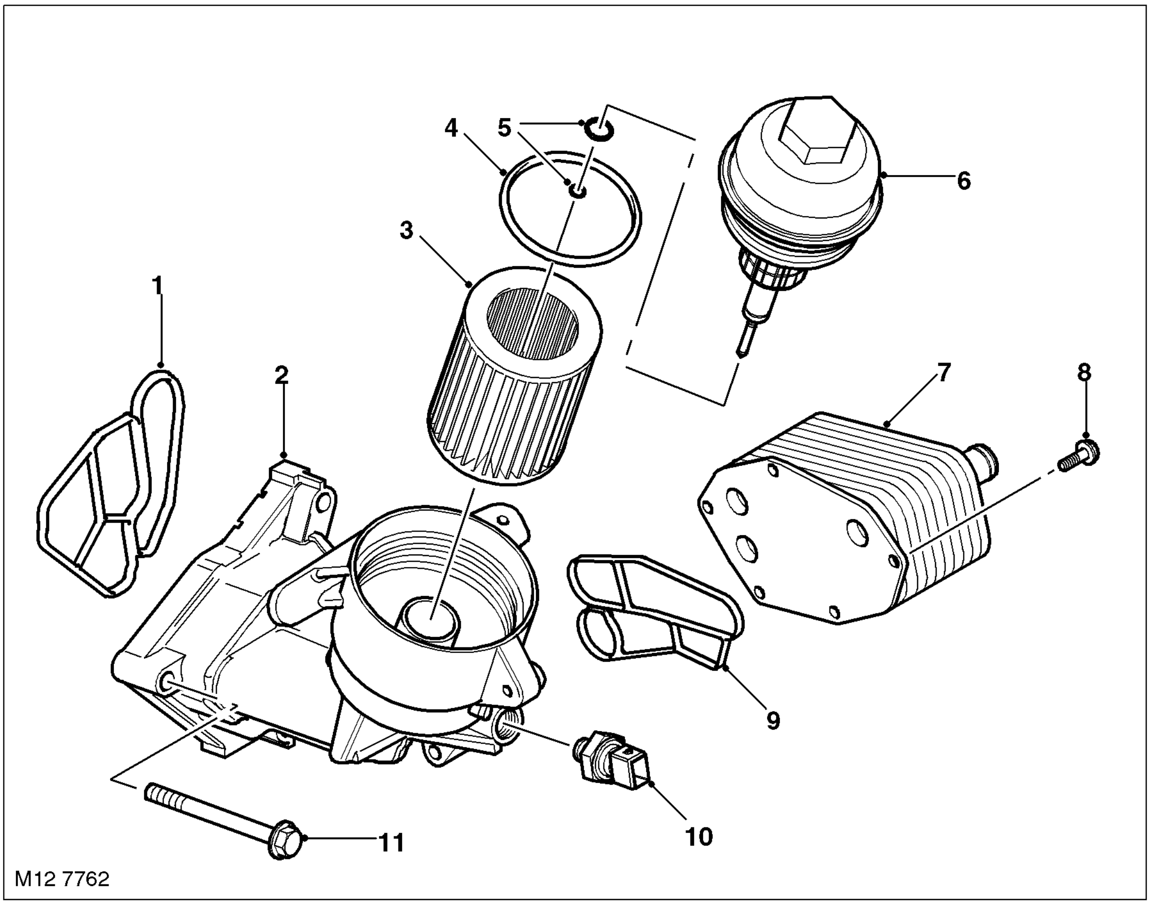
Td 6 – External View

M12 7758A

Integrated Oil Cooler and Filter Assembly



1 Sealing gasket
2 Filter housing
3 Filter element
4 O-ring seal – cap
5 O-ring seal (2 off)
6 Filter cap
7 Heat exchanger
8 Heat exchanger to filter housing attachment bolt (Torx –3 off)
9 Heat exchanger to filter housing gasket
10 Oil pressure switch
11 Filter housing to engine block attachment bolts – 3 off

The combined engine oil cooler and filter assembly, mounted to the left side of the engine block, is connected to the vehicle cooling and lubrication systems. The disposable paper filter element is replaced by unscrewing the cover from the filter housing.

The oil filter housing has an integral thermostatic valve which controls the amount of oil flowing through the oil cooler, dependent on the oil temperature.

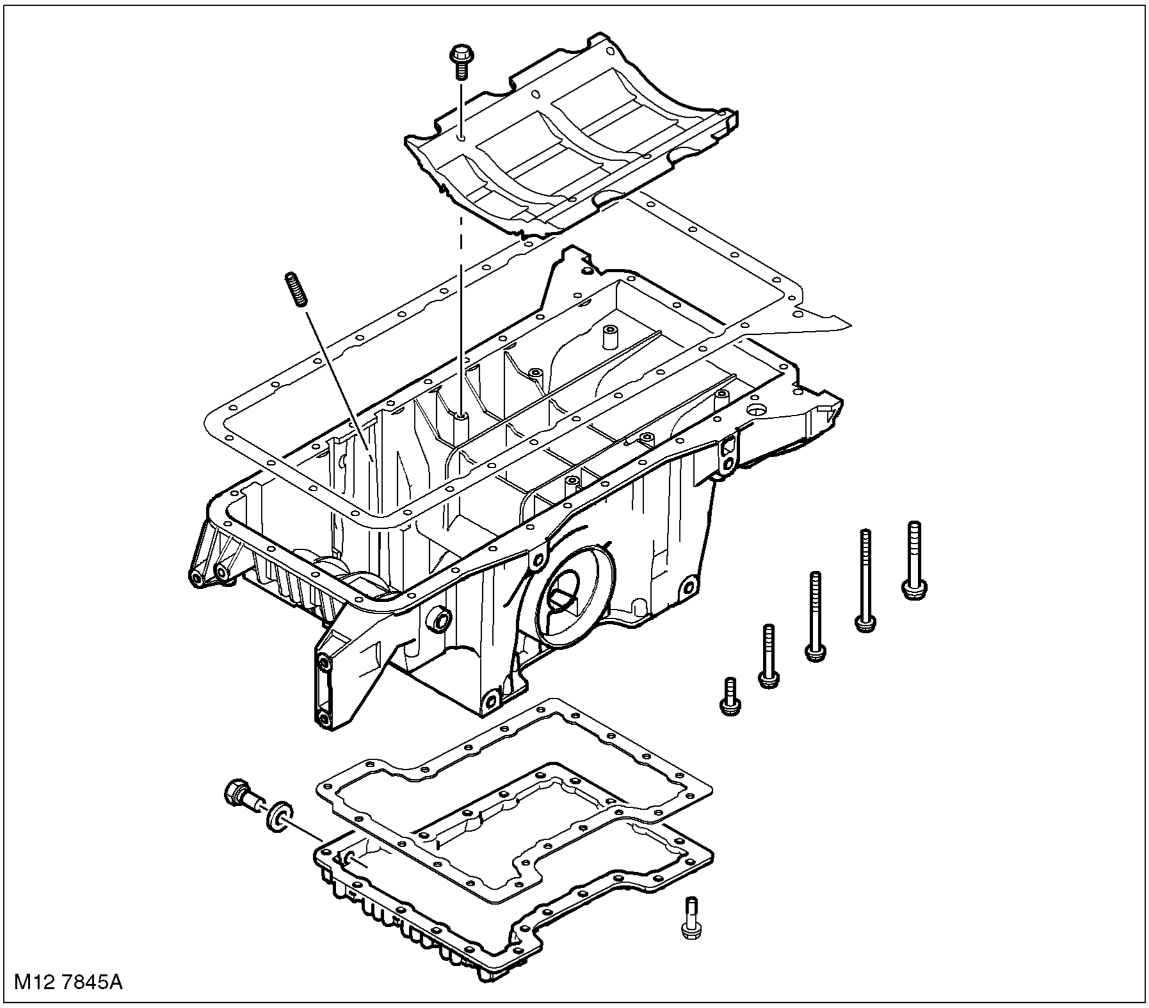
Oil from the cylinder block passes through the oil filter housing and partial flow is directed through the oil cooler before it is returned to the cylinder block. The coolant for the heat exchanger is supplied directly from the crankcase.

The oil pressure switch, operating a warning lamp in the instrument pack, is fitted to the oil filter housing.

Oil Pressure Switch

The oil pressure switch is located in a port in the oil filter housing. If the oil pressure drops below a given value the switch operates the warning lamp in the instrument pack

Sump



The two-piece aluminium die-cast sump, with an integral tunnel for the differential drive shaft, is sealed to the lower crankcase extension using a rubber metal-backed gasket. The sump is fixed to the lower crankcase extension using 25 bolts. An oil deflector plate is attached to the crankcase reinforcing shell above the sump. The sump incorporates a drain plug and a dip-stick guide tube.

Oil Pump

The oil pump housing and cover is manufactured from cast aluminium. The gear type oil pump is driven via the crankshaft.

The oil pump is located in the sump and is attached to Nos 1 and 2 main bearing caps. The rotor-type pump produces a regulated pressure of approximately 4.5 bar.

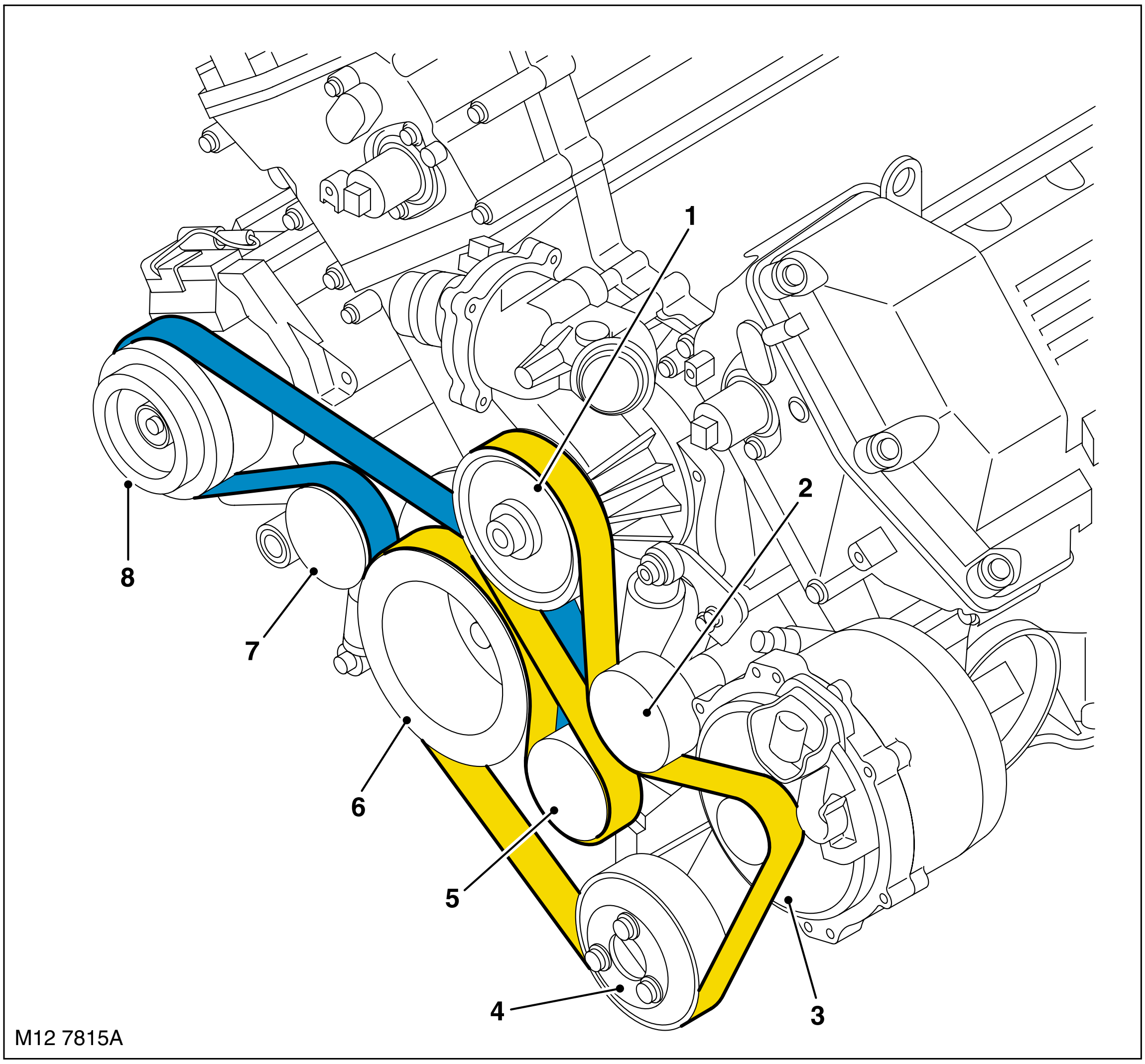
A metal suction pipe obtains oil from the sump.

Ancillary Components and Belt Drive

The ancillary components, the torsional vibration damper, alternator, A/C compressor, steering pump and water pump, are driven by the engine crankshaft by the aid of the ancillary drive belts. The A/C compressor is driven by a separate belt.

The belts, which are maintenance free poly-vee type belts, are automatically pre-loaded by two tensioning spring pots and are routed over deflection pulleys in order to maintain sufficient adhesion about the ancillary pulleys. This ensures slip-free drive of the ancillary components.

Belt Drive



- **1** Coolant pump
- **2** Idler pulley
- **3** Alternator
- **4** Power assisted steering pump
- **5** Tensioner pulley
- **6** Crankshaft pulley
- **7** Tensioner pulley
- **8** A/C compressor

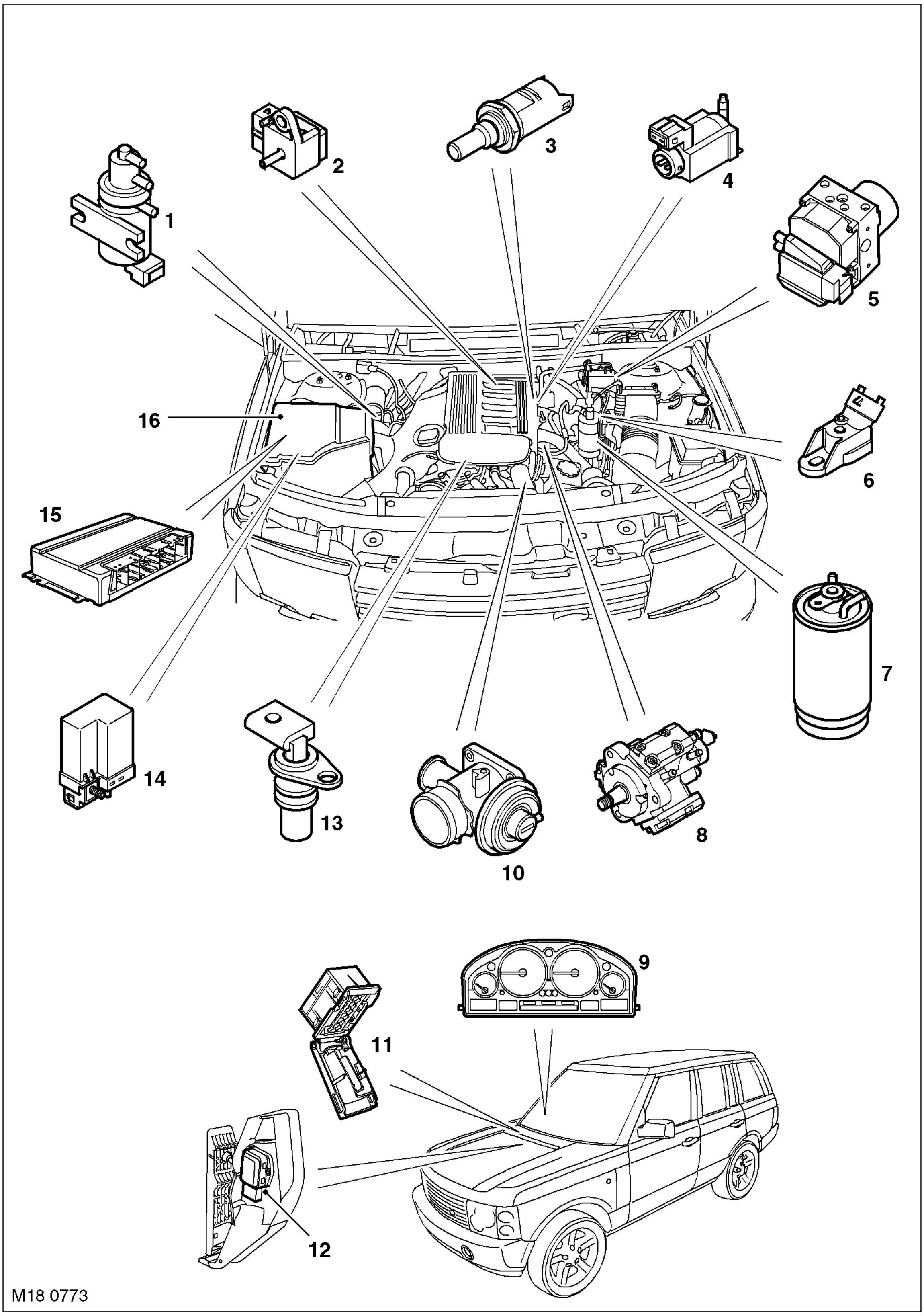
Air Intake System

The inlet manifold is a light weight, one piece plastic moulding. Fuel is supplied by a single fuel rail and regulated by a single pressure regulator mounted on the end of the rail. The manifold is acoustically decoupled from the cylinder heads to reduce noise and vibrations.

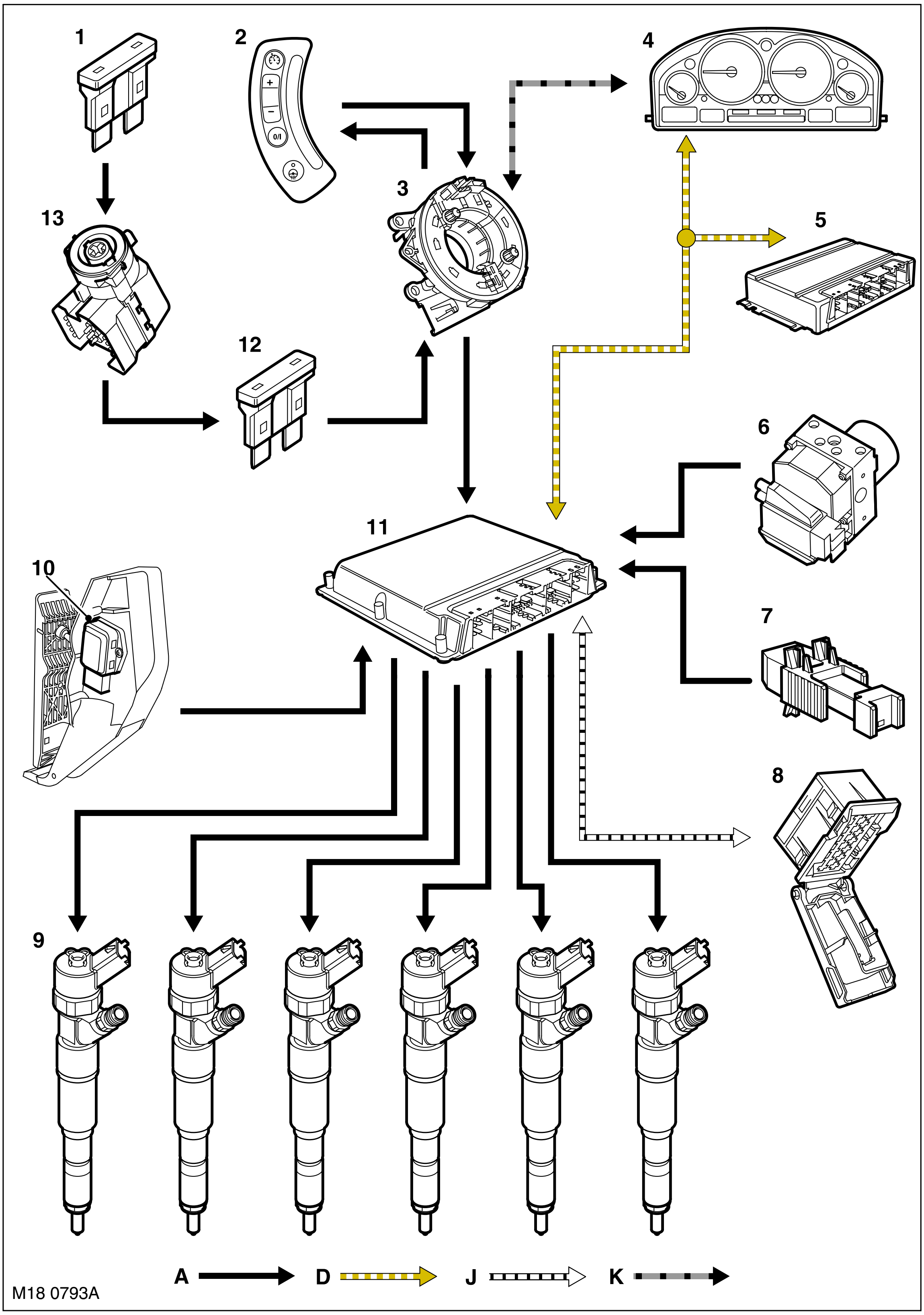
The throttle plate has two wedges screwed directly to it, these provide a curved zone for smoother throttle response during idle, off-idle transition.

The combined output of the mixing plate ensures that the gasses and vapours are evenly distributed among all the cylinders, which can improve idle quality.

Engine Management Component Location – Sheet 1 of 2



Cruise Control, Control Diagram

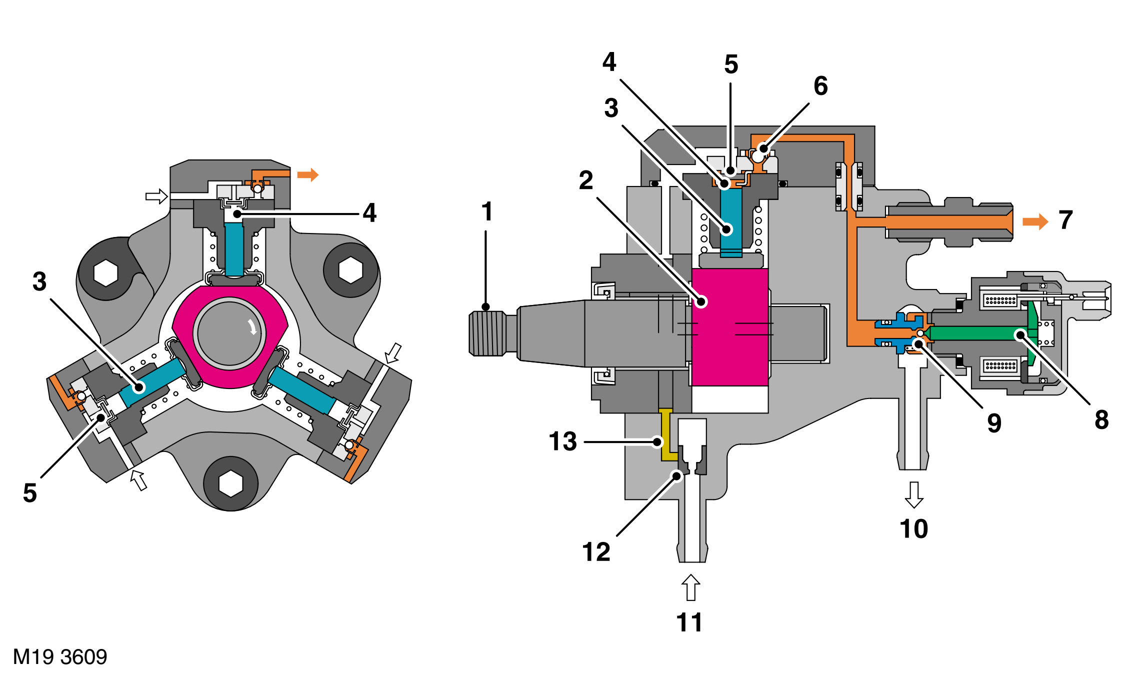


A = Hardwired connection; D = CAN bus; J = Diagnostic ISO9141 K Line; K = I bus

Engine Management P Codes

P Code No.	Component/Signal	Fault Description
0010	LH bank CMP sensor	Signal malfunction
0011	LH bank CMP sensor	Timing over-advanced or system performance
0012	LH bank CMP sensor	Timing over-retarded
0020	RH bank CMP sensor	Signal malfunction
0021	RH bank CMP sensor	Timing over-advanced or system performance
0022	RH bank CMP sensor	Timing over-retarded
0030	LH bank front HO2S heater circuit	Circuit intermittent
0031	LH bank front HO2S heater circuit	Short circuit to ground
0032	LH bank front HO2S heater circuit	Short circuit to battery
0036	LH bank rear HO2S heater circuit	Circuit intermittent
0037	LH bank rear HO2S heater circuit	Short circuit to ground
0038	LH bank rear HO2S heater circuit	Short circuit to battery
0050	RH bank front HO2S heater circuit	Circuit intermittent
0051	RH bank front HO2S heater circuit	Short circuit to ground
0052	RH bank front HO2S heater circuit	Short circuit to battery
0056	RH bank rear HO2S heater circuit	Circuit intermittent
0057	RH bank rear HO2S heater circuit	Short circuit to ground
0058	RH bank rear HO2S heater circuit	Short circuit to battery
0102	MAF sensor signal	Short circuit to ground
0103	MAF sensor signal	Short circuit to battery
0106	ECM internal ambient pressure sensor	Performance problem
0107	ECM internal ambient pressure	Short circuit to ground
0108	ECM internal ambient pressure	Open circuit or short circuit to battery
0112	IAT sensor	Short circuit to ground
0113	IAT sensor	Open circuit or short circuit to battery
0114	Ambient temperature input	Fault data received
0116	ECT sensor	Signal implausible
0117	ECT sensor	Short circuit to ground
0118	ECT sensor	Open circuit or short circuit to battery
0120	APP sensor switch A	Implausible
0121	APP sensor switch A	Range/ Performance problem
0122	APP sensor switch A	Open circuit or short circuit to ground
0123	APP sensor switch A	Short circuit to battery
0125	ECT sensor	Insufficient coolant temperature for closed loop control
0128	Thermostat monitoring sensor	Low coolant temperature – thermostat stuck open
0130	LH bank front HO2S signal	Circuit malfunction
0131	LH bank front HO2S signal	Short circuit to ground
0132	LH bank front HO2S signal	Short circuit to battery
0133	LH bank front HO2S signal	Slow response
0134	LH bank front HO2S signal	No activity
0135	LH bank front HO2S heater circuit	Circuit malfunction
0136	LH bank rear HO2S signal	Circuit malfunction
0137	LH bank rear HO2S signal	Short circuit to ground
0138	LH bank rear HO2S signal	Short circuit to battery
0139	LH bank rear HO2S signal	Slow response
0140	LH bank rear HO2S signal	No activity
0141	LH bank rear HO2S heater circuit	Circuit malfunction
0150	RH bank front HO2S signal	Circuit malfunction

High Pressure Fuel Pump Cross Section



1	Drive shaft	**8**	Pressure control valve
2	Cam	**9**	Ball valve
3	Piston	**10**	HP return
4	Chamber	**11**	LP fuel supply
5	Inlet valve	**12**	Safety valve with throttle bore
6	Pressure valve	**13**	LP fuel gallery
7	HP supply to fuel rail		

Fuel is delivered via the filter to the high pressure fuel pump intake and the safety valve situated behind it. It is forced through the throttle bore into the low pressure duct. This duct is connected to the lubrication and coolant circuit of the high pressure pump. It is therefore not connected to an oil circuit.

The drive shaft is driven via the chain drive at more than half of the engine speed (max. 3300 rpm). It moves the three pump pistons up and down with its eccentric cam, depending on the cam shape.

If the pressure in the low-pressure duct exceeds the opening pressure of the suction valve (0.5 -1.5 bar), the advance delivery pump can force fuel into the element chamber where the pump piston moves downwards (suction stroke). If the dead centre point of the pump piston is exceeded, then the intake valve closes. The fuel in the element chamber can no longer escape. It is then compressed in the intake line by the delivery pressure. The accumulating pressure opens the exhaust valve as soon as the pressure in the rail is achieved. The compressed fuel enters the high pressure system.

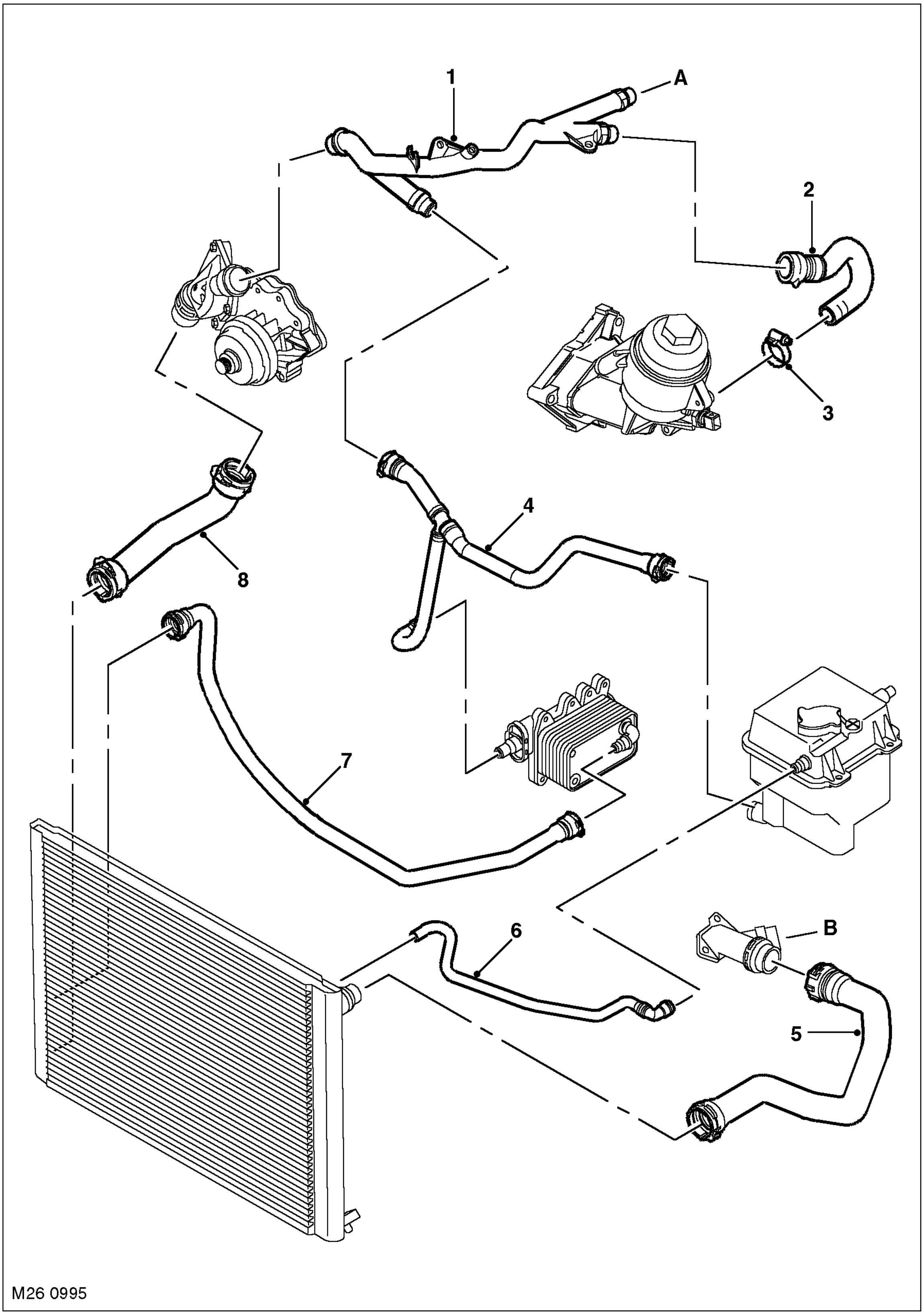
The pump piston delivers fuel until the upper dead centre point is reached (delivery stroke). The pressure then falls again, which closes the outlet valve. The remaining fuel is no longer subject to pressure. The pump piston moves downwards.

If the pressure in the element chamber falls below the pressure in the low pressure duct, then the intake valve opens again. The whole process is repeated from the beginning.

The high pressure pump constantly generates the system pressure for the high pressure accumulator (rail). The pressure in the rail is determined by the pressure control valve.

The high pressure is generated by means of three pump pistons arranged radially within the high pressure pump. Three delivery strokes per revolution ensure low injection torque and uniform load over the pump drive. At 16 Nm, the average torque is only approx. 1/9 of the drive torque required for a comparable distributor pump.

Td6 Cooling System – Sheet 1 of 2



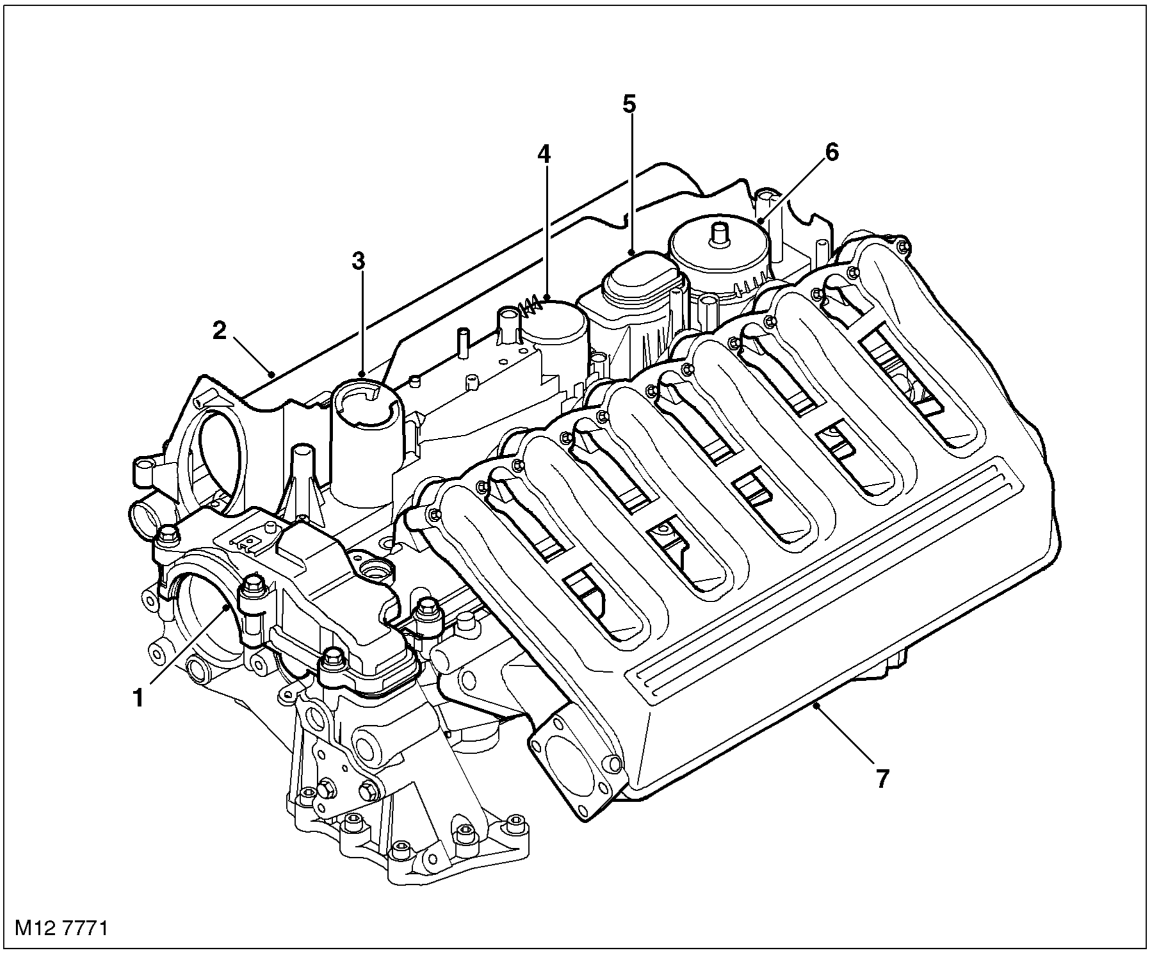
A = Heater matrix, B = Coolant elbow

Description

General
The inlet manifold directs cooled and compressed air from the turbocharger and intercooler into the cylinders, where it is mixed with fuel from the injectors. Exhaust gases from the exhaust manifold can also be directed into the inlet manifold via a pipe from the exhaust manifold and an Exhaust Gas Regulator (EGR) valve on the inlet manifold. The exhaust manifold allows combustion gases from the cylinders to leave the engine where they are directed into the turbocharger and exhaust system.

The exhaust system is attached to the turbocharger and is directed along the underside of the vehicle to emit exhaust gases from the tail pipes located at the rear of the vehicle.

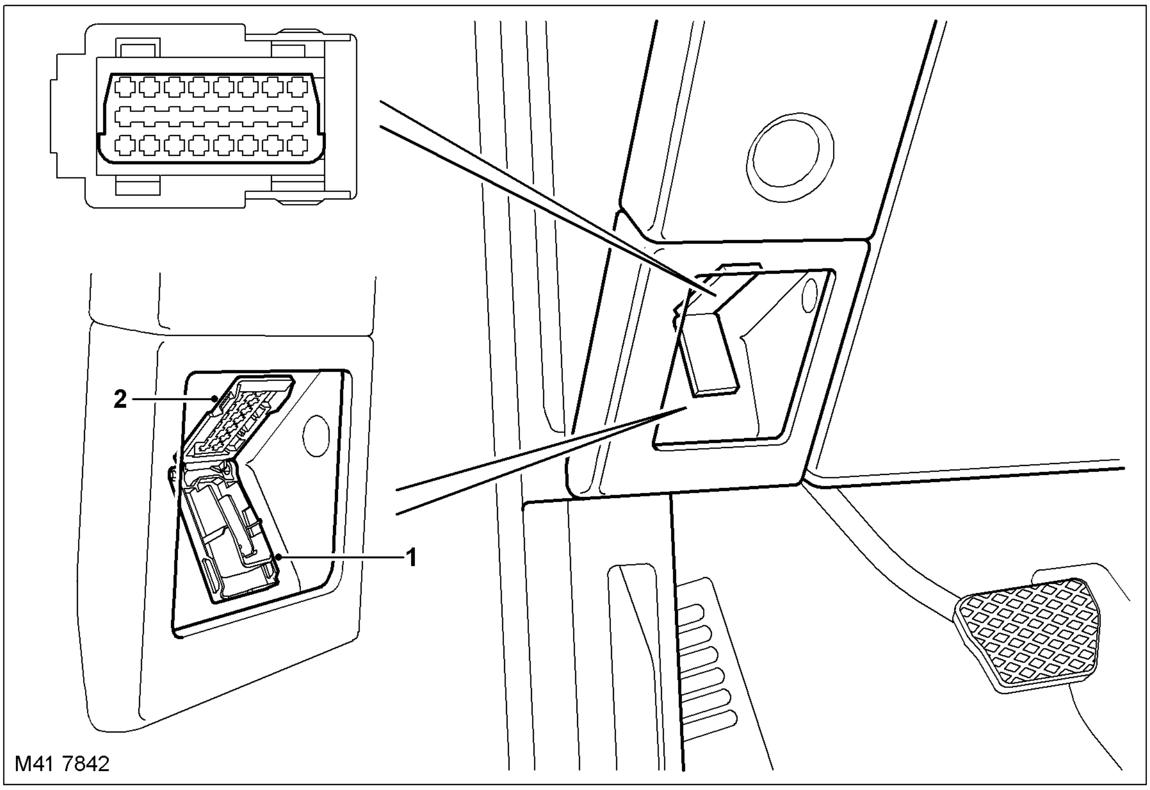
Intake Assembly



- **1** Upper Timing Chain Cover
- **2** Air Filter
- **3** Oil filler aperture
- **4** Camshaft Cover
- **5** Oil Depression Limiter
- **6** Oil Depression Limiter
- **7** Inlet Manifold

Diagnostics
The transfer box ECU can store fault codes which can be retrieved using TestBook/T4 or a diagnostic tool using KW2000* protocol.

Diagnostic Socket



LHD model shown

1 Cover
2 Diagnostic socket

The information is communicated via a diagnostic socket which is located in the fascia, in the driver's side stowage tray. The socket is secured in the fascia panel and protected by a hinged cover.

The diagnostic socket allows the exchange of information between the various ECU's on the bus systems and TestBook/T4 or another suitable diagnostic tool. The information is communicated to the socket via a diagnostic DS2 bus. This allows the retrieval of diagnostic information and programming of certain functions using TestBook/T4 or another suitable diagnostic tool.

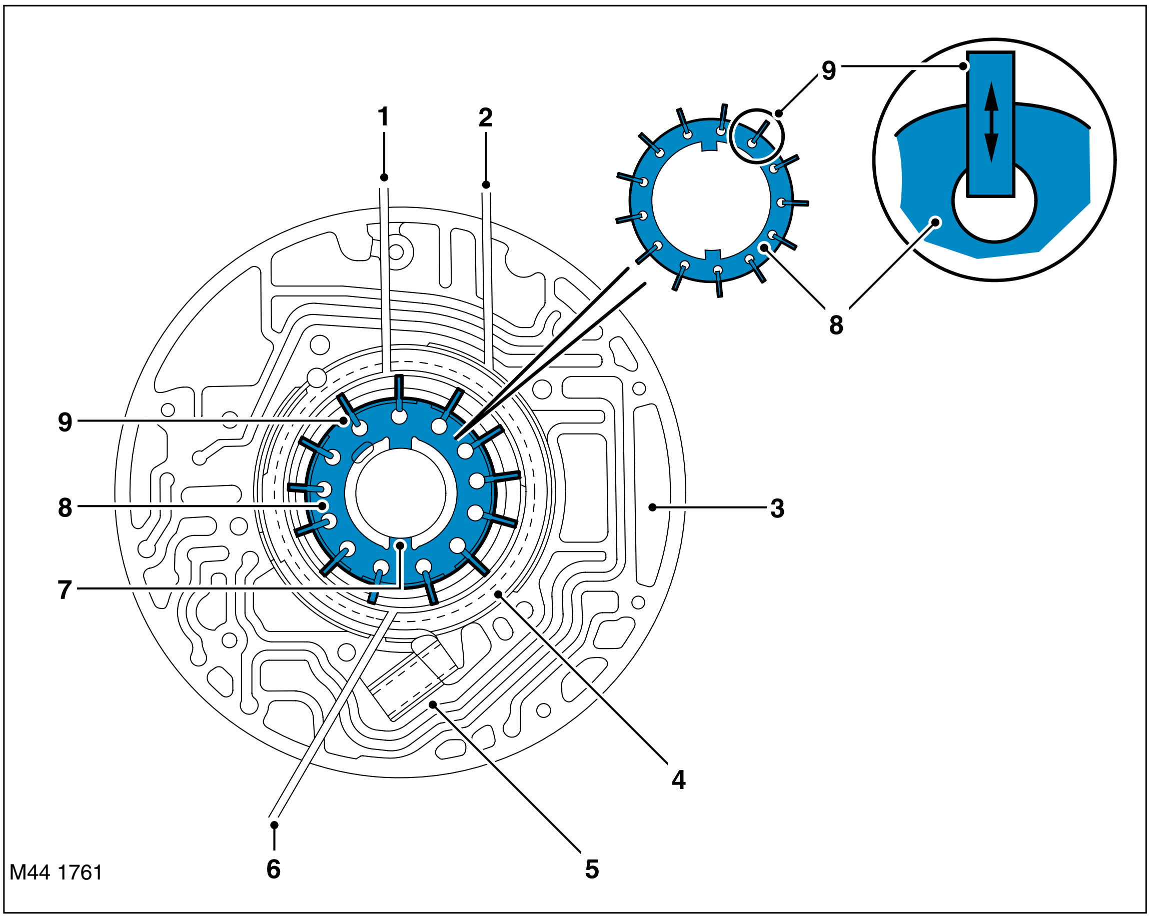
The transfer box ECU uses Diagnostic Trouble Codes (DTC) which relate to transfer box electrical faults.

Controller Area Network (CAN) Bus
The CAN bus is a high speed broadcast network connected between various vehicle ECUs.
☞ **COMMUNICATION DATA BUSES, DESCRIPTION AND OPERATION, Description.**

The CAN allows the fast exchange of data between ECU's every few microseconds. The bus comprises two wires which are identified as CAN high (H) and CAN low (L). The two wires are coloured yellow/black (H) and yellow/brown (L) and are twisted together to minimise electromagnetic interference (noise) produced by the CAN messages.

In the event of a CAN bus failure the following symptoms may be observed:
- Shift from high to low or low to high inoperative
- Instrument pack low range warning lamp inoperative
- Instrument pack transfer box messages in message centre inoperative.

Fluid Pump



1 Line (output) pressure
2 Decrease pressure (input)
3 Bell housing
4 Slide
5 Spring
6 Fluid supply from fluid pan
7 Drive tangs
8 Rotor
9 Vane

The pump comprises a rotor with thirteen vanes which are located in a recess in the rear face of the bell housing. A pump cover, with cast channels to direct fluid flow, is bolted to the bell housing to enclose the pressure regulator, the boost valve, the TCC enable valve, the TCC control valve and the springs.

The rotor and vanes are located in a slide. As the rotor is turned, centrifugal force causes the vanes to move outwards in the slots in the rotor and contact the inner surface of the slide. As the rotor is turns, the vanes collect fluid from the oil supply port in the pump cover. The vanes carry the fluid to the line output pressure port in the pump cover where it passes into the transmission valve block.

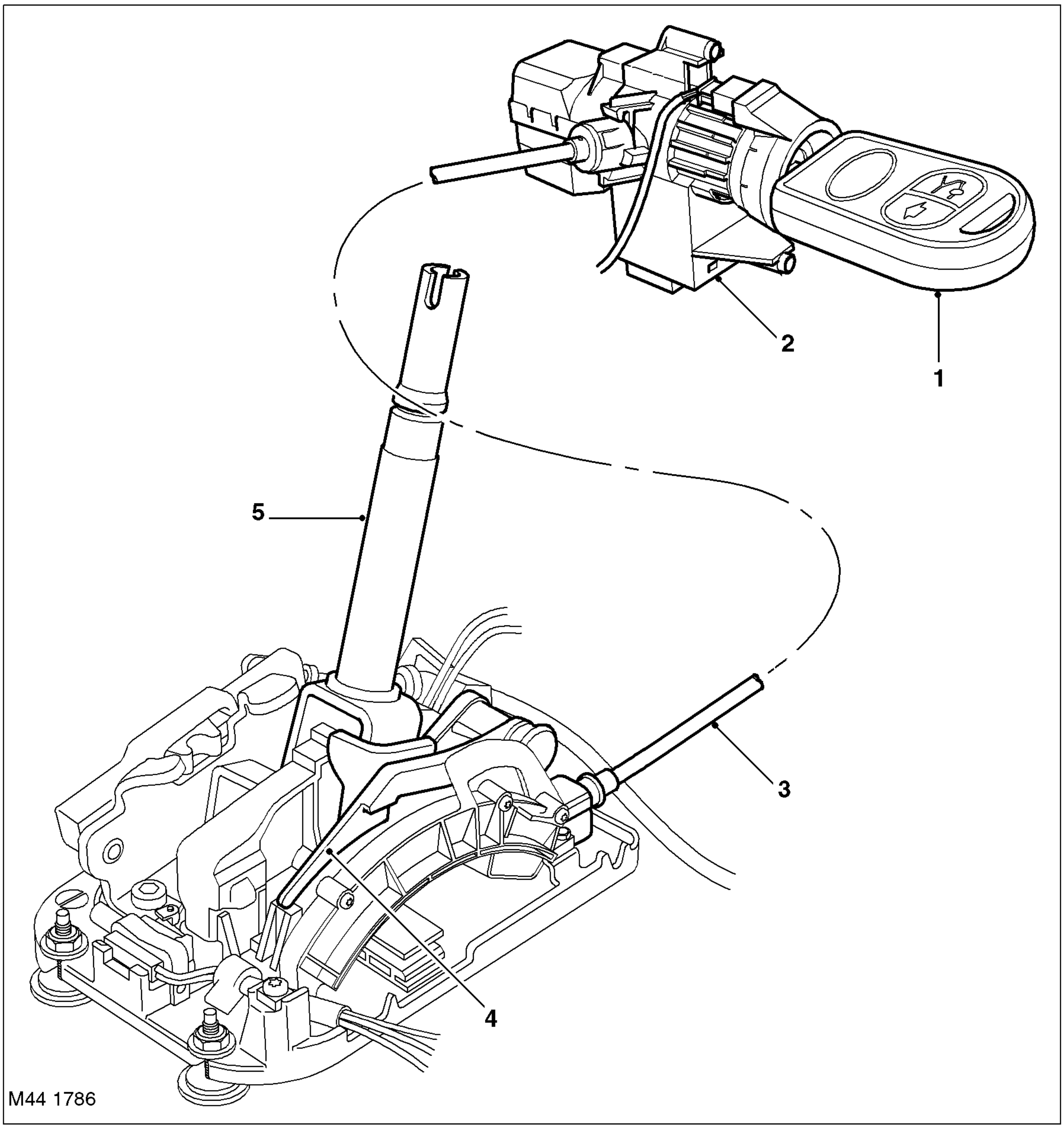
The slide is mounted on a pivot pin and can move about the pin axis controlled by a calibrated spring and line pressure from a pressure regulator valve in the valve block.

As the slide pivots, it changes the eccentricity of the rotor to the slide. This changes the swept volume of the vanes and hence the pump output volume.

As the rotor turns and the vanes pass the line pressure port, the space between the rotor vanes and the slide increases. The increasing volume between the vanes causes a depression which draws fluid (which is subject to atmospheric pressure) from the fluid pan as the vanes pass the fluid supply port.

As the rotor turns and the vanes pass the fluid supply port, the fluid becomes trapped between the vanes. As the rotor turns further, the space between the vanes decreases, pressurising the fluid. When the vanes reach the line pressure port, the fluid is displaced under pressure into the port to provide the operational pressure for the transmission.

Key Interlock Mechanism



1 Ignition key
2 Ignition switch
3 Bowden cable
4 Latch gate
5 Selector lever assembly

The key interlock mechanism prevents the key from being removed from the ignition switch when the selector lever is any position other than 'P' PARK. This prevents the vehicle being accidentally left in neutral which would cause the vehicle to move if the handbrake was not applied.

The mechanical mechanism is operated by a Bowden cable which is attached between the selector lever assembly and the ignition switch. When the ignition switch is turned to the on position, the switch rotates a lever which in turn pulls the cable. This lifts a latch in the selector lever assembly which is engaged with the selector lever when in the 'P' position.

The crescent spacer is fixed in its position by a pin and is located between the ring gear and the impeller. The impeller is driven by the drive from the torque converter which is located a needle roller bearing in the pump housing. The impeller teeth mesh with those of the ring gear. When the impeller is rotated, the motion is transferred to the ring gear which rotates in the same direction.

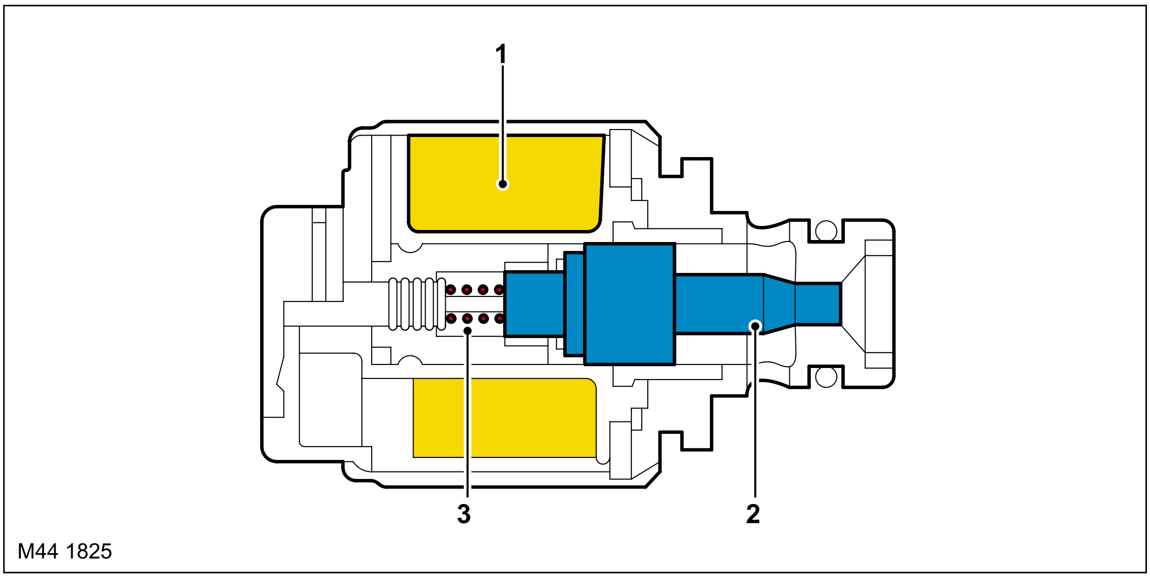
The rotational motion of the ring gear and the impeller collects fluid from the intake port in the spaces between the teeth. When the teeth reach the crescent spacer, the oil is trapped in the spaces between the teeth and is carried with the rotation of the gears. The spacer tapers near the outlet port. This reduces the space between the gear teeth causing a build up of fluid pressure as the oil reaches the outlet port. When the teeth pass the end of the spacer the pressurised fluid is passed to the outlet port.

The fluid emerging from the outlet port is passed through the fluid pressure control valve. At high operating speeds the pressure control valve maintains the output pressure to the gearbox at a predetermined maximum level. Excess fluid is relieved from the pressure control valve and is directed, via the main pressure valve in the valve block, back to the pump inlet port. This provides a pressurised feed to the pump inlet which prevents cavitation and reduces pump noise.

Valve Block and Solenoid Valves
The valve block is located in the bottom of the transmission and is covered by the fluid pan. The valve block houses electrical actuators, and control valves which provide all electro-hydraulic control for all transmission functions. The valve block comprises the following components:

- Five pressure regulator solenoids
- Three shift control solenoids
- Six dampers
- Twenty one hydraulic spool valves
- Manually operated selector valve.

Pressure Regulator Solenoids



1 Coil winding
2 Valve
3 Spring

Five Electronic Pressure Regulator Solenoids (EPRS) are located in the valve block. The solenoids are controlled by PWM signals from the EAT ECU. The solenoids convert the electrical signals into hydraulic control pressure proportional to the signal to actuate the spool valves for precise transmission operation. EPRS4 is used for pressure regulation for the torque converter lock-up clutch.

The following conflicts will illuminate the manipulation point:

- The VIN transferred from the LCM on the I Bus to instrument pack is 0
- The VIN in the instrument pack is 0
- The VIN in the LCM is different to the VIN in the instrument pack
- A default value in the EEPROM is used until a CAN index message is sent when the ignition is switched on.

If the EEPROM is in an unlocked (unprotected) condition, the manipulation point will flash, irrespective of whether or not the stored data matches or conflicts.

CAUTION: When a new instrument pack is to be installed, TestBook/T4 must be connected to vehicle and the instrument pack renewal procedure followed to replace the pack. This will ensure that vehicle coding data is correctly installed in the new instrument pack. TestBook/T4 will also record the current service interval data and restore the settings to the new instrument pack.

Instrument Pack Harness Connectors