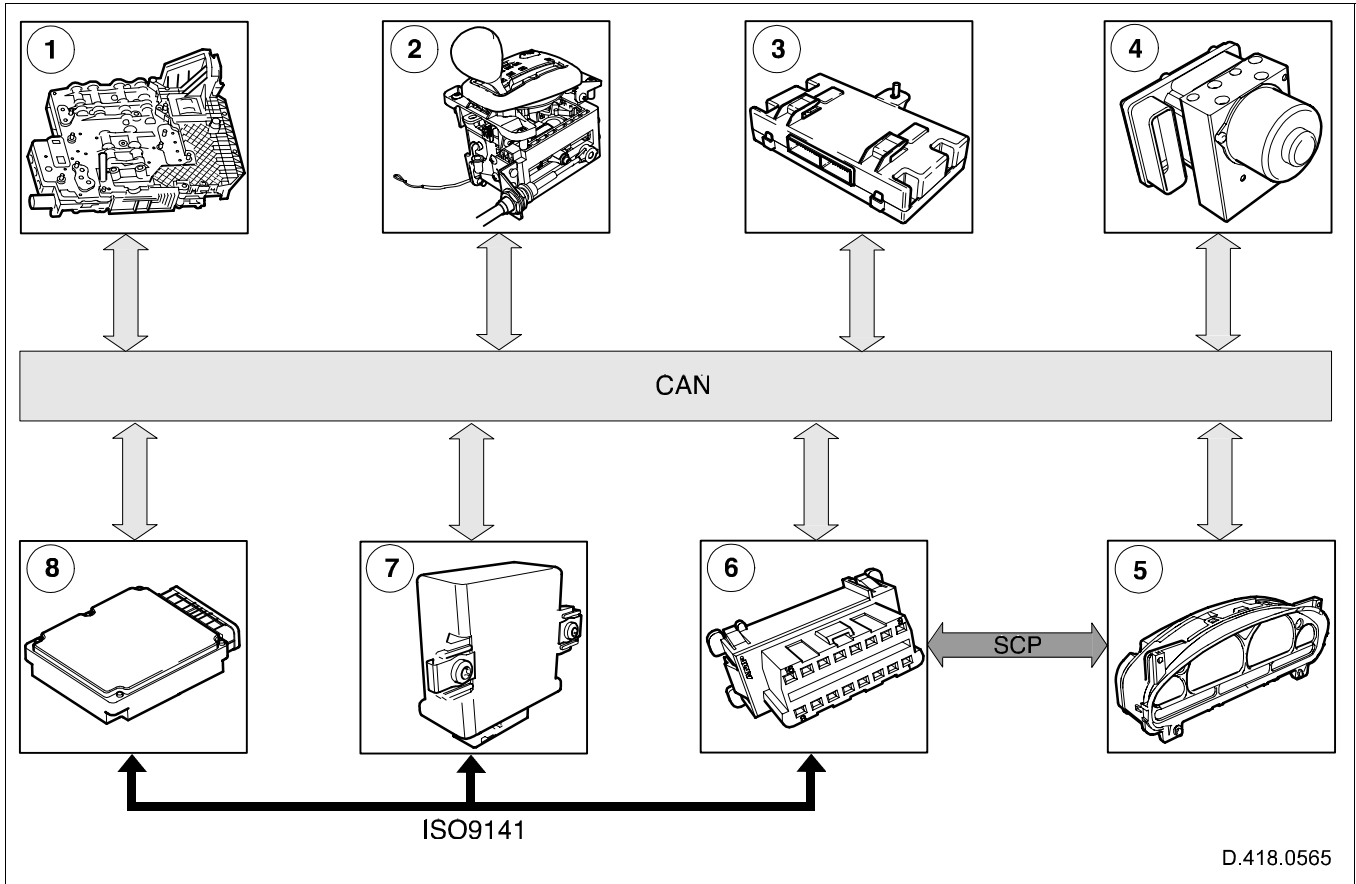


Fig. 102 Controller area network (CAN)

- | | |
|--|-------------------------------------|
| 1. Transmission control module (and main control valve body) | 5. Instrument cluster |
| 2. J-gate module (automatic only) | 6. Diagnostic connector |
| 3. Remote climate control module (telematics only) | 7. Headlamp leveling control module |
| 4. ABS/TC/DSC module | 8. Engine control module |

Standard Corporate Protocol (SCP) Network

Fig. 103 provides a schematic representation of the SCP network interconnections; refer to **S-TYPE Electrical Guide** for detailed information.

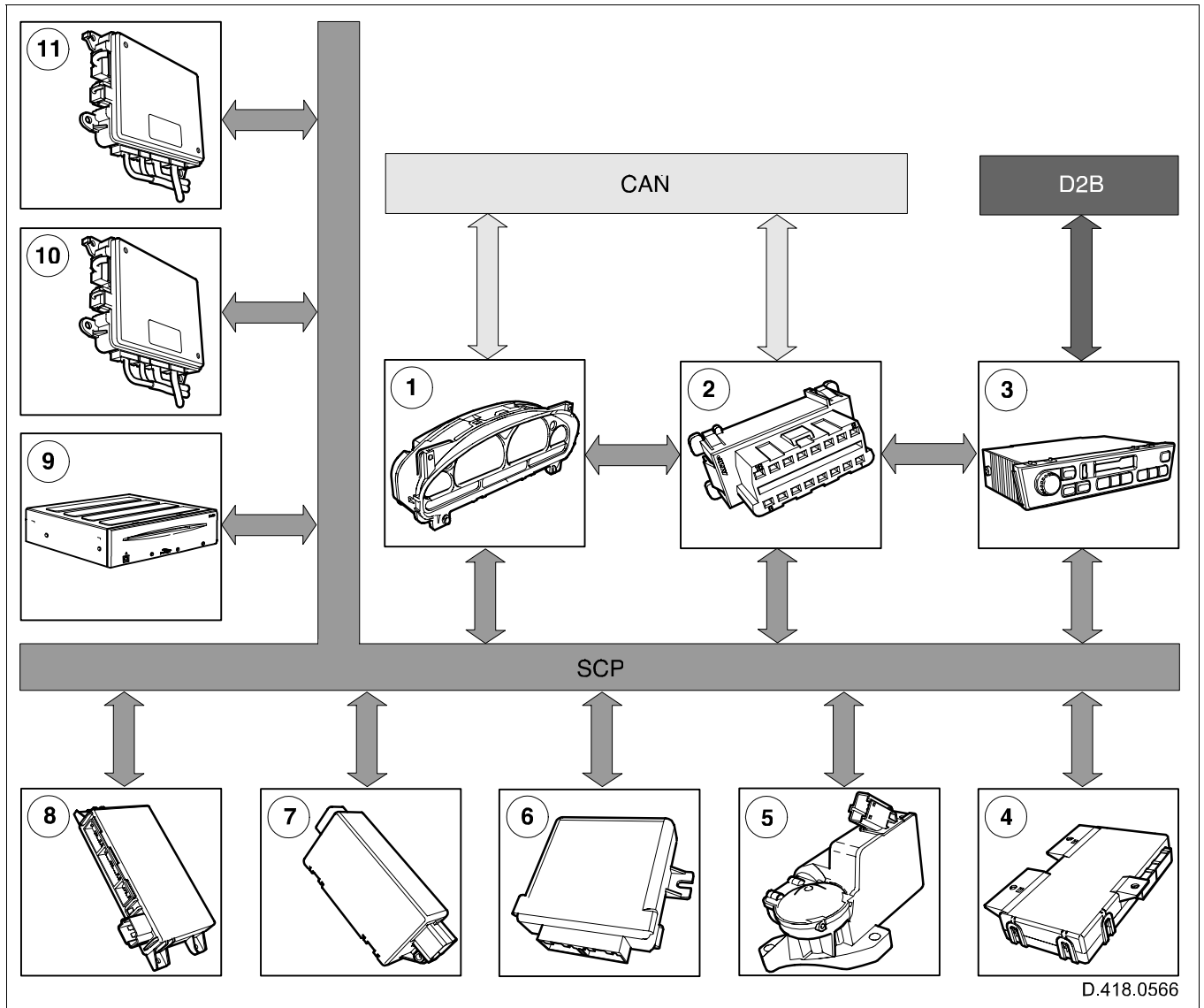


Fig. 103 SCP network

- | | |
|------------------------------------|---------------------------------------|
| 1. Instrument cluster | 7. Parking brake module |
| 2. Diagnostic connector | 8. Driver door control module |
| 3. Audio unit | 9. Navigation control module |
| 4. Driver seat control module | 10. General electronic control module |
| 5. Steering column lock module | 11. Rear electronic control module |
| 6. Adaptive damping control module | |

Electrical

Network modules

Fig. 104 shows the main modules and locations; refer to the appropriate section and to **S-TYPE Electrical Guide** for detailed information.

NOTE: Refer to **Navigation System** for location of Navigation Control Module.

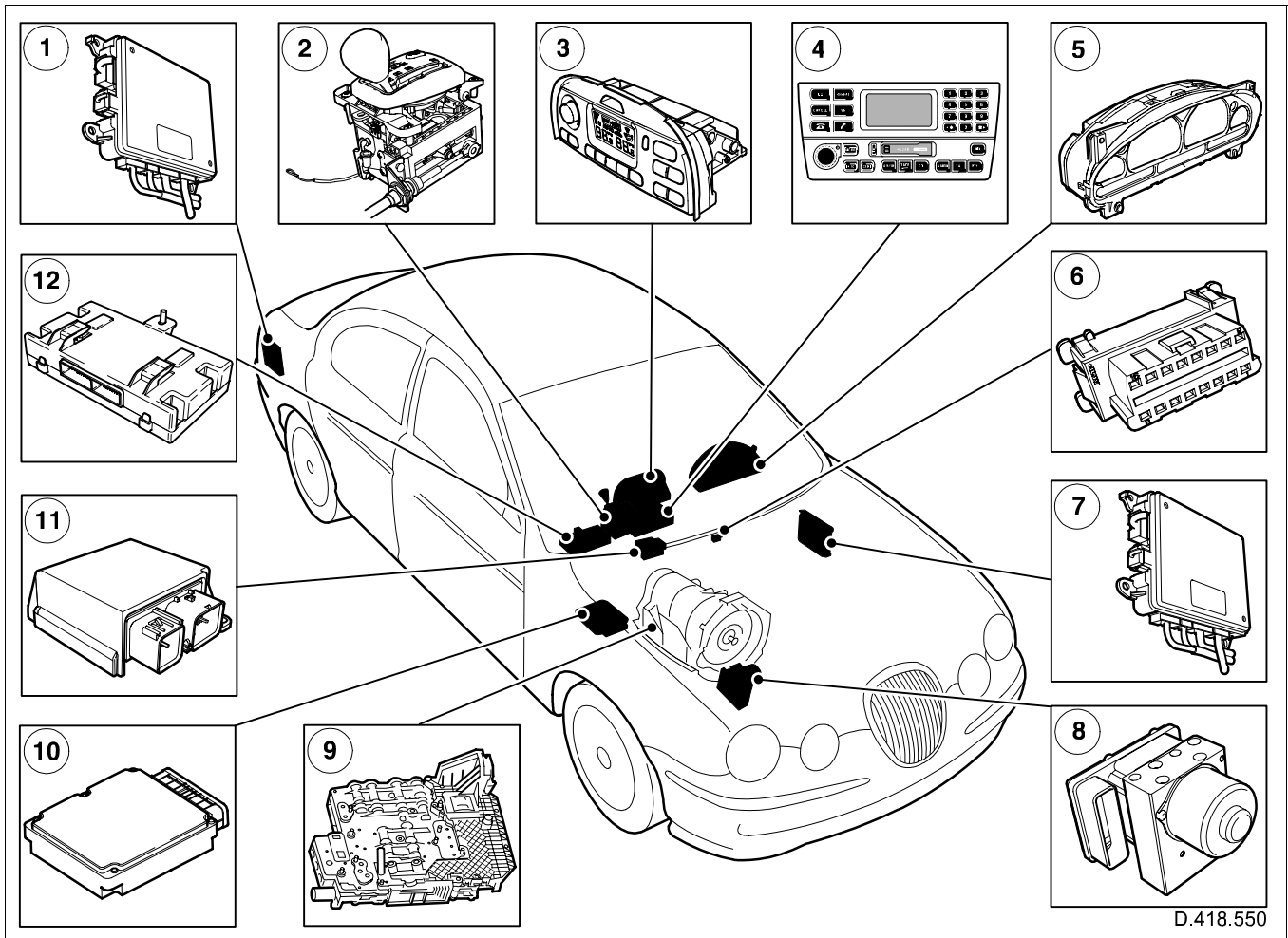


Fig. 104 Location of network modules

1. Rear electronic control module
2. J-gate module (automatic only)
3. Climate control module (non-telematics)
4. Audio unit (non-telematics)
5. Instrument cluster
6. Diagnostic connector
7. General electronic control module
8. ABS/TC/DSC module
9. Transmission control module (and main control valve body)
10. Engine control module
11. Restraints control module
12. Remote climate control module (telematics only)

D2B network

The D2B network comprises:

- Optical fiber.
- Wake-up wire.
- Master module (audio unit).
- Slave module(s).

- Intermediate connectors.

The network:

- is structured as a unidirectional ring;
- uses plastic optical fiber to transport data from one module to another in ring order.

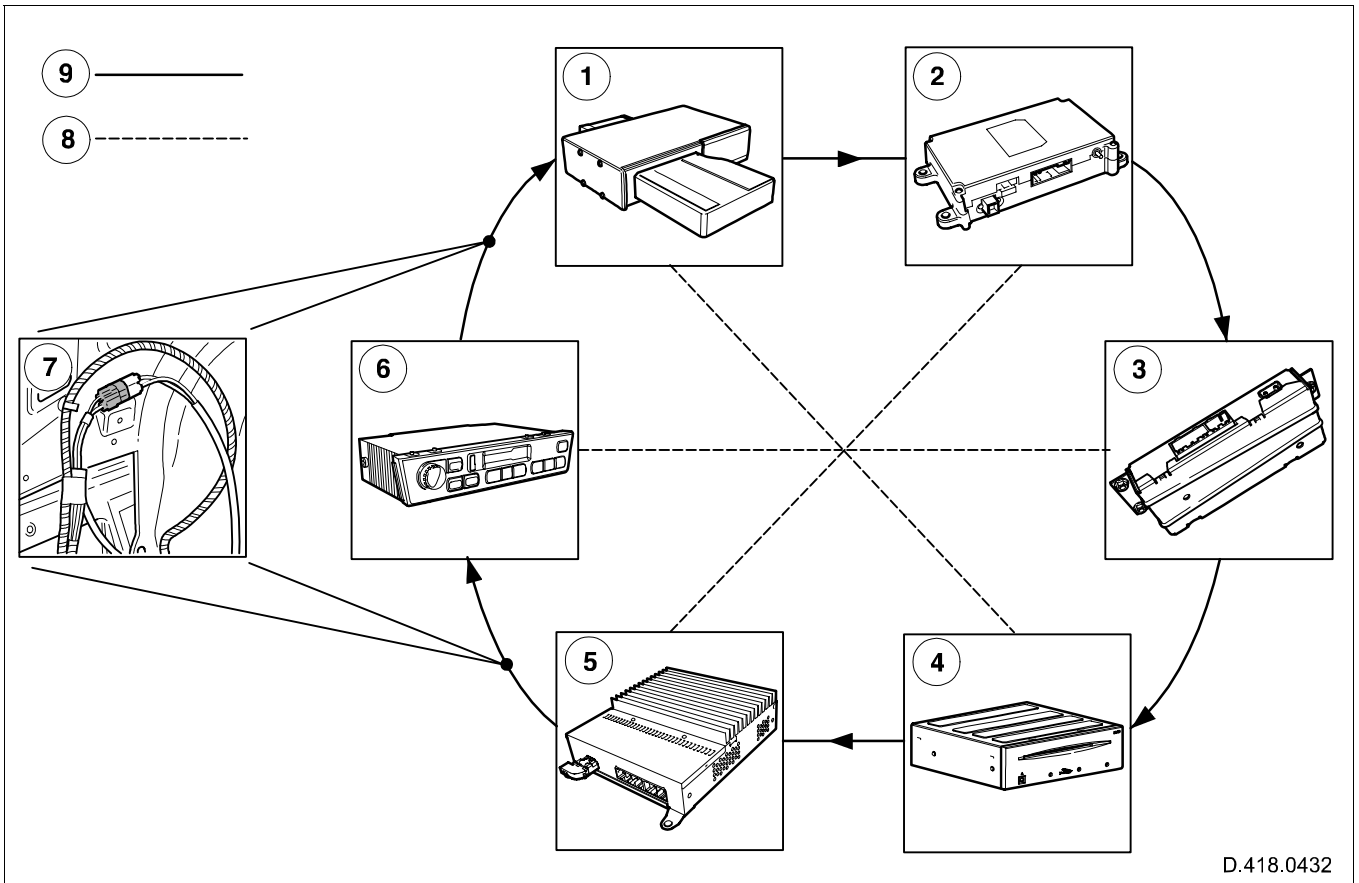


Fig. 105 D2B network

- | | |
|---|-------------------------------|
| 1. CD changer | 6. Audio unit (master module) |
| 2. Cellular phone control module | 7. D2B intermediate connector |
| 3. Voice activation control module | 8. Wake-up wire |
| 4. Navigation control module | 9. Optical fiber |
| 5. Power amplifier (premium entertainment system) | |

Optical Fiber

The fiber comprises a 1mm polymer core with a 3.5mm diameter outer protective jacket.

The fiber facilitates the transport of data in the form of pulses of light which are too fast to be seen by the eye, at a data bit rate of approximately 5.5M bits per second.

Wake-up Wire

The wake-up wire comprises copper wire configured in a star-like arrangement that connects to a single pin on each of the modules; refer to **Fig. 105**.

- The audio unit sends a wake-up command (an electrical pulse) via the copper wire to initialize the slave module(s).
- The wake-up pulse is sent when the ignition key is turned to position '1'.
- The pulse triggers slave modules to look at the preceding module for a 'light signal' (originated by the audio unit) and to participate with the audio unit in network initialization.
- At the end of this initialization procedure, the modules are ready for full network operation.

NOTE: Any malfunction during the initialization stage will cause a DTC to be stored by the audio unit.

Master Module

The master module is the audio unit; it manages the D2B network and provides the gateway to the SCP network.

Slave Module(s)

A slave module is any other system module that is connected to the D2B network and includes:

- Navigation control module
- CD changer
- Cellular phone control module
- Voice activation control module

Intermediate Connector

There are two D2B intermediate connectors, one (located at the left-hand A-post) provides harness interconnection only; the other one (located in the luggage compartment to the left-hand side) provides the interconnection point for the slave modules.

NOTE: For vehicles that have modules already installed that utilize the optical network, the D2B intermediate connector may be accessible only after removing the installed module(s); refer to appropriate **Accessory Fitting Instructions** for details.

Modules that connect to the D2B network, use special optical fiber assemblies which interface with the D2B intermediate connector in the luggage compartment; the assemblies may vary depending on the particular combination of modules connected to the network.

NOTE: Optical fibers are incorporated into the instrument panel and cabin harnesses during manufacture to support dealer installation of the CD changer, voice control and cellular phone systems.

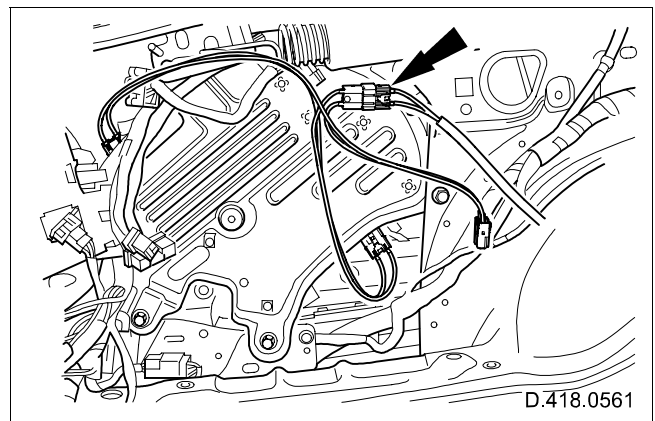


Fig. 106 Location of D2B intermediate connector

Differences Between D2B and CAN or SCP

- D2B provides multiple communications channels instead of one channel.
- D2B has a control channel (which operates in a similar way to CAN or SCP) but in addition has three source data channels which can be used to transport up to three separate streams of 16-bit digital stereo data.

Optical Fiber Cables and Connectors

Under normal installation conditions, the system is robust and failures should not occur, however since the optical fibers convey data using light, it is vital that the passage of light down the fiber is unobstructed. Obstruction of light can be caused by:

- contamination of the fiber ends;
- damage to the fiber ends;
- bending, kinking or damaging the cable.

NOTE: Fibers damaged by kinking or exposure of the optical core due to abrasion must be replaced.

Handling

Take special care to avoid damage or contamination when handling or working in the vicinity of fiber optical cables and connectors.

NOTE: Damage or contamination includes scratches to the cable ends and pollution caused by dust, dirt or oil.

CAUTION: When handling optical fibers, cleanliness is of paramount importance. The fiber ends should not be touched even with clean bare hands, as the natural oils deposited from the skin may penetrate the fiber or may cause dirt to adhere to the fiber end.

System malfunctions and unnecessary warranty claims can be minimized by following these guidelines:

- After disconnection of any cables, carefully install an appropriate dust cap to protect the mating face of the connectors from damage or contamination.
- Avoid introducing tight bends (less than 25mm radius) or kinks into the optical fiber during service or repair. Tight bends or kinks could:
 - impair system operation;
 - cause immediate system failure;
 - cause future system failure.
- Avoid excessive force, strain or stress on the fibers and connectors, especially permanent stress after reinstallation.

Optical Network Diagnostics

Unlike the other networks that communicate with WDS via the diagnostic connector, the optical network interfaces with the diagnostic connector via the audio unit and the SCP network.

NOTE: Diagnosis and Testing is quite complex and specific; refer to **JTIS** for details.

Electronic Feature Group

Anti-Theft

NOTE: Refer to **S-TYPE Electrical Guide** for detailed electrical connection information.

Anti-theft options depend on market specification and include a perimeter alarm system, an intrusion sensing system and a passive anti-theft system (PATS). The system is based around the following modules which all communicate via the SCP network:

- general electronic control module (GECM);
- instrument cluster;
- rear electronic control module (RECM);
- driver door control module (DDCM);
- steering column lock module (SCLM).

In addition, where appropriate, the engine control module (ECM), based on messages exchanged via CAN, provides PATS security by disabling the starter relay, fuel injectors, ignition coils and the fuel pump module.

GECM

NOTE: For functions not associated with anti-theft refer to **Multifunction Electronic Control Modules**.

The GECM monitors the status of the:

- front door ajar switches (integral to the door latches);
- hood ajar switch;
- intrusion sensors (integral to the overhead console);
- audio unit (anti-theft sensing line);
- inclination sensor (providing intrusion sensors are installed).

Depending on market specification and the alarm status, where appropriate, the GECM provides the necessary electrical output signals to the:

- vehicle horns;
- passive sounder / battery-backed sounder (BBS);
- front turn-signal indicator lamps.

NOTE: When commanded to do so by the instrument cluster, the GECM also provides the ground supply line for the SCLM.

RECM

NOTE: For functions not associated with anti-theft refer to **Multifunction Electronic Control Modules**.

The RECM monitors the status of the:

- rear passenger door ajar switches (integral to the door latches);
- luggage compartment lid ajar switch

Depending on market specification and the alarm status, where appropriate, the RECM provides the necessary electrical output signals to the rear turn-signal indicator lamps.

NOTE: When commanded to do so by the instrument cluster, the RECM also provides the power supply line for the SCLM.

Instrument Cluster

NOTE: For functions not associated with anti-theft refer to **Instrumentation and Warning Systems**.

The instrument cluster:

- provides multiplex network gateway functionality for CAN and SCP;
- drives the security system indicator lamp;
- interfaces with the PATS transceiver coil;
- communicates with the ECM and key transponder (stores PATS key codes).

DDCM

NOTE: For functions not associated with anti-theft refer to **Multifunction Electronic Control Modules**.

The DDCM where appropriate, monitors the status of the driver's door switches (except the door ajar switch) and the valet switch (where installed).

NOTE: The ground supply line for the external luggage compartment lid-release is via the driver's door unlock latch status.

SCLM

The SCLM is fixed to the upper steering column. Before the module can handle data it must have its power supply activated. When commanded to do so by the instrument cluster, the RECM provides the power supply line and the GECM provides the ground supply line for the SCLM. Once activated, the module processes data on the SCP network and when appropriate, activates the motor to lock or unlock the steering column.

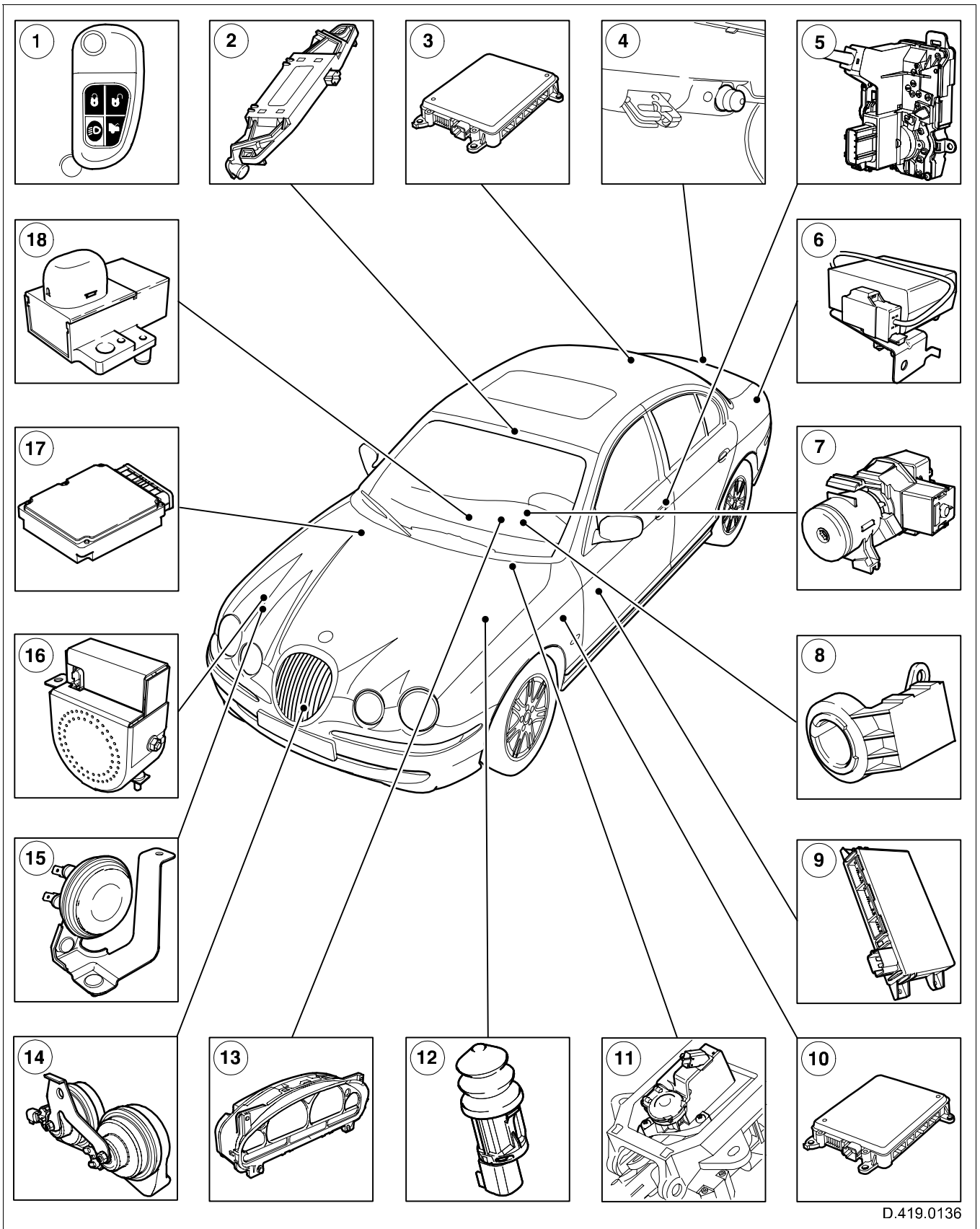


Fig. 107 Anti theft component locations

Electrical

Key to Fig. 107

1. Integrated key transmitter
2. Intrusions sensors (where applicable)
3. Rear electronic control module
4. Luggage compartment lid ajar switch
5. Driver door ajar switch
6. Inclination sensor (where applicable)
7. Ignition switch
8. Transceiver coil
9. Driver door control module
10. General electronic control module
11. Steering column lock module
12. Hood ajar switch
13. Instrument cluster
14. Horns
15. Passive sounder
16. Battery-backed sounder (where applicable)
17. Engine control module
18. Security system indicator lamp

System Features

The S-TYPE incorporates the following, either as standard or dealer installed options:

- Key barrel on driver's side only.
- Encrypted instrument cluster/engine control module immobilization system, controlled by the ignition key transceiver/transponder.
- Radio frequency remote transmitter (part of integrated key transmitter).
 - Four control buttons (lock, unlock, luggage compartment lid release, headlamp convenience / panic).
- Double locking by key and remote transmitter (not North America or Japan).
- Central locking by key, remote transmitter and interior handle.
- Auto-locking
 - Drive-away locking (standard, except Japan).
- Passive arming.
- Perimeter alarm of doors, hood and luggage compartment lid.
- Intrusion sensing (integrated into overhead console).
- Inclination sensing - (part of security pack in Netherlands, option in Europe but intrusion sensing must also be installed).
- Panic alarm - remote transmitter operated.
- Integrated security system indicator lamp (dual function - indicates vehicle alarm system armed and PATS fault codes).
- Two-stage unlocking (certain markets).
- Separate security horn or battery backed security sounder (market dependent).

Definition of terms:

- Double-locking - the vehicle cannot be unlocked via the interior door handles.
- Auto-locking (drive-away locking) - the doors will lock automatically when the vehicle is driven away, at a speed in excess of 5 km/h (3 mile/h).
- Two-stage unlocking - a security feature where only the driver's door unlocks under normal operation of key or transponder remote (passenger door can be unlocked with a second unlock operation).

System Arming and Disarming

The security system is armed by locking the vehicle using the driver's door lock or by pressing the lock button on the integrated key transmitter.

- A single button-press or lock by key, activates the perimeter sensing.
- A double button-press or unlock to lock action within 3 seconds, activates the perimeter and intrusion sensing (where applicable) and invokes double-locking (where applicable).

NOTE: There is no pre-arm phase when the vehicle is double locked.

Once the pre-arm phase (20 seconds after locking) has passed and provided no apertures remain ajar, the vehicle becomes fully armed (depending on market and vehicle specification). Once fully armed, any of the following will trigger an alarm:

- Opening a door/hood/luggage compartment lid (unless via RF transmitter).
- Using an invalid PATS ignition key.
- Movement inside the vehicle (with intrusion sensor fitted and vehicle double locked).
- Excessive movement of vehicle (with inclination sensor fitted and vehicle double locked).
- Removal of modules.
- Disconnection of battery-backed sounder.

When the alarm is activated, the turn signals flash and the vehicle horn sounds. Where fitted, the security horn or battery-backed sounder sound in conjunction with the vehicle horn.

The security system can be disarmed by unlocking the driver's door lock (not in Europe), pressing the unlock button on the integrated key transmitter, or turning a valid key in the ignition.

Telematics

Telematics refers to the convergence of telecommunications and information technology within the vehicle, enabling the seamless transport of information and data to provide various services to and from the vehicle (or mobile communications devices).

Telematics Display Module

The telematics display module is the principle user interface for the following subsystems:

- Navigation; refer to **Navigation System**.
- Climate control; refer to **Climate Control System**.
- Entertainment; refer to **Entertainment Systems**.
- Cellular phone/JaguarNet (optional); refer to **Cellular Phone**.
- Television (optional); refer to **Video System**.
- Voice training modes (optional): refer to **Voice Activated Control System**.

When the ignition key is at position 'I' or 'II' the touch screen will display the Jaguar leaper followed by the last 'top level' menu of the screen used before the ignition key was turned to position '0'. Display of touch-screen options for other systems is obtained by pressing the appropriate perimeter button.

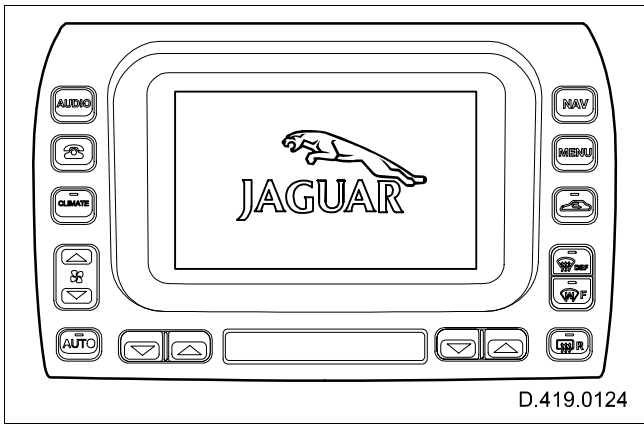


Fig. 108 Telematics display module

NOTE: The touch screen and inner bezel must be kept clean to maintain optimum performance. Finger marks and attracted dust should be regularly removed using a soft cloth and a Jaguar approved cleaning agent.

Touch screen features are designed to be user-friendly and intuitive like a personal computer. The tables show typical examples of the text displayed using the screen menus.

MENU	
Brightness/Contrast	Volume Preset
System Setup	TV
Screen OFF	Logo Screen

Table 4 Menu text displayed

SYSTEM SETUP	Cancel
Set Clock	
User Settings	

Table 5 System setup text displayed

USER SETTINGS		Cancel	
Audible Feedback	Yes	Touch Screen	No
Units	Metric	Imperial	
Language	Flag		

Table 6 User settings displayed

Voice Activated Control System

The voice activated control system, offers the user the option to activate by voice, certain features for the following systems:

- Entertainment.
- Cellular phone.
- Climate control.
- Navigation.
- Television (where installed) and teletext (where available).

NOTE: Vehicles are pre-wired during manufacture to facilitate, in appropriate markets, the dealer installation of the voice activation control system, as an accessory.

The system components comprise:

- Voice activation control module (VACM), located in the luggage compartment to the left-hand side and mounted

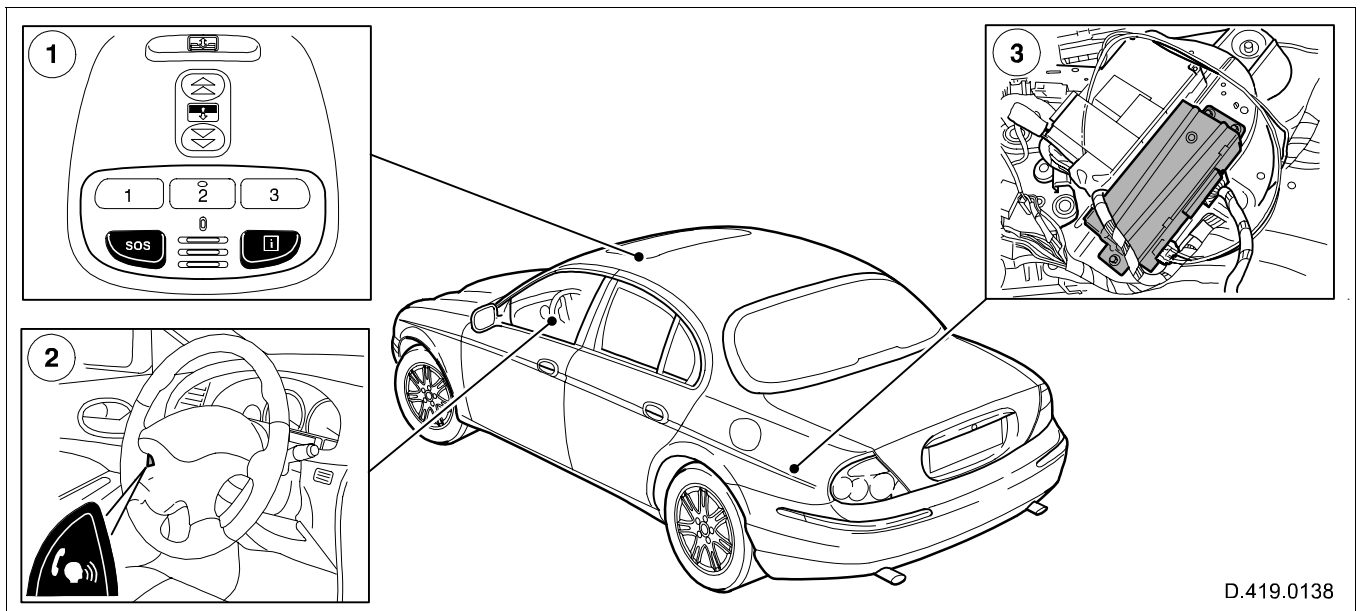
to the inside of a bracket that is shared with the cellular phone control module (CPCM).

- Microphone, shared with the phone and located in the roof console.
- Push-to-talk button, mounted on the steering wheel, shared with the phone and wired through the audio unit.

NOTE: Where applicable, providing the parking brake is engaged, it is possible to initiate a training mode which enables the voice activation control system to fine-tune the voice recognition capability.

The VACM is not serviceable but will need to be reconfigured using WDS if changes are made to the systems it controls; for example, after the installation of a CD changer.

NOTE: VACM is part of the optical network; refer to **D2B network**.



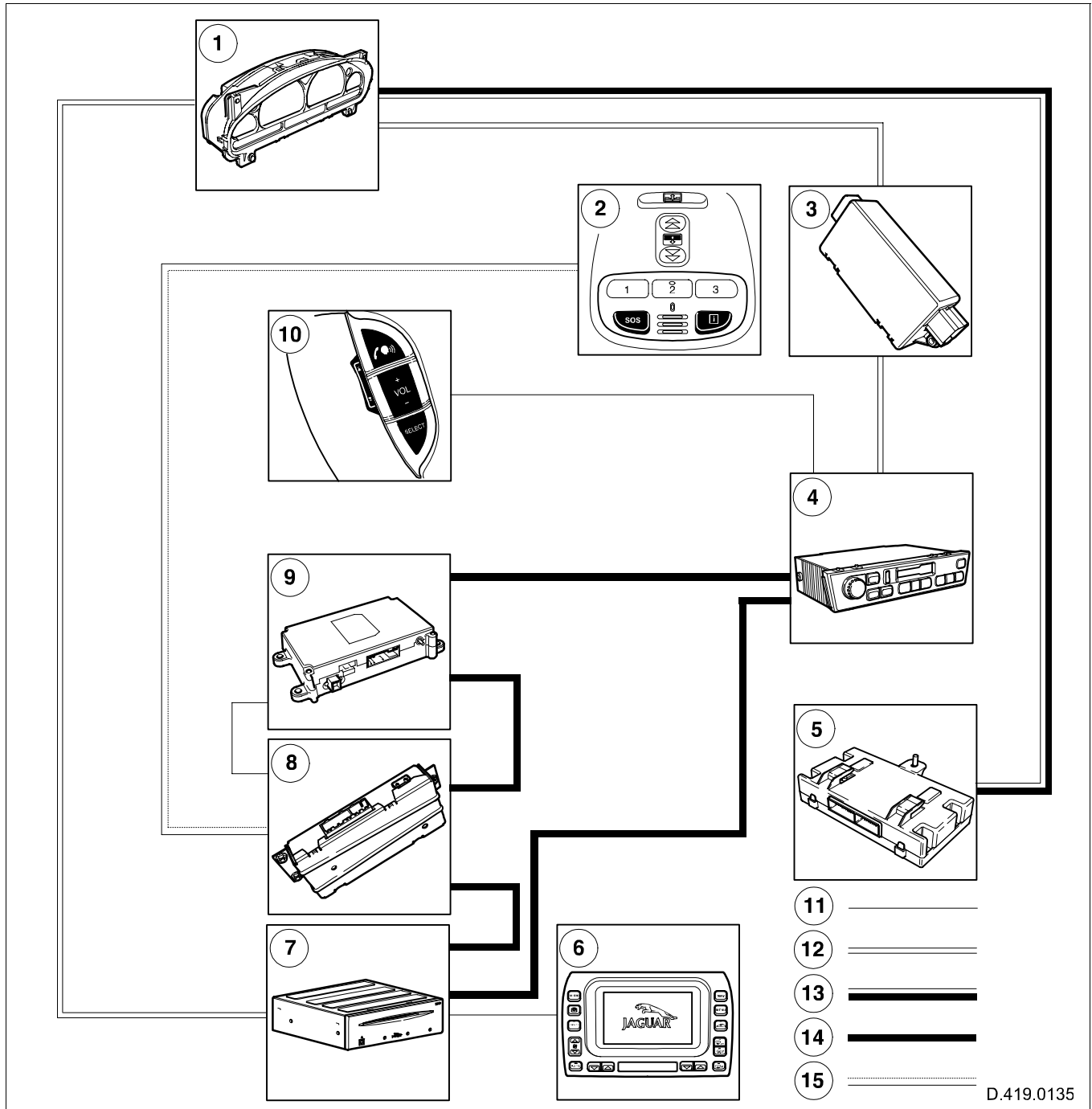
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Fig. 109 Voice-activated control - component locations

1. Microphone
2. Push-to-talk button
3. Voice activation control module
(shown with mounting-bracket removed from vehicle)

Electrical

Figure Fig. 110 provides an indication of the interconnectivity for the voice-activated control system; refer to **S-TYPE Electrical Guide** for detailed information.



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Fig. 110 Voice-activated control system

Key to Fig. 110

1. Instrument cluster
2. Microphone
3. Electric parking-brake module
4. Audio unit
5. Climate control module (remote)
6. Telematics display module
7. Navigation control module
8. Cellular phone control module
9. Voice activation control module
10. Push-to-talk button
11. Wired connection
12. SCP
13. CAN
14. D2B
15. Shielded twisted-pair

Electrical

Navigation System

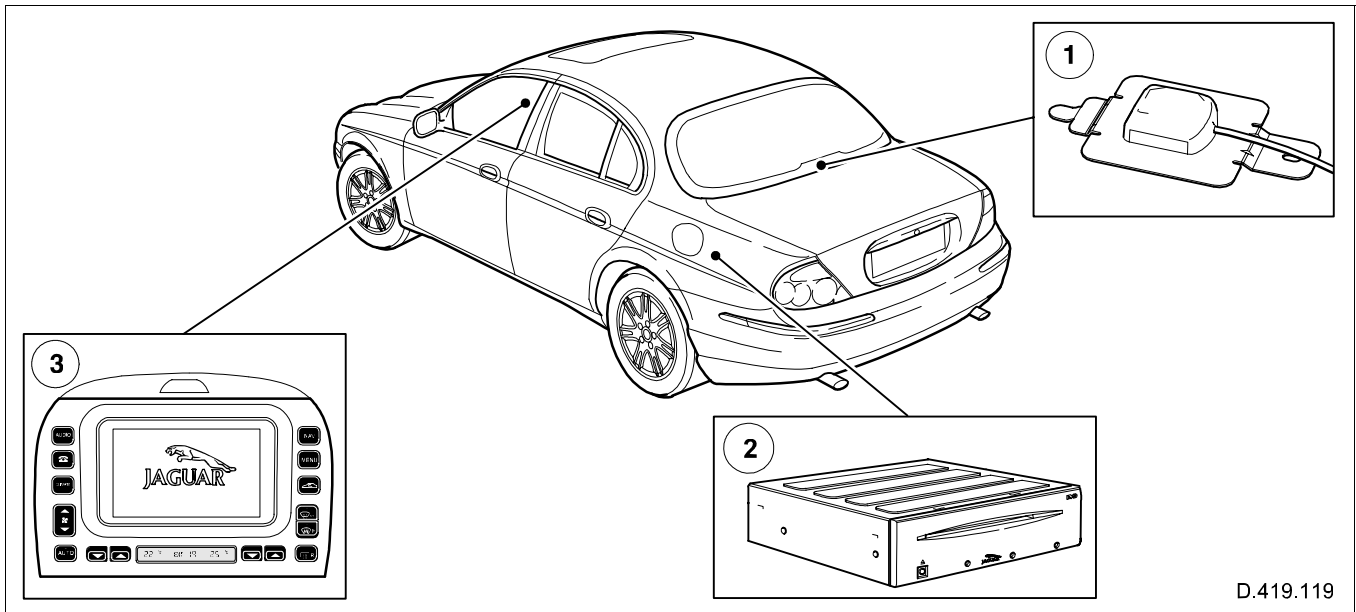
The navigation system comprises:

- Navigation control module complete with DVD reader.
- Navigation system antenna.
- Navigation data DVD.
- Navigation system display module.

NOTE: The navigation system uses the **Telematics Display Module** as the navigation system display module; refer to the appropriate section for more information.

The vehicle location/direction is determined using the following:

- global positioning system (GPS);
- vehicle speed;
- gyroscope to detect directional changes; refer to **Navigation Control Module**;
- navigation map-matching software integral to the **Navigation Control Module**;
- navigation data stored on the DVD disk.



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Fig. 111 Navigation system component location

1. Navigation system antenna
2. Navigation control module
3. Telematics display module

Navigation Control Module

The NCM is:

- located in the luggage compartment to the left-hand side;
- fixed to a bracket which also supports (where applicable) the CD changer and the remote amplifier.

The navigation control module (NCM) comprises:

- Navigation software which controls:
 - generation of map display;
 - routing functions.
- Graphics display driver.
- D2B output of audio data for voice guidance and television.
- SCP link for communications between other modules.
- Subsystem control software to generate control screens for other modules and support communications.
- GPS decoder which amplifies and decodes the GPS signal received from the antenna.
- Gyroscope to monitor vehicle direction.
- DVD drive which reads the map database stored on disk.
- Diagnostic software.

NOTE: Japan uses a different NCM that incorporates a Japanese voice activation control module (VACM). The module permits extensive recognition of navigation system commands (including the ability to enter full addresses) and the display of traffic information via vehicle information communications system (VICS).

Navigation System Display Module

The display module is a multifunction touch-screen console which comprises on-screen simulated buttons (soft buttons) and perimeter buttons (hard buttons). Unlike some Jaguar models, the display module is not dedicated to navigation, it is also the principal interface for several subsystems; refer to **Telematics Display Module**.

Navigation System Antenna

The navigation system antenna is a satellite GPS type that is common to all models and is mounted on the parcel shelf to optimize reception. A coaxial cable links the antenna module to the NCM and:

- provides 5V dc power from the NCM to the active receiver circuits of the antenna via the inner coaxial conductor;
- transfers incoming signals from the antenna to the NCM.

NOTE: Signal reception may be affected by the presence of: metal objects or foil, on or near the parcel shelf or rear glass; metallic screen-coatings on the rear glass.

Electrical

Cellular Phone

The cellular phone system comprises:

- Cellular phone control module.
- Cellular phone antenna.
- JaguarNet antenna (where applicable).
- JaguarNet (GPS) system antenna (where applicable)

- Cellular phone handset and cradle.
- Microphone.
- Steering wheel telematics controls.
- Audio unit.

NOTE: The user interface for the cellular phone is integral to the audio unit; refer to **Audio Unit** for details.

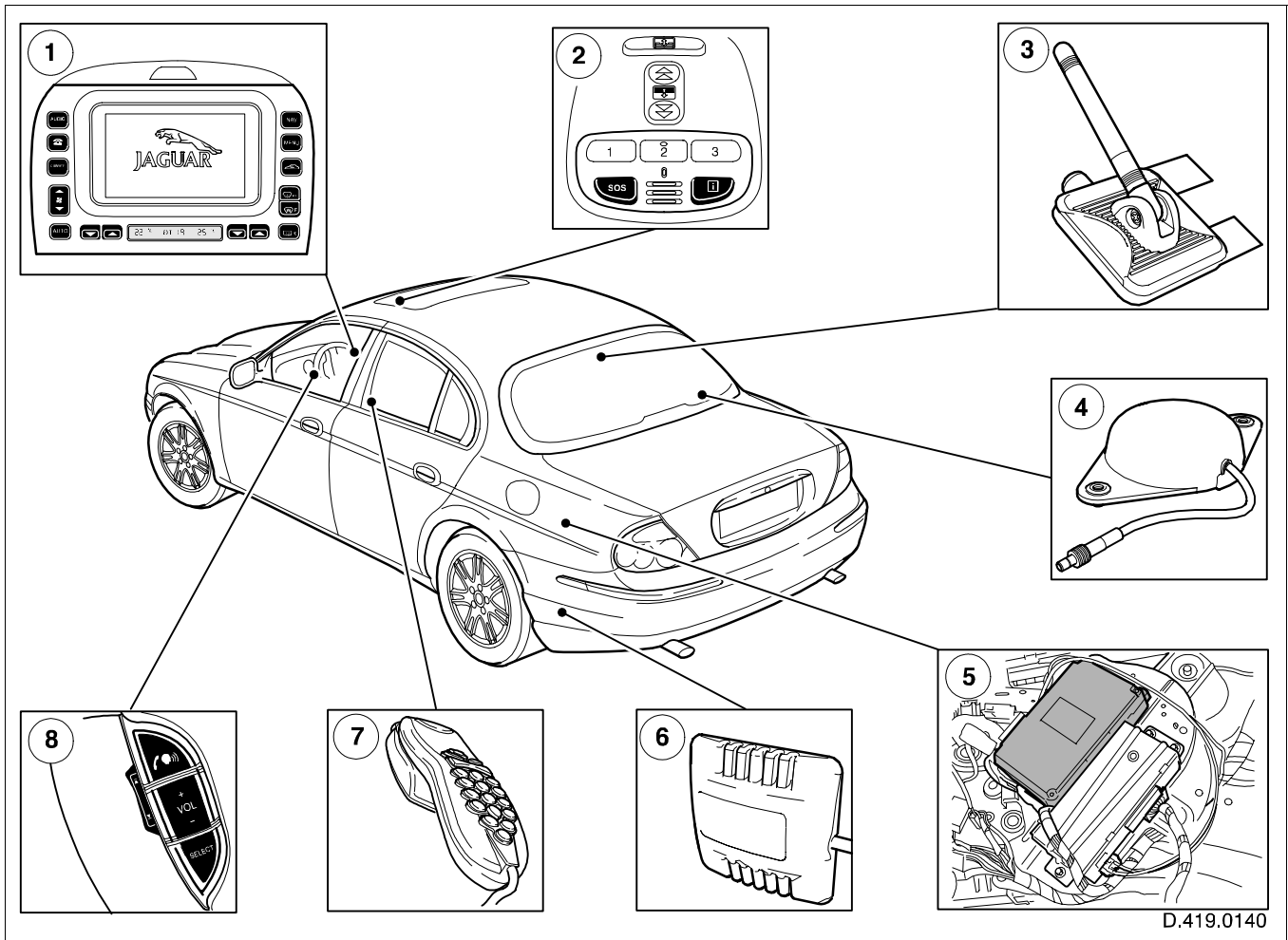


Fig. 112 Cellular phone system component location

1. Audio unit - telematics version
2. Microphone
3. JaguarNet antenna (option)
4. JaguarNet GPS antenna (option)
5. Cellular phone control module
6. Cellular phone antenna (not JaguarNet)
7. Cellular phone handset and cradle (GSM shown)
8. Steering wheel telematics controls

Cellular Phone Control Module

The CPCM is market dependent and:

- located in the luggage compartment to the left-hand side;
- mounted to the inside of a bracket that is shared with the voice activation control module (VACM);
- has one electrical connector, one optical connector;
- has one antenna connector (cellular phone only).

NOTE: Where JaguarNet is available, the module has an additional connector for the navigation (GPS) system antenna.

Steering Wheel Telematics Controls

To ensure minimum disruption to concentration when driving, limited control of audio, telephone and voice activation systems is possible using the steering wheel telematics controls.

The controls provide the following phone functionality:

- Answer phone call/end handsfree calls.
- Increase or decrease volume.
- Selection of phone ready mode.
- Cycle through phone memory.

JaguarNet

JaguarNet is available as an option in certain markets (but is not available as a dealer-installed accessory).

JaguarNet functions as a vehicle emergency messaging system, designed to automatically initiate an 'SOS' call when the air bags are deployed.

NOTE: This feature will only be initialized when the ignition key is at position II.

Pressing the appropriate button also permits quick access to emergency services, roadside assistance or local information. JaguarNet can be used wherever a cellular phone service is available and uses the Jaguar in-car phone installation to communicate with the Jaguar security response center.

NOTE: The Jaguar phone must be installed and working correctly.

In addition to the standard cellular phone system components, JaguarNet uses:

- GPS (global positioning system) antenna.
- Information / SOS buttons (part of roof console).

NOTE: JaguarNet uses an antenna that is integral to the rear window glass instead of the bumper-mounted antenna used by the standard cellular phone system.

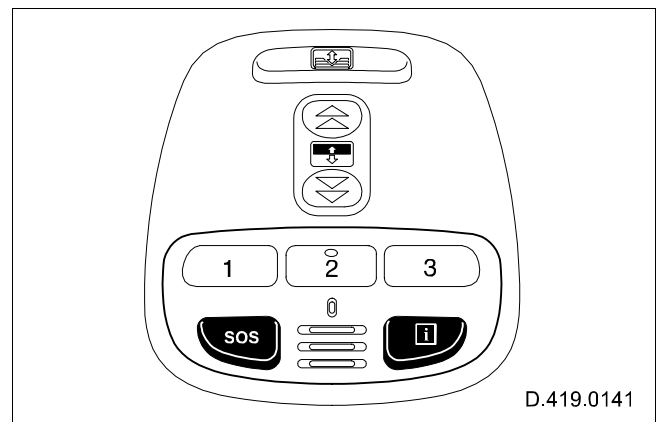


Fig. 113 SOS / Information buttons

Limitations of the system

WARNING: It is important that the customer fully understands the operation of the system before attempting to use it. Note the following summary of limitations:

- The system will only operate in areas with cellular phone coverage and when connection to the network is established. This can be affected by adverse weather conditions, geographical features or tall buildings.
- A roaming airtime agreement is required so that the system can be used in all areas.
- Loss of contact with the global positioning system (GPS) could result in an inaccurate vehicle position being sent to the response center.
- If the vehicle is involved in an accident, components could be damaged rendering the system inoperative.

Emergency assistance (SOS)

The emergency assistance feature allows rapid access to the emergency services (police, fire, or ambulance).

GPS is used to identify the position and direction of travel of the vehicle.

Data message

When contact with the response center is established, an electronic data message is automatically transmitted to the response center computer. This data message will include:

- Type of alarm (information, emergency or air bag deployed).
- Latitude and longitude coordinates.
- Vehicle position history.
- 'Time tag' identifying when last position was taken.

Information assistance (Info)

Information assistance may be used to request help, breakdown assistance or services from the response center operator. The list of services will depend upon facilities available to the response center operator, which may include information regarding local hotels, local petrol stations, shops and services and traffic information.

Operation of the system

NOTE: The ignition key must be turned to position '1'.

The system is operated from the controls on the audio unit or the overhead console buttons. While in use, the audio unit displays a sequence of messages and the red lamps in the overhead console buttons will flash to indicate activation.

NOTE: The phone handset will be switched off during an assistance call.

Call activation and termination

Operation will continue even if the ignition key is turned to position '0' during an activation.

NOTE: Once a call has been initiated, attempts to crank the engine may cancel the activation.

Making an emergency call (SOS)

Emergency assistance can be summoned by:

- Pressing and holding the 'SOS' button in the overhead console for 2 seconds or
- Touching and holding the 'SOS' button in the JaguarNet menu on the audio unit for 2 seconds.

A call to the response center is automatically sent using the Jaguar in-car phone.

The audio unit shows 'SOS REQUEST' and the red lamp in the SOS button starts to flash.

Operator contact

After the data message transmission has been completed, voice contact with an operator is established. The operator has the details of the vehicle available, including its present location. The operator verbally obtains details of the emergency and, if necessary, establishes a three-way phone call with Jaguar Roadside Assistance or other emergency service. The appropriate assistance will then be dispatched to the vehicle location.

Requesting Information

A call to the response centre is automatically sent using the Jaguar in-car phone by:

- Pressing and holding the 'i' button in the overhead console for 2 seconds or
- Touching and holding the 'Info' button on the JaguarNet menu on the audio unit for 2 seconds.

Terminating assistance calls

When the operator is satisfied that the situation has been dealt with, the call will be terminated and the red lamp in the SOS button will extinguish.

Terminating an information call

An information call may be terminated via the audio unit or by the response center.

On-screen messages

During an assistance call, various status messages are displayed on the audio unit, which enable the progress of the call to be followed.

While in contact with the response center, the vehicle location messages (LAT and LON) are displayed in sequence, except when the display of another message is required.

System self-test

The system will perform a self-test each time the ignition key is turned to position 'I'. This is indicated by the illumination of a red lamp in the Information button. The lamp will remain illuminated for the duration of the test. If the lamp does not extinguish within 10 seconds, a DTC will be recorded.

Cellular phone interface (JaguarNet USA only)

The cellular phone must be connected to the vehicle, and registered with a cellular network for the system to work. If the phone is in use when the system is activated (for example an air bag deployment) that call will be terminated and the response center will be called in the usual way.

When an activation is terminated, the phone is left unlocked, in the 'On' state, and may not return to its previous call restriction or system selection setting. It can be reprogrammed to the previous settings as desired. The phone user's manual provides further information.

Battery disconnection

If the battery has been disconnected, the vehicle location will be lost.

NOTE: On reconnection, it may take up to approximately 15 minutes to re-establish vehicle position.

Multifunction Electronic Control Modules

General Electronic Control Module

The general electronic control module (GECM) is located at the base of the left-hand side A-post.

There are five electrical connectors each with unique keyways.

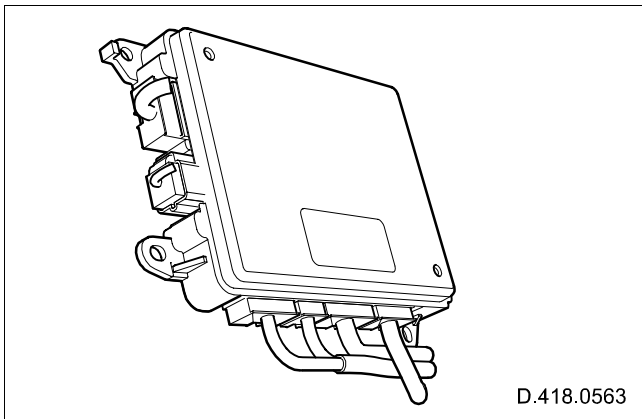


Fig. 114 General electronic control module

The GECM communicates via the SCP network, is configured for market options and where appropriate controls or provides an interface for the following major functions:

- Easy entry-easy exit lighting.
- Courtesy / demand lighting.
- Front exterior lighting.
- Adjustable pedals.
- Battery saver (interior lights).
- Turn signals and hazard warning lamps.
- Fluid and pressure metrics (low washer fluid, low oil pressure).
- Memory functions.
- Day-time running lamps.
- Security; refer to **Anti-Theft**.
- VAPS solenoid; refer to **Steering System**.

NOTE: The vehicle speed signal (received from the instrument cluster via SCP) is compared to VAPS curves (stored in the memory of the GECM) and an appropriate predetermined signal is output to the VAPS solenoid.

Rear Electronic Control Module

The rear electronic control module (RECM) is located to the right-hand side of the luggage compartment, behind a trim panel.

The RECM communicates via the SCP network, is configured for market options and where appropriate controls or provides an interface for the following major functions:

- Inertia switch operation (disables fuel pump driver and triggers door unlock command).
- Fuel pump driver circuit and fuel level indication.
- Exterior rear lamps, park, fog, stop, turn, hazard, reversing lamps.
- Heated rear window.
- Luggage compartment lid release.
- Trailer functionality
- Electrochromic mirror operation (reverse).
- Security; refer to **Anti-Theft**.

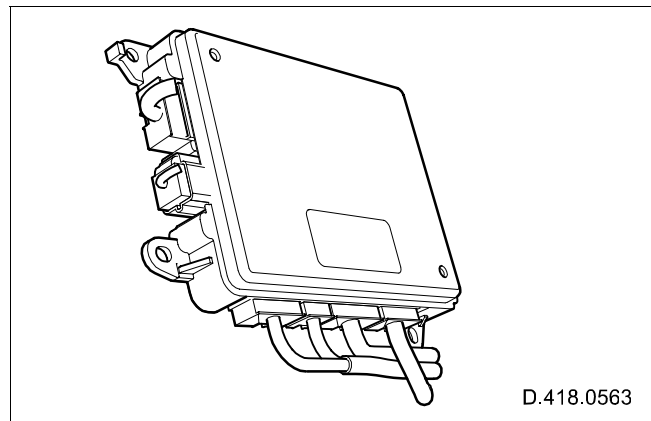


Fig. 115 Rear electronic control module

Driver Door Control Module

The driver door control module (DDCM) is matched to the operating frequency of the appropriate market and located in the driver's door.

The DDCM communicates via the SCP network, is configured for market options and where appropriate controls or provides an interface for the following functions:

- RF decoder for remote keyless entry.
- Personality configurations 1 and 2 linked to memory feature.
- Power windows.
- Driver mirror.
- Exterior mirror movement
- Power locks/automatic door locks
- Easy entry/exit
- Horn chirp

NOTE: A remote keyless module is installed for certain markets.

Rear View Mirrors

Interior

Electrochromic Mirror

The electrochromic mirror (where installed) is designed to reduce the glare from a following vehicle's headlamps using an integral, variable, auto-dimming feature (when selected). The mirror comprises a :

- forward-facing sensor;
- rearward-facing sensor;
- 'AUTO' button for enabling the auto-dimming feature;
- 'OFF' button for disabling the auto-dimming feature.

The mirror is manufactured using an electronically-controlled reflective surface (electrochromic). When the auto-dimming feature is enabled, the mirror utilizes both the forward and rear-facing sensors to determine if the auto-dimming feature should be activated and if the feature is activated, by how much it dims. For example, based on the difference between the amount of light entering the two sensors, the main beam headlamps from a closely following vehicle at night, will cause the reflective surface to fully darken (to approximately 15% reflectivity), while a daylight running vehicle in dull day conditions may only slightly darken the reflective surface. If the conditions in front of the vehicle are brighter or equal to the conditions behind the vehicle, the mirror's reflective surface will not darken. The reflective surface always clears to maximum reflectivity when reverse gear is selected.

NOTE: An accumulation of dust/dirt on the mirror sensors, will affect the functionality of the feature.

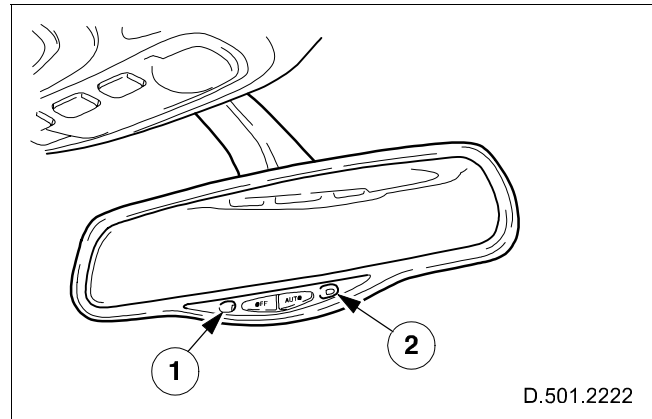


Fig. 116 Electrochromic mirror

1. Rear-facing, auto-dimming sensor
2. LED - Auto-dimming feature on/off

Electrochromic door mirrors (where installed) function in the same manner as the interior mirror and are controlled by the same buttons; refer to **S-TYPE Electrical Guide** for detailed connection information.

Manual-dip mirror

The mirror is mounted on an adjustable arm to provide a wider choice of height and lateral positions.

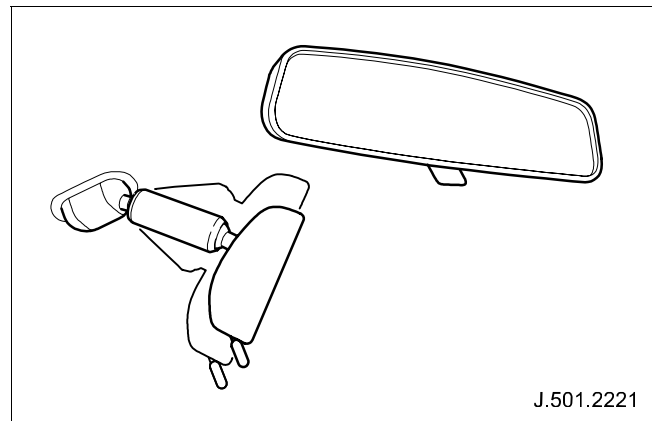


Fig. 117 Manual-dip mirror

Seating

Front Seats

WARNING: Prior to seat removal and before disconnecting the seat harness (which includes air-bag connectors), the vehicle battery should be disconnected and a period of at least one minute allowed to elapse. The same amount of care should be taken when handling and storing these seats, as would be taken when handling and storing vehicle air bags in isolation.

NOTE: Refer to JTIS for detailed Removal and Installation instructions.

All front seats are fitted with the following features as standard:

- Integral side air bags; refer to **Occupant Safety, Air Bag Modules**.
- Head restraints.
- Safety belt buckle/pretensioner; refer to **Occupant Safety, Safety Belts**.
- Anti-whiplash mechanism; refer to **Occupant Safety, Anti-whiplash System**.

The driver and passenger seats, although almost identical, have some unique components fitted: the driver's seat has a seat-track position sensor and the passenger's seat has a weight-sensing system. In both instances the components form an integral part of the occupant safety system; refer to **Occupant Safety, Sensors**.

NOTE: Individual components of the passenger seat weight-sensing system, which includes the seat cushion, are not serviceable and must be replaced as a complete cushion-unit; refer to JTIS.

Power Front Seat

The front seats are electrically adjustable and can be fitted with heated cushions, heated backrests and an electrically adjustable lumbar support where specified. In addition to the standard features, depending upon the market and vehicle specification, the following options may be available as an upgrade package:

- Electrically adjustable head restraint.
- Electrically extendible seat cushion.
- Four-position lumbar support.



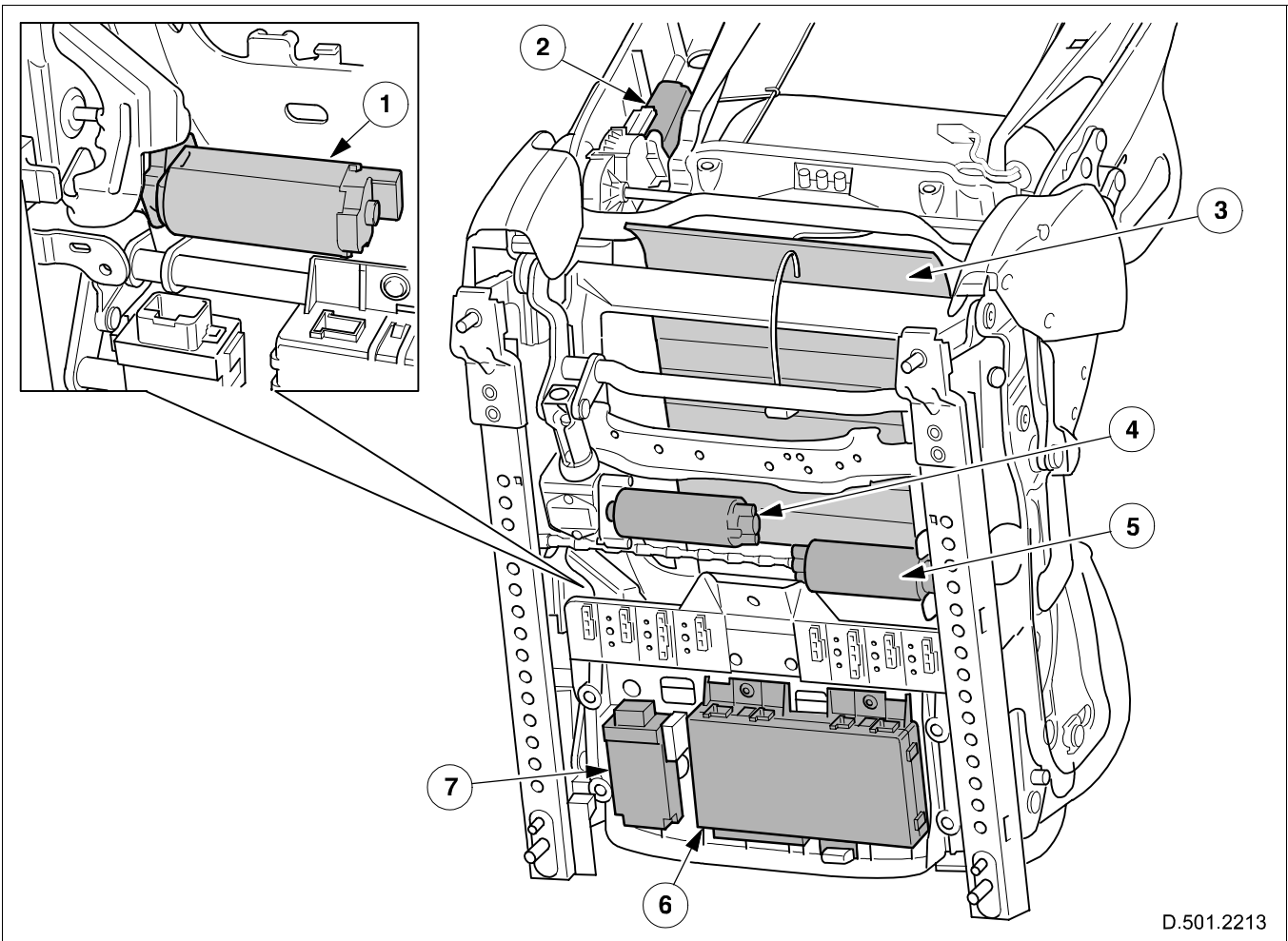
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Fig. 118 Power front seat (LHD)

Driver seat control module

The driver seat control module (DSCM) is located under the driver seat. In addition to supporting current seat functionality and controlling seat position for personality configurations 1 and 2, the DSCM supports (where applicable) the extra functionality required for the electrically-operated head restraint and the extendible seat-cushion; refer to **S-TYPE Electrical Guide** for detailed connection information.

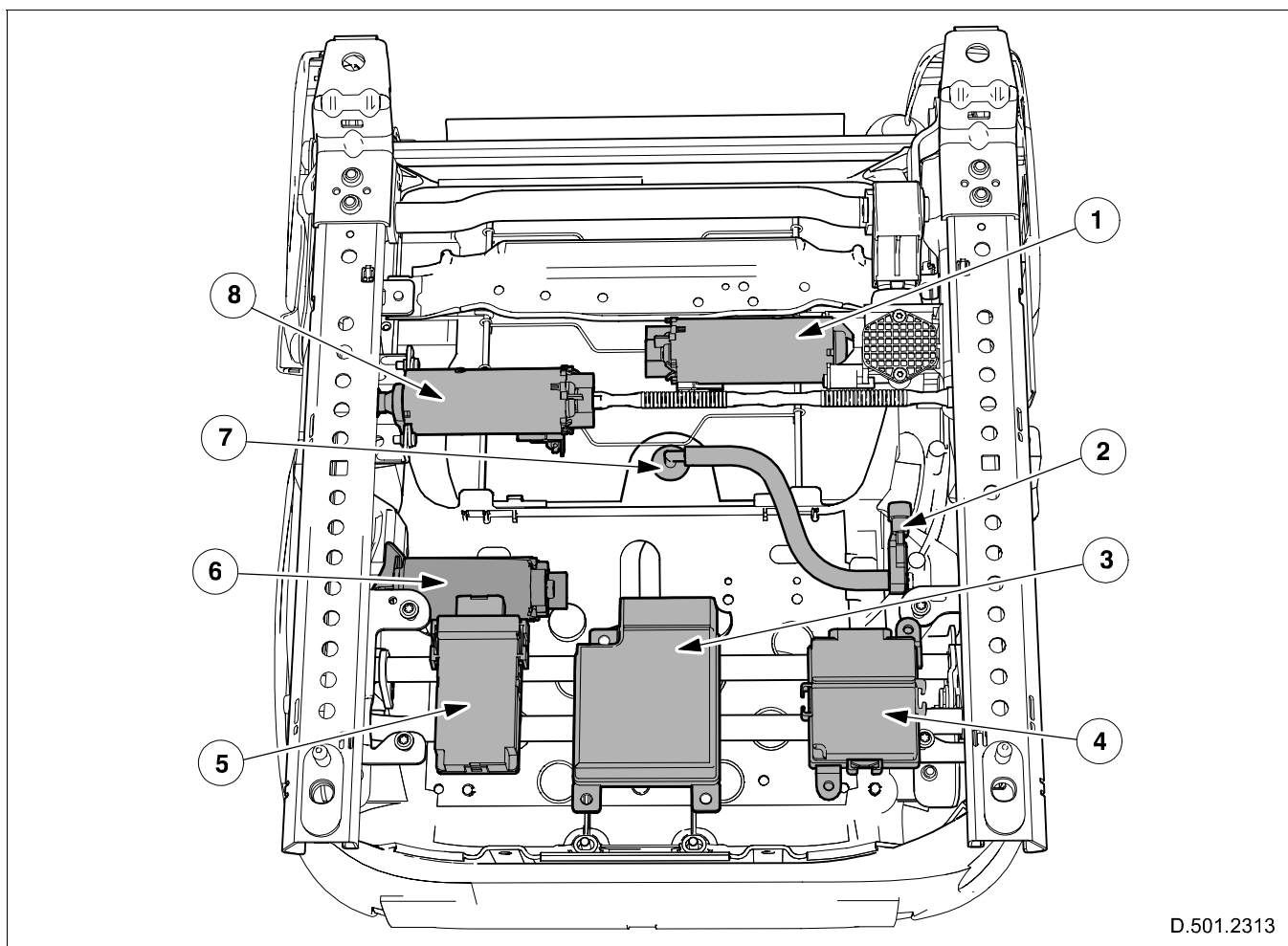
NOTE: Lumbar positions cannot be saved using the memory feature.



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Fig. 119 Driver power-seat - component locations

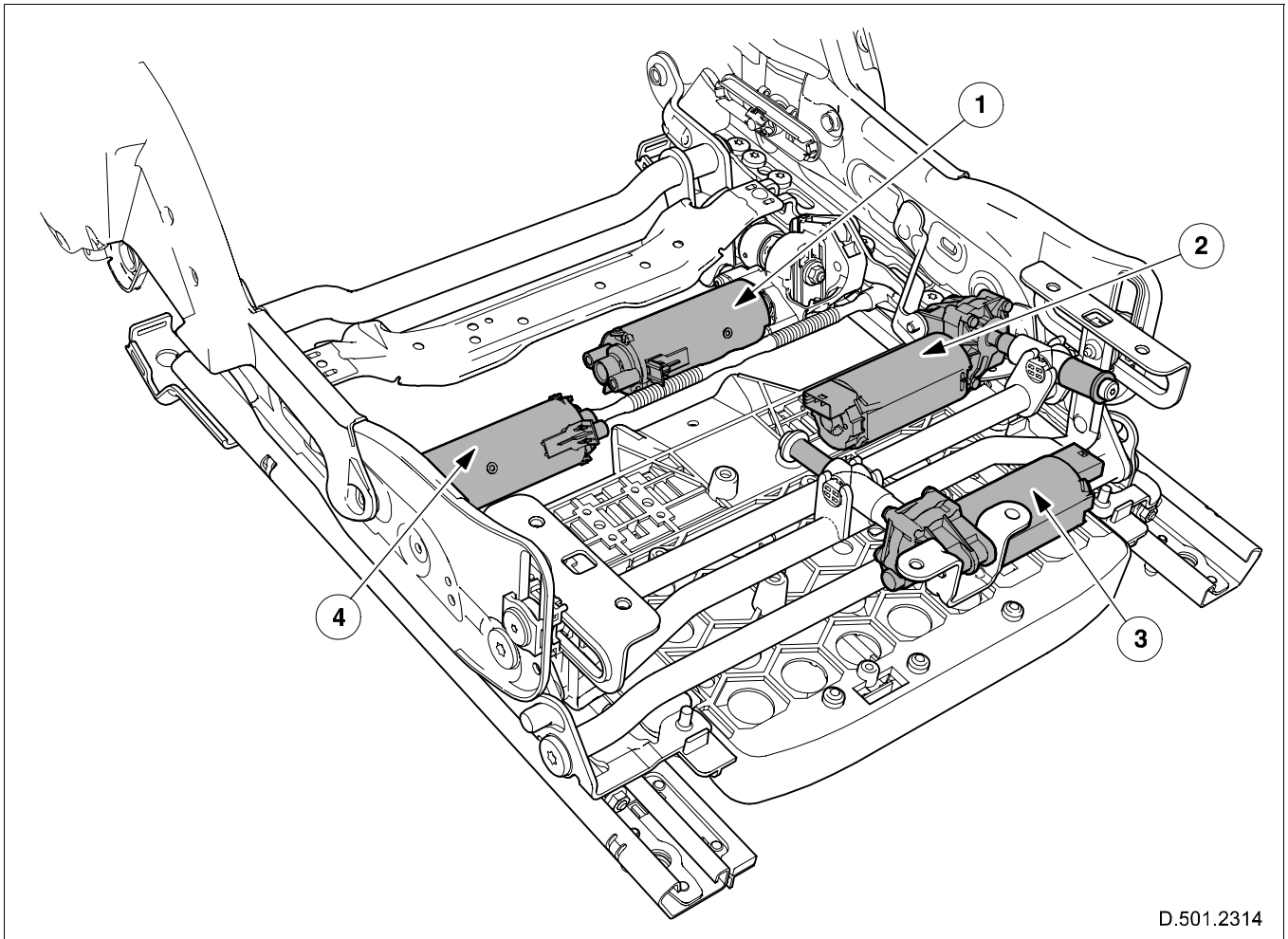
- | | |
|----------------------------------|-------------------------------|
| 1. Rake adjustment motor (front) | 5. Fore/aft adjustment motor |
| 2. Recline adjustment motor | 6. Driver seat control module |
| 3. Seat cushion heater | 7. Heated seat module |
| 4. Height-adjustment motor | |



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Fig. 120 Passenger power-seat - component locations (mounting tray removed)

- | | |
|-------------------------------|---------------------------------------|
| 1. Height-adjustment motor | 5. Heated seat module |
| 2. Pressure sensor | 6. Rake adjustment motor (front) |
| 3. Occupancy sensing module | 7. Silicon bladder connector and pipe |
| 4. Seat weight-sensing module | 8. Fore/aft adjustment motor |



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Fig. 121 Power seat with extendible cushion

1. Height-adjustment motor
2. Rake adjustment motor (front)
3. Cushion-extend motor
4. Fore/aft adjustment motor

Electrically-operated head restraint

The electrically-operated head restraint (where applicable) is occupant-controlled from the seat-mounted switch. The driver seat control module (DSCM) responds to the switch position chosen, by providing an output to the respective drive motor; refer to **S-TYPE Electrical Guide** for detailed connection information.

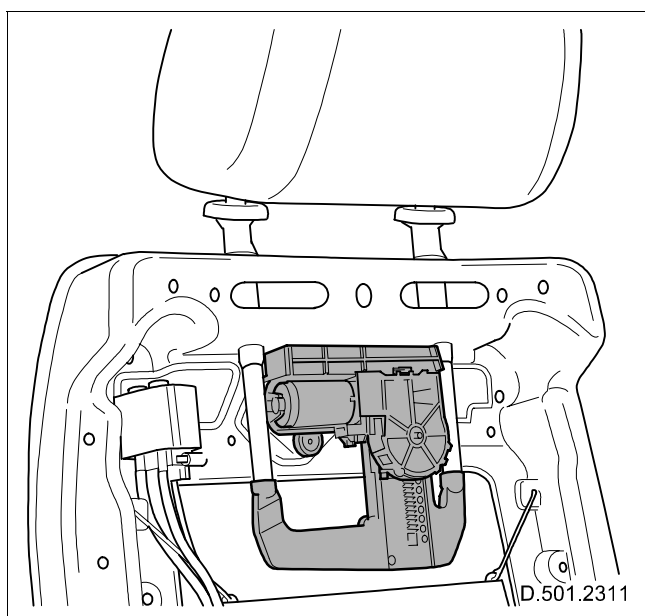


Fig. 122 Electrically operated head restraint

Power lumbar

The 4-position version of the power lumbar (where installed) comprises a single motor-driven pump, which inflates or deflates air cells as required to provide upper and lower lumbar support. The degree of support is determined by the operation of the seat-mounted switch. Depending on the switch-direction chosen, one of four solenoids housed within the solenoid pack is connected to the pump, which provides lumbar support by adjusting the amount of air in the appropriate cell. Vehicles fitted with the basic power-lumbar, utilize the lower air-cell only and do not need the solenoid pack; refer to **S-TYPE Electrical Guide** for detailed connection information.

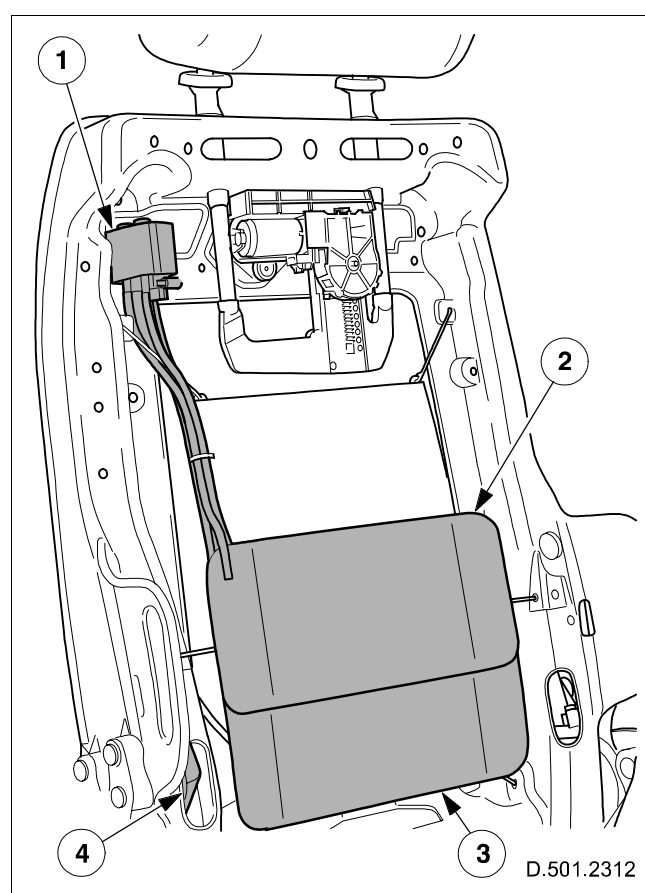


Fig. 123 Power lumbar - 4-position version

1. Solenoid pack
2. Upper air-cell
3. Lower air-cell
4. Motor-driven pump

Heated Seats

The heated seat system comprises:

- Heated seat switches.
- Heated seat module.
- Backrest heater element
- Cushion heater element and thermostat

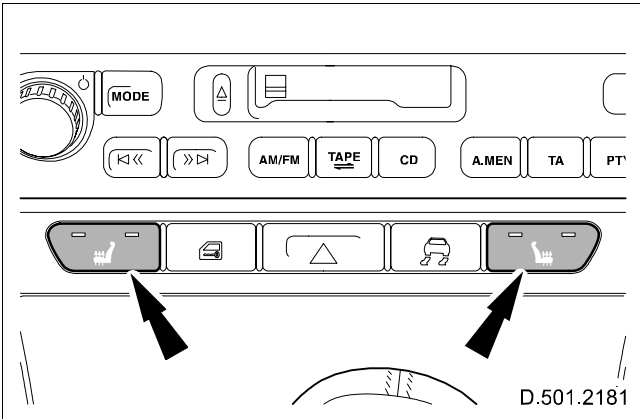


Fig. 124 Heated seat switches

The heated seat function (when selected) permits the electrical heating of the backrest and cushion on the driver and front passenger seats. The heating system for each seat is selected by separate switches located in the center console.

Pressing the appropriate switch facilitates the three stage operation of the heated seat function:

- One press of the switch activates the high setting (providing a seat surface temperature of approximately 42°C).
- A second press of the switch activates the low setting (providing a seat surface temperature of approximately 37°C).
- A third press of the switch deactivates the heating function.

Once the heated seat function has been activated, it will persist until one of the following conditions have been satisfied:

- A fixed period of time has expired (10 minutes)
- The function is deactivated by pressing the switch for a third time.
- The ignition key is not at position II.
- A malfunction is detected by the heated seat module.

Confirmation that the heated seat function is active is provided by the illumination of the relevant switch:

- a single red light indicates the low temperature setting;
- both red lights indicates the high temperature setting.

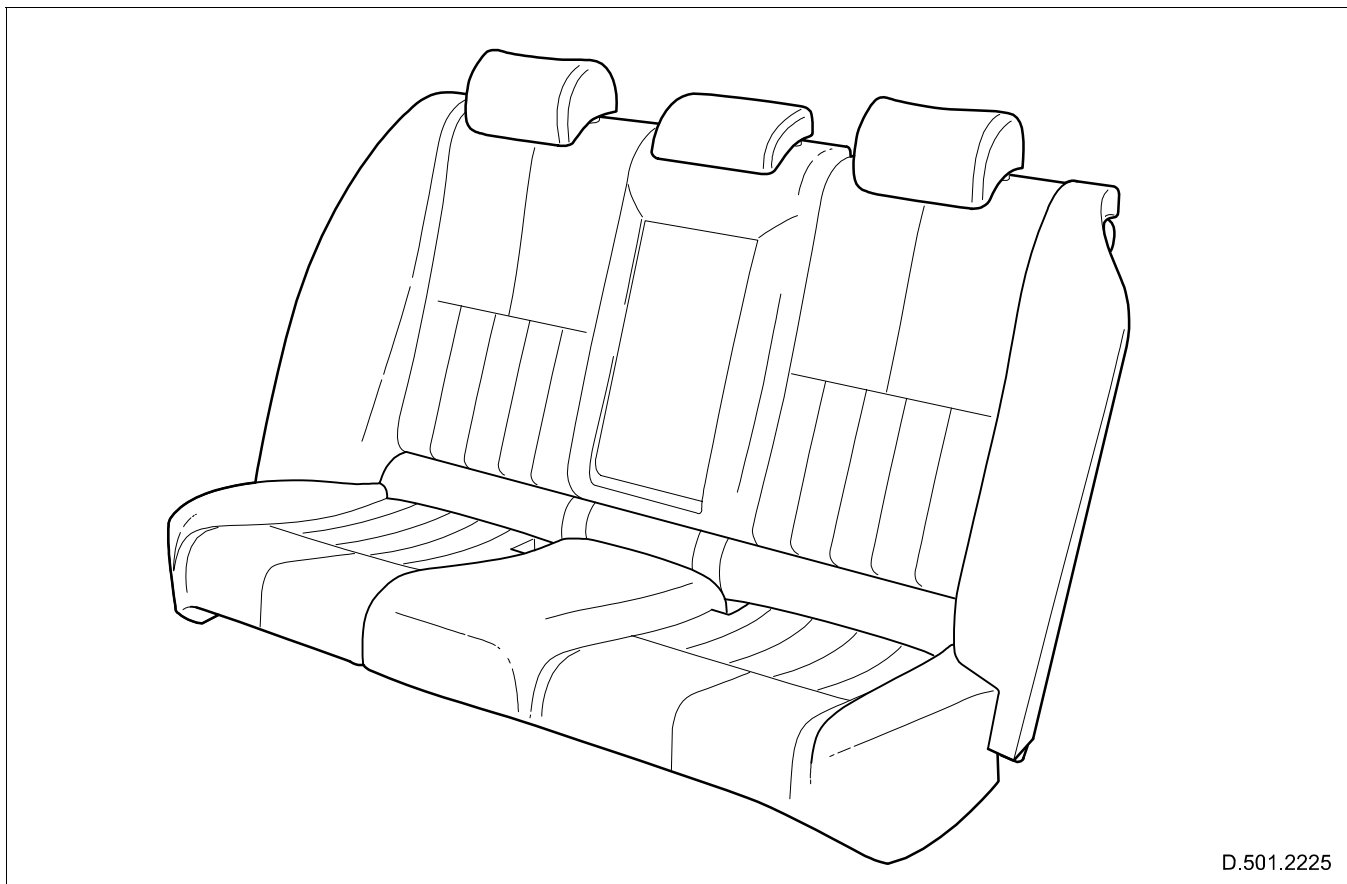
NOTE: The seat heaters are designed to operate at temperatures below a predetermined limit and therefore operation may be inhibited due to: storing the vehicle in a heated garage, body heat or warm ambient temperatures.

Heated seat module

The module is located under the front edge of seat and controls the seat heating function by providing the appropriate response depending on the status of the heated seat switches; refer to **S-TYPE Electrical Guide** for detailed connection information.

Rear Seats

Depending on market and vehicle specification, the rear seats will be fixed or split (66/34).



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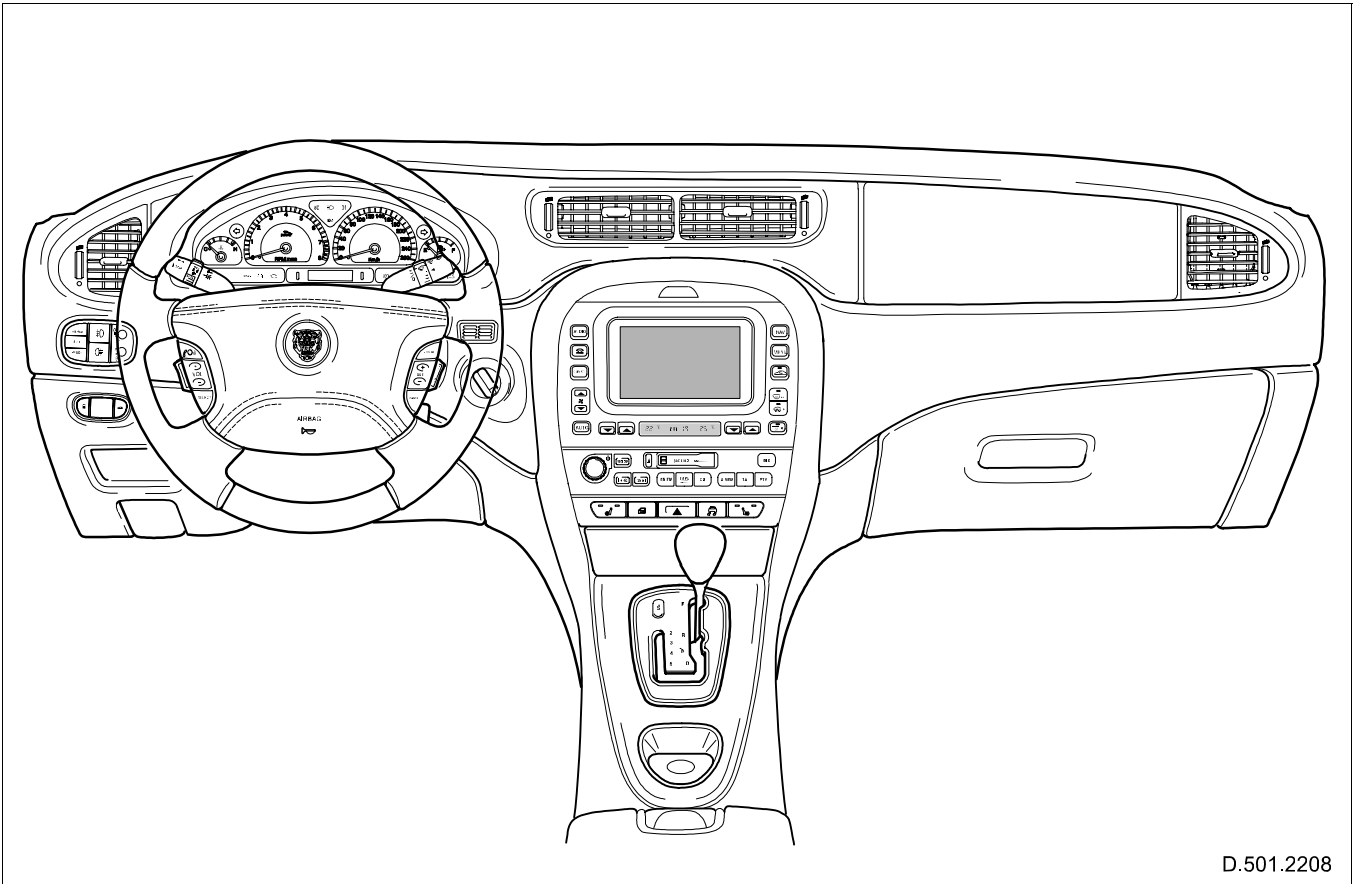
Fig. 125 Rear seats

NOTE: Fixed seats are secured by utilizing the same release and latching mechanism as fold-down seats. The release mechanism is concealed behind the luggage compartment carpet close to the hinges; refer to **JTIS** for detailed Removal and Installation instructions.

Instrument Panel and Console

Instrument Panel

The instrument panel is a new assembly built around a magnesium cross-car beam. The magnesium casting provides benefits in terms of both weight and accuracy of alignment.



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Fig. 126 Instrument panel

The following components are fitted to, or installed within the instrument panel:

- instrument cluster;
- passenger air bag module;
- glove compartment;
- air distribution registers;
- air distribution ducting;
- auxiliary lighting switch;
- in-vehicle temperature sensor;
- sunload/autolamp sensor;
- ignition switch;
- driver's stowage compartment;
- remote climate control module (only applicable to vehicles fitted with telematics display module);
- driver's knee-bolster;
- hood release-lever;
- driver's switch assembly (fuel filler-flap / luggage compartment lid release);
- valet switch (located within the glove compartment, when installed).

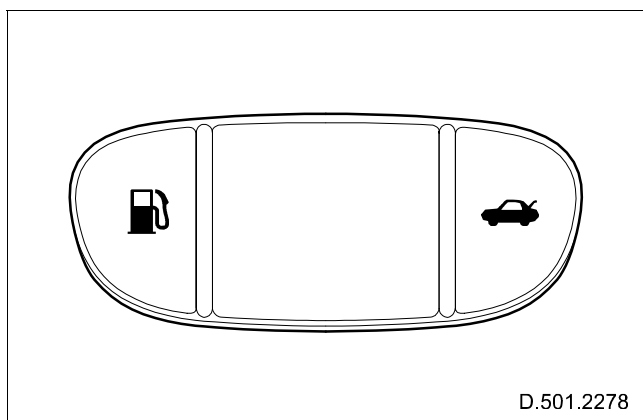


Fig. 127 Fuel filler-flap/luggage compartment lid release

The center console of the instrument panel houses the following:

- climate control panel / module or telematics display module; refer to **Climate Control System**;
- audio unit; refer to **Entertainment Systems**;
- occupancy sensor (one of four); refer to **Occupancy Sensors**;
- center console switch assembly (heated-seat switches, global-close switch, hazard warning switch, dynamic stability control switch).

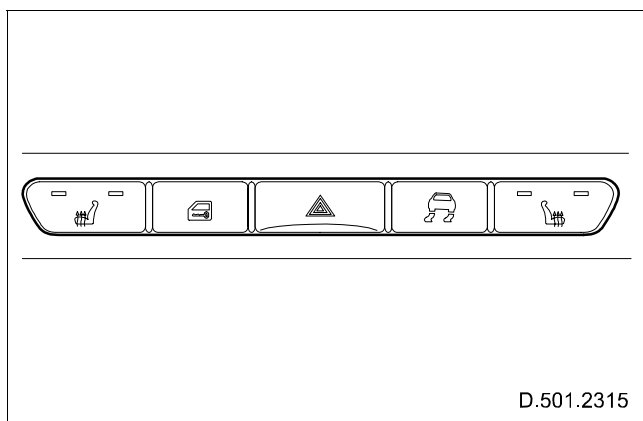


Fig. 128 Center console switch assembly

Floor Console

The floor console, depending upon vehicle specification, consists of the ashtray, cigar lighter and sliding armrest. The center section of the console carries a stowage box complete with integral accessory power-socket and a clip-in secondary cup holder. The cellular phone (where installed) is located on the underside of the armrest.

NOTE: The j-gate casting is made from magnesium and secured to the cross-car beam to minimize variation between the instrument cluster and the floor console.

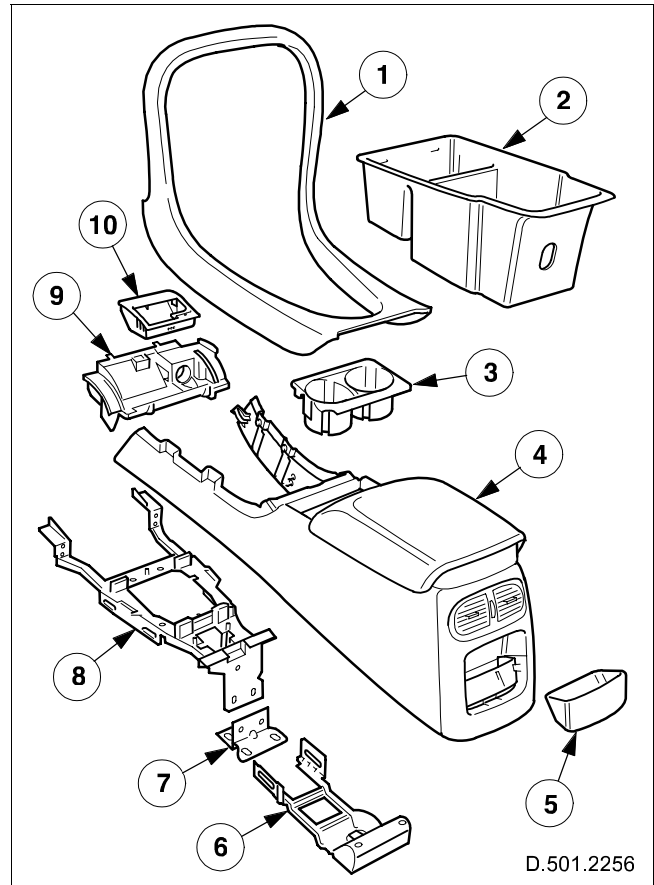


Fig. 129 Floor console assembly

1. Hoop
2. Stowage box
3. Cupholder
4. Armrest
5. Trinket tray
6. Rear bracket
7. Yaw rate sensor bracket
8. J-gate casting
9. Ashtray
10. Ashcan

Overhead Console

The roof console, depending on market and vehicle specification, incorporates the following:

- sunblind switch;
- courtesy lamp;
- reading/map lamps;
- remote convenience buttons (garage door opener);
- roof opening panel switch;
- emergency messaging buttons;
- microphone;
- intrusion sensors;
- mood lamp.

All switches have back-light illumination and tell-tale lamps where applicable. The console has an integral sunglasses bin with sprung and damped opening.

The mood lamp provides 'soft' illumination of the floor console and cup-holder area. The lamp is part of the back-light illumination circuit and therefore illuminates in synchronization with the side lamps. The level of back-lighting is determined by the dimmer control mounted within the auxiliary lighting switch; refer to **Auxiliary Lighting Switch**.

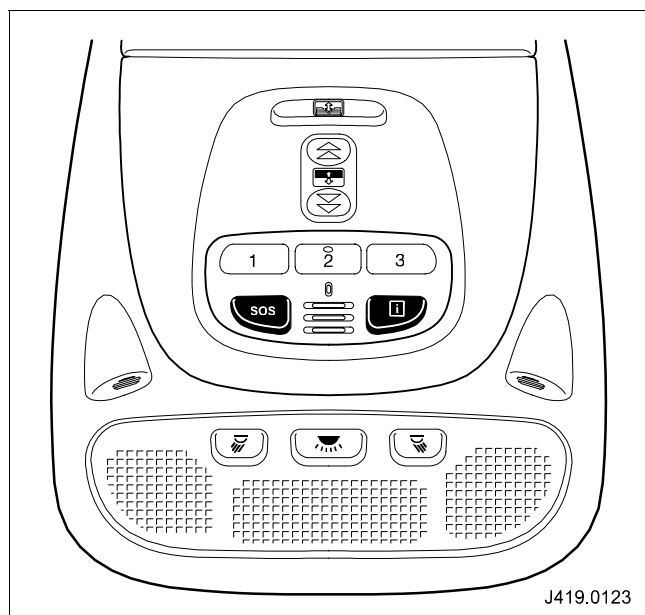


Fig. 130 Overhead console

The remote convenience transceiver, (where fitted), can be programmed to transmit up to three different radio frequencies, to activate garage doors, gates, home lighting, security systems or other radio frequency operated equipment.

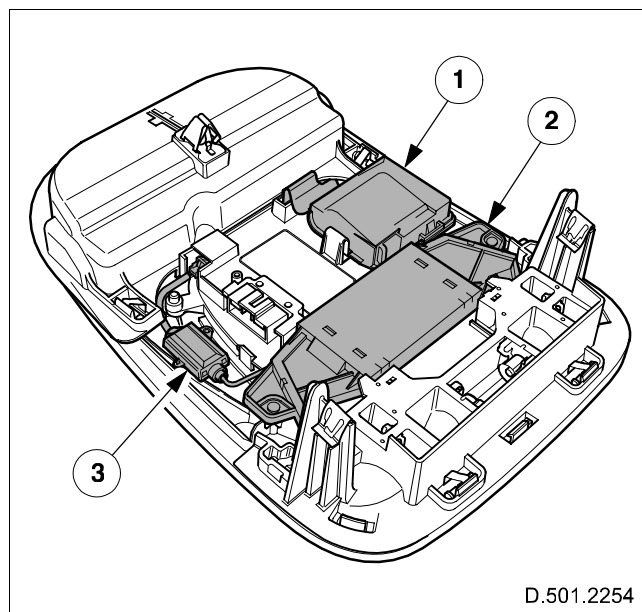


Fig. 131 Overhead console components

1. Remote convenience transceiver (garage door opener)
2. Intrusion sensors
3. Microphone amplifier

NOTE: Principal components of the overhead console are 'heat-staked' for robustness and consequently cannot be serviced separately; refer to **JTIS** for details.

Advanced Restraints System

Introduction

New technologies have permitted the development of an 'Advanced Restraint System' that provides an improved overall level of crash protection for vehicle occupants. The system analyzes the occupancy scenario and crash severity before activating the appropriate safety devices to help better protect a range of occupants in a variety of crash situations. Benefits of the new system include:

- Optimization of the deployment restraint devices and the reduction in potential for air bag induced injuries.
- The significant reduction in passenger air bag deployments (particularly when passenger seats are unoccupied) and a general reduction in all air bag deployments.

Some typical passenger position scenarios are illustrated in Fig. 132.

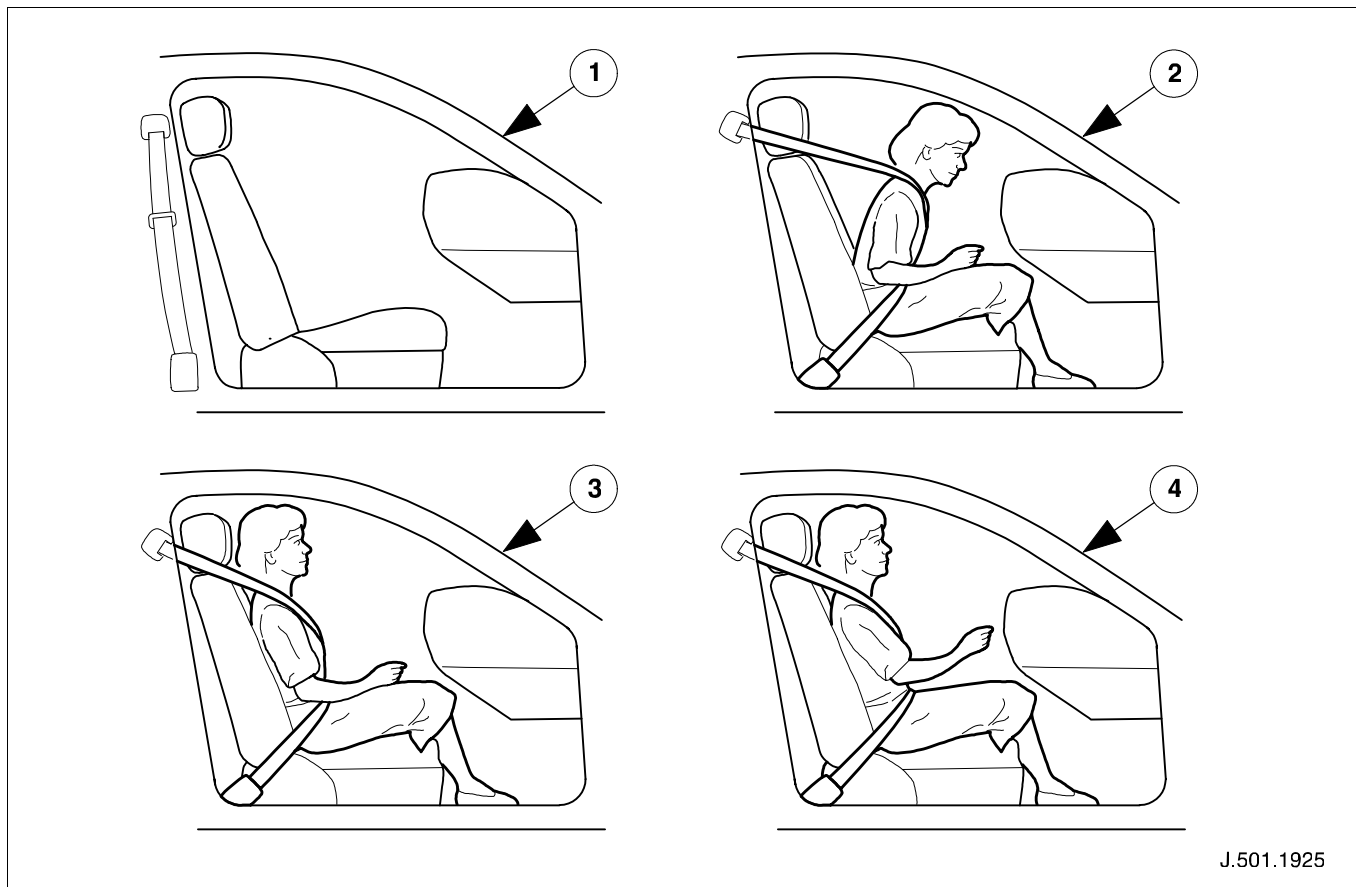


Fig. 132 Basic occupancy scenarios (passenger side)

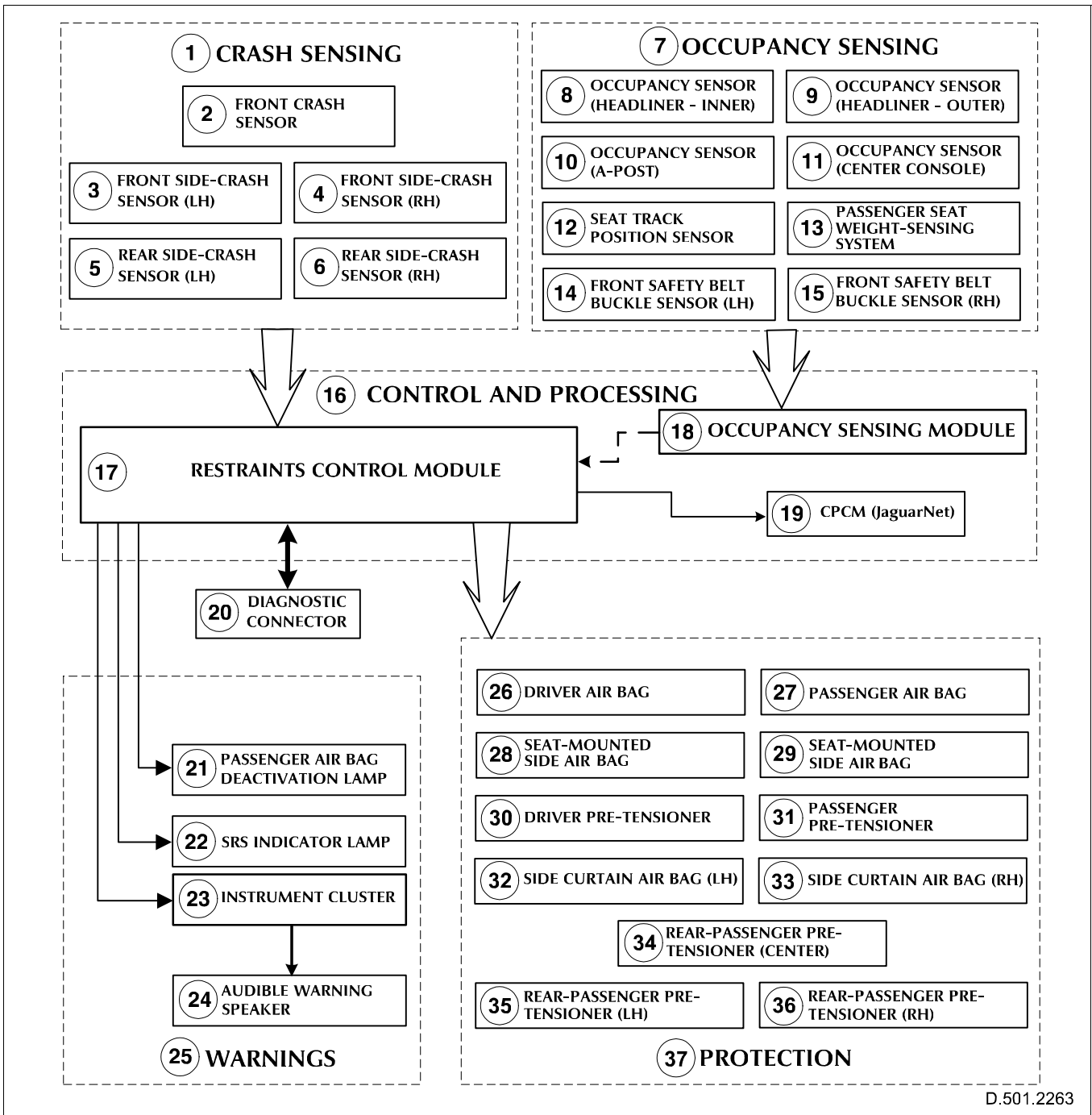
1. Empty seat - No deploy
2. Out of position- No deploy
3. In position- Deploy
4. Extremities - No effect on deployment decision

In order to support the advanced restraint system requirements, a restraint control architecture has been introduced comprising the following systems or components:

- Passenger occupancy-sensing system
- All-electronic crash sensing with including frontal crash severity sensing and advanced restraints management.
- Driver air bag with twin stage inflator.
- Passenger air bag with twin stage inflator.
- Child seat lower ISOfix anchors for rear seats.
- Safety belt system including: front belt use detection, load limiting retractors and pre-tensioners.
- Rear safety belts with pre-tensioners.
- Front seats including: driver seat-track position sensor and passenger seat weight-sensing system.
- Lower steering column.
- Front seat-mounted side air bags.
- Side-curtain air bags.

The systems diagram **Fig. 133** provides an indication of how the electrical component parts interact with each other; refer to **S-TYPE Electrical Guide** for detailed information.

Occupant Safety



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Fig. 133 Advanced restraints system diagram

Key to Fig. 133

1. Crash sensing
2. Front crash sensor
3. Front side-crash sensor (LH)
4. Front side-crash sensor (RH)
5. Rear side-crash sensor (LH)
6. Rear side-crash sensor (RH)
7. Occupancy sensing
8. Occupancy sensor (headliner - inner)
9. Occupancy sensor (headliner - outer)
10. Occupancy sensor (headliner - A-post)
11. Occupancy sensor (center console)
12. Seat-track position sensor
13. Passenger seat weight-sensing system
14. Front safety belt buckle sensor (LH)
15. Front safety belt buckle sensor (RH)
16. Control and processing
17. Restraints control module
18. Occupancy sensing module
19. CPCM (JaguarNet)
20. Diagnostic connector
21. Passenger air bag deactivation lamp
22. SRS indicator lamp
23. Instrument cluster
24. Audible warning speaker
25. Warnings
26. Driver air bag
27. Passenger air bag
28. Seat-mounted side air bag
29. Seat-mounted side air bag
30. Driver pre-tensioner
31. Passenger pre-tensioner
32. Side-curtain air bag (LH)
33. Side-curtain air bag (RH)
34. Rear passenger pre-tensioner (center)
35. Rear passenger pre-tensioner (LH)
36. Rear passenger pre-tensioner (RH)
37. Protection

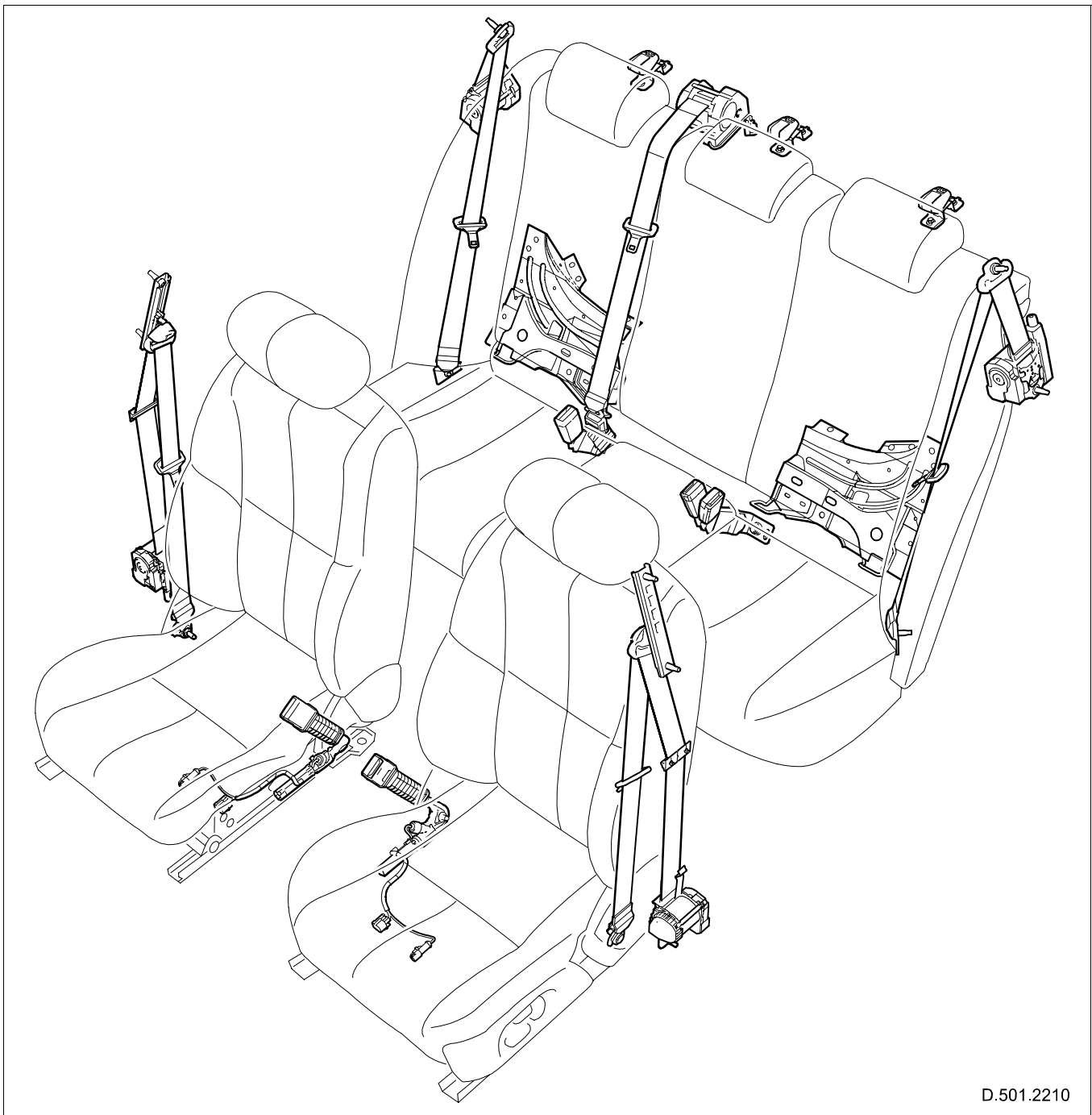
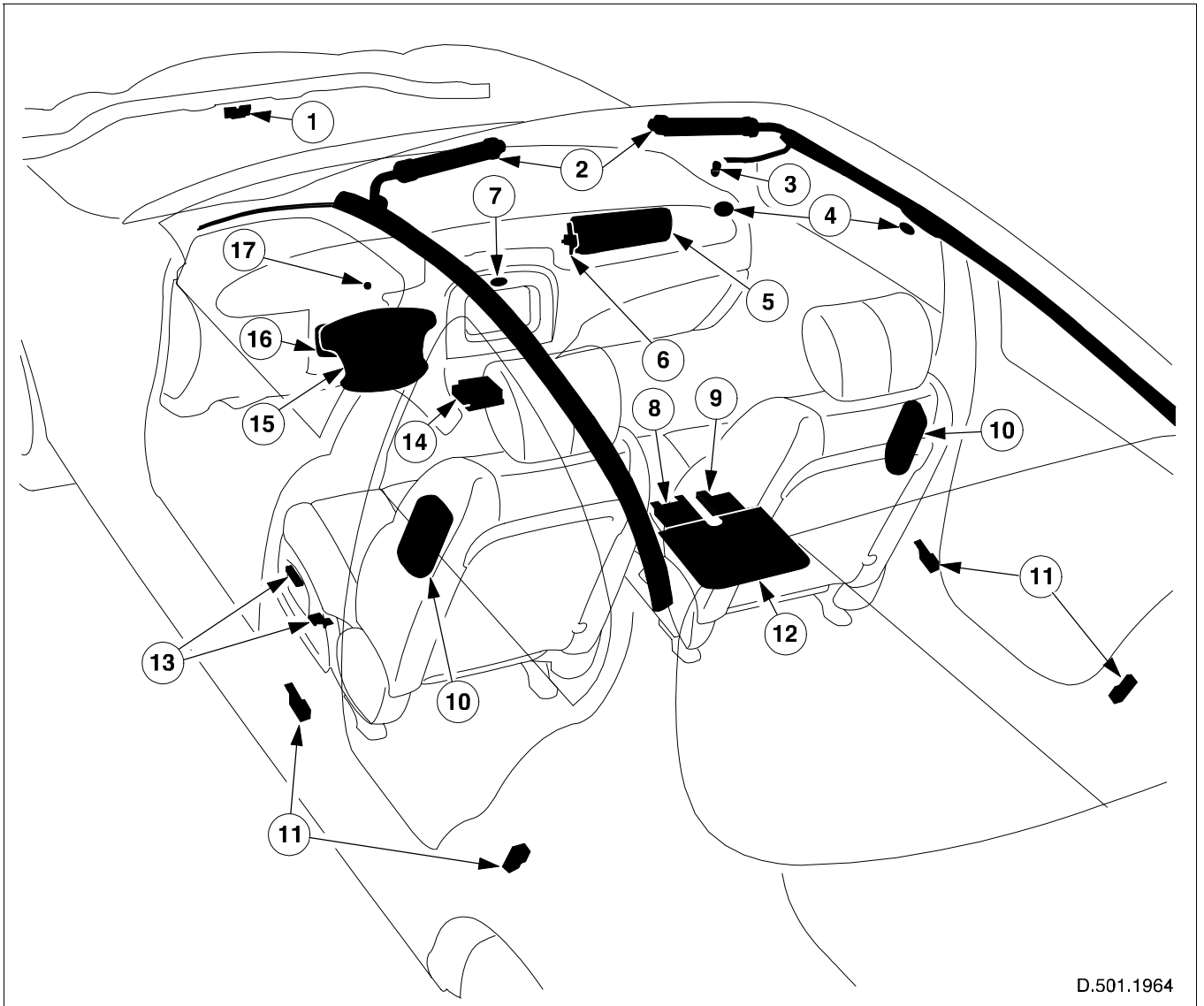


Fig. 134 Occupant restraints - location of active components



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Fig. 135 Occupant restraints - location of passive components

- | | |
|--|---|
| 1. Front crash sensor | 10. Seat-mounted side air bag module |
| 2. Side-curtain air bag | 11. Side-crash sensor |
| 3. Occupancy sensor - A-post | 12. Passenger seat weight-sensing bladder |
| 4. Occupancy sensors - headlining | 13. Seat-track position sensor |
| 5. Passenger air bag module | 14. Restraint control module |
| 6. Passenger air bag deactivation indicator lamp | 15. Driver air bag module |
| 7. Occupancy sensor - center console | 16. Clockspring |
| 8. Occupancy sensing module | 17. SRS indicator lamp |
| 9. Passenger seat weight-sensing module | |

Occupant Safety

Sensors

WARNING: Before commencing work on any part of the restraint system, the vehicle battery should be disconnected and a period of at least one minute allowed to elapse.

- The sensors do not contain any serviceable parts.
- Serial numbers of new parts should be logged against VIN for traceability.

Front Crash Scenario

The restraints control module (RCM), controls air bag deployment decisions by using signals from its internal accelerometer and the following sensors:

- Front crash sensor.
- Seat-track position sensor.
- Safety belt buckle sensor.
- Passenger seat weight-sensing system.
- Occupancy sensors.

Front Crash Sensor

The front crash sensor:

- is mounted on a bracket which is located in the center of the upper mounting crossmember;
- collects acceleration data from the front of the vehicle and sends it back to the RCM as an analogue signal;
- provides the main source of data that enables the RCM to gauge the severity of a frontal impact.

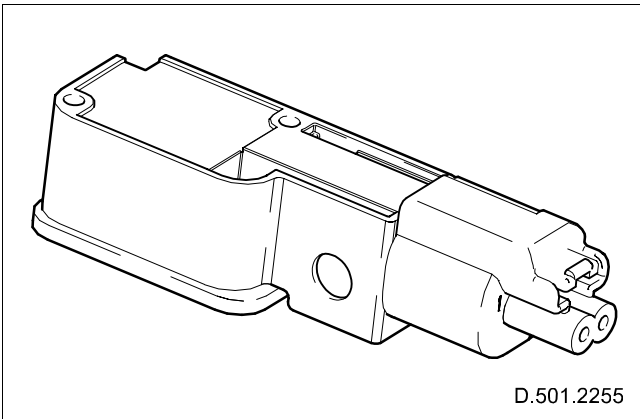


Fig. 136 Front crash sensor

Seat-track Position Sensor

The seat-track position sensor, a 'Hall effect' type, is fitted to the underside of the driver's seat. The sensor is actuated by the magnet that is attached to the seat slide; refer to **Fig. 137**. The magnetic field disturbance caused, when the magnet passes the sensor, creates an output signal for the RCM. On receipt of this signal, which indicates when the seat is forward of a defined point in its travel, the RCM disables the second stage output of the driver air bag. Malfunction of the sensor or associated circuits will cause the SRS indicator lamp to illuminate. Diagnosis must be undertaken using WDS.

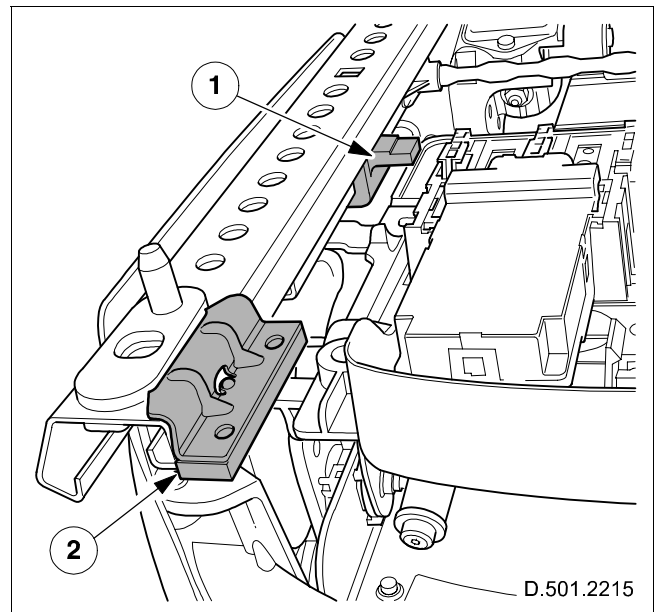


Fig. 137 Seat-track position sensor

1. Hall effect sensor
2. Magnet

Safety Belt Buckle Sensor

The safety belt buckle sensor is a 'Hall effect' type, which provides an output signal in response to the magnetic field disturbance caused by the insertion of the safety-belt tongue into the buckle. The output signal from the sensor is used by the RCM to determine whether the front seat occupants are correctly restrained. Malfunction of the sensor or associated circuits will cause the SRS indicator lamp to illuminate. Diagnosis should be undertaken using WDS.

The Hall effect sensor is used in conjunction with the other components of the advanced restraint system to ensure that air bag and safety belt deployment only occurs where necessary.

Passenger Seat Weight-Sensing System

NOTE: The seat weight-sensing system does not comprise any serviceable items.

The following components are combined and calibrated during manufacture to form the seat weight-sensing system:

- Passenger seat cushion.
- Silicone-filled bladder (integrated into the passenger seat cushion).
- Seat weight-sensing module (mounted under the seat).
- Pressure sensor (attached to the bladder and mounted under the seat).

The silicone-filled bladder responds to weight changes on the passenger seat. The pressure sensor responds to these pressure changes and provides an appropriate signal to the seat weight-sensing module. The seat weight-sensing module, processes the input signal received from the pressure sensor and makes it available to the restraints control module

(RCM) via the local CAN. In addition, the module performs self-diagnostic functions on the system, with any malfunctions being notified to the RCM accordingly. Malfunction of the sensing system or associated circuits will cause the SRS indicator lamp to illuminate. Diagnosis of the system can only be undertaken using WDS; refer to **JTIS** for further information.

The seat weight-sensing system responds to the occupancy of the front passenger seat in accordance with **Table 7**. The advanced restraints system via the RCM, monitors and processes the data from the seat weight-sensing system and several other sensors, before making a deployment decision; refer to the advanced restraints system diagram **Fig. 133**. The system is designed to take account of several variables in addition to weight, including: inclination of the vehicle; exact position and structure of the weight on the seat.

NOTE: The seat weight-sensing system cannot discriminate between a passenger and an object.

Passenger seat status	Passenger air bag status	Passenger air bag deactivation lamp status
Empty	OFF	OFF
Occupied (small occupant)	OFF	ON
Occupied (large occupant)	ON	OFF

Table 7 Passenger seat weight-sensing system

Service Kit

Individual components of the seat weight-sensing system are not serviceable; the system must be replaced as a complete unit. Due to the sophistication of the weight-sensing system, each replacement system requires calibration. To avoid the

need to provide each dealer with calibration equipment, a pre-calibrated service kit assembly is available. The kit has two fixed connectors and a single connector to interface with the vehicle harness. After installation, the system will require initialization by WDS; refer to **JTIS** for further information.

Occupant Safety

Occupancy Sensors

The occupancy sensor system uses ultrasound at an operating frequency of 40 kHz to monitor passenger seat occupancy.

NOTE: Medical studies have shown that frequencies within this range do not present any danger or discomfort.

The advanced restraints system uses four ultrasonic sensors, one at the passenger-side A-post, one in the center console and two in the headlining assembly; refer to **Fig. 135**.

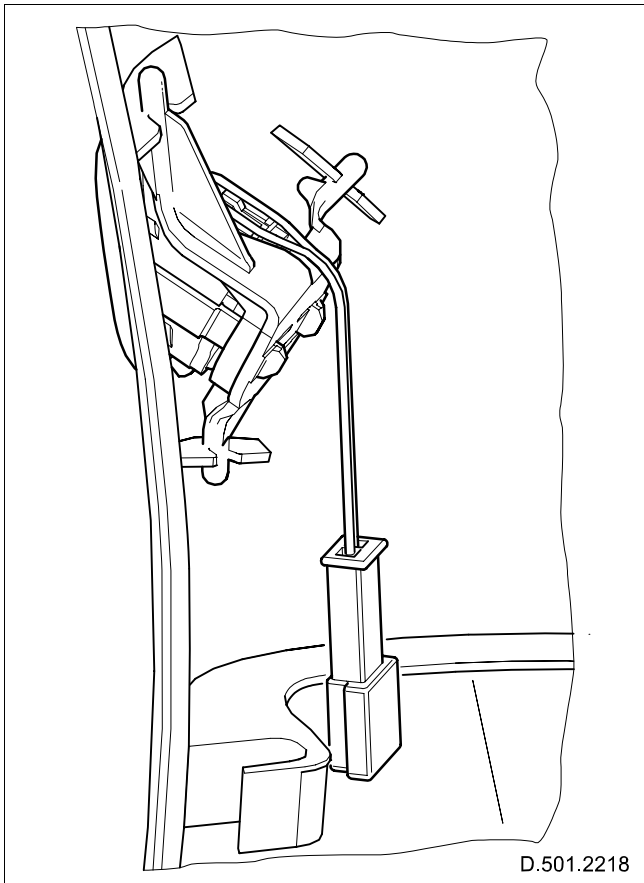


Fig. 138 Occupancy sensor - A-post

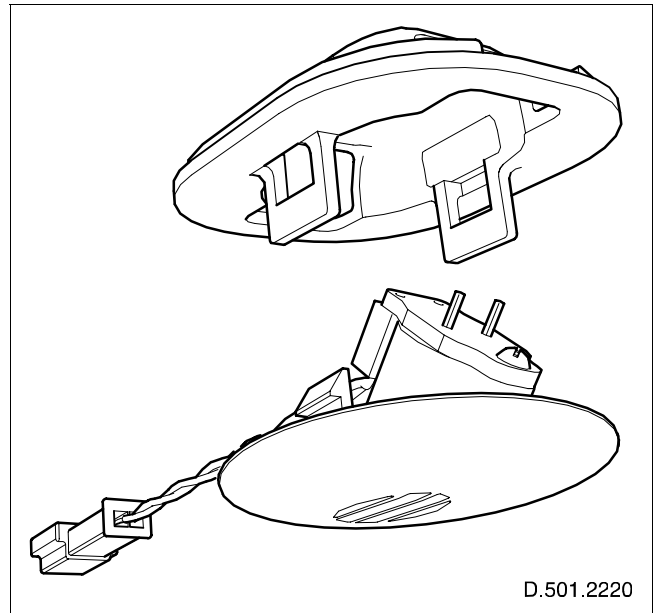


Fig. 139 Occupancy sensor - headlining

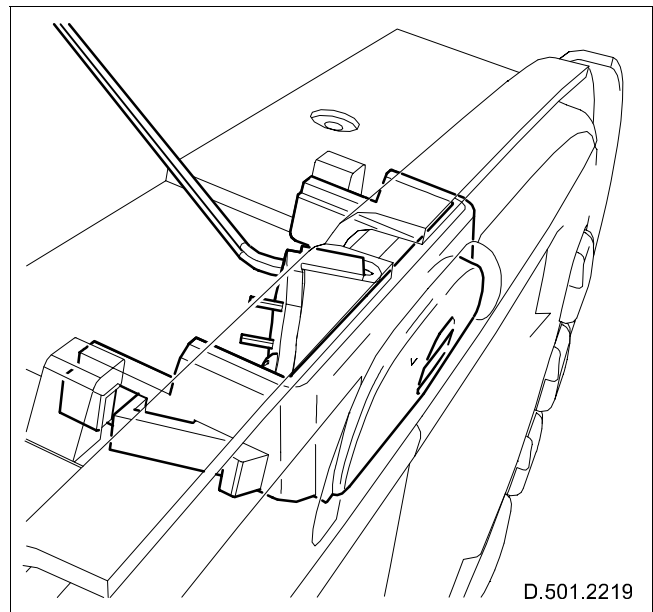


Fig. 140 Occupancy sensor - center console

The sensors:

- Determine the presence and position of the front seat occupant with respect to the passenger air bag deployment door.
- Determine air bag deployment decisions by classifying occupants as either 'in position' or 'out of position'.
- Are part of a system that is sophisticated enough to be unaffected by body extremities; refer to **Fig. 132**.

The four sensors are strategically placed to detect the presence and movement of the front passenger seat occupant.

The occupancy sensing module constantly monitors and processes the signals received from the occupancy sensors.

The RCM uses the data received from the occupancy sensing module, in conjunction with data from other sensors in the system (refer to **Fig. 133**), to make deployment decisions.

Data from the sensors is correlated by the occupancy sensing module and used to decide when the front passenger seat occupant has leaned into an area in front of the passenger air bag door, known as the 'keep-out zone'.

NOTE: The system is designed to ignore body extremities (hands, feet) and respond only to head or body movements. When the passenger leans forward into the zone, the system will disable the passenger air bag and provide visual confirmation by illuminating the passenger air bag deactivation lamp; refer to Air Bag Modules.

Refer to **JTIS** for sensor servicing information.

Side Crash Scenario

Data from the side crash sensors are used by the restraints control module (RCM), in conjunction with acceleration data from the RCM's internal accelerometer to make a deployment decision. The RCM processes the acceleration data and subject to an impact being of high enough severity, decides whether the seat-mounted side air bag and the side-curtain air bag should be deployed. The decision is forwarded to the deployment handler (within the RCM) which responds appropriately; for example: in the case that the occupancy-sensing module calculates that the seat is empty, or occupied by a small person, the passenger-side air bag will be disabled.

NOTE: The appropriate side-curtain air bag will still deploy to afford protection for any corresponding rear occupant.

Side Crash Sensors

The side crash sensors:

- Comprise accelerometer and processing circuits but do not make deployment decisions.
- The front side-crash sensor is mounted behind the B-post trim close to the safety belt retractor fixing.
- The rear side-crash sensor is mounted directly to the vehicle body at a rear mid-wheel location, close to the rear lower safety belt anchor.

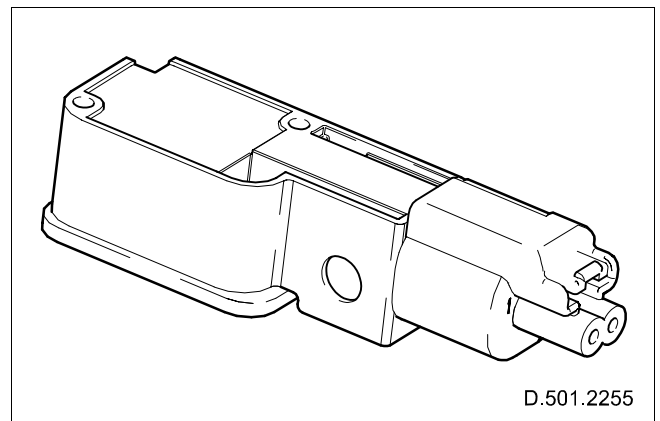


Fig. 141 Side crash sensor

Occupant Safety

Control and Processing

Restraints Control Module

Internally, the restraints control module (RCM) has two areas that determine which elements of the restraint system are to be deployed:

Area 1 - Crash severity evaluation

The first area evaluates crash severity by using data from the RCM's internal accelerometer, the front crash sensor and the safety-belt buckle sensor. Based on this data, the RCM decides which level of air bag deployment is required and forwards the information to the second area, the deployment handler.

Area 2 - Deployment handler

The status of the seat-track position sensor, occupancy sensors, seat weight-sensing system and safety-belt buckle sensors are examined before a decision is made about which restraints should finally be deployed. For instance, if the occupancy sensing and seat weight-sensing system indicates that the passenger seat is empty, then no restraint deployment will take place on the passenger side, even if full deployment takes place for the driver.

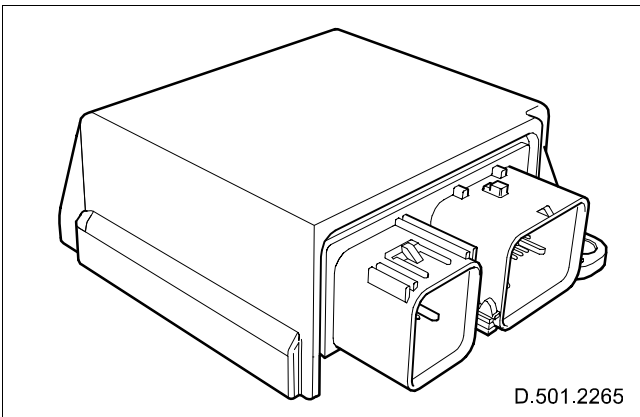


Fig. 142 Restraints control module

The restraints control module:

- Is fixed to the top of the driveshaft tunnel below the center console.

NOTE: Due to the importance of the module being securely fixed to the vehicle body, the ground connection is made via the fixings and is monitored by the diagnostic system. A bad connection causes a diagnostic trouble code (DTC) to be generated. Refer to **JTIS** for the correct torque figures.

- Identifies severity and direction of impact and makes decision on deployment of air bags and pre-tensioners.
- Provides firing signals to all air bags and pre-tensioners.
- Performs on board testing of the air bag and pre-tensioner firing circuits, warning indicator circuits and module status (the front and side-crash sensors perform basic self-tests).
- Stores DTCs.
- Drives the SRS indicator lamp on the instrument cluster: if the warning lamp fails and there is an additional malfunction within the system (DTC recorded) a secondary-warning audible tone is emitted.
- In the event of a crash, sends a signal to the vehicle emergency message system (VEMS) and the ECM to indicate that a crash has occurred.
- Is connected to the diagnostic connector via the ISO data bus to enable communication with WDS or scan-tool.
- In the event of loss of battery supply in crash conditions, provides a temporary back-up power supply (100ms after the RCM loses its supply) to operate the front air bag modules and pre-tensioners.
- In the event of a crash, records certain data for subsequent access via the diagnostic connector. This data includes deceleration information, firing delay and DTCs.

NOTE: Diagnosis of any malfunctions relating to the adaptive restraints system must always be undertaken using WDS.

Occupancy Sensing Module

The module:

- is located beneath the front passenger seat;
- processes signals received from the occupancy sensors;
- processes signals received from the seat weight-sensing system;
- makes data available to the RCM via a local CAN.

Safety Belts

In appropriate markets, all passenger safety belts (not the driver's) have an integral automatic locking retractor (ALR), providing a 'static reel mode' for use with child seats. When activated, the static reel mode prevents further extraction of the belt and locks the child seat firmly in position.

The static reel mode is activated by pulling the belt to its full extension to engage the ratchet mechanism. After ensuring the child seat is in the required position the belt tongue should be inserted into the buckle and the belt allowed to slowly retract back onto the reel (a ratchet operation may be felt as the belt retracts) until it fits snugly around the child seat.

Unbuckling the belt and allowing the webbing to fully retract will disengage the ALR feature.

NOTE: Safety belts are not serviceable items. As with all electronically monitored, occupant safety components, the SRS indicator lamp will illuminate if a DTC has been stored. Diagnosis must be undertaken using WDS.

WARNING: Prior to the removal of safety belts and before disconnecting safety belt electrical connectors, the vehicle battery should be disconnected and a period of at least one minute allowed to elapse. The same amount of care should be taken when handling and storing safety belts, as would be taken when handling and storing air bag modules.

The front safety belt retractors incorporate a load limiting device, that allows progressive 'payout' of additional safety belt webbing when the force exerted exceeds a predetermined limit.

NOTE: Each front safety belt buckle assembly incorporates a 'Hall effect' sensor; refer to **Sensors**.

Pyrotechnic pre-tensioners

The pre-tensioner will only be activated when the restraints control module (RCM) sends an appropriate firing signal; refer to **Control and Processing**.

The pre-tensioners are:

- designed to remove excess webbing from the safety belt in the event of a crash;
- deploy very quickly and early on in the crash before the occupant starts loading the safety belt.

WARNING: In the event that a pre-tensioner deploys, the complete safety belt system (front and rear) must be replaced; refer to JTIS.

The front safety belts employ buckle-type pre-tensioners; refer to **Fig. 143**.

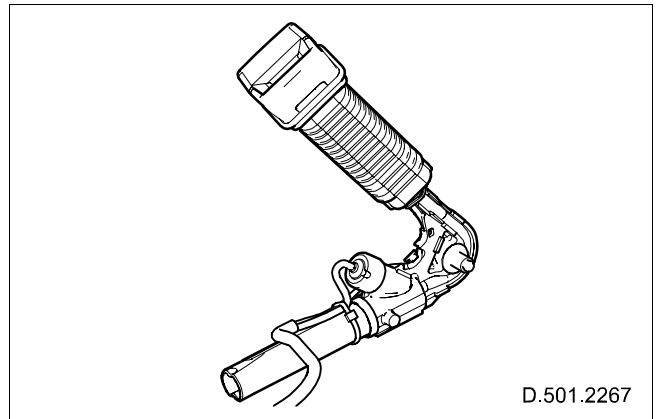


Fig. 143 Buckle-type pre-tensioner

The rear safety belts employ retractor-type pre-tensioners; refer to **Fig. 144** and **Fig. 145**.

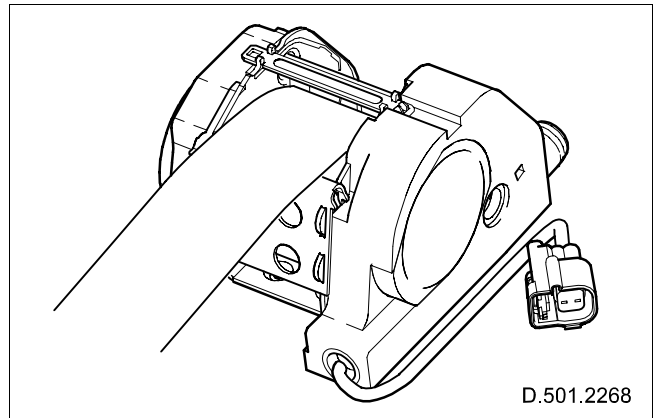


Fig. 144 Retractor-type pre-tensioner (rear center)

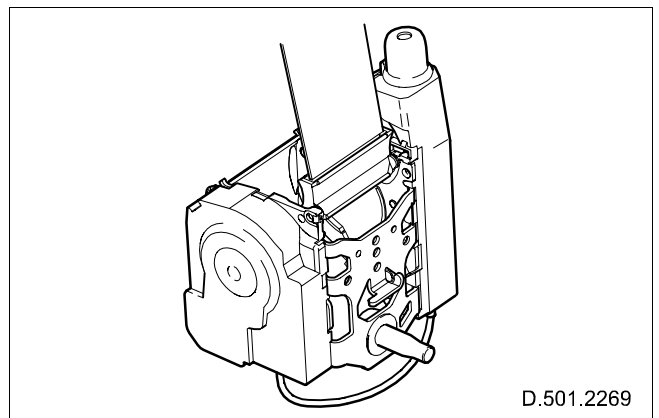


Fig. 145 Retractor-type pre-tensioner (rear left-hand)

Occupant Safety

Anti-whiplash System

In order to reduce the incidence of whiplash injuries, two anti-whiplash mechanisms (one either side) are incorporated into each front seat. The mechanisms are designed to respond to rear impacts at low speeds, by controlling the rearward motion of the backrest to reduce the likelihood of neck injuries.

Depending on the weight of the seat occupant and the severity of the collision, the mechanisms begin to operate at collision speeds between approximately 8.7 and 11.2 mile/h (14 and 18 km/h).

Immediately after a rear impact, the seat forces the backrest against the occupant (Fig. 146A). At this point the mechanism is activated and progresses through a controlled phase of movement:

1. the backrest moves rearwards (but in an upright position) for a distance of approximately 50mm (Fig. 146B);
2. the backrest tilts rearwards (Fig. 146C) but is limited to an angle of approximately 15 degrees.

The combined effects of movements 1 and 2, absorb impact energy, reducing the relative acceleration of the head and body.

NOTE: The positioning of items behind the front seats will prevent the activation of the mechanism (Fig. 146D).

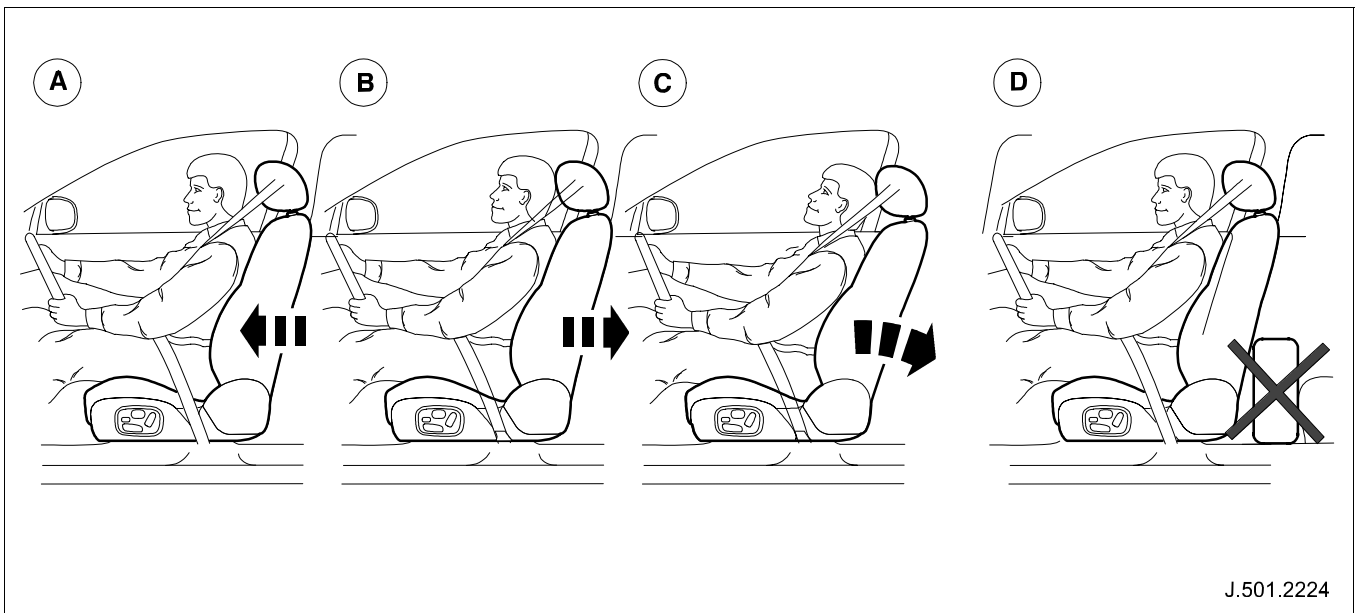


Fig. 146 Anti-whiplash feature

With reference to **Fig. 147**, the mechanism has been engineered so that during a rear impact collision, the movement of the recliner plate(7) and backrest, is controlled. This is achieved by constraining the movement of the guide-pin(4) within the window(3) of the outer side-plate(1).

NOTE: The displacement of the guide-pin in the window, will vary depending on occupant weight, occupant posture and the impact severity.

The tilting movement of the backrest is determined by the design parameters of the deformation link(5) which collapses (**Fig. 147C**) to provide gentle braking.

NOTE: The shape of the window, the angle between the two links (**Fig. 147B**) and the return spring (2), prevents the mechanism from being activated during normal driving.

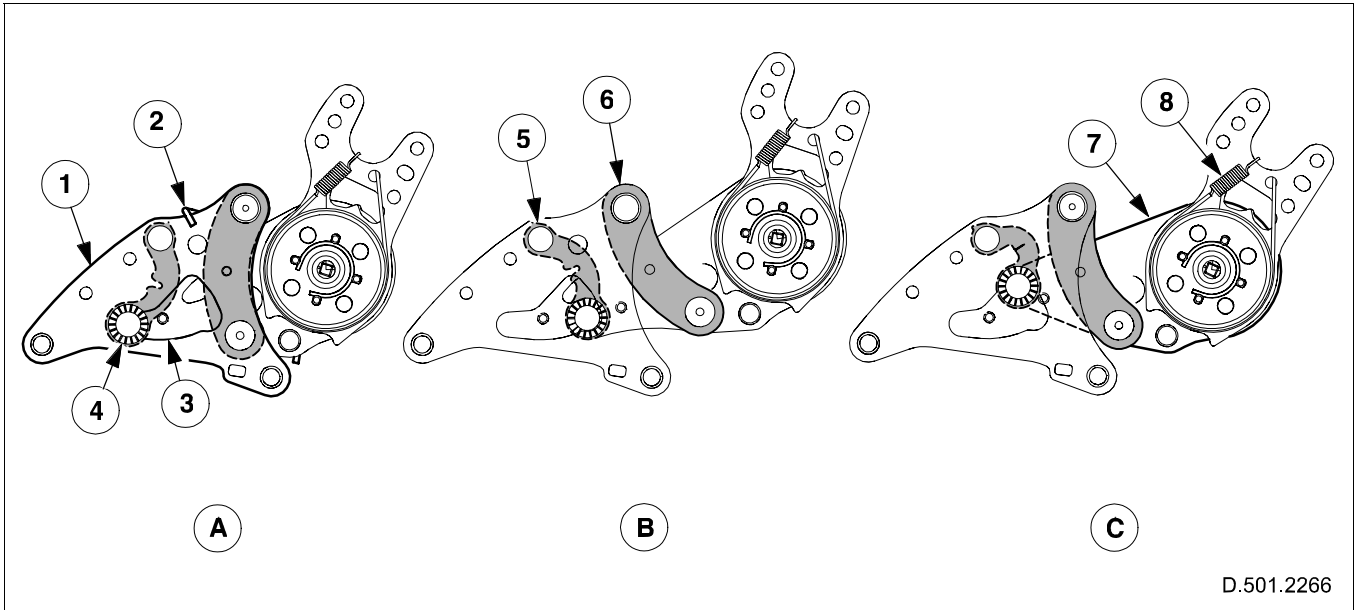


Fig. 147 Anti-whiplash mechanism (left-hand side)

- A. Installed condition
- B. Fully rearwards condition
- C. Fully deployed condition
- 1. Outer side-plate
- 2. Return spring
- 3. Window

- 4. Guide-pin
- 5. Deformation link
- 6. Rear link
- 7. Recliner plate
- 8. Brake spring

NOTE: The anti-whiplash mechanism has no serviceable components. In the case of a minor collision, even though the protective system has been activated, there may be no apparent change to the seat. The seat must always be inspected after a rear collision; refer to **JTIS**.

Air Bag Modules

Driver Air Bag Module

The driver air bag module is controlled by the restraints control module (RCM), which chooses between first or second stage deployment, depending on driver seat buckle usage, the seat position and crash severity.

NOTE: Variation in driver air bag deployment is determined by the timing of the first and second stage ignition signals. This facilitates adaptation of the stiffness and timing of the air bag to optimize occupant protection.

The module comprises:

- A twin stage inflator as opposed to the single stage inflator.
- Separate chambers for the two inflation stages, each independently activated by the RCM.
- Two air bag connectors, that have foolproof mechanical keying and are color coded to the respective plug on the inflator.
- A non-azide propellant that reduces particulates and effluents.

The air bag deploys radially, to reduce the risk of air bag induced injury to a driver that is positioned close to the steering wheel.

NOTE: Disposal of twin stage air bags is different to single stage air bags; refer to **JTIS**.

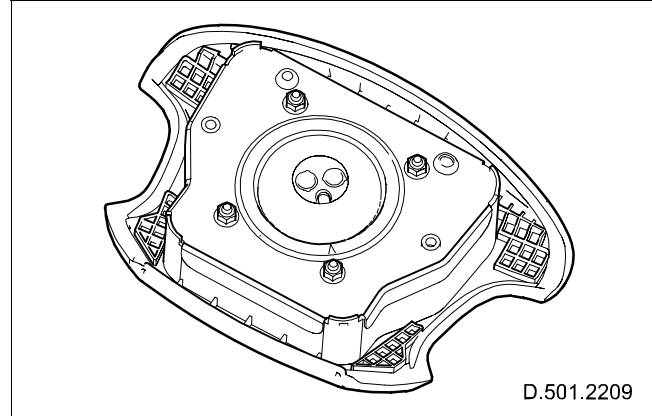


Fig. 148 Driver air bag module

Passenger Air Bag Module

The module is attached to a mounting bracket which is in-turn attached to the cross-car beam; refer to JTIS.

The module comprises:

- A twin-stage inflator as opposed to the single-stage inflator.
- Two air bag connectors to accommodate the twin-stage inflation.

The heated gas inflator:

- Comprises a high-pressure mix of clean air and hydrogen gas, triggered by two separate igniters.
- Produces a controlled generation of clean gas to rapidly fill the air bag.
- Is classified as a stored flammable gas (not as an explosive) and as such, has less restrictive storage and transportation requirements.
- Produces a very clean burn and almost no particulates.
- Is almost free of any toxins, making disposal or recycling much easier.

NOTE: Disposal of twin-stage air bags is different to single-stage air bags; refer to JTIS.

The passenger air bag module is controlled by the restraints control module (RCM), which chooses between first or second-stage deployment, depending on occupant status and crash severity.

NOTE: Variation in passenger air bag deployment is determined by the timing of the first and second-stage ignition signals. This facilitates adaptation of the stiffness and timing of the air bag to optimize occupant protection.

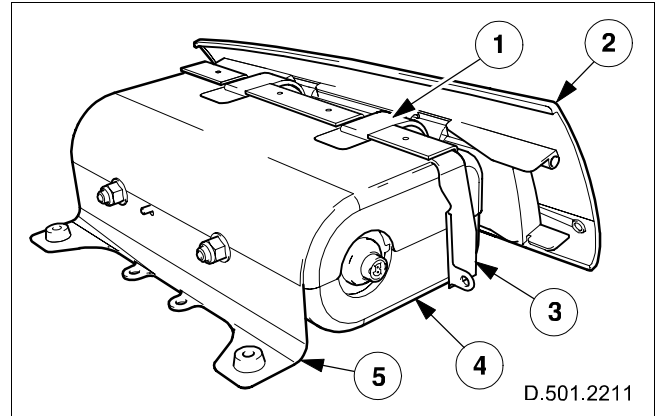


Fig. 149 Passenger twin-stage air bag module

1. Webbing straps
2. Air bag deployment door
3. Tether bar
4. Passenger air bag module
5. Mounting bracket

Occupant Safety

Passenger Air Bag Deployment Door

The passenger air bag deployment door is clipped into the instrument panel and tethered to the mounting bracket via webbing straps.

NOTE: Removal of the door complete with webbing straps and tether bar can only be achieved after removing the passenger air bag module; refer to **JTIS**.

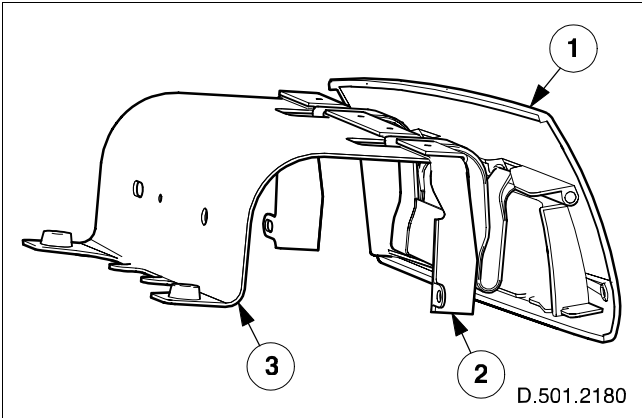


Fig. 150 Passenger air bag door

1. Deployment door
2. Tether bar
3. Mounting bracket

The passenger air bag deployment door incorporates a lens that displays the air-bag deactivated symbol. The symbol is backlit by the air-bag deactivation indicator lamp, which is mounted in a separate housing attached to the instrument panel. The illumination of the symbol is designed to inform the front seat occupants whether or not the passenger air bag has been deactivated; refer to **Sensors**.

NOTE: The lamp is not a serviceable item; the complete housing must be changed; refer to **JTIS**.

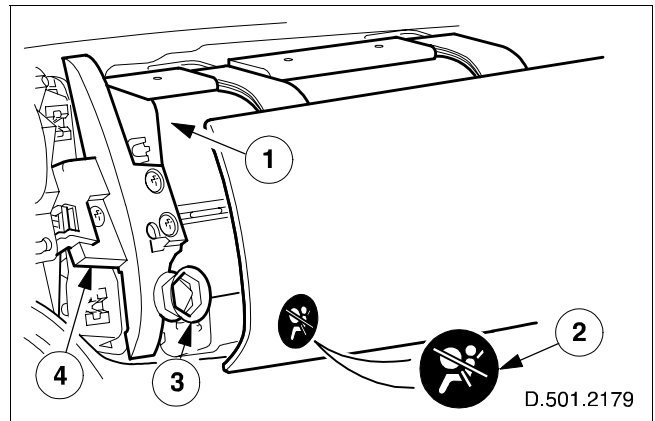


Fig. 151 Passenger air bag deactivation

1. Air bag module
2. Air bag deactivation indicator lens
3. Air bag deactivation indicator lamp
4. Air bag deactivation indicator lamp housing

Side-Curtain Air Bag

The side-curtain air bag comprises:

- Attachment brackets (p-clips).
- Fill tube.
- Air bag.
- Housing.
- Inflator.
- Front/rear tethers.

The side-curtain air bag:

- is standard fit and specification in all markets;
- is located under the headliner and stabilized at the A-post and C-post by tethers;
- does not require routine maintenance;
- has no serviceable parts;
- uses compressed argon to inflate the air bag;
- deploys to coincide with seat-mounted side air bag deployment.

NOTE: If the passenger air bag is deactivated, the corresponding seat-mounted side air bag is also deactivated, however the side-curtain air bag will still deploy to afford protection to any corresponding rear occupant.

- After deployment, the side-curtain air bag extends down to approximately shoulder height providing head protection for both the front and rear occupants.

The inflator:

- generates the gas needed to fill the air bag;
- consists of a high strength steel casing filled with a solid propellant charge, an electrically activated igniter and a cold gas bottle containing pressurized gas.

When appropriate, the restraints control module (RCM) sends a signal to the igniter causing the following sequence of events:

- the propellant is ignited;
- the burning propellant opens the membrane of the cold gas bottle and heats the pressurized gas;
- the expanding gas is directed into the fill tube by the inflator housing assembly;
- the gas emerges through holes in the fill tube and enters the front and rear side-curtain air bag chambers.

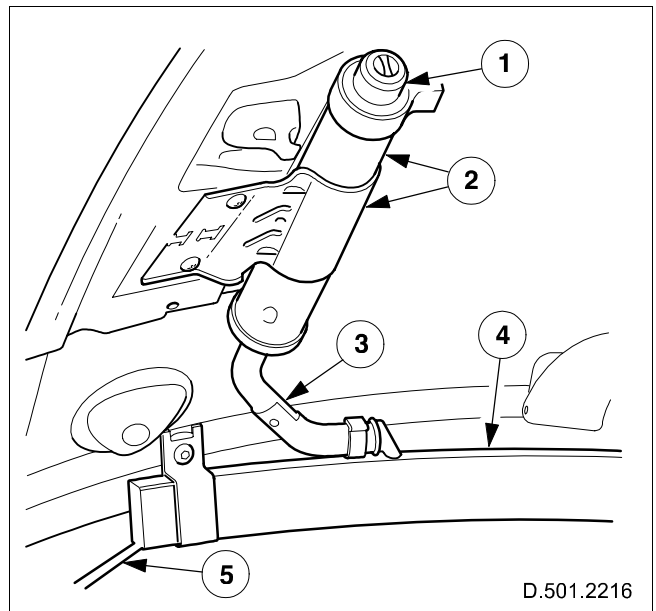


Fig. 152 Side-curtain air bag

1. Inflator
2. Canister and bracket assembly
3. Fill tube
4. Housing
5. Front tether

Occupant Safety

Steering Column

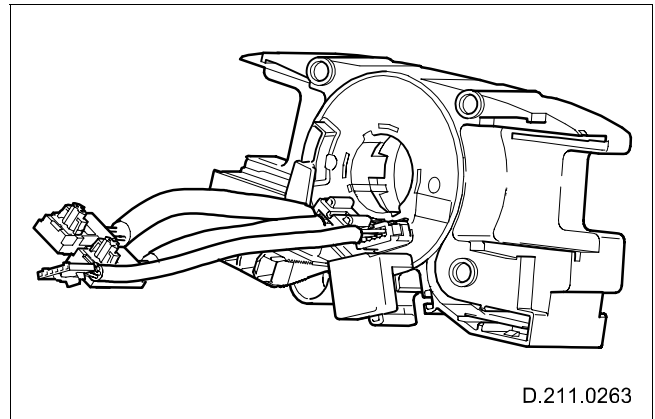
The steering column is an integral part of the occupant safety system; refer to Chassis, Steering System, **Steering Column**.

Clockspring

The clockspring provides a flexible coupling for electrical components that are attached to the steering wheel, including:

- horn;
- speed control buttons;
- telematics control buttons;
- driver air bag module.

NOTE: The clockspring has two electrical connectors that interface between the twin-stage driver air bag module and the restraints control module (RCM); refer to **Driver Air Bag Module**.



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Fig. 153 Clockspring

