Land Rover Series III
Cab Heater Upgrade

20th – 23rd Feb 2013

Index

Objective

The objective was to improve the effectiveness of the internal Series III cab heater by retrofitting a larger and more powerful defender heater unit into the vehicle.

Introduction

Shortly after taking delivery of this 90" Land Rover Series III hybrid, the heater motor started making odd noises and running somewhat intermittently. Replacing the motor was one of the first major jobs undertaken on the vehicle – but even with a new motor and a free flowing heater matrix it was abundantly clear that the heating was far from ideal.

While a Series III heater is marginally capable of demisting the front windscreen, and just about able to heat the cab (but only when the vehicle is stationary), I'm afraid that any notional idea of comfort for a driver making the mistake of actually driving, is a non starter – for a number of reasons.

The first comes down to the sheer amount of cold air bypassing the somewhat leaky bulkhead vent seals. While this isn't a heater problem per se, it does overwhelm the ability of a marginal heater to warm incoming air. Even if steps are taken to reduce the cold air (by lining the vents with plastic), a standard and well setup Series III heater remains a marginal heating system at best. The second and linked reason, involves the inability of both (a) the heater fan to generate sufficient air flow as well as (b) the relative inefficiency of the heater matrix to adequately exchange heat.

The three issues (bulkhead seals, air flow and matrix efficiency) need to be worked on, in order to achieve anything remotely like a modern vehicle heater.

Defender heater units employ an all-in-one design incorporating the motor, housing, matrix and two control flaps (one to blend cold with hot air and which is mounted on the top) and one to variably control the amount of air flow into the cab (and which is mounted on the side). It is designed to mate with a bulkhead that is largely compatible with the Series III design. While the internal heat exchange matrix radiator is almost identical in size to the old Series III unit the blower motor is marginally faster (but, the fan does have a more efficient blade layout and is also balanced). In addition the direct coupling of the fan to the matrix housing box avoids the need for a round flexible air hose.

Otherwise the physical differences between the two heating systems are not as great as one might imagine. The heater matrix size turns out to be very similar to the old Series III heater (they might even employ the same unit) and while the defender fan is faster – it isn't vastly different from the Series III. The two most significant differences are (a) the way air flow can be routed round the matrix rather than continuously through it and (b) the way the heater assembly unit mates with the bulkhead.

While the Series III unit forces all air to pass through the heater matrix (because the temperature is controlled on a Series III vehicle via a water flow valve) this results in much reduced air flow rate. It also results in a hot cab in the summer (*ironically the one time the heater actually appears to work quite well*). By contrast the defender unit uses a cable controlled blend flap to alter the

temperature. When the blend control is opened to admit more cold air, the flow completely bypasses the heater matrix and so enters the bulkhead at far greater speed. From the point of view of getting warmed (not necessarily roasting hot air) into the cab, it is clear that the defender unit will move air at a significantly higher rate of flow. Just how comfortable that makes the cab in the winter remains to be seen.

There are a number of issues to deal with when it comes to fitting a defender unit into a Series III vehicle.

1. While the upper most two mounting screws for the heater box look to be in the same position as the existing Series III heater matrix box, the same is not true of the lower mounting bolt holes. These will need to be fabricated and drilled through the bulkhead. In addition, the bulkhead holes used by the original matrix and blower motor body will need to be blocked to prevent the ingress of water, engine bay fumes and cold air.

2. The existing wheel arch mud shield (inner) steel skin will, if left in place foul the new heater, and so this will need to be removed initially, and then re-fabricated to protect that area from stone chips etc.

3. The defender heater gets its air intake from a wing mounted snorkel (fitted on the underside of the wing) instead of from the round vent hole as used on the side of a Series III wing. A problem here is that when the Series III heater is removed and a standard defender heater assembly (complete with its built in fan blower) put in its place, the back of the new fan body will partially block a standard Series III air vent and will also foul the round vent grill trim. A consequence of this is that any direct air connection from the old air vent to the new fan blower would be quite difficult to engineer. It seems to me that there are four ways to deal with this:-

    a. The Series III vent grill trim would first be modified to allow it to be fitted and screwed home – but so that it would act as a dummy trim serving no purpose[*1]. A standard snorkel would then be fitted to the underside of the wing as per a *defender* ensuring that clean air reached the heater. If a raised air intake scope happened to be employed on the topside of the wing then the system could take advantage of ram air. Alternatively a snow cowl could be fitted to prevent ingress of water or snow.

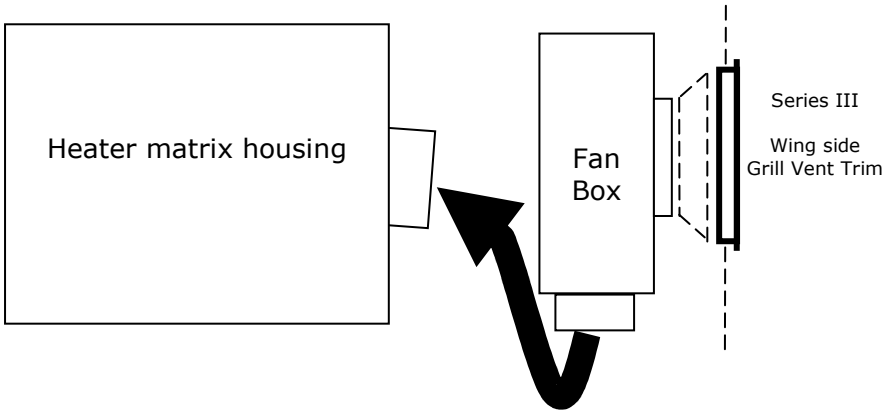
    b. Again – the Series III vent grill trim could be modified to allow it to be fitted as a dummy vent[*1]. But this time the air intake to the new defender blower motor could be connected via a length of flexible hose to the front of the vehicle – perhaps either to a hole on the front of the wing or maybe even the side, or to a position behind the radiator grill. This would guarantee clean air entering the heater and might also take advantage of ram air but would require a fairly large diameter hose to be routed over what is a relatively long path.

    c. Again – the Series III vent grill trim could be modified to allow it to be fitted as a dummy vent[*1]. But this time the air intake to the new defender blower motor would be left disconnected allowing the fan to draw air directly from under the wing. An obvious non starter and one that *would* fail any MOT worth a damn, because although arguably safe when moving, it allows any build up of CO to be

drawn directly into the cab when the vehicle is either stationary with engine running or moving relatively slowly. CO is toxic in even very small quantities and has the unpleasant side effect of compromising victim awareness – which is why deaths resulting from badly maintained boilers can and do occur.

d. The fan motor housing could be separated from the body of the heater box (on inspection – this is definitely a viable possibility). A set of brackets would need to be fabricated so that the now separate blower could be mounted to the bulkhead in such a way that the air intake of the blower was brought close to the existing series III wing side vent – perhaps then employing the original Series III soft cone seal to link the two. The air flow from the blower (which exits via a square hole) would then have to be coupled to the recipient square hole on the heater matrix housing.

While option (d) might be possible, it would also be rather difficult to engineer. The resulting gap between the separate motor and heater box would leave very little room for blower mounts and even if the blower *could* be mounted, the resulting configuration would leave the air intake to the heater box and the corresponding blower outlet aligned poorly with respect to one another. The fact that those two ends are also square (and not round) adds yet more difficulty when trying to reconnect the two. The diagram below illustrates the orientation problem.



Option (d) was quickly rejected due to the engineering difficulties mentioned above along with the fact that the warrantee on the heater assembly would be invalidated as soon as the two units were separated. Option (b) was rejected simply because it offered no real advantage (other than arguably requiring less time) compared to a well engineered defender snorkel implementation. Option (c) was never considered, leaving option (a) as the best solution involving the need to…

a. Fabricate the hole that that snorkel will use (in both the wing, and in this vehicles case also in the checker plate that sits on top of the wing).

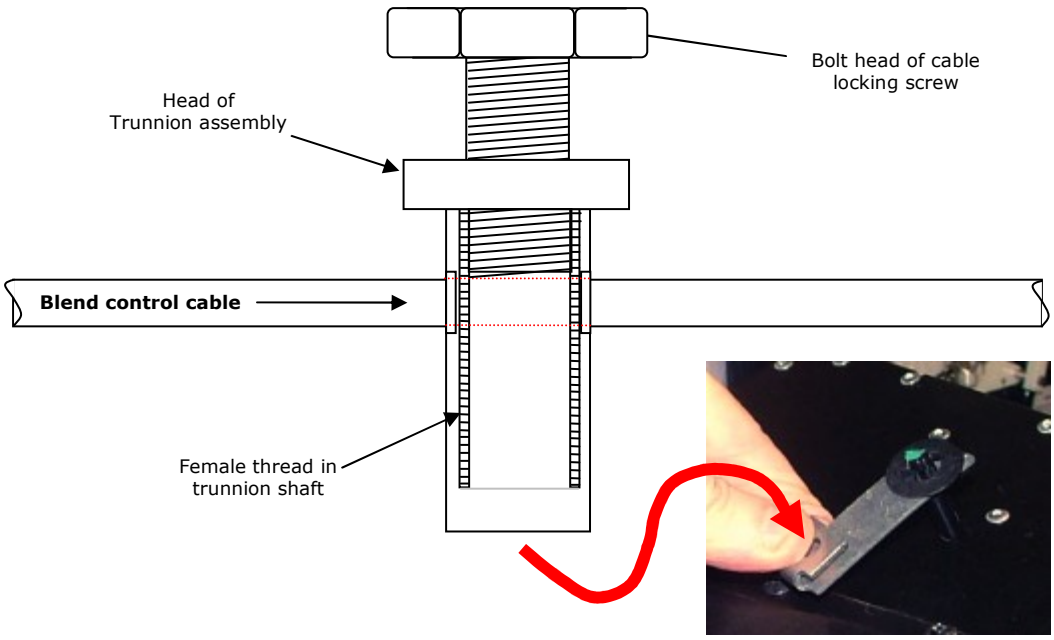
b. Modify the original Series III air intake grill trim so that it doesn't foul the rear of the fan motor in the new defender heater assembly.

**1: It is worth mentioning that even if the Series III air intake grill trim served no useful purpose from the point of view of the heater, leaving the grill trim in place in the wing side will provide just a little much needed engine bay ventilation and air flow during the hot summer months – a welcome and desirable feature when running a V8.*

4. The wiring of the defender unit is slightly different. The motor exposes a three wire circuit consisting of one purple wire, and two green (one with a yellow and the other with a purple stripe). Instead of switching +12 as per the Series III, the defender unit should now be fed a continuous fused 12v feed on its purple wire, and the dash switch should now ground one of the other two wires in order to set the motor speed (green/purple for fast, green/yellow for slow). In effect, the wiring will need some kind of inverter ideally at the dash switch end in order to deal with the polarity change – trivial, but just requires a little thought

5. The motor power consumption is marginally higher than the existing and relatively small Series III motor (measuring the two side by side actually showed barely a 400mA difference at run time, with a slightly larger inrush load on start-up). Existing wiring should cope without modification.

6. The Standard Series III temperature control cable isn't long enough to control the blend flap on a defender assembly. Fortunately a defender blend cable can be used as a direct replacement as it is compatible with the dash control end. However, one word of warning applies. When the cable is fitted to the defender heater assembly, you use what is called a "trunnion" to lock it in place. In effect this is like a bolt with a hole for the cable, and which is separately threaded in the centre – as shown below.



The locking screw is threaded into the trunnion shaft in order to lock the cable. In this vehicle, the trunnion wouldn't actually fit into the receiving control lever on the defender heater matrix (see red arrow above) because the two holes in the lever didn't line up properly. At that point the bonnet makes it awkward to do much about the problem. Take my advice and trial fit both the blend control cable and the trunnion into the heater control lever BEFORE you fit the heater assembly into the vehicle.

So in summary, while this heater upgrade modification cannot be said to be trivial it does look very approachable.

The project commenced with the arrival of 95% of the parts on 20th Feb 2013. The parts were split into two batches consisting of the snorkel first followed by the other components

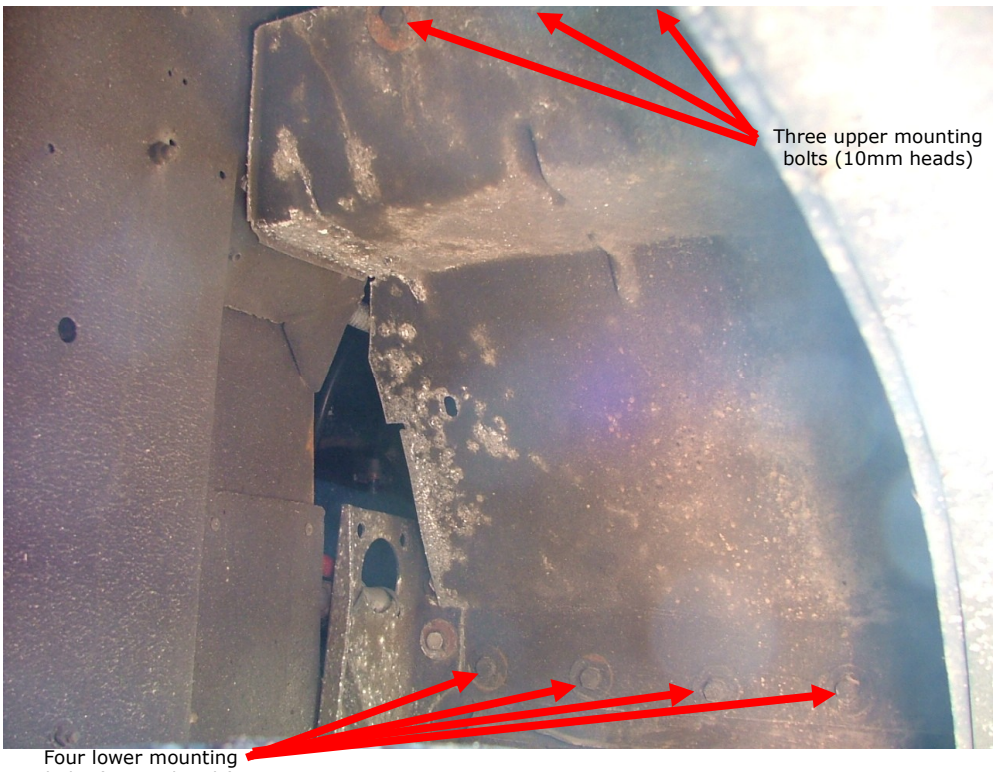
Description	From
Complete Defender heater assembly	Bought aftermarket, new from LR Series at £199.99. At the time of checking there was one complete unit in very good condition available for auction on eBay ie: new/second hand which actually went for £100. There were also a number of old and fairly poor condition units going for perhaps £30, however, if you factor in the cost of refurbishing both the motor and the matrix while still ending up with a fairly tatty looking box, you might as well buy aftermarket new – and get the additional security of a warrantee. LR Series are a good company to deal with and their prices are quite competitive.
Wing snorkel air intake	Bought 2nd hand (for £9) from eBay. All told this item (with its plastic vents) would have come to roughly £60 if purchased new. In fact this bargain gave the green light to proceed with the project.
New foam seal between snorkel and fan entry point	Purchased new from LR Series
Assorted screws, nuts and a new dump valve for the snorkel (designed to allow water to drain out)	Purchased new from LR Series
New control cable for air blend	Purchased new along with a set of press in cable clips
Snow Cowl	The standard defender wing mounted air intake snorkel has one design weakness where snow (dirt and leaves etc) can block the upward facing wing mounted vent. Just when you most need the heater to work, it can't get any air!! Originally designed for the military, a snow cowl fitted onto the top of the existing defender air intake is simply a plastic cover which effectively flips the air intake over, thereby protecting it from snow but without reducing the amount of air that can flow through the system. The underside is entirely open – so there is very little restriction to the air flow. It isn't cheap at £16 but it is well worth fitting as the picture below nicely demonstrates. 

20th Feb 2013 – Removal of Series III components

The strip down commenced in timely fashion – and took vastly less time than the first time repair work was undertaken on the heater motor many years ago (probably down to vehicle unfamiliarity at that time).

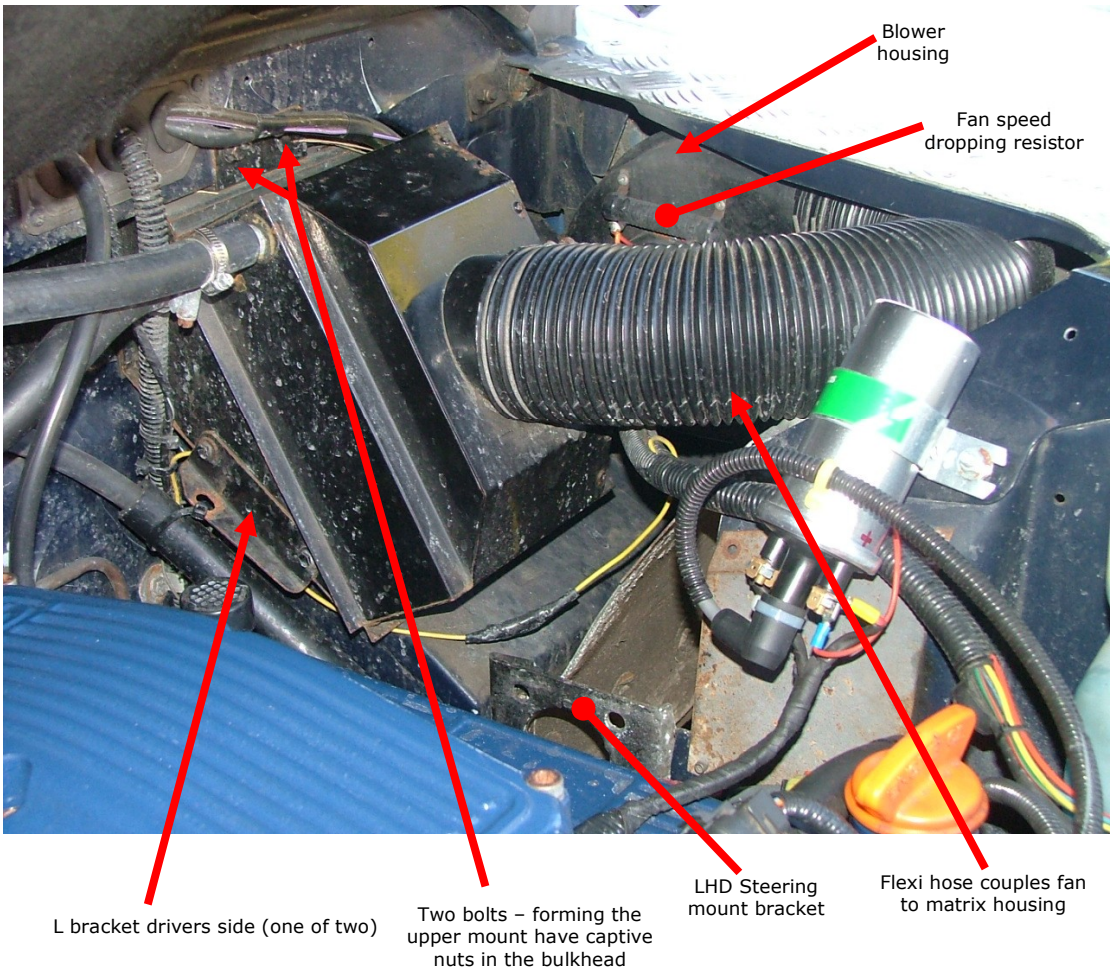
The vehicle is now on stands, with both wheels off. The antifreeze is partially drained and the Series III matrix, connecting flexible hose, blower and the soft air intake coupler are now fully removed (the side mounted external air vent is still in place in the wing). In addition – the mud shield on the underside of the wheel arch has now been removed – as is the rubber strip that Rob has used to try to seal the bulkhead entry point for the heated air (which was actually broken, and a little uneven – so hot air could easily have been escaping). Lastly the checker plate on the top surface of the wing has been removed (10 or so rivets needed to be drilled out).

Just to remind you of the general layout the following pictures will help. From the underside, the mud shield looks as follows. The top horizontal edge is secured by 3 x 10mm bolts (each of which use locking nuts). The lower edge is secured by much heavier bolts (four of them). It looks like it's made of galvanised steel, so making this fit the new arrangement may not be too hard.



The existing Series III matrix and blower (complete with the wire wound resistor) is shown below. You can see the flexible connecting air hose coupling the blower unit to the matrix and also the lower L mounting bracket for the matrix (there is a second identical L mount on the other (passenger) side – but interestingly only the passenger side mount is bolted to the bodywork (the visible drivers side L mount (visible below) is unsupported).

The upper two mounting bolts thread into captive nuts on the bulkhead and that bracket is fortunately in exactly the same place on the new defender heater. In effect these two upper mount bolts will be our registration markers.

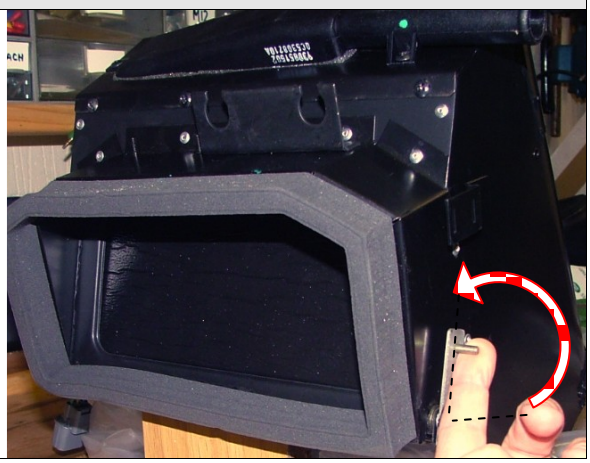


There are two observations worthy of note. While the defender box will couple to the Series III bulkhead, it will extend further towards the passenger side by roughly 2 inches or so. Fortunately the bulkhead is clear of any obstructions along that line so it shouldn't be a problem. Also the bracket at the bottom of the old matrix and which is bolted to the inside surface of the chassis rail will foul the new heater box. This bracket is mirrored on both sides of the vehicle and is designed to accept a left hand drive steering box. Due to its position we will need to grind this down.

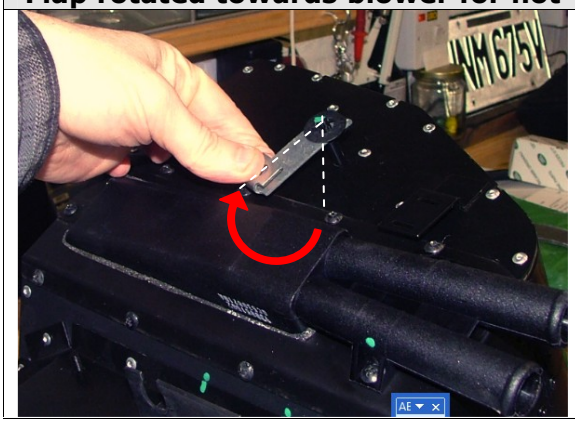
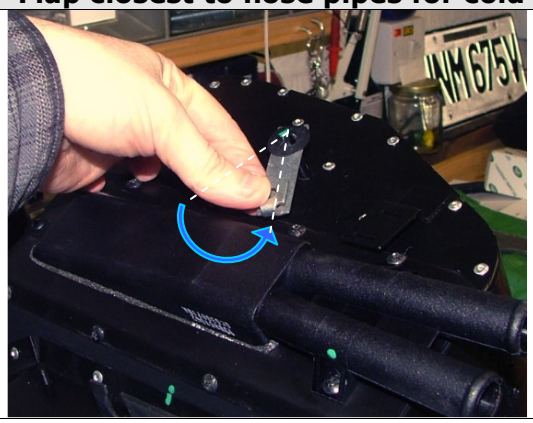
At the end of about 1 hour 45 mins – the entire area was cleared and was ready to offer up the new heater and also tackle the wing mounted snorkel.

Inspection of new defender heater assembly

Turning attention to the new blower assembly while on the bench – some notes are worth making regarding the flap controls, and the wiring. Firstly the flap controlling the amount of air leaving the assembly and entering the car is located on the side that will be nearest the engine. It works as follows…

Flap (resting) when downwards All air leaves the blower and enters the car. Note you can see the matrix through the aperture.	**Flap rotated upwards All air flow blocked.**
	

The second flap controlling the blending of hot and cold air – ie: the temperature of air entering the vehicle is located on the top of the assembly. It works as follows

Flap rotated towards blower for hot	**Flap closest to hose pipes for cold**
	

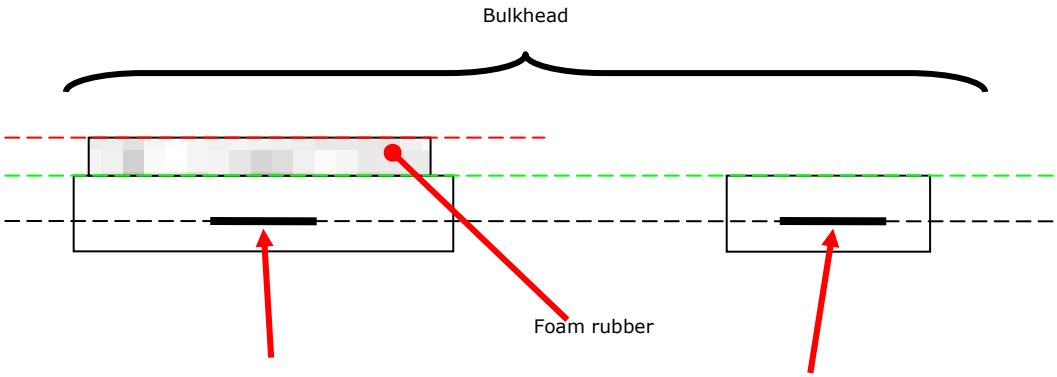
The wiring of the new unit is as follows

Colour	**Description**
Purple wire	Feed with a fused continuous 12V supply adequately rated
Green / Yellow	Switched to ground for SLOW fan operation
Green / Purple	Switched to ground for FAST fan operation (note that shorting the two green wires behaves the same as fast mode).

The new assembly had a small number of minor air leaks (visible when a bright light was placed inside the unit in a darkened room), which were sealed with

silicon mastic (note that there is a very small drain hole at the bottom of the unit which is purpose made for the task – and which (off course) has not been sealed.

Comparing the relative position of the two units when they are bolted to the bulkhead reveals one clearance issue. If the old and new units are lined up so that the uppermost 2 bolt brackets on both units are on the same horizontal plane you get the following layout when looking down (birds eye perspective) on the two.



Top view of defender heating unit (the part the bolts to the bulkhead)

The arrow points to the upper 2 bolt mounting bracket

Top view of original Series III heating unit (the part the bolts to the bulkhead).

The arrow points to the upper 2 bolt mounting bracket

In the view above, the uppermost brackets for the defender box (on the left) and the Series III Matrix box (on the right) are in line (shown as the grey dashed line). In effect these are our reference points. The bulkhead is shown at the top.

The original Series III heater meets the bulkhead on the green dashed line. The metal box of the defender unit ends on the green dashed line BUT the defender box has an additional half inch of rubber seal glued to the box (shown in yellow) – and which must be compressed between the box and the bulkhead when it is bolted up. In effect the defender unit meets the bulkhead on the red dashed line – a considerable difference between the two.

Trial fittings will be interesting – because as if the defender unit does fit with ease, then the gap between the bulkhead and the old Series III matrix might have been far greater than expected (read that as lots of hot air escaping via a whopping great gap). If not, then there may be a need to place some kind of spacer on the upper bracket employing longer bolts so that the foam on the new defender box is evenly compressed, but not over compressed, to perhaps half its size. We'll need to confirm the thread of the upper two bolts as well as it is very unlikely that these will be metric (*turns out they are both M8*)

Keep this in mind as we do the trial fittings.

That's it for now. Assuming it doesn't snow tomorrow, offering up the heater matrix, in order to deal with that LHD steering bracket is next on the list – given it will almost certainly have to be ground out.

21st Feb 2013 – Trial fitting

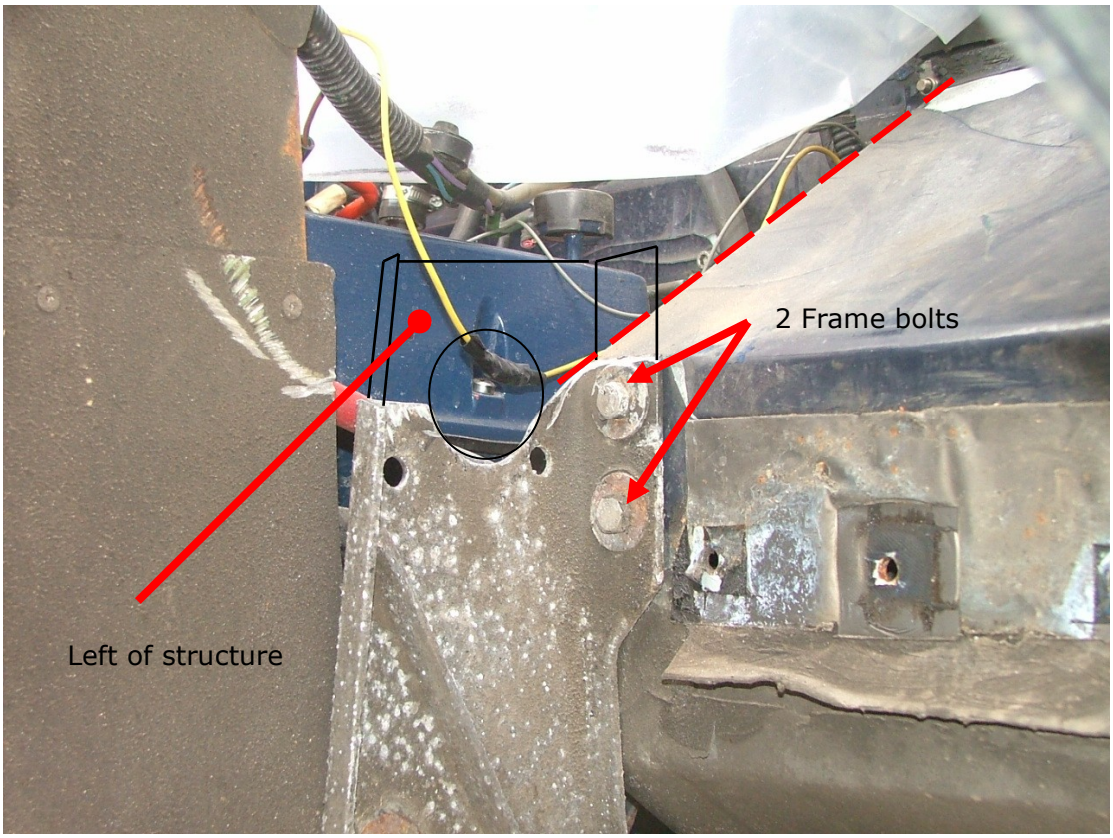
Apart from the cold, today was a fairly good day and about 2 hours were spent looking at the fitting. Three things quickly became clear.

First the old matrix has a significant gap between it and the bulkhead even when the uppermost two bolts are tight. Surprisingly it is in the order of a quarter of an inch or so which almost certainly means a good deal of that precious hot air was escaping from the gap. That does imply that the new defender unit will correctly compress its foam gasket to close this gap, and without any need for spacers on the top mount.

Second the steering bracket definitely fouls the bottom of the heater.

Third the blower motor has a very small fouling problem with both the lip of the wing and also with the original Series III air intake grill screwed into the side of the wing. The wing lip has to be ground back, and (for now) the air intake grill will be removed – with a mind to modifying it separately later on.

So the first order of business is to grind off the extended part of the steering bracket, while not compromising its strength. This is a moderate gauge steel support in the order of about 1/8th inch thick so removing it is relatively easy.



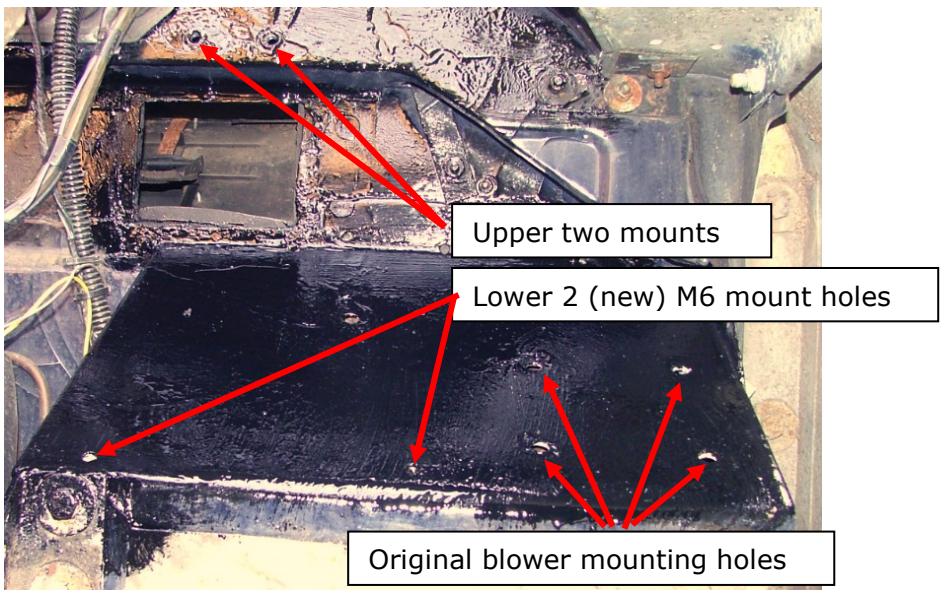
I've shown the outline of the now cut out shape in black. Note that close to the two frame bolts you must cut following the line of the sloped surface (shown as a dashed red line). You actually don't need to cut off the part illustrated with the words "*Left of structure*" but as the remaining spur would be unpleasant to work with top side (for example when changing the spark plugs) it made sense to remove it along a neat line with filled edges to make sure it was smooth.

Turning to the wing you need to cut a small relief into the lip of the wing so that the blower motor housing doesn't foul when it is tightened into position. On this vehicles wing it required a cut roughly 3/8th of an inch high, and extending for about 2 inches (be very careful using a full size high speed grinder to do this as the heat generated will inevitably cause paint to bubble. Either cut it little by little, or preferably use something like a Dremel with a cutting disk or even nibblers or snipers' to cut).

The following picture shows this small relief – photographed from the other side of the vehicle and showing the Series III air intake hole (now minus the grill trim) on the side of the wing

On first offering up the heater assembly into position it appeared that the bracket on the underside of the heater (drilled with a number of holes) actually would overhang the slopped plate of the bulkhead. However when the heater assembly is pushed firmly into its final position (so that the foam gasket is properly compressed) then the lower bracket just sits in the right position so that two bolts can be fitted.

Two 6.5mm holes were drilled into the heater assembly bracket in such a way that M6 bolts could be placed into the bracket. After that the unit was fitted and the new 6mm holes marked on the bulkhead – and then drilled. With that work done the area was cleaned and painted using paint for galvanised metal and after that had dried, the 6 open holes (as used to fix the old Series III components) were blocked with mastic and small plastic plates.



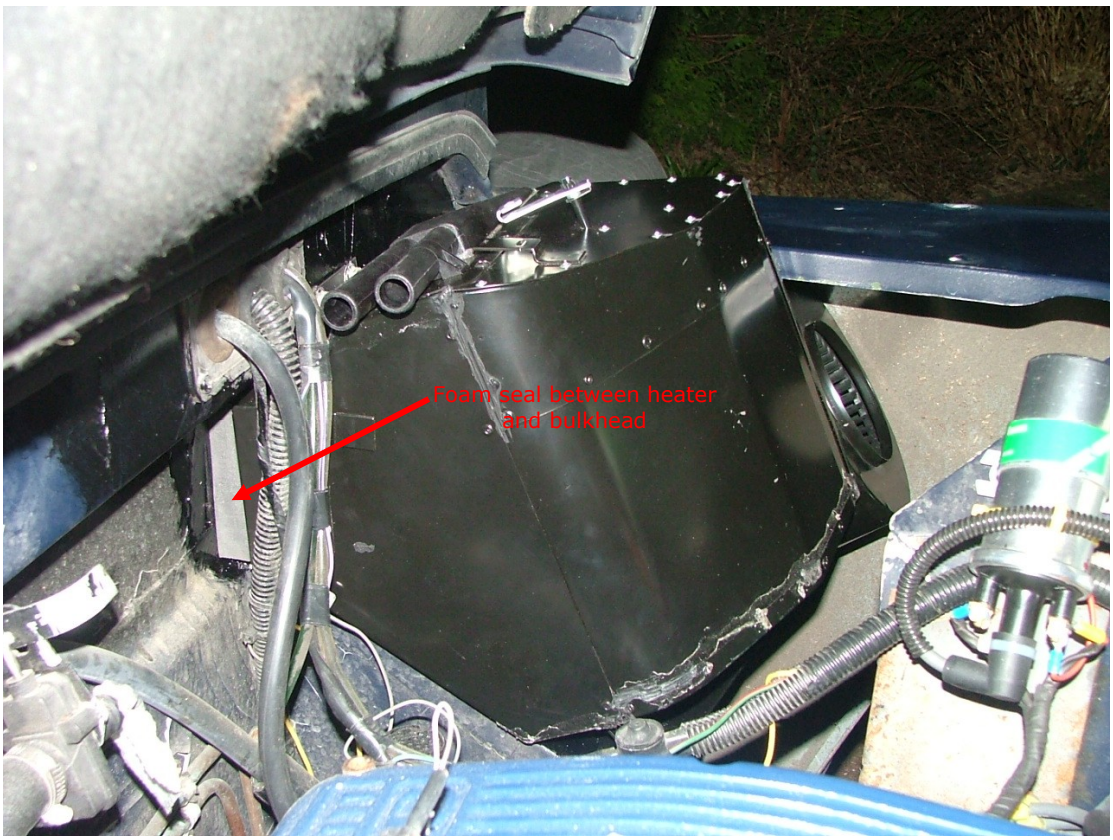
Fitting the Defender heater assembly

As mentioned above, shortly after painting the area, small plastic plates with mastic were pressed onto all the bulkhead holes used to mount the Series III motor and matrix. These will guarantee that the bulkhead won't allow water or engine bay fumes into the cab.

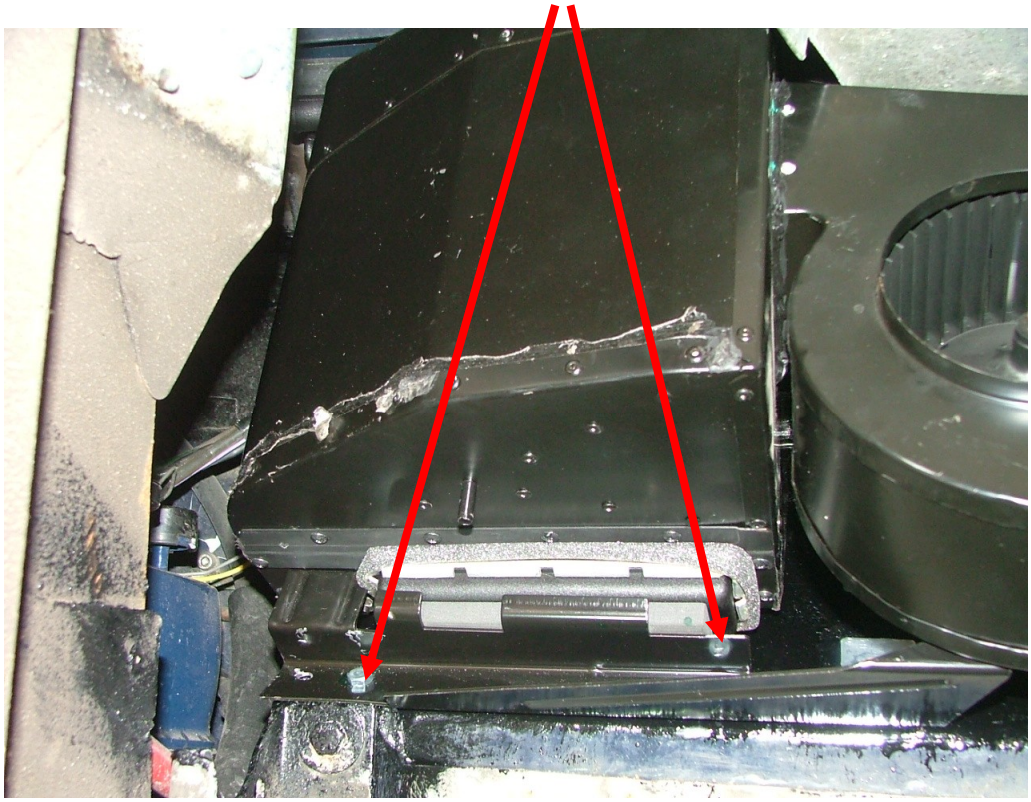
The matrix was then placed into position. The bottom two M6 bolts are awkward to fit simply because the entire assembly has to be pushed firmly upwards to compress the foam seal. Regarding the foam rubber compression issue discussed above, the upper bolts did screw fully home so no spacer was required. As a consequence the bulkhead foam gasket is very compressed on the side nearest the wing but on the other side it's sufficiently compressed to seal but not over compressed to distort.

The quality of the seal is therefore in my mind slightly in question so the next move will be to run the fan, and look for air leaks using a wet finger. The clearance to the bonnet has also been checked and all is well. Assuming the foam bulkhead seal is Ok, plumbing and wiring comes next.

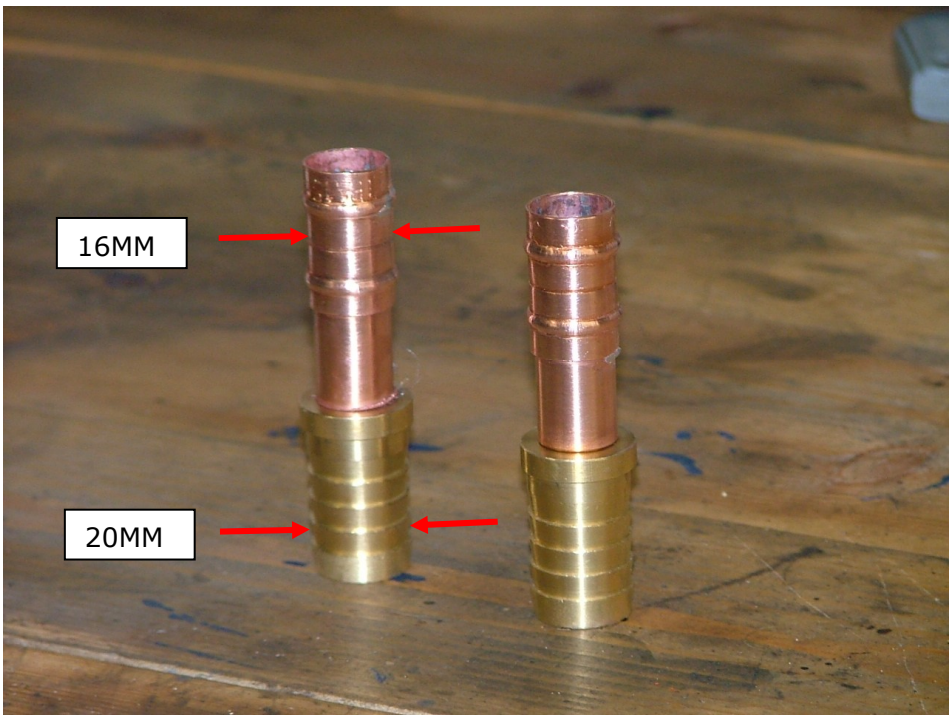
The following picture shows the final position of the entire assembly.



Here you can see a view from under the wheel arch (and which nicely shows why a mud shield is required, given the exposure of the assembly). The lower mounting bolt on the driver side is visible (while the other lower mounting bolt can only be seen as a reflection due to the difficult angle of the photo)



For the plumbing two 20mm to 16mm adapters were fabricated on the bench however one of these will be altered yet further in order to help link the matrix to the up-pipe at the back of the manifold (which are at two different heights).

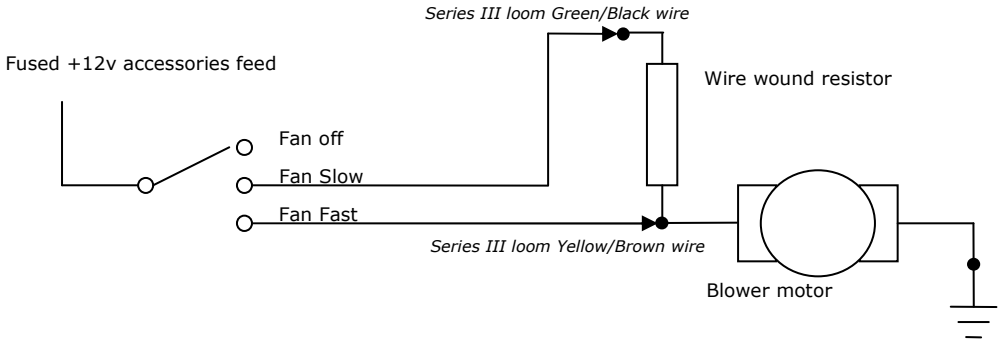


22nd Feb 2013 – Wiring

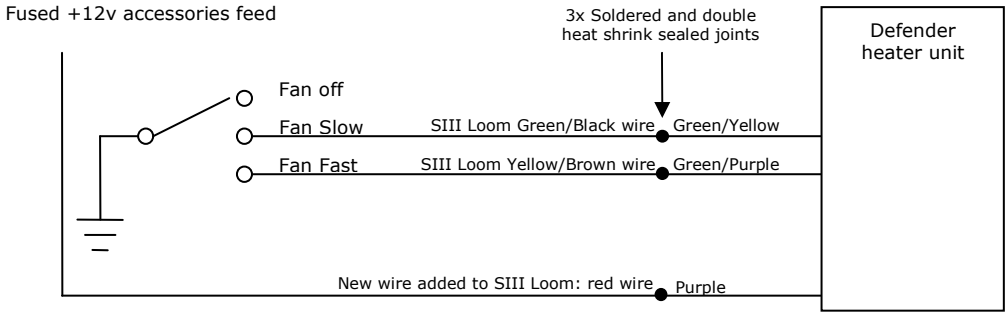
Still awaiting delivery of the flap control cables and the air snorkel isn't fitted.

The objective today is to run the fan just to assess (with a wet finger) how effectively the foam is sealing the union between the heater assembly and the bulkhead. It turns out, rather well.

In order to run the motor for a quick test it was reasonable to run long jumpers directly to the battery. However the final wiring for the heater using the existing Series III wiring loom is so trivial that it made more sense to wire it correctly from the start. The original Series III heater motor was wired as follows



The heater motor speed control switch on the dashboard is a three position toggle employing spade terminals for all of its connections. Wiring the new defender unit makes use of the existing Series III two-wire loom along with one additional wire that must be run from the dash board through the bulkhead to the purple wire on the heater assembly. The new wiring looks as follows:-



1. Start by unscrewing the dashboard, and removing the wire supplying ignition switched +12v to the heater speed control switch (and which will be connected to the uppermost spade on the back of the switch).[*1]

2. Leaving the switch spade disconnected, solder an extension cable suitably sized, to this wire passing it through the bulkhead and connecting to the purple wire of the new heater.

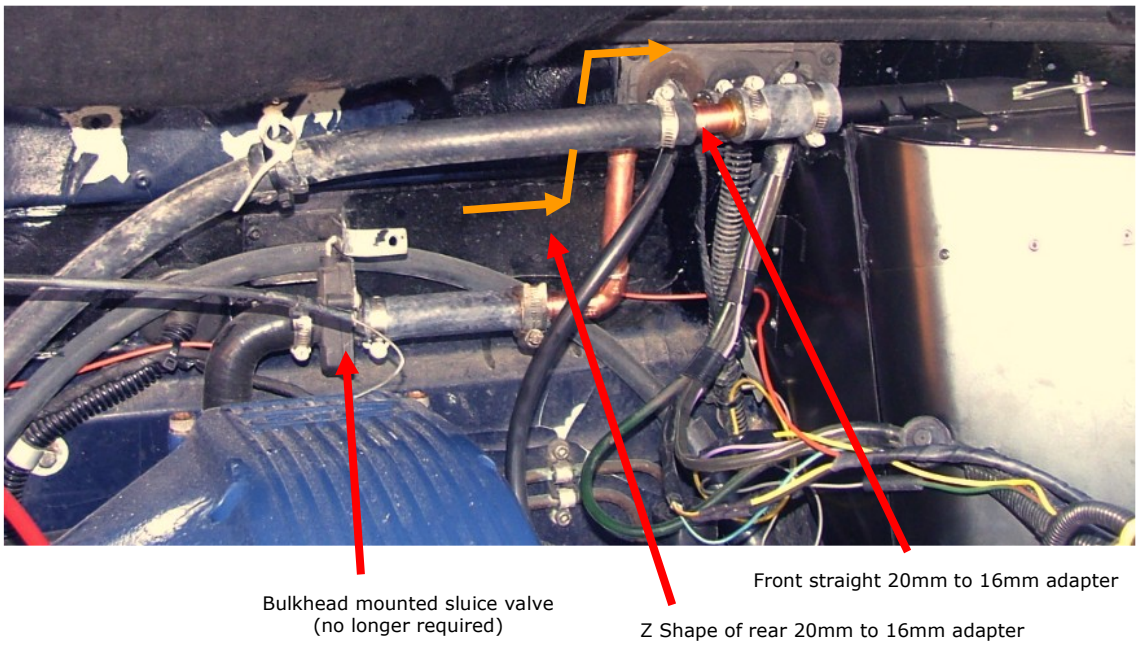
[*1] when this vehicle was first purchased the switched heater motor +12v supply was wired to the run side of the ignition switch. That meant that when the ignition switch was set to "off" the heater motor remained electrically connected to both the ignition coil and the EFi. Speaking electrically – an unpowered spinning motor acts like a generator for as long as momentum keeps the commutator rotating. As a result the heater motor was quite capable of generating sufficient voltage to run both the EFi and the ignition for about 4-5 seconds after the ignition key had been physically removed from the vehicle. The fault behaved a little like engine run on, but only when the heater was switched on (a big clue to the cause of the problem). Rewiring the +12v heater motor feed from the run side of the ignition switch to the accessories side resolved the problem because the heater motor and EFi/Ignition circuits were then electrically isolated from one another whenever the ignition was switched off. It was a rather interesting fault to resolve.

3. Connect the now unconnected uppermost spade on the heater switch (ie: the old +12v) to ground.

4. Use the existing two Series III heater control wires in the loom (which were used to feed the old Series III blower) to connect to the green/yellow and the green/purple wires of the new defender heater. Use a multimeter to make sure you get them the right way round so that when the dash board switch is in the mid position the green/yellow wire is earthed, and when in the max flow position (downwards), the green/purple is earthed.

On this vehicle the wiring was more than able to cope in terms of current carrying capacity, and the fuse is also adequately rated to deal with the inrush load of the fan motor. Even with wrapping the resulting loom with amalgamated tape it took barely 30mins to wire the unit up and test the foam seal – which turned out to be very effective (no leaks were found).

The plumbing was the next step. Note at this point there is a risk that the entire unit may have to be removed, so the wiring loom which includes the screen wash pipe work will be left in a *temporary* state. Proper fixings and support will come later.



Plumbing

The defender unit employs 20mm water fittings, whereas the Series III employed 16mm. Two adapters were therefore made using brass and copper pipe to provide a straight union for coupling 20mm to 16mm hose. The one closest to the front of the vehicle looked as follows with 20mm on the right. This assembly is fully soldered.

The adapter used on the pipe nearest the rear of the vehicle has been further modified from the above design in order to create a Z shape (see above diagram) permitting an easier connection between the existing bulkhead sluice valve (which remains in situ even though it is effectively redundant) and the heater matrix given they are at two different heights.

The adapter works well.

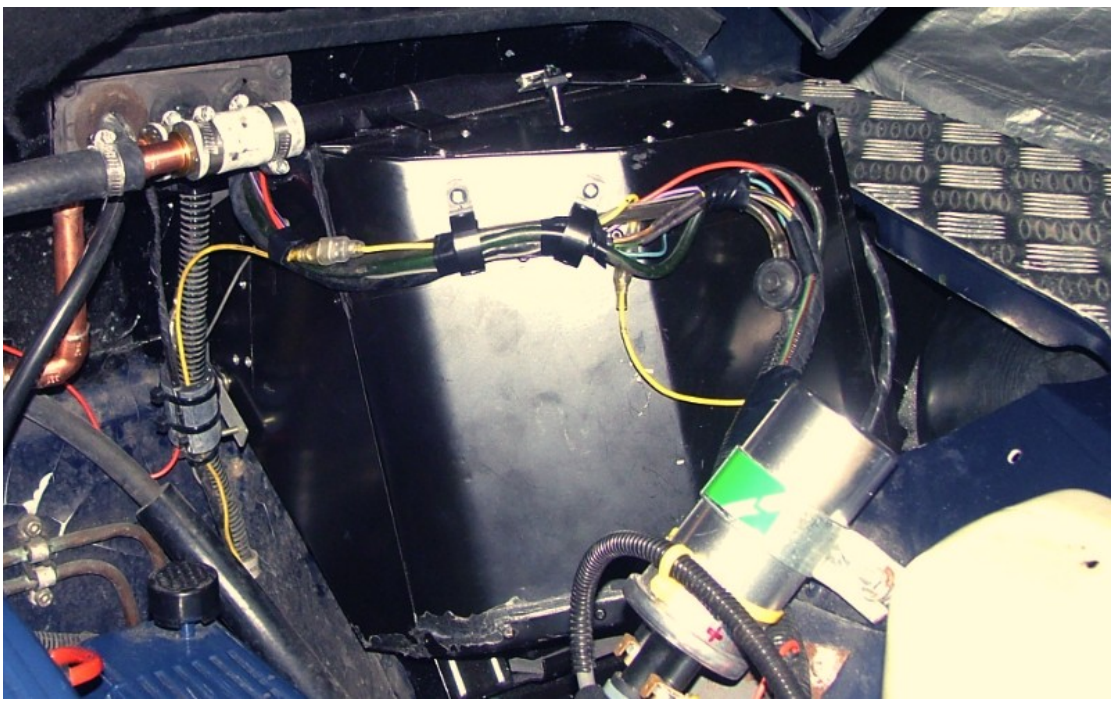
After tightening all the joints, the radiator was filled with fluid and the engine started. With the defender heater airflow set to slow, the air flow inside the vehicle was quite similar to the air flow of the old Series III unit when set to fast. The defender unit in fast mode is entirely different, with a veritable torrent of air entering the cab. On running the engine just up to 45°C it was getting noticeably warm. Until everything is finished it isn't possible to be 100% sure of the success of this project – but the early signs are promising. Next step is to make a support for the long heater supply hose and then to start on the snorkel and the mud shield.

Preparing to fit the snorkel tomorrow

With spare time in the evening, and even though it was bitterly cold outside, time was spent finalising the wiring loom and engine bay in preparation for the major work tomorrow fitting the snorkel and mud shield.

That meant forming the wiring loom properly, and creating two P clip supports using self tappers into the body of the heater box (well away from the matrix).

A bracket was also fitted to the bulkhead to act as an anchor for ties securing the long sweeping 16mm heater hose.



The end result is a well supported albeit not the prettiest loom in the world (it will be further tidied later). All the pipes and cables are fixed – and where necessary covered to protect from friction damage. One other thing – as the heater blend

control cable still hasn't arrived, the blend flap has been tied to hot. With all this cold weather there won't be much need for cold air.

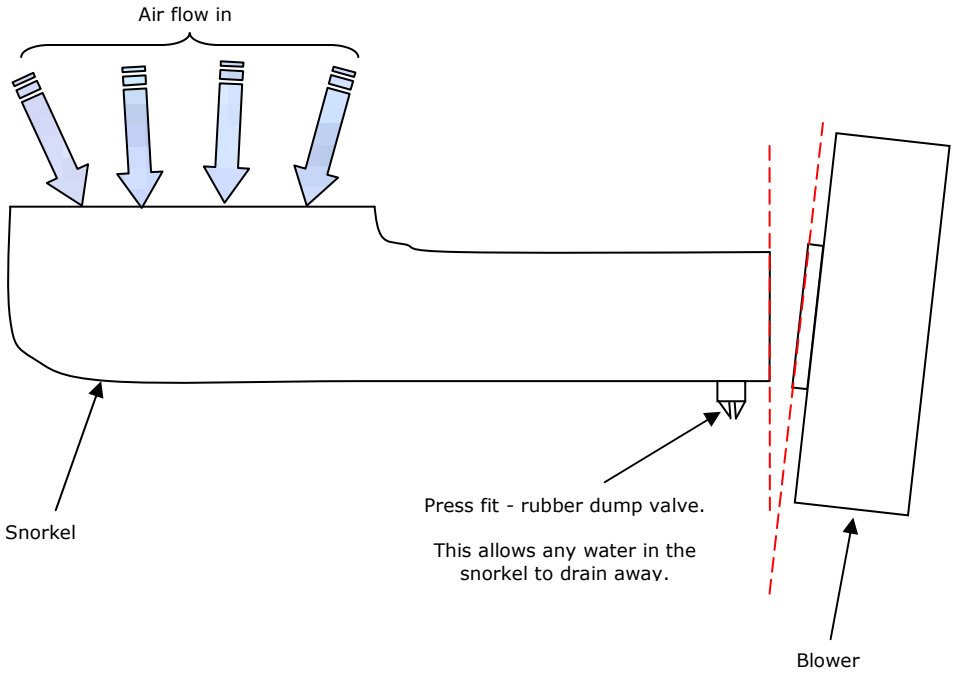
23rd Feb 2013 – Snorkel and Mud shield

With gentle flurries of snow falling on and off all day, work commenced at 9am.

By 4pm the snorkel and mud shield were fully fitted and secured. By 5pm the garage was cleared and swept, and the Series III air intake grill trim rebuilt to accommodate the new heater restrictions. The vehicle was also on the road.

Before starting, a new dump drain rubber was fitted into the bottom of the snorkel. The old one was very brittle and was also blocked. The snorkel body was also cleaned.

There is one point to note about the snorkel – and that is that it shouldn't be expected to make anything like a good fit to the intake of the blower motor. When it is screwed properly to the underside of the wing, the end supplying air to the blower motor is actually cocked upwards resulting in an angle between it and the blower as shown via the two red dashed lines below



While that looks a bit odd, it is compounded by the fact that the end of the snorkel doesn't actually "fit" into the blower motor aperture in any kind of positive way. It feels really odd – and in fact it was considered that there may be a wrong mix of parts involved.

However, neither of these two issues cause any problems whatsoever due to the use of a very forgiving soft foam seal between the two units. The key issue is to have the snorkel aperture close enough to the blower aperture so that when the snorkel is fixed to the wing, the soft foam is compressed neatly all the way round. That seal will then properly join the two units in order to minimise the risk of passing any engine bay gasses into the cab. It is worth remembering that a good

MOT tester will assess this seal – just as they routinely did for the old Series III cone type seals fitted between the side wing air intake and the blower motor.

The new foam seal comes as a horizontal strip – which might appear puzzling at first, but closer inspection reveals a neat cut in the centre line. It is simply split apart and placed round the lip on the blower aperture (exactly as shown below). Placing the two cut out ends (shaped like small triangles) on the left and right (ie: at 9 and 3 O'Clock when fitted into the vehicle) of the blower aperture helps the air seal given the foam has to fill the largest gap at the top of the joint.

Fitting the snorkel is relatively easy – but it is a time consuming process all the more so when it is bitterly cold. A Dremel armed with 31mm cutting disks does a very good job – and in this case five discs were required to cut both the wing and the checker plate. The advantage with such a tool is that the cutting is both controlled and accurate compared to employing a larger grinder. It also avoids overly heating the area it is grinding compared to a larger 115mm grinder reducing the risk of damaging surrounding paintwork.

The snorkel is first positioned on the underside of the wing so that it is in the middle area between the shut line of the bonnet, and the outside edge of the wing. Doing this confirmed that the threaded portion of one of the wing securing bolts was fouling the snorkel and pushing it inbound (which would make the air intake appear to be at an odd angle if fixed into position). The first job therefore was to grind the spare threaded portion of that bolt right down to the head of the nut.

The underside of a Series III wing has an L brace made of steel which is about 6 inches long and runs in parallel with the front axle. It is drilled with three holes to accommodate the upper mounting bolts for the now removed wheel arch mud shield. This L plate is lightly welded to the underside of the wing and because it fouls the snorkel must be removed – although the side that is arc welded to the underside of the wing can be left. Be careful when grinding it out not to cut into the wing itself.

The head of the snorkel is then positioned under the wing making sure firstly that it butts to the blower (in such a way that it will adequately compress the foam) and secondly that the snorkels outside edge (nearest to the outside of the wing) runs parallel and true to the line of the wing running from the front-to-the-back of the vehicle.

From under the wing, the outside edge of the snorkel head can then be marked onto the underside of the wing using a felt tip pen. The snorkel is then taken to the bench and used to create a cardboard template of its air intake head. Once that template is made and cut out, it is then marked using the unscrewed plastic snorkel vent in its centre (ie: this will be the part that needs to be removed from the wing) and that centre part is then cut out of the template with a sharp knife.

It is then a simple matter to take the template and place it under the wing, lining up the outside edge of the cardboard template with the previously made snorkel head marks. A marker pen is then used to draw the outline of the hole inside the template on the wing. In effect – this mark defines the boundary of the area we need to cut from the wing.

Four pilot holes are then drilled from under the wing to orientate the position. The template is then moved top side of the wing, lined up with the four previously drilled pilot holes and then the marker pen is used to draw the inside boundary on the top side of the wing. At that point the wing is ready to cut.

> **This sounds simple and rather linear. However the old maxim "*measure twice, cut once*" was being practised exhaustively throughout this process.**

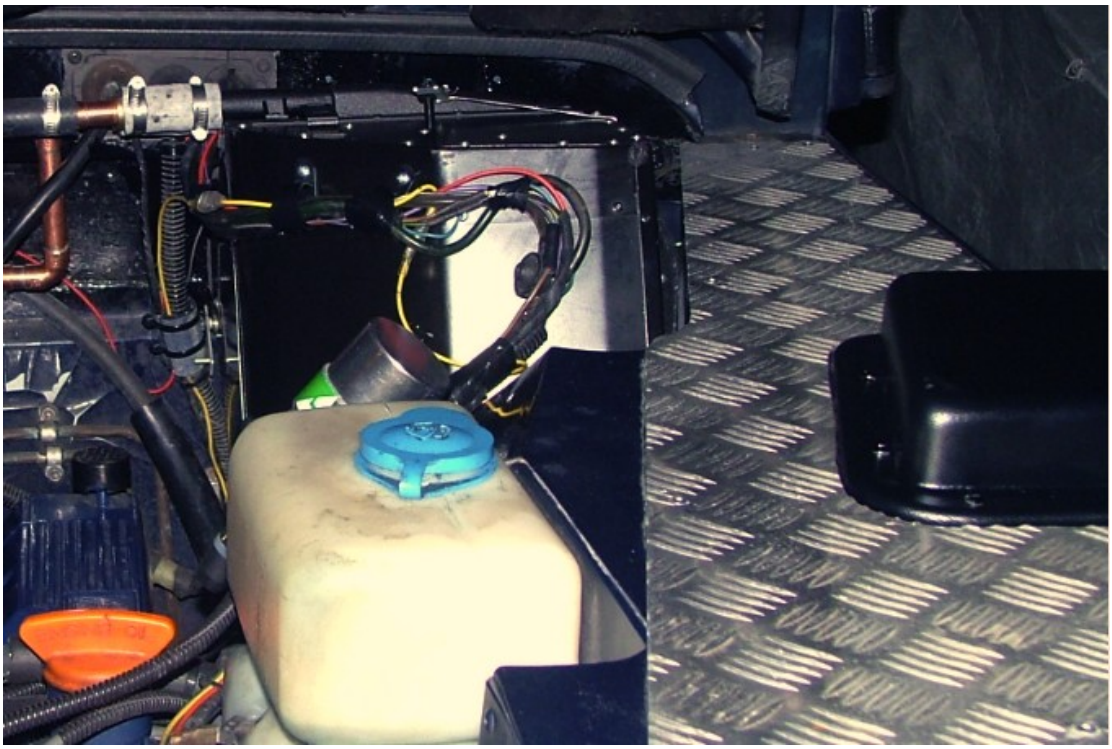
There follows a long, noisy and slow process of carefully using the Dremel to cut out the section of the wing – using the plastic vent from the Snorkel to carefully recheck progress all the time. It was in an ideal position when finished.

This vehicles Series III wing has checker plate on the top surface – so another cardboard template was created using four of the rivet holes used to fix the checker plate to the wing as a reference, and which provided the somewhat oversized hole that will be required to accommodate the defender vent AND the snow cowl (which adds a good 5mm all the way round). A second long and slow process of again using the Dremel to carefully cut out the section of the checker plate followed, and with reqgular checks to ensure all was well. Checker plate is harder than a land rover panel – but it's definitely not steel. So the process works well so long as one has patience. The checker plate was also in a very good position when finished.

Before fitting the snorkel, the freshly cut surfaces were painted, the soft foam seal was fitted to the blower, and then the snorkel was fitted. It needs to be pushed very firmly towards the blower to get the foam to compress properly, and so it will be a little bit of a struggle until at least two of the vent screws thread. The rest of the screws were then screwed home to make absolutely sure the fit was correct, well spaced, and looked right. The bonnet was then closed to make sure there was no fouling.

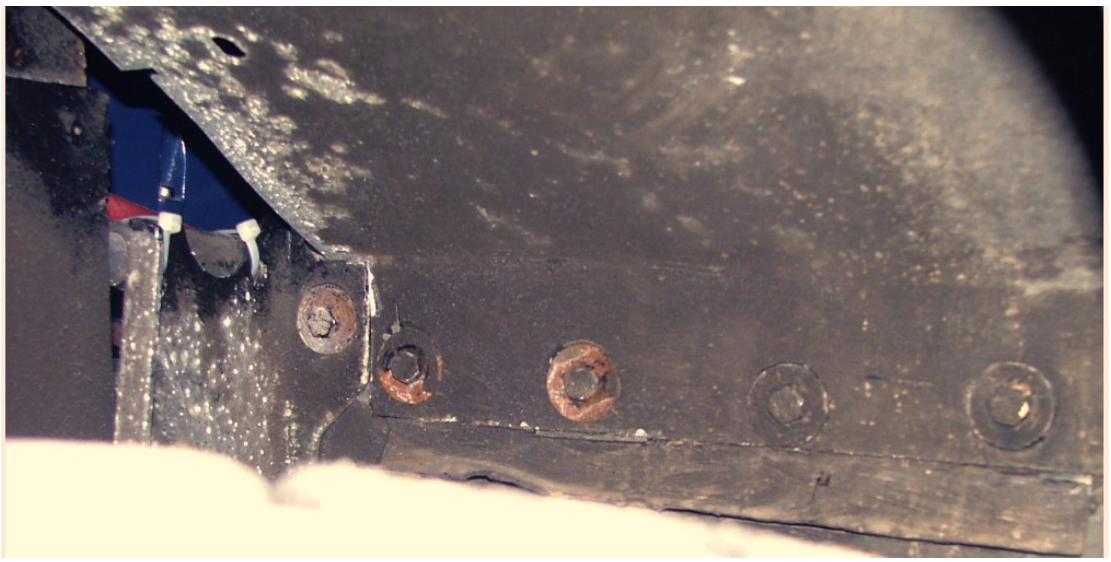
The newly cut checker plate was then fitted with 10 new rivets to fix it into place. The appropriate six screws were removed from the vent and the snow cowl fitted using the six supplied (and slightly longer) screws. The plastic caps supplied to hide the screws were actually of poor quality (splitting as soon as the screw was tightened), and so these were left off and the screws were given a dab of paint on the top.

The end result looks elegant and built for purpose. The view from the front of the vehicle – showing the snow cowl, and the heater box is as follows:-



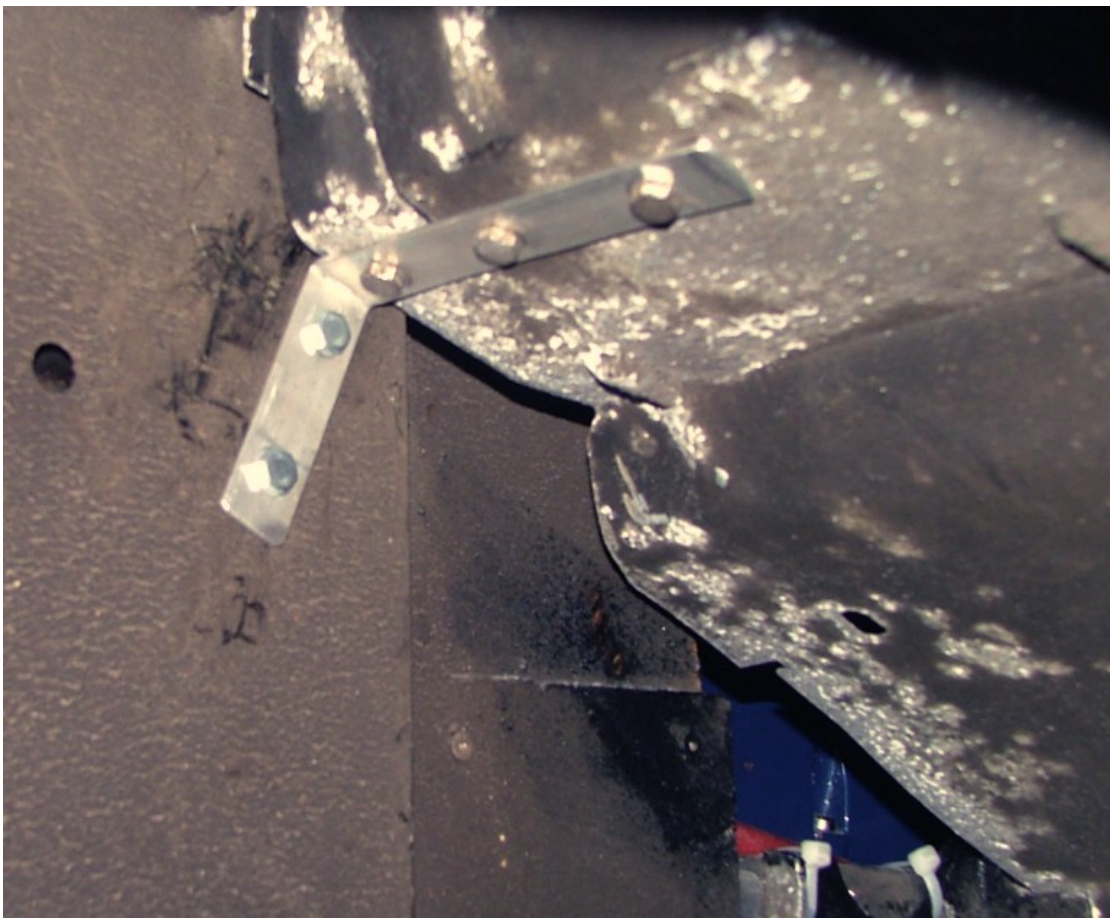
The snow cowl is properly recessed into the checker plate, and not just clumsily screwed to the top. The gaps between the cowl and the checker plate look even and the entire unit looks purpose built.

The mud shield was next, and believe it or not that was even easier than expected. Armed with the original mud shield, it is relatively easy to bend the sheet steel to get it into a better position. The side nearest the engine had to be trimmed for clearance and also a U shape had to be cut into the top edge so that the rounded snorkel could sit into the recess – and so an hour or so was spent gradually forming it into shape. All the time the four existing lower mount bolts were being used as a fixed point of reference.



Once it was more or less right (and interestingly looking much the same as the mud shield on the other side of the vehicle) the four lower bolts were fixed and then an L bracket was purpose made using an 1/8” aluminium plate drilled with

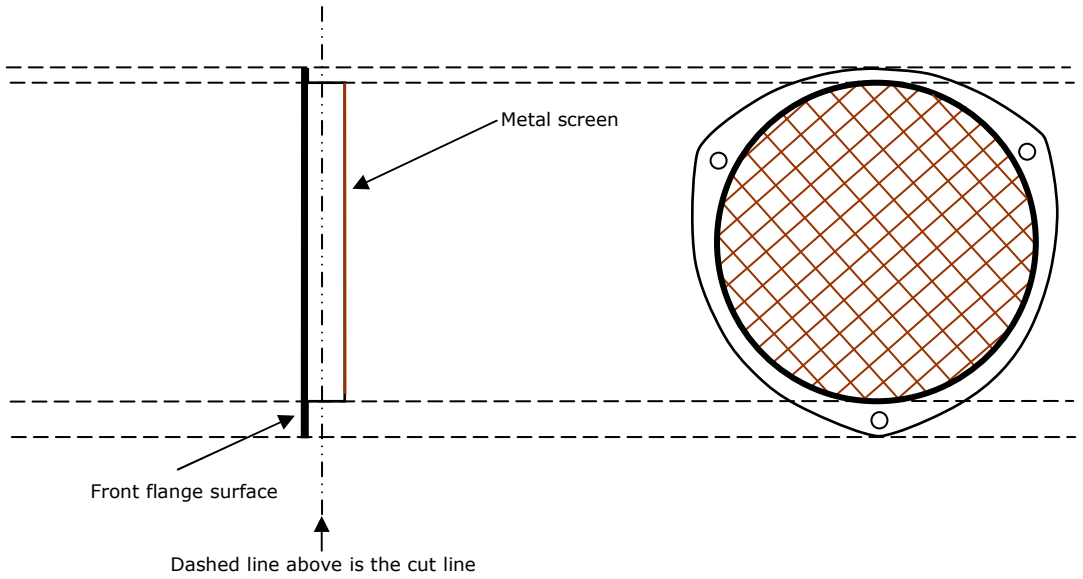
five 6.5mm holes so that the upper side of the mud shield could be permanently fixed to the engine bay metal work – using three M6 bolts with locking nuts on the top of the mud shield, and two M6 bolts into the engine bay. The shield is now secure and won't cause any problems with the MOT.



At that point the project is basically finished, with but one job remaining – namely making good the original Series III wing side air intake grill. The Series III air intake grill trim screws into the wing using three self tapping screws and extends into the wing by something like 20mm. The new defender blower motor unfortunately fouls this and means that the grill can only extend into the body by perhaps 6mm or so.

That leaves an interesting problem – because although the eye certainly won't appreciate an unfilled hole, it will equally dislike a blanking plate. Blocking the vent hole also comes with the disadvantage of further restricting engine bay venting and air flow (a very useful feature in the summer). The answer is to carefully modify the original plastic grill – again using the Dremel to effectively shorten its depth so that it doesn't extend so far into the wing and therefore doesn't foul the new defender blower motor.

Using bull nose cutters, the plastic lip locking the metal grill into position was first removed. After removing the galvanised grill, the body of the plastic was accurately marked – working on the basis that the old grill would later be glued into what would become a shortened body. Note that the body of this trim does taper, so the metal grill will be slightly undersized when it is refitted.



After carefully cutting the plastic body and using sanding paper on a flat surface to smooth the cut line completely flat – a number of dabs of araldite were used to fix the grill into position. It will be left for 24 hours to cure (as it is so cold) and then the galvanised metal grill will be sprayed satin black and the entire unit fitted tomorrow. The end result is as shown below. The galvanised metal grill can be seen now to be much closer to the top plastic flange (between the two red arrows) as compared to a standard Series III grill which is something like 15 mm deeper. (Reflections from two of the dabs of araldite can be seen in the lower part of the grill).

The side view of the vehicle (allowing for the reflection from the car cover fitted to the vehicle alongside) looks neat and tidy with just a hint of the silver blower motor visible through the grill.

The first test run

Whilst driving in bitterly cold weather, the driver was actually comfortable. It isn't "cooking" warm, but feet and hands are warm enough with plenty of demist windscreen warm air. After 30mins, the fan could be switched to slow in order to reduce the warmth, which by any standard is a very good result indeed.

Subsequently fitting the "Blend" control cable

The standard Series III hot/cold control cable must be replaced with the longer defender cable (part number: MRC6194 or JFF500010). This longer cable is compatible with the Series III dashboard control, however, you will need to order a small metal fixing clip used to clamp the control cable onto the defender heater box (part number 13H7343L), and also the trunnion clamp used to fix the moveable cable to the blend control lever (part number: RTC5978). Note the warning mentioned at the start – that it is wise to trial fit the cable and trunnion BEFORE fitting the entire heating assembly into the vehicle.

Summary

Swapping the standard Series III heater matrix and blower motor with a Defender heater assembly is not a trivial task. Costing something like £270 for parts, it calls for fabrication as well as modifications to the plumbing of the coolant feeds, re-wiring to drive the motor, altering the wing (and any checker plate if fitted) to add the snorkel and altering the existing Series III air intake grill. With that in mind the work required is definitely within the range of a competent home mechanic.

For a 90" Land Rover the change has the important benefit of increasing driver comfort without requiring additional cab space (something that may have been required if some kind of supplementary heater had been added). The sound level of the fan is perfectly acceptable, as is the performance.

I can heartily recommend this modification to any owner of a 90" Series III Land Rover.