

## SECTION 10A

### INSTALLATION OF ENGINE AND GEARBOX - FUEL INJECTED VAUXHALL

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Although this section is broadly similar to section 10 of the assembly guide, there are some key differences between installation of the injected Vauxhall engine and Ford crossflow engines. To avoid duplication please refer to section 10 in conjunction with this section.

#### **10A.1 Installation of Gearbox Kit - 5/6 Speed**

1.1 The Vauxhall powered car uses the same Caterham or Ford gearboxes, though with a different bellhousing which eliminates the need for an adapter between the gearbox and bellhousing. The optional dry sump system uses an integral bellhousing/oil tank and employs a hydraulic clutch mechanism, so after assembling the gearbox itself please refer to 10A.4.2.

1.2 Follow the gearbox build up instructions in 10.1 with the exception of 10.1.2, as no spacer is required. The bellhousing bolts directly to the front of the gearbox, noting that the gasket still needs to be used. Tighten the M12x40mm fine thread bolts (with springwashers) to 45 lbft.

#### **10A.2 Bellhousing / Dry Sump Tank Assembly**

2.1 This is a complicated aluminium casting, and although it will have been pressure washed by both the manufacturers and Caterham Cars, it is possible that some sand may remain in the oil tank. It is vitally important therefore to check inside very carefully and to scrub out any remaining sand residues. The bellhousing assembly is shown in figure 10A.2.

- 2.2 Fit the clutch bleed screw to the left hand upper face of the casting.
- 2.3 To the lower left hand side of the casting, fit a 1/2" by 5/8" male/male adapter, screwing the 1/2" end into the casting using a crush washer (Dowty seal) to prevent leakage. To the right hand side of the casting, fit the small blanking screw.
- 2.4 Apply a smear of silicon sealant and attach the square cast base plate to the underside of the casting using M6x16mm caphead screws. We recommend the use of loctite on these screws.
- 2.5 Attach the rectangular plate with the oil filler neck to the top of the casting again using M6x16mm caphead screws with loctite and silicon sealant.
- 2.6 This top contains two horizontal and one vertical holes. The right hand horizontal hole is blanked off with the plug provided and the left hand hole is fitted with an aluminium elbow, which will eventually be connected to the engine oil catch tank.
- 2.7 The vertical left hand hole is fitted with a 1/2" by 1/2" male/male adapter screwed in with a Dowty seal.
- 2.8 The hole on the upper right hand side of the belltank assembly is fitted with a 1/2" by 5/8" male/male adapter, the 1/2" end being screwed into the casing with a Dowty seal.
- 2.9 The bellhousing assembly is attached to the front of the gearbox with 4 M12x110mm fine thread bolts using loctite and tightened to 45 lbft. It is very important that the gasket is fitted between the two, and some additional sealer applied where the selector shaft extends into the belltank will prevent any oil leaks from the gearbox.
- 2.10 The clutch slave cylinder and integral release bearing assembly is pre-fitted into the belltank at the factory. This should not be removed as the rear seal is inevitably damaged in the process.

### **10A.3 Preparing Engine For Fitment In Car**

- 3.1 The two removable upper engine bay diagonals allow the engine and gearbox assembly to be fitted as a unit, once the diagonals have been removed. This greatly simplifies assembly as fitting the engine to the gearbox is very much easier out of the car. Take care to ensure the fixings for the diagonals are retained, so the correct bolts can be re-used. Please note that the diagonals are fitted in a different position on Vauxhall powered cars (see figure 10A.3.1

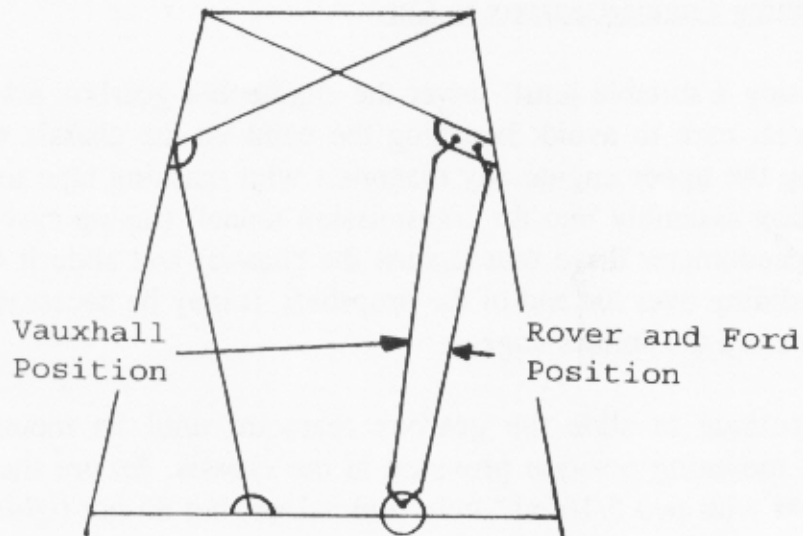


Figure 10A.3.1 Upper Engine bay Diagonals

3.2 The engine can be fully kitted before installation with the exception of the exhaust manifold. It is recommended that the engine mounting brackets are left off at this stage to avoid the risk of damaging the fragile body side panels. This will mean that the alternator has to be left off also. The 'J' shaped water rail (see cooling kit installation 10A.10.2) should be attached to the water pump and inlet manifold and the 5/8" hose to the heater connected to the rearmost outlet on the water rail and tightened.

3.3 Before being fitted to the chassis, the gearbox needs to be fitted to the engine. Slide the gearbox into place on the rear of the engine. It may be necessary to turn the crankshaft using the bolt on the front pulley in order to line up the gearbox first motion shaft splines with the clutch. Once the gearbox is in place on the engine, connect the two together using 6 M12x40mm bolts with spring washers where possible and loctite where not. An M12x60mm bolt passes through the starter and engine flanges to secure the top of the starter. Please note that the thread in the top of the starter motor is drilled out to permit this, earlier cars had this bolt fitted the other way round.

3.4 Before fitting the engine/gearbox assembly, two operations must be carried out.

- i) The transmission tunnel top must be removed by releasing the four screws that hold it in place.
- ii) Fit the metal/rubber engine mountings to the chassis using 4 5/16" x 1 3/4" bolts, plain washers and nylocs, but do not tighten at this stage. Do not fit the mounting brackets themselves to the block at this stage, as they will foul the chassis and steering column while the engine is being fitted.

#### 10A.4 Fitting Engine/Gearbox In Car

4.1 Using a suitable hoist, lower the engine and gearbox assembly into the chassis taking great care to avoid damaging the paint on the chassis tubes. We recommend protecting the upper engine bay diagonals with masking tape to avoid damage. Insert the gearbox assembly into the transmission tunnel, (taking care to avoid touching the fragile speedometer drive unit against the chassis) and slide it back with the tailshaft housing sliding over the end of the propshaft. It may be necessary to turn the propshaft slightly before the splines engage.

4.2 Continue to slide the gearbox rearward until its mounting locates onto the rearmost mounting position provided in the chassis. Secure the gearbox mounting to the chassis with two 5/16"x1" bolts and nylocs, but do not tighten at this stage as final tightening has yet to take place.

4.3 With the engine still suspended, attach the exhaust manifold and engine mounting brackets to the cylinder block. The left-hand mounting bracket is then attached using 2 M10 x 25mm and 1 M10 x 45mm bolt into the rearmost position. The right-hand bracket fitment varies according to whether a dry or wet sump system is installed.

i) Wet sump: Attach the mounting to the block using 2 M10x45mm bolts and position the two cylindrical aluminium spacers provided between the mounting and the cylinder block.

ii) Dry sump: The mounting is secured through the oil scavenge pump, so the two bolts holding this to the block must first be removed. When doing this take care to ensure that the two spacing washers between this casing and the block do not drop out, or if they do, are put back as otherwise tightening the engine mounting will put unnecessary stress on this aluminium casting and change the adjustment of the toothed belt driving the oil pump. Fit the mounting to the block using 2 M10x45mm bolts.

4.4 The engine can now be lowered onto its mountings and secured with two 1/2"UNF x 2 1/2" bolts and lockwashers. If the engine mountings do not align it may be necessary to loosen the bolts holding the rubber mounts to the chassis rails temporarily to get a little more movement. It also helps to keep a trolley jack under the engine to facilitate alignment.

4.5 Finally the gearbox can be adjusted in the tunnel using its slotted mountings, to achieve equal clearance on both sides within the transmission tunnel, and its mounting bolts tightened.

4.6 Refit the upper engine bay diagonals as in figure 10A.3.1, noting that the right hand diagonal passes under the inlet manifold and is attached in a different position to the Ford. Refit the 5/16" x 1 3/4" caphead bolts and torque to 25 lbft.

### **10A.5 Connection Of Dry Sump Oil System**

5.1 There are two braided oil pipes provided which are the main feeds to and from the oil tank. The pipe marked 70105 has one 45 degree and one 90 degree union and is connected between the scavenge pump on the right-hand side of the engine block and the union on the right-hand side of the oil tank. The 90 degree union fits to the oil tank. The second pipe marked 70106 has two 90 degree connections and fits between the sump itself and the bottom left-hand side of the oil tank, providing the main oil feed to the engine.

5.2 The oil tank should be filled with oil, we recommend a synthetic oil such as BP Visco 2000. Ensure that the tank is filled to within approximately 5" from the top which amounts to about 4 litres of oil. Do not allow the level to fall below 2/3 full (about 2.8 litres) or some surge could be encountered under hard cornering. On the other hand over filling will lead to excess oil being blown messily out of the breather. The oil level in a dry sump system can only be checked with the engine running. The left-hand union on top of the oil tank should be connected to the breather outlet on the front right-hand side of the cam cover using the rubber hose provided secured with Jubilee clips.

5.3 The final operation is to fit another rubber hose to the aluminium union emerging from the side of the top cover of the tank and trim to length so that it breathes to atmosphere adjacent to the bottom of the gearbox.

### **10A.6 Clutch Connection**

6.1 The normal wet sump installation uses a cable clutch mechanism similar to that used in Ford powered Sevens, except that it is capable of being adjusted from both ends. Please refer to section 10.4.6 but note that it should be adjusted so that the minimum amount of the outer cable enters the pedal box. If the dry sump has been specified the nylon hose must be fitted between the master cylinder on the pedal box and the threaded hole on the right-hand side of the bellhousing.

6.2 The clutch master cylinder should be filled with brake fluid, and having loosened the bleed screw, bleed using long steady strokes of the clutch pedal until the fluid emerging is free from bubbles. Tighten the bleed screw and check that the pedal operates the clutch correctly. The clutch itself is self-adjusting although the pedal location can be adjusted along with that of the brake pedal (see section 17). The use of silicon clutch fluid is not recommended.

### **10A.7 Air Intake System**

7.1 Vauxhall Fuel Injection engines are supplied with the inlet manifold and throttle body fitted, in which state the engine should be installed in the chassis. The throttle body will have a plastic bung in it to prevent ingress of foreign matter, which should be left in place until the rest of the air intake system is fitted.

7.2 After removing this plastic bung, the fibreglass elbow should be fitted to the throttle body using a smear of silicon sealant and four panhead bolts (2 M6x55, 1x M6x35 and 1 M6x25). The idle air bypass valve can then be fitted between the inlet manifold and the intake elbow. The valve is an aluminium barrel shaped device, 45mm in diameter and 100mm in length. The horizontal takeoff (marked with an arrow) is connected to a port on the side of the inlet manifold using a short 50mm length of pipe and the vertical take off is connected to the intake elbow with a curved rubber tube around 200mm long. Both these lengths of pipe should be cut from the complex pipe labelled 90323561223.

7.3 The large bore straight, flexible pipe should then be fitted between the elbow and the throttle body, and fixed in place using jubilee clips. The curved 'bellows' pipe is then fitted between the air flow meter and the air filter assembly, which is fitted on the scuttle, over the hole in the aluminium panel above the gearbox. This round hole may have a blanking plate fitted over it, if so this should be removed, and a tubular aluminium spinning should be riveted in place.

7.4 Having loosely assembled the air intake trunking, and with the heater fitted in the scuttle, the location for the air filter can be fixed. To fit the air filter assembly, the top half of the box and the filter element should be removed, along with the rear upper to lower box clip. The bottom half of the filter box should be positioned on the scuttle in front of the heater.

7.5 The mounting holes for the air filter can then be marked out and drilled, and the air box riveted in place. Before refitting the upper half of the air filter box, drill a 15mm hole in the front face to accept the air temperature sensor. The sensor should be pushed in and sealed with silicon sealant. Take care to ensure the intake pipes take as smooth a run as possible before bolting down the air filter, and use jubilee clips on all joints.

7.6 The 24" long trunking should then be fitted facing rearwards within the tunnel, with the 90 degree elbow attached to the aluminium spinning fitted in section 7.2. The elbow should be attached with a jubilee clip, and the long end should be secured to the chassis tubes above the gearbox with ty-wraps.

**10A.8 Electrical Connections**

8.1 The alternator is fitted to the left engine mounting bracket on the horizontal tube running parallel to the engine. Attach the alternator using a 5/16" x 5" bolt and nyloc.

8.2 The adjusting strap is attached to the hexagonal block already bolted to the engine using a 3/8" bolt and spring washer and to the alternator by an M8 x 25 bolt using both spring and plain washers. fit the alternator drive belt and tighten by swinging the alternator away from the engine until there is no more than 1/2" movement in the belt.

8.3 The live battery connection is made using the short red lead between the positive terminal on the battery and the bolt on the starter solenoid. The earth strap connects between the negative terminal on the battery and the lower fixing bolt (13mm across flats) for the distributor or phase sensor on the back of the cam.

**N.B. Do not actually connect this earth lead to the battery until all electrical equipment is installed and connected and the car is ready to run.**

8.4 The engine in turn is earthed to the chassis on the rear engine mounting rubber fixing bolt on the right hand lower chassis tube. The other end of the strap is bolted to an unused threaded hole in the engine block adjacent to the engine mounting bracket.

8.5 Vauxhall injection cars have two separate wiring harnesses, which are joined together with a multi pin plug. The main wiring harness is fitted to the chassis by Caterham Cars, and the engine harness, which covers all the connections to equipment on the engine, is supplied fitted to the engine. This leaves a number of connections to be made once the engine is fitted in the car. Most of the connectors in the engine harness are labelled with their destinations and the following connections need to be made:- (See figure 10A.8) The numbers in brackets refer to the labelling of figure 10A.8.

Inlet air temperature sensor (1)	2 pin plug, labelled 'I.A. Temp' connects to plug on air filter box
Air flow meter (2)	4 pin plug, labelled 'flow', on air flow meter (see Air Intake section)
Purge Valve (8)	2 pin plug, labelled purge, goes to top of charcoal canister
Air bypass valve (12)	2 pin plug, labelled 'bypass', on bottom of air bypass valve (see Air Intake section)

Fuel Quality Plug (16)	3 pin plug, labelled 'F/Qual' connects to small brown part in area of inertia switch.
Diagnostic plug (17)	Labelled 'Diag', and fitted to bracket on scuttle, does not connect to anything on car.
Relays (18)	The relays are fitted to the loom, but need to be bolted to the scuttle
Inertia switch (19)	3 pin plug, labelled 'Inertia' on a black plastic part with a rubber button on top of the scuttle.
Warning Light (20)	Plug in red light in scuttle area
Engine E.C.U. (21)	Multipin connector for the E.C.U. on footbox
Ignition module (22)	7 pin connector to small black plastic part in footbox/scuttle area.
Main Harness Connector (23)	Multipin Connector in main harness in engine bay
Lambda Probe (24)	4 pin plug (see exhaust section)
Alternator (25)	brown, brown, and brown/yellow wires in a plastic connector, Brown/yellow to B+
Earth	ring terminal, labelled earth, bolts to 3 way brake union by front suspension

8.6 There are 3 wires in the main harness that are not used with the Vauxhall engine, and should be insulated and taped back into the loom. These are the white and white/black wires by the pedal box and the purple wire from a similar area.

8.7 Once all the connections have been made, and the upper engine bay diagonals have been refitted, the engine harness should be routed along the right hand upper engine bay diagonal. Do not bolt the intake manifold support bracket into place until the wiring harness is in place.

### **10A.9 Exhaust System**

9.1 The Vauxhall exhaust system consists of a one piece fabricated exhaust manifold/collector assembly, and a one piece silencer and tail pipe which also incorporates the catalytic converter. The exhaust manifold, using the gasket supplied,



is fitted to the studs on the engine using M8 plain nuts and lockwashers. It can then be secured to the engine block using the "cats cradle" bracket provided. This attaches to the vertical face of the bellhousing substituting 60mm rather than 40mm long bolts holding the engine to the bellhousing and to the cylinder block using an M10 x 45mm bolt. The cradle is then attached to the rear face of the integral collector using 2 x 5/16" bolts springwashers and plain nuts.

9.2 Bolt the small angle bracket to the lower nearside of the car in front of the rear wheel as per 10.8.4. The silencer assembly can be slid in through the aperture in the body skin and over the manifold using a single band clamp, and hung onto the rubber bobbins using M8 nuts and lockwashers.

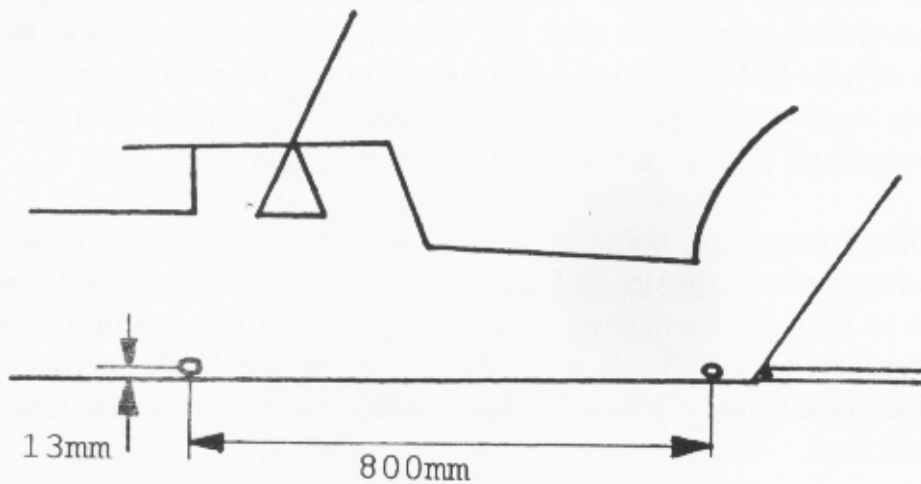


Figure 10A.9 Front Exhaust Bush Location

9.3 The side exit catalyst exhaust has an extra mount at the front of the silencer to support the catalyst. This mount uses the same type bracket and bobbin as the rear mount and is fitted as follows. There is a threaded bush in the chassis to which the front angle bracket bolts, which can be found 800mm forward from the rear exhaust bush, and 13mm up from the base of the chassis. This should be revealed with a pilot hole which can be expanded to suit the bolt, taking care not to damage the threads. See figure 10A.9

9.4 Assembly is completed in exactly the same way as with the Ford installation except that the exhaust guard is fitted with three jubilee clips not two, and that if catalyst equipped no clamp should be fitted to the catalyst itself as this gets extremely hot in service. The jubilee clip adjuster should be positioned in the gap between the body and the silencer, such that it is above the level of the base of the silencer

9.5 Finally screw the Lambda sensor into the top face of the manifold collector and attach to the engine wiring loom with the special 4 pin plug. Ensure that the wires are tied out of contact with the exhaust manifold.

#### **10A.10**     Cooling System

10.1 Refer to section 10.7.1 for the fitment of the cooling fan and 10.7.2 for the radiator. The radiator itself is fitted with a blanking plug which must be positioned face upward. The plug is removed and a thermostatic fan switch fitted in its place, to which the black/green and green wires are connected.

10.2 The J shaped stainless steel water rail will have already been fitted to the water pump (section 10A.3.2) using a 3" length of hose. This length of hose should be cut from the short end of hose 594/3 after the 90° bend. This is connected to the radiator using the rest of hose 594/3 which should be routed over the steering column and rack. This hose may need to be trimmed at the radiator end to achieve a good fit. The remaining connections should be evident from diagram 10A.10

10.3 The plastic expansion bottle is located on top of the cruciform immediately behind the radiator where it sits on 5/16" x 3" bolt. The bolt is screwed into the boss in the chassis to protrude vertically, where it is locked in place with a lock nut. It is held by two brackets on the chassis secured to the expansion bottle by two 1/4" x 3/4" bolts and nylocs (see figure 10A.10.3). The position of the expansion tank should be adjusted so it is level.

10.4 The underside of this bottle is connected to the water rail with a rubber hose cut to length, and a second thinner hose runs backwards from the top of the bottle to the water connection on the inlet manifold.

10.5 The heater is connected to the outlet on the rear of the block using an 'L' shaped hose, with the short end having a larger bore than the long end. The larger bore end fits on the rear of the block.

10.6 The cooling system should be filled with a 33% antifreeze solution to the level marked on the expansion tank. Carefully bleed with the engine running and the bleed valve on the radiator loosened until normal operating temperature is reached and the air is bled out of the radiator. After the car has been road tested the radiator should be bled once again to ensure that all the air is removed from the system.

#### **10A.11**     Fuel System

11.1 The fuel system is complete for injection cars except for the attachment of the fuel feed and return pipes to the injection system, and the connections to the charcoal

canister from the inlet manifold and the fuel filler neck. These can be seen in figure 10A.11

11.2 There are three pipes that travel through the transmission tunnel, a metal pipe and two black plastic pipes. The metal pipe is the fuel feed from the fuel tank to the inlet manifold, and is connected to a rubber fuel hose leading to the fuel rail on the inlet manifold. The black plastic fuel return pipe connects to the fuel return valve on the fuel rail (mushroom shaped, brass coloured object) using a short length of 1/4" rubber hose and jubilee clips. This plastic pipe will have been connected to the top of the fuel tank at the factory. The second plastic pipe connects to the 'tank' connection on the charcoal canister using a short length of rubber hose and jubilee clips. This pipe will already have been connected to the fuel filler neck at the rear. A further length of 3/16" rubber fuel hose is connected between the throttle body and the purge connection on the charcoal canister. The air connection on the charcoal canister is left free to allow the canister to vent to atmosphere.

#### **10A.12**     Throttle and Speedometer Cable

12.1 At the throttle body, the barrel on the inner cable fits into a slot in the quadrant in which the cable lies. The rubber bush at the end of the outer cable clips into the aluminium bracket above the inlet manifold. At the pedal end, the outer cable sits directly in the front of the pedal box, and the nipple clips into the pedal. See figure 10A.11.

12.2 The speedometer cable should be fed through the large grommet above the steering column in the front bulkhead and connected to the back of the speedo where it is hand tightened.

Bolt Size	Usage	Torque
M12 x 40mm	Gearbox to bellhousing	45 lbft
M6 x 16mm	Belltank top plate	5 lbft
M12 x 110mm	Dry sump belltank to gearbox	45 lbft
M12 x 40mm	Engine to bellhousing	45 lbft
M12 x 60mm	Engine to bellhousing	45 lbft
5/16"UNF x 1 3/4"	Engine mount rubber to chassis	12-15 lbft
5/16"UNF x 1"	Gearbox mount to chassis	12-15 lbft
M12 x 25mm	Gearbox mount to gearbox	45 lbft
M10 x 25mm	Left engine mount	25 lbft
M10 x 45	Left and Right engine mount	25 lbft
1/2"UNF x 2 1/2"	Mounting brackets to rubbers	12-15 lbft
5/16"UNF x 5"	Alternator	12-15 lbft
5/16"UNF x 1 3/4"	Upper engine bay diagonals	25 lbft
M8 x 25mm	Alternator to strap	12-15 lbft
M10 x 60mm	Cats cradle to bellhousing	25 lbft
M10 x 45mm	Cats cradle to block	25 lbft
5/16"UNF x 1 3/4"	Cats cradle to manifold	12-15 lbft
5/16"UNF x 3/4"	Exhaust bracket	12-15 lbft
M8 nuts	Exhaust manifold	12-15 lbft
5/16"UNF x 3 1/2"	Expansion tank support	12-15 lbft
1/4"UNF x 3/4"	Expansion tank brackets	8 lbft

Table 10A.1 Vauxhall engine installation - Torques

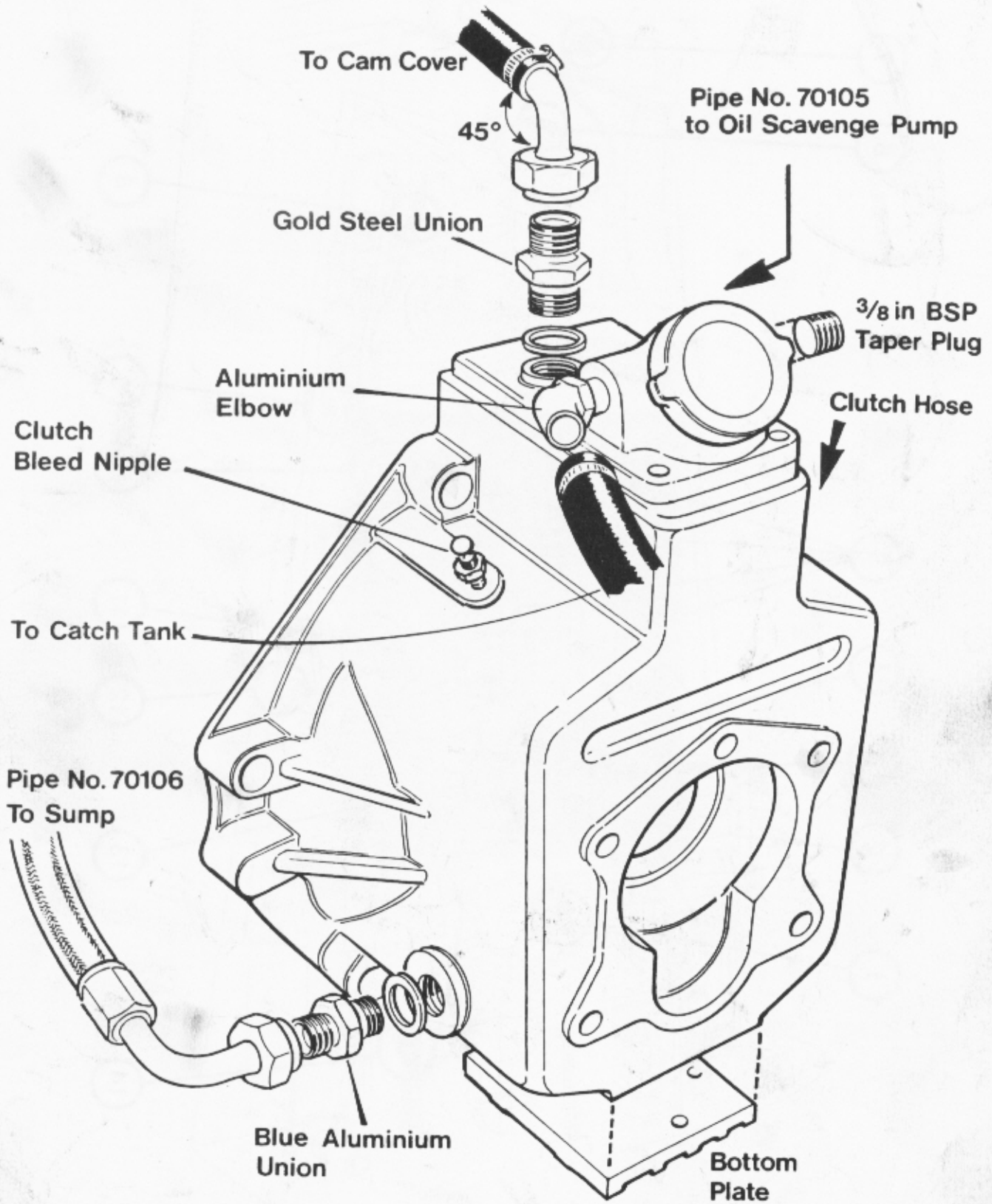
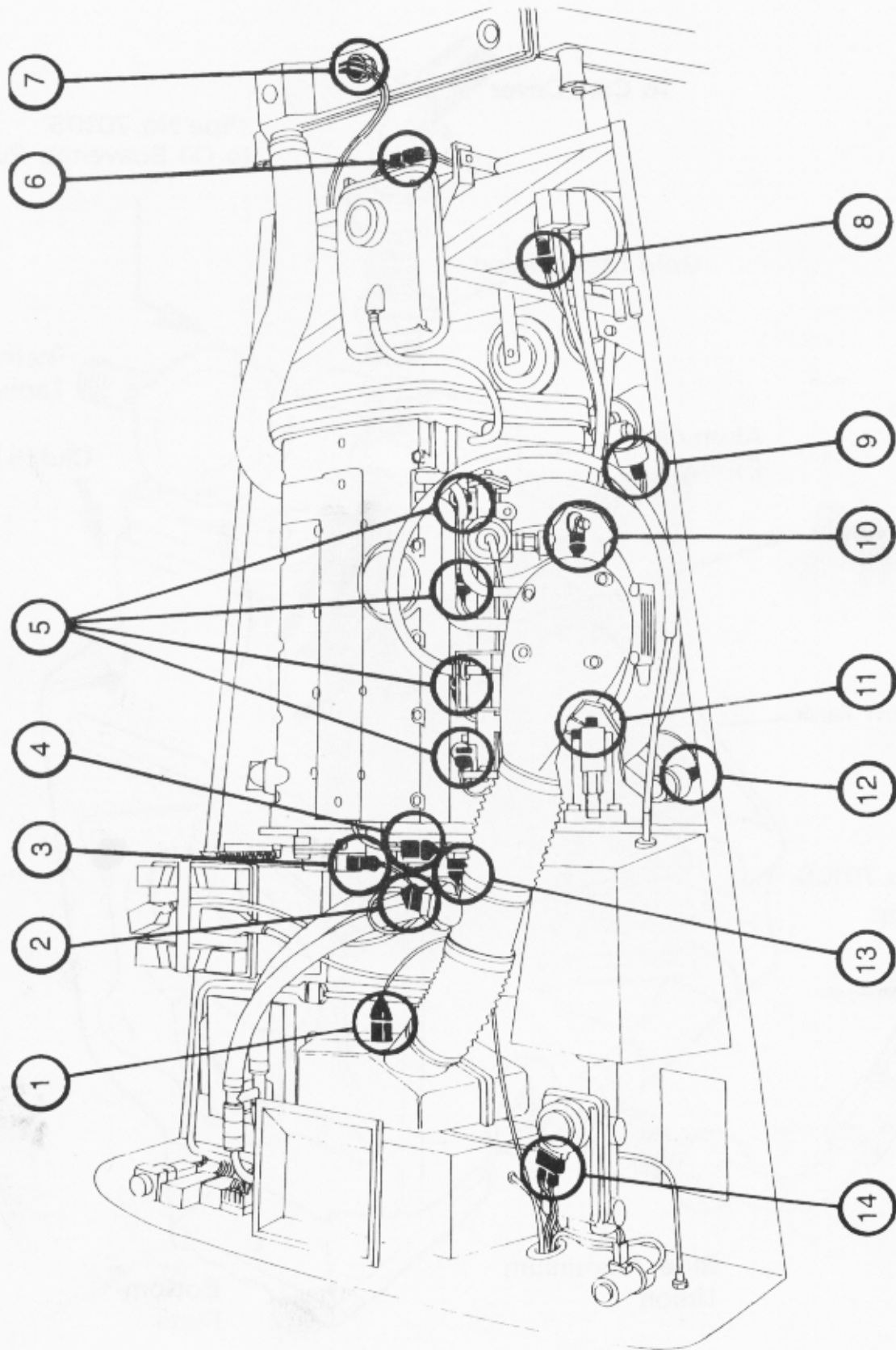
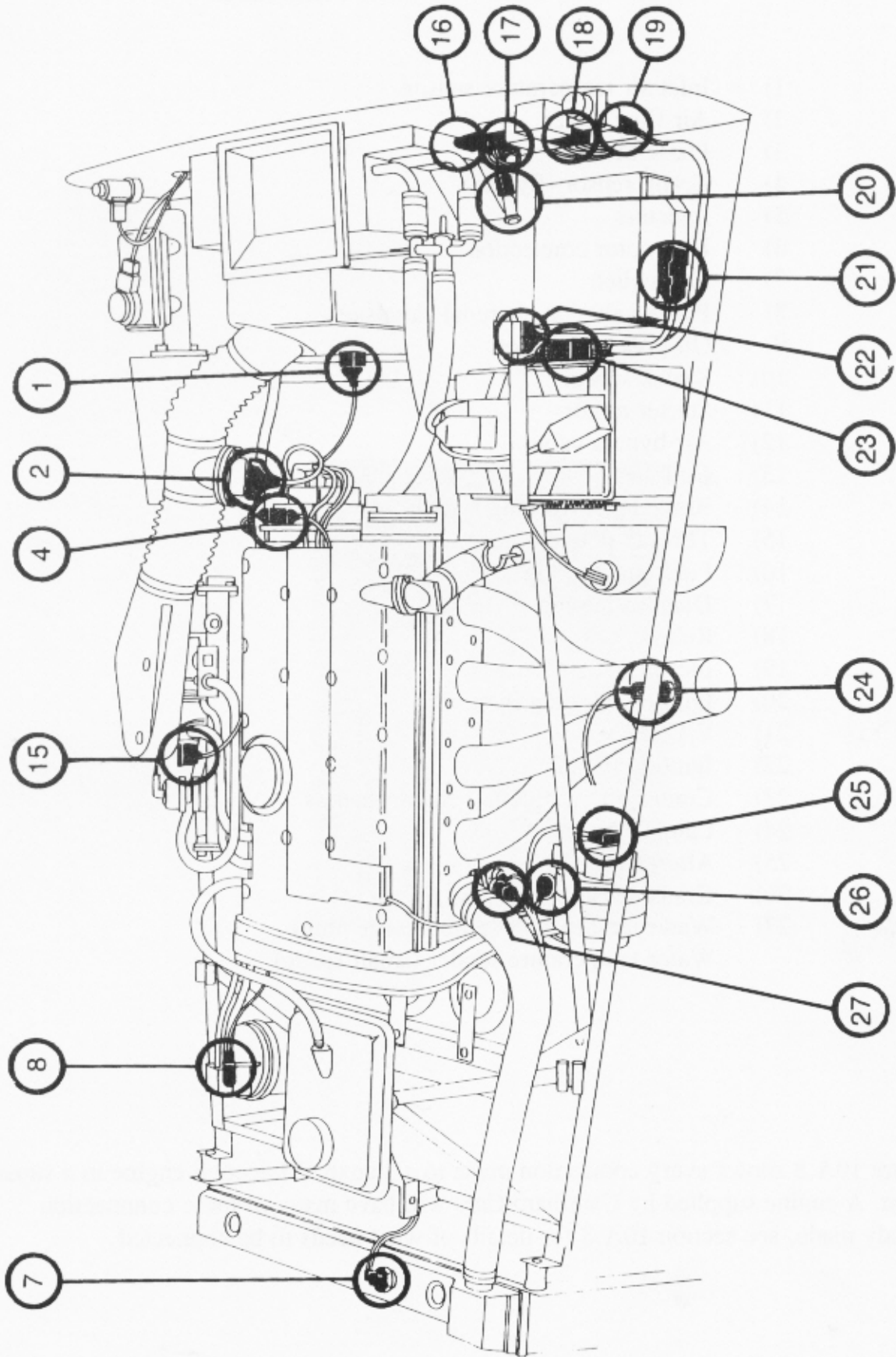


Figure 10A.2 Dry Sump Bell Tank Housing



10A.8 (1) Vauxhall Injection Electrical Connections



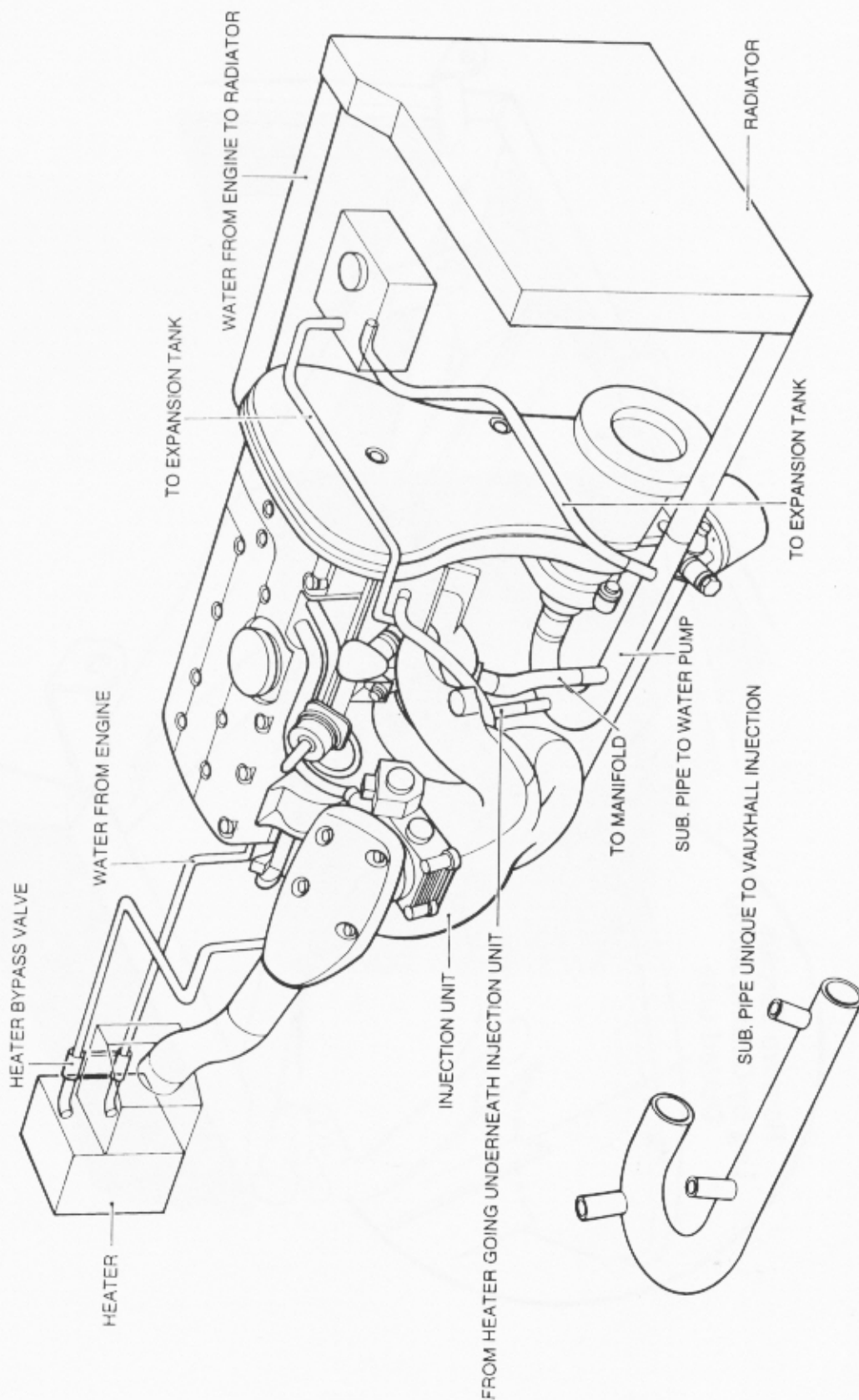
10A.8 (2) Vauxhall Injection Electrical Connections

**Vauxhall Injection - Electrical Connections**

- 1) Inlet air temperature sensor
- 2) Air flow meter
- 3) Phase Sensor
- 4) Crank sensor (flylead)
- 5) Injectors
- 6) Fan motor connection
- 7) Fan switch
- 8) Purge valve on charcoal cannister
- 9) Oil pressure sender
- 10) Knock sensor
- 11) Starter motor
- 12) Air bypass valve
- 13) Coil pack
- 14) Brake level warning switch
- 15) Throttle potentiometer
- 16) Fuel quality plug
- 17) Diagnostic plug
- 18) Relays
- 19) Inertia switch
- 20) Ignition warning light
- 21) E.C.U.
- 22) Ignition module
- 23) Connector, engine to vehicle harness
- 24) Lambde probe
- 25) Alternator
- 26) Crank sensor (on engine)
- 27) Water temperature sensor (large plug)  
Water temperature sender (small spade)

Figure 10A.8 shows every connection made to a Vauxhall injection engine in a super seven. A engine supplied by Caterham Cars will have many of these connection already made, see section 10A.8 for details of what needs to be connected





VAUXHALL INJECTION COOLING SYSTEM

Figure 10A.10 Vauxhall Injection Cooling System

**Expansion Bottle Installation**

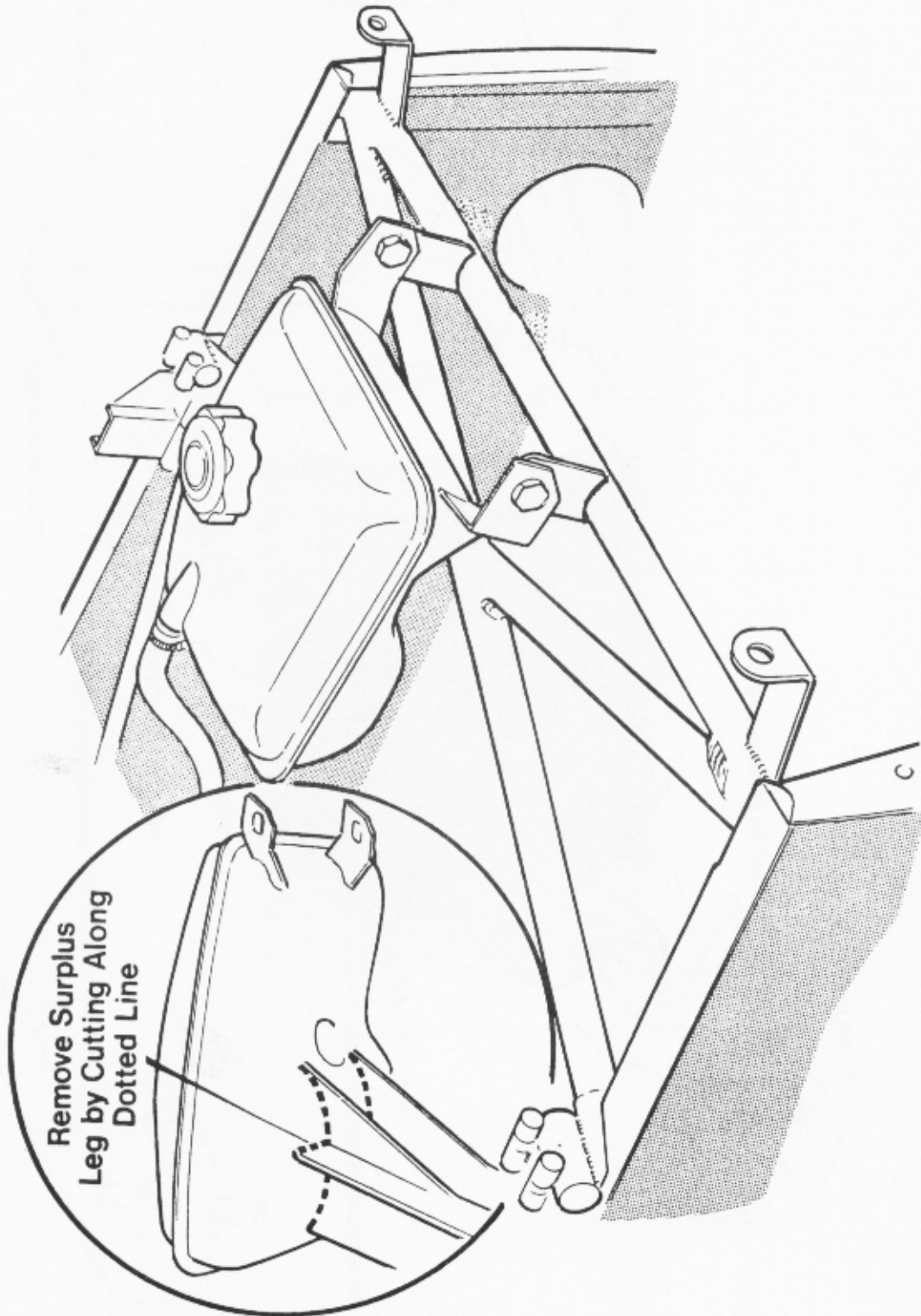


Figure 10A.10.3 Expansion Bottle Installation

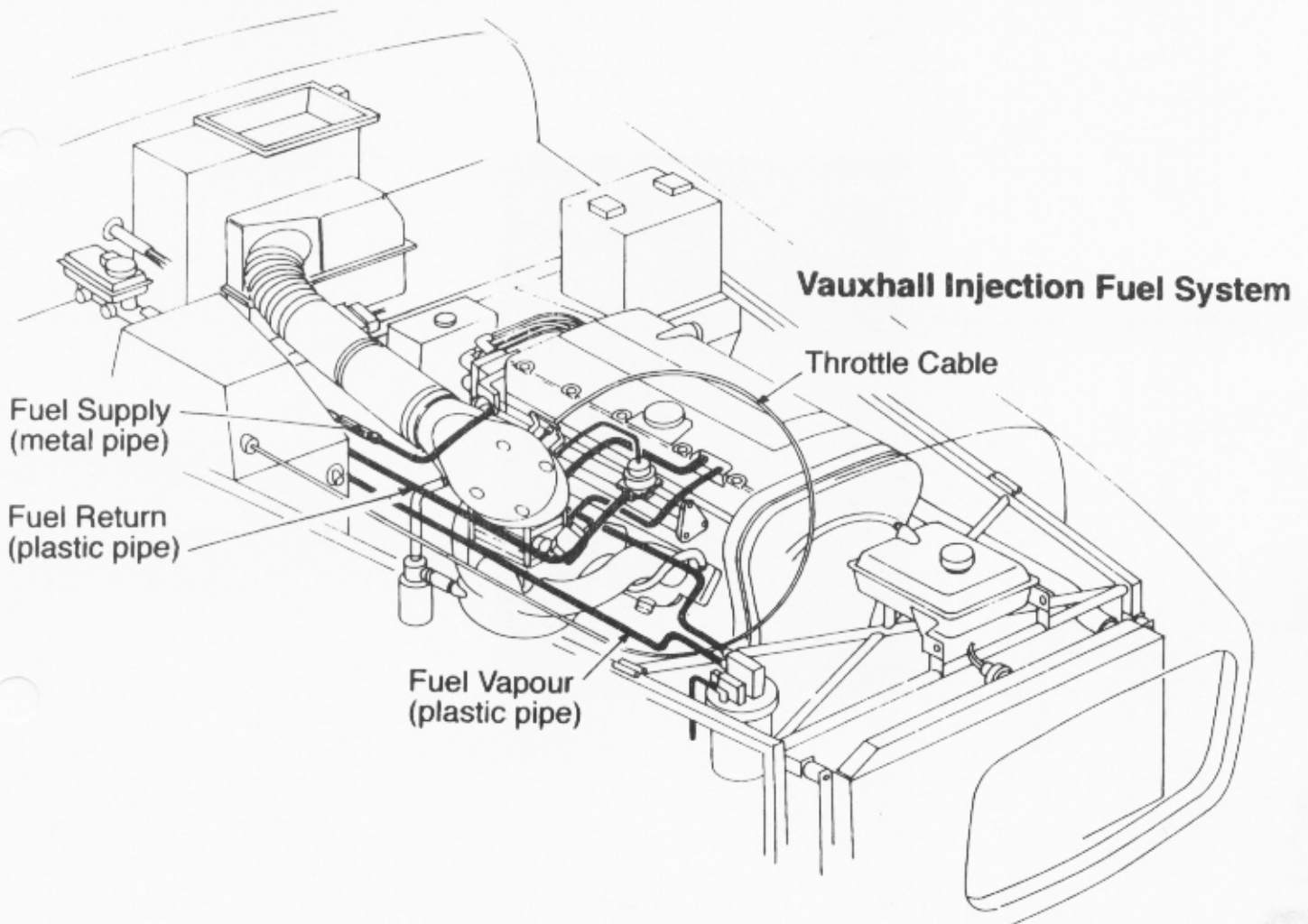


Figure 10A.11 Vauxhall Injection Fuel System