

FI Hose Damage Due to Crimping or Clamping

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1976 XJ-S

The Problem

The Jaguar V12 HE fuel injectors and rail nipples were designed for a push on seal requiring no clamps. There is only a shallow, dished cap at each end. Arguments have long raged on the Jag-Lovers XJ-S and V12 Engines mail list as to (a) whether one should put a clamp over the joint “for extra insurance,” and (b) whether the caps are really necessary. Here I offer my perspective on these questions, along with some evidence that I believe supports these beliefs.

Nipple Styles

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. You can see the HE rail nipples in Figure 1. 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 exterior of 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 2, 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.

Hose

Let's be clear that the hose we are talking about is electronic fuel injection (EFI) hose, e.g., SAE 30R9, which has an internal lining and an interwoven braid between rubber plies. It is available in any auto parts store for about \$4/foot, as I recall. In his online book, *Experience in a Book*, Kirby Palm mentions some alternatives available in hydraulic supply stores. The interwoven braid layer is extremely important for the push-on joints to work. It is what keeps the hose from simply expanding out and slipping over the barbs.



Figure 1 Fuel injector hose joints



Figure 2 Bendix injector nipple

The Clamp Issue

Some insist on using clamps over the Christmas tree style nipples "just to be sure." At first thought, this seems reasonable. Terms like "just to be sure," and "for extra insurance" always occur in the arguments advanced for clamps. The second argument, the clincher for those having a need to clamp, is usually something like "After all, what can it hurt?"

The first argument is really a "fear of failure" argument, that the push-on concept is faulted from the beginning. That is, the joint is going to fail because there is really nothing there to hold the hose on, so it could just pop off under pressure, or perhaps suddenly begin leaking. It seems to me that these fears are unjustified, as the arguments are contradicted by three facts: (a) Jaguar doesn't use clamps on the joints, (b) many, many of our engines run without clamps and without leaks, and (b) Parker-Hannifin makes a very similar hose connector line called Push-Lok and their specifications clearly state that clamps should not be used. I therefore dismiss these arguments.

The second argument, "What can it hurt?", is easily be answered: The clamping pressure can cause the barbs to damage the inner liner of the hose. Anyone who doesn't believe this will have to take up their arguments with Parker-Hannifin, because in their , document B-256, Push-Lok 82 Series Assembly Instructions, they say "Caution: Sealing

integrity may be damaged by use of exterior clamps.” Their Push-Lok series hose connectors look exactly like the Christmas tree nipples on Jaguar FI rails and injectors.

I recently had some first hand experience that the Parker-Hannifin warning is worth remembering. Although this experience was with crimping rather than clamping, and was with a barbed air hose fittings, I believe it also applies to clamps and the Jaguar or Parker-Hannifin push-on nipples.

The problem came up a year after I retrofitted an HE fuel rail to my preHE engine. To do the retrofit I had to fabricate inlet and outlet hose assemblies. Since I had retained both of the preHE regulators, plumbed in parallel at the exit of the rail, I had to have a tee in the rail outlet line to feed both regulators. I used a brass, Christmas tree style tee fitting found in the air hose section of an industrial hardware store. The store offered crimping services, so I had them crimp the FI hose to the tee using brass ferrules. The joints looked great, and I was proud of the job.

I drove the car for about a year like this, then began experiencing some problems that caused me to decide to changing the plumbing to eliminate one of the regulators. When I made the change I discovered that my outlet hose assembly was almost totally blocked, taking great effort to blow through the tee joint. What I found is shown in Figure 3, where I have sliced the hose lengthwise to allow viewing of the damage.

What we see here is that the crimping process pressed the hose against the sharp barbs so tight as to cut the inner liner of the hose. The liner then separated from the hose and folded inward, accordion-like, blocking the flow.

It is not difficult to see the factors at play here, not all of which *necessarily* apply to a clamp on a Jaguar FI nipple. For one thing, the air fitting barbs are a bit sharper than the Jaguar fittings. Also, I would judge that the person doing the crimping overdid it a bit. The OD of the fuel hose doesn't match up very well with available ferrule sizes and the one used was oversized, so the guy gave it another go after the first pull on his little hand operated crimper left it still a bit loose. And then perhaps another pull. When he finished the inside of the hose had been cut to pieces, although it looked great on the outside.

In spite of the differences between crimping and clamping, and between brass air fittings and steel FI barbs, there are more similarities. When you use a clamp over the FI nipples it is still the same lined FI hose being pressed tightly against a sharp barb. It is quite clear to me that excessive pressure, which can easily come from over-tightening a clamp, can severely damage the hose.



Figure 3 Crimping problem

Hose End Caps

The use of the dished hose end caps (see Figure 1) 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-Lok 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 dowel-plugged hoses pop off, ripping across the garage with serious speed. Moreover, at the end of testing I had no difficulty whatever in getting the hoses 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 anything 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.