JAGUAR

Technical Guide

The XJ range
Introduction
2004 Model Year

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

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Preface

The Jaguar Technical Guide is intended to provide an overview only 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, design changes to the vehicle may be made in the period between the completion of this publication and the introduction of vehicles. Details of 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
ASM	air suspension module
BTS	belt tension sensor
CAN	controller area network
CATS	computer active technology suspension
CCM	climate control module
CD	compact disc
CKP sensor	crankshaft position sensor
cm	centimeter
D2B	digital data bus
dc	direct current
DDM	driver door module
DSC	dynamic stability control
DSM	driver seat module
DTC	diagnostic trouble code
DVD	digital versatile disc
ECM	engine control module
EGR	exhaust gas recirculation
ELMS	electrical load management system
EVAP canister	evaporative emission canister
FCCS	front climate control system
FEM	front electronic module
FM	frequency modulation
FP module	fuel pump module
GPS	global positioning system
HID	high-intensity discharge
HO2 sensor 1	heated oxygen sensor 1
HO2 sensor 2	Heated oxygen sensor 2
HSW	heated steering wheel
IAT sensor	intake air temperature sensor
IC	instrument cluster
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 airflow 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
NAS	North American specification
NCM	navigation control module
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
RCCP	rear climate control panel
RCCS	rear climate control system
RCM	restraints control module
REM	rear electronic module
RF	radio frequency
RH	right-hand
RHD	right-hand drive
RKE	remote keyless entry
RMM	rear memory module
SCLM	steering column lock module
SCP	standard corporate protocol
SRS	supplementary restraints system
SSP	switched system power
TCM	transmission control module
TG	technical guide
TP sensor	throttle position sensor
Tset	temperature set
VAM	voice activation 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

Introduction

The new XJ, Jaguar's flagship luxury sedan, takes full advantage of the many new systems and technological developments now available.

- The monocoque body, manufactured almost entirely from aluminum, is approximately 40% lighter than an equivalent steel body and contributes significantly towards improved fuel economy and vehicle performance.
- The instrument panel assembly is built around a magnesium cross-car beam. The glove compartment includes a shelf and an accessory power socket; the door is electrically secured and features one-touch release. In addition to the standard floor-console, a dedicated four-zone version accommodates the rear climate control system.
- All seats are constructed using magnesium frames and incorporate electrically adjustable lumbar supports and head restraints. The front seats incorporate anti-whiplash mechanisms and the now familiar occupant safety features.
- Side-curtain air bags, occupancy sensing and rear safety-belt pre-tensioners are standard installations.

Powertrain features:

- The AJ-V8 4.2-liter, an upgrade and replacement of the previous 4.0-liter engine, is available in both normally aspirated and supercharged variants.
- The AJ-V8 3.5-liter, an upgrade and replacement of the previous 3.2-liter engine, is available as normally aspirated only. The 3.5-liter engine makes its Jaguar debut in the XJ.
- The AJ-V6 3.0 liter completes the line-up.
- All four engines are coupled to the 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 cooling pack assembly includes: the integration of the receiver-drier into the condenser and the cooling fan directly driven by a brushless motor.
- The exhaust system is constructed of stainless steel with polished, detachable tail-pipe sleeves.
- The fuel system is an electronic returnless fuel type and features a saddle tank positioned underneath the vehicle. A single fuel-pump located inside the tank on normally aspirated vehicles, provides optimum fuel-delivery performance. A twin-pump fuel delivery system meets the flow-rate requirement of supercharged vehicles.

Chassis features:

- A significant development is the microprocessor based chassis control system, comprising an advanced air suspension system and enhanced adaptive damping. Specially designed to accommodate the lightweight aluminum-body of the XJ, the system provides optimum driving stability and comfort.
- The front and rear suspension are both double-wishbone arrangements assembled on isolated subframes. Extensive use of aluminum provides both a lighter and more responsive suspension.
- An enhanced steering system, which when combined with changes made to the suspension system provides excellent steering response and feel.
- The upper steering column features a unique crash-load absorption system and the lower column incorporates a new crash-collapse mechanism.
- Dynamic Stability Control (DSC) features all-new hardware and is fitted as standard.
- Panic brake assist, responds to the driver's reactions in an emergency-braking situation by providing an increased braking force to activate the ABS.
- The adjustable pedals have been designed to complement the adjustable steering column in providing some drivers with a range of improved driving positions.
- An electric parking brake is fitted as standard. In addition to saving space within the passenger compartment, the parking brake is easier to use and automatically actuated when the ignition key is removed.

Introduction

Electrical features:

- An intelligent electrical load management system has been introduced. The system uses a subtle, electrical monitoring and control strategy, designed to accommodate an increase in major electrical features, by limiting the detrimental effect on the battery and ultimately the vehicle.
- A two-zone automatic climate control system is installed as standard. The system includes an air-intake filter, a single blower, a receiver-drier that is integral to the condenser and a clutchless compressor. The four-zone system (where installed) provides rear-seated passengers with the option to control the climate for their individual zones independently from the front two zones.
- The rear multimedia system provides rear seat occupants with the opportunity to select from a choice of different entertainment sources, independent of each other and to that selected by the front passenger.
- In conjunction with the rear multimedia system, multizone voice (where installed) facilitates the voice control of most functions available to the front seat passengers and also provides the option to engage in telephone conference calls.
- Xenon headlamps provide improved visibility and reliability. To comply with legislation, signals from the air suspension system are utilized for automatic headlamp adjustment. Tail and stop lighting features LED technology for improved reliability and responsiveness.
- The telematics system with optional multi-functional touch-screen, allows control of audio, climate, phone, navigation and TV. DVD technology is used for the navigation system.

Dimensions

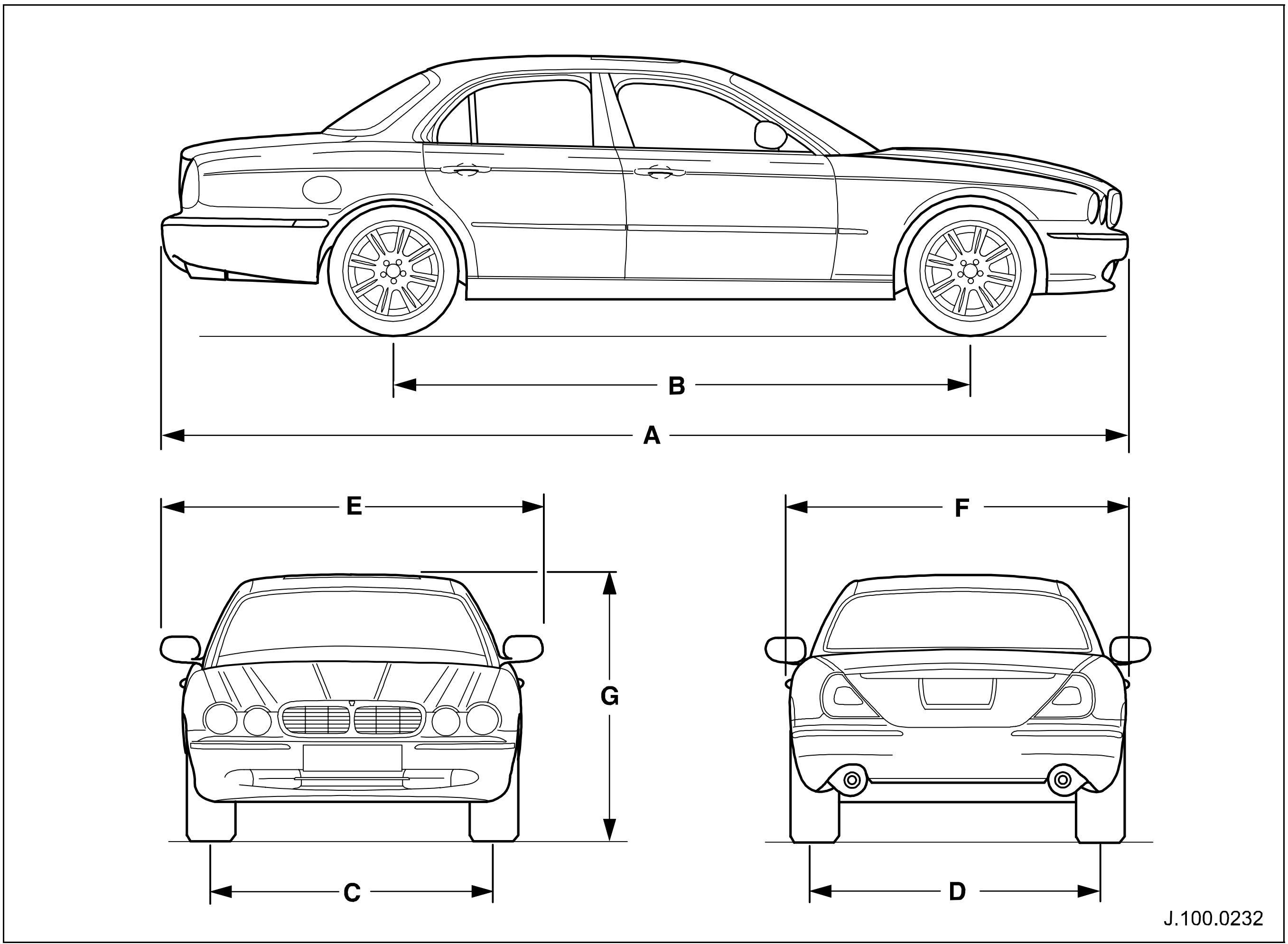

Fig. 1 External dimensions

Dimension	inches	millimeters
A	200.4	5090
B	119.5	3034
C	61.3	1556
D	60.9	1546
E	83	2108
F	73.3	1860
G	55	1448

Table 1 External dimensions (refer to Fig. 1)

Measurement **G** is the vehicle standard ride-height; refer to **Air Suspension**.

Jacking and Lifting

CAUTION:

- **Jacking and lifting points are critical.**
- **Vehicle support stands should only be used in conjunction with cushioned pads.**

Refer to JTIS for detailed information.

Vehicle Recovery and Towing

CAUTION: It is critical that the correct recovery method is always employed; refer to JTIS for detailed information.

Repair Technology

Body And Paint Repairs

Repairs to aluminum requires different tools and techniques to those used for steel. Repairs should only be undertaken by trained Body and Paint Repair technicians; refer to **New XJ Range Body and Paint Repair Supplement** for detailed information.

General Repairs

- Avoid using components that could damage the paint system, such as, self-tapping screws, spring-steel clip or paint-clearing screws.
- To ensure anti-corrosion integrity is maintained, use only genuine Jaguar fasteners; refer to **JTIS**.
- Always reinstate the paintwork to its condition prior to commencing the repair; refer to **New XJ Range Body and Paint Repair Supplement** for detailed information.

The new XJ has been carefully designed to take into account the benefits of using aluminum but also to prevent the electrolytic interaction of dissimilar metals; refer to **Body Construction**.

Accessories

Only Jaguar approved accessories should be installed.

CAUTION: Always install accessories in accordance with the fitting instructions supplied and using the recommended fasteners.

Suspension

Introduction

A completely redesigned suspension system, provides the following enhancements:

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

An extensive use of aluminum is used in the manufacture of the suspension components to provide a lighter and more responsive suspension.

A further and significant development is the microprocessor based chassis control system, comprising an advanced air suspension system and enhanced adaptive damping. The system consists of a number of components interconnected by pneumatic lines and an air suspension module (ASM). The system provides optimum driving stability and comfort, and is specially designed to accommodate the lightweight aluminum-body of the XJ. Refer to the **Air Suspension** and **Adaptive Damping** sections.

CAUTION: Do not use jacking equipment on suspension components, use identified jacking points only; refer to 'JTIS'.

Front Suspension

The front suspension is assembled on an isolated subframe, mounted via four bolts to the vehicle body. Hydrabushes incorporated in the rear mountings of the subframe provide added suspension refinement; the front mounting bushes are conventional rubber types. Spacer bars located between the subframe and vehicle body provide support for the vehicle's cooling pack and cross-brace. The cross-brace improves NVH characteristics by increasing body stiffness.

The front suspension arrangement is a double-wishbone type, with the length ratio between the two control arms calculated to optimize track and camber control. In addition, the upper control-arm is designed to improve castor trail and subsequently steering-feel. Inclination of the upper control-arm axis provides an anti-dive and anti-squat action during vehicle braking and acceleration. The lower control arm is a split design, which de-couples to allow for improved bush adaptation. A hydrabush fitted to the forward lower-control arm where it attaches to the subframe provides vibration damping. The swan-neck wheel knuckle is supplied in two derivatives to accommodate the different caliper mounting points of normally aspirated and supercharged vehicles.

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.

Front Spring and Damper Assembly

Refer to **Air Suspension** and **Adaptive Damping** sections.

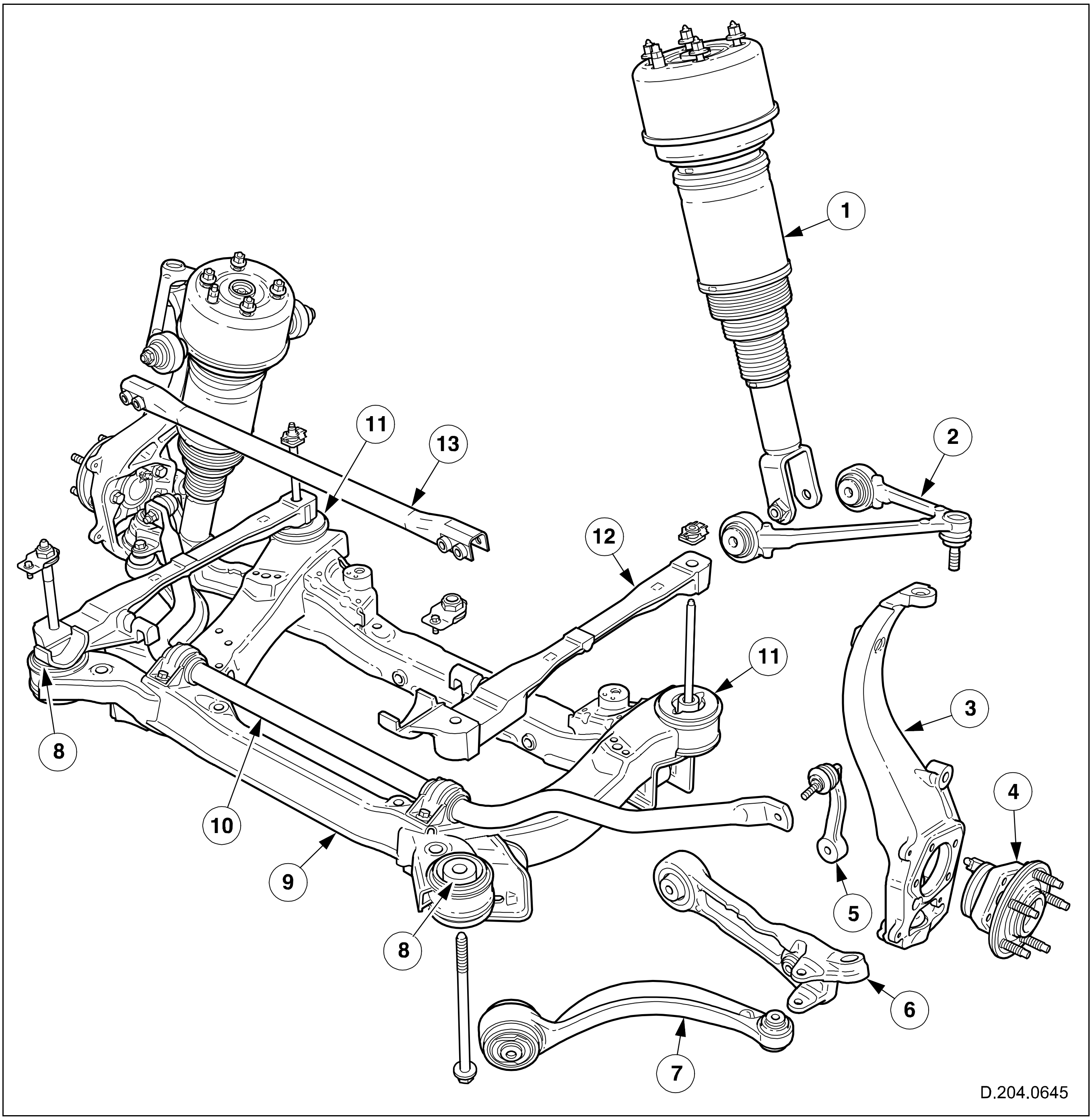

Fig. 2 Front suspension components

Key to Fig. 2

1. Air spring and damper assembly
2. Upper control arm
3. Swan neck wheel knuckle
4. Wheel hub and bearing assembly
5. Stabilizer-bar drop link
6. Lower control arm - lateral
7. Lower control arm - forward
8. Conventional mounting bush
9. Subframe
10. Stabilizer bar
11. Hydrabush mounting
12. Spacer rail
13. Cross brace

Rear Suspension

The rear suspension is assembled on an isolated subframe, mounted via four bolts to the vehicle body. Two hydrabushes incorporated in the forward mountings and two void-type bushes in the rear mountings provide optimum suspension refinement. The double-shear bracket brace improves NVH characteristics by providing additional mounting stiffness.

As with the front suspension the rear suspension is also a double-wishbone type. Inclination of the upper control-arm axis provides an anti-dive and anti-squat action during vehicle braking and acceleration. The wheel knuckle is supplied in two derivatives to accommodate the different caliper mounting points of normally aspirated and supercharged vehicles.

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.

Rear Spring and Damper Assembly

Refer to **Air Suspension** and **Adaptive Damping** sections

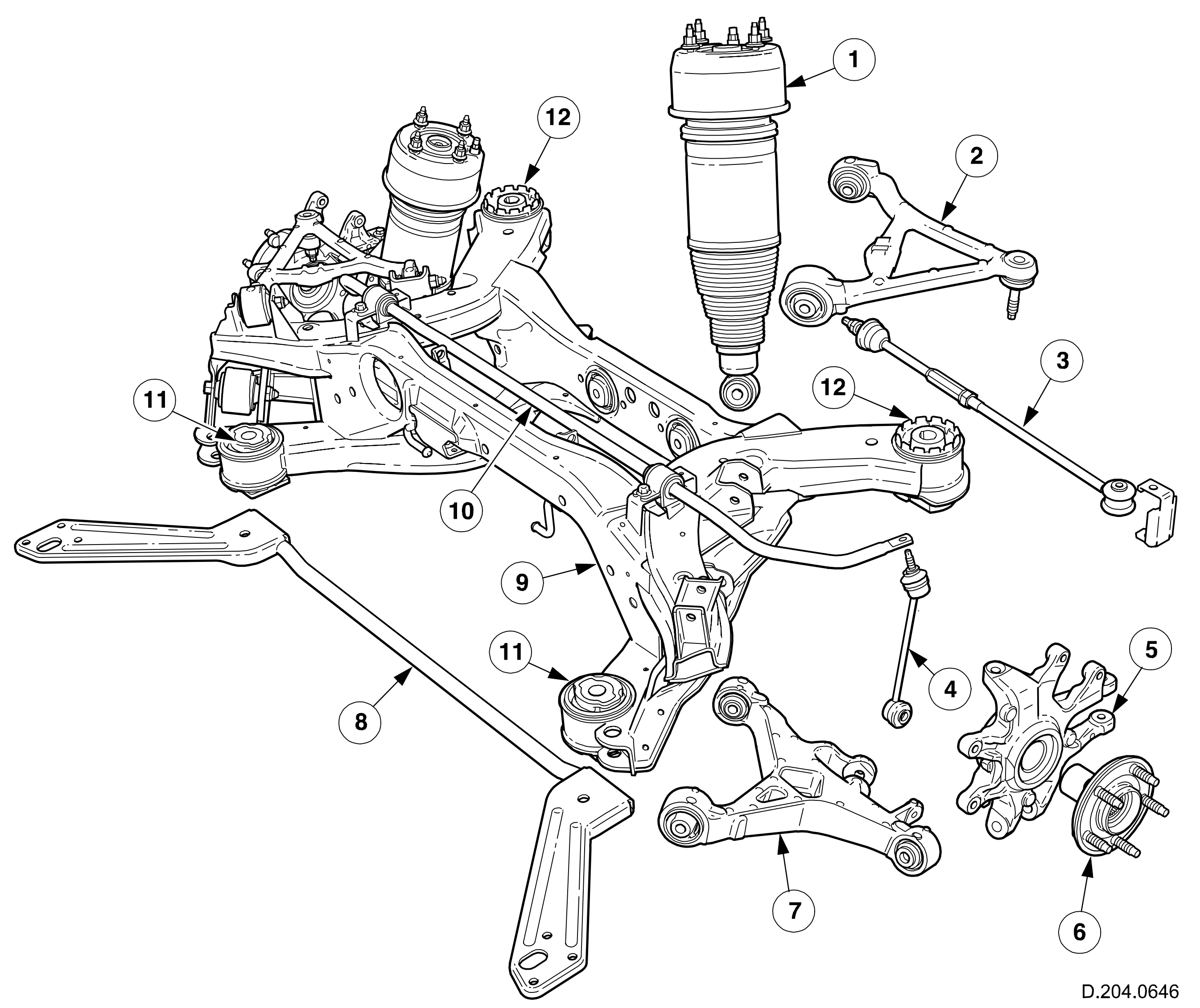

Fig. 3 Rear Suspension Components

1. Air spring and damper assembly
2. Upper control arm
3. Toe control link
4. Stabilizer-bar drop link
5. Wheel knuckle
6. Wheel hub and bearing assembly
7. Lower control arm
8. Double-shear brackets and brace
9. Subframe
10. Stabilizer bar
11. Hydrabush
12. Voided rubber bush

Air Suspension

With the introduction of the lightweight aluminum body, the payload of the new XJ is now a higher percentage of the vehicle's total weight. To accommodate this reduction in body-weight a vehicle with a conventional coil-spring suspension would need either:

- an increase in unladen height, or
- a higher spring-rate.

Both of which would mean a compromise between driving dynamics, ride comfort and the vehicle's stance appearance. To overcome these compromises and maintain a constant vehicle height independent of load changes, the XJ features a newly developed four-corner air suspension system in place of the coil-spring suspension.

Air suspension ensures maximum spring travel is always available providing excellent ride comfort and optimum driving safety. Another benefit of the system is the ability to lower the vehicle at a configured road speed to improve aerodynamic efficiency and further improve vehicle stability and fuel efficiency. The air suspension system is fully automatic, requiring no driver intervention.

The air suspension is available in either standard ride or sport ride derivatives depending on vehicle specification.

System Overview

The air suspension is a microprocessor based chassis-control system, comprising a number of components interconnected by pneumatic lines and the air suspension module (ASM). The vehicle weight is supported by compressed air enclosed in the rubber bellows of the air springs. Suspension height and level control are obtained by supplying or releasing compressed air with instantaneous response from the air springs. This process is actuated individually at each wheel by means of fast acting solenoid valves.

The necessary values for controlling the valves are supplied to the ASM by the height sensors located inboard of each wheel. The height sensors measure the distance between the suspension and the vehicle's body. Various other vehicle status values processed by the ASM are supplied via the controller area network (CAN). The ASM uses these values to provide the optimum suspension condition for existing road and driving conditions.

Driver Information

There are two messages that may be displayed on the vehicle message center associated to the air suspension system; refer to table below:

Message	Warning Light	Priority Indicator	Meaning
AIR SUSPENSION FAULT	None	None	Drive the vehicle with caution and inform your nearest Jaguar Dealer to have the fault rectified.
VEHICLE TOO LOW	None	None	The air suspension system is too low. Start the engine and wait for the message to clear before driving the vehicle. If the message is displayed while you are driving, restrict your speed until the message is cleared. If the message is persistently shown, inform your Jaguar Dealer.

Components

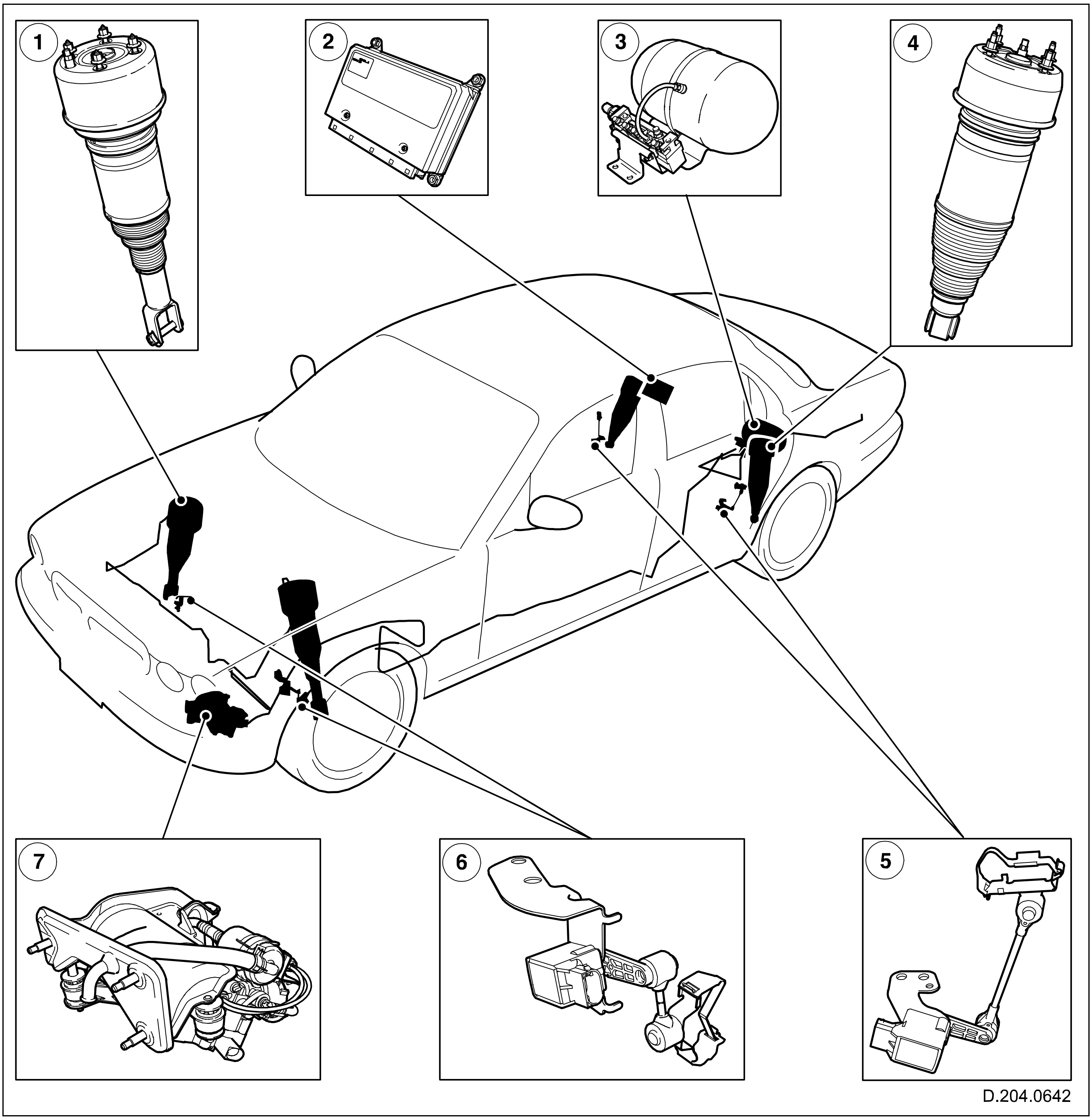

Fig. 4 Air suspension components

1. Front air spring and damper assembly
2. Air suspension module
3. Air reservoir and valve block
4. Rear air spring and damper assembly
5. Rear height sensor
6. Front height sensor
7. Air compressor

WARNING: The air suspension system must be depressurized using WDS before commencing any repair operations on the air suspension system; refer to 'JTIS' for further information.

Air Suspension Module

The air suspension module (ASM), which also controls the adaptive damping system and provides height sensor information for the automatic headlight leveling, is located behind the rear seat. The ASM provides a number of air suspension operational modes dependent on the vehicle state; refer to **Operating Modes and Strategies**.

ASM hardwired inputs:

- Height sensors
- Valve block pressure sensor
- Vertical accelerometers (adaptive damping only)
- Valve block solenoid control

ASM inputs, via the CAN:

- Vehicle speed
- Engine speed
- Engine torque
- Lateral acceleration
- Steering wheel angle
- Steering wheel velocity
- Brake line pressure
- Ambient temperature

The ASM will require calibrating using WDS if:

- the ASM is replaced;
- a height sensor is removed and reinstalled;
- a height sensor is replaced.

Refer to 'JTIS' for further information.

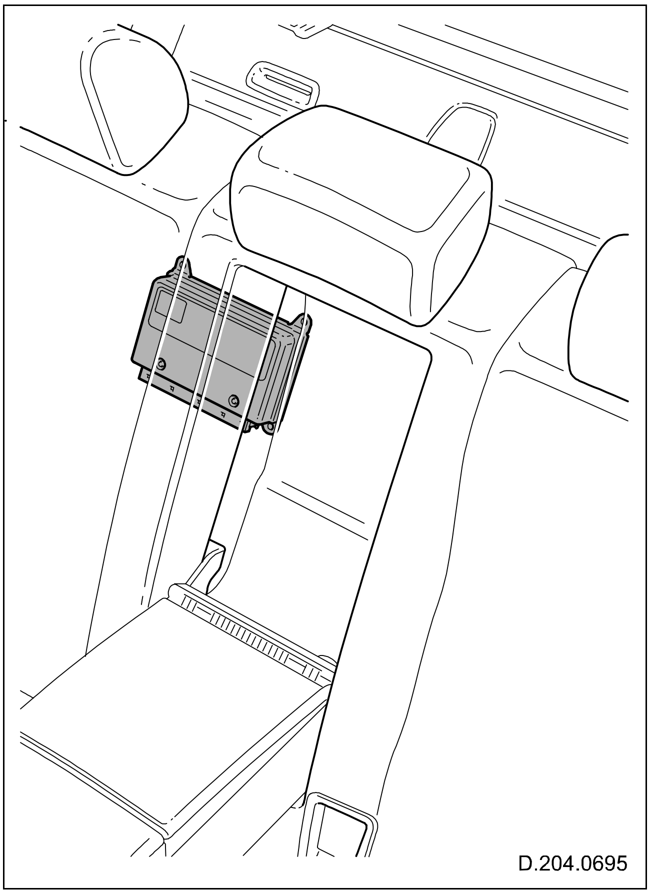

Fig. 5 Air suspension module

Air Compressor

The air compressor is mounted on the left-hand side of the vehicle behind the front bumper beam. To maintain a quiet operation the compressor is isolated from the vehicle's body by three mounting rubbers. The compressor performs the following functions:

- Air compression: Air is drawn into the compressor through a snorkel located inside the vehicle's front bumper, via a filter, and compressed by a motor-driven, single-cylinder reciprocating piston.
- Air drying: An integral air-drier maintains a low-moisture environment inside the suspension's pneumatic system. Desiccant in the drier removes moisture from high-pressure air as it is pumped into the suspension system. Air vented from the suspension system flows over the desiccant at low pressure, removing moisture from the desiccant and returning it to atmosphere. This regenerates the desiccant so it can remove moisture during subsequent compression cycles.
- Operating pressure: Nominal operating pressure is 15 bar, a pressure-retaining valve maintains a minimum pressure of 3 bar in the system to protect the air springs.
- Pressure relief: A pressure relief valve set at 17.5 bar diverts high-pressure air to atmosphere when the nominal operating threshold is exceeded. This protects the air springs and other system components in the event of a system malfunction.
- Thermal protection: Compressor run time is limited to two minutes. If the operating temperature exceeds a defined limit within this time the compressor will shutdown. The compressor will resume operation when it cools to its normal operating temperature (usually within 30 to 40 seconds).
- Air release: Air exhausted from the suspension system exits through the snorkel located inside the vehicle's front bumper.

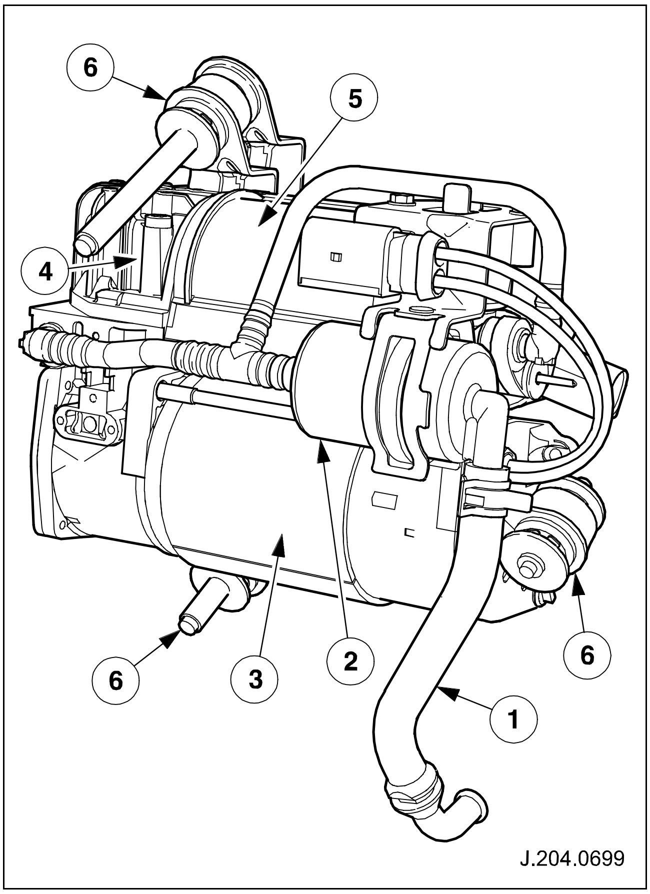

Fig. 6 Air compressor

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

Reservoir and Valve Block

The reservoir and valve block, are installed underneath the spare wheel and protected by a cover; the cover also acts to suppress noise emitted from the solenoid valves.

Reservoir:

- Reservoir volume is 4.5 liters with a maximum pressure of 15 bar, as controlled by the ASM.
- The compressor operates for approximately two minutes to complete a full recharge of the reservoir.
- With the reservoir at maximum pressure, the reservoir is capable of one complete lift of the vehicle.
- The air suspension operates within a defined pressure range; under normal operating conditions the reservoir does not deplete below the pressure of 9 bar. This prevents the air pressure held within the air springs transferring to the reservoir.

Valve Block:

- The valve block is mounted onto the reservoir bracket via isolators to reduce noise being transmitted to the vehicle body when the solenoid valves switch.
- The solenoid valves as commanded by the ASM perform the air distribution within the air suspension system.
- There are five solenoid valves installed in the valve block one for each of the four springs and one for the reservoir.
- The valve block contains a pressure sensor to monitor the pressure within the air springs and reservoir. The data supplied by the pressure sensor is one of the inputs used by the ASM to determine whether to raise the vehicle using the compressor or the reservoir reserves.

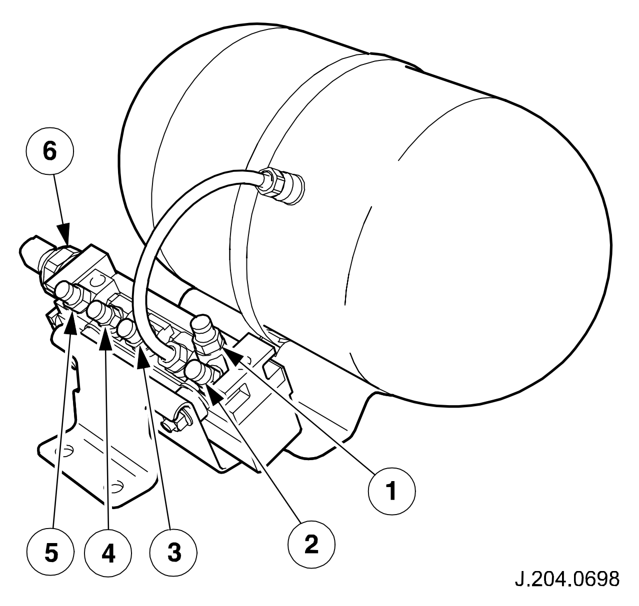

Fig. 7 Reservoir and valve block

1. Air compressor port
2. Air spring port - left-hand-rear
3. Air spring port - right-hand-front
4. Air spring port - right-hand-rear
5. Air spring port - left-hand-front
6. Pressure sensor

Air Springs and Dampers

WARNING: The air suspension system must be depressurized using WDS before commencing any repair operations on the air suspension system; refer to 'JTIS' for further information.

CAUTION: Care must be taken not to damage the air springs during repair operations; refer to 'JTIS' for care points.

- The air springs are integrated into the suspension in a manner similar to conventional coil springs and are actuated by either the air compressor or reservoir to control vehicle ride height and leveling.
- The front air springs are controlled as a pair, whereas the rear air springs are controlled independently. This is to provide level correction for uneven distribution of loads, which is usually more severe in the rear of a vehicle. Load distribution usually remains constant in the front of a vehicle.
- An outer support sleeve assembled over the damper, guides the air spring. An integral pressure retaining-valve ensures that the air pressure never drops below 3 bar within the spring. This pressure maintains the spring's internal components in their correct orientation and prevents the bellow's membrane from creasing.
- Normal operating pressure of the air spring is approximately between 7 and 9 bar, with a maximum 'full bump' pressure of approximately 20 bar.
- There are two derivatives of air spring dependant on vehicle specification:
  - Comfort: high air volume = softer ride.
  - Sport: low air volume = stiffer ride.
- The air springs are complemented by adaptive damping actuation; refer to the **Adaptive Damping** section.
- Other air spring features which improve ride quality and noise, vibration and harshness (NVH) refinement include:
  - A unique top-mount feature to isolate the damper from the body.
  - An air spring isolator, which reduces generated high frequency inputs, for example when traveling over rough terrain.
- Due to the nature of the sealing arrangement between the air spring and damper, the two parts cannot be separated and must be replaced as a complete unit.

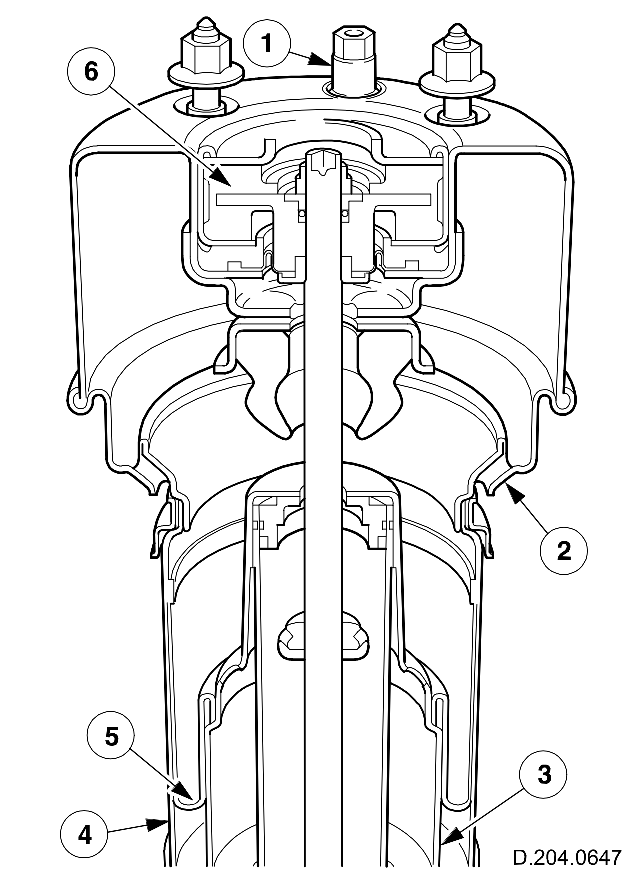

Fig. 8 Air spring internals

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

Height Sensors

- Four Hall effect rotary height sensors measure relative displacement between the body and a suspension component. The motion ratio of the height sensor attachment to the suspension component and the measured height sensor displacement are used to determine vehicle ride height.
  - The front height sensors are mounted to the front subframe and connected to the lower control arm.
  - The rear sensors are mounted to the rear subframe and connected to the upper control arm.
- Each sensor transmits raw unfiltered data to the ASM, where the data is then filtered to respond to either fast or slow vehicle loading/unloading:
  - Fast filter: Sudden weight changes due to passenger and luggage loading/unloading; or the vehicle traveling over rough terrain. The suspension reacts instantaneously to correct the ride height.
  - Slow filter: Gradual weight reduction due to fuel consumption, the suspension counters the weight loss by slowly adjusting the ride height.

Air Harness

- The rear air harness is integrated into the electrical harness; the front air harness is routed underneath the floor and within the engine compartment.
- The front harness has a 6mm diameter; the rear harness has a 4mm diameter. This difference in diameter is to balance the response time in air spring actuation and exhaust, in respect to the distance of the springs from the valve block and reservoir.
- The harness tubes are color coded to ensure correct installation; refer to 'JTIS'.
- The harness is manufactured from Polyamide tube, which has good abrasion resistance properties.

System Operation

This subsection discusses the base operation of the air suspension system and should be read in conjunction with the subsection **Operating Modes and Strategies**.

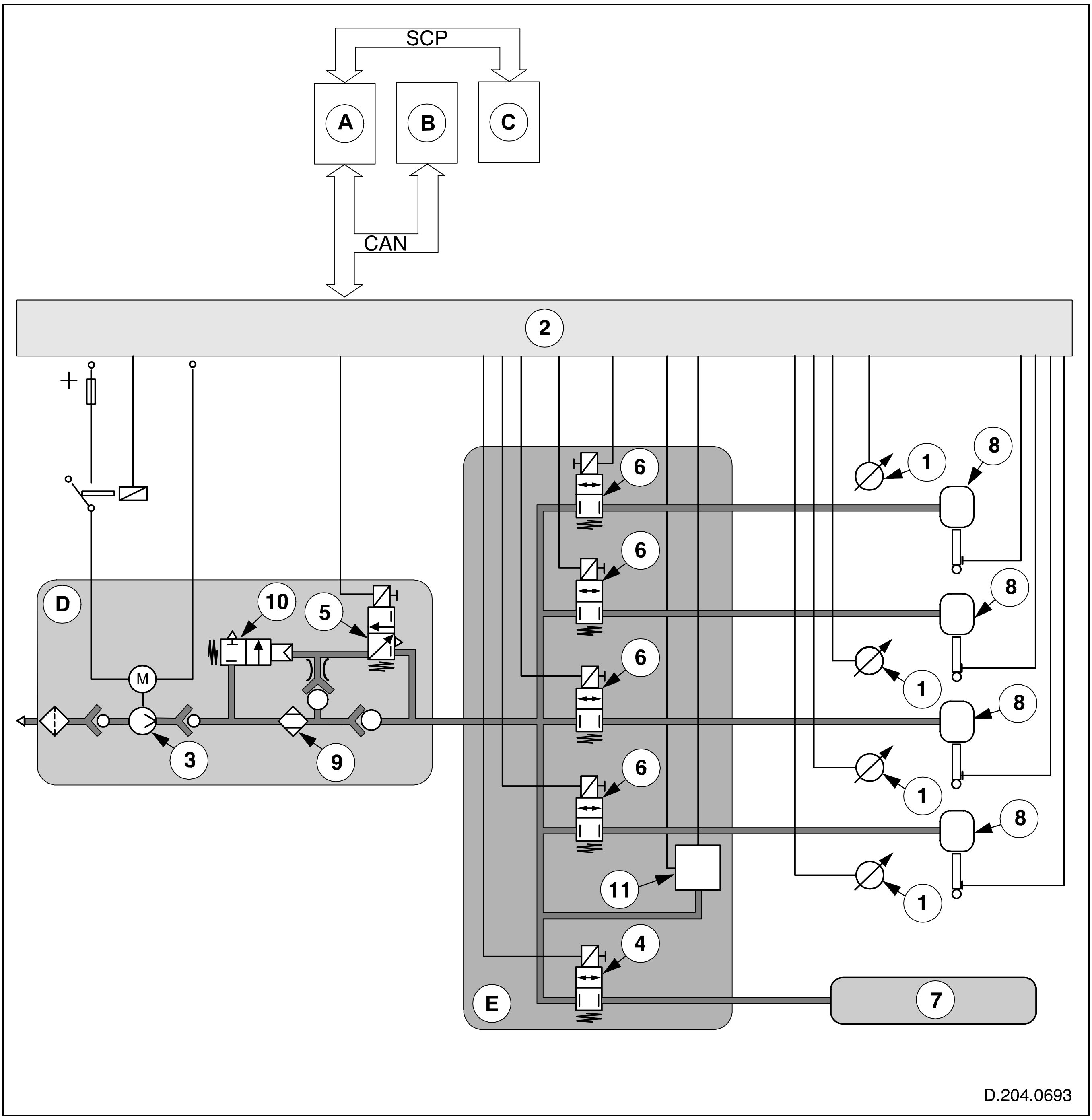

Fig. 9 System diagram

Key to Fig. 9

A. Instrument cluster - provides signals of vehicle system status
B. ABS module - provides vehicle speed signals
C. REM - provides trailer tow, brake switch on/off status and system switch power (SSP) signals
D. Air compressor unit
E. Valve block
1. Height sensors
2. Air suspension module (ASM)
3. Air compressor motor
4. Reservoir solenoid
5. Vent solenoid
6. Air spring solenoid valves
7. Reservoir
8. Air springs
9. Air drier
10. Relay valve
11. Pressure sensor

- The height sensors (**1**) monitor the distance between the vehicle's suspension and body. In response to changes in ride height, the electronic signals from the sensors reflect the height changes. These signals are monitored by the ASM (**2**), and compared to stored reference values. The ASM calculates this information to either raise or lower the vehicle and retain a constant suspension level.
- To raise the vehicle the ASM, depending on vehicle status, activates either:
  – the electric motor of the compressor (**3**), or
  – the reservoir solenoid (**4**).
- To lower the vehicle the ASM activates the vent solenoid (**5**).
- Every process simultaneously causes the air-spring solenoid valves (**6**) to be actuated to allow air to flow, to and from the air springs.
- When the vehicle is being raised:
  – the compressor motor (**3**) via air drier (**9**), or the
  – reservoir (**7**) via the reservoir solenoid (**4**),
  – delivers air into the air-spring bellows (**8**) until required height has been reached.
- When the vehicle is being lowered, the air flows from the air spring bellows (**8**), through the vent solenoid (**5**) of the air drier (**9**), via the relay valve (**10**) and evacuated to atmosphere.
- The pressure sensor (**11**) is incorporated to monitor spring and reservoir pressure. The ASM uses the pressure sensor data plus the data received via the CAN relating to vehicle status, to determine whether to raise the vehicle using the compressor or the reservoir reserves.

Operating Modes and Strategies

The ASM provides a number of air suspension operational modes dependent on the vehicle state:

Transportation Mode

Vehicles arrive at dealers in transportation mode and will need to be switched, using WDS, to customer mode.

- Transportation mode levels the vehicle to 15mm above the standard ride height to avoid ground clearance issues when loading the vehicle on to transporters, ships, etc.
- When the engine is running the compressor only is used to level the vehicle, independent of road speed.
- When in transportation mode the message center will continuously display 'Air Suspension Fault' until the vehicle is switched to customer mode.

WARNING: Once the vehicle has been switched to 'customer mode', body-securing straps/chains must not be used to secure the vehicle to a recovery transporter. Use straps over the wheels/tires only, to secure the vehicle to the transporter.

Leveling Strategy

- Raising has priority over lowering.
- The rear axle will rise before the front axle.
- The front axle will lower before the rear axle.
- To compensate for uneven loading of the vehicle, the rear air springs are regulated individually, this means the comparison of the nominal and actual level is performed for both sides individually.
- As front loading is not as extreme as rear loading, and to allow for a stable adjustment process, the front air springs are regulated and adjusted as a pair.

Customer Mode

The modes diagram below shows the transitions between the different modes within customer mode, these modes are dependant on various ASM input signals and the switched system power (SSP) signal. The SSP signal is functioned by the rear electronic module (REM) and is used to monitor and switch the modes, as necessary, when the ignition key is removed.

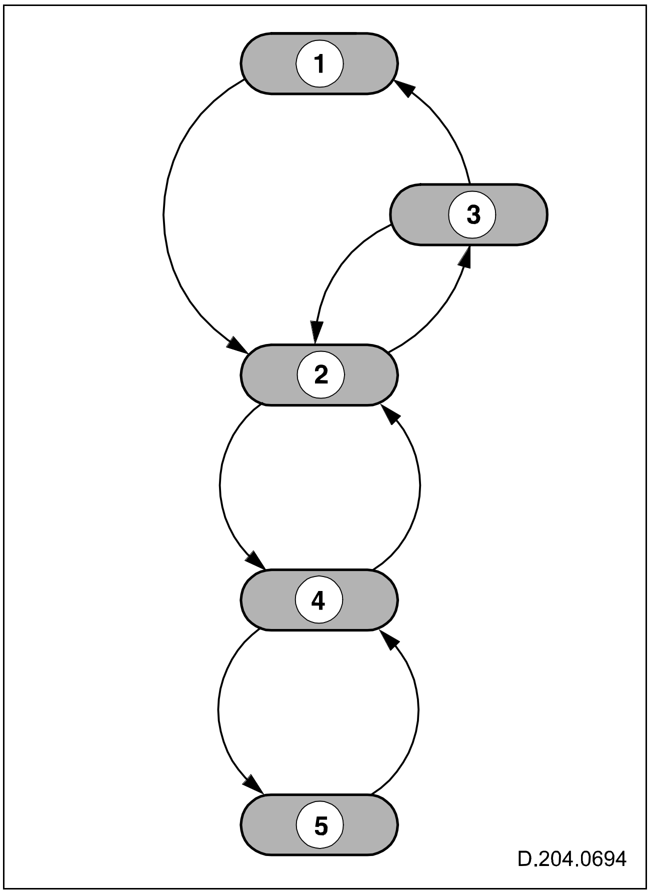

Fig. 10 Customer modes

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

NOTE: Ambient temperatures affect the vehicle ride height; the suspension lowers as the ambient temperature lowers, and rises as the ambient temperature rises.

1. Sleep Mode
   Sleep mode is invoked approximately thirty minutes after the ignition is switched off and the last door or luggage lid activity has been detected. The air suspension system shuts down when the vehicle is not in use and automatically wakes up every twenty-four hours to check the vehicle ride height. Twenty-four hour multiples are used to avoid temperature variation, for example to avoid the variability between day and night temperatures.
   If the suspension level requires correcting, the suspension's lowest corner will be used as the height value and the suspension will be lowered to meet that height. If the suspension lowers to the minimum height, the ASM makes no further adjustments. To conserve reservoir pressure and battery power the system does not raise the ride height when in sleep mode.
   When the SSP signal detects a door or luggage lid activity the suspension will switch to preliminary mode.
2. Preliminary Mode
   This mode is activated by any of the three following actions:
   - The SSP signal detecting a door or luggage lid activity when in sleep mode.
   - The SSP signal detecting a door or luggage lid activity when in post mode.
   - Switching the engine 'off' in stance mode.

   To avoid excessive leveling actions during vehicle loading/unloading, the ride height tolerances in preliminary mode are greater than those used in stance and drive modes. In preliminary mode the ride-height is raised using the reservoir's supply only. Suspension lowering is also functioned if necessary. The height sensors use a fast filter signal to enable a quick leveling response to load changes; refer to **Height Sensors**.
   The preliminary mode will switch to either of the two following modes depending on signals transmitted to the ASM:
   - If the engine is started the suspension will switch to stance mode.
   - When there has been no loading/unloading or door activity for a predetermined length of time, the SSP instructs the ASM to switch to post mode.

3. Post Mode
   Post mode is activated if SSP detects no loading/unloading or door activity for a predetermined length of time in preliminary mode.
   Post mode will raise the vehicle to the standard ride height if there is enough pressure within the reservoir. Compressor function is inhibited.
   The post mode will switch to either of the two following modes depending on signals transmitted to the ASM:
   – If the SSP signal detects a door or luggage lid activity the suspension will switch to preliminary mode.
   – If a predetermined amount of time elapses with no loading/unloading or door activity, the suspension will switch to sleep mode.
4. Stance Mode
   The ASM switches from preliminary mode to stance mode when the vehicle is stationary and the engine is started.
   The vehicle is leveled to a tighter tolerance to ensure the ride height is correct before vehicle moves off. The ride height is raised using the reservoir's supply, unless the vehicle is below a minimum height and the reservoir's supply is depleted. In this event the compressor is used to raise the vehicle. The height sensors use a fast filter signal to enable a quick leveling response to load changes; refer to **Height Sensors**.
   The stance mode will switch to either of the two following modes depending on signals transmitted to the ASM:
   – If the vehicle accelerates above 1 km/h (0.6 mile/h) the suspension will switch to drive mode.
   – If the engine is switched 'off' the suspension will switch to preliminary mode.
5. Drive Mode
   The ASM switches from stance mode to drive mode when the vehicle accelerates above 1 km/h (0.6 mile/h).
   Above a predetermined road speed, the compressor is used to raise the vehicle ride height. This mode is also used to replenish the reservoir. The height sensor filtering is switched to slow filter at speeds above 1 km/h (0.6 mile/h), although this will change to fast filter when leveling occurs; refer to **Height Sensors**.
   If vehicle speed is lower than 1 km/h (0.6 mile/h), the ASM switches to stance mode.

Additional Modes and Strategies

- Speed Lowering Mode
  The speed-lowering mode is a function of drive mode:
  – When the vehicle maintains a speed of 160 km/h (100 mile/h) or above, and 10 seconds elapse, the suspension lowers 15 mm below the standard ride height.
  – The suspension returns to the standard ride height when the vehicle speed decreases below 140 km/h (88 mile/h) and 5 seconds elapse.
- Towing Mode
  The ASM inhibits the speed lowering function when the vehicle is towing.

  WARNING: The towing mode inhibits speed lowering, when using Jaguar approved towing equipment only.
- Rough Road Detection
  The ASM inhibits the speed lowering function when a rough road surface is detected; the vehicle is raised to the standard ride height to ensure passenger comfort.
- Leveling Inhibits
  The ASM recognizes significant cornering, braking and acceleration actions and inhibits suspension leveling during these periods.
- Jacking Mode
  The ASM detects when the vehicle is being raised using jacking equipment by monitoring height changes at the individual wheels. The ASM will initially attempt to adjust the suspension, but will recognize that the vehicle height is not responding as normal and inhibit suspension leveling.
  A suspension inhibit will also be initiated when the vehicle is suspended on a lift, and all four-wheels are being lowered. In this condition, when the suspension travel exceeds a predetermined value, air exhausting will be inhibited.
  The inhibit function will remain initiated until the vehicle height returns to normal, or a wheel speed signal of 3 km/h (2 mile/h) is detected.
- Inclination Mode
  The ASM activates the inclination mode when the vehicle is parked on an uneven surface for example, with one wheel on a curb. If the ASM detects what is effectively a sufficient twist between the front and rear axles, the axles will be leveled as a pair. This avoids suspension leveling when the vehicle is moving away.
- Diagnostics
  System fault codes are stored in the ASM for diagnosis using worldwide diagnostic system (WDS).

Adaptive Damping

The adaptive damping system also known as computer active technology suspension (CATS) has been enhanced to improve vehicle:

- control when accelerating and braking;
- stability when making lane change maneuvers;
- stability and comfort when cornering.

As with the previous version the dampers, depending on road and vehicle dynamic conditions, are switched between:

- a 'soft' setting for a comfort saloon ride, or
- a 'firm' setting for a stiffer sports ride.

Further enhancements made to the system can now function the damper settings to switch in pairs:

- front or rear,
- left or right (inside or outside when the vehicle is cornering).

Adaptive damping is fully automatic, with no visual indication communicated to the driver when the dampers switch between settings.

System Functionality

The dampers are switched between a 'soft' or 'firm' setting by electronics integrated into the air suspension module (ASM); refer to **Air Suspension**. Various vehicle status values are processed by the ASM; refer to **Fig. 11**. The ASM compares this data with stored data and starts a programmed arithmetic process (algorithm) to calculate the optimum setting to apply to the dampers at a specific vehicle state. For example, when the vehicle is either: braking, accelerating or cornering.

The damper-setting control signals are transmitted to an actuator integrated into each of the dampers. The actuators change the speed of damper piston movement by altering the rate of fluid-flow within the dampers:

- Soft setting - maximizes fluid flow to produce less resistance, therefore a quicker piston movement.
- Firm setting - minimizes fluid flow to produce more resistance, therefore a slower piston movement.

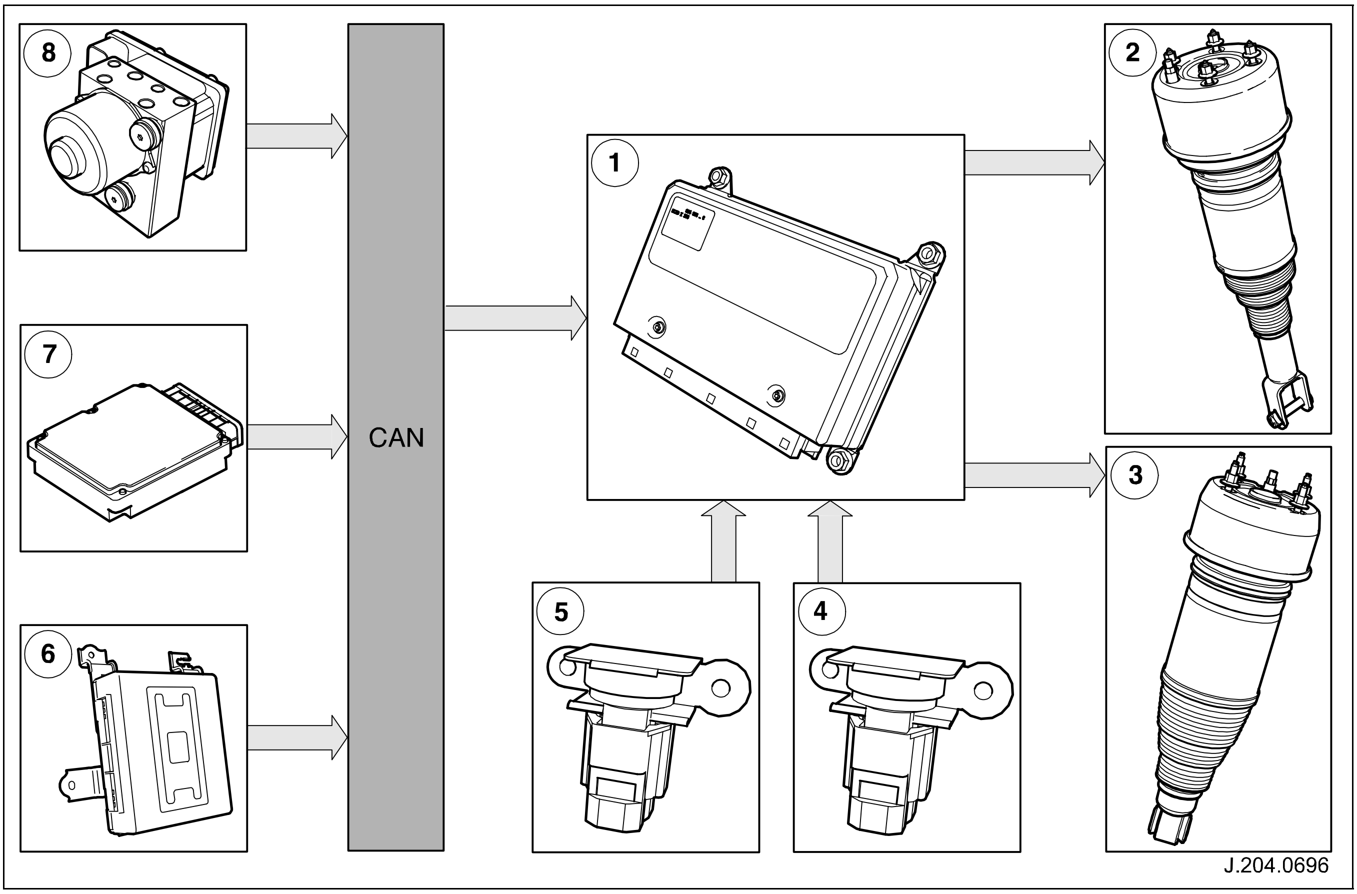

Fig. 11 Control system diagram

1. Air suspension module
2. Front damper (integral with air spring)
3. Rear damper (integral with air spring)
4. Front vertical accelerometer
- vertical acceleration
5. Rear vertical accelerometer
- vertical acceleration
6. Climate control module
- ambient air temperature
7. Engine control module
- engine speed
- engine torque
8. ABS module
- brake line pressure
- vehicle reference speed
- lateral acceleration
- steering wheel angle
- steering wheel velocity

Adaptive Damping Strategy

The following strategies are an overview only.

Under normal driving conditions, the adaptive damping system adopts the following strategy:

- At system start-up and up to 1 km/h (0.6 mile/h) the system will be set to 'firm'. This is the default setting in the event of a malfunction.
- At 1 km/h (0.6 mile/h) the setting is switched to 'soft' to provide a saloon-ride comfort.
- At speed of 145 km/h (90 mile/h) and above, the system is switched to 'firm'. This setting provides further vehicle stability at higher speeds.

Using the above strategy as a base, the adaptive damping system adopts the following strategies to adjust to changes in vehicle dynamics, road conditions and ambient temperatures:

- Braking
  The front dampers switch to 'firm' slightly before the rear dampers to prevent the front of the vehicle lowering.
- Acceleration
  To maintain optimum vehicle control when accelerating the 'firm' damper setting is adopted.
- Cornering
  The front and rear algorithm improves the stability and comfort performance of the vehicle during cornering:
  - At low speeds, the rear dampers switch to 'firm' slightly before the front dampers to reduce transient understeer.
  - At high speeds, the front dampers switch to 'firm' slightly before the rear dampers to increase transient understeer.

  If the vehicle is still cornering after the front-rear algorithm has finished, the left-right algorithm checks if the inner dampers can be switched to 'soft'. If initiated this further switching helps to generate less motion in the vehicle, and maintains the driven wheels with a more consistent contact with the road surface.
- Long Wave Detection
  The two vertical accelerometers identify natural vehicle-body undulations when the vehicle is traveling on a relatively straight road. In these circumstances, the 'firm' damper setting is adopted as this increases the ability of the vehicle's wheels to follow the contours of the road surface, therefore counteracting vertical-body undulations and increasing tire to road contact. The dampers will switch back to 'soft' when vehicle body undulations subside. The vertical accelerometers are located:
  - Front: right-hand-front wheel arch.
  - Rear: left-hand-side of luggage compartment.

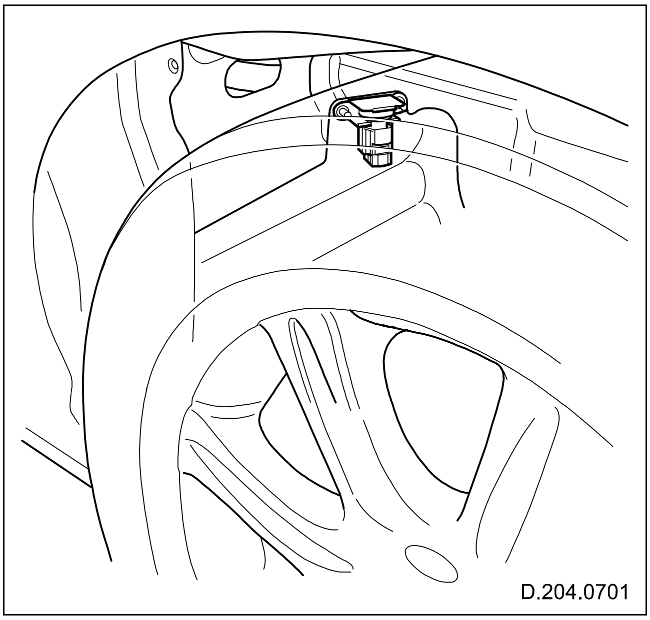

Fig. 12 Front vertical accelerometer

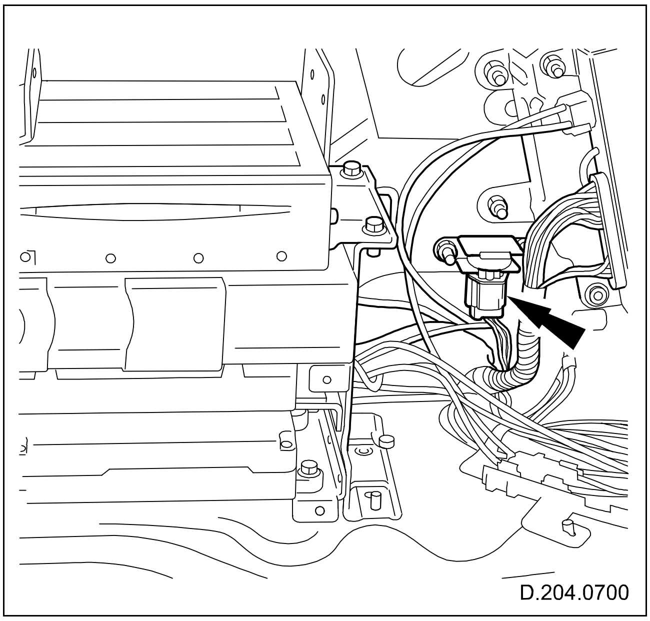

Fig. 13 Rear vertical accelerometer

- Cold Environment
  To improve air-suspension performance in cold environments, when the damper fluid is thick (high viscosity) making damper movement slow, the dampers are switched to the 'soft' setting. This maximizes fluid-flow within the damper when the air-suspension is either lifting or lowering the vehicle. This function operates below a preset vehicle speed and ambient air-temperature.
- System Malfunction
  The 'firm' damper setting provides greater vehicle stability at all driving conditions and has a higher priority than the 'soft' setting. Therefore, in the event of a malfunction in the adaptive damping or air-suspension systems the dampers will default to the 'firm' setting.
- Diagnostics:
  System fault codes are stored in the ASM for diagnosis using worldwide diagnostic system (WDS).

Driveline

Driveshaft

- A new two-piece driveshaft manufactured of lightweight steel is used, which comes in two derivatives to accommodate both powertrain applications:
  - V6 engine with automatic transmission.
  - V8 engine with automatic transmission.
- The driveshaft aligns with the centerline of the vehicle's body and is supported in a rubber center bearing.
- The driveshaft comprises the following:
  - Rubber couplings at each end of the driveshaft.
  - Center Hookes joint.
  - The driveshaft's front-tube is of swage construction, designed to collapse in a controlled manner in the event of the vehicle being involved in a front-end collision.
  - Low friction splines at the center of the driveshaft provide the driveshaft's plunge capability. There is no spline-locking feature on this driveshaft.

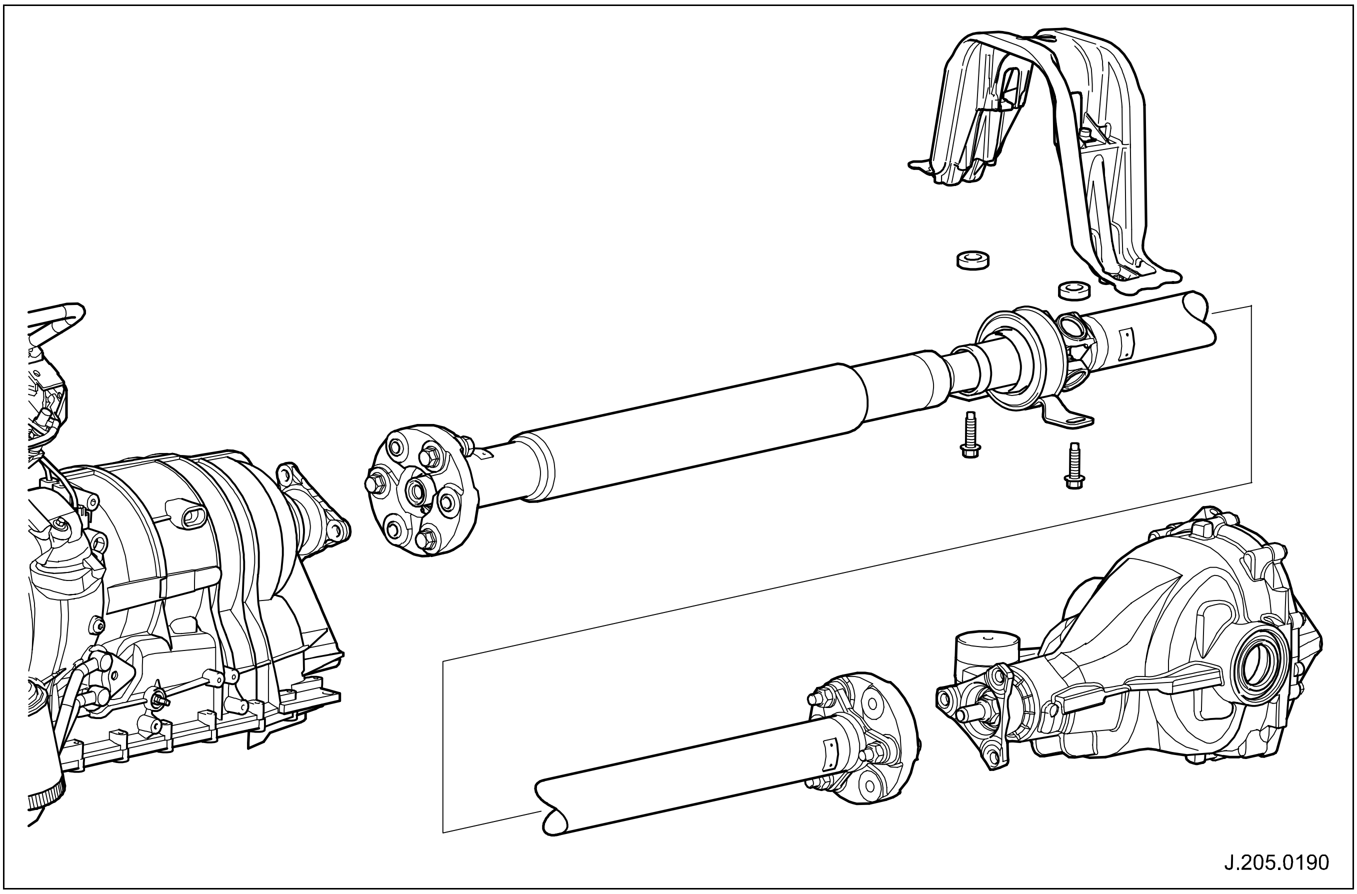

Fig. 14 Driveshaft and final drive unit

Final Drive Unit

- The final drive unit is supported at three mounting points, one at the front of the unit, and two at the rear, through rubber bushes to the vehicle's rear subframe. This mounting arrangement plus the subframe to vehicle-body mounting arrangement, refer to the **Suspension** section, provides the rear driveline with double isolation from the vehicle's body.
- The final drive unit is constructed of a new lightweight cast-iron main casing, with an aluminum rear cover.
- The pinion shaft aligns with the centerline of the vehicle's body and is supported by two taper-roller bearings.
- The hypoid-gear set is supported by taper roller bearings.
- The final drive lubricant is fill for life; the level-plug is located in the rear cover.
- Final drive ratios:
  - V6 3.0 liter - 3.31:1
  - V8 3.5 liter - 3.07:1
  - V8 4.2 liter normally aspirated - 2.87:1
  - V8 4.2 liter supercharged - 2.87:1

Axle Shafts

- There are two derivatives of axle shaft:
  - V6 and V8 normally aspirated engines: tubular axle-shafts including constant-velocity joints with high-torque capacity.
  - V8 supercharged engine: solid axle-shafts including constant-velocity joints with high-torque capacity.
- The left-hand and right-hand axle shafts are different lengths.
- The inboard constant-velocity joint is a sliding arrangement, providing the axle shaft's plunge capability. The outboard constant-velocity joint is fixed.
- The axle shaft is a spline interference-fit into the wheel hub, and a spline slide-fit into the final drive unit retained by a spring circlip.

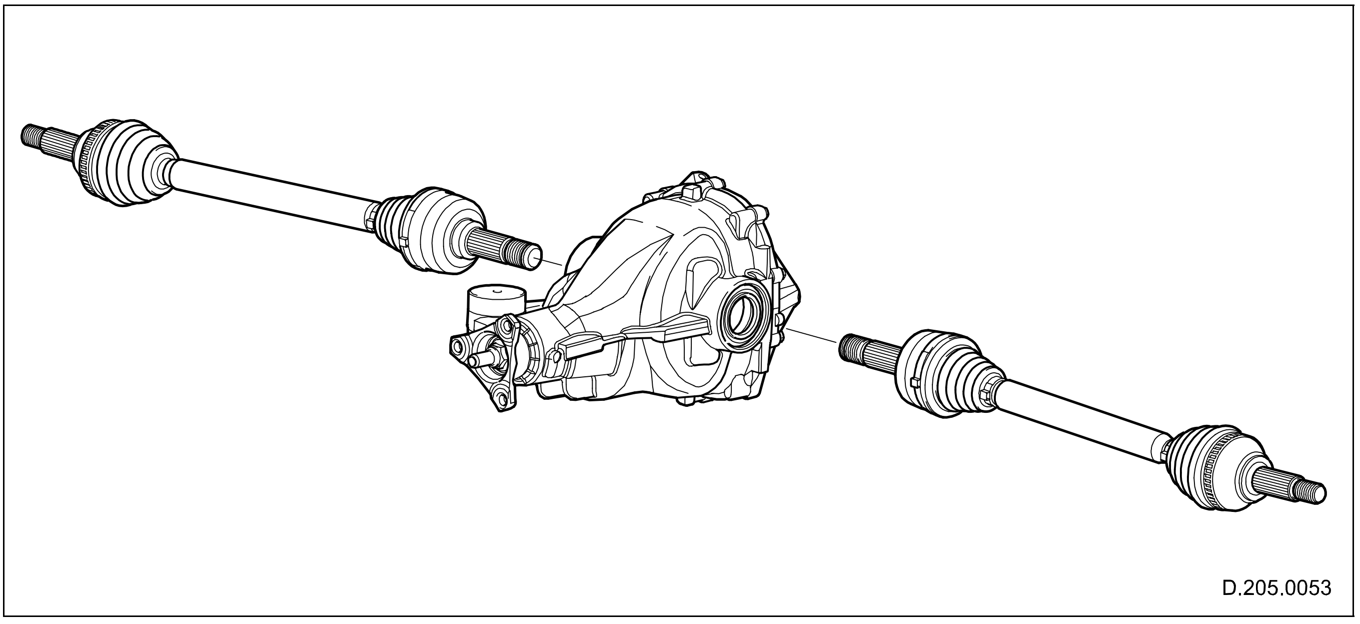

Fig. 15 Axle shafts and final drive unit

Brake System

Introduction

The XJ incorporates a new braking system comprising the following components and functions:

- Panic brake assist.
  - An enhancement to the anti-lock braking system (ABS).
- Dynamic stability control (DSC).
  - Incorporates all new hardware.
- Electric parking brake.
  - Refer to **Electric Parking Brake**.
- Pedal-adjustment system.
  - Refer to **Pedal-adjustment System**.

To complement the new braking system and further enhance the vehicle's braking capability the foundation brakes have also been upgraded:

Front calipers:

- Normally aspirated vehicles incorporate a double-piston sliding arrangement.
- Supercharged vehicles incorporate a Brembo monobloc four-piston fixed arrangement.

Rear calipers:

- Normally aspirated vehicles incorporate a single-piston sliding arrangement with a self-adjusting mechanism.
- Supercharged vehicles incorporate a Brembo two-piece four-piston fixed arrangement; the electric parking brake uses a separate caliper.

Steel-braided brake hoses are installed, 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:

Components	Normally Aspirated Vehicles	Supercharged Vehicles
Ventilated Front Discs 320 x 30	X	
Solid Rear Discs 288 x 20	X	
Aluminum Front Caliper	X	
Rear Aluminum Caliper	X	
Brembo Front Ventilated Disc 365 x 32		X
Brembo Rear Solid Disc 330 x 15		X
Brembo Front Caliper		X
Brembo Rear Caliper		X
Electric Parking Brake	X	X
Separate Rear Brake Caliper		X
Steel Braided Hoses - Front and Rear	X	X

Table 3 Brake components

Brake Booster and Master Cylinder

The active brake booster is used to provide the panic brake assist function. The booster also provides improved crash capability, with the elimination of the internal retaining studs as used on the previous booster.

A short-stroke master-cylinder, offering less protrusion from the booster, is incorporated to provide improved packaging and crash performance. The master-cylinder is of tandem design, which in the event of one brake circuit failing, the other circuit will remain operational. An integral fluid-level switch is incorporated in the master-cylinder's reservoir. If brake fluid is low, the brake warning light in the instrument cluster will illuminate and 'LOW BRAKE FLUID' will be displayed in the message center.

The pressure transducer attached to the master-cylinder provides the ABS/DSC module with brake pressure information. This information informs the system how hard the driver is braking and is used as an aid for the DSC to achieve accurate brake pressure control.

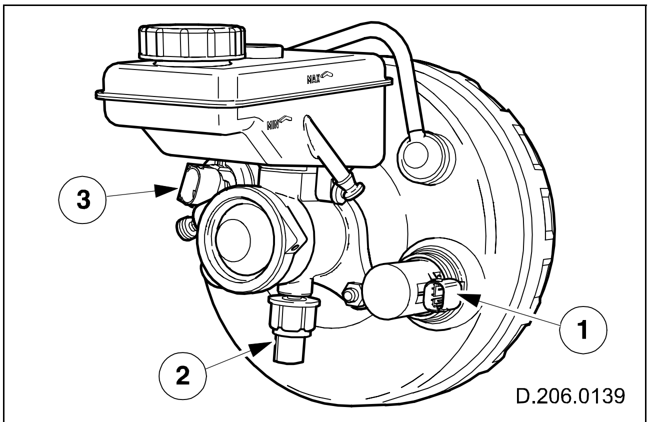

Fig. 16 Active brake booster

1. Diaphragm travel sensor
2. Pressure transducer
3. Solenoid connector

Panic Brake Assist

In an emergency braking situation, a driver presses down on the brake pedal much faster than in normal braking conditions, but often without sufficient force. The initial application of the brake pedal is a reflex reaction. After the initial application, many drivers do not brake hard enough because of concerns that they might cause the vehicle to skid. To aid the driver, the panic brake assist (PBA) intervenes in bringing the vehicle to a halt, sooner and in a controlled manner, in emergency braking situation. The PBA system monitors the speed of brake pedal activation, and at a calibrated pedal activation speed, the PBA provides maximum brake force and makes full use of the ABS.

PBA is controlled by the ABS/DSC module, which monitors a travel sensor attached to the internal vacuum diaphragm of the brake booster. The sensor determines the position of the diaphragm and the speed of the diaphragm movement. If the sensor's signal indicates an emergency braking situation, the ABS/DSC module will open an electric solenoid on the brake booster. The solenoid directs 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/DSC module instantly releases the brakes.

Anti-lock Braking System

The anti-lock braking system (ABS) is a four-channel system having independent inputs from all four-wheel speed sensors. The ABS module, monitors signals from the sensors to calculate: brake slip, acceleration and deceleration of individual wheels. When the brake pedal is depressed, and the ABS module detects incipient wheel lock-up from the incoming signals, it triggers the re-circulation pump inside the module's 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 illumination of the brake warning light and 'ABS FAULT' displayed in the message center. 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

Traction control is a function of dynamic stability control (DSC), and is operated in association with the DSC system; refer to **Dynamic Stability Control** 'Driver Interface and Control' subsection.

Traction control prevents excessive wheel-spin at standing starts, or during acceleration. Wheel-spin is usually caused by excessive use of the accelerator pedal, or slippery, loose or bumpy road surfaces. To prevent excessive wheel-spin and maintain vehicle stability such situations are 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 and control to enable the system to generate braking pressure at the calipers. An engine interface also enables 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 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 ABS/DSC module calculates the torque, which should be applied by the engine to reduce the wheel-slip (this torque does not 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.

A traction control gearshift pattern is automatically selected within the automatic transmission software whenever traction control is active.

Brake Intervention

This function operates by increasing the pressure in the brake caliper of the slipping wheel, 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 modulated at the caliper via the inlet and outlet valves to achieve the desired wheel-slip target to maximize traction.

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 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:

- 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' at the rear wheels. This motion is counteracted by applying the brake at the right-hand front wheel to provide 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' at the front wheels. Applying the brakes at the left-hand rear wheel to generate a corrective yaw moment to help to turn the vehicle can counteract this motion.
- Even when the tires are at the limits of their grip, such as in sharp steering maneuvers due to driver 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 and Control

- DSC is switched 'On' when the engine is started.
- When the system is operating, the DSC light in the instrument cluster will flash, at the rate of twice a second.
- DSC can be switched 'OFF' by pressing the control switch, located on the J-gate surround.
  - The DSC light in the instrument cluster will illuminate continuously when the system is switched 'OFF'.
  - 'DSC OFF' 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 by the following:
  - The DSC light in the instrument cluster will illuminate continuously.
  - The message 'DSC NOT AVAILABLE' will be displayed in the message center.
- If vehicle speed control is engaged it will automatically disengage when traction control is operating.

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.

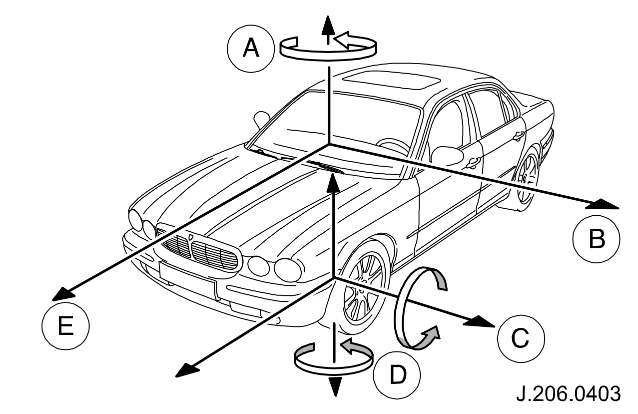

Fig. 17 Vehicle travel directions

A. Yaw rate

B. Lateral acceleration

C. Wheel roll

D. Steering motion

E. Longitudinal acceleration

The ABS/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;
- Yaw rate, defined as the rotation around the vertical axis, as measured by the 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 traction control combined, while relying on the components of these systems. It also incorporates these additional sensors for measuring the vehicle's motion and brake system pressure:

- Yaw rate sensor - located to the rear of J-gate in the transmission tunnel;
- Lateral acceleration sensor - integrated with the yaw rate sensor;
- Steering angle sensor - located on the upper steering column;
- Pressure transducer - located on master cylinder.

The ABS/DSC module supports data exchange with other vehicle electronic systems via the CAN; the module also enables diagnostic interrogation using WDS.

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

- Electronic engine control system: position of accelerator pedal.
- Brake master cylinder pressure transducer: 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 ABS/DSC 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 ABS/DSC module is to determine the current vehicle status based on the yaw-rate signal and the slip as estimated by the ABS/DSC 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 ABS/DSC module controls the selected wheels using the ABS hydraulic system and engine control system. In the event of engine intervention the ABS/DSC module calculates the torque which should be supplied by the engine to the wheels, and relays this request signal to the 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, 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.

Electric Parking Brake

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

- Space - deletion of the 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.

Overall control of the electric parking brake is via a control module, which controls an actuator unit to operate the rear brake calipers. The control module, depending on the vehicle status, is either functioned by the driver-operated switch, or various control signals to apply or release the parking brake.

Components

The electric parking brake comprises the following components:

- Switch - mounted in the floor console.

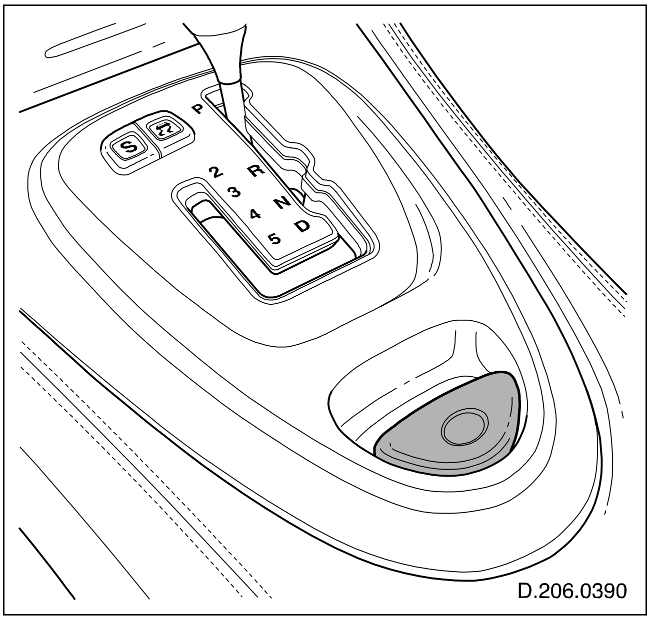

Fig. 18 Parking brake switch

- Parking brake module - located behind the trim, on the right-hand-side of the luggage compartment.

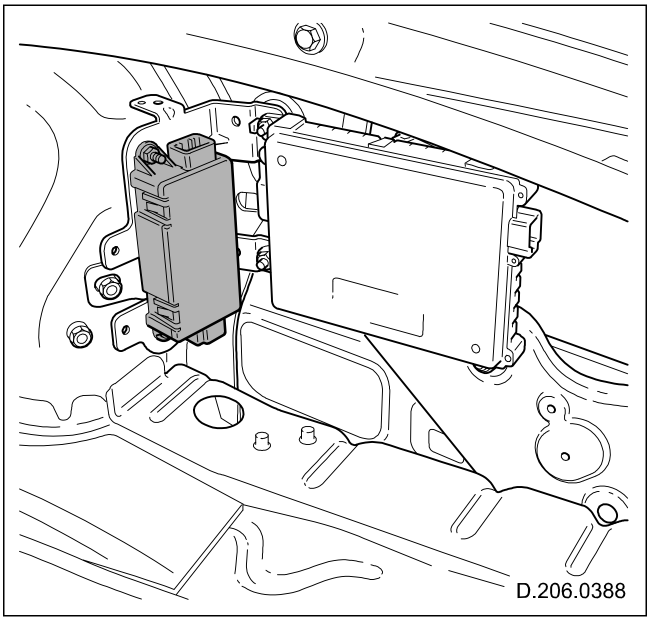

Fig. 19 Parking brake module

- Motorized actuator unit and cables - mounted on the rear subframe.
  - The actuator mounting and cable routing is different on normally aspirated and supercharged vehicles to correspond with the positioning of the calipers.
  - On normally aspirated vehicles, the brake and parking brake caliper is a combined unit.
  - On supercharged vehicles, the brake caliper and parking brake caliper are separate units.

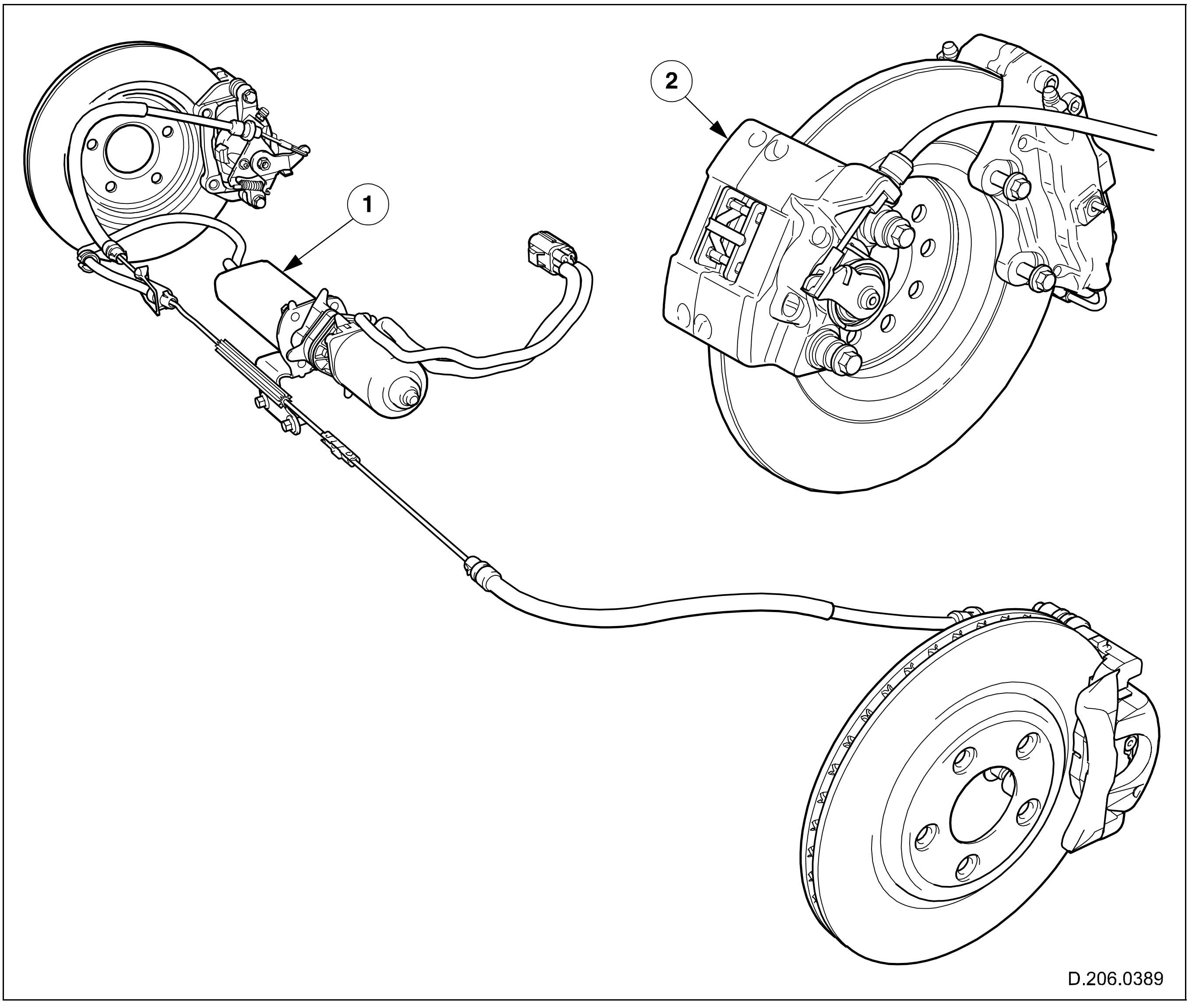

Fig. 20 Actuator unit and cables

1. Actuator unit and cables - normally aspirated vehicle arrangement
2. Parking brake caliper - supercharged vehicle arrangement

Driver Operation

The parking brake switch is mounted on the floor console, to the rear of the gear selector. The switch is a pull/push operation providing the following functions:

Pull up - applies the parking brake.

Neutral - central default position; the switch, when released by the driver, returns to this position regardless of parking brake state.

Push down - releases the parking brake.

The parking brake can be applied in two ways:

1. Pull the switch up and then release. The 'Brake' warning light on the instrument cluster will illuminate to confirm parking brake application.

NOTE: The 'Brake' warning light, on the instrument cluster, will remain illuminated for a short period if the ignition key is turned to position '0' or the key is removed.

2. The parking brake will automatically apply when the ignition key is removed.

The parking brake can be released in three ways:

1. With the ignition switch in position 'II' or with the engine running, apply the footbrake and push the switch down.
2. The parking brake will automatically release when the gear selector is moved from the park 'P' position.
3. With the parking brake applied and the gear selector in either drive 'D' or reverse 'R'. The parking brake will automatically release when the accelerator pedal is depressed.

NOTE: The 'Brake' warning light, on the instrument cluster, will extinguish to confirm parking brake release.

In circumstances when the parking brake needs to be released when the ignition key is removed:

- hold the parking brake switch down,
- at the same time, remove the ignition key.

CAUTION: Ensure the vehicle's wheels are securely wedged, if parking the vehicle with the parking brake released.

Drive-away Release

Drive-away release is activated when the gear selector is in either drive 'D' or reverse 'R' and a positive throttle angle is detected. The ECM, via the SCP BUS, provides the throttle position signals.

Safety Functions

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

If the parking brake is applied while the vehicle is moving, the message 'PARK BRAKE ON' will be displayed on the message center, the 'Brake' warning light will illuminate, and a warning chime will sound.

To release the parking brake while the vehicle is moving:

- Push the 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.

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:
  - Pulling-up the switch, results in the parking brake applying at full force.
- Low Speed Dynamic - speeds between 3 and 32 km/h (2 and 20 mile/h), in this mode:
  - The Parking brake applies at full force to the corresponding time the switch is pulled-up and held therefore, the parking brake will apply until the switch is depressed 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. Each subsequent pull and release of the switch will apply the parking brake for 250 ms. Full parking brake force will be achieved 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

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 position memory. On battery connection, ‘APPLY PARK BRAKE’ will be displayed, in the message center, when the ignition is next switched on. This indicates the parking brake requires re-setting.

To reset the parking brake:

- with the foot brake depressed,
- pull-up and release the parking brake switch.

Service

To allow work to be performed on the rear calipers, a special tool is available to release parking-brake cable tension; refer to ‘JTIS’.

Parking brake adjustment:

- An initial setting is necessary when replacing the brake pads; refer to ‘JTIS’. After the initial setting, the parking brake adjusts automatically with use of the vehicle.

Diagnostics

Diagnosis of the electric parking brake system is achieved using ‘WDS’.

Actuator Internals

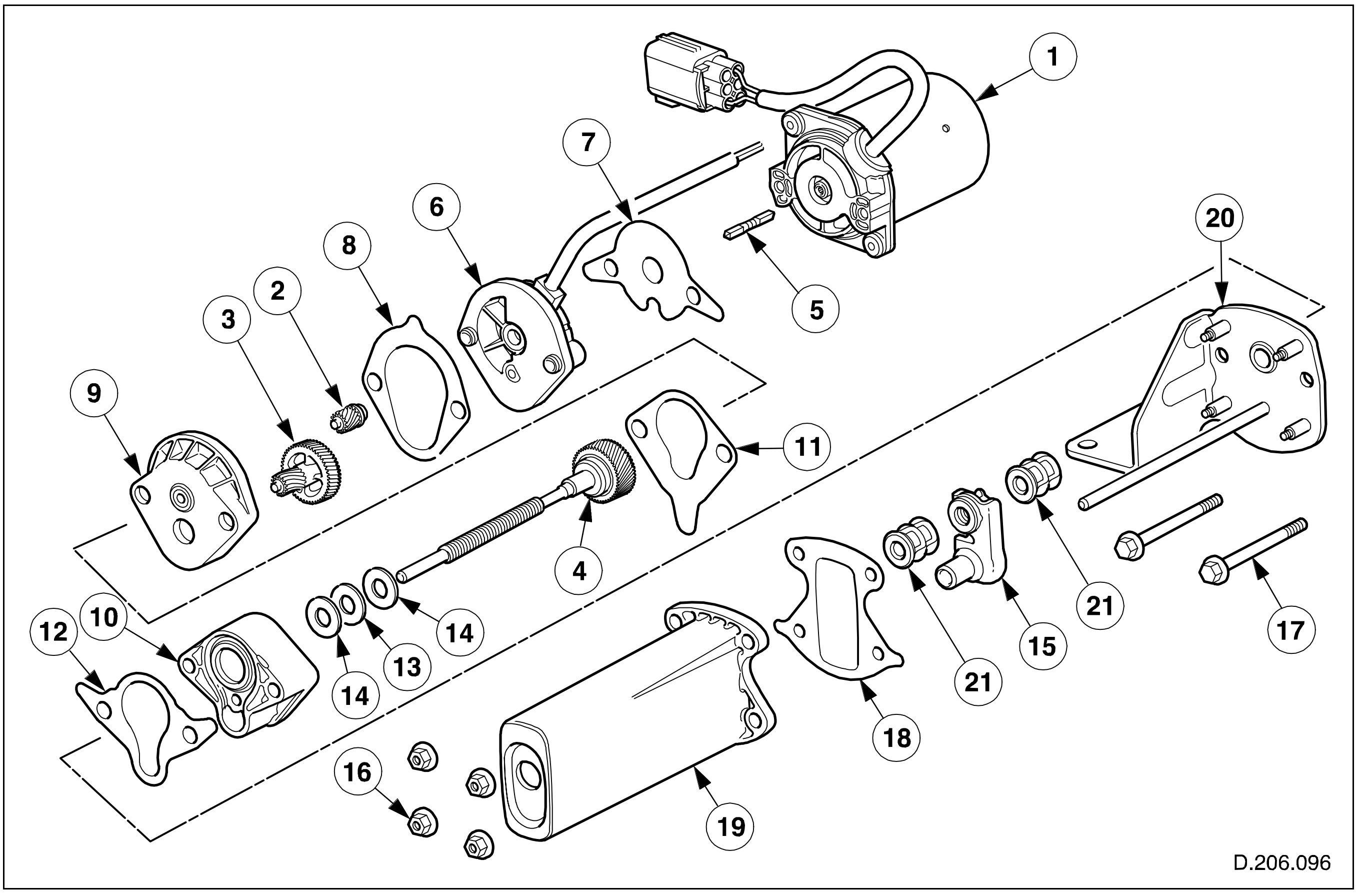

Fig. 21 Motorized actuator unit — internals

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

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:

- front electronic module (FEM);
- pedal-adjustment motor;
- pedal-adjustment sensor;
- pedal-adjustment switch.

NOTE: The motor and sensor are part of the accelerator-pedal assembly.

The front electronic module (FEM) 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, three different pedal-position settings may be stored in the vehicle memory-system.

Fig. 22 shows the basic system interconnections; refer to **New XJ Range Electrical Guide** for detailed information.

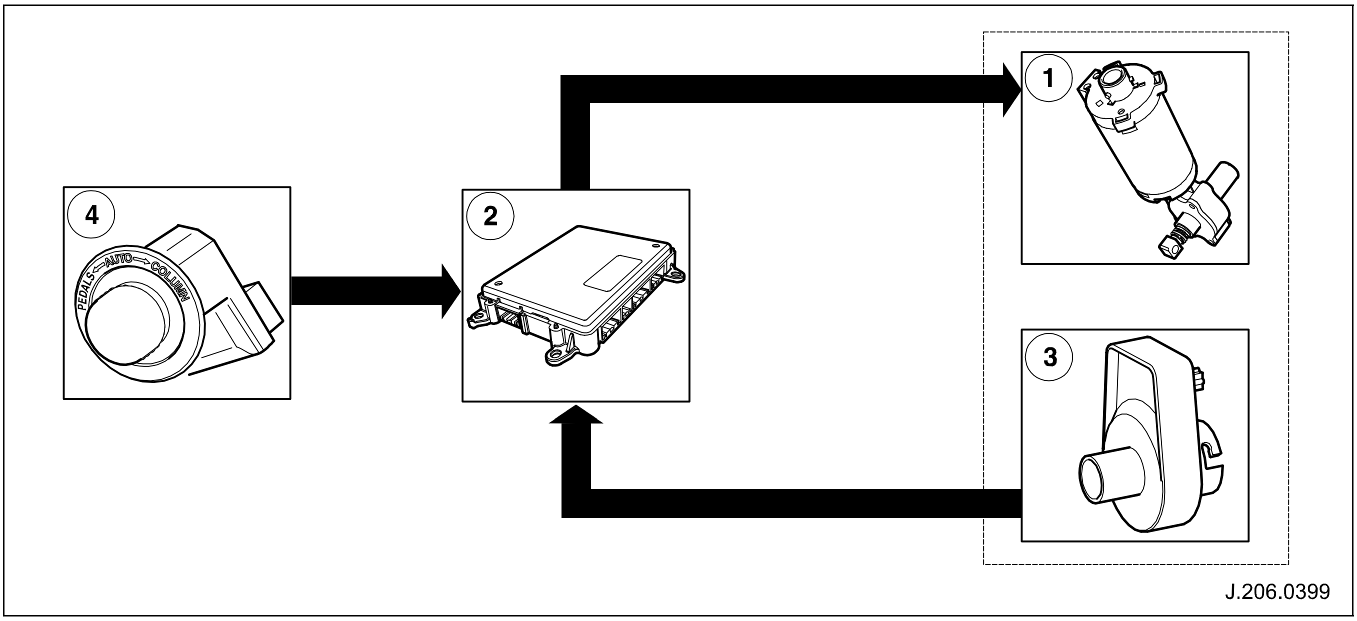

Fig. 22 Pedal adjustment system

1. Pedal-adjustment motor
2. Front electronic module
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.

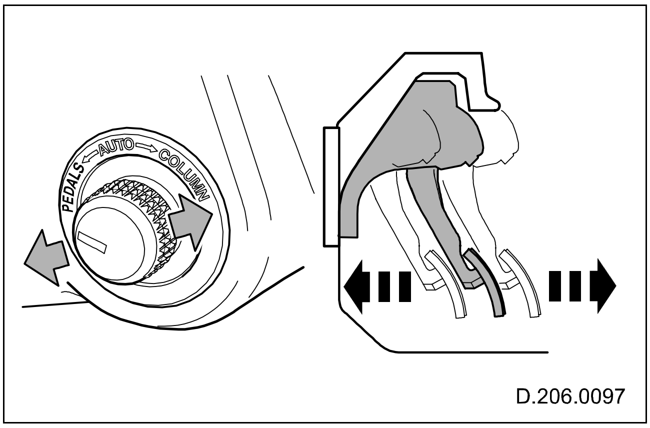

Fig. 23 Pedal-adjustment switch

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'.

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

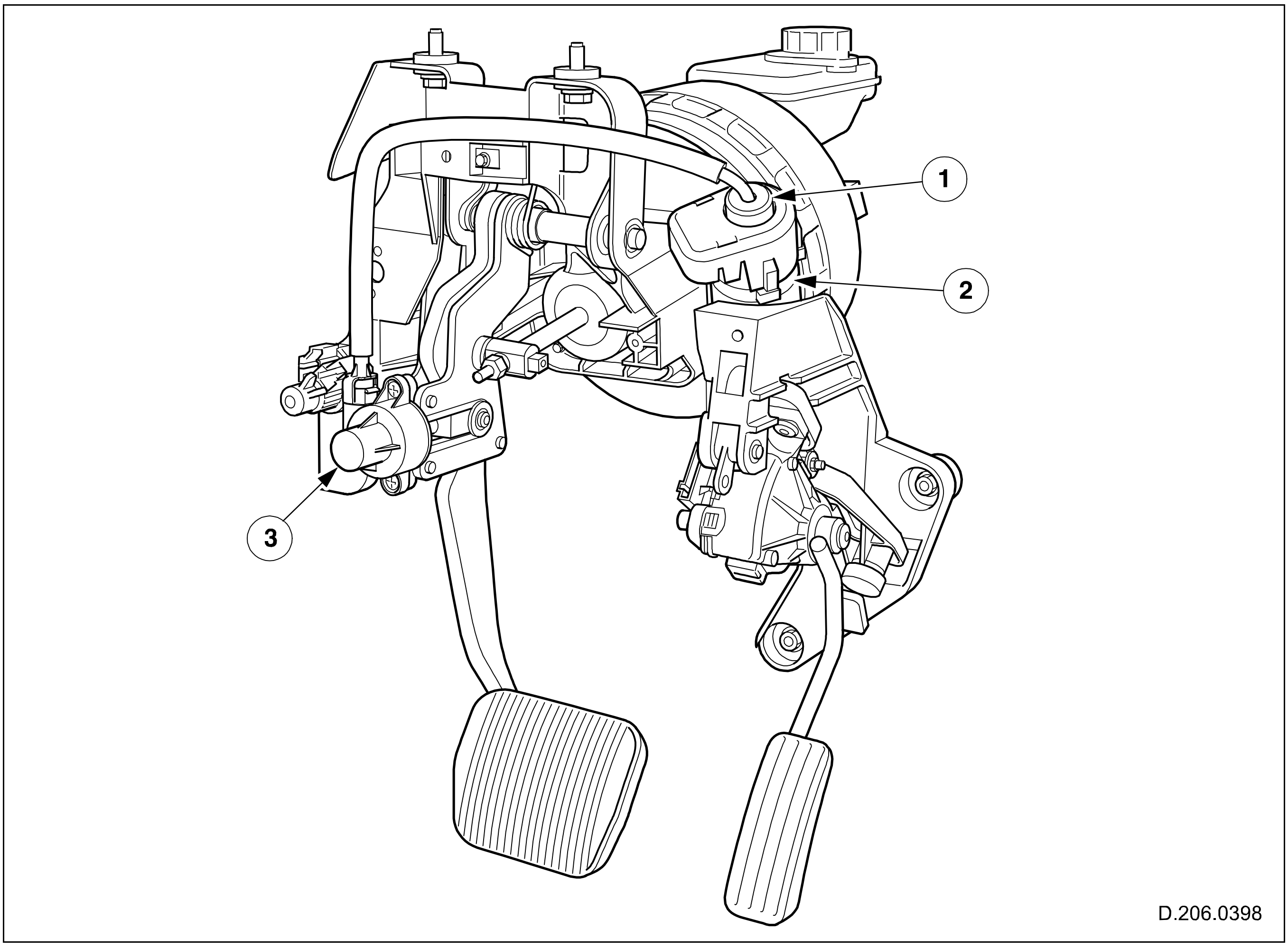

Fig. 24 Pedal-adjustment assembly

1. Pedal-adjustment position sensor
2. Pedal-adjustment motor
3. Brake-pedal adjustment drive-gear cover

Steering System

Introduction

An enhanced steering system is introduced into the XJ Range, which when combined with changes made to the suspension system provides excellent steering response and feel. The steering system is also specially tuned to complement the suspension changes, providing a further enhancement to the vehicle's ride characteristics; refer to **Suspension**.

Changes made to the steering system include:

- New upper steering column, refer to **Steering Column** below.
- New lower steering column, refer to **Steering Column** below.
- The hydraulic pressure switches have been removed from the high-pressure hoses; functionality is now integrated into the front electronic module (FEM), providing a faster response time; refer to **Servotronic Power Steering** below.
- All XJ models share the majority of steering system components, with the main exception of the pump pulley, which is smaller on the V8 derivative.

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.

The operating function of the Servotonic system is explained below:

- Road speed data, as measured by the electronic speedometer is transmitted to the FEM by the instrument cluster, via the SCP bus.
- Using the variable assisted power steering (VAPS) curve data stored within its memory, the FEM calculates the amount of current needed to supply the VAPS solenoid, which is an integral part of the Servotronic transducer.
- Based on the amount of current received from the FEM, the VAPS solenoid controls the hydraulic reaction of the rotary valve.
- This hydraulic reaction determines the amount of torque (effort) 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 variable ratio design, providing ease of parking maneuverability while maintaining the on-center steering precision required at high vehicle speeds. The steering rack is a compact unit, mounted via dual-rate rubber bushes to the rear of the vehicle's front subframe. The rotary motion of the steering-wheel is transformed by the pinion into the axial motion of the rack. The tie rods, attached at each end of the steering rack, transmit the steering motion to the wheel knuckles. From lock-to-lock the steering rack requires 2.8 turns of the steering wheel.

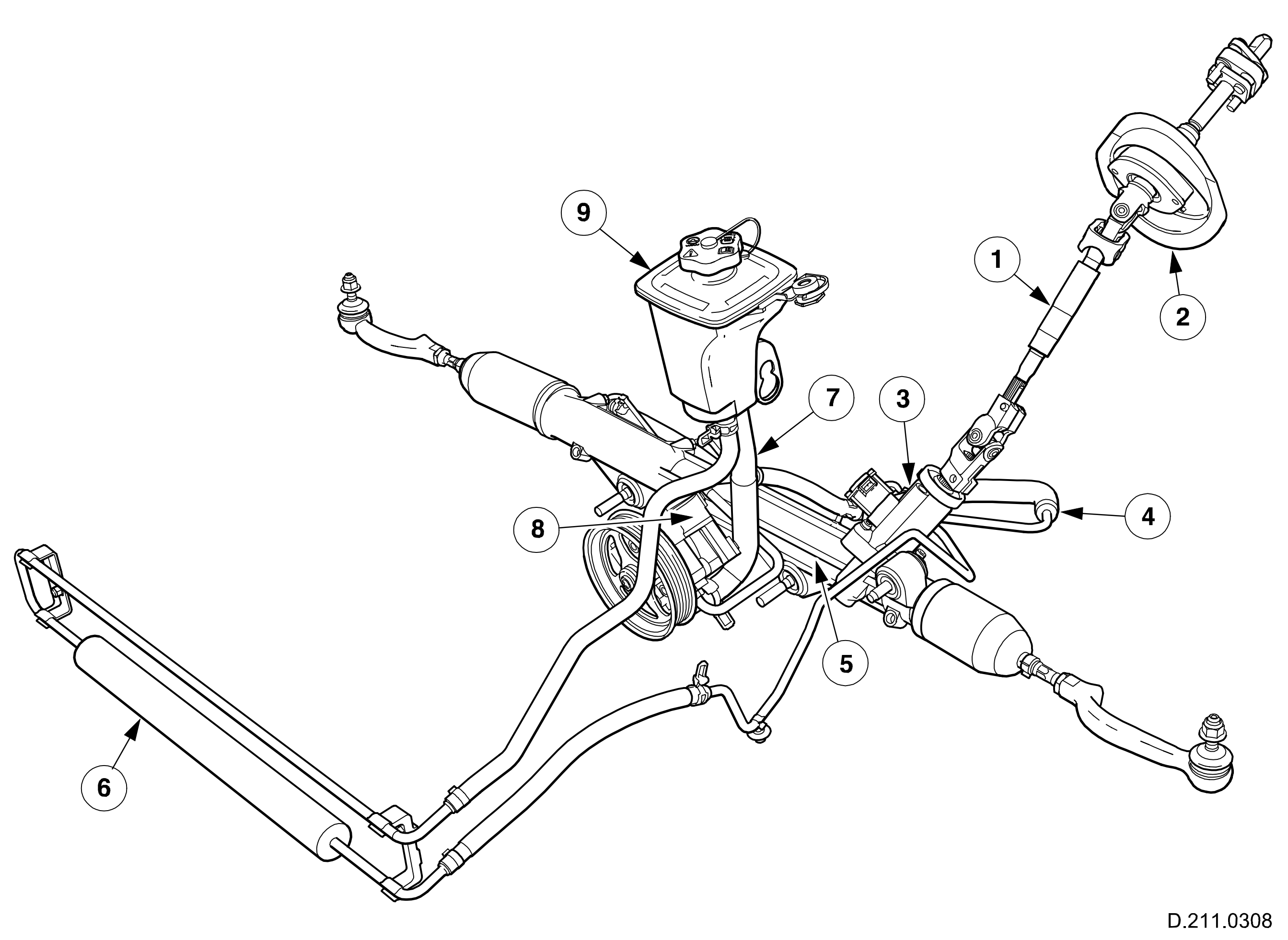

Fig. 25 Steering system assembly — V8 derivative shown

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

Steering Column

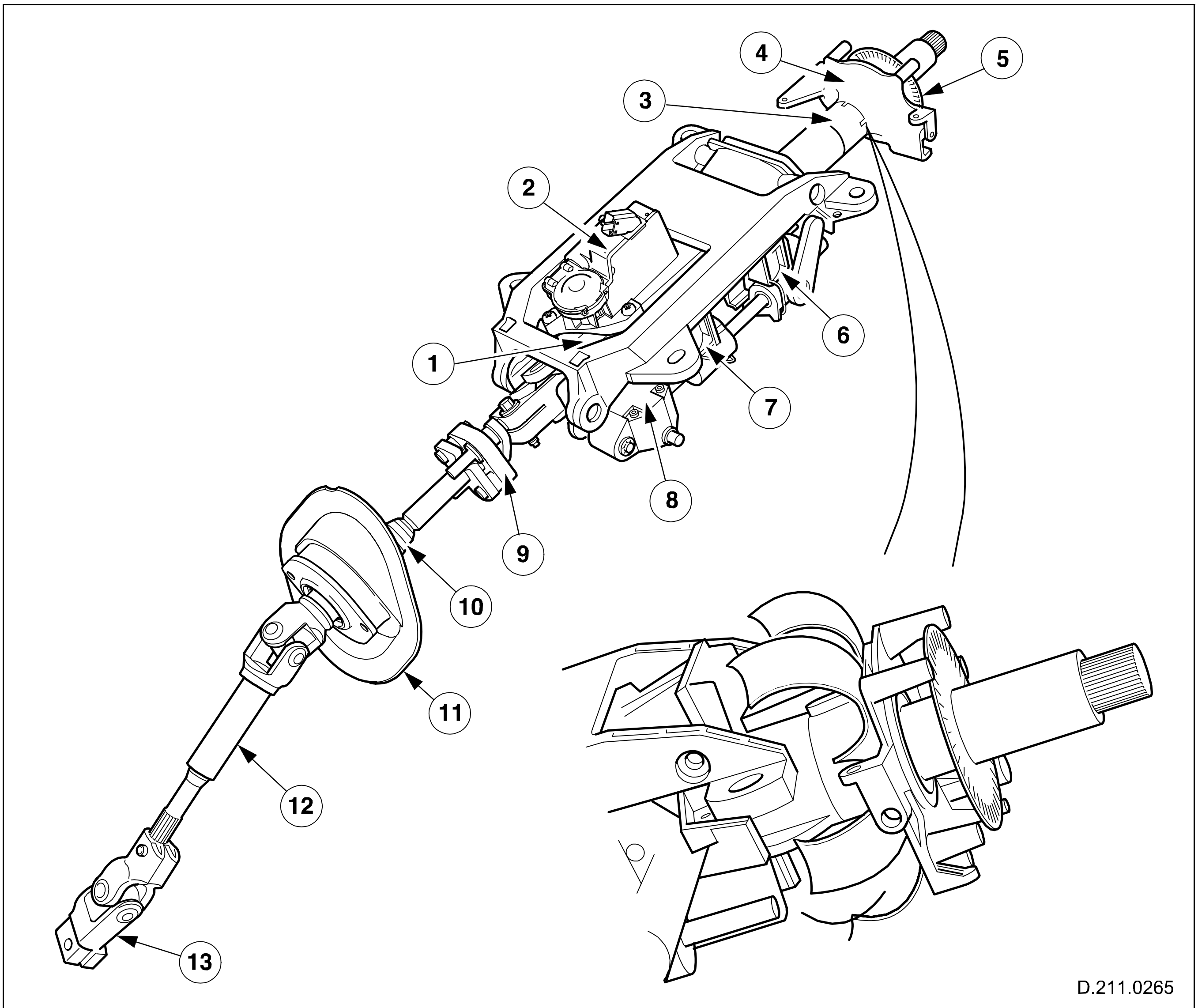

Fig. 26 Steering column

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

Upper Steering 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. 26**.
- The column is equipped with a sensor ring, which is monitored by the steering angle sensor for dynamic stability control (DSC) functionality.
- All steering column electrical connections are 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 the instrument cluster is 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,
- rake adjustment is +/- 2.5 degrees from the nominal setting.

The steering column is adjusted for reach and rake by operating the four-way control switch on the steering column; refer to **Fig. 27**.

Steering column adjustment:

- Moving the switch forwards and backwards controls reach adjustment.
- Moving the switch up and down controls rake adjustment.

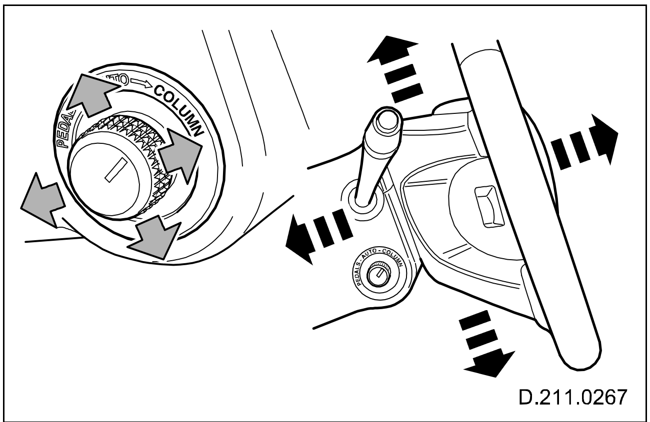

Fig. 27 Steering column adjustment

Driver Position Memory System

The driver-position memory system, functioned by the instrument cluster, stores three column positions that can be recalled in conjunction with the driver position setting, plus an entry/exit mode to give the driver maximum room to enter and exit the vehicle.

The entry/exit mode is selected by setting the steering column adjustment switch to the ‘AUTO’ position. When the ignition key is removed the steering column will move to the uppermost rake position.

Refer to vehicle owner literature for further information on the above memory functions.

Steering Column Lock

The steering lock is remote from the ignition switch and controlled electronically. The lock engages when the ignition key is removed; the lock disengages 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 shows signs of damage, the lower shroud assembly must be replaced.

Lower Steering 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 breakaway from the crimped fixing of the outer tube at a predetermined load.
- The rubber isolator is 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 part of the lower column assembly.
- The lower steering column attaches to the steering-rack’s pinion via a universal joint.

V6 Engine

Introduction

The 3.0 liter AJ-V6 engine is introduced into the XJ Range, which when combined with the lightweight aluminum body provides excellent performance and economy figures. The engine performance figures have mainly been achieved by the use of continuous variable valve timing on the intake camshafts to provide optimum engine torque over a wide-range of engine speeds. Continuous variable valve timing was first used on the V6 in the X-TYPE and later the S-TYPE.

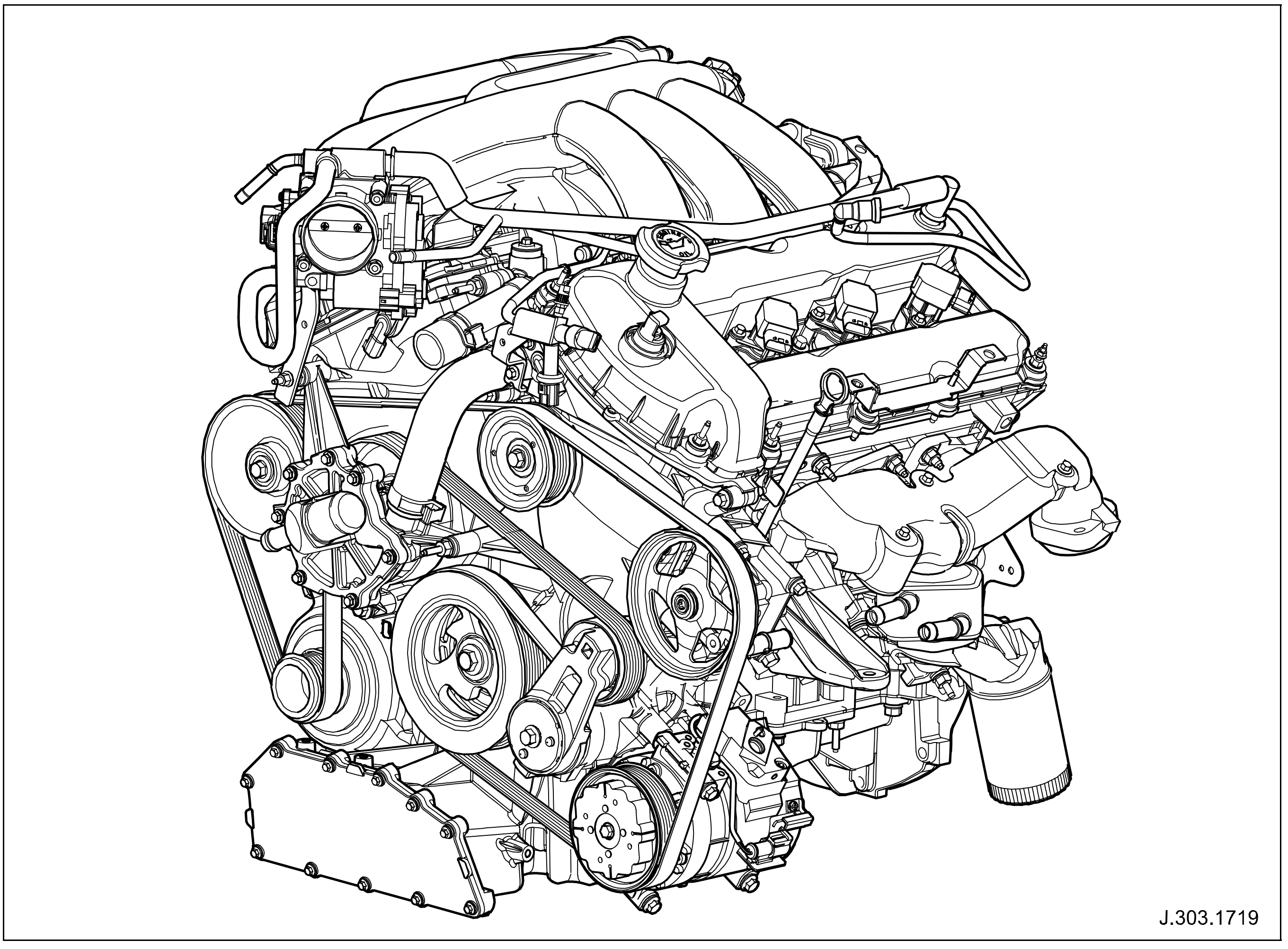

Fig. 28 V6 engine

Engine Components

The engine is a water-cooled six-cylinder unit, arranged in two planes in a 60 degree 'V' configuration, comprising:

- A lightweight aluminum cylinder-block with dry steel-liners.
- Aluminum pistons with valve cutouts in the crown to accommodate the advanced inlet timing of the variable valve timing system.
- A cylinder bore of 89 mm and piston stroke of 79.5 mm, provides:
  - 2967 cm^3 engine capacity, and a
  - 10.5:1 compression ratio.
- A steel crankshaft supported by four main-bearings.
- Sinter forged and fractured split connecting rods.
- 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.
- Aluminum cylinder heads with precision cooling technology and square squish chambers to provide optimum economy and emissions.
- Continuously variable valve timing on the intake camshafts, refer to **Continuous Variable Valve Timing** below.
- Two chain-driven, overhead-camshafts per bank.
- Four-valves per cylinder, activated by direct acting mechanical bucket tappets with top mounted steel shims.
- Single spark plug positioned central to each of the cylinder's four valves.
- Crankshaft mounted oil-pump, providing increased-flow characteristics to supply the requirements of the variable valve timing system.
- Magnesium camshaft covers with rubber seals to reduce airborne noise.
- An extensive use of aluminum, and some magnesium components to minimize engine weight.
- A positive crankcase ventilation (PCV) valve, which regulates crankcase depression, and controls the flow of crankcase gases into the intake manifold and oil separator. The PCV valve is located in the bank-2 camshaft cover.

Continuous Variable Valve Timing

The continuous variable valve timing (VVT) used on this engine is a further development of the two-positional system. 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. Providing 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 airflow 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** below.

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.

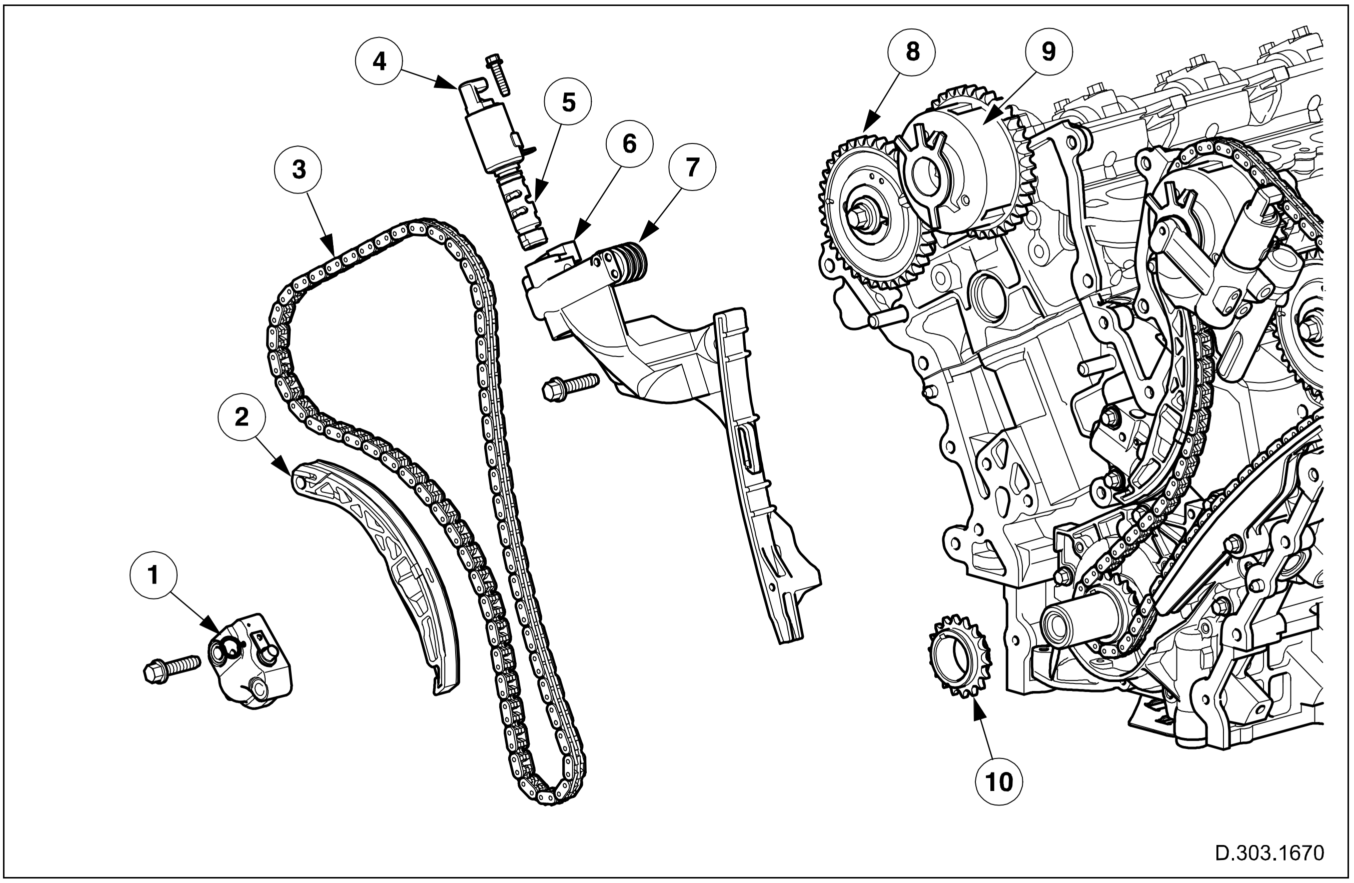

Fig. 29 Timing mechanism

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.

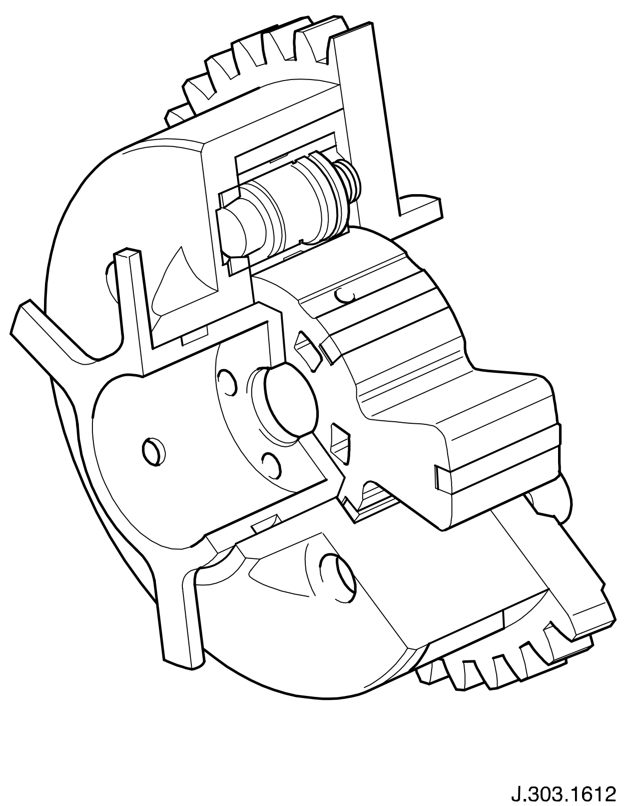

Fig. 30 VVT unit

The timing chain drives the VVT unit, which 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

Two new V8 engines are introduced into the XJ Range:

- The AJ-V8 4.2-liter, an upgrade and replacement of the previous 4.0-liter engine, is available in both normally aspirated and supercharged variants. Jaguar first introduced this engine in the S-TYPE.
- The AJ-V8 3.5-liter, an upgrade and replacement of the previous 3.2-liter engine, is available as normally aspirated only. The 3.5-liter engine makes its Jaguar debut in the XJ Range.

Improvements made to the engines provide excellent performance data, and when combined with the lightweight aluminum body of the XJ produces best-in-class performance, economy, and refinement figures.

Engine Data

- AJ-V8 4.2-liter engine:
  - cylinder bore: 86 mm
  - piston stroke: 90.3 mm
  - engine capacity: 4196 cm^3
  - compression ratio - normally aspirated: 11.0:1
  - compression ratio - supercharged: 9.0:1
- AJ-V8 3.5-liter engine:
  - cylinder bore: 86 mm
  - piston stroke: 76.5 mm
  - engine capacity: 3555 cm^3
  - compression ratio: 11.0:1

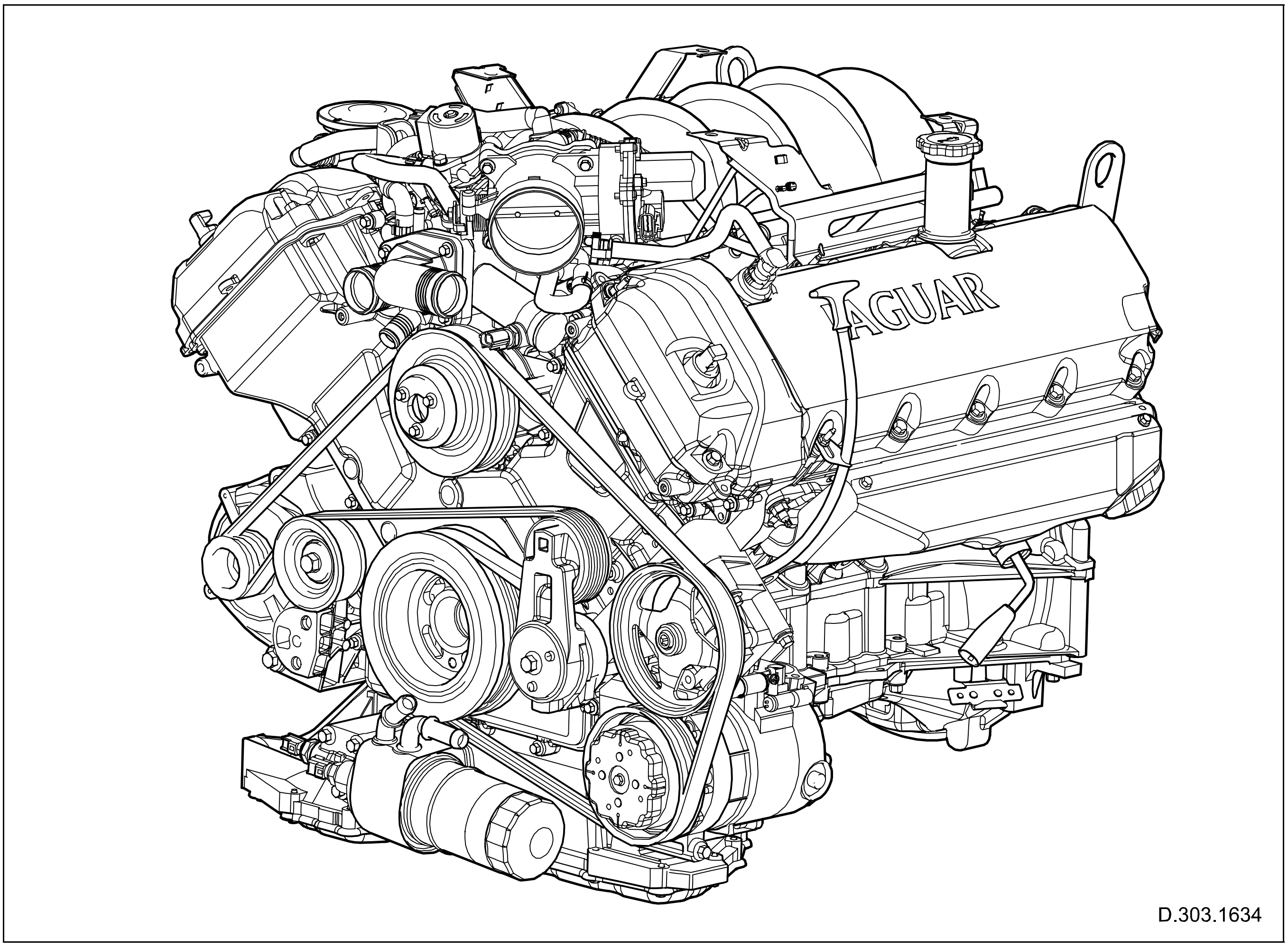

Fig. 31 V8 normally aspirated engine

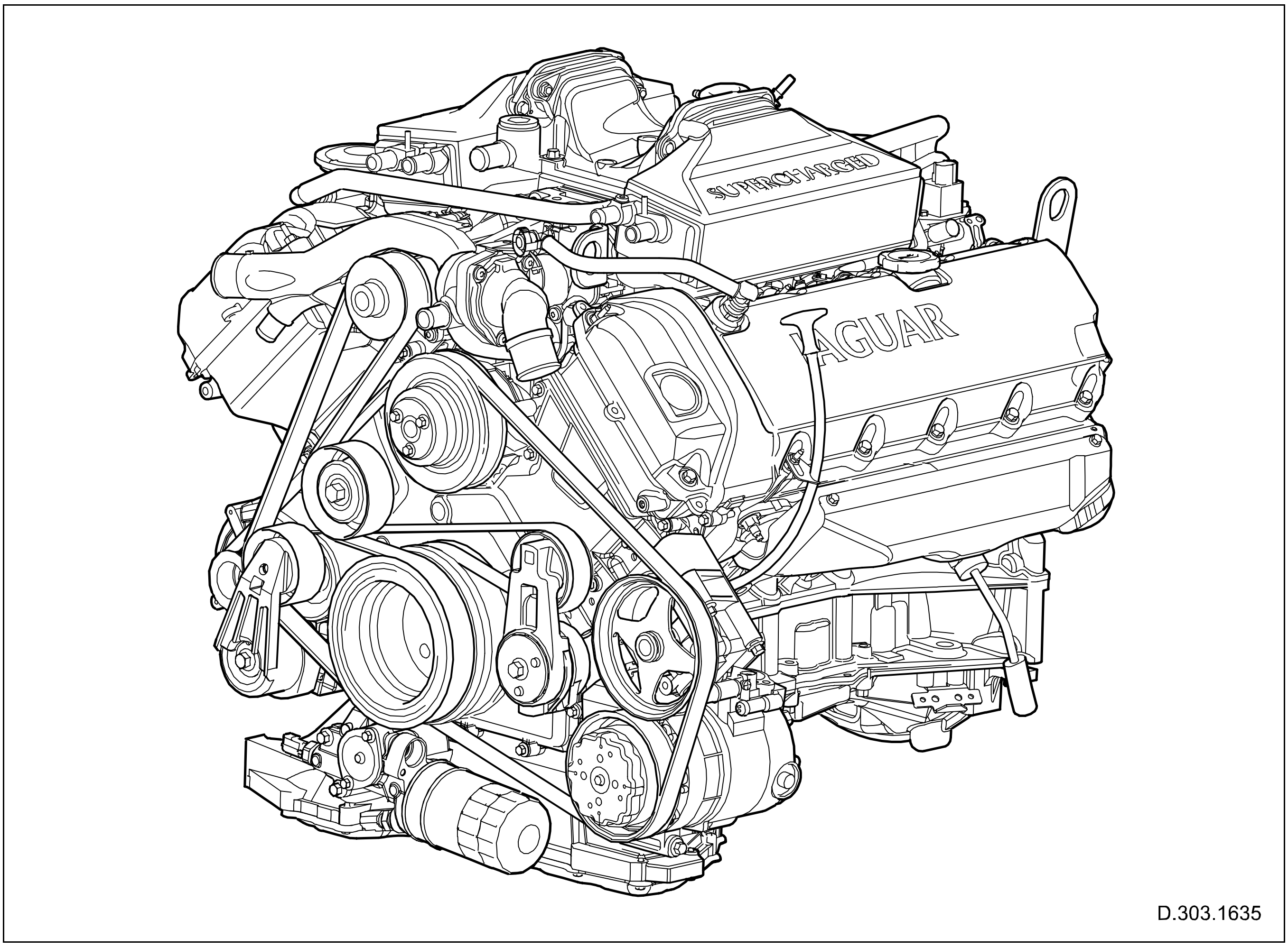

Fig. 32 V8 supercharged engine

Engine Components

The water-cooled engines, are constructed of aluminum alloy with eight cast-iron cylinder liners, arranged in two-planes in a 90-degree 'V' configuration. An extensive use of aluminum and some magnesium-alloy engine components provides a low engine-weight. The 3.5-liter and 4.2-liter engines share the majority of engine components.

New and upgraded engine features are discussed in this section.

Cylinder Heads

The cylinder heads are unique to each cylinder bank and incorporate, two chain-driven overhead camshafts per-bank, which activate four-valves per cylinder via direct acting bucket tappets. The cylinder heads have been modified as follows:

- Adapted intake ports improve volumetric efficiency.
- Redesigned combustion chambers with the inclusion of 'squish' areas around the valves improve economy and emissions.
  - The 'squish' area is a raised feature on the periphery of the piston crown, which enables the piston to get within approximately 1mm distance of the cylinder head at TDC compression. At TDC, the 'squish' area forces the fuel/air charge into the center of the combustion chamber with significant turbulence to aid combustion.
- New thinner cylinder head gaskets, constructed from multi-layer steel with sintered steel combustion rings.
- The engine lifting-eye, which was part of the cylinder-head cast, is replaced by a threaded hole to accept a steel lifting-bracket.

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 normally aspirated pistons are cast aluminum with a three-piece oil control ring.
- For improved robustness and to withstand mechanical and thermal stresses, the supercharged pistons are manufactured of forged aluminum with a two-piece ultra compact oil control ring.
  - The supercharged engine also employs piston-cooling jets, which inject oil on the underside of the piston's crown to provide improved temperature control; refer to **Fig. 33**

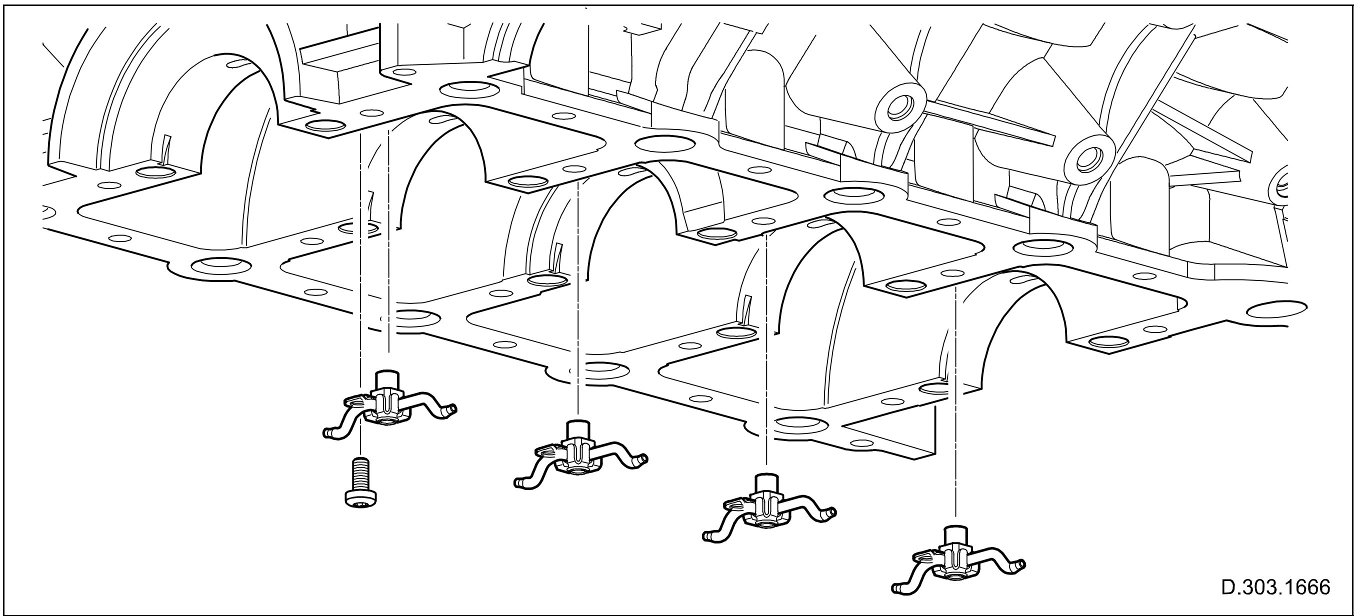

Fig. 33 Piston cooling jets - supercharged engine only

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.

Crankshaft

The crankshaft is supported by five main bearings.

- AJ-V8 4.2-liter engine: 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.
- AJ-V8 3.5-liter engine: the crankshaft stroke has been reduced for 3.5-liter displacement. To reflect the stroke reduction and to allow for the use of a shared cylinder block with the 4.2-liter engine, the connecting rods have been lengthened to maintain the required compression ratio.

Primary Chain

A new primary chain, with a reduced-pitch and inverted-tooth design reduces loading and radiated noise levels. The chain's associated sprockets are also modified to accommodate the new chain design.

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

Lubrication of the primary chain and crankshaft sprockets is via two squirt-jets directly mounted to the oil pump.

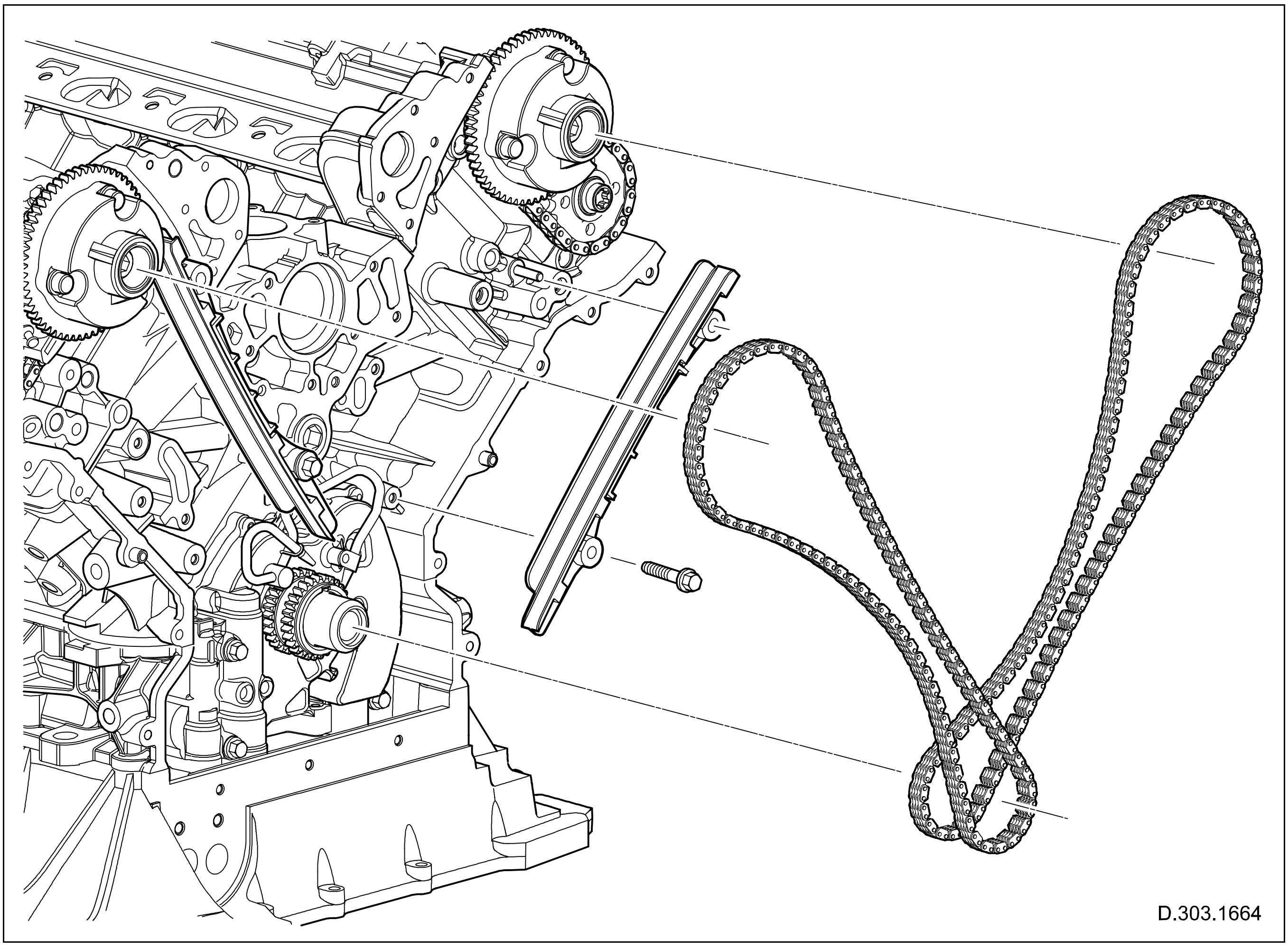

Fig. 34 Primary chain

Fuel Injectors

New multi-hole injector's supply improved spray performance and targeting within the combustion chamber, enabling the engine to extract the full-energy potential from every droplet of fuel. This acts to boost engine performance and improve fuel economy, without the additional components of air-assist injection.

Engine Lubrication

An upgraded lubrication system, mainly to provide improved variable valve timing (VVT) response on normally aspirated engines is introduced. The pumping element is an eccentric rotor, directly driven by the crankshaft. The oil inlet of the pump is through a directly mounted pick-up pipe; the outlet port aligns with the oil passage in the engine's bedplate. An integral pressure relief valve regulates pump pressure at 4.7 bar.

Two squirt-jets directly mounted to the pump provide lubrication to the primary chain. An over-pressure valve incorporated within the pump protects the engine components during cold starts.

Supercharged variants incorporate a thermostatically controlled oil-diverter valve, installed in the pump's outlet passage, to divert the oil through to the engine's oil cooler at high engine temperatures.

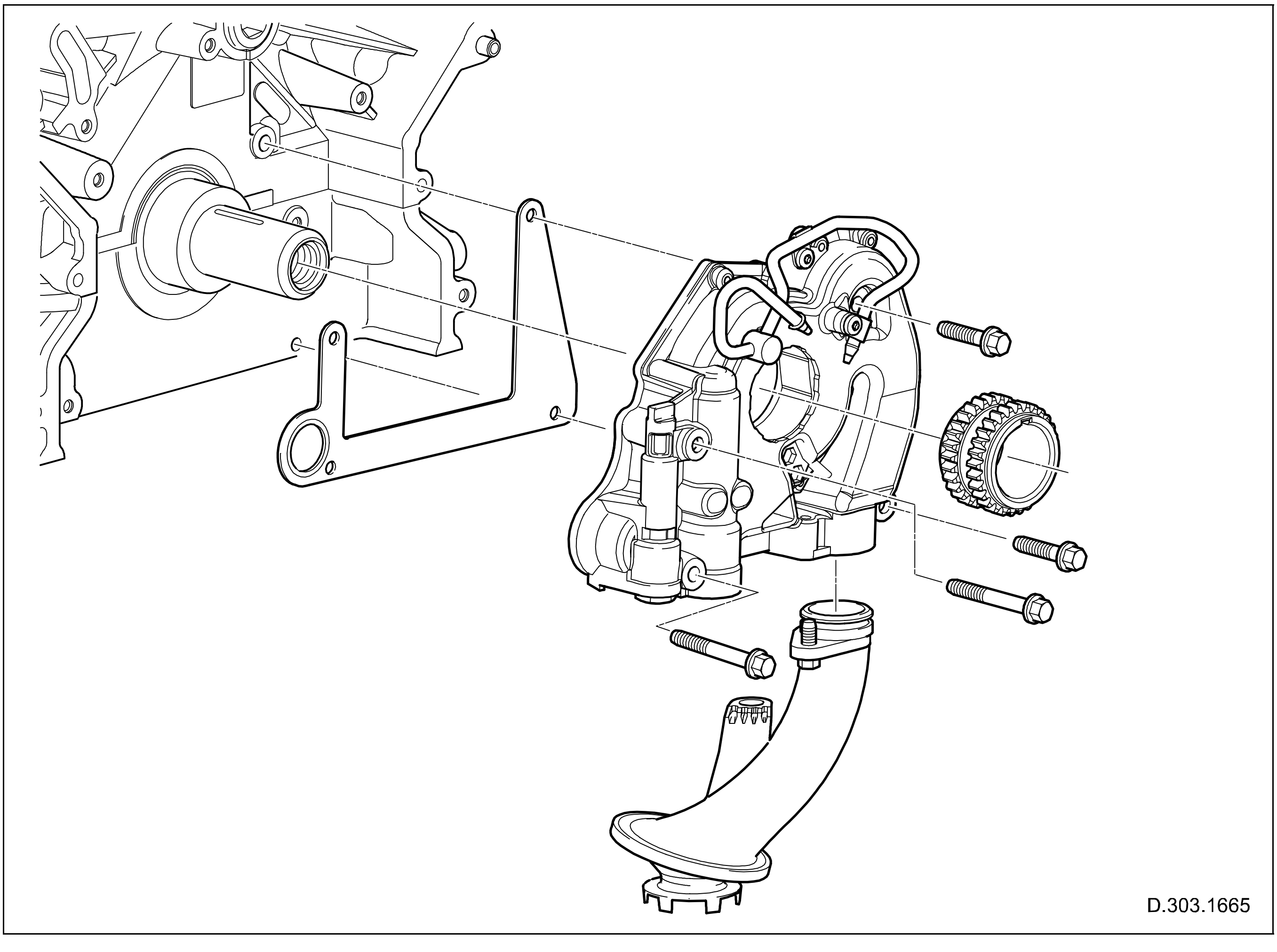

Fig. 35 Oil pump

Exhaust Manifold

The exhaust manifolds are now manufactured from cast stainless steel. On the normally aspirated engine, the manifolds are branched, providing a tuning effect that increases torque at low engine speed. The exhaust manifold on the supercharged engine remains as the conventional 'log' design.

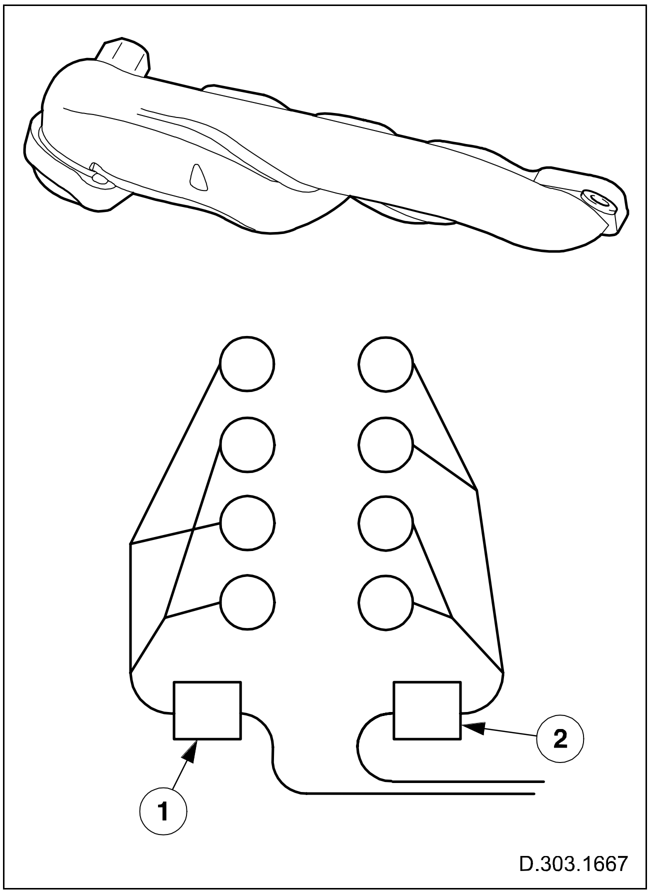

Fig. 36 Branched exhaust manifold - normally aspirated engines only

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.

To optimize engine performance, the valve timing on the 4.2-liter and 3.5 liter engines is specially tuned to reflect the size of the engine.

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 engine control module (ECM) controls the VVT, using 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.
- Improves full-load torque characteristics as the camshaft timing is 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

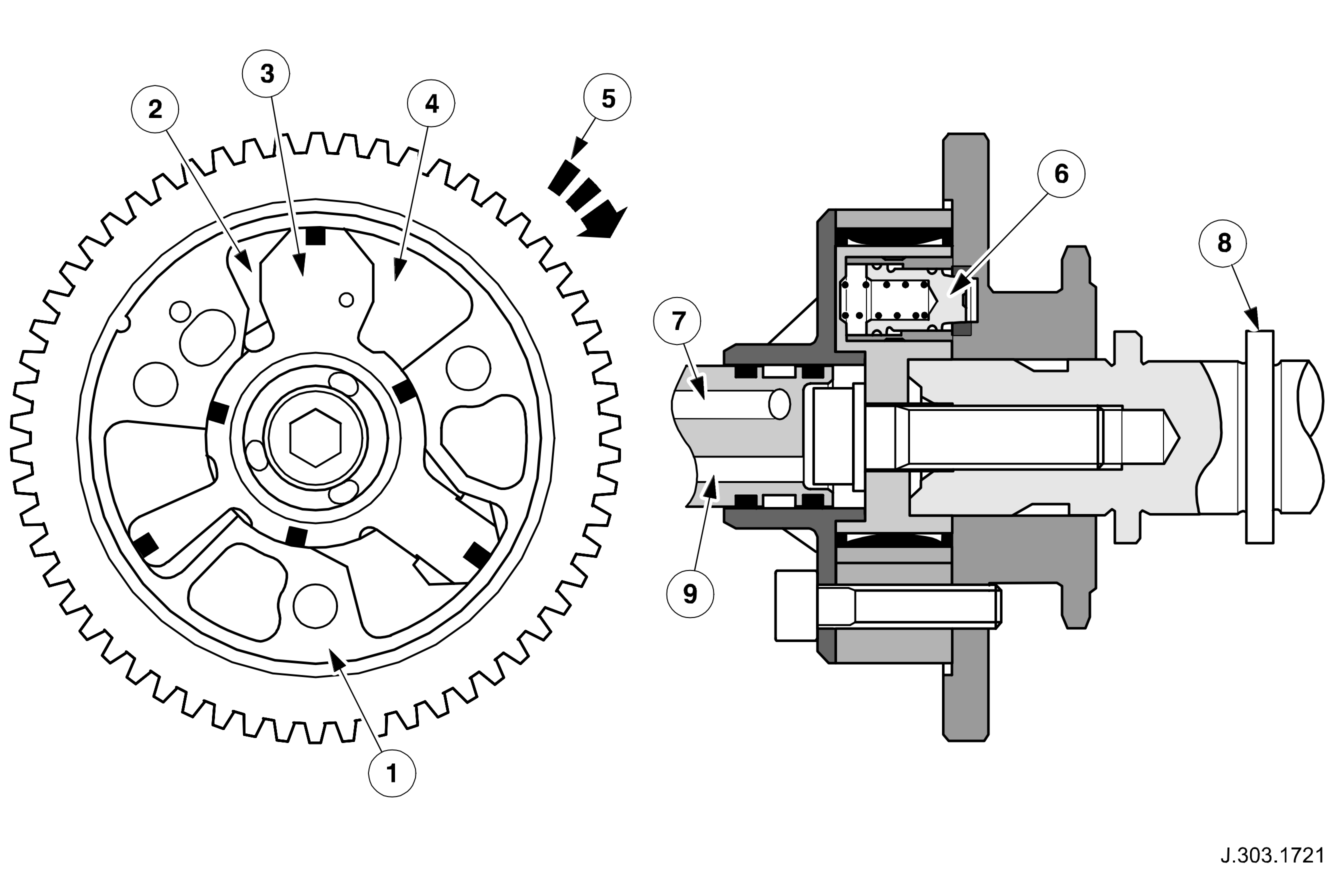

Fig. 37 VVT unit

1. Vane housing
2. Advance chamber
3. Vane shaft
4. Retard chamber
5. Rotation direction
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 primary 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 optimum position between full advance and retard for a particular engine speed and load. This is achieved by the ECM sending the energizing signal to the oil control solenoid until the target position is met. At this point, the energizing signal is reduced to hold the solenoid position, and as a result the position of the shuttle valve. This function is under closed-loop control, where the ECM will assess any decrease in shuttle-valve oil-pressure, via signals from the camshaft position sensor. The ECM will increase the energizing signal, when required, to maintain the shuttle-valve hold position.

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 oil-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, plus 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.

The VVT does not operate when engine oil-pressure is below 1.25 bar, as there is insufficient pressure to release the VVT unit's internal stopper pin. This usually occurs when the engine is shutting-down and the VVT has returned to the retarded position. The stopper pin locks the camshaft to the VVT unit to ensure camshaft stability during the next engine start-up.

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**.

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

The coolant expansion tank has an integral bleed screw and coolant-level sensor.

The auxiliary coolant-flow pump is fitted as standard, except for vehicles installed with the V6 engine and 2-zone climate control.

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

- 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, the climate control pressure-transducer and the transmission oil temperature sensor. 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.

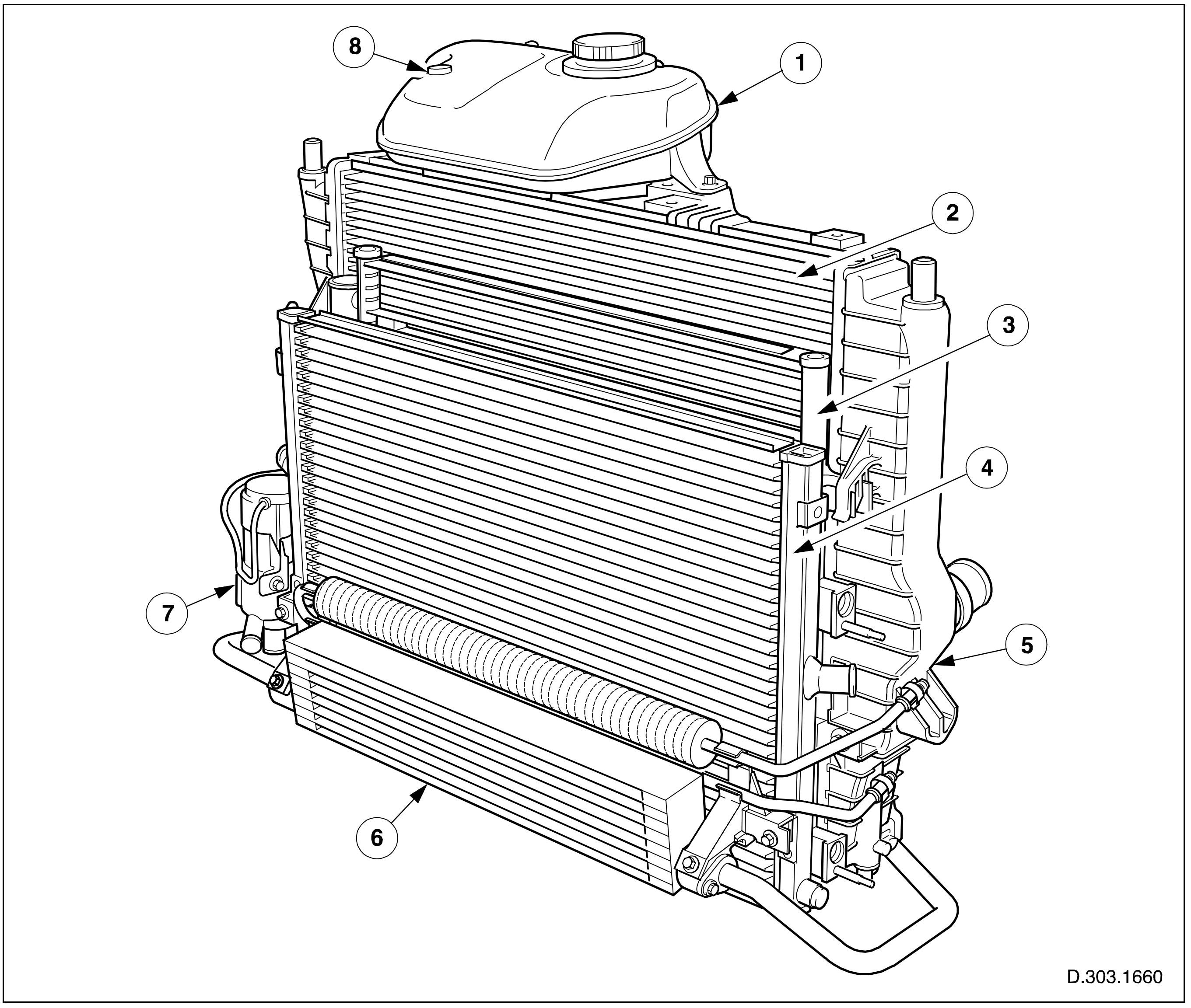

Fig. 38 Cooling pack (SC)

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

Cooling System (V6)

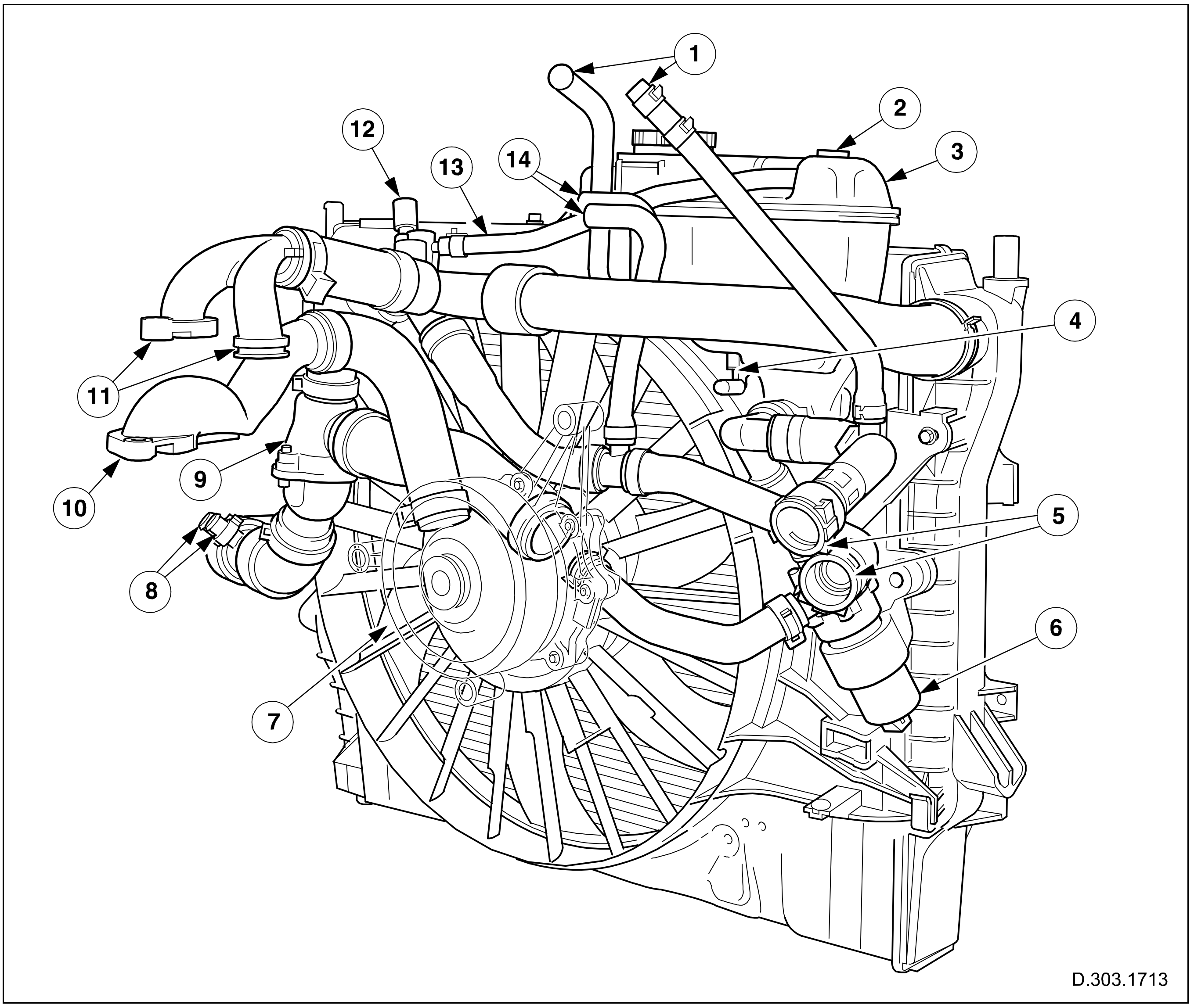

Fig. 39 V6 cooling system components and connections (4-zone climate control variant)

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

Coolant Flow (V6)

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

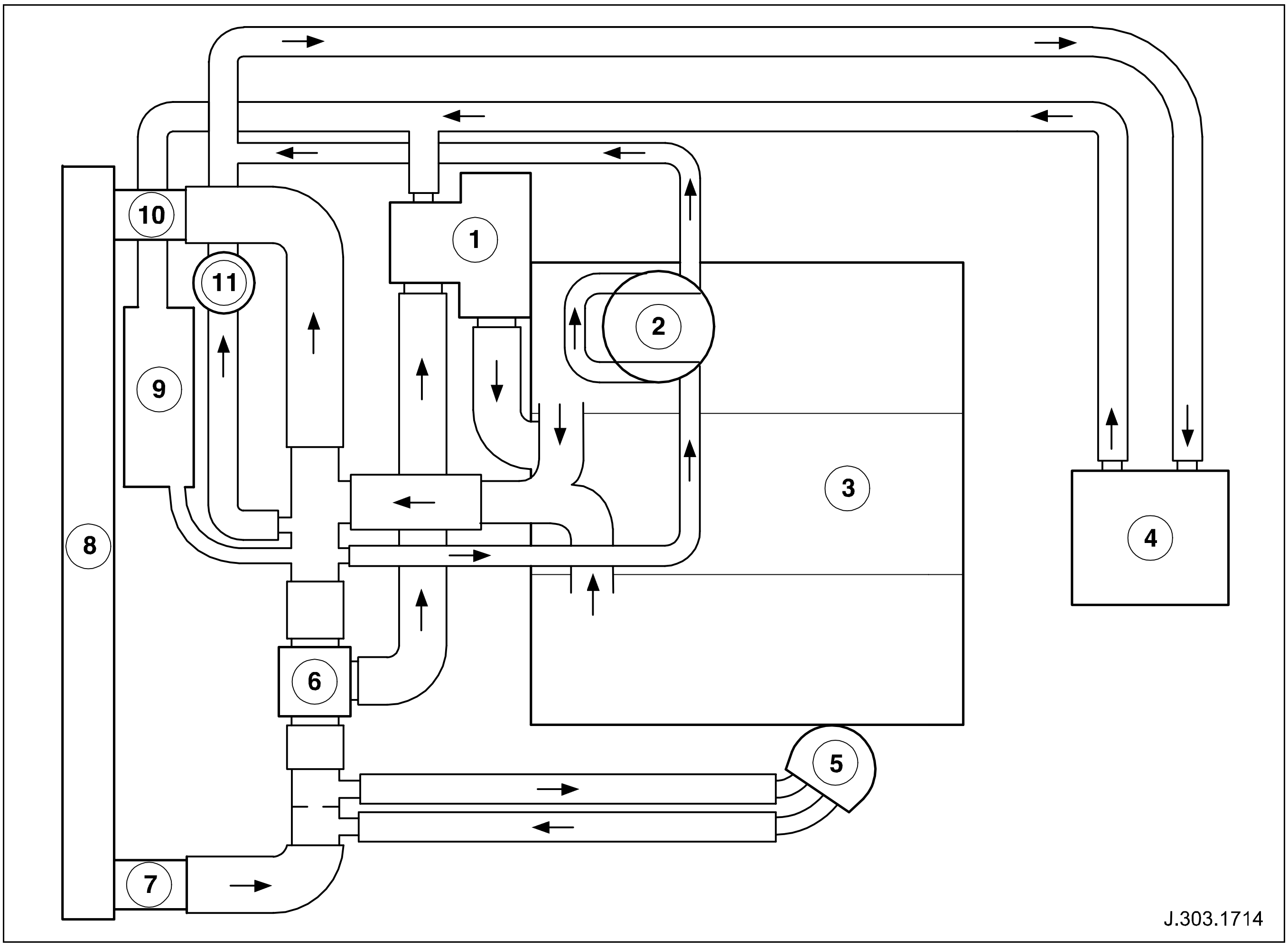

Fig. 40 V6 coolant-flow diagram (4-zone climate control variant)

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

Cooling System (V8)

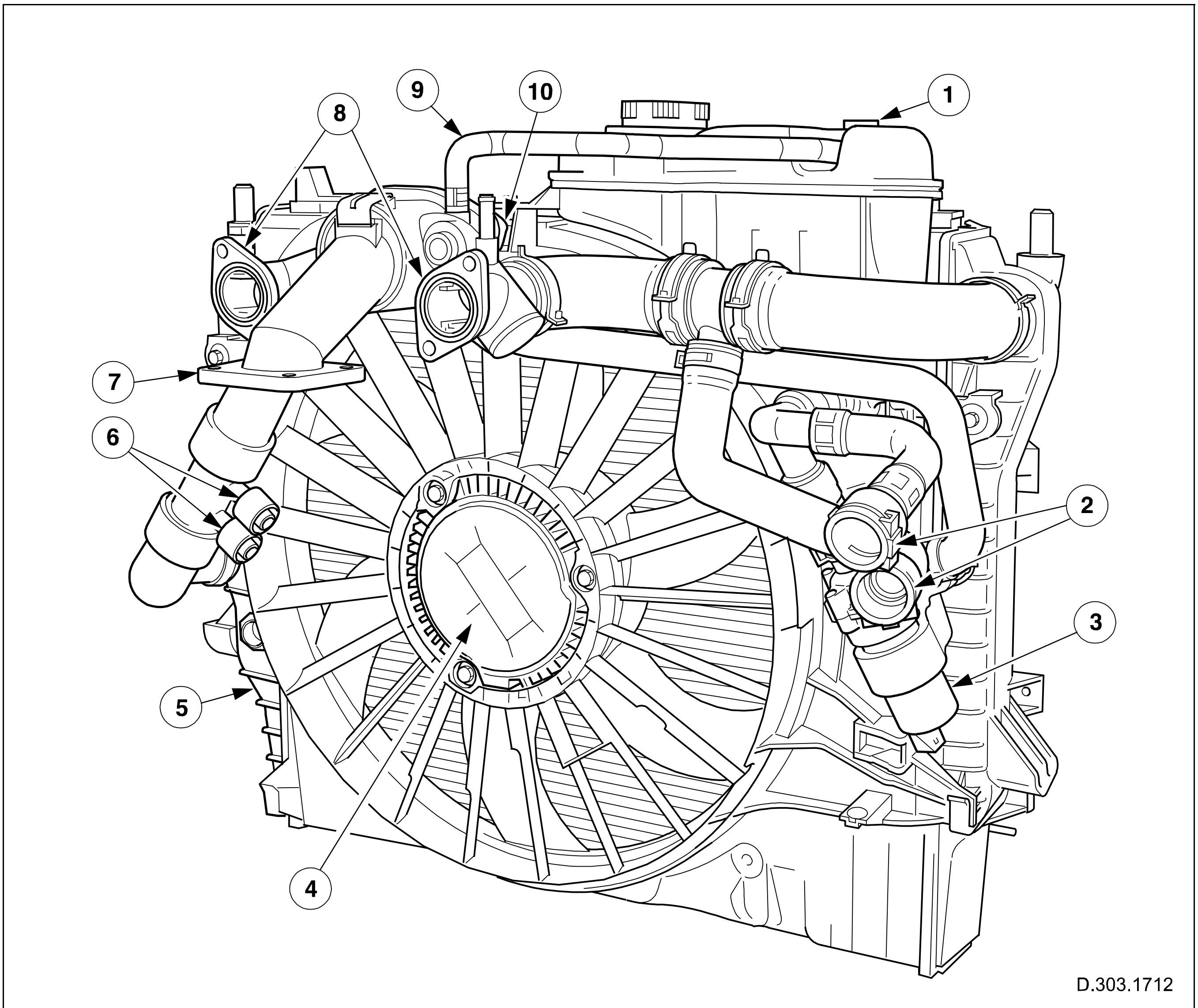

Fig. 41 V8 cooling system components and connections

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

Coolant Flow (V8)

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

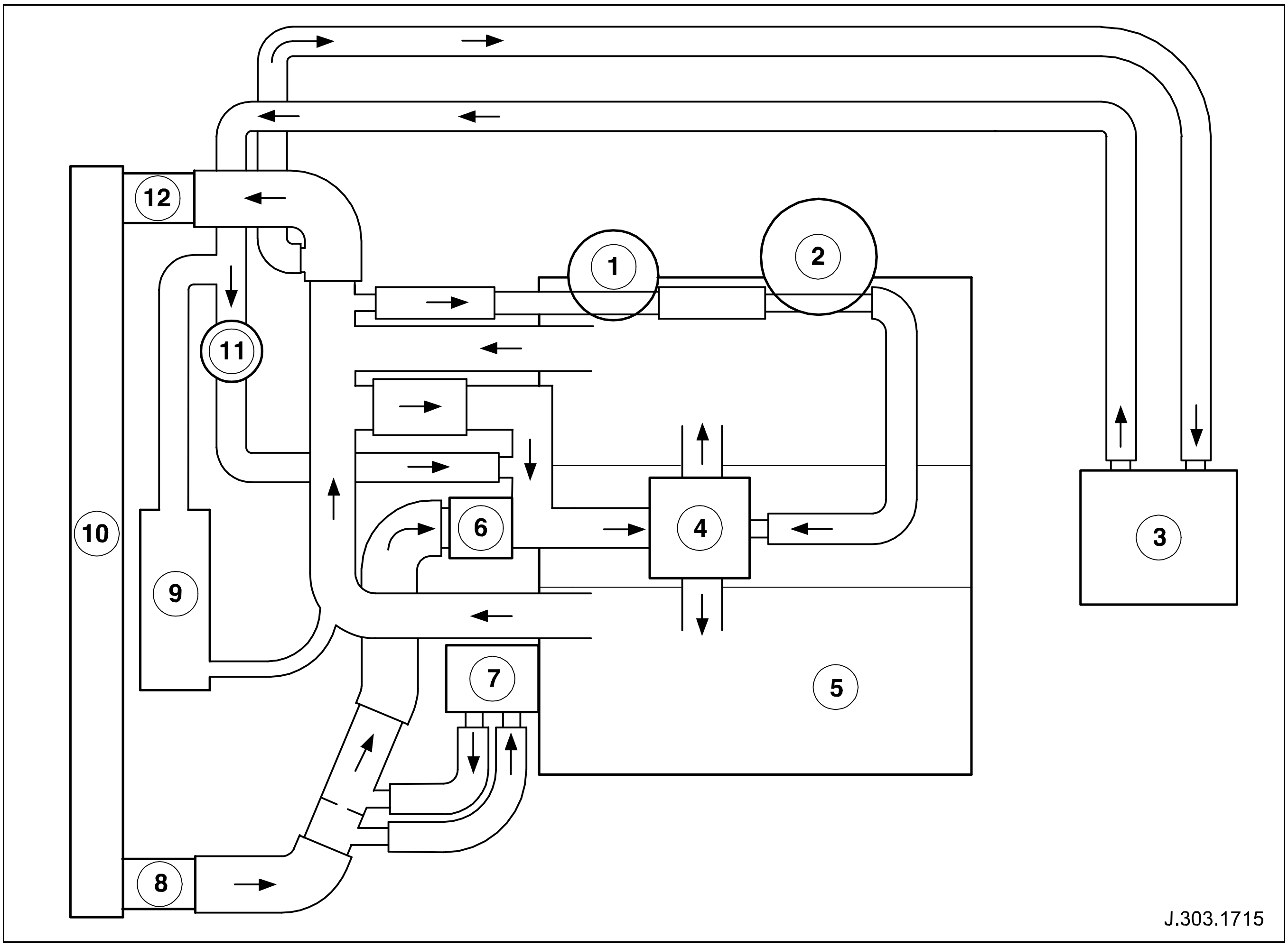

Fig. 42 V8 coolant-flow diagram

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

Cooling System (V8 SC)

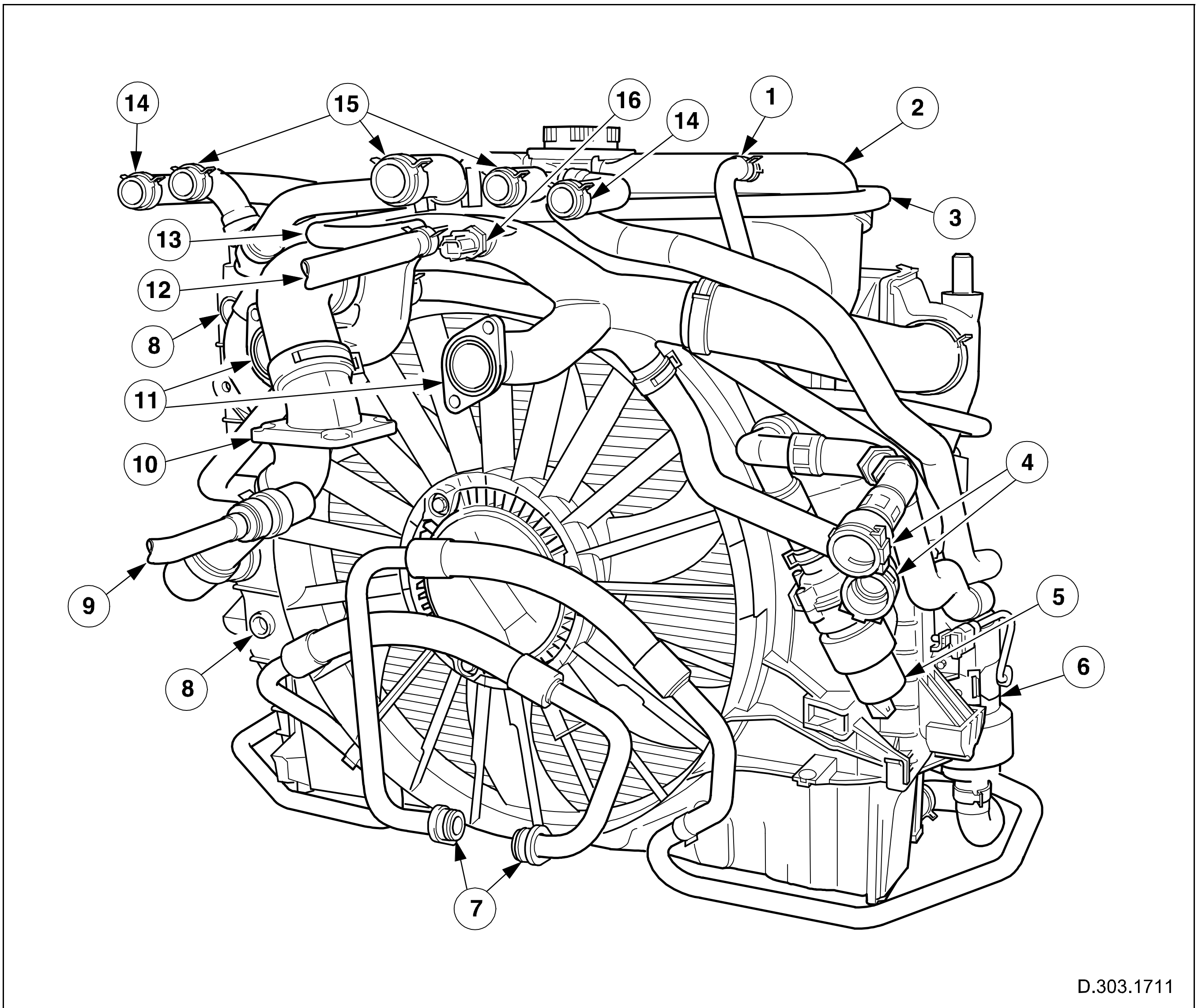

Fig. 43 V8 SC cooling system components and connections

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

Coolant Flow (V8 SC)

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

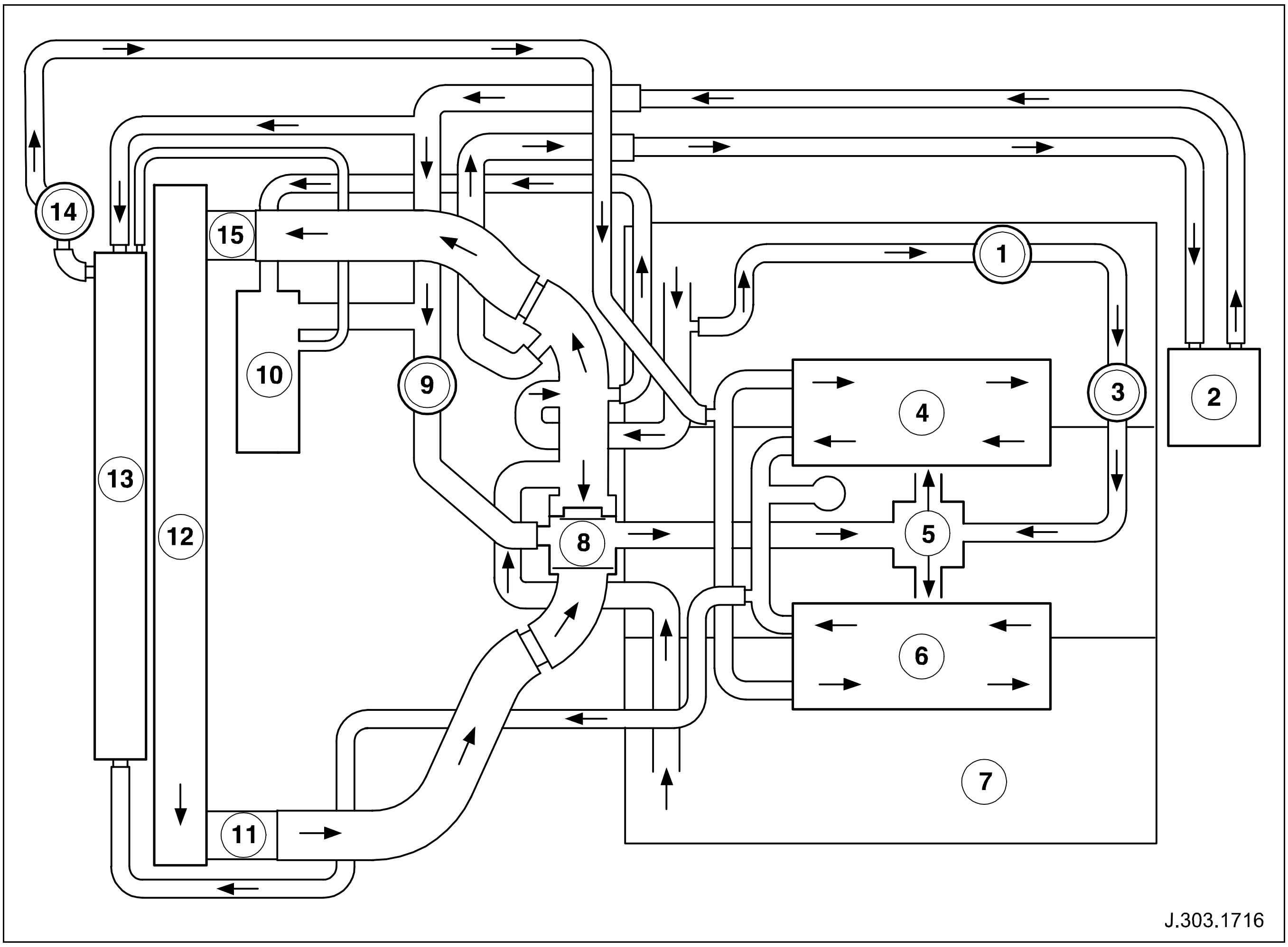

Fig. 44 V8 SC coolant-flow diagram

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

Fuel Charging and Controls

Electronic Throttle Control

An 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. These signals are used by the engine control module (ECM) to analyze 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. For further information refer to **Electronic Engine Controls**.

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 returnless 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 airflow from the intake manifold. Refer to **Electronic Engine Controls** for more information on fuel injection.

NOTE: New multi-hole injectors are introduced, supplying improved spray performance and targeting within the combustion chamber, enabling the engine to extract the full-energy potential from every droplet of fuel. This type of injector helps to boost engine performance and improve fuel economy, without the additional components of air-assist injection.

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 body.

V6 Normally Aspirated

A reduced volume three-stage variable-geometry upper intake-manifold is introduced into the XJ Range with identical concept and operating parameters as the intake manifold used on the S-TYPE and X-TYPE V6 engines.

The intake manifold; refer to **Fig. 46**, is designed to improve response rates and 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, this type of manifold can set the geometry to three different configurations. This is achieved 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 Normally Aspirated

The air-intake manifold on the 3.5 liter and 4.2 liter normally aspirated engines; refer to **Fig. 47**, operates on the same concept as the previous 4.0 liter system.

The very smooth inner walls of the injection molded manifold offer minimum air flow restriction. This, combined with low thermal conductivity of the nylon manifold, helps improve engine performance by as much as 1% to 2% over that of an aluminum manifold. The low thermal conductivity of the nylon manifold also helps improve engine performance. The nylon manifold insulates the air inside it from engine heat, and thus allows high-density intake air to flow into the engine.

V8 Supercharged

The introduction of the 4.2 liter supercharged engine, also introduces a revised air intake system and supercharger unit into the XJ Range; refer to **Fig. 45** and **Fig. 48**. The modifications as listed below, enhance engine performance by either improving intake airflow or increasing supercharger speed by 5%.

- Supercharger rotors driven by helical-cut gears in place of spur-cut gears.
- Supercharger rotors have a more efficient coating to improve airflow.
- A more efficient air-intake trunking to improve airflow.
- Low loss supercharger outlet ducts.
- Twin air-intake into the air cleaner housing.
  – The ECM directly controls the solenoid; refer to **Fig. 45**, 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.
- High-density fin intercoolers also provide improved supercharger cooling efficiency.

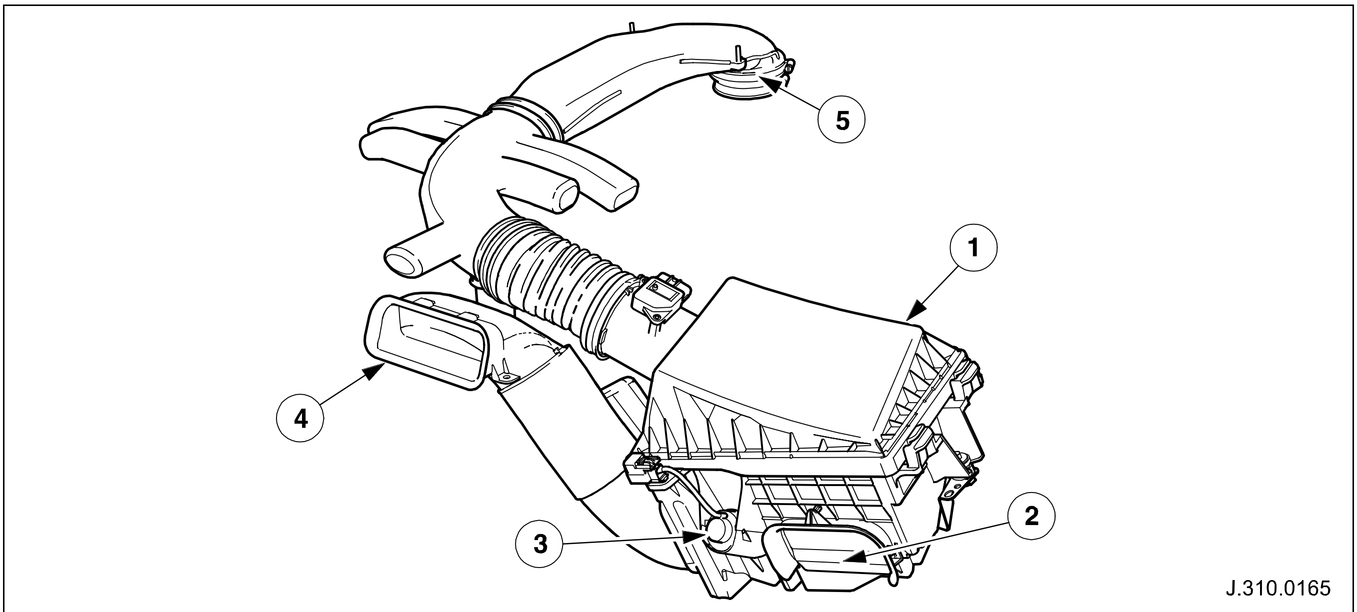

Fig. 45 V8 supercharged air-intake assembly

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

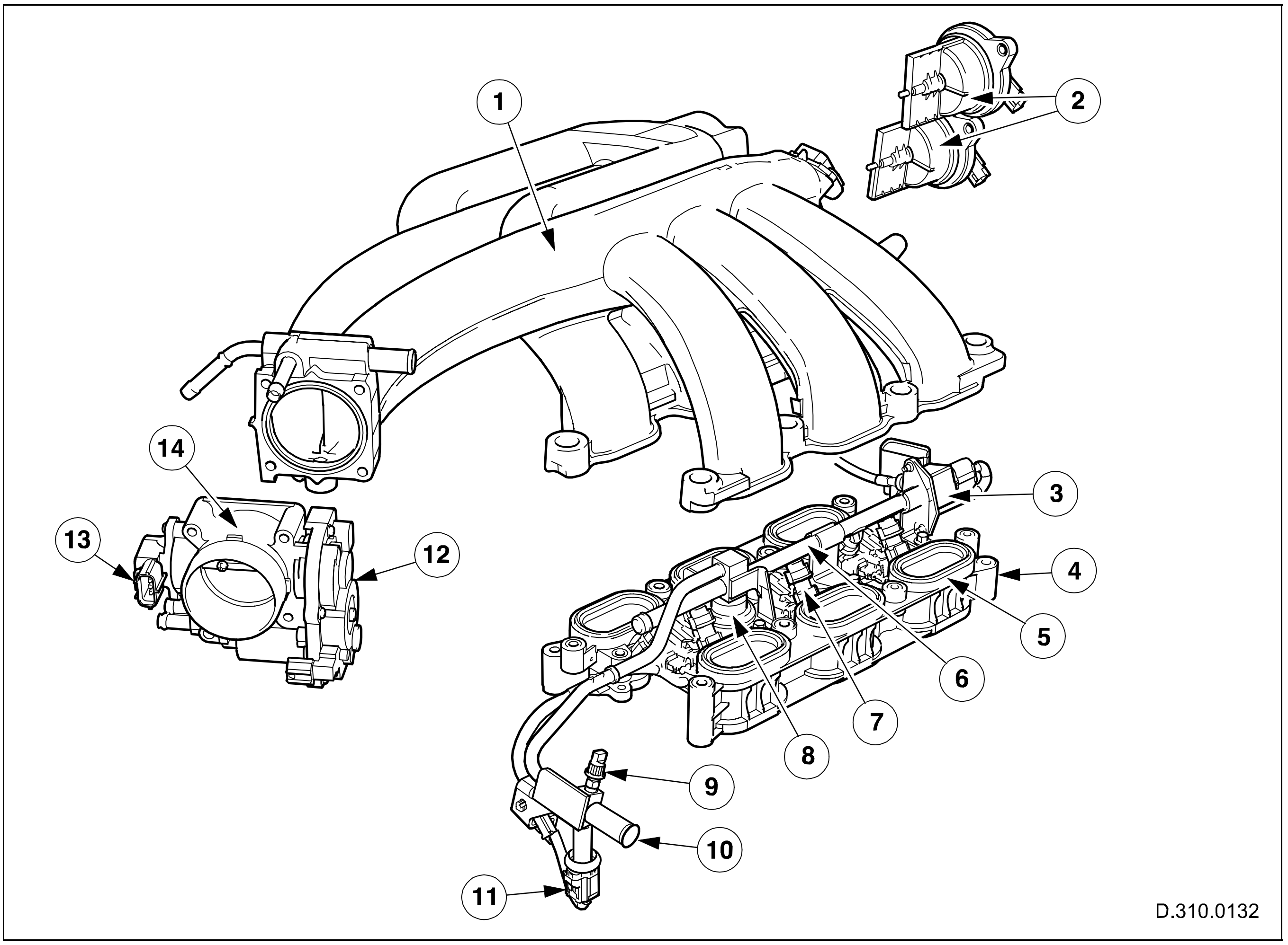

Fig. 46 Fuel charging system - V6 normally aspirated

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

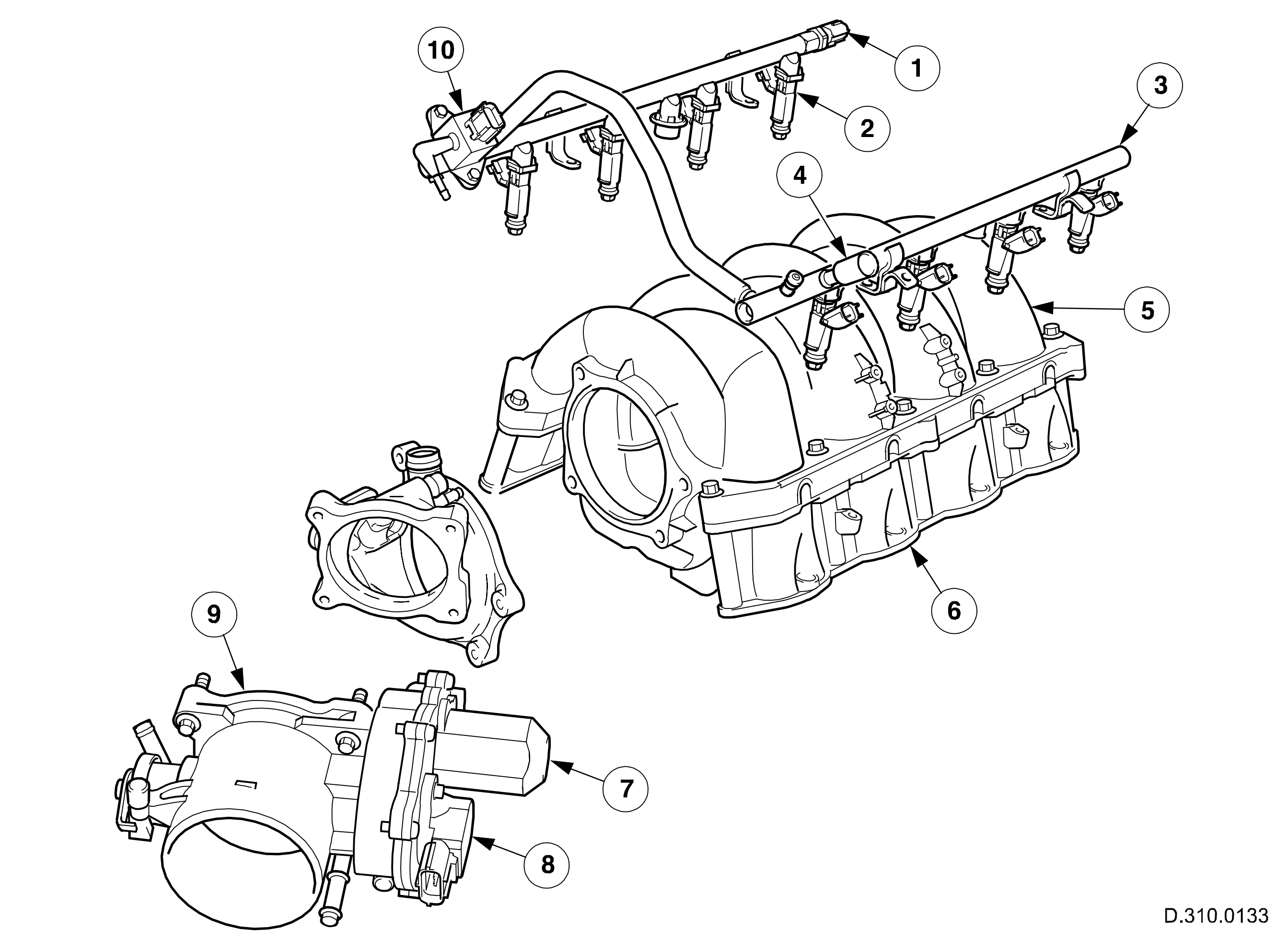

Fig. 47 Fuel charging system — V8 normally aspirated

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

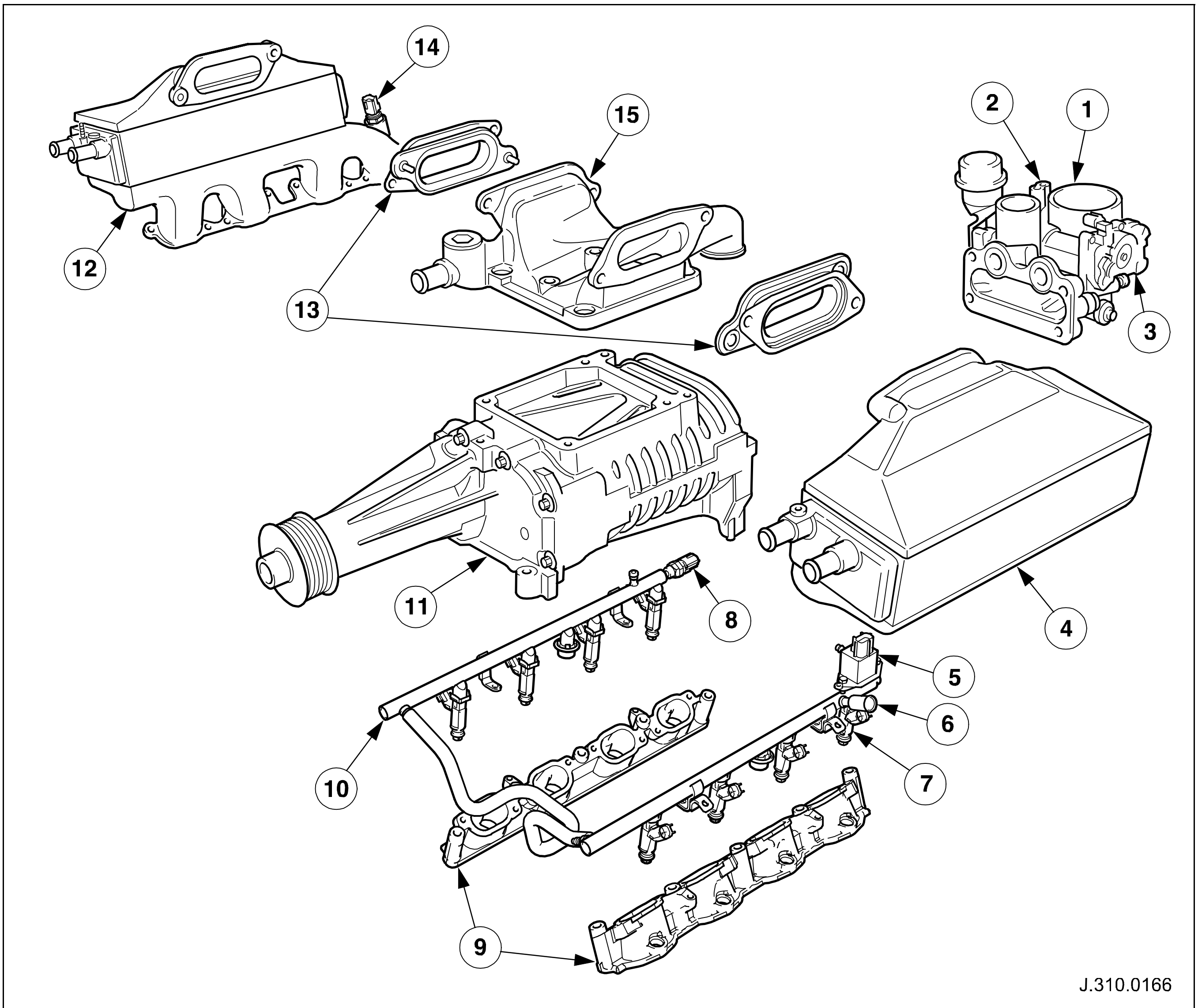

Fig. 48 Fuel charging system — V8 supercharged

1. Throttle body
2. Throttle position sensor
3. Throttle motor
4. Charge air cooler and intake manifold
5. Fuel pressure sensor
6. Fuel supply
7. Injector
8. Engine fuel temperature sensor
9. Fuel rail adaptors
10. Fuel rail
11. Supercharger
12. Charge air cooler and intake manifold
13. Cool-air engine charge duct
14. Air temperature sensor
15. 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 fuel-dispenser nozzle region, provides a liquid seal against the escape of vapor. A check valve also located 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. Then through to the EVAP canister where hydrocarbons are removed from the vapor to meet emission regulations. The purified air passes to atmosphere through the vent pipe; refer to **Evaporative Emission Canister**. The remaining 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**.

The rising fuel-level in the fuel tank closes the float-level vent-valve when the fuel tank reaches full, and the resulting backpressure 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.

NOTE: 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 atmosphere.

The ORVR system 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 rollover.

Evaporative Emission Canister

A new single EVAP canister is introduced, replacing the twin canister system; refer to **Fig. 49**. 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 is 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 dust box acts as a filter to protect the close valve from the ingress of moisture and dust particles.

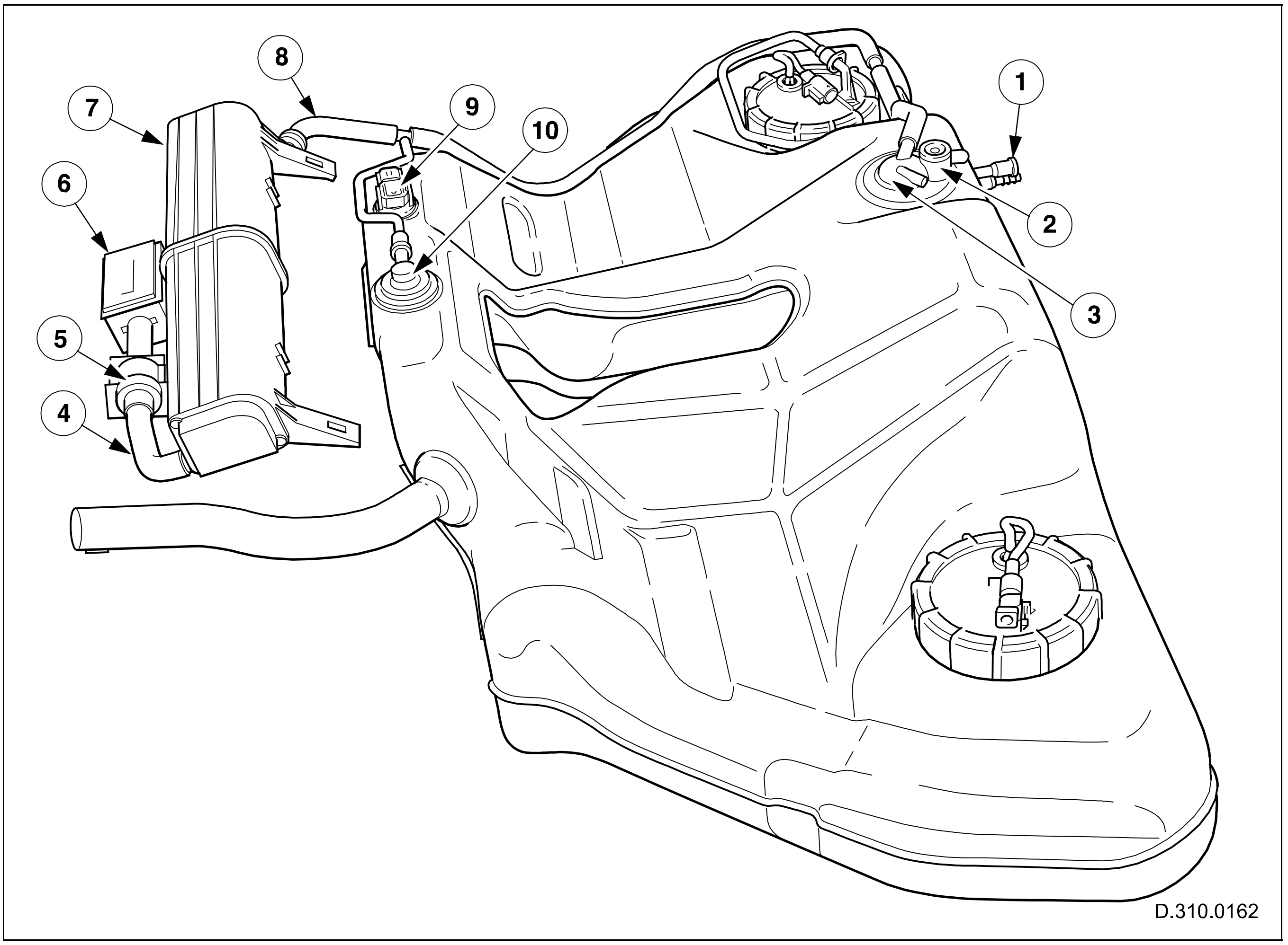

Fig. 49 Evaporative emission system

1. Pipe to EVAP canister purge valve
2. Pressure relief valve
3. Float level valve
4. Vent pipe
5. EVAP canister close valve
6. Dust box
7. EVAP canister
8. EVAP canister, inlet and outlet pipe
9. Fuel tank pressure sensor
10. Grade vent valve

Evaporative Emission Canister Purge Valve

The 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 (the extent that 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 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 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.

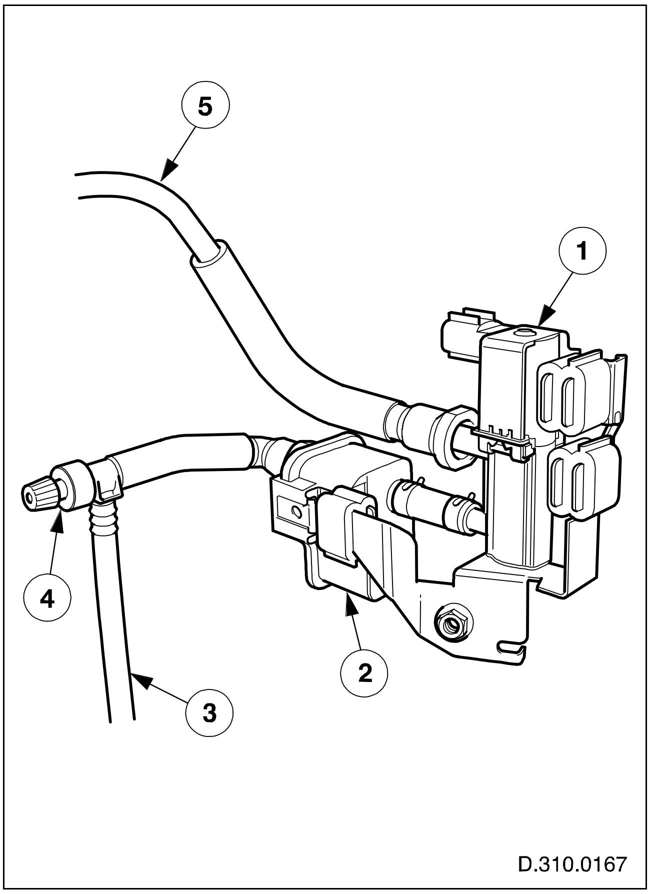

Fig. 50 Evaporative emission canister purge valve

1. Purge valve
2. Reservoir
3. Pipe to fuel tank
4. Test port — NAS function only
5. Pipe to engine

Electronic Engine Controls

Introduction

A new electronic engine control system is introduced into the new XJ, used 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 ECM, using calibrated data-tables and maps, evaluates the sensor information. 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 via 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, each of which is dependent on engine and vehicle state at any moment of time and driver requirements, are listed below:

- 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(s) 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.

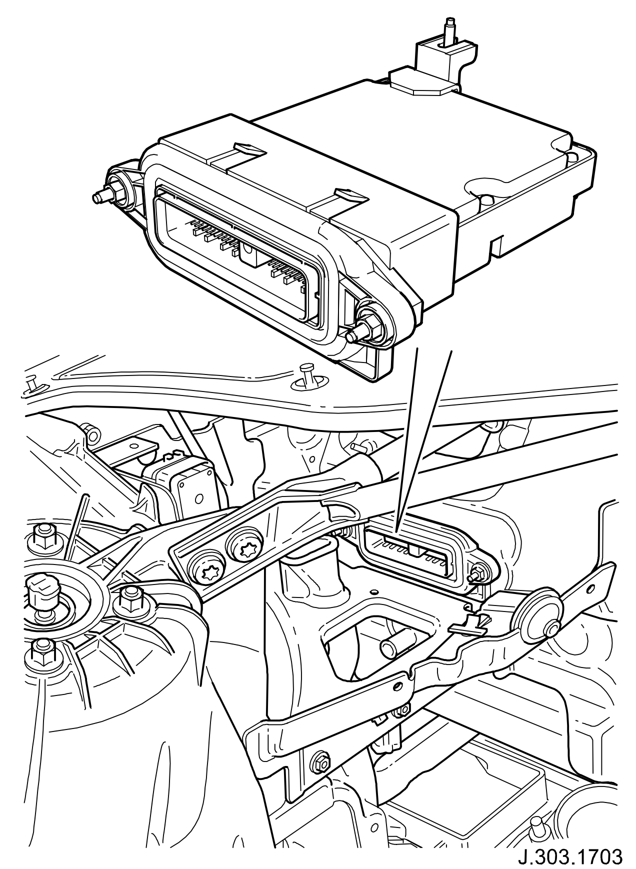

Fig. 51 Engine control module

Electrical Load Management

The electrical load management system used on the XJ is a new concept. The system utilizes the capability of existing vehicle messaging and subsystems, including the ECM, to analyze the overall power supply condition. Using this data the system makes its decision on which electrical features can be supported at any one time, therefore preventing the risk of damaging the battery.

For further information on this system; refer to **Battery and Charging Systems**.

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 various systems and the ECM is discussed in the relevant section of the publication.

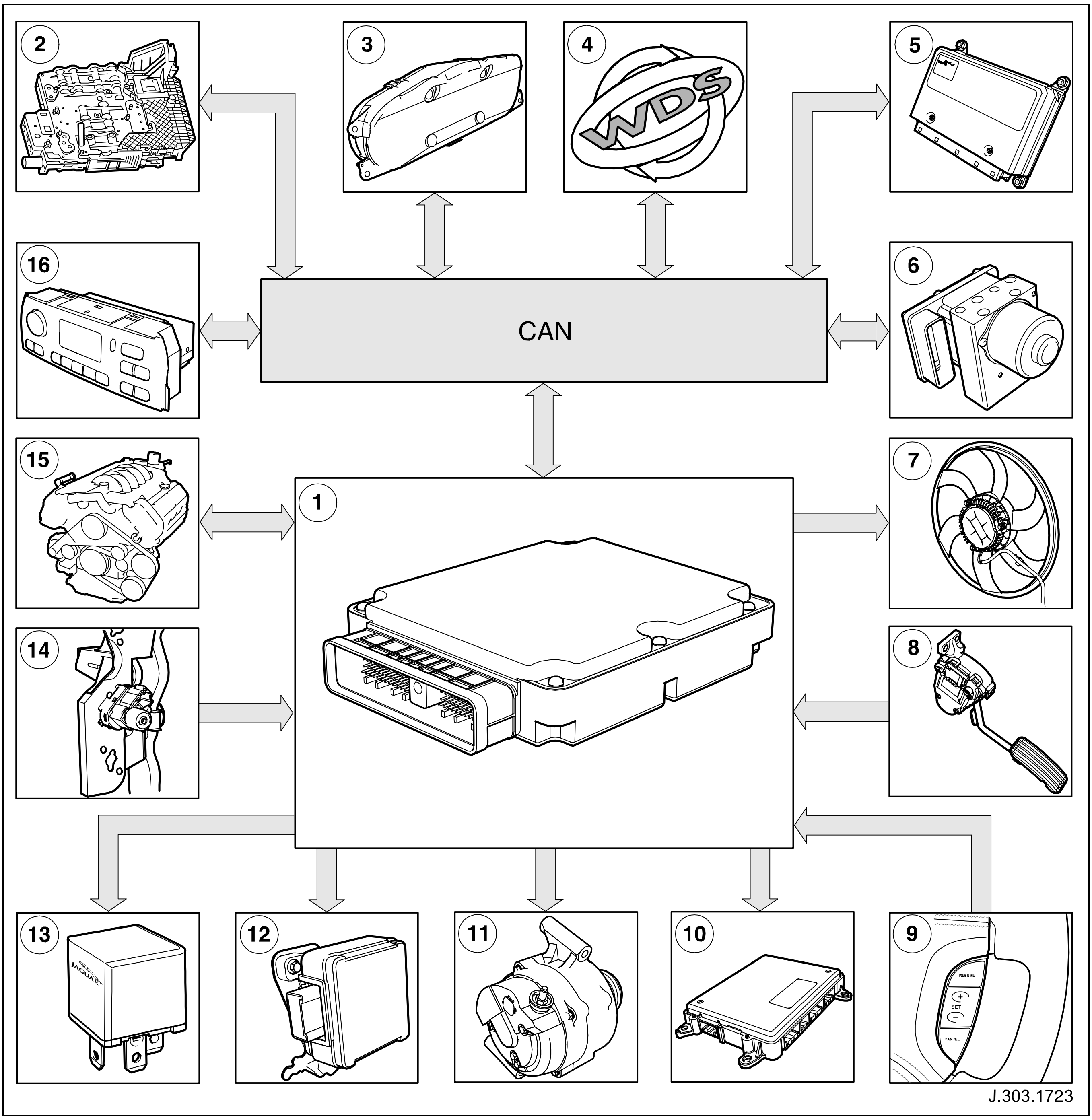

Fig. 52 System interfaces

Key to Fig. 52

1. Engine control module
2. Transmission control module (TCM)
3. Instrument cluster
4. Diagnostics
5. Air suspension module (ASM)
6. ABS / TC / DSC
7. Fan control module - integrated with fan motor
8. Accelerator pedal - electronic throttle control
9. Cruise control switches
10. Fuel pump driver module - integrated in rear electronic module (REM)
11. Alternator
12. Second fuel pump driver module - supercharged vehicles only
13. Starter relay
14. Brake pedal switches
15. Engine
16. 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 determined so that:
  – exact fuel control is possible at minimum engine load, with the allowance for purge valve correction,
  – and also to provide a sufficient fuel-flow at all engine speeds and maximum engine load.

- 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,
  – and 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 ratio-metric match to the metered airflow.
- The ECM is capable of adapting to fuel system tolerances and engine internal wear under all operating conditions.
- The ECM continuously 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: 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: initialized and used during engine cranking and under-speed 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 (Normally Aspirated Engines)

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

- The target position of both camshafts is 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 provide a smooth vehicle operation.
- 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 a smooth vehicle operation for all engine operating conditions.

Interface to Electronic Throttle

- The system incorporates an electronic throttle to control the airflow into the engine under closed-loop feedback 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 with 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. The speed control switches are momentary action and are mounted on the steering wheel. 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 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 is 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 feedback control on the intake camshaft's position relative to the position of the crankshaft and exhaust camshafts.
- Oil control solenoid — variable valve timing (normally aspirated 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 the fuel being injected into the engine. The ECM uses this value to provide compensation for the changing flow-characteristics of the fuel system when affected by changes in temperature.
- 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 position of the IMT valves is 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 airflow into the engine by use of the throttle motor andthrottle position sensor (TP sensor).
  - The throttle motor, via signals received from the accelerator-pedal position sensor, operates the throttle disc position; the ECM transmits these signals.
  - The ECM via the TP sensor, monitors throttle-disc angle.
  - The ECM on the application of external loads, for example the air conditioning compressor, makes compensation to the throttle disc angle.

- Mass air flow sensor with integrated intake air temperature sensor:
  - The mass airflow sensor (MAF sensor) informs the ECM of the rate of airflow entering the engine by producing a voltage which increases as the rate of airflow 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 intake air temperature sensor (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 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 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 used in conjunction with the ECM provides 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.
  - The sensor is used by the ECM as a 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.
  - The sensor also monitors catalyst efficiency.
- Exhaust gas recirculation valve:
  - As controlled by the ECM, a defined portion of the engine's exhaust emissions are extracted and returned to the intake mixture via a solenoid valve.
- Air intake control-flap solenoid (supercharged engine):
  - The ECM directly controls the solenoid, to open and close the air intake control-flap in the air-cleaner assembly. The control flap opens 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.

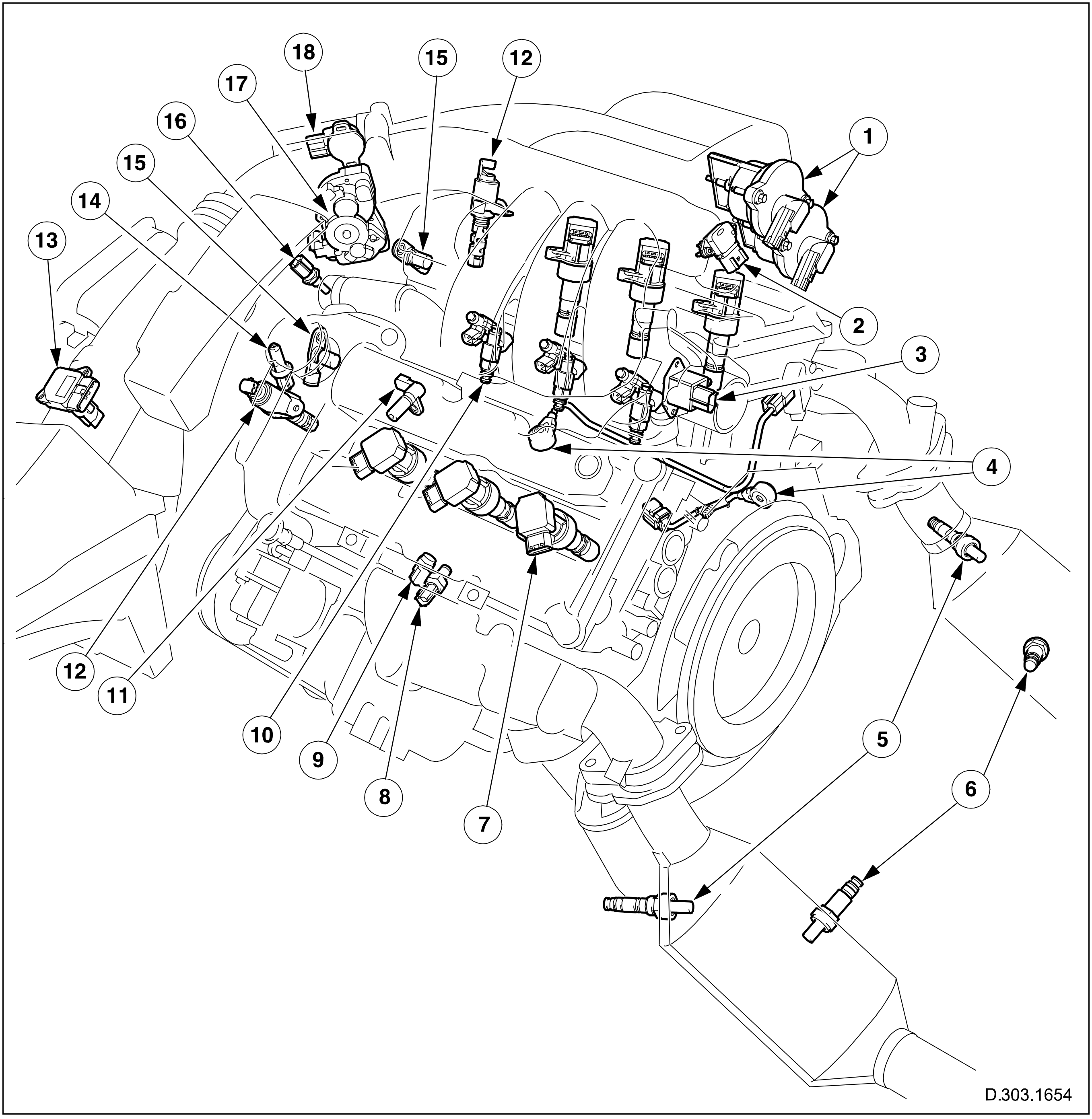

Fig. 53 V6 Normally Aspirated Engine — sensor and actuator location

Key to Fig. 53

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 air-temperature sensor
14. Engine fuel temperature sensor
15. Camshaft position sensor
16. Engine coolant temperature sensor
17. Throttle motor
18. Throttle position sensor

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

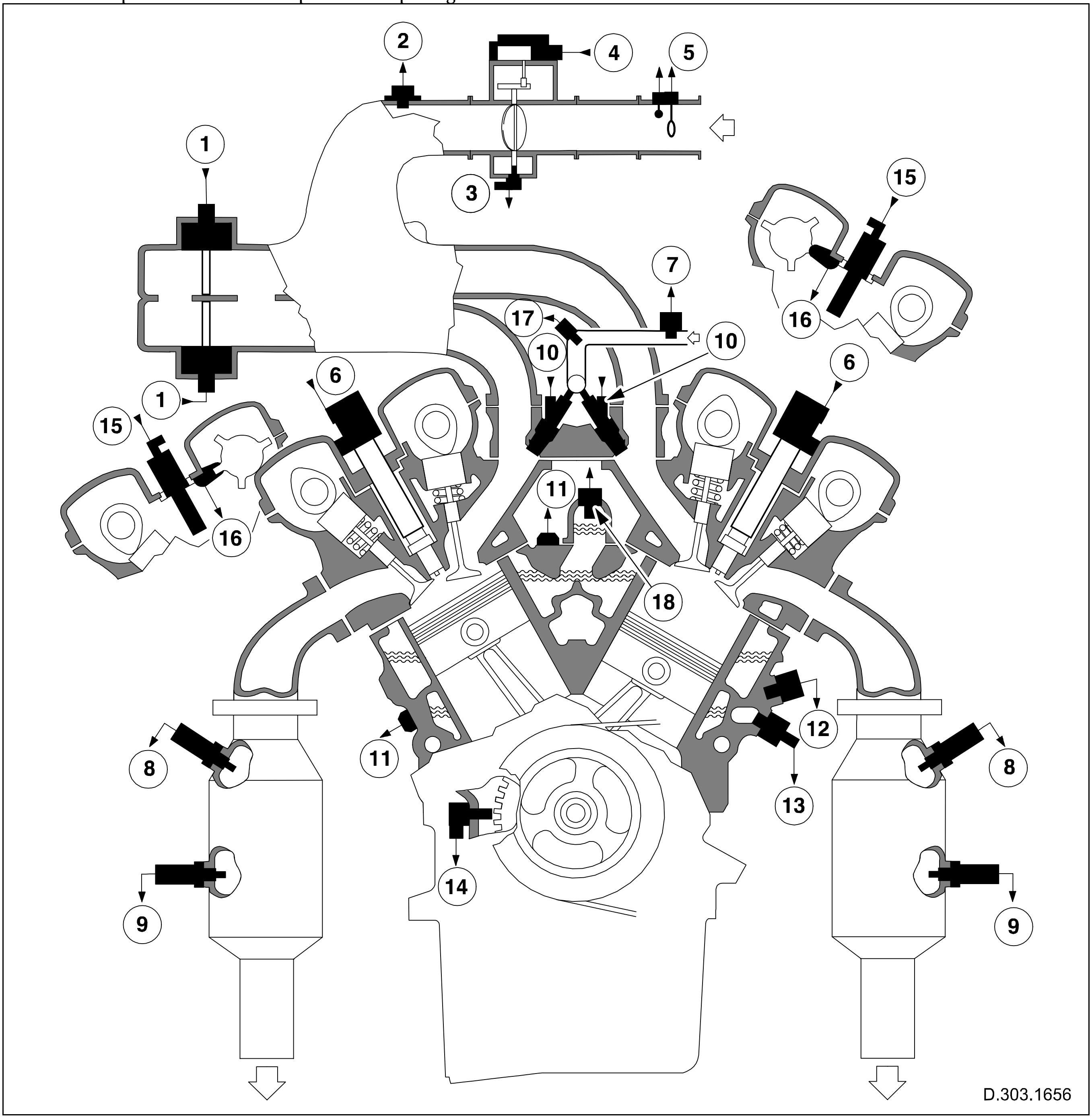

Fig. 54 V6 Normally Aspirated Engine — sensors and actuators schematic

Key to Fig. 54

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

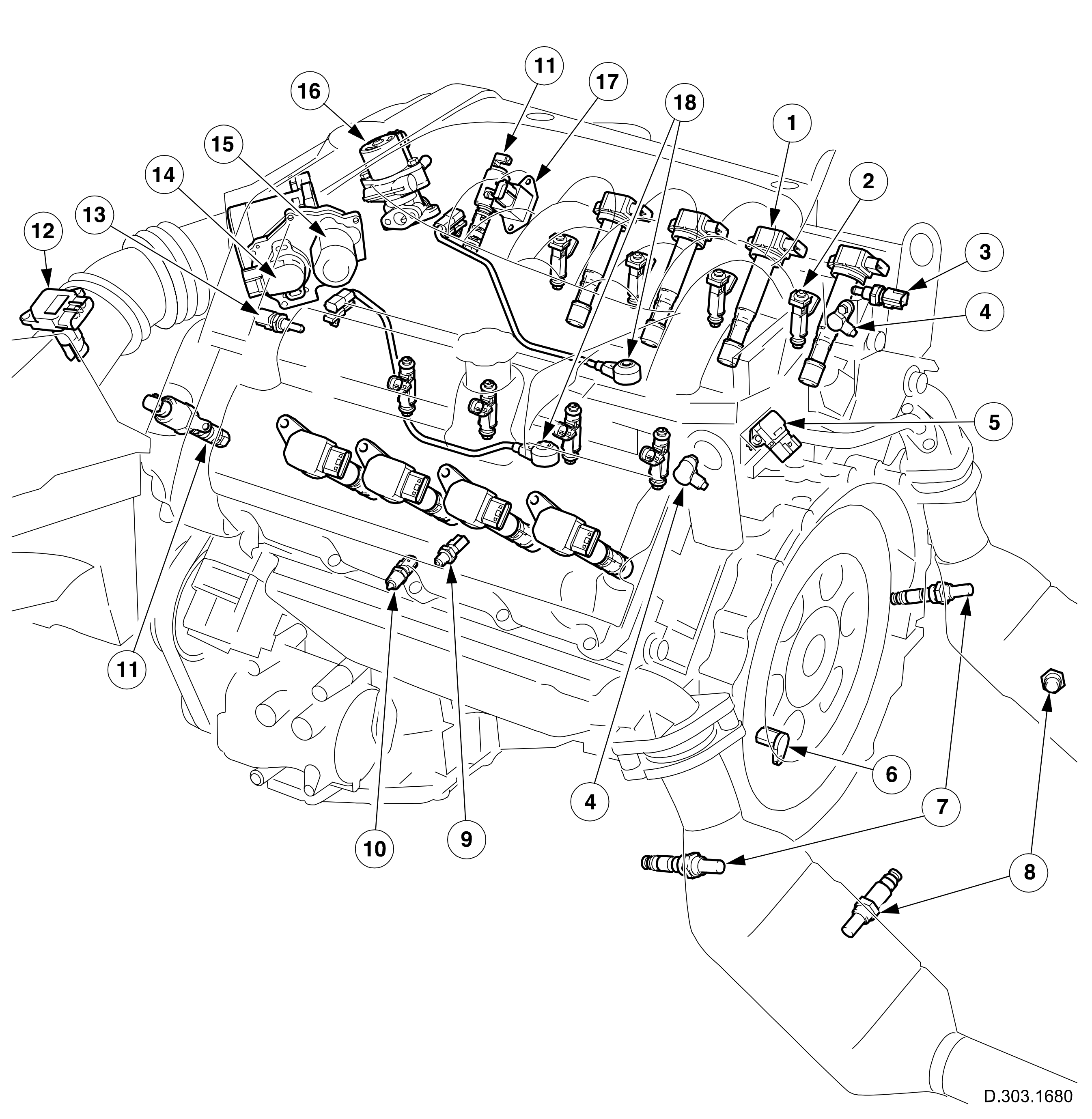

Fig. 55 V8 Normally Aspirated Engine — sensor and actuator location

Key to Fig. 55

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

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

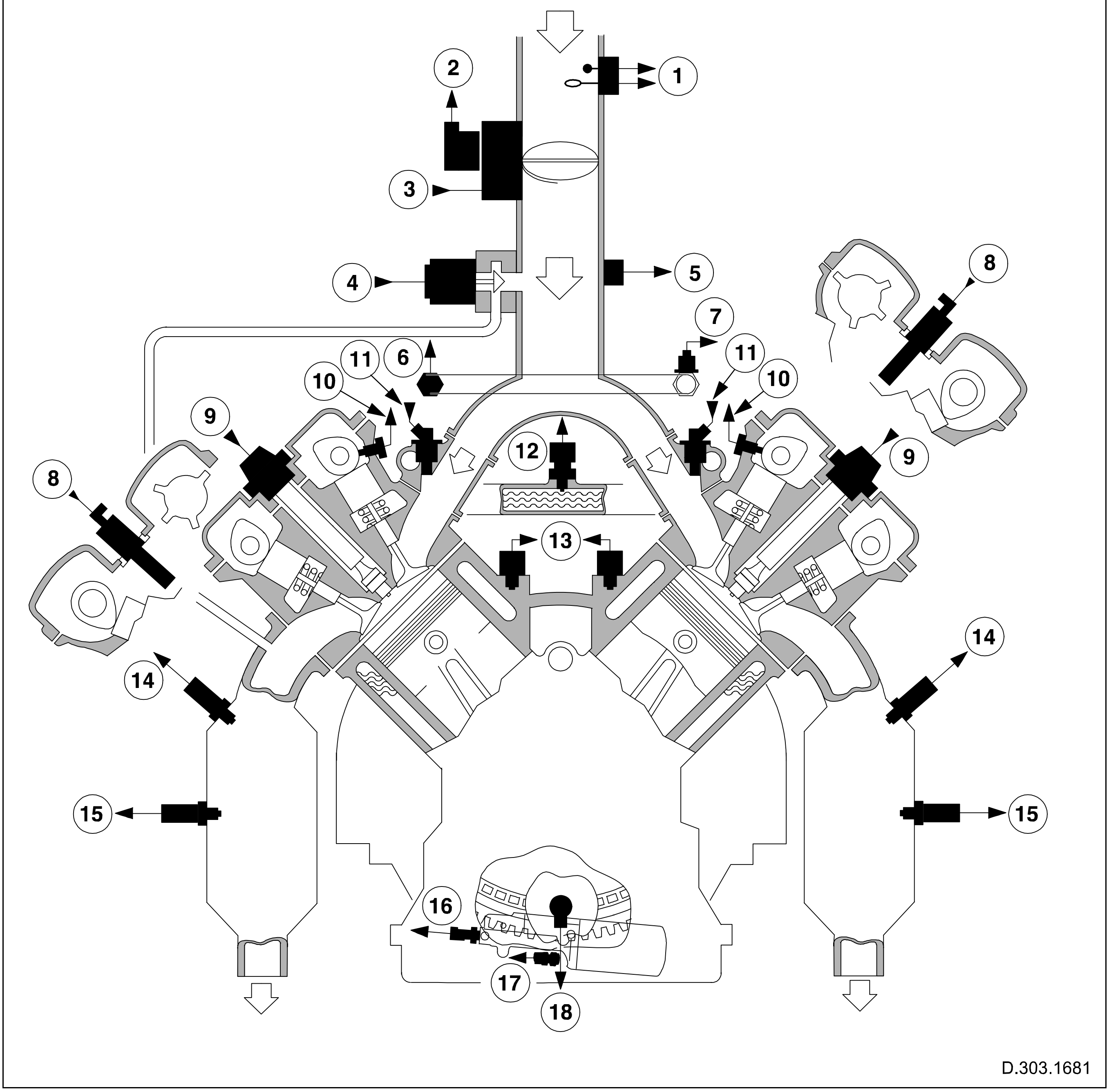

Fig. 56 V8 Normally Aspirated Engine — sensors and actuators schematic

Key to Fig. 56

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

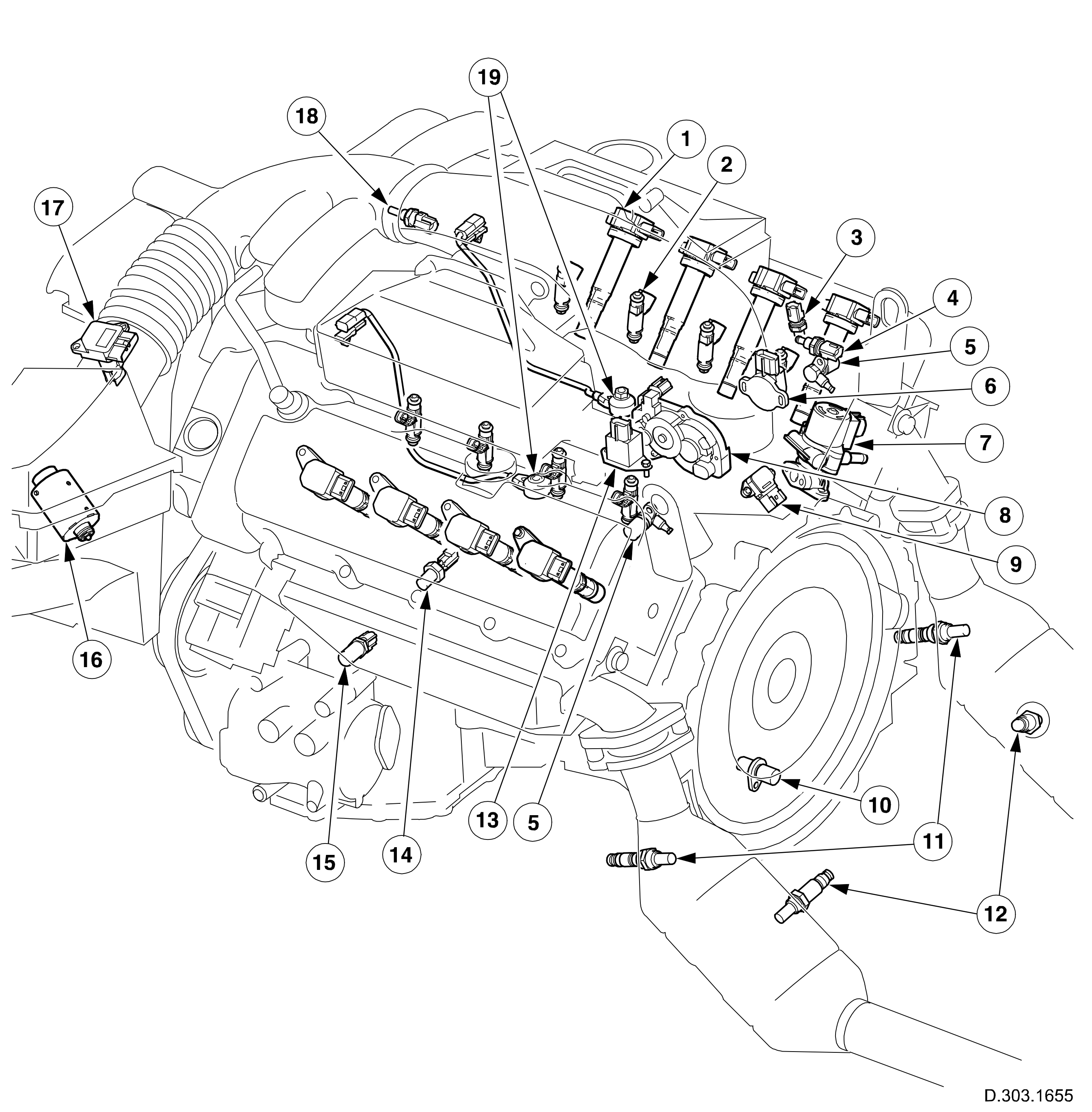

Fig. 57 V8 supercharged Engine — sensor and actuator location

Key to Fig. 57

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

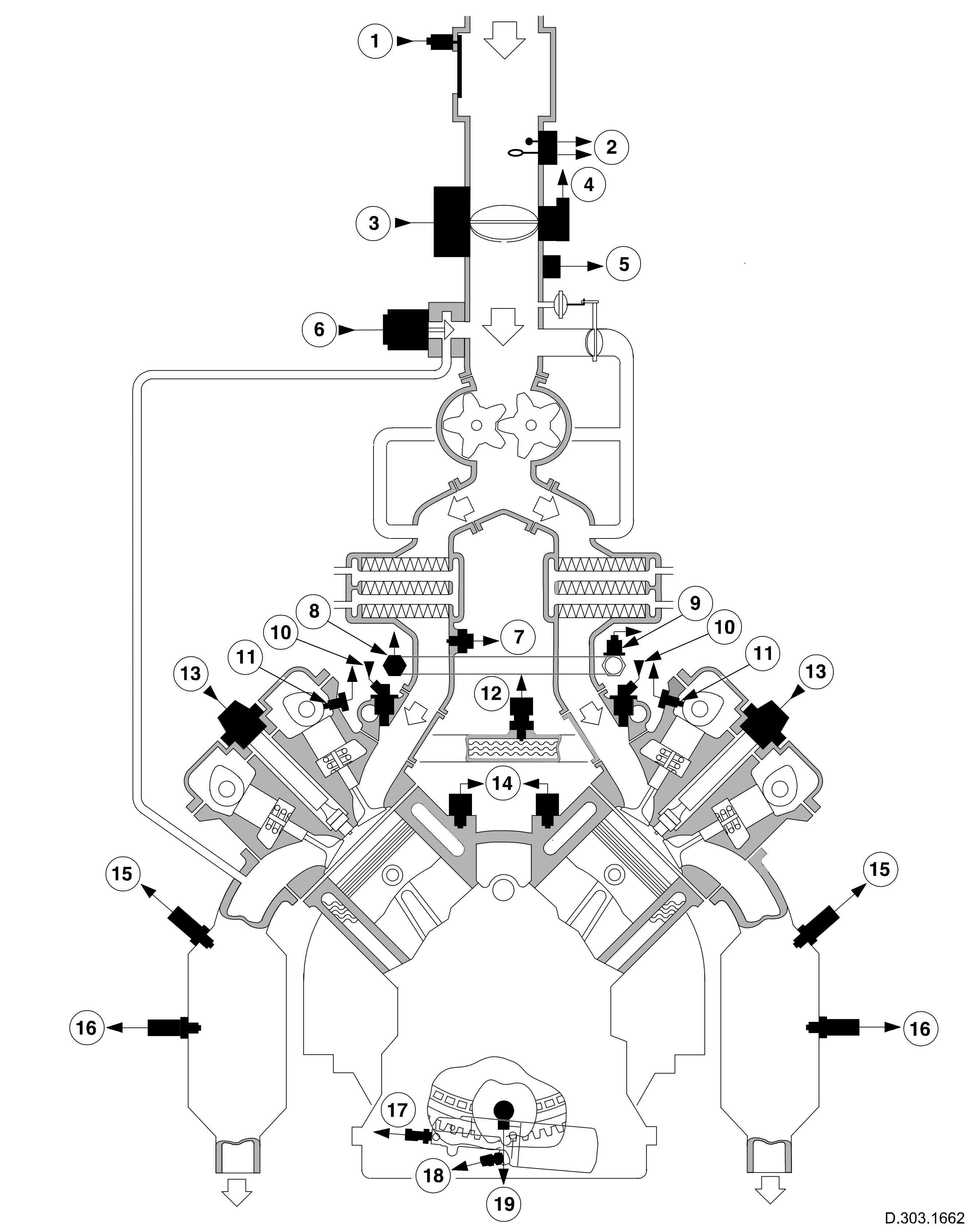

Fig. 58 V8 supercharged Engine — sensors and actuators schematic

Key to Fig. 58

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 six-speed, electronically controlled, automatic transmission is introduced into the new XJ, which is compatible with all engine applications. The transmission has been specially developed for vehicles with an engine torque of up to 600 Newton-meters (Nm).

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

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

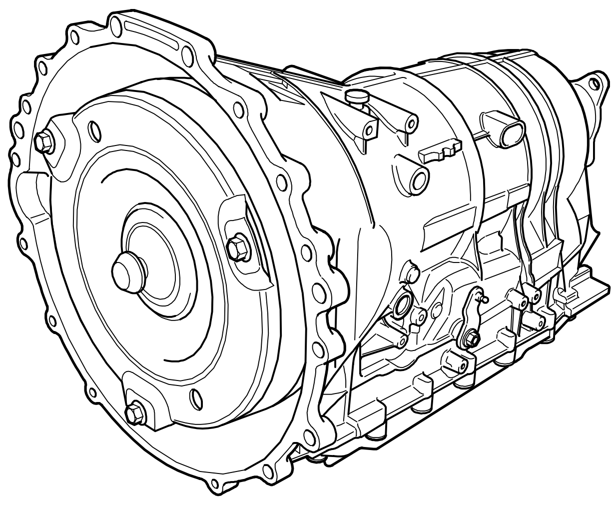

Fig. 59 Automatic transmission

The transmission is physically different for V6 and V8 engine applications. The main difference is that the V8 application has recesses in the bell housing to accommodate the exhaust catalysts.

Key Data

- Six forward gears;
- One reverse gear;
- Coaxial planetary transmission;
- Hydrodynamic torque converter with an integral 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 combined element, installed 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 torque converter with an 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 six-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: third or fifth gear fixed, dependent upon gear selection at the time of the malfunction.

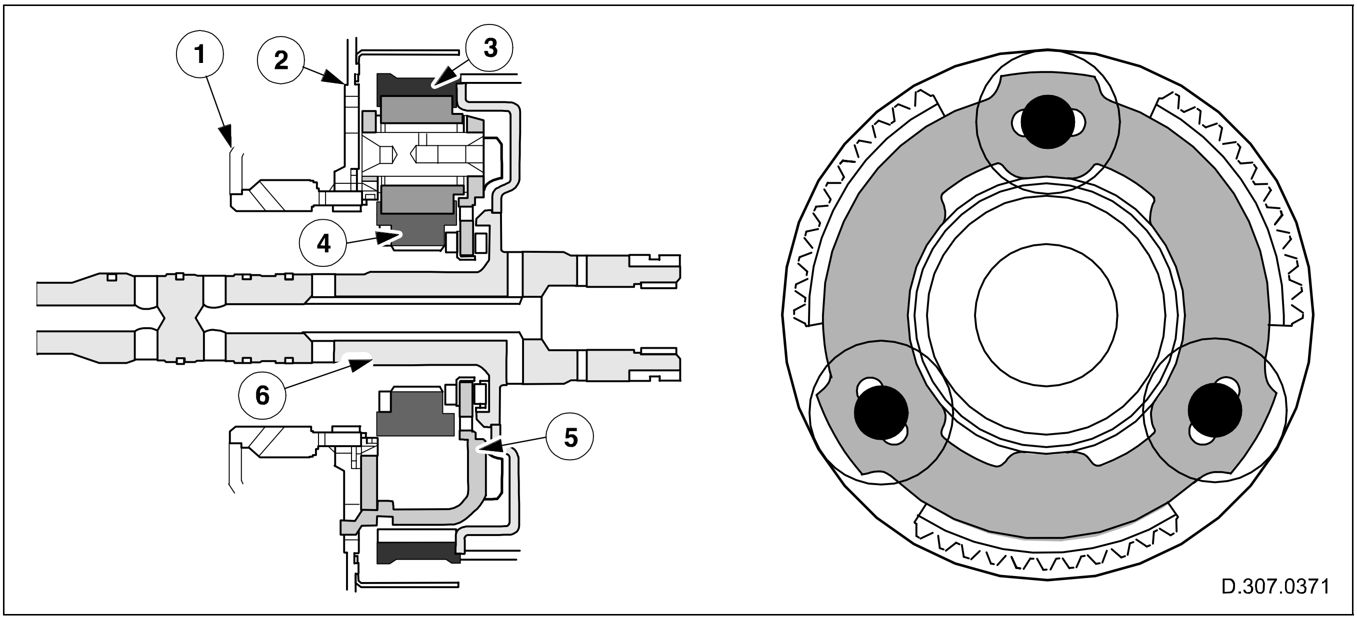

Fig. 60 Single-web planetary gear set

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

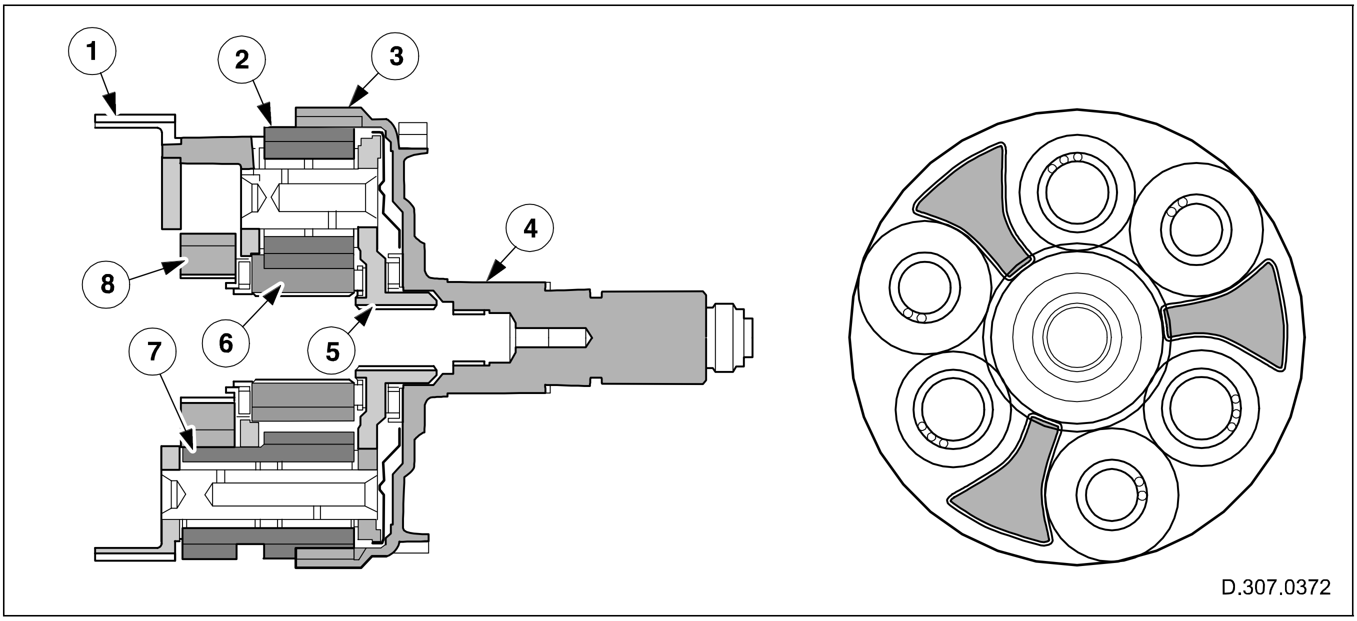

Fig. 61 Double-web planetary gear set

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

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 of the six forward gears.

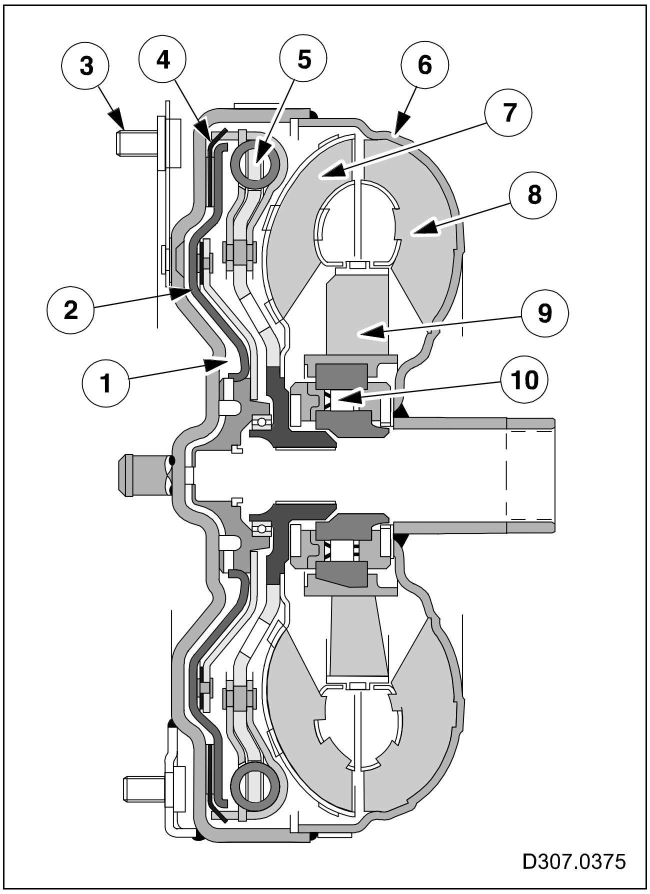

Fig. 62 Torque converter with torsional vibration damper

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 a 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

Another feature of the transmission, is that freewheels (one-way clutches) are replaced by actuation of the relevant clutches when overlap gearshift takes place. This arrangement provides a reduction in transmission weight and size.

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.

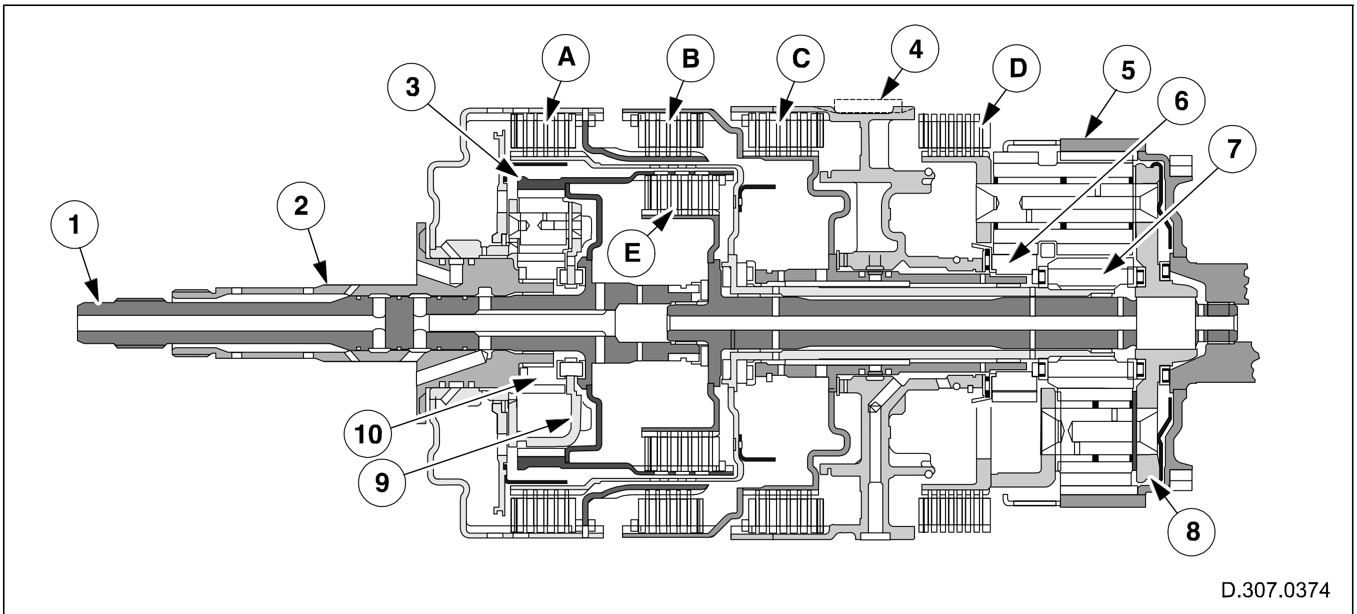

Fig. 63 Shift elements

A. Clutch
B. Clutch
C. Brake
D. Brake
E. Clutch
1. Turbine shaft
2. Stator shaft
3. Ring gear 1
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 a combined unit, 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 gearshifts;
- 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, for example:

- transmission input and output speeds;

via the CAN:

- throttle pedal position;
- gear selector position;
- engine torque and speed;
- transmission fluid temperature;
- brake pedal status;
- engine oil temperature;
- engine coolant temperature;
- wheel speed.

Using these signals and stored information, the TCM calculates the correct gear and torque converter lock-up clutch setting, plus 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 (turbine 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. Signals from the position sensor also ensure that the engine will only start when the gear selector is in the park or neutral position. The ECM uses the signals to prohibit operation of the starter relay if the incorrect gear is selected.

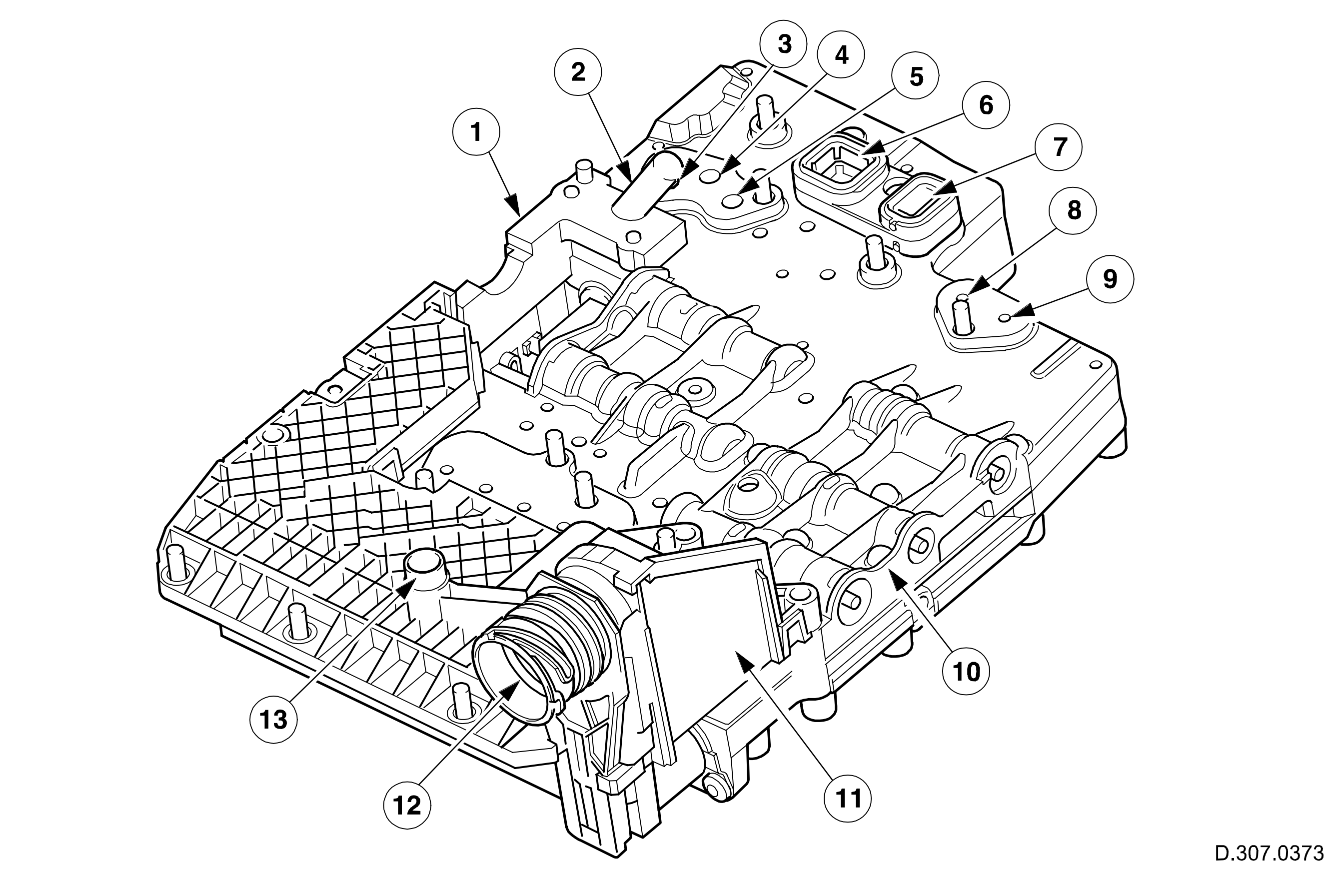

Fig. 64 Transmission Control Module / Valve Body

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

Safety Features

The safety features protect against incorrect operation by the driver and system malfunctions. For example:

- Each time the vehicle is started a 'fail-safe' check is performed on the TCM and associated electronics;
- A 'limp-home' mode is functioned, if a power failure occurs;
- Prevents reverse gear selection at forward speeds;
- Prevents manual gear down-shifting at excessive engine speeds.

Shift Selection

The TCM uses various driver selected modes and adaptive modes as below. Each mode introduces a different gear selection strategy, depending on driver requirements and driving conditions (vehicle status).

Driver selected modes:

- Normal mode:
  - Activated by the sports 'S' switch on the J-Gate surround, the switch does not illuminate when normal mode is selected.
  - Normal mode will remain active until the driver selects 'sports mode' or 'cruise control'. On the deactivation of 'cruise control', the system returns to the mode previously activated.
  - Normal mode can be overridden by various adaptive modes.
- Sport mode:
  - Activated by the sports 'S' switch on the J-Gate surround, the switch will illuminate when sport mode is selected.
  - The sport mode strategy enables gearshift points to be extended to higher engine speeds, and downshifts at lower accelerator-pedal angles.
  - Sport mode will remain active until the driver selects 'normal mode' or 'cruise control'. On the deactivation of 'cruise control', the system returns to the mode previously activated.
  - Sport mode can be overridden by various adaptive modes.
- Cruise control mode:
  - When activated the TCM receives signals from the ECM via the CAN.
  - The TCM implements a shift-map strategy to reduce gearshift activity and subsequently increase fuel economy.

Adaptive modes, these modes are selected automatically depending on driving conditions and vehicle status:

- Hot mode:
  - A gear selection and torque converter lock-up strategy is implemented, to reduce heat generated in the transmission when any of the following become hot enough to reach a critical threshold value:
    transmission fluid,
    transmission casing,
    engine oil,
    engine coolant temperature.
  - The hot mode strategy reduces generated heat by selecting higher gears and engaging the lock-up clutch at lower vehicle speeds.

  NOTE: With hot mode implemented the driver may experience unexpected up-shifts when running at high vehicle speeds and loads.
- Traction control mode:
  - Under normal driving conditions an increase or decrease in wheel speed would be recognized by the TCM as the vehicle accelerating or decelerating and a gear would be selected in proportion to the speed of wheel rotation.
  - In a situation where the vehicle is not accelerating in proportion to the wheel rotation speed, for example a slipping wheel. The TCM, in response to signals from the ABS module, will still command the transmission to select a higher-gear to help reduce wheel slip. The high gear will remain engaged until traction at the slipping wheel is regained.
- Gradient and towing mode:
  - The gradient and towing mode is activated when the TCM detects reduced vehicle acceleration at given throttle positions. This reduction in acceleration is recognized by the TCM as the vehicle either towing or ascending a gradient. Therefore, to provide the vehicle with maximum traction effort, a shift-map is used that extends the amount of time lower-gears are engaged, and subsequently delays the selection of higher gears.

Adaptive Shift Strategy

By increasing the linking of the transmission control system with other vehicle systems such as engine, brakes (ABS) and steering, a number of signals are made available to the TCM, which describe how the vehicle is being driven and on what road conditions. Using this information the TCM is able to exploit the vehicle's performance capability, and conversely maximize driving refinement and economy.

By monitoring signals associated to:

- 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 TCM can be realized. On the basis, of this information the TCM 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 are made regarding the vehicle's actual load status and the topography of the stretch of road (uphill or downhill gradient), and what shift strategy should be applied to the transmission function.

For example, when 'sport' mode is selected and an enthusiastic driving style is detected on a demanding road. The TCM will adjust the transmission shift strategy to complement the conditions by inhibiting sixth-gear and selecting lower gears earlier to prevent 'hunting' between gears.

Under heavy braking, the TCM will select a lower gear to enable an immediate acceleration response on application of the accelerator pedal. Similarly, if the accelerator pedal is released rapidly following hard acceleration, selection of a higher gear is inhibited to increase engine braking and improve subsequent acceleration response.

To complement these features, when the TCM detects the vehicle rounding a corner, selection of a higher gear is inhibited until the vehicle exits the corner.

Once a more sedate driving style is detected, sixth gear will be reinstated and the shift strategy will return to normal.

Transmission Cooling

Transmission Fluid Cooler

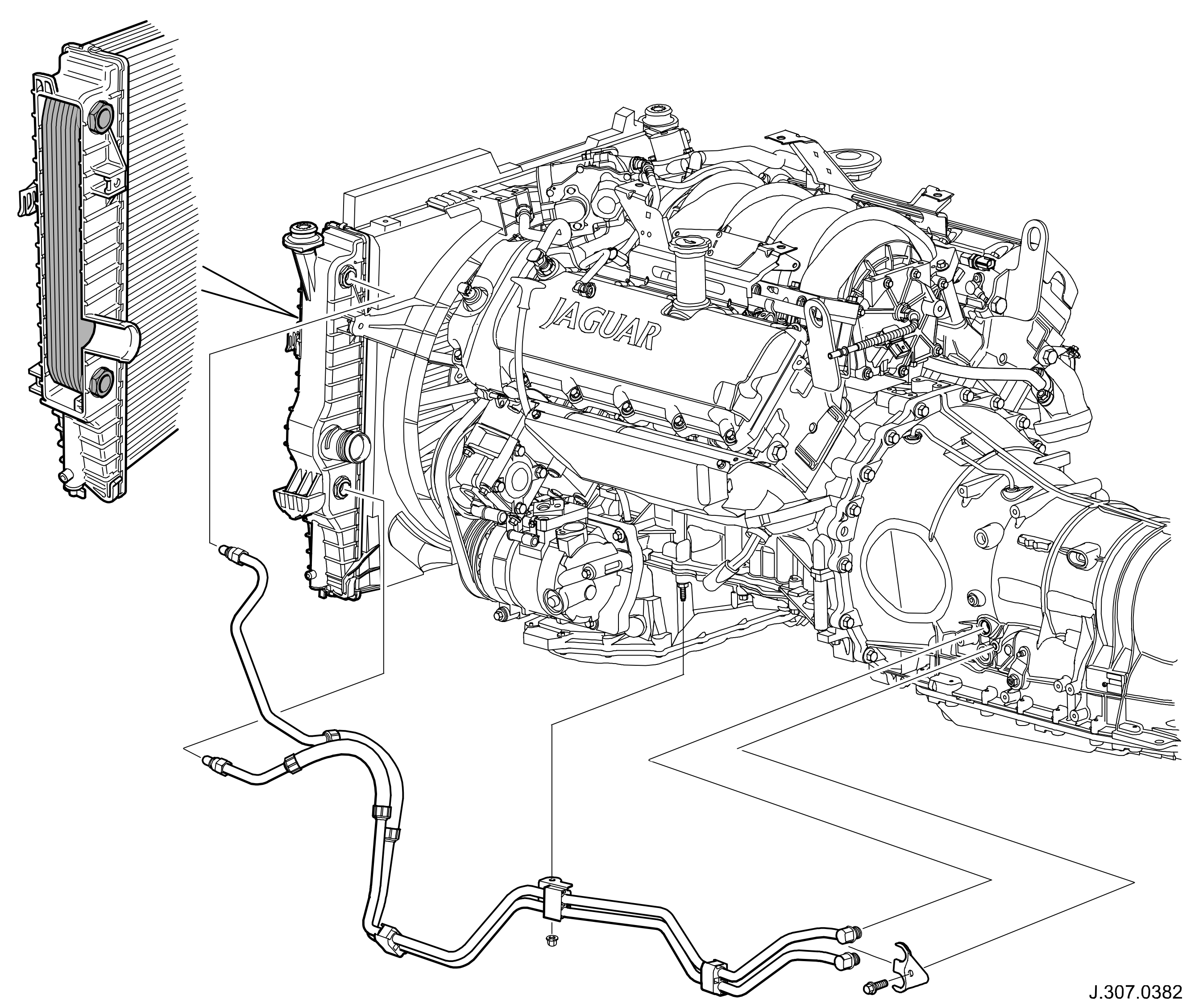

Fig. 65 Transmission cooling (V8 derivative shown)

The transmission fluid-cooler is integrated into the end-tank of the engine's coolant radiator. The fluid cooler is of aluminum construction, comprising tubes and louvered fin-cores. The tubes are arranged horizontally to provide a cross flow of the transmission fluid through the cooler. The engine coolant passes through the cooler's fins to provide the cooling effect.

This arrangement provides improved cooling performance in comparison to the air-cooled system, as the transmission-fluid temperature is controlled in conjunction with the engine coolant temperature. Improved temperature control is also achieved when the vehicle is at a standstill with the engine running.

Automatic Transmission External Controls

Transmission Selector Mechanism

The XJ incorporates a new design of transmission selector mechanism with:

- Improved mounting frame and installation method;
- Improved setting procedure;
- New design of selector interlock mechanism;
- New design of key interlock mechanism;
- Reduction in component weight.

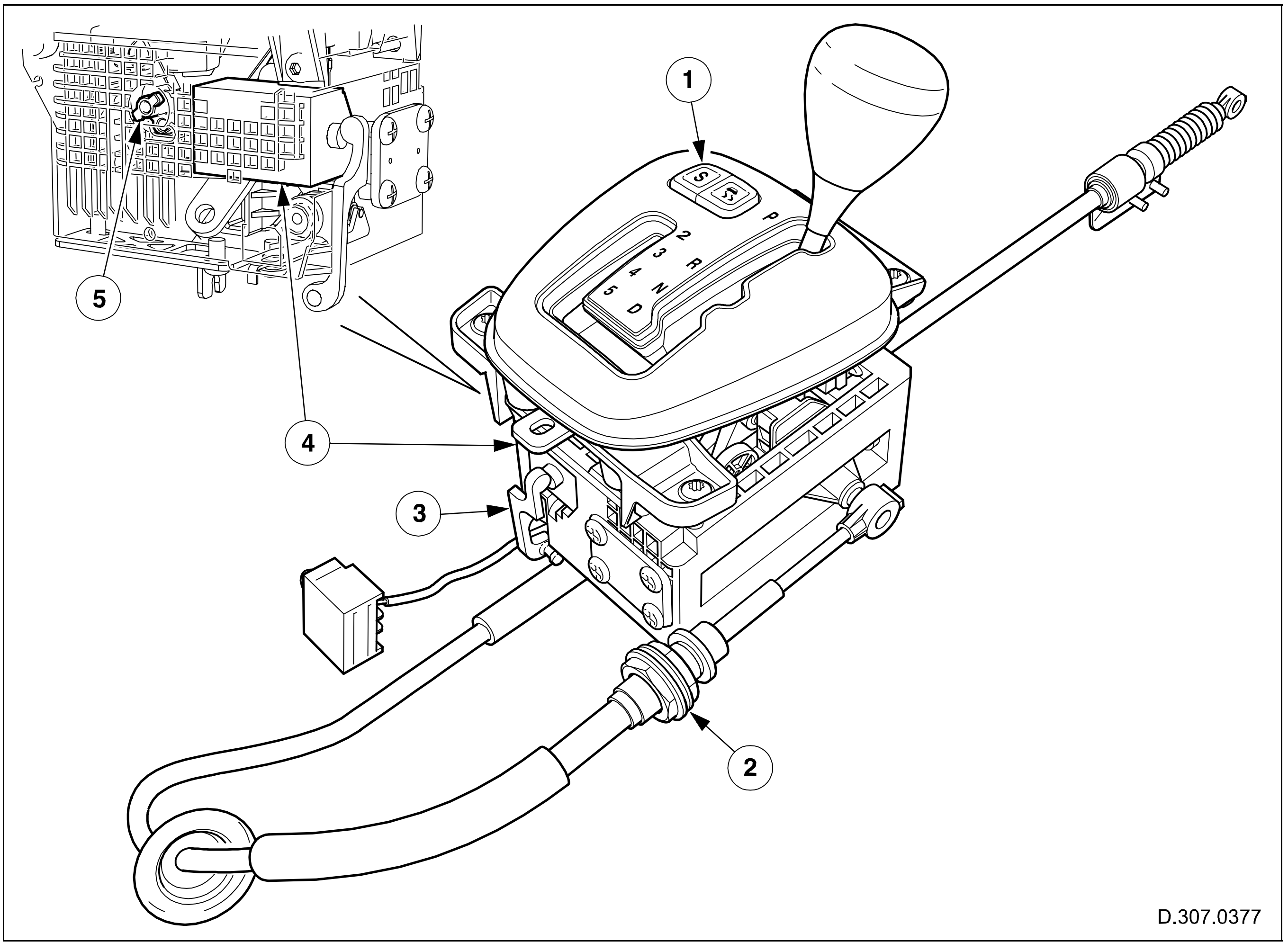

Fig. 66 Transmission selector mechanism and cable

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

J-gate

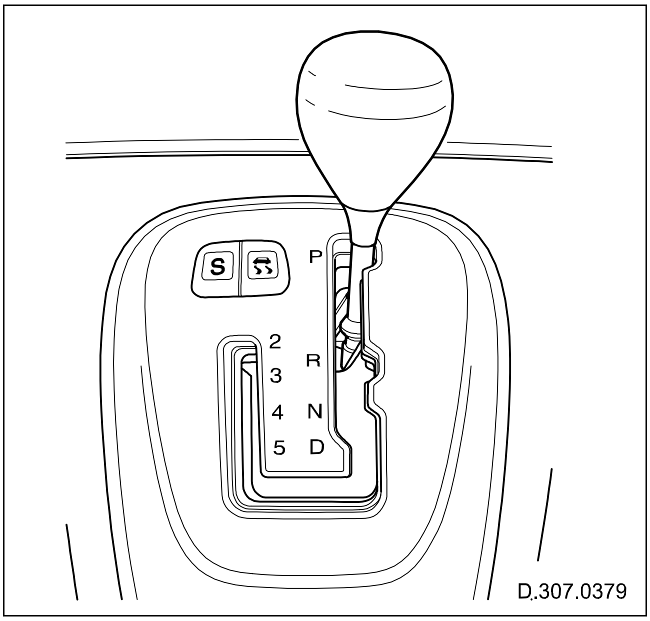

Fig. 67 J-gate selector positions

The J-gate is designed to accommodate either automatic or manual driving techniques:

- Automatic, right-hand side of the J-gate:
  - Enables selection of park 'P' through to drive 'D'.
  - The link between the selector lever and the transmission is via a cable.
  - A position switch within the transmission informs the transmission control module (TCM) of gear selection.
  - The TCM transmits gear selection information to other vehicle modules via the CAN.
  - With drive 'D' selected, gear selection is controlled by the TCM in response to signals received relating to vehicle status, for example throttle position, vehicle speed, etc. These signals are received via the CAN.
  - In addition, when 'D' is selected and sixth gear is engaged, the selector lever can be shifted sideways across the gate to fifth gear. Sixth gear will be inhibited until the selector lever is moved back to 'D'.
- Manual, left-hand side of the J-gate:
  - Enables individual selection of second, third, fourth and fifth gears.
  - The TCM detects the driver's gear selection through signals transmitted from the selector mechanism, via the CAN.

The sports mode switch, marked 'S' on the J-gate surround enables the driver to select either normal 'N' or sport 'S' modes. For further information on gear selection and sports mode switch, refer to **Automatic Transmission**.

Selector Interlock

The selector interlock is solenoid-operated; refer to **Fig. 66**. Its function, is to prevent the selector lever being moved from park 'P' 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 selector lever to be moved out of park 'P'.

NOTE: If the selector lever is moved into park 'P' 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 selector lever to be moved out of park 'P'.

Selector Interlock Override

In the event of a discharged or disconnected battery a provision is made to manually override the selector interlock solenoid enabling the selector lever to be moved from the park 'P' position. The interlock override is accessed by removing the top cover of the J-gate; refer to 'JTIS'.

Key Interlock

The key interlock system prevents the removal of the ignition key when the gear-shift lever is not in the park 'P' position.

- ROW vehicles: The park-switch incorporated in the selector mechanism functions the key interlock solenoid located in the ignition barrel to prevent the removal of the ignition key.
- NAS vehicles: The key interlock system is functioned by a cable operated mechanism to prevent the removal of the ignition key.

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; refer to **Automatic Transmission**. The selector mechanism performs its own internal fault monitoring and relays any fault codes to the TCM for diagnosis using 'WDS'.

Exhaust System

The exhaust system on the New XJ is constructed of stainless steel with polished tail-pipe sleeves, which are detachable. The system meets specific flow-resistance requirements and general engine conditions of each XJ powertrain variant.

Exhaust system performance is optimized with the introduction of thin-wall high-cell-density substrates to increase geometric surface-area and minimize backpressure. A low-weight exhaust system on the normally aspirated vehicle has revised resonator internals to optimize noise quality. The resonators on the supercharged variant are tuned to provide low backpressure and optimum sound quality.

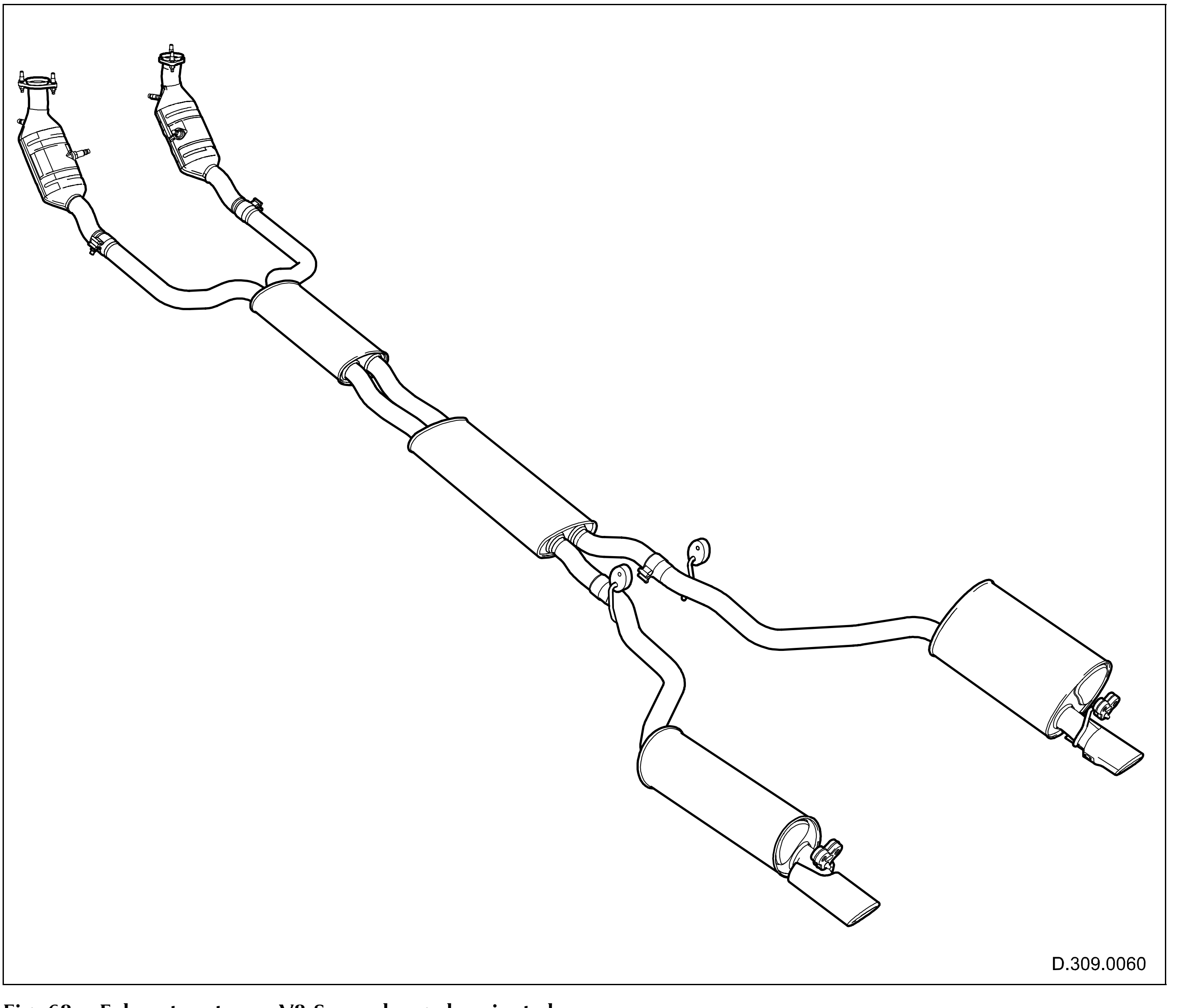

Fig. 68 Exhaust system - V8 Supercharged variant shown

Exhaust system tuning for each engine variant are as follows:

- The V8 normally aspirated system has 2 x 44 in^3 catalyst bricks in each down pipe, the front having 900 cells/in^2 and the rear 400 cells/in^2.
- The V8 supercharged system has 2 x 44 in^3 catalyst bricks in each down pipe, the front and rear bricks both having 600 cells/in^2.
- The V6 system has 2 x 44 in^3 catalyst bricks in each down pipe, the front and rear bricks both having 600 cells/in^2.
- The internals of the rear mufflers are different for each powertrain variant to achieve a different sound quality.

The entire exhaust system is assembled as follows:

- Two-bolt flanges, which are self-sealing, connect the two down-pipe catalyst assemblies to the exhaust manifolds.
- The resonator assembly attaches to the two down pipes and is secured by clamps. The two mufflers connect to the rear of the resonator assembly and are also secured by clamps.
- Four isolator rubbers support the exhaust system: two at the front of the muffler assembly and two at the tailpipe end.

Fuel Tank and Lines

Introduction

The XJ Range features a new fuel system incorporating a saddle tank positioned underneath the vehicle. A single fuel-pump located inside the tank on normally aspirated vehicles, provides optimal fuel-delivery performance. The flow-rate requirement of supercharged vehicle is achieved by the employment of a twin-pump fuel delivery system. The addition of an electronic returnless fuel system is also a further enhancement to the system.

Key Data

- Fuel tank capacity:
  - normally aspirated 85 liters (18.7 gallons),
  - supercharged 84.5 liters (18.6 gallons).
- Fuel rail pressure: 3.8 - 5.0 bar referenced to inlet manifold pressure.
- Maximum fuel flow - normally aspirated: 120 liters/hour at 3.8 bar (to atmosphere).
- Maximum fuel flow - supercharged: 180 liters/hour at 4.8 bar (to atmosphere).

Fuel Tank

To optimize luggage compartment capacity the fuel tank is now positioned underneath the vehicle, below the rear seat. This positioning necessitated the installation of a saddle tank to allow the vehicle's driveshaft to pass through the arch of tank. The tank is constructed of high-density polyethylene and is retained by two metal straps attached to the vehicle's underbody. A heat shield fitted to the underside of the tank isolates the tank from exhaust heat.

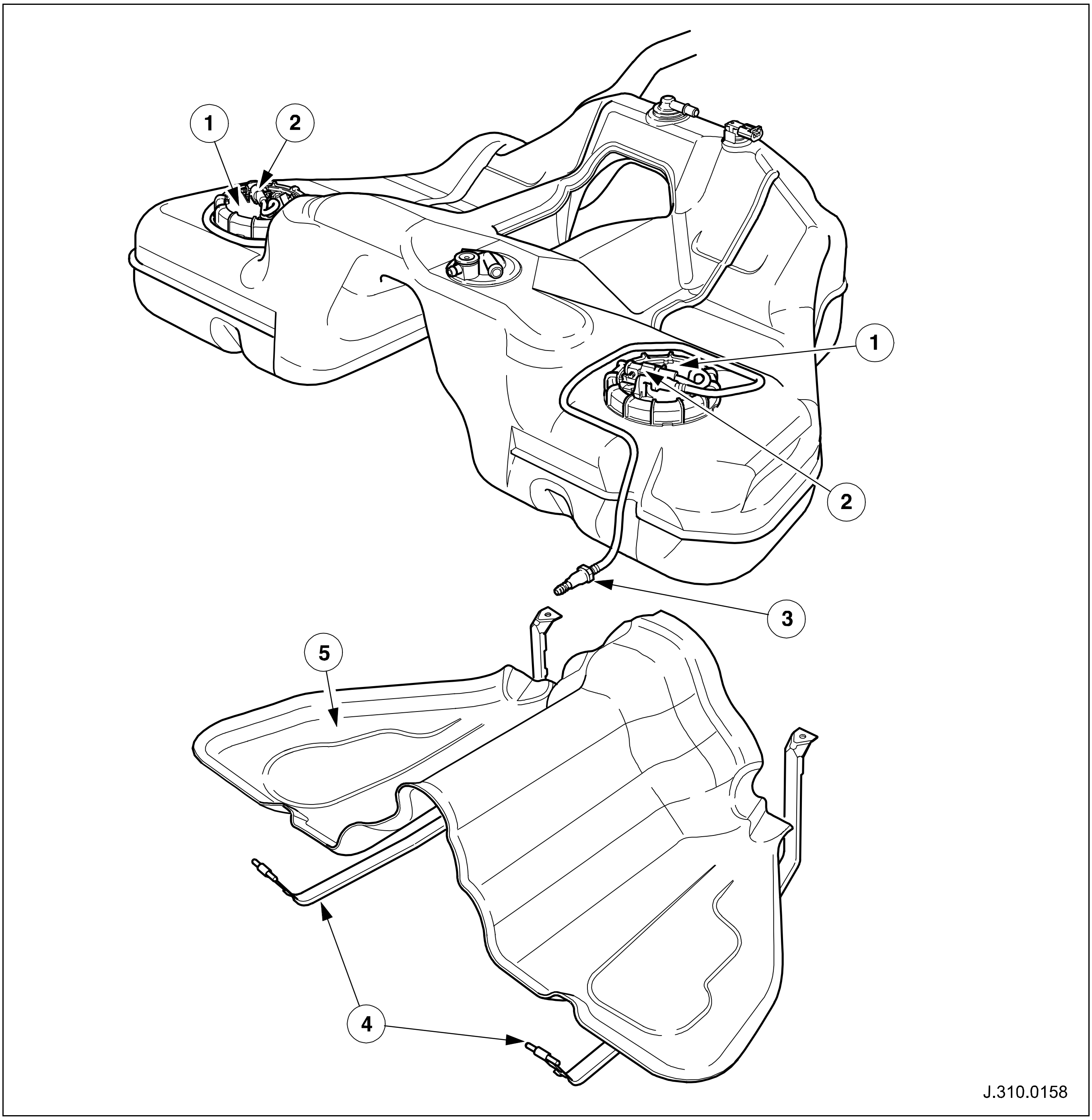

Fig. 69 Fuel tank - supercharged application shown

1. Fuel pump
2. Fuel pump and fuel level sensor, electrical connector
3. Fuel delivery line
4. Fuel tank retaining straps
5. Heat shield

Fuel Delivery - Normally Aspirated Vehicles

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. 70**. Both components are secured by screw-on plastic closure rings and have integral top plates for external line-work and electrical connectors.

The fuel delivery line connects to the module on the right-hand-side of the tank. The line has a revised diameter and route, with the fuel filter situated underneath the vehicle's floor on the left-hand side of the vehicle.

Fuel is maintained at an equal level between the fuel tank compartments by circulating the fuel through internal crossover lines 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. Fuel is drawn into this low-pressure area and directed into the crossover line 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 fuel delivery line 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 line is severed.

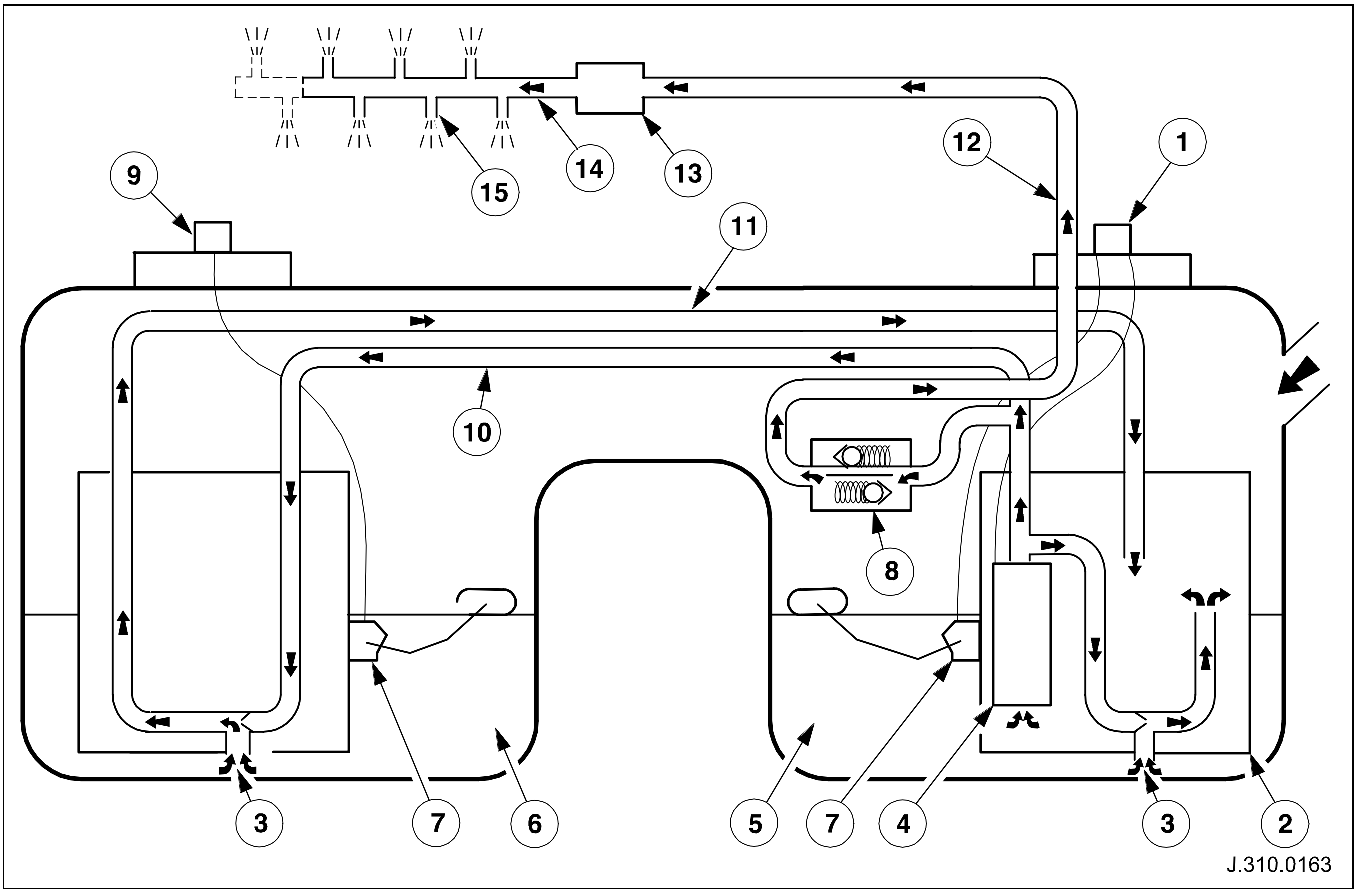

Fig. 70 Schematic of fuel tank internals - normally aspirated application

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

Fuel Delivery - Supercharged Vehicles

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. 71**. The pumps are secured by screw-on plastic closure rings and have integral top plates for external line-work and electrical connectors.

The fuel delivery line connects to the module on the left-hand-side of the tank. The line has a revised diameter and route, with the fuel filter situated underneath the vehicle's floor on the left-hand side of the vehicle.

Fuel is maintained at an equal level between the fuel tank compartments by circulating the fuel through internal crossover lines 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.

Fuel is drawn into this low-pressure area and directed into the crossover lines 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 fuel supply line 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 line is severed.

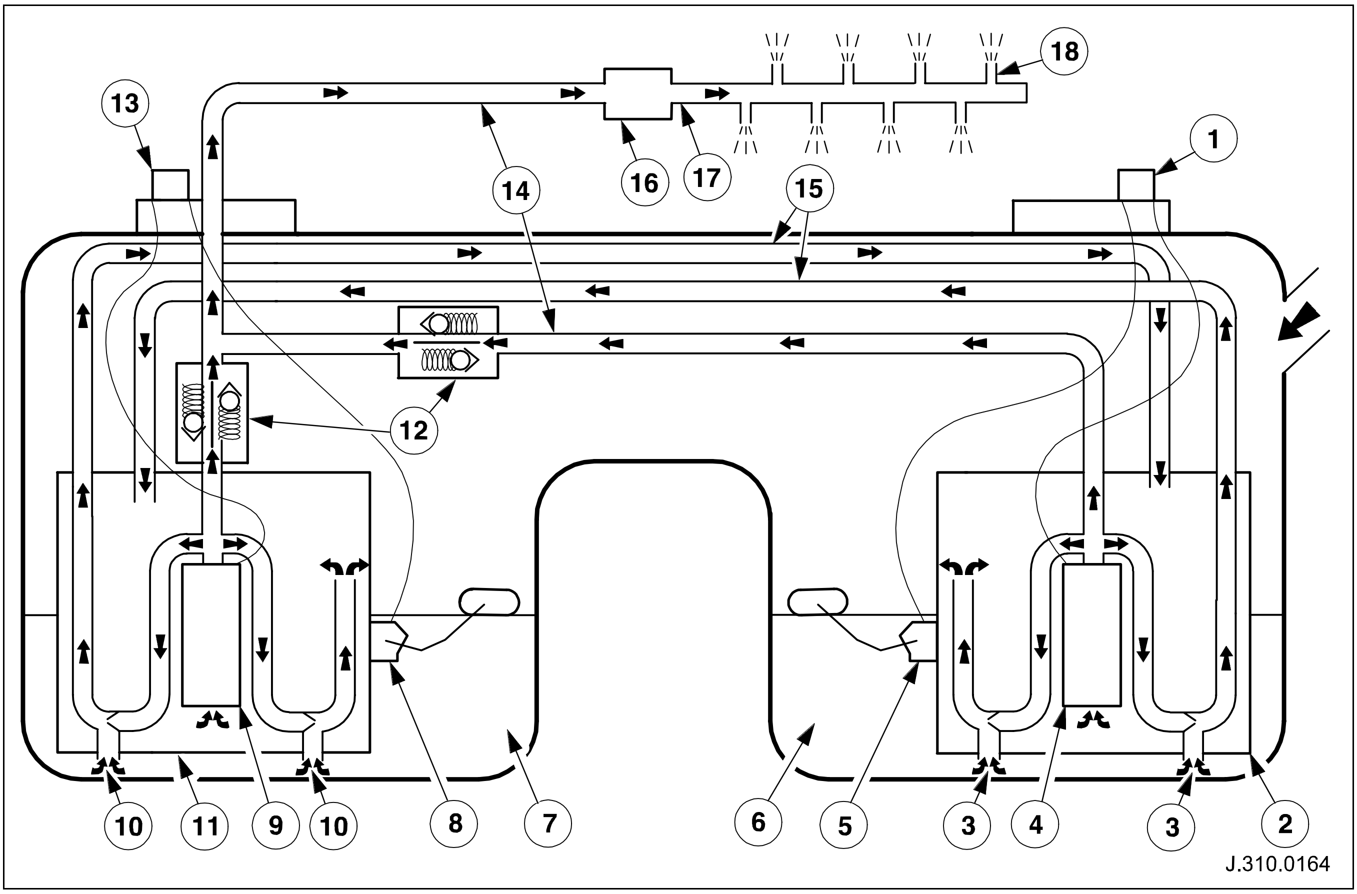

Fig. 71 Schematic of fuel tank internals - supercharged application

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

Returnless Fuel System

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

The benefits of the returnless fuel system are listed below:

- 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.

Normally Aspirated 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 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 module (REM), located in the right-hand side of the luggage compartment.

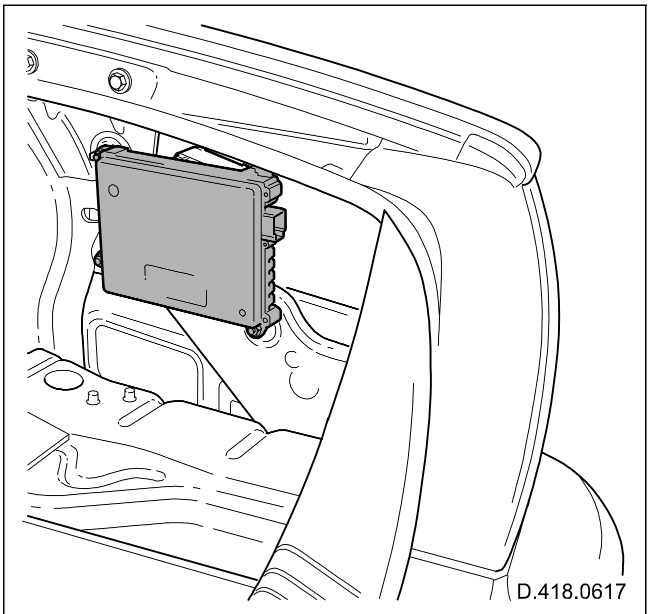

Fig. 72 Fuel pump module (integral to rear electronic module)

Supercharged Vehicles

The supercharged engine's fuel system works on the same principal as the normally aspirated 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. 71**. The right-hand fuel pump is controlled by the FP module integrated into the REM, via signals from the ECM. A secondary FP module, also via signals from the ECM controls the left-hand fuel pump.

- The secondary FP module is located in the right-hand side of the luggage compartment, behind the REM.

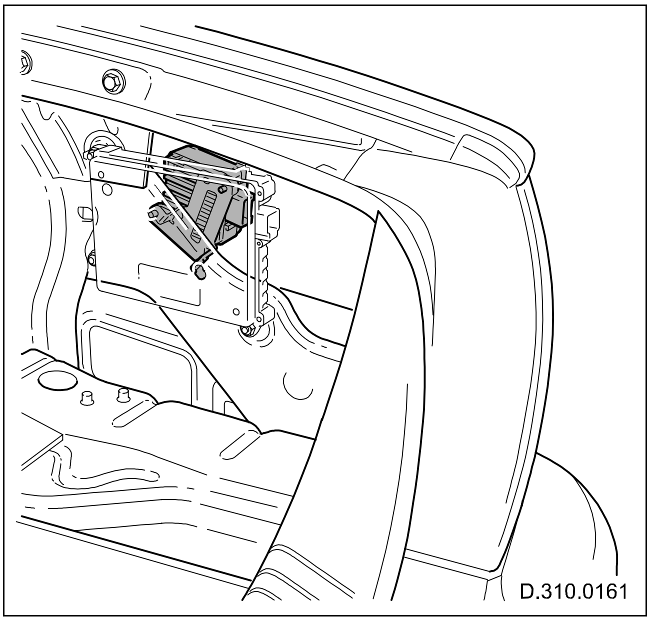

Fig. 73 Secondary fuel pump module - supercharged

Fuel Tank Level Monitoring

Each fuel tank compartment incorporates an independent fuel level sensor. Signals from each sensor are calculated by the REM and then relayed to the instrument cluster. The total quantity of fuel in the tank is displayed on the fuel gauge. A low-fuel warning light is also displayed on the fuel gauge face.

Inertia Fuel Shutoff Switch

In the event of an accident, the inertia fuel shutoff switch may trip, (depending on the severity and type of impact), isolating the fuel pump operation. Once the switch has tripped it must be reset before attempting to restart the engine.

The 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.

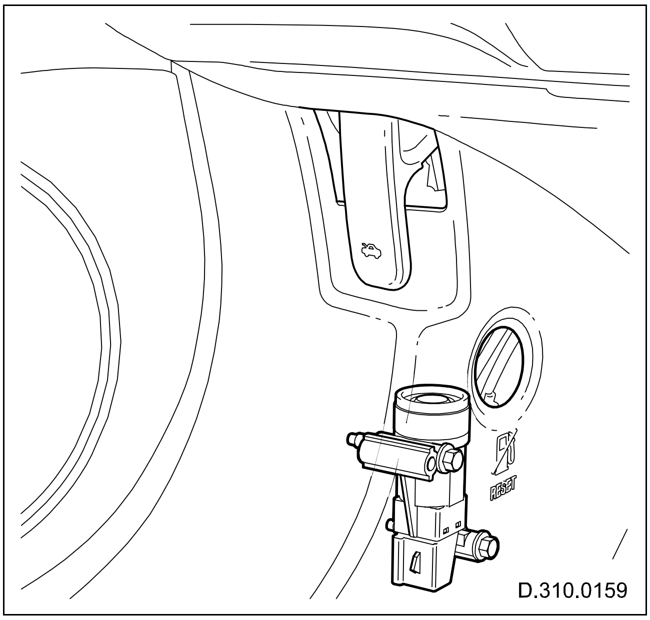

Fig. 74 Inertia fuel shutoff switch

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

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

The climate control system provides filtered air to the passenger compartment from a fully automatic, temperature controlled system.

A 2-zone system is installed as standard and provides dual automatic distribution as a default, where:

- Driver and front passenger can independently control the passenger-compartment air temperature for their individual comfort.
- Mode selections such as face, face/floor, floor and defrost are automatic and also independent from side-to-side.

NOTE: The automatic mode selection reflects the temperature set (Tset) from side-to-side.

- Default operation for the Tset is: the passenger side Tset follows the driver Tset. The 'Dual' operation indicator remains extinguished.
- Changes to the passenger Tset will illuminate the 'Dual' indicator, confirming the Tset for each side can be chosen independently.
- Should the passenger Tset be different to the driver Tset and that situation is no longer desirable (the passenger has vacated the vehicle), selecting 'Dual' extinguishes the indicator and synchronizes the passenger side temperature with the driver side Tset (returns the operation of the system to the default).

A 4-zone system is available as an optional installation. The additional two zones, refers to the passenger compartment area behind the front seats.

Independent control of the temperature in the two rear zones can be achieved using the rear climate control panel or using the touch-screen (where fitted); refer to **Rear Climate Control System**.

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

The system is designed to provide efficient regulation of the vehicle environment without intervention from the occupant(s). Sensors inside the vehicle, monitor temperature, humidity and direct sunlight. In response, the electronic control system automatically adjusts the heat input, blower 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.

Major Differences

When compared to the previous XJ range of vehicles, the new XJ has the following major differences:

- No water control valve;
- Re-introduction of air blend doors;
- Side-to-side automatic temperature control;
- Side-to-side air flow distribution;
- Variable displacement compressor (no magnetic clutch);
- Condenser with integral receiver-drier.
- Air intake filter;
- Single blower.

Display and User Controls

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 tell-tale LED.

NOTE: In manual mode, the LCD uses graphic symbols to provide confirmation of the system status.

The LCD in figure **Fig. 81** shows a range of symbols and messages that could be displayed; it is for guidance only.

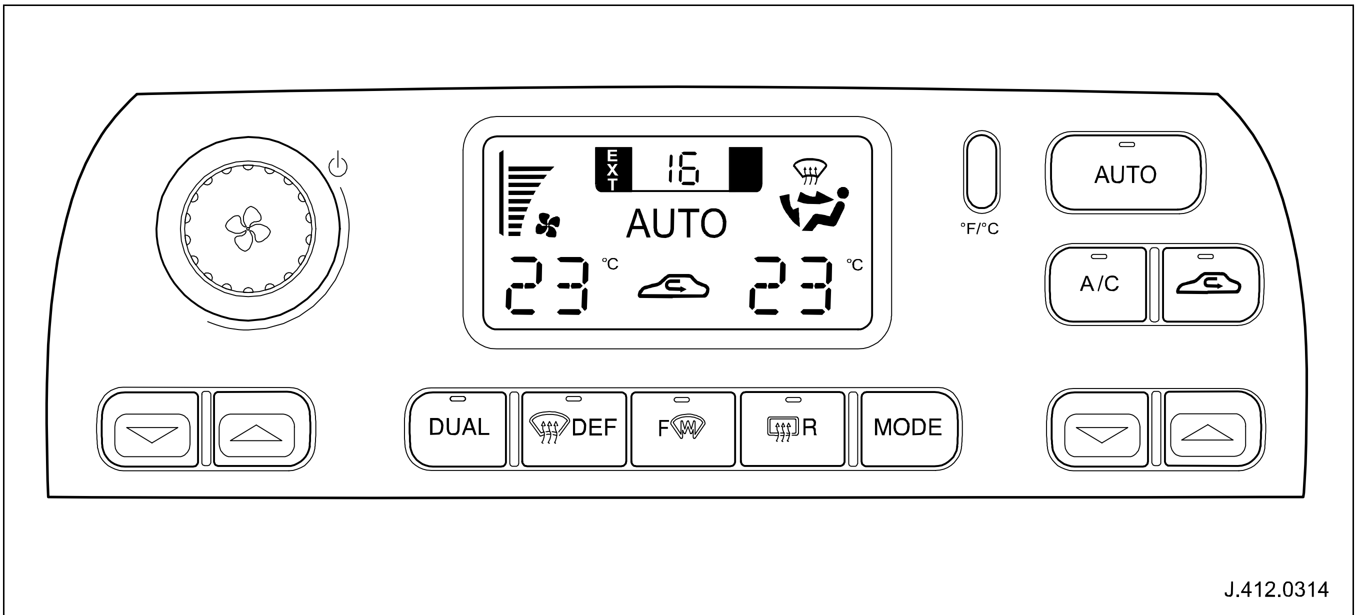

Fig. 75 Control panel with LCD (heated front screen option)

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.

Selecting 'Options' will cause a different screen to be displayed. From the available options, front seat occupants (subject to market and vehicle specification) may choose:

- 'Adjust settings' for the rear climate control system.
- 'Match' the rear system settings to those chosen by the driver.
- 'Lock' the rear control panel so that rear seat occupants are unable to change any settings.
- °C or °F as default unit of measurement.
- Smog sensitivity level (where applicable).

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).

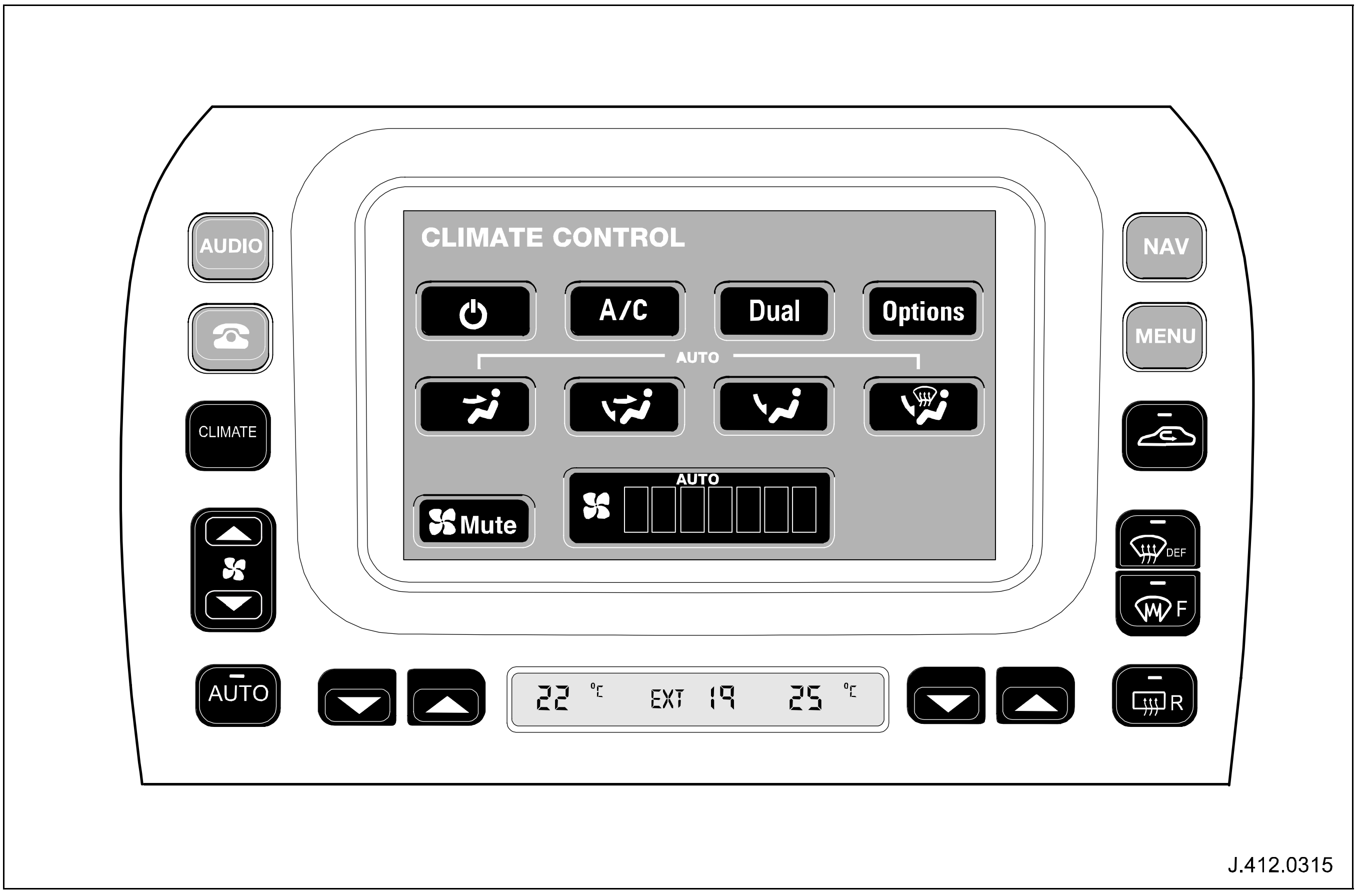

Fig. 76 Climate control buttons

Automatic Climate Control

The automatic climate control system comprises:

- Control panel with LCD or touch-screen control panel (telematics display module).
- Climate control assembly; refer to **Heating and Ventilation**.
- Air conditioning components; refer to **Air Conditioning**.
- Discrete sensors; refer to **Control Components**.
- Climate control module; refer to **Control Components**.

System Features

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 be established by 'pressing and holding' the 'AUTO' button for 2 seconds.

When the ignition key is turned to position '0' or removed from the ignition, the system (depending on conditions) may set the air distribution doors to a predetermined configuration after 120 seconds.

Defrost

Selecting defrost 'DEF' automatically selects 'A/C'and:

- deactivates timed or latched air-recirculation (a condition which cannot be reversed while the system is in this mode);

NOTE: Selecting 'AUTO' or 'DEF' cancels the condition.

- Activates heated front and rear screens (where fitted).

Recirculated and fresh air

NOTE: Timed or latched recirculation are not available when 'DEF' has been selected.

When automatic control (AUTO) is selected, as part of a complex strategy to prevent window-misting and improve occupant comfort, the fresh-air intake door is controlled automatically. In addition, 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 tell-tale LED will remain illuminated and extinguish after the time-out period has elapsed.

NOTE: The telematics screen (where fitted) confirms the status by displaying a timed recirculation symbol.

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'.

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

Latched fresh air

Pressing the recirculation button when the recirculation LED is illuminated, closes the recirculation door and sends the system to the latched fresh-air condition.

NOTE: Smog sensor operation (where applicable) is automatically cancelled.

Pressing the 'AUTO' button returns the recirculation door to normal, automatic operation.

NOTE: Timed recirculation, latched recirculation and latched fresh air modes are cancelled when the ignition key is turned to position '0'.

Electrical Connections

Refer to **New XJ Range Electrical Guide** for detailed connection information between climate control components

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.

Air Distribution and Filtering

Air distribution and filtering is achieved using the following:

- Combination filter.
- Instrument panel registers.
- Footwell ducting.
- Defrost ducting.
- Defrost and cool-air bypass doors (driver and passenger).
- Floor/face doors (driver and passenger).
- Temperature blend doors (driver and passenger).
- Recirculation door.
- Rear floor-ducting.
- Rear face-ducting.

NOTE: Vehicles installed with the rear climate control system (RCCS) do not utilize the rear face-ducting, which is terminated at the climate control assembly. The RCCS uses direct ducting; refer to **Floor Console**.

The combination filter provides particle filtration and in addition minimizes odors entering the vehicle via the air distribution system.

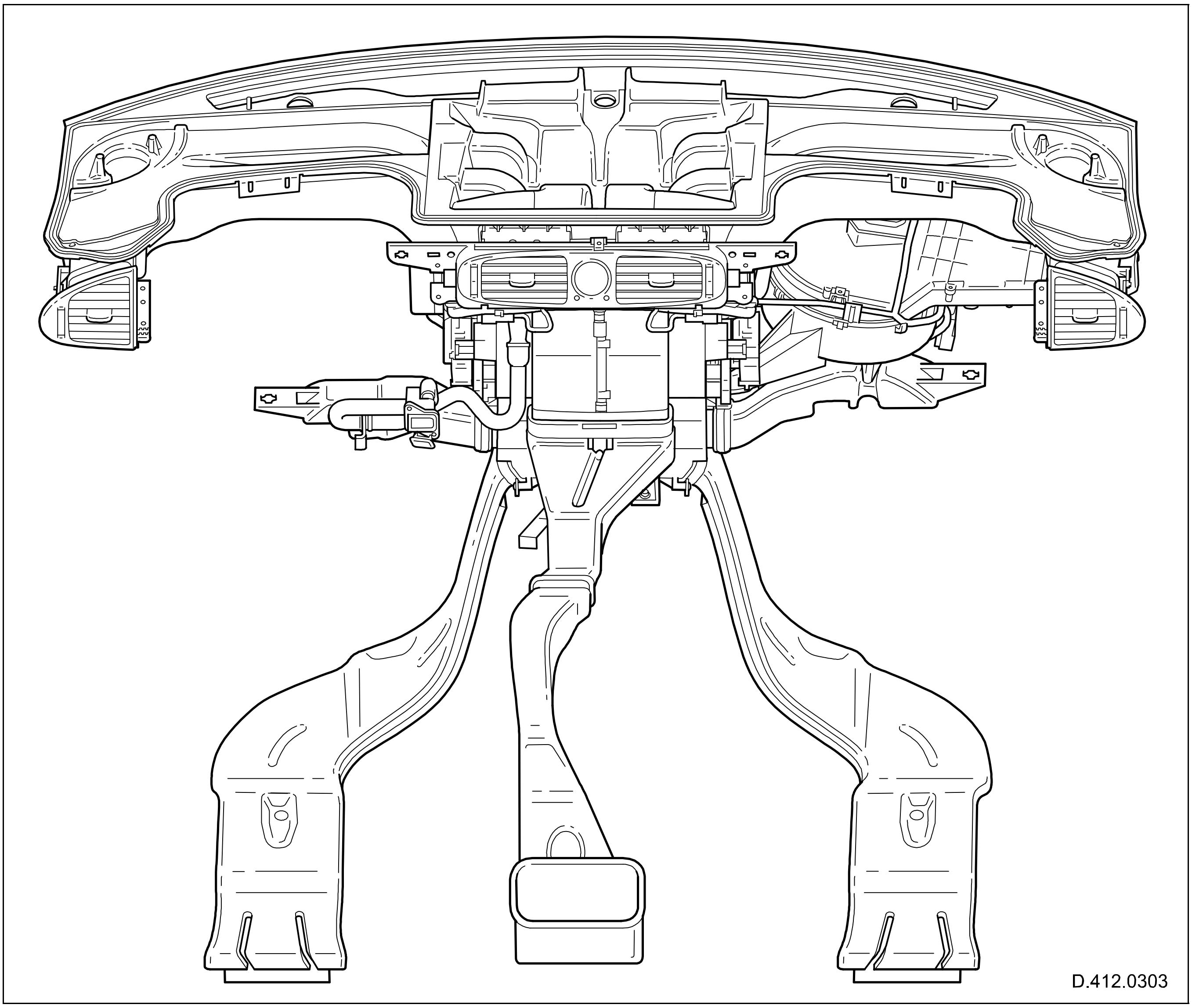

Fig. 77 Air distribution and filtering (2-zone)

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 (not installed for V6 2-zone climate control variant).
- Blower and blower speed module.
- Door actuators; refer to **Control Components**.
- Airflow doors; refer to **Air Distribution and Filtering**.
- Evaporator and discharge sensors; refer to **Control Components**.

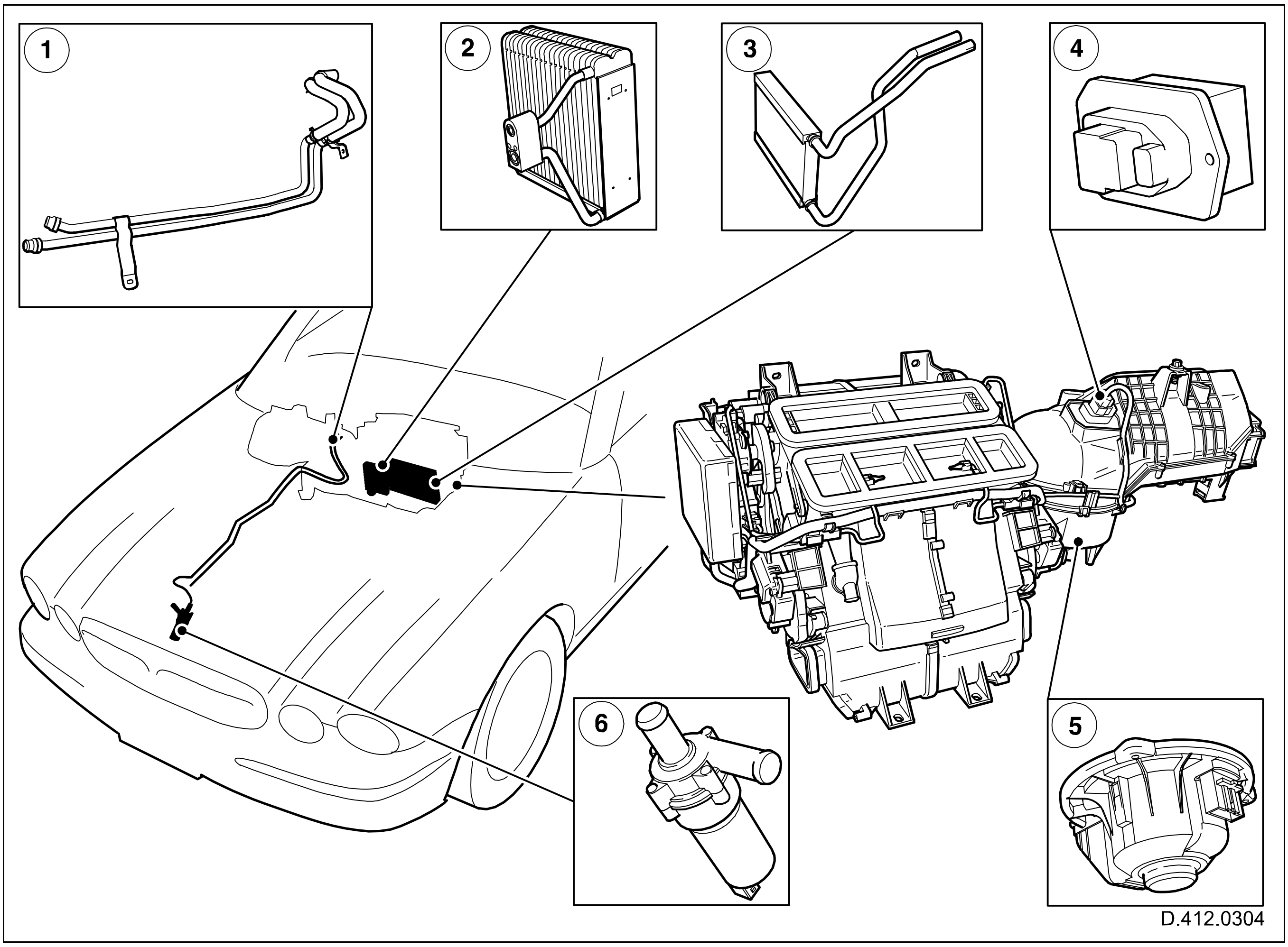

Fig. 78 Heating and ventilation components

1. Heater hose assembly
2. Evaporator core
3. Heater core
4. Blower speed module
5. Blower motor
6. Auxiliary coolant pump (not V6 2-zone)

Heater Core

The single heater core is located within the climate control assembly and connected via the heater pipes to the engine cooling system; refer to **Powertrain, Engine Cooling**.

Auxiliary Coolant Pump

Also part of the engine cooling system, the auxiliary coolant pump is located at the radiator and cooling fan assembly and controlled via the blower motor relay, by the CCM.

Blower

The blower is driven by a d.c. motor. The motor receives battery voltage via the blower motor relay, as determined by the CCM. The motor speed is determined by the blower speed module.

Blower Speed Module

The blower speed module determines the blower motor speed depending on the signal received from the CCM. If 'AUTO' mode is selected, the speed module responds to the CCM, by selecting an appropriate output voltage. The difference between that voltage and the battery voltage determines the voltage across the motor and hence its speed. One of up to 32 different voltage levels can be chosen by the module.

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 version.

NOTE: Until the engine coolant temperature has reached a predetermined level, the auto-blower control will only operate at low speed.

Heated Screens and Mirrors

Heater functionality is constantly monitored by the electrical load management system (ELMS); refer to **Electrical Load Management System**. The ELMS dictates that in circumstances where the generated electrical power is less than the electrical consumption, selected systems may be temporarily inhibited or operated for a reduced period of time if necessary.

NOTE: Tell-tale LEDs remain illuminated so that any corrective action is not apparent to the driver.

Heated front screen

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

NOTE: The total heating option comprises two independent grids, one for the driver's side and one for the passenger side.

On receipt of a ground signal from the CCM, battery voltage is switched via separate relays to both sides of the screen. 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.

As part of the continuous demisting strategy, when the ambient temperature is low, providing the power consumption is less than the generated power, the ELMS will permit the activation of the heated front screen to prevent the possibility of misting.

NOTE: The tell-tale LED will not illuminate so that the action is not apparent to the driver.

The heated front screen (where fitted) is automatically selected when the engine is 'running' and the ambient temperature falls below 5°C.

NOTE: The tell-tale LED will illuminate.

Heated rear screen

On receipt of a ground signal from the CCM, battery voltage is switched via a relay, to the heated rear screen (HRS).

NOTE: The strategy for activating the heated rear screen is identical to the strategy for the HFS.

Heated exterior mirrors

The heated exterior mirrors are activated by the same relay as the heated rear screen but are separately fused.

Basic functionality

NOTE: Both heated screens will be activated automatically at temperatures below predetermined levels.

The heated rear screen and both exterior mirror heaters will operate when selected, provided the engine is running; operation will halt after 21 minutes or can be manually halted.

The heated front screen (if fitted), will operate when selected, provided the engine is running; operation will halt after 6.5 minutes or can be manually halted.

Heated Steering Wheel

The steering wheel heater, where installed, is activated when the driver's seat heater switch is operated. The switch provides an input to the front electronic module (FEM), which responds by supplying an output signal via the clockspring contacts to the heated steering wheel (HSW) electronics . The HSW electronics receives supply voltage via the power coupling and slip rings.

The HSW power coupling, which attaches to the clockspring, comprises two spring contacts that interface with the HSW electronics, to ensure power and ground connections are maintained.

The HSW electronics, controls the operation of the HSW element when appropriate, maintaining a surface temperature of approximately 30°C (86°F).

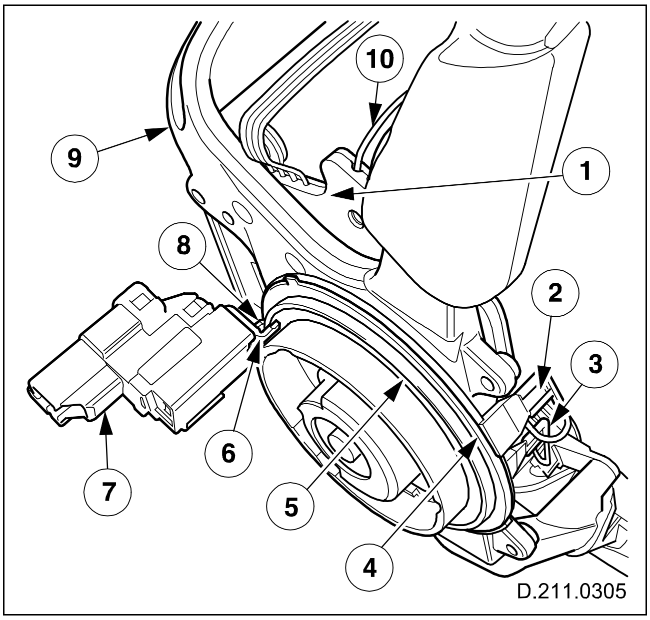

Fig. 79 Heated steering wheel connections

1. HSW electronics
2. Spade connector (positive)
3. Spade connector (negative)
4. Slip ring (positive)
5. Slip ring (negative)
6. Spring contact (negative)
7. Power coupling
8. Spring contact (positive)
9. Steering wheel armature
10. To HSW heater element

Air Conditioning

Air conditioning comprises the following system components:

- Evaporator core and thermal expansion valve.
- Compressor inlet line.
- Compressor.
- Condenser with integral receiver-drier.
- Condenser outlet line.
- Pressure transducer (part of compressor outlet line but serviceable separately).
- Combined evaporator intake/discharge line assembly with integral service ports.
- Compressor outlet line.

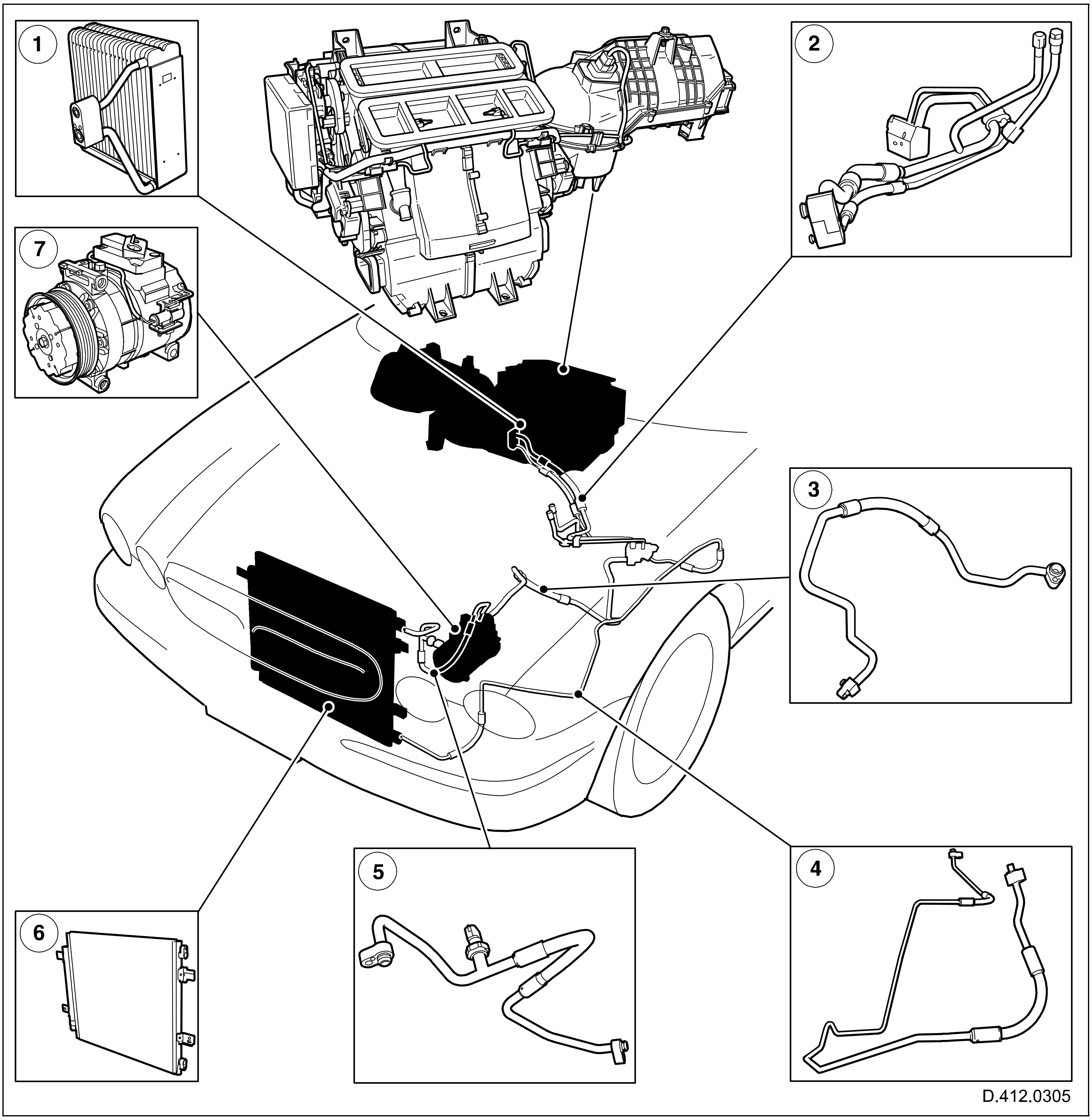

Fig. 80 Air conditioning components

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

Operation

With reference to **Fig. 81**:

- 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 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 cool 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 single, integrated condensate drain-tube.

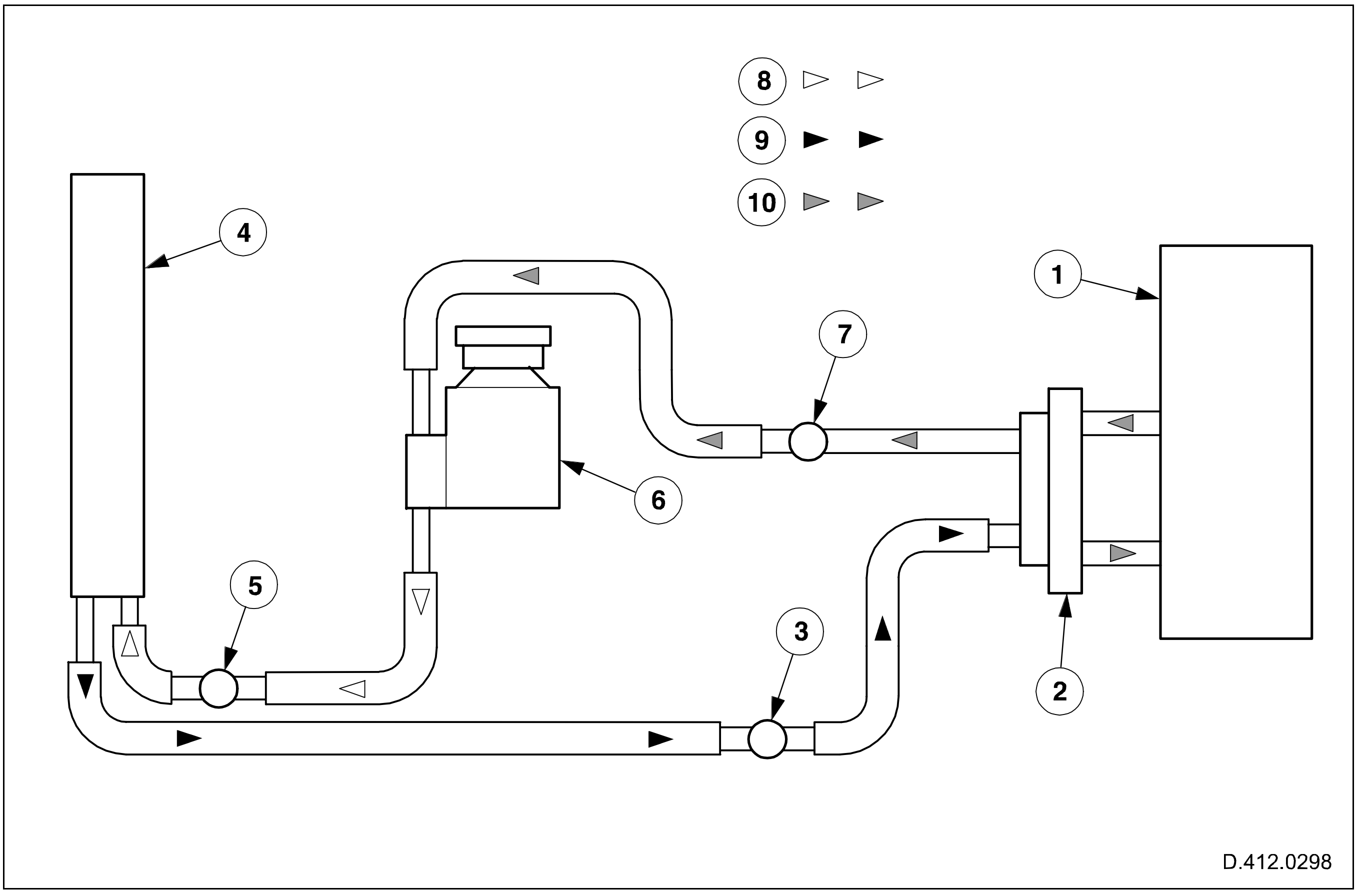

Fig. 81 Air-conditioning refrigerant flow (2–zone)

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

Compressor

The compressor installed is uniquely designed to suit the engine configuration and whether a 2-zone or a 4-zone climate control system is installed. The compressor does not have a magnetic clutch, instead, operation is continuous in response to a PWM signal supplied directly from the CCM to the compressor solenoid. Since there is no clutch cycling, the operation of the compressor is significantly quieter and more efficient as far as engine load is concerned. This type of compressor is capable of responding to smaller changes in system demands to accommodate requirements such as providing a 'chilling' effect without causing 'icing' of the evaporator.

Evaporator temperature

As part of an advanced automatic, evaporator temperature control, the evaporator temperature is controlled and varied by the CCM in response to parameters which include:

- Length of time the vehicle has been running.
- Ambient temperature.
- Passenger compartment temperature.
- Passenger compartment humidity.

NOTE: Selecting defrost automatically selects the air conditioning a condition which cannot be overridden while the system is in this mode.

Condenser/receiver-drier

The condenser and receiver-drier are integrated into a single unit, which incorporates a serviceable desiccant-sack.

Service ports

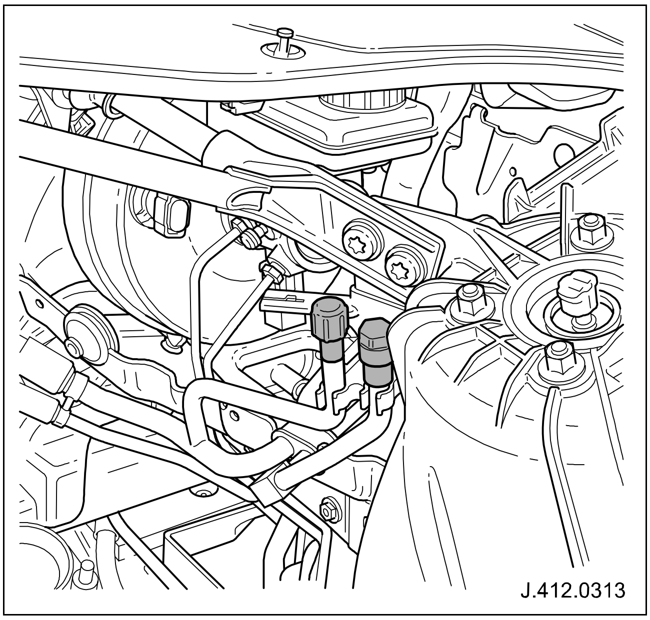

Fig. 82 Location of service ports

Control Components

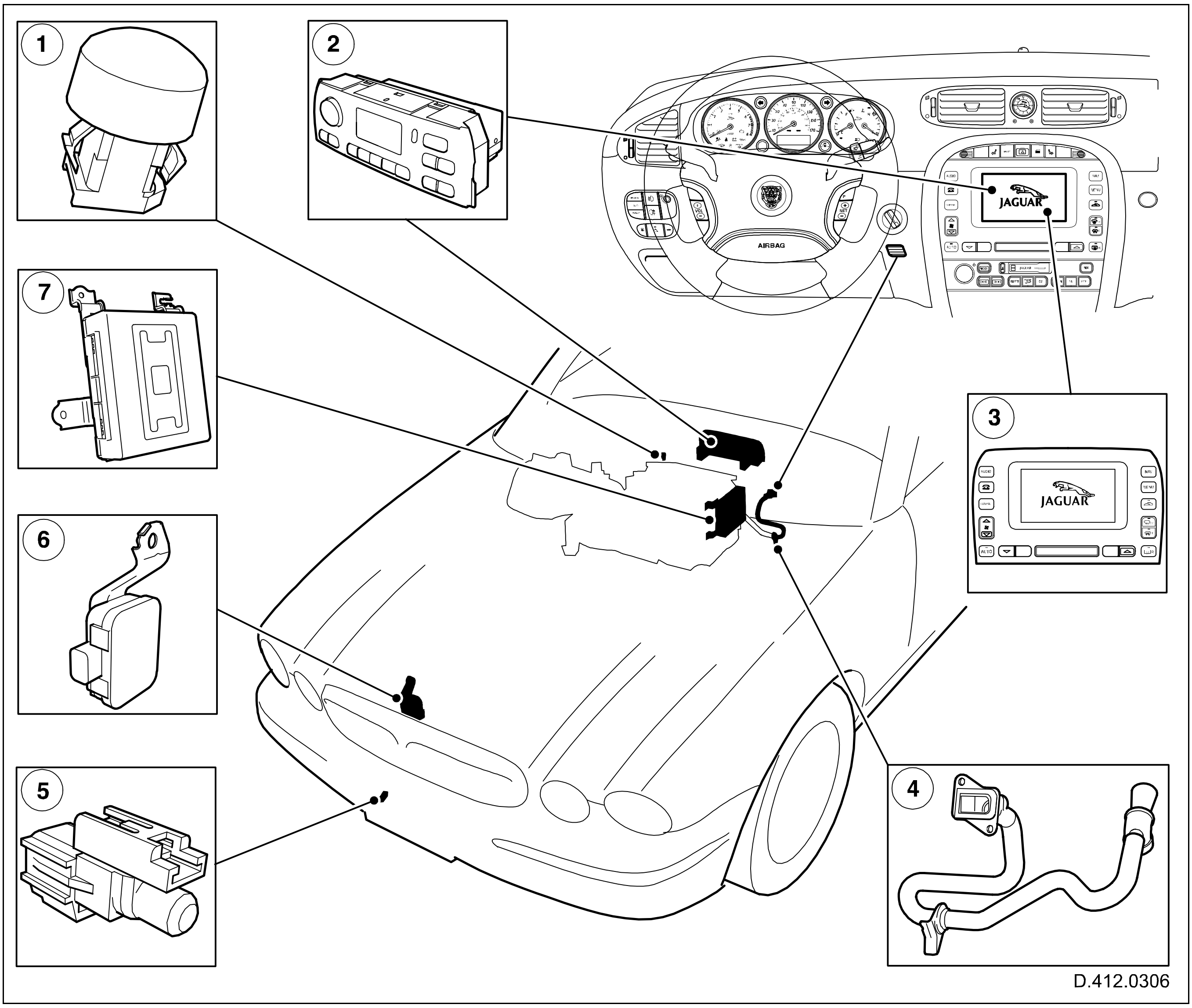

Fig. 83 Automatic climate control components

1. Dual sunload-sensor
2. Control panel with LCD
3. Telematics display module (optional installation)
4. In-vehicle temperature and humidity sensor
5. Ambient air temperature sensor
6. Air quality (smog) sensor
7. Climate control module

Climate Control Module

The climate control module (CCM) is mounted to the driver's side of the climate control assembly; refer to **Fig. 83** and configured to suit either the control panel with LCD or the touch-screen.

Configuration

The module is configured to suit the following options:

- telematics display module or climate control panel with LCD;
- Left-hand drive or right-hand drive;
- Heated front screen or heated wiper park;
- Smog sensor installed or smog sensor not installed;
- 2-zone or 4-zone climate control system.

NOTE: A replacement climate control module must be configured using WDS; refer to **JTIS.**

In response to signals from the in-vehicle temperature sensor, the CCM can drive the air distribution system (when under automatic control) to unique distribution modes in order to reduce the possibility of misting. In addition, the CCM may also increase the auto-blower speed. Manually selected distribution or blower speeds are unaffected.

NOTE: If the CCM detects the risk of misting, signals from the smog sensor are ignored until it is considered acceptable to resume normal operation.

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;
- air-conditioning compressor inhibit.

Signals provided by the CCM to the ECM include:

- compressor torque;
- heated screen request.

Climate Control Sensors

The climate control module uses feedback from the following sensors before making any necessary adjustments; refer to **New XJ Range 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. The CCM processes this signal along with others and provides an output to the compressor.

NOTE: The evaporator sensor is integral to the evaporator housing and is therefore not individually serviceable.

Discharge temperature sensors

The discharge temperature sensors are thermistor-type devices, strategically placed to measure the temperature of the face-level air being discharged by the climate control assembly for both driver and front passenger.

NOTE: The sensors are not serviceable.

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.

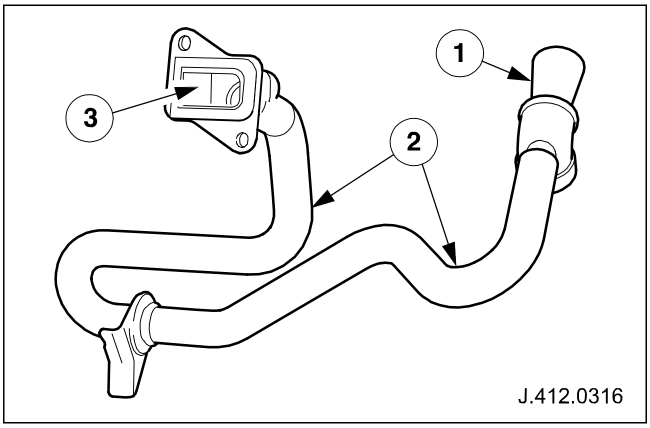

Fig. 84 In-vehicle temperature and humidity sensors

1. Venturi
2. Venturi to sensor hoses
3. Sensor housing

Ambient air temperature sensor

NOTE: The displayed ambient temperature will not change unless the vehicle is travelling faster than 40 km/h (25 mile/h).

The ambient air temperature sensor is a thermistor-type device, located behind the lower front grille.

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.

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

Air quality (smog) sensor

The air quality sensor (when installed) is mounted in the engine compartment, in front of the radiator. The sensor detects the presence of petroleum based compounds such as CO and NOx. The levels of CO and NOx, triggers a chemical reaction within the sensor, which generates an electrical output signal proportional to the reaction. The signal is used by the climate control module (CCM) to determine whether the recirculation door should be closed.

The sensitivity of the air quality sensor, for vehicles fitted with the touch-screen (telematics display module) can be set from the 'Options' screen:

- select the 'Climate' hard button;
- select the 'Options' soft button from the climate control screen;
- adjust settings to suit:
  5 - most sensitive.
  3 - regular usage.
  1 - least sensitive.
  0 - sensor inactive.

NOTE: When the sensitivity is set to '0', the recirculation door can still be operated manually and will also be automatically operated when so determined by the CCM.

The sensitivity of the sensor, for vehicles not fitted with the touch-screen can be adjusted from the climate control panel in the following manner:

- Simultaneously pressing 'AUTO' and 'RECIRC' will display a single digit number in the LCD.
- The driver's 'temperature demand' buttons can be used to change the sensitivity level.
- Pressing 'MODE' exits the adjustment mode (exit is automatic after 6 seconds).

NOTE: The smog sensor signal is ignored if:

- **the air conditioning is active and the ambient temperature is 0°C (32°F) or less;**
- **the air conditioning is inactive and the ambient temperature is 5°C (41°F) or less;**
- **the CCM detects conditions which may give rise to interior misting;**
- **latched fresh-air recirculation has been selected.**

Actuators

All actuators are dc motors, mounted to the climate control assembly and controlled by the CCM.

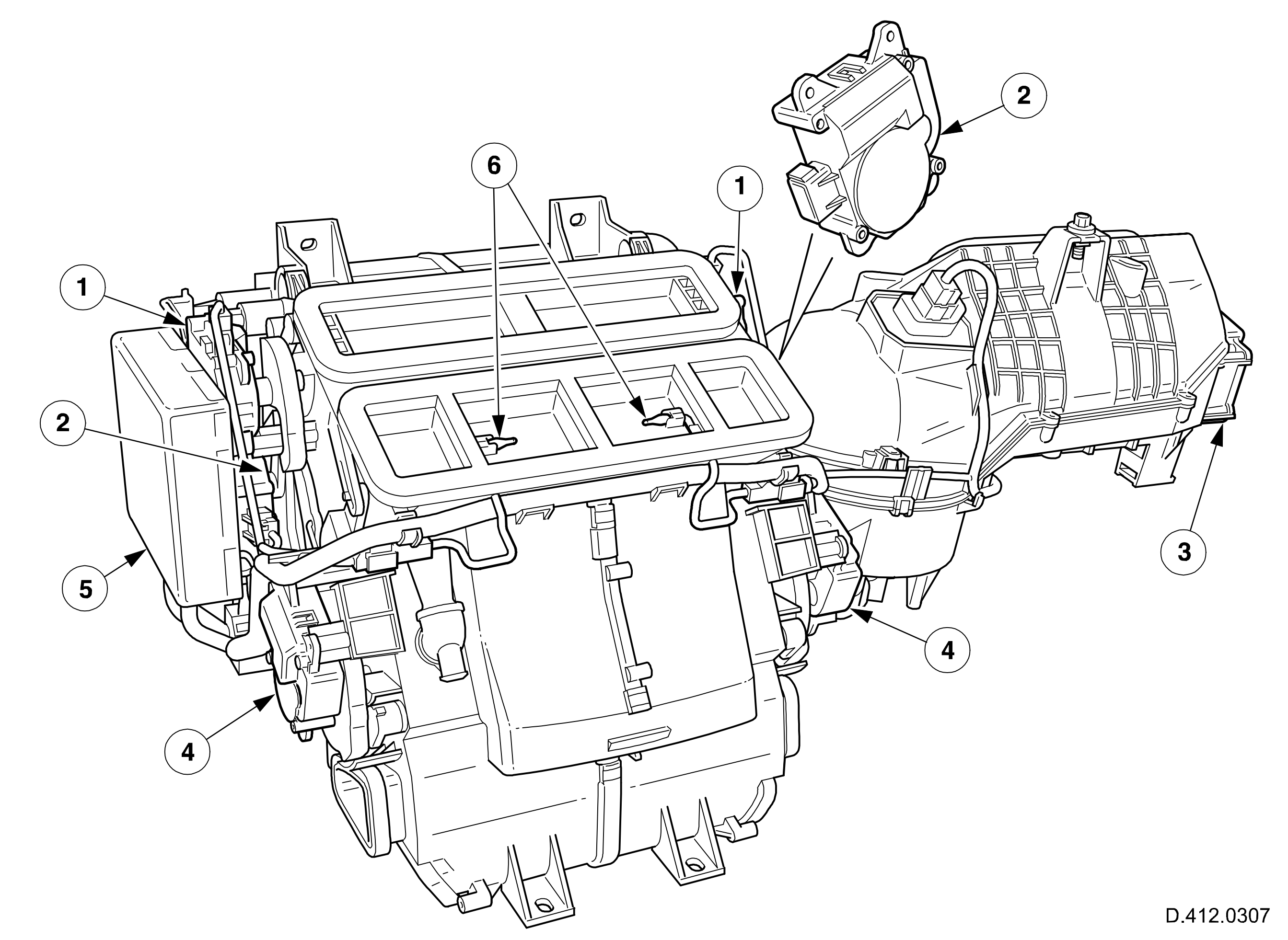

Fig. 85 Control components - climate control assembly

1. Defrost and cool-air bypass door actuator
2. Temperature blend door actuator
3. Recirculation door actuator
4. Floor/face door actuator
5. Climate control module
6. Discharge sensor
7. Evaporator temperature sensor (not illustrated)

Rear Climate Control System

NOTE: Where installed, the rear climate control system (RCCS) will only function when the front climate control system (FCCS) has first been activated. Any deactivation of the FCCS, will automatically deactivate the RCCS. Reactivation of the FCCS will not automatically reactivate the RCCS, manual intervention is required.

Rear Climate Control Panel

The rear climate control panel has its own integrated control module that, where appropriate can be overridden by signals from the main CCM.

Provided the FCCS is already active, the RCCS can be controlled by:

- rear seat passengers using the rear climate control panel (RCCP);
- front seat passengers using the touch-screen (telematics display module).

NOTE: Adjustments using the RCCP are ignored when the telematics display is showing the 4-zone climate control.

Climate control features can be controlled by push buttons and a rotary control. When a function button is pressed, selection is confirmed by a 'beep'. The LCD uses graphic symbols to provide additional confirmation of the system status.

NOTE: The RCCP is not configurable but may be reprogrammed using WDS if necessary; refer to **JTIS**.

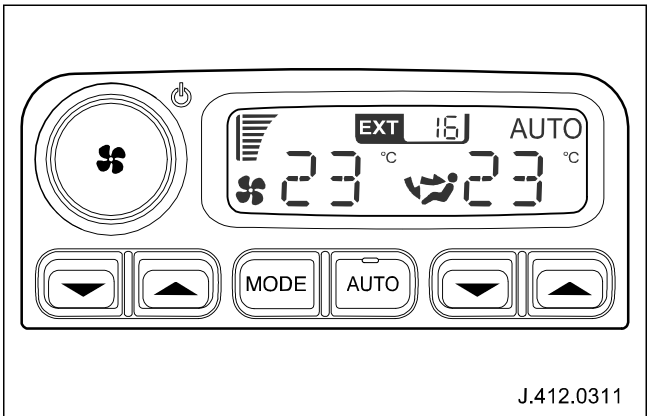

Fig. 86 Rear climate control panel

Operation

Provided the FCCS is already active, the RCCS can be activated using the RCCP by selecting 'AUTO' or depressing the blower knob.

AUTO operation

Selecting 'AUTO' provides full automatic temperature control, including blower speed and air distribution, for both rear positions.

Temperature control

The left and right zone temperatures can be set independently using the red and blue buttons, in the same manner as the front system.

NOTE:

- **HI/LO (maximum/minimum temperatures) cannot be selected from the rear control panel.**
- **Selection of HI/LO using the driver's Tset button, will apply to all four zones and overrides any rear temperature selections.**

MODE button

Pressing the 'MODE' button deselects the 'AUTO' tell-tale LED and allows a choice of manual air distribution. Each press of the 'MODE' button, will cycle through the following air flow options: face level only; face and floor levels; floor only.

Blower speed

Rotating the blower speed knob deselects the 'AUTO' tell-tale LED and allows the blower speed to be changed as confirmed by the bars on the LCD.

NOTE: Selecting the defrost (DEF) option from the front control panel, will limit the rear system blower-speed, but otherwise the rear system will function normally.

Deactivation

Depressing the blower control knob will deactivate the rear system.

Air Distribution

Air distribution to the rear passenger zones is via the registers that are integral to the 4–zone floor console; refer to **Floor Console**.

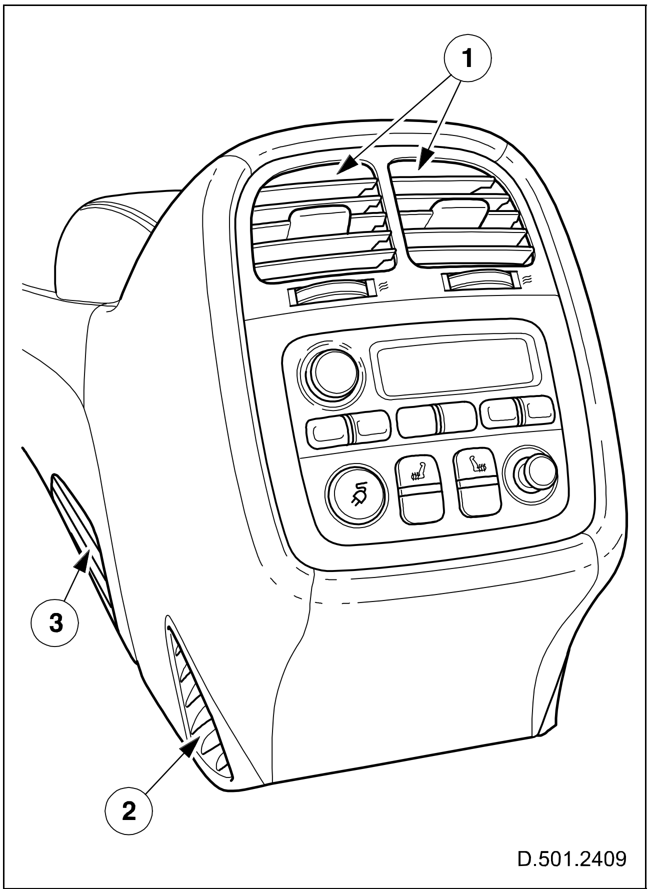

Fig. 87 Rear air distribution

1. Rear face-registers
2. Rear floor-registers
3. Input register

NOTE: The rear face-registers are unique to the 4-zone arrangement.

General

Refer to **New XJ Range Electrical Guide** for detailed connection information and an indication of the flow of electrical data between climate control components.

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.

Air conditioning charge weight

The air conditioning charge weight for 4-zone systems is different to 2-zone systems; refer to the information label located in the engine compartment and to **JTIS**.

Rear Climate Control System Components

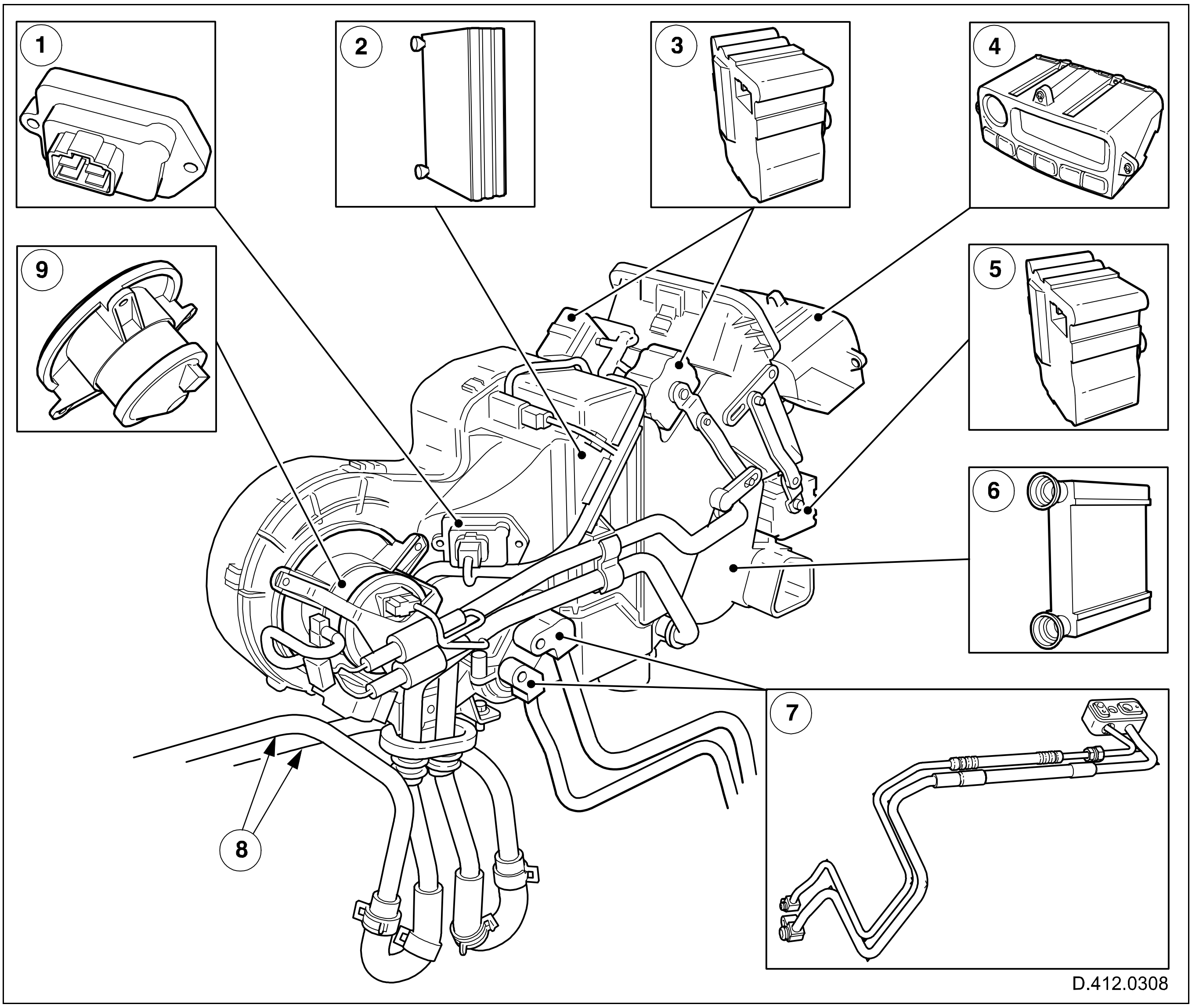

Fig. 88 System components

1. Blower speed module
2. Evaporator core
3. Temperature blend door actuator
4. Climate control panel (includes control module)
5. Floor/face door actuator
6. Heater core
7. Evaporator lines assembly
8. Heater pipes
9. Blower motor
10. Evaporator sensor (not shown)

NOTE: The blower speed module used for the rear climate control assembly is unique and not interchangeable with that installed to the front climate control assembly.

NOTE: Not illustrated, but part of the system and integral to the rear climate control assembly are the thermal expansion valve and magnetic shut-off valve for the refrigerant.

System Interconnections

Fig. 89 shows a typical layout for vehicles fitted with front and rear climate control systems.

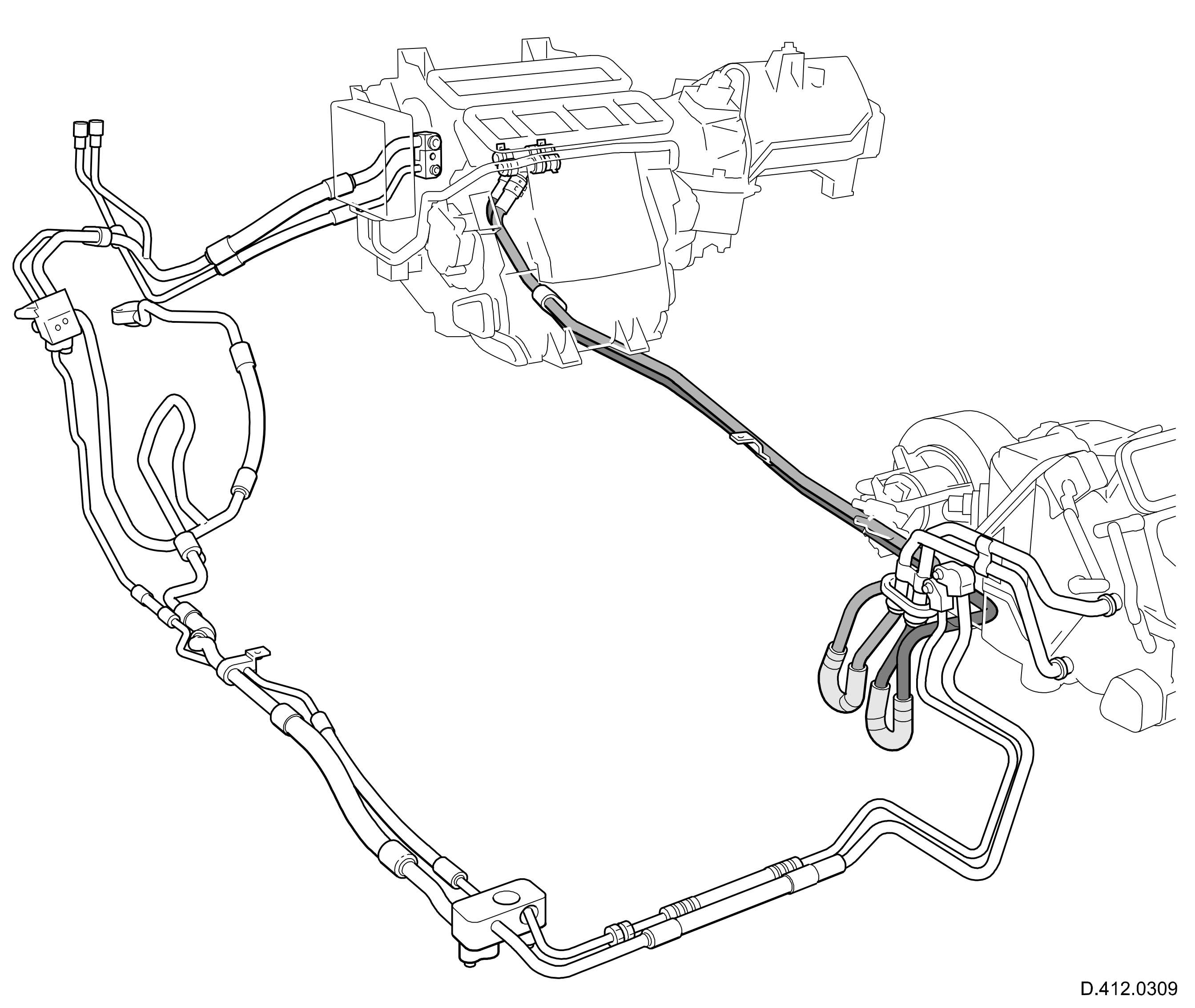

Fig. 89 Rear climate control - typical layout

Refrigerant Flow

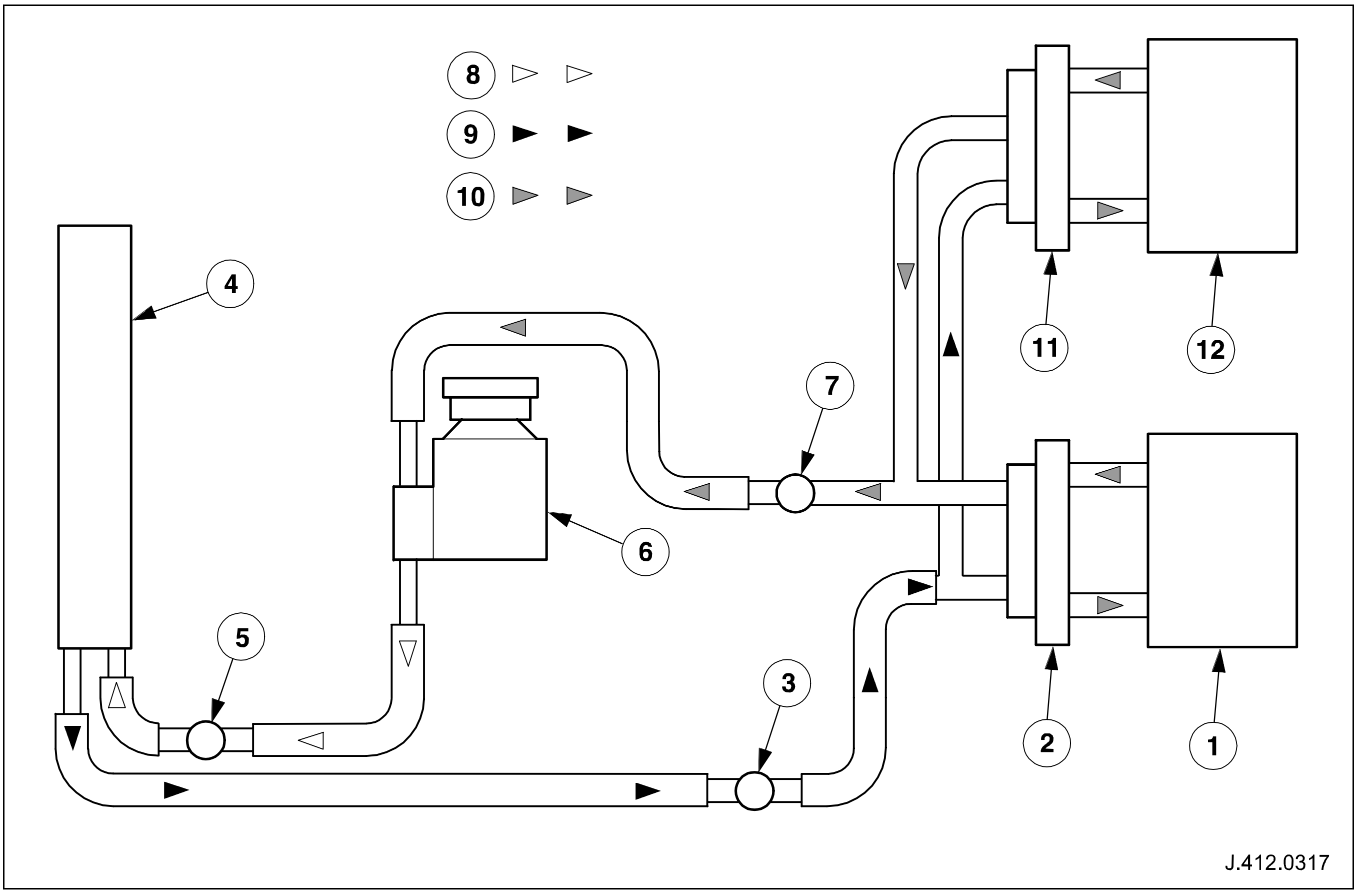

Fig. 90 Air-conditioning refrigerant flow (4–zone)

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

NOTE: Not illustrated, but part of the system and integral to the rear climate control assembly is the magnetic shut-off valve for the refrigerant.

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.
- J-gate module (LEDs).
- Auxiliary lighting switch assembly.
- Steering wheel mounted switches.
- Center console switch assembly.
- Fuel filler-flap and trunk lid release switch assembly.
- Overhead console switches and mood lamp.
- Driver door and memory switch assembly.
- Window switches.
- Front and rear ashtray/cigar lighter.
- Front and rear accessory power points.
- Rear climate control panel.
- Climate control registers.
- Rear seat switches.
- Rear seat heater switches.
- Rear grab handle.
- Mood lamp; refer to **Overhead Console**.

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

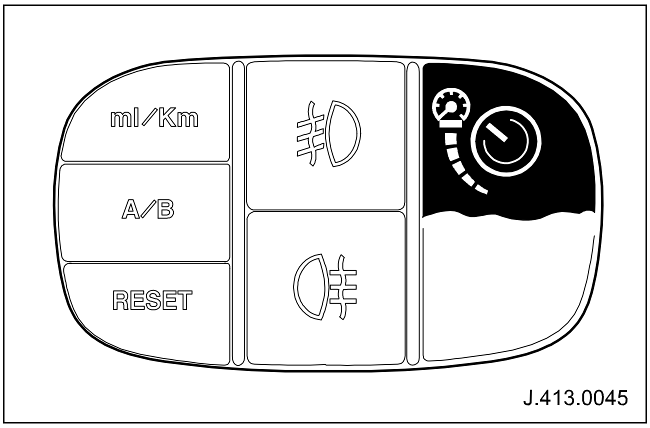

Fig. 91 Dimmer control

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 front electronic module (FEM), appropriate to the chosen setting. The FEM responds by outputting a pulse-width modulated (PWM) signal to drive the backlighting at the chosen level.

NOTE: The instrument cluster backlighting uses LEDs which are controlled internally - not via the FEM.

Instrument Cluster

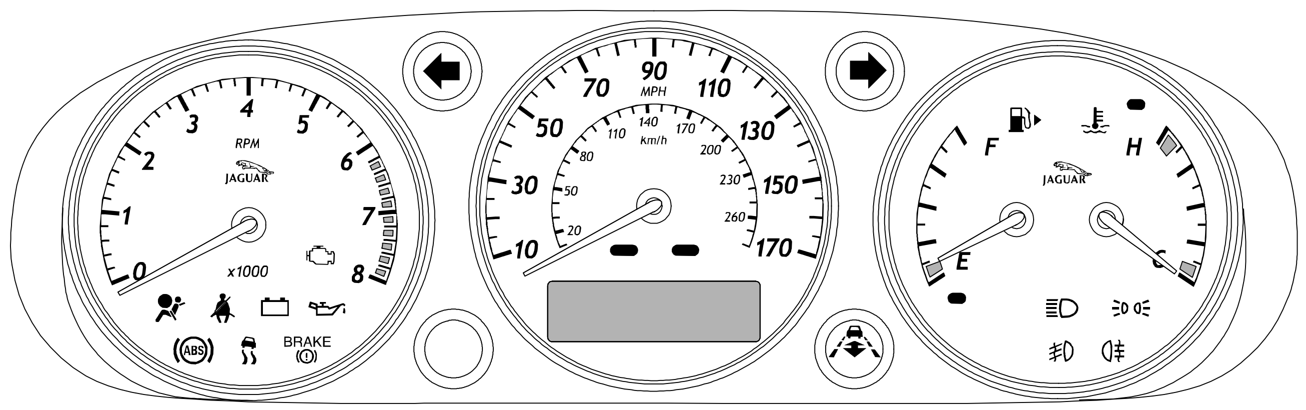

Fig. 92 Instrument cluster

Detailed instrument cluster (IC) 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, the engine control module (ECM) and the rear electronic module (REM) to enable the immobilization feature; refer to **Anti-Theft**;
- 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**;
- provides a signal to the VAPS solenoid; refer to **Steering System**.

NOTE: The vehicle speed signal is compared to VAPS curves (stored in the memory of the IC) and an appropriate predetermined signal is output to the VAPS solenoid.

- outputs the warning chimes, except parking aid and adaptive speed control (driver intervene);
- provides decoding for the ignition, courtesy lighting switch and exterior lighting switch.

NOTE: The instrument cluster must be configured to match the ECM and SCLM (refer to **JTIS**).

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

Two warning lamps are located above 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.

In addition to the indicators normally found on the instrument cluster such as the malfunction indicator lamp (MIL), there are indicators for:

- Speed control follow-mode active.
- Dynamic stability control/traction control.

Depending on market and vehicle specifications, the following warnings may be displayed via the message:

NOTE: In some instances there is no equivalent visual indicator on the cluster.

- Engine malfunction.
- Door ajar warnings.
- Low washer fluid.
- Dynamic stability control/traction control warning (confirmation of status).
- Speed (cruise) control.

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

- transmission fault warnings;
- turn signal indicator bulb failure;
- low coolant warning;
- parking brake fault;
- check fuel filler cap;
- DSC on/off/fail;
- autolamp delay setting message;
- pedal (adjustment) inhibit (when speed control is activated);
- column / pedal adjustment status (visual confirmation of selection made using rotary action of the column / pedal adjustment switch);
- ACC (speed control) 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

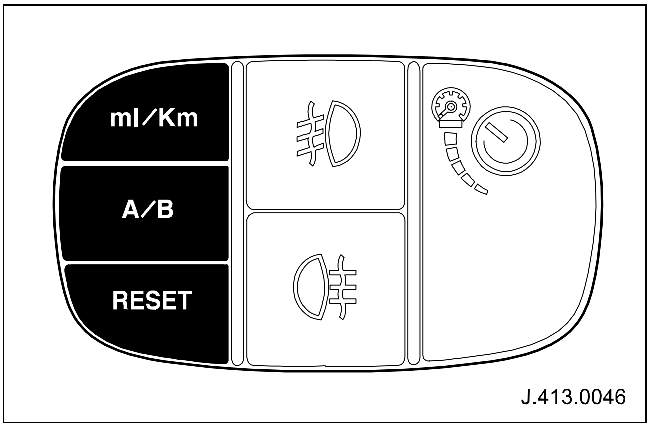

Fig. 93 Trip computer control switches

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.

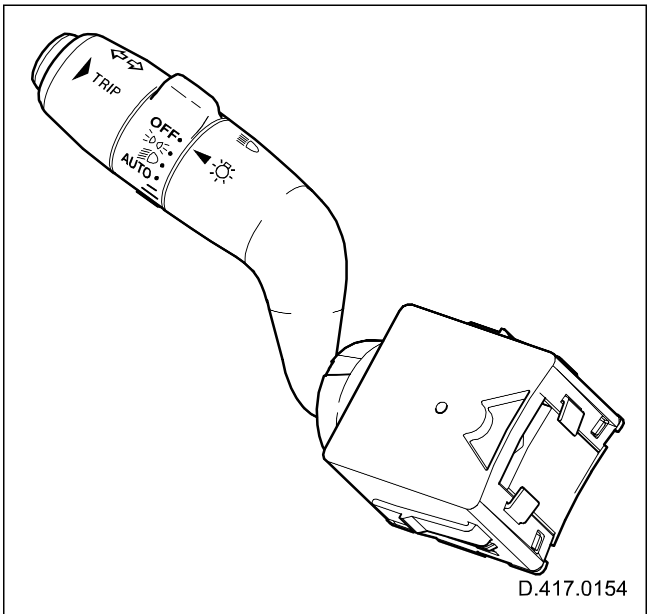

Fig. 94 Trip button

Parking Aid

Reverse Parking Aid

The reverse parking aid system is installed as standard and comprises:

- Parking aid module.
- Audible warning speaker.
- Ultrasonic sensors.

The parking aid module is mounted in the left-hand corner of the luggage compartment near the spare wheel.

NOTE: The module cannot be configured and the system cannot be deactivated manually.

The reverse parking aid system becomes active when the ignition key is turned to position 'II'.

CAUTION: Completing a parking maneuver with the gear shift lever in neutral is not advisable; the sensors are not active and therefore no audible warning will be emitted.

The ultrasonic sensors are designed to detect the presence of obstacles as the vehicle is being parked. Should an object be detected within the sensor range of 1.8m (71 inches) from the rear of the vehicle, the speaker should emit an intermittent audible warning. As the vehicle moves closer to the object, at a distance of 0.3m (12 inches), the intermittent audible warning should change to a continuous audible warning.

NOTE: When driving into a confined space such as a home garage, the outer sensors will detect the side walls and after 3 seconds will disable the audible warning; as movement continues, the inner sensors will eventually detect the rear wall and the audible warning will recommence.

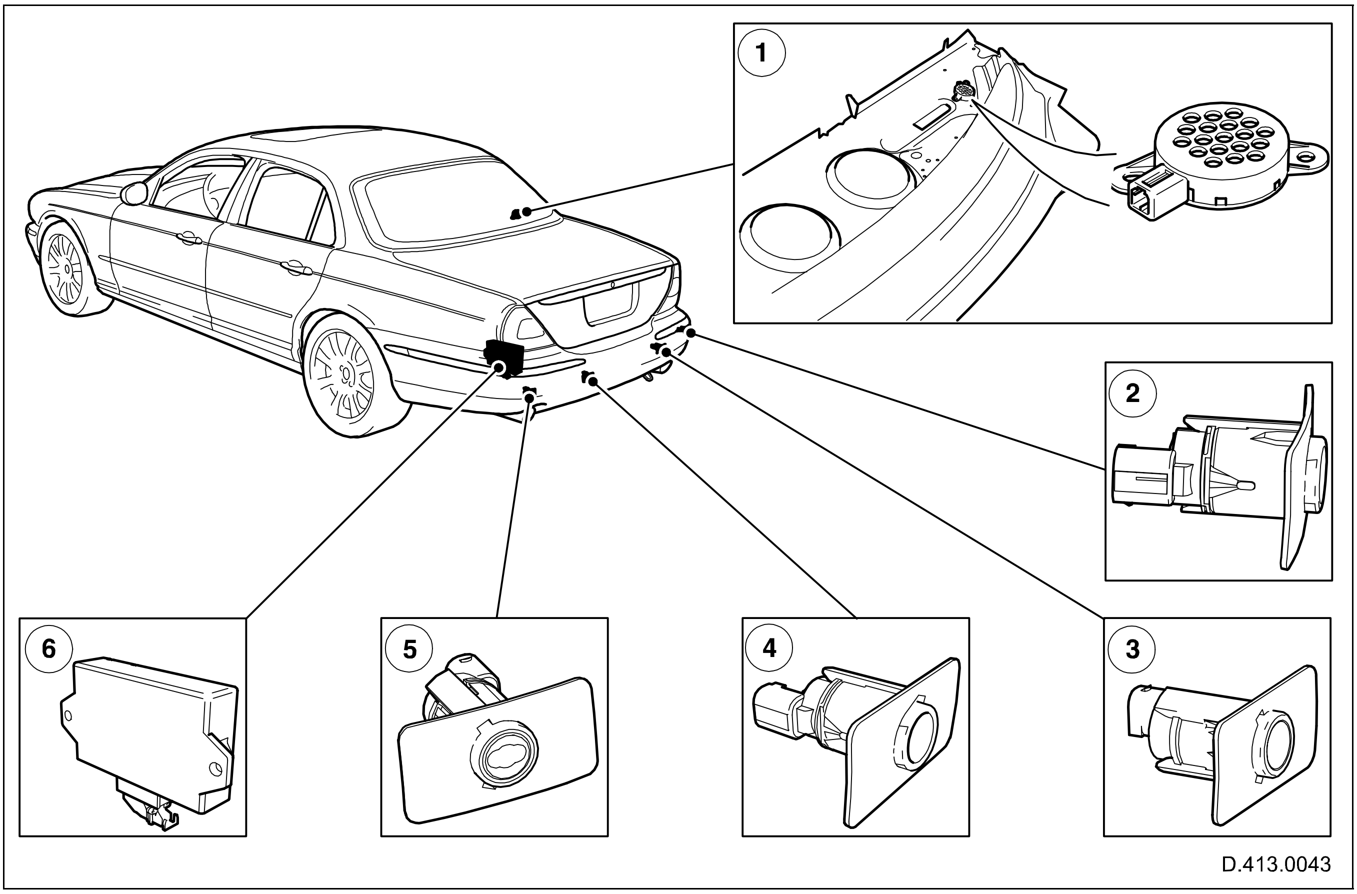

Fig. 95 Reverse parking aid components

1. Speaker
2. Ultrasonic sensor
3. Ultrasonic sensor
4. Ultrasonic sensor
5. Ultrasonic sensor
6. Parking aid module

When trying to establish whether the system is behaving correctly, the following points should be taken into account:

- The range reduces to 0.6m (23.6 inches) at the vehicle corners.
- The vertical range is designed to protect the highest and lowest points at the rear of the vehicle.
- Curbs that are low enough to pass under the vehicle will not be detected.
- Curbs that are higher than 0.18m (7 inches) will be detected.

NOTE: The system is automatically inhibited when the trailer socket is connected.

Front Parking Aid

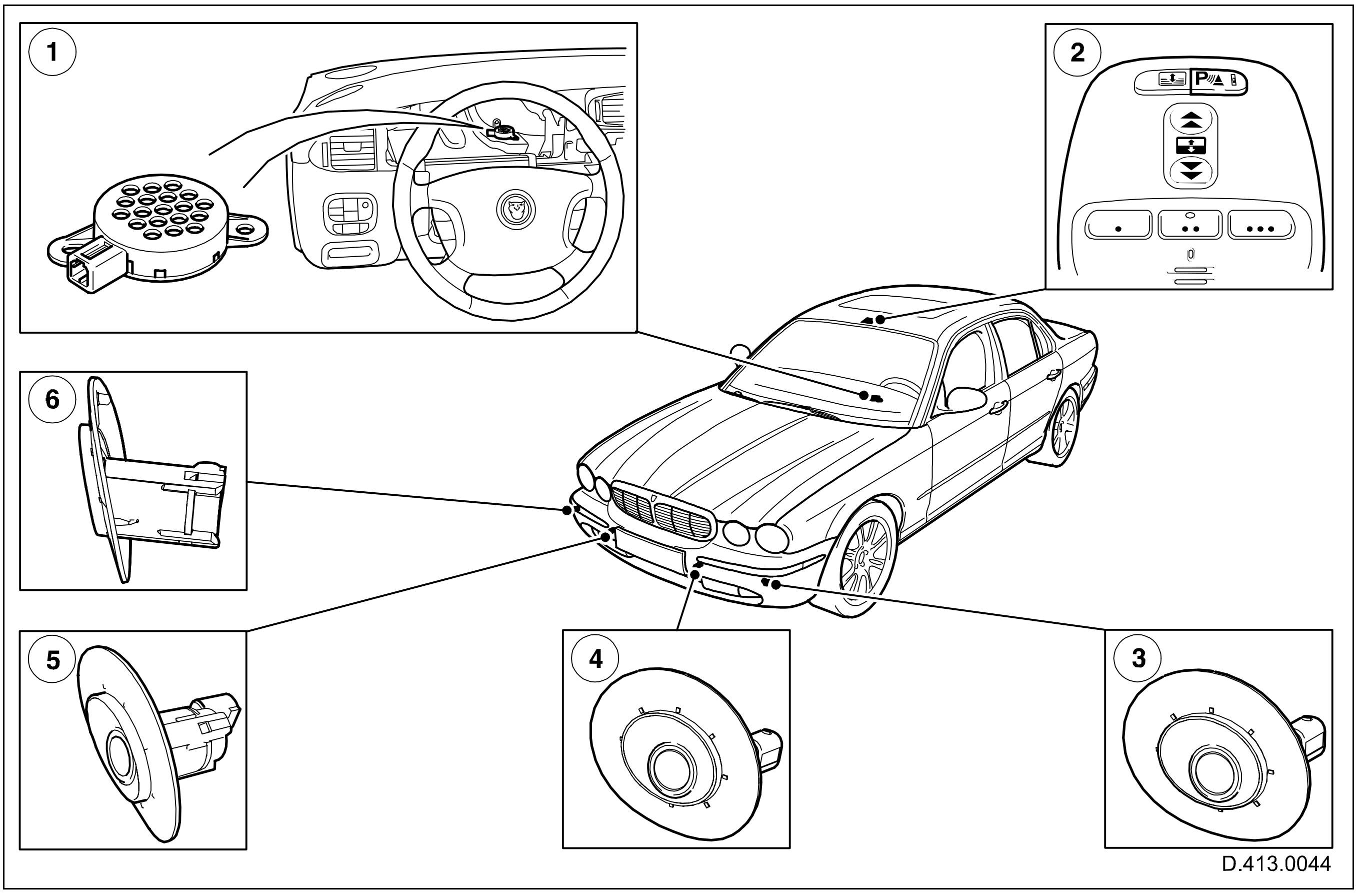

Fig. 96 Parking aid components (front)

1. Speaker
2. Deactivation switch
3. Ultrasonic sensor
4. Ultrasonic sensor
5. Ultrasonic sensor
6. Ultrasonic sensor

The front parking aid system, is installed as an option, requires a different parking aid module to that installed for the reverse parking aid system and comprises:

- Parking aid module.
- Audible warning speaker.
- Ultrasonic sensors.
- Deactivation switch.

The deactivation switch, located in the overhead console, provides the driver with the option to deactivate the system.

CAUTION: Deactivation applies to both the front and reverse parking aid systems.

A warning lamp, integral to the switch, illuminates to confirm the systems have been deactivated.

NOTE: Should a malfunction be detected, the system will be automatically deactivated and the warning lamp illuminated.

The ultrasonic sensors are designed to detect the presence of obstacles as the vehicle is being parked. Should an object be detected within the sensor range of 0.8m (31 ins) from the front of the vehicle, the speaker should emit an intermittent audible warning. As the vehicle moves closer to the object, at a distance of 0.25m (10 inches), the intermittent audible warning should change to a continuous audible warning.

NOTE: The front sensors are not effective at speeds above 15 km/h (9 mile/h) or below 7 km/h (4.5 mile/h).

System Malfunctions

Retrieval of the DTC and subsequent diagnosis of the system should be undertaken using WDS.

NOTE: For reliable operation, all sensors should be kept free from ice and grime. Cleaning the sensors using a high pressure spray should only be undertaken briefly and not from a distance of less than 200 mm (8 inches).

Reverse parking aid only

When reverse gear is engaged, any system malfunction will cause a continuous audible warning to be emitted for 3 seconds (only once per ignition cycle) and a DTC will be stored.

Front and reverse parking aid

When a system malfunction is detected, once per ignition cycle:

- a continuous audible warning will be emitted for 3 seconds;
- the deactivation switch LED will illuminate;
- the system will be deactivated;
- a DTC will be stored.

Battery and Charging Systems

Electrical Load Management System

Load management is not a new concept, but previous forms were restricted to specific modules and worked in isolation from the rest of the electrical system.

A subtle, centralized, electrical monitoring and control strategy has been introduced, designed to accommodate an increase in major electrical features, by limiting the detrimental effect on the battery and ultimately the vehicle.

The electrical load management system (ELMS) does not affect the core functionality of any vehicle system and is transparent to the customer:

- Spare capacity from the generator is utilized to ensure the most efficient operation of components that have particularly demanding power requirements.
- The battery is protected from rapid discharge by the temporary de-selection of features that will only be reinstated when the ELMS permits.

The system constantly compares power consumption against generated power using the vehicle systems listed in **Table 4**.

System	Provides data	Processes data	Performs actions
Engine management	x	x	x
Climate control	x	x	x
Electrical body	x	x	x
Suspension	x		
CAN		x	
SCP		x	
Instrument cluster		x	

Table 4 Contribution of vehicle systems to the ELMS

The ELMS is co-ordinated by the engine control module (ECM), which holds look-up tables (for data comparison purposes) and determines the following operating sequence:

1. Estimate maximum available generator current:
   – uses engine speed, road speed, ECT, IAT, electrical system voltage (at the ECM) and time (since the engine was started).

NOTE: The load management strategy will be inhibited should there be a failure in measurement of any of the above parameters.

2. Calculate the present level of vehicle electrical system loading based on network messages and EMS information:
   – uses CAN and SCP to determine which features are active. Intermittent loads such as seat movements, window lifts and turn signals are not considered.
3. Assess the operational condition of the electrical power supply by continuously monitoring:
   – system voltage at ECM;
   – ambient air temperature.
4. Decide what actions, if any, are required to protect the battery:
   – dependent on the results of the power supply calculations;
   – decides which features to inhibit;
   – determines required idle speed required to support features (subject to limits imposed by the requirements of the powertrain).
5. Perform required actions via CAN or SCP to inhibit or reinstate features.

The ELMS will be inhibited when:

- a CAN system failure is detected;
- the charge warning indicator while the engine is running.

NOTE: When the charge warning indicator is illuminated, the ELMS inhibits the operation of all electrically heated components. This maximizes the period for which the vehicle will remain operational before the battery becomes fully discharged.

Electrical Features

The following features are considered when accessing the level of electrical load:

- Heated front screen.
- Heated rear screen / heated mirrors.
- Heated wiper park.
- Blower motor.
- Side lamps.
- Dipped beam.
- Main beam.
- Front fog lamps.
- Rear fog lamps.
- Windscreen wipers - low speed.
- Windscreen wipers - high speed.
- Heated steering wheel.
- Heated seat (driver).
- Heated seat (passenger).
- Rear heated seat (behind front passenger).
- Rear heated seat (behind driver).
- Air suspension compressor.
- Adaptive damping mode.
- Engine cooling fan.
- Brake lights.

Feature Priority

The operation of the various electrically heated components is continually monitored by the ELMS. The ELMS determines that, in circumstances where the generated electrical power is less than the electrical consumption, selected systems may be inhibited or operated using reduced power for as long as is necessary.

NOTE: Warning LEDs remain illuminated so that any corrective action is not apparent to the driver.

The inhibition of features is examined in the following order:

1. Heated wiper park.
2. Heated rear screen / heated mirrors.
3. Heated front screen.
4. Heated steering wheel.
5. Rear heated seat (behind driver).
6. Rear heated seat (behind front passenger).
7. Heated seat (passenger).
8. Heated seat (driver).

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.

When measured at the generator terminals:

- 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 when both the ECT and the IAT are below 15°C (59°F).
- The intermediate time period is selected when either the ECT or the IAT are above 15°C (59°F) and are also within 10°C (50°F) of each other.
- 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 ranges between 14 volts and 14.6 volts (measured at the ECM) 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 **New XJ Range Electrical Guide** for details:

1. The voltage regulator request setting from the ECM to the generator.
2. A square 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.

In-vehicle Entertainment Systems

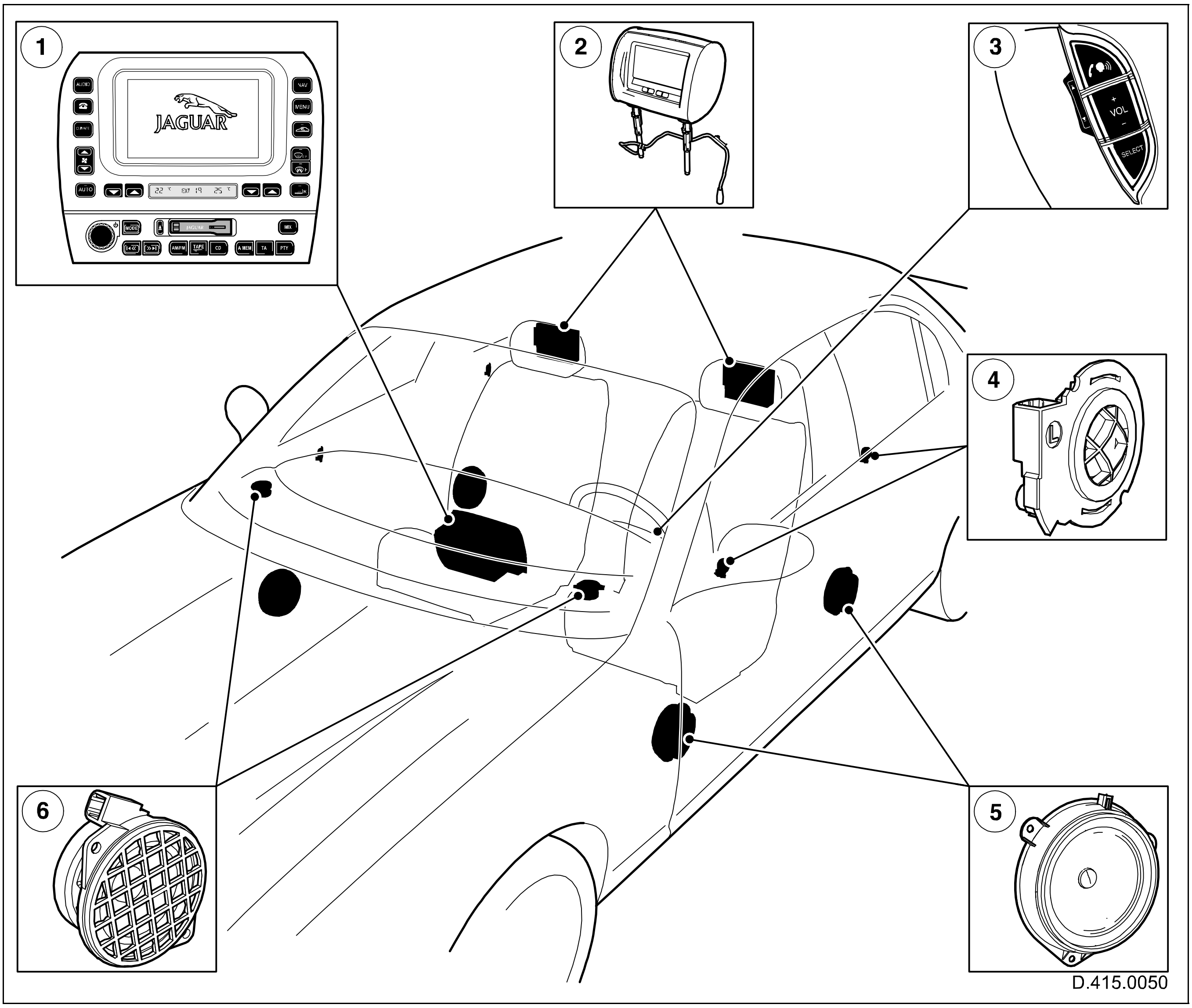

Fig. 97 Entertainment system components - forward locations

1. Audio unit (telematics version)
2. Rear multimedia display (option)
3. Steering wheel telematics controls
4. Tweeter
5. Mid-bass speaker
6. Mid-range speaker

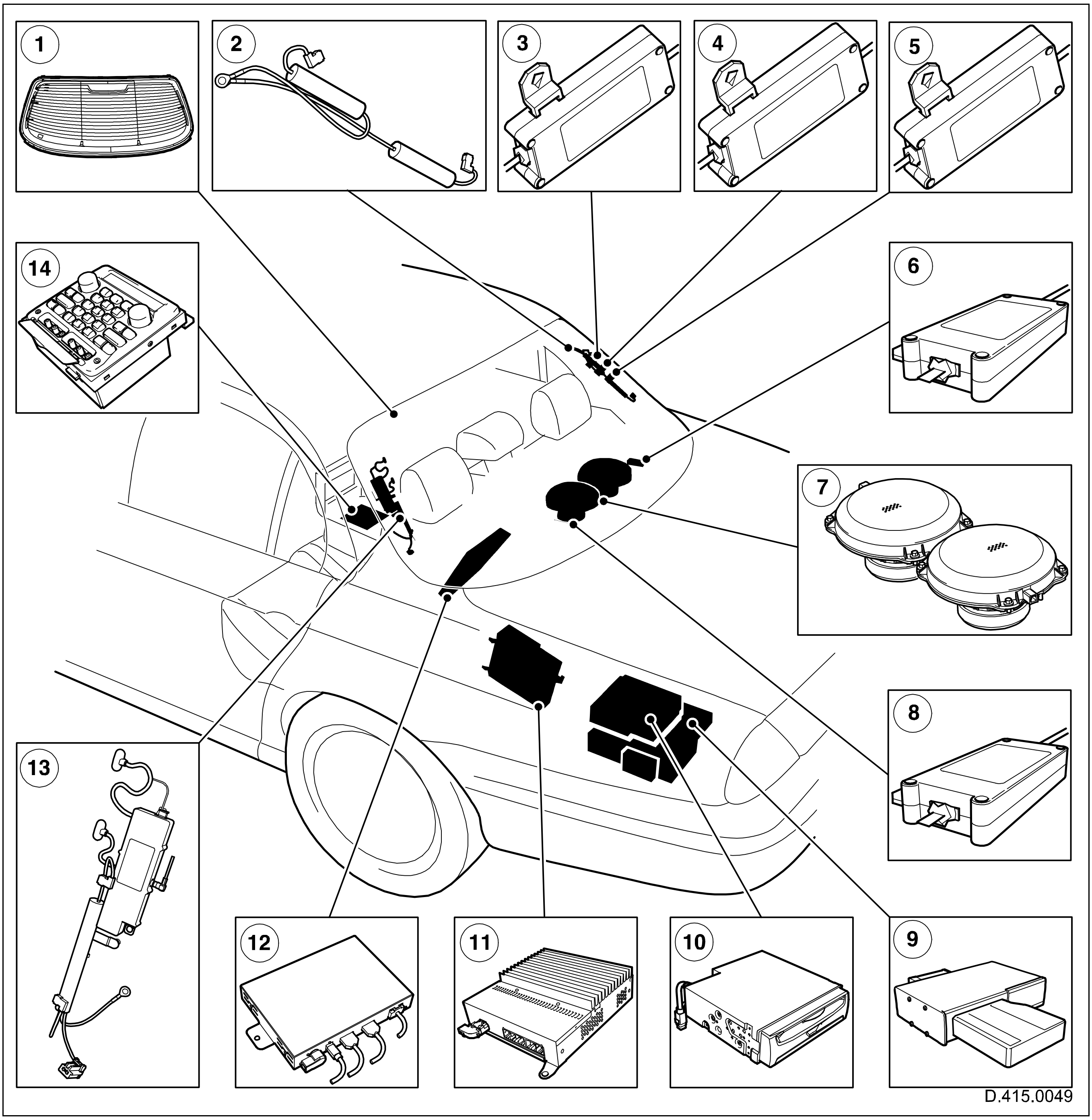

Fig. 98 Entertainment system components - rearward locations

Key to Fig. 98

1. Antennas
2. Double-wavetrap
3. VICS antenna amplifier (Japan only)
4. Television antenna amplifier
5. Television antenna amplifier
6. Television antenna amplifier
7. Sub-woofers (premium system)
8. Television antenna amplifier
9. CD changer (option)
10. DVD player (option)
11. Remote amplifier (premium system)
12. Audio/video switching unit
13. Antenna amplifier and wavetrap
14. Passenger entertainment control panel

NOTE: Specific components will vary according to vehicle and market specifications.

The entertainment systems comprise:

- Audio system.
- Antenna.
- Speakers.
- Video system.
- Rear multimedia system; refer to **Rear Multimedia 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. 99**) or integrated with the phone keypad and small LCD (non-telematics version, **Fig. 100**).

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 audio system will necessitate the reconfiguration of the system using WDS.

Fig. 99 Audio unit - telematics version

Telematics version

NOTE: The telematics display module also provides the ability for the user to control such features as climate control; refer to **Telematics Display Module**.

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).

When the rear multimedia option is installed, a 'pop-up window' will appear when certain functions from the rear multimedia system are selected; the window is for information only and will disappear after a few seconds.

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).

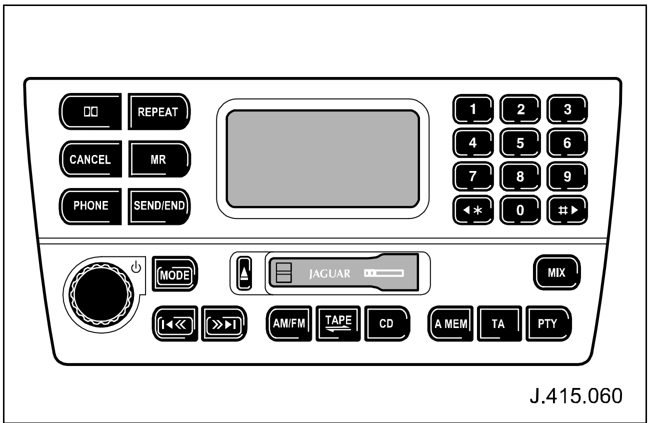

Fig. 100 Audio unit - non-telematics version

NOTE: The non-telematics version of the audio unit is complemented 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**.

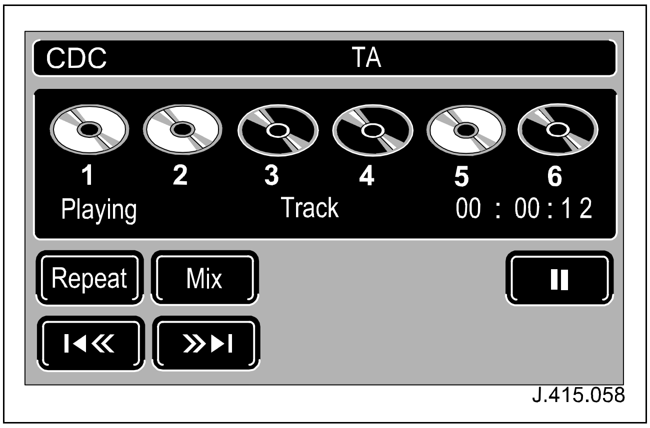

Fig. 101 CD changer - telematics display screen

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. 98**.

Speakers

The premium audio sound system comprises:

- Four lightweight mid-bass door speakers;
- Four door-mounted tweeters;
- Two mid-range speakers (instrument panel mounted);
- Two sub-woofers.

The standard audio sound system comprises:

- Four lightweight mid-bass door speakers;
- Four door-mounted tweeters.

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.

NOTE: The video system may have been extended to accommodate rear seat passengers; refer to **Rear Multimedia System**.

Rear Multimedia System

The rear multimedia system, which is an optional installation, depending on market and vehicle specifications, comprises:

- Passenger entertainment control panel;
- Rear multimedia displays;
- DVD player;
- Audio/video switching unit.

The rear multimedia system provides rear seat passengers with the opportunity to select from a choice of different entertainment sources, independent of each other and to that selected by the front passenger. The system is flexible enough to allow for example, the front passenger to watch a television broadcast, one rear passenger to watch a DVD and the other to use a games console.

NOTE: Rear seat passengers can also control the main entertainment system components: audio unit (tape cassette/mini-disc/tuner) and CD changer.

In addition, when combined with the multi-zone voice option, the system allows rear seat passengers to participate in hands-free conference calls (provided the cellular phone system is installed) or to voice-control audio and climate control functions.

Passenger Entertainment Control Panel

Depending on market and vehicle specifications, the panel is located in the rear armrest or the rear floor console. The panel is part of the D2B network; refer to **D2B network** and interfaces with the audio/video switching unit to facilitate user control of any installed multimedia options; refer to **Fig. 105**.

The panel has two input sockets to allow individual connection of audio headsets and two sets of auxiliary inputs to allow connection of external audio/video sources such as a games console, a camcorder or an MP3 player.

NOTE: The passenger entertainment control panel can be inhibited by front seat passengers.

To inhibit the passenger entertainment control panel:

- non-telematics version - select and hold the 'MODE' button on the audio unit until 'TRAFFIC' is displayed. Repeatedly press the 'MODE' button until 'RMS' mode is displayed (this immediately follows the RMS rear speaker mode setting). Use the 'TRACK UP'/'TRACK DOWN' keys to make the desired selection.
- telematics version - select 'MENU' from the telematics screen, followed by 'REAR MULTIMEDIA', then select from one of the three options: Unlock, Headphone Only, Lock.

NOTE: Cellular phone and voice capabilities will also be inhibited.

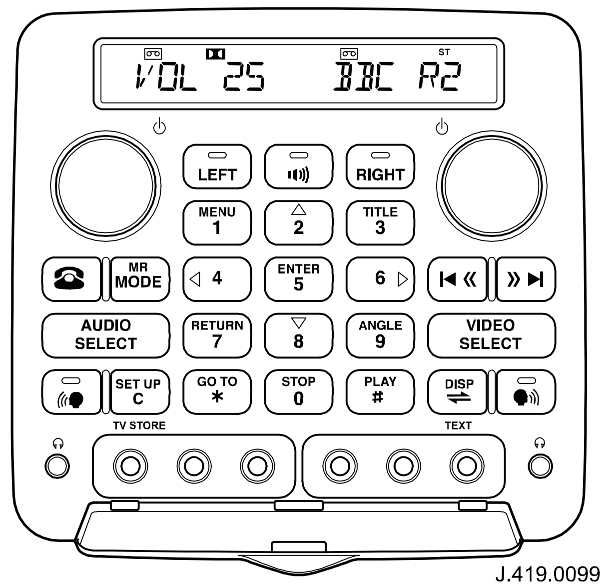

Fig. 102 Passenger entertainment control panel

Depending on the options installed, the control panel can be used to select and control the following: single CD, mini-disc, tape cassette and tuner, DVD, TV (including teletext, where available) and cellular phone dialing.

NOTE: The panel, provided the multi-zone voice option is installed, allows rear seat passengers to participate in hands-free conference calls (provided the cellular phone system is installed) or to voice-control audio and climate control functions; refer to **Voice Activated Control System**.

Audio can be directed to one of three output sources by selecting the appropriate mode:

- LEFT headset
- CABIN speakers
- RIGHT headset

NOTE: Selection of the mode is confirmed by the illumination of the tell-tale LED on the corresponding button.

Momentarily pressing the 'AUDIO SELECT' button on the passenger entertainment control panel displays the current signal source. A different source can be selected by each subsequent press of the button until the desired choice is displayed. Available options (subject to that particular option being installed) include: FM, AM (MW, LW), TAPE (or MD, CD), TV, DVD, AUX1, AUX2.

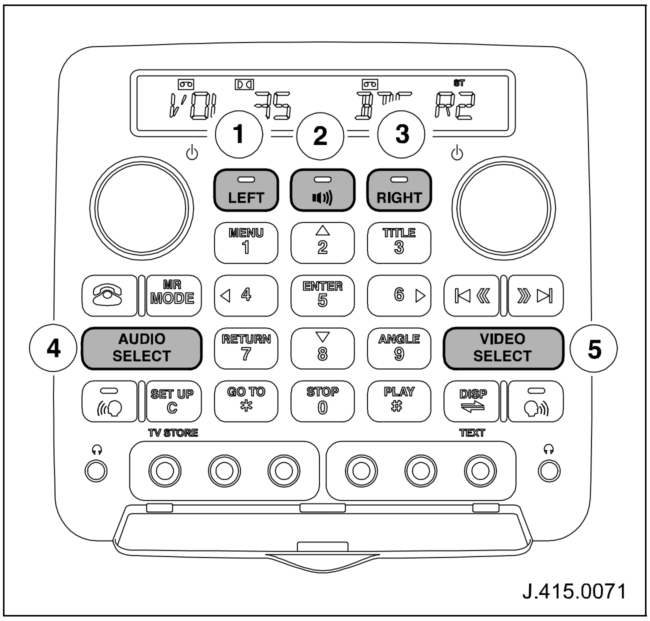

Fig. 103 Selection control buttons

1. LEFT headset select
2. CABIN speakers select
3. RIGHT headset select
4. AUDIO SELECT
5. VIDEO SELECT

Rear Multimedia Display

The rear multimedia displays are 6.5in color liquid crystal displays, mounted within the head restraints of the front seats.

Each display has the following user controls:

- 'ON/OFF' button.
- 'MENU' button.
- Two buttons: '-' and '+'for navigating the 'on-screen' options.

Momentarily pressing the 'VIDEO SELECT' button on the passenger entertainment control panel displays the current signal source. A different source can be selected by each subsequent press of the button until the desired choice is displayed. Available options (subject to that particular option being installed) include: TV, DVD, AUX1, AUX2.

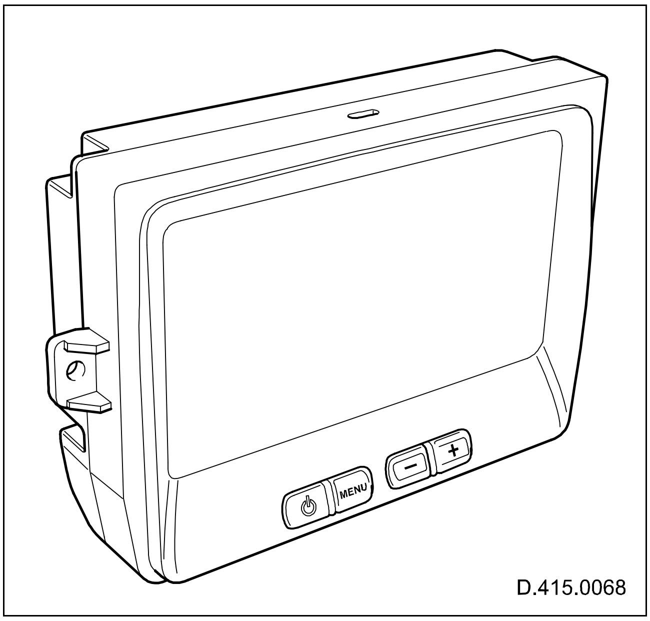

Fig. 104 Rear multimedia display

DVD Player

The optional DVD player is mounted to the left-hand side of the luggage compartment as part of the multimedia stack.

NOTE: The DVD player is region-specific and therefore will only read compatible DVDs.

Audio/video Switching Unit

The audio/video switching unit interfaces with any installed multimedia equipment and the passenger entertainment control panel to allow rear seat passengers to select a particular signal source, which typically includes:

- Television (via the telematics display module).
- Main audio (CD, mini-disc, tuner).
- DVD player.

The diagram, **Fig. 105** provides an indication of how the unit interfaces the multimedia components; refer to **New XJ Range Electrical Guide** for detailed connection information.

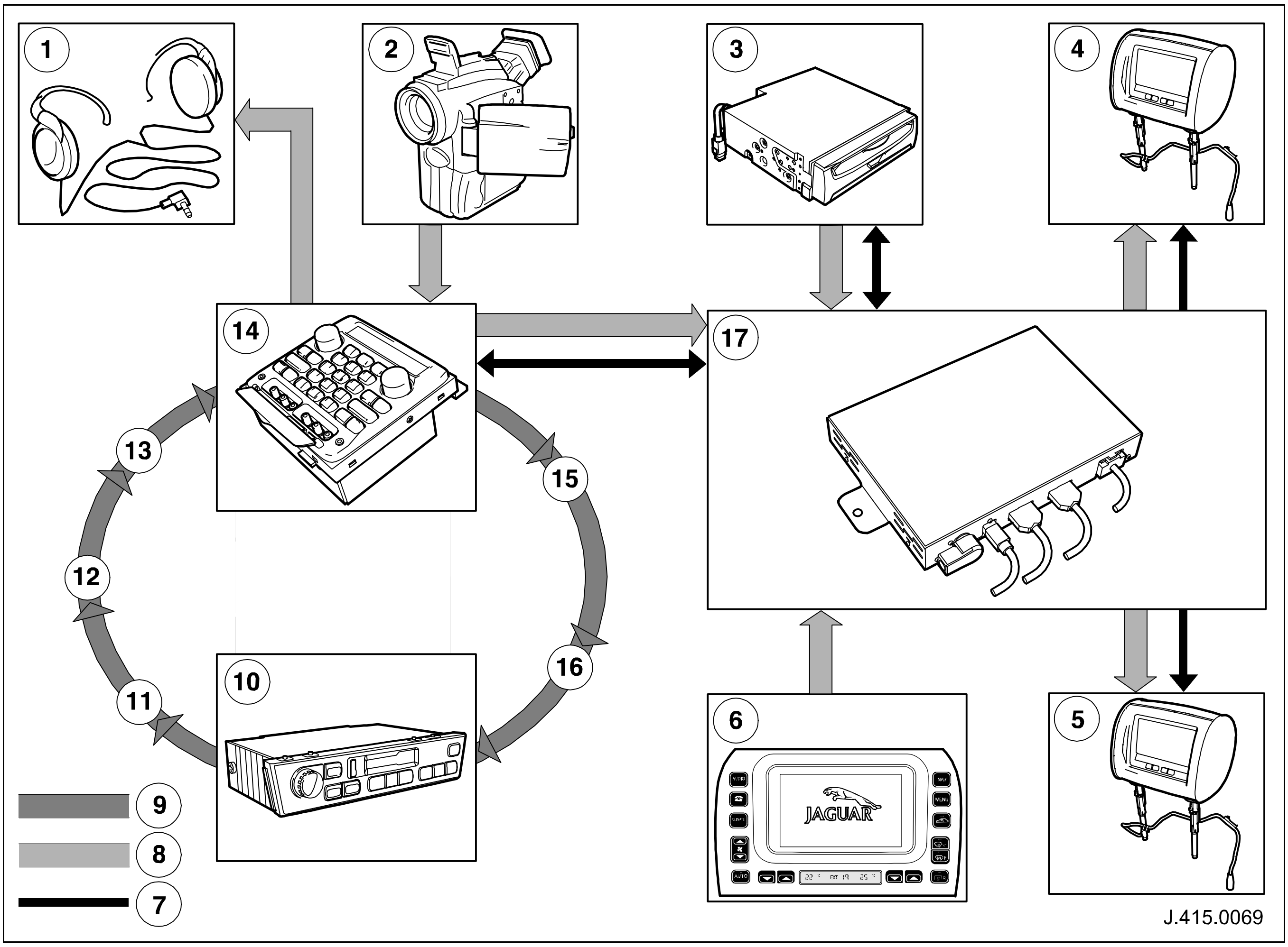

Fig. 105 Audio/video switching interface diagram

1. Personal headset
2. Camcorder (or other compatible device)
3. DVD player
4. Rear multimedia display
5. Rear multimedia display
6. TV receiver (integral to telematics module)
7. Control signals
8. Audio/video signals
9. D2B network
10. Audio unit
11. CD changer
12. Cellular phone control module
13. Voice activation module
14. Passenger entertainment control panel
15. Navigation control module
16. Power amplifier
17. Audio/video switching unit

Lighting

Exterior Lighting

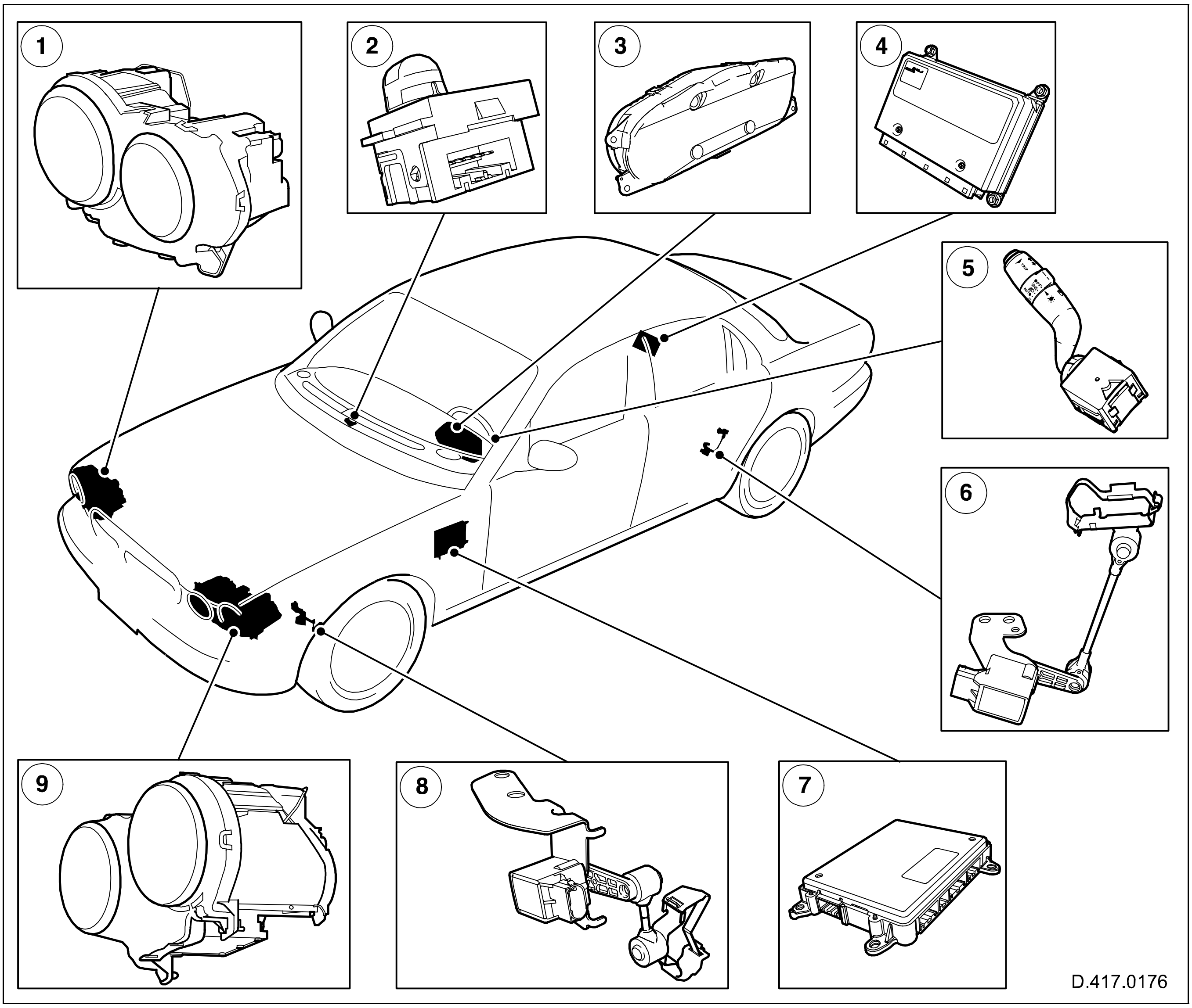

Fig. 106 Headlamp features

1. Right-hand headlamp assembly
2. Autolamp sensor
3. Instrument cluster
4. Air suspension module
5. Main lighting switch
6. Left-hand rear-axle level sensor assembly
7. Front electronic module
8. Left-hand front-axle level sensor assembly
9. Left-hand headlamp assembly

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

Depending on market and vehicle specification the headlamp assembly will comprise one of three options:

- Conventional halogen lighting.
- Xenon, high intensity discharge lighting (low beam functionality only).

NOTE: A conventional halogen bulb is used for the high beam and 'flash-to-pass' feature.

- Bi-xenon, high intensity discharge lighting (high and low beam functionality).

NOTE: A conventional halogen bulb is used for the 'flash-to-pass' feature only. The xenon lamp is not suitable for operating in this manner, doing so will cause premature failure of the lamp and/or the control module.

All lighting input signals are decoded by the instrument cluster and an appropriate signal sent via the SCP network to the front electronic module (FEM) and rear electronic module (REM). Providing other conditions are correct, the FEM and REM will output a ground signal to the appropriate lamps or relays; refer to **New XJ Range 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;
- Exit delay;
- Trip cycle; refer to **Odometer, Trip Odometer / Trip Computer**.

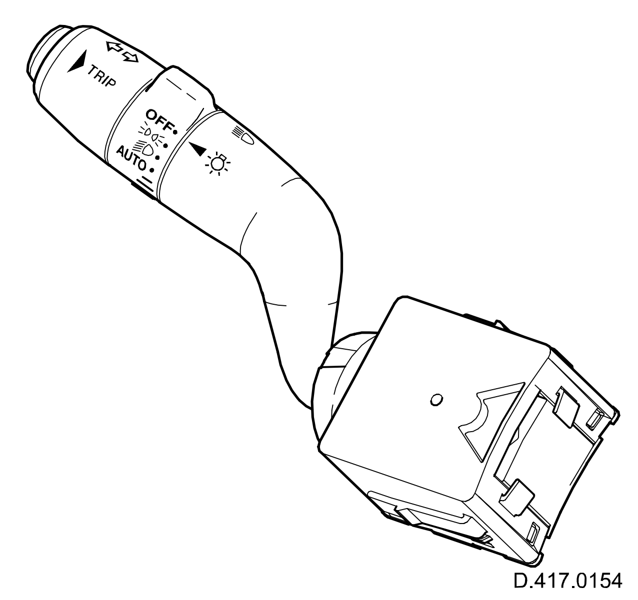

Fig. 107 Main lighting switch

Exit delay

The exit-delay feature is controlled by the front electronic module (FEM) and is activated when one of the exit-delay positions is selected using the rotary collar on the main lighting switch. Depending on the position selected, the main beam will illuminate for 10s, 30s or 2m.

NOTE: The feature does not function when the rotary collar is set to 'AUTO'.

Halogen Headlamps

NOTE: Approximately 5 minutes after activating the headlamps, 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**.

Bi-xenon and Xenon High-Intensity Discharge Headlamps

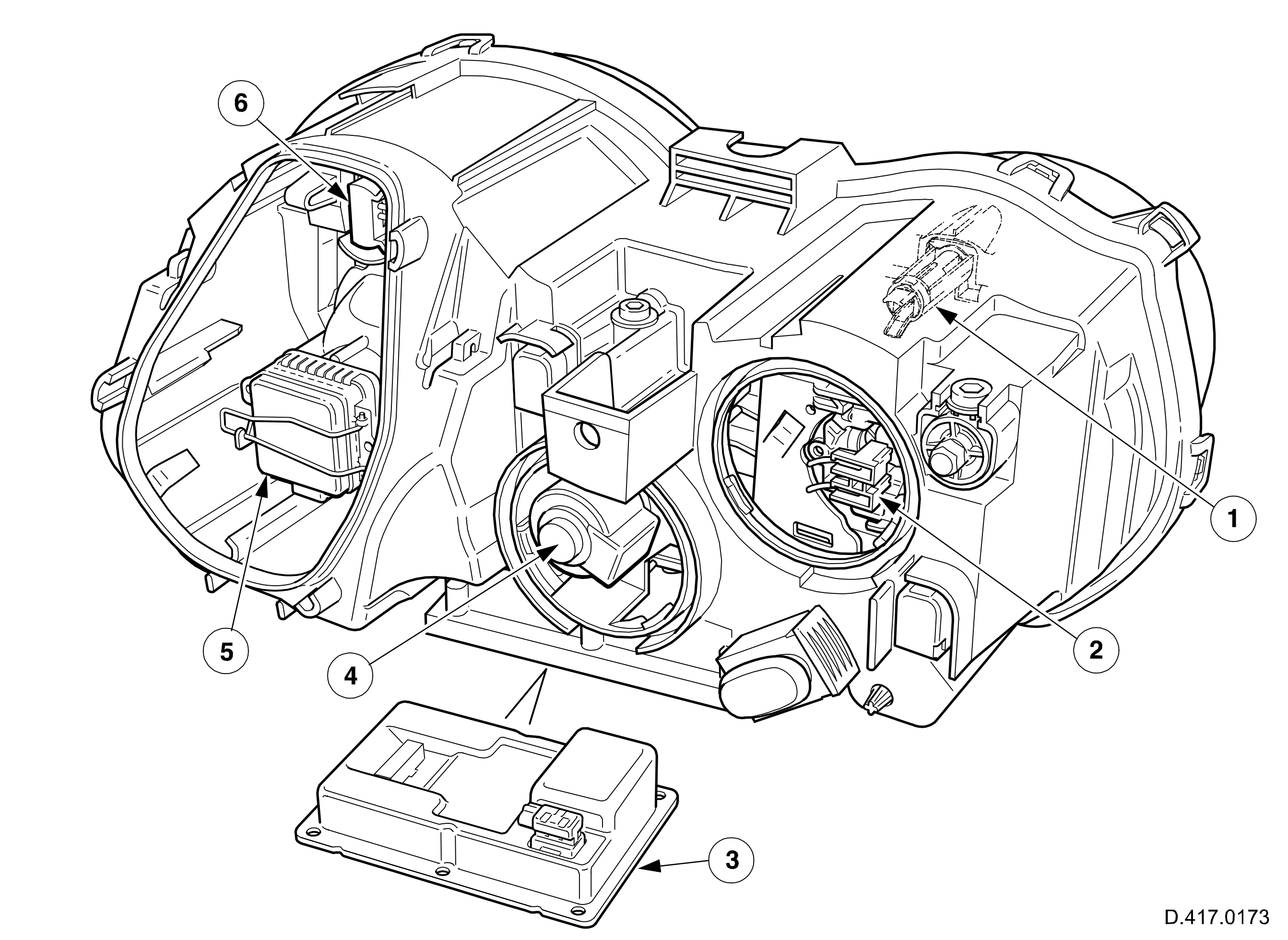

Fig. 108 High-intensity discharge lamp assembly

1. Pilot lamp
2. High beam (flash-to-pass) lamp
3. Xenon lamp control module
4. Motor (automatic headlamp leveling)
5. Xenon lamp assembly
6. Turn signal lamp

NOTE: Due to national legislation, vehicles equipped with high-intensity discharge headlamps require the installation of **Automatic Headlamp Leveling** and a **Headlamp Cleaning System**.

The high-intensity discharge headlamp assembly (where applicable) comprises:

- Xenon lamp;
- Halogen lamp;
- Pilot 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.

NOTE: In some markets, vehicles are fitted with a bi-xenon lamp assembly that can also provide a high beam output; refer to **Xenon Lamp Assembly**

- The turn signal and pilot lamps are conventional lamps.

Xenon Lamp Assembly

The bi-xenon lamp uses a solenoid-operated flap to switch between low and high-beam operation. During low-beam operation the flap prevents light from entering the bottom of the diverging lens. When high-beam is required, operation of the high-beam switch, energizes the solenoid, which moves the flap away from the xenon lamp, allowing light to enter the bottom of the diverging lens to produce the high-beam pattern.

NOTE: A conventional halogen bulb is used for the 'flash-to-pass' feature only; the xenon lamp is not operated. Igniting and extinguishing the xenon lamp several times during a small period of time, will cause premature failure of the lamp and/or the control module.

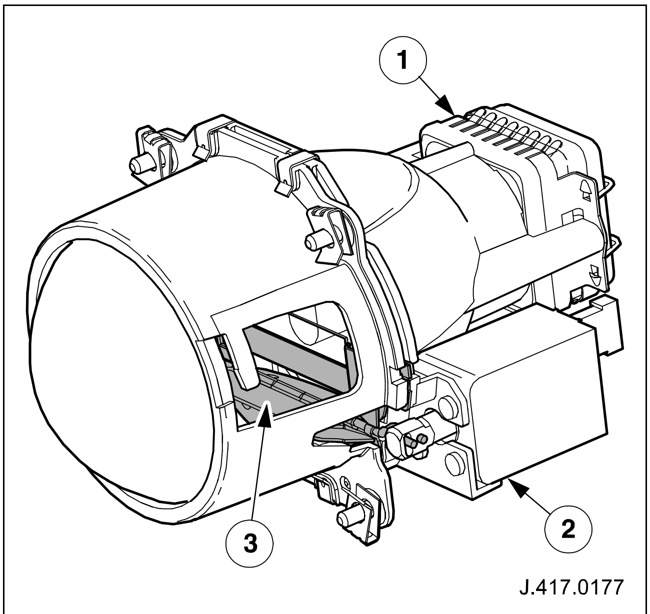

Fig. 109 Bi-xenon lamp assembly

1. Igniter
2. Solenoid
3. Flap

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. 110**) 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 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.

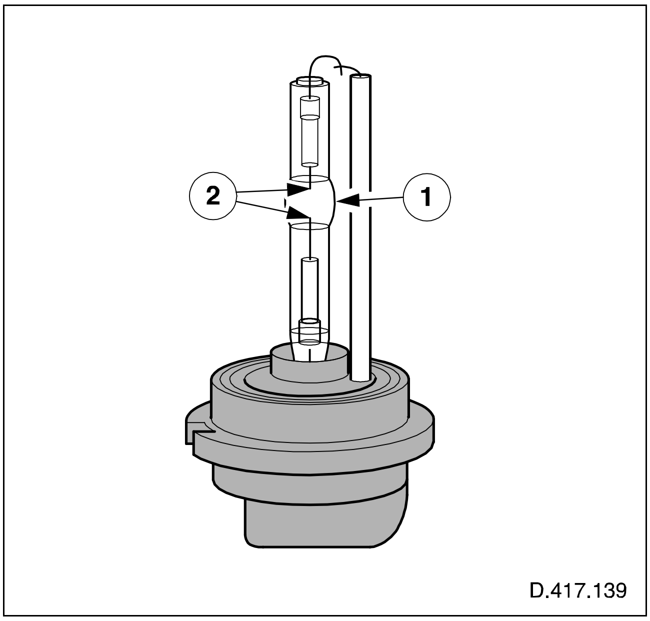

Fig. 110 Xenon lamp

1. Gas-filled chamber
2. Electrodes

Xenon Lamp Control Module

Each high-intensity discharge (HID) lamp assembly has a separate control module, which in addition to regulating start-up and stabilizing output, provides circuit protection by recognizing malfunction conditions such as power supply deviations and short circuits.

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

In addition, a headlamp leveling drive circuit is integral to the xenon lamp control module. The drive circuit monitors input signals received from the air suspension module and outputs a drive signal to the headlamp leveling motor that will correct the position of the lamps.

Automatic Headlamp Leveling

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

The system comprises:

- Left-hand front, height sensor assembly;
- Left-hand rear, height sensor assembly;
- Air suspension module;
- Left-hand, headlamp leveling motor;
- Left-hand, xenon lamp control module;
- Right-hand headlamp leveling motor;
- Right-hand xenon lamp control module.

Automatic headlamp leveling is operational when the ignition key is at position ‘II’.

NOTE: Each time that the ignition key is turned to position ‘II’, the headlamp levelling motors are recalibrated to ensure that the headlamps are set at the correct height in relation to vehicle attitude.

The headlamp leveling drive circuit is integral to the xenon lamp control module. The left-hand height-sensors (part of the air suspension system) are inductive devices that respond to the vertical position of the vehicle and supply feedback signals to the air suspension module (ASM). The ASM processes the data and supplies a pulse-width modulated (PWM) signal to each xenon lamp control module. The signal is monitored every 10ms, should it deviate from the last stored values, the module will cause the headlamp leveling motors to drive the headlamps to a new, calculated position. A schematic representation of the component interconnections is shown in **Fig. 111**; refer to **New XJ Range Electrical Guide** for detailed connection information.

NOTE: Due to data processing time, there is a delay of approximately 80ms between changes in suspension height and any headlamp adjustments that may be required.

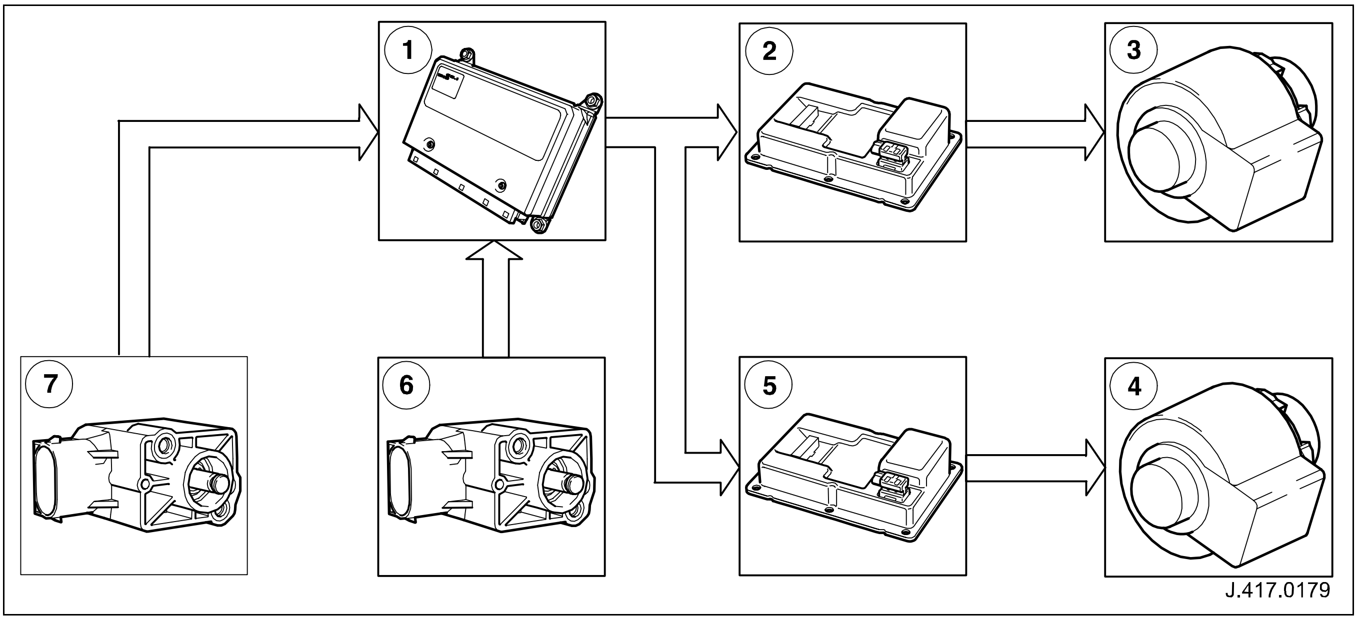

Fig. 111 Automatic headlamp leveling system

1. Air suspension module
2. Left-hand xenon lamp control module
3. Left-hand headlamp leveling motor
4. Right-hand headlamp leveling motor
5. Right-hand xenon lamp control module
6. Left-hand front height sensor
7. Left-hand rear height sensor

Diagnostics

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

Auxiliary Lighting Switch

The auxiliary lighting switch assembly comprises:

- Dimmer control; refer to **Instrument Cluster and Panel Illumination**.
- Trip computer switches; refer to **Odometer, Trip Odometer / Trip Computer**.
- Front and rear fog switches; refer to **Front and Rear Fog Lamp Switches**.

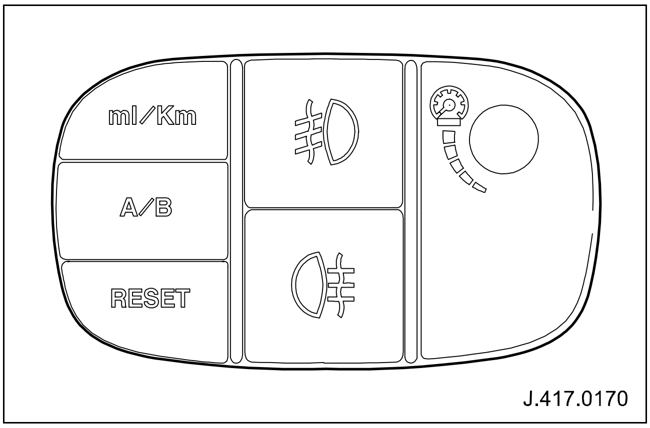

Fig. 112 Auxiliary lighting switch

Autolamp

The operation of the autolamp feature (where applicable) is dependent on ambient light levels, monitored by photo-diodes integrated into the autolamp sensor. The sensor provides feedback to the instrument cluster, which responds by supplying control signals on the SCP network to the front electronic module (FEM) and rear electronic module (REM). Where appropriate, the side lamps and low-beam headlamps will operate automatically 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 3 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.

NOTE: Japanese specification autolamp responds to darkness after 1.5 seconds and daylight after 4 seconds.

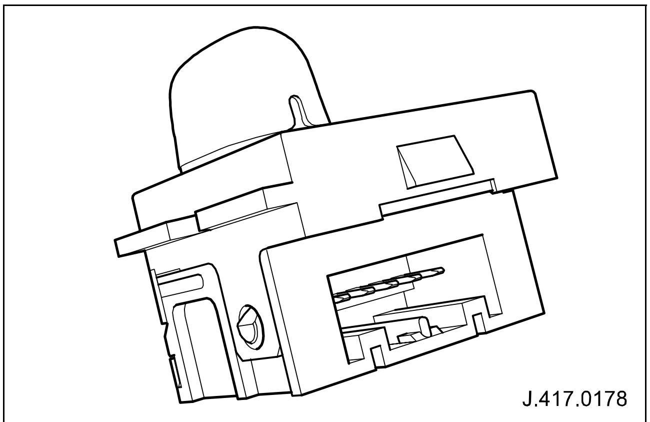

Fig. 113 Autolamp sensor

Rear Lamp Assembly

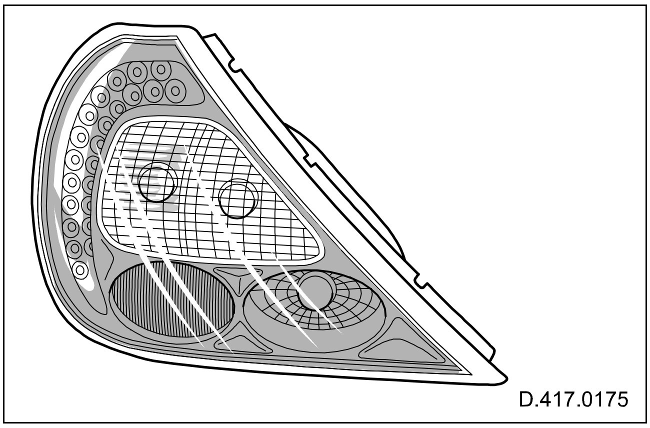

Fig. 114 Lens - rear lamp assembly

The rear lamp assembly uses conventional tungsten bulbs for the turn signal, fog guard and reversing lights.

The tail and stop lights share twenty-four, pcb-mounted LEDs.

Using LEDs instead of conventional tungsten filament bulbs provides the following advantages:

- Lower energy consumption.
- Reduction in heat generated (allowing the distance between the lens and the light source to be reduced).
- Increased reliability and longer service life.
- Constant light intensity over the life of the LEDs.
- A faster operational response time of approximately 130ms for the LEDs compared with 210ms for a conventional bulb.

NOTE: The LEDs can be replaced only as a complete PCB assembly.

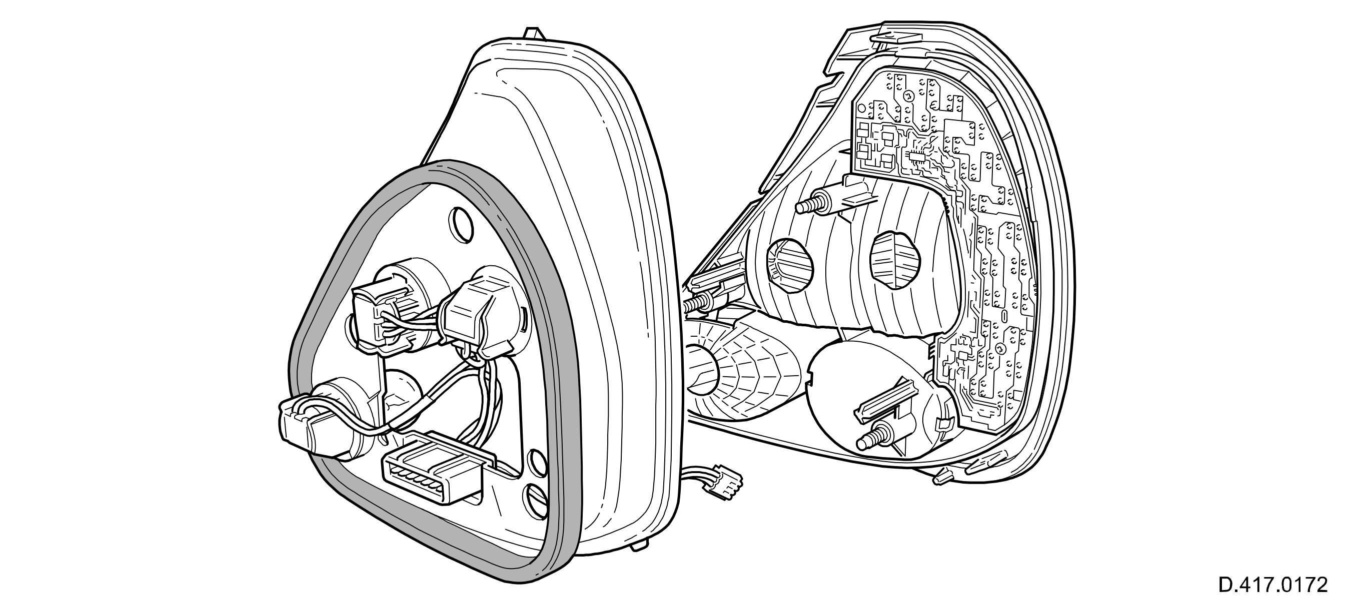

Fig. 115 Rear lamp assembly

When the lighting switch is operated to activate the main vehicle lighting, all LEDs are illuminated at a constant intensity level to provide the tail lights. Subsequent operation of the footbrake pedal will cause all LEDs to illuminate at a higher intensity to provide the stop lights.

NOTE: The high-mounted stop light operates in synchronization with the stop lights.

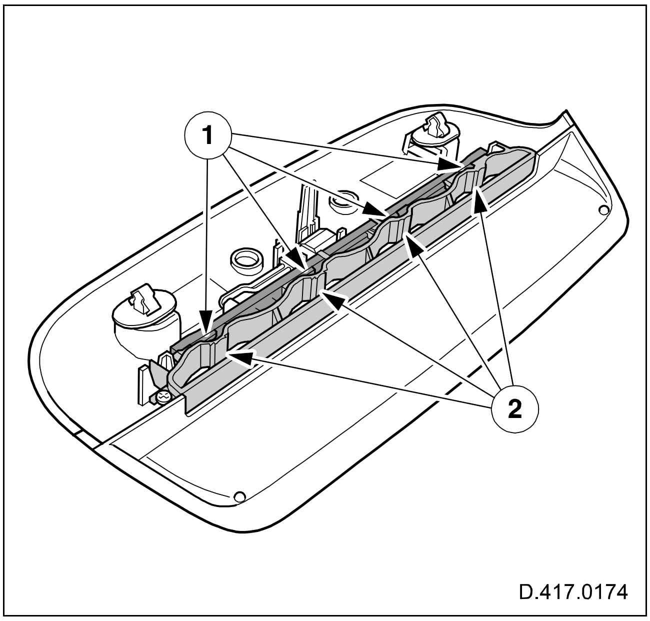

Fig. 116 High-mounted stop light

1. LEDs
2. Fresnel lens

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.

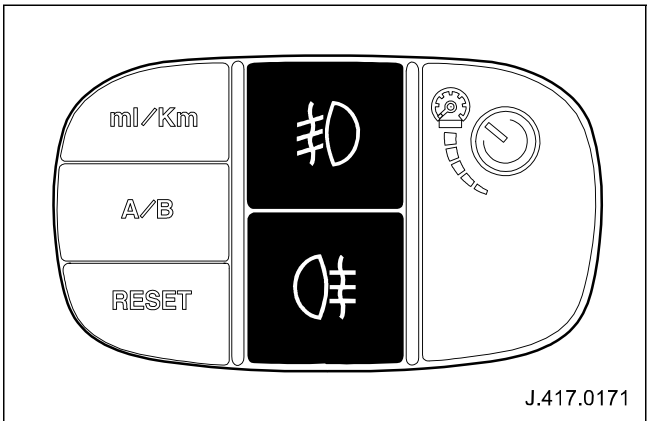

Fig. 117 Front and rear fog lamp switches

Refer to **New XJ Range Electrical Guide** for detailed electrical connection information.

Approach Lamps

Approach lamps are integrated in the exterior mirrors to provide ground illumination for the area around the front doors. Although the lamps are mounted externally, they are controlled by the interior lighting circuit: refer to **Interior Lighting**.

Interior Lighting

The interior lighting comprises:

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

NOTE: Refer to **New XJ Range Electrical Guide** for detailed connection information.

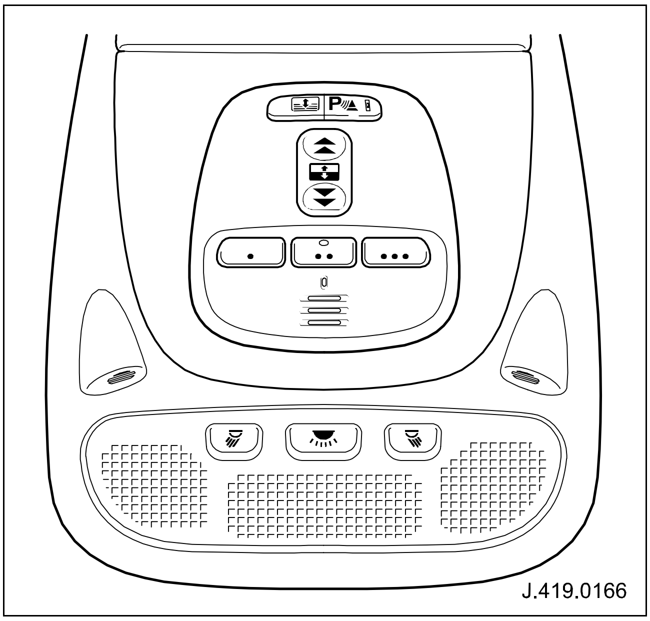

Fig. 118 Front interior lighting

Battery Saver

A timer function within the front electronic module (FEM) and rear electronic module (REM) 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 FEM and/or REM 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 front and rear electronic control modules in the following circumstances:

- Any of the vehicle's doors are open/closed.
- 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:

- Fifteen 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.

Approach Lamps

Approach lamps are integrated in the exterior mirrors to provide ground illumination for the area around the front doors. The lamps are activated when:

- the vehicle is unlocked using the key, the key transmitter or the master locking switch;
- the headlamp convenience button on the key transmitter is pressed;
- reverse is selected.

NOTE: The approach lamps will not illuminate if the ambient light, as determined by the autolamp sensor, is above a predetermined level.

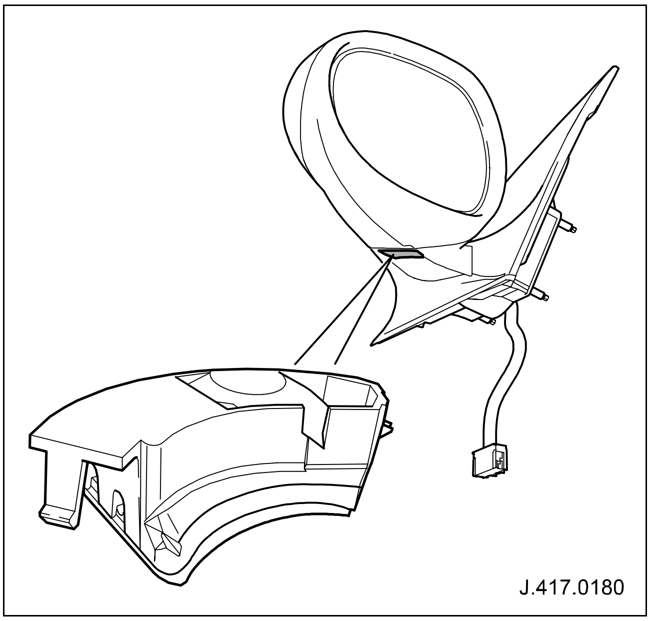

Fig. 119 Approach lamp

Electrical Distribution

Module Communications Network

The most significant change to the XJ 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 5**.

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
D2B	Very high-speed, real-time audio data.	5500

Table 5 Network communication

Fig. 120 provides a representation of the major network interconnections; refer to **New XJ Range Electrical Guide** for detailed information.

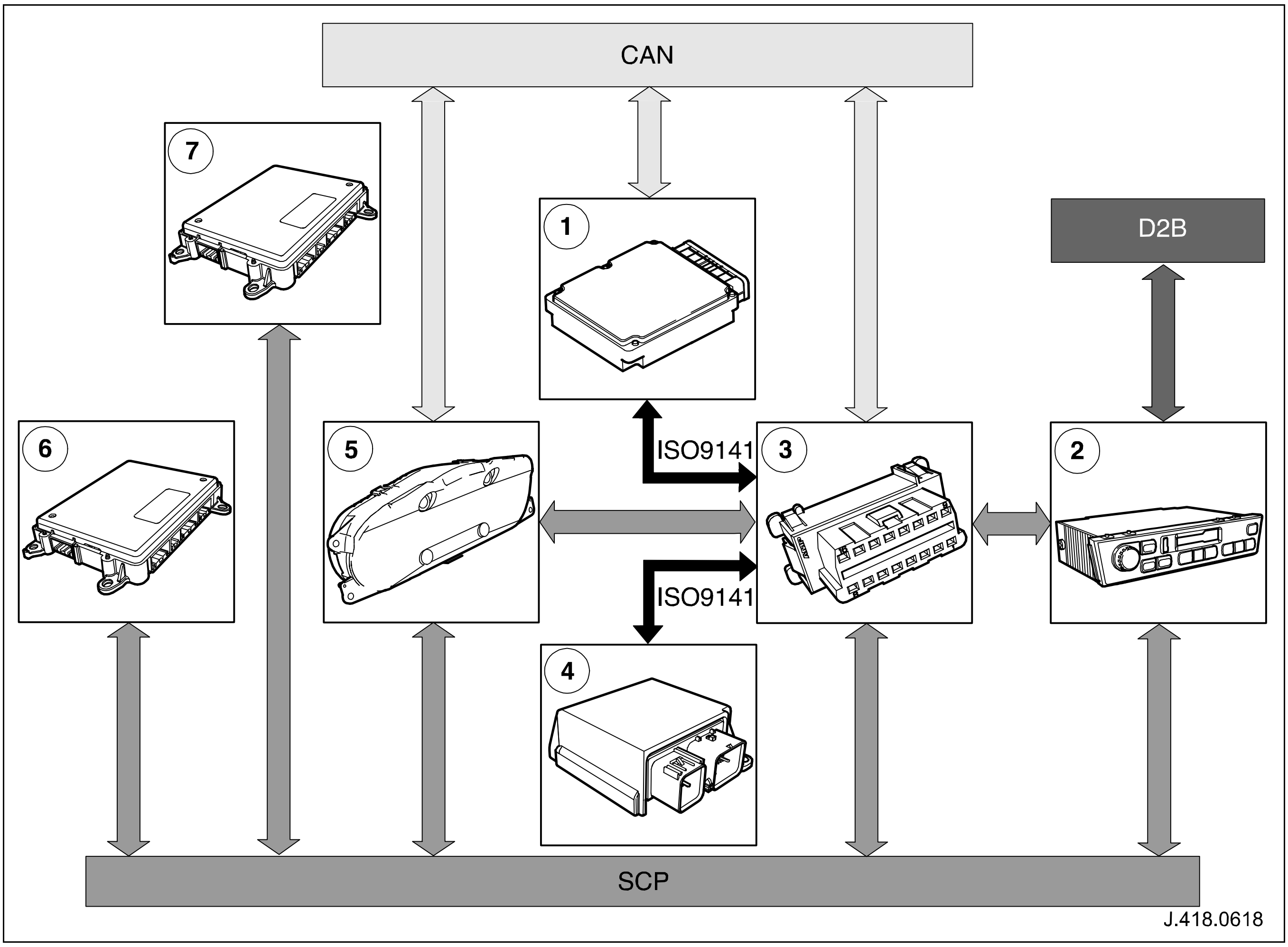

Fig. 120 Network interconnections

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

Controller Area Network (CAN)

Fig. 121 provides a schematic representation of the CAN interconnections; refer to **New XJ Range Electrical Guide** for detailed information.

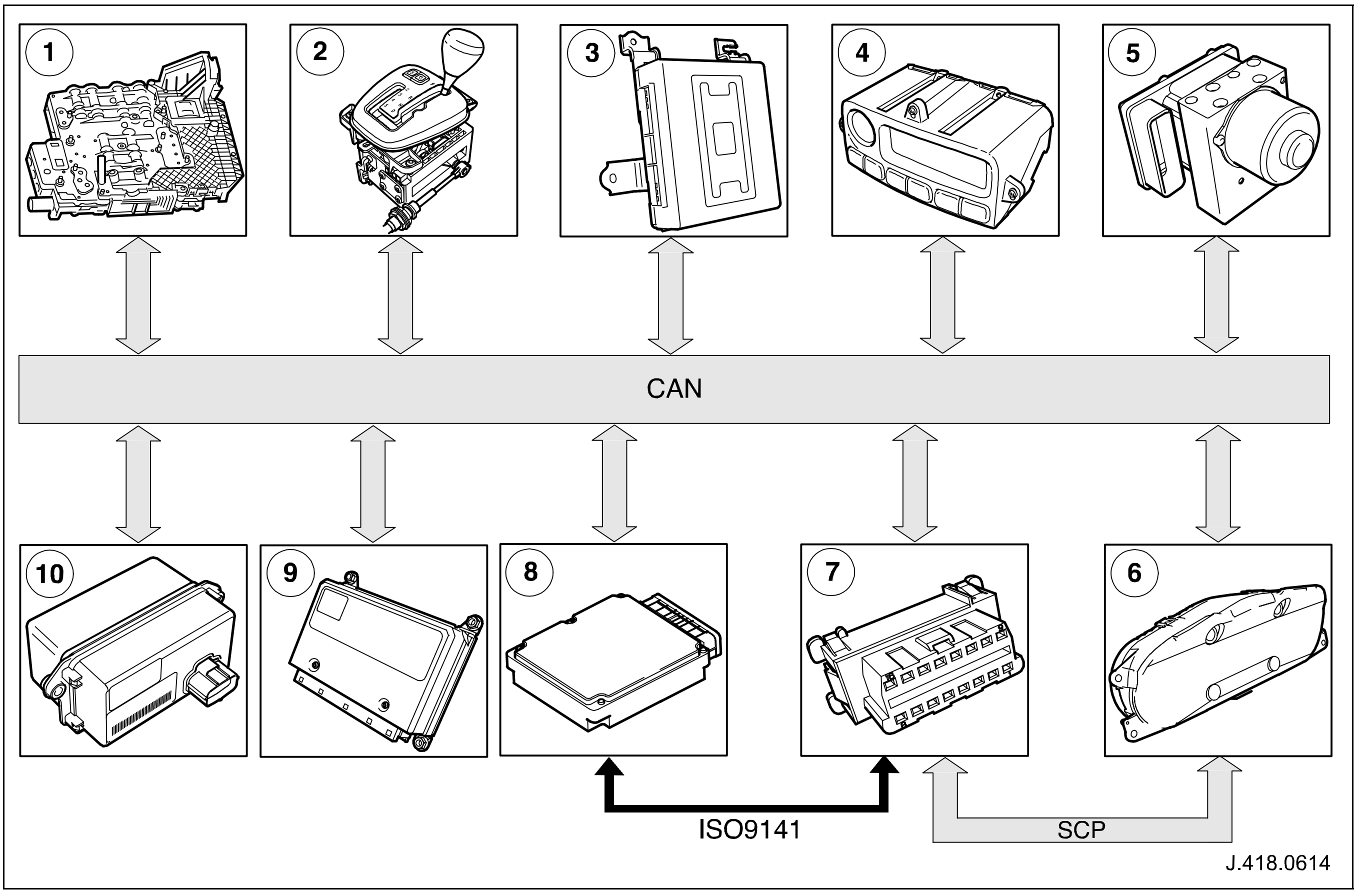

Fig. 121 Controller area network (CAN)

1. Transmission control module (and main control valve body)
2. J-gate module
3. Remote climate control module (telematics only)
4. Rear climate control panel
5. ABS module
6. Instrument cluster
7. Diagnostic connector
8. Engine control module
9. Air suspension module
10. Adaptive speed control module

Standard Corporate Protocol (SCP) Network

Fig. 122 provides a schematic representation of the SCP network interconnections; refer to **New XJ Range Electrical Guide** for detailed information.

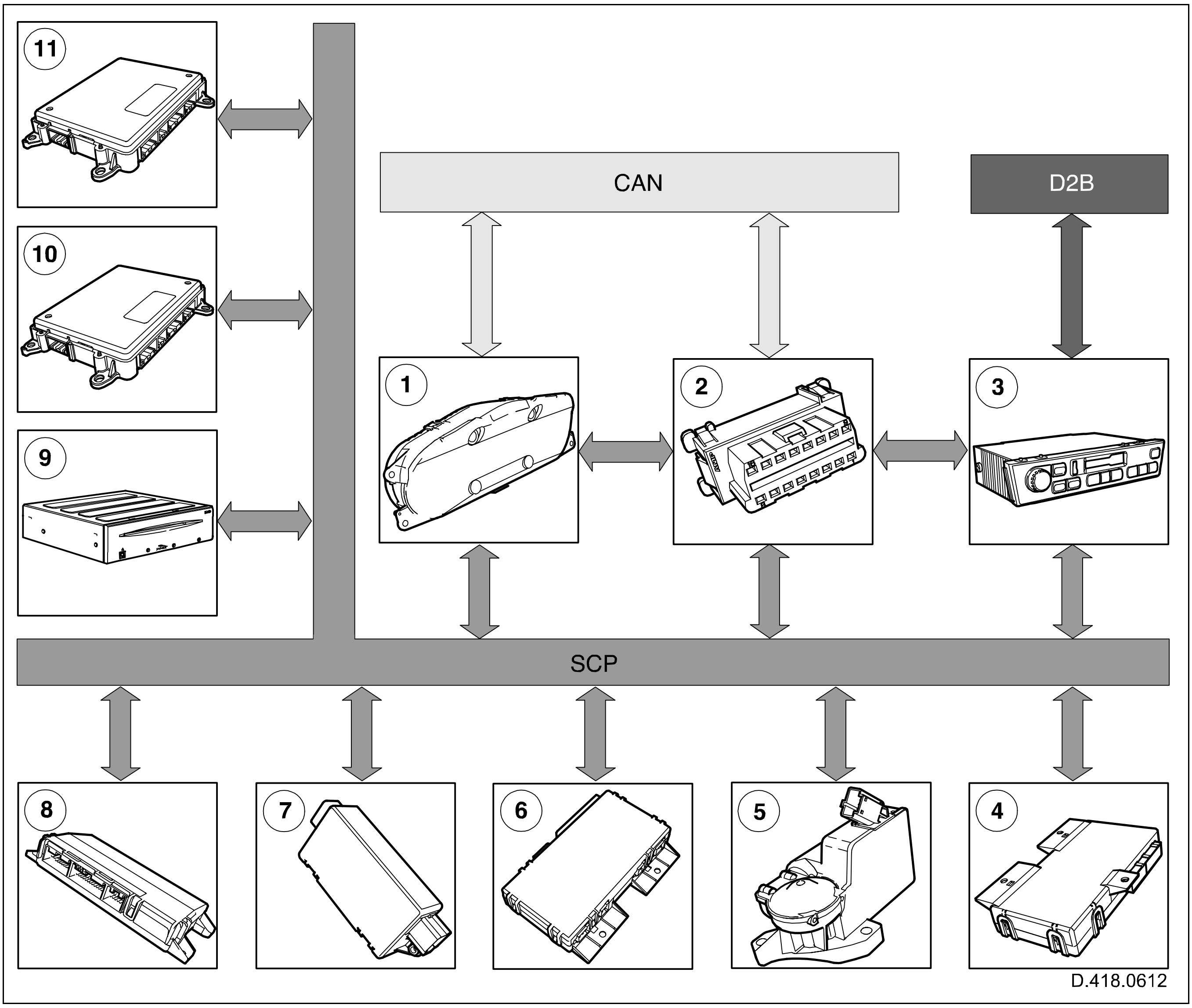

Fig. 122 SCP network

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

Network modules

Fig. 123 shows the main modules and locations; refer to the appropriate section and to **New XJ Range Electrical Guide** for detailed information.

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

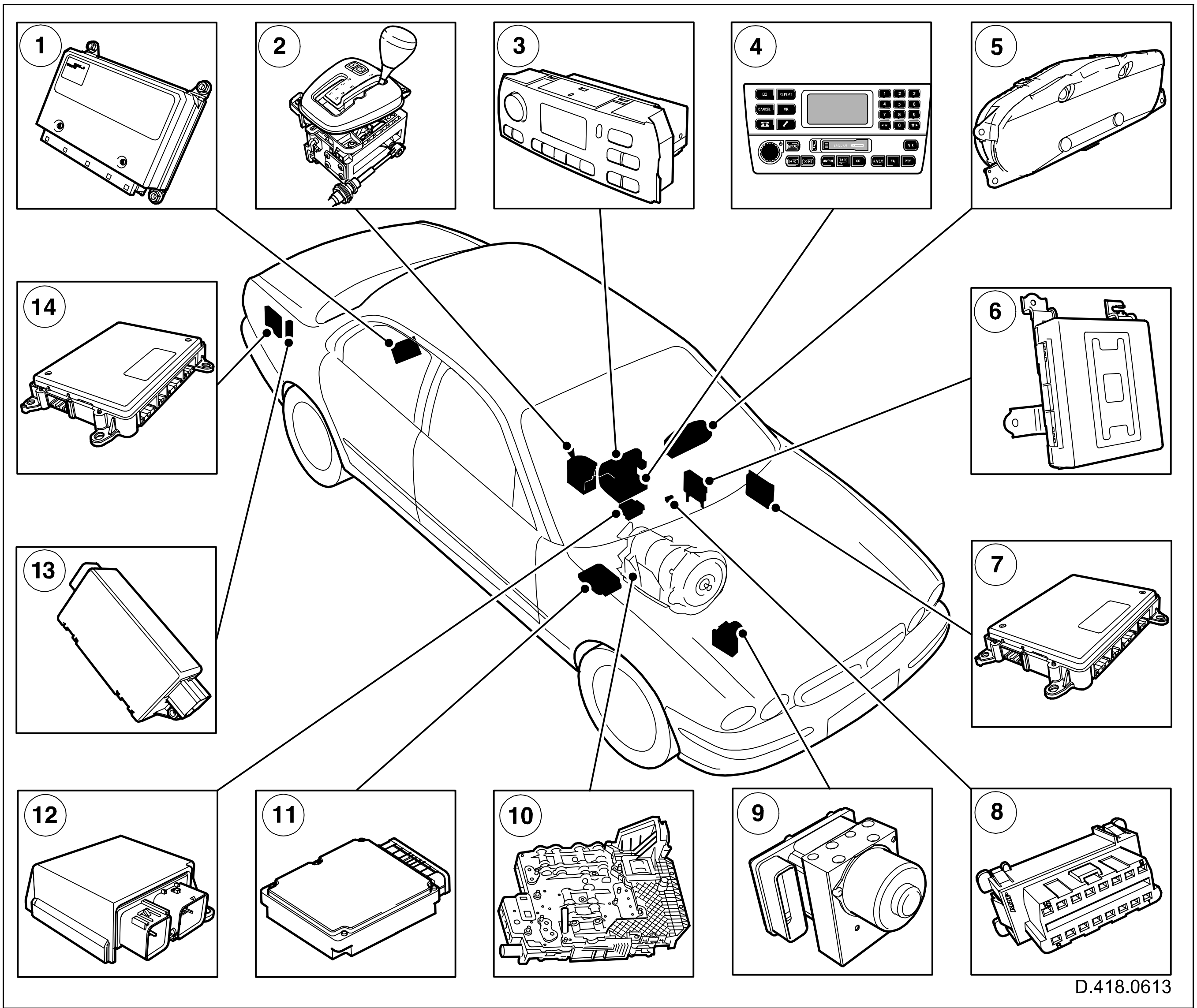

Fig. 123 Location of network modules

1. Air suspension module
2. J-gate module
3. Climate control module (non-telematics)
4. Audio unit (non-telematics)
5. Instrument cluster
6. Remote climate control module (telematics only)
7. Front electronic module
8. Diagnostic connector
9. ABS module
10. Transmission control module (and main control valve body)
11. Engine control module
12. Restraints control module
13. Parking brake module
14. Rear electronic module

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.

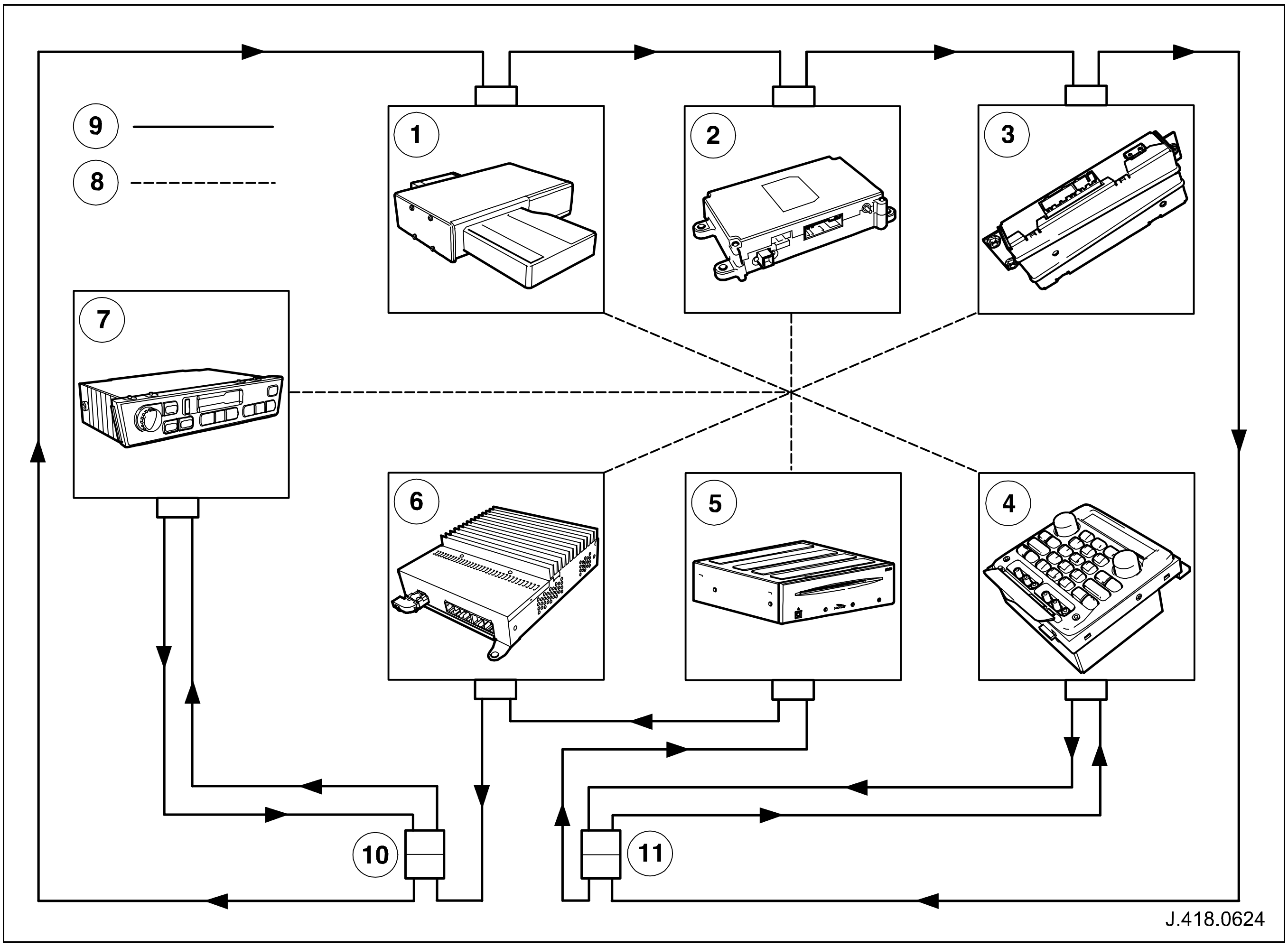

Fig. 124 D2B network

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

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. 124**.

- 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 'I'.
- 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 Connectors

There are two intermediate connectors, one close to the j-gate (providing connection to the audio unit) and one located in the luggage compartment to the left-hand side (item 1, **Fig. 125**) that provides the interconnection point for the slave modules. Vehicles installed with rear multimedia system have two additional intermediate connectors, one close to the passenger entertainment control panel and one located in the luggage compartment to the left-hand side (item 2, **Fig. 125**) that provides the interconnection point for the slave modules.

NOTE: To install slave modules, follow the detailed **accessory fitting instructions** supplied with the modules.

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.

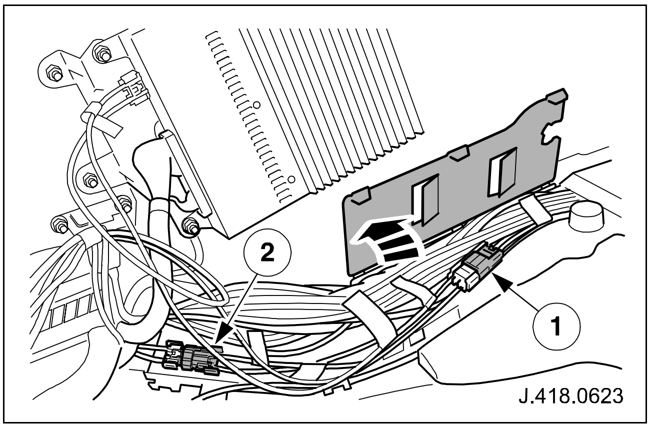

Fig. 125 Slave module intermediate connectors

1. Intermediate connector 1
2. Intermediate connector 2

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 **New XJ Range Electrical Guide** for detailed electrical connection information.

Anti-theft options vary according to market and vehicle specification; typical options include:

- a perimeter alarm system;
- an intrusion sensing system;
- a passive anti-theft system (PATS).

Module Functionality

The anti-theft system incorporates the following modules, which all communicate via the SCP network:

- front electronic module (FEM);
- instrument cluster (IC);
- rear electronic module (REM);
- driver door module (DDM);
- steering column lock module (SCLM).

NOTE: Whenever a new REM or DDM is installed, in order to maintain correct communications between modules, the modules should be re-configured using WDS (follow ID transfer process).

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.

Front Electronic Module

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

The FEM monitors, depending on vehicle specification, the status of the following inputs:

- front passenger-door ajar switch;
- hood ajar switch;
- audio unit (anti-theft sensing line);
- telematics display (anti-theft sensing line);
- master lock switch;
- valet mode switch;
- luggage compartment-lid release switch (internal);
- fuel filler-flap release switch;
- glove compartment switch.

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

- vehicle horns, via the horn relay;
- front turn-signal indicator lamps, pilot lamps, side marker lamps.

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

Rear Electronic Module

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

The REM monitors the status of the following inputs:

- rear passenger door ajar switches;
- luggage compartment-lid ajar switch;
- intrusion sensors;
- inclination sensor;
- luggage compartment-lid release switch (external).

NOTE: The external luggage compartment lid-release cannot be activated unless the correct status is detected for the driver's door unlock latch, valet mode and transmission park.

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

- passive sounder or battery-backed sounder (BBS);
- rear turn-signal indicator lamps, tail lamps, side marker lamps.

The REM has hard-wired, anti-theft sense-inputs from the FEM and the DDM. When commanded to do so by the instrument cluster, the REM also provides the power supply line for the SCLM.

NOTE: In addition to the functionality detailed above, on receipt of a request (from the FEM, via the SCP network), to release the fuel filler-flap the REM also provides an electrical output to drive the fuel filler-flap motor, provided the J-gate is in park.

Instrument Cluster

NOTE: For functions not associated with anti-theft refer to **Instrument Cluster**.

The instrument cluster:

- provides multiplex network gateway functionality for CAN and SCP;
- drives the anti-theft system indicator lamp;
- interfaces with the PATS transceiver coil;
- communicates with the ECM and key transponder (stores PATS key codes).
- interfaces with the electronic steering column lock module (SCLM).

Driver door module

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

The DDM where appropriate, monitors the status of the driver's door:

- unlocked switch;
- locked switch;
- ajar switch.

Except for Japan and Korea, the receiver for the remote transmitter is located in the DDM. Japan and Korea use a remote keyless entry (RKE) receiver, which interfaces to the DDM and is located behind the instrument cluster.

NOTE: The RKE receiver may be susceptible to RF interference in areas that have a high density of radio or mobile phone masts.

Steering column lock module

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 REM provides the power supply line and the FEM 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.

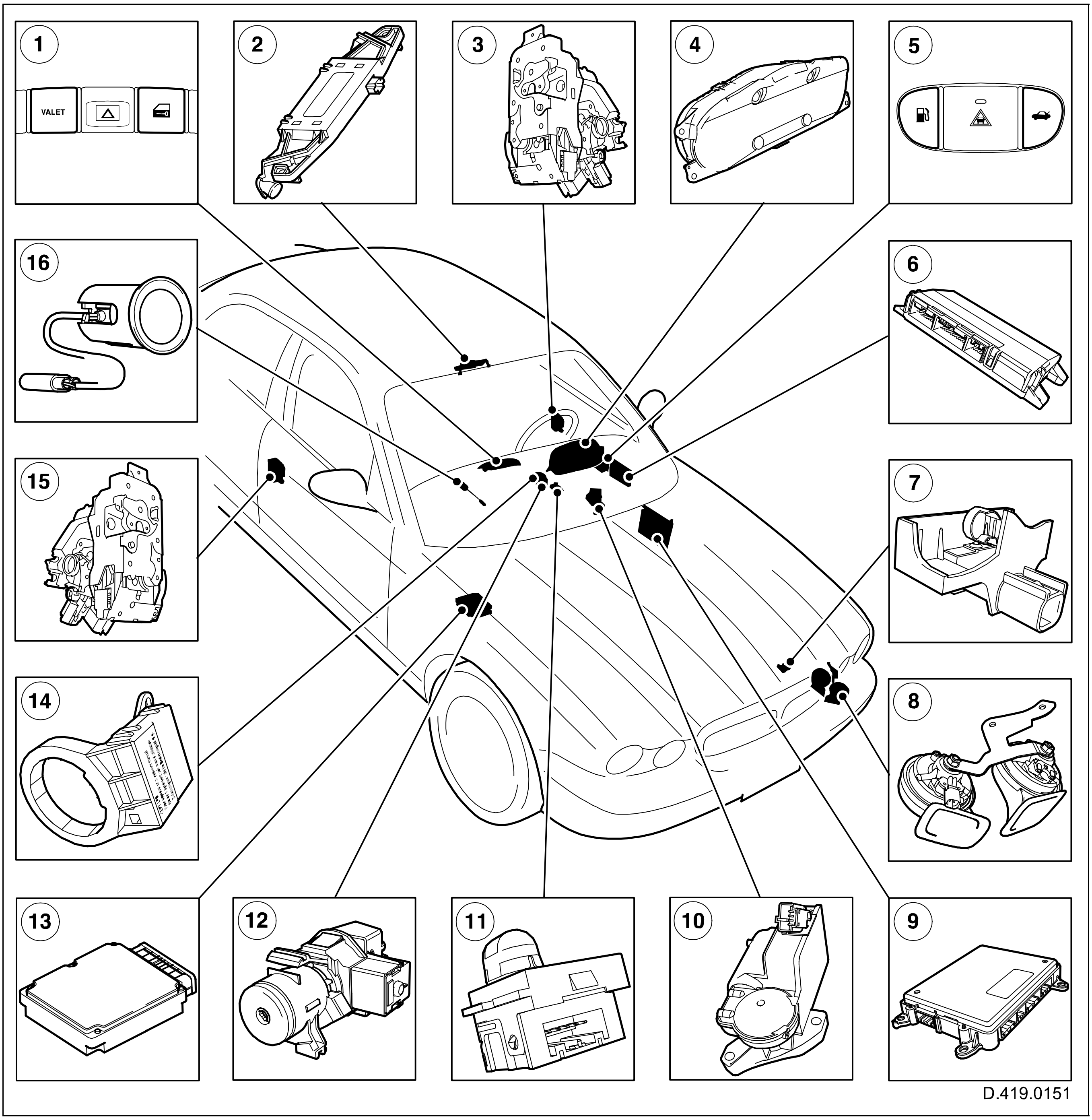

Fig. 126 Anti-theft component locations - front

Key to Fig. 126

1. Valet mode switch and master lock switch
2. Intrusions sensors (where applicable)
3. Driver door ajar switch
4. Instrument cluster
5. Fuel filler-flap release switch and luggage compartment-lid release switch
6. Driver door module
7. Hood ajar switch
8. Horns
9. Front electronic module
10. Steering column lock module (where applicable)
11. Anti-theft system indicator lamp
12. Ignition switch
13. Engine control module
14. Transceiver coil
15. Passenger door ajar switch
16. Glove compartment switch

Although part of the anti-theft system, for clarity of illustration, the following components have not been included:

- Integrated key transmitter.
- Turn signals, pilot, tail and side marker lamps.
- J-gate interlock.
- Driver's door key barrel.
- Remote keyless entry receiver (where applicable).

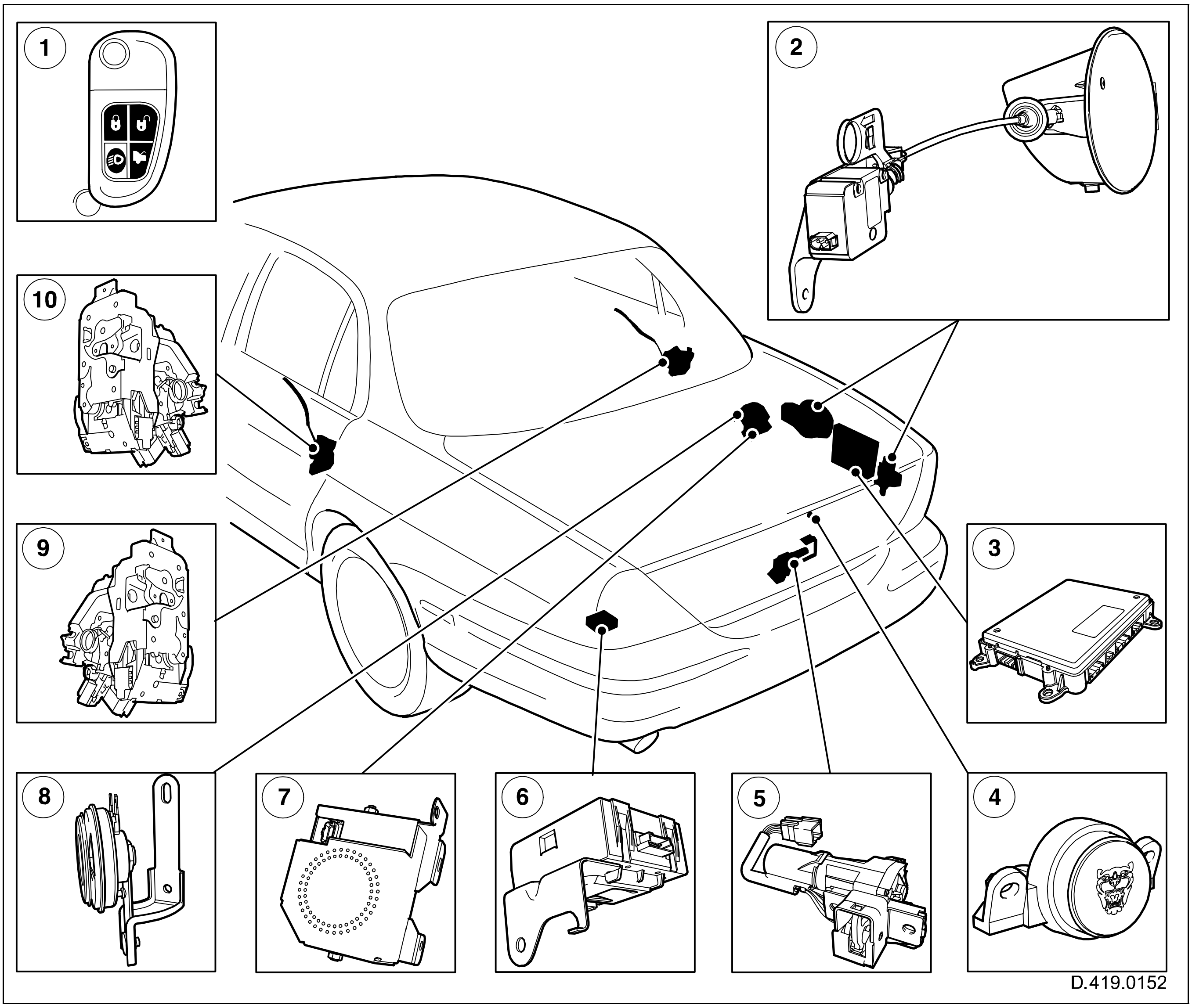

Fig. 127 Anti-theft component locations - rear

1. Integrated key transmitter
2. Fuel filler-flap release assembly
3. Rear electronic module
4. External luggage compartment-lid release switch
5. Luggage compartment lid-ajar switch
6. Inclination sensor (where applicable)
7. Battery-backed sounder (where applicable)
8. Passive sounder (where applicable)
9. RH rear passenger door ajar switch
10. LH rear passenger door ajar switch

System Features

Depending on market specification, the following features may be incorporated as either standard or dealer installed options:

Passive anti-theft system

- Encrypted instrument cluster/engine control module immobilization system, controlled by the ignition key transceiver/transponder.

Vehicle and passenger compartment security

- Key barrel on the driver's side only.
- 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 Japan or NAS vehicles).
- Central locking by key, remote transmitter and interior handle.
- Auto-relocking (dealer programmable).
- Drive-away locking (standard, except Japan).
- Two-stage unlocking (certain markets).
- Steering column lock (certain markets).
- Passive arming (dealer programmable).
- Ignition key-barrel interlock (mechanical or electrical depending on market).
- J-gate interlock.

Master lock functionality

The master lock switch can be used to:

- centrally lock or unlock the vehicle; this feature can also be controlled by the remote transmitter (where applicable) or from the driver's door key barrel;
- initiate global closing or global opening of windows or roof opening panel;
- disable the intrusion sensing and inclination sensing (where applicable).

NOTE: To avoid false alarms when transporting the vehicle particularly by ferry in severe weather conditions, the intrusion sensing and inclination sensing can be disabled for one arm-cycle.

Provided all windows are fully closed and the ignition key is at position '0' or removed from the ignition, the sensors can be disabled by pressing the master lock switch. The anti-theft system indicator lamp will flash five times to confirm the sensors are disabled.

Compartment security

- Electrically secured glove compartment.
- Electrically secured fuel filler-flap.
- Internal luggage compartment-lid release.
- External luggage compartment-lid release.
- Valet mode.

The glove and luggage compartments are secured by remote locking, driver's key barrel locking or by selecting valet mode. Selection of valet mode is confirmed by an audible warning or if the ignition key is at position 'II', the instrument cluster will display a status message. Once valet mode has been selected, a valet chime (or message, depending on the status of the ignition) will confirm that access is denied when any of the following buttons are pressed:

- valet mode;
- glove compartment;
- external luggage compartment-lid release;
- internal luggage compartment-lid release.

The valet mode can only be cancelled by using the:

- remote unlock;
- integrated key or the black-headed key to directly open the luggage compartment.

NOTE: Opening the luggage compartment using the release button on the integrated key transmitter does not cancel the valet mode.

Sensing and indication

- Anti-theft system indicator lamp - indicates system is armed and PATS fault codes.
- Perimeter sensing for doors, hood and luggage compartment lid.
- Removal sensing for audio unit and telematics display (where applicable).
- Intrusion sensing (where applicable).
- Inclination sensing (dealer installation).
- Separate anti-theft horn or battery backed sounder (market dependent).

Remote control features

- Panic alarm - remote transmitter operated (standard for NAS markets, otherwise dealer programmable).
- Remote two-stage toggle (standard worldwide, except Japan).

Definition of terms

- Double-locking - the vehicle cannot be unlocked via the interior door handles.
- Drive-away locking - the doors will lock automatically when the gearshift lever is moved for one second or more, from position 'P' or 'N' into position 'D' or 'R'.
- Auto-relocking - provided the anti-theft feature is enabled and the vehicle has previously been locked and armed, after unlocking the vehicle using the integrated key transmitter, the doors will automatically lock and the system re-arm after 45 seconds providing the:
  - hood, trunk lid or any door, has not been opened;
  - ignition key has not been inserted into the ignition key barrel;
  - key barrel unlock or lock operation has not occurred.

- Two-stage unlocking can be achieved by using either the integrated key transmitter or the key in the barrel lock:
  - the first-stage unlock operation, unlocks only the driver's door;
  - the second-stage unlock operation, unlocks the remaining doors.
- Remote two-stage toggle - allows the vehicle owner to switch the unlocking preference between 'central unlocking' and 'two-stage unlocking'.
  - Simultaneously pressing for 4 seconds, the lock and unlock buttons on the integrated key transmitter, toggles locking from the current condition to the alternative condition. Each repetition of the operation will revert locking to the former condition.

  NOTE: Two-stage unlocking can also be activated or deactivated after accessing the 'vehicle settings' from the 'system setup' menu using the telematics screen (where applicable).

System Arming And Disarming

NOTE: The following details are market dependent.

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

- Pressing the 'lock' button on the integrated key transmitter once, or locking the driver's door with the key, activates the perimeter sensing.
- Pressing the 'lock' button on the integrated key transmitter twice, or completing the driver's door unlock and lock operation with the key, within 3 seconds (where applicable):
  - activates the perimeter and intrusion sensing;
  - activates the inclination sensor;
  - invokes double-locking.

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

Once the pre-arm phase (20 seconds after locking) has passed (or double-locking action occurs) and provided no closures 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 integrated key transmitter).
- Turning an invalid PATS ignition key to position 'II'.
- Movement inside the vehicle (providing intrusion sensors are installed and the vehicle is double locked).
- Excessive movement of vehicle (providing inclination sensor is installed and the vehicle is double locked).
- Removal of modules, including audio unit or telematics display.
- Disconnection of the battery-backed sounder.

NOTE: Disconnection or interruption of the battery supply also activates the battery-backed sounder (where applicable).

When the alarm is activated, a visual warning is provided by the turn signals and an audible warning by the vehicle horns. Where installed, the passive sounder or battery-backed sounder, provide an additional audible warning.

NOTE: In some markets, pilot, side and tail lamps provide additional or alternative visual indication.

The anti-theft system can be disarmed by unlocking the driver's door lock (not European or Middle East vehicles), pressing the unlock button on the integrated key transmitter, or inserting and turning a valid ignition key to position 'II'.

Locking Error Codes

Error codes are standard for all vehicles with an anti-theft system installed. The error codes, in the form of tones (two chirps) or flashes (five flashes of the turn signals) are evident when an attempt is made to lock the vehicle using the integrated key transmitter or using the key in the driver's door lock in the following circumstances:

- a door is ajar;
- the luggage compartment lid is ajar;
- the hood is ajar;
- a key is in the ignition.

NOTE: If door key operation occurs (and the key is not in the ignition), the arming sequence will be completed, followed by the error codes. Should the key be in the ignition, the arming sequence will fail and an error code will be transmitted.

Failure of an intrusion sensor or inclination sensor (where applicable) is confirmed when unlocking after double lock, by error tones (two chirps) or flashes (six flashes of the turn signals).

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 **In-vehicle Entertainment Systems**.
- Cellular phone; refer to **Cellular Phone**.
- Television (optional); refer to **Video System**.
- Voice training modes (optional): refer to **Voice Activated Control System**.

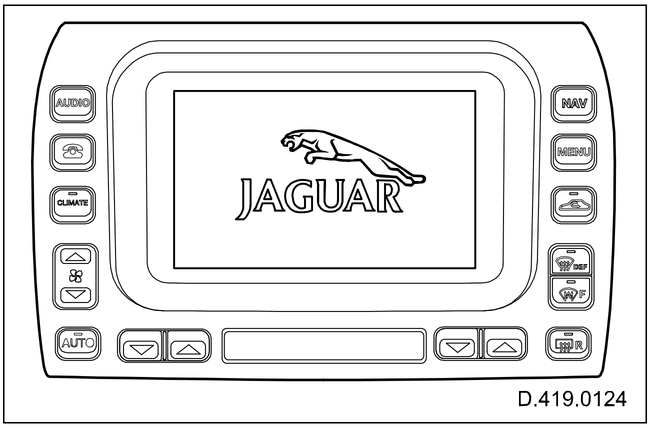

Fig. 128 Telematics display module

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.

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	TV
System Setup	Rear Multimedia	
Screen Off	Logo Screen	

Table 6 Menu text displayed

SYSTEM SETUP	**Cancel**
Vehicle Settings	
User Settings	

Table 7 System setup text displayed

USER SETTINGS			
Audible Feedback	All	Touch Screen	None
Language	Flag Change		
Navigation units	Metric	Imperial	
			OK

Table 8 User settings displayed

Voice Activated Control System

NOTE: The system will not operate until the audio unit security code has been entered.

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.
- Television (where installed) and teletext (where available).
- Navigation.

NOTE: The navigation ‘Caution Screen’ must be cleared after every ignition cycle, before the navigation system will respond to any voice commands issued.

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 module (VAM), located in the luggage compartment to the left-hand side and mounted to the stack-bracket that is shared with the multimedia modules.
- Microphone, shared with the phone and located in the overhead 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 VAM 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: VAM is part of the optical network; refer to **D2B network**.

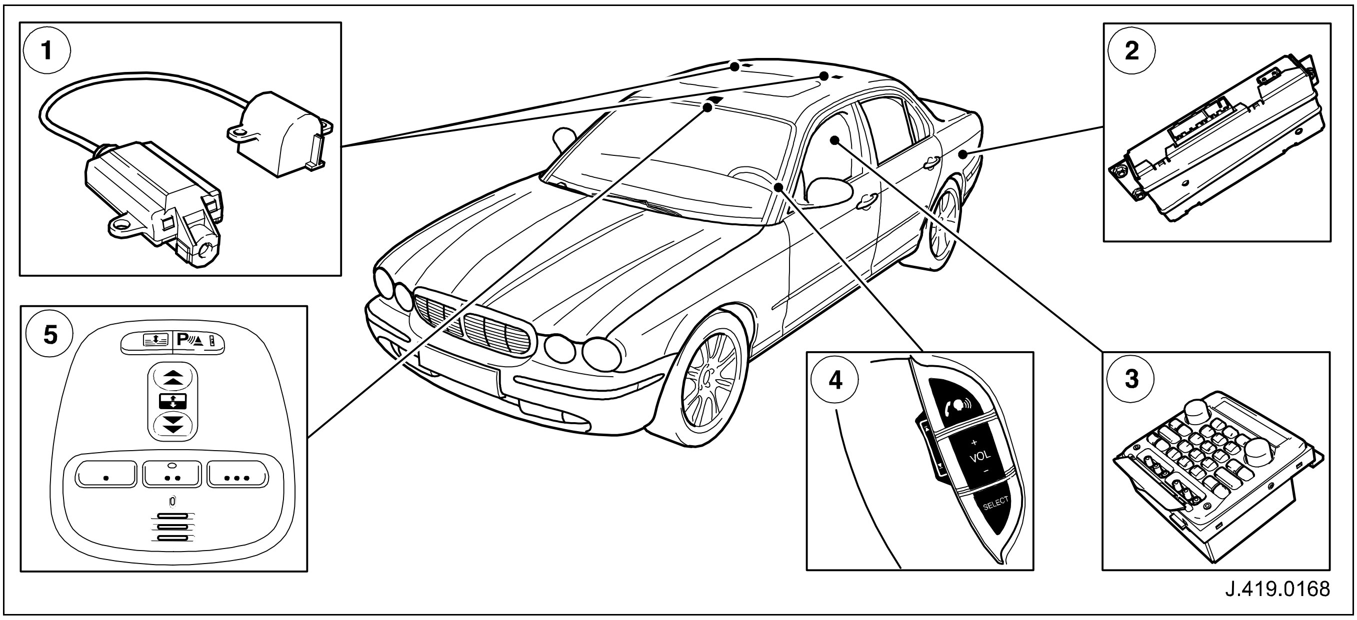

Fig. 129 Voice-activated control - component locations

1. Rear microphone
2. Voice activation module
3. Passenger entertainment control panel
4. Push-to-talk button
5. Front microphone

Provided the multi-zone voice option is installed, voice activated control for most functions may be achieved by rear seat passengers:

- Two microphones are located in the headliner, one above each of the rear passenger seat positions.
- Voice activation can be initialized by pressing one of the 'TALK' buttons on the passenger entertainment control panel.
- For a voice command to be successful, the rear multimedia system must be in the mode that will direct audio to the device selected: 'LEFT' headset, 'CABIN' speakers or 'RIGHT' headset.
- Selection of the mode is confirmed by the illumination of the tell-tale LED on the corresponding button.

NOTE: To allow a voice command to be issued, currently active audio will be temporarily muted.

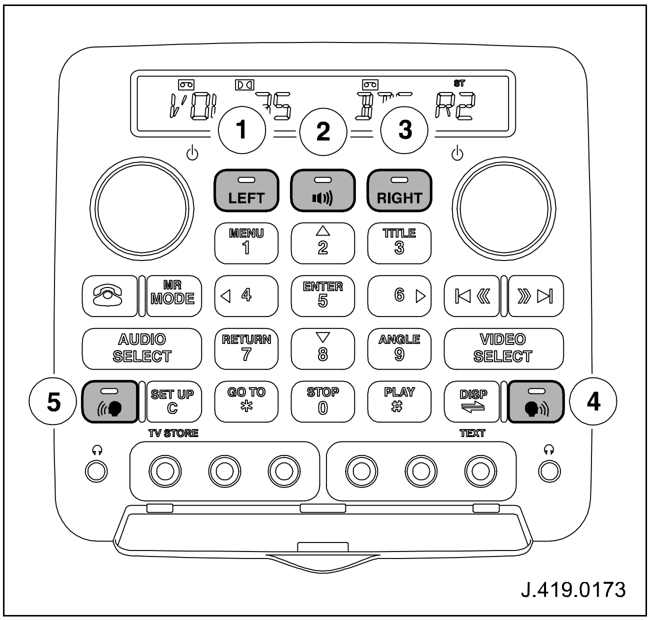

Fig. 130 Rear voice activation - control buttons

1. LEFT headset select
2. CABIN speakers select
3. RIGHT headset select
4. Right TALK select
5. Left TALK select

Navigation System

The navigation system comprises:

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

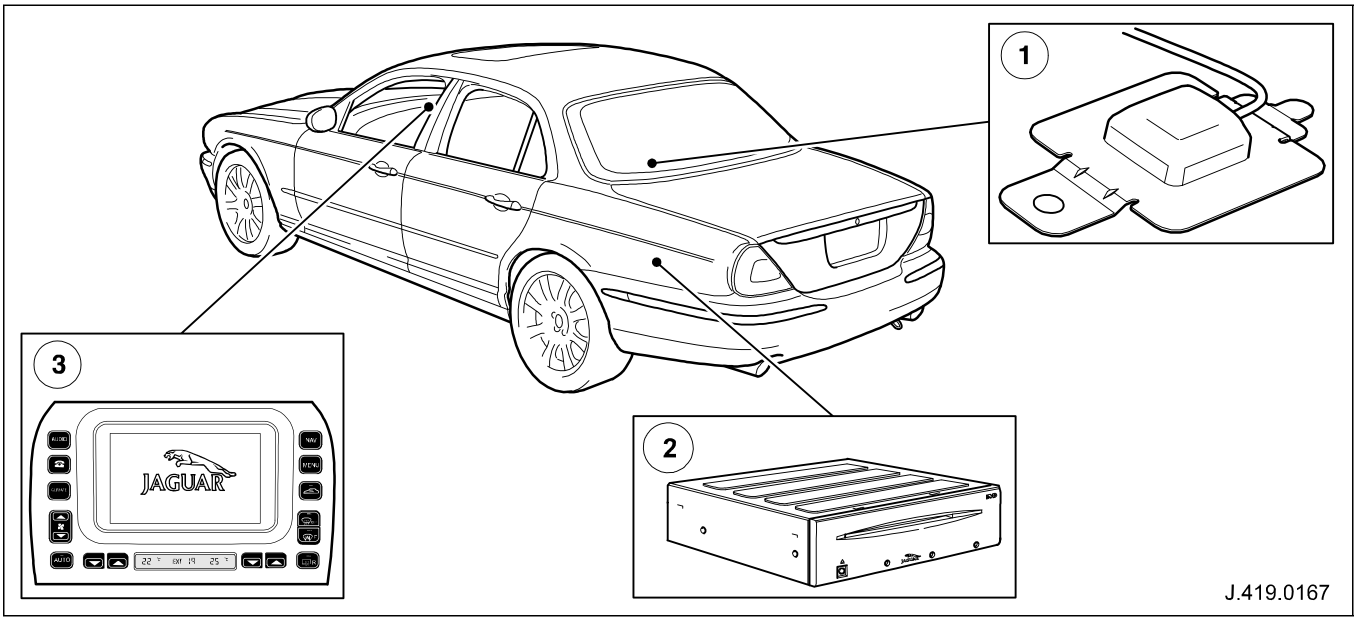

Fig. 131 Navigation system component location

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) other multimedia modules.

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 disc.
- Diagnostic software.

NOTE: Japan uses a different NCM that incorporates a Japanese voice activation module (VAM). 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 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.

Cellular Phone

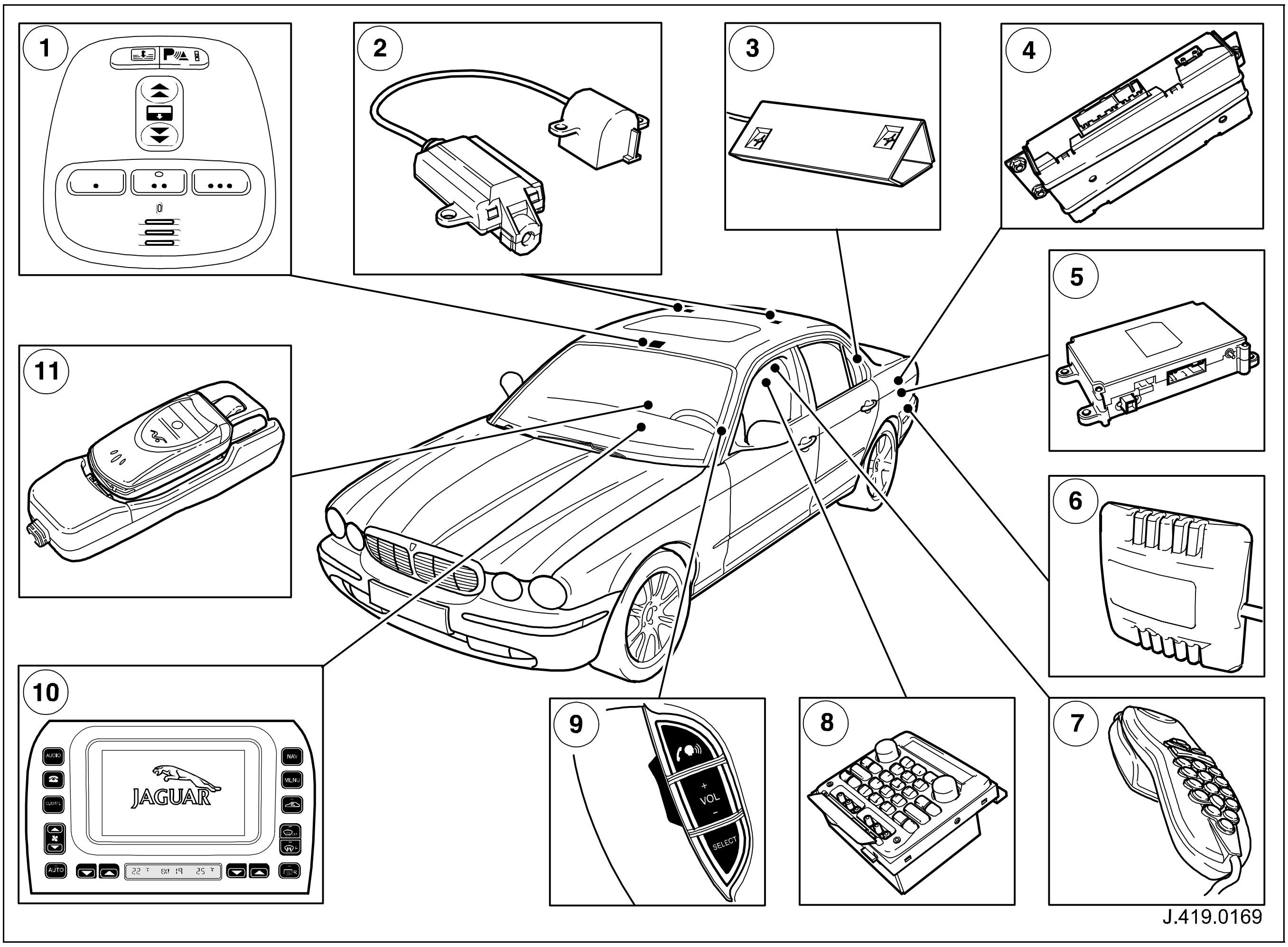

Fig. 132 Cellular phone system component location

1. Front microphone (option)
2. Rear microphone (option)
3. Cellular phone antenna (NAS)
4. Voice activation module (option)
5. Cellular phone control module
6. Cellular phone antenna (GSM)
7. Cellular phone handset and cradle (GSM)
8. Passenger entertainment control panel (option)
9. Steering wheel telematics controls
10. Telematics display module (option)
11. Cellular phone handset (NAS)

The cellular phone system is market dependent and comprises the following:

- Cellular phone control module.
- Cellular phone antenna.
- Cellular phone handset and cradle.
- Steering wheel telematics controls.
- Remote keypad.

NOTE: The remote keypad for the cellular phone is dependent on the vehicle specification; it is selectable from the telematics display module (where installed) or integral to the audio unit (non-telematics version); refer to **Audio Unit** for details.

Hands-free operation of the phone is possible by the addition of a microphone (part of the overhead console) and the voice activation module (VAM); refer to **Voice Activated Control System**.

Cellular Phone Control Module

The CPCM is market dependent and:

- located in the luggage compartment to the left-hand side;
- fixed to a bracket which also supports (where applicable) other multimedia modules;
- has one electrical connector, one optical connector;
- has one antenna connector (GSM only).

NOTE: The NAS antenna connects directly to the hang-up cup.

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 hands-free calls.
- Increase or decrease volume.
- Selection of phone ready mode.
- Cycle through phone memory.

Rear Cellular Phone

The rear cellular phone facility is a dealer-installed option, subject to market and vehicle specification.

- Vehicles installed with twin rear seats and rear floor console have the phone fitted to the rear console lid.
- Vehicles installed with the fold-down armrest have the phone installed within the armrest.

To facilitate conference calls, hands-free operation of the phone is possible by the addition of multizone voice option, which comprises two microphones (located in the headliner, one above each of the rear passenger seat positions), the voice activation module (VAM); refer to **Voice Activated Control System** and the passenger entertainment control panel; refer to **Rear Multimedia System**.

The appropriate microphone is selected by pressing the left or right-hand 'TALK' button on the passenger entertainment control panel during a call. The active microphone is indicated by the illumination of the tell-tale LED in the 'TALK' button.

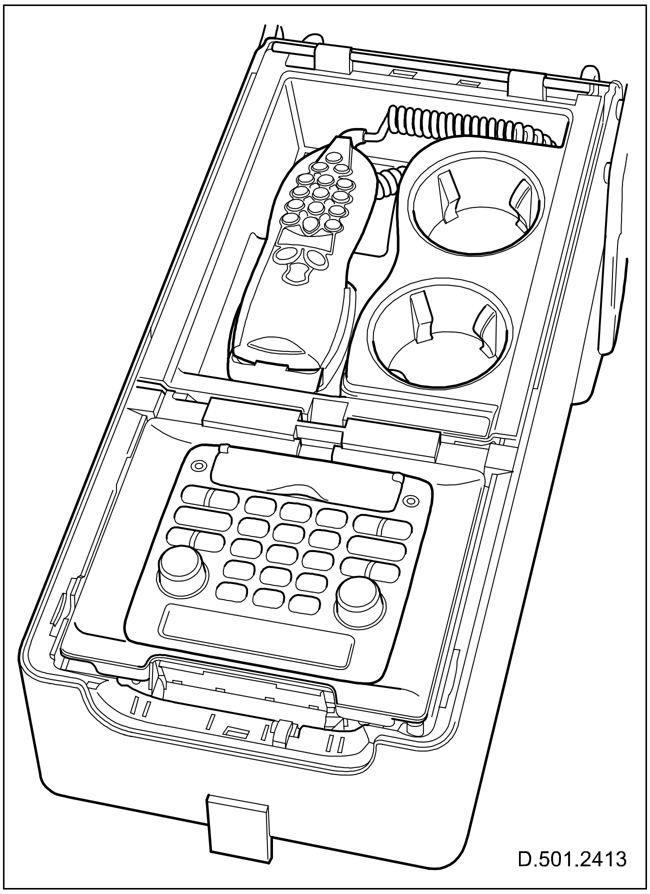

Fig. 133 Rear armrest (without covers)

Multifunction Electronic Control Modules

Front Electronic Module

The front electronic module (FEM) is located at the base of the left-hand side A-post.

There are five electrical connectors each with unique keyways.

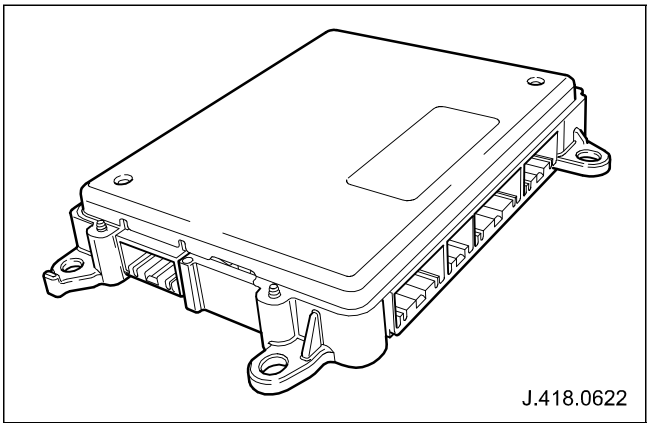

Fig. 134 Front electronic module

The FEM 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.
- Turn signals and hazard warning lamps.
- Daytime running lamps.
- Battery saver (interior lights).
- Adjustable pedals.
- Fluid and pressure metrics (low washer fluid, low oil pressure).
- Memory functions.
- Front heated seats.
- Security; refer to **Anti-Theft**.

Rear Electronic Module

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

The REM 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.
- Rear heated seats.
- Luggage compartment lid release.
- Trailer functionality.
- Electrochromic mirror operation (reverse).
- Security; refer to **Anti-Theft**.

Driver Door Module

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

The DDM 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; refer to **Anti-Theft**.
- Three personality configurations linked to the memory feature.
- Power windows.
- Driver mirror.
- Exterior mirror movement
- Power locks/automatic door locks
- Easy entry/exit
- Horn chirp

Body Construction

The body is a monocoque structure, designed from aluminum to provide the following benefits:

- Reduce the weight of the vehicle bodyshell by approximately 40%.
- Improve fuel economy and vehicle performance.
- Provide enhanced corrosion protection.

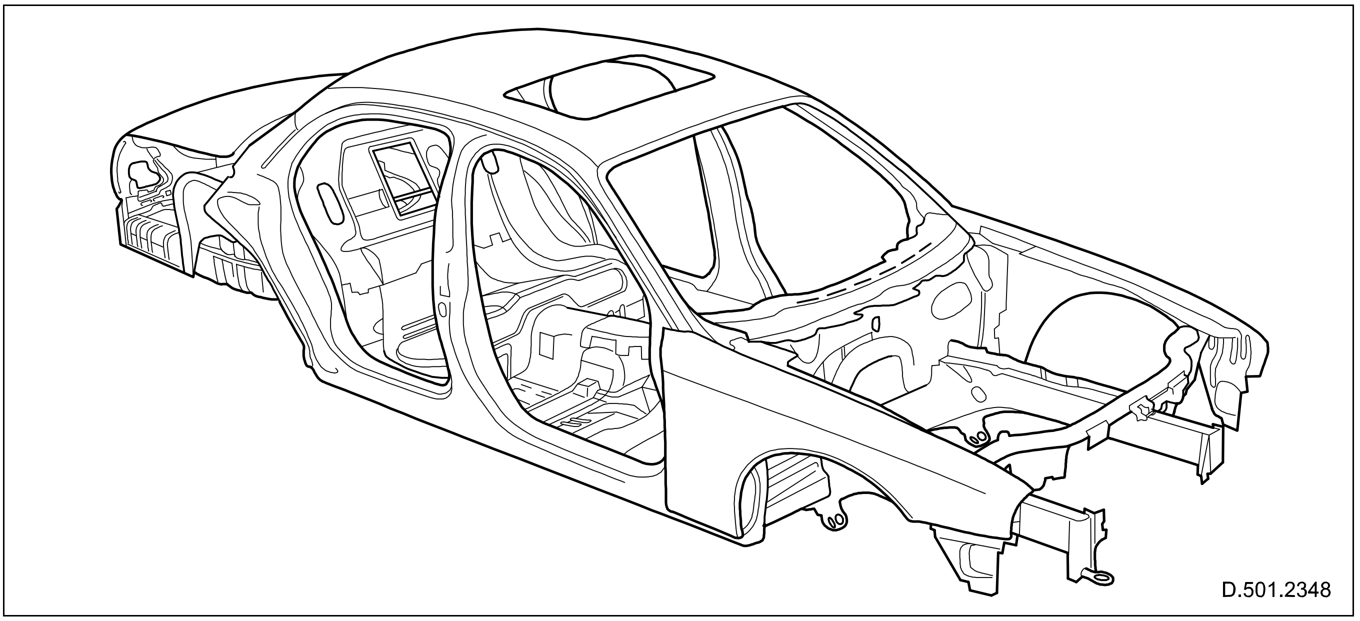

Fig. 135 Body shell

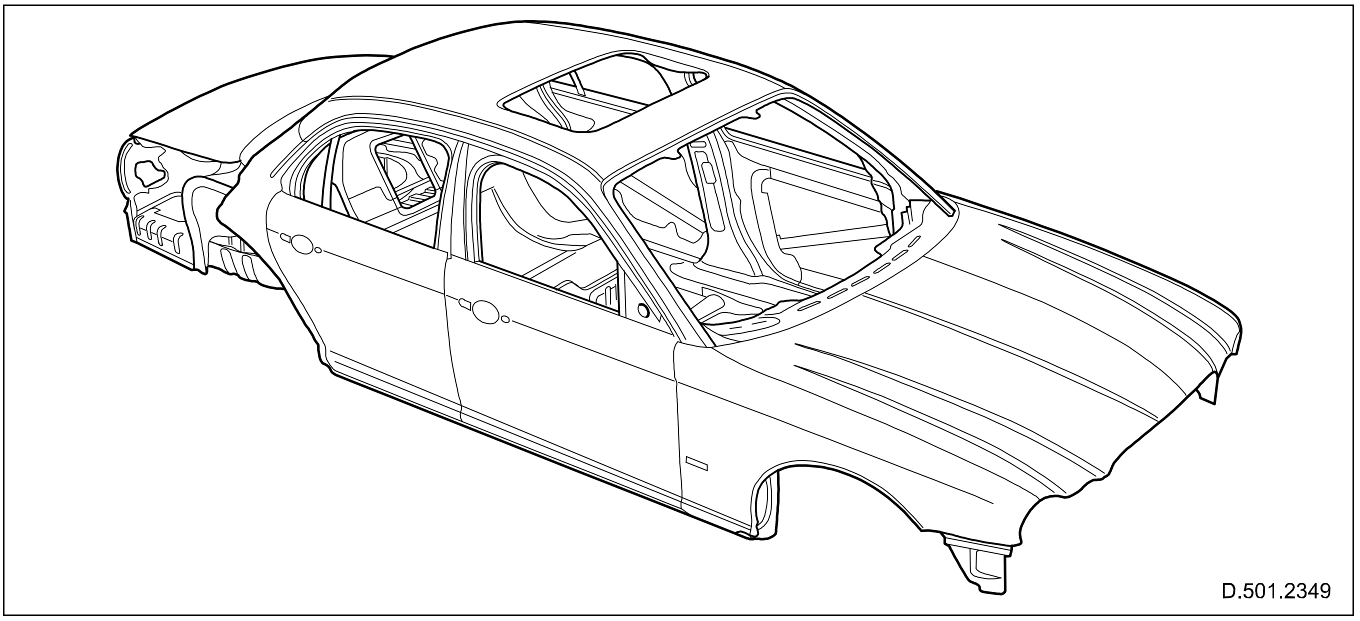

Fig. 136 Body shell with closures

Body Repair Technology

Repairs to aluminum requires different tools and techniques to those used for steel. Repairs should only be undertaken by trained Body and Paint Repair technicians; refer to **New XJ Range Body and Paint Repair Supplement** for detailed information.

Aluminum

Background Facts

- The most abundant metallic element and the third most abundant element in the Earth's crust (only oxygen and silicon are present in larger quantities).
- Discovered and named in 1808 by British scientist, Sir Humphry Davy.
- First isolated as a metal by Danish scientist, Hans Christian Oersted in 1925.
- Naturally exists in very stable combinations with other materials and is therefore not readily accessible.
- Most commonly produced from bauxite ore using the Bayer Process which refines the ore into alumina (aluminum oxide). The final part of the process produces primary aluminum using electrolysis (Hall-Heroult Process).
- More aluminum is now produced than the combined total of all other non-ferrous metals.

Alloying Elements

Aluminum is not used in its purest form, it is alloyed with other elements to enhance its properties. Selected quantities of certain alloys (copper, manganese, silicon, magnesium, zinc, lithium and others) are added to produce the required physical properties or characteristics.

Products

There are three broad classes of aluminum products:

- Ingots
  - cast from furnaces and the source material from which both wrought products and castings are manufactured.
- Wrought products
  - extrusions, tube, rod, plate and foil are mechanically deformed during production to suit defined uses.
- Castings
  - allows the production of shapes in which mechanical properties are determined by alloying elements and thermal treatments after casting.

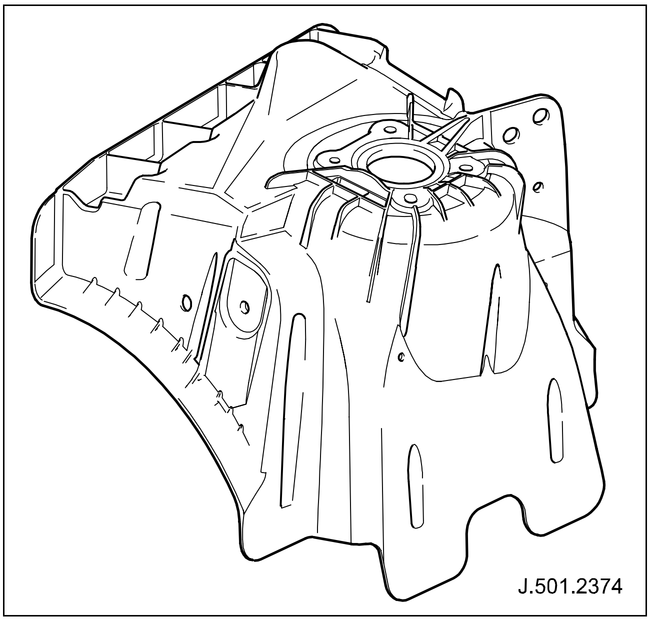

Fig. 137 Typical casting (448 alloy)

The aluminum industry uses a standardized numbering system to distinguish one alloy from another: wrought alloys are designated a four-digit number; cast alloys are designated a three-digit number. The first digit is used to represent the principal alloy, for example: 5 for magnesium; 6 for magnesium and silicon.

Properties and Characteristics

- Silver/grey in appearance.
- Light - one third of the mass of mild steel.
- Strong - double the strength-to-weight ratio of steel.
- Corrosion resistant; refer to **Corrosion**.
- Good thermal conductor.
- Good electrical conductor.

Corrosion

Under normal environmental conditions, aluminum is protected by an oxide-layer that forms and naturally inhibits the onset of corrosion.

NOTE: Under certain circumstances the oxide-layer can break down and rapid corrosion can result due to the chemically reactive nature of aluminum alloys.

The two principle types of corrosion are crevice and galvanic:

- Crevice corrosion occurs in environments where atmospheric oxygen is excluded and an electrolyte, such as salt water, is present.

NOTE: Such conditions could occur where road debris and mud is allowed to accumulate.

- Galvanic corrosion occurs when aluminum is placed in direct contact with a more noble metal or carbon in the presence of an electrolyte.

NOTE: A moist environment can act as an electrolyte.

CAUTION:

- **Avoid using components that could damage the paint system, such as, self-tapping screws, spring-steel clips or paint-clearing screws.**
- **To ensure anti-corrosion integrity is maintained, use only genuine Jaguar fasteners; refer to JTIS.**
- **Always reinstate the paintwork to its condition prior to commencing the repair; refer to New XJ Range Body and Paint Repair Supplement for detailed information.**

Material Incompatibility

Materials that are incompatible with aluminum include:

- All copper alloys (brasses, aluminum and silicon bronzes, cupro-nickels and gun metals such as phosphor and tin bronzes).

NOTE: Copper and its alloys should not be used unless suitably coated or isolated.

- Noble metals such as gold, silver and its alloys (including some hard solders), platinum and rhodium. These metals should not be placed in contact with aluminum even with an intervening paint layer.

NOTE: A noble metal is defined as one that resists chemical action, does not corrode or tarnish in air or water, and is not easily attacked by acids.

Materials containing carbon black should not be used, examples include certain rubber compounds and some black (paint) finishes. Similarly, plastics and composites containing carbon (graphite) fibers should not be used in direct contact with aluminum.

Material Compatibility

Materials that are generally compatible with aluminum include: all plastics, magnesium, zinc and suitably protected steel.

NOTE: Suitable protection for steel includes organic finishes such as electrocoat and powder coat. Sacrificial coatings such as passivated zinc, zinc alloy platings and proprietary 'organic' finishes are all generally suitable.

Stainless steel is generally compatible with aluminum although under certain conditions the protective oxide films on both metals could break down resulting in rapid galvanic corrosion. Anodically protected steel such as zinc coating is generally preferable.

Benefits

The high-strength and low-weight characteristics of aluminum, potentially lead to benefits in the following areas:

Weight

Vehicle sizes can be maintained while reducing overall weight.

Fuel

The reduction in weight leads to improved fuel economy and therefore reduced vehicle exhaust emissions.

Recycling

Recycling is readily achieved and provides significant environmental benefits. Recycling requires far less energy and produces far less emissions when compared with the primary production of aluminum.

Jaguar Usage

- Outer-surface panels including closures, roof and fenders are manufactured from 6111 alloy, which gains its property of high dent resistance whilst going through the electrocoating and paint-bake cycles.
- The chassis and support structure is constructed using various gauges of 5754 alloy. 5754 has a low magnesium content (less than a nominal 3%) which produces a combination of long-term stability, good formability and strength to provide good crash performance.
- Cast elements of the body allow strong, accurate, lightweight construction for areas like the suspension mounting points but are not considered repairable.
- High strength and rigid joints are achieved using a combination of adhesive and self-piercing rivets.

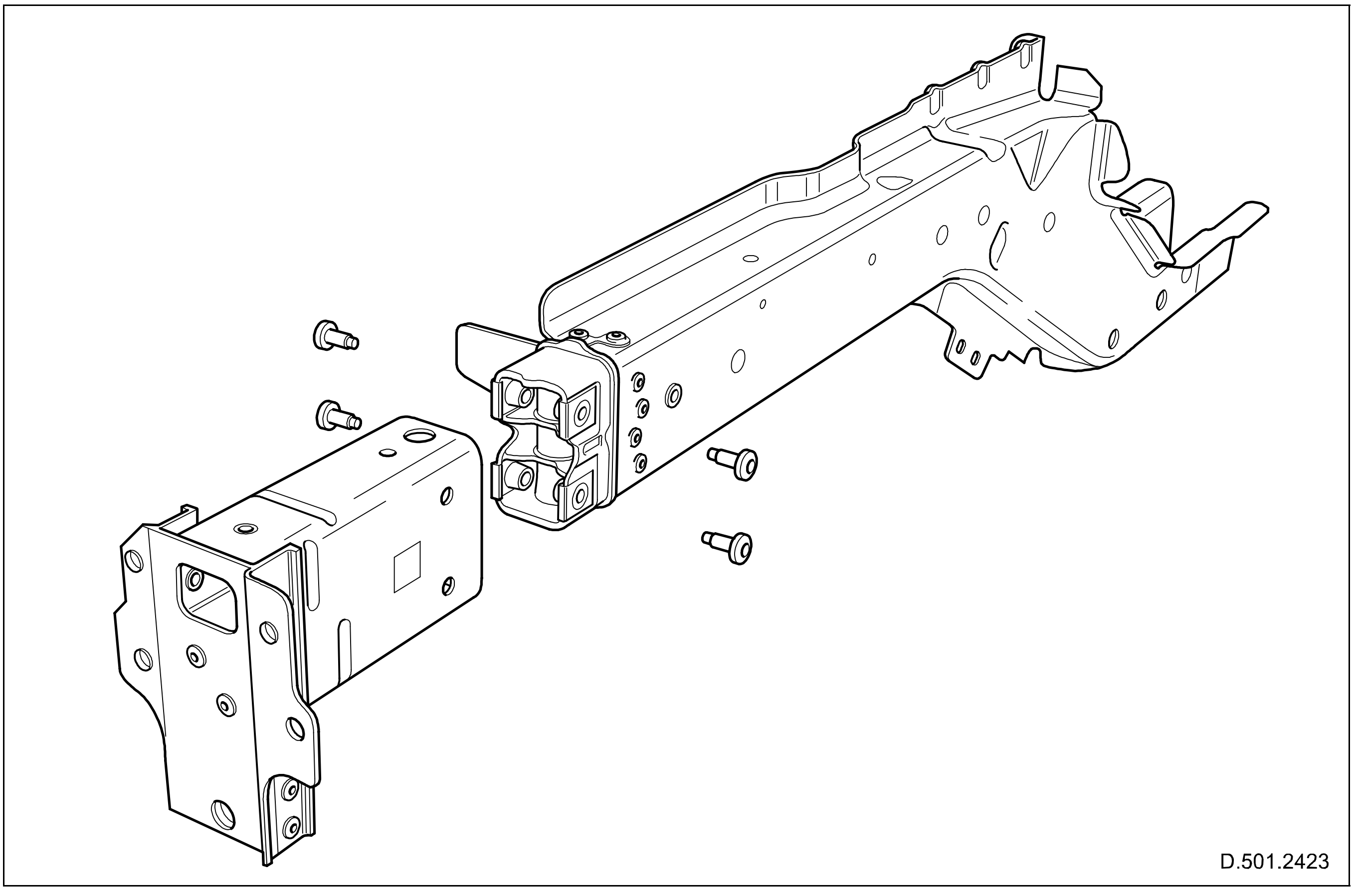

Fig. 138 Bolt-on crush-can

Secondary Bulkhead

A secondary bulkhead, which is attached to the main bulkhead, has been introduced to reduce noise and eliminate fume ingress into the passenger compartment.

NOTE: To simplify access for service, two panels on the driver's side of the secondary bulkhead are removable; refer to **JTIS**.

The pollen-filter intake-bucket, located on the passenger side of all vehicles, performs a similar function to the secondary bulkhead. The bucket has improved water-management capabilities, to minimize moisture around the engine control module (ECM) connector, which is located directly underneath.

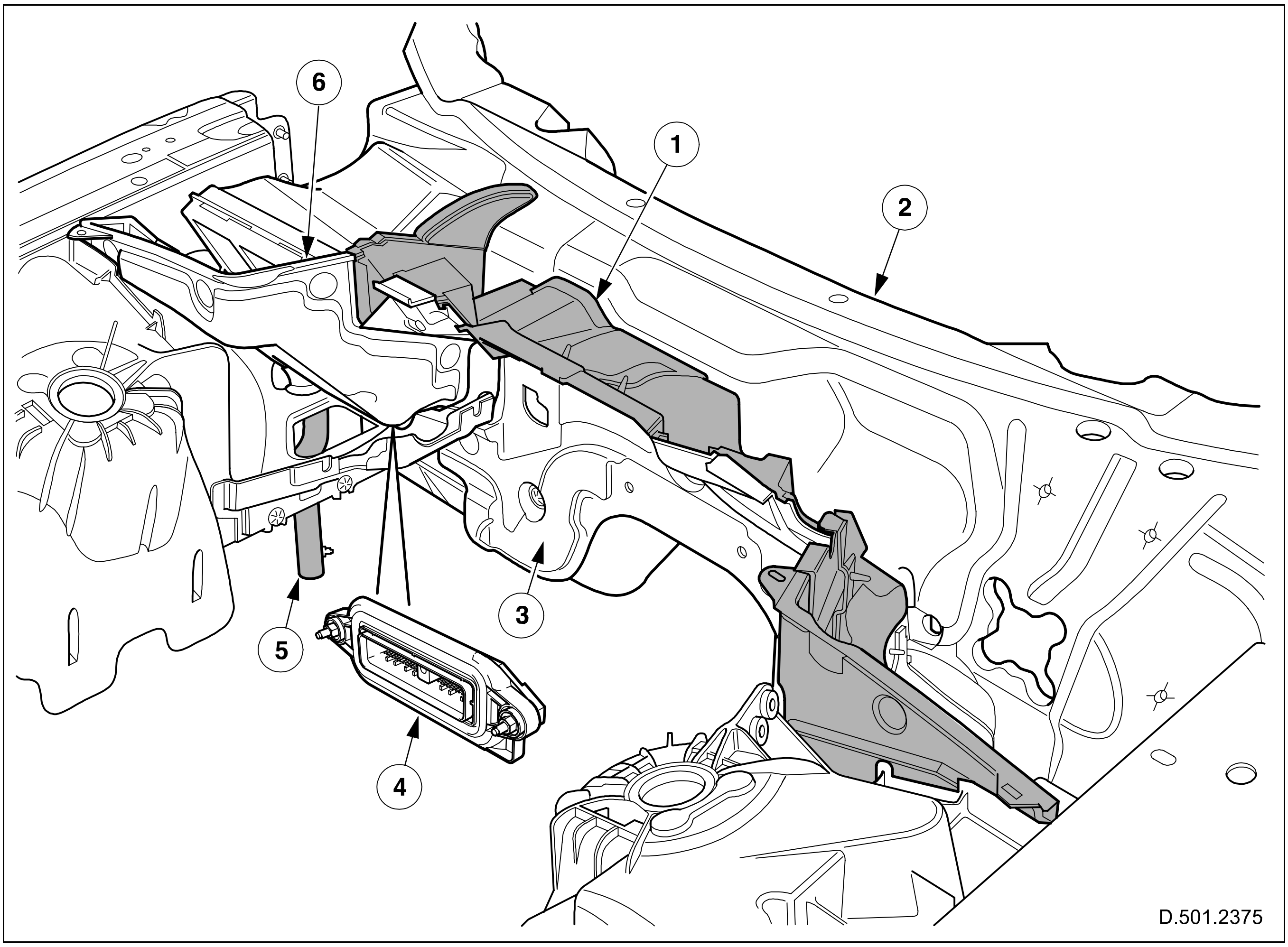

Fig. 139 Secondary bulkhead location

1. Secondary bulkhead
2. Bulkhead
3. Sound proofing
4. ECM electrical connector
5. Drain tube
6. Air intake bucket

Seats

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 an occupant weight-sensing system. In both instances the components form an integral part of the occupant safety system; refer to **Occupant Safety, Occupancy and Position Sensing**.

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

Driver Seat

Depending on specification, the vehicle may be installed with heated cushions and backrest. In addition to the standard electrical seat functionality, the following features may also be adjusted electrically:

- Head restraint.
- Extendible seat cushion.
- Lumbar support.

Driver seat module

The driver seat module (DSM) is located under the driver seat. In addition to supporting standard seat functionality the module also supports the electrically-adjustable head restraint and extendible seat-cushion; refer to **New XJ Range Electrical Guide** for detailed connection information.

Up to three personality configurations in relation to seat positions, are possible using the seat memory switch. The positions are stored and retrieved from the driver door module (DDM).

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

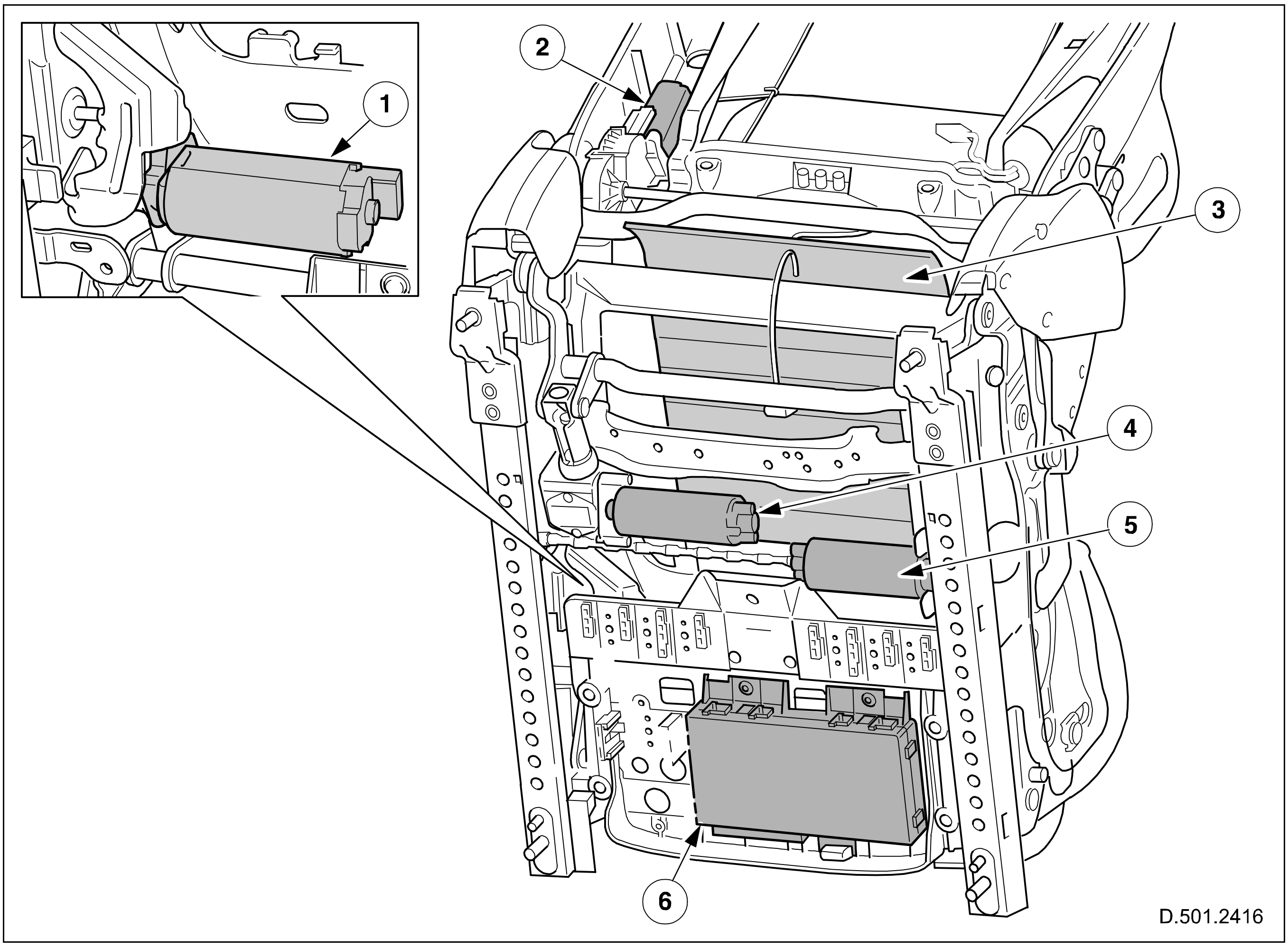

Fig. 140 Driver power-seat - component locations

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

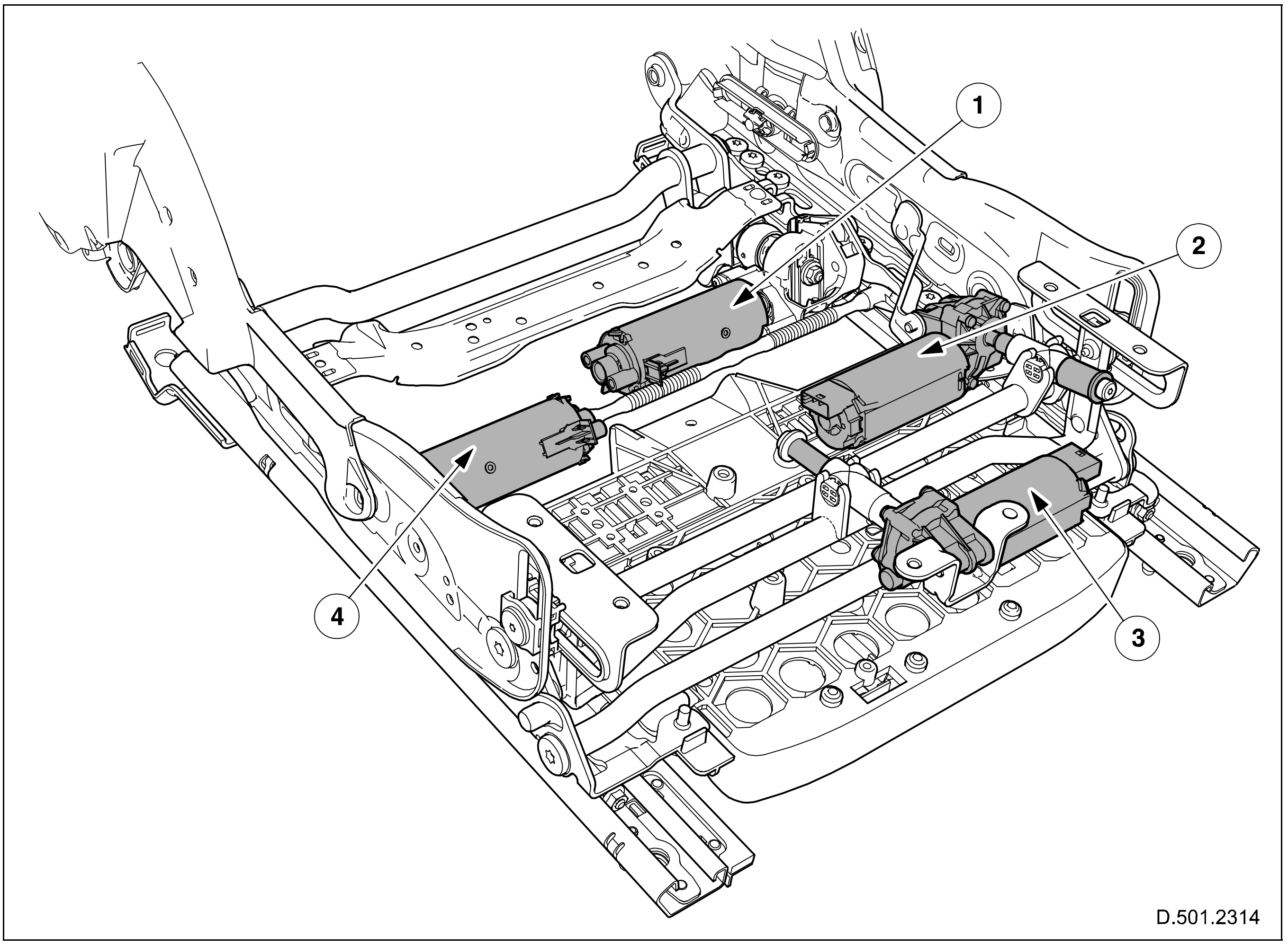

Fig. 141 Power seat with extendible cushion

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

Passenger Seat

The switches for electrically adjusting the passenger seat are wired directly to the appropriate motor; refer to **New XJ Range Electrical Guide** for detailed electrical connection information.

NOTE: Rear seats with electrical functionality, have a switch installed (where specified) that will allow adjustment of the front passenger seat, recline and fore/aft positions, by the rear occupant seated directly behind.

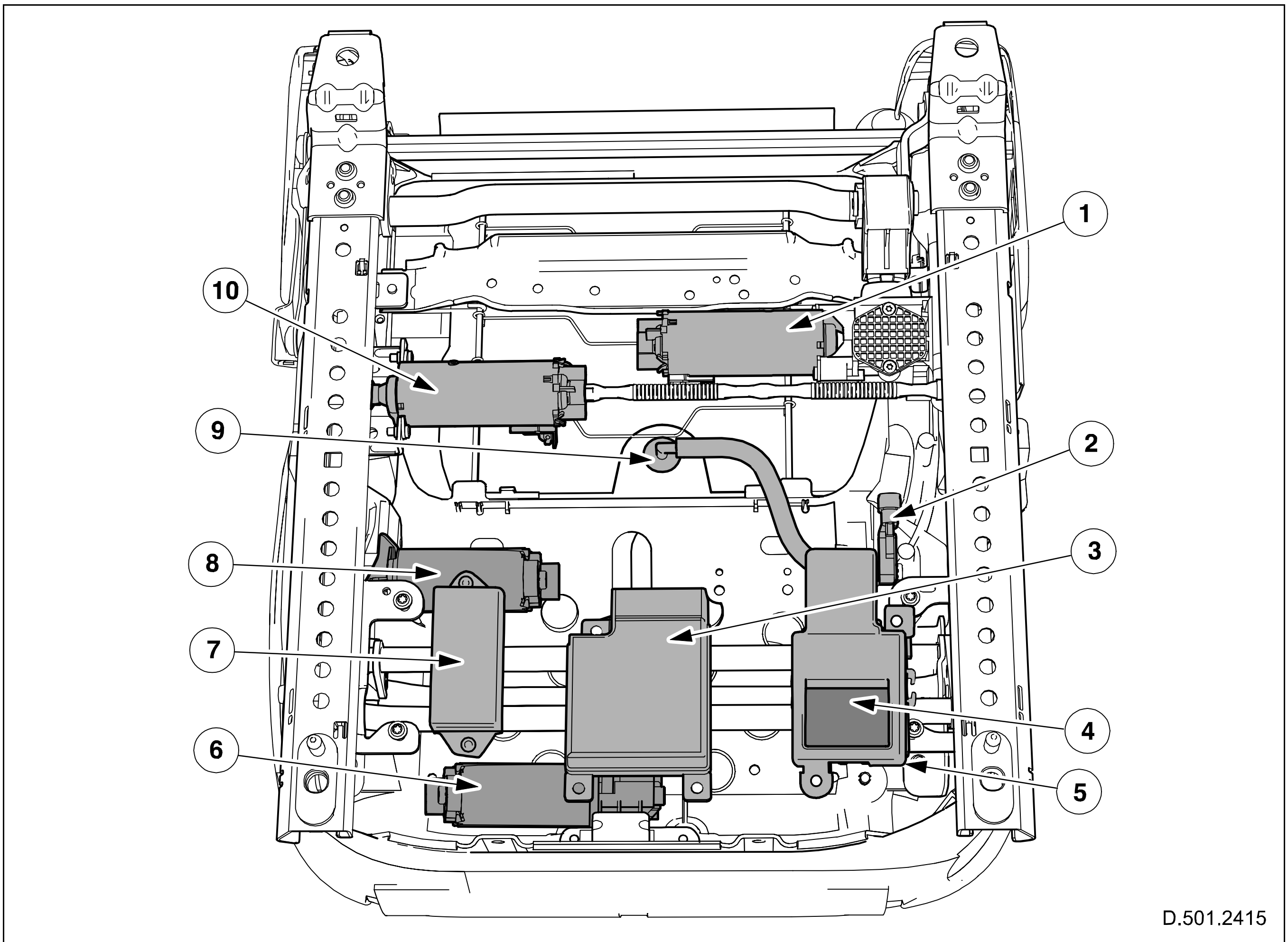

Fig. 142 Passenger power-seat - component locations (mounting tray removed)

1. Height-adjustment motor
2. Pressure sensor
3. Occupancy sensing module
4. Seat weight-sensing module
5. Seat weight-sensing module cover
6. Cushion-extend motor
7. Passenger rear-adjust relay module
8. Rake adjustment motor (front)
9. Silicon bladder connector and pipe
10. 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 module (DSM) responds to the switch position chosen, by providing an output to the respective drive motor; refer to **New XJ Range Electrical Guide** for detailed connection information.

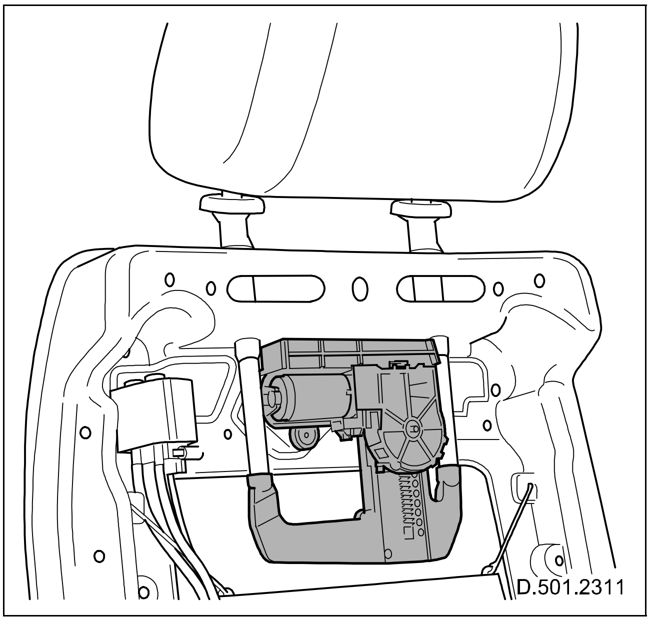

Fig. 143 Electrically operated head restraint

Power Lumbar

The 4-position 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; refer to **New XJ Range Electrical Guide** for detailed connection information.

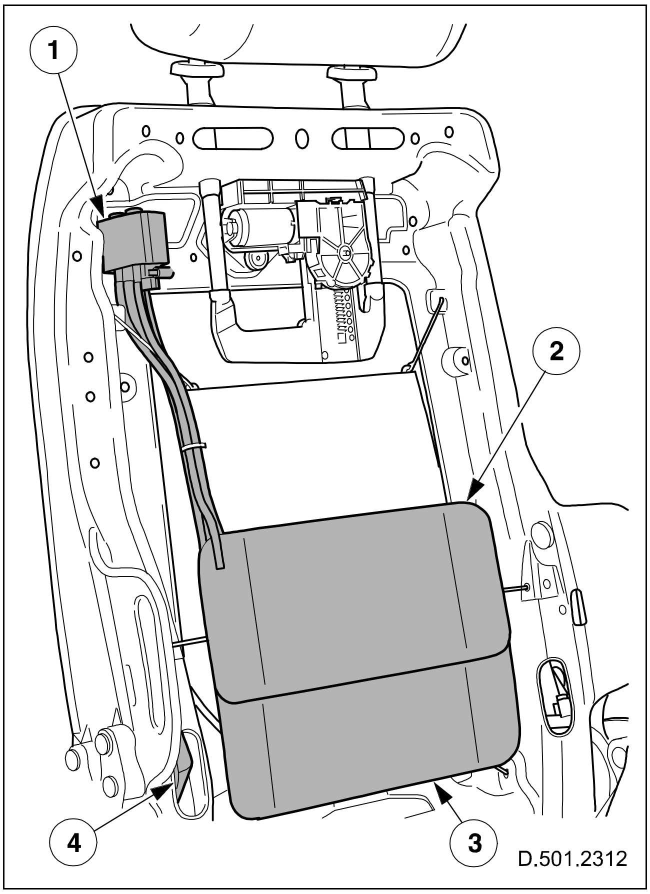

Fig. 144 Power lumbar

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

Heated Seats

The heated seat system which offers a choice of three settings, comprises:

- Heated seat switches.
- Heated seat status LEDs.
- Backrest heater element.
- Cushion heater element and thermostat.
- Front electronic module.

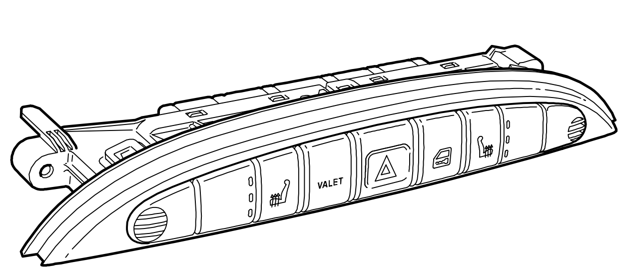

Fig. 145 Heated seat switches

As one of its many functions, the front electronic module (FEM) controls the seat heating feature by providing the appropriate response depending on the status of the heated seat switches; refer to **New XJ Range Electrical Guide** for detailed connection information.

Heater functionality is constantly monitored by the electrical load management system (ELMS); refer to **Electrical Load Management System**. The ELMS dictates that in circumstances where the generated electrical power is less than the electrical consumption, selected systems may be inhibited or operated using reduced power for as long as is necessary.

NOTE: Tell-tale LEDs remain illuminated so that any corrective action is not apparent to the driver.

The heated seat function (when selected) permits the electrical heating of the backrest and cushion. The heating system for each seat is activated by separate switches. The switches complete with status LEDs are located in the center console switch assembly.

NOTE: Where applicable, the heated steering wheel function is automatically activated concurrent with the driver's heated seat switch; refer to **Heated Steering Wheel**.

Provided the engine is 'running', pressing a heated seat switch, will select the maximum heat setting for the chosen seat, as confirmed by three illuminated red LEDs. A second press selects the mid-setting (two LEDs) and a third press selects the lowest heat setting (one LED). A fourth press deactivates the seat heater.

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

- The function is deactivated by pressing the switch for a fourth time.
- The ignition key is turned to position 'I'.
- A malfunction is detected by the front electronic module (FEM).

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.

Rear Seats

Depending on market and vehicle specification, the rear seats will be one of the following:

- Fixed bench style with armrest.
- Electrically-adjustable, twin-back and bench cushion style (complete with armrest).
- Electrically-adjustable twin seats.

NOTE: Vehicles fitted with twin seats have a Rear Floor Console installed; refer to **Rear Floor Console**.

Depending on vehicle specification, heaters may be integral to the cushions and backrest; refer to **Rear Heated Seats**.

The following features are electrically adjustable (where applicable):

- Head restraint.
- Lumbar support.
- Backrest.

Electrically-Adjustable Backrest

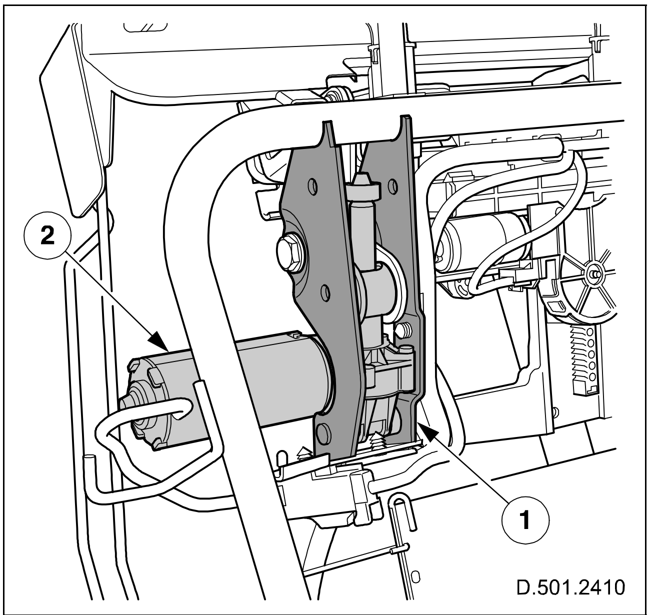

Fig. 146 Electrically-adjustable backrest

1. Backrest recline mechanism
2. Backrest recline adjustment motor

The electrically-adjustable backrest (where applicable) is occupant-controlled from the seat-mounted switch. The rear memory module (RMM) responds to the switch position chosen, by providing an output to the drive motor; refer to **New XJ Range Electrical Guide** for detailed connection information.

Electrically-Adjustable Head Restraint

The electrically-adjustable head restraint (where applicable) is occupant-controlled from the seat-mounted switch. The rear memory module (RMM) responds to the switch position chosen, by providing an output to the drive motor; refer to **New XJ Range Electrical Guide** for detailed connection information.

Power Lumbar

The 4-position 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; refer to **New XJ Range Electrical Guide** for detailed connection information.

Front Passenger Seat Adjustment

Depending on vehicle specification, the rear seats may have switch installed that will allow adjustment of the front passenger seat, recline and fore/aft positions, by the rear occupant seated directly behind. The relevant front passenger seat motors are activated by the passenger rear-adjust relay module (item 7, **Fig. 142**) in response to the switch position selected; refer to **New XJ Range Electrical Guide** for detailed connection information.

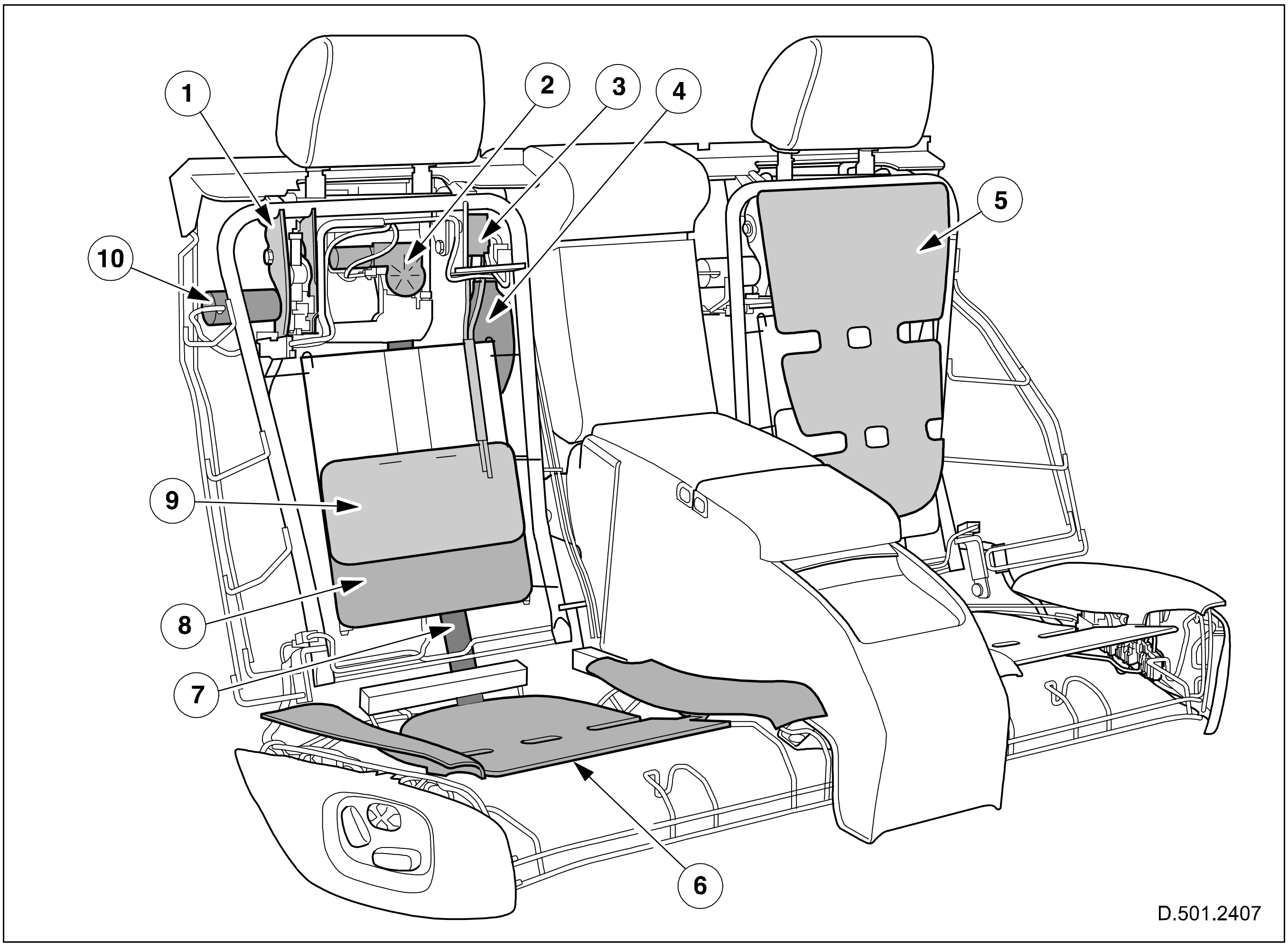

Fig. 147 Electrically-adjustable twin rear seats

1. Backrest recline mechanism
2. Head restraint mechanism
3. Lumbar solenoid pack
4. Motor-driven lumbar pump
5. Heater (backrest)
6. Heater (cushion)
7. Release strap
8. Lower air-cell
9. Upper air-cell
10. Backrest recline adjustment motor

NOTE: For clarity, the right-hand seat position is illustrated with the backrest heater removed.

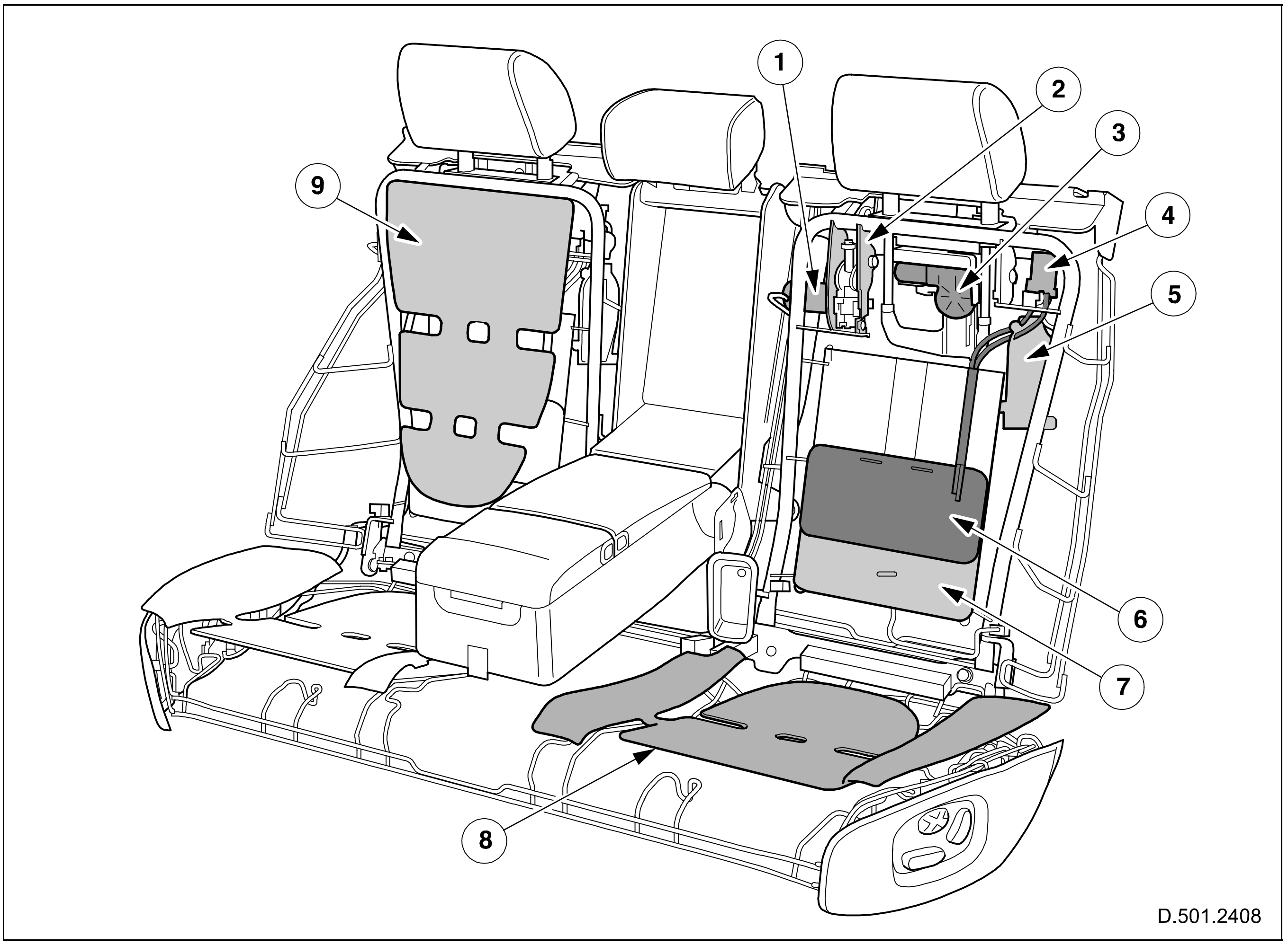

Fig. 148 Electrically-adjustable rear bench seat with armrest

1. Recline adjustment motor
2. Recline mechanism
3. Head restraint mechanism
4. Lumbar solenoid pack
5. Motor-driven lumbar pump
6. Upper air-cell
7. Lower air-cell
8. Heater (cushion)
9. Heater (backrest)

NOTE: For clarity, the left-hand seat position is illustrated with the backrest heater removed.

Backrest Release Mechanism

Access for service purposes is achieved by unlatching the backrest using the release strap, which is accessible once the seat cushion has been removed.

CAUTION: Make sure the backrest is in its most rearward position before removal; refer to JTIS for detailed Removal and Installation instructions.

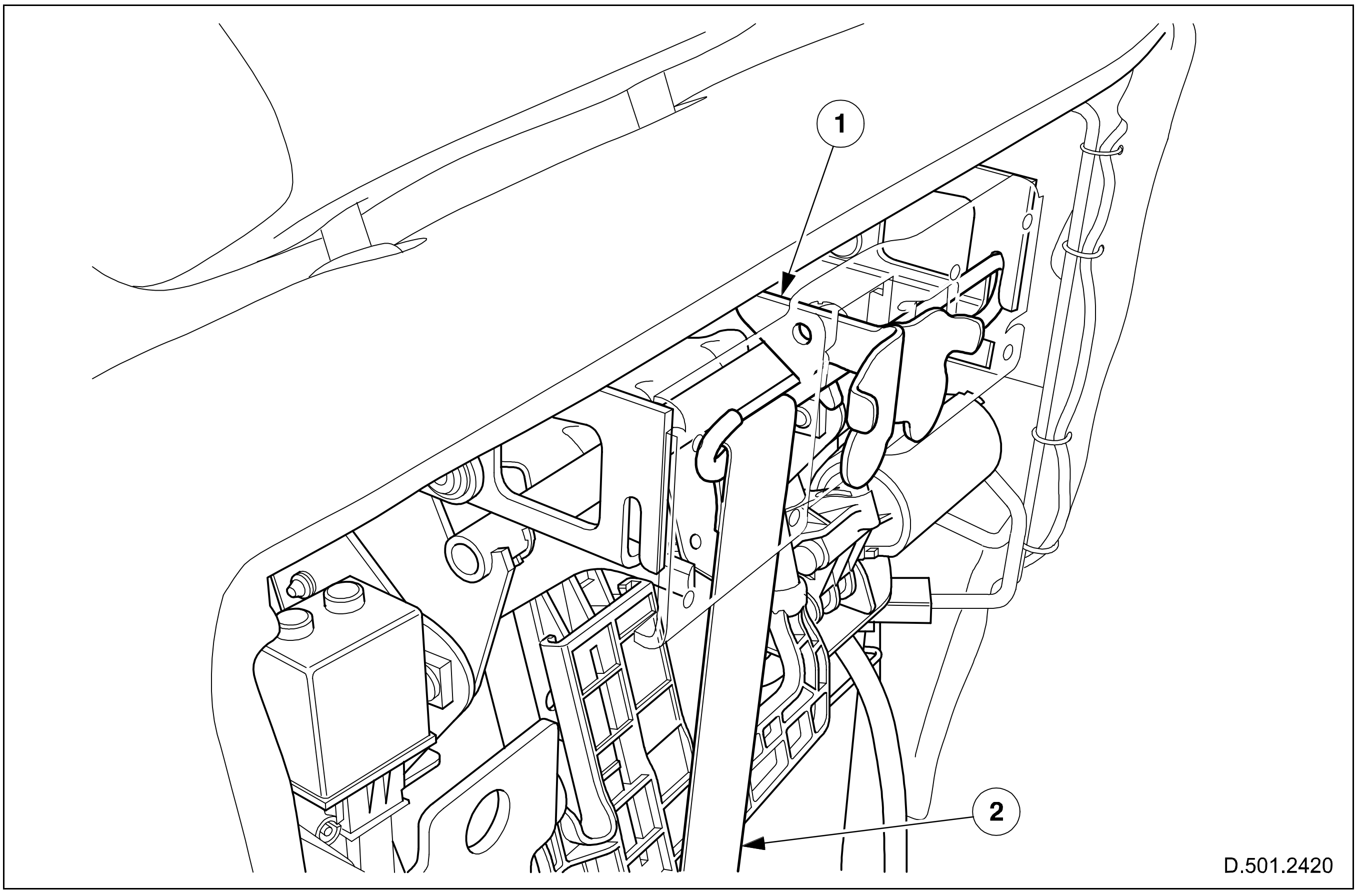

Fig. 149 Backrest release mechanism

1. Latch (secured to body panel)
2. Release strap

Rear memory module

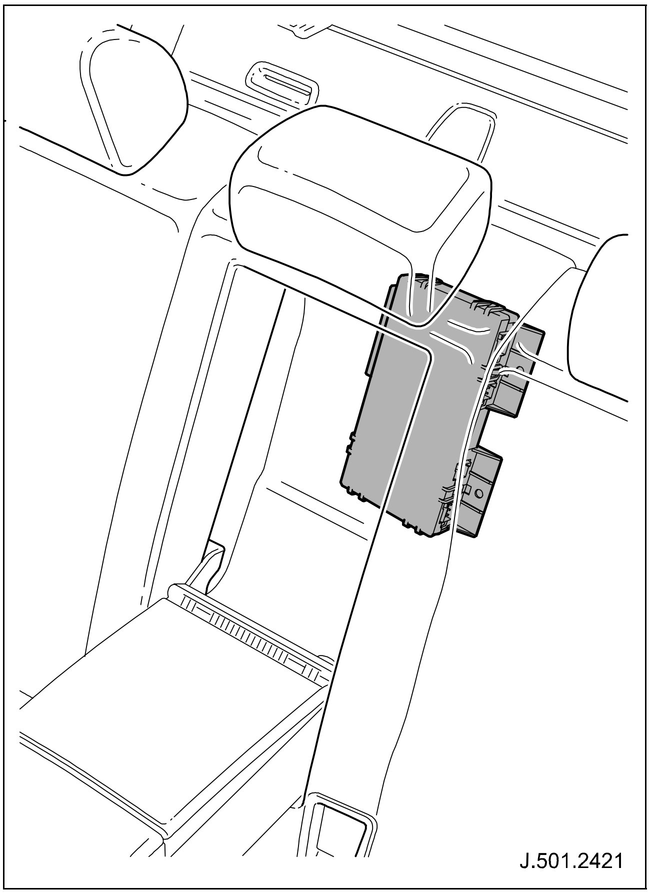

Fig. 150 Rear memory module

The rear memory module (RMM) is attached to the body-in-white behind the seat or to the ski-hatch blanking plate if the Rear Multimedia System is installed.

The RMM interfaces with the seat memory switches and the seat-mounted switchpack to control the rear seat electrical functionality. In response to selections made by the rear seat occupants, output signals are sent to the motors that control the:

- rake of the backrest;
- head restraint.

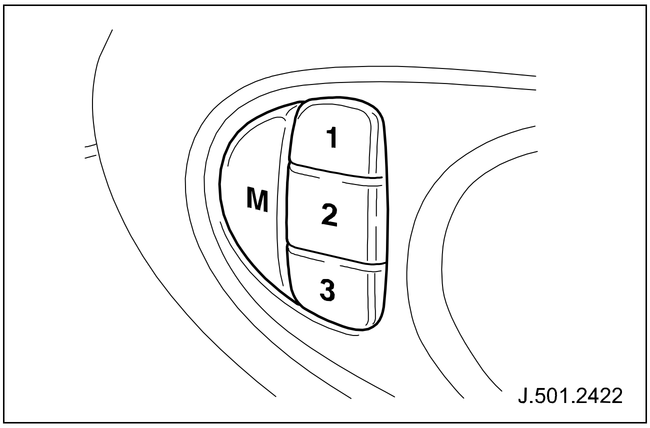

Fig. 151 Memory switch

Up to three personality configurations in relation to seat positions, are possible using the seat memory switch. The positions are stored and retrieved from the rear memory module (RMM).

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

Refer to **New XJ Range Electrical Guide** for detailed connection information.

Rear Heated Seats

Where applicable, the heated seat system comprises:

- Heated seat switches.
- Backrest heater element.
- Cushion (inner and outer) heater element and thermostat.
- Rear electronic module (REM).

As one of its many functions, the rear electronic module (REM) controls the seat heating feature by providing the appropriate response depending on the status of the heated seat switches; refer to **New XJ Range Electrical Guide** for detailed connection information.

The heated seats is one of the areas monitored by the electrical load management system (ELMS); refer to **Electrical Load Management System**. The ELMS dictates that in circumstances where the generated electrical power is less than the electrical consumption, selected systems may be inhibited or operated using reduced power for as long as is necessary.

NOTE: The tell-tale LED will remain illuminated so that the action is not apparent to the driver.

The heated seat function (when selected) permits the electrical heating of the backrest and cushion. The heating system for each seat is activated by separate switches, located in the floor console.

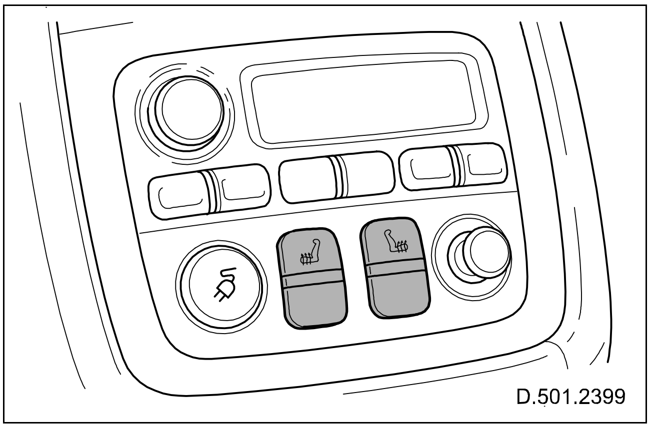

Fig. 152 Heated seat switches (4–zone console)

Provided the engine is 'running', pressing a heated seat switch, will select the maximum heat setting for the chosen seat, as confirmed by three illuminated red LEDs. A second press selects the mid-setting (two LEDs) and a third press selects the lowest heat setting (one LED). A fourth press deactivates the seat heater.

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

- The function is deactivated by pressing the switch for a fourth time.
- The ignition key is turned to position 'I'.
- A malfunction is detected by the REM.

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.

Armrest

The fold-down armrest has integral cup holders and depending on market and vehicle specification may also be fitted with passenger entertainment control panel; refer to **Passenger Entertainment Control Panel**.

NOTE: The cellular phone is a dealer installed option for certain markets; refer to **Cellular Phone**.

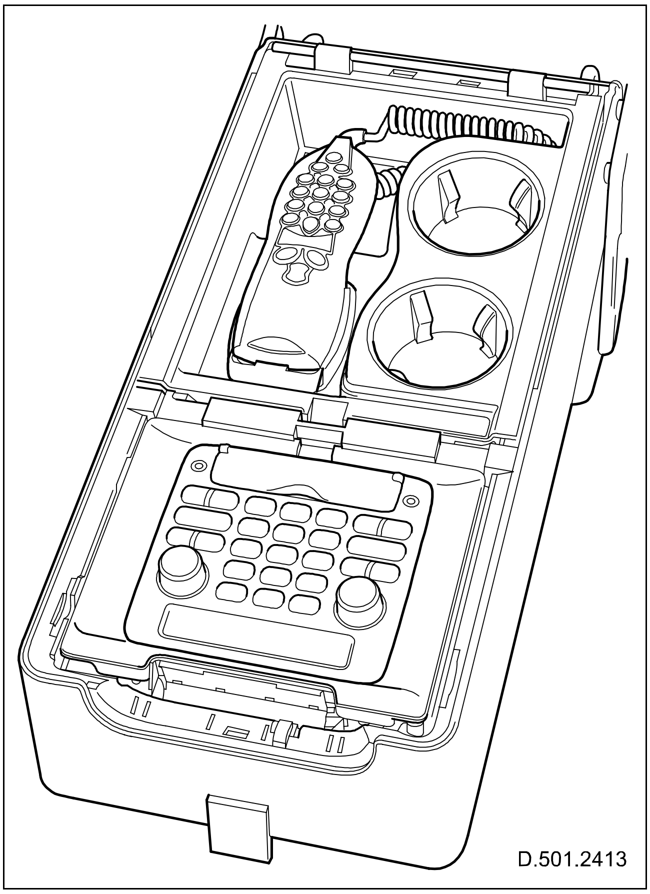

Fig. 153 Armrest (without covers)

Instrument Panel And Consoles

Instrument Panel

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

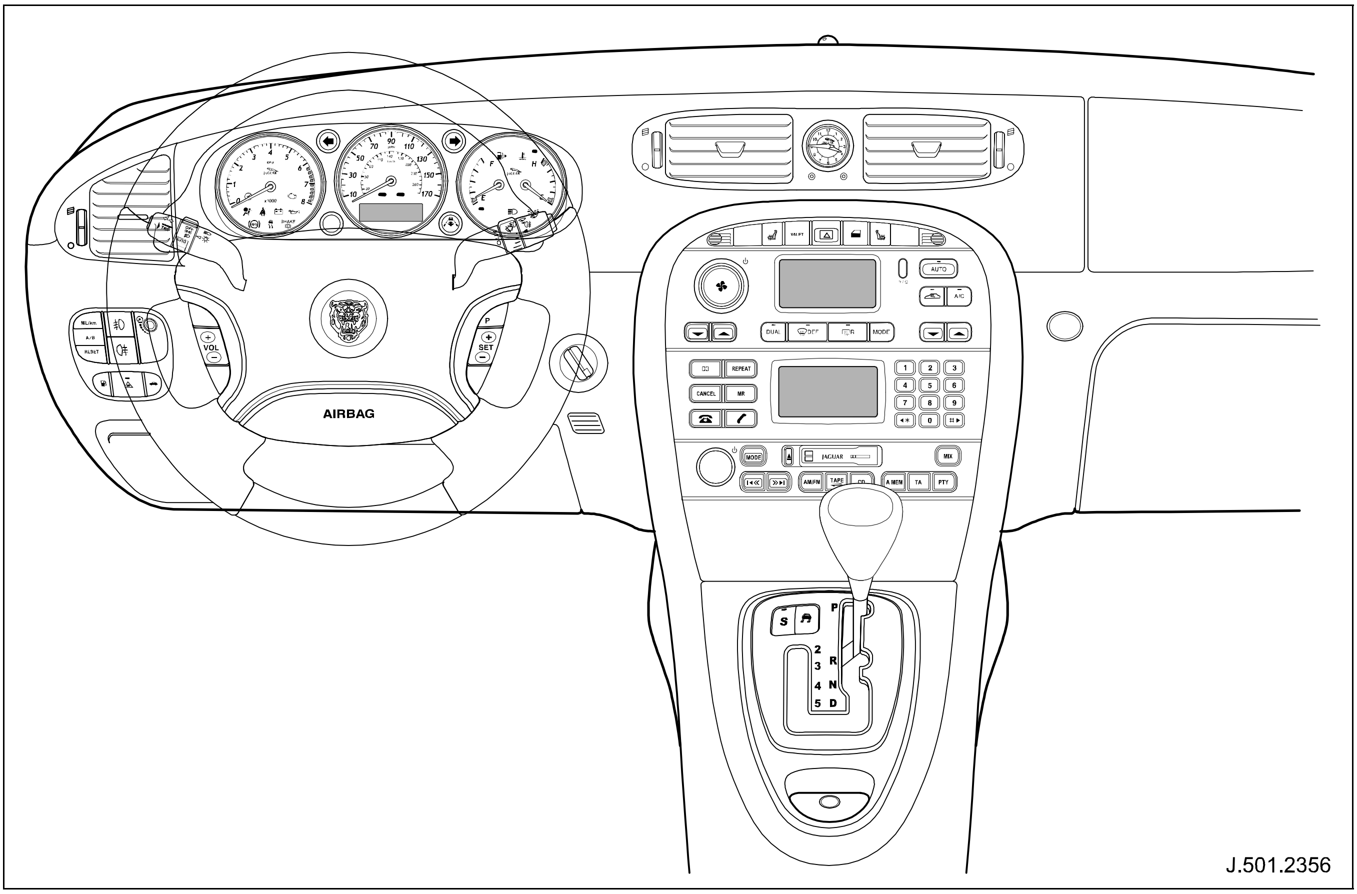

Fig. 154 Instrument panel

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;
- driver’s knee-bolster;
- hood release-lever;
- driver’s switch assembly (fuel filler-flap / forward alert switch / luggage compartment lid release);
- glove compartment release switch.
- clock

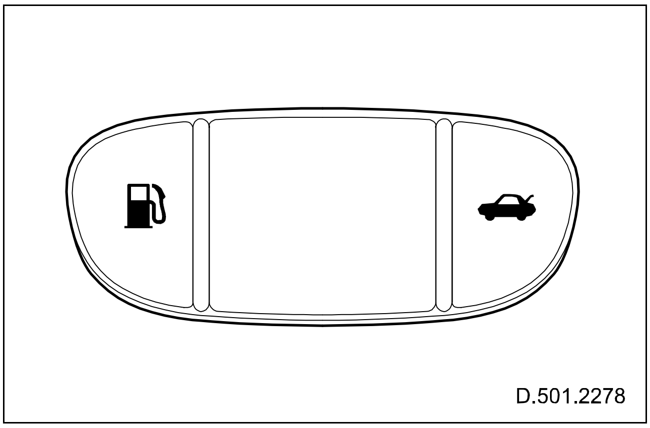

Fig. 155 Fuel filler-flap/luggage compartment lid release

The center console of the instrument panel houses the following:

- center console switch assembly;
- climate control panel or telematics display module; refer to **Climate Control System**;
- audio unit; refer to **In-vehicle Entertainment Systems**.

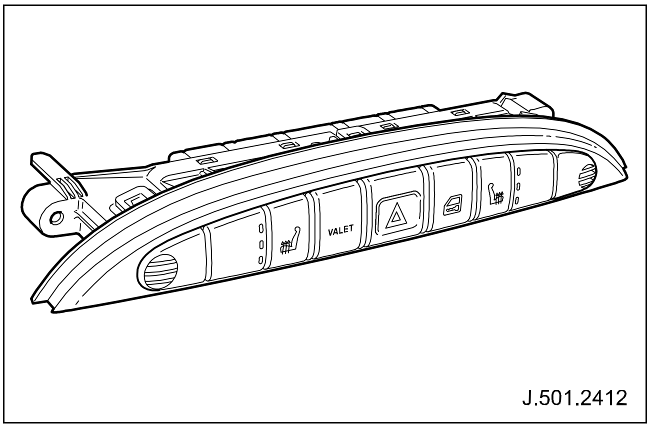

Fig. 156 Center console switch assembly

Depending on vehicle specification, the center console switch assembly comprises:

- heated-seat switches;
- master lock switch;
- hazard warning switch;
- valet mode switch;
- occupancy sensor (one of four); refer to **Occupancy Sensors**.

NOTE: The sensor is installed adjacent to the passenger side of the assembly. To maintain symmetry, the opposite end of the assembly has only the sensor housing installed.

Glove Compartment

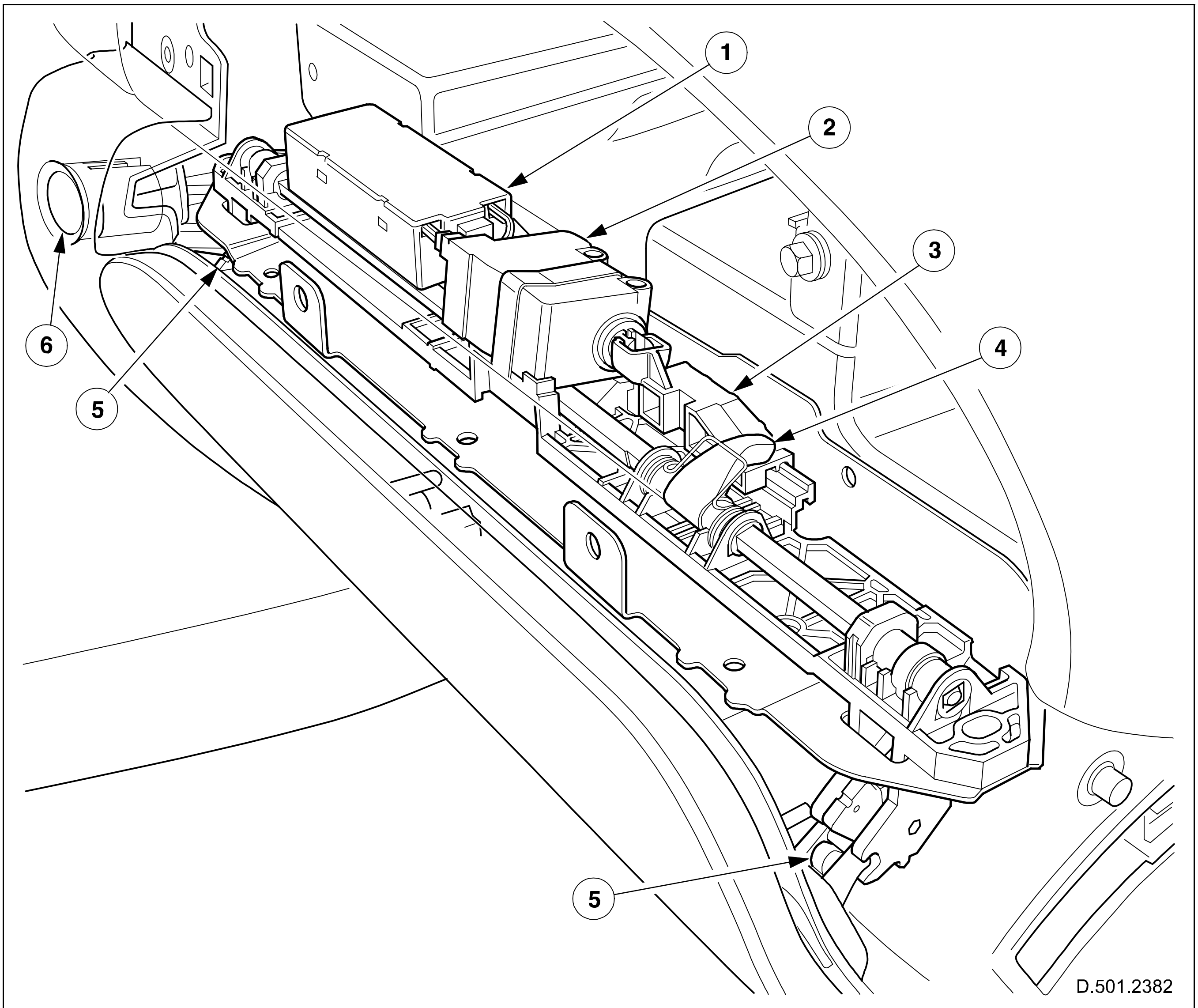

Fig. 157 Glove compartment door release mechanism

1. Control-electronics
2. Motor
3. Actuating slide
4. Release lever
5. Latch
6. Switch

The glove compartment door is electrically secured and can only be released by operating the switch.

NOTE: Should it prove necessary, removal of the end closing panel, from the passenger side of the instrument panel will permit access so that technicians can manually release the mechanism; refer to **JTIS**.

The door is a component part of the anti-theft strategy and therefore cannot be opened when:

- the anti-theft system is actively or passively armed;
- the vehicle is in valet mode;
- the vehicle is centrally or super-locked from the door key-barrel or integrated key transmitter.
- the auto-relocking function has been activated.

NOTE: Access is not inhibited by drive-away door-locking or activation of the master-locking switch or internal door locking/unlocking mechanism.

Providing the mechanism has not been inhibited by a security feature, when the switch is pressed, the front electronic module (FEM) responds by sending a control signal to the motor, via the control-electronics. When activated, the motor causes the actuating-slide to operate the release lever. The lever releases the two latches mounted either side of the door, allowing the door to lower to its fully-open position.

NOTE: If the switch is operated more that 15 times within a 20 second period, the opening function is inhibited. The opening function is reactivated after 20 seconds have elapsed.

An accessory power socket is mounted, outboard, inside the glove compartment.

Floor Console

The 4–zone floor console (where installed) is designed to accommodate the rear climate control system; refer to **Rear Climate Control System**. Actual features vary according to vehicle specification.

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

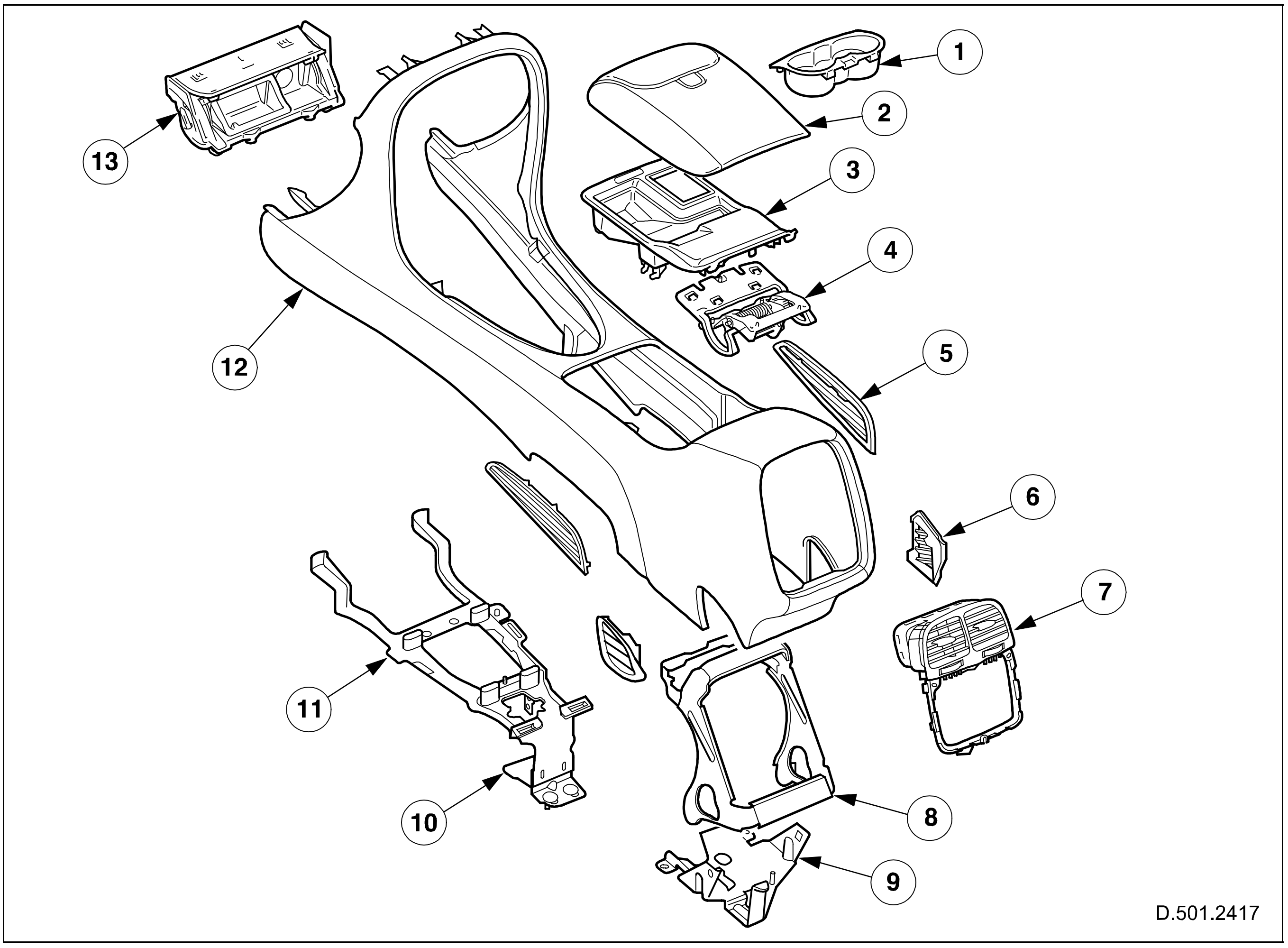

Fig. 158 Floor console assembly (4–zone)

1. Cupholder
2. Armrest
3. Phone (where applicable) stowage area
4. Armrest hinge assembly
5. Climate control input register
6. Climate control floor register
7. Climate control face ducting and registers
8. Console bracket
9. Console to floor mounting bracket
10. Yaw rate sensor bracket
11. J-gate support casting
12. Console
13. Ashtray

The 2–zone floor console, depending upon vehicle specification, consists of the accessory power-socket, ashtray, cigar lighter, heated seat switches and sliding armrest. The center section of the console carries a stowage box complete with a clip-in secondary cup holder. The cellular phone (where installed) is located on the underside of the armrest.

NOTE: The 2–zone floor console is the standard installation and is not designed to accommodate the rear climate control system.

Rear Floor Console

The rear floor console is installed for vehicles fitted with rear twin seats. Depending upon market and vehicle specification, the following features are integral to the console:

- twin cupholders;
- stowage box;
- cellular phone (dealer installation); refer to **Cellular Phone**;
- passenger entertainment control panel; refer to **Passenger Entertainment Control Panel**.

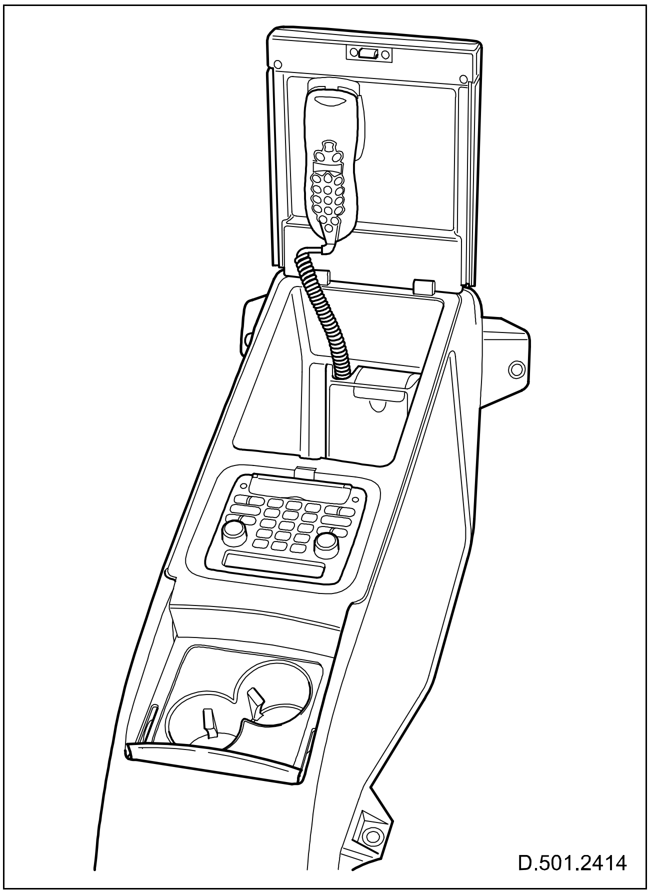

Fig. 159 Rear floor console (with front armrest removed)

Overhead Console

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

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

All switches have backlight 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 backlight 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 **Instrument Cluster and Panel Illumination**.

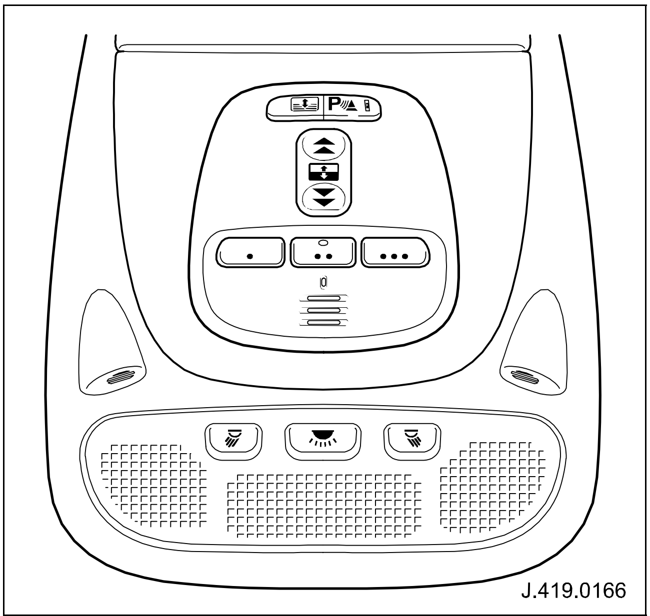

Fig. 160 Overhead console

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.

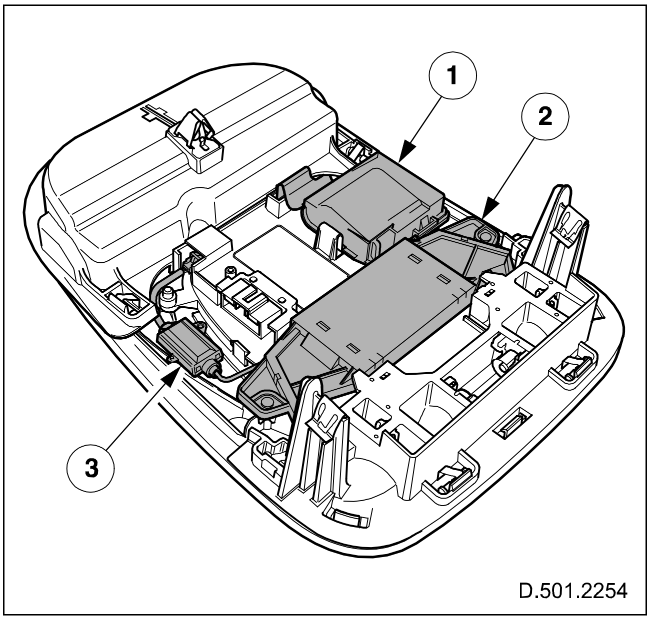

Fig. 161 Overhead console components

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

The continued development of the 'Advanced Restraint System' 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 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. 162**.

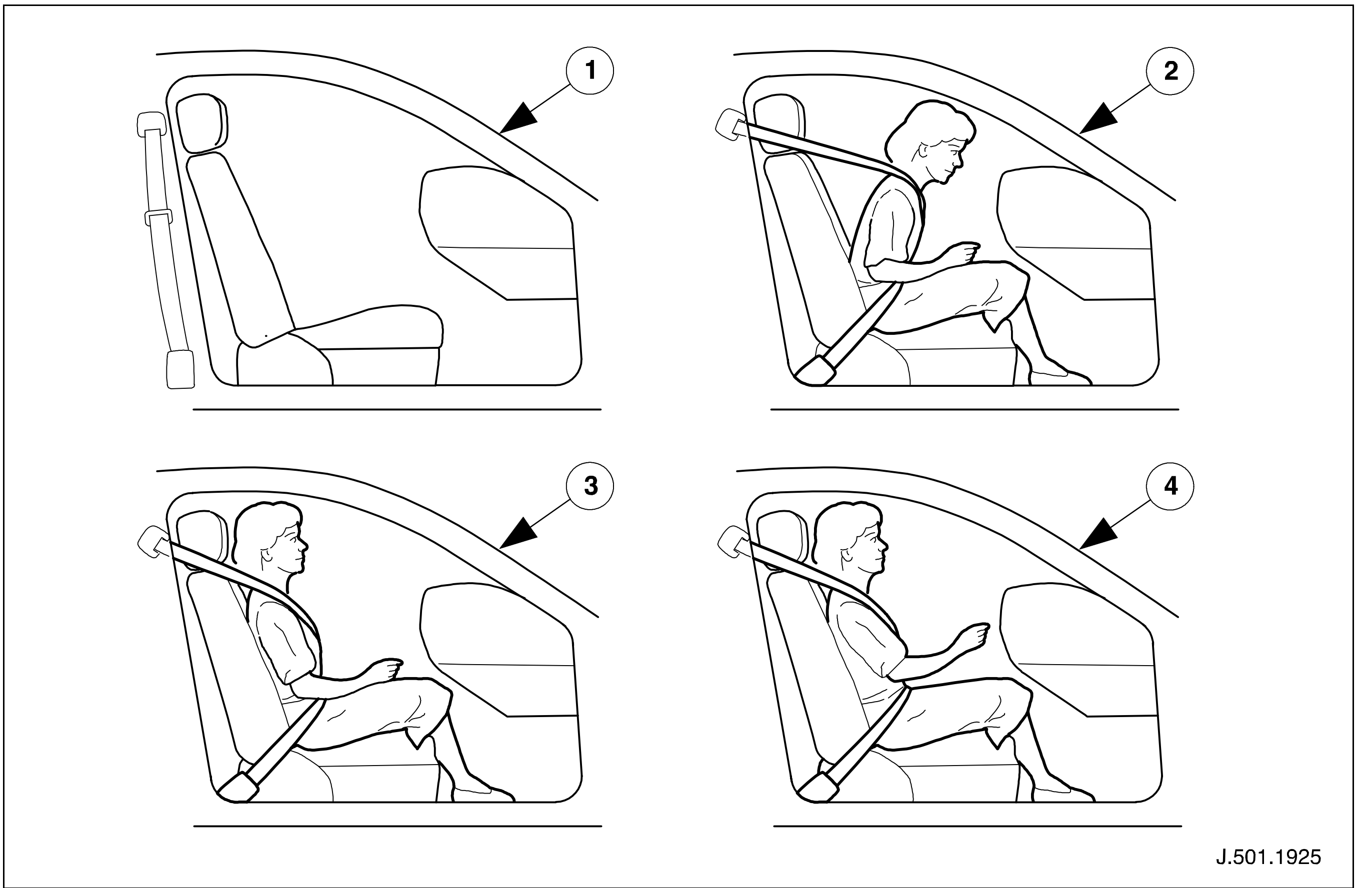

Fig. 162 Basic occupancy scenarios (passenger side)

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. 163** provides an indication of how the electrical component parts interact with each other; refer to **New XJ Range Electrical Guide** for detailed information.

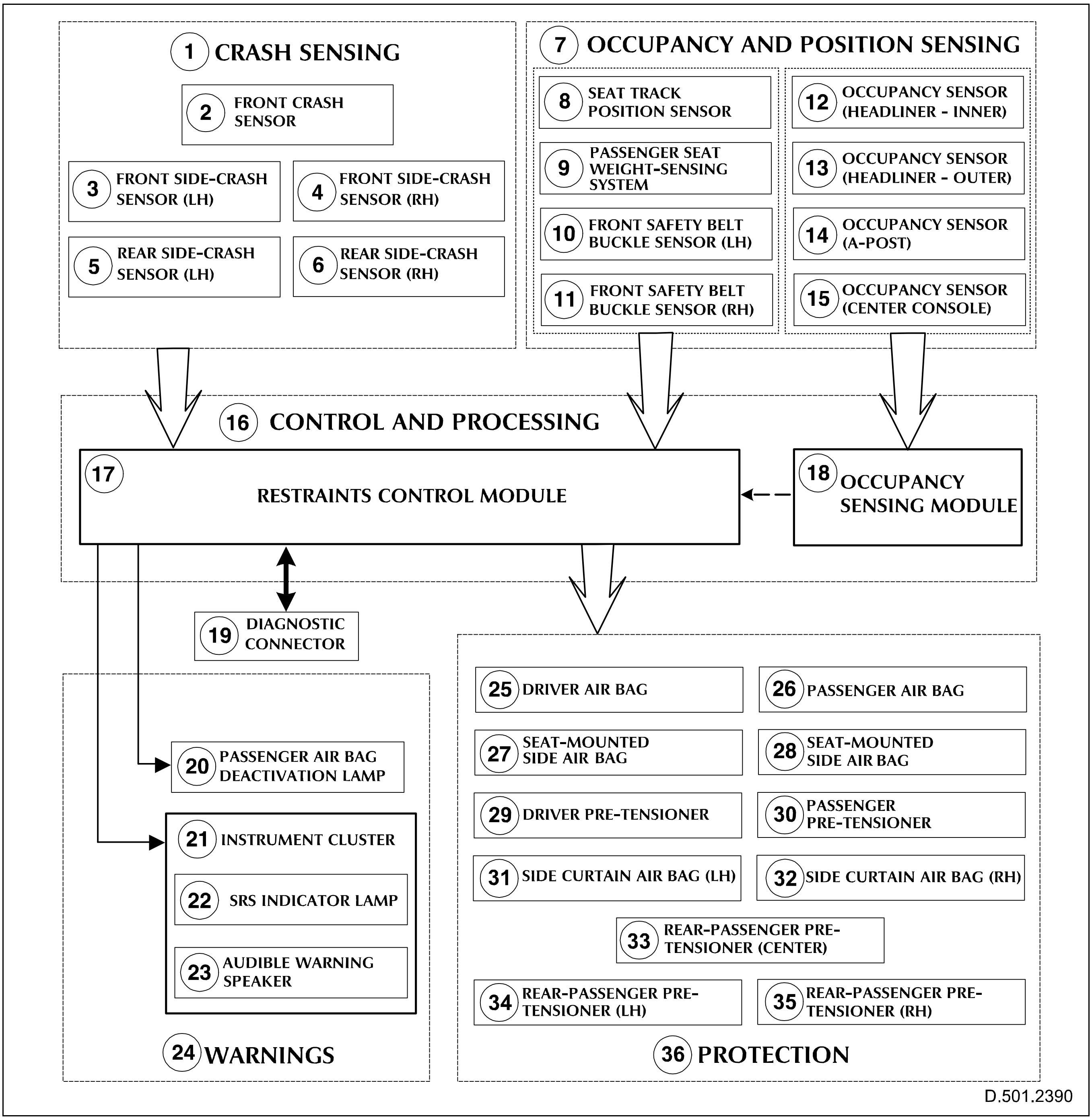

Fig. 163 Advanced restraints system diagram

Key to Fig. 163

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 and position sensing
8. Seat-track position sensor
9. Passenger seat weight-sensing system
10. Front safety belt buckle sensor (LH)
11. Front safety belt buckle sensor (RH)
12. Occupancy sensor (headliner - inner)
13. Occupancy sensor (headliner - outer)
14. Occupancy sensor (headliner - A-post)
15. Occupancy sensor (center console)
16. Control and processing
17. Restraints control module
18. Occupancy sensing module
19. Diagnostic connector
20. Passenger air bag deactivation lamp
21. Instrument cluster
22. SRS indicator lamp
23. Audible warning speaker
24. Warnings
25. Driver air bag
26. Passenger air bag
27. Seat-mounted side air bag
28. Seat-mounted side air bag
29. Driver pre-tensioner
30. Passenger pre-tensioner
31. Side-curtain air bag (LH)
32. Side-curtain air bag (RH)
33. Rear passenger pre-tensioner (center)
34. Rear passenger pre-tensioner (LH)
35. Rear passenger pre-tensioner (RH)
36. Protection

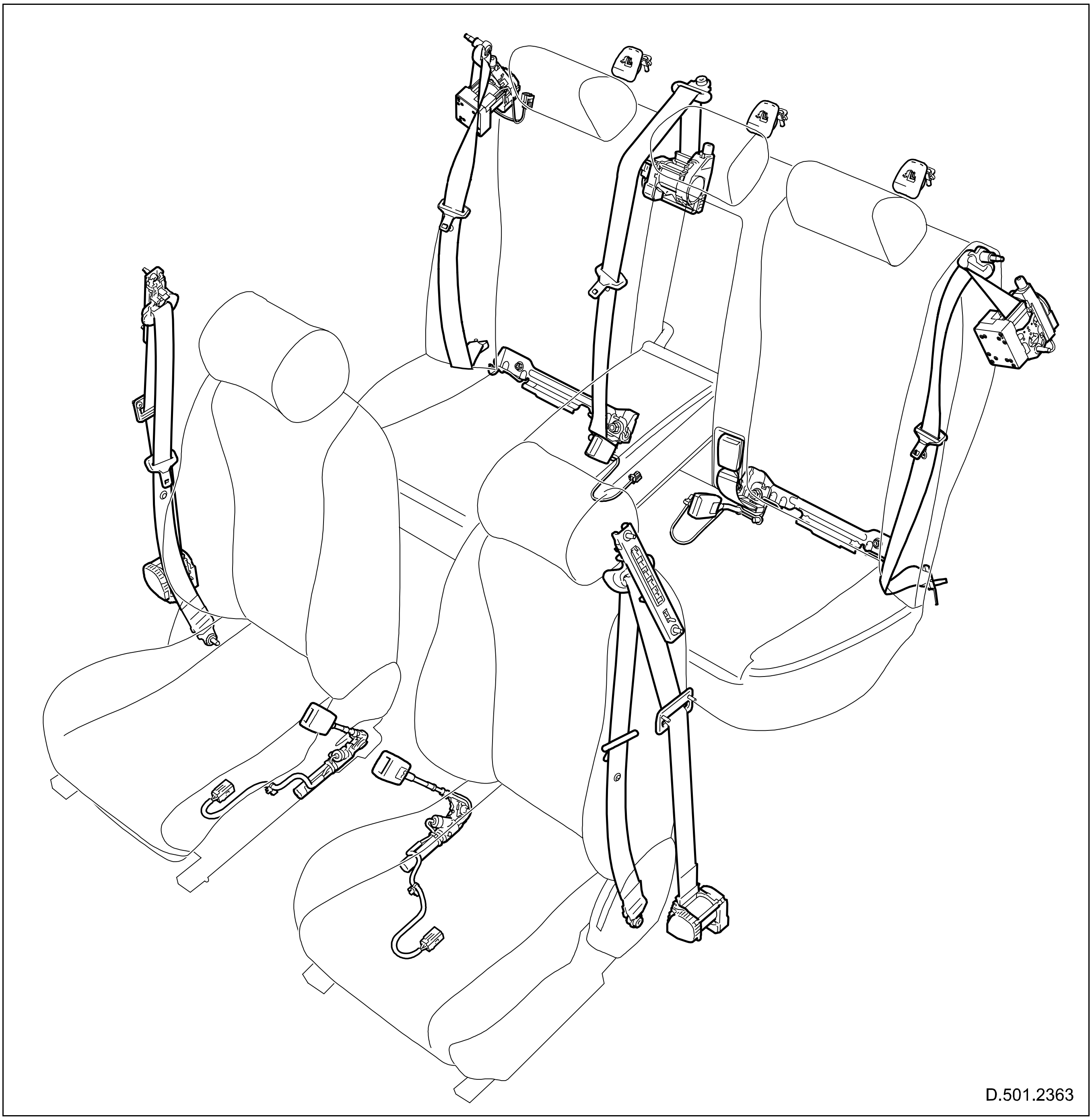

Fig. 164 Occupant restraints - location of active components

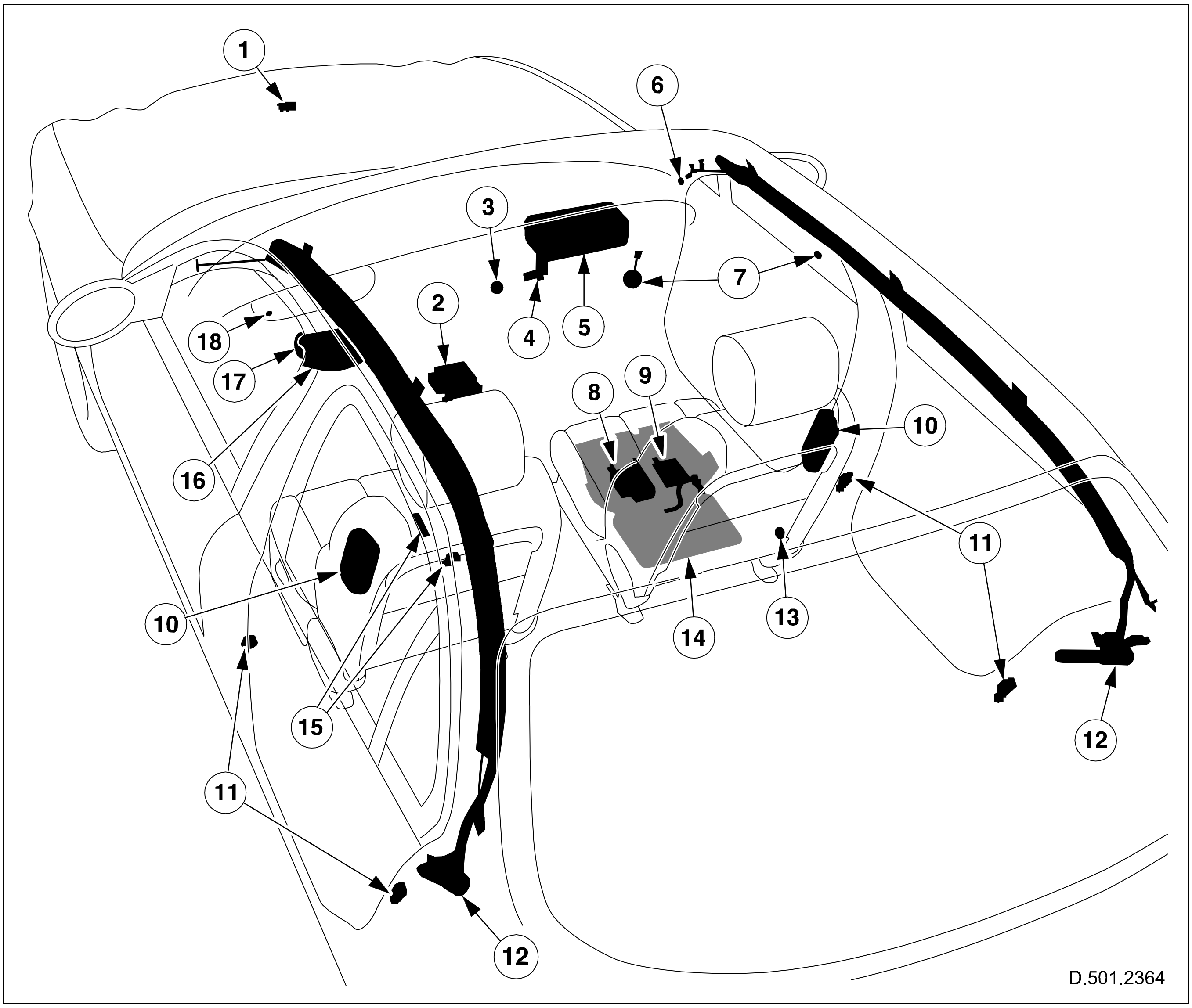

Fig. 165 Occupant restraints - location of passive components

1. Front crash sensor
2. Restraint control module
3. Occupancy sensor - center console
4. Passenger air bag deactivation indicator lamp
5. Passenger air bag module
6. Occupancy sensor - A-post
7. Occupancy sensors - headliner
8. Occupancy sensing module
9. Passenger seat weight-sensing module
10. Seat-mounted side air bag module
11. Side-crash sensor
12. Side-curtain air bag
13. Belt tension sensor (where applicable)
14. Passenger seat weight-sensing bladder
15. Seat-track position sensor
16. Driver air bag module
17. Clockspring
18. SRS indicator lamp

Crash Sensing

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.

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 should be deployed. The decision is forwarded to the deployment handler (within the RCM) which responds appropriately; for example: in the case that the data received indicates that the passenger 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.

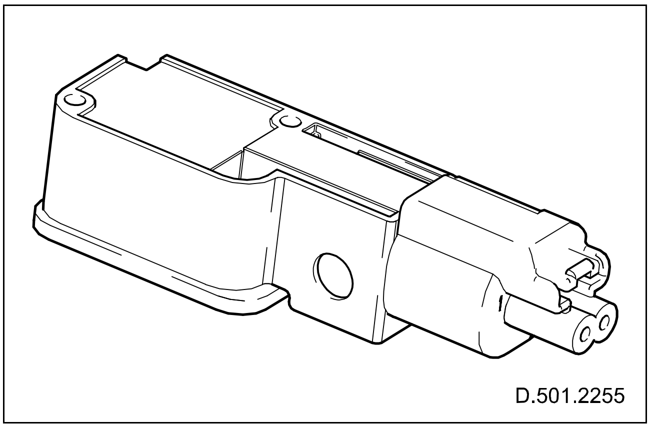

Fig. 166 Crash sensor

Occupancy and Position Sensing

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. 167**. 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.

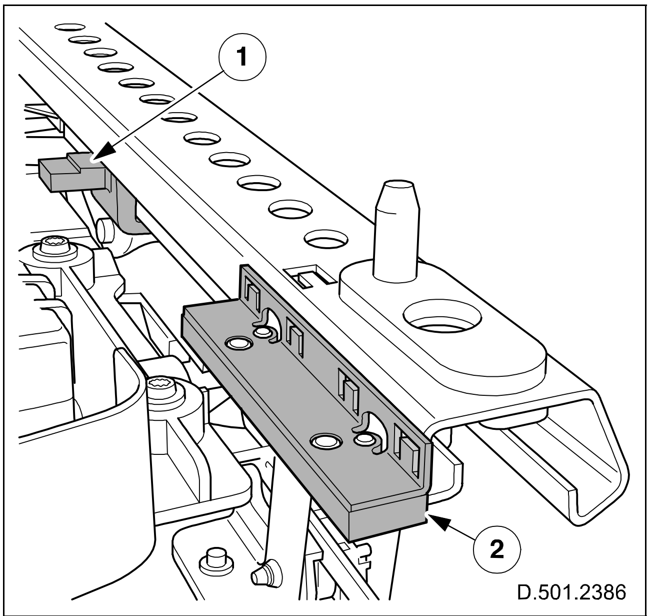

Fig. 167 Seat-track position sensor

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

The seat weight-sensing system forms part of a strategy to control passenger air bag deployment depending on the occupancy scenario. The strategy also takes into account the data received from the occupancy sensors; refer to **Occupancy Sensors**.

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).

NOTE: In some markets, the belt tension sensor (an integral part of the front passenger safety belt seat-anchor) has been introduced; refer to **Belt tension sensor**.

Locations for the seat weight-sensing components are shown in **Body, Seats, Fig. 142**.

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. In addition, the belt tension sensor (where applicable), provides a separate input to the seat weight-sensing module; refer to **Belt tension sensor**. The module processes the input signals received from the sensors and forwards an appropriate signal 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 9**. 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. 163**. 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 9 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.

Belt tension sensor

The belt tension sensor (BTS) is a strain-gauge type, encapsulated within the passenger safety belt anchor. The sensor converts the force applied to the belt into an electrical signal. In the event that a child-seat is installed onto the front passenger seat (not recommended), the force applied to the passenger safety belt is reflected by the output signal from the sensor, which provides data to supplement that received from the silicon bladder. The passenger seat weight-sensing module processes the input data and makes it available to the restraints control module (RCM), which then makes the necessary adjustments in respect of passenger air bag deployment.

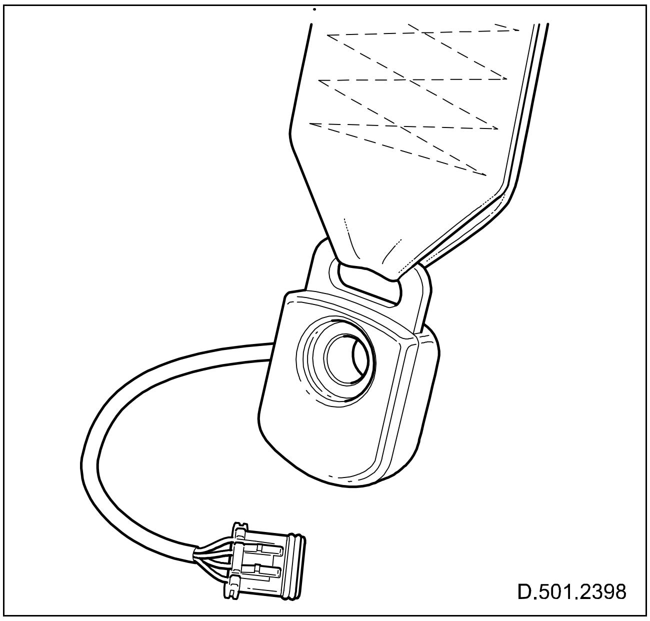

Fig. 168 Belt tension sensor

Occupancy Sensors

The occupancy sensors form part of a strategy to control passenger air bag deployment, depending on the occupancy scenario; refer to **Fig. 162**. The strategy also takes into account the data received from the seat weight-sensing system; refer to **Passenger Seat Weight-Sensing System**.

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 headliner assembly; refer to **Fig. 165**.

The sensors:

- are strategically placed to detect the presence and movement of the front passenger seat occupant;
- 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. 162**.

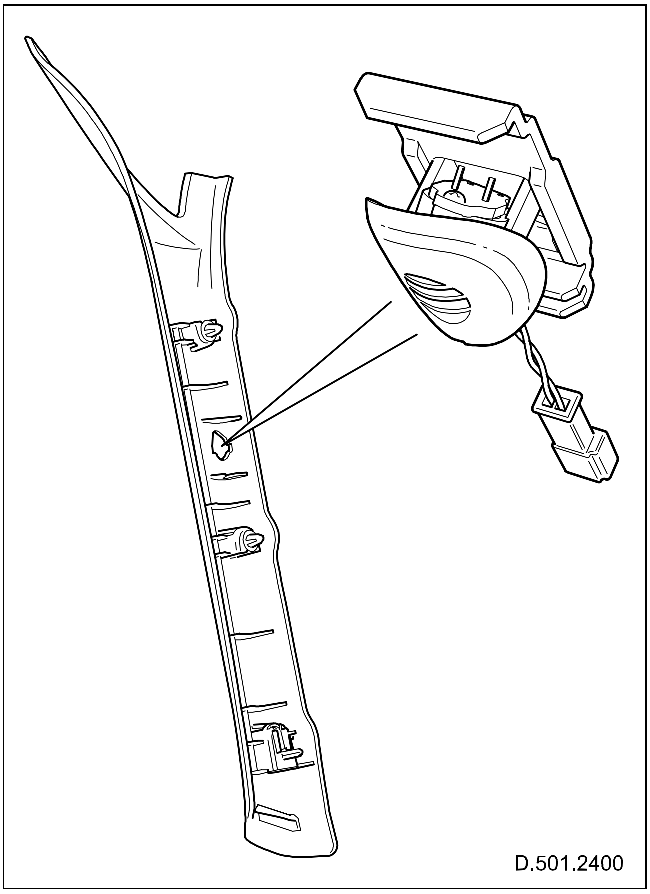

Fig. 169 Occupancy sensor - A-post

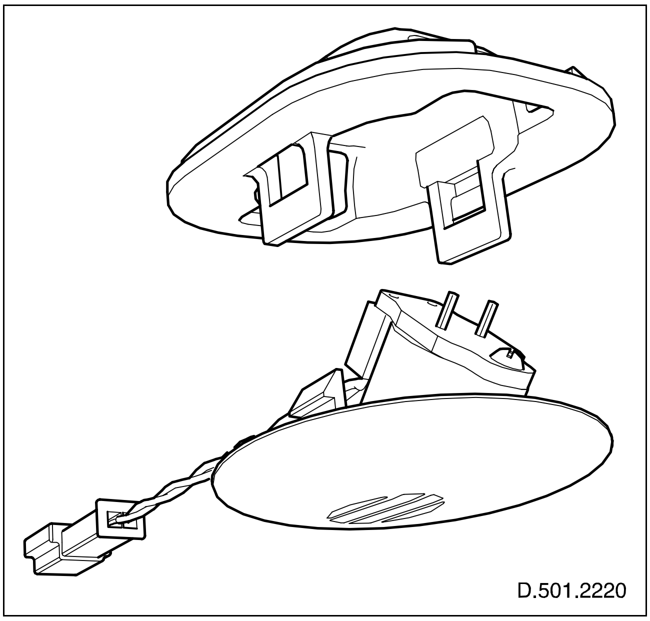

Fig. 170 Occupancy sensor - headliner

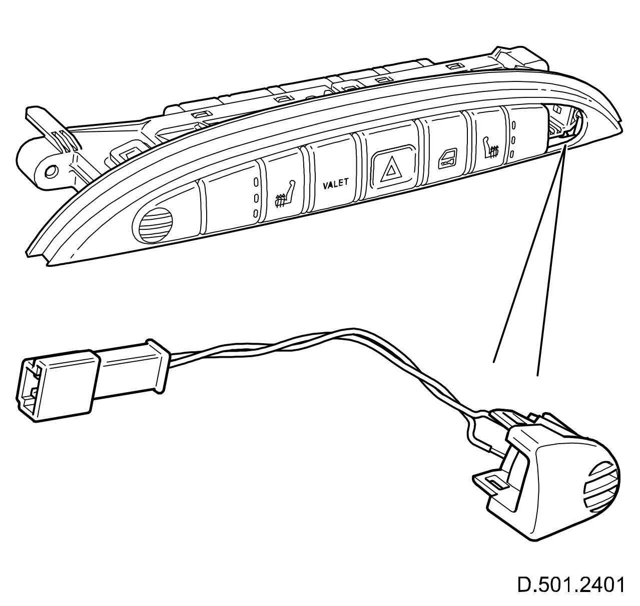

Fig. 171 Occupancy sensor - center console

The occupancy sensing module constantly monitors and processes the signals received from the occupancy sensors; refer to **Occupancy Sensing Module**. 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 **Passenger Air Bag Module**.

The RCM uses the data received from the occupancy sensing module, in conjunction with data from other sensors in the system (refer to **Fig. 163**), to make deployment decisions; refer to **Restraints Control Module**.

Refer to **JTIS** for sensor servicing information and to **New XJ Range Electrical Guide** for connection information.

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.

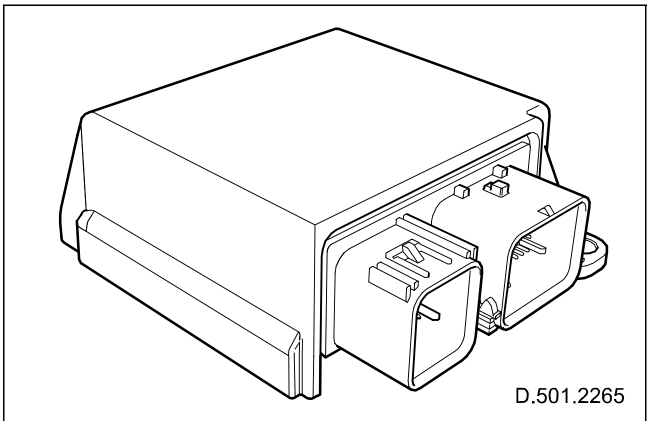

Fig. 172 Restraints control module

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; refer to **Occupancy Sensors**;
- processes signals received from the seat weight-sensing system; refer to **Passenger 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 **Safety Belt Buckle Sensor**. In some markets, a belt tension sensor is incorporated into the front passenger, lower safety belt anchor; refer to **Belt tension sensor**.

Front Safety Belt Warning Reminder

NOTE: To suit market legislation, the feature can be activated or disabled as appropriate.

- When the front passenger seat is unoccupied, the reminder will pertain only to the driver's safety belt and will cease when the belt is buckled.
- When the front passenger seat is occupied, the reminder will pertain to both safety belts and will cease only when **both** belts are buckled.

NOTE: The presence of a front seat passenger is detected by the **Passenger Seat Weight-Sensing System**.

Provided the reminder feature is activated, detection of an unfastened front safety belt is indicated by the illumination of the safety belt warning lamp and an audible warning.

NAS functionality

For the first 60 seconds after the ignition key has been turned to position 'II'/'III':

- If the driver's safety belt is unfastened, the safety belt warning lamp will remain illuminated and be accompanied by a single six-second audible warning.
- Fastening the driver's safety belt will cause the warnings to cease.
- Failure to fasten the driver's safety belt will cause the audible warning to cease after 6 seconds and the warning lamp to extinguish after 60 seconds.
- After 75 seconds have elapsed, the reminder feature will operate as described for rest-of-world functionality.

Rest-of-world functionality

An intermittent audible warning will start/resume and the safety belt warning lamp will flash under the following conditions:

- a front seat occupant is present and their safety belt is unfastened;
- the vehicle is travelling at a speed greater than 10 mile/h (16 km/h).

The warning will remain active for a 5 minute period, every 30 seconds during this period, the intermittent audible warning and flashing lamp will be evident for 10 seconds. These incremental warnings will cease when either of the following conditions are satisfied:

- front seat occupants fasten their safety belts;
- the vehicle is halted.

Disabling the reminder

The front passenger seat must be unoccupied and the following steps completed within 60 seconds:

1. Turn the ignition key to position 'II' (do not start the engine).
2. Repeat the following actions, nine times:
   – fasten the driver safety belt buckle, check the safety belt warning lamp extinguishes and then unfasten the driver safety belt buckle, check the safety belt warning lamp illuminates.

   NOTE: After completion of step 2, a single chime confirms that the reminder feature has been disabled.

Enabling the reminder

The procedure for enabling the reminder is identical to the disabling procedure.

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. 173**.

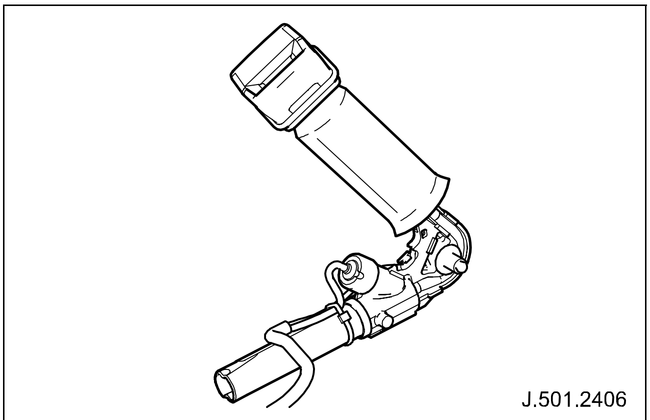

Fig. 173 Buckle-type pre-tensioner

The rear safety belts employ retractor-type pre-tensioners; refer to **Fig. 174** and **Fig. 175**.

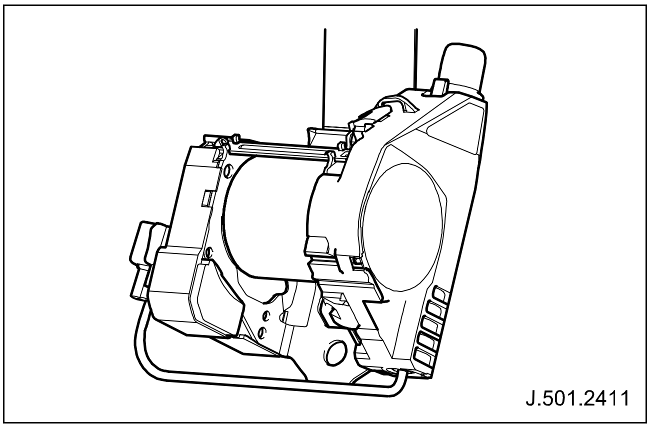

Fig. 174 Retractor-type pre-tensioner (rear center)

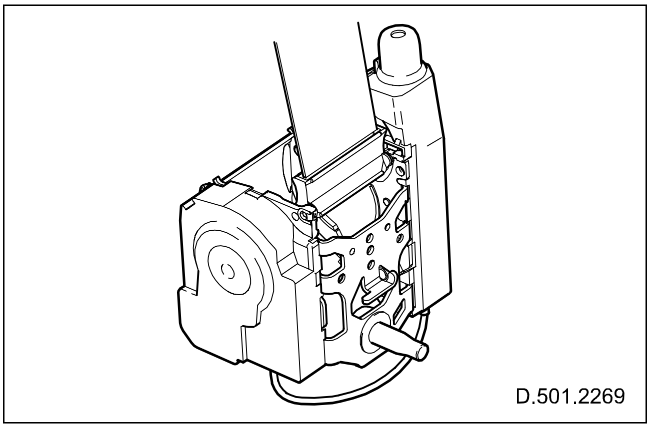

Fig. 175 Retractor-type pre-tensioner (rear left-hand)

Rear Safety Belt Comfort System

NOTE: The following applies only to vehicles fitted with electrically adjustable rear seats.

The rear safety belts for the outboard positions have an integral comfort solenoid, designed to be activated when the belts are fastened. During the period that a belt remains fastened, the solenoid switches operation from the retraction spring to a comfort spring, which reduces the force exerted on the occupant by the safety belt webbing. When the belt is unfastened, the comfort solenoid disengages the comfort spring, re-engages the retraction spring and causes the force on the webbing to immediately revert to the standard retraction mode.

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. 176A**). 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. 176B**);
2. the backrest tilts rearwards (**Fig. 176C**) 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. 176D**).

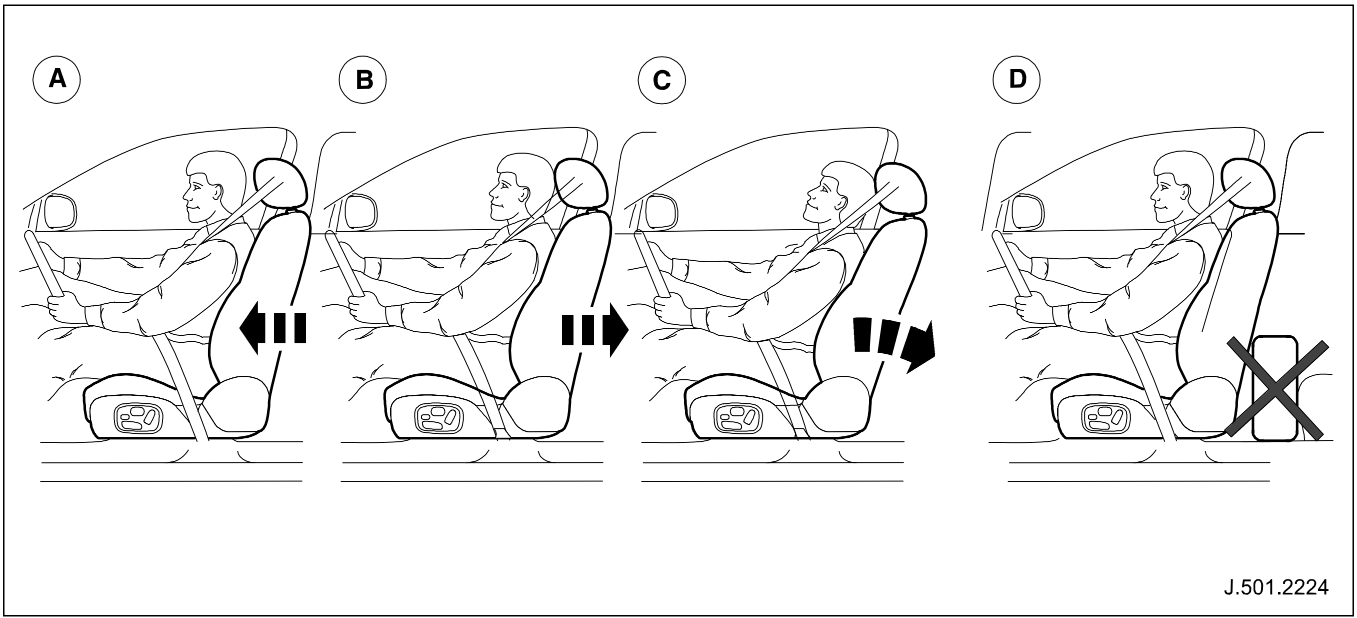

Fig. 176 Anti-whiplash feature

With reference to **Fig. 177**, 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. 177C**) to provide gentle braking.

NOTE: The shape of the window, the angle between the two links (**Fig. 177B**) and the return spring (2), prevents the mechanism from being activated during normal driving.

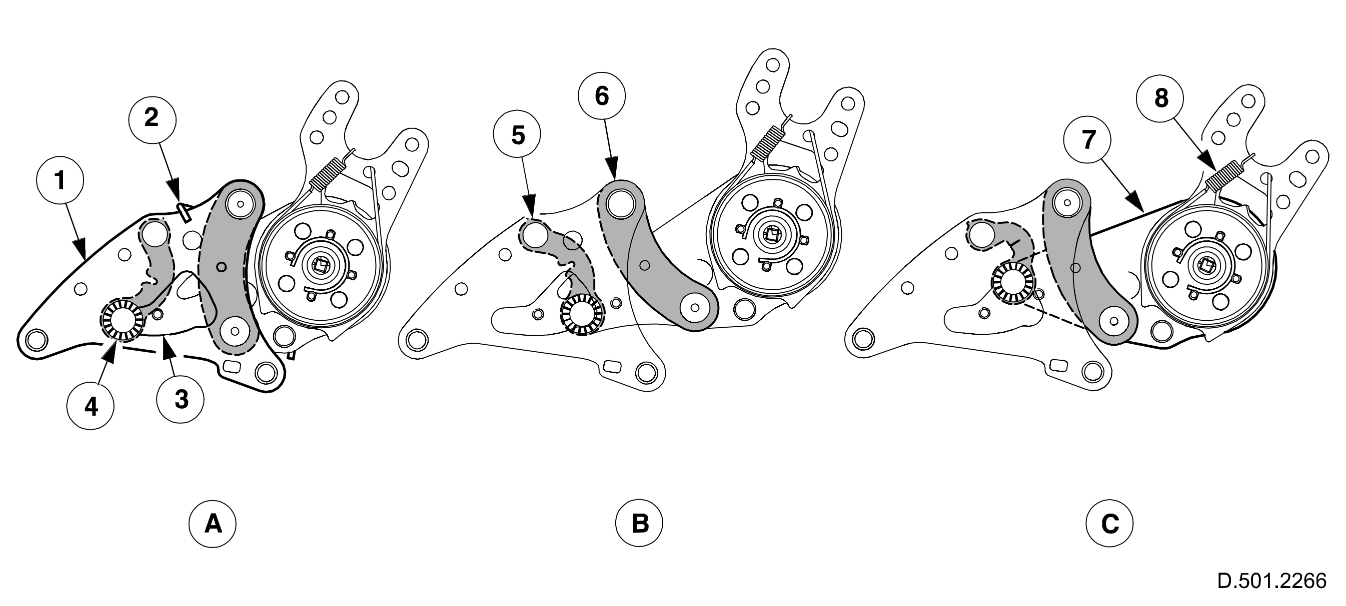

Fig. 177 Anti-whiplash mechanism (left-hand side)

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**.

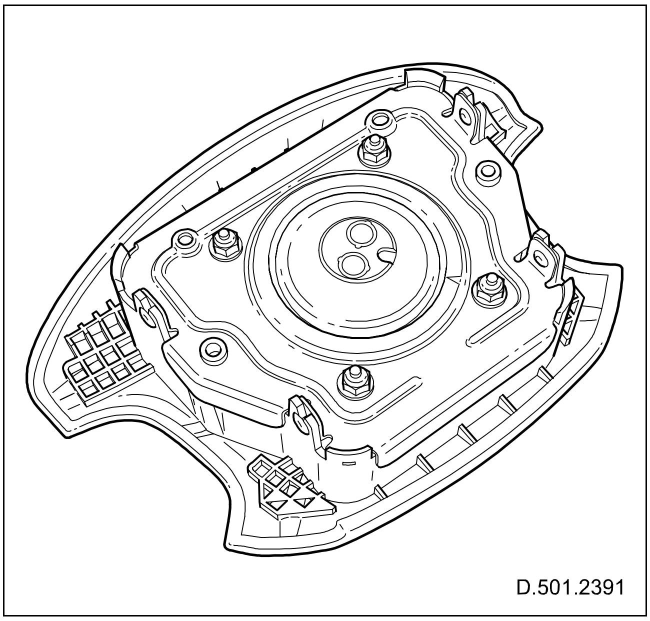

Fig. 178 Driver air bag module

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.

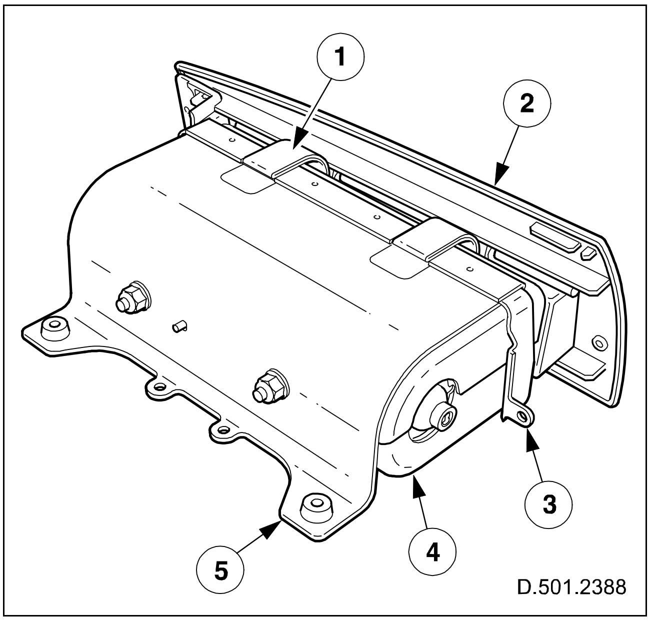

Fig. 179 Passenger twin-stage air bag module

1. Webbing straps
2. Air bag deployment door
3. Tether bar
4. Passenger air bag module
5. Mounting bracket

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**.

The passenger air bag deployment door incorporates a lens that displays the air-bag deactivated symbol.

NOTE: In some markets, the symbol may be replaced by the phrase 'PASS AIRBAG OFF'.

The lens 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 lens is designed to inform the front seat occupants whether or not the passenger air bag has been deactivated; refer to **Occupancy and Position Sensing**.

NOTE: The lamp is not a serviceable item; the complete housing must be changed; refer to **JTIS**.

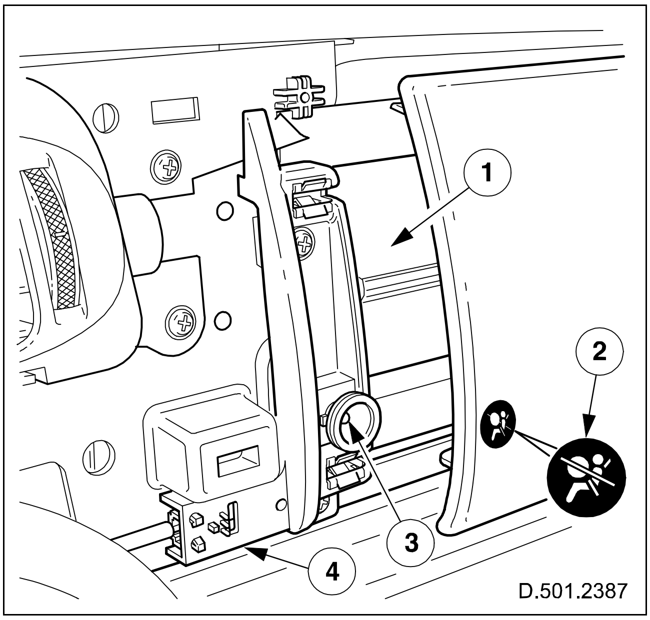

Fig. 180 Passenger air bag deactivation

1. Air bag module
2. Air bag deactivation indicator lens
3. Air bag deactivation indicator lamp
4. Air bag deactivation indicator lamp housing

Seat-Mounted Side Air Bag Module

The seat-mounted side air bag module is designed to provide protection for the thorax (the part of the torso between the neck and the abdomen). The module:

- is mounted in the outboard bolster of each front seat;
- is standard fit and specification in all markets;
- does not require routine maintenance;
- has no serviceable parts;
- uses compressed argon to inflate the bag.

NOTE: As with all occupant safety components, the SRS indicator lamp will illuminate if a DTC has been stored. Diagnosis must be undertaken using WDS.

In an air bag deployment situation, the air bag deploys through the stitched seam in the side bolster. A chute has been designed into the inside of the trim cover to ensure the air bag always emerges at the same point.

WARNING: In a service situation, the module must be correctly located in the chute. Failure to follow the service procedure could result in incorrect air bag deployment; refer to JTIS.

NOTE: In the event of a side impact that is sufficient to deploy the bag, it will be necessary to replace the complete seat.

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.

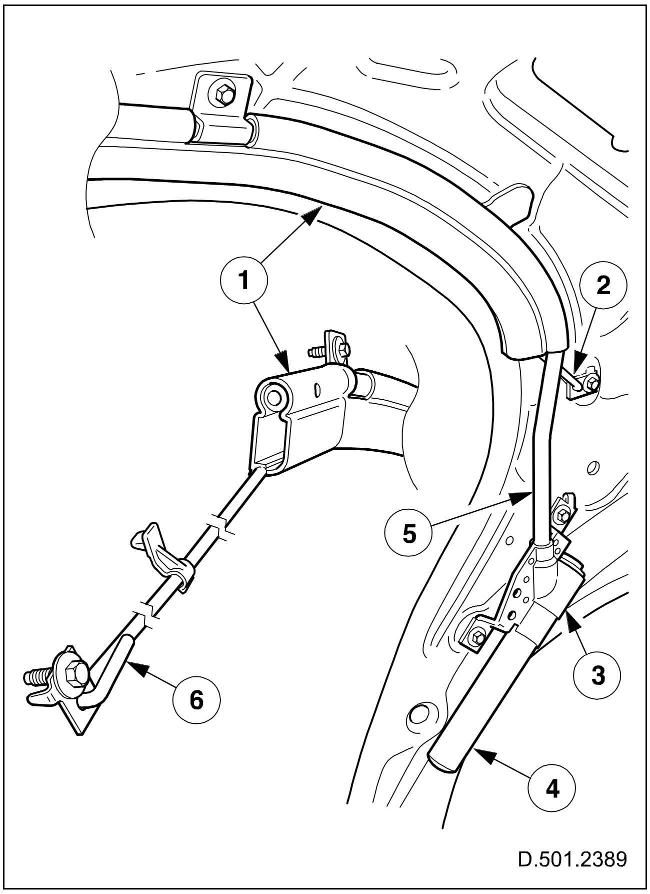

Fig. 181 Side curtain air bag

1. Housing
2. Rear tether
3. Inflator housing assembly
4. Inflator
5. Fill tube
6. Front tether

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 connection of 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**.

Vehicles installed with the heated steering wheel option have an additional power coupling; refer to **Climate Control System**, **Heated Steering Wheel**.

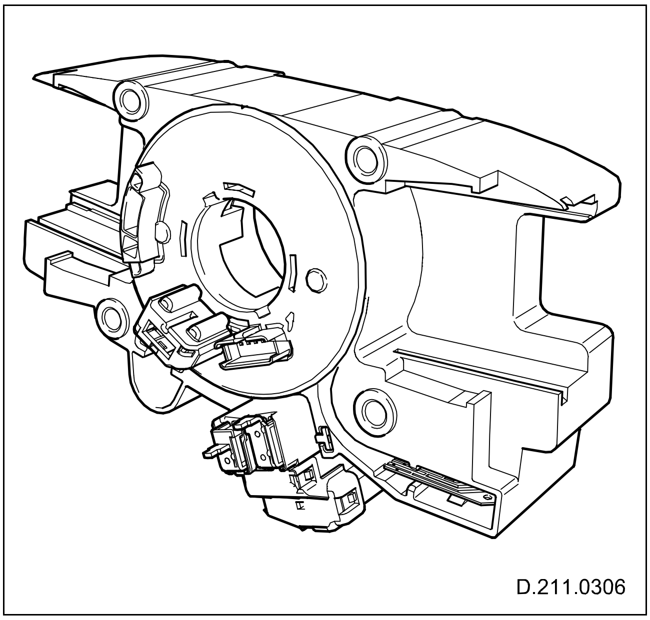

Fig. 182 Clockspring

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