Installation of HE Rail in 1976 (pre-HE) XJ-S

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1976 XJ-S

The Problem

The Jaguar V-12 engine in the early XJ-S has dual fuel rails, one for each bank. Each of these is in a "race-track" configuration, with rather complicated plumbing apparently designed to maintain good flow and equal friction pressure drop to all injectors. There is a separate pressure regulator on each rail. The rails are shown in Figure 1.

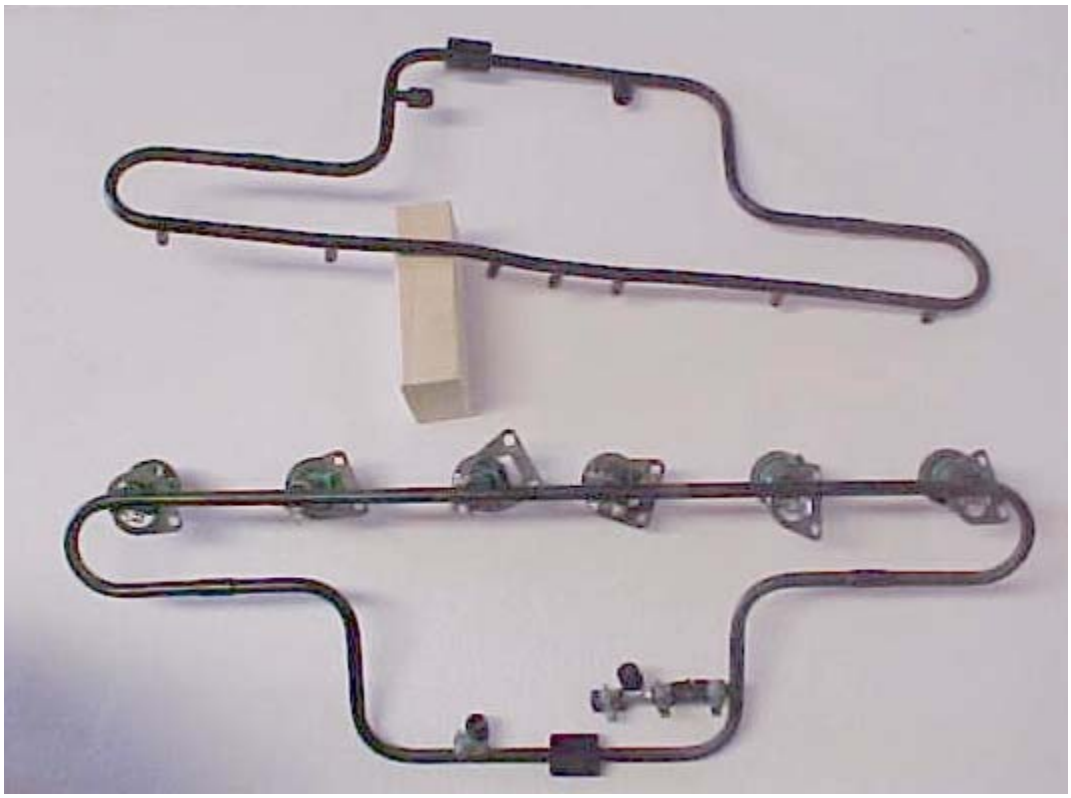

Figure 1 Pre-HE fuel rails.

For a long time I experienced rough running when hot problems, including a mild "pop pop pop" when restarted after a brief rest in warm weather. In addition, sometimes, there was rough running at idle when hot. I did all sorts of things trying to fix this problem, and seemed to alternate my current theory between electrical and fueling. On the fueling side I speculated that there was vapor formation in the rail due to heat soak-back. This problem has been confirmed through extensive discussions on the Jag-Lovers XJ-S and V-12 Engines mail lists. Several other people with early XJ-Ss have had the problem, including Bernie Embden who solved it by installing a custom built one-piece rail (http://bernardembden.com). Also, Jaguar engine design team member Roger Bywater (http://www.jagweb.com/aj6eng/) acknowledged that vapor formation was a well-known

problem in these early V12s. The problem seems to be that, in spite of design intentions, the early rail encourages vapor formation due to its thin cross-section and makes clearing of the vapor uncertain by the presence of numerous parallel flow paths. Several people, including Bernie, have reported rail modifications to address the problem. According to Roger, several rail design changes in later models (the HE engine, to be specific) were implemented to address the problem. Among the changes made were switching to a single, U-shaped rail, and introduction of rail temperature sensors in attempts to reduce vapor formation, and mitigate effects if it does form.

In this write-up I describe the retrofit of a fuel rail from a later model Jaguar V-12, the so-called HE engine to a pre-HE engine. Several people on the Jag Lovers XJ-S and V12 Engines mail lists have reported success with this retrofit so I expected few problems. It turned out there were some problems, but I managed to work through them and believe the project to be a success. At the time of this write-up, late September 2003, the work has just been completed, and the car runs beautifully. However, the fall weather is now upon us so I may not know till next summer if the hot rough running problem is fully behind me.

Modifications to the HE Rail

I used rail from a 1987 XJ-S, but two modifications were required.

Because the '87 does not have cold start injectors I had two extra hose nipples, salvaged from a 1983 rail, welded onto the '87 rail. Also, as I unfortunately found out midway through the project, the crossover tube at the front of the U interferes with the air-conditioning test port at the end of the fuel cooler. The latter problem could have been dealt with by going to a later model fuel cooler mounted on the left air filter housing, but this would have required new fittings and hoses as well as recharging the AC system. Moreover, by the time I discovered the problem I had the old fuel rail off so I could not even drive the car to an AC shop to pump out the refrigerant. (Even though it's R-134A one is not supposed to dump it to the atmosphere.) So, I decided to challenge my welder (Center Line Welding, Anaheim CA) a little more, having him weld a new crossover with a dip to miss the test port. Note that the dip has to be positioned off-center towards the left side of the rail (right in the photo). I didn't notice this at first so it took two tries to get it right. My advice to others is to tack weld it in place and try it on the car before doing the final welding.

Figure 2 shows the modified rail. You can see the cold start injector ports on the sides. The left side of the rail (right side in the photo) has a fuel pressure test port, seen better in Figure 3.

Wanting a good-looking installation I had the rail zinc plated, for the princely sum of $85. Unfortunately, however, I rushed to the platers before trying to fit the rail to the engine, so careful inspection of Figure 2 will show that the crossover is painted rather than plated.

Figure 2 Rail ready for installation.

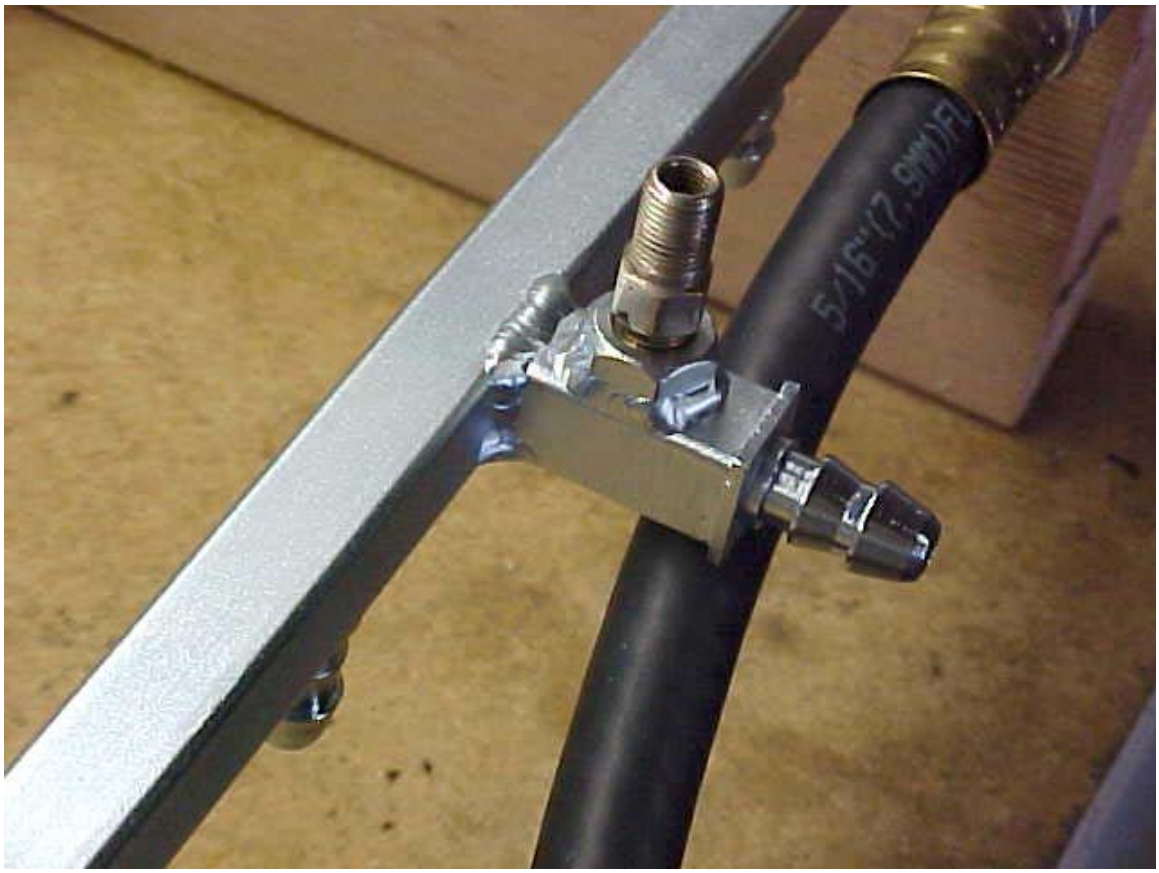

Figure 3 Fuel pressure test port

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Testing the Modified Rail

Although the welder pressure tested to see if his welds were leak free, I felt it prudent to do my own tests. To do so I made up a bunch of short hoses lengths blocked off with 5/16" dowel pins to cap the 14 nipples. I also blocked off the inlet and outlet ports with my first attempt at inlet and outlet lines.[1] This is shown in Figure 4. This allowed me to pressurize the rail through the fuel pressure test port using a test rig I built, and a bicycle pump. (This test rig is described in a separate write-up, Testing Fuel Injectors.) I tested it at 60 PSIG, spraying soapy water mixture on all the welds. They were good, of course.

I later repeated this test with the injectors installed on the rail, this time checking for leaks at hose joints.

[1] I had at first though they were 1/4" BSPP threads.

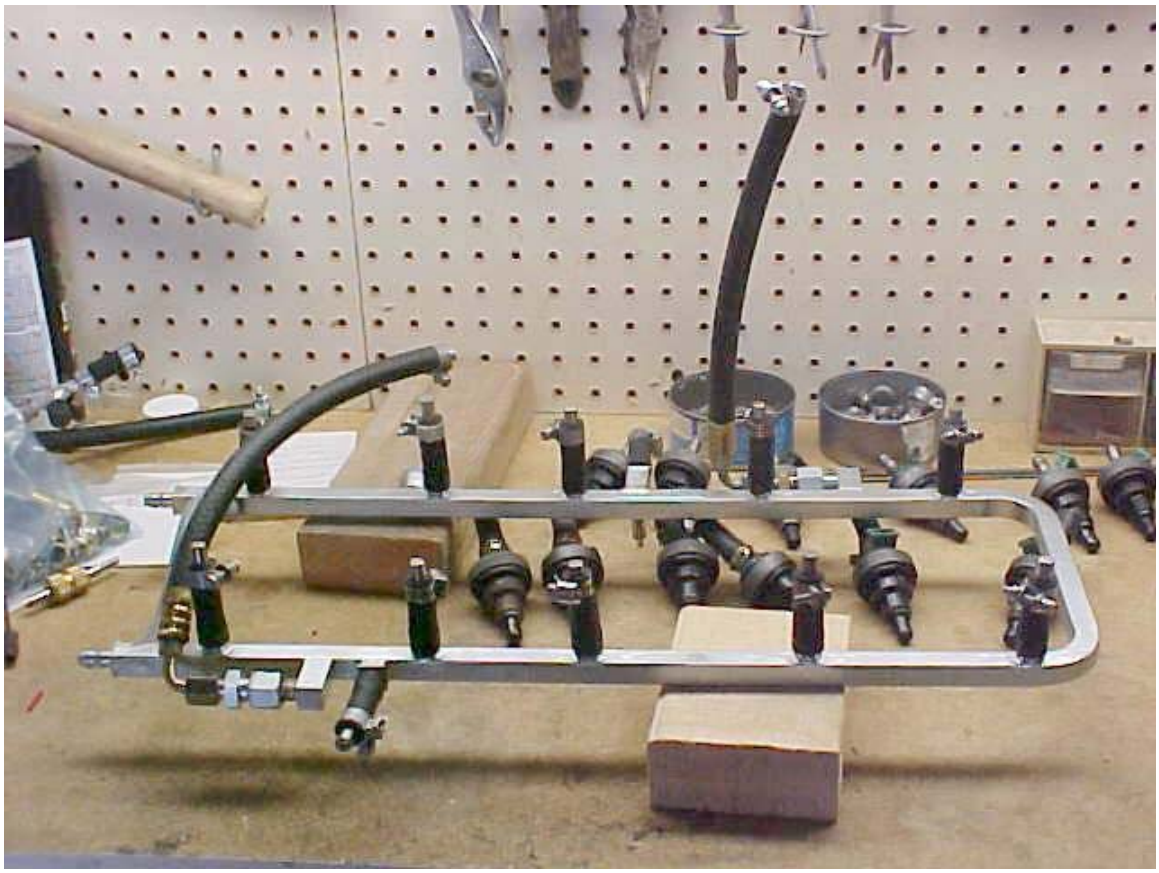

Figure 4 Testing the rail

Which Regulator(s) to Use

One of my main questions as I began to consider the HE rail retrofit was whether to use the pre-HE or HE pressure regulator, and whether to use one or two.

If the HE regulators could be used it would give a neater installation because a lot of the HE mounting hardware and connection plumbing could be used. Also, it has been said that one of Jaguar's objectives in the HE fueling system design was relocating the regulators completely out of the valley. It presumably would be safer too, because the only clamped joints would be where the supply and returns are spliced in. The down side, though, is that it could be expensive. Even if one managed to pick up a pair of decent used regulators and the mounting hardware it is unlikely that used connection lines would be in acceptable condition because of the rubber hose sections in them. From the looks of them, these lines would be expensive to buy new from Jaguar, but a quality hose shop could possibly rebuild them for a reasonable price (or, clamps could be used).

The real question, though, is weather the HE regulators can and should be used at all on a pre-HE engine. Let it be clear that you **cannot use the HE regulators with a standard, unmodified pre-HE ECU**. The HE regulators are not adjustable, and are preset to operate at a pressure that is way too high for the pre-HE (38 PSIG I believe). However, Roger Bywater says that **AJ6 Engineering** can modify the pre-HE ECU to deal with this.

They fit a trim pot to the ECU to allow adjustment of off-idle pulse width, thus allowing compensation for the higher rail pressure.[2] According to Roger, with the ECU modified in this manner the HE regulators can be used, *but without the vacuum lines attached.*

In the end, I chose to stick with pre-HE regulators, even though John Hathaway kindly gave me a pair of HEs and all the mounting hardware. The overriding reasons were that it made for an easier retrofit, and my regulators were practically new. I was also comforted by the knowledge that almost all pre-HE fuel rail retrofit projects I've heard of (see Alternatives below) used the pre-HE regulator with success, as did Bernie Embden in his custom fabricated rail.

I also decided to use both regulators, mounted in their original locations, even though others have gotten by with one. There were several reasons for this, including the fact that it made the retrofit easier. Another reason, pointed out by Roger Bywater, was that if a single pre-HE regulator is used it means that the entire pump flow is being handled by a regulator designed for half that flow rate. Notwithstanding the successful single-regulator experience of several others, e.g., Bernie Embden and John Cave, it is clear that the regulator will be closer to the high end of its capacity than when the flow is split between two regulators. I admit, this decision goes against my goal of minimizing hose connections, and adds to clutter on the engine.

Using two regulators and keeping them in the original location meant all I had to do plumbing-wise was to make up two hose assemblies. The inlet assembly is a simply a hose from the fuel filter with an metric 14 male fitting to connect to the right side of the rail. The outlet assembly is a little more complicated because it has to have a tee to connect the rail outlet fitting to the inlets of *both* regulators. This puts the regulators in parallel, and puts the total fuel flow through the rail.

Originally, I had planned to tee off of the rail inlet to the right hand regulator, and off the rail outlet to the left regulator. The symmetry of this is appealing, and it would allow a shorter hose to the right regulator. However, it’s a bad idea. The reason is it would draw off half the fuel flow and dump it into the return line without passing through the rail! That's not good because you want as much flow in the rail as possible to sweep away vapor that may form during post shutdown heat soak back. I therefore believe it's better to feed both regulators off the rail outlet, in spite of the hose to the right one going across the valley.

Having two regulators in parallel brings up the issue of possible interaction. If they are identical mechanically, set at precisely the same regulation pressure, and have precisely the same resistance in the supply and return paths, regulators in parallel will operate in unison and flow through each will always be the same. However, any difference in one or more of these factors may result in an unequal flow split. In the standard, dual rail pre-HE configuration, this is a serious matter, since it means the injectors in one bank are being fed under different conditions than the those on the other.[3] However, in the arrangement

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[2] This modification might make sense even with the pre-HE regulators because it would allow moving the rail pressure up a notch to discourage vaporization.

[3] Indeed, Roger Bywater once remarked that this might be the root cause of many of the pre-HE fueling problems.

advocated here there isn't a problem of this nature since all the flow goes through the rail regardless.

I regret that I did not make a photo of the hose assemblies before installation, but perhaps you can get the idea from photos of the final installation. Figure 5 shows the outlet hose, feeding forward from the connection at the rail and dipping slightly to go under the cold start injector nipple and pressure test port. I crimped the original HE male fitting to a 6 ¼" length of FI hose, connecting to a brass tee. You can barely see this tee at center left in the photo, just above the regulator. A short length of hose (about 5" as I recall) is crimped to the center nipple of the tee and dives down to the regulator inlet, much like it would in the standard pre-HE installation. The straight-through branch of the tee is fitted with a longer hose that snakes across the valley in front of the distributor, going down below the cap to get past the distributor and mate up with the right side regulator inlet.[4] The brass tee and crimp sleeves were purchased at an industrial hardware supply, in the compressed air fittings department. The same store did the crimps for me for about $5.

Figure 5 Outlet hose

The inlet hose assembly, on the right side of the rail, connects the fuel filter outlet to the rail inlet. The only difficulty here is that with the original location of the filter the hose would have to make an awkward S-bend while somehow avoiding the hot air injection rail. To improve matters in this regard I decided to relocate the filter, mounting it at the front of the intake manifold, Figure 6. The mounting bracket was made from 1/16" aluminum stock, Figure 7, and mounted with 5/16" ID steel spacers to allow it to clear the over-run valve. A large diameter stainless steel hose clamp fits through a pair of slots cut into the bracket with a drill and Dremel cutting disc. I also made a cradle from 1/8" aluminum to support the filter and allow it to clear the rather large heads of the 5/16" Allen head cap screws that fasten the assembly to the manifold.

The tricky part of this design is getting the stiff hose clamp to pass through the two slots in the mounting plate. The edges of the slots must be chamfered at a low angle (another job for the Dremel) in order to get the hose clamp to slid through, albeit with some

[4] Note that I have installed a Crane XR 700 ignition system so the ignition amplifier is not in the way.

difficulty.[5] I'm reasonably happy with the way it turned out. If I may say so, it looks a little better than the stock mounting.

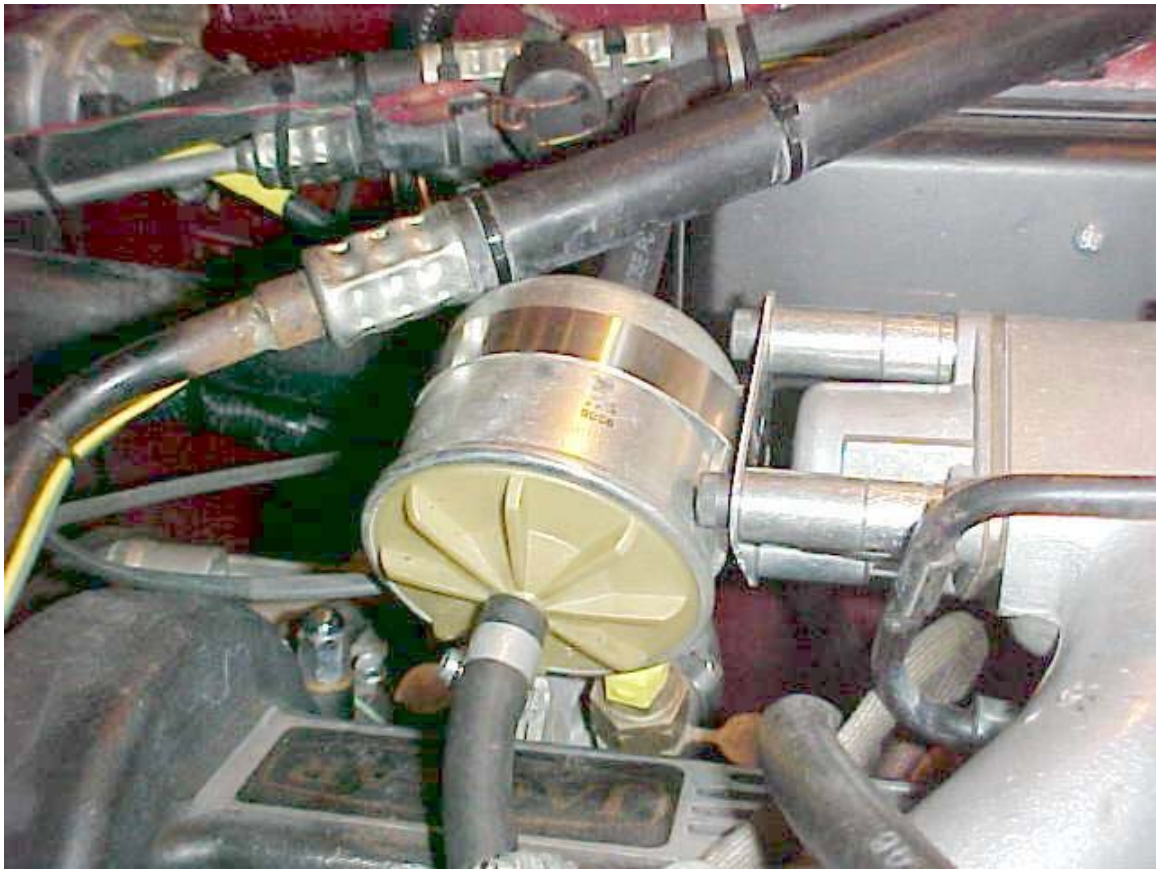

Figure 6 Relocated fuel filter

[5] I later thought of other ways that this could be done, e.g., the cradle could be screwed to the bracket plate, clamping the hose clamp underneath.

Figure 7 Filter mounting bracket

With the fuel filter thus relocated the fuel inlet line makes a single, fairly easy bend to connect the filter to the rail. It clears the hot air rail nicely, although I do use a cable tie to keep it that way. The final installation is shown in Figure 8 where it can be seen that the hose is routed under the air rail. The metric 14 male connector from the HE rail inlet line is crimped to the hose.

Figure 8 Inlet hose

There is little that needs to be said about the fuel return lines from the regulators since nothing is changed here. You can see the original right bank return line in Figure 8, the black tube coming up from under the intake manifold, turning rearward and then across

to the left side. The left regulator outlet joins this line below the front of the left manifold, and the combined flow goes to the fuel cooler.[6] I changed none of this.

Fitting Injectors to the Rail

Nipple Styles, Clamps and End Caps

The injector hose nipples on the HE rail are completely different than those on the pre-HE rail. Those on the pre-HE are designed for a hose clamp and therefore have a single barb with a flat land for the clamp. In contrast, the HE nipples have two barbs and no flat land for a clamp. This style, sometimes called "push-on" or "Christmas tree," is not designed for clamps, and clamps should not be used.[7] You can see the HE rail nipples in Figure 9. There is a shallow dish-shaped end cap that goes on the nipple first, and then the hose is pushed into place.

Also shown in the photo are two different styles of injector nipples. The one at the top is the older style with flat land behind a single barb, calling for a clamp or a crimped ferrule. Note the style of the clamp, too. The spiral screw type clamps should not be used because they damage the hose. The injector at the bottom has the newer Christmas-tree barb like the HE rail. It needs the shallow dished end cap, but no clamp. I also discovered a third nipple style on two of my injectors, made by Bendix. This style, shown in Figure 10, has a single, very sharp barb with a flat land in front of the barb instead of behind it. Originally, these were crimped on with brass ferrules, but I used clamps on them. I'm a bit uneasy about these but they are not leaking.

In summary, Christmas-tree nipples used shallow dished caps, while other styles need non-spiral clamps.

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[6] An advantage of a single regulator would be elimination of the return line going across the engine through the hot valley.

[7] Some insist on using clamps "just to be sure." However, Jaguar doesn't use clamps, and Parker-Hannifin makes a very similar hose connector line called Push-Lock and their specifications clearly state that clamps should not be used.

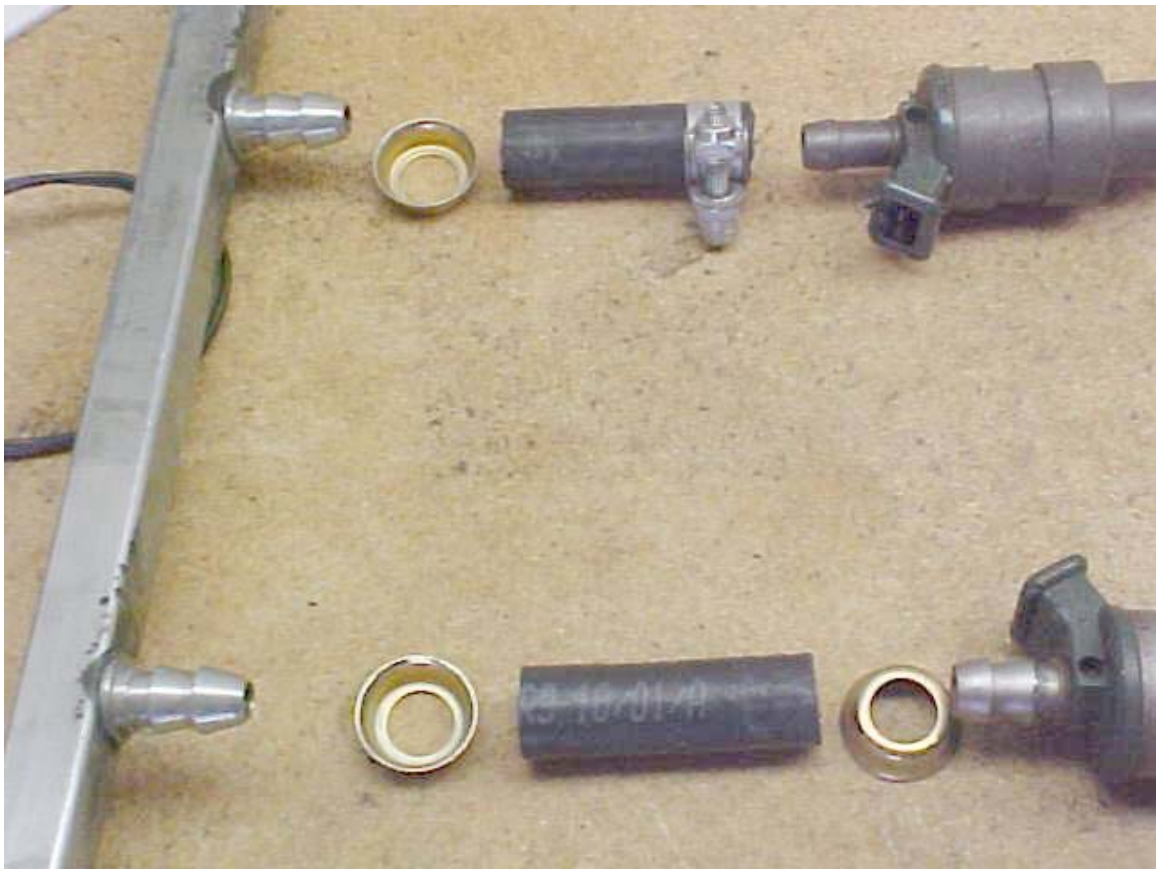

Figure 9 Injector and rail hose connections

Figure 10 Bendix injector nipple

Hose End Caps

The use of the dished hose end caps (see Figure 9) at the Christmas tree style nipples is somewhat controversial. Some choose not to use them because they are difficult to get off, making hose replacement more of an ordeal. They argue that these caps are there for aesthetic purposes only, i.e., they are simply "beauty caps." Early in these discussions I argued for the Jaguar caps on the grounds that they tend to compress the hose end around the barb when the hose is pressed on, making a tighter joint and resisting any tendency to pop off when pressurized. Others pointed out that the very similar Parker-Hannifin Push-Lock series hose connectors have plastic caps which are so flimsy they can't possibly offer much in the way of extra strength of the joint. Eventually, I bought into that argument. However, at that time I had no experience with the HE rail. While doing this retrofit project I had an experience that caused me to go back to my original position and fit the end caps at all push-on nipples.

In order to pressurize the rail for leak testing I capped each injector nipple with a short length of FI hose blocked off with a 5/16" dowel pin clamped into one end. I did not fit the end caps when I pushed these hoses onto the rail. On two occasions during testing I had one of these caps pop off, ripping across the garage with serious speed. Moreover, at the end of testing I had no difficulty whatever in getting the caps off. A little twisting and bending while pulling was all that was required. On the other hand, a couple times I had need to remove hoses from the rail after pushing them on *with* caps. In this case I found

them *impossible* to remove without cutting them off. Now, I admit I was testing at 60 PSIG, and never had any pop off when pressurized only to the normal 30 PSIG. However, I have read of regulator failure causing rail pressure of 50 PSIG, so it's not unthinkable for such pressure to exist on a running engine. Consequently, I decided to fit the end caps, and endure the attendant hardships when I renew my hoses.

Removing Injector Hoses

Chances are, sooner or later you will need to remove hoses from the Christmas tree style barbs. The task is challenging because cutting is necessary and you must not nick the barb. It's been said that even a very slight nick can cause a leak.

One way to remove the hose (as recommended by Kirby Palm) is shown in Figure 11. Using a new blade in a utility knife, shave thin layers off the hose, using the point to extend the cut all the way to the bottom of the end cap. A couple cuts like this, being very careful to not go so deep as to hit the barb, will take you through the woven fiber layer that gives the hose its strength. Another very fine and careful cut, keeping the blade essentially parallel to the barb, will reveal the outer diameter of the barb. Now, use the point of your knife to carefully cut the rubber in the groove between the two barbs. Once you do that the hose can be easily pulled off the nipple. However, if the hose is old and hardened it may break off, leaving a messy hose end down in the end cap. If this happens you just have to whittle it away with the knife point.

I have read that Jaguar recommends using a soldering iron to burn through the hose rather than cutting with a knife. I have not tried it, although some have reported using this technique with good results. For one thing, I imagine I would have to buy a more powerful soldering iron than I now own.

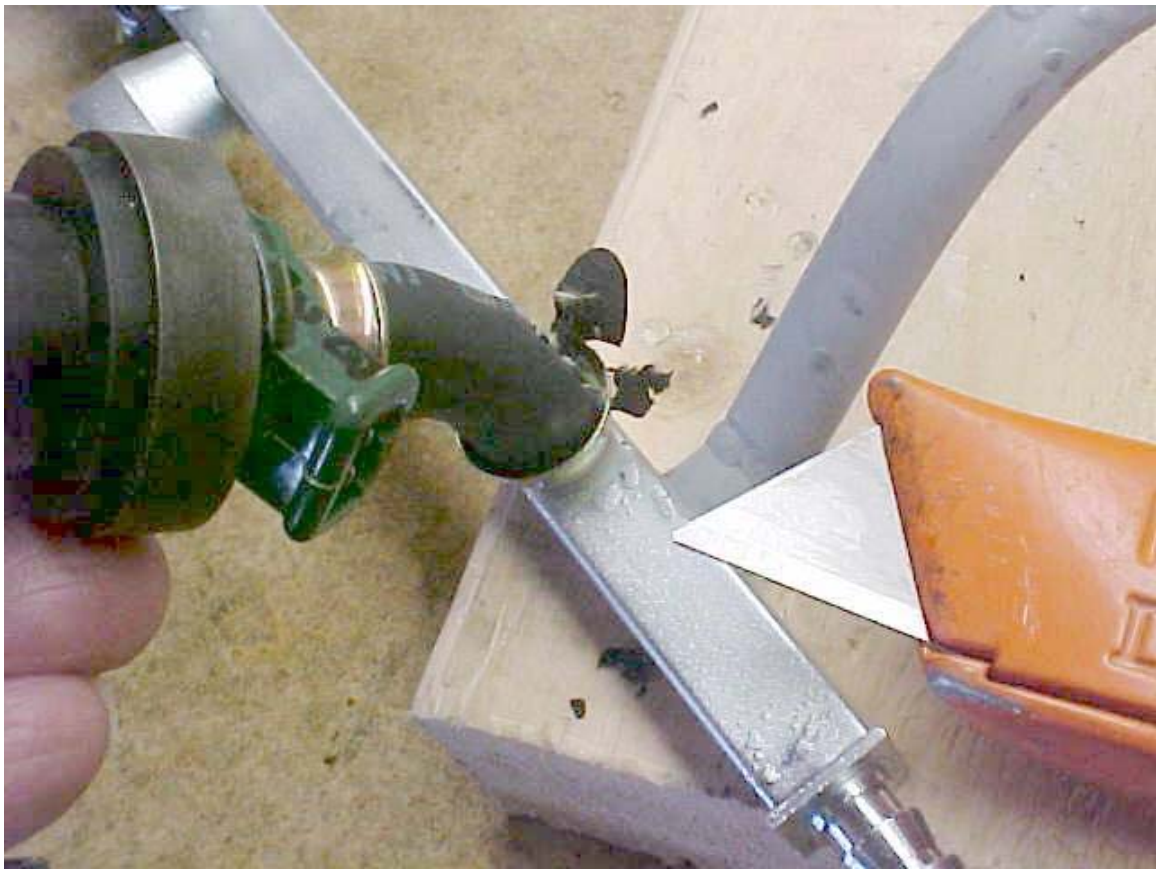

Figure 11 Removing injector hose

Injector Hose Diameter and Length

Discussions on the Jag-Lovers mail lists have not reached a solid consensus on what diameter hose to use for the HE, Christmas tree style injector and rail nipples. Many insist that it should be 7.5 mm (I.D.), while others say that the more commonly available (in the US anyway) 5/16" (7.94 mm) is quite good enough. I chose to use a high quality 5/16" FI hose (e.g., Goodyear SAE 30R9) since it is available at my nearest auto parts store and many people have used it in this application without reported problems. Moreover, the Jaguar parts supplier that I use most often (Exotic Car Parts in Upland, CA) recommends it and does not even stock bulk Jaguar injector hose.[8] One final advantage of the 5/16" hose is that while it fits tightly on the Christmas tree barbs it is not as tight as the 7.5 mm, and therefore is a lot easier to push on.

On the other hand, I must point out that when you buy a new Lucas injector from Jaguar it comes fitted with a 7.5mm hose. Roger Bywater says that when they did that kind of work at AJ6 they always used "the hose supplied by Jaguar." Although he could not remember the size, presumably it was 7.5 mm.

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[8] I understand that the bulk 7.5mm hose is available from Jaguar and is used by some Jaguar parts houses and some injector repair/testing shops.

Regarding hose lengths, I can only say what I used for the HE rail fitted on a pre-HE engine with pre-HE injectors:

- A1 and B1 injectors: 3 1/8"
- All other injectors: 1 ½"

The 1 ½ " is critical because if they are too short the rail will not clear the air rail plumbing at the rear of the engine, and if too long the rail will interfere with the kick-down switch on the throttle cable.

To come up with the length of the shorter hoses I temporarily installed the A2, B2, A6 and B6 injectors and laid the rail on the engine. I then put shims between the B6 injector nipple and its matching rail nipple until the rail cleared both the air rail and the kick down switch. This turned out to be approximately 1/8". Then I put the rail and injector on the workbench with the nipples separated by the shim and measured the distance between the base of the barbs on the rail and the injector, giving 1 ½".

As can be seen in Figure 2 the nipples for A1 and B1 injectors project forward from the rail, parallel to the ground. Thus the hoses must arch forward and down, and are longer than the other ten. I found that 3 1/8" was about right for the length. The risk of getting them too long or too short would be to put lateral stress on the connections.

I emphasize that the above lengths worked for me, but you should make your own determination. Since completing my retrofit project I have examined several HEs and observed that they use somewhat longer hoses. I studied these carefully trying to figure out how this could be, given the tight constraints imposed by the air rail and the kick down switch. It looks as if the throttle pedestal is higher than on my car, raising the kick down switch. This could be done by use of longer spacers under the throttle pulley. How they did this without having the throttle pulley hit the bonnet I'm not quite sure.

Seals

There are two rubber rings at each injector, a small one fitting over the tip and a large one that fits in a groove in the body, capped by a metal ring. The small one is a true seal, sealing against air leakage into the manifold, but the large one is not a seal at all. It acts as a mechanical and thermal barrier between the intake manifold and the injector body. I replace the smaller tip seals every time I remove the injectors, but only replace the large ones if they feel hard.

The tip seal slips tightly over the "pintle cap," which is the plastic cover over the injector tip. It's a bit more difficult to replace the large ones. You have to pry the metal cap ring up, and then pry the seal out of the groove. A little soapy water helps. In fitting the new ones I find it helps the slip the seal over the injector from the bottom, stopping when only the upper edge is in the groove. This tends to force the upper part of the seal to a slightly smaller diameter, allowing you to start it into the cap ring. Then you sort of squeeze the cap ring and seal together, working your way around until the seal is fully into the groove and the cap ring is firmly over it. About 1/8" of the seal thickness is left exposed when the ring is in place.

Installing the Hoses

The first question here is whether to install the injectors to the rail before or after installing the injectors in the car. Some advocate the latter, i.e., installing the injectors in the engine, then installing the hoses on the rail and finally dropping the rail down onto the waiting hoses. I used to do it this way on my pre-HE rail, but it doesn't appeal to me for the HE rail because of the greater force required to get the hoses onto the Christmas tree nipples. I found this to take all the strength I could muster doing them one at a time with a little twisting. Doing 10 of them at once while leaning over the fender, and without the benefit of twisting seems more of a challenge than I am up to.

Doing it the other way, i.e., fitting all 12 to the rail and installing the assembly on the engine has its own set of challenges. The first caution I give if you do it this way is to be sure you put the clamping rings (the pieces which bolt to the manifold) on the injectors while you can. What I mean by that is you cannot get them on after the large seal is in place and the injector is attached to the rail by its hose. If you forget to put the clamping rings on you will have to either remove the cap ring and seal or cut the hose off!

Installing the Rail

Assuming you have chosen to install all the injectors to the rail beforehand you have before you the challenge of getting the 12 injectors to simultaneously drop into their respective holes in the manifold. In addition each one has a clamp ring flopping around that has to drop correctly onto two studs and the upper seal cap ring. It is a bit of a juggling act, to say the least.

Before you install it though you might want to do a final leak test. This is a good idea, especially if you have a few injectors with old style clamped nipples. It's a lot easier to get a screwdriver to these clamps for an extra bit of tightening while the rail is still on the bench. See my write-up on Injector Testing for how you can do this testing.

Also, put a little rubber lubricant on the outside of the lower seals (now in place on the injector pintle caps) so they will slip more easily into their holes in the manifold.

Once you are sure everything is ready the installation begins by maneuvering the rail, with dangling injectors, into position. Keep an eye on various electrical harness elements, such as for the temperature sensors, as they have to wind up above the rail, not snaking in between the injectors. Now try to line up each injector tip with its manifold hole, working along one side at a time, back to front. Bend the two front injector hoses and poke the injector tips into the A1 and B1 holes. Check the clamp rings and try to maneuver them in alignment with their manifold studs.

After the initial effort you will find that some of the injectors are caught on the edge of their holes, keeping the rail from dropping further down, while others are still flopping around, not having reach their holes at all. To proceed, keep a little downward pressure on the rail with one hand while working the injectors that are hung up into alignment so they drop further into their holes. This allows the rail to drop down a bit, and will result in a different set hanging up. Work these into alignment, allowing the rail to drop down a bit more, and repeat the process until all are seated. All the while, keep a watch on the

clamping rings, and the A1 and B1 injectors to be sure they don't jump out. Using a flashlight, inspect each injector tip to be sure it is well into its manifold hole. You don't want to clamp the injectors with seals caught up on the edges of holes, as this will damage the lower seals and result in vacuum leaks.

Once you are sure all injectors are properly seated begin working the clamp rings into place. Since the seals are new you will probably find that a little pressure is need on the rail above an injector to allow the ring to drop down far enough to get the nuts started. However, don't tighten them until all 12 clamps are in place. Then work around the rail in some reasonable pattern tightening the clamp nuts so as not to distort the rail.

Once all the injectors are in place and clamped you can connect the inlet and outlet lines.

Alternatives

There are several decisions to be made along the way when doing the HE rail retrofit. My goal was to gain the better fuel flow path offered by the HE design and reduce the number of clamped hose joints, while minimizing changes wherever possible and improving engine appearance. Unfortunately, this seems to have led me along the most expensive route at every turn. The rail modifications alone cost $195 ($110 welding and $85 plating). A much less expensive conversion was done by John Cave. First, he omitted the cold start injector ports since they are unneeded except in the most extreme weather. Second, he solved the crossover interference problem by simply cutting it out and connecting the two stubs with hose. Also, he used a single pre-HE regulator, relocated to the front of the left intake manifold as on the HE. These decisions kept him away from the welders and platers, and his use of high quality 250 PSI Goodyear Ortac hose resulted in a very safe and sound conversion that has been running for several years without problems. A picture he sent me is shown in Figure 12.

Figure 12 John Cave's conversion

I have had communication with at least two other people who have retrofitted HE rails to pre-HE V12s. David Robson of Canberra apparently did no rail modifications so he must not have a fuel cooler in the way, although it is a '77 XJ-S. He writes "I got a hydraulic and fuel hose company, 'Pirtek', to high pressure crimp the appropriate size high pressure fuel hose onto brass screw-on fittings that screwed on to the HE fuel rail inlet and outlet using brass adapters. I mounted the single Pre-HE fuel pressure regulator in the usual position for the regulator on the B bank inlet manifold. I used the original mounting bracket but adjusted it so that the regulator sat flat in relation to the fuel rail. This lined the hoses up in a better arrangement than if the regulator had been left at its original angle." A photo showing part of his installation is shown in Figure 13. You can see how he has adjusted the mounting of the regulator, and his fitting of a pressure gauge.

Figure 13 David Robson's conversion

Jerry Bergman also did the conversion using a single, aftermarket regulator and Aeroquip fittings from Summit Racing. His installation is shown in Figure 14. From the looks of the crossover tube, upper left in the photo, he did not have a fuel cooler to worry about. My guess is he removed it, since his car is almost exactly the same age as mine--- made in November 1975 vs. December 1975 for me.

Figure 14 Jerry Bergman's conversion

You can see in the photos of the Robson and Bergman conversions that they use an adapter to get from the HE rail fitting to the AN fittings commonly available in the US. Wayne Estrada did the same thing in the process of his "engine beautification" project on his HE and was able to tell me that the connector at the fuel rail is a metric 14 millimeter thread with 1.5 pitch. At one point in my efforts I was considering switching to the AN fittings and was almost fooled into thinking it was 1/4" BSPP male, which fits loosely. In the end, however, I elected to have new hose crimped to a salvaged HE male fitting.

Results

I have been very pleased with the results. There are no leaks, and the car runs better than it has in years. A week or so after the retrofit I took it on a 550-mile trip up the coast. The weather was mild so this was definitely not a severe test, but I had absolutely no rough running problems after fuel stops, etc., as I usually did before.

What I Would Have Done Differently

When I planned this retrofit I hoped to complete the rail modifications, including welding, testing, and plating, then tear down the car and install it. This was a mistake because I failed to see the interference with the AC test port on the fuel cooler. As a result, I wound up going back to the welder two or three more times, and messing up my beautiful $85 plating job. In hindsight it would have been far smarter to have tack welds done and a trial fitting before final welding, testing and plating.

Things Yet To Be Done

I have an electrical type temperature switch that screws into the rail on the left side. This is the device used before the V12s were fitted with the vacuum relief type temperature switch, intended to open the air temperature sensor circuit to enrich the mixture on high rail temperature. On Roger Bywater's advice I will eventually install it as an added measure to deal with the milder form of rail/injector vapor blockage sometimes suffered by the HE rail. Beyond that, if I do have hot weather problems (I'm still hopeful I won't) I will send my ECU to AJ6 Engineering for modification to allow higher rail pressure. I probably won't be motivated to take either of these steps until next summer.