The Wonderful World of Type II HVAC Systems

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Definitions

The following is a short list of definitions that I use throughout this article that comprise many of the major components of the Type II system:

- **Blower Motor**
  Small motor and squirrel cage fan mounted on the side of the HVAC box. It pushes air through the system.

- **HVAC box**
  This is the large black box that is dead center of the coach and is mounted directly on the firewall behind the two access hatches. This box is more or less divided into four chambers: the air inlet, the evaporator section, the heater core section and the air outlet into the Distribution Plenum.

- **Distribution Plenum**
  This is a black plastic assembly that is attached to the bottom of the dashboard. It has an opening, dead center, to allow air in from the HVAC box to be directed to the defroster, A/C or heat vents

- **A/C Vents**
  These include the passenger side vent (two dash openings), the driver's side vent in the arm rest, and the center vent (two dash openings). The center vent also distributes heat, unlike the other A/C vents.

- **Heat Vents**
  One located directly above the driver's foot well and one located under the dash in front of the passenger seat.

- **Defroster Door**
  Located in the Distribution Plenum opening that sits directly above the HVAC box.

- **Max-Air Opening/Door**
  The opening is located directly below the center vent in the dashboard at the same level as the passenger heat vents. The Max-Air door is the vacuum operated door in the HVAC box that is normally closed to block this opening. This door only opens when the temperature lever is in the far left (Recirculating) position. The 'Recirculating' label is a carryover from the prior years' panel and is incorrect because the Type II does not have any recirculating ability.

It Began With One Question, "Why is my dash airflow so bad?"

First, I am not an HVAC guy nor am I an engineer so I can't and don't pretend to speak from a background of training or expertise on this subject. My thoughts and opinions are based strictly on admittedly subjective observations and opinions based on my own hands-on experimentation with the system on my 76 Eleganza.

First, is the airflow really so bad? For me, GM answered this question itself with the introduction of the Type II system and its 'Max-Air' door. This was an attempt to improve airflow by routing ALL, repeat ALL, A/C air through a large rectangular opening in the floor that ended in two add-on ducts bolted to the dashboard. It completely bypassed the Distribution Plenum and therefore, all dash mounted A/C vents. How did it achieve this? Simple – the system used a vacuum operated door to close off airflow up into the Distribution Plenum. All A/C air was then directed through the 'Max-Air' opening and its two vents. Did it work? Again, GM answered with a redesigned system in 1977 so, no, it didn't work as well as GM hoped. For me, GM's Type II 'Max-Air' door design indicated that the Distribution Plenum had some pretty serious airflow problems that GM couldn't easily overcome. In fact, the A/C airflow makes four right angle turns in the HVAC box alone and several more in the Distribution Plenum. Now add in the all the leaky seams in the Distribution Plenum and the poor connections to the vents and it's a wonder that we get any air at all!

Step One: Relocate the Blower Motor to the Front of the HVAC Case

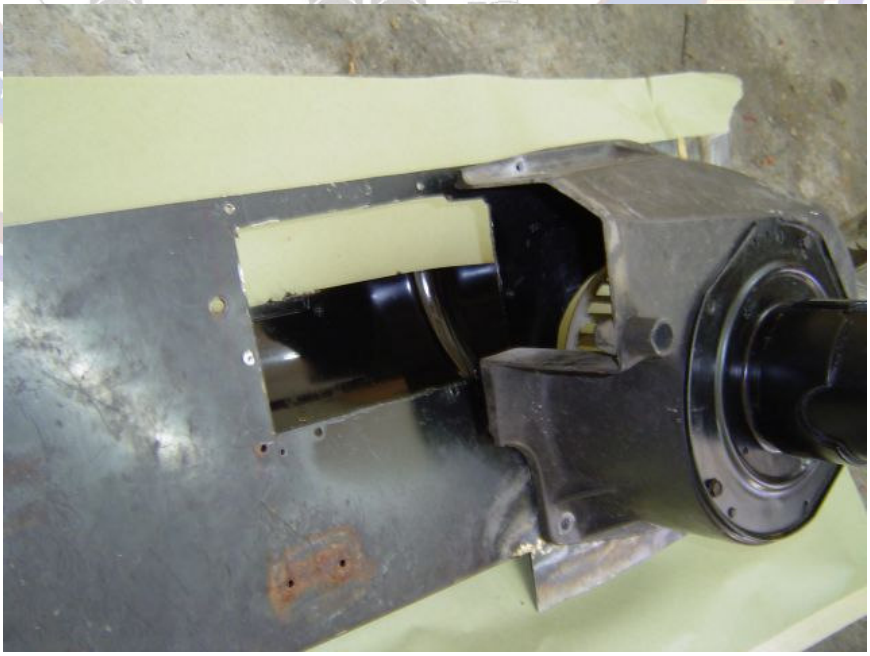
This actually began with a seed planted by reviewing Dave ????'s design where he cut openings into the HVAC cover and routed some ducts up through the floor with great A/C airflow results. I wanted the same results but I wanted good airflow through the heating system too and Dave's only worked for A/C. I also wanted the air to flow through the stock dash vents if possible. I thought about a couple of different methods and none of them really panned out because of the tight space in front of the HVAC box. On a complete whim, I unbolted the stock Blower Motor and its case and stuck it on the front of the HVAC case - it actually fit in the small space! This meant that I could pull air *through* the evaporator and blow it directly into the HVAC case and eliminate three right angle turns.

The actual fabrication for relocating the motor was easy. First, I split the front cover for the HVAC box horizontally. The split is exactly on the sheet metal bar that divides the heater core chamber from the evaporator chamber. You don't have to do this but it makes it much easier to take the cover on and off because you can leave the heater core cover in place. It also provides a very good reference line for cutting the openings into the lower cover.

The important cuts are for the new air inlet for the squirrel cage and the air outlet into the HVAC box. You have to effectively separate the air coming from the evaporator from that being blown back into the HVAC box. Unfortunately, there is not much room to do that because GM only left a space about 2.5" tall by the width of the HVAC box. Above that 2.5" is the heater core and below it is the evaporator so you have to have your outgoing, chilled air, go through this 2.5" space. If it weren't for that black curved deflector in the following picture guiding the air into that small opening, the chilled air meant for the HVAC box and your warm face would be blown right back into the evaporator.

The top of the squirrel cage motor housing is even with the top of the evaporator. With a small piece of sheet metal cut to fit the curved edge of the deflector, you have a divider between the air coming into the fan and that going out to the HVAC box. Hopefully you can see that the curved plastic diverter in the picture to the left fits into this space when the cover is in place. I used a piece of open cell foam along the edge of the diverter for a better seal. Closed cell might work too but I was concerned about its ability to compress enough. I just slipped the sheet metal between the existing sheet metal in the HVAC box and the top of the evaporator and caulked it in place. Inelegant but functional.

The top of that black plastic diverter is also even with the top of the evaporator. The diverter is a register deflector from Home Depot. It is adjustable to accommodate different size floor registers but even at its shortest, it was too long so I sawed off some of it until it was the right length for the blower case and pop riveted it in place and caulked all seams.

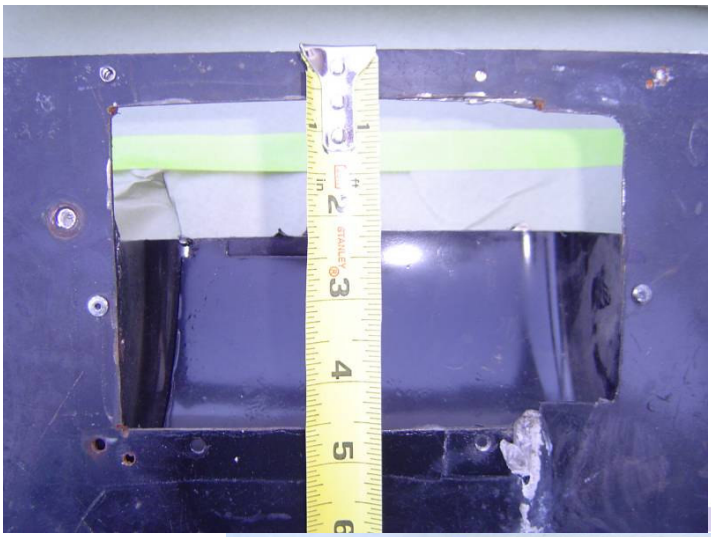


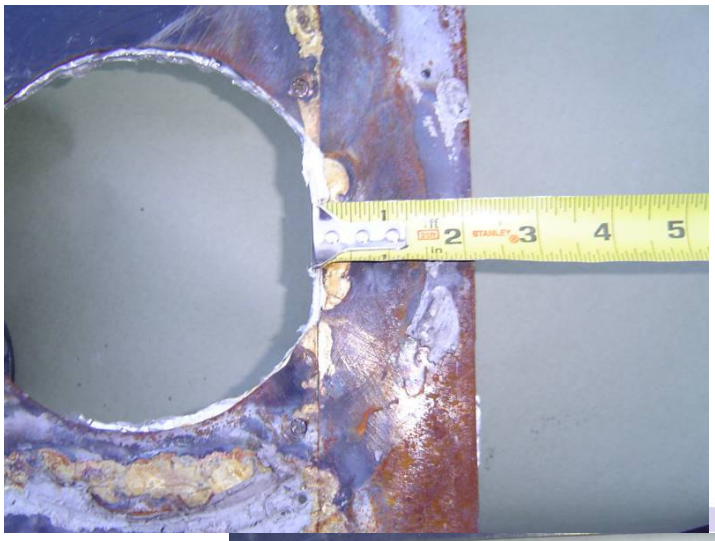
A combination of factors determine where you install the blower motor assembly. Fortunately it is pretty self evident once you get it apart. The plastic shroud that is part of the factory motor is a key guide. The top of it has to be even with the edge of the cover (now cut in half) and the left edge has to be as far to the left of the HVAC case as you can get it and still be blowing air into the 2.5" inlet mentioned earlier. As you can see from the picture, this is a few inches from the actual edge of the cover. That's because the HVAC cover actually extends to cover some of the factory inlet for fresh air.

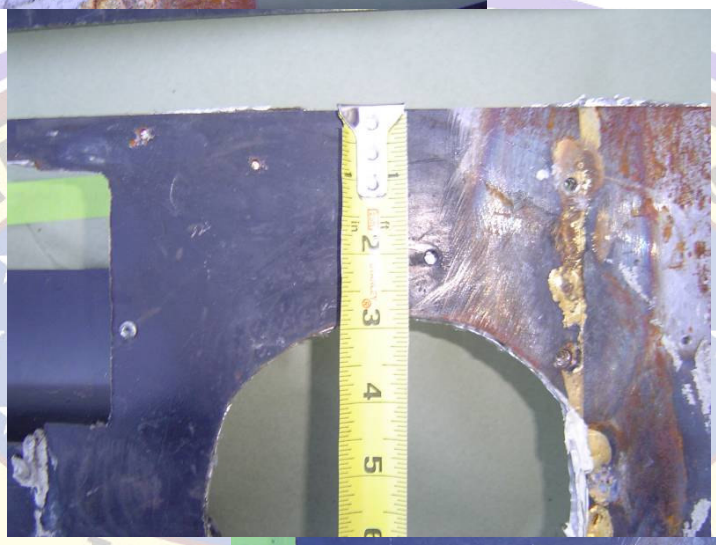
The measurements are:

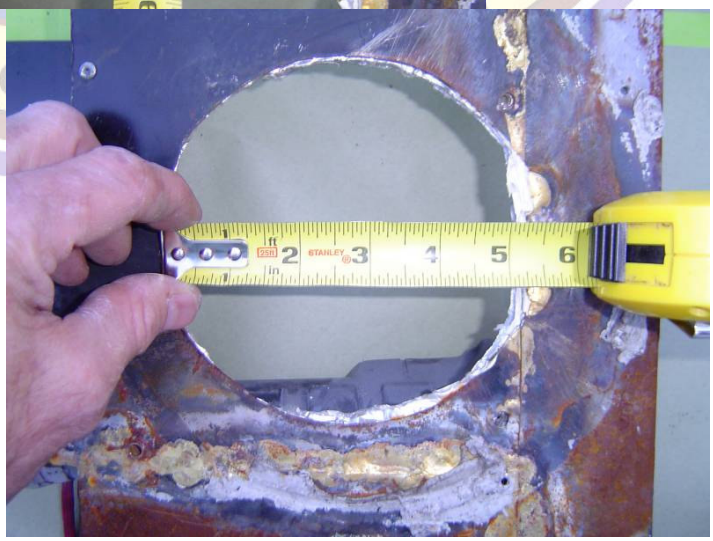
- For the deflector opening –
    - The top edge is a touch over ½ inch from where the cover is cut in half,
    - The left edge is just over 6 ¼" " from the left edge
    - The opening is just over 6" wide
    - The bottom edge of the deflector (inside view) is about 3 ¼" from the bottom
    -

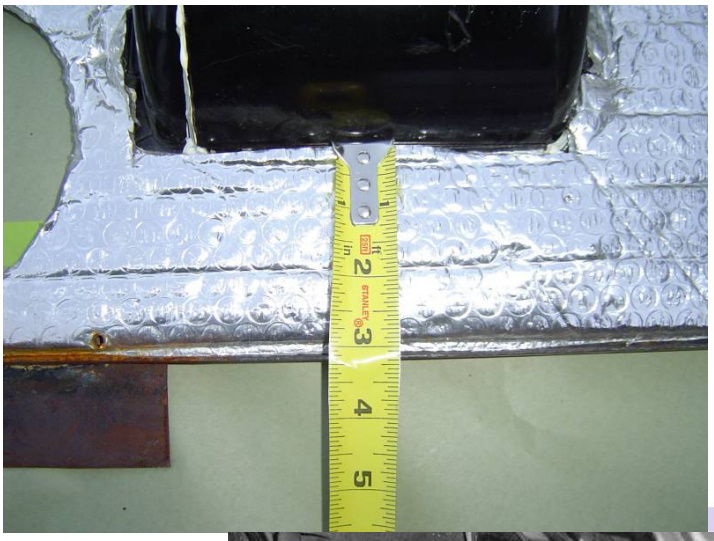
- For the motor opening –
    - 3" from the top where the cover is cut in half
    - About 2 1/8" from the right side
    - About 2 7/8" from the top edge
    - The circle is about 5 ¼" wide











So now we have fewer right turns which means much better airflow through the Distribution Plenum and A/C vents, right?

Not quite. I got almost zero improvement out of the dash vents but good airflow out of the defroster and great airflow out of the Type II opening. The Type II improvement made sense – the air was blowing in directly from the fan outlet without any direction changes but I expected better results from the Distribution Plenum. To try to pinpoint the problem, I stuck a Shop-Vac blower directly into the passenger side plenum duct via the HVAC box and still got lousy airflow. This little test led me to conclude that it wouldn't matter how large a fan I put on the system, it just wasn't going to push air through the Distribution Plenum so the plenum had to go.

Step Two: Plug the Plenum

So the plenum was a big part of the problem. Now what? Remember it also contains the defroster door and I wanted to maintain that functionality. But it also routes the heat through the heat vents or the A/C through the A/C vents. The heat-A/C one was easy for me. After all, GM routed both heat and A/C through the dash mounted center vents. After looking at the dash for a bit, I felt that the vents were placed so low on the dash that the separate heat vent was really unnecessary and I could route both heat and A/C through all the vents just like GM did on the center vent.

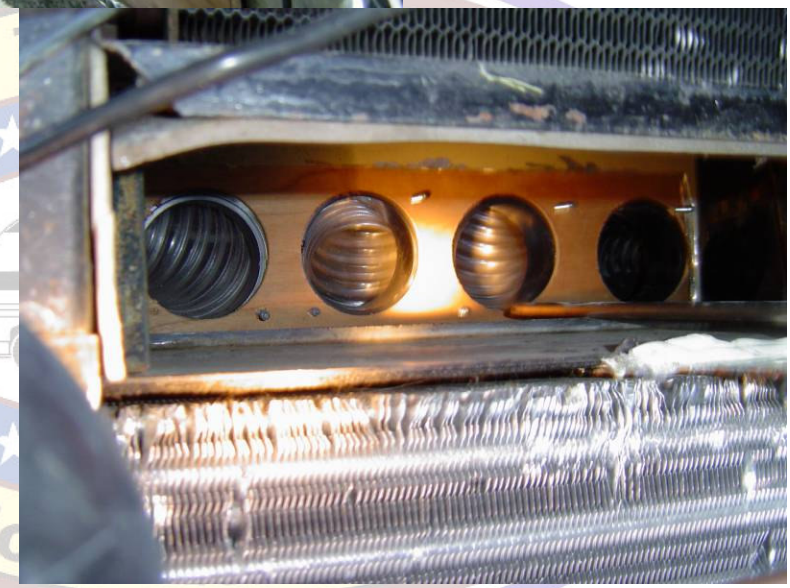
After a little experimentation, I determined that the best solution for me was to bypass the plenum for the dash vents and create new ductwork from the Type II opening to the existing A/C vents. There was plenty of room inside the dash for new 2.5" A/C hose and the backs of the A/C vents had nice housings easily adaptable to the 2.5" hose. But because the plenum was still connected to the system via the HVAC box, I had to plug it, except for the defroster door, to eliminate any possibility of air flowing through it rather than the Type II opening or the defroster door. This was easily accomplished with Great Stuff expanding foam that I shot into the plenum from the center vent and passenger vent and from the top of the HVAC box. I sprayed in the foam after I had removed the A/C vent housings from inside the dash and the HVAC box. This gives you access to the plenum inlets and outlets. You just have to be careful that you keep the defroster door operational. I got foam all over the vacuum door lever but it scraped off easily enough.

Step Three: Ductwork Design

Now that I had made the decision to have all air flow out of the Type II opening or the stock defroster opening, I no longer needed the Type II door inside the HVAC box. So it was time to remove the HVAC box. Mine was held in with 5 nuts and bolts. The bolts are located along both sides of the HVAC box accessed through the two front hatch openings. Be aware that on mine, the bolts did not have caged nuts so two people were needed to remove these. I removed the grill; took off one wiper assembly (I'm not sure I really had to do that); and slid the evaporator out of the HVAC box and moved it out of the way. The HVAC box then slid right down and out the grill opening.

Opening up the HVAC box to remove the Type II door, I discovered that the back of the HVAC box has a sort of false wall that I felt would restrict airflow so I removed the entire back wall along with the Type II door.

There is no insulation at the back of the box or on the firewall and I am not sure adding any would create a tangible benefit. With the back removed, the firewall acts as the back of the HVAC box and the airflow restriction into the coach is entirely dependent on how large you make the Type II opening in the firewall. I left my opening the original width but made it about three inches taller than stock. A panel over that opening accepts four 2.5" A/C duct hoses which route the air to the A/C vents, bypassing the foam-sealed Distribution Plenum.



This allows air from the blower motor only two potential outlets; either the Type II opening or the defroster door. In any position other than Defroster Mode, the defroster door is closed and all air exits through the Type II opening. In Defroster Mode, the defroster door opens and air exits there as well as the Type II opening. I was concerned that there would not be enough air coming out the defroster with no restriction on the Type II outlet but it is actually better than the stock arrangement.

Connecting the center vent and the passenger vent was very straightforward. You have to remove the glove box first and take all the screws out of the bottom of the dash for easier access. Each A/C vent has a black plastic housing attached to it inside the dash.. This housing has two pop rivets connecting it to the Distribution Plenum and one Phillips screw connecting it to dash. I just removed the screw and twisted the housing back and forth until it broke free from the pop rivets. I drilled a 2.5” hole in the back of each

housing and inserted a 2.5” elbow used in a woodshop dust collection system and then put a bead of caulk around the elbow. I did a few other things here to improve airflow. I filled the plenum openings with Great Stuff to keep air from flowing back into the plenum. I also notched the sides of the plastic housings so I could easily slide the housing back onto the plenum openings and then screwed them back in place and duct taped around the joint as best I could. When you do the center vent you have to be sure not to bind up the defroster door like I did. Spent a few minutes scraping away excess foam to free it up!

All the hose fittings are dust collection fittings available at Rockler, Woodcraft, etc. I connected a hose from each elbow, center and passenger vent to two of the four fittings on my new Type II opening cover - instant improved air flow. The hose to the passenger side vent runs under the fuse box to the vent and I had to cut a slight opening in the bottom of the dash for hose clearance. If you used normal A/C duct hose, it would probably be flexible enough to squeeze in the dash without the cut. I used very stiff woodshop hose.

Moving over to the driver's side required me to cut an opening in the side panel which I did without removing the panel. I just used an air powered cutoff wheel to make an opening giving me access to the factory flex duct. I then pulled the duct from its firewall fitting - it came right off. Then I ran a hose from one of the two remaining fittings on my new Type II cover, under the column, through the dash, and down to this factory hose. The factory hose was a little large than 2.5" which allowed me to slide the 2.5" hose inside it. With a little, what else, duct tape, a perfect seal. The final result of this was very good airflow out of the center vent and good airflow out of the driver's side vent and passenger side vent.

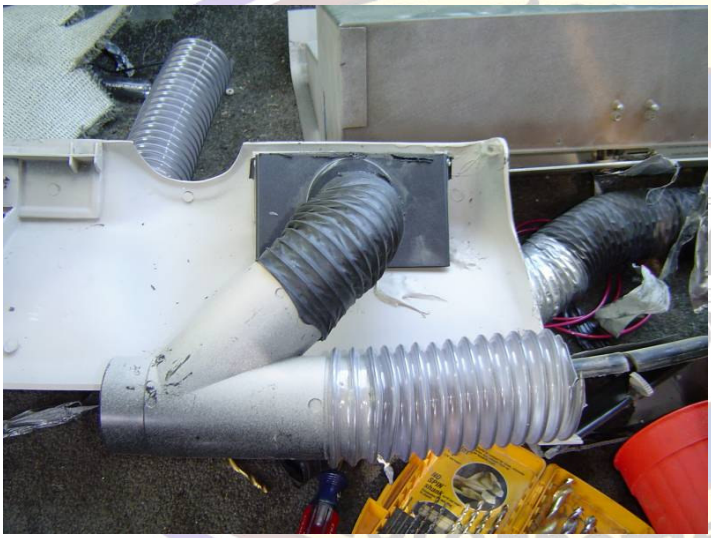
One feature that I need to point out is that all air, heated or cooled, comes out of the A/C vents or defroster. The two floor heat vents are no longer functional in my design. Since GM had heat and A/C coming out of the center vent, I felt that the same functionality would work on the other vents as well. Given that the A/C vents are mounted relatively low on the dash – just above the heat vent on the passenger side – I felt this wouldn't be a problem and it is not. Although a matter of opinion, my wife and I both feel the heater is much more effective and comfortable through the dash vents.

Step Four: Scotty, We Need More Air….

I still wanted more vents by the driver so I added the A/C panel that GM added to the 1977/78 units. I got one from Jim Bounds - cheap. To fit it to an earlier unit requires just a few modifications because of the ashtray. If you wanted to get rid of that and just glue the door shut, you wouldn't have to do much of anything. I kept my ashtray functional (I don't smoke but I figured it makes a great change holder) so I had to cut a bit off the back bracing to clear the brake switch plate. I also had to cut away part of the brace connecting the left and right side of the dash that the stock panel under the column connects to. The

brace is still fully functional. Since my coach had the Captain's table accessory, I also had to cut away part of its aluminum support so the new A/C unit could fit up against the dash. To mount the new panel, I drilled several new holes in the 77/78 panel. One screw connects the assembly to the aluminum Captain's table brace from underneath, two screws connect it to the steel brace running under the column mentioned above using the original mounting holes in the brace and one screw goes through the top of the left A/C opening into the stock screw hole that my original cover connected to.

After test fitting the piece, I cut a 2.5" hole in the dashboard directly behind the A/C vent in the right side of the new panel. Using an elbow and a short length of hose, I connected this fitting to the last of the four fittings on the Type II cover. To connect the left vent, I used a 2.5" 'Y' fitting that I fit into the back of this vent. The back for the new vent is a dust collector for a router table. I then routed the hose that connects the driver's side armrest vent to the 'Y' and the legs of the 'Y' feed armrest vent and the new left vent in the GMC panel.

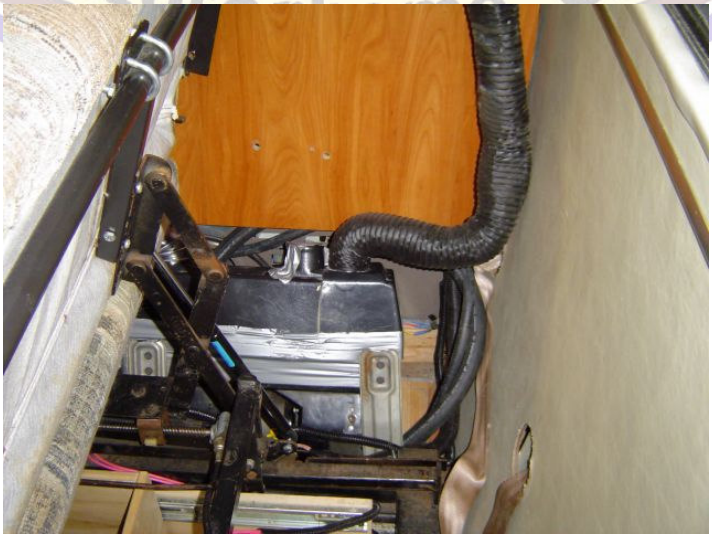


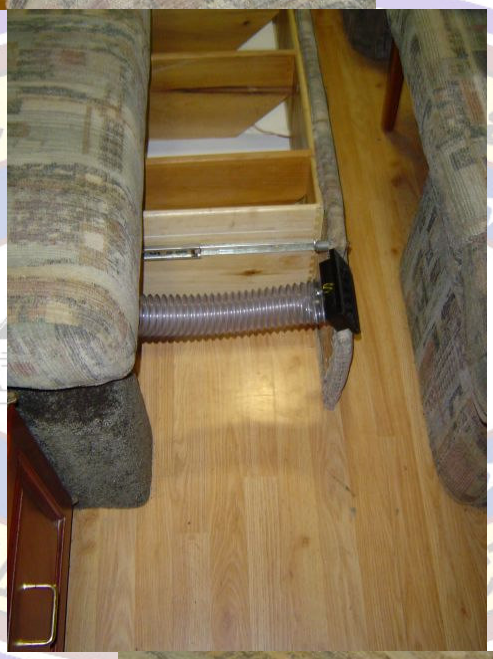
Results

The net result of all this is that I now have very good to excellent flow out of the stock center vent and the right vent on the new 77/78 A/C panel. This makes sense because these are very short hose runs from the Type II opening. The airflow out of the passenger side vent is good and the airflow out of the left vent on the 77/78 panel and armrest vent are decent but not great because of the length of hose and two vents running off one hose.

Second Evaporator

Since you can never have enough cold air, I also added a second evaporator. I placed the evaporator next to the couch and ran duct hoses to two vents mounted on a door on the front of my couch and to two vents installed in a new duct mounted on the wire race.





The evaporator is out of a junkyard conversion van. This one happened to be out of a GM van that had the optional rear factory air so mine is only an evaporator and not a combination evaporator/heater core like most conversion vans. The combo unit might be better for people who do more cold weather traveling because it could provide A/C and heat.

The setup was straightforward. I had a local A/C shop tee into the A/C lines up near the compressor and run them under the driver's side of the coach then up through the floor to the evaporator. I slightly modified the evaporator housing so that I could add a second motor with two squirrel cages for better airflow. The unit now has 2 motors with 4 squirrel cages pushing air through the evaporator. This gives me good airflow through the upper duct. I mounted a 3-speed fan switch on the side of the kitchen sink cabinet to control this unit.

System Configuration

Stock compressor and front evaporator but with an R-134 expansion valve. The second evaporator runs a stock R-12 expansion valve and generally runs slightly cooler then the front evaporator. I don't know why.

Recirculating Air

The other modification I made was to go to 100% recirculating air. The HVAC box hangs several inches below the sloped portion of the firewall/floor. To get recirculating air, I cut a hole in the sloped portion of the floor directly in front of the HVAC box. I then cut a corresponding hole in the HVAC box using a hole saw. I cut several holes next to each other and then cut the connecting pieces out with a small reciprocating metal saw. I used a Home Depot wall heating duct designed for use between studs. This type has a relatively narrow oval shape that worked well as a connection between the HVAC box

and the passenger compartment. Ken H. came up with an idea to seal up this connection with a sheet metal piece running from the bottom of the HVAC box to the firewall/floor with the edges folded upwards to seal the sides against the floor. I haven't done this yet but I plan to this summer.

Miscellaneous:

Just a couple of items/tasks that this project involved:

- Remove the vacuum module and bypass door in passenger side A/C vent and plug the vacuum hose.
- Remove vacuum module for the Max-air door and plug the hose.
- I left in place the vacuum lines and modules on the driver's side for the time being. I will likely remove the lines and plug them later for a cleaner design. For the time being, they don't negatively impact anything because the ducts are no longer connected to the system.
- I also left in place the passenger side heat vent although this can be removed and plugged as well.