

# New Product Introduction

## 2006 XJ

### Technical Guide



E62185



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## XJ 2006 Model Year Update

The XJ 2006 model year (MY) update provide changes to the vehicle in the following areas:

- Introduction of Tire Pressure Monitoring System (TPMS).
- Changes to the braking system.
  - Installation of non-active brake booster.
  - Introduction of single piston brake calipers to all vehicles.
  - Revised brake disc fitment.
  - Introduction of vacuum assist.
  - Two new hydraulic control unit and anti-lock brake system (ABS) modules.
- Introduction of variable valve timing to supercharged vehicles.
- Installation of secondary air injection for emission reduction.
- Revised petrol catalyts loadings to further improve exhaust emissions.
  - Assists in compliance from EU Stage 3 to EU Stage 4 petrol emission standards.
  - Assists in compliance to Low Emission Vehicle (LEV) II Standards and North American Ultra Low Emission Vehicle (ULEV) II Standards.
- Relocation of evaporative emission canister purge valve.
  - Assists in cabin noise reduction.
- Bluetooth® telephone communications network system.

## Terminology Glossary

The following abbreviations and acronyms are used in this publication:

Abbreviation / Acronym	Description
ABS	Anti-lock Brake System
ACC	Adaptive Cruise Control
CAN	Controller Area Network
CO	Carbon Monoxide
DSC	Dynamic Stability Control
GHz	GigaHertz
GTR	Global Technical Reference
ECM	Engine Control Module
EGR	Exhaust Gas Recirculation
EU	European Union
HC	Hydrocarbon
km/h	kilometers per hour
LEV	Low Emission Vehicle
LF	Low Frequency
MHz	MegaHertz
MY	Model Year
mph	miles per hour
NAS	North American Specification
PCM	Powertrain Control Module
PSE	Portable Support Electronics module
REM	Rear Electronics Module
RF	Radio Frequency
SCP	Standard Corporate Protocol
TPMS	Tire Pressure Monitoring System
ULEV	Ultra Low Emission Vehicle

<b>Abbreviation / Acronym</b>	<b>Description</b>
VVT	Variable Valve Timing
VACM	Voice Activated Control Module
WDS	Worldwide Diagnostic System



## Tire Pressure Monitoring System (TPMS)

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

- improve fuel consumption
- maintain ride and handling characteristics
- reduce the risk of rapid tire deflation – which may be caused by under inflated tires
- comply with legislation in relevant markets.

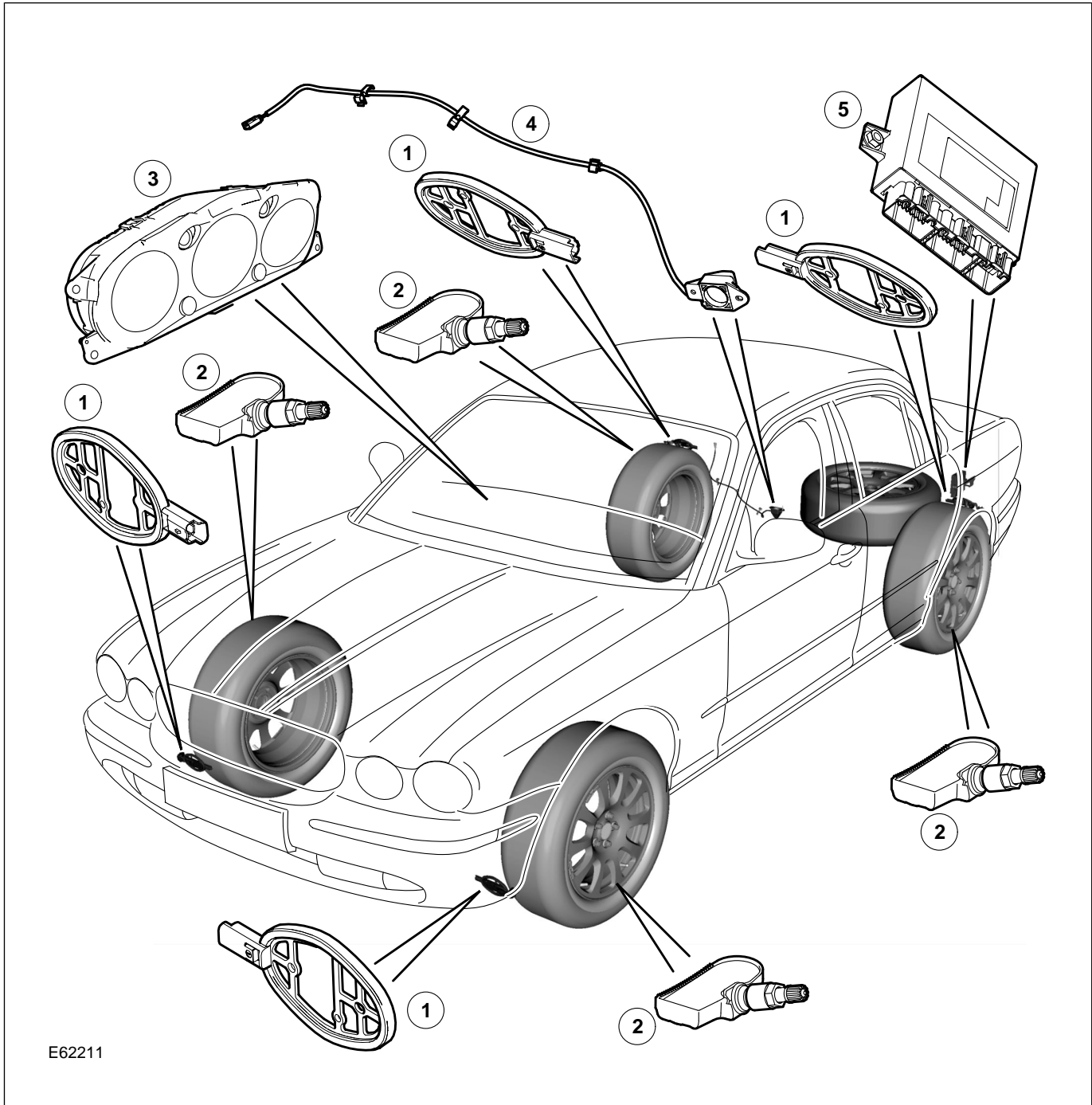
The TPMS measures the pressure in each of the tires on the vehicle (including the full size spare, if fitted) and issues a warning to the driver if any of the pressures deviate from a defined tolerance.

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

The instrument cluster displays warnings to the driver through the use of the low tire pressure warning indicator, the secondary amber warning indicator and the text message display.

The location of the tire with a pressure outside of the set limits is identified by a text message displayed in the instrument cluster message center. In addition the text message display will scroll through messages if more than one tire has reached the low tire pressure threshold.

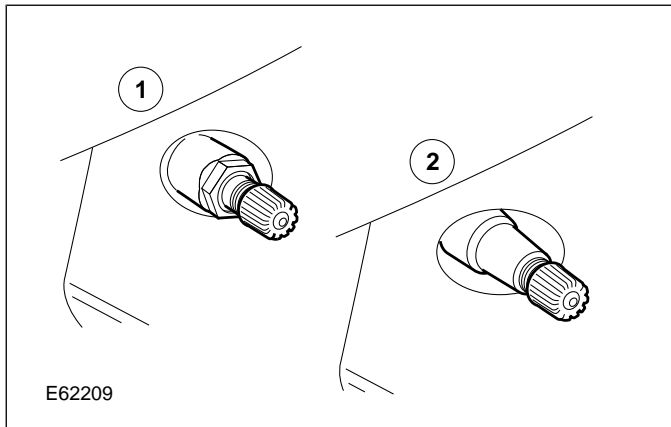
Tire Pressure Monitoring System - Component Location



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Item	Description	Item	Description
1	Initiator	4	External antenna
2	Tire low pressure sensor	5	TPMS module
3	Instrument cluster		

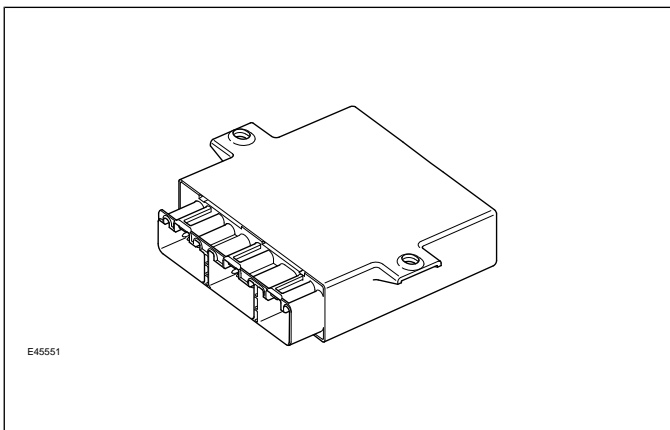
### Visual Identification



Wheels fitted with TPMS can be visually identified by the external metal lock nut and valve (1). All Jaguar non-TPMS wheels have a rubber valve fitted (2).

The TPMS monitors pressure in each tire including the full size spare tire (temporary-use spare wheels are not fitted with sensors and are consequently not monitored).

### TPMS Module



The TPMS module is located in the left-hand side of the spare wheel well. The TPMS module is fixed in position to a shared mounting bracket using a retaining nut. The connectors of the TPMS module point downwards and the external antenna connector points upwards.

The TPMS module's main function is to detect the following:

- the tire pressure is below the recommended low tolerance value – under inflated tire
- the location of the tire on the vehicle.

The TPMS module also communicates with the vehicle instrument cluster to provide the driver with appropriate warnings and indicate the status/failure of TPMS components.

### Tire Location

Because of the requirement for different pressure targets and thresholds for the front and rear tires, the TPMS module can identify the position of the tires on the vehicle.

The TPMS module then assigns a received tire low pressure sensor identification to a specific position on the vehicle (i.e. FL (front left), FR (front right), RL (rear left) or RR (rear right)).

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

The TPMS module can automatically detect, under normal operating conditions, the following:

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

### Spare Tire Identification

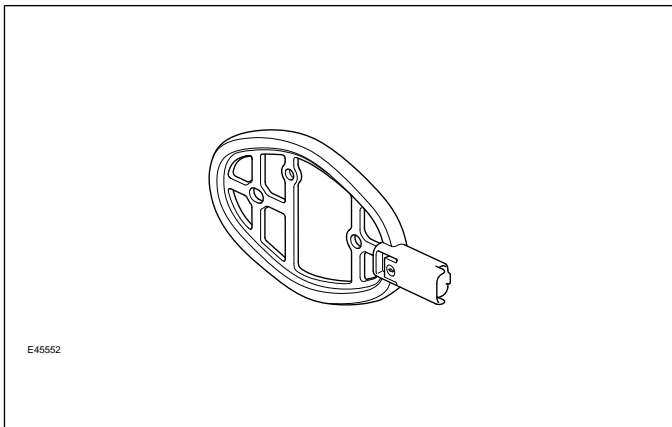
Depending on the vehicle specification, the spare tire may or may not be fitted with a tire low pressure sensor.

Temporary-use spare wheels are not fitted with a tire low pressure sensor and therefore pressures cannot be monitored.

When a full size spare wheel is fitted with a tire low pressure sensor, the TPMS module can detect it, determine that it is the spare tire and monitor its pressure and issue warnings to the driver accordingly. If the TPMS module does not detect a spare tire with a tire low pressure sensor, the module will not show a fault to the driver, however a fault code will be stored in the TPMS module.

If the spare tire is being monitored and the driver replaces a flat ‘running’ tire with the spare tire, the module will not continually warn the driver that the original flat tire (now in the spare position) is flat. This prevents distraction of the driver by constant warnings being issued. This warning will only be displayed for the first 20 seconds when the ignition switch is turned to the ON position.

**Initiator**

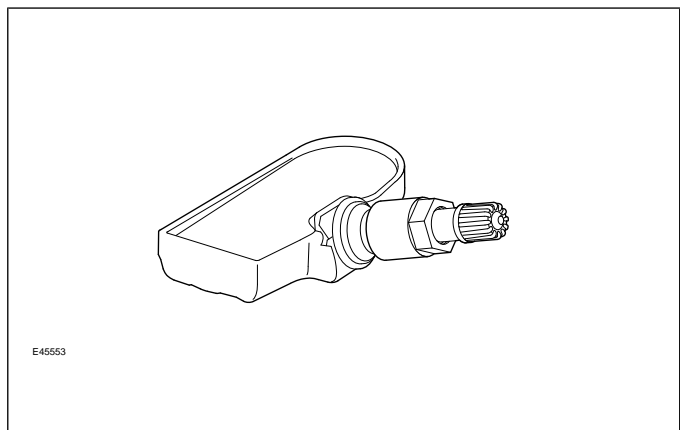


The initiators are located at the front of the front wheel arches and at the rear of the rear wheel arches. The TPMS system has four initiators. Each initiator has a connector which connects with the body harness.

The initiator is a passive, LF transmitter. Each initiator is controlled by the TPMS module and provides an auto-location feature to identify tire positions on the vehicle.

The TPMS module energizes each initiator in turn using LF drivers. The corresponding tire low pressure sensor detects the resulting LF transmission and responds by modifying a mode status bit within the RF transmission. This data is received by the TPMS module through the external antenna. The module then determines which sensor is transmitting and its location on the vehicle.

**Tire low pressure sensor**



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

The sensors periodically measure the pressure and temperature of the air inside the tire. Pressure and temperature measurements are transmitted periodically to the external antenna on the vehicle.

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

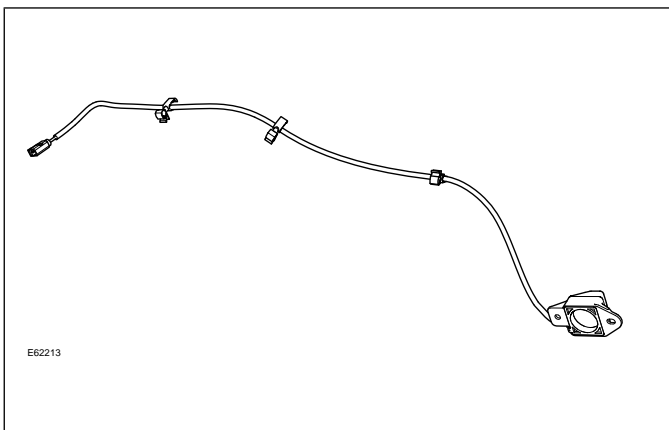
Care must be taken when changing a tire to avoid damage to the tire low pressure sensor. If the tire low pressure sensor is removed, the valve cap, valve core, nut, seal and washer must also be replaced and the tire low pressure sensor tightened to the correct torque value.

The valve cap, valve core, nut, seal and washer are replaced at every tire change.

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

In order to conserve battery power, the tire low pressure sensor uses different transmission rates when the wheel is stationary or moving. The vehicle speed required to change between the stationary and moving transmission rates is approximately 20 km/h (12.5 mph).

**External Antenna**

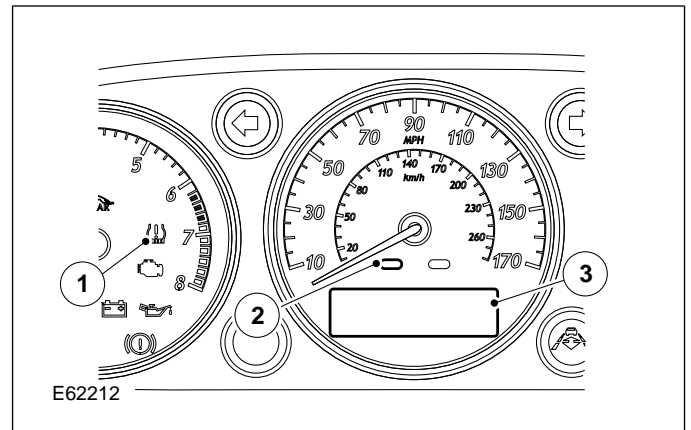


The TPMS external antenna is located at the rear of the vehicle and is mounted between the spare wheel well and rear subframe.

The unit receives tire pressure, temperature and acceleration readings from each tire and interfaces with the TPMS module. The TPMS module then transmits the appropriate messages to the instrument cluster.

The unit also receives further information from each tire pressure sensor concerning wheel identification, mode status and the condition of the tire pressure sensor battery.

**Instrument Cluster Indications**



Item	Description
1	Low tire pressure warning indicator
2	Secondary amber warning indicator
3	Message center

Warnings are conveyed by the low tire pressure warning indicator, the secondary amber warning indicator and a text message displayed in the message center.

The warning indicators are driven by CAN messages from the TPMS module. The warning indicators are illuminated by the cluster software for 3 seconds when the ignition is switched to position II for a bulb check.

**NOTE:** If the vehicle is not fitted with the TPMS, the warning indicators will not illuminate at any time.

The following table shows the warning indicator functionality for given events.

<b>Message</b>	<b>Meaning</b>
"CHECK PRESSURE RH or LH FRONT or REAR TIRE" + secondary amber warning indicator + low tire pressure warning indicator	Tire is significantly under-inflated. Stop as soon as safely possible to check tires and inflate to the recommended pressure.
"CHECK PRESSURE SPARE TIRE" + secondary amber warning indicator, displayed for 20 seconds only at ignition.	Spare tire is significantly under-inflated. Inflate spare tire to the recommended pressure.
"TIRE PRESSURE SENSOR FAULT" + secondary amber warning indicator	Temporary spare tire fitted. Limit vehicle speed to 80 kilometers per hour (km/h) (50 miles per hour (mph)). Replace the temporary spare tire with a correctly inflated full size tire as soon as possible.
	A tire low pressure sensor has become defective, an unapproved accessory is interfering with the TPMS or a wheel and tire which does not have a tire low pressure sensor has been fitted.
"TIRE PRESSURE SYSTEM FAULT" + secondary amber warning indicator	Wheel and tire which does not have a tire low pressure sensor has been fitted. Stop as soon as safely possible and have tire low pressure sensor fitted to the wheels and tires.
	Tire low pressure sensors have become defective, an unapproved accessory is interfering with the TPMS or a general fault has been detected in the TPMS.
"TIRE PRESSURES LOW FOR SPEED" + secondary amber warning indicator + low tire pressure warning indicator NOTE: This warning will only occur on non-NAS vehicles.	Tire pressures are not suitable for high speed driving. Reduce vehicle speed and stop as soon as safely possible to check tires and inflate to the recommended pressure for high speed driving.

Each time the vehicle is driven, the TPMS module activates each Low Frequency (LF) initiator in turn. The corresponding tire low pressure sensor detects the LF signal and responds by modifying the mode status within the RF transmission.

The system enters 'parking mode' after the vehicle speed has been less than 20 kilometers per hour (km/h) (12.5 miles per hour (mph)) for 12 minutes. In parking mode the tire low pressure sensors transmit a coded signal to

**System Operation**

The tire low pressure sensor transmits by Radio Frequency (RF) (315 MHz or 433 MHz depending on market) signal. These signals contains data which corresponds to tire low pressure sensor identification, tire pressure, tire temperature, acceleration and tire low pressure sensor mode.

the module once every 13 hours. If the tire pressure decreases by more than 0.06 bar (1 lbf/in<sup>2</sup>) the sensor will transmit more often as pressure is lost.

The spare tire sensor transmits a signal every 13 hours in the same manner as the road wheels when in parking mode. If the tire pressure decreases by more than 0.06 bar (1 lbf/in<sup>2</sup>) the sensor will transmit more often as pressure is lost.

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

When the vehicle has been parked for more than 15 minutes and then driven at a speed of more than 12.5 mph (20 km/h), the initiators fire in turn for 6 seconds on all except NAS vehicles or for 18 seconds on NAS only vehicles in the following order:

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

Each tire low pressure sensor responds in turn so the module can establish the sensor positions at the start of the drive cycle. This process is repeated up to three times but less if the sensor positions are already known in the module. This process is known as 'Auto Location' and takes 3 to 4 minutes on all except NAS vehicles and 7 to 8 minutes on NAS vehicles to complete. During this period the tire low pressure sensors transmit at regular intervals, once every 5 seconds on all except NAS vehicles and once every 15 seconds on NAS vehicles. For the remainder of the drive cycle the tire

low pressure sensors transmit once every 60 seconds or if a change in tire pressure is sensed until the vehicle stops and the system returns to parking mode.

Once the wheel position is established, the initiators stop firing and do not fire again until the vehicle has been parked for more than 15 minutes. The signal transmissions from each tire low pressure sensor continue at 1 minute intervals whilst the vehicle is being driven. This transmission is to monitor the tire pressure. The warning occurs at 25% deflation and comprises of message center amber secondary warning light, the low tire pressure warning indicator and an appropriate message displayed in the instrument cluster message center. The message center will also display additional information about the position of the affected wheel(s).

## Braking System - Introduction

The 06 model year (MY) update incorporates a new braking system comprising the following components and functions:

- Dynamic stability control (DSC).
  - Incorporates all new hardware.
  - For additional information, refer to: Hydraulic Control Unit and Anti-lock Brake System (ABS) Module.
- New foundation brake system components.
  - For additional information, refer to: Brake System Components.
- New supercharger brake system components.
  - For additional information, refer to: Brake System Components.

## Brake System Components

The brake system components is an all new for both foundation and supercharger braking systems and further enhance the vehicle's braking capability.

The modifications to the system are:

### Front calipers:

- All vehicles:- 60 mm (2.36 in) single-piston sliding arrangement.

### Front brake discs:

- Foundation:- 326 x 30 mm (12.83 x 1.18 in) ventilated brake discs.
- Supercharger:- 355 x 32 (13.98 x 1.26 in) ventilated brake discs.

### Rear calipers:

- All vehicles:- 45 mm (1.77 in) single-piston sliding arrangement with a self-adjusting mechanism.
- All vehicles:- utilize single caliper for electric parking brake actuation.

### Rear brake discs:

- All vehicles:- 326 x 20 (9.29 x 0.78 in) ventilated brake discs.

Steel-braided brake hoses are installed as standard to the braking systems providing the following advantages over conventional hoses:

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

## Non-Active Brake Booster

A non-active brake booster is now fitted to the vehicle.

On the previous MY vehicles an active booster was required to assist in a faster response at low temperatures whilst Speed Control and/or Stability Assist where in operation. The Speed Control and Stability Assist are now supported solely by the Dynamic Stability Control (DSC) module which incorporates the anti-lock brake system (ABS) hydraulic control unit.

The active brake booster required a brake booster travel switch and a pressure sensor. The non-active brake booster system has no need for the brake booster travel switch and sees the pressure sensor integrated into the ABS hydraulic control unit.

There are two brake boosters available, one for vehicles with and one for vehicles without a vacuum assist . For additional information, refer to: Vacuum Assist.

For vehicles fitted with vacuum assist, the booster is fitted with a vacuum sensor. The sensor identifies when the system vacuum is below the required value and operates the ABS hydraulic control unit to bring the system brake fluid line pressure within defined limits.



### **Vacuum Assist**

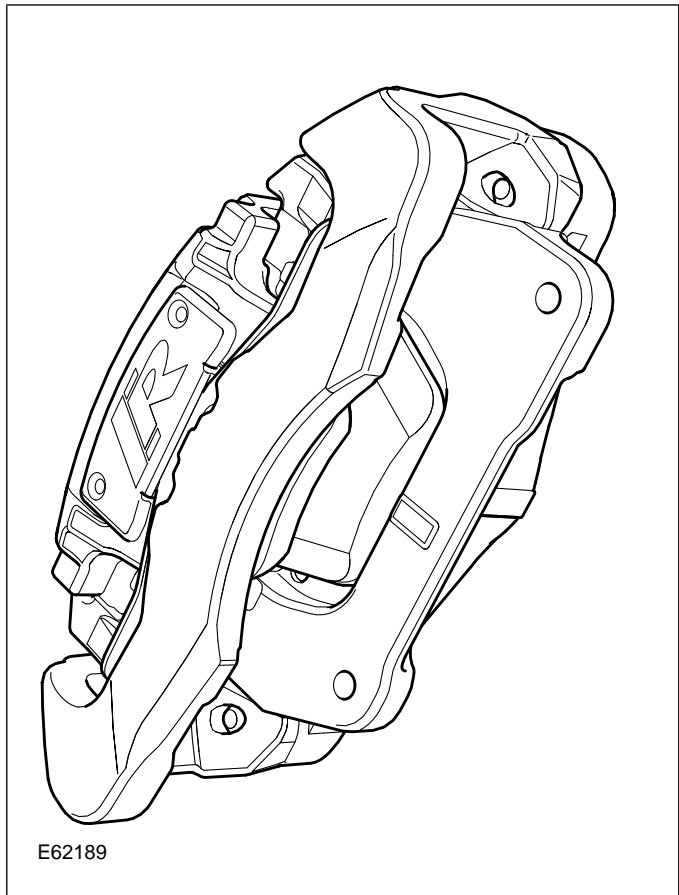
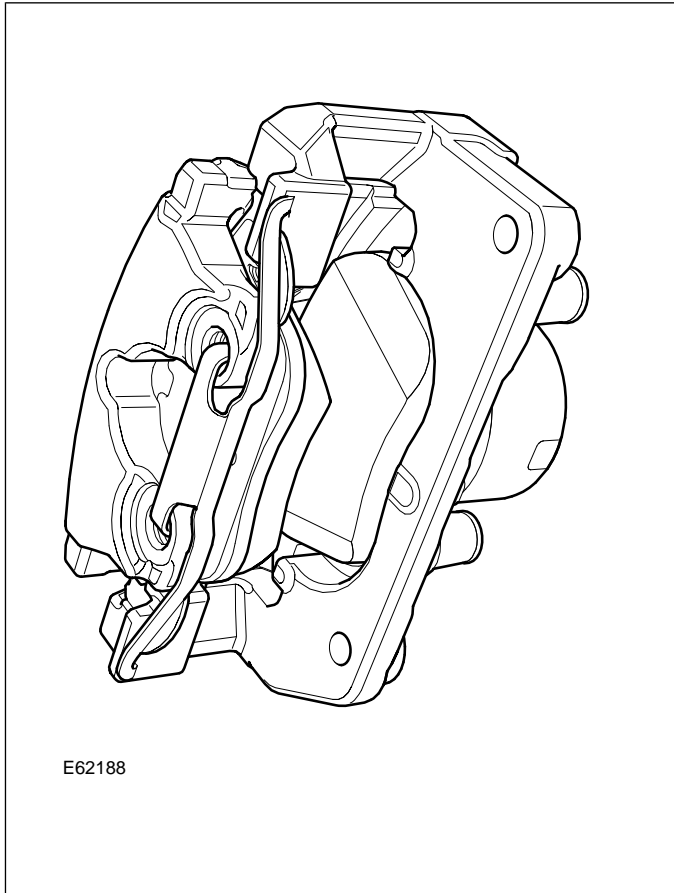
To assist braking effort at low temperatures the vehicle is fitted with a vacuum assist to supply additional pressure in the brake fluid line when required.

When the vehicle engine temperature is low and the required braking assistance is not available, the vacuum assist becomes operational when the vacuum sensor fitted to the brake booster determines that there is insufficient brake booster vacuum and requests additional pressure in the brake fluid line. This additional brake fluid line pressure ensures the driver can brake with confidence at all times.

Vehicles fitted with a 3.0 ltr V6 or a 3.5 ltr V8 engine require a vacuum assist.

**V6, V8 N/A and Diesel Vehicles**

Foundation level brake caliper assemblies for 06 model year (MY) are now made from cast iron. The caliper is now a single 60 mm (2.36 in) piston.



The brake discs are larger than the foundation brake discs at 355 mm.

The supercharged vehicles also have an “R” branded anti-rattle spring fitted to the caliper.

With the increased caliper piston size, the brake discs have also been enlarged from 300 mm to 326 mm.

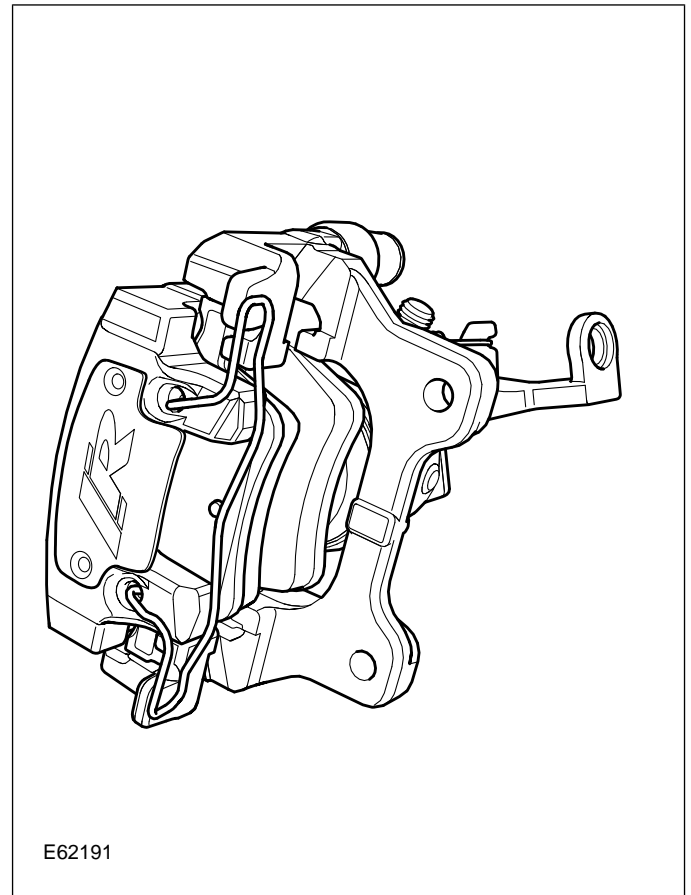
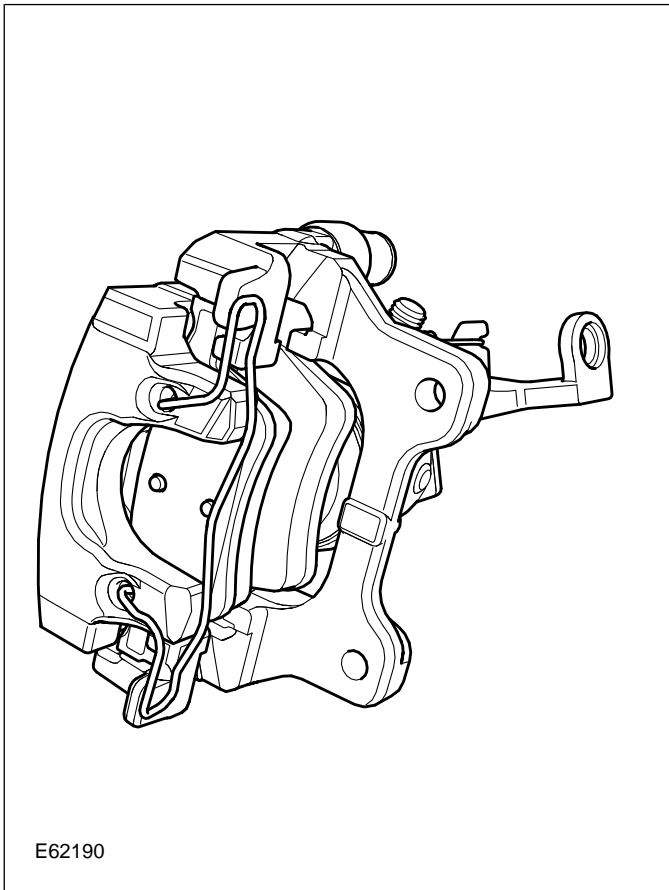
**Supercharged Vehicles**

Supercharged vehicles brake calipers are also a single 60 mm (2.36 in) piston, but the caliper is a composite design made from an aluminum piston side housing and a cast iron bridge/frame and caliper anchor plate.

### V6, V8 N/A and Diesel Vehicles

Foundation level brake calipers for this model year (MY) are now made from aluminum. The caliper has a single 45 mm (1.77 in) piston.

The brake caliper still contains the park brake mechanism.



The brake discs are also 326 mm.

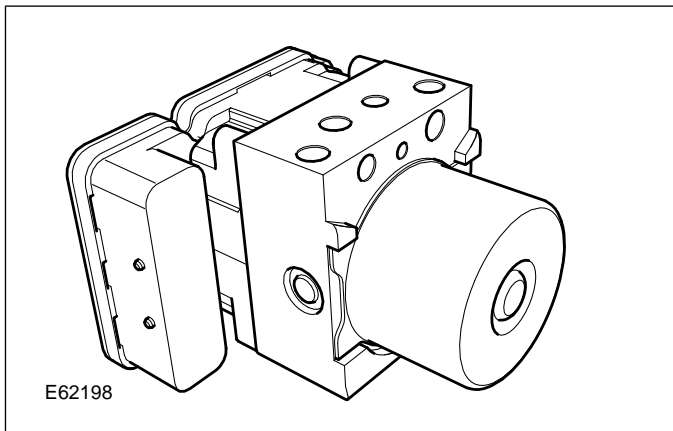
The supercharged vehicles also have an “R” branded logo plate fitted to the caliper.

There is now only one size of brake disc available for foundation level brakes at 326 mm.

### Supercharged Vehicles

On previous MY supercharged vehicles Brembo brakes were fitted, which required an additional park brake caliper. These have been superseded by the single piston brake caliper with park brake mechanism as fitted to foundation level brakes.

## Hydraulic Control Unit and Anti-lock Brake System (ABS) Module



to the instrument cluster and then the standard corporate protocol (SCP) network to the rear electronics module (REM).

This model year (MY) vehicle sees the introduction of two variants of the hydraulic control unit and anti-lock brake system (ABS) module. The two hydraulic control unit and ABS modules are for non-adaptive cruise control (ACC) and ACC equipped vehicles.

The operation of the hydraulic control unit and ABS module is fundamentally the same as previous MY, but with the additional functionality for vacuum assist. This feature is only active when brake vacuum is low, and in the first five minutes after the engine is switched on.

Vacuum assist uses the hydraulic control unit pump to supply additional pressure in the brake fluid line when required to improve braking effort. For additional information, refer to: Brake System.

The hydraulic control unit and ABS module controls the brake lamp illumination only when ACC is operational. Brake lamp illumination is controlled by the hydraulic control unit and ABS module using the multiplex network.

Due to removal of active brake booster, (for additional information, refer to: Brake System) the brake pedal no longer moves when the ACC system is braking the vehicle, therefore the brake lamp switches no longer operate the brake lights in ACC mode. The hydraulic control unit and ABS module request that the brake lamps are operated using controller area network (CAN)

### Variable Valve Timing (Vehicles with supercharger)

The continuous variable valve timing (VVT) as seen on the naturally aspirated engine has been introduced to the super charged engine for this model year update. VVT offers improved low and high-speed engine performance and excellent idle quality.

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

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

The VVT system uses a vane device to control the camshaft angle, refer to VVT Operation in this section. The system operates over a range of 48° and is advanced or retarded to the optimum angle within this range.

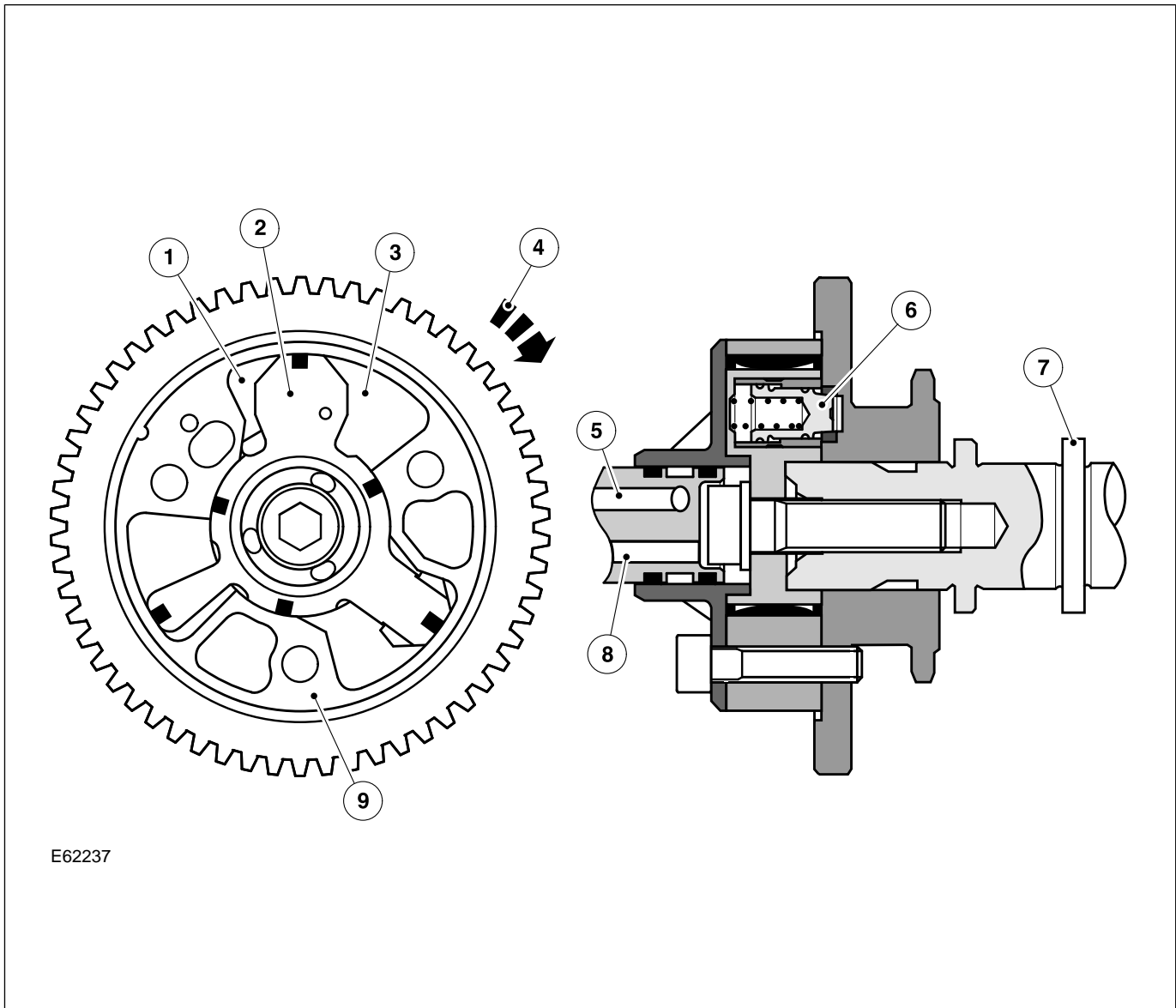
The engine control module (ECM) controls the VVT, using engine control signals pertaining to engine speed and load, and engine oil temperature to calculate the appropriate camshaft position.

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



Item	Description	Item	Description
1	Vane housing	6	Stopper pin
2	Vane shaft	7	Intake camshaft
3	Retard chamber	8	Retard chamber oil channel
4	Rotation direction	9	Advance chamber
5	Advance 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.

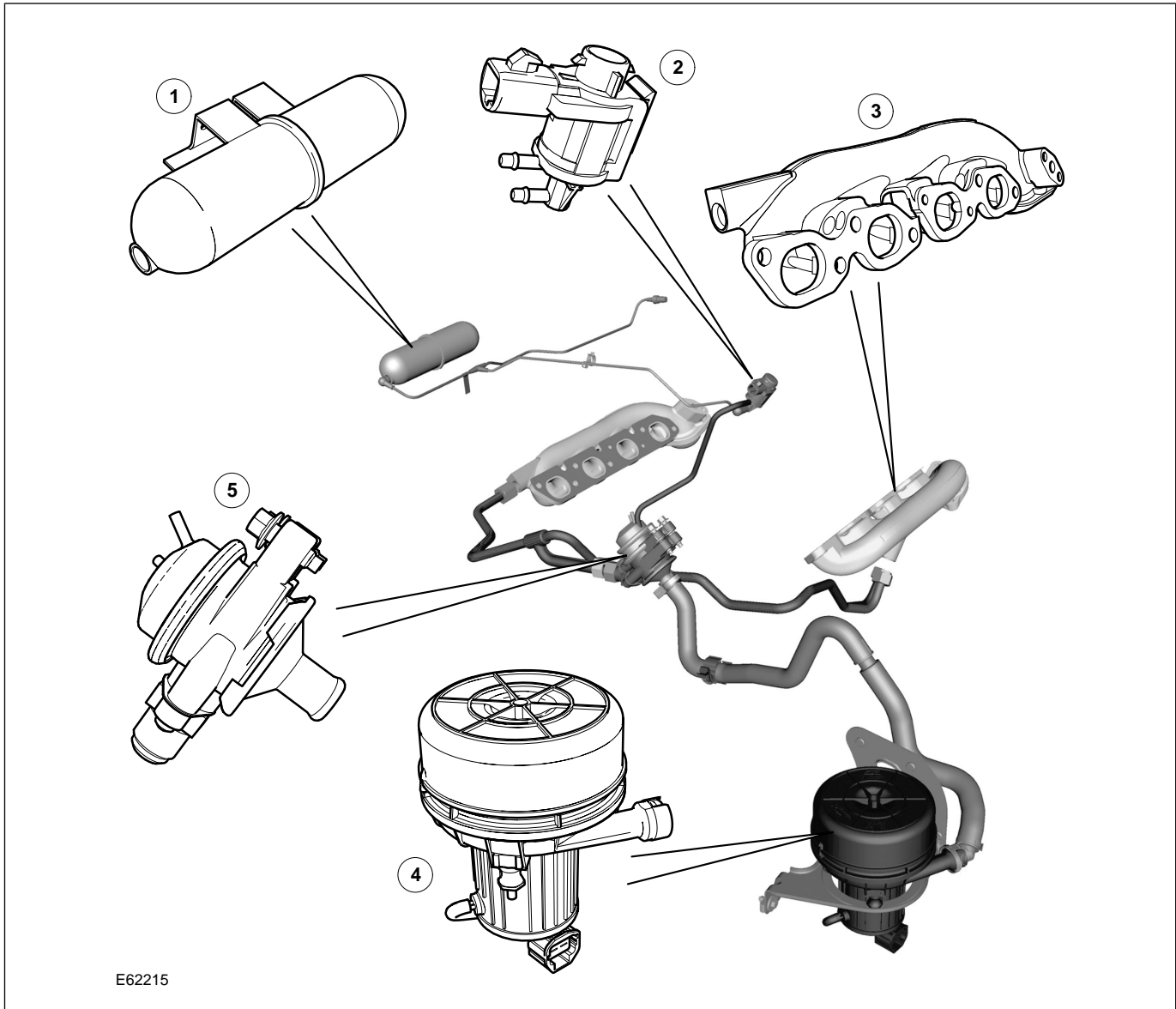
Engine oil properties and temperature can affect the ability of the VVT mechanism to follow demand changes to the cam phase angle. At very low oil-temperatures, movement of the VVT mechanism is sluggish due to increased viscosity, and at high oil-temperatures the reduced viscosity may impair operation 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.

### Secondary Air Injection (AIR)

To assist in the reduction of exhaust emissions to meet European Union (EU) Stage 4 and Federal petrol Emission standards, secondary air injection (AIR) is now fitted to the vehicle.



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**NOTE:** V8 secondary air injection system shown, V6 similar.



Item	Description	Item	Description
1	Secondary air injection vacuum reservoir	4	Secondary air injection pump
2	Secondary air injection vacuum solenoid valve	5	Secondary air injection control valve
3	Secondary air injection exhaust manifold		

The secondary air injection pump is used to provide a supply of air into the exhaust manifolds during the cold start period. The hot unburnt fuel particles leaving the combustion chamber mix with the air injected into the exhaust manifolds and heat up due to a chemical reaction known as an exothermic reaction.

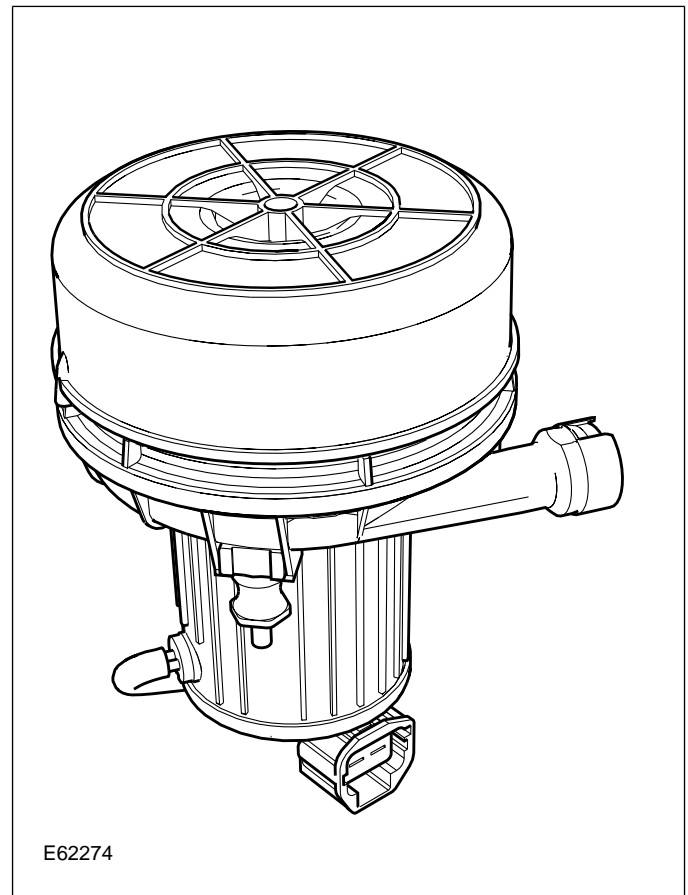
The additional heat generated in the exhaust manifold also provides rapid heating of the exhaust system catalytic converters. The additional oxygen which is delivered to the catalytic converters also generate an exothermic reaction which causes the catalytic converters to reach their optimum operating temperature and 'light off' quickly.

The catalytic converters only start to provide effective treatment of emission pollutants when they reach an operating temperature of approximately 250°C (482°F) and need to be between temperatures of 400°C (752°F) and 800°C (1472°F) for optimum efficiency. Consequently, the heat produced by the secondary air injection exothermic reaction reduces the time delay before the catalysts reach an efficient operating temperature.

The secondary air injection system comprises the following components:

- Secondary air injection pump
- Secondary air injection vacuum solenoid valve
- Secondary air injection control valve
- Secondary air injection vacuum reservoir
- Secondary air injection pump relay
- Secondary air injection pressure switch (North American Specification (NAS) vehicles only).

**Secondary Air Injection Pump**



The secondary air injection pump is located behind the left-hand side of the front bumper cover. The pump is fitted on rubber mountings to help suppress noise generated by secondary air injection pump operation. The secondary air injection pump is powered from the battery by a dedicated relay and supplies approximately 10-15 kg/hr (22-33 lb/hr) of air when the vehicle is at idle on initial start up from 20°C (68°F).

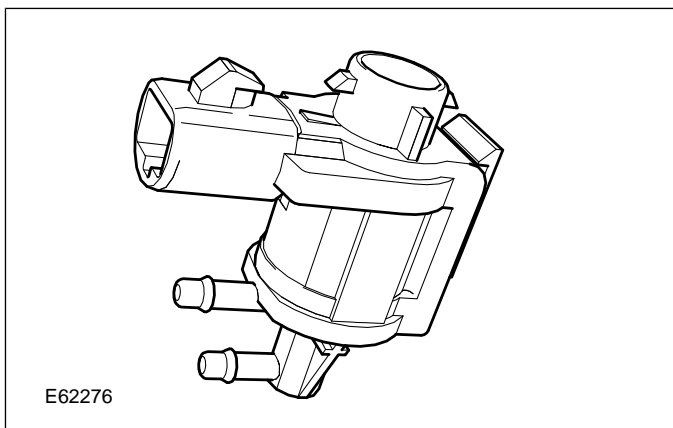
Air is drawn into the secondary air injection pump through vents in its front cover and is then passed through a foam filter. The air is delivered to the exhaust manifold on each side of the engine through a combination of plastic pipes and stainless steel tubes.

At the same time the secondary air injection pump is started, the engine control module (ECM) operates a secondary air injection vacuum solenoid valve, which opens to allow vacuum from the secondary air injection vacuum reservoir to be applied to the vacuum operated secondary air injection control valve. When the vacuum is applied to the secondary air injection control valve, it opens to allow the air from the secondary air injection pump through to the exhaust manifolds.

When the ECM operates the secondary air injection vacuum solenoid valve, the vacuum supply to the secondary air injection control valve is cut-off and the valve closes to prevent further air being injected into the exhaust manifold. At the same time as the secondary air injection vacuum solenoid valve is closed, the ECM operates the secondary air injection pump relay and this stops the secondary air injection pump.

If the secondary air injection pump is found to be malfunctioning the system can be checked using Worldwide Diagnostic System (WDS).

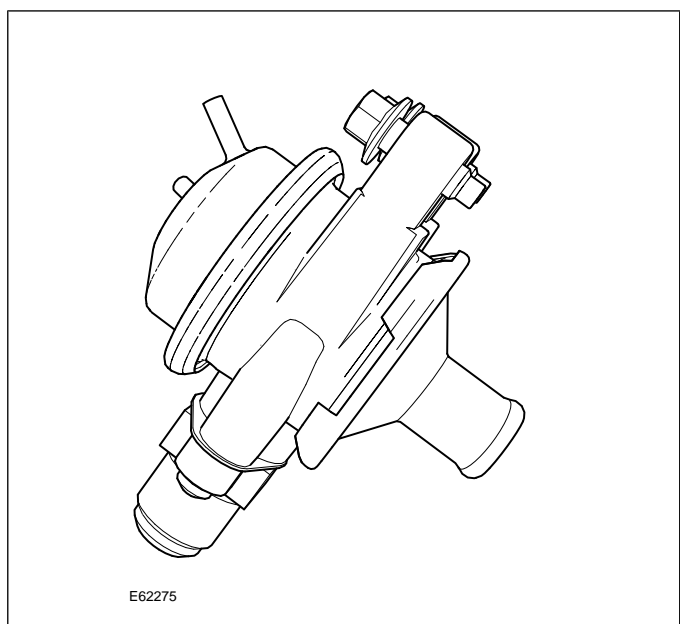
**Secondary Air Injection Vacuum Solenoid Valve**



The ECM switches on the secondary air injection vacuum solenoid valve at the same time as initiating secondary air injection pump operation. When the secondary air injection vacuum solenoid valve is open, a steady vacuum supply is allowed through to open the vacuum operated secondary air injection control valve. When the ECM de-energizes the secondary air injection vacuum solenoid valve, the valve closes and immediately shuts off the vacuum supply to the secondary air injection control valve at the same time as secondary air injection pump operation is terminated.

When the secondary air injection vacuum solenoid valve is de-energized, the vacuum supply line opens to atmosphere. This causes the secondary air injection vacuum solenoid valve to close automatically to prevent further air injection.

**Secondary Air Injection Control Valve**



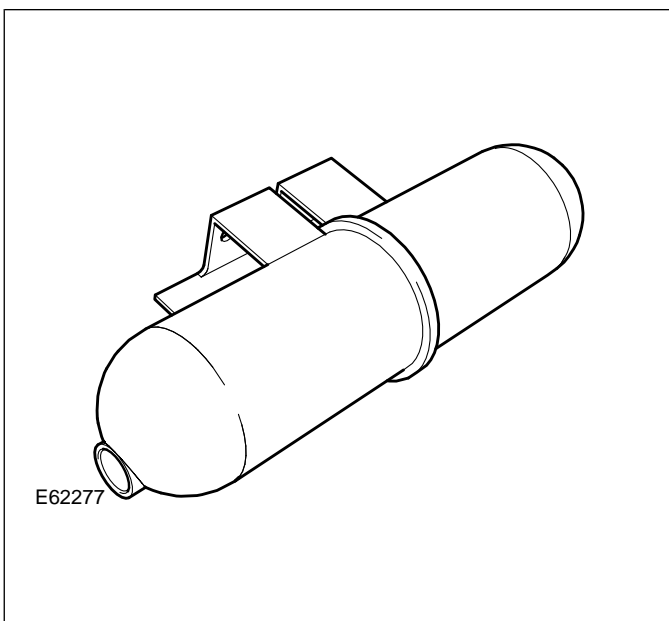
Forced air from the secondary air injection pump is controlled by the secondary air injection control valve. This allows the correct amount of air to be injected directly into the exhaust manifolds. The secondary air injection control valve prevents exhaust gases from blowing back into the secondary air injection pump.

The secondary air injection control valve is provided a vacuum from the secondary air injection vacuum reservoir located in the right-hand side of the engine bay. This allows the secondary air injection pump to run with less load, which reduces noise levels produced by the secondary air injection pump.

When the pressure in the exhaust system is higher than in the secondary air injection system, the secondary air injection control valve closes the circuit. This protects the secondary air injection system from exhaust gasses flowing back into the secondary air injection system.

Vacuum to the secondary air injection vacuum solenoid valve is supplied from the intake manifold vacuum by the secondary air injection vacuum reservoir. A small bore vacuum hose provides the vacuum route between the secondary air injection vacuum reservoir and secondary air injection vacuum solenoid valve. A further small bore vacuum hose is used to connect the secondary air injection vacuum solenoid valve to the secondary air injection control valve.

### Secondary Air Injection Vacuum Reservoir



A secondary air injection vacuum reservoir is located on the right-hand side of the engine bay.

The secondary air injection vacuum reservoir is included in the vacuum supply line between the intake manifold and the secondary air injection vacuum solenoid valve.

The secondary air injection vacuum reservoir contains a one-way valve to stop vacuum leaking back towards the intake manifold side of the system. The secondary air injection vacuum reservoir holds a constant vacuum so that the secondary air injection control valve opens instantaneously as soon as the secondary air injection solenoid valve is energized.

### Secondary Air Injection Pump Relay

The secondary air injection pump relay is located in the engine compartment junction box. The ECM controls operation of the secondary air injection pump by energizing or de-energizing the secondary air injection pump relay.

The secondary air injection pump receives its voltage supply from the secondary air injection pump relay. The ECM monitors the state of the relay for correct operation as part of its system diagnosis.

### Secondary Air Injection Pressure Switch

The secondary air injection pressure switch is fitted to North American Specification (NAS) market vehicles only. The secondary air injection system is monitored by observing the system pressure by using the secondary air injection pressure switch at several instances during its cycle of operation.

Secondary air injection system pressure is measured before operation of the secondary air injection pump. The secondary air injection pump is then switched on simultaneously with the opening of the secondary air injection vacuum solenoid valve. After a delay to allow the secondary air injection system to stabilize, the system pressure is measured again, this time by taking the average of a 1 second duration of readings, and normalizing for variations in battery voltage and

atmospheric pressure. If the system pressure measured at this time has not risen enough with respect to the initial secondary air injection pressure reading then a failure will be flagged.

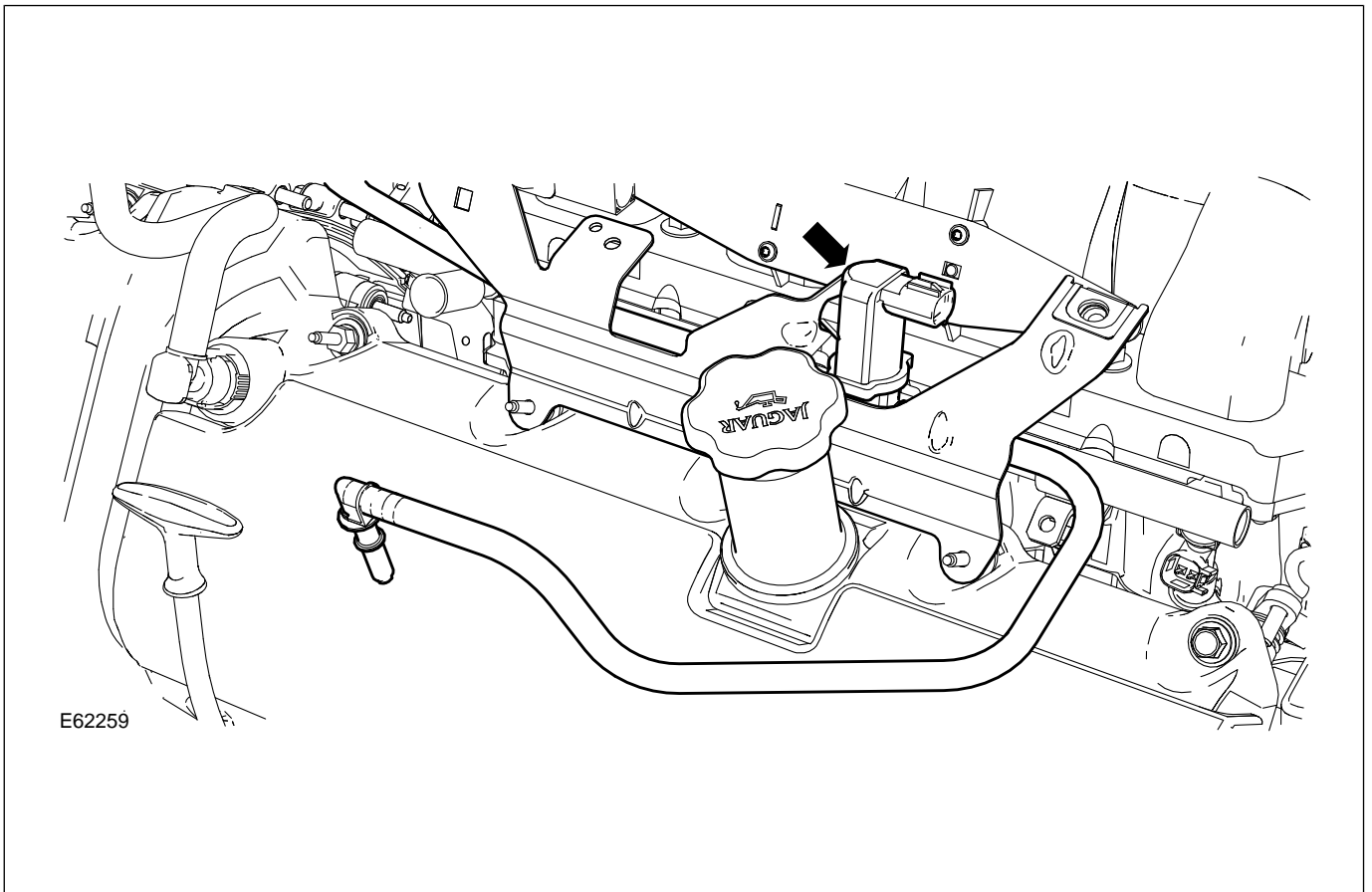
A second pressure measurement is made after the requirement for secondary air injection into the exhaust system has expired, but continuing on from the same period of secondary air injection pump operation. In this instance the pump is left running, against a closed secondary air injection vacuum solenoid valve. Again this pressure measurement is the average of a 1 second duration of readings normalized for variations in battery voltage and atmospheric pressure. If the system pressure measured at this time has not risen enough or has risen too much with respect to the system pressure during normal operation of secondary air injection then a failure will be flagged.

A final pressure reading is taken after the secondary air injection system has been switched off to ensure the system shuts down.

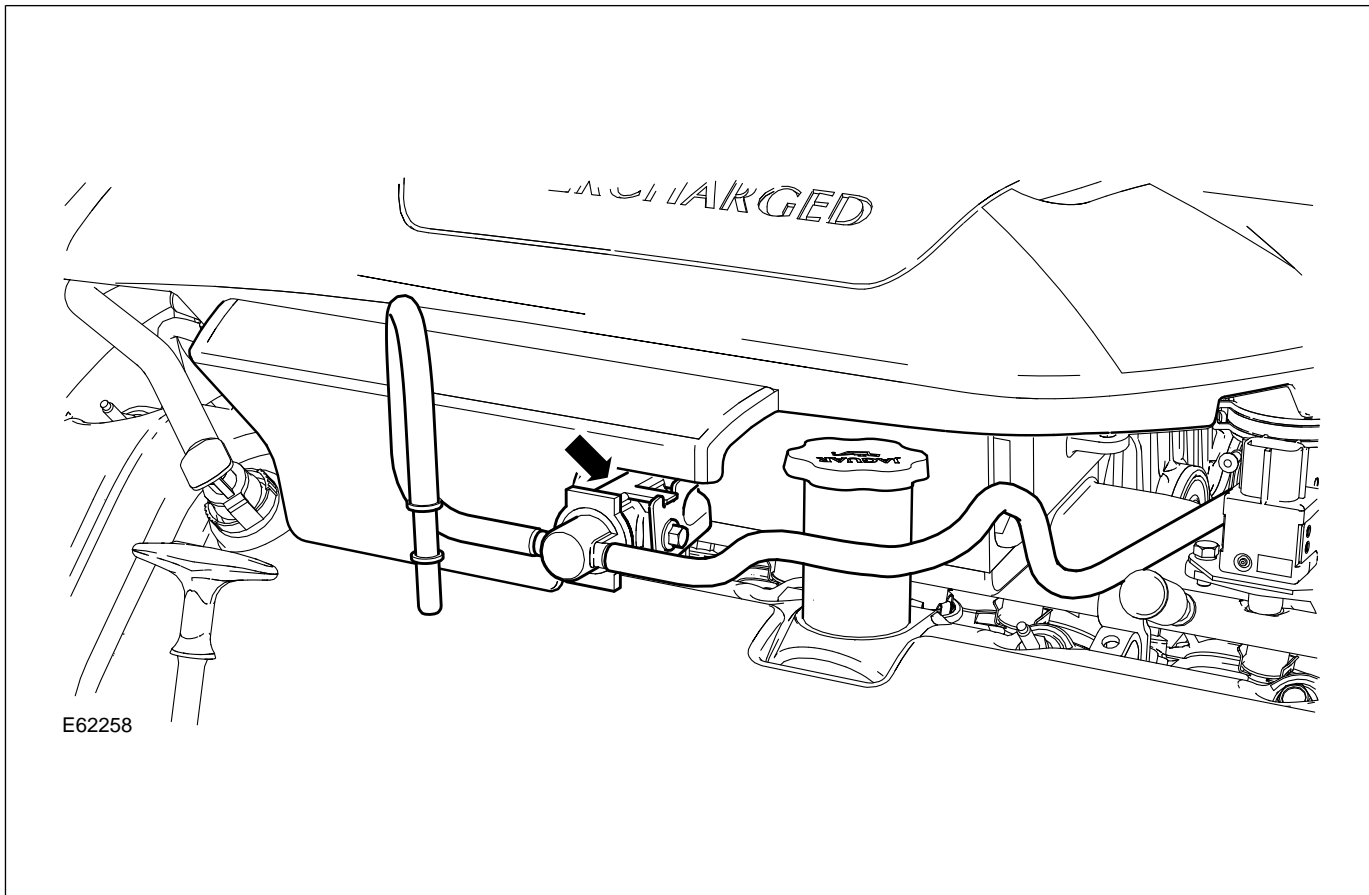
## Evaporative Emission Canister Purge Valve

The evaporative emission canister purge valve has now been located on the engine in the left-hand bank cylinder head area. This has reduced noise emissions previously encountered when the valve was located on the engine compartment bulkhead.

**Vehicles without supercharger**



## Vehicles with supercharger



The Engine Control Module (ECM) operates the valve to purge fuel vapor from the evaporative emission 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 fueling 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 North American Specification (NAS) markets only, is provided on the purge valve line to enable leak test diagnosis of the fuel system.

### Variable Valve Timing (Vehicles with supercharger)

The Engine Control Module (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.

**Three-way Catalytic Converter**

Petrol vehicles use three-way catalytic converters. These three-way catalytic converters use honeycomb structured monolithic elements known as substrates. The substrates are coated with palladium which converts hydrocarbons, carbon monoxide and nitrogen oxides into harmless products (carbon dioxide, water and nitrogen).

In order to meet more stringent European Union (EU) Stage 4 Petrol Emission standards and North American Low Emission Vehicle (LEV) II Ultra Low Emission Vehicle (ULEV) II standards, the catalyst substrates have been changed so that all engine derivatives employ 2 x 44 in<sup>3</sup> catalyst substrates in each downpipe, the front having 900 cells/in<sup>2</sup> and the rear 400 cells/in<sup>2</sup>. They have also received additional coatings of palladium.

Please see the below tables for the improvements in the exhaust emissions.

**Exhaust Emission Comparison EU Stage 3 to EU stage 4**

**Vehicles with Petrol Engine**

<b>EU Emissions Standard</b>	<b>HC (Hydrocarbon)</b>	<b>NOx (Nitric oxide and nitrogen dioxide)</b>	<b>CO (Carbon monoxide)</b>
Stage 3	0.20 grammes per km at 80,000 km	0.15 grammes per km at 80,000 km	2.30 grammes per km at 80,000 km
	0.20 grammes per 0.62 mile at 49,600 miles	0.15 grammes per 0.62 mile at 49,600 miles	2.30 grammes per 0.62 mile at 49,600 miles
Stage 4	0.10 grammes per km at 100,000 km	0.08 grammes per km at 100,000 km	1.0 grammes per km at 100,000 km
	0.10 grammes per 0.62 mile at 62,000 miles	0.08 grammes per 0.62 mile at 62,000 miles	1.0 grammes per 0.62 mile at 62,000 miles

**Exhaust Emissions North America**

**Exhaust Emissions to Ultra Low Emission Vehicle (ULEV) II Standards.**

**Vehicles without Supercharger**

<b>Emissions Standard</b>	<b>Hydrocarbons</b>
ULEV II	0.055 grammes per mile at 120,000 miles

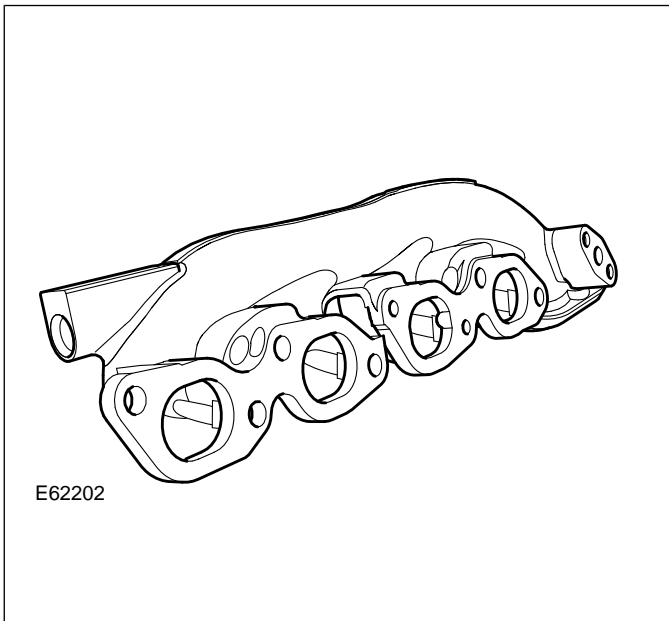


**Exhaust Emissions to North American Low Emission Vehicle (LEV) II Standards.**

**Vehicles with Supercharger**

Emissions Standard	Hydrocarbons
LEV II	0.090 grammes per mile at 100,000 miles

**Exhaust Manifold**



Due to the introduction of secondary air injection, this vehicle has been fitted with revised exhaust manifolds.

These manifolds have a threaded union which the stainless steel secondary air injection tubes attach to.

If a vehicle is not fitted with secondary air injection, these threaded unions are fitted with a blanking cap to seal the exhaust system.

## Bluetooth

2006 model year (MY) sees the introduction of a Bluetooth® communications network system to the XJ.

Bluetooth is a way of communicating with various electronic devices that are equipped with specialized chips using a short-range radio link. It allows most devices to converse with one another by creating a universal language. The devices then form a private network known as a "personal area network".

Interaction between Bluetooth devices can take place without direct human intervention whenever two or more Bluetooth devices are within each other's range. This then enables the Bluetooth transceiver chip to trigger an automatic connection to deliver and accept a flow of data.

Bluetooth devices operate on a radio frequency band known as the Industrial, Scientific, and Medical frequency. The Industrial, Scientific, and Medical radio frequency band is 2.40 GigaHertz (GHz) to 2.48 GHz which is divided into 79 channels, each carrying a bandwidth of 1 MegaHertz (MHz).

The devices use the 79 individual randomly chosen channels within the frequency band, changing from one to another on a regular basis. The Bluetooth transmitters change frequencies approximately 1,600 times every second, meaning that more devices can utilize the limited slice of the radio frequency.

Since every Bluetooth transmitter uses this technique automatically, it's most unlikely that two transmitters will be on the same frequency at the same time. This technique minimizes the risk of disruption to Bluetooth devices, as any interference on a particular frequency will last only a fraction of a second.

The Bluetooth system comprises of:

- A Bluetooth upgrade module
- A Portable Support Electronics (PSE) module
- A voice activated control module

- A microphone
- Steering wheel telematics control switches
- The audio unit.

The Bluetooth upgrade module allows the driver to integrate their personal cellular phone to the vehicle. When a cellular phone is paired to the vehicle, it allows the storage of up to 500 individual phone numbers and 40 related voice tags to the voice activated control module. These stored phone numbers can then be accessed using the audio unit control buttons, the audio unit touch screen (if fitted) or steering wheel telematics control switches. The voice tags can be accessed by using the steering wheel telematics control switches when utilizing the voice activation facility.

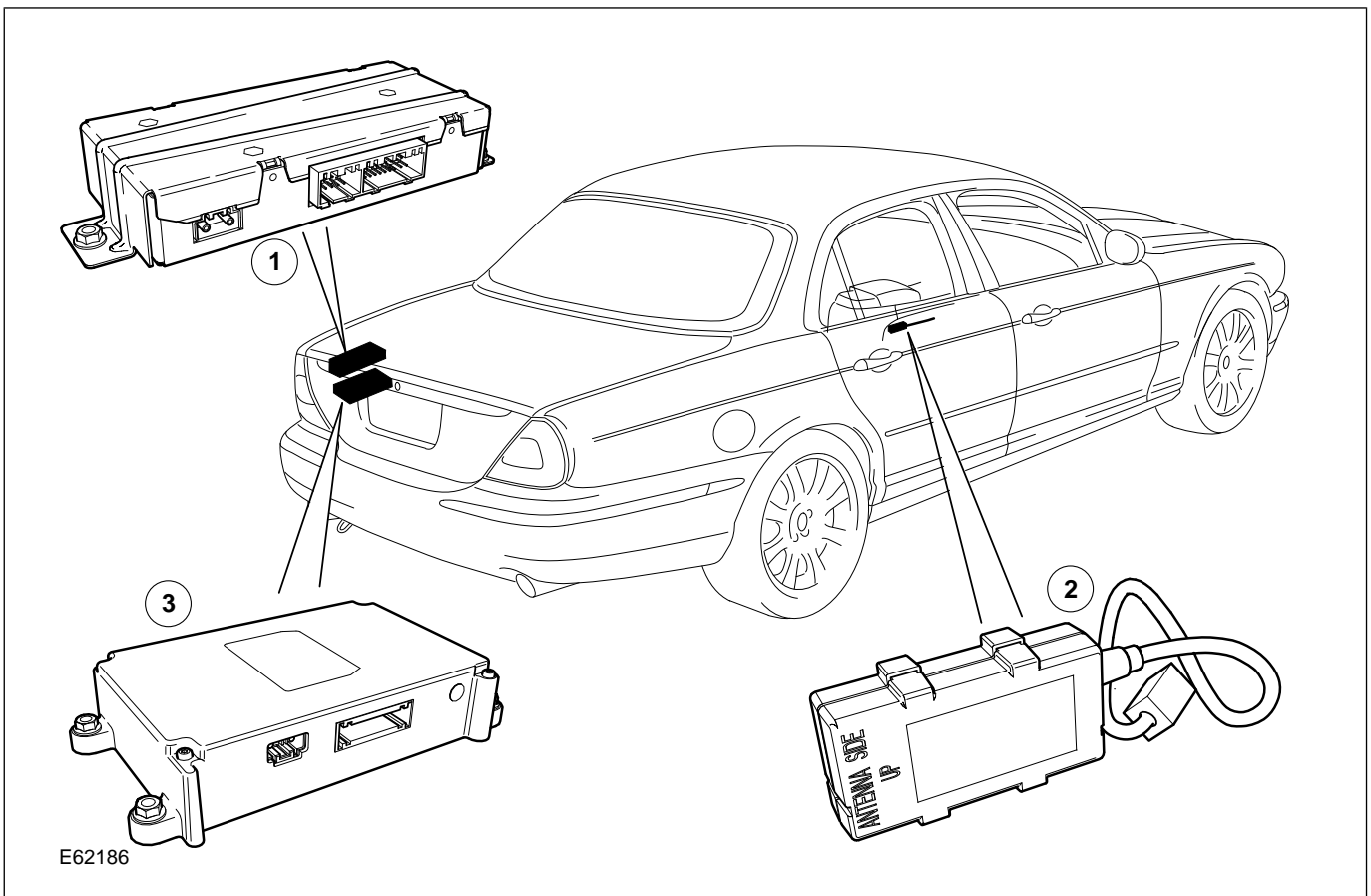
If a cellular phone has been paired to the vehicle and an additional cellular phone is also paired to the vehicle, the new stored phone numbers and voice tags will overwrite the previous phones stored data.

Phone numbers stored to the PSE and voice tags stored to the voice activated control module need to be manually updated should alterations be required. If a new phone number has been added to the cellular phone memory, it will need to be added manually to the vehicle memory.

Once stored to the vehicle, the phone numbers can be viewed on the audio unit screen. The audio unit and touch screen operates as per previous models.

For vehicles fitted with a touch screen controlled audio unit it is possible to memory redial the last 10 dialed phone numbers from the vehicle. For vehicles fitted without a touch screen controlled audio unit it is only possible to memory redial the last dialed phone number from the vehicle. These dialed phone numbers are stored in the PSE module memory and not from the cellular phone's memory.

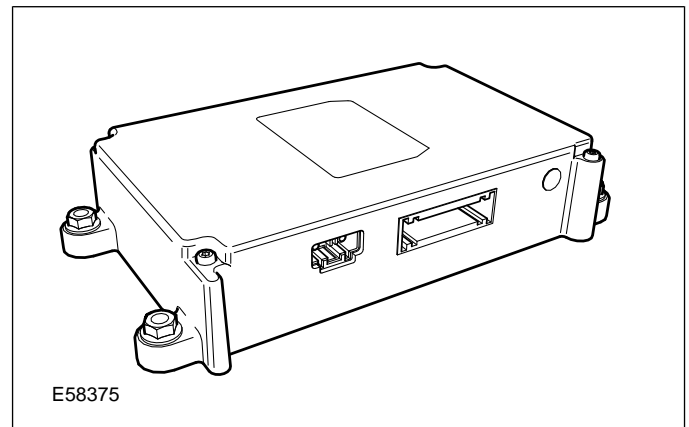
The Bluetooth system does not require a phone cradle or its own individual vehicle antenna. As a consequence of this, there is no cellular phone signal amplification or in-car charging facilities.



Item	Description
1	Voice activated control module
2	Bluetooth upgrade module
3	Portable Support Electronics (PSE)

### Portable Support Electronics (PSE) Module

The Portable Support Electronics (PSE) module is located in the left-hand side of the luggage compartment.



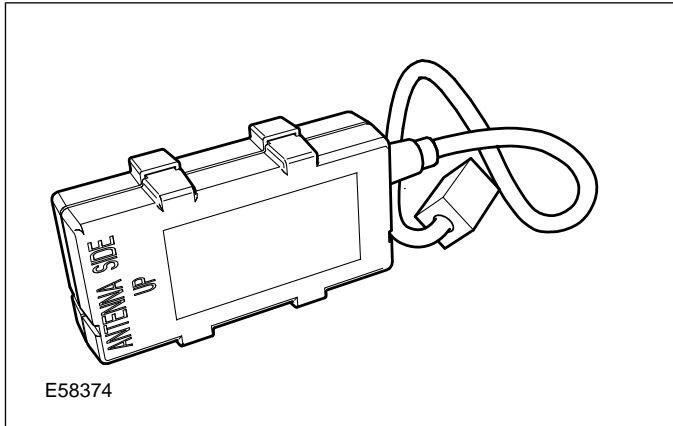
The PSE module is fixed to a bracket which also supports the Voice Activation Control Module (VACM) and the navigation control module.

The PSE module has one electrical connector and one optical connector. The module is unique to Jaguar, but utilizes carry over hardware.

The PSE module stores up to 500 phone numbers and the last 10 dialed phone numbers from the vehicle.

### Bluetooth Upgrade Module

The Bluetooth upgrade module is located under the center console and is attached to the center console using velcro.

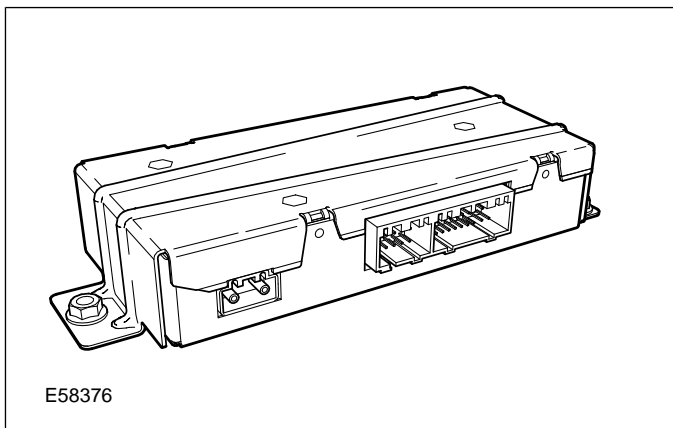


The Bluetooth upgrade module has one electrical connector and communicates with the PSE module by it's own proprietary communications bus.

The Bluetooth upgrade module communicates with the drivers cellular phone and integrates it into the vehicle system transferring information such as call status and phonebook information to the PSE.

### Voice Activated Control Module

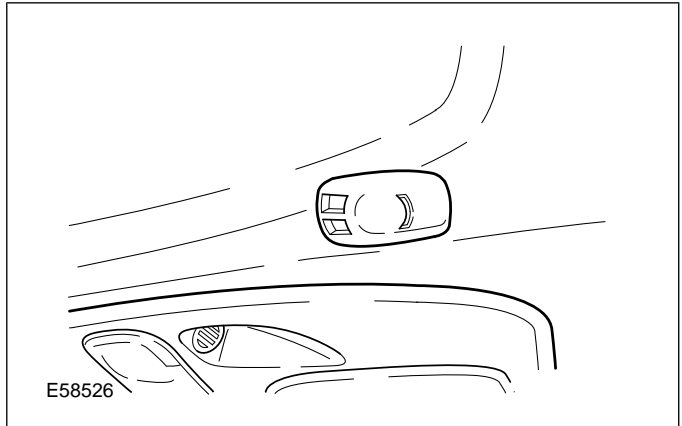
The voice activated control module is located in the left-hand side of the luggage compartment.



The voice activated control module is fixed to a bracket which also supports the PSE and the navigation control module.

The voice activated control module stores up to 40 voice tags.

### Microphone



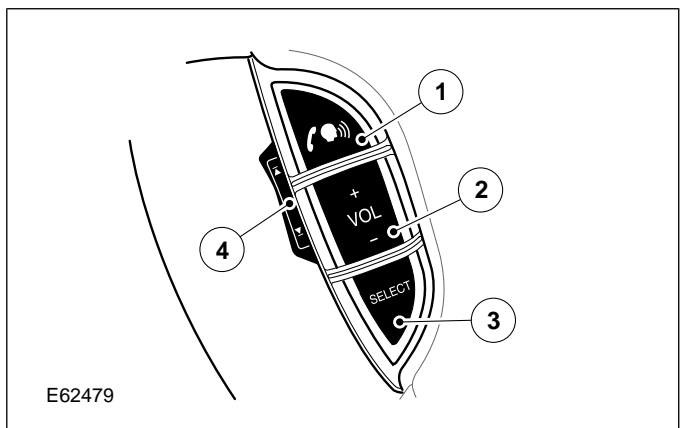
The microphone is located above the driver and is attached to the headliner.

### Steering Wheel Telematics Control Switches

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

The control switches provide the following phone functionality:

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



<b>Item</b>	<b>Description</b>
1	Press to start voice session, or mute when voice is not fitted. Answer phone call when ringing. Send/End when in phone mode.
2	Press as required to increase or decrease volume.
3	Press and hold for 2 seconds to select Phone Ready mode.
4	In phone mode main screen, press to scroll up or down through the numbers stored in the phone memory.